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**OAK RIDGE
NATIONAL
LABORATORY**

LOCKHEED MARTIN

**White Oak Dam
Stability Analysis**

Volume II

Syed B. Ahmed

940R2246

MANAGED AND OPERATED BY
LOCKHEED MARTIN ENERGY RESEARCH CORPORATION
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

ORNL-27 (3-96)

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X-OE-708

Central Engineering Services Division

**WHITE OAK DAM
STABILITY ANALYSIS**

APPENDIX

VOLUME II

Date Issued--January 1994

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Oak Ridge, Tennessee
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for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400**

APPENDIX

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A-1 CALCULATION - SOIL PROPERTIES

**MARTIN MARIETTA ENERGY SYSTEMS
DESIGN ANALYSIS AND CALCULATIONS - (DAC)**

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PROJECT NO./TITLE <i>White Oak Dam Soil Properties Evaluation</i>		DATE STARTED <i>1-7-93</i>
LOCATION SITE <i>X-10</i>		BUILDING(S) OR AREA <i>White Oak Dam</i>
TEAM PE <i>N/A</i>		RED <i>Syed B Ahmed</i>
DEPT. <i>CV</i>		DESIGNERS (CONTRIBUTING)
		CALC. NO. <i>DAC. - CV-020030-A001</i>
		ESO <i>Ax453007</i>
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Applies to Project - WBS/Items/Systems:

And Reports/Dwgs./Rev. No.:

	REV. 0	REV. 1	REV. 2	REV. 3
Signature / Date				
Prepared by: <i>Syed B Ahmed 1/24/94</i>				
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Other Designers: <i>N/A</i>				
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Approved by RED: <i>1</i>				
Approved by Supervisor: <i>W E Manrood 1/24/94</i>				
Reviewed by PE: <i>N/A</i>				
Other: <i>N/A</i>				

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	2.0 Basis for Design/Evaluation
	2.1 Scope
2	2.2 References
3	3.0 Analysis and Calculations
13	4.0 Conclusions and Recommendations
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Fig. 1

GENERAL DESIGN AND COMPUTATION SHEET

JOB	White Oak Dam	DATE	1-22-94	SHEET	1 of 14
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WHITE OAK DAM - Soil Properties Evaluation

1.0 Introduction & Objective.

White Oak Dam is an earth & rockfill structure originally constructed as a roadway embankment over White Oak Creek. The rockfill berm on the downstream slope and the Emergency Spillway were completed in 1980 and 1983, respectively. The main objective of this calculation is to evaluate ranges of engineering properties for WOD embankment and foundation materials. These calculated properties will be used in the parametric study of the WOD slope stability Analysis (Ref. 1)

2.0 Basis for Design/Evaluation

Soil Investigation data from Ref. 2 and 3 will be used. However, if the information in Ref. 2 and 3 is not sufficient, the soil properties will be evaluated from the literature search (Ref. 4, 5, 6, & 7).

2.1 Scope.

For slope stability analysis, shear strength properties and the unit weights of the materials are generally required. This calculation is limited to the evaluation of the shear strength parameters in terms of cohesion c and angle of internal friction ϕ , and the unit weights of the materials presented on soil Profiles 1, 2, and 3.

Total unit weight, Saturated unit weight, Apparent (consolidated-undrained) and Effective (consolidated-drained) cohesion and angle of internal friction will be determined for the

GENERAL DESIGN AND COMPUTATION SHEET

JOB	White Oak Dam	DATE	1-22-94	SHEET	2 of 14
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following soil/material layers encountered in the WOD embankment and foundation.

- a) Soft Silty Clay
- b) medium silty clay
- c) Stiff silty clay
- d) very stiff silty clay
- e) Rockfill, and
- f) Foundation rock.

2.2 References.

- (1) MMES "White Oak Dam - Stability Analysis Meeting 7/23/92 Minutes" dated July 29, 92.
- (2) Geotek Report, "Evaluation of White Oak Dam" Geotek Project No. 79-687 B, dated Nov. 14, 1979.
- (3) Geologic Associates, EDGE, Report "White Oak Dam Investigation" GA File No. 88-X503, dated Apr. 12, 1988.
- (4) TVA calculation B04 '89 0530 200 "Intake Channel Slope Stability Analysis, Browns Ferry Nuclear plant" dated May 26, 1989.
- (5) Drum, Eric C., and Bennett, Richard M., "Slope Stability Analysis of White Oak Dam," Apr. 21, 1988
- (6) Tennessee Valley Authority, "Correlation of Properties of Laboratory Compacted Soils" CE.84-28, Dec. 12, 1984.
- (7) NAVFAC DM-7.2 "Foundations and Earth Structures", May 1982 Department of Navy, Naval Facilities Engineering Command.

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JOB WHITE OAK DAM

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SHEET 3 of 1.

ESO NO. A8018 ABI

COMPUTED SBA

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3.0 Analysis and Calculations

Soft silty clay; $N \leq 4$; $q_m = 0.25 - 0.5 \text{ tsf}$ i.e. 500 - 1000 psf

Refer (2) GEOTEK Data: Unconfined Compressive Strength (q_u)

Boring 9, depth 8.0', $q_u = 850 \text{ psf}$

" " , " 12.0' , $= 570 \text{ "}$

" " , " 14.0' , $= 680 \text{ "}$

Range $q_u = 570 - 850 \text{ psf}$.

Range Cohesion $C = \frac{1}{2} q_u = 285 - 425 \text{ psf}$

A literature search was made to estimate a range of $C-u$, and $C-d$ shear strength properties but there was no information available in soil mechanics Text books and some other projects I worked on except for TVA Browns Ferry Nuclear Plant (BFN) (Ref. 4).
 $C-u$ shear strength at BFN for soft clay; $\phi = 10^\circ$, $C = 460 \text{ psf}$
 and $\phi = 0$, $C = 285 \text{ psf}$.

For $C-u$, $\phi = 0$, and $C = 285 - 425 \text{ psf}$ should be conservative.

Similarly for $C-d$; use $\phi = 0$, and $C = 285 - 425 \text{ psf}$.

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Medium (stiff) clay - $N = 4 \text{ to } 8$; $q_u = 0.5 \text{ to } 1.0 \text{ tsf}$ i.e. 1000 to 2000 psf ^{Tc}

Ref. 3, Geologic Associates Test Data on Shelby tube sample
(corresponding SPT sample $N=6$) Boring # C, depth 16.5-18.5 ft Sample # 2

C-u $\phi = 16^\circ$, $C = 225 \text{ PSF}$ by Dr. Drumm ^(Ref. 5) from P-q criteria.

$\phi = 16^\circ$, $C = 260 \text{ PSF}$ by Syed Ahmed from Mohr's circle
for max. $\frac{\sigma_1}{\sigma_3}$

Therefore use $\phi = 16^\circ$, and $C = 225 - 260 \text{ PSF}$.

C-d $\phi = 30^\circ$, $C = 0$ by Dr. Drumm from P-q curve

$\phi = 29.5^\circ$, $C = 70 \text{ PSF}$ by Syed Ahmed from Mohr's circle
for max. $\frac{\sigma_1}{\sigma_3}$

Therefore use $\phi = 29 - 30^\circ$, and $C = 0 \text{ to } 70 \text{ PSF}$

Lower Bound $\phi = 30^\circ$, $C = 0$

Upper Bound $\phi = 29^\circ$, $C = 70 \text{ PSF}$

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JOB White Oak Dam - Slope Stability

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Consolidated Undrained Triaxial Test (Pore Pressure Measurement)

Total Shear strength: $\phi = 16^\circ$, $c = 260 \text{ psf}$
(Apparent)

medium silty clay

$\phi = 16^\circ$, $c = 1.8 \text{ PSI} (259 \text{ psf})$

GENERAL DESIGN AND COMPUTATION SHEET

JOB White Oak Dam - Slope Stability DATE 1-9-93 SHEET 6 of 14
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Consolidated-Undrained Triaxial Test (Pore Pressure measurement)

Effective Shear Strength

Medium silty clay

Shear Stress, Psi

Normal Stress, Psi

$\bar{\phi} = 29.5^\circ$, $\bar{c} = 0.5 \text{ Psi}$ (72 Psf)
 $s_{p2} = 10 \text{ Psf}$

GENERAL DESIGN AND COMPUTATION SHEET

JOB <u>White Oak Dam</u>	DATE <u>1-10-93</u>	SHEET <u>7 of 1.</u>
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Stiff Silty clay $N = 8 - 15$; $q_{cu} = 1.0 - 2.0 \text{ tsf}$ i.e. 2000 to 4000 PSF

Geotek Data: Unconfined compressive Strength.		Std. Proctor's γ_d max
Ref. (2)		Deg. of compaction
	3200 PSF	104.4
	2550 "	100.2
	3000 "	103.1
	2600 "	91.8
	3600 "	91.4

Range 2550 to 3600 PSF.

Mean: 98.18%

Range of cohesion is 1275 - 1800 PSF.

C-u Shear Strength

Looking at the Deg. of compaction, it can be compared with TVA test data for soils compacted at 95 percent compaction of Std. Proctor's max. dry density.

Index Properties

	LL	PI	γ_d , PCF
<u>Geotek Data</u>	32.6	6.8	109.8
	33.5	7.2	107.7
	33.8	4.6	108.5
	32.6	5.5	96.6
	36.6	8.5	91.4
<u>Geologic Associates</u>	47.0	16.0	—
	39.0	8.0	—
	42	20.0	92.1 (CL)
	32.6 - 47.0	4.6 - 16.0	91.4 - 109.8 PCF
Range			
Mean	37.1	9.6	101.0 PCF

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JOB <u>White Oak Dam</u>	DATE <u>1-10-93</u>	SHEET <u>8 of 14</u>
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TVA Data: Ref. 6			Std. Proctor		
<u>ML</u> : soil	<u>LL</u>	<u>PI</u>	<u>γ_{dmax} PCF</u>	<u>% γ_d</u>	<u>γ_d (pcf)</u>
Range	22.5 - 47.3	0 - 18.7	96.8 - 113.2	94.7 - 95.4	91.7 - 108.0
Mean	38.8	10.6	104.5	94.98	99.3

Comparing the mean values for LL, PI, and γ_d , it appears that the insitu stiff soil at WOD (based upon test data from Geotek/G.A. investigation) is similar to the compacted ML soil from TVA data bank^{Ref. (6)}. Therefore it seems logical to use the mean values of shear strength for the c-u, and c-d conditions.

For c-u (without pore pressure) $\phi = 15.5^\circ$, $C = 1671$ PSF.
total stress (P)

Say $\phi = 15^\circ$; $C = 1650$ PSF

From my experience $\phi = 15^\circ$ is a reasonable value; The cohesion value, however, could be reduced by $\frac{1}{3}$ to be on the conservative side. $C = \frac{2}{3}(1650) = 1100$ PSF.

Therefore for the parametric analysis, use

$\phi = 15^\circ$; $C = 1100 - 1650$ PSF.

For c-d (Effective stress); from TVA data^{Ref. (6)}, mean values of shear strength; $\bar{\phi} = 27.3^\circ$, $\bar{C} = 306$ PSF (Triaxial Tests)

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$$\bar{\Phi} = 32.4^{\circ}, \bar{C} = 295 \text{ psf (Direct shear test).}$$

A range of $\bar{\Phi} = 27 \text{ to } 32^{\circ}$ is reasonable.

For $\bar{C}$, however; reduce the value by $\frac{1}{3}$ to be on the conservative side. $\bar{C} = \frac{2}{3}(300) = 200 \text{ psf.}$

So use a range of $\bar{C} = 200 \text{ to } 300 \text{ psf}$

DM-7 Ref.(7)

Refer Table 1 Typical Properties of Compacted soils

Pg. 7.2-39 -

typical values for

For ML compacted to max. std. Proctor, effective, shear strength envelope are $\bar{\Phi} = 32^{\circ}$, and $\bar{C} = 190 \text{ psf}$. which are close to the values arrived from the TVA Data.

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JOB	White Oak Dam	DATE	1-10-93	SHEET	10 of 14
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Very Stiff Silty Clay $N = 15-30$; $q_{uc} = 2.0-4.0 \text{ tsf}$
i.e. 4000 to 8000 PSF

Refer Geotek Data. (Ref. 2)

$$q_{uc} = 4,400 \text{ PSF}$$

$$= 5,400 \text{ PSF}$$

Range of Cohesion = 2,200 - 2,700 PSF.

It appears logical to use an upperbound shear strength values of stiff silty clay;

C-u $\phi = 15^\circ$; $c = 1650 \text{ PSF}$

C-d $\bar{\phi} = 32^\circ$; $\bar{c} = 3000 \text{ PSF}$.

Rockfill

Use same shear strength properties as used by Dr. Drumm (Ref. 5)

C-u $\phi = 35^\circ$; $c = 0$

C-d $\bar{\phi} = 35^\circ$; $\bar{c} = 0$

Foundation Rock

Shear strength properties used by Dr. Drumm (Ref. 5)

C-u $\phi = 35^\circ$; $c = 5.76 \times 10^5 \text{ PSF}$

C-d $\bar{\phi} = 35^\circ$; $\bar{c} = 5.76 \times 10^5 \text{ PSF}$.

For simplicity use $\phi = 35^\circ$; and $c = 10,000 \text{ PSF}$ for both C-u and C-d shear strength properties.

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(Unit Weights)
Densities

γ_d = Dry Density ; $\gamma_{total} = \gamma_{moist}$ = Total (moist) Density

Soft silty clay

$\gamma_d = 90.3 \text{ PCF}$

$\gamma_{total} = \gamma_d (1 + \text{moist. cont}) = 90.3 (1 + .307) = 118.0 \text{ PCF}$

$= 90.7 \text{ "}$

$= 116.4 \text{ PCF}$

$= 91.5 \text{ "}$

$= 117.6 \text{ PCF}$

Mean $\gamma_d = 90.83$

Mean $\gamma_T = 117.3 \text{ PCF}$; Say $\gamma_T = 117 \text{ PCF}$

$\gamma_{sat} = (1 - \frac{1}{G}) \gamma_d + \gamma_w$;

Assume $G = 2.74$ (From TVA correlation for ML)
Ref (6)

$\gamma_{sat} = (1 - \frac{1}{2.74}) \gamma_d + 62.4 = (0.635)(90.8) + 62.4 = 120.06$

Medium Silty clay

γ_d, PCF

γ_T, PCF

96.4

121.1

109.3

122.3

92.2

118.9

97.1

123.1

98.2

110.8

Mean $\gamma_d = 98.64$

119.24 say 119 PCF ; $\gamma_{sat} = 125.03$, Say 125 PCF

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Stiff Silty clay

<u>γ_d, PCF</u>	<u>γ_T, PCF</u>
109.8	125.4
107.7	122.3
108.5	126.2
96.6	121.8
91.4	117.5
Mean <u>102.8</u>	<u>122.64</u> say <u>122 PCF.</u>

$$\gamma_{sat} = 127.6 \text{ PCF} \quad \text{say } \underline{127 \text{ PCF}}$$

Very stiff Silty clay

<u>γ_d, PCF</u>	<u>γ_T, PCF</u>
106.2	126.3
105.9	126.5
103.1	128.8
Mean <u>105.66</u>	<u>127.2</u> say <u>127 PCF</u>

$$\gamma_{sat} = 129.1 \text{ PCF}; \quad \text{say } \underline{129 \text{ PCF}}$$

Rockfill same γ_T and γ_{sat} as used by Dr. Drumm (Ref. 5) i.e.

$$\gamma_T = 135 \text{ PCF}; \quad \gamma_{sat} = 135 \text{ PCF}$$

Foundation Rock same γ_T and γ_{sat} as used by Dr. Drumm (Ref. 5)

$$\gamma_T = 165 \text{ PCF}; \quad \gamma_{sat} = 165 \text{ PCF}$$

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JOB	White Oak Dam	DATE	1-22-94	SHEET	13 of 14
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4.0 Conclusions & Recommendations.

The recommend ranges of soil/material properties covering the total unit weight, Saturated unit weight, consolidated-undrained and consolidated-undrained shear strengths are listed in Table 1 (Page 14/14)

It is concluded that the recommended Properties are reasonable for use in the parametric study relating to the stability of the White Oak Dam.

TABLE 1 SOIL PROPERTIES

SOIL	TOTAL UNIT WEIGHT (PCF)	SATURATED UNIT WEIGHT (PCF)	CONSOLIDATED - UNDRAINED SHEAR STRENGTH		CONSOLIDATED - DRAINED SHEAR STRENGTH	
			ANGLE OF INTERNAL FRICTION DEG	COHESION PSF	ANGLE OF INTERNAL FRICTION (DEG)	COHESION (PSF)
SOFT SILTY CLAY	117	120	0	285-425	0	285-425
MEDIUM SILTY CLAY	119	125	16	225-260	29-30	0-70
STIFF SILTY CLAY	122	127	15	1100-1650	27-32	200-300
VERY STIFF SILTY CLAY	127	129	15	1650	32	300
ROCKFILL	135	135	35	0	35	0
FOUNDATION ROCK	165	165	35	10000	35	10000

A-2 CALCULATION - SLOPE STABILITY ANALYSIS

**MARTIN MARIETTA ENERGY SYSTEMS
DESIGN ANALYSIS AND CALCULATIONS - (DAC)**

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PROJECT NO./TITLE <i>White Oak Dam Slope Stability Analysis</i>		DATE STARTED <i>Aug. 9, 93</i>
LOCATION SITE <i>X-10</i>		CALC. NO.: DAC. - CV-020030-A002
BUILDING(S) OR AREA <i>X AREA White Oak Dam</i>	ESO <i>A X 453007</i>	
TEAM PE	RED <i>Syed & Ahmed</i>	PJ
DEPT. <i>CV</i>	SUPV. <i>K.E. Emanuel</i>	
DESIGNERS (CONTRIBUTING)		

Applies to Project - WBS/Items/Systems:

And Reports/Dwgs./Rev. No.:

Signature / Date

Prepared by:

Lead Designer/IFA Date:

Other Designers:

Review - Approvals:

Checked by:

Approved by RED:

Approved by Supervisor:

Reviewed by PE:

Other:

REV. 0	REV. 1	REV. 2	REV. 3
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<i>K.E. Emanuel 1/24/94</i>			
<i>K.E. Emanuel 1/24/94</i>			

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2	3.0 Methods to be used
	4.0 Scope
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	7.0 Conclusions
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Fig. 1

White Oak Dam - slope Stability Analysis

Syed B Ahmed

Ax 453007

X-10

BUILDING(S) OR AREA/EIN X AREA
White Oak Dam

DESIGN ANALYSIS AND CALCULATIONS FOLDER CONTENTS FORM

GENERAL DESIGN AND COMPUTATION SHEET

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ESO NO.	AX453007	COMPUTED	SBA	CHECKED BY	

WHITE OAK DAM - SLOPE STABILITY ANALYSIS

1.0 Introduction & Objective

White Oak Dam (WOD) is an earth & rockfill structure originally constructed (in 1940s) as a roadway embankment on White Oak Creek. In 1980 rock fill berm was constructed on the downstream slope to stabilize the dam. The emergency spillway was completed in 1983 to satisfy the discharge capacity requirement.

The main objective of this calculation is to verify the stability of the WOD.

2.0 Basis for Design/Evaluation

Slope stability analysis will be performed using the soil investigation data from Ref. 1 and 2. Static and Pseudo-static analysis will be conducted on soil Profiles 1, 2, and 3. Upper bound and lower bound soil/material properties will be used. These properties are discussed in the "MMS calculations" White Oak Dam, Soil Properties evaluation".

The Evaluation Basis Earthquake (EBE)* for the WOD is defined as an earthquake with a magnitude $m_b = 5.6$ occurring about 40 km from the dam resulting in a Peak Ground Acceleration (PGA) of 0.13g at the WOD site. This EBE will be used in the slope study analysis for the seismic event.

Safety factors^(SF) will be computed and compared against the safety factors desired by FERC (Ref. 3).

* The EBE is determined for the dam hazard classification "low".

GENERAL DESIGN AND COMPUTATION SHEET

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ESO NO.	AX 453 007	COMPUTED	SBA	CHECKED BY	

3.0 Method(s) to be Used

A limiting equilibrium slope stability analysis using circular arc surfaces Modified Bishop method will be performed with the aid of the Computer Program STABL 4 (Ref. 4). This computer program will be used to determine the safety factors of both static and pseudo-static conditions of the WOD.

4.0 Scope.

Slope stability analysis will be performed to compute the minimum safety factors for the following loading conditions:

- (1) Upstream Slope - Rapid Drawdown from Max. Pool El. 755
- (2) " " - Rapid Drawdown from Top of Gate El. 750
- (3) Downstream Slope - Steady Seepage, Max. Pool El. 755
- (4) " " - Steady Seepage, Top of Gate El. 750
- (5) " " - Pseudo-static, Normal Pool El. 744
Acceleration = 0.13 g (H)

For loading conditions (1), (2), and (5), apparent shear strength (consolidated-undrained) parameters will be used.

For loading conditions (3) and (4), effective shear strength (consolidated-drained) parameters will be used.

Safety factors for shallow and skinny sliding surfaces which have no significant impact on the slope stability of the dam will be ruled out.

GENERAL DESIGN AND COMPUTATION SHEET

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5.0 References -

- (1) Geotek Report, "Evaluation of White Oak Dam" Geotek Project No. 79-687B, dated Nov. 14, 1979
- (2) Geologic Associates, EDGE, Report "White Oak Dam Investigation" GA File No. 88-X 503, dated Apr. 12, 1988.
- (3) FEDERAL ENERGY Regulatory Commission, FERC 0119-2, "Engineering Guidelines for the Evaluation of Hydro Power Projects", Apr. 1991.
- (4) Carpenter, J.R., 1985, "PC STABL4 User Manual" Report to U.S. Department of Transportation, Federal Highway Administration, Office of Research, Development and Technology, Washington, D.C.

6.0 Analysis and calculations -

The results of the analysis are tabulated on pages 4, 5, and 6.

Sliding surfaces for the most critical loading conditions are shown on pages 7 and 8.

Refer pages 9 through 280 for the computer printouts showing the details of the analysis.

7.0 Conclusions -

Based upon the results of the slope stability analyses, it is concluded that the White Oak Dam is safe and stable during the applicable static and seismic events defined in section 2.0

**SUMMARY - SLOPE STABILITY ANALYSIS
SOIL PROFILE 1**

LOADING CONDITIONS	MINIMUM FACTOR OF SAFETY			COMMENTS
	LOWER BOUND PROPERTIES	UPPER BOUND PROPERTIES	FERC	
Upstream Slope Rapid Drawdown from Max Pool (elev = 755 ft)	2.0	2.4	1.1	Acceptable
Upstream Slope Rapid Drawdown from Top of Gate (elev = 750 ft)	2.1	2.5	1.2	Acceptable
Downstream Slope Steady Seepage at Max Pool (elev = 755 ft)	1.4	1.6	1.4	Acceptable
Downstream Slope Steady Seepage at Top of Gate (elev = 750 ft)	1.4	1.6	1.5	Acceptable
Downstream Slope Normal Pool (elev = 744 ft) Seismic 0.13g(H)	1.1	1.2	1.0	Acceptable

**SUMMARY - SLOPE STABILITY ANALYSIS
SOIL PROFILE 2**

LOADING CONDITIONS	MINIMUM FACTOR OF SAFETY			COMMENTS
	LOWER BOUND PROPERTIES	UPPER BOUND PROPERTIES	FERC	
Upstream Slope Rapid Drawdown from Max Pool (elev = 755 ft)	1.3	1.9	1.1	Acceptable
Upstream Slope Rapid Drawdown from Top of Gate (elev = 750 ft)	1.4	2.0	1.2	Acceptable
Downstream Slope Steady Seepage at Max Pool (elev = 755 ft)	2.7	2.7	1.4	Acceptable
Downstream Slope Steady Seepage at Top of Gate (elev = 750 ft)	2.7	2.7	1.5	Acceptable
Downstream Slope Normal Pool (elev = 744 ft) Seismic 0.13g(H)	1.8	1.8	1.0	Acceptable

**SUMMARY - SLOPE STABILITY ANALYSIS
SOIL PROFILE 3**

LOADING CONDITIONS	MINIMUM FACTOR OF SAFETY			COMMENTS
	LOWER BOUND PROPERTIES	UPPER BOUND PROPERTIES	FERC	
Upstream Slope Rapid Drawdown from Max Pool (elev = 755 ft)	1.4	2.1	1.1	Acceptable
Upstream Slope Rapid Drawdown from Top of Gate (elev = 750 ft)	1.5	2.1	1.2	Acceptable
Downstream Slope Steady Seepage at Max Pool (elev = 755 ft)	1.6	1.9	1.4	Acceptable
Downstream Slope Steady Seepage at Top of Gate (elev = 750 ft)	1.7	1.9	1.5	Acceptable
Downstream Slope Normal Pool (elev = 744.ft) Seismic 0.13g(H)	1.0	1.4	1.0	Acceptable

Figure 9 Slope Stability, Soil Profile 1-1
Critical sliding Surfaces

Figure 10 Slope Stability, Soil Profile 3-3
Critical Sliding Surfaces

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: Aug. 25, 93

Time of Run:

Run By: SBA

Input Data Filename: WCP1DDL.DAT

Output Filename: WCP1DDL.OUT

PROBLEM DESCRIPTION : WOD - Soil Profile 1 - Upstream Slope - Rapid Drawdown
From Max. Pool (El. 755) - Upper Bound Properties.

BOUNDARY COORDINATES

12 Top Boundaries
29 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	36.00	108.00	36.00	1
2	108.00	36.00	119.00	42.00	1
3	119.00	42.00	133.00	49.00	2
4	133.00	49.00	148.00	51.00	2
5	148.00	51.00	152.00	53.00	2
6	152.00	53.00	164.00	53.00	2
7	164.00	53.00	174.00	54.00	3
8	174.00	54.00	194.00	55.00	3
9	194.00	55.00	216.00	54.00	3
10	216.00	54.00	224.00	49.00	3
11	224.00	49.00	231.00	44.00	1
12	231.00	44.00	350.00	44.00	1
13	164.00	53.00	192.00	46.00	1
14	192.00	46.00	201.00	49.00	1
15	201.00	49.00	224.00	49.00	1
16	119.00	42.00	141.00	42.00	1
17	141.00	42.00	154.00	49.00	1
18	154.00	49.00	164.00	53.00	1
19	163.00	40.00	174.00	45.00	4
20	174.00	45.00	192.00	40.00	4
21	192.00	40.00	201.00	41.00	3
22	201.00	41.00	350.00	41.00	3
23	163.00	40.00	192.00	40.00	4

24	158.00	40.00	176.00	28.00	2
25	.00	31.00	149.00	31.00	5
26	149.00	31.00	158.00	27.00	5
27	158.00	27.00	176.00	28.00	5
28	176.00	28.00	210.00	29.00	5
29	210.00	29.00	350.00	29.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	119.0	125.0	260.0	16.0	.00	.0	1
2	122.0	127.0	1650.0	15.0	.00	.0	1
3	135.0	135.0	.0	35.0	.00	.0	1
4	117.0	120.0	425.0	.0	.00	.0	1
5	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 12 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	44.00
2	119.00	44.00
3	126.00	49.00
4	133.00	54.00
5	156.00	55.00
6	176.00	54.00
7	186.00	53.00
8	196.00	49.00
9	209.00	42.00
10	231.00	42.00
11	234.00	40.00
12	350.00	40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 100.00$ ft.
and $X = 125.00$ ft.

Each Surface Terminates Between $X = 130.00$ ft.
and $X = 210.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = 27.00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	125.00	48.29
2	128.58	44.80
3	132.46	41.64
4	136.60	38.83
5	140.97	36.41
6	145.54	34.38
7	150.27	32.77
8	155.13	31.58
9	160.07	30.83
10	165.06	30.52
11	170.06	30.65
12	175.03	31.23
13	179.92	32.24
14	184.71	33.69
15	189.35	35.55
16	193.81	37.82
17	198.04	40.47
18	202.03	43.49
19	205.73	46.85
20	208.79	50.17

Factor Of Safety For The Preceding Specified Surface =*****

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

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

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.31	42.15
3	126.28	42.68
4	130.44	45.46
5	132.82	49.86
6	132.86	53.90

Circle Center At X = 122.7 ; Y = 52.5 and Radius, 10.4

✓ *** 2.414 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	119.44	44.32
2	124.01	42.28
3	129.01	42.07
4	133.72	43.74
5	137.49	47.03
6	139.76	51.48
7	140.03	54.31

Circle Center At X = 127.0 ; Y = 55.2 and Radius, 13.3

*** 2.823 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
--------------	----------------	----------------

1	113.89	44.00
2	118.57	42.25
3	123.56	41.95
4	128.42	43.14
5	132.71	45.71
6	136.05	49.43
7	138.15	53.97
8	138.19	54.23

Circle Center At X = 122.0 ; Y = 58.7 and Radius, 16.8

*** 3.053 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.50	42.70
3	126.48	43.06
4	131.08	45.03
5	134.77	48.41
6	137.15	52.80
7	137.38	54.19

Circle Center At X = 122.9 ; Y = 57.7 and Radius, 15.0

*** 3.133 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	44.00
2	115.92	42.64
3	120.88	42.01
4	125.88	42.12
5	130.81	42.96
6	135.56	44.52
7	140.03	46.77
8	144.11	49.65
9	147.73	53.10
10	148.96	54.69

Circle Center At X = 122.7 ; Y = 75.7 and Radius, 33.8

*** 3.270 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.89	44.00
2	118.78	42.94
3	123.78	42.86
4	128.69	43.78
5	133.33	45.64
6	137.51	48.39
7	141.06	51.90
8	142.76	54.42

Circle Center At X = 121.7 ; Y = 68.0 and Radius, 25.2

*** 3.400 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.33	44.00
2	112.98	42.15
3	117.87	41.11
4	122.87	40.93
5	127.82	41.60
6	132.59	43.11
7	137.03	45.41
8	141.01	48.44
9	144.41	52.10
10	146.02	54.57

Circle Center At X = 121.4 ; Y = 70.1 and Radius, 29.2

*** 3.410 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	44.00

2	110.21	42.18
3	115.13	41.29
4	120.13	41.37
5	125.02	42.41
6	129.62	44.38
7	133.75	47.19
8	137.27	50.75
9	139.61	54.29

Circle Center At X = 117.2 ; Y = 67.0 and Radius, 25.8

*** 3.613 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.19	41.87
3	126.07	40.79
4	131.07	40.83
5	135.94	41.97
6	140.43	44.17
7	144.32	47.31
8	147.42	51.23
9	149.07	54.70

Circle Center At X = 128.4 ; Y = 63.1 and Radius, 22.4

*** 4.020 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.33	44.00
2	113.20	42.86
3	118.19	42.59
4	123.16	43.18
5	127.94	44.64
6	132.40	46.90
7	136.40	49.90
8	139.81	53.56
9	140.31	54.32

Circle Center At X = 117.3 ; Y = 71.2 and Radius, 28.6

4.173

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop MethodRun Date: Aug. 24, 93
Time of Run:
Run By: SBA
Input Data Filename: WCP1UUL.DAT
Output Filename: WCP1UUL.OUTPROBLEM DESCRIPTION White Oak Dam - Soil Profile 1 - Upstream Slope - Rapid Drawdown
From (El. 755). Max. Pool - Lower Bound Properties.

BOUNDARY COORDINATES

12 Top Boundaries
29 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	44.00	119.00	44.00	1
2	119.00	44.00	126.00	49.00	1
3	126.00	49.00	133.00	54.00	2
4	133.00	54.00	156.00	55.00	2
5	156.00	55.00	176.00	54.00	2
6	176.00	54.00	186.00	53.00	2
7	186.00	53.00	198.00	53.00	3
8	198.00	53.00	203.00	51.00	3
9	203.00	51.00	217.00	49.00	3
10	217.00	49.00	231.00	42.00	3
11	231.00	42.00	242.00	36.00	1
12	242.00	36.00	350.00	36.00	1
13	126.00	49.00	149.00	49.00	1
14	149.00	49.00	158.00	46.00	1
15	158.00	46.00	186.00	53.00	1
16	186.00	53.00	196.00	49.00	1
17	196.00	49.00	209.00	42.00	1
18	209.00	42.00	231.00	42.00	1
19	.00	41.00	149.00	41.00	2
20	149.00	41.00	158.00	40.00	2
21	158.00	40.00	176.00	45.00	4
22	176.00	45.00	187.00	40.00	4
23	158.00	40.00	187.00	40.00	1

24	158.00	40.00	176.00	28.00	2
25	.00	31.00	149.00	31.00	5
26	149.00	31.00	158.00	27.00	5
27	158.00	27.00	176.00	28.00	5
28	176.00	28.00	210.00	29.00	5
29	210.00	29.00	350.00	29.00	5

1

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	119.0	125.0	225.0	16.0	.00	.0	1
2	122.0	127.0	1100.0	15.0	.00	.0	1
3	135.0	135.0	.0	35.0	.00	.0	1
4	117.0	120.0	285.0	.0	.00	.0	1
5	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 12 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	44.00
2	119.00	44.00
3	126.00	49.00
4	133.00	54.00
5	156.00	55.00
6	176.00	54.00
7	186.00	53.00
8	196.00	49.00
9	209.00	42.00
10	231.00	42.00
11	234.00	40.00
12	350.00	40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 100.00$ ft.
and $X = 125.00$ ft.

Each Surface Terminates Between $X = 130.00$ ft.
and $X = 210.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = 27.00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	125.00	48.29
2	128.58	44.80
3	132.46	41.64
4	136.60	38.83
5	140.97	36.41
6	145.54	34.38
7	150.27	32.77
8	155.13	31.58
9	160.07	30.83
10	165.06	30.52
11	170.06	30.65
12	175.03	31.23
13	179.92	32.24
14	184.71	33.69
15	189.35	35.55
16	193.81	37.82
17	198.04	40.47
18	202.03	43.49
19	205.73	46.85
20	208.79	50.17

Factor Of Safety For The Preceding Specified Surface = -79.847

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

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

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.31	42.15
3	126.28	42.68
4	130.44	45.46
5	132.82	49.86
6	132.86	53.90

✓ Circle Center At X = 122.7 ; Y = 52.5 and Radius, 10.4

*** 1.991 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	119.44	44.32
2	124.01	42.28
3	129.01	42.07
4	133.72	43.74
5	137.49	47.03
6	139.76	51.48
7	140.03	54.31

Circle Center At X = 127.0 ; Y = 55.2 and Radius, 13.3

*** 2.210 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
-----------	-------------	-------------

1	113.89	44.00
2	118.57	42.25
3	123.56	41.95
4	128.42	43.14
5	132.71	45.71
6	136.05	49.43
7	138.15	53.97
8	138.19	54.23

Circle Center At X = 122.0 ; Y = 58.7 and Radius, 16.8

*** 2.347 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.50	42.70
3	126.48	43.06
4	131.08	45.03
5	134.77	48.41
6	137.15	52.80
7	137.38	54.19

Circle Center At X = 122.9 ; Y = 57.7 and Radius, 15.0

*** 2.375 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	44.00
2	115.92	42.64
3	120.88	42.01
4	125.88	42.12
5	130.81	42.96
6	135.56	44.52
7	140.03	46.77
8	144.11	49.65
9	147.73	53.10
10	148.96	54.69

Circle Center At X = 122.7 ; Y = 75.7 and Radius, 33.8

*** 2.544 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.89	44.00
2	118.78	42.94
3	123.78	42.86
4	128.69	43.78
5	133.33	45.64
6	137.51	48.39
7	141.06	51.90
8	142.76	54.42

Circle Center At X = 121.7 ; Y = 68.0 and Radius, 25.2

*** 2.592 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.33	44.00
2	112.98	42.15
3	117.87	41.11
4	122.87	40.93
5	127.82	41.60
6	132.59	43.11
7	137.03	45.41
8	141.01	48.44
9	144.41	52.10
10	146.02	54.57

Circle Center At X = 121.4 ; Y = 70.1 and Radius, 29.2

*** 2.619 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	44.00

WCP1UUL.OUT

August 24, 1993

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2	110.21	42.18
3	115.13	41.29
4	120.13	41.37
5	125.02	42.41
6	129.62	44.38
7	133.75	47.19
8	137.27	50.75
9	139.61	54.29

Circle Center At X = 117.2 ; Y = 67.0 and Radius, 25.8

*** 2.808 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.19	41.87
3	126.07	40.79
4	131.07	40.83
5	135.94	41.97
6	140.43	44.17
7	144.32	47.31
8	147.42	51.23
9	149.07	54.70

Circle Center At X = 128.4 ; Y = 63.1 and Radius, 22.4

*** 3.007 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.33	44.00
2	113.20	42.86
3	118.19	42.59
4	123.16	43.18
5	127.94	44.64
6	132.40	46.90
7	136.40	49.90
8	139.81	53.56
9	140.31	54.32

Circle Center At X = 117.3 ; Y = 71.2 and Radius, 28.6

3.171

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: Sept. 10, 93

Time of Run:

Run By: SBA

Input Data Filename: WCP1UUL.DAT

Output Filename: WCP1UUL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 1 - upstream slope - Rapid Drawdown
From Top of Gate (El. 750) - Lower Bound Properties.

BOUNDARY COORDINATES

12 Top Boundaries

29 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	44.00	119.00	44.00	1
2	119.00	44.00	126.00	49.00	1
3	126.00	49.00	133.00	54.00	2
4	133.00	54.00	156.00	55.00	2
5	156.00	55.00	176.00	54.00	2
6	176.00	54.00	186.00	53.00	2
7	186.00	53.00	198.00	53.00	3
8	198.00	53.00	203.00	51.00	3
9	203.00	51.00	217.00	49.00	3
10	217.00	49.00	231.00	42.00	3
11	231.00	42.00	242.00	36.00	1
12	242.00	36.00	350.00	36.00	1
13	126.00	49.00	149.00	49.00	1
14	149.00	49.00	158.00	46.00	1
15	158.00	46.00	186.00	53.00	1
16	186.00	53.00	196.00	49.00	1
17	196.00	49.00	209.00	42.00	1
18	209.00	42.00	231.00	42.00	1
19	.00	41.00	149.00	41.00	2
20	149.00	41.00	158.00	40.00	2
21	158.00	40.00	176.00	45.00	4
22	176.00	45.00	187.00	40.00	4
23	158.00	40.00	187.00	40.00	1

24	158.00	40.00	176.00	28.00	2
25	.00	31.00	149.00	31.00	5
26	149.00	31.00	158.00	27.00	5
27	158.00	27.00	176.00	28.00	5
28	176.00	28.00	210.00	29.00	5
29	210.00	29.00	350.00	29.00	5

1

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	119.0	125.0	225.0	16.0	.00	.0	1
2	122.0	127.0	1100.0	15.0	.00	.0	1
3	135.0	135.0	.0	35.0	.00	.0	1
4	117.0	120.0	285.0	.0	.00	.0	1
5	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	44.00
2	119.00	44.00
3	127.00	50.00
4	193.00	50.00
5	209.00	42.00
6	231.00	42.00
7	234.00	40.00
8	350.00	40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 100.00 ft.
and X = 125.00 ft.

Each Surface Terminates Between X = 130.00 ft.
and X = 210.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 27.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	125.00	48.29
2	128.58	44.80
3	132.46	41.64
4	136.60	38.83
5	140.97	36.41
6	145.54	34.38
7	150.27	32.77
8	155.13	31.58
9	160.07	30.83
10	165.06	30.52
11	170.06	30.65
12	175.03	31.23
13	179.92	32.24
14	184.71	33.69
15	189.35	35.55
16	193.81	37.82
17	198.04	40.47
18	202.03	43.49
19	205.73	46.85
20	208.79	50.17

Factor Of Safety For The Preceding Specified Surface = -92.966

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical

First.

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

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.31	42.15
3	126.28	42.68
4	130.44	45.46
5	132.82	49.86
6	132.86	53.90

Circle Center At X = 122.7 ; Y = 52.5 and Radius, 10.4

*** √ 2.114 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	119.44	44.32
2	124.01	42.28
3	129.01	42.07
4	133.72	43.74
5	137.49	47.03
6	139.76	51.48
7	140.03	54.31

Circle Center At X = 127.0 ; Y = 55.2 and Radius, 13.3

*** 2.479 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.89	44.00
2	118.57	42.25
3	123.56	41.95
4	128.42	43.14

5	132.71	45.71
6	136.05	49.43
7	138.15	53.97
8	138.19	54.23

Circle Center At X = 122.0 ; Y = 58.7 and Radius, 16.8

*** 2.538 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.50	42.70
3	126.48	43.06
4	131.08	45.03
5	134.77	48.41
6	137.15	52.80
7	137.38	54.19

Circle Center At X = 122.9 ; Y = 57.7 and Radius, 15.0

*** 2.583 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	44.00
2	115.92	42.64
3	120.88	42.01
4	125.88	42.12
5	130.81	42.96
6	135.56	44.52
7	140.03	46.77
8	144.11	49.65
9	147.73	53.10
10	148.96	54.69

Circle Center At X = 122.7 ; Y = 75.7 and Radius, 33.8

*** 2.798 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.89	44.00
2	118.78	42.94
3	123.78	42.86
4	128.69	43.78
5	133.33	45.64
6	137.51	48.39
7	141.06	51.90
8	142.76	54.42

Circle Center At X = 121.7 ; Y = 68.0 and Radius, 25.2

*** 2.827 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.33	44.00
2	112.98	42.15
3	117.87	41.11
4	122.87	40.93
5	127.82	41.60
6	132.59	43.11
7	137.03	45.41
8	141.01	48.44
9	144.41	52.10
10	146.02	54.57

Circle Center At X = 121.4 ; Y = 70.1 and Radius, 29.2

*** 2.838 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	44.00
2	110.21	42.18
3	115.13	41.29
4	120.13	41.37
5	125.02	42.41

6	129.62	44.38
7	133.75	47.19
8	137.27	50.75
9	139.61	54.29

Circle Center At X = 117.2 ; Y = 67.0 and Radius, 25.8

*** 2.994 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.19	41.87
3	126.07	40.79
4	131.07	40.83
5	135.94	41.97
6	140.43	44.17
7	144.32	47.31
8	147.42	51.23
9	149.07	54.70

Circle Center At X = 128.4 ; Y = 63.1 and Radius, 22.4

*** 3.293 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.33	44.00
2	113.20	42.86
3	118.19	42.59
4	123.16	43.18
5	127.94	44.64
6	132.40	46.90
7	136.40	49.90
8	139.81	53.56
9	140.31	54.32

Circle Center At X = 117.3 ; Y = 71.2 and Radius, 28.6

*** 3.396 ***

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: Sept. 10, 1993

Time of Run:

Run By: SBA

Input Data Filename: WCP1UUL.DAT

Output Filename: WCP1UUL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 1 - Upstream slope - Rapid Drawdown
From Top of Gate (El. 750) - Upper Bound Properties.

BOUNDARY COORDINATES

12 Top Boundaries
29 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	44.00	119.00	44.00	1
2	119.00	44.00	126.00	49.00	1
3	126.00	49.00	133.00	54.00	2
4	133.00	54.00	156.00	55.00	2
5	156.00	55.00	176.00	54.00	2
6	176.00	54.00	186.00	53.00	2
7	186.00	53.00	198.00	53.00	3
8	198.00	53.00	203.00	51.00	3
9	203.00	51.00	217.00	49.00	3
10	217.00	49.00	231.00	42.00	3
11	231.00	42.00	242.00	36.00	1
12	242.00	36.00	350.00	36.00	1
13	126.00	49.00	149.00	49.00	1
14	149.00	49.00	158.00	46.00	1
15	158.00	46.00	186.00	53.00	1
16	186.00	53.00	196.00	49.00	1
17	196.00	49.00	209.00	42.00	1
18	209.00	42.00	231.00	42.00	1
19	.00	41.00	149.00	41.00	2
20	149.00	41.00	158.00	40.00	2
21	158.00	40.00	176.00	45.00	4
22	176.00	45.00	187.00	40.00	4
23	158.00	40.00	187.00	40.00	1

24	158.00	40.00	176.00	28.00	2
25	.00	31.00	149.00	31.00	5
26	149.00	31.00	158.00	27.00	5
27	158.00	27.00	176.00	28.00	5
28	176.00	28.00	210.00	29.00	5
29	210.00	29.00	350.00	29.00	5

1

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	119.0	125.0	260.0	16.0	.00	.0	1
2	122.0	127.0	1650.0	15.0	.00	.0	1
3	135.0	135.0	.0	35.0	.00	.0	1
4	117.0	120.0	425.0	.0	.00	.0	1
5	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	44.00
2	119.00	44.00
3	127.00	50.00
4	193.00	50.00
5	209.00	42.00
6	231.00	42.00
7	234.00	40.00
8	350.00	40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 100.00 ft.
and X = 125.00 ft.

Each Surface Terminates Between X = 130.00 ft.
and X = 210.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 27.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	125.00	48.29
2	128.58	44.80
3	132.46	41.64
4	136.60	38.83
5	140.97	36.41
6	145.54	34.38
7	150.27	32.77
8	155.13	31.58
9	160.07	30.83
10	165.06	30.52
11	170.06	30.65
12	175.03	31.23
13	179.92	32.24
14	184.71	33.69
15	189.35	35.55
16	193.81	37.82
17	198.04	40.47
18	202.03	43.49
19	205.73	46.85
20	208.79	50.17

Factor Of Safety For The Preceding Specified Surface =*****

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical

First.

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

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.31	42.15
3	126.28	42.68
4	130.44	45.46
5	132.82	49.86
6	132.86	53.90

Circle Center At X = 122.7 ; Y = 52.5 and Radius, 10.4

*** J 2.548 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	119.44	44.32
2	124.01	42.28
3	129.01	42.07
4	133.72	43.74
5	137.49	47.03
6	139.76	51.48
7	140.03	54.31

Circle Center At X = 127.0 ; Y = 55.2 and Radius, 13.3

*** 3.121 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.89	44.00
2	118.57	42.25
3	123.56	41.95
4	128.42	43.14

5	132.71	45.71
6	136.05	49.43
7	138.15	53.97
8	138.19	54.23

Circle Center At X = 122.0 ; Y = 58.7 and Radius, 16.8

*** 3.263 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.50	42.70
3	126.48	43.06
4	131.08	45.03
5	134.77	48.41
6	137.15	52.80
7	137.38	54.19

Circle Center At X = 122.9 ; Y = 57.7 and Radius, 15.0

*** 3.365 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	44.00
2	115.92	42.64
3	120.88	42.01
4	125.88	42.12
5	130.81	42.96
6	135.56	44.52
7	140.03	46.77
8	144.11	49.65
9	147.73	53.10
10	148.96	54.69

Circle Center At X = 122.7 ; Y = 75.7 and Radius, 33.8

*** 3.546 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.33	44.00
2	112.98	42.15
3	117.87	41.11
4	122.87	40.93
5	127.82	41.60
6	132.59	43.11
7	137.03	45.41
8	141.01	48.44
9	144.41	52.10
10	146.02	54.57

Circle Center At X = 121.4 ; Y = 70.1 and Radius, 29.2

*** 3.650 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.89	44.00
2	118.78	42.94
3	123.78	42.86
4	128.69	43.78
5	133.33	45.64
6	137.51	48.39
7	141.06	51.90
8	142.76	54.42

Circle Center At X = 121.7 ; Y = 68.0 and Radius, 25.2

*** 3.660 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	44.00
2	110.21	42.18
3	115.13	41.29
4	120.13	41.37
5	125.02	42.41

6	129.62	44.38
7	133.75	47.19
8	137.27	50.75
9	139.61	54.29

Circle Center At X = 117.2 ; Y = 67.0 and Radius, 25.8

*** 3.818 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	44.00
2	121.19	41.87
3	126.07	40.79
4	131.07	40.83
5	135.94	41.97
6	140.43	44.17
7	144.32	47.31
8	147.42	51.23
9	149.07	54.70

Circle Center At X = 128.4 ; Y = 63.1 and Radius, 22.4

*** 4.338 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.33	44.00
2	113.20	42.86
3	118.19	42.59
4	123.16	43.18
5	127.94	44.64
6	132.40	46.90
7	136.40	49.90
8	139.81	53.56
9	140.31	54.32

Circle Center At X = 117.3 ; Y = 71.2 and Radius, 28.6

*** 4.425 ***

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: Sept. 14, 93

Time of Run:

Run By: SBA

Input Data Filename: WCP1DDL.DAT

Output Filename: WCP1DDL.OUT

Soil Profile 1

PROBLEM DESCRIPTION WOD. Downstream Slope. Steady Seepage at Max. Pool El. 755
Lower Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries

29 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	36.00	108.00	36.00	1
2	108.00	36.00	119.00	42.00	1
3	119.00	42.00	133.00	49.00	2
4	133.00	49.00	148.00	51.00	2
5	148.00	51.00	152.00	53.00	2
6	152.00	53.00	164.00	53.00	2
7	164.00	53.00	174.00	54.00	3
8	174.00	54.00	194.00	55.00	3
9	194.00	55.00	216.00	54.00	3
10	216.00	54.00	224.00	49.00	3
11	224.00	49.00	231.00	44.00	1
12	231.00	44.00	350.00	44.00	1
13	164.00	53.00	192.00	46.00	1
14	192.00	46.00	201.00	49.00	1
15	201.00	49.00	224.00	49.00	1
16	119.00	42.00	141.00	42.00	1
17	141.00	42.00	154.00	49.00	1
18	154.00	49.00	164.00	53.00	1
19	163.00	40.00	174.00	45.00	4
20	174.00	45.00	192.00	40.00	4
21	192.00	40.00	201.00	41.00	3
22	201.00	41.00	350.00	41.00	3
23	163.00	40.00	192.00	40.00	4

WCP1DDL.OUT

September 14, 1993

Page 1-2

24	.00	29.00	140.00	29.00	5
25	140.00	29.00	174.00	28.00	5
26	174.00	28.00	192.00	40.00	3
27	174.00	28.00	192.00	27.00	5
28	192.00	27.00	201.00	31.00	5
29	201.00	31.00	350.00	31.00	5

1

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	119.0	125.0	.0	30.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	200.0	27.0	.00	.0	1
4	117.0	120.0	285.0	.0	.00	.0	1
5	165.0	165.0	576000.0	35.0	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 9 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	116.00	40.00
3	119.00	42.00
4	141.00	42.00
5	154.00	49.00
6	164.00	53.00
7	174.00	54.00
8	194.00	55.00
9	350.00	55.00

1

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 80.00$ ft.
and $X = 125.00$ ft.

Each Surface Terminates Between $X = 135.00$ ft.
and $X = 200.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = .00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	115.00	37.15
3	119.93	37.96
4	124.69	39.51
5	129.16	41.75
6	133.24	44.64
7	136.84	48.11
8	138.03	49.67

Circle Center At $X = 112.1$; $Y = 70.2$ and Radius, 33.1

*** 1.160 *** *shallow - ignore (insignificant impact on slope stability)*

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.92	38.00
3	119.73	39.35

4	124.40	41.13
5	128.90	43.32
6	133.17	45.91
7	137.20	48.88
8	138.09	49.68

Circle Center At X = 102.4 ; Y = 91.8 and Radius, 55.2

*** 1.206 *** Shallow - ignore (insignificant impact on slope stability)

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.88	38.18
3	119.66	39.64
4	124.31	41.47
5	128.81	43.67
6	133.12	46.20
7	137.21	49.07
8	137.93	49.66

Circle Center At X = 98.6 ; Y = 99.9 and Radius, 63.8

*** 1.216 *** Shallow - ignore (insignificant impact on slope stability)

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.99	36.83
3	119.98	37.22
4	124.87	38.24
5	129.59	39.89
6	134.06	42.14
7	138.20	44.94
8	141.94	48.26
9	143.85	50.45

Circle Center At X = 114.5 ; Y = 75.5 and Radius, 38.6

*** 1.352 *** Shallow - ignore (insignificant impact on slope stability)

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.00	39.82
2	119.68	41.59
3	124.27	43.57
4	128.76	45.76
5	133.16	48.14
6	135.06	49.27

Circle Center At X = 77.5 ; Y = 145.7 and Radius, 112.4

*** 1.362 *** *shallow - ignore (insignificant impact on slope stability)*

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	36.00
2	89.91	35.03
3	94.87	34.46
4	99.87	34.30
5	104.86	34.56
6	109.82	35.22
7	114.71	36.29
8	119.49	37.75
9	124.13	39.60
10	128.61	41.82
11	132.89	44.41
12	136.94	47.33
13	139.98	49.93

Circle Center At X = 99.3 ; Y = 95.2 and Radius, 60.9

*** 1.385 *** *shallow - ignore (insignificant impact on slope stability)*

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.00	36.00
2	99.66	34.18

3	104.50	32.94
4	109.46	32.31
5	114.46	32.28
6	119.43	32.87
7	124.28	34.06
8	128.96	35.83
9	133.38	38.16
10	137.49	41.01
11	141.22	44.34
12	144.51	48.11
13	146.32	50.78

Circle Center At X = 112.2 ; Y = 73.1 and Radius, 40.9

✓
*** 1.395 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.00	39.82
2	119.98	39.38
3	124.94	40.05
4	129.62	41.81
5	133.79	44.56
6	137.25	48.18
7	138.15	49.69

Circle Center At X = 119.5 ; Y = 61.7 and Radius, 22.4

*** 1.405 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.00	39.82
2	120.00	39.94
3	124.92	40.84
4	129.64	42.49
5	134.04	44.85
6	138.03	47.87
7	140.01	49.93

Circle Center At X = 116.7 ; Y = 71.9 and Radius, 32.1

*** 1.496 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	90.00	36.00
2	94.42	33.66
3	99.09	31.88
4	103.95	30.70
5	108.92	30.14
6	113.92	30.19
7	118.87	30.87
8	123.70	32.16
9	128.34	34.04
10	132.70	36.48
11	136.73	39.44
12	140.35	42.88
13	143.52	46.75
14	146.03	50.74

Circle Center At X = 111.0 ; Y = 70.2 and Radius, 40.1

*** 1.507 ***

```

      Y      A      X      I      S      F      T
      .00    43.75   87.50  131.25  175.00  218.75
X      .00 +-----**W+-----+-----+-----+-----+
      -
      -
      -
      -
      43.75 +
      -
      -
      -
      -
      ..
A      87.50 +   .6
      -   ...6
      -   ...06
      -   ...7*
      -   ...71W*
      -   ...0715
X      131.25 + .....741*

```


** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: Sept. 15, 93

Time of Run:

Run By: SBA

Input Data Filename: WCP1DDL.DAT

Output Filename: WCP1DDL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 1 - Downstream Slope - Steady Seepage at
Max. Pool Et. 755 - Upper Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries
29 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	36.00	108.00	36.00	1
2	108.00	36.00	119.00	42.00	1
3	119.00	42.00	133.00	49.00	2
4	133.00	49.00	148.00	51.00	2
5	148.00	51.00	152.00	53.00	2
6	152.00	53.00	164.00	53.00	2
7	164.00	53.00	174.00	54.00	3
8	174.00	54.00	194.00	55.00	3
9	194.00	55.00	216.00	54.00	3
10	216.00	54.00	224.00	49.00	3
11	224.00	49.00	231.00	44.00	1
12	231.00	44.00	350.00	44.00	1
13	164.00	53.00	192.00	46.00	1
14	192.00	46.00	201.00	49.00	1
15	201.00	49.00	224.00	49.00	1
16	119.00	42.00	141.00	42.00	1
17	141.00	42.00	154.00	49.00	1
18	154.00	49.00	164.00	53.00	1
19	163.00	40.00	174.00	45.00	4
20	174.00	45.00	192.00	40.00	4
21	192.00	40.00	201.00	41.00	3
22	201.00	41.00	350.00	41.00	3
23	163.00	40.00	192.00	40.00	4

24	.00	29.00	140.00	29.00	5
25	140.00	29.00	174.00	28.00	5
26	174.00	28.00	192.00	40.00	3
27	174.00	28.00	192.00	27.00	5
28	192.00	27.00	201.00	31.00	5
29	201.00	31.00	350.00	31.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	119.0	125.0	70.0	29.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	200.0	27.0	.00	.0	1
4	117.0	120.0	285.0	.0	.00	.0	1
5	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 9 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	116.00	40.00
3	119.00	42.00
4	141.00	42.00
5	154.00	49.00
6	164.00	53.00
7	174.00	54.00
8	194.00	55.00
9	350.00	55.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 80.00 ft.
and X = 125.00 ft.

Each Surface Terminates Between X = 135.00 ft.
and X = 200.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	115.00	37.15
3	119.93	37.96
4	124.69	39.51
5	129.16	41.75
6	133.24	44.64
7	136.84	48.11
8	138.03	49.67

Circle Center At X = 112.1 ; Y = 70.2 and Radius, 33.1

*** 1.445 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.92	38.00
3	119.73	39.35

4	124.40	41.13
5	128.90	43.32
6	133.17	45.91
7	137.20	48.88
8	138.09	49.68

Circle Center At X = 102.4 ; Y = 91.8 and Radius, 55.2

*** 1.541 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.88	38.18
3	119.66	39.64
4	124.31	41.47
5	128.81	43.67
6	133.12	46.20
7	137.21	49.07
8	137.93	49.66

Circle Center At X = 98.6 ; Y = 99.9 and Radius, 63.8

*** 1.573 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.99	36.83
3	119.98	37.22
4	124.87	38.24
5	129.59	39.89
6	134.06	42.14
7	138.20	44.94
8	141.94	48.26
9	143.85	50.45

Circle Center At X = 114.5 ; Y = 75.5 and Radius, 38.6

*** 1.578 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.00	36.00
2	99.66	34.18
3	104.50	32.94
4	109.46	32.31
5	114.46	32.28
6	119.43	32.87
7	124.28	34.06
8	128.96	35.83
9	133.38	38.16
10	137.49	41.01
11	141.22	44.34
12	144.51	48.11
13	146.32	50.78

Circle Center At X = 112.2 ; Y = 73.1 and Radius, 40.9

✓ *** 1.643 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	125.00	45.00
2	129.67	46.79
3	134.25	48.78
4	135.33	49.31

Circle Center At X = 87.8 ; Y = 149.3 and Radius, 110.7

*** 1.658 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.00	39.82
2	119.98	39.38
3	124.94	40.05
4	129.62	41.81

5	133.79	44.56
6	137.25	48.18
7	138.15	49.69

Circle Center At X = 119.5 ; Y = 61.7 and Radius, 22.4

*** 1.671 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.00	36.00
2	109.47	33.77
3	114.26	32.33
4	119.23	31.75
5	124.22	32.02
6	129.09	33.14
7	133.70	35.09
8	137.90	37.80
9	141.58	41.19
10	144.62	45.16
11	146.93	49.59
12	147.35	50.91

Circle Center At X = 120.1 ; Y = 60.7 and Radius, 29.0

*** 1.705 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.00	36.00
2	99.42	33.67
3	104.09	31.88
4	108.94	30.67
5	113.90	30.04
6	118.90	30.01
7	123.87	30.58
8	128.74	31.73
9	133.43	33.46
10	137.88	35.74
11	142.03	38.53
12	145.81	41.80
13	149.18	45.49
14	152.08	49.56

15 153.96 53.00

Circle Center At X = 116.7 ; Y = 71.7 and Radius, 41.8

*** 1.726 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.00	39.82
2	120.00	39.94
3	124.92	40.84
4	129.64	42.49
5	134.04	44.85
6	138.03	47.87
7	140.01	49.93

Circle Center At X = 116.7 ; Y = 71.9 and Radius, 32.1

*** 1.745 ***

1

	Y	A	X	I	S	F	T
	.00	43.75	87.50	131.25	175.00	218.75	
X	.00	+	+	+	+	+	+
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	43.75	+	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
A	87.50	+	..	..	..	..	..
	-	-	...5	...95	...5*	...51w*	...8516
	-	-	...9541*	...95*1	...85*		
X	131.25	+					

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: Aug. 25, 93

Time of Run:

Run By: SBA

Input Data Filename: wcp1uul.dat

Output Filename: wcp1uul.out

PROBLEM DESCRIPTION WOD - Soil Profile 1 - Downstream Slope - Steady Seepage
at Top of Gate 61.750 - Lower Bound Properties.

BOUNDARY COORDINATES

12 Top Boundaries
29 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	44.00	119.00	44.00	1
2	119.00	44.00	126.00	49.00	1
3	126.00	49.00	133.00	54.00	2
4	133.00	54.00	156.00	55.00	2
5	156.00	55.00	176.00	54.00	2
6	176.00	54.00	186.00	53.00	2
7	186.00	53.00	198.00	53.00	3
8	198.00	53.00	203.00	51.00	3
9	203.00	51.00	217.00	49.00	3
10	217.00	49.00	231.00	42.00	3
11	231.00	42.00	242.00	36.00	1
12	242.00	36.00	350.00	36.00	1
13	126.00	49.00	149.00	49.00	1
14	149.00	49.00	158.00	46.00	1
15	158.00	46.00	186.00	53.00	1
16	186.00	53.00	196.00	49.00	1
17	196.00	49.00	209.00	42.00	1
18	209.00	42.00	231.00	42.00	1
19	.00	41.00	149.00	41.00	2
20	149.00	41.00	158.00	40.00	2
21	158.00	40.00	176.00	45.00	4
22	176.00	45.00	187.00	40.00	4
23	158.00	40.00	187.00	40.00	1

24	.00	29.00	140.00	29.00	5
25	140.00	29.00	174.00	28.00	5
26	174.00	28.00	192.00	40.00	3
27	174.00	28.00	192.00	27.00	5
28	192.00	27.00	201.00	31.00	5
29	201.00	31.00	350.00	31.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	119.0	125.0	.0	30.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	200.0	27.0	.00	.0	1
4	117.0	120.0	285.0	.0	.00	.0	1
5	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	116.00	40.00
3	119.00	42.00
4	141.00	42.00
5	156.00	50.00
6	350.00	50.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 80.00 ft.

and $X = 125.00$ ft.

Each Surface Terminates Between $X = 135.00$ ft.
and $X = 200.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = .00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	115.00	37.15
3	119.93	37.96
4	124.69	39.51
5	129.16	41.75
6	133.24	44.64
7	136.84	48.11
8	138.03	49.67

Circle Center At $X = 112.1$; $Y = 70.2$ and Radius, 33.1

*** 1.160 *** shallow - ignore (insignificant impact on slope stability)

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.92	38.00
3	119.73	39.35
4	124.40	41.13
5	128.90	43.32
6	133.17	45.91

7	137.20	48.88
8	138.09	49.68

Circle Center At X = 102.4 ; Y = 91.8 and Radius, 55.2

*** 1.206 *** shallow - ignore (insignificant impact on slope stability)

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.88	38.18
3	119.66	39.64
4	124.31	41.47
5	128.81	43.67
6	133.12	46.20
7	137.21	49.07
8	137.93	49.66

Circle Center At X = 98.6 ; Y = 99.9 and Radius, 63.8

*** 1.216 *** shallow - ignore (insignificant impact on slope stability)

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.99	36.83
3	119.98	37.22
4	124.87	38.24
5	129.59	39.89
6	134.06	42.14
7	138.20	44.94
8	141.94	48.26
9	143.85	50.45

Circle Center At X = 114.5 ; Y = 75.5 and Radius, 38.6

*** 1.352 *** shallow - ignore (insignificant impact on slope stability)

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.00	39.82
2	119.68	41.59
3	124.27	43.57
4	128.76	45.76
5	133.16	48.14
6	135.06	49.27

Circle Center At X = 77.5 ; Y = 145.7 and Radius, 112.4

*** 1.362 *** *shallow - ignore (insignificant impact on slope stability)*

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	36.00
2	89.91	35.03
3	94.87	34.46
4	99.87	34.30
5	104.86	34.56
6	109.82	35.22
7	114.71	36.29
8	119.49	37.75
9	124.13	39.60
10	128.61	41.82
11	132.89	44.41
12	136.94	47.33
13	139.98	49.93

Circle Center At X = 99.3 ; Y = 95.2 and Radius, 60.9

*** 1.385 *** *shallow - ignore (insignificant impact on slope stability)*

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.00	36.00
2	99.66	34.18
3	104.50	32.94
4	109.46	32.31
5	114.46	32.28

6	119.43	32.87
7	124.28	34.06
8	128.96	35.83
9	133.38	38.16
10	137.49	41.01
11	141.22	44.34
12	144.51	48.11
13	146.32	50.78

Circle Center At X = 112.2 ; Y = 73.1 and Radius, 40.9

✓
*** 1.395 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.00	39.82
2	119.98	39.38
3	124.94	40.05
4	129.62	41.81
5	133.79	44.56
6	137.25	48.18
7	138.15	49.69

Circle Center At X = 119.5 ; Y = 61.7 and Radius, 22.4

*** 1.405 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.00	39.82
2	120.00	39.94
3	124.92	40.84
4	129.64	42.49
5	134.04	44.85
6	138.03	47.87
7	140.01	49.93

Circle Center At X = 116.7 ; Y = 71.9 and Radius, 32.1

*** 1.496 ***

[illegible]

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: Aug. 26, 93

Time of Run:

Run By: SBA

Input Data Filename: wcp1ddl.dat

Output Filename: wcp1ddl.out

PROBLEM DESCRIPTION WOD - Soil Profile 1 - Downstream slope - Steady Seepage
at Top of Gate El. 750 - Upper Bound Properties.

BOUNDARY COORDINATES

12 Top Boundaries

29 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	36.00	108.00	36.00	1
2	108.00	36.00	119.00	42.00	1
3	119.00	42.00	133.00	49.00	2
4	133.00	49.00	148.00	51.00	2
5	148.00	51.00	152.00	53.00	2
6	152.00	53.00	164.00	53.00	2
7	164.00	53.00	174.00	54.00	3
8	174.00	54.00	194.00	55.00	3
9	194.00	55.00	216.00	54.00	3
10	216.00	54.00	224.00	49.00	3
11	224.00	49.00	231.00	44.00	1
12	231.00	44.00	350.00	44.00	1
13	164.00	53.00	192.00	46.00	1
14	192.00	46.00	201.00	49.00	1
15	201.00	49.00	224.00	49.00	1
16	119.00	42.00	141.00	42.00	1
17	141.00	42.00	154.00	49.00	1
18	154.00	49.00	164.00	53.00	1
19	163.00	40.00	174.00	45.00	4
20	174.00	45.00	192.00	40.00	4
21	192.00	40.00	201.00	41.00	3
22	201.00	41.00	350.00	41.00	3
23	163.00	40.00	192.00	40.00	4

24	.00	29.00	140.00	29.00	5
25	140.00	29.00	174.00	28.00	5
26	174.00	28.00	192.00	40.00	3
27	174.00	28.00	192.00	27.00	5
28	192.00	27.00	201.00	31.00	5
29	201.00	31.00	350.00	31.00	5

1

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	119.0	125.0	70.0	29.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	300.0	32.0	.00	.0	1
4	117.0	120.0	425.0	.0	.00	.0	1
5	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	116.00	40.00
3	119.00	42.00
4	141.00	42.00
5	156.00	50.00
6	350.00	50.00

1

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 80.00 ft.

and $X = 125.00$ ft.

Each Surface Terminates Between $X = 135.00$ ft.
and $X = 200.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = .00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	115.00	37.15
3	119.93	37.96
4	124.69	39.51
5	129.16	41.75
6	133.24	44.64
7	136.84	48.11
8	138.03	49.67

Circle Center At $X = 112.1$; $Y = 70.2$ and Radius, 33.1

*** 1.445 *** *shallow - ignore (insignificant impact on slope stability)*

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.92	38.00
3	119.73	39.35
4	124.40	41.13
5	128.90	43.32
6	133.17	45.91

7	137.20	48.88
8	138.09	49.68

Circle Center At X = 102.4 ; Y = 91.8 and Radius, 55.2

*** 1.541 *** *shallow - ignore (insignificant impact on slope stability)*

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.88	38.18
3	119.66	39.64
4	124.31	41.47
5	128.81	43.67
6	133.12	46.20
7	137.21	49.07
8	137.93	49.66

Circle Center At X = 98.6 ; Y = 99.9 and Radius, 63.8

*** 1.573 *** *shallow - ignore (insignificant impact on slope stability)*

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.99	36.83
3	119.98	37.22
4	124.87	38.24
5	129.59	39.89
6	134.06	42.14
7	138.20	44.94
8	141.94	48.26
9	143.85	50.45

Circle Center At X = 114.5 ; Y = 75.5 and Radius, 38.6

*** 1.578 *** *shallow - ignore (insignificant impact on slope stability)*

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.00	36.00
2	99.66	34.18
3	104.50	32.94
4	109.46	32.31
5	114.46	32.28
6	119.43	32.87
7	124.28	34.06
8	128.96	35.83
9	133.38	38.16
10	137.49	41.01
11	141.22	44.34
12	144.51	48.11
13	146.32	50.78

Circle Center At X = 112.2 ; Y = 73.1 and Radius, 40.9

✓ *** 1.643 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	125.00	45.00
2	129.67	46.79
3	134.25	48.78
4	135.33	49.31

Circle Center At X = 87.8 ; Y = 149.3 and Radius, 110.7

*** 1.658 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.00	39.82
2	119.98	39.38
3	124.94	40.05
4	129.62	41.81
5	133.79	44.56
6	137.25	48.18
7	138.15	49.69

Circle Center At X = 119.5 ; Y = 61.7 and Radius, 22.4

*** 1.671 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.00	36.00
2	109.47	33.77
3	114.26	32.33
4	119.23	31.75
5	124.22	32.02
6	129.09	33.14
7	133.70	35.09
8	137.90	37.80
9	141.58	41.19
10	144.62	45.16
11	146.93	49.59
12	147.35	50.91

Circle Center At X = 120.1 ; Y = 60.7 and Radius, 29.0

*** 1.705 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.00	36.00
2	99.42	33.67
3	104.09	31.88
4	108.94	30.67
5	113.90	30.04
6	118.90	30.01
7	123.87	30.58
8	128.74	31.73
9	133.43	33.46
10	137.88	35.74
11	142.03	38.53
12	145.81	41.80
13	149.18	45.49
14	152.08	49.56
15	153.96	53.00

Circle Center At X = 116.7 ; Y = 71.7 and Radius, 41.8

*** 1.727 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.00	39.82
2	120.00	39.94
3	124.92	40.84
4	129.64	42.49
5	134.04	44.85
6	138.03	47.87
7	140.01	49.93

Circle Center At X = 116.7 ; Y = 71.9 and Radius, 32.1

*** 1.745 ***

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: Sept. 28, 93

Time of Run:

Run By: SBA

Input Data Filename: wcp1ddl.dat

Output Filename: wcp1ddl.out

PROBLEM DESCRIPTION WOD - Soil Profile 1 - Downstream Slope - Normal Pool El. 744
Seismic Event (0.139 H) - Lower Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries
29 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	36.00	108.00	36.00	1
2	108.00	36.00	119.00	42.00	1
3	119.00	42.00	133.00	49.00	2
4	133.00	49.00	148.00	51.00	2
5	148.00	51.00	152.00	53.00	2
6	152.00	53.00	164.00	53.00	2
7	164.00	53.00	174.00	54.00	3
8	174.00	54.00	194.00	55.00	3
9	194.00	55.00	216.00	54.00	3
10	216.00	54.00	224.00	49.00	3
11	224.00	49.00	231.00	44.00	1
12	231.00	44.00	350.00	44.00	1
13	164.00	53.00	192.00	46.00	1
14	192.00	46.00	201.00	49.00	1
15	201.00	49.00	224.00	49.00	1
16	119.00	42.00	141.00	42.00	1
17	141.00	42.00	154.00	49.00	1
18	154.00	49.00	164.00	53.00	1
19	163.00	40.00	174.00	45.00	4
20	174.00	45.00	192.00	40.00	4
21	192.00	40.00	201.00	41.00	3
22	201.00	41.00	350.00	41.00	3
23	163.00	40.00	192.00	40.00	4

24	.00	29.00	140.00	29.00	5
25	140.00	29.00	174.00	28.00	5
26	174.00	28.00	192.00	40.00	3
27	174.00	28.00	192.00	27.00	5
28	192.00	27.00	201.00	31.00	5
29	201.00	31.00	350.00	31.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	119.0	125.0	225.0	16.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	1100.0	15.0	.00	.0	1
4	117.0	120.0	285.0	.0	.00	.0	1
5	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	116.00	40.00
3	119.00	42.00
4	141.00	42.00
5	147.00	44.00
6	350.00	44.00

A Horizontal Earthquake Loading Coefficient
Of .130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between $X = 80.00$ ft.
and $X = 125.00$ ft.

Each Surface Terminates Between $X = 135.00$ ft.
and $X = 200.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is $Y = .00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

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

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.00	36.00
2	99.42	33.67
3	104.09	31.88
4	108.94	30.67
5	113.90	30.04
6	118.90	30.01
7	123.87	30.58
8	128.74	31.73
9	133.43	33.46
10	137.88	35.74
11	142.03	38.53
12	145.81	41.80
13	149.18	45.49
14	152.08	49.56
15	153.96	53.00

✓ Circle Center At $X = 116.7$; $Y = 71.7$ and Radius, 41.8

*** ✓ 1.132 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.00	36.00
2	109.39	33.61
3	114.07	31.83
4	118.93	30.69
5	123.91	30.20
6	128.91	30.38
7	133.84	31.22
8	138.61	32.70
9	143.14	34.81
10	147.36	37.50
11	151.18	40.73
12	154.53	44.44
13	157.37	48.56
14	159.62	53.00

Circle Center At X = 125.1 ; Y = 67.7 and Radius, 37.6

*** 1.140 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.00	36.00
2	109.47	33.77
3	114.26	32.33
4	119.23	31.75
5	124.22	32.02
6	129.09	33.14
7	133.70	35.09
8	137.90	37.80
9	141.58	41.19
10	144.62	45.16
11	146.93	49.59
12	147.35	50.91

Circle Center At X = 120.1 ; Y = 60.7 and Radius, 29.0

*** 1.142 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.50	34.92
3	119.30	33.51
4	124.26	32.91
5	129.26	33.12
6	134.15	34.15
7	138.81	35.97
8	143.11	38.52
9	146.93	41.74
10	150.18	45.55
11	152.76	49.83
12	154.02	53.00

Circle Center At X = 125.5 ; Y = 63.4 and Radius, 30.5

*** 1.195 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	125.00	45.00
2	129.67	46.79
3	134.25	48.78
4	135.33	49.31

Circle Center At X = 87.8 ; Y = 149.3 and Radius, 110.7

*** 1.200 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	90.00	36.00
2	94.41	33.64
3	99.07	31.83
4	103.92	30.60
5	108.87	29.95

6	113.87	29.90
7	118.84	30.45
8	123.71	31.60
9	128.40	33.32
10	132.86	35.59
11	137.01	38.38
12	140.79	41.65
13	144.16	45.35
14	147.05	49.42
15	147.90	50.99

Circle Center At X = 111.8 ; Y = 71.4 and Radius, 41.6

*** 1.203 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.64	35.24
3	119.48	33.96
4	124.43	33.27
5	129.43	33.18
6	134.40	33.70
7	139.28	34.81
8	143.98	36.50
9	148.45	38.75
10	152.62	41.51
11	156.42	44.76
12	159.80	48.44
13	162.72	52.50
14	162.99	53.00

Circle Center At X = 127.6 ; Y = 74.6 and Radius, 41.4

*** 1.211 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.00	36.00
2	99.66	34.18
3	104.50	32.94
4	109.46	32.31
5	114.46	32.28

6	119.43	32.87
7	124.28	34.06
8	128.96	35.83
9	133.38	38.16
10	137.49	41.01
11	141.22	44.34
12	144.51	48.11
13	146.32	50.78

Circle Center At X = 112.2 ; Y = 73.1 and Radius, 40.9

*** 1.220 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	90.00	36.00
2	94.42	33.66
3	99.09	31.88
4	103.95	30.70
5	108.92	30.14
6	113.92	30.19
7	118.87	30.87
8	123.70	32.16
9	128.34	34.04
10	132.70	36.48
11	136.73	39.44
12	140.35	42.88
13	143.52	46.75
14	146.03	50.74

Circle Center At X = 111.0 ; Y = 70.2 and Radius, 40.1

*** 1.226 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.00	36.00
2	108.92	32.89
3	113.44	30.76
4	118.33	29.73
5	123.33	29.84
6	128.17	31.10
7	132.59	33.44

	Y	A	X	I	S	F	T
	.00	43.75	87.50	131.25	175.00	218.75	
X	.00	+	+	+	+	+	+
	-						
	-						
	-						
	-						
	43.75	+					
	-						
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	-						
A	87.50	+	..				
			.6				
	-		...1				
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	-		...1*				
	-		...14W*				
	-		...14.5				
X	131.25	+	...118.*				
			...*11*5				
	-		22W3*				
	-		22**				
	-		*.2*				
	-						
I	175.00	+	*...*				
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	-		• * *				
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S	218.75	+		*			
	-			•			
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	262.50	+					
	-						

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 01-14-94

Time of Run:

Run By: SBA

Input Data Filename: WCP1DDL.DAT

Output Filename: WCP1DDL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 1 - Normal Pool El. 744
Seismic Event (0.139 H) - Upper Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries

29 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	36.00	108.00	36.00	1
2	108.00	36.00	119.00	42.00	1
3	119.00	42.00	133.00	49.00	2
4	133.00	49.00	148.00	51.00	2
5	148.00	51.00	152.00	53.00	2
6	152.00	53.00	164.00	53.00	2
7	164.00	53.00	174.00	54.00	3
8	174.00	54.00	194.00	55.00	3
9	194.00	55.00	216.00	54.00	3
10	216.00	54.00	224.00	49.00	3
11	224.00	49.00	231.00	44.00	1
12	231.00	44.00	350.00	44.00	1
13	164.00	53.00	192.00	46.00	1
14	192.00	46.00	201.00	49.00	1
15	201.00	49.00	224.00	49.00	1
16	119.00	42.00	141.00	42.00	1
17	141.00	42.00	154.00	49.00	1
18	154.00	49.00	164.00	53.00	1
19	163.00	40.00	174.00	45.00	4
20	174.00	45.00	192.00	40.00	4
21	192.00	40.00	201.00	41.00	3
22	201.00	41.00	350.00	41.00	3
23	163.00	40.00	192.00	40.00	4

24	.00	29.00	140.00	29.00	5
25	140.00	29.00	174.00	28.00	5
26	174.00	28.00	192.00	40.00	3
27	174.00	28.00	192.00	27.00	5
28	192.00	27.00	201.00	31.00	5
29	201.00	31.00	350.00	31.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	119.0	125.0	260.0	16.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	1650.0	15.0	.00	.0	1
4	117.0	120.0	425.0	.0	.00	.0	1
5	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	116.00	40.00
3	119.00	42.00
4	141.00	42.00
5	147.00	44.00
6	350.00	44.00

A Horizontal Earthquake Loading Coefficient
Of .130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 80.00 ft.
and X = 125.00 ft.

Each Surface Terminates Between X = 135.00 ft.
and X = 200.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	125.00	45.00
2	129.67	46.79
3	134.25	48.78
4	135.33	49.31

Circle Center At X = 87.8 ; Y = 149.3 and Radius, 110.7

*** ✓ 1.200 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
--------------	----------------	----------------

1	95.00	36.00
2	99.42	33.67
3	104.09	31.88
4	108.94	30.67
5	113.90	30.04
6	118.90	30.01
7	123.87	30.58
8	128.74	31.73
9	133.43	33.46
10	137.88	35.74
11	142.03	38.53
12	145.81	41.80
13	149.18	45.49
14	152.08	49.56
15	153.96	53.00

Circle Center At X = 116.7 ; Y = 71.7 and Radius, 41.8

*** 1.223 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.00	36.00
2	109.39	33.61
3	114.07	31.83
4	118.93	30.69
5	123.91	30.20
6	128.91	30.38
7	133.84	31.22
8	138.61	32.70
9	143.14	34.81
10	147.36	37.50
11	151.18	40.73
12	154.53	44.44
13	157.37	48.56
14	159.62	53.00

Circle Center At X = 125.1 ; Y = 67.7 and Radius, 37.6

*** 1.223 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
--------------	----------------	----------------

1	105.00	36.00
2	109.47	33.77
3	114.26	32.33
4	119.23	31.75
5	124.22	32.02
6	129.09	33.14
7	133.70	35.09
8	137.90	37.80
9	141.58	41.19
10	144.62	45.16
11	146.93	49.59
12	147.35	50.91

Circle Center At X = 120.1 ; Y = 60.7 and Radius, 29.0

*** 1.230 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.50	34.92
3	119.30	33.51
4	124.26	32.91
5	129.26	33.12
6	134.15	34.15
7	138.81	35.97
8	143.11	38.52
9	146.93	41.74
10	150.18	45.55
11	152.76	49.83
12	154.02	53.00

Circle Center At X = 125.5 ; Y = 63.4 and Radius, 30.5

*** 1.285 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	90.00	36.00
2	94.41	33.64
3	99.07	31.83
4	103.92	30.60
5	108.87	29.95

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January 14, 1994

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6	113.87	29.90
7	118.84	30.45
8	123.71	31.60
9	128.40	33.32
10	132.86	35.59
11	137.01	38.38
12	140.79	41.65
13	144.16	45.35
14	147.05	49.42
15	147.90	50.99

Circle Center At X = 111.8 ; Y = 71.4 and Radius, 41.6

*** 1.301 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	37.09
2	114.64	35.24
3	119.48	33.96
4	124.43	33.27
5	129.43	33.18
6	134.40	33.70
7	139.28	34.81
8	143.98	36.50
9	148.45	38.75
10	152.62	41.51
11	156.42	44.76
12	159.80	48.44
13	162.72	52.50
14	162.99	53.00

Circle Center At X = 127.6 ; Y = 74.6 and Radius, 41.4

*** 1.301 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.00	36.00
2	99.66	34.18
3	104.50	32.94
4	109.46	32.31
5	114.46	32.28

6	119.43	32.87
7	124.28	34.06
8	128.96	35.83
9	133.38	38.16
10	137.49	41.01
11	141.22	44.34
12	144.51	48.11
13	146.32	50.78

Circle Center At X = 112.2 ; Y = 73.1 and Radius, 40.9

*** 1.324 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	90.00	36.00
2	94.42	33.66
3	99.09	31.88
4	103.95	30.70
5	108.92	30.14
6	113.92	30.19
7	118.87	30.87
8	123.70	32.16
9	128.34	34.04
10	132.70	36.48
11	136.73	39.44
12	140.35	42.88
13	143.52	46.75
14	146.03	50.74

Circle Center At X = 111.0 ; Y = 70.2 and Radius, 40.1

*** 1.328 ***

Failure Surface Specified By 11 Coordinate Points . .

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.00	36.00
2	108.92	32.89
3	113.44	30.76
4	118.33	29.73
5	123.33	29.84
6	128.17	31.10
7	132.59	33.44

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-7-93

Time of Run:

Run By: SBA

Input Data Filename: WCP2UUL.DAT

Output Filename: WCP2UUL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 2, Upstream slope, Rapid Drawdown
From Max. Pool El. 755 - Lower Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries

35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	44.00	149.00	44.00	1
2	149.00	44.00	152.00	46.00	1
3	152.00	46.00	156.00	49.00	2
4	156.00	49.00	164.00	55.00	3
5	164.00	55.00	182.00	55.00	3
6	182.00	55.00	204.00	54.00	3
7	204.00	54.00	211.00	53.00	3
8	211.00	53.00	231.00	53.00	4
9	231.00	53.00	241.00	49.00	4
10	241.00	49.00	263.00	48.00	4
11	263.00	48.00	281.00	39.00	4
12	281.00	39.00	400.00	39.00	5
13	156.00	49.00	170.00	48.00	2
14	170.00	48.00	211.00	53.00	2
15	211.00	53.00	213.00	52.00	2
16	213.00	52.00	228.00	42.00	1
17	228.00	42.00	270.00	42.00	4
18	270.00	42.00	275.00	39.00	4
19	275.00	39.00	281.00	39.00	4
20	152.00	46.00	170.00	42.00	3
21	170.00	42.00	191.00	43.00	3
22	191.00	43.00	213.00	52.00	1
23	152.00	46.00	170.00	38.00	1

24	170.00	38.00	191.00	43.00	1
25	228.00	42.00	236.00	36.00	1
26	236.00	36.00	274.00	36.00	3
27	274.00	36.00	281.00	39.00	5
28	.00	28.00	170.00	28.00	6
29	170.00	28.00	191.00	30.00	6
30	191.00	30.00	206.00	30.00	3
31	206.00	30.00	236.00	36.00	3
32	191.00	30.00	206.00	28.00	6
33	206.00	28.00	274.00	36.00	5
34	206.00	28.00	260.00	29.00	6
35	260.00	29.00	400.00	29.00	6

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	285.0	.0	.00	.0	1
2	119.0	125.0	225.0	16.0	.00	.0	1
3	122.0	127.0	1100.0	15.0	.00	.0	1
4	135.0	135.0	.0	35.0	.00	.0	1
5	127.0	129.0	1650.0	15.0	.00	.0	1
6	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 12 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	44.00
2	149.00	44.00
3	152.00	46.00
4	156.00	49.00
5	164.00	55.00
6	182.00	55.00
7	204.00	54.00
8	211.00	53.00
9	213.00	52.00
10	228.00	42.00
11	230.00	40.00

12 400.00 40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 120.00 ft.
and X = 155.00 ft.

Each Surface Terminates Between X = 160.00 ft.
and X = 200.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 20.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	44.00
2	123.62	40.55
3	127.57	37.49
4	131.82	34.85
5	136.32	32.66
6	141.01	30.95
7	145.86	29.72
8	150.81	29.00
9	155.81	28.79
10	160.80	29.10
11	165.73	29.91
12	170.55	31.23
13	175.22	33.04
14	179.67	35.31
15	183.87	38.03

16	187.76	41.16
17	191.31	44.68
18	194.49	48.54
19	197.25	52.71
20	198.06	54.27

Circle Center At X = 155.3 ; Y = 77.5 and Radius, 48.7

*** 1.311 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.60	40.65
3	131.65	37.71
4	135.97	35.21
5	140.54	33.17
6	145.29	31.62
7	150.19	30.58
8	155.16	30.06
9	160.16	30.05
10	165.13	30.57
11	170.02	31.61
12	174.78	33.16
13	179.35	35.19
14	183.68	37.69
15	187.72	40.62
16	191.44	43.97
17	194.78	47.69
18	197.72	51.73
19	199.16	54.22

Circle Center At X = 157.7 ; Y = 77.7 and Radius, 47.7

*** 1.317 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	131.67	44.00
2	135.26	40.52
3	139.25	37.51
4	143.57	35.00
5	148.17	33.03

6	152.97	31.64
7	157.91	30.84
8	162.90	30.65
9	167.89	31.06
10	172.78	32.08
11	177.52	33.69
12	182.02	35.86
13	186.23	38.56
14	190.08	41.75
15	193.51	45.38
16	196.48	49.41
17	198.93	53.77
18	199.12	54.22

Circle Center At X = 162.0 ; Y = 71.7 and Radius, 41.1

*** 1.319 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	131.67	44.00
2	135.23	40.50
3	139.22	37.47
4	143.55	34.98
5	148.17	33.06
6	152.99	31.74
7	157.94	31.04
8	162.94	30.97
9	167.91	31.54
10	172.76	32.74
11	177.42	34.54
12	181.82	36.92
13	185.88	39.84
14	189.54	43.25
15	192.73	47.10
16	195.41	51.32
17	196.82	54.33

Circle Center At X = 160.9 ; Y = 70.2 and Radius, 39.3

*** 1.337 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
--------------	----------------	----------------

1	123.89	44.00
2	127.56	40.60
3	131.57	37.62
4	135.89	35.10
5	140.46	33.07
6	145.22	31.54
7	150.12	30.55
8	155.10	30.10
9	160.10	30.20
10	165.06	30.84
11	169.92	32.02
12	174.62	33.73
13	179.10	35.94
14	183.32	38.62
15	187.22	41.76
16	190.75	45.30
17	193.87	49.20
18	196.55	53.42
19	196.99	54.32

Circle Center At X = 156.7 ; Y = 75.7 and Radius, 45.7

*** 1.343 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.44	40.48
3	131.38	37.40
4	135.64	34.79
5	140.18	32.69
6	144.93	31.12
7	149.83	30.12
8	154.81	29.68
9	159.81	29.82
10	164.75	30.54
11	169.59	31.82
12	174.24	33.65
13	178.65	36.01
14	182.76	38.85
15	186.52	42.16
16	189.87	45.87
17	192.76	49.94
18	195.17	54.32
19	195.21	54.40

Circle Center At X = 156.1 ; Y = 73.0 and Radius, 43.3

*** 1.344 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.70	40.76
3	131.81	37.92
4	136.20	35.52
5	140.80	33.57
6	145.59	32.11
7	150.49	31.14
8	155.47	30.68
9	160.47	30.72
10	165.44	31.28
11	170.32	32.34
12	175.08	33.89
13	179.65	35.92
14	183.99	38.40
15	188.05	41.31
16	191.80	44.62
17	195.19	48.30
18	198.19	52.30
19	199.34	54.21

Circle Center At X = 157.5 ; Y = 79.6 and Radius, 49.0

*** 1.349 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.12	40.49
3	143.11	37.48
4	147.45	34.99
5	152.07	33.09
6	156.90	31.80
7	161.86	31.14
8	166.86	31.12
9	171.82	31.75
10	176.66	33.00
11	181.29	34.87
12	185.65	37.32
13	189.66	40.32
14	193.25	43.80
15	196.36	47.71

16	198.94	51.99
17	199.91	54.19

Circle Center At X = 164.5 ; Y = 69.9 and Radius, 38.8

*** 1.356 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.19	40.57
3	143.24	37.63
4	147.63	35.23
5	152.28	33.42
6	157.14	32.22
7	162.11	31.65
8	167.11	31.73
9	172.05	32.44
10	176.87	33.79
11	181.47	35.74
12	185.79	38.26
13	189.75	41.32
14	193.28	44.86
15	196.32	48.83
16	198.84	53.15
17	199.29	54.21

Circle Center At X = 164.0 ; Y = 70.5 and Radius, 38.9

*** 1.368 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.13	40.50
3	143.14	37.52
4	147.51	35.09
5	152.17	33.28
6	157.03	32.10
7	162.01	31.59
8	167.00	31.75
9	171.94	32.57
10	176.71	34.04

	Y	A	X	I	S	F	T
	.00	50.00	100.00	150.00	200.00	250.00	
X	.00	+	+	+	+	+	+
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	50.00	+					
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A	100.00	+					
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S	250.00	+					
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T 400.00 + * *

***** - Illegal Command *****

Legal Commands - PROFIL

LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-7-93

Time of Run:

Run By: SBA

Input Data Filename: WCP2UUL.DAT

Output Filename: WCP2UUL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 2, Upstream Slope, Rapid Drawdown
From Max. Pool El. 755 - Upper Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries

35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	44.00	149.00	44.00	1
2	149.00	44.00	152.00	46.00	1
3	152.00	46.00	156.00	49.00	2
4	156.00	49.00	164.00	55.00	3
5	164.00	55.00	182.00	55.00	3
6	182.00	55.00	204.00	54.00	3
7	204.00	54.00	211.00	53.00	3
8	211.00	53.00	231.00	53.00	4
9	231.00	53.00	241.00	49.00	4
10	241.00	49.00	263.00	48.00	4
11	263.00	48.00	281.00	39.00	4
12	281.00	39.00	400.00	39.00	5
13	156.00	49.00	170.00	48.00	2
14	170.00	48.00	211.00	53.00	2
15	211.00	53.00	213.00	52.00	2
16	213.00	52.00	228.00	42.00	1
17	228.00	42.00	270.00	42.00	4
18	270.00	42.00	275.00	39.00	4
19	275.00	39.00	281.00	39.00	4
20	152.00	46.00	170.00	42.00	3
21	170.00	42.00	191.00	43.00	3
22	191.00	43.00	213.00	52.00	1
23	152.00	46.00	170.00	38.00	1

24	170.00	38.00	191.00	43.00	1
25	228.00	42.00	236.00	36.00	1
26	236.00	36.00	274.00	36.00	3
27	274.00	36.00	281.00	39.00	5
28	.00	28.00	170.00	28.00	6
29	170.00	28.00	191.00	30.00	6
30	191.00	30.00	206.00	30.00	3
31	206.00	30.00	236.00	36.00	3
32	191.00	30.00	206.00	28.00	6
33	206.00	28.00	274.00	36.00	5
34	206.00	28.00	260.00	29.00	6
35	260.00	29.00	400.00	29.00	6

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	425.0	.0	.00	.0	1
2	119.0	125.0	260.0	16.0	.00	.0	1
3	122.0	127.0	1650.0	15.0	.00	.0	1
4	135.0	135.0	.0	35.0	.00	.0	1
5	127.0	129.0	1650.0	15.0	.00	.0	1
6	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 12 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	44.00
2	149.00	44.00
3	152.00	46.00
4	156.00	49.00
5	164.00	55.00
6	182.00	55.00
7	204.00	54.00
8	211.00	53.00
9	213.00	52.00
10	228.00	42.00
11	230.00	40.00

12 400.00 40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 120.00 ft.
and X = 155.00 ft.

Each Surface Terminates Between X = 160.00 ft.
and X = 200.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 20.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

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

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	44.00
2	123.62	40.55
3	127.57	37.49
4	131.82	34.85
5	136.32	32.66
6	141.01	30.95
7	145.86	29.72
8	150.81	29.00
9	155.81	28.79
10	160.80	29.10
11	165.73	29.91
12	170.55	31.23
13	175.22	33.04
14	179.67	35.31
15	183.87	38.03

16	187.76	41.16
17	191.31	44.68
18	194.49	48.54
19	197.25	52.71
20	198.06	54.27

Circle Center At X = 155.3 ; Y = 77.5 and Radius, 48.7

*** 1.928 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.60	40.65
3	131.65	37.71
4	135.97	35.21
5	140.54	33.17
6	145.29	31.62
7	150.19	30.58
8	155.16	30.06
9	160.16	30.05
10	165.13	30.57
11	170.02	31.61
12	174.78	33.16
13	179.35	35.19
14	183.68	37.69
15	187.72	40.62
16	191.44	43.97
17	194.78	47.69
18	197.72	51.73
19	199.16	54.22

Circle Center At X = 157.7 ; Y = 77.7 and Radius, 47.7

*** 1.932 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	131.67	44.00
2	135.26	40.52
3	139.25	37.51
4	143.57	35.00
5	148.17	33.03

6	152.97	31.64
7	157.91	30.84
8	162.90	30.65
9	167.89	31.06
10	172.78	32.08
11	177.52	33.69
12	182.02	35.86
13	186.23	38.56
14	190.08	41.75
15	193.51	45.38
16	196.48	49.41
17	198.93	53.77
18	199.12	54.22

Circle Center At X = 162.0 ; Y = 71.7 and Radius, 41.1

*** 1.939 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	131.67	44.00
2	135.23	40.50
3	139.22	37.47
4	143.55	34.98
5	148.17	33.06
6	152.99	31.74
7	157.94	31.04
8	162.94	30.97
9	167.91	31.54
10	172.76	32.74
11	177.42	34.54
12	181.82	36.92
13	185.88	39.84
14	189.54	43.25
15	192.73	47.10
16	195.41	51.32
17	196.82	54.33

Circle Center At X = 160.9 ; Y = 70.2 and Radius, 39.3

*** 1.969 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
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1	123.89	44.00
2	127.56	40.60
3	131.57	37.62
4	135.89	35.10
5	140.46	33.07
6	145.22	31.54
7	150.12	30.55
8	155.10	30.10
9	160.10	30.20
10	165.06	30.84
11	169.92	32.02
12	174.62	33.73
13	179.10	35.94
14	183.32	38.62
15	187.22	41.76
16	190.75	45.30
17	193.87	49.20
18	196.55	53.42
19	196.99	54.32

Circle Center At X = 156.7 ; Y = 75.7 and Radius, 45.7

*** 1.975 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.70	40.76
3	131.81	37.92
4	136.20	35.52
5	140.80	33.57
6	145.59	32.11
7	150.49	31.14
8	155.47	30.68
9	160.47	30.72
10	165.44	31.28
11	170.32	32.34
12	175.08	33.89
13	179.65	35.92
14	183.99	38.40
15	188.05	41.31
16	191.80	44.62
17	195.19	48.30
18	198.19	52.30
19	199.34	54.21

Circle Center At X = 157.5 ; Y = 79.6 and Radius, 49.0

*** 1.975 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.44	40.48
3	131.38	37.40
4	135.64	34.79
5	140.18	32.69
6	144.93	31.12
7	149.83	30.12
8	154.81	29.68
9	159.81	29.82
10	164.75	30.54
11	169.59	31.82
12	174.24	33.65
13	178.65	36.01
14	182.76	38.85
15	186.52	42.16
16	189.87	45.87
17	192.76	49.94
18	195.17	54.32
19	195.21	54.40

Circle Center At X = 156.1 ; Y = 73.0 and Radius, 43.3

*** 1.981 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.12	40.49
3	143.11	37.48
4	147.45	34.99
5	152.07	33.09
6	156.90	31.80
7	161.86	31.14
8	166.86	31.12
9	171.82	31.75
10	176.66	33.00
11	181.29	34.87
12	185.65	37.32
13	189.66	40.32
14	193.25	43.80
15	196.36	47.71

16	198.94	51.99
17	199.91	54.19

Circle Center At X = 164.5 ; Y = 69.9 and Radius, 38.8

*** 2.000 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.19	40.57
3	143.24	37.63
4	147.63	35.23
5	152.28	33.42
6	157.14	32.22
7	162.11	31.65
8	167.11	31.73
9	172.05	32.44
10	176.87	33.79
11	181.47	35.74
12	185.79	38.26
13	189.75	41.32
14	193.28	44.86
15	196.32	48.83
16	198.84	53.15
17	199.29	54.21

Circle Center At X = 164.0 ; Y = 70.5 and Radius, 38.9

*** 2.010 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.13	40.50
3	143.14	37.52
4	147.51	35.09
5	152.17	33.28
6	157.03	32.10
7	162.01	31.59
8	167.00	31.75
9	171.94	32.57
10	176.71	34.04

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F 350.00 +
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T 400.00 + * *

***** - Illegal Command *****

Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-7-93

Time of Run:

Run By: SBA

Input Data Filename: WCP2UUL.DAT

Output Filename: WCP2UUL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 2 - Upstream Slope, Rapid Drawdown
From Top of Gate El. 750 - Lower Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries
35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	44.00	149.00	44.00	1
2	149.00	44.00	152.00	46.00	1
3	152.00	46.00	156.00	49.00	2
4	156.00	49.00	164.00	55.00	3
5	164.00	55.00	182.00	55.00	3
6	182.00	55.00	204.00	54.00	3
7	204.00	54.00	211.00	53.00	3
8	211.00	53.00	231.00	53.00	4
9	231.00	53.00	241.00	49.00	4
10	241.00	49.00	263.00	48.00	4
11	263.00	48.00	281.00	39.00	4
12	281.00	39.00	400.00	39.00	5
13	156.00	49.00	170.00	48.00	2
14	170.00	48.00	211.00	53.00	2
15	211.00	53.00	213.00	52.00	2
16	213.00	52.00	228.00	42.00	1
17	228.00	42.00	270.00	42.00	4
18	270.00	42.00	275.00	39.00	4
19	275.00	39.00	281.00	39.00	4
20	152.00	46.00	170.00	42.00	3
21	170.00	42.00	191.00	43.00	3
22	191.00	43.00	213.00	52.00	1
23	152.00	46.00	170.00	38.00	1

24	170.00	38.00	191.00	43.00	1
25	228.00	42.00	236.00	36.00	1
26	236.00	36.00	274.00	36.00	3
27	274.00	36.00	281.00	39.00	5
28	.00	28.00	170.00	28.00	6
29	170.00	28.00	191.00	30.00	6
30	191.00	30.00	206.00	30.00	3
31	206.00	30.00	236.00	36.00	3
32	191.00	30.00	206.00	28.00	6
33	206.00	28.00	274.00	36.00	5
34	206.00	28.00	260.00	29.00	6
35	260.00	29.00	400.00	29.00	6

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	285.0	.0	.00	.0	1
2	119.0	125.0	225.0	16.0	.00	.0	1
3	122.0	127.0	1100.0	15.0	.00	.0	1
4	135.0	135.0	.0	35.0	.00	.0	1
5	127.0	129.0	1650.0	15.0	.00	.0	1
6	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	44.00
2	149.00	44.00
3	152.00	46.00
4	156.00	49.00
5	157.00	50.00
6	216.00	50.00
7	230.00	40.00
8	400.00	40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 120.00 ft.
and X = 155.00 ft.

Each Surface Terminates Between X = 160.00 ft.
and X = 200.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 20.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	44.00
2	123.62	40.55
3	127.57	37.49
4	131.82	34.85
5	136.32	32.66
6	141.01	30.95
7	145.86	29.72
8	150.81	29.00
9	155.81	28.79
10	160.80	29.10
11	165.73	29.91
12	170.55	31.23
13	175.22	33.04
14	179.67	35.31
15	183.87	38.03
16	187.76	41.16
17	191.31	44.68
18	194.49	48.54
19	197.25	52.71

20 198.06 54.27

Circle Center At X = 155.3 ; Y = 77.5 and Radius, 48.7

*** 1.373 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.60	40.65
3	131.65	37.71
4	135.97	35.21
5	140.54	33.17
6	145.29	31.62
7	150.19	30.58
8	155.16	30.06
9	160.16	30.05
10	165.13	30.57
11	170.02	31.61
12	174.78	33.16
13	179.35	35.19
14	183.68	37.69
15	187.72	40.62
16	191.44	43.97
17	194.78	47.69
18	197.72	51.73
19	199.16	54.22

Circle Center At X = 157.7 ; Y = 77.7 and Radius, 47.7

*** 1.382 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	131.67	44.00
2	135.26	40.52
3	139.25	37.51
4	143.57	35.00
5	148.17	33.03
6	152.97	31.64
7	157.91	30.84
8	162.90	30.65
9	167.89	31.06

10	172.78	32.08
11	177.52	33.69
12	182.02	35.86
13	186.23	38.56
14	190.08	41.75
15	193.51	45.38
16	196.48	49.41
17	198.93	53.77
18	199.12	54.22

Circle Center At X = 162.0 ; Y = 71.7 and Radius, 41.1

*** 1.384 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	131.67	44.00
2	135.23	40.50
3	139.22	37.47
4	143.55	34.98
5	148.17	33.06
6	152.99	31.74
7	157.94	31.04
8	162.94	30.97
9	167.91	31.54
10	172.76	32.74
11	177.42	34.54
12	181.82	36.92
13	185.88	39.84
14	189.54	43.25
15	192.73	47.10
16	195.41	51.32
17	196.82	54.33

Circle Center At X = 160.9 ; Y = 70.2 and Radius, 39.3

*** 1.408 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.56	40.60
3	131.57	37.62

4	135.89	35.10
5	140.46	33.07
6	145.22	31.54
7	150.12	30.55
8	155.10	30.10
9	160.10	30.20
10	165.06	30.84
11	169.92	32.02
12	174.62	33.73
13	179.10	35.94
14	183.32	38.62
15	187.22	41.76
16	190.75	45.30
17	193.87	49.20
18	196.55	53.42
19	196.99	54.32

Circle Center At X = 156.7 ; Y = 75.7 and Radius, 45.7

*** 1.412 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.44	40.48
3	131.38	37.40
4	135.64	34.79
5	140.18	32.69
6	144.93	31.12
7	149.83	30.12
8	154.81	29.68
9	159.81	29.82
10	164.75	30.54
11	169.59	31.82
12	174.24	33.65
13	178.65	36.01
14	182.76	38.85
15	186.52	42.16
16	189.87	45.87
17	192.76	49.94
18	195.17	54.32
19	195.21	54.40

Circle Center At X = 156.1 ; Y = 73.0 and Radius, 43.3

*** 1.413 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.70	40.76
3	131.81	37.92
4	136.20	35.52
5	140.80	33.57
6	145.59	32.11
7	150.49	31.14
8	155.47	30.68
9	160.47	30.72
10	165.44	31.28
11	170.32	32.34
12	175.08	33.89
13	179.65	35.92
14	183.99	38.40
15	188.05	41.31
16	191.80	44.62
17	195.19	48.30
18	198.19	52.30
19	199.34	54.21

Circle Center At X = 157.5 ; Y = 79.6 and Radius, 49.0

*** 1.418 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.12	40.49
3	143.11	37.48
4	147.45	34.99
5	152.07	33.09
6	156.90	31.80
7	161.86	31.14
8	166.86	31.12
9	171.82	31.75
10	176.66	33.00
11	181.29	34.87
12	185.65	37.32
13	189.66	40.32
14	193.25	43.80
15	196.36	47.71
16	198.94	51.99
17	199.91	54.19

Circle Center At X = 164.5 ; Y = 69.9 and Radius, 38.8

*** 1.420 ***

1
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.19	40.57
3	143.24	37.63
4	147.63	35.23
5	152.28	33.42
6	157.14	32.22
7	162.11	31.65
8	167.11	31.73
9	172.05	32.44
10	176.87	33.79
11	181.47	35.74
12	185.79	38.26
13	189.75	41.32
14	193.28	44.86
15	196.32	48.83
16	198.84	53.15
17	199.29	54.21

Circle Center At X = 164.0 ; Y = 70.5 and Radius, 38.9

*** 1.439 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.13	40.50
3	143.14	37.52
4	147.51	35.09
5	152.17	33.28
6	157.03	32.10
7	162.01	31.59
8	167.00	31.75
9	171.94	32.57
10	176.71	34.04
11	181.25	36.15
12	185.46	38.84
13	189.28	42.07
14	192.63	45.78

Circle Center At X = 163.3 ; Y = 68.8 and Radius, 37.3

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F 350.00 +
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T 400.00 + • •

***** - Illegal Command *****

Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-7-93

Time of Run:

Run By: SBA

Input Data Filename: WCP2UUL.DAT

Output Filename: WCP2UUL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 2 - Upstream Slope, Rapid Drawdown
From Top of Gate El. 750. Upper Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries
35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	44.00	149.00	44.00	1
2	149.00	44.00	152.00	46.00	1
3	152.00	46.00	156.00	49.00	2
4	156.00	49.00	164.00	55.00	3
5	164.00	55.00	182.00	55.00	3
6	182.00	55.00	204.00	54.00	3
7	204.00	54.00	211.00	53.00	3
8	211.00	53.00	231.00	53.00	4
9	231.00	53.00	241.00	49.00	4
10	241.00	49.00	263.00	48.00	4
11	263.00	48.00	281.00	39.00	4
12	281.00	39.00	400.00	39.00	5
13	156.00	49.00	170.00	48.00	2
14	170.00	48.00	211.00	53.00	2
15	211.00	53.00	213.00	52.00	2
16	213.00	52.00	228.00	42.00	1
17	228.00	42.00	270.00	42.00	4
18	270.00	42.00	275.00	39.00	4
19	275.00	39.00	281.00	39.00	4
20	152.00	46.00	170.00	42.00	3
21	170.00	42.00	191.00	43.00	3
22	191.00	43.00	213.00	52.00	1
23	152.00	46.00	170.00	38.00	1

24	170.00	38.00	191.00	43.00	1
25	228.00	42.00	236.00	36.00	1
26	236.00	36.00	274.00	36.00	3
27	274.00	36.00	281.00	39.00	5
28	.00	28.00	170.00	28.00	6
29	170.00	28.00	191.00	30.00	6
30	191.00	30.00	206.00	30.00	3
31	206.00	30.00	236.00	36.00	3
32	191.00	30.00	206.00	28.00	6
33	206.00	28.00	274.00	36.00	5
34	206.00	28.00	260.00	29.00	6
35	260.00	29.00	400.00	29.00	6

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	425.0	.0	.00	.0	1
2	119.0	125.0	260.0	16.0	.00	.0	1
3	122.0	127.0	1650.0	15.0	.00	.0	1
4	135.0	135.0	.0	35.0	.00	.0	1
5	127.0	129.0	1650.0	15.0	.00	.0	1
6	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	44.00
2	149.00	44.00
3	152.00	46.00
4	156.00	49.00
5	157.00	50.00
6	216.00	50.00
7	230.00	40.00
8	400.00	40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 120.00$ ft.
and $X = 155.00$ ft.

Each Surface Terminates Between $X = 160.00$ ft.
and $X = 200.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = 20.00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	44.00
2	123.62	40.55
3	127.57	37.49
4	131.82	34.85
5	136.32	32.66
6	141.01	30.95
7	145.86	29.72
8	150.81	29.00
9	155.81	28.79
10	160.80	29.10
11	165.73	29.91
12	170.55	31.23
13	175.22	33.04
14	179.67	35.31
15	183.87	38.03
16	187.76	41.16
17	191.31	44.68
18	194.49	48.54
19	197.25	52.71

20 198.06 54.27

Circle Center At X = 155.3 ; Y = 77.5 and Radius, 48.7

*** 2.005 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.60	40.65
3	131.65	37.71
4	135.97	35.21
5	140.54	33.17
6	145.29	31.62
7	150.19	30.58
8	155.16	30.06
9	160.16	30.05
10	165.13	30.57
11	170.02	31.61
12	174.78	33.16
13	179.35	35.19
14	183.68	37.69
15	187.72	40.62
16	191.44	43.97
17	194.78	47.69
18	197.72	51.73
19	199.16	54.22

Circle Center At X = 157.7 ; Y = 77.7 and Radius, 47.7

*** 2.012 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	131.67	44.00
2	135.26	40.52
3	139.25	37.51
4	143.57	35.00
5	148.17	33.03
6	152.97	31.64
7	157.91	30.84
8	162.90	30.65
9	167.89	31.06

10	172.78	32.08
11	177.52	33.69
12	182.02	35.86
13	186.23	38.56
14	190.08	41.75
15	193.51	45.38
16	196.48	49.41
17	198.93	53.77
18	199.12	54.22

Circle Center At X = 162.0 ; Y = 71.7 and Radius, 41.1

*** 2.019 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	131.67	44.00
2	135.23	40.50
3	139.22	37.47
4	143.55	34.98
5	148.17	33.06
6	152.99	31.74
7	157.94	31.04
8	162.94	30.97
9	167.91	31.54
10	172.76	32.74
11	177.42	34.54
12	181.82	36.92
13	185.88	39.84
14	189.54	43.25
15	192.73	47.10
16	195.41	51.32
17	196.82	54.33

Circle Center At X = 160.9 ; Y = 70.2 and Radius, 39.3

*** 2.055 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.56	40.60
3	131.57	37.62

4	135.89	35.10
5	140.46	33.07
6	145.22	31.54
7	150.12	30.55
8	155.10	30.10
9	160.10	30.20
10	165.06	30.84
11	169.92	32.02
12	174.62	33.73
13	179.10	35.94
14	183.32	38.62
15	187.22	41.76
16	190.75	45.30
17	193.87	49.20
18	196.55	53.42
19	196.99	54.32

Circle Center At X = 156.7 ; Y = 75.7 and Radius, 45.7

*** 2.058 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.70	40.76
3	131.81	37.92
4	136.20	35.52
5	140.80	33.57
6	145.59	32.11
7	150.49	31.14
8	155.47	30.68
9	160.47	30.72
10	165.44	31.28
11	170.32	32.34
12	175.08	33.89
13	179.65	35.92
14	183.99	38.40
15	188.05	41.31
16	191.80	44.62
17	195.19	48.30
18	198.19	52.30
19	199.34	54.21

Circle Center At X = 157.5 ; Y = 79.6 and Radius, 49.0

*** 2.059 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.89	44.00
2	127.44	40.48
3	131.38	37.40
4	135.64	34.79
5	140.18	32.69
6	144.93	31.12
7	149.83	30.12
8	154.81	29.68
9	159.81	29.82
10	164.75	30.54
11	169.59	31.82
12	174.24	33.65
13	178.65	36.01
14	182.76	38.85
15	186.52	42.16
16	189.87	45.87
17	192.76	49.94
18	195.17	54.32
19	195.21	54.40

Circle Center At X = 156.1 ; Y = 73.0 and Radius, 43.3

*** 2.066 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.12	40.49
3	143.11	37.48
4	147.45	34.99
5	152.07	33.09
6	156.90	31.80
7	161.86	31.14
8	166.86	31.12
9	171.82	31.75
10	176.66	33.00
11	181.29	34.87
12	185.65	37.32
13	189.66	40.32
14	193.25	43.80
15	196.36	47.71
16	198.94	51.99
17	199.91	54.19

Circle Center At X = 164.5 ; Y = 69.9 and Radius, 38.8

*** 2.080 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.19	40.57
3	143.24	37.63
4	147.63	35.23
5	152.28	33.42
6	157.14	32.22
7	162.11	31.65
8	167.11	31.73
9	172.05	32.44
10	176.87	33.79
11	181.47	35.74
12	185.79	38.26
13	189.75	41.32
14	193.28	44.86
15	196.32	48.83
16	198.84	53.15
17	199.29	54.21

Circle Center At X = 164.0 ; Y = 70.5 and Radius, 38.9

*** 2.097 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.56	44.00
2	139.13	40.50
3	143.14	37.52
4	147.51	35.09
5	152.17	33.28
6	157.03	32.10
7	162.01	31.59
8	167.00	31.75
9	171.94	32.57
10	176.71	34.04
11	181.25	36.15
12	185.46	38.84
13	189.28	42.07
14	192.63	45.78

F 350.00 +
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T 400.00 + * *

***** - Illegal Command *****

Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 8-26-93

Time of Run:

Run By: SBA

Input Data Filename: WCP2DDL.DAT

Output Filename: WCP2DDL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 2 - Downstream Slope - Steady Seepage.
Max. Pool El. 755 - Lower Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries

35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	39.00	119.00	39.00	1
2	119.00	39.00	137.00	48.00	2
3	137.00	48.00	159.00	49.00	2
4	159.00	49.00	169.00	53.00	2
5	169.00	53.00	189.00	53.00	2
6	189.00	53.00	196.00	54.00	3
7	196.00	54.00	218.00	55.00	3
8	218.00	55.00	236.00	55.00	3
9	236.00	55.00	244.00	49.00	3
10	244.00	49.00	248.00	46.00	4
11	248.00	46.00	251.00	44.00	5
12	251.00	44.00	400.00	44.00	5
13	119.00	39.00	125.00	39.00	2
14	125.00	39.00	130.00	42.00	2
15	130.00	42.00	172.00	42.00	2
16	172.00	42.00	187.00	52.00	5
17	187.00	52.00	189.00	53.00	4
18	189.00	53.00	230.00	48.00	4
19	230.00	48.00	244.00	49.00	4
20	187.00	52.00	209.00	43.00	5
21	209.00	43.00	230.00	42.00	3
22	230.00	42.00	248.00	46.00	3
23	209.00	43.00	230.00	38.00	5

24	230.00	38.00	248.00	46.00	5
25	119.00	39.00	126.00	36.00	1
26	126.00	36.00	164.00	36.00	3
27	164.00	36.00	172.00	42.00	5
28	164.00	36.00	194.00	30.00	3
29	194.00	30.00	209.00	30.00	3
30	209.00	30.00	230.00	28.00	6
31	230.00	28.00	400.00	28.00	6
32	126.00	36.00	194.00	28.00	1
33	.00	29.00	140.00	29.00	6
34	140.00	29.00	194.00	28.00	6
35	194.00	28.00	209.00	30.00	6

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	127.0	129.0	300.0	32.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	200.0	27.0	.00	.0	1
4	119.0	125.0	.0	30.0	.00	.0	1
5	117.0	120.0	285.0	.0	.00	.0	1
6	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 9 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	169.00	40.00
3	172.00	42.00
4	187.00	52.00
5	189.00	53.00
6	196.00	54.00
7	218.00	55.00
8	236.00	55.00
9	400.00	55.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 100.00$ ft.
and $X = 150.00$ ft.

Each Surface Terminates Between $X = 160.00$ ft.
and $X = 220.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = 20.00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.99	48.35
3	159.95	49.02
4	164.70	50.58
5	169.09	52.98
6	169.11	53.00

Circle Center At $X = 153.8$; $Y = 75.7$ and Radius, 27.3

*** 2.719 ***

Failure Surface Specified By 6 Coordinate Points

Point	X-Surf	Y-Surf
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No.	(ft)	(ft)
1	150.00	48.59
2	154.93	47.73
3	159.93	47.85
4	164.80	48.95
5	169.38	50.97
6	172.27	53.00

Circle Center At X = 156.8 ; Y = 73.2 and Radius, 25.5

*** 2.851 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	39.00
2	121.48	37.66
3	126.36	36.57
4	131.30	35.75
5	136.26	35.19
6	141.26	34.90
7	146.26	34.87
8	151.25	35.11
9	156.22	35.62
10	161.17	36.38
11	166.06	37.42
12	170.89	38.71
13	175.64	40.25
14	180.31	42.05
15	184.87	44.09
16	189.32	46.38
17	193.64	48.90
18	197.82	51.64
19	201.36	54.24

Circle Center At X = 144.3 ; Y = 128.7 and Radius, 93.8

*** 3.094 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	39.00
2	110.44	37.95

3	115.36	37.05
4	120.31	36.31
5	125.27	35.72
6	130.25	35.29
7	135.25	35.01
8	140.25	34.89
9	145.25	34.93
10	150.24	35.13
11	155.23	35.48
12	160.20	35.98
13	165.16	36.64
14	170.09	37.46
15	175.00	38.43
16	179.87	39.56
17	184.70	40.83
18	189.50	42.26
19	194.24	43.84
20	198.93	45.56
21	203.57	47.43
22	208.15	49.45
23	212.66	51.60
24	217.10	53.90
25	219.07	55.00

Circle Center At X = 141.5 ; Y = 194.5 and Radius, 159.6

*** 3.249 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	39.00
2	115.93	37.65
3	120.80	36.51
4	125.71	35.58
5	130.65	34.85
6	135.63	34.33
7	140.62	34.03
8	145.62	33.93
9	150.62	34.05
10	155.60	34.37
11	160.58	34.91
12	165.52	35.65
13	170.43	36.61
14	175.29	37.77
15	180.10	39.13
16	184.85	40.70
17	189.53	42.46
18	194.13	44.42
19	198.64	46.57
20	203.06	48.92

21	207.37	51.44
22	211.58	54.15
23	212.43	54.75

Circle Center At X = 145.4 ; Y = 152.4 and Radius, 118.4

*** 3.264 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.22	40.61
2	127.17	41.30
3	132.12	42.07
4	137.04	42.92
5	141.96	43.83
6	146.86	44.83
7	151.74	45.90
8	156.61	47.04
9	161.46	48.25
10	166.29	49.54
11	171.10	50.91
12	175.89	52.34
13	177.97	53.00

Circle Center At X = 79.2 ; Y = 366.1 and Radius, 328.3

*** 3.314 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	39.00
2	115.48	36.58
3	120.06	34.56
4	124.80	32.97
5	129.67	31.82
6	134.62	31.12
7	139.61	30.87
8	144.61	31.07
9	149.56	31.74
10	154.44	32.85
11	159.19	34.40
12	163.78	36.37
13	168.18	38.76

14	172.34	41.54
15	176.22	44.68
16	179.81	48.17
17	183.06	51.97
18	183.79	53.00

Circle Center At X = 139.8 ; Y = 85.7 and Radius, 54.8

*** 3.409 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	39.00
2	104.91	38.08
3	109.85	37.29
4	114.81	36.64
5	119.78	36.14
6	124.77	35.77
7	129.77	35.55
8	134.77	35.46
9	139.77	35.52
10	144.76	35.71
11	149.75	36.05
12	154.73	36.52
13	159.69	37.14
14	164.63	37.90
15	169.55	38.79
16	174.44	39.82
17	179.30	40.99
18	184.13	42.30
19	188.92	43.74
20	193.66	45.32
21	198.36	47.02
22	203.01	48.86
23	207.61	50.83
24	212.15	52.93
25	216.14	54.92

Circle Center At X = 135.3 ; Y = 213.2 and Radius, 177.7

*** 3.513 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
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1	111.11	39.00
2	115.77	37.18
3	120.57	35.80
4	125.49	34.86
5	130.46	34.38
6	135.46	34.36
7	140.44	34.80
8	145.36	35.70
9	150.18	37.04
10	154.85	38.82
11	159.34	41.03
12	163.61	43.63
13	167.61	46.62
14	171.33	49.96
15	174.14	53.00

Circle Center At X = 133.2 ; Y = 88.6 and Radius, 54.3

*** 3.514 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	39.00
2	110.46	38.03
3	115.42	37.38
4	120.41	37.06
5	125.41	37.08
6	130.40	37.42
7	135.35	38.09
8	140.25	39.08
9	145.08	40.40
10	149.80	42.03
11	154.41	43.97
12	158.88	46.21
13	163.19	48.74
14	167.33	51.55
15	169.19	53.00

Circle Center At X = 122.7 ; Y = 112.8 and Radius, 75.8

*** 3.526 ***

129

		.00	50.00	100.00	150.00	200.00	250.00
X	.00	+	-----*	-----*	-----*	-----*	-----*
		-					
		-					
		-					
		-					
	50.00	+					
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A	100.00	+	.8				
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		-	..*306.				
X	150.00	+	..73061				
		-	...396*				
		-	...*491*				
		-	*762				
		-	...33*7				
		-	..*433*				
I	200.00	+	...43*				
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S	250.00	+	*				
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	300.00	+					
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F	350.00	+					
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T	400.00	+	* * W				

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*****
*****  - Illegal Command  *****
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Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 8-27-93

Time of Run:

Run By: SBA

Input Data Filename: wcp2ddl.dat

Output Filename: wcp2ddl.out

PROBLEM DESCRIPTION WOD - Soil Profile 2 - Downstream Slope - Steady Seepage.
Max. Pool El. 755 - Upper Bound Properties.

BOUNDARY COORDINATES

12 Top Boundaries

35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	39.00	119.00	39.00	1
2	119.00	39.00	137.00	48.00	2
3	137.00	48.00	159.00	49.00	2
4	159.00	49.00	169.00	53.00	2
5	169.00	53.00	189.00	53.00	2
6	189.00	53.00	196.00	54.00	3
7	196.00	54.00	218.00	55.00	3
8	218.00	55.00	236.00	55.00	3
9	236.00	55.00	244.00	49.00	3
10	244.00	49.00	248.00	46.00	4
11	248.00	46.00	251.00	44.00	5
12	251.00	44.00	400.00	44.00	5
13	119.00	39.00	125.00	39.00	2
14	125.00	39.00	130.00	42.00	2
15	130.00	42.00	172.00	42.00	2
16	172.00	42.00	187.00	52.00	5
17	187.00	52.00	189.00	53.00	4
18	189.00	53.00	230.00	48.00	4
19	230.00	48.00	244.00	49.00	4
20	187.00	52.00	209.00	43.00	5
21	209.00	43.00	230.00	42.00	3
22	230.00	42.00	248.00	46.00	3
23	209.00	43.00	230.00	38.00	5

24	230.00	38.00	248.00	46.00	5
25	119.00	39.00	126.00	36.00	1
26	126.00	36.00	164.00	36.00	3
27	164.00	36.00	172.00	42.00	5
28	164.00	36.00	194.00	30.00	3
29	194.00	30.00	209.00	30.00	3
30	209.00	30.00	230.00	28.00	6
31	230.00	28.00	400.00	28.00	6
32	126.00	36.00	194.00	28.00	1
33	.00	29.00	140.00	29.00	6
34	140.00	29.00	194.00	28.00	6
35	194.00	28.00	209.00	30.00	6

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	127.0	129.0	300.0	32.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	300.0	32.0	.00	.0	1
4	119.0	125.0	.0	30.0	.00	.0	1
5	117.0	120.0	425.0	.0	.00	.0	1
6	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 9 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	169.00	40.00
3	172.00	42.00
4	187.00	52.00
5	189.00	53.00
6	196.00	54.00
7	218.00	55.00
8	236.00	55.00
9	400.00	55.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 100.00$ ft.
and $X = 150.00$ ft.

Each Surface Terminates Between $X = 160.00$ ft.
and $X = 220.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = 20.00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.99	48.35
3	159.95	49.02
4	164.70	50.58
5	169.09	52.98
6	169.11	53.00

Circle Center At $X = 153.8$; $Y = 75.7$ and Radius, 27.3

*** 2.719 ***

Failure Surface Specified By 6 Coordinate Points

Point	X-Surf	Y-Surf
-------	--------	--------

No.	(ft)	(ft)
1	150.00	48.59
2	154.93	47.73
3	159.93	47.85
4	164.80	48.95
5	169.38	50.97
6	172.27	53.00

Circle Center At X = 156.8 ; Y = 73.2 and Radius, 25.5

*** 2.851 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.22	40.61
2	127.17	41.30
3	132.12	42.07
4	137.04	42.92
5	141.96	43.83
6	146.86	44.83
7	151.74	45.90
8	156.61	47.04
9	161.46	48.25
10	166.29	49.54
11	171.10	50.91
12	175.89	52.34
13	177.97	53.00

Circle Center At X = 79.2 ; Y = 366.1 and Radius, 328.3

*** 3.314 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	39.00
2	110.46	38.03
3	115.42	37.38
4	120.41	37.06
5	125.41	37.08
6	130.40	37.42
7	135.35	38.09
8	140.25	39.08

9	145.08	40.40
10	149.80	42.03
11	154.41	43.97
12	158.88	46.21
13	163.19	48.74
14	167.33	51.55
15	169.19	53.00

Circle Center At X = 122.7 ; Y = 112.8 and Radius, 75.8

*** 3.526 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	39.00
2	115.48	36.58
3	120.06	34.56
4	124.80	32.97
5	129.67	31.82
6	134.62	31.12
7	139.61	30.87
8	144.61	31.07
9	149.56	31.74
10	154.44	32.85
11	159.19	34.40
12	163.78	36.37
13	168.18	38.76
14	172.34	41.54
15	176.22	44.68
16	179.81	48.17
17	183.06	51.97
18	183.79	53.00

Circle Center At X = 139.8 ; Y = 85.7 and Radius, 54.8

*** 3.637 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.44	48.34
2	149.38	47.53
3	154.37	47.27
4	159.36	47.58

5	164.29	48.44
6	169.09	49.85
7	173.70	51.78
8	175.88	53.00

Circle Center At X = 154.1 ; Y = 91.9 and Radius, 44.7

*** 3.639 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	39.00
2	109.97	36.66
3	114.60	34.75
4	119.38	33.31
5	124.29	32.34
6	129.27	31.85
7	134.27	31.85
8	139.24	32.33
9	144.15	33.30
10	148.94	34.73
11	153.56	36.63
12	157.98	38.97
13	162.15	41.73
14	166.04	44.87
15	169.60	48.39
16	172.80	52.23
17	173.32	53.00

Circle Center At X = 131.8 ; Y = 83.1 and Radius, 51.3

*** 3.668 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.57	46.56
3	159.50	45.74
4	164.48	46.20
5	169.18	47.90
6	173.30	50.73
7	175.27	53.00

Circle Center At X = 160.2 ; Y = 65.4 and Radius, 19.6

*** 3.673 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	39.00
2	115.77	37.18
3	120.57	35.80
4	125.49	34.86
5	130.46	34.38
6	135.46	34.36
7	140.44	34.80
8	145.36	35.70
9	150.18	37.04
10	154.85	38.82
11	159.34	41.03
12	163.61	43.63
13	167.61	46.62
14	171.33	49.96
15	174.14	53.00

Circle Center At X = 133.2 ; Y = 88.6 and Radius, 54.3

*** 3.682 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	39.00
2	109.97	36.64
3	114.58	34.71
4	119.35	33.23
5	124.25	32.20
6	129.21	31.64
7	134.21	31.55
8	139.20	31.94
9	144.13	32.79
10	148.95	34.11
11	153.63	35.87
12	158.12	38.07
13	162.38	40.69
14	166.38	43.69
15	170.07	47.06

Circle Center At X = 132.6 ; Y = 84.4 and Radius, 52.9

*** 3.684 ***

1

F 350.00 +
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-
-

T 400.00 + • • W

***** - Illegal Command *****

Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-8-93

Time of Run:

Run By: SBA

Input Data Filename: WCP2DDL.DAT

Output Filename: WCP2DDL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 2 - Downstream Slope - Steady Seepage.
Top of Gate El. 750 - Lower Bound Properties.

BOUNDARY COORDINATES

12 Top Boundaries

35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	39.00	119.00	39.00	1
2	119.00	39.00	137.00	48.00	2
3	137.00	48.00	159.00	49.00	2
4	159.00	49.00	169.00	53.00	2
5	169.00	53.00	189.00	53.00	2
6	189.00	53.00	196.00	54.00	3
7	196.00	54.00	218.00	55.00	3
8	218.00	55.00	236.00	55.00	3
9	236.00	55.00	244.00	49.00	3
10	244.00	49.00	248.00	46.00	4
11	248.00	46.00	251.00	44.00	5
12	251.00	44.00	400.00	44.00	5
13	119.00	39.00	125.00	39.00	2
14	125.00	39.00	130.00	42.00	2
15	130.00	42.00	172.00	42.00	2
16	172.00	42.00	187.00	52.00	5
17	187.00	52.00	189.00	53.00	4
18	189.00	53.00	230.00	48.00	4
19	230.00	48.00	244.00	49.00	4
20	187.00	52.00	209.00	43.00	5
21	209.00	43.00	230.00	42.00	3
22	230.00	42.00	248.00	46.00	3
23	209.00	43.00	230.00	38.00	5

24	230.00	38.00	248.00	46.00	5
25	119.00	39.00	126.00	36.00	1
26	126.00	36.00	164.00	36.00	3
27	164.00	36.00	172.00	42.00	5
28	164.00	36.00	194.00	30.00	3
29	194.00	30.00	209.00	30.00	3
30	209.00	30.00	230.00	28.00	6
31	230.00	28.00	400.00	28.00	6
32	126.00	36.00	194.00	28.00	1
33	.00	29.00	140.00	29.00	6
34	140.00	29.00	194.00	28.00	6
35	194.00	28.00	209.00	30.00	6

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	127.0	129.0	300.0	32.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	200.0	27.0	.00	.0	1
4	119.0	125.0	.0	30.0	.00	.0	1
5	117.0	120.0	285.0	.0	.00	.0	1
6	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	169.00	40.00
3	172.00	42.00
4	184.00	50.00
5	400.00	50.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 100.00$ ft.
and $X = 150.00$ ft.

Each Surface Terminates Between $X = 160.00$ ft.
and $X = 220.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = 20.00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.99	48.35
3	159.95	49.02
4	164.70	50.58
5	169.09	52.98
6	169.11	53.00

Circle Center At $X = 153.8$; $Y = 75.7$ and Radius, 27.3

*** 2.719 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.93	47.73

3	159.93	47.85
4	164.80	48.95
5	169.38	50.97
6	172.27	53.00

Circle Center At X = 156.8 ; Y = 73.2 and Radius, 25.5

*** 2.851 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.67	39.00
2	121.48	37.66
3	126.36	36.57
4	131.30	35.75
5	136.26	35.19
6	141.26	34.90
7	146.26	34.87
8	151.25	35.11
9	156.22	35.62
10	161.17	36.38
11	166.06	37.42
12	170.89	38.71
13	175.64	40.25
14	180.31	42.05
15	184.87	44.09
16	189.32	46.38
17	193.64	48.90
18	197.82	51.64
19	201.36	54.24

Circle Center At X = 144.3 ; Y = 128.7 and Radius, 93.8

*** 3.153 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.22	40.61
2	127.17	41.30
3	132.12	42.07
4	137.04	42.92
5	141.96	43.83
6	146.86	44.83

7	151.74	45.90
8	156.61	47.04
9	161.46	48.25
10	166.29	49.54
11	171.10	50.91
12	175.89	52.34
13	177.97	53.00

Circle Center At X = 79.2 ; Y = 366.1 and Radius, 328.3

*** 3.314 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	39.00
2	115.93	37.65
3	120.80	36.51
4	125.71	35.58
5	130.65	34.85
6	135.63	34.33
7	140.62	34.03
8	145.62	33.93
9	150.62	34.05
10	155.60	34.37
11	160.58	34.91
12	165.52	35.65
13	170.43	36.61
14	175.29	37.77
15	180.10	39.13
16	184.85	40.70
17	189.53	42.46
18	194.13	44.42
19	198.64	46.57
20	203.06	48.92
21	207.37	51.44
22	211.58	54.15
23	212.43	54.75

Circle Center At X = 145.4 ; Y = 152.4 and Radius, 118.4

*** 3.372 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
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1	105.56	39.00
2	110.44	37.95
3	115.36	37.05
4	120.31	36.31
5	125.27	35.72
6	130.25	35.29
7	135.25	35.01
8	140.25	34.89
9	145.25	34.93
10	150.24	35.13
11	155.23	35.48
12	160.20	35.98
13	165.16	36.64
14	170.09	37.46
15	175.00	38.43
16	179.87	39.56
17	184.70	40.83
18	189.50	42.26
19	194.24	43.84
20	198.93	45.56
21	203.57	47.43
22	208.15	49.45
23	212.66	51.60
24	217.10	53.90
25	219.07	55.00

Circle Center At X = 141.5 ; Y = 194.5 and Radius, 159.6

*** 3.393 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	39.00
2	115.48	36.58
3	120.06	34.56
4	124.80	32.97
5	129.67	31.82
6	134.62	31.12
7	139.61	30.87
8	144.61	31.07
9	149.56	31.74
10	154.44	32.85
11	159.19	34.40
12	163.78	36.37
13	168.18	38.76
14	172.34	41.54
15	176.22	44.68
16	179.81	48.17
17	183.06	51.97

18 183.79 53.00

Circle Center At X = 139.8 ; Y = 85.7 and Radius, 54.8

*** 3.409 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	39.00
2	115.77	37.18
3	120.57	35.80
4	125.49	34.86
5	130.46	34.38
6	135.46	34.36
7	140.44	34.80
8	145.36	35.70
9	150.18	37.04
10	154.85	38.82
11	159.34	41.03
12	163.61	43.63
13	167.61	46.62
14	171.33	49.96
15	174.14	53.00

Circle Center At X = 133.2 ; Y = 88.6 and Radius, 54.3

*** 3.514 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	39.00
2	110.46	38.03
3	115.42	37.38
4	120.41	37.06
5	125.41	37.08
6	130.40	37.42
7	135.35	38.09
8	140.25	39.08
9	145.08	40.40
10	149.80	42.03
11	154.41	43.97
12	158.88	46.21
13	163.19	48.74

*** 3.526 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	39.00
2	109.97	36.66
3	114.60	34.75
4	119.38	33.31
5	124.29	32.34
6	129.27	31.85
7	134.27	31.85
8	139.24	32.33
9	144.15	33.30
10	148.94	34.73
11	153.56	36.63
12	157.98	38.97
13	162.15	41.73
14	166.04	44.87
15	169.60	48.39
16	172.80	52.23
17	173.32	53.00

Circle Center At X = 131.8 ; Y = 83.1 and Radius, 51.3

*** 3.557 ***

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-
A  100.00 + ..
-      .05
-      ..5*
-      .0**
-      ..73*4*
-      ..*394.
X  150.00 + ..73941
-      ...384*
-      ...*W81*
-      ....*742
-      ...33*7
-      *.533*
I  200.00 + ...53*
-      *..*55
-      .6*
-
-      * * **
-      *
S  250.00 + *
-
-
-
300.00 +
-
-
-
F  350.00 +
-
-
-
-
T  400.00 + * *W

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*****
***** - Illegal Command *****
*****

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Legal Commands - PROFIL
                  LOADS
                  TIES
                  WATER
                  SURFAC
                  EXECUT
                  EQUAKE
                  SOIL
                  RANDOM
                  CIRCLE
                  CIRCL2
                  BLOCK

```

149

BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 1-14-94

Time of Run:

Run By: SBA

Input Data Filename:

WCP2DDL.DAT

Output Filename:

WCP2DDL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 2 - Downstream Slope -
Steady Seepage - Top of Gate El. 750 -
Upper Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries

35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	39.00	119.00	39.00	1
2	119.00	39.00	137.00	48.00	2
3	137.00	48.00	159.00	49.00	2
4	159.00	49.00	169.00	53.00	2
5	169.00	53.00	189.00	53.00	2
6	189.00	53.00	196.00	54.00	3
7	196.00	54.00	218.00	55.00	3
8	218.00	55.00	236.00	55.00	3
9	236.00	55.00	244.00	49.00	3
10	244.00	49.00	248.00	46.00	4
11	248.00	46.00	251.00	44.00	5
12	251.00	44.00	400.00	44.00	5
13	119.00	39.00	125.00	39.00	2
14	125.00	39.00	130.00	42.00	2
15	130.00	42.00	172.00	42.00	2
16	172.00	42.00	187.00	52.00	5
17	187.00	52.00	189.00	53.00	4
18	189.00	53.00	230.00	48.00	4
19	230.00	48.00	244.00	49.00	4
20	187.00	52.00	209.00	43.00	5
21	209.00	43.00	230.00	42.00	3
22	230.00	42.00	248.00	46.00	3
23	209.00	43.00	230.00	38.00	5

24	230.00	38.00	248.00	46.00	5
25	119.00	39.00	126.00	36.00	1
26	126.00	36.00	164.00	36.00	3
27	164.00	36.00	172.00	42.00	5
28	164.00	36.00	194.00	30.00	3
29	194.00	30.00	209.00	30.00	3
30	209.00	30.00	230.00	28.00	6
31	230.00	28.00	400.00	28.00	6
32	126.00	36.00	194.00	28.00	1
33	.00	29.00	140.00	29.00	6
34	140.00	29.00	194.00	28.00	6
35	194.00	28.00	209.00	30.00	6

1

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	127.0	129.0	300.0	32.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	300.0	32.0	.00	.0	1
4	119.0	125.0	70.0	29.0	.00	.0	1
5	117.0	120.0	425.0	.0	.00	.0	1
6	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	169.00	40.00
3	172.00	42.00
4	184.00	50.00
5	400.00	50.00

1

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 100.00 ft.
and X = 150.00 ft.

Each Surface Terminates Between X = 160.00 ft.
and X = 220.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 20.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.99	48.35
3	159.95	49.02
4	164.70	50.58
5	169.09	52.98
6	169.11	53.00

Circle Center At X = 153.8 ; Y = 75.7 and Radius, 27.3

*** 2.719 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.93	47.73

3	159.93	47.85
4	164.80	48.95
5	169.38	50.97
6	172.27	53.00

Circle Center At X = 156.8 ; Y = 73.2 and Radius, 25.5

*** 2.851 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.22	40.61
2	127.17	41.30
3	132.12	42.07
4	137.04	42.92
5	141.96	43.83
6	146.86	44.83
7	151.74	45.90
8	156.61	47.04
9	161.46	48.25
10	166.29	49.54
11	171.10	50.91
12	175.89	52.34
13	177.97	53.00

Circle Center At X = 79.2 ; Y = 366.1 and Radius, 328.3

*** 3.314 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	39.00
2	110.46	38.03
3	115.42	37.38
4	120.41	37.06
5	125.41	37.08
6	130.40	37.42
7	135.35	38.09
8	140.25	39.08
9	145.08	40.40
10	149.80	42.03
11	154.41	43.97
12	158.88	46.21

13	163.19	48.74
14	167.33	51.55
15	169.19	53.00

Circle Center At X = 122.7 ; Y = 112.8 and Radius, 75.8

*** 3.526 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	39.00
2	115.48	36.58
3	120.06	34.56
4	124.80	32.97
5	129.67	31.82
6	134.62	31.12
7	139.61	30.87
8	144.61	31.07
9	149.56	31.74
10	154.44	32.85
11	159.19	34.40
12	163.78	36.37
13	168.18	38.76
14	172.34	41.54
15	176.22	44.68
16	179.81	48.17
17	183.06	51.97
18	183.79	53.00

Circle Center At X = 139.8 ; Y = 85.7 and Radius, 54.8

*** 3.637 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.44	48.34
2	149.38	47.53
3	154.37	47.27
4	159.36	47.58
5	164.29	48.44
6	169.09	49.85
7	173.70	51.78
8	175.88	53.00

Circle Center At X = 154.1 ; Y = 91.9 and Radius, 44.7

*** 3.639 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	39.00
2	109.97	36.66
3	114.60	34.75
4	119.38	33.31
5	124.29	32.34
6	129.27	31.85
7	134.27	31.85
8	139.24	32.33
9	144.15	33.30
10	148.94	34.73
11	153.56	36.63
12	157.98	38.97
13	162.15	41.73
14	166.04	44.87
15	169.60	48.39
16	172.80	52.23
17	173.32	53.00

Circle Center At X = 131.8 ; Y = 83.1 and Radius, 51.3

*** 3.668 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.57	46.56
3	159.50	45.74
4	164.48	46.20
5	169.18	47.90
6	173.30	50.73
7	175.27	53.00

Circle Center At X = 160.2 ; Y = 65.4 and Radius, 19.6

*** 3.673 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	39.00
2	115.77	37.18
3	120.57	35.80
4	125.49	34.86
5	130.46	34.38
6	135.46	34.36
7	140.44	34.80
8	145.36	35.70
9	150.18	37.04
10	154.85	38.82
11	159.34	41.03
12	163.61	43.63
13	167.61	46.62
14	171.33	49.96
15	174.14	53.00

Circle Center At X = 133.2 ; Y = 88.6 and Radius, 54.3

*** 3.682 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.56	39.00
2	109.97	36.64
3	114.58	34.71
4	119.35	33.23
5	124.25	32.20
6	129.21	31.64
7	134.21	31.55
8	139.20	31.94
9	144.13	32.79
10	148.95	34.11
11	153.63	35.87
12	158.12	38.07
13	162.38	40.69
14	166.38	43.69
15	170.07	47.06
16	173.43	50.77
17	175.10	53.00

Circle Center At X = 132.6 ; Y = 84.4 and Radius, 52.9

	Y	A	X	I	S	F	T
	.00	50.00	100.00	150.00	200.00	250.00	
X	.00	+	+	+	+	+	+
		-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
	50.00	+	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
A	100.00	+	..	-	-	-	-
		-	.74	-	-	-	-
		-	..4*	-	-	-	-
		-	.7**.	-	-	-	-
		-	..54*3*	-	-	-	-
		-	..*7436	-	-	-	-
X	150.00	+	..57431	-	-	-	-
		-	...573*	-	-	-	-
		-	...*W71*	-	-	-	-
		-	*532	-	-	-	-
		-	*5	-	-	-	-
		-	*.....*	-	-	-	-
I	200.00	+	*	-	-	-	-
		-	*...*..	-	-	-	-
		-	..*	-	-	-	-
		-		-	-	-	-
		-	* * **	-	-	-	-
		-	*	-	-	-	-
S	250.00	+	*	-	-	-	-
		-		-	-	-	-
		-		-	-	-	-
		-		-	-	-	-
	300.00	+		-	-	-	-
		-		-	-	-	-
		-		-	-	-	-
		-		-	-	-	-
F	350.00	+		-	-	-	-
		-		-	-	-	-

-
-
-
T 400.00 + * *W

1

***** - Illegal Command *****

Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-29-93

Time of Run:

Run By: SBA

Input Data Filename: wcp2ddl.dat

Output Filename: wcp2ddl.out

PROBLEM DESCRIPTION WOD - Soil Profile 2 - Downstream Slope - Normal Pool El. 749
Seismic Event 0.13g (H) - Lower Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries
35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	39.00	119.00	39.00	1
2	119.00	39.00	137.00	48.00	2
3	137.00	48.00	159.00	49.00	2
4	159.00	49.00	169.00	53.00	2
5	169.00	53.00	189.00	53.00	2
6	189.00	53.00	196.00	54.00	3
7	196.00	54.00	218.00	55.00	3
8	218.00	55.00	236.00	55.00	3
9	236.00	55.00	244.00	49.00	3
10	244.00	49.00	248.00	46.00	4
11	248.00	46.00	251.00	44.00	5
12	251.00	44.00	400.00	44.00	5
13	119.00	39.00	125.00	39.00	2
14	125.00	39.00	130.00	42.00	2
15	130.00	42.00	172.00	42.00	2
16	172.00	42.00	187.00	52.00	5
17	187.00	52.00	189.00	53.00	4
18	189.00	53.00	230.00	48.00	4
19	230.00	48.00	244.00	49.00	4
20	187.00	52.00	209.00	43.00	5
21	209.00	43.00	230.00	42.00	3
22	230.00	42.00	248.00	46.00	3
23	209.00	43.00	230.00	38.00	5

24	230.00	38.00	248.00	46.00	5
25	119.00	39.00	126.00	36.00	1
26	126.00	36.00	164.00	36.00	3
27	164.00	36.00	172.00	42.00	5
28	164.00	36.00	194.00	30.00	3
29	194.00	30.00	209.00	30.00	3
30	209.00	30.00	230.00	28.00	6
31	230.00	28.00	400.00	28.00	6
32	126.00	36.00	194.00	28.00	1
33	.00	29.00	140.00	29.00	6
34	140.00	29.00	194.00	28.00	6
35	194.00	28.00	209.00	30.00	6

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	127.0	129.0	1650.0	15.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	1100.0	15.0	.00	.0	1
4	119.0	125.0	225.0	16.0	.00	.0	1
5	117.0	120.0	285.0	.0	.00	.0	1
6	165.0	165.0	576000.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	169.00	40.00
3	172.00	42.00
4	175.00	44.00
5	400.00	44.00

A Horizontal Earthquake Loading Coefficient
Of .130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 100.00 ft.
and X = 150.00 ft.

Each Surface Terminates Between X = 160.00 ft.
and X = 220.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 20.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.99	48.35
3	159.95	49.02
4	164.70	50.58
5	169.09	52.98
6	169.11	53.00

Circle Center At X = 153.8 ; Y = 75.7 and Radius, 27.3

*** 1.775 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.93	47.73
3	159.93	47.85
4	164.80	48.95
5	169.38	50.97
6	172.27	53.00

Circle Center At X = 156.8 ; Y = 73.2 and Radius, 25.5

*** 1.862 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.22	40.61
2	127.17	41.30
3	132.12	42.07
4	137.04	42.92
5	141.96	43.83
6	146.86	44.83
7	151.74	45.90
8	156.61	47.04
9	161.46	48.25
10	166.29	49.54
11	171.10	50.91
12	175.89	52.34
13	177.97	53.00

Circle Center At X = 79.2 ; Y = 366.1 and Radius, 328.3

*** 2.001 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.44	48.34
2	149.38	47.53

3	154.37	47.27
4	159.36	47.58
5	164.29	48.44
6	169.09	49.85
7	173.70	51.78
8	175.88	53.00

Circle Center At X = 154.1 ; Y = 91.9 and Radius, 44.7

*** 2.166 ***

1

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	138.89	48.09
2	143.88	47.72
3	148.88	47.67
4	153.87	47.92
5	158.84	48.48
6	163.76	49.34
7	168.63	50.50
8	173.41	51.96
9	176.19	53.00

Circle Center At X = 147.3 ; Y = 129.1 and Radius, 81.4

*** 2.259 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	138.89	48.09
2	142.92	45.12
3	147.18	42.51
4	151.65	40.28
5	156.30	38.43
6	161.09	36.98
7	165.98	35.95
8	170.94	35.33
9	175.94	35.14
10	180.93	35.38
11	185.89	36.03
12	190.77	37.11
13	195.54	38.60
14	200.17	40.49

15	204.62	42.76
16	208.87	45.41
17	212.87	48.41
18	216.60	51.73
19	219.69	55.00

Circle Center At X = 175.7 ; Y = 93.9 and Radius, 58.8

*** 2.273 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.78	43.39
2	132.74	43.98
3	137.70	44.62
4	142.65	45.32
5	147.60	46.07
6	152.53	46.88
7	157.46	47.74
8	162.37	48.65
9	167.28	49.62
10	172.17	50.64
11	177.05	51.72
12	181.92	52.85
13	182.53	53.00

Circle Center At X = 76.9 ; Y = 494.3 and Radius, 453.8

*** 2.285 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.57	46.56
3	159.50	45.74
4	164.48	46.20
5	169.18	47.90
6	173.30	50.73
7	175.27	53.00

Circle Center At X = 160.2 ; Y = 65.4 and Radius, 19.6

*** 2.323 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.78	43.39
2	132.77	43.71
3	137.75	44.12
4	142.72	44.63
5	147.69	45.24
6	152.64	45.94
7	157.57	46.73
8	162.49	47.63
9	167.40	48.61
10	172.28	49.69
11	177.14	50.86
12	181.98	52.13
13	185.06	53.00

Circle Center At X = 113.7 ; Y = 303.0 and Radius, 260.0

*** 2.369 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.78	43.39
2	132.77	43.67
3	137.76	44.05
4	142.73	44.53
5	147.70	45.11
6	152.65	45.77
7	157.60	46.54
8	162.52	47.40
9	167.43	48.35
10	172.32	49.40
11	177.19	50.55
12	182.03	51.78
13	186.43	53.00

Circle Center At X = 115.5 ; Y = 302.0 and Radius, 258.9

*** 2.399 ***

***** - Illegal Command *****

Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-29-93

Time of Run:

Run By: SBA

Input Data Filename: wcp2ddl.dat

Output Filename: wcp2ddl.out

PROBLEM DESCRIPTION WOD - Soil Profile 2 - Downstream Slope - Normal Pool El. 74.
Seismic Event 0.139 (H) - Upper Bound Properties

BOUNDARY COORDINATES

12 Top Boundaries

35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	39.00	119.00	39.00	1
2	119.00	39.00	137.00	48.00	2
3	137.00	48.00	159.00	49.00	2
4	159.00	49.00	169.00	53.00	2
5	169.00	53.00	189.00	53.00	2
6	189.00	53.00	196.00	54.00	3
7	196.00	54.00	218.00	55.00	3
8	218.00	55.00	236.00	55.00	3
9	236.00	55.00	244.00	49.00	3
10	244.00	49.00	248.00	46.00	4
11	248.00	46.00	251.00	44.00	5
12	251.00	44.00	400.00	44.00	5
13	119.00	39.00	125.00	39.00	2
14	125.00	39.00	130.00	42.00	2
15	130.00	42.00	172.00	42.00	2
16	172.00	42.00	187.00	52.00	5
17	187.00	52.00	189.00	53.00	4
18	189.00	53.00	230.00	48.00	4
19	230.00	48.00	244.00	49.00	4
20	187.00	52.00	209.00	43.00	5
21	209.00	43.00	230.00	42.00	3
22	230.00	42.00	248.00	46.00	3
23	209.00	43.00	230.00	38.00	5

24	230.00	38.00	248.00	46.00	5
25	119.00	39.00	126.00	36.00	1
26	126.00	36.00	164.00	36.00	3
27	164.00	36.00	172.00	42.00	5
28	164.00	36.00	194.00	30.00	3
29	194.00	30.00	209.00	30.00	3
30	209.00	30.00	230.00	28.00	6
31	230.00	28.00	400.00	28.00	6
32	126.00	36.00	194.00	28.00	1
33	.00	29.00	140.00	29.00	6
34	140.00	29.00	194.00	28.00	6
35	194.00	28.00	209.00	30.00	6

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	127.0	129.0	1650.0	15.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	122.0	127.0	1650.0	15.0	.00	.0	1
4	119.0	125.0	260.0	16.0	.00	.0	1
5	117.0	120.0	425.0	.0	.00	.0	1
6	165.0	165.0	576000.0	35.0	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	169.00	40.00
3	172.00	42.00
4	175.00	44.00
5	400.00	44.00

A Horizontal Earthquake Loading Coefficient
Of .130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 100.00 ft.
and X = 150.00 ft.

Each Surface Terminates Between X = 160.00 ft.
and X = 220.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 20.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.99	48.35
3	159.95	49.02
4	164.70	50.58
5	169.09	52.98
6	169.11	53.00

Circle Center At X = 153.8 ; Y = 75.7 and Radius, 27.3

*** 1.775 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.93	47.73
3	159.93	47.85
4	164.80	48.95
5	169.38	50.97
6	172.27	53.00

Circle Center At X = 156.8 ; Y = 73.2 and Radius, 25.5

*** 1.862 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.22	40.61
2	127.17	41.30
3	132.12	42.07
4	137.04	42.92
5	141.96	43.83
6	146.86	44.83
7	151.74	45.90
8	156.61	47.04
9	161.46	48.25
10	166.29	49.54
11	171.10	50.91
12	175.89	52.34
13	177.97	53.00

Circle Center At X = 79.2 ; Y = 366.1 and Radius, 328.3

*** 2.001 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.44	48.34
2	149.38	47.53

3	154.37	47.27
4	159.36	47.58
5	164.29	48.44
6	169.09	49.85
7	173.70	51.78
8	175.88	53.00

Circle Center At X = 154.1 ; Y = 91.9 and Radius, 44.7

*** 2.166 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	138.89	48.09
2	143.88	47.72
3	148.88	47.67
4	153.87	47.92
5	158.84	48.48
6	163.76	49.34
7	168.63	50.50
8	173.41	51.96
9	176.19	53.00

Circle Center At X = 147.3 ; Y = 129.1 and Radius, 81.4

*** 2.259 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.78	43.39
2	132.74	43.98
3	137.70	44.62
4	142.65	45.32
5	147.60	46.07
6	152.53	46.88
7	157.46	47.74
8	162.37	48.65
9	167.28	49.62
10	172.17	50.64
11	177.05	51.72
12	181.92	52.85
13	182.53	53.00

Circle Center At X = 76.9 ; Y = 494.3 and Radius, 453.8

*** 2.285 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	48.59
2	154.57	46.56
3	159.50	45.74
4	164.48	46.20
5	169.18	47.90
6	173.30	50.73
7	175.27	53.00

Circle Center At X = 160.2 ; Y = 65.4 and Radius, 19.6

*** 2.323 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.78	43.39
2	132.77	43.71
3	137.75	44.12
4	142.72	44.63
5	147.69	45.24
6	152.64	45.94
7	157.57	46.73
8	162.49	47.63
9	167.40	48.61
10	172.28	49.69
11	177.14	50.86
12	181.98	52.13
13	185.06	53.00

Circle Center At X = 113.7 ; Y = 303.0 and Radius, 260.0

*** 2.369 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.78	43.39
2	132.77	43.67
3	137.76	44.05
4	142.73	44.53
5	147.70	45.11
6	152.65	45.77
7	157.60	46.54
8	162.52	47.40
9	167.43	48.35
10	172.32	49.40
11	177.19	50.55
12	182.03	51.78
13	186.43	53.00

Circle Center At X = 115.5 ; Y = 302.0 and Radius, 258.9

*** 2.399 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.33	46.17
2	138.33	45.95
3	143.33	45.94
4	148.33	46.14
5	153.31	46.54
6	158.27	47.15
7	163.21	47.96
8	168.10	48.97
9	172.95	50.19
10	177.75	51.60
11	181.88	53.00

Circle Center At X = 141.0 ; Y = 167.5 and Radius, 121.6

*** 2.561 ***

Y A X I S F T

.00 50.00 100.00 150.00 200.00 250.00

TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

/77

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-9-93

Time of Run:

Run By: SBA

Input Data Filename: WCP3UUL.DAT

Output Filename: WCP3UUL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 3, Upstream Slope, Rapid Drawdown
From Max. Pool El 755 - Lower Bound Properties

BOUNDARY COORDINATES

11 Top Boundaries

25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	43.00	112.00	43.00	1
2	112.00	43.00	123.00	47.00	1
3	123.00	47.00	147.00	54.00	2
4	147.00	54.00	169.00	56.00	2
5	169.00	56.00	177.00	55.50	2
6	177.00	55.50	198.00	55.00	2
7	198.00	55.00	207.00	54.00	2
8	207.00	54.00	228.00	52.00	3
9	228.00	52.00	238.00	48.00	3
10	238.00	48.00	282.00	43.00	3
11	282.00	43.00	400.00	42.00	1
12	207.00	54.00	209.00	51.00	2
13	209.00	51.00	230.00	42.00	2
14	230.00	42.00	282.00	43.00	1
15	123.00	47.00	125.00	46.00	1
16	125.00	46.00	167.00	49.00	1
17	167.00	49.00	220.00	43.00	1
18	220.00	43.00	230.00	42.00	1
19	.00	34.00	125.00	34.00	4
20	125.00	34.00	167.00	41.00	5
21	167.00	41.00	220.00	31.00	5
22	220.00	31.00	400.00	31.00	4
23	125.00	34.00	157.00	37.00	4

24	157.00	37.00	167.00	34.00	4
25	167.00	34.00	220.00	31.00	4

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	285.0	.0	.00	.0	1
2	119.0	125.0	225.0	16.0	.00	.0	1
3	135.0	135.0	.0	35.0	.00	.0	1
4	165.0	165.0	576000.0	35.0	.00	.0	1
5	122.0	127.0	1100.0	15.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 12 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	43.00
2	112.00	43.00
3	123.00	47.00
4	147.00	54.00
5	169.00	56.00
6	177.00	55.50
7	198.00	55.00
8	207.00	54.00
9	209.00	51.00
10	230.00	42.00
11	282.00	43.00
12	400.00	40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 80.00$ ft.
and $X = 130.00$ ft.

Each Surface Terminates Between $X = 135.00$ ft.
and $X = 200.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = .00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	107.78	43.00
2	111.87	40.12
3	116.38	37.96
4	121.18	36.58
5	126.15	36.01
6	131.14	36.28
7	136.02	37.37
8	140.65	39.26
9	144.91	41.89
10	148.66	45.18
11	151.82	49.06
12	154.29	53.41
13	154.77	54.71

Circle Center At $X = 127.0$; $Y = 66.0$ and Radius, 30.0

*** 1.413 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
--------------	----------------	----------------

1	107.78	43.00
2	112.17	40.61
3	116.85	38.85
4	121.72	37.73
5	126.70	37.29
6	131.70	37.53
7	136.61	38.44
8	141.36	40.02
9	145.85	42.22
10	150.00	45.01
11	153.73	48.34
12	156.97	52.15
13	158.84	55.08

Circle Center At X = 127.5 ; Y = 74.0 and Radius, 36.7

*** 1.438 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	43.49
2	117.80	41.24
3	122.49	39.50
4	127.34	38.28
5	132.29	37.62
6	137.29	37.50
7	142.27	37.94
8	147.17	38.93
9	151.94	40.45
10	156.50	42.49
11	160.81	45.02
12	164.82	48.02
13	168.46	51.44
14	171.71	55.24
15	172.10	55.81

Circle Center At X = 135.8 ; Y = 82.6 and Radius, 45.1

*** 1.449 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
--------------	----------------	----------------

1	113.33	43.49
2	117.92	41.49
3	122.67	39.94
4	127.55	38.86
5	132.52	38.24
6	137.51	38.10
7	142.50	38.45
8	147.43	39.26
9	152.27	40.55
10	156.95	42.29
11	161.45	44.48
12	165.72	47.08
13	169.72	50.08
14	173.41	53.45
15	175.36	55.60

Circle Center At X = 136.4 ; Y = 90.3 and Radius, 52.2

*** 1.505 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	91.11	43.00
2	95.48	40.58
3	100.07	38.58
4	104.82	37.02
5	109.69	35.91
6	114.65	35.27
7	119.65	35.11
8	124.64	35.41
9	129.58	36.18
10	134.43	37.42
11	139.13	39.11
12	143.66	41.23
13	147.96	43.77
14	152.01	46.71
15	155.76	50.02
16	159.19	53.66
17	160.39	55.22

Circle Center At X = 118.9 ; Y = 88.0 and Radius, 52.9

*** 1.559 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	107.78	43.00
2	111.33	39.48
3	115.59	36.86
4	120.33	35.29
5	125.31	34.85
6	130.26	35.55
7	134.92	37.38
8	139.03	40.22
9	142.39	43.93
10	144.80	48.31
11	146.15	53.12
12	146.18	53.76

Circle Center At X = 124.7 ; Y = 56.5 and Radius, 21.7

*** 1.610 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.67	43.00
2	100.59	39.90
3	104.94	37.44
4	109.61	35.66
5	114.50	34.61
6	119.49	34.31
7	124.47	34.77
8	129.32	35.97
9	133.94	37.90
10	138.21	40.51
11	142.03	43.73
12	145.32	47.49
13	148.01	51.71
14	149.10	54.19

Circle Center At X = 119.0 ; Y = 67.2 and Radius, 32.9

*** 1.618 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
--------------	----------------	----------------

1	113.33	43.49
2	117.74	41.12
3	122.51	39.62
4	127.47	39.02
5	132.46	39.35
6	137.30	40.61
7	141.83	42.73
8	145.88	45.66
9	149.33	49.28
10	152.04	53.48
11	152.45	54.50

Circle Center At X = 128.2 ; Y = 65.9 and Radius, 26.9

*** 1.624 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.67	43.00
2	101.09	40.67
3	105.75	38.86
4	110.59	37.59
5	115.54	36.88
6	120.53	36.74
7	125.52	37.16
8	130.42	38.16
9	135.17	39.70
10	139.72	41.78
11	144.00	44.36
12	147.96	47.41
13	151.55	50.90
14	154.66	54.70

Circle Center At X = 119.3 ; Y = 80.5 and Radius, 43.8

*** 1.665 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	118.89	45.51
2	122.82	42.42
3	127.27	40.13
4	132.06	38.70

Circle Center At $X = 137.2$; $Y = 64.9$ and Radius, 26.7

	Y	A	X	I	S	F	T
	.00	50.00	100.00	150.00	200.00	250.00	
X	.00 +	*.**	- - - - -	+ .	+ .	+ .	+ .
	-						
	-						
	-						
	50.00 +						
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	-						
	-						
	-	...					
	-	..55					
A	100.00 +	..57					
	-	..51*					
	-	...513					
	-	...*2*					
	-	...12..					
	-	166.					
X	150.00 +	...211*					
	-	..*3321					
	-	..**4**					
	-	●					
	-						
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I	200.00 +	●					
	-	**					
	-	*	*				
	-	*	*				
	-	*	*				
	-	*	*				
S	250.00 +	*	*				
	-						
	-						
	-						

300.00 +

F 350.00 +

T 400.00 + * *

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*****
*****      - Illegal Command      *****
*****
```

Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-9-93

Time of Run:

Run By: SBA

Input Data Filename: WCP3UUL.DAT

Output Filename: WCP3UUL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 3, Upstream slope, Rapid Drawdown
From Max. Pool El. 755 - Upper Bound Properties

BOUNDARY COORDINATES

11 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Brd
1	.00	43.00	112.00	43.00	1
2	112.00	43.00	123.00	47.00	1
3	123.00	47.00	147.00	54.00	2
4	147.00	54.00	169.00	56.00	2
5	169.00	56.00	177.00	55.50	2
6	177.00	55.50	198.00	55.00	2
7	198.00	55.00	207.00	54.00	2
8	207.00	54.00	228.00	52.00	3
9	228.00	52.00	238.00	48.00	3
10	238.00	48.00	282.00	43.00	3
11	282.00	43.00	400.00	42.00	1
12	207.00	54.00	209.00	51.00	2
13	209.00	51.00	230.00	42.00	2
14	230.00	42.00	282.00	43.00	1
15	123.00	47.00	125.00	46.00	1
16	125.00	46.00	167.00	49.00	1
17	167.00	49.00	220.00	43.00	1
18	220.00	43.00	230.00	42.00	1
19	.00	34.00	125.00	34.00	4
20	125.00	34.00	167.00	41.00	5
21	167.00	41.00	220.00	31.00	5
22	220.00	31.00	400.00	31.00	4
23	125.00	34.00	157.00	37.00	4

24	157.00	37.00	167.00	34.00	4
25	167.00	34.00	220.00	31.00	4

1

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	425.0	.0	.00	.0	1
2	119.0	125.0	260.0	16.0	.00	.0	1
3	135.0	135.0	.0	35.0	.00	.0	1
4	165.0	165.0	576000.0	35.0	.00	.0	1
5	122.0	127.0	1650.0	15.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 12 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	43.00
2	112.00	43.00
3	123.00	47.00
4	147.00	54.00
5	169.00	56.00
6	177.00	55.50
7	198.00	55.00
8	207.00	54.00
9	209.00	51.00
10	230.00	42.00
11	282.00	43.00
12	400.00	40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 80.00$ ft.
and $X = 130.00$ ft.

Each Surface Terminates Between $X = 135.00$ ft.
and $X = 200.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = .00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	107.78	43.00
2	111.87	40.12
3	116.38	37.96
4	121.18	36.58
5	126.15	36.01
6	131.14	36.28
7	136.02	37.37
8	140.65	39.26
9	144.91	41.89
10	148.66	45.18
11	151.82	49.06
12	154.29	53.41
13	154.77	54.71

Circle Center At $X = 127.0$; $Y = 66.0$ and Radius, 30.0

*** 2.066 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
--------------	----------------	----------------

1	107.78	43.00
2	112.17	40.61
3	116.85	38.85
4	121.72	37.73
5	126.70	37.29
6	131.70	37.53
7	136.61	38.44
8	141.36	40.02
9	145.85	42.22
10	150.00	45.01
11	153.73	48.34
12	156.97	52.15
13	158.84	55.08

Circle Center At X = 127.5 ; Y = 74.0 and Radius, 36.7

*** 2.091 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	43.49
2	117.80	41.24
3	122.49	39.50
4	127.34	38.28
5	132.29	37.62
6	137.29	37.50
7	142.27	37.94
8	147.17	38.93
9	151.94	40.45
10	156.50	42.49
11	160.81	45.02
12	164.82	48.02
13	168.46	51.44
14	171.71	55.24
15	172.10	55.81

Circle Center At X = 135.8 ; Y = 82.6 and Radius, 45.1

*** 2.106 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
--------------	----------------	----------------

1	113.33	43.49
2	117.92	41.49
3	122.67	39.94
4	127.55	38.86
5	132.52	38.24
6	137.51	38.10
7	142.50	38.45
8	147.43	39.26
9	152.27	40.55
10	156.95	42.29
11	161.45	44.48
12	165.72	47.08
13	169.72	50.08
14	173.41	53.45
15	175.36	55.60

Circle Center At X = 136.4 ; Y = 90.3 and Radius, 52.2

*** 2.182 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	91.11	43.00
2	95.48	40.58
3	100.07	38.58
4	104.82	37.02
5	109.69	35.91
6	114.65	35.27
7	119.65	35.11
8	124.64	35.41
9	129.58	36.18
10	134.43	37.42
11	139.13	39.11
12	143.66	41.23
13	147.96	43.77
14	152.01	46.71
15	155.76	50.02
16	159.19	53.66
17	160.39	55.22

Circle Center At X = 118.9 ; Y = 88.0 and Radius, 52.9

*** 2.271 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	43.49
2	117.74	41.12
3	122.51	39.62
4	127.47	39.02
5	132.46	39.35
6	137.30	40.61
7	141.83	42.73
8	145.88	45.66
9	149.33	49.28
10	152.04	53.48
11	152.45	54.50

Circle Center At X = 128.2 ; Y = 65.9 and Radius, 26.9

*** 2.350 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.67	43.00
2	100.59	39.90
3	104.94	37.44
4	109.61	35.66
5	114.50	34.61
6	119.49	34.31
7	124.47	34.77
8	129.32	35.97
9	133.94	37.90
10	138.21	40.51
11	142.03	43.73
12	145.32	47.49
13	148.01	51.71
14	149.10	54.19

Circle Center At X = 119.0 ; Y = 67.2 and Radius, 32.9

*** 2.369 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	107.78	43.00

2	111.33	39.48
3	115.59	36.86
4	120.33	35.29
5	125.31	34.85
6	130.26	35.55
7	134.92	37.38
8	139.03	40.22
9	142.39	43.93
10	144.80	48.31
11	146.15	53.12
12	146.18	53.76

Circle Center At X = 124.7 ; Y = 56.5 and Radius, 21.7

*** 2.372 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.67	43.00
2	101.09	40.67
3	105.75	38.86
4	110.59	37.59
5	115.54	36.88
6	120.53	36.74
7	125.52	37.16
8	130.42	38.16
9	135.17	39.70
10	139.72	41.78
11	144.00	44.36
12	147.96	47.41
13	151.55	50.90
14	154.66	54.70

Circle Center At X = 119.3 ; Y = 80.5 and Radius, 43.8

*** 2.417 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	118.89	45.51
2	122.82	42.42
3	127.27	40.13
4	132.06	38.70

★★★ 2.477 ★★★

300.00 +
-
-
-
-
-
F 350.00 +
-
-
-
-
-
T 400.00 + * *

1

***** - Illegal Command *****

Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-9-93

Time of Run:

Run By: SBA

Input Data Filename: WCP3UUL.DAT

Output Filename: WCP3UUL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 3, upstream slope, Rapid Drawdown
From Top of Gate El. 750 - Lower Bound Properties.

BOUNDARY COORDINATES

11 Top Boundaries

25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	43.00	112.00	43.00	1
2	112.00	43.00	123.00	47.00	1
3	123.00	47.00	147.00	54.00	2
4	147.00	54.00	169.00	56.00	2
5	169.00	56.00	177.00	55.50	2
6	177.00	55.50	198.00	55.00	2
7	198.00	55.00	207.00	54.00	2
8	207.00	54.00	228.00	52.00	3
9	228.00	52.00	238.00	48.00	3
10	238.00	48.00	282.00	43.00	3
11	282.00	43.00	400.00	42.00	1
12	207.00	54.00	209.00	51.00	2
13	209.00	51.00	230.00	42.00	2
14	230.00	42.00	282.00	43.00	1
15	123.00	47.00	125.00	46.00	1
16	125.00	46.00	167.00	49.00	1
17	167.00	49.00	220.00	43.00	1
18	220.00	43.00	230.00	42.00	1
19	.00	34.00	125.00	34.00	4
20	125.00	34.00	167.00	41.00	5
21	167.00	41.00	220.00	31.00	5
22	220.00	31.00	400.00	31.00	4
23	125.00	34.00	157.00	37.00	4

24	157.00	37.00	167.00	34.00	4
25	167.00	34.00	220.00	31.00	4

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	285.0	.0	.00	.0	1
2	119.0	125.0	225.0	16.0	.00	.0	1
3	135.0	135.0	.0	35.0	.00	.0	1
4	165.0	165.0	576000.0	35.0	.00	.0	1
5	122.0	127.0	1100.0	15.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	43.00
2	112.00	43.00
3	123.00	47.00
4	137.00	50.00
5	210.00	50.00
6	230.00	42.00
7	282.00	42.00
8	400.00	40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 80.00 ft.
and X = 130.00 ft.

Each Surface Terminates Between X = 135.00 ft.
and X = 200.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	107.78	43.00
2	111.87	40.12
3	116.38	37.96
4	121.18	36.58
5	126.15	36.01
6	131.14	36.28
7	136.02	37.37
8	140.65	39.26
9	144.91	41.89
10	148.66	45.18
11	151.82	49.06
12	154.29	53.41
13	154.77	54.71

Circle Center At X = 127.0 ; Y = 66.0 and Radius, 30.0

*** 1.471 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	107.78	43.00
2	112.17	40.61
3	116.85	38.85

4	121.72	37.73
5	126.70	37.29
6	131.70	37.53
7	136.61	38.44
8	141.36	40.02
9	145.85	42.22
10	150.00	45.01
11	153.73	48.34
12	156.97	52.15
13	158.84	55.08

Circle Center At X = 127.5 ; Y = 74.0 and Radius, 36.7

*** 1.506 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	43.49
2	117.80	41.24
3	122.49	39.50
4	127.34	38.28
5	132.29	37.62
6	137.29	37.50
7	142.27	37.94
8	147.17	38.93
9	151.94	40.45
10	156.50	42.49
11	160.81	45.02
12	164.82	48.02
13	168.46	51.44
14	171.71	55.24
15	172.10	55.81

Circle Center At X = 135.8 ; Y = 82.6 and Radius, 45.1

*** 1.532 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	43.49
2	117.92	41.49
3	122.67	39.94
4	127.55	38.86

5	132.52	38.24
6	137.51	38.10
7	142.50	38.45
8	147.43	39.26
9	152.27	40.55
10	156.95	42.29
11	161.45	44.48
12	165.72	47.08
13	169.72	50.08
14	173.41	53.45
15	175.36	55.60

Circle Center At X = 136.4 ; Y = 90.3 and Radius, 52.2

*** 1.594 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	91.11	43.00
2	95.48	40.58
3	100.07	38.58
4	104.82	37.02
5	109.69	35.91
6	114.65	35.27
7	119.65	35.11
8	124.64	35.41
9	129.58	36.18
10	134.43	37.42
11	139.13	39.11
12	143.66	41.23
13	147.96	43.77
14	152.01	46.71
15	155.76	50.02
16	159.19	53.66
17	160.39	55.22

Circle Center At X = 118.9 ; Y = 88.0 and Radius, 52.9

*** 1.624 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	107.78	43.00

2	111.33	39.48
3	115.59	36.86
4	120.33	35.29
5	125.31	34.85
6	130.26	35.55
7	134.92	37.38
8	139.03	40.22
9	142.39	43.93
10	144.80	48.31
11	146.15	53.12
12	146.18	53.76

Circle Center At X = 124.7 ; Y = 56.5 and Radius, 21.7

*** 1.654 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.67	43.00
2	100.59	39.90
3	104.94	37.44
4	109.61	35.66
5	114.50	34.61
6	119.49	34.31
7	124.47	34.77
8	129.32	35.97
9	133.94	37.90
10	138.21	40.51
11	142.03	43.73
12	145.32	47.49
13	148.01	51.71
14	149.10	54.19

Circle Center At X = 119.0 ; Y = 67.2 and Radius, 32.9

*** 1.667 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	43.49
2	117.74	41.12
3	122.51	39.62
4	127.47	39.02

5	132.46	39.35
6	137.30	40.61
7	141.83	42.73
8	145.88	45.66
9	149.33	49.28
10	152.04	53.48
11	152.45	54.50

Circle Center At X = 128.2 ; Y = 65.9 and Radius, 26.9

*** 1.706 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.67	43.00
2	101.09	40.67
3	105.75	38.86
4	110.59	37.59
5	115.54	36.88
6	120.53	36.74
7	125.52	37.16
8	130.42	38.16
9	135.17	39.70
10	139.72	41.78
11	144.00	44.36
12	147.96	47.41
13	151.55	50.90
14	154.66	54.70

Circle Center At X = 119.3 ; Y = 80.5 and Radius, 43.8

*** 1.733 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.22	43.00
2	105.77	39.48
3	109.98	36.77
4	114.65	35.00
5	119.60	34.24
6	124.59	34.53
7	129.41	35.85
8	133.86	38.14

	Y	A	X	I	S	F	T
	.00	50.00	100.00	150.00	200.00	250.00	
X	.00 +-----+	*+-----+	+-----+	+-----+	+-----+	+-----+	
	-						
	-						
	-						
	-						
	50.00 +						
	-						
	-						
	-						
	-						
	-	...					
	-	..55					
A	100.00 +	..57					
	-	..51*					
	-	...513					
	-	...*2*					
	-	...12.W					
	-	1660					
X	150.00 +	211*					
	-	..*3321					
	-	..**4**					
	-	●					
	-						
	-						
I	200.00 +	*					
	-	**					
	-	* *					
	-	●					
	-	*					
	-	●					
S	250.00 +						
	-						
	-						
	-						
	-	W*					
	-						
	300.00 +						
	-						

-
-
-
F 350.00 +
-
-
-

T 400.00 + * *

1

***** - Illegal Command *****

Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-9-93

Time of Run:

Run By: SBA

Input Data Filename: WCP3UUL.DAT

Output Filename: WCP3UUL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 3, Upstream slope, Rapid Drawdown
From Top of Gate E1.750 - Upper Bound Properties.

BOUNDARY COORDINATES

11 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	43.00	112.00	43.00	1
2	112.00	43.00	123.00	47.00	1
3	123.00	47.00	147.00	54.00	2
4	147.00	54.00	169.00	56.00	2
5	169.00	56.00	177.00	55.50	2
6	177.00	55.50	198.00	55.00	2
7	198.00	55.00	207.00	54.00	2
8	207.00	54.00	228.00	52.00	3
9	228.00	52.00	238.00	48.00	3
10	238.00	48.00	282.00	43.00	3
11	282.00	43.00	400.00	42.00	1
12	207.00	54.00	209.00	51.00	2
13	209.00	51.00	230.00	42.00	2
14	230.00	42.00	282.00	43.00	1
15	123.00	47.00	125.00	46.00	1
16	125.00	46.00	167.00	49.00	1
17	167.00	49.00	220.00	43.00	1
18	220.00	43.00	230.00	42.00	1
19	.00	34.00	125.00	34.00	4
20	125.00	34.00	167.00	41.00	5
21	167.00	41.00	220.00	31.00	5
22	220.00	31.00	400.00	31.00	4
23	125.00	34.00	157.00	37.00	4

24	157.00	37.00	167.00	34.00	4
25	167.00	34.00	220.00	31.00	4

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	425.0	.0	.00	.0	1
2	119.0	125.0	260.0	16.0	.00	.0	1
3	135.0	135.0	.0	35.0	.00	.0	1
4	165.0	165.0	576000.0	35.0	.00	.0	1
5	122.0	127.0	1650.0	15.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	43.00
2	112.00	43.00
3	123.00	47.00
4	137.00	50.00
5	210.00	50.00
6	230.00	42.00
7	282.00	42.00
8	400.00	40.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 80.00 ft.
and X = 130.00 ft.

Each Surface Terminates Between X = 135.00 ft.
and X = 200.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	107.78	43.00
2	111.87	40.12
3	116.38	37.96
4	121.18	36.58
5	126.15	36.01
6	131.14	36.28
7	136.02	37.37
8	140.65	39.26
9	144.91	41.89
10	148.66	45.18
11	151.82	49.06
12	154.29	53.41
13	154.77	54.71

Circle Center At X = 127.0 ; Y = 66.0 and Radius, 30.0

*** 2.139 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	107.78	43.00
2	112.17	40.61
3	116.85	38.85

5	132.52	38.24
6	137.51	38.10
7	142.50	38.45
8	147.43	39.26
9	152.27	40.55
10	156.95	42.29
11	161.45	44.48
12	165.72	47.08
13	169.72	50.08
14	173.41	53.45
15	175.36	55.60

Circle Center At X = 136.4 ; Y = 90.3 and Radius, 52.2

*** 2.294 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	91.11	43.00
2	95.48	40.58
3	100.07	38.58
4	104.82	37.02
5	109.69	35.91
6	114.65	35.27
7	119.65	35.11
8	124.64	35.41
9	129.58	36.18
10	134.43	37.42
11	139.13	39.11
12	143.66	41.23
13	147.96	43.77
14	152.01	46.71
15	155.76	50.02
16	159.19	53.66
17	160.39	55.22

Circle Center At X = 118.9 ; Y = 88.0 and Radius, 52.9

*** 2.351 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	107.78	43.00

2	111.33	39.48
3	115.59	36.86
4	120.33	35.29
5	125.31	34.85
6	130.26	35.55
7	134.92	37.38
8	139.03	40.22
9	142.39	43.93
10	144.80	48.31
11	146.15	53.12
12	146.18	53.76

Circle Center At X = 124.7 ; Y = 56.5 and Radius, 21.7

*** 2.429 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.67	43.00
2	100.59	39.90
3	104.94	37.44
4	109.61	35.66
5	114.50	34.61
6	119.49	34.31
7	124.47	34.77
8	129.32	35.97
9	133.94	37.90
10	138.21	40.51
11	142.03	43.73
12	145.32	47.49
13	148.01	51.71
14	149.10	54.19

Circle Center At X = 119.0 ; Y = 67.2 and Radius, 32.9

*** 2.431 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	43.49
2	117.74	41.12
3	122.51	39.62
4	127.47	39.02

5	132.46	39.35
6	137.30	40.61
7	141.83	42.73
8	145.88	45.66
9	149.33	49.28
10	152.04	53.48
11	152.45	54.50

Circle Center At X = 128.2 ; Y = 65.9 and Radius, 26.9

*** 2.450 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.67	43.00
2	101.09	40.67
3	105.75	38.86
4	110.59	37.59
5	115.54	36.88
6	120.53	36.74
7	125.52	37.16
8	130.42	38.16
9	135.17	39.70
10	139.72	41.78
11	144.00	44.36
12	147.96	47.41
13	151.55	50.90
14	154.66	54.70

Circle Center At X = 119.3 ; Y = 80.5 and Radius, 43.8

*** 2.501 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.22	43.00
2	105.77	39.48
3	109.98	36.77
4	114.65	35.00
5	119.60	34.24
6	124.59	34.53
7	129.41	35.85
8	133.86	38.14

212

F 350.00 +

T 400.00 +

• •

***** - Illegal Command *****

Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-8-93

Time of Run:

Run By: SBA

Input Data Filename: WCP3DDL.DAT

Output Filename: WCP3DDL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 3, Downstream Slope, steady Seepage
Max. Pool El. 755 - Lower Bound Properties

BOUNDARY COORDINATES

11 Top Boundaries

25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	118.00	43.00	1
2	118.00	43.00	163.00	48.00	2
3	163.00	48.00	172.00	52.00	2
4	172.00	52.00	193.00	53.00	2
5	193.00	53.00	202.00	54.00	3
6	202.00	54.00	223.00	54.50	3
7	223.00	54.50	231.00	55.00	3
8	231.00	55.00	253.00	54.00	3
9	253.00	54.00	277.00	47.00	3
10	277.00	47.00	288.00	43.00	1
11	288.00	43.00	400.00	43.00	1
12	118.00	43.00	170.00	42.00	1
13	170.00	42.00	191.00	51.00	3
14	191.00	51.00	193.00	53.00	3
15	170.00	42.00	180.00	43.00	1
16	180.00	43.00	233.00	49.00	1
17	233.00	49.00	275.00	46.00	1
18	275.00	46.00	277.00	47.00	1
19	.00	31.00	180.00	31.00	4
20	180.00	31.00	233.00	41.00	5
21	233.00	41.00	275.00	35.00	5
22	275.00	35.00	400.00	35.00	4
23	180.00	31.00	233.00	34.00	4

24	233.00	34.00	243.00	37.00	4
25	243.00	37.00	275.00	35.00	4

1

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	285.0	.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	119.0	125.0	.0	30.0	.00	.0	1
4	165.0	165.0	576000.0	35.0	.00	.0	1
5	122.0	127.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 9 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	118.00	43.00
3	170.00	42.00
4	191.00	51.00
5	193.00	53.00
6	202.00	54.00
7	223.00	54.50
8	231.00	55.00
9	400.00	55.00

1

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
 Along The Ground Surface Between X = 100.00 ft.
 and X = 160.00 ft.

Each Surface Terminates Between X = 170.00 ft.
and X = 220.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 20.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	43.22
2	124.16	40.44
3	128.53	38.02
4	133.09	35.96
5	137.80	34.28
6	142.63	33.00
7	147.55	32.13
8	152.53	31.66
9	157.53	31.60
10	162.52	31.96
11	167.46	32.72
12	172.32	33.89
13	177.07	35.46
14	181.67	37.42
15	186.09	39.75
16	190.31	42.43
17	194.29	45.45
18	198.01	48.80
19	201.44	52.43
20	202.71	54.02

Circle Center At X = 155.7 ; Y = 92.1 and Radius, 60.6

*** 1.592 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.33	44.70
2	136.97	41.28
3	141.02	38.34
4	145.41	35.94
5	150.06	34.11
6	154.91	32.89
7	159.88	32.30
8	164.88	32.34
9	169.83	33.01
10	174.66	34.30
11	179.28	36.20
12	183.63	38.67
13	187.63	41.67
14	191.22	45.15
15	194.34	49.06
16	196.93	53.34
17	196.98	53.44

Circle Center At X = 162.1 ; Y = 71.6 and Radius, 39.4

*** 1.686 ***

1

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	42.96
2	117.65	40.44
3	122.14	38.24
4	126.78	36.37
5	131.54	34.86
6	136.41	33.70
7	141.34	32.89
8	146.32	32.46
9	151.32	32.39
10	156.31	32.69
11	161.27	33.36
12	166.16	34.39
13	170.97	35.77
14	175.66	37.51
15	180.20	39.58
16	184.59	41.99
17	188.78	44.71
18	192.77	47.73
19	196.52	51.04
20	199.09	53.68

Circle Center At X = 149.7 ; Y = 100.3 and Radius, 67.9

*** 1.700 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	126.67	43.96
2	131.14	41.73
3	135.74	39.77
4	140.45	38.09
5	145.25	36.70
6	150.13	35.61
7	155.07	34.81
8	160.04	34.32
9	165.04	34.13
10	170.04	34.24
11	175.02	34.66
12	179.97	35.38
13	184.86	36.40
14	189.69	37.71
15	194.42	39.32
16	199.05	41.21
17	203.56	43.38
18	207.92	45.82
19	212.13	48.52
20	216.17	51.47
21	219.74	54.42

Circle Center At X = 165.7 ; Y = 116.3 and Radius, 82.2

*** 1.795 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	45.44
2	143.55	41.92
3	147.51	38.87
4	151.82	36.34
5	156.41	34.36
6	161.21	32.96
7	166.15	32.17
8	171.15	32.01
9	176.13	32.46

10	181.01	33.53
11	185.73	35.20
12	190.20	37.44
13	194.35	40.22
14	198.13	43.49
15	201.48	47.21
16	204.33	51.31
17	205.79	54.09

Circle Center At X = 170.0 ; Y = 72.2 and Radius, 40.2

*** 1.797 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	42.85
2	104.33	40.35
3	108.81	38.13
4	113.42	36.20
5	118.15	34.56
6	122.97	33.23
7	127.86	32.20
8	132.81	31.49
9	137.79	31.09
10	142.79	31.00
11	147.79	31.23
12	152.76	31.78
13	157.68	32.64
14	162.54	33.81
15	167.32	35.29
16	171.99	37.06
17	176.55	39.13
18	180.96	41.48
19	185.22	44.11
20	189.30	47.00
21	193.19	50.14
22	196.75	53.42

Circle Center At X = 141.6 ; Y = 110.0 and Radius, 79.0

*** 1.813 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
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1	133.33	44.70
2	137.69	42.25
3	142.21	40.11
4	146.87	38.30
5	151.65	36.82
6	156.51	35.68
7	161.45	34.88
8	166.43	34.44
9	171.43	34.35
10	176.42	34.61
11	181.39	35.23
12	186.29	36.19
13	191.12	37.50
14	195.84	39.14
15	200.43	41.11
16	204.88	43.41
17	209.15	46.01
18	213.22	48.90
19	217.09	52.08
20	219.55	54.42

Circle Center At X = 170.2 ; Y = 105.1 and Radius, 70.8

*** 1.842 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.00	47.67
2	165.00	47.75
3	169.63	49.62
4	172.17	52.01

Circle Center At X = 162.3 ; Y = 61.1 and Radius, 13.6

*** 1.859 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	45.44
2	144.29	42.88
3	148.83	40.77
4	153.55	39.14

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5	158.42	38.02
6	163.39	37.40
7	168.39	37.30
8	173.37	37.72
9	178.28	38.65
10	183.07	40.09
11	187.68	42.02
12	192.07	44.41
13	196.19	47.25
14	199.99	50.50
15	203.35	54.03

Circle Center At X = 166.8 ; Y = 85.5 and Radius, 48.2

*** 1.933 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	42.96
2	118.03	41.24
3	122.80	39.73
4	127.63	38.44
5	132.51	37.36
6	137.44	36.51
7	142.39	35.88
8	147.38	35.46
9	152.37	35.28
10	157.37	35.31
11	162.37	35.58
12	167.34	36.06
13	172.29	36.77
14	177.21	37.70
15	182.07	38.84
16	186.88	40.21
17	191.63	41.79
18	196.30	43.58
19	200.88	45.57
20	205.37	47.77
21	209.76	50.17
22	214.03	52.77
23	216.38	54.34

Circle Center At X = 154.0 ; Y = 146.8 and Radius, 111.5

*** 1.940 ***

	Y	A	X	I	S	F	T
	.00	50.00	100.00	150.00	200.00	250.00	
X	.00	+	+	+	+	+	+
		-					
		-					
		-					
	50.00	+					
		-					
		-					
		-					
A	100.00	+	.6				
		-	.6.				
		-	.63*				
		-	.6314				
		-	.6122				
		-	.6125				
X	150.00	+	.125.				
		-	.129.8				
		-	.11*.*				
		-	.513.*				
		-	*11*..				
		-	.511**				
I	200.00	+	.441*				
		-	.445				
		-	44				
		-	*				
		-	** **				
		-	*				
S	250.00	+	*				
		-					
		-	* *				
		-					
	300.00	+	*				
		-					
		-					
F	350.00	+					
		-					
		-					
		-					
T	400.00	+	* * W				

1

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*****
***** - Illegal Command *****
*****
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Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-8-93

Time of Run:

Run By: SBA

Input Data Filename: WCP3DDL.DAT

Output Filename: WCP3DDL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 3, Downstream Slope, Steady Seepage,
Max. Pool El. 755 - Upper Bound Properties.

BOUNDARY COORDINATES

11 Top Boundaries

25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	118.00	43.00	1
2	118.00	43.00	163.00	48.00	2
3	163.00	48.00	172.00	52.00	2
4	172.00	52.00	193.00	53.00	2
5	193.00	53.00	202.00	54.00	3
6	202.00	54.00	223.00	54.50	3
7	223.00	54.50	231.00	55.00	3
8	231.00	55.00	253.00	54.00	3
9	253.00	54.00	277.00	47.00	3
10	277.00	47.00	288.00	43.00	1
11	288.00	43.00	400.00	43.00	1
12	118.00	43.00	170.00	42.00	1
13	170.00	42.00	191.00	51.00	3
14	191.00	51.00	193.00	53.00	3
15	170.00	42.00	180.00	43.00	1
16	180.00	43.00	233.00	49.00	1
17	233.00	49.00	275.00	46.00	1
18	275.00	46.00	277.00	47.00	1
19	.00	31.00	180.00	31.00	4
20	180.00	31.00	233.00	41.00	5
21	233.00	41.00	275.00	35.00	5
22	275.00	35.00	400.00	35.00	4
23	180.00	31.00	233.00	34.00	4

24	233.00	34.00	243.00	37.00	4
25	243.00	37.00	275.00	35.00	4

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	425.0	.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	119.0	125.0	70.0	29.0	.00	.0	1
4	165.0	165.0	576000.0	35.0	.00	.0	1
5	122.0	127.0	300.0	32.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 9 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	118.00	43.00
3	170.00	42.00
4	191.00	51.00
5	193.00	53.00
6	202.00	54.00
7	223.00	54.50
8	231.00	55.00
9	400.00	55.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 100.00 ft.
and X = 160.00 ft.

Each Surface Terminates Between X = 170.00 ft.
and X = 220.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 20.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.00	47.67
2	165.00	47.75
3	169.63	49.62
4	172.17	52.01

Circle Center At X = 162.3 ; Y = 61.1 and Radius, 13.6

*** 1.859 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	43.22
2	124.16	40.44
3	128.53	38.02
4	133.09	35.96
5	137.80	34.28
6	142.63	33.00
7	147.55	32.13
8	152.53	31.66
9	157.53	31.60
10	162.52	31.96
11	167.46	32.72

12	172.32	33.89
13	177.07	35.46
14	181.67	37.42
15	186.09	39.75
16	190.31	42.43
17	194.29	45.45
18	198.01	48.80
19	201.44	52.43
20	202.71	54.02

Circle Center At X = 155.7 ; Y = 92.1 and Radius, 60.6

*** 2.377 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.33	44.70
2	136.97	41.28
3	141.02	38.34
4	145.41	35.94
5	150.06	34.11
6	154.91	32.89
7	159.88	32.30
8	164.88	32.34
9	169.83	33.01
10	174.66	34.30
11	179.28	36.20
12	183.63	38.67
13	187.63	41.67
14	191.22	45.15
15	194.34	49.06
16	196.93	53.34
17	196.98	53.44

Circle Center At X = 162.1 ; Y = 71.6 and Radius, 39.4

*** 2.484 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	42.96
2	117.65	40.44
3	122.14	38.24

4	126.78	36.37
5	131.54	34.86
6	136.41	33.70
7	141.34	32.89
8	146.32	32.46
9	151.32	32.39
10	156.31	32.69
11	161.27	33.36
12	166.16	34.39
13	170.97	35.77
14	175.66	37.51
15	180.20	39.58
16	184.59	41.99
17	188.78	44.71
18	192.77	47.73
19	196.52	51.04
20	199.09	53.68

Circle Center At X = 149.7 ; Y = 100.3 and Radius, 67.9

*** 2.520 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.00	47.67
2	164.88	46.58
3	169.37	48.78
4	170.58	51.37

Circle Center At X = 164.0 ; Y = 54.1 and Radius, 7.5

*** 2.611 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	45.44
2	143.55	41.92
3	147.51	38.87
4	151.82	36.34
5	156.41	34.36
6	161.21	32.96
7	166.15	32.17
8	171.15	32.01

9	176.13	32.46
10	181.01	33.53
11	185.73	35.20
12	190.20	37.44
13	194.35	40.22
14	198.13	43.49
15	201.48	47.21
16	204.33	51.31
17	205.79	54.09

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Circle Center At X = 170.0 ; Y = 72.2 and Radius, 40.2

*** 2.624 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	42.85
2	104.33	40.35
3	108.81	38.13
4	113.42	36.20
5	118.15	34.56
6	122.97	33.23
7	127.86	32.20
8	132.81	31.49
9	137.79	31.09
10	142.79	31.00
11	147.79	31.23
12	152.76	31.78
13	157.68	32.64
14	162.54	33.81
15	167.32	35.29
16	171.99	37.06
17	176.55	39.13
18	180.96	41.48
19	185.22	44.11
20	189.30	47.00
21	193.19	50.14
22	196.75	53.42

Circle Center At X = 141.6 ; Y = 110.0 and Radius, 79.0

*** 2.670 ***

Failure Surface Specified By 21 Coordinate Points

Point	X-Surf	Y-Surf
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No.	(ft)	(ft)
1	126.67	43.96
2	131.14	41.73
3	135.74	39.77
4	140.45	38.09
5	145.25	36.70
6	150.13	35.61
7	155.07	34.81
8	160.04	34.32
9	165.04	34.13
10	170.04	34.24
11	175.02	34.66
12	179.97	35.38
13	184.86	36.40
14	189.69	37.71
15	194.42	39.32
16	199.05	41.21
17	203.56	43.38
18	207.92	45.82
19	212.13	48.52
20	216.17	51.47
21	219.74	54.42

Circle Center At X = 165.7 ; Y = 116.3 and Radius, 82.2

*** 2.672 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.33	44.70
2	137.69	42.25
3	142.21	40.11
4	146.87	38.30
5	151.65	36.82
6	156.51	35.68
7	161.45	34.88
8	166.43	34.44
9	171.43	34.35
10	176.42	34.61
11	181.39	35.23
12	186.29	36.19
13	191.12	37.50
14	195.84	39.14
15	200.43	41.11
16	204.88	43.41
17	209.15	46.01
18	213.22	48.90
19	217.09	52.08
20	219.55	54.42

★★★ 2.725 ★★★

*** 2.795 ***

23/

		-	.74*
		-	.7428
		-	.7233
		-	..7236
X	150.00	+	..236.
		-	..230.1
		-	..22*5*
		-	.624.*
		-	.*22*..
		-	.622**
I	200.00	+	..862*
		-	.866
		-	88
		-	•
		-	** **
		-	•
S	250.00	+	•
		-	
		-	* *
		-	
		-	•
	300.00	+	
		-	
		-	
		-	
F	350.00	+	
		-	
		-	
		-	
		-	
T	400.00	+	* * *

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*****
*****      - Illegal Command      *****
*****
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Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-9-93

Time of Run:

Run By: SBA

Input Data Filename: WCP3DDL.DAT

Output Filename: WCP3DDL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 3, Downstream Slope, Steady Seepage,
Top of Gate El. 750 - Lower Bound Properties

BOUNDARY COORDINATES

11 Top Boundaries

25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	118.00	43.00	1
2	118.00	43.00	163.00	48.00	2
3	163.00	48.00	172.00	52.00	2
4	172.00	52.00	193.00	53.00	2
5	193.00	53.00	202.00	54.00	3
6	202.00	54.00	223.00	54.50	3
7	223.00	54.50	231.00	55.00	3
8	231.00	55.00	253.00	54.00	3
9	253.00	54.00	277.00	47.00	3
10	277.00	47.00	288.00	43.00	1
11	288.00	43.00	400.00	43.00	1
12	118.00	43.00	170.00	42.00	1
13	170.00	42.00	191.00	51.00	3
14	191.00	51.00	193.00	53.00	3
15	170.00	42.00	180.00	43.00	1
16	180.00	43.00	233.00	49.00	1
17	233.00	49.00	275.00	46.00	1
18	275.00	46.00	277.00	47.00	1
19	.00	31.00	180.00	31.00	4
20	180.00	31.00	233.00	41.00	5
21	233.00	41.00	275.00	35.00	5
22	275.00	35.00	400.00	35.00	4
23	180.00	31.00	233.00	34.00	4

24	233.00	34.00	243.00	37.00	4
25	243.00	37.00	275.00	35.00	4

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	285.0	.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	119.0	125.0	.0	30.0	.00	.0	1
4	165.0	165.0	576000.0	35.0	.00	.0	1
5	122.0	127.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	118.00	43.00
3	170.00	42.00
4	191.00	50.00
5	400.00	50.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 100.00 ft.
and X = 160.00 ft.

Each Surface Terminates Between X = 170.00 ft.
and X = 220.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = 20.00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	43.22
2	124.16	40.44
3	128.53	38.02
4	133.09	35.96
5	137.80	34.28
6	142.63	33.00
7	147.55	32.13
8	152.53	31.66
9	157.53	31.60
10	162.52	31.96
11	167.46	32.72
12	172.32	33.89
13	177.07	35.46
14	181.67	37.42
15	186.09	39.75
16	190.31	42.43
17	194.29	45.45
18	198.01	48.80
19	201.44	52.43
20	202.71	54.02

Circle Center At $X = 155.7$; $Y = 92.1$ and Radius, 60.6

*** 1.673 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
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1	133.33	44.70
2	136.97	41.28
3	141.02	38.34
4	145.41	35.94
5	150.06	34.11
6	154.91	32.89
7	159.88	32.30
8	164.88	32.34
9	169.83	33.01
10	174.66	34.30
11	179.28	36.20
12	183.63	38.67
13	187.63	41.67
14	191.22	45.15
15	194.34	49.06
16	196.93	53.34
17	196.98	53.44

Circle Center At X = 162.1 ; Y = 71.6 and Radius, 39.4

*** 1.749 ***

1

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	42.96
2	117.65	40.44
3	122.14	38.24
4	126.78	36.37
5	131.54	34.86
6	136.41	33.70
7	141.34	32.89
8	146.32	32.46
9	151.32	32.39
10	156.31	32.69
11	161.27	33.36
12	166.16	34.39
13	170.97	35.77
14	175.66	37.51
15	180.20	39.58
16	184.59	41.99
17	188.78	44.71
18	192.77	47.73
19	196.52	51.04
20	199.09	53.68

Circle Center At X = 149.7 ; Y = 100.3 and Radius, 67.9

*** 1.762 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	42.85
2	104.33	40.35
3	108.81	38.13
4	113.42	36.20
5	118.15	34.56
6	122.97	33.23
7	127.86	32.20
8	132.81	31.49
9	137.79	31.09
10	142.79	31.00
11	147.79	31.23
12	152.76	31.78
13	157.68	32.64
14	162.54	33.81
15	167.32	35.29
16	171.99	37.06
17	176.55	39.13
18	180.96	41.48
19	185.22	44.11
20	189.30	47.00
21	193.19	50.14
22	196.75	53.42

Circle Center At X = 141.6 ; Y = 110.0 and Radius, 79.0

*** 1.855 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.00	47.67
2	165.00	47.75
3	169.63	49.62
4	172.17	52.01

Circle Center At X = 162.3 ; Y = 61.1 and Radius, 13.6

*** 1.859 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	45.44
2	143.55	41.92
3	147.51	38.87
4	151.82	36.34
5	156.41	34.36
6	161.21	32.96
7	166.15	32.17
8	171.15	32.01
9	176.13	32.46
10	181.01	33.53
11	185.73	35.20
12	190.20	37.44
13	194.35	40.22
14	198.13	43.49
15	201.48	47.21
16	204.33	51.31
17	205.79	54.09

Circle Center At X = 170.0 ; Y = 72.2 and Radius, 40.2

*** 1.901 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	126.67	43.96
2	131.14	41.73
3	135.74	39.77
4	140.45	38.09
5	145.25	36.70
6	150.13	35.61
7	155.07	34.81
8	160.04	34.32
9	165.04	34.13
10	170.04	34.24
11	175.02	34.66
12	179.97	35.38
13	184.86	36.40
14	189.69	37.71
15	194.42	39.32
16	199.05	41.21
17	203.56	43.38
18	207.92	45.82
19	212.13	48.52
20	216.17	51.47

21 219.74 54.42

Circle Center At X = 165.7 ; Y = 116.3 and Radius, 82.2

*** 1.919 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.33	44.70
2	137.69	42.25
3	142.21	40.11
4	146.87	38.30
5	151.65	36.82
6	156.51	35.68
7	161.45	34.88
8	166.43	34.44
9	171.43	34.35
10	176.42	34.61
11	181.39	35.23
12	186.29	36.19
13	191.12	37.50
14	195.84	39.14
15	200.43	41.11
16	204.88	43.41
17	209.15	46.01
18	213.22	48.90
19	217.09	52.08
20	219.55	54.42

Circle Center At X = 170.2 ; Y = 105.1 and Radius, 70.8

*** 1.972 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	42.96
2	117.72	40.55
3	122.27	38.49
4	126.98	36.80
5	131.80	35.48
6	136.71	34.55
7	141.68	34.00
8	146.68	33.84

9	151.67	34.08
10	156.63	34.71
11	161.53	35.73
12	166.33	37.12
13	171.01	38.89
14	175.53	41.02
15	179.87	43.51
16	184.00	46.32
17	187.90	49.45
18	191.54	52.87
19	191.60	52.93

Circle Center At X = 146.2 ; Y = 97.5 and Radius, 63.6

*** 1.986 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	43.22
2	123.89	40.08
3	128.13	37.43
4	132.67	35.33
5	137.43	33.79
6	142.34	32.86
7	147.33	32.53
8	152.32	32.81
9	157.24	33.71
10	162.01	35.20
11	166.56	37.26
12	170.83	39.87
13	174.74	42.98
14	178.25	46.55
15	181.29	50.52
16	182.45	52.50

Circle Center At X = 147.5 ; Y = 73.2 and Radius, 40.7

*** 1.996 ***

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300.00 +
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*****
***** - Illegal Command *****
*****
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Legal Commands - PROFIL
LOADS
TIES
WATER

SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-9-93

Time of Run:

Run By: SBA

Input Data Filename: WCP3DDL.DAT

Output Filename: WCP3DDL.OUT

PROBLEM DESCRIPTION WOD - Soil Profile 3, Downstream Slope, steady Seepage,
Top of Gate El. 750 - Upper Bound Properties

BOUNDARY COORDINATES

11 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	118.00	43.00	1
2	118.00	43.00	163.00	48.00	2
3	163.00	48.00	172.00	52.00	2
4	172.00	52.00	193.00	53.00	2
5	193.00	53.00	202.00	54.00	3
6	202.00	54.00	223.00	54.50	3
7	223.00	54.50	231.00	55.00	3
8	231.00	55.00	253.00	54.00	3
9	253.00	54.00	277.00	47.00	3
10	277.00	47.00	288.00	43.00	1
11	288.00	43.00	400.00	43.00	1
12	118.00	43.00	170.00	42.00	1
13	170.00	42.00	191.00	51.00	3
14	191.00	51.00	193.00	53.00	3
15	170.00	42.00	180.00	43.00	1
16	180.00	43.00	233.00	49.00	1
17	233.00	49.00	275.00	46.00	1
18	275.00	46.00	277.00	47.00	1
19	.00	31.00	180.00	31.00	4
20	180.00	31.00	233.00	41.00	5
21	233.00	41.00	275.00	35.00	5
22	275.00	35.00	400.00	35.00	4
23	180.00	31.00	233.00	34.00	4

24	233.00	34.00	243.00	37.00	4
25	243.00	37.00	275.00	35.00	4

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	425.0	.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	119.0	125.0	70.0	29.0	.00	.0	1
4	165.0	165.0	576000.0	35.0	.00	.0	1
5	122.0	127.0	300.0	32.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	118.00	43.00
3	170.00	42.00
4	191.00	50.00
5	400.00	50.00

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 100.00 ft.
and X = 160.00 ft.

Each Surface Terminates Between X = 170.00 ft.
and X = 220.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = 20.00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.00	47.67
2	165.00	47.75
3	169.63	49.62
4	172.17	52.01

Circle Center At $X = 162.3$; $Y = 61.1$ and Radius, 13.6

*** 1.859 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	43.22
2	124.16	40.44
3	128.53	38.02
4	133.09	35.96
5	137.80	34.28
6	142.63	33.00
7	147.55	32.13
8	152.53	31.66
9	157.53	31.60
10	162.52	31.96
11	167.46	32.72
12	172.32	33.89
13	177.07	35.46
14	181.67	37.42
15	186.09	39.75

16	190.31	42.43
17	194.29	45.45
18	198.01	48.80
19	201.44	52.43
20	202.71	54.02

Circle Center At X = 155.7 ; Y = 92.1 and Radius, 60.6

*** 2.469 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.33	44.70
2	136.97	41.28
3	141.02	38.34
4	145.41	35.94
5	150.06	34.11
6	154.91	32.89
7	159.88	32.30
8	164.88	32.34
9	169.83	33.01
10	174.66	34.30
11	179.28	36.20
12	183.63	38.67
13	187.63	41.67
14	191.22	45.15
15	194.34	49.06
16	196.93	53.34
17	196.98	53.44

Circle Center At X = 162.1 ; Y = 71.6 and Radius, 39.4

*** 2.558 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	42.96
2	117.65	40.44
3	122.14	38.24
4	126.78	36.37
5	131.54	34.86
6	136.41	33.70
7	141.34	32.89

8	146.32	32.46
9	151.32	32.39
10	156.31	32.69
11	161.27	33.36
12	166.16	34.39
13	170.97	35.77
14	175.66	37.51
15	180.20	39.58
16	184.59	41.99
17	188.78	44.71
18	192.77	47.73
19	196.52	51.04
20	199.09	53.68

Circle Center At X = 149.7 ; Y = 100.3 and Radius, 67.9

*** 2.589 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.00	47.67
2	164.88	46.58
3	169.37	48.78
4	170.58	51.37

Circle Center At X = 164.0 ; Y = 54.1 and Radius, 7.5

*** 2.611 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	42.85
2	104.33	40.35
3	108.81	38.13
4	113.42	36.20
5	118.15	34.56
6	122.97	33.23
7	127.86	32.20
8	132.81	31.49
9	137.79	31.09
10	142.79	31.00
11	147.79	31.23
12	152.76	31.78

13	157.68	32.64
14	162.54	33.81
15	167.32	35.29
16	171.99	37.06
17	176.55	39.13
18	180.96	41.48
19	185.22	44.11
20	189.30	47.00
21	193.19	50.14
22	196.75	53.42

Circle Center At X = 141.6 ; Y = 110.0 and Radius, 79.0

*** 2.717 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	45.44
2	143.55	41.92
3	147.51	38.87
4	151.82	36.34
5	156.41	34.36
6	161.21	32.96
7	166.15	32.17
8	171.15	32.01
9	176.13	32.46
10	181.01	33.53
11	185.73	35.20
12	190.20	37.44
13	194.35	40.22
14	198.13	43.49
15	201.48	47.21
16	204.33	51.31
17	205.79	54.09

Circle Center At X = 170.0 ; Y = 72.2 and Radius, 40.2

*** 2.751 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	126.67	43.96
2	131.14	41.73

3	135.74	39.77
4	140.45	38.09
5	145.25	36.70
6	150.13	35.61
7	155.07	34.81
8	160.04	34.32
9	165.04	34.13
10	170.04	34.24
11	175.02	34.66
12	179.97	35.38
13	184.86	36.40
14	189.69	37.71
15	194.42	39.32
16	199.05	41.21
17	203.56	43.38
18	207.92	45.82
19	212.13	48.52
20	216.17	51.47
21	219.74	54.42

Circle Center At X = 165.7 ; Y = 116.3 and Radius, 82.2

*** 2.816 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	43.22
2	123.89	40.08
3	128.13	37.43
4	132.67	35.33
5	137.43	33.79
6	142.34	32.86
7	147.33	32.53
8	152.32	32.81
9	157.24	33.71
10	162.01	35.20
11	166.56	37.26
12	170.83	39.87
13	174.74	42.98
14	178.25	46.55
15	181.29	50.52
16	182.45	52.50

Circle Center At X = 147.5 ; Y = 73.2 and Radius, 40.7

*** 2.824 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.33	46.93
2	158.30	46.39
3	163.30	46.54
4	168.23	47.39
5	172.99	48.92
6	177.49	51.09
7	179.38	52.35

Circle Center At X = 159.7 ; Y = 82.2 and Radius, 35.9

*** 2.836 ***

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300.00 +
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1

***** - Illegal Command *****

Legal Commands - PROFIL
LOADS
TIES
WATER
SURFAC
EXECUT
EQUAKE
SOIL
RANDOM
CIRCLE
CIRCL2
BLOCK
BLOCK2
LIMITS
ANISO
SURBIS

** PCSTABL4 **

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-28-93

Time of Run:

Run By: SBA

Input Data Filename: wcp3ddl.dat

Output Filename: wcp3ddl.out

PROBLEM DESCRIPTION WOD - Soil Profile 3, Downstream Slope, Normal Pool El. 744
Seismic Event 0.13g (H), Lower Bound Properties

BOUNDARY COORDINATES

11 Top Boundaries

25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	118.00	43.00	1
2	118.00	43.00	163.00	48.00	2
3	163.00	48.00	172.00	52.00	2
4	172.00	52.00	193.00	53.00	2
5	193.00	53.00	202.00	54.00	3
6	202.00	54.00	223.00	54.50	3
7	223.00	54.50	231.00	55.00	3
8	231.00	55.00	253.00	54.00	3
9	253.00	54.00	277.00	47.00	3
10	277.00	47.00	288.00	43.00	1
11	288.00	43.00	400.00	43.00	1
12	118.00	43.00	170.00	42.00	1
13	170.00	42.00	191.00	51.00	3
14	191.00	51.00	193.00	53.00	3
15	170.00	42.00	180.00	43.00	1
16	180.00	43.00	233.00	49.00	1
17	233.00	49.00	275.00	46.00	1
18	275.00	46.00	277.00	47.00	1
19	.00	31.00	180.00	31.00	4
20	180.00	31.00	233.00	41.00	5
21	233.00	41.00	275.00	35.00	5
22	275.00	35.00	400.00	35.00	4
23	180.00	31.00	233.00	34.00	4

24	233.00	34.00	243.00	37.00	4
25	243.00	37.00	275.00	35.00	4

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	285.0	.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	119.0	125.0	225.0	16.0	.00	.0	1
4	165.0	165.0	576000.0	35.0	.00	.0	1
5	122.0	127.0	1100.0	15.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	118.00	42.00
3	170.00	42.00
4	174.00	44.00
5	400.00	44.00

A Horizontal Earthquake Loading Coefficient
Of .130 Has Been AssignedA Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 100.00$ ft.
and $X = 160.00$ ft.

Each Surface Terminates Between $X = 170.00$ ft.
and $X = 220.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = 20.00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	43.22
2	124.16	40.44
3	128.53	38.02
4	133.09	35.96
5	137.80	34.28
6	142.63	33.00
7	147.55	32.13
8	152.53	31.66
9	157.53	31.60
10	162.52	31.96
11	167.46	32.72
12	172.32	33.89
13	177.07	35.46
14	181.67	37.42
15	186.09	39.75
16	190.31	42.43
17	194.29	45.45
18	198.01	48.80
19	201.44	52.43
20	202.71	54.02

Circle Center At $X = 155.7$; $Y = 92.1$ and Radius, 60.6

*** .953 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	126.67	43.96
2	131.14	41.73
3	135.74	39.77
4	140.45	38.09
5	145.25	36.70
6	150.13	35.61
7	155.07	34.81
8	160.04	34.32
9	165.04	34.13
10	170.04	34.24
11	175.02	34.66
12	179.97	35.38
13	184.86	36.40
14	189.69	37.71
15	194.42	39.32
16	199.05	41.21
17	203.56	43.38
18	207.92	45.82
19	212.13	48.52
20	216.17	51.47
21	219.74	54.42

Circle Center At X = 165.7 ; Y = 116.3 and Radius, 82.2

*** 1.003 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	42.96
2	117.65	40.44
3	122.14	38.24
4	126.78	36.37
5	131.54	34.86
6	136.41	33.70
7	141.34	32.89
8	146.32	32.46
9	151.32	32.39
10	156.31	32.69
11	161.27	33.36

12	166.16	34.39
13	170.97	35.77
14	175.66	37.51
15	180.20	39.58
16	184.59	41.99
17	188.78	44.71
18	192.77	47.73
19	196.52	51.04
20	199.09	53.68

Circle Center At X = 149.7 ; Y = 100.3 and Radius, 67.9

*** 1.012 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	42.85
2	104.33	40.35
3	108.81	38.13
4	113.42	36.20
5	118.15	34.56
6	122.97	33.23
7	127.86	32.20
8	132.81	31.49
9	137.79	31.09
10	142.79	31.00
11	147.79	31.23
12	152.76	31.78
13	157.68	32.64
14	162.54	33.81
15	167.32	35.29
16	171.99	37.06
17	176.55	39.13
18	180.96	41.48
19	185.22	44.11
20	189.30	47.00
21	193.19	50.14
22	196.75	53.42

Circle Center At X = 141.6 ; Y = 110.0 and Radius, 79.0

*** 1.016 ***

Failure Surface Specified By 20 Coordinate Points

Point	X-Surf	Y-Surf
-------	--------	--------

No.	(ft)	(ft)
1	133.33	44.70
2	137.69	42.25
3	142.21	40.11
4	146.87	38.30
5	151.65	36.82
6	156.51	35.68
7	161.45	34.88
8	166.43	34.44
9	171.43	34.35
10	176.42	34.61
11	181.39	35.23
12	186.29	36.19
13	191.12	37.50
14	195.84	39.14
15	200.43	41.11
16	204.88	43.41
17	209.15	46.01
18	213.22	48.90
19	217.09	52.08
20	219.55	54.42

Circle Center At X = 170.2 ; Y = 105.1 and Radius, 70.8

*** 1.025 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.33	44.70
2	136.97	41.28
3	141.02	38.34
4	145.41	35.94
5	150.06	34.11
6	154.91	32.89
7	159.88	32.30
8	164.88	32.34
9	169.83	33.01
10	174.66	34.30
11	179.28	36.20
12	183.63	38.67
13	187.63	41.67
14	191.22	45.15
15	194.34	49.06
16	196.93	53.34
17	196.98	53.44

Circle Center At X = 162.1 ; Y = 71.6 and Radius, 39.4

*** 1.055 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	45.44
2	143.55	41.92
3	147.51	38.87
4	151.82	36.34
5	156.41	34.36
6	161.21	32.96
7	166.15	32.17
8	171.15	32.01
9	176.13	32.46
10	181.01	33.53
11	185.73	35.20
12	190.20	37.44
13	194.35	40.22
14	198.13	43.49
15	201.48	47.21
16	204.33	51.31
17	205.79	54.09

Circle Center At X = 170.0 ; Y = 72.2 and Radius, 40.2

*** 1.095 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	43.22
2	123.89	40.08
3	128.13	37.43
4	132.67	35.33
5	137.43	33.79
6	142.34	32.86
7	147.33	32.53
8	152.32	32.81
9	157.24	33.71
10	162.01	35.20
11	166.56	37.26
12	170.83	39.87
13	174.74	42.98
14	178.25	46.55
15	181.29	50.52
16	182.45	52.50

Circle Center At X = 147.5 ; Y = 73.2 and Radius, 40.7

*** 1.095 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	42.96
2	117.72	40.55
3	122.27	38.49
4	126.98	36.80
5	131.80	35.48
6	136.71	34.55
7	141.68	34.00
8	146.68	33.84
9	151.67	34.08
10	156.63	34.71
11	161.53	35.73
12	166.33	37.12
13	171.01	38.89
14	175.53	41.02
15	179.87	43.51
16	184.00	46.32
17	187.90	49.45
18	191.54	52.87
19	191.60	52.93

Circle Center At X = 146.2 ; Y = 97.5 and Radius, 63.6

*** 1.102 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	43.22
2	123.98	40.20
3	128.30	37.67
4	132.88	35.66
5	137.66	34.22
6	142.59	33.34
7	147.58	33.06
8	152.57	33.37
9	157.49	34.26
10	162.27	35.73
11	166.84	37.76

12	171.14	40.31
13	175.11	43.35
14	178.69	46.84
15	181.83	50.73
16	182.96	52.52

Circle Center At $X = 147.5$; $Y = 75.3$ and Radius, 42.2

*** 1.111 ***

** PCSTABL4 **

261

by
Purdue University--Slope Stability Analysis--
Simplified Janbu Method of Slices
or Simplified Bishop Method

Run Date: 9-28-93

Time of Run:

Run By: SBA

Input Data Filename: wcp3ddl.dat

Output Filename: wcp3ddl.out

PROBLEM DESCRIPTION WOD - Soil Profile 3, Downstream Slope, Normal Pool El. 744
Seismic Event 0.139 (H), Upper Bound Properties

BOUNDARY COORDINATES

11 Top Boundaries

25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	118.00	43.00	1
2	118.00	43.00	163.00	48.00	2
3	163.00	48.00	172.00	52.00	2
4	172.00	52.00	193.00	53.00	2
5	193.00	53.00	202.00	54.00	3
6	202.00	54.00	223.00	54.50	3
7	223.00	54.50	231.00	55.00	3
8	231.00	55.00	253.00	54.00	3
9	253.00	54.00	277.00	47.00	3
10	277.00	47.00	288.00	43.00	1
11	288.00	43.00	400.00	43.00	1
12	118.00	43.00	170.00	42.00	1
13	170.00	42.00	191.00	51.00	3
14	191.00	51.00	193.00	53.00	3
15	170.00	42.00	180.00	43.00	1
16	180.00	43.00	233.00	49.00	1
17	233.00	49.00	275.00	46.00	1
18	275.00	46.00	277.00	47.00	1
19	.00	31.00	180.00	31.00	4
20	180.00	31.00	233.00	41.00	5
21	233.00	41.00	275.00	35.00	5
22	275.00	35.00	400.00	35.00	4
23	180.00	31.00	233.00	34.00	4

24	233.00	34.00	243.00	37.00	4
25	243.00	37.00	275.00	35.00	4

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	117.0	120.0	425.0	.0	.00	.0	1
2	135.0	135.0	.0	35.0	.00	.0	1
3	119.0	125.0	260.0	16.0	.00	.0	1
4	165.0	165.0	576000.0	35.0	.00	.0	1
5	122.0	127.0	1650.0	15.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	40.00
2	118.00	42.00
3	170.00	42.00
4	174.00	44.00
5	400.00	44.00

A Horizontal Earthquake Loading Coefficient
Of .130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

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

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 100.00$ ft.
and $X = 160.00$ ft.

Each Surface Terminates Between $X = 170.00$ ft.
and $X = 220.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = 20.00$ ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

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

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.00	47.67
2	165.00	47.75
3	169.63	49.62
4	172.17	52.01

Circle Center At $X = 162.3$; $Y = 61.1$ and Radius, 13.6

*** 1.353 *** *shallow - ignore (insignificant impact on stability)*

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	43.22
2	124.16	40.44
3	128.53	38.02
4	133.09	35.96
5	137.80	34.28

6	142.63	33.00
7	147.55	32.13
8	152.53	31.66
9	157.53	31.60
10	162.52	31.96
11	167.46	32.72
12	172.32	33.89
13	177.07	35.46
14	181.67	37.42
15	186.09	39.75
16	190.31	42.43
17	194.29	45.45
18	198.01	48.80
19	201.44	52.43
20	202.71	54.02

Circle Center At X = 155.7 ; Y = 92.1 and Radius, 60.6

*** 1.375 ***

1

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	126.67	43.96
2	131.14	41.73
3	135.74	39.77
4	140.45	38.09
5	145.25	36.70
6	150.13	35.61
7	155.07	34.81
8	160.04	34.32
9	165.04	34.13
10	170.04	34.24
11	175.02	34.66
12	179.97	35.38
13	184.86	36.40
14	189.69	37.71
15	194.42	39.32
16	199.05	41.21
17	203.56	43.38
18	207.92	45.82
19	212.13	48.52
20	216.17	51.47
21	219.74	54.42

Circle Center At X = 165.7 ; Y = 116.3 and Radius, 82.2

*** 1.439 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.33	42.96
2	117.65	40.44
3	122.14	38.24
4	126.78	36.37
5	131.54	34.86
6	136.41	33.70
7	141.34	32.89
8	146.32	32.46
9	151.32	32.39
10	156.31	32.69
11	161.27	33.36
12	166.16	34.39
13	170.97	35.77
14	175.66	37.51
15	180.20	39.58
16	184.59	41.99
17	188.78	44.71
18	192.77	47.73
19	196.52	51.04
20	199.09	53.68

Circle Center At X = 149.7 ; Y = 100.3 and Radius, 67.9

*** 1.449 ***

1

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	42.85
2	104.33	40.35
3	108.81	38.13
4	113.42	36.20
5	118.15	34.56
6	122.97	33.23
7	127.86	32.20
8	132.81	31.49
9	137.79	31.09
10	142.79	31.00
11	147.79	31.23
12	152.76	31.78
13	157.68	32.64
14	162.54	33.81
15	167.32	35.29
16	171.99	37.06

17	176.55	39.13
18	180.96	41.48
19	185.22	44.11
20	189.30	47.00
21	193.19	50.14
22	196.75	53.42

Circle Center At X = 141.6 ; Y = 110.0 and Radius, 79.0

*** 1.457 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.33	44.70
2	137.69	42.25
3	142.21	40.11
4	146.87	38.30
5	151.65	36.82
6	156.51	35.68
7	161.45	34.88
8	166.43	34.44
9	171.43	34.35
10	176.42	34.61
11	181.39	35.23
12	186.29	36.19
13	191.12	37.50
14	195.84	39.14
15	200.43	41.11
16	204.88	43.41
17	209.15	46.01
18	213.22	48.90
19	217.09	52.08
20	219.55	54.42

Circle Center At X = 170.2 ; Y = 105.1 and Radius, 70.8

*** 1.460 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.33	44.70
2	136.97	41.28
3	141.02	38.34

4	145.41	35.94
5	150.06	34.11
6	154.91	32.89
7	159.88	32.30
8	164.88	32.34
9	169.83	33.01
10	174.66	34.30
11	179.28	36.20
12	183.63	38.67
13	187.63	41.67
14	191.22	45.15
15	194.34	49.06
16	196.93	53.34
17	196.98	53.44

Circle Center At X = 162.1 ; Y = 71.6 and Radius, 39.4

*** 1.490 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	45.44
2	143.55	41.92
3	147.51	38.87
4	151.82	36.34
5	156.41	34.36
6	161.21	32.96
7	166.15	32.17
8	171.15	32.01
9	176.13	32.46
10	181.01	33.53
11	185.73	35.20
12	190.20	37.44
13	194.35	40.22
14	198.13	43.49
15	201.48	47.21
16	204.33	51.31
17	205.79	54.09

Circle Center At X = 170.0 ; Y = 72.2 and Radius, 40.2

*** 1.521 ***

Failure Surface Specified By 19 Coordinate Points

Point	X-Surf	Y-Surf
-------	--------	--------

No.	(ft)	(ft)
1	113.33	42.96
2	117.72	40.55
3	122.27	38.49
4	126.98	36.80
5	131.80	35.48
6	136.71	34.55
7	141.68	34.00
8	146.68	33.84
9	151.67	34.08
10	156.63	34.71
11	161.53	35.73
12	166.33	37.12
13	171.01	38.89
14	175.53	41.02
15	179.87	43.51
16	184.00	46.32
17	187.90	49.45
18	191.54	52.87
19	191.60	52.93

Circle Center At X = 146.2 ; Y = 97.5 and Radius, 63.6

*** 1.561 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	43.22
2	123.89	40.08
3	128.13	37.43
4	132.67	35.33
5	137.43	33.79
6	142.34	32.86
7	147.33	32.53
8	152.32	32.81
9	157.24	33.71
10	162.01	35.20
11	166.56	37.26
12	170.83	39.87
13	174.74	42.98
14	178.25	46.55
15	181.29	50.52
16	182.45	52.50

Circle Center At X = 147.5 ; Y = 73.2 and Radius, 40.7

*** 1.566 ***

 ***** - Illegal Command *****

Legal Commands - PROFIL
 LOADS
 TIES
 WATER
 SURFAC
 EXECUT
 EQUAKE
 SOIL
 RANDOM
 CIRCLE
 CIRCL2
 BLOCK
 BLOCK2
 LIMITS
 ANISO
 SURBIS

A-3 CALCULATION - LIQUEFACTION POTENTIAL

**MARTIN MARIETTA ENERGY SYSTEMS
DESIGN ANALYSIS AND CALCULATIONS - (DAC)**

ES-0.7
10-17-88
Rev. 8-16-89
Page 5 of 8

PROJECT NO./TITLE <i>White Oak Dam - Liquefaction Potential</i>		DATE STARTED <i>1-29-92</i>
LOCATION SITE <i>X-10</i>		CALC. NO. <i>DAC. - CV-020030-A003</i>
BUILDING(S) OR AREA <i>X AREA</i> <i>White Oak Dam</i>		ESO <i>AX 453007</i>
TEAM PE	RED <i>Syed B Ahmed</i> <i>1-24-94</i>	PJ
DEPT. <i>CV</i>	DESIGNERS (CONTRIBUTING)	
		SUPV. <i>W. E. Manrood</i>

Applies to Project - WBS/Items/Systems:

And Reports/Dwgs./Rev. No.:

Signature / Date

	REV. 0	REV. 1	REV. 2	REV. 3
Prepared by:	<i>Syed B Ahmed 1/24/94</i>			
Lead Designer/IFA Date:	<i>Syed B Ahmed 1/24/94</i>			
Other Designers:				
Review - Approvals:				
Checked by:	<i>W. E. Manrood 1/24/94</i>			
Approved by RED:				
Approved by Supervisor:	<i>W. E. Manrood 1/24/94</i>			
Reviewed by PE:				
Other:				

PAGE NO.	CONTENTS DESCRIPTION (List Attachments)
1	Section 1.0 Introduction & Objective
	Section 2.0 Basis for Design / Evaluation
	Section 3.0 Scope
2	Section 4.0 Methods to be Used
3	Section 5.0 References
4	Section 6.0 Analysis & Calculations
45	Section 7.0 Conclusions

List this DAC on contents page

Fig. 1

Fig. 2

GENERAL DESIGN AND COMPUTATION SHEET

JOB	White Oak Dam	DATE	1-23-94	SHEET	1 of
ESO NO.	AX 453007	COMPUTED	SBA	CHECKED BY	

WHITE OAK DAM - Liquefaction Potential

1.0 Introduction & Objective.

White Oak Dam (WOD) is an earth & rockfill structure originally constructed as a roadway embankment over White Oak Creek. The rockfill berm on the downstream slope and the Emergency Spillway were completed in 1980 and 1983, respectively.

The main objective of this calculation is to evaluate the liquefaction potential of the WOD embankment and foundation soils during the seismic event.

2.0 Basis for Design/Evaluation

Liquefaction potential of the WOD embankment and foundation soils will be evaluated using the soil investigation data from Ref. 1 & 6.

The WOD hazard classification is determined to be "low". The Evaluation Basis Earthquake (EBE) for the WOD is defined as an Earthquake with a magnitude $m_b = 5.6$ occurring about 40 km from the dam resulting in a Peak Ground Acceleration (PGA) of 0.13g at the WOD site. This EBE will be used in the evaluation of liquefaction potential of WOD embankment and foundation soils.

3.0 Scope

Liquefaction Potential will be evaluated for all the standard Penetration Test (SPT) samples recovered during the soil investigation program presented in Ref. 1 and 6.

GENERAL DESIGN AND COMPUTATION SHEET

JOB	White Oak Dam	DATE	1-23-94	SHEET	2 of
ISO NO.	AX453007	COMPUTED	SBA	CHECKED BY	

4.0 Methods to be Used.

This calculation will use Seed et. al., methodologies for (1) clayey soils and (2) cohesionless soils with varying percentages of fines (Ref. 2).

4.1 According to Seed et. al., (Ref. 2), clayey soils may be vulnerable to liquefaction as a result of earth shaking if they have the following characteristics:

- a) Percent finer than $0.075 \text{ mm} < 15$
- b) Liquid Limit < 35
- c) Water Content $> 0.9 \times \text{Liquid Limit}$

Additionally, "if soils with these characteristics plot above A-line on the Plasticity Chart, the best means of determining their cyclic loading characteristics is by tests. Otherwise clayey soils may be considered nonvulnerable to liquefaction."

4.2 Seed et. al., (Ref. 2 and 3) have developed the boundaries of liquefaction zones for sandy soils containing varying percentages of fines. These boundaries are based upon the relationship between the SPT blow counts (N) and the Cyclic Stress Ratio (CSR).

Three curves were developed by Seed et. al., to evaluate the liquefaction potential for silty sands containing $< 5\%$, 15% , and 35% fines for a Richter Earthquake magnitude of 7.5 (Ref. 2). The magnitude of the EBE at the WOD site is 5.6. Therefore, a correction factor = 1.4 has been applied to the three curves.

GENERAL DESIGN AND COMPUTATION SHEET

JOB	White Oak Dam	DATE	1-23-94	SHEET	3 of
ESO NO.	AX453007	COMPUTED	SBA	CHECKED BY	

5.0 References:

1. Geologic Associates, EDGE, Report, "White Oak Dam Investigation" GA File No. 88-X503, dated Apr. 12, 1988.
2. Seed, H.B., et. al., "Evaluation of Liquefaction Potential using Field Performance Data," ASCE Journal of Geotechnical Engineering, Vol. 109, No. 3, 1983
3. Seed, H.B., et. al., "Influence of SPT Procedures in Soil Liquefaction Resistance Evaluations", ASCE Journal of Geotechnical Engineering, Vol. 111, No. 12, 1985.
4. Liao, S.S.C, et. al., "Overburden Correction Factors for SPT in Sand", ASCE Journal of Geotechnical Engineering, Vol. 112, No. 3, 1985.
5. Seed, H.B., et. al., "Simplified Procedures for Evaluating Soil Liquefaction Potential", Journal of the Soil Mechanics and Foundation Division, Vol. 97, No. SM 9
6. GEOTEK Report, "Evaluation of White Oak Dam" Geotek Project No. 79-687B, dated Nov. 14, 1979.

GENERAL DESIGN AND COMPUTATION SHEET

JOB		White Oak Dam		ESO NO.		AX 453007		COMPUTED		SBA		CHECKED BY	
DATE		1-23-94		SHEET		4 of 4							

6.0 Analysis & Calculations

- 6.1 The data on liquid limit and natural moisture content are plotted on Fig. 1. It is clear from this plot that all the samples are outside the zone of potential liquefaction. Fig. 2 shows the plots of the liquid limits and plasticity indices on the plasticity chart. This plot indicates that 23 points are below the A-line and therefore, they are not liquefiable. The remaining 2 points are just above the A-line but these points are located in the Non-liquefiable zone on Fig. 1.
- Although, Grain size distribution data are not available in Ref. 1, and there are some samples in Ref. 2 for percent finer than .005 mm, it is interpreted from the visual examination and the Atterberg limits that the LOD embankment and foundation soils should have sufficient fines to qualify as non-liquefiable soils.
- 6.2 Seed, et al., (Ref. 2) criteria relating N values with CSR applies to sandy soils and such soils are not encountered in the LOD embankment or foundation. Therefore this criteria (N vs CSR) is not applicable to the LOD soils. However, this calculation is performed on the basis of hypothetical assumption and it is verified that even if seeds criteria for silty sand is applied, the LOD embankment and foundation soils are nonvulnerable to liquefaction.
- These calculations are shown on Pages 5 through 30 and N vs CSR plots are presented in Fig. 3 through 17.

which do not satisfy Seed's criteria

LIQUEFACTION POTENTIAL EVALUATION WHITE OAK DAM

Fig. 1 - LIQUID LIMIT VS NATURAL MOISTURE CONTENT

LIQUEFACTION POTENTIAL EVALUATION WHITE OAK DAM

Fig. - PLASTICITY CHART

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Ref.(2)

$$\text{Average Cyclic (Shear) Stress ratio} = \frac{\tau_{ave}}{\sigma'} \approx 0.65 \frac{a_{max}}{g} \frac{b}{b'} r_d$$

τ_{ave} = Average Cyclic Shear stress

σ' = Vertical effective stress

σ = Vertical total stress

a_{max} = max ground acceleration

g = acceleration due to gravity

r_d = Stress reduction factor

Corrections applied to N values account for the effects of: (1) Overburden (2) Hammer Energy ratio and (3) Very short drill rod lengths

(1) Overburden Correction - Ref.(4)

$$C_N = \left(\frac{1}{\sigma'} \right)^{1/2} ; C_N = \text{Correction Factor}$$

σ' = Effective Overburden Pressure in tons per sq. ft.

$N_1 = C_N N ; N_1 = \text{modified penetration resistance}$

$N = \text{field Blow count.}$

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(2) Hammer Energy Ratio; Correction for variation
(Ref. 3)
in the SPT method. Most common methods
used in U.S. (Safety hammer with 2 wraps of
a rope around a pulley) results in energy ratio
of approx. 60% of free-fall energy.

I checked with Larry Benson of ERCE to confirm
if they used a safety hammer with
2 wraps of rope in their SPT
procedure. Correction factor for this procedure
is 1.0.

(3) Very short drill rod lengths. (Ref 3)

According to Seed et al. (1985), apply a
correction factor of 0.75 to all "N" values
taken at a depth of 10 ft. or less.

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Groundwater levels assumed to be at the elevations
noted on the boring logs.

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Limit Weights

Soil

Wet unit wt. of soil = 119 pcf ; Dry unit wt. of soil = 92.1 pcf

$$\gamma_s = \text{Saturated " " " } = \left(1 - \frac{1}{G}\right) \gamma_{dry} + \gamma_w$$

Assume Sp. Gravity $G = 2.70$

$$Y_{sat} = \left(1 - \frac{1}{2.70}\right)(92.1) + 62.4 = 120.3; \text{ Say } 121 \text{ PCF}$$

$$\gamma_{\text{sub}} = 121 - 62.4 = 58.6 \text{ PCF}; \text{ Say } \underline{59 \text{ PCF}}$$

Rockfill; $\gamma = 135 \text{ pcf}$. (Eric has used this value)
(Riprap) _{Drum}

$$\gamma_{\text{sub}} = 72.6 \text{ say } 73 \text{ pcf}$$

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G.A. Borings 8' deep sample $\sigma = 119(8) = 952 \text{ psf}$; $\sigma' = 952 \text{ psf}$; $\frac{\sigma}{\sigma'} = 1.0$
 Boring A' $(\frac{\sigma}{\sigma'})^{\frac{1}{2}} = 1.05$
 Groundwater, 14.6' depth 13' deep sample $\sigma = 119(13) = 1547 \text{ psf}$; $\sigma' = 1547 \text{ psf}$; $\frac{\sigma}{\sigma'} = 1.0$ $(\frac{\sigma}{\sigma'})^{\frac{1}{2}} = 1.0$
 16.5' deep sample; $\sigma = 1737.4 + 121(1.9) = 1967.3 \text{ psf}$

$$\sigma' = 1737.4 + 59(1.9) = 1849.5 \text{ psf} = 0.924 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = \frac{1967.3}{1849.5} = 1.06$$

$$\left(\frac{\sigma}{\sigma'}\right)^{\frac{1}{2}} = 1.04$$

20' deep

$$\sigma = 1737.4 + 121(5.4) = 2391 \text{ psf}$$

$$\sigma' = 1737.4 + 59(5.4) = 2056 \text{ psf} = 1.03 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = \frac{2391}{2056} = 1.16$$

$$\left(\frac{\sigma}{\sigma'}\right)^{\frac{1}{2}} = \left(\frac{1}{1.03}\right)^{\frac{1}{2}} = 0.99$$

23.5' deep

$$\sigma = 1737.4 + 121(8.9) = 2814 \text{ psf}$$

$$\sigma' = 1737.4 + 59(8.9) = 2262.5 \text{ psf} = 1.13 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = \frac{2814}{2262.5} = 1.24$$

$$\left(\frac{\sigma}{\sigma'}\right)^{\frac{1}{2}} = \left(\frac{1}{1.13}\right)^{\frac{1}{2}} = 0.94$$

27' deep

$$\sigma = 1737.4 + 121(12.4) = 3237.8 \text{ psf}$$

$$\sigma' = 1737.4 + 59(12.4) = 2469 \text{ psf} = 1.23 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = 1.31; \left(\frac{\sigma}{\sigma'}\right)^{\frac{1}{2}} = 0.90$$

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Boring B water level 14 deep

16.5 deep Sample. $\sigma = 119(14) + 121(2.5) = 1969 \text{ PSF}$
 $\sigma' = 1666 + 59(2.5) = 1814 \text{ PSF} = 0.91 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = \frac{1969}{1814} = 1.09 ; \left(\frac{1}{\sigma'}\right)^{1/2} = 1.05$

20
 $\sigma = 1666 + 121(6) = 2392 \text{ PSF}$
 $\sigma' = 1666 + 59(6) = 2020 \text{ PSF} = 1.01 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = \frac{2392}{2020} = 1.18 ; \left(\frac{1}{\sigma'}\right)^{1/2} = 0.99 \text{ say } 1.0$

23.5
 $\sigma = 1666 + 121(9.5) = 2816 \text{ PSF}$
 $\sigma' = 1666 + 59(9.5) = 2227 \text{ PSF} = 1.11 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = \frac{2816}{2227} = 1.26 ; \left(\frac{1}{\sigma'}\right)^{1/2} = 0.94$

26.5
 $\sigma = 1666 + 121(12.5) = 3178.5 \text{ PSF}$
 $\sigma' = 1666 + 59(12.5) = 2403.5 \text{ PSF} = 1.20 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = \frac{3178.5}{2403.5} = 1.32 ; \left(\frac{1}{\sigma'}\right)^{1/2} = 0.91$

7
 $\sigma = 119(7) = 833 \text{ PSF}, \sigma' = 833 \text{ PSF} = 0.42 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = 1.0 ; \left(\frac{1}{\sigma'}\right)^{1/2} = 1.54$

13
 $\sigma = 119(13) = 1547 \text{ PSF}; \sigma' = 1547 \text{ PSF} = 0.77 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = 1.0 ; \left(\frac{1}{\sigma'}\right)^{1/2} = 1.14$

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Boring C Water level 11' deep.

16' deep sample: $\sigma = 135(11) + 121(5) = 2090 \text{ psf}$

$\sigma' = 1485 + 59(5) = 1780 \text{ psf} = 0.89 \text{ tsf}$

$\frac{\sigma}{\sigma'} = \frac{2090}{1780} = \boxed{1.17}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = 1.06$

19.5' deep

$\sigma = 1485 + 121(8.5) = 2513.5$

$\sigma' = 1485 + 59(8.5) = 1986.5 = 0.99 \text{ tsf}$

$\frac{\sigma}{\sigma'} = \frac{2513.5}{1986.5} = \boxed{1.27}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.00}$

Boring D Water level 14' deep; 8' deep sample $\sigma = 119(8) = 952 \text{ psf}$; $\sigma' = 952 \text{ psf} = 0.48 \text{ tsf}$

$\frac{\sigma}{\sigma'} = \boxed{1.0}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.44}$

13' deep sample $\sigma = 119(13) = 1547 \text{ psf}$; $\sigma' = 1547 \text{ psf} = 0.77 \text{ tsf}$; $\frac{\sigma}{\sigma'} = \boxed{1.0}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.14}$

16.5' deep sample $\sigma = 119(14) + 121(2.5) = 1968.5 \text{ psf}$

$\sigma' = 1666 + 59(2.5) = 1813.5 = 0.91 \text{ tsf}$

$\frac{\sigma}{\sigma'} = \frac{1968.5}{1813.5} = \boxed{1.08}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = (0.91)^{1/2} = \boxed{1.04}$

20' deep

$\sigma = 1666 + 121(6) = 2392 \text{ psf}$

$\sigma' = 1666 + 59(6) = 2020 \text{ psf} = 1.01$

$\frac{\sigma}{\sigma'} = \frac{2392}{2020} = \boxed{1.18}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = (1.024)^{1/2} = \boxed{0.99}$

24' deep

$\sigma = 1666 + 121(10) = 2876 \text{ psf}$

$\sigma' = 1666 + 59(10) = 2256 \text{ psf} = 1.13$

$\frac{\sigma}{\sigma'} = \boxed{1.27}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{0.94}$

GENERAL DESIGN AND COMPUTATION SHEET

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Boring E Groundwater = 19' deep

$$\sigma' = 119(11) = 1309 \text{ psf}$$

$$\sigma' = 1309 \text{ psf} = 0.65 \text{ tsf}$$

$$\frac{\sigma'}{\sigma_1} = 1.0 \Rightarrow \left(\frac{\sigma'}{\sigma_1}\right)^{1/2} = 1.0$$

$$\boxed{1.24} = \left(\frac{\sigma'}{\sigma_1}\right)^{1/2}$$

15' deep Sample: $\sigma = 119(14) + 121(1) = 1787 \text{ psf}$

$$\frac{\sigma'}{\sigma_1} = \frac{1787}{1725} = 1.04$$

$$\left(\frac{\sigma'}{\sigma_1}\right)^{1/2} = 1.02$$

$$\boxed{1.07} = \left(\frac{\sigma'}{\sigma_1}\right)^{1/2}$$

18.5' deep

$$\frac{\sigma'}{\sigma_1} = \frac{2210.5}{1931.5} = 1.14$$

$$\left(\frac{\sigma'}{\sigma_1}\right)^{1/2} = 1.01$$

$$\boxed{1.01} = \left(\frac{\sigma'}{\sigma_1}\right)^{1/2}$$

22' deep

$$\frac{\sigma'}{\sigma_1} = \frac{2,634}{2,138} = 1.23$$

$$\left(\frac{\sigma'}{\sigma_1}\right)^{1/2} = 0.96$$

$$\boxed{0.96} = \left(\frac{\sigma'}{\sigma_1}\right)^{1/2}$$

8' deep

$$\sigma = 119(8) = 952 \text{ psf}; \sigma' = 952 = 0.47 \text{ tsf}; \frac{\sigma'}{\sigma_1} = 1.0; \left(\frac{\sigma'}{\sigma_1}\right)^{1/2} = 1.0$$

$$\boxed{1.45} = \left(\frac{\sigma'}{\sigma_1}\right)^{1/2}$$

Boring F

Groundwater = 9' 4" deep

14.5' deep Sample: $\sigma = 135(9) + 135(4.5) + 121(1) = 1944 \text{ psf}$

$$\frac{\sigma'}{\sigma_1} = \frac{1944}{1603} = 1.21$$

$$\left(\frac{\sigma'}{\sigma_1}\right)^{1/2} = 1.12$$

$$\boxed{1.12} = \left(\frac{\sigma'}{\sigma_1}\right)^{1/2}$$

16.5' deep

$$\frac{\sigma'}{\sigma_1} = \frac{2186}{1721} = 1.27$$

$$\left(\frac{\sigma'}{\sigma_1}\right)^{1/2} = 1.08$$

$$\boxed{1.08} = \left(\frac{\sigma'}{\sigma_1}\right)^{1/2}$$

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Boring G Groundwater = 14.5'

15' deep sample; $\sigma = 119(14.5) + 121(0.5) = 1786 \text{ PSF}$

$\sigma' = 1725.5 + 59(0.5) = 1755 \text{ PSF} = 0.88 \text{ tsf}$

$\frac{\sigma}{\sigma'} = \frac{1786}{1755} = \boxed{1.02}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.07}$

19.5 deep ;

$\sigma = 119(14.5) + 121(5) = 2,331 \text{ PSF}$

$\sigma' = 1725.5 + 59(5) = 2020.5 \text{ PSF} = 1.01 \text{ tsf}$

$\frac{\sigma}{\sigma'} = \frac{2,331}{2021} = \boxed{1.15}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.0}$

21' deep ;

$\sigma = 1725.5 + 121(6.5) = 2,512 \text{ PSF}$

$\sigma' = 1725.5 + 59(6.5) = 2,109 \text{ PSF} = 1.05 \text{ tsf}$

$\frac{\sigma}{\sigma'} = \frac{2,512}{2,109} = \boxed{1.19}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = 0.98$

Boring H Groundwater = 15' deep

16' deep sample; $\sigma = 119(15) + 121(1) = 1906 \text{ PSF}$

$\sigma' = 1785 + 59(1) = 1844 \text{ PSF} = 0.92 \text{ tsf}$

$\frac{\sigma}{\sigma'} = \frac{1906}{1844} = \boxed{1.03}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.04}$

Boring H Groundwater = 15.5' deep

16.5' deep sample; $\sigma = 135(6.5) + 119(10) = 2068 \text{ PSF}$

$\sigma' = 877.5 + 119(9) + 59(1) = 2008 \text{ PSF} = 1.00 \text{ tsf}$

$\frac{\sigma}{\sigma'} = \frac{2068}{2008} = \boxed{1.03}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.0}$

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Boring H (Contd) 8' deep $\sigma = 877.5 + 119(1.5) = 1056 \text{ PSF}$; $\sigma' = 1056 \text{ PSF} = 0.53 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = 1.0$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.37}$

12.5' deep $\sigma = 877.5 + 119(6) = 591.5 \text{ PSF}$; $\sigma' = 1591.5 \text{ PSF} = 0.8 \text{ tsf}$; $\frac{\sigma}{\sigma'} = \boxed{1.0}$
 $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.12}$

20' deep sample $\sigma = 877.5 + 119(13.5) = 2484 \text{ PSF}$
 $\sigma' = 877.5 + 119(9) + 59(4.5) = 2214 \text{ PSF} = 1.11 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = \boxed{1.12}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{0.95}$

Boring I Groundwater = 5' deep.

8' deep sample $\sigma = 675 + 121(3) = 1038 \text{ PSF}$
 $\sigma' = 135(5) + 59(3) = 852 \text{ PSF} = 0.43 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = \boxed{1.22}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.52}$

11.5' deep $\sigma = 675 + 121(6.5) = 1462 \text{ PSF}$
 $\sigma' = 675 + 59(6.5) = 1059 \text{ PSF} = 0.53 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = \frac{1462}{1059} = \boxed{1.38}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.37}$

13' deep $\sigma = 675 + 121(8) = 1643 \text{ PSF}$
 $\sigma' = 675 + 59(8) = 1147 \text{ PSF} = 0.57 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = \boxed{1.43}$; $\left(\frac{1}{\sigma'}\right)^{1/2} = \boxed{1.32}$

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Geotek Borings

Boring # 4. Groundwater El; (assume at 10' depth - not defined in the report)

Sample depth 1.5' - N = 14

$$\sigma = 119(1.5) = 178.5 \text{ psf}; \quad \sigma' = 178.5 \text{ psf}; \quad \frac{\sigma}{\sigma'} = 1.0$$

$$\left(\frac{1}{\sigma'}\right)^{0.5} = \underline{3.34}$$

Sample depth 3.5' N = 8

$$\sigma = 178.5 + 119(2) = 416.5 \text{ psf}; \quad \sigma' = 416.5 \text{ psf}; \quad \frac{\sigma}{\sigma'} = 1.0$$

$$\left(\frac{1}{\sigma'}\right)^{0.5} = \underline{2.19}$$

Sample depth 5.5' N = 10

$$\sigma = 416.5 + 119(2) = 654.5 \text{ psf}; \quad \sigma' = 654.5 \text{ psf}; \quad \frac{\sigma}{\sigma'} = 1.0$$

$$\left(\frac{1}{\sigma'}\right)^{0.5} = \underline{1.75}$$

Sample depth 7.5' N = 7

$$\sigma = 654.5 + 119(2) = 892.5 \text{ psf}; \quad \sigma' = 892.5 \text{ psf}; \quad \frac{\sigma}{\sigma'} = 1.0$$

$$\left(\frac{1}{\sigma'}\right)^{0.5} = \underline{1.50}$$

Sample depth 9.5' N = 7

$$\sigma = 892.5 + 119(2) = 1130.5; \quad \sigma' = 1130.5 \text{ psf}$$

$$\left(\frac{1}{\sigma'}\right)^{0.5} = \underline{1.33}$$

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$$N = 6$$

Sample depth 11.5' $\sigma = 1130.5 \text{ psf} + 119(2) = 1368.5 \text{ psf}$

$$\sigma' = 1130.5 + 119(0.5) + 59(1.5) = 1278.5 \text{ psf} = 0.64 \text{ tsf}$$

$\begin{matrix} 59.5 & 88.5 \end{matrix}$

$$\frac{\sigma}{\sigma'} = 1.07$$

$$\left(\frac{1}{\sigma'}\right)^{1/2} = 1.25$$

Sample depth 13.5'

$$N = 14$$

$$\sigma = 1368.5 + 119(2) = 1606.5 \text{ psf}$$

$$\sigma' = 1278.5 + 59(2) = 1396.5 \text{ psf} = 0.70 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = 1.15 ; \left(\frac{1}{\sigma'}\right)^{0.5} = 1.20$$

Sample depth 15.5'

$$N = 15$$

$$\sigma = 1606.5 + 119(2) = 1844.5 \text{ psf}$$

$$\sigma' = 1396.5 + 59(2) = 1514.5 \text{ psf} = 0.76 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = 1.22 ; \left(\frac{1}{\sigma'}\right)^{0.5} = 1.15$$

Sample depth 17.5'

$$N = 1$$

$$\sigma = 1844.5 + 119(2) = 2082.5 \text{ psf}$$

$$\sigma' = 1514.5 + 59(2) = 1632.5 \text{ psf} = 0.82 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = 1.28 ; \left(\frac{1}{\sigma'}\right)^{0.5} = 1.10$$

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GEOTEK Borings -

Boring 5 Groundwater 15.5' deep

2' deep sample. 1

$$\sigma = 119(2) = 238 \text{ psf}; \quad \sigma' = 238 \text{ psf}; \quad \frac{\sigma}{\sigma'} = 1.0$$

$$\underline{N=16} \quad \left(\frac{1}{\sigma'}\right)^{0.5} = 2.9$$

4.5' deep sample

$$\sigma = 119(4.5) = 535.5 \text{ psf}; \quad \sigma' = 535.5 \text{ psf}; \quad \frac{\sigma}{\sigma'} = 1.0$$

$$\underline{N=14} \quad \left(\frac{1}{\sigma'}\right)^{\frac{1}{2}} = 1.93$$

$$\underline{7' \text{ deep}} \quad \sigma = 119(7) = 833 \text{ psf}; \quad \sigma' = 833 \text{ psf}; \quad \frac{\sigma}{\sigma'} = 1.0$$

$$\underline{N=6} \quad \left(\frac{1}{\sigma'}\right)^{\frac{1}{2}} = 1.55$$

9.5' deep

$$\sigma = 119(9.5) = 1130.5 \text{ psf}; \quad \sigma' = 1130.5 \text{ psf}; \quad \frac{\sigma}{\sigma'} = 1.0$$

$$\underline{N=4} \quad \left(\frac{1}{\sigma'}\right)^{\frac{1}{2}} = 1.33$$

$$\underline{12' \text{ deep}} \quad \sigma = 119(12.5) = 1487.5 \text{ psf}; \quad \sigma' = 1487.5 \text{ psf}; \quad \frac{\sigma}{\sigma'} = 1.0$$

$$\underline{N=7} \quad \left(\frac{1}{\sigma'}\right)^{\frac{1}{2}} = 1.16$$

$$\underline{14.5' \text{ deep}} \quad \sigma = 119(14.5) = 1725.5 \text{ psf}; \quad \sigma' = 1725.5 \text{ psf}; \quad \frac{\sigma}{\sigma'} = 1.0$$

$$\underline{N=10} \quad \left(\frac{1}{\sigma'}\right)^{\frac{1}{2}} = \left(\frac{1}{0.863 \text{ tsf}}\right)^{\frac{1}{2}} = 1.08$$

Water Table at 15.5'

$$\underline{17' \text{ deep}} \quad \sigma = 119(15.5) + 119(1.5)$$

$$\underline{N=11} \quad \sigma = 1844.5 + 178.5 = 2023 \text{ psf}$$

$$\sigma' = 1844.5 + 59(1.5) = 1844.5 + 88.5 = 1933 \text{ psf} = 0.97 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = \frac{2023}{1933} = 1.05; \quad \left(\frac{1}{\sigma'}\right)^{\frac{1}{2}} = \left(\frac{1}{0.97}\right)^{\frac{1}{2}} = 1.02$$

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19.5' deep

N=9

$$\sigma = 2023 + 119(2.5) = \underline{2320.5 \text{ psf}}$$

$$\sigma' = 1933 + 59(2.5) = \underline{2080.5 \text{ psf}} = 1.04 \text{ tsf}$$

$$\left(\frac{\sigma}{\sigma'}\right)^{1/2} = \underline{0.98}$$

$$\frac{\sigma}{\sigma'} = \underline{1.12}$$

22' deep

N=8

$$\sigma = 2320.5 \text{ psf} + (2.5)(119) = 2618 \text{ psf}$$

$$\sigma' = 2080.5 + 59(2.5) = 2228 \text{ psf} = 1.14 \text{ tsf}$$

$$\left(\frac{\sigma}{\sigma'}\right)^{1/2} = \underline{0.95}$$

$$\frac{\sigma}{\sigma'} = \underline{1.18}$$

24.5' deep

N=8

$$\sigma = 2,618 + 119(2.5) = 2915.5 \text{ psf}$$

$$\sigma' = 2228 + 59(2.5) = 2375.5 \text{ psf} = 1.19 \text{ tsf}$$

$$\left(\frac{\sigma}{\sigma'}\right)^{1/2} = 0.92$$

$$\frac{\sigma}{\sigma'} = \underline{1.23}$$

Boring 6 - (Assume water table at 10')

16.5' deep

N=10

$$\sigma = 119(16.5) = 1963.5 \text{ psf}; \quad \sigma' = 119(10) + 59(6.5) = 1573.5 \text{ psf} = 0.79 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = \underline{1.25}; \quad \left(\frac{\sigma}{\sigma'}\right)^{0.5} = \underline{1.13}$$

21' deep

N=17

$$\sigma = 1963.5 + 119(4.5) = 2499 \text{ psf}; \quad \sigma' = 1573.5 + 59(4.5) = 1839 \text{ psf} = 0.92 \text{ tsf}$$

$$\left(\frac{\sigma}{\sigma'}\right) = \underline{1.36}; \quad \left(\frac{\sigma}{\sigma'}\right)^{0.5} = \underline{1.09}$$

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JOB	WOD	DATE	1-3-94	SHEET	21 of
ESO NO.	COMPUTED	SBA		CHECKED BY	

Boring 7B

Assume Groundwater at 10' depth

Depth = 7 ft.

N = 4

$$\sigma = 119(7) = 833 \text{ psf}, \quad \sigma' = 833 = 0.42 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = 1.0, \quad \left(\frac{1}{\sigma'}\right)^{0.5} = 1.54$$

Depth = 11 ft.

N = 4

$$\sigma = 833 + 119(4) = 1309 \text{ psf},$$

$$\sigma' = 833 + 119(3) + 59(1) = 1249 \text{ psf} = 0.62 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = 1.05; \quad \left(\frac{1}{\sigma'}\right)^{0.5} = 1.27$$

Depth = 15 ft.

N = 4

$$\sigma = 1309 + 119(4) = 1785 \text{ psf}$$

$$\sigma' = 1249 + 59(4) = 1485 \text{ psf} = 0.74 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = 1.20; \quad \left(\frac{1}{\sigma'}\right)^{0.5} = 1.16$$

Depth = 19 ft

N = 9

$$\sigma = 1785 + 119(4) = 2261 \text{ psf}$$

$$\sigma' = 1485 + 59(4) = 1721 \text{ psf} = 0.86 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = 1.31; \quad \left(\frac{1}{\sigma'}\right)^{0.5} = 1.08$$

Depth = 23 ft.

N = 3

$$\sigma = 2261 + 119(4) = 2737 \text{ psf}$$

$$\sigma' = 1721 + 59(4) = 1957 \text{ psf} = 0.98 \text{ tsf}$$

$$\frac{\sigma}{\sigma'} = 1.40; \quad \left(\frac{1}{\sigma'}\right)^{0.5} = 1.01$$

GENERAL DESIGN AND COMPUTATION SHEET

JOB	WOD	DATE	1-3-76	SHEET	22 of
ESO NO.	Ax 453007	COMPUTED	SBA	CHECKED BY	

Boring 8 Groundwater at 11 ft.

Depth = 5' ; $\sigma = 119(5) = 595 \text{ psf}$; $\sigma' = 595 \text{ psf} = 0.3 \text{ tsf}$
 $N = 5$ $\frac{\sigma}{\sigma'} = 1.0$; $\left(\frac{1}{\sigma'}\right)^{0.5} = 1.83$

Depth = 9' ; $\sigma = 595 + 119(4) = 1,071 \text{ psf}$; $\sigma' = 1,071 \text{ psf} = 0.54 \text{ tsf}$
 $N = 5$ $\frac{\sigma}{\sigma'} = 1.0$; $\left(\frac{1}{\sigma'}\right)^{0.5} = 1.36$

Depth = 13' ; $\sigma = 1,071 + 119(4) = 1,547 \text{ psf}$;
 $N = 1$ $\sigma' = 1,071 + 119(2) + 59(2) = 1,427 \text{ psf} = 0.71 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = 1.08$; $\left(\frac{1}{\sigma'}\right)^{0.5} = 1.19$

Depth = 17' ; $\sigma = 1,547 + 119(4) = 2,023 \text{ psf}$;
 $N = 5$ $\sigma' = 1,427 + 59(4) = 1,663 \text{ psf} = 0.83 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = 1.22$; $\left(\frac{1}{\sigma'}\right)^{0.5} = 1.10$

Depth = 21' $\sigma = 2,023 + 119(4) = 2,499 \text{ psf}$
 $N = 1$ $\sigma' = 1,663 + 59(4) = 1,899 \text{ psf} = 0.95 \text{ tsf}$
 $\frac{\sigma}{\sigma'} = 1.32$; $\left(\frac{1}{\sigma'}\right)^{0.5} = 1.03$

GENERAL DESIGN AND COMPUTATION SHEET

White Oak Dam ; Evaluation of Liquefaction Potential

JOB: LL PI DATE: 1-29-92 SHEET: 23 of 23
 ISO NO. COMPUTED: SBA 44 CL 30 ML CHECKED BY: 2

$$\frac{a_{max}}{g} = 0.13$$

Geologic Assoc. Boring	Ground-water depth(ft)	SPT Sample depth (ft)	Vertical Total Stress σ_{psf}	Vertical Effective Stress σ'_{psf}	$C_n \quad k_2 = \left(\frac{1}{\sigma_1}\right)$	$\frac{\sigma}{\sigma_1}$	r_d	$\frac{T_{max}}{\sigma} = \frac{0.65 a_{max}}{\sigma_1} \times r_d$	Blow Counts N	Correction Factors $\begin{matrix} 1 & 2 & 3 \end{matrix}$	Modified N_1
A'	14.6	8'	952	952	1.45	1.0	0.98	.08	21	1.45 1.0 0.75	22.8
		13'	1547	1547	1.14	1.0	0.97	.08	5	1.14 1.0 1.0	5.70
		16.5	1967	1850	1.04	1.06	0.97	.09	5	1.04 1.0 1.0	5.20
		20	2391	2056	0.99	1.16	0.96	.09	10	.99 1.0 1.0	9.90
		23.5	2814	2263	0.94	1.24	0.95	.10	12	.94 1.0 1.0	11.28
		27	3238 3008	2469 2357	0.90 0.92	1.31 1.28	0.94	.1	31	.92 1.0 1.0	28.52
B	14	7	833	833	1.54	1.0	0.98	.08	7	1.54 1.0 0.75	8.09
		13	1547	1547	1.14	1.0	0.97	.08	2	1.14 1.0 1.0	2.28
		16.5	1969	1814	1.05	1.09	0.97	.09	5	1.05 1.0 1.0	5.25
		20	2392	2020	1.0	1.18	0.96	.10	6	1.0 1.0 1.0	6.00
		23.5	2816	2227	0.94	1.26	0.95	.10	5	.94 1.0 1.0	4.70
		26.5	3179	2404	0.91	1.32	0.94	.10	65	.91 1.0 1.0	59.15

GENERAL DESIGN AND COMPUTATION SHEET

White Oak Dam ; Evaluation of Liquefaction Potential

$$\frac{\sigma_{max}}{9} = 0.13$$

Boring #	Ground-water depth (ft)	Sample depth (ft)	Vertical Total stress σ	Vertical Effective Stress σ_1	$C_n \quad \frac{1}{2} = \left(\frac{1}{\sigma_1} \right)$	$\frac{\sigma}{\sigma_1}$	r_d	$\frac{T_{max}}{\sigma} = 0.65 \frac{\sigma}{\sigma_1} \times r_d$	Blow Counts N	Correction Factors			Modified N_1
										1	2	3	
C	11	16	2090	1780	1.06	1.17	0.97	.10	6	1.00	1.0	1.0	6.36
		19.5	2514	1987	1.00 0.99	1.27	0.96	.10	5	.99	1.0	1.0	4.95
D	14	8	952	952	1.45	1.0	0.98	.08	13	1.45	1.0	.75	14.13
		13	1547	1547	1.14	1.0	0.97	.08	4	1.14	1.0	1.0	4.56
		16.5	1969 1997	1814 1842	1.04	1.08	0.97	.09	4	1.04	1.0	1.0	4.16
		20	2392 2420	2020 2048	0.99	1.18	0.96	.103	6	.99	1.0	1.0	5.94
		24	2876 2904	2256 2284	0.94	1.27	0.95	.101	10	.94	1.0	1.0	9.40
E	14	8	952	952	1.45	1.0	0.98	.08	3	1.45	1.0	.75	3.26
		11	1309	1309	1.24	1.0	0.97	.08	2	1.24	1.0	1.0	2.48
		15	1787 1815	1725 1753	1.07	1.04	0.97	.09	1	1.07	1.0	1.0	1.07
		18.5	2121 2237	1932 1960	1.01	1.14	0.96	.09	4	1.01	1.0	1.0	4.04
		22	2163 2262	2138 2166	0.96	1.23	0.95	.10	4	.96	1.0	1.0	3.84

0 NO.	LL	47	17	COMPUTED	SBA	50	20	DATE	1-29-92	SHEET	24 of 21
	ML					ML	WH	CHECKED BY	40	ML	

$$\frac{a_{max}}{g} = 0.13$$

GENERAL DESIGN AND COMPUTATION SHEET

White Oak Dam ; Evaluation of Liquefaction Potential

$\frac{a_{max}}{g} = 0.13$										DATE	20	92	SHEET	25	of	31
SO NO.										COMPUTED BY		CHECKED BY				
LL PI										SBA		3981				
Boring #	Ground-water depth(ft)	Sample depth (ft)	Vertical Total Stress σ	Vertical Effective Stress σ_1	$C_n^{1/2} = \left(\frac{1}{\sigma_1}\right)$	$\frac{\sigma}{\sigma_1}$	r_d	$T_{max} \frac{\sigma}{\sigma_1} = 0.65 \frac{a_{max}}{g} \times r_d$	Blow Counts N	Correction Factors	Modified N_1					
										$\begin{matrix} 1 & 2 & 3 \end{matrix}$						
F	9	14.5	$\begin{matrix} 1944 \\ 1952 \end{matrix}$	1603	1.12	1.28	0.98	.10	11	1.12 1.0 1.0	12.32					
		16.5	2186	1721	1.08	1.27	0.97	.10	20	1.08 1.0 1.0	21.60					
G	14.5	8	952	952	1.45	1.0	0.98	.08	11	1.45 1.0 .75	11.96					
		13	1547	1547	1.14	1.0	0.97	.08	30	1.14 1.0 1.0	34.2					
		15	1786	1755	1.07	1.02	0.98	.08	55	1.07 1.0 1.0	58.85					
		19.5	2331	2021	1.00	1.15	0.96	.09	31	1.0 1.0 1.0	31.00					
		21	2512	2109	0.98	1.19	0.96	.107	19	.98 1.0 1.0	18.62					
H	15	8	952	952	1.45	1.0	0.98	.08	8	1.45 1.0 .75	8.70					
		13	1547	1547	1.14	1.0	0.97	.08	10	1.14 1.0 1.0	11.40					
		16	1906	1844	1.04	1.03	0.97	.08	27	1.04 1.0 1.0	28.08					
H	15.5	8	1056	1056	1.37	1.0	0.98	.08	6	1.37 1.0 .75	6.17					
		12.5	1591.5	1591.5	1.12	1.0	0.97	.08	3	1.12 1.0 1.0	3.36					

$$\frac{a_{max}}{g} = 0.13$$

GENERAL DESIGN AND COMPUTATION SHEET

White Oak Dam ; Evaluation of Liquefaction Potential

[illegible]

GENERAL DESIGN AND COMPUTATION SHEET

JOB: **White Oak Dam - Evaluation of Liquefaction** DATE: **1-3-94** SHEET: **27 of**
 ESO NO. **AX 45307** COMPUTED BY **SBA** CHECKED BY

$$\frac{a_{max}}{g} = 0.13$$

- *1 = Overburden Correction
 *2 = Hammer Energy Ratio Correction
 *3 = Very short Drill rod length Correction, depth $\leq 10'$

Boring #	Ground-water Depth (ft)	Sample Depth (ft)	Vertical Total Stress σ psf	Vertical Effective Stress σ' psf	$C_m = \left(\frac{1}{\sigma'}\right)^{1/2}$	b/b_1	r_d	$\frac{\tau_{max}}{\sigma'_1} = \frac{0.65 a_{max}}{\sigma'_1 \times r_d}$	Blow Cnts N	Correction Factors			Modified N_1
										1*	2*	3*	
4	10' (assumed)	1.5	178.5	178.5	3.34	1.0	1.0	.08	14	3.34	1.0	0.75	35.1
		3.5	416.5	416.5	2.19	1.0	0.99	.08	8	2.19	1.0	0.75	13.1
		5.5	654.5	654.5	1.75	1.0	0.99	.08	10	1.75	1.0	0.75	13.1
		7.5	892.5	892.5	1.50	1.0	0.98	.08	7	1.50	1.0	0.75	7.9
		9.5	1130.5	1130.5	1.33	1.0	0.97	.08	7	1.33	1.0	0.75	7.0
		11.5	1368.5	1278.5	1.25	1.07	0.97	.09	6	1.25	1.0	1.0	7.5
		13.5	1606.5	1396.5	1.20	1.15	0.97	.09	14	1.20	1.0	1.0	16.8
		15.5	1844.5	1514.5	1.15	1.22	0.97	.10	15	1.15	1.0	1.0	17.3
		17.5	2082.5	1632.5	1.10	1.28	0.97	.10	1	1.10	1.0	1.0	1.0
5	15.5	2	238.0	238.0	2.9	1.0	1.0	.08	16	2.9	1.0	0.75	34.8
		4.5	535.5	535.5	1.93	1.0	0.99	.08	14	1.93	1.0	0.75	20.3

104 ES0

COMPUTED

ENCLOSURE

1-3-94

28 of

$$\frac{a_{\max}}{g} = 0.13$$

[illegible]

GENERAL DESIGN AND COMPUTATION SHEET

JOB White Oak Dam - Evaluation of Liquefaction Potential DATE 1-3-94 SHEET 29 of

ESO NO. Ax45307 COMPUTED SBA CHECKED BY

$$\frac{\alpha_{max}}{g} = 0.13$$

Boring #	Ground-water Depth (ft)	Sample Depth (ft)	Vertical Total Stress σ' psf	Vertical Effective Stress σ'_v psf	$C_m = \left(\frac{1}{\sigma'_v}\right)^{1/2}$	$\frac{\sigma'_v}{\sigma'_v}$	r_d	$\frac{\tau_{max}}{\sigma'_v} = \frac{0.65 \alpha_{max}}{\sigma'_v \times 1.7}$	Blow Cts N	Correction Factors			Modified N_1
										1	2	3	
7B	10 (assumed)	7	833	833	1.54	1.0	0.98	0.08	4	1.54	1.0	0.75	4.6
		11	1309	1249	1.27	1.05	0.97	0.09	4	1.27	1.0	1.0	5.1
		15	1785	1485	1.16	1.20	0.97	0.10	4	1.16	1.0	1.0	4.6
		19	2261	1721	1.08	1.31	0.96	0.11	9	1.08	1.0	1.0	9.7
		23	2737	1957	1.01	1.40	0.95	0.11	3	1.01	1.0	1.0	3.0
8	11	5	595	595	1.83	1.0	0.99	0.08	5	1.83	1.0	0.75	6.9
		9	1,071	1,071	1.36	1.0	0.97	0.08	5	1.36	1.0	0.75	5.1
		13	1,547	1,427	1.19	1.08	0.97	0.09	1	1.19	1.0	1.0	1.2
		17	2,023	1,663	1.10	1.22	0.97	0.10	5	1.10	1.0	1.0	5.0
		21	2,499	1,899	1.03	1.32	0.96	0.11	1	1.03	1.0	1.0	1.0

LIQUEFACTION POTENTIAL EVALUATION WHITE OAK DAM

LEGEND :

SPT SAMPLE ○

Boring A'

Fig. 3 - NO OF BLOWS VS CYCLIC STRESS RATIO

LIQUEFACTION POTENTIAL EVALUATION WHITE OAK DAM

Fig. 4 - NO OF BLOWS VS CYCLIC STRESS RATIO

LIQUEFACTION POTENTIAL EVALUATION

WHITE OAK DAM

LEGEND :
 SPT SAMPLE ○

Boring C

Fig. 5 - NO OF BLOWS VS CYCLIC STRESS RATIO

LIQUEFACTION POTENTIAL EVALUATION WHITE OAK DAM

LEGEND :

SPT SAMPLE ○

Boring D'

Fig. 6 - NO OF BLOWS VS CYCLIC STRESS RATIO

LIQUEFACTION POTENTIAL EVALUATION

WHITE OAK DAM

LEGEND :

SPT SAMPLE ○

Boring E

Fig. 7 - NO OF BLOWS VS CYCLIC STRESS RATIO

LIQUEFACTION POTENTIAL EVALUATION

WHITE OAK DAM

Boring F

Fig. 8 - NO OF BLOWS VS CYCLIC STRESS RATIO

LIQUEFACTION POTENTIAL EVALUATION WHITE OAK DAM

LEGEND :

SPT SAMPLE ○

Boring G'

Fig. 9 - NO OF BLOWS VS CYCLIC STRESS RATIO

LIQUEFACTION POTENTIAL EVALUATION

WHITE OAK DAM

LEGEND :

SPT SAMPLE ○

Boring H¹

Fig.10 - NO OF BLOWS VS CYCLIC STRESS RATIO

LIQUEFACTION POTENTIAL EVALUATION WHITE OAK DAM

LEGEND :

SPT SAMPLE ○

Boring H

Fig. // - NO OF BLOWS VS CYCLIC STRESS RATIO

LIQUEFACTION POTENTIAL EVALUATION

WHITE OAK DAM

LEGEND :

SPT SAMPLE ○

Boring I.

Fig. 12 - NO OF BLOWS VS CYCLIC STRESS RATIO

LIQUEFACTION POTENTIAL EVALUATION WHITE OAK DAM

Boring # 4

LEGEND :
SPT SAMPLE
BORING # 4

Fig. 13 No. of Blows VS Cyclic stress Ratio

BORING 5

Fig. 14 No. of Blows vs Cyclic stress Ratio

--- -- -- -- --

LIQUEFACTION POTENTIAL EVALUATION WHITE OAK DAM

Boring 6

LEGEND :

SPT SAMPLE

Boring 6

Fig 15 No. of Blows vs Cyclic stress Ratio

LIQUEFACTION POTENTIAL EVALUATION WHITE OAK DAM

Boring 7B

Fig. 16 No. of blows vs Cyclic stress Ratio

LEGEND :

SPT SAMPLE

BORING - 7B

LIQUEFACTION POTENTIAL EVALUATION

WHITE OAK DAM

Boring #

Fig. 17 No. of Blows vs Cyclic Stress Ratio

LEGEND :

SPT SAMPLE

Boring #5

GENERAL DESIGN AND COMPUTATION SHEET

JOB	White Oak Dam	DATE	1-23-94	SHEET	45 of
ESO NO.	Ax453007	COMPUTED	SBA	CHECKED BY	

7.0 Conclusions :

Evaluation of the liquefaction potential leads to the conclusion that the WOD embankment and foundation soils are not vulnerable to liquefaction. Therefore, the Evaluation Basis Earthquake will have no adverse effect on the structural integrity of the White Oak Dam.

A-4 DAM HAZARD CLASSIFICATION

Internal Correspondence

MARTIN MARIETTA ENERGY SYSTEMS, INC.

Pg. A4 - 1

August 31, 1993

Documentation of ORNL Facility Categorization for White Oak Lake Dam

Ray Gaddis

This letter documents the performance of a hazard screening and facility categorization for White Oak Lake Dam. The purpose of these activities is to group facilities and processes according to the magnitude of their hazards. This hazard classification process is restricted to human safety issues only. The hazard screening process is described in detail in the Hazard Screening Application Guide (CSET-2).

The first step of the hazard screening process is preliminary hazard screening. This is a sorting process used to screen obviously benign facilities or processes from unnecessarily detailed hazard screening analysis. The preliminary hazard screening may be bypassed if it is apparent that a more detailed analysis is needed. Since there is currently a significant inventory of radionuclides in the sediments of White Oak Lake, a more detailed analysis is needed and the preliminary hazard screening will not be performed.

Facilities or processes that are not eliminated by the preliminary hazard screening are divided into functional systems and then subjected to an initial event selection which uses a modified Hazard and Operability technique or a Failure Modes and Effects Analysis to generate calculations which assign the system an initial hazard classification. At this point, a preliminary hazard identification matrix form must be filled out (see Attachment 1).

Initial event selection for the White Oak Lake Dam facility results from the obvious potential hazard resulting from a dam failure. At least one credible (physically possible) event needs to be postulated to support the event selection. For the White Oak Lake Dam failure, two events can be postulated, an earthquake or a major flood event. At this point in the analysis it is not expected that the probability of the initiating event be quantified. Based on this process, a preliminary hazard analysis worksheet has been filled out (see Attachment 2).

The next step is scenario development which is used to determine the bounding accident scenario and allow for the consequences of the scenario to be evaluated. The bounding scenario is defined as that which produces the most severe consequences to the on-site or off-site personnel. Calculations are then performed based on the assumptions in the bounding scenario. This scenario and resultant dose calculations have already been developed and are documented in an August 30, 1988 letter from J.P. Witherspoon of the Environmental and Health Protection Division to H. Wayne Hibberts of US DOE-Oak Ridge Operations (see Attachment 3). Using the more conservative second scenario developed in the letter, the maximum dose rate would be 63 mrem/year. This estimate is based on losing 100% of the approximately 400 Ci of Cs-137 in the White Oak Lake sediments. More recent studies have

suggested that 100-300 Ci would probably be lost through a dam failure. Using the same exposure assumptions, this would result in conservative dose estimates of 15-45 mrem/year. Credit for additional dilution, sediment partitioning, and the construction of White Oak Creek Embayment have not been factored in for these screening calculations. These calculations have been performed to give a general idea of the consequences of the relative magnitude of a dam failure, it does not imply that these exposures are expected to occur, or if they did, that they would be acceptable.

Based on these results, an initial hazard classification can be assigned based on one of three categories: low, medium, or high. Table 2.6-4 in CSET-2 defines exposure levels of the order calculated for the White Oak Dam failure scenario as comprising negligible health effects. This results in an initial hazard classification of low for this scenario.

The final step in the hazard screening process is obtaining consensus. The installation management needs to review and concur with the hazard classification recommendations to ensure that the results are reasonable and to ensure management awareness of all hazard classifications.

The ORNL categorization of facilities form has also been filled out as part of this documentation (see Attachment 4). The net score was four resulting in an assignment of Category C based on the operations categories according to the risk evaluation.

Tom Purucker
Risk Analysis Section

enclosures (4):

- Preliminary Hazard Identification Matrix
- Preliminary Hazard Analysis Worksheet
- August 30, 1988 Witherspoon to Hibbitts correspondence
- ORNL Categorization of Facilities Form

Attachment 1

PRELIMINARY HAZARD IDENTIFICATION MATRIX

DATE: 8/31/93

FACILITY: Lake O.E. De

HAZARD TYPE

Item No.	System/ subsystem description	Special/ radioactive source material	Radiation sources	Toxic/ corrosive reactive materials	Flammable materials	Explosive/ pyrophoric materials	Electrical energy	Thermal energy	Elastic energy	Potential energy	Other	Remarks
	Waste Oil Dr	X	Cs-137 in solvent	X	X	X	X	X	X	✓		

Fig. 22-2. Preliminary Hazard Identification Matrix.

Attachment 2

DATE: 8/31/93
 FACILITY: White Oak Dam

PRELIMINARY HAZARDS ANALYSIS WORKSHEET

PAGE 1 OF 1

ITEM NO.	SYSTEM/SYSTEM DESCRIPTION	HAZARD TYPE	CONSEQUENCE	INITIATING EVENT	STANDARD EXISTING HAZARD Y OR N	JUSTIFICATION FOR STD. IND. HAZARD AND COMMENTS
	White Oak Lake Dam	Dam failure	release of contaminated Cs-137 in sediments	significant flood event or earthquake	N	

Fig. 22-4. Preliminary Hazards Analysis Worksheet.

Attachment 3

5

OAK RIDGE NATIONAL LABORATORY

OPERATED BY KAPPA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

AUGUST 30, 1988

U.S. Department of Energy
Oak Ridge Operations
Attention: H. Wayne Hibbitts, Director
Environmental Protection Division
Post Office Box 2
Oak Ridge, Tennessee 37831

Dear Mr. Hibbitts:

White Oak Dam Failure Radiation Doses

The following estimates of radiation dose to off-site persons in the event of a failure of White Oak Dam have been made. The numbers for Scenario #1 have changed since we are now using 1987 data.

Scenario #1.

Average radionuclide concentrations in White Oak Lake are as given in Attachment 1 (1987 Surveillance Report, ES/ESH-4/V2). Using the dose conversion factors given in Attachment 2 and the factors for radionuclide concentration in fish (Attachment 2), an effective total-body dose of 72.3 mrem/yr is calculated for drinking 730 l of water/yr and eating 21 kg of fish/yr directly from White Oak Lake.

Obviously, if White Oak Lake flows into the Clinch River, the lake water will be diluted. White Oak Lake is about 24 acres ($9.71 \times 10^4 \text{ m}^2$). If we assume it averages one meter in depth, the lake volume is $9.7 \times 10^{10} \text{ cm}^3$. The average daily flow rate of the Clinch River is $1.3 \times 10^{13} \text{ cm}^3/\text{d}$. Thus, if White Oak Lake were to spill into the Clinch River and be diluted by one days flow, the lake water would be diluted by a factor of $1.3 \times 10^{13} / 9.7 \times 10^{10}$ or 134. The radionuclide concentration and dose would also be reduced by a factor of 134. The dose to a downstream individual would then be 72.3 mrem/134 or 0.54 mrem/yr.

Scenario #2.

A near impossible scenario would be a situation where White Oak Lake and the entire surrounding, contaminated soil mass washes into the Clinch River. This would represent the largest possible dose case. In 1962, T. F. Lomenick made a thorough radiological survey of White Oak lake bed (55 acres). Assuming 25 years of radioactive decay, and using Lomenick's 1962 estimates, the lake bed contains 396.5 Ci of Cs-137, 5.6 Ci of

August 30, 1988

Co-60 and 7.9 Ci of Sr-90. If all of this soil washed into the Clinch River and the radionuclides all became soluble over a period of one year, then the radionuclides would be contained in $4.7 \times 10^{15} \text{ cm}^3$ -- the average annual flow rate of Clinch River. This would result in concentrations of

$8.38 \times 10^{-2} \text{ pCi Cs-137/cm}^3$,
 $1.10 \times 10^{-3} \text{ pCi Co-60/cm}^3$, and
 $1.68 \times 10^{-3} \text{ pCi Sr-90/cm}^3$.

Drinking an average of 1.2 l of water/d and eating 7.3 kg of fish/yr would result in an individual dose of 23.2 mrem/yr. If maximum consumption rates (730 l/yr and 21 kg/yr) are used, the dose would be about 63 mrem.

Even at the larger dose, the population of Harriman, Kingston, and Rockwood (29,500 persons) would receive a dose of 1859 person-rem -- about 21% of the background dose of about 300 mrem per year.

Neither of these scenarios takes credit for additional dilution downstream, filtration at water intakes or settling out of activity in the Clinch River. These events would reduce estimated doses by at least an order of magnitude.

J. P. Witherspoon
J. P. Witherspoon
Environmental and Health
Protection Division

JFW:sm:FAILURE.DOS

Attachments (2)

cc/att: F. R. O'Donnell, 4500S, MS-6102
File, NoRC

A Hachment 4

ORNL CATEGORIZATION OF FACILITIES

7

Division _____

Facility Type White Oak Lake Dam

Score
(Yes=1, No=0)

1. Enter the Hazard Assessment of the facility type Low
(Note 1)

Point Value: High 8
Moderate 5
Low 1
Generally Acceptable 0

1

2. a. Does the facility contain standard industrial hazards that could reasonably cause death? (Note 2)

0

b. Does the facility contain standard industrial hazards that could reasonably cause serious injury? (Note 2)

0

3. Is high availability of the facility or operation required or is rigidly scheduled output required?

1

4. Does the product or service (hardware or software) of the operation have high visibility or require high assurance of quality, requiring traceable and accountable records or is the product or service used in (or by) another highly visible program or facility or in facilities with hazards, rigidly scheduled output or required high availability?

1

5. Are special safeguards or security required for facility access?

1

TOTAL POINTS

4

Note 1: If the hazard screening is not complete, enter the initial estimate.

Note 2: Standard industrial hazards are routinely encountered in everyday life, or typically encountered in industry, and controlled by consensus standards (OSHA, ANSI, NFPA, etc). Do not include points for sabotage or deliberate attempts to cause death or injury.

Operation Categories According to Risk Evaluation:

Category A - Scores 9 through 13

Category B - Scores 5 through 8

Category C - Scores 0 through 4

Approved:

Division Director _____

Date: _____

Fig. 5.1. ORNL Categorization of Facilities

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Table 26-4. Radiological health effect
exposure levels

CAUTION: THESE EXPOSURE LEVELS ARE ONLY TO BE USED FOR HAZARD SCREENING.	
IRREVERSIBLE:	> 100 REM
REVERSIBLE:	10 - 100 REM
NEGLECTIBLE HEALTH EFFECT:	< 10 REM

*
Source

MMS, "Hazard Screening Application
Guide", ES/CSET-2/R1, ^{dated June 1992} Prepared for the
U.S. Department of Energy.