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Appendix D.2

Cherry Island Landfill
Expansion Project
Wilmington, Delaware

prepared by:

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Appendix VIb-D.2

Landfill Stability Analyses - Static
Phases III to V

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task #:** 2.2.5

TITLE OF COMPUTATIONS Landfill Stability Analysis (Static) – Phases III to V

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APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: Shana Opdyke Date: 06/20/02 Reviewed by: R.D. Espinoza Date: 4/3/03

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LANDFILL STABILITY ANALYSIS (STATIC) PHASES III TO V

1. INTRODUCTION

The purpose of this analysis is to evaluate the overall stability of the Cherry Island Landfill (CIL). The analysis focuses on the stability of the waste mass at maximum capacity during waste placement and for long-term conditions. Also, stability analysis for extreme static conditions, such as flooding, is also addressed in this calculation package. Seismic stability is addressed in a separate calculation package, entitled "Landfill Stability Analysis (Dynamic) – Phases III to V. (Appendix VIb-D.3). Similarly, local stability of the proposed Mechanically Stabilized Earth Berm (MSEB) is addressed in a separate calculation package entitled "Perimeter Berm Construction Analysis" (Appendix VIb-D.4).

The landfill is divided into five phases. Phases I and II are currently filled with asbestos, whereas Phases III through V are filled with municipal solid waste (MSW). The current permit allows waste placement up to an approximate elevation of 125 feet mean sea level (ft-msl) in Phases I and II, and up to an elevation 145 ft-msl in Phases III, IV and V. Currently, the elevation of waste in Phases III through V is approximately 80 ft-msl and the bottom of waste is at elevation of approximately 40 ft-msl, resulting in an average waste thickness of approximately 40 ft. The maximum elevation in Phases I and II is at approximately 90 ft-msl and the bottom of waste is at approximately 10 ft-msl (i.e., maximum waste thickness is approximately 80 ft). In the proposed landfill expansion, the maximum elevation in Phases III to V are increased to approximately 290 ft-msl, whereas the maximum elevation in Phases I and II is essentially unchanged except at the boundary with Phases III to V. The expansion consists of the construction of a MSEB and the installation of prefabricated vertical drains (PVD) along the perimeter of Phases III, IV, and V.

2. SECTIONS FOR ANALYSIS

A plan view of the site, with the proposed final grading plan, is shown in Figure 1. The proposed grading plan incorporates a vertical expansion approximately 210-ft higher than the existing grade. The proposed grading plan will yield approximately 37 million cubic yards (mcy) of airspace. To reach an airspace capacity of 22 mcy, the landfill grades should be filled to approximately 160 ft-msl (i.e., an 80-ft expansion). The estimated annual waste intake in Phases III through V is approximately 1 mcy. A total of eight (8) sections located in Phases III through V were selected for analysis.

Each of the cross sections was selected to take into consideration unique features of the landfill geometry (e.g., maximum height, bench location), foundation stratigraphy (thickness of dredge/alluvium, thickness of the Columbia and Potomac Formations) and other surface features (e.g., distance to the river, wetlands). Figures 2a through 2h show the geometric and stratigraphic characteristics of each of the eight sections analyzed.

The ground surface information along the Christina and Delaware rivers was obtained from 2002-bathymetric information provided by the U.S. Army Corps of Engineers. Dredging operations only affect a limited area approximately 25 ft outside the limits of the navigation channels. As the limits of the navigation channels are located approximately 800 ft away from the shoreline, dredging operations will not affect the overall stability of the landfill.

3. STABILITY CRITERIA

The slope stability analysis is performed to verify that the final configuration has an adequate factor of safety (FS) against failure under static loading conditions and an adequate probability of failure (PF).

According to technical manual published by the USEPA entitled, "Solid Waste Disposal Facility Criteria" [USEPA, 1993], the minimum recommended factor of safety against slope stability failure for permanent conditions is 1.5. For the temporary conditions, the minimum recommended factor of safety against static slope stability failure is 1.25.

For long-term conditions, after waste placement has ended, a minimum factor of safety of 1.5 is used. In general, waste placement is a temporary condition. However, based on the estimated rate of waste placement, it will take approximately 37 years to reach the proposed configuration. Therefore, the recommended minimum factor of safety during waste placement is 1.4. For other temporary conditions (e.g., analyzing the 100-yr flood elevation), a factor of safety of 1.3 is used.

In addition to these deterministic requirements, a reliability analysis was performed to evaluate the adequacy of the design. This analysis was based on the method proposed by Duncan [2000]. Using this method, a probability of failure is calculated to supplement the factor of safety.

4. LOADING CONDITIONS

4.1 Static Loads

The main static load applied to the soft dredge/alluvial deposits, Columbia Formation and Potomac Formation, are the gravity loads exerted by the waste placement and perimeter berm. Because these loads are a function of the unit weight of the material, having an understanding of the magnitude of the unit weight of the waste is of paramount importance. GeoSyntec performed a thorough analysis of the waste unit weight and it is presented in Appendix O [GeoSyntec, 2003].

4.2 Rate of Load Application

4.2.1 Introduction

The presence of dredge/alluvium material under the waste imposes a restriction on the rate of waste placement. As load (i.e., waste) is placed, excess pore pressures are generated in the dredge/alluvium. Placing waste without causing overall stability problems depends upon the ability of this soft material to gain additional strength (i.e., dissipate pore pressures) as waste is placed. For the existing conditions, excess pore pressure of the dredge/alluvium under the existing waste footprint dissipate vertically as drainage to the Columbia Formation and leachate collection system takes place.

The dredge/alluvium's ability to dissipate excess pore pressures generated during loading is directly proportional to the material's permeability and inversely proportional to the square of the layer thickness. The thickness of dredge/alluvium varies between 60 and 100 ft at the CIL site. Assuming that the permeability at the site is approximately homogeneous, the strength gain rate of the thinner layers will be approximately three times faster than that of the thicker layers.

At locations where PVDs are installed, the dredge/alluvium ability to drain will be significantly improved. Therefore, a higher load placement rate can be used at these locations. The proposed PVDs will be installed primarily under the proposed perimeter MSEB from the ground surface to the Columbia Formation.

4.2.2 Rate of Waste Intake

The volume of waste and daily cover placed per year at the CIL site was calculated from the volume differential over a period of 51 months using topographic maps surveyed in January 1998, April 1999, October 2000, and April 2002. Details of calculations from topographic

survey information are provided in Attachment A. As shown in the attachment, the average airspace used per year, in the 51-month period under consideration, is 805,000 cy. The total volume required for the minimum target waste capacity of 22 years is calculated by extrapolating the calculated average airspace for the next 22 years and assuming a 2 percent per year volume increase (Attachment A). The volume required for the next 22-year period is approximately 22 million cubic yards (mcy). Therefore, in what follows, an average waste intake of 1 mcy per year will be used for the analysis.

4.2.3 Waste Placement Rate

The rate of waste placement depends on the footprint of the area used for placement (i.e., the smaller the footprint, the thicker the waste lift). In this analysis, it is assumed that each lift of waste will cover the entire area available for waste disposal before any additional waste is placed on a subsequent lift. This is consistent with the current landfill operation practice. Based on these assumptions and on the proposed grading plan, the resulting waste placement rates at different elevations are presented below.

Top of Waste Elevation (ft-msl)	Volume (mcy)	Time (yr)	Placement Rate (ft/yr)
165	22	22	3.6 (1)
220	33	33	5
260(2)	37	37	10

(1) Calculated based upon an initial elevation of 85 ft-msl.
(2) This elevation corresponds to the average top of elevation found at the end of the 3H:1V slope.

If the areas available for waste placement are reduced and/or the waste intake volume is significantly increased, a reassessment of the waste placement rate needs to be performed.

5. STRATIGRAPHY AND MATERIAL PARAMETERS

5.1 General

As shown in the cross sections (Figures 2a through 2h), the stratigraphy at the CIL site includes dredge, alluvium, the Columbia Formation and the Potomac Formation. On the river side, the soil above the Columbia Formation is assumed to be alluvium. For each cross section, the stratigraphy is based upon the information collected in the Geotechnical Characterization

Report (GCR) [GeoSyntec, 2002]. The boundary between the dredge/alluvium and the Columbia Formation is based on the stratigraphy presented in the GCR (Figures B.1 to B.4 in Attachment B). The boundary between the Columbia and Potomac Formations is based the information provided by Terraqua [1982] (Figures B.5 to B.9 in Attachment B). The remainder of this section addresses the parameters of these soil types used in the stability analysis. A table in section 5.7 of this calculation package summarizes the soil parameters used in the analysis.

5.2 Waste

GeoSyntec performed field investigations and laboratory testing in March and April 2002 to characterize the waste at the CIL site. Based on the results of the field investigation and subsequent laboratory testing, the MSW was found to have an average density ranging from 50 pcf (at the top lift) to 75 pcf (20 ft below the waste surface). Higher densities (i.e., 80 to 100 pcf) were found for saturated waste. Because the current maximum thickness of waste at the CIL varies approximately from 40 ft to 80 ft, the results of the field investigation were complemented with values obtained from the literature. In the analysis, the waste unit weight varies with depth as shown in the table below. The saturated unit waste is assumed equal to 100 pcf.

Depth (ft)	Total Unit Weight (pcf)
0 - 20	60
20 - 100	75
100 - 150	80
150 - 200	85
>200	90

Nine laboratory shear strength tests performed on saturated waste at different rates indicate that, except for one test, waste at CIL exhibits a friction angle ranging from 34 degrees to 40 degrees, with an average of 36 degrees and a cohesion ranging from 0 psf to 165 psf. A friction angle of 33 degrees and no cohesion was conservatively used in the analysis. Further discussion on these results can be found in Appendix O of the GCR.

5.3 Dredge/Alluvium

5.3.1 General

GeoSyntec conducted field investigations in March and April 2002 to evaluate the subsurface soil conditions at the site. A brief summary of the findings related to the dredge and alluvium, is presented herein; additional details can be found in the GCR. The dredge consists primarily of sandy silty clay to clayey silt and varies in thickness from between 30 and 40 feet. The alluvium is comprised of clayey silts and silty clays with varying amounts of sand and organic matter and silty sands. Because of the similar characteristics between the dredge spoils and the alluvium; these layers are treated as one soil type in the analysis. Although there is no soil data along the river bed of the Delaware and Christina rivers, these sediments are likely to have similar soil characteristics as the dredge/alluvium.

The average total unit weight for the dredge/alluvium is 85 pcf while the average saturated unit weight is 97 pcf. The shear strength in the dredge/alluvium depends upon the amount of pore pressure dissipated during loading. Therefore, in this analysis, the dredge/alluvium strength parameters have been classified into three conditions: (i) consolidated undrained parameters; (ii) partially consolidated undrained parameters; and (iii) drained parameters. A discussion of the strength parameters follows.

5.3.2 Consolidated Undrained Parameters

This condition is applicable to the dredge/alluvium located outside the PVD area and along the river area. The dredge/alluvium in this zone is assumed to be normally consolidated and it is modeled having an undrained shear strength that is a function of the existing maximum vertical effective pressure that has developed to date in the dredge. The strength (S_u) of the layer is estimated using the following linear relationship:

$$S_u / \sigma'_v = 0.29 \quad (1)$$

where σ'_v is the effective vertical stress. The value of 0.29 is in agreement with previous and recent laboratory and field investigation results summarized in the GCR.

5.3.3 Partially Consolidated Undrained Parameters

During the proposed vertical expansion, the height of the waste mass will be increased incrementally over a 37-year period, which is the estimated life of the landfill. The rate of

incremental loading will have an effect on the consolidation of the dredge/alluvium and, hence, on the shear strength. The computer program CONSOL, Version 2.0 [Duncan et al. 1988], was used to calculate the effective stresses in the dredge/alluvium as they are subjected to the incremental loads during the proposed landfill expansion. For the CONSOL analysis, the dredge/alluvium was subdivided into six (6) horizontal layers and the vertical effective stresses at different times were calculated. The loading simulation is presented in a separate calculation package (Appendix VIb-D.1). The calculated vertical stresses were calculated using the pore pressures provided by CONSOL along with Equation (1) to estimate the unconsolidated undrained dredge.

To represent the waste side slopes more accurately, the dredge/alluvium in each cross section was subdivided into several columns of soils layers. The effective vertical stresses for each of these columns and for different loadings were calculated in the calculation package entitled, "Evaluation of the Partially Consolidated Undrained Parameters," (Appendix VIb-D.1) and are summarized in Tables 1 through 12. Also, Tables 1 through 12 show the corresponding undrained shear strength calculated using Equation (1) after 9, 21, and 37 years of waste placement. These shear strength parameters are used in the analysis.

5.3.4 Drained Parameters

A series of prefabricated vertical drains (PVD) will be installed underneath and beyond the MSEB. The PVDs will be installed from the ground surface to the Columbia Formation. This area is outside the existing waste footprint. The PVDs will be installed to enhance the dredge's ability to drain and accelerate the dissipation of excess pore pressures generated during berm construction and subsequent waste placement. The rapid dissipation of excess pore pressures in the dredge/alluvium by means of the PVDs, allows the dredge/alluvium to be modeled assuming drained conditions during the relatively slow waste placement. An assessment of dredge/alluvium drained conditions is presented in Appendix VIb-D.5. An assessment of the long-term performance of the PVD is presented in the "Prefabricated Vertical Drain Evaluation" calculation package (Appendix VIb-D.6).

The dredge/alluvium drained shear strength is modeled as an envelope based on effective strength parameters obtained from laboratory testing as follows [GeoSyntec, 2003]:

Effective Normal Stress (psf)	Shear Stress (psf)	Effective Friction Angle (Degrees)
0 – 1,000	0 – 1,000	45
1,000 – 3,000	1,000 – 2,678	40
> 3,000	–	34

The envelope is also used to model all the dredge/alluvium layers for long-term conditions, after landfilling operations have concluded and all excess pore pressures have been completely dissipated.

5.4 Columbia Formation

The Columbia Formation, which is encountered under the dredge/alluvium, consists of poorly sorted, fine-to-coarse sand and gravel with silty sand, silty clay, and clayey silt lenses of varying thicknesses. An effective a friction angle of 40 degrees and no cohesion are used to model the strength of this layer. The unit weight for this formation is 125 pcf. Detailed discussion on the selection of these parameters can be found in the GCR. At locations where silty clay lenses were significantly thick (i.e., greater than 5 ft), undrained parameters were used. The undrained strength parameters of the lenses were obtained from field investigation data, near the analyzed cross section, presented in the GCR.

5.5 Potomac Formation

The Potomac Formation is encountered under the Columbia Formation. The Potomac Formation consists of a brownish red (often described as varicolored), stiff to hard, heavily over consolidated, clayey silt to silty clay, with traces of fine sand. Layers of sand are often found in this formation. Based on the information collected in the GCR, the thickness of the Potomac Formation varies from approximately 120 ft along the Delaware River, to approximately 5 ft along the western boundary of the CIL site. The strength parameter of the Potomac Formation is conservatively described for undrained analysis as:

$$S_u = 4{,}500 \text{ psf} + 14.4\,d \qquad (2)$$

where S_u is the undrained shear strength (psf) and d is depth measured from the top of the Potomac Formation. For drained analysis, an effective friction angle of 21° is used.

5.6 Reinforced Soil

Non-traditional and cost-effective materials such as dredge and fly ash will be considered for construction. Therefore, the unit weight of the MSEB is represented in the analysis with a unit weight of 90 pcf and a friction angle (ϕ_{MSE}) of 29°. For design purposes, a high strength geogrid of 5,000 lbs/lf, and a high strength geotextile of 21,000 lb/lf are considered at the base. The interface friction angle (δ), for both materials, was assumed equal to:

$$\tan(\delta) = 0.85 \tan \phi_{MSE} \quad (3)$$

The length of the reinforcement and width of berm was iteratively calculated to provide an adequate factor of safety for temporary and long-term conditions.

5.7 Summary of Properties

A summary table of the soil parameters used in this analysis is provided below.

Material	Label[1]	Condition	Cohesion (psf)	Friction Angle (°)	Unit Weight (pcf)	Unit Weight Saturated (pcf)
Waste	Waste (0 to20)	Drained	0	33	60	100
	Waste (20 to100)				75	
	Waste (100 to150)				80	
	Waste (150 to 200)				85	
	Waste (> 200)				90	
Dredge/ Alluvium	Drained PVD Area	Drained	0	34[2]	85	97
	River Sediments, Wetlands [3]	Consolidated Undrained	0.29 σ'_v	-		
	d11, d12, d13, thorough d56 [3]	Partially Consolidated	0.29 σ'_v (t) [4]	-		
Columbia	Columbia Formation	Drained	0	40	–	125
Potomac Formation	Potomac Formation	Undrained	4,500[5]	–	120	120
		Drained	–	21		
MSEB	MSE Wall Soil	Drained	0	29	90	90

Notes:

(1) Label used for SLIDE analysis (see Figure 3).

(2) Dredge drained parameters is an envelope with a slope of 34 degrees for effective stresses greater than 3,000 psf.

(3) Drained parameters will be also used for the river sediments, wetlands, and dredge/alluvium layers under waste (i.e., d11 through d56) for long-term conditions analysis.

(4) The effective overburden pressure (σ'_v) is a function of time (t), and it is calculated in the calculation package entitled, "Evaluation of the Partially Consolidated Undrained Parameters," (Appendix VIb-D.1). The values used for each of the cross sections are presented in Table 1.

(5) Minimum undrained strength is 4,500 psf and increases with depth.

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6. WATER TABLE/LIQUID LEVELS

The current liquid level in the dredge/alluvium is dictated by the elevation of the Delaware, and Christina Rivers, liquids in the waste, and the water level at the time of dredge placement. The liquid level in the dredge/alluvium was selected as follows:

- *Under the landfill*: Because dredge is placed fully saturated, the water level can be assumed at the dredge ground surface. For the stability analysis, for undrained conditions, the factors of safety are calculated using total unit weights. Hence, the location of the water level does not influence the calculation of the factors of safety except for the calculation of unit weight.

- *In the PVD area*: Because the PVDs connect the dredge/alluvium with the Columbia Formation, the water level of the dredge/alluvium is influenced by the groundwater elevation of the Columbia Formation. In this area, the water level is assumed to be at elevation 5 ft-msl, which corresponds to measured values of the groundwater elevation of the Columbia Formation around the perimeter berm. This value is 2-ft higher than the average river level.

- *Outside the PVD area (river side and wetland areas)*: The water level in this area is assumed to be influenced by the river elevation. The average river level is approximately 3 ft-msl. In this area the water level is assumed to be at elevation 5 ft-msl. The water level in wetland areas is assumed to be at the ground surface. For the stability analysis, for undrained conditions, the factors of safety are calculated using total unit weights. Hence, the location of the river elevation does not influence the calculation of the factors of safety.

The piezometric level in the Columbia and Potomac Formations is assumed to be equal to the assumed liquid levels in the dredge/alluvium. This assumption is conservative, particularly under the landfill, where the piezometric level in the Columbia and Potomac Formations is likely to be less than the water level in the dredge/alluvium. Higher piezometric levels results in lower effective stresses with corresponding lower shear strength.

For temporary conditions, the water level in the PVD zone and in the river level is assumed to be at 10-ft-msl (which corresponds to the 100-yr flood plain elevation).

7. METHOD OF ANALYSIS

7.1 Introduction

The stability of the selected cross sections was evaluated based on limit equilibrium theory using the methods of slices. The computer program SLIDE [Rocscience, 2002] was used to perform the analyses. SLIDE is a 2D slope stability program for evaluating the factor of safety of circular and non-circular (also referred to as block) failure surfaces in soils. The procedure consisted of analyzing numerous potential failure surfaces to find the critical failure surface that renders the minimum factor of safety for the slope. Circular and non-circular failure surfaces can be analyzed. For circular and non-circular failure surfaces, the Spencer method [Spencer, 1967] is used. In the Spencer method both force and moment equilibrium are satisfied in each slice, the slope of the inter slice forces is assumed constant and parallel to each other.

During the analysis, the search boundaries were varied to ensure that the most critical surface was captured during the search. Numerous potential failure surfaces were analyzed to find the critical failure surface that result in the minimum factor of safety for the slope. For the slope stability cases analyzed in this calculation, both non-circular and circular failure surfaces were considered. All slip surfaces were allowed to pass through the dredge material.

In order to verify the SLIDE results, an additional slope stability analysis was performed by GeoSyntec using a different slope stability program. Section H-H (37 Year Analysis) was analyzed using Slope/W [Geo-Slope, 2002]. The analysis was performed by a different GeoSyntec branch (Walnut Creek, California). The program employs a user-directed search routine to determine the critical shear surface with the minimum factor of safety. Similar to SLIDE, slope stability in Slope/W is evaluated using limit equilibrium procedures specified in Spencer, 1967,

7.2 Implementation

7.2.1 Deterministic Analysis

The ground surfaces of the selected cross sections were obtained using AutoCADD, placed in an x,y coordinate system and subsequently entered into SLIDE. The bottom of existing waste, assumed to be at elevation 40 ft-msl, is based upon record drawings for Phases III, IV, and V. The horizontal extent of existing waste was assumed to coincide with the existing limits of waste. The dredge/alluvium strata was divided into six layers. In order to minimize errors, a specific labeling system was developed for the various materials. Figure 3 shows an example of

an idealized cross section implemented in SLIDE with layer divisions and the labeling system used for all analyses. Consistent labeling systems and material boundaries allowed material properties to be exported to a different file. For example, materials in a file containing a circular analysis of Section C-C were exported to a new file for a non-circular analysis of Section C-C. Through this exportation, the materials were automatically the same for both files.

Once the sections were fully developed, both circular and non-circular failure analyses were performed. The same analysis parameters were used for the circular failure mode in each section. Parameters for the circular search for the Spencer analysis method include using fifty (50) slices, a tolerance of 0.005, of maximum fifty (50) iterations, and for each slip center, 75 regularly spaced circles were analyzed. These parameters were selected such that the analysis was performed accurately and expediently. Sections C-C and D-D were used in a parametric study to evaluate the influence of each these parameters. Specifically, the number of slices was changed from 25 to 75, the tolerance from 0.0025 to 0.0075, the maximum number of iterations from 25 to 75, and the number of circles per slip center from 50 to 100. These variations resulted in a change in the factor of safety of less than one percent.

For the circular search, a search grid with 20 horizontal increments and 20 vertical increments was used to find the minimum factor of safety (Figure 4). SLIDE provides both the minimum and a contour map of the calculated factors of safety (Figure 4). In some cases, when the contour lines that contain the minimum factor of safety were not fully closed, the search grid was expanded horizontally or vertically and the analysis performed again. This iterative process ensured that a global, not a local minimum, factor of safety was calculated.

As shown in Figure 5, a minimum of two search windows were used to analysis non-circular failures for each section. These windows were iteratively placed to obtain the minimum factor of safety. Parameters used in the Spencer analysis method included using fifty (50) slices, a tolerance of 0.005, a maximum of fifty iterations, a left projection angle of the failure plane ranging from 135 to 160 degrees and a right projection angle of the failure plane ranging from 30 to 60 degrees. Variation of the left projection angle from 95 to 180 degrees and the right projection angle from 0 to 85 degrees, resulted in changes in the factor of safety of less than one percent. All sections were extended horizontally in both directions to ensure that the critical failure surface was not constrained by geometry. For example, if a critical failure surface was found near the right or left boundary, the boundary was extended, and the analysis performed again.

7.2.2 Probabilistic Analysis

The reliability analysis was performed using SLIDE 5.0. Section E-E is representative of the minimum factor of safety and was thus chosen for reliability analysis. The method consists of performing deterministic slope stability analysis to determine the slip surface with the overall (Global Minimum) factor of safety, of all the slip surfaces analyzed. The probabilistic analysis is then carried out on the Global Minimum slip surface, using the samples generated for each random variable. This means that the slope stability calculation is repeated N times (where N = Number of Samples) for the Global Minimum Slip surface. This results in N calculated safety factors. The Probability of Failure is then simply the number of analyses which result in a safety factor less than 1, divided by the total Number of Samples. The Global Minimum Probabilistic Analysis Type, assumes that the Probability of Failure calculated for the (Deterministic) Global Minimum slip surface, is representative of the Probability of Failure for the entire slope. In many cases, this is a valid and reasonable assumption. The section geometry and material locations were imported from Section E-E (37-Year case) for both circular and block analyses. A global minimum analysis was performed using a Monte-Carlo sample method with 2,500 samples. These parameters were used for both circular and non-circular analyses.

The variability in the material properties were accounted for by using probability distribution (i.e., beta, normal or uniform). For the reliability analysis, the undrained and drained shear strength of the dredge/alluvium were changed from the static stability analysis. Because of limitation of the SLIDE software, the drained shear strength envelope used in the static analysis could not be varied in the reliability analysis. To overcome this limitation, the dredge/alluvium drained shear strength was modeled using a Mohr-Coulomb failure envelope with an average cohesion of 750 psf and an internal friction angle of 34 degrees. This values are consistent with the GCR [2003]. Although the average dredge/alluvium undrained shear strength (S_u/σ'_v) is equal to 0.31, In the deterministic analysis, this value was conservatively assumed equal to 0.29. For the reliability analysis, an average value of 0.31 is used.

The shear strength and unit weight parameters for all the layers except Columbia, Potomac and MSE berm were varied for the probabilistic analysis. Except for the unconsolidated shear strength parameters, all the parameters used in the probabilistic analysis (i.e., average, minimum and maximum) were obtained from the GCR [GeoSyntec, 2003]. For the unconsolidated shear strength parameters, the maximum and minimum values were selected as 30% higher and lower than the values calculated using CONSOL. The standard deviation of each property was calculated using the three-sigma rule [Duncan, 2000].

8. STABILITY RESULTS

Stability analyses were performed for the selected cross sections for the following conditions:

(i) during waste placement at the end of 9, 21, and 37 years ;
(ii) long-term conditions after waste placement has ceased; and
(iii) during short-term flooding conditions.

Table 13 presents a summary of the results of the stability analyses performed. Output files for the cross sections analyzed during waste placement and long-term conditions are provided in Attachments C through J. An example of how to interpret a SLIDE output file is provided as Figure 6.

Sections E and F were selected for the analysis of the 100-year flood conditions. The output files are presented in Attachment K. As shown Table 13, the factors of safety for the 37 year case for all cases are greater than 1.4. Similarly, for the cases analyzed, the long-term conditions (i.e., drained analysis) are greater than 1.5. For the sections analyzed, the factor of safety for the 100-year flood condition is greater than 1.3. The location of the critical failure surface for each of the cases analyzed is presented in Attachments C though K. Stability results from Section H-H (37 Year analysis), analyzed by an independent office using Slope/W [Geo-Slope, 2002] can be found in Attachment L. As shown in Figures L.1 and L.2, the results were similar to those found using SLIDE.

9. RELIABILITY RESULTS

Both the circular and non-circular analyses showed a probability of failure of 0.000%. Due to the significant digits used in the calculation of the probability of failure, a probability of failure of 0.000% indeed implies $PF<1\times10^{-5}$. Results of the reliability analysis are presented in Appendix M. Properties that were varied as well as the assigned probability distribution, respective minimum, maximum and standard deviation, are shown in Table M.1 (Attachment M). The river elevation was assumed to be the same for both reliability and static analyses. However, the liquid elevation under the MSE berm is assumed to be at a minimum elevation of 5 feet and a maximum elevation of 15 ft. Likewise, the liquid elevation within the existing waste footprint is assumed to be at a minimum at the top of dredge/alluvium (i.e., El. 40 ft-msl) and a maximum of 15 feet above the top of dredge/alluvium (El. 55 ft-msl). In addition to the reliability analysis, sensitivity analyses were performed for both the circular and block surfaces.

Specifically, the circular analysis showed a circular failure through the first two layers of waste and the MSE berm. In analyzing the sensitivity of the factor of safety to various parameters, it was found that the unit weight of the first layer of waste (i.e., 0-20′ depth) has the greatest impact on the factor of safety. As shown in Figure M.1, varying the unit weight from 45 to 71 pcf changed the factor of safety by 4%. In general, the factor of safety increased with decreasing unit weight of waste and increasing angle of internal friction of the waste (Figure M.1).

The block analysis showed a failure surface through the first four layers of waste, six layers of unconsolidated dredge/alluvium (i.e. d31, d32, d33, d34, d24, and d14), and the Drained PVD Area. As shown in Figures M.2, M.3, and M.4, the factor of safety increased with decreasing waste and dredge unit weight. Also, as expected, the factor of safety increased with increasing dredge/alluvium unconsolidated undrained shear strength (Figures M.5 and M.6). The factor of safety also increased with increasing internal angle of friction and unit weight of the PVD area (Figure M.6). Figure M.7 shows the increased factor of safety for the minimum water table surface. The following parameters had the greatest impact on change in factor of safety: (i) unit weight of waste from 20′-100′ and 100′-150′, with changes in factor of safety of 11% and 5% respectively, (ii) unit weight of PVD Area with change in factor of safety of 5%, (iii) cohesion of material layer label "d24" with change in factor of safety of 4% and (iv) location of water table with change in factor of safety of 4%.

10. CONCLUSION

The analysis presented in this calculation package shows that waste placement can be performed while maintaining an appropriate factor of safety throughout the entire life of the landfill. Specifically, the calculated factors of safety are greater than the recommended minimum values. Similarly, reliability analysis performed for one of the most critical cross-sections indicates a high degree of reliability of the proposed design.

11. REFERENCES

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TABLES

Table 1

C-C				
9 Years				
Zone 1				
Consol File: xc1.out				
Accumulated Settlement[2]	12	ft		
Elevation of Overburden	104	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	5017	561	4456	1292
di2	5415	1815	3600	1044
di3	5899	2807	3093	897
di4	6384	3030	3353	972
di5	6868	2413	4455	1292
di6	7283	935	6348	1841

C-C				
21 Years				
Zone 1				
Consol File: xc1.out				
Accumulated Settlement[2]	17	ft		
Elevation of Overburden	133	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d11	7378	478	6900	2001
d12	7776	1676	6100	1769
d13	8260	2785	5475	1588
d14	8745	3117	5627	1632
d15	9229	2482	6747	1957
d16	9644	951	8693	2521

C-C				
21 Years				
Zone 2				
Consol File: xc2.out				
Accumulated Settlement[2]	17	ft		
Elevation of Overburden	149	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	8607	680	7927	2299
di2	9005	2324	6680	1937
di3	9489	3738	5751	1668
di4	9974	4097	5876	1704
di5	10458	3280	7178	2082
di6	10873	1277	9596	2783

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

Table 2

C-C				
37 Years				
Zone 1				
Consol File: xc1.out				
Accumulated Settlement[2]	19	ft		
Elevation of Overburden	133	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d11	7464	191	7273	2109
d12	7862	676	7187	2084
d13	8347	1142	7204	2089
d14	8831	1306	7525	2182
d15	9316	1054	8262	2396
d16	9731	406	9325	2704

C-C				
37 Years				
Zone 2				
Consol File: xc2.out				
Accumulated Settlement[2]	21	ft		
Elevation of Overburden	165	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d21	9956	311	9645	2797
d22	10354	1116	9238	2679
d23	10839	1902	8936	2591
d24	11323	2175	9147	2653
d25	11807	1762	10045	2913
d26	12223	684	11539	3346

C-C				
37 Years				
Zone 3				
Consol File: xf3.out				
Accumulated Settlement[2]	23	ft		
Elevation of Overburden	200	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d31	12650	543	12107	3511
d32	13048	2007	11041	3202
d33	13533	3494	10039	2911
d34	14017	4005	10012	2903
d35	14501	3186	11315	3281
d36	14917	1211	13706	3975

C-C				
37 Years				
Zone 4				
Consol File: xc4.out				
Accumulated Settlement[2]	23	ft		
Elevation of Overburden	225	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d41	14535	922	13613	3948
d42	14933	3395	11538	3346
d43	15417	5768	9649	2798
d44	15901	6463	9438	2737
d45	16386	5128	11258	3265
d46	16801	1960	14841	4304

C-C				
37 Years				
Zone 5				
Consol File: xc5.out				
Accumulated Settlement[2]	24	ft		
Elevation of Overburden	265	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d51	17563	1507	16056	4656
d52	17961	5202	12759	3700
d53	18445	8319	10126	2937
d54	18930	9061	9869	2862
d55	19414	7314	12100	3509
d56	19829	2878	16952	4916

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

Table 3

D-D				
9 Years				
Zones 1, 2, 3, 4 and 5				
Consol File: xd1.out				
Accumulated Settlement[2]	12	ft		
Elevation of Overburden	104	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	5510	1042	4467	1295
di2	6029	2685	3344	970
di3	6548	3539	3008	872
di4	7067	3702	3365	976
di5	7586	3099	4487	1301
di6	8105	1294	6810	1975

D-D				
21 Years				
Zone 1				
Consol File: xd1.out				
Accumulated Settlement[2]	17	ft		
Elevation of Overburden	133	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d11	7872	1066	6806	1974
d12	8391	2854	5537	1606
d13	8910	3941	4969	1441
d14	9429	4225	5204	1509
d15	9948	3574	6374	1848
d16	10467	1502	8965	2600

D-D				
21 Years				
Zones 2, 3, 4 and 5				
Consol File: xd2.out				
Accumulated Settlement[2]	18	ft		
Elevation of Overburden	149	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	9101	1399	7702	2234
di2	9620	3679	5941	1723
di3	10139	4957	5182	1503
di4	10658	5236	5422	1572
di5	11177	4422	6755	1959
di6	11696	1862	9833	2852

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

Table 4

D-D				
37 Years				
Zone 1				
Consol File: xd1.out				
Accumulated Settlement[2]	20	ft		
Elevation of Overburden	133	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d11	7973	586	7387	2142
d12	8492	1592	6900	2001
d13	9011	2263	6749	1957
d14	9530	2501	7029	2038
d15	10049	2161	7888	2288
d16	10568	916	9652	2799

D-D				
37 Years				
Zone 2				
Consol File: xd2.out				
Accumulated Settlement[2]	22	ft		
Elevation of Overburden	165	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d21	10463	884	9580	2778
d22	10982	2408	8574	2486
d23	11501	3421	8080	2343
d24	12020	3768	8252	2393
d25	12539	3269	9270	2688
d26	13058	1397	11661	3382

D-D				
37 Years				
Zone 3				
Consol File: xf3.out				
Accumulated Settlement[2]	24	ft		
Elevation of Overburden	200	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d31	13156	1375	11780	3416
d32	13675	3821	9854	2858
d33	14194	5487	8707	2525
d34	14713	6010	8703	2524
d35	15232	5137	10095	2927
d36	15751	2169	13582	3939

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

Table 5

E-E				
9 Years				
Zones 1, 2, 3, 4 and 5				
Consol File: xe1.out				
Accumulated Settlement[2]	11	ft		
Elevation of Overburden	104	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	5096	995	4101	1189
di2	5615	2580	3035	880
di3	6134	3457	2677	776
di4	6653	3775	2877	834
di5	7172	3601	3570	1035
di6	7777	1699	6078	1763

E-E				
21 Years				
Zone 1				
Consol File: xe1.out				
Accumulated Settlement[2]	16	ft		
Elevation of Overburden	133	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d11	7443	1098	6346	1840
d12	7962	2964	4999	1450
d13	8481	4189	4293	1245
d14	9000	4779	4222	1224
d15	9519	4784	4735	1373
d16	10125	2328	7797	2261

E-E				
21 Years				
Zones 2, 3, 4 & 5				
Consol File: xe2.out				
Accumulated Settlement[2]	16	ft		
Elevation of Overburden	149	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	8677	1440	7237	2099
di2	9196	3809	5387	1562
di3	9715	5227	4487	1301
di4	10234	5784	4449	1290
di5	10753	5626	5126	1487
di6	11358	2701	8657	2511

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

Table 6

E-E				
37 Years				
Zone 1				
Consol File: xe1.out				
Accumulated Settlement[2]	18	ft		
Elevation of Overburden	133	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d11	7537	703	6834	1982
d12	8056	1945	6111	1772
d13	8575	2898	5678	1647
d14	9094	3548	5547	1609
d15	9613	3768	5845	1695
d16	10219	1876	8343	2419

E-E				
37 Years				
Zone 2				
Consol File: xe2.out				
Accumulated Settlement[2]	20	ft		
Elevation of Overburden	165	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d21	10025	1042	8984	2605
d22	10544	2868	7676	2226
d23	11063	4222	6841	1984
d24	11582	5097	6485	1881
d25	12101	5375	6726	1951
d26	12707	2673	10034	2910

E-E				
37 Years				
Zone 3				
Consol File: xf3.out				
Accumulated Settlement[2]	22	ft		
Elevation of Overburden	200	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d31	12714	1553	11161	3237
d32	13233	4337	8896	2580
d33	13752	6393	7360	2134
d34	14271	7568	6704	1944
d35	14790	7819	6972	2022
d36	15396	3859	11536	3346

E-E				
37 Years				
Zone 4				
Consol File: xe4.out				
Accumulated Settlement[2]	23	ft		
Elevation of Overburden	225	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d41	14619	2253	12366	3586
d42	15138	6122	9016	2615
d43	15657	8567	7090	2056
d44	16176	9511	6665	1933
d45	16695	8988	7707	2235
d46	17301	4174	13127	3807

E-E				
37 Years				
Zone 5				
Consol File: xe5.out				
Accumulated Settlement[2]	24	ft		
Elevation of Overburden	265	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d51	17662	3207	14456	4192
d52	18181	8411	9770	2833
d53	18700	11308	7392	2144
d54	19219	12216	7004	2031
d55	19738	11186	8553	2480
d56	20344	5074	15270	4428

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

Table 7

F-F and G-G				
9 Years				
Zones 1, 2, 3, 4, and 5				
Consol File: xf1.out				
Accumulated Settlement[2]	11	ft		
Elevation of Overburden	104	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	5047	841	4206	1220
di2	5566	2391	3175	921
di3	6171	3405	2767	802
di4	6777	3655	3122	905
di5	7382	3120	4263	1236
di6	7988	1319	6669	1934

F-F and G-G				
21 Years				
Zone 1				
Consol File: xf1.out				
Accumulated Settlement[2]	16	ft		
Elevation of Overburden	133	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d11	7405	874	6531	1894
d12	7924	2666	5259	1525
d13	8530	4043	4486	1301
d14	9135	4469	4666	1353
d15	9741	3866	5875	1704
d16	10346	1648	8698	2522

F-F and G-G				
21 Years				
Zones 2, 3, 4 and 5				
Consol File: xf2.out				
Accumulated Settlement[2]	16	ft		
Elevation of Overburden	149	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	8626	1189	7437	2157
di2	9145	3489	5656	1640
di3	9751	5106	4645	1347
di4	10356	5555	4801	1392
di5	10962	4811	6150	1784
di6	11567	2063	9504	2756

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

Table 8

F-F and G-G				
9 Years				
Zones 1, 2, 3, 4, and 5				
Consol File: xf1.out				
Accumulated Settlement[2]	11	ft		
Elevation of Overburden	104	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	5047	841	4206	1220
di2	5566	2391	3175	921
di3	6171	3405	2767	802
di4	6777	3655	3122	905
di5	7382	3120	4263	1236
di6	7988	1319	6669	1934

F-F and G-G				
21 Years				
Zone 1				
Consol File: xf1.out				
Accumulated Settlement[2]	16	ft		
Elevation of Overburden	133	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d11	7405	874	6531	1894
d12	7924	2666	5259	1525
d13	8530	4043	4486	1301
d14	9135	4469	4666	1353
d15	9741	3866	5875	1704
d16	10346	1648	8698	2522

F-F and G-G				
21 Years				
Zones 2, 3, 4 and 5				
Consol File: xf2.out				
Accumulated Settlement[2]	16	ft		
Elevation of Overburden	149	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	8626	1189	7437	2157
di2	9145	3489	5656	1640
di3	9751	5106	4645	1347
di4	10356	5555	4801	1392
di5	10962	4811	6150	1784
di6	11567	2063	9504	2756

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

Table 9

H-H and J-J				
9 Years				
Zones 1, 2, 3, 4, and 5				
Consol File: xh1.out				
Accumulated Settlement[2]	11	ft		
Elevation of Overburden	104	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	5082	1002	4080	1183
di2	5566	2620	2947	855
di3	6051	3535	2516	730
di4	6535	3856	2679	777
di5	7020	3646	3373	978
di6	7521	1708	5813	1686

H-H and J-J				
21 Years				
Zone 1				
Consol File: xh1.out				
Accumulated Settlement[2]	15	ft		
Elevation of Overburden	133	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d11	7413	1055	6358	1844
d12	7897	2884	5014	1454
d13	8382	4123	4259	1235
d14	8866	4721	4145	1202
d15	9351	4701	4650	1348
d16	9852	2274	7578	2198

H-H and J-J				
21 Years				
Zone 2, 3, 4 and 5				
Consol File: xh2.out				
Accumulated Settlement[2]	16	ft		
Elevation of Overburden	149	ft		
Layer[1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	8656	1314	7342	2129
di2	9141	3530	5610	1627
di3	9625	4909	4716	1368
di4	10109	5453	4656	1350
di5	10594	5232	5362	1555
di6	11096	2472	8624	2501

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

Table 10

H-H and J-J				
37 Years				
Zone 1				
Consol File: xh1.out				
Accumulated Settlement[2]	19	ft		
Elevation of Overburden	133	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d11	7543	636	6907	2003
d12	8027	1777	6250	1813
d13	8512	2667	5845	1695
d14	8996	3260	5736	1663
d15	9481	3426	6055	1756
d16	9982	1691	8291	2405

H-H and J-J				
37 Years				
Zone 2				
Consol File: xh2.out				
Accumulated Settlement[2]	20	ft		
Elevation of Overburden	165	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d21	10007	881	9127	2647
d22	10432	2468	8023	2327
d23	10976	3691	7285	2113
d24	11461	4479	6982	2025
d25	11945	4693	7252	2103
d26	12447	2318	10129	2937

H-H and J-J				
37 Years				
Zone 3				
File: xh3.out				
Accumulated Settlement[2]	22	ft		
Elevation of Overburden	200	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d31	12699	1337	11362	3295
d32	13183	3810	9374	2718
d33	13668	5729	7939	2302
d34	14152	6843	7309	2120
d35	14637	7033	7603	2205
d36	15138	3446	11692	3391

H-H and J-J				
37 Years				
Zone 4				
Consol File: xh4.out				
Accumulated Settlement[2]	23	ft		
Elevation of Overburden	225	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d41	14607	1986	12621	3660
d42	15091	5523	9569	2775
d43	15576	7881	7695	2232
d44	16060	8709	7351	2132
d45	16545	7905	8640	2506
d46	17046	3539	13507	3917

H-H and J-J				
37 Years				
Zone 5				
Consol File: xh5.out				
Accumulated Settlement[2]	24	ft		
Elevation of Overburden	265	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d51	17647	2914	14733	4273
d52	18132	7782	10350	3002
d53	18616	10601	8015	2324
d54	19100	11382	7718	2238
d55	19585	10098	9487	2751
d56	20087	4449	15637	4535

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

Table 11

K-K				
9 Years				
Zone 0				
Consol File: xk0.out				
Accumulated Settlement[2]	11	ft		
Elevation of Overburden	90	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d01	3991	527	3464	1005
d02	4423	1445	2978	864
d03	4856	2038	2817	817
d04	5288	2198	3090	896
d05	5721	1829	3892	1129
d06	6153	750	5403	1567

K-K				
9 Years				
Zones 1, 2, 3, 4 and 5				
Consol File: xk1.out				
Accumulated Settlement[2]	12	ft		
Elevation of Overburden	104	ft		
Layer [1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	5080	813	4267	1237
di2	5513	2169	3343	970
di3	5945	2951	2994	868
di4	6378	3124	3254	944
di5	6810	2622	4188	1214
di6	7243	1094	6149	1783

K-K				
21 Years				
Zone 0				
Consol File: xk0.out				
Accumulated Settlement[2]	12	ft		
Elevation of Overburden	90	ft		
Layer	Drained Effective Stress(2) (psf)	Pore Pressure Due to Loading(3) (psf)	Effective Stress (psf)	Undrained Strength (psf)
d01	4060	277	3783	1097
d02	4493	771	3722	1079
d03	4925	1115	3810	1105
d04	5358	1236	4122	1195
d05	5790	1048	4742	1375
d06	6223	434	5789	1679

K-K				
21 Years				
Zones 1, 2, 3, 4 and 5				
Consol File: xk1.out				
Accumulated Settlement[2]	17	ft		
Elevation of Overburden	133	ft		
Layer [1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	7442	739	6703	1944
di2	7874	2069	5805	1683
di3	8307	2980	5327	1545
di4	8739	3255	5484	1590
di5	9172	2759	6412	1860
di6	9604	1154	8450	2451

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

Table 12

K-K				
37 Years				
Zone 0				
Consol File: xk0.out				
Accumulated Settlement[2]	14	ft		
Elevation of Overburden	90	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d01	4105	121	3984	1155
d02	4538	338	4200	1218
d03	4970	490	4480	1299
d04	5403	546	4856	1408
d05	5835	466	5369	1557
d06	6268	193	6074	1762

K-K				
37 Years				
Zones 1&2				
Consol File: xk1.out				
Accumulated Settlement[2]	19	ft		
Elevation of Overburden	133	ft		
Layer [1]	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
di1	7528	302	7226	2098
di2	7961	854	7107	2061
di3	8393	1252	7141	2071
di4	8826	1398	7428	2154
di5	9258	1206	8053	2335
di6	9691	508	9183	2663

K-K				
37 Years				
Zone 3				
Consol File: xf3.out				
Accumulated Settlement[2]	23	ft		
Elevation of Overburden	200	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d31	12711	847	11864	3440
d32	13143	2474	10670	3094
d33	13576	3721	9855	2858
d34	14008	4158	9850	2857
d35	14441	3537	10904	3162
d36	14873	1473	13400	3886

K-K				
37 Years				
Zone 4				
Consol File: xk4.out				
Accumulated Settlement[2]	23	ft		
Elevation of Overburden	225	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d41	14598	1426	13173	3820
d42	15031	4121	10910	3164
d43	15463	6054	9409	2729
d44	15896	6611	9284	2692
d45	16328	5566	10762	3121
d46	16761	2313	14448	4190

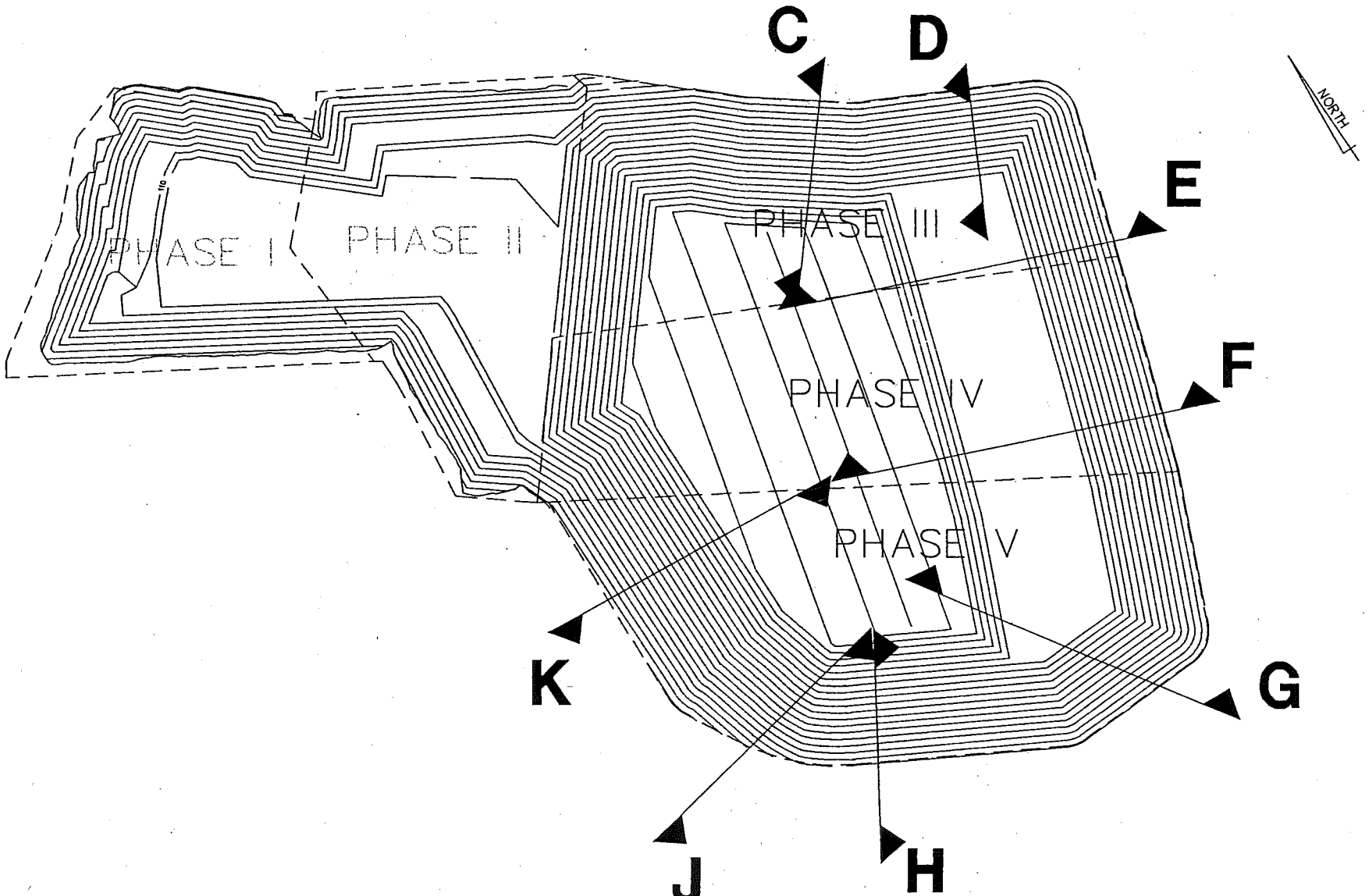
K-K				
37 Years				
Zone 5				
Consol File: xk5.out				
Accumulated Settlement[2]	24	ft		
Elevation of Overburden	265	ft		
Layer	Drained Effective Stress[2] (psf)	Pore Pressure Due to Loading[3] (psf)	Effective Stress (psf)	Undrained Strength (psf)
d51	17612	2258	15353	4452
d52	18044	6239	11805	3424
d53	18477	8702	9775	2835
d54	18909	9273	9637	2795
d55	19342	7862	11480	3329
d56	19774	3311	16463	4774

1) i represents the zone number, for example, di1 represents d11, d21, d31, etc.
2) Calculated at mid-point of layer
3) Obtained from CONSOL analysis

TABLE 13
STATIC STABILITY RESULTS
CALCULATED FACTORS OF SAFETY

Analysis	Section	Circular	Controlling Layer	Non-Circular	Controlling Layer
9 Years of Waste Placement	C-C	1.6	MSE Berm	2.9	Dredge/Alluvium
	D-D	1.5	MSE Berm	3.1	Dredge/Alluvium
	E-E	1.4	Dredge/Alluvium	2.1	Dredge/Alluvium
	F-F	1.5	Dredge/Alluvium	2.2	Dredge/Alluvium
	G-G	1.6	Dredge/Alluvium	2.9	Dredge/Alluvium
	H-H	1.6	MSE Berm	2.9	Dredge/Alluvium
	J-J	1.8	MSE Berm	2.9	Dredge/Alluvium
	K-K	3.1	Dredge/Alluvium	2.9	Dredge/Alluvium
21 Years of Waste Placement	C-C	1.5	MSE Berm	2.3	Dredge/Alluvium
	D-D	1.5	MSE Berm	2.3	Dredge/Alluvium
	E-E	1.4	Dredge/Alluvium	1.9	Dredge/Alluvium
	F-F	1.5	Dredge/Alluvium	2.1	Dredge/Alluvium
	G-G	1.6	Dredge/Alluvium	2.1	Dredge/Alluvium
	H-H	1.5	MSE Berm	2.1	Dredge/Alluvium
	J-J	1.7	MSE Berm	2.1	Dredge/Alluvium
	K-K	2.5	Dredge/Alluvium	2.2	Dredge/Alluvium
37 Years of Waste Placement	C-C	1.5	Potomac Formation	1.6	Dredge/Alluvium
	D-D	1.5	MSE Berm	1.6	Dredge/Alluvium
	E-E	1.4	Dredge/Alluvium	1.4	Dredge/Alluvium
	F-F	1.5	Dredge/Alluvium	1.5	Dredge/Alluvium
	G-G	1.5	Dredge/Alluvium	1.7	Dredge/Alluvium
	H-H	1.4	Potomac Formation	1.4	Dredge/Alluvium
	J-J	1.4	Dredge/Alluvium	1.4	Dredge/Alluvium
	K-K	1.4	Dredge/Alluvium	1.5	Dredge/Alluvium
Long-Term ConDredge/Alluviu	C-C	1.5	MSE Berm	2.3	Dredge/Alluvium
	D-D	1.5	MSE Berm	1.8	Dredge/Alluvium
	E-E	1.5	MSE Berm	2.2	Dredge/Alluvium
	F-F	1.5	MSE Berm	2.2	Dredge/Alluvium
	G-G	1.7	MSE Berm	2.4	Dredge/Alluvium
	H-H	1.5	MSE Berm	2.1	Dredge/Alluvium
	J-J	1.6	MSE Berm	2.5	Dredge/Alluvium
	K-K	2.3	Potomac Formation	2.6	Dredge/Alluvium

FIGURES



PLAN VIEW OF ANALYSIS SECTIONS

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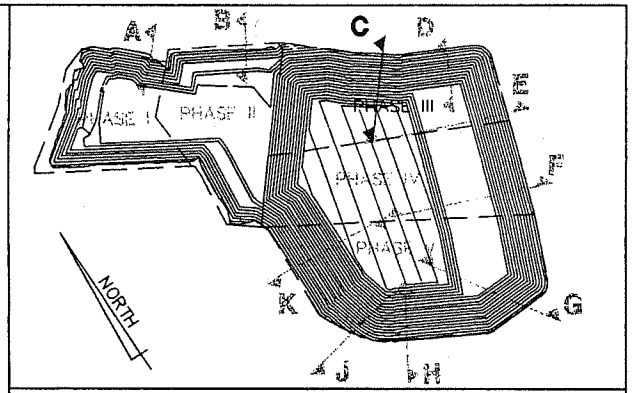
SCALE: 1" = 450'

GEOSYNTEC CONSULTANTS

COLUMBIA, MARYLAND

FIGURE NO.	1
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609-2

SECTION C
STA 33+00



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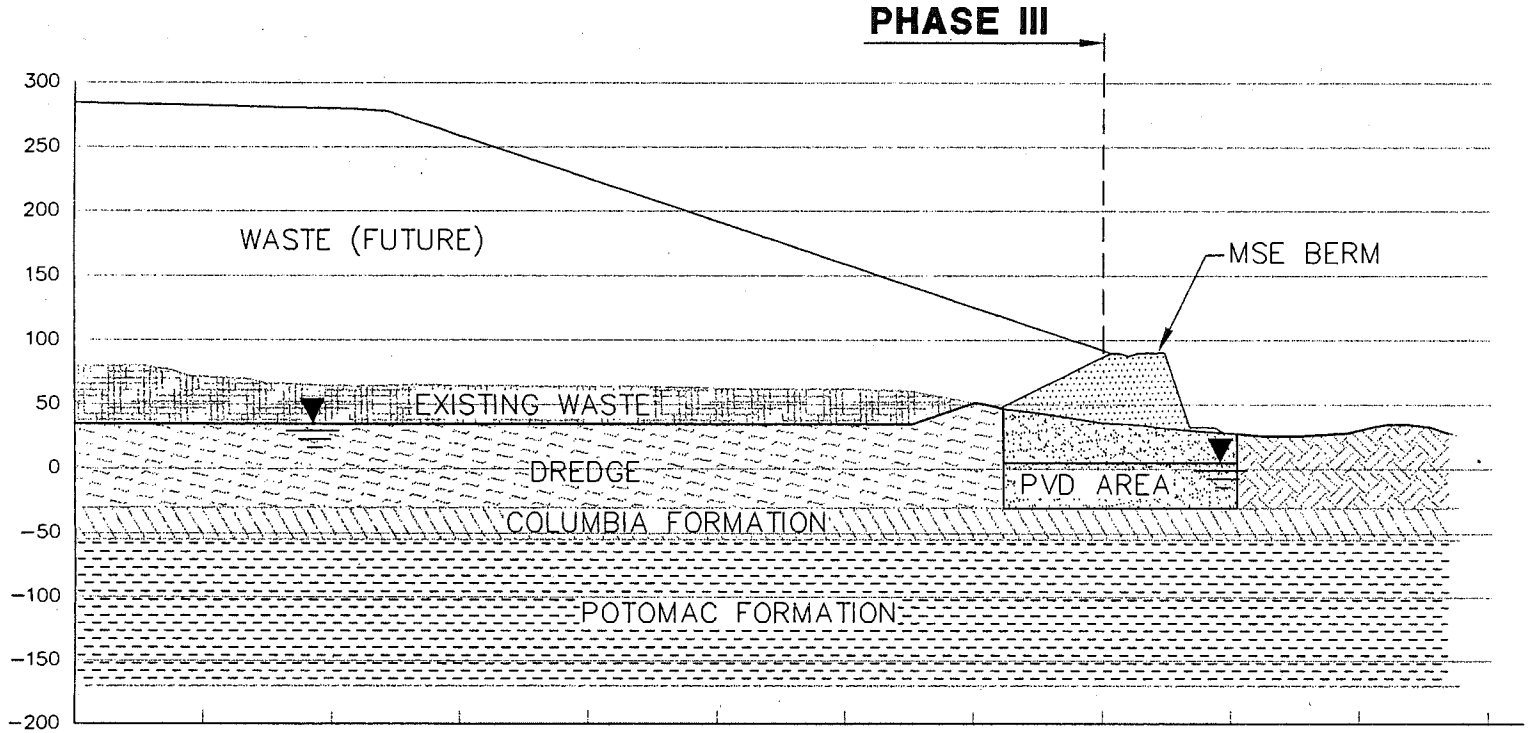

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GeoSyntec Consultants
COLUMBIA, MARYLAND

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DOCUMENT NO.	
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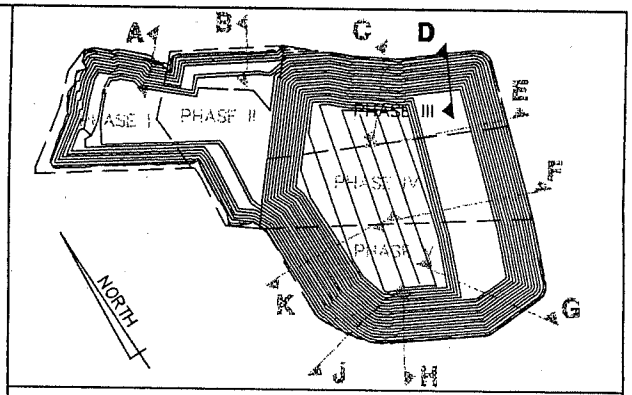
SECTION D
STA 40+00



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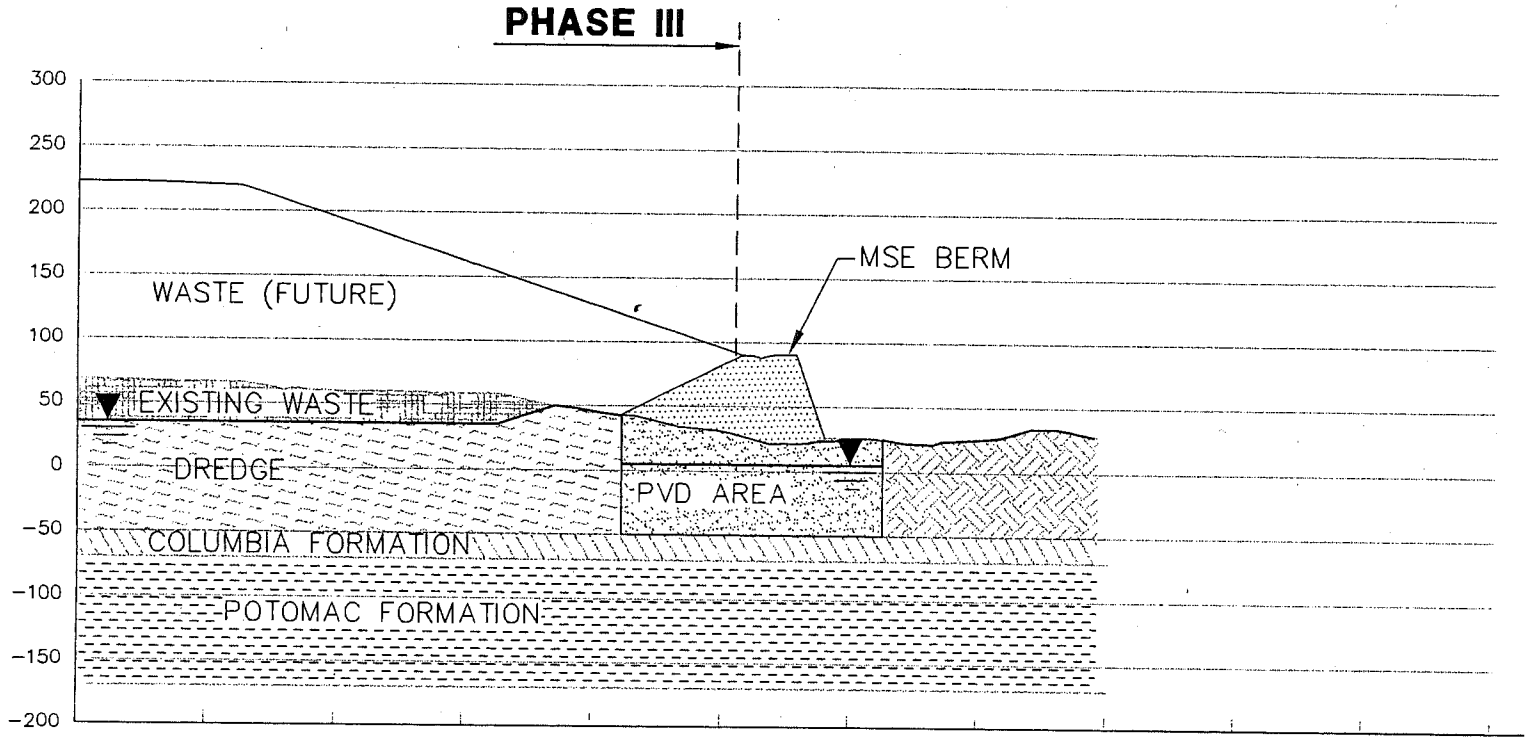

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GeoSyntec Consultants

COLUMBIA, MARYLAND

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FILE NO.	0250F609

SECTION E
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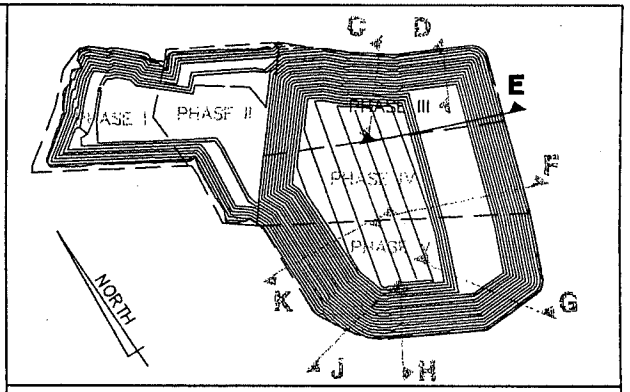

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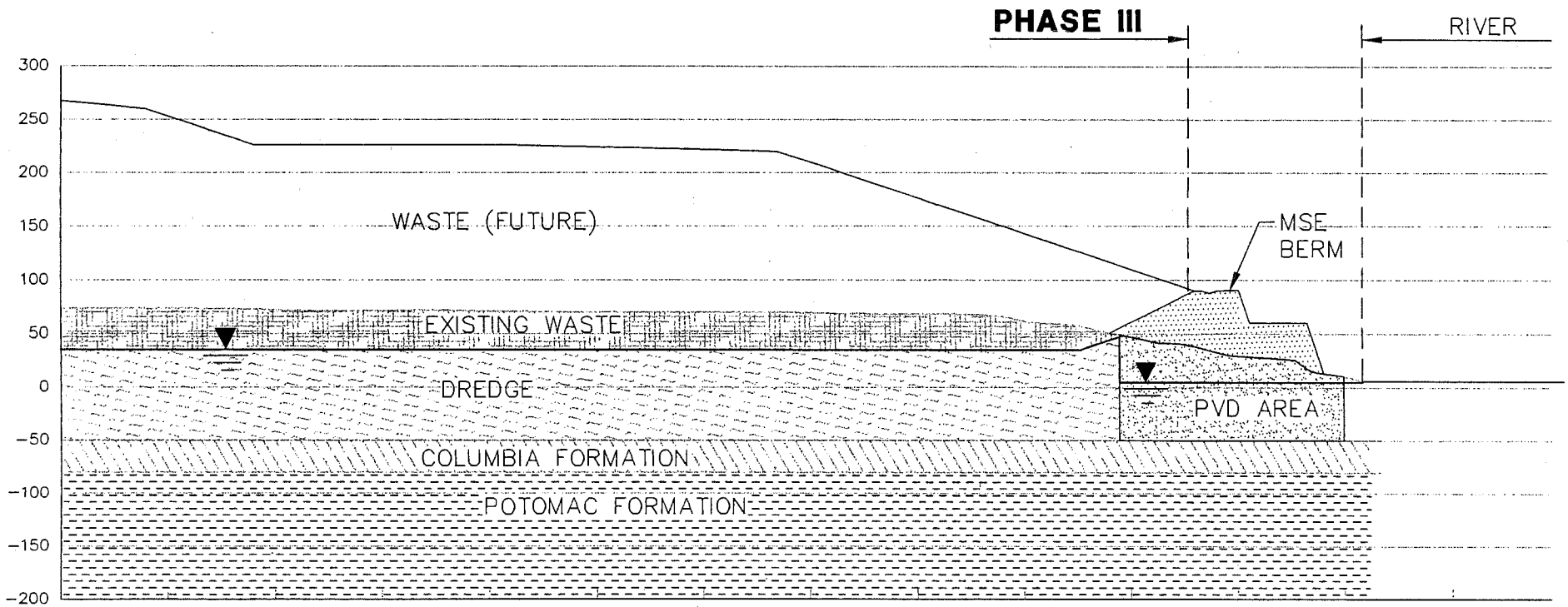

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GeoSyntec Consultants

COLUMBIA, MARYLAND

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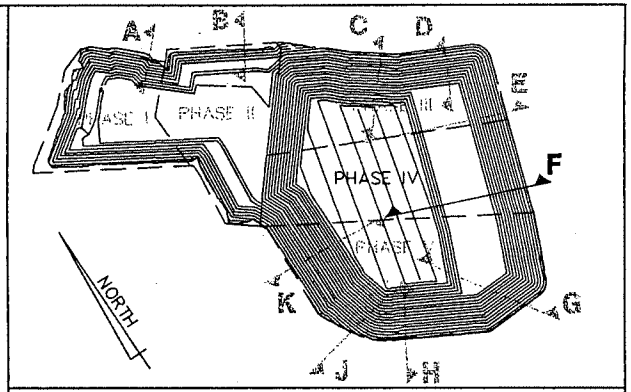
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609-2

SECTION F
STA 58+00



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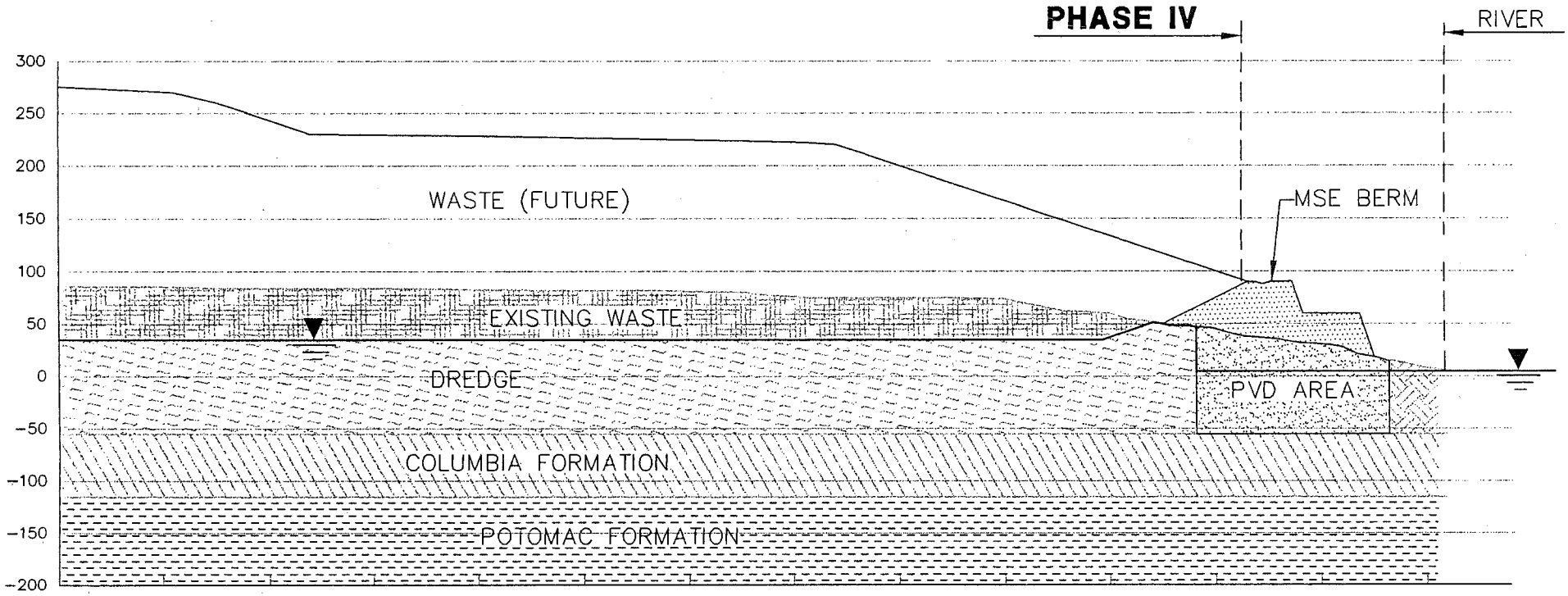

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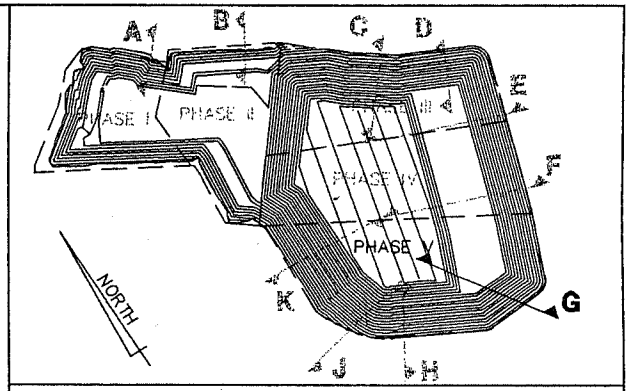
GeoSyntec Consultants
COLUMBIA, MARYLAND

FIGURE NO.	2D
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609

SECTION G

STA 69.46



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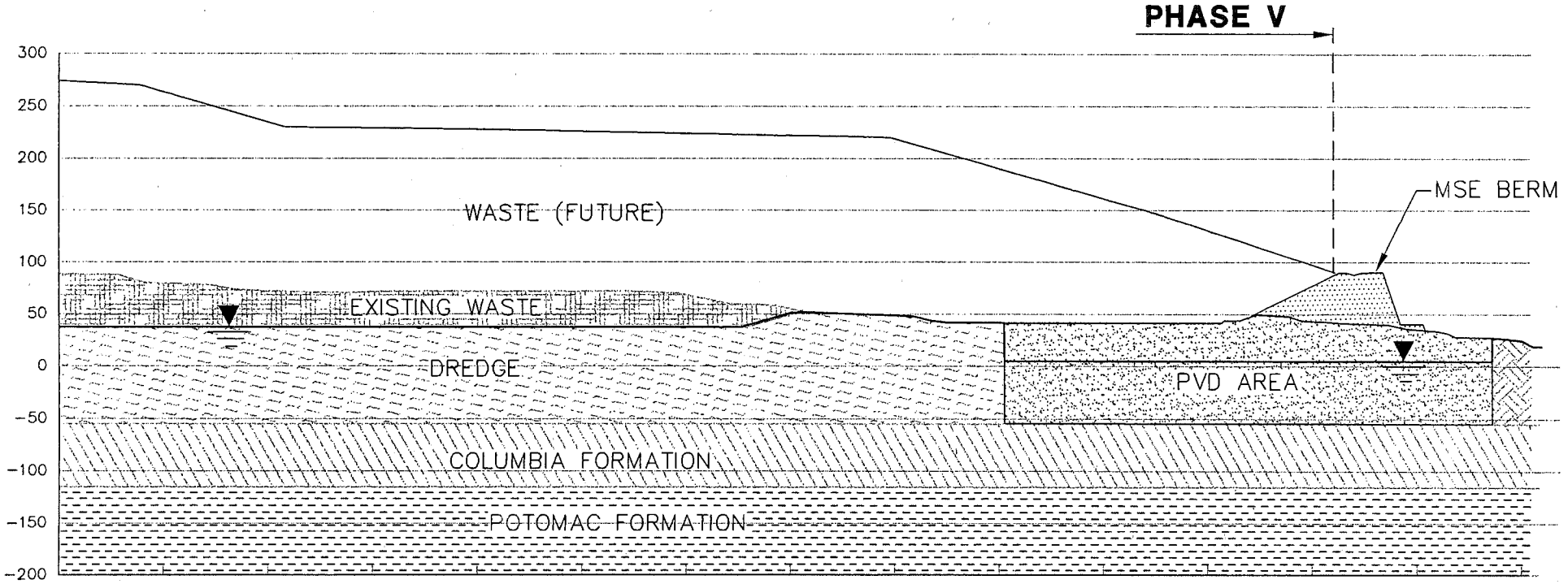

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FIGURE NO.	2E
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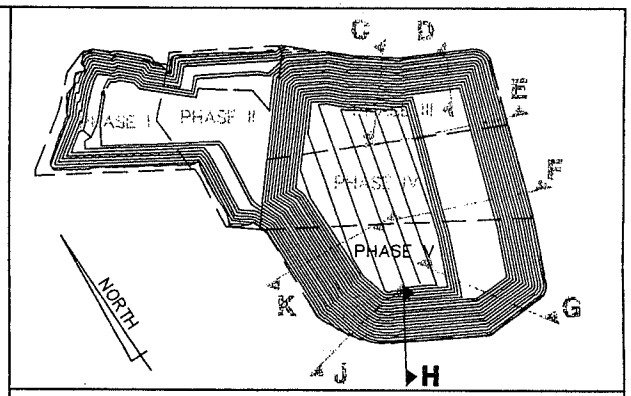
DOCUMENT NO.	
FILE NO.	0250F609

SECTION H
STA 83+00



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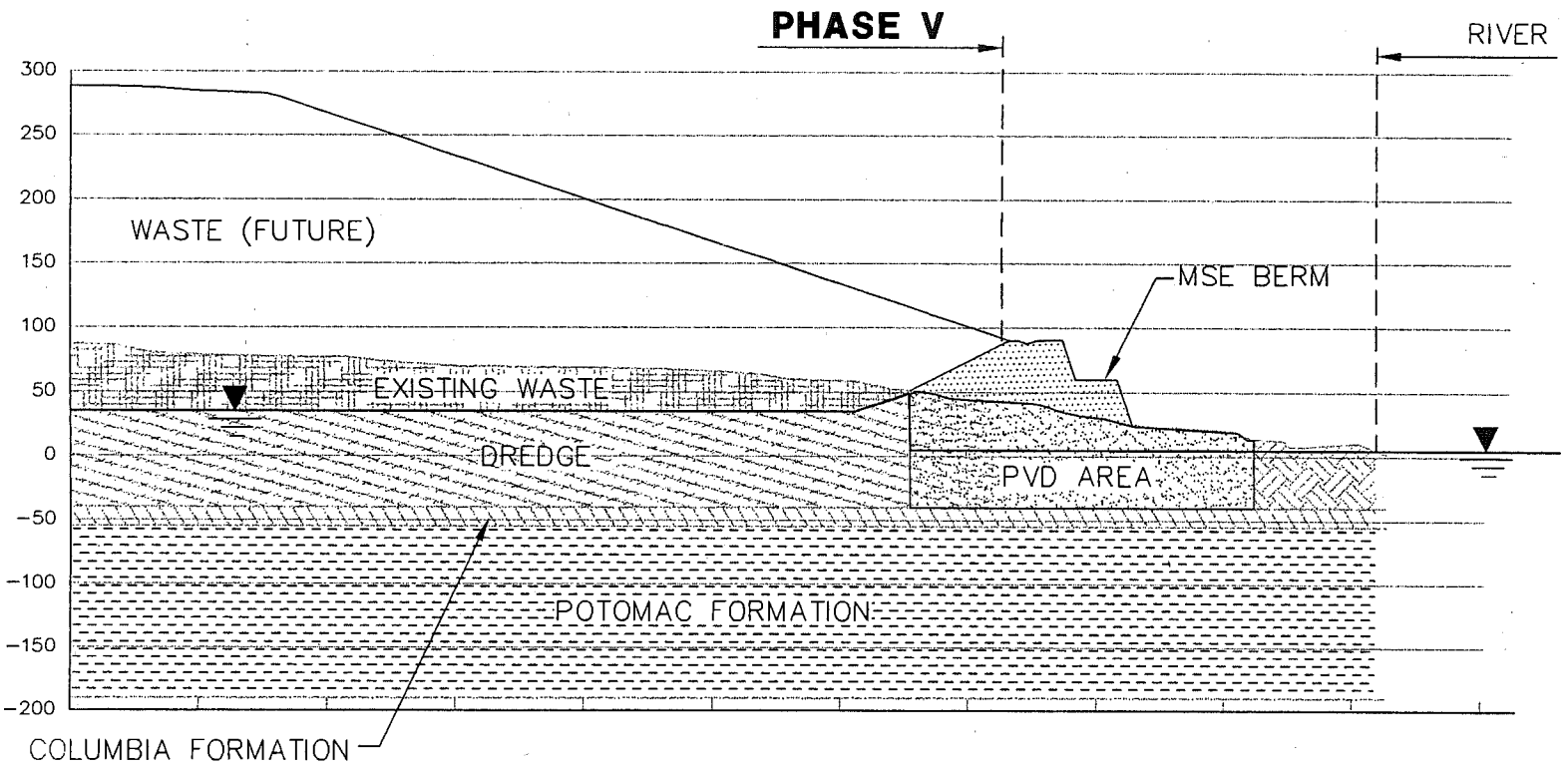

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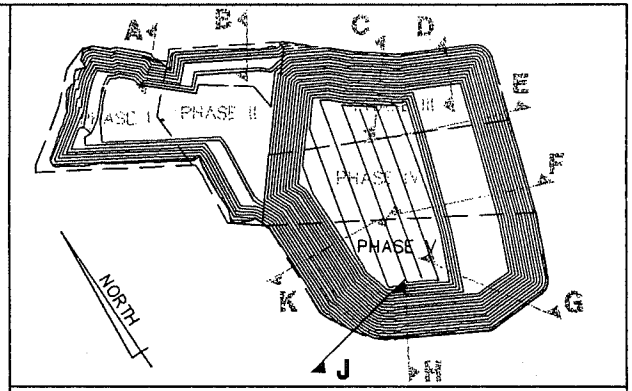
COLUMBIA, MARYLAND

FIGURE NO.	2F
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609-2

SECTION J
STA 90+00



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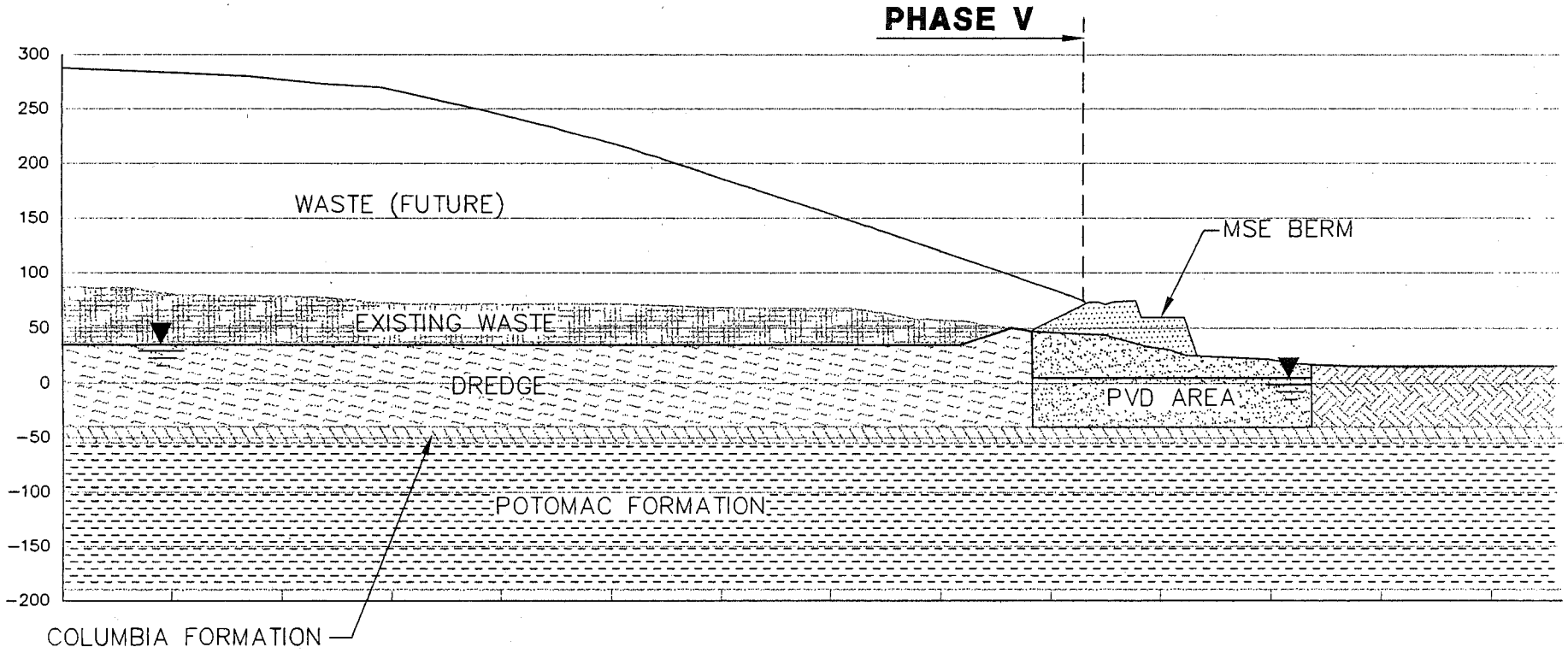

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SCALE: 1" = 150'

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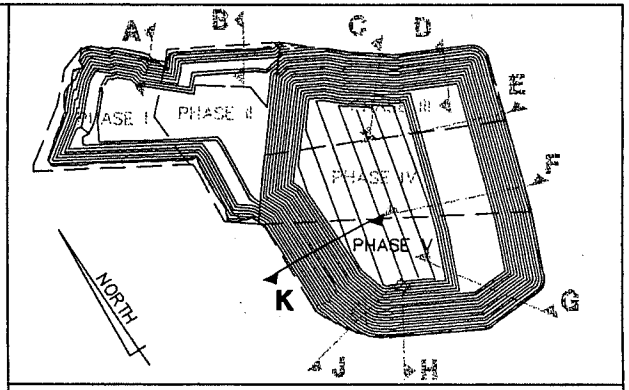
COLUMBIA, MARYLAND

FIGURE NO.	2G
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609

SECTION K

STA 100+00



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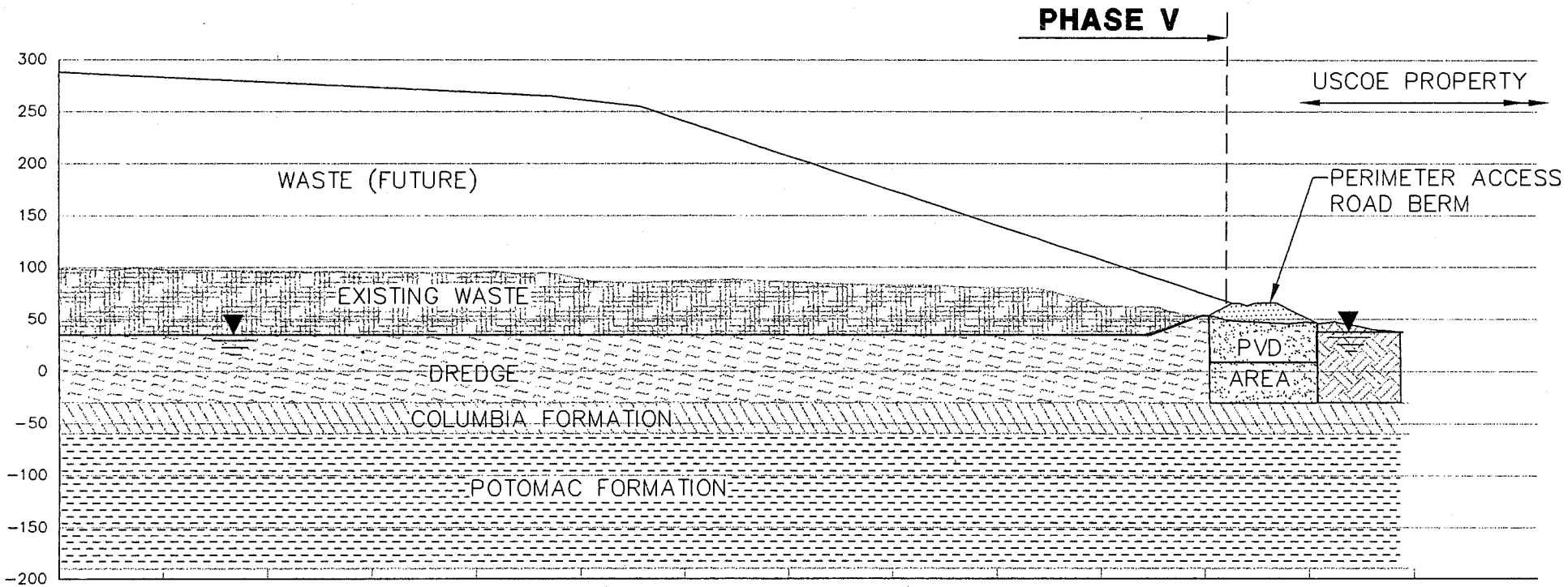

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SCALE: 1" = 150'

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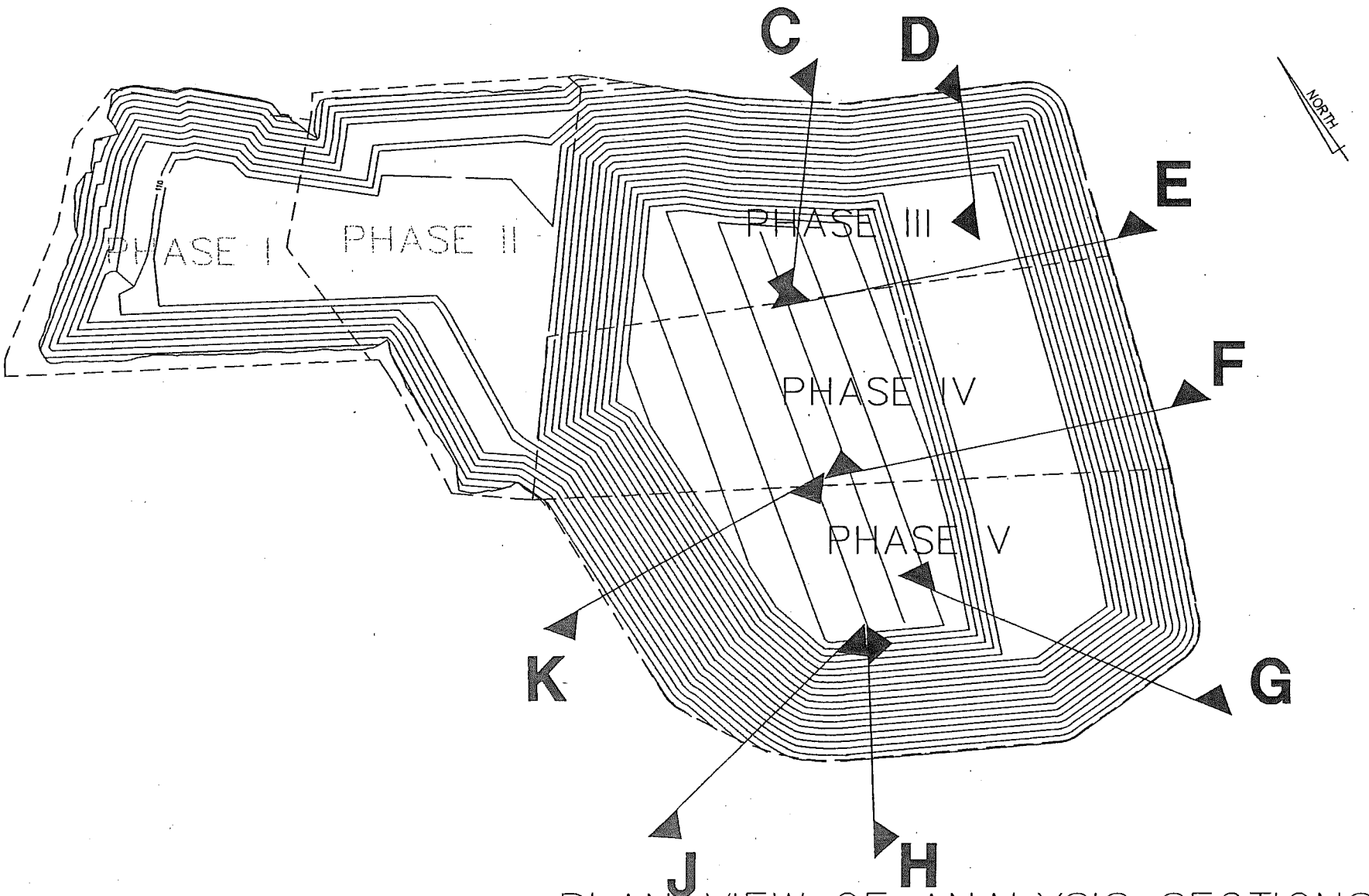
COLUMBIA, MARYLAND

FIGURE NO.	2H
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609



PLAN VIEW OF ANALYSIS SECTIONS

450 225 0 450

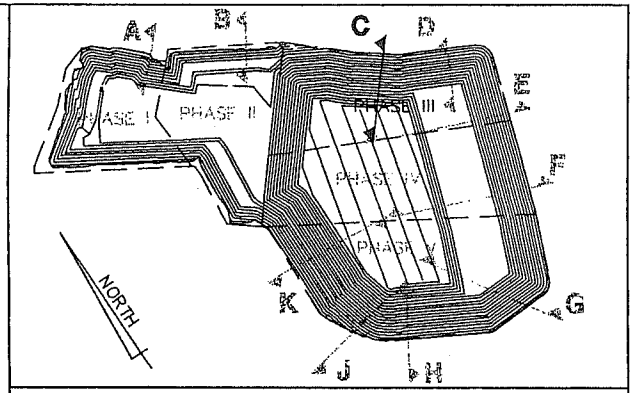
SCALE: 1" = 450'

GeoSyntec Consultants

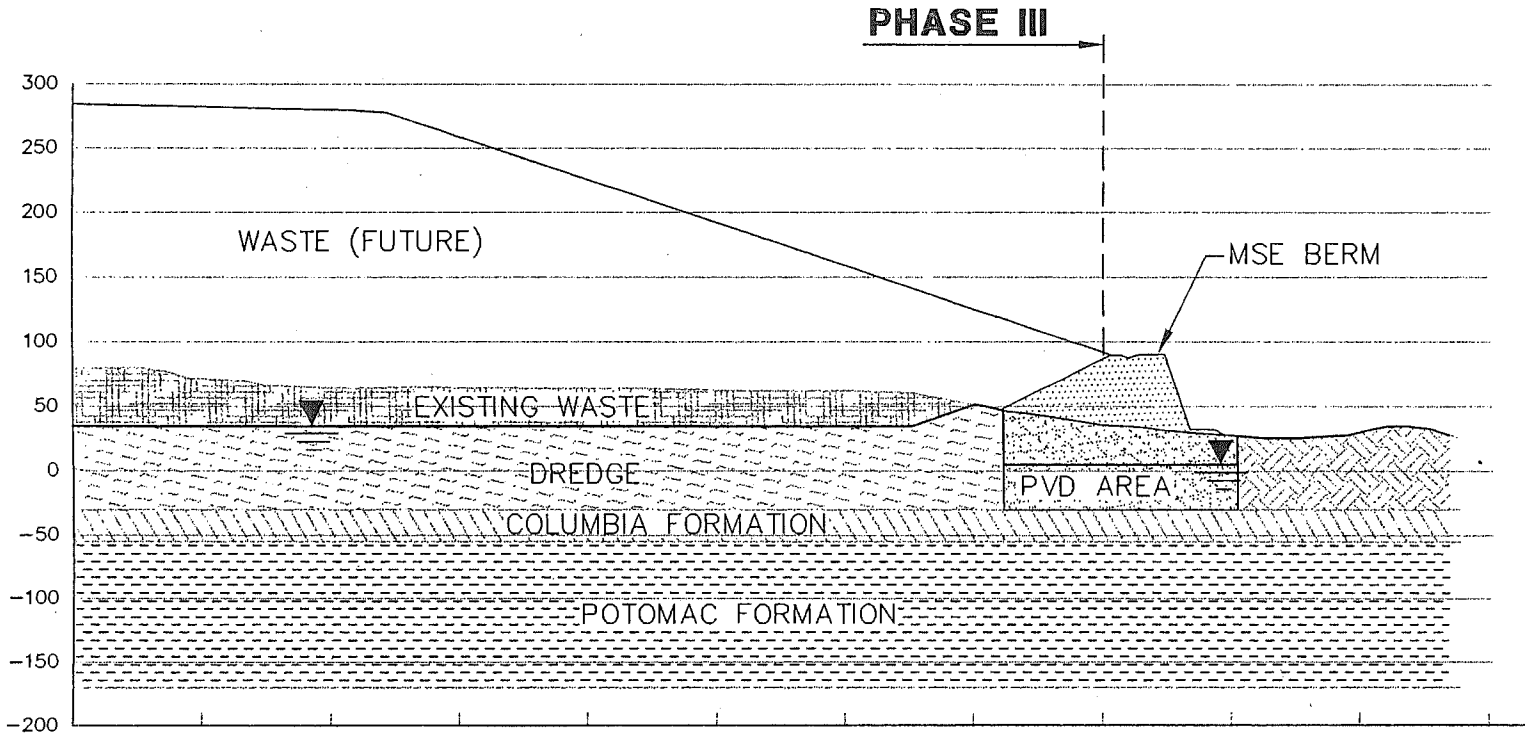
COLUMBIA, MARYLAND

FIGURE NO.	1
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609-2

SECTION C
STA 33+00



KEY MAP

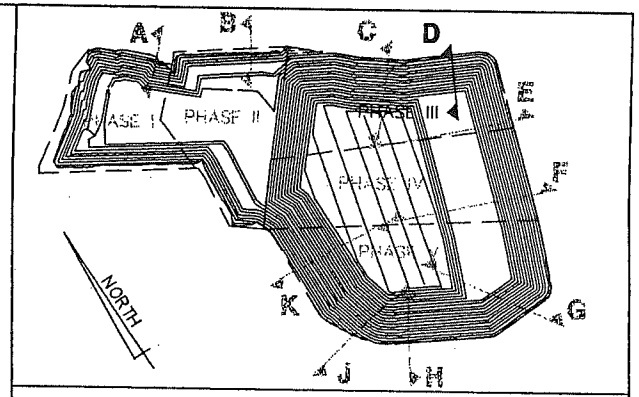


150 75 0 150
SCALE: 1" = 150'

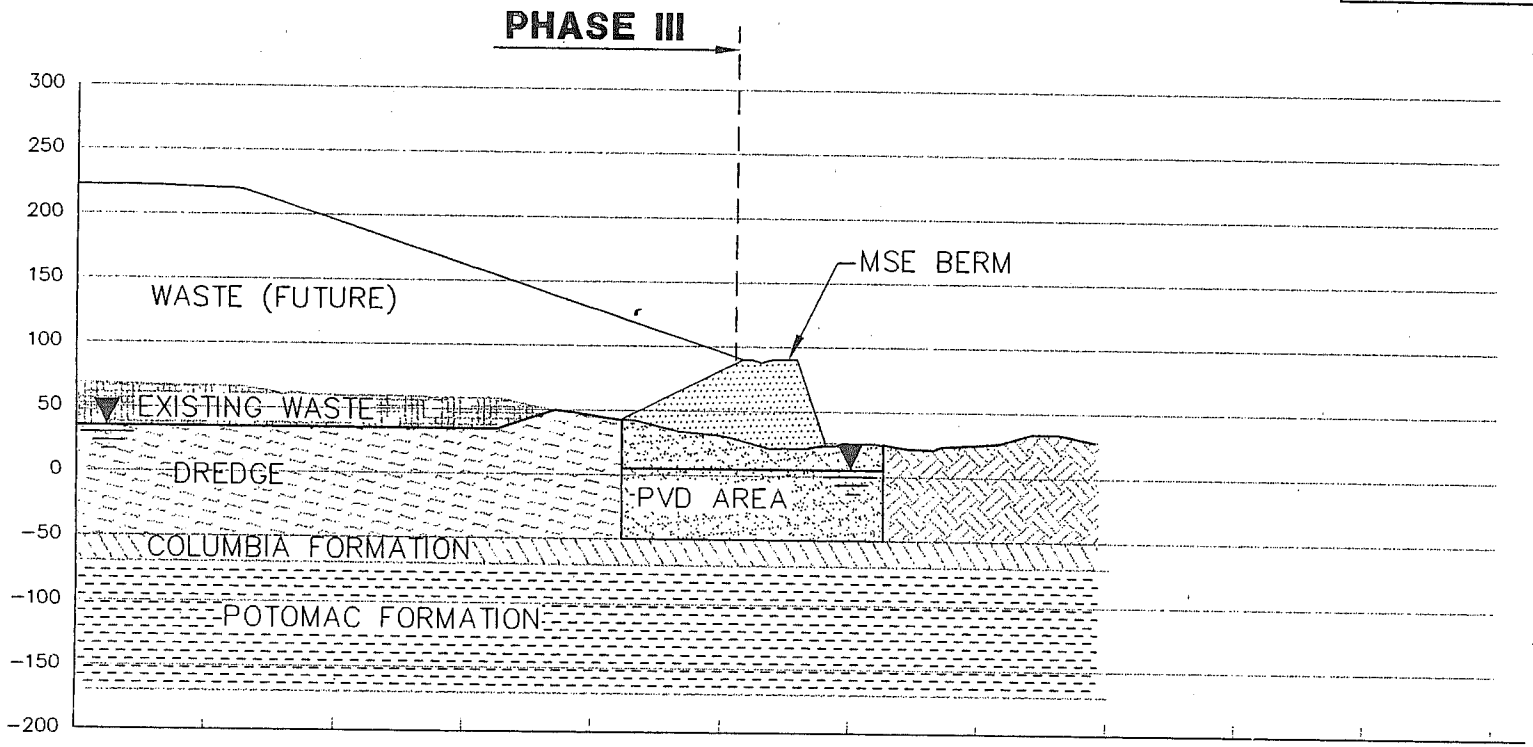
GeoSyntec Consultants
COLUMBIA, MARYLAND

FIGURE NO.	2A
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609

SECTION D
STA 40+00



KEY MAP

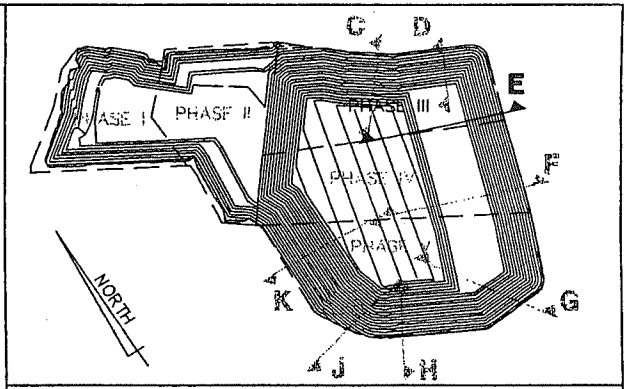


150 75 0 150
SCALE: 1" = 150'

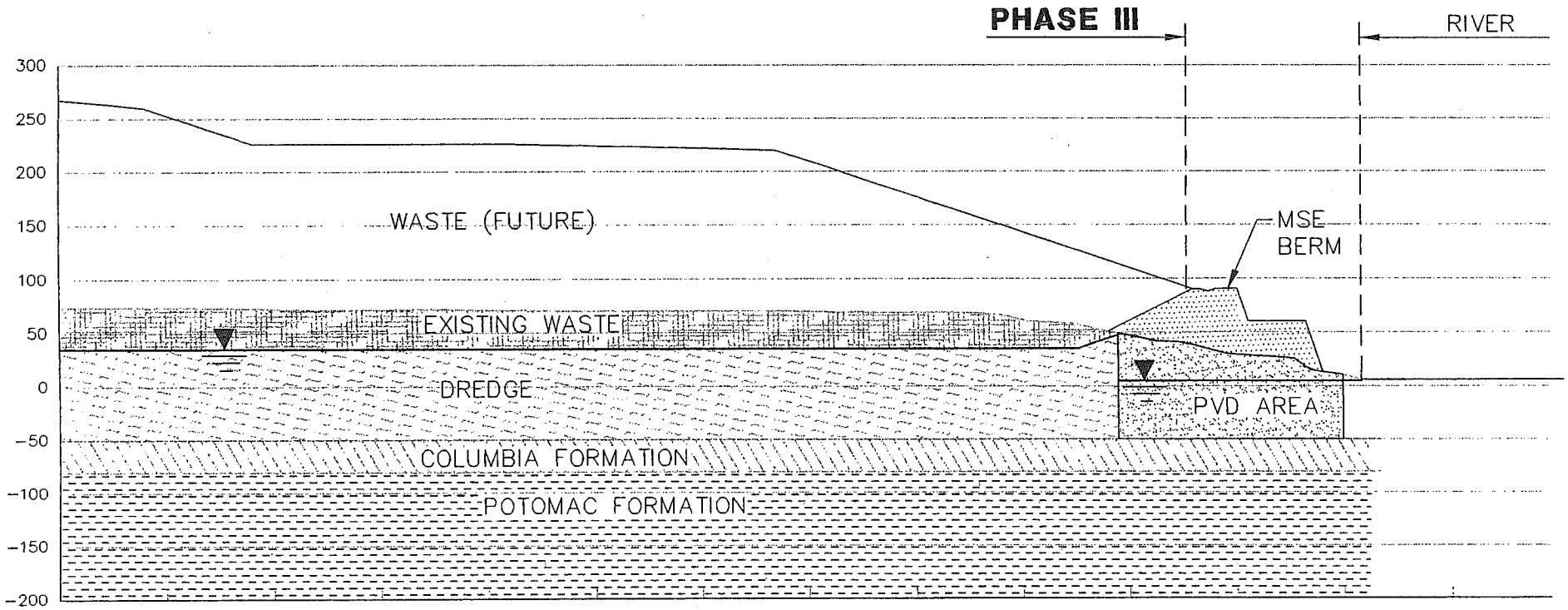
GeoSyntec Consultants
COLUMBIA, MARYLAND

FIGURE NO.	2B
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609

SECTION E
STA 50+00



KEY MAP

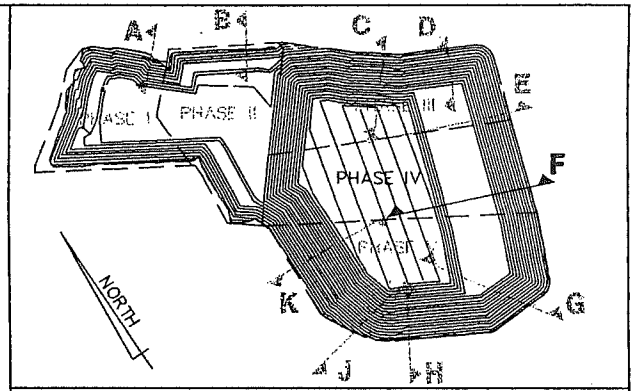


150 75 0 150
SCALE: 1" = 150'

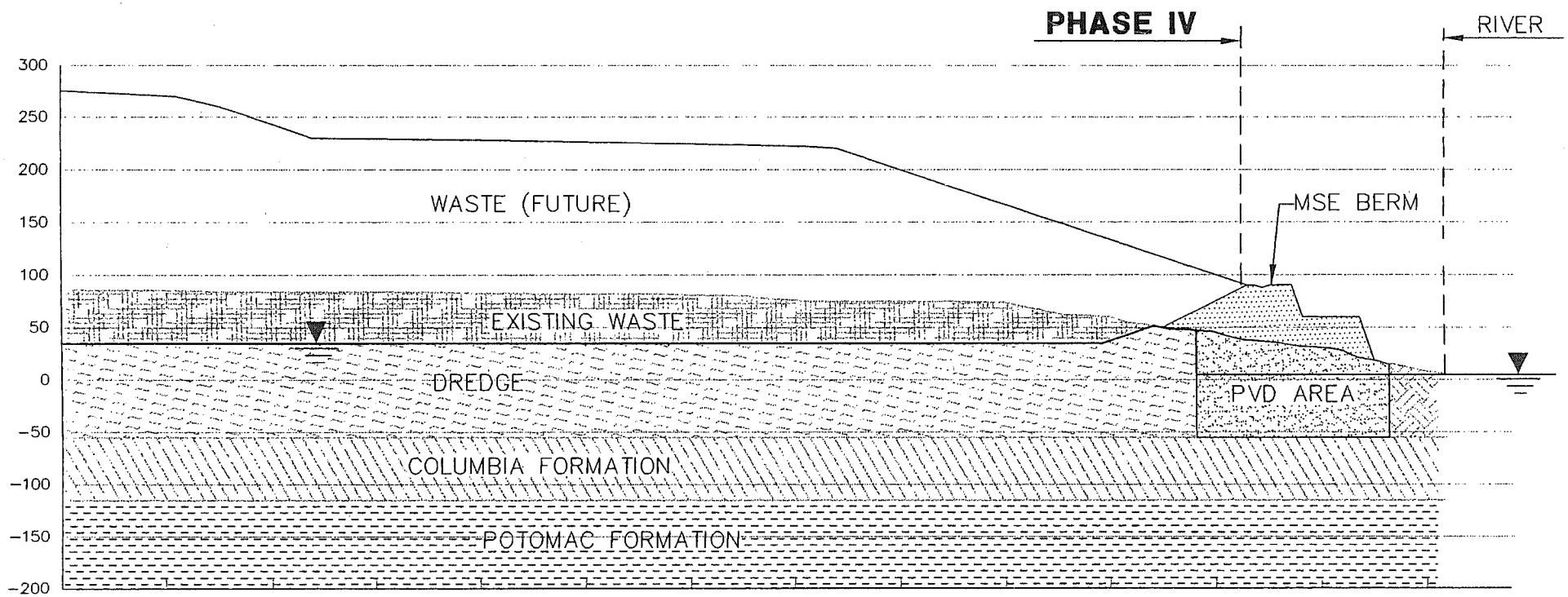
GeoSyntec Consultants
COLUMBIA, MARYLAND

FIGURE NO.	2C
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609−2

SECTION F
STA 58+00



KEY MAP

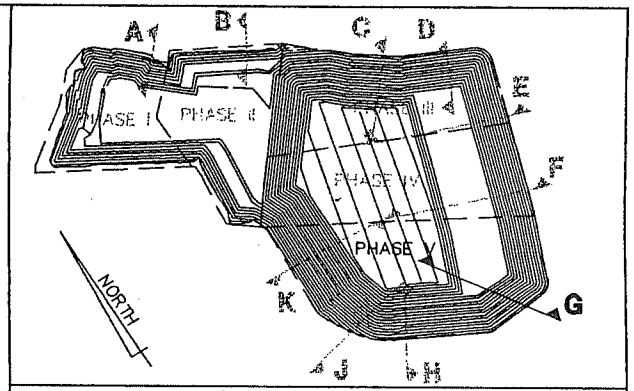


150 75 0 150
SCALE: 1" = 150'

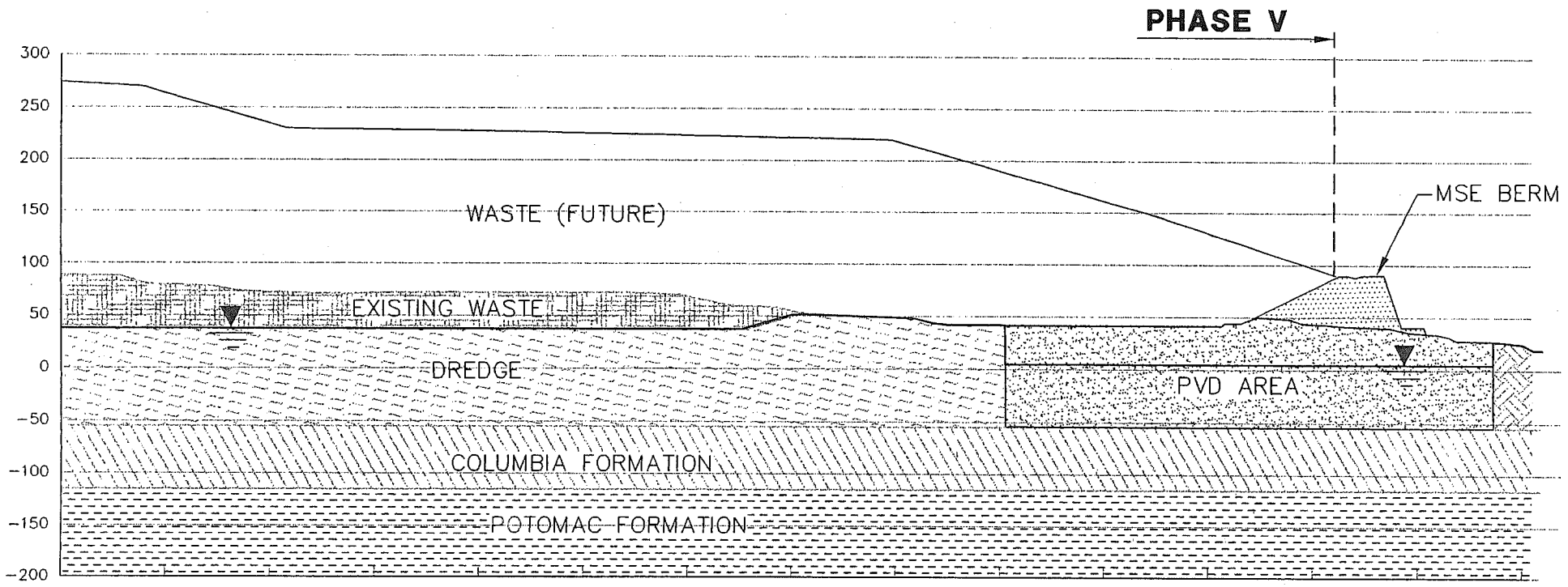
GeoSyntec Consultants
COLUMBIA, MARYLAND

FIGURE NO.	2D
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609

SECTION G
STA 69.46



KEY MAP

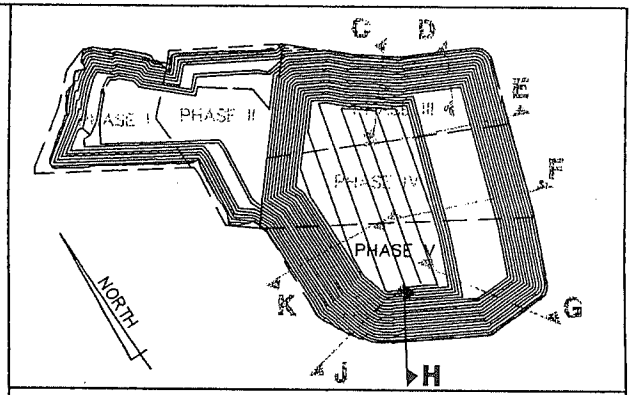


150 75 0 150
SCALE: 1" = 150'.

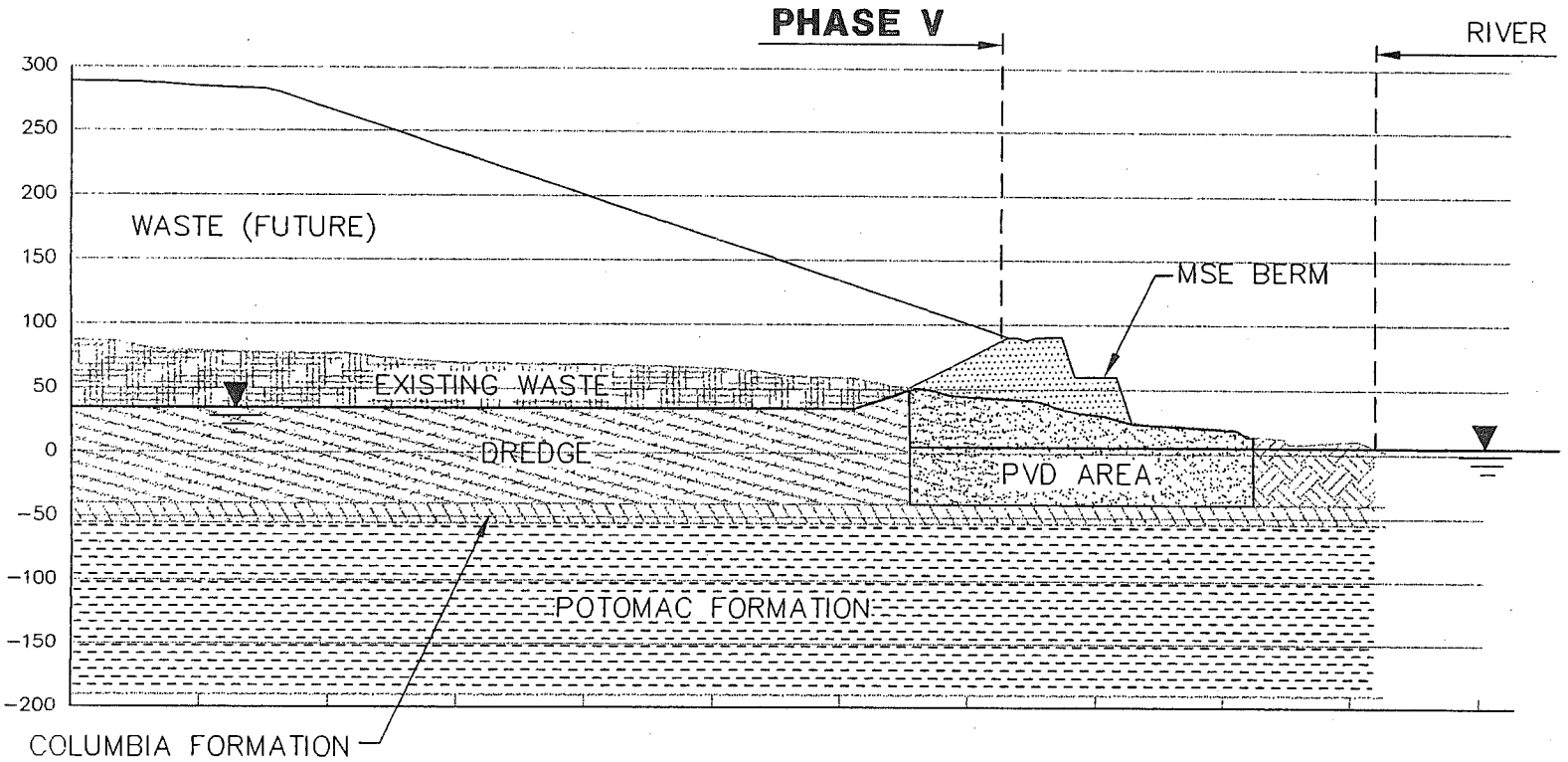
GeoSyntec Consultants
COLUMBIA, MARYLAND

FIGURE NO.	2E
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609

SECTION H
STA 83+00



KEY MAP

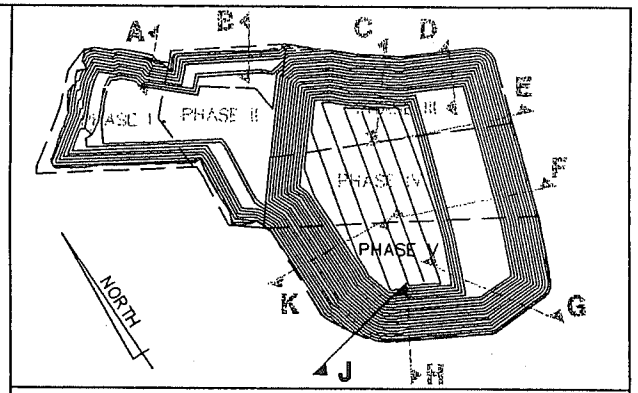


150 75 0 150
SCALE: 1" = 150'

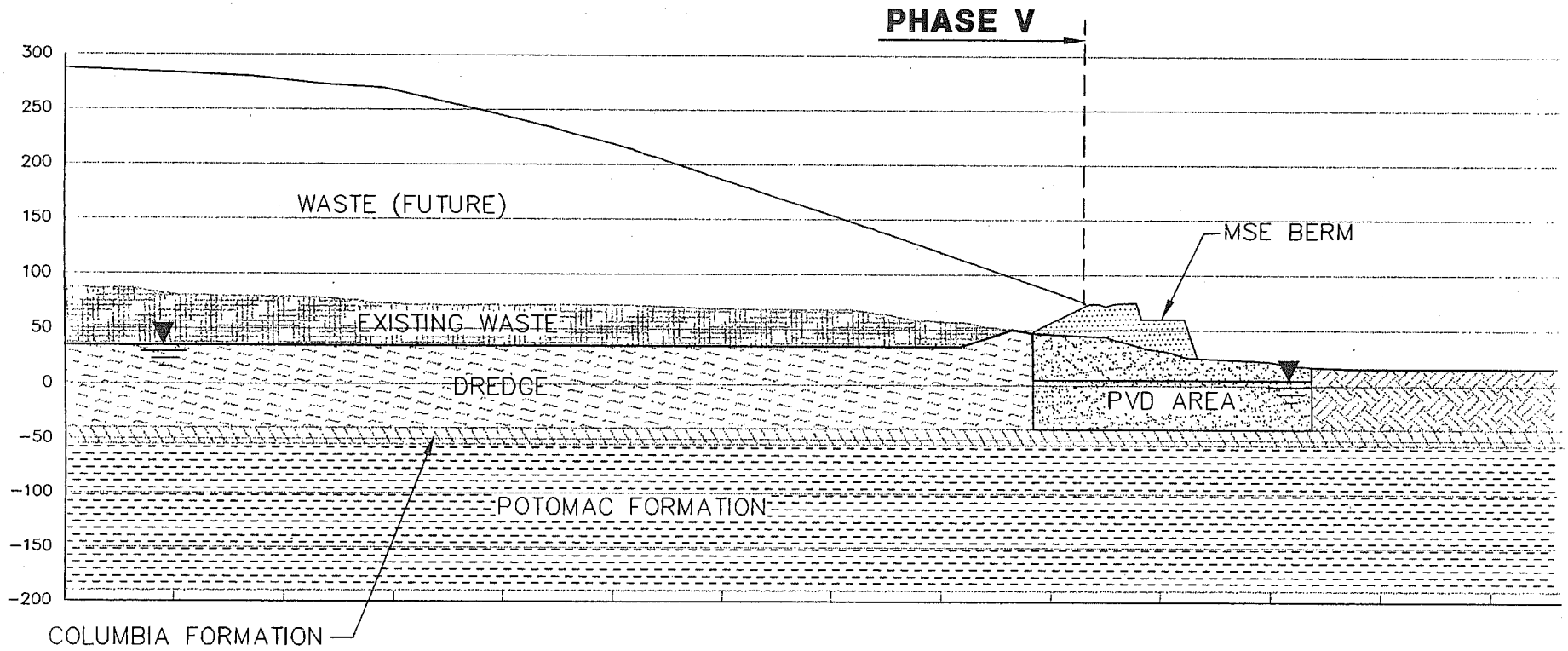
GeoSyntec Consultants
COLUMBIA, MARYLAND

FIGURE NO.	2F
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609-2

SECTION J
STA 90+00



KEY MAP



150 75 0 150

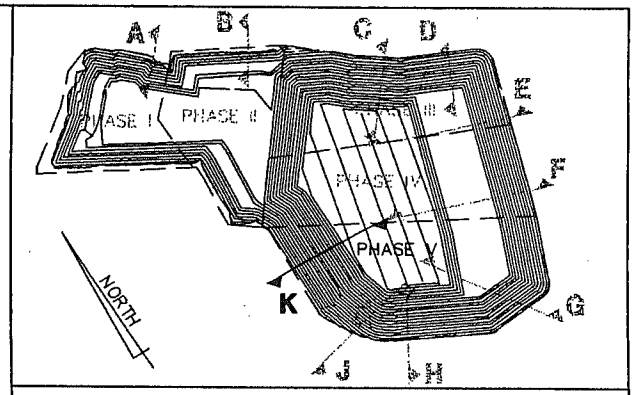
SCALE: 1" = 150'

GeoSyntec Consultants

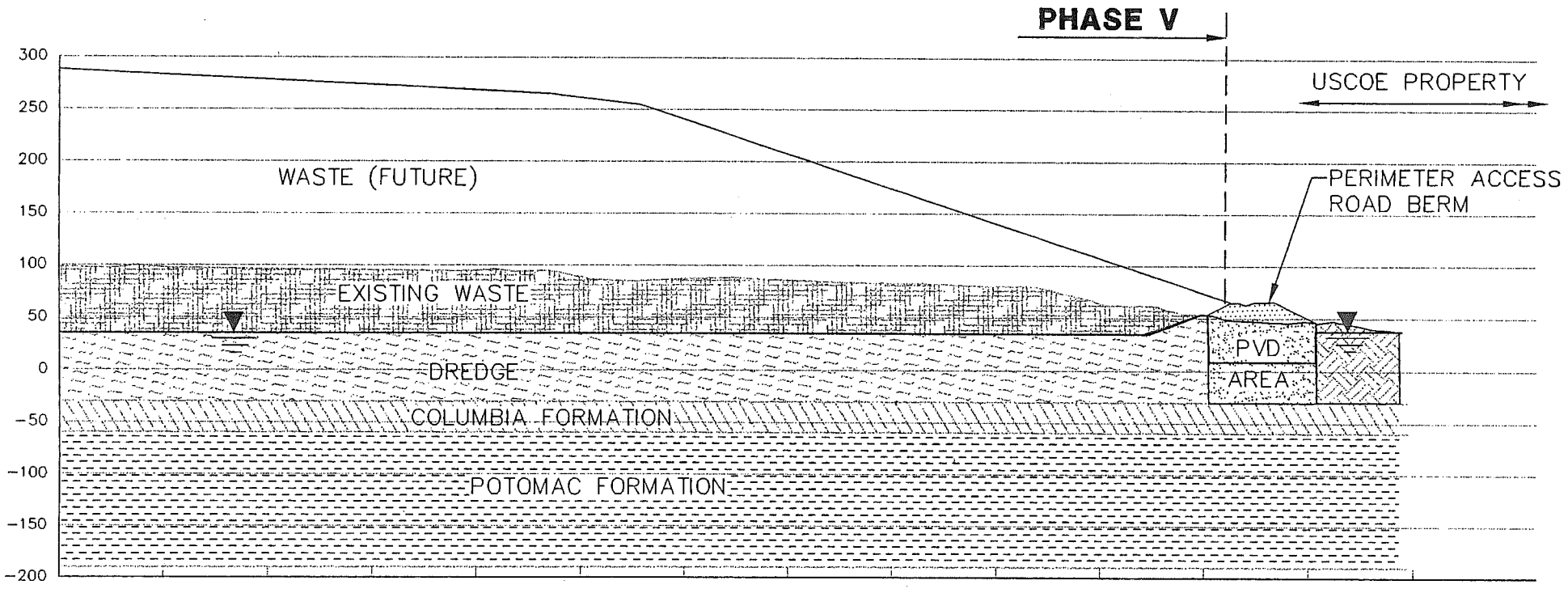
COLUMBIA, MARYLAND

FIGURE NO.	2G
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609

SECTION K
STA 100+00



KEY MAP



150 75 0 150

SCALE: 1" = 150'

GeoSyntec Consultants

COLUMBIA, MARYLAND

FIGURE NO.	2H
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609

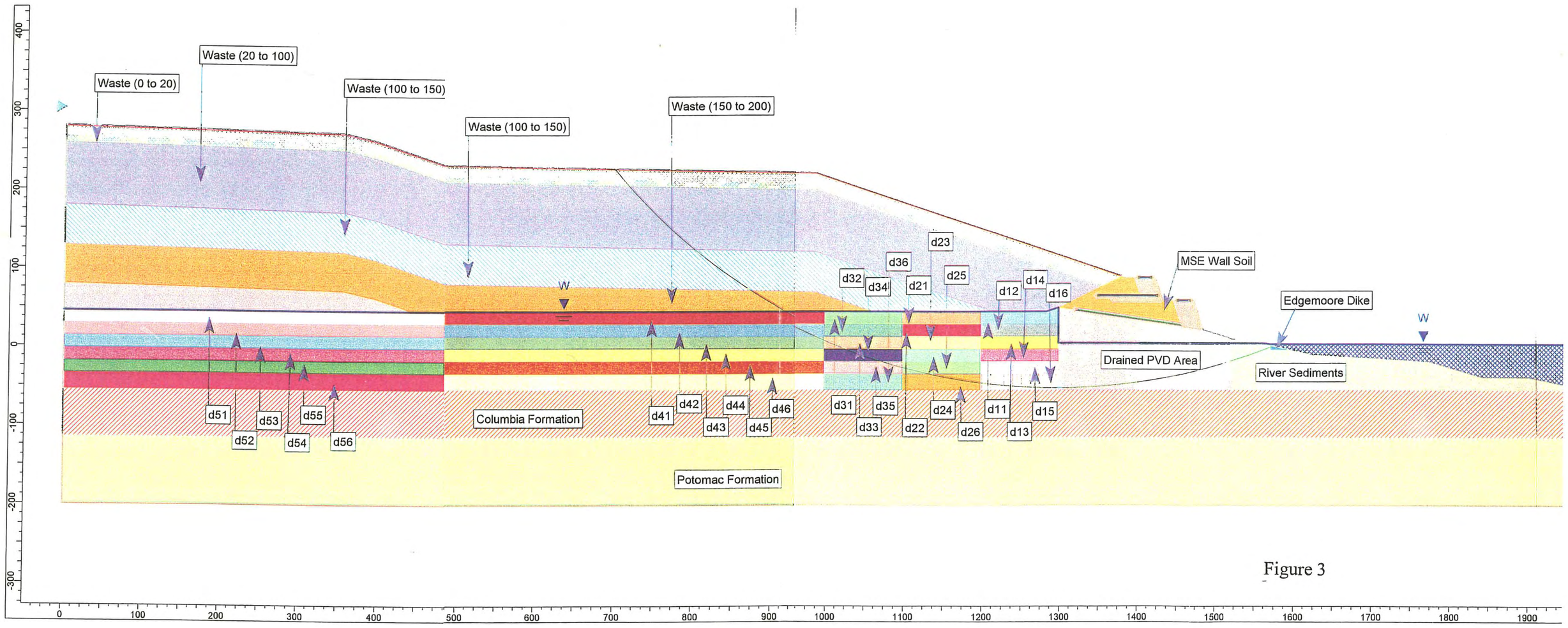

Waste (0 to 20)
Waste (20 to 100)
Waste (100 to 150)
Waste (100 to 150)
Waste (150 to 200)
d23
d36
d32
d34
d21
d25
d12
d14
d16
MSE Wall Soil
Edgemoore Dike
W
W
Drained PVD Area
River Sediments
d51
d52
d53
d54
d55
d56
Columbia Formation
d41
d42
d43
d44
d45
d46
d31
d33
d35
d22
d24
d26
d11
d13
d15
Potomac Formation
400
300
200
100
0
-100
-200
-300
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900

Figure 3

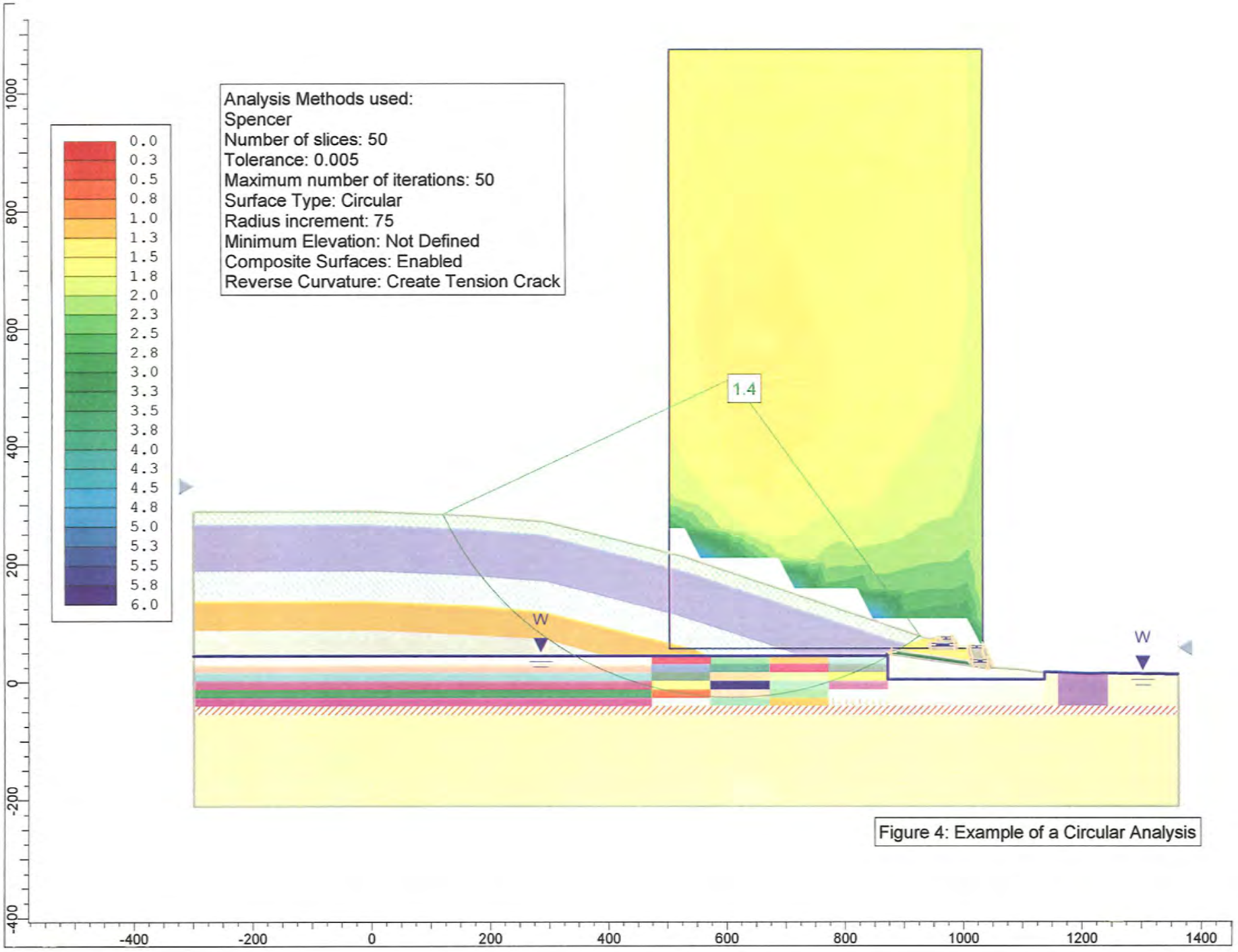


Figure 4: Example of a Circular Analysis

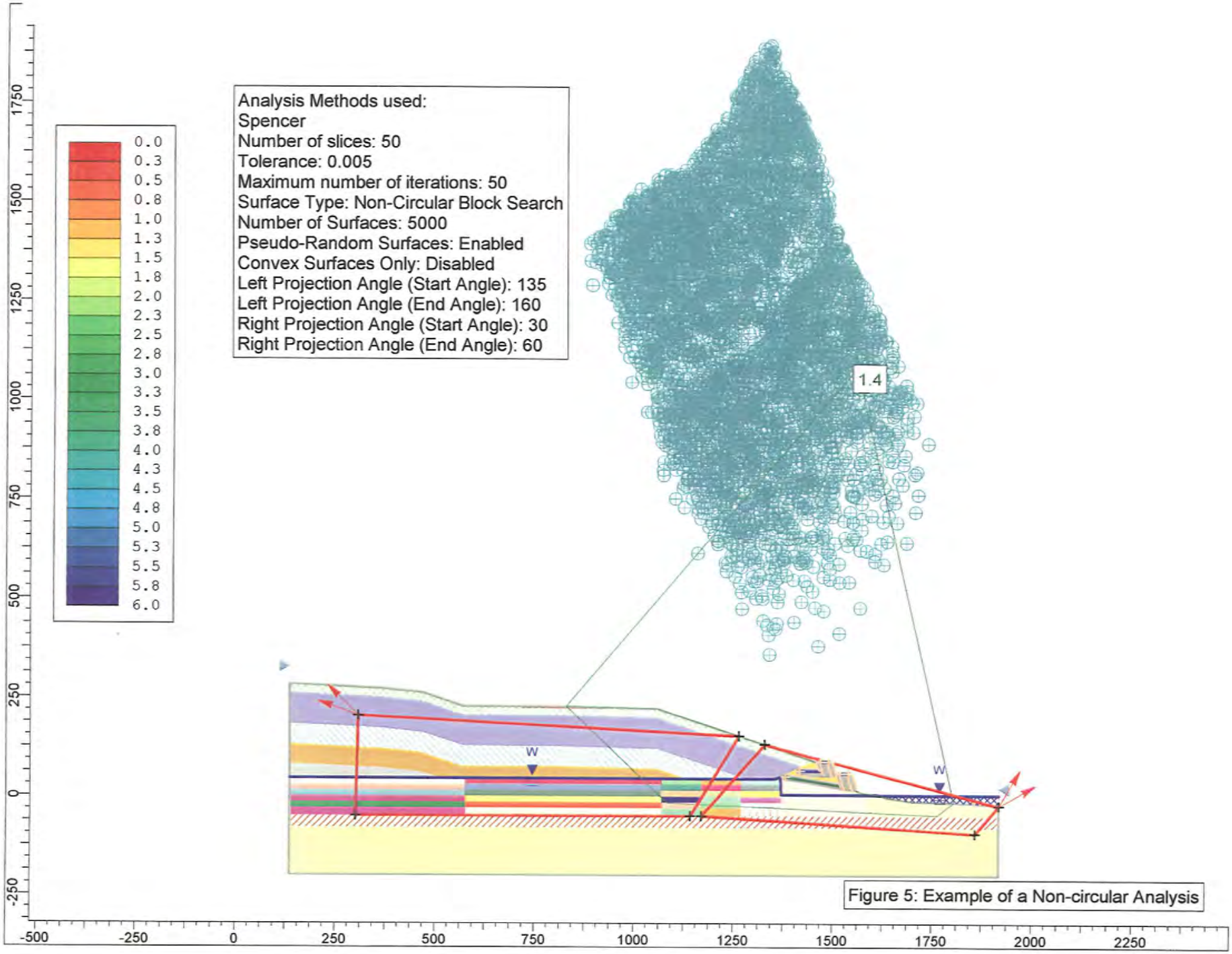


Figure 5: Example of a Non-circular Analysis

Slide Analysis Information

Document Name

File Name: c-c(9 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

SETTINGS

Analysis Methods

Analysis Methods used:
Spencer

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

ANALYSIS PARAMETERS

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

SEARCH OPTIONS

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

LOADING

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

MATERIAL PROPERTIES (1)

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1292 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1044 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 897 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 972 psf
Water Surface: None

(1) Note: The unit weight reported in the SLIDE output files is only the moist unit weight. The saturated unit weight is not provided. For reference, the saturated unit weight of all waste is 100 pcf and for dredge is 95 pcf. Also, the water table is not assigned to dredge materials d11 though d56 because the material uses an undrained strength parameter.

FIGURE 6

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1292 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1841 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

REINFORCEMENT PROPERTIES

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

ANALYSIS RESULTS

Method: spencer
SF: 1.57083
Center: 927.14, 198.071
Radius: 175.699
Left Slip Surface Endpoint: 782.492, 98.3361
Right Slip Surface Endpoint: 868.132, 32.5773

Method Statistics

STATISTICS AND ERROR CODES

Method: spencer
Number of Valid Surfaces: 22061
Number of Invalid Surfaces: 11455
Error Codes:
Error Code -106 reported for 110 surfaces
Error Code -107 reported for 791 surfaces
Error Code -108 reported for 1889 surfaces
Error Code -111 reported for 8665 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

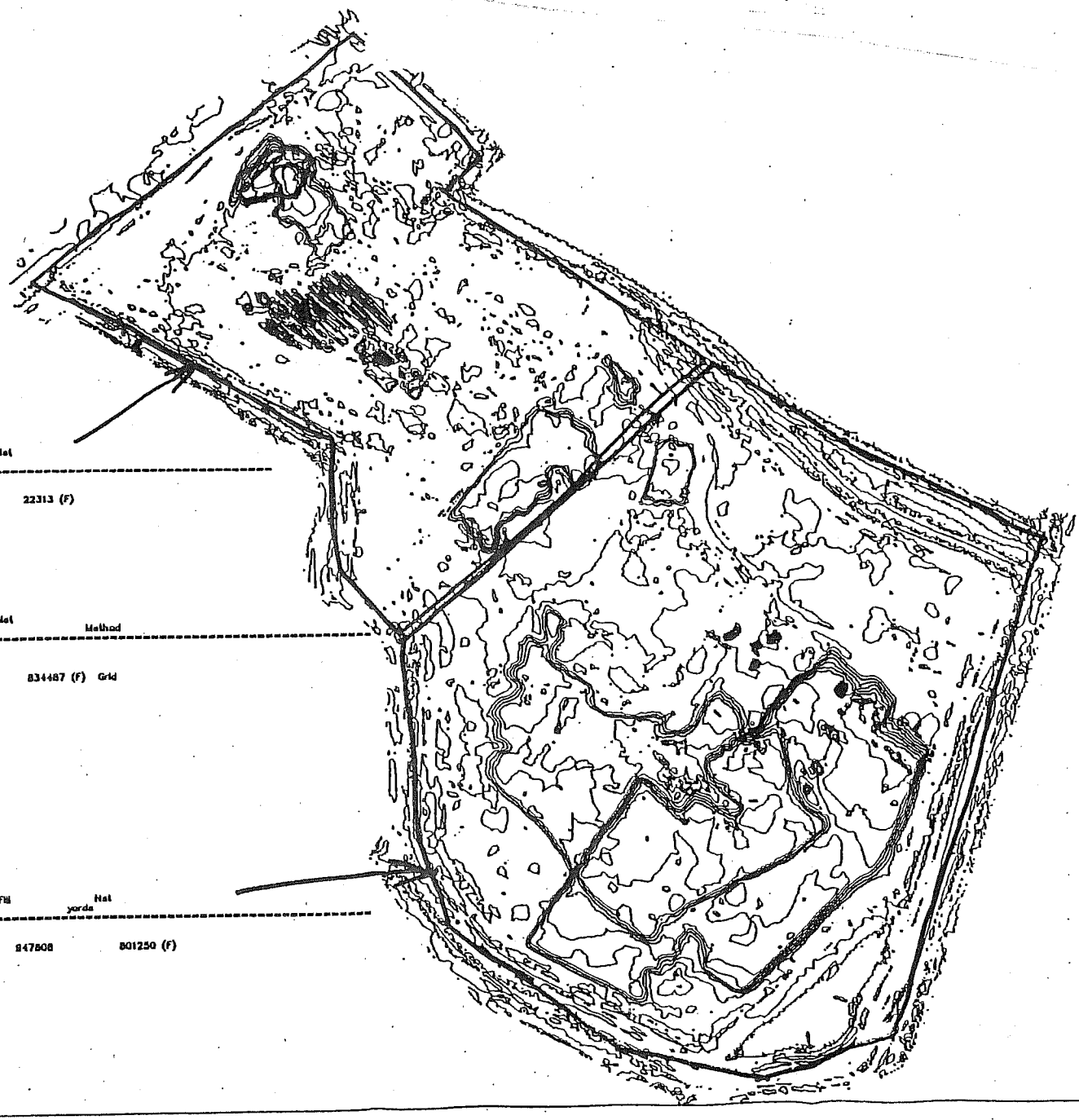
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

FIGURE 6 (cont.)

Attachment A

Estimate of Average Yearly Airspace



Subsite Volume Table: Unadjusted

...site	Stratum	Surf1	Surf2	Cut yards	Fill yards	Net yards
	vol7	sur4	sur8	109077	131390	22313 (F)

Site Volume Table: Unadjusted

...	Stratum	Surf1	Surf2	Cut yards	Fill yards	Net yards	Method
...Dvol7	vol7	sur4	sur8	271394	1105882	834487 (F)	Grid

Subsite Volume Table: Unadjusted

Subsite	Stratum	Surf1	Surf2	Cut yards	Fill yards	Net yards
0	vol7	sur4	sur8	146558	947808	801250 (F)

Table A.1 - Evaluation of Target Waste Capacity
Design and Construction Inspection Services
Cherry Island Landfill

Surveyed Data				
Beginning	End	Months	Volume of waste (cy)[1]	Volume of waste (cy/month)
Jan-98	Apr-99	15.00	871,471	~ 58,000
Apr-99	Oct-00	18.00	1,196,158	~ 66,000
Oct-00	Apr-01	6.00	517,391	~ 86,000
Apr-01	Apr-02	12.00	834,487	~ 70,000
Total		51.00	3,419,507	~ 67,000
			804,590	cy/year

Rate Increase: 0.02 per year
Required Volume (cy): 804,590 (as of 2002)

			Projected Volume (cy)	
No	Year	Factor	Per Year	Cumulative
1	2002	1.000	804,590	804,590
2	2003	1.040	837,095	1,641,685
3	2004	1.061	853,837	2,495,522
4	2005	1.082	870,914	3,366,436
5	2006	1.104	888,332	4,254,769
6	2007	1.126	906,099	5,160,868
7	2008	1.149	924,221	6,085,088
8	2009	1.172	942,705	7,027,794
9	2010	1.195	961,559	7,989,353
10	2011	1.219	980,791	8,970,144
11	2012	1.243	1,000,406	9,970,550
12	2013	1.268	1,020,415	10,990,965
13	2014	1.294	1,040,823	12,031,787
14	2015	1.319	1,061,639	13,093,427
15	2016	1.346	1,082,872	14,176,299
16	2017	1.373	1,104,529	15,280,828
17	2018	1.400	1,126,620	16,407,448
18	2019	1.428	1,149,152	17,556,601
19	2020	1.457	1,172,136	18,728,736
20	2021	1.486	1,195,578	19,924,314
21	2022	1.516	1,219,490	21,143,804
22	2023	1.546	1,243,880	22,387,684
	Average	1.265	1,017,622	

(1) Volumes have been calculated using the computer program SOFTDESK

☐ GEOSYNTEC CONSULTANTS — CADD Volume Calculation

CADD Operator: Brown Date: 02/02/11 (YY MM DD) Reviewed by: _____ Date: / / (YY MM DD)

Client: _____ Project: Cherry Island Project No.: ME0250 Task No.: _____

Description of volume to be calculated:

topo 1998 existing ground to 1999 existing ground topo

Softdesk Project Name: 0250

Surface Generation:

Surface 1 (Surface existing first):

Source of Grading (Contours, Points, Faults)

Filename: 1998-eg

Surface Name: sur-1

Description: 1998 existing ground

Surface 2 (Resulting from cut and fill on Surface 1):

Source of Grading (Contours, Points, Faults)

Filename: 1999-eg

Surface Name: sur-2

Description: 1999 existing ground

Contours generated from surfaces 1 and 2 checked by (initial): _____ Plots attached: yes no

Site Information:

Site Name: 0250 v1

Confirm that site limits are appropriate for smallest surface (Initial): _____

Site Approximate Dimensions: Length = 5270 Width = 5580

Grid Size: 10 x 10

Results:

Cut-Fill Surface:

Stratum Name: vol1 Description: 1999 ex vol

Volume Surface Name (typically same as Stratum Name): vol 1

Cut and fill contours checked by (initial): JS Plot attached: (yes) no

Volume:

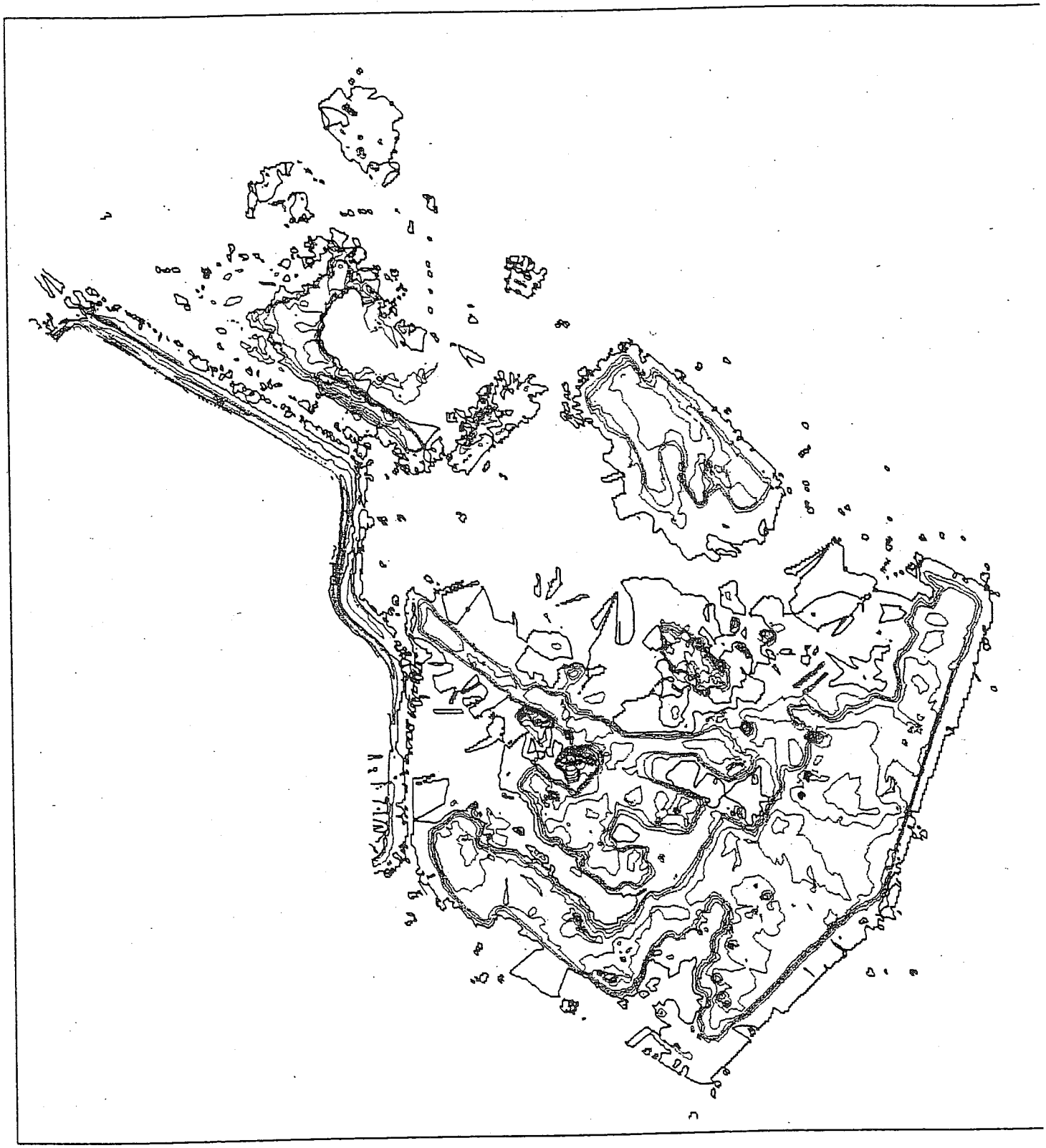
Units: m^3 (yd^3)

Cut = 55,122	Fill = 926,594	Net = 871,471	Cut (Fill)

Notes:

Site Volume Table: Unadjusted

Site	Stratum	Surf1	Surf2	Cut yards	Fill yards	Net yards	Method
0250v1	vol1	sur1	sur2	55122	926594	871471 (F)	Grid



☐ GeoSyntec Consultants

CADD Volume Calculation

CADD Operator: BROWN Date: 02/02/11 (YY MM DD) Reviewed by: _____ Date: / / (YY MM DD)

Client _____ Project: Cherry Island Project No.: ME0250 Task No.: _____

Description of volume to be calculated:

topo 1999 existing ground to 2000 existing ground topo

Softdesk Project Name: 0250

Surface Generation:

Surface 1 (Surface existing first):

Source of Grading (Contours, Points, Faults)

Filename: 1999-eg

Surface Name: SUR-2

Description: 1999 existing ground

Surface 2 (Resulting from cut and fill on Surface 1):

Source of Grading (Contours, Points, Faults)

Filename: 2000-eg

Surface Name: SUR-3

Description: 2000 existing ground

Contours generated from surfaces 1 and 2 checked by (initial): _____ Plots attached: yes no

Site Information:

Site Name: 0250v2

Confirm that site limits are appropriate for smallest surface (Initial): _____

Site Approximate Dimensions: Length = 5230 Width = 5530

Grid Size: 10x10

Results:

Cut-Fill Surface:

Stratum Name: Vol2 Description: 2000 ex vol

Volume Surface Name (typically same as Stratum Name): Vol 2

Cut and fill contours checked by (initial): JB Plot attached: (yes) no

Volume:

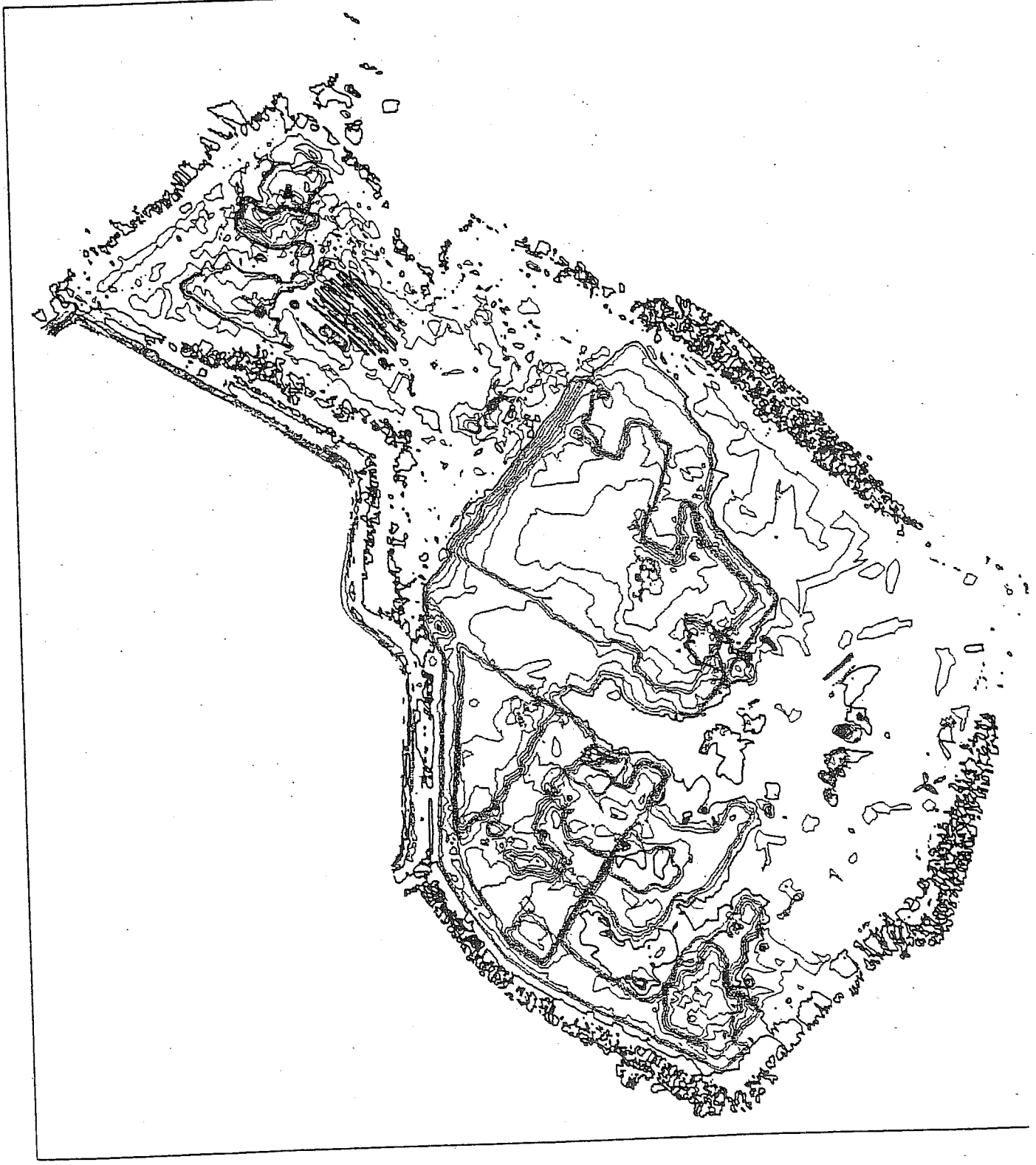
Units: m^3 (yd^3)

Cut = 236,145	Fill = 1,432,303	Net = 1,196,158 (Cut) Fill

Notes:

Site Volume Table: Unadjusted

Site	Stratum	Surf1	Surf2	Cut yards	Fill yards	Net yards	Meth.
0250v2	vol2	sur2	sur3	236145	1432303	1196158 (F)	Grid



☐ GEOSYNTEC CONSULTANTS — CADD Volume Calculation

CADD Operator: Brown Date: 02/02/11 (YY MM DD) Reviewed by: _____ Date: / / (YY MM DD)

Client: _____ Project: Cherry Island Project No.: ME0250 Task No.: _____

Description of volume to be calculated:

topo 2000 existing ground to 2001 existing ground topo

Softdesk Project Name: 0250

Surface Generation:

Surface 1 (Surface existing first):

Source of Grading (Contours, Points, Faults)

Filename: 2000-eg

Surface Name: SUR-3

Description: 2000 existing ground

Surface 2 (Resulting from cut and fill on Surface 1):

Source of Grading (Contours, Points, Faults)

Filename: 2001-eg

Surface Name: SUR-4

Description: 2001 existing ground

Contours generated from surfaces 1 and 2 checked by (initial): _____ Plots attached: yes no

Site Information:

Site Name: 0250x3

Confirm that site limits are appropriate for smallest surface (Initial): _____

Site Approximate Dimensions: Length = 5220 Width = 5530

Grid Size: 10x10

Results:

Cut-Fill Surface:

Stratum Name: VOL3 Description: 2001 ex vol

Volume Surface Name (typically same as Stratum Name): VOL3

Cut and fill contours checked by (initial): MB Plot attached: (yes) no

Volume:

Units: m^3 (yd^3)

Cut = 66,957	Fill = 584,349	Net = 517,391	Cut (Fill)

Notes:

Site Volume Table: Unadjusted

Site	Stratum	Surf1	Surf2	Cut yards	Fill yards	Net yards	Method
0250v3	vol3	sur3	sur4	66957	584349	517391 (F)	Grid

☐ GEOSYNTEC CONSULTANTS

CADD Volume Calculation

CADD Operator: Mandeville Date: 02/07/11 (YY MM DD) Reviewed by: _____ Date: / / (YY MM DD)

Client: DSWA Project: CIL Project No.: ME0250 Task No.: _____

Description of volume to be calculated:

April 2001 existing ground to April 2002 existing ground

Softdesk Project Name: 0250

Surface Generation:

Surface 1 (Surface existing first):

Source of Grading (Contours, Points, Faults)

Filename: 2001-eg

Surface Name: SUR-4

Description: 2001 existing ground

Surface 2 (Resulting from cut and fill on Surface 1):

Source of Grading (Contours, Points, Faults)

Filename: 2002-eg

Surface Name: SUR-9

Description: 2002 existing ground

Contours generated from surfaces 1 and 2 checked by (initial): JM **Plots attached:** yes (no)

Site Information:

Site Name: 0250vol7

Confirm that site limits are appropriate for smallest surface (Initial): JM

Site Approximate Dimensions: Length = 7870 Width = 5500

Grid Size: 10 x 10

Results:

Cut-Fill Surface:

Stratum Name: vol7 Description: volume between 2001 and 2002 existing ground

Volume Surface Name (typically same as Stratum Name) : vol7

Cut and fill contours checked by (initial): JM **Plot attached:** yes no

Volume:

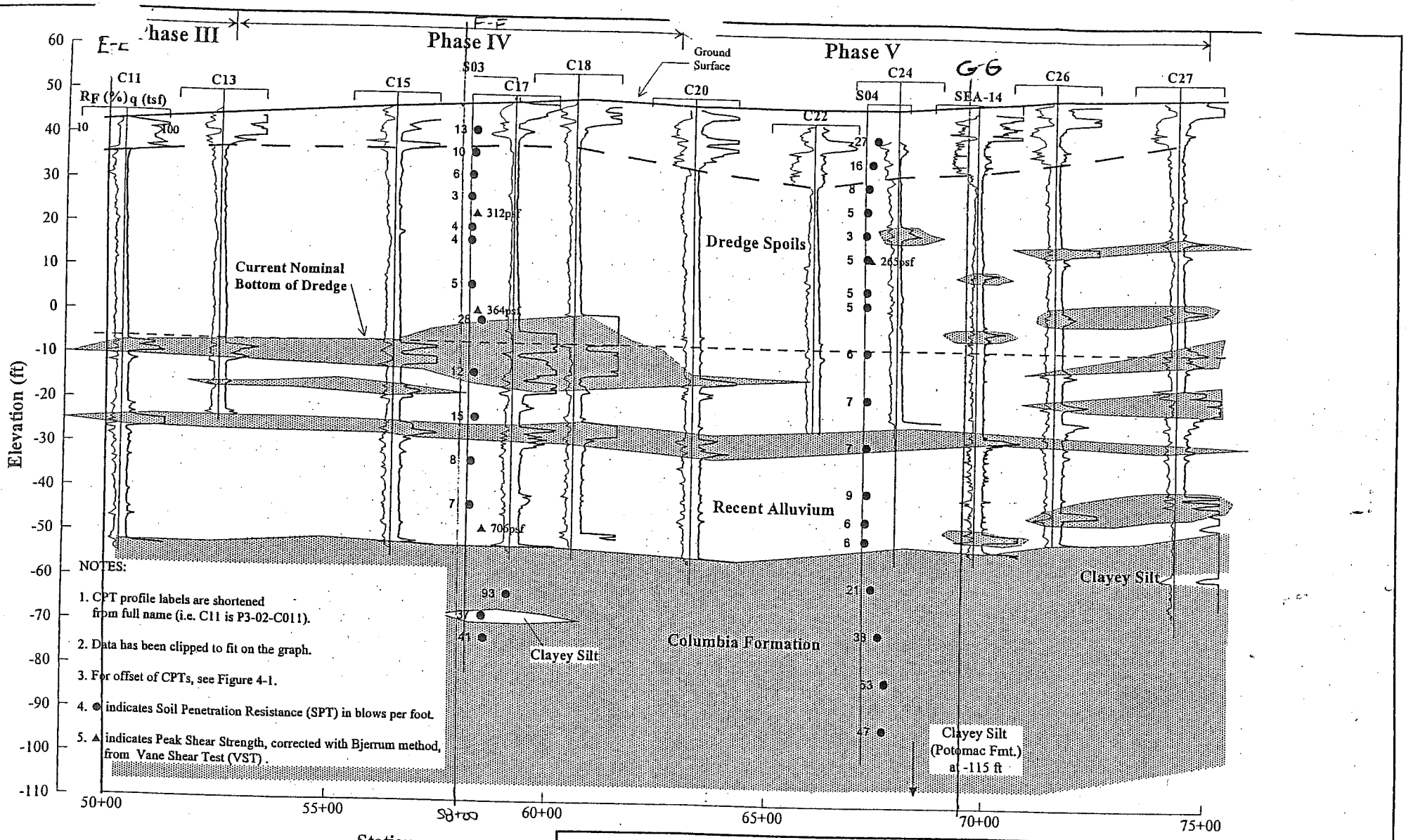
Units: m^3 (yd^3)

Cut = 271,394	Fill = 1,105,882	Net = 834,487 Cut (Fill)

Notes:

Attachment B

Soil Stratigraphy



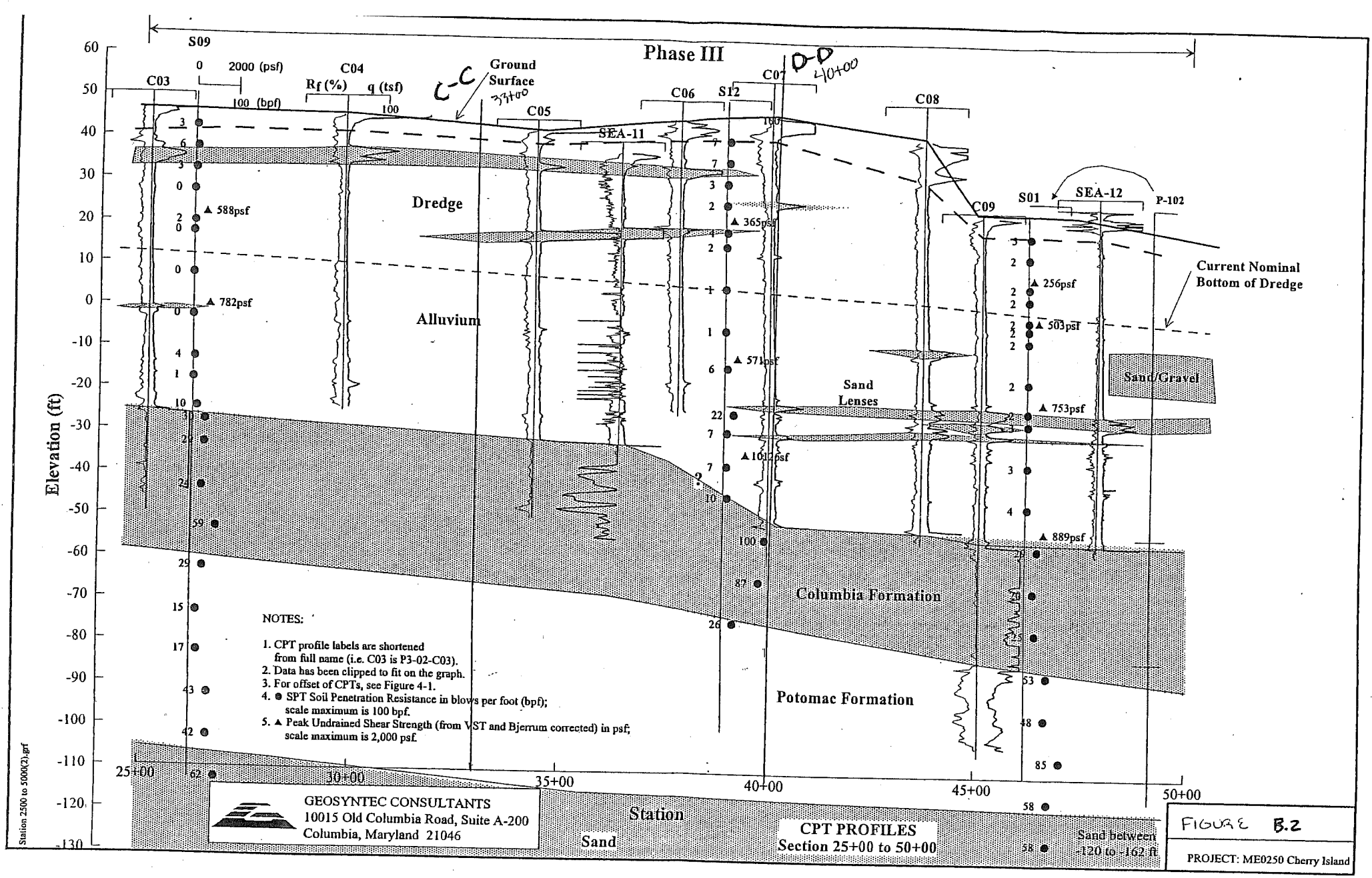
Station 5000 to 7500aa(2).grf

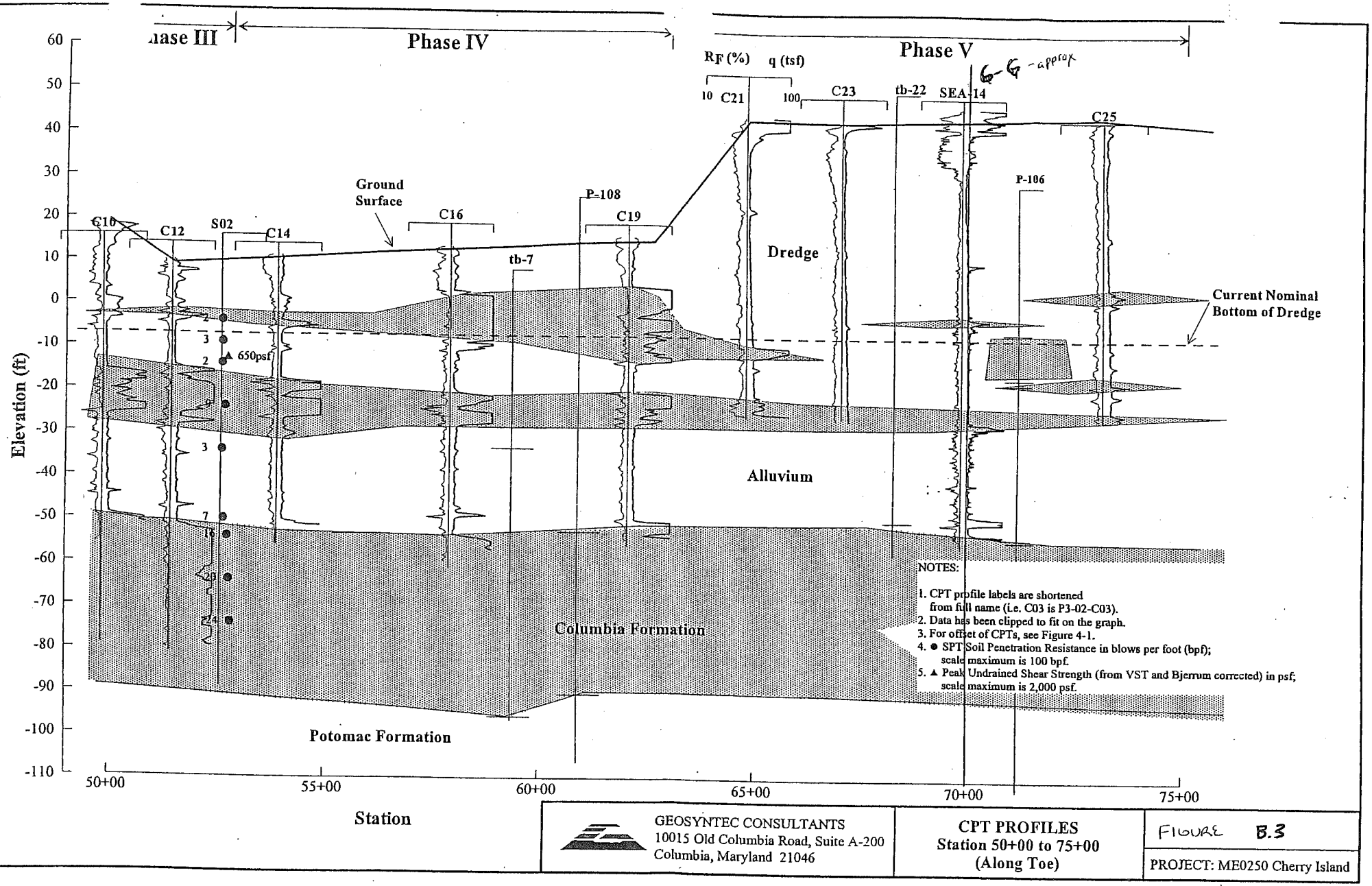
GEOSYNTEC CONSULTANTS
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046

CPT PROFILES
Station 50+00 to 75+00
(Along Dike)

FIGURE B.1

PROJECT: ME0250 Cherry Island


S09
Phase III
C-C
D-D
C03
C04
C05
C06
S12
C07
C08
C09
S01
SEA-11
SEA-12
P-102
0 2000 (psf)
100 (bpf)
Rf (%) q (tsf)
100
Ground Surface
3+00
4+00
Dredge
Alluvium
Sand Lenses
Sand/Gravel
Columbia Formation
Potomac Formation
Current Nominal Bottom of Dredge
▲ 588psf
▲ 782psf
▲ 365psf
▲ 571psf
▲ 1012psf
▲ 256psf
▲ 503psf
▲ 753psf
▲ 889psf
Elevation (ft)
Station
Sand
Sand between -120 to -162 ft
NOTES:
1. CPT profile labels are shortened from full name (i.e. C03 is P3-02-C03).
2. Data has been clipped to fit on the graph.
3. For offset of CPTs, see Figure 4-1.
4. ● SPT Soil Penetration Resistance in blows per foot (bpf); scale maximum is 100 bpf.
5. ▲ Peak Undrained Shear Strength (from VST and Bjerrum corrected) in psf; scale maximum is 2,000 psf.
GEOSYNTEC CONSULTANTS
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046
CPT PROFILES
Section 25+00 to 50+00
FIGURE B.2
PROJECT: ME0250 Cherry Island
Station 2500 to 5000(2).grf



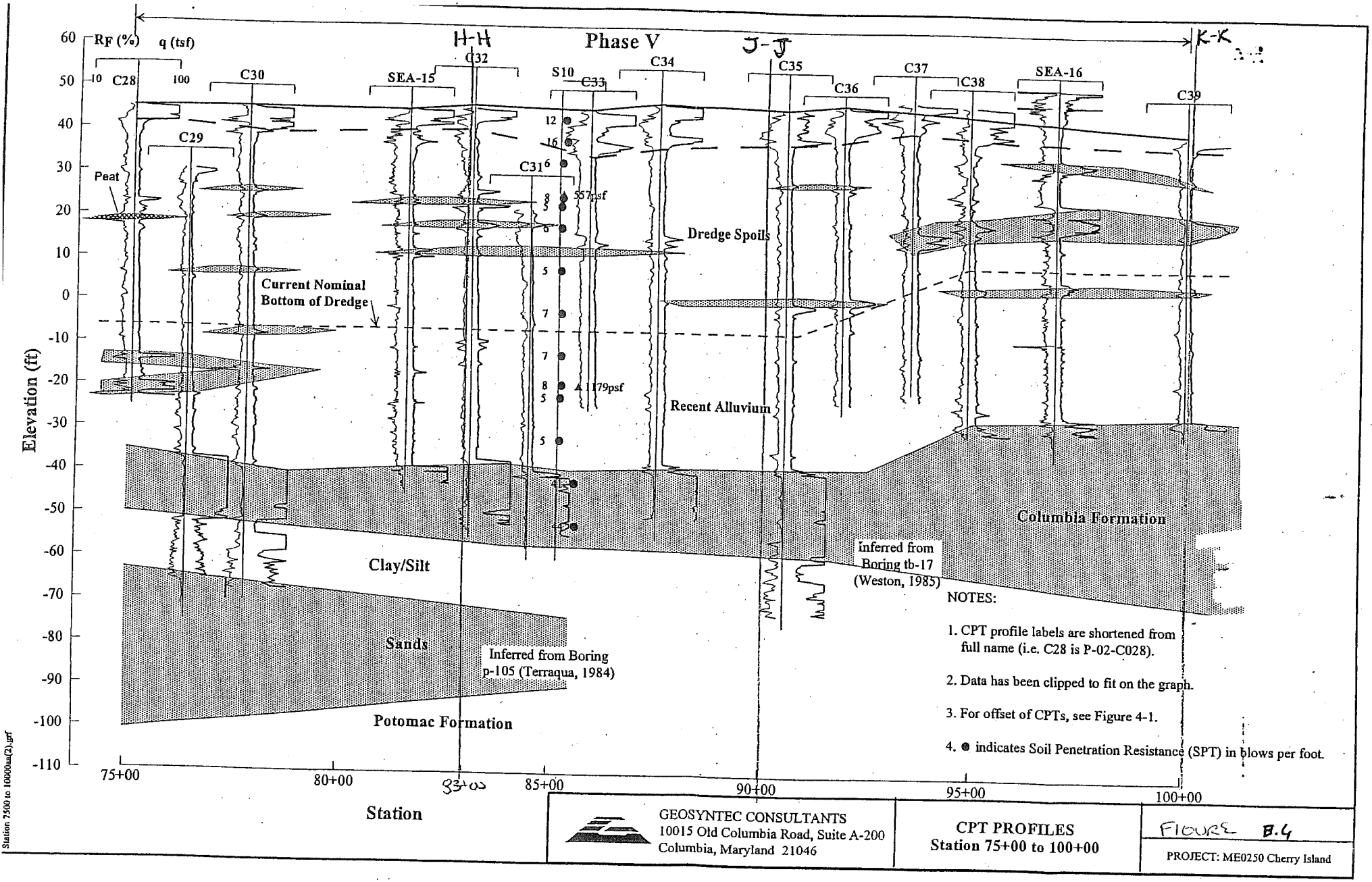
GEOSYNTEC CONSULTANTS
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046

CPT PROFILES
Station 50+00 to 75+00
(Along Toe)

FIGURE B.3

PROJECT: ME0250 Cherry Island

Station 5000 to 7500bb(2).grf



Station 7500 to 10000aa(2).grf

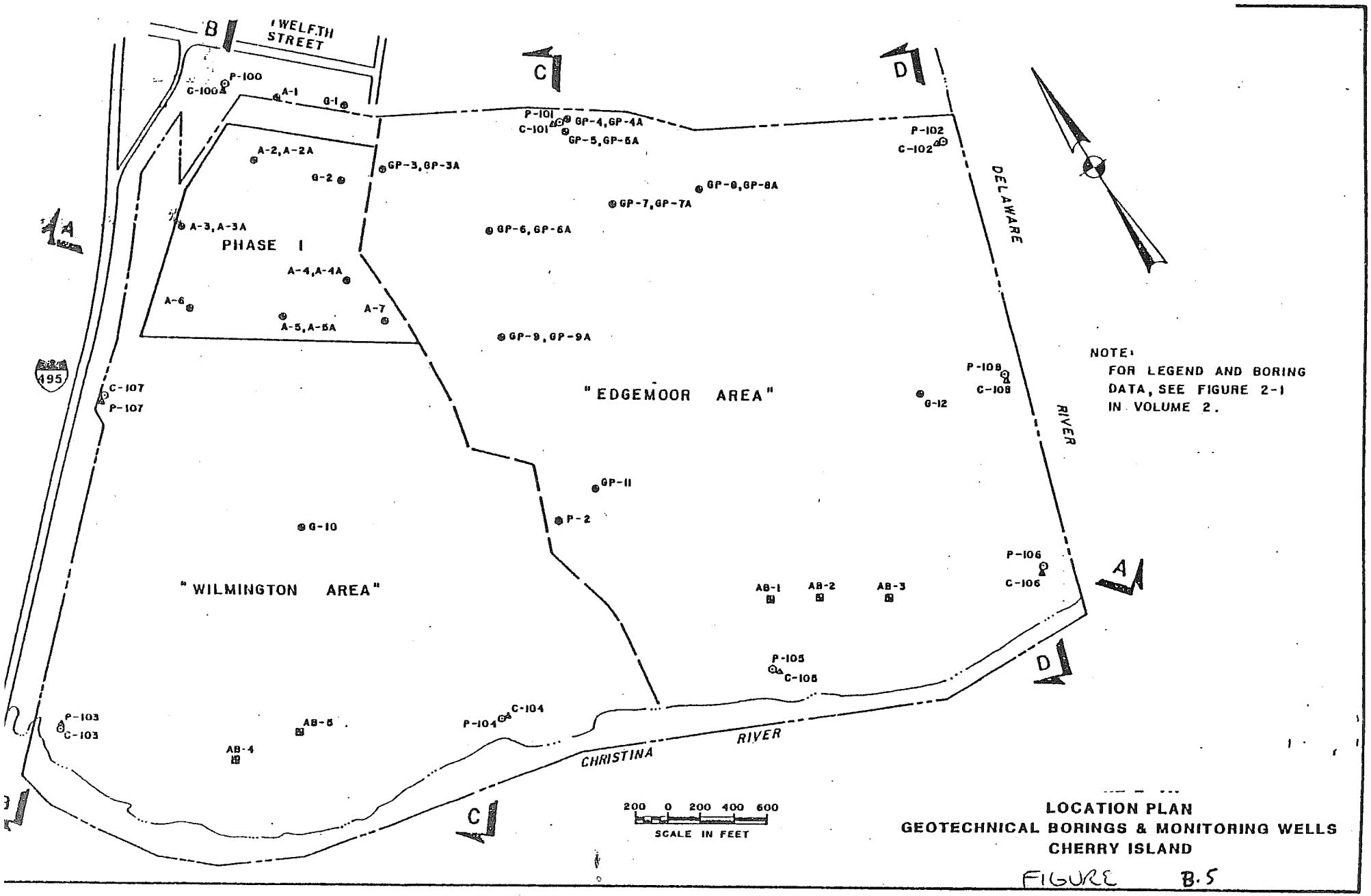
GEOSYNTEC CONSULTANTS
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046

CPT PROFILES
Station 75+00 to 100+00

FIGURE B.4

PROJECT: ME0250 Cherry Island

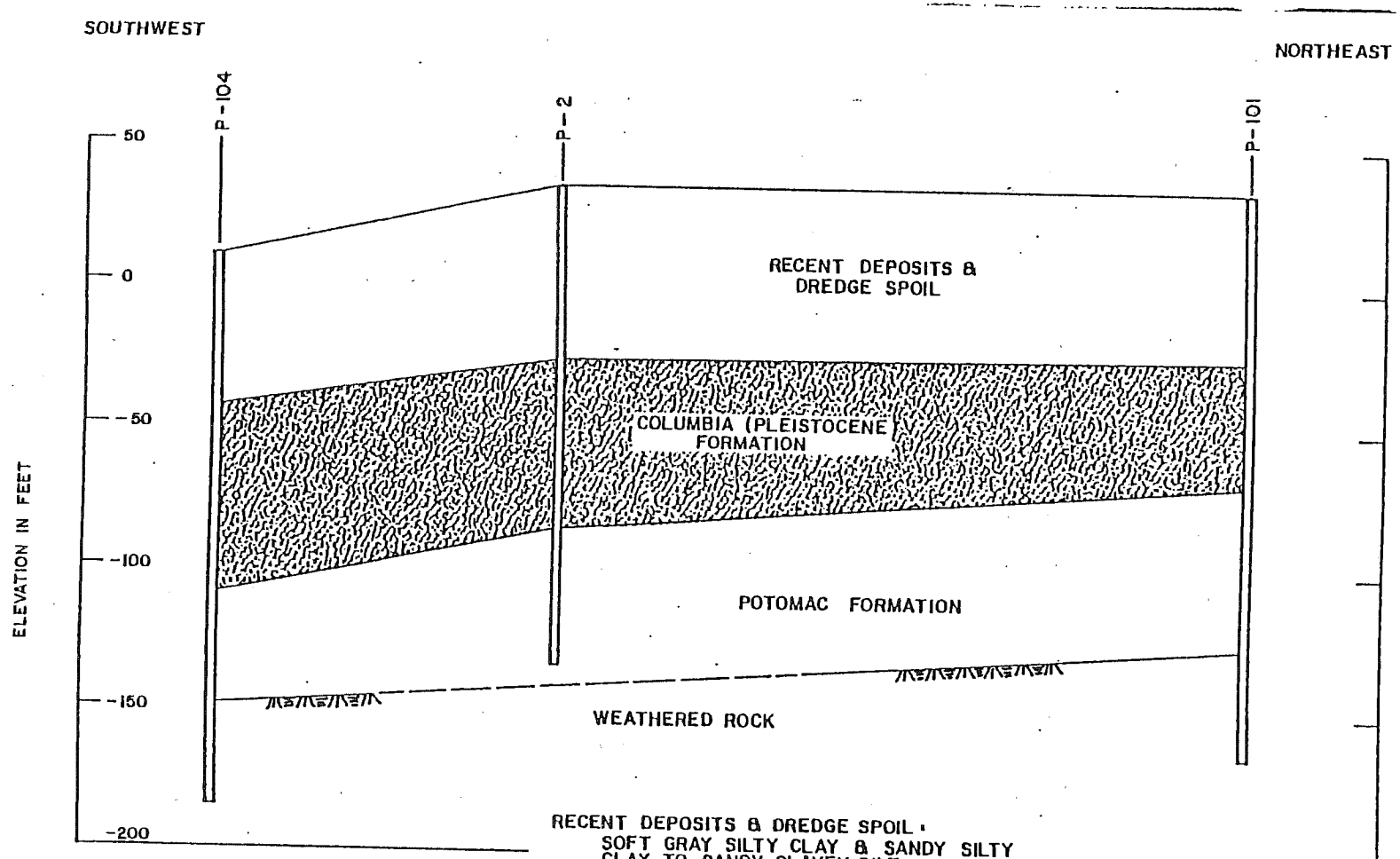
Terraqua Resources/Duffield (1984). "Site [illegible]bility Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



LOCATION PLAN
GEOTECHNICAL BORINGS & MONITORING WELLS
CHERRY ISLAND

FIGURE B.5

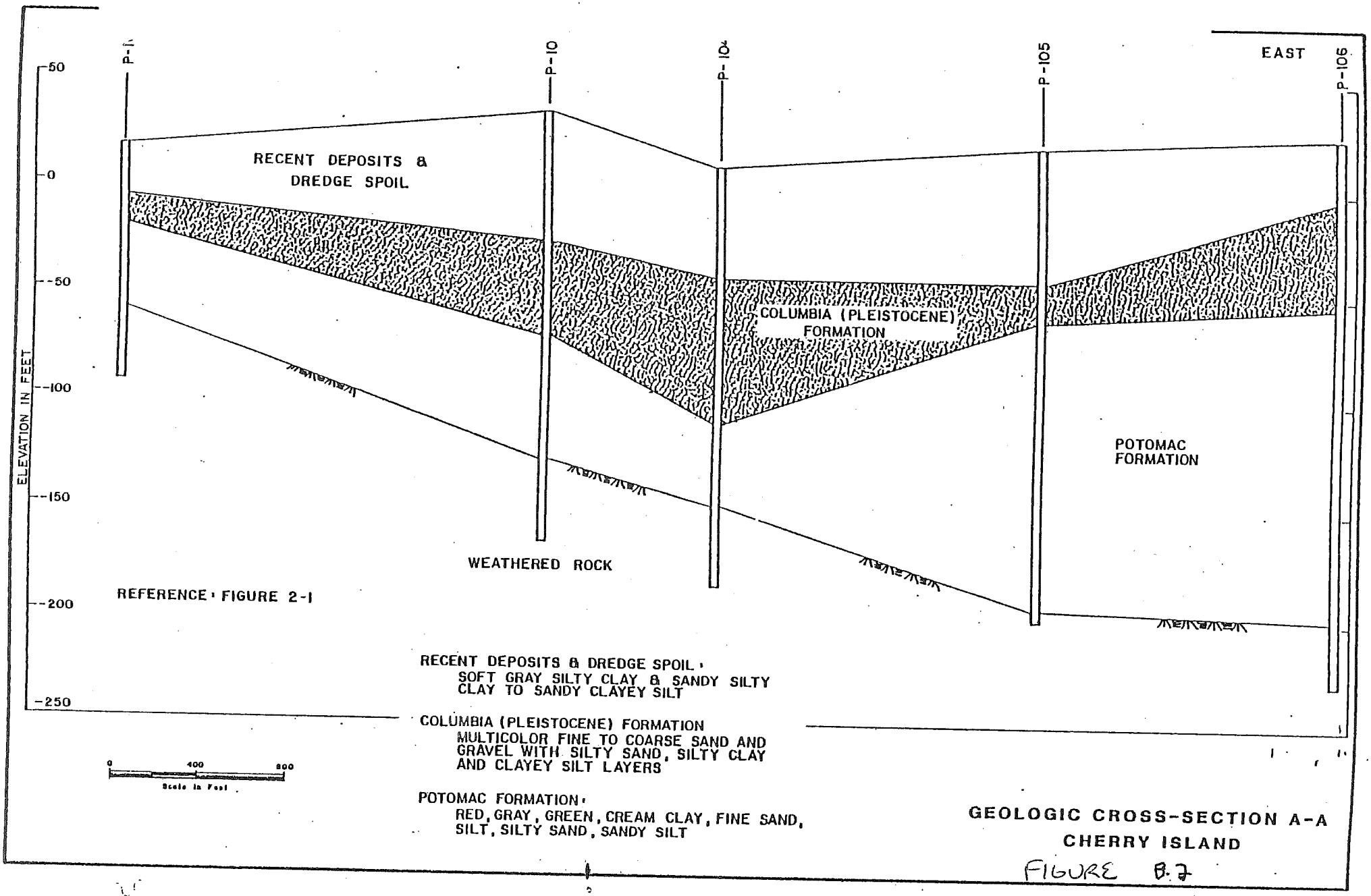
Terraqua Resources/Dufield (1984). "Site Suitability Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



GEOLOGIC CROSS-SECTION C-C
CHERRY ISLAND

FIGURE B.6

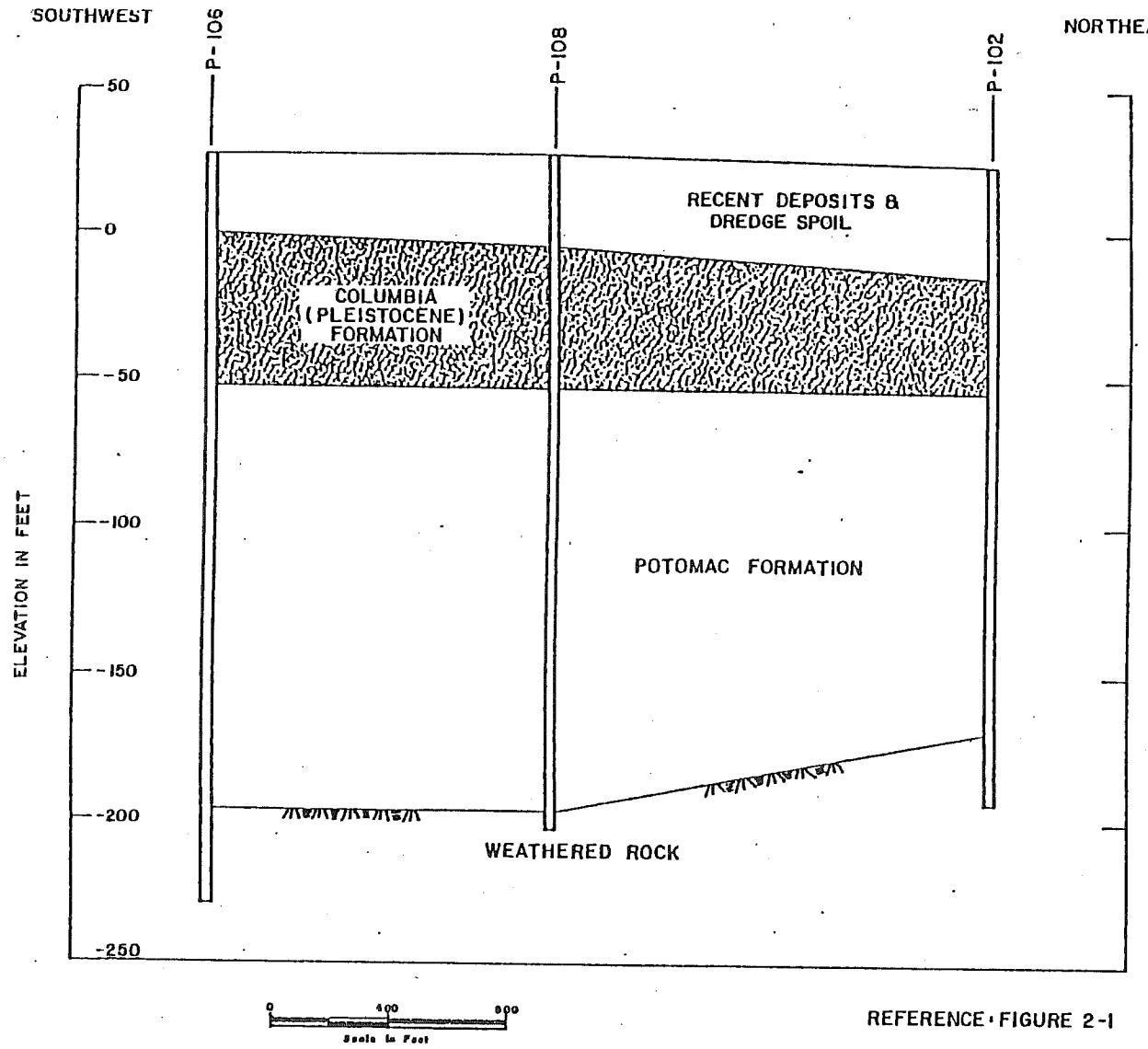
Terraqua Resources/Duffield (1984). "Site S ility Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



GEOLOGIC CROSS-SECTION A-A
CHERRY ISLAND

FIGURE B.7

Terraqua Resources/Duffield (1984). "Site Suitability Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



REFERENCE: FIGURE 2-1

RECENT DEPOSITS & DREDGE SPOIL:
SOFT GRAY SILTY CLAY & SANDY SILTY CLAY TO SANDY CLAYEY SILT

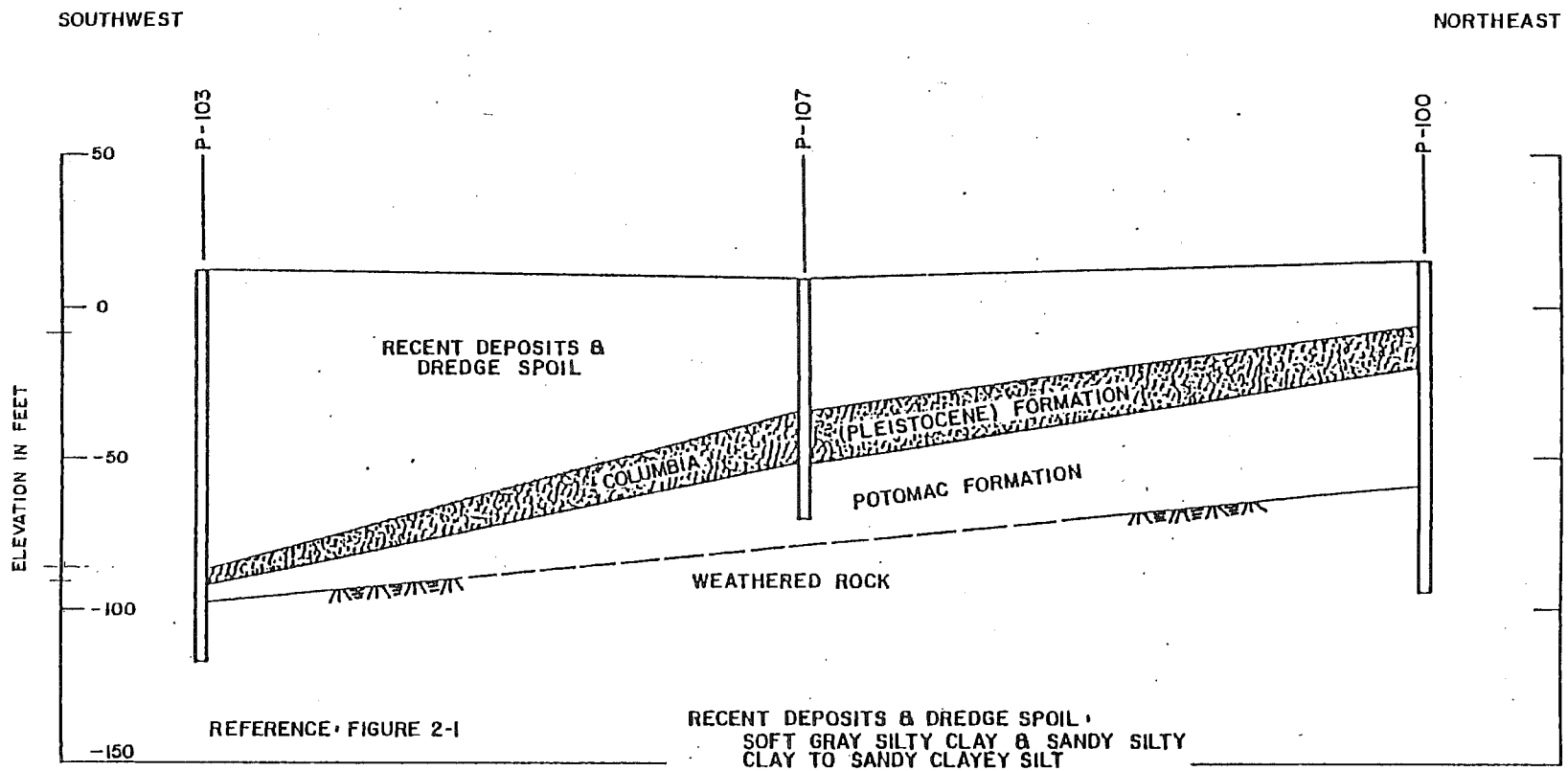
COLUMBIA (PLEISTOCENE) FORMATION
MULTICOLOR FINE TO COARSE SAND AND GRAVEL WITH SILTY SAND, SILTY CLAY AND CLAYEY SILT LAYERS

POTOMAC FORMATION:
RED, GRAY, GREEN, CREAM CLAY, FINE SAND, SILT, SILTY SAND, SANDY SILT

GEOLOGIC CROSS-SECTION D-D
CHERRY ISLAND

FIGURE B8

Terraqua Resources/Duffield (1984). "Site S ility Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Is. d Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



RECENT DEPOSITS & DREDGE SPOIL:
SOFT GRAY SILTY CLAY & SANDY SILTY CLAY TO SANDY CLAYEY SILT

COLUMBIA (PLEISTOCENE) FORMATION
MULTICOLOR FINE TO COARSE SAND AND GRAVEL WITH SILTY SAND, SILTY CLAY AND CLAYEY SILT LAYERS

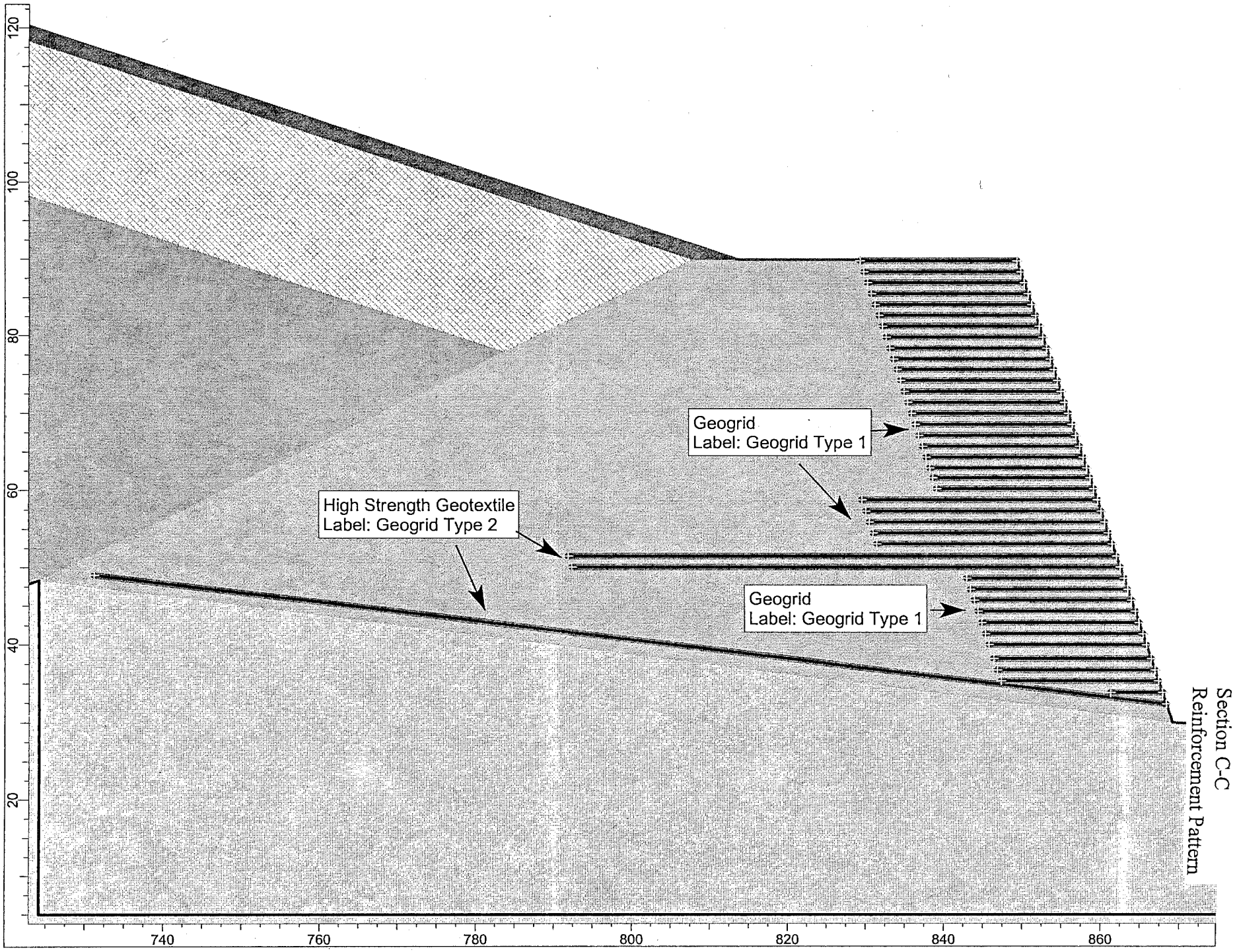
POTOMAC FORMATION:
RED, GRAY, GREEN, CREAM CLAY, FINE SAND, SILT, SILTY SAND, SANDY SILT

GEOLOGIC CROSS-SECTION B-B
CHERRY ISLAND

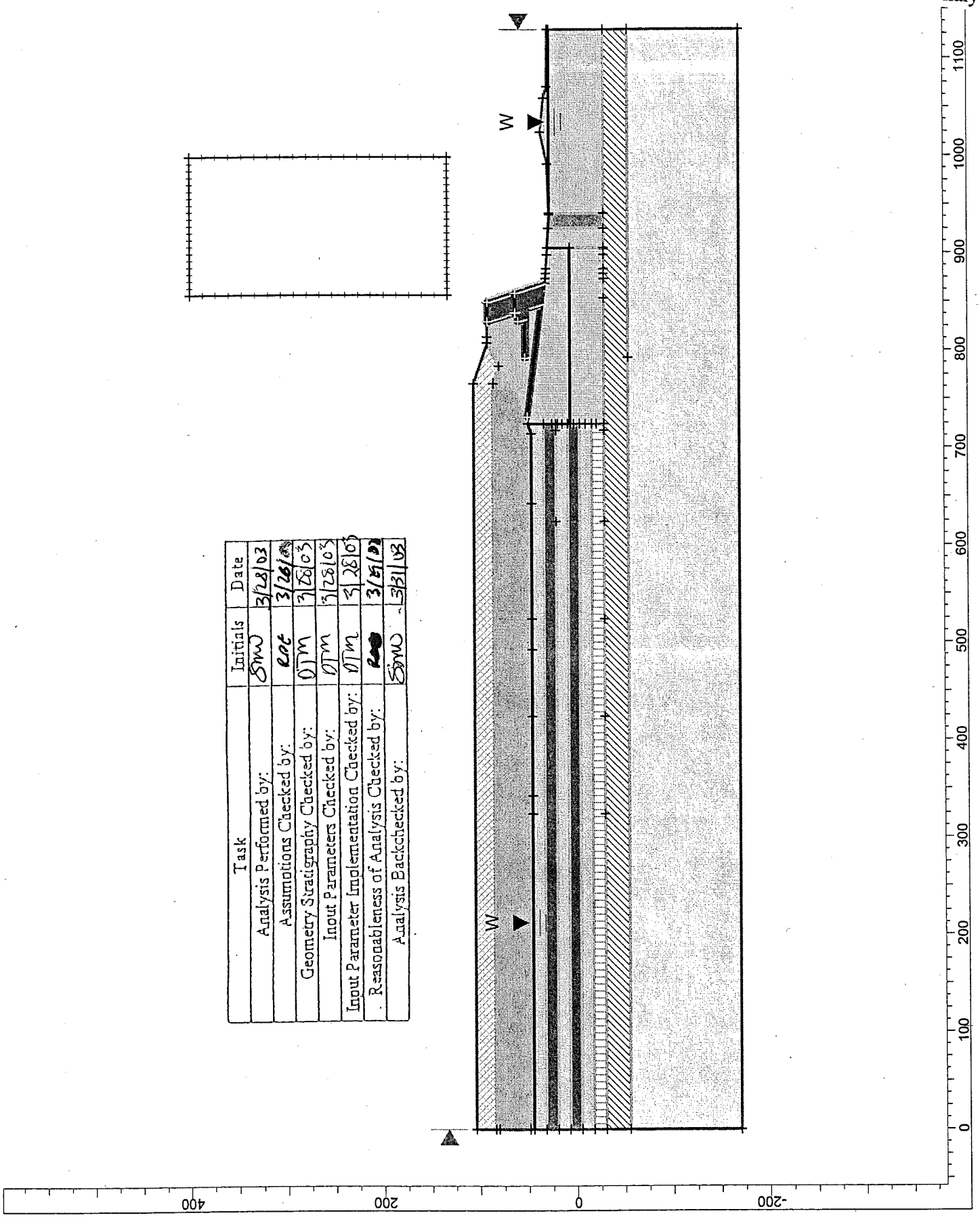
FIGURE B.9

Attachment C

Stability Analysis Results for Cross Section C-C


120
100
80
60
40
20
740
760
780
800
820
840
860
Geogrid
Label: Geogrid Type 1
High Strength Geotextile
Label: Geogrid Type 2
Geogrid
Label: Geogrid Type 1
Section C-C
Reinforcement Pattern

Section C-C
9 Year Stability
Circular Analysis



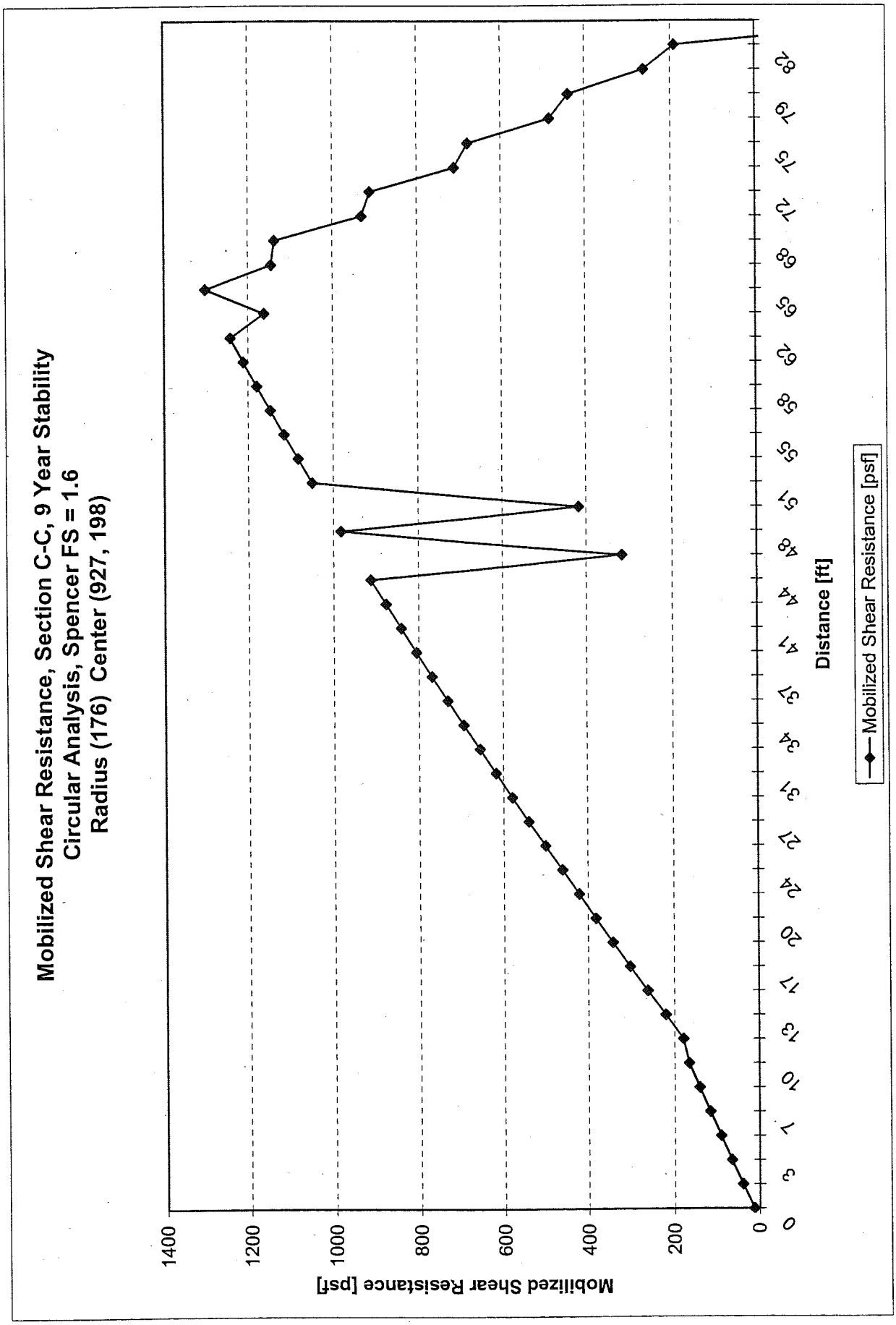
Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	[illegible]	3/26/03
Geometry Stratigraphy Checked by:	DJM	3/26/03
Input Parameters Checked by:	DJM	3/26/03
Input Parameter Implementation Checked by:	DJM	3/26/03
Reasonableness of Analysis Checked by:	[illegible]	3/31/03
Analysis Backchecked by:	SMW	3/31/03

C9-1

Section C-C
9 Year Stability
Circular Analysis

C9-2

Section C-C
9 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance C

C9-3

Slide Analysis Information

Document Name

File Name: c-c(9 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1292 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1044 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 897 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 972 psf
Water Surface: None

C9-C

Section C-C
9 Year Stability
Circular Analysis

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1292 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1841 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.57083
Center: 927.14, 198.071
Radius: 175.699
Left Slip Surface Endpoint: 782.492, 98.3361
Right Slip Surface Endpoint: 868.132, 32.5773

Method Statistics

Method: spencer
Number of Valid Surfaces: 22061
Number of Invalid Surfaces: 11455
Error Codes:
Error Code -106 reported for 110 surfaces
Error Code -107 reported for 791 surfaces
Error Code -108 reported for 1889 surfaces
Error Code -111 reported for 8665 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure

direction is specified, or if high external or anchor loads are applied against the failure direction.

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

-111 = safety factor equation did not converge

Section C-C
9 Year Stability
Circular Analysis

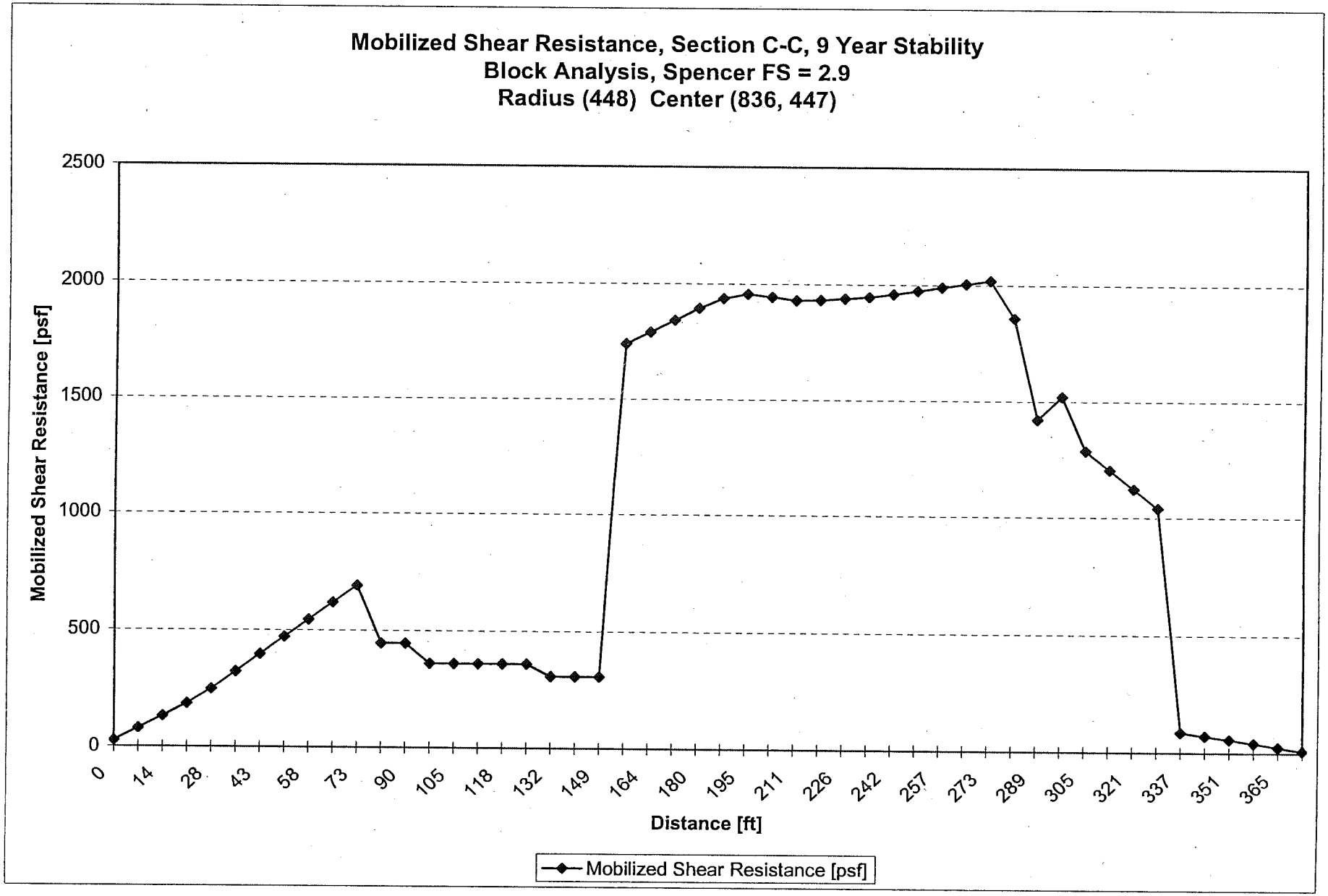
Section C-C
9 Year Stability
Block Analysis

Task	Initials	Date
Analysis Performed by:	SMO	3/31/05
Assumptions Checked by:	RDE	3/31/05
Geometry Stratigraphy Checked by:	DTM	3/31/05
Input Parameters Checked by:	DTM	3/31/05
Input Parameter Implementation Checked by:	DTM	3/31/05
Reasonableness of Analysis Checked by:	RDE	3/31/05
Analysis Backchecked by:	SMO	3/31/05

C9-6

Section C-C
9 Year Stability
Block Analysis

C9 - 7



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance C

Section C-C
9 Year Stability
Block Analysis

C9 - 8

Slide Analysis Information

Document Name

File Name: c-c(9 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1292 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1044 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 897 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section C-C
9 Year Stability
Block Analysis

C9-9

Cohesion: 972 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1292 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1841 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.89509
Axis Location: 836.264, 446.974
Left Slip Surface Endpoint: 567.785, 104
Right Slip Surface Endpoint: 949.556, 26.406

Method Statistics

Method: spencer
Number of Valid Surfaces: 2984
Number of Invalid Surfaces: 2016
Error Codes:
Error Code -107 reported for 559 surfaces
Error Code -108 reported for 1100 surfaces
Error Code -111 reported for 356 surfaces
Error Code -112 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

Section C-C
9 Year Stability
Block Analysis

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

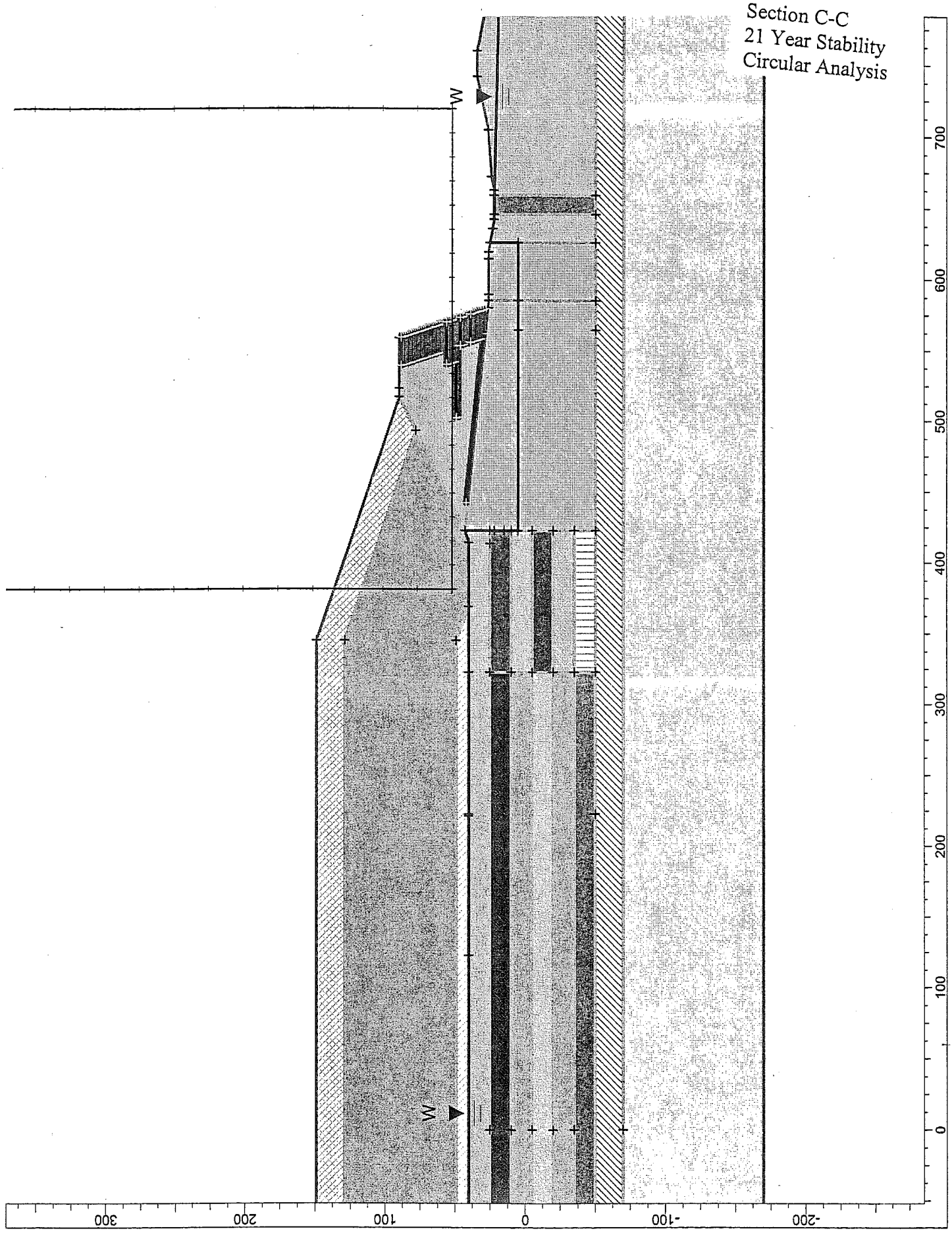
-111 = safety factor equation did not converge

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

Section C-C
21 Year Stability
Circular Analysis

Task	Initials	Date
Analysis Performed by:	SMS	3/27/03
Assumptions Checked by:	BMS	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDD	3/28/03
Analysis Backchecked by:	SMC	3/31/03

C21-1

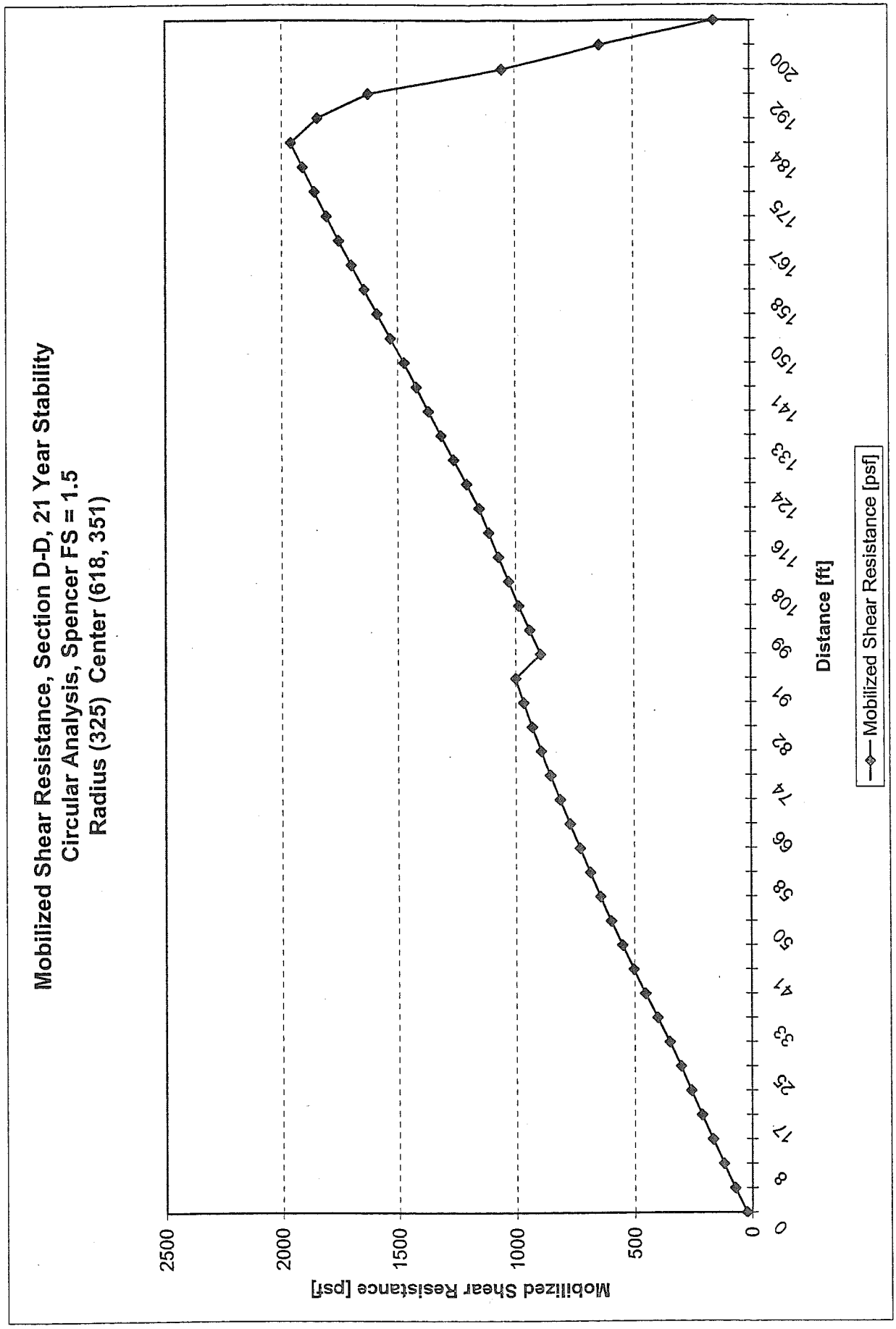

Section C-C
21 Year Stability
Circular Analysis
W
W
700
600
500
400
300
200
100
0
300
200
100
0
-100
-200

C21-2

Section C-C
21 Year Stability
Circular Analysis

C21-3

Section C-C
21 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance D

C21-4

Slide Analysis Information

Document Name

File Name: d-d(21 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1974 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1606 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1441 psf
Water Surface: None

Section C-C
21 Year Stability
Circular Analysis

C21-5

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1509 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1848 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2600 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2234 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1723 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1503 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1572 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1959 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2852 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive

Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.49181
Center: 618.194, 350.813
Radius: 324.927
Left Slip Surface Endpoint: 370.611, 140.384
Right Slip Surface Endpoint: 579.467, 28.2015

Method Statistics

Method: spencer
Number of Valid Surfaces: 23990
Number of Invalid Surfaces: 9526
Error Codes:
Error Code -106 reported for 117 surfaces
Error Code -107 reported for 1603 surfaces
Error Code -108 reported for 1223 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 4543 surfaces
Error Code -112 reported for 2037 surfaces
Error Code -200 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

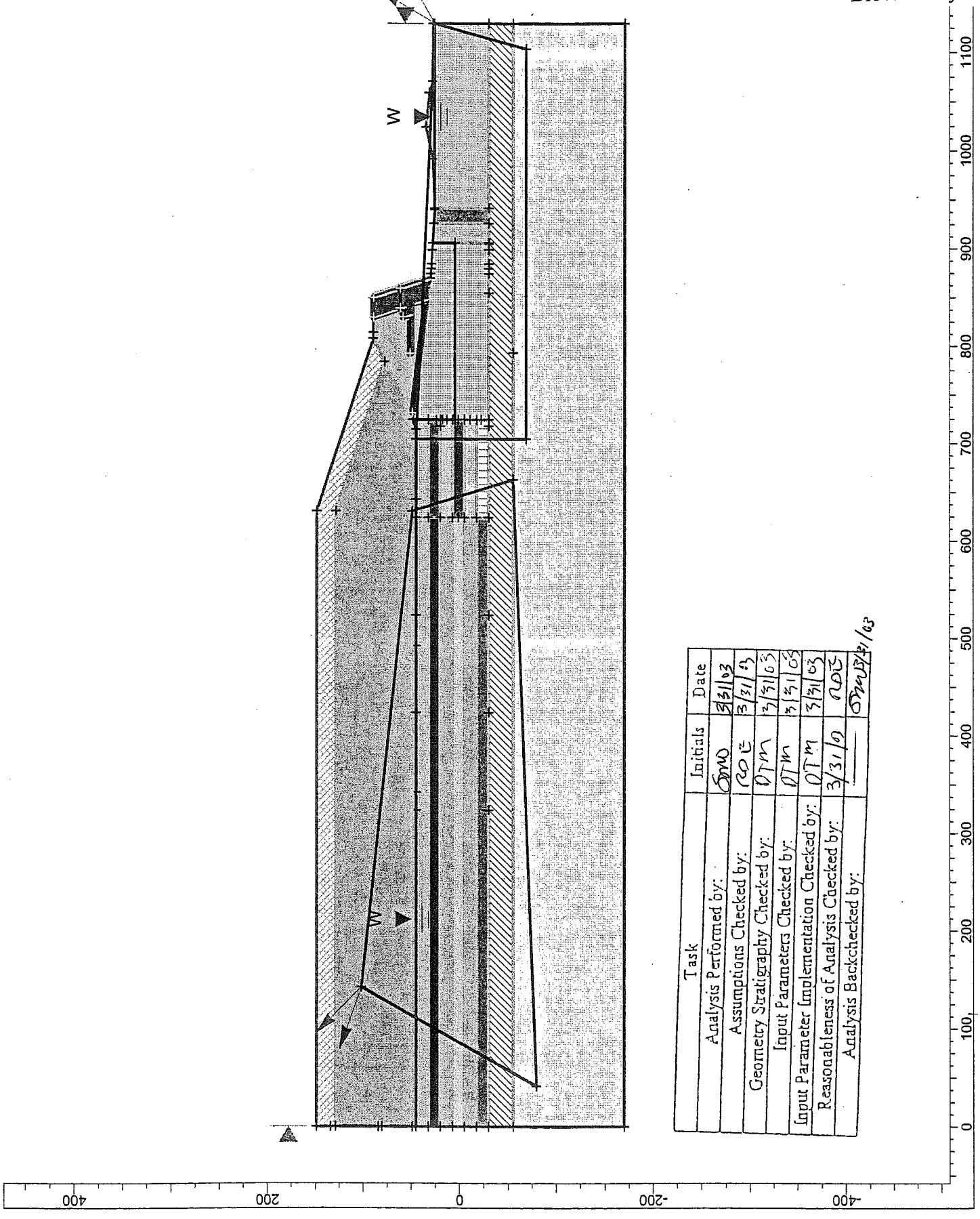
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

-200 = Factor of Safety = 0. Could mean 0 Normal/Shear resistance along part of the slip surface

Section C-C
21 Year Stability
Circular Analysis

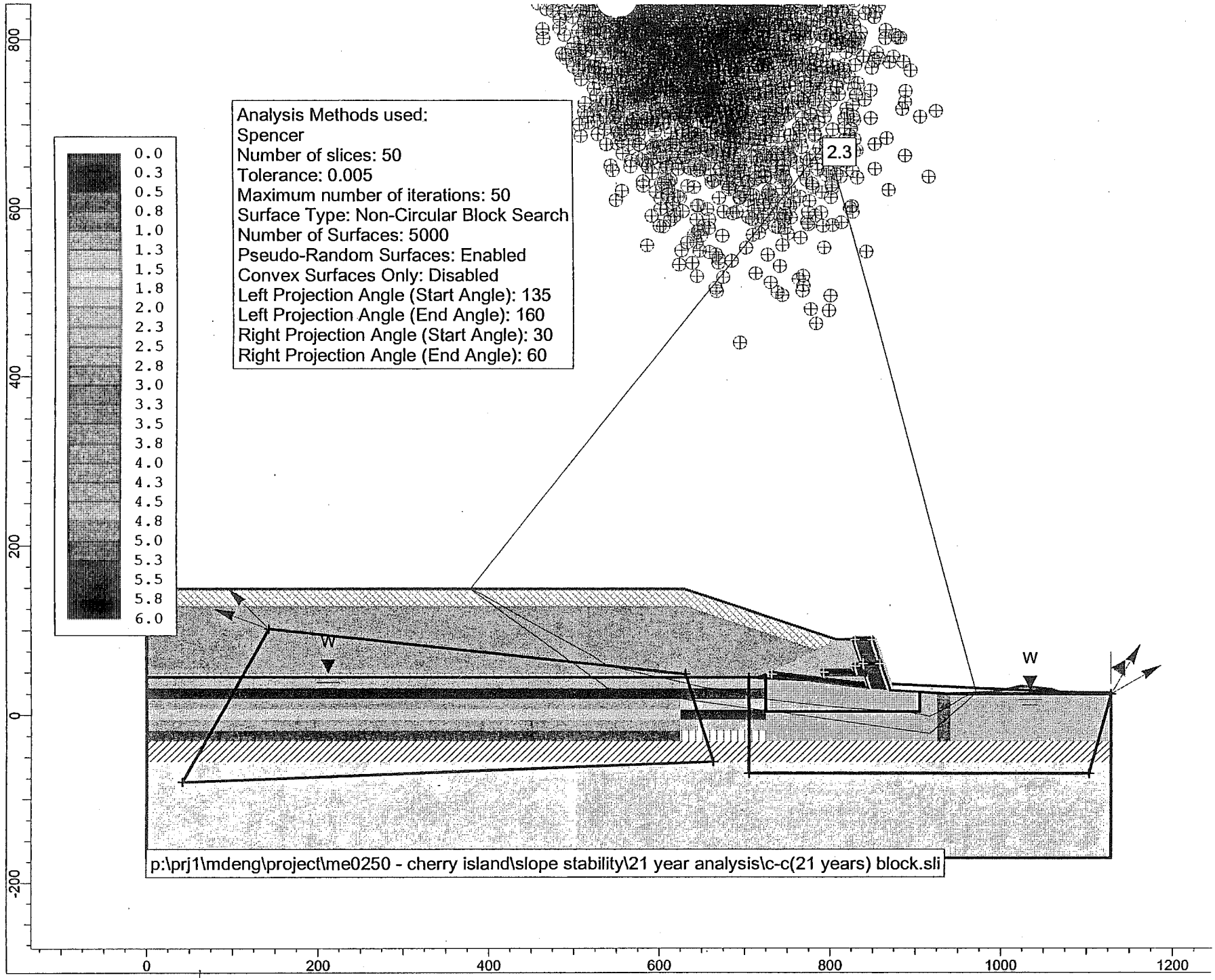
C21-C

Section C-C
21 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMD	3/31/03
Assumptions Checked by:	ROE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	3/31/03	ROE
Analysis Backchecked by:		SMD 3/31/03

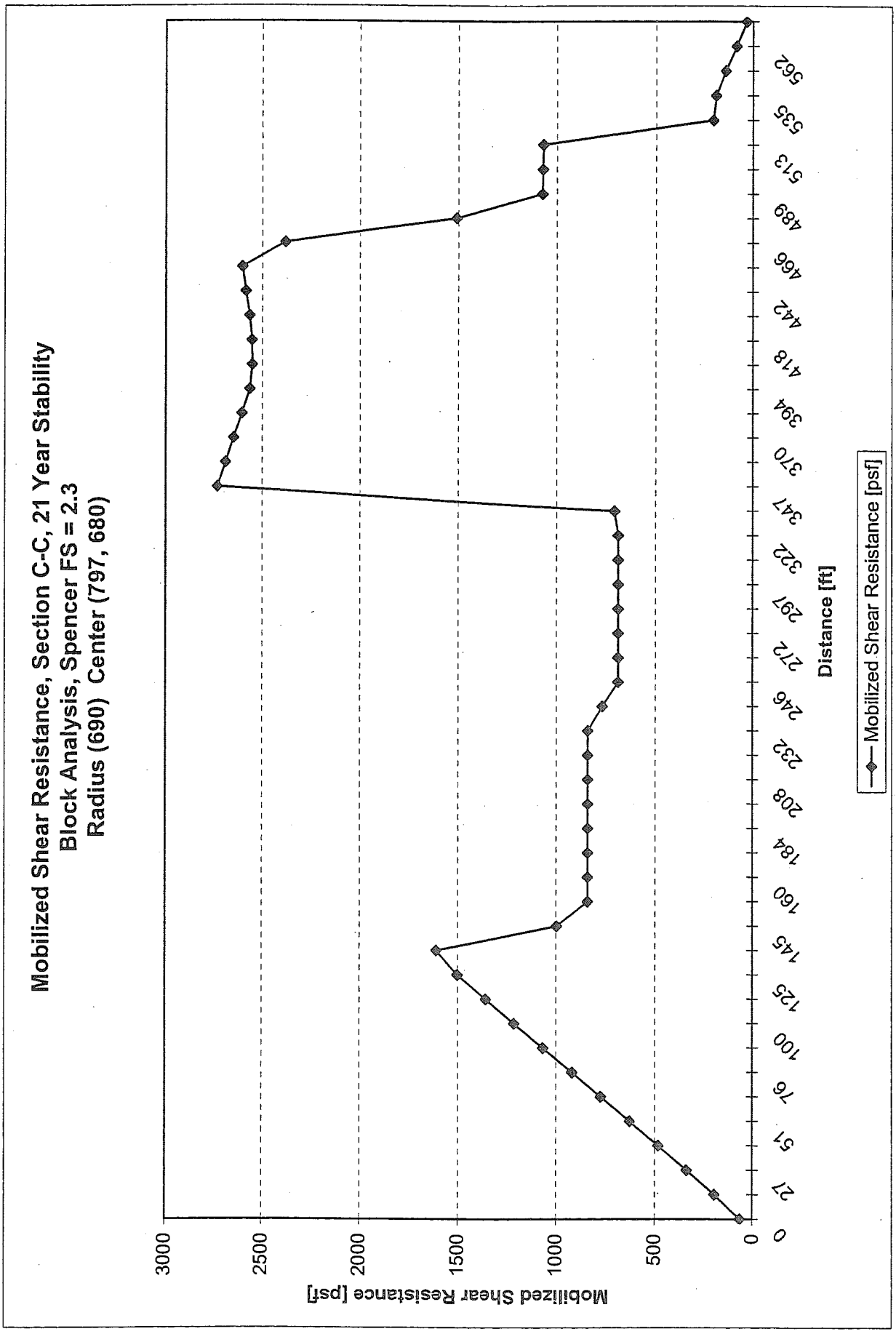
C21-7



Section C-C
21 Year Stability
Block Analysis

C21-2

Section C-C
21 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance C

C21-9

Slide Analysis Information

Document Name

File Name: c-c(21 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2001 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1769 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3

Section C-C
21 Year Stability
Block Analysis

C21-18

Cohesion Type: Constant
Cohesion: 1588 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1632 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1957 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2521 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2299 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1937 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1668 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1704 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2082 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2783 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.3045
Axis Location: 796.859, 679.925
Left Slip Surface Endpoint: 379.195, 149
Right Slip Surface Endpoint: 971.001, 27.2389

Method Statistics

Method: spencer
Number of Valid Surfaces: 3533
Number of Invalid Surfaces: 1467
Error Codes:
Error Code -105 reported for 8 surfaces
Error Code -107 reported for 61 surfaces
Error Code -108 reported for 1360 surfaces
Error Code -111 reported for 36 surfaces
Error Code -112 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

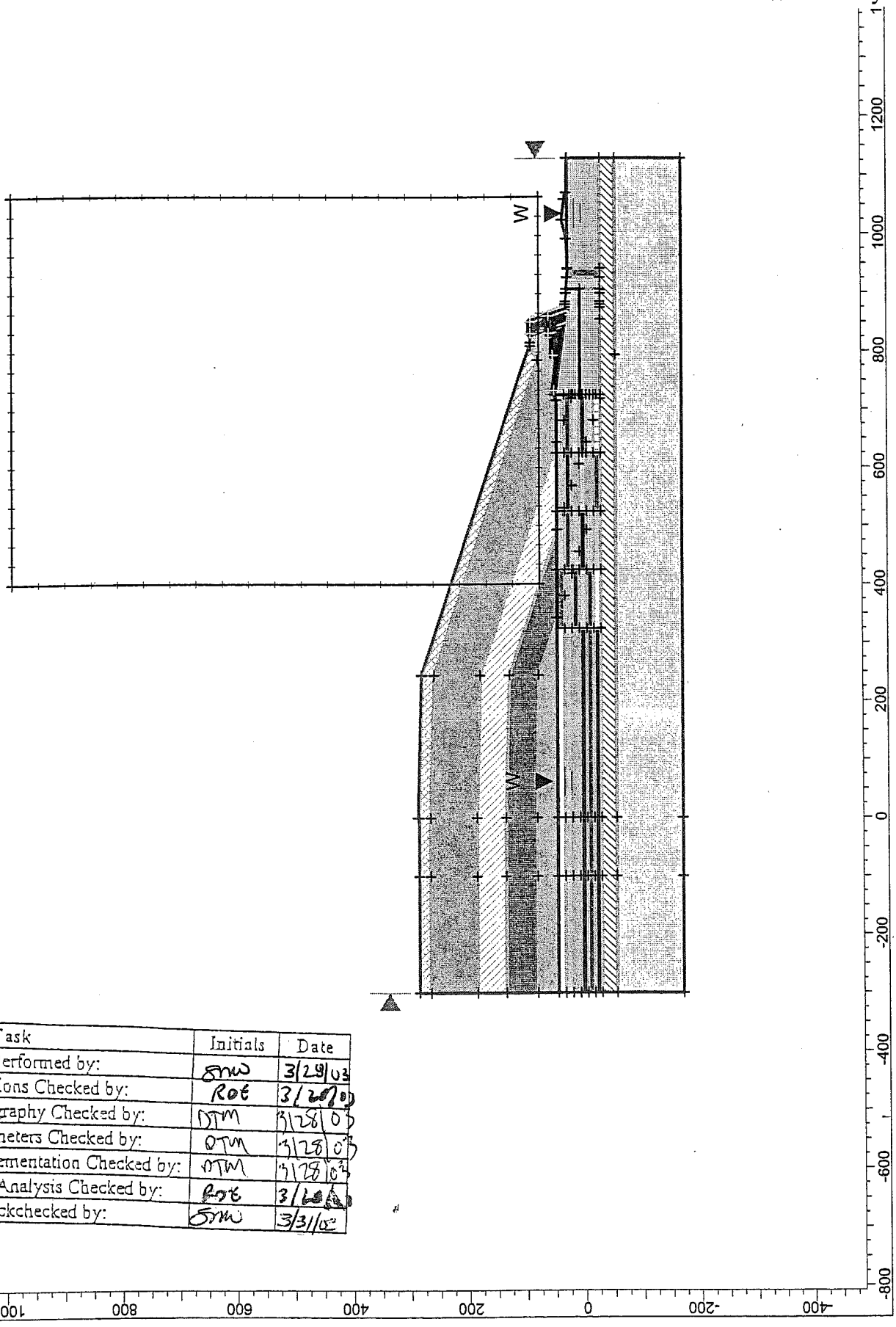
-111 = safety factor equation did not converge

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

Section C-C
21 Year Stability
Block Analysis

C21-11

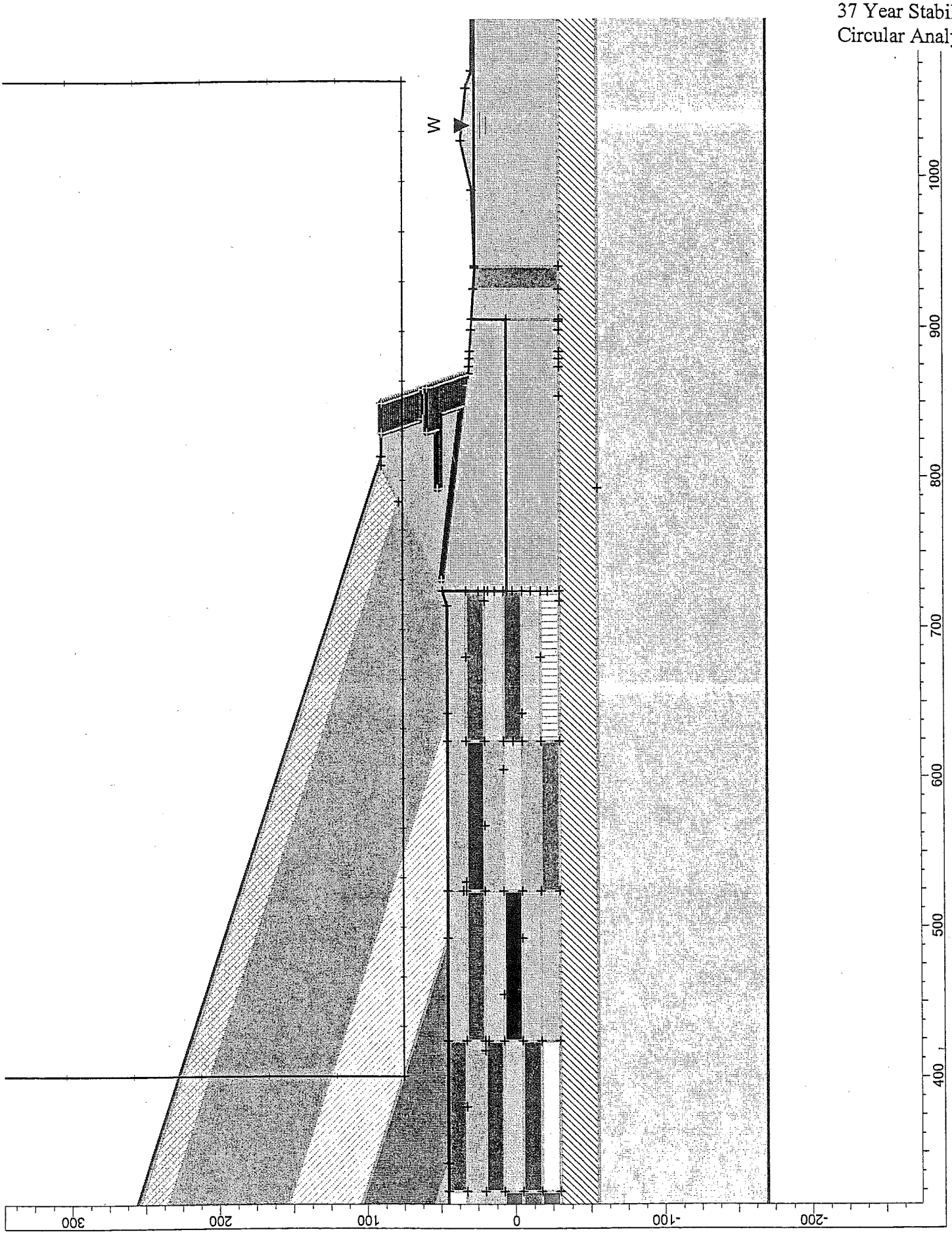
Section C-C
37 Year Stability
Circular Analysis



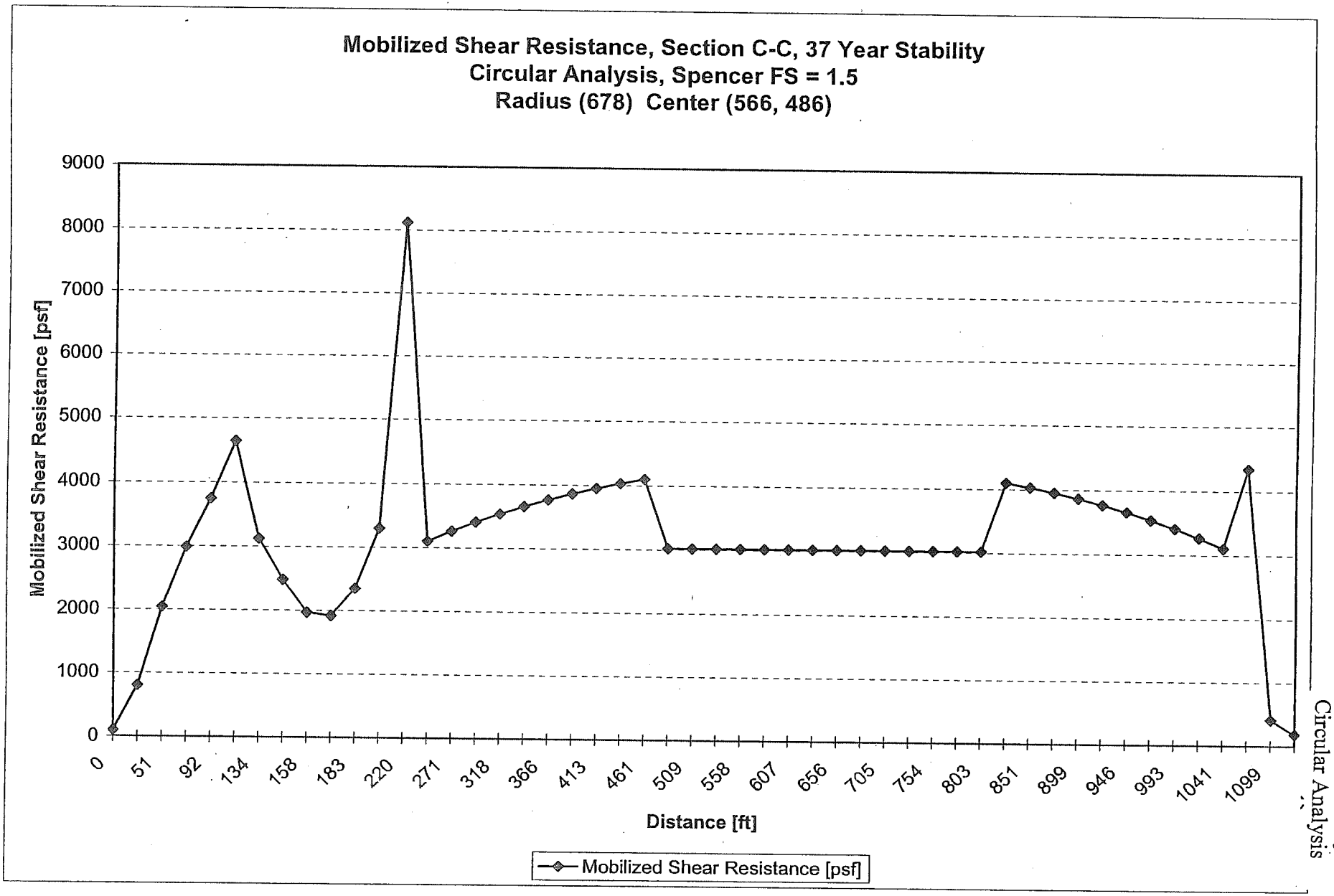
Task	Initials	Date
Analysis Performed by:	SMW	3/29/05
Assumptions Checked by:	RDE	3/29/05
Geometry Stratigraphy Checked by:	DTM	3/28/05
Input Parameters Checked by:	DTM	3/28/05
Input Parameter Implementation Checked by:	DTM	3/28/05
Reasonableness of Analysis Checked by:	RDE	3/30/05
Analysis Backchecked by:	SMW	3/31/05

C37-1

Section C-C
37 Year Stability
Circular Analysis



C37-2



Section C-C
37 Year Stability
Circular Analysis

C37-2

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance C

Section C-C
37 Year Stability
Circular Analysis

C37-4

Slide Analysis Information

Document Name

File Name: c-c(37 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function

C37-5

Section C-C
37 Year Stability
Circular Analysis

Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2109 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2084 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2089 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2182 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2396 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2704 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2797 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2679 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2591 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2653 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2913 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3511 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3202 psf

Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2911 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2903 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3281 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3975 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3948 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2798 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2737 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3265 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4304 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4656 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3700 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2937 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2862 psf
Water Surface: None

Section C-C
37 Year Stability
Circular Analysis

C37-6

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3509 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4916 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.48972
Center: 565.882, 486.073
Radius: 678.112
Left Slip Surface Endpoint: -81.4534, 284.1
Right Slip Surface Endpoint: 1066.77, 28.9698

Method Statistics

Method: spencer
Number of Valid Surfaces: 26464
Number of Invalid Surfaces: 7052
Error Codes:
Error Code -106 reported for 132 surfaces
Error Code -107 reported for 614 surfaces
Error Code -108 reported for 616 surfaces
Error Code -109 reported for 3 surfaces
Error Code -111 reported for 2433 surfaces
Error Code -112 reported for 3254 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

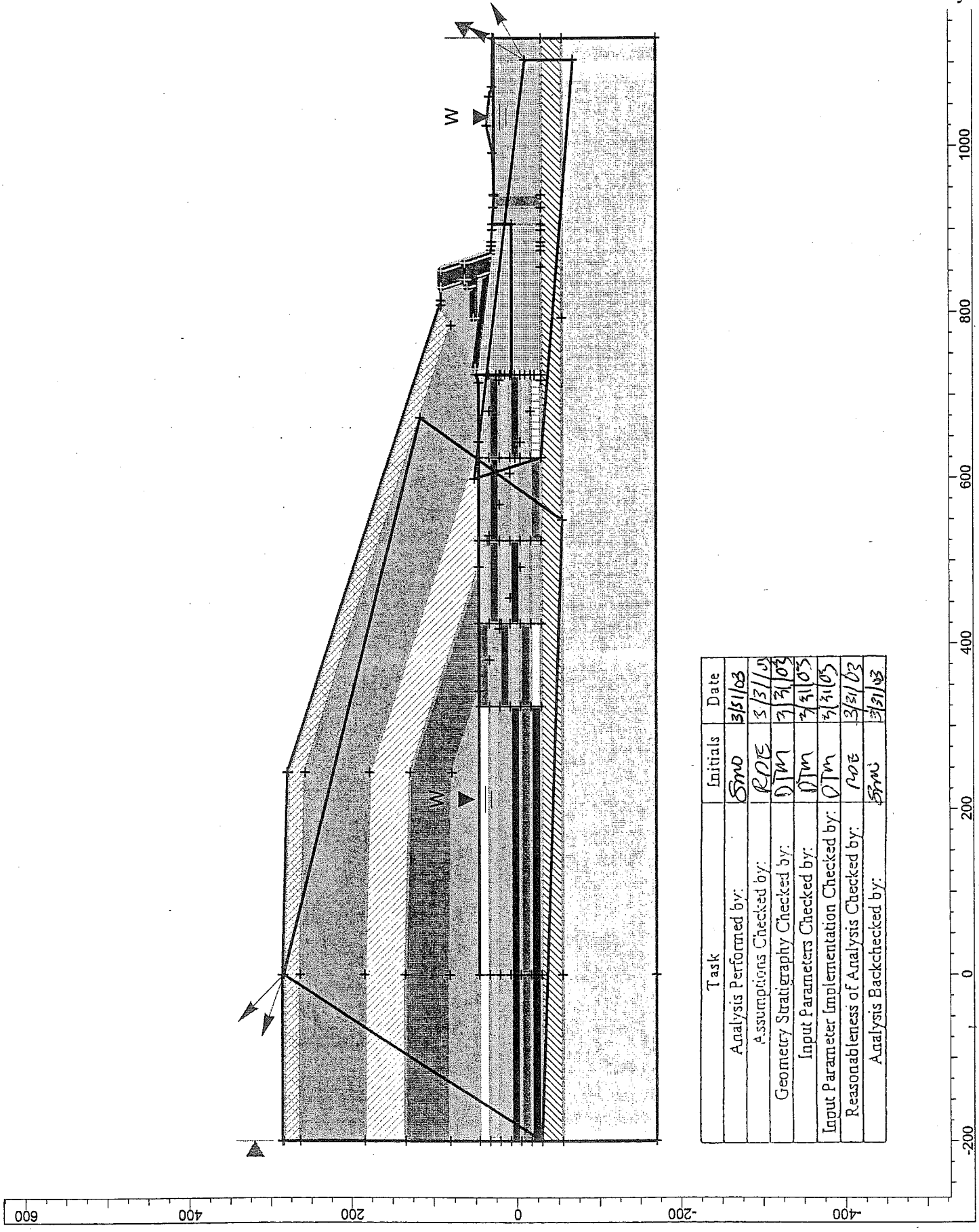
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

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

Section C-C
37 Year Stability
Block Analysis

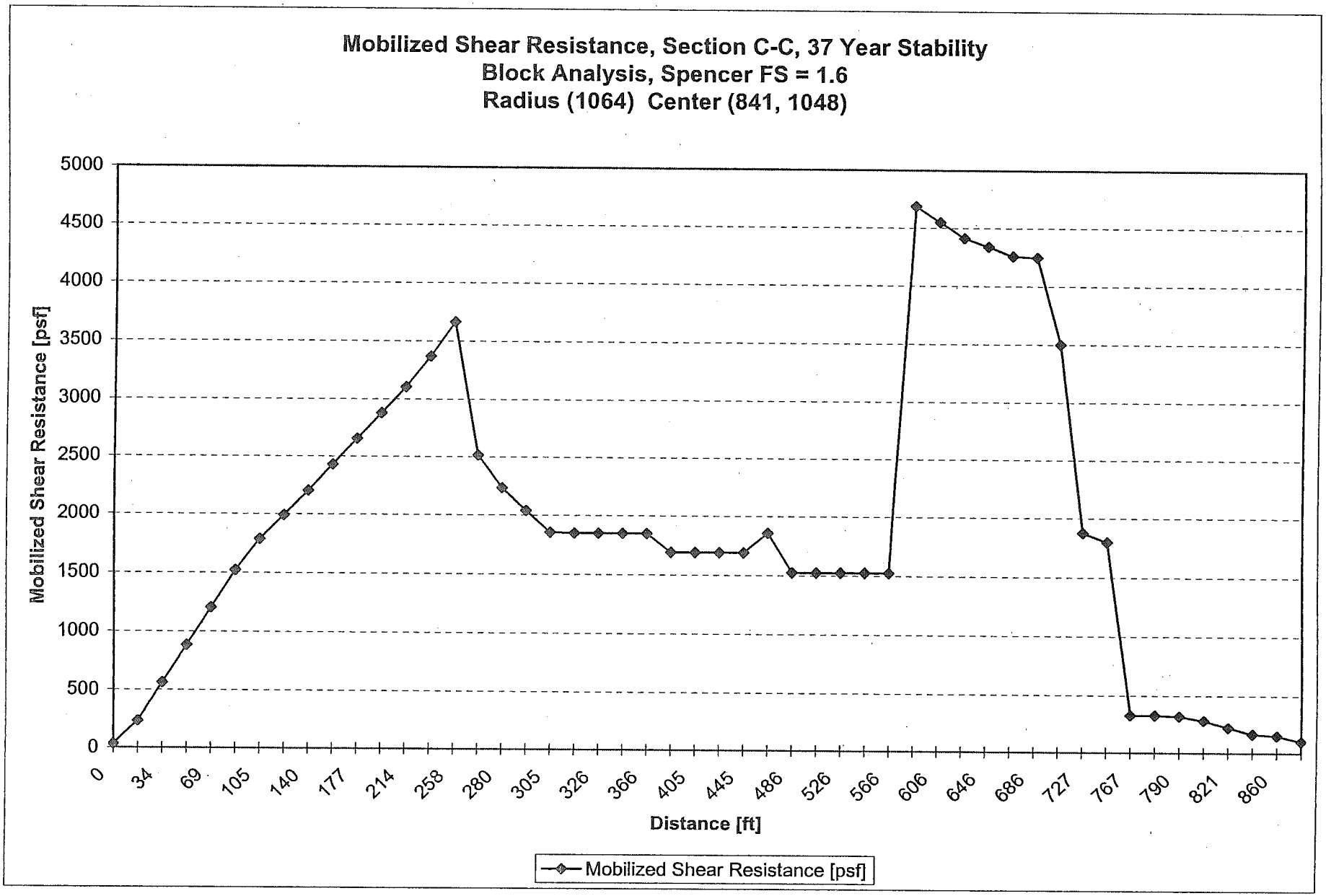


Task	Initials	Date
Analysis Performed by:	SMO	3/31/03
Assumptions Checked by:	ROE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	ROE	3/31/03
Analysis Backchecked by:	SMO	3/31/03

C37-8

Section C-C
37 Year Stability
Block Analysis

C37-9



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance C

Section C-C
37 Year Stability
Block Analysis

C37-10

Slide Analysis Information

Document Name

File Name: c-c(37 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Section C-C
37 Year Stability
Block Analysis

C37-11

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2109 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2084 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2089 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2182 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2396 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2704 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2797 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2679 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2591 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2653 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2913 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3511 psf
Water Surface: None

Material: d32
Strength Type: Undrained

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3202 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2911 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2903 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3281 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3975 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3948 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2798 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2737 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3265 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4304 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4656 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3700 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2937 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section C-C
37 Year Stability
Block Analysis

C37-12

Cohesion: 2862 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3509 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4916 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 0

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.56981
Axis Location: 840.718, 1048.37
Left Slip Surface Endpoint: 147.095, 282.264
Right Slip Surface Endpoint: 1037.43, 33.8061

Method Statistics

Method: spencer
Number of Valid Surfaces: 1662
Number of Invalid Surfaces: 3338
Error Codes:
Error Code -105 reported for 3 surfaces
Error Code -108 reported for 633 surfaces
Error Code -110 reported for 2605 surfaces
Error Code -111 reported for 48 surfaces
Error Code -112 reported for 49 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

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

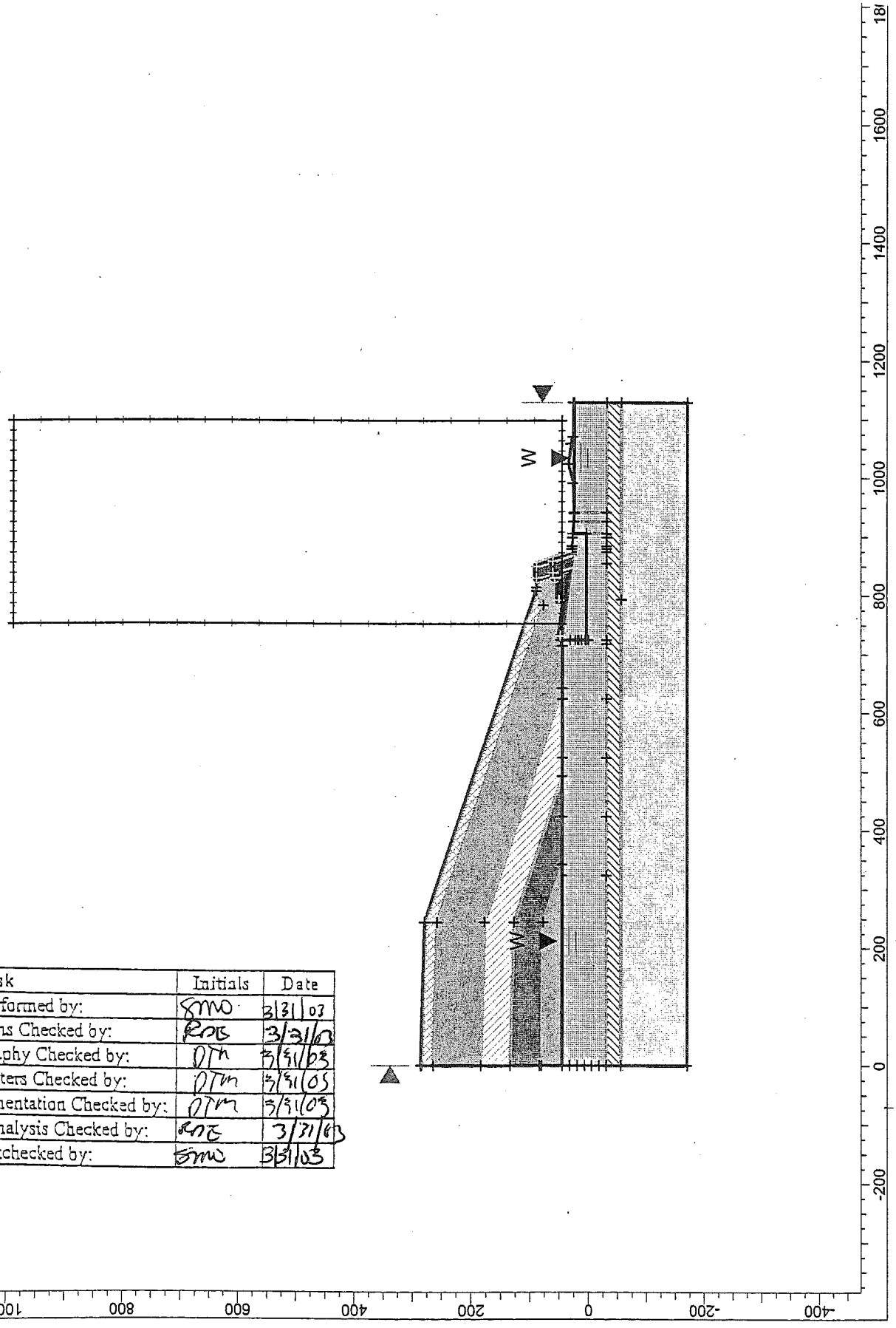
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

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

Section C-C
37 Year Stability
Block Analysis

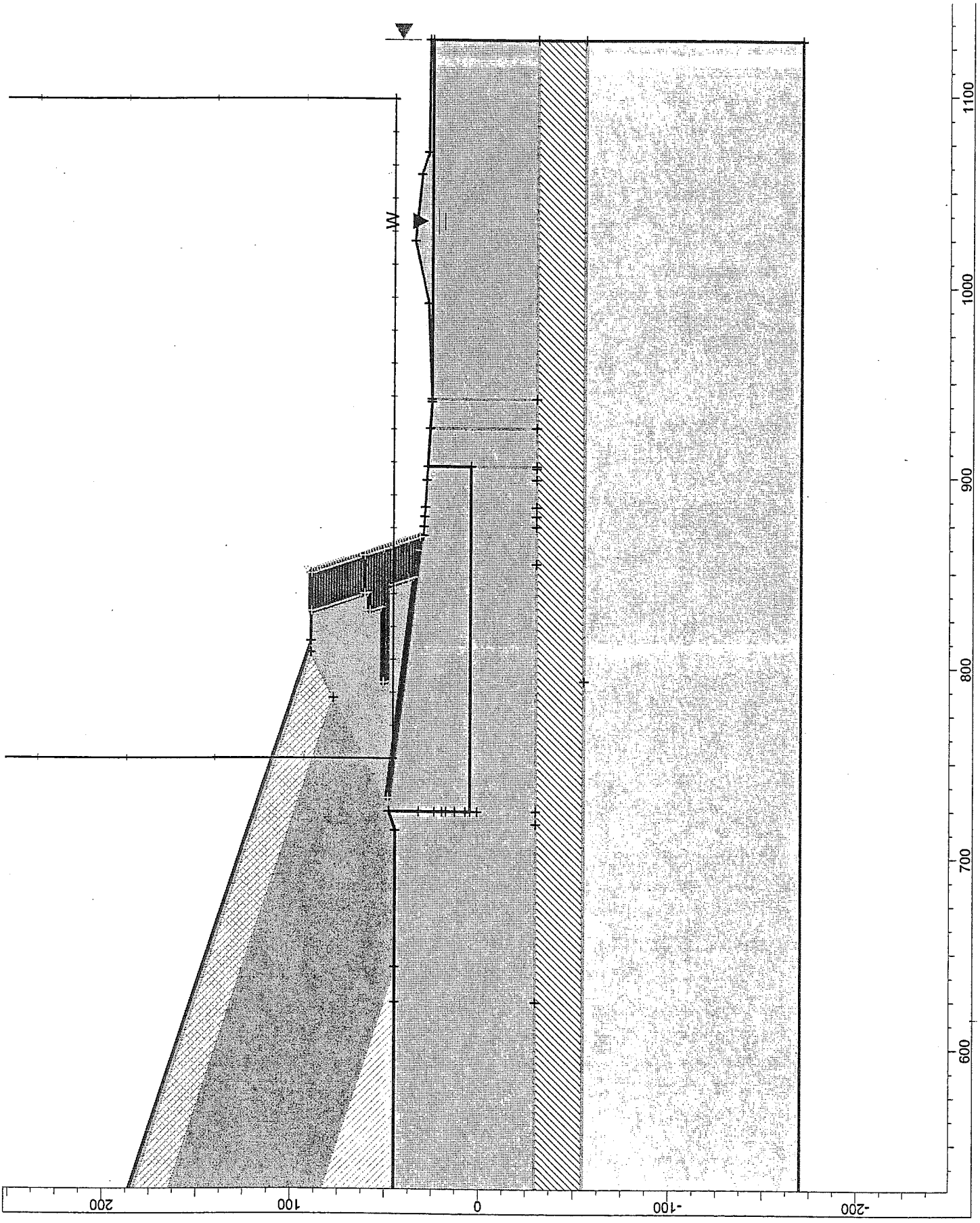
Section C-C
Long-Term Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RDE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMW	3/31/03

CLT-1

Section C-C
Long-Term Stability
Circular Analysis

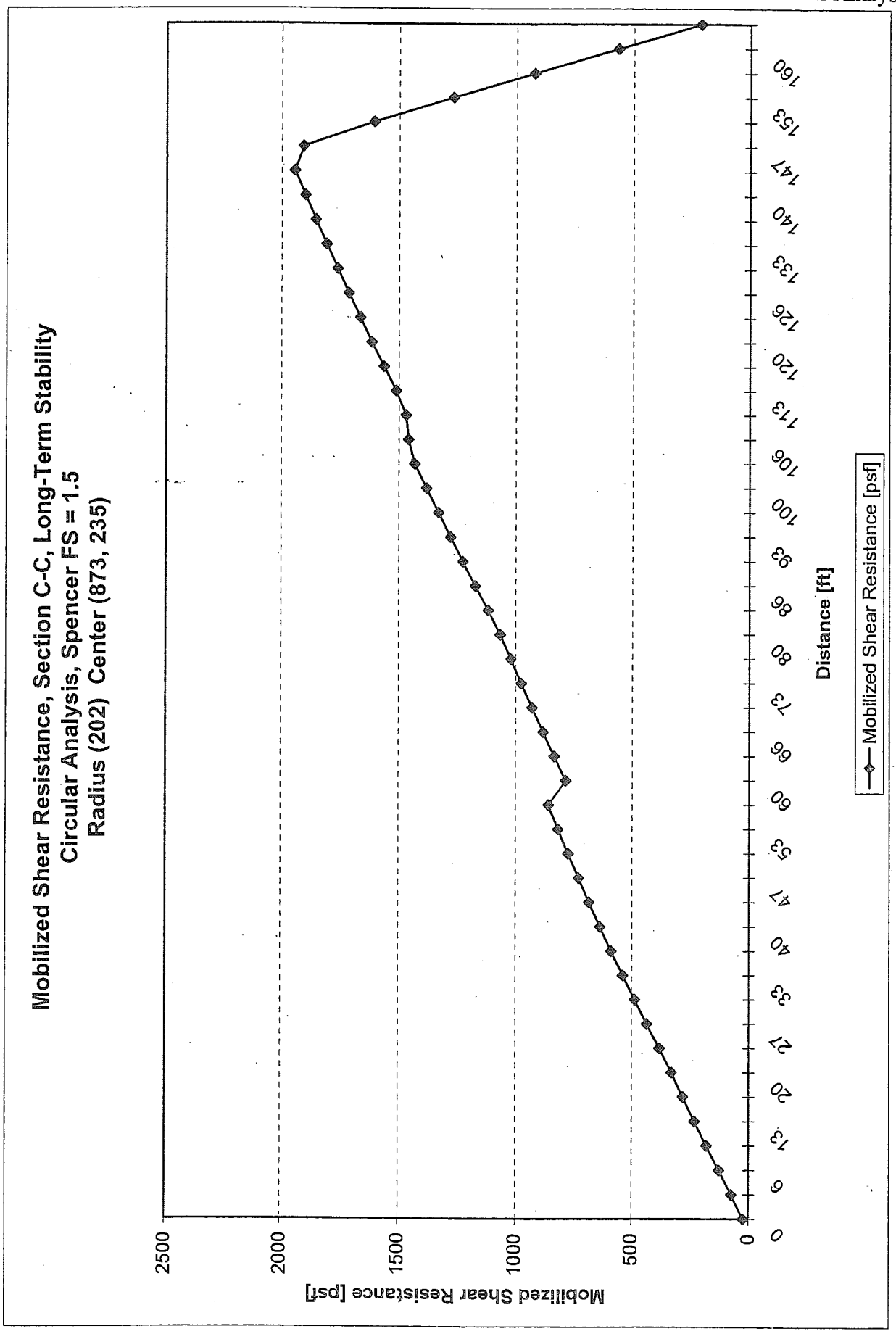


CLT-2

Section C-C
Long-Term Stability
Circular Analysis

CLT-3

Section C-C
Long-Term Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance C

CLT-4

Slide Analysis Information

Document Name

File Name: c-c(long-term) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table

Section C-C
Long-Term Stability
Circular Analysis

CCT-5

Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.50061
Center: 872.669, 234.692
Radius: 201.556
Left Slip Surface Endpoint: 702.24, 127.087
Right Slip Surface Endpoint: 867.927, 33.1917

Method Statistics

Method: spencer
Number of Valid Surfaces: 24666
Number of Invalid Surfaces: 8850
Error Codes:
Error Code -100 reported for 1 surface
Error Code -105 reported for 2 surfaces
Error Code -106 reported for 325 surfaces
Error Code -107 reported for 858 surfaces
Error Code -108 reported for 1464 surfaces
Error Code -111 reported for 5353 surfaces
Error Code -112 reported for 847 surfaces

Error Codes

The following errors were encountered during the computation:

-100 = Both surface / slope intersections are on the same horizontal surface. In general, this will give a very high or infinite factor of safety (zero driving force), if calculated.

-105 = More than two surface / slope intersections with no valid slip surface.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

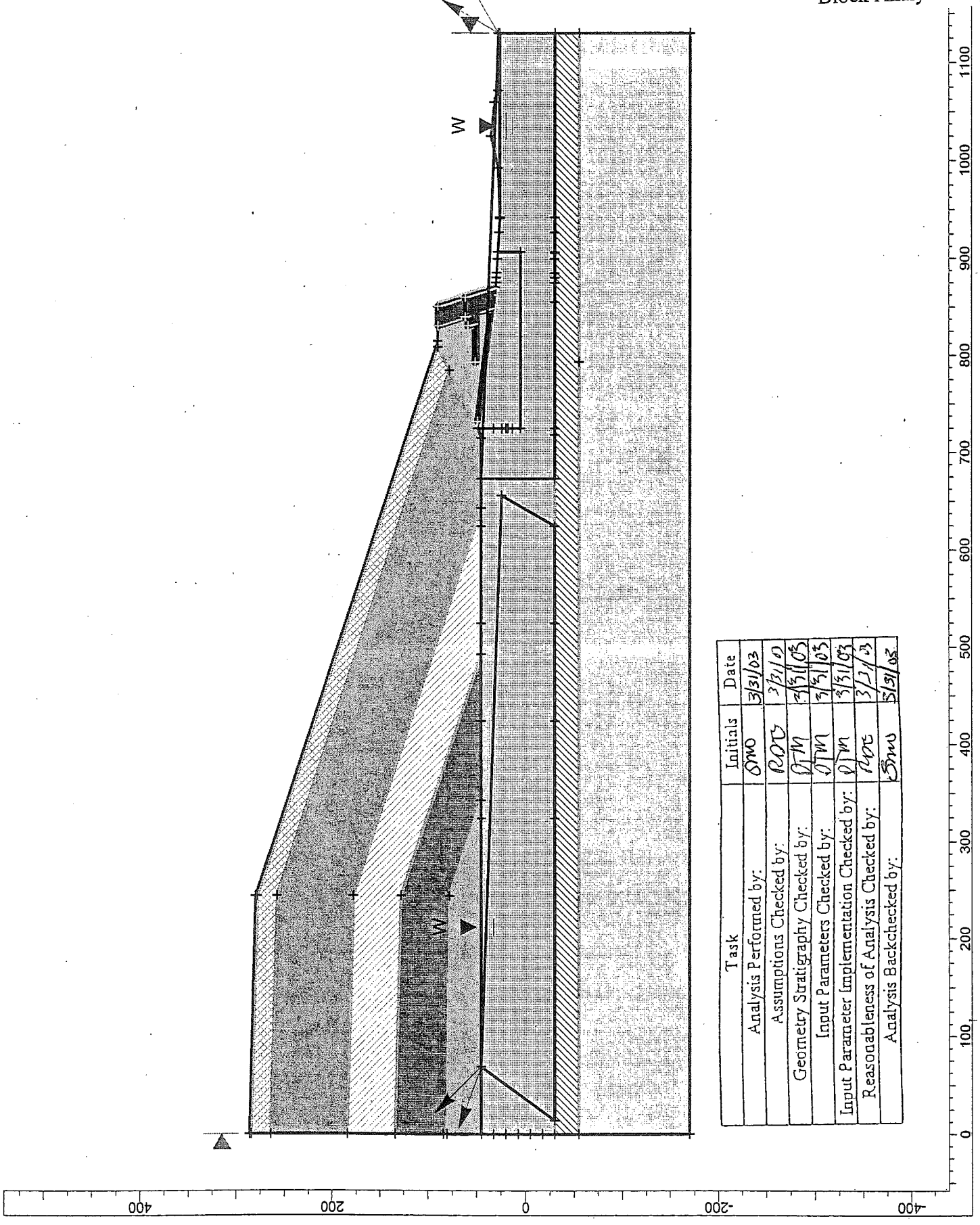
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

-111 = safety factor equation did not converge

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

Section C-C
Long-Term Stability
Block Analysis



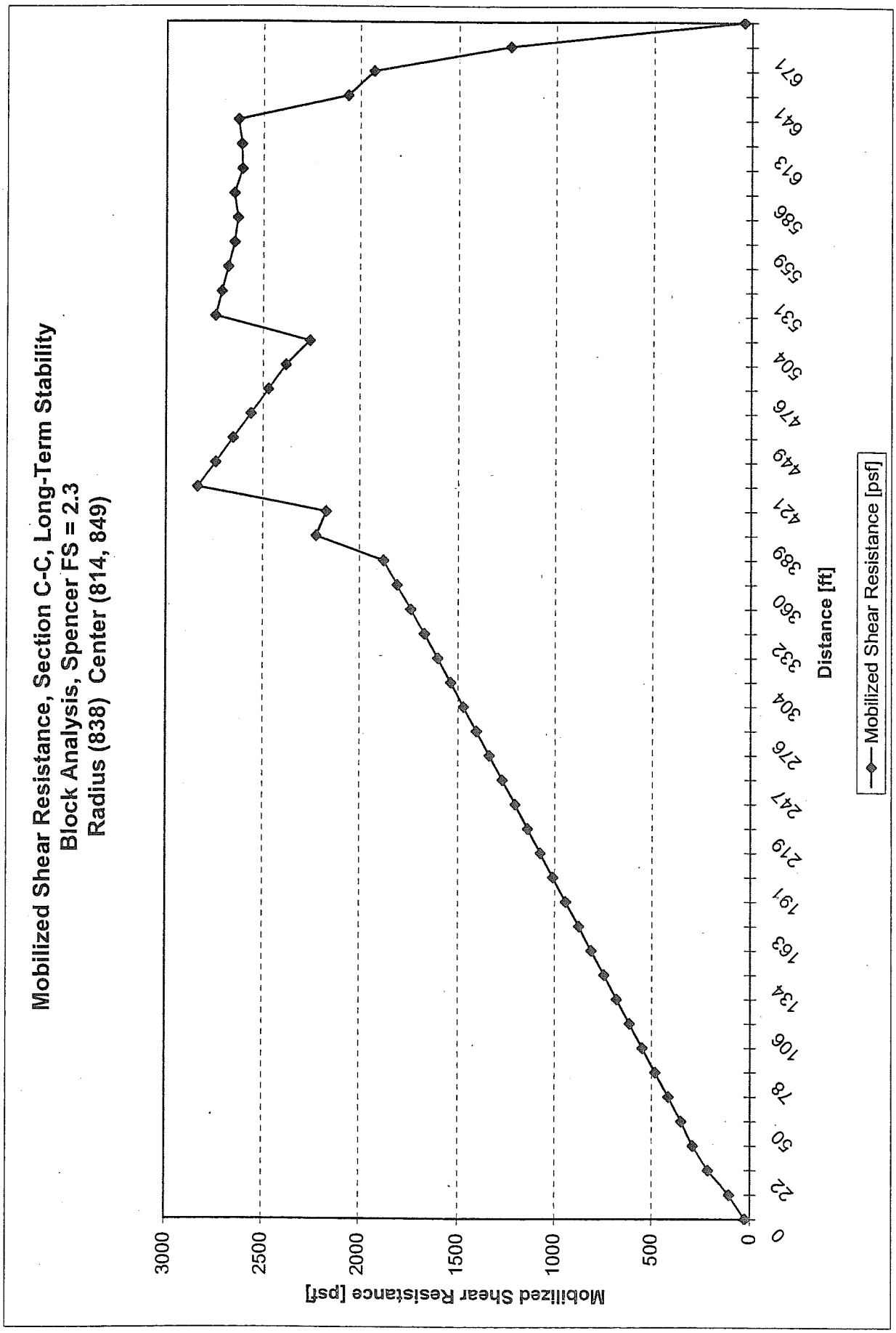
Task	Initials	Date
Analysis Performed by:	SMO	3/31/03
Assumptions Checked by:	ROC	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMO	3/31/03

CLT-6

Section C-C
Long-Term Stability
Block Analysis

C-LT-7

Section C-C
Long-Term Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance C

CLT-8

Slide Analysis Information

Document Name

File Name: c-c(long-term) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area

C LT-9

Section C-C
Long-Term Stability
Block Analysis

Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.29145
Axis Location: 813.616, 849.119
Left Slip Surface Endpoint: 213.425, 280.579
Right Slip Surface Endpoint: 908.333, 27.8417

Method Statistics

Method: spencer
Number of Valid Surfaces: 3667
Number of Invalid Surfaces: 1333
Error Codes:
Error Code -108 reported for 1293 surfaces
Error Code -111 reported for 40 surfaces

Error Codes

The following errors were encountered during the computation:

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

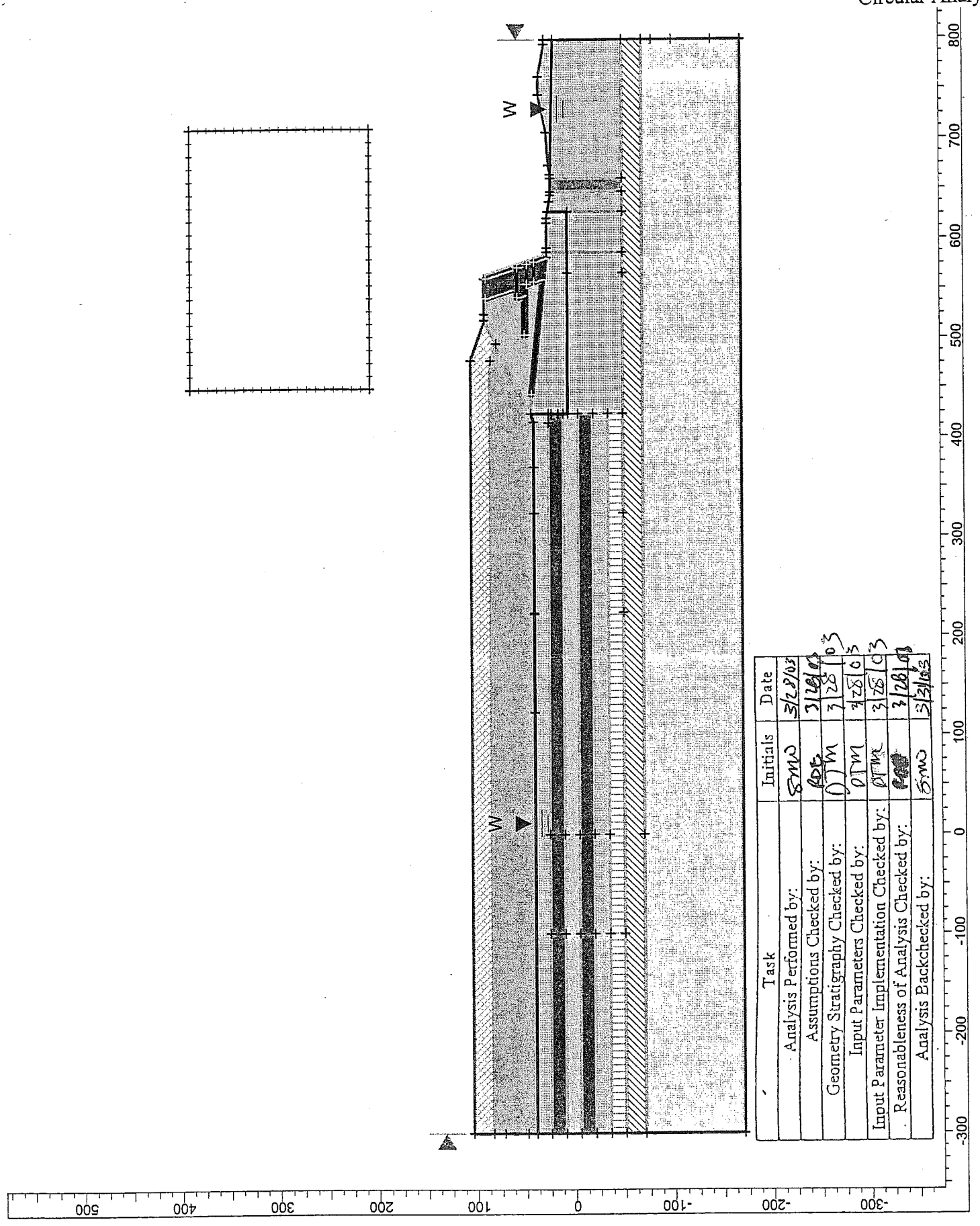
-111 = safety factor equation did not converge

Attachment D

Stability Analysis Results for Cross Section D-D

Section D-D
Reinforcement Pattern
Geogrid
Label: Geogrid Type 1
Geogrid
Label: Geogrid Type 1
High Strength Geotextile
Label: Geogrid Type 2
1360
1340
1320
1300
1280
1260
1240
1220
120
100
80
60
40
20

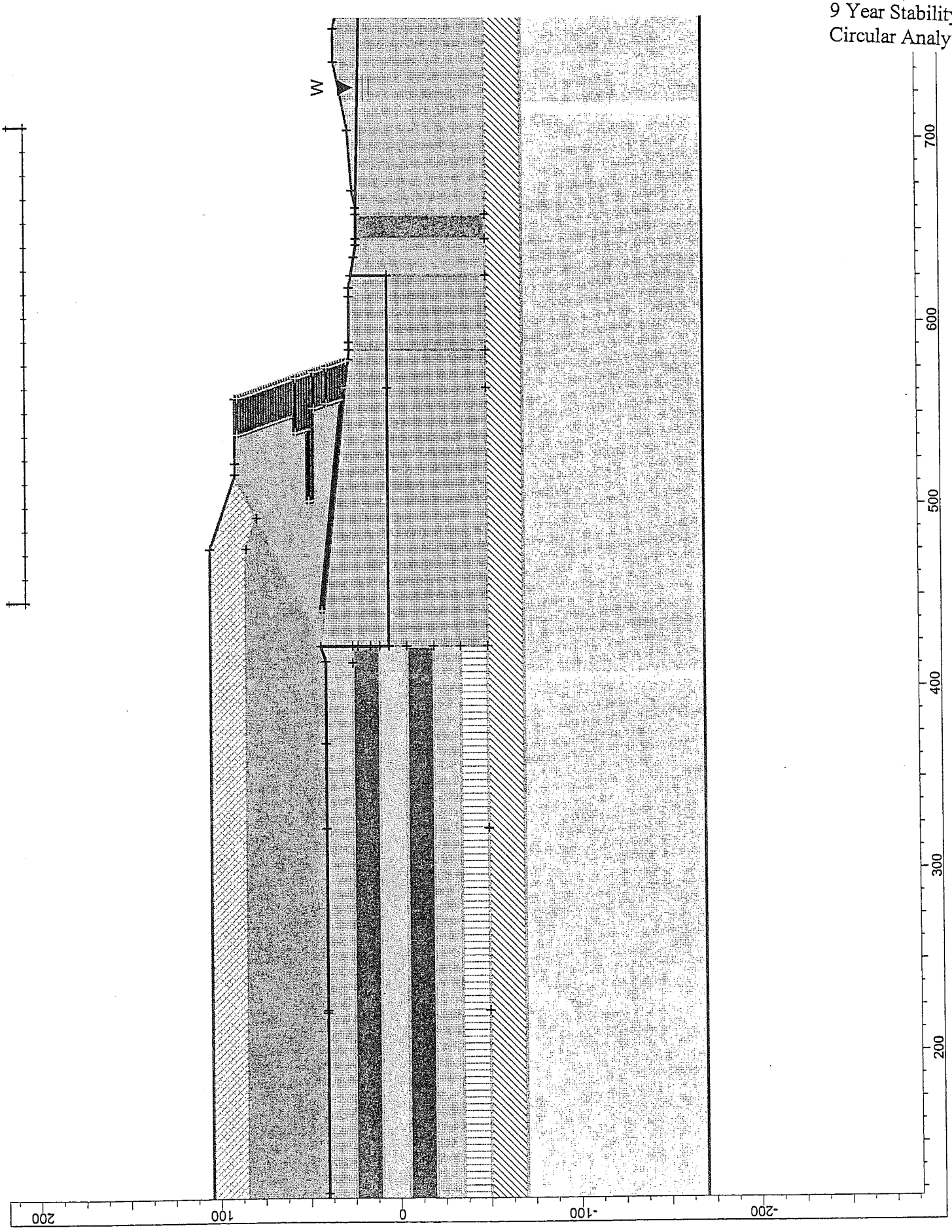
Section D-D
9 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMD	3/28/03
Assumptions Checked by:	ADF	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	[illegible]	3/28/03
Analysis Backchecked by:	SMD	3/31/03

D9-1

Section D-D
9 Year Stability
Circular Analysis

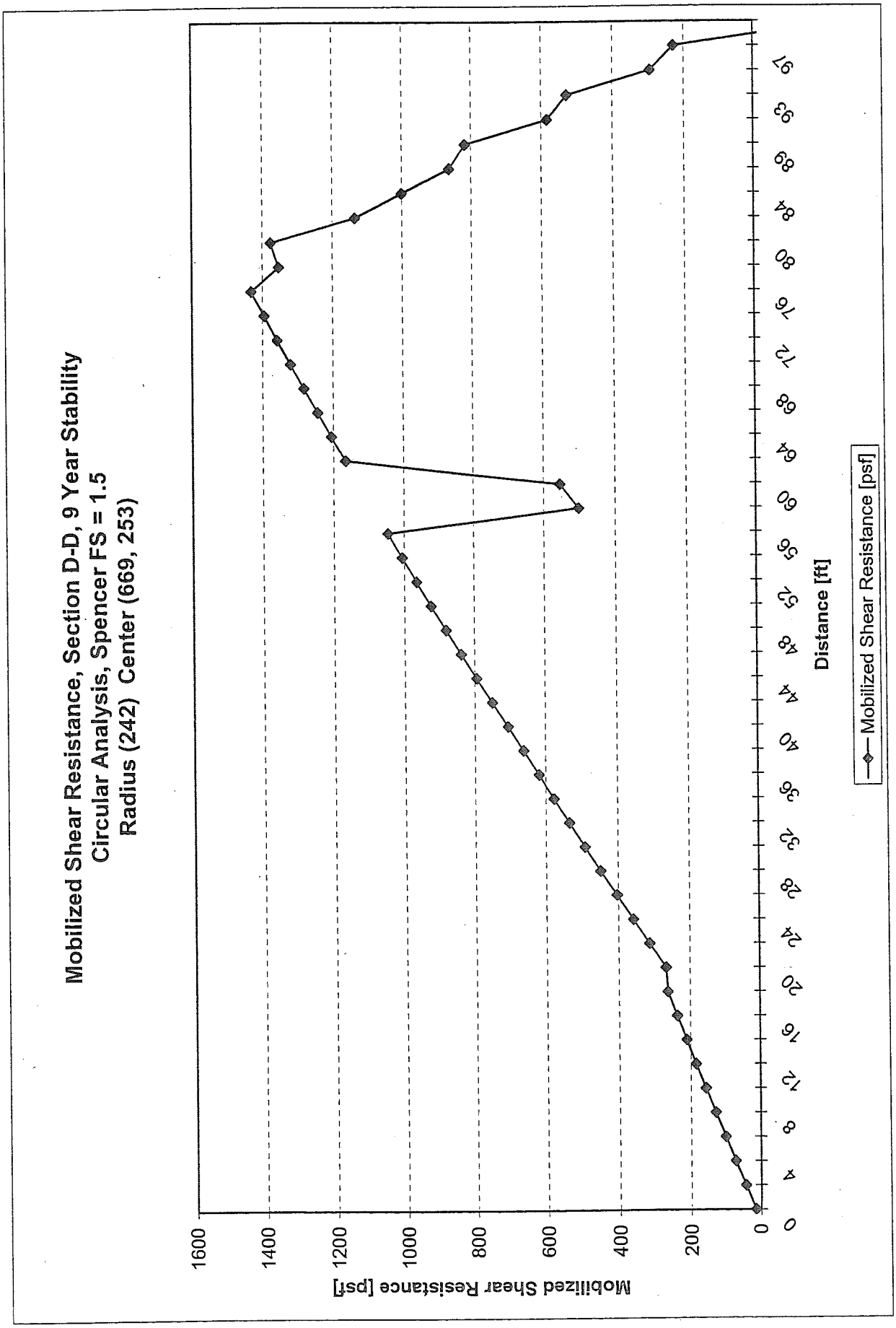


D9-2

Section D-D
9 Year Stability
Circular Analysis

D9-3

Section D-D
9 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance D

DS-4

Slide Analysis Information

Document Name

File Name: d-d(9 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius Increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1295 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 970 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 872 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 976 psf
Water Surface: None

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Circular Analysis

A2-3

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1301 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1975 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.47615
Center: 669.232, 252.665
Radius: 241.962
Left Slip Surface Endpoint: 478.958, 103.195
Right Slip Surface Endpoint: 579.556, 27.935

Method Statistics

Method: spencer
Number of Valid Surfaces: 25728
Number of Invalid Surfaces: 7788
Error Codes:
Error Code -106 reported for 141 surfaces
Error Code -107 reported for 120 surfaces
Error Code -108 reported for 1297 surfaces
Error Code -111 reported for 6230 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure

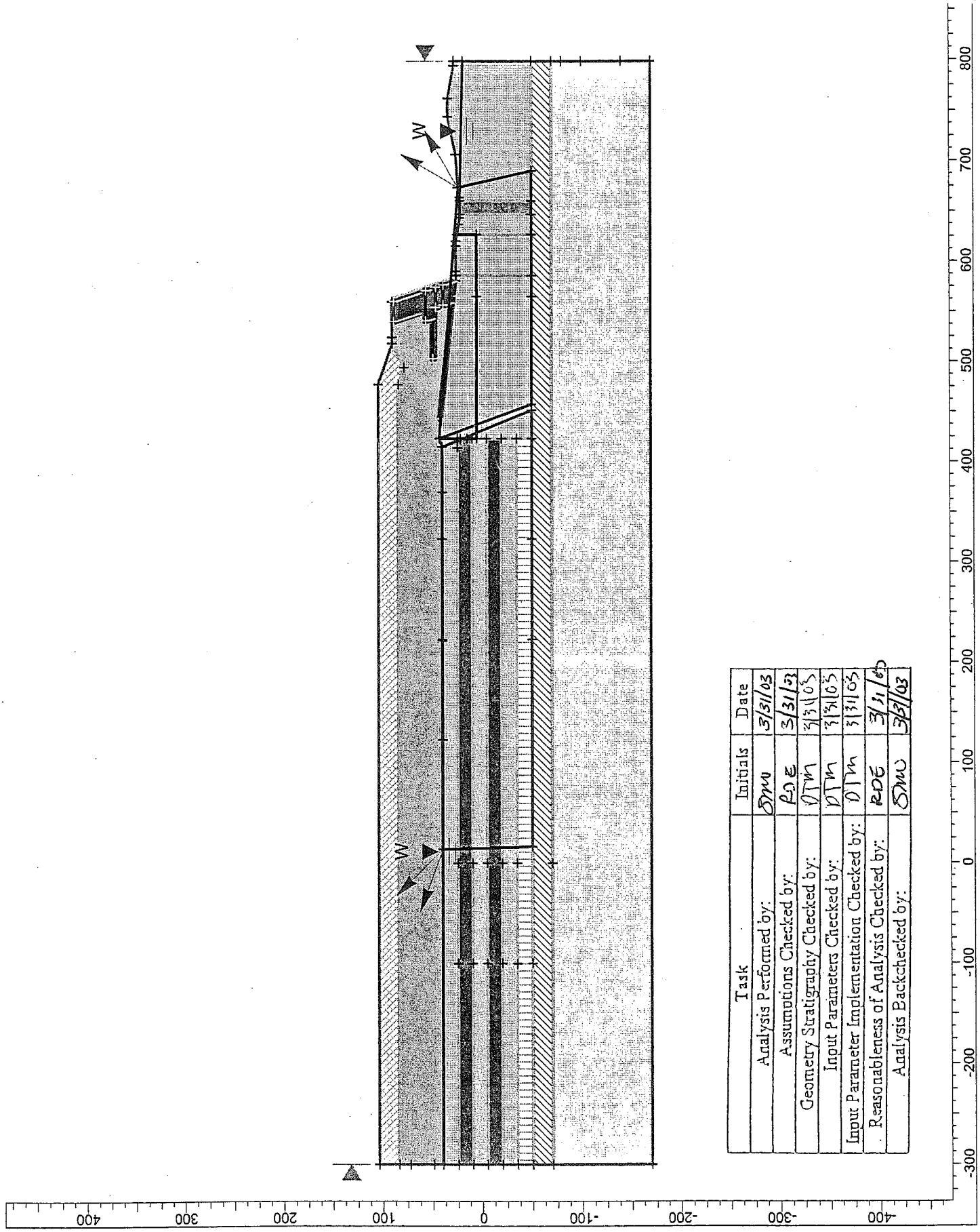
Section D-D
9 Year Stability
Circular Analysis

direction is specified, or if high external or anchor loads are applied against the failure direction.

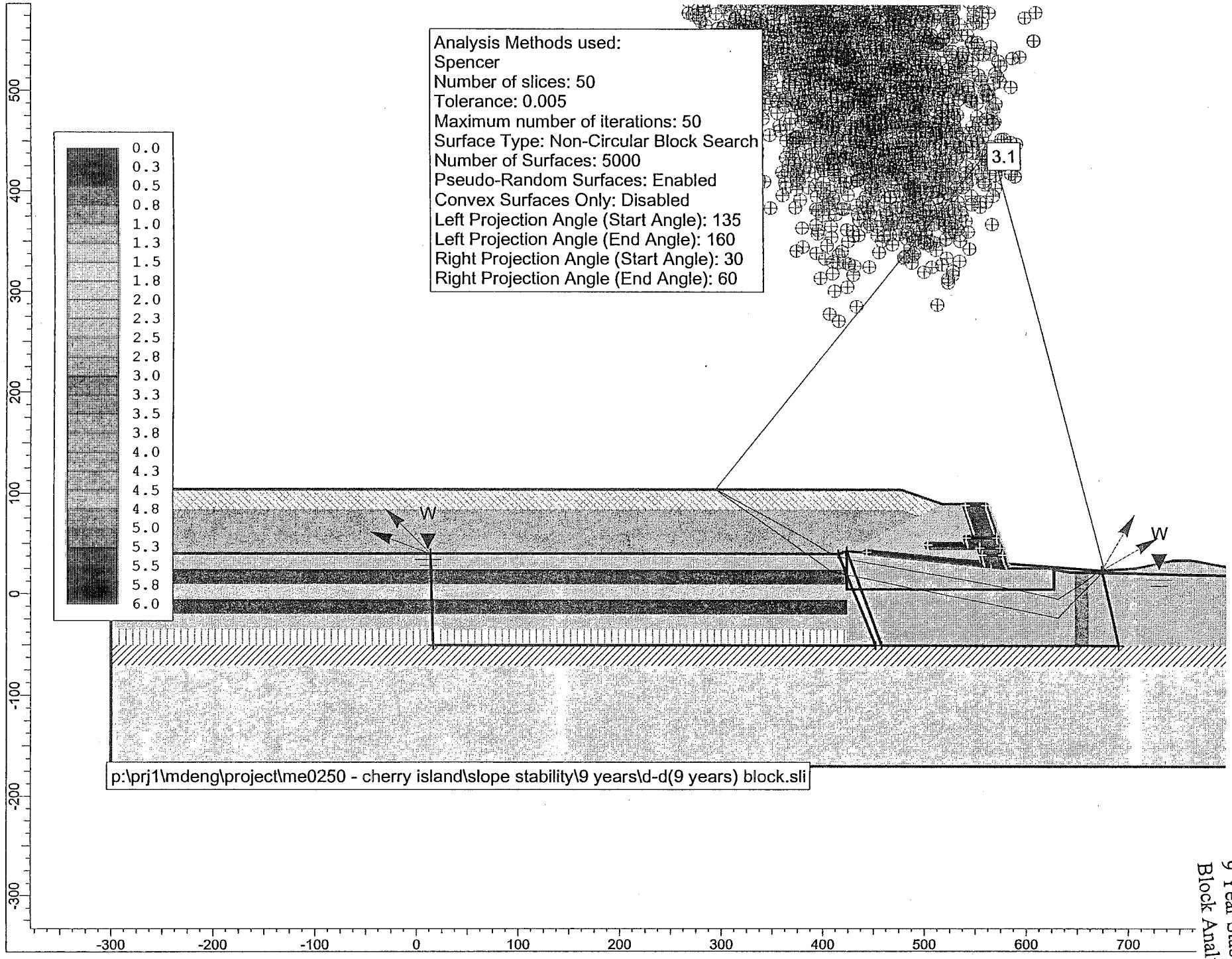
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

Section D-D
9 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RDE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMW	3/31/03



Section D-D
9 Year Stability
Block Analysis

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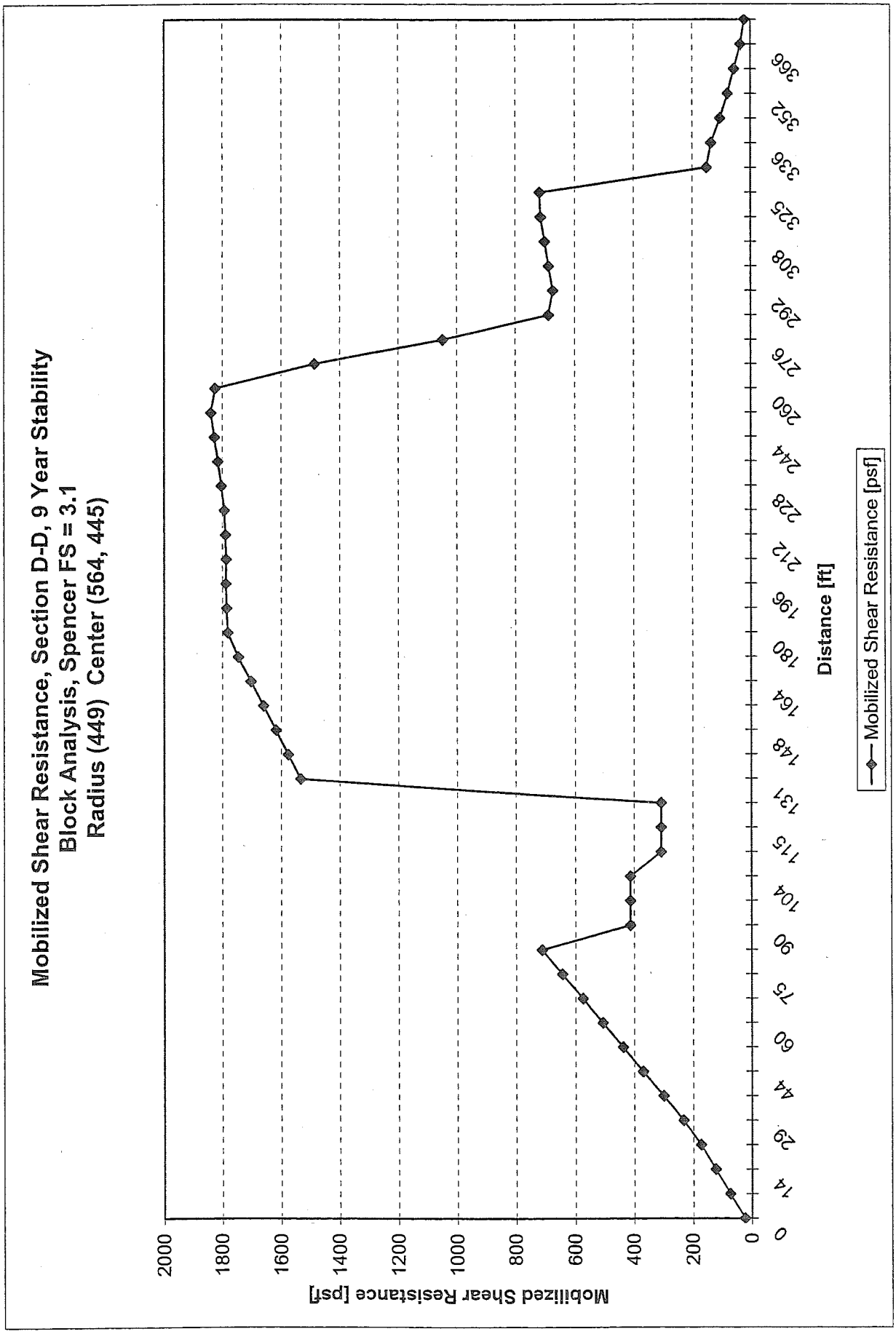
Section D-D
9 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance L

Slide Analysis Information

Document Name

File Name: d-d(9 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: .1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1295 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 970 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 872 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section D-D
9 Year Stability
Block Analysis

Cohesion: 976 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1301 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1975 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 3.1346
Axis Location: 564.373, 445.387
Left Slip Surface Endpoint: 293.915, 104
Right Slip Surface Endpoint: 675.208, 24.1889

Method Statistics

Method: spencer
Number of Valid Surfaces: 2339
Number of Invalid Surfaces: 2661
Error Codes:
Error Code -105 reported for 2 surfaces
Error Code -107 reported for 791 surfaces
Error Code -108 reported for 1370 surfaces
Error Code -111 reported for 497 surfaces
Error Code -112 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

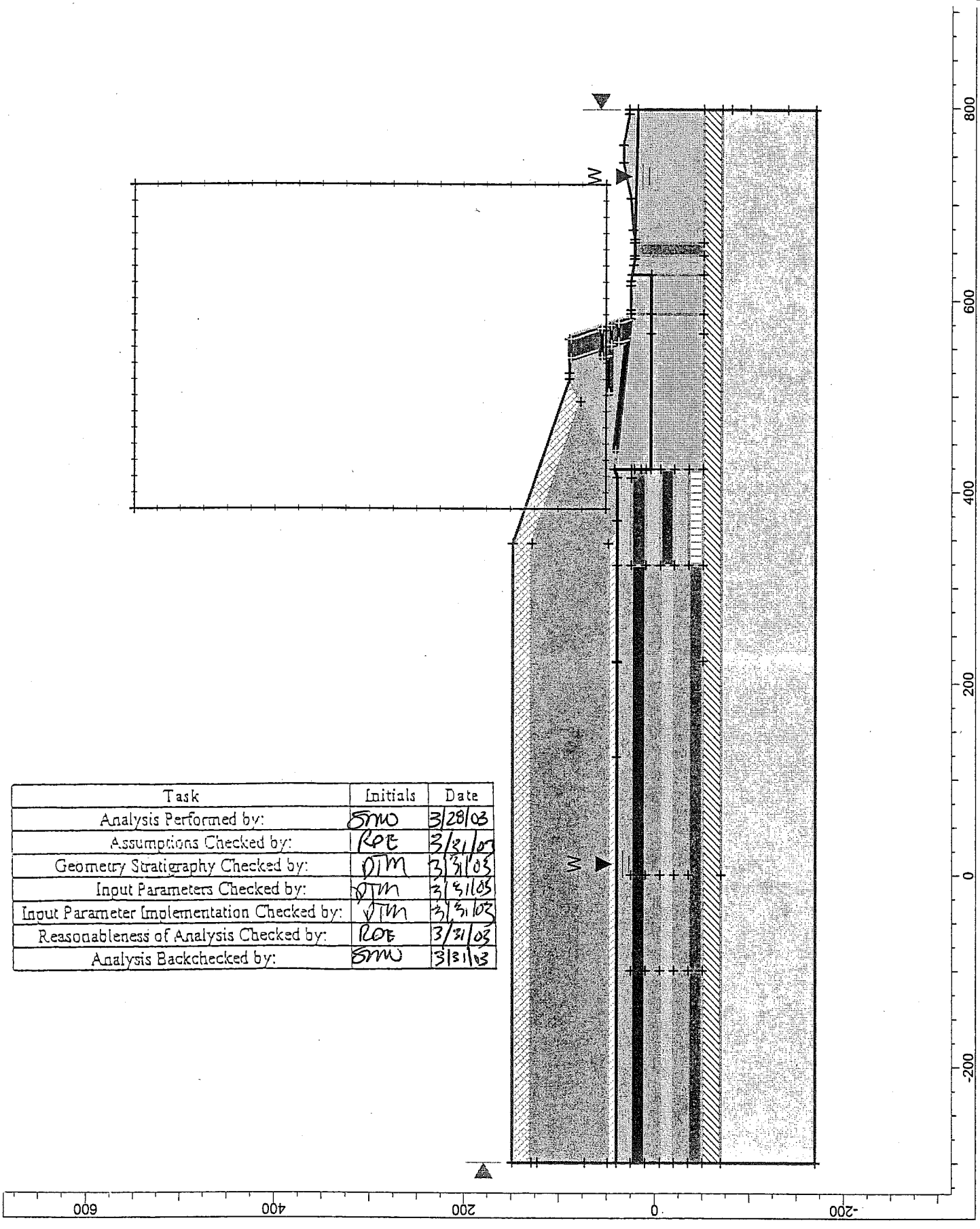
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

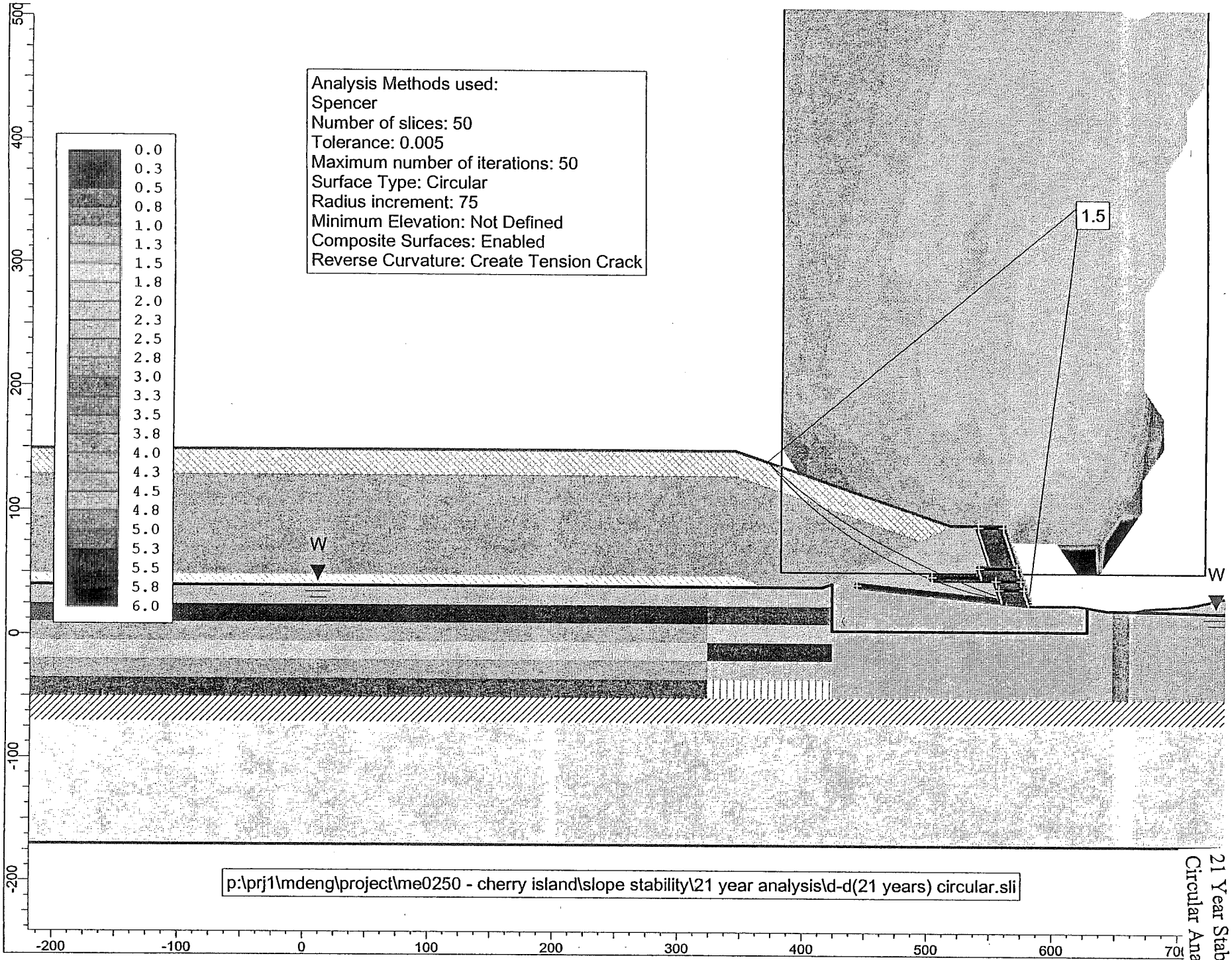
Section D-D
9 Year Stability
Block Analysis

Section D-D
21 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	ROE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	ROE	3/31/03
Analysis Backchecked by:	SMW	3/31/03

D21-1



Section D-D
21 Year Stability
Circular Analysis

D21-2

Slide Analysis Information

Document Name

File Name: d-d(21 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1974 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1606 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1441 psf
Water Surface: None

Section D-D
21 Year Stability
Circular Analysis

121-3

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1509 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1848 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2600 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2234 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1723 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1503 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1572 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1959 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2852 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive

Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.49181
Center: 618.194, 350.813
Radius: 324.927
Left Slip Surface Endpoint: 370.611, 140.384
Right Slip Surface Endpoint: 579.467, 28.2015

Method Statistics

Method: spencer
Number of Valid Surfaces: 23990
Number of Invalid Surfaces: 9526
Error Codes:
Error Code -106 reported for 117 surfaces
Error Code -107 reported for 1603 surfaces
Error Code -108 reported for 1223 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 4543 surfaces
Error Code -112 reported for 2037 surfaces
Error Code -200 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

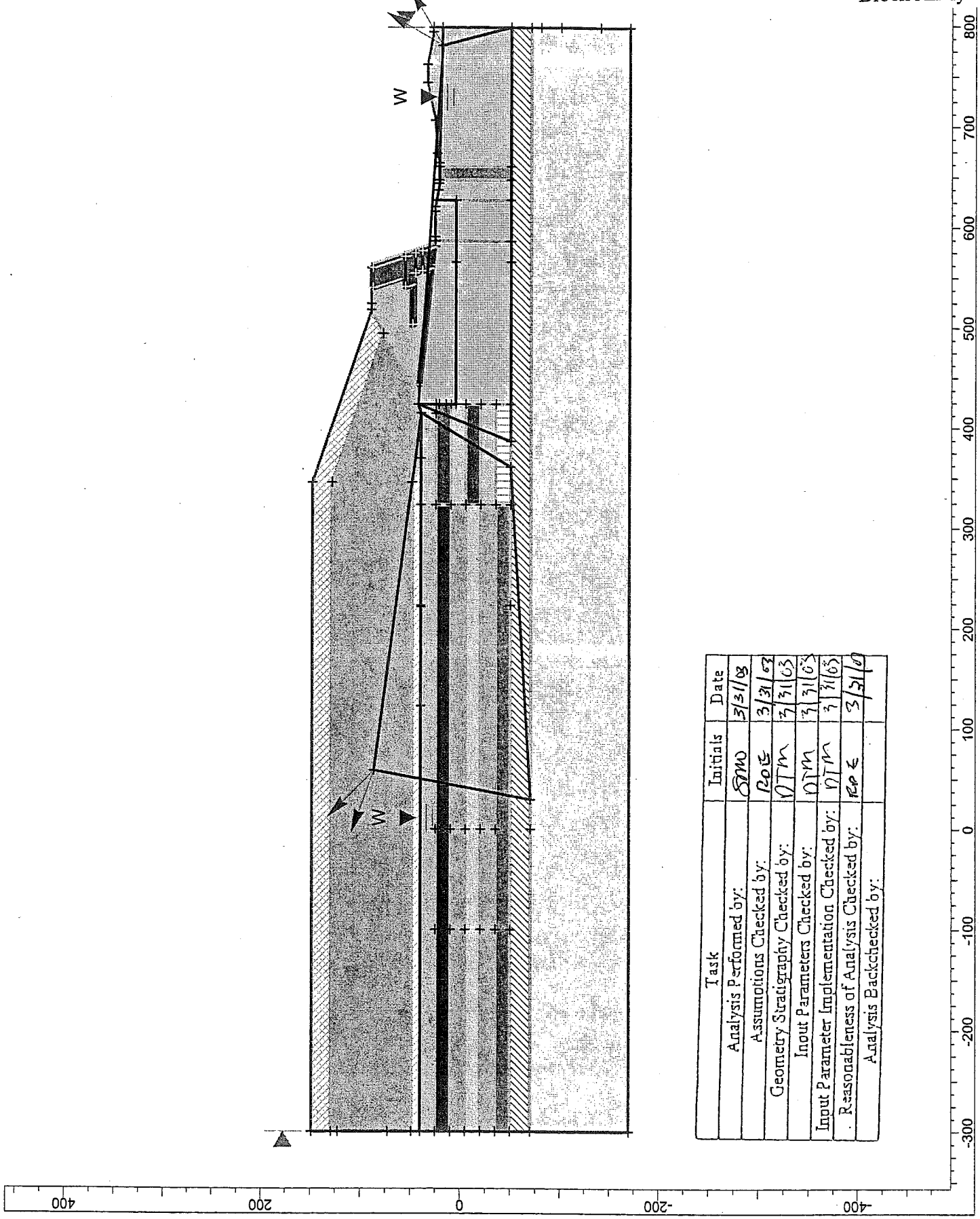
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

-200 = Factor of Safety = 0. Could mean 0 Normal/Shear resistance along part of the slip surface

Section D-D
21 Year Stability
Circular Analysis

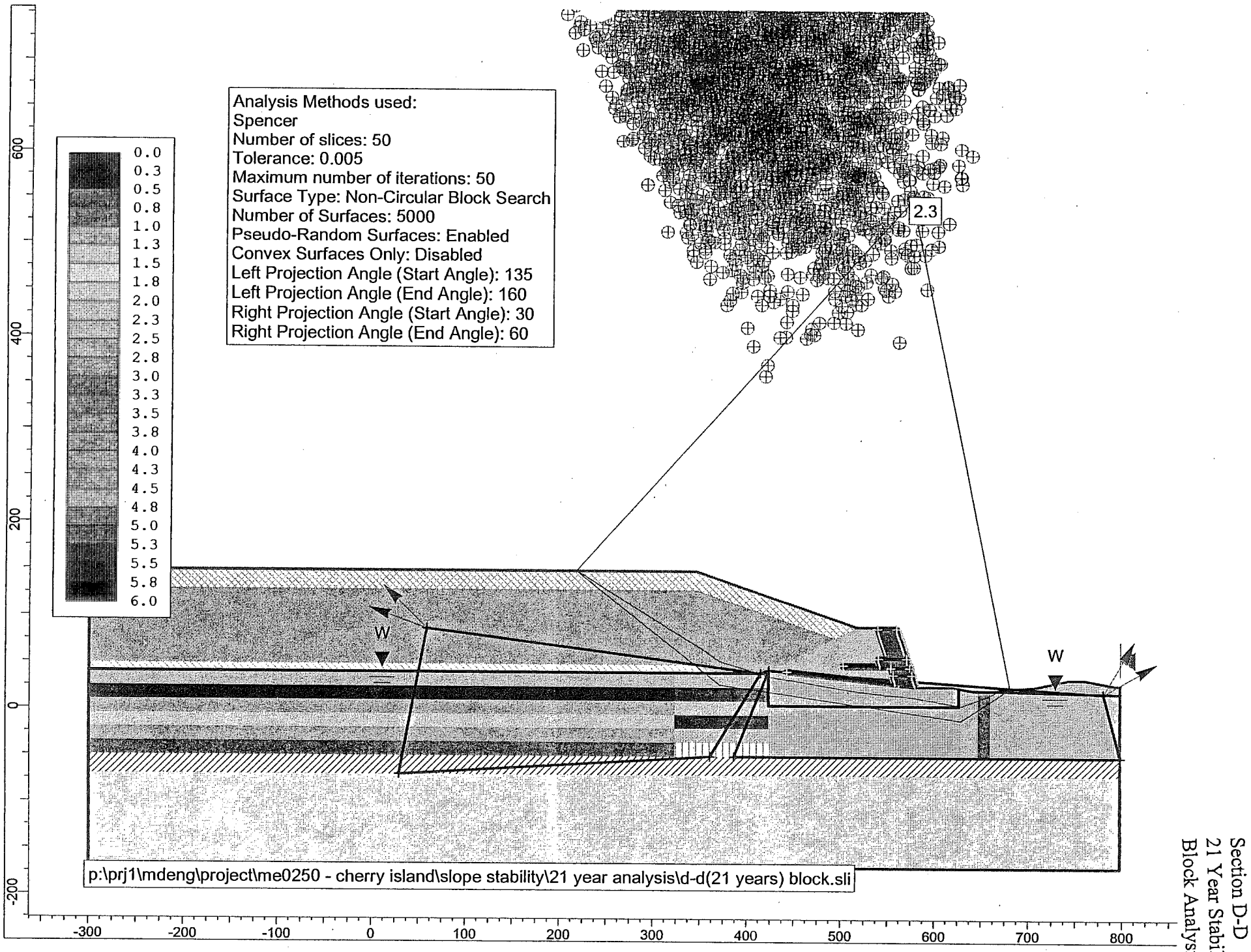
D2-4

Section D-D
21 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/31/05
Assumptions Checked by:	RDE	3/31/05
Geometry Stratigraphy Checked by:	DTM	3/31/05
Input Parameters Checked by:	DTM	3/31/05
Input Parameter Implementation Checked by:	DTM	3/31/05
Reasonableness of Analysis Checked by:	RDE	3/31/05
Analysis Backchecked by:		

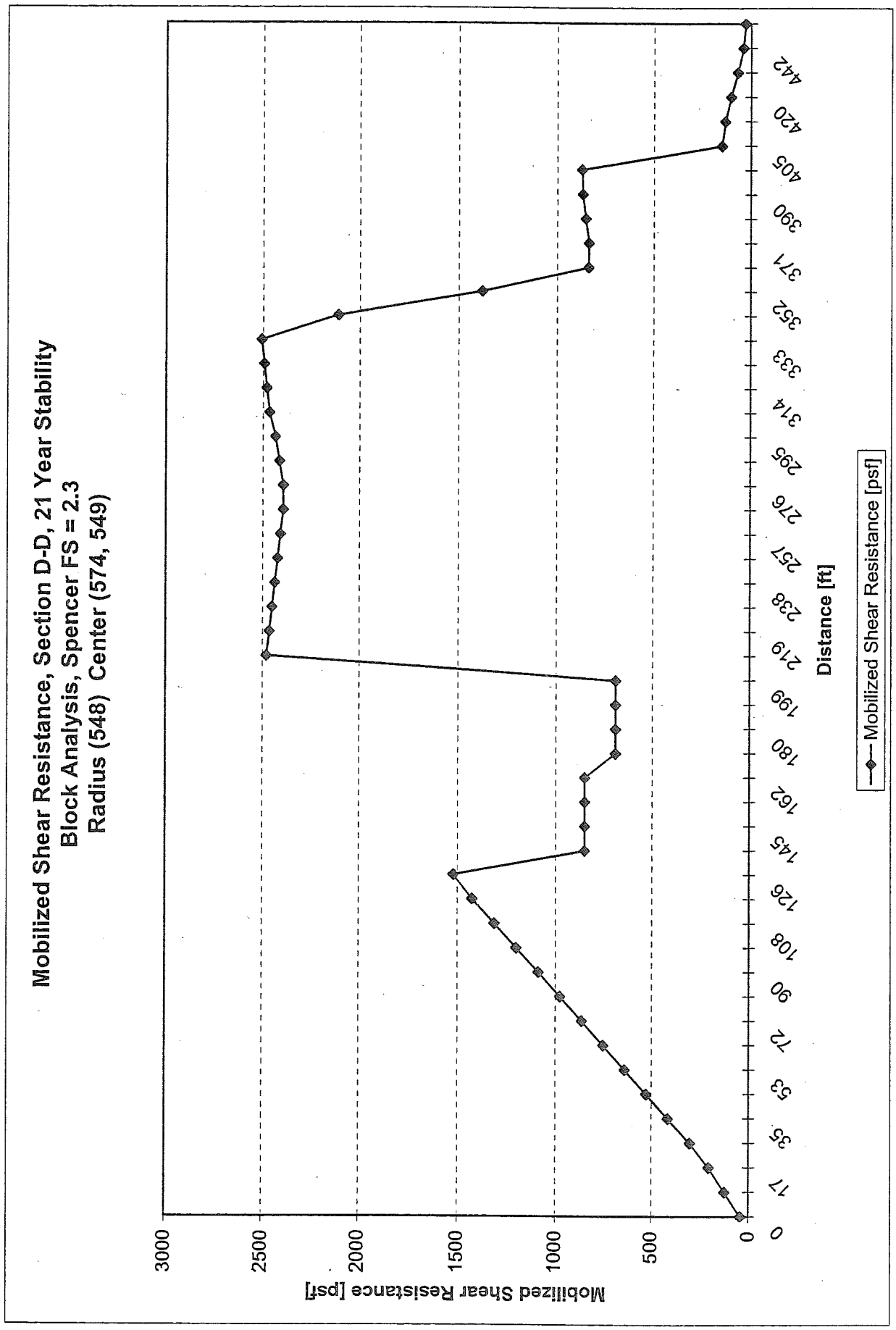
7-12-5



Section D-D
21 Year Stability
Block Analysis

D21-6

Section D-D
21 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance D

D2-7

Slide Analysis Information

Document Name

File Name: d-d(21 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1974 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1606 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3

Section D-D
21 Year Stability
Block Analysis

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Cohesion Type: Constant
Cohesion: 1441 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1509 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1848 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2600 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2234 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1723 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1503 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1572 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1959 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2852 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.32507
Axis Location: 573.577, 549.23
Left Slip Surface Endpoint: 217.88, 149
Right Slip Surface Endpoint: 680.343, 24.5344

Method Statistics

Method: spencer
Number of Valid Surfaces: 3174
Number of Invalid Surfaces: 1826
Error Codes:
Error Code -105 reported for 1 surface
Error Code -107 reported for 86 surfaces
Error Code -108 reported for 1655 surfaces
Error Code -111 reported for 83 surfaces
Error Code -112 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

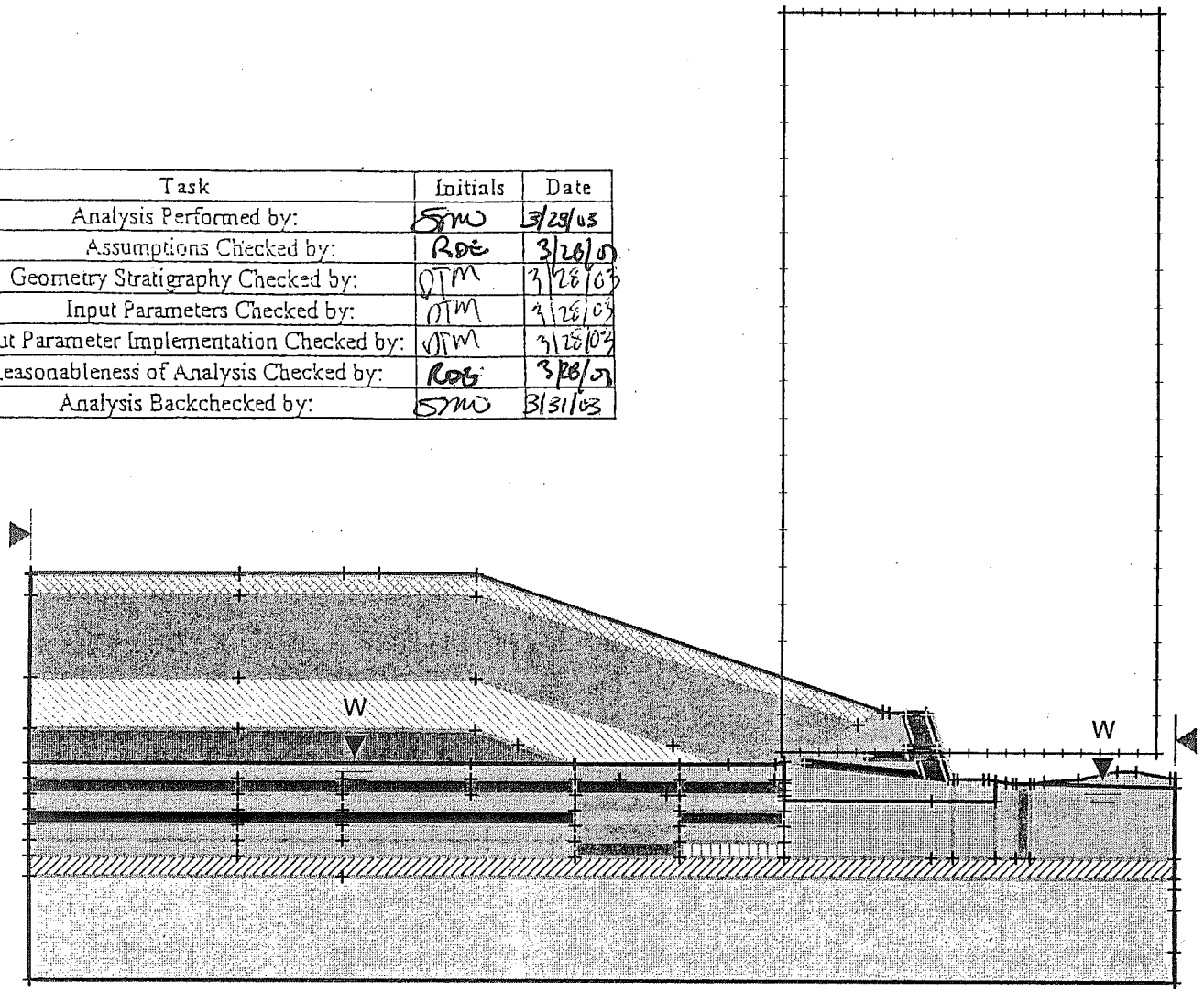
-111 = safety factor equation did not converge

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

Section D-D
21 Year Stability
Block Analysis

D21-9

Task	Initials	Date
Analysis Performed by:	SMO	3/29/03
Assumptions Checked by:	RDE	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDE	3/28/03
Analysis Backchecked by:	SMO	3/31/03



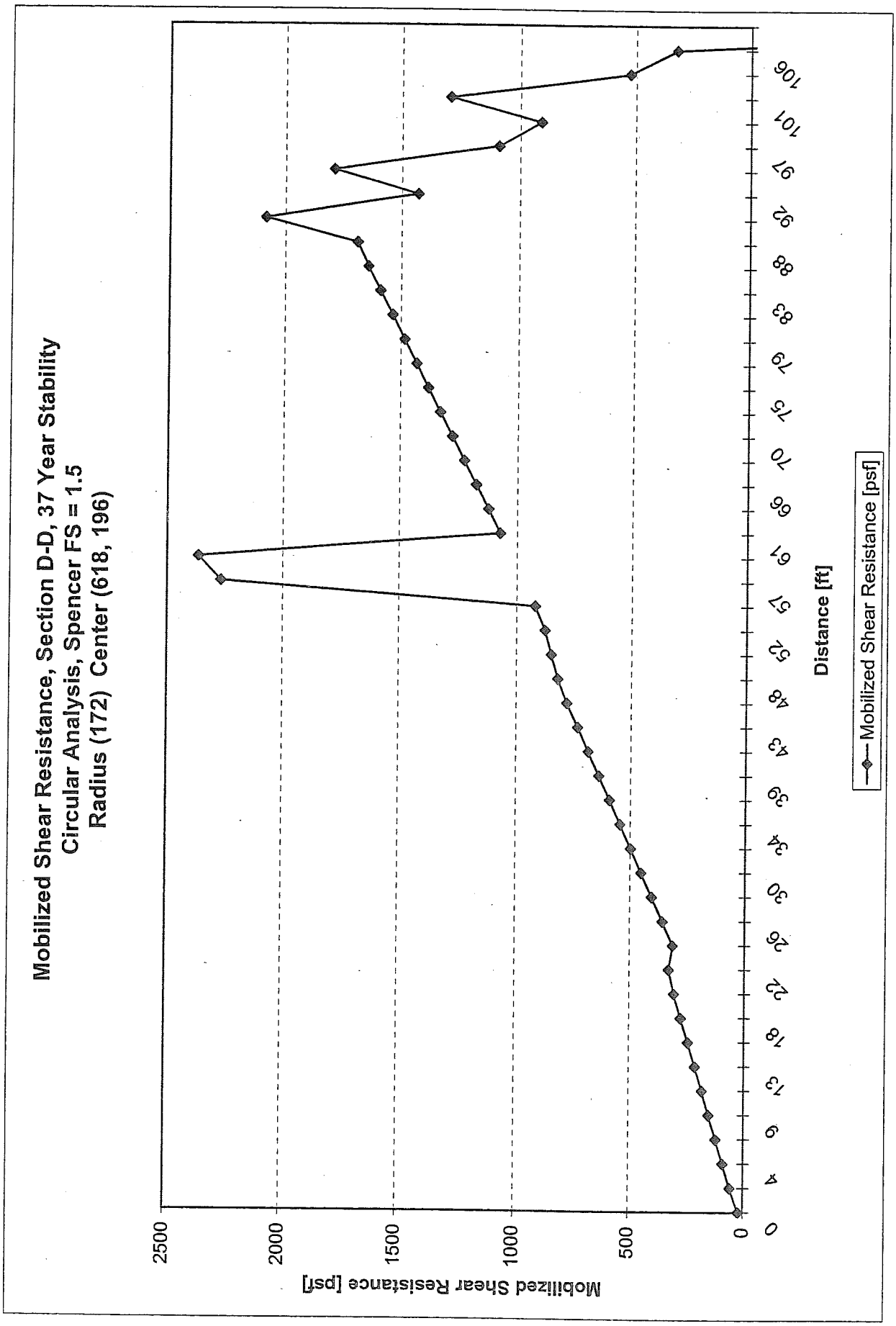
D-7-1

Section D-D
37 Year Stability
Circular Analysis

Section D-D
37 Year Stability
Circular Analysis

D37-2

Section D-D
37 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance D

D37-3

Slide Analysis Information

Document Name

File Name: d-d(37 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius Increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section D-D
37 Year Stability
Circular Analysis

D37-4

Cohesion: 2142 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2001 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1957 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2038 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2288 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2799 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2778 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2486 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2343 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2393 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2688 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3382 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3416 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2858 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2525 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2524 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2927 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3939 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.45513
Center: 617.695, 195.548
Radius: 171.9
Left Slip Surface Endpoint: 469.679, 108.135
Right Slip Surface Endpoint: 579.557, 27.9316

Method Statistics

Method: spencer
Number of Valid Surfaces: 23835
Number of Invalid Surfaces: 9681
Error Codes:
Error Code -100 reported for 1 surface
Error Code -106 reported for 285 surfaces
Error Code -107 reported for 1927 surfaces
Error Code -108 reported for 1116 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 5084 surfaces
Error Code -112 reported for 1267 surfaces

Section D-D
37 Year Stability
Circular Analysis

D37-5

Error Codes

The following errors were encountered during the computation:

-100 = Both surface / slope intersections are on the same horizontal surface. In general, this will give a very high or infinite factor of safety (zero driving force), if calculated.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

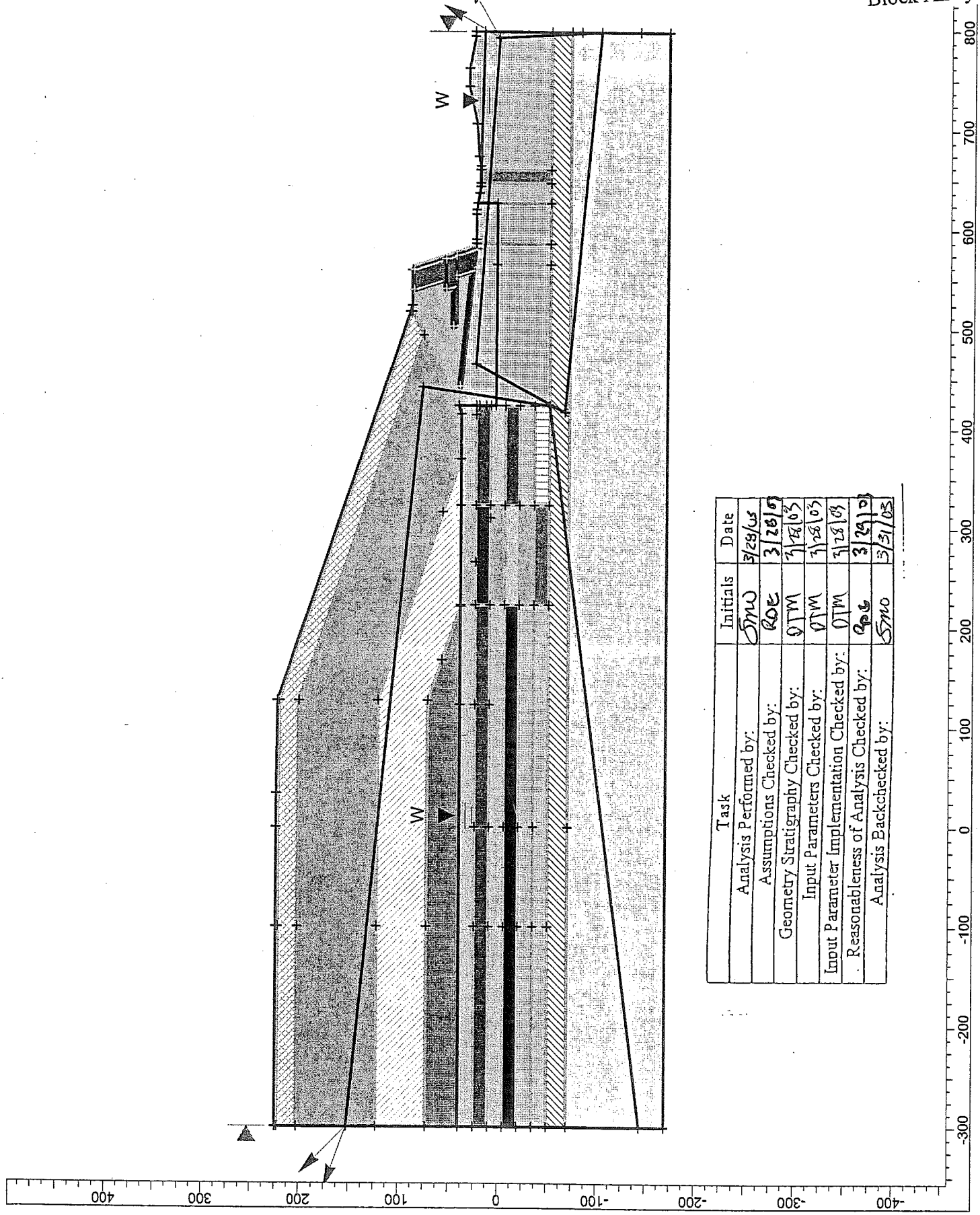
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

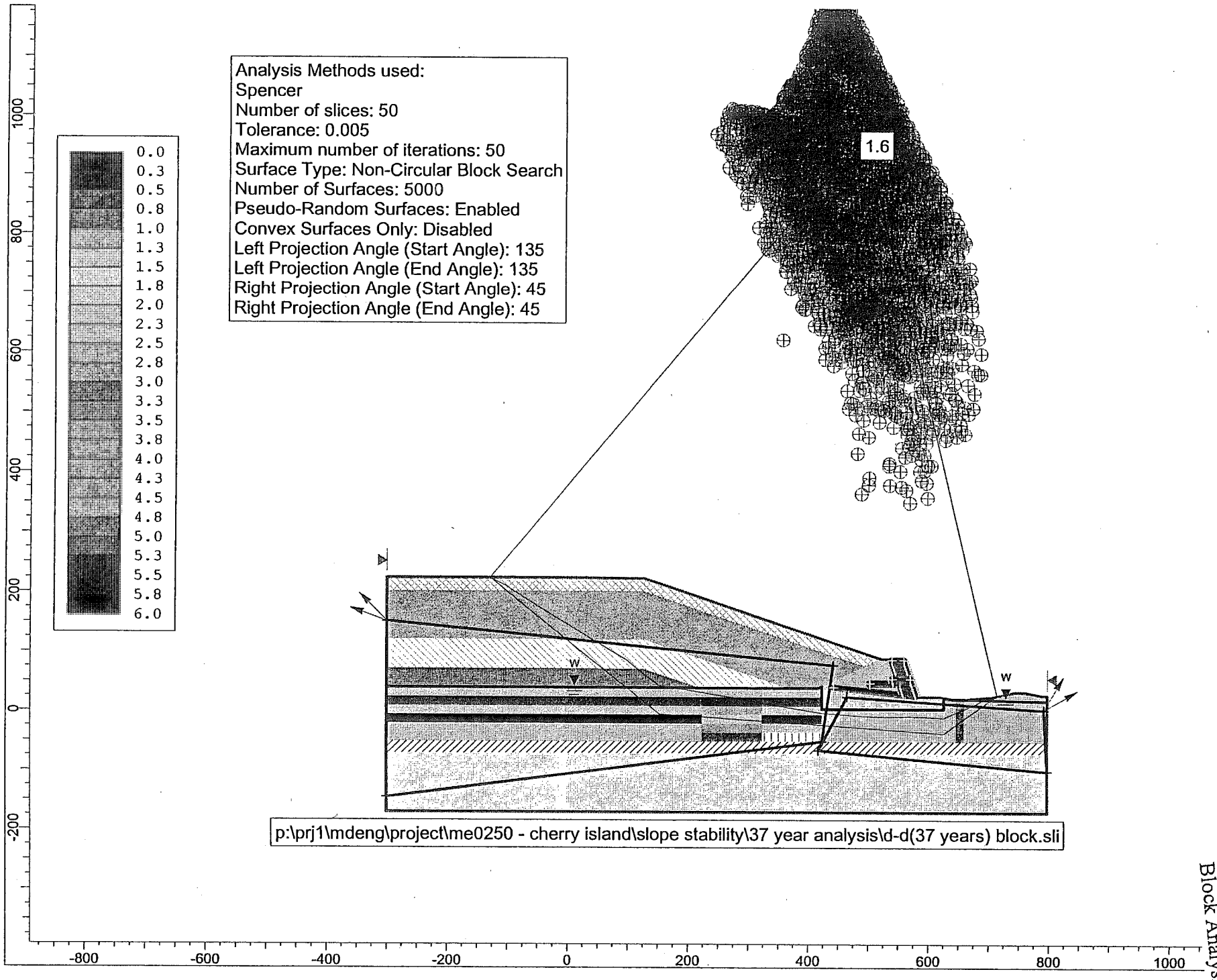
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

Section D-D
37 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/28/05
Assumptions Checked by:	ROE	3/28/05
Geometry Stratigraphy Checked by:	DTM	3/28/05
Input Parameters Checked by:	DTM	3/28/05
Input Parameter Implementation Checked by:	DTM	3/28/05
Reasonableness of Analysis Checked by:	ROE	3/29/05
Analysis Backchecked by:	SMO	3/31/05

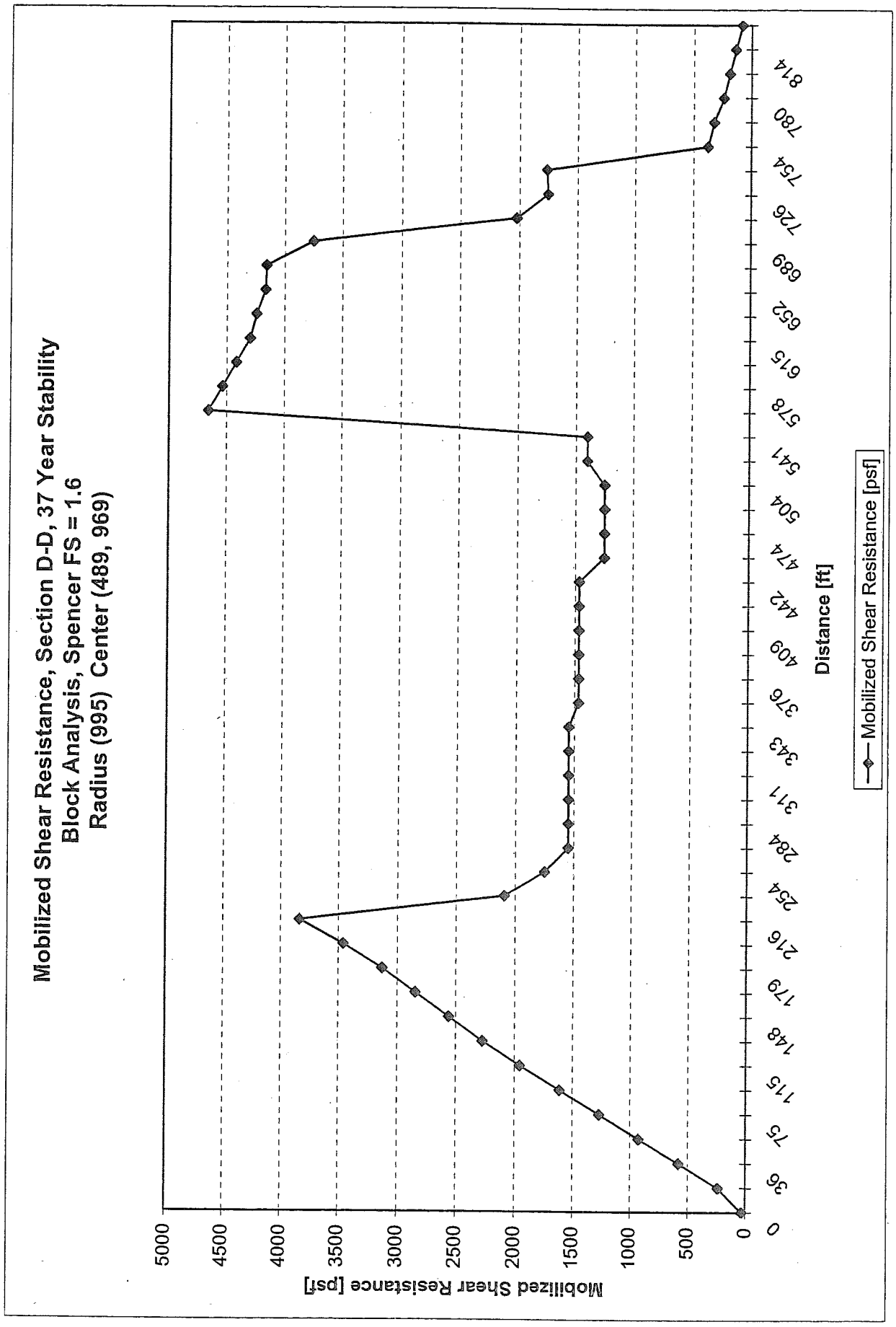
D37-6



Section D-D
37 Year Stability
Block Analysis

D37.7

Section D-D
37 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance D

D37-8

Slide Analysis Information

Document Name

File Name: d-d(37 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11

Section D-D
37 Year Stability
Block Analysis

Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2142 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2001 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1957 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2038 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2288 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2799 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2778 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2486 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2343 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2393 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2688 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3382 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3416 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2858 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3

Cohesion Type: Constant
Cohesion: 2525 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2524 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2927 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3939 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.63124
Axis Location: 489.026, 969.155
Left Slip Surface Endpoint: -128.95, 224.6
Right Slip Surface Endpoint: 713.885, 28.0419

Method Statistics

Method: spencer
Number of Valid Surfaces: 3370
Number of Invalid Surfaces: 1630
Error Codes:
Error Code -108 reported for 1444 surfaces
Error Code -111 reported for 124 surfaces
Error Code -112 reported for 62 surfaces

Error Codes

Section D-D
37 Year Stability
Block Analysis

D-37-1

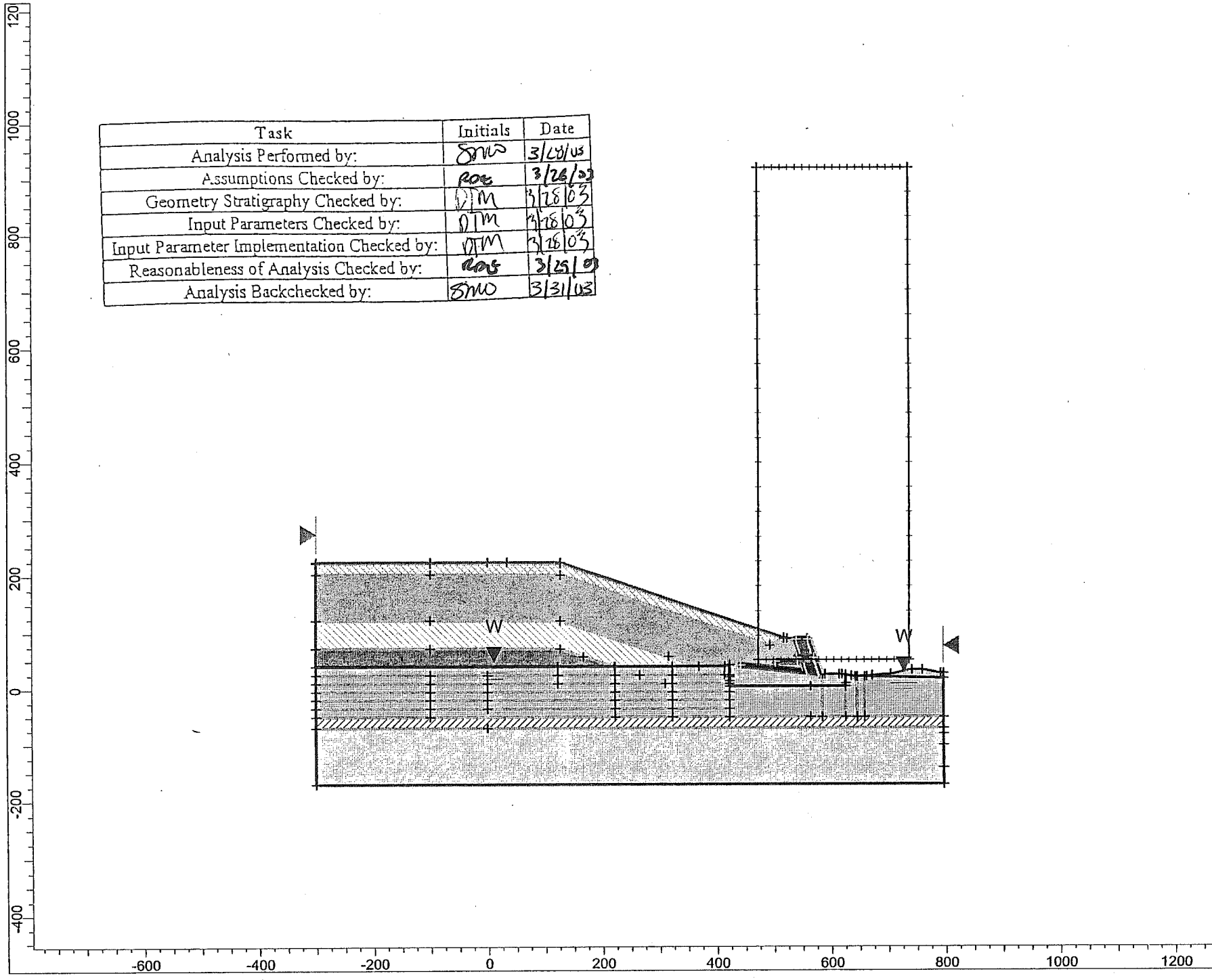
The following errors were encountered during the computation:

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

-111 = safety factor equation did not converge

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

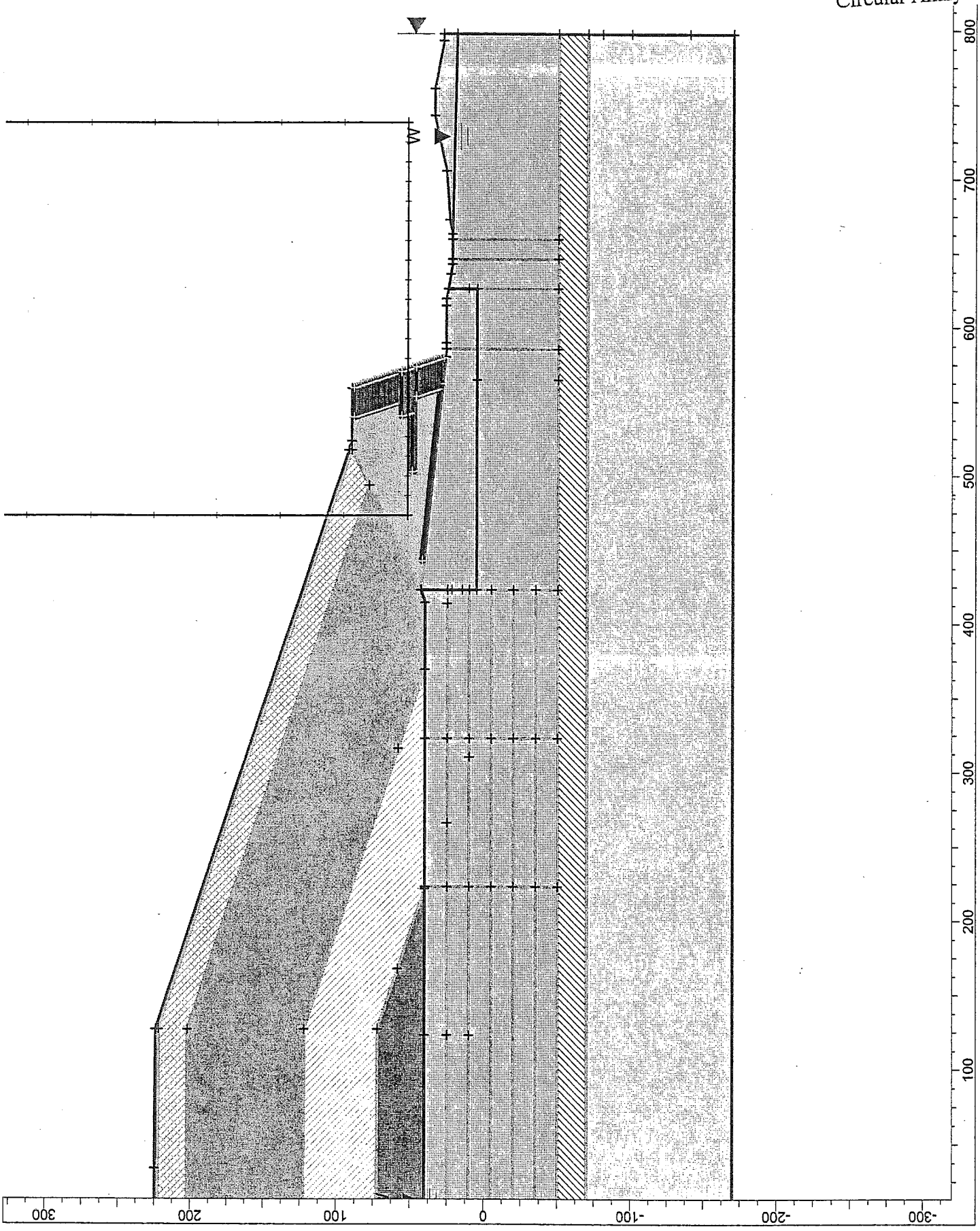
Task	Initials	Date
Analysis Performed by:	SMO	3/28/03
Assumptions Checked by:	RDE	3/26/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDE	3/29/03
Analysis Backchecked by:	SMO	3/31/03



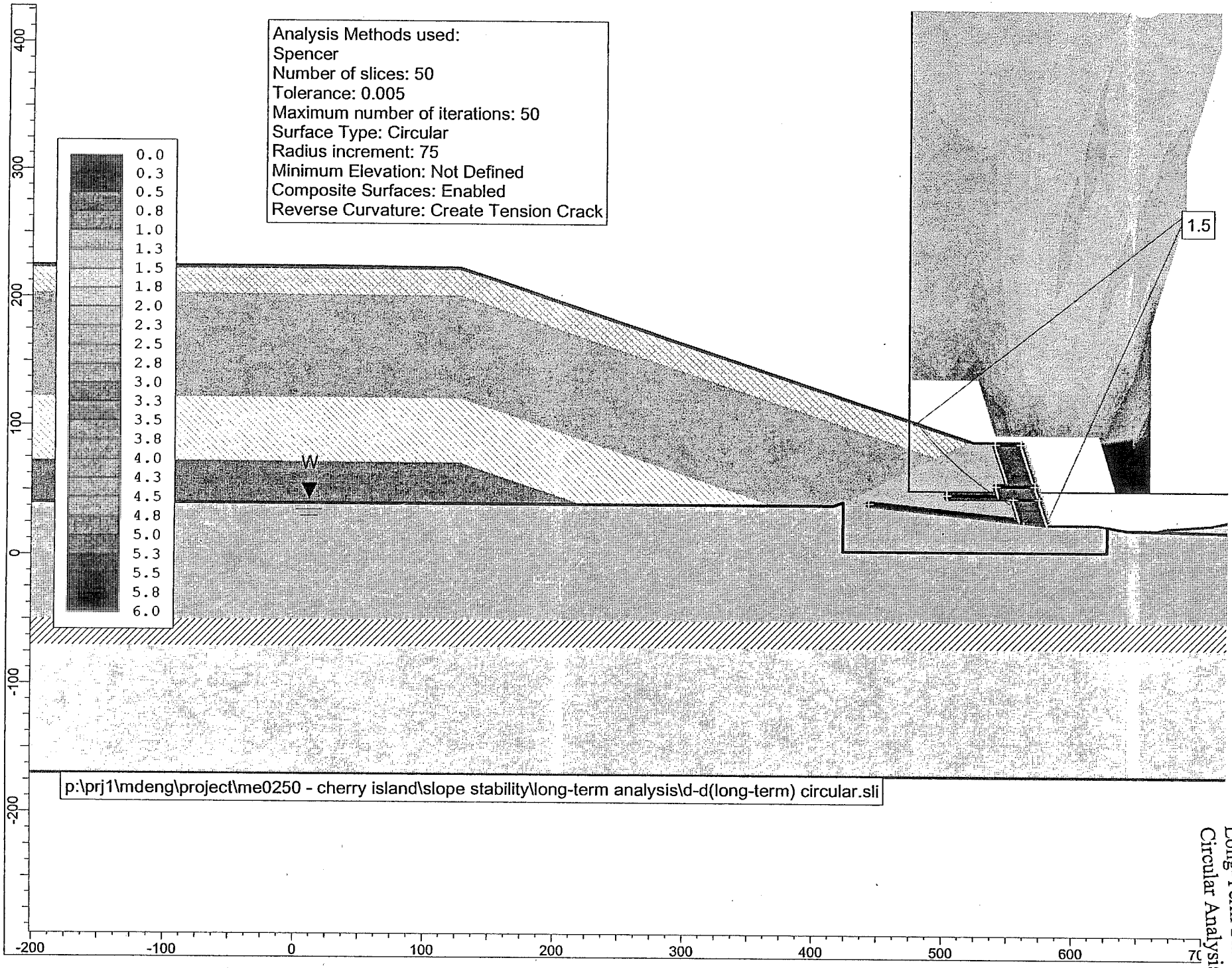
Section D-D
Long-Term Stability
Circular Analysis

DCT-1

Section D-D
Long-Term Stability
Circular Analysis



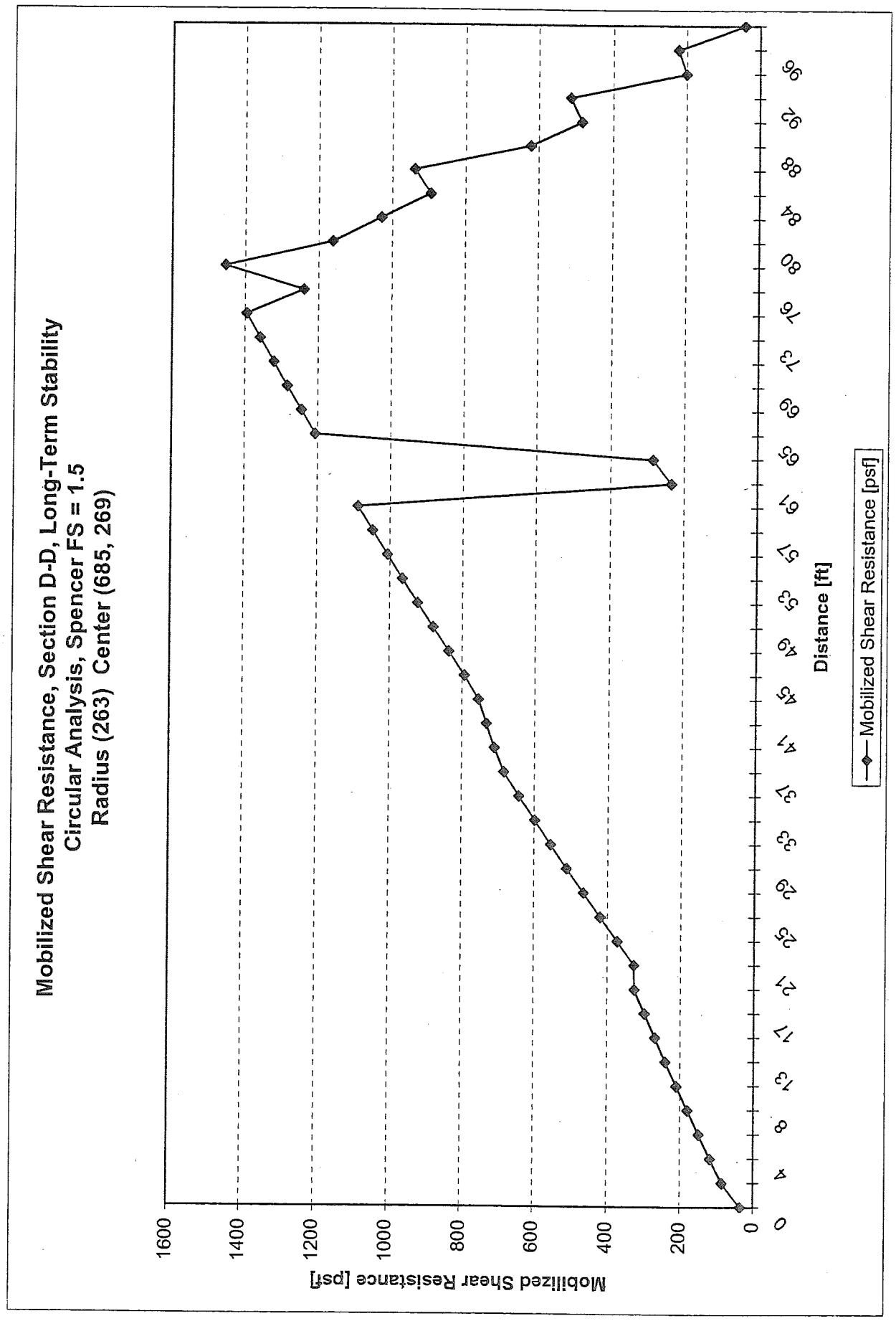
DcT-2



Section D-D
Long-Term Stability
Circular Analysis

DCT-3

Section D-D
Long-Term Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance D

DLT-4

Slide Analysis Information

Document Name

File Name: d-d(long-term) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius Increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees

DLT-5

Section D-D
Long-Term Stability
Circular Analysis

Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.4562
Center: 684.672, 269.149
Radius: 263.06
Left Slip Surface Endpoint: 479.169, 104.926
Right Slip Surface Endpoint: 579.529, 28.0157

Method Statistics

Method: spencer
Number of Valid Surfaces: 23266
Number of Invalid Surfaces: 10250

Error Codes:
Error Code -100 reported for 1 surface
Error Code -106 reported for 128 surfaces
Error Code -107 reported for 1595 surfaces
Error Code -108 reported for 1529 surfaces
Error Code -109 reported for 2164 surfaces
Error Code -111 reported for 4088 surfaces
Error Code -112 reported for 745 surfaces

Error Codes

The following errors were encountered during the computation:

-100 = Both surface / slope intersections are on the same horizontal surface. In general, this will give a very high or infinite factor of safety (zero driving force), if calculated.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

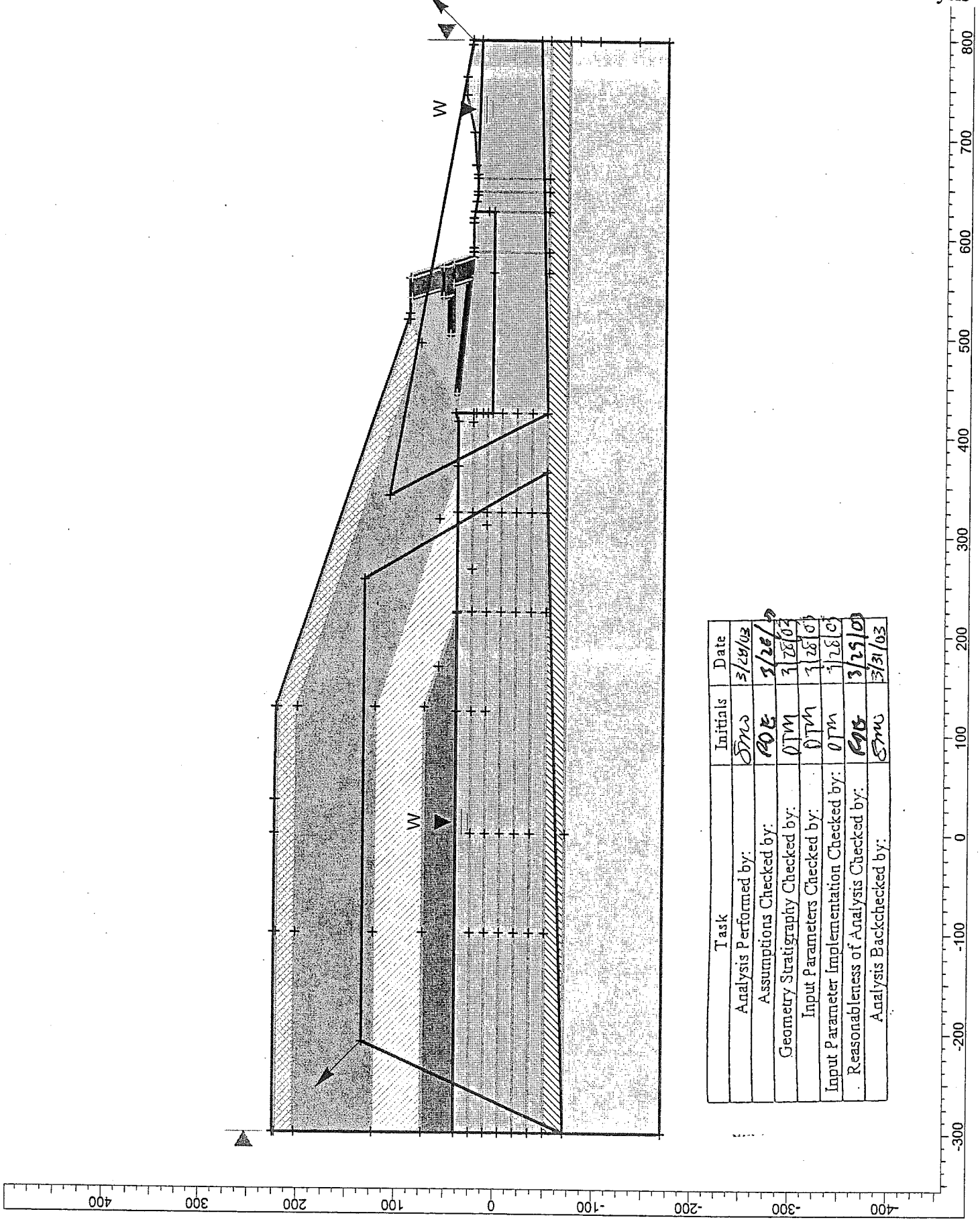
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

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

Section D-D
Long-Term Stability
Block Analysis

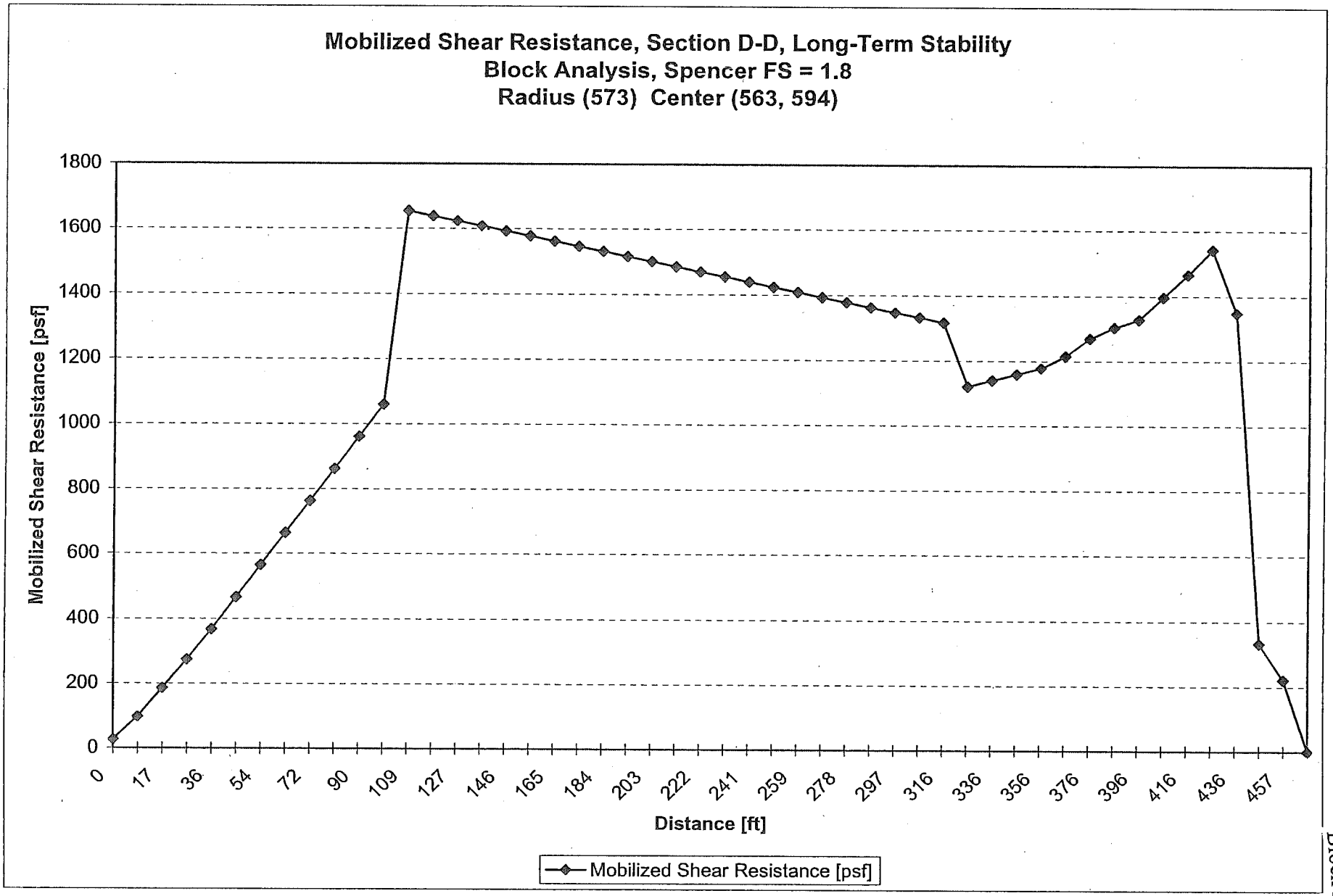


Task	Initials	Date
Analysis Performed by:	SMS	3/29/02
Assumptions Checked by:	AOE	3/28/02
Geometry Stratigraphy Checked by:	DTM	3/28/02
Input Parameters Checked by:	DTM	3/28/02
Input Parameter Implementation Checked by:	DTM	3/28/02
Reasonableness of Analysis Checked by:	GJS	3/29/02
Analysis Backchecked by:	SMS	3/31/02

DLT-6

Section D-D
Long-Term Stability
Block Analysis

DLT-7



Section D-D
Long-Term Stability
Block Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance D

D1-8

Slide Analysis Information

Document Name

File Name: d-d(long-term) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb

Section D-D
Long-Term Stability
Block Analysis

D-T-9

Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.84071
Axis Location: 562.857, 594.332
Left Slip Surface Endpoint: 131.275, 222.555
Right Slip Surface Endpoint: 601.33, 26

Method Statistics

Method: spencer

Number of Valid Surfaces: 3662
Number of Invalid Surfaces: 1338
Error Codes:
Error Code -105 reported for 115 surfaces
Error Code -108 reported for 832 surfaces
Error Code -109 reported for 264 surfaces
Error Code -111 reported for 51 surfaces
Error Code -200 reported for 76 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

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

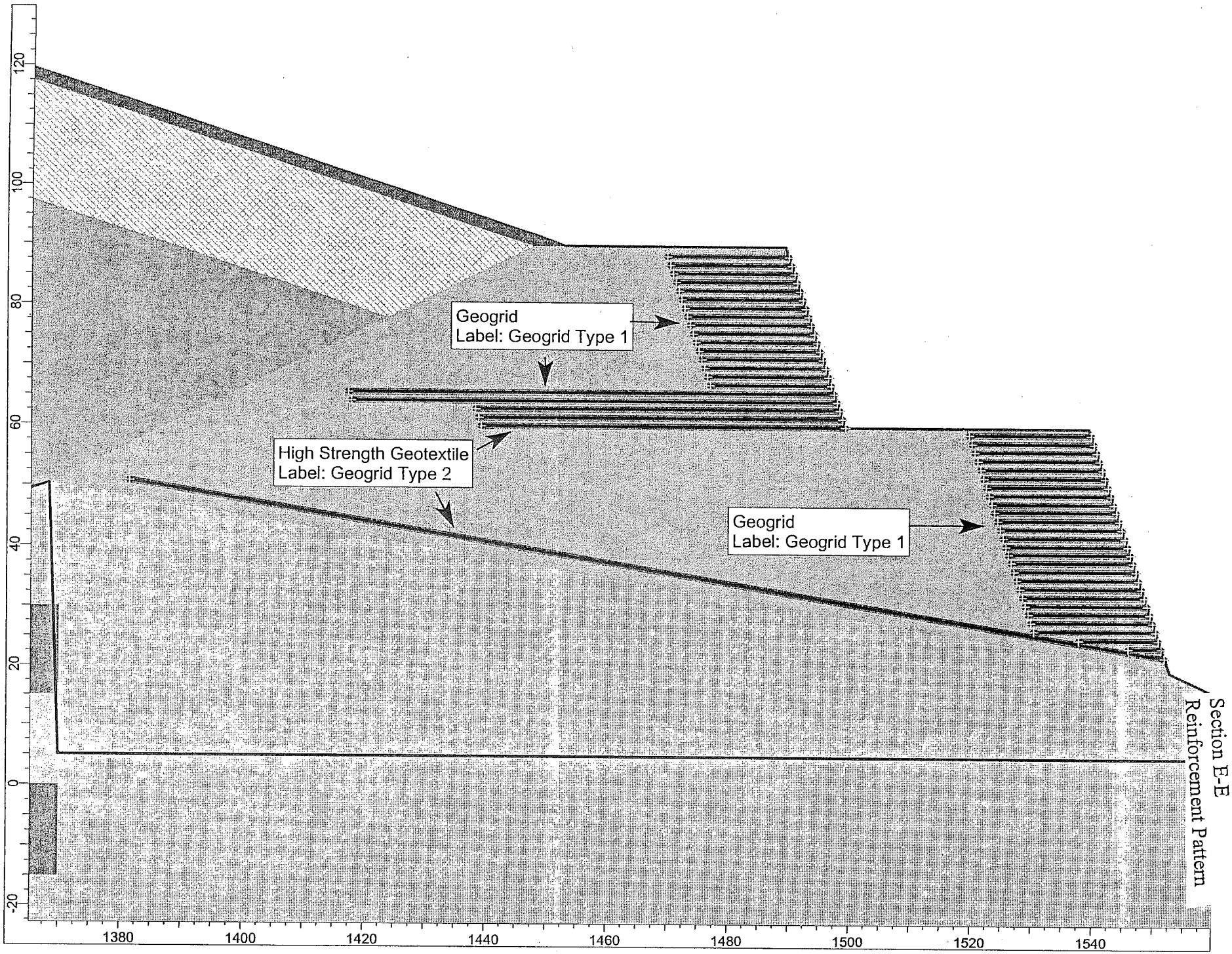
-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

-200 = Factor of Safety = 0. Could mean 0 Normal/Shear resistance along part of the slip surface

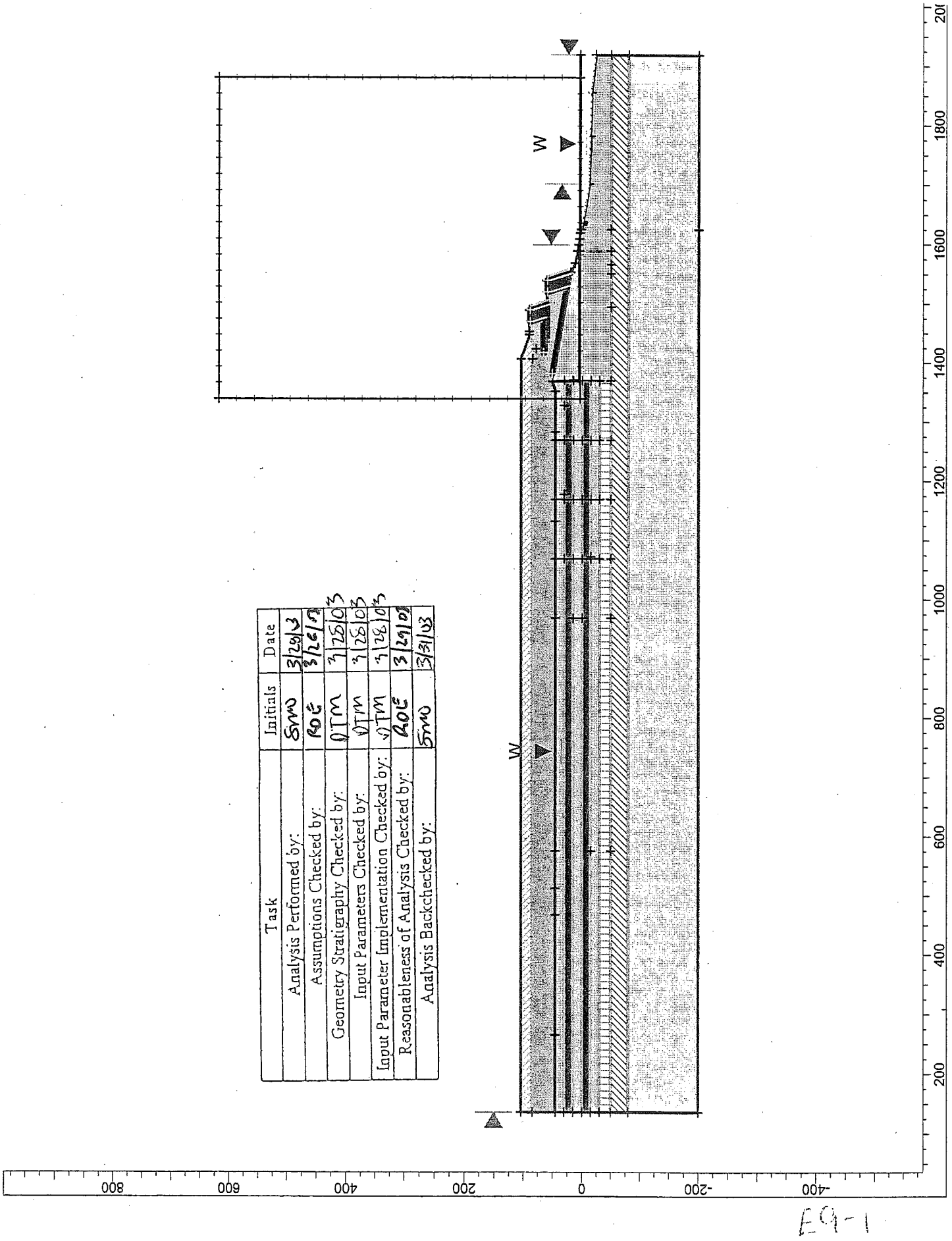
Attachment E

Stability Analysis Results for Cross Section E-E



Section E-E
Reinforcement Pattern

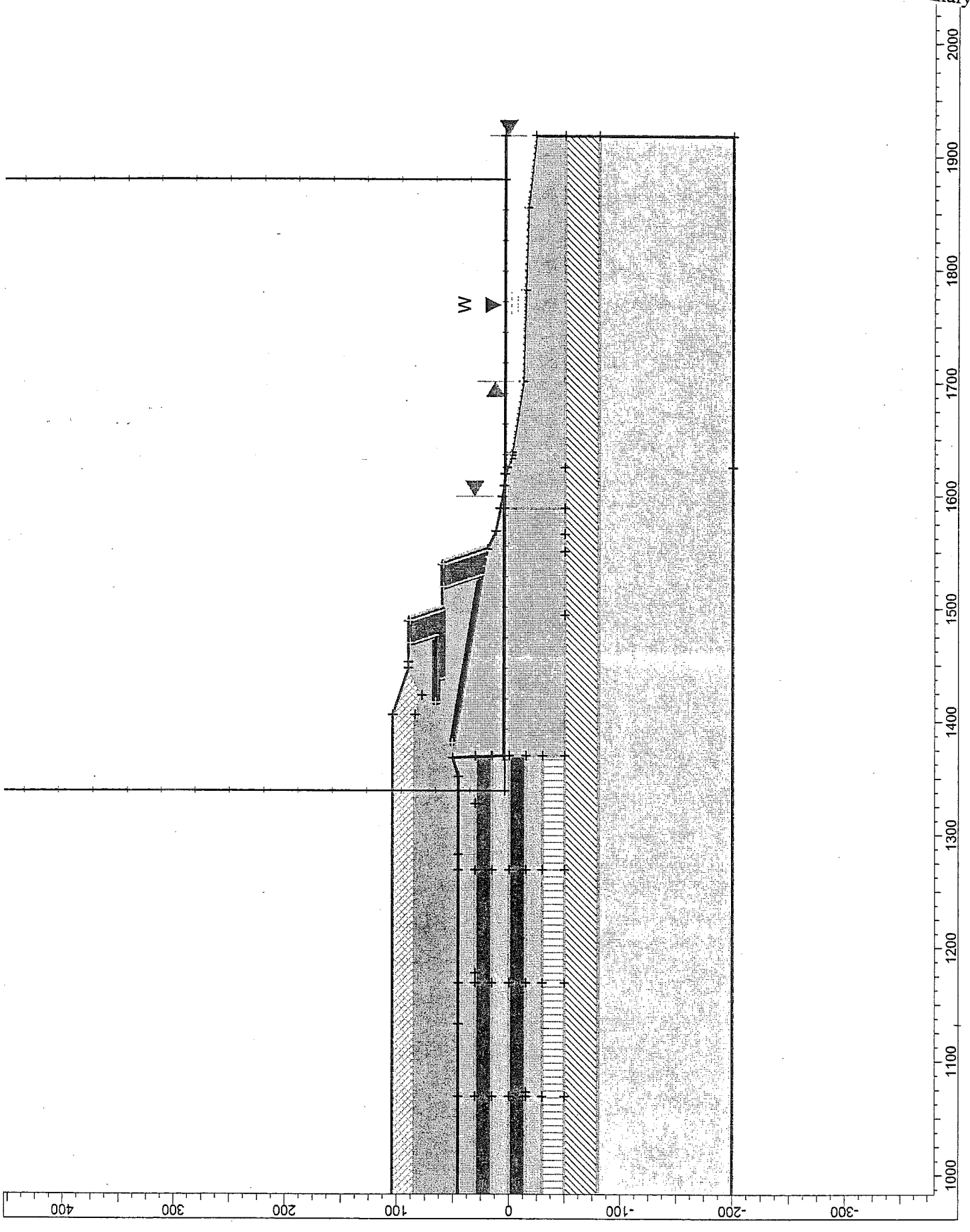
Section E-E
9 Year Stability
Circular Analysis



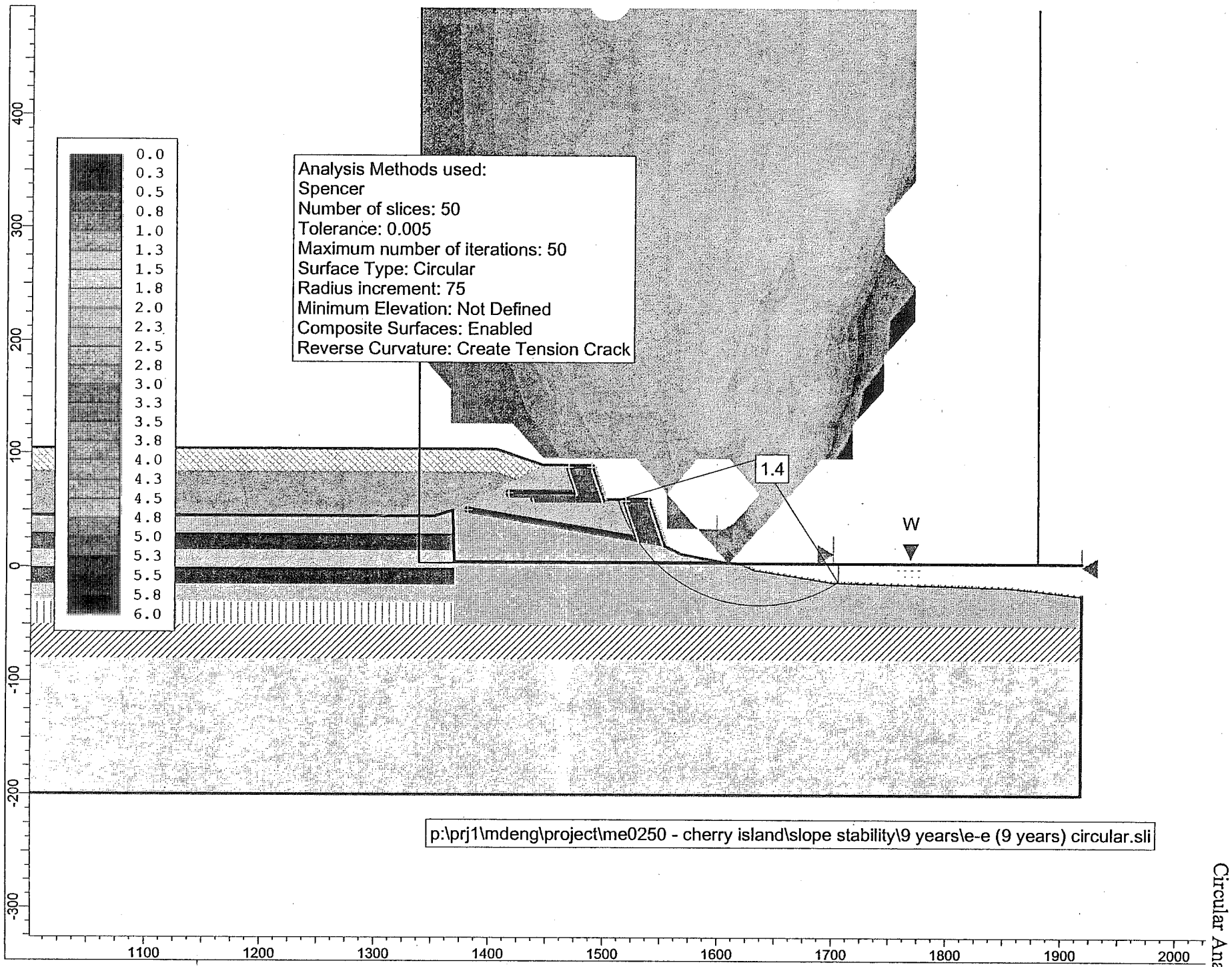
Task	Initials	Date
Analysis Performed by:	SWD	3/29/13
Assumptions Checked by:	ROE	3/26/13
Geometry Stratigraphy Checked by:	JTM	3/26/13
Input Parameters Checked by:	JTM	3/26/13
Input Parameter Implementation Checked by:	JTM	3/26/13
Reasonableness of Analysis Checked by:	ROE	3/29/13
Analysis Backchecked by:	SWD	3/31/13

E9-1

Section E-E
9 Year Stability
Circular Analysis



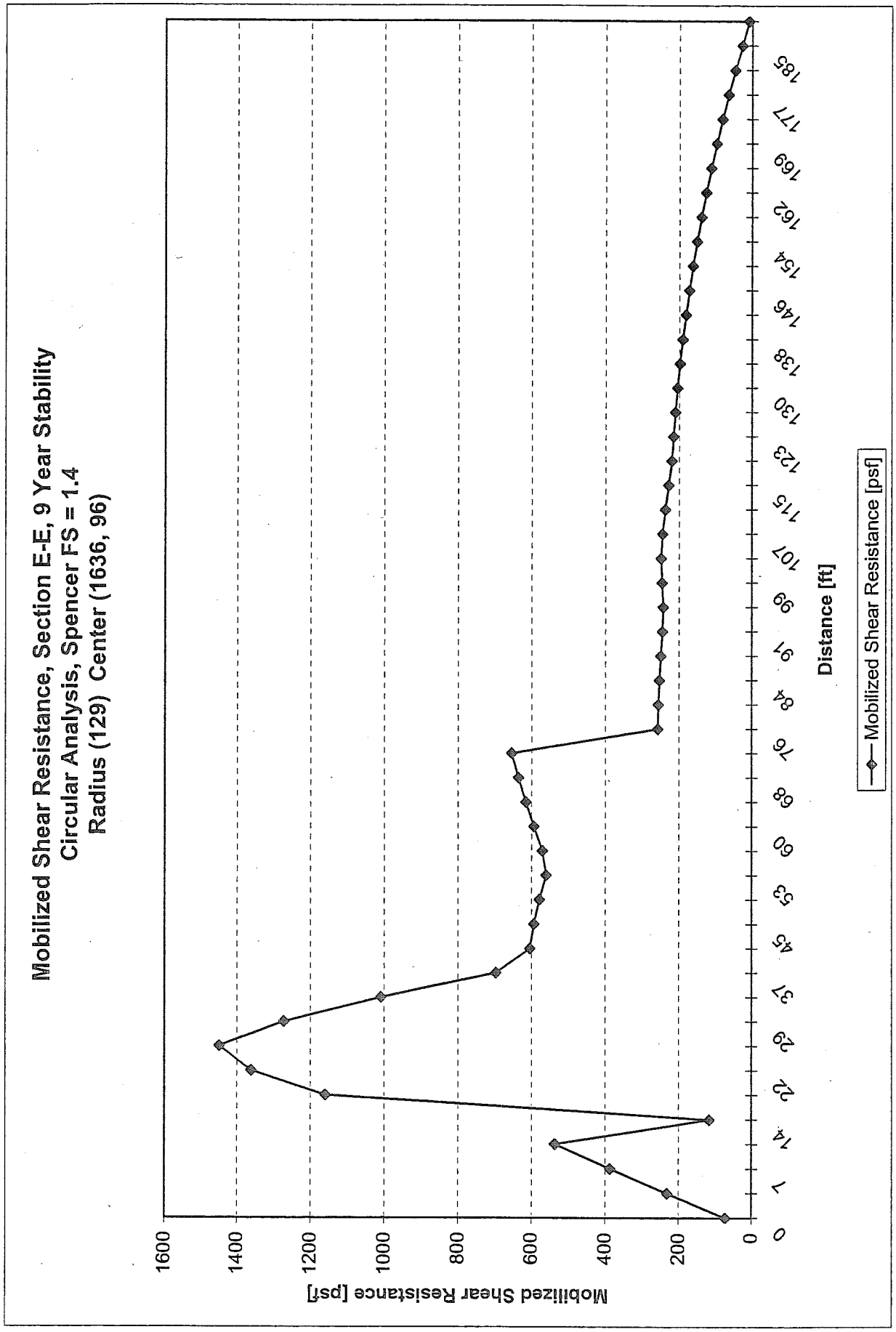
E9-2



E-E-3

Section E-E
9 Year Stability
Circular Analysis

Section E-E
9 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance E

E9-4

Slide Analysis Information

Document Name

File Name: e-e (9 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1189 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 880 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 776 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 834 psf
Water Surface: None

E-5-5

Section E-E
9 Year Stability
Circular Analysis

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1035 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1763 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.41076
Center: 1636.39, 96.2834
Radius: 128.533
Left Slip Surface Endpoint: 1513.08, 60
Right Slip Surface Endpoint: 1705.67, -11.9801
Left Slope Intercept: 1513.08 60
Right Slope Intercept: 1705.67 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 19974
Number of Invalid Surfaces: 13542
Error Codes:
Error Code -101 reported for 216 surfaces
Error Code -103 reported for 62 surfaces
Error Code -108 reported for 178 surfaces
Error Code -111 reported for 1725 surfaces
Error Code -112 reported for 3628 surfaces
Error Code -113 reported for 1501 surfaces
Error Code -1000 reported for 6232 surfaces

Error Codes

The following errors were encountered during the computation:

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

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of

extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

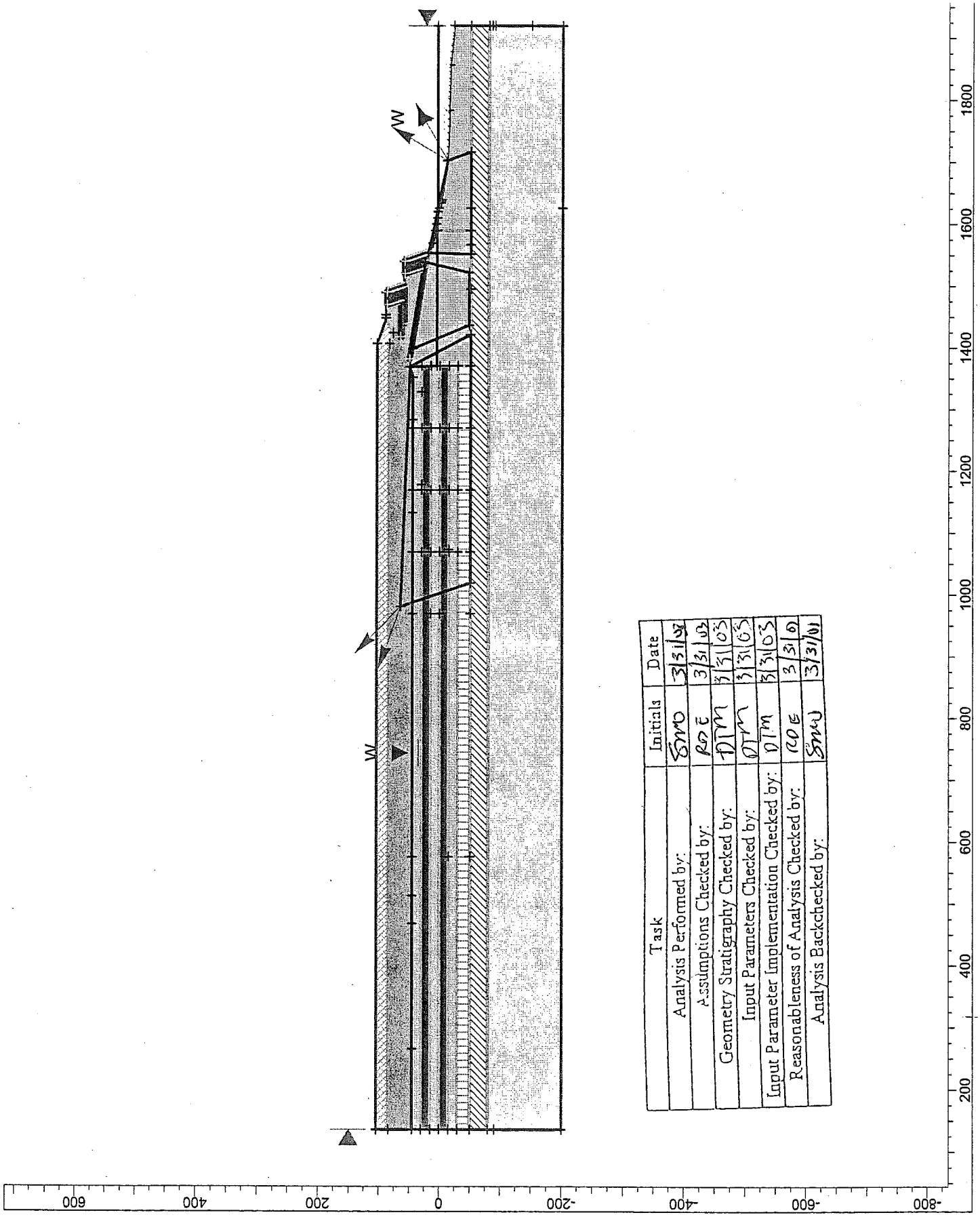
-111 = safety factor equation did not converge

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

-113 = Surface intersects outside slope limits.

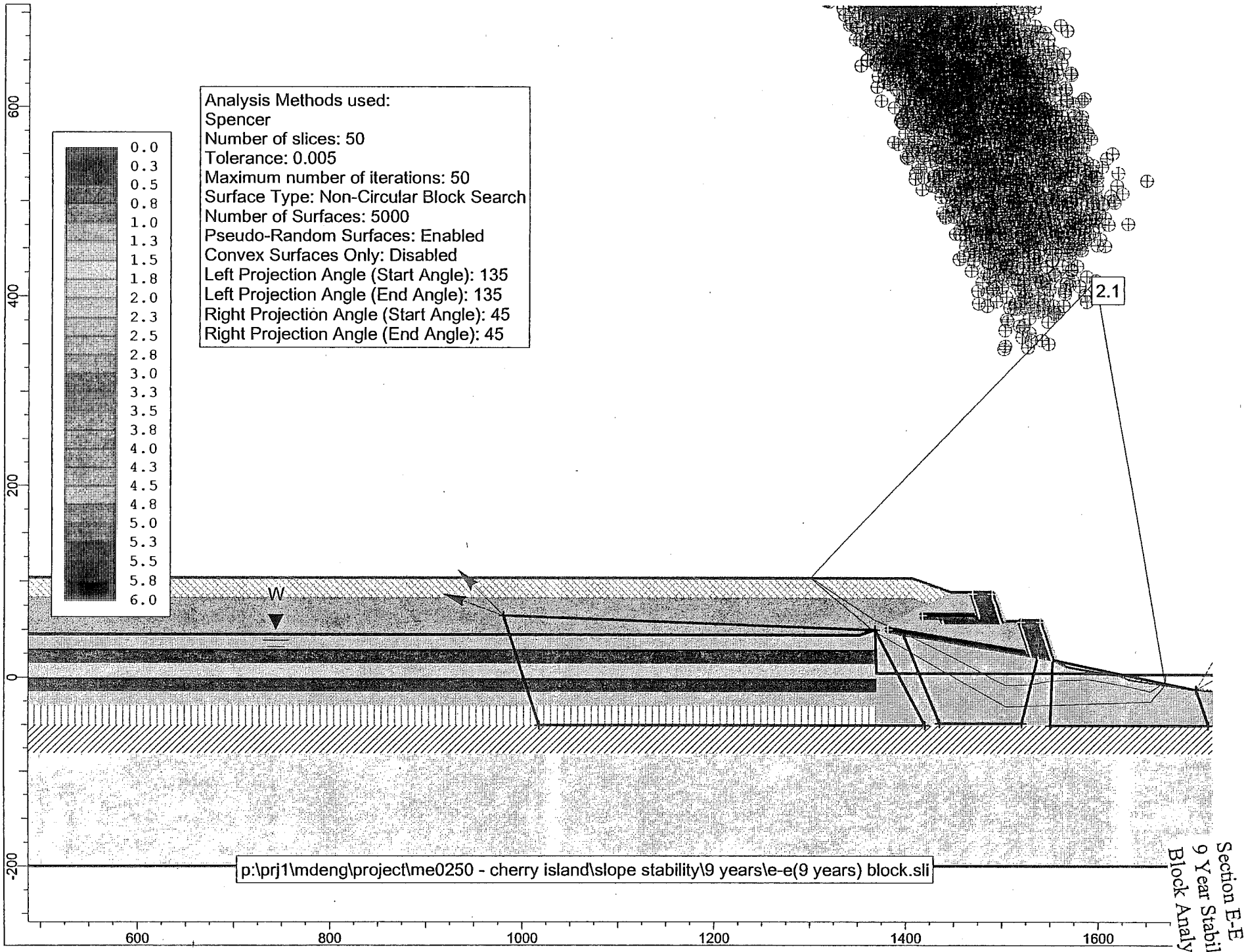
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section E-E
9 Year Stability
Block Analysis



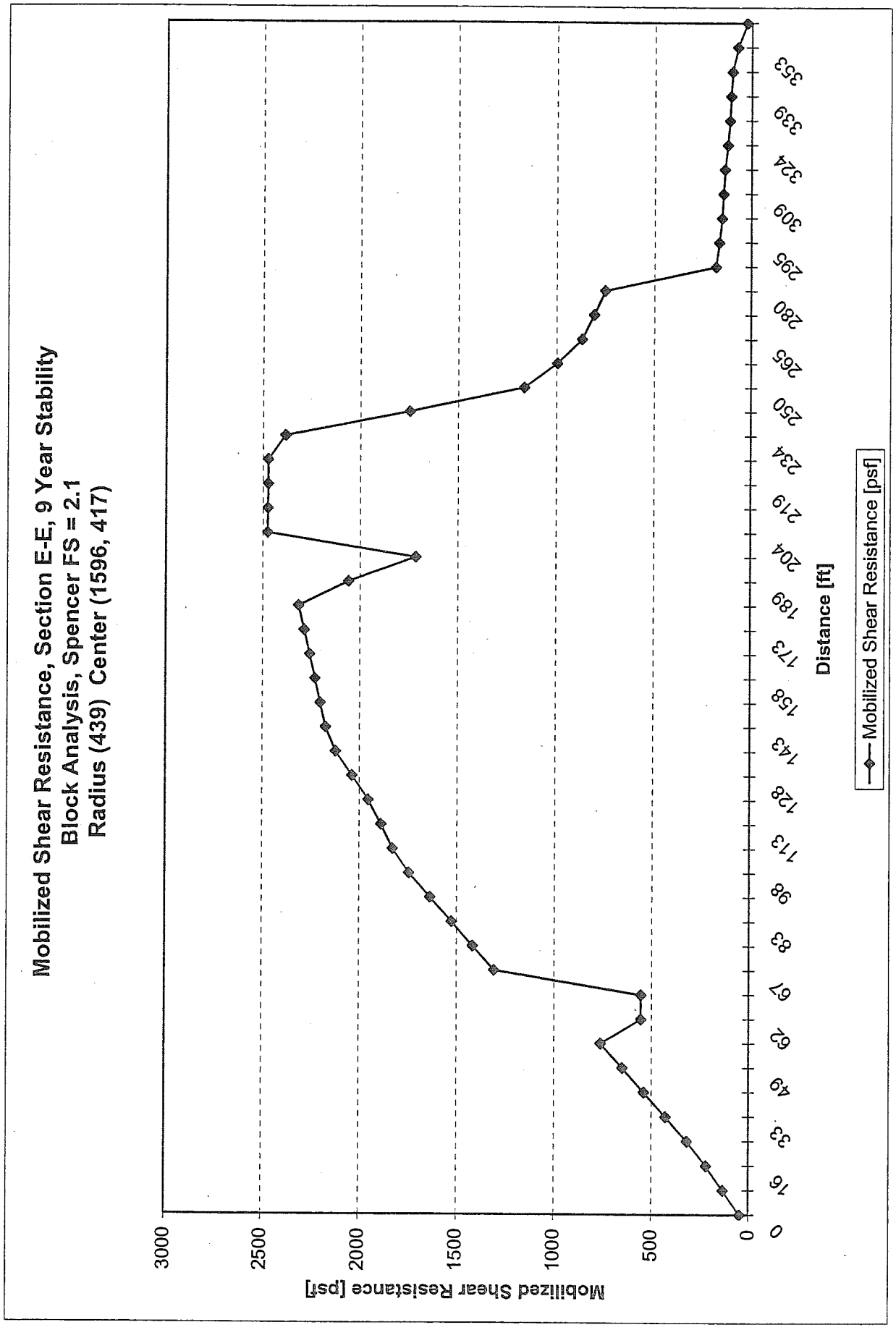
Task	Initials	Date
Analysis Performed by:	SMO	3/31/03
Assumptions Checked by:	RDE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMO	3/31/03

E9-7


Analysis Methods used:
Spencer
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50
Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
3.8
4.0
4.3
4.5
4.8
5.0
5.3
5.5
5.8
6.0
2.1
W
600
400
200
0
-200
600
800
1000
1200
1400
1600
p:\prj1\mdeng\project\me0250 - cherry island\slope stability\9 years\e-e(9 years) block.sli
Section E-E
9 Year Stability
Block Analysis

E9-8

Section E-E
9 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance E

E9-9

Slide Analysis Information

Document Name

File Name: e-e(9 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1189 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 880 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 776 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

E9-10

Section E-E
9 Year Stability
Block Analysis

Cohesion: 834 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1035 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1763 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.14659
Axis Location: 1596.03, 417.315
Left Slip Surface Endpoint: 1300.76, 104
Right Slip Surface Endpoint: 1669.52, -6.88723
Left Slope Intercept: 1300.76 104
Right Slope Intercept: 1669.52 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 4730
Number of Invalid Surfaces: 270
Error Codes:
Error Code -108 reported for 265 surfaces
Error Code -111 reported for 5 surfaces

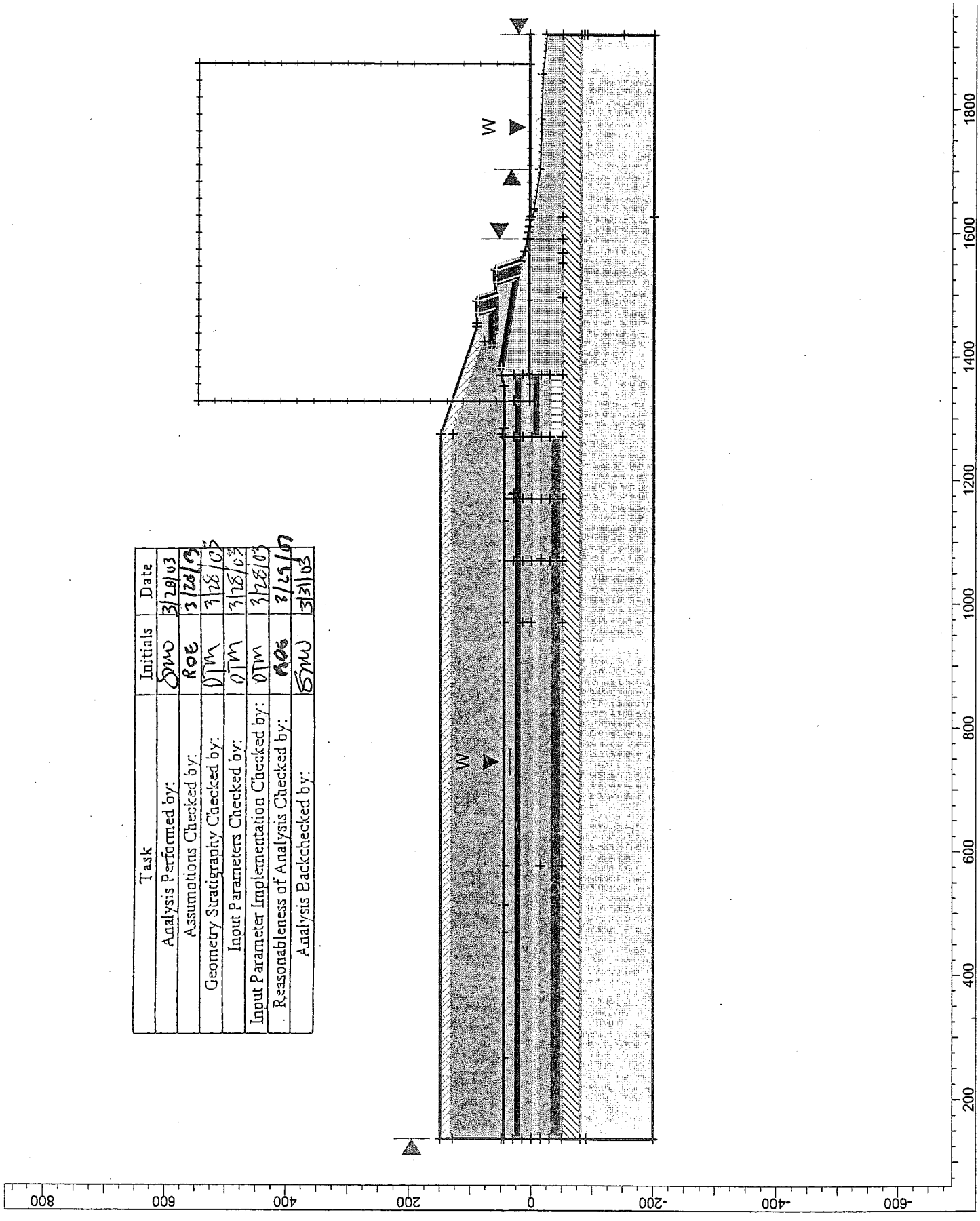
Error Codes

The following errors were encountered during the computation:

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

-111 = safety factor equation did not converge

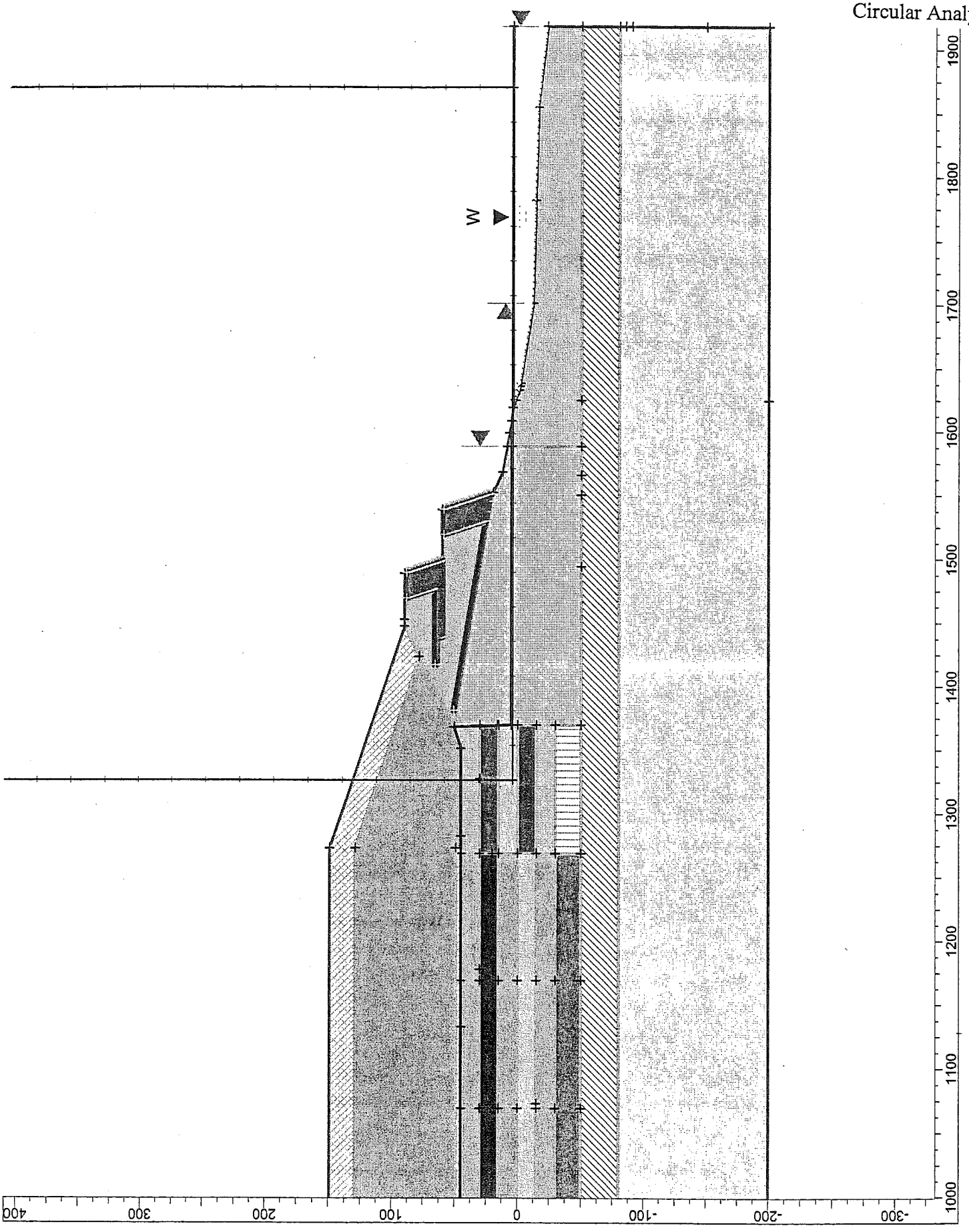
Section E-E
21 Year Stability
Circular Analysis



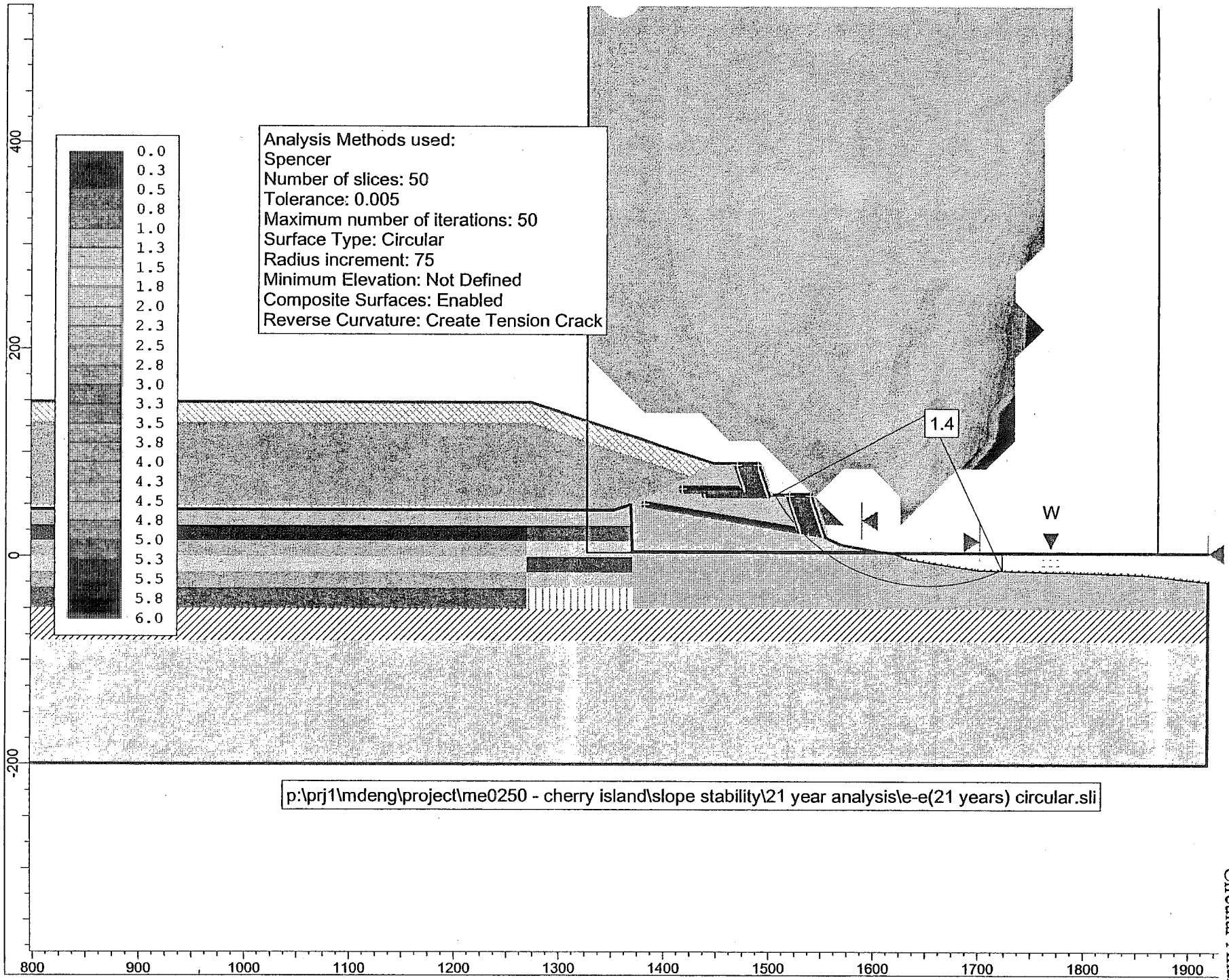
Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	ROE	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	ROE	3/29/03
Analysis Backchecked by:	SMW	3/31/03

E21-1

Section E-E
21 Year Stability
Circular Analysis



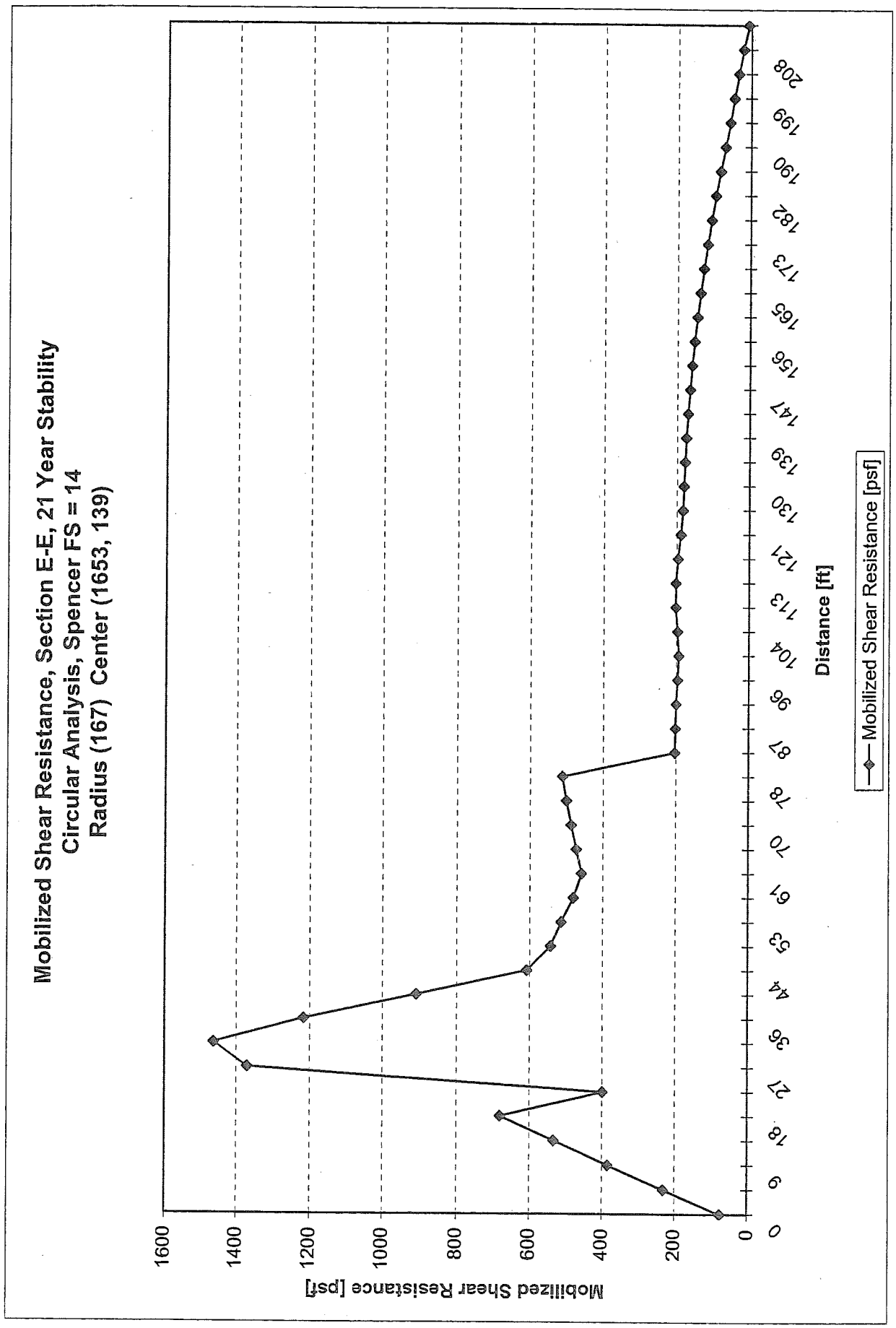
E21-2



Section E-E
21 Year Stability
Circular Analysis

E21-3

Section E-E
21 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance E

E21-4

Slide Analysis Information

Document Name

File Name: e-e(21 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1840 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1450 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1245 psf
Water Surface: None

E21-S

Section E-E
21 Year Stability
Circular Analysis

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1224 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1373 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2261 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2099 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1562 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1301 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1290 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1487 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2511 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.38688
Center: 1652.76, 139.216
Radius: 166.81
Left Slip Surface Endpoint: 1505.96, 60
Right Slip Surface Endpoint: 1722.32, -12.3994
Left Slope Intercept: 1505.96 60
Right Slope Intercept: 1722.32 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 18484
Number of Invalid Surfaces: 15032
Error Codes:
Error Code -101 reported for 147 surfaces
Error Code -103 reported for 102 surfaces
Error Code -108 reported for 216 surfaces
Error Code -111 reported for 1829 surfaces
Error Code -112 reported for 5380 surfaces
Error Code -113 reported for 1278 surfaces
Error Code -1000 reported for 6080 surfaces

Error Codes

The following errors were encountered during the computation:

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

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

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

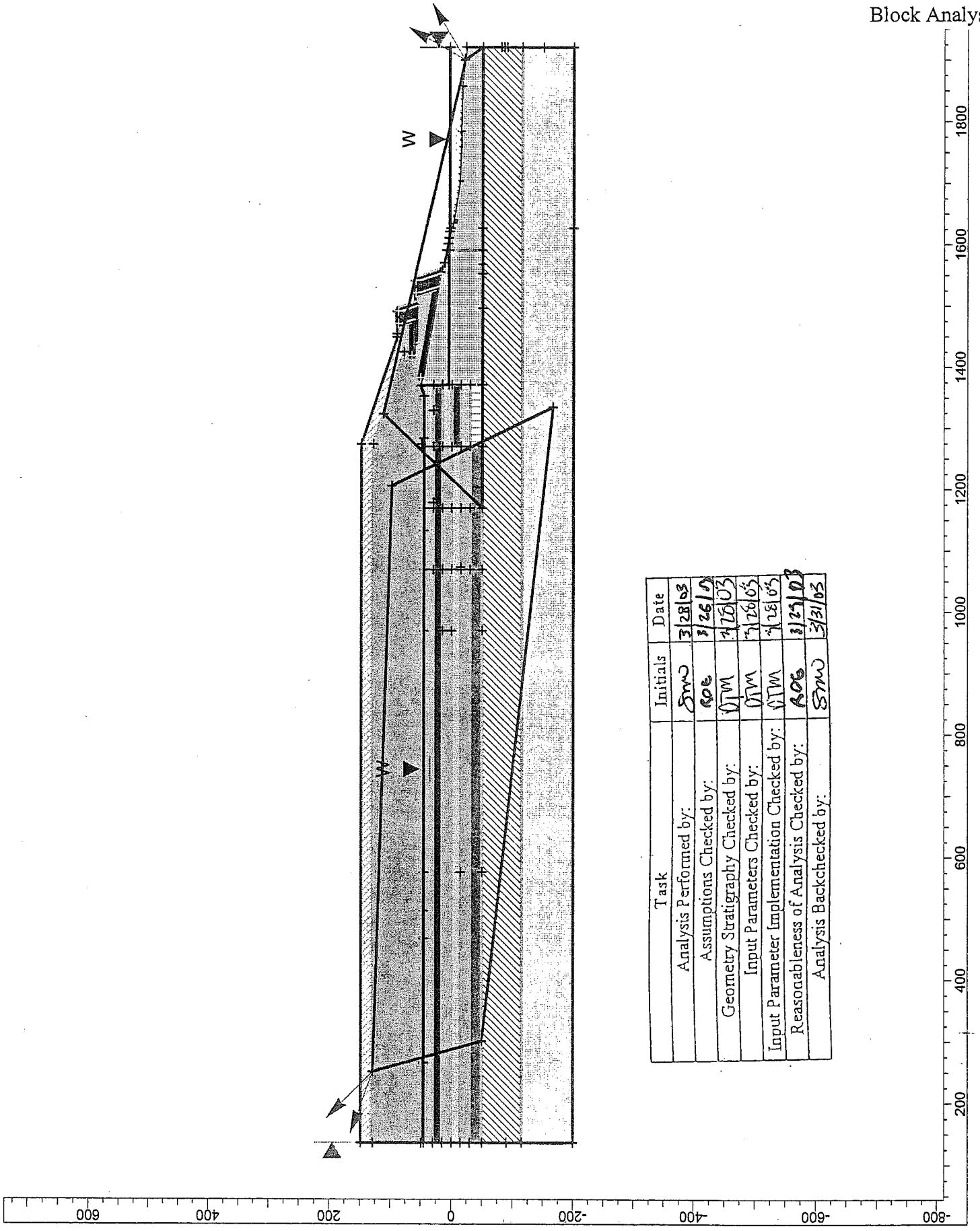
-111 = safety factor equation did not converge

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

-113 = Surface intersects outside slope limits.

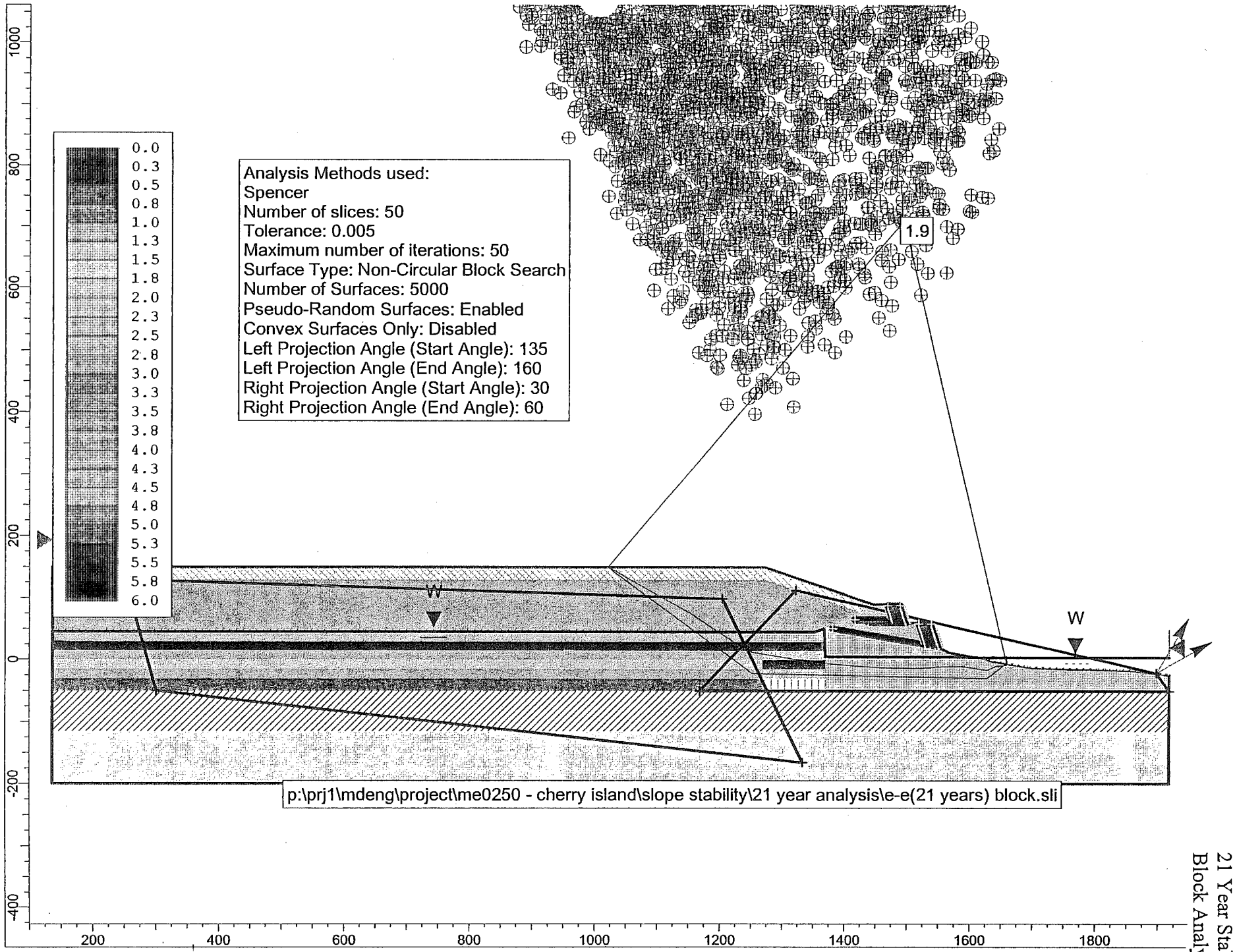
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section E-E
21 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/28/03
Assumptions Checked by:	ROE	3/26/03
Geometry Stratigraphy Checked by:	DTM	3/26/03
Input Parameters Checked by:	DTM	3/26/03
Input Parameter Implementation Checked by:	DTM	3/26/03
Reasonableness of Analysis Checked by:	ROE	3/27/03
Analysis Backchecked by:	SMO	3/31/03

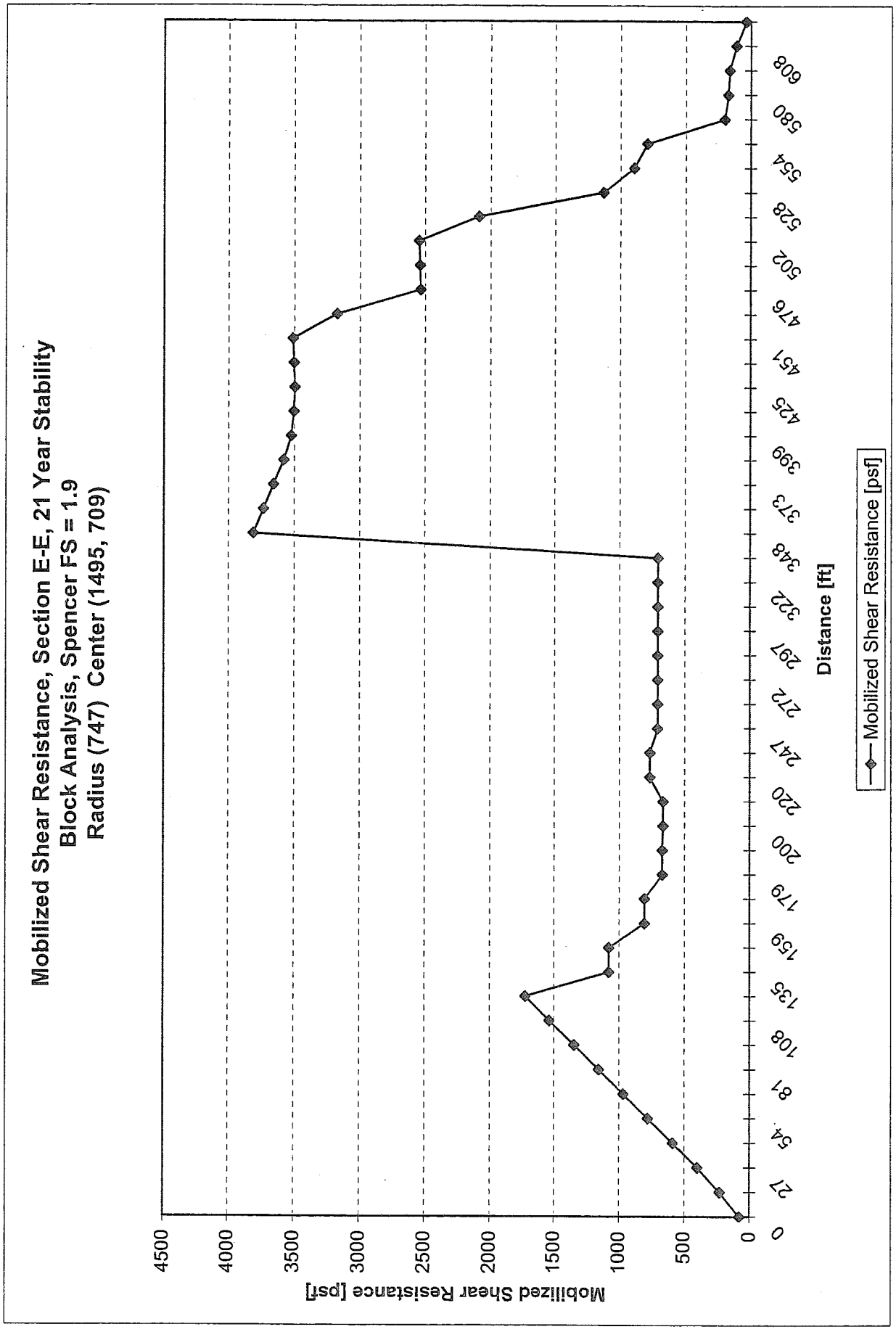
E21-7



Section E-E
21 Year Stability
Block Analysis

E 21-8

Section E-E
21 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance E

E21-9

Slide Analysis Information

Document Name

File Name: e-e(21 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1840 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1450 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3

E21-10

Section E-E
21 Year Stability
Block Analysis

Cohesion Type: Constant
Cohesion: 1245 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1224 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1373 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2261 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2099 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1562 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1301 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1290 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1487 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2511 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent

Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.94363
Axis Location: 1495.12, 709.37
Left Slip Surface Endpoint: 1022.02, 149
Right Slip Surface Endpoint: 1659.56, -5.3248
Left Slope Intercept: 1022.02 149
Right Slope Intercept: 1659.56 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 3347
Number of Invalid Surfaces: 1653
Error Codes:
Error Code -105 reported for 50 surfaces
Error Code -107 reported for 407 surfaces
Error Code -108 reported for 973 surfaces
Error Code -111 reported for 218 surfaces
Error Code -112 reported for 5 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

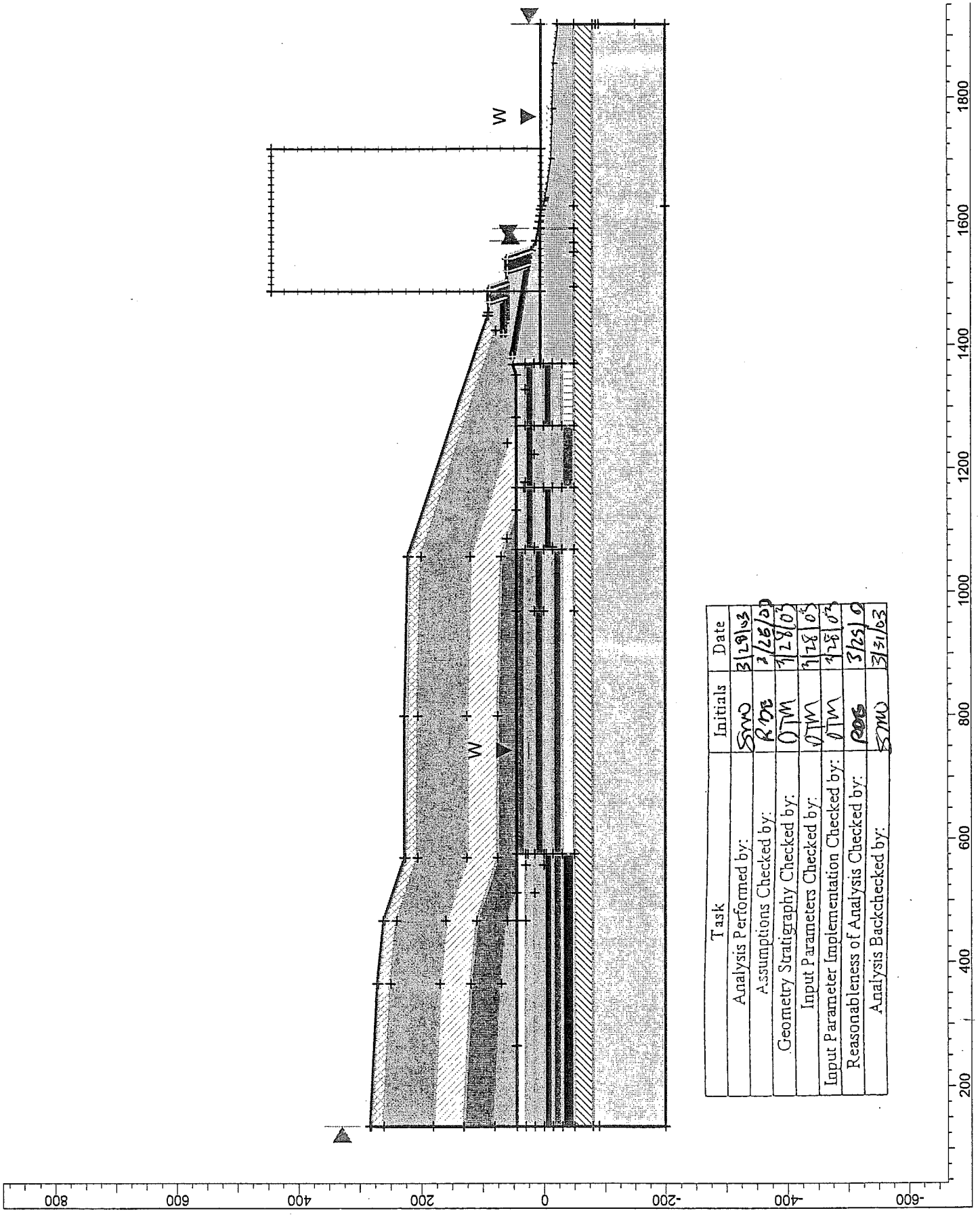
-111 = safety factor equation did not converge

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

E21-11

Section E-E
21 Year Stability
Block Analysis

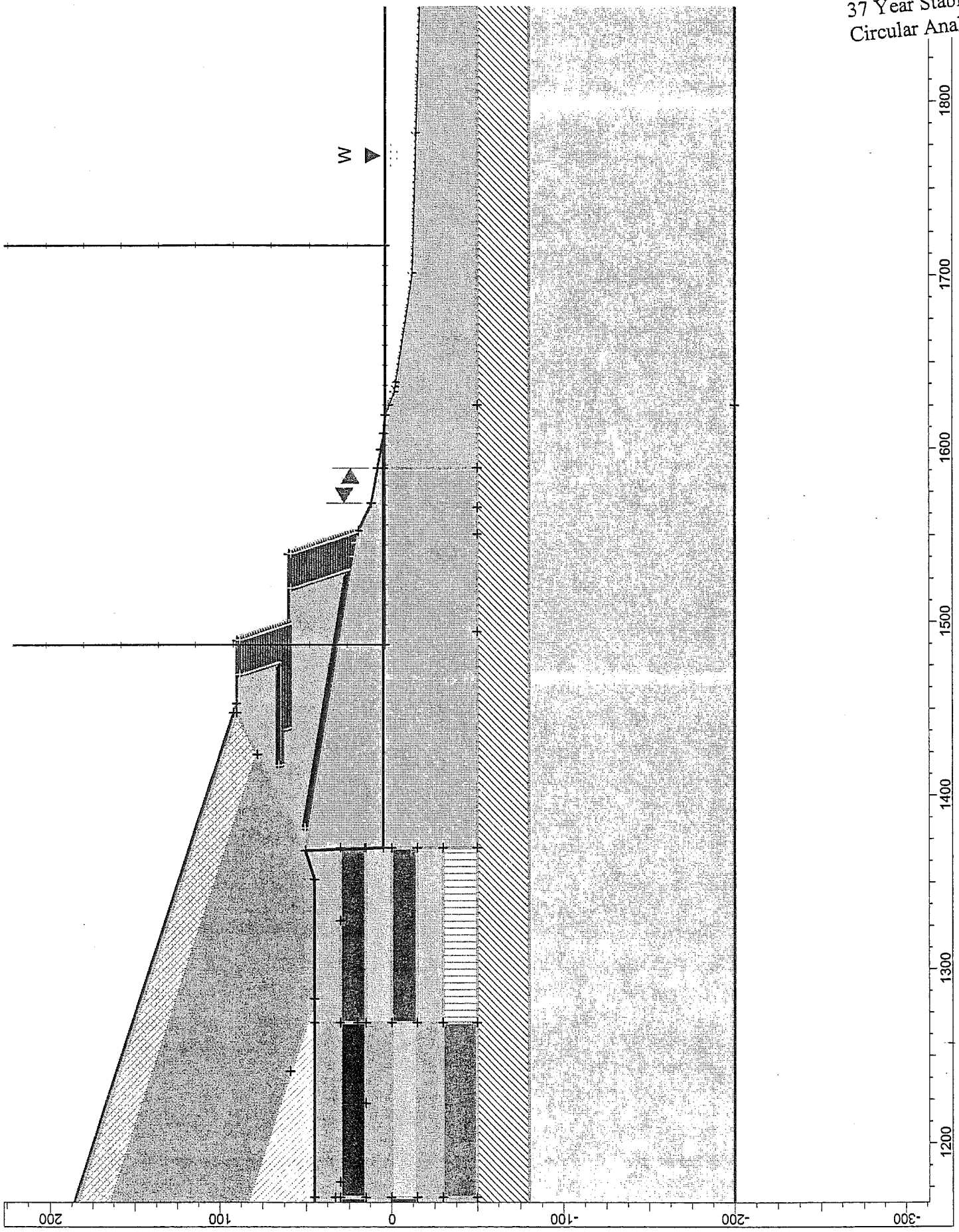
Section E-E
37 Year Stability
Circular Analysis



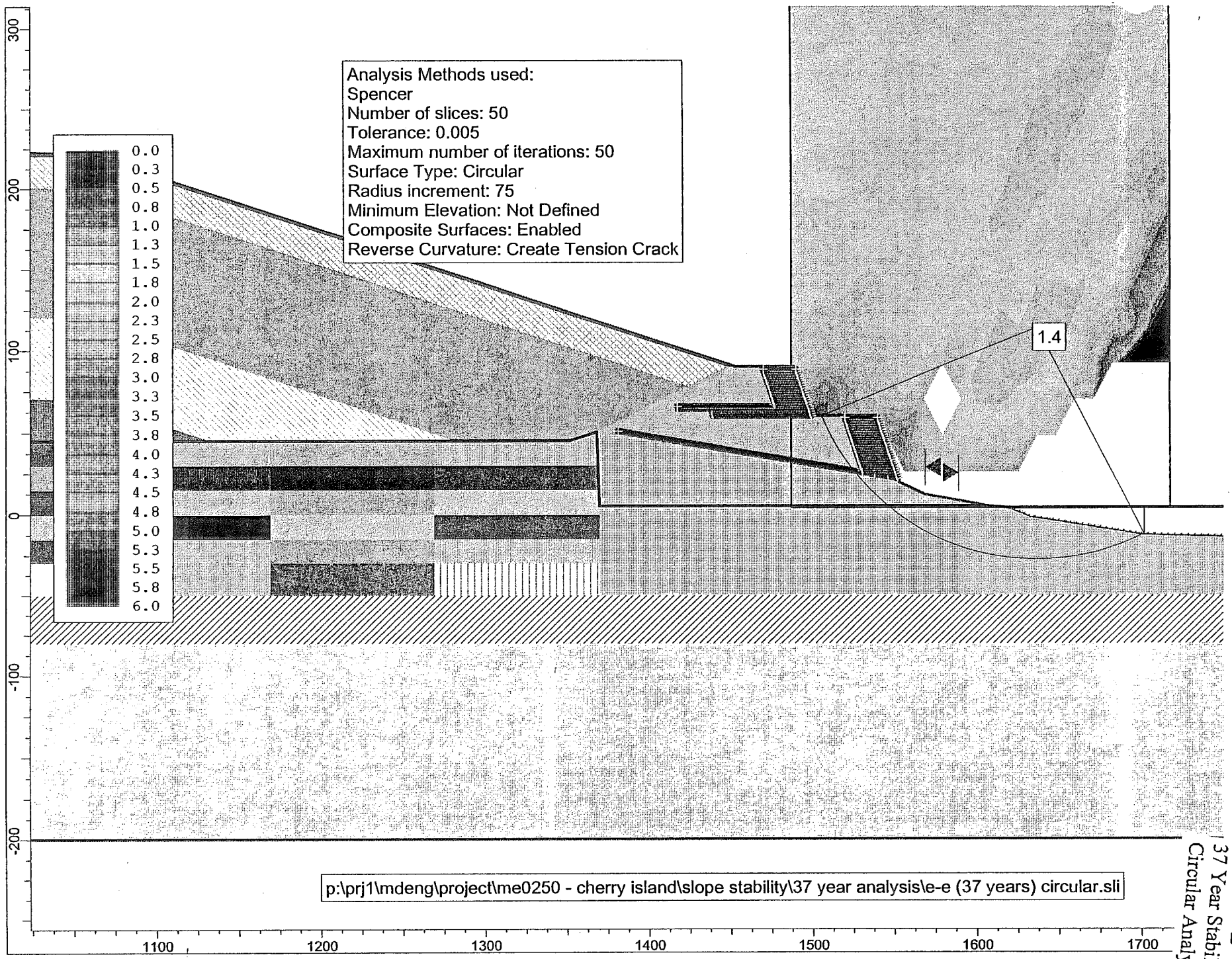
Task	Initials	Date
Analysis Performed by:	SMO	3/28/03
Assumptions Checked by:	RDS	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDS	3/25/03
Analysis Backchecked by:	SMO	3/31/03

E 37-1

Section E-E
37 Year Stability
Circular Analysis

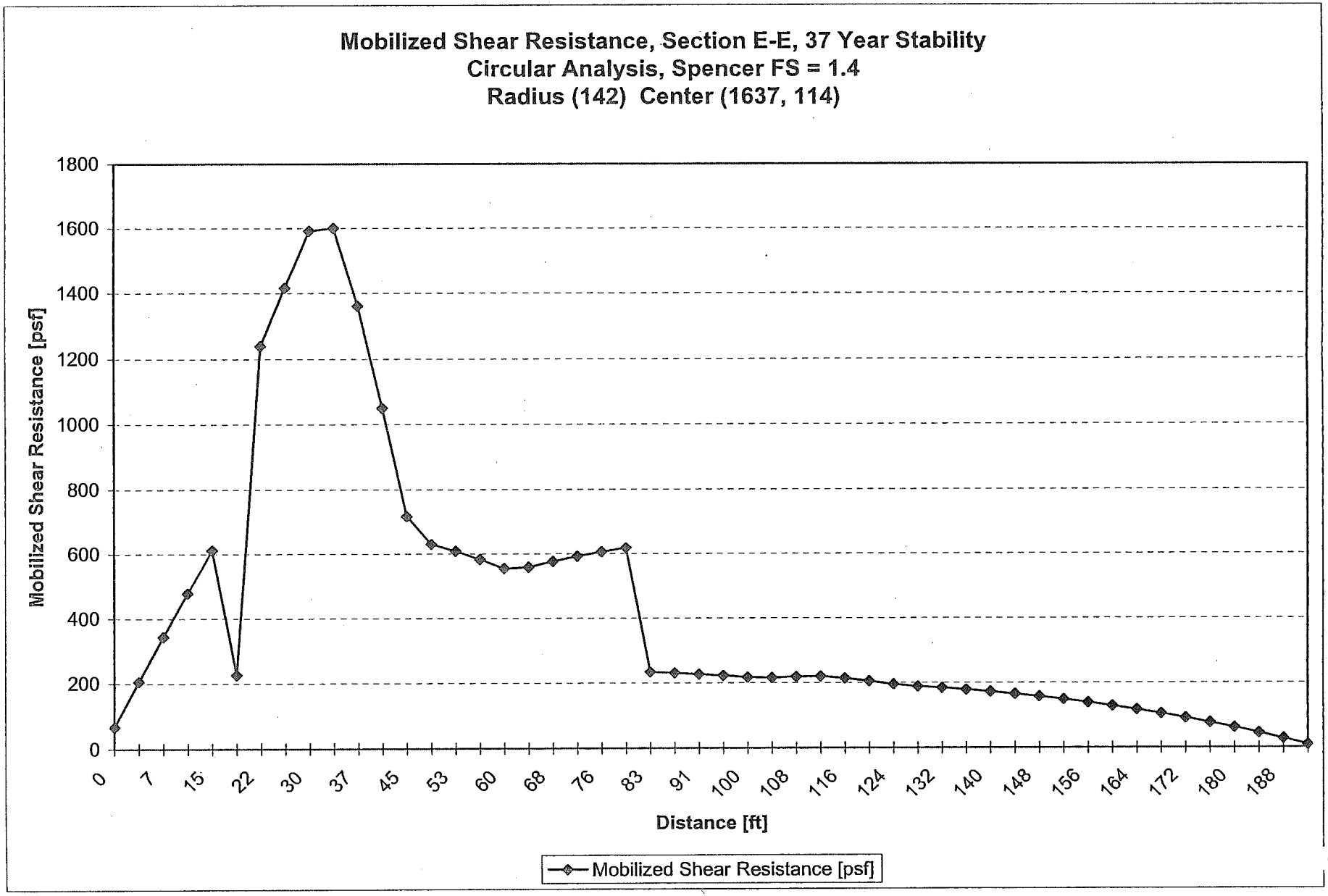


E37-2



E37-3

Section E-E
37 Year Stability
Circular Analysis



E3.4

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance E

Section E-E
37 Year Stability
Circular Analysis

Slide Analysis Information

Document Name

File Name: e-e (37 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 20
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function

E 37-5

Section E-E
37 Year Stability
Circular Analysis

Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1982 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1772 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1647 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1609 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2419 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2605 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2226 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1984 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1881 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1951 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2910 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3237 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2580 psf

Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2134 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1944 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2022 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3586 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2615 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2056 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1933 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2235 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3807 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4192 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2833 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2144 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2031 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2480 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4428 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.38997
Center: 1636.53, 114.16
Radius: 141.727
Left Slip Surface Endpoint: 1505.56, 60
Right Slip Surface Endpoint: 1701.36, -11.8715
Left Slope Intercept: 1505.56 60
Right Slope Intercept: 1701.36 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 6521
Number of Invalid Surfaces: 2740
Error Codes:
Error Code -101 reported for 295 surfaces
Error Code -103 reported for 49 surfaces
Error Code -108 reported for 167 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 729 surfaces
Error Code -112 reported for 1326 surfaces
Error Code -113 reported for 173 surfaces

Error Codes

The following errors were encountered during the computation:

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

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of

extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

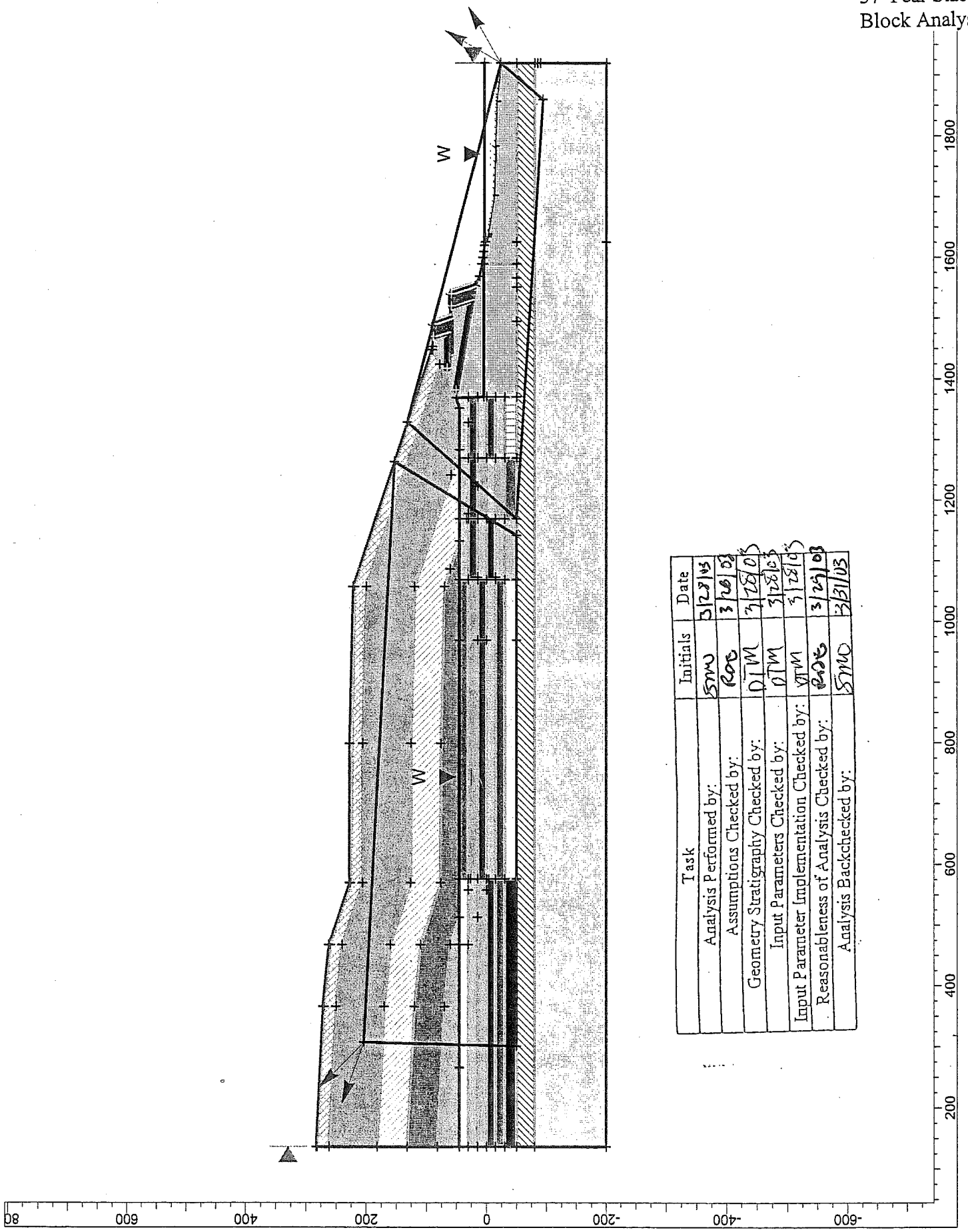
-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

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

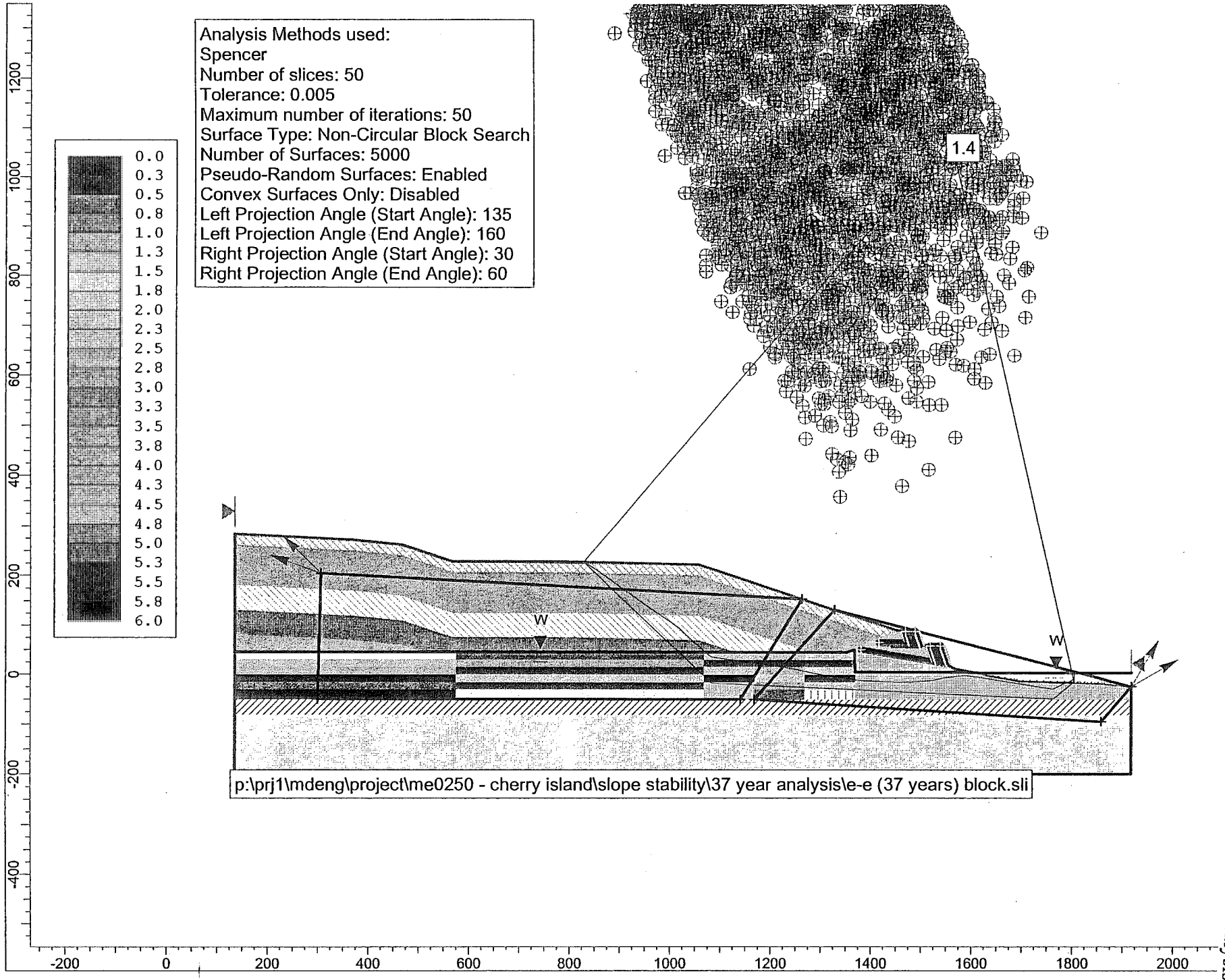
-113 = Surface intersects outside slope limits.

Section E-E
37 Year Stability
Block Analysis



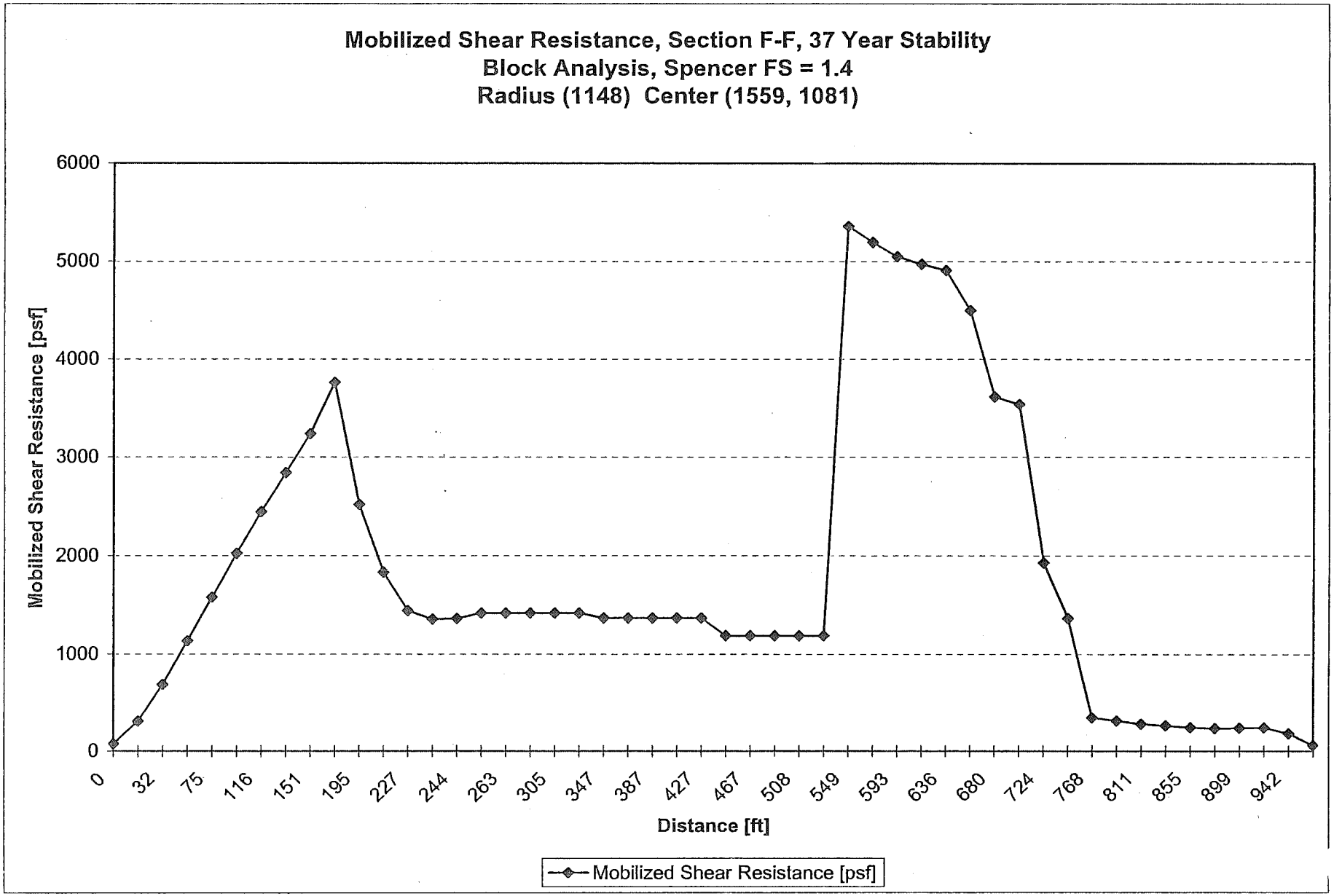
Task	Initials	Date
Analysis Performed by:	SMO	3/28/03
Assumptions Checked by:	ROS	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	ROS	3/29/03
Analysis Backchecked by:	SMO	3/31/03

E37-8



Section E-E
37 Year Stability
Block Analysis

E37-9



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance E

Section E-E
37 Year Stability
Block Analysis

E37-10

Slide Analysis Information

Document Name

File Name: e-e (37 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

E37-11

Section E-E
37 Year Stability
Block Analysis

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1982 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1772 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1647 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1609 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2419 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2605 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2226 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1984 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1881 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1951 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2910 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3237 psf
Water Surface: None

Material: d32
Strength Type: Undrained

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2580 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2134 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1944 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2022 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3586 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2615 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2056 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1933 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2235 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3807 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4192 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2833 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2144 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section E-E
37 Year Stability
Block Analysis

E37-12

Cohesion: 2031 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2480 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4428 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.42469
Axis Location: 1558.82, 1081.27
Left Slip Surface Endpoint: 829.712, 227.033
Right Slip Surface Endpoint: 1804.75, -14.5581
Left Slope Intercept: 829.712 227.033
Right Slope Intercept: 1804.75 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 4334
Number of Invalid Surfaces: 666
Error Codes:
Error Code -105 reported for 81 surfaces
Error Code -108 reported for 527 surfaces
Error Code -111 reported for 20 surfaces
Error Code -112 reported for 38 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

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

-111 = safety factor equation did not converge

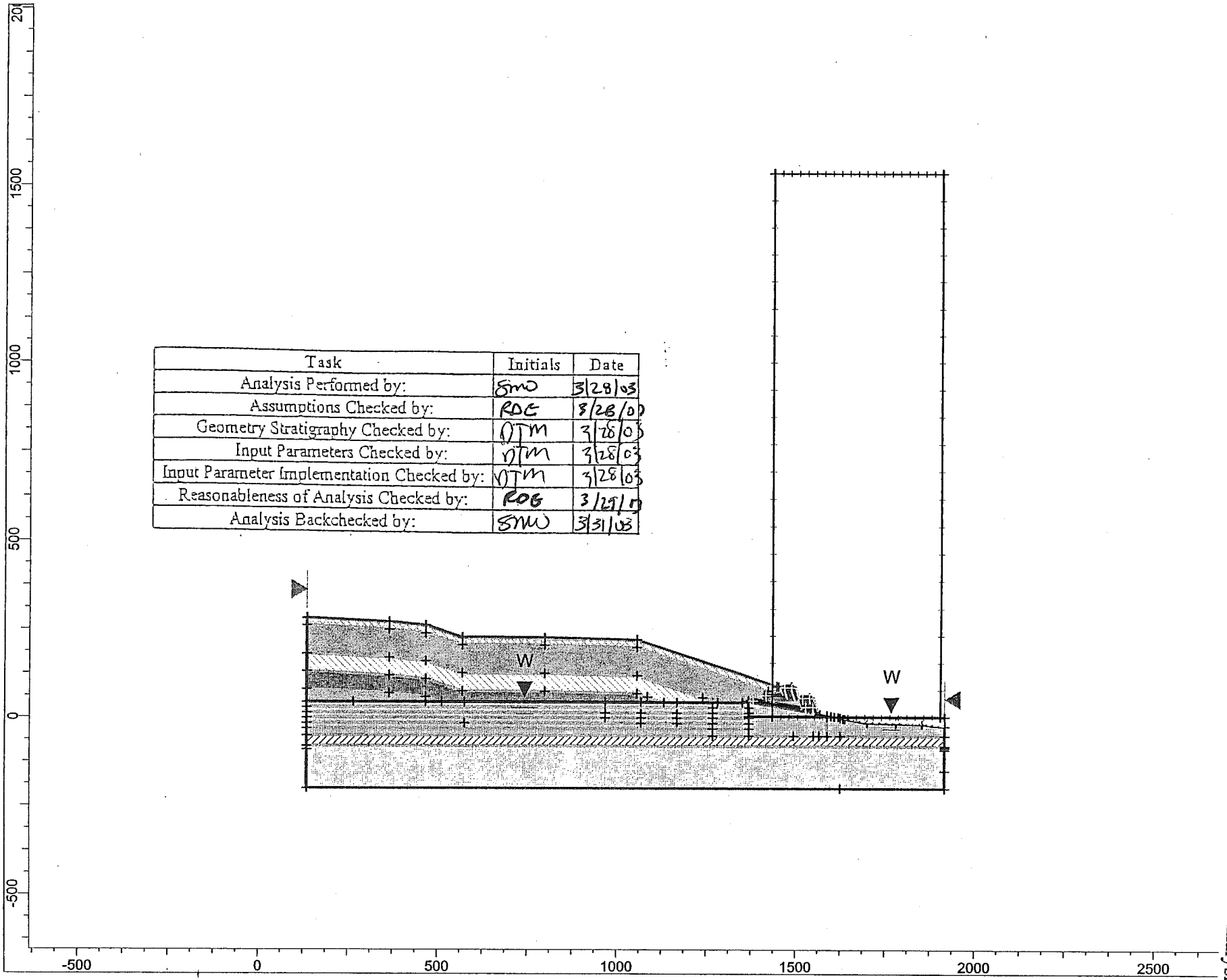
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration

Section E-E
37 Year Stability
Block Analysis

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

E37-13

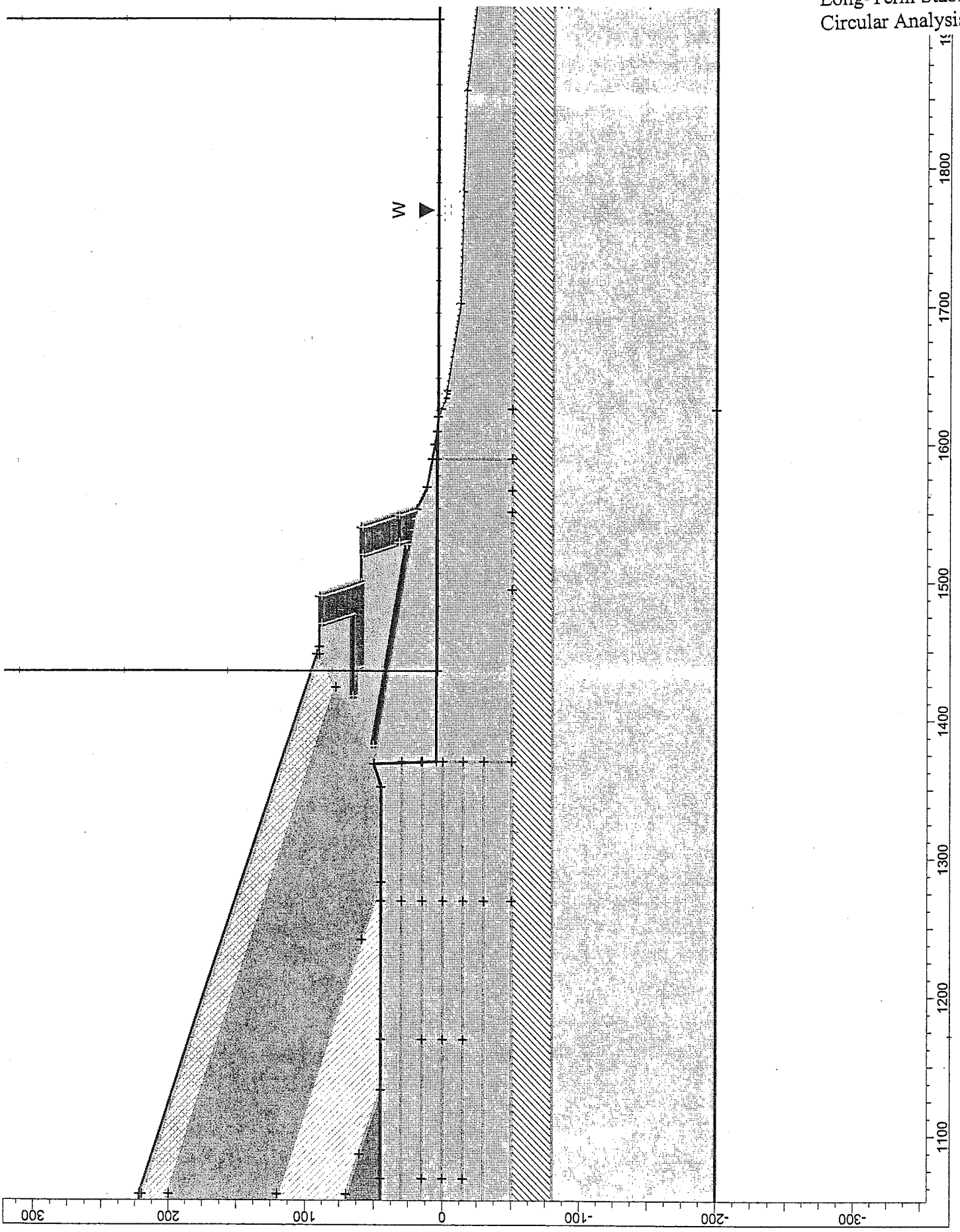
Task	Initials	Date
Analysis Performed by:	SMO	3/28/03
Assumptions Checked by:	RDC	3/28/03
Geometry Stratigraphy Checked by:	NJTM	3/28/03
Input Parameters Checked by:	NJTM	3/28/03
Input Parameter Implementation Checked by:	NJTM	3/28/03
Reasonableness of Analysis Checked by:	ROG	3/29/03
Analysis Backchecked by:	SMO	3/31/03



Section E-E
Long-Term Stability
Circular Analysis

E LT-1

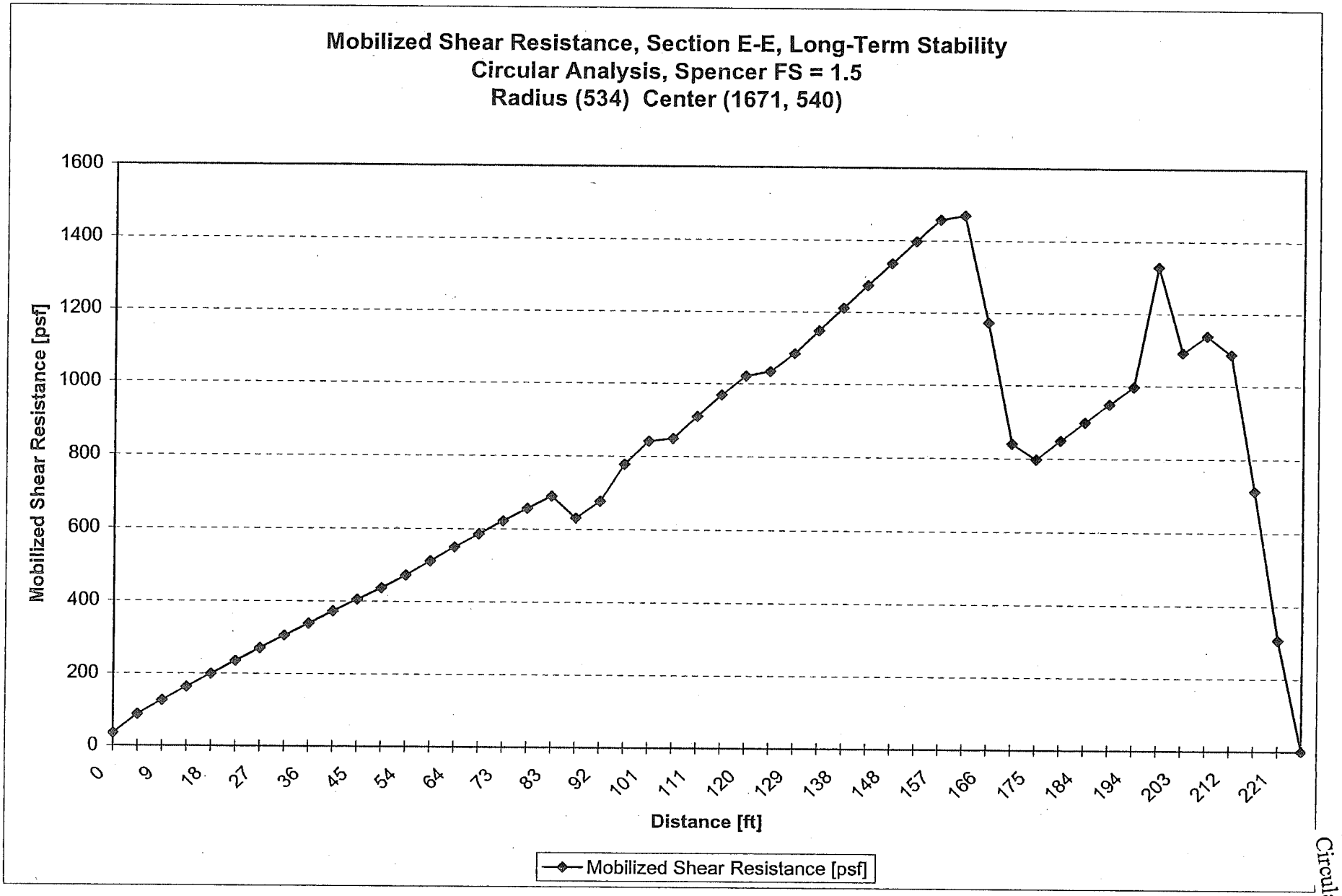
Section E-E
Long-Term Stability
Circular Analysis



ELT-2

Section E-E
Long-Term Stability
Circular Analysis

ELT-3



Section E-E
Long-Term Stability
Circular Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance E

E1-4

Slide Analysis Information

Document Name

File Name: e-e(long-term) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3

ELT-S1

Section E-E
Long-Term Stability
Circular Analysis

Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.5078
Center: 1670.77, 540.419
Radius: 534.122

Left Slip Surface Endpoint: 1325.81, 132.629
Right Slip Surface Endpoint: 1552.87, 19.4702

Method Statistics

Method: spencer
Number of Valid Surfaces: 23108
Number of Invalid Surfaces: 10408
Error Codes:
Error Code -104 reported for 21 surfaces
Error Code -106 reported for 497 surfaces
Error Code -108 reported for 1322 surfaces
Error Code -111 reported for 7697 surfaces
Error Code -112 reported for 868 surfaces
Error Code -200 reported for 3 surfaces

Error Codes

The following errors were encountered during the computation:

-104 = Same as -102. Surface / nonslope intersections also exist, but these points lie outside the arc defined by the two surface / slope intersections.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

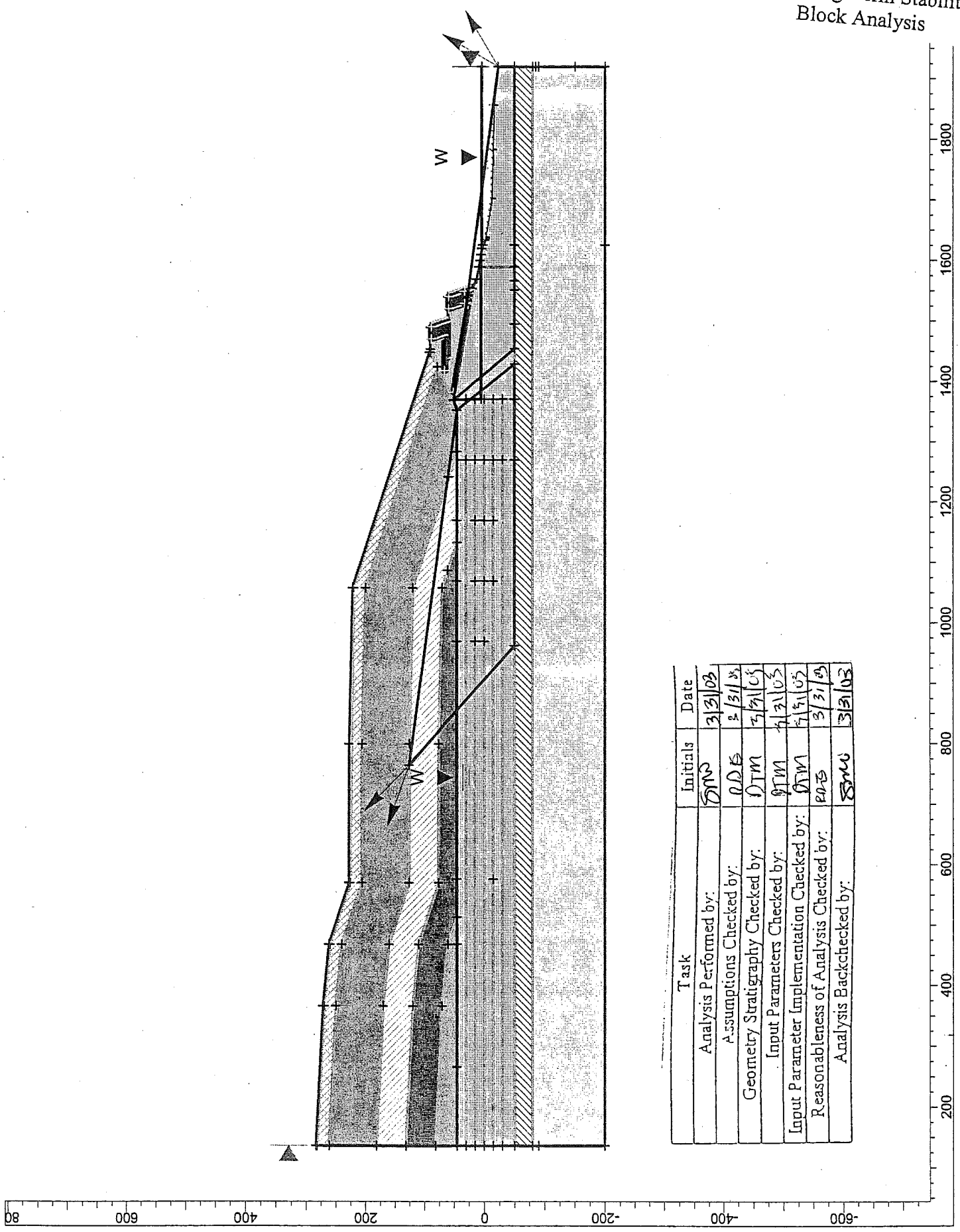
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

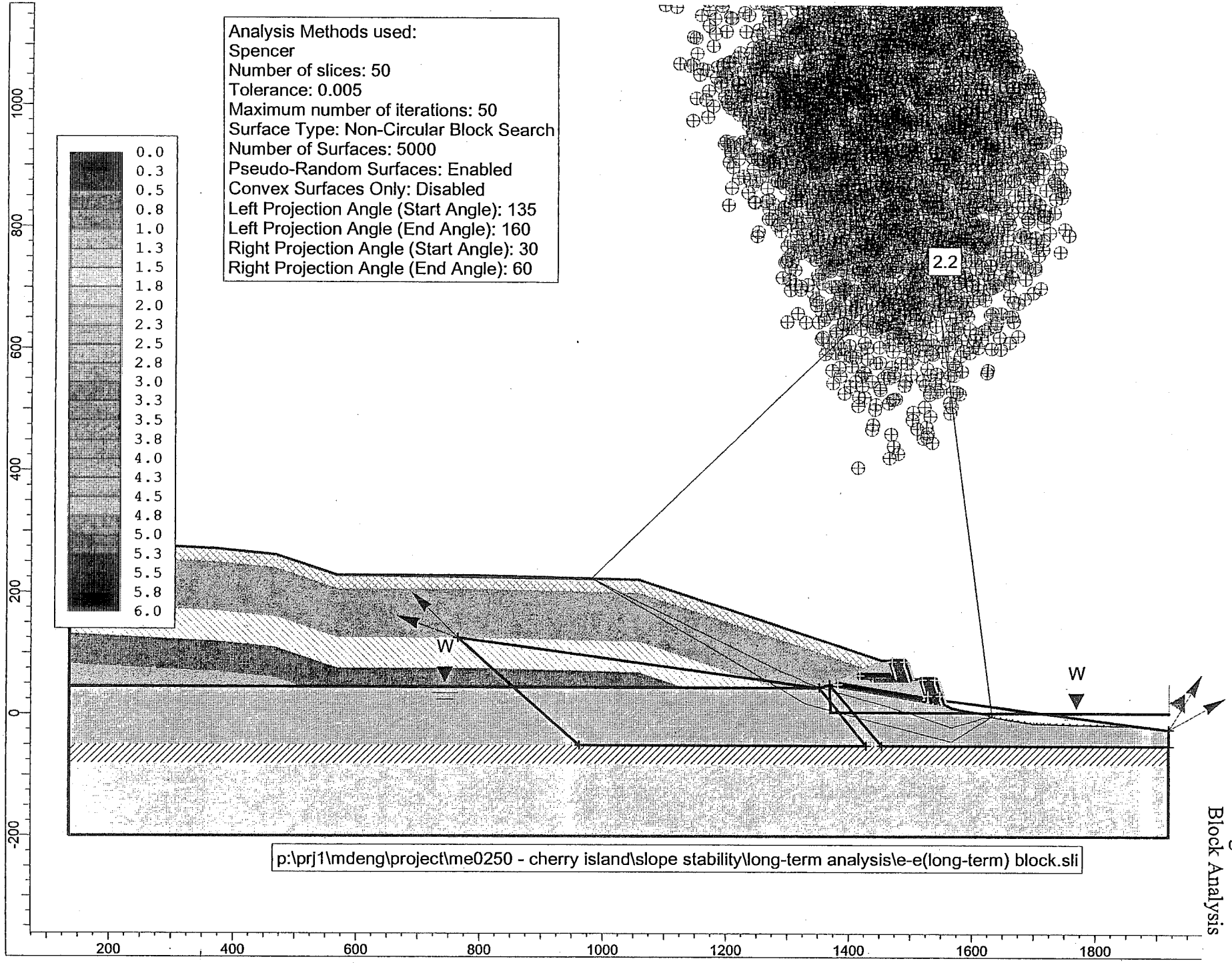
-200 = Factor of Safety = 0. Could mean 0 Normal/Shear resistance along part of the slip surface

Section E-E
Long-Term Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	BMS	3/31/03
Assumptions Checked by:	RDS	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	BTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	RDS	3/31/03
Analysis Backchecked by:	BMS	3/31/03

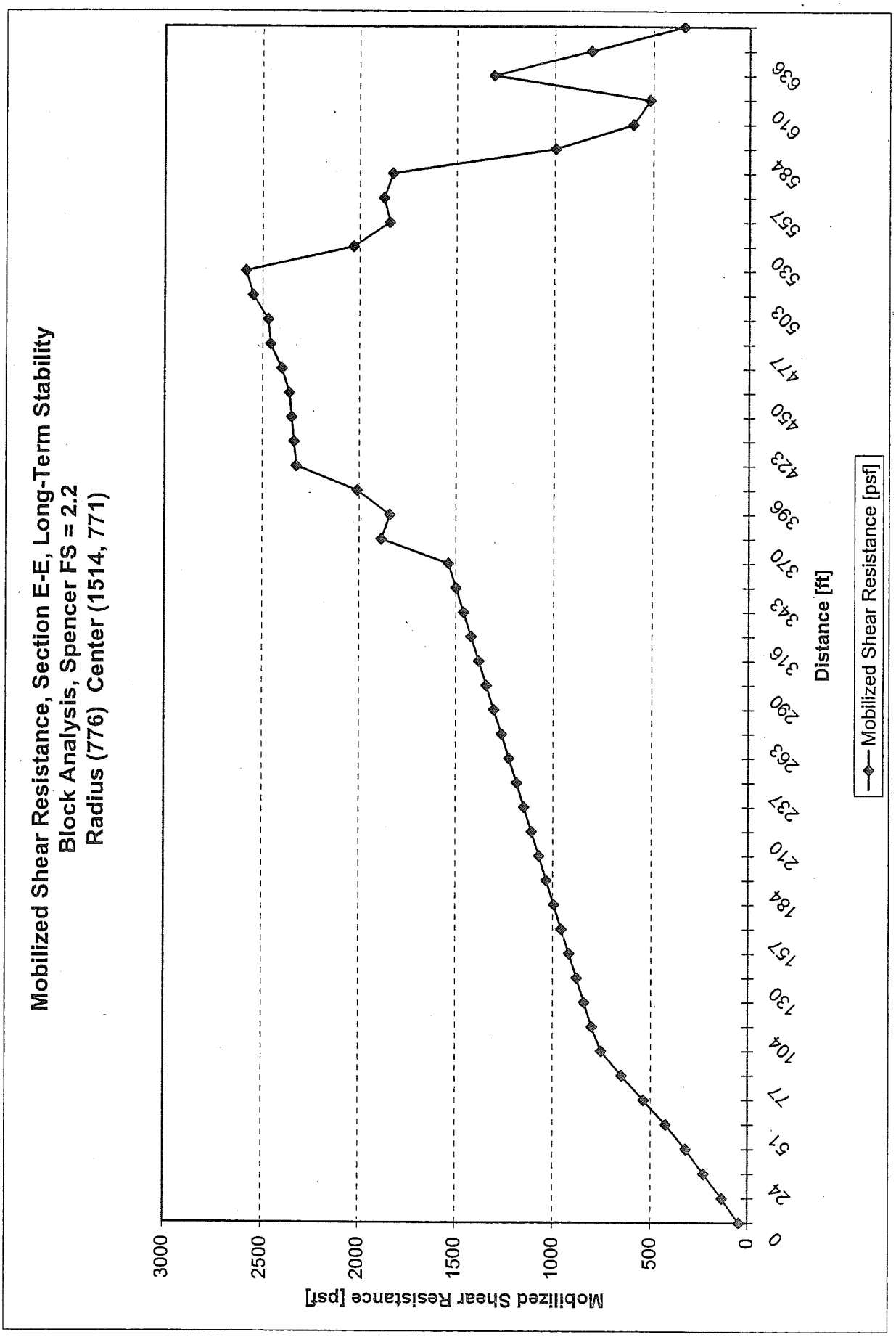
ELT-6



Section E-E
Long-Term Stability
Block Analysis

E L T-7

Section E-E
Long-Term Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance E

ELT-8

Slide Analysis Information

Document Name

File Name: e-e(long-term) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

EET-9

Section E-E
Long-Term Stability
Block Analysis

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer

SF: 2.154
Axis Location: 1531.9, 762.405
Left Slip Surface Endpoint: 981.595, 223.68
Right Slip Surface Endpoint: 1632.7, -1.07043
Left Slope Intercept: 981.595 223.68
Right Slope Intercept: 1632.7 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 4045
Number of Invalid Surfaces: 955
Error Codes:
Error Code -105 reported for 52 surfaces
Error Code -108 reported for 871 surfaces
Error Code -111 reported for 32 surfaces

Error Codes

The following errors were encountered during the computation:

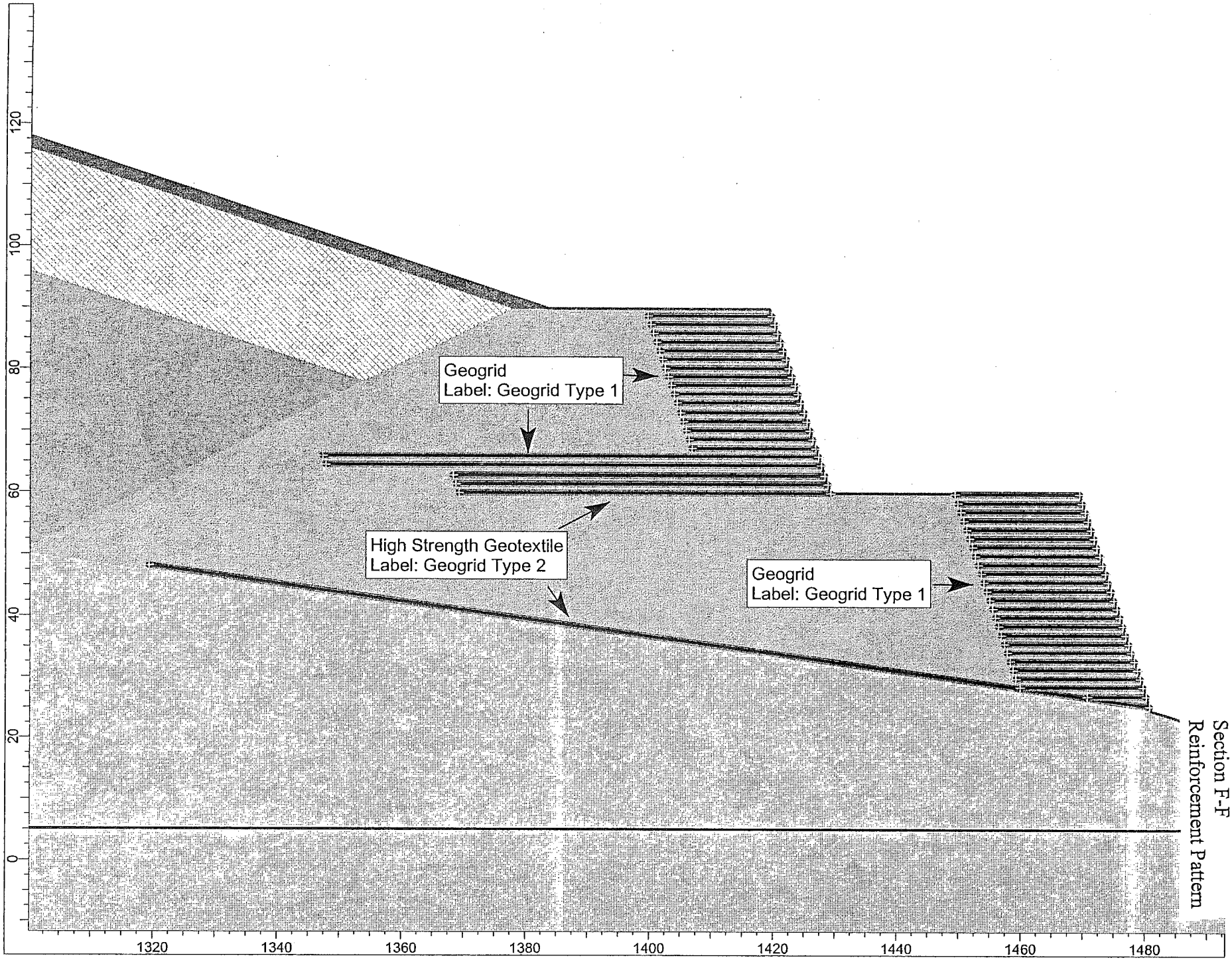
-105 = More than two surface / slope intersections with no valid slip surface.

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

-111 = safety factor equation did not converge

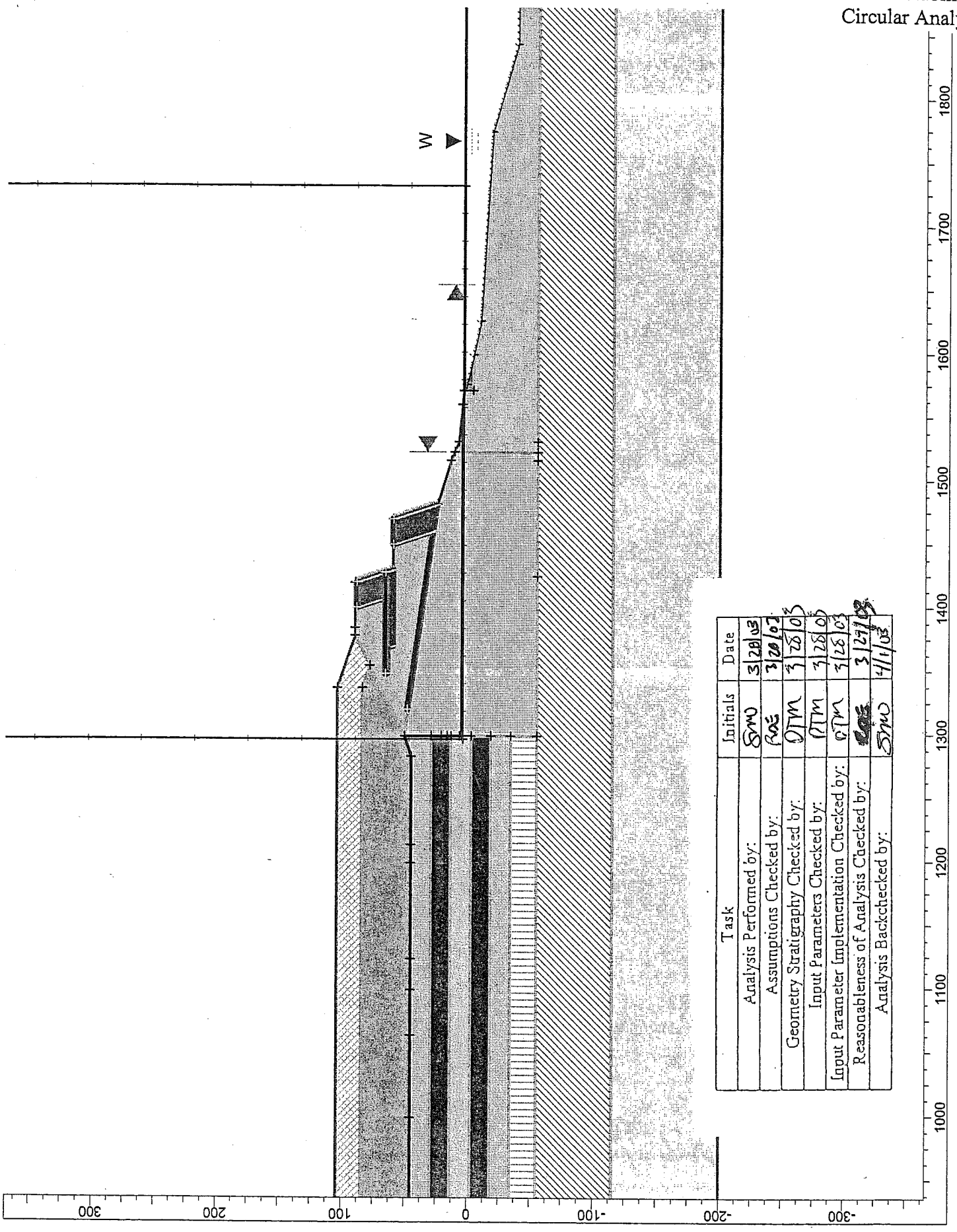
Attachment F

Stability Analysis Results for Cross Section F-F



Section F-F
Reinforcement Pattern

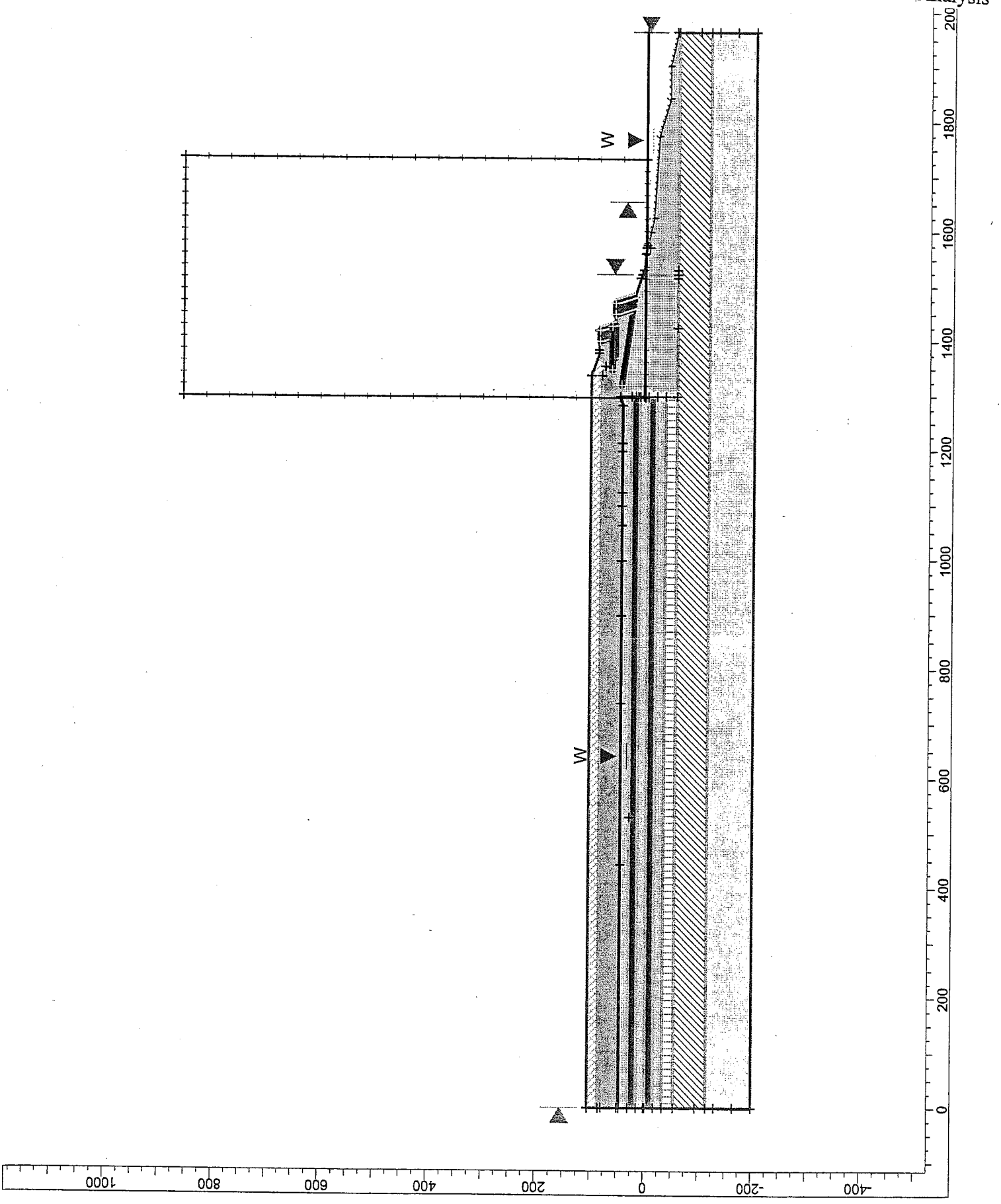
Section F-F
9 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/28/03
Assumptions Checked by:	RAE	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	[illegible]	3/27/03
Analysis Backchecked by:	SMO	4/1/03

F9-1

Section F-F
9 Year Stability
Circular Analysis

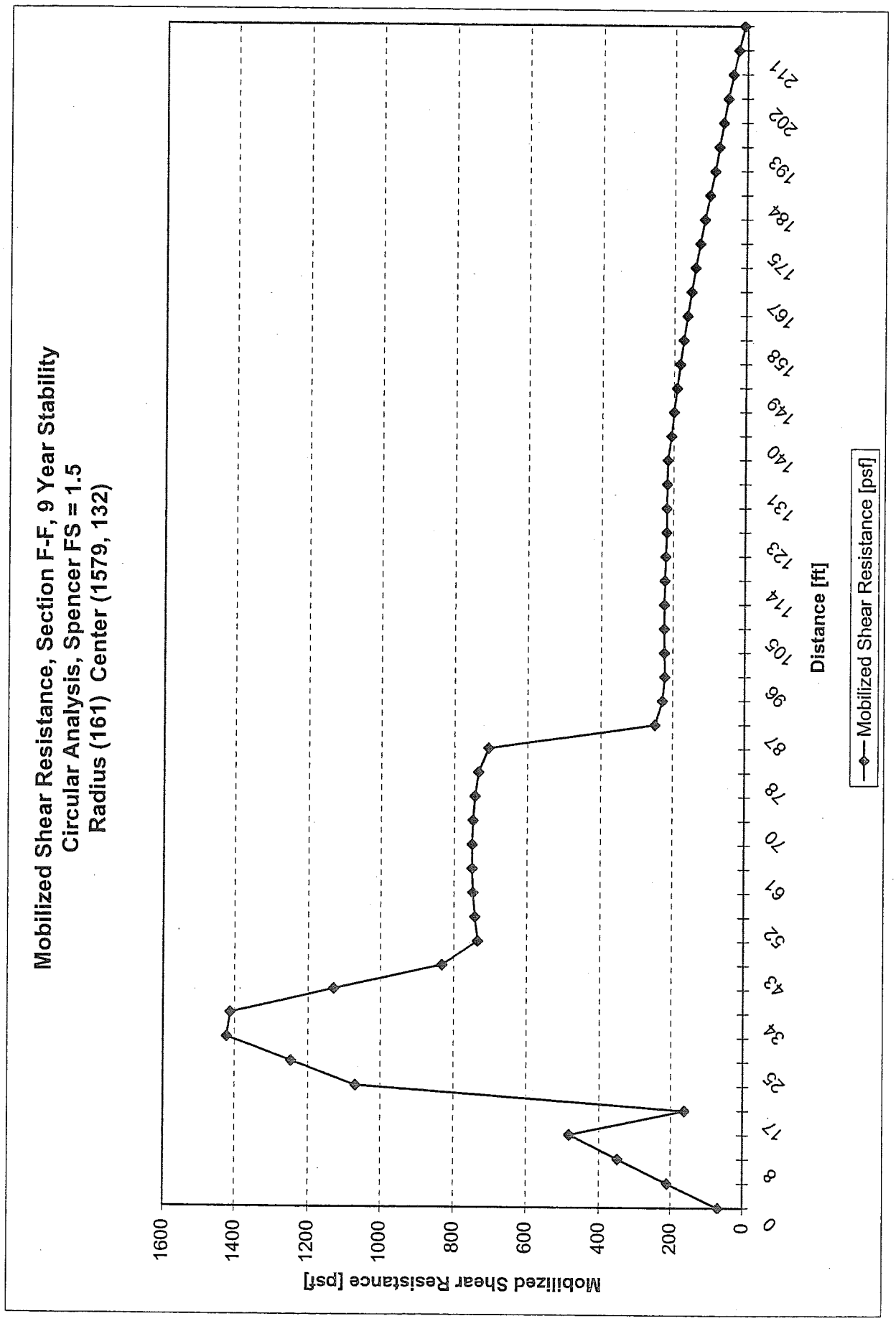


F 9-2

Section F-F
9 Year Stability
Circular Analysis

F9-3

Section F-F
9 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance F

F9-4

Slide Analysis Information

Document Name

File Name: f-f(9 year) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius Increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1220 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 921 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 802 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 905 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1236 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1934 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.51699
Center: 1578.96, 132.129
Radius: 161.321
Left Slip Surface Endpoint: 1434.66, 60
Right Slip Surface Endpoint: 1653.89, -10.7326
Left Slope Intercept: 1434.66 60
Right Slope Intercept: 1653.89 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 27092
Number of Invalid Surfaces: 6424
Error Codes:
Error Code -101 reported for 245 surfaces
Error Code -103 reported for 58 surfaces
Error Code -108 reported for 179 surfaces
Error Code -111 reported for 1477 surfaces
Error Code -112 reported for 4033 surfaces
Error Code -113 reported for 432 surfaces

Error Codes

The following errors were encountered during the computation:

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

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

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

-111 = safety factor equation did not converge

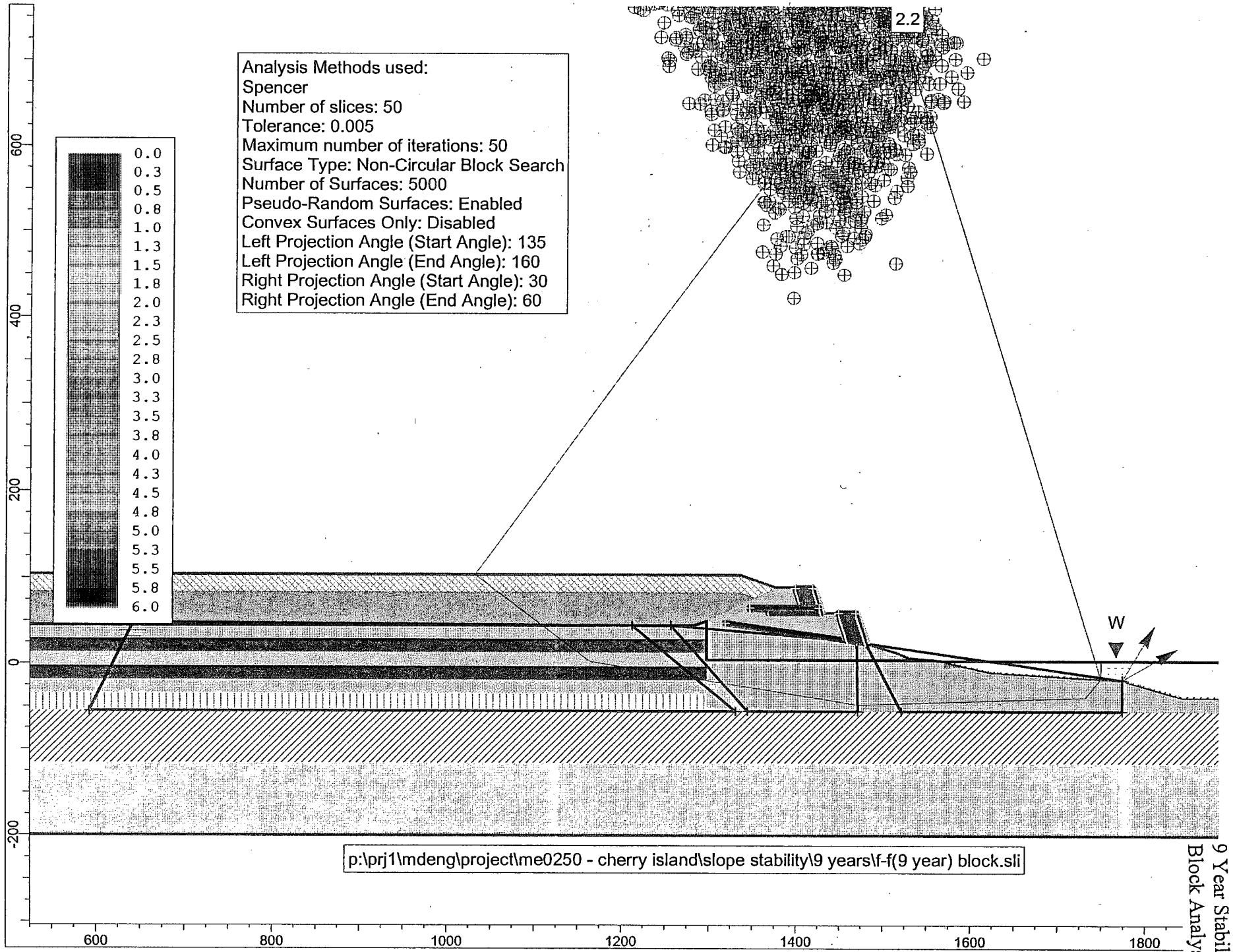
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

-113 = Surface intersects outside slope limits.

Section F-F
9 Year Stability
Block Analysis

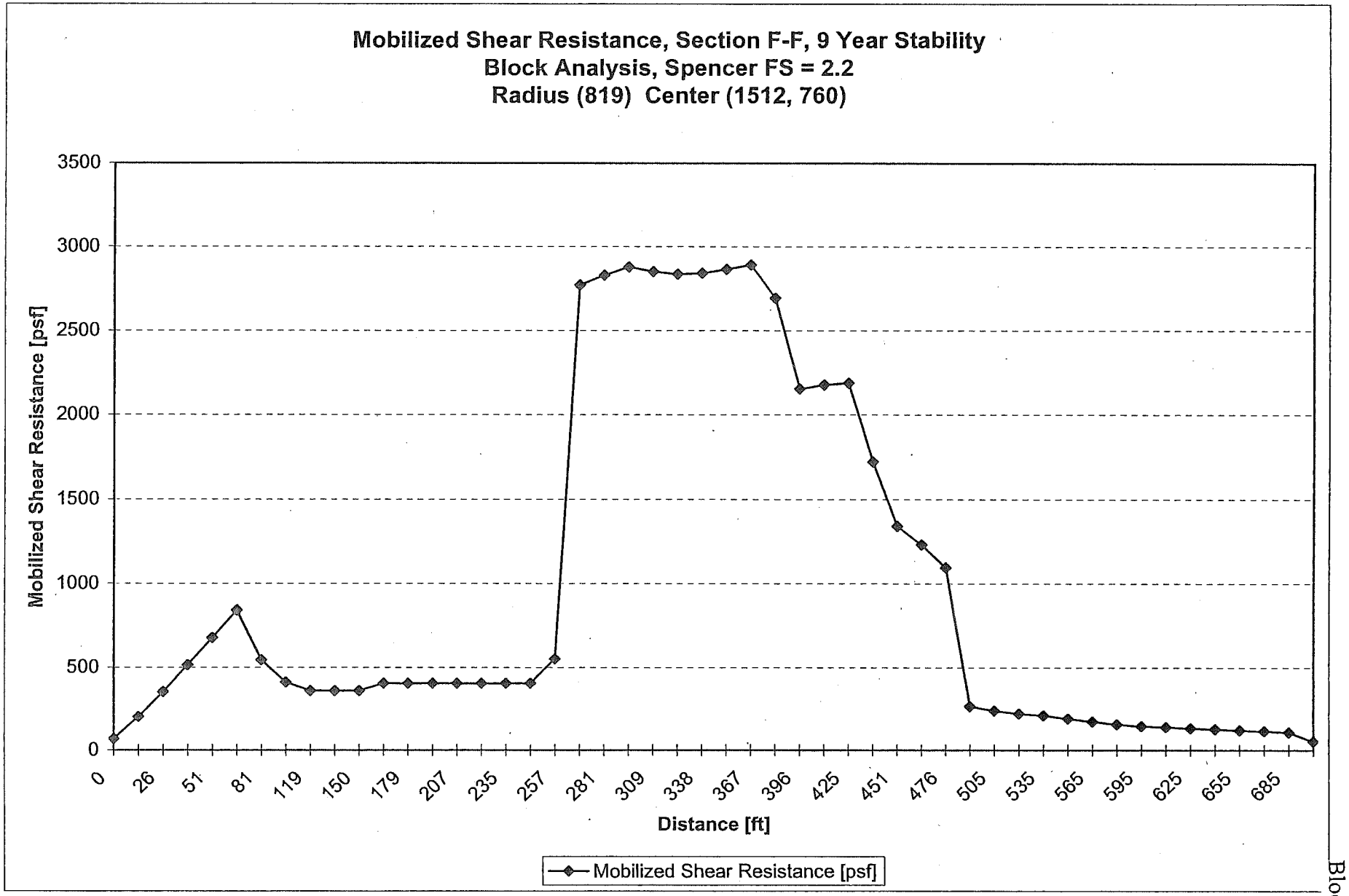
Task	Initials	Date
Analysis Performed by:	SMO	3/31/03
Assumptions Checked by:	ROE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	ROE	3/31/03
Analysis Backchecked by:	SMO	4/1/03

F-9-7



Section F-F
9 Year Stability
Block Analysis

F9-8



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance

Section F-F
9 Year Stability
Block Analysis

Slide Analysis Information

Document Name

File Name: f-f(9 year) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1220 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 921 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 802 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

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Section F-F
9 Year Stability
Block Analysis

Cohesion: 905 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1236 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1934 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.2394
Axis Location: 1511.74, 760.368
Left Slip Surface Endpoint: 1032.9, 104
Right Slip Surface Endpoint: 1749.53, -16.5275
Left Slope Intercept: 1032.9 104
Right Slope Intercept: 1749.53 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 4905
Number of Invalid Surfaces: 95
Error Codes:
Error Code -105 reported for 16 surfaces
Error Code -108 reported for 64 surfaces
Error Code -111 reported for 12 surfaces
Error Code -112 reported for 3 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

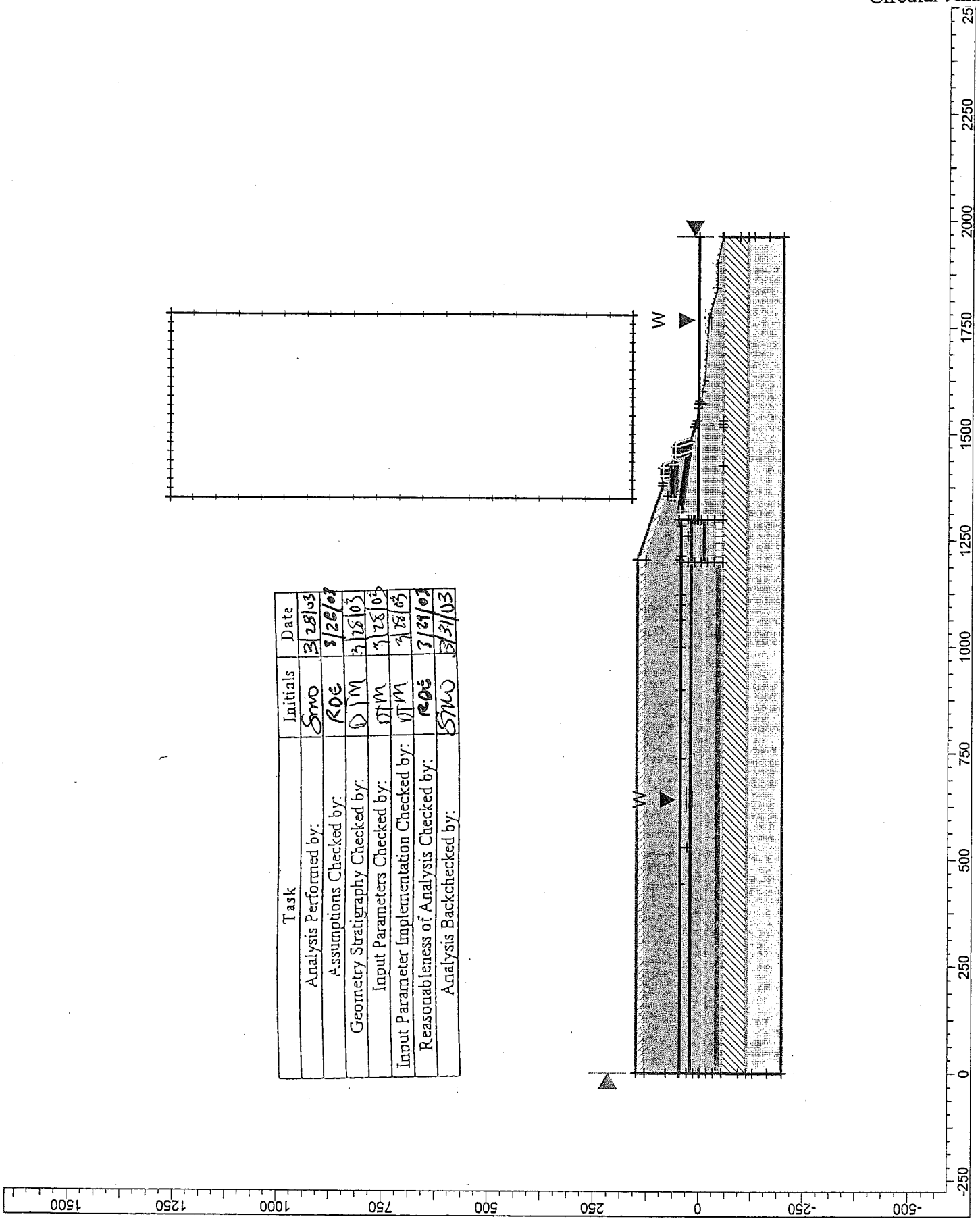
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

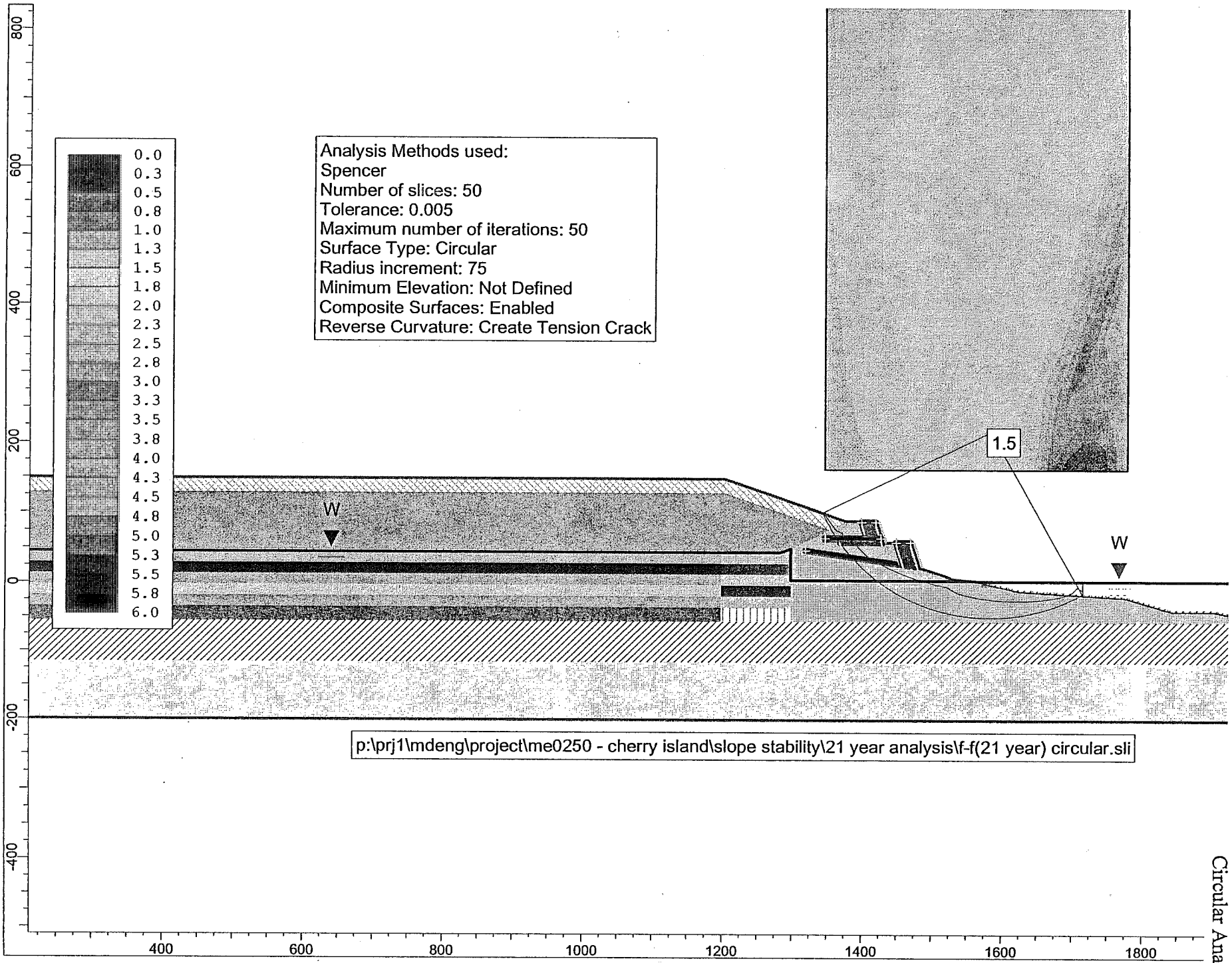
Section F-F
9 Year Stability
Block Analysis

Section F-F
21 Year Stability
Circular Analysis



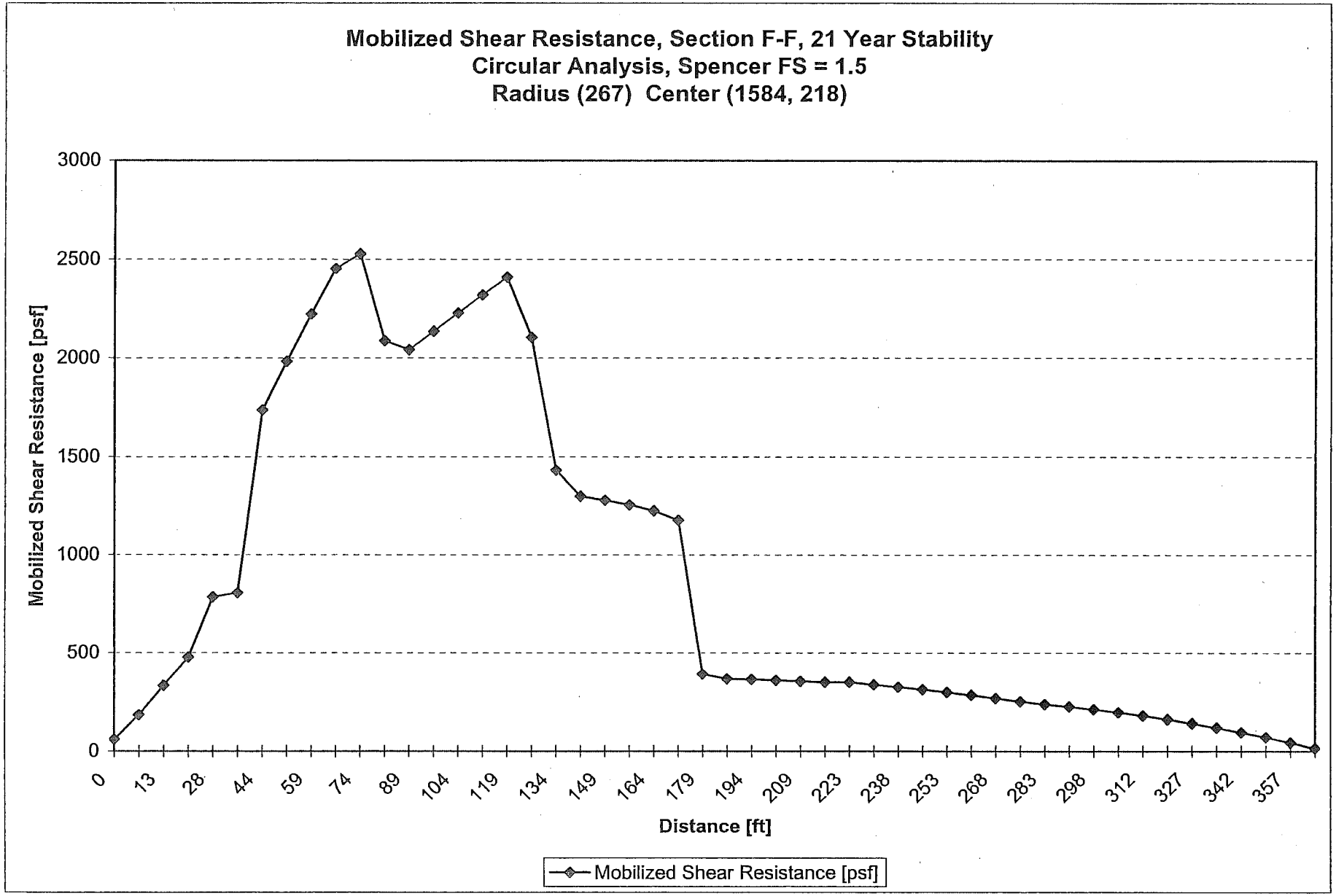
Task	Initials	Date
Analysis Performed by:	SMO	3/28/03
Assumptions Checked by:	RDE	3/28/03
Geometry Stratigraphy Checked by:	DJM	3/28/03
Input Parameters Checked by:	DJM	3/28/03
Input Parameter Implementation Checked by:	DJM	3/28/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMO	3/31/03

F21-1



Section F-F
21 Year Stability
Circular Analysis

F21-2



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance F

Section F-F
21 Year Stability
Circular Analysis

F-21-3

Slide Analysis Information

Document Name

File Name: f-f(21 year) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1894 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1525 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1301 psf
Water Surface: None

F2 1-4

Section F-F
21 Year Stability
Circular Analysis

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1353 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1704 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2522 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2157 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1640 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1347 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1392 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1784 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2756 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile

Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.51875
Center: 1583.72, 217.666
Radius: 266.624
Left Slip Surface Endpoint: 1343.73, 101.497
Right Slip Surface Endpoint: 1714.94, -14.4315
Left Slope Intercept: 1343.73 101.497
Right Slope Intercept: 1714.94 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 29982
Number of Invalid Surfaces: 3534
Error Codes:
Error Code -100 reported for 1 surface
Error Code -106 reported for 254 surfaces
Error Code -108 reported for 481 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 2485 surfaces
Error Code -112 reported for 312 surfaces

Error Codes

The following errors were encountered during the computation:

-100 = Both surface / slope intersections are on the same horizontal surface. In general, this will give a very high or infinite factor of safety (zero driving force), if calculated.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

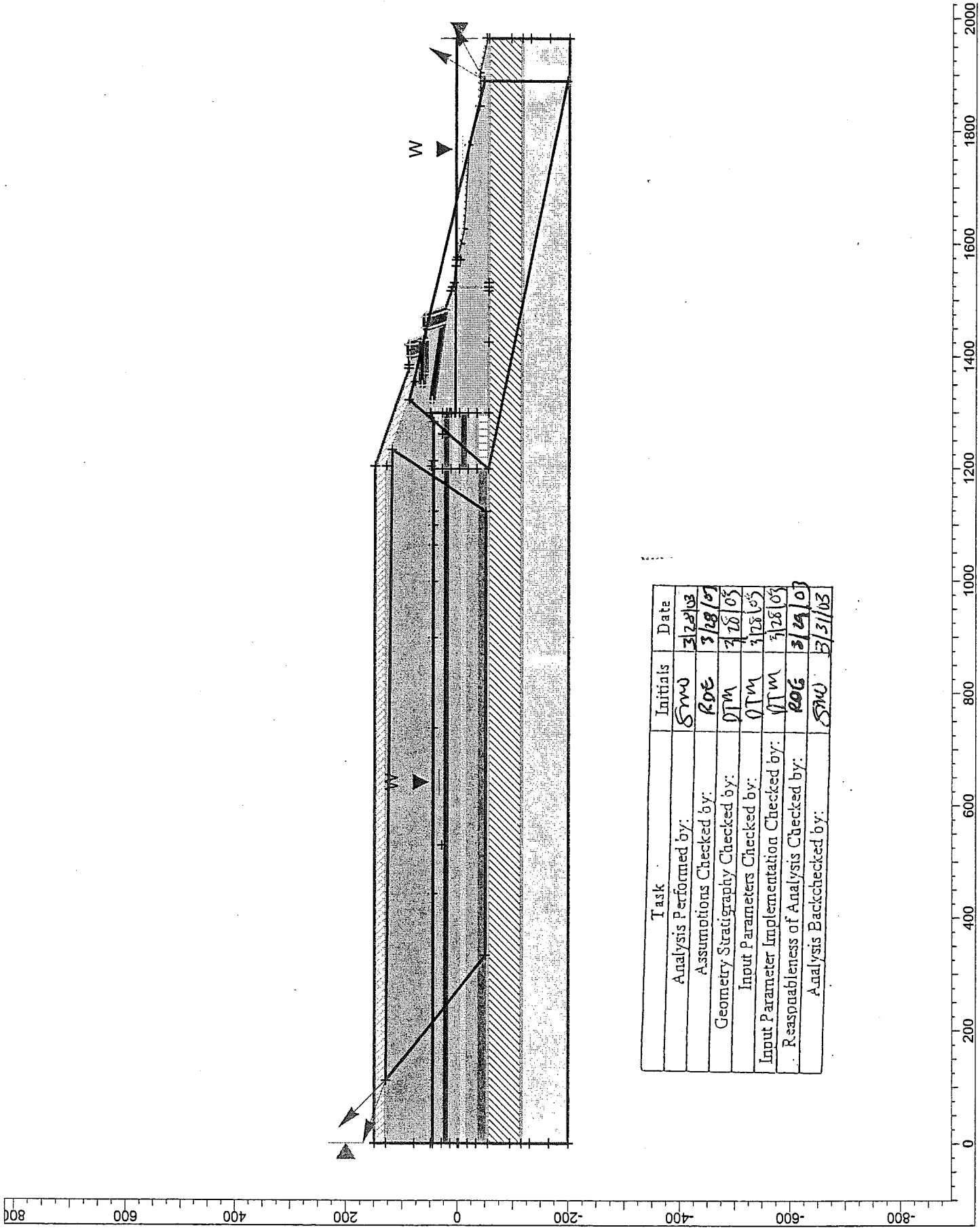
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

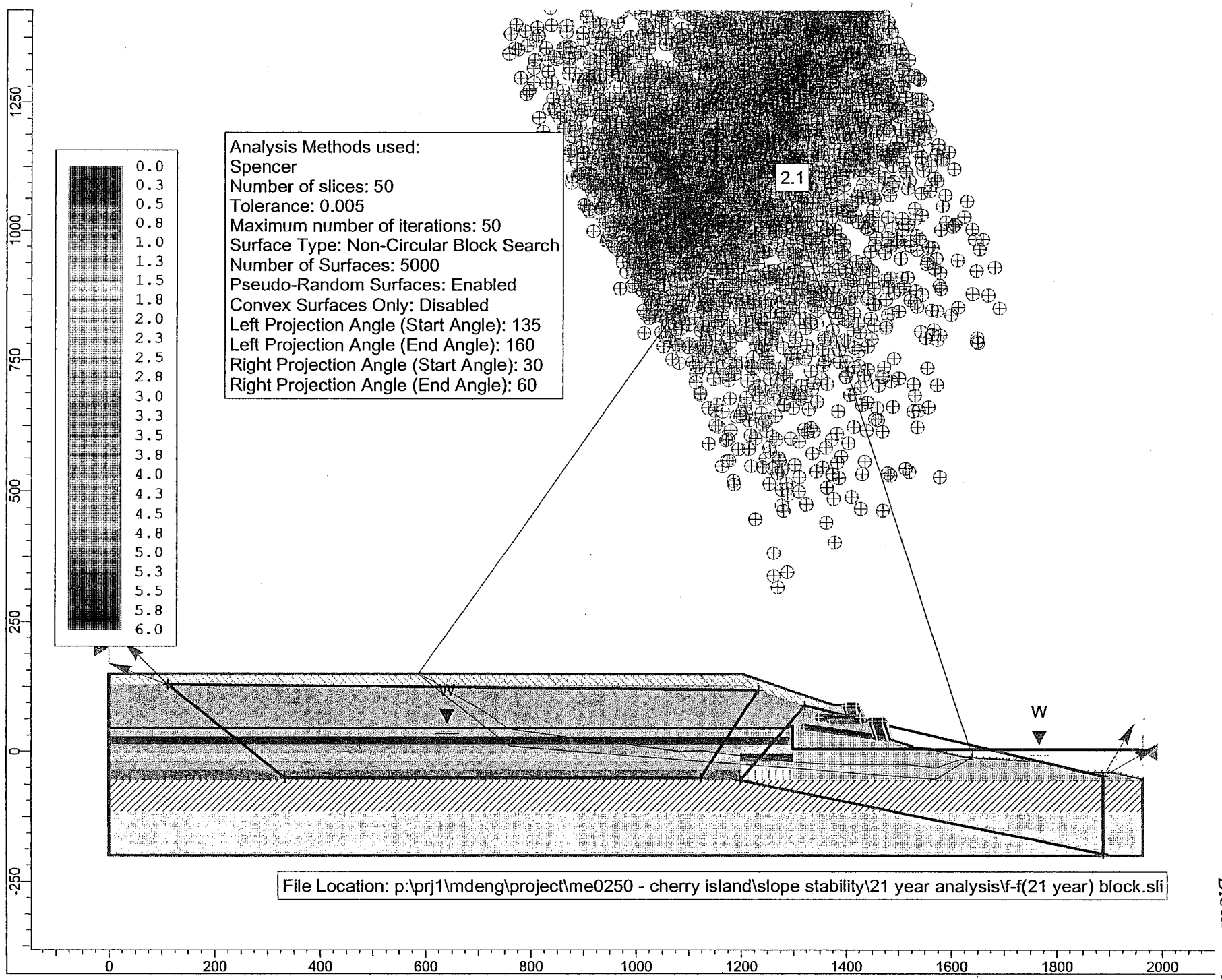
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

Section F-F
21 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	RDE	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDE	3/29/03
Analysis Backchecked by:	SMW	3/31/03

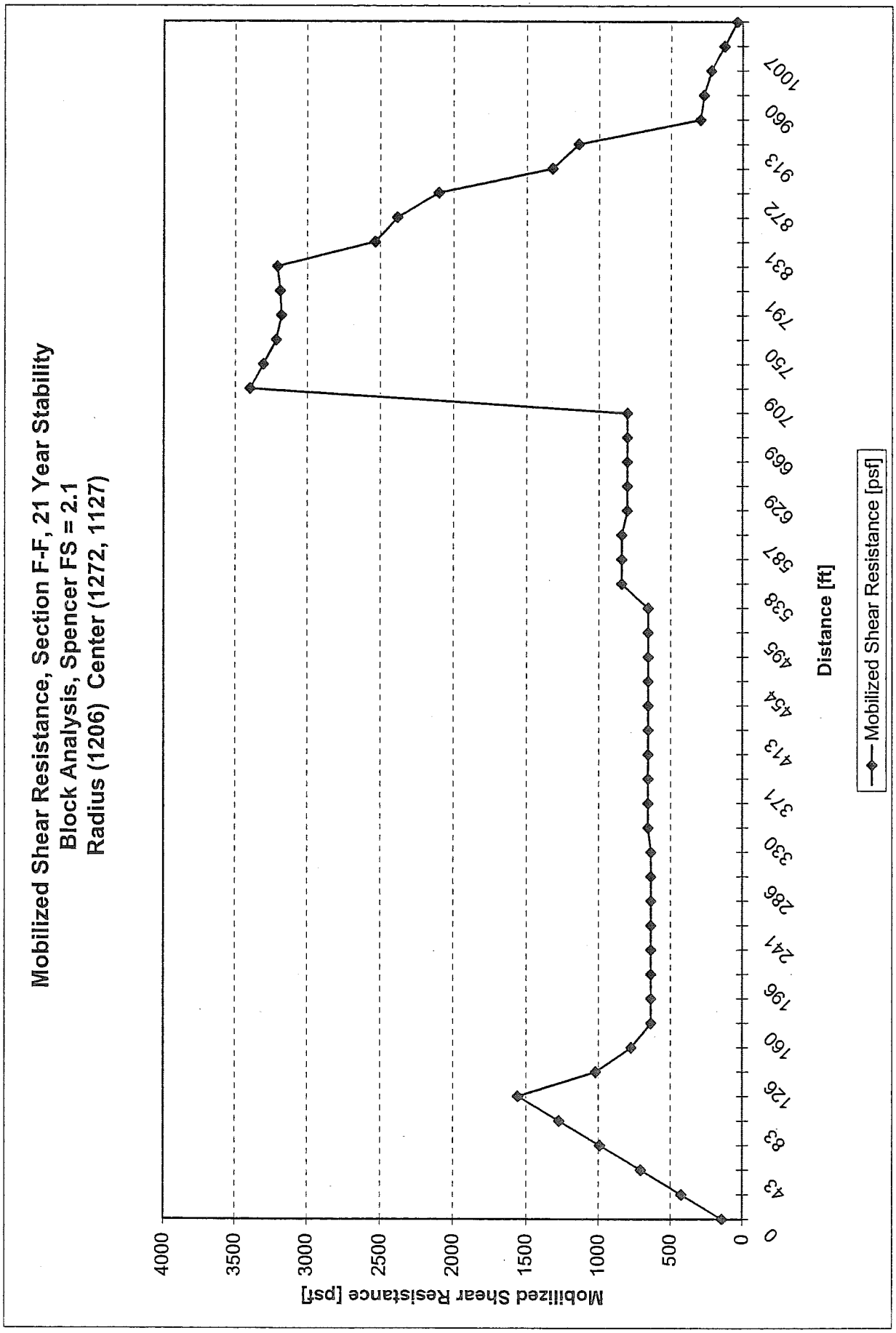
F21-6



Section F-F
21 Year Stability
Block Analysis

F - 21 - 1

Section F-F
21 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance F

F21-8

Slide Analysis Information

Document Name

File Name: f-f(21 year) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1894 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1525 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3

Section F-F
21 Year Stability
Block Analysis

F21-5

Cohesion Type: Constant
Cohesion: 1301 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1353 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1704 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2522 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2157 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1640 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1347 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1392 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1784 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2756 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.11785
Axis Location: 1272.4, 1123.69
Left Slip Surface Endpoint: 586.401, 149
Right Slip Surface Endpoint: 1640.55, -9.92435
Left Slope Intercept: 586.401 149
Right Slope Intercept: 1640.55 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 3913
Number of Invalid Surfaces: 1087
Error Codes:
Error Code -105 reported for 1 surface
Error Code -107 reported for 220 surfaces
Error Code -108 reported for 788 surfaces
Error Code -111 reported for 70 surfaces
Error Code -112 reported for 8 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

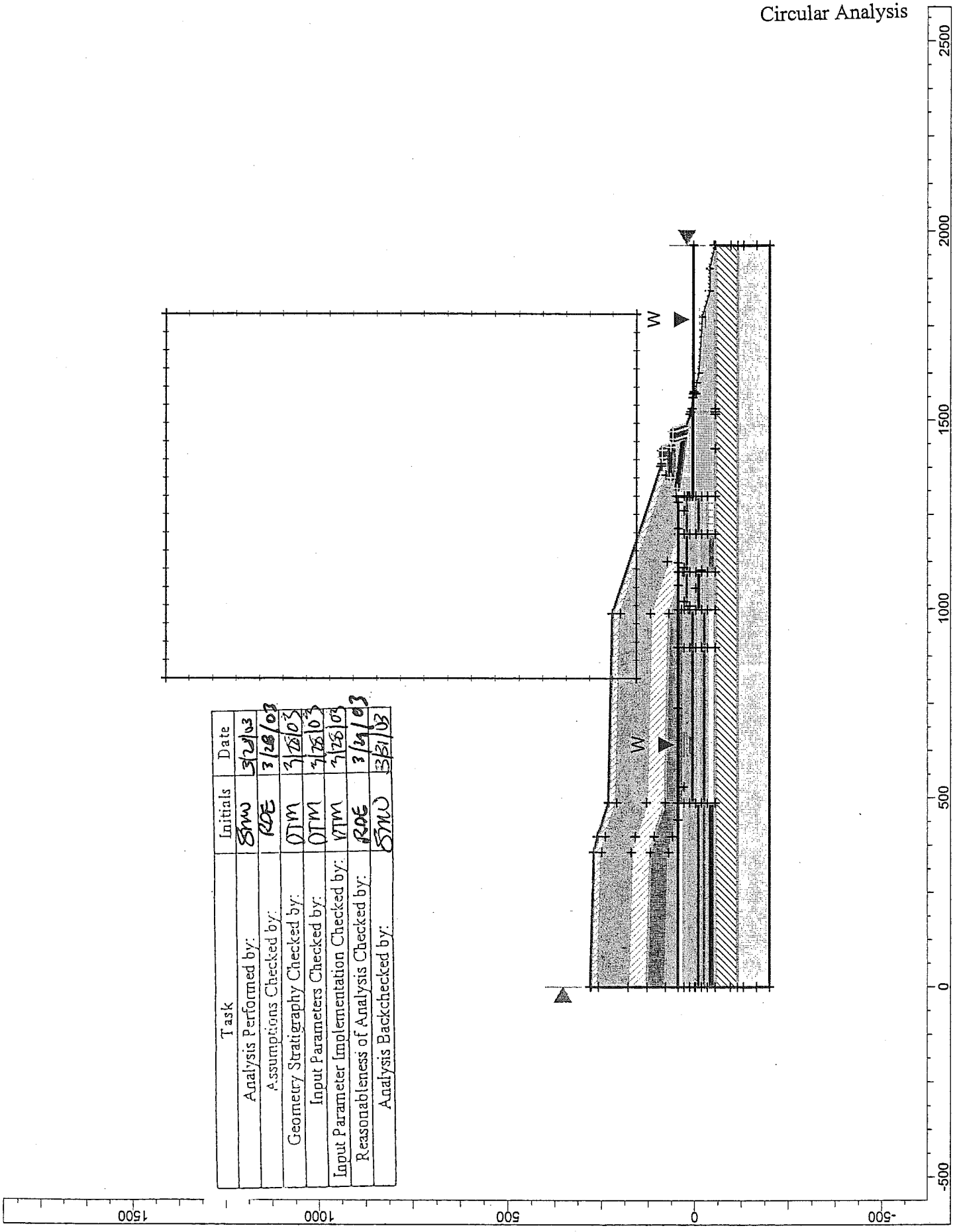
-111 = safety factor equation did not converge

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

Section F-F
21 Year Stability
Block Analysis

C-1-18

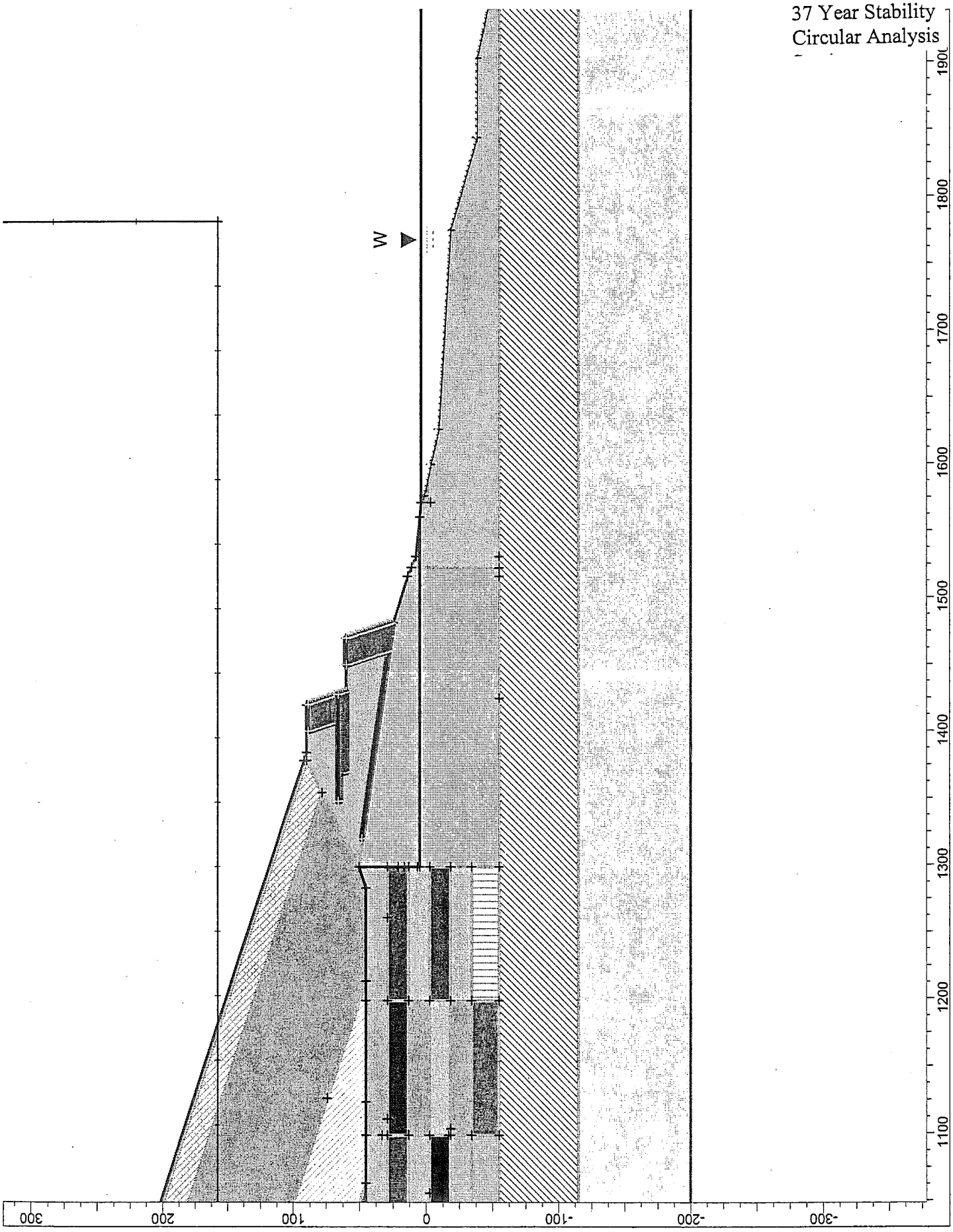
Section F-F
37 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	RDE	3/28/03
Geometry/Stratigraphy Checked by:	DTM	3/26/03
Input Parameters Checked by:	DTM	3/26/03
Input Parameter Implementation Checked by:	DTM	3/26/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMO	3/31/03

F37-1

Section F-F
37 Year Stability
Circular Analysis

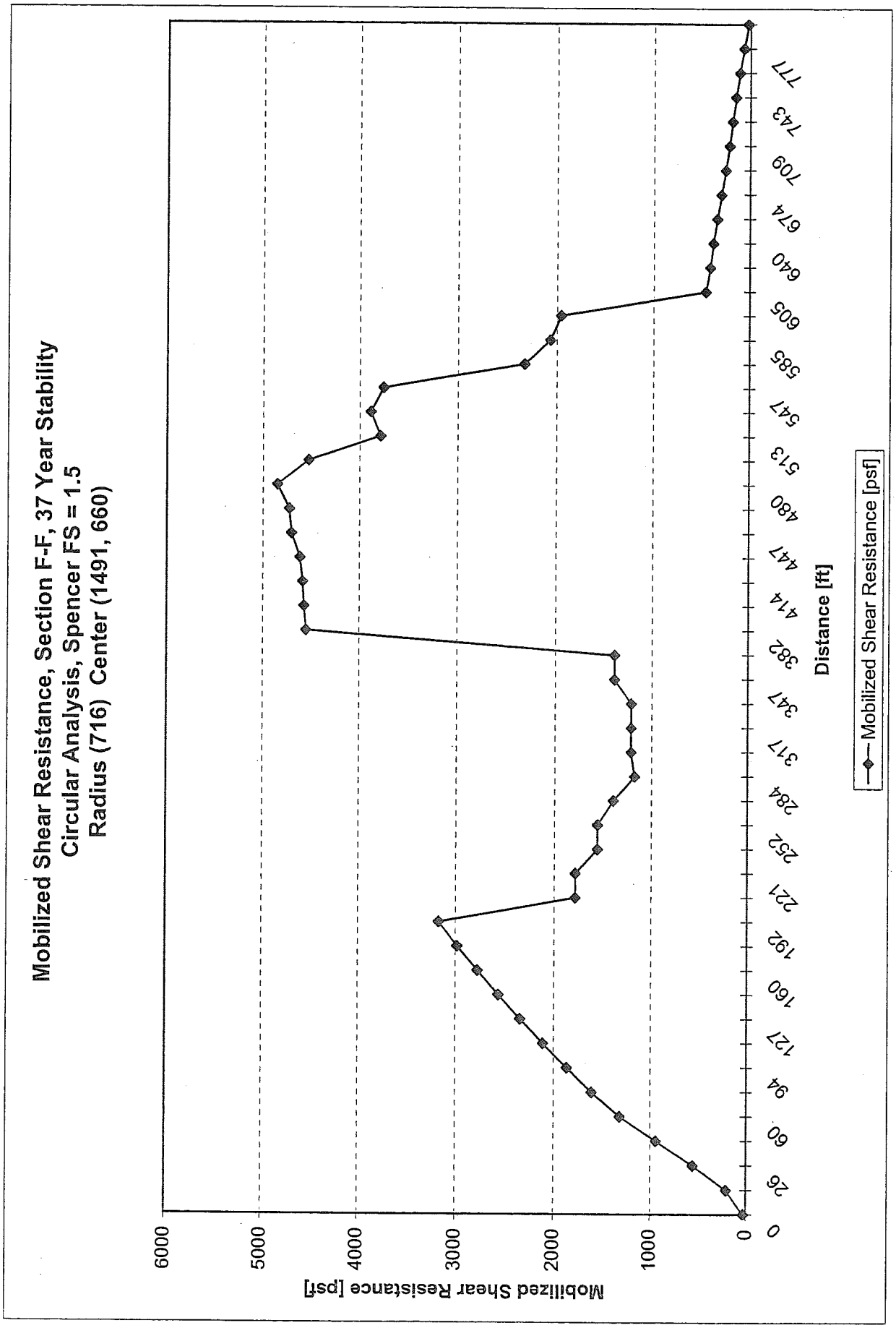


F37-2

Section F-F
37 Year Stability
Circular Analysis

F37-3

Section F-F
37 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance F

F37-4

Slide Analysis Information

Document Name

File Name: f-f(37 year) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function

F-F-1

Section F-F
37 Year Stability
Circular Analysis

Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1852 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1750 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1807 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2075 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2693 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2665 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2086 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2094 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2392 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3227 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3326 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2709 psf

Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2237 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2174 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2565 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3746 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3695 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2757 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2075 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2531 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4029 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4335 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3029 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2247 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2181 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2781 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4655 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.49154
Center: 1491.05, 660.066
Radius: 715.623
Left Slip Surface Endpoint: 924.193, 223.27
Right Slip Surface Endpoint: 1727.92, -15.2181
Left Slope Intercept: 924.193 223.27
Right Slope Intercept: 1727.92 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 29246
Number of Invalid Surfaces: 4270
Error Codes:
Error Code -105 reported for 1 surface
Error Code -106 reported for 116 surfaces
Error Code -108 reported for 499 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 1360 surfaces
Error Code -112 reported for 2293 surfaces

Error Codes

The following errors were encountered during the computation:

Section F-F
37 Year Stability
Circular Analysis

-105 = More than two surface / slope intersections with no valid slip surface.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

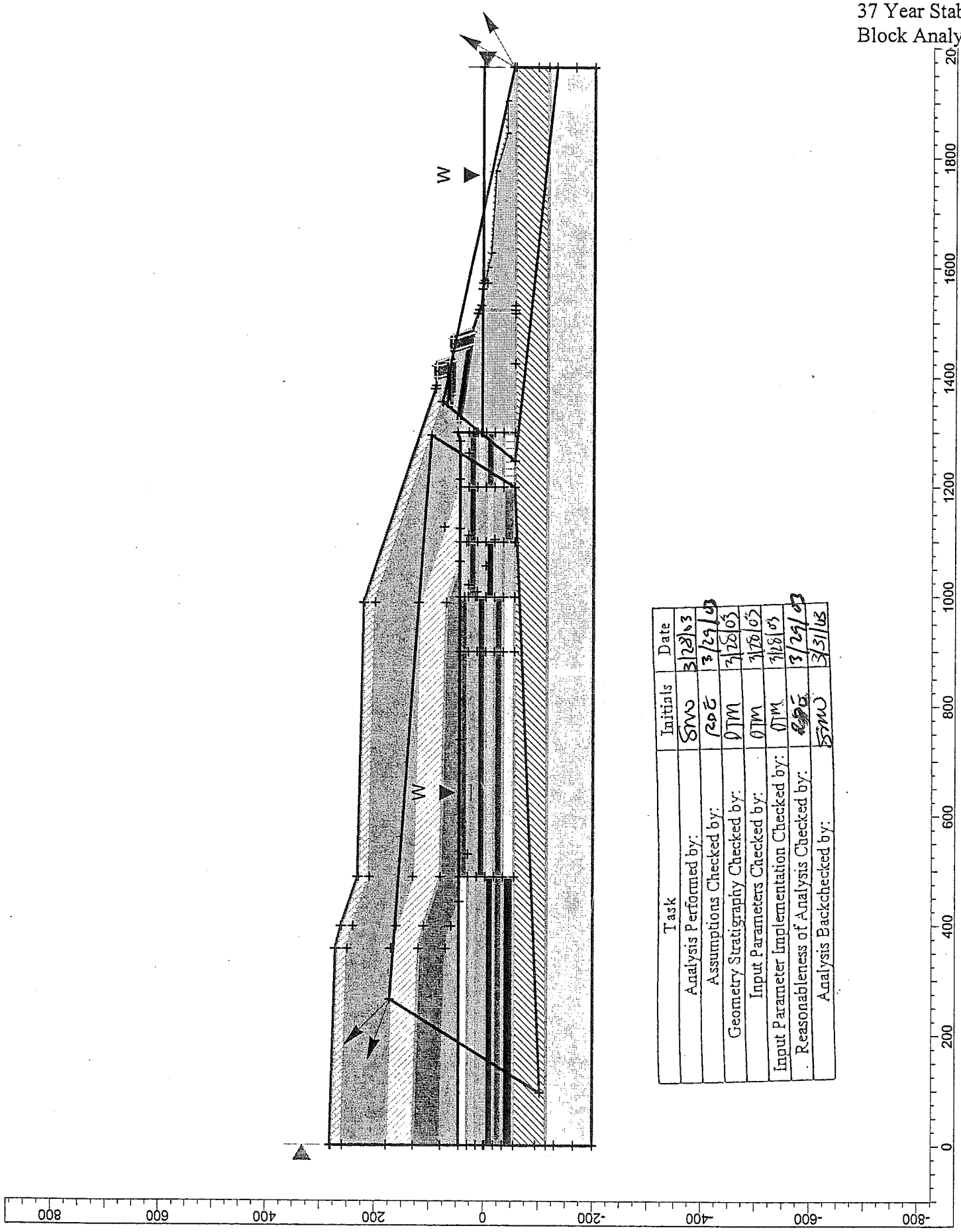
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

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

Section F-F
37 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/28/03
Assumptions Checked by:	RDE	3/29/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDE	3/29/03
Analysis Backchecked by:	SMO	3/31/03

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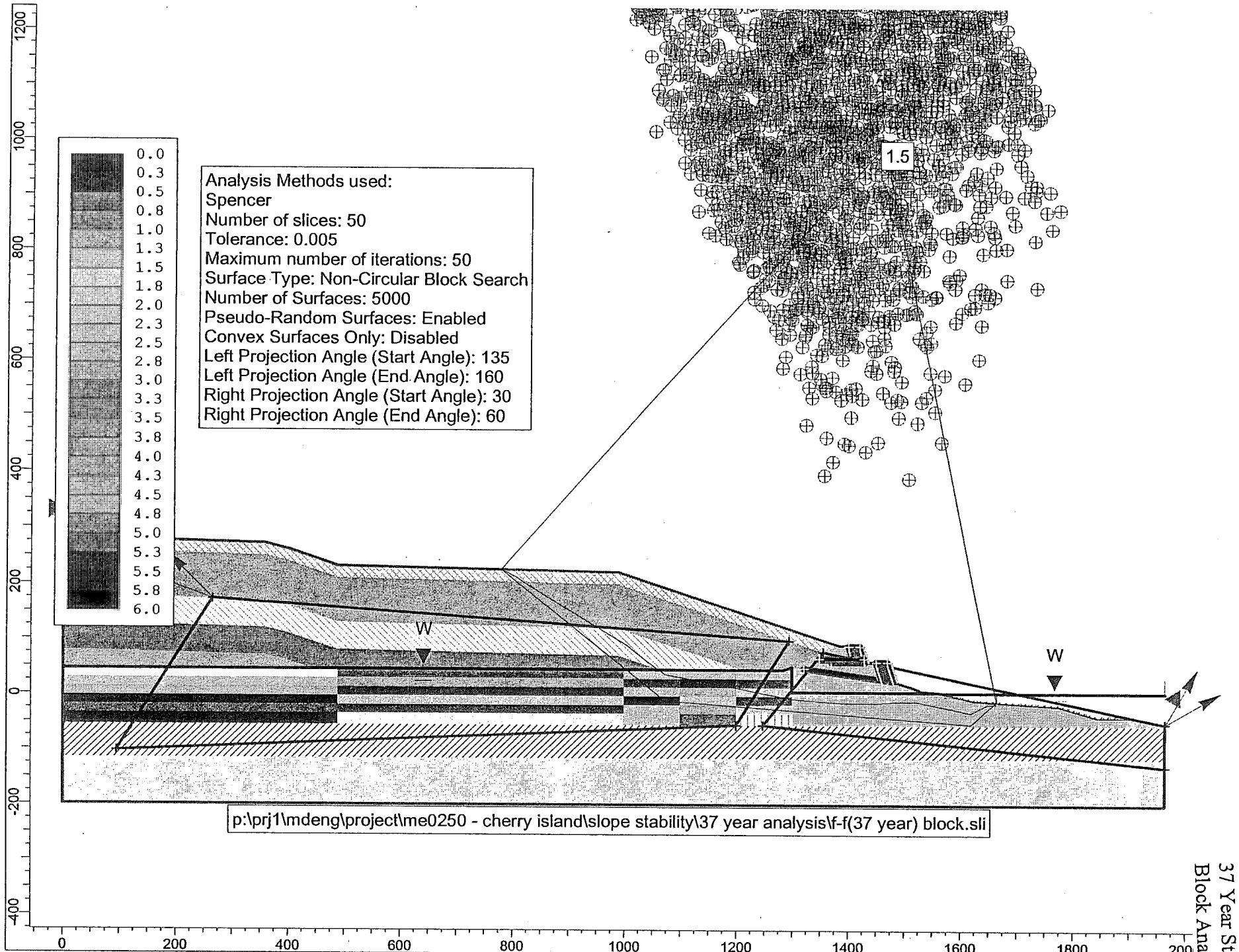
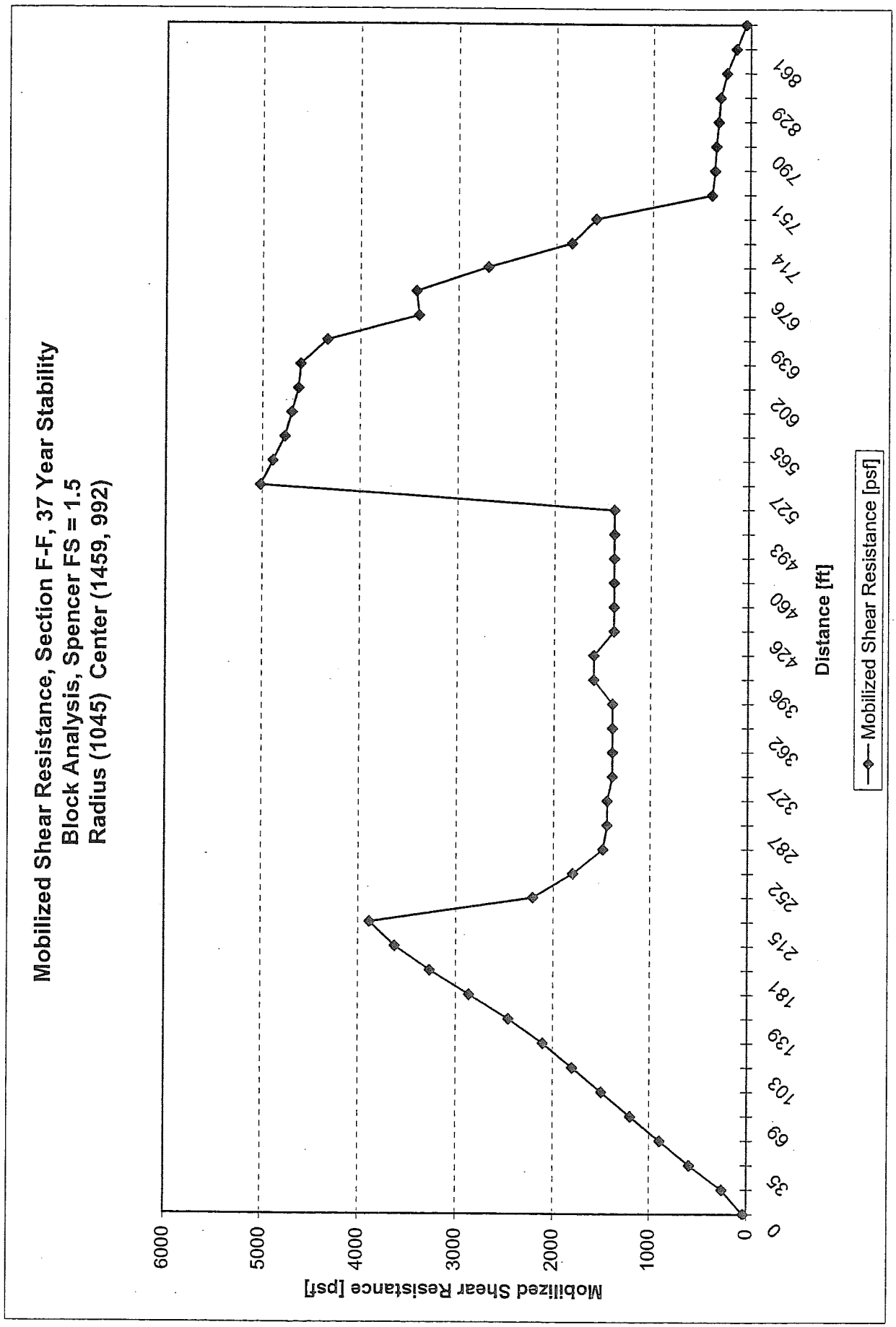


Section F-F
37 Year Stability
Block Analysis

F-37-1

Section F-F
37 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance F

F37-10

Slide Analysis Information

Document Name

File Name: f-f(37 year) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

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Section F-F
37 Year Stability
Block Analysis

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1852 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1750 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1807 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2075 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2693 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2665 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2086 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2094 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2392 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3227 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3326 psf
Water Surface: None

Material: d32
Strength Type: Undrained

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2709 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2237 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2174 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2565 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3746 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3695 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2757 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2075 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2531 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4029 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4335 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3029 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2247 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section F-F
37 Year Stability
Block Analysis

F37-11

Cohesion: 2181 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2781 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4655 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.50372
Axis Location: 1458.71, 992.005
Left Slip Surface Endpoint: 778.933, 226.175
Right Slip Surface Endpoint: 1663.51, -11.3152
Left Slope Intercept: 778.933 226.175
Right Slope Intercept: 1663.51 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 4291
Number of Invalid Surfaces: 709
Error Codes:
Error Code -105 reported for 15 surfaces
Error Code -108 reported for 454 surfaces
Error Code -111 reported for 18 surfaces
Error Code -112 reported for 222 surfaces

Error Codes

The following errors were encountered during the computation:

Section F-F
37 Year Stability
Block Analysis

-105 = More than two surface / slope intersections with no valid slip surface.

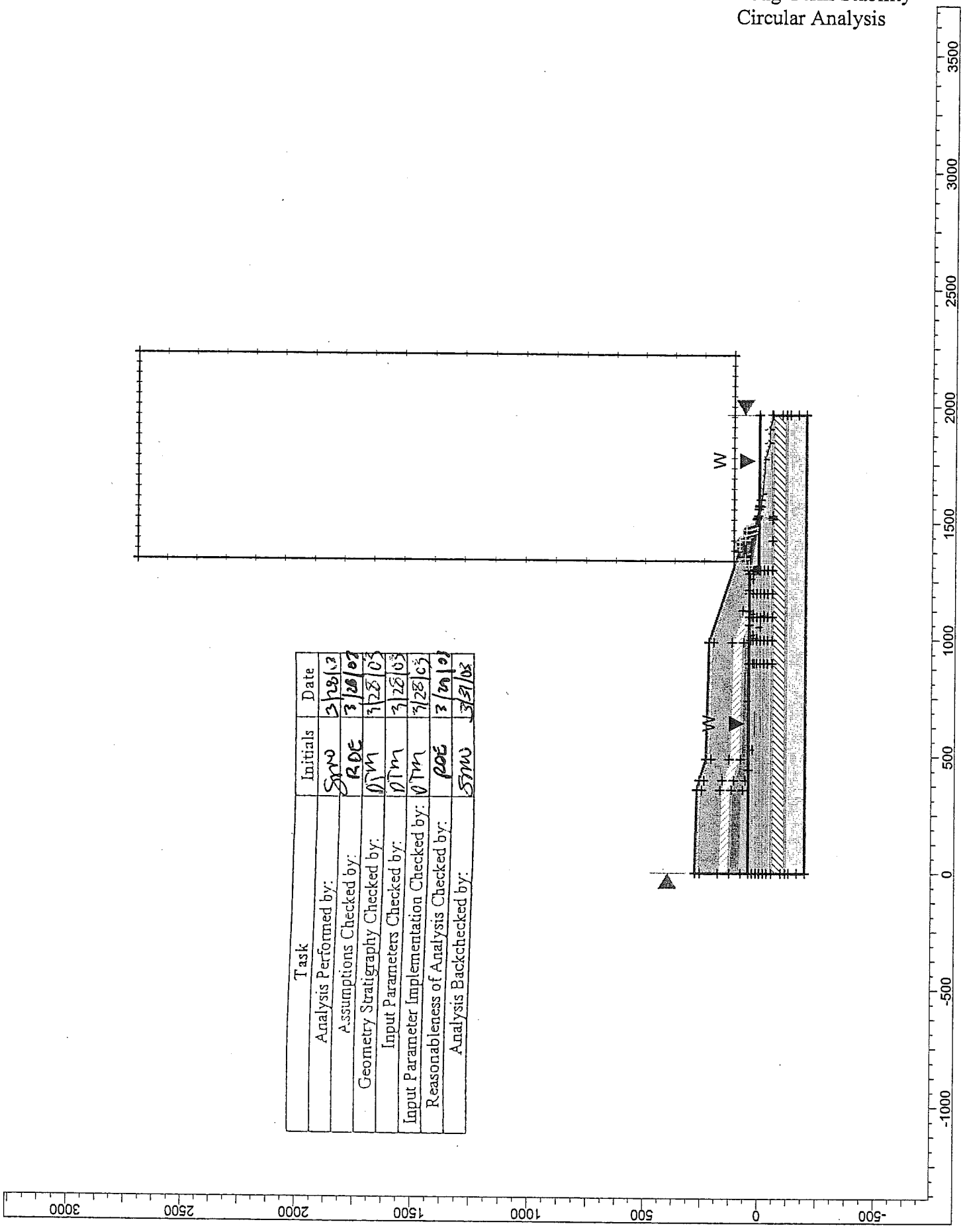
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

F37-12

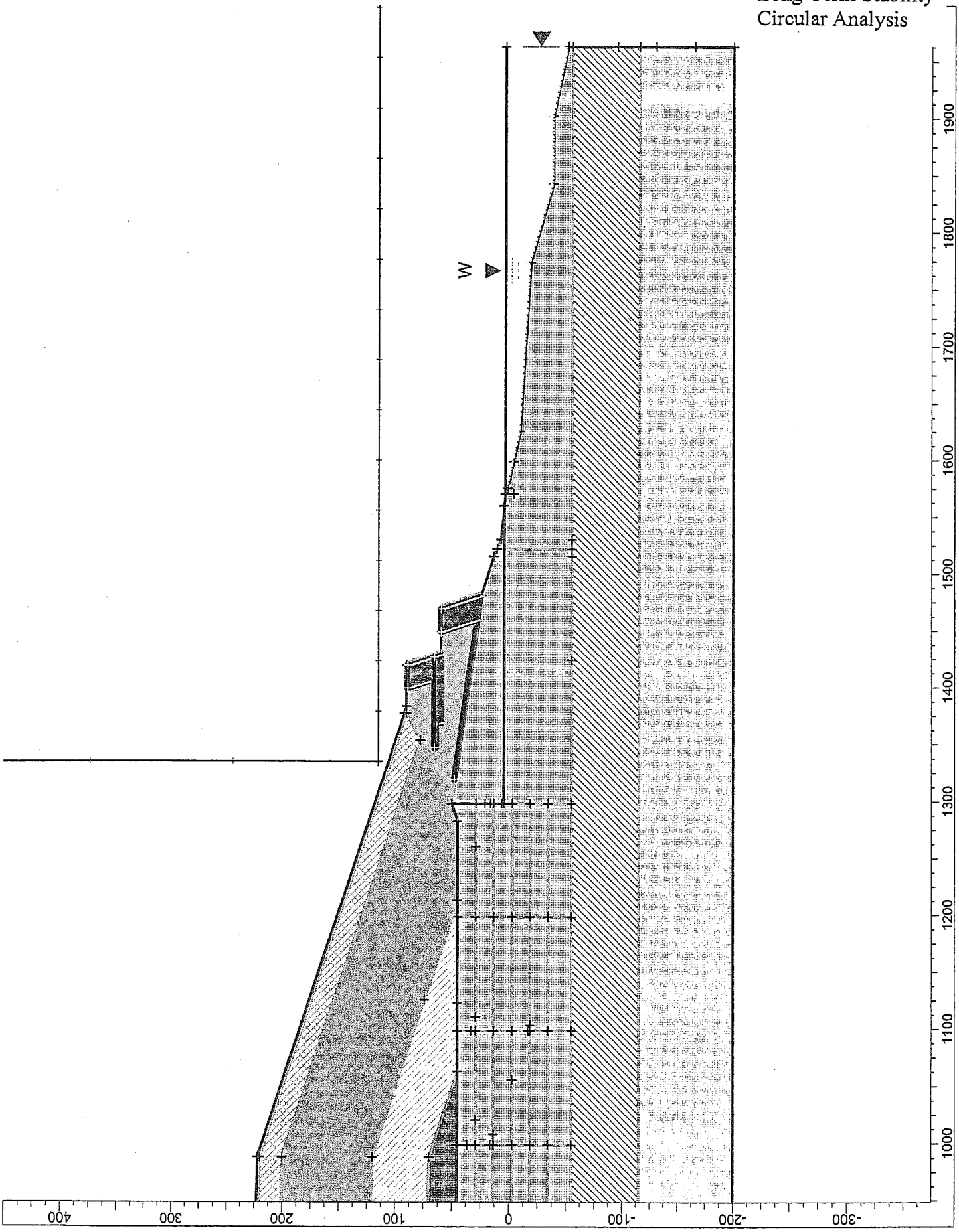
Section F-F
Long-Term Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/28/07
Assumptions Checked by:	ROE	3/28/07
Geometry Stratigraphy Checked by:	DTM	3/28/07
Input Parameters Checked by:	DTM	3/28/07
Input Parameter Implementation Checked by:	DTM	3/28/07
Reasonableness of Analysis Checked by:	ROE	3/29/07
Analysis Backchecked by:	SMW	3/31/07

FLT-1

Section F-F
Long-Term Stability
Circular Analysis

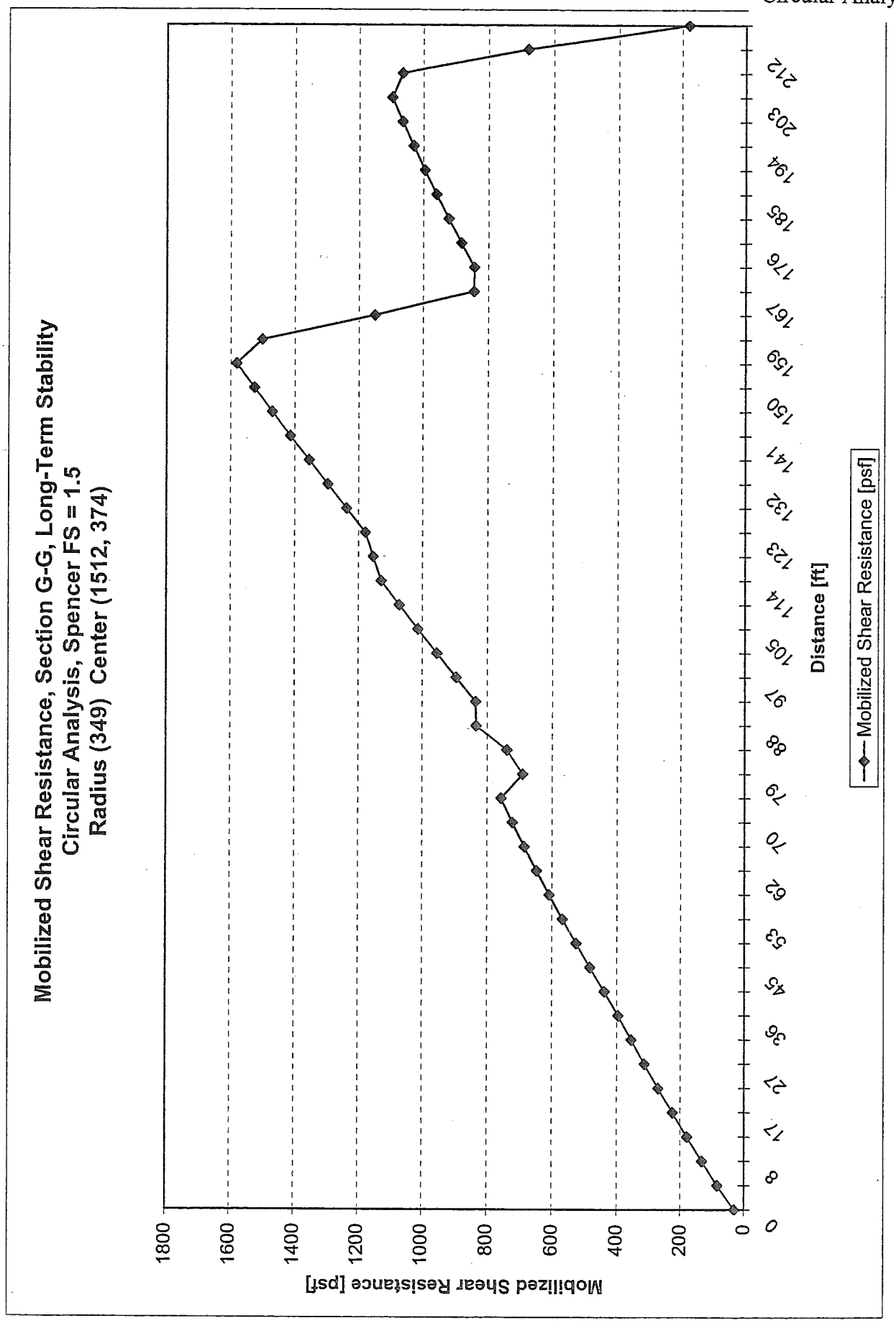


FLT-2

Section F-F
Long-Term Stability
Circular Analysis
Analysis Methods used:
Spencer
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50
Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
3.8
4.0
4.3
4.5
4.8
5.0
5.3
5.5
5.8
6.0
1.5
W
W
p:\prj1\mdeng\projectme0250 - cherry island\slope stability\long-term analysis\f-f(long-term) circular.sli
600
400
200
0
-200
400
600
800
1000
1200
1400
1600

F1 T-3

Section F-F
Long-Term Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance

F1-4

Slide Analysis Information

Document Name

File Name: f-f(long-term) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3

FLT-4

Section F-F
Long-Term Stability
Circular Analysis

Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.53462
Center: 1511.61, 373.796
Radius: 349.218
Left Slip Surface Endpoint: 1260.57, 131.044
Right Slip Surface Endpoint: 1480.38, 25.9775

Method Statistics

Method: spencer
Number of Valid Surfaces: 21715
Number of Invalid Surfaces: 11801
Error Codes:
Error Code -102 reported for 28 surfaces
Error Code -106 reported for 859 surfaces
Error Code -108 reported for 332 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 8322 surfaces
Error Code -112 reported for 283 surfaces
Error Code -1000 reported for 1976 surfaces

Error Codes

The following errors were encountered during the computation:

-102 = Two surface / slope intersections, but resulting arc is actually outside soil region.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

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

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

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

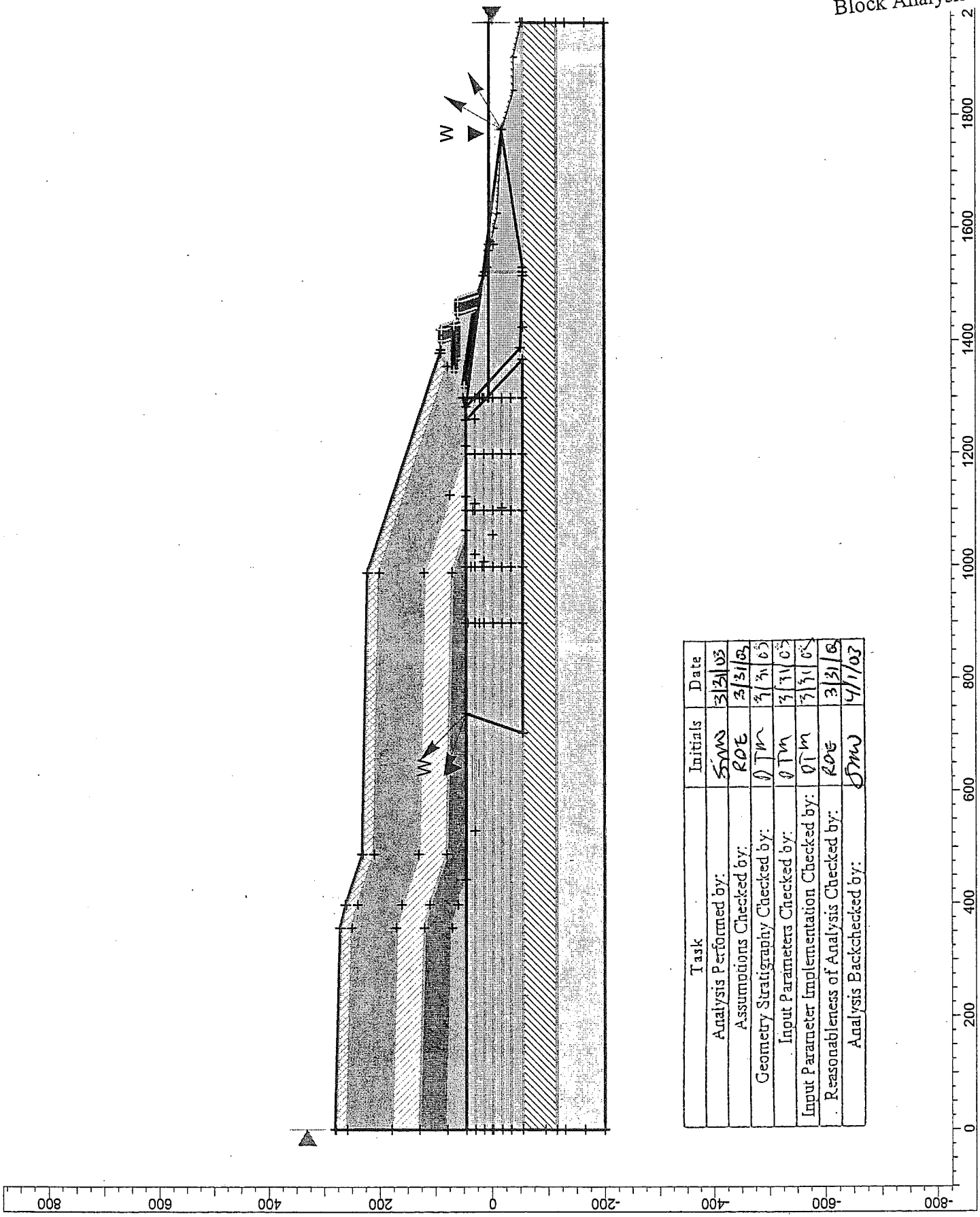
Section F-F
Long-Term Stability
Circular Analysis

angle slices in the passive zone.

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

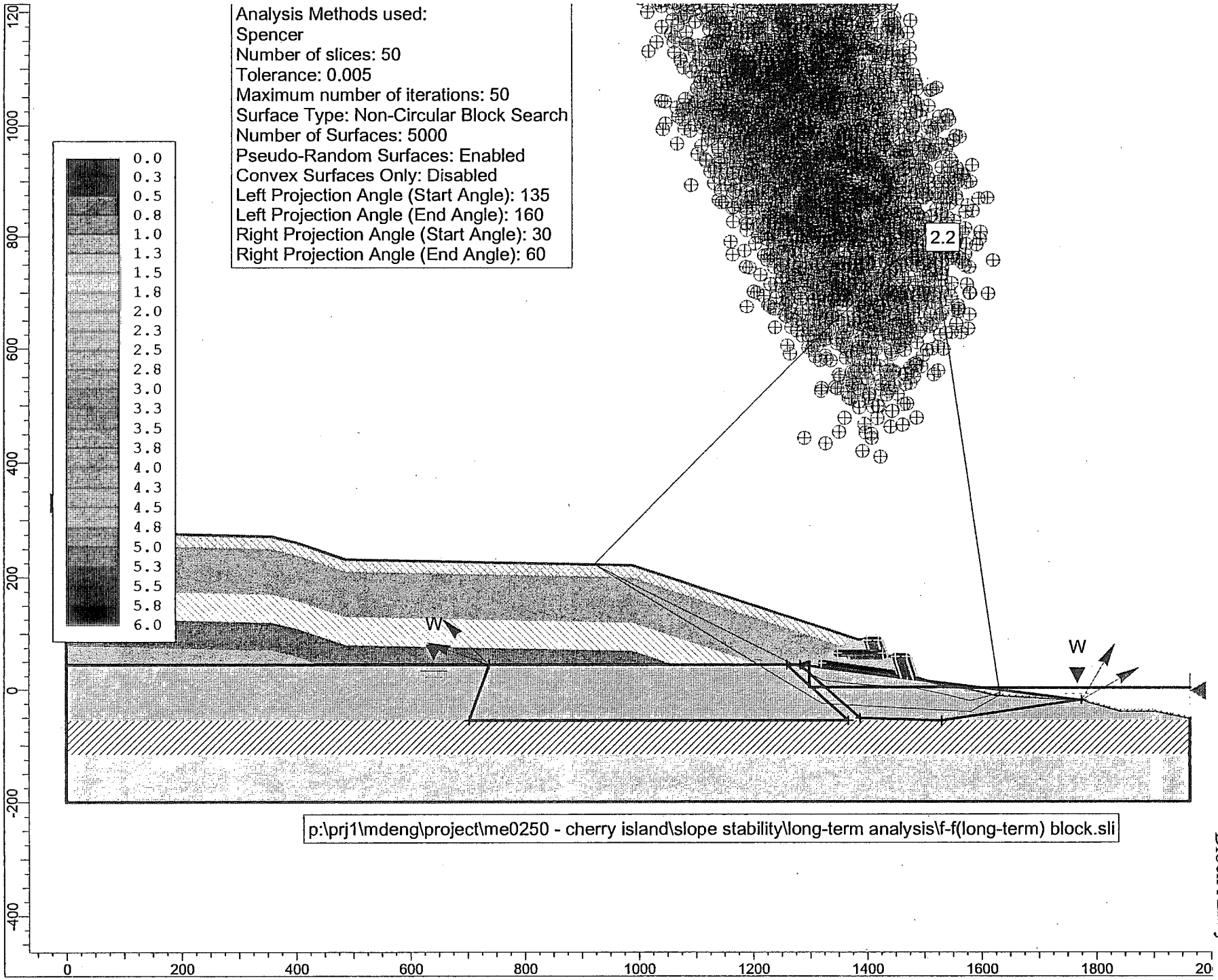
FLT-6

Section F-F
Long-Term Stability
Block Analysis



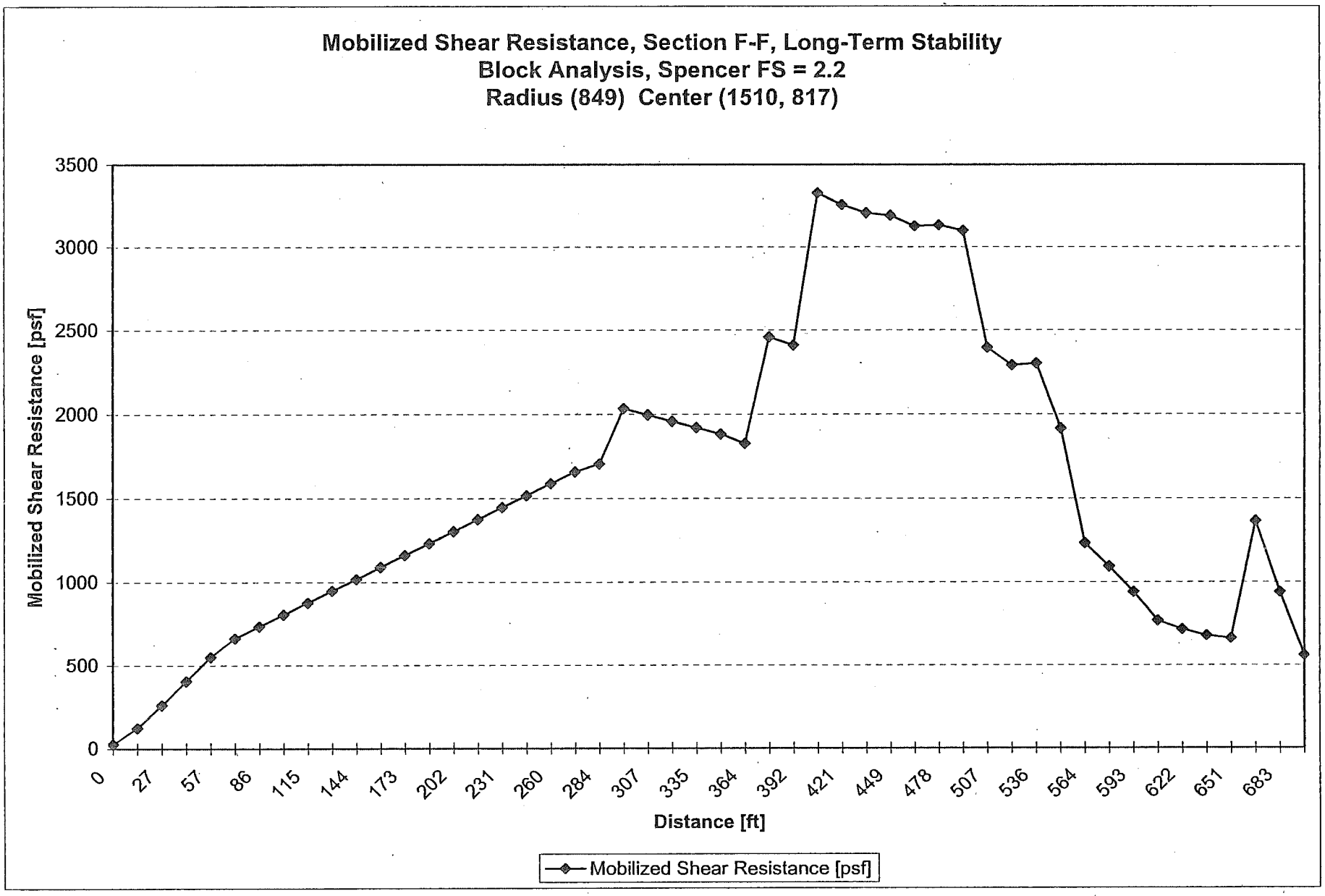
Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RDE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMW	4/1/03

FLT-7



Section F-F
Long-Term Stability
Block Analysis

FLT-8



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance F

Section F-F
Long-Term Stability
Block Analysis

5-13

Slide Analysis Information

Document Name

File Name: f-f(long-term) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Section F-F
Long-Term Stability
Block Analysis

F-1-12

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.21568
Axis Location: 1509.52, 817.223
Left Slip Surface Endpoint: 921.665, 223.321
Right Slip Surface Endpoint: 1631.93, -9.40162
Left Slope Intercept: 921.665 223.321
Right Slope Intercept: 1631.93 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 3741
Number of Invalid Surfaces: 1259
Error Codes:
Error Code -108 reported for 1240 surfaces
Error Code -111 reported for 15 surfaces
Error Code -112 reported for 4 surfaces

Error Codes

The following errors were encountered during the computation:

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

-111 = safety factor equation did not converge

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

Slide Analysis Information

Document Name

File Name: f-f(9 year) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1220 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 921 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 802 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section F-F
Long-Term Stability
Block Analysis

F-1-1

Cohesion: 905 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1236 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1934 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.2394
Axis Location: 1511.74, 760.368
Left Slip Surface Endpoint: 1032.9, 104
Right Slip Surface Endpoint: 1749.53, -16.5275
Left Slope Intercept: 1032.9 104
Right Slope Intercept: 1749.53 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 4905
Number of Invalid Surfaces: 95
Error Codes:
Error Code -105 reported for 16 surfaces
Error Code -108 reported for 64 surfaces
Error Code -111 reported for 12 surfaces
Error Code -112 reported for 3 surfaces

Error Codes

The following errors were encountered during the computation:

Section F-F
Long-Term Stability
Block Analysis

-105 = More than two surface / slope intersections with no valid slip surface.

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

-111 = safety factor equation did not converge

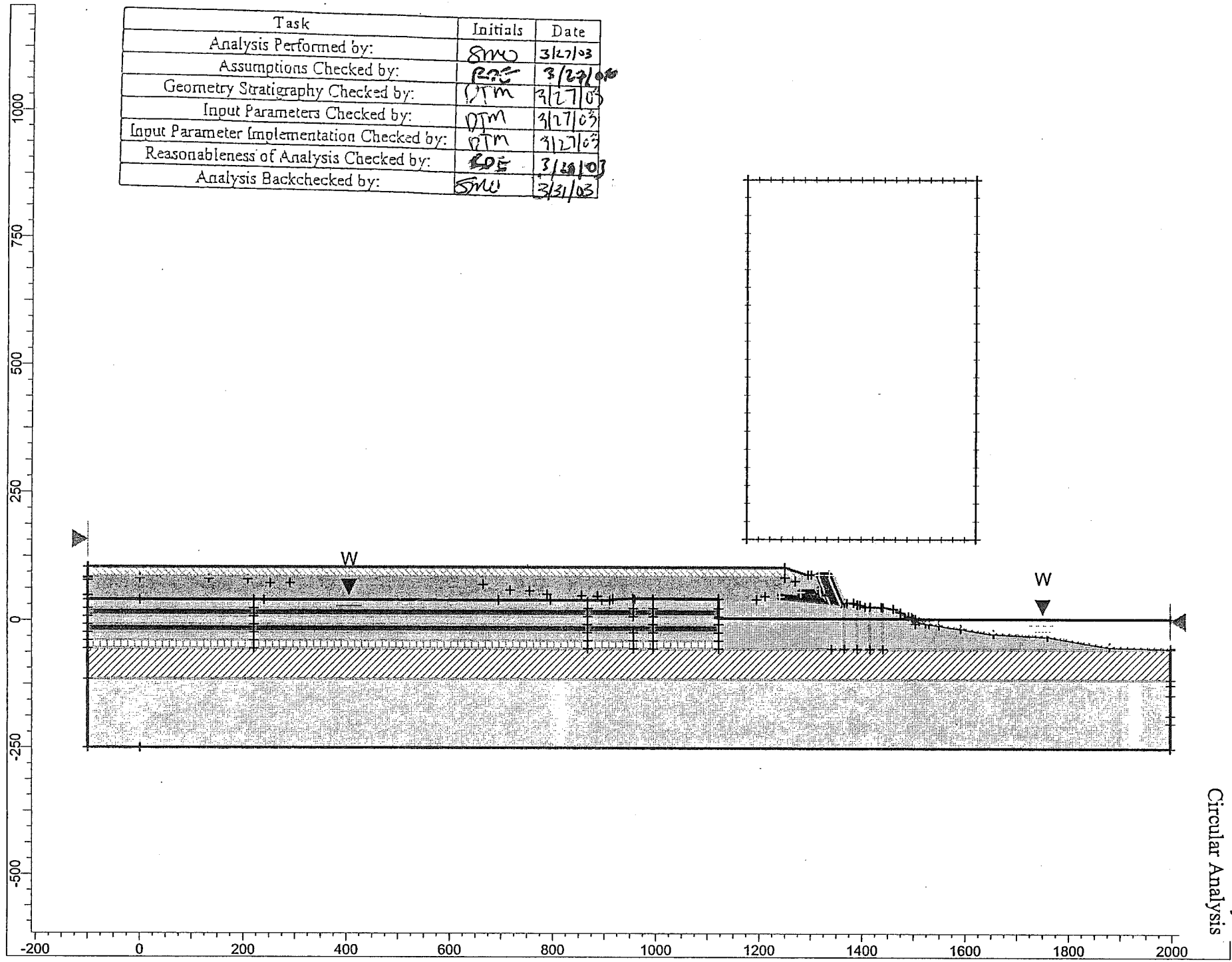
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

Attachment G

Stability Analysis Results for Cross Section G-G

Section G-G
Reinforcement Pattern

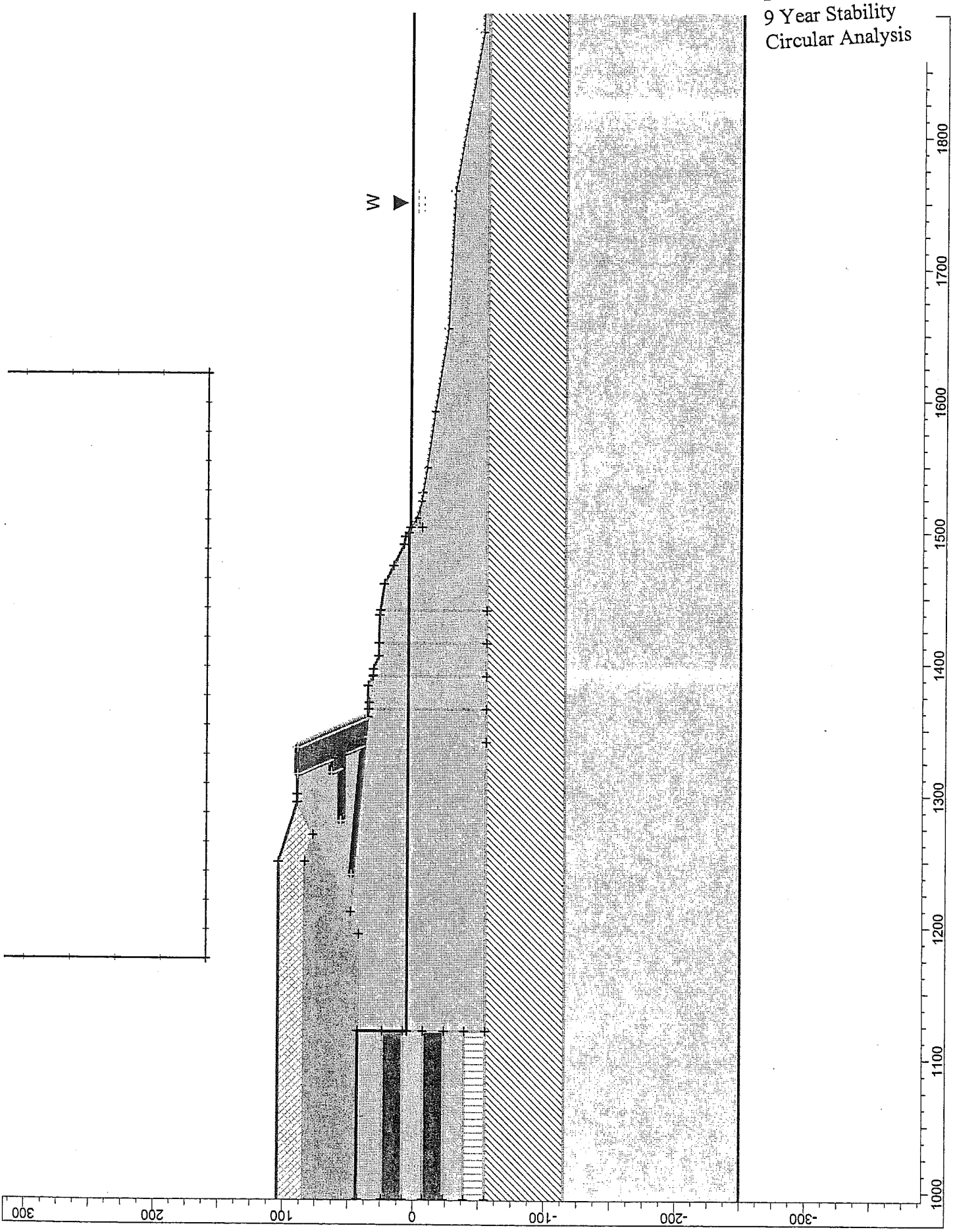
Task	Initials	Date
Analysis Performed by:	SMW	3/27/03
Assumptions Checked by:	RDE	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	RDE	3/28/03
Analysis Backchecked by:	SMW	3/31/03



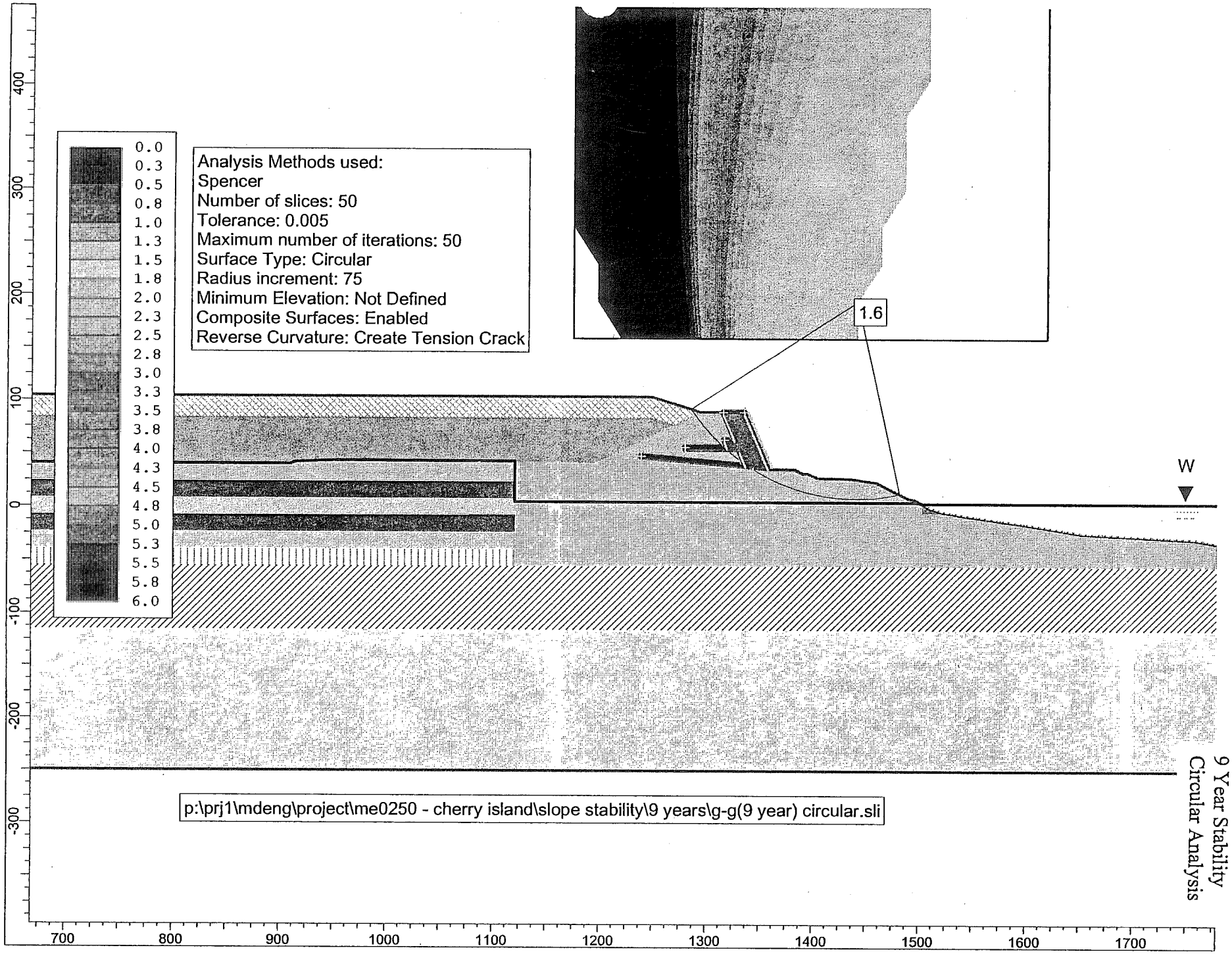
Section G-G
9 Year Stability
Circular Analysis

1-69

Section G-G
9 Year Stability
Circular Analysis

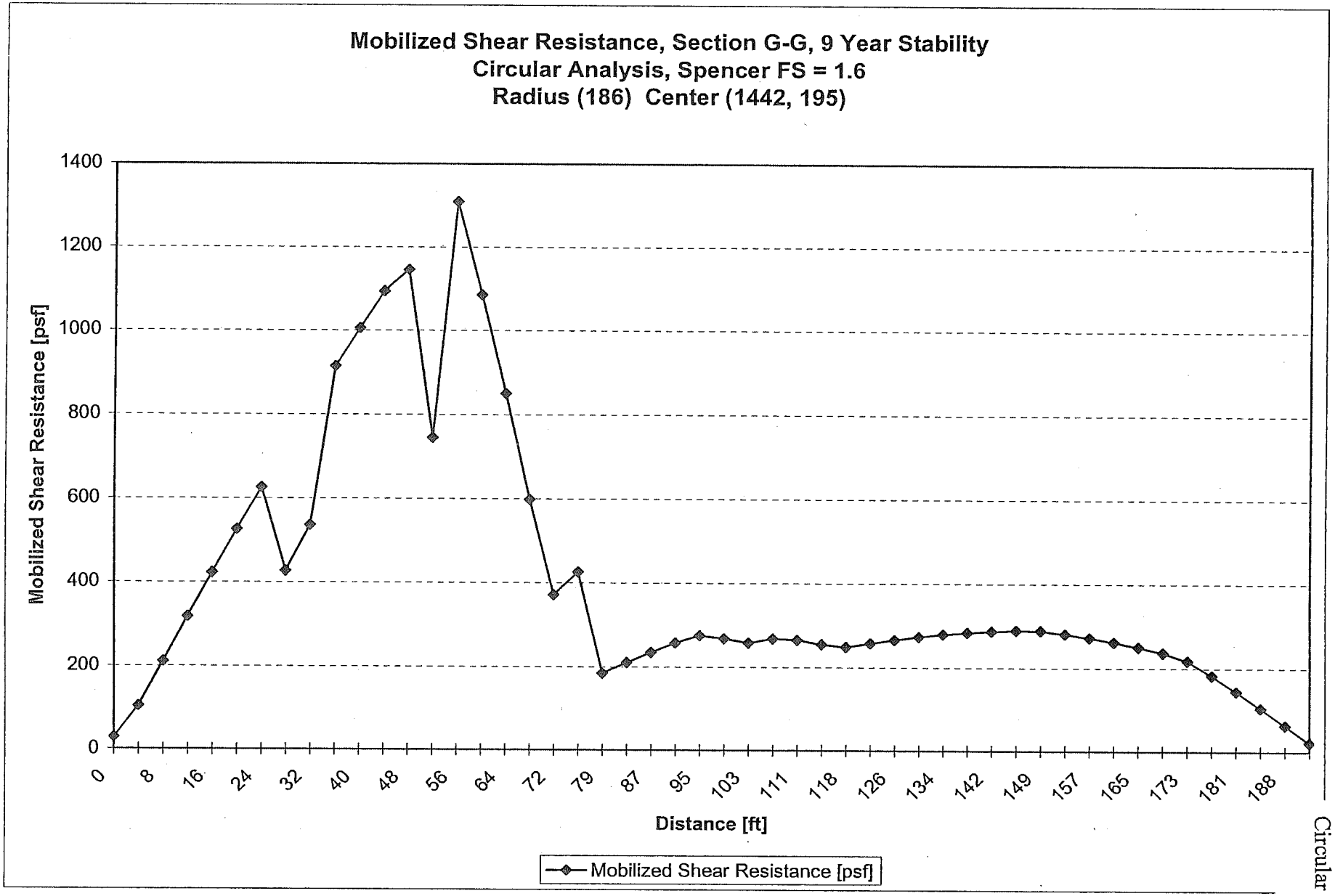


G9-2



Section G-G
9 Year Stability
Circular Analysis

G9-2



PRJ1/ME0250/SlopeStability/Mobilized Shear Resista

Section G-G
9 Year Stability
Circular Analysis

G9-4

Slide Analysis Information

Document Name

File Name: g-g(9 year) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: 5
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1220 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 921 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 802 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 905 psf
Water Surface: None

Section G-G
9 Year Stability
Circular Analysis

G9-5

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1236 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1934 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.58959
Center: 1441.63, 194.784
Radius: 186.199
Left Slip Surface Endpoint: 1285.95, 92.6415
Right Slip Surface Endpoint: 1481.99, 13.0108

Method Statistics

Method: spencer
Number of Valid Surfaces: 20686
Number of Invalid Surfaces: 12830
Error Codes:
Error Code -108 reported for 224 surfaces
Error Code -111 reported for 8882 surfaces
Error Code -1000 reported for 3724 surfaces

Error Codes

The following errors were encountered during the computation:

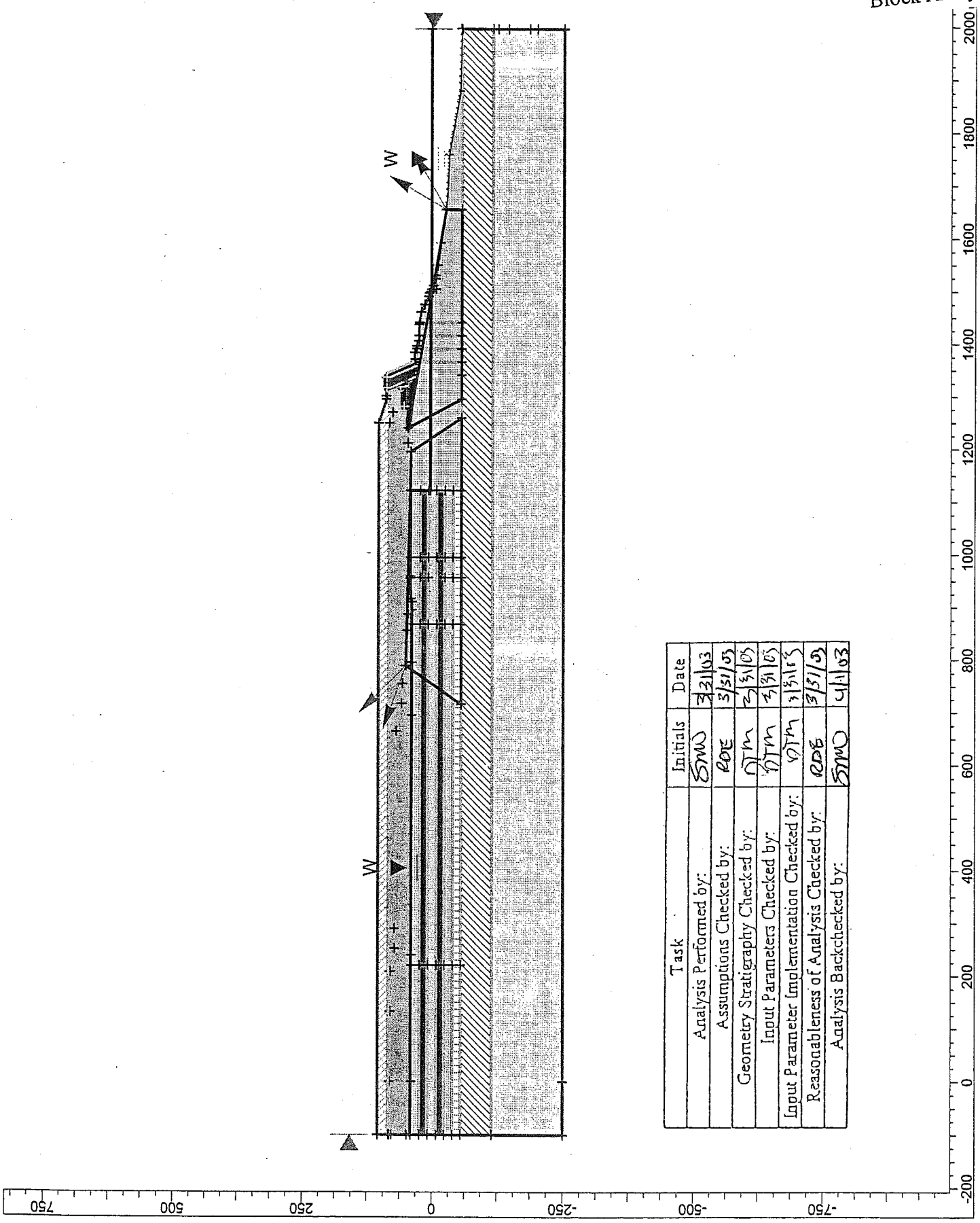
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

Section G-G
9 Year Stability
Circular Analysis

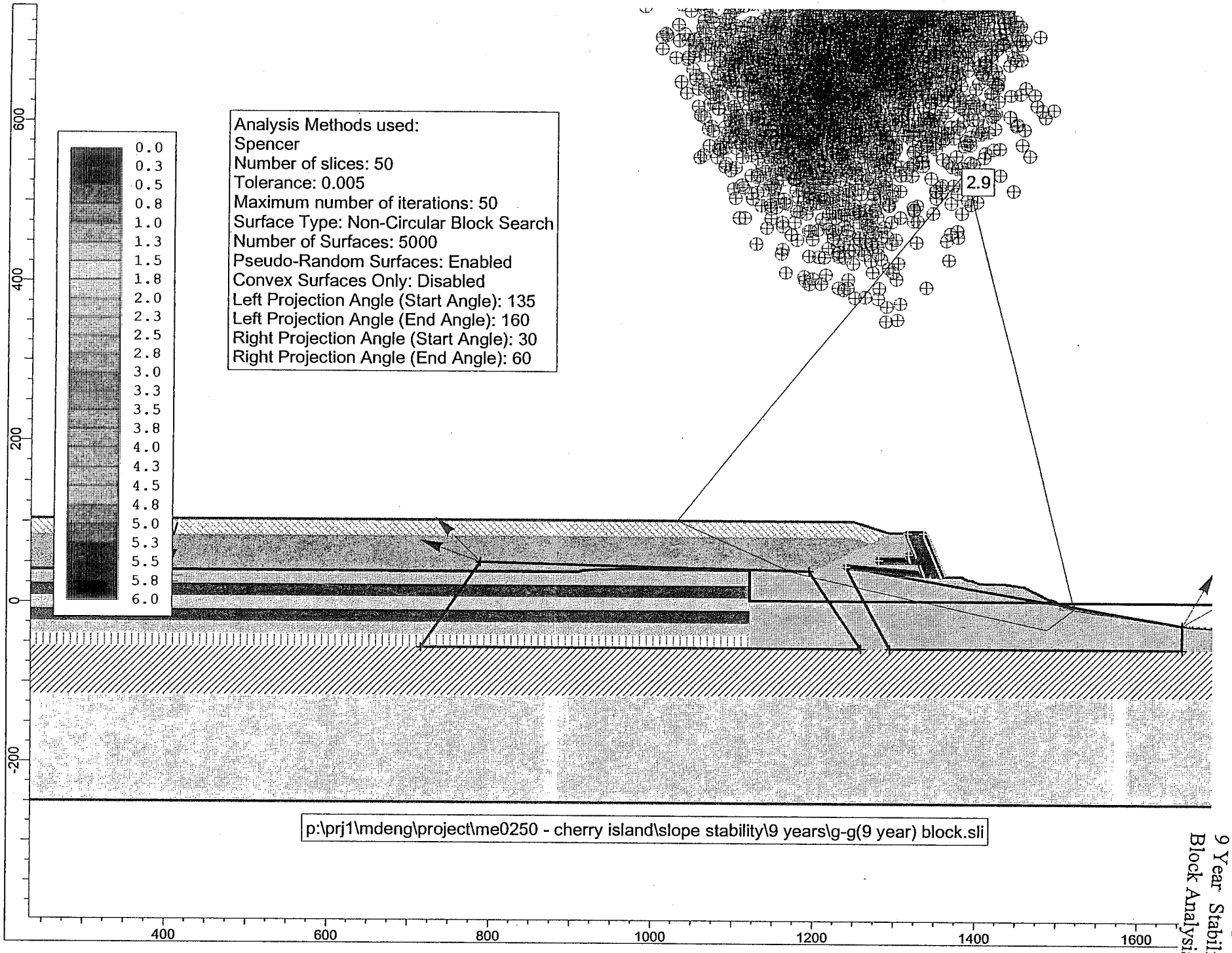
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section G-G
9 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/31/03
Assumptions Checked by:	RDE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMO	4/1/03

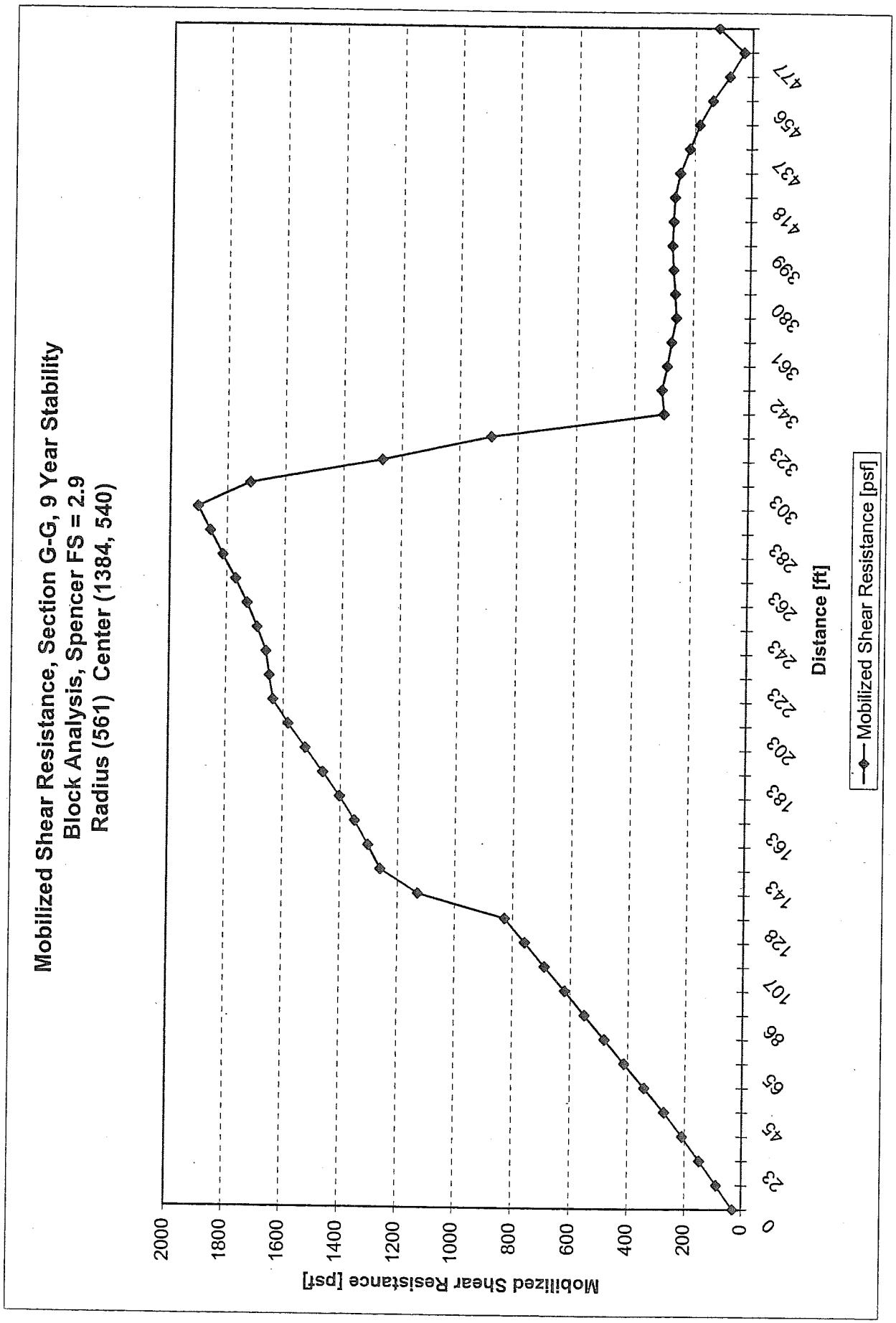
G9-7



Section G-G
9 Year Stability
Block Analysis

G-G

Section G-G
9 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance G

G9-9

Slide Analysis Information

Document Name

File Name: g-g(9 year) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1220 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 921 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 802 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section G-G
9 Year Stability
Block Analysis

G-G-18

Cohesion: 905 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1236 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1934 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.85042
Axis Location: 1383.72, 540.332
Left Slip Surface Endpoint: 1031.22, 104
Right Slip Surface Endpoint: 1521.29, -3.47233
Left Slope Intercept: 1031.22 104
Right Slope Intercept: 1521.29 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 4112
Number of Invalid Surfaces: 888
Error Codes:
Error Code -107 reported for 173 surfaces
Error Code -108 reported for 575 surfaces
Error Code -111 reported for 140 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure

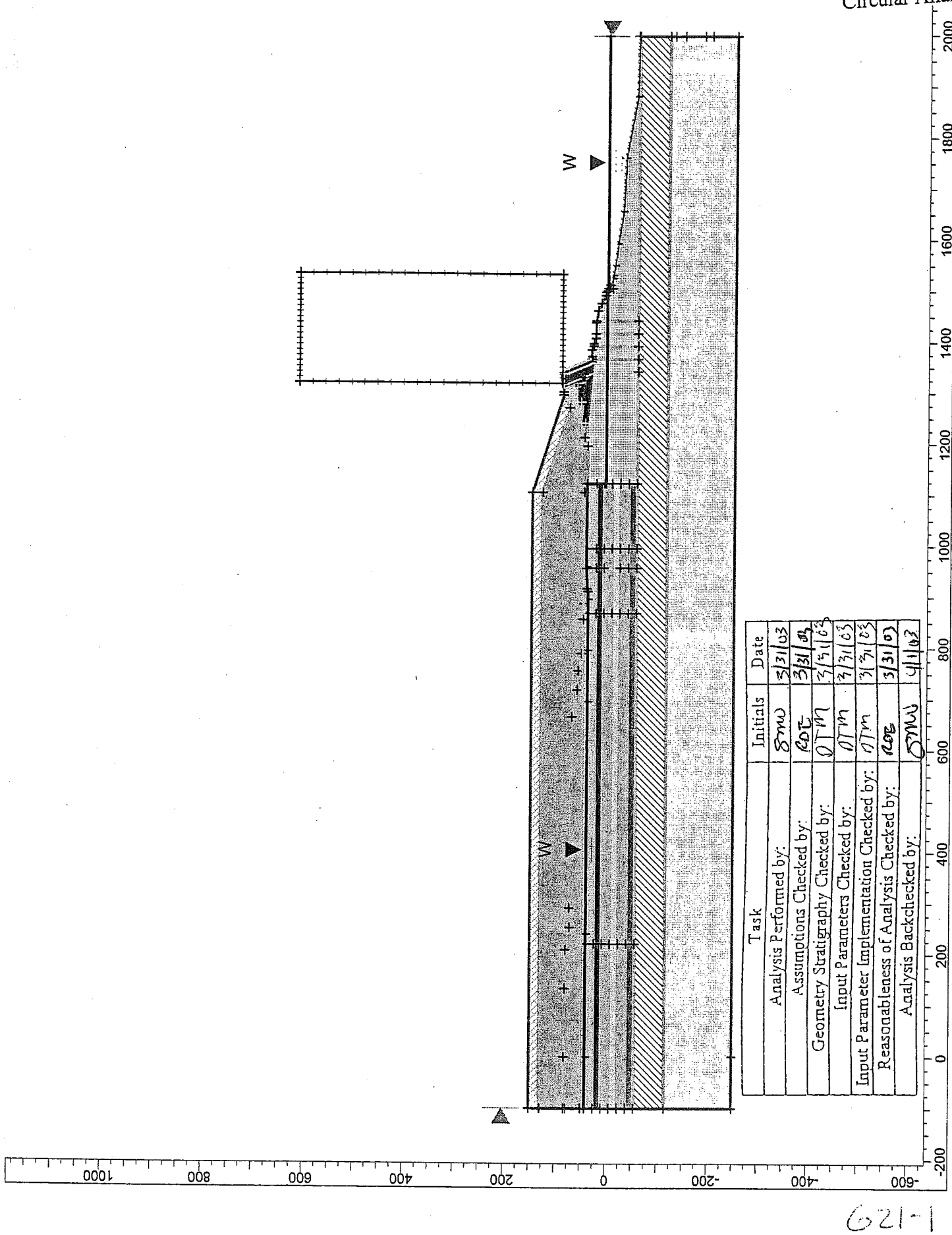
Section G-G
9 Year Stability
Block Analysis

direction is specified, or if high external or anchor loads are applied against the failure direction.

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

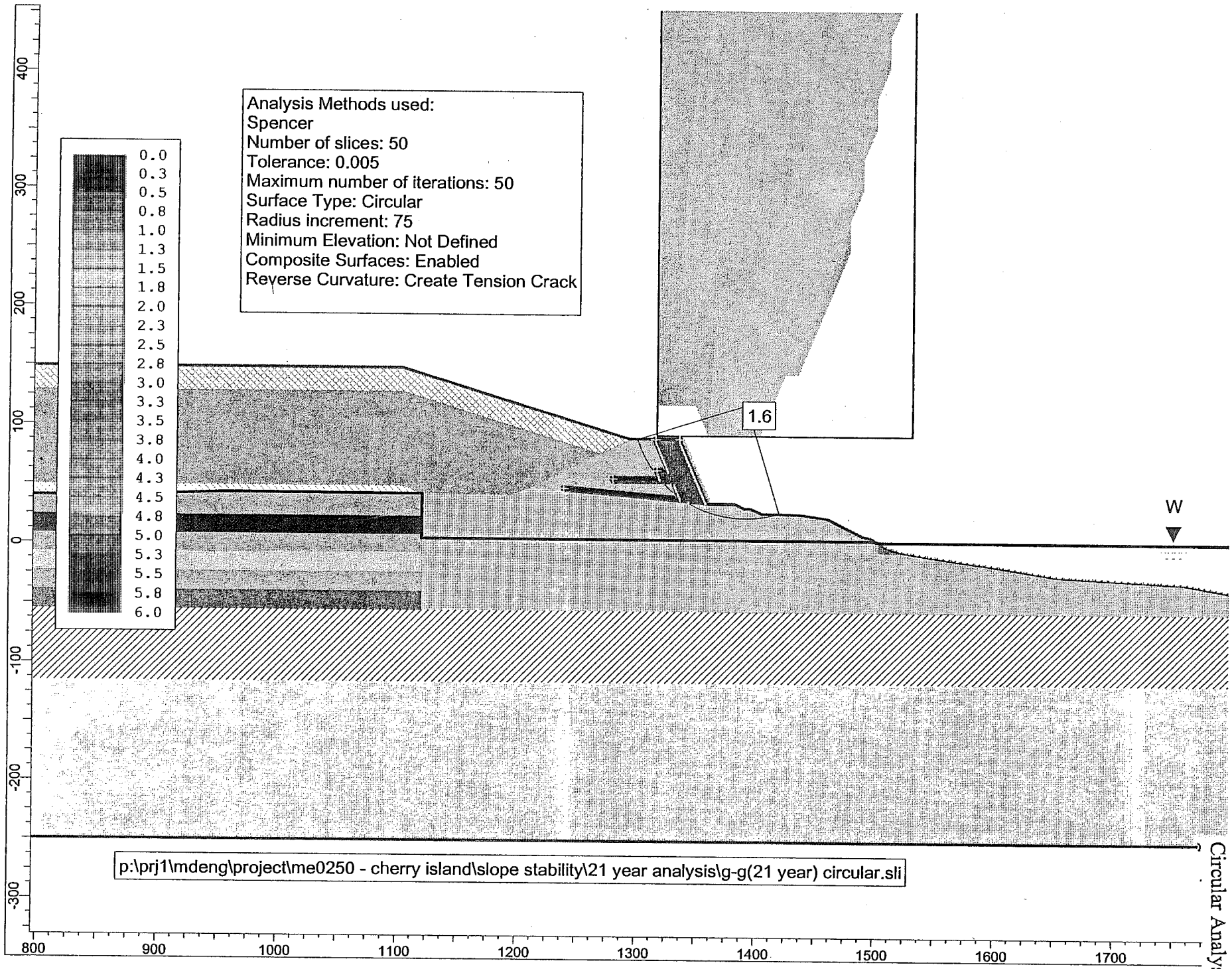
-111 = safety factor equation did not converge

Section G-G
21 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	BMW	3/31/03
Assumptions Checked by:	ROE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	ROE	3/31/03
Analysis Backchecked by:	BMW	4/1/03

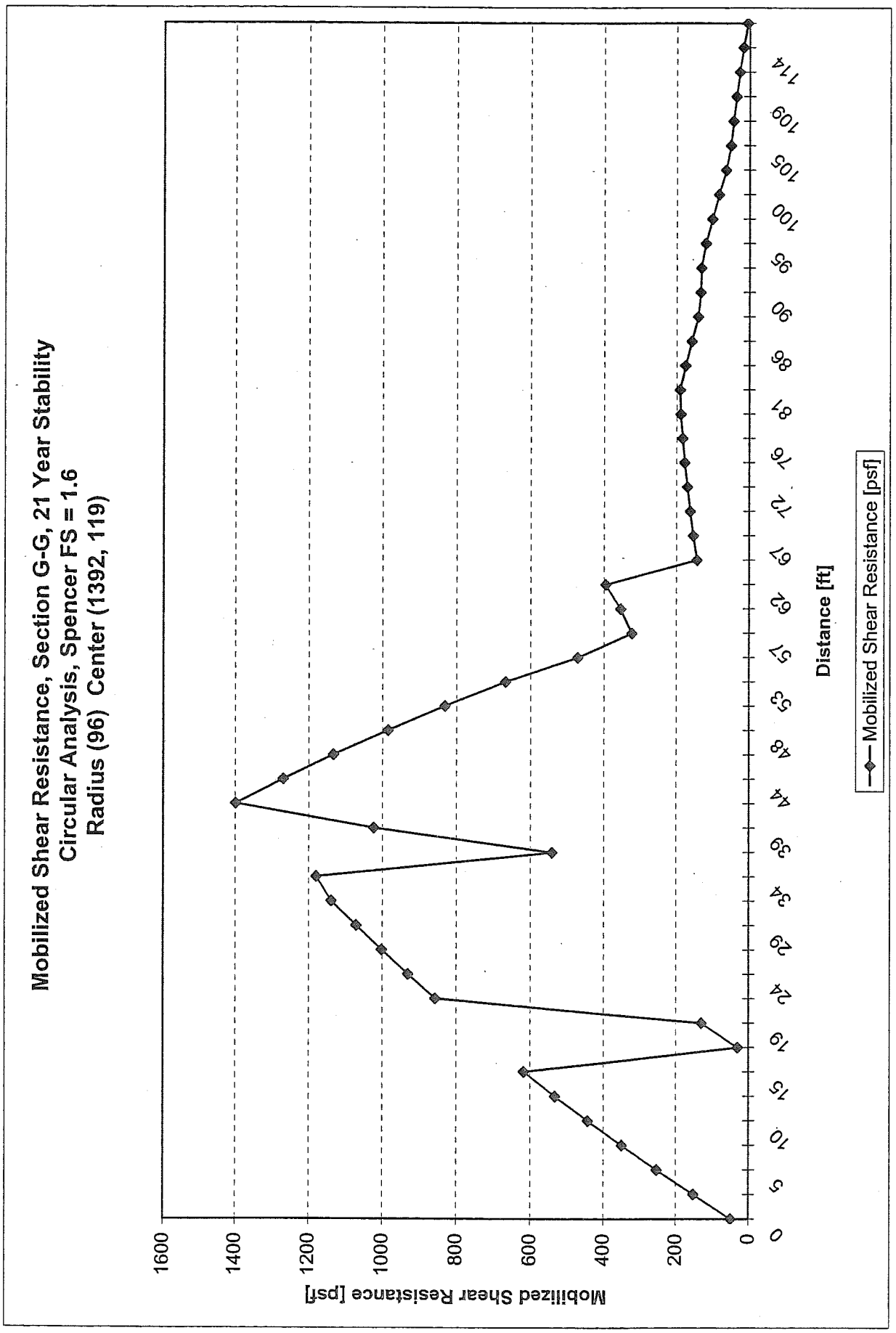
621-1



Section G-G
21 Year Stability
Circular Analysis

G21-2

Section G-G
21 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance G

G21-3

Slide Analysis Information

Document Name

File Name: g-g(21 year) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius Increment: 75
Minimum Elevation: 5
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2157 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1640 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1347 psf
Water Surface: None

Section G-G
21 Year Stability
Circular Analysis

G21-4

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1392 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1784 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2756 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.55477
Center: 1391.64, 119.134
Radius: 95.5501
Left Slip Surface Endpoint: 1300.64, 90
Right Slip Surface Endpoint: 1419.47, 27.7275

Method Statistics

Method: spencer
Number of Valid Surfaces: 19829
Number of Invalid Surfaces: 13687
Error Codes:
Error Code -108 reported for 3 surfaces
Error Code -111 reported for 9161 surfaces
Error Code -112 reported for 39 surfaces
Error Code -1000 reported for 4484 surfaces

Error Codes

The following errors were encountered during the computation:

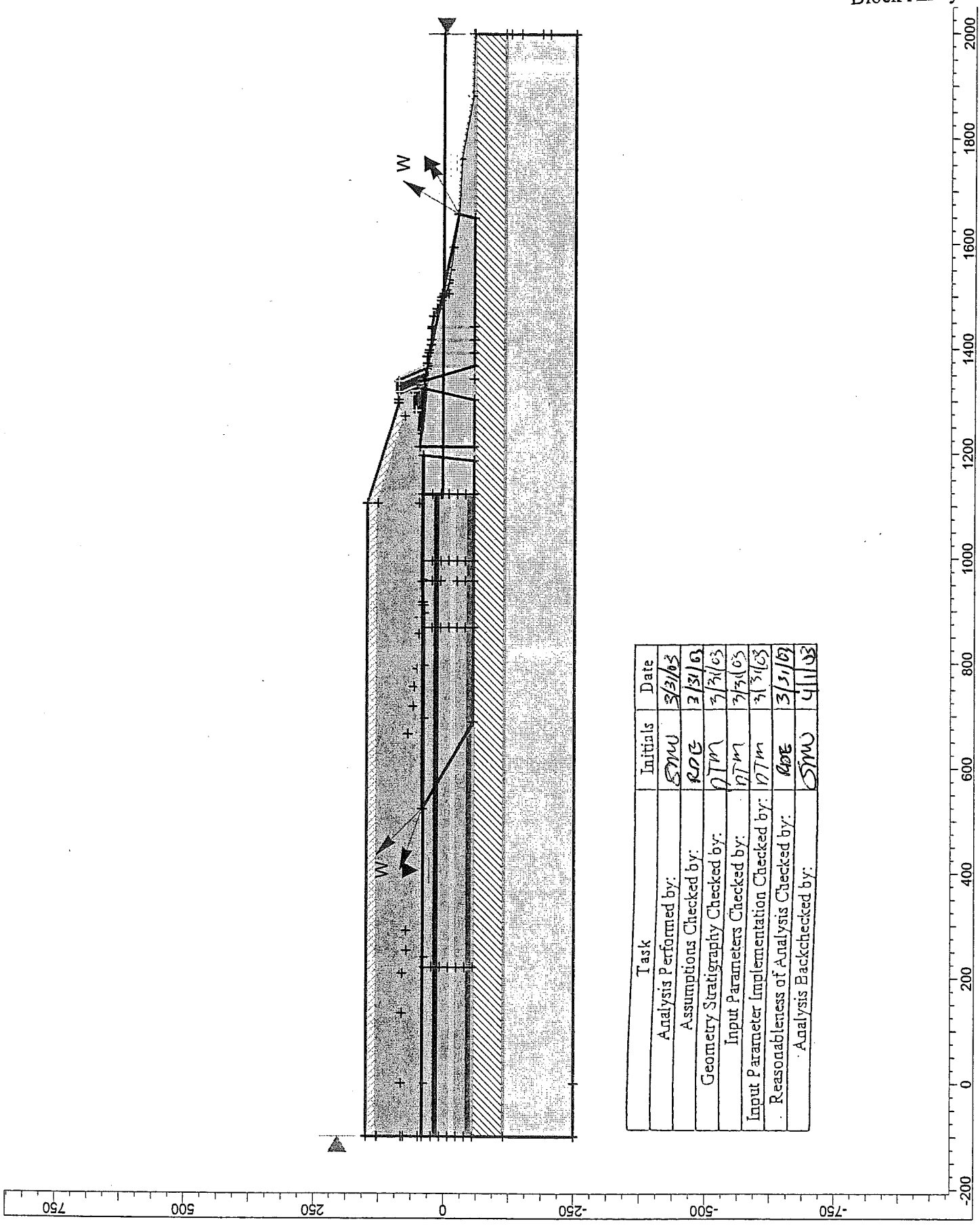
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

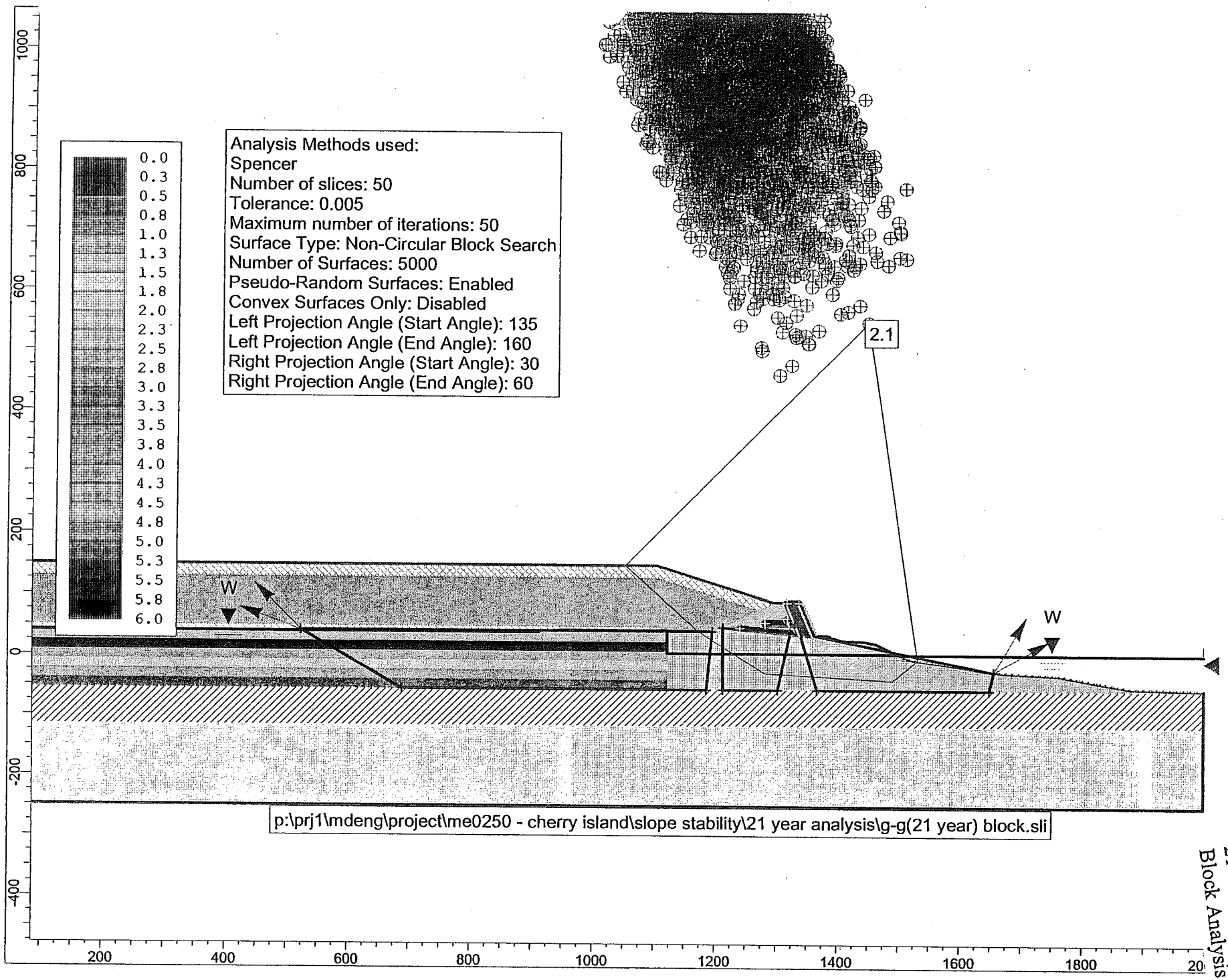
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section G-G
21 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RDE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMW	4/1/03

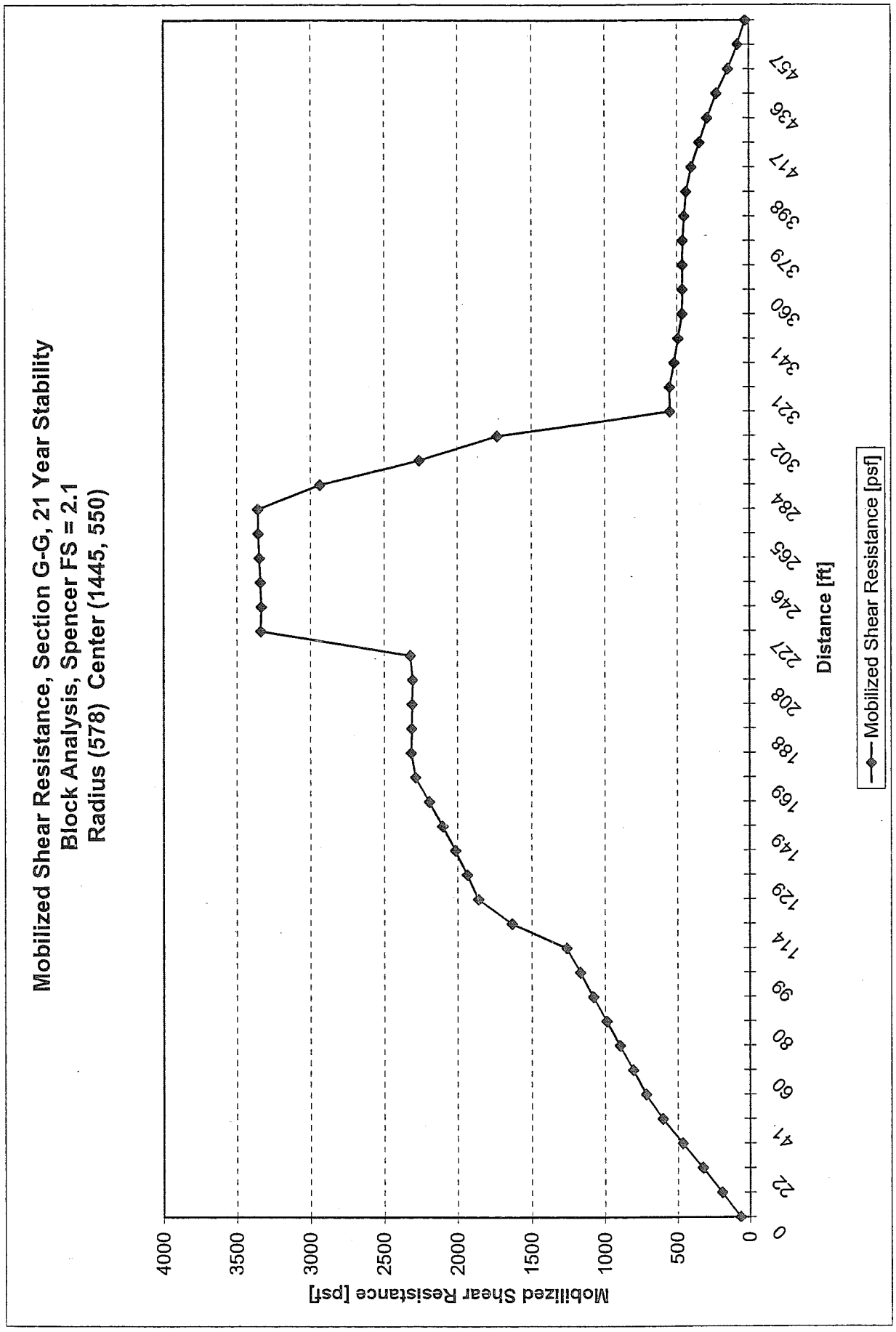
G21-6



Section G-G
21 Year Stability
Block Analysis

G21-7

Section G-G
21 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance G

G21-8

Slide Analysis Information

Document Name

File Name: g-g(21 year) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2157 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1640 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3

Section G-G
21 Year Stability
Block Analysis

G 21-9

Cohesion Type: Constant
Cohesion: 1347 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1392 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1784 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2756 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu valua: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.0781
Axis Location: 1445.42, 549.712
Left Slip Surface Endpoint: 1052.4, 149
Right Slip Surface Endpoint: 1530.18, -5.13448
Left Slope Intercept: 1052.4 149
Right Slope Intercept: 1530.18 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 4948
Number of Invalid Surfaces: 52
Error Codes:
Error Code -108 reported for 52 surfaces

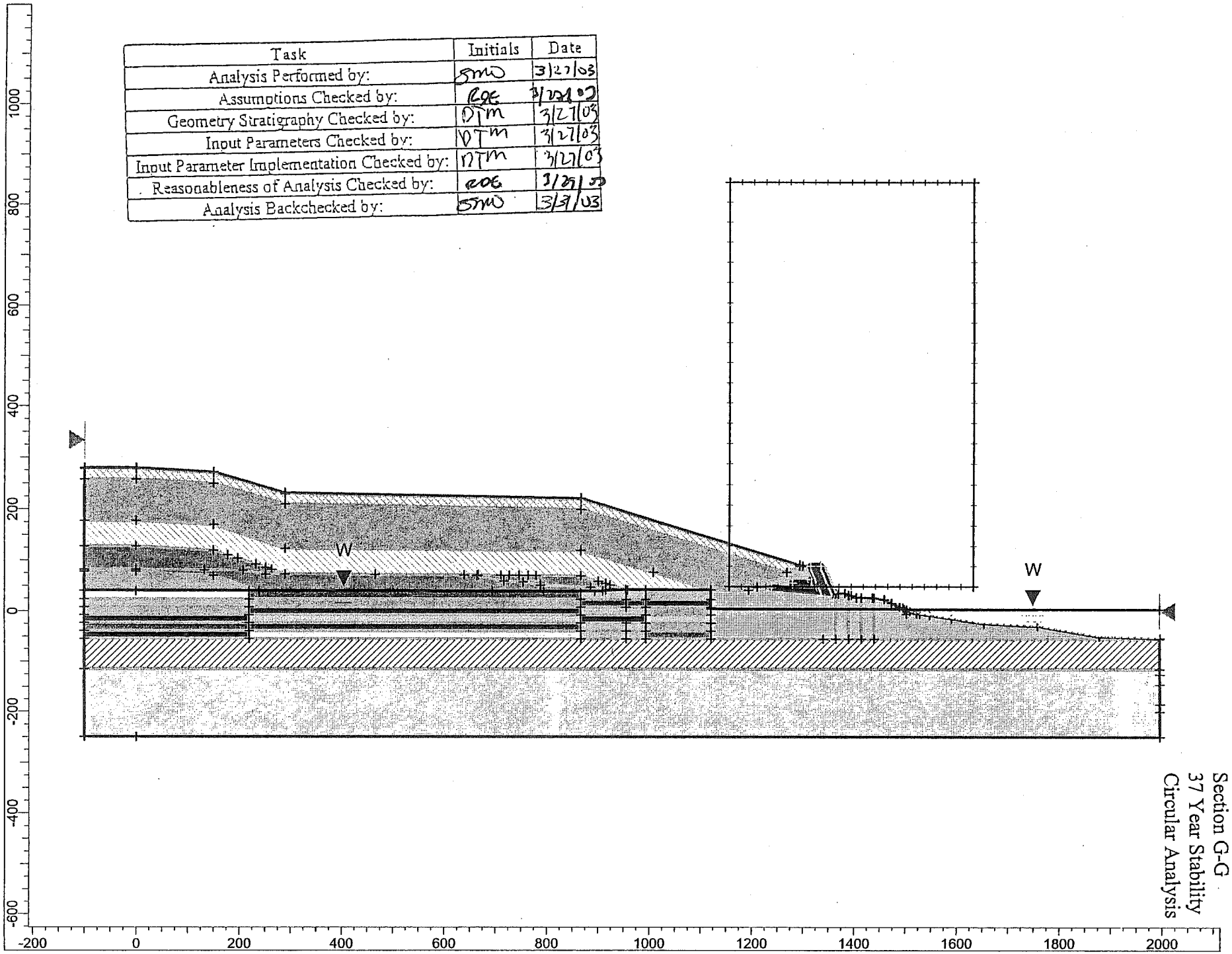
Error Codes

Section G-G
21 Year Stability
Block Analysis

The following errors were encountered during the computation:

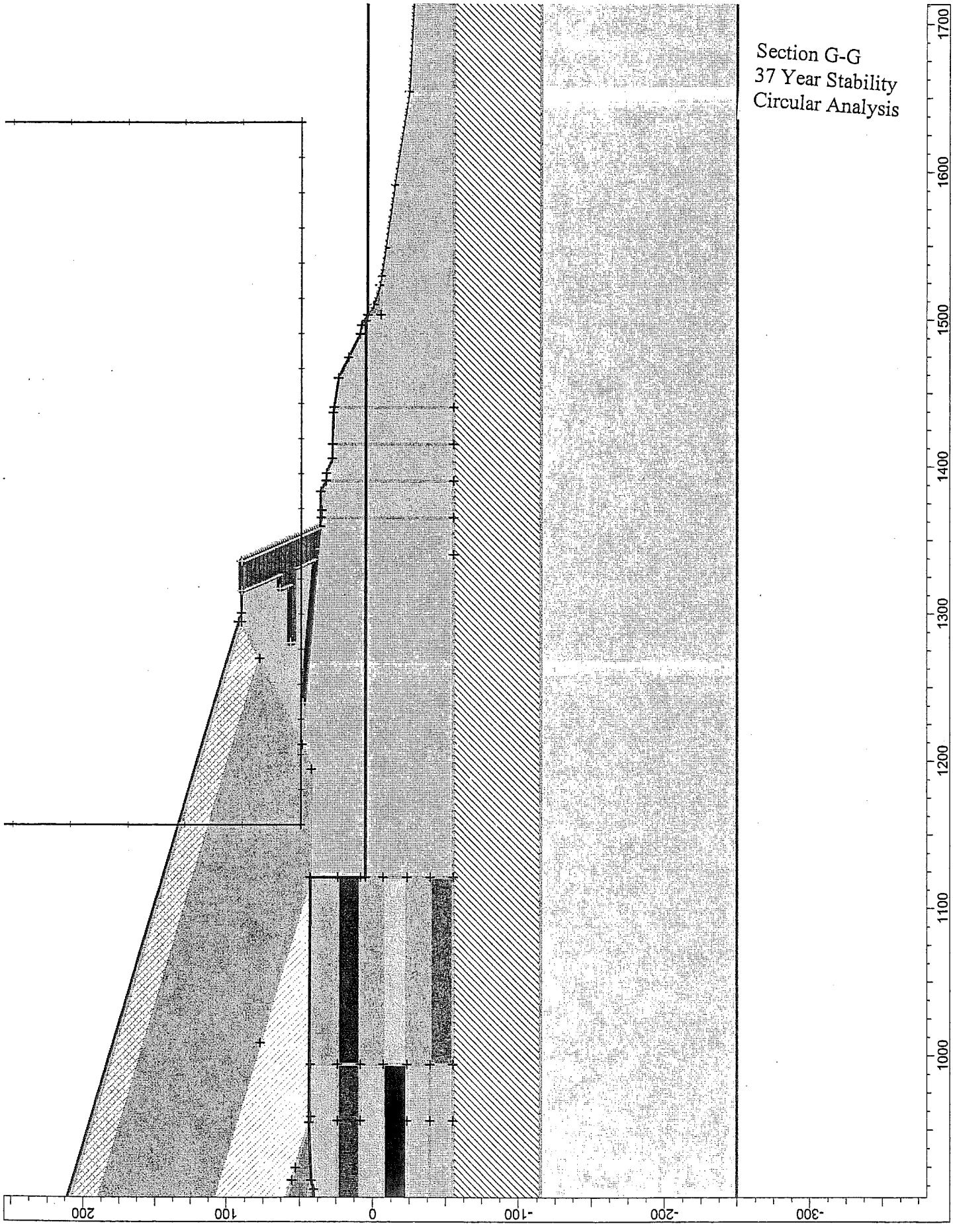
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Task	Initials	Date
Analysis Performed by:	SMD	3/27/03
Assumptions Checked by:	RDE	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	RDE	3/27/03
Analysis Backchecked by:	SMD	3/31/03

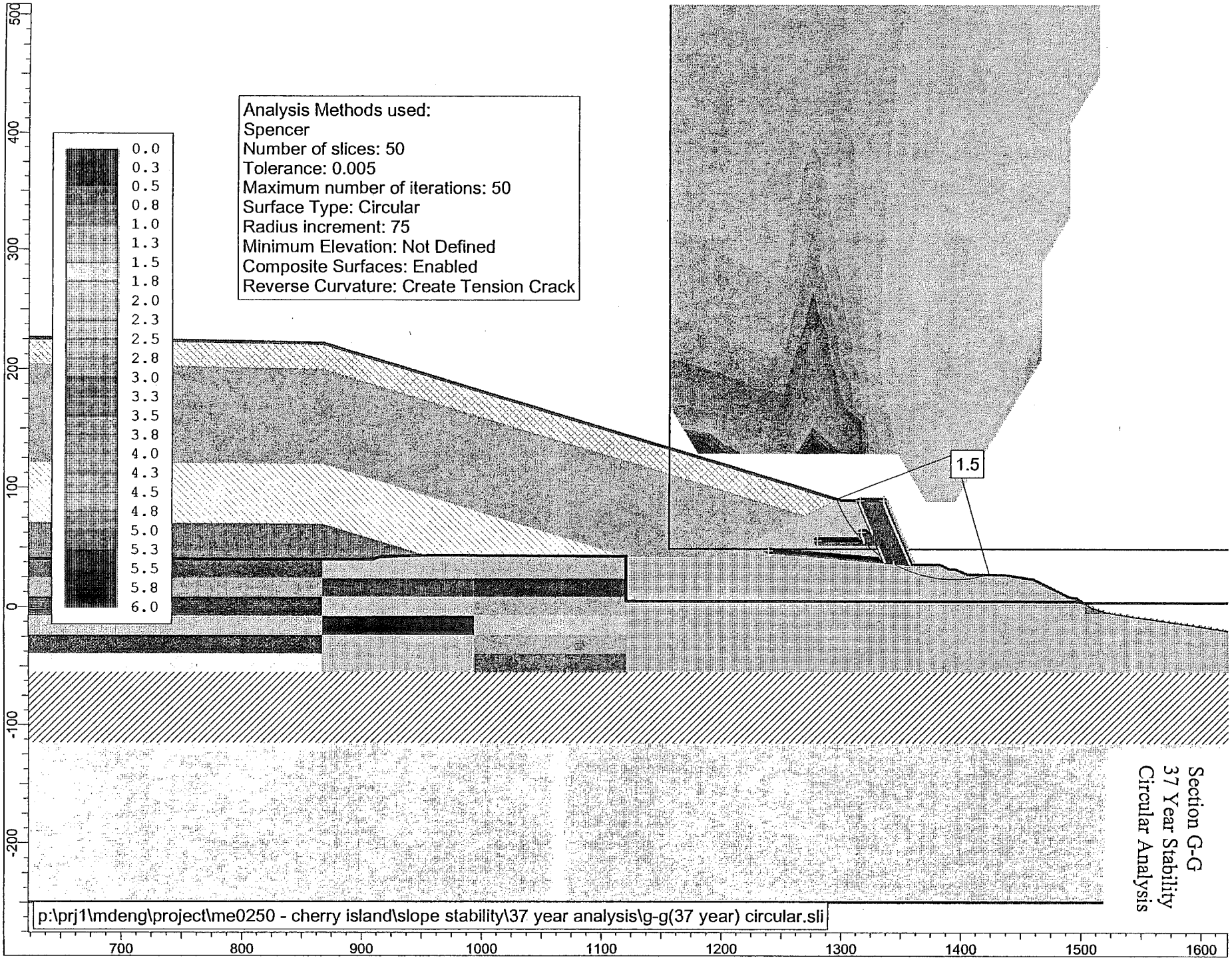


Section G-G
37 Year Stability
Circular Analysis

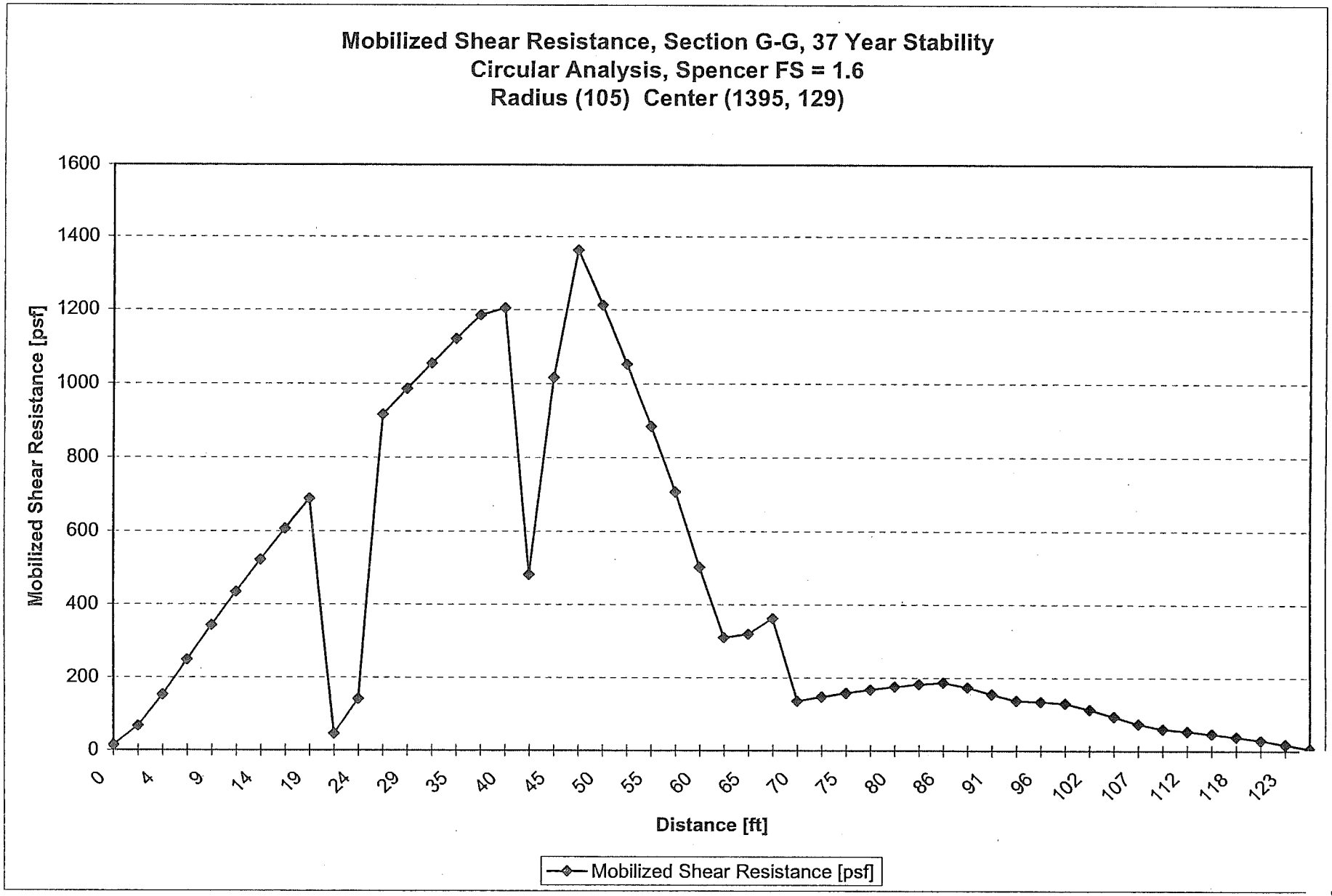
G34-1


Section G-G
37 Year Stability
Circular Analysis
200
100
0
-100
-200
-300
1700
1600
1500
1400
1300
1200
1100
1000

G37-2


Analysis Methods used:
Spencer
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50
Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
3.8
4.0
4.3
4.5
4.8
5.0
5.3
5.5
5.8
6.0
1.5
500
400
300
200
100
0
-100
-200
700
800
900
1000
1100
1200
1300
1400
1500
1600
p:\prj1\mdeng\project\me0250 - cherry island\slope stability\37 year analysis\g-g(37 year) circular.sli
Section G-G
37 Year Stability
Circular Analysis

G37-3



Section G-G
37 Year Stability
Circular Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance G

h-37

Slide Analysis Information

Document Name

File Name: g-g(37 year) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius Increment: 75
Minimum Elevation: 5
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function

Section G-G
37 Year Stability
Circular Analysis

G37-5

Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2665 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2086 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2094 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2392 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3227 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3326 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2709 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2237 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2174 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2565 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3746 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3695 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2757 psf

Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2075 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2531 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4029 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4335 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3029 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2247 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2181 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2781 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4655 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees

Section G-G
37 Year Stability
Circular Analysis

G37-6

Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel end Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.54979
Center: 1394.87, 129.095
Radius: 105.492
Left Slip Surface Endpoint: 1296.35, 91.383
Right Slip Surface Endpoint: 1423.79, 27.6444

Method Statistics

Method: spencer
Number of Valid Surfaces: 19885
Number of Invalid Surfaces: 13631
Error Codes:
Error Code -108 reported for 36 surfaces
Error Code -111 reported for 6162 surfaces
Error Code -112 reported for 965 surfaces
Error Code -200 reported for 8 surfaces
Error Code -1000 reported for 6460 surfaces

Error Codes

The following errors were encountered during the computation:

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

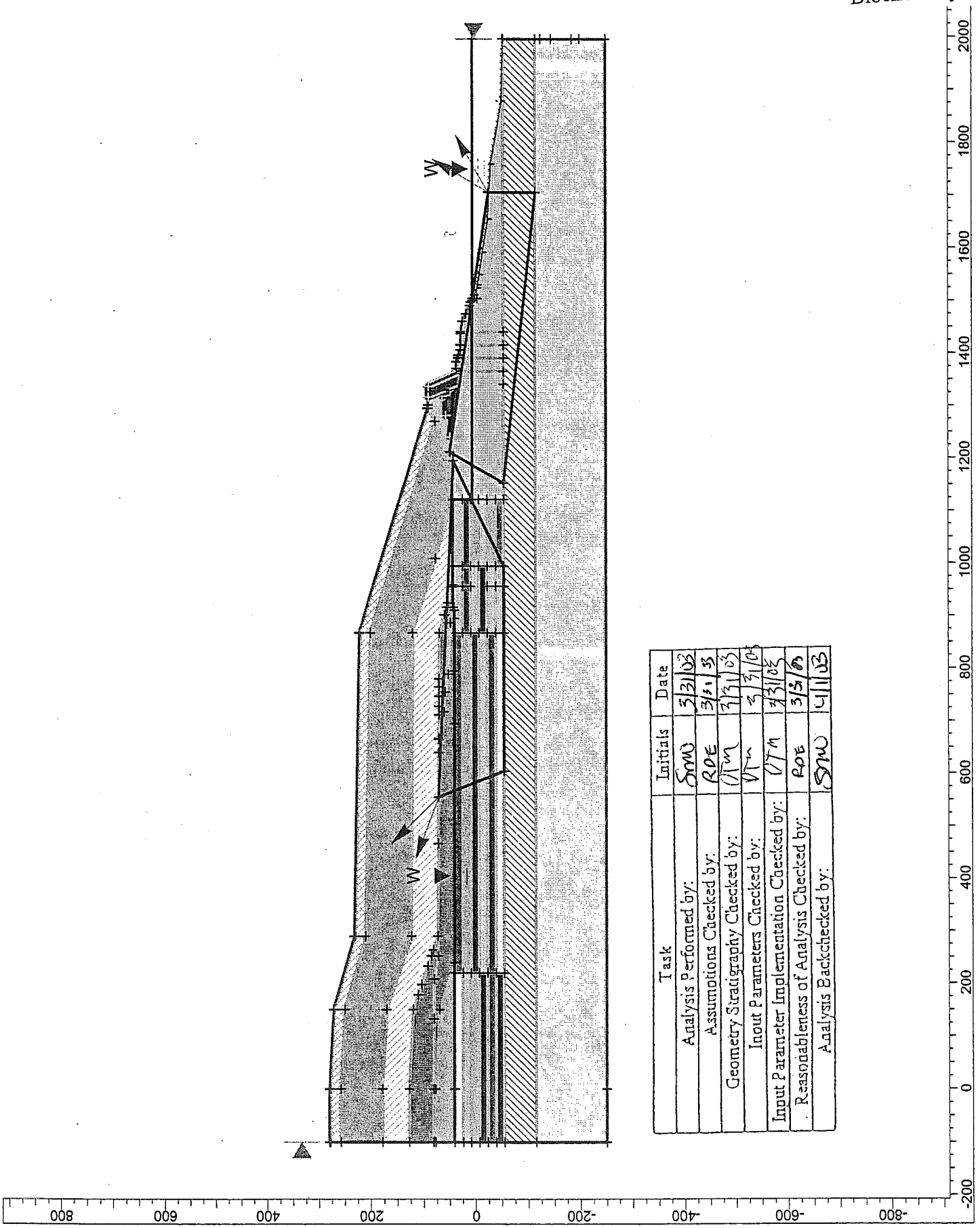
-111 = safety factor equation did not converge

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

-200 = Factor of Safety = 0. Could mean 0 Normal/Shear resistance along part of the slip surface

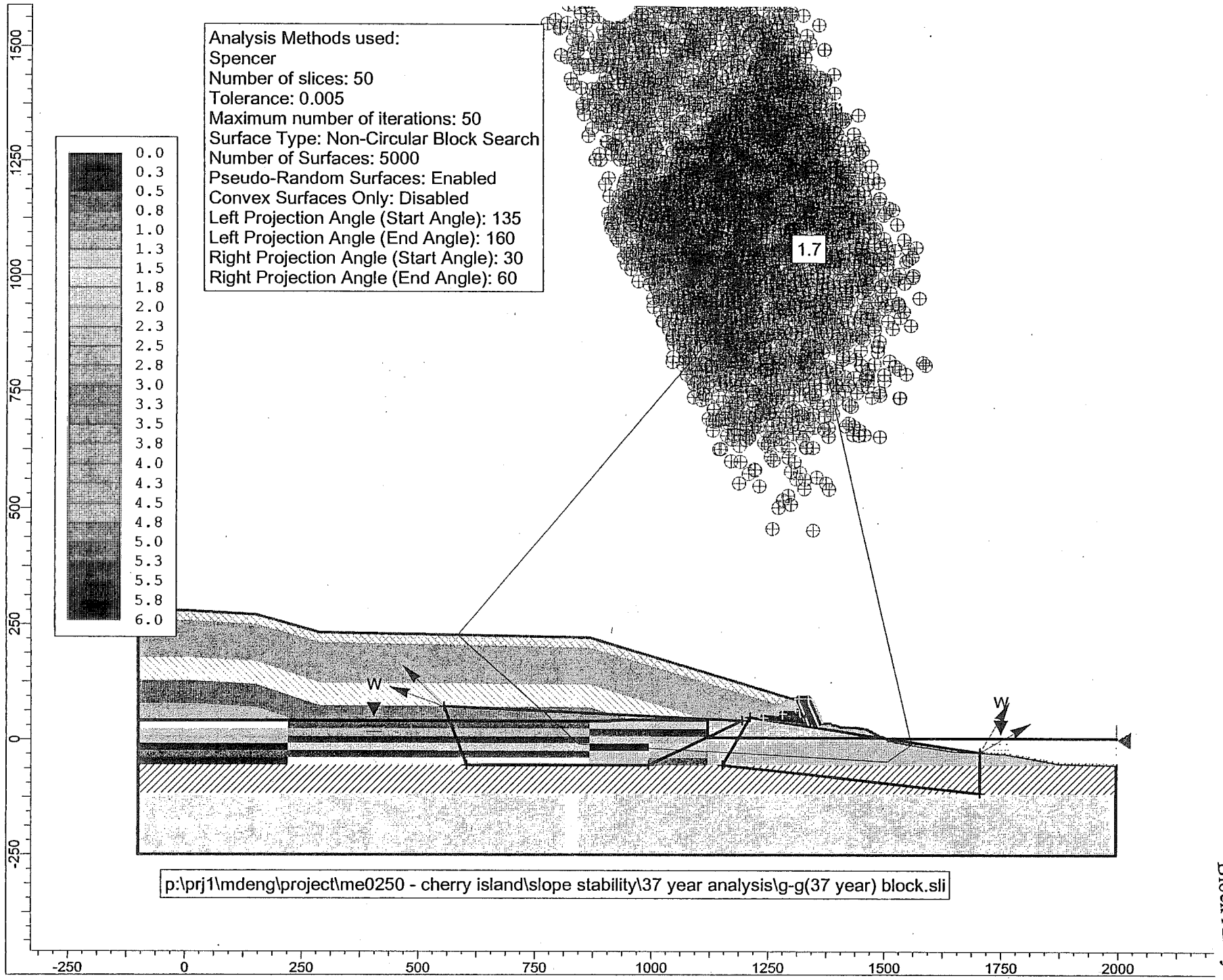
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section G-G
37 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/31/05
Assumptions Checked by:	ROE	3/31/05
Geometry Stratigraphy Checked by:	DTM	3/31/05
Input Parameters Checked by:	DTM	3/31/05
Input Parameter Implementation Checked by:	DTM	3/31/05
Reasonableness of Analysis Checked by:	ROE	3/31/05
Analysis Backchecked by:	SMO	4/1/05

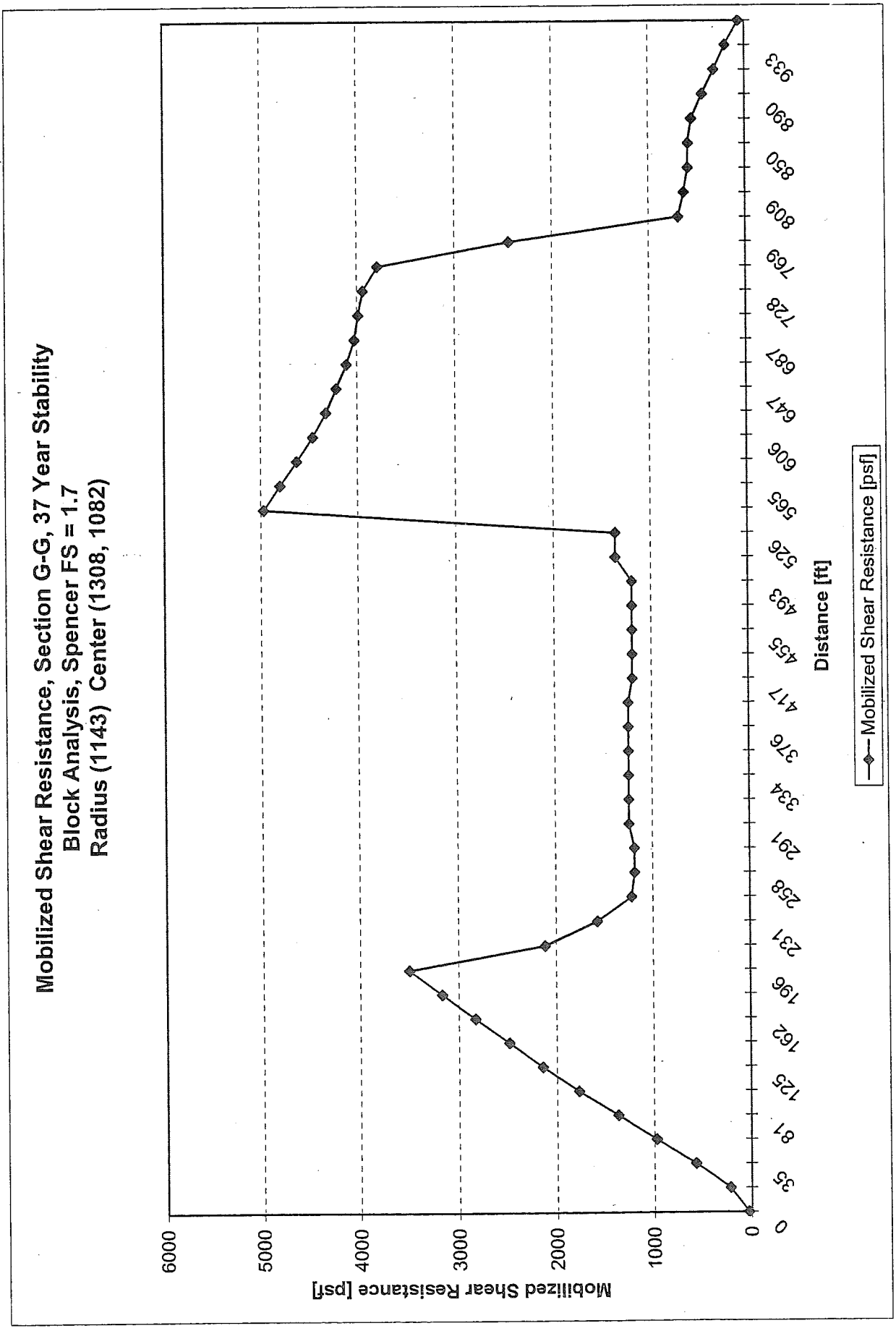
G37-7



Section G-G
37 Year Stability
Block Analysis

G-G

Section G-G
37 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance G

G27-9

Slide Analysis Information

Document Name

File Name: g-g(37 year) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Section G-G
37 Year Stability
Block Analysis

(21-27)

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2665 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2086 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2094 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2392 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3227 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3326 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2709 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2237 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2174 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2565 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3746 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3695 psf
Water Surface: None

Material: d42
Strength Type: Undrained

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2757 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2075 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2531 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4029 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4335 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3029 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2247 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2181 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2781 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4655 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb

Section G-G
37 Year Stability
Block Analysis

C-27-11

Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.74816
Axis Location: 1308.18, 1082.03
Left Slip Surface Endpoint: 585.206, 226.88
Right Slip Surface Endpoint: 1558.51, -9.43528
Left Slope Intercept: 585.206 226.88
Right Slope Intercept: 1558.51 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 4137
Number of Invalid Surfaces: 863
Error Codes:
Error Code -108 reported for 708 surfaces
Error Code -111 reported for 22 surfaces
Error Code -112 reported for 133 surfaces

Error Codes

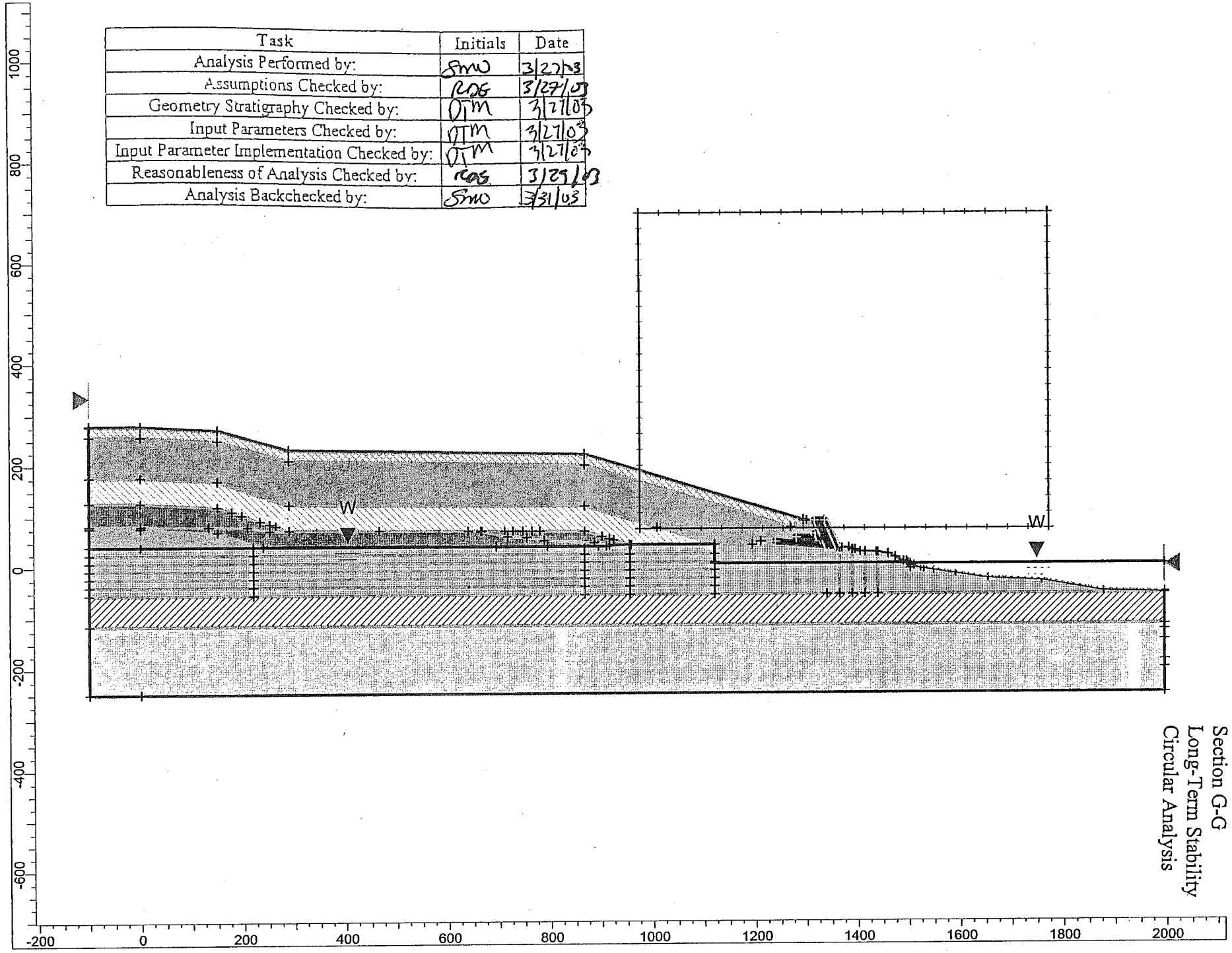
The following errors were encountered during the computation:

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

-111 = safety factor equation did not converge

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

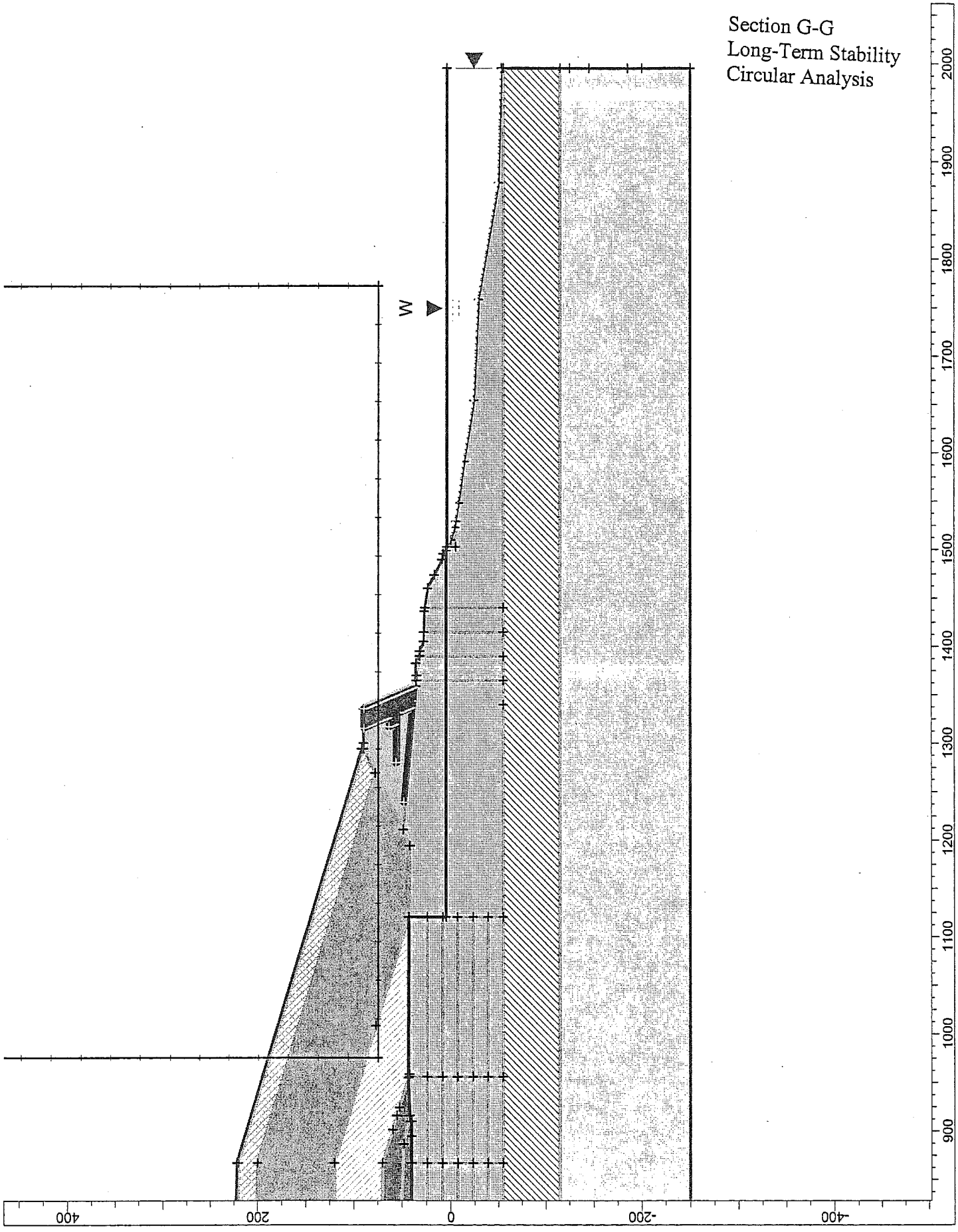
Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	RDG	3/27/03
Geometry Stratigraphy Checked by:	JTM	3/27/03
Input Parameters Checked by:	JTM	3/27/03
Input Parameter Implementation Checked by:	JTM	3/27/03
Reasonableness of Analysis Checked by:	RDG	3/29/03
Analysis Backchecked by:	SMO	3/31/03



Section G-G
Long-Term Stability
Circular Analysis

GLT-1

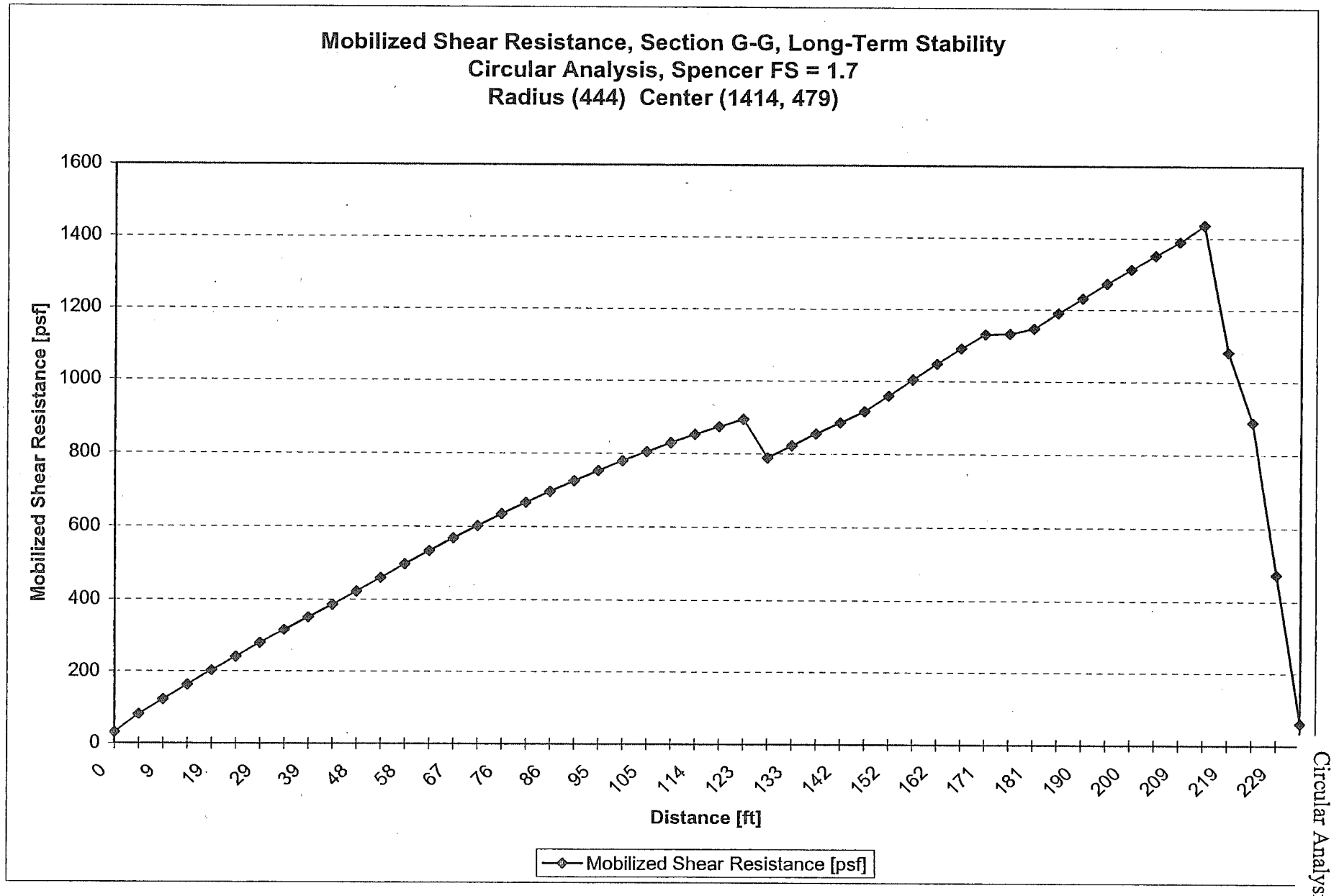
Section G-G
Long-Term Stability
Circular Analysis



GLT-2

Section G-G
Long-Term Stability
Circular Analysis

GLT-3



Section G-G
Long-Term Stability
Circular Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance 5

G LT - 4

Slide Analysis Information

Document Name

File Name: g-g(long-term) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3

Section G-G
Long-Term Stability
Circular Analysis

GLT-5

Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.7047
Center: 1413.59, 479.007
Radius: 444.448
Left Slip Surface Endpoint: 1120.42, 144.963
Right Slip Surface Endpoint: 1358.02, 38.046

Method Statistics

Method: spencer
Number of Valid Surfaces: 24778
Number of Invalid Surfaces: 8738
Error Codes:
Error Code -105 reported for 1 surface
Error Code -106 reported for 174 surfaces
Error Code -108 reported for 838 surfaces
Error Code -111 reported for 2901 surfaces
Error Code -112 reported for 4824 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

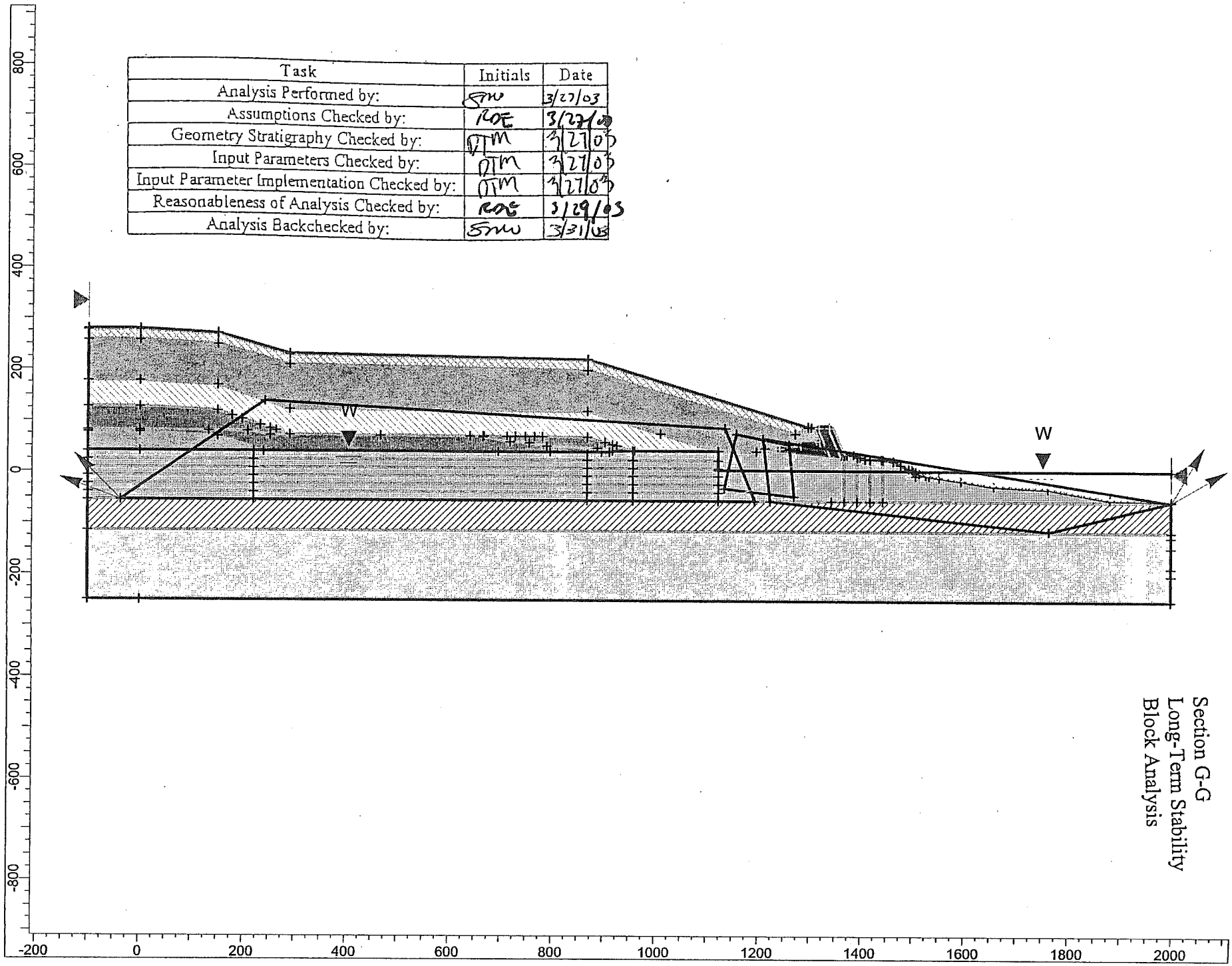
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

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

-111 = safety factor equation did not converge

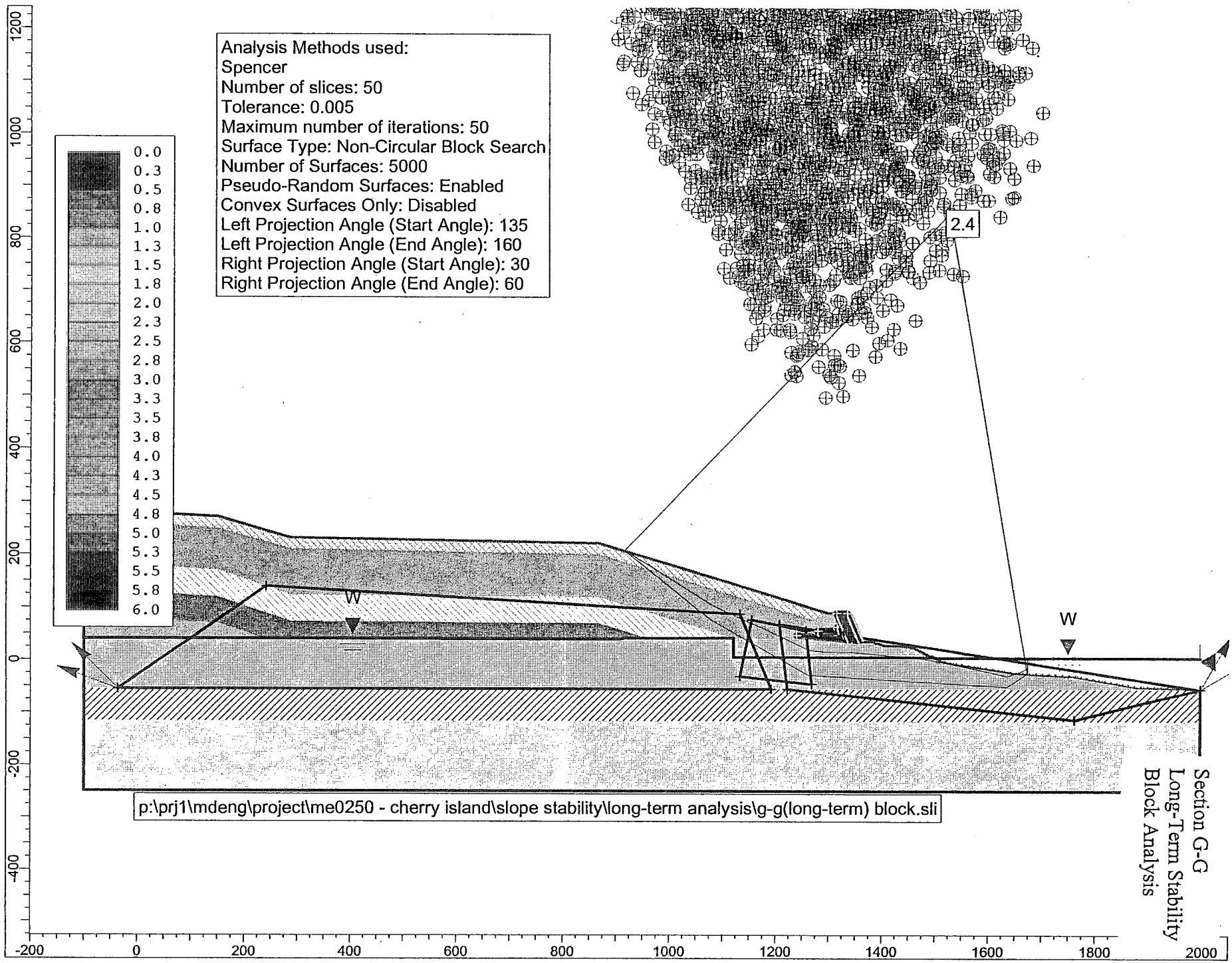
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

Task	Initials	Date
Analysis Performed by:	SMW	3/27/03
Assumptions Checked by:	ROE	3/27/03
Geometry Stratigraphy Checked by:	MTM	3/27/03
Input Parameters Checked by:	MTM	3/27/03
Input Parameter Implementation Checked by:	MTM	3/27/03
Reasonableness of Analysis Checked by:	ROE	3/29/03
Analysis Backchecked by:	SMW	3/31/03

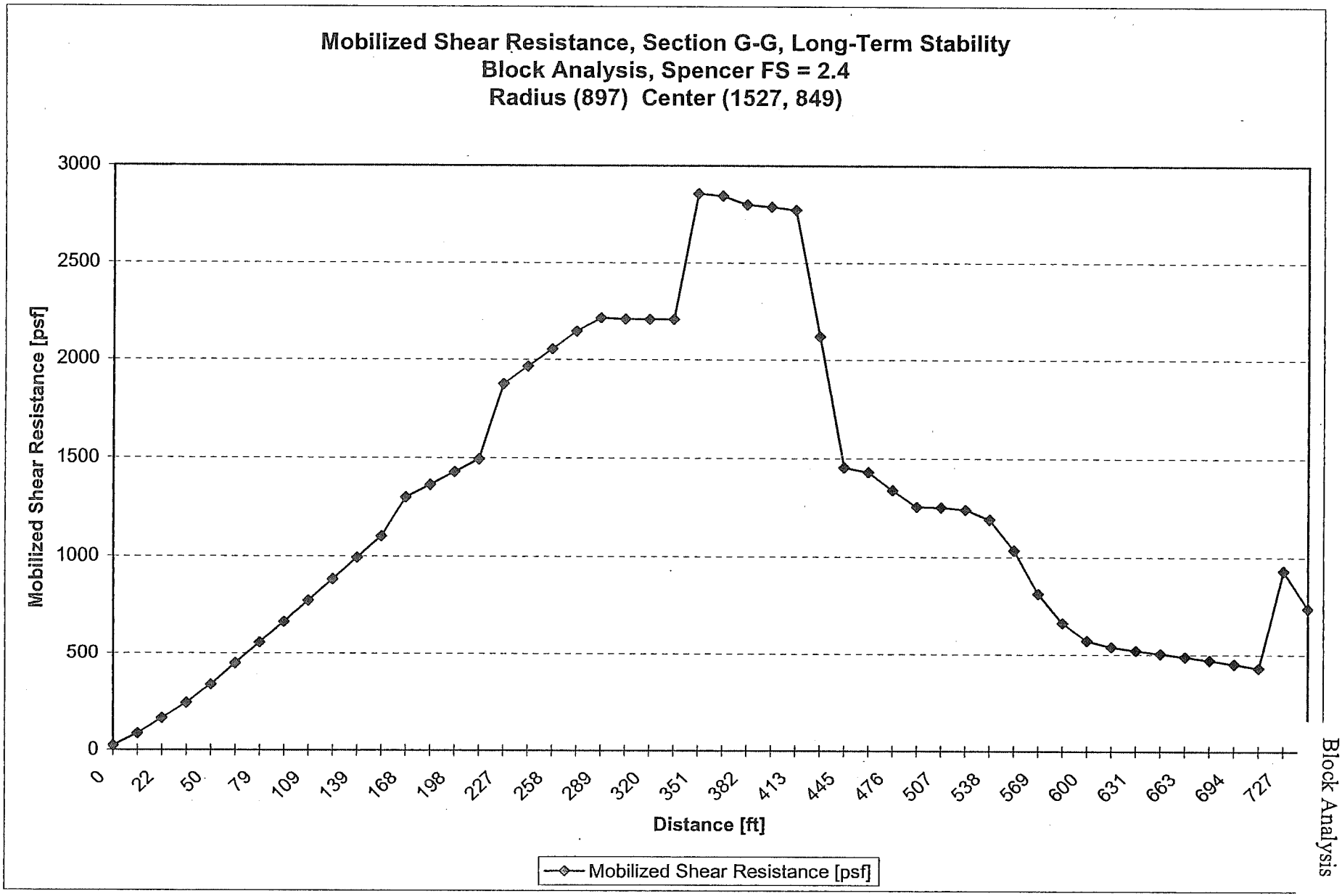


Section G-G
Long-Term Stability
Block Analysis

GLT-6


Analysis Methods used:
Spencer
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50
Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
3.8
4.0
4.3
4.5
4.8
5.0
5.3
5.5
5.8
6.0
2.4
W
W
p:\prj1\mdeng\project\me0250 - cherry island\slope stability\long-term analysis\g-g(long-term) block.sli
Section G-G
Long-Term Stability
Block Analysis
1200
1000
800
600
400
200
0
-200
-400
-200
0
200
400
600
800
1000
1200
1400
1600
1800
2000

G-1-7



Section G-G
Long-Term Stability
Block Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance G

G-T-8

Slide Analysis Information

Document Name

File Name: g-g(long-term) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Section G-G
Long-Term Stability
Block Analysis

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.44149
Axis Location: 1526.91, 848.546
Left Slip Surface Endpoint: 916.121, 207.116
Right Slip Surface Endpoint: 1673.58, -24.9413
Left Slope Intercept: 916.121 207.116
Right Slope Intercept: 1673.58 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 3908
Number of Invalid Surfaces: 1092
Error Codes:
Error Code -105 reported for 41 surfaces
Error Code -108 reported for 1001 surfaces
Error Code -111 reported for 42 surfaces
Error Code -112 reported for 8 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

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

-111 = safety factor equation did not converge

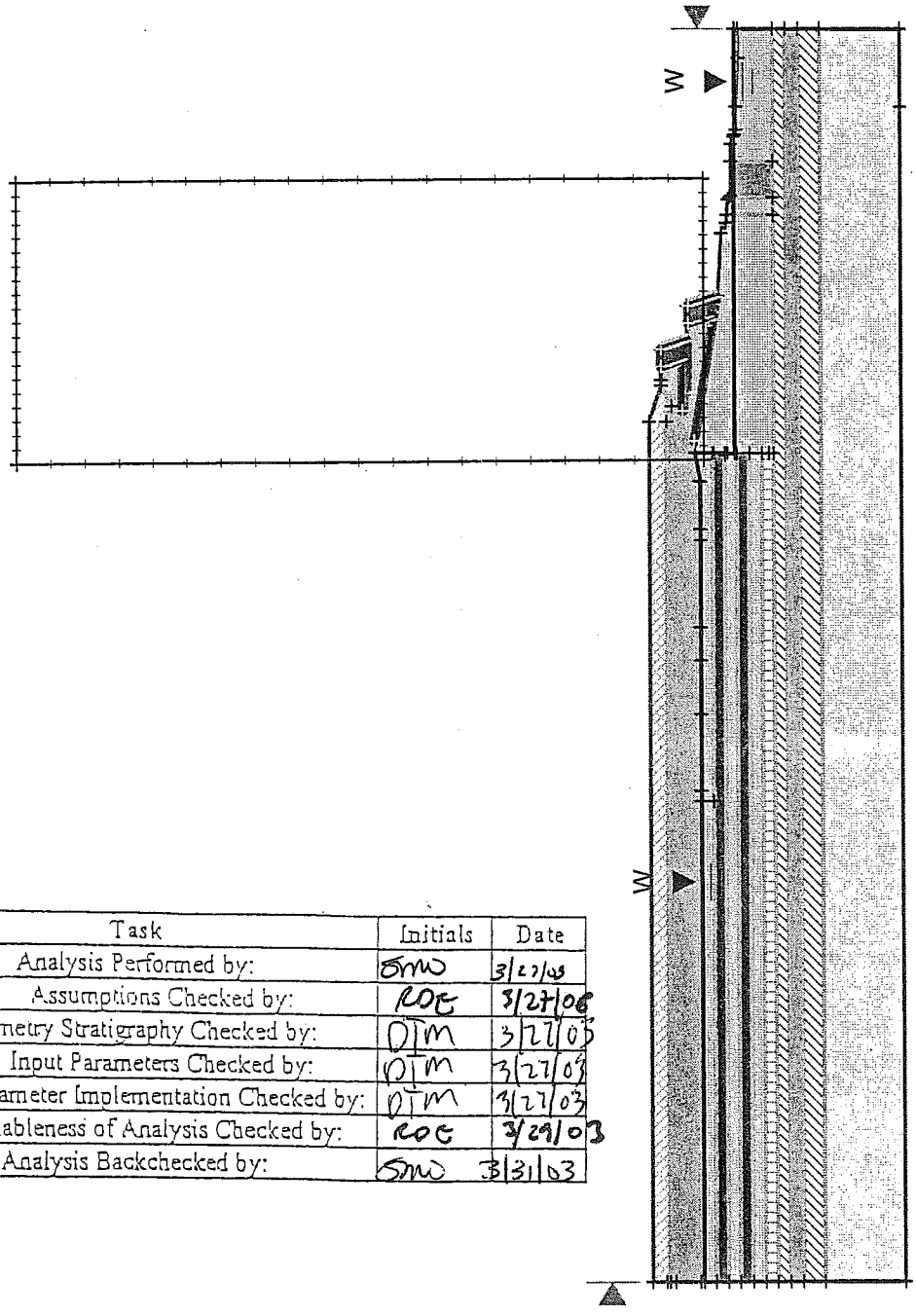
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

Attachment H

Stability Analysis Results for Cross Section H-H

Reinforcement Pattern
Section H-H

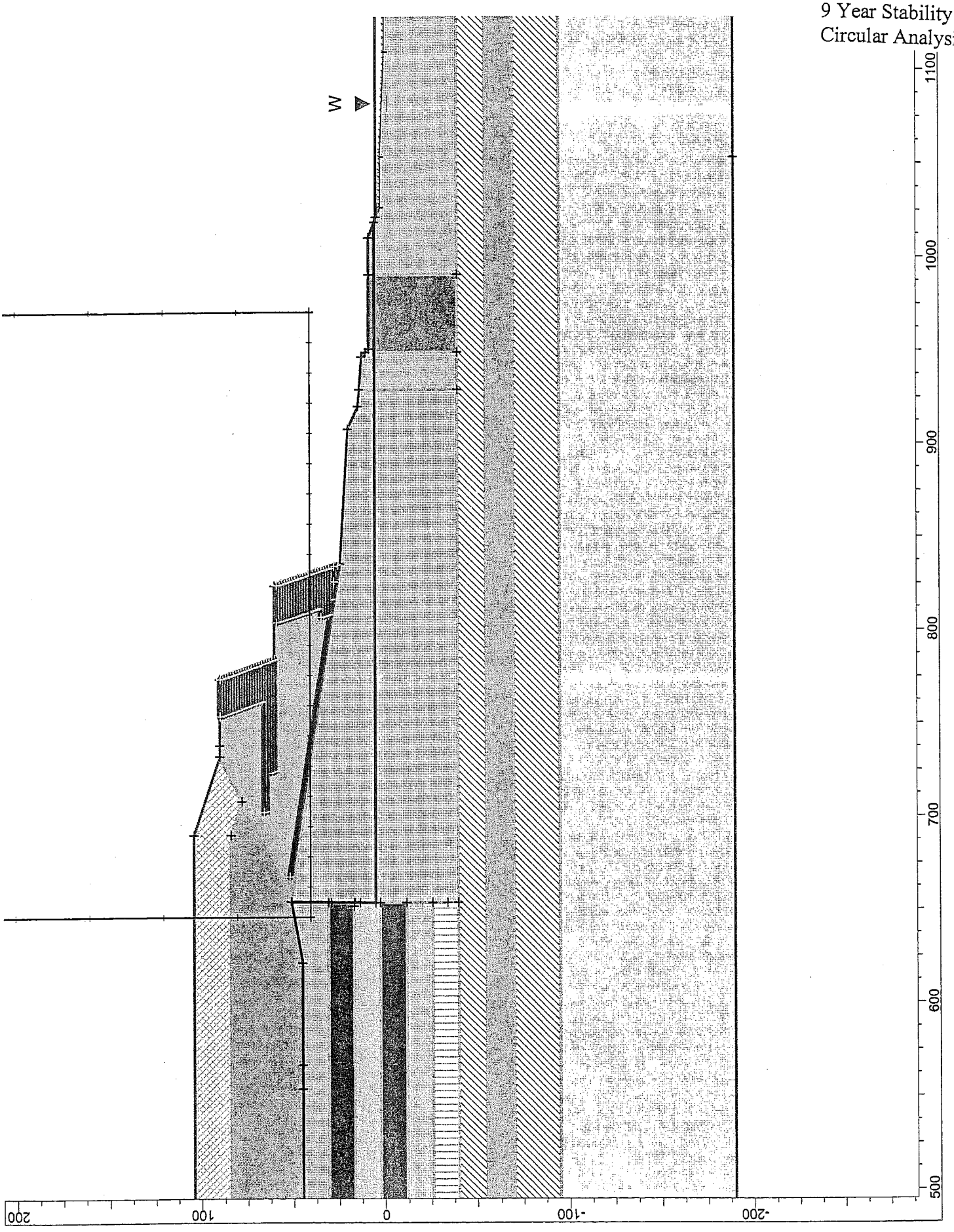
Section H-H
9 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/27/03
Assumptions Checked by:	ROE	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	ROE	3/29/03
Analysis Backchecked by:	SMW	3/31/03

H9-1

Section H-H
9 Year Stability
Circular Analysis

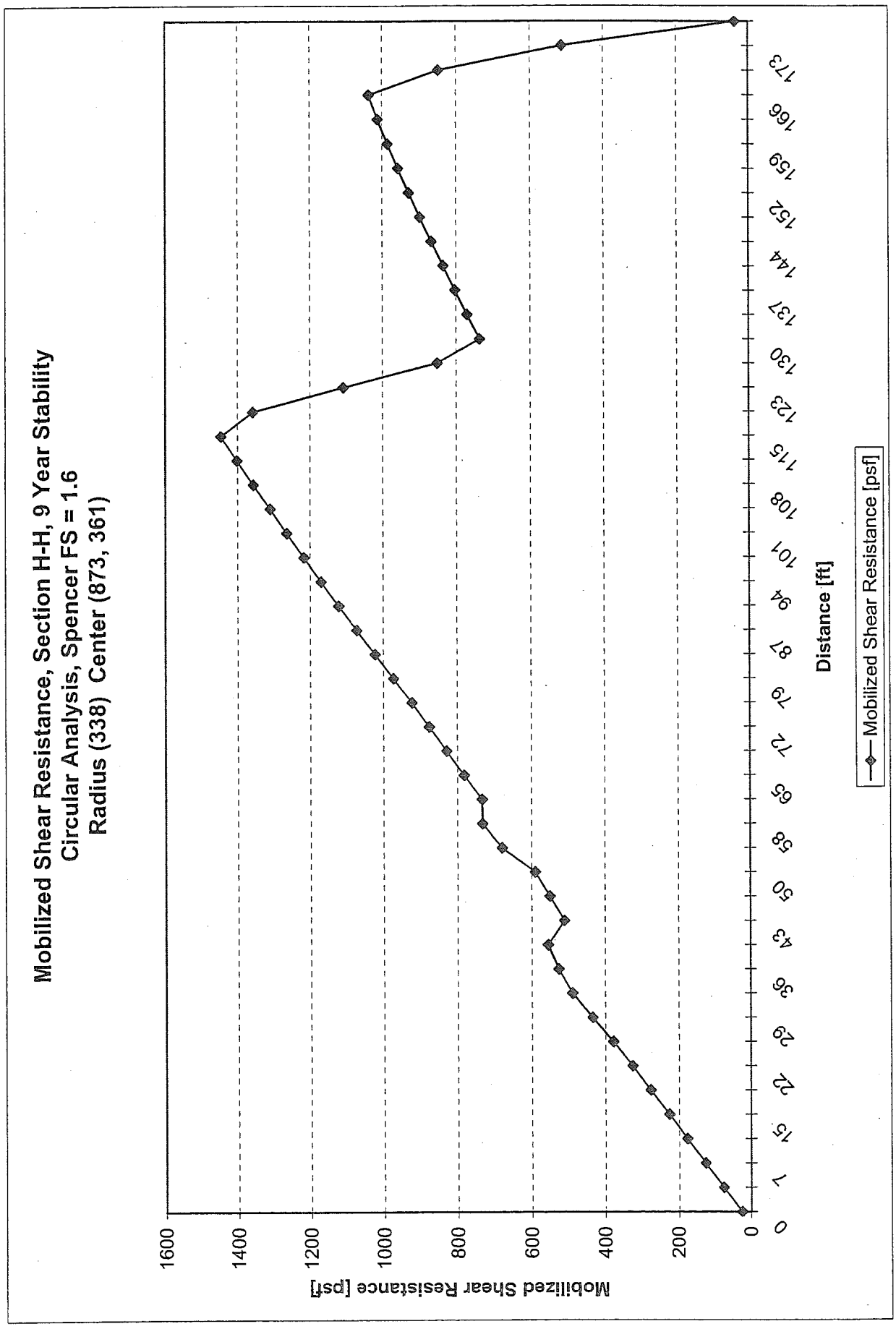


H9-2

Section H-H
9 Year Stability
Circular Analysis

H9-3

Section H-H
9 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance H

H9-4

Slide Analysis Information

Document Name

File Name: h-h(9 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1183 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 855 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 730 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 777 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 978 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1686 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.59823
Center: 873.18, 361.272
Radius: 337.721
Left Slip Surface Endpoint: 654.396, 104
Right Slip Surface Endpoint: 834.935, 25.7233

Method Statistics

Method: spencer
Number of Valid Surfaces: 28407
Number of Invalid Surfaces: 5109
Error Codes:
Error Code -105 reported for 1 surface
Error Code -106 reported for 85 surfaces
Error Code -107 reported for 6 surfaces
Error Code -108 reported for 715 surfaces
Error Code -111 reported for 2257 surfaces
Error Code -112 reported for 2045 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

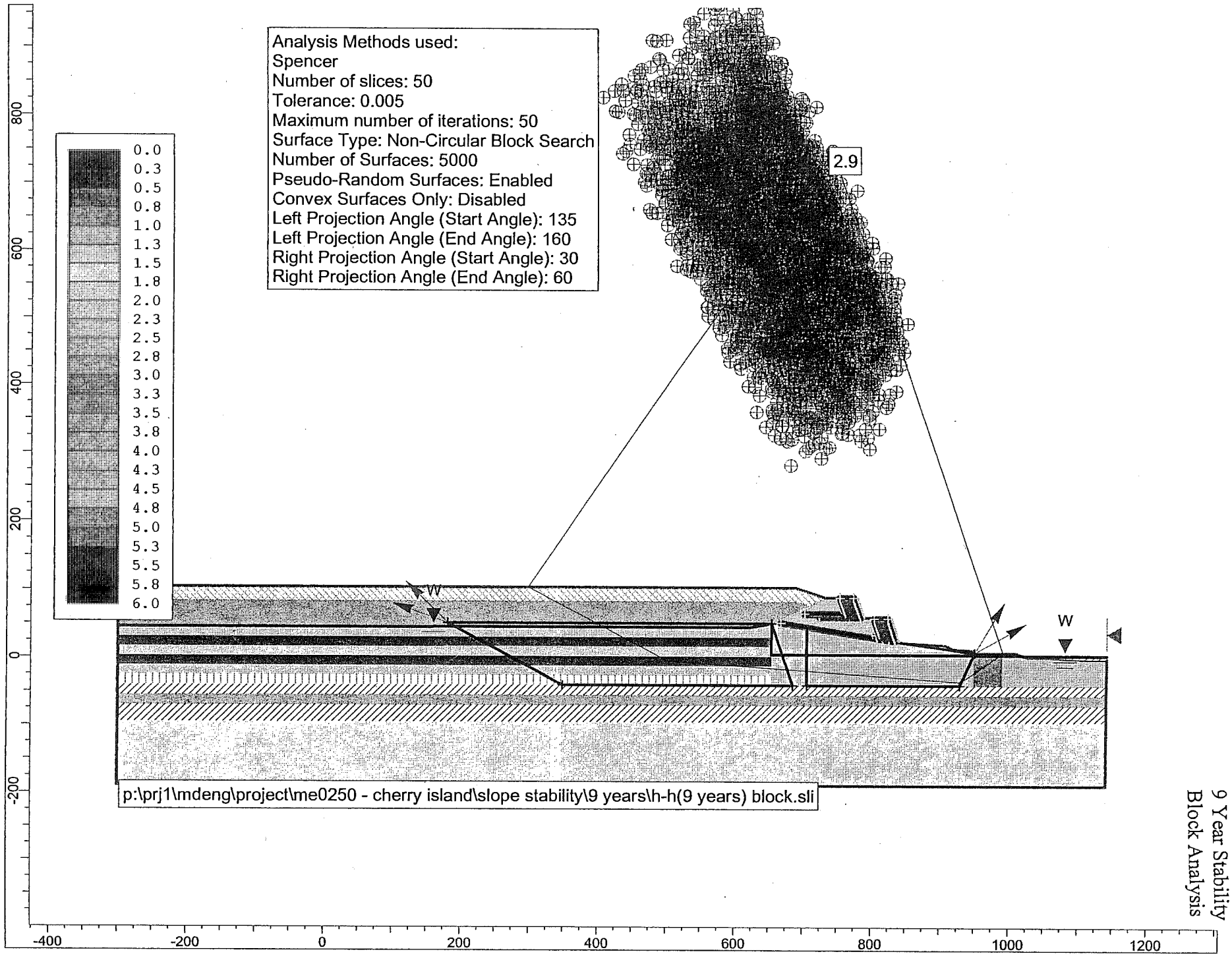
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

Section H-H
9 Year Stability
Block Analysis

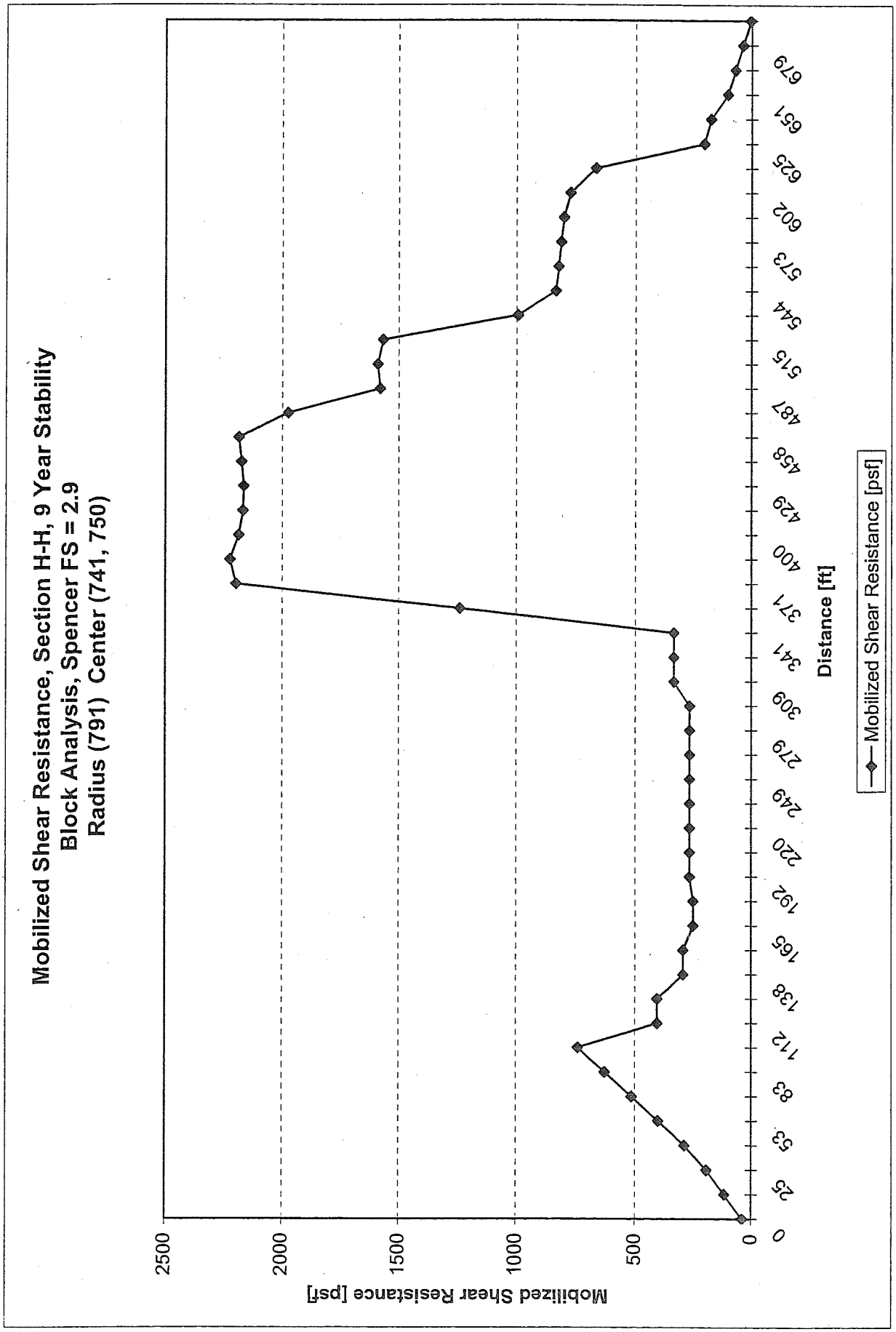
Task	Initials	Date
Analysis Performed by:	SMO	3/31/03
Assumptions Checked by:	@DB	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	@DB	3/31/03
Analysis Backchecked by:	SMO	3/31/03



Section H-H
9 Year Stability
Block Analysis

H-9-08

Section H-H
9 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance H

H9-9

Slide Analysis Information

Document Name

File Name: h-h(9 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1183 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 855 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 730 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Cohesion: 777 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 978 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1686 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0.psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.91657
Axis Location: 741.249, 749.516
Left Slip Surface Endpoint: 298.616, 104
Right Slip Surface Endpoint: 992.083, 8.1

Method Statistics

Method: spencer
Number of Valid Surfaces: 2567
Number of Invalid Surfaces: 2433
Error Codes:
Error Code -107 reported for 293 surfaces
Error Code -108 reported for 1900 surfaces
Error Code -111 reported for 239 surfaces
Error Code -112 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

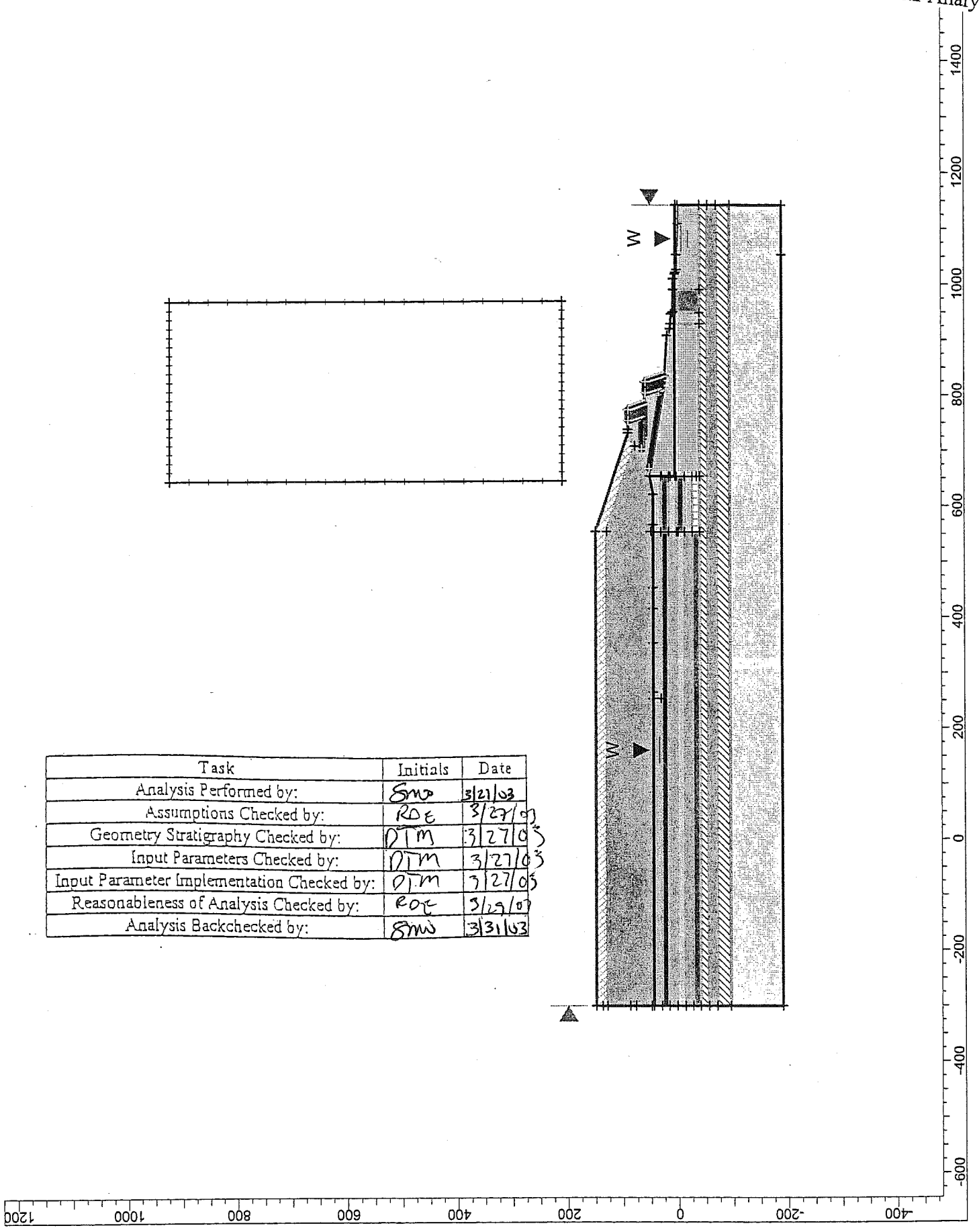
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

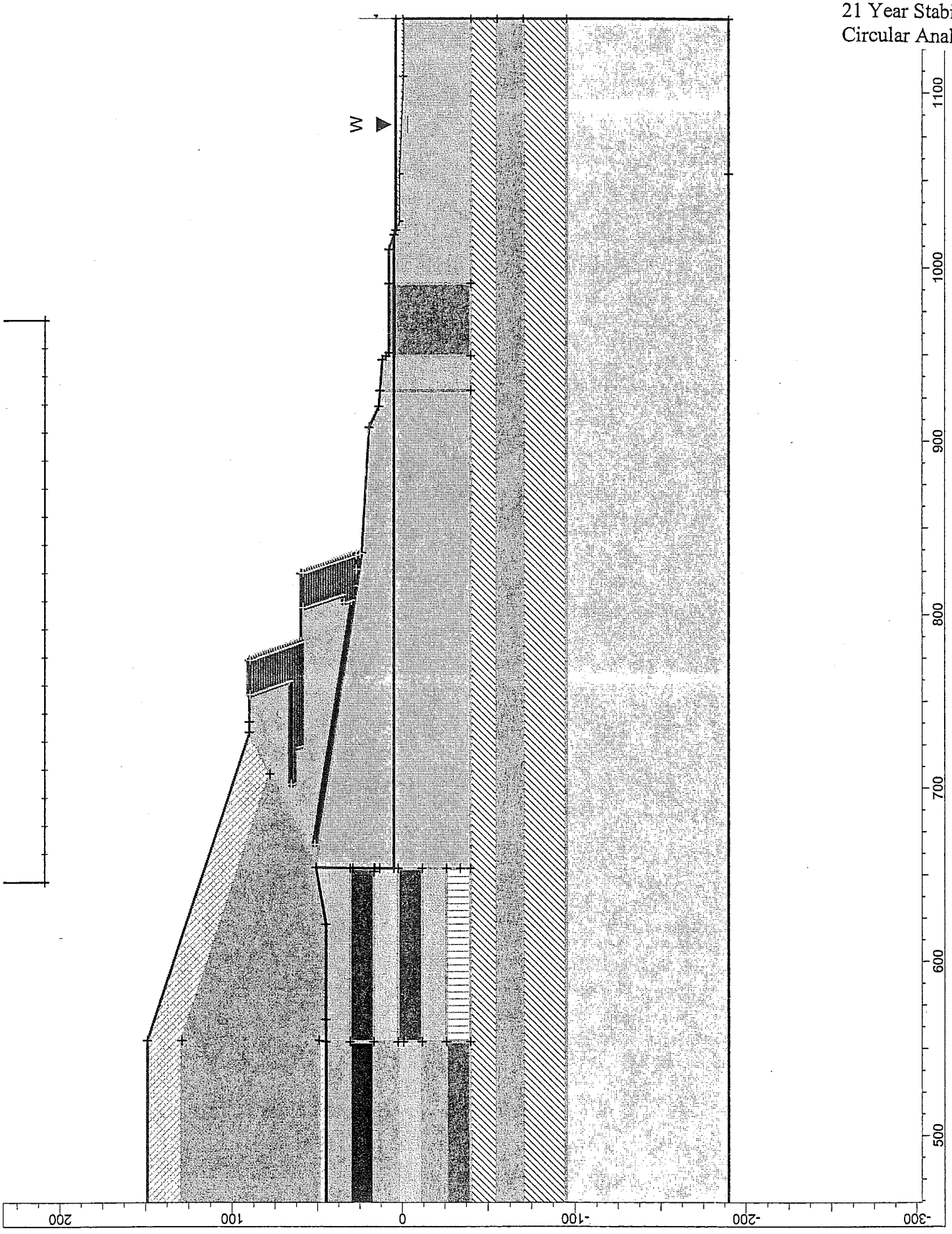
Section H-H
21 Year Stability
Circular Analysis

Task	Initials	Date
Analysis Performed by:	SMW	3/21/03
Assumptions Checked by:	ROE	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	ROE	3/29/03
Analysis Backchecked by:	SMW	3/31/03

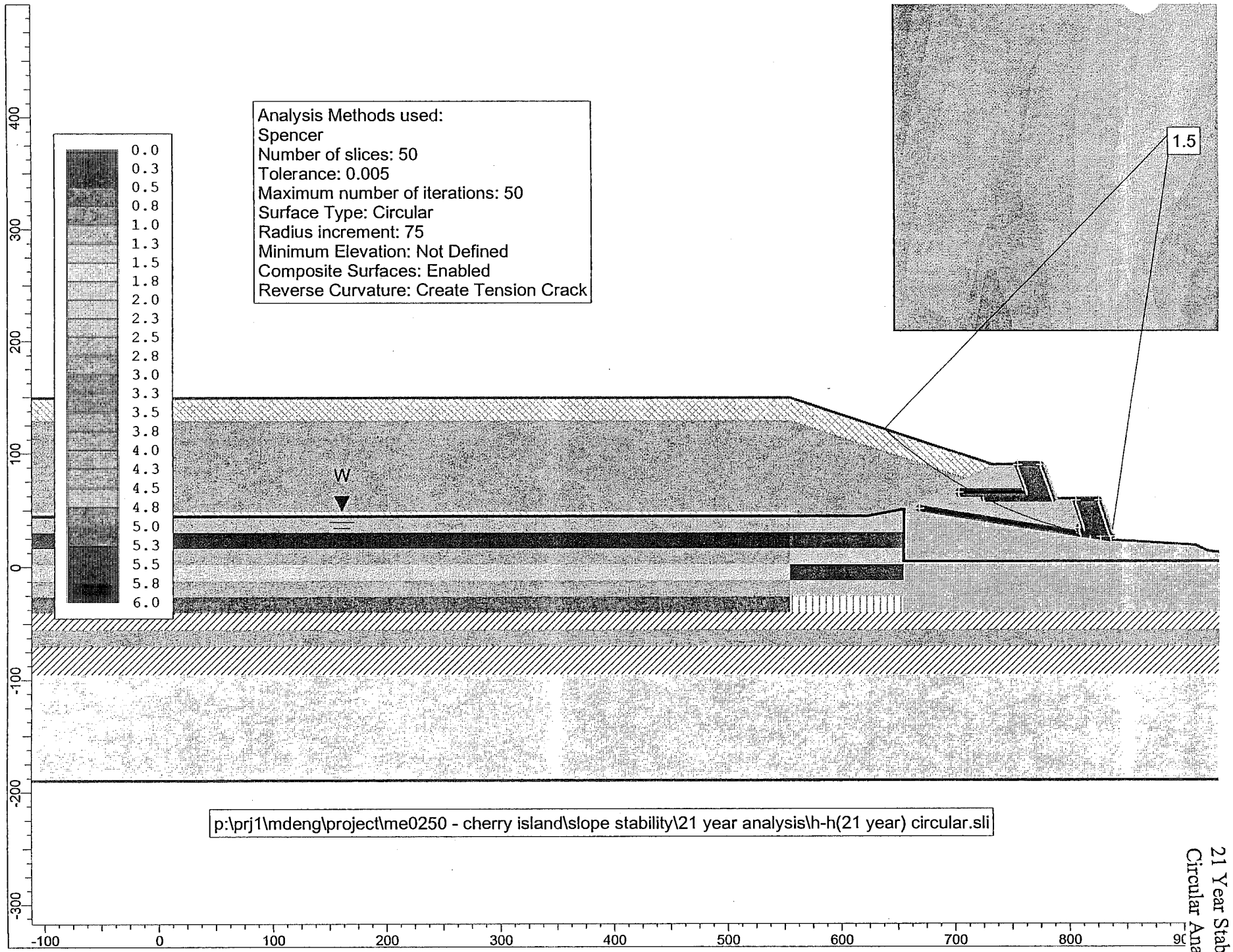


H21-1

Section H-H
21 Year Stability
Circular Analysis



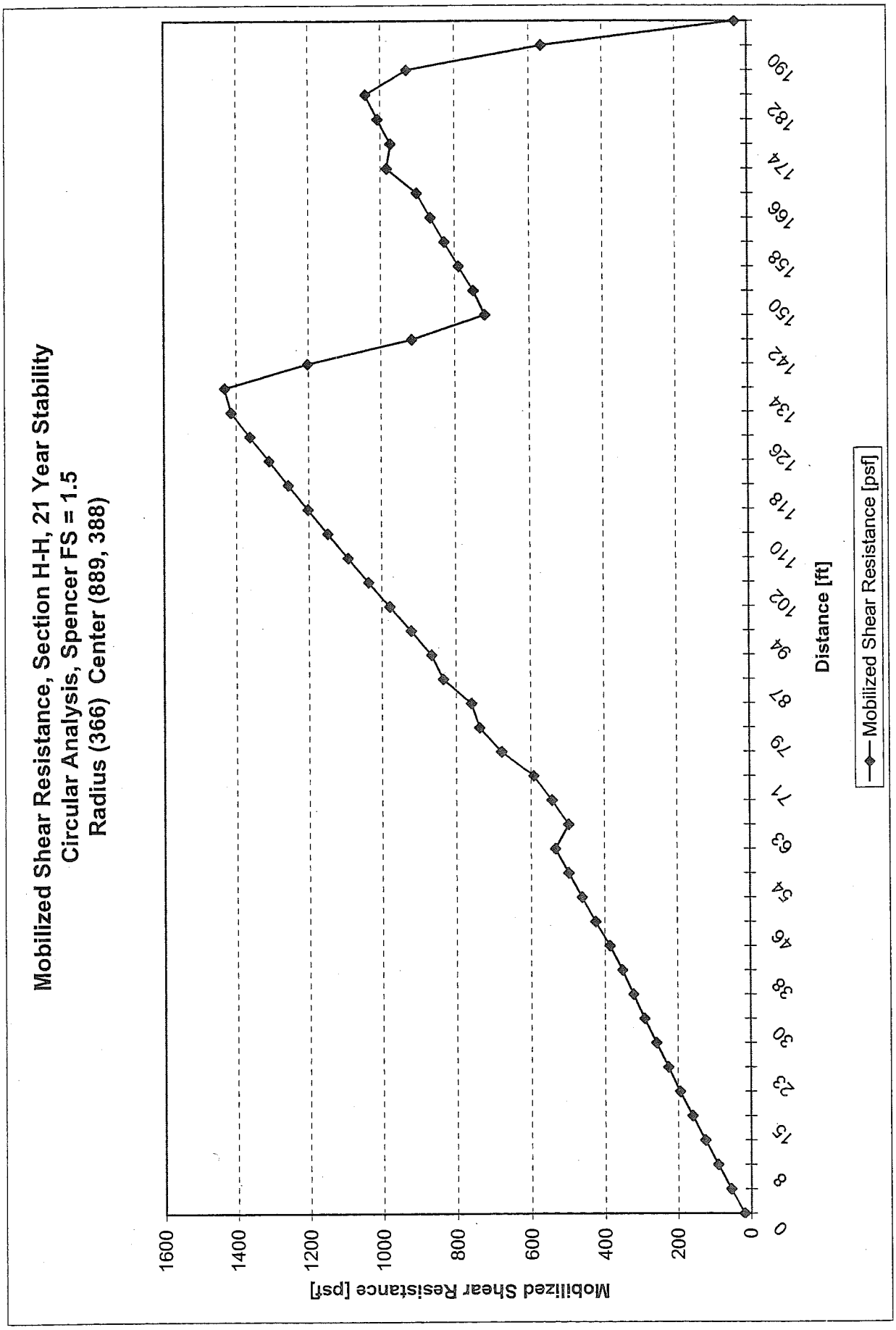
H21-2



Section H-H
21 Year Stability
Circular Analysis

H21-3

Section H-H
21 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance H

H21-4

Slide Analysis Information

Document Name

File Name: h-h(21 year) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius Increment: 30
Minimum Elevation: -5
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1844 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1454 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1235 psf
Water Surface: None

H21-S

Section H-H
21 Year Stability
Circular Analysis

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1202 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1348 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2198 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2129 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1627 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1368 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1350 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1555 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2501 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.52914
Center: 888.84, 387.653
Radius: 366.13
Left Slip Surface Endpoint: 637.447, 121.47
Right Slip Surface Endpoint: 835.008, 25.5013

Method Statistics

Method: spencer
Number of Valid Surfaces: 12241
Number of Invalid Surfaces: 1430
Error Codes:
Error Code -106 reported for 59 surfaces
Error Code -108 reported for 283 surfaces
Error Code -111 reported for 1088 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

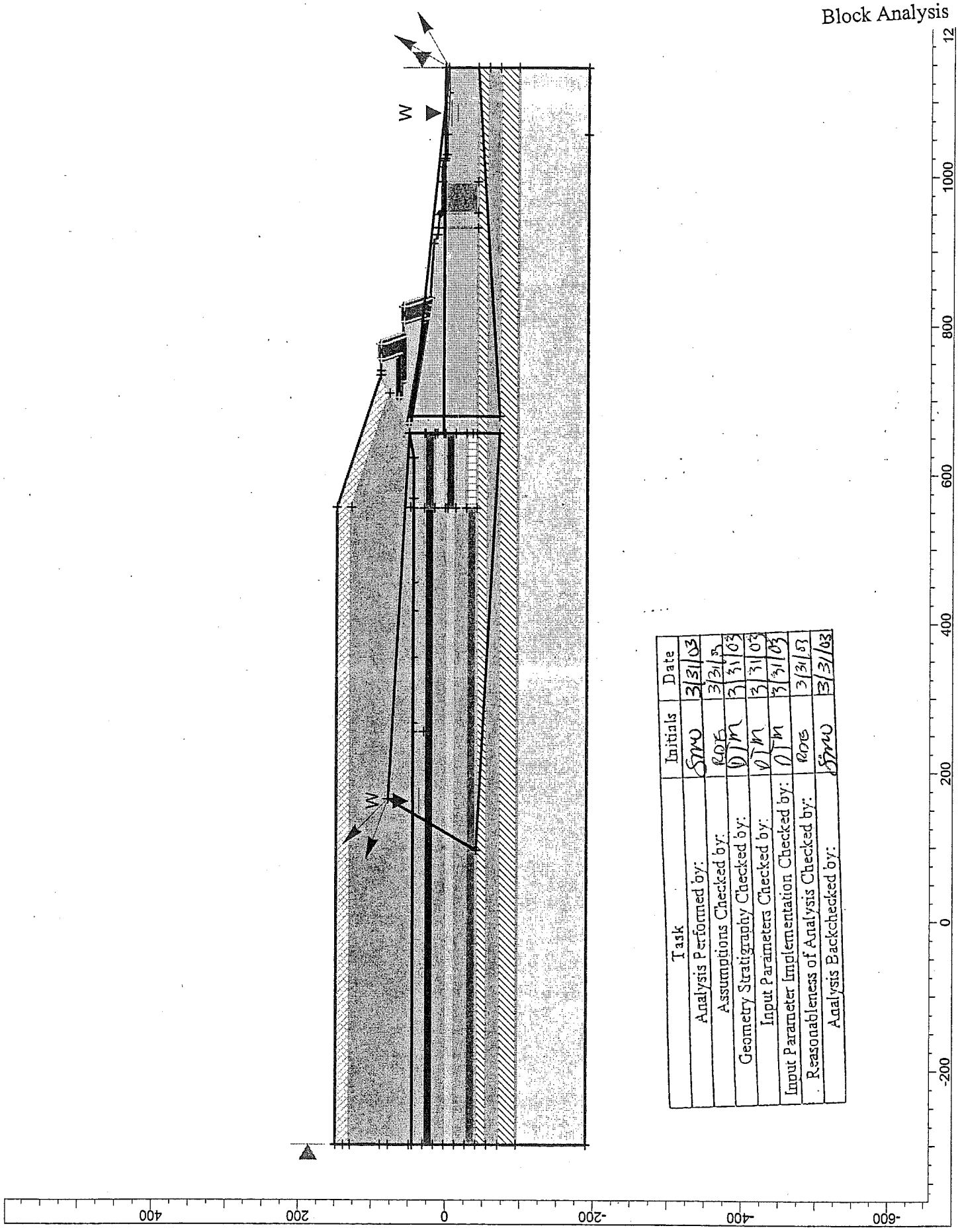
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

H21-6

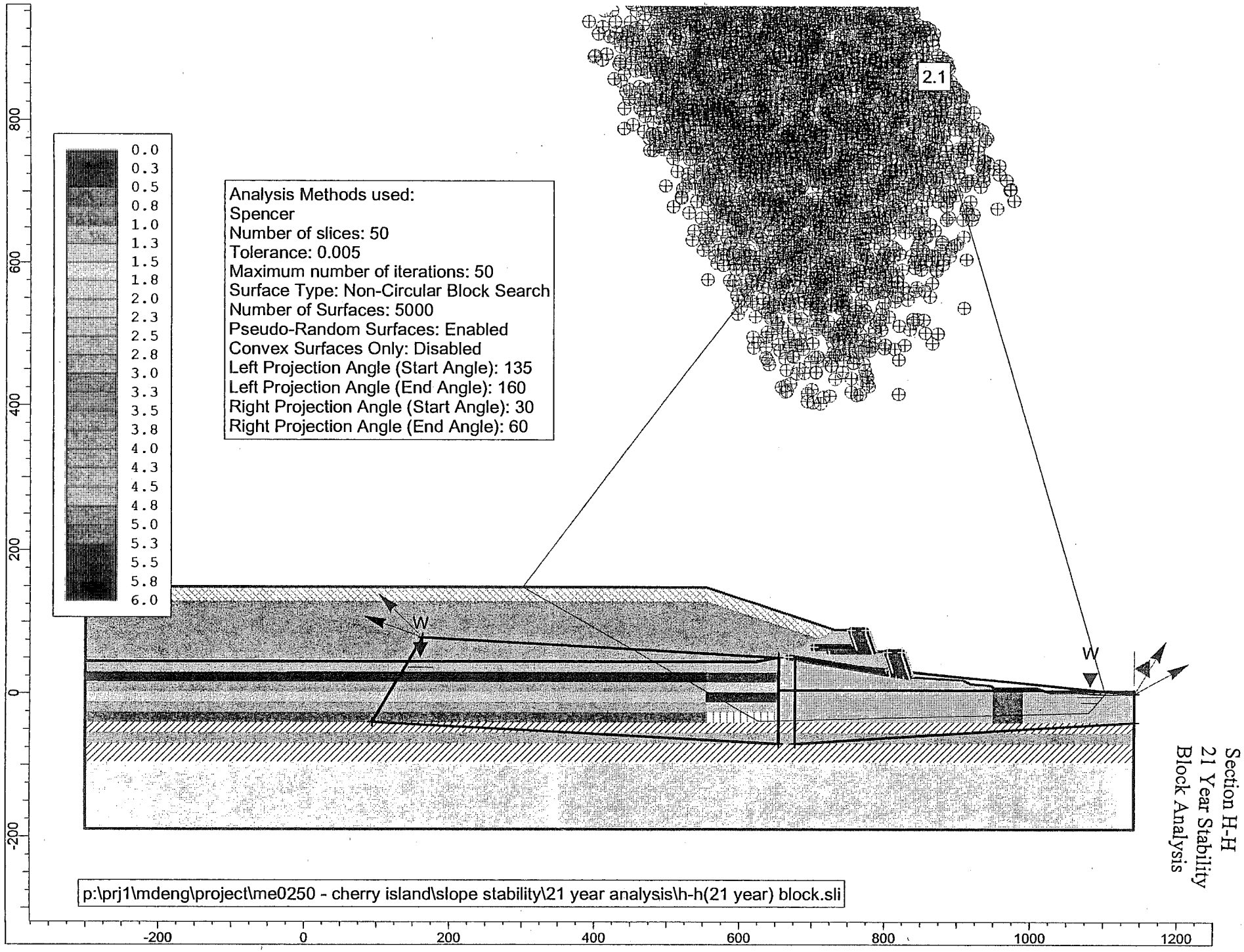
Section H-H
21 Year Stability
Circular Analysis

Section H-H
21 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RDE	3/31/03
Geometry Stratigraphy Checked by:	DJM	3/31/03
Input Parameters Checked by:	DJM	3/31/03
Input Parameter Implementation Checked by:	DJM	3/31/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMW	3/31/03

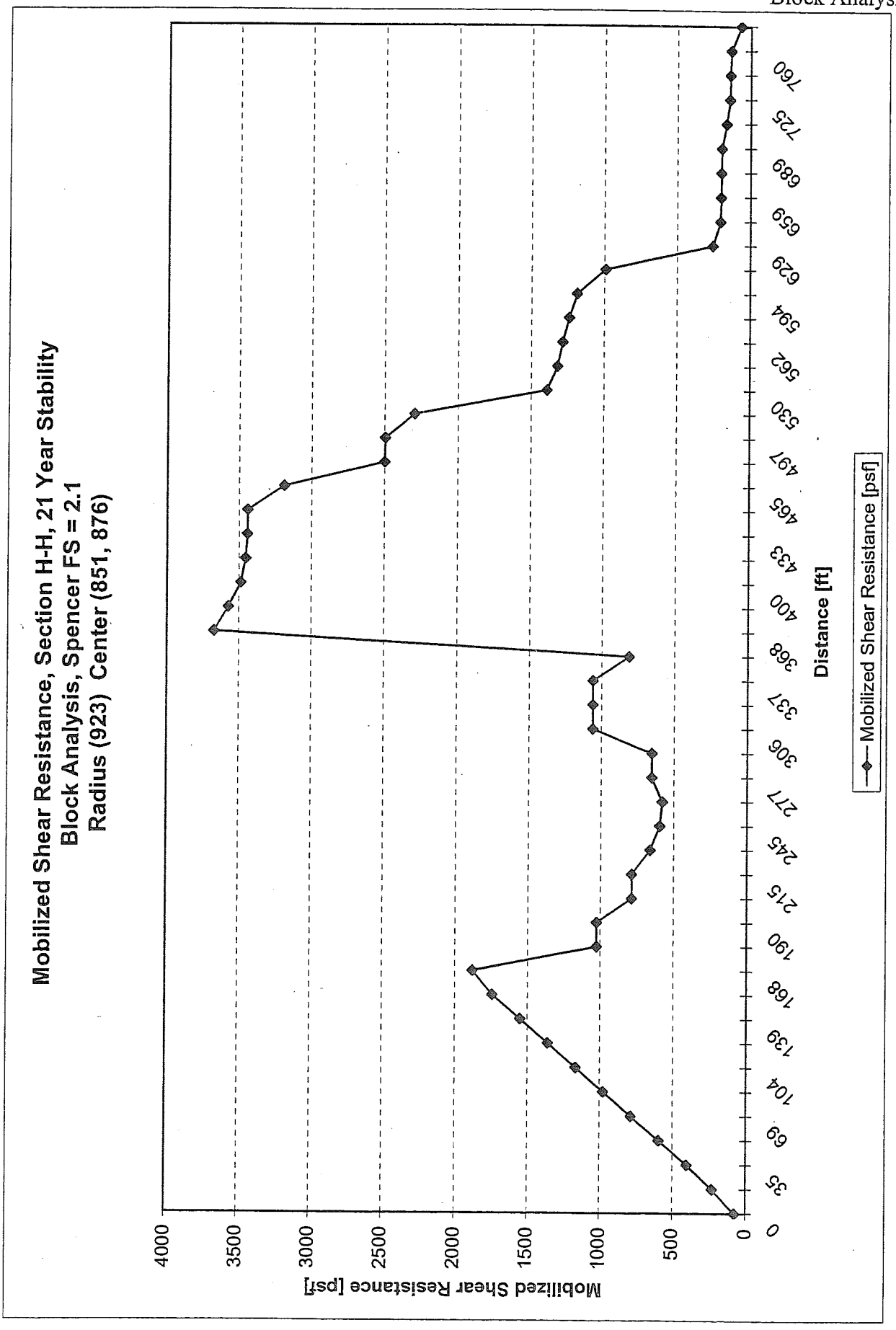
H21-7



Section H-H
21 Year Stability
Block Analysis

H21-8

Section H-H
21 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance H

H21-9

Slide Analysis Information

Document Name

File Name: h-h(21 year) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1844 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1454 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3

Section H-H
21 Year Stability
Block Analysis

H21-10

Cohesion Type: Constant
Cohesion: 1235 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1202 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1348 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2198 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2129 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1627 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1368 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1350 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1555 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2501 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3

Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.07582
Axis Location: 851.066, 875.531
Left Slip Surface Endpoint: 301.63, 149
Right Slip Surface Endpoint: 1102.63, 0.0635452
Left Slope Intercept: 301.63 149
Right Slope Intercept: 1102.63 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 3831
Number of Invalid Surfaces: 1169
Error Codes:
Error Code -105 reported for 4 surfaces
Error Code -107 reported for 12 surfaces
Error Code -108 reported for 1116 surfaces
Error Code -111 reported for 36 surfaces
Error Code -112 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

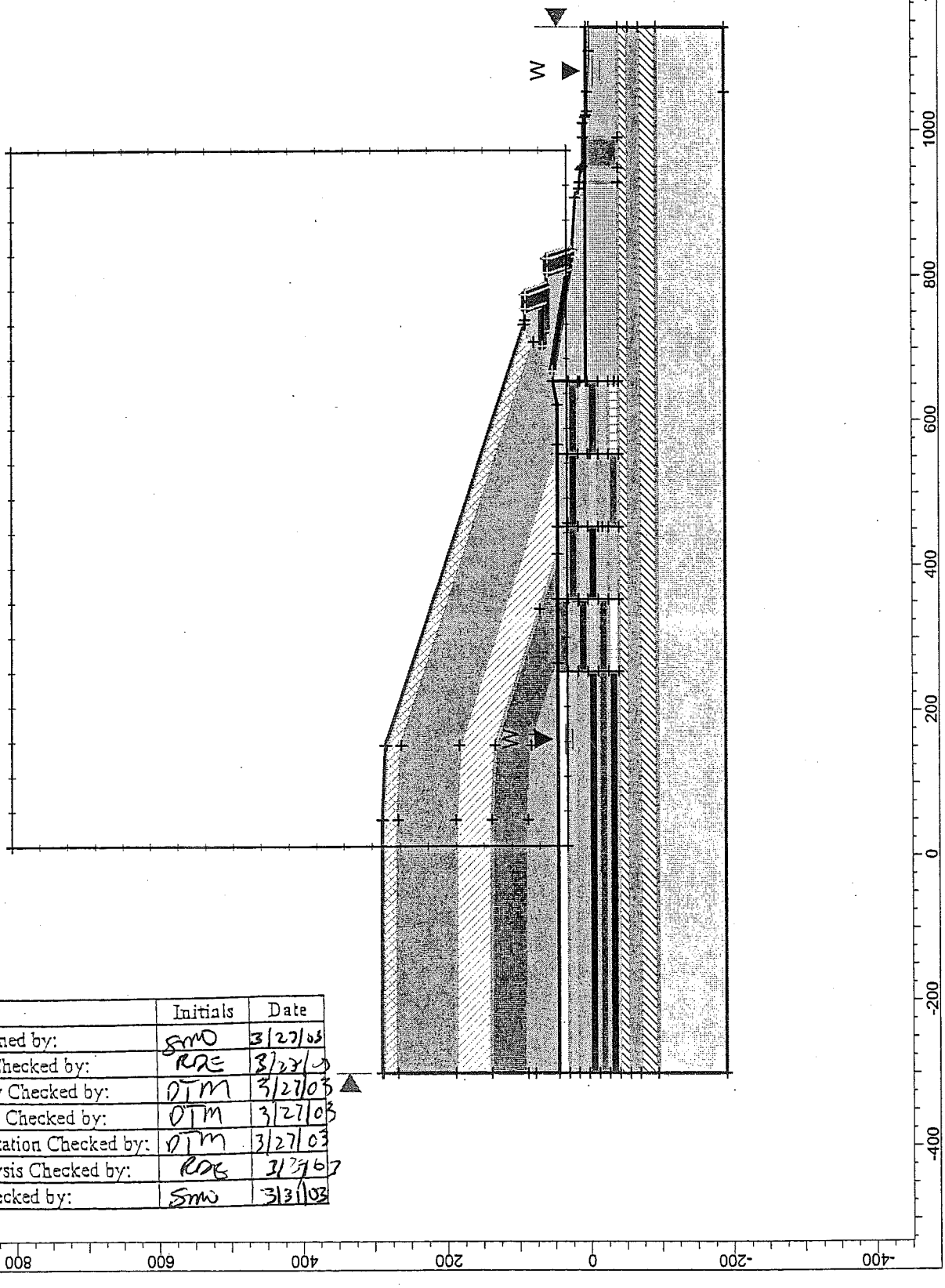
-111 = safety factor equation did not converge

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

Section H-H
21 Year Stability
Block Analysis

H21-11

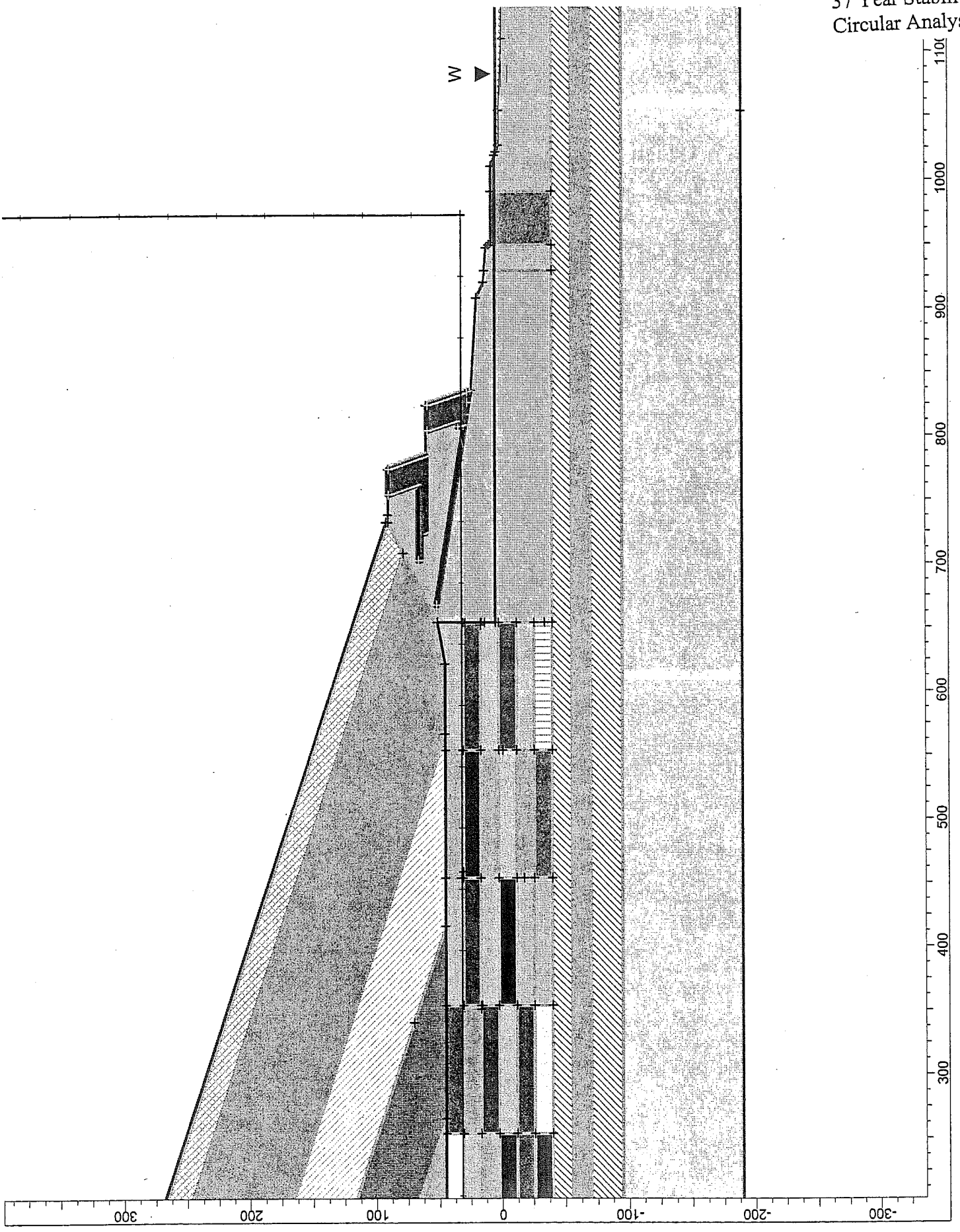
Section H-H
37 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	RDE	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	RDE	3/27/03
Analysis Backchecked by:	SMO	3/31/03

H5 / 1

Section H-H
37 Year Stability
Circular Analysis

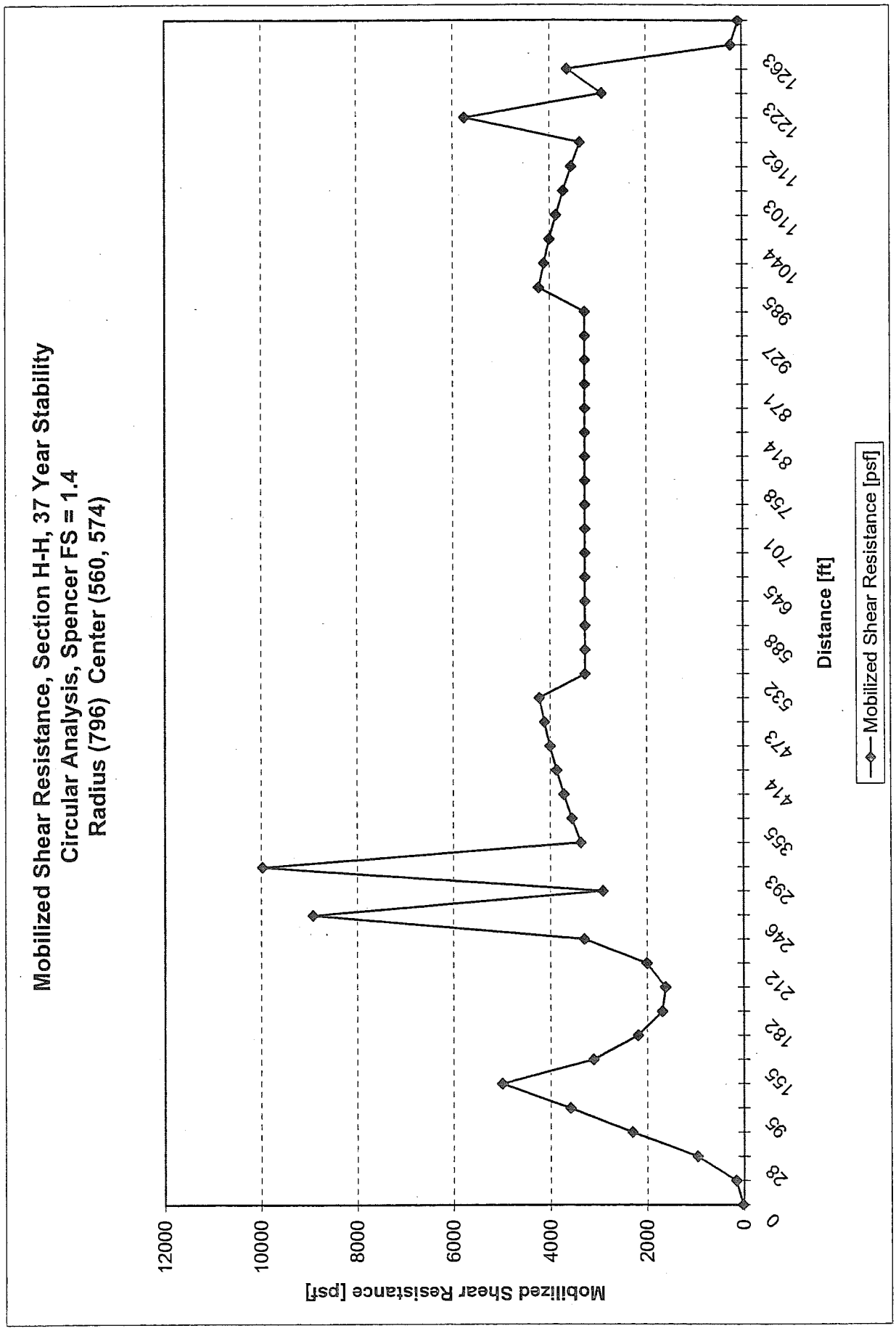


HS1-2

Section H-H
37 Year Stability
Circular Analysis

H37-3

Section H-H
37 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance H

H37-4

Slide Analysis Information

Document Name

File Name: h-h(37 year) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function

H37-5

Section H-H
37 Year Stability
Circular Analysis

Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2003 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1813 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1663 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1756 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2405 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2647 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2327 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2113 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2103 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2937 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3295 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2718 psf

Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2302 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2120 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2205 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3391 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3660 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2775 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2232 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d45
Strength Type: Undreined
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2506 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3917 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4273 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3002 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2238 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2751 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4535 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.37245
Center: 560.275, 573.67
Radius: 796.437
Left Slip Surface Endpoint: -183.843, 289.767
Right Slip Surface Endpoint: 1112.53, -0.2
Left Slope Intercept: -183.843 289.767
Right Slope Intercept: 1112.53 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 31874
Number of Invalid Surfaces: 1642
Error Codes:
Error Code -106 reported for 2 surfaces
Error Code -108 reported for 180 surfaces
Error Code -111 reported for 438 surfaces
Error Code -112 reported for 1022 surfaces

Error Codes

The following errors were encountered during the computation:

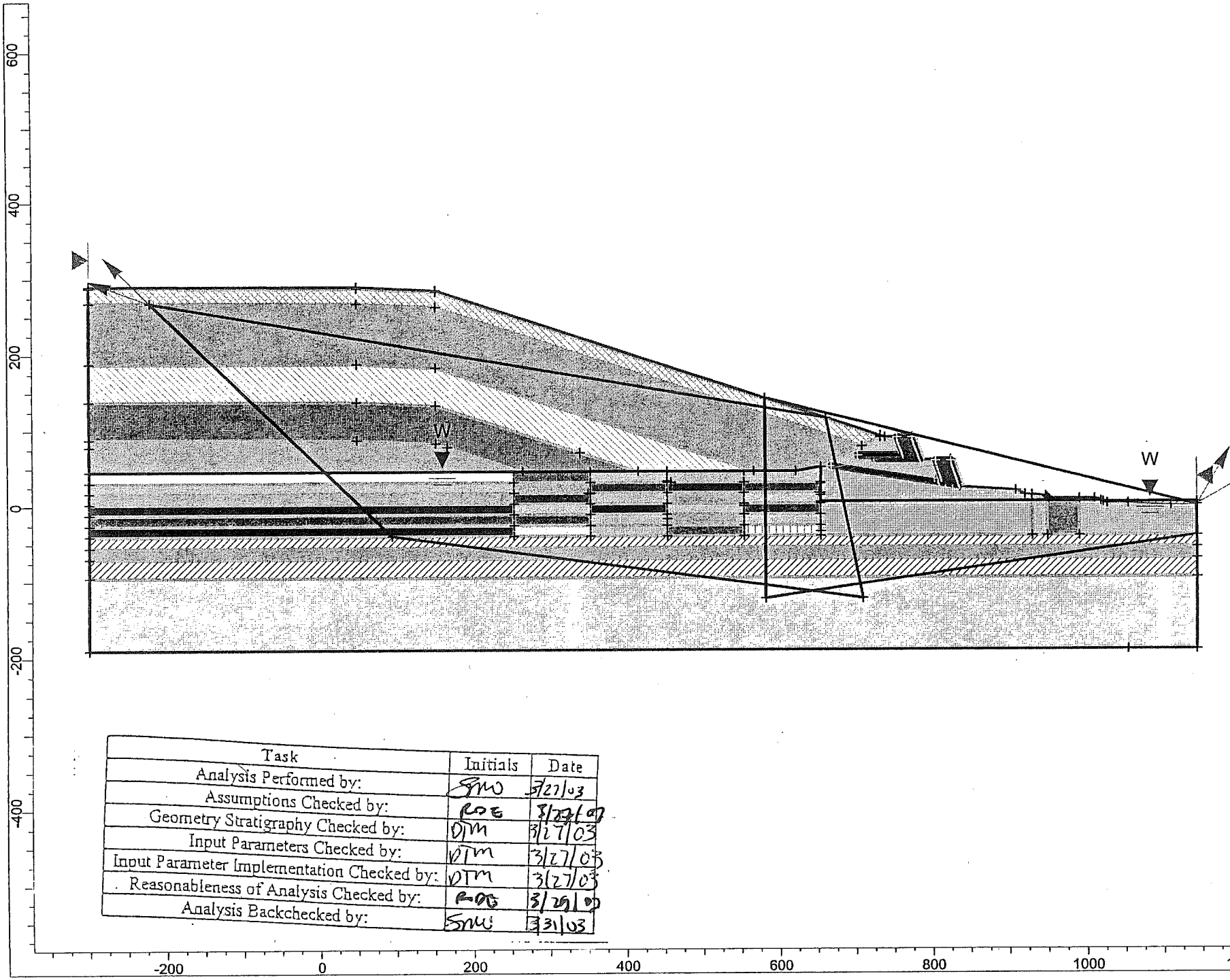
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

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

-111 = safety factor equation did not converge

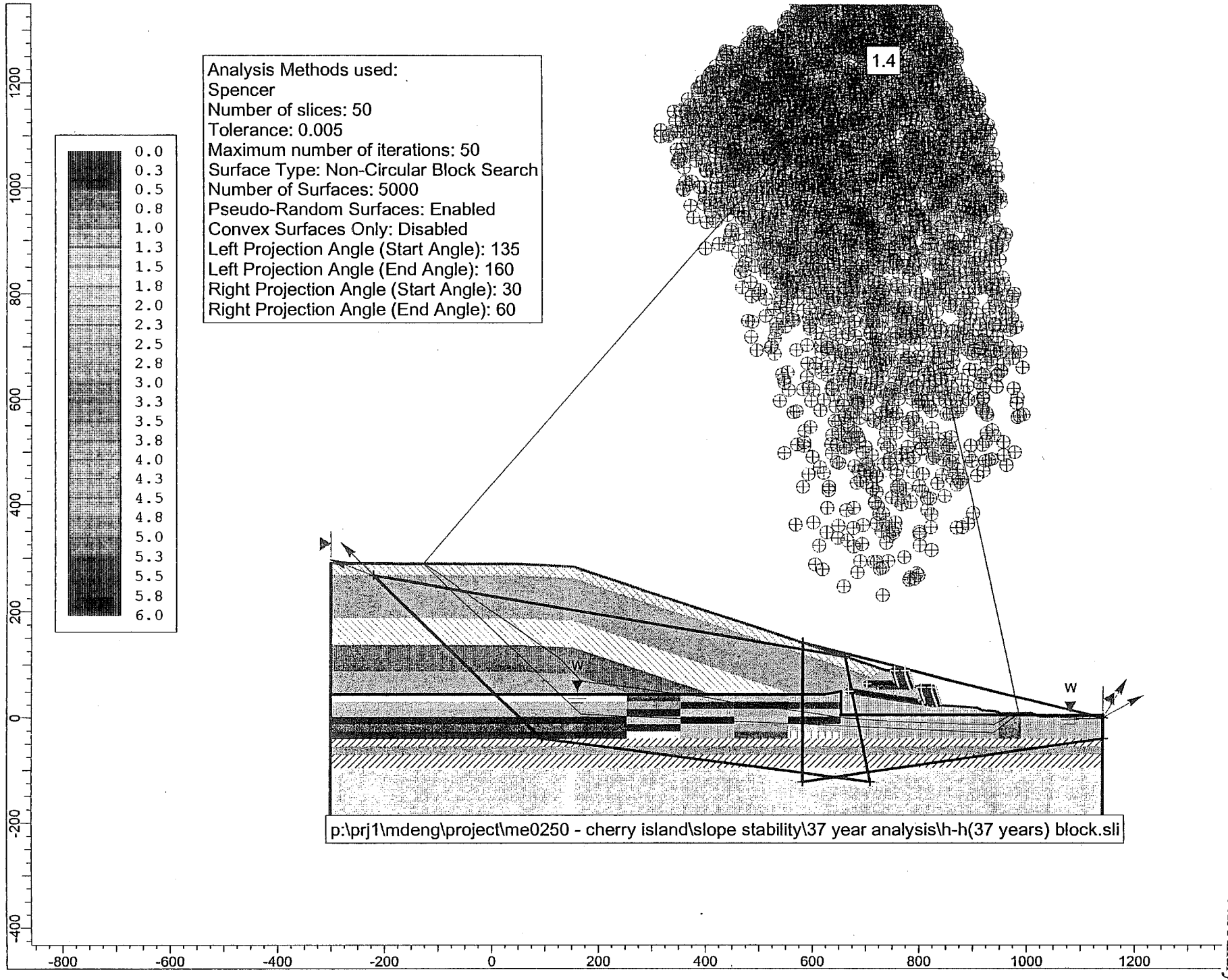
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

Section H-H
37 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/27/03
Assumptions Checked by:	RDE	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	RDE	3/29/03
Analysis Backchecked by:	SMW	3/31/03

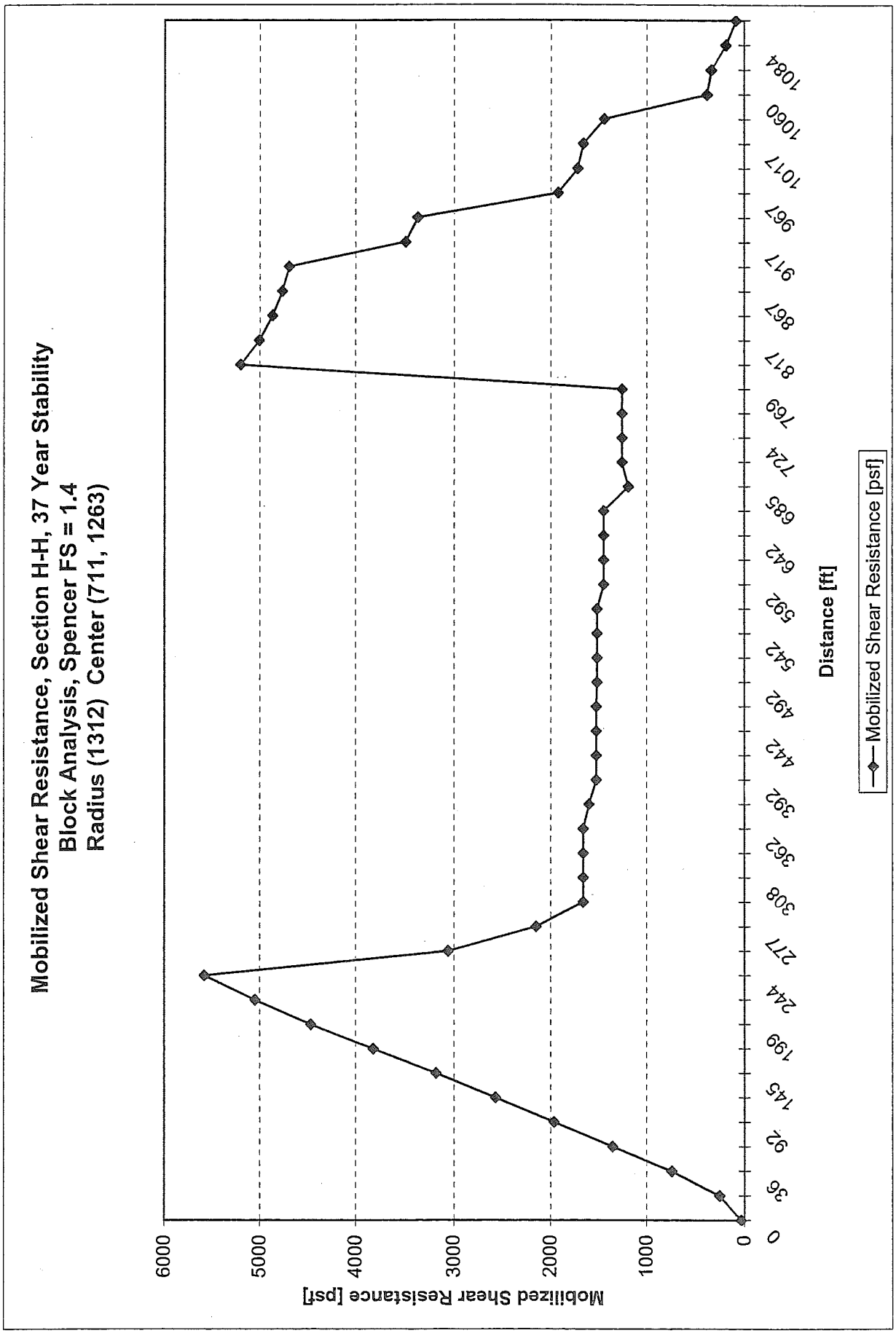
H37-8



Section H-H
37 Year Stability
Block Analysis

H37-9

Section H-H
37 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance H

H37-10

Slide Analysis Information

Document Name

File Name: h-h(37 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

H-37-11

Section H-H
37 Year Stability
Block Analysis

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2003 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1813 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1663 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1756 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2405 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2647 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2327 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2113 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2103 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2937 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3295 psf
Water Surface: None

Material: d32
Strength Type: Undrained

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2718 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2302 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2120 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2205 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3391 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3660 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2775 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2232 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2506 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3917 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4273 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3002 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section H-H
37 Year Stability
Block Analysis

H37-12

Cohesion: 2238 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2751 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4535 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.39611
Axis Location: 711.41, 1262.57
Left Slip Surface Endpoint: -126.99, 289.653
Right Slip Surface Endpoint: 986.703, 8.1

Method Statistics

Method: spencer
Number of Valid Surfaces: 3683
Number of Invalid Surfaces: 1317
Error Codes:
Error Code -105 reported for 186 surfaces
Error Code -108 reported for 949 surfaces
Error Code -111 reported for 120 surfaces
Error Code -112 reported for 62 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

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

-111 = safety factor equation did not converge

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

Section H-H
Long-Term Stability
Circular Analysis

Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	RAE	7/23/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	RAE	8/24/03
Analysis Backchecked by:	SMO	8/31/03

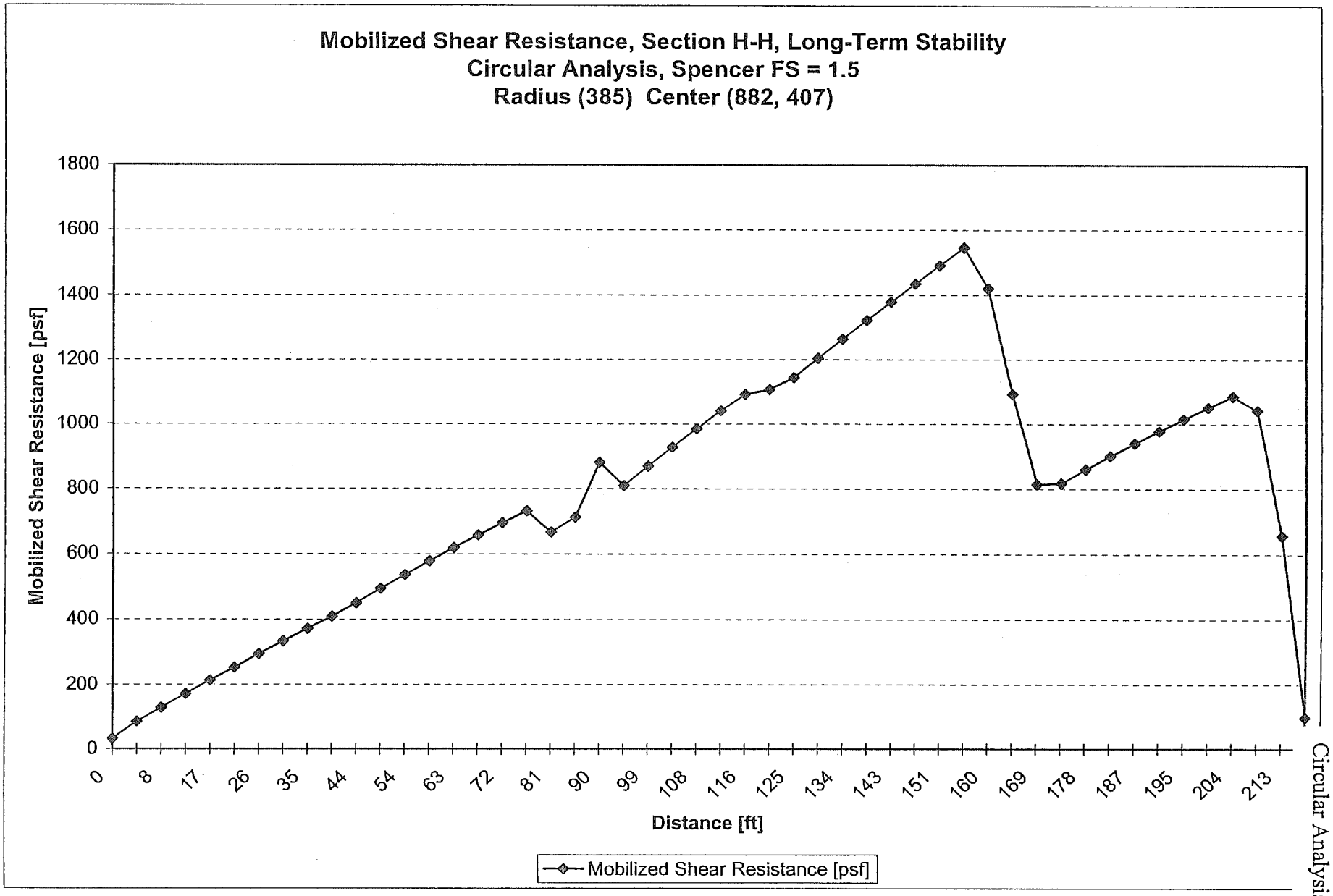
HLT-1

Section H-H
Long-Term Stability
Circular Analysis
1100
1000
900
800
700
600
500
400
200
100
0
-100
-200

HLT-2

Section H-H
Long-Term Stability
Circular Analysis

HLT-3



Section H-H
Long-Term Stability
Circular Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance H

H-LT-H

Slide Analysis Information

Document Name

File Name: h-h(long-term) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: 5
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3

Section H-H
Long-Term Stability
Circular Analysis

H-LT-5

Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.52926
Center: 882.027, 407.17
Radius: 384.685
Left Slip Surface Endpoint: 613.953, 131.273
Right Slip Surface Endpoint: 835.053, 25.3632

Method Statistics

Method: spencer
Number of Valid Surfaces: 19716
Number of Invalid Surfaces: 13800
Error Codes:
Error Code -106 reported for 577 surfaces
Error Code -108 reported for 1078 surfaces
Error Code -109 reported for 2428 surfaces
Error Code -111 reported for 5130 surfaces
Error Code -112 reported for 255 surfaces
Error Code -1000 reported for 4332 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

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

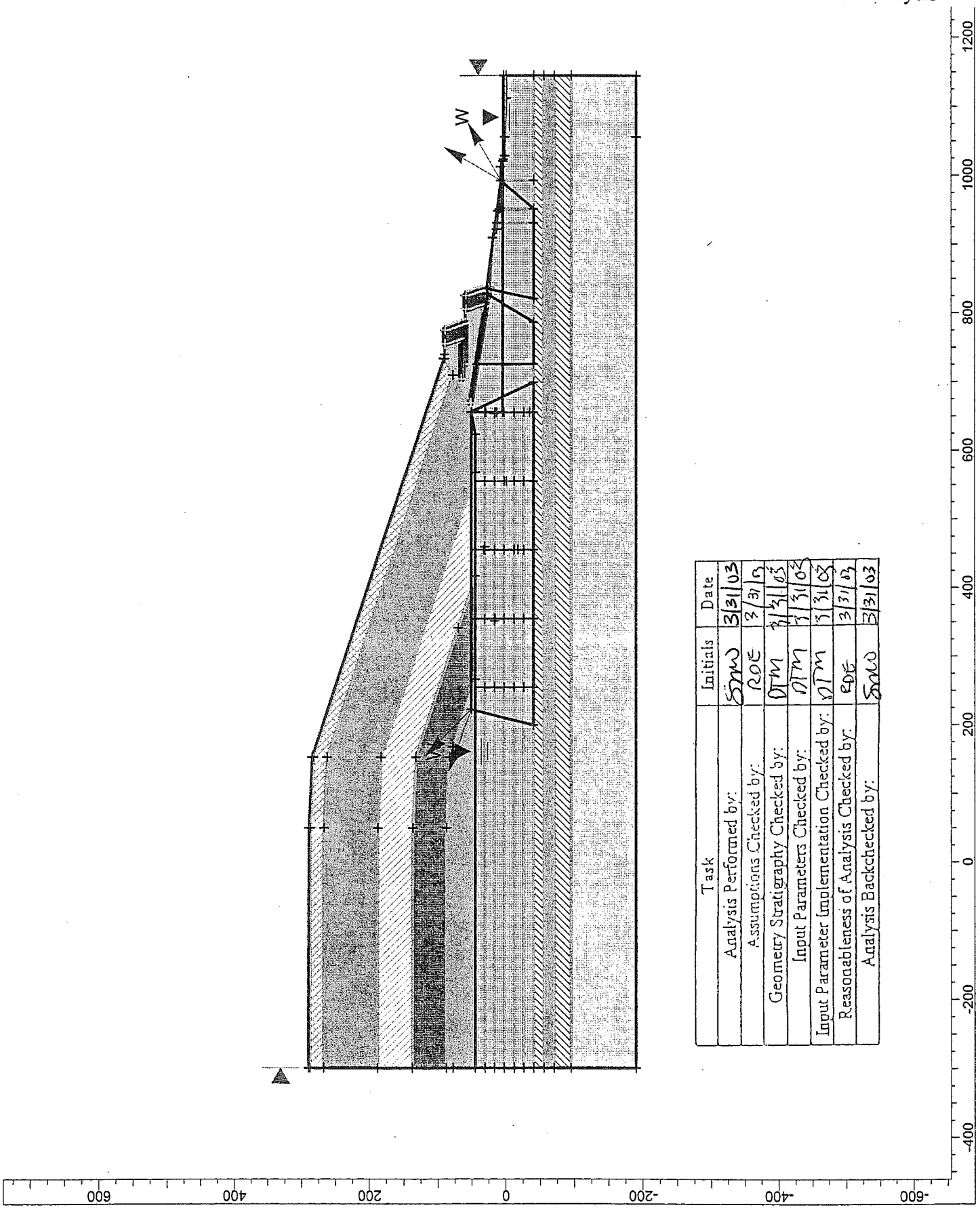
-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

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

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

Section H-H
Long-Term Stability
Block Analysis

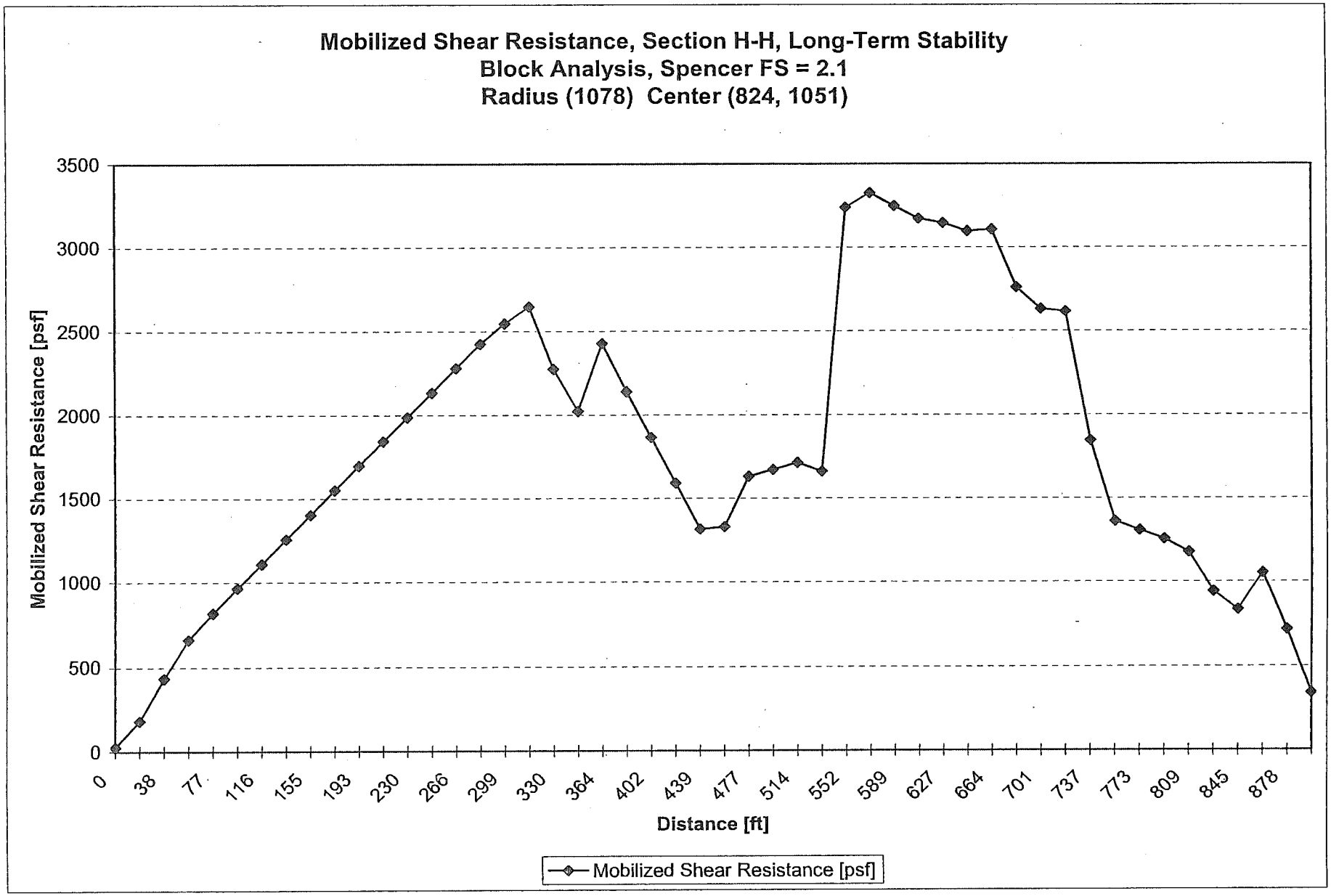


Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	ROE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	ROE	3/31/03
Analysis Backchecked by:	SMW	3/31/03

HLT-6

Section H-H
Long-Term Stability
Block Analysis

HLT-7



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance H

Section H-H
Long-Term Stability
Block Analysis

HLT-8

Slide Analysis Information

Document Name

File Name: h-h(long-term) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.14734
Axis Location: 824.497, 1051.21
Left Slip Surface Endpoint: 93.5583, 287.28
Right Slip Surface Endpoint: 997.074, 8.1

Method Statistics

Method: spencer
Number of Valid Surfaces: 1983
Number of Invalid Surfaces: 3017
Error Codes:
Error Code -105 reported for 2 surfaces
Error Code -108 reported for 418 surfaces
Error Code -109 reported for 2597 surfaces

Error Codes

The following errors were encountered during the computation:

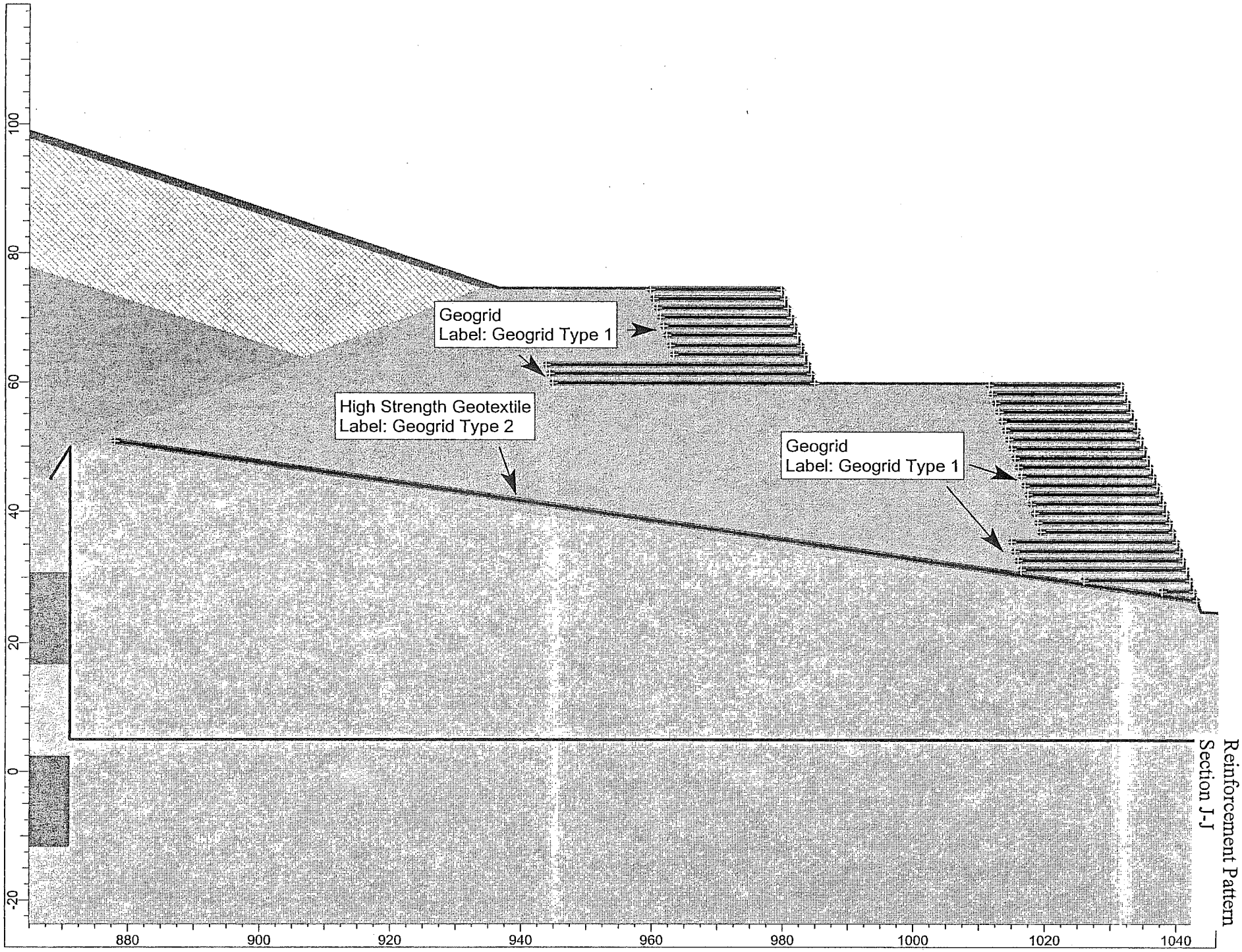
-105 = More than two surface / slope intersections with no valid slip surface.

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

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

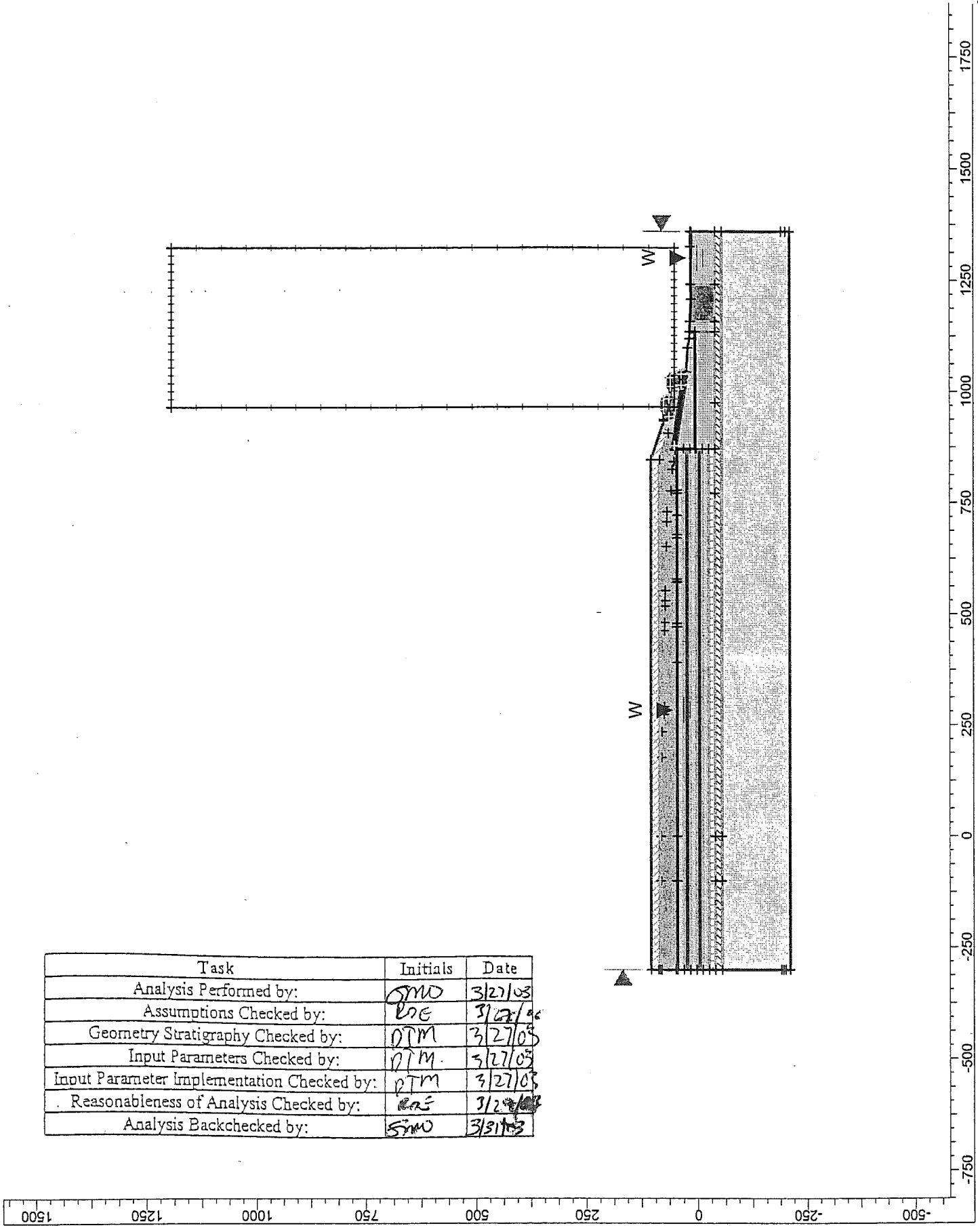
Attachment I

Stability Analysis Results for Cross Section J-J



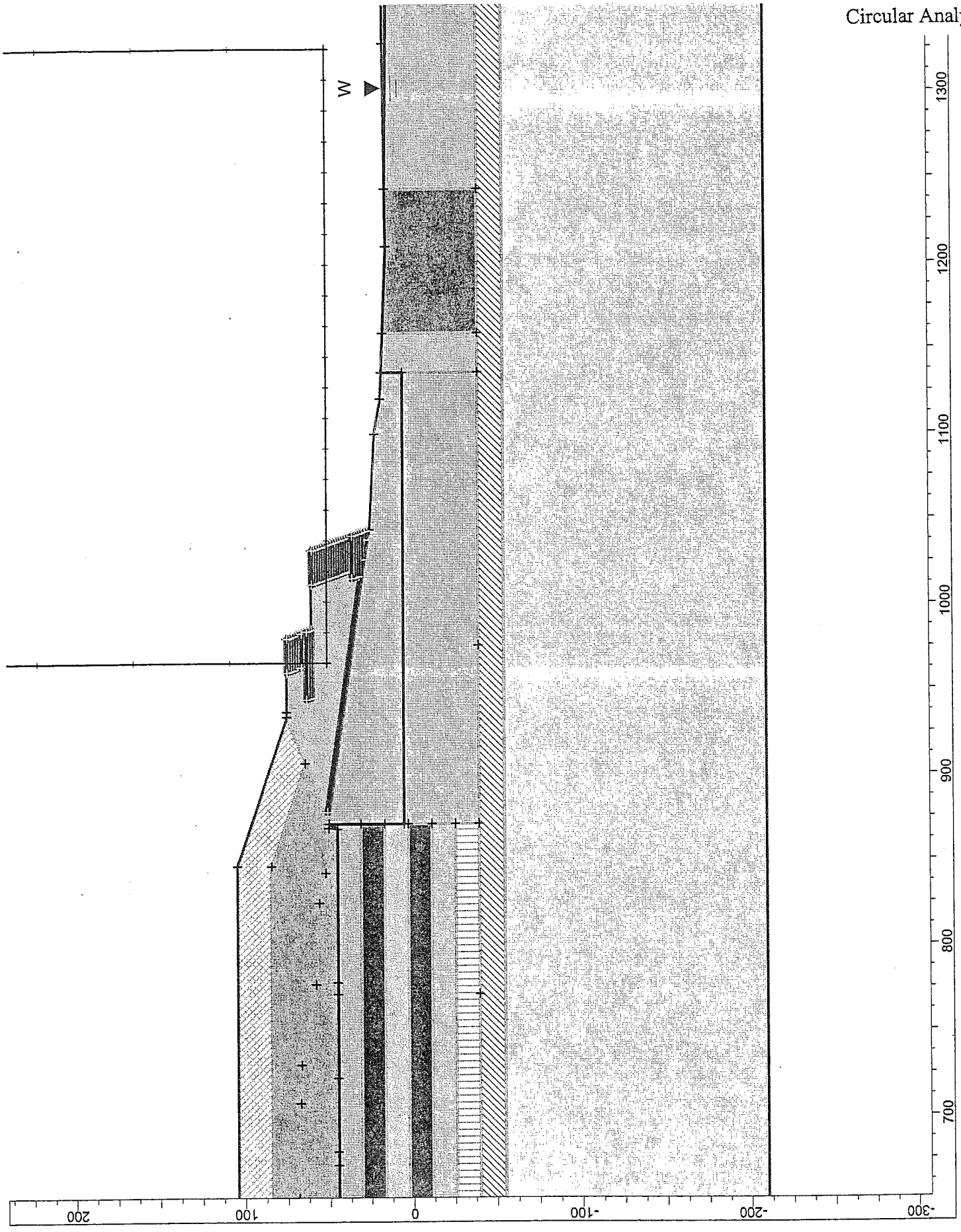
Reinforcement Pattern
Section J-J

Section J-J
9 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	RDE	3/27/03
Geometry Stratigraphy Checked by:	RTM	3/27/03
Input Parameters Checked by:	RTM	3/27/03
Input Parameter Implementation Checked by:	RTM	3/27/03
Reasonableness of Analysis Checked by:	RDE	3/27/03
Analysis Backchecked by:	SMO	3/31/03

Section J-J
9 Year Stability
Circular Analysis

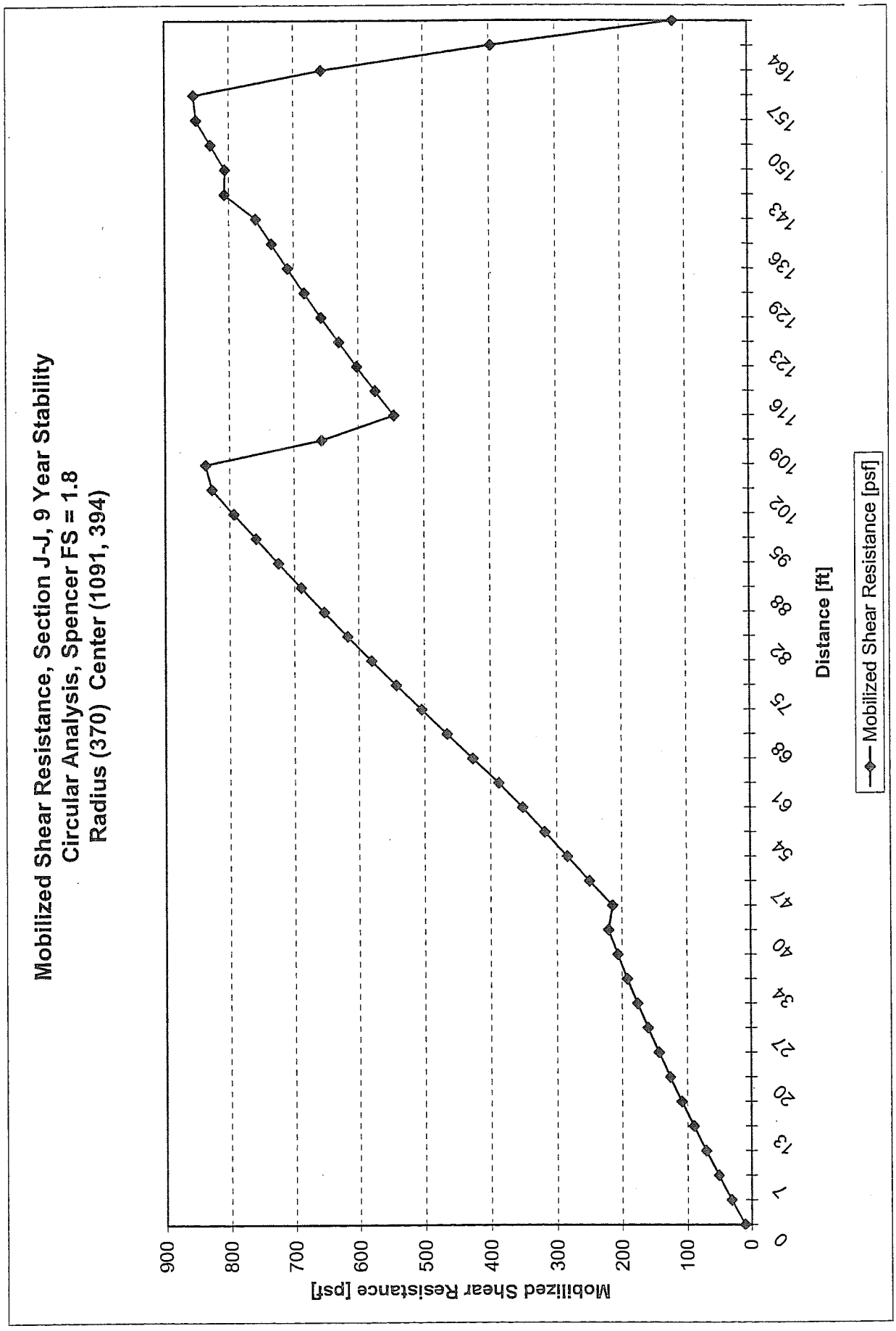


59-2

Section J-J
9 Year Stability
Circular Analysis

J9-3

Section J-J
9 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance .

J9-4

Slide Analysis Information

Document Name

File Name: j-j(9 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1183 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 855 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 730 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 777 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 978 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1686 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.77609
Center: 1090.94, 394.078
Radius: 370.244
Left Slip Surface Endpoint: 872.297, 95.2893
Right Slip Surface Endpoint: 1042.78, 26.9802

Method Statistics

Method: spencer
Number of Valid Surfaces: 21185
Number of Invalid Surfaces: 12331
Error Codes:
Error Code -100 reported for 1 surface
Error Code -105 reported for 1 surface
Error Code -106 reported for 1576 surfaces
Error Code -107 reported for 4911 surfaces
Error Code -108 reported for 594 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 4523 surfaces
Error Code -112 reported for 724 surfaces

Error Codes

The following errors were encountered during the computation:

-100 = Both surface / slope intersections are on the same horizontal surface. In general, this will

give a very high or infinite factor of safety (zero driving force), if calculated.

-105 = More than two surface / slope intersections with no valid slip surface.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

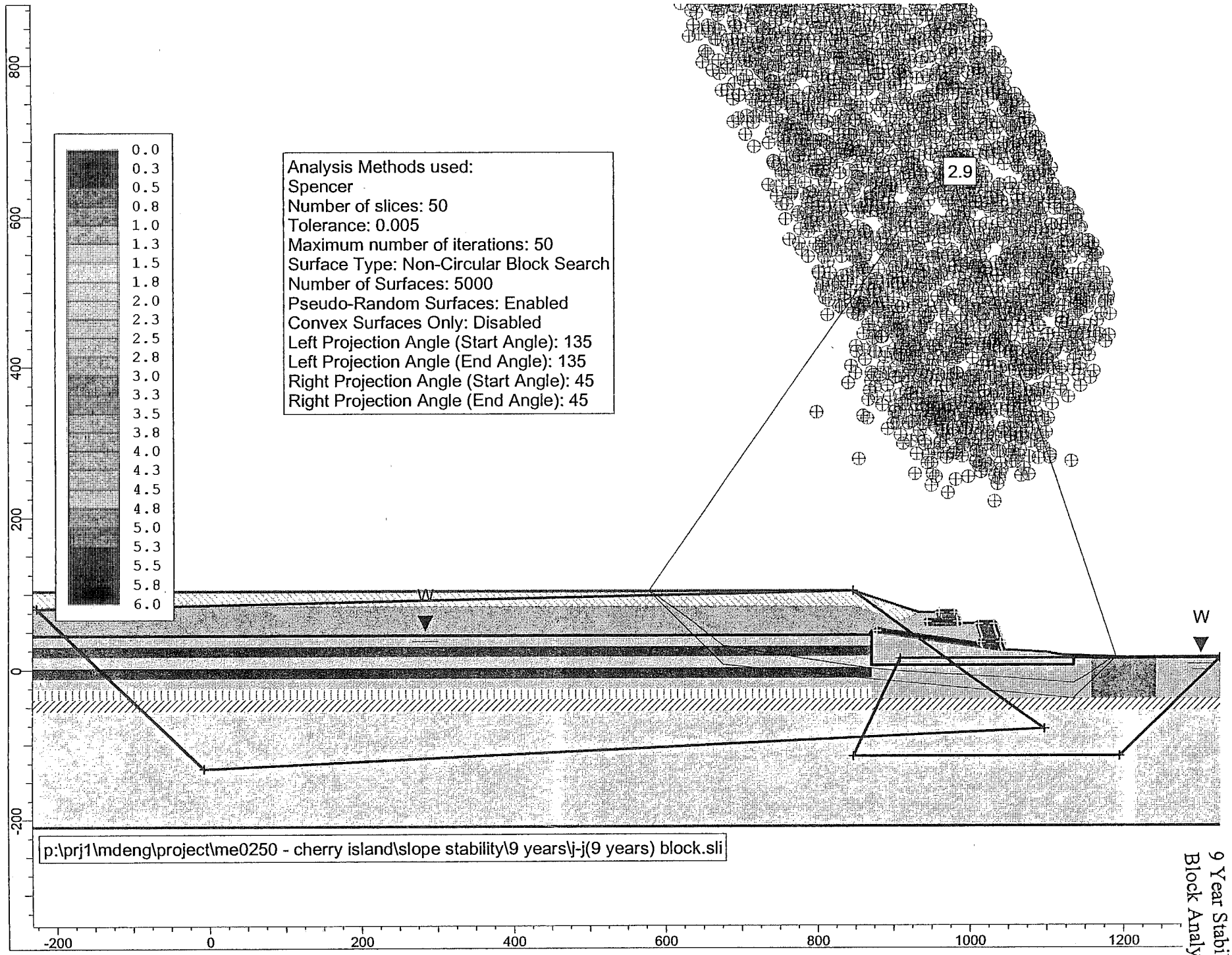
-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

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

Section J-J
9 Year Stability
Block Analysis

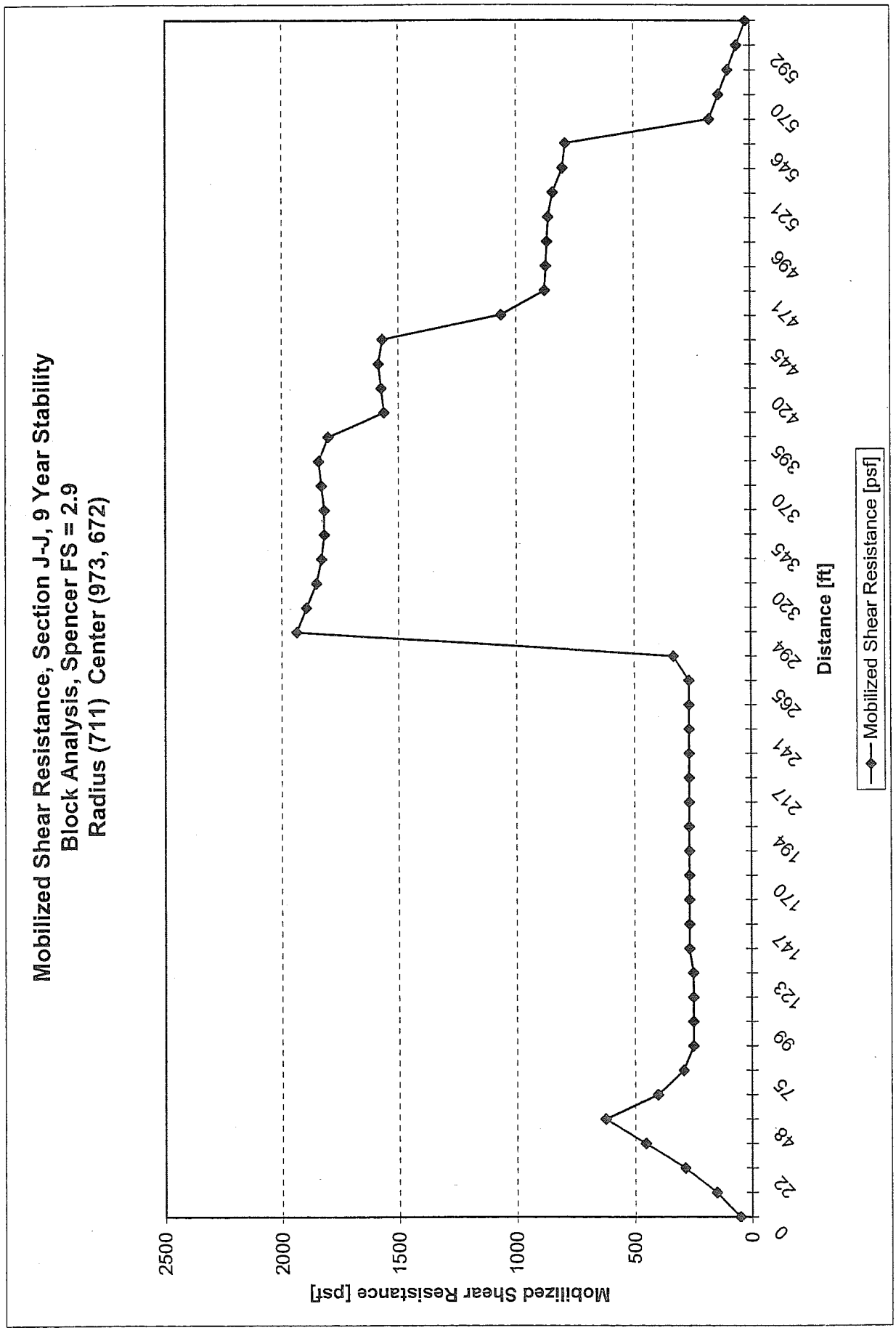
Task	Initials	Date
Analysis Performed by:	SMO	3/27/13
Assumptions Checked by:	EOS	3/28/13
Geometry Stratigraphy Checked by:	DTM	3/27/13
Input Parameters Checked by:	DTM	3/27/13
Input Parameter Implementation Checked by:	DTM	3/27/13
Reasonableness of Analysis Checked by:	MOS	3/29/13
Analysis Backchecked by:	SMO	3/31/13



J-J

Section J-J
9 Year Stability
Block Analysis

Section J-J
9 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance J

J9-9

Slide Analysis Information

Document Name

File Name: J-J(9 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1183 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 855 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 730 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

J-J-10

Section J-J
9 Year Stability
Block Analysis

Cohesion: 777 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 978 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1686 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.92458
Axis Location: 972.962, 672.426
Left Slip Surface Endpoint: 577.997, 104
Right Slip Surface Endpoint: 1190.72, 15.3982

Method Statistics

Method: spencer
Number of Valid Surfaces: 2755
Number of Invalid Surfaces: 2245
Error Codes:
Error Code -105 reported for 7 surfaces
Error Code -107 reported for 127 surfaces
Error Code -108 reported for 1888 surfaces
Error Code -111 reported for 199 surfaces
Error Code -112 reported for 2 surfaces
Error Code -200 reported for 22 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

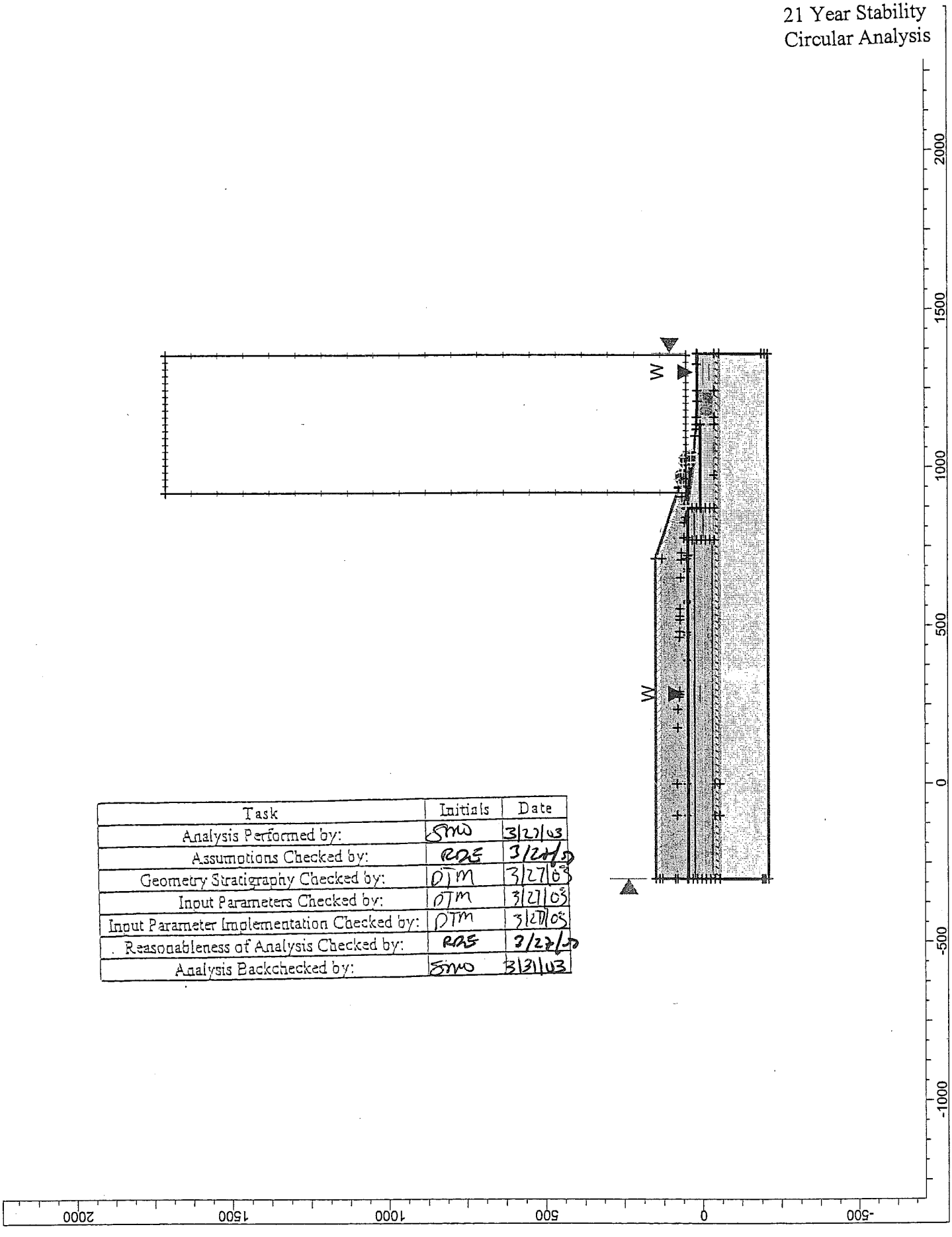
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

-200 = Factor of Safety = 0. Could mean 0 Normal/Shear resistance along part of the slip surface

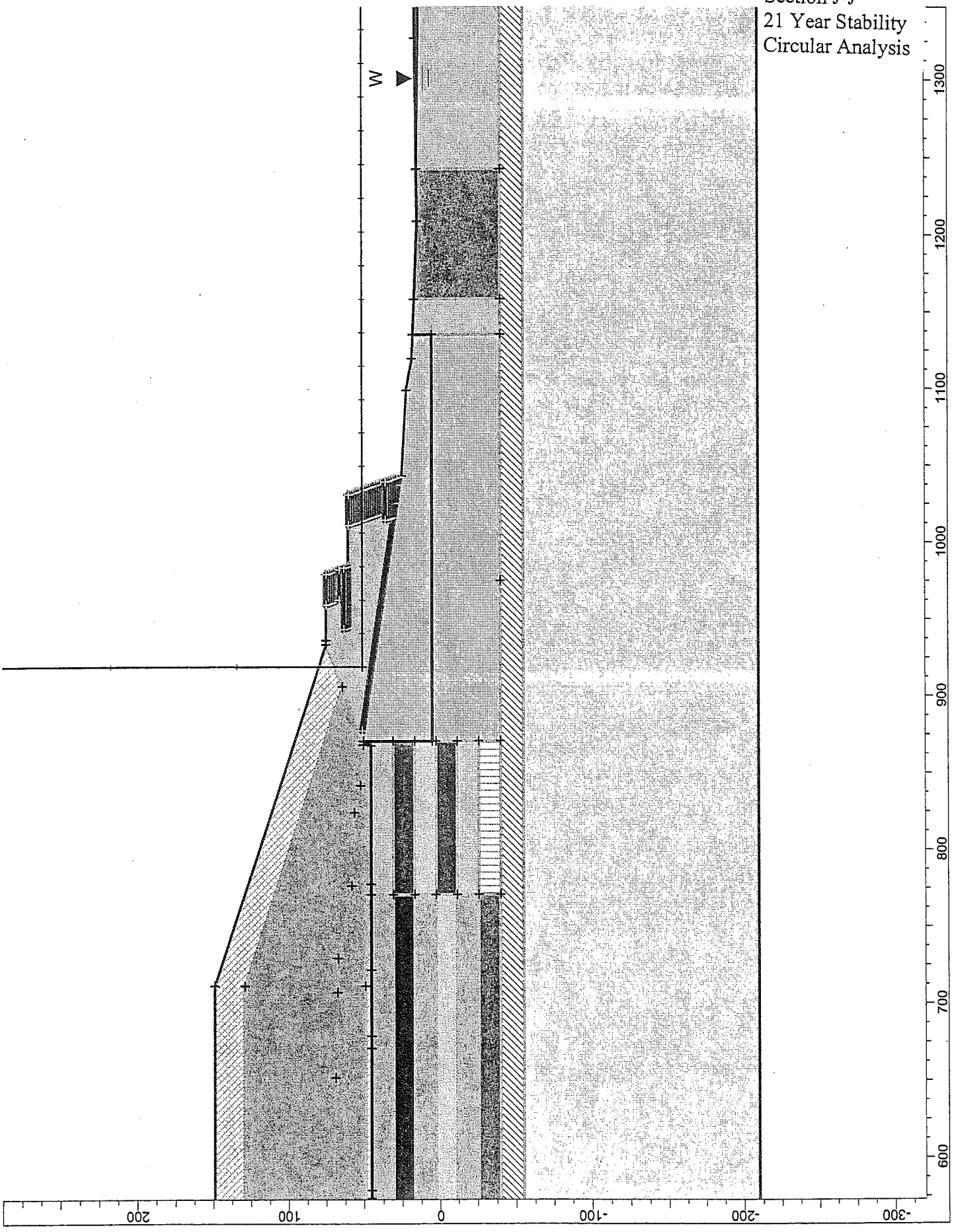
Section J-J
21 Year Stability
Circular Analysis



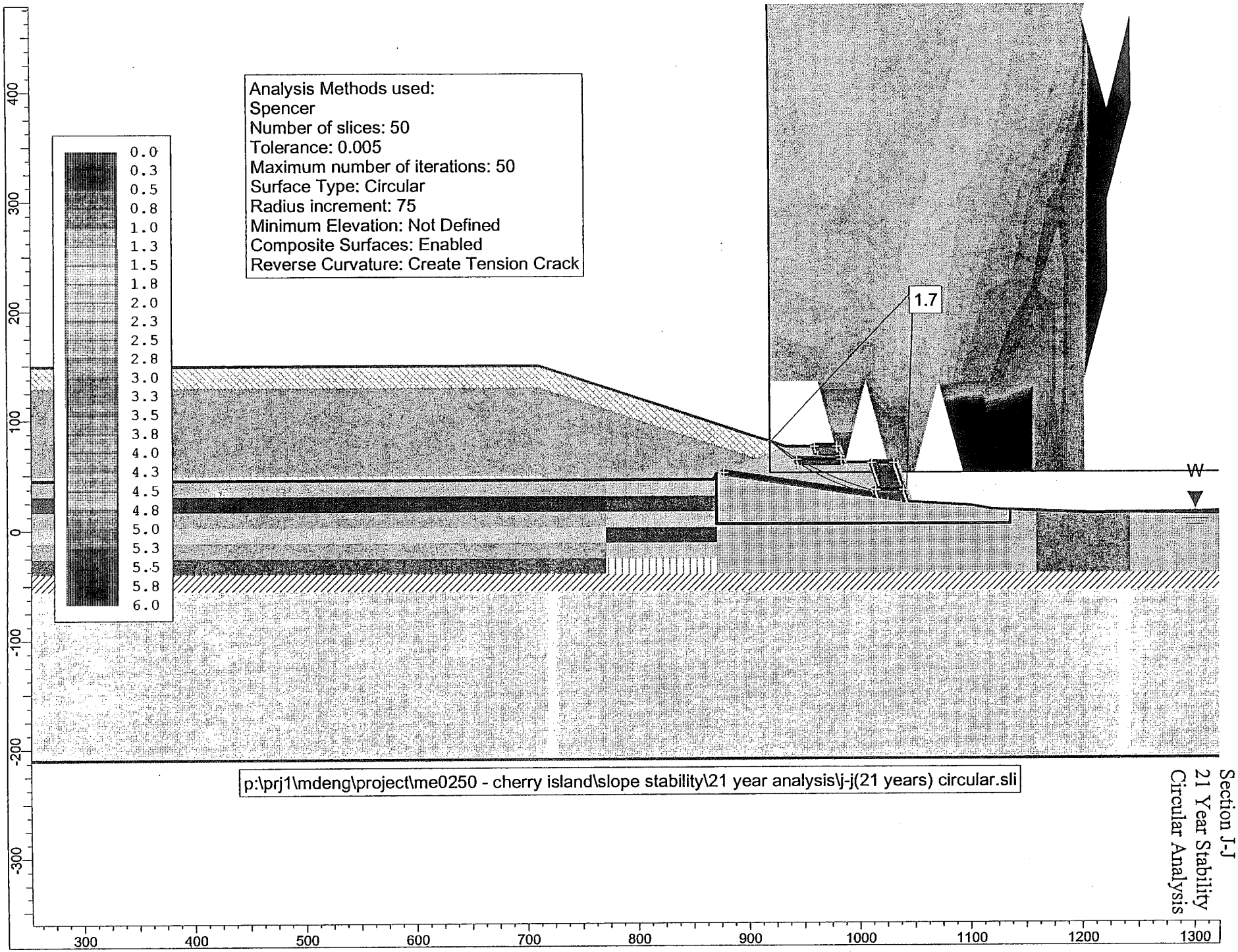
Task	Initials	Date
Analysis Performed by:	SMW	3/27/03
Assumptions Checked by:	RDS	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	RDS	3/27/03
Analysis Backchecked by:	SMW	3/31/03

J21-1

Section J-J
21 Year Stability
Circular Analysis

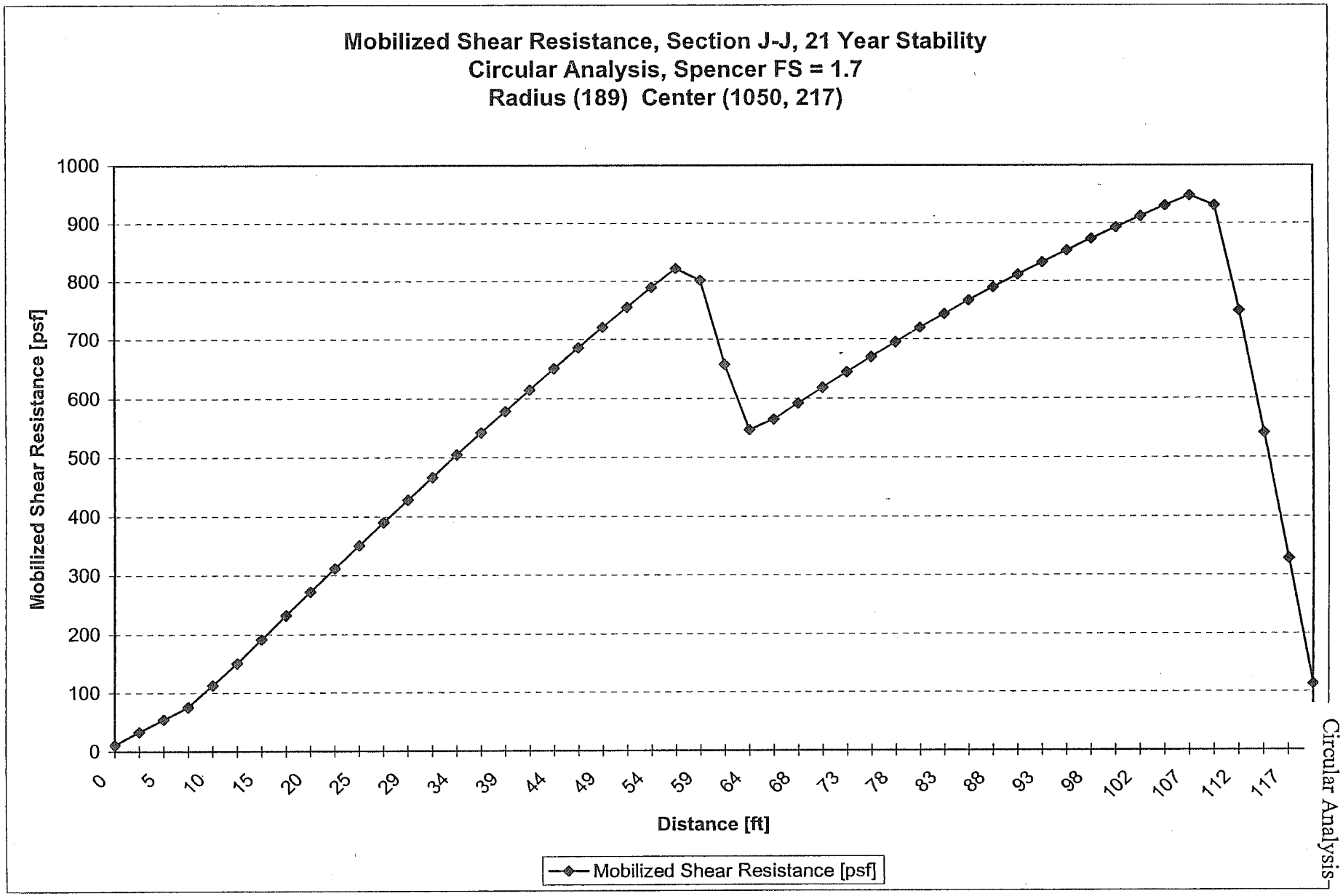


J21-2



Section J-J
21 Year Stability
Circular Analysis

J21.3



Section J-J
21 Year Stability
Circular Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance J

Slide Analysis Information

Document Name

File Name: j-j(21 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1844 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1454 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1235 psf
Water Surface: None

Section J-J
21 Year Stability
Circular Analysis

J21-5

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1202 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1348 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2198 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2129 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1627 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1368 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1350 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1555 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2501 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive

Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.69337
Center: 1049.94, 217.325
Radius: 189.348
Left Slip Surface Endpoint: 920.416, 79.2068
Right Slip Surface Endpoint: 1042.38, 28.1284

Method Statistics

Method: spencer
Number of Valid Surfaces: 23189
Number of Invalid Surfaces: 10327
Error Codes:
Error Code -106 reported for 2021 surfaces
Error Code -107 reported for 3561 surfaces
Error Code -108 reported for 349 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 3619 surfaces
Error Code -112 reported for 776 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

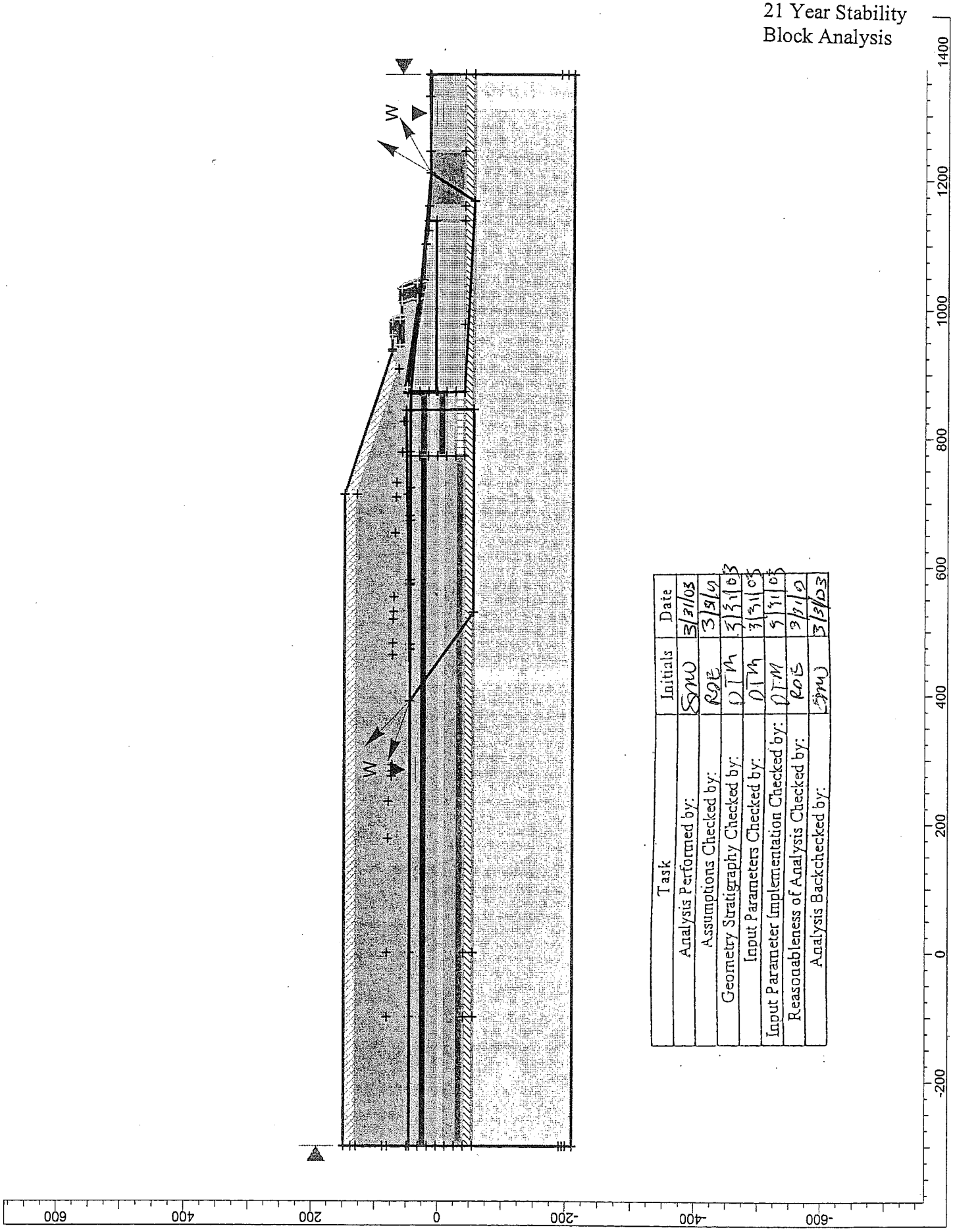
-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

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

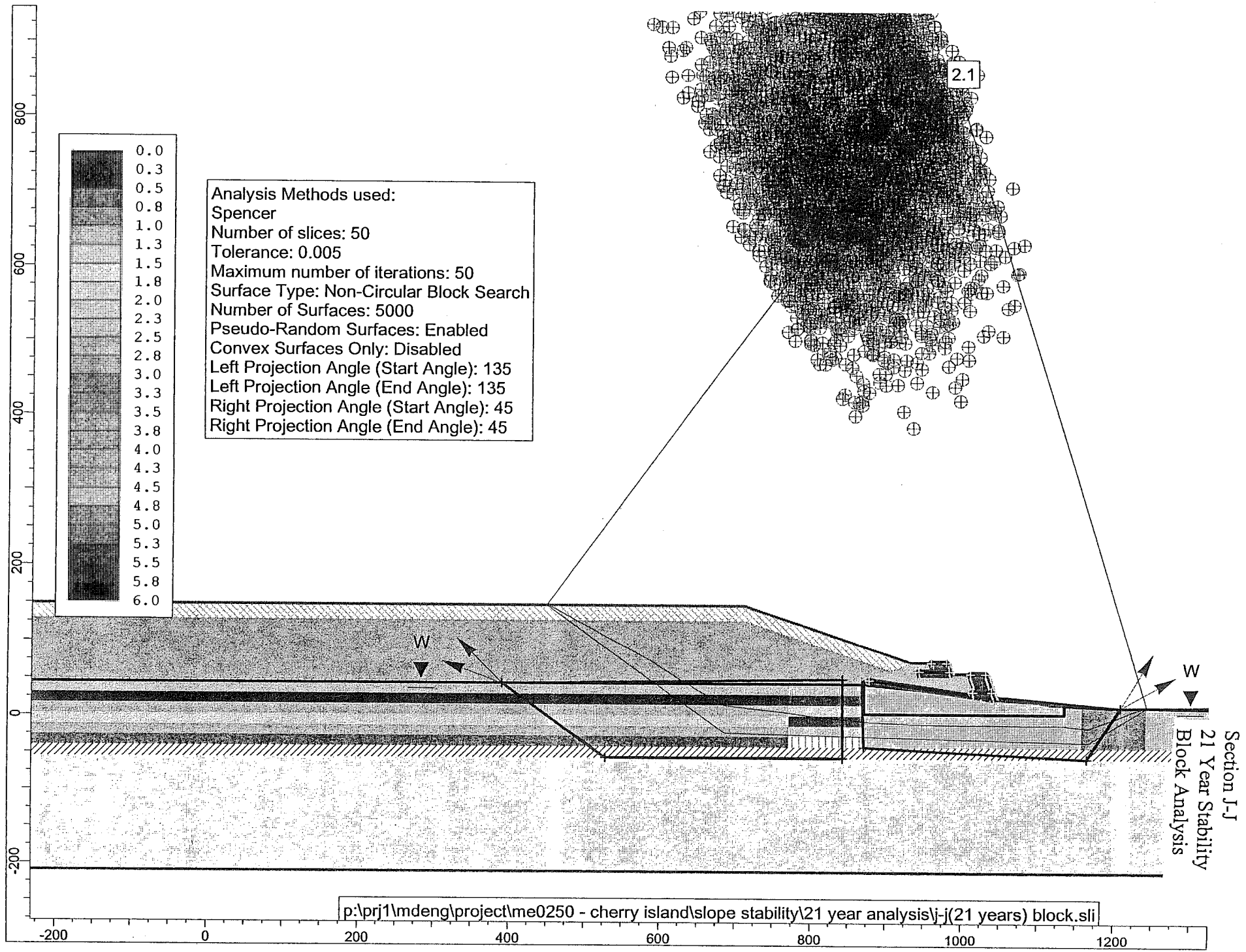
Section J-J
21 Year Stability
Circular Analysis

Section J-J
21 Year Stability
Block Analysis



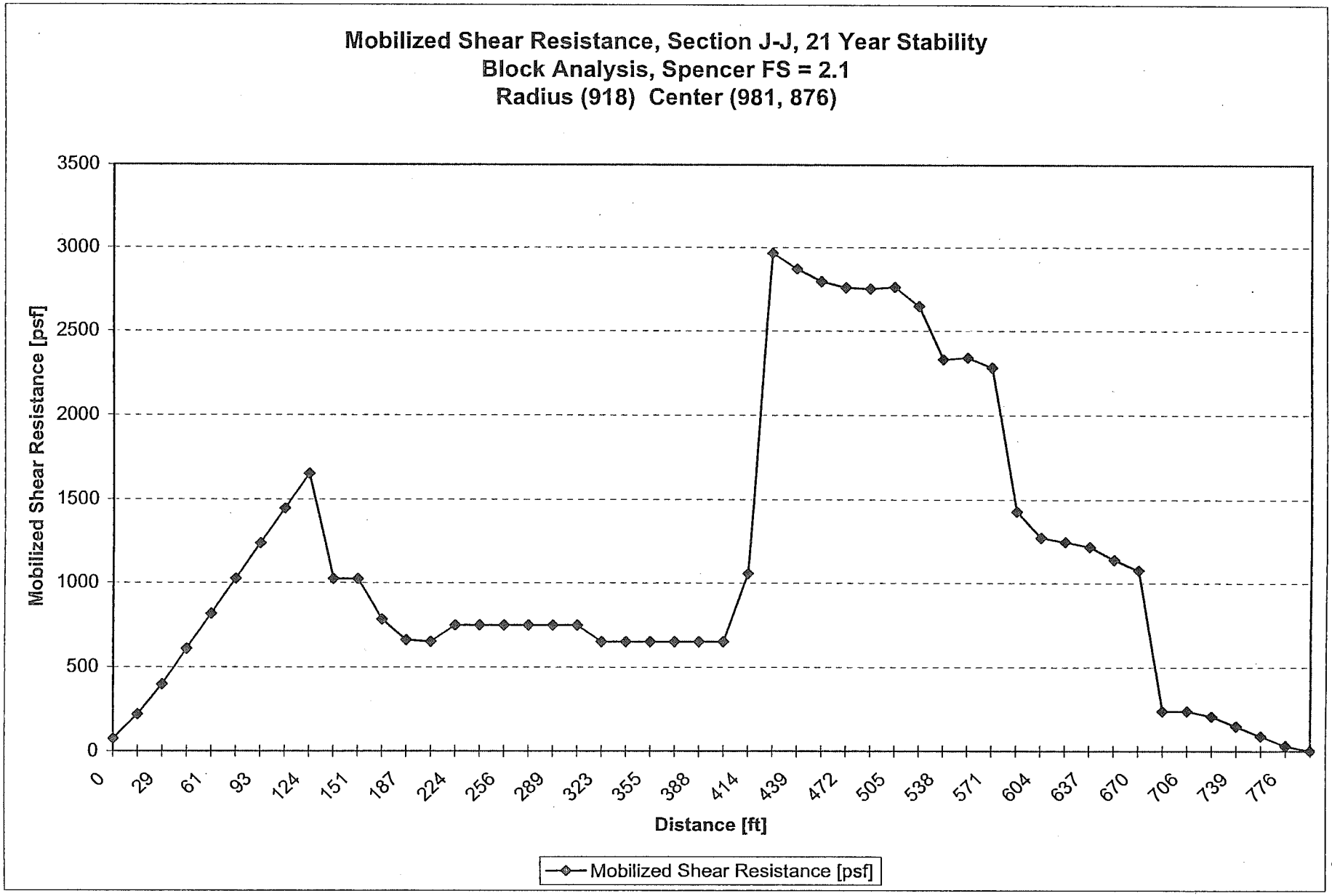
Task	Initials	Date
Analysis Performed by:	SMO	3/21/03
Assumptions Checked by:	ROE	3/9/0
Geometry Stratigraphy Checked by:	DTM	5/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	5/31/03
Reasonableness of Analysis Checked by:	ROE	3/1/0
Analysis Backchecked by:	SMO	3/31/03

J21-7



Section J-J
21 Year Stability
Block Analysis

J21-8C



Section J-J
21 Year Stability
Block Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance J

6-125

Slide Analysis Information

Document Name

File Name: J-J(21 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1844 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1454 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3

Section J-J
21 Year Stability
Block Analysis

J21-10

Cohesion Type: Constant
Cohesion: 1235 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1202 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1348 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2198 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2129 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1627 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1368 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1350 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1555 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2501 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.07863
Axis Location: 980.729, 876.111
Left Slip Surface Endpoint: 449.779, 149
Right Slip Surface Endpoint: 1243.85, 15.0839

Method Statistics

Method: spencer
Number of Valid Surfaces: 3372
Number of Invalid Surfaces: 1628
Error Codes:
Error Code -105 reported for 1 surface
Error Code -107 reported for 3 surfaces
Error Code -108 reported for 1575 surfaces
Error Code -111 reported for 39 surfaces
Error Code -112 reported for 10 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

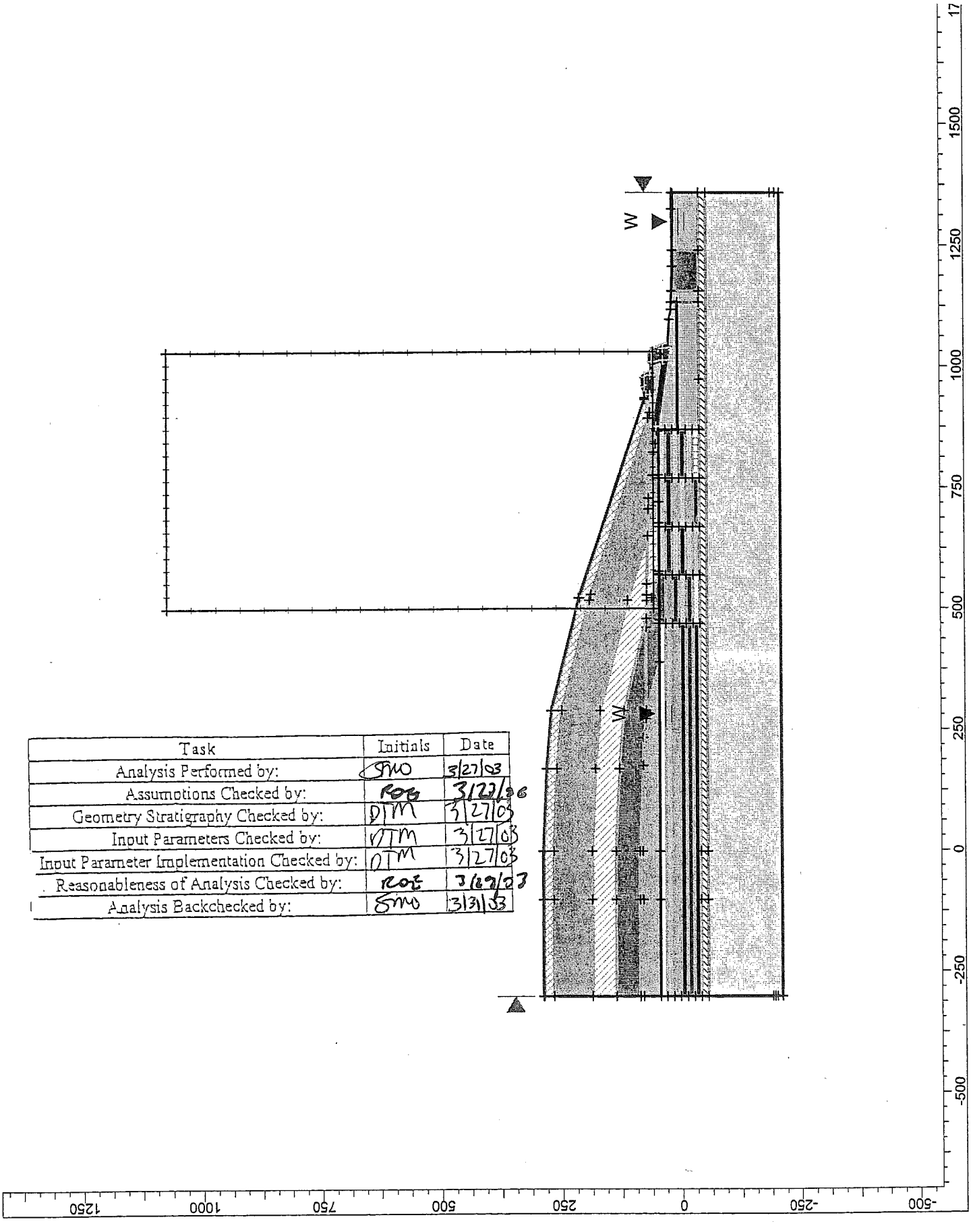
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

Section J-J
21 Year Stability
Block Analysis

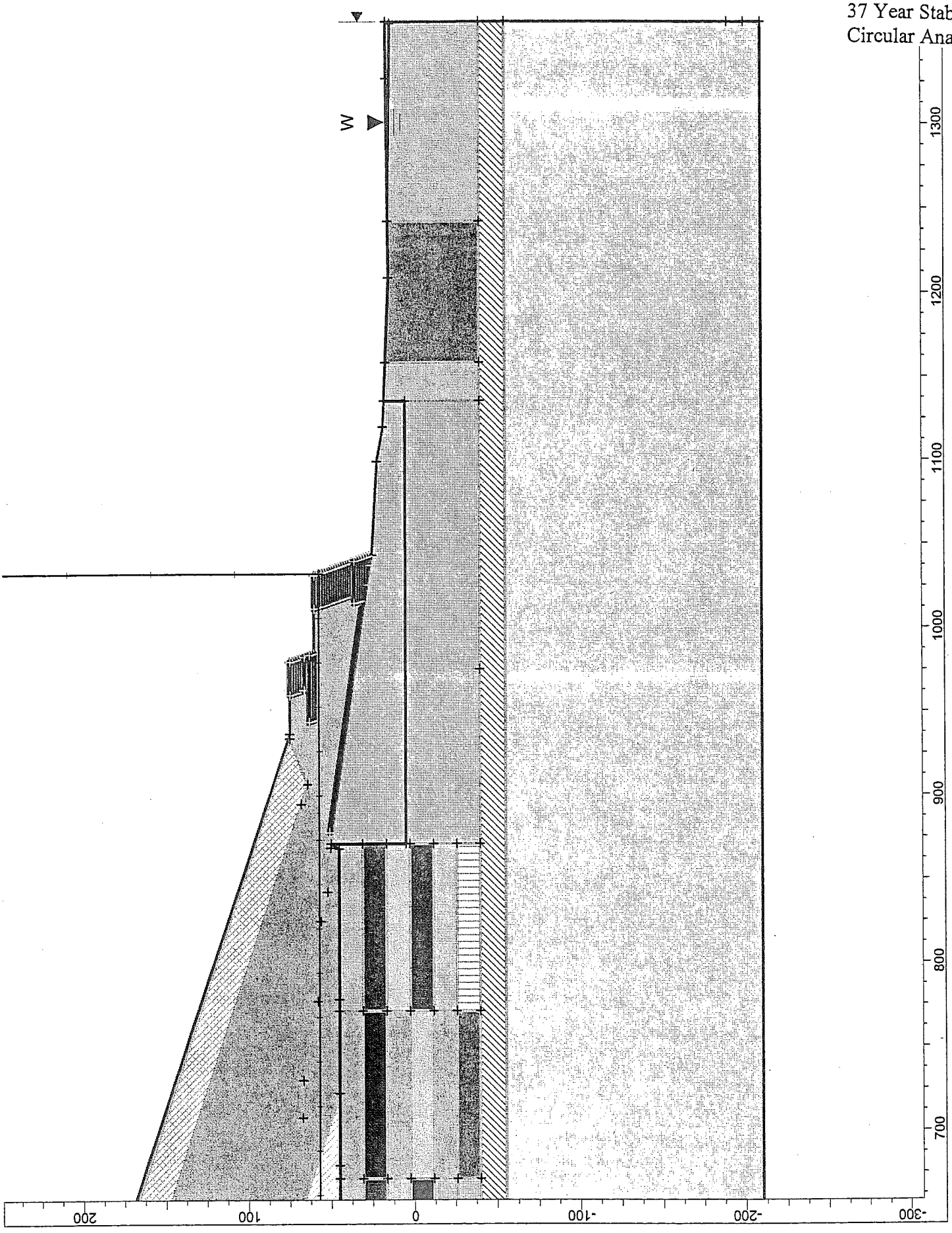
Section J-J
37 Year Stability
Circular Analysis



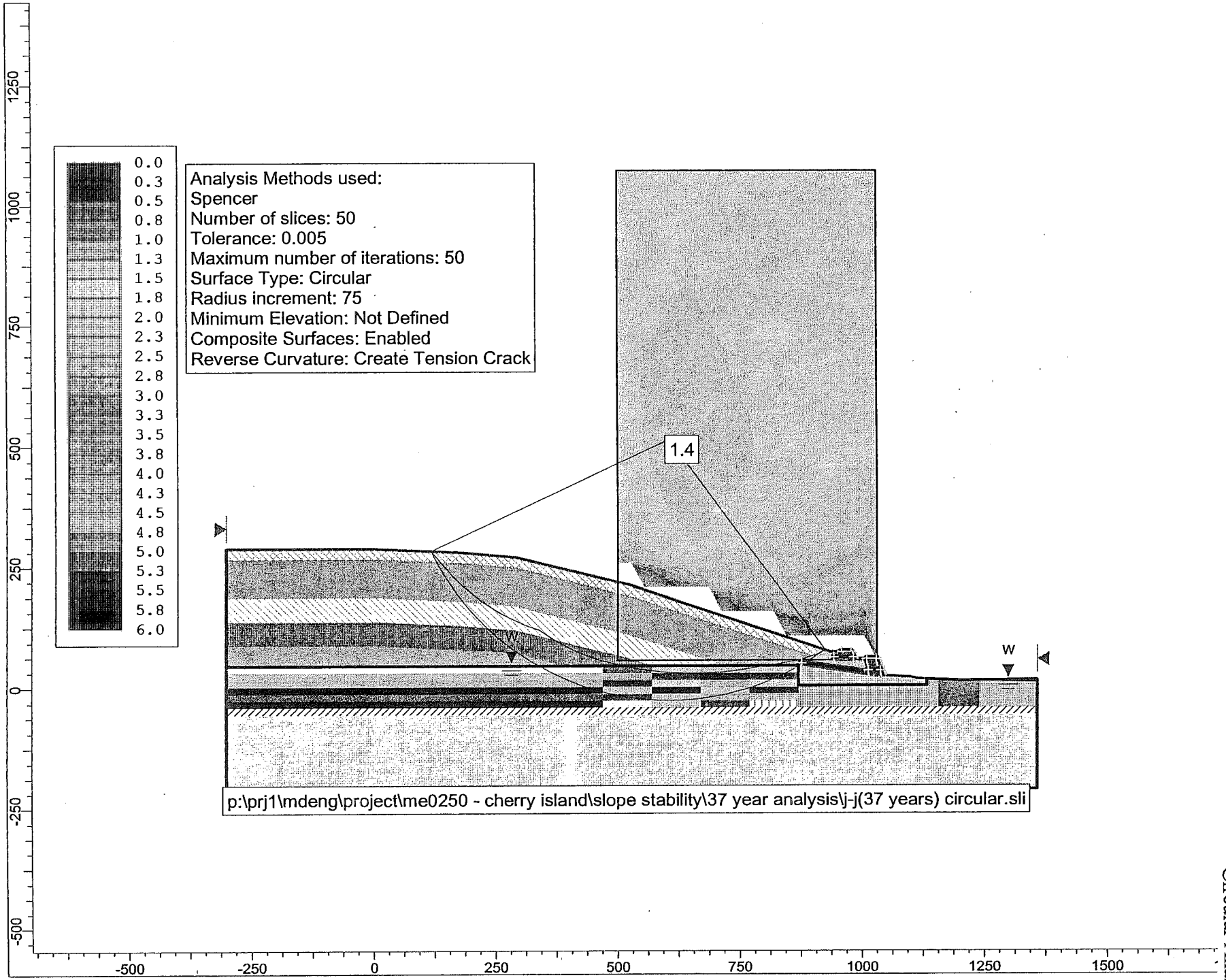
Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	ROE	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	ROE	3/27/03
Analysis Backchecked by:	SMO	3/31/03

J37-1

Section J-J
37 Year Stability
Circular Analysis

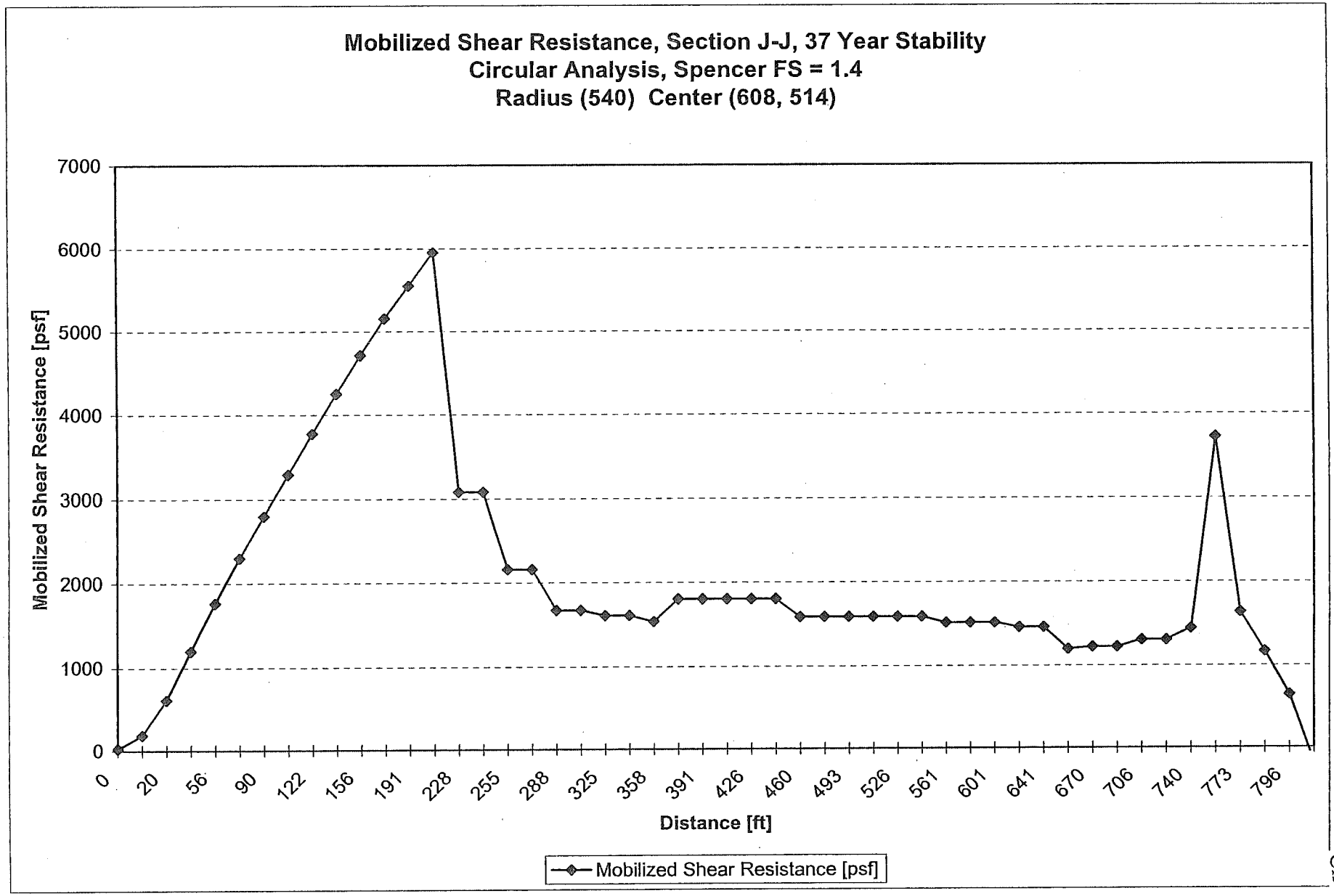


J37-2



J37-3

Section J-J
37 Year Stability
Circular Analysis



Section J-J
37 Year Stability
Circular Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance J

J37-4

Slide Analysis Information

Document Name

File Name: j-j(37 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function

J37-5

Section J-J
37 Year Stability
Circular Analysis

Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2003 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1813 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1663 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1756 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2405 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2647 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2327 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2113 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2103 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2937 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3295 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2718 psf

Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2302 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2120 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2205 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3391 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3660 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2775 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2232 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2506 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3917 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4273 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3002 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2238.psf
Water Surface: None

J37.6

Section J-J
37 Year Stability
Circular Analysis

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2751 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4535 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.38634
Center: 608.097, 514.443
Radius: 540.158
Left Slip Surface Endpoint: 119.437, 284.265
Right Slip Surface Endpoint: 926.528, 78.1259

Method Statistics

Method: spencer
Number of Valid Surfaces: 27444
Number of Invalid Surfaces: 6072
Error Codes:
Error Code -106 reported for 1 surface
Error Code -108 reported for 530 surfaces
Error Code -111 reported for 290 surfaces
Error Code -112 reported for 5251 surfaces

Error Codes

The following errors were encountered during the computation:

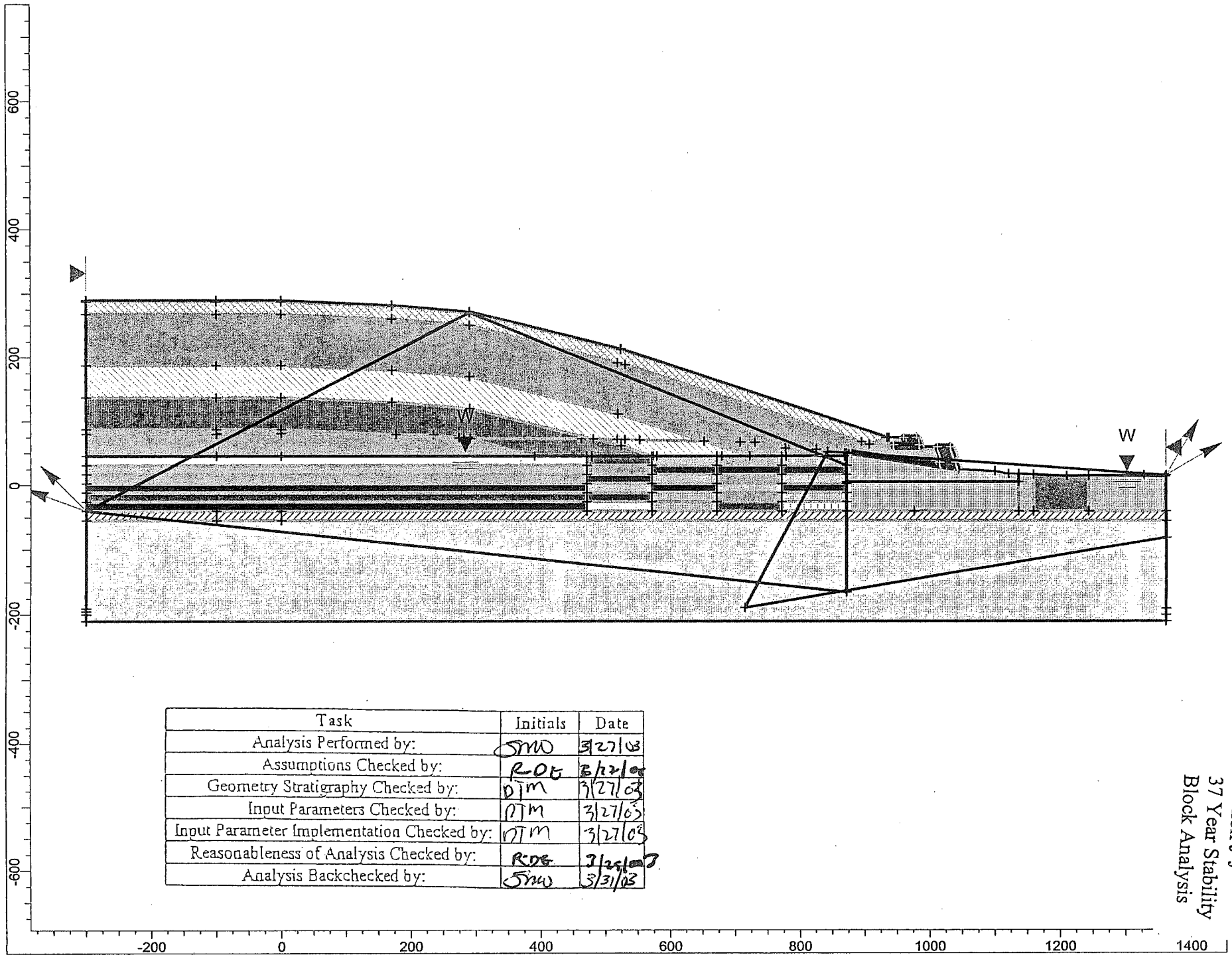
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of

extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

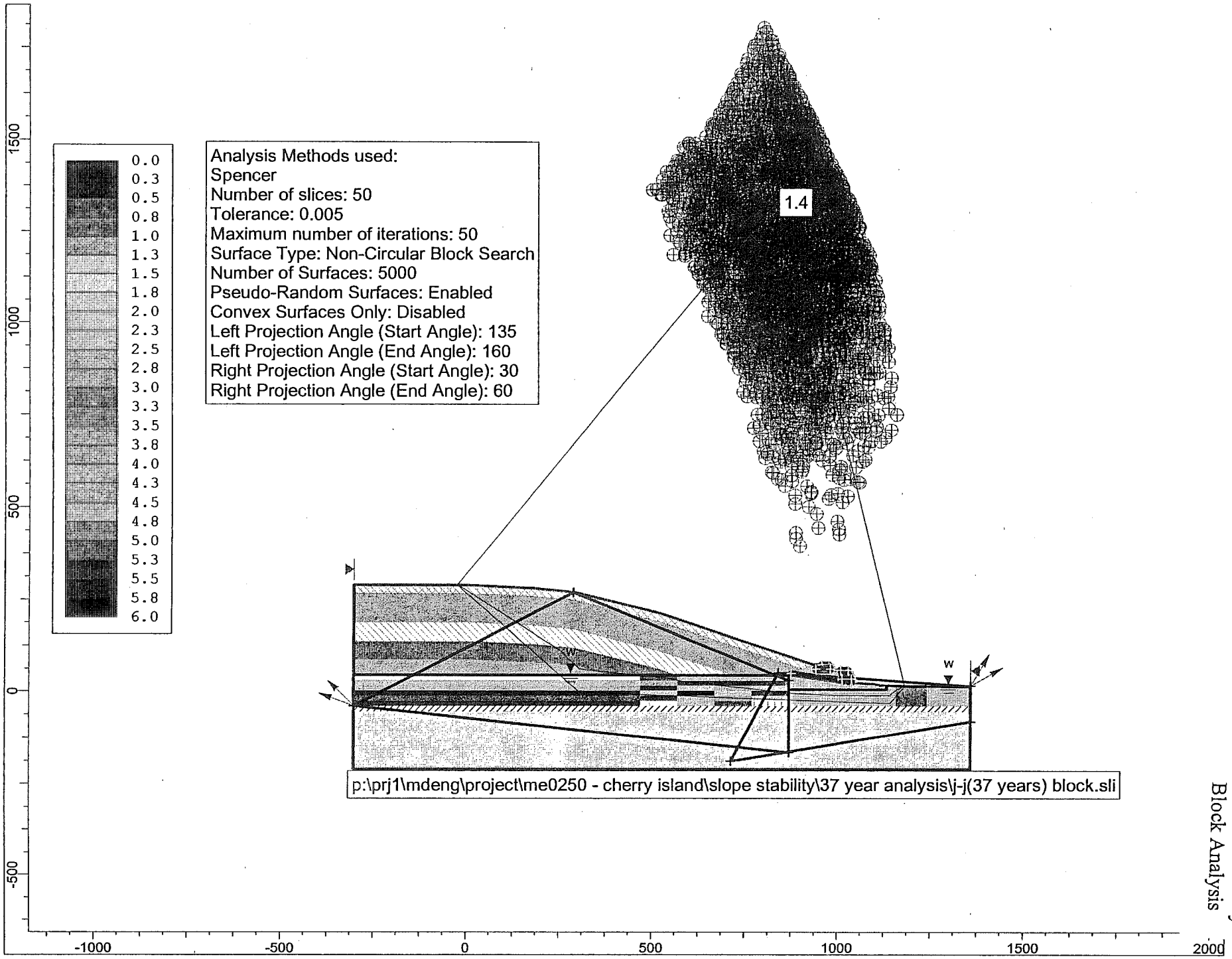
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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



Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	ROE	3/27/03
Geometry Stratigraphy Checked by:	DJM	3/27/03
Input Parameters Checked by:	DJM	3/27/03
Input Parameter Implementation Checked by:	DJM	3/27/03
Reasonableness of Analysis Checked by:	RDG	3/28/03
Analysis Backchecked by:	SMO	3/31/03

Section J-J
37 Year Stability
Block Analysis

J37-08



Section J-J
37 Year Stability
Block Analysis

J37-9

Section H-H
Long-Term Stability
Circular Analysis

Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	RAE	7/23/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	RAE	8/24/03
Analysis Backchecked by:	SMO	8/31/03

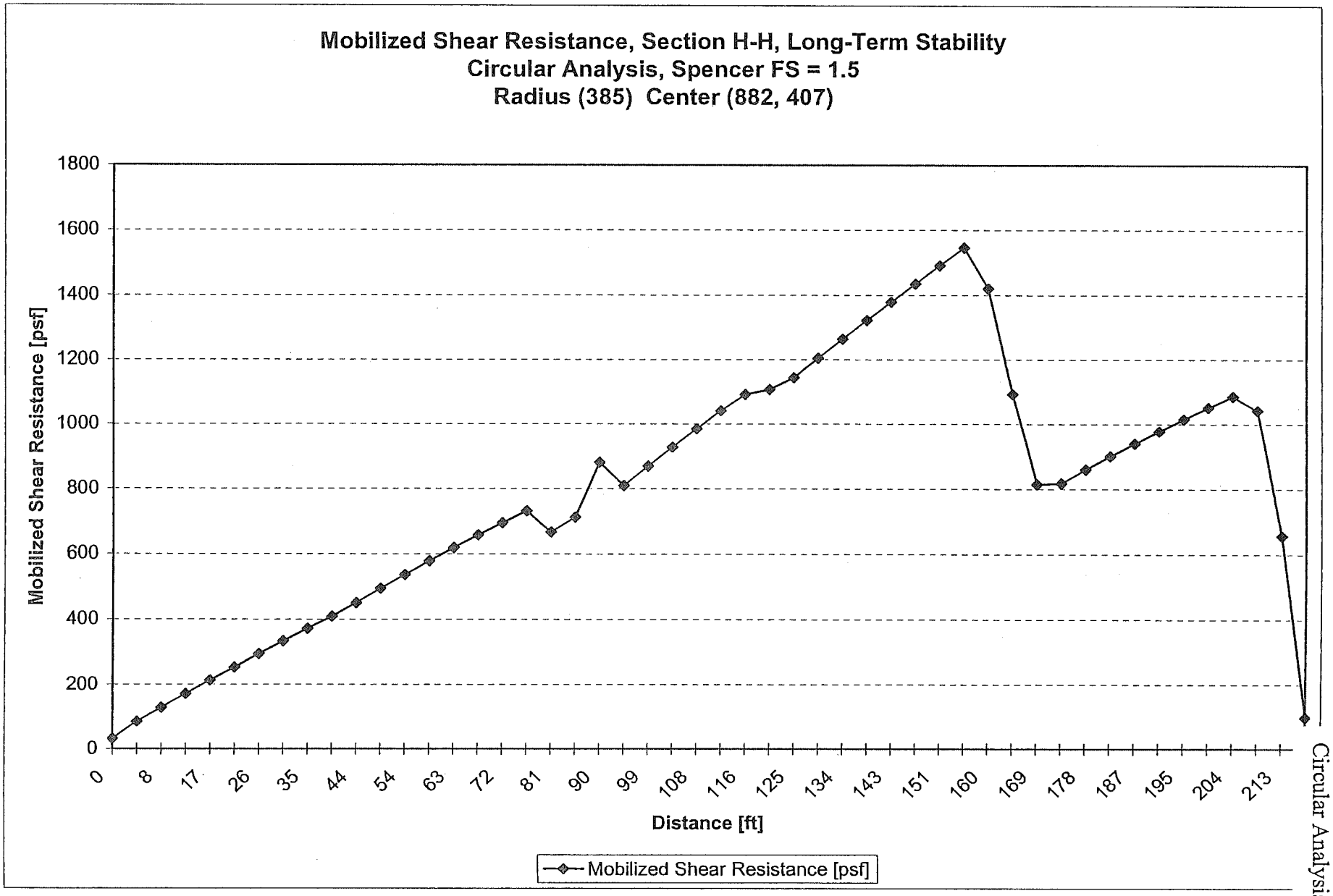
HLT-1

Section H-H
Long-Term Stability
Circular Analysis
1100
1000
900
800
700
600
500
400
200
100
0
-100
-200

HLT-2

Section H-H
Long-Term Stability
Circular Analysis

HLT-3



Section H-H
Long-Term Stability
Circular Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance H

H-LT-H

Slide Analysis Information

Document Name

File Name: h-h(long-term) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: 5
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3

Section H-H
Long-Term Stability
Circular Analysis

H-LT-5

Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.52926
Center: 882.027, 407.17
Radius: 384.685
Left Slip Surface Endpoint: 613.953, 131.273
Right Slip Surface Endpoint: 835.053, 25.3632

Method Statistics

Method: spencer
Number of Valid Surfaces: 19716
Number of Invalid Surfaces: 13800
Error Codes:
Error Code -106 reported for 577 surfaces
Error Code -108 reported for 1078 surfaces
Error Code -109 reported for 2428 surfaces
Error Code -111 reported for 5130 surfaces
Error Code -112 reported for 255 surfaces
Error Code -1000 reported for 4332 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

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

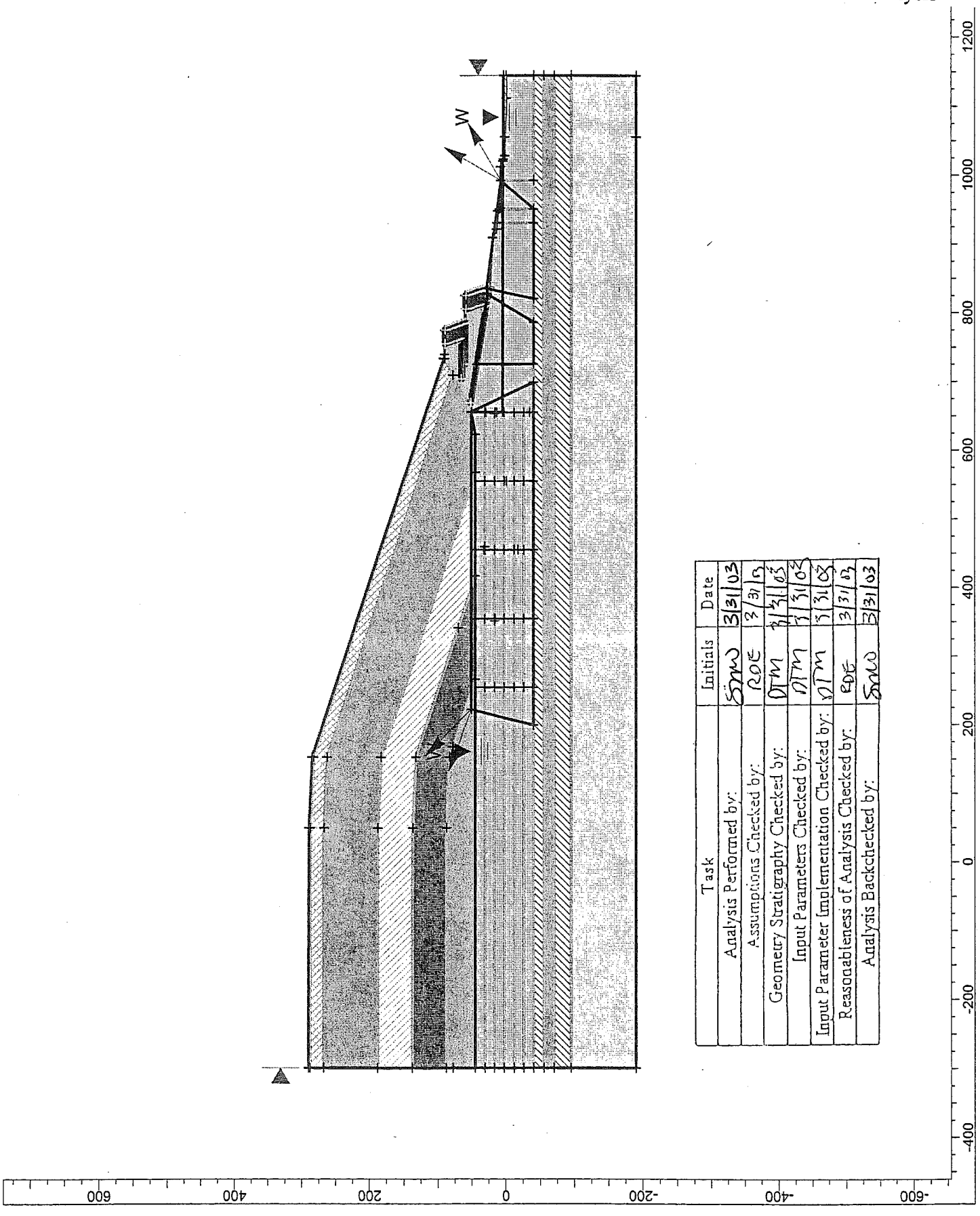
-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

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

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

Section H-H
Long-Term Stability
Block Analysis

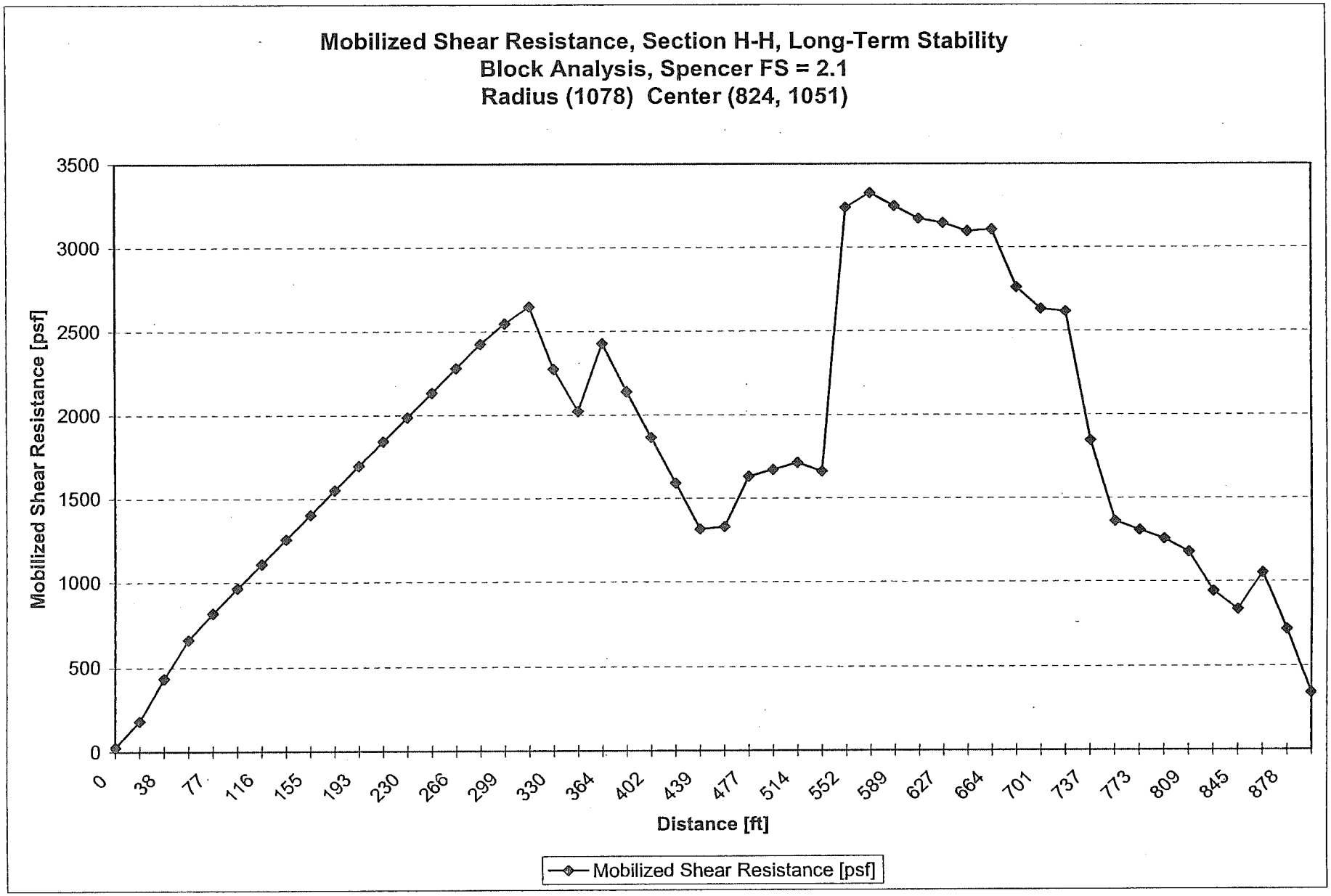


Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	ROE	3/31/03
Geometry Stratigraphy Checked by:	DTM	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	ROE	3/31/03
Analysis Backchecked by:	SMW	3/31/03

HLT-6

Section H-H
Long-Term Stability
Block Analysis

HLT-7



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance H

Section H-H
Long-Term Stability
Block Analysis

HLT-8

Slide Analysis Information

Document Name

File Name: h-h(long-term) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.14734
Axis Location: 824.497, 1051.21
Left Slip Surface Endpoint: 93.5583, 287.28
Right Slip Surface Endpoint: 997.074, 8.1

Method Statistics

Method: spencer
Number of Valid Surfaces: 1983
Number of Invalid Surfaces: 3017
Error Codes:
Error Code -105 reported for 2 surfaces
Error Code -108 reported for 418 surfaces
Error Code -109 reported for 2597 surfaces

Error Codes

The following errors were encountered during the computation:

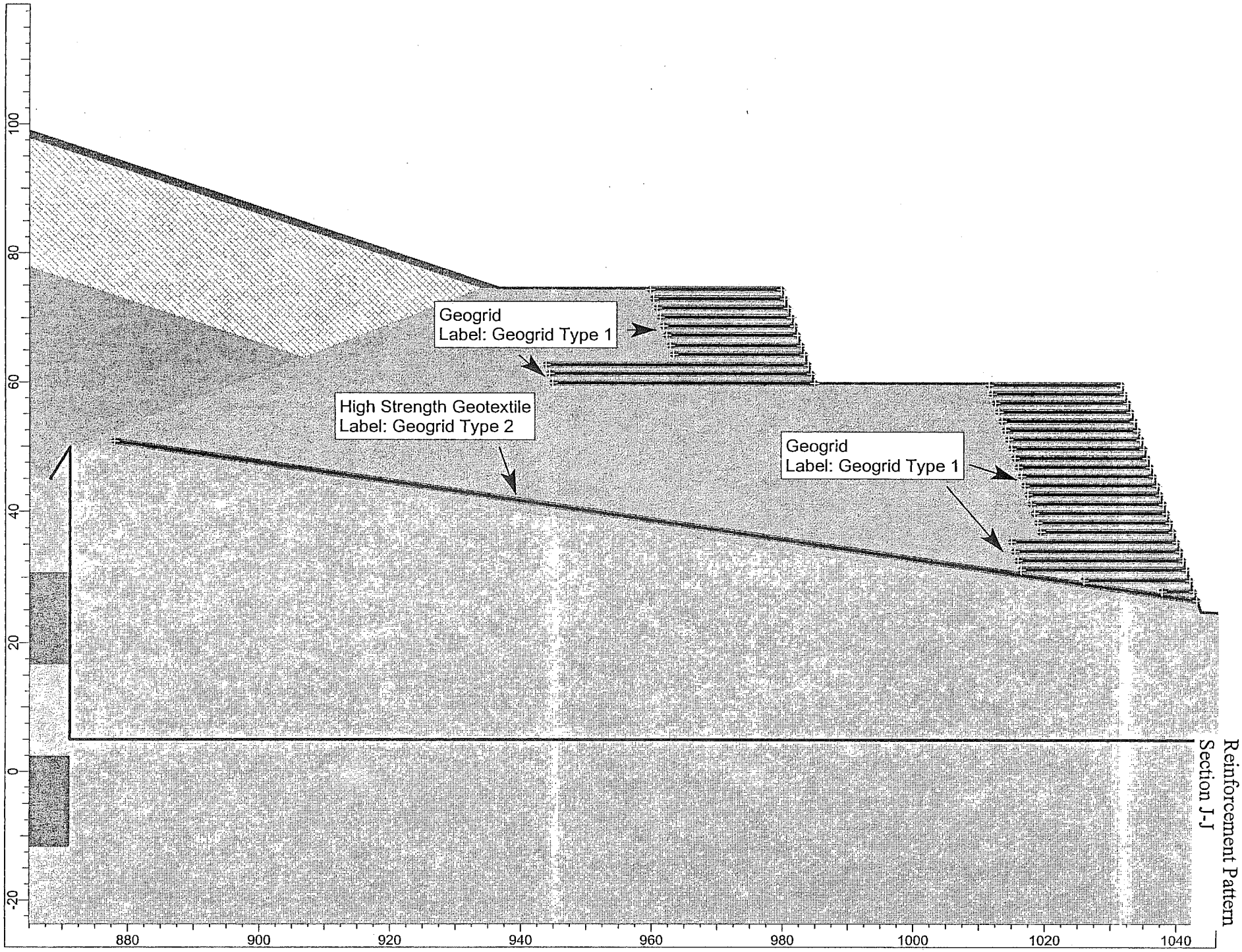
-105 = More than two surface / slope intersections with no valid slip surface.

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

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

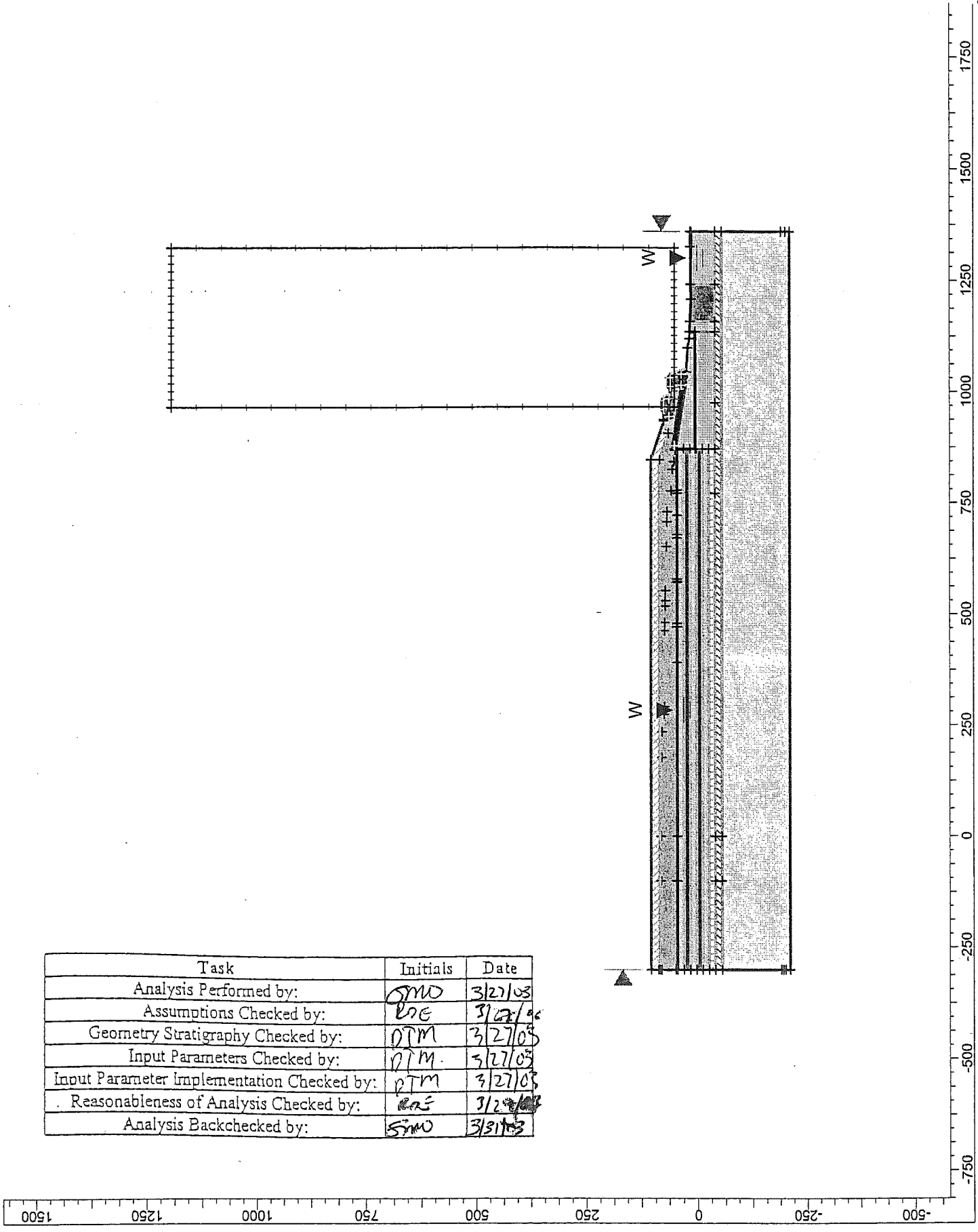
Attachment I

Stability Analysis Results for Cross Section J-J



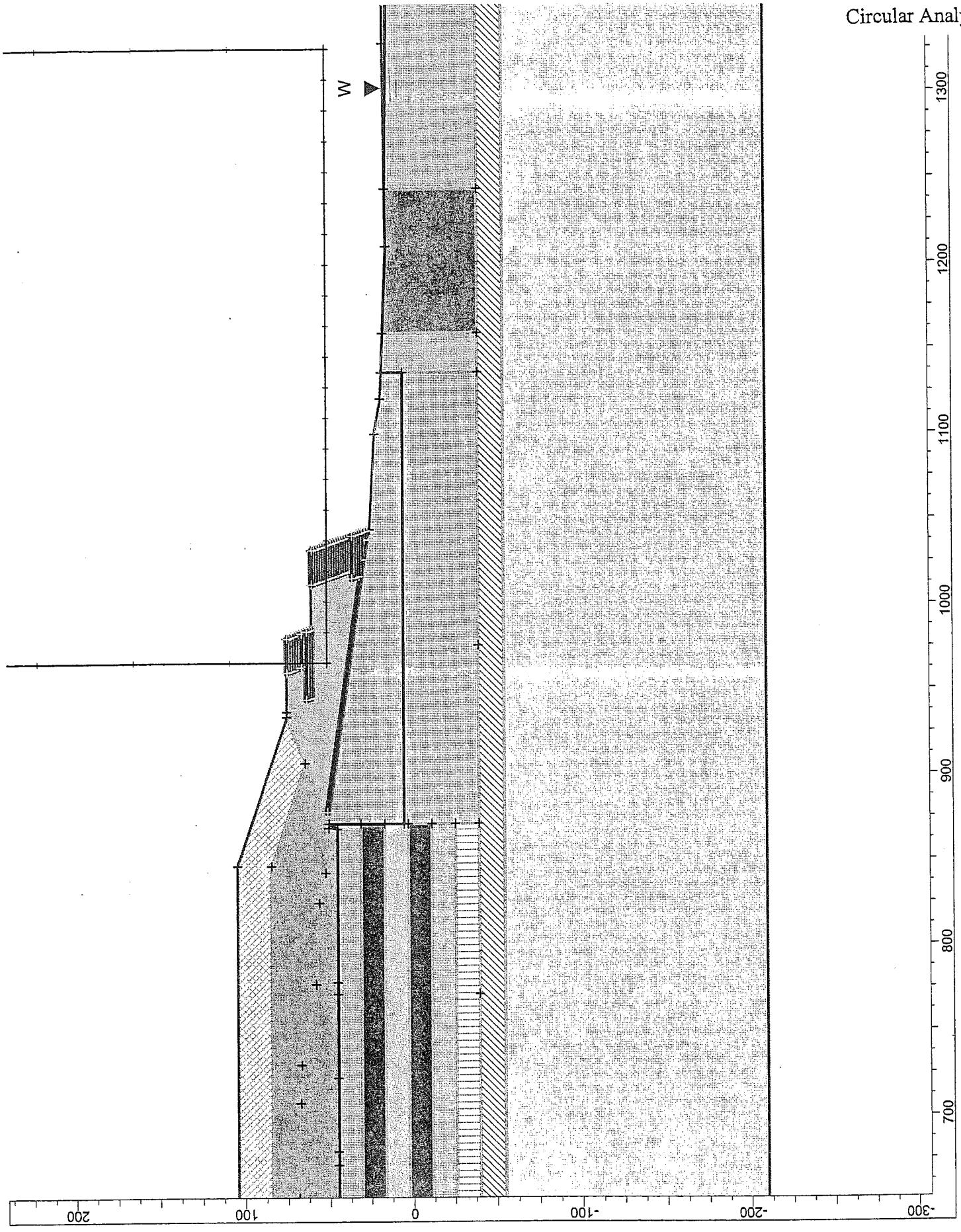
Reinforcement Pattern
Section J-J

Section J-J
9 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	RDE	3/27/03
Geometry Stratigraphy Checked by:	RTM	3/27/03
Input Parameters Checked by:	RTM	3/27/03
Input Parameter Implementation Checked by:	RTM	3/27/03
Reasonableness of Analysis Checked by:	RDE	3/27/03
Analysis Backchecked by:	SMO	3/31/03

Section J-J
9 Year Stability
Circular Analysis

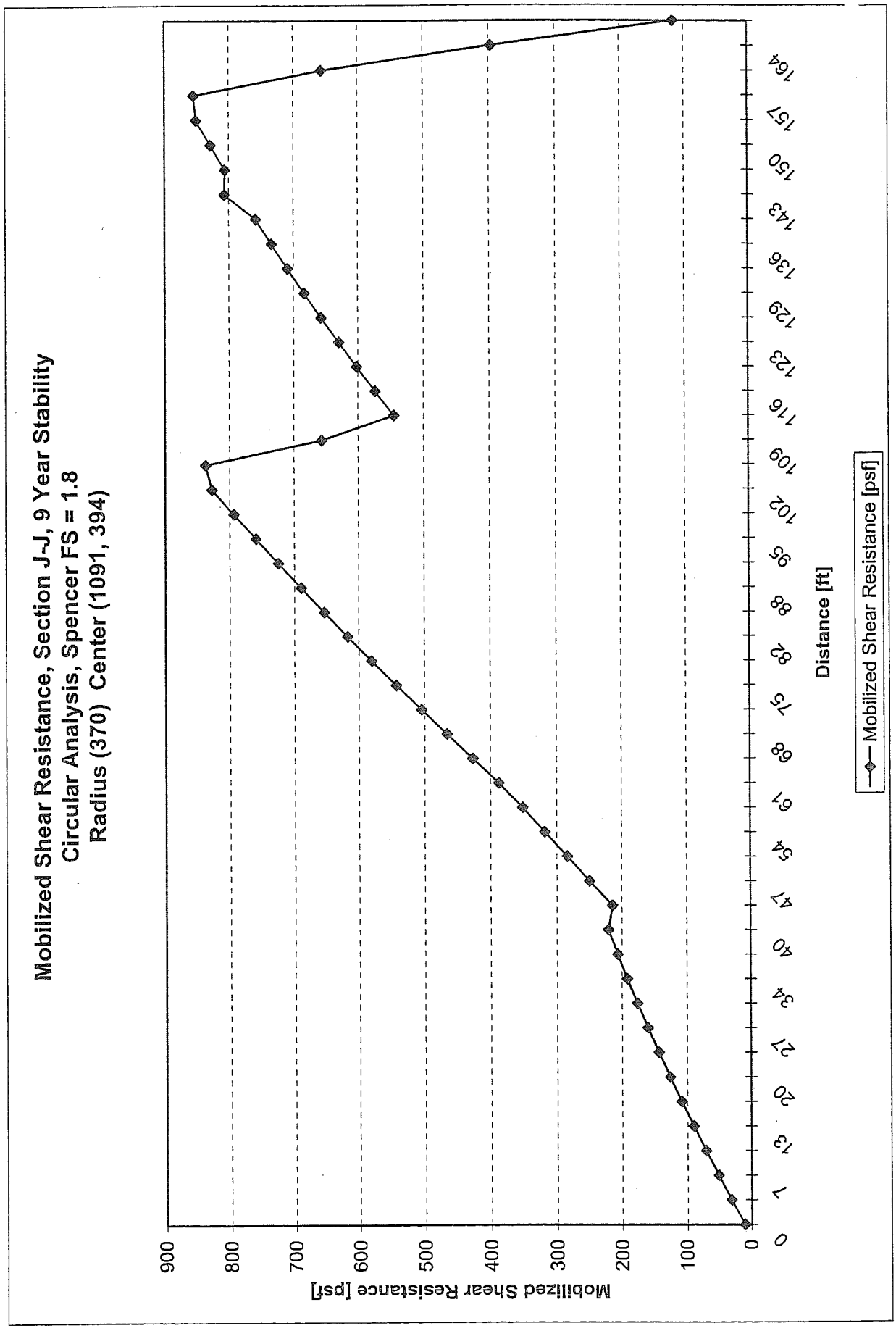


59-2

Section J-J
9 Year Stability
Circular Analysis

J9-3

Section J-J
9 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance .

J9-4

Slide Analysis Information

Document Name

File Name: j-j(9 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1183 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 855 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 730 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 777 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 978 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1686 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.77609
Center: 1090.94, 394.078
Radius: 370.244
Left Slip Surface Endpoint: 872.297, 95.2893
Right Slip Surface Endpoint: 1042.78, 26.9802

Method Statistics

Method: spencer
Number of Valid Surfaces: 21185
Number of Invalid Surfaces: 12331
Error Codes:
Error Code -100 reported for 1 surface
Error Code -105 reported for 1 surface
Error Code -106 reported for 1576 surfaces
Error Code -107 reported for 4911 surfaces
Error Code -108 reported for 594 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 4523 surfaces
Error Code -112 reported for 724 surfaces

Error Codes

The following errors were encountered during the computation:

-100 = Both surface / slope intersections are on the same horizontal surface. In general, this will

give a very high or infinite factor of safety (zero driving force), if calculated.

-105 = More than two surface / slope intersections with no valid slip surface.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

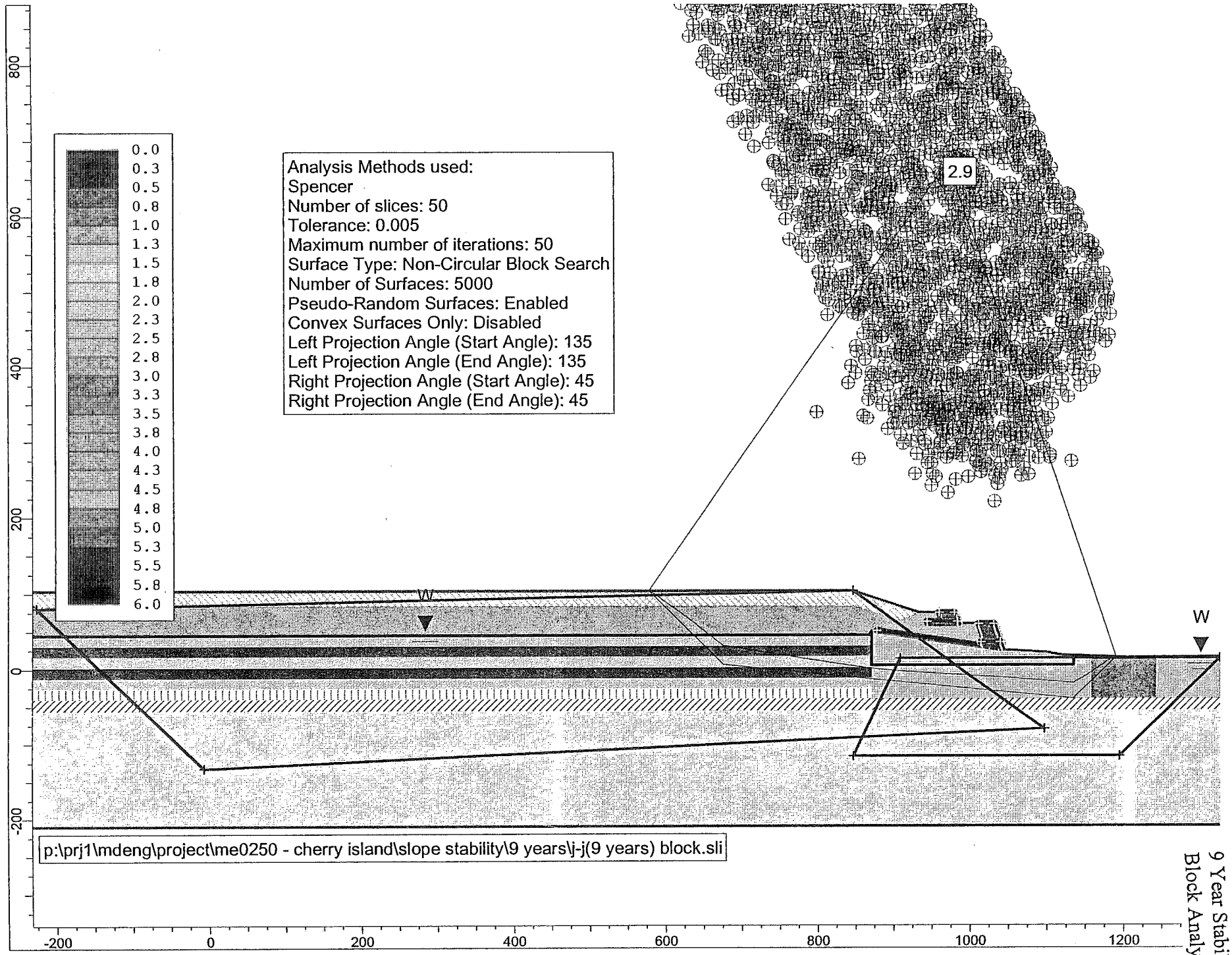
-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

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

Section J-J
9 Year Stability
Block Analysis

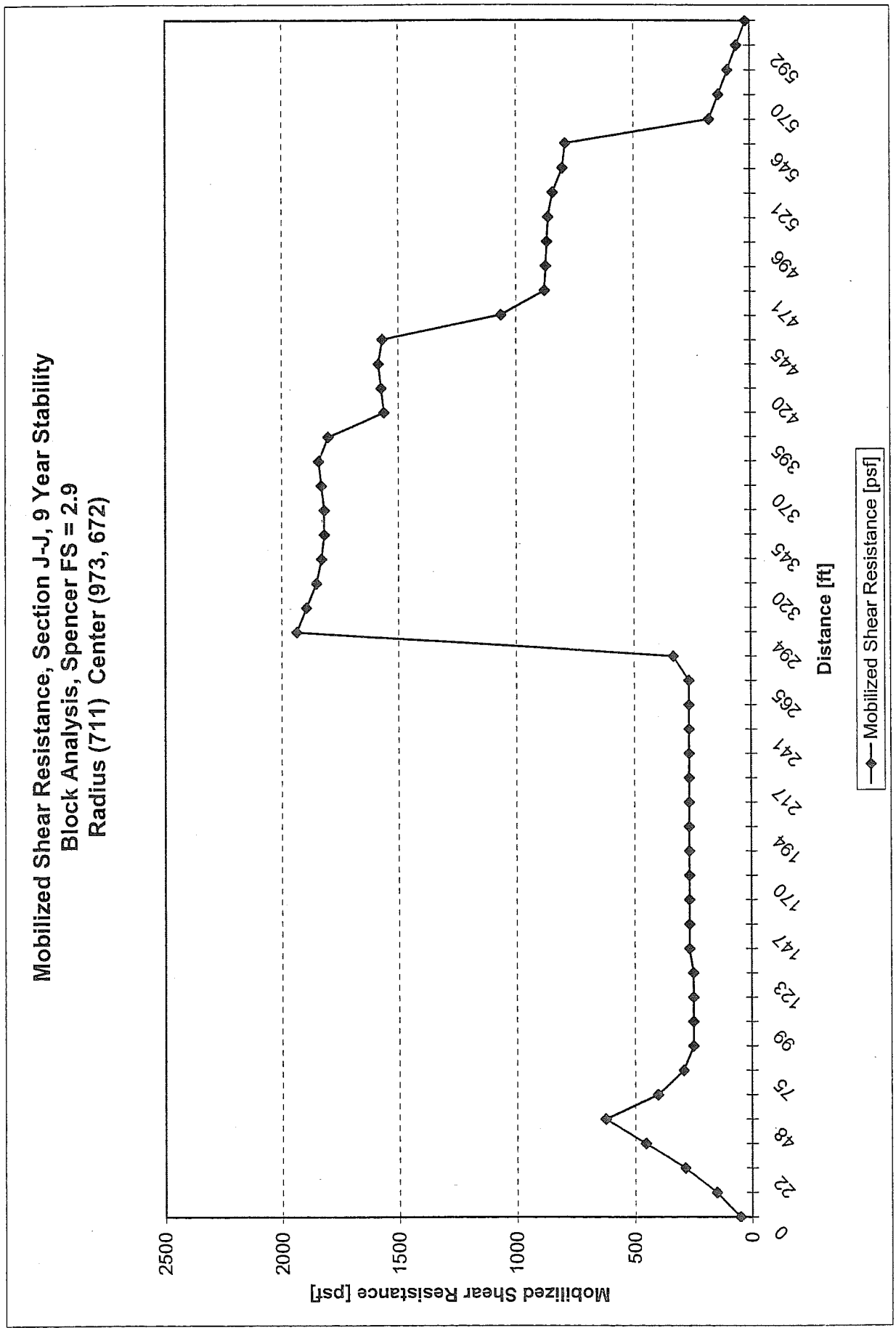
Task	Initials	Date
Analysis Performed by:	SMO	3/27/13
Assumptions Checked by:	EOS	3/28/13
Geometry Stratigraphy Checked by:	DTM	3/27/13
Input Parameters Checked by:	DTM	3/27/13
Input Parameter Implementation Checked by:	DTM	3/27/13
Reasonableness of Analysis Checked by:	MOS	3/29/13
Analysis Backchecked by:	SMO	3/31/13



J-J

Section J-J
9 Year Stability
Block Analysis

Section J-J
9 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance J

J9-9

Slide Analysis Information

Document Name

File Name: J-J(9 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1183 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 855 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 730 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

J-J-10

Section J-J
9 Year Stability
Block Analysis

Cohesion: 777 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 978 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1686 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.92458
Axis Location: 972.962, 672.426
Left Slip Surface Endpoint: 577.997, 104
Right Slip Surface Endpoint: 1190.72, 15.3982

Method Statistics

Method: spencer
Number of Valid Surfaces: 2755
Number of Invalid Surfaces: 2245
Error Codes:
Error Code -105 reported for 7 surfaces
Error Code -107 reported for 127 surfaces
Error Code -108 reported for 1888 surfaces
Error Code -111 reported for 199 surfaces
Error Code -112 reported for 2 surfaces
Error Code -200 reported for 22 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

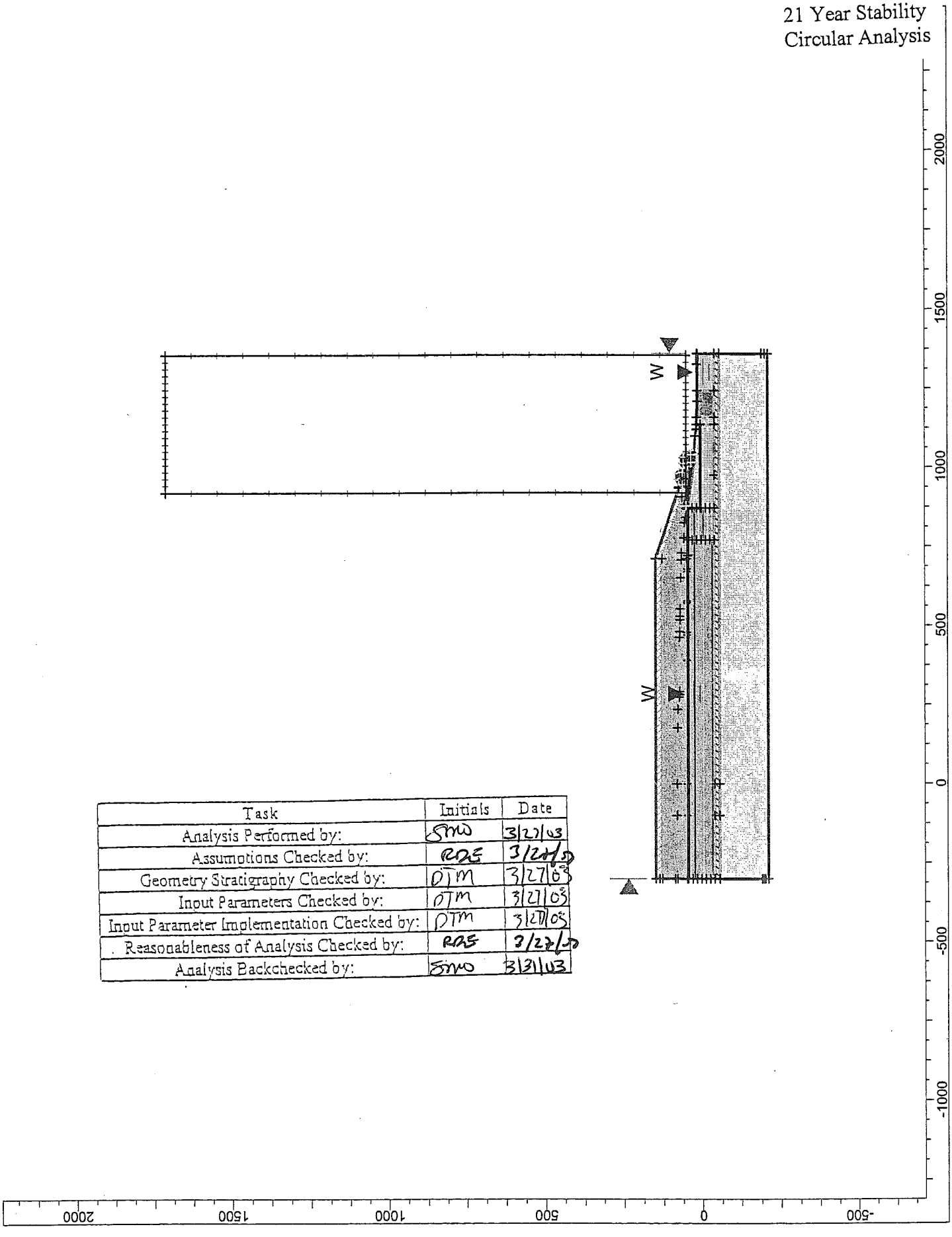
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

-200 = Factor of Safety = 0. Could mean 0 Normal/Shear resistance along part of the slip surface

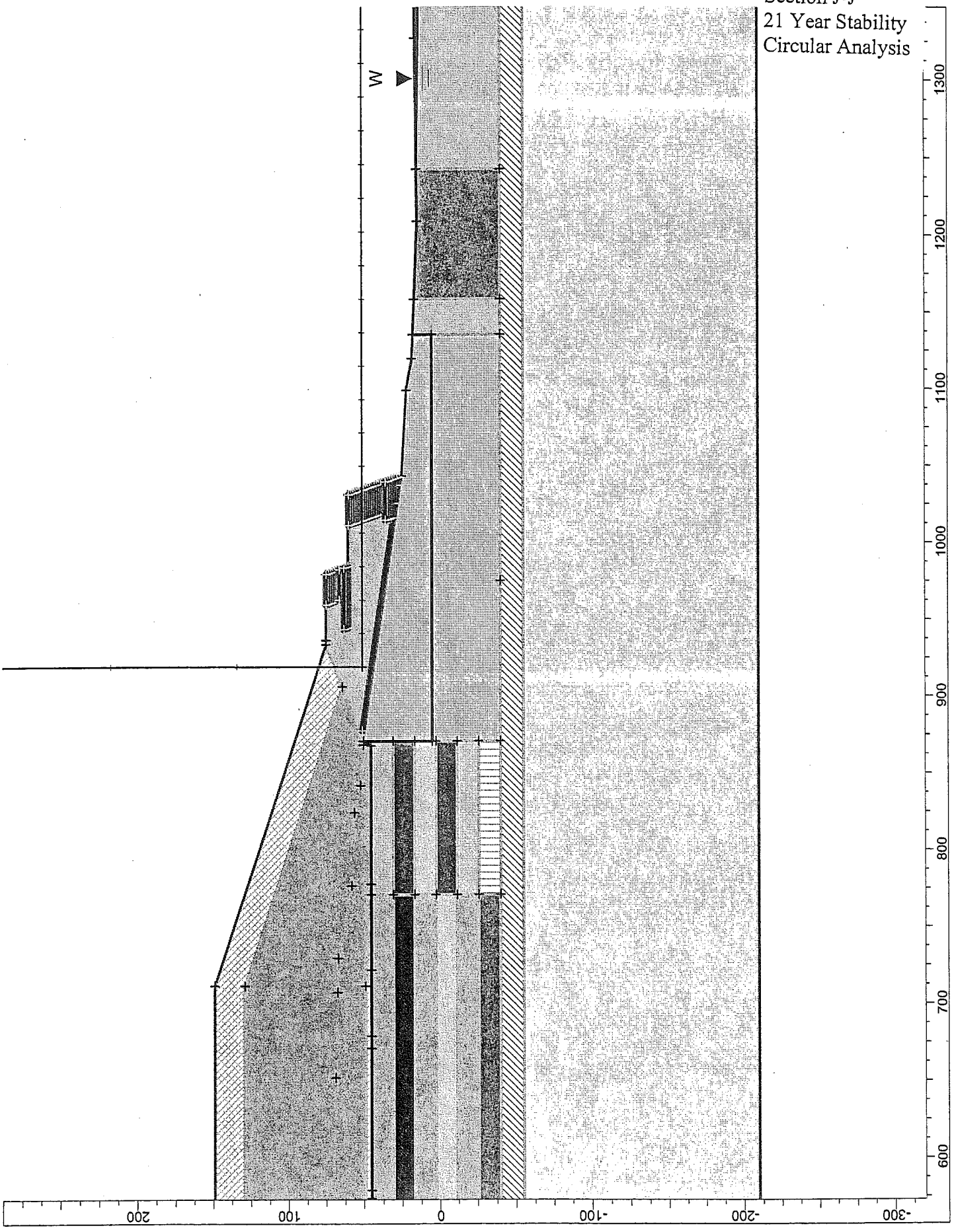
Section J-J
21 Year Stability
Circular Analysis



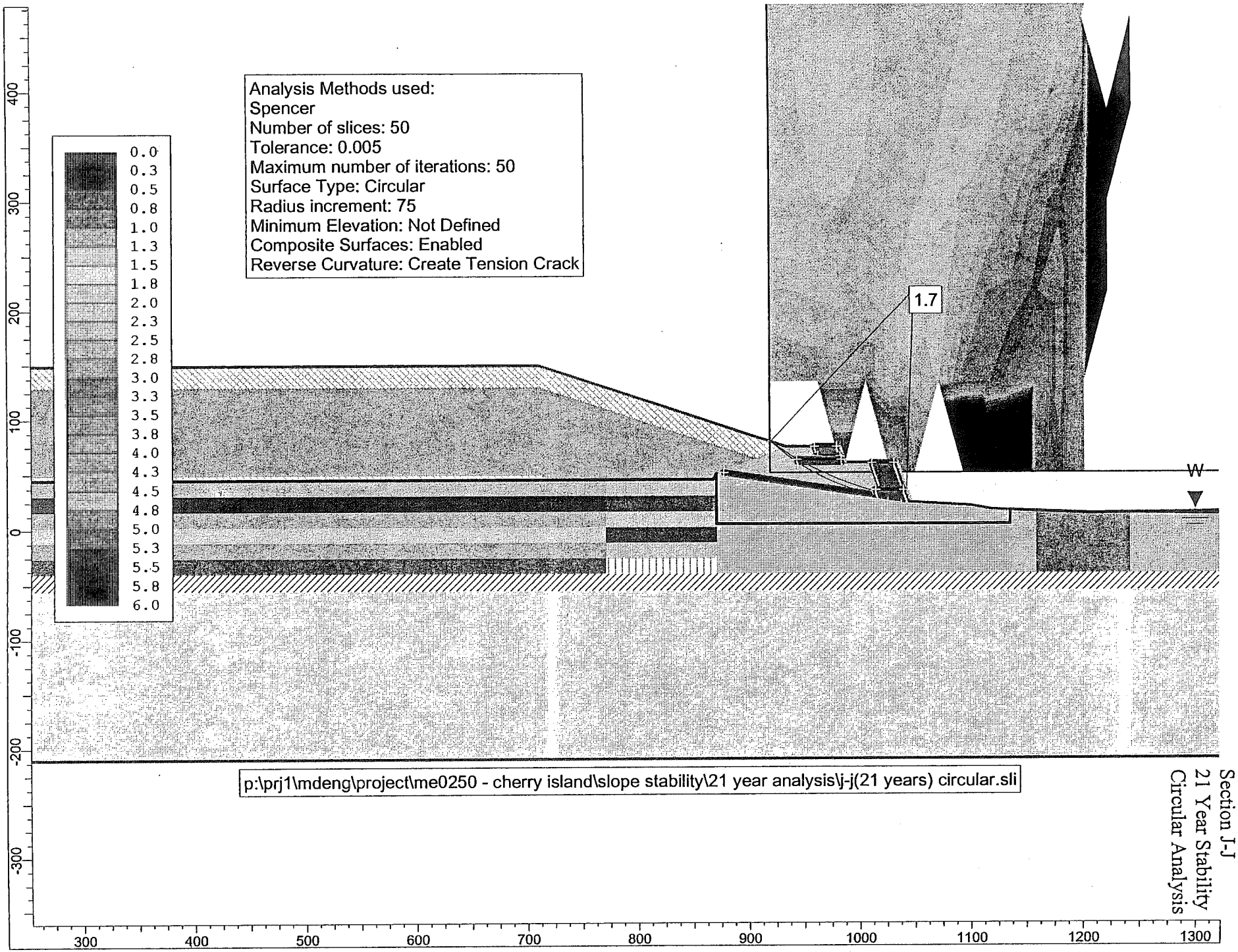
Task	Initials	Date
Analysis Performed by:	SMW	3/27/03
Assumptions Checked by:	RDS	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	RDS	3/27/03
Analysis Backchecked by:	SMW	3/31/03

J21-1

Section J-J
21 Year Stability
Circular Analysis

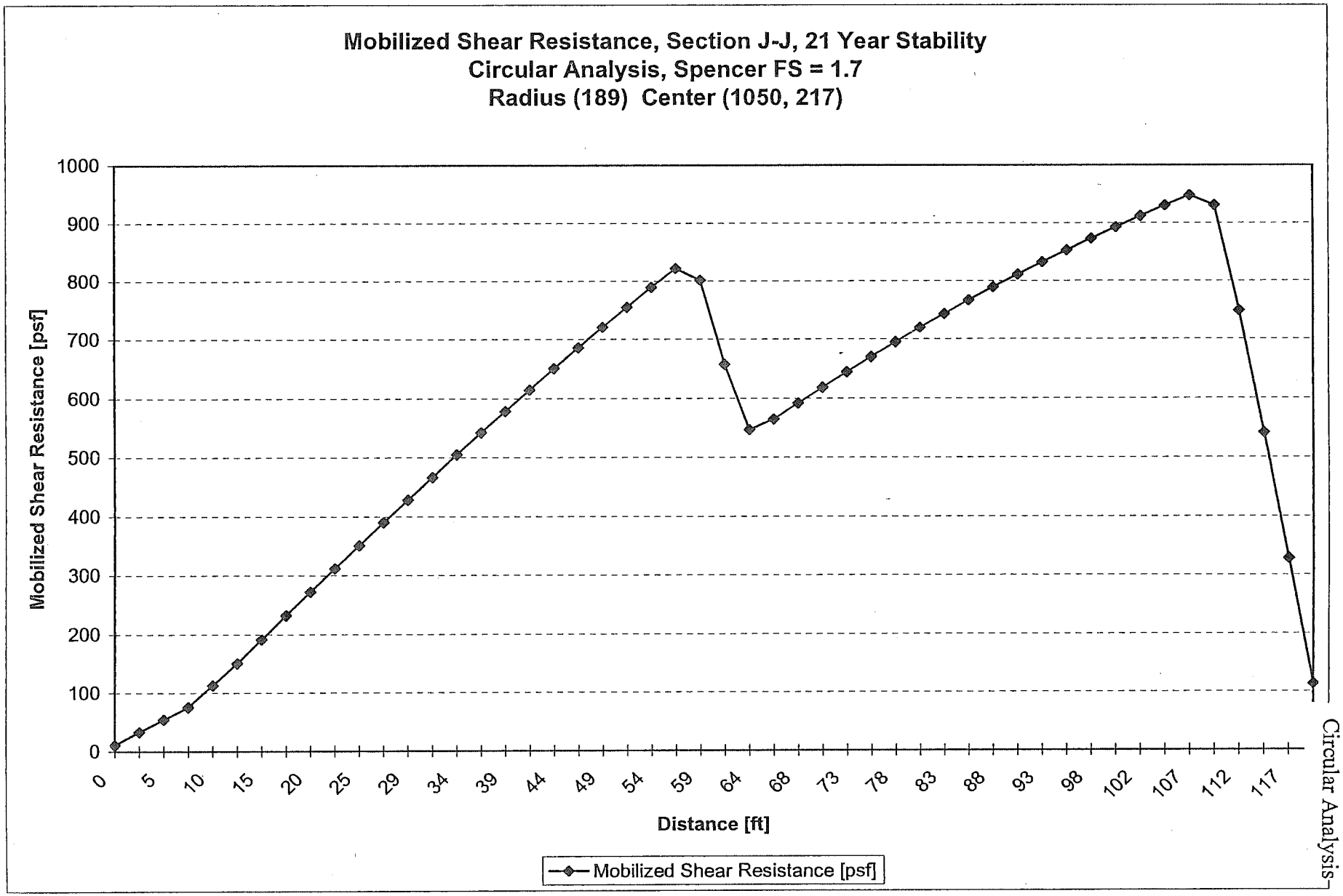


J21-2



Section J-J
21 Year Stability
Circular Analysis

J21.3



Section J-J
21 Year Stability
Circular Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance J

Slide Analysis Information

Document Name

File Name: j-j(21 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1844 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1454 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1235 psf
Water Surface: None

Section J-J
21 Year Stability
Circular Analysis

J21-5

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1202 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1348 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2198 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2129 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1627 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1368 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1350 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1555 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2501 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive

Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.69337
Center: 1049.94, 217.325
Radius: 189.348
Left Slip Surface Endpoint: 920.416, 79.2068
Right Slip Surface Endpoint: 1042.38, 28.1284

Method Statistics

Method: spencer
Number of Valid Surfaces: 23189
Number of Invalid Surfaces: 10327
Error Codes:
Error Code -106 reported for 2021 surfaces
Error Code -107 reported for 3561 surfaces
Error Code -108 reported for 349 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 3619 surfaces
Error Code -112 reported for 776 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

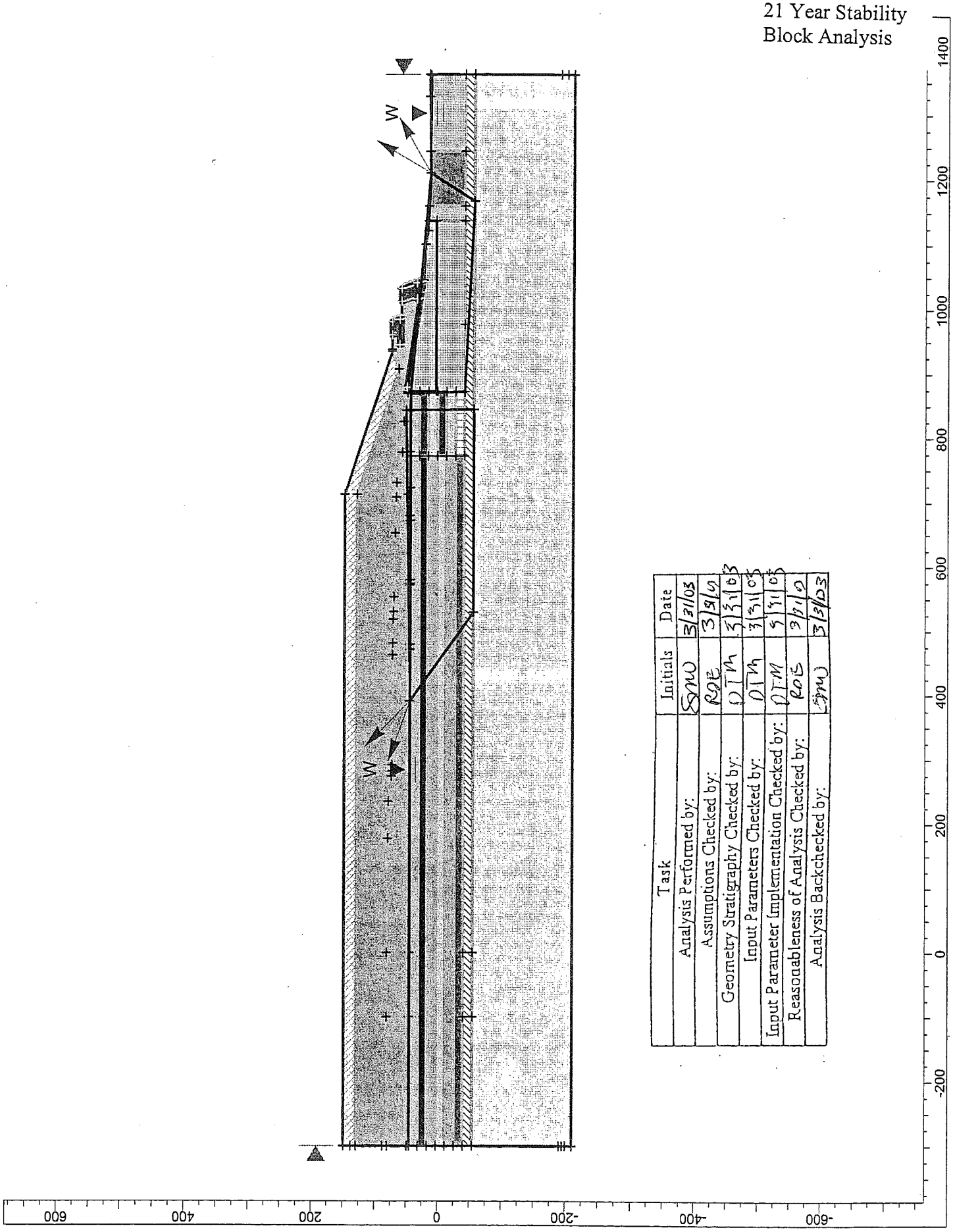
-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

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

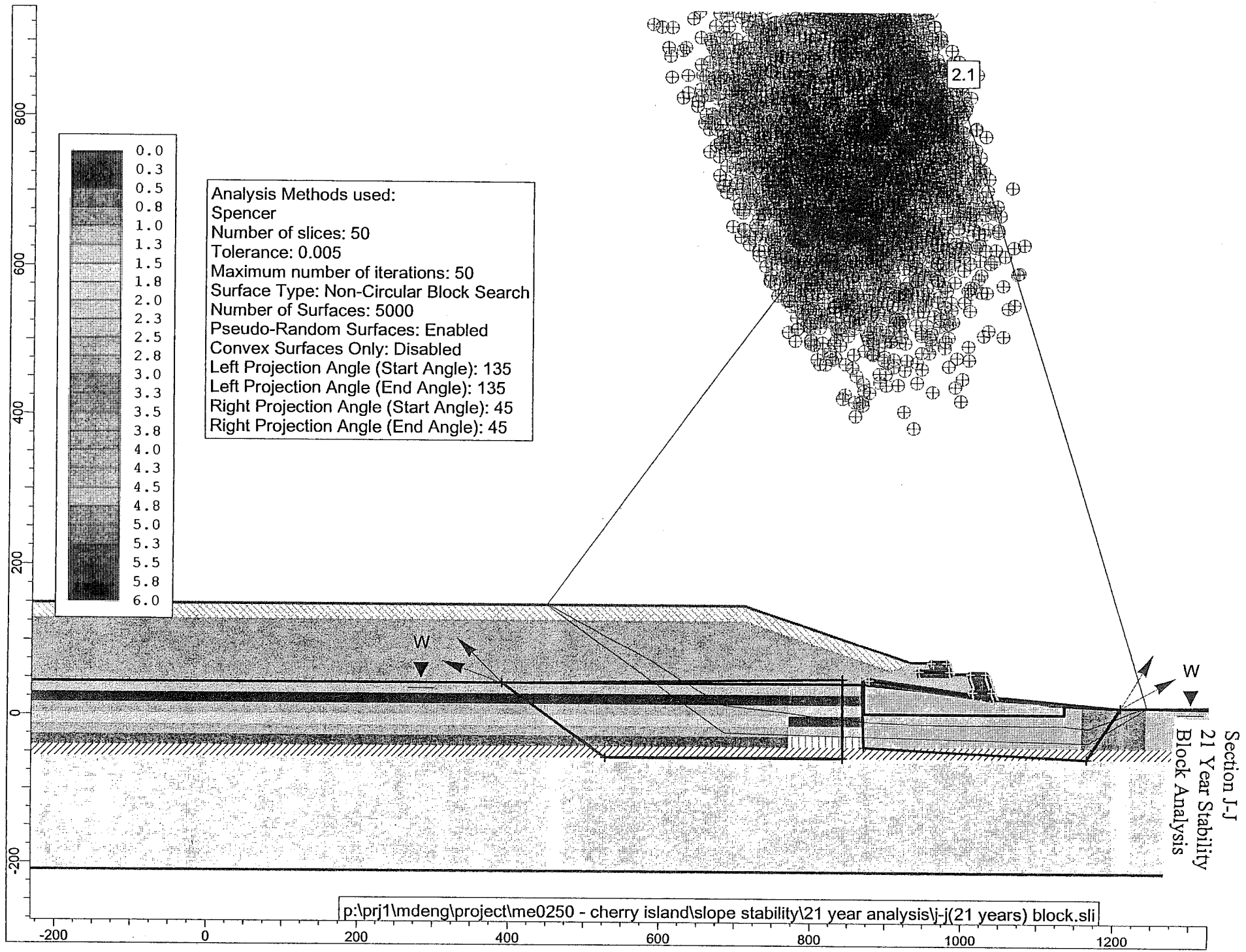
Section J-J
21 Year Stability
Circular Analysis

Section J-J
21 Year Stability
Block Analysis



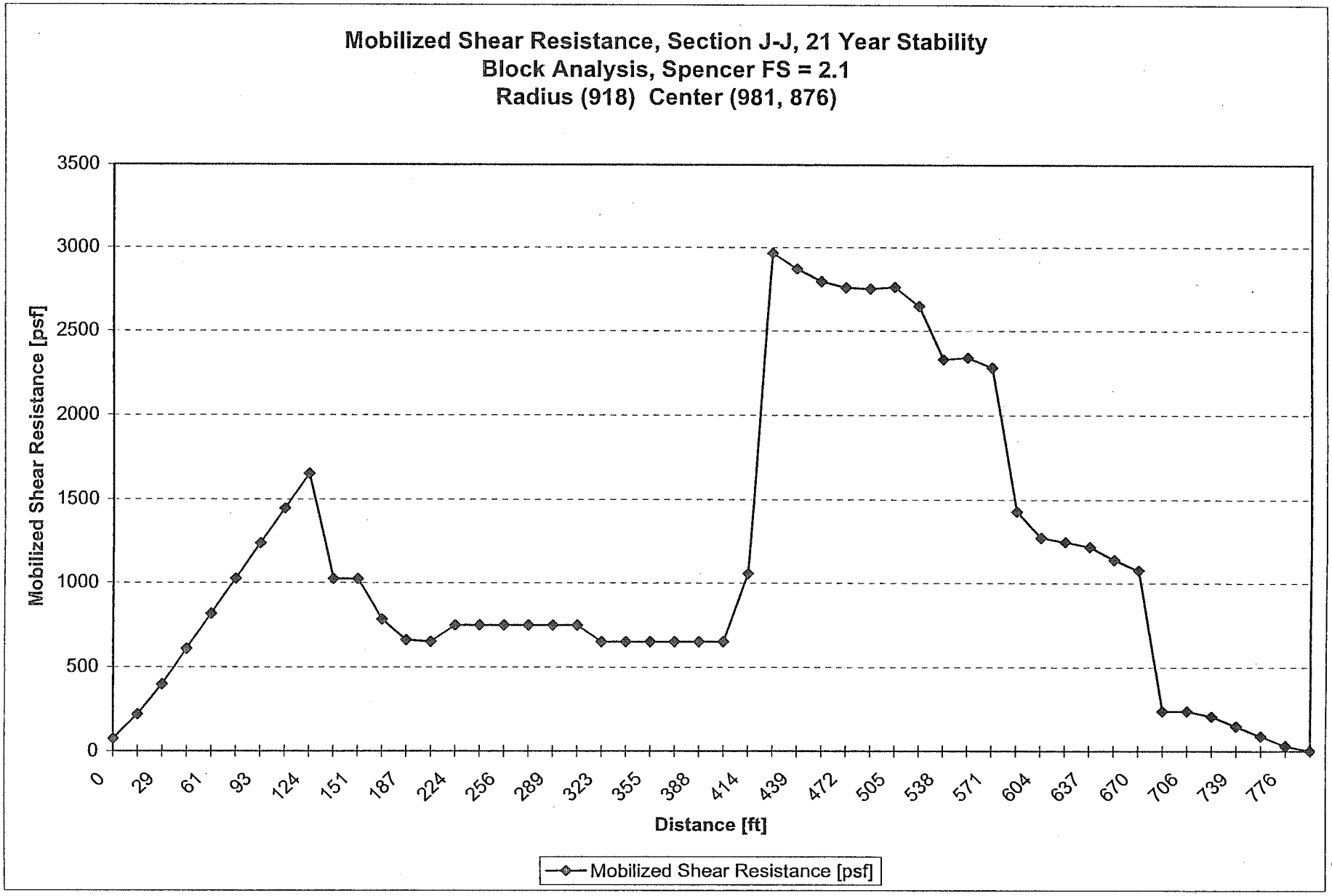
Task	Initials	Date
Analysis Performed by:	SMO	3/21/03
Assumptions Checked by:	ROE	3/9/0
Geometry Stratigraphy Checked by:	DTM	5/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	5/31/03
Reasonableness of Analysis Checked by:	ROE	3/1/0
Analysis Backchecked by:	SMO	3/31/03

J21-7



Section J-J
21 Year Stability
Block Analysis

J21-8C



Section J-J
21 Year Stability
Block Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance J

6-125

Slide Analysis Information

Document Name

File Name: J-J(21 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1844 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1454 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3

Section J-J
21 Year Stability
Block Analysis

J21-10

Cohesion Type: Constant
Cohesion: 1235 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1202 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1348 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2198 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2129 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1627 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1368 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1350 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1555 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2501 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.07863
Axis Location: 980.729, 876.111
Left Slip Surface Endpoint: 449.779, 149
Right Slip Surface Endpoint: 1243.85, 15.0839

Method Statistics

Method: spencer
Number of Valid Surfaces: 3372
Number of Invalid Surfaces: 1628
Error Codes:
Error Code -105 reported for 1 surface
Error Code -107 reported for 3 surfaces
Error Code -108 reported for 1575 surfaces
Error Code -111 reported for 39 surfaces
Error Code -112 reported for 10 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

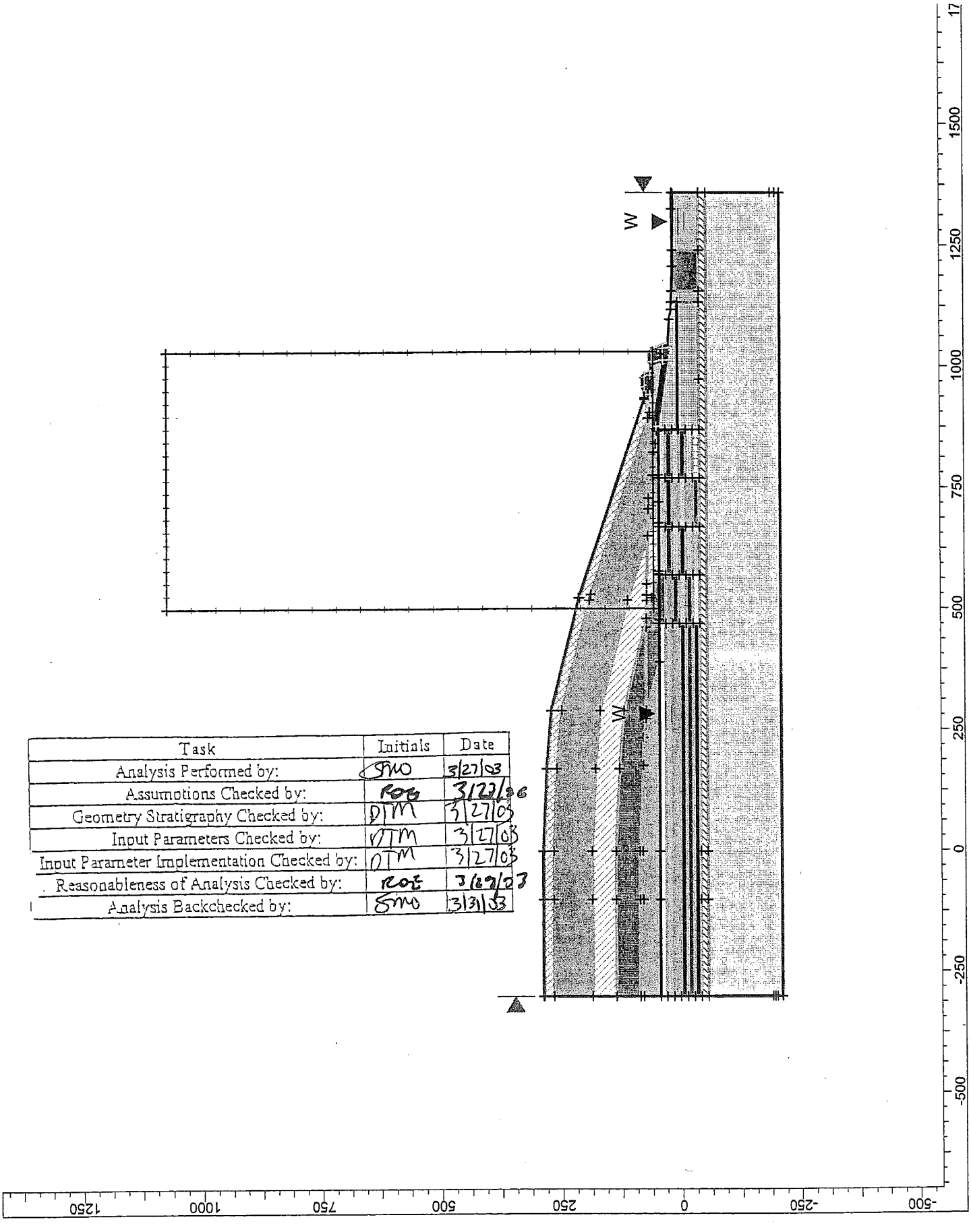
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

Section J-J
21 Year Stability
Block Analysis

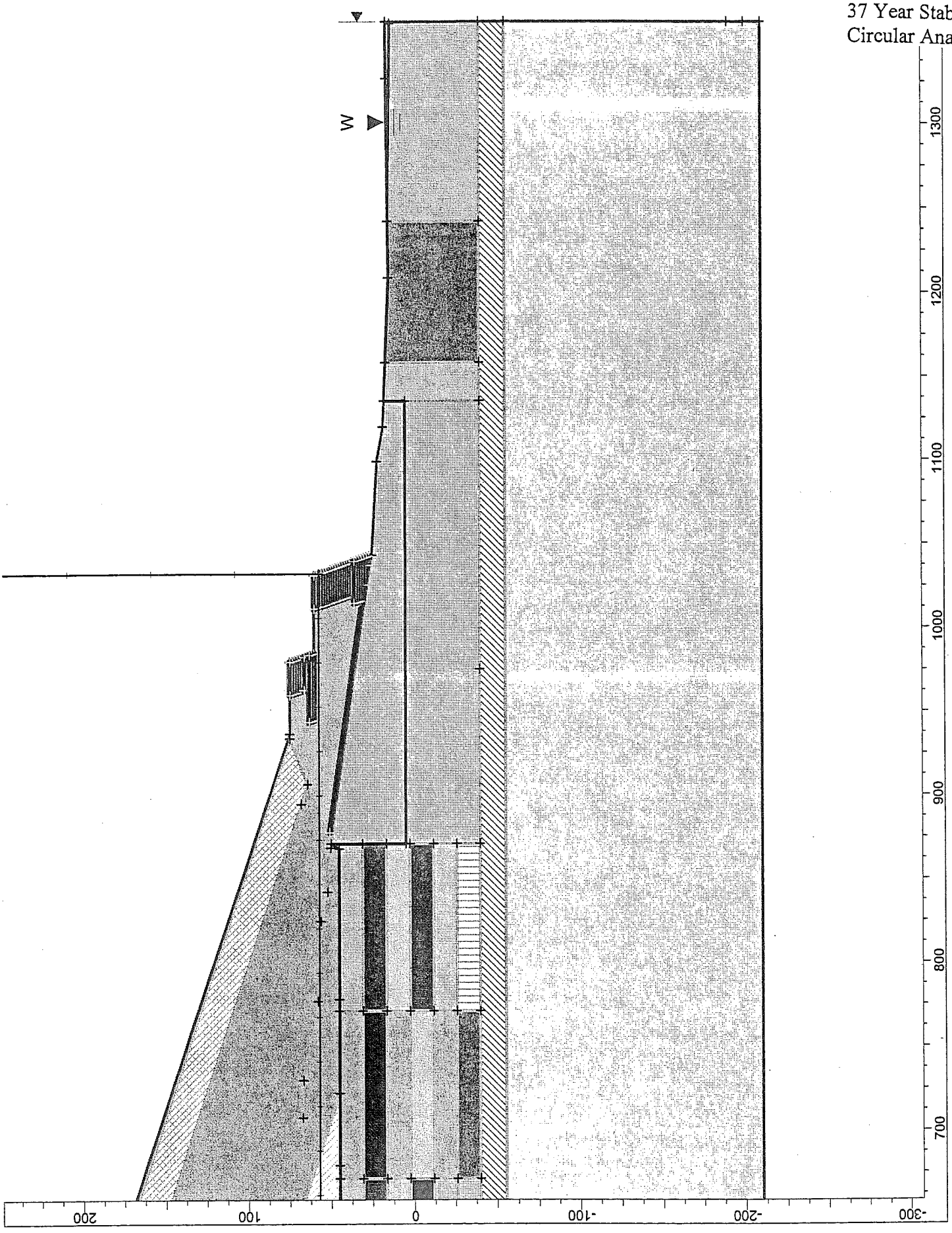
Section J-J
37 Year Stability
Circular Analysis



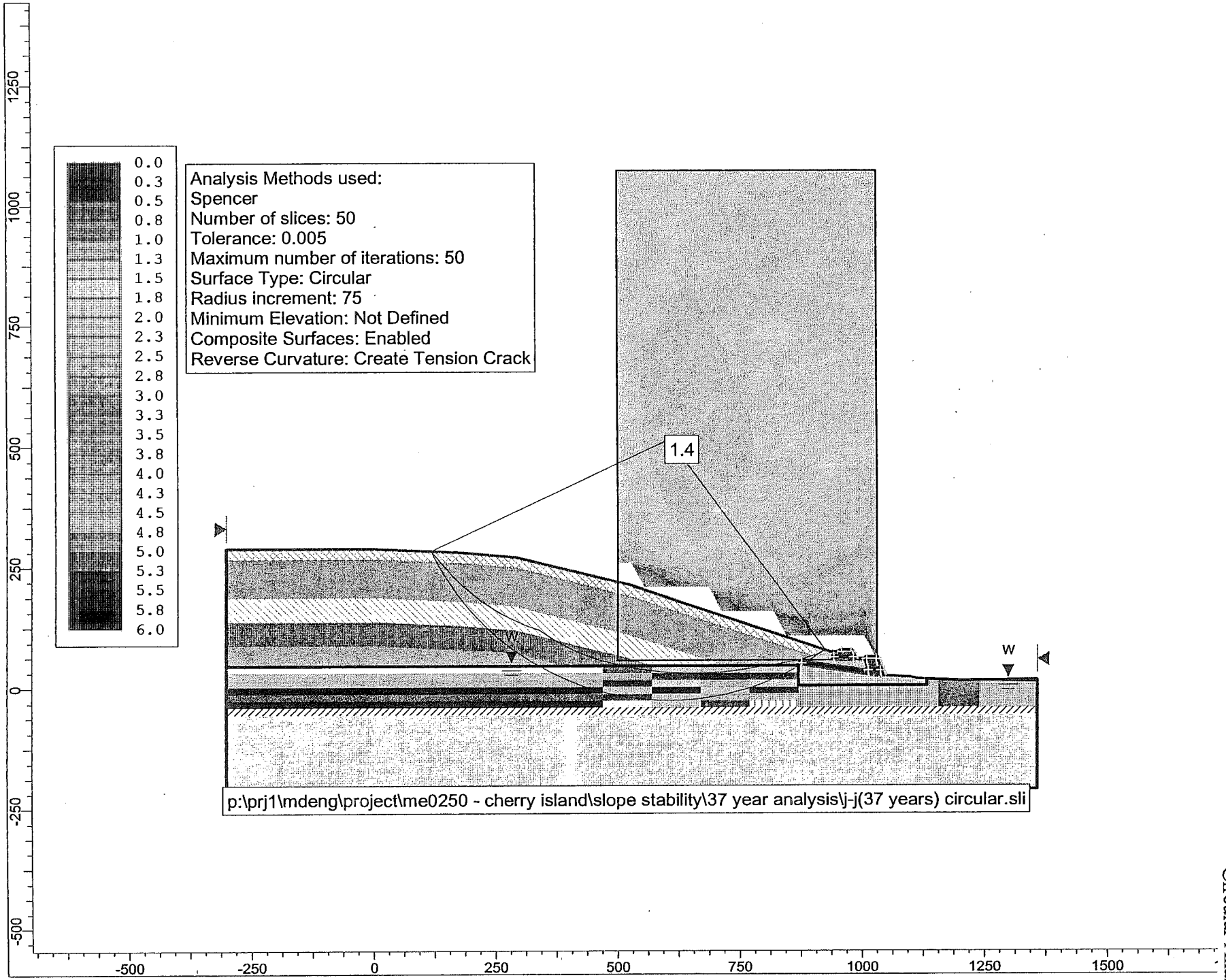
Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	ROE	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	ROE	3/27/03
Analysis Backchecked by:	SMO	3/31/03

J37-1

Section J-J
37 Year Stability
Circular Analysis

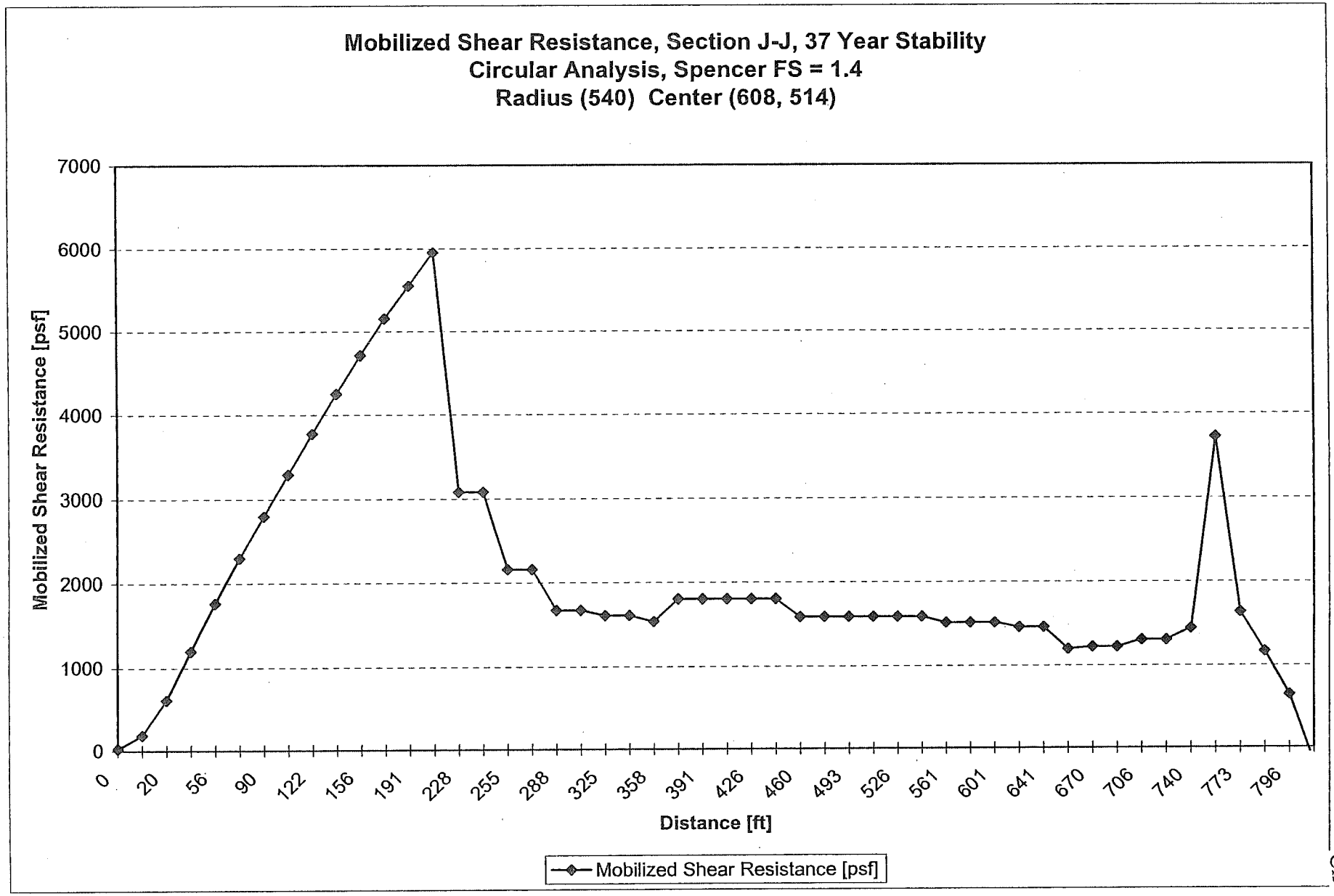


J37-2



J37-3

Section J-J
37 Year Stability
Circular Analysis



Section J-J
37 Year Stability
Circular Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance J

J37-4

Slide Analysis Information

Document Name

File Name: j-j(37 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function

J37-5

Section J-J
37 Year Stability
Circular Analysis

Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2003 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1813 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1663 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1756 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2405 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2647 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2327 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2113 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2103 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2937 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3295 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2718 psf

Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2302 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2120 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2205 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3391 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3660 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2775 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2232 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2506 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3917 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4273 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3002 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2238.psf
Water Surface: None

J37.6

Section J-J
37 Year Stability
Circular Analysis

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2751 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4535 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.38634
Center: 608.097, 514.443
Radius: 540.158
Left Slip Surface Endpoint: 119.437, 284.265
Right Slip Surface Endpoint: 926.528, 78.1259

Method Statistics

Method: spencer
Number of Valid Surfaces: 27444
Number of Invalid Surfaces: 6072
Error Codes:
Error Code -106 reported for 1 surface
Error Code -108 reported for 530 surfaces
Error Code -111 reported for 290 surfaces
Error Code -112 reported for 5251 surfaces

Error Codes

The following errors were encountered during the computation:

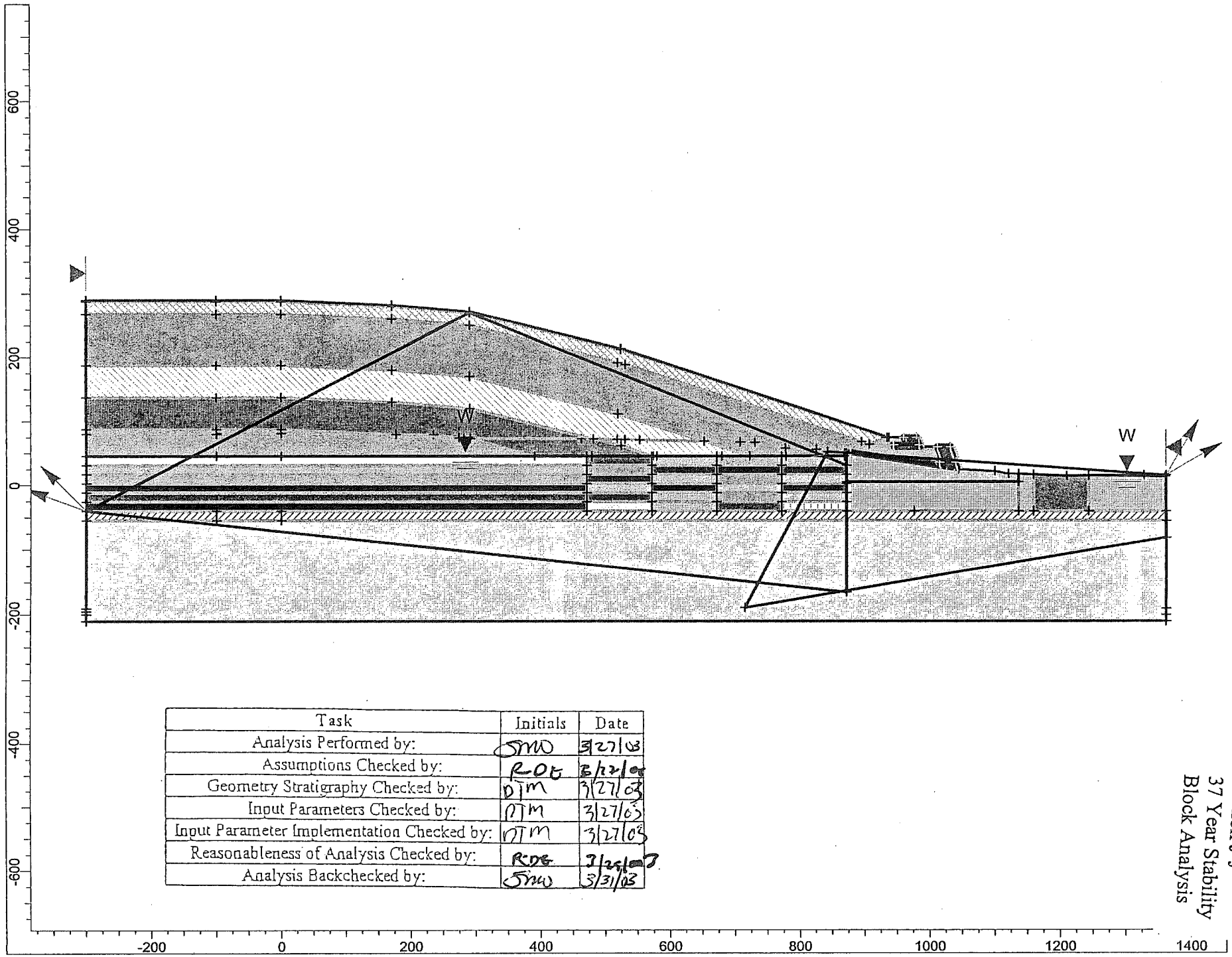
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of

extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

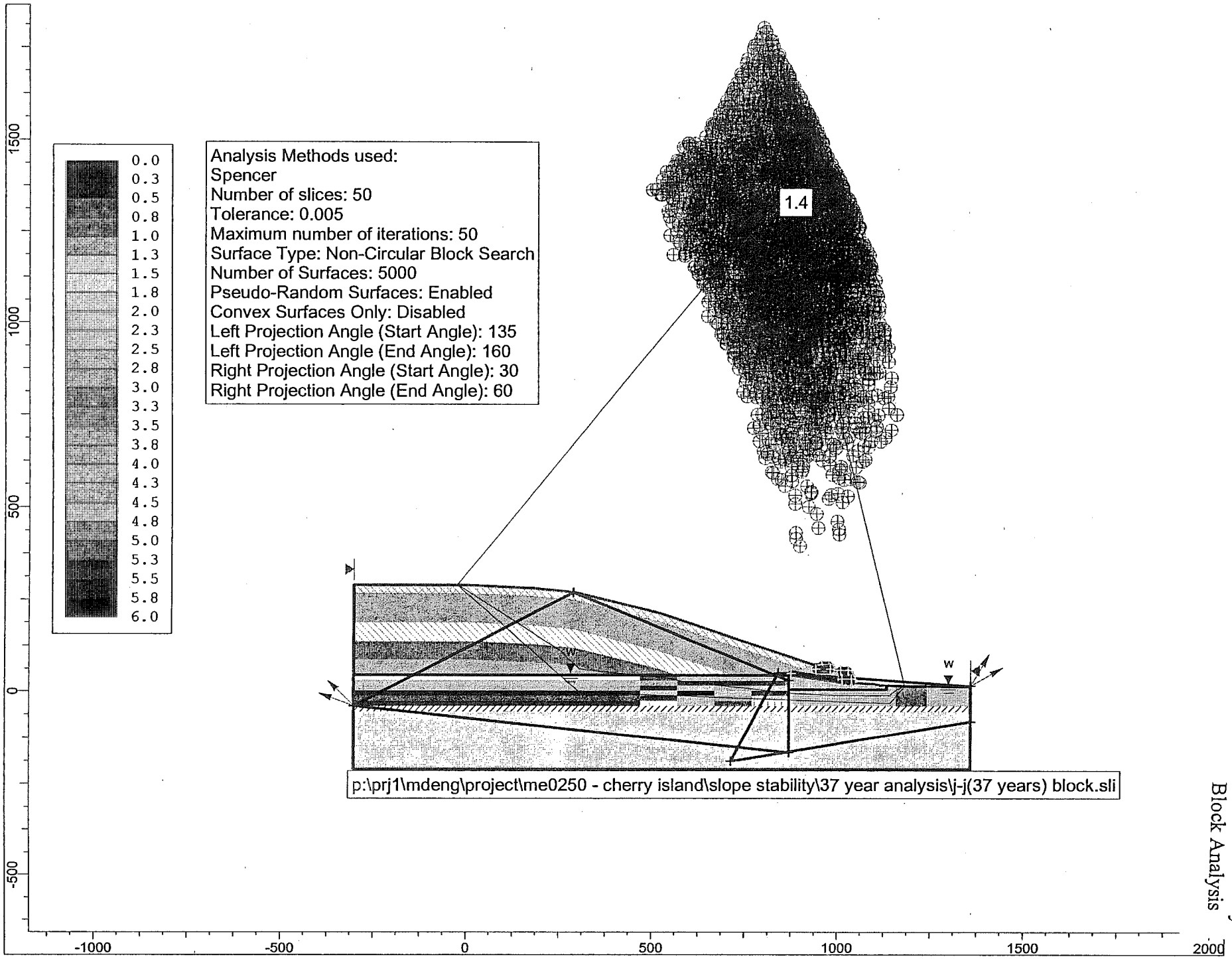
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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



Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	ROE	3/27/03
Geometry Stratigraphy Checked by:	DJM	3/27/03
Input Parameters Checked by:	DJM	3/27/03
Input Parameter Implementation Checked by:	DJM	3/27/03
Reasonableness of Analysis Checked by:	RDG	3/28/03
Analysis Backchecked by:	SMO	3/31/03

Section J-J
37 Year Stability
Block Analysis

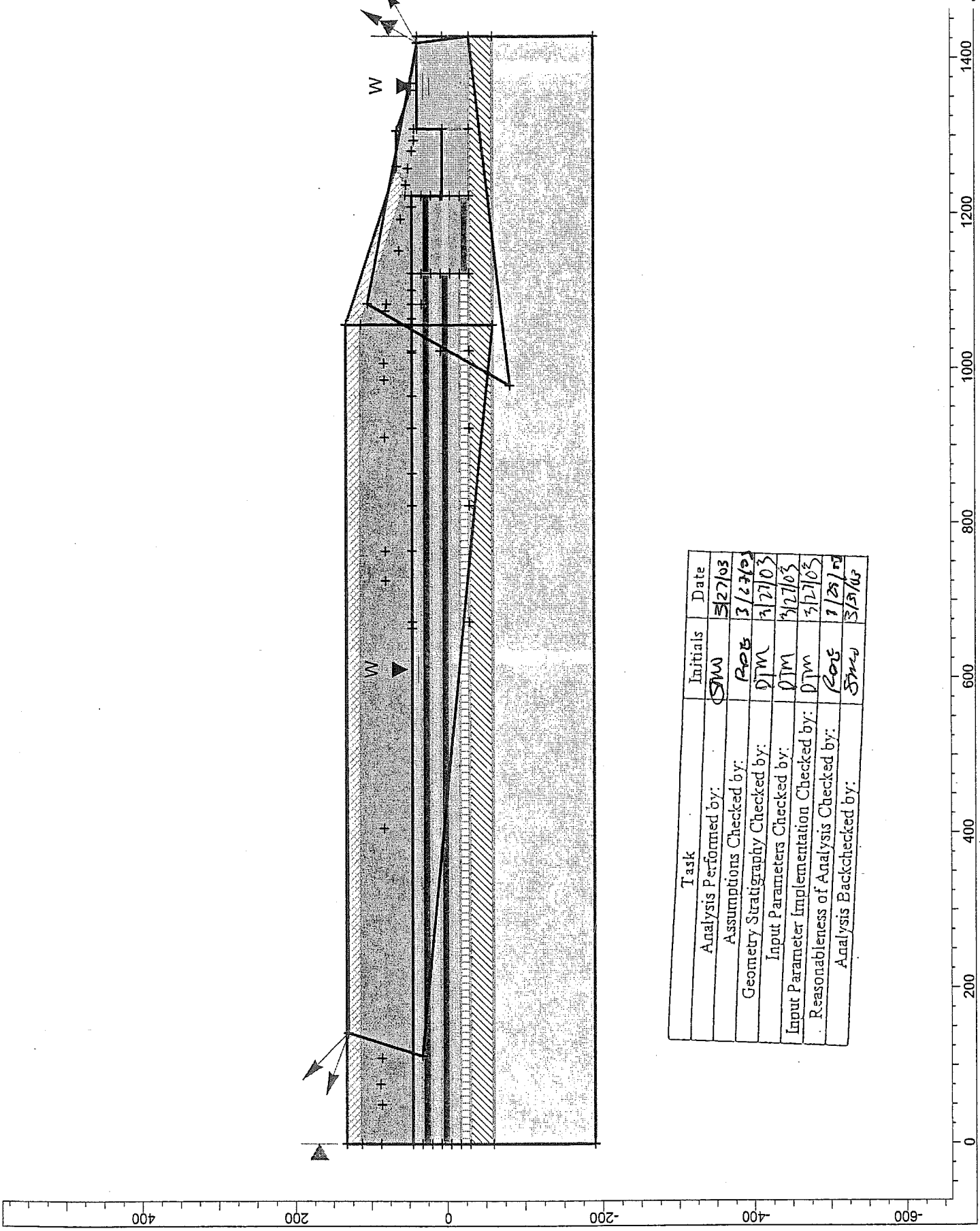
J37-08



Section J-J
37 Year Stability
Block Analysis

J37-9

Section K-K
21 Year Stability
Block Analysis



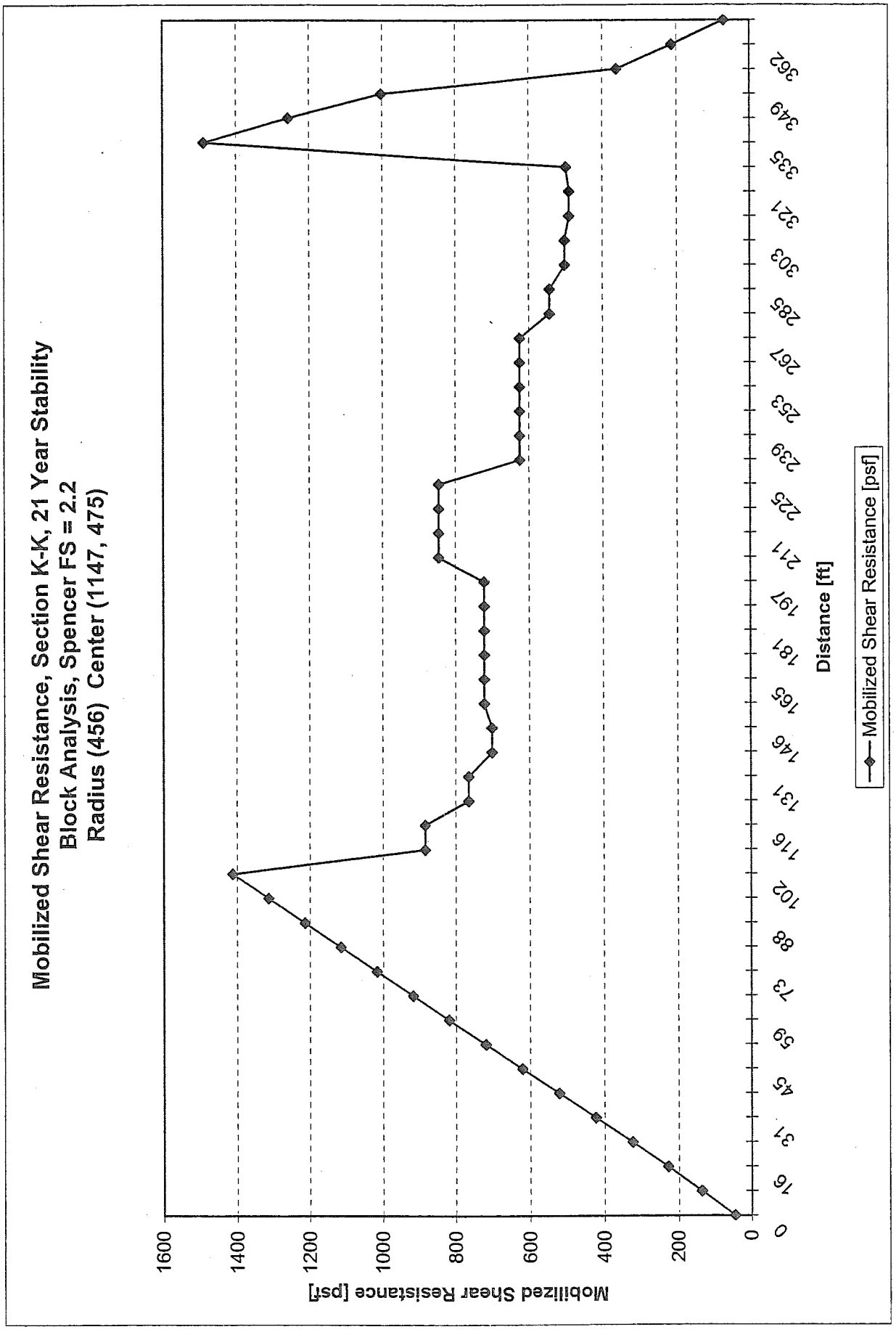
Task	Initials	Date
Analysis Performed by:	SMW	3/27/03
Assumptions Checked by:	RDS	3/27/03
Geometry Stratigraphy Checked by:	DJM	3/27/03
Input Parameters Checked by:	DJM	3/27/03
Input Parameter Implementation Checked by:	DJM	3/27/03
Reasonableness of Analysis Checked by:	RDS	3/28/03
Analysis Backchecked by:	SMW	3/31/03

K21-6

Section K-K
21 Year Stability
Block Analysis

K21-7

Section K-K
21 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance K

K21-8

Slide Analysis Information

Document Name

File Name: k-k(21 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1944 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1683 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1545 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Cohesion: 1590 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1860 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2451 psf
Water Surface: None

Material: d01
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1097 psf
Water Surface: None

Material: d02
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1079 psf
Water Surface: None

Material: d03
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1105 psf
Water Surface: None

Material: d04
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1195 psf
Water Surface: None

Material: d05
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1375 psf
Water Surface: None

Material: d06
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1679 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: spencer
SF: 2.19981
Axis Location: 1146.64, 475.051
Left Slip Surface Endpoint: 890.616, 133
Right Slip Surface Endpoint: 1266.67, 65

Method Statistics

Method: spencer
Number of Valid Surfaces: 2959
Number of Invalid Surfaces: 2041
Error Codes:
Error Code -105 reported for 1 surface
Error Code -107 reported for 1034 surfaces
Error Code -108 reported for 923 surfaces

Error Code -110 reported for 17 surfaces
Error Code -111 reported for 64 surfaces
Error Code -112 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

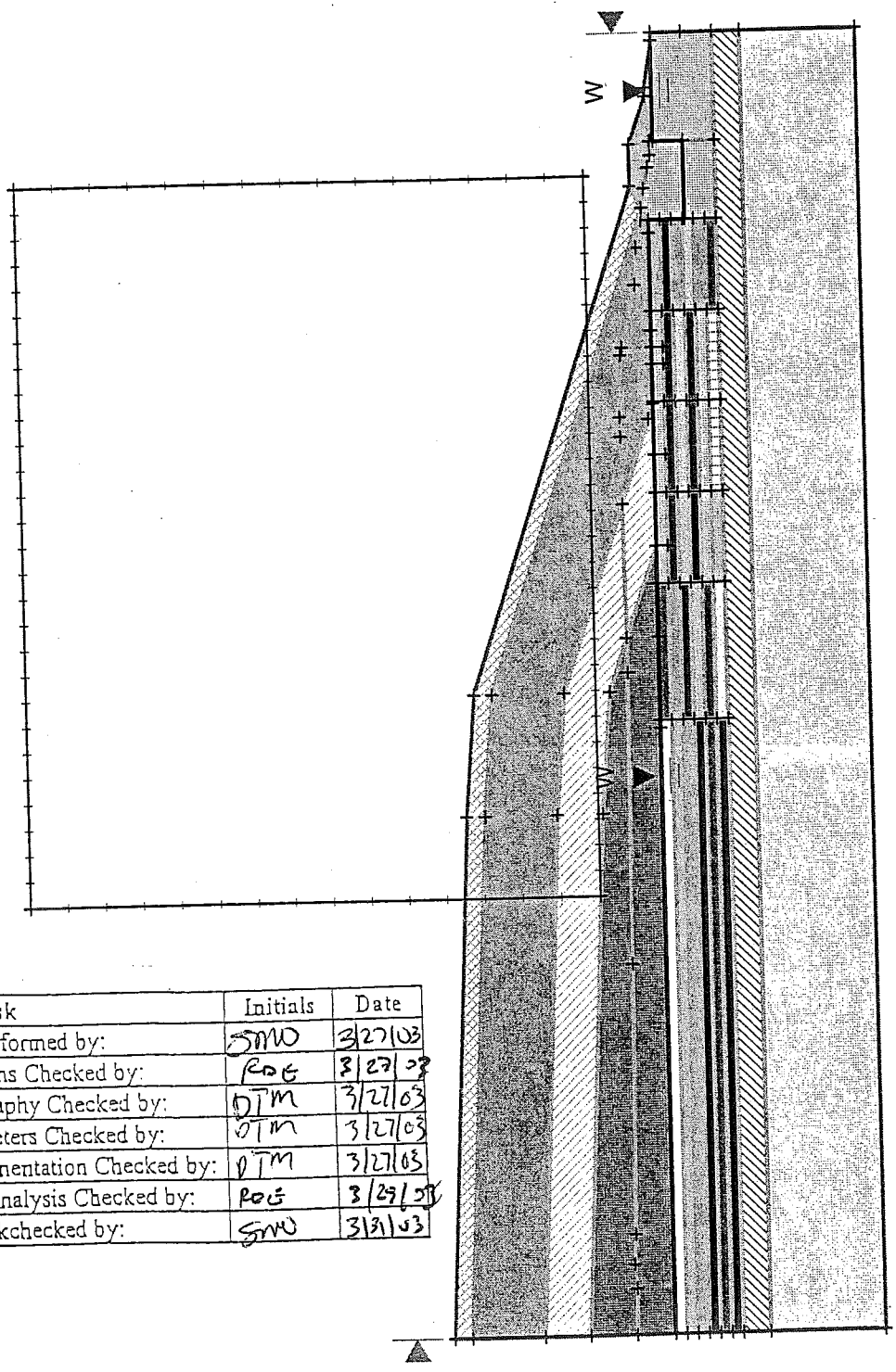
-111 = safety factor equation did not converge

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

Section K-K
21 Year Stability
Block Analysis

K-21-02

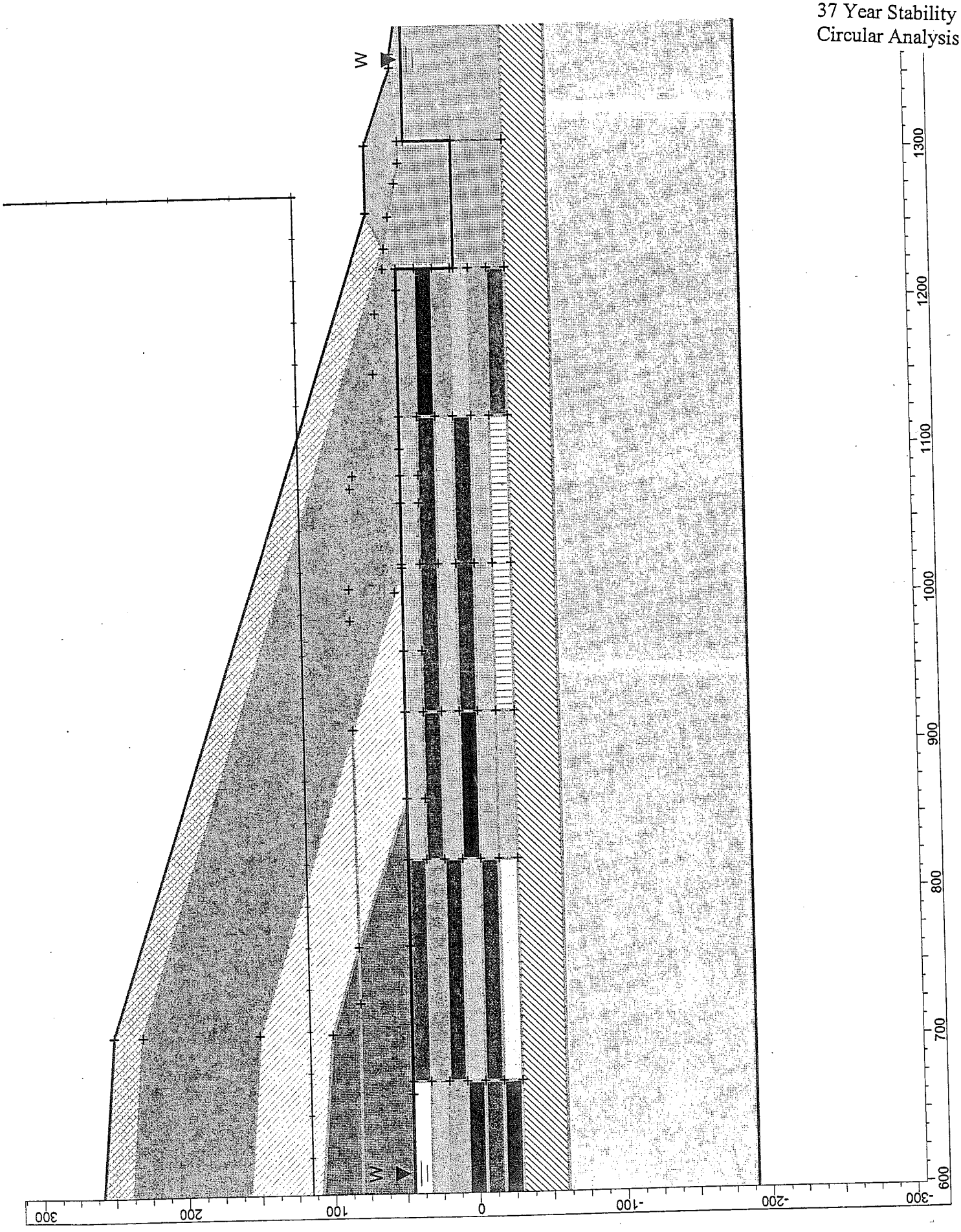
Section K-K
37 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/27/03
Assumptions Checked by:	ROG	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	ROG	3/29/03
Analysis Backchecked by:	SMW	3/31/03

K37-1

Section K-K
37 Year Stability
Circular Analysis

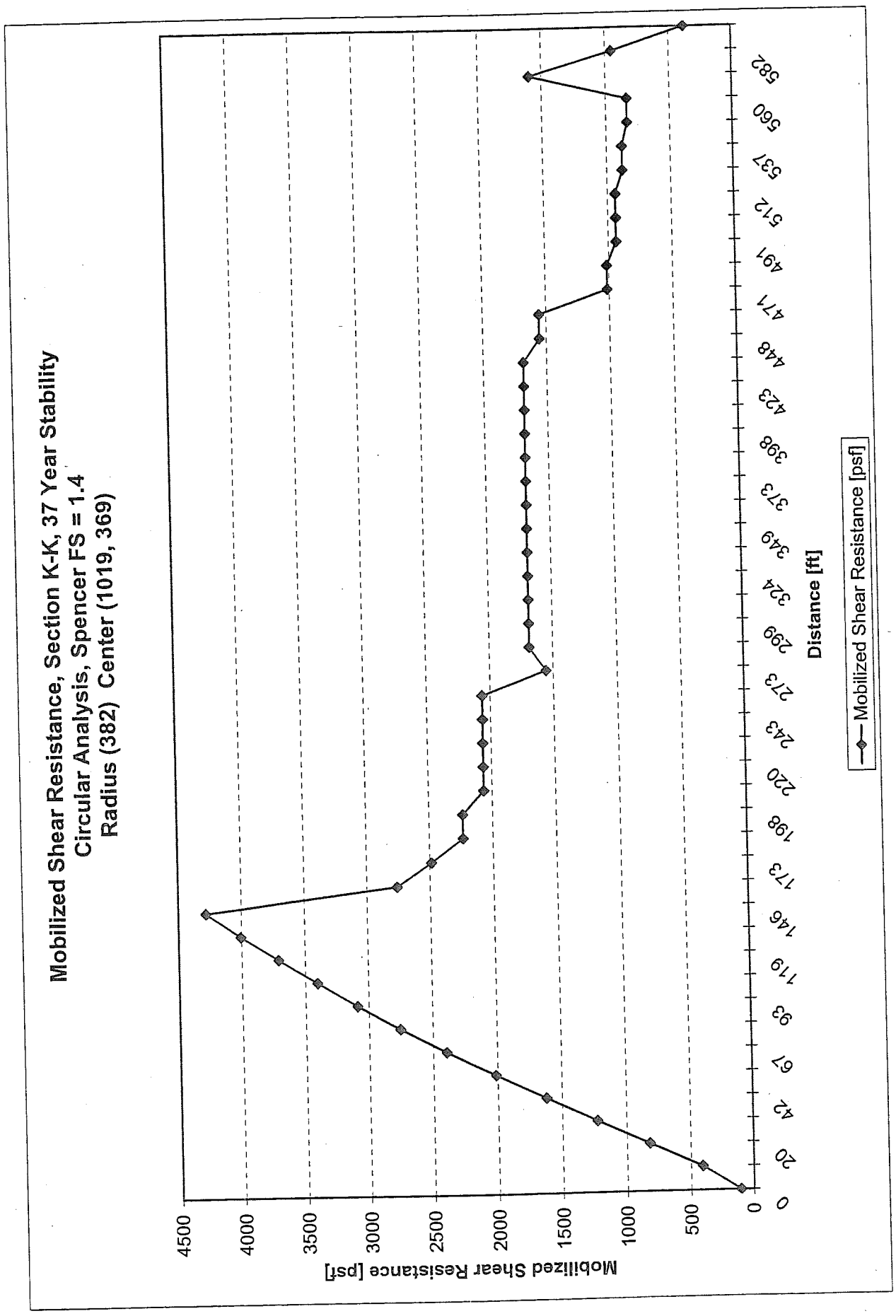


IC37-2

Section K-K
37 Year Stability
Circular Analysis

K37-3

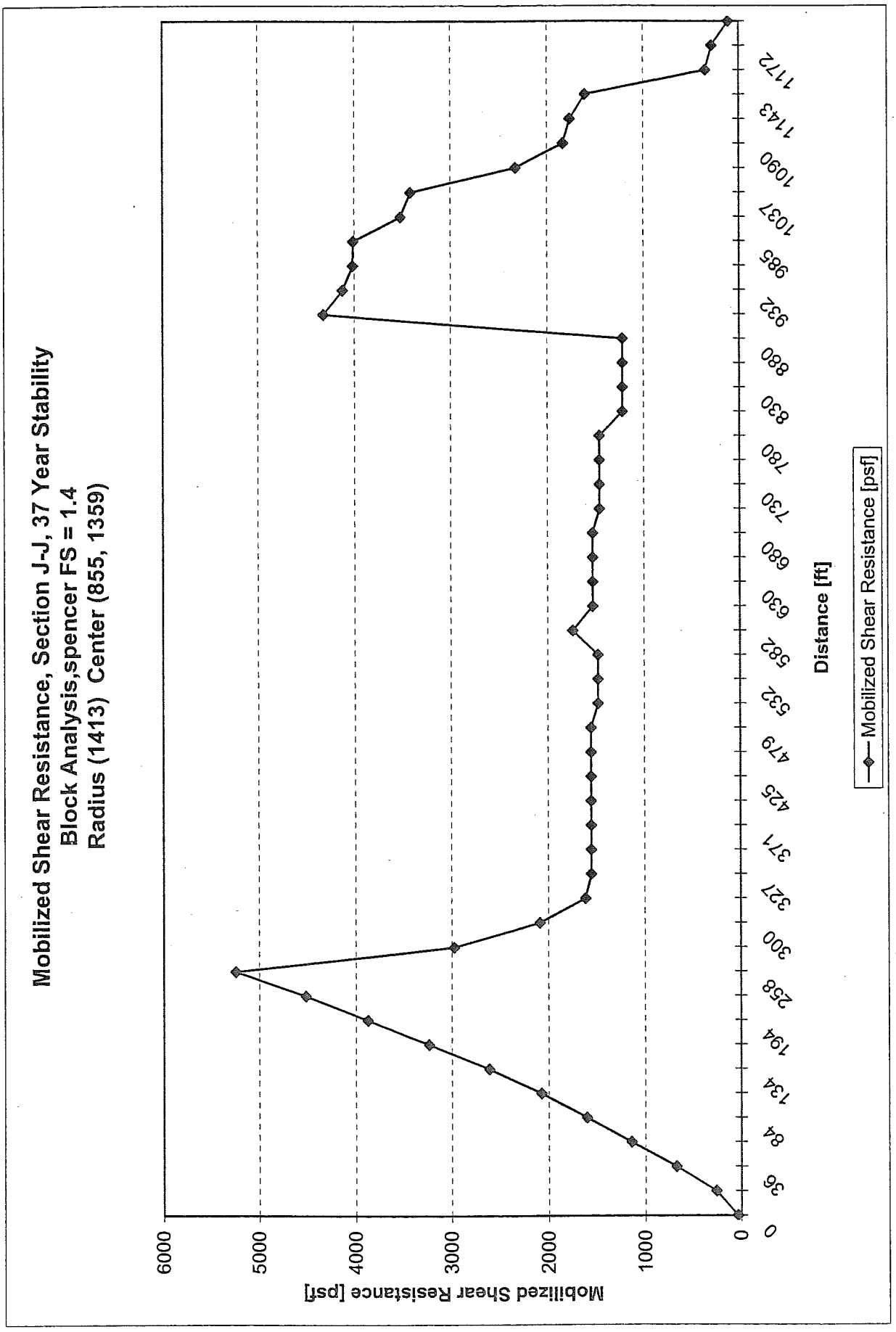
Section K-K
37 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance K

K37-4

Section J-J
37 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance J

J37-10

Slide Analysis Information

Document Name

File Name: j-j(37 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Section J-J
37 Year Stability
Block Analysis

J37-11

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2003 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1813 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1663 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1756 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2405 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2647 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2327 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2113 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2103 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2937 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3295 psf
Water Surface: None

Material: d32
Strength Type: Undrained

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2718 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2302 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2120 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2205 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3391 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3660 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2775 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2232 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2506 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3917 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4273 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3002 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section J-J
37 Year Stability
Block Analysis

J37-12

Cohesion: 2238 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2751 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4535 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.43658
Axis Location: 854.733, 1358.52
Left Slip Surface Endpoint: -22.074, 289.5
Right Slip Surface Endpoint: 1183.86, 15.6604

Method Statistics

Method: spencer
Number of Valid Surfaces: 3481
Number of Invalid Surfaces: 1519
Error Codes:
Error Code -105 reported for 35 surfaces
Error Code -108 reported for 1061 surfaces
Error Code -111 reported for 147 surfaces
Error Code -112 reported for 276 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of

Section J-J
37 Year Stability
Block Analysis

extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

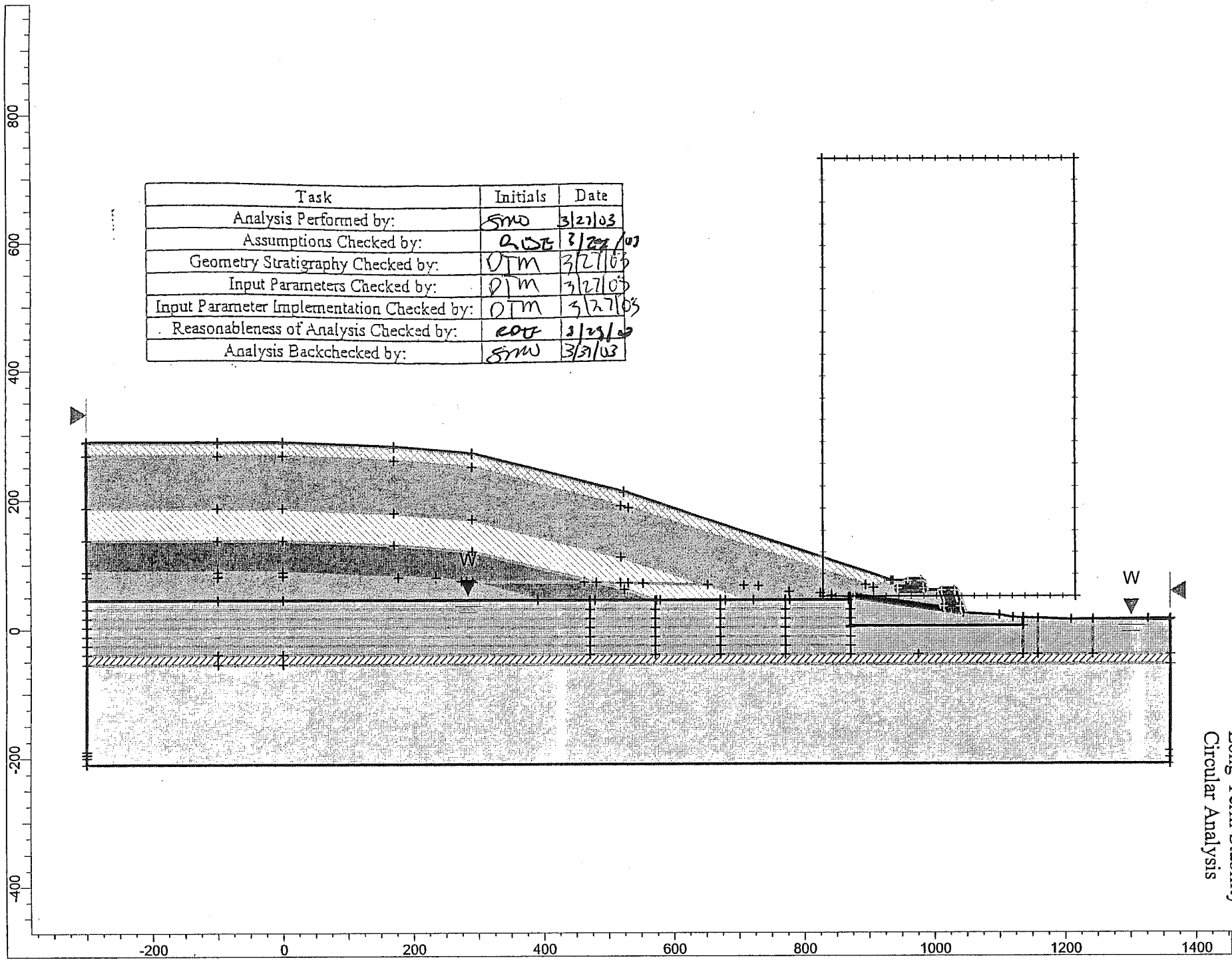
-111 = safety factor equation did not converge

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

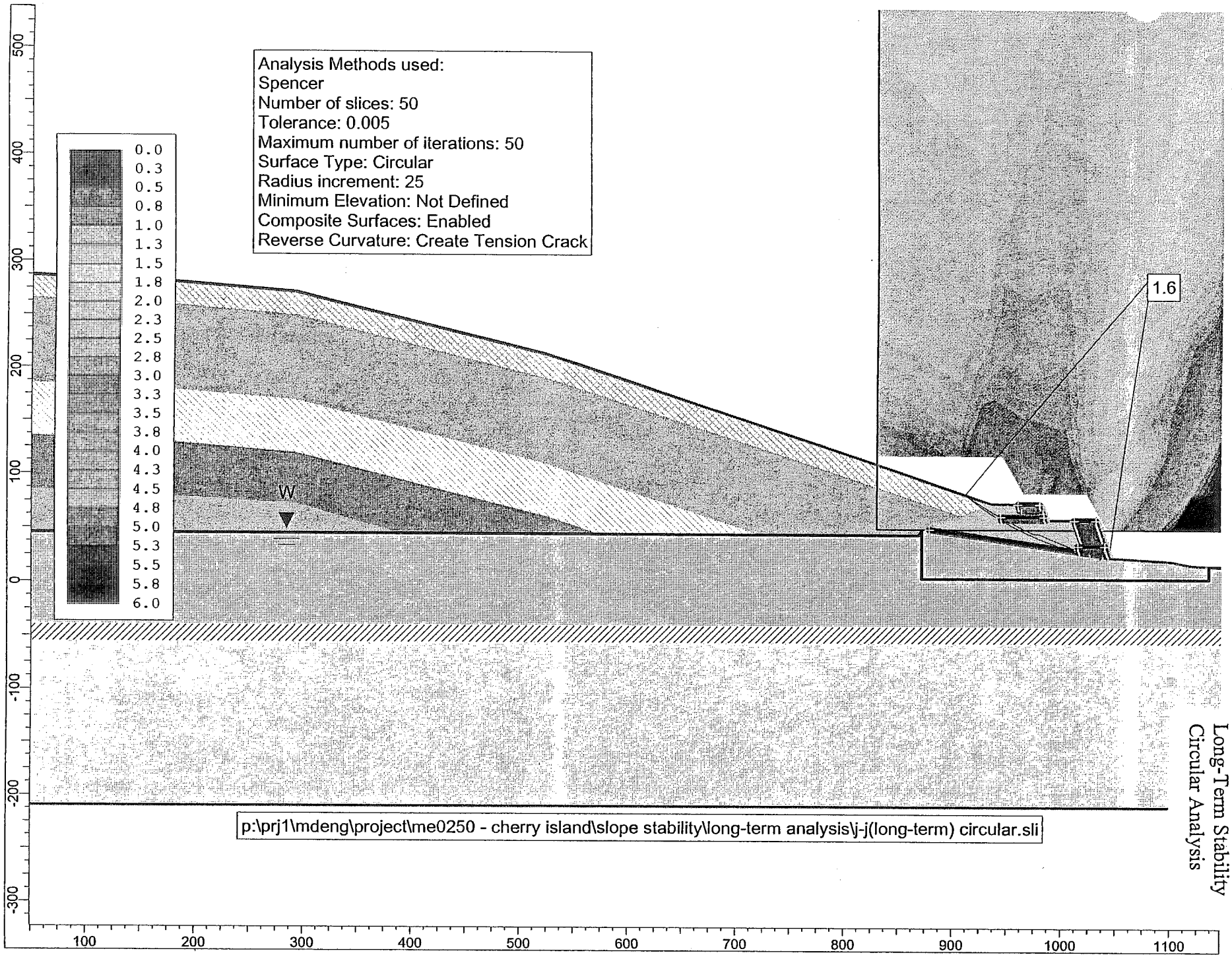
J37-13

Section J-J
Long-Term Stability
Circular Analysis

Task	Initials	Date
Analysis Performed by:	SMW	3/27/03
Assumptions Checked by:	RDE	3/29/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	RDE	3/29/03
Analysis Backchecked by:	SMW	3/31/03



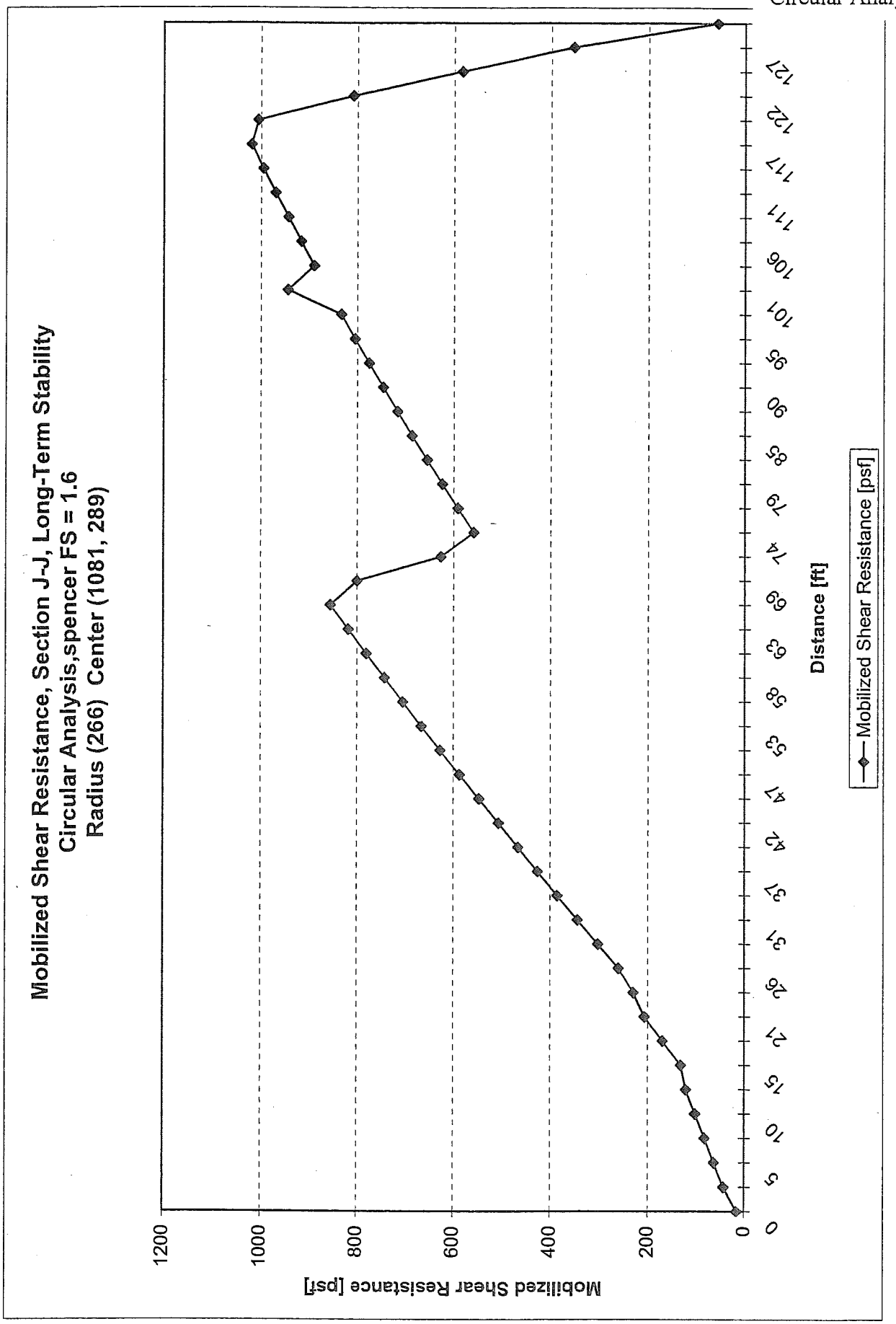
JLT-1



Section J-J
Long-Term Stability
Circular Analysis

J-J - 2

Section J-J
Long-Term Stability
Circular Analysis



JCT-3

Slide Analysis Information

Document Name

File Name: J-J(long-term) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3

JLT-4

Section J-J
Long-Term Stability
Circular Analysis

Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 3100 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.58016
Center: 1080.6, 288.773
Radius: 266.342

Left Slip Surface Endpoint: 911.115, 83.3173
Right Slip Surface Endpoint: 1043.45, 25.0343

Method Statistics

Method: spencer
Number of Valid Surfaces: 26695
Number of Invalid Surfaces: 6821
Error Codes:
Error Code -106 reported for 547 surfaces
Error Code -108 reported for 2147 surfaces
Error Code -111 reported for 2357 surfaces
Error Code -112 reported for 1770 surfaces

Error Codes

The following errors were encountered during the computation:

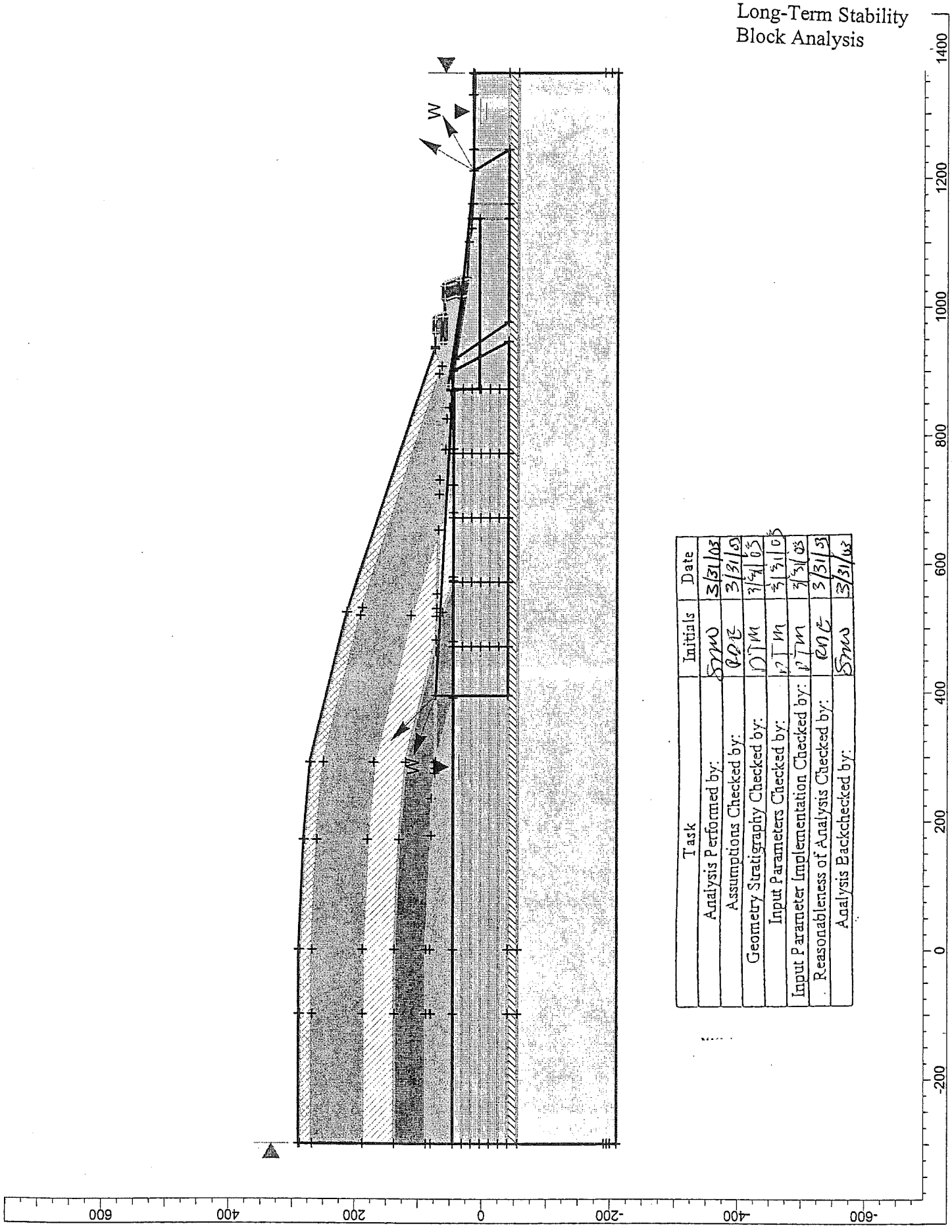
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

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

-111 = safety factor equation did not converge

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

Section J-J
Long-Term Stability
Block Analysis

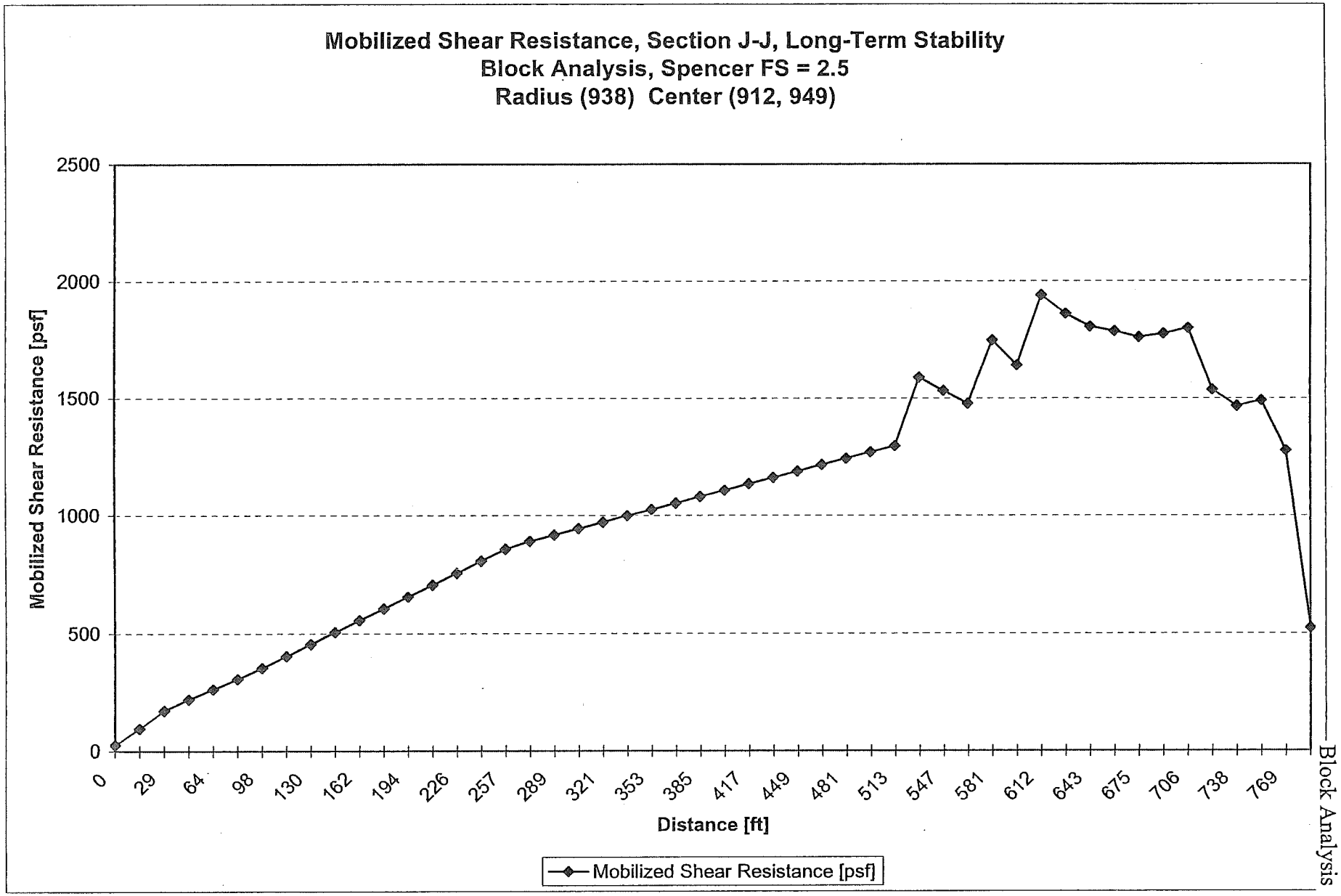


Task	Initials	Date
Analysis Performed by:	SMO	3/31/05
Assumptions Checked by:	RDE	3/31/05
Geometry Stratigraphy Checked by:	DTM	3/31/05
Input Parameters Checked by:	DTM	3/31/05
Input Parameter Implementation Checked by:	DTM	3/31/05
Reasonableness of Analysis Checked by:	RDE	3/31/05
Analysis Backchecked by:	SMO	3/31/05

JLT-5

Section J-J
Long-Term Stability
Block Analysis

JLT-6



Section J-J
Long-Term Stability
Block Analysis

PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance J

Slide Analysis Information

Document Name

File Name: j-j(long-term) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Section J-J
Long-Term Stability
Block Analysis

JLT-8

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 0

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 3100 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer

SF: 2.47113
Axis Location: 911.915, 949.395
Left Slip Surface Endpoint: 261.234, 274.483
Right Slip Surface Endpoint: 1061.44, 23.9035

Method Statistics

Method: spencer
Number of Valid Surfaces: 3899
Number of Invalid Surfaces: 1101
Error Codes:
Error Code -108 reported for 1079 surfaces
Error Code -111 reported for 20 surfaces
Error Code -112 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

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

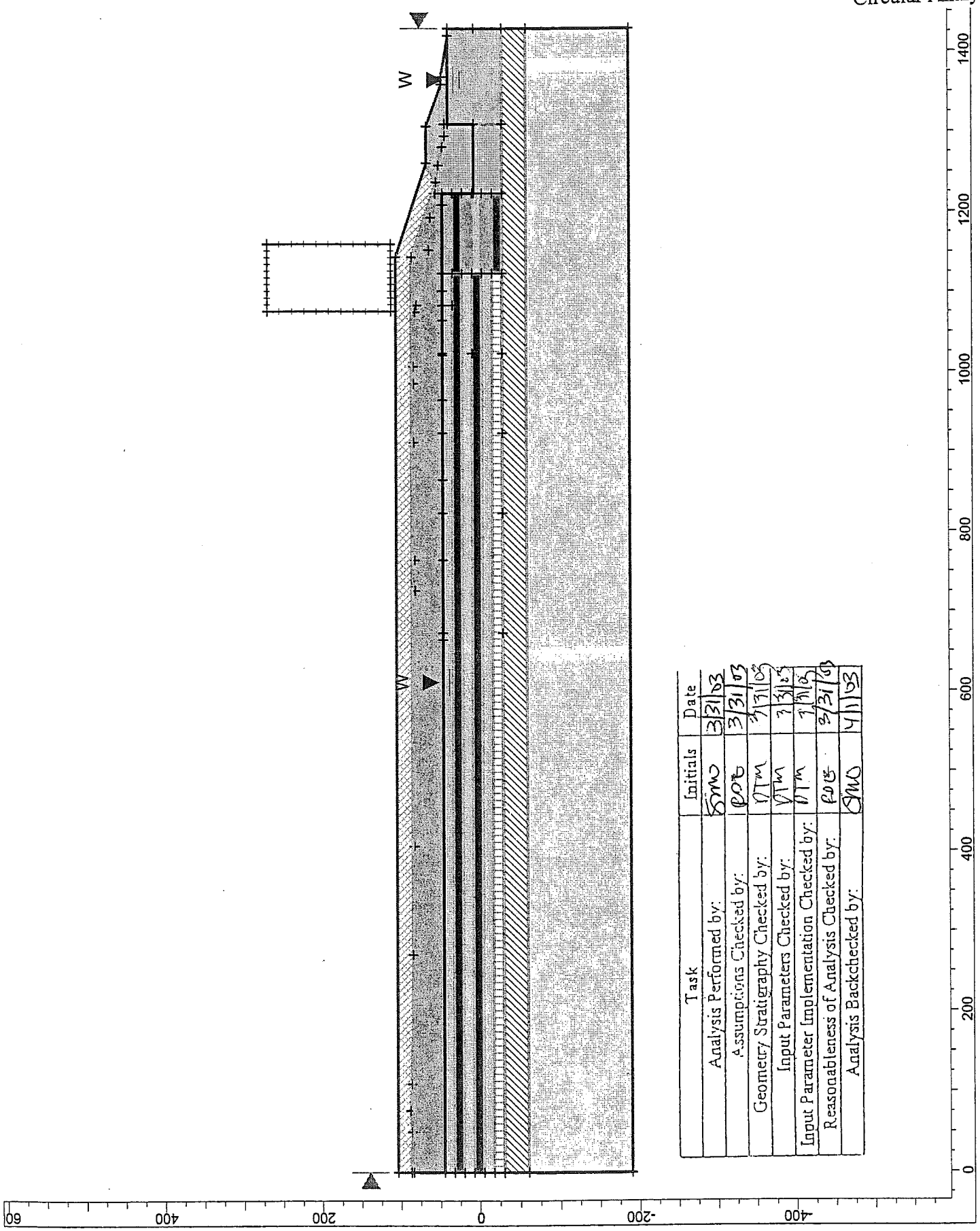
-111 = safety factor equation did not converge

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

Attachment J

Stability Analysis Results for Cross Section K-K

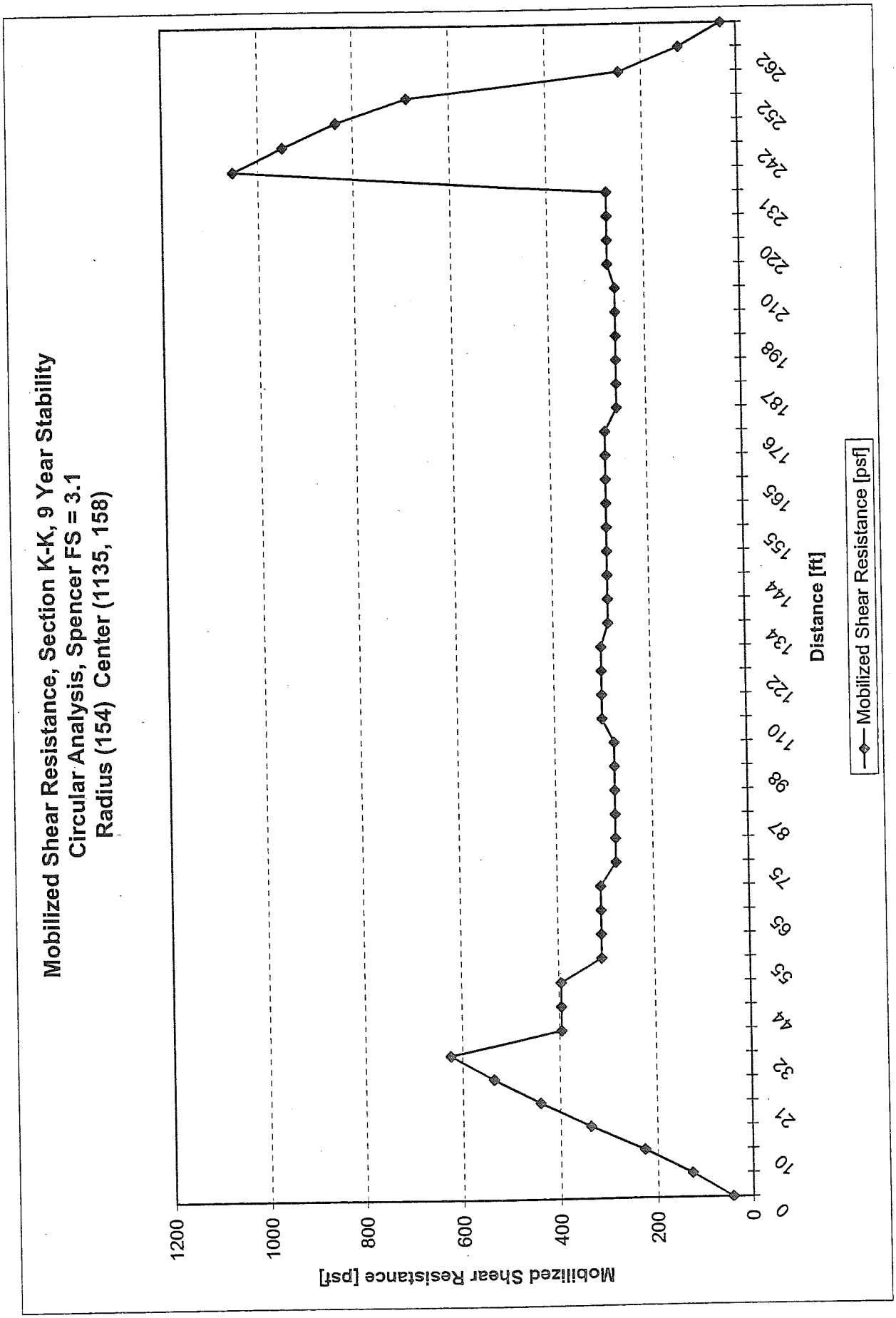
Section K-K
9 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/31/03
Assumptions Checked by:	RDE	3/31/03
Geometry Stratigraphy Checked by:	VTM	3/31/03
Input Parameters Checked by:	VTM	3/31/03
Input Parameter Implementation Checked by:	VTM	3/31/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMO	4/1/03

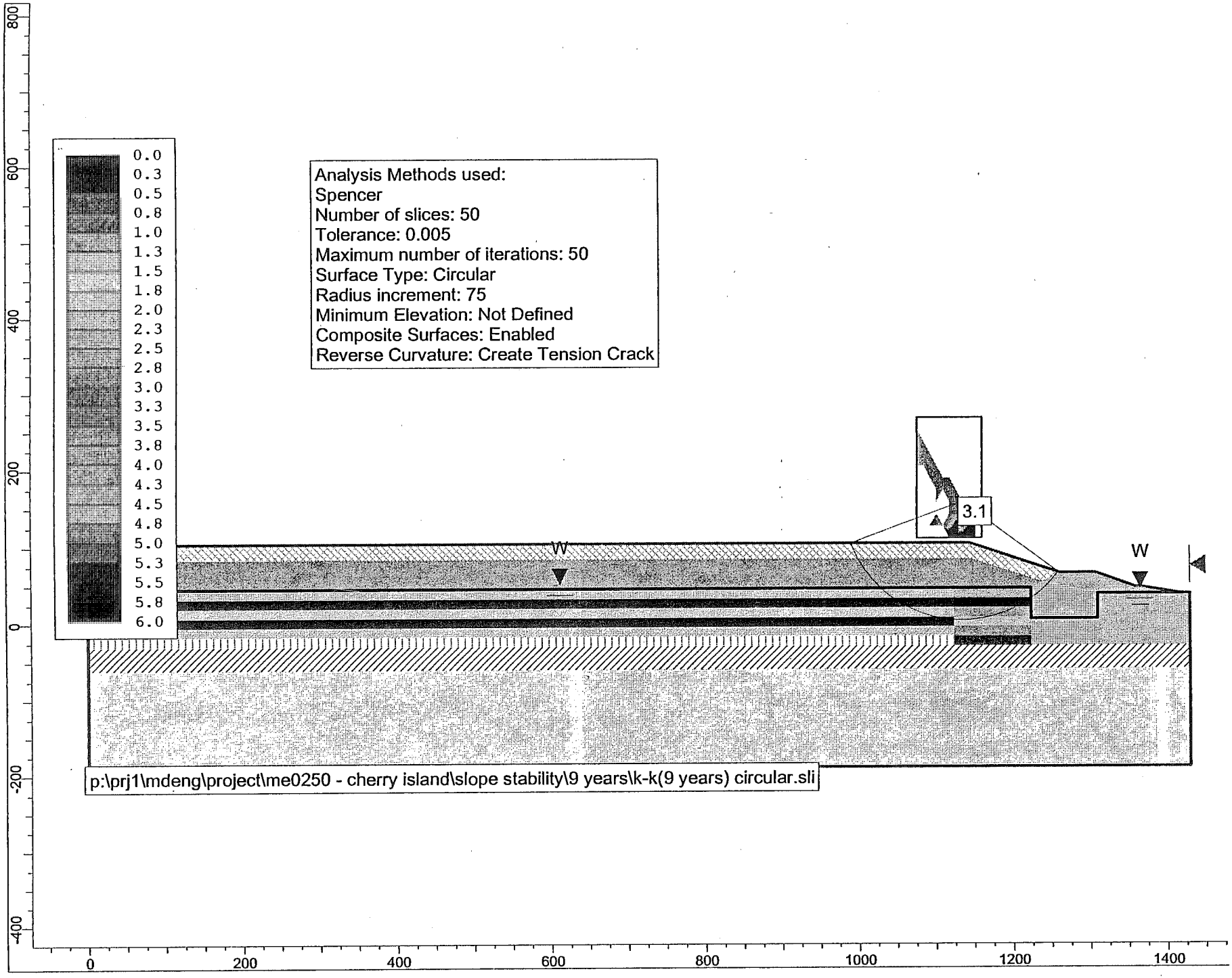
K9-1

Section K-K
9 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance K

K9-2



Section K-K
9 Year Stability
Circular Analysis

K9-3

Slide Analysis Information

Document Name

File Name: k-k(9 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 80
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1237 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 970 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 868 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 944 psf
Water Surface: None

K-K

Section K-K
9 Year Stability
Circular Analysis

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1214 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1783 psf
Water Surface: None

Material: d01
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1005 psf
Water Surface: None

Material: d02
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 864 psf
Water Surface: None

Material: d03
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 817 psf
Water Surface: None

Material: d04
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 896 psf
Water Surface: None

Material: d05
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1129 psf
Water Surface: None

Material: d06
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1567 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: spencer
SF: 3.13118
Center: 1135.08, 157.738
Radius: 154.493
Left Slip Surface Endpoint: 990.233, 104
Right Slip Surface Endpoint: 1259.15, 65.6827

Method Statistics

Method: spencer
Number of Valid Surfaces: 2658
Number of Invalid Surfaces: 7143
Error Codes:
Error Code -108 reported for 378 surfaces
Error Code -111 reported for 851 surfaces
Error Code -112 reported for 973 surfaces
Error Code -1000 reported for 4941 surfaces

Error Codes

The following errors were encountered during the computation:

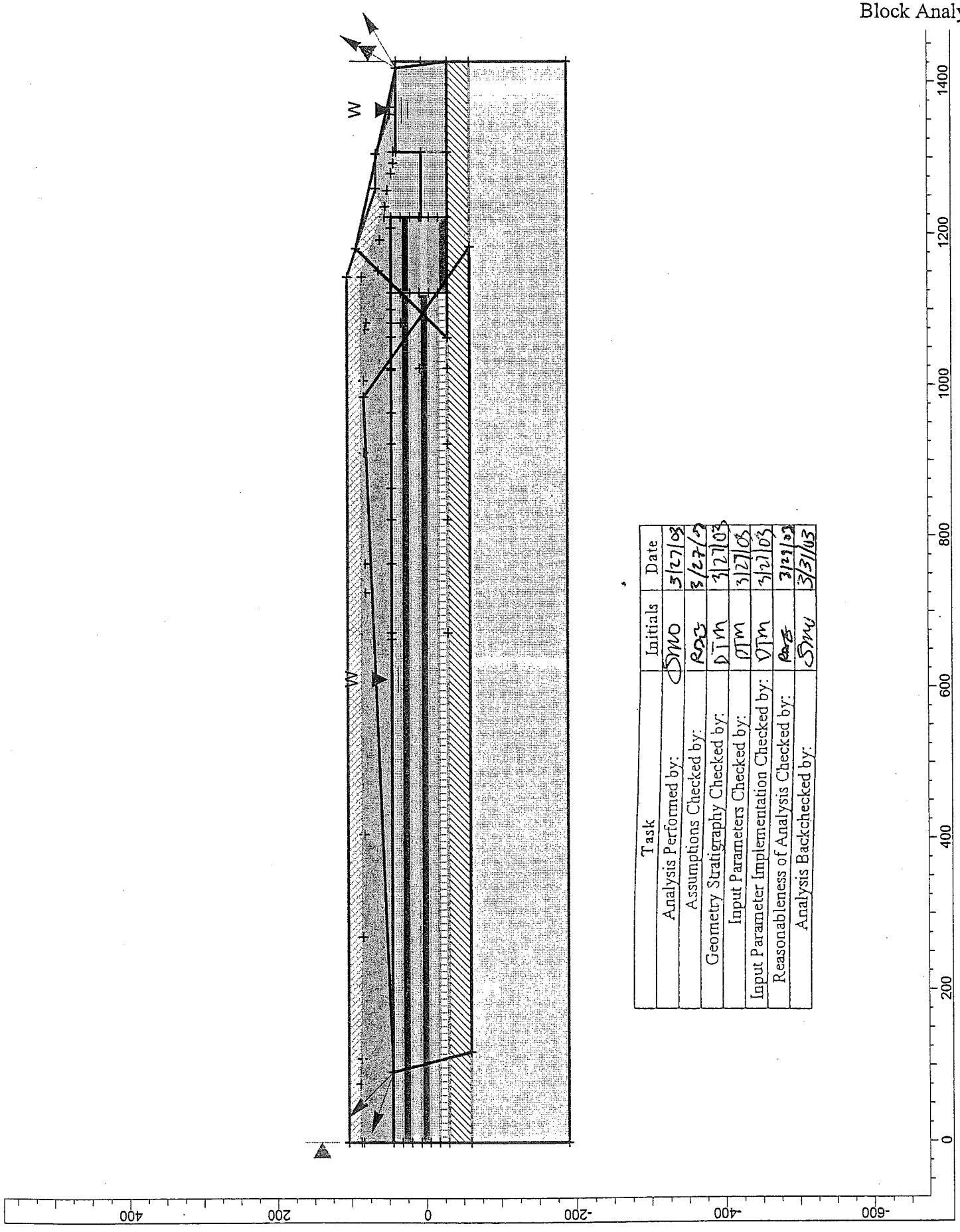
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

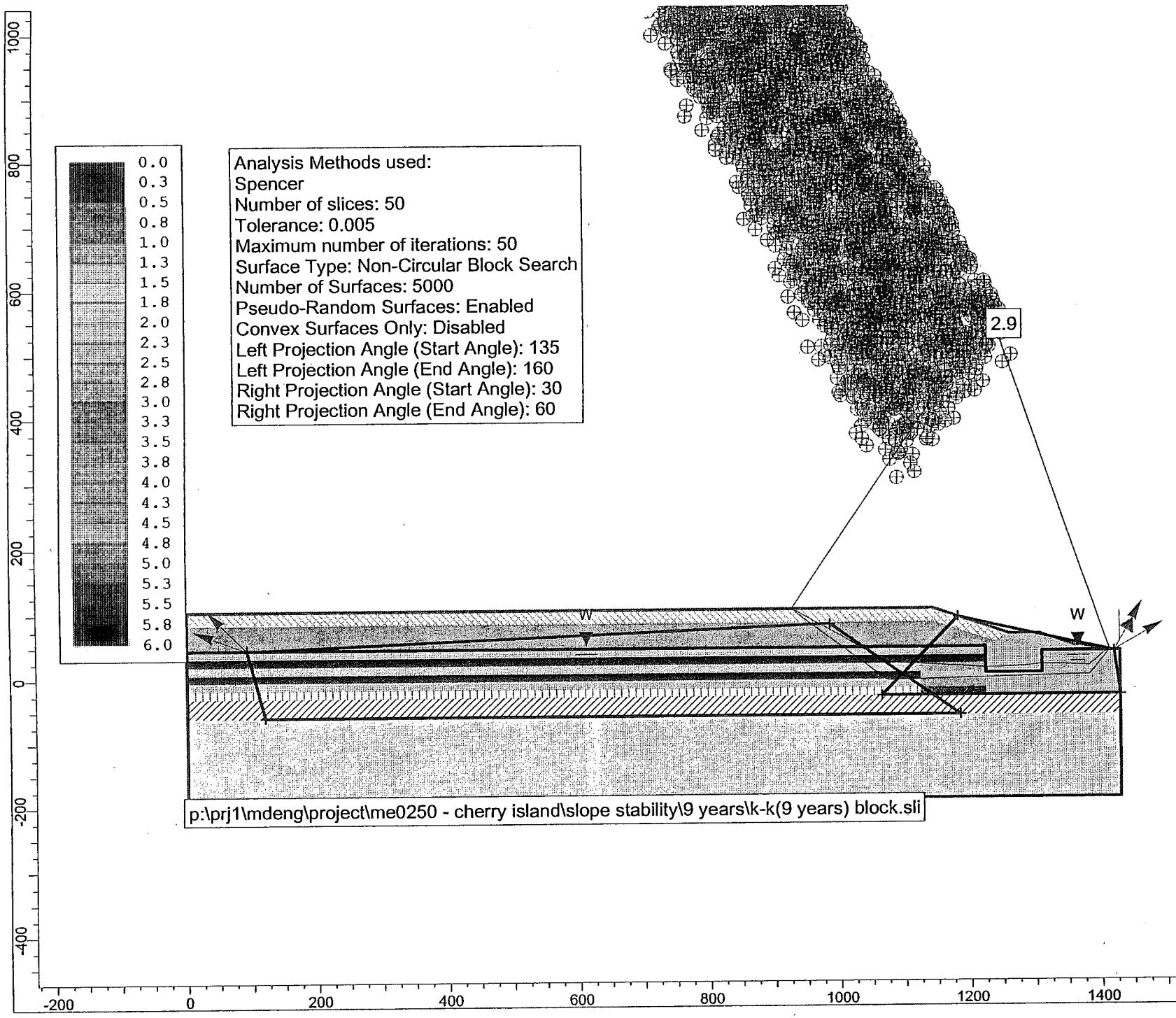
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section K-K
9 Year Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	RSS	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	RSS	3/27/03
Analysis Backchecked by:	SMO	3/31/03

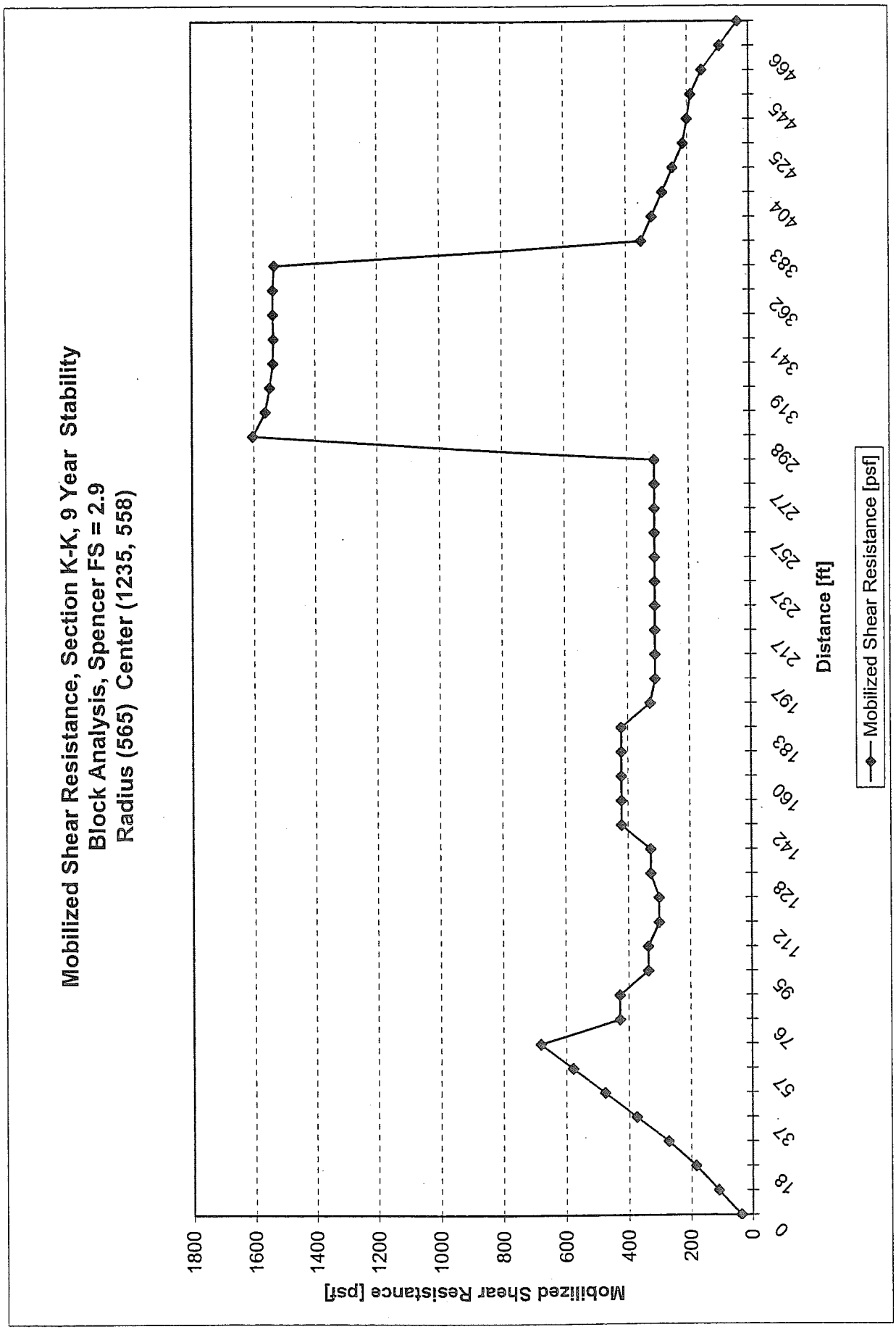
K9-10



Section K-K
9 Year Stability
Block Analysis

K9 - 7

Section K-K
9 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance K

K9-8

Slide Analysis Information

Document Name

File Name: k-k(9 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1237 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 970 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 868 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section K-K
9 Year Stability
Block Analysis

K9-9

Cohesion: 944 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1214 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1783 psf
Water Surface: None

Material: d01
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1005 psf
Water Surface: None

Material: d02
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 864 psf
Water Surface: None

Material: d03
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 817 psf
Water Surface: None

Material: d04
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 896 psf
Water Surface: None

Material: d05
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1129 psf
Water Surface: None

Material: d06
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1567 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: spencer
SF: 2.88807
Axis Location: 1235.04, 557.789
Left Slip Surface Endpoint: 926.971, 104
Right Slip Surface Endpoint: 1413.23, 39.0587

Method Statistics

Method: spencer
Number of Valid Surfaces: 2988
Number of Invalid Surfaces: 2012
Error Codes:
Error Code -107 reported for 440 surfaces
Error Code -108 reported for 1301 surfaces
Error Code -110 reported for 23 surfaces

Error Code -111 reported for 244 surfaces
Error Code -112 reported for 4 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.

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

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

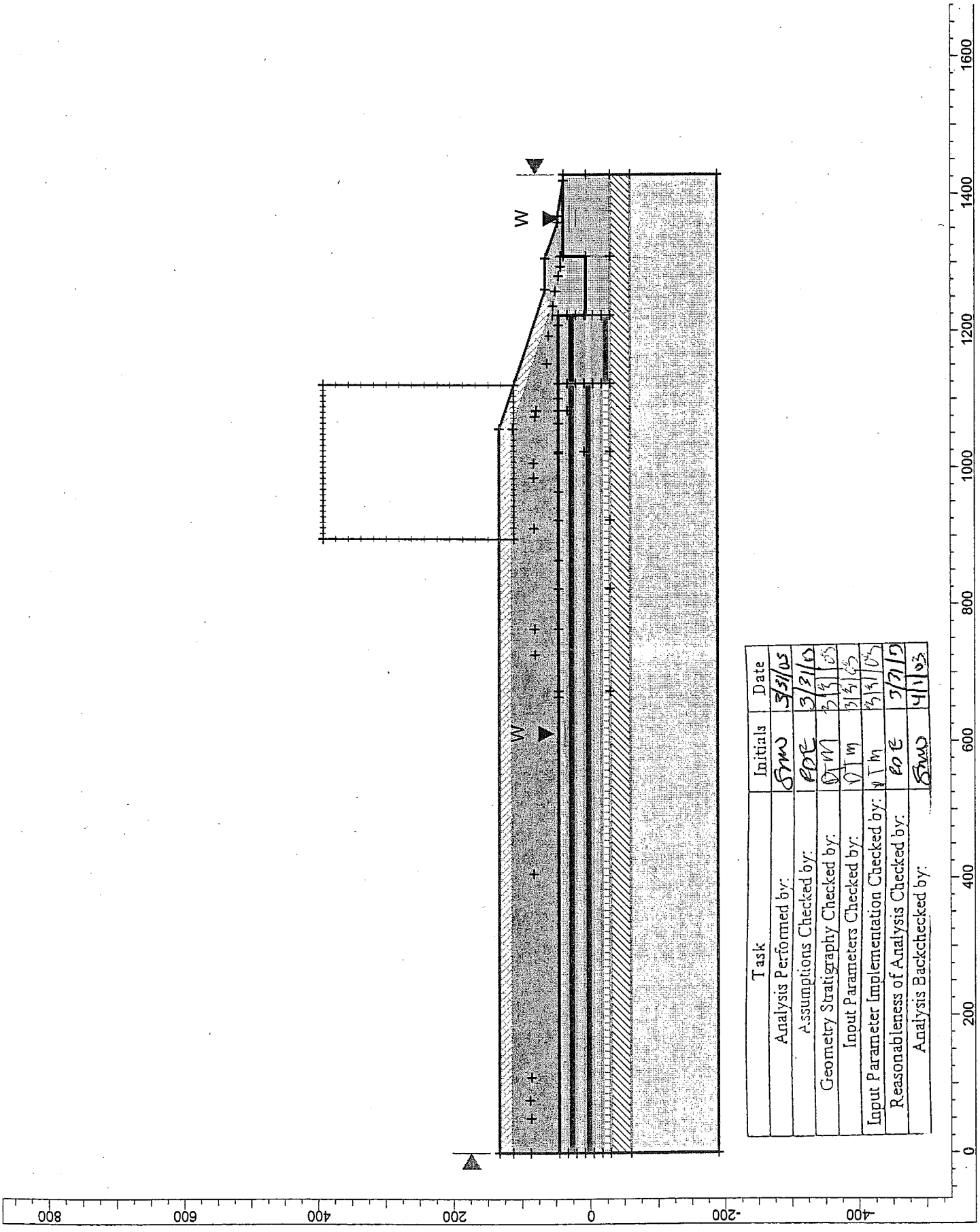
-111 = safety factor equation did not converge

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

Section K-K
9 Year Stability
Block Analysis

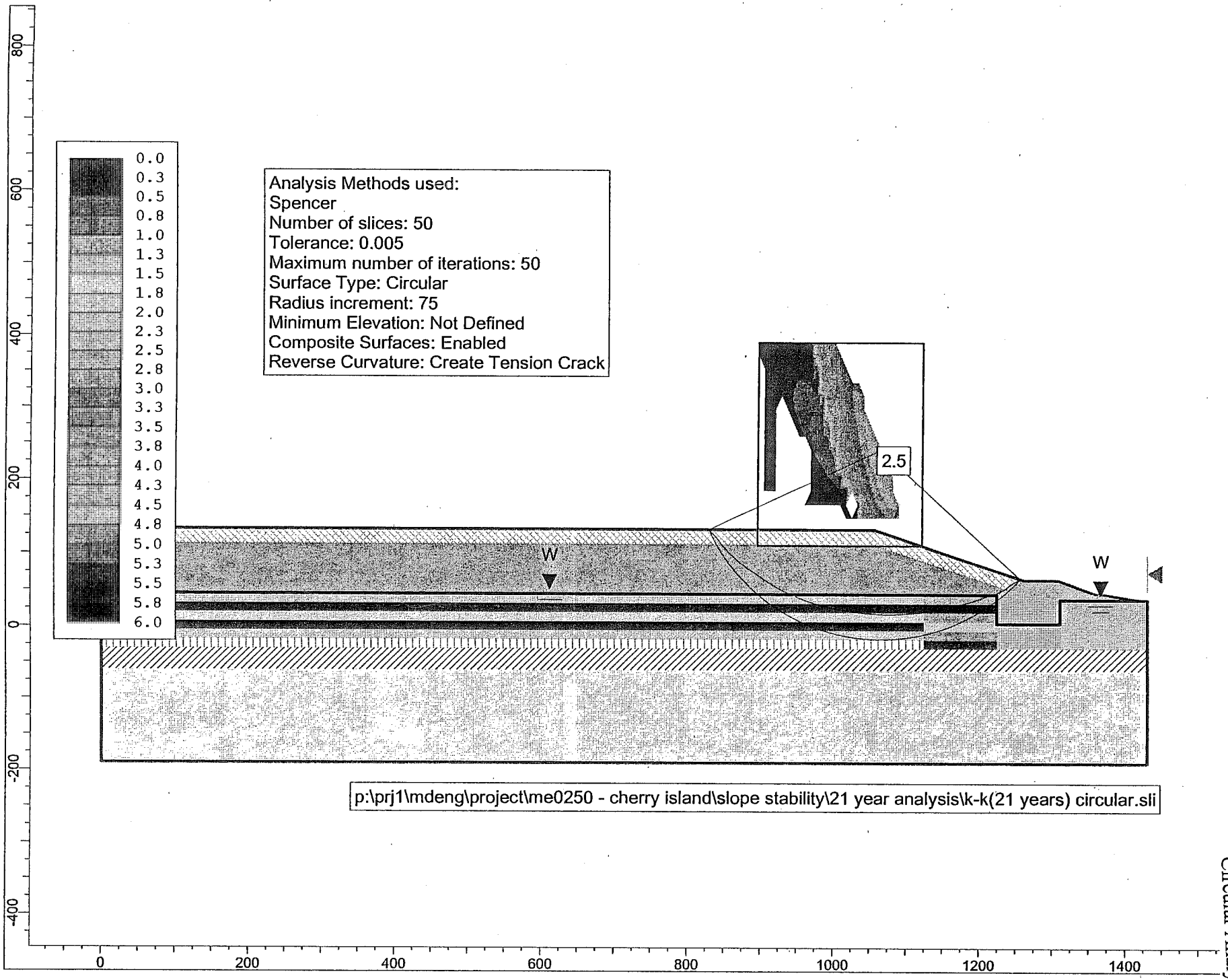
VQ-10

Section K-K
21 Year Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	BMD	3/31/05
Assumptions Checked by:	RDE	3/31/05
Geometry Stratigraphy Checked by:	BMD	3/31/05
Input Parameters Checked by:	DTM	3/31/05
Input Parameter Implementation Checked by:	JTH	3/31/05
Reasonableness of Analysis Checked by:	RDE	3/31/05
Analysis Backchecked by:	BMD	4/1/05

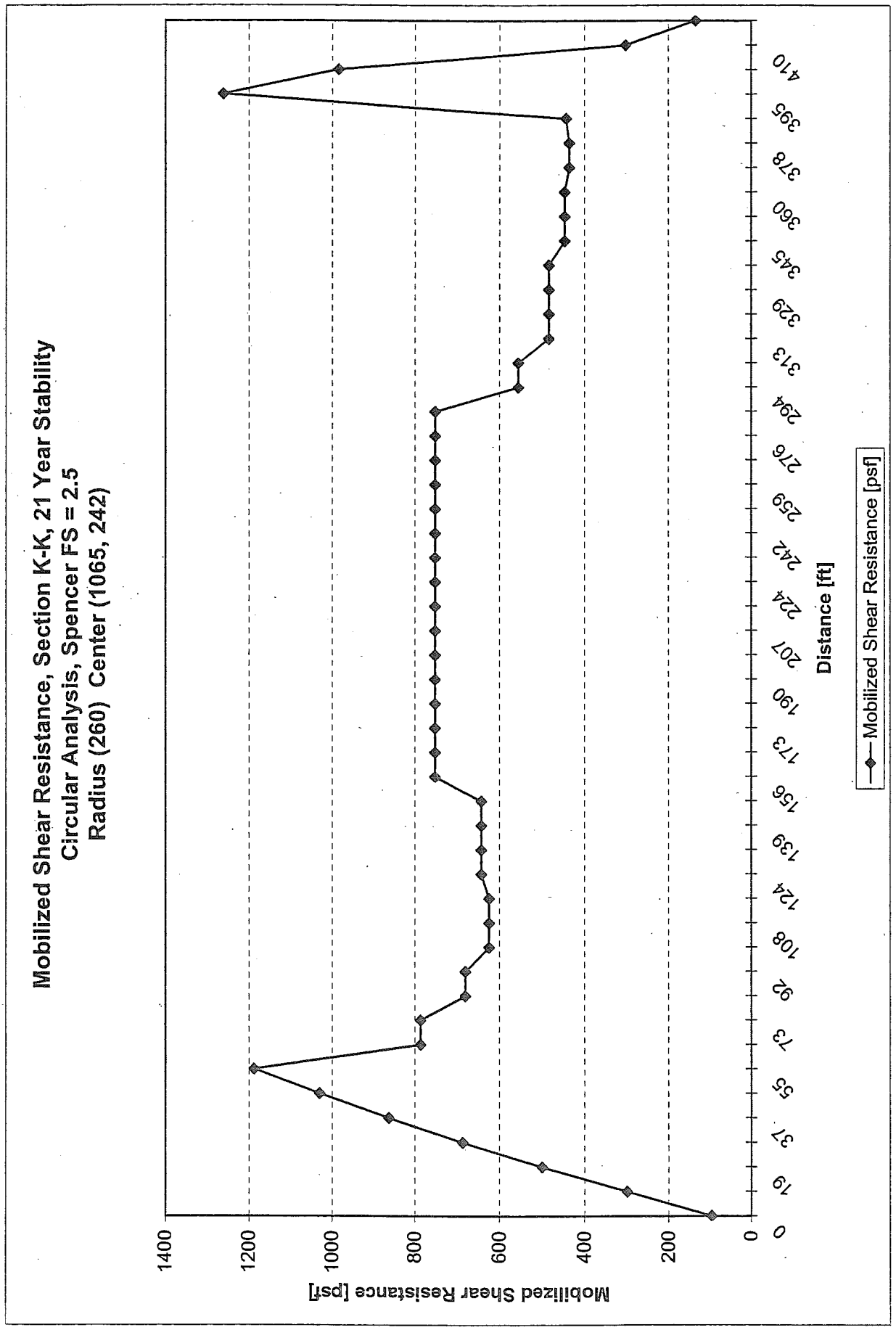
K21-1



Section K-K
21 Year Stability
Circular Analysis

K21-2

Section K-K
21 Year Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance K

K21-3

Slide Analysis Information

Document Name

File Name: k-k(21 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1944 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1683 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1545 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1590 psf
Water Surface: None

IC21-4

Section K-K
21 Year Stability
Circular Analysis

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1860 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2451 psf
Water Surface: None

Material: d01
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1097 psf
Water Surface: None

Material: d02
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1079 psf
Water Surface: None

Material: d03
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1105 psf
Water Surface: None

Material: d04
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1195 psf
Water Surface: None

Material: d05
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1375 psf
Water Surface: None

Material: d06
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1679 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: spencer
SF: 2.47314
Center: 1065.02, 242.259
Radius: 259.549
Left Slip Surface Endpoint: 829.59, 133
Right Slip Surface Endpoint: 1256.17, 66.6764

Method Statistics

Method: spencer
Number of Valid Surfaces: 16745
Number of Invalid Surfaces: 18519
Error Codes:
Error Code -108 reported for 719 surfaces
Error Code -111 reported for 2426 surfaces
Error Code -112 reported for 5489 surfaces
Error Code -115 reported for 5 surfaces
Error Code -1000 reported for 9880 surfaces

Error Codes

The following errors were encountered during the computation:

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

-111 = safety factor equation did not converge

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

-115 = Surface too shallow, below the minimum depth.

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

Slide Analysis Information

Document Name

File Name: k-k(37 years) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2096 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2061 psf

Section K-K
37 Year Stability
Circular Analysis

K 27-5

Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2071 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2154 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2335 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2663 psf
Water Surface: None

Material: d01
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1155 psf
Water Surface: None

Material: d02
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1218 psf
Water Surface: None

Material: d03
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1299 psf
Water Surface: None

Material: d04
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1408 psf
Water Surface: None

Material: d05
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1557 psf
Water Surface: None

Material: d06
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1762 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3440 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3094 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2858 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2857 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3162 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3886 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3820 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3164 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2729 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2692 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3121 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4190 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4452 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3424 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2835 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2795 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3329 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4774 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)

Section K-K
37 Year Stability
Circular Analysis

K237-G

Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: spencer
SF: 1.38507
Center: 1018.9, 368.744
Radius: 382.301
Left Slip Surface Endpoint: 654.195, 254.094
Right Slip Surface Endpoint: 1254.11, 67.3624

Method Statistics

Method: spencer
Number of Valid Surfaces: 28459
Number of Invalid Surfaces: 6805
Error Codes:
Error Code -108 reported for 262 surfaces
Error Code -111 reported for 238 surfaces
Error Code -112 reported for 6296 surfaces
Error Code -113 reported for 9 surfaces

Error Codes

The following errors were encountered during the computation:

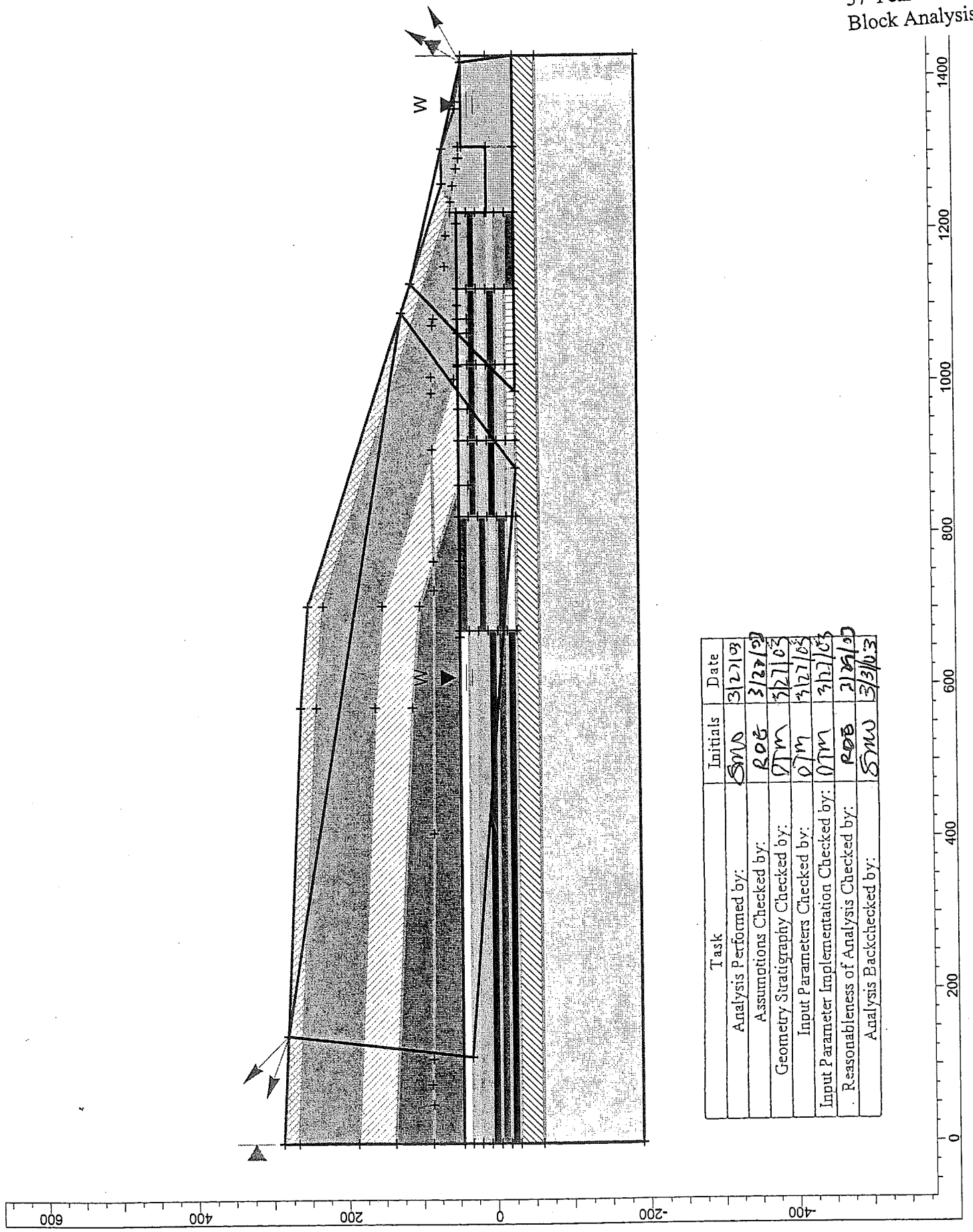
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

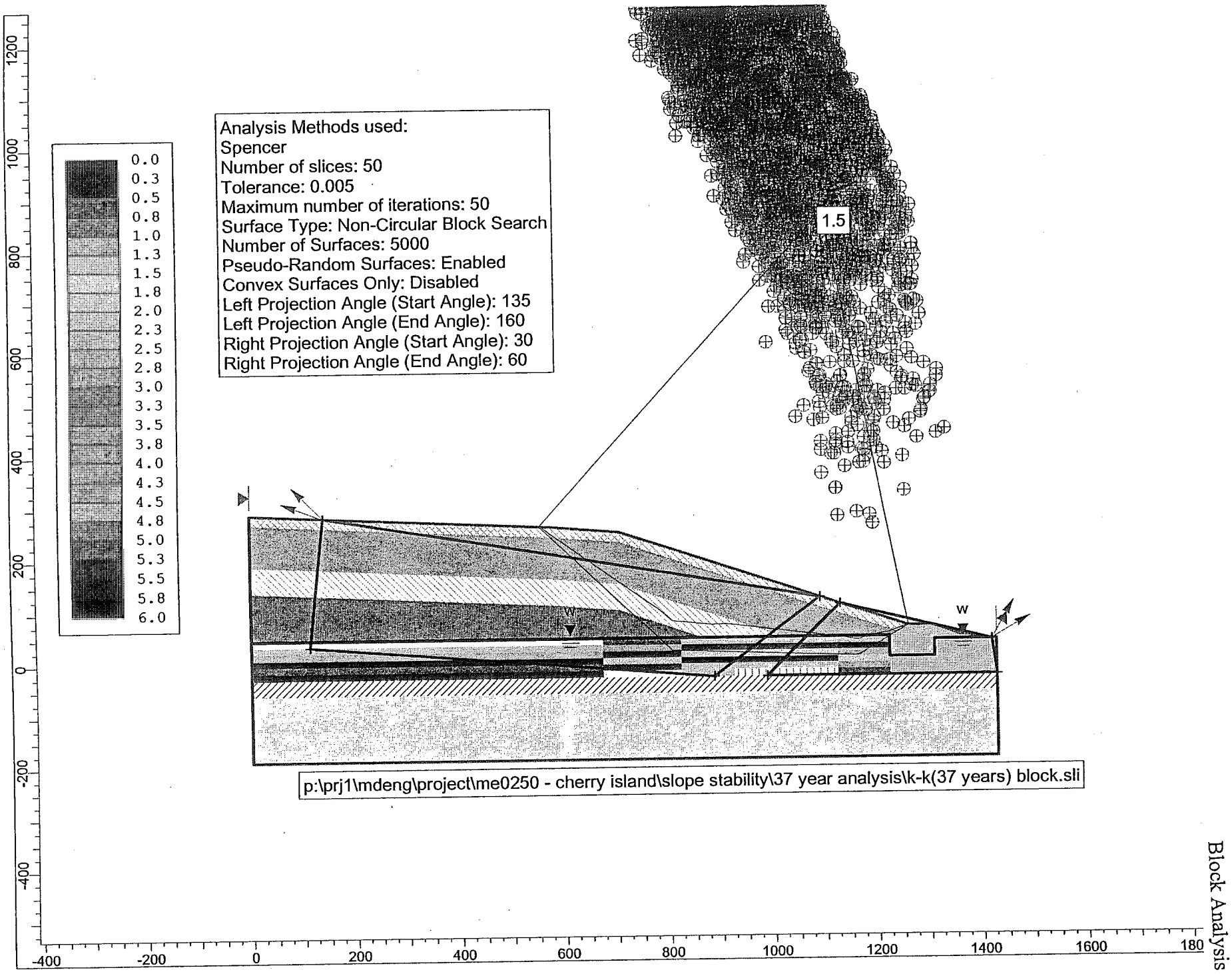
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

-113 = Surface intersects outside slope limits.

Section K-K
37 Year Stability
Block Analysis



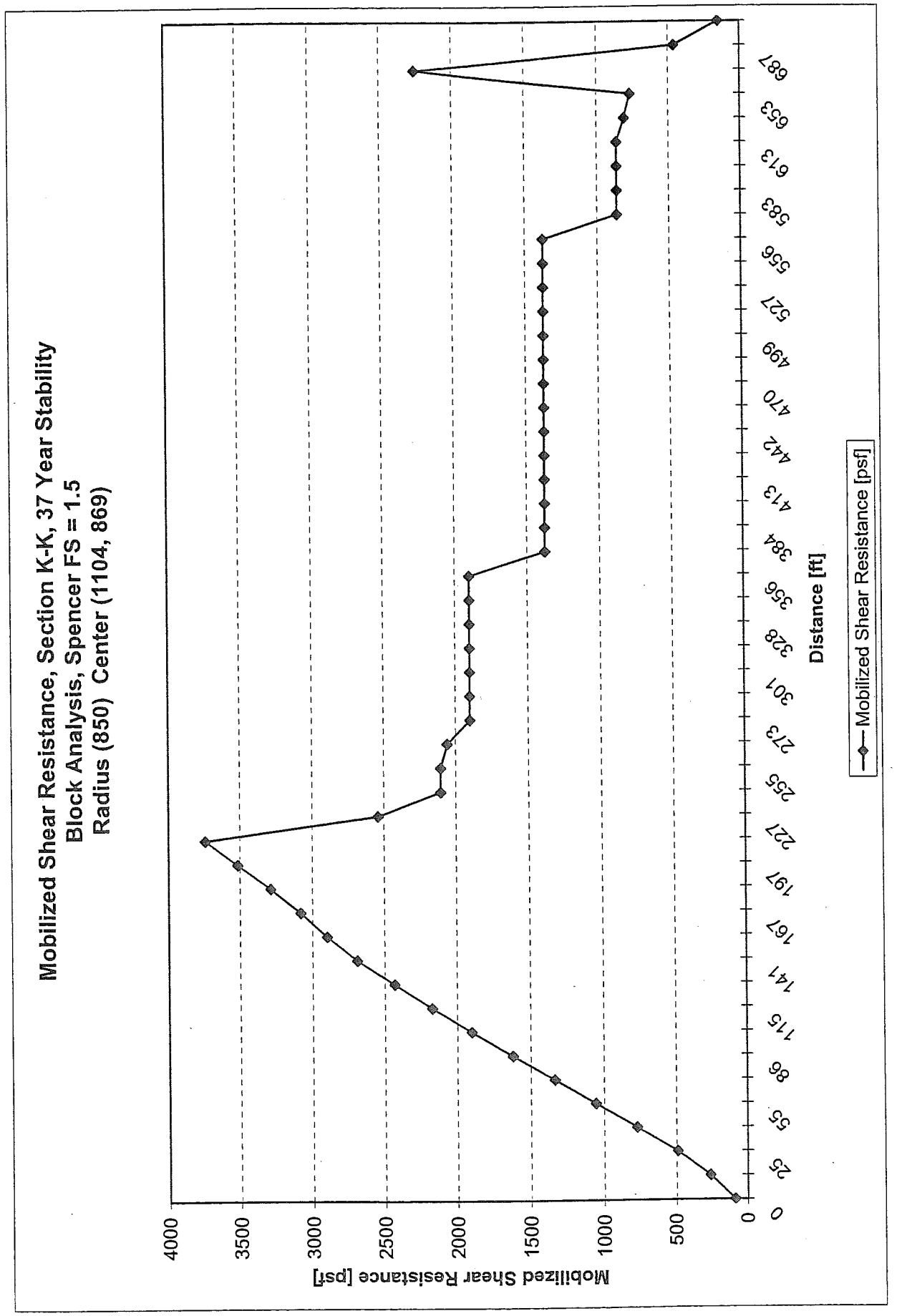
Task	Initials	Date
Analysis Performed by:	SMS	3/27/13
Assumptions Checked by:	ROE	3/27/13
Geometry Stratigraphy Checked by:	DTM	3/27/13
Input Parameters Checked by:	DTM	3/27/13
Input Parameter Implementation Checked by:	DTM	3/27/13
Reasonableness of Analysis Checked by:	ROE	3/28/13
Analysis Backchecked by:	SMW	3/3/13



Section K-K
37 Year Stability
Block Analysis

K37-8

Section K-K
37 Year Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance K

K37-9

Slide Analysis Information

Document Name

File Name: k-k(37 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2096 psf
Water Surface: None

Material: d12
Strength Type: Undrained

Section K-K
37 Year Stability
Block Analysis

k 37-10

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2061 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2071 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2154 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2335 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2663 psf
Water Surface: None

Material: d01
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1155 psf
Water Surface: None

Material: d02
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1218 psf
Water Surface: None

Material: d03
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1299 psf
Water Surface: None

Material: d04
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1408 psf
Water Surface: None

Material: d05
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1557 psf
Water Surface: None

Material: d06
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1762 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3440 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3094 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2858 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Cohesion: 2857 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3162 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3886 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3820 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3164 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2729 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2692 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3121 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4190 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4452 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3424 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2835 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2795 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3329 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4774 psf
Water Surface: None

Section K-K
37 Year Stability
Block Analysis

1C37-11

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: spencer
SF: 1.50403
Axis Location: 1104.07, 869.094
Left Slip Surface Endpoint: 554.914, 261.413
Right Slip Surface Endpoint: 1260.72, 65.1593

Method Statistics

Method: spencer
Number of Valid Surfaces: 4627
Number of Invalid Surfaces: 373
Error Codes:
Error Code -108 reported for 337 surfaces
Error Code -110 reported for 15 surfaces
Error Code -111 reported for 13 surfaces
Error Code -112 reported for 8 surfaces

Error Codes

The following errors were encountered during the computation:

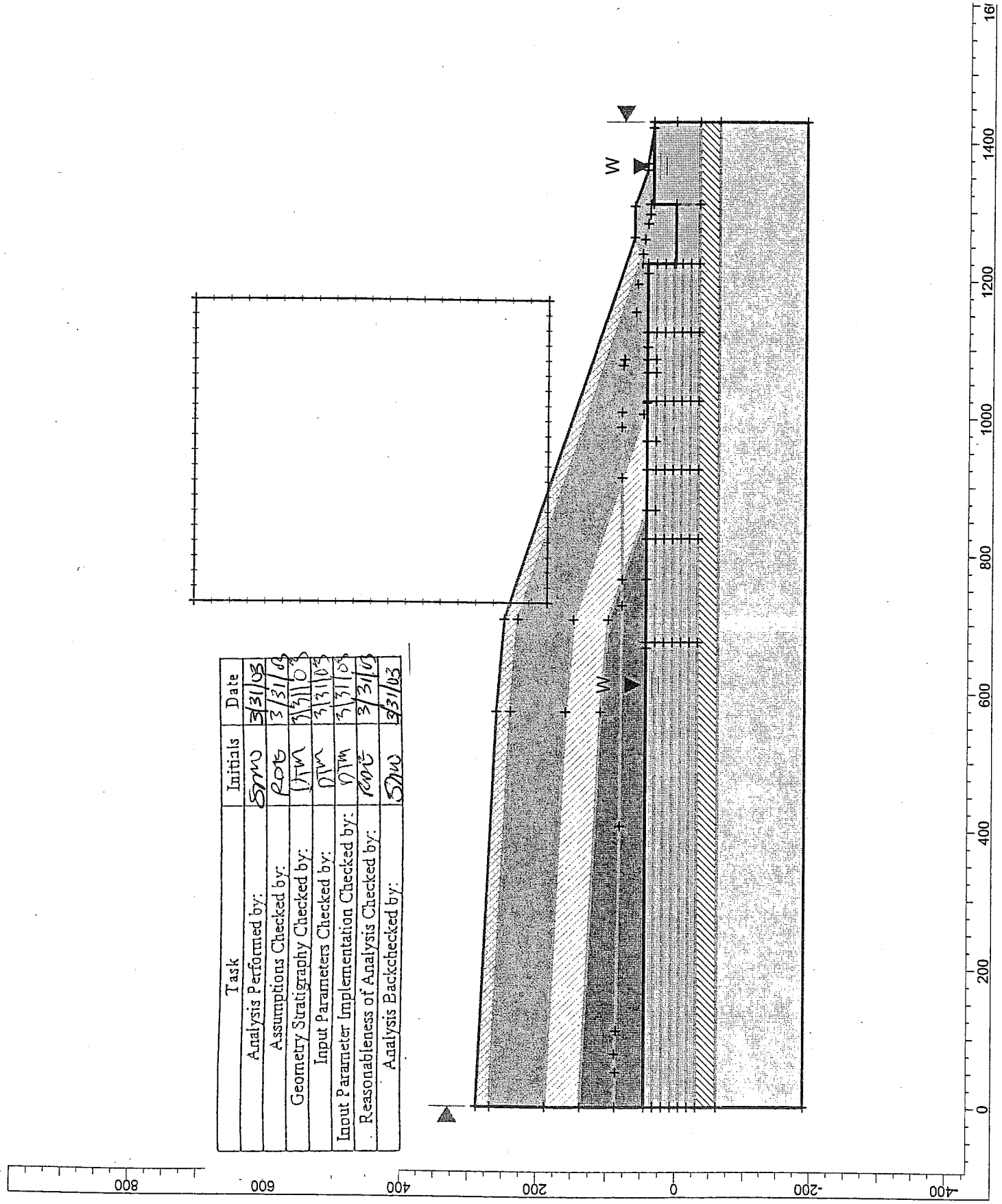
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

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

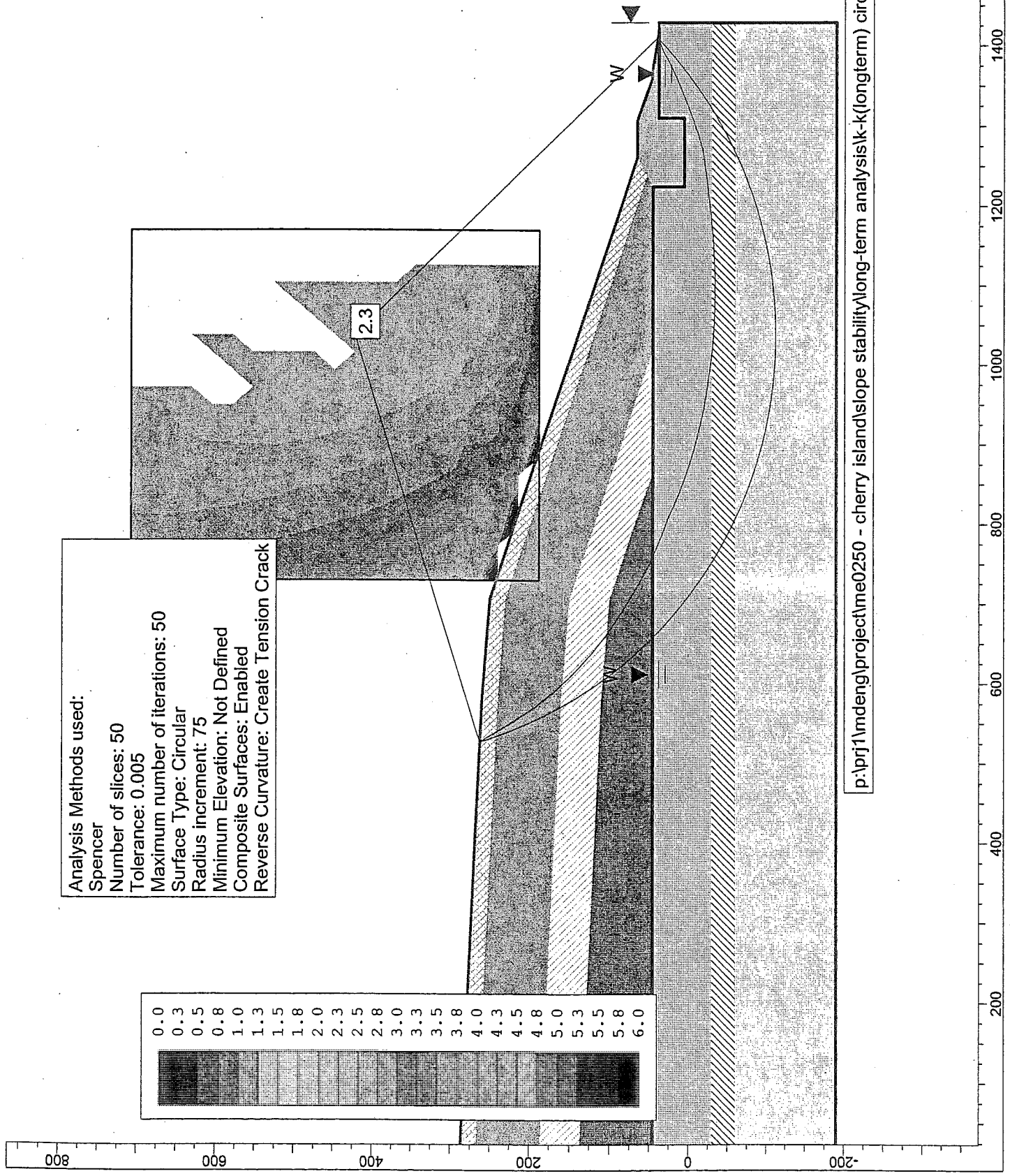
Section K-K
Long-Term Stability
Circular Analysis



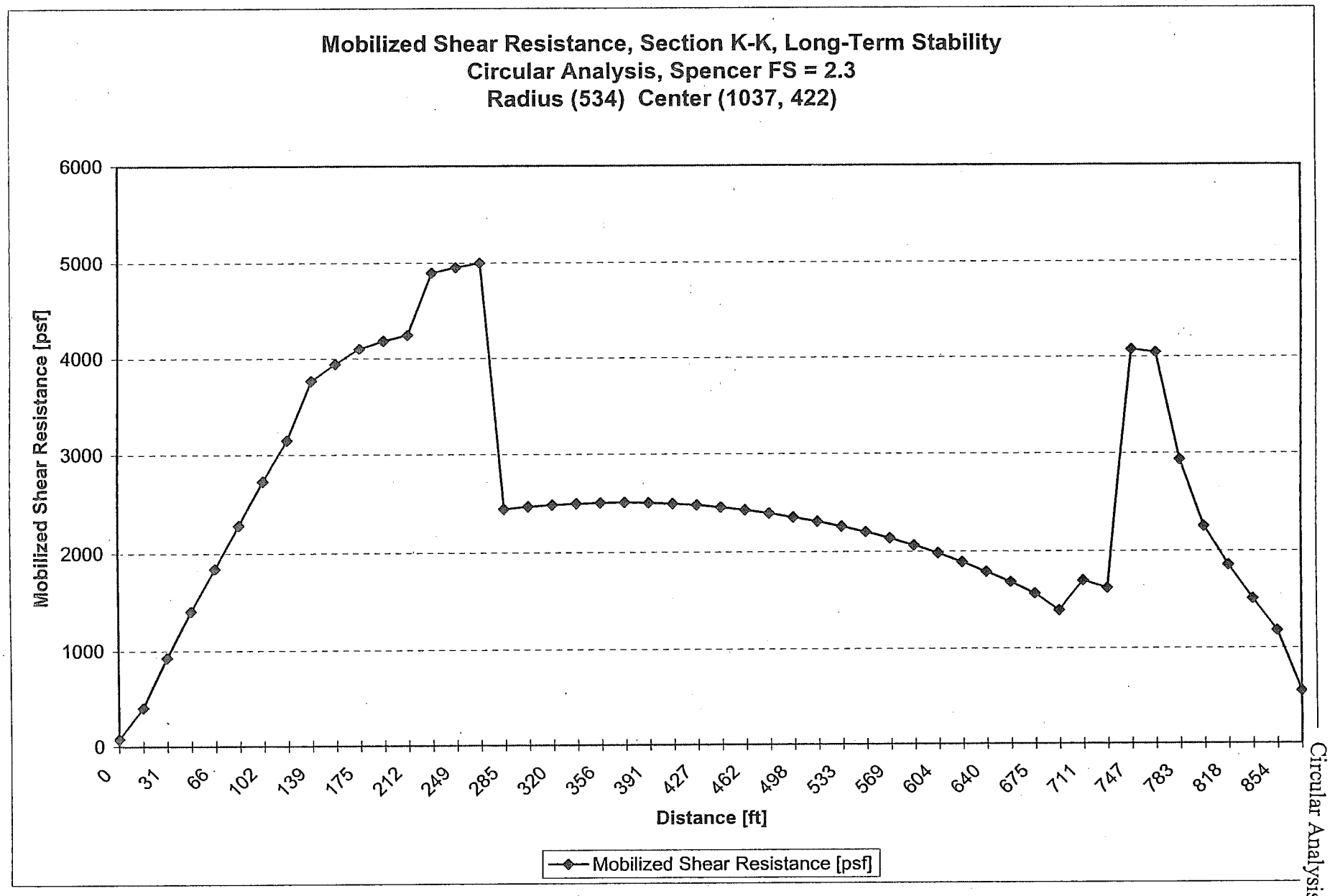
Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RDE	3/31/03
Geometry Stratigraphy Checked by:	JTW	3/31/03
Input Parameters Checked by:	DTM	3/31/03
Input Parameter Implementation Checked by:	DTM	3/31/03
Reasonableness of Analysis Checked by:	RDE	3/31/03
Analysis Backchecked by:	SMW	3/31/03

KLT-1

Section K-K
Long-Term Stability
Circular Analysis



KLT-2



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance K

KLT-3

Slide Analysis Information

Document Name

File Name: k-k(longterm) circular

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees

Section K-K
Long-Term Stability
Circular Analysis

K L 7-4

Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: spencer
SF: 2.27149
Center: 1036.92, 421.888
Radius: 534.4
Left Slip Surface Endpoint: 526.77, 262.736
Right Slip Surface Endpoint: 1410.27, 39.5356

Method Statistics

Method: spencer
Number of Valid Surfaces: 23350
Number of Invalid Surfaces: 10166
Error Codes:
Error Code -108 reported for 405 surfaces
Error Code -111 reported for 226 surfaces
Error Code -112 reported for 2011 surfaces
Error Code -1000 reported for 7524 surfaces

Error Codes

The following errors were encountered during the computation:

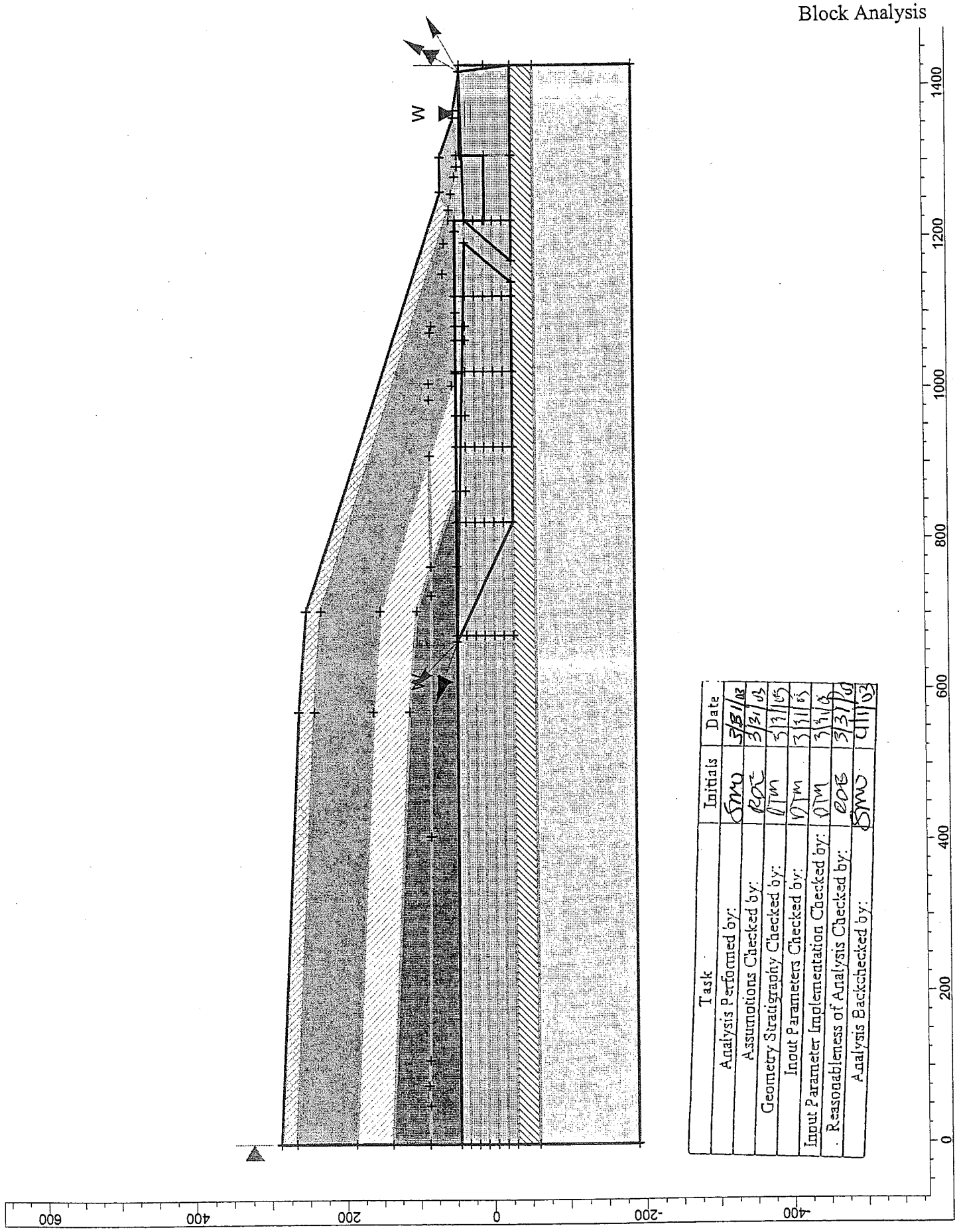
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

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

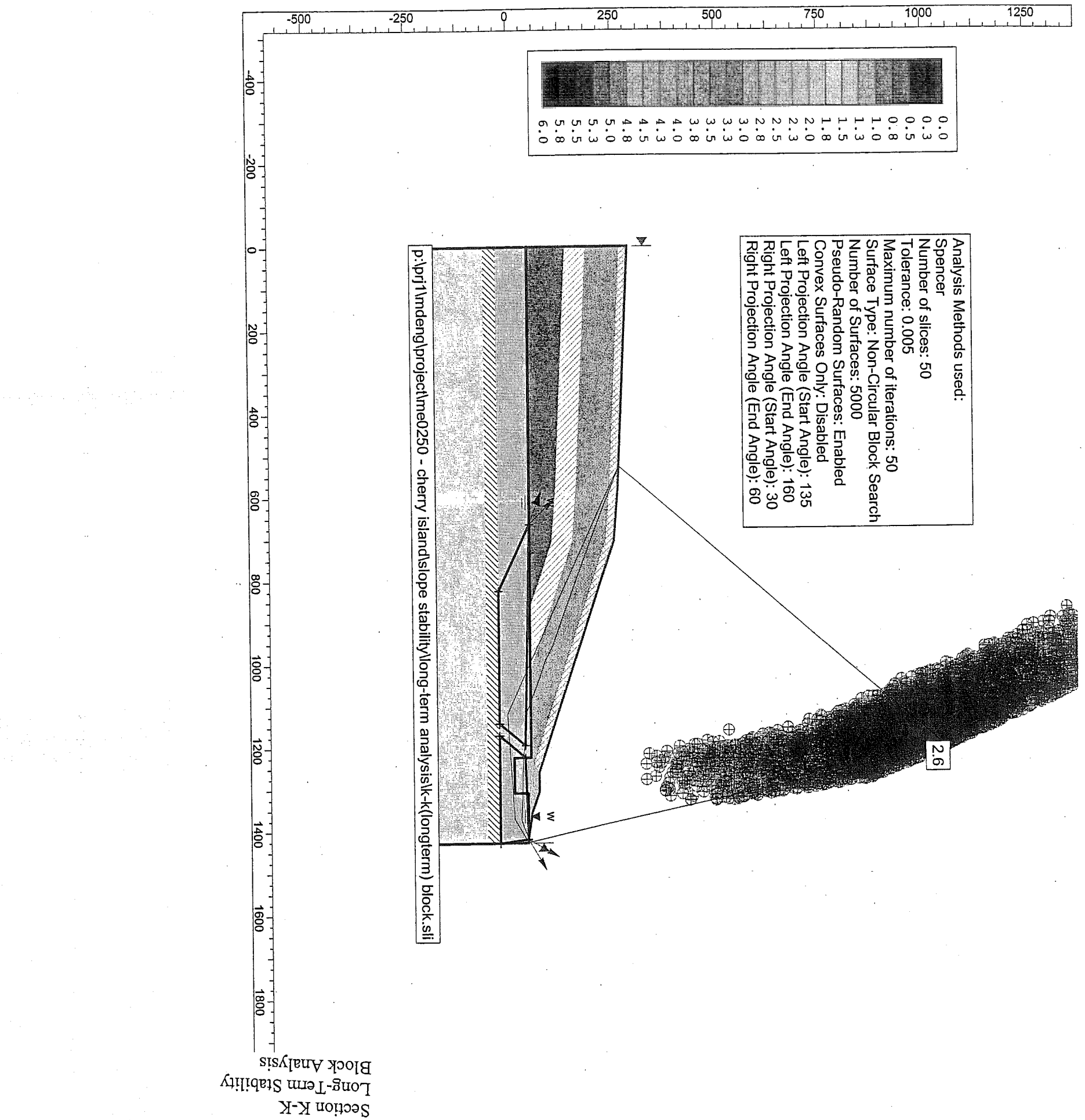
Section K-K
Long-Term Stability
Block Analysis



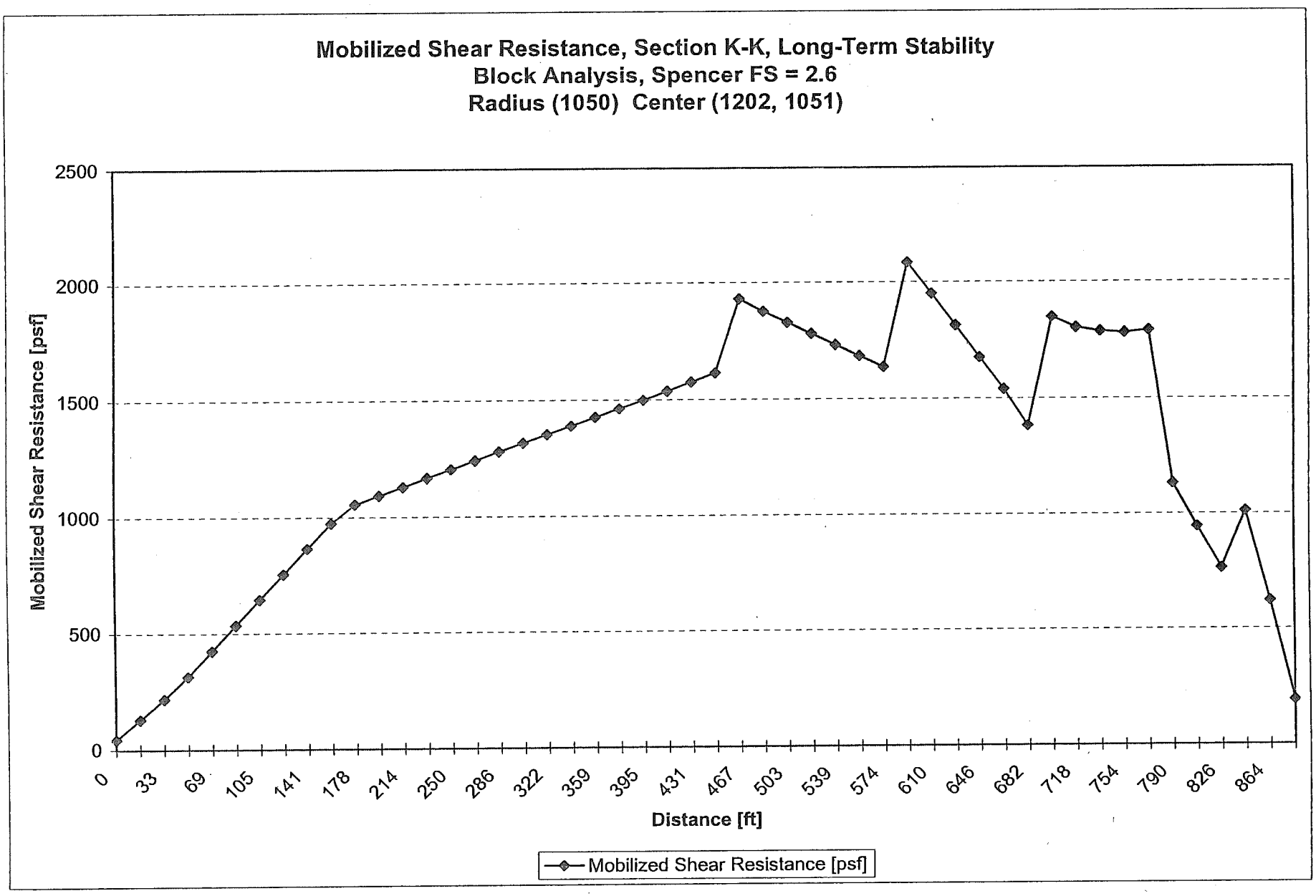
Task	Initials	Date
Analysis Performed by:	SMO	3/31/05
Assumptions Checked by:	EOE	3/31/05
Geometry Stratigraphy Checked by:	DTM	3/31/05
Input Parameters Checked by:	DTM	3/31/05
Input Parameter Implementation Checked by:	DTM	3/31/05
Reasonableness of Analysis Checked by:	EOE	3/31/05
Analysis Backchecked by:	SMO	4/1/05

KLT-5

LLT-6



Section K-K
Long-Term Stability
Block Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Resistance K

Section K-K
Long-Term Stability
Block Analysis

KLT-7

Slide Analysis Information

Document Name

File Name: k-k(longterm) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb

Section K-K
Long-Term Stability
Block Analysis

K-LT-K

Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: spencer
SF: 2.64707
Axis Location: 1201.88, 1051.05
Left Slip Surface Endpoint: 526.81, 262.734
Right Slip Surface Endpoint: 1427.49, 38

Method Statistics

Method: spencer
Number of Valid Surfaces: 3386
Number of Invalid Surfaces: 1614
Error Codes:
Error Code -108 reported for 1552 surfaces
Error Code -110 reported for 41 surfaces
Error Code -111 reported for 14 surfaces
Error Code -112 reported for 7 surfaces

Error Codes

The following errors were encountered during the computation:

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

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

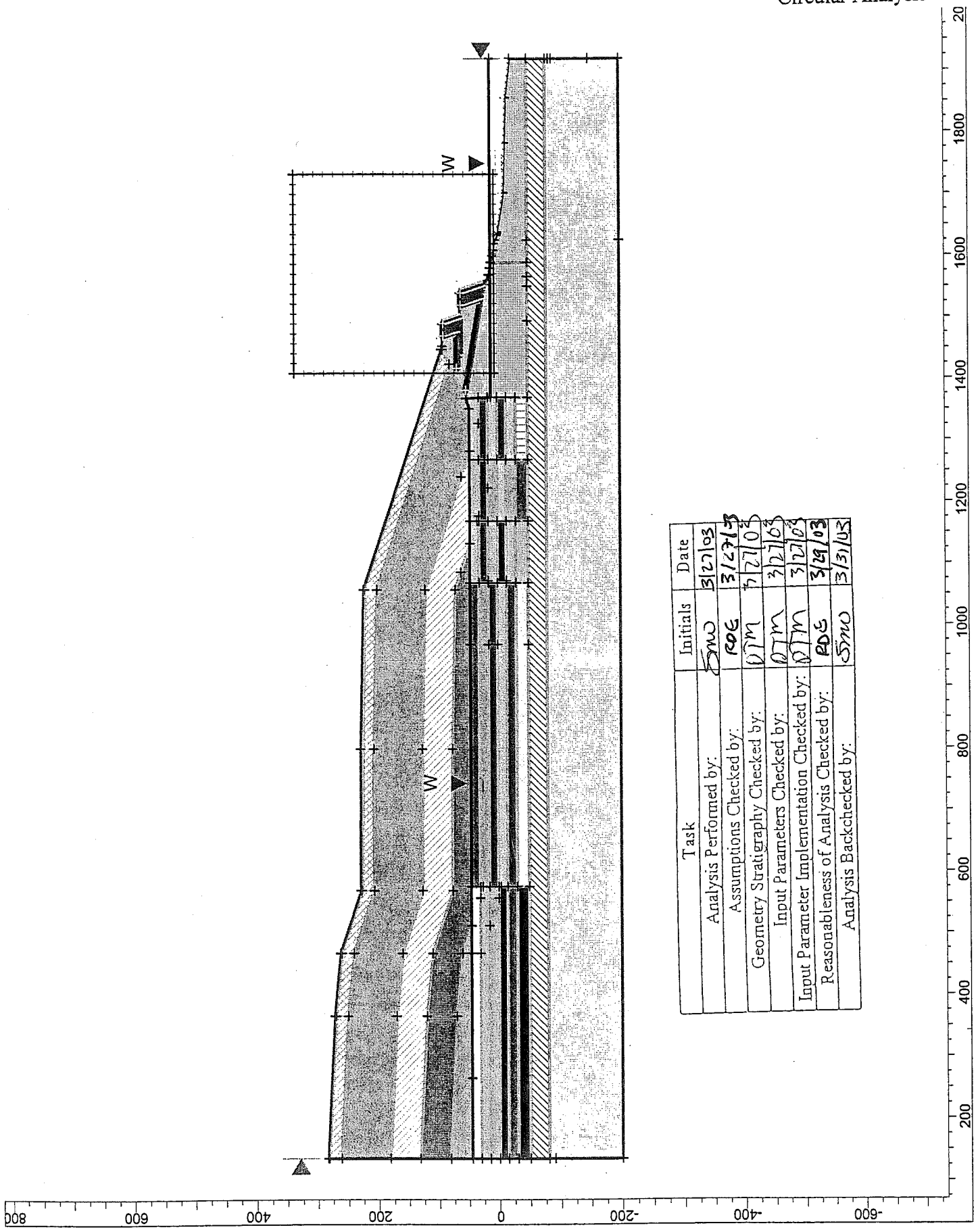
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

Attachment K

Stability Analysis Results
for 100-Year Flood Conditions

Section E

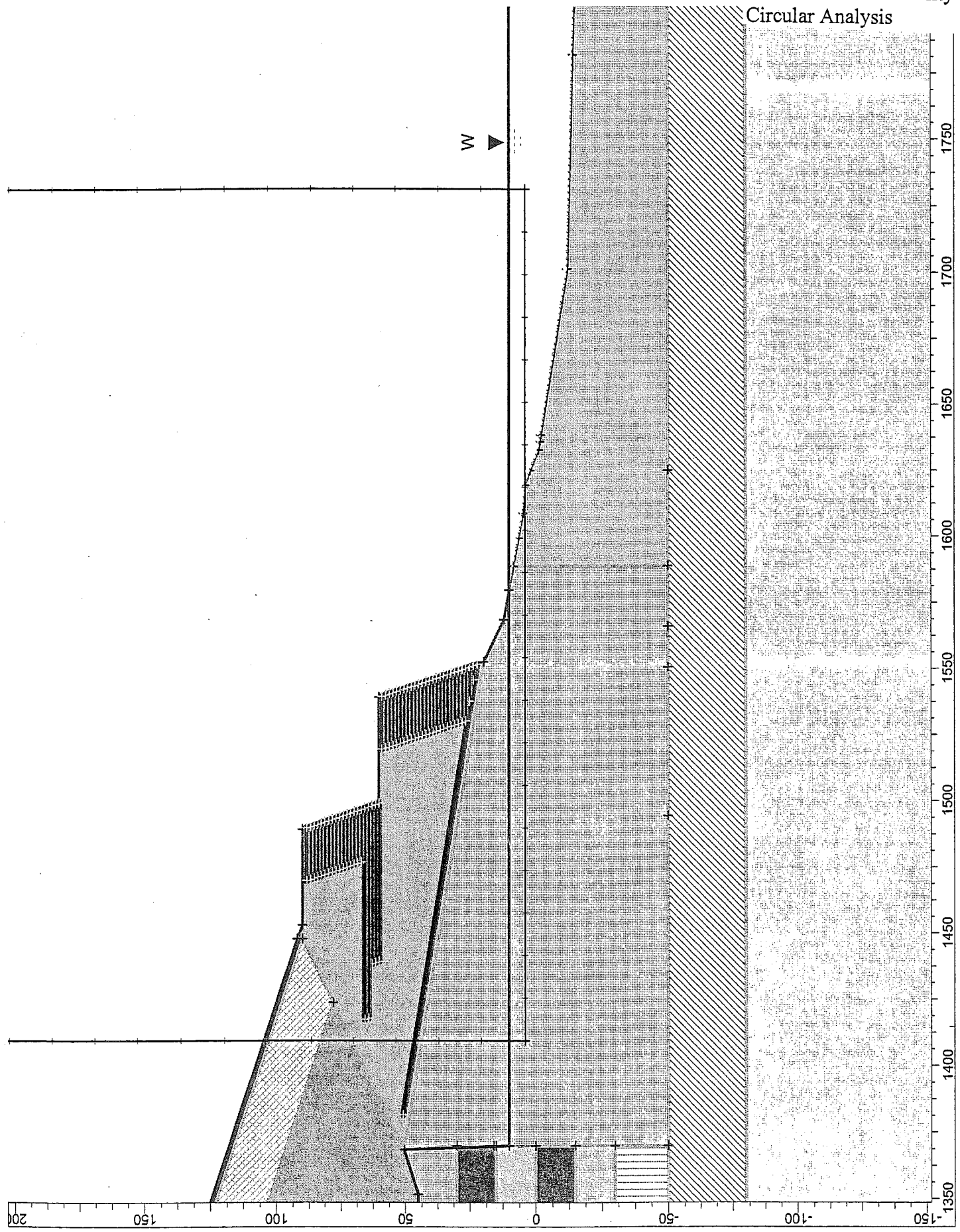
Section E-E
100 Year Flood Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	BMO	3/27/03
Assumptions Checked by:	ROE	3/27/03
Geometry Stratigraphy Checked by:	DJM	3/27/03
Input Parameters Checked by:	DJM	3/27/03
Input Parameter Implementation Checked by:	DJM	3/27/03
Reasonableness of Analysis Checked by:	RDE	3/29/03
Analysis Backchecked by:	BMO	3/31/03

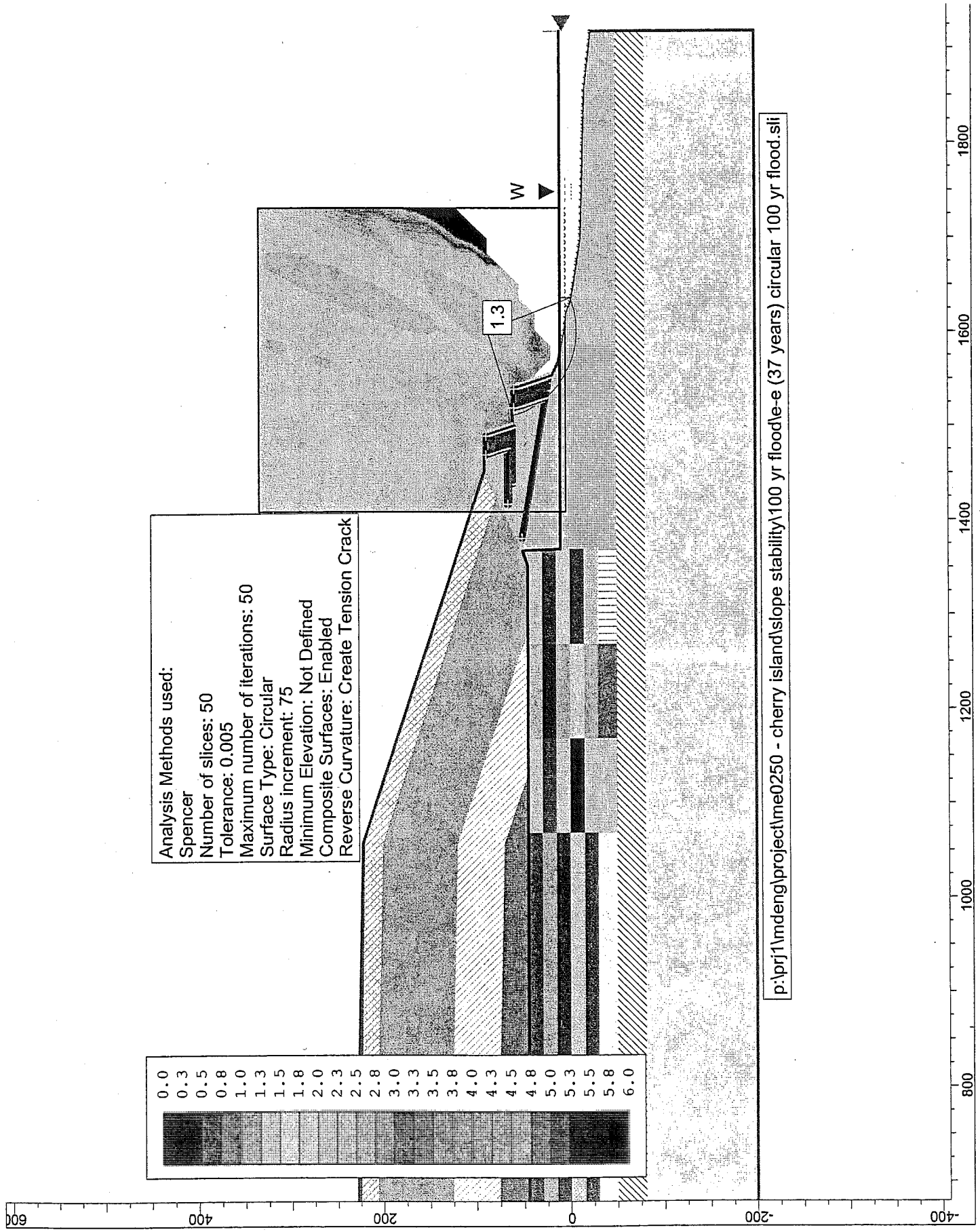
E1004

Section E-E
100 Year Flood Stability
Circular Analysis

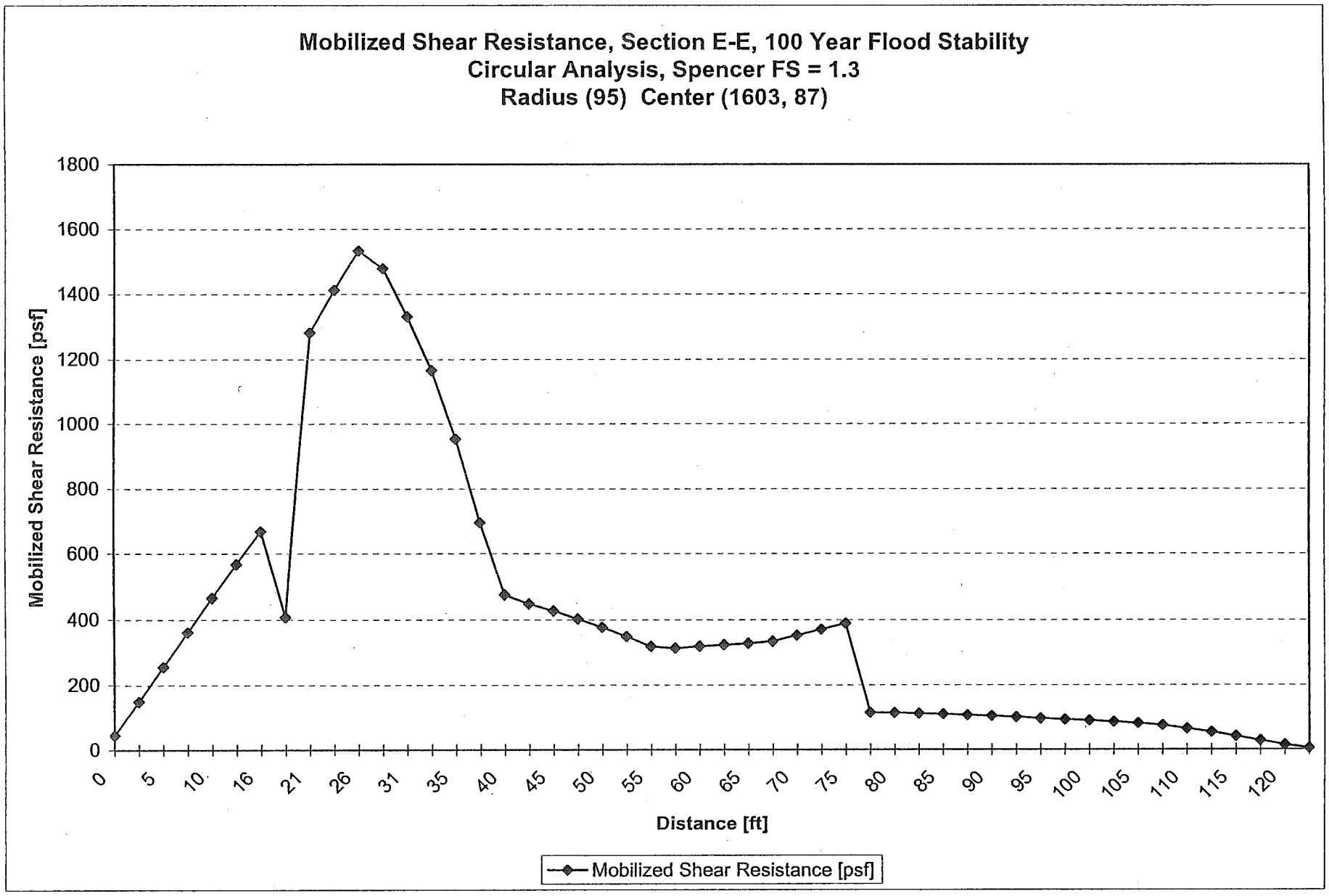


E100-2

Section E-E
100 Year Flood Stability
Circular Analysis



E100-3



E100-4

PRJ1/ME0250/SlopeStability/e 100 yr flood

Section E-E
100 Year Flood Stability
Circular Analysis

Slide Analysis Information

Document Name

File Name: e-e (37 years) circular 100 yr flood

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function

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Section E-E
100 Year Flood Stabil
Circular Analysis

Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1982 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1772 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1647 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1609 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2419 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2605 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2226 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1984 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1881 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1951 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2910 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3237 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2580 psf

Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2134 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1944 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2022 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3586 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2615 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2056 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1933 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2235 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3807 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4192 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2833 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2144 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2031 psf
Water Surface: None

Section E-E
100 Year Flood Stability
Circular Analysis

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Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2480 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4428 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.3367
Center: 1602.51, 86.639
Radius: 94.6853
Left Slip Surface Endpoint: 1511.65, 60
Right Slip Surface Endpoint: 1636.55, -1.71671
Left Slope Intercept: 1511.65 60
Right Slope Intercept: 1636.55 10

Method Statistics

Method: spencer
Number of Valid Surfaces: 19157
Number of Invalid Surfaces: 14359
Error Codes:
Error Code -104 reported for 63 surfaces
Error Code -106 reported for 312 surfaces
Error Code -108 reported for 1634 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 5168 surfaces
Error Code -112 reported for 7180 surfaces
Error Code -200 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-104 = Same as -102. Surface / nonslope intersections also exist, but these points lie outside the arc defined by the two surface / slope intersections.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

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

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

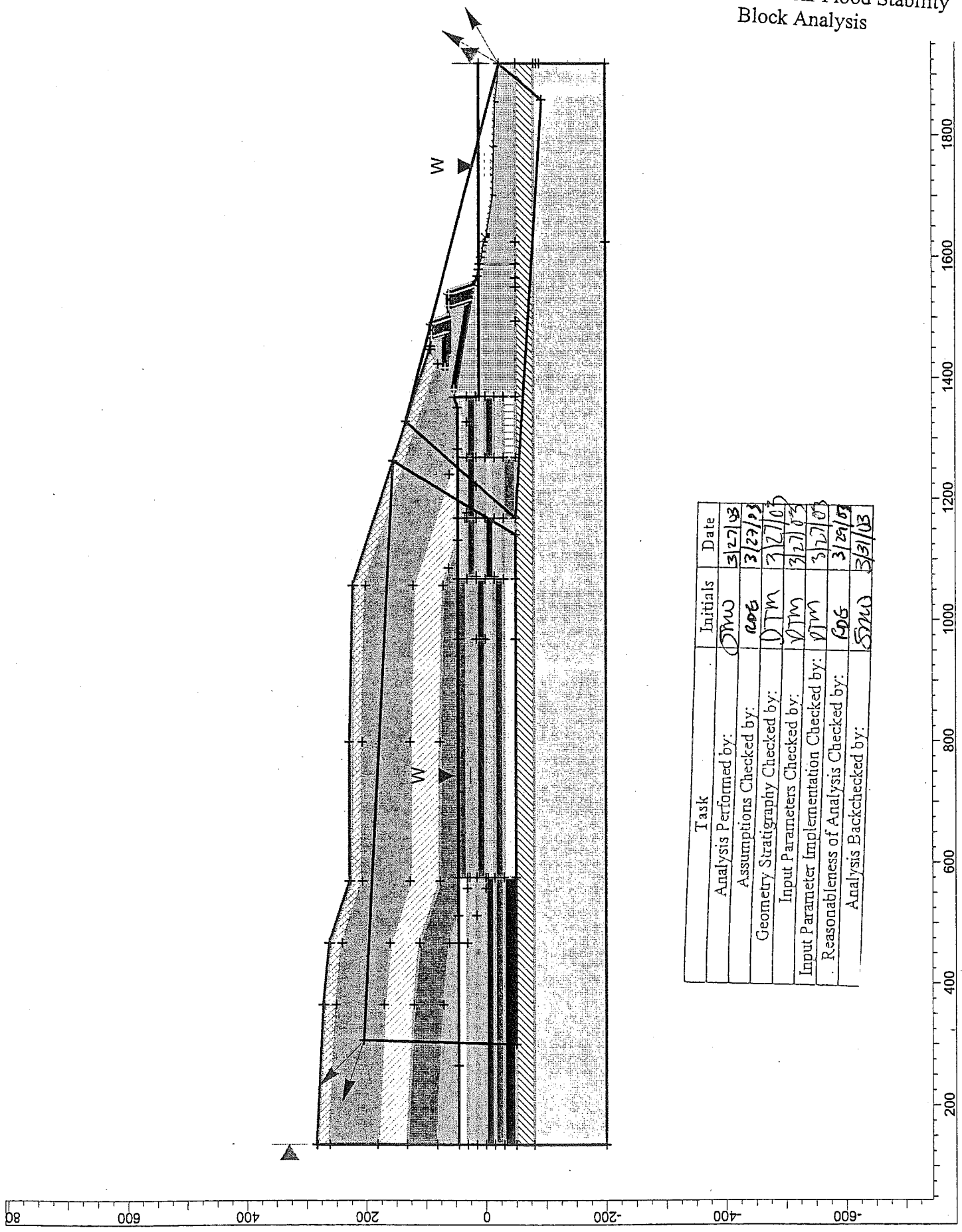
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices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

-200 = Factor of Safety = 0. Could mean 0 Normal/Shear resistance along part of the slip surface

E100-4

Section E-E
100 Year Flood Stability
Circular Analysis

Section E-E
100 Year Flood Stability
Block Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/27/03
Assumptions Checked by:	MDB	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	MDB	3/29/03
Analysis Backchecked by:	SMW	3/31/03

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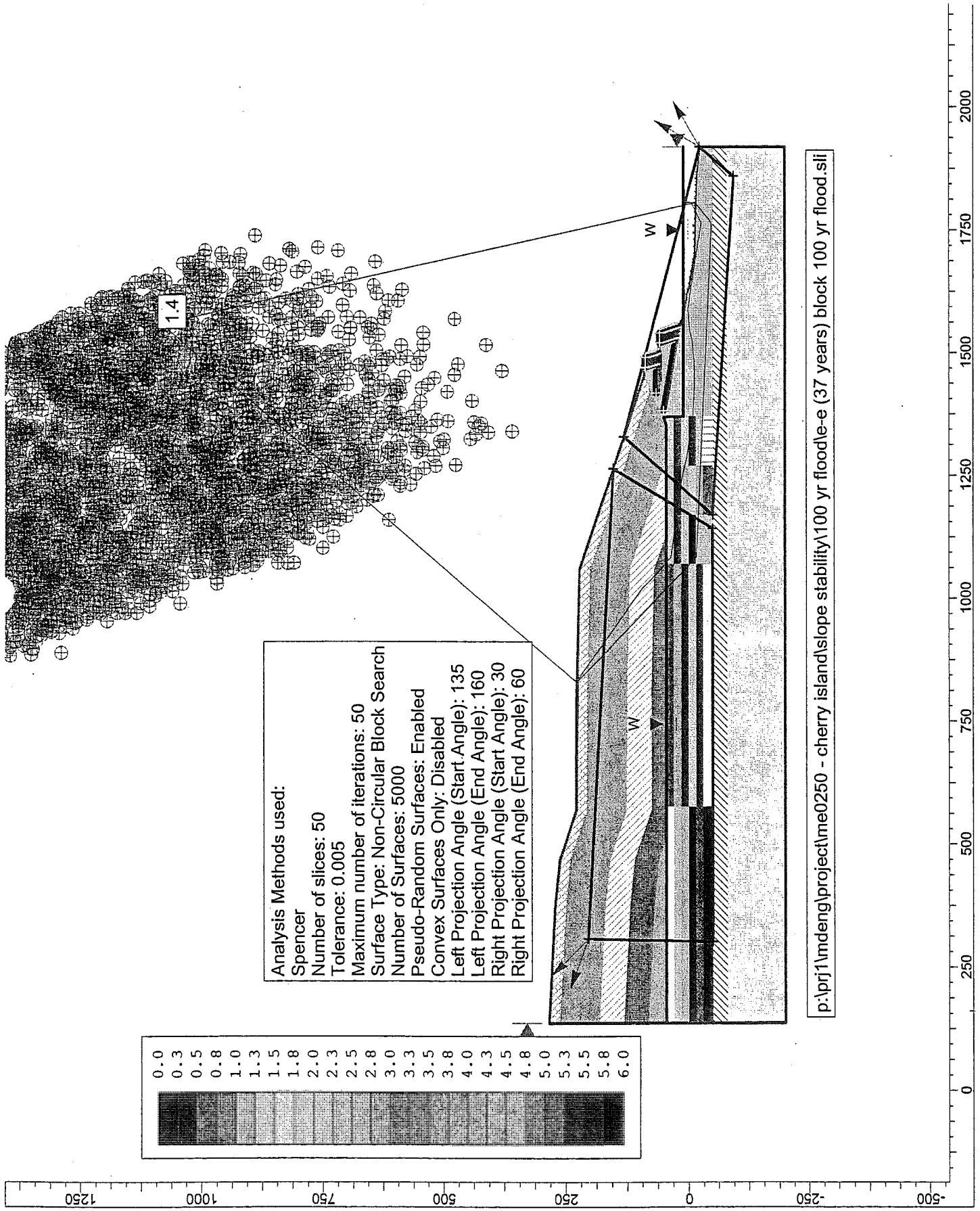
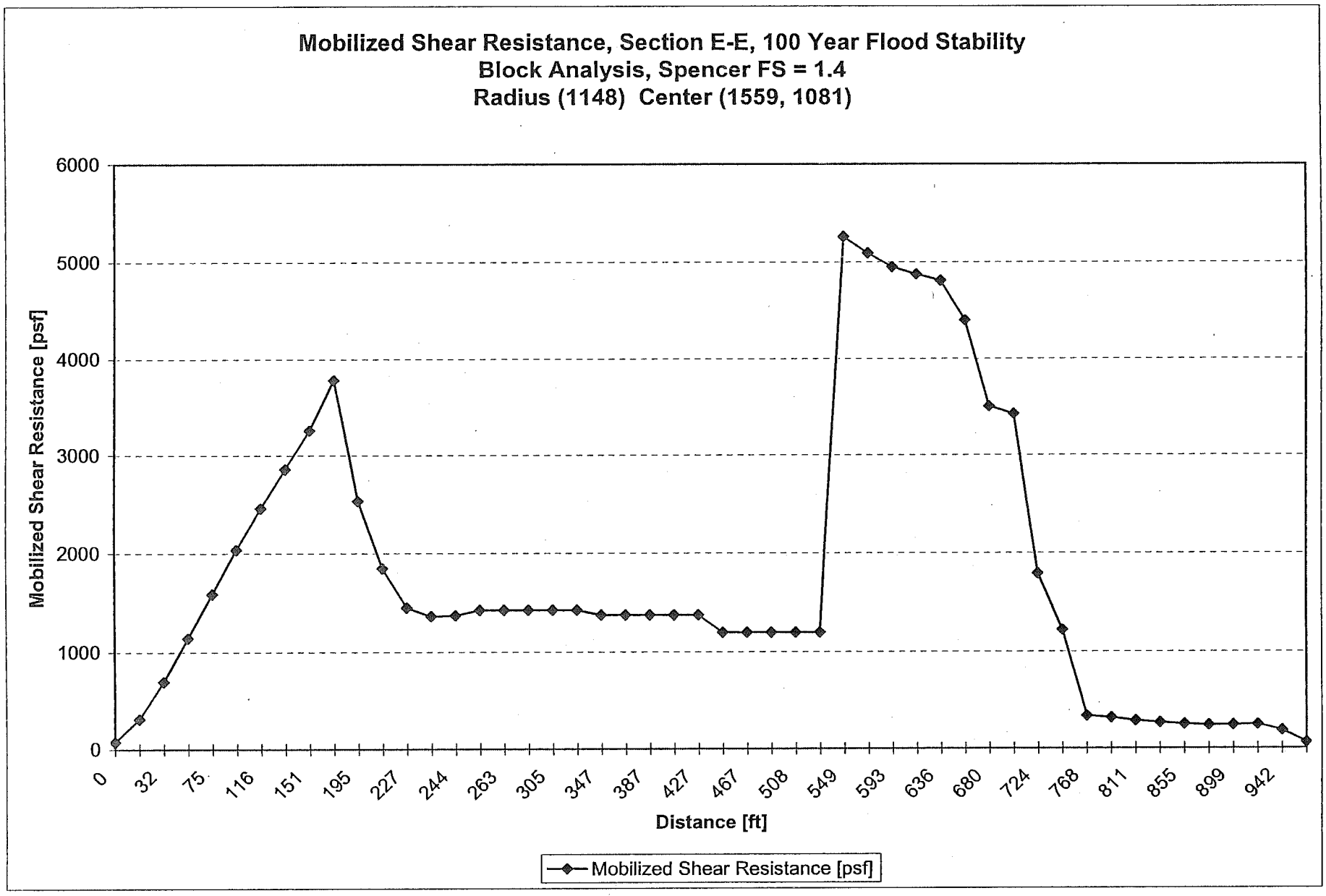
Section E-E
100 Year Flood Stability
Block Analysis



E1004



PRJ1/ME0250/SlopeStability/e 100 yr flooc

Section E-E
100 Year Flood
Block Analysis
Stability

E10-10

Slide Analysis Information

Document Name

File Name: e-e (37 years) block 100 yr flood

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

E10

C-11

Section E-E
100 Year Flood
Block Analysis
Stability

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1982 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1772 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1647 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1609 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2419 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2605 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2226 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1984 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1881 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1951 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2910 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3237 psf
Water Surface: None

Material: d32
Strength Type: Undrained

Section E-E
100 Year Flood Stability
Block Analysis

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2580 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2134 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1944 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2022 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3586 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2615 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2056 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1933 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2235 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3807 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4192 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2833 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2144 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

E100-12

Cohesion: 2031 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2480 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4428 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.41551
Axis Location: 1558.82, 1081.27
Left Slip Surface Endpoint: 829.712, 227.033
Right Slip Surface Endpoint: 1804.75, -14.5581
Left Slope Intercept: 829.712 227.033
Right Slope Intercept: 1804.75 10

Method Statistics

Method: spencer
Number of Valid Surfaces: 4337
Number of Invalid Surfaces: 663
Error Codes:
Error Code -105 reported for 81 surfaces
Error Code -108 reported for 525 surfaces
Error Code -111 reported for 20 surfaces
Error Code -112 reported for 37 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

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

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration

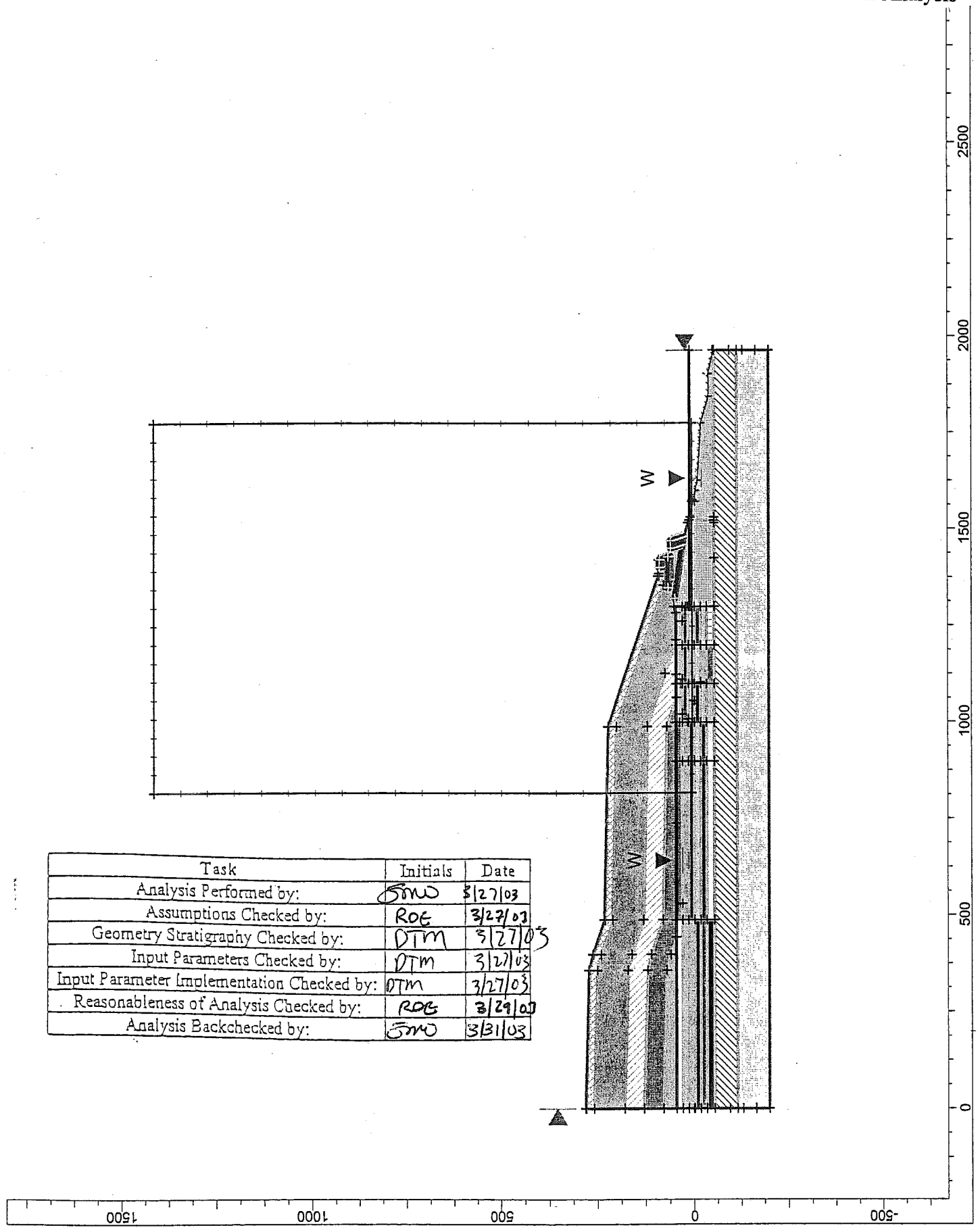
Section E-E
100 Year Flood Stability
Block Analysis

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

E100-15

Section F

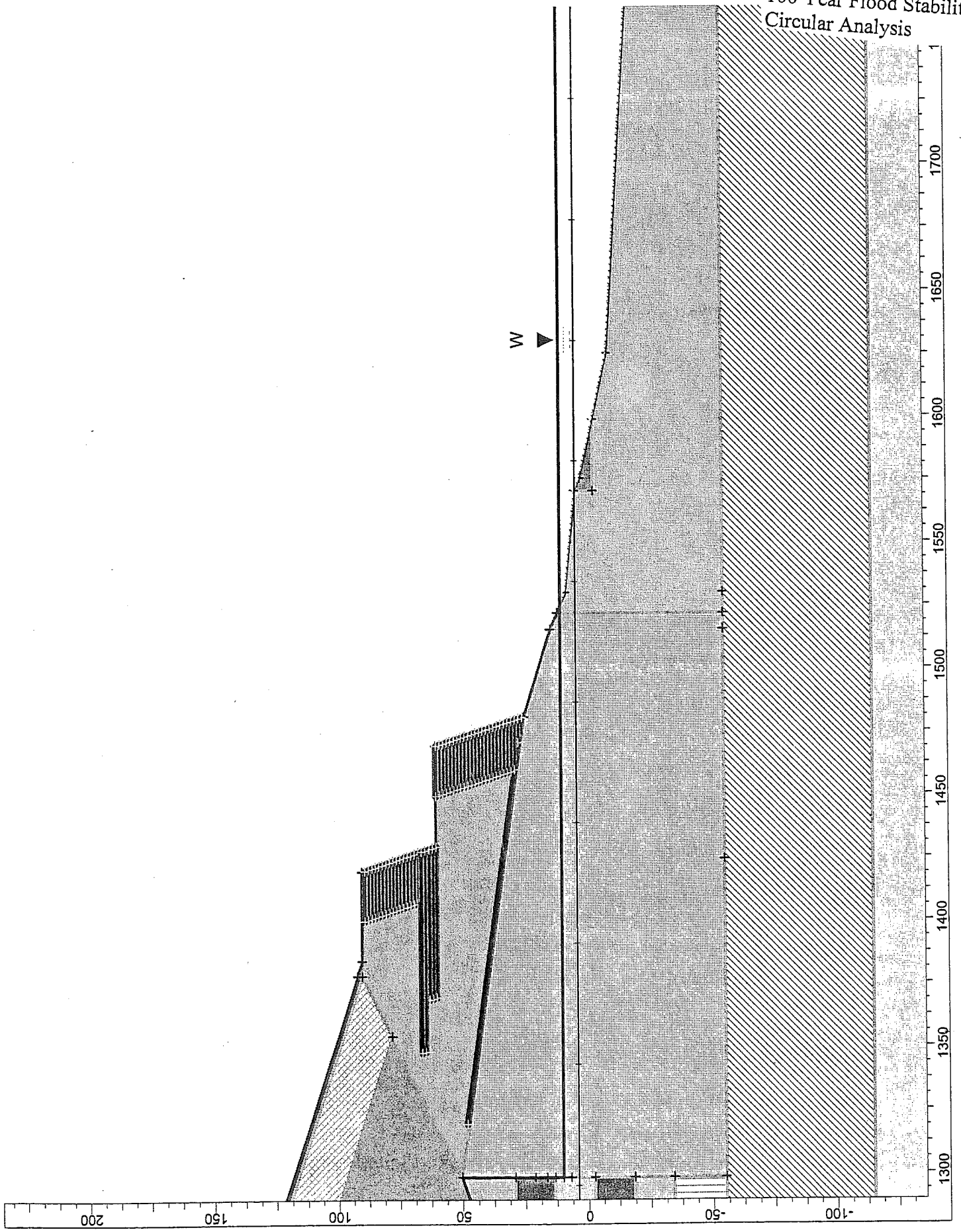
Section F-F
100 Year Flood Stability
Circular Analysis

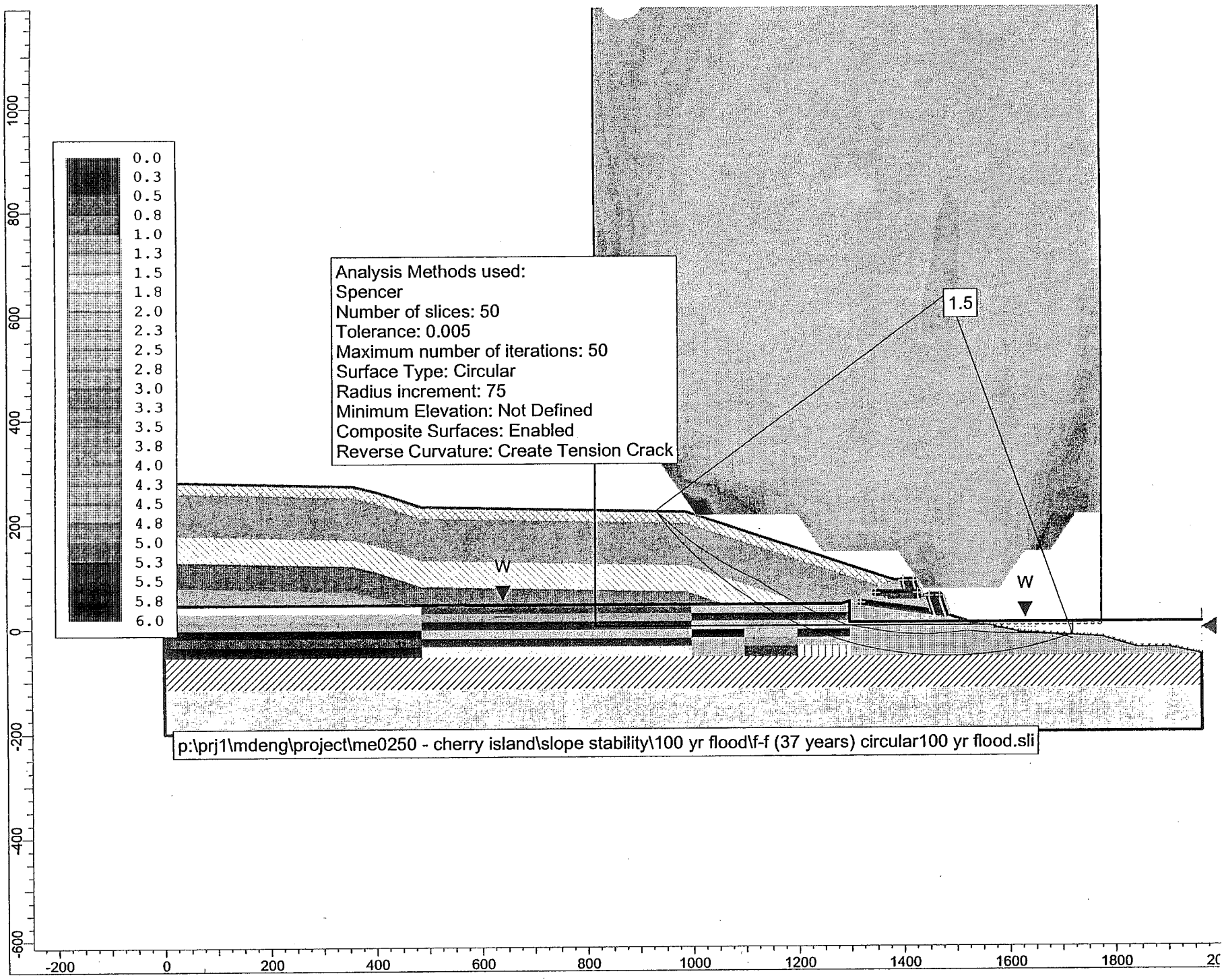


Task	Initials	Date
Analysis Performed by:	SMO	3/27/03
Assumptions Checked by:	ROE	3/27/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	ROE	3/29/03
Analysis Backchecked by:	SMO	3/31/03

F100-1

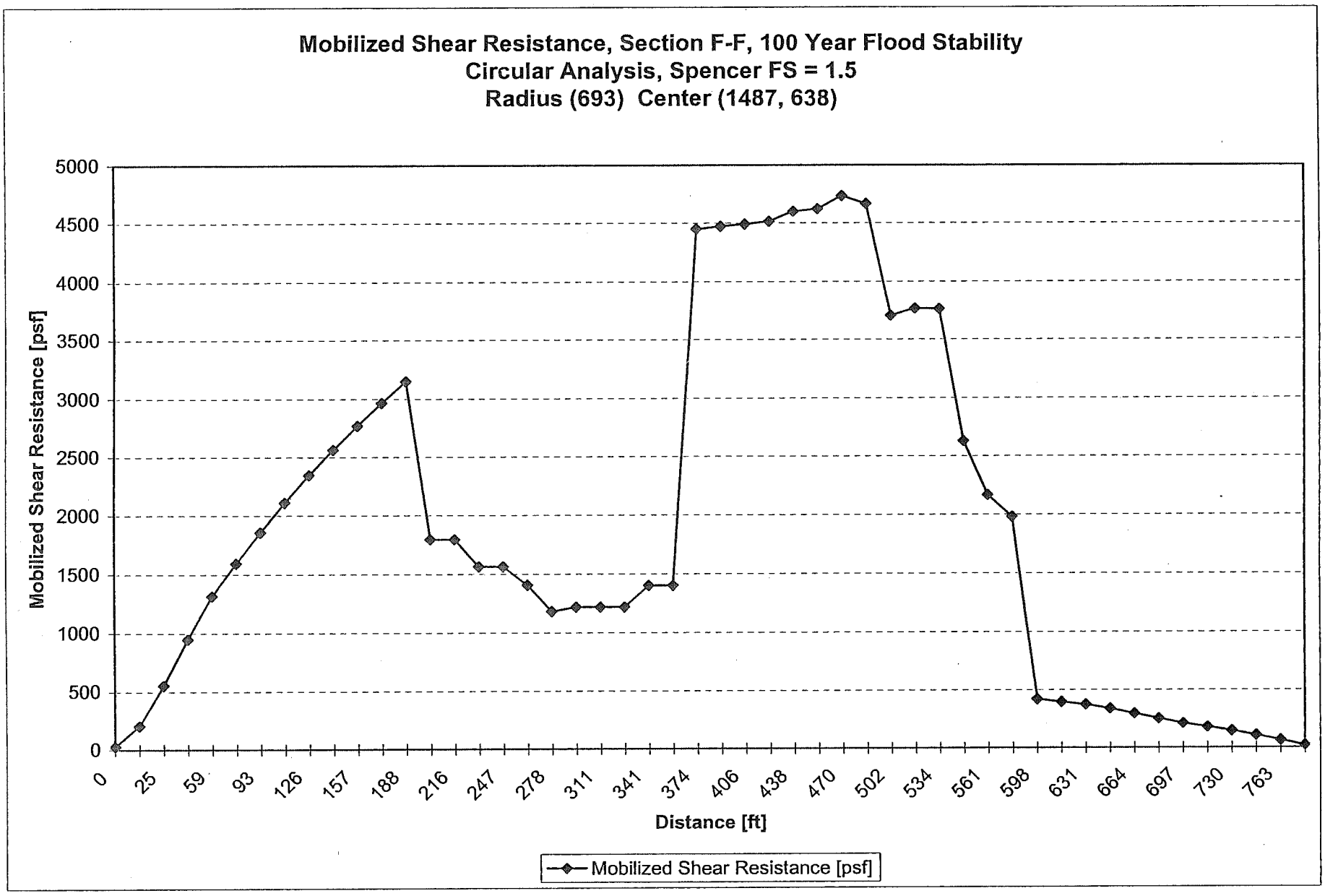
Section F-F
100 Year Flood Stability
Circular Analysis





Section F-F
100 Year Flood Stabili
Circular Analysis

F1C-3



F100-4

PRJ1/ME0250/SlopeStability/f 100 yr flood

Section F-F
100 Year Flood Stability
Circular Analysis

Slide Analysis Information

Document Name

File Name: f-f (37 years) circular100 yr flood

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function

F100-5

Section F-F
100 Year Flood Stab
Circular Analysis

Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1852 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1750 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1807 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2075 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2693 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2665 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2086 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2094 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2392 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3227 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3326 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2709 psf

Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2237 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2174 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2565 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3746 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3695 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2757 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2075 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2531 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4029 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4335 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3029 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2247 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2181 psf
Water Surface: None

Section F-F
100 Year Flood Stability
Circular Analysis

F100-6

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2781 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4655 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.48328
Center: 1486.52, 638.347
Radius: 693.459
Left Slip Surface Endpoint: 931.11, 223.132
Right Slip Surface Endpoint: 1719.73, -14.7219
Left Slope Intercept: 931.11 223.132
Right Slope Intercept: 1719.73 10

Method Statistics

Method: spencer
Number of Valid Surfaces: 26201
Number of Invalid Surfaces: 7315
Error Codes:
Error Code -103 reported for 5 surfaces
Error Code -104 reported for 825 surfaces
Error Code -106 reported for 103 surfaces
Error Code -108 reported for 492 surfaces
Error Code -111 reported for 1965 surfaces
Error Code -112 reported for 3925 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-104 = Same as -102. Surface / nonslope intersections also exist, but these points lie outside the arc defined by the two surface / slope intersections.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

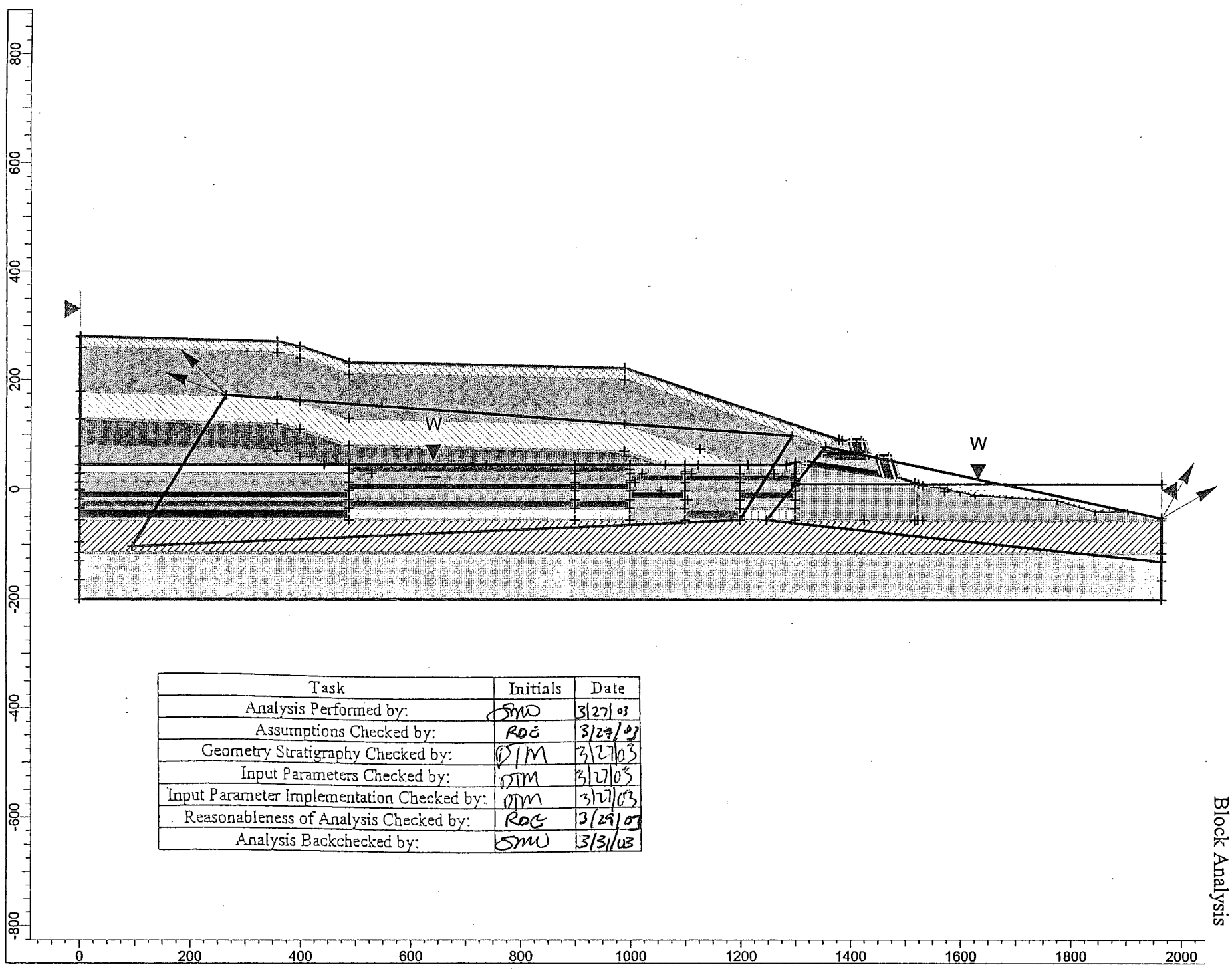
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

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

Section F-F
100 Year Flood S
Circular Analysis

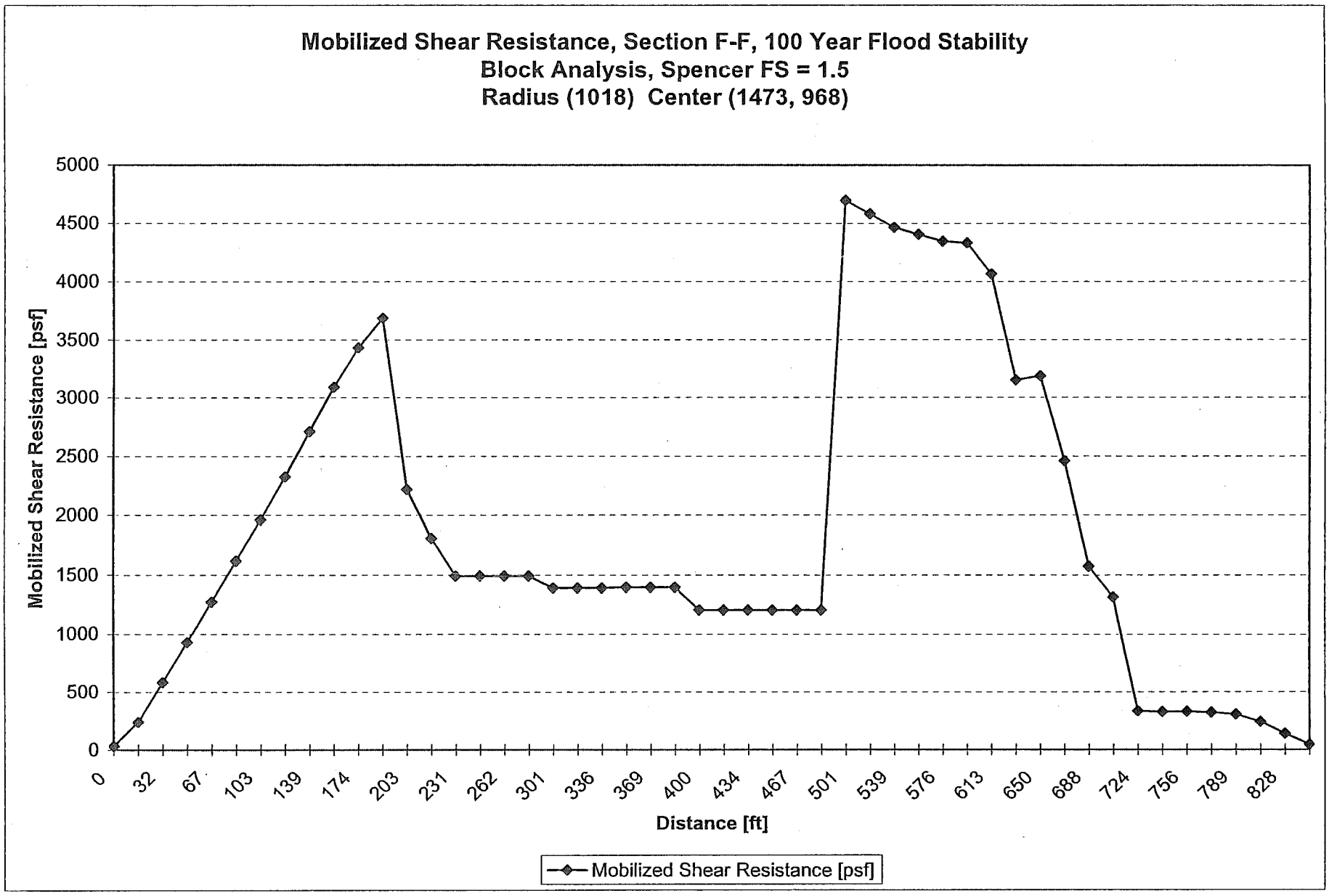
tability



Task	Initials	Date
Analysis Performed by:	SMU	3/27/03
Assumptions Checked by:	RDG	3/29/03
Geometry Stratigraphy Checked by:	DTM	3/27/03
Input Parameters Checked by:	DTM	3/27/03
Input Parameter Implementation Checked by:	DTM	3/27/03
Reasonableness of Analysis Checked by:	RDG	3/29/03
Analysis Backchecked by:	SMU	3/31/03

Section F-F
100 Year Flood Stability
Block Analysis

F-F

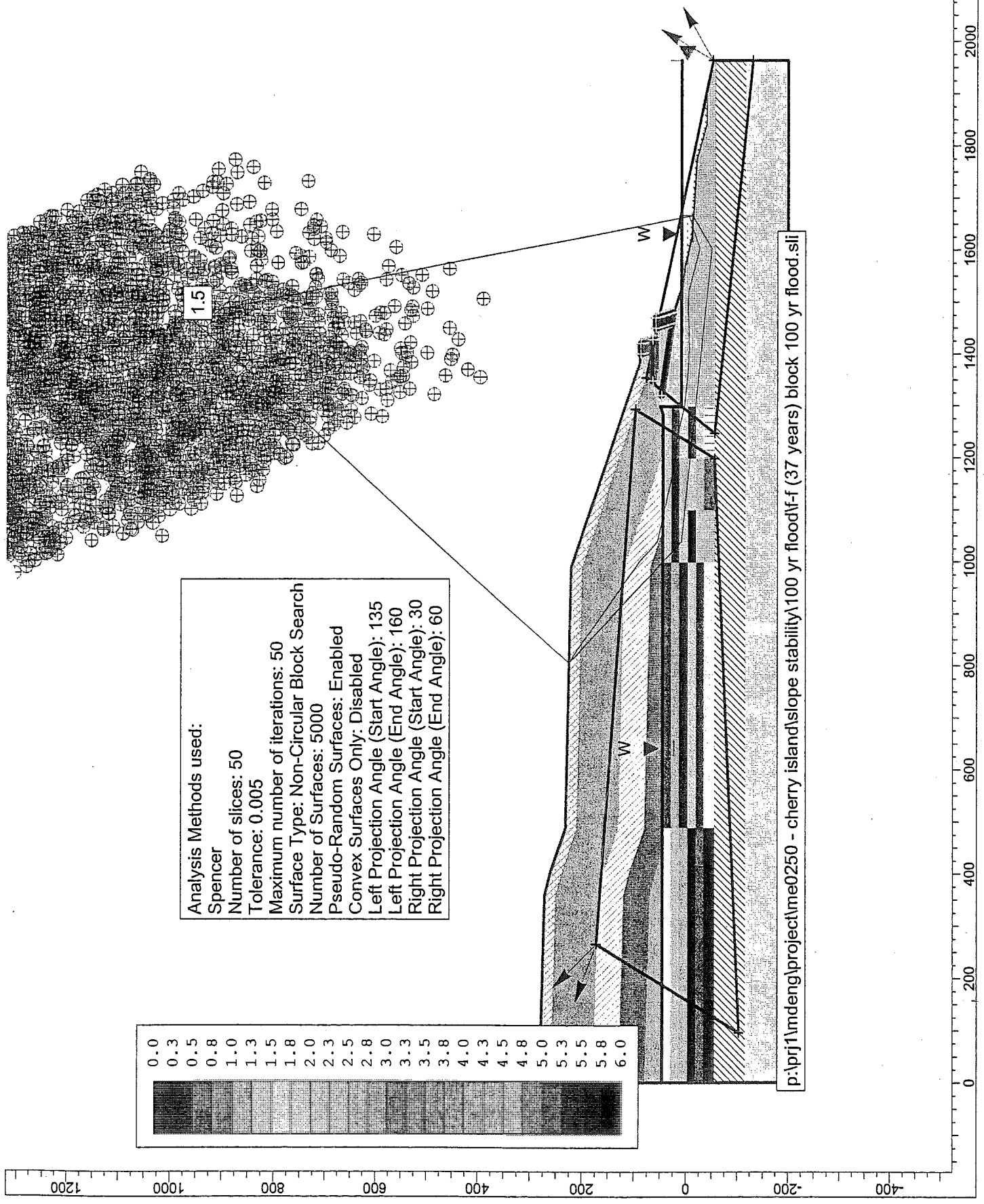


Section F-F
100 Year Flood
Block Analysis
Stability

PRJ1/ME0250/SlopeStability/f 100 yr flood

F-1 CC

Section F-F
100 Year Flood Stability
Block Analysis



F100-10

Slide Analysis Information

Document Name

File Name: f-f (37 years) block 100 yr flood

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Section F-F
100 Year Flood
Block Analysis
Stability

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1852 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1750 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1807 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2075 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2693 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2665 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2086 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2094 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2392 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3227 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3326 psf
Water Surface: None

Material: d32
Strength Type: Undrained

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2709 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2237 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2174 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2565 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3746 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3695 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2757 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2075 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2531 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4029 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4335 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3029 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2247 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

Section F-F
100 Year Flood Stability
Block Analysis

F100-12

Cohesion: 2181 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2781 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4655 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Edgemoore Dike
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.49902
Axis Location: 1472.58, 967.609
Left Slip Surface Endpoint: 805.228, 225.649
Right Slip Surface Endpoint: 1665.74, -11.4503
Left Slope Intercept: 805.228 225.649
Right Slope Intercept: 1665.74 10

Method Statistics

Method: spencer
Number of Valid Surfaces: 4285
Number of Invalid Surfaces: 715
Error Codes:
Error Code -105 reported for 15 surfaces
Error Code -108 reported for 452 surfaces
Error Code -111 reported for 17 surfaces
Error Code -112 reported for 231 surfaces

Error Codes

The following errors were encountered during the computation:

Section F-F
100 Year Flood Stability
Block Analysis

-105 = More than two surface / slope intersections with no valid slip surface.

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

-111 = safety factor equation did not converge

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

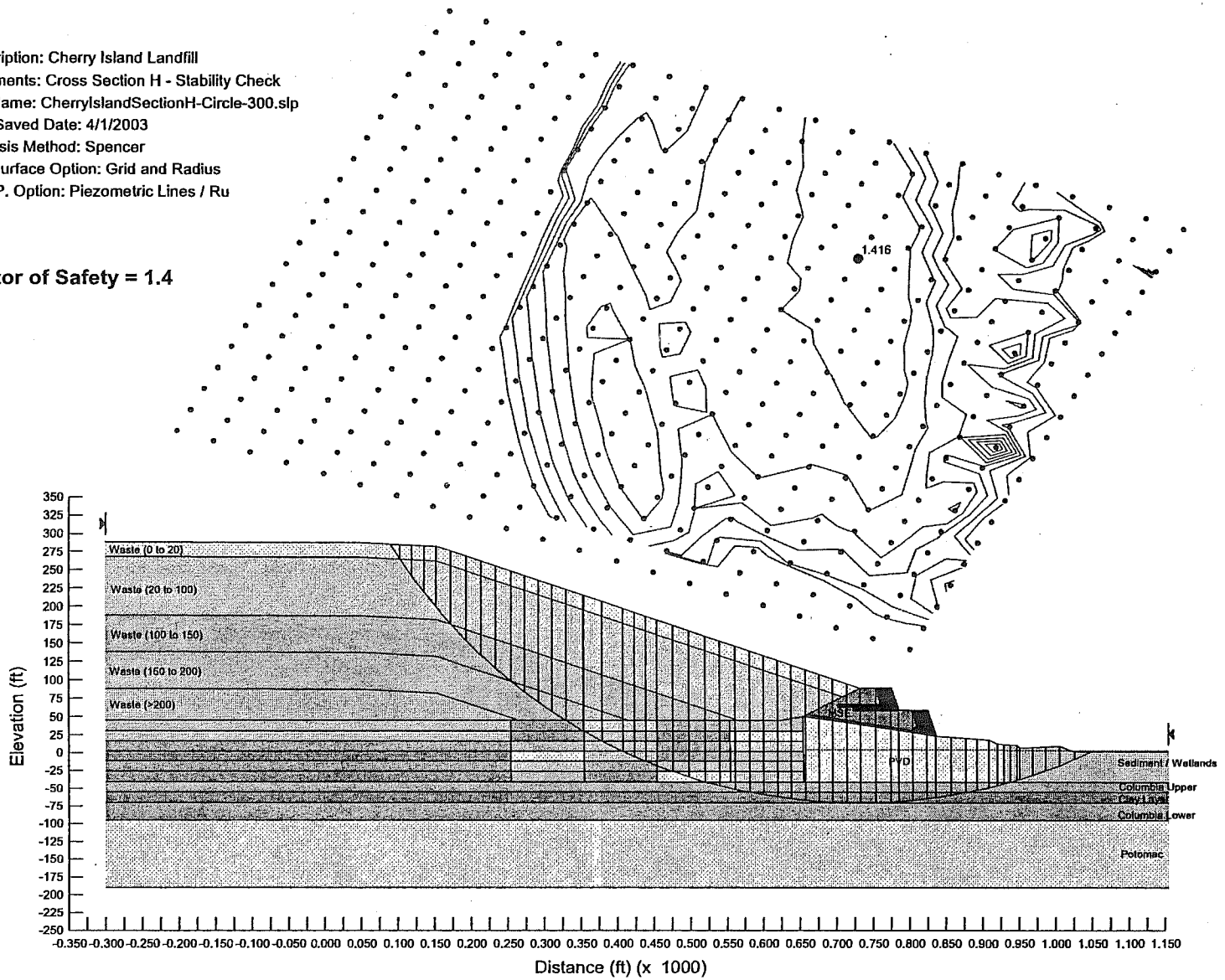
F100-15

Attachment L

Independent Office Results Obtained Using Slope/W

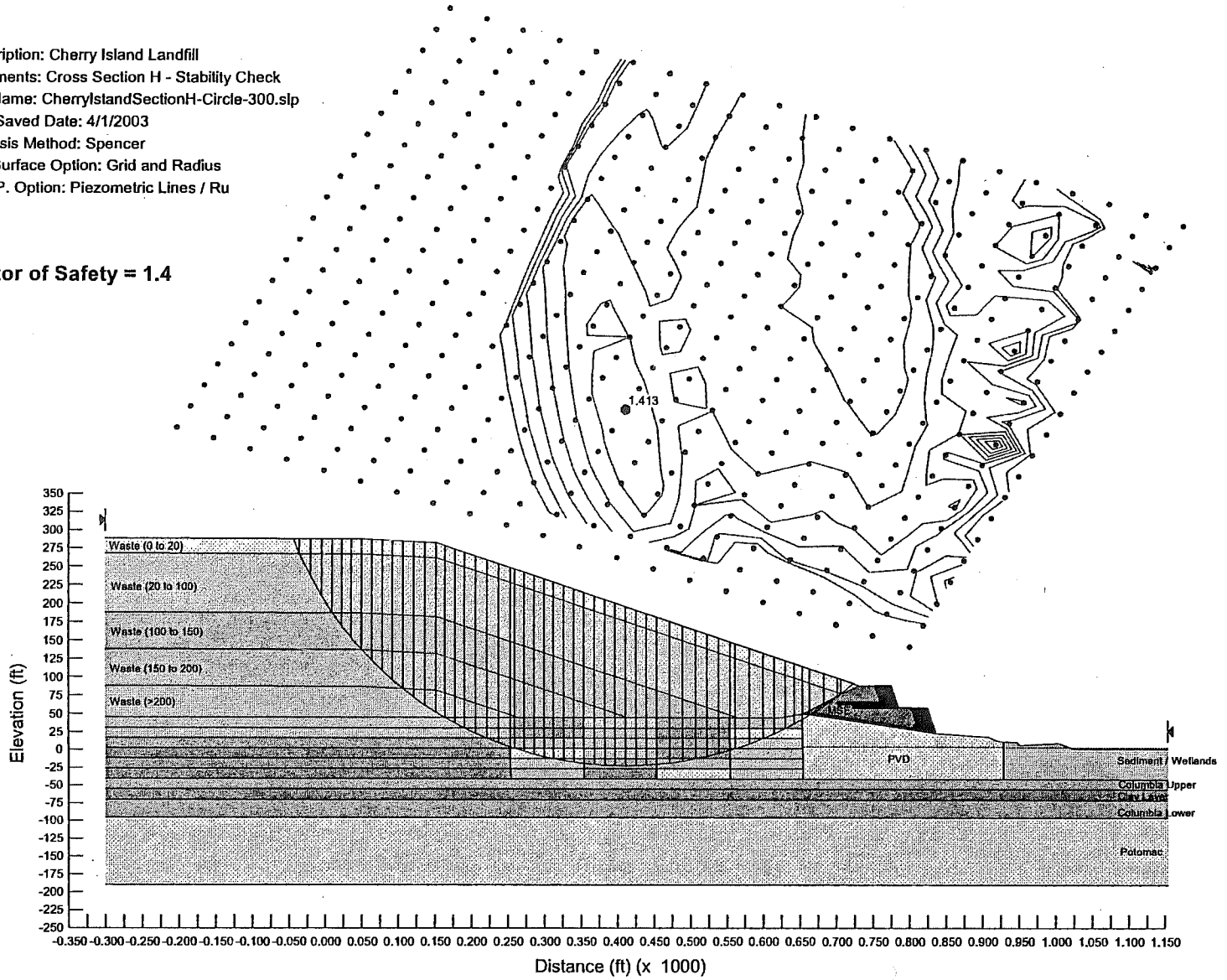
Description: Cherry Island Landfill
Comments: Cross Section H - Stability Check
File Name: CherryIslandSectionH-Circle-300.slp
Last Saved Date: 4/1/2003
Analysis Method: Spencer
Slip Surface Option: Grid and Radius
P.W.P. Option: Piezometric Lines / Ru

Factor of Safety = 1.4



Description: Cherry Island Landfill
Comments: Cross Section H - Stability Check
File Name: CherryIslandSectionH-Circle-300.slp
Last Saved Date: 4/1/2003
Analysis Method: Spencer
Slip Surface Option: Grid and Radius
P.W.P. Option: Piezometric Lines / Ru

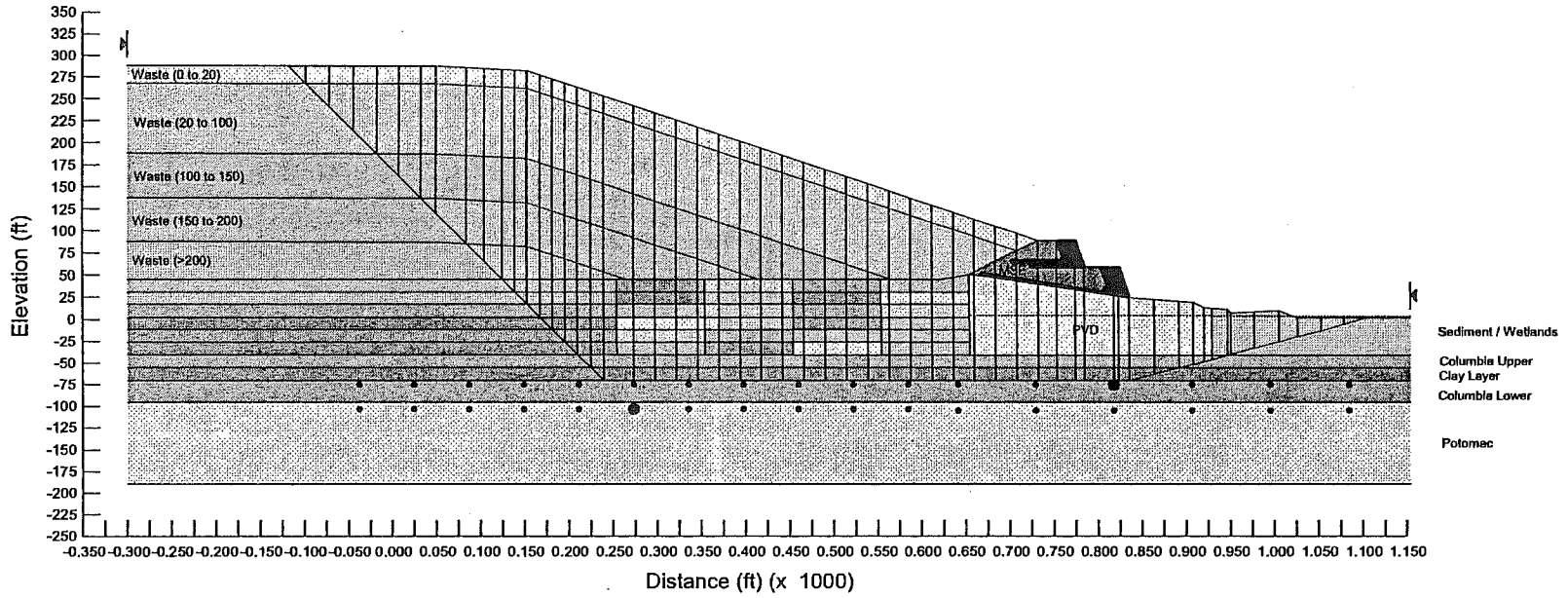
Factor of Safety = 1.4



Description: Cherry Island Landfill
Comments: Cross Section H - Stability Check
File Name: CherryIslandSectionH-BlockClay-300.slp
Last Saved Date: 4/1/2003
Analysis Method: Spencer
Slip Surface Option: Block Specified
P.W.P. Option: Piezometric Lines / Ru

1.383

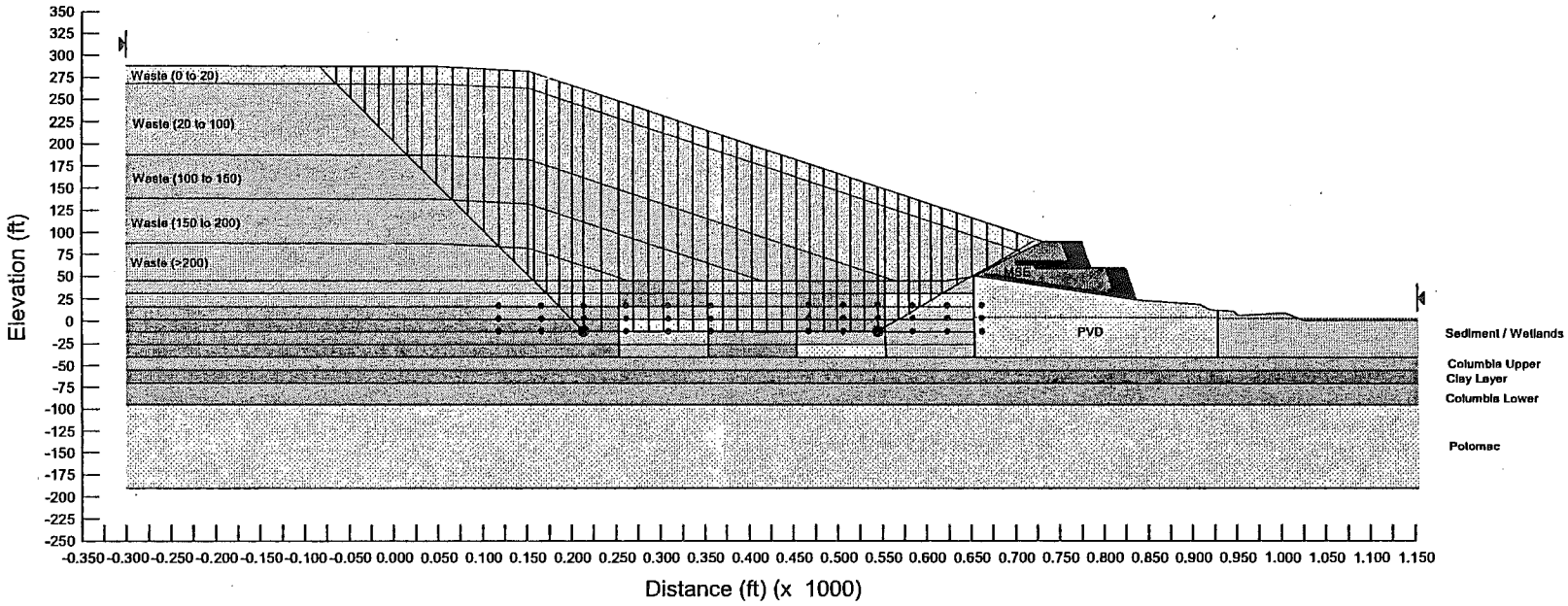
Factor of Safety = 1.4



Description: Cherry Island Landfill
Comments: Cross Section H - Stability Check
File Name: CherryIslandSectionH-BlockDredge-300.slp
Last Saved Date: 4/1/2003
Analysis Method: Spencer
Slip Surface Option: Block Specified
P.W.P. Option: Piezometric Lines / Ru

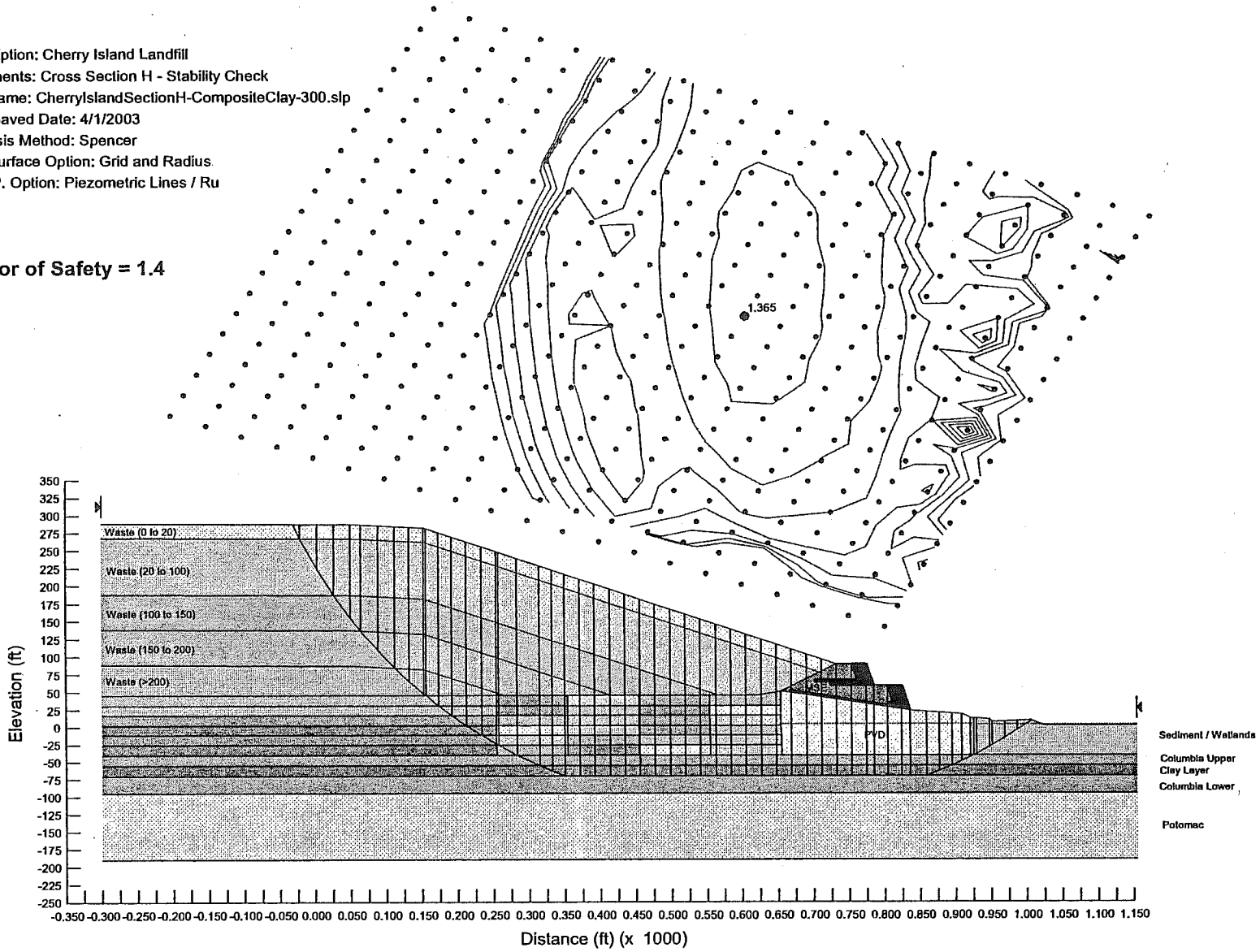
1.394

Factor of Safety = 1.4



Description: Cherry Island Landfill
Comments: Cross Section H - Stability Check
File Name: CherryIslandSectionH-CompositeClay-300.slp
Last Saved Date: 4/1/2003
Analysis Method: Spencer
Slip Surface Option: Grid and Radius
P.W.P. Option: Piezometric Lines / Ru

Factor of Safety = 1.4



Attachment M

Reliability Analysis

TABLE M.1
MATERIAL PARAMETERS USED IN RELIABILITY ANALYSIS

Material Name	Property	Distribution	Mean[1]	Std. Dev.[2]	Min[1]	Max[1]	Relative Min[3]	Relative Max[3]
Waste (0 to 20)	Phi	Beta	33	0.83	30	35	3	2
Waste (0 to 20)	Unit Weight	Beta	60	4.3	45	71	15	11
Waste (20 to 100)	Phi	Beta	33	0.83	30	35	3	2
Waste (20 to 100)	Unit Weight	Beta	75	4.5	56	83	19	8
Waste (100 to 150)	Phi	Beta	33	0.83	30	35	3	2
Waste (100 to 150)	Unit Weight	Beta	80	4.5	70	97	10	17
Waste (150 to 200)	Phi	Beta	33	0.83	30	35	3	2
Waste (150 to 200)	Unit Weight	Beta	85	4.2	79	104	6	19
Waste (>200)	Phi	Beta	33	0.8	30	35	3	2
Waste (>200)	Unit Weight	Beta	90	4	82	106	8	16
Drained PVD Area	Unit Weight	Normal	85	3.3	75	95	10	10
Drained PVD Area	Cohesion	Normal	750	36.7	620	840	130	90
Drained PVD Area	Phi	Normal	34	0.50	32	35	2	1
d11	Unit Weight	Uniform	85	3.3	75	95	10	10
d11	Cohesion	Uniform	1982	198	1387	2577	595	595
d12	Unit Weight	Uniform	85	3.3	75	95	10	10
d12	Cohesion	Uniform	1772	177	1241	2304	531	532
d13	Cohesion	Uniform	1647	165	1153	2140	494	493
d13	Unit Weight	Uniform	85	3.3	75	95	10	10
d14	Unit Weight	Uniform	85	3.3	75	95	10	10
d14	Cohesion	Uniform	1609	161	1126	2091	483	482
d15	Unit Weight	Uniform	85	3.3	75	95	10	10
d15	Cohesion	Uniform	1695	170	1187	2204	508	509
d16	Unit Weight	Uniform	85	3.3	75	95	10	10
d16	Cohesion	Uniform	2419	242	1694	3145	725	726
d21	Unit Weight	Uniform	85	3.3	75	95	10	10
d21	Cohesion	Uniform	2605	261	1824	3387	781	782
d22	Cohesion	Uniform	2226	223	1558	2894	668	668
d22	Unit Weight	Uniform	85	3.3	75	95	10	10
d23	Unit Weight	Uniform	85	3.3	75	95	10	10
d23	Cohesion	Uniform	1984	198	1389	2579	595	595
d24	Unit Weight	Uniform	85	3.3	75	95	10	10
d24	Cohesion	Uniform	1881	188	1317	2445	564	564
d25	Unit Weight	Uniform	85	3.3	75	95	10	10
d25	Cohesion	Uniform	1951	195	1365	2536	586	585
d26	Cohesion	Uniform	2910	291	2037	3783	873	873
d26	Unit Weight	Uniform	85	3.3	75	95	10	10
d31	Unit Weight	Uniform	85	3.3	75	95	10	10
d31	Cohesion	Uniform	3237	324	2266	4208	971	971
d32	Cohesion	Uniform	2580	258	1806	3354	774	774
d32	Unit Weight	Uniform	85	3.3	75	95	10	10
d33	Unit Weight	Uniform	85	3.3	75	95	10	10
d33	Cohesion	Uniform	2134	214	1494	2775	640	641
d34	Unit Weight	Uniform	85	3.3	75	95	10	10
d34	Cohesion	Uniform	1944	194	1361	2527	583	583
d35	Cohesion	Uniform	2022	202	1415	2628	607	606
d35	Unit Weight	Uniform	85	3.3	75	95	10	10
d36	Unit Weight	Uniform	85	3.3	75	95	10	10
d36	Cohesion	Uniform	3346	335	2342	4349	1004	1003
d41	Cohesion	Uniform	3586	359	2510	4662	1076	1076
d41	Unit Weight	Uniform	85	3.3	75	95	10	10
d42	Unit Weight	Uniform	85	3.3	75	95	10	10
d42	Cohesion	Uniform	2615	262	1830	3399	785	784
d43	Unit Weight	Uniform	85	3.3	75	95	10	10
d43	Cohesion	Uniform	2056	206	1439	2673	617	617
d44	Cohesion	Uniform	1933	193	1353	2513	580	580
d44	Unit Weight	Uniform	85	3.3	75	95	10	10
d45	Unit Weight	Uniform	85	3.3	75	95	10	10
d45	Cohesion	Uniform	2235	224	1565	2906	670	671
d46	Unit Weight	Uniform	85	3.3	75	95	10	10
d46	Cohesion	Uniform	3807	381	2665	4949	1142	1142
d51	Unit Weight	Uniform	85	3.3	75	95	10	10
d51	Cohesion	Uniform	4192	419	2935	5450	1257	1258
d52	Unit Weight	Uniform	85	3.3	75	95	10	10
d52	Cohesion	Uniform	2833	283	1983	3683	850	850
d53	Cohesion	Uniform	2144	214	1501	2787	643	643
d53	Unit Weight	Uniform	85	3.3	75	95	10	10
d54	Unit Weight	Uniform	85	3.3	75	95	10	10
d54	Cohesion	Uniform	2031	203	1422	2640	609	609
d55	Unit Weight	Uniform	85	3.3	75	95	10	10
d55	Cohesion	Uniform	2480	248	1736	3224	744	744
d56	Unit Weight	Uniform	85	3.3	75	95	10	10
d56	Cohesion	Uniform	4428	443	3100	5757	1328	1329
River Sediments	Unit Weight	Normal	85	3.3	75	95	10	10
River Sediments	Vertical Stress Ratio	Normal	0.31	0.0083	0.28	0.33	0.03	0.02
Wetlands	Vertical Stress Ratio	Normal	0.31	0.0083	0.28	0.33	0.03	0.02
Wetlands	Unit Weight	Normal	85	3.3	75	95	10	10

(1) From Geotechnical Characterization Report (2003)
(2) Calculated for 6 standard deviations (i.e. (MAX-MIN)/6)
(3) Calculated as distance away from the mean

Reliability Circular Analysis
Section E-E
Sensitivity Plot

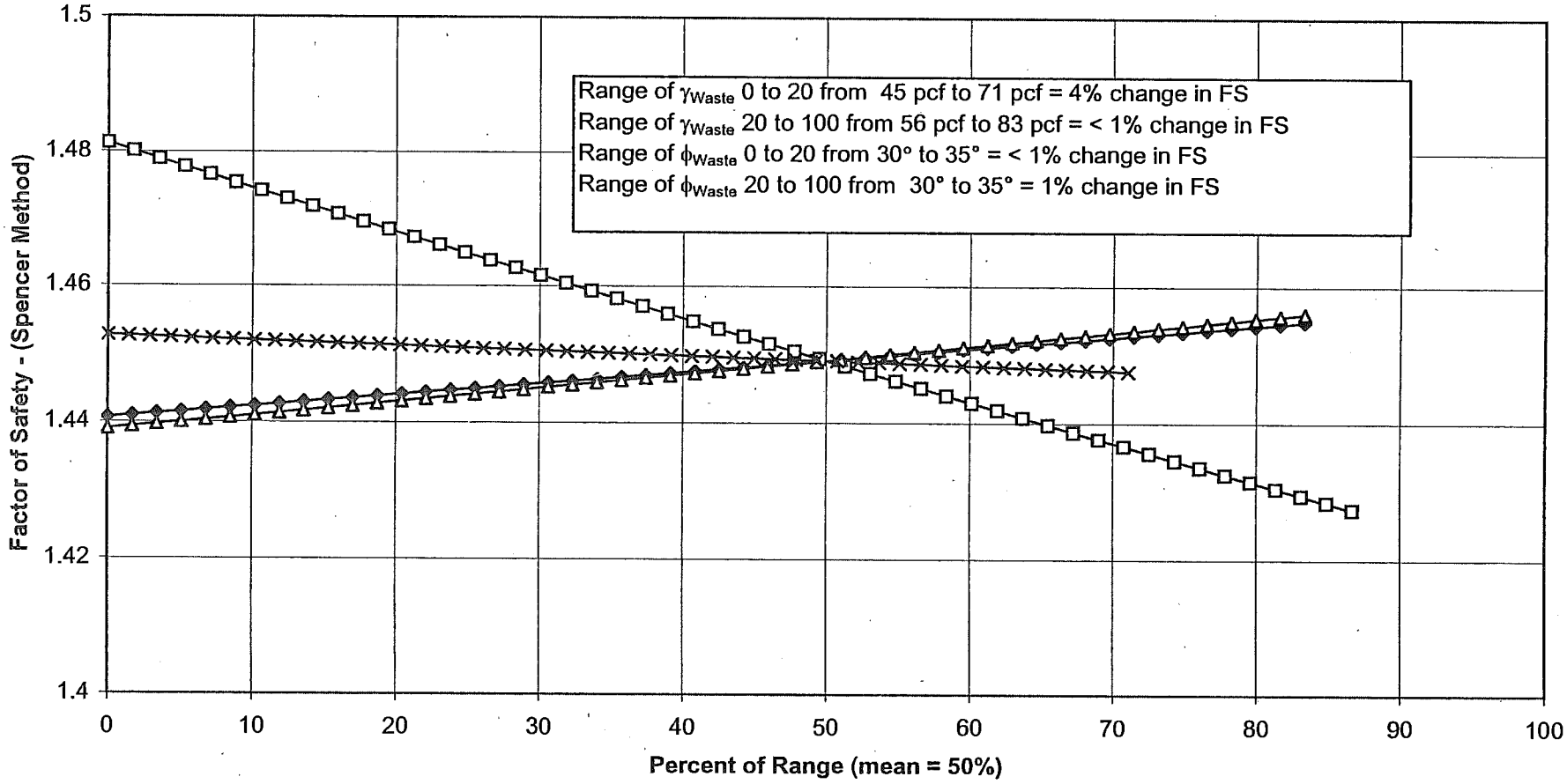


FIGURE M.1

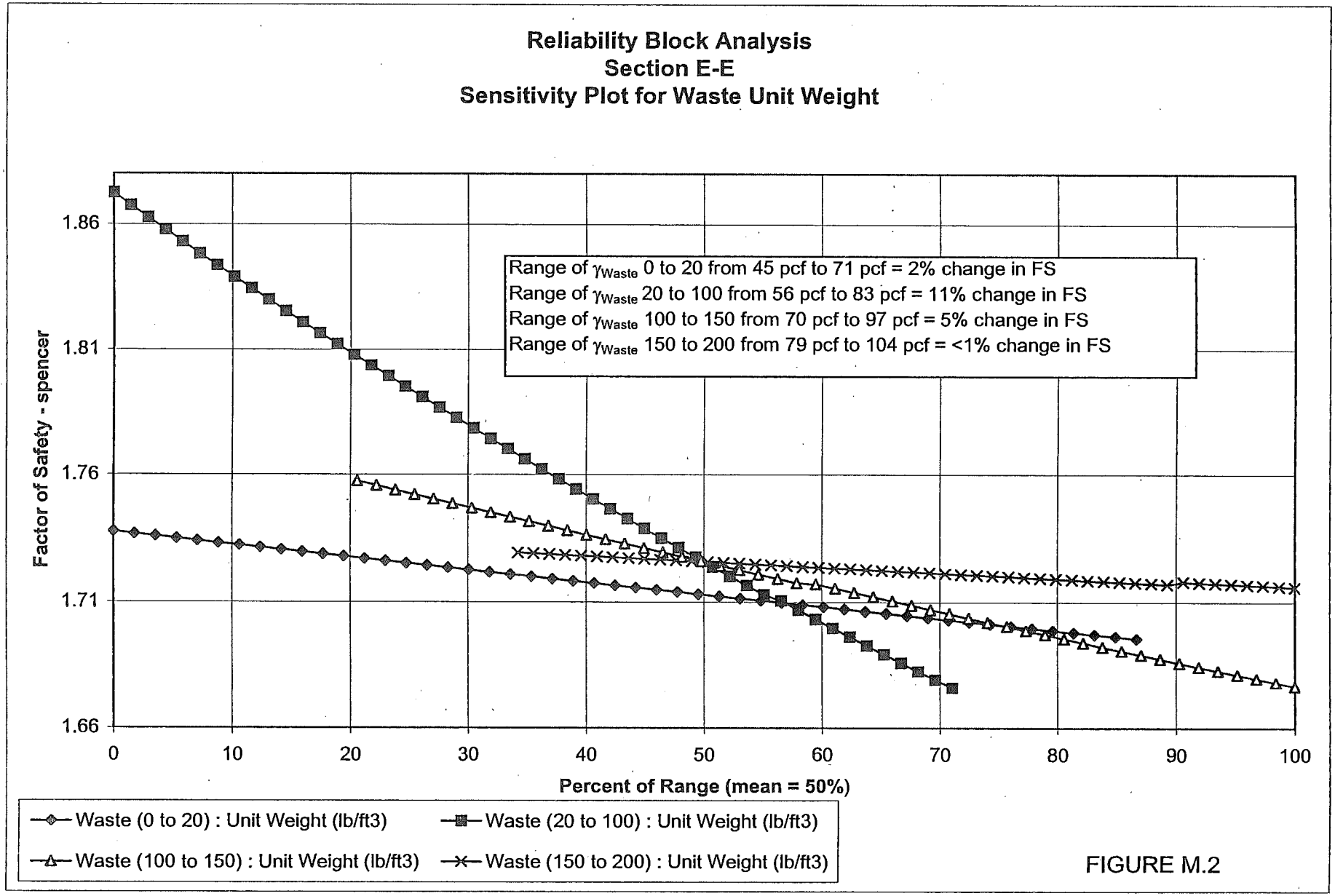

Reliability Block Analysis
Section E-E
Sensitivity Plot for Waste Unit Weight
Range of γ_{Waste} 0 to 20 from 45 pcf to 71 pcf = 2% change in FS
Range of γ_{Waste} 20 to 100 from 56 pcf to 83 pcf = 11% change in FS
Range of γ_{Waste} 100 to 150 from 70 pcf to 97 pcf = 5% change in FS
Range of γ_{Waste} 150 to 200 from 79 pcf to 104 pcf = <1% change in FS
Factor of Safety - spencer
1.86
1.81
1.76
1.71
1.66
0
10
20
30
40
50
60
70
80
90
100
Percent of Range (mean = 50%)
Waste (0 to 20) : Unit Weight (lb/ft3)
Waste (20 to 100) : Unit Weight (lb/ft3)
Waste (100 to 150) : Unit Weight (lb/ft3)
Waste (150 to 200) : Unit Weight (lb/ft3)

FIGURE M.2

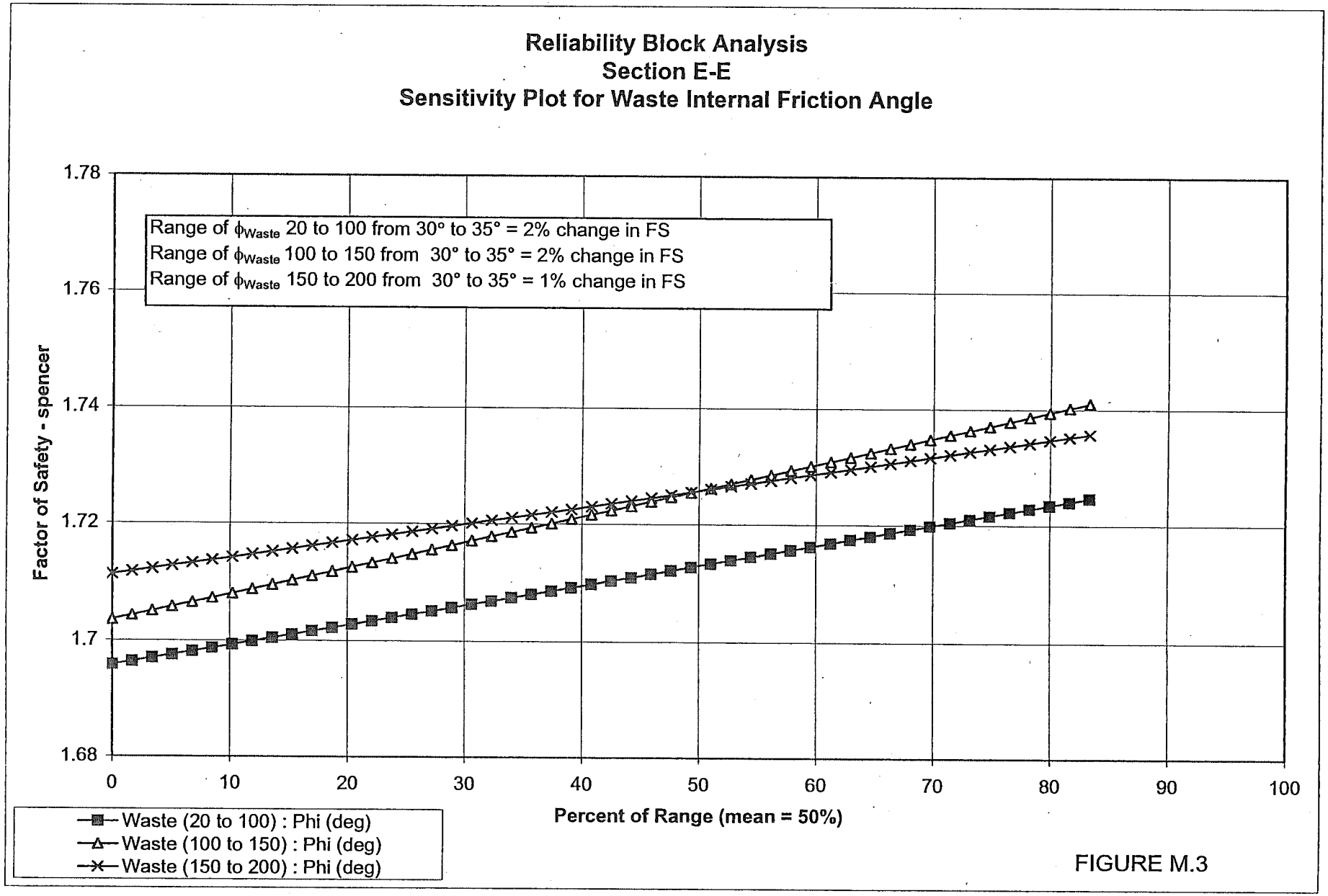
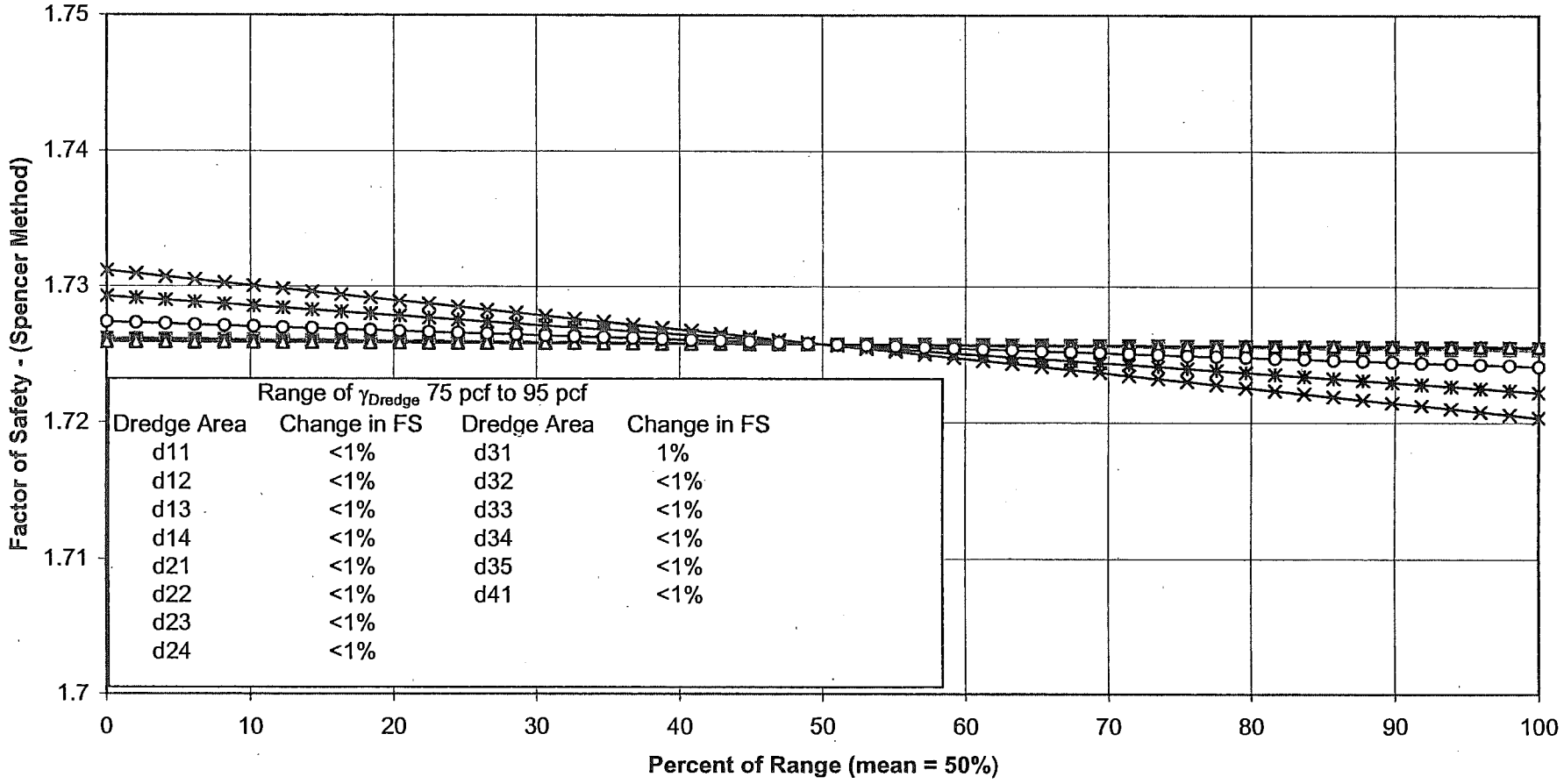

Reliability Block Analysis
Section E-E
Sensitivity Plot for Waste Internal Friction Angle
Range of ϕ_{Waste} 20 to 100 from 30° to 35° = 2% change in FS
Range of ϕ_{Waste} 100 to 150 from 30° to 35° = 2% change in FS
Range of ϕ_{Waste} 150 to 200 from 30° to 35° = 1% change in FS
Factor of Safety - spencer
1.78
1.76
1.74
1.72
1.7
1.68
0
10
20
30
40
50
60
70
80
90
100
Percent of Range (mean = 50%)
Waste (20 to 100) : Phi (deg)
Waste (100 to 150) : Phi (deg)
Waste (150 to 200) : Phi (deg)

FIGURE M.3

Reliability Block Analysis
Section E-E
Sensitivity Plot for Dredge Unit Weight Parameters



Range of γ_{Dredge} 75 pcf to 95 pcf

Dredge Area	Change in FS	Dredge Area	Change in FS
d11	<1%	d31	1%
d12	<1%	d32	<1%
d13	<1%	d33	<1%
d14	<1%	d34	<1%
d21	<1%	d35	<1%
d22	<1%	d41	<1%
d23	<1%		
d24	<1%		

FIGURE M.4

Reliability Block Analysis
Section E-E
Sensitivity Plot for Dredge Cohesion

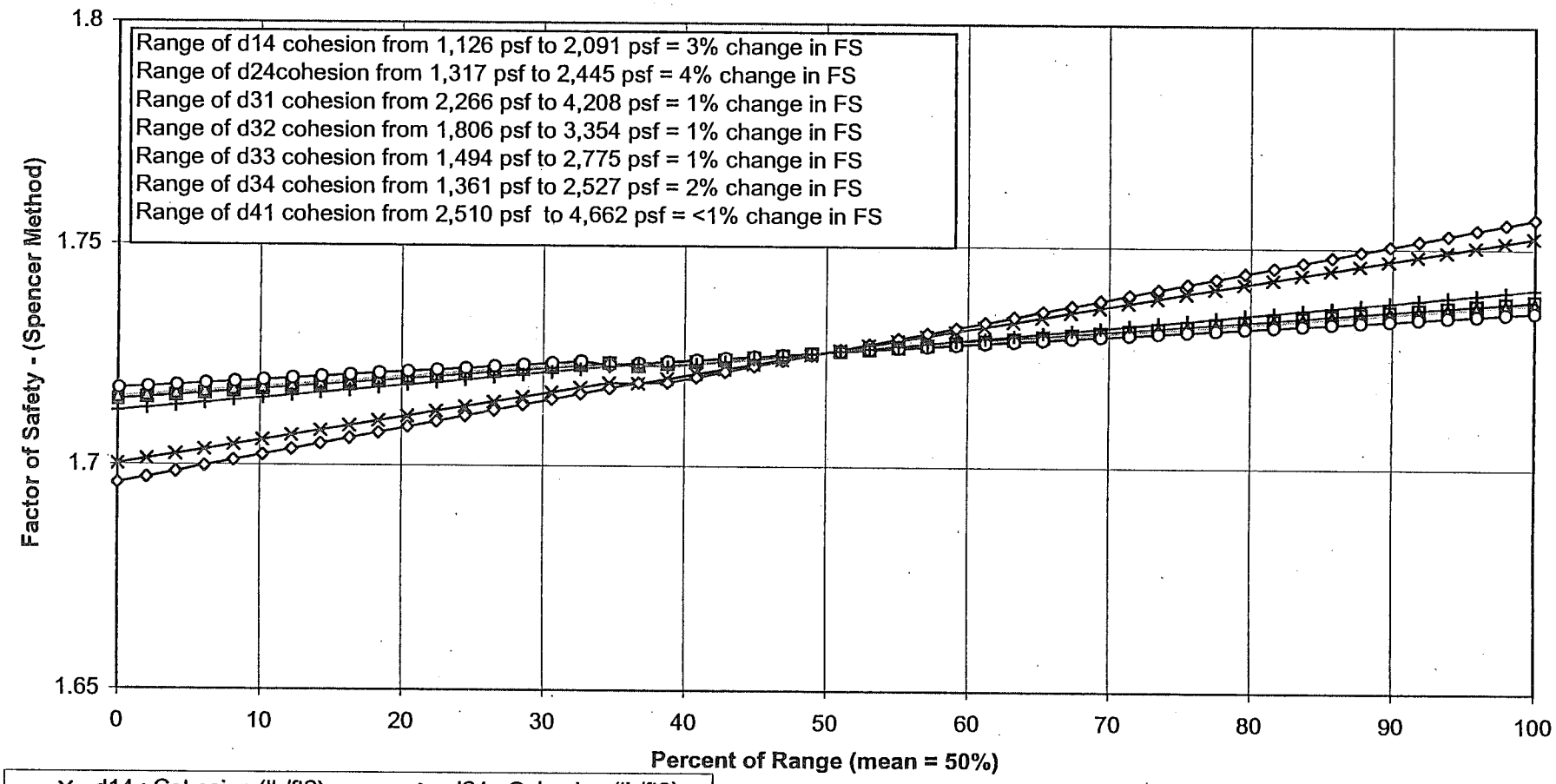


FIGURE M.5

Reliability Block Analysis
Section E-E
Sensitivity Plot for PVD Area Parameters

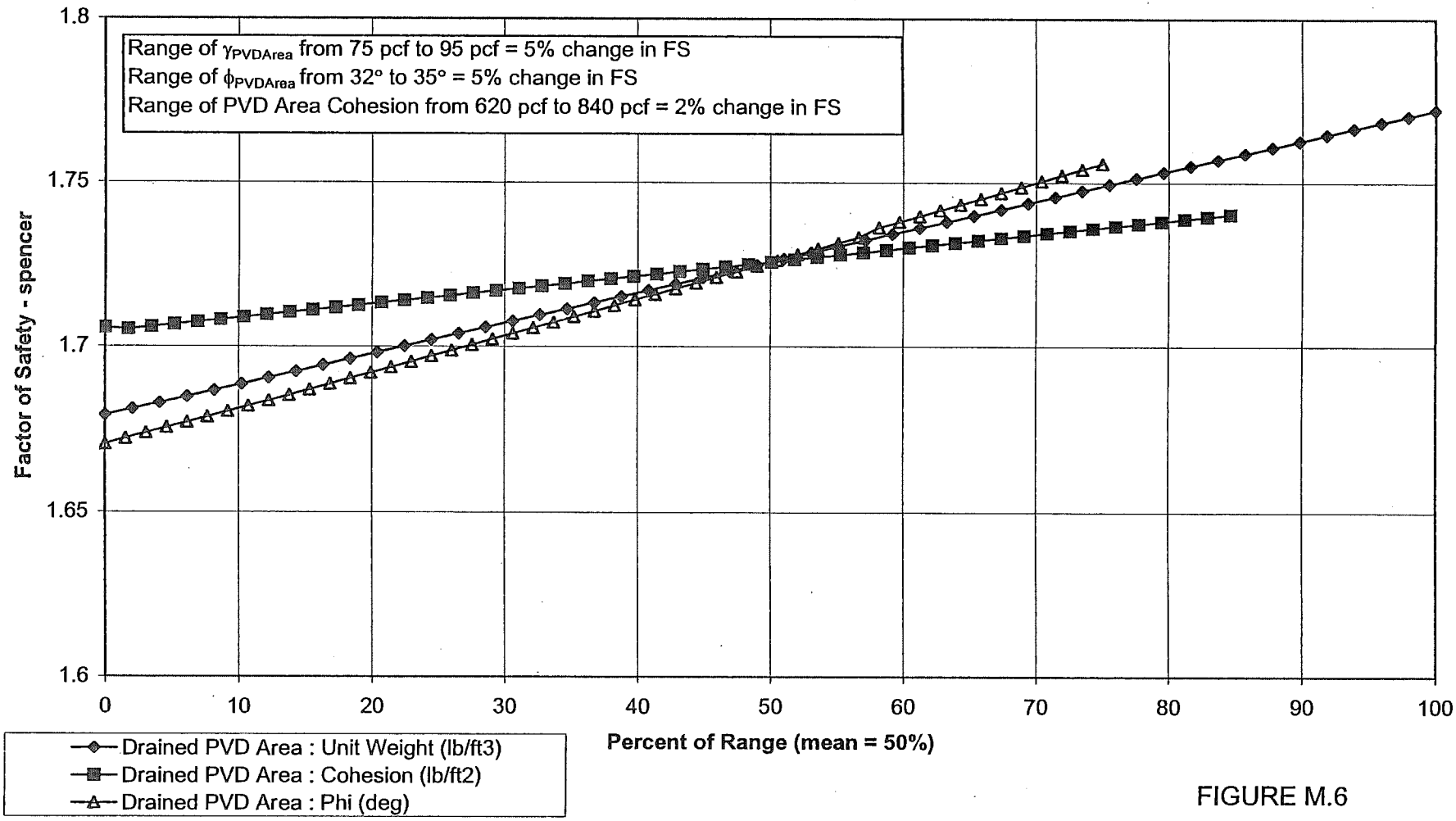


FIGURE M.6

Reliability Block Analysis
Section E-E
Sensitivity Plot for Water Table Location

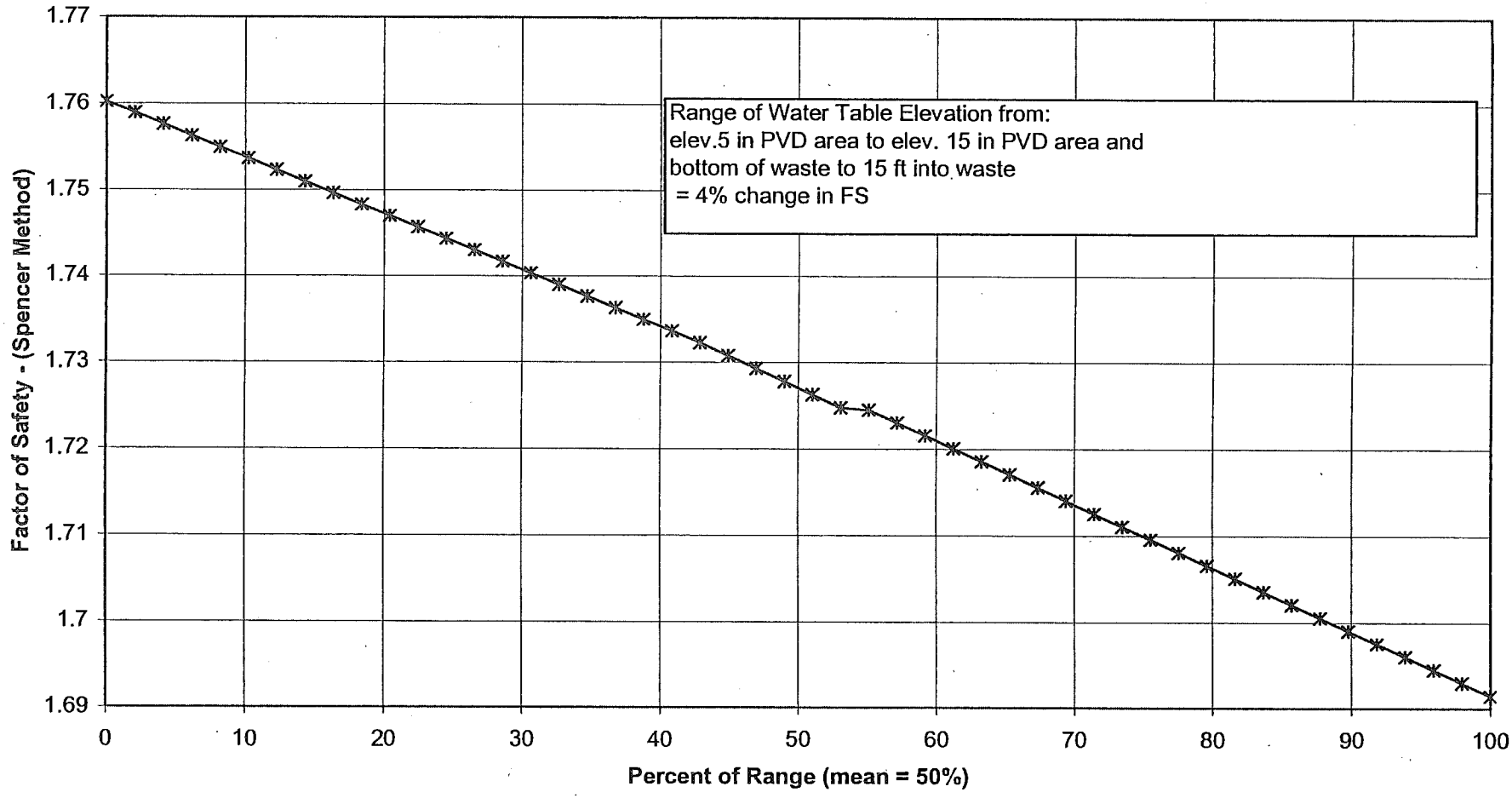
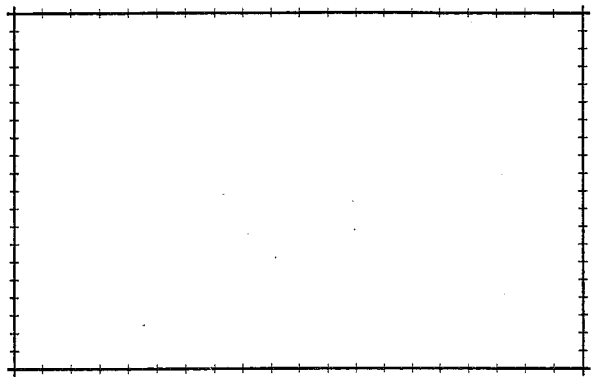
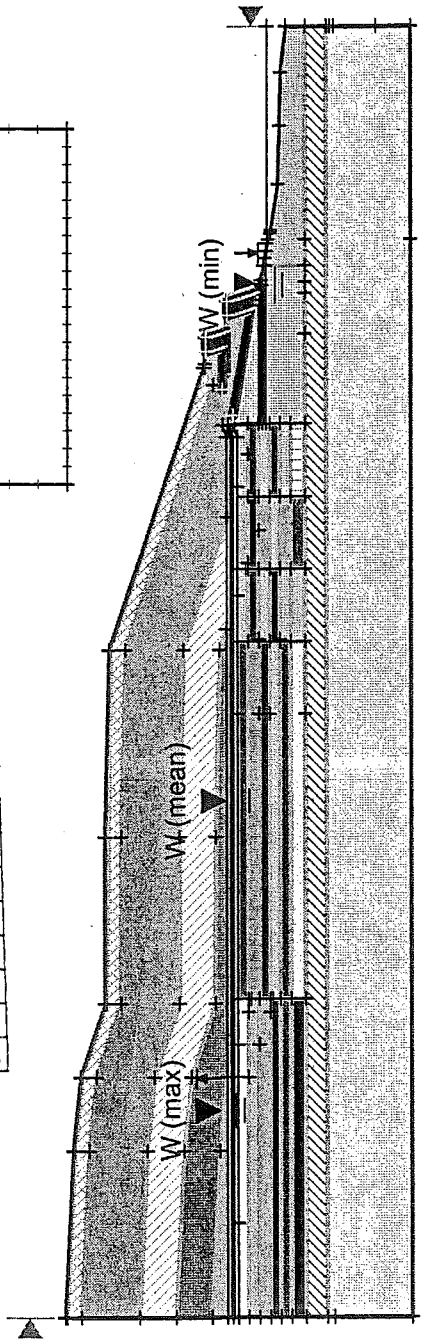


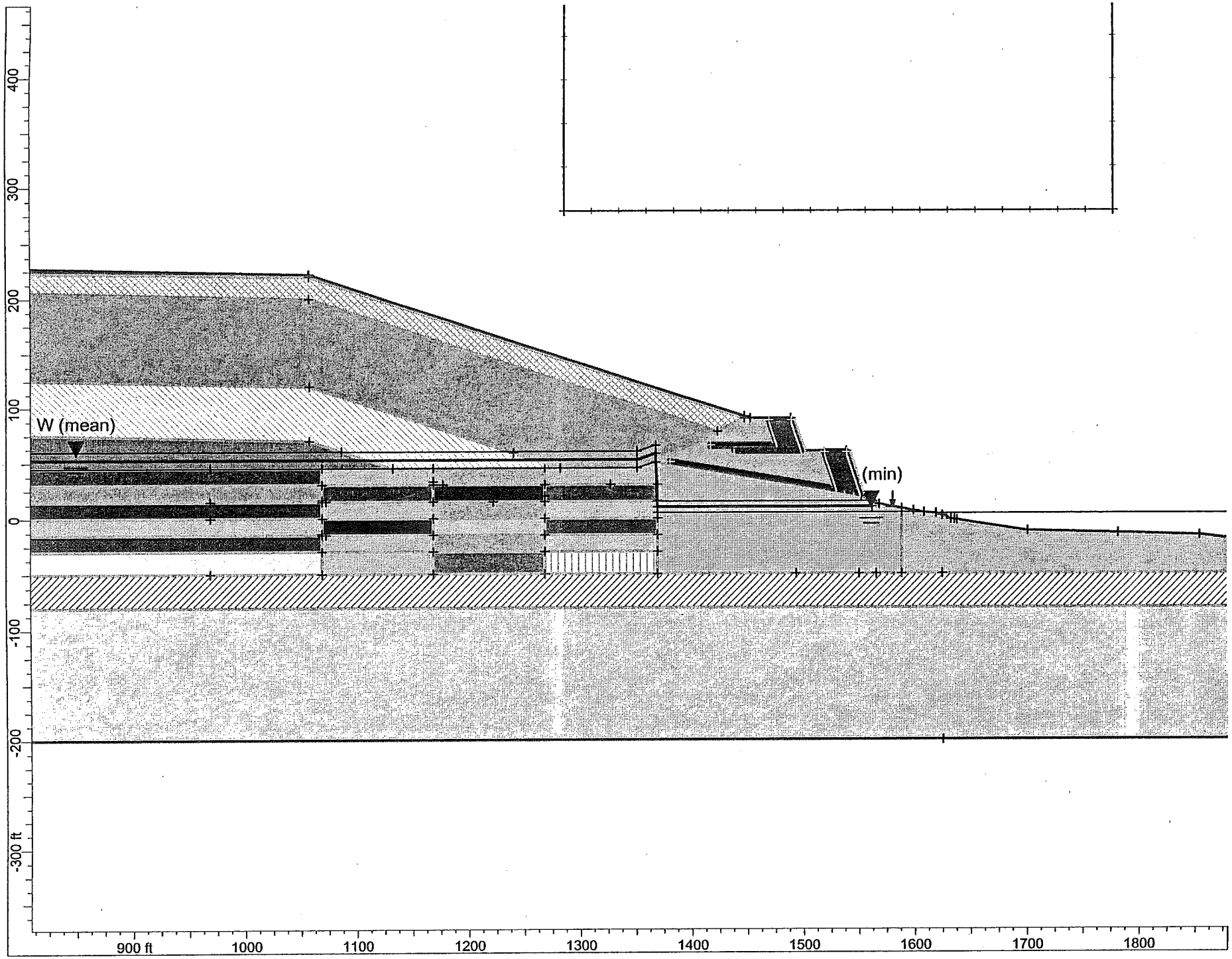
FIGURE M.7

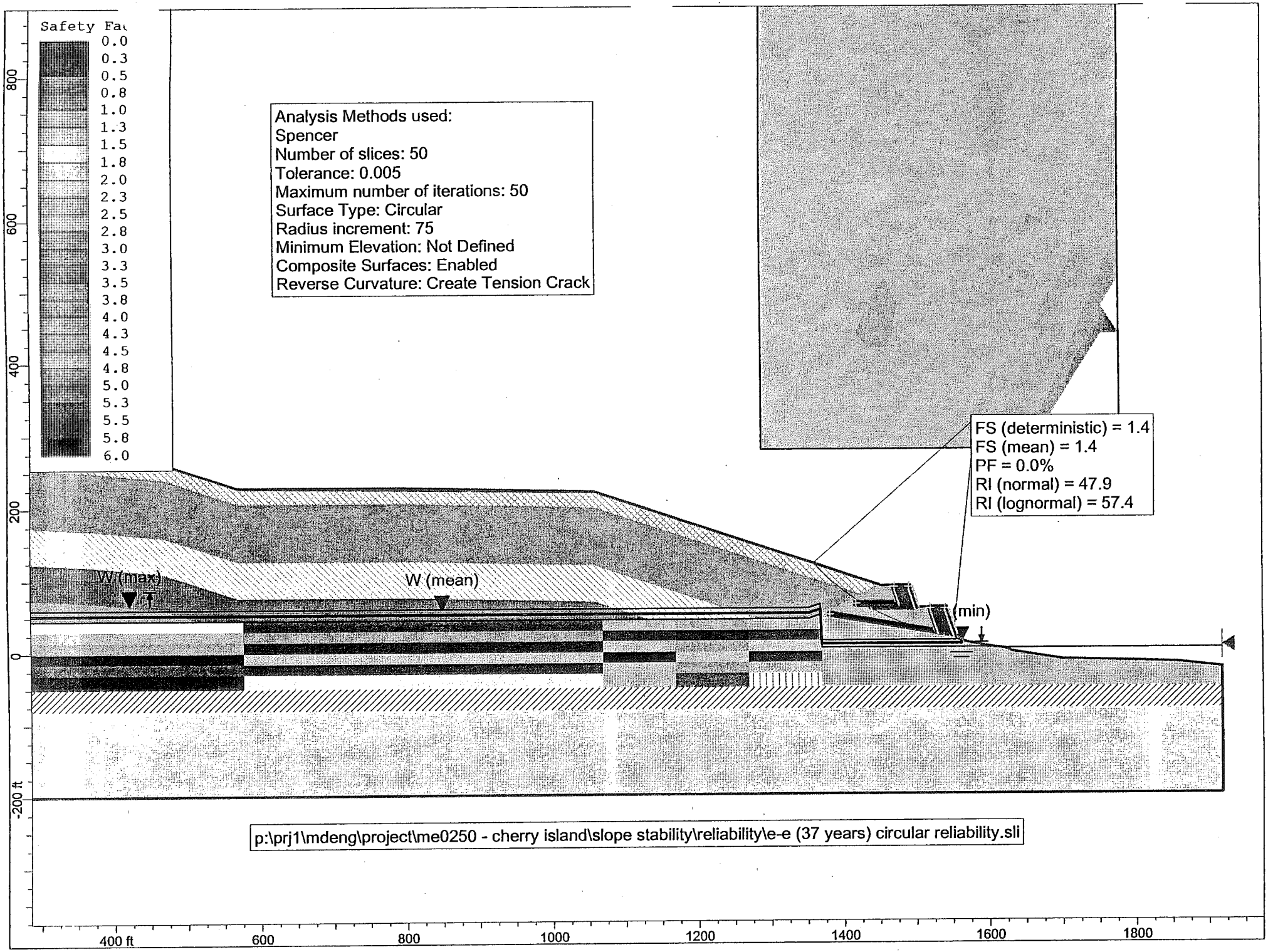
Reliability Analysis
Section E-E
Circular Analysis





Task	Initials	Date
Analysis Performed by:	SMW	4/1/03
Assumptions Checked by:	RDE	4/1/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:	RDE	4/2/03
Analysis Backchecked by:	SMW	4/2/03


400
300
200
100
0
-100
-200
-300 ft
W (mean)
(min)
900 ft
1000
1100
1200
1300
1400
1500
1600
1700
1800


Safety Fa
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
3.8
4.0
4.3
4.5
4.8
5.0
5.3
5.5
5.8
6.0
Analysis Methods used:
Spencer
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50
Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack
FS (deterministic) = 1.4
FS (mean) = 1.4
PF = 0.0%
RI (normal) = 47.9
RI (lognormal) = 57.4
W (max)
W (mean)
(min)
p:\prj1\mdeng\project\me0250 - cherry island\slope stability\reliability\e-e (37 years) circular reliability.sli
800
600
400
200
0
-200 ft
400 ft
600
800
1000
1200
1400
1600
1800

Slide Analysis Information

Document Name

File Name: e-e (37 years) circular reliability

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: rand

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 750 psf
Friction Angle: 34 degrees
Water Surface: Water Table

Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1982 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1772 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1647 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1609 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2419 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2605 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2226 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1984 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1881 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1951 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2910 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3237 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2580 psf
Water Surface: None

Material: d33
Strength Type: Undrained

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2134 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1944 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2022 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3586 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2615 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2056 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1933 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2235 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3807 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4192 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2833 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2144 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2031 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2480 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4428 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.31
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
FS: 1.448320
Center: 1581.952, 318.535
Radius: 297.325
Left Slip Surface Endpoint: 1359.325, 121.458
Right Slip Surface Endpoint: 1551.549, 22.769
Resisting Moment=8.17363e+007 lb-ft
Driving Moment=5.64351e+007 lb-ft
Resisting Horizontal Force=251710 lb
Driving Horizontal Force=173794 lb

Valid / Invalid Surfaces

Method: spencer
Number of Valid Surfaces: 16939
Number of Invalid Surfaces: 16577
Error Codes:
Error Code -106 reported for 194 surfaces
Error Code -110 reported for 13759 surfaces
Error Code -1000 reported for 2624 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than
0.0001 * (maximum horizontal extent of soil region).
This limitation is imposed to avoid numerical errors
which may result from too many slices, or too
small a slip region.

-110 = The water table or a piezoline
does not span the slip region for a given slip
surface, when Water Surfaces is specified as
the method of pore pressure calculation. If this
error occurs, check that the water table or
piezoline(s) span the appropriate soil cells.

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

Probabilistic Analysis Input

Project Settings
Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Monte-Carlo
Number of Samples: 2500
Analysis Type: Global Minimum

Material: Waste (0 to 20)
Property: Phi
Distribution: Beta
Minimum: 30 (relative minimum: 3)
Mean: 33
Maximum: 35 (relative maximum: 2)
Standard Deviation: 0.833333

Material: Waste (0 to 20)
Property: Unit Weight
Distribution: Beta
Minimum: 45 (relative minimum: 15)
Mean: 60
Maximum: 71 (relative maximum: 11)
Standard Deviation: 4.33333

Material: Waste (20 to 100)
Property: Phi
Distribution: Beta
Minimum: 30 (relative minimum: 3)
Mean: 33
Maximum: 35 (relative maximum: 2)
Standard Deviation: 0.833333

Material: Waste (20 to 100)
Property: Unit Weight
Distribution: Beta
Minimum: 56 (relative minimum: 19)
Mean: 75
Maximum: 83 (relative maximum: 8)
Standard Deviation: 4.5

Material: Waste (100 to 150)
Property: Phi
Distribution: Beta
Minimum: 30 (relative minimum: 3)
Mean: 33
Maximum: 35 (relative maximum: 2)
Standard Deviation: 0.833333

Material: Waste (100 to 150)
Property: Unit Weight
Distribution: Beta
Minimum: 70 (relative minimum: 10)
Mean: 80
Maximum: 97 (relative maximum: 17)
Standard Deviation: 4.5

Material: Waste (150 to 200)
Property: Phi
Distribution: Beta
Minimum: 30 (relative minimum: 3)
Mean: 33
Maximum: 35 (relative maximum: 2)
Standard Deviation: 0.833333

Material: Waste (150 to 200)
Property: Unit Weight
Distribution: Beta
Minimum: 79 (relative minimum: 6)
Mean: 85
Maximum: 104 (relative maximum: 19)
Standard Deviation: 4.16667

Material: Waste (>200)
Property: Phi
Distribution: Beta
Minimum: 30 (relative minimum: 3)
Mean: 33
Maximum: 35 (relative maximum: 2)
Standard Deviation: 0.833333

Material: Waste (>200)
Property: Unit Weight
Distribution: Beta
Minimum: 82 (relative minimum: 8)
Mean: 90
Maximum: 106 (relative maximum: 16)
Standard Deviation: 4

Material: Drained PVD Area
Property: Unit Weight
Distribution: Normal
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)
Standard Deviation: 3.33333

Material: Drained PVD Area
Property: Cohesion
Distribution: Normal
Minimum: 620 (relative minimum: 130)
Mean: 750
Maximum: 840 (relative maximum: 90)
Standard Deviation: 36.6667

Material: Drained PVD Area
Property: Phi
Distribution: Normal
Minimum: 32 (relative minimum: 2)
Mean: 34
Maximum: 35 (relative maximum: 1)
Standard Deviation: 0.5

Material: d11
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d11
Property: Cohesion
Distribution: Uniform
Minimum: 1387 (relative minimum: 595)
Mean: 1982
Maximum: 2577 (relative maximum: 595)

Material: d12
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d12
Property: Cohesion
Distribution: Uniform
Minimum: 1241 (relative minimum: 531)
Mean: 1772
Maximum: 2304 (relative maximum: 532)

Material: d13
Property: Cohesion
Distribution: Uniform
Minimum: 1153 (relative minimum: 494)
Mean: 1647
Maximum: 2140 (relative maximum: 493)

Material: d13
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d14
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d14
Property: Cohesion
Distribution: Uniform
Minimum: 1126 (relative minimum: 483)
Mean: 1609
Maximum: 2091 (relative maximum: 482)

Material: d15
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d15
Property: Cohesion
Distribution: Uniform
Minimum: 1187 (relative minimum: 508)
Mean: 1695
Maximum: 2204 (relative maximum: 509)

Material: d16
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d16
Property: Cohesion
Distribution: Uniform
Minimum: 1694 (relative minimum: 725)

Mean: 2419
Maximum: 3145 (relative maximum: 726)

Material: d21
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d21
Property: Cohesion
Distribution: Uniform
Minimum: 1824 (relative minimum: 781)
Mean: 2605
Maximum: 3387 (relative maximum: 782)

Material: d22
Property: Cohesion
Distribution: Uniform
Minimum: 1558 (relative minimum: 668)
Mean: 2226
Maximum: 2894 (relative maximum: 668)

Material: d22
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d23
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d23
Property: Cohesion
Distribution: Uniform
Minimum: 1389 (relative minimum: 595)
Mean: 1984
Maximum: 2579 (relative maximum: 595)

Material: d24
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d24
Property: Cohesion
Distribution: Uniform
Minimum: 1317 (relative minimum: 564)
Mean: 1881
Maximum: 2445 (relative maximum: 564)

Material: d25
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d25
Property: Cohesion
Distribution: Uniform
Minimum: 1365 (relative minimum: 586)
Mean: 1951
Maximum: 2536 (relative maximum: 585)

Material: d26
Property: Cohesion
Distribution: Uniform
Minimum: 2037 (relative minimum: 873)
Mean: 2910
Maximum: 3783 (relative maximum: 873)

Material: d26
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d31
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d31
Property: Cohesion
Distribution: Uniform
Minimum: 2266 (relative minimum: 971)

Mean: 3237
Maximum: 4208 (relative maximum: 971)

Material: d32
Property: Cohesion
Distribution: Uniform
Minimum: 1806 (relative minimum: 774)
Mean: 2580
Maximum: 3354 (relative maximum: 774)

Material: d32
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d33
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d33
Property: Cohesion
Distribution: Uniform
Minimum: 1494 (relative minimum: 640)
Mean: 2134
Maximum: 2775 (relative maximum: 641)

Material: d34
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d34
Property: Cohesion
Distribution: Uniform
Minimum: 1361 (relative minimum: 583)
Mean: 1944
Maximum: 2527 (relative maximum: 583)

Material: d35
Property: Cohesion
Distribution: Uniform
Minimum: 1415 (relative minimum: 607)
Mean: 2022
Maximum: 2628 (relative maximum: 606)

Material: d35
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d36
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d36
Property: Cohesion
Distribution: Uniform
Minimum: 2342 (relative minimum: 1004)
Mean: 3346
Maximum: 4349 (relative maximum: 1003)

Material: d41
Property: Cohesion
Distribution: Uniform
Minimum: 2510 (relative minimum: 1076)
Mean: 3586
Maximum: 4662 (relative maximum: 1076)

Material: d41
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d42
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d42
Property: Cohesion
Distribution: Uniform
Minimum: 1830 (relative minimum: 785)

Mean: 2615
Maximum: 3399 (relative maximum: 784)

Material: d43
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d43
Property: Cohesion
Distribution: Uniform
Minimum: 1439 (relative minimum: 617)
Mean: 2056
Maximum: 2673 (relative maximum: 617)

Material: d44
Property: Cohesion
Distribution: Uniform
Minimum: 1353 (relative minimum: 580)
Mean: 1933
Maximum: 2513 (relative maximum: 580)

Material: d44
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d45
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d45
Property: Cohesion
Distribution: Uniform
Minimum: 1565 (relative minimum: 670)
Mean: 2235
Maximum: 2906 (relative maximum: 671)

Material: d46
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d46
Property: Cohesion
Distribution: Uniform
Minimum: 2665 (relative minimum: 1142)
Mean: 3807
Maximum: 4949 (relative maximum: 1142)

Material: d51
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d51
Property: Cohesion
Distribution: Uniform
Minimum: 2935 (relative minimum: 1257)
Mean: 4192
Maximum: 5450 (relative maximum: 1258)

Material: d52
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d52
Property: Cohesion
Distribution: Uniform
Minimum: 1983 (relative minimum: 850)
Mean: 2833
Maximum: 3683 (relative maximum: 850)

Material: d53
Property: Cohesion
Distribution: Uniform
Minimum: 1501 (relative minimum: 643)
Mean: 2144
Maximum: 2787 (relative maximum: 643)

Material: d53
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)

Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d54
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d54
Property: Cohesion
Distribution: Uniform
Minimum: 1422 (relative minimum: 609)
Mean: 2031
Maximum: 2640 (relative maximum: 609)

Material: d55
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d55
Property: Cohesion
Distribution: Uniform
Minimum: 1736 (relative minimum: 744)
Mean: 2480
Maximum: 3224 (relative maximum: 744)

Material: d56
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d56
Property: Cohesion
Distribution: Uniform
Minimum: 3100 (relative minimum: 1328)
Mean: 4428
Maximum: 5757 (relative maximum: 1329)

Material: River Sediments
Property: Unit Weight
Distribution: Normal
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)
Standard Deviation: 3.33333

Material: River Sediments
Property: Vertical Stress Ratio
Distribution: Normal
Minimum: 0.28 (relative minimum: 0.03)
Mean: 0.31
Maximum: 0.33 (relative maximum: 0.02)
Standard Deviation: 0.00833333

Material: Wetlands
Property: Vertical Stress Ratio
Distribution: Normal
Minimum: 0.28 (relative minimum: 0.03)
Mean: 0.31
Maximum: 0.33 (relative maximum: 0.02)
Standard Deviation: 0.00833333

Material: Wetlands
Property: Unit Weight
Distribution: Normal
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)
Standard Deviation: 3.33333

Water Table Location
Distribution: Normal
Normalized Mean: 0.5
Normalized Standard Deviation: 0

Correlation Coefficients
Material: Drained PVD Area
Correlation: 1

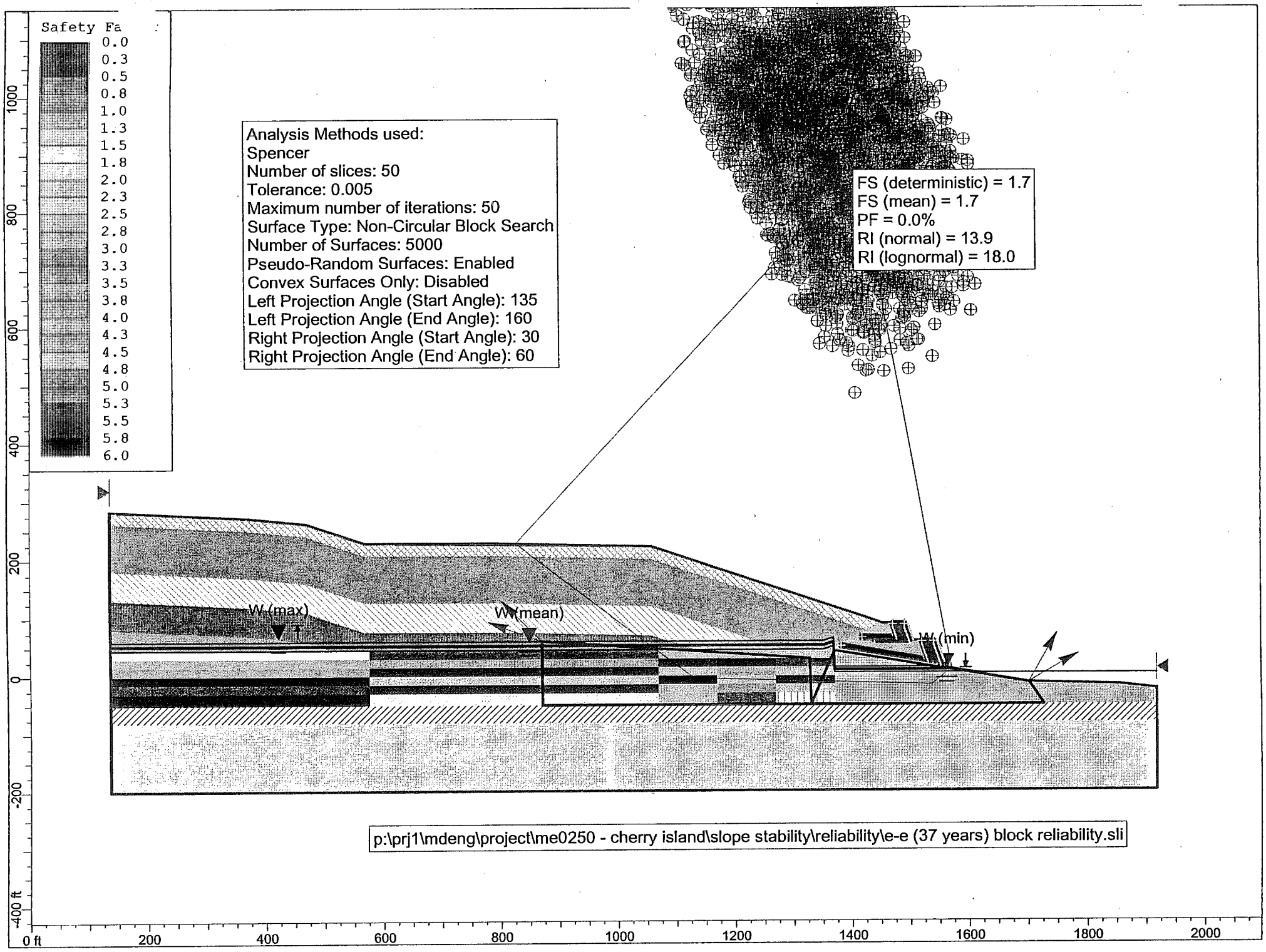
Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.449533
Factor of Safety, standard deviation: 0.009380
Factor of Safety, minimum: 1.423720
Factor of Safety, maximum: 1.478690
Probability of Failure: 0.000% (= 0 failed surfaces / 2500 valid surfaces)
Reliablity index: 47.92368 (assuming normal distribution)
Reliablity index: 57.36582 (assuming lognormal distribution)

* best fit = Beta

Reliability Analysis
Section E-E
Block Analysis

Task	Initials	Date
Analysis Performed by:	BMO	4/1/03
Assumptions Checked by:	RDE	4/1/03
Geometry Stratigraphy Checked by:	DTM	4/2/03
Input Parameters Checked by:	DTM	4/2/03
Input Parameter Implementation Checked by:	DTM	4/2/03
Reasonableness of Analysis Checked by:	RDE	4/4/03
Analysis Backchecked by:	BMO	4/2/03


Safety Fa
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
3.8
4.0
4.3
4.5
4.8
5.0
5.3
5.5
5.8
6.0
Analysis Methods used:
Spencer
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50
Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60
FS (deterministic) = 1.7
FS (mean) = 1.7
PF = 0.0%
RI (normal) = 13.9
RI (lognormal) = 18.0
W (max)
W (mean)
W (min)
p:\prj1\mdeng\project\me0250 - cherry island\slope stability\reliability\e-e (37 years) block reliability.sli
1000
800
600
400
200
0
-200
-400 ft
0 ft
200
400
600
800
1000
1200
1400
1600
1800
2000

Slide Analysis Information

Document Name

File Name: e-e (37 years) block reliability

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: rand

Analysis Methods

Analysis Methods used:
Spencer

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

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3

Cohesion: 750 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1982 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1772 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1647 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1609 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2419 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2605 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2226 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1984 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1881 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1951 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2910 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3237 psf
Water Surface: None

Material: d32
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2580 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2134 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1944 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2022 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3586 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2615 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2056 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1933 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2235 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3807 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4192 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2833 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2144 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2031 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3

Cohesion Type: Constant
Cohesion: 2480 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4428 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.31
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
FS: 1.712530
Axis Location: 1414.116, 863.079
Left Slip Surface Endpoint: 826.823, 227.097
Right Slip Surface Endpoint: 1570.526, 11.655
Resisting Moment=2.39652e+009 lb-ft
Driving Moment=1.3994e+009 lb-ft
Resisting Horizontal Force=2.50711e+006 lb
Driving Horizontal Force=1.46398e+006 lb

Valid / Invalid Surfaces

Method: spencer
Number of Valid Surfaces: 2007
Number of Invalid Surfaces: 2993
Error Codes:
Error Code -108 reported for 553 surfaces
Error Code -110 reported for 2323 surfaces
Error Code -111 reported for 109 surfaces
Error Code -112 reported for 8 surfaces

Error Codes

The following errors were encountered during the computation:

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

-110 = The water table or a piezoline
does not span the slip region for a given slip
surface, when Water Surfaces is specified as
the method of pore pressure calculation. If this
error occurs, check that the water table or
piezoline(s) span the appropriate soil cells.

-111 = safety factor equation did not converge

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

Probabilistic Analysis Input

Project Settings
Sensitivity Analysis: On
Probabilistic Analysis: On
Sampling Method: Monte-Carlo
Number of Samples: 2500
Analysis Type: Global Minimum

Material: Waste (0 to 20)
Property: Phi
Distribution: Beta
Minimum: 30 (relative minimum: 3)
Mean: 33
Maximum: 35 (relative maximum: 2)
Standard Deviation: 0.833333

Material: Waste (0 to 20)
Property: Unit Weight
Distribution: Beta
Minimum: 45 (relative minimum: 15)
Mean: 60
Maximum: 71 (relative maximum: 11)
Standard Deviation: 4.33333

Material: Waste (20 to 100)
Property: Phi
Distribution: Beta
Minimum: 30 (relative minimum: 3)
Mean: 33
Maximum: 35 (relative maximum: 2)
Standard Deviation: 0.833333

Material: Waste (20 to 100)
Property: Unit Weight
Distribution: Beta
Minimum: 56 (relative minimum: 19)
Mean: 75
Maximum: 83 (relative maximum: 8)
Standard Deviation: 4.5

Material: Waste (100 to 150)
Property: Phi
Distribution: Beta
Minimum: 30 (relative minimum: 3)
Mean: 33
Maximum: 35 (relative maximum: 2)
Standard Deviation: 0.833333

Material: Waste (100 to 150)
Property: Unit Weight
Distribution: Beta
Minimum: 70 (relative minimum: 10)
Mean: 80
Maximum: 97 (relative maximum: 17)
Standard Deviation: 4.5

Material: Waste (150 to 200)
Property: Phi
Distribution: Beta
Minimum: 30 (relative minimum: 3)
Mean: 33
Maximum: 35 (relative maximum: 2)
Standard Deviation: 0.833333

Material: Waste (150 to 200)
Property: Unit Weight
Distribution: Beta
Minimum: 79 (relative minimum: 6)
Mean: 85
Maximum: 104 (relative maximum: 19)
Standard Deviation: 4.16667

Material: Waste (>200)
Property: Phi
Distribution: Beta
Minimum: 30 (relative minimum: 3)
Mean: 33
Maximum: 35 (relative maximum: 2)
Standard Deviation: 0.833333

Material: Waste (>200)
Property: Unit Weight
Distribution: Beta
Minimum: 82 (relative minimum: 8)
Mean: 90
Maximum: 106 (relative maximum: 16)
Standard Deviation: 4

Material: Drained PVD Area
Property: Unit Weight
Distribution: Normal
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)
Standard Deviation: 3.33333

Material: Drained PVD Area
Property: Cohesion
Distribution: Normal
Minimum: 620 (relative minimum: 130)
Mean: 750
Maximum: 840 (relative maximum: 90)
Standard Deviation: 36.6667

Material: Drained PVD Area
Property: Phi
Distribution: Normal
Minimum: 32 (relative minimum: 2)
Mean: 34
Maximum: 35 (relative maximum: 1)
Standard Deviation: 0.5

Material: d11
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d11
Property: Cohesion
Distribution: Uniform
Minimum: 1387 (relative minimum: 595)
Mean: 1982
Maximum: 2577 (relative maximum: 595)

Material: d12
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d12
Property: Cohesion
Distribution: Uniform
Minimum: 1241 (relative minimum: 531)
Mean: 1772
Maximum: 2304 (relative maximum: 532)

Material: d13
Property: Cohesion
Distribution: Uniform
Minimum: 1153 (relative minimum: 494)
Mean: 1647
Maximum: 2140 (relative maximum: 493)

Material: d13
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d14
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d14
Property: Cohesion
Distribution: Uniform
Minimum: 1126 (relative minimum: 483)
Mean: 1609
Maximum: 2091 (relative maximum: 482)

Material: d15
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d15
Property: Cohesion
Distribution: Uniform
Minimum: 1187 (relative minimum: 508)
Mean: 1695
Maximum: 2204 (relative maximum: 509)

Material: d16
Property: Unit Weight
Distribution: Uniform

Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d16
Property: Cohesion
Distribution: Uniform
Minimum: 1694 (relative minimum: 725)
Mean: 2419
Maximum: 3145 (relative maximum: 726)

Material: d21
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d21
Property: Cohesion
Distribution: Uniform
Minimum: 1824 (relative minimum: 781)
Mean: 2605
Maximum: 3387 (relative maximum: 782)

Material: d22
Property: Cohesion
Distribution: Uniform
Minimum: 1558 (relative minimum: 668)
Mean: 2226
Maximum: 2894 (relative maximum: 668)

Material: d22
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d23
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d23
Property: Cohesion
Distribution: Uniform
Minimum: 1389 (relative minimum: 595)
Mean: 1984
Maximum: 2579 (relative maximum: 595)

Material: d24
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d24
Property: Cohesion
Distribution: Uniform
Minimum: 1317 (relative minimum: 564)
Mean: 1881
Maximum: 2445 (relative maximum: 564)

Material: d25
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d25
Property: Cohesion
Distribution: Uniform
Minimum: 1365 (relative minimum: 586)
Mean: 1951
Maximum: 2536 (relative maximum: 585)

Material: d26
Property: Cohesion
Distribution: Uniform
Minimum: 2037 (relative minimum: 873)
Mean: 2910
Maximum: 3783 (relative maximum: 873)

Material: d26
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d31
Property: Unit Weight
Distribution: Uniform

Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d31
Property: Cohesion
Distribution: Uniform
Minimum: 2266 (relative minimum: 971)
Mean: 3237
Maximum: 4208 (relative maximum: 971)

Material: d32
Property: Cohesion
Distribution: Uniform
Minimum: 1806 (relative minimum: 774)
Mean: 2580
Maximum: 3354 (relative maximum: 774)

Material: d32
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d33
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d33
Property: Cohesion
Distribution: Uniform
Minimum: 1494 (relative minimum: 640)
Mean: 2134
Maximum: 2775 (relative maximum: 641)

Material: d34
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d34
Property: Cohesion
Distribution: Uniform
Minimum: 1361 (relative minimum: 583)
Mean: 1944
Maximum: 2527 (relative maximum: 583)

Material: d35
Property: Cohesion
Distribution: Uniform
Minimum: 1415 (relative minimum: 607)
Mean: 2022
Maximum: 2628 (relative maximum: 606)

Material: d35
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d36
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d36
Property: Cohesion
Distribution: Uniform
Minimum: 2342 (relative minimum: 1004)
Mean: 3346
Maximum: 4349 (relative maximum: 1003)

Material: d41
Property: Cohesion
Distribution: Uniform
Minimum: 2510 (relative minimum: 1076)
Mean: 3586
Maximum: 4662 (relative maximum: 1076)

Material: d41
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d42
Property: Unit Weight
Distribution: Uniform

Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d42
Property: Cohesion
Distribution: Uniform
Minimum: 1830 (relative minimum: 785)
Mean: 2615
Maximum: 3399 (relative maximum: 784)

Material: d43
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d43
Property: Cohesion
Distribution: Uniform
Minimum: 1439 (relative minimum: 617)
Mean: 2056
Maximum: 2673 (relative maximum: 617)

Material: d44
Property: Cohesion
Distribution: Uniform
Minimum: 1353 (relative minimum: 580)
Mean: 1933
Maximum: 2513 (relative maximum: 580)

Material: d44
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d45
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d45
Property: Cohesion
Distribution: Uniform
Minimum: 1565 (relative minimum: 670)
Mean: 2235
Maximum: 2906 (relative maximum: 671)

Material: d46
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d46
Property: Cohesion
Distribution: Uniform
Minimum: 2665 (relative minimum: 1142)
Mean: 3807
Maximum: 4949 (relative maximum: 1142)

Material: d51
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d51
Property: Cohesion
Distribution: Uniform
Minimum: 2935 (relative minimum: 1257)
Mean: 4192
Maximum: 5450 (relative maximum: 1258)

Material: d52
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d52
Property: Cohesion
Distribution: Uniform
Minimum: 1983 (relative minimum: 850)
Mean: 2833
Maximum: 3683 (relative maximum: 850)

Material: d53
Property: Cohesion
Distribution: Uniform

Minimum: 1501 (relative minimum: 643)
Mean: 2144
Maximum: 2787 (relative maximum: 643)

Material: d53
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d54
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d54
Property: Cohesion
Distribution: Uniform
Minimum: 1422 (relative minimum: 609)
Mean: 2031
Maximum: 2640 (relative maximum: 609)

Material: d55
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d55
Property: Cohesion
Distribution: Uniform
Minimum: 1736 (relative minimum: 744)
Mean: 2480
Maximum: 3224 (relative maximum: 744)

Material: d56
Property: Unit Weight
Distribution: Uniform
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)

Material: d56
Property: Cohesion
Distribution: Uniform
Minimum: 3100 (relative minimum: 1328)
Mean: 4428
Maximum: 5757 (relative maximum: 1329)

Material: River Sediments
Property: Unit Weight
Distribution: Normal
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)
Standard Deviation: 3.33333

Material: River Sediments
Property: Vertical Stress Ratio
Distribution: Normal
Minimum: 0.28 (relative minimum: 0.03)
Mean: 0.31
Maximum: 0.33 (relative maximum: 0.02)
Standard Deviation: 0.00833333

Material: Wetlands
Property: Vertical Stress Ratio
Distribution: Normal
Minimum: 0.28 (relative minimum: 0.03)
Mean: 0.31
Maximum: 0.33 (relative maximum: 0.02)
Standard Deviation: 0.00833333

Material: Wetlands
Property: Unit Weight
Distribution: Normal
Minimum: 75 (relative minimum: 10)
Mean: 85
Maximum: 95 (relative maximum: 10)
Standard Deviation: 3.33333

Water Table Location
Distribution: Normal
Normalized Mean: 0.5
Normalized Standard Deviation: 0

Correlation Coefficients
Material: Drained PVD Area
Correlation: 1

Probabilistic Analysis Results (Global Minimum)

Method: spencer
Factor of Safety, mean: 1.722495
Factor of Safety, standard deviation: 0.052081
Factor of Safety, minimum: 1.566230
Factor of Safety, maximum: 1.896840
Probability of Failure: 0.000% (= 0 failed surfaces / 2500 valid surfaces)
Reliablity index: 13.87245 (assuming normal distribution)
Reliablity index: 17.97333 (assuming lognormal distribution) * best fit = Lognormal