American Technologies, Inc.
Oak Ridge, Tennessee

Y/EN-5362

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SEISMIC ANALYSIS OF INDUSTRIAL WASTE LANDFILL IV AT Y-12 PLANT

For

Martin Marietta Energy Systems, Inc.

Contract No. 28K-DRT27C
STD No. AT 95-002

April 7, 1995

by

American Technologies, Inc.
101 N. Rutgers Ave., Suite 202
Oak Ridge, Tennessee 37830

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

PROJECT NO./TITLE SEISMIC ANALYSIS OF LANDFILL IV		DATE STARTED CALC. NO.: DAC. —
LOCATION SITE Y-12 PLANT	BUILDING(S) OR AREA INDUSTRIAL WASTE LANDFILL IV	ESO PJ
TEAM PE	RED	SUPV.
DEPT	DESIGNERS (CONTRIBUTING)	

Applies to Project - WBS/Items/Systems:

And Reports/Dwgs./Rev. No.:

Signature / Date

	REV. 0	REV. 1	REV. 2	REV. 3
Prepared by:	L. D. Stone 4-7-95			
Lead Designer/IFA Date:				
Other Designers:				
Review - Approvals:				
Checked by:	Syed B. Ahmed 4-12-95			
Approved by RED:				
Approved by Supervisor:				
Reviewed by PE:				
Other:				

PAGE NO.	CONTENTS DESCRIPTION (List Attachments)

List this DAC on contents page

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(6 11-88)

Fig. 1

DESIGN ANALYSIS AND CALCULATIONS TITLE/APPROVAL FORM

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PURPOSE

THIS CALCULATION WAS PREPARED TO SEISMICALLY EVALUATE LANDFILL IV AT THE Y-12 PLANT AS REQUIRED BY TENNESSEE RULE 1200-1-7-.04(2) FOR SEISMIC IMPACT ZONES.

METHODS

1 - THE SEISMIC ANALYSES WILL BE PERFORMED IN ACCORDANCE WITH THE TENNESSEE DIVISION OF SOLID WASTE "EARTHQUAKE EVALUATION GUIDANCE DOCUMENT". THIS DOCUMENT WILL BE FOLLOWED TO DETERMINE GLOBAL SLOPE STABILITY, VENEER STABILITY AND FOR LIQUEFACTION EVALUATION.

2 - HORIZONTAL GROUND ACCELERATION WILL BE DETERMINED BY THE USGS OPEN-FILE NO. 82-1033 FOR EXPECTED HORIZONTAL GROUND ACCELERATION WITH A 90% OR GREATER PROBABILITY THAT THE ACCELERATION WILL NOT BE EXCEEDED IN 250 YEARS.

3 - THE STABILITY OF THE LANDFILL SLOPES WILL BE ANALYZED WITH STABL5M.

4 - MAXIMUM HORIZONTAL CREST ACCELERATION WILL BE DETERMINED BY THE MAKDISI/SEED SIMPLIFIED PROCEDURE.

5 - GLOBAL STABILITY (DEFORMATION) WILL BE DETERMINED BY METHODS DEVELOPED BY NEWMARK AND LATER REFINED BY MAKDISI AND SEED.

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ASSUMPTIONS

1 - THE ANALYSES WILL ONLY BE CONCERNED WITH SEISMICALLY QUALIFYING FINAL CLOSURE SLOPES. QUALIFICATION OF SLOPES DURING OPERATION IS NOT ADDRESSED IN THIS CALCULATION. IT IS ASSUMED THAT ANY FAILURE OF A "WORKING FACE" SLOPE DURING OPERATION WOULD:

a- EASILY BE RESTORED WITH STANDARD LANDFILL EARTH MOVING EQUIPMENT.

b- HAVE NO THREAT TO THE ENVIRONMENT SINCE THE WASTE MATERIAL WOULD BE CONFINED WITHIN THE INTERIOR OF THE LANDFILL PERIMETER.

2 - THE NON-LINEAR SOIL PROPERTIES (SHEAR MODULUS, G, AND DAMPING, D) AT LANDFILL IV VARY AS INDICATED IN FIGURE 1 OF THE TENNESSEE DIVISION OF SOLID WASTE "EARTHQUAKE EVALUATION GUIDANCE DOCUMENT" (REF. 2).

3 - DUE TO LACK OF DATA AND FOR SIMPLICITY, ASSUME THE 12 " GRANULAR DRAINAGE LAYER ABOVE THE CLAY LINER HAS THE SAME SHEAR STRENGTH AND DENSITY AS THE WASTE FILL (CONSERVATIVE).

4 - THE EARTHQUAKE WILL ONLY HAVE A HORIZONTAL ACCELERATION COMPONENT. NO VERTICAL COMPONENT WILL BE USED.

5 - THE TAFT RECORD (NORTH-SOUTH COMPONENT) SHOWN IN FIGURE 2 OF REFERENCE 2 CAN BE USED TO SIMULATE THE ACCELERATION RESPONSE SPECTRA OF AN EAST TENNESSEE EARTHQUAKE.

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DESIGN INPUT

LANDFILL IV DESIGN DRAWINGS

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REFERENCES

1 - Soil Sampling and Testing - Proposed Industrial Waste Landfill IV. Y-12 Plant. May 1987. Geotek Project No. 83-1370. Geotek Engineering Co.

2 - Earthquake Evaluation Guidance Document, Tennessee Division of Solid Waste.

3 - TN 1200-1-7-.04(2) Solid Waste Regulations.

4 - Proceedings of a Workshop on Research Priorities for Seismic Design of Solid Waste Landfills. August 26, 27 , 1993, University of Southern California. Los Angeles.

5 - Correlation of Properties of Laboratory Compacted Soils, Report No. CEB-84-28. Tennessee Valley Authority, December 1984.

6 - MMES, Engineering Procedure, EP-C-20, Design Analyses and Calculations.

7 - USGS Map MF-2120, Horizontal Acceleration (90% Probability of Not Being Exceeded in 250 Years).

8 - Users Guide for PC STABL 5M, December 1988. Eftychios Achilleos. Purdue University.

9 - Makdisi, F. I. and Seed, H. Bolton (1977), A Simplified Procedure for Estimating Earthquake Induced Deformations in Dams and Embankments , Report No. UCB/EERC - 77/19.

10 - Makdisi, F. I. and Seed, H. Bolton (1977), A Simplified Procedure for Computing Maximum Crest Acceleration and Natural Period for Embankments, In press.

11 - Seed, H. B., Idriss, I. M., and Arango, I., (1983), "Evaluation of Liquefaction Potential Using Field Performance Data", Journal of the Geotechnical Engineering Division, ASCE, Vol. 109, No. 3, pp 458 - 482.

12 - Dynamic Soil and Backfill Parameters, Appendix O, 1989, Watts Bar Nuclear Plant. Tennessee Valley Authority.

13 - Geotechnics of Waste Fills, ASTM STP 1070.

14 - Earthquake Engineering , Robert L. Wiegel, Prentice-Hall, Inc. 1970.

15 - H. G. Seed and I. M. Idriss, (Sept. 1971), "Simplified Procedure for Evaluating Soil Liquefaction Potential" , Journal of the Soil Mechanics and Foundation Division , ASCE, Vol. 97, No. SM 9, Pg. 1249.

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ENGINEERING PROPERTIES DEVELOPMENT

PG. 27 OF REF. 4 CONTAINS INFORMATION THAT INDICATES THE SAME WASTE FILL SHEAR STRENGTHS ARE COMMONLY USED FOR BOTH STATIC AND SEISMIC STABILITY ANALYSES AND FOR SEISMIC DEFORMATION/DISPLACEMENT STUDIES. *

UNDRAINED SHEAR STRENGTHS ARE NORMALLY USED IN PSEUDO-STATIC SEISMIC STABILITY ANALYSES SINCE IT IS ASSUMED THAT THE SHAKING INDUCED BY THE EARTHQUAKE GENERATES EXCESS PORE WATER PRESSURE WITHIN THE SOIL MASS.

ALTHOUGH PG. 5 OF REF. 1 STATES, "FREE WATER WAS NOT ENCOUNTERED IN ANY OF THE BORINGS", USE UNDRAINED SHEAR STRENGTHS ANYWAY FOR THE IN-SITU NATURAL SOIL. (THIS SHOULD BE CONSERVATIVE). HOWEVER, THERE IS NO JUSTIFICATION TO MODEL A PHREATIC SURFACE DUE TO THE LACK OF FREE WATER.

EFFECTIVE SOIL SHEAR STRENGTHS WILL BE USED FOR THE WASTE MATERIAL, COMPACTED LINER AND CAP BECAUSE:

1- PGS. 26-27 OF REF. 4 INDICATES EFFECTIVE STRESS ANALYSIS ARE ROUTINELY USED SINCE WASTE FILLS ARE NOT GENERALLY ALLOWED TO BECOME SATURATED. *

2- LANDFILL IV WILL HAVE A RELATIVELY IMPERVIOUS COMPACTED CLAY CAP ($k \cong 1 \times 10^{-7}$ cm/sec).

THEREFORE, EXCESS PORE WATER PRESSURES SHOULD NEVER DEVELOP IN THE WASTE MATERIAL, LINER OR CAP DURING AN EARTHQUAKE AND EFFECTIVE SHEAR STRENGTH PARAMETERS ARE APPROPRIATE.

* Minor editorial revisions on 5-8-95 for clarification of text to eliminate any copyright concerns.

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COMPACTED CLAY LINER AND CLAY CAP

FROM REF. 1

Chestnut Ridge Landfill @ Y-12
April 1, 1987

TABLE B-3: STANDARD PROCTOR (ASTM D698) TEST DATA

BORING NUMBER	DEPTH, ft	LIQUID LIMIT	PLASTICITY INDEX	MAXIMUM DRY DENSITY, pcf	OPTIMUM MOISTURE, %	SOIL DESCRIPTION
1	40.0-42.0	71.3	52.2	99.7	23.8	CLAY, reddish tan w/some silt & chert fragments
2B	10.0-12.0	41.0	18.8	105.2	17.0	SILTY CLAY, tannish red w/chert fragments
3	40.0-42.0	56.7	32.0	100.4	22.4	CLAY, reddish tan w/some silt & chert fragments
4	42.0-44.0	64.1	35.8	95.3	25.7	CLAY, reddish tan & brown w/some chert fragments
5	20.0-27.0	62.9	34.0	100.9	24.1	CLAY, reddish tan w/some silt & chert fragments
				AVG. = 100.3 pcf	22.6%	

MINIMUM ALLOWABLE = 95% STANDARD COMPACTION

$$\gamma_{DRY} = 0.95\,\gamma_{DRY\ MAX} = 0.95\,(100.3) = 95.3 \text{ pcf}$$

ASSUME COMPACTED FILL MATERIAL WILL BE PLACED AT NATURAL WATER CONTENT.

FROM TABLE B-2, (NEXT PAGE).

AVERAGE NATURAL WATER CONTENT = 27.5%

$$\therefore \gamma_{MOIST} = \gamma_{DRY}(1 + w)$$

$$\gamma_{MOIST} = 95.3\,(1 + 0.275)$$

$$\gamma_{MOIST} = 121.5 \text{ pcf} \qquad \text{USE } \gamma_{MOIST} = 122. \text{ pcf}$$

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FROM REF 1

Chestnut Ridge Landfill @ Y-12
April 1, 1987

TABLE B-2: PERMEABILITY TEST DATA

Boring	Depth (ft)	Natural Water Content (%)	Wet Unit Weight (pcf)	Liquid Limit	Plasticity Index	Hydraulic Conductivity (cm/s)	Comments
1	20.0-22.0	29.3	124.6	51.6	23.1	5.80 x 10 EE-8	Undisturbed
1	40.0-42.0	27.4	120.9	71.3	52.2	2.35 x 10 EE-8	Remolded*
1	40.0-42.0	33.4	123.1	64.5	33.5	3.04 x 10 EE-8	Undisturbed
2A	20.0-22.0	25.3	130.3	54.8	25.9	7.42 x 10 EE-7	Undisturbed
2B	10.0-12.0	17.0	130.8	41.0	18.8	3.37 x 10 EE-8	Remolded*
2B	28.0-30.0	23.5	136.7	56.7	31.1	4.26 x 10 EE-8	Undisturbed
2B	38.0-40.0	29.2	133.4	56.2	32.0	1.30 x 10 EE-7	Undisturbed
2B	48.0-50.0	22.6	132.1	43.1	20.3	4.68 x 10 EE-8	Undisturbed
3	10.0-12.0	24.8	121.2	47.0	17.3	3.03 x 10 EE-6	Undisturbed
3	30.0-32.0	28.7	125.4	52.9	28.5	3.52 x 10 EE-8	Undisturbed
3	40.0-42.0	30.5	124.2	67.2	35.8	3.21 x 10 EE-7	Undisturbed
3	40.0-42.0	30.5	122.0	56.7	32.0	6.05 x 10 EE-8	Remolded*
4	10.0-12.0	23.3	120.3	51.5	21.5	3.60 x 10 EE-7	Undisturbed
4	18.0-20.0	27.3	120.2	58.6	29.3	1.52 x 10 EE-7	Undisturbed
4	28.0-30.0	35.9	124.9	63.3	35.2	3.86 x 10 EE-8	Undisturbed
4	38.0-40.0	23.8	122.1	57.7	29.2	3.80 x 10 EE-7	Undisturbed
4	42.0-44.0	28.1	126.0	64.1	35.8	2.20 x 10 EE-8	Remolded*
4	48.0-50.0	37.7	124.8	56.8	29.9	3.61 x 10 EE-7	Undisturbed
5	8.0-10.0	26.7	117.4	54.2	18.6	4.61 x 10 EE-7	Undisturbed
5	18.0-20.0	30.1	120.9	59.5	18.8	6.82 x 10 EE-7	Undisturbed
5	20.0-27.0	27.8	129.8	62.9	34.0	2.29 x 10 EE-8	Remolded*
5	28.0-30.0	22.2	121.9	60.1	22.6	7.91 x 10 EE-7	Undisturbed
5	38.0-40.0	23.9	118.3	64.0	33.1	3.83 x 10 EE-7	Undisturbed
5	48.0-50.0	29.8	117.0	65.8	37.0	4.40 x 10 EE-7	Undisturbed
		AVG.= 27.5	AVG.=124.1 **				

*Sample remolded and compacted to 95% of standard Proctor (ASTM D698) Maximum Dry Density.

Note: All tests run @ greater than 98% saturation.

** AVERAGE OF UNDISTURBED SAMPLES ONLY. DOES NOT INCLUDE REMOLDED SAMPLES.

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SINCE NO SHEAR STRENGTH TEST RESULTS ARE AVAILABLE FOR THE COMPACTED CLAY LINER, THESE VALUES MUST BE ESTIMATED.

USE REF. 5 FOR ESTIMATE. REF. 5 CONTAINS SEVERAL HUNDRED TEST DATA ON CL AND CH SOILS WHICH ARE THE PREDOMINANT SOILS IDENTIFIED IN THE SOIL SAMPLING AND TESTING FOR LANDFILL IV (SEE REF. 1). REF. 5 ALSO CONTAINS SOIL DATA FROM EAST TENNESSEE. ADDITIONALLY, CL AND CH SOILS ARE THE PREDOMINANT SOIL TYPES REPORTED IN REF. 5.

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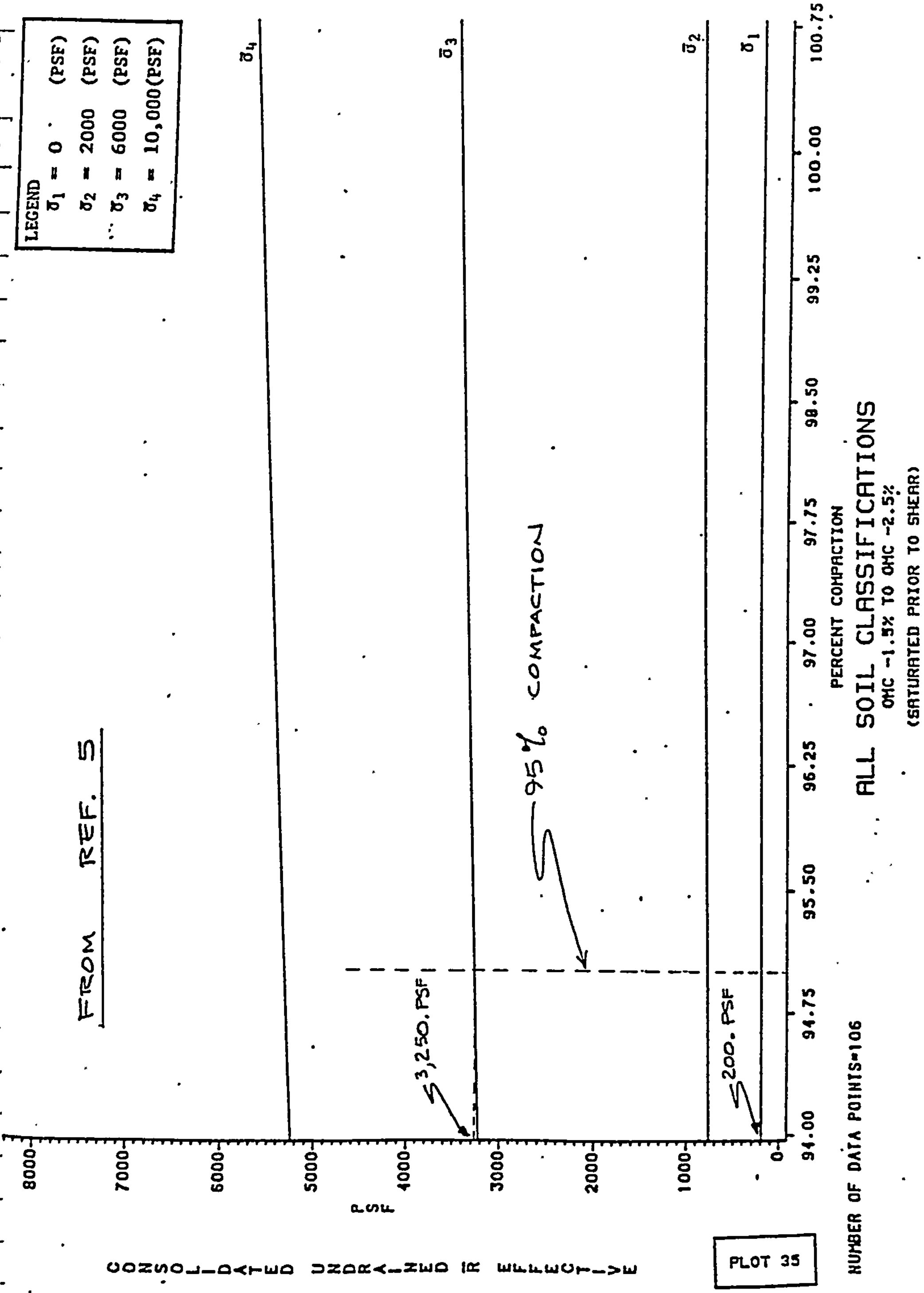

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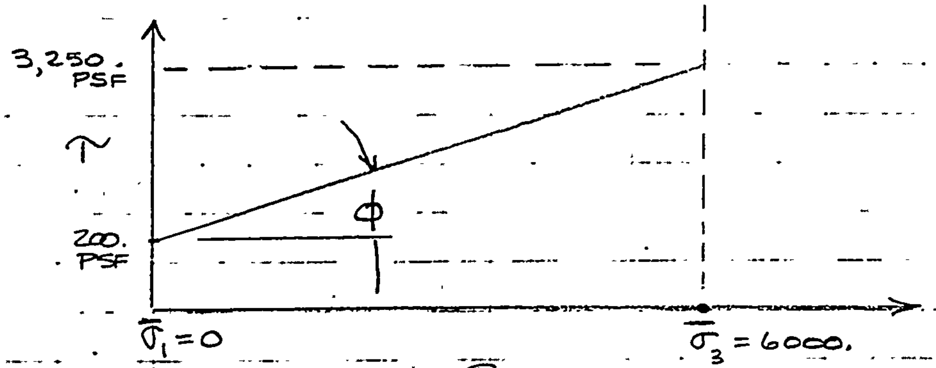
FROM PLOT 35,



(N.T.S.)

$$\phi = \tan^{-1}\left(\frac{3250 - 200}{6000}\right) = \tan^{-1}\frac{3050}{6000.} = \tan^{-1} 0.5083$$

$\phi = 26.9°$, $c = 200.$ PSF FOR $\bar{R}$

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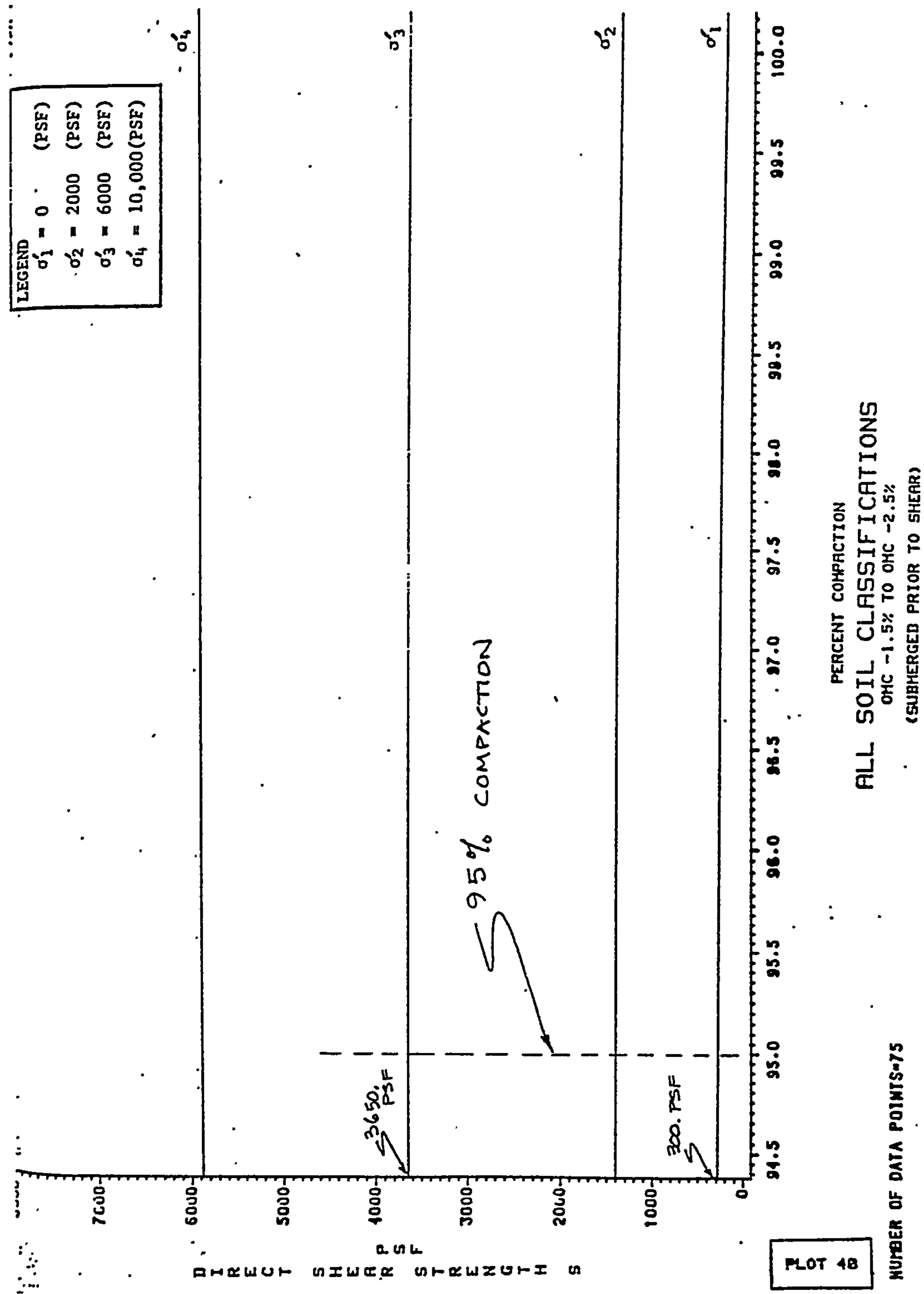

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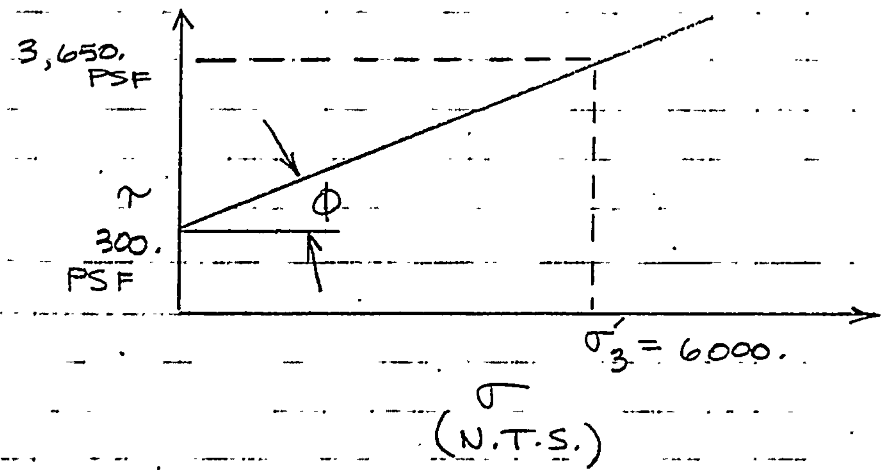
FROM PLOT 40,



$$\phi = \tan^{-1}\left(\frac{3650 - 300}{6000}\right) = \tan^{-1}\left(\frac{3350.}{6000.}\right) = \tan^{-1}(0.5583)$$

$\phi = 29.2°$, $C = 300.$ PSF FOR S

TAKE AVERAGE OF $\bar{R}$ AND S.

TEST	φ	C
$\bar{R}$	26.9°	200. PSF
S	29.2°	300. PSF
AVG. =	28.05°	250. PSF

PER PG. 4 OF REF. 2, USE 80% OF MAXIMUM UNDRAINED SHEAR STRENGTH (REF. 9 CLEARLY INDICATES 80% OF STRESS-STRAIN CURVE. SINCE REF. 1 HAS NO STRESS-STRAIN CURVES, ASSUME 80% APPLIES TO MOHR ENVELOPE).

$\phi = 0.80\,(28.05°) = 22.4°$

$C = 0.80\,(250\text{ PSF}) = 200.$ PSF

USE $\phi = 22.°$, $C = 200.$ PSF , $\gamma_M = 122.$ pcf

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IN-SITU NATURAL SOIL (MUST ESTIMATE "UNDRAINED" STRENGTH)

FROM TABLE B-2, REF. 1 (PG 7 OF THIS CALC.)

AVERAGE WET UNIT WEIGHT OF UNDISTURBED IN-SITU NATURAL SOIL $= \gamma_{MOIST} = 124.1$ PCF

AVERAGE NATURAL WATER CONTENT $= 27.5\%$

$$\gamma_M = \gamma_{DRY}(1 + w)$$

$$\gamma_{DRY} = \frac{\gamma_M}{(1+w)} = \frac{124.1}{1.275} = 97.3 \text{ PCF}$$

SINCE IN-SITU NATURAL SOIL MATERIAL IS THE SAME MATERIAL THAT WILL BE USED FOR COMPACTED LINER, ASSUME THAT THE SHEAR STRENGTHS VARY PROPORTIONALLY WITH DENSITY (γ DRY.)

$$\frac{\gamma_{DRY\ IN\text{-}SITU\ N.S.}}{\gamma_{DRY\ LINER}} = \frac{\phi_{IN\text{-}SITU\ N.S.}}{\phi_{LINER}} = \frac{C_{IN\text{-}SITU\ N.S.}}{C_{LINER}}$$

WHAT WOULD BE THE % COMPACTION IF THE IN-SITU NATURAL SOIL WERE COMPACTED TO A $\gamma_{DRY} = 97.3$ PCF?

$$\text{EQUIVALENT \% COMPACTION} = \frac{97.3}{100.3}$$

FROM TABLE B-3 PAGE 6 OF THIS CALCULATION.

EQUIVALENT % COMPACTION $\cong 97.\%$

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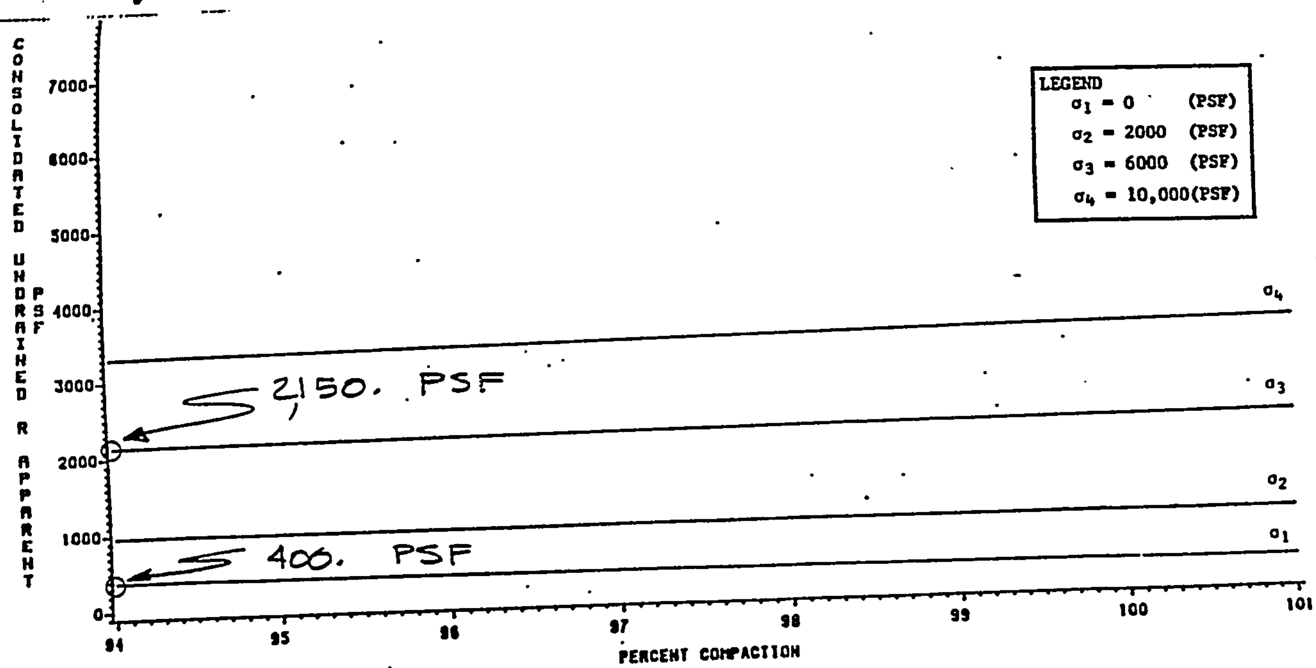
OBVIOUSLY, THERE ARE SOIL MATRIX STRUCTURAL DIFFERENCES BETWEEN NATURAL SOIL DEPOSITS AND COMPACTED SOIL EVEN FOR THE SAME IDENTICAL SOIL. ASSUME THIS DIFFERENCE IS NOT TOO GREAT, i.e.,

ASSUME EQUIVALENT 97% COMPACT. OF NAT. SOILS ≅ 94% OF COMPACTED SOIL

PLOT 30, FROM REF. 5



PLOT 30

ALL SOIL CLASSIFICATIONS

NUMBER OF DATA POINTS=129

OMC -1.5% TO OMC -2.5%
(SATURATED PRIOR TO SHEAR)

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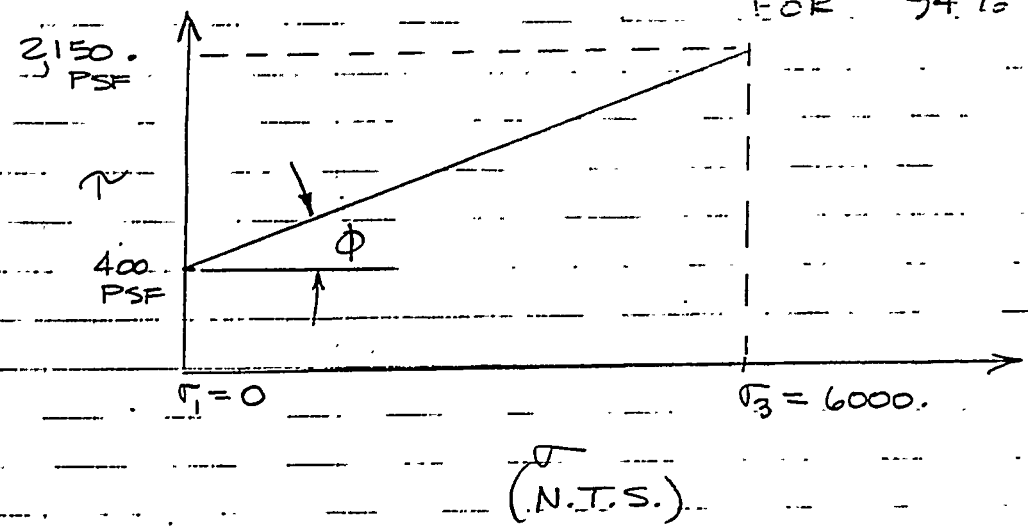
FROM PLOT 30 (R - APPARENT SHEAR STR FOR 94% COMPACTION)



$$\phi = \tan^{-1}\left(\frac{2150. - 400.}{6000.}\right) = \tan^{-1}(0.2916) = 16.3^\circ$$

$$C = 400. \text{ PSF}$$

APPLY 80% REDUCTION (PG. 4, REF. 2)

$$\phi = 0.80(16.3^\circ) = 13.04^\circ \cong 13.^\circ$$

$$C = 0.80(400.) = 320. \text{ PSF}$$

USE

$$\phi = 13.^\circ, \quad C = 320. \text{ PSF}, \quad \gamma_M = 124. \text{ PCF}$$

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LANDFILL WASTE

THE LANDFILL WASTE WILL CONSIST OF SOLIDS AND SOIL INTERSPERSED WITH THE SOLIDS AND SOIL AS AN INTERMEDIATE CELL COVER. THE WASTE (SOLIDS AND SOIL MIXTURE) WILL BE COMPACTED FOR VOLUME REDUCTION PURPOSES. THE VOLUME REDUCTION COMPACTION WILL BE SOMEWHAT LESS THAN COMPACTION TO AN ENGINEERED FILL SUCH AS THE COMPACTED CLAY LINER. (THE SOIL THAT WILL BE INTERSPERSED WITH THE WASTE WILL BE THE SAME SOIL TYPES USED FOR THE LINER.)

THEREFORE, ASSUME THE LANDFILL WASTE HAS ONLY 75% OF THE ENGINEERING PROPERTIES OF THE COMPACTED CLAY LINER.

$$\phi = 0.75(22^\circ) = 16.5^\circ, \text{ SAY } 16^\circ$$

$$c = 0.75(200.\ \text{PSF}) = 150.\ \text{PSF}$$

JUSTIFICATION :

(1) ASSUMES THAT SOLID OBJECTS IN LANDFILL DO NOT "REINFORCE" THE SOIL. CONSERVATIVE ASSUMPTION THAT ONLY THE INTERSPERSED SOIL SUPPLIES RESISTANCE TO SHEAR FAILURE. PG. 80 OF REF. 4 CONTAINS INFORMATION THAT SUGGESTS THE SHEARING STRENGTH OF A COMPOSITE FILL (i.e., WASTE, WASTE CONTAINERS AND DAILY SOIL COVER) CAN PROBABLY BE CONSERVATIVELY ESTIMATED TO BE EQUAL TO THE SHEAR STRENGTH OF THE BACKFILL SOIL AT A RELATIVE LOW LEVEL OF COMPACTION. *

* Minor editorial revisions on 5-8-95 for clarification of text to eliminate any copyright concerns.

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FIGURE 6 ON PAGE 83 OF REFERENCE 4 SHOWS A GRAPHICAL PLOT OF RECOMMENDED LANDFILL WASTE SHEAR STRENGTH PARAMETERS DERIVED FROM -

(1) LABORATORY TESTING

(2) BACK CALCULATION FROM FIELD TESTS AND OPERATIONAL RECORDS AND

(3) IN - SITU TESTING.

THIS GRAPHICAL PLOT SHOWS VARIOUS COMBINATIONS OF COHESION AND FRICTION ANGLE. WHEN THE ASSUMED VALUES OF LANDFILL IV ($\phi = 16.°$, C = 150. PSF) ARE COMPARED TO THE SHADED SUMMARY PLOT OF RECOMMENDED PARAMETERS ON FIGURE 6, THE PARAMETERS FOR LANDFILL IV ARE LOWER THAN THE RECOMMENDED PARAMETERS. THEREFORE, THE ASSUMED LANDFILL IV PARAMETERS ARE QUITE CONSERVATIVE. *

$\therefore$ USE $\phi = 16.°$, C = 150. PSF

* Minor editorial revisions on 5-8-95 for clarification of text to eliminate any copyright concerns.

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DETERMINE APPROPRIATE γ FOR WASTE MATERIAL *

PG. 81 OF REF. 4 REPORTS TYPICAL UNIT WEIGHTS FOR REFUSE GENERALLY RANGE FROM ABOUT 6.3 kN/m^3 TO 11.8 kN/m^3 (APPROXIMATELY 38. PCF TO 72. PCF).

TABLE 3 OF REF. 13 CONTAINS AVERAGE UNIT WEIGHTS OF REFUSE FILL FROM SEVERAL SOURCES, SUCH AS:

(1) THE DEPT. OF NAVY, NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC) SUGGESTS A UNIT WEIGHT OF 40. PCF FOR GOOD COMPACTION OF NON-SHREDDED SANITARY LANDFILL.

(2) DATA PROPOSED BY SOWERS INDICATES UNIT WEIGHTS OF 30-60 PCF FOR SANITARY REFUSE DEPENDING ON THE COMPACTION EFFORT.

(3) NSWMA PRESENTS DATA FOR MUNICIPAL REFUSE IN A LANDFILL OF UNIT WEIGHTS RANGING FROM 44 - 49 PCF.

(4) NSWMA ALSO PROPOSES UNIT WEIGHTS FOR MUNICIPAL REFUSE OF 63 - 70 PCF AFTER DEGRADATION AND SETTLEMENT HAS OCCURRED.

* Minor editorial revisions on 5-8-95 for clarification of text to eliminate any copyright concerns.

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(5) LANDVA AND CLARK HAVE COLLECTED DATA FROM TEST PIT MEASUREMENTS OF REFUSE AT MUNICIPAL LANDFILLS IN CANADA AND REPORT UNIT WEIGHTS RANGING FROM 57 TO 84. PCF. *

(6) EMCON ASSOCIATES HAVE STUDIED FILLS FROM 6:1 REFUSE TO DAILY SOIL COVER BY USE OF TONNAGE RECORDS AND AREAL SURVEY MAPS AND REPORT A UNIT WEIGHT OF 46. PCF.

BASED UPON THE ABOVE DATA (ON PAGE 18 AND THIS PAGE), A MOIST UNIT WEIGHT OF 55. PCF APPEARS TO BE A MID-RANGE VALUE THAT IS APPROPRIATE FOR AVERAGE CONDITIONS FOR WASTE AND REFUSE FILLS UNDER SEVERAL DIFFERENT PLACEMENT CONDITIONS.

∴ THEREFORE USE $\gamma_M = 55.$ PCF

* Minor editorial revisions on 5-8-95 for clarification of text to eliminate any copyright concerns.

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ESTIMATE INTERFACE SHEAR STRENGTH BETWEEN RECOMPACTED CLAY LINER/CAP AND FLEXIBLE MEMBRANE LINER.

ASSUME COMPACTED FILL WILL BE PLACED NEAR NATURAL WATER CONTENT, WITH SOME SLIGHT DRYING DURING EXCAVATION, HANDLING & COMPACTION.

AVG. NATURAL WATER CONTENT ≅ 27.5% (SEE PG. 7)

AVG. OPTIMUM MOISTURE CONTENT ≅ 22.6% (SEE PG. 6)

DIFFERENCE = 27.5 − 22.6 = 4.9% WET OF OPTIMUM.

ASSUME LOSS OF MOISTURE DURING EXCAVATION, HANDLING AND COMPACTION OF ≅ 2.9%

ESTIMATE "ZONE" USING FIGURE 7(a) OF REF. 4. *

(FIG. 7b APPLIES TO PRESOAKING AND NOT APPLICABLE)

ASSUME:

1- "SIMILARITY" BETWEEN STANDARD PROCTOR CURVE (ASTM D698) IN FIG. 7(a) AND STANDARD PROCTORS FOR LANDFILL IV.

2- PLACEMENT AT 95% STANDARD PROCTOR AND APPROX. 2% WET OF OPTIMUM MOISTURE CONTENT.

* Minor editorial revisions on 5-8-95 for clarification of text to eliminate any copyright concerns.

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FIG. 7(a) OF REF. 4 SHOWS A MAXIMUM DRY DENSITY ($\gamma_{dry\ MAX}$) OF APPROXIMATELY 115.6 PCF FOR STANDARD PROCTOR, ASTM D 698. *

95% OF THIS VALUE IS:

$$0.95\,(115.6) = 109.8 \cong 110.\ PCF$$

IF A DRY DENSITY OF 110. PCF AND 2% WET OF OPTIMUM IS PLOTTED, FIG. 7(a) SUGGESTS THAT THE INTERFACE SHEAR STRENGTH FOR LANDFILL IV WOULD BE A ZONE III SITUATION WHERE A ZONE III ϕ VARIES FROM 17 TO 24 DEGREES.

$\therefore$ ASSUME 19° FOR INTERFACE SHEAR STRENGTH

* Minor editorial revisions on 5-8-95 for clarification of text to eliminate any copyright concerns.

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COMPILATION/SUMMARY OF ENGINEERING PROPERTIES

MATERIAL	ϕ	C	γ_M
IN-SITU NATURAL SOIL ✓	13° ✓	320. ✓ PSF	124. ✓ PCF
COMPACTED LINER/CAP	22° ✓	200. ✓ PSF	122. ✓ PCF
WASTE FILL	16° ✓	150. ✓ PSF	✓ 55. PCF
INTERFACE CLAY LINER & FLEXIBLE MEMBRANE LINER	19° ✓	0. ✓	——

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SELECTION OF CROSS SECTIONS FOR ANALYSES

THE CROSS SECTIONS SELECTED FOR STABILITY ANALYSES SHOULD:

1 - BE REPRESENTATIVE OF THE FINAL CLOSURE SLOPES.

2 - BE REPRESENTATIVE OF THE STEEPER SLOPES FOR SAKE OF CONSERVATISM.

3 - EVALUATE THE "FREE STANDING" WASTE FILL TO ASSESS ITS SELF SUPPORTING CAPABILITY.

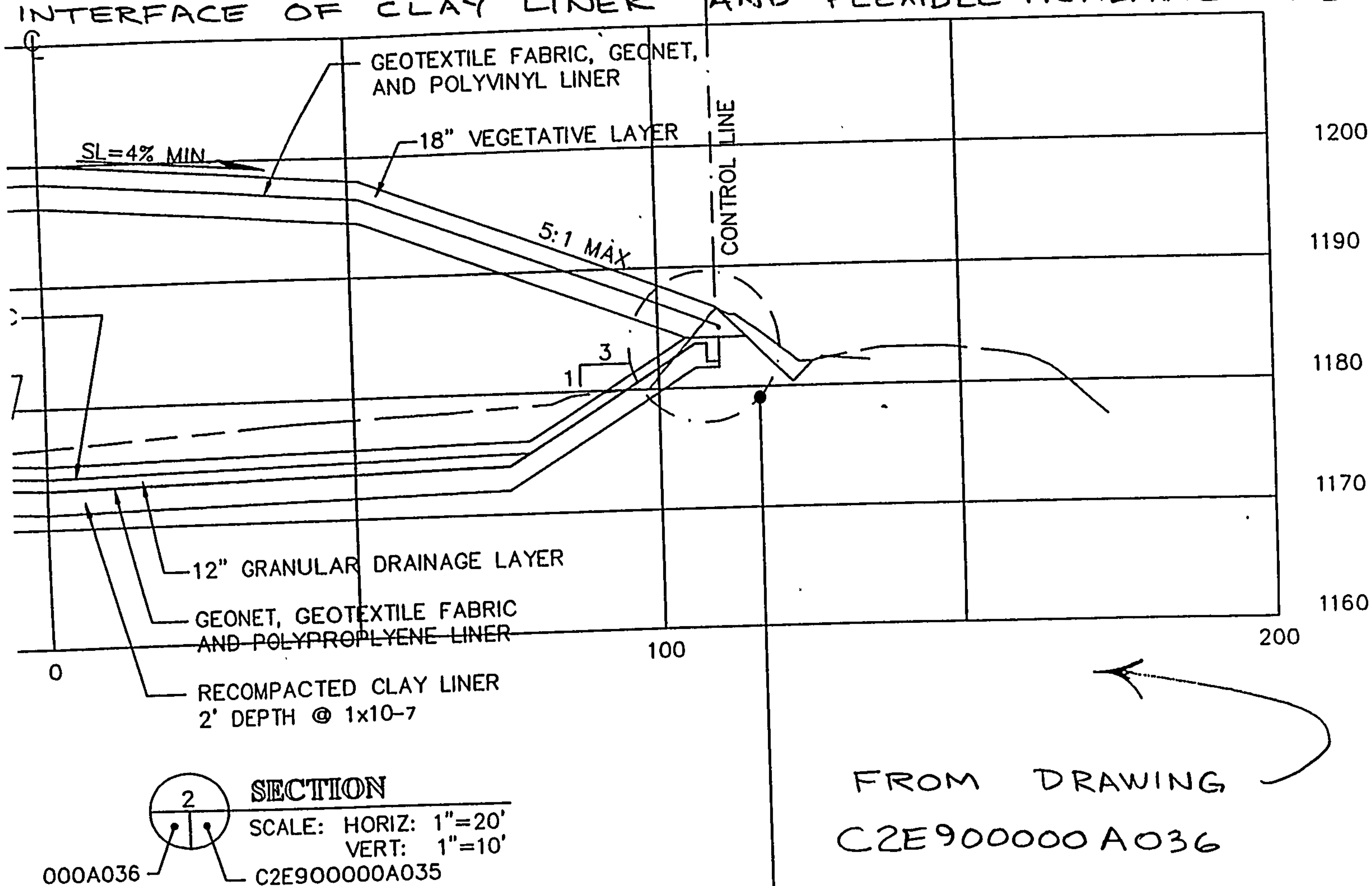
4 - EVALUATE THE IN-SITU NATURAL SOIL THAT SERVES AS A FOUNDATION AND PROVIDES LATERAL SUPPORT TO RETAIN THE WASTE FILL.

5 - EVALUATE SLIDING AT BASE OF LANDFILL ALONG INTERFACE OF CLAY LINER AND FLEXIBLE MEMBRANE LINER.

SECTION 1

1- USE THIS SECTION TO EVALUATE "FREE STANDING" SLOPE. (THE STEEPER 1 ON 3 FREE STANDING SLOPE AT EAST END OF LANDFILL IS ONLY 3± FT. HIGH. THEREFORE, THIS SLOPE IS MORE REPRESENTATIVE OF DESIGN).

2- USE THIS SECTION TO EVALUATE SLIDING AT BASE ALONG INTERFACE OF CLAY LINER AND FLEXIBLE MEMBRANE LINER.



FROM DRAWING C2E900000A036

GENERAL DESIGN AND COMPUTATION SHEET

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DATE: 3-28-95
SHEET: 25 of 94
ESO NO.: ES-0.7-2 CIVIL ENGINEERING
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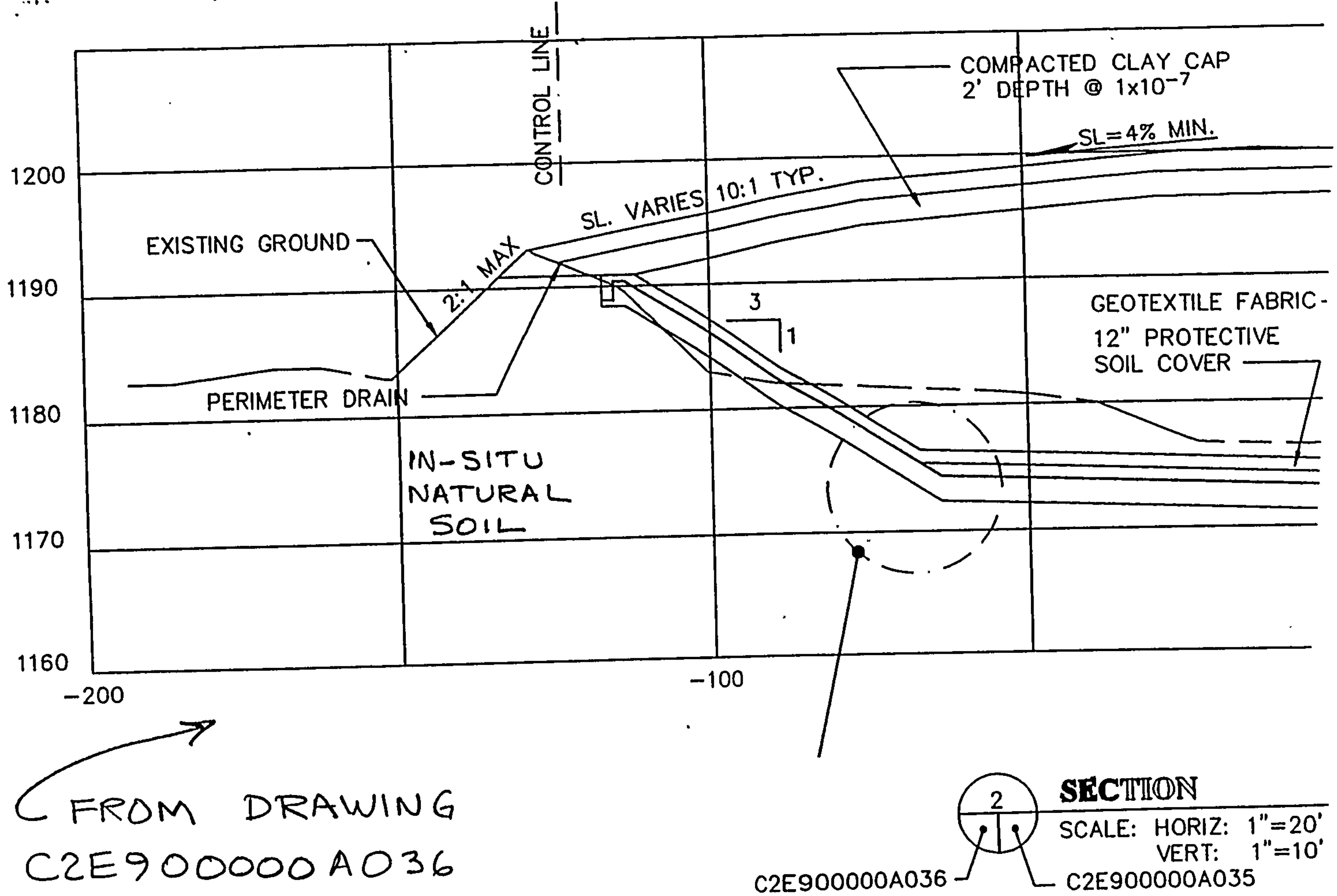
SECTION 2

USE THIS SECTION TO EVALUATE THE IN-SITU NATURAL SOIL TO PROVIDE FOUNDATION AND LATERAL SUPPORT TO RETAIN WASTE FILL AT STEEPEST SECTION (2:1 MAX).



FROM DRAWING C2E900000A036

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QUALITY CHECK OF STABL 5M

PERFORM A QUALITY CHECK OF STABL5M BY:

1- CREATE INPUT FILE (NAMED "ATITEST.IN") THAT EXACTLY MATCHES EXAMPLE PROBLEM ON PAGE 99 OF USER GUIDE FOR PC STABL 5M, BY EFTYCHIOS ACHILLEOUS OF PURDUE UNIVERSITY, DEC. 15, 1988.

2- PERFORM STABILITY ANALYSIS ON ATI COMPUTER.

3- COMPARE OUTPUT FILE (NAMED "ATITEST.OUT") WITH OUTPUT FROM EXAMPLE PROBLEM ON PGS. 100 - 107 OF USER GUIDE.

RESULTS

ATITEST.IN AND ATITEST.OUT MATCHES BOTH FILES IN USERS GUIDE.

ATITEST.IN AND ATITEST.OUT ARE IN THE APPENDIX OF THIS CALCULATION

GENERAL DESIGN AND COMPUTATION SHEET

JOB SEISMIC ANALYSIS OF LANDFILL IV		DATE 3-29-95	SHEET 27 of 94
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SECTION 2 ANALYSIS

1- PERFORM STATIC STABILITY ANALYSIS, i.e., ACCELERATION = 0.0 g

2- DETERMINE YIELD ACCELERATION, k_y

(a) EVALUATE 100 POTENTIAL FAILURE SURFACES FOR EACH EARTHQUAKE ACCELERATION, i.e., 0.40 g, 0.45 g, 0.50 g, etc.

(b) PLOT RESULTS TO DETERMINE ACCELERATION THAT PRODUCES A FACTOR OF SAFETY OF 1.0 (YIELD ACCELERATION, k_y)

3 - DETERMINE a_{MAX} = HORIZONTAL ACCELERATION - (90% PROBABILITY OF NOT BEING EXCEEDED IN 250 YEARS).

4 - DETERMINE MAX. CREST ACCELERATION, $u_{MAX.}$

5 - DETERMINE THEORETICAL DISPLACEMENT, u.

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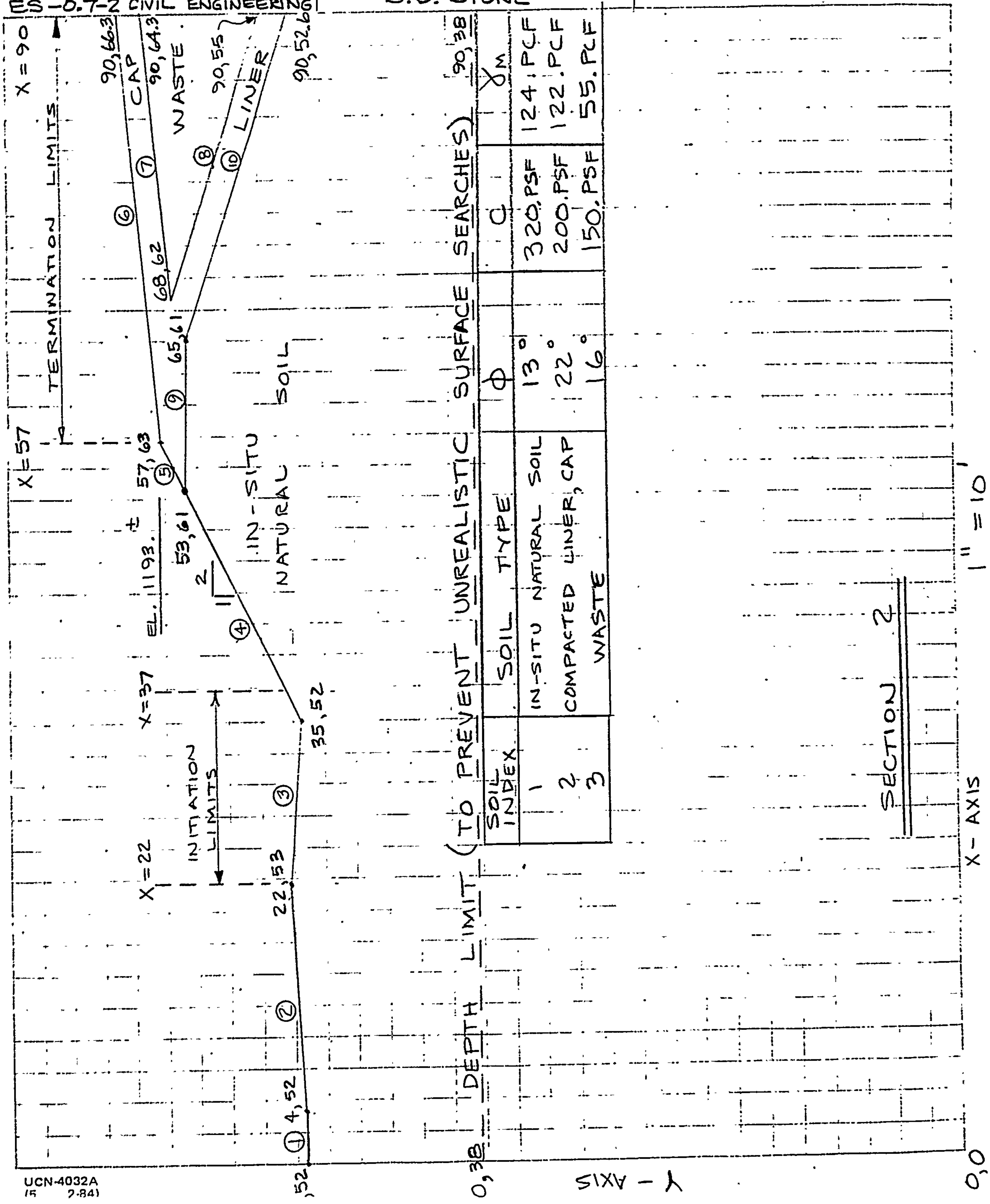

SOIL INDEX	SOIL TYPE	ϕ	C	γ_M
1	IN-SITU NATURAL SOIL	13°	320. PSF	124. PCF
2	COMPACTED LINER, CAP	22°	200. PSF	122. PCF
3	WASTE	16°	150. PSF	55. PCF

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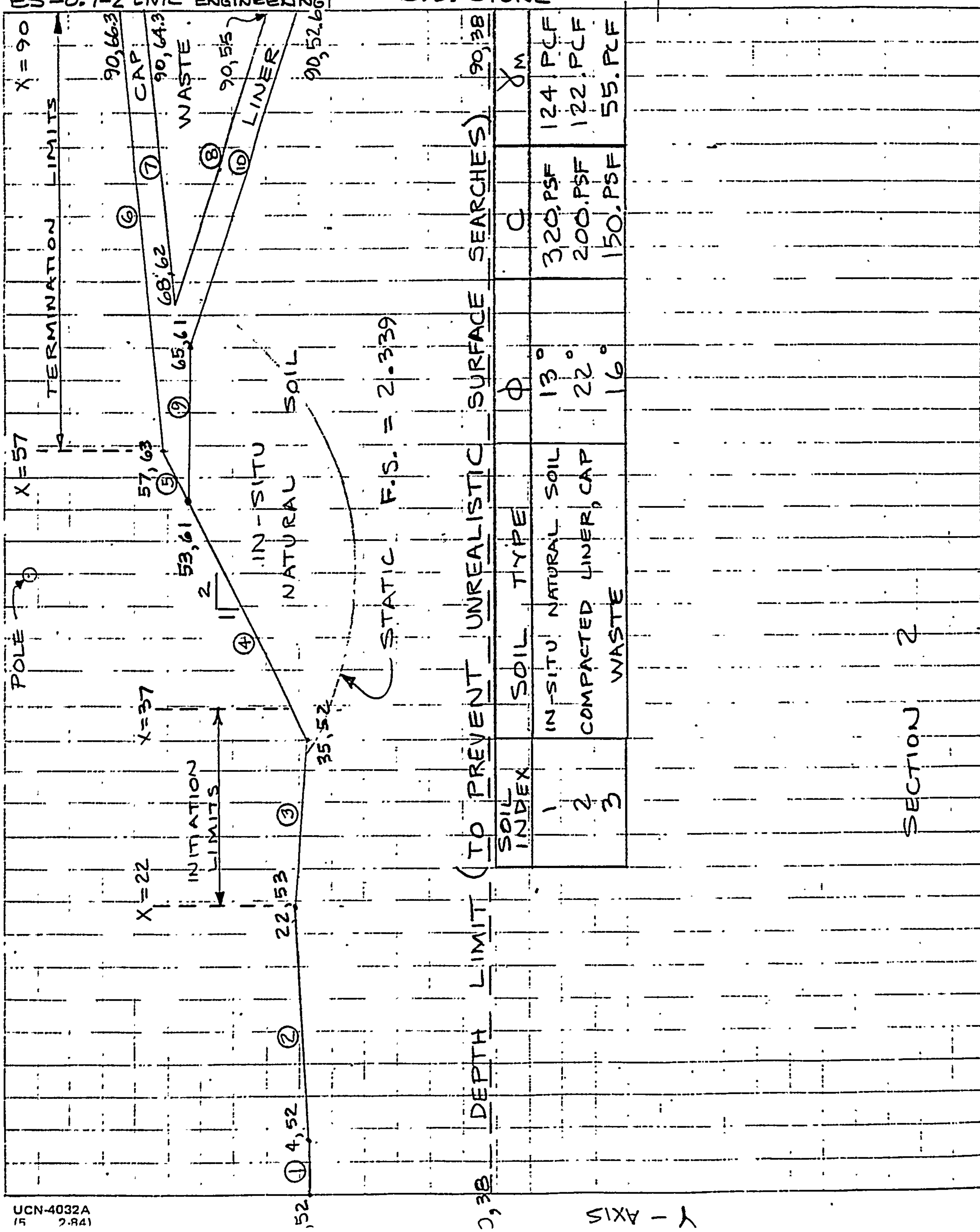
JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	3-29-95	29 of 94

ESO NO.	COMPUTED	CHECKED BY
ES-0.7-2 CIVIL ENGINEERING	S.D. STONE	



SOIL INDEX	SOIL TYPE	ϕ	C	γ_M
1	IN-SITU NATURAL SOIL	13°	320. PSF	124 PCF
2	COMPACTED LINER, CAP	22°	200. PSF	122. PCF
3	WASTE	16°	150. PSF	55. PCF

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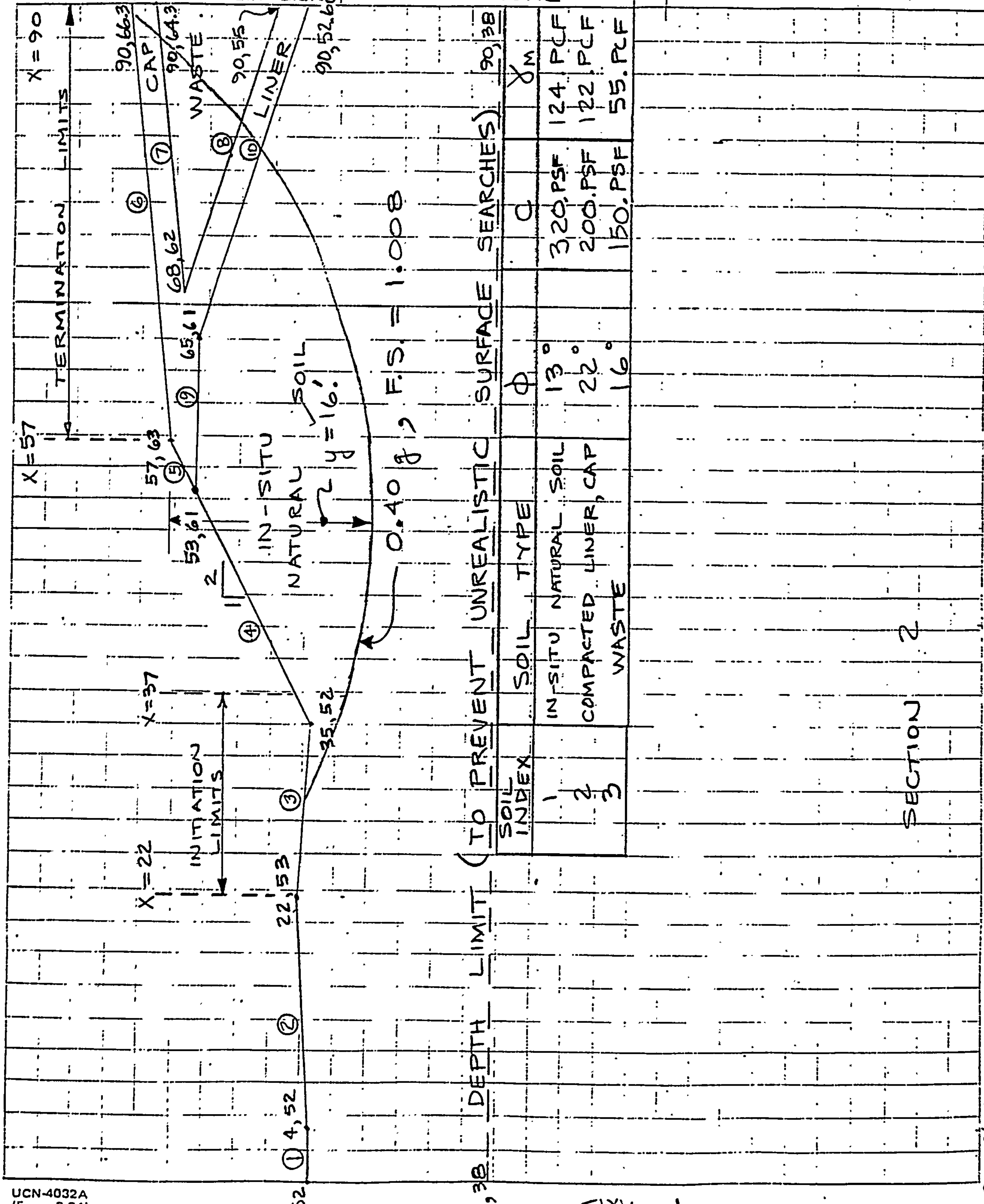
JOB: SEISMIC ANALYSIS OF LANDFILL IV		DATE: 3-29-95	SHEET: 30 of 94
ESO NO.: ES-0.7-2 CIVIL ENGINEERING	COMPUTED: S.D. STONE	CHECKED BY: S. B. Ahmed 4-12-95	



SOIL INDEX	SOIL TYPE	φ	C	γ_M
1	IN-SITU NATURAL SOIL	13°	320. PSF	124. PCF
2	COMPACTED LINER, CAP	22°	200. PSF	122. PCF
3	WASTE	16°	150. PSF	55. PCF

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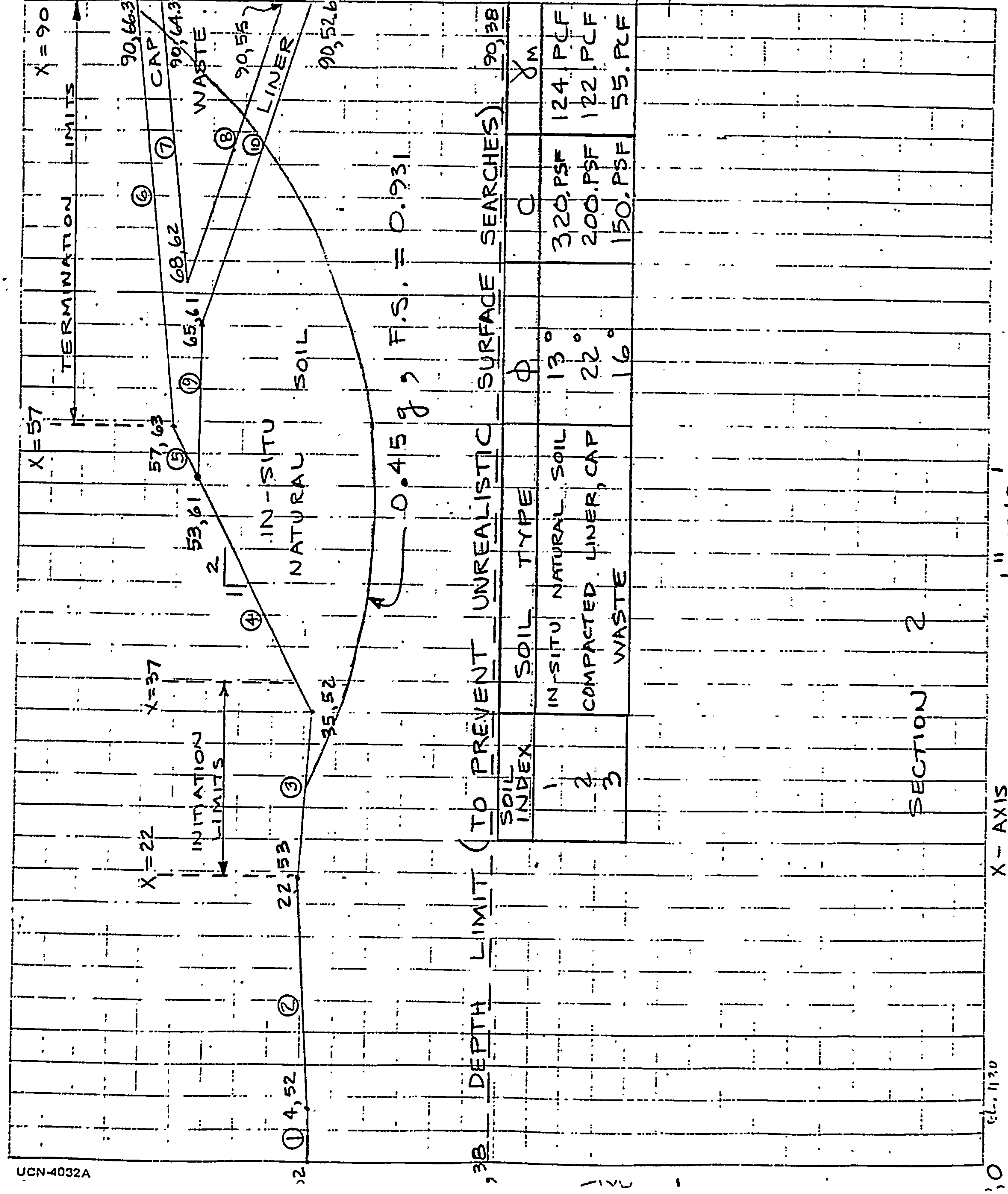
JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	3-29-95	31 of 94

ESO NO.	COMPUTED	CHECKED BY
ES-0.7-2 CIVIL ENGINEERING	S.D. STONE	



SOIL INDEX	SOIL TYPE	φ	C	γ_M
1	IN-SITU NATURAL SOIL	13°	320. PSF	124. PCF
2	COMPACTED LINER, CAP	22°	200. PSF	122. PCF
3	WASTE	16°	150. PSF	55. PCF

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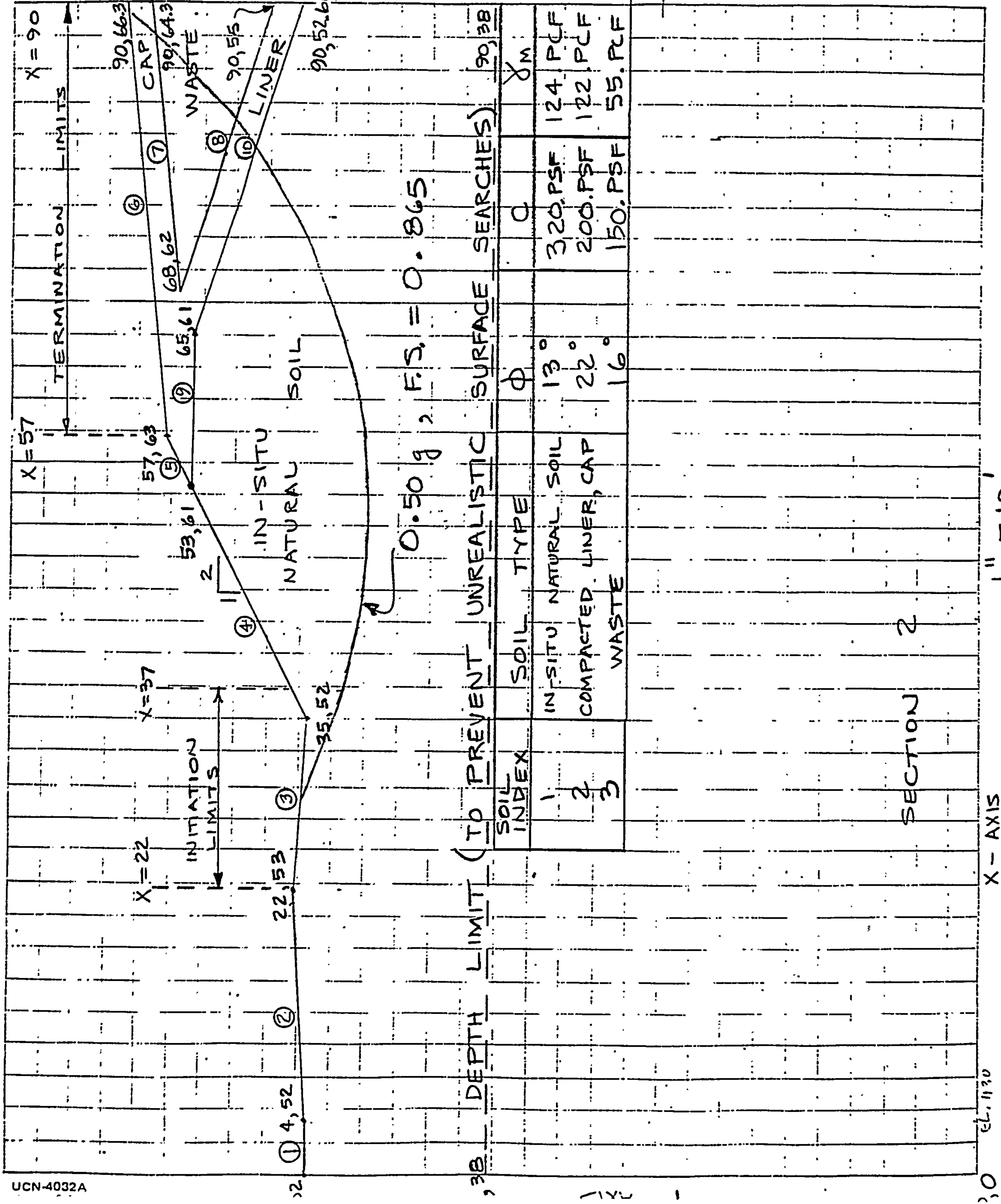
JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	3-29-95	32 of 94

ESO NO.	COMPUTED	CHECKED BY
ES-0.7-2 CIVIL ENGINEERING	S.D. STONE	



SOIL INDEX	SOIL TYPE	γ_M	C	ϕ
1	IN-SITU NATURAL SOIL	124. PCF	320. PSF	13°
2	COMPACTED LINER, CAP	122. PCF	200. PSF	22°
3	WASTE	55. PCF	150. PSF	16°

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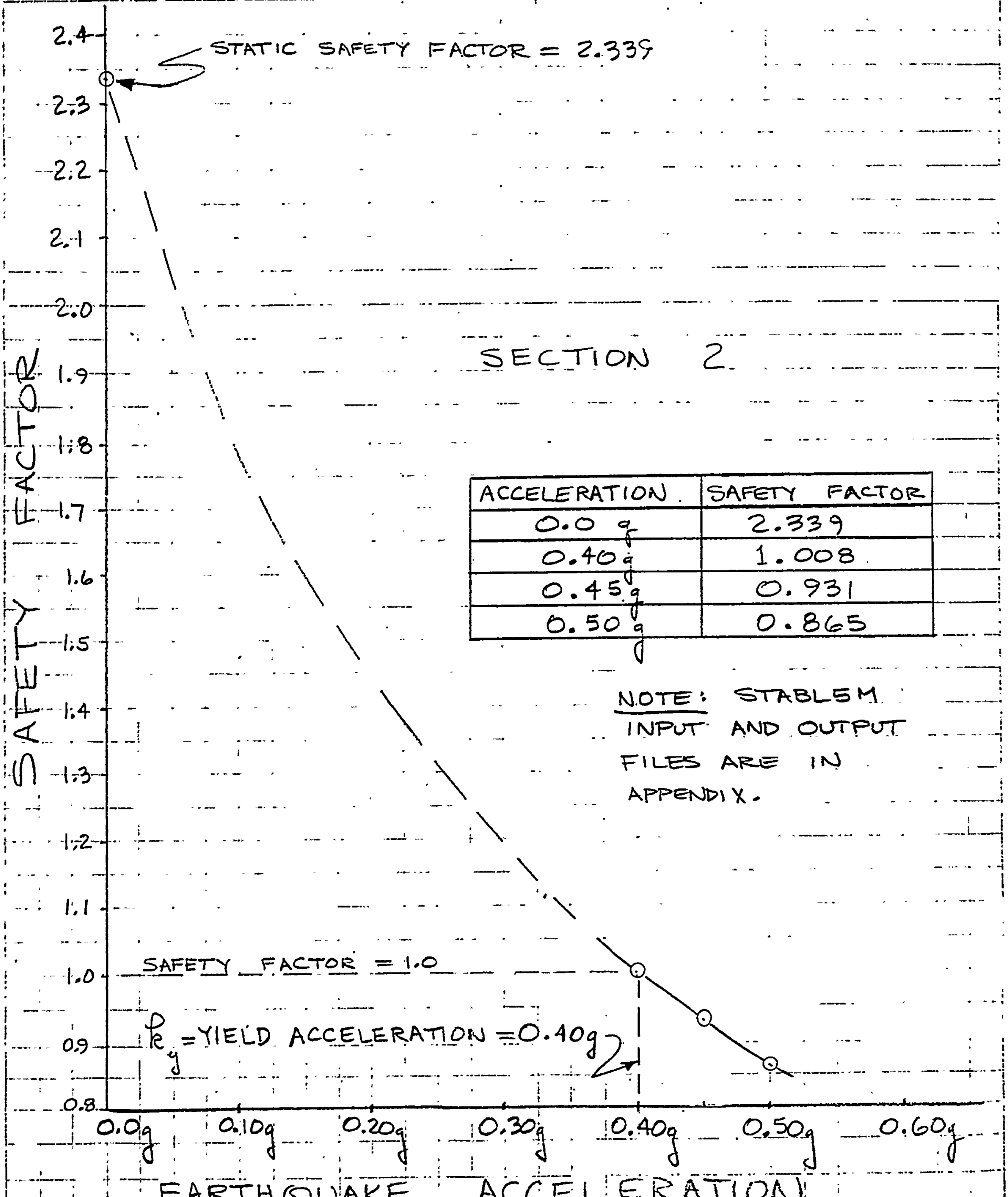

ACCELERATION	SAFETY FACTOR
0.0 g	2.339
0.40 g	1.008
0.45 g	0.931
0.50 g	0.865

NOTE: STABL5M INPUT AND OUTPUT FILES ARE IN APPENDIX.

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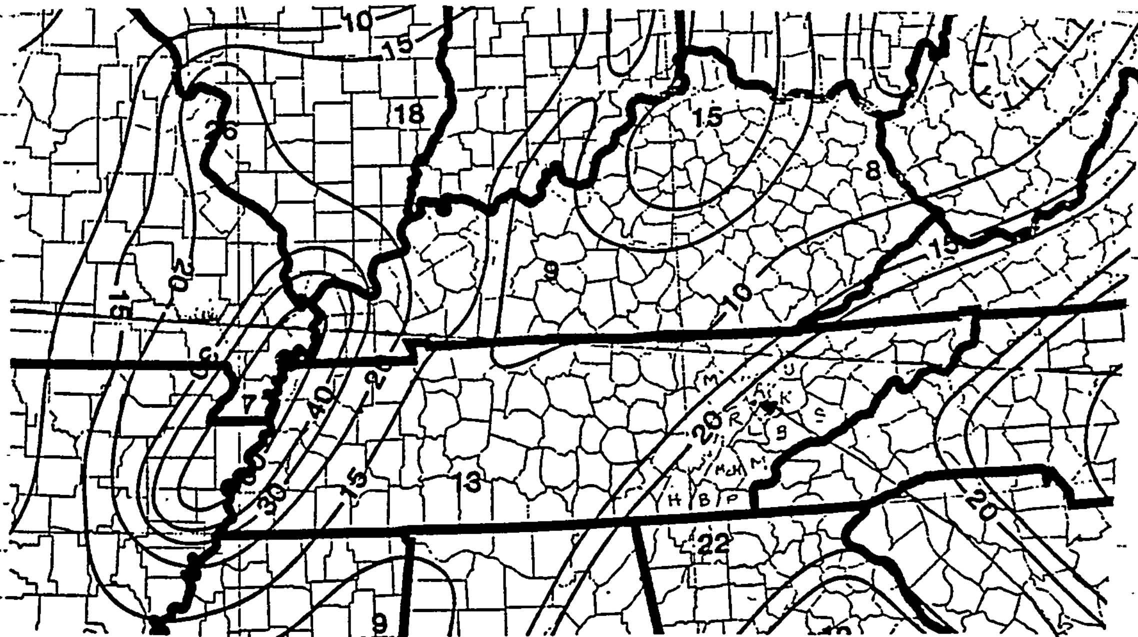
FROM REF. 7.



LANDFILL IV SITE

$a_{MAX} = 0.20g$ = HORIZONTAL ACCELERATION (90% PROBABILITY OF NOT BEING EXCEEDED IN 250 YEARS)

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ESTIMATE TOP OF ROCK ELEVATION

ROCK ELEVATIONS from MONITORING WELLS at LANDFILL IV

	Gr. Elev.	Top Cas. El	Top Wea. Rk *	Top Fresh Rk. *
GW-141	1183.5	1186.1	NA	1129.1
GW-217	1174.3	1176.9	1121.9	1101.9
GW-305	1181.1	1183.6	1130.6	1099.6
GW-521	1179.5	1182.7	NA	1128.7
GW-522	1172.0	1175.3	1090.3	1045.3

BORING	TOP OF GROUND ELEV.	SOURCE	SOIL DEPTH	APPROX. TOP OF ROCK ELEV.
B-1	1155.49	DRWG. A585	46'	1110. ±
B-2B	1199.95	" "	50' +	1150. ±
B-3	1178.36	" "	50' +	1128. ±
B-4	1193.96	" "	50' +	1144. ±
B-5	1181.83	" "	50' +	1132. ±
GW-217		ABOVE TABLE		1121. ±
GW-305		"		1130. ±
GW-522		"		1090. ±

ROCK SURFACE IS IRREGULAR WITH NO PARTICULAR TREND OR UNIFORMITY. THEREFORE, USE AVERAGE OF ABOVE APPROX. TOP OF ROCK ELEVATIONS OF 1125. ±

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DETERMINE MAX. CREST ACCELERATION ($\ddot{u}_{max}$)

USE MAKDISI / SEED PROCEDURE (REF. 10.)

ASSUME HEIGHT OF EMBANKMENT IS FROM APPROX. TOP OF ROCK TO CREST ELEVATION OF LANDFILL (NOT FROM FREE STANDING SLOPE HEIGHT).

$\therefore h = 1193. - 1125. = 68.$ ft. (NOT 11' ±)

$\rho = \dfrac{\gamma_m}{32.2 \text{ ft./sec}^2} = \dfrac{124.}{32.2}$ (FOR NATURAL SOIL)

$\rho = 3.85$

G = SHEAR MODULUS

NOTE REF. 2 STATES $G_{MAX} = 65\ N$ (tsf).

HOWEVER, SEED, IDRISS, AND ARANGO (REF. 11) RECOMMENDED THIS FOR SANDS AND SILTY SANDS, NOT FOR CLAYS SUCH AS THOSE ENCOUNTERED AT THE LANDFILL IV SITE. THEREFORE, DO NOT USE $G_{MAX} = 65\ N$ WHERE N = STANDARD PENETRATION TEST (SPT) BLOW COUNT.

SINCE THE SITE INVESTIGATION (REF. 1) DID NOT PRODUCE G OR SHEAR WAVE VELOCITY (Vs) DATA, THESE VALUES MUST BE ESTIMATED.

THE MOST EXTENSIVE TESTING PERFORMED IN EAST TENNESSEE RELATED TO G AND Vs (KNOWN TO CALCULATION PREPARER) HAS BEEN AT THE WATTS BAR NUCLEAR PLANT.

REF. 12 STATES A RANGE OF GMAX OF 3,000. TO 6,000. KSF AND A DESIGN VALUE OF 4,500. KSF FOR IN-SITU COHESIVE SOILS. THIS SHOULD BE APPROPRIATE FOR

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THE CL AND CH CLAYS AT LANDFILL IV

$$\therefore \checkmark V_{MAX} = \sqrt{\frac{G_{MAX}}{\rho}}$$

$$\checkmark V_{MAX} = \sqrt{\frac{\checkmark 4,500,000.}{\checkmark 3.85}}$$

$$\checkmark V_{MAX} = \checkmark 1,081. \text{ FT/SEC}$$

1ST. ITERATION:

ASSUME $\checkmark V_S = 800.$ FT/SEC

$$\frac{G}{G_{MAX}} = \left(\frac{V_S}{V_{SMAX}}\right)^2 = \left(\frac{\checkmark 800.}{\checkmark 1081.}\right)^2 = \checkmark 0.548$$

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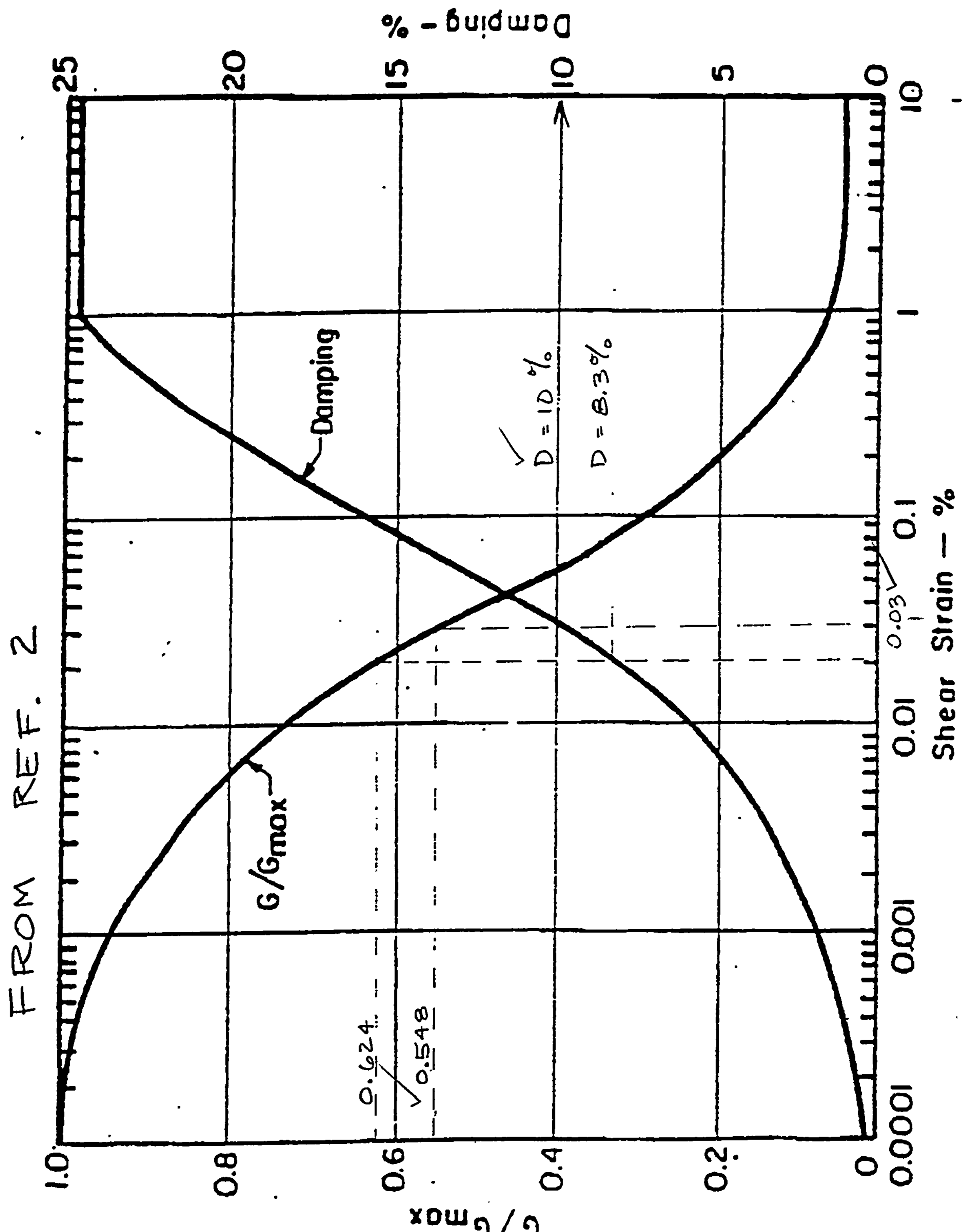

FIGURE 1: SHEAR MODULUS AND DAMPING CHARACTERISTICS USED IN RESPONSE CALCULATIONS

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ϵ = SHEAR STRAIN = 0.03 %

λ = DAMPING = 10. %

DETERMINE FIRST NATURAL FREQUENCIES AND PERIODS.

$$\omega_1 = 2.4 \frac{V_s}{h} = 2.4 \left(\frac{800.}{68.}\right) = 28.24 \text{ rad/sec}$$

$$T_1 = 2\pi / \omega_1 = \frac{2\pi}{28.24} = 0.222 \text{ sec.}$$

$$\omega_2 = 5.52 \frac{V_s}{h} = 5.52 \left(\frac{800.}{68.}\right) = 64.94 \text{ rad/sec}$$

$$T_2 = \frac{2\pi}{\omega_2} = \frac{2\pi}{64.94} = 0.097 \text{ sec.}$$

$$\omega_3 = 8.65 \frac{V_s}{h} = 8.65 \left(\frac{800.}{68.}\right) = 101.76 \text{ rad/sec}$$

$$T_3 = \frac{2\pi}{\omega_3} = \frac{2\pi}{101.76} = 0.062 \text{ sec.}$$

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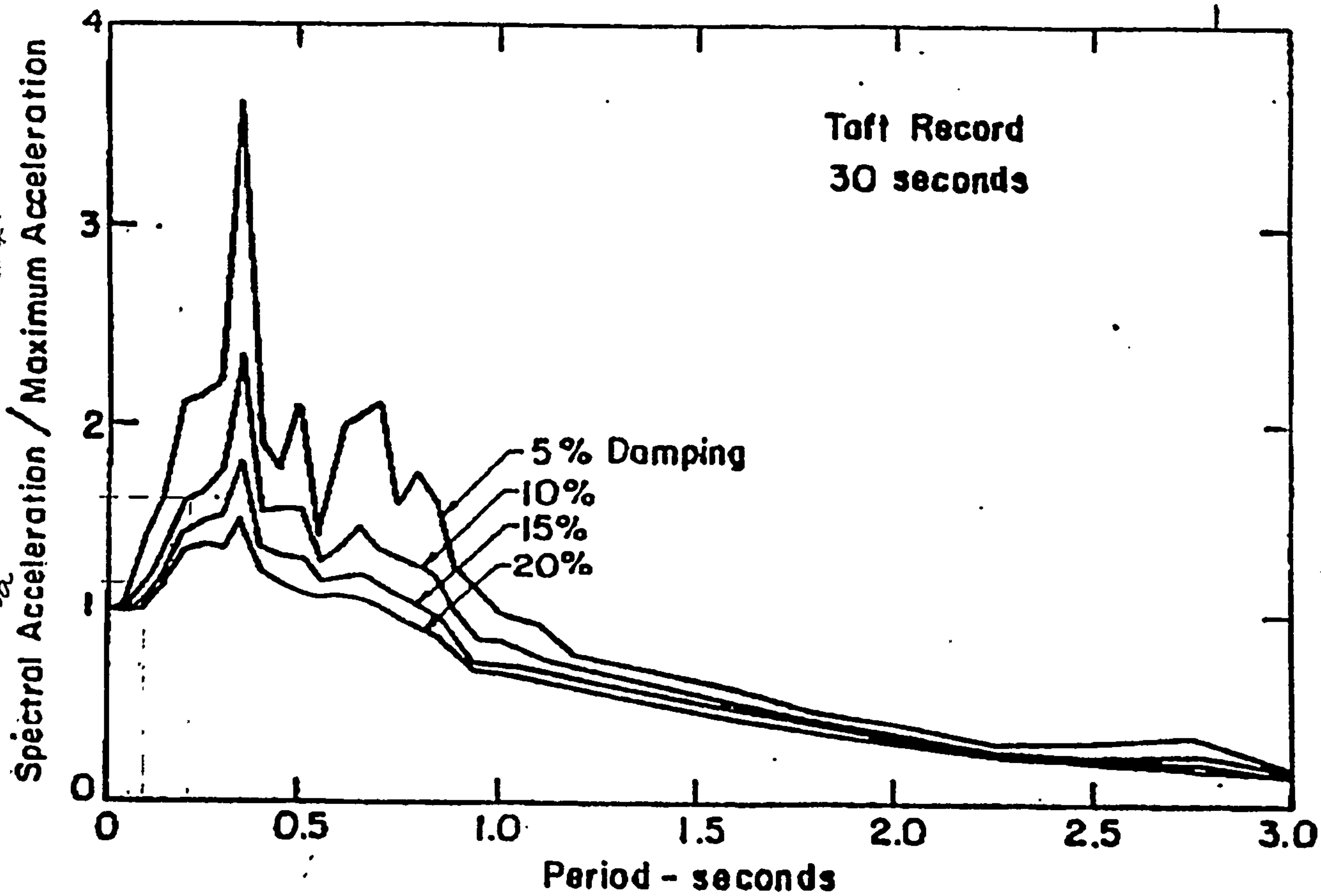
FROM REF. 2



NORMALIZED ACCELERATION RESPONSE SPECTRA - TAFT RECORD (NORTH - SOUTH COMPONENT)

SPECTRAL ACCELERATION

$\frac{S_{a_1}}{a_{MAX}} = 1.60$ ✓ $\quad S_{a_1} = 1.60\,(0.20) = 0.32\,g$ ✓

$\frac{S_{a_2}}{a_{MAX}} = 1.15$ ✓ $\quad S_{a_2} = 0.23\,g$ ✓

$\frac{S_{a_3}}{a_{MAX}} = 1.05$ ✓ $\quad S_{a_3} = 0.21\,g$ ✓

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MAX. CREST ACCELERATION FOR FIRST THREE MODES OF VIBRATION

$$\ddot{u}_{1\,MAX} = 1.6\,S_{a_1} = 1.6\,(0.32) = 0.512\,g$$

$$\ddot{u}_{2\,MAX} = 1.06\,S_{a_2} = 1.06\,(0.23) = 0.244\,g$$

$$\ddot{u}_{3\,MAX} = 0.86\,S_{a_3} = 0.86\,(0.21) = 0.181\,g$$

SQUARE ROOT OF SUM OF SQUARES OF $\ddot{u}$ MAX

$$\ddot{u}_{MAX} = \left[(\ddot{u}_{1MAX})^2 + (\ddot{u}_{2MAX})^2 + (\ddot{u}_{3MAX})^2\right]^{1/2}$$

$$= \left[0.512^2 + 0.244^2 + 0.181^2\right]^{1/2}$$

$$= (0.262 + 0.060 + 0.033)^{1/2}$$

$$\ddot{u}_{MAX} = \underline{0.60\,g}$$

$$(\gamma_{AVG})_{eq} = 0.65\,(0.3)\,\frac{h}{V_s^2}\,S_{a_1}$$ = AVG. EQUIVALENT SHEAR STRAIN

$$= \frac{0.65\,(0.3)(68.)(0.32)\,32.2}{(800.)^2} = 0.00021$$

$$(\gamma_{AVG})_{eq} = 0.021\,\%$$

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DO SECOND ITERATION

FOR $\epsilon = 0.021\ \%$

$$G/G_{MAX} = 0.624 = \left(\frac{V_s}{V_{MAX}}\right)^2$$

$$D = 8.3\%$$

$$\frac{V_s}{V_{MAX}} = \sqrt{\frac{G}{G_{MAX}}} = \sqrt{0.624} = 0.79$$

$$V_s = 0.79\ V_{MAX} = 0.79\ (1081) = 854.\ \text{FT/SEC}$$

$$\omega_1 = 2.4\left(\frac{854}{68}\right) = 30.14\ \text{rad/sec}$$

$$T_1 = \frac{2\pi}{\omega_1} = 0.208\ \text{sec.}$$

$$\omega_2 = 5.52\left(\frac{854}{68}\right) = 69.32\ \text{rad/sec}$$

$$T_2 = 0.091\ \text{sec}$$

$$\omega_3 = 8.65\left(\frac{V_s}{h}\right) = 108.63\ \text{rad/sec}$$

$$T_3 = 0.058\ \text{sec.}$$

$$\frac{S_{a_1}}{a_{max}} = 1.71 \qquad S_{a_1} = 1.71\,(0.20) = 0.342\ g$$

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GENERAL DESIGN AND COMPUTATION SHEET

JOB SEISMIC ANALYSIS OF LANDFILL IV		DATE 3-30-95	SHEET 43 of 94
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$$\frac{Sa_2}{a_{MAX}} = 1.20 \qquad Sa_2 = 1.20(0.20) = 0.24\,g$$

$$\frac{Sa_3}{a_{MAX}} = 1.08 \qquad Sa_3 = 1.08(0.20) = 0.216\,g$$

$$\ddot{u}_{1\,MAX} = 1.6\,(0.342) = 0.547\,g$$

$$\ddot{u}_{2\,MAX} = 1.06\,(0.24) = 0.254\,g$$

$$\ddot{u}_{3\,MAX} = 0.86\,(0.216) = 0.186\,g$$

$$\ddot{u}_{MAX} = \left[\overline{0.547}^2 + \overline{0.254}^2 + \overline{0.186}^2\right]^{1/2} =$$

$$= (0.299 + 0.065 + 0.035)^{1/2} = (0.399)^{1/2}$$

$$\ddot{u}_{MAX} = \underline{0.632}\,g$$

$$(\gamma_{AVG})_{eq} = \frac{0.65\,(0.3)(68)\,0.342\,(32.2)}{(854)^2} = 0.00020$$

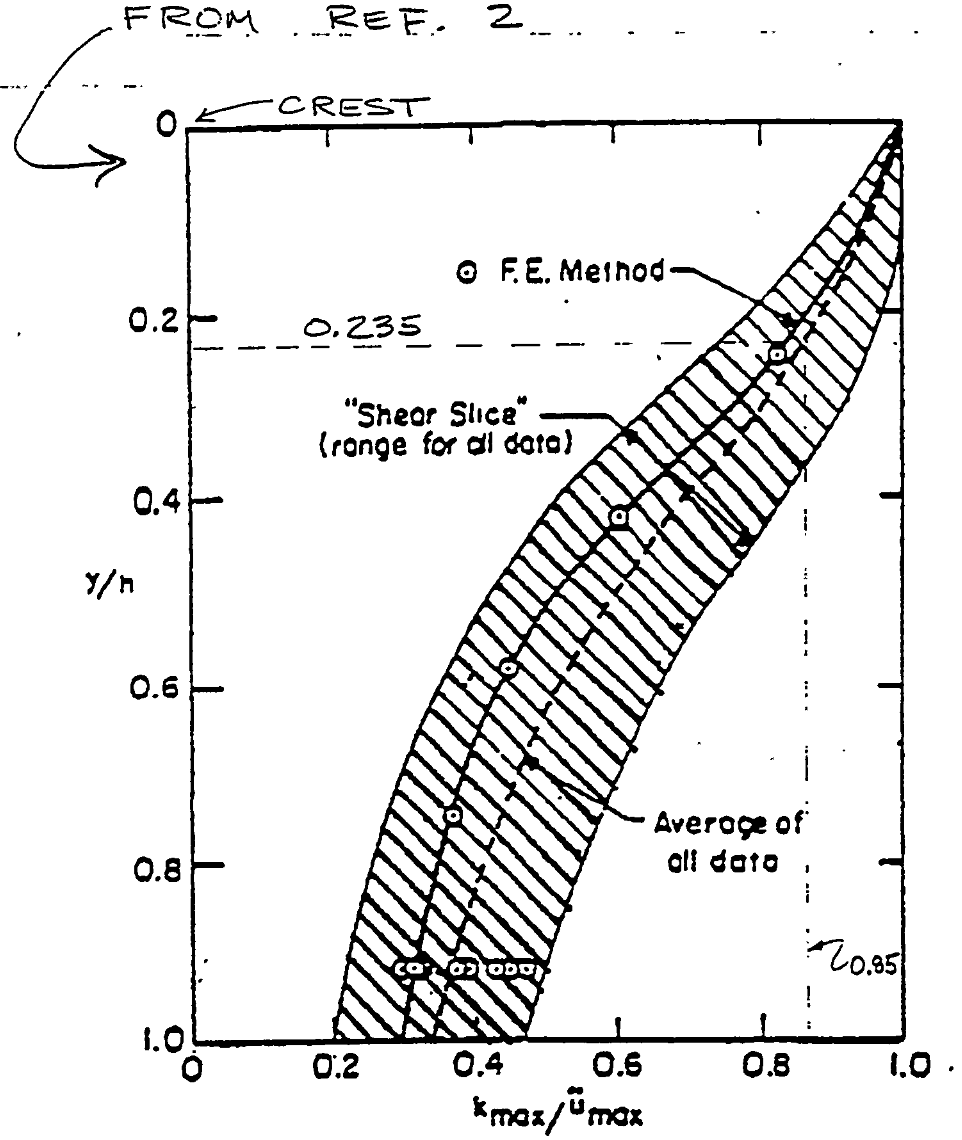
$$(\gamma_{AVG})_{eq} = 0.020\,\%$$

SINCE $0.020\,\% \cong 0.021\,\%$, NO FURTHER ITERATIONS REQUIRED.

GENERAL DESIGN AND COMPUTATION SHEET

JOB SEISMIC ANALYSIS OF LANDFILL IV		DATE 3-30-95	SHEET 44 of 94
ESO NO. ES-0.7-2 CIVIL ENGINEERING	COMPUTED S.D. STONE	CHECKED BY S. B. Ahmed 4-12-95	

FROM REF. 2



VARIATION OF " MAXIMUM ACCELERATION RATIO " WITH DEPTH OF SLIDING MASS

FOR SECTION 2, y = DEPTH OF FAILURE PLANE

$y \cong 16.$ FT

$$y/h = \frac{16.}{68.} = 0.235$$

$$k_{MAX}/\ddot{u}_{MAX} = 0.85$$

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GENERAL DESIGN AND COMPUTATION SHEET

JOB SEISMIC ANALYSIS OF LANDFILL IV	DATE 5-8-95	SHEET 45 of 94
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$$k_{MAX} = 0.85\, \ddot{u}_{MAX} = 0.85(0.632) = 0.54g$$

$$\frac{k_y}{k_{MAX}} = \frac{0.40}{0.54} = 0.74$$

TABLE 4.3 OF REF. 14 CONTAINS DATA THAT CORRELATES VARIOUS MAXIMUM GROUND ACCELERATIONS (%g) AND DURATION OF SHAKING (SECS) FOR VARIOUS EARTHQUAKE MAGNITUDES. THE DATA SUGGESTS AN ACCELERATION OF 0.22g CORRESPONDS TO AN EARTHQUAKE WITH A MAGNITUDE OF 6.0. *

SINCE AN EARTHQUAKE ACCELERATION OF $a_{MAX} = 0.20g$ (90% PROBABILITY OF NOT BEING EXCEEDED IN 250 YEARS) IS BEING USED IN THIS STUDY, USING THE M = 6 ½ CURVE IN THE FIGURE ON NEXT PAGE IS CONSERVATIVE.

* Minor editorial revisions on 5-8-95 for clarification of text to eliminate any copyright concerns.

GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	3-30-95	46 of 94

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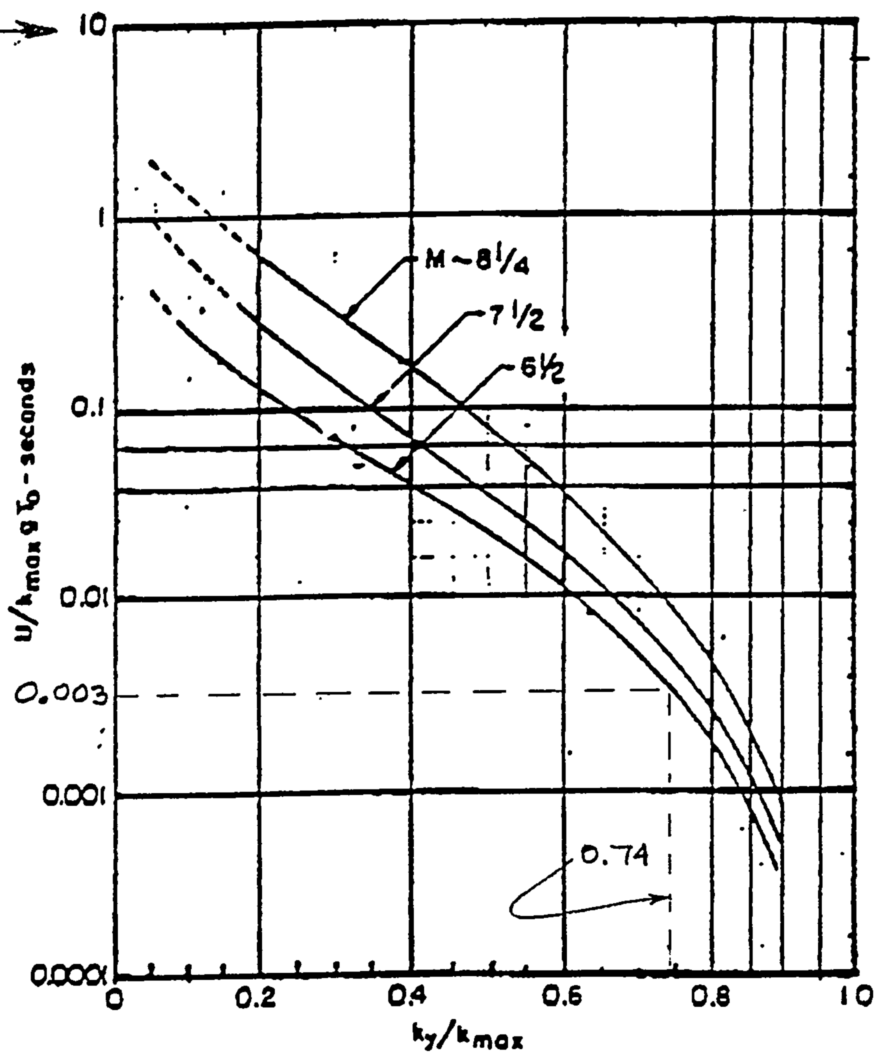
FOR $a = 0.20g$, $M \cong 6\frac{1}{2}$

FROM REF. 2



VARIATION OF AVERAGE NORMALIZED DISPLACEMENT WITH YIELD ACCELERATION

$$\frac{u}{k_{MAX}\; g\; T_0} = 0.003$$

DISPLACEMENT $= u = 0.003\,(0.54)(32.2)(0.208) = 0.0109$ ft $= 0.13''$

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GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
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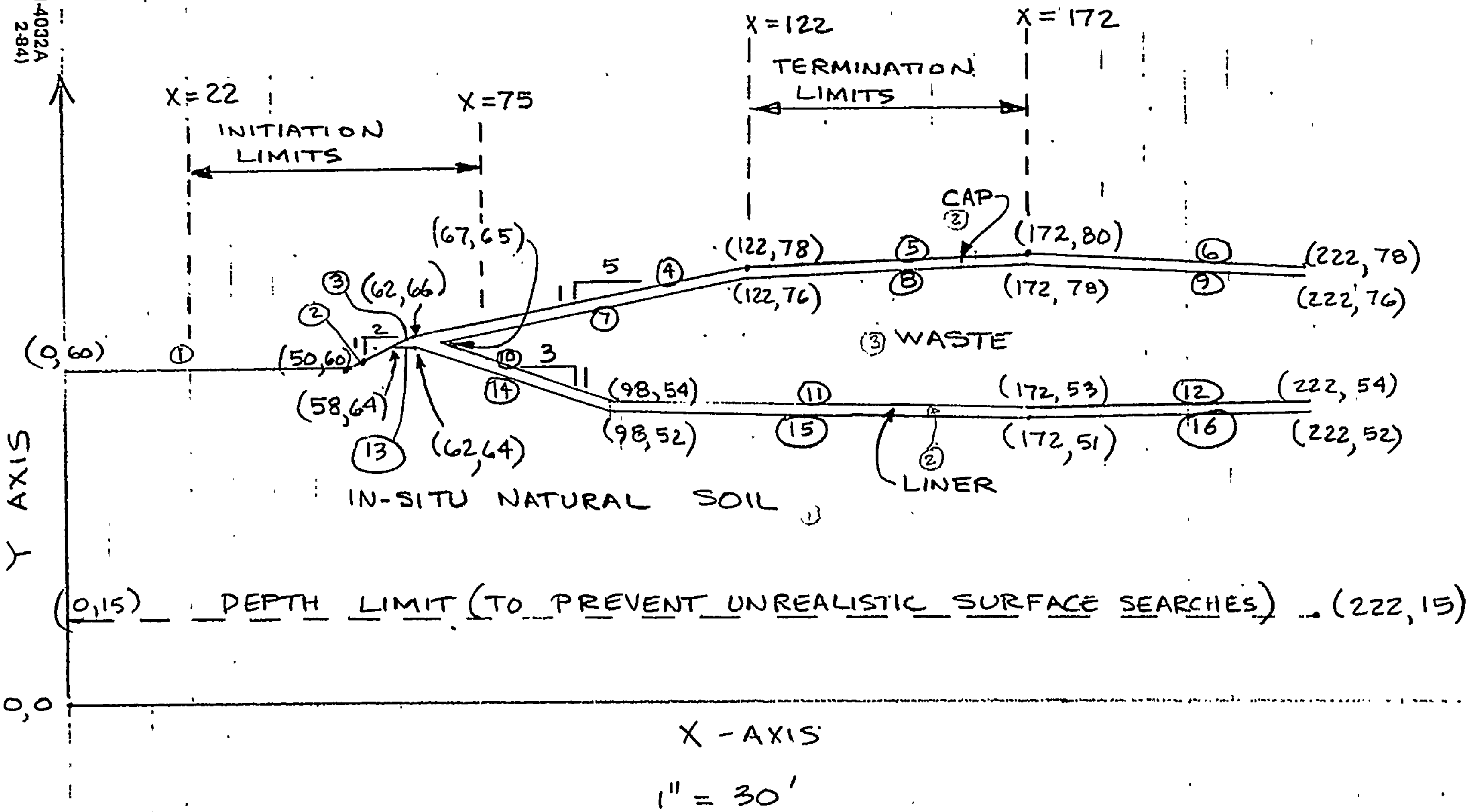
SECTION 1 ANALYSIS

1- PERFORM "GLOBAL" STABILITY ANALYSIS FOLLOWING METHODOLOGY LISTED ON PG. 27 FOR SECTION 2.

2- PERFORM AN ANALYSIS TO EVALUATE SLIDING AT BASE ALONG INTERFACE OF CLAY LINER AND FLEXIBLE MEMBRANE LINER

GENERAL DESIGN AND COMPUTATION SHEET



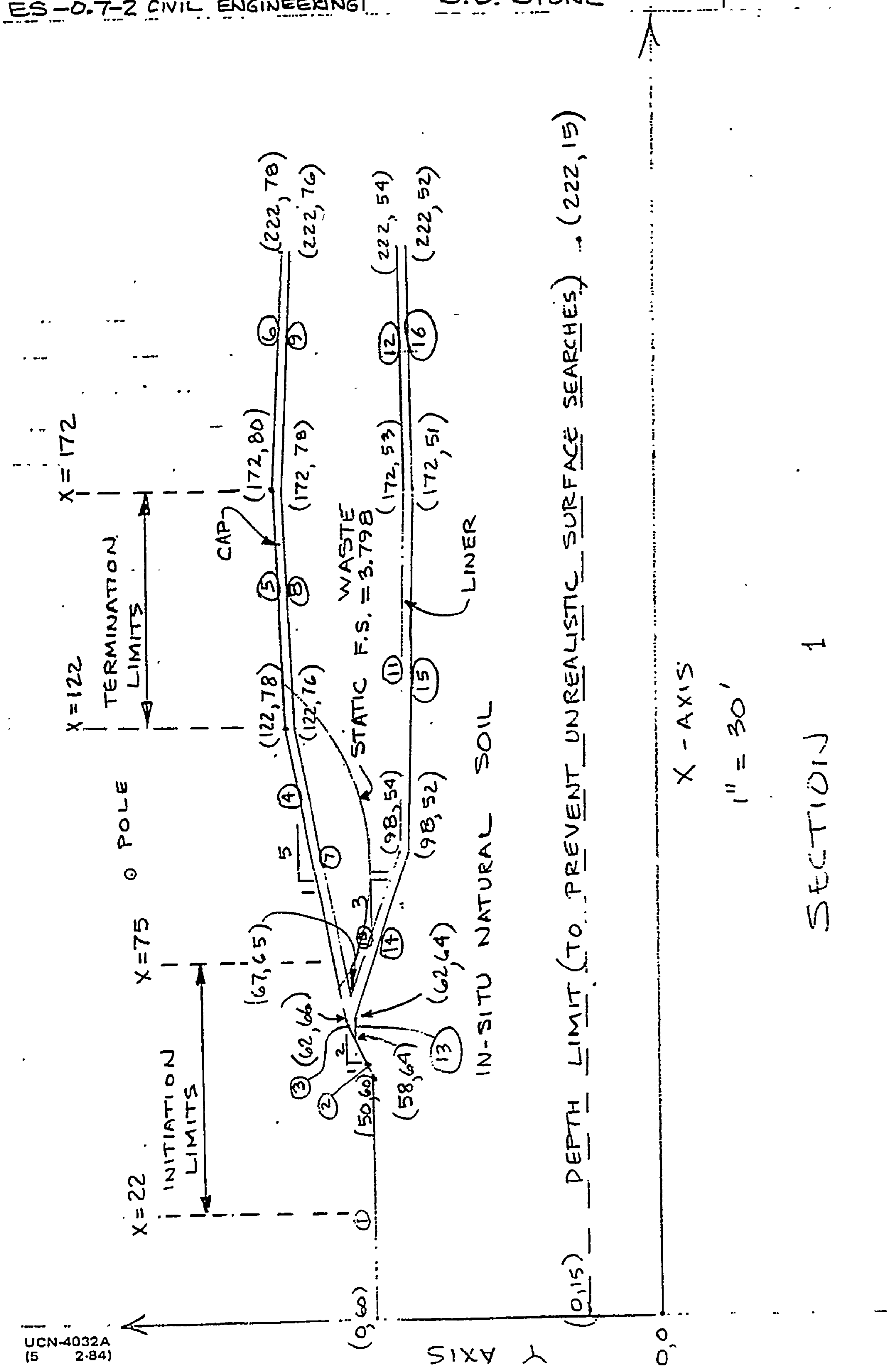
SECTION 1

(SECTION ROTATED 180° FROM AS SHOWN ON DRAWING CZE900000 -A036 SINCE STABL5M REQS. 1ST QUADRANT)

SOIL INDEX	SOIL TYPE	ϕ	C	γ_M
1	IN-SITU NATURAL SOIL	13°	320. PSF	124. PCF
2	COMPACTED LINER, CAP	22°	200. PSF	122. PCF
3	WASTE	16°	150. PSF	55. PCF

GENERAL DESIGN AND COMPUTATION SHEET

JOB: SEISMIC ANALYSIS OF LANDFILL IV		DATE: 3-31-95	SHEET 49 of 94
ESO NO.: ES-0.7-2 CIVIL ENGINEERING	COMPUTED: S.D. STONE		CHECKED BY



SOIL INDEX	SOIL TYPE	ϕ	C	γ_M
1	IN-SITU NATURAL SOIL	13°	320. PSF	124. PCF
2	COMPACTED LINER, CAP	22°	200. PSF	122. PCF
3	WASTE	16°	150. PSF	55. PCF

GENERAL DESIGN AND COMPUTATION SHEET

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SEISMIC ANALYSIS OF LANDFILL IV	3-31-95	50 of 94
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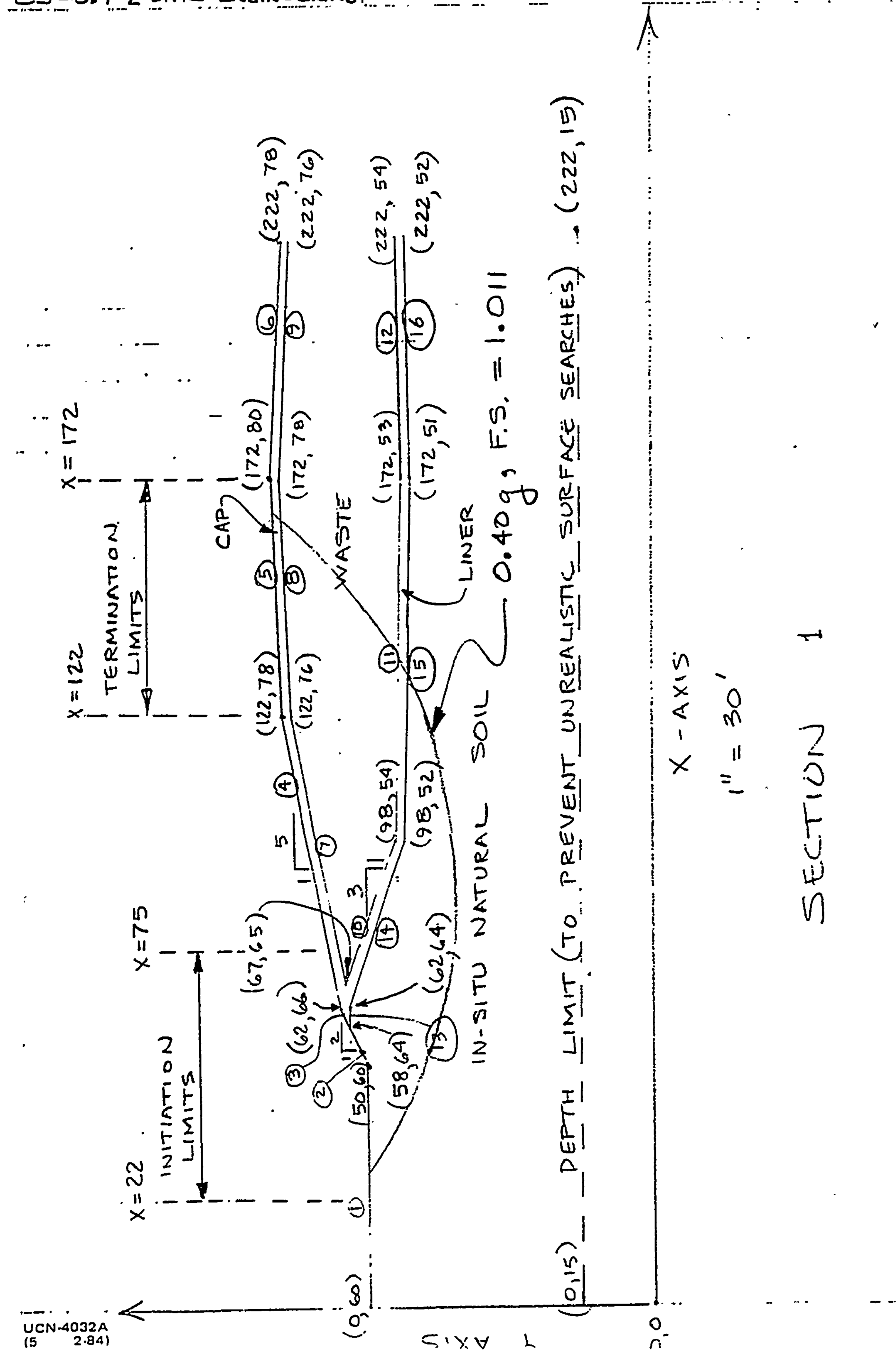

SOIL INDEX	SOIL TYPE	ϕ	C	γ_M
1	IN-SITU NATURAL SOIL	13°	320. PSF	124. PCF
2	COMPACTED LINER, CAP	22°	200. PSF	122. PCF
3	WASTE	16°	150. PSF	55. PCF

GENERAL DESIGN AND COMPUTATION SHEET

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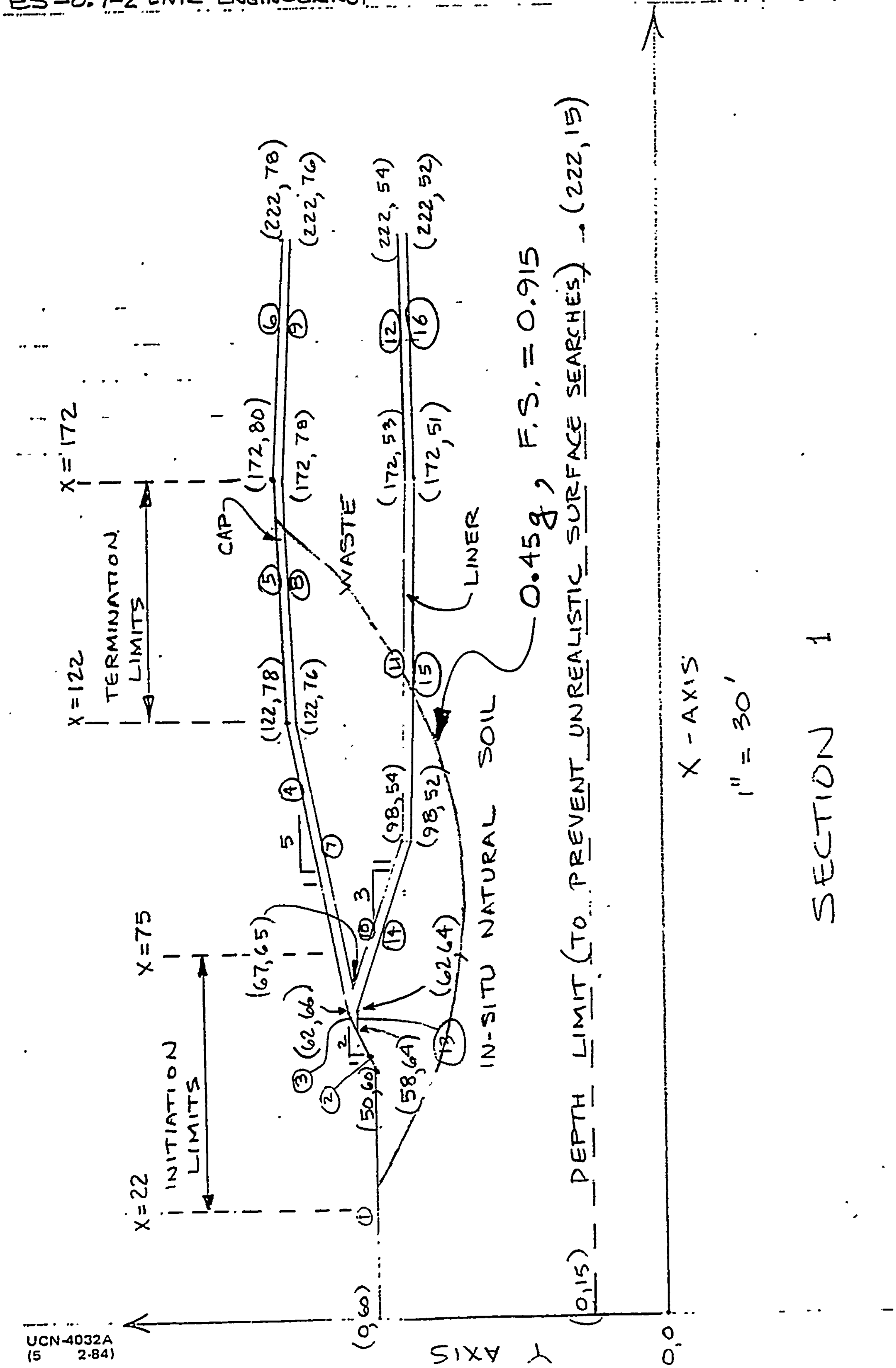
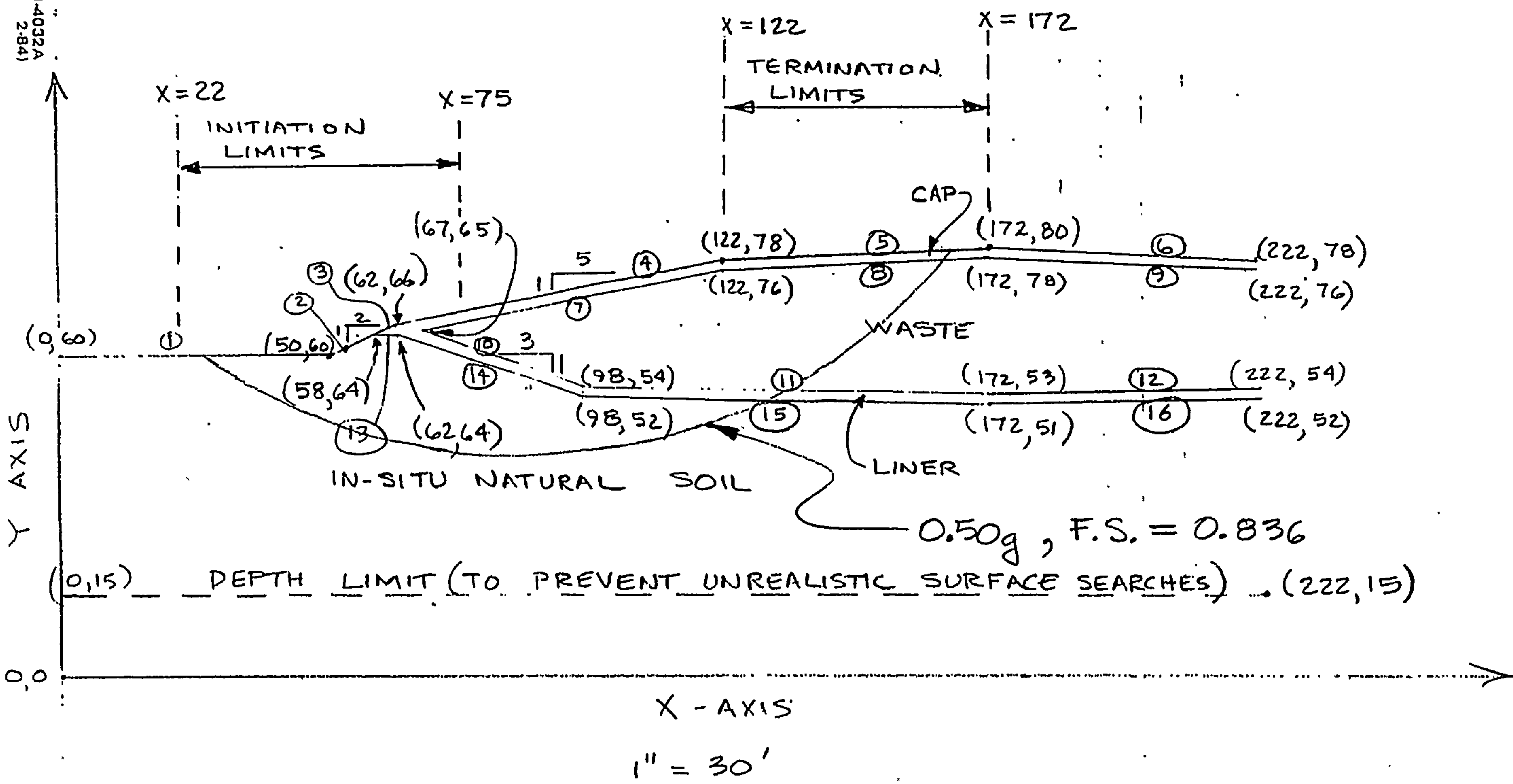
SEISMIC ANALYSIS OF LANDFILL IV	3-31-95	51 of 94
ES-0.7-2 CIVIL ENGINEERING	COMPUTED S.D. STONE	CHECKED BY



SOIL INDEX	SOIL TYPE	ϕ	C	γ_M
1	IN-SITU NATURAL SOIL	13°	320. PSF	124. PCF
2	COMPACTED LINER, CAP	22°	200. PSF	122. PCF
3	WASTE	16°	150. PSF	55. PCF

GENERAL DESIGN AND COMPUTATION SHEET

JOB: SEISMIC ANALYSIS OF LANDFILL IV | DATE: 3-31-95 | SHEET: 52 of 94
ESO NO.: ES-0.7-2 CIVIL ENGINEERING | COMPUTED: S.D. STONE | CHECKED BY:

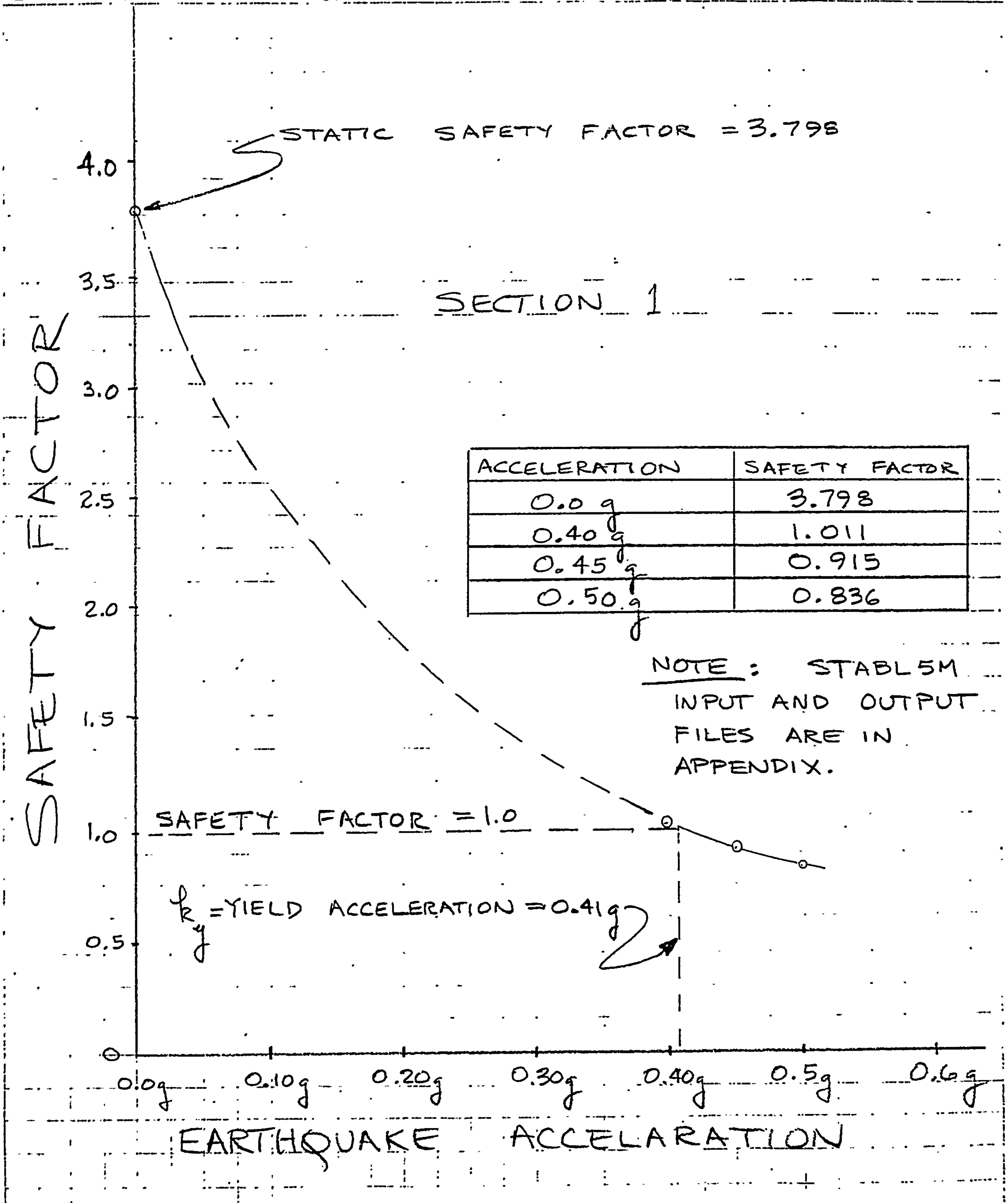


SECTION 1

SOIL INDEX	SOIL TYPE	ϕ	C	γ_M
1	IN-SITU NATURAL SOIL	13°	320. PSF	124. PCF
2	COMPACTED LINER, CAP	22°	200. PSF	122. PCF
3	WASTE	16°	150. PSF	55. PCF

GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	3-31-95	53 of 94
ESO NO. ES-0.7-2 CIVIL ENGINEERING	COMPUTED S.D. STONE	CHECKED BY S.B. Ahmed 4-12-95



ACCELERATION	SAFETY FACTOR
0.0 g	3.798
0.40 g	1.011
0.45 g	0.915
0.50 g	0.836

GENERAL DESIGN AND COMPUTATION SHEET

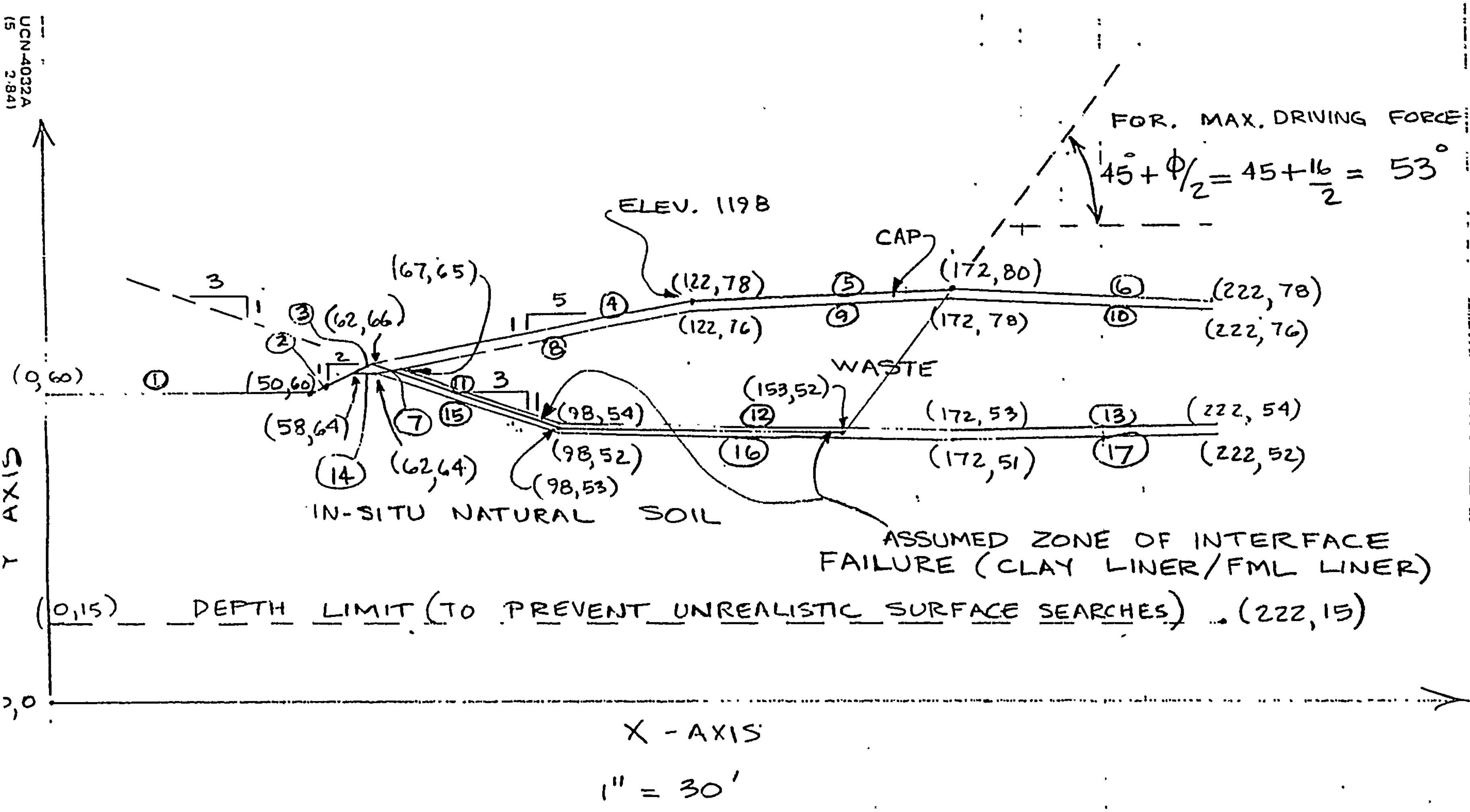
JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	4-1-95	54 of 94
ESO NO. ES-0.7-2 CIVIL ENGINEERING	COMPUTED S.D. STONE	CHECKED BY

SECTION 1. INTERFACE ANALYSIS

PERFORM AN ANALYSIS FOR SLIDING AT BASE ALONG INTERFACE OF CLAY LINER AND FLEXIBLE MEMBRANE LINER TO COMPARE k_{yield} FOR GLOBAL STABILITY vs. k_{yield} FOR BASE SLIDING TO DETERMINE WHICH FAILURE MECHANISM CONTROLS SECTION 1.

GENERAL DESIGN AND COMPUTATION SHEET

JOB	SEISMIC ANALYSIS OF LANDFILL IV
DATE	4-1-95
SHEET	55 of 94
ESO NO.	ES-0.7-2 CIVIL ENGINEERING
COMPUTED	S.D. STONE
CHECKED BY	



SECTION 1

SOIL INDEX	SOIL TYPE	ϕ	C	γ_M
1	IN-SITU NATURAL SOIL	13°	320. PSF	124. PCF
2	COMPACTED LINER, CAP	22°	200. PSF	122. PCF
3	WASTE	16°	150. PSF	55. PCF
4	INTERFACE CLAY LINER & FLEXIBLE MEM. LINER	19°	0.	122. PCF

GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	4-1-95	56 of 94

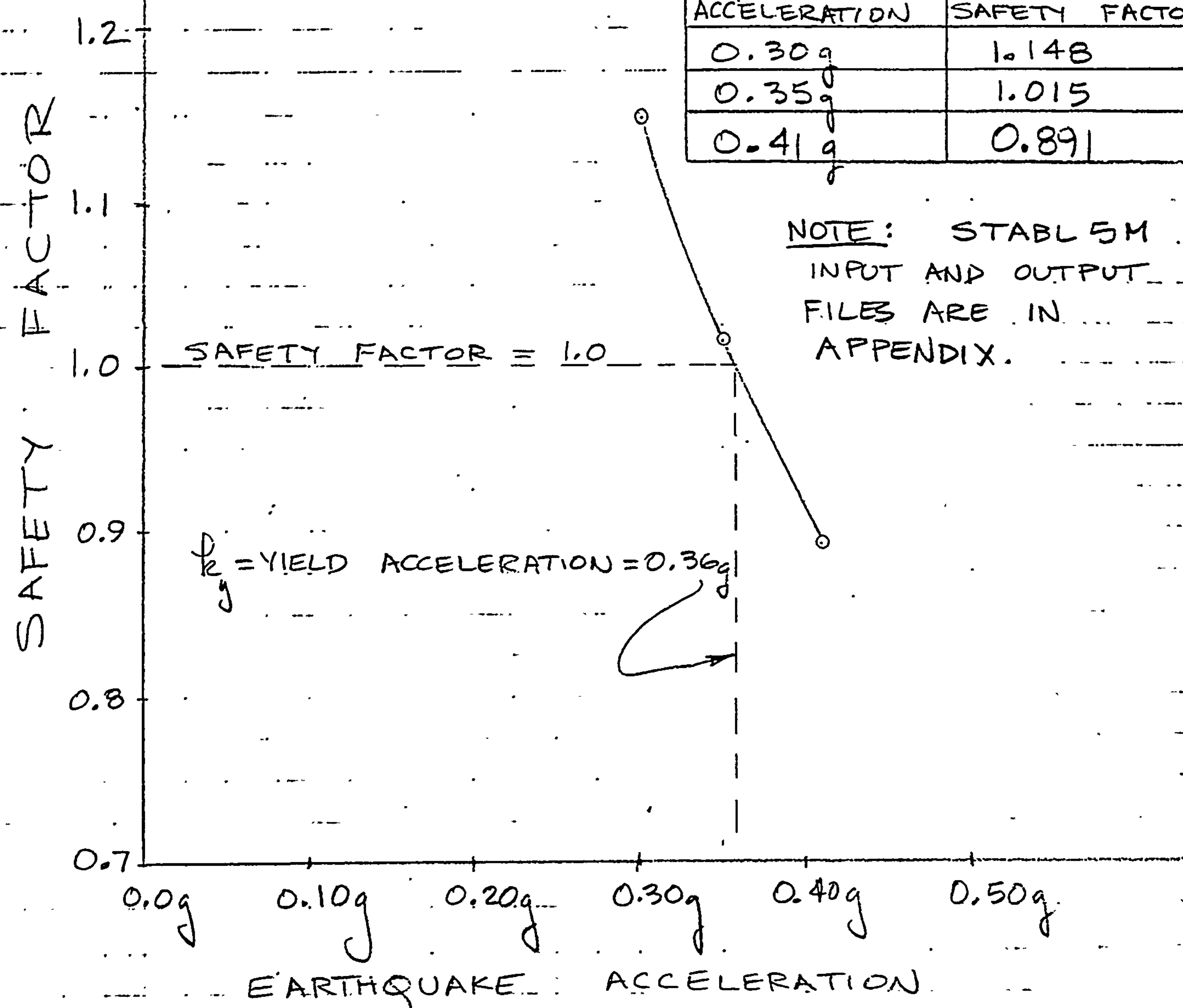
ESO NO.	COMPUTED	CHECKED BY
ES-0.7-2 CIVIL ENGINEERING	S.D. STONE	

SECTION 1

ASSUMED INTERFACE FAILURE
(CLAY LINER/FML LINER)

ACCELERATION	SAFETY FACTOR
0.30g	1.148
0.35g	1.015
0.41g	0.891

NOTE: STABL5M INPUT AND OUTPUT FILES ARE IN APPENDIX.



GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	4-1-95	57 of 94

ESO NO.	COMPUTED	CHECKED BY
ES-0.7-2 CIVIL ENGINEERING	S.D. STONE	

$k_{yield} = 0.36g$ FOR BASE FAILURE

$k_{yield} = 0.41g$ FOR GLOBAL FAILURE
(SEE PG. 53)

THEREFORE, BASE FAILURE WILL OCCUR FIRST AND CONTROLS, i.e., $0.36g < 0.41g$

PROCEED TO CALCULATE THEORETICAL DISPLACEMENT ASSOCIATED WITH BASE FAILURE.

GENERAL DESIGN AND COMPUTATION SHEET

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DETERMINE MAX. CREST ACCELERATION ($\ddot{U}_{max}$)

CREST IS AT TOP OF 1 ON 5 SLOPE, EL. 1198

$\therefore h = 1198. - 1125. = 73.$ FT.

TOP OF ROCK ELEV. (SEE SHEET 35)

$h = (27^{\pm}$ FT. OF WASTE$) + (46^{\pm}$ FT. OF NATURAL SOIL$)$

$h = 27^{\pm} + 46^{\pm} = 73.$

$h = 37^{\pm}\%$ WASTE $+ 63^{\pm}\%$ NATURAL SOIL

PRO-RATED $\gamma_M = 0.37\,(55.\text{PCF}) + 0.63\,(124.\text{ PCF})$

" " $= 20.4 + 78.1$

PRO-RATED γ_M = 98.5 PCF

$V_s = 854.^{\pm}$ FT/SEC. FOR NATURAL SOIL (CONFIRMED IN SECOND ITERATION, PG. 42)

GENERAL DESIGN AND COMPUTATION SHEET

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TABLE 1 OF REFERENCE 4 CONTAINS SHEAR WAVE VELOCITIES OF MUNICIPAL SOLID WASTE FROM SEVERAL SOURCES. THESE SHEAR WAVE VELOCITY DATA RELATE TO WASTE DEPTHS OF 2, 10, 20 AND 30 METERS. AN AVERAGE SHEAR WAVE VELOCITY OF 116.5 METERS/SEC. WOULD BE REPRESENTATIVE FOR A WASTE DEPTH OF 2 METERS WHILE A VALUE OF 168.2 METERS/SEC. WOULD BE REPRESENTATIVE FOR A DEPTH OF 10 METERS. *

AN AVERAGE OF THE ABOVE TWO VALUES WOULD APPROXIMATE MID-DEPTH OF 27± FT. OF WASTE AT LANDFILL IV. *

$$V_{S\ AVG.} = \left(\frac{116.5 + 168.2}{2}\right) = 142.4\ M/SEC \cong 467.\ FT/SEC$$

$$\text{PRO-RATED } V_S = 0.37\,(467.) + 0.63\,(854.)$$

$$= 172.8 + 538.0$$

$$\text{PRO-RATED } V_S = 710.^{\pm}\ FT/SEC$$

ESTIMATE V_{MAX} FOR PRO-RATED WASTE/SOIL COLUMN. *
FROM PAGE 37 V_{MAX} FOR IN-SITU NAT. SOIL = 1,081. FT/SEC

* Minor editorial revisions on 5-8-95 for clarification of text to eliminate any copyright concerns.

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JOB SEISMIC ANALYSIS OF LANDFILL IV		DATE 4-1-95	SHEET 60 of 94
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$$\frac{V_{MAX\ PRO.\ R.}}{V_{MAX\ N.S.}} = \frac{V_{S\ PRO.\ R.}}{V_{S\ N.S.}}$$

$$V_{MAX\ PRO.\ R.} = V_{MAX\ N.S.}\left(\frac{V_{S\ PRO.\ R.}}{V_{S\ N.S.}}\right)$$

$$= 1081.\ \frac{(710.)}{(854.)}$$

PRO-RATED $V_{MAX} = 898.7$, SAY $= 900.$ FT/SEC

$$\frac{G}{G_{MAX}} = \left(\frac{\text{PRO-RATED } V_S}{\text{PRO-RATED } V_{MAX}}\right)^2 = \left(\frac{710.}{900.}\right)^2 = 0.62$$

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JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	4-1-95	61 of 94

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(FROM REF. 2

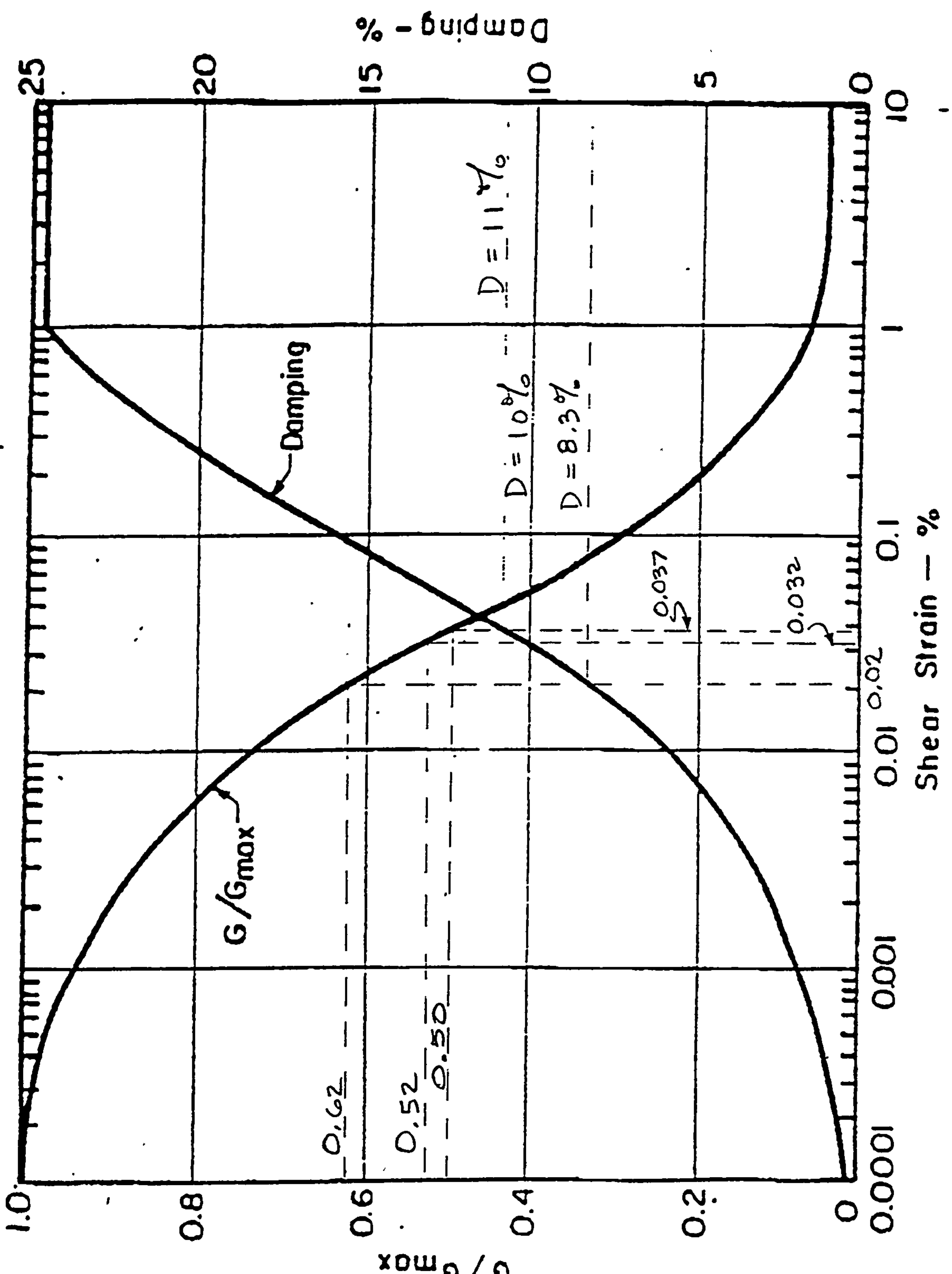

FIGURE 1: SHEAR MODULUS AND DAMPING CHARACTERISTICS USED IN RESPONSE CALCULATIONS

GENERAL DESIGN AND COMPUTATION SHEET

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SHEAR STRAIN = 0.02 %

λ = DAMPING = 8.3 %

DETERMINE FIRST NATURAL FREQUENCIES AND PERIODS

$$\omega_1 = 2.4 \frac{V_s}{h} = 2.4 \left(\frac{710.}{73.}\right) = 23.34 \text{ rad/sec}$$

$$T_1 = \frac{2\pi}{\omega_1} = \frac{2\pi}{23.34} = 0.269 \text{ SEC.}$$

$$\omega_2 = 5.52 \frac{V_s}{h} = 5.52 \left(\frac{710.}{73.}\right) = 53.69 \text{ rad/sec}$$

$$T_2 = \frac{2\pi}{\omega_2} = \frac{2\pi}{53.69} = 0.117 \text{ SEC.}$$

$$\omega_3 = 8.65 \frac{V_s}{h} = 8.65 \left(\frac{710.}{73.}\right) = 84.13 \text{ rad/sec}$$

$$T_3 = \frac{2\pi}{\omega_3} = \frac{2\pi}{84.13} = 0.075 \text{ SECS.}$$

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FROM REF. 2

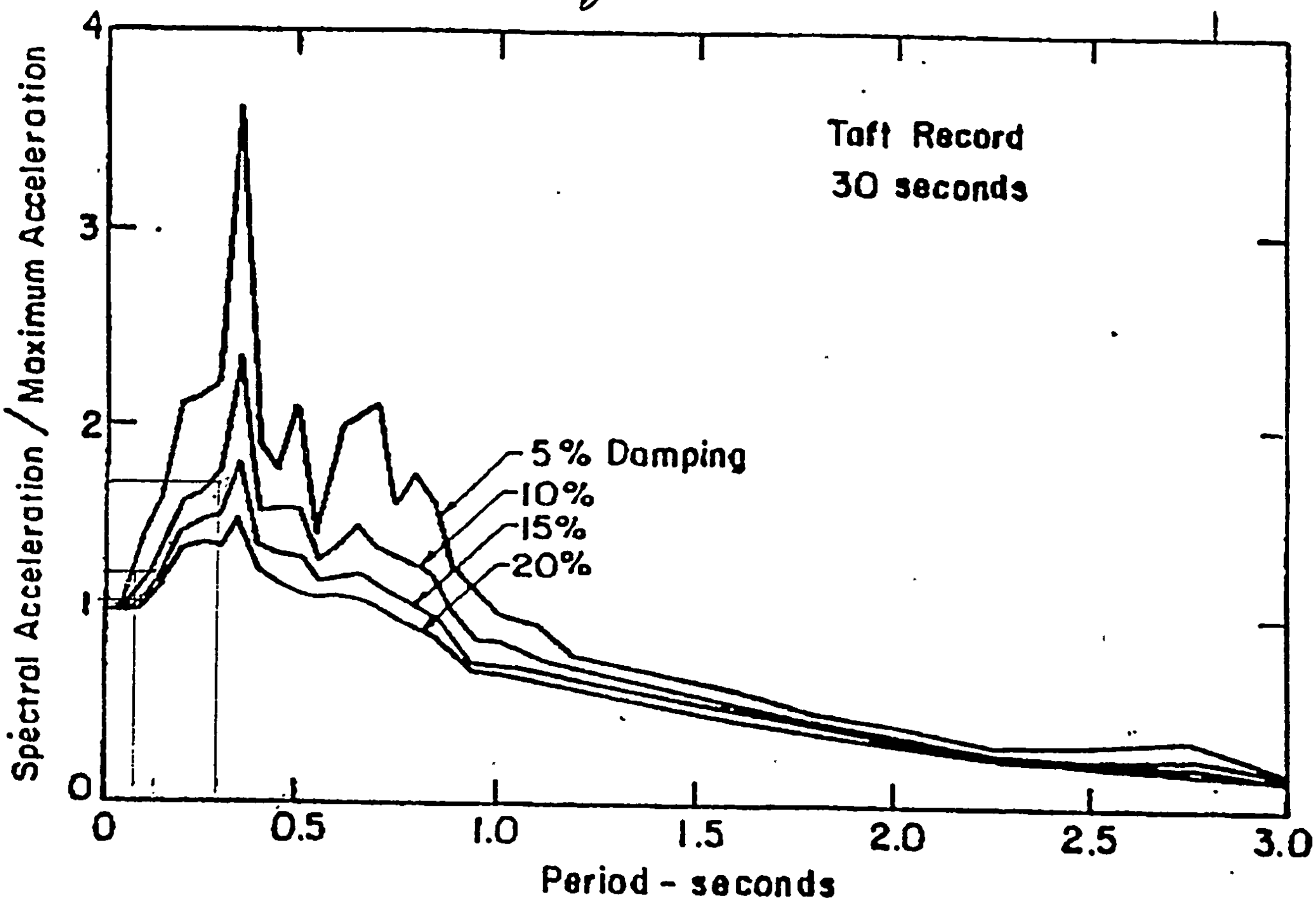

FIGURE 2: NORMALIZED ACCELERATION RESPONSE SPECTRA - TAFT RECORD (NORTH - SOUTH COMPONENT)

$\frac{S_{a_1}}{a_{MAX}} = 1.80$ ✓ $\quad S_{a_1} = 1.80\,(0.20) = 0.36\,g$ ✓

$\frac{S_{a_2}}{a_{MAX}} = 1.25$ ✓ $\quad S_{a_2} = 0.25\,g$ ✓

$\frac{S_{a_3}}{a_{MAX}} = 1.12$ ✓ $\quad S_{a_3} = 0.224\,g$ ✓

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MAX. CREST ACCELERATION FOR FIRST THREE MODES OF VIBRATION.

$$\ddot{u}_{1MAX} = 1.6\ Sa_1 = 1.6\,(0.36) = 0.576\ g$$

$$\ddot{u}_{2MAX} = 1.06\ Sa_2 = 1.06\,(0.25) = 0.265\ g$$

$$\ddot{u}_{3MAX} = 0.86\ Sa_3 = 0.86\,(0.224) = 0.193\ g$$

$$\ddot{u}_{MAX} = \left[(0.576)^2 + (0.265)^2 + (0.193)^2\right]^{1/2}$$

$$= \left[0.332 + 0.070 + 0.037\right]^{1/2} = (0.439)^{1/2}$$

$$\ddot{u}_{MAX} = 0.66\ g$$

$$(\gamma_{AVG})_{eq} = 0.65\,(0.3)\frac{h}{V_s^2}\,Sa_1$$ = AVG. EQUIVALENT SHEAR STRAIN

$$= \frac{0.65\,(0.3)(73.)\,(0.36)\,32.2}{(710)^2} = 0.00032$$

$$(\gamma_{AVG.})_{eq} = 0.032\ \%$$

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SECOND ITERATION

FOR $\epsilon = 0.032\ \%$

$$\frac{G}{G_{MAX}} = 0.52 = \left(\frac{V_S}{V_{MAX}}\right)^2$$

$$D = 10\ \%$$

$$\frac{V_S}{V_{MAX}} = \sqrt{0.52} = 0.721$$

$$V_S = 0.721\ V_{MAX} = 0.721\ (900.) = 649.\ \text{FT/SEC}$$

$$w_1 = 2.4\ \frac{V_S}{h} = 2.4\ \frac{(649)}{73} = 21.34\ \text{rad/sec.}$$

$$T_1 = \frac{2\pi}{w_1} = 0.294\ \text{SEC.}$$

$$w_2 = 5.52\left(\frac{649}{73}\right) = 49.08\ \text{rad/sec}$$

$$T_2 = 0.128\ \text{SEC}$$

$$w_3 = 8.65\left(\frac{649}{73}\right) = 76.90\ \text{rad/sec}$$

$$T_3 = 0.082\ \text{SEC.}$$

$$\frac{Sa_1}{a_{MAX}} = 1.71 \qquad Sa_1 = 1.71\ (0.20) = 0.342\ g$$

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$$\frac{S_{a_2}}{a_{MAX}} = 1.24 \qquad S_{a_2} = 1.24(0.20) = 0.248\ g$$

$$\frac{S_{a_3}}{a_{MAX}} = 1.10 \qquad S_{a_3} = 1.10(0.20) = 0.22\ g$$

$$\ddot{u}_{1MAX} = 1.6\ (0.342) = 0.547\ g$$

$$\ddot{u}_{2MAX} = 1.06\ (0.248) = 0.263\ g$$

$$\ddot{u}_{3MAX} = 0.86\ (0.22) = 0.189\ g$$

$$\ddot{u}_{MAX} = \left[(0.547)^2 + (0.263)^2 + (0.189)^2\right]^{1/2}$$

$$= (0.299 + 0.069 + 0.036)^{1/2} = (0.404)^{1/2}$$

$$\ddot{u}_{MAX} = \underline{0.636\ g}$$

$$(\gamma_{AVG})_{eq} = \frac{0.65\ (0.3)(73.)(0.342)(32.2)}{(649.)^2} = 0.00037$$

$$(\gamma_{AVG})_{eq} = 0.037\ \%$$

$$0.032 \neq 0.037$$

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DO THIRD ITERATION

FOR $\epsilon = 0.037\%$

$$G/G_{MAX} = 0.50 = \left(\frac{V_S}{V_{MAX}}\right)^2$$

$$D = 11\%$$

$$\frac{V_S}{V_{MAX}} = \sqrt{0.50} = 0.707$$

$$V_S = 0.707\, V_{MAX} = 0.707\,(900.) = 636. \text{ FT/SEC.}$$

$$w_1 = 2.4\,\frac{V_S}{h} = 2.4\left(\frac{636.}{73.}\right) = 20.91 \text{ rad/sec.}$$

$$T_1 = \frac{2\pi}{w_1} = \frac{2\pi}{20.91} = 0.30 \text{ SEC.}$$

$$w_2 = 5.52\left(\frac{636.}{73}\right) = 48.09 \text{ rad/sec}$$

$$T_2 = \frac{2\pi}{w_2} = 0.13 \text{ SEC}$$

$$w_3 = 8.65\left(\frac{636.}{73.}\right) = 75.36 \text{ rad/sec}$$

$$T_3 = \frac{2\pi}{w_3} = 0.08 \text{ SEC.}$$

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$$\frac{Sa_1}{a_{MAX}} = 1.68 \qquad Sa_1 = 1.68\,(a_{MAX}) = 1.68\,(0.20) = 0.336\ g$$

$$\frac{Sa_2}{a_{MAX}} = 1.20 \qquad Sa_2 = 0.240\ g$$

$$\frac{Sa_3}{a_{MAX}} = 1.05 \qquad Sa_3 = 0.210\ g$$

$$\ddot{u}_{1\,MAX} = 1.6\,Sa_1 = 1.6\,(0.336) = 0.538\ g$$

$$\ddot{u}_{2\,MAX} = 1.06\,Sa_2 = 1.06\,(0.240) = 0.254\ g$$

$$\ddot{u}_{3\,MAX} = 0.86\,Sa_3 = 0.86\,(0.210) = 0.181\ g$$

$$\ddot{u}_{MAX} = \left[(0.538)^2 + (0.254)^2 + (0.181)^2\right]^{1/2} =$$

$$= (0.289 + 0.065 + 0.033)^{1/2} = (0.387)^{1/2}$$

$$\ddot{u}_{MAX} = 0.622\ g$$

$$(\gamma_{AVG})_{eq} = \frac{0.65\,(0.3)(73.)(0.336)\,32.2}{(636)^2} = 0.00038$$

$$(\gamma_{AVG})_{eq} = 0.038\ \%$$

ASSUMED 0.037% $\cong$ COMPUTED 0.038%

∴ NO FURTHER ITERATIONS REQUIRED

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FROM REF. 2

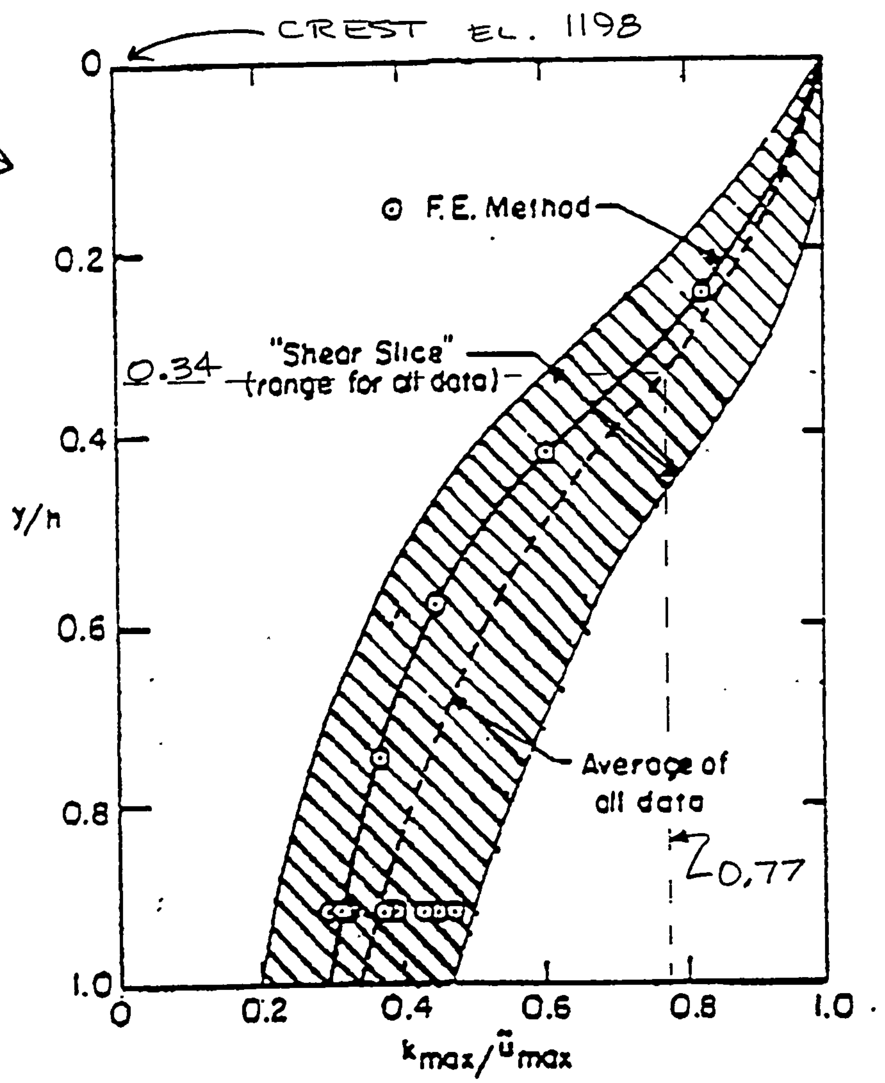

FIGURE 3: VARIATION OF " MAXIMUM ACCELERATION RATIO " WITH DEPTH OF SLIDING MASS

FOR SECTION 1, ASSUMED INTERFACE FAILURE,

y = DEPTH TO FAILURE PLANE ≅ 25. FT.

$$y/h = \frac{25.}{73.} = 0.34$$

$$k_{MAX}/\ddot{u}_{MAX} = 0.77$$

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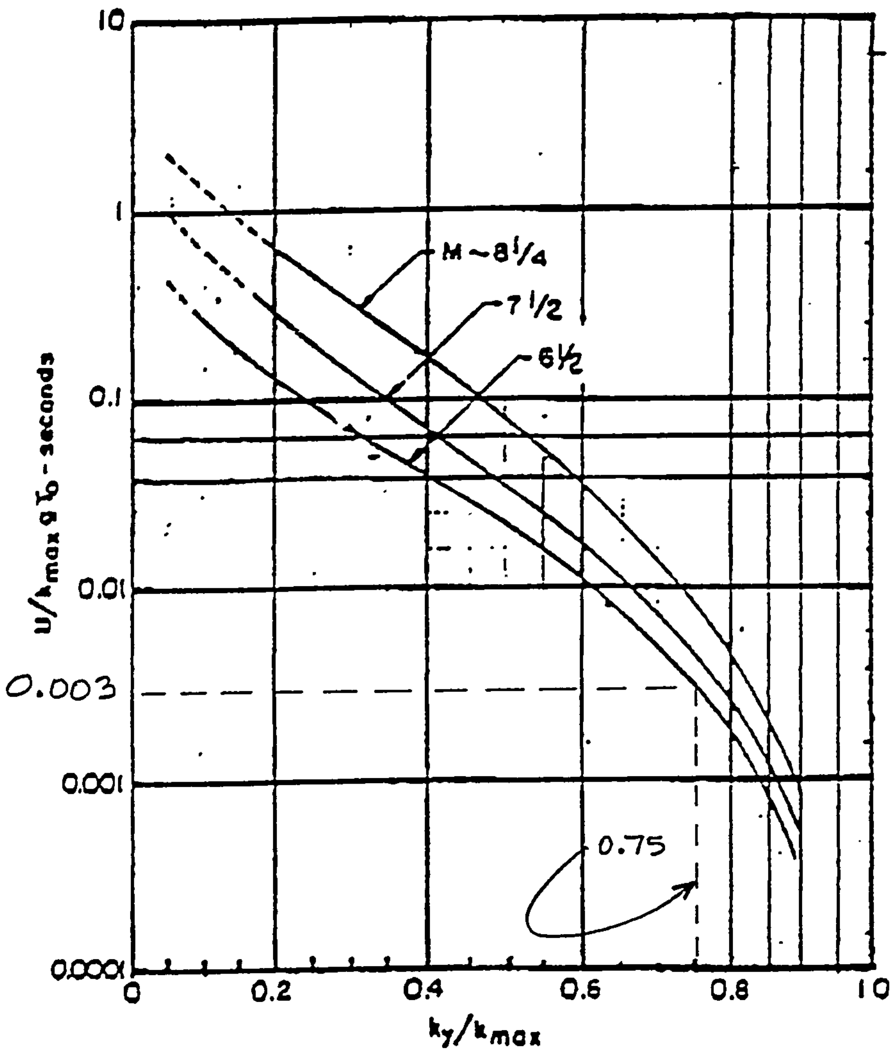
$$k_{MAX} = 0.77\ \ddot{u}_{MAX} = 0.77\,(0.622) = 0.479$$

$$\frac{k_y}{k_{MAX}} = \frac{0.36}{0.479} = 0.75$$



VARIATION OF AVERAGE NORMALIZED DISPLACEMENT WITH YIELD ACCELERATION

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$$\frac{u}{k_{MAX}\, g\, T_o} = 0.003$$

$$u = 0.003\,(0.479)(32.2)(0.30) = 0.0139 \text{ FT.} = \underline{\underline{0.17''}}$$

u = DISPLACEMENT

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CHECK VENEER STABILTY OF COVER SYSTEM

FROM REF. 2

$$\text{FACTOR OF SAFETY} = \frac{\text{RESISTING FORCES}}{\text{DRIVING FORCES}} = \frac{[\cos\alpha - a_{MAX}\sin\alpha]\tan\phi}{\sin\alpha + a_{MAX}\cos\alpha}$$

α = SLOPE ANGLE

ϕ = INTERFACE FRICTION ANGLE = 19.°

a_{MAX} = SEISMIC COEFFICIENT

CHECK 1 ON 10 SLOPE AT SECTION 2

$$\alpha = \tan^{-1}\left(\frac{1}{10}\right) = \tan^{-1}(0.100) = 5.7°$$

$a_{MAX} = \ddot{u}_{MAX}$ = CREST ACCELERATION, EL. 1193 (SEE PG. 43)

$$a_{MAX} = 0.632\ g$$

$$F.S. = \frac{[\cos 5.7 - 0.632(\sin 5.7)]\tan 19°}{\sin 5.7 + 0.632(\cos 5.7)}$$

$$= \frac{(0.995 - 0.063)\ 0.344}{0.0993 + 0.629} = \frac{0.3206}{0.7283}$$

F.S. = 0.44 < REQD. 1.0

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JOB SEISMIC ANALYSIS OF LANDFILL IV	DATE 4-3-95	SHEET 73 of 94
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CHECK 1 ON 5 SLOPE AT SECTION 1

$$\alpha = \tan^{-1}\left(\frac{1}{5}\right) = \tan^{-1}(0.200) = 11.3^\circ$$

$a_{MAX} = \ddot{u}_{MAX}$ = CREST ACCELERATION, EL. 1198 (SEE PG. 68)

$$a_{MAX} = 0.622\,g$$

$$F.S. = \frac{\left[\cos 11.3^\circ - 0.622(\sin 11.3^\circ)\right] \tan 19^\circ}{\sin 11.3^\circ + 0.622(\cos 11.3^\circ)}$$

$$= \frac{(0.981 - 0.122)\,0.344}{0.196 + 0.610} = \frac{0.295}{0.806}$$

$$F.S. = 0.37 < \text{REQD. } 1.0$$

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CHECK 1 ON 3 SLOPE AT EAST END OF LANDFILL

$a_{MAX} = \ddot{u}_{MAX}$ = CREST ACCELERATION SHOULD BE APPROX. THE SAME AS SECTION 2 DUE TO SIMILAR ELEVATIONS AND HIGH % OF IN-SITU NATURAL SOIL BENEATH SLOPE

$\therefore \; a_{MAX} \cong 0.632g$

$\alpha = \tan^{-1}\left(\frac{1}{3}\right) = \tan^{-1}(0.333) = 18.4°$

$$F.S. = \frac{\left[\cos 18.4° - 0.632(\sin 18.4)\right] \tan 19°}{\sin 18.4° + 0.632(\cos 18.4°)}$$

$$= \frac{(0.949 - 0.199)\,0.344}{0.316 + 0.600} = \frac{0.258}{0.916}$$

F.S. = 0.28 < REQD. 1.0

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FOR STATIC CONDITIONS

$$a_{MAX} = 0.0g$$

$$F.S. = \frac{\cos\alpha \tan\phi}{\sin\alpha}$$

FOR 1 ON 3 SLOPE, $\alpha = 18.4°$

$$F.S. = \frac{\cos 18.4° (\tan 19°)}{\sin 18.4}$$

$$= \frac{0.949 (0.344)}{0.316}$$

$$F.S. = 1.03$$

CONCLUSION:

THE VEGETATIVE COVER WILL MOST LIKELY BE DISPLACED AND MOVE DURING A LARGE SEISMIC EVENT SUCH AS THE EARTHQUAKE REQUIRED IN THIS ANALYSIS. MOVEMENT OF THE VEGETATIVE COVER IS NOT CONSIDERED A SERIOUS DEFICIENCY BECAUSE:

a - DISPLACED VEGETATIVE COVER WOULD BE EASILY SEEN AND RECOGNIZED DURING AN INSPECTION.

b - THE VEGETATIVE COVER WOULD BE EASY TO RESTORE SINCE IT IS A COSMETIC, SURFACE REPAIR.

c - THERE IS NO IMPACT ON THE STRUCTURAL INTEGRITY OF THE LANDFILL AND THERE WOULD BE NO RELEASE OF WASTE TO THE ENVIRONMENT.

d - THE VEGETATIVE COVER HAS NO ENGINEERING SIGNIFICANCE TO THE STRUCTURAL STABILITY OF THE LANDFILL.

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LIQUEFACTION EVALUATION

REF. 2 DEFINES LIQUEFACTION AS: THE TERM LIQUEFACTION IS USED TO DESCRIBE A PHENOMENON IN WHICH COHESIONLESS SOILS LIQUEFY SO THAT THE MATERIAL TAKES ON THE CHARACTERISTICS OF A FLUID.

REF. 15 ALSO CONTAINS A DEFINITION FOR LIQUEFACTION WHICH INDICATES THE NECESSITY OF A COHESIONLESS SOIL FOR THIS PHENOMENON TO OCCUR. *

NOTE: KEY WORD IS COHESIONLESS SOIL, i.e., SAND.
TYPICALLY CLEAN, UNIFORM SANDS ARE MOST LIKELY TO LIQUEFY.

FROM REF 1, 140 SAMPLES WERE OBTAINED AND CLASSIFIED.

139 OF 140 SAMPLES (99%) HAD A SOIL DESCRIPTION OF CLAY.

1 OF 140 SAMPLES (1%) HAD A SOIL DESCRIPTION OF SILTY SAND, brown w/SILTY CLAY (BORING NO. 1 AT DEPTH = 42. FT). THIS ONE SAMPLE OBVIOUSLY REPRESENTS AN ISOLATED LENSE OF SAND — THERE IS NO EVIDENCE OF CONTINUITY OF THIS MATERIAL SINCE NO OTHER SAMPLE CLASSIFIED AS SAND.

* Minor editorial revisions on 5-8-95 for clarification of text to eliminate any copyright concerns.

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THE 140 SAMPLES CLASSIFIED IN REF. 1 REPRESENTS THE IN-SITU NATURAL SOIL FOUNDATION FOR THE LANDFILL

AND

THE SOIL THAT WILL BE INTERMIXED WITH THE WASTE AS DAILY COVER, CELL FILL, ETC.

CONCLUSION — THERE IS ONLY ±1% OF THE SOIL ENCOUNTERED THAT WOULD EVEN BE CONSIDERED AS COHESIONLESS. (THIS MATERIAL HAD AN EXTREMELY HIGH STANDARD PENETRATION TEST "N" VALUE OF 44, AND CONTAINED SILTY CLAY).

ADDITIONALLY, A COHESIONLESS SOIL MUST BE SATURATED IN ORDER TO LIQUEFY. REF. 1 STATES "FREE WATER WAS NOT ENCOUNTERED IN ANY OF THE BORINGS".

√ THEREFORE, LIQUEFACTION IS NOT A POSSIBILITY AT THIS SITE AND IS NOT A CONCERN.

FROM REF. 2, EVALUATE THE FOLLOWING STATEMENT.

It has been shown that clay soils generally will not liquefy, however, recent studies conducted in China have shown that certain types of clayey soils are vulnerable to substantial strength loss as a result of earthquake vibration. These type of clayey soils generally have the following characteristics:

Percent finer than 0.005 mm < 15%	
liquid limit	< 35
Water Content	> .9 x liquid limit

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FROM REF. 1

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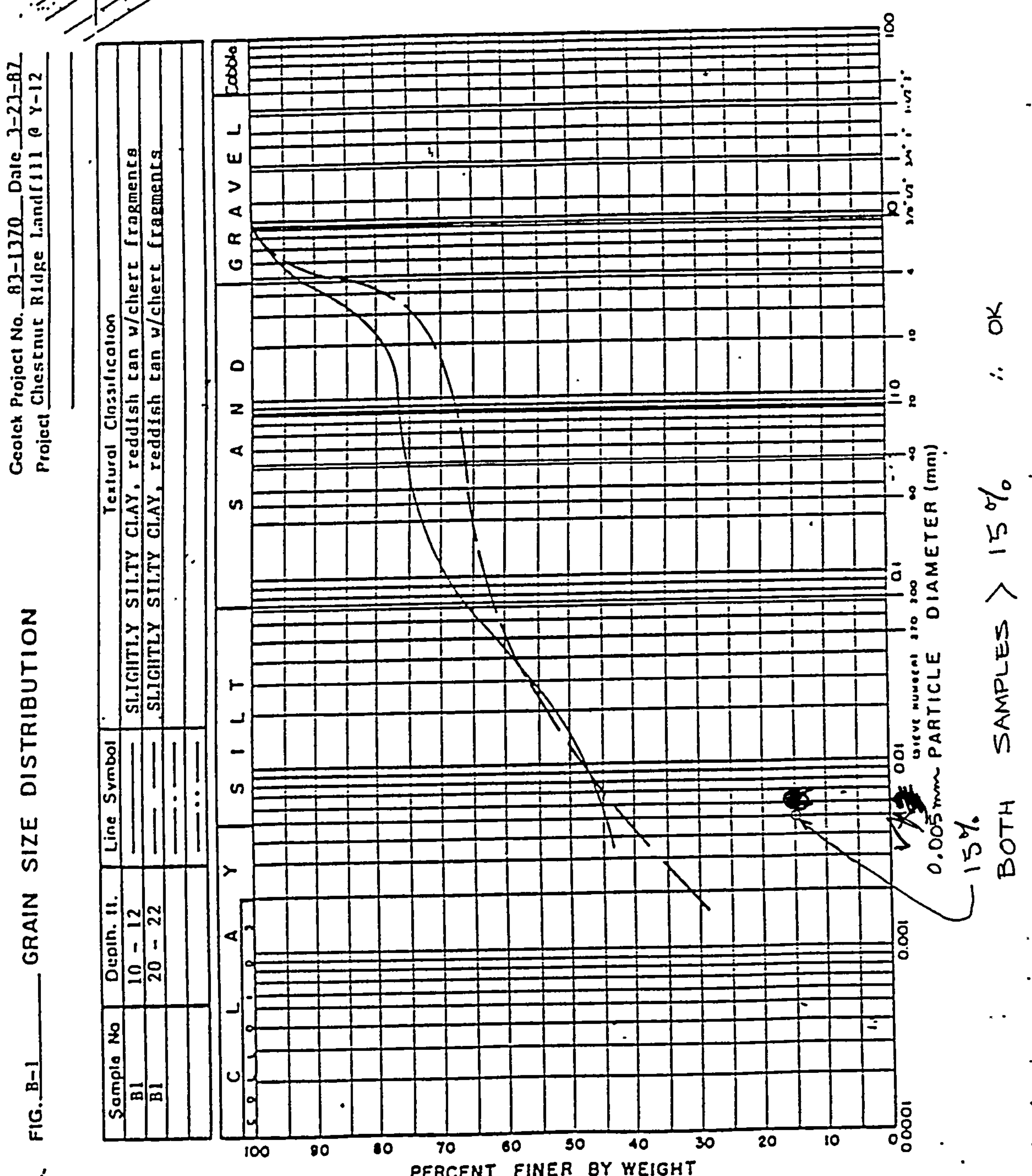

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JOB SEISMIC ANALYSIS OF LANDFILL IV	DATE 4-4-95	SHEET 79 of 94
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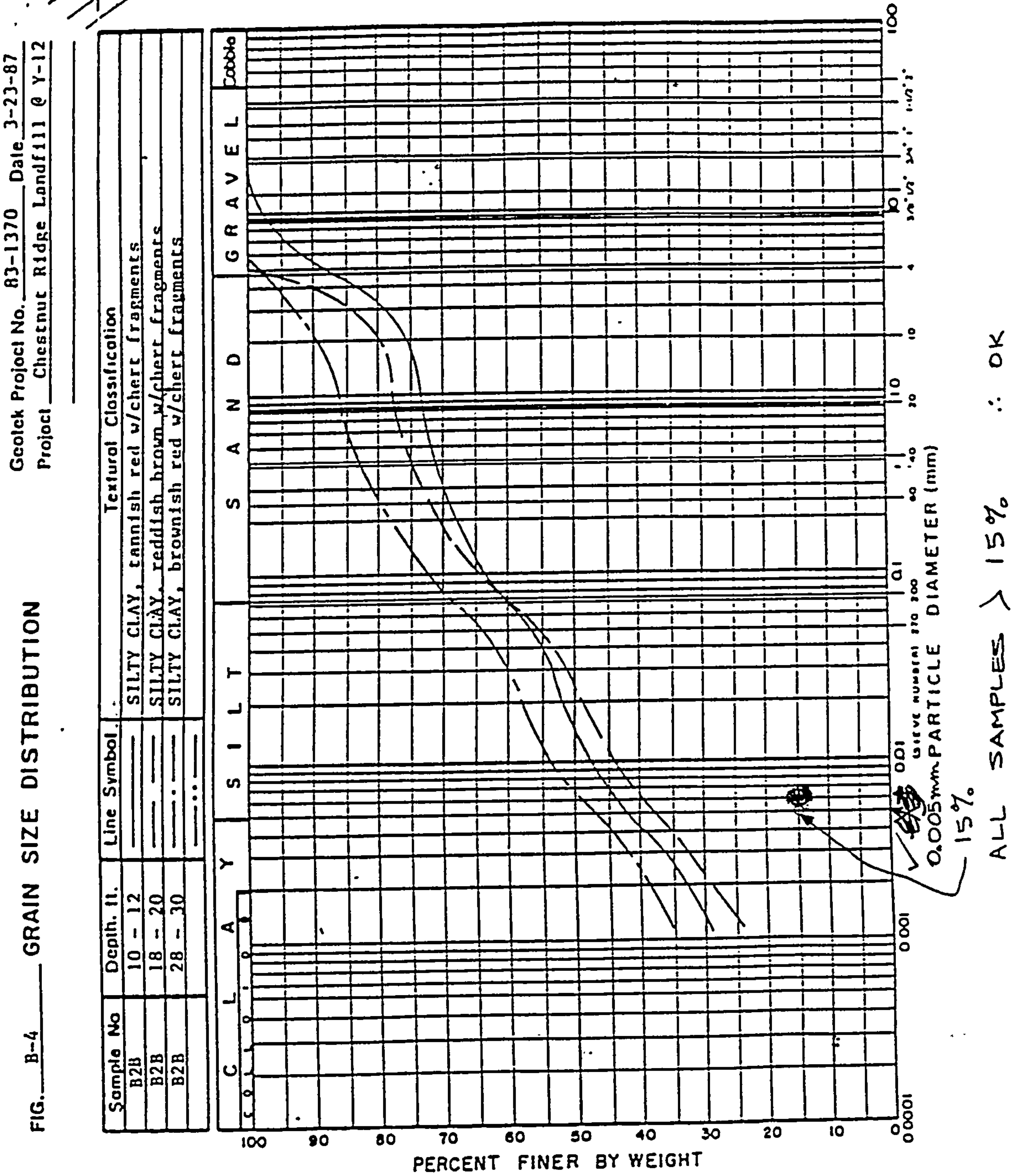

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GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	4-4-95	80 of 94
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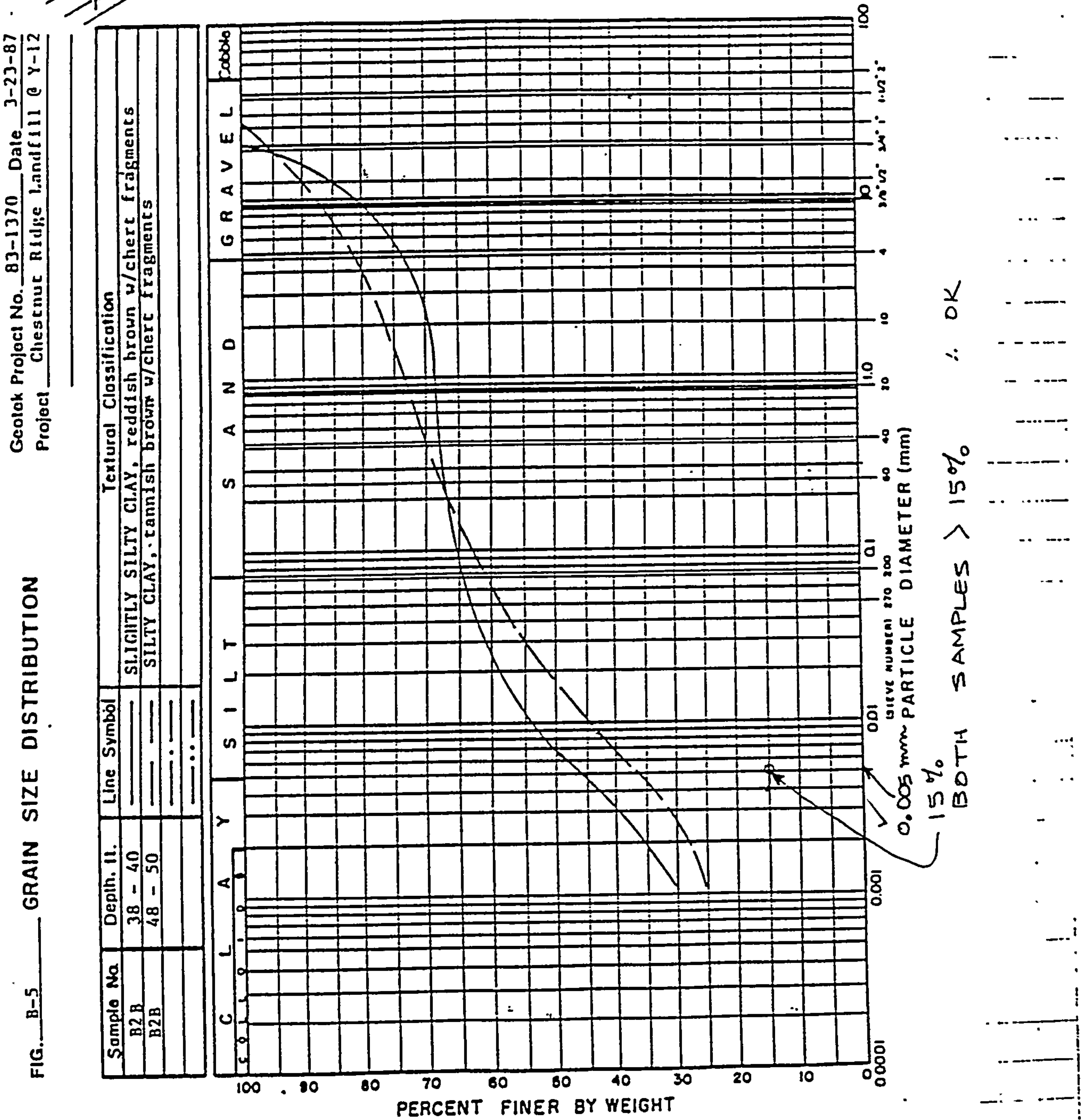

GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	4-4-95	81 of 94

ESO NO.	COMPUTED	CHECKED BY
ES-0.7-2 CIVIL ENGINEERING	S.D. STONE	S. B. Ahmed 4-12-95

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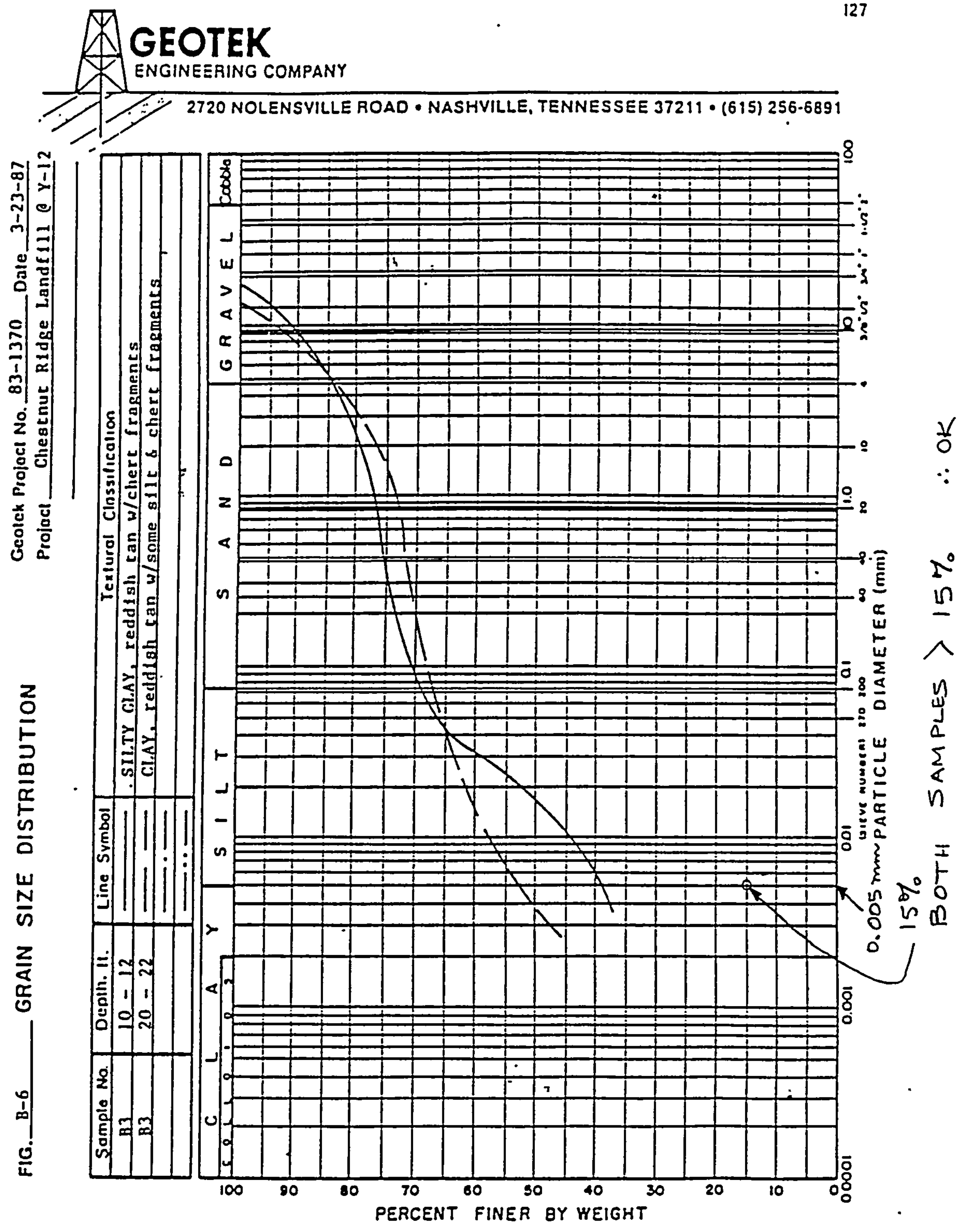

GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	4-4-95	82 of 94

ESO NO.	COMPUTED	CHECKED BY
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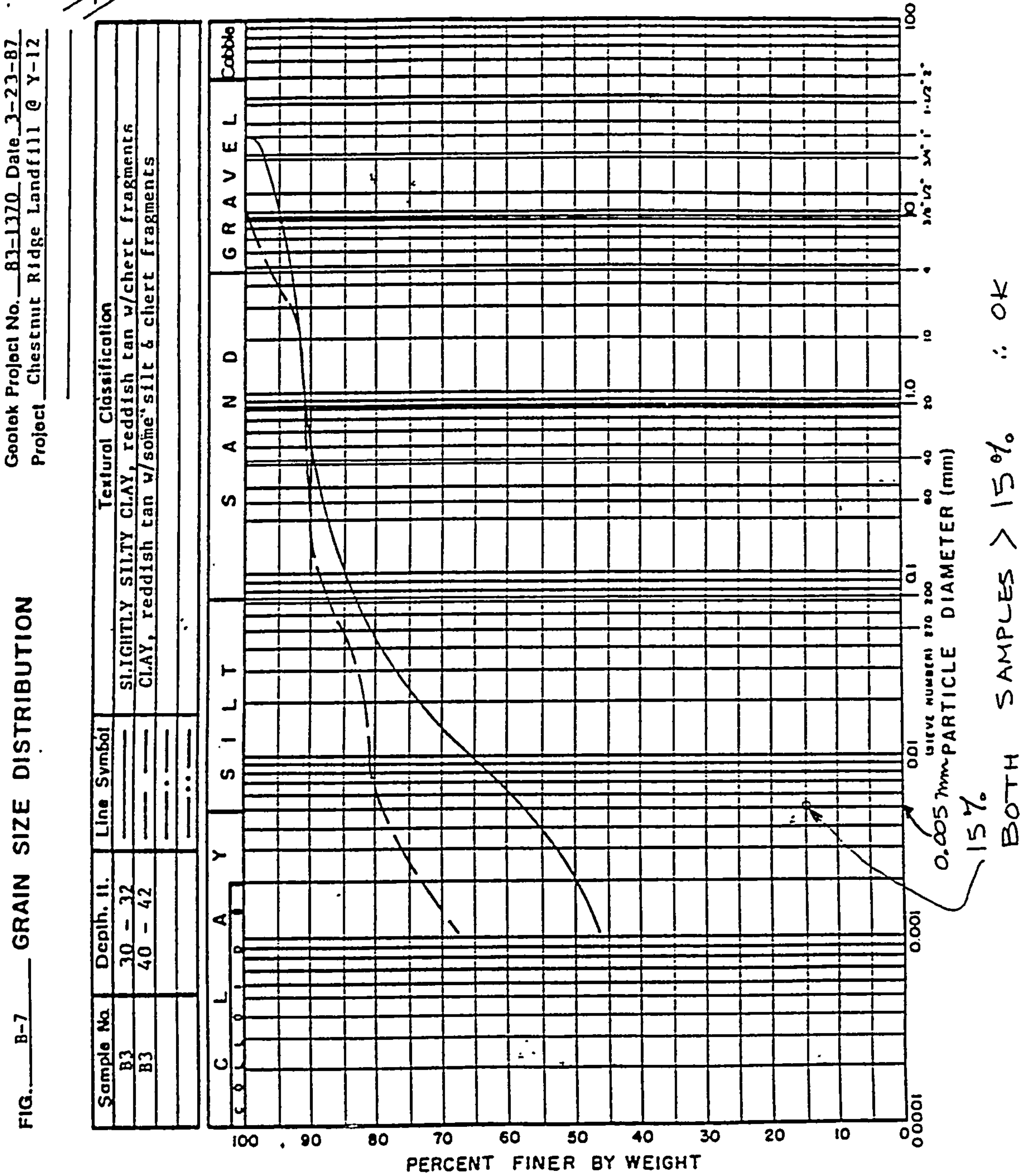
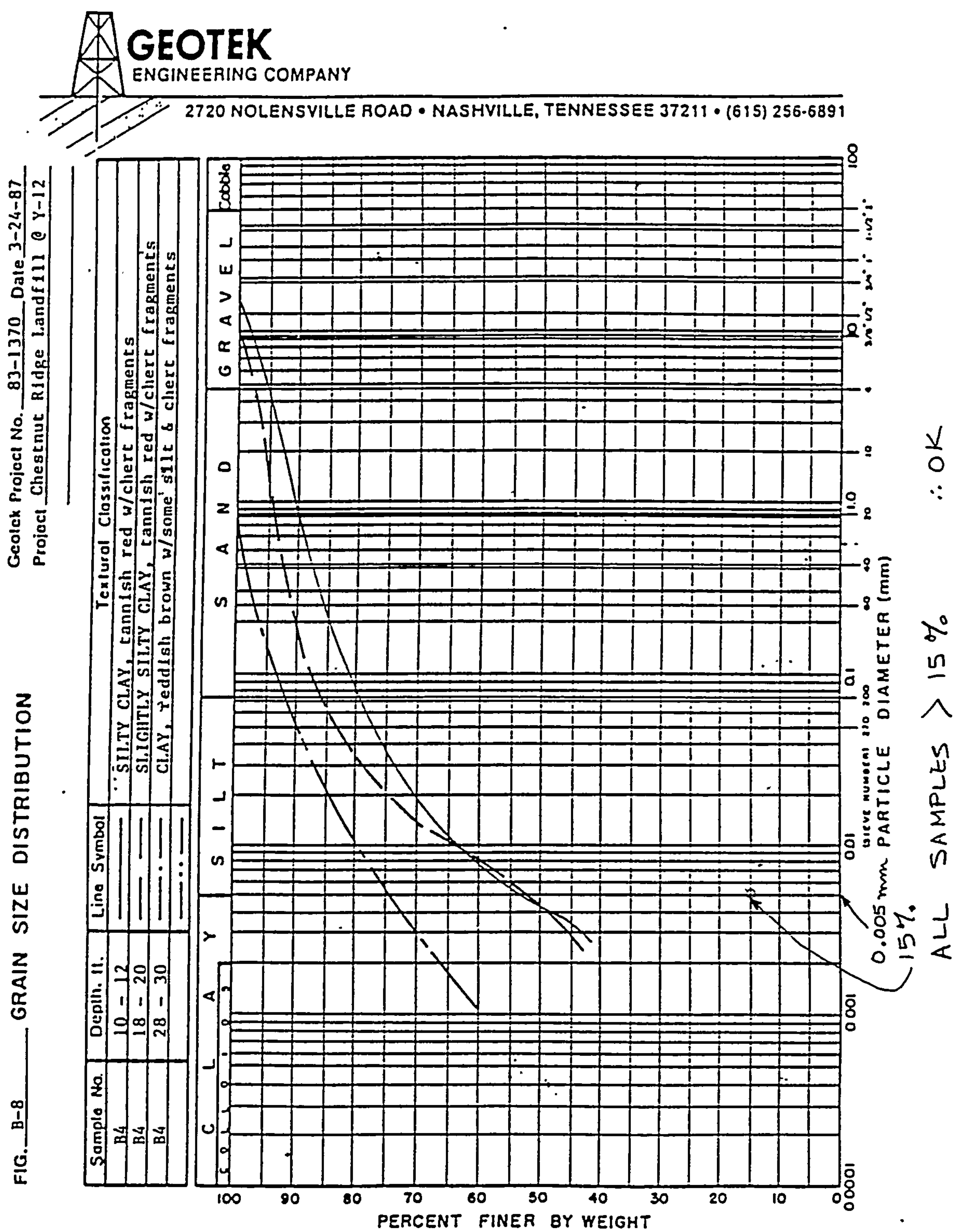


GENERAL DESIGN AND COMPUTATION SHEET

JOB: SEISMIC ANALYSIS OF LANDFILL IV	DATE: 4-4-95	SHEET 83 of 94
ESO NO.: ES-0.7-2 CIVIL ENGINEERING	COMPUTED: S.D. STONE	CHECKED BY: S.B. Ahmed 4-12-95



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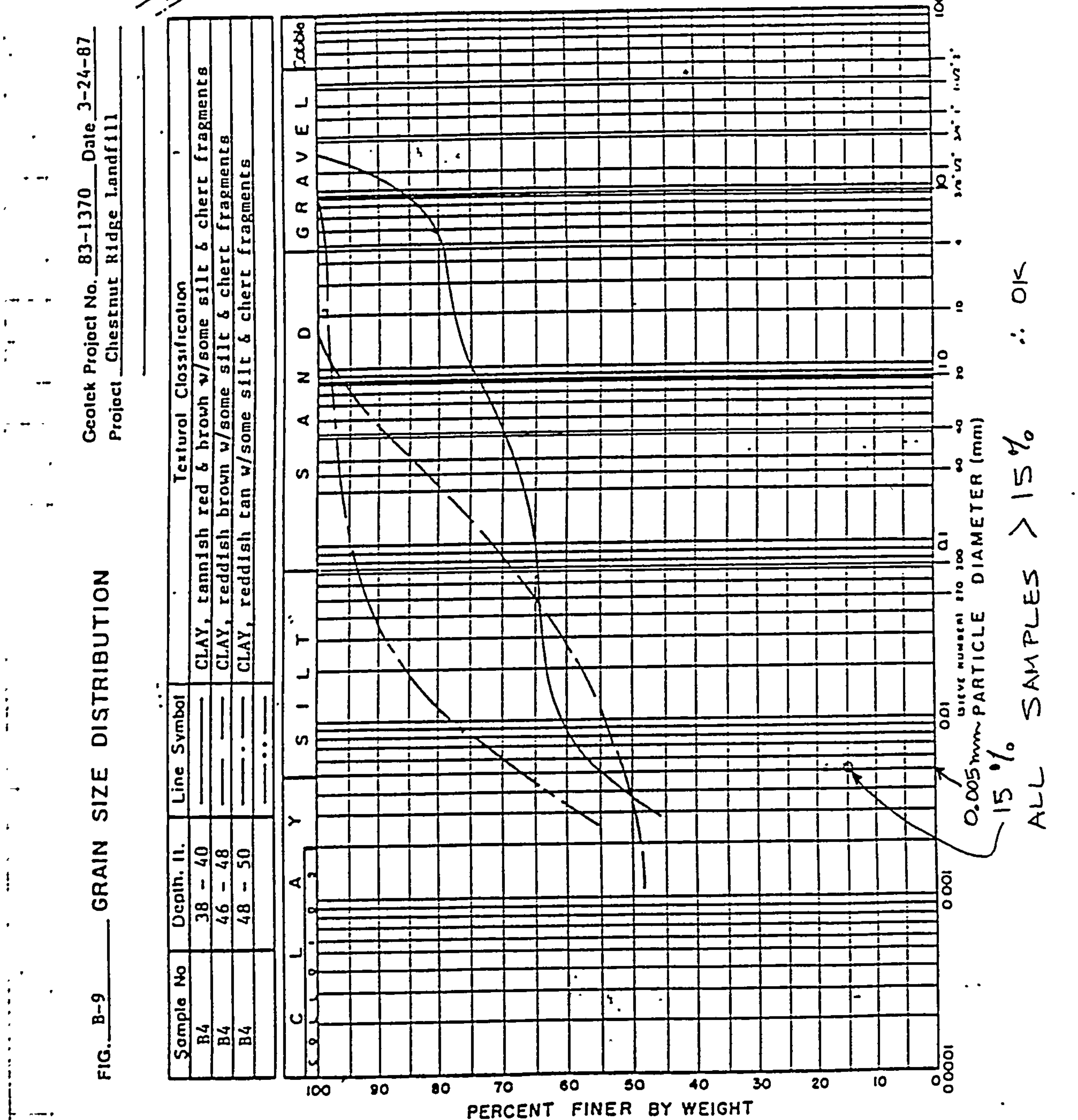

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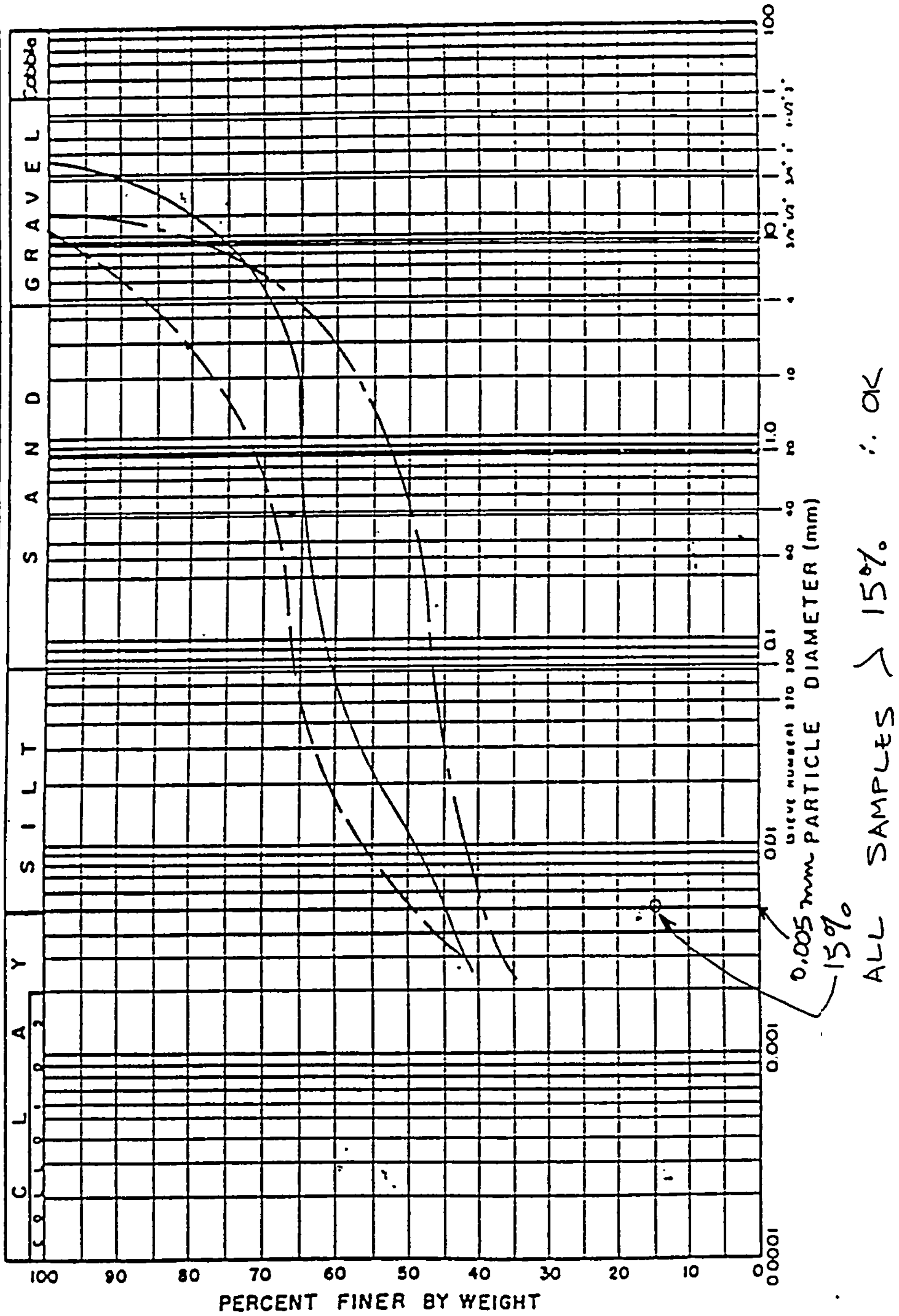
FIG. B-10 GRAIN SIZE DISTRIBUTION

Geotek Project No. 83-1370 Date 3-23-87
Project Chestnut Ridge Landfill @ Y-12

Sample No	Depth, ft.	Line Symbol	Textural Classification
B5	8 - 10	———	SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
B5	18 - 20	— — —	CLAY, reddish tan w/some silt & chert fragments
B5	28 - 30	—·—·—	CLAY, reddish tan w/some silt & chert fragments



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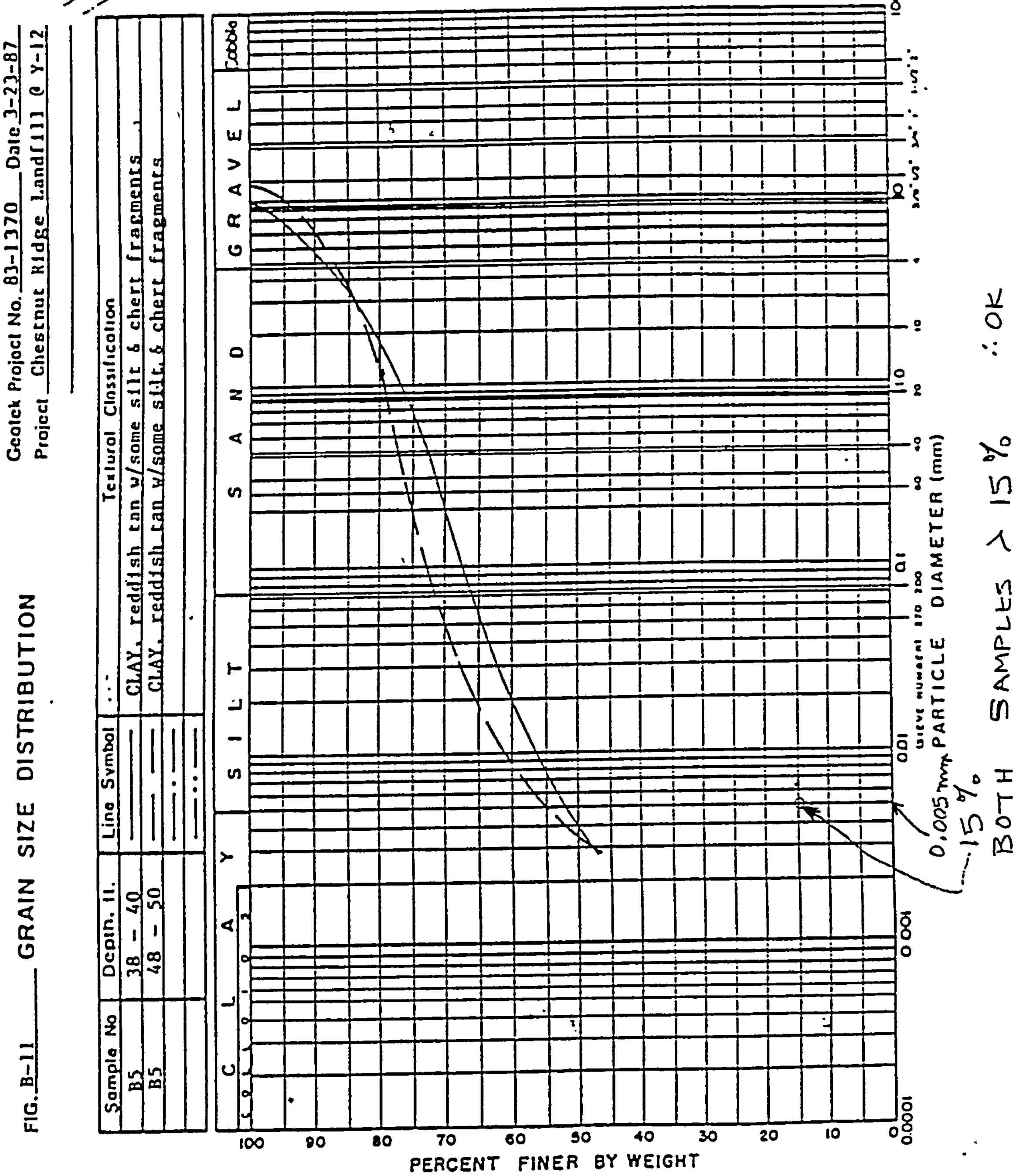

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JOB SEISMIC ANALYSIS OF LANDFILL IV		DATE 4-4-95	SHEET 87 of 94
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FIRST CRITERIA

CONCLUSION — EVERY SAMPLE TESTED HAD A SUBSTANTIAL PERCENT FINER THAN 0.005 mm, i.e., MUCH MORE THAN 15% CRITERIA.

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FROM REF. 1

TABLE 8-1: SOIL DESCRIPTION AND INDEX DATA

BORING NUMBER	DEPTH OF SAMPLE, ft	N-VALUE	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT	0.9 X LIQUID LIMIT	PLASTICITY INDEX	SOIL DESCRIPTION
1	0.0 - 2.0	8	33.4	65.8	59.2	37.4	CLAY, reddish tan w/some silt & chert fragments
	2.0 - 4.0	39	31.4				CLAY, reddish tan w/some silt & chert fragments
	4.0 - 6.0	22	34.3	61.2	55.1	33.1	CLAY, reddish tan w/some silt & chert fragments
	6.0 - 8.0	27	30.8				CLAY, reddish tan w/some silt & chert fragments
	8.0 -10.0	44	30.7	64.5	58.1	35.6	CLAY, reddish tan w/some silt & chert fragments
	10.0 -12.0		30.5	53.1	47.8	22.1	SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	12.0 -14.0	28	29.8				CLAY, reddish tan w/some silt & chert fragments
	14.0 -16.0	33	32.5	62.1	55.9	35.2	CLAY, reddish tan w/some silt & chert fragments
	16.0 -18.0	26	28.5				CLAY, reddish tan w/some silt & chert fragments
	18.0 -20.0	29	29.2	72.5	65.3	42.9	CLAY, reddish tan w/some silt & chert fragments
	20.0 -22.0		29.3	51.6	46.4	23.1	SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	22.0 -24.0	29	31.0				CLAY, reddish tan w/some silt & chert fragments
	24.0 -26.0	27	25.7	62.2	56.0	36.0	CLAY, reddish tan w/some silt & chert fragments
	26.0 -28.0	22	30.1				CLAY, reddish tan w/some silt & chert fragments
	28.0 -30.0	18	32.0	75.6	68.0	42.9	CLAY, reddish tan w/some silt & chert fragments
	30.0 -32.0		23.9	55.4	49.9	24.6	SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	32.0 -34.0	17	41.3				CLAY, reddish tan w/some silt & chert fragments
	34.0 -36.0	24	33.9	79.2	71.3	49.9	CLAY, reddish tan w/some silt & chert fragments
	36.0 -38.0	18	30.1				CLAY, reddish tan w/some silt & chert fragments
	38.0 -40.0	21	32.5	61.6	55.4	34.2	CLAY, reddish tan w/some silt & chert fragments
	40.0 -42.0		33.4	64.5	58.1	33.5	CLAY, reddish tan w/some silt & chert fragments
	40.0 -42.0 (cuttings)		27.4	71.3	64.2	52.2	CLAY, reddish tan w/some silt & chert fragments
	42.0 -44.0	44	9.7				SILTY SAND, brown w/silty clay
	44.0 -45.3	89+	29.3	32.3	29.1	17.1	CLAY, reddish tan w/some silt & chert fragments
2A	0.0 - 2.0	13	23.9	37.4	33.7	12.4	SILTY CLAY, reddish tan w/chert fragments
	2.0 - 4.0	76	19.3				SILTY CLAY, reddish tan w/chert fragments
	4.0 - 6.0	54	20.3	44.0	39.6	19.4	SILTY CLAY, reddish tan w/chert fragments
	6.0 - 8.0	46	18.4				SILTY CLAY, reddish tan w/chert fragments
	8.0 -10.0	64	22.4	51.2	46.1	19.0	SILTY CLAY, reddish tan w/chert fragments
	10.0 -12.0		17.4	43.7	39.3	19.2	SILTY CLAY, reddish tan w/chert fragments
	12.0 -14.0	63	20.8				SILTY CLAY, reddish tan w/chert fragments
	14.0 -16.0	48	24.1	51.2	46.1	26.2	SILTY CLAY, reddish tan w/chert fragments
	16.0 -18.0	41	18.2				SILTY CLAY, reddish tan w/chert fragments
	18.0 -20.0	32	22.9	46.9	42.2	20.7	SILTY CLAY, reddish tan w/chert fragments
	20.0 -22.0		25.3	54.8	49.3	25.9	SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	22.0 -24.0	45	23.0				SLIGHTLY SILTY CLAY, reddish brown w/chert fragments
	24.0 -26.0	65+	24.3	52.1	46.9	25.9	SLIGHTLY SILTY CLAY, reddish brown w/chert fragments

THIS COLUMN 1 LL < 35

THIS COLUMN 1 NAT. MOIST CONT. > 0.9LL

GENERAL DESIGN AND COMPUTATION SHEET

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SEISMIC ANALYSIS OF LANDFILL IV	4-4-95	89 of 94

ESO NO.	COMPUTED	CHECKED BY
ES-0.7-2 CIVIL ENGINEERING	S.D. STONE	S. B. Ahmed 4-12-95

TABLE 8-1: SOIL DESCRIPTION AND INDEX DATA

BORING NUMBER	DEPTH OF SAMPLE, ft	N-VALUE	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT	0.9 x LIQUID LIMIT	PLASTICITY INDEX	SOIL DESCRIPTION
28	0.0 - 2.0	11	18.8	22.5	20.1	6.9	SILTY CLAY, brown w/some topsoil & chert fragments
	2.0 - 4.0	14	19.7				SILTY CLAY, brown w/some topsoil & chert fragments
	4.0 - 6.0	17	23.4				SILTY CLAY, reddish brown w/chert fragments
	6.0 - 8.0	50	15.5				SILTY CLAY, reddish brown w/chert fragments
	8.0 -10.0	49	15.7	51.1	46.0	24.4	SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	10.0 -12.0		17.0	44.1	39.7	23.9	SILTY CLAY, tannish red w/chert fragments
	10.0 -12.0 (cuttings)		17.0	41.0	36.9	18.8	SILTY CLAY, tannish red w/chert fragments
	12.0 -14.0	26	24.4				SILTY CLAY, tannish brown w/chert fragments
	14.0 -16.0	30	25.6	51.1	46.0	23.1	SLIGHTLY SILTY CLAY, reddish brown w/chert fragments
	16.0 -18.0	42	27.4				SLIGHTLY SILTY CLAY, reddish brown w/chert fragments
	18.0 -20.0	32	27.0	42.6	38.3	21.2	SILTY CLAY, reddish brown w/chert fragments
	20.0 -22.0	18	29.0	51.1	46.0	21.5	SLIGHTLY SILTY CLAY, reddish brown w/chert fragments
	22.0 -24.0	33	18.1				SLIGHTLY SILTY CLAY, tannish brown w/chert fragments
	24.0 -26.0	21	24.2				SLIGHTLY SILTY CLAY, brown w/chert fragments
	26.0 -28.0	24	21.6	52.1	46.9	26.2	SLIGHTLY SILTY CLAY, brownish red w/chert fragments
	28.0 -30.0		23.5	43.2	38.9	23.2	SILTY CLAY, brownish red w/chert fragments
	30.0 -32.0	22	33.7	56.7	51.0	31.1	SLIGHTLY SILTY CLAY, brownish red w/chert fragments
	32.0 -34.0	26	29.4				SLIGHTLY SILTY CLAY, tannish brown w/chert fragments
	34.0 -36.0	21	33.9	71.8	64.6	37.1	CLAY, brownish red w/some silt & chert fragments
	36.0 -38.0	25	21.4				SLIGHTLY SILTY CLAY, reddish brown w/chert fragments
	38.0 -40.0		29.2	56.2	50.6	32.0	SLIGHTLY SILTY CLAY, reddish brown w/chert fragments
	40.0 -42.0	26	28.4	60.8	54.7	37.9	SLIGHTLY SILTY CLAY, brown w/chert fragments
	42.0 -44.0	24	30.0				SLIGHTLY SILTY CLAY, tannish brown w/chert fragments
	44.0 -46.0	21	28.8	55.4	49.9	26.3	SLIGHTLY SILTY CLAY, tannish brown w/chert fragments
	46.0 -48.0	29	27.5				SLIGHTLY SILTY CLAY, tannish brown w/chert fragments
	48.0 -50.0		22.6	43.1	38.8	20.3	SILTY CLAY, tannish brown w/chert fragments
3	0.0 - 2.0	13	23.3	44.8	40.3	18.7	SILTY CLAY, reddish tan w/chert fragments
	2.0 - 4.0	36	26.9	45.8	41.2	19.5	SILTY CLAY, reddish tan w/chert fragments
	4.0 - 6.0	30	24.1				SILTY CLAY, reddish tan w/chert fragments
	6.0 - 8.0	28	24.9	47.5	42.8	21.2	SILTY CLAY, reddish tan w/chert fragments
	8.0 -10.0	42	25.5				SILTY CLAY, reddish tan w/chert fragments
	10.0 -12.0		24.8	47.0	42.3	17.3	SILTY CLAY, reddish tan w/chert fragments
	12.0 -14.0	54	21.1	54.6	49.1	27.0	SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	14.0 -16.0	61	25.1				SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	16.0 -18.0	41	24.6	56.8	51.1	27.9	SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	18.0 -20.0	24	34.7	59.4	53.5	24.3	CLAY, reddish tan w/some silt & chert fragments
	20.0 -22.0		36.5	60.0	54.0	21.9	CLAY, reddish tan w/some silt & chert fragments
	22.0 -24.0	35	27.8	56.1	50.5	23.6	CLAY, reddish tan w/some silt & chert fragments
	24.0 -26.0	42	26.3				CLAY, reddish tan w/some vilt & chert fragments
	26.0 -28.0	41	23.2				SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	28.0 -30.0	36	27.0	54.3	48.9	29.9	SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	30.0 -32.0		28.7	52.9	47.6	28.5	SLIGHTLY SILTY CLAY, reddish tan w/chert fragments

THIS COLUMN 1 LL < 35

THIS COLUMN NO NAT. MOIST CONT. > 0.9LL

GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	4-4-95	90 of 94
ESO NO. ES-0.7-2 CIVIL ENGINEERING; COMPUTED S.D. STONE	CHECKED BY S.B. Ahmed 4-12-95	

TABLE B-1: SOIL DESCRIPTION AND INDEX DATA

BORING NUMBER	DEPTH OF SAMPLE, ft	N-VALUE	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT	0.9X LIQUID LIMIT	PLASTICITY INDEX	SOIL DESCRIPTION
	32.0 -34.0	28	26.1				SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	34.0 -36.0	27	27.7	58.0	52.2	30.9	SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	36.0 -38.0	25	25.6				SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	38.0 -40.0	26	32.8	64.9	58.4	36.7	CLAY, reddish tan w/some silt & chert fragments
	40.0 -42.0		30.5	67.2	60.5	35.8	CLAY, reddish tan w/some silt & chert fragments
	40.0 -42.0 (cuttings)		30.5	56.7	51.0	32.0	CLAY, reddish tan w/some silt & chert fragments
	42.0 -44.0	29	33.5				CLAY, reddish tan w/some silt & chert fragments
	44.0 -46.0	22	40.4	57.5	51.8	31.0	CLAY, reddish tan w/some silt & chert fragments
	46.0 -48.0	31	33.9				CLAY, reddish tan w/some silt & chert fragments
4	0.0 - 2.0	9	22.8	33.3	30.0	14.8	SILTY CLAY, reddish brown w/chert fragments
	2.0 - 4.0	28	26.6				SILTY CLAY, reddish brown w/chert fragments
	4.0 - 6.0	29	32.9	54.1	48.7	20.3	SLIGHTLY SILTY CLAY, reddish brown w/chert fragments
	6.0 - 8.0	19	28.2				SILTY CLAY, reddish brown w/chert fragments
	8.0 -10.0	38	30.9	59.7	53.7	24.2	SLIGHTLY SILTY CLAY, reddish brown w/chert fragments
	10.0 -12.0		23.3	51.5	46.4	21.5	SILTY CLAY, tannish red w/chert fragments
	12.0 -14.0	38	27.7				SILTY CLAY, tannish red w/chert fragments
	14.0 -16.0	28	30.8	59.3	53.4	26.9	SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	16.0 -18.0	26	34.3				SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	18.0 -20.0		27.3	58.6	52.7	29.3	SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	20.0 -22.0	28	32.0	55.3	49.8	26.5	SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	22.0 -24.0	24	23.3				SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	24.0 -26.0	24	35.9	68.9	62.0	36.3	CLAY, reddish brown w/some silt & chert fragments
	26.0 -28.0	20	35.2				CLAY, reddish brown w/some silt & chert fragments
	28.0 -30.0		35.9	63.3	57.0	35.2	CLAY, reddish brown w/some silt & chert fragments
	30.0 -32.0	21	34.1				CLAY, reddish brown w/some silt & chert fragments
	32.0 -34.0	26	32.5				SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	34.0 -36.0	24	30.3	55.5	50.0	26.1	SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	36.0 -38.0	17	26.3				SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	38.0 -40.0		23.8	57.7	51.9	29.2	CLAY, tannish red & brown w/some silt & chert fragments
	40.0 -42.0	16	30.9	52.7	47.4	28.6	CLAY, tannish red & brown w/some silt & chert fragments
	42.0 -44.0	18	25.5	61.1	55.0	34.2	CLAY, tannish red & brown w/some silt & chert fragments
	42.0 -44.0 (cuttings)		28.1	64.1	57.7	35.8	CLAY, reddish tan & brown w/some silt & chert fragments
	44.0 -46.0	20	31.5	57.7	51.9	30.1	CLAY, tannish red & brown w/some silt & chert fragments
	46.0 -48.0	17	36.0				CLAY, reddish brown w/some silt & chert fragments
	48.0 -50.0		37.7	56.8	51.1	29.9	CLAY, reddish tan w/some silt & chert fragments

THIS COLUMN 1 LL < 35

THIS COLUMN NO. NAT. MOIST CONT. >0.9LL

GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	4-4-95	91 of 94

ESO NO	COMPUTED	CHECKED BY
ES-0.7-2 CIVIL ENGINEERING	S.D. STONE	S. B. Ahmed 4-12-95

TABLE 8-1: SOIL DESCRIPTION AND INDEX DATA

BORING NUMBER	DEPTH OF SAMPLE, ft	N-VALUE	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT	0.9 X LIQUID LIMIT	PLASTICITY INDEX	SOIL DESCRIPTION
5	0.0 - 2.0	9	29.6	48.2	43.4	16.3	SILTY CLAY, tannish red w/chert fragments
	2.0 - 4.0	12	23.8				SILTY CLAY, tannish red w/chert fragments
	4.0 - 6.0	18	24.6	49.0	44.1	17.8	SILTY CLAY, tannish red w/chert fragments
	6.0 - 8.0	27	27.1	51.6	46.4	18.9	SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	8.0 -10.0		26.7	54.2	48.8	18.6	SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	10.0 -12.0	24	22.6				SLIGHTLY SILTY CLAY, tannish red w/chert fragments
	12.0 -14.0	33	24.2	52.4	47.2	19.5	SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	14.0 -16.0	25	26.2				SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	16.0 -18.0	30	23.1	54.6	49.1	18.9	SLIGHTLY SILTY CLAY, reddish tan w/chert fragments
	18.0 -20.0		30.1	59.5	53.6	18.8	CLAY, reddish tan w/some silt & chert fragments
	20.0 -22.0	34	29.1	63.9	57.5	28.9	CLAY, reddish tan w/some silt & chert fragments
	22.0 -24.0	33	28.6				CLAY, reddish tan w/some silt & chert fragments
	24.0 -26.0	30	22.6	58.7	52.8	25.8	CLAY, reddish tan w/some silt & chert fragments
	26.0 -28.0	25	23.1	58.6	52.7	23.2	CLAY, reddish tan w/some silt & chert fragments
	20.0 -27.0 (cuttings)		27.8	62.9	56.6	34.0	CLAY, reddish tan w/some silt & chert fragments
	28.0 -30.0		22.2	60.1	54.1	22.6	CLAY, reddish tan w/some silt & chert fragments
	30.0 -32.0	35	22.4	59.6	53.6	24.5	CLAY, reddish tan w/some silt & chert fragments
	32.0 -34.0	22	26.5				CLAY, reddish tan w/some silt & chert fragments
	34.0 -36.0	24	21.8	58.4	52.6	23.9	CLAY, reddish tan w/some silt & chert fragments
	36.0 -38.0	29	34.7				CLAY, reddish tan w/some silt & chert fragments
	38.0 -40.0		23.9	64.6	58.1	33.1	CLAY, reddish tan w/some silt & chert fragments
	40.0 -42.0	42	32.3	68.7	61.8	39.9	CLAY, reddish tan w/some silt & chert fragments
	42.0 -44.0	48	37.5	68.0	61.2	37.4	CLAY, reddish tan w/some silt & chert fragments
	44.0 -46.0	42	37.7				CLAY, reddish tan w/some silt & chert fragments
	46.0 -48.0	48	38.7				CLAY, reddish tan w/some silt & chert fragments
	48.0 -50.0		29.8	65.8	59.2	37.0	CLAY, reddish tan w/some silt & chert fragments

THIS COLUMN
NO LL < 35

THIS COLUMN
NO NAT. MOIST CONT. > 0.9LL

UCN-4032A
(5 2-84)

GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	4-4-95	92 of 94

ESO NO.	COMPUTED	CHECKED BY
ES-0.7-2 CIVIL ENGINEERING	S.D. STONE	S.B. Ahmed 4-12-95

SECOND CRITERIA,

LIQUID LIMIT < 35

THERE WERE 88 SAMPLES THAT HAD LIQUID LIMIT TESTS.

ONLY 3 OF 88 SAMPLES (3.5% ±) HAD LIQUID LIMITS LESS THAN 35. THESE THREE SAMPLES WERE WIDELY DISPERSED AND SHOWED NO CONTINUITY OR PATTERN (DEPTH, SPACING, ETC.). THEREFORE, IT CAN BE CONCLUDED THAT THERE SHOULD BE NO PROBLEM WITH LOW LIQUID LIMITS.

THIRD CRITERIA

NATURAL WATER CONTENT > 0.9 x LIQUID LIMIT.

ONLY 1 OF 88 SAMPLES (1.1% ±) HAD A NATURAL WATER CONTENT > 0.9 x LIQUID LIMIT. THIS IS AN INSIGNIFICANT PERCENTAGE.

BASED UPON THE THREE CHINESE CRITERIA, THE CLAY SOILS OF LANDFILL IV ARE NOT VULNERABLE TO SHEAR STRENGTH LOSS AS A RESULT OF EARTHQUAKE VIBRATION.

GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV	4-4-95	93 of 94
ESO NO. ES-0.7-2 CIVIL ENGINEERING	COMPUTED S.D. STONE	CHECKED BY S.B. Ahmed 4-12-95

TABLES OF RESULTS

SLOPE STABILITY

SECTION	STATIC FACTOR OF SAFETY	YIELD ACCELERATION, k_y	MAX. CREST ACCELERATION, $\ddot{u}_{MAX}$	THEORETICAL DISPLACEMENT, u
1 (GLOBAL)	3.798	0.41 g	(1)	(1)
1 (INTERFACE)	——	0.36g	0.622g	0.17 INCHES
2	2.339	0.40g	0.632g	0.13 INCHES

(1) NOT COMPUTED SINCE SECTION 1 (INTERFACE) CONTROLLED WITH LOWER YIELD ACCELERATION.

VENEER STABILITY

SECTION	CREST ACCELERATION	SEISMIC FACTOR OF SAFETY
1 (1 ON 5 SLOPE)	0.622g	0.37
2 (1 ON 10 SLOPE)	0.632 g	0.44
EAST END (1 ON 3 SLOPE)	0.632 g	0.28
EAST END (1 ON 3 SLOPE)	0.0g	STATIC F.S. = 1.03

GENERAL DESIGN AND COMPUTATION SHEET

JOB SEISMIC ANALYSIS OF LANDFILL IV	DATE 4-5-95	SHEET 94 OF 94
E.O. NO. ES-0-7-2 CIVIL ENGINEERING	COMPUTED S.D. STONE	CHECKED BY S. B. Ahmed 4-12-95

CONCLUSIONS

1 - THIS EVALUATION VERIFIES THAT LANDFILL IV MEETS THE SEISMIC REQUIREMENTS OF THE TENNESSEE DIVISION OF SOLID WASTE. "EARTHQUAKE EVALUATION GUIDANCE DOCUMENT".

2 - THE THEORETICAL DISPLACEMENTS OF 0.17 INCHES AND 0.13 INCHES CALCULATED IN THESE ANALYSES FOR THE DESIGN BASIS EARTHQUAKE ARE WELL BELOW THE LIMITING SEISMIC SLOPE STABILITY DESIGN CRITERIA IN THE "EARTHQUAKE EVALUATION GUIDANCE DOCUMENT", i.e., 6 INCHES OF DEFORMATION ASSOCIATED WITH LEACHATE COLLECTION SYSTEMS AND COLLECTION PIPES <u>AND</u> DEFORMATIONS EXCEEDING ONE-HALF THE THICKNESS OF THE CLAY LINER (12 " = 1/2 THE LINER THICKNESS FOR LANDFILL IV).

3 - THERE IS NO POTENTIAL FOR LIQUEFACTION FOR LANDFILL IV DUE TO THE ABSENCE OF COHESIONLESS SOILS AT THE SITE.

4 - THERE IS NO POTENTIAL FOR LOSS OR REDUCTION OF SHEAR STRENGTH FOR THE CLAYS FOUND AT THIS SITE AS A RESULT OF EARTHQUAKE VIBRATION.

5 - THE VEGETATIVE COVER LOCATED ON SLOPES WILL MOST LIKELY BE DISPLACED AND MOVE DURING A LARGE SEISMIC EVENT SUCH AS THE EARTHQUAKE RÉQUIRED IN THIS ANALYSIS. MOVEMENT OF THE VEGETATIVE COVER IS NOT CONSIDERED A SERIOUS DEFICIENCY BECAUSE:

a - DISPLACED VEGETATIVE COVER WOULD BE EASILY SEEN AND RECOGNIZED DURING AN INSPECTION.

b - THE VEGETATIVE COVER WOULD BE EASY TO RESTORE SINCE IT IS A COSMETIC, SURFACE REPAIR.

c - THE VEGETATIVE COVER HAS NO ENGINEERING SIGNIFICANCE TO THE STRUCTURAL STABILITY OF THE LANDFILL.

d - THERE WOULD BE NO RELEASE OF WASTE TO THE ENVIRONMENT.

GENERAL DESIGN AND COMPUTATION SHEET

JOB	DATE	SHEET
SEISMIC ANALYSIS OF LANDFILL IV		of
ESO NO: ES-0.7-2 CIVIL ENGINEERING	COMPUTED: S.D. STONE	CHECKED BY:

LEGEND FOR NAMING STABL5M FILES

EXAMPLES:

CROSS SECTION 2

INPUT FILE

LFIV240G.IN

LANDFILL IV

0.40g ACCELERATION

CROSS SECTION 1

OUTPUT FILE

LFIV135G.OUT

LANDFILL IV

0.35g ACCELERATION

```
PROFIL
atitest.in
6 5
0. 68. 22. 67. 1
22. 67. 38. 63. 1
38. 63. 101. 88. 1
101. 88. 138. 103. 2
138. 103. 205. 110. 2
101. 88. 205. 99. 1
SOIL
2
116.4 124.2 500. 14. 0. 0. 1
116.4 116.4 0. 0. 0. 0. 1
WATER
1 0.
9
0. 68.
22. 67.
38. 63.
63. 73.
83. 78.
104. 82.
122. 85.
140. 87.
205. 93.
LIMITS
8 8
0. 15. 29. 24.
29. 24. 51. 26.
51. 26. 78. 56.
78. 56. 94. 65.
94. 65. 113. 64.
113. 64. 133. 56.
133. 56. 161. 58.
161. 58. 205. 76.
CIRCLE
1 2
10 10
38. 70. 120. 180.
0. 10. 0. 0.
```

** PCSTABL5M **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

```
Run Date:                 ~~5~~ 3/15/95
Time of Run:          SDL 3:15
Run By:                   sds
Input Data Filename:      atitest.in
Output Filename:          atitest.out
```

PROBLEM DESCRIPTION   atitest.in

BOUNDARY COORDINATES

5 Top   Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	68.00	22.00	67.00	1
2	22.00	67.00	38.00	63.00	1
3	38.00	63.00	101.00	88.00	1
4	101.00	88.00	138.00	103.00	2
5	138.00	103.00	205.00	110.00	2
6	101.00	88.00	205.00	99.00	1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	116.4	124.2	500.0	14.0	.00	.0	1
2	116.4	116.4	.0	.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	68.00
2	22.00	67.00
3	38.00	63.00
4	63.00	73.00
5	83.00	78.00
6	104.00	82.00
7	122.00	85.00
8	140.00	87.00
9	205.00	93.00

Searching Routine Will Be Limited To An Area Defined By 8 Boundaries Of Which The First 8 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)

1	.00	15.00	29.00	24.00
2	29.00	24.00	51.00	26.00
3	51.00	26.00	78.00	56.00
4	78.00	56.00	94.00	65.00
5	94.00	65.00	113.00	64.00
6	113.00	64.00	133.00	56.00
7	133.00	56.00	161.00	58.00
8	161.00	58.00	205.00	76.00

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

Janbus Empirical Coef. is being used for the case of c & phi both > 0
100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 38.00 ft.
and X = 70.00 ft.

Each Surface Terminates Between X = 120.00 ft.
and X = 180.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = .00 ft.

10.00 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 Janbu Method * *

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	41.56	64.41
2	51.43	62.82
3	61.40	62.11
4	71.40	62.29
5	81.35	63.34
6	91.16	65.27
7	100.76	68.05

8	110.09	71.67
9	119.05	76.10
10	127.59	81.30
11	135.64	87.24
12	143.13	93.86
13	150.01	101.12
14	152.73	104.54

*** 1.371 ***

Individual data on the 21 slices

ce .	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
	9.9	3362.4	.0	1614.7	.0	.0	.0	.0	.0
	10.0	9673.2	.0	4587.9	.0	.0	.0	.0	.0
	1.6	2068.2	.0	978.5	.0	.0	.0	.0	.0
	8.4	12854.5	.0	6024.0	.0	.0	.0	.0	.0
	9.9	18860.2	.0	8194.0	.0	.0	.0	.0	.0
	1.7	3454.7	.0	1457.9	.0	.0	.0	.0	.0
	8.2	17999.6	.0	7295.3	.0	.0	.0	.0	.0
	9.6	22638.2	.0	8465.7	.0	.0	.0	.0	.0
	.2	569.2	.0	206.5	.0	.0	.0	.0	.0

3.0	7241.1	.0	2562.6	.0	.0	.0	.0	.0
6.1	14700.4	.0	4828.8	.0	.0	.0	.0	.0
9.0	21149.9	.0	6077.9	.0	.0	.0	.0	.0
2.9	6668.0	.0	1648.0	.0	.0	.0	.0	.0
5.6	11993.3	.0	2318.5	.0	.0	.0	.0	.0
6.9	13218.9	.0	1146.5	.0	.0	.0	.0	.0
1.2	2016.9	.0	.0	.0	.0	.0	.0	.0
2.4	3911.5	.0	.0	.0	.0	.0	.0	.0
3.3	4795.4	.0	.0	.0	.0	.0	.0	.0
1.8	2181.3	.0	.0	.0	.0	.0	.0	.0
6.9	5130.7	.0	.0	.0	.0	.0	.0	.0
2.7	495.4	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	38.00	63.00
2	47.77	60.88
3	57.72	59.84
4	67.72	59.89
5	77.65	61.04
6	87.40	63.27
7	96.85	66.55
8	105.88	70.84
9	114.38	76.10
10	122.26	82.26
11	129.42	89.24

12	135.77	96.96
13	139.84	103.19

*** 1.372 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	52.22	68.64
2	61.90	66.12
3	71.79	64.66
4	81.78	64.28
5	91.76	64.98
6	101.60	66.77
7	111.19	69.61
8	120.41	73.47
9	129.16	78.32
10	137.33	84.08
11	144.83	90.70
12	151.56	98.09
13	156.56	104.94

*** 1.392 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.11	65.82
2	54.83	63.45
3	64.76	62.30
4	74.76	62.37
5	84.67	63.68
6	94.35	66.20
7	103.64	69.89
8	112.41	74.70
9	120.52	80.55
10	127.85	87.35
11	134.28	95.01
12	139.57	103.16

*** 1.419 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	59.33	71.47
2	68.78	68.18
3	78.56	66.08
4	88.52	65.19
5	98.51	65.53
6	108.39	67.10
7	118.00	69.87
8	127.19	73.79
9	135.84	78.81
10	143.81	84.86
11	150.97	91.84
12	157.22	99.64
13	160.76	105.38

*** 1.433 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	48.67	67.23
2	58.55	65.72
3	68.53	65.02
4	78.53	65.14
5	88.48	66.08
6	98.33	67.84
7	107.99	70.39
8	117.42	73.74
9	126.54	77.84
10	135.29	82.68
11	143.61	88.22
12	151.45	94.43
13	158.76	101.26
14	162.68	105.58

*** 1.435 ***

Failure Surface Specified By 12 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	52.22	68.64
2	61.79	65.74
3	71.67	64.22
4	81.67	64.12
5	91.59	65.44
6	101.21	68.16
7	110.35	72.22
8	118.82	77.53
9	126.45	83.99
10	133.09	91.48
11	138.59	99.82
12	140.20	103.23

*** 1.437 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	48.67	67.23
2	58.55	65.73
3	68.53	65.00

4	78.53	65.05
5	88.49	65.88
6	98.36	67.49
7	108.08	69.86
8	117.58	72.98
9	126.80	76.84
10	135.70	81.40
11	144.21	86.65
12	152.29	92.55
13	159.88	99.05
14	166.82	106.01

*** 1.440 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.89	72.88
2	72.11	69.01
3	81.78	66.44
4	91.70	65.21
5	101.70	65.34

6	111.59	66.83
7	121.18	69.66
8	130.29	73.77
9	138.77	79.08
10	146.44	85.50
11	153.16	92.90
12	158.81	101.15
13	160.93	105.40

*** 1.456 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.89	72.88
2	71.99	68.74
3	81.68	66.25
4	91.65	65.50
5	101.60	66.50
6	111.22	69.22
7	120.22	73.57
8	128.32	79.44
9	135.28	86.63

10	140.87	94.92
11	144.77	103.71

*** 1.457 ***

```
                Y           A     X     I     S            F      T

                 .00       25.63     51.25     76.88    102.50     128.13

X        .00 +-----L---+---------+------*--+---------+---------+
             -
             -
             -
             -
             -                          *
       25.63 +
             -        L
             -
             -                         *
             -                         1
             -                       .2.4
A      51.25 +         L              .1 3
             -                       . 4..
             -                       21.3.5
```

```
            -                        4 ..W
            -                       2.6.5...
            -                       .13.9..
X     76.88 +                      L.265....
            -                       ..19...W.
            -                        .2.....
            -                         16.... .
            -                         L4......
            -                         .2.......
I    102.50 +                         931....W.*
            -                          562..... .
            -                         L9314......
            -                           ..62......
            -                           58314.......
            -                              ..2W.....
S    128.13 +                            .5631742....
            -                      L      9 .....74...
            -                             ..5631...27*
            -                              .  .W..0..2
            -                               ..563.1..0.
            -                                . ..5631 .
     153.75 +                                  ..8....1
            -                                  . ...563
            -                       L            .....5
            -                                     ....8
            -                                       ....
            -                                         ..
F    179.38 +                                         ..
            -
            -
```

```
              -
              -
              -
T    205.00 +                    L     W  *    *
```

PROFIL
LFIV100G.IN (Landfill IV - Static Case, 0.0g)
16 6
0. 60. 50. 60. 1
50. 60. 58. 64. 1
58. 64. 62. 66. 2
62. 66. 122. 78. 2
122. 78. 172. 80. 2
172. 80. 222. 78. 2
67. 65. 122. 76. 3
122. 76. 172. 78. 3
172. 78. 222. 76. 3
67. 65. 98. 54. 2
98. 54. 172. 53. 2
172. 53. 222. 54. 2
58. 64. 62. 64. 1
62. 64. 98. 52. 1
98. 52. 172. 51. 1
172. 51. 222. 52. 1
SOIL
3
124. 124. 320. 13. 0. 0. 0
122. 122. 200. 22. 0. 0. 0
55. 55. 150. 16. 0. 0. 0
EQUAKE
0. 0. 0.
LIMITS
1 1
0. 15. 222. 15.
CIRCL2
10 10
22. 75. 122. 172.
15. 5. 0. 0.

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 3-31-95
Time of Run: 2:35
Run By: S. D. Stone
Input Data Filename: LFIV100G.IN
Output Filename: LFIV100G.OUT

PROBLEM DESCRIPTION LFIV100G.IN (Landfill IV - Static Case, 0.0g)

BOUNDARY COORDINATES

6 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	60.00	50.00	60.00	1
2	50.00	60.00	58.00	64.00	1
3	58.00	64.00	62.00	66.00	2
4	62.00	66.00	122.00	78.00	2
5	122.00	78.00	172.00	80.00	2
6	172.00	80.00	222.00	78.00	2
7	67.00	65.00	122.00	76.00	3
8	122.00	76.00	172.00	78.00	3
9	172.00	78.00	222.00	76.00	3
10	67.00	65.00	98.00	54.00	2

11	98.00	54.00	172.00	53.00	2
12	172.00	53.00	222.00	54.00	2
13	58.00	64.00	62.00	64.00	1
14	62.00	64.00	98.00	52.00	1
15	98.00	52.00	172.00	51.00	1
16	172.00	51.00	222.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

3 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	124.0	124.0	320.0	13.0	.00	.0	0
2	122.0	122.0	200.0	22.0	.00	.0	0
3	55.0	55.0	150.0	16.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .000 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	15.00	222.00	15.00

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 = 22.00 ft.
and X = 75.00 ft.

Each Surface Terminates Between X = 122.00 ft.
and X = 172.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 15.00 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 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	69.11	67.42
2	73.57	65.16
3	78.23	63.35
4	83.05	62.01
5	87.97	61.16

6	92.96	60.80
7	97.96	60.94
8	102.92	61.58
9	107.79	62.70
10	112.52	64.31
11	117.08	66.38
12	121.40	68.89
13	125.45	71.83
14	129.19	75.14
15	132.20	78.41

Circle Center At X = 94.0 ; Y = 111.0 and Radius, 50.2

*** 3.798 ***

Individual data on the 17 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	2.8	344.5	.0	.0	.0	.0	.0	.0	.0
2	1.6	450.6	.0	.0	.0	.0	.0	.0	.0
3	4.7	1785.3	.0	.0	.0	.0	.0	.0	.0
4	4.8	2513.8	.0	.0	.0	.0	.0	.0	.0
5	4.9	3131.6	.0	.0	.0	.0	.0	.0	.0
6	5.0	3607.7	.0	.0	.0	.0	.0	.0	.0
7	5.0	3919.8	.0	.0	.0	.0	.0	.0	.0
8	5.0	4054.8	.0	.0	.0	.0	.0	.0	.0
9	4.9	4009.7	.0	.0	.0	.0	.0	.0	.0
10	4.7	3791.4	.0	.0	.0	.0	.0	.0	.0
11	4.6	3416.7	.0	.0	.0	.0	.0	.0	.0
12	4.3	2911.2	.0	.0	.0	.0	.0	.0	.0
13	.6	372.9	.0	.0	.0	.0	.0	.0	.0
14	3.4	1883.3	.0	.0	.0	.0	.0	.0	.0
15	3.7	1473.3	.0	.0	.0	.0	.0	.0	.0
16	1.1	301.5	.0	.0	.0	.0	.0	.0	.0
17	1.9	233.7	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.22	66.24
2	67.83	64.30
3	72.57	62.72
4	77.43	61.52
5	82.36	60.70
6	87.34	60.27
7	92.34	60.23
8	97.33	60.59
9	102.27	61.34
10	107.14	62.47
11	111.91	63.98
12	116.54	65.86
13	121.01	68.09
14	125.30	70.67
15	129.36	73.58
16	133.19	76.80
17	134.94	78.52

Circle Center At X = 90.3 ; Y = 123.9 and Radius, 63.7

*** 3.823 ***

1

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.44	60.72
2	56.44	60.56
3	61.44	60.52
4	66.44	60.60
5	71.44	60.80
6	76.43	61.12
7	81.41	61.56
8	86.38	62.12

9	91.33	62.80
10	96.27	63.60
11	101.18	64.52
12	106.07	65.55
13	110.94	66.71
14	115.77	67.98
15	120.58	69.37
16	125.35	70.87
17	130.08	72.49
18	134.77	74.22
19	139.42	76.06
20	144.02	78.02
21	146.11	78.96

Circle Center At X = 60.7 ; Y = 267.8 and Radius, 207.3

*** 3.827 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.44	60.72
2	56.44	60.53
3	61.44	60.46
4	66.44	60.51
5	71.44	60.67
6	76.43	60.96
7	81.41	61.37
8	86.39	61.89
9	91.34	62.54
10	96.28	63.30
11	101.21	64.18
12	106.11	65.18
13	110.98	66.30
14	115.83	67.53
15	120.64	68.88
16	125.42	70.34
17	130.17	71.92

18	134.87	73.61
19	139.53	75.41
20	144.15	77.33
21	148.02	79.04

Circle Center At X = 62.0 ; Y = 269.2 and Radius, 208.7

*** 3.846 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.22	66.24
2	68.11	65.18
3	73.04	64.37
4	78.01	63.80
5	83.00	63.49
6	88.00	63.43
7	93.00	63.62
8	97.98	64.06
9	102.93	64.75
10	107.84	65.69
11	112.70	66.88
12	117.49	68.31
13	122.20	69.98
14	126.82	71.88
15	131.34	74.02
16	135.75	76.38
17	139.62	78.70

Circle Center At X = 86.7 ; Y = 162.6 and Radius, 99.2

*** 3.918 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	69.11	67.42
2	73.41	64.86
3	77.92	62.72
4	82.62	61.00
5	87.45	59.73
6	92.39	58.92
7	97.38	58.57
8	102.37	58.68
9	107.34	59.27
10	112.23	60.31
11	117.00	61.81
12	121.61	63.75
13	126.02	66.10
14	130.19	68.86
15	134.08	72.00
16	137.67	75.48
17	140.44	78.74

Circle Center At X = 98.6 ; Y = 112.1 and Radius, 53.5

*** 3.927 ***

1

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.89	60.00
2	32.79	59.03
3	37.73	58.24
4	42.70	57.65
5	47.68	57.24
6	52.67	57.02

7	57.67	56.99
8	62.67	57.15
9	67.66	57.51
10	72.63	58.05
11	77.58	58.77
12	82.49	59.69
13	87.37	60.79
14	92.20	62.08
15	96.98	63.55
16	101.70	65.20
17	106.35	67.03
18	110.94	69.03
19	115.44	71.21
20	119.85	73.55
21	124.18	76.06
22	127.59	78.22

Circle Center At X = 55.9 ; Y = 188.5 and Radius, 131.5

*** 3.952 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	39.67	60.00
2	44.32	58.18
3	49.08	56.63
4	53.91	55.36
5	58.81	54.37
6	63.76	53.66
7	68.75	53.24
8	73.74	53.10
9	78.74	53.25
10	83.72	53.69
11	88.67	54.41
12	93.57	55.42
13	98.40	56.70
14	103.15	58.27

15	107.80	60.10
16	112.34	62.20
17	116.75	64.55
18	121.02	67.15
19	125.13	70.00
20	129.07	73.07
21	132.83	76.37
22	135.02	78.52

Circle Center At X = 73.6 ; Y = 140.0 and Radius, 86.9

*** 4.038 ***

1

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.33	63.67
2	62.30	63.06
3	67.28	62.62
4	72.27	62.35
5	77.27	62.25
6	82.27	62.33
7	87.26	62.58
8	92.24	63.00
9	97.21	63.60
10	102.15	64.36
11	107.06	65.30
12	111.94	66.40
13	116.77	67.68
14	121.56	69.11
15	126.30	70.72
16	130.98	72.48
17	135.59	74.41
18	140.13	76.49
19	144.60	78.73
20	144.94	78.92

Circle Center At X = 77.5 ; Y = 207.0 and Radius, 144.7

*** 4.067 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.22	66.24
2	67.69	64.00
3	72.37	62.24
4	77.21	61.00
5	82.16	60.29
6	87.16	60.10
7	92.15	60.46
8	97.07	61.35
9	101.86	62.77
10	106.48	64.68
11	110.86	67.09
12	114.97	69.95
13	118.74	73.23
14	122.13	76.90
15	122.98	78.04

Circle Center At X = 86.3 ; Y = 106.6 and Radius, 46.5

*** 4.130 ***

1

```
        Y     A  X  I  S     F  T

       .00   27.75   55.50   83.25   111.00   138.75

X     .00 +----L----+---------+-*-------+---------+---------+
```

PROFIL
LFIV140G.IN (Landfill IV - Seismic Case. 0.40g)
16 6
0. 60. 50. 60. 1
50. 60. 58. 64. 1
58. 64. 62. 66. 2
62. 66. 122. 78. 2
122. 78. 172. 80. 2
172. 80. 222. 78. 2
67. 65. 122. 76. 3
122. 76. 172. 78. 3
172. 78. 222. 76. 3
67. 65. 98. 54. 2
98. 54. 172. 53. 2
172. 53. 222. 54. 2
58. 64. 62. 64. 1
62. 64. 98. 52. 1
98. 52. 172. 51. 1
172. 51. 222. 52. 1
SOIL
3
124. 124. 320. 13. 0. 0. 0
122. 122. 200. 22. 0. 0. 0
55. 55. 150. 16. 0. 0. 0
EQUAKE
0.40 0. 0.
LIMITS
1 1
0. 15. 222. 15.
CIRCL2
10 10
22. 75. 122. 172.
15. 5. 0. 0.

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 3-31-95
Time of Run: 3:45
Run By: S.D. Stone
Input Data Filename: LFIV140G.IN
Output Filename: LFIV140G.OUT

PROBLEM DESCRIPTION LFIV140G.IN (Landfill IV - Seismic Case, 0.40g)

BOUNDARY COORDINATES

6 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	60.00	50.00	60.00	1
2	50.00	60.00	58.00	64.00	1
3	58.00	64.00	62.00	66.00	2
4	62.00	66.00	122.00	78.00	2
5	122.00	78.00	172.00	80.00	2
6	172.00	80.00	222.00	78.00	2
7	67.00	65.00	122.00	76.00	3
8	122.00	76.00	172.00	78.00	3
9	172.00	78.00	222.00	76.00	3
10	67.00	65.00	98.00	54.00	2

11	98.00	54.00	172.00	53.00	2
12	172.00	53.00	222.00	54.00	2
13	58.00	64.00	62.00	64.00	1
14	62.00	64.00	98.00	52.00	1
15	98.00	52.00	172.00	51.00	1
16	172.00	51.00	222.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

3 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	124.0	124.0	320.0	13.0	.00	.0	0
2	122.0	122.0	200.0	22.0	.00	.0	0
3	55.0	55.0	150.0	16.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .400 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	15.00	222.00	15.00

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 = 22.00 ft.
and X = 75.00 ft.

Each Surface Terminates Between X = 122.00 ft.
and X = 172.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 15.00 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 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.89	60.00
2	32.03	57.20
3	36.30	54.60
4	40.70	52.22
5	45.21	50.05

6	49.82	48.12
7	54.51	46.41
8	59.29	44.93
9	64.14	43.70
10	69.04	42.70
11	73.98	41.95
12	78.95	41.44
13	83.95	41.18
14	88.95	41.17
15	93.94	41.40
16	98.92	41.88
17	103.87	42.60
18	108.77	43.57
19	113.62	44.77
20	118.41	46.22
21	123.12	47.90
22	127.74	49.81
23	132.26	51.94
24	136.67	54.30
25	140.96	56.87
26	145.12	59.65
27	149.13	62.63
28	152.99	65.81
29	156.69	69.17
30	160.22	72.71
31	163.57	76.42
32	166.31	79.77

Circle Center At X = 86.7 ; Y = 142.4 and Radius, 101.3

*** 1.011 ***

Individual data on the 40 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	4.1	719.7	.0	.0	.0	.0	287.9	.0	.0
2	4.3	2173.7	.0	.0	.0	.0	869.5	.0	.0

3	4.4	3593.2	.0	.0	.0	.0	1437.3	.0	.0
4	4.5	4955.4	.0	.0	.0	.0	1982.1	.0	.0
5	4.6	6238.4	.0	.0	.0	.0	2495.4	.0	.0
6	.2	273.1	.0	.0	.0	.0	109.2	.0	.0
7	4.5	7781.0	.0	.0	.0	.0	3112.4	.0	.0
8	3.5	7458.8	.0	.0	.0	.0	2983.5	.0	.0
9	1.3	3074.2	.0	.0	.0	.0	1229.7	.0	.0
10	2.7	6954.1	.0	.0	.0	.0	2781.6	.0	.0
11	2.1	5883.3	.0	.0	.0	.0	2353.3	.0	.0
12	2.9	8251.1	.0	.0	.0	.0	3300.5	.0	.0
13	2.0	6037.9	.0	.0	.0	.0	2415.2	.0	.0
14	4.9	14777.4	.0	.0	.0	.0	5911.0	.0	.0
15	5.0	14927.6	.0	.0	.0	.0	5971.0	.0	.0
16	5.0	14888.3	.0	.0	.0	.0	5955.3	.0	.0
17	5.0	14658.6	.0	.0	.0	.0	5863.5	.0	.0
18	5.0	14240.3	.0	.0	.0	.0	5696.1	.0	.0
19	4.1	11166.8	.0	.0	.0	.0	4466.7	.0	.0
20	.9	2480.9	.0	.0	.0	.0	992.4	.0	.0
21	4.9	13252.7	.0	.0	.0	.0	5301.1	.0	.0
22	4.9	12870.4	.0	.0	.0	.0	5148.2	.0	.0
23	4.9	12314.1	.0	.0	.0	.0	4925.6	.0	.0
24	4.8	11593.0	.0	.0	.0	.0	4637.2	.0	.0
25	3.6	8237.7	.0	.0	.0	.0	3295.1	.0	.0
26	1.1	2475.6	.0	.0	.0	.0	990.2	.0	.0
27	4.6	9566.2	.0	.0	.0	.0	3826.5	.0	.0
28	3.7	6813.5	.0	.0	.0	.0	2725.4	.0	.0
29	.8	1438.4	.0	.0	.0	.0	575.4	.0	.0
30	2.9	4664.9	.0	.0	.0	.0	1865.9	.0	.0
31	1.5	2236.6	.0	.0	.0	.0	894.6	.0	.0
32	4.3	6020.1	.0	.0	.0	.0	2408.0	.0	.0
33	4.2	5261.7	.0	.0	.0	.0	2104.7	.0	.0
34	4.0	4481.8	.0	.0	.0	.0	1792.7	.0	.0
35	3.9	3691.6	.0	.0	.0	.0	1476.7	.0	.0
36	3.7	2902.8	.0	.0	.0	.0	1161.1	.0	.0
37	3.5	2127.0	.0	.0	.0	.0	850.8	.0	.0
38	3.4	1376.2	.0	.0	.0	.0	550.5	.0	.0
39	1.0	291.9	.0	.0	.0	.0	116.7	.0	.0
40	1.7	206.1	.0	.0	.0	.0	82.5	.0	.0

Failure Surface Specified By 34 Coordinate Points

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

1	22.00	60.00
2	25.88	56.85
3	29.92	53.90
4	34.11	51.16
5	38.42	48.64
6	42.87	46.35
7	47.42	44.28
8	52.07	42.45
9	56.81	40.86
10	61.63	39.51
11	66.51	38.42
12	71.43	37.57
13	76.40	36.97
14	81.39	36.63
15	86.39	36.55
16	91.38	36.72
17	96.36	37.15
18	101.32	37.83
19	106.23	38.76
20	111.09	39.94
21	115.88	41.37
22	120.59	43.05
23	125.21	44.96
24	129.73	47.10
25	134.13	49.48
26	138.40	52.07
27	142.54	54.88
28	146.53	57.90
29	150.35	61.12
30	154.01	64.52
31	157.49	68.12
32	160.78	71.88
33	163.87	75.81
34	166.69	79.79

Circle Center At X = 85.5 ; Y = 134.3 and Radius, 97.8

*** 1.013 ***

1

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	60.00
2	26.32	57.49
3	30.77	55.19
4	35.32	53.12
5	39.97	51.28
6	44.70	49.68
7	49.51	48.31
8	54.38	47.18
9	59.30	46.30
10	64.26	45.66
11	69.25	45.27
12	74.25	45.13
13	79.24	45.24
14	84.23	45.60
15	89.20	46.21
16	94.12	47.06
17	99.00	48.16
18	103.82	49.49
19	108.56	51.07
20	113.22	52.88
21	117.79	54.92
22	122.24	57.19
23	126.58	59.67
24	130.79	62.37
25	134.86	65.28
26	138.78	68.38
27	142.54	71.67
28	146.14	75.15
29	149.55	78.81
30	149.81	79.11

Circle Center At X = 74.6 ; Y = 145.4 and Radius, 100.3

*** 1.014 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.89	60.00
2	31.94	57.07
3	36.14	54.36
4	40.48	51.87
5	44.94	49.61
6	49.51	47.59
7	54.18	45.80
8	58.94	44.27
9	63.77	42.98
10	68.66	41.95
11	73.60	41.17
12	78.58	40.65
13	83.57	40.39
14	88.57	40.39
15	93.56	40.65
16	98.54	41.18
17	103.47	41.96
18	108.37	42.99
19	113.20	44.29
20	117.95	45.83
21	122.62	47.61
22	127.19	49.64
23	131.65	51.90
24	135.99	54.40
25	140.19	57.11
26	144.24	60.04
27	148.13	63.18
28	151.85	66.51
29	155.40	70.04
30	158.76	73.74
31	161.92	77.62
32	163.41	79.66

Circle Center At X = 86.0 ; Y = 136.2 and Radius, 95.8

*** 1.021 ***

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.78	60.00
2	38.59	58.65
3	43.45	57.46
4	48.34	56.42
5	53.26	55.53
6	58.21	54.80
7	63.17	54.22
8	68.15	53.79
9	73.15	53.53
10	78.15	53.42
11	83.15	53.46
12	88.14	53.66
13	93.13	54.02
14	98.10	54.54
15	103.06	55.21
16	107.99	56.03
17	112.89	57.01
18	117.76	58.14
19	122.59	59.42
20	127.38	60.86
21	132.13	62.44
22	136.82	64.17
23	141.45	66.05
24	146.03	68.07
25	150.53	70.23
26	154.97	72.53
27	159.34	74.97
28	163.62	77.55
29	167.12	79.80

Circle Center At X = 79.2 ; Y = 213.2 and Radius, 159.8

*** 1.027 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	60.00
2	25.67	56.61
3	29.52	53.41
4	33.52	50.42
5	37.68	47.64
6	41.97	45.08
7	46.39	42.74
8	50.93	40.64
9	55.57	38.77
10	60.30	37.15
11	65.11	35.78
12	69.98	34.66
13	74.91	33.80
14	79.87	33.19
15	84.86	32.84
16	89.86	32.74
17	94.85	32.91
18	99.83	33.34
19	104.79	34.03
20	109.70	34.97
21	114.55	36.17
22	119.34	37.61
23	124.04	39.31
24	128.65	41.24
25	133.16	43.42
26	137.54	45.82
27	141.79	48.45
28	145.91	51.29
29	149.86	54.35
30	153.66	57.61
31	157.28	61.05
32	160.71	64.69
33	163.95	68.49
34	167.00	72.46
35	169.83	76.58
36	171.92	80.00

Circle Center At X = 89.1 ; Y = 128.9 and Radius, 96.2

*** 1.027 ***

1

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.78	60.00
2	38.46	58.26
3	43.21	56.68
4	48.01	55.28
5	52.86	54.06
6	57.75	53.02
7	62.67	52.15
8	67.63	51.46
9	72.60	50.96
10	77.59	50.63
11	82.59	50.49
12	87.59	50.53
13	92.58	50.76
14	97.57	51.16
15	102.53	51.75
16	107.47	52.51
17	112.38	53.46
18	117.25	54.58
19	122.08	55.89
20	126.86	57.36
21	131.58	59.01
22	136.24	60.83
23	140.82	62.82
24	145.33	64.98
25	149.76	67.29
26	154.11	69.77
27	158.36	72.41
28	162.51	75.19
29	166.55	78.13
30	168.78	79.87

Circle Center At X = 84.0 ; Y = 187.6 and Radius, 137.1

*** 1.029 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	39.67	60.00
2	44.48	58.66
3	49.34	57.49
4	54.24	56.49
5	59.18	55.67
6	64.14	55.03
7	69.11	54.56
8	74.11	54.28
9	79.10	54.17
10	84.10	54.24
11	89.10	54.49
12	94.08	54.92
13	99.04	55.52
14	103.98	56.30
15	108.89	57.26
16	113.76	58.39
17	118.58	59.70
18	123.36	61.18
19	128.08	62.83
20	132.74	64.64
21	137.33	66.62
22	141.85	68.77
23	146.29	71.07
24	150.64	73.53
25	154.90	76.15
26	159.07	78.91
27	159.91	79.52

Circle Center At X = 79.6 ; Y = 194.0 and Radius, 139.9

*** 1.035 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	60.00
2	25.62	56.55
3	29.42	53.30
4	33.38	50.25
5	37.51	47.42
6	41.77	44.82
7	46.17	42.44
8	50.69	40.31
9	55.32	38.41
10	60.04	36.77
11	64.85	35.38
12	69.72	34.25
13	74.64	33.38
14	79.60	32.77
15	84.59	32.43
16	89.59	32.35
17	94.59	32.54
18	99.57	33.00
19	104.51	33.72
20	109.42	34.70
21	114.26	35.94
22	119.03	37.44
23	123.71	39.19
24	128.30	41.19
25	132.77	43.43
26	137.11	45.90
27	141.32	48.60
28	145.38	51.52
29	149.27	54.66
30	153.00	57.99
31	156.54	61.53
32	159.89	65.24
33	163.03	69.13
34	165.96	73.18
35	168.68	77.37
36	170.14	79.93

Circle Center At X = 88.5 ; Y = 126.1 and Radius, 93.8

*** 1.036 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.44	60.72
2	56.33	59.66
3	61.25	58.75
4	66.19	58.00
5	71.16	57.42
6	76.14	57.00
7	81.13	56.74
8	86.13	56.65
9	91.13	56.71
10	96.13	56.95
11	101.11	57.34
12	106.08	57.90
13	111.03	58.62
14	115.95	59.50
15	120.84	60.54
16	125.69	61.74
17	130.51	63.09
18	135.27	64.61
19	139.98	66.27
20	144.64	68.10
21	149.24	70.07
22	153.76	72.19
23	158.22	74.46
24	162.60	76.87
25	166.90	79.43
26	167.51	79.82

Circle Center At X = 86.5 ; Y = 209.7 and Radius, 153.0

*** 1.041 ***

PROFIL
LFIV145G.IN (Landfill IV - Seismic Case, 0.45g)
16 6
0. 60. 50. 60. 1
50. 60. 58. 64. 1
58. 64. 62. 66. 2
62. 66. 122. 78. 2
122. 78. 172. 80. 2
172. 80. 222. 78. 2
67. 65. 122. 76. 3
122. 76. 172. 78. 3
172. 78. 222. 76. 3
67. 65. 98. 54. 2
98. 54. 172. 53. 2
172. 53. 222. 54. 2
58. 64. 62. 64. 1
62. 64. 98. 52. 1
98. 52. 172. 51. 1
172. 51. 222. 52. 1
SOIL
3
124. 124. 320. 13. 0. 0. 0
122. 122. 200. 22. 0. 0. 0
55. 55. 150. 16. 0. 0. 0
EQUAKE
0.45 0. 0.
LIMITS
1 1
0. 15. 222. 15.
CIRCL2
10 10
22. 75. 122. 172.
15. 5. 0. 0.

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 3-31-95
Time of Run: 4:20
Run By: S. D. stone
Input Data Filename: LFIV145G.IN
Output Filename: LFIV145G.OUT

PROBLEM DESCRIPTION LFIV145G.IN (Landfill IV - Seismic Case, 0.45g)

BOUNDARY COORDINATES

6 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	60.00	50.00	60.00	1
2	50.00	60.00	58.00	64.00	1
3	58.00	64.00	62.00	66.00	2
4	62.00	66.00	122.00	78.00	2
5	122.00	78.00	172.00	80.00	2
6	172.00	80.00	222.00	78.00	2
7	67.00	65.00	122.00	76.00	3
8	122.00	76.00	172.00	78.00	3
9	172.00	78.00	222.00	76.00	3
10	67.00	65.00	98.00	54.00	2

11	98.00	54.00	172.00	53.00	2
12	172.00	53.00	222.00	54.00	2
13	58.00	64.00	62.00	64.00	1
14	62.00	64.00	98.00	52.00	1
15	98.00	52.00	172.00	51.00	1
16	172.00	51.00	222.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

3 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	124.0	124.0	320.0	13.0	.00	.0	0
2	122.0	122.0	200.0	22.0	.00	.0	0
3	55.0	55.0	150.0	16.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .450 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	15.00	222.00	15.00

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 = 22.00 ft.
and X = 75.00 ft.

Each Surface Terminates Between X = 122.00 ft.
and X = 172.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 15.00 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 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.89	60.00
2	32.03	57.20
3	36.30	54.60
4	40.70	52.22
5	45.21	50.05

6	49.82	48.12
7	54.51	46.41
8	59.29	44.93
9	64.14	43.70
10	69.04	42.70
11	73.98	41.95
12	78.95	41.44
13	83.95	41.18
14	88.95	41.17
15	93.94	41.40
16	98.92	41.88
17	103.87	42.60
18	108.77	43.57
19	113.62	44.77
20	118.41	46.22
21	123.12	47.90
22	127.74	49.81
23	132.26	51.94
24	136.67	54.30
25	140.96	56.87
26	145.12	59.65
27	149.13	62.63
28	152.99	65.81
29	156.69	69.17
30	160.22	72.71
31	163.57	76.42
32	166.31	79.77

Circle Center At X = 86.7 ; Y = 142.4 and Radius, 101.3

*** .915 ***

Individual data on the 40 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	4.1	719.7	.0	.0	.0	.0	323.9	.0	.0
2	4.3	2173.7	.0	.0	.0	.0	978.2	.0	.0

3	4.4	3593.2	.0	.0	.0	.0	1617.0	.0	.0
4	4.5	4955.4	.0	.0	.0	.0	2229.9	.0	.0
5	4.6	6238.4	.0	.0	.0	.0	2807.3	.0	.0
6	.2	273.1	.0	.0	.0	.0	122.9	.0	.0
7	4.5	7781.0	.0	.0	.0	.0	3501.4	.0	.0
8	3.5	7458.8	.0	.0	.0	.0	3356.4	.0	.0
9	1.3	3074.2	.0	.0	.0	.0	1383.4	.0	.0
10	2.7	6954.1	.0	.0	.0	.0	3129.3	.0	.0
11	2.1	5883.3	.0	.0	.0	.0	2647.5	.0	.0
12	2.9	8251.1	.0	.0	.0	.0	3713.0	.0	.0
13	2.0	6037.9	.0	.0	.0	.0	2717.1	.0	.0
14	4.9	14777.4	.0	.0	.0	.0	6649.8	.0	.0
15	5.0	14927.6	.0	.0	.0	.0	6717.4	.0	.0
16	5.0	14888.3	.0	.0	.0	.0	6699.7	.0	.0
17	5.0	14658.6	.0	.0	.0	.0	6596.4	.0	.0
18	5.0	14240.3	.0	.0	.0	.0	6408.1	.0	.0
19	4.1	11166.8	.0	.0	.0	.0	5025.0	.0	.0
20	.9	2480.9	.0	.0	.0	.0	1116.4	.0	.0
21	4.9	13252.7	.0	.0	.0	.0	5963.7	.0	.0
22	4.9	12870.4	.0	.0	.0	.0	5791.7	.0	.0
23	4.9	12314.1	.0	.0	.0	.0	5541.3	.0	.0
24	4.8	11593.0	.0	.0	.0	.0	5216.8	.0	.0
25	3.6	8237.7	.0	.0	.0	.0	3707.0	.0	.0
26	1.1	2475.6	.0	.0	.0	.0	1114.0	.0	.0
27	4.6	9566.2	.0	.0	.0	.0	4304.8	.0	.0
28	3.7	6813.5	.0	.0	.0	.0	3066.1	.0	.0
29	.8	1438.4	.0	.0	.0	.0	647.3	.0	.0
30	2.9	4664.9	.0	.0	.0	.0	2099.2	.0	.0
31	1.5	2236.6	.0	.0	.0	.0	1006.5	.0	.0
32	4.3	6020.1	.0	.0	.0	.0	2709.0	.0	.0
33	4.2	5261.7	.0	.0	.0	.0	2367.8	.0	.0
34	4.0	4481.8	.0	.0	.0	.0	2016.8	.0	.0
35	3.9	3691.6	.0	.0	.0	.0	1661.2	.0	.0
36	3.7	2902.8	.0	.0	.0	.0	1306.3	.0	.0
37	3.5	2127.0	.0	.0	.0	.0	957.2	.0	.0
38	3.4	1376.2	.0	.0	.0	.0	619.3	.0	.0
39	1.0	291.9	.0	.0	.0	.0	131.3	.0	.0
40	1.7	206.1	.0	.0	.0	.0	92.8	.0	.0

Failure Surface Specified By 34 Coordinate Points

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

1	22.00	60.00
2	25.88	56.85
3	29.92	53.90
4	34.11	51.16
5	38.42	48.64
6	42.87	46.35
7	47.42	44.28
8	52.07	42.45
9	56.81	40.86
10	61.63	39.51
11	66.51	38.42
12	71.43	37.57
13	76.40	36.97
14	81.39	36.63
15	86.39	36.55
16	91.38	36.72
17	96.36	37.15
18	101.32	37.83
19	106.23	38.76
20	111.09	39.94
21	115.88	41.37
22	120.59	43.05
23	125.21	44.96
24	129.73	47.10
25	134.13	49.48
26	138.40	52.07
27	142.54	54.88
28	146.53	57.90
29	150.35	61.12
30	154.01	64.52
31	157.49	68.12
32	160.78	71.88
33	163.87	75.81
34	166.69	79.79

Circle Center At X = 85.5 ; Y = 134.3 and Radius, 97.8

*** .916 ***

1

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	60.00
2	26.32	57.49
3	30.77	55.19
4	35.32	53.12
5	39.97	51.28
6	44.70	49.68
7	49.51	48.31
8	54.38	47.18
9	59.30	46.30
10	64.26	45.66
11	69.25	45.27
12	74.25	45.13
13	79.24	45.24
14	84.23	45.60
15	89.20	46.21
16	94.12	47.06
17	99.00	48.16
18	103.82	49.49
19	108.56	51.07
20	113.22	52.88
21	117.79	54.92
22	122.24	57.19
23	126.58	59.67
24	130.79	62.37
25	134.86	65.28
26	138.78	68.38
27	142.54	71.67
28	146.14	75.15
29	149.55	78.81
30	149.81	79.11

Circle Center At X = 74.6 ; Y = 145.4 and Radius, 100.3

*** .921 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.89	60.00
2	31.94	57.07
3	36.14	54.36
4	40.48	51.87
5	44.94	49.61
6	49.51	47.59
7	54.18	45.80
8	58.94	44.27
9	63.77	42.98
10	68.66	41.95
11	73.60	41.17
12	78.58	40.65
13	83.57	40.39
14	88.57	40.39
15	93.56	40.65
16	98.54	41.18
17	103.47	41.96
18	108.37	42.99
19	113.20	44.29
20	117.95	45.83
21	122.62	47.61
22	127.19	49.64
23	131.65	51.90
24	135.99	54.40
25	140.19	57.11
26	144.24	60.04
27	148.13	63.18
28	151.85	66.51
29	155.40	70.04
30	158.76	73.74
31	161.92	77.62
32	163.41	79.66

Circle Center At X = 86.0 ; Y = 136.2 and Radius, 95.8

*** .924 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	60.00
2	25.67	56.61
3	29.52	53.41
4	33.52	50.42
5	37.68	47.64
6	41.97	45.08
7	46.39	42.74
8	50.93	40.64
9	55.57	38.77
10	60.30	37.15
11	65.11	35.78
12	69.98	34.66
13	74.91	33.80
14	79.87	33.19
15	84.86	32.84
16	89.86	32.74
17	94.85	32.91
18	99.83	33.34
19	104.79	34.03
20	109.70	34.97
21	114.55	36.17
22	119.34	37.61
23	124.04	39.31
24	128.65	41.24
25	133.16	43.42
26	137.54	45.82
27	141.79	48.45
28	145.91	51.29
29	149.86	54.35
30	153.66	57.61
31	157.28	61.05
32	160.71	64.69
33	163.95	68.49
34	167.00	72.46
35	169.83	76.58
36	171.92	80.00

Circle Center At X = 89.1 ; Y = 128.9 and Radius, 96.2

*** .929 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.78	60.00
2	38.46	58.26
3	43.21	56.68
4	48.01	55.28
5	52.86	54.06
6	57.75	53.02
7	62.67	52.15
8	67.63	51.46
9	72.60	50.96
10	77.59	50.63
11	82.59	50.49
12	87.59	50.53
13	92.58	50.76
14	97.57	51.16
15	102.53	51.75
16	107.47	52.51
17	112.38	53.46
18	117.25	54.58
19	122.08	55.89
20	126.86	57.36
21	131.58	59.01
22	136.24	60.83
23	140.82	62.82
24	145.33	64.98
25	149.76	67.29
26	154.11	69.77
27	158.36	72.41
28	162.51	75.19
29	166.55	78.13
30	168.78	79.87

Circle Center At X = 84.0 ; Y = 187.6 and Radius, 137.1

*** .935 ***

1

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.78	60.00
2	38.59	58.65
3	43.45	57.46
4	48.34	56.42
5	53.26	55.53
6	58.21	54.80
7	63.17	54.22
8	68.15	53.79
9	73.15	53.53
10	78.15	53.42
11	83.15	53.46
12	88.14	53.66
13	93.13	54.02
14	98.10	54.54
15	103.06	55.21
16	107.99	56.03
17	112.89	57.01
18	117.76	58.14
19	122.59	59.42
20	127.38	60.86
21	132.13	62.44
22	136.82	64.17
23	141.45	66.05
24	146.03	68.07
25	150.53	70.23
26	154.97	72.53
27	159.34	74.97
28	163.62	77.55
29	167.12	79.80

Circle Center At X = 79.2 ; Y = 213.2 and Radius, 159.8

*** .936 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	60.00
2	25.62	56.55
3	29.42	53.30
4	33.38	50.25
5	37.51	47.42
6	41.77	44.82
7	46.17	42.44
8	50.69	40.31
9	55.32	38.41
10	60.04	36.77
11	64.85	35.38
12	69.72	34.25
13	74.64	33.38
14	79.60	32.77
15	84.59	32.43
16	89.59	32.35
17	94.59	32.54
18	99.57	33.00
19	104.51	33.72
20	109.42	34.70
21	114.26	35.94
22	119.03	37.44
23	123.71	39.19
24	128.30	41.19
25	132.77	43.43
26	137.11	45.90
27	141.32	48.60
28	145.38	51.52
29	149.27	54.66
30	153.00	57.99
31	156.54	61.53
32	159.89	65.24
33	163.03	69.13
34	165.96	73.18

35	168.68	77.37
36	170.14	79.93

Circle Center At X = 88.5 ; Y = 126.1 and Radius, 93.8

*** .937 ***

1

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	39.67	60.00
2	44.48	58.66
3	49.34	57.49
4	54.24	56.49
5	59.18	55.67
6	64.14	55.03
7	69.11	54.56
8	74.11	54.28
9	79.10	54.17
10	84.10	54.24
11	89.10	54.49
12	94.08	54.92
13	99.04	55.52
14	103.98	56.30
15	108.89	57.26
16	113.76	58.39
17	118.58	59.70
18	123.36	61.18
19	128.08	62.83
20	132.74	64.64
21	137.33	66.62
22	141.85	68.77
23	146.29	71.07
24	150.64	73.53
25	154.90	76.15
26	159.07	78.91
27	159.91	79.52

Circle Center At X = 79.6 ;·Y = 194.0 and Radius, 139.9

*** .943 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	60.00
2	25.66	56.60
3	29.51	53.41
4	33.54	50.44
5	37.72	47.70
6	42.05	45.20
7	46.51	42.95
8	51.10	40.95
9	55.79	39.21
10	60.57	37.75
11	65.42	36.55
12	70.33	35.63
13	75.29	34.98
14	80.28	34.62
15	85.28	34.53
16	90.28	34.73
17	95.25	35.21
18	100.19	35.97
19	105.09	37.00
20	109.91	38.31
21	114.66	39.89
22	119.30	41.73
23	123.84	43.83
24	128.25	46.19
25	132.53	48.78
26	136.64	51.62
27	140.60	54.68
28	144.37	57.96
29	147.96	61.44
30	151.34	65.12
31	154.51	68.99

32	157.46	73.03
33	160.17	77.23
34	161.51	79.58

Circle Center At X = 84.2 ; Y = 123.3 and Radius, 88.8

*** .944 ***

1

```
        Y      A  X  I  S      F  T

         .00   27.75   55.50   83.25  111.00  138.75

 X    .00 +----L----+---------+-*-------+---------+---------+
          -
          -
          -
          -
          -            2
   27.75 +              2231
          -           2 316
          -          52316
          -         5231679
          -        52.1.69.
          -        2.1.6.9*
 A   55.50 +          52.1.67...
          -       52.13..7..**
          -       5241..67..*.
          -      50213..69....
          -      50.13.679.....
          -      52.13.679.....
 X   83.25 +        52.13.679.....
          -      52.1.3679.....
          -      82.1.3679.....
          -      52.1.36*7......
          -      5021..367......
          -      5024..367..... .
 I  111.00 +        52.1..3.7......
          -       5021...37......
          -       85021..639....**
```

```
PROFIL
LFIV150G.IN (Landfill IV - Seismic Case, 0.50g)
16 6
0. 60. 50. 60. 1
50. 60. 58. 64. 1
58. 64. 62. 66. 2
62. 66. 122. 78. 2
122. 78. 172. 80. 2
172. 80. 222. 78. 2
67. 65. 122. 76. 3
122. 76. 172. 78. 3
172. 78. 222. 76. 3
67. 65. 98. 54. 2
98. 54. 172. 53. 2
172. 53. 222. 54. 2
58. 64. 62. 64. 1
62. 64. 98. 52. 1
98. 52. 172. 51. 1
172. 51. 222. 52. 1
SOIL
3
124. 124. 320. 13. 0. 0. 0
122. 122. 200. 22. 0. 0. 0
55. 55. 150. 16. 0. 0. 0
EQUAKE
0.50 0. 0.
LIMITS
1 1
0. 15. 222. 15.
CIRCL2
10 10
22. 75. 122. 172.
15. 5. 0. 0.
```

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 3-31-95
Time of Run: 3:10
Run By: S. D. Stone
Input Data Filename: LFIV150G.IN
Output Filename: LFIV150G.OUT

PROBLEM DESCRIPTION LFIV100G.IN (Landfill IV - Seismic Case, 0.50g)

BOUNDARY COORDINATES

6 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	60.00	50.00	60.00	1
2	50.00	60.00	58.00	64.00	1
3	58.00	64.00	62.00	66.00	2
4	62.00	66.00	122.00	78.00	2
5	122.00	78.00	172.00	80.00	2
6	172.00	80.00	222.00	78.00	2
7	67.00	65.00	122.00	76.00	3
8	122.00	76.00	172.00	78.00	3
9	172.00	78.00	222.00	76.00	3
10	67.00	65.00	98.00	54.00	2

11	98.00	54.00	172.00	53.00	2
12	172.00	53.00	222.00	54.00	2
13	58.00	64.00	62.00	64.00	1
14	62.00	64.00	98.00	52.00	1
15	98.00	52.00	172.00	51.00	1
16	172.00	51.00	222.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

3 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	124.0	124.0	320.0	13.0	.00	.0	0
2	122.0	122.0	200.0	22.0	.00	.0	0
3	55.0	55.0	150.0	16.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .500 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	15.00	222.00	15.00

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 = 22.00 ft.
and X = 75.00 ft.

Each Surface Terminates Between X = 122.00 ft.
and X = 172.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 15.00 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 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.89	60.00
2	32.03	57.20
3	36.30	54.60
4	40.70	52.22
5	45.21	50.05

6	49.82	48.12
7	54.51	46.41
8	59.29	44.93
9	64.14	43.70
10	69.04	42.70
11	73.98	41.95
12	78.95	41.44
13	83.95	41.18
14	88.95	41.17
15	93.94	41.40
16	98.92	41.88
17	103.87	42.60
18	108.77	43.57
19	113.62	44.77
20	118.41	46.22
21	123.12	47.90
22	127.74	49.81
23	132.26	51.94
24	136.67	54.30
25	140.96	56.87
26	145.12	59.65
27	149.13	62.63
28	152.99	65.81
29	156.69	69.17
30	160.22	72.71
31	163.57	76.42
32	166.31	79.77

Circle Center At X = 86.7 ; Y = 142.4 and Radius, 101.3

*** .836 ***

Individual data on the 40 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	4.1	719.7	.0	.0	.0	.0	359.9	.0	.0
2	4.3	2173.7	.0	.0	.0	.0	1086.8	.0	.0

3	4.4	3593.2	.0	.0	.0	.0	1796.6	.0	.0
4	4.5	4955.4	.0	.0	.0	.0	2477.7	.0	.0
5	4.6	6238.4	.0	.0	.0	.0	3119.2	.0	.0
6	.2	273.1	.0	.0	.0	.0	136.6	.0	.0
7	4.5	7781.0	.0	.0	.0	.0	3890.5	.0	.0
8	3.5	7458.8	.0	.0	.0	.0	3729.4	.0	.0
9	1.3	3074.2	.0	.0	.0	.0	1537.1	.0	.0
10	2.7	6954.1	.0	.0	.0	.0	3477.1	.0	.0
11	2.1	5883.3	.0	.0	.0	.0	2941.7	.0	.0
12	2.9	8251.1	.0	.0	.0	.0	4125.6	.0	.0
13	2.0	6037.9	.0	.0	.0	.0	3019.0	.0	.0
14	4.9	14777.4	.0	.0	.0	.0	7388.7	.0	.0
15	5.0	14927.6	.0	.0	.0	.0	7463.8	.0	.0
16	5.0	14888.3	.0	.0	.0	.0	7444.2	.0	.0
17	5.0	14658.6	.0	.0	.0	.0	7329.3	.0	.0
18	5.0	14240.3	.0	.0	.0	.0	7120.1	.0	.0
19	4.1	11166.8	.0	.0	.0	.0	5583.4	.0	.0
20	.9	2480.9	.0	.0	.0	.0	1240.5	.0	.0
21	4.9	13252.7	.0	.0	.0	.0	6626.3	.0	.0
22	4.9	12870.4	.0	.0	.0	.0	6435.2	.0	.0
23	4.9	12314.1	.0	.0	.0	.0	6157.0	.0	.0
24	4.8	11593.0	.0	.0	.0	.0	5796.5	.0	.0
25	3.6	8237.7	.0	.0	.0	.0	4118.8	.0	.0
26	1.1	2475.6	.0	.0	.0	.0	1237.8	.0	.0
27	4.6	9566.2	.0	.0	.0	.0	4783.1	.0	.0
28	3.7	6813.5	.0	.0	.0	.0	3406.8	.0	.0
29	.8	1438.4	.0	.0	.0	.0	719.2	.0	.0
30	2.9	4664.9	.0	.0	.0	.0	2332.4	.0	.0
31	1.5	2236.6	.0	.0	.0	.0	1118.3	.0	.0
32	4.3	6020.1	.0	.0	.0	.0	3010.0	.0	.0
33	4.2	5261.7	.0	.0	.0	.0	2630.8	.0	.0
34	4.0	4481.8	.0	.0	.0	.0	2240.9	.0	.0
35	3.9	3691.6	.0	.0	.0	.0	1845.8	.0	.0
36	3.7	2902.8	.0	.0	.0	.0	1451.4	.0	.0
37	3.5	2127.0	.0	.0	.0	.0	1063.5	.0	.0
38	3.4	1376.2	.0	.0	.0	.0	688.1	.0	.0
39	1.0	291.9	.0	.0	.0	.0	145.9	.0	.0
40	1.7	206.1	.0	.0	.0	.0	103.1	.0	.0

Failure Surface Specified By 34 Coordinate Points

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

1	22.00	60.00
2	25.88	56.85
3	29.92	53.90
4	34.11	51.16
5	38.42	48.64
6	42.87	46.35
7	47.42	44.28
8	52.07	42.45
9	56.81	40.86
10	61.63	39.51
11	66.51	38.42
12	71.43	37.57
13	76.40	36.97
14	81.39	36.63
15	86.39	36.55
16	91.38	36.72
17	96.36	37.15
18	101.32	37.83
19	106.23	38.76
20	111.09	39.94
21	115.88	41.37
22	120.59	43.05
23	125.21	44.96
24	129.73	47.10
25	134.13	49.48
26	138.40	52.07
27	142.54	54.88
28	146.53	57.90
29	150.35	61.12
30	154.01	64.52
31	157.49	68.12
32	160.78	71.88
33	163.87	75.81
34	166.69	79.79

Circle Center At X = 85.5 ; Y = 134.3 and Radius, 97.8

*** .837 ***

1

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	60.00
2	26.32	57.49
3	30.77	55.19
4	35.32	53.12
5	39.97	51.28
6	44.70	49.68
7	49.51	48.31
8	54.38	47.18
9	59.30	46.30
10	64.26	45.66
11	69.25	45.27
12	74.25	45.13
13	79.24	45.24
14	84.23	45.60
15	89.20	46.21
16	94.12	47.06
17	99.00	48.16
18	103.82	49.49
19	108.56	51.07
20	113.22	52.88
21	117.79	54.92
22	122.24	57.19
23	126.58	59.67
24	130.79	62.37
25	134.86	65.28
26	138.78	68.38
27	142.54	71.67
28	146.14	75.15
29	149.55	78.81
30	149.81	79.11

Circle Center At X = 74.6 ; Y = 145.4 and Radius, 100.3

*** .844 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.89	60.00
2	31.94	57.07
3	36.14	54.36
4	40.48	51.87
5	44.94	49.61
6	49.51	47.59
7	54.18	45.80
8	58.94	44.27
9	63.77	42.98
10	68.66	41.95
11	73.60	41.17
12	78.58	40.65
13	83.57	40.39
14	88.57	40.39
15	93.56	40.65
16	98.54	41.18
17	103.47	41.96
18	108.37	42.99
19	113.20	44.29
20	117.95	45.83
21	122.62	47.61
22	127.19	49.64
23	131.65	51.90
24	135.99	54.40
25	140.19	57.11
26	144.24	60.04
27	148.13	63.18
28	151.85	66.51
29	155.40	70.04
30	158.76	73.74
31	161.92	77.62
32	163.41	79.66

Circle Center At X = 86.0 ; Y = 136.2 and Radius, 95.8

*** .844 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	60.00
2	25.67	56.61
3	29.52	53.41
4	33.52	50.42
5	37.68	47.64
6	41.97	45.08
7	46.39	42.74
8	50.93	40.64
9	55.57	38.77
10	60.30	37.15
11	65.11	35.78
12	69.98	34.66
13	74.91	33.80
14	79.87	33.19
15	84.86	32.84
16	89.86	32.74
17	94.85	32.91
18	99.83	33.34
19	104.79	34.03
20	109.70	34.97
21	114.55	36.17
22	119.34	37.61
23	124.04	39.31
24	128.65	41.24
25	133.16	43.42
26	137.54	45.82
27	141.79	48.45
28	145.91	51.29
29	149.86	54.35
30	153.66	57.61
31	157.28	61.05
32	160.71	64.69
33	163.95	68.49
34	167.00	72.46
35	169.83	76.58
36	171.92	80.00

Circle Center At X = 89.1 ; Y = 128.9 and Radius, 96.2

*** .847 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	60.00
2	25.62	56.55
3	29.42	53.30
4	33.38	50.25
5	37.51	47.42
6	41.77	44.82
7	46.17	42.44
8	50.69	40.31
9	55.32	38.41
10	60.04	36.77
11	64.85	35.38
12	69.72	34.25
13	74.64	33.38
14	79.60	32.77
15	84.59	32.43
16	89.59	32.35
17	94.59	32.54
18	99.57	33.00
19	104.51	33.72
20	109.42	34.70
21	114.26	35.94
22	119.03	37.44
23	123.71	39.19
24	128.30	41.19
25	132.77	43.43
26	137.11	45.90
27	141.32	48.60
28	145.38	51.52
29	149.27	54.66
30	153.00	57.99
31	156.54	61.53
32	159.89	65.24
33	163.03	69.13
34	165.96	73.18

35	168.68	77.37
36	170.14	79.93

Circle Center At X = 88.5 ; Y = 126.1 and Radius, 93.8

*** .855 ***

1

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.78	60.00
2	38.46	58.26
3	43.21	56.68
4	48.01	55.28
5	52.86	54.06
6	57.75	53.02
7	62.67	52.15
8	67.63	51.46
9	72.60	50.96
10	77.59	50.63
11	82.59	50.49
12	87.59	50.53
13	92.58	50.76
14	97.57	51.16
15	102.53	51.75
16	107.47	52.51
17	112.38	53.46
18	117.25	54.58
19	122.08	55.89
20	126.86	57.36
21	131.58	59.01
22	136.24	60.83
23	140.82	62.82
24	145.33	64.98
25	149.76	67.29
26	154.11	69.77
27	158.36	72.41

28	162.51	75.19
29	166.55	78.13
30	168.78	79.87

Circle Center At X = 84.0 ; Y = 187.6 and Radius, 137.1

*** .856 ***

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.78	60.00
2	38.59	58.65
3	43.45	57.46
4	48.34	56.42
5	53.26	55.53
6	58.21	54.80
7	63.17	54.22
8	68.15	53.79
9	73.15	53.53
10	78.15	53.42
11	83.15	53.46
12	88.14	53.66
13	93.13	54.02
14	98.10	54.54
15	103.06	55.21
16	107.99	56.03
17	112.89	57.01
18	117.76	58.14
19	122.59	59.42
20	127.38	60.86
21	132.13	62.44
22	136.82	64.17
23	141.45	66.05
24	146.03	68.07
25	150.53	70.23
26	154.97	72.53
27	159.34	74.97

28	163.62	77.55
29	167.12	79.80

Circle Center At X = 79.2 ; Y = 213.2 and Radius, 159.8

*** .859 ***

1

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	60.00
2	25.66	56.60
3	29.51	53.41
4	33.54	50.44
5	37.72	47.70
6	42.05	45.20
7	46.51	42.95
8	51.10	40.95
9	55.79	39.21
10	60.57	37.75
11	65.42	36.55
12	70.33	35.63
13	75.29	34.98
14	80.28	34.62
15	85.28	34.53
16	90.28	34.73
17	95.25	35.21
18	100.19	35.97
19	105.09	37.00
20	109.91	38.31
21	114.66	39.89
22	119.30	41.73
23	123.84	43.83
24	128.25	46.19
25	132.53	48.78
26	136.64	51.62
27	140.60	54.68

28	144.37	57.96
29	147.96	61.44
30	151.34	65.12
31	154.51	68.99
32	157.46	73.03
33	160.17	77.23
34	161.51	79.58

Circle Center At X = 84.2 ; Y = 123.3 and Radius, 88.8

*** .862 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	39.67	60.00
2	44.48	58.66
3	49.34	57.49
4	54.24	56.49
5	59.18	55.67
6	64.14	55.03
7	69.11	54.56
8	74.11	54.28
9	79.10	54.17
10	84.10	54.24
11	89.10	54.49
12	94.08	54.92
13	99.04	55.52
14	103.98	56.30
15	108.89	57.26
16	113.76	58.39
17	118.58	59.70
18	123.36	61.18
19	128.08	62.83
20	132.74	64.64
21	137.33	66.62
22	141.85	68.77
23	146.29	71.07

24	150.64	73.53
25	154.90	76.15
26	159.07	78.91
27	159.91	79.52

Circle Center At X = 79.6 ; Y = 194.0 and Radius, 139.9

*** .867 ***

1

```
          Y      A  X  I  S      F  T

          .00   27.75   55.50   83.25   111.00   138.75

X     .00 +----L----+---------+-*-------+---------+---------+
          -
          -
          -
          -
          -            2
    27.75 +             2231
          -           2 317
          -          52317
          -          5231780
          -         52.1.70.
          -         2.1.7.0*
A   55.50 +             52.1.78...
          -        52.13..8..**
          -        5241..78..*.
          -       59213..70....
          -       59.13.780.....
          -       52.13.780.....
X   83.25 +           52.13.780.....
          -       52.1.3780.....
          -       62.1.3780.....
          -       52.1.37*8......
          -       5921..378......
          -       5924..378.... .
I  111.00 +           52.1..3.8......
          -        5921...38......
```

PROFIL
LFIV130G.IN (Landfill IV - Interface Failure. 0.30g)
17 6
0. 60. 50. 60. 1
50. 60. 58. 64. 1
58. 64. 62. 66. 2
62. 66. 122. 78. 2
122. 78. 172. 80. 2
172. 80. 222. 78. 2
62. 64. 67. 65. 4
67. 65. 122. 76. 3
122. 76. 172. 78. 3
172. 78. 222. 76. 3
67. 65. 98. 54. 4
98. 54. 172. 53. 4
172. 53. 222. 54. 4
58. 64. 62. 64. 1
62. 64. 98. 52. 1
98. 52. 172. 51. 1
172. 51. 222. 52. 1
SOIL
4
124. 124. 320. 13. 0. 0. 0
122. 122. 200. 22. 0. 0. 0
55. 55. 150. 16. 0. 0. 0
122. 122. 0. 19. 0. 0. 0
EQUAKE
0.30 0. 0.
SURFAC
4
62. 66.
98. 53.
153. 52.
172. 80.
EXECUT

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 4-1-95
Time of Run: 10:01
Run By: S. D. Stone
Input Data Filename: LFIV130G.IN
Output Filename: LFIV130G.OUT

PROBLEM DESCRIPTION LFIV130G.IN (Landfill IV - Interface Failure, 0.30g)

BOUNDARY COORDINATES

6 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	60.00	50.00	60.00	1
2	50.00	60.00	58.00	64.00	1
3	58.00	64.00	62.00	66.00	2
4	62.00	66.00	122.00	78.00	2
5	122.00	78.00	172.00	80.00	2
6	172.00	80.00	222.00	78.00	2
7	62.00	64.00	67.00	65.00	4
8	67.00	65.00	122.00	76.00	3
9	122.00	76.00	172.00	78.00	3
10	172.00	78.00	222.00	76.00	3

11	67.00	65.00	98.00	54.00	4
12	98.00	54.00	172.00	53.00	4
13	172.00	53.00	222.00	54.00	4
14	58.00	64.00	62.00	64.00	1
15	62.00	64.00	98.00	52.00	1
16	98.00	52.00	172.00	51.00	1
17	172.00	51.00	222.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

4 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	124.0	124.0	320.0	13.0	.00	.0	0
2	122.0	122.0	200.0	22.0	.00	.0	0
3	55.0	55.0	150.0	16.0	.00	.0	0
4	122.0	122.0	.0	19.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .300 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

Trial Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.00	66.00
2	98.00	53.00

3	153.00	52.00
4	172.00	80.00

Factor Of Safety For The Preceding Specified Surface = 1.148

1

```
             Y      A  X  I  S      F  T

            .00     27.75     55.50     83.25    111.00    138.75

X      .00 +---------+---------+-*-------+---------+---------+
           -
           -
           -
           -
           -
     27.75 +
           -
           -
           -
           -
           -            *
A    55.50 +
           -            **
           -            *
           -
           -
           -
X    83.25 +
           -
           -
           -         *
           -
           -
I   111.00 +
           -
           -               **
           -
           -
           -
S   138.75 +
```

```
          -
          -
          -      S
          -
          -
   166.50 +
          -      **    **
          -
          -
          -
          -
F  194.25 +
          -
          -
          -
          -
          -
T  222.00 +         *    **
```

```
PROFIL
LFIV135G.IN (Landfill IV - Interface Failure, 0.35g)
17 6
0. 60. 50. 60. 1
50. 60. 58. 64. 1
58. 64. 62. 66. 2
62. 66. 122. 78. 2
122. 78. 172. 80. 2
172. 80. 222. 78. 2
62. 64. 67. 65. 4
67. 65. 122. 76. 3
122. 76. 172. 78. 3
172. 78. 222. 76. 3
67. 65. 98. 54. 4
98. 54. 172. 53. 4
172. 53. 222. 54. 4
58. 64. 62. 64. 1
62. 64. 98. 52. 1
98. 52. 172. 51. 1
172. 51. 222. 52. 1
SOIL
4
124. 124. 320. 13. 0. 0. 0
122. 122. 200. 22. 0. 0. 0
55. 55. 150. 16. 0. 0. 0
122. 122. 0. 19. 0. 0. 0
EQUAKE
0.35 0. 0.
SURFAC
4
62. 66.
98. 53.
153. 52.
172. 80.
EXECUT
```

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4-1-95
Time of Run: 10:03
Run By: S. D. Stone
Input Data Filename: LFIV135G.IN
Output Filename: LFIV135G.OUT

PROBLEM DESCRIPTION LFIV135G.IN (Landfill IV - Interface Fai
lure, 0.35g)

BOUNDARY COORDINATES

6 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	60.00	50.00	60.00	1
2	50.00	60.00	58.00	64.00	1
3	58.00	64.00	62.00	66.00	2
4	62.00	66.00	122.00	78.00	2
5	122.00	78.00	172.00	80.00	2
6	172.00	80.00	222.00	78.00	2
7	62.00	64.00	67.00	65.00	4
8	67.00	65.00	122.00	76.00	3
9	122.00	76.00	172.00	78.00	3
10	172.00	78.00	222.00	76.00	3

11	67.00	65.00	98.00	54.00	4
12	98.00	54.00	172.00	53.00	4
13	172.00	53.00	222.00	54.00	4
14	58.00	64.00	62.00	64.00	1
15	62.00	64.00	98.00	52.00	1
16	98.00	52.00	172.00	51.00	1
17	172.00	51.00	222.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

4 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	124.0	124.0	320.0	13.0	.00	.0	0
2	122.0	122.0	200.0	22.0	.00	.0	0
3	55.0	55.0	150.0	16.0	.00	.0	0
4	122.0	122.0	.0	19.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .350 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

Trial Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.00	66.00
2	98.00	53.00

3	153.00	52.00
4	172.00	80.00

Factor Of Safety For The Preceding Specified Surface = 1.015

1

```
              Y       A  X  I  S      F  T

             .00     27.75     55.50     83.25    111.00    138.75

   X     .00 +---------+---------+-*-------+---------+---------+
             -
             -
             -
             -
             -
       27.75 +
             -
             -
             -
             -
             -           *
   A   55.50 +
             -            **
             -            *
             -
             -
             -
   X   83.25 +
             -
             -
             -         *
             -
             -
   I  111.00 +
             -
             -              **
             -
             -
             -
   S  138.75 +
```

```
          -
          -
          -          S
          -
          -
   166.50 +
          -          **      **
          -
          -
          -
          -
F  194.25 +
          -
          -
          -
          -
          -
T  222.00 +              *     **
```

```
PROFIL
LFIV141G.IN (Landfill IV - Interface Failure, 0.41g)
17 6
0. 60. 50. 60. 1
50. 60. 58. 64. 1
58. 64. 62. 66. 2
62. 66. 122. 78. 2
122. 78. 172. 80. 2
172. 80. 222. 78. 2
62. 64. 67. 65. 4
67. 65. 122. 76. 3
122. 76. 172. 78. 3
172. 78. 222. 76. 3
67. 65. 98. 54. 4
98. 54. 172. 53. 4
172. 53. 222. 54. 4
58. 64. 62. 64. 1
62. 64. 98. 52. 1
98. 52. 172. 51. 1
172. 51. 222. 52. 1
SOIL
4
124. 124. 320. 13. 0. 0. 0
122. 122. 200. 22. 0. 0. 0
55. 55. 150. 16. 0. 0. 0
122. 122. 0. 19. 0. 0. 0
EQUAKE
0.41 0. 0.
SURFAC
4
62. 66.
98. 53.
153. 52.
172. 80.
EXECUT
```

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4-1-94
Time of Run: 9:28
Run By: S. D. Stone
Input Data Filename: LFIV141G.IN
Output Filename: LFIV141G.OUT

PROBLEM DESCRIPTION LFIV141G.IN (Landfill IV - Interface Fai
lure, 0.41g)

BOUNDARY COORDINATES

6 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	60.00	50.00	60.00	1
2	50.00	60.00	58.00	64.00	1
3	58.00	64.00	62.00	66.00	2
4	62.00	66.00	122.00	78.00	2
5	122.00	78.00	172.00	80.00	2
6	172.00	80.00	222.00	78.00	2
7	62.00	64.00	67.00	65.00	4
8	67.00	65.00	122.00	76.00	3
9	122.00	76.00	172.00	78.00	3
10	172.00	78.00	222.00	76.00	3

11	67.00	65.00	98.00	54.00	4
12	98.00	54.00	172.00	53.00	4
13	172.00	53.00	222.00	54.00	4
14	58.00	64.00	62.00	64.00	1
15	62.00	64.00	98.00	52.00	1
16	98.00	52.00	172.00	51.00	1
17	172.00	51.00	222.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

4 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	124.0	124.0	320.0	13.0	.00	.0	0
2	122.0	122.0	200.0	22.0	.00	.0	0
3	55.0	55.0	150.0	16.0	.00	.0	0
4	122.0	122.0	.0	19.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .410 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

Trial Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.00	66.00
2	98.00	53.00

```
   3      153.00      52.00
   4      172.00      80.00
```

Factor Of Safety For The Preceding Specified Surface = .891

```
1

          Y        A   X   I   S        F   T

            .00    27.75    55.50    83.25    111.00    138.75

 X        .00 +---------+---------+-*-------+---------+---------+
              -
              -
              -
              -
              -
        27.75 +
              -
              -
              -
              -
              -            *
 A      55.50 +
              -             **
              -             *
              -
              -
              -
 X      83.25 +
              -
              -
              -          *
              -
              -
 I     111.00 +
              -
              -                **
              -
              -
              -
 S     138.75 +
```

```
          -
          -
          -       S
          -
          -
   166.50 +
          -       **     **
          -
          -
          -
          -
F  194.25 +
          -
          -
          -
          -
          -
T  222.00 +           *     **
```

```
PROFIL
LFIV200G.IN (Landfill IV-Static Case, 0.0g)
10 6
0. 52. 4. 52. 1
4. 52. 22. 53. 1
22. 53. 35. 52. 1
35. 52. 53. 61. 1
53. 61. 57. 63. 2
57. 63. 90. 66.3 2
68. 62. 90. 64.3 3
68. 62. 90. 55. 2
53. 61. 65. 61. 1
65. 61. 90. 52.6 1
SOIL
3
124. 124. 320. 13. 0. 0. 0
122. 122. 200. 22. 0. 0. 0
55. 55. 150. 16. 0. 0. 0
EQUAKE
0. 0. 0.
LIMITS
1 1
0. 38. 90. 38.
CIRCL2
10 10
22. 37. 57. 90.
38. 3.5 0. 0.
```

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 3-29-95
Time of Run: 12:45
Run By: S.D. Stone
Input Data Filename: LFIV200G.IN
Output Filename: LFIV200.OUT

PROBLEM DESCRIPTION LFIV200G.IN (Landfill IV-Static Case, 0.
0g)

BOUNDARY COORDINATES

6 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	52.00	4.00	52.00	1
2	4.00	52.00	22.00	53.00	1
3	22.00	53.00	35.00	52.00	1
4	35.00	52.00	53.00	61.00	1
5	53.00	61.00	57.00	63.00	2
6	57.00	63.00	90.00	66.30	2
7	68.00	62.00	90.00	64.30	3
8	68.00	62.00	90.00	55.00	2
9	53.00	61.00	65.00	61.00	1
10	65.00	61.00	90.00	52.60	1

1

ISOTROPIC SOIL PARAMETERS

3 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	124.0	124.0	320.0	13.0	.00	.0	0
2	122.0	122.0	200.0	22.0	.00	.0	0
3	55.0	55.0	150.0	16.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .000 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	38.00	90.00	38.00

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 = 22.00 ft.
and X = 37.00 ft.

Each Surface Terminates Between X = 57.00 ft.
and X = 90.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 38.00 ft.

3.50 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 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.67	52.10
2	36.74	50.43
3	40.02	49.20
4	43.43	48.43
5	46.92	48.15
6	50.41	48.36
7	53.85	49.05
8	57.15	50.21
9	60.26	51.82
10	63.11	53.84
11	65.66	56.24

12	67.84	58.98
13	69.63	61.99
14	70.62	64.36

Circle Center At X = 47.2 ; Y = 73.2 and Radius, 25.0

*** 2.339 ***

Individual data on the 21 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	1.3	51.6	.0	.0	.0	.0	.0	.0	.0
2	1.7	330.9	.0	.0	.0	.0	.0	.0	.0
3	3.3	1575.2	.0	.0	.0	.0	.0	.0	.0
4	3.4	2773.3	.0	.0	.0	.0	.0	.0	.0
5	3.5	3805.4	.0	.0	.0	.0	.0	.0	.0
6	3.5	4583.8	.0	.0	.0	.0	.0	.0	.0
7	2.6	3762.4	.0	.0	.0	.0	.0	.0	.0
8	.8	1284.8	.0	.0	.0	.0	.0	.0	.0
9	3.2	4924.1	.0	.0	.0	.0	.0	.0	.0
10	.1	235.0	.0	.0	.0	.0	.0	.0	.0
11	3.1	4673.2	.0	.0	.0	.0	.0	.0	.0
12	2.9	3752.5	.0	.0	.0	.0	.0	.0	.0
13	1.9	2091.2	.0	.0	.0	.0	.0	.0	.0
14	.7	639.7	.0	.0	.0	.0	.0	.0	.0
15	2.2	1710.6	.0	.0	.0	.0	.0	.0	.0
16	.2	95.3	.0	.0	.0	.0	.0	.0	.0
17	.4	205.8	.0	.0	.0	.0	.0	.0	.0
18	1.0	401.1	.0	.0	.0	.0	.0	.0	.0
19	.3	69.6	.0	.0	.0	.0	.0	.0	.0
20	.1	21.0	.0	.0	.0	.0	.0	.0	.0
21	.9	116.5	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 16 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	30.33	52.36
2	33.36	50.59
3	36.57	49.21
4	39.93	48.23
5	43.39	47.68
6	46.89	47.55
7	50.37	47.86
8	53.80	48.59
9	57.10	49.73
10	60.24	51.28
11	63.17	53.19
12	65.84	55.46
13	68.21	58.03
14	70.25	60.88
15	71.92	63.95
16	72.14	64.51

Circle Center At X = 46.2 ; Y = 75.9 and Radius, 28.4

*** 2.346 ***

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.67	52.10
2	36.77	50.49
3	40.12	49.46
4	43.59	49.04
5	47.09	49.25
6	50.49	50.08
7	53.68	51.51
8	56.58	53.48
9	59.07	55.94
10	61.08	58.80
11	62.55	61.98

12	62.97	63.60

Circle Center At X = 44.2 ; Y = 68.5 and Radius, 19.4

*** 2.354 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	32.00	52.23
2	35.22	50.85
3	38.60	49.96
4	42.08	49.58
5	45.58	49.72
6	49.02	50.37
7	52.32	51.52
8	55.42	53.15
9	58.25	55.21
10	60.74	57.67
11	62.84	60.47
12	64.50	63.55
13	64.58	63.76

Circle Center At X = 42.9 ; Y = 73.2 and Radius, 23.7

*** 2.355 ***

1

Failure Surface Specified By 14 Coordinate Points

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

1	30.33	52.36
2	33.41	50.69
3	36.69	49.48
4	40.12	48.78
5	43.62	48.58
6	47.10	48.90
7	50.50	49.74
8	53.74	51.06
9	56.75	52.84
10	59.47	55.05
11	61.83	57.64
12	63.78	60.54
13	65.29	63.70
14	65.33	63.83

Circle Center At X = 43.2 ; Y = 72.3 and Radius, 23.7

*** 2.357 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.33	52.36
2	33.16	50.29
3	36.24	48.64
4	39.53	47.44
5	42.96	46.72
6	46.45	46.49
7	49.94	46.75
8	53.36	47.51
9	56.64	48.73
10	59.71	50.41
11	62.51	52.51
12	64.99	54.97
13	67.10	57.77
14	68.79	60.83
15	70.03	64.10
16	70.08	64.31

Circle Center At X = 46.3 ; Y = 71.2 and Radius, 24.7

*** 2.367 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	32.00	52.23
2	34.87	50.22
3	38.00	48.65
4	41.32	47.56
5	44.77	46.97
6	48.27	46.88
7	51.74	47.31
8	55.12	48.24
9	58.32	49.66
10	61.28	51.52
11	63.93	53.81
12	66.23	56.45
13	68.11	59.40
14	69.54	62.60
15	70.02	64.30

Circle Center At X = 47.1 ; Y = 70.7 and Radius, 23.9

*** 2.369 ***

Failure Surface Specified By 11 Coordinate Points

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

1	33.67	52.10
2	36.94	50.85
3	40.37	50.16
4	43.86	50.04
5	47.33	50.50
6	50.68	51.52
7	53.82	53.08
8	56.65	55.13
9	59.11	57.62
10	61.12	60.49
11	62.60	63.56

Circle Center At X = 42.8 ; Y = 71.2 and Radius, 21.2

*** 2.369 ***

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	35.33	52.17
2	38.40	50.48
3	41.72	49.38
4	45.19	48.91
5	48.69	49.07
6	52.10	49.87
7	55.30	51.27
8	58.20	53.24
9	60.68	55.70
10	62.68	58.57
11	64.13	61.76
12	64.62	63.76

Circle Center At X = 46.0 ; Y = 67.9 and Radius, 19.0

*** 2.388 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.00	52.62
2	30.04	50.88
3	33.27	49.54
4	36.65	48.61
5	40.11	48.10
6	43.61	48.03
7	47.09	48.40
8	50.50	49.19
9	53.78	50.40
10	56.89	52.01
11	59.78	53.99
12	62.39	56.31
13	64.70	58.94
14	66.67	61.84
15	67.81	64.08

Circle Center At X = 42.4 ; Y = 76.2 and Radius, 28.1

*** 2.405 ***

1

```
          Y       A   X   I   S       F   T

         .00    14.59    29.17    43.76    58.35    72.93

 X       .00 +---------+---------+-----L---+-----*---+---------+
             -
             -                         *
             -
             -
             -
       14.59 +
```

```
PROFIL
LFIV240G.IN (Landfill IV-Seismic Stability, 0.40g)
10 6
0. 52. 4. 52. 1
4. 52. 22. 53. 1
22. 53. 35. 52. 1
35. 52. 53. 61. 1
53. 61. 57. 63. 2
57. 63. 90. 66.3 2
68. 62. 90. 64.3 3
68. 62. 90. 55. 2
53. 61. 65. 61. 1
65. 61. 90. 52.6 1
SOIL
3
124. 124. 320. 13. 0. 0. 0
122. 122. 200. 22. 0. 0. 0
55. 55. 150. 16. 0. 0. 0
EQUAKE
0.40 0. 0.
LIMITS
1 1
0. 38. 90. 38.
CIRCL2
10 10
22. 37. 57. 90.
38. 3.5 0. 0.
```

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 3-29-95
Time of Run: 12:47
Run By: S. D. Stone
Input Data Filename: LFIV240G.IN
Output Filename: LFIV240G.OUT

PROBLEM DESCRIPTION LFIV240G.IN (Landfill IV-Seismic Stabili
ty, 0.40g)

BOUNDARY COORDINATES

6 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	52.00	4.00	52.00	1
2	4.00	52.00	22.00	53.00	1
3	22.00	53.00	35.00	52.00	1
4	35.00	52.00	53.00	61.00	1
5	53.00	61.00	57.00	63.00	2
6	57.00	63.00	90.00	66.30	2
7	68.00	62.00	90.00	64.30	3
8	68.00	62.00	90.00	55.00	2
9	53.00	61.00	65.00	61.00	1
10	65.00	61.00	90.00	52.60	1

1

ISOTROPIC SOIL PARAMETERS

3 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	124.0	124.0	320.0	13.0	.00	.0	0
2	122.0	122.0	200.0	22.0	.00	.0	0
3	55.0	55.0	150.0	16.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .400 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	38.00	90.00	38.00

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 = 22.00 ft.
and X = 37.00 ft.

Each Surface Terminates Between X = 57.00 ft.
and X = 90.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 38.00 ft.

3.50 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 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.67	52.49
2	31.85	51.03
3	35.13	49.81
4	38.49	48.82
5	41.91	48.08
6	45.37	47.58
7	48.86	47.34
8	52.36	47.35
9	55.85	47.61
10	59.32	48.12
11	62.73	48.87

12	66.09	49.87
13	69.36	51.11
14	72.54	52.58
15	75.60	54.28
16	78.53	56.19
17	81.32	58.31
18	83.95	60.62
19	86.40	63.11
20	88.67	65.78
21	88.98	66.20

Circle Center At X = 50.5 ; Y = 96.0 and Radius, 48.7

*** 1.008 ***

Individual data on the 28 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	3.2	239.1	.0	.0	.0	.0	95.7	.0	.0
2	3.2	656.0	.0	.0	.0	.0	262.4	.0	.0
3	.1	35.1	.0	.0	.0	.0	14.0	.0	.0
4	3.4	1495.3	.0	.0	.0	.0	598.1	.0	.0
5	3.4	2608.1	.0	.0	.0	.0	1043.2	.0	.0
6	3.5	3647.1	.0	.0	.0	.0	1458.8	.0	.0
7	3.5	4587.7	.0	.0	.0	.0	1835.1	.0	.0
8	3.5	5408.7	.0	.0	.0	.0	2163.5	.0	.0
9	.6	1062.8	.0	.0	.0	.0	425.1	.0	.0
10	2.9	5025.7	.0	.0	.0	.0	2010.3	.0	.0
11	1.1	2130.7	.0	.0	.0	.0	852.3	.0	.0
12	2.3	4348.2	.0	.0	.0	.0	1739.3	.0	.0
13	3.4	6300.5	.0	.0	.0	.0	2520.2	.0	.0
14	2.3	4055.2	.0	.0	.0	.0	1622.1	.0	.0
15	1.1	1901.5	.0	.0	.0	.0	760.6	.0	.0
16	1.9	3250.3	.0	.0	.0	.0	1300.1	.0	.0
17	1.4	2209.3	.0	.0	.0	.0	883.7	.0	.0
18	3.2	4641.8	.0	.0	.0	.0	1856.7	.0	.0
19	3.1	3713.9	.0	.0	.0	.0	1485.6	.0	.0

20	2.9	2753.4	.0	.0	.0	.0	1101.4	.0	.0
21	.2	188.8	.0	.0	.0	.0	75.5	.0	.0
22	2.0	1343.6	.0	.0	.0	.0	537.4	.0	.0
23	.5	271.3	.0	.0	.0	.0	108.5	.0	.0
24	2.6	1240.1	.0	.0	.0	.0	496.1	.0	.0
25	2.5	866.5	.0	.0	.0	.0	346.6	.0	.0
26	.8	203.8	.0	.0	.0	.0	81.5	.0	.0
27	1.5	221.5	.0	.0	.0	.0	88.6	.0	.0
28	.3	7.4	.0	.0	.0	.0	3.0	.0	.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.67	52.49
2	31.84	51.01
3	35.12	49.78
4	38.48	48.80
5	41.90	48.07
6	45.37	47.61
7	48.86	47.40
8	52.36	47.47
9	55.85	47.79
10	59.30	48.38
11	62.69	49.23
12	66.02	50.32
13	69.25	51.67
14	72.37	53.26
15	75.36	55.08
16	78.20	57.11
17	80.89	59.36
18	83.39	61.80
19	85.71	64.43
20	86.89	65.99

Circle Center At X = 49.8 ; Y = 93.7 and Radius, 46.3

*** 1.010 ***

1

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.67	52.49
2	31.67	50.69
3	34.81	49.14
4	38.06	47.85
5	41.41	46.82
6	44.83	46.07
7	48.29	45.59
8	51.79	45.39
9	55.29	45.47
10	58.77	45.82
11	62.21	46.46
12	65.59	47.37
13	68.89	48.55
14	72.08	49.98
15	75.14	51.67
16	78.06	53.60
17	80.82	55.76
18	83.40	58.13
19	85.78	60.69
20	87.94	63.45
21	89.83	66.28

Circle Center At X = 52.6 ; Y = 89.1 and Radius, 43.7

*** 1.013 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.67	52.87
2	26.52	50.85
3	29.54	49.07

4	32.70	47.56
5	35.97	46.32
6	39.34	45.37
7	42.77	44.70
8	46.25	44.32
9	49.75	44.24
10	53.24	44.46
11	56.71	44.97
12	60.11	45.77
13	63.44	46.86
14	66.66	48.23
15	69.76	49.86
16	72.70	51.75
17	75.48	53.88
18	78.06	56.24
19	80.44	58.82
20	82.59	61.58
21	84.49	64.51
22	85.19	65.82

Circle Center At X = 48.9 ; Y = 85.5 and Radius, 41.2

*** 1.017 ***

1

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	32.00	52.23
2	35.05	50.52
3	38.24	49.08
4	41.55	47.93
5	44.94	47.08
6	48.40	46.53
7	51.89	46.28
8	55.39	46.35
9	58.87	46.72
10	62.31	47.40

11	65.67	48.37
12	68.93	49.64
13	72.06	51.20
14	75.05	53.02
15	77.87	55.10
16	80.49	57.42
17	82.89	59.96
18	85.07	62.71
19	86.99	65.63
20	87.20	66.02

Circle Center At X = 52.9 ; Y = 85.9 and Radius, 39.6

*** 1.022 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.33	52.74
2	28.55	51.37
3	31.86	50.21
4	35.23	49.28
5	38.66	48.57
6	42.12	48.10
7	45.62	47.85
8	49.12	47.84
9	52.61	48.06
10	56.08	48.52
11	59.51	49.21
12	62.89	50.12
13	66.20	51.26
14	69.43	52.61
15	72.56	54.18
16	75.57	55.95
17	78.47	57.92
18	81.22	60.08
19	83.83	62.42
20	86.27	64.93

21	87.20	66.02

Circle Center At X = 47.5 ; Y = 100.2 and Radius, 52.4

*** 1.023 ***

1

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.67	52.87
2	26.47	50.77
3	29.45	48.94
4	32.58	47.38
5	35.84	46.10
6	39.20	45.13
7	42.64	44.47
8	46.12	44.12
9	49.62	44.08
10	53.11	44.36
11	56.56	44.96
12	59.94	45.86
13	63.23	47.07
14	66.39	48.57
15	69.41	50.35
16	72.25	52.39
17	74.89	54.68
18	77.32	57.20
19	79.51	59.93
20	81.45	62.85
21	82.93	65.59

Circle Center At X = 48.3 ; Y = 82.8 and Radius, 38.7

*** 1.025 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	35.33	52.17
2	38.71	51.24
3	42.15	50.61
4	45.64	50.27
5	49.14	50.23
6	52.63	50.49
7	56.08	51.04
8	59.48	51.88
9	62.79	53.00
10	66.00	54.41
11	69.08	56.08
12	72.00	58.00
13	74.75	60.17
14	77.30	62.56
15	79.65	65.16
16	79.73	65.27

Circle Center At X = 47.9 ; Y = 91.4 and Radius, 41.2

*** 1.027 ***

1

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	53.00
2	24.69	50.76
3	27.57	48.77
4	30.61	47.03
5	33.79	45.57
6	37.08	44.38

7	40.46	43.49
8	43.91	42.89
9	47.40	42.60
10	50.90	42.61
11	54.39	42.92
12	57.83	43.53
13	61.21	44.45
14	64.50	45.65
15	67.67	47.13
16	70.70	48.88
17	73.56	50.89
18	76.25	53.14
19	78.72	55.62
20	80.97	58.30
21	82.98	61.16
22	84.73	64.19
23	85.51	65.85

Circle Center At X = 49.0 ; Y = 82.8 and Radius, 40.3

*** 1.029 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	32.00	52.23
2	34.96	50.36
3	38.10	48.81
4	41.38	47.60
5	44.77	46.74
6	48.24	46.23
7	51.73	46.09
8	55.23	46.32
9	58.68	46.91
10	62.05	47.85
11	65.30	49.14
12	68.40	50.77
13	71.31	52.71

14	74.01	54.94
15	76.46	57.44
16	78.63	60.19
17	80.51	63.14
18	81.66	65.47

Circle Center At X = 51.3 ; Y = 79.5 and Radius, 33.4

*** 1.040 ***

1

```
            Y      A  X  I  S      F  T

           .00   14.59   29.17   43.76   58.35   72.93

X      .00 +---------+---------+-----L---+-----*---+---------+
           -
           -                       *
           -
           -
           -
     14.59 +
           -
           -
           -                       *
           -                      94
           -                     9.4.
A    29.17 +                        ..461
           -                     74615
           -                    9..15*
           -                   9.4...8
           -                  ..4.158.
           -                  .9.31.8..
X    43.76 +                      .9743......
           -                 .94..18.... .
           -                 ..43168....
           -                 .9.35........
           -                 .94.12.8......*
           -                 ...351.8.......*
I    58.35 +                     ..93516.8.......
```

```
PROFIL
LFIV245G.IN (Landfill IV-Seismic Stability, 0.45g)
10 6
0. 52. 4. 52. 1
4. 52. 22. 53. 1
22. 53. 35. 52. 1
35. 52. 53. 61. 1
53. 61. 57. 63. 2
57. 63. 90. 66.3 2
68. 62. 90. 64.3 3
68. 62. 90. 55. 2
53. 61. 65. 61. 1
65. 61. 90. 52.6 1
SOIL
3
124. 124. 320. 13. 0. 0. 0
122. 122. 200. 22. 0. 0. 0
55. 55. 150. 16. 0. 0. 0
EQUAKE
0.45 0. 0.
LIMITS
1 1
0. 38. 90. 38.
CIRCL2
10 10
22. 37. 57. 90.
38. 3.5 0. 0.
```

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 3-29-95
Time of Run: 12:47
Run By: S. D. Stone
Input Data Filename: LFIV245G.IN
Output Filename: LFIV245G.OUT

PROBLEM DESCRIPTION LFIV245G.IN (Landfill IV-Seismic Stabili
ty, 0.45g)

BOUNDARY COORDINATES

6 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	52.00	4.00	52.00	1
2	4.00	52.00	22.00	53.00	1
3	22.00	53.00	35.00	52.00	1
4	35.00	52.00	53.00	61.00	1
5	53.00	61.00	57.00	63.00	2
6	57.00	63.00	90.00	66.30	2
7	68.00	62.00	90.00	64.30	3
8	68.00	62.00	90.00	55.00	2
9	53.00	61.00	65.00	61.00	1
10	65.00	61.00	90.00	52.60	1

1

ISOTROPIC SOIL PARAMETERS

3 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	124.0	124.0	320.0	13.0	.00	.0	0
2	122.0	122.0	200.0	22.0	.00	.0	0
3	55.0	55.0	150.0	16.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .450 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	38.00	90.00	38.00

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 = 22.00 ft.
and X = 37.00 ft.

Each Surface Terminates Between X = 57.00 ft.
and X = 90.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 38.00 ft.

3.50 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 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.67	52.49
2	31.85	51.03
3	35.13	49.81
4	38.49	48.82
5	41.91	48.08
6	45.37	47.58
7	48.86	47.34
8	52.36	47.35
9	55.85	47.61
10	59.32	48.12
11	62.73	48.87

12	66.09	49.87
13	69.36	51.11
14	72.54	52.58
15	75.60	54.28
16	78.53	56.19
17	81.32	58.31
18	83.95	60.62
19	86.40	63.11
20	88.67	65.78
21	88.98	66.20

Circle Center At X = 50.5 ; Y = 96.0 and Radius, 48.7

*** .931 ***

Individual data on the 28 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Surcharge Ver Lbs(kg)	Load Lbs(kg)
1	3.2	239.1	.0	.0	.0	.0	107.6	.0	.0
2	3.2	656.0	.0	.0	.0	.0	295.2	.0	.0
3	.1	35.1	.0	.0	.0	.0	15.8	.0	.0
4	3.4	1495.3	.0	.0	.0	.0	672.9	.0	.0
5	3.4	2608.1	.0	.0	.0	.0	1173.7	.0	.0
6	3.5	3647.1	.0	.0	.0	.0	1641.2	.0	.0
7	3.5	4587.7	.0	.0	.0	.0	2064.5	.0	.0
8	3.5	5408.7	.0	.0	.0	.0	2433.9	.0	.0
9	.6	1062.8	.0	.0	.0	.0	478.3	.0	.0
10	2.9	5025.7	.0	.0	.0	.0	2261.5	.0	.0
11	1.1	2130.7	.0	.0	.0	.0	958.8	.0	.0
12	2.3	4348.2	.0	.0	.0	.0	1956.7	.0	.0
13	3.4	6300.5	.0	.0	.0	.0	2835.2	.0	.0
14	2.3	4055.2	.0	.0	.0	.0	1824.8	.0	.0
15	1.1	1901.5	.0	.0	.0	.0	855.7	.0	.0
16	1.9	3250.3	.0	.0	.0	.0	1462.7	.0	.0
17	1.4	2209.3	.0	.0	.0	.0	994.2	.0	.0
18	3.2	4641.8	.0	.0	.0	.0	2088.8	.0	.0
19	3.1	3713.9	.0	.0	.0	.0	1671.3	.0	.0

20	2.9	2753.4	.0	.0	.0	.0	1239.0	.0	.0
21	.2	188.8	.0	.0	.0	.0	85.0	.0	.0
22	2.0	1343.6	.0	.0	.0	.0	604.6	.0	.0
23	.5	271.3	.0	.0	.0	.0	122.1	.0	.0
24	2.6	1240.1	.0	.0	.0	.0	558.1	.0	.0
25	2.5	866.5	.0	.0	.0	.0	389.9	.0	.0
26	.8	203.8	.0	.0	.0	.0	91.7	.0	.0
27	1.5	221.5	.0	.0	.0	.0	99.7	.0	.0
28	.3	7.4	.0	.0	.0	.0	3.3	.0	.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.67	52.49
2	31.84	51.01
3	35.12	49.78
4	38.48	48.80
5	41.90	48.07
6	45.37	47.61
7	48.86	47.40
8	52.36	47.47
9	55.85	47.79
10	59.30	48.38
11	62.69	49.23
12	66.02	50.32
13	69.25	51.67
14	72.37	53.26
15	75.36	55.08
16	78.20	57.11
17	80.89	59.36
18	83.39	61.80
19	85.71	64.43
20	86.89	65.99

Circle Center At X = 49.8 ; Y = 93.7 and Radius, 46.3

*** .934 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.67	52.49
2	31.67	50.69
3	34.81	49.14
4	38.06	47.85
5	41.41	46.82
6	44.83	46.07
7	48.29	45.59
8	51.79	45.39
9	55.29	45.47
10	58.77	45.82
11	62.21	46.46
12	65.59	47.37
13	68.89	48.55
14	72.08	49.98
15	75.14	51.67
16	78.06	53.60
17	80.82	55.76
18	83.40	58.13
19	85.78	60.69
20	87.94	63.45
21	89.83	66.28

Circle Center At X = 52.6 ; Y = 89.1 and Radius, 43.7

*** .935 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.67	52.87
2	26.52	50.85
3	29.54	49.07

4	32.70	47.56
5	35.97	46.32
6	39.34	45.37
7	42.77	44.70
8	46.25	44.32
9	49.75	44.24
10	53.24	44.46
11	56.71	44.97
12	60.11	45.77
13	63.44	46.86
14	66.66	48.23
15	69.76	49.86
16	72.70	51.75
17	75.48	53.88
18	78.06	56.24
19	80.44	58.82
20	82.59	61.58
21	84.49	64.51
22	85.19	65.82

Circle Center At X = 48.9 ; Y = 85.5 and Radius, 41.2

*** .941 ***

1

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	32.00	52.23
2	35.05	50.52
3	38.24	49.08
4	41.55	47.93
5	44.94	47.08
6	48.40	46.53
7	51.89	46.28
8	55.39	46.35
9	58.87	46.72
10	62.31	47.40

11	65.67	48.37
12	68.93	49.64
13	72.06	51.20
14	75.05	53.02
15	77.87	55.10
16	80.49	57.42
17	82.89	59.96
18	85.07	62.71
19	86.99	65.63
20	87.20	66.02

Circle Center At X = 52.9 ; Y = 85.9 and Radius, 39.6

*** .945 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.33	52.74
2	28.55	51.37
3	31.86	50.21
4	35.23	49.28
5	38.66	48.57
6	42.12	48.10
7	45.62	47.85
8	49.12	47.84
9	52.61	48.06
10	56.08	48.52
11	59.51	49.21
12	62.89	50.12
13	66.20	51.26
14	69.43	52.61
15	72.56	54.18
16	75.57	55.95
17	78.47	57.92
18	81.22	60.08
19	83.83	62.42
20	86.27	64.93

21	87.20	66.02

Circle Center At X = 47.5 ; Y = 100.2 and Radius, 52.4

*** .946 ***

1

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.67	52.87
2	26.47	50.77
3	29.45	48.94
4	32.58	47.38
5	35.84	46.10
6	39.20	45.13
7	42.64	44.47
8	46.12	44.12
9	49.62	44.08
10	53.11	44.36
11	56.56	44.96
12	59.94	45.86
13	63.23	47.07
14	66.39	48.57
15	69.41	50.35
16	72.25	52.39
17	74.89	54.68
18	77.32	57.20
19	79.51	59.93
20	81.45	62.85
21	82.93	65.59

Circle Center At X = 48.3 ; Y = 82.8 and Radius, 38.7

*** .951 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	35.33	52.17
2	38.71	51.24
3	42.15	50.61
4	45.64	50.27
5	49.14	50.23
6	52.63	50.49
7	56.08	51.04
8	59.48	51.88
9	62.79	53.00
10	66.00	54.41
11	69.08	56.08
12	72.00	58.00
13	74.75	60.17
14	77.30	62.56
15	79.65	65.16
16	79.73	65.27

Circle Center At X = 47.9 ; Y = 91.4 and Radius, 41.2

*** .953 ***

1

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	53.00
2	24.69	50.76
3	27.57	48.77
4	30.61	47.03
5	33.79	45.57
6	37.08	44.38

7	40.46	43.49
8	43.91	42.89
9	47.40	42.60
10	50.90	42.61
11	54.39	42.92
12	57.83	43.53
13	61.21	44.45
14	64.50	45.65
15	67.67	47.13
16	70.70	48.88
17	73.56	50.89
18	76.25	53.14
19	78.72	55.62
20	80.97	58.30
21	82.98	61.16
22	84.73	64.19
23	85.51	65.85

Circle Center At X = 49.0 ; Y = 82.8 and Radius, 40.3

*** .953 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	32.00	52.23
2	34.96	50.36
3	38.10	48.81
4	41.38	47.60
5	44.77	46.74
6	48.24	46.23
7	51.73	46.09
8	55.23	46.32
9	58.68	46.91
10	62.05	47.85
11	65.30	49.14
12	68.40	50.77
13	71.31	52.71

14	74.01	54.94
15	76.46	57.44
16	78.63	60.19
17	80.51	63.14
18	81.66	65.47

Circle Center At X = 51.3 ; Y = 79.5 and Radius, 33.4

*** .964 ***

1

```
        Y      A  X  I  S      F  T

        .00   14.59   29.17   43.76   58.35   72.93

X     .00 +---------+---------+-----L---+-----*---+---------+
          -
          -                        *
          -
          -
          -
    14.59 +
          -
          -
          -                        *
          -                        94
          -                       9.4.
A   29.17 +                         ..461
          -                       74615
          -                      9..15*
          -                     9.4...8
          -                    ..4.158.
          -                    .9.31.8..
X   43.76 +                       .9743......
          -                    .94..18.... .
          -                    ..43168....
          -                    .9.35........
          -                    .94.12.8......*
          -                    ...351.8.......*
I   58.35 +                       ..93516.8.......
```

```
PROFIL
LFIV250G.IN (Landfill IV-Seismic Stability, 0.50g)
10 6
0. 52. 4. 52. 1
4. 52. 22. 53. 1
22. 53. 35. 52. 1
35. 52. 53. 61. 1
53. 61. 57. 63. 2
57. 63. 90. 66.3 2
68. 62. 90. 64.3 3
68. 62. 90. 55. 2
53. 61. 65. 61. 1
65. 61. 90. 52.6 1
SOIL
3
124. 124. 320. 13. 0. 0. 0
122. 122. 200. 22. 0. 0. 0
55. 55. 150. 16. 0. 0. 0
EQUAKE
0.50 0. 0.
LIMITS
1 1
0. 38. 90. 38.
CIRCL2
10 10
22. 37. 57. 90.
38. 3.5 0. 0.
```

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 3-29-95
Time of Run: 12:49
Run By: S. D. Stone
Input Data Filename: LFIV250G.IN
Output Filename: LFIV250G.OUT

PROBLEM DESCRIPTION LFIV250G.IN (Landfill IV-Seismic Stabili
ty, 0.50g)

BOUNDARY COORDINATES

6 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	52.00	4.00	52.00	1
2	4.00	52.00	22.00	53.00	1
3	22.00	53.00	35.00	52.00	1
4	35.00	52.00	53.00	61.00	1
5	53.00	61.00	57.00	63.00	2
6	57.00	63.00	90.00	66.30	2
7	68.00	62.00	90.00	64.30	3
8	68.00	62.00	90.00	55.00	2
9	53.00	61.00	65.00	61.00	1
10	65.00	61.00	90.00	52.60	1

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ISOTROPIC SOIL PARAMETERS

3 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	124.0	124.0	320.0	13.0	.00	.0	0
2	122.0	122.0	200.0	22.0	.00	.0	0
3	55.0	55.0	150.0	16.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .500 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	38.00	90.00	38.00

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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 = 22.00 ft.
and X = 37.00 ft.

Each Surface Terminates Between X = 57.00 ft.
and X = 90.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 38.00 ft.

3.50 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 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.67	52.49
2	31.85	51.03
3	35.13	49.81
4	38.49	48.82
5	41.91	48.08
6	45.37	47.58
7	48.86	47.34
8	52.36	47.35
9	55.85	47.61
10	59.32	48.12
11	62.73	48.87

12	66.09	49.87
13	69.36	51.11
14	72.54	52.58
15	75.60	54.28
16	78.53	56.19
17	81.32	58.31
18	83.95	60.62
19	86.40	63.11
20	88.67	65.78
21	88.98	66.20

Circle Center At X = 50.5 ; Y = 96.0 and Radius, 48.7

*** .865 ***

Individual data on the 28 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	3.2	239.1	.0	.0	.0	.0	119.6	.0	.0
2	3.2	656.0	.0	.0	.0	.0	328.0	.0	.0
3	.1	35.1	.0	.0	.0	.0	17.5	.0	.0
4	3.4	1495.3	.0	.0	.0	.0	747.7	.0	.0
5	3.4	2608.1	.0	.0	.0	.0	1304.1	.0	.0
6	3.5	3647.1	.0	.0	.0	.0	1823.6	.0	.0
7	3.5	4587.7	.0	.0	.0	.0	2293.9	.0	.0
8	3.5	5408.7	.0	.0	.0	.0	2704.4	.0	.0
9	.6	1062.8	.0	.0	.0	.0	531.4	.0	.0
10	2.9	5025.7	.0	.0	.0	.0	2512.8	.0	.0
11	1.1	2130.7	.0	.0	.0	.0	1065.3	.0	.0
12	2.3	4348.2	.0	.0	.0	.0	2174.1	.0	.0
13	3.4	6300.5	.0	.0	.0	.0	3150.2	.0	.0
14	2.3	4055.2	.0	.0	.0	.0	2027.6	.0	.0
15	1.1	1901.5	.0	.0	.0	.0	950.7	.0	.0
16	1.9	3250.3	.0	.0	.0	.0	1625.2	.0	.0
17	1.4	2209.3	.0	.0	.0	.0	1104.7	.0	.0
18	3.2	4641.8	.0	.0	.0	.0	2320.9	.0	.0
19	3.1	3713.9	.0	.0	.0	.0	1857.0	.0	.0

20	2.9	2753.4	.0	.0	.0	.0	1376.7	.0	.0
21	.2	188.8	.0	.0	.0	.0	94.4	.0	.0
22	2.0	1343.6	.0	.0	.0	.0	671.8	.0	.0
23	.5	271.3	.0	.0	.0	.0	135.7	.0	.0
24	2.6	1240.1	.0	.0	.0	.0	620.1	.0	.0
25	2.5	866.5	.0	.0	.0	.0	433.3	.0	.0
26	.8	203.8	.0	.0	.0	.0	101.9	.0	.0
27	1.5	221.5	.0	.0	.0	.0	110.7	.0	.0
28	.3	7.4	.0	.0	.0	.0	3.7	.0	.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.67	52.49
2	31.84	51.01
3	35.12	49.78
4	38.48	48.80
5	41.90	48.07
6	45.37	47.61
7	48.86	47.40
8	52.36	47.47
9	55.85	47.79
10	59.30	48.38
11	62.69	49.23
12	66.02	50.32
13	69.25	51.67
14	72.37	53.26
15	75.36	55.08
16	78.20	57.11
17	80.89	59.36
18	83.39	61.80
19	85.71	64.43
20	86.89	65.99

Circle Center At X = 49.8 ; Y = 93.7 and Radius, 46.3

*** .868 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.67	52.49
2	31.67	50.69
3	34.81	49.14
4	38.06	47.85
5	41.41	46.82
6	44.83	46.07
7	48.29	45.59
8	51.79	45.39
9	55.29	45.47
10	58.77	45.82
11	62.21	46.46
12	65.59	47.37
13	68.89	48.55
14	72.08	49.98
15	75.14	51.67
16	78.06	53.60
17	80.82	55.76
18	83.40	58.13
19	85.78	60.69
20	87.94	63.45
21	89.83	66.28

Circle Center At X = 52.6 ; Y = 89.1 and Radius, 43.7

*** .868 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.67	52.87
2	26.52	50.85
3	29.54	49.07

4	32.70	47.56
5	35.97	46.32
6	39.34	45.37
7	42.77	44.70
8	46.25	44.32
9	49.75	44.24
10	53.24	44.46
11	56.71	44.97
12	60.11	45.77
13	63.44	46.86
14	66.66	48.23
15	69.76	49.86
16	72.70	51.75
17	75.48	53.88
18	78.06	56.24
19	80.44	58.82
20	82.59	61.58
21	84.49	64.51
22	85.19	65.82

Circle Center At X = 48.9 ; Y = 85.5 and Radius, 41.2

*** .876 ***

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Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	32.00	52.23
2	35.05	50.52
3	38.24	49.08
4	41.55	47.93
5	44.94	47.08
6	48.40	46.53
7	51.89	46.28
8	55.39	46.35
9	58.87	46.72
10	62.31	47.40

11	65.67	48.37
12	68.93	49.64
13	72.06	51.20
14	75.05	53.02
15	77.87	55.10
16	80.49	57.42
17	82.89	59.96
18	85.07	62.71
19	86.99	65.63
20	87.20	66.02

Circle Center At X = 52.9 ; Y = 85.9 and Radius, 39.6

*** .878 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.33	52.74
2	28.55	51.37
3	31.86	50.21
4	35.23	49.28
5	38.66	48.57
6	42.12	48.10
7	45.62	47.85
8	49.12	47.84
9	52.61	48.06
10	56.08	48.52
11	59.51	49.21
12	62.89	50.12
13	66.20	51.26
14	69.43	52.61
15	72.56	54.18
16	75.57	55.95
17	78.47	57.92
18	81.22	60.08
19	83.83	62.42
20	86.27	64.93

21	87.20	66.02

Circle Center At X = 47.5 ; Y = 100.2 and Radius, 52.4

*** .880 ***

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Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.67	52.87
2	26.47	50.77
3	29.45	48.94
4	32.58	47.38
5	35.84	46.10
6	39.20	45.13
7	42.64	44.47
8	46.12	44.12
9	49.62	44.08
10	53.11	44.36
11	56.56	44.96
12	59.94	45.86
13	63.23	47.07
14	66.39	48.57
15	69.41	50.35
16	72.25	52.39
17	74.89	54.68
18	77.32	57.20
19	79.51	59.93
20	81.45	62.85
21	82.93	65.59

Circle Center At X = 48.3 ; Y = 82.8 and Radius, 38.7

*** .886 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	53.00
2	24.69	50.76
3	27.57	48.77
4	30.61	47.03
5	33.79	45.57
6	37.08	44.38
7	40.46	43.49
8	43.91	42.89
9	47.40	42.60
10	50.90	42.61
11	54.39	42.92
12	57.83	43.53
13	61.21	44.45
14	64.50	45.65
15	67.67	47.13
16	70.70	48.88
17	73.56	50.89
18	76.25	53.14
19	78.72	55.62
20	80.97	58.30
21	82.98	61.16
22	84.73	64.19
23	85.51	65.85

Circle Center At X = 49.0 ; Y = 82.8 and Radius, 40.3

*** .887 ***

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Failure Surface Specified By 16 Coordinate Points

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

1	35.33	52.17
2	38.71	51.24
3	42.15	50.61
4	45.64	50.27
5	49.14	50.23
6	52.63	50.49
7	56.08	51.04
8	59.48	51.88
9	62.79	53.00
10	66.00	54.41
11	69.08	56.08
12	72.00	58.00
13	74.75	60.17
14	77.30	62.56
15	79.65	65.16
16	79.73	65.27

Circle Center At X = 47.9 ; Y = 91.4 and Radius, 41.2

*** .888 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.00	53.00
2	24.56	50.61
3	27.31	48.45
4	30.24	46.53
5	33.31	44.86
6	36.52	43.46
7	39.83	42.33
8	43.23	41.48
9	46.68	40.92
10	50.17	40.66
11	53.67	40.69
12	57.16	41.01
13	60.60	41.63
14	63.99	42.53

15	67.28	43.72
16	70.46	45.18
17	73.51	46.90
18	76.40	48.87
19	79.11	51.08
20	81.63	53.51
21	83.94	56.15
22	86.01	58.96
23	87.85	61.95
24	89.42	65.07
25	89.91	66.29

Circle Center At X = 51.6 ; Y = 82.2 and Radius, 41.5

*** .897 ***

1

```
         Y     A  X  I  S     F  T

        .00   14.59   29.17   43.76   58.35   72.93

X      .00 +---------+---------+-----L---+-----*---+---------+
           -
           -                   *
           -
           -
           -
     14.59 +
           -
           -
           -                   *
           -                   84
           -                  8.4.
A    29.17 +                     0.461
           -                  74615
           -                 8..15*
           -                 8.4...9
           -                0.4.159.
           -                .8.31.9..
X    43.76 +                  08743......
```