STUDY OF SLOPE STABILITY FOR RECLAIMED HIGHWALLS IN NORTH FLORIDA

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TABLE OF CONTENTS

APPENDIX A - Investigation Data

APPENDIX B - Geology

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Current Florida Administrative Code regulations that govern the steepness of reclaimed highwalls in North Florida have been criticized for having a single slope criteria of 4H:1V that is applied to all reclaimed highwalls regardless of site specific factors, such as soil type, soil erodability, and hydrological patterns, that govern the final reclaimed highwall slope stability. Consequently, the Florida Department of Natural Resources (DNR) is reviewing the appropriateness of these requirements.

The purpose of this investigation is to evaluate the stability of highwalls at two locations using soil properties determined from insitu and laboratory tests, examine the current highwall standards, suggest guidelines for performing stability analyses, and examine the stability of several reclaimed highwall geometries.

The objectives were accomplished through completion of the following tasks:

1) Circular arc stability analyses based on "best guess" typical highwall soil properties were performed for various combinations of highwall heights, unit

weights, shear strength parameters, and seepage conditions.

2) Detailed site investigations at two highwall locations were performed to obtain more realistic input parameters for evaluating the stability of actual highwalls. The site investigations included performing insitu tests -- electric cone penetration and Iowa borehole shear, locating seepage, and observing the existing slope geometries.

3) Three laboratory tests -- moisture content, bulk density, and direct shear -- were performed on undisturbed soil samples from the two highwall sites to obtain better input parameters for the stability analyses.

4) Non-circular arc and wedge stability analyses using input parameters from the insitu and laboratory tests were executed to determine the stability of the existing highwalls at the two sites and to examine various reclaimed highwall slope configurations with a minimum factor of safety of 2.0.

5) Recommended guidelines for evaluating the stability of reclaimed highwalls were provided based on the results of the above tasks 1 - 4.

Analyses of the existing highwalls produced factor of safety values of approximately 1.0, which are consistent with observations of distressed highwalls with cracks and shallow slope failures below the seepage zone. This in turn provided confidence in our input parameters and method of stability analysis. From these engineering observations and the presented stable reclamation slopes that are steeper than the present 4H:1V standard, it is apparent that these sites could be reclaimed at a slope steeper than 4H:1V while maintaining a minimum factor of safety of 2.0. A variety of highwall reclamation scenarios were examined and maximum slopes for a factor of safety of 2.0 provided. However, this study does not account for other factors such as erosion (especially in the zone of seepage), maintenance, and safety of people and livestock. Also, these conclusions are site specific.

CHAPTER I
INTRODUCTION

Background

Current Florida Administrative Code regulations that govern the steepness of reclaimed highwalls in North Florida have been criticized for having a single slope criterium of 4H:1V. This is applied to all reclaimed highwalls regardless of site specific factors, such as soil type, soil erodibility, and hydrological patterns, that govern the final reclaimed highwall slope stability. Consequently, the Florida Department of Natural Resources (DNR) is reviewing the appropriateness of these requirements. An initial qualitative comparative analysis performed by the DNR showed that slopes varying from 4H:1V could be acceptable if they were supported by the following:

1) A slope stability analysis performed by a registered professional engineer experienced in soil mechanics demonstrating that the proposed reclamation slope has a minimum factor of safety of 2.0.
2) Detailed construction methodology that includes provisions for safety, revegetation establishment and maintenance, and erosion and sedimentation control.
3) Landform data which indicates that the reclaimed

highwall is harmonious with the surrounding areas and minimizes the visual impacts of mining.

4) Land use data which indicates that the reclaimed highwall does not represent a conflict with the local comprehensive land use plan.

Purpose

The purpose of this investigation is to evaluate the stability of highwalls at two locations using soil properties determined from insitu and laboratory tests, examine the current highwall standards, suggest guidelines for performing stability analyses, and examine the stability of several reclaimed highwall geometries.

Scope

The objectives were accomplished through completion of the following tasks:

1) Circular arc stability analyses based on "best guess" typical highwall soil properties were performed for various combinations of highwall heights, unit weights, shear strength parameters, and seepage conditions.

2) Detailed site investigations at two highwall locations were performed to obtain more realistic input parameters for evaluating the stability of actual highwalls. The site investigations included performing insitu tests (electric cone penetration and Iowa borehole shear), locating seepage, and observing the existing slope geometries.

3) Three laboratory tests (moisture content, bulk density, and direct shear) were performed on undisturbed soil samples from the two highwall sites to obtain better input parameters for the stability analyses.

4) Non-circular arc and wedge stability analyses using input parameters from the insitu and laboratory tests were executed to determine the stability of the existing highwalls at the two sites and to examine various reclaimed highwall slope configurations with a minimum factor of safety of 2.0.

5) Recommended guidelines for evaluating the stability of reclaimed highwalls were provided based on the results of the above tasks 1 - 4.

CHAPTER II
SUMMARY

Objectives and Scope

The objective of this investigation was to examine the appropriateness of the current Florida Administrative Code requirement of a minimum 4H:1V slope for reclaimed highwalls. This objective was accomplished by field and laboratory investigations of two existing highwalls at Floridin's Quincy mine and Englehard's La Camelia mine, followed by computerized slope stability analyses. From these experiences, a methodology for relaxing the 4H:1V criteria is recommended in Chapter III.

Assumptions

Factor of Safety (FS). A minimum allowable factor of safety of 2.0 was assumed. Although modern dams usually have minimum FS values of 1.5, they are compacted structures and undergo periodic inspection and maintenance. However, reclaimed highwalls, are in natural materials with high variability and DNR guidance suggested a minimum inspection and maintenance program would follow reclamation. Accordingly, a minimum FS of 2.0 was assumed.

Geotechnical Considerations. Simplifying assumptions are inherent in geotechnical field and laboratory investigations, and slope stability analyses. Accordingly, they apply to this study as follows:

1. Insitu Tests. The thickness of each strata, obtained

from one cone penetration test, was assumed to be constant over the entire highwall slope.

2. <u>Laboratory Tests.</u> The direct shear test accurately measures the insitu strength, and the strength parameters from the tested samples are representative of the strata from which they were obtained, and are not affected by disturbance. It was assumed that excess pore water pressures dissipated during shear, i.e. drained strengths were obtained.

3. <u>Stability Analyses.</u> It was assumed that Janbu's method of slices for general (non-circular) failure surfaces could accurately determine the stability of reclaimed highwalls. Thus the inherent assumptions of this analytical method are presented. They are the following:

A. Limit equilibrium conditions of peak strength apply and progressive failure does not occur.

B. Plane strain conditions apply.

C. Long term stability is more critical than end of construction stability.

D. Input parameters -- For the stability analyses, it was assumed that deep failures were limited to a depth below the minable clay equal to one half times the slope height. Also, the piezometric surface was assumed to follow the surface of seepage. This latter assumption is conservative since if the slope is partially submerged, the water pool formed from runoff will provide a buttressing support to the slope and the actual water table may be located deeper in the Hawthorn Formation. In addition, shear strengths and densities of the fill and some sand layers were assumed due to the unavailability of data.

Results

To evaluate the appropriateness of these assumptions, detailed site investigations and comparison laboratory tests were performed to analyze two existing highwalls. These analyses resulted in FS values of approximately 1.0 (Figures 6.5 - 6.8), which are consistant with visual observations of the distressed conditions of these highwalls. From this standpoint, the methodology and assumptions we followed have been "calibrated" with the field conditions. Incidently, a cursory attempt to assume typical engineering values and analyze these highwalls produced erroneous results.

Since the objective was to evalute relaxation of the current 4H:1V slope criteria, stability analyses of several possible reclamation highwall schemes were evaluated. A summary of the slope inclinations having a FS of 2.0 for these example schemes is presented in Table 2.1 and shows slopes steeper than 4H:1V. However, these results are site specific and are <u>only for illustration</u>.

Recommendation

Assuming a minimum FS of 2.0, it is possible to reclaim highwall slopes steeper than 4H:1V provided detailed field, laboratory, and stability analyses are performed. Chapter III provides a recommended methodology. However, factors of erosion, maintanence, and safety of people and livestock are not addressed.

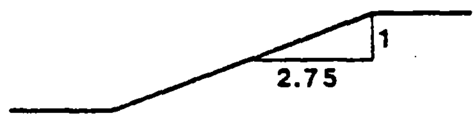
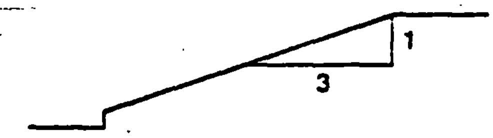
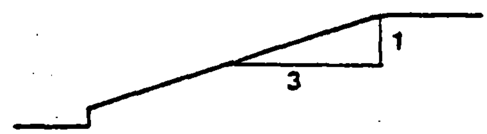
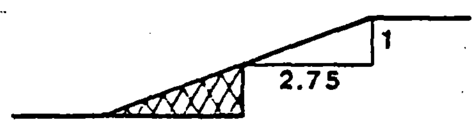
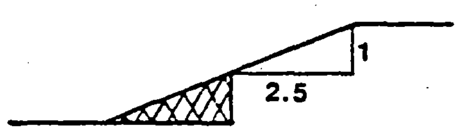
Reclaimed Slopes With A Minimum Factor Of Safety Of 2.0	
FLORIDIN MINE	**LA CAMELIA MINE**
2.75H:IV Slope 	2.5H:IV Slope 
3H:IV Bench with 1:1 Cut 	3H:IV Bench with 1:1 Cut 
2.75H:IV Cut/Fill 	2.5H:IV Cut/Fill 

Table 2.1 Reclaimed Slopes with a Minimum Factor of Safety of 2.0

CHAPTER III
RECOMMENDATIONS

A methodology for analyzing the stability of reclaimed slopes, as shown as in Figure 3.1, was developed during this study. First, the site must be investigated to determine the sequence and extent of soil strata, physical properties of the soils, and groundwater conditions at the site. This can be accomplished by examining the soil cores removed during exploratory boring and by visual inspection of the site if mining has exposed a highwall. The distance between exploratory boreholes should be a maximum of 330 feet (the standard for phosphate mines) due to the variable subsurface conditions in the north Florida mining area. Borings should be carried to the bottom of the minable strata.

Second, samples of each strata down to the minable strata must be recovered from the borings for laboratory tests. Due to the friable nature of a majority of the soil types, it is advisable to collect more samples than needed. Samples should be recovered from exploratory borings and be approximately twice the size necessary for laboratory shear tests (Note: Direct shear tests were used in this study and samples from a 4 inch exploratory boring would have been acceptable.) The samples need to be kept intact and at the natural moisture content until testing.

Third, bulk density and drained direct shear or other laboratory shear tests need to be performed on each soil

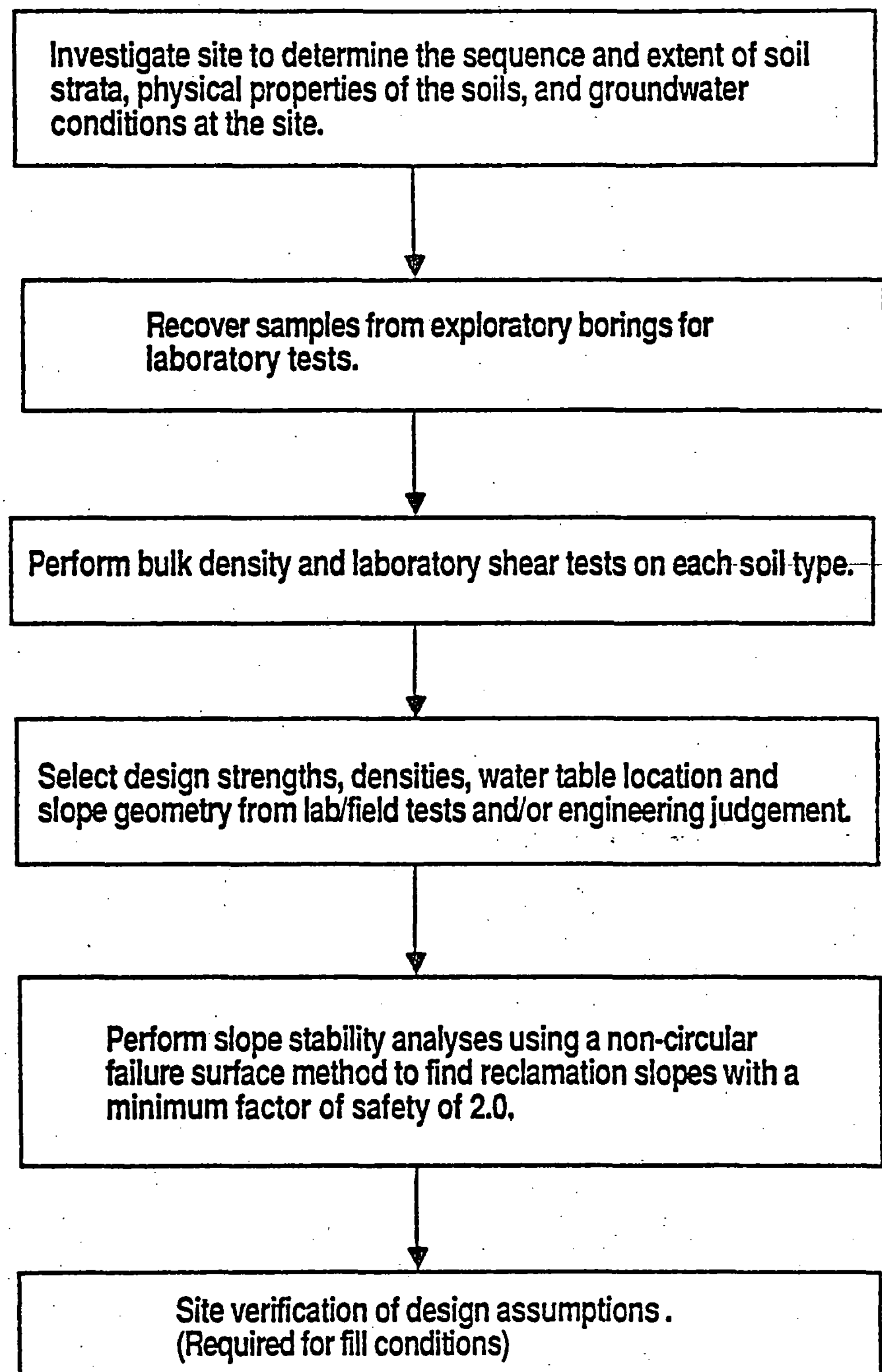


Figure 3.1 Stability Analyses Methodology For Reclaimed Slopes

type. The bulk density should be determined using the procedure and calculations specified in ASTM 1188 but substituting "chunk soil samples" for "compacted bituminous mixtures". The specific gravity of paraffin was assumed to be 0.91 at 15°C, the average density of paraffin listed in the CRC Handbook of Chemistry and Physics. Direct shear tests should be performed according to ASTM 3080 with the following additions and modifications to the procedure:

1) Apply increments of normal stress to a soil type that correspond to the range of stress existing in the field.
2) Adjust the time allowed for consolidation to take into account the type of soil that will be sheared. For example, a sandy soil may consolidate almost instantaneously while a clayey soil may require 25 minutes to consolidate.
3) Soils that lie above ground water should be sheared without water in the shear box; soils that lie below the ground water should be inundated during shear.
4) Additional direct shear tests should be performed on soil samples which have been soaked for 48 hours if the soil is known to lie below ground water.
5) The shear frames should be raised more than the specified 0.01 in. when a varved soil specimen is sheared. This is to allow the soil specimen to fail along a weak plane rather than specifically on the horizontal plane.

The results of the laboratory/field strength tests should be plotted and a range of possible friction angles and cohesion values interpreted. Table 3.1 provides examples of typical density and shear strength values for the various soil layers tested in this study.

Fourth, the anticipated reclaimed highwall slope geometry should be selected. The soil profiles and properties determined from the field and laboratory should be selected as input values for the analyses. The ground water should be specified to create the least stable condition that could exist. In the case of fill sections, the density and strength depend upon the method of placement and compaction, and thus, may be unknown at the time of analyses. Accordingly, test fills and/or engineering judgment will be required to obtain the input parameters.

Fifth, a non-circular slope stability analysis, such as PCSTABL4, should be performed. Reclamation slopes that have a minimum FS of 2.0 are acceptable.

Lastly, field visitation by the design engineer to verify design assumptions and actual construction compatibility with those assumptions is recommended. In the case of fill sections, density and strength tests of the actual fill should be performed. If adverse conditions (i.e. ground water, fill, or other assumed properties) exist, the engineer has the responsibility to reanalyze the slope and alter reclamation accordingly.

It should be pointed out that these recommendations only consider stability and the effects of erosion, maintenance, and human/livestock safety are <u>not</u> considered.

COMPUTER INPUT VALUES

Location	Layer Thickness (ft)	Cohesion (psf)	Friction Angle (deg)	Soaked Cohesion (psf)	Soaked Friction (deg)	Bulk Density (pcf)
Quincy Layer 1	6.6	150.	22.3			126.2
Quincy Layer 2	7.2	1450.	7.3			108.1
Quincy Layer 3	6.4	2150.	30.4			107.1
Quincy Layer 4	19.2	1450.	21.3			97.4
Quincy Layer 5	19.1	1300.	16.0			109.5
Quincy Layer 6	4.0	4100.	7.0			108.7
Quincy Layer 7	5.0	3000.	7.5	1700.	7.6	114.7
Quincy Layer 8	20.0	5100.	7.3	2700.	7.4	95.5

Englehard Layer 1	6.5	1150.	36.2			122.6
Englehard Layer 2	12.3	80.	35.0			122.5
Englehard Layer 3	21.0	3200.	15.8			122.0
Englehard Layer 4	8.2	800.	12.3			119.5
Englehard Layer 5	6.3	3600.	11.3	3000.	9.8	111.2
Englehard Layer 6	20.0	5100.	7.3	2700.	7.4	94.8

TABLE 3.1 COMPUTER INPUT VALUES

CHAPTER IV
STABILITY ANALYSES METHODOLOGY

The potential of an embankment to experience shear failure during its lifetime can be examined by analyzing two critical stages -- end of construction and long term. Usually, the end of construction phase requires total stress analyses since the excess pore pressures in silty and clayey soils of the embankment, caused by a change in total stress, have not dissipated and are not known, unless measured. In this case, the undrained strengths, c_u and ϕ_u, are used in stability analyses. The long term situation involves effective stress analyses since excess pore water pressures generated in silty and clayey soils have dissipated. Effective strength analyses requires c, Ø, and pore pressures corresponding to natural ground water conditions to be known. Generally, the long-term situation is critical for a slope.

For the particular case of the reclaimed highwalls in North Florida the long-term situation is critical. Pore pressures in the highwall have probably dissipated by the time it is reclaimed. If the land is reclaimed by removing overburden to get an appropriate slope, negative excess pore pressures will be generated in the silty and clayey soils which will increase the apparent strength of these soils. Over time, the negative pore pressures will dissipate resulting in a decrease in the apparent strength of the material. If the highwall is reclaimed by a cut and fill method, negative pore pressures will be generated in silty and clayey soils as they are removed from the ground to be used as fill. When these materials are compacted, overburden pressures will cause pore pressures to increase positively. The excess pore pressures in the fill during shear depend on the degree of overconsolidation of the material -- a soil that is normally consolidated will experience positive pore pressures when subjected to shear stresses; a soil that is overconsolidated will experience negative excess pore pressures. The excess pore pressures that exist in the fill at the end of construction are not known and may be either positive or negative. Most likely, the average excess pore pressures in the fill would be negative since the fill is compacted to a density less than that of the undisturbed soil. Therefore, the fill would act overall as an overconsolidated soil and would lose strength with time.

The shear strength parameters used to analyze these conditions can be obtained from laboratory or insitu tests. In the laboratory, shear strength parameters are usually determined from direct shear or triaxial tests. Direct shear tests were used, in this investigation, to determine soil strength parameters because the tests are useful for running drained shear tests on silty and clayey soil. Pore pressures dissipate faster from the thin samples employed in direct shear tests than from the samples used in triaxial tests.

Also, it is more convenient to subject samples to large strains in a direct shear apparatus. Finally, direct shear tests are much simpler and less time consuming than triaxial tests.

Direct shear tests may overestimate the shear strength of overconsolidated silty and clayey samples if the load is applied too rapidly, allowing excess negative pore pressures to develop, which, in turn, increases the apparent shear strength of the soil. Likewise, the strength of normally consolidated silty and clayey materials may be underestimated if positive pore pressures develop. If the loads of the tests performed in this study were applied too fast, significant increments of pore pressure would not be developed during this partially drained loading if the soil samples were not highly saturated with water. This occurs because air in the pore fluid is much more compressible than the water or the soil skeleton. When the soil is saturated, significant increments of pore pressure develop due to the relatively high compressibility of the soil skeleton compared to that of water. Also fissures in the samples allow pore pressures to dissipate rapidly. The friction angles of sands, obtained from direct shear tests, is about the same regardless of the rate of loading.

To select appropriate shear strength values to be used in the analyses, consideration must be given to the following factors: the range of normal stresses a soil layer might experience in the field, the level of water i.e. whether a soil is or may become submerged, the amount of strain a soil experiences to reach peak shear strength (too much strain increases the chances of a progressive failure), and whether a soil develops residual strength.

Among the possible methods of stability analysis are the infinite slope, the circular arc, sliding wedge, and non-circular failure surface analyses. The pronounced layering of the Miccosukee and Hawthorn Formations requires that non-circular failure surface analyses be used.

CHAPTER V
INVESTIGATION

Preliminary Evaluations

On May 5, 1986, the Floridin Corporation's Quincy mine was visited to examine existing highwalls and mining operations. Based upon these observations, initial slope stability analyses were performed using a circular arc method (modified Bishop) and the estimated soil parameters shown in Table 5.1. The results of the analyses produced factors of safety much less than 1 for slopes of 4H:1V when the failure circle passed through the lower layers of soil. Since the existing slope stands nearly vertical without showing distress, the strength parameters for the lower soil layers were underestimated and circular arc analysis inappropriate.

Insitu Tests

Electric cone penetration. Electric cone penetration tests were performed at the Floridin Corporation's Quincy mine and the Englehard Mineral and Chemical Corporation's La Camelia mine during June 30, 1986 to July 3, 1986 to determine the corresponding soil profiles -- soil layer thicknesses and soil types. Testing was completed, according to ASTM D 3441, from the University of Florida's cone penetration testing truck -- an all wheel drive vehicle designed especially for quasi-static penetration testing.

ESTIMATED SOIL STRENGTH PARAMETERS

Seepage is assumed to flow along layer 3

Location	Soil Description	Layer Thickness (ft)	Cohesion (psf)	Friction Angle (deg)	Moist Density (pcf)
Layer 1	Sand	5. - 25.	0. - 200.	30. - 40.	100. - 120.
Layer 2	Clay with sand	10. - 35.	0. - 200.	30. - 40.	100. - 120.
Layer 3	Overconsolidated clay with slickensides	0. - 5.	0. - 1000.	0. - 10.	100. - 120.
Layer 4	Hawthorn Formation	30. - 70.	500. - 1000.	0. - 10.	100. - 120.

TABLE 5.1 ESTIMATED SOIL STRENGTH PARAMETERS

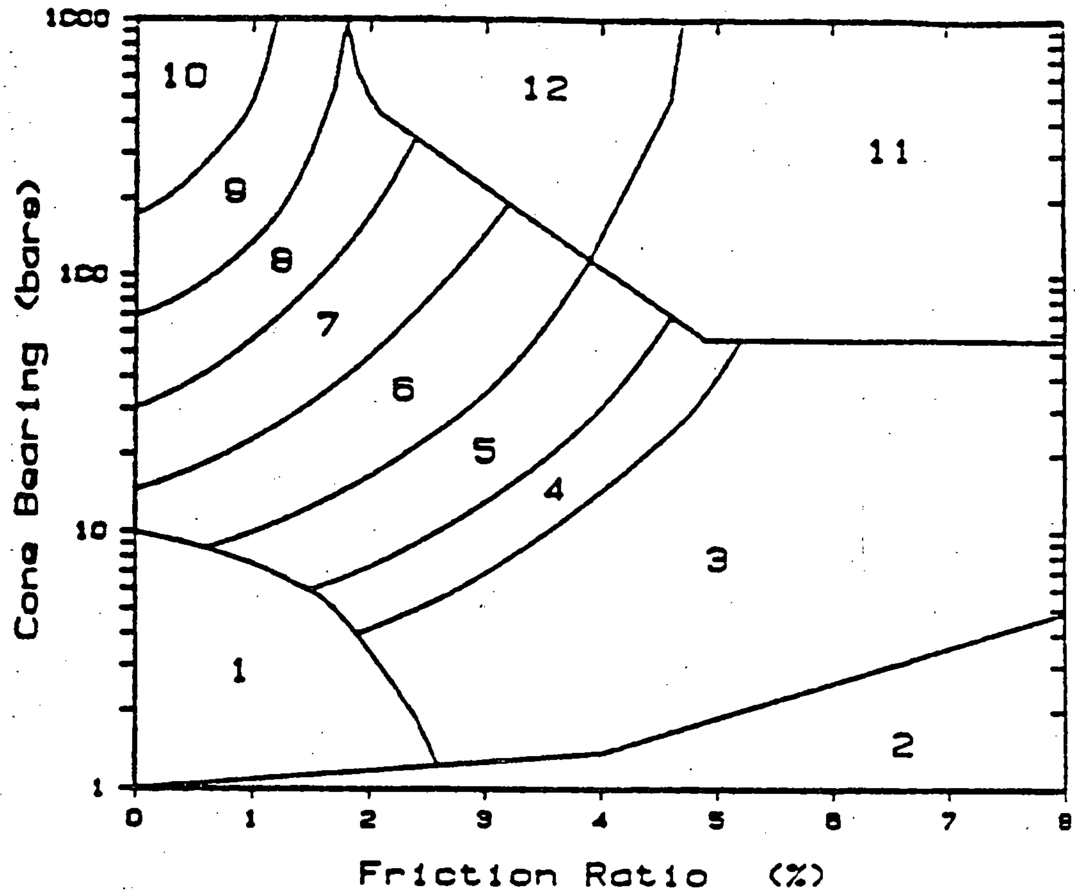
The soundings were performed with a 20-ton ram assembly mounted in the truck, an electric Hogentogler/GMF 15 ton piezometer cone, drive rods including a special "friction reducer" rod, and a system that automatically logs, reduces, and plots data.

When data from the cone penetration test -- cone tip resistance and friction ratio -- were plotted versus depth, the subsurface profile could be approximated. A change in soil type was indicated by a characteristic change in the cone tip resistance and friction ratio versus depth plots. Soil types were interpreted from Robertson and Campanella's (1984) chart shown in Figure 5.1 and visual observations.

Although the cone had a pore pressure transducer, it was not functioning properly. Therefore, pore pressure measurements, which would have helped determine soil types and the location of the water table, could not be used.

Of the eleven soundings, whose data and plots are presented in Appendix A, five were stopped when the local friction became greater than 10.43 tsf, three were terminated when the cone penetrated a very stiff layer after passing through a weak layer which could potentially buckle and break the drive rods, two were concluded when it became difficult to push the rods into the soil, and one was ended when the inclination of the rods exceeded 5.0 degrees from vertical at a depth of 5.00 meters or less. When the test was stopped for excessive local friction, subsequent baseline readings were taken to confirm that the final baseline readings did

1 bar = 100 kPa = 1.02 kg/cm^2



Zone	Soil Behaviour Type	Q_c/N
1)	sensitive fine grained	2
2)	organic material	1
3)	clay	1
4)	silty clay to clay	1.5
5)	clayey silt to silty clay	2
6)	sandy silt to clayey silt	2.5
7)	silty sand to sandy silt	3
8)	sand to silty sand	4
9)	sand	5
10)	gravelly sand to sand	6
11)	very stiff fine grained (*)	1
12)	sand to clayey sand (*)	2

(*) overconsolidated or cemented

FIGURE 3.1 SOIL BEHAVIOR CHART
(from Robertson and Campanella, 19[illegible])

not vary significantly from the initial baseline readings automatically recorded before each sounding. The limiting tip resistance of 10.44 tsf was not reached during the soundings, which were recorded for a total depth of 79.90 meters.

Iowa borehole shear. Basically, the Iowa borehole shear test consists of performing an insitu direct shear test. The maximum shear strength is plotted versus the normal stress to get a Mohr-Coulomb failure envelope. Discrete values of cohesion and friction angle are defined by this failure envelope. Since the data is reduced in the field, tests can be repeated immediately if necessary. The tested soils can be identified because the shear test is performed in an augered borehole.

The Iowa borehole shear test is very versatile. It has successfully been performed in vertical, horizontal, and inclined holes; above and below the water table; in snow; and under water in lake bottoms. Testing soils with a gravel content greater than 10% or loose caving sand which is dry or below the water table, however, is difficult. When a soil is too stiff, with a cohesion greater than about 1200 psf, the shear plates of the testing device do not seat during application of normal stress. When this occurs, the teeth of the shear plates scrape over the soil causing the friction angle to be overestimated and the cohesion to be underestimated or negative.

On July 3, 1986, Iowa borehole tests were attempted at the La Camelia mine but could not be completed since the soil was too stiff to penetrate with a hand auger.

On August 26, 1986, Iowa borehole tests were performed at the La Camelia mine. This time "starter" holes were made with a 1/2 inch electric drill powered by a portable Honda gasoline generator. The drill bit stem was modified from part of a hand penetration cone rod and the bit itself, the 1 inch clay cutter or sand cutter that is used with the self boring pressuremeter, could be threaded onto the stem. Hand penetration rods could be added as necessary until the required length was reached. After the 1 inch hole was completed to the desired depth, the hand auger was used to make the borehole 3 inches in diameter.

Although the Iowa borehole test has been performed in horizontal boreholes, the author had difficulty augering horizontally into a highwall. The drill bit did not remove the material as it was being augered so the bit had to be withdrawn frequently from the hole to pull the soil out. Subsequent hand augering was just as difficult and had the same problem of soil removal. Five tests, presented in Appendix A, were performed -- three in one borehole and two in another -- in soil layer 2 at the La Camelia mine. No tests were performed at the Floridin mine.

<u>Dilatometer.</u> Dilatometer tests could not be performed due to the high local friction of the soils.

<u>Laboratory Tests</u>

Chunk soil samples were removed from the highwalls at the Floridin and La Camelia mines, placed in Ziploc bags, properly labeled, and taken back to the laboratory for testing. The samples were hand carved from the excavations using the following equipment: a hand shovel, hoe, hacksaw, and pocket knife. Each sample was at least two times the 2" x 2" sample size required for the direct shear test. The required thickness of the sample depended on the type of soil and is discussed below with the direct shear test. The variability of the soil in each layer made it difficult to obtain representative soil samples. For example, the soil sample removed from a soil strata that consisted of red, orange, and white-grey clayey silt may be composed of one of the materials, two of the materials, or all three of the soils in an array of different compositions.

When the chunk samples reached the laboratory, smaller samples were removed to perform moisture content and bulk density tests. The larger samples were coated with paraffin to seal the moisture in the sample and to make the sample less susceptible to crumbling when cut for the direct shear test. The coated samples were stored in Ziploc bags until they were needed for testing. The results of the laboratory tests are presented in Appendix A.

<u>Moisture Content.</u> At least two moisture content tests were performed on each soil sample by following ASTM D 2216. The data obtained was not used in the stability analyses.

<u>Bulk Density.</u> Two bulk density tests were performed on each soil sample by following ASTM 1188 but substituting

"chunk soil samples" for "compacted bituminous mixtures". The specific gravity of paraffin was assumed to be 0.91 at 15°C, the average density of paraffin listed in the CRC Handbook of Chemistry and Physics. The bulk density was used in the stability analyses instead of the absolute density because the samples would disintegrate in water and the samples occur naturally in a partially cemented form in the field.

Direct Shear. Sixty-five strain-controlled direct shear tests were performed on moist samples following ASTM 3080 with several additions and modifications. The normal stresses applied to each soil type were chosen to represent a range close to the normal stress in the field. After applying the normal stress, the soil was allowed to consolidate for a time period that took into account the type of soil that was sheared. For example, a sandy soil that consolidates almost instantaneously was sheared immediately, while a clayey soil may be given 25 minutes to consolidate before it was sheared. Soils that lay above ground water were sheared without water in the shear box; soils that lay below the ground water were sheared with water. Additional tests were made on soil samples that were inundated for 48 hours if the soil was known to lay below ground water. When fissured soil specimens were sheared, the shear frames were raised more than the specified 0.01 in. This was to allow the soil specimens to fail along a weak plane rather than specifically on the horizontal plane. After the test results were plotted, a range of soil shear strength values were determined for each soil from linear regression analyses.

Computer Analyses

The stabilities of the existing highwalls at the Floridin and La Camelia mines were reanalyzed using Janbu's non-circular method. Both an arc and a wedge failure surface were considered. Furthermore, the wedge analysis included decreasing the cohesion of the soil layer that is immediately below the line of seepage (layer 7 at the Floridin mine; layer 5 at the La Camelia mine) to 0. to provide confidence in the soaked strength input values. The depth to which the failure surfaces could extend below the bottom of the cut was limited to one-half the height of the highwall since we did not know the strength of the soils underlying the fuller's earth. For the Floridin mine this depth was 45 feet below the bottom of the cut; for the La Camelia mine it was 40 feet.

Several slopes representing various reclamation scenarios -- slopes from the bottom of the mine to the natural ground surface, benched slopes, cut/fill slopes, and fill slopes --were analyzed using Janbu's method to find a minimum factor of safety of 2.0.

To be conservative, the piezometric head was assumed to follow the surface of seepage, exit on the face of the slope, and continue down the slope along the ground surface.

The analyses were accomplished with the aid of PCSTABL4, a slope stability microcomputer program that calculated the factor of safety against slope failure using the simplified Janbu method of slices with a general failure shape. When the Janbu method is selected, the program user can find the critical failure surface which is circular, irregularly-shaped, or wedge-shaped. PCSTABL4 also handles heterogeneous soil properties, anisotropic soil strength parameters, excess pore water pressure due to shear, static groundwater and surface water, pseudo-static earthquake loading, surcharge, and tieback loading. The user has the option of generating a plot file that can be plotted on an HP7470A plotter when a separate BASIC program, PLOTSTBL, is used. The program can be obtained from:

Mr. John Hooks
Federal Highway Administration
Office of Implementation (HRT-10)
Turner-Fairbank Highway Research Center
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CHAPTER VI
RESULTS

Insitu Tests

The cone penetration test soundings were interpreted to provide the soil profiles for the Floridin Corporation's Quincy mine and the Englehard Mineral and Chemical Corporation's La Camelia mine. These profiles are shown in Figures 6.1 and 6.2. The soil strength parameters stated in the legend on these figures were obtained from the direct shear test, discussed below. The strength parameters of soil layer 2 in the La Camelia soil profile was determined from a combination of the Iowa borehole and direct shear test results shown in Appendix A. A typical Iowa borehole test result is shown in Figure 6.3.

Laboratory Tests

The moist densities and the soil strength parameters used as input parameters in the computer analyses are presented in Table 3.1. The input densities were an average of the determined densities for a soil layer. The soil strength parameters were obtained from the direct shear test plots found in Appendix A. A typical direct shear test result is shown in Figure 6.4. The strength of soil layer 2 from the La Camelia was, as stated above, determined from a combination of the direct shear tests and the the Iowa

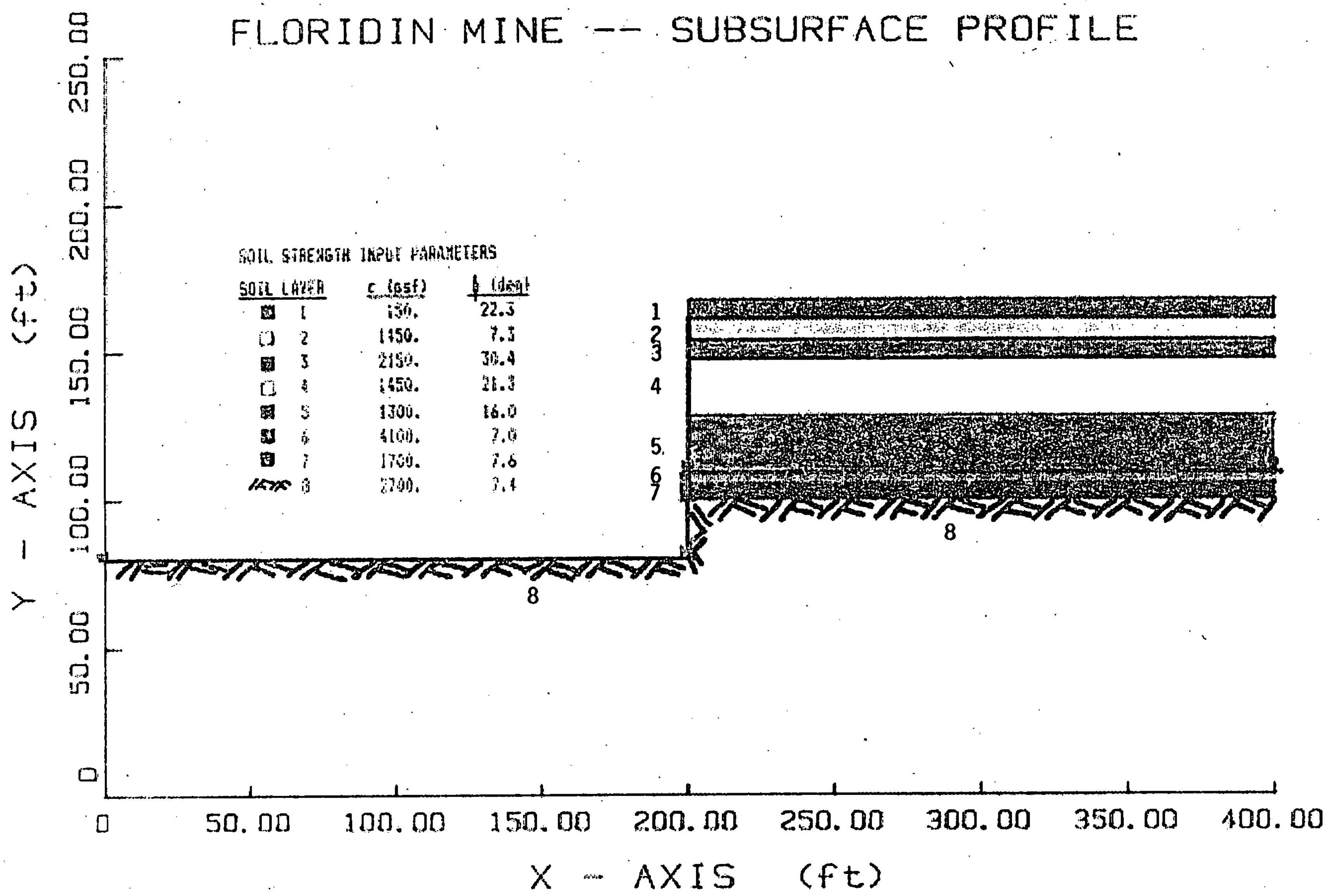

FIGURE 5.1 SOIL STRATIFICATION AT THE FLORIDIN MINE AS DETERMINED FROM CONE PENETRATION SOUNDINGS

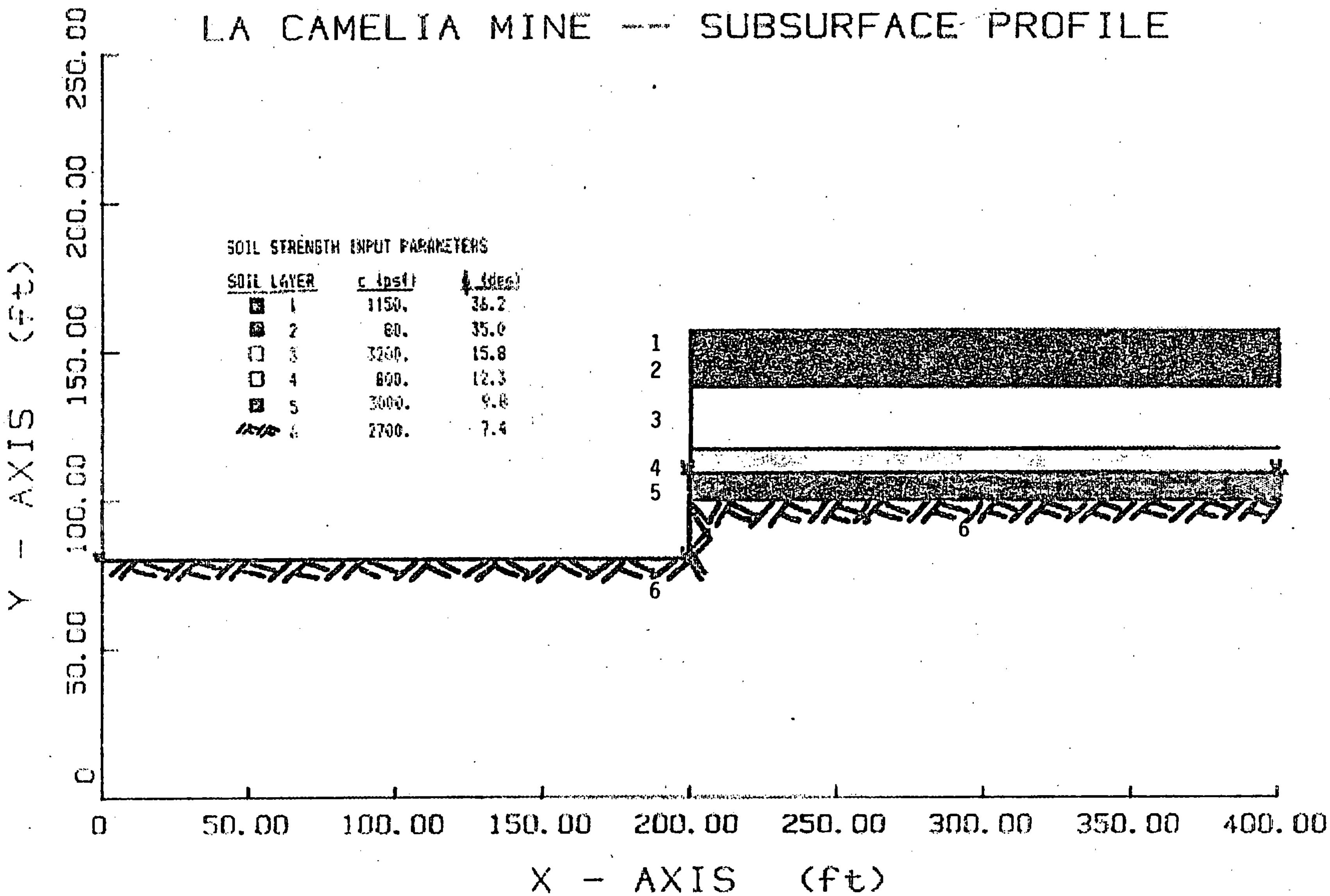

FIGURE 6.2 SOIL STRATIFICATION AT THE LA CAMELIA MINE AS DETERMINED FROM CONE PENETRATION SOUNDINGS

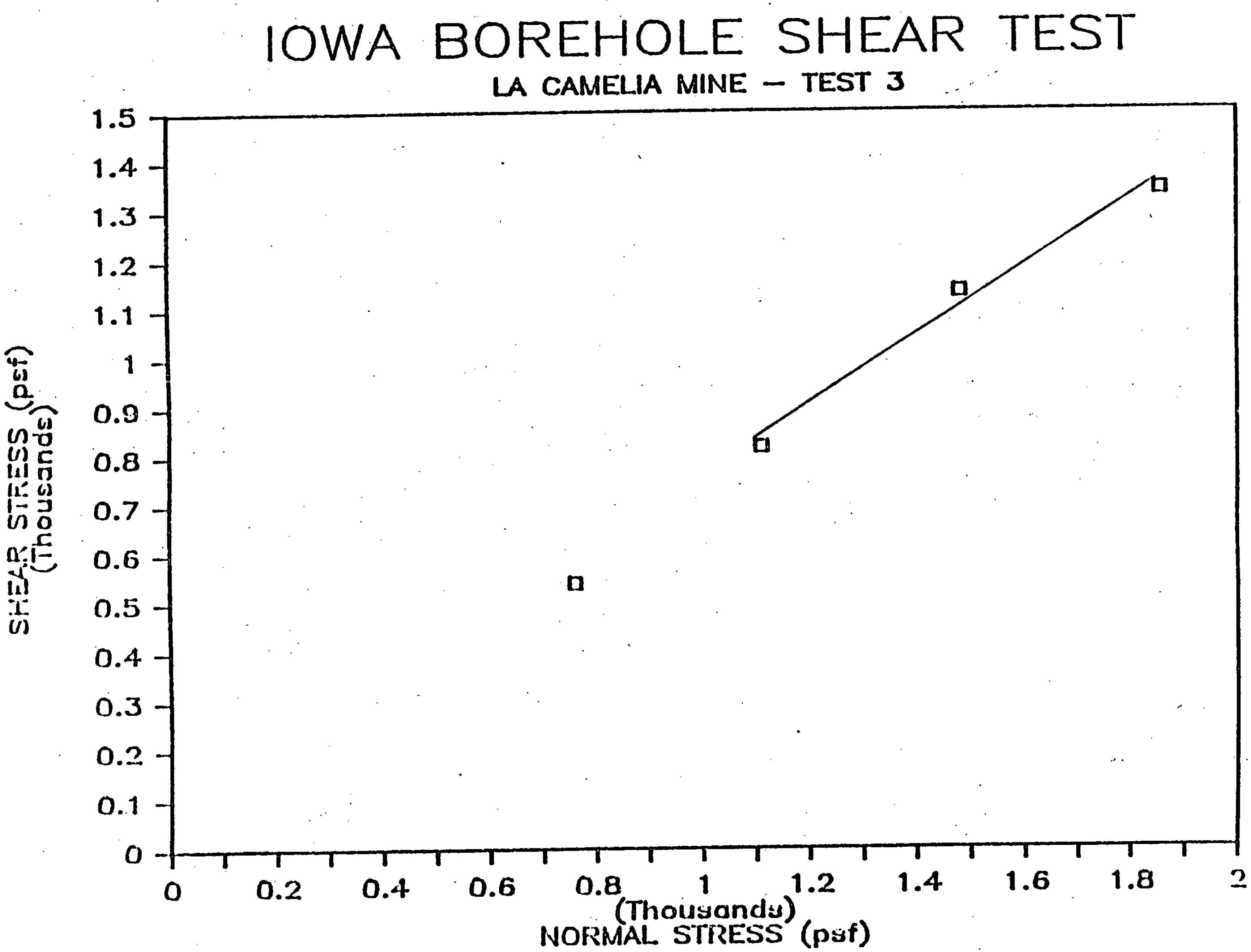

FIGURE 6.3 TYPICAL IOWA BOREHOLE TEST PLOT
FROM SOIL LAYER 2 AT THE LA CAMELIA MINE

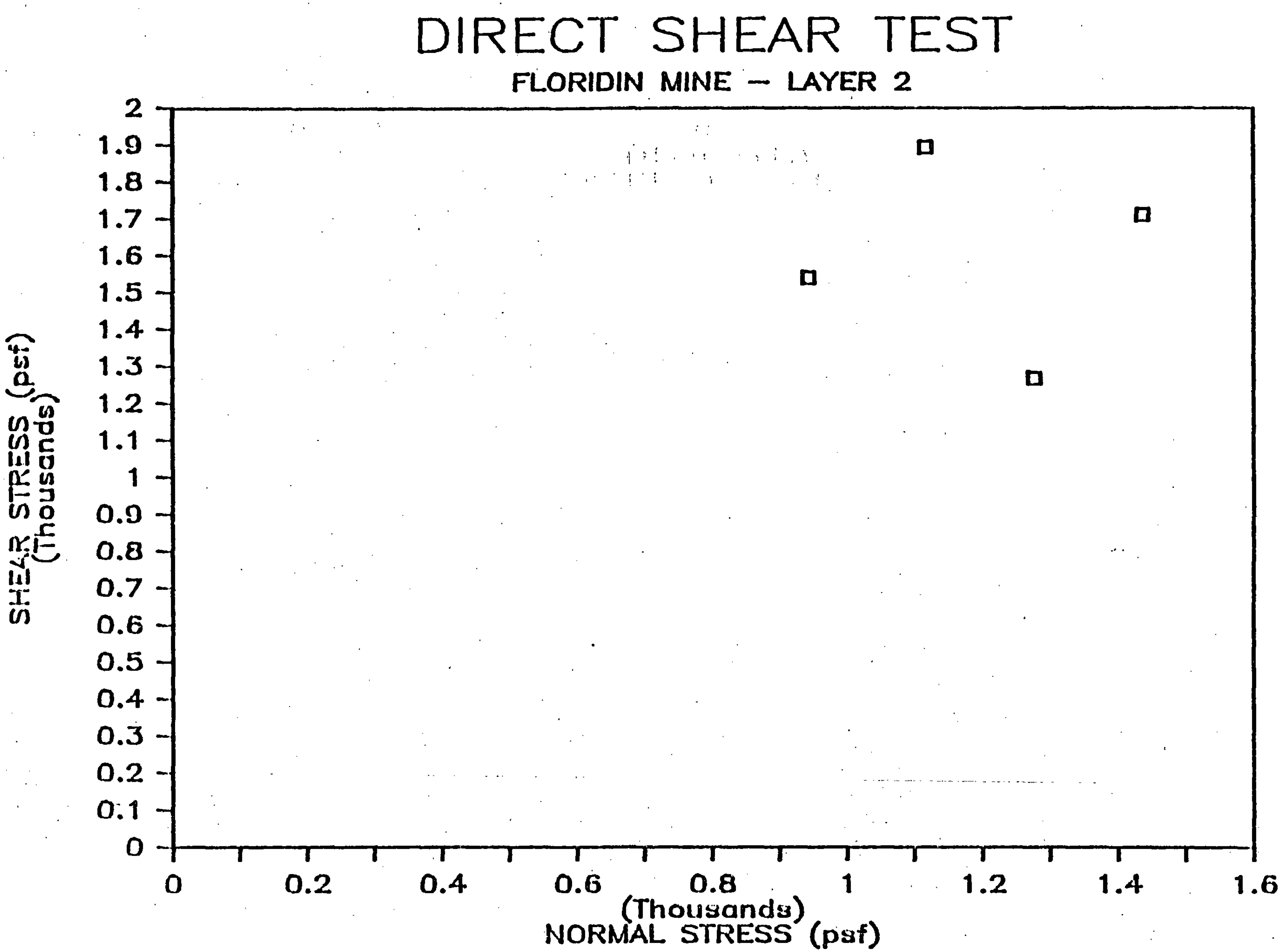

FIGURE 6.4 TYPICAL DIRECT SHEAR TEST PLOT

borehole tests.

The direct shear soil strength parameters obtained for the deeper overconsolidated clays may be artificially high since the increased strain-rate in the laboratory as compared to the natural strain rate in the field may overpredict the strength of the soil if excess negative pore pressures develop.

<u>Computer Analyses</u>

Using the previous mentioned input parameters, the existing Floridin highwall was calculated to have a minimum factor of safety of .94, while the La Camelia minimum factor of safety was calculated to be 1.1 as shown in Figures 6.5 and 6.6. These results suggest marginally stable highwalls which are consistent with visual observations of cracked highwalls and shallow slope failures below the line of seepage and thus provide confidence to our analyses method and input parameter values.

When wedge failure was considered, the existing Floridin highwall was analyzed to have a minimum factor of safety of .97; the La Camelia mine had a minimum factor of safety of 1.1. These values show practically no variation from the factors of safety calculated for the existing highwalls. The corresponding critical failure surfaces are shown in Figures 6.7 and 6.8.

To analyze the effects that seepage might have on the soil layer immediately below the line of seepage and to determine if the soaked strength values used in the stability

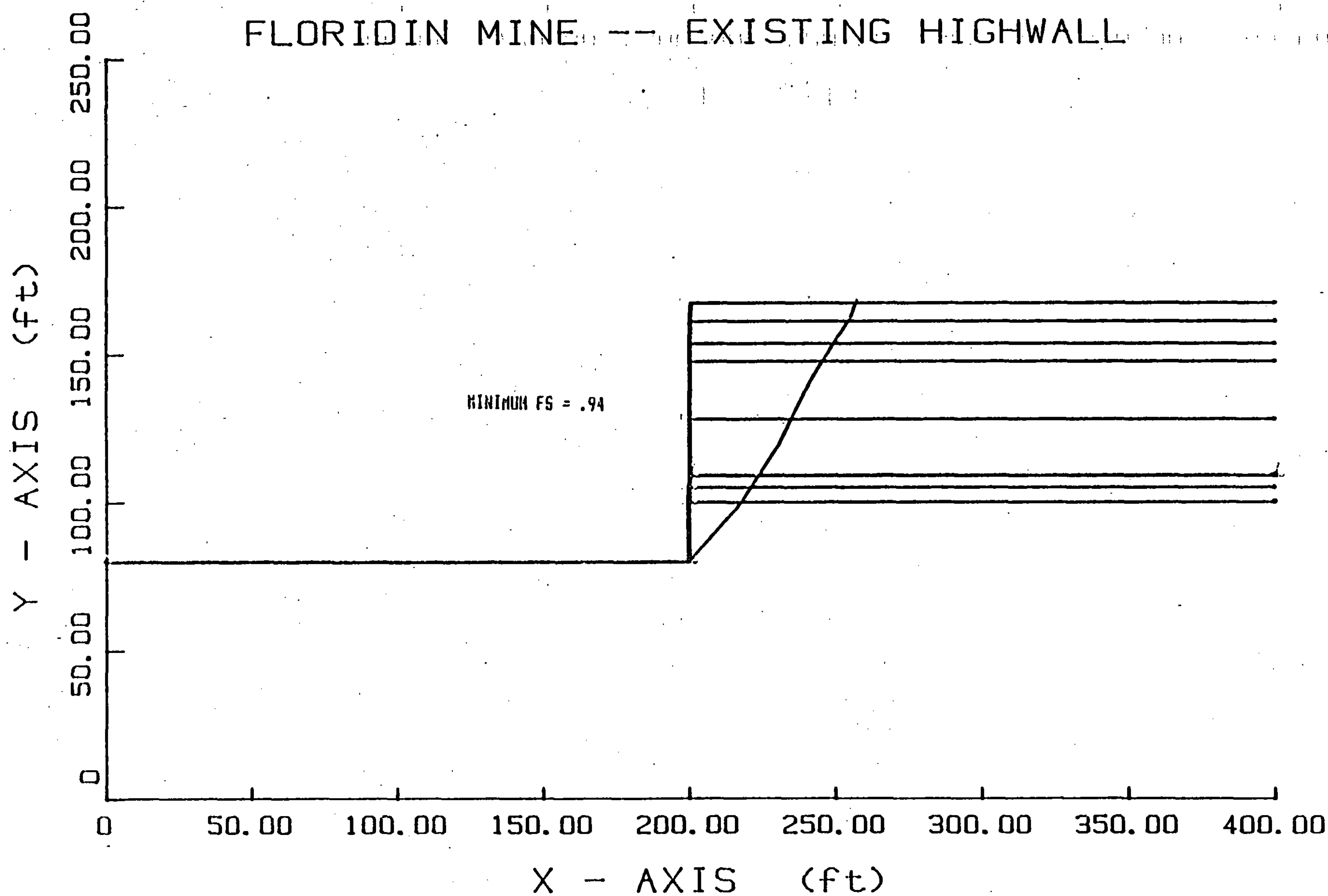

FIGURE 6.5 CRITICAL FAILURE SURFACE OF THE
FLORIDIN MINE EXISTING HIGHWALL

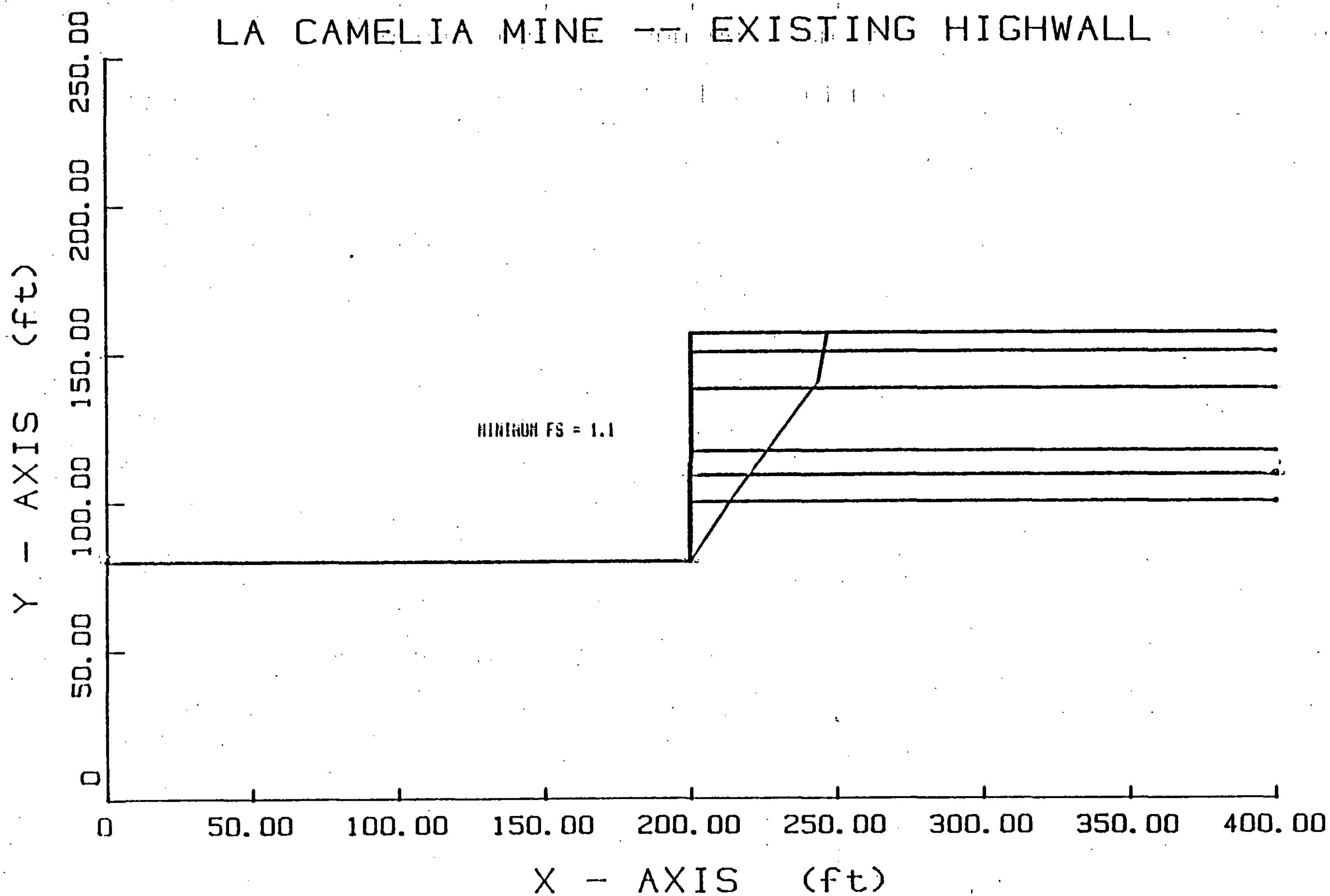

FIGURE 5.6 CRITICAL FAILURE SURFACE OF THE LA CAMELIA MINE EXISTING HIGHWALL

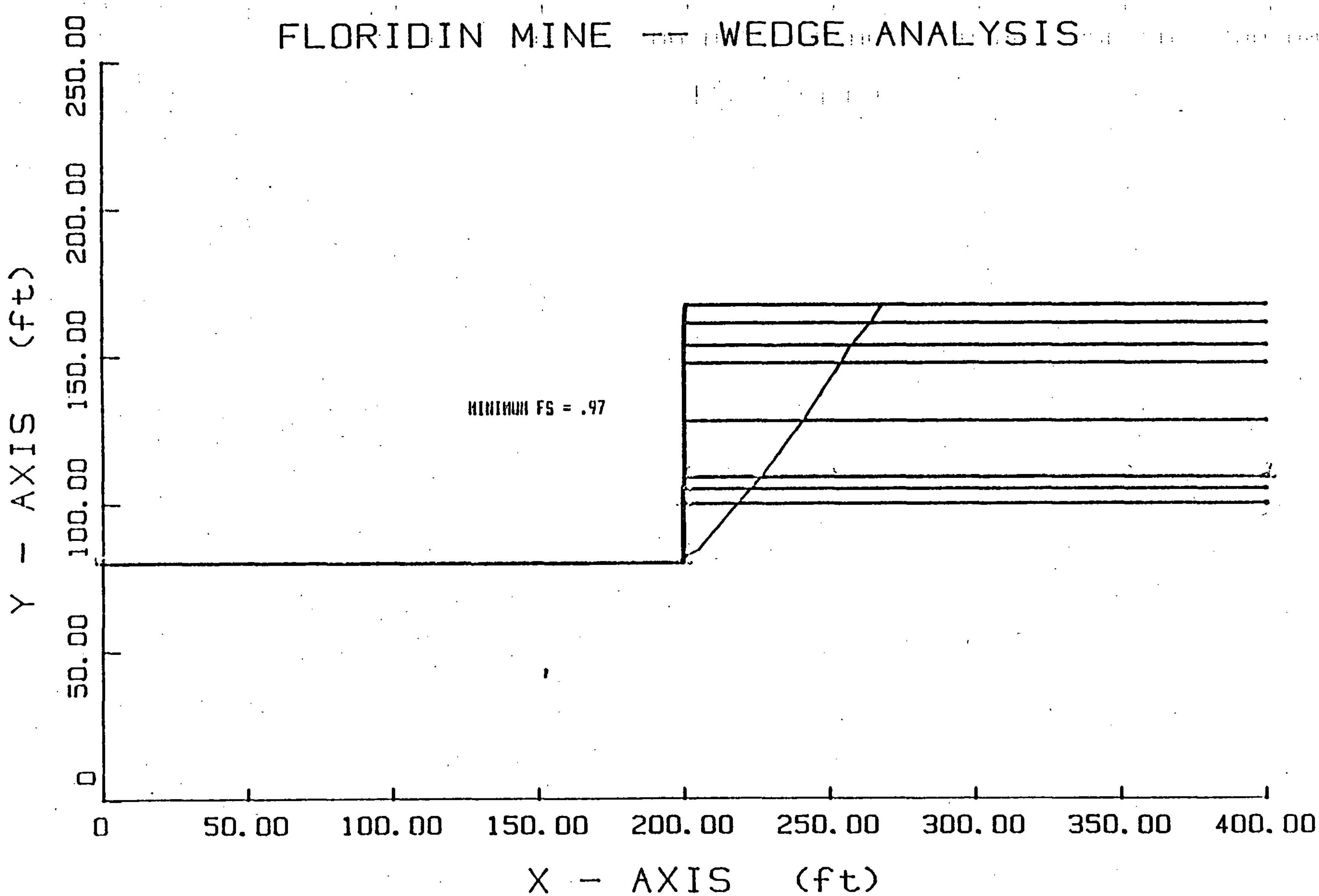

FIGURE 6.7 CRITICAL WEDGE FAILURE SURFACE OF THE FLORIDIN MINE EXISTING HIGHWALL

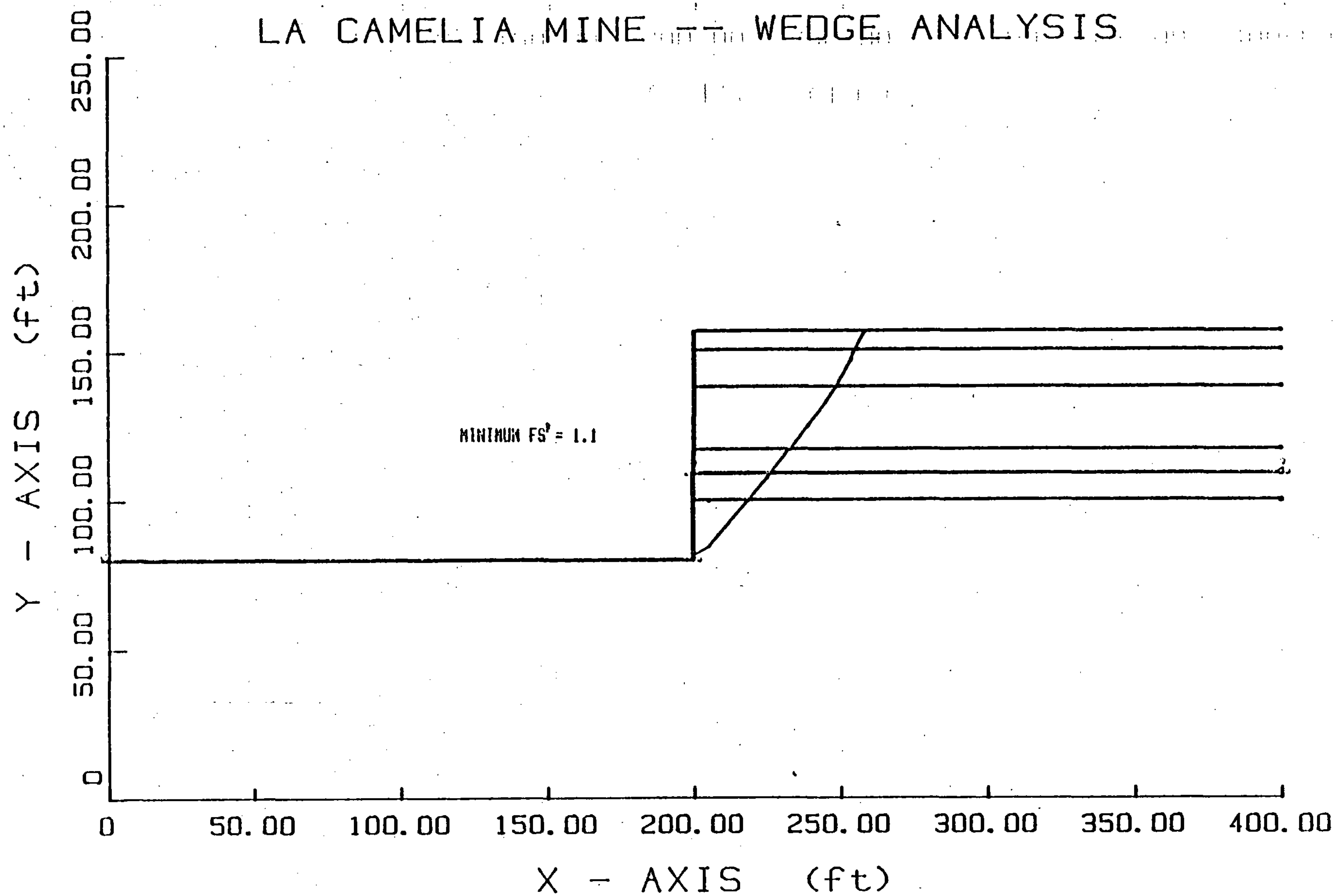

FIGURE 6.3 CRITICAL WEDGE FAILURE SURFACE OF THE LA CAMELIA MINE EXISTING HIGHWALL

analyses are appropriate, the cohesion of this layer was decreased to 0. Water seeping over this layer of soil, lying above the fuller's earth, may drastically decrease its strength. Wedge analyses were performed through this layer of soil and the underlying fuller's earth. This caused the minimum factor of safety of the Floridin mine to attenuate to .92, while the minimum factor of safety of the La Camelia was calculated at .96. The respective critical failure surfaces are presented in Figures 6.9 and 6.10. The minimum factor of safety of the highwalls did not seem particularly sensitive to the reduction in the cohesion of the soil overlying the fuller's earth. These factors of safety calculated from wedge failure analyses are also indicative of marginally safe highwalls. This provides confidence to the input soaked strengths and the method of stability analysis.

With this confidence, several slopes representing various reclamation schemes were analyzed using the profiles and strength values of the existing two vertical slopes as guides. These schemes were analyzed to provide a minimum factor of safety of 2. Table 2.1 presents a summary of these analyses. If the slope is not benched or composed of fill, the maximum slope of the Floridin site is 2.75H:1V while the maximum slope of the La Camelia site is 2.5H:1V to provide a minimum factor of safety of 2. These slopes are shown in Figures 6.11 and 6.12. If the reclaimed slope is benched through the fuller's earth, the slope must be decreased to 3.0H:1V for both locations, as shown in Figures 6.13 and 6.14.

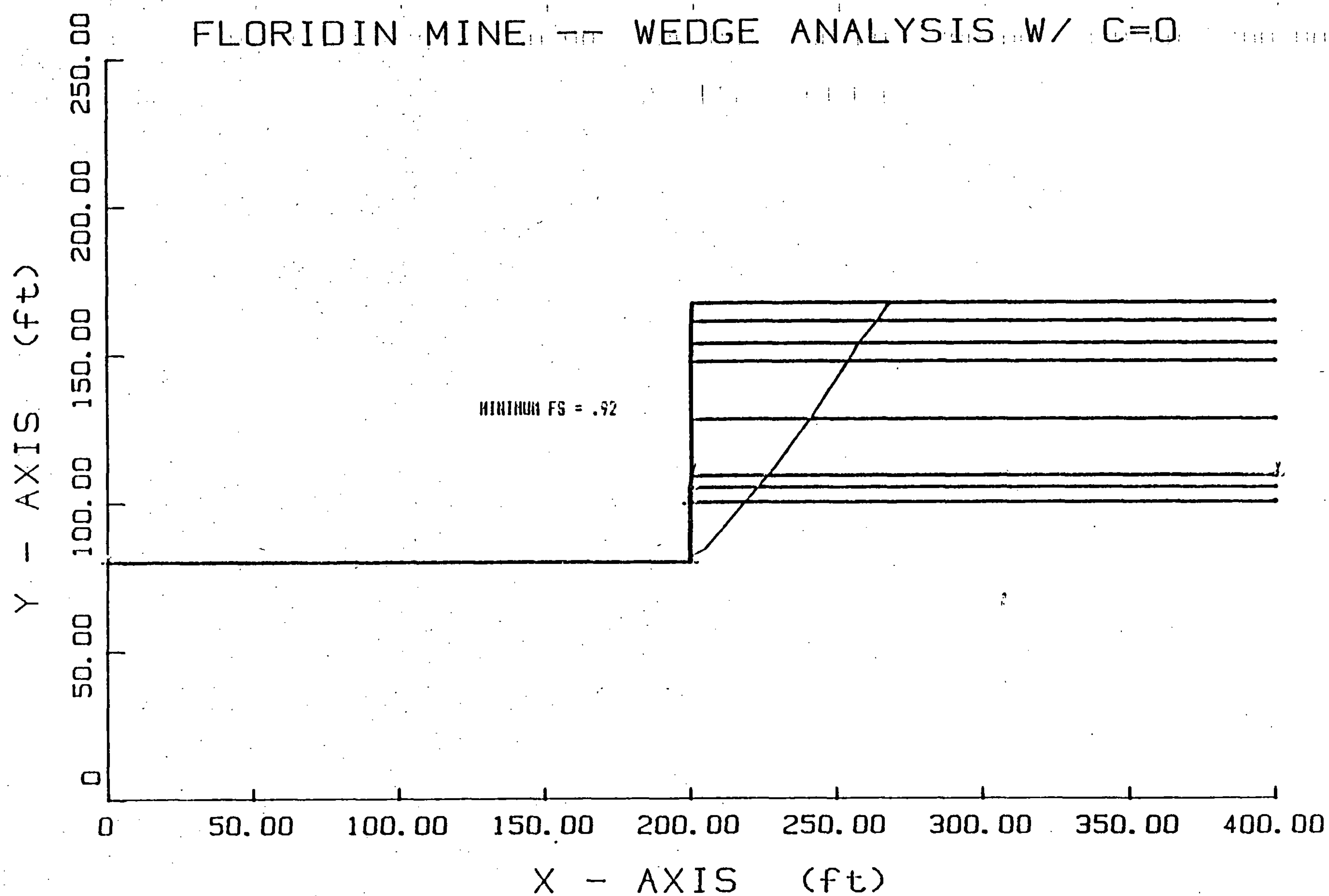

FIGURE 6.9 CRITICAL WEDGE FAILURE SURFACE OF THE FLORIDIN MINE EXISTING HIGHWALL WHEN THE [illegible] OF SOIL LAYER 7 EQUALS 0.0

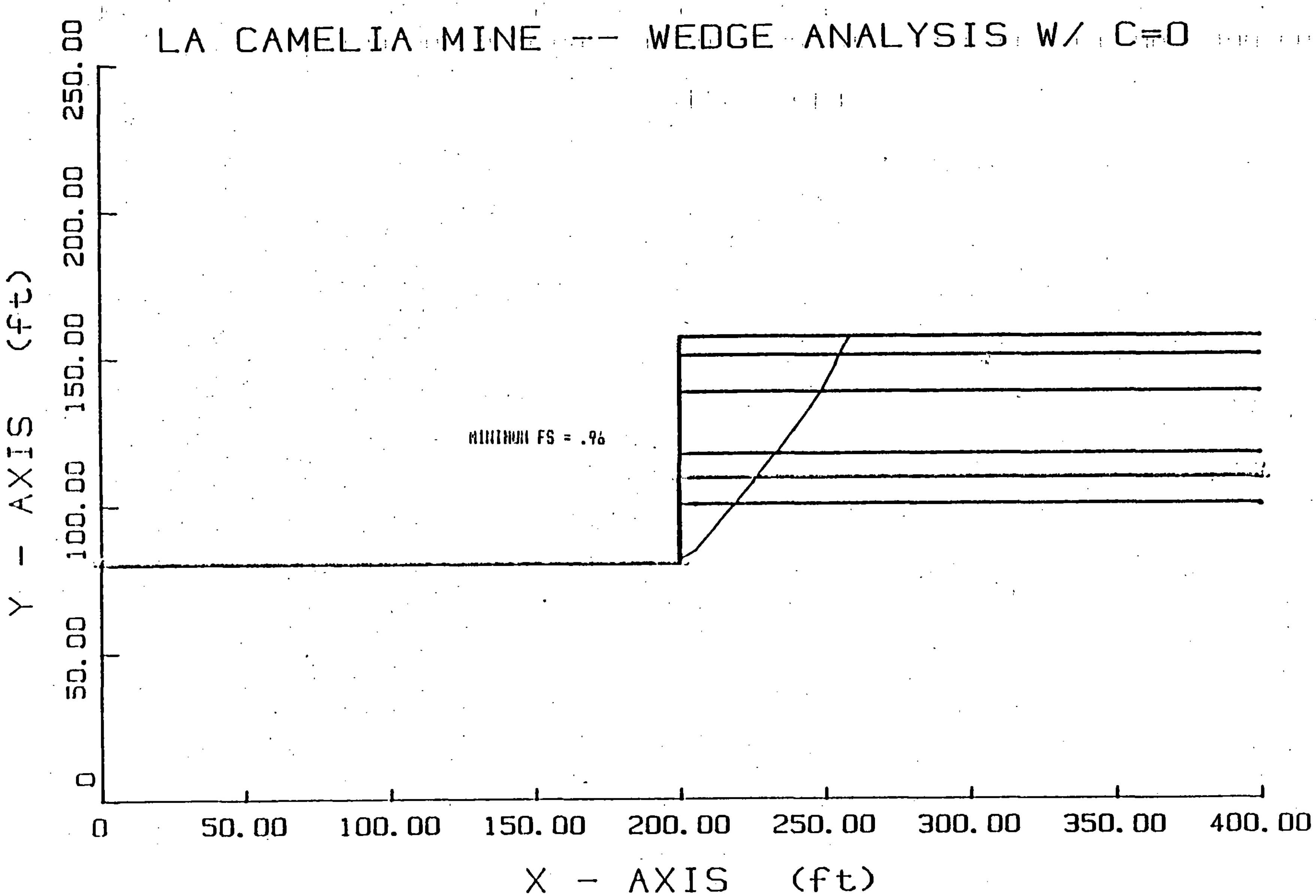

FIGURE 6.10 CRITICAL WEDGE FAILURE SURFACE
OF THE LA CAMELIA MINE EXISTING HIGHWALL WHEN

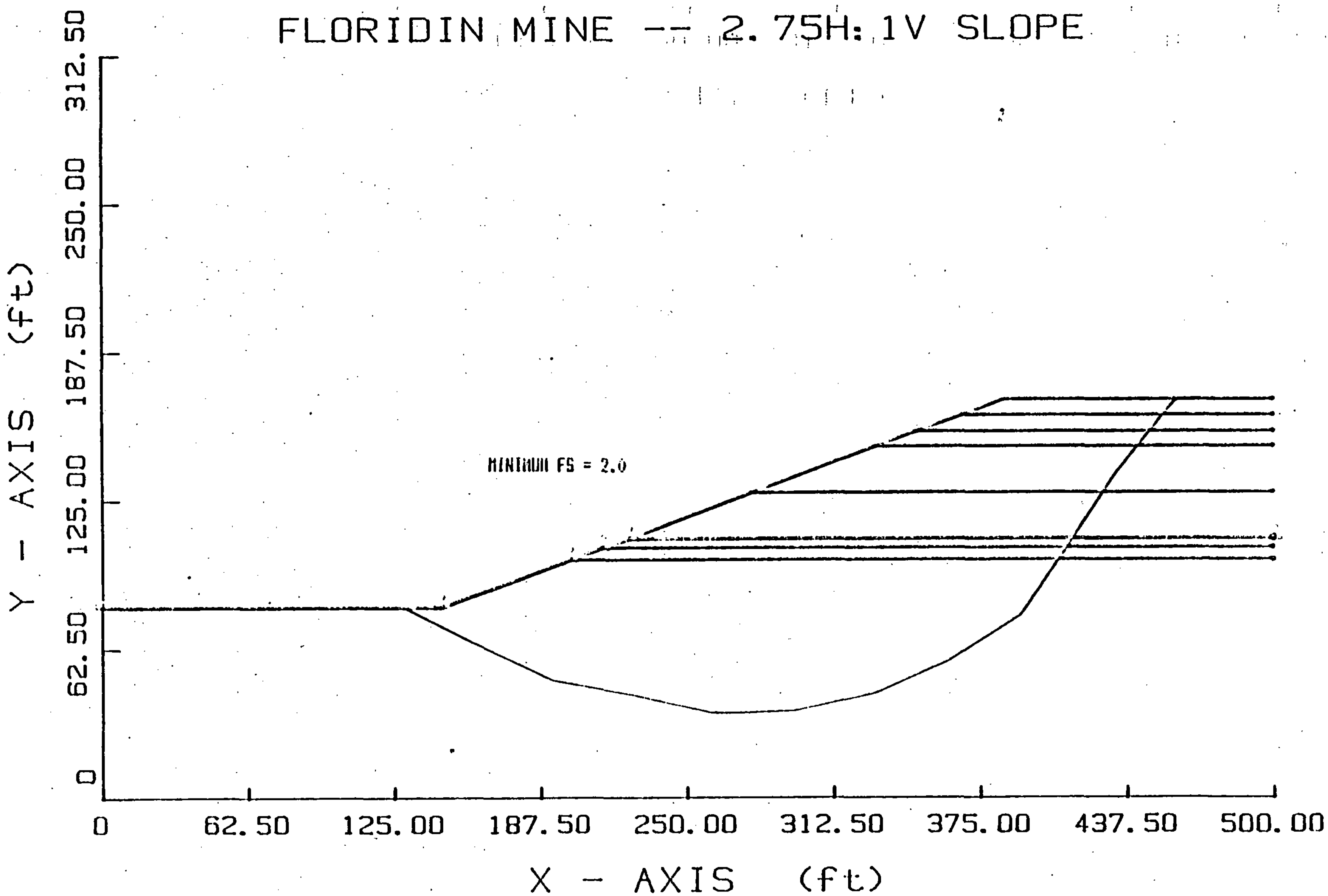

FIGURE 6.11 CRITICAL FAILURE SURFACE OF A
FLORIDIN MINE RECLAIMED SLOPE

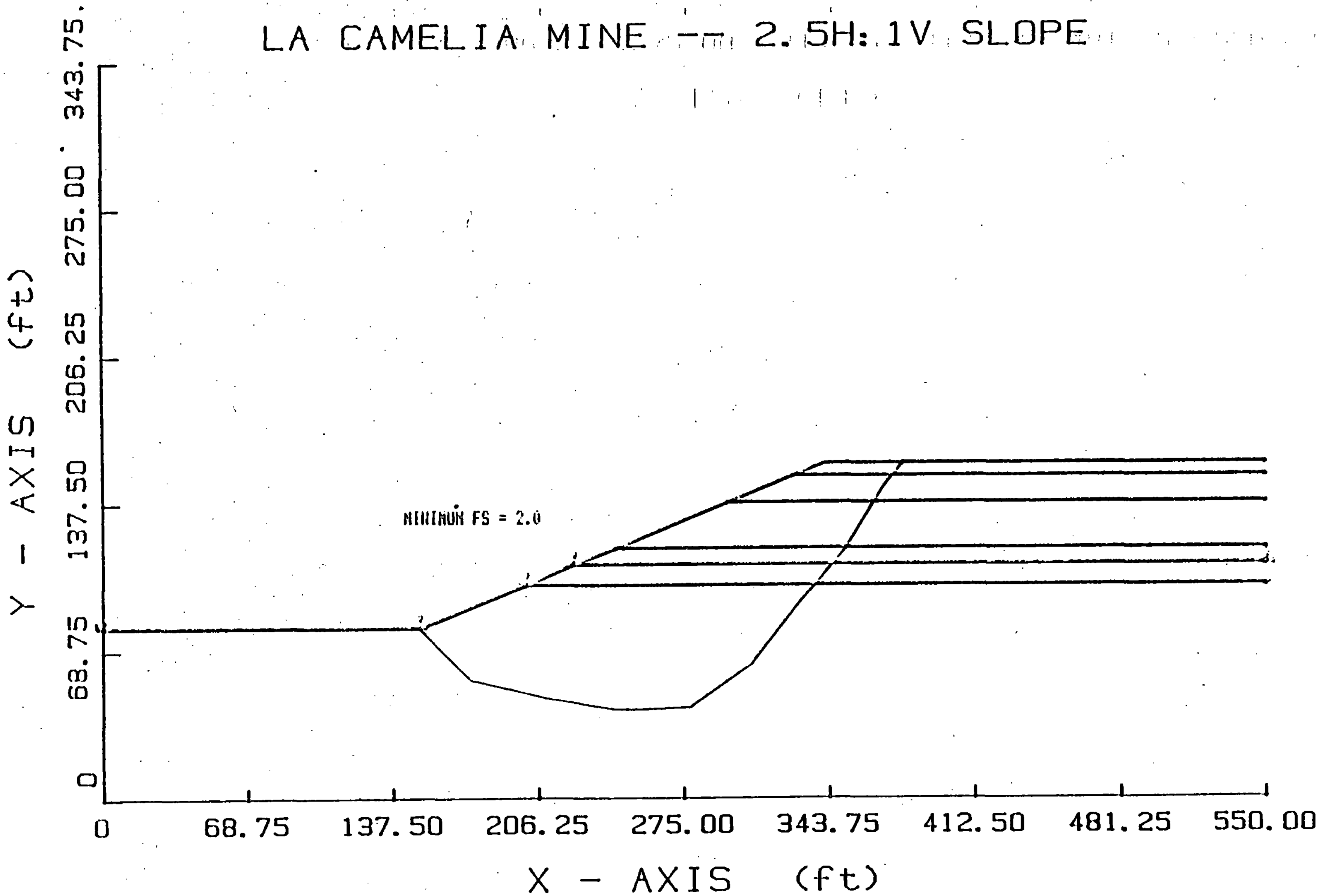

FIGURE 6.12 CRITICAL FAILURE SURFACE OF A LA CAMELIA MINE RECLAIMED SLOPE.

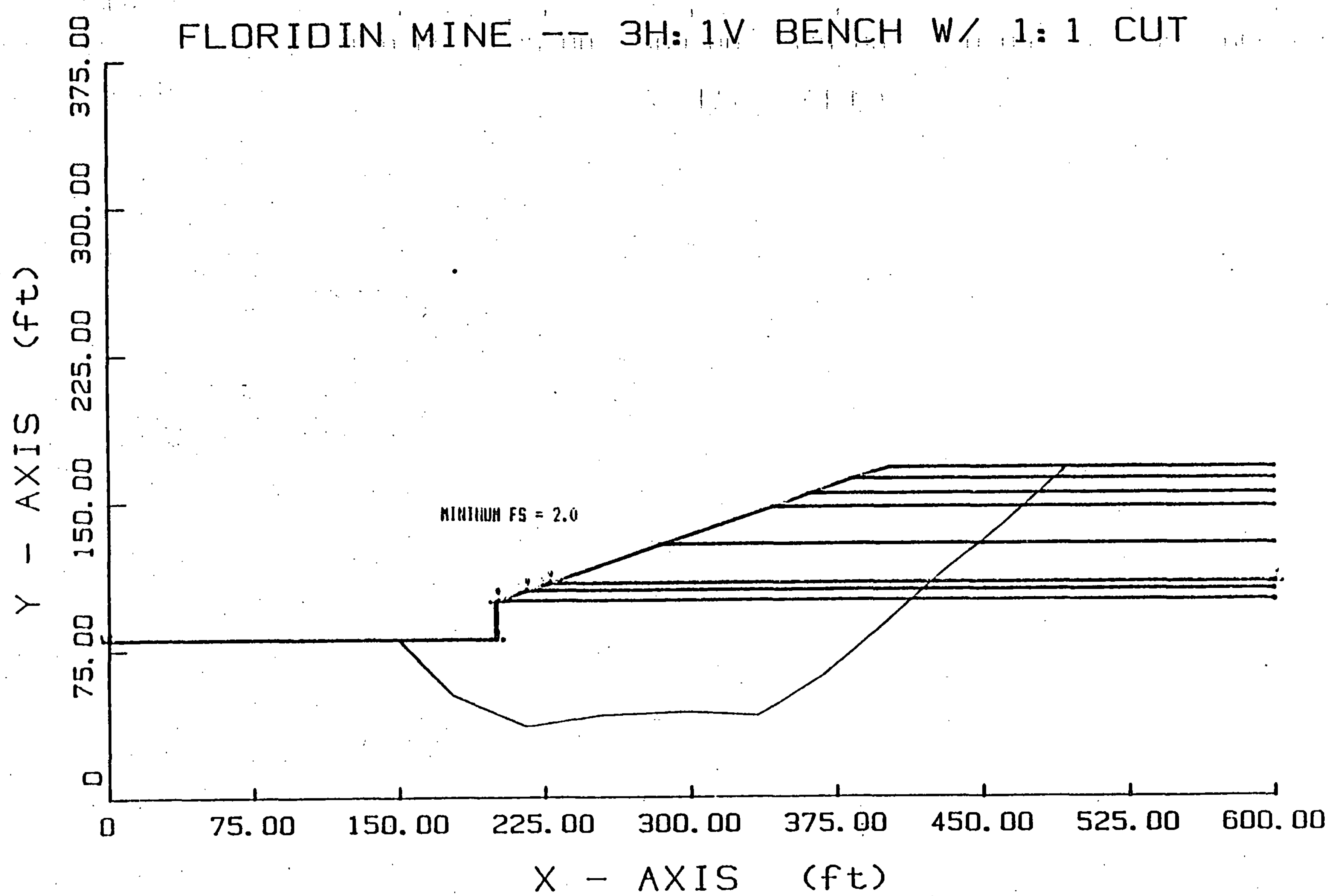

FIGURE 6.13 CRITICAL FAILURE SURFACE OF A FLORIDIN MINE RECLAIMED BENCHED SLOPE

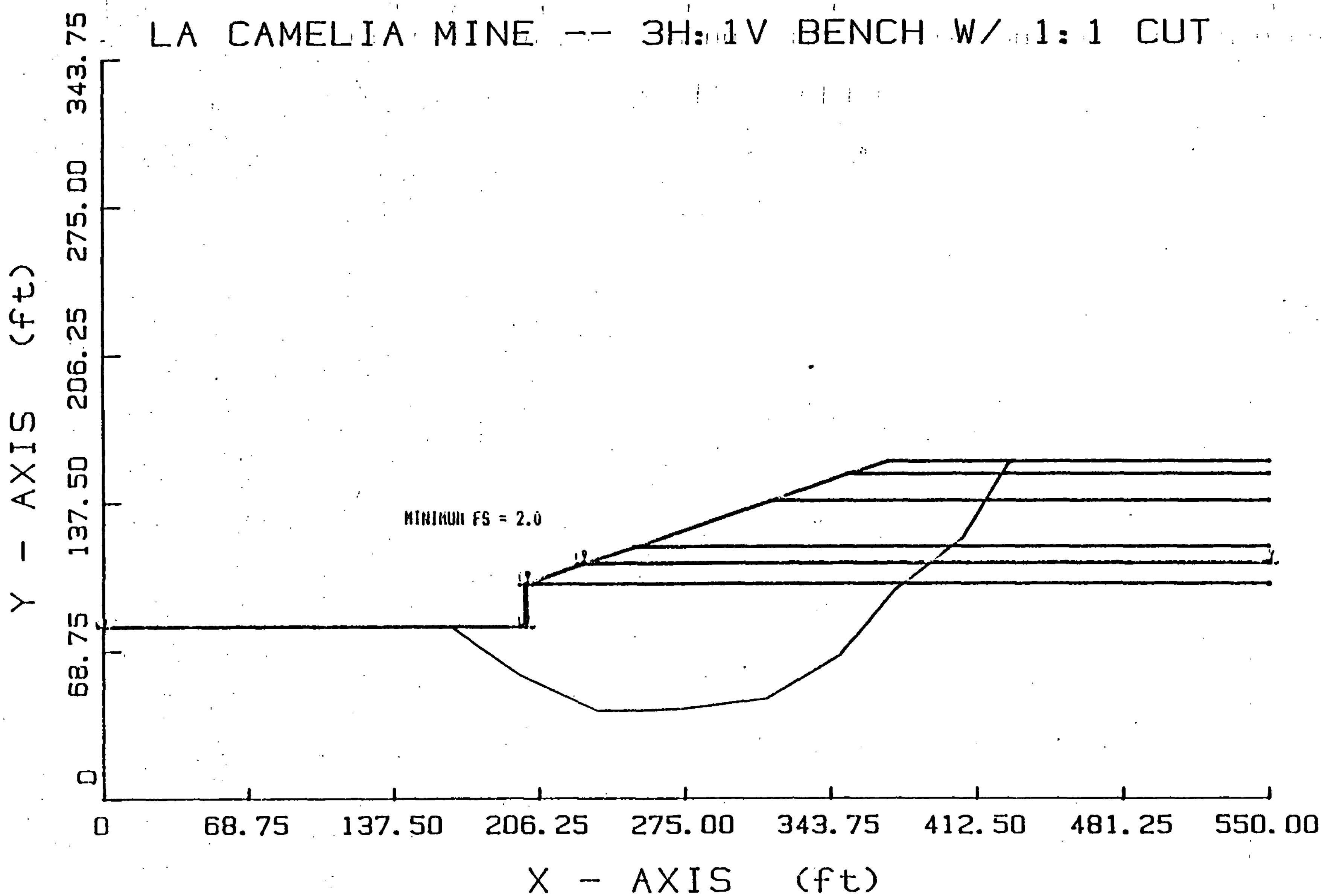

FIGURE 6.14 CRITICAL FAILURE SURFACE OF A
LA CAMELIA MINE RECLAIMED BENCHED SLOPE

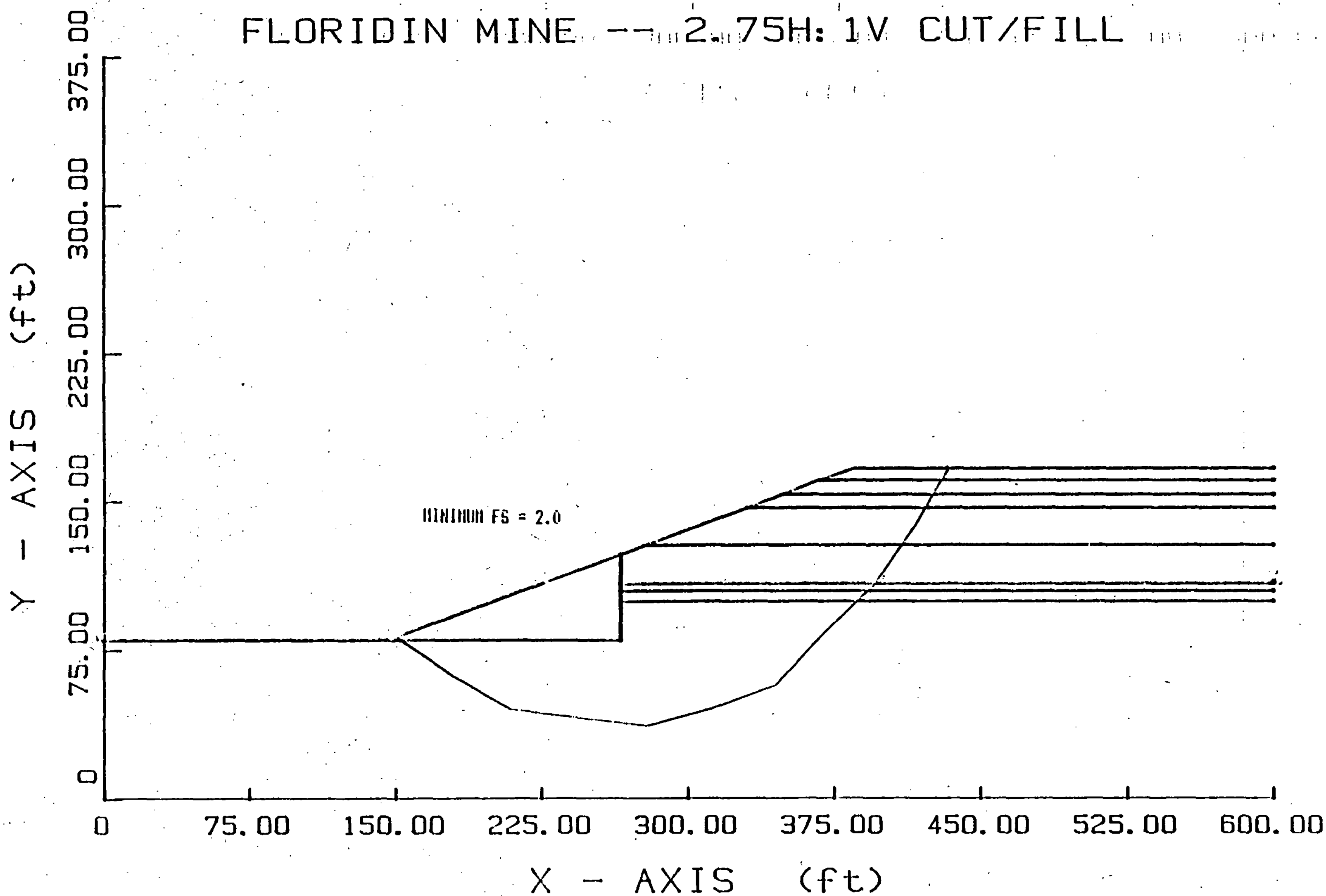

FIGURE 6.15 CRITICAL FAILURE SURFACE OF A
FLORIDIN MINE RECLAIMED CUT/FILL SLOPE

The situation of cut and fill was analyzed for both mines assuming, conservatively, that the fill would have a compacted density of 100 psf, a friction angle of 25 degrees, and a cohesion of 200 psf. In the instance of cut and fill, the maximum reclaimed slopes were determined to be 2.75H:1V and 2.5H:1V, which are the same as calculated for the slopes through the natural material. The critical failure surfaces of the maximum cut and fill slopes for the Floridin and La Camelia mines, given in Figures 6.15 and 6.16, pass through the natural material, not through the fill. Therefore, the fill only contributes to the weight of the failure surface and not to the strength, for the specific sites examined. If the highwall is reclaimed by filling in the slope without cutting, as presented in Figures 6.17 and 6.18, the slopes cannot be steeper than 5.25H:1V to have a minimum factor of safety of 2.0. Obviously, this slope if flatter than the current 4H:1V standard and not practical. The 5.25H:1v slope merely reflects an overconservative assumption for the fill properties. Accordingly, in the case of fill situations, sampling of test fills or engineering judgment may be required to obtain the needed input parameters. Therefore, it is recommended that a site visitation be made to verify construction compliance with design assumptions.

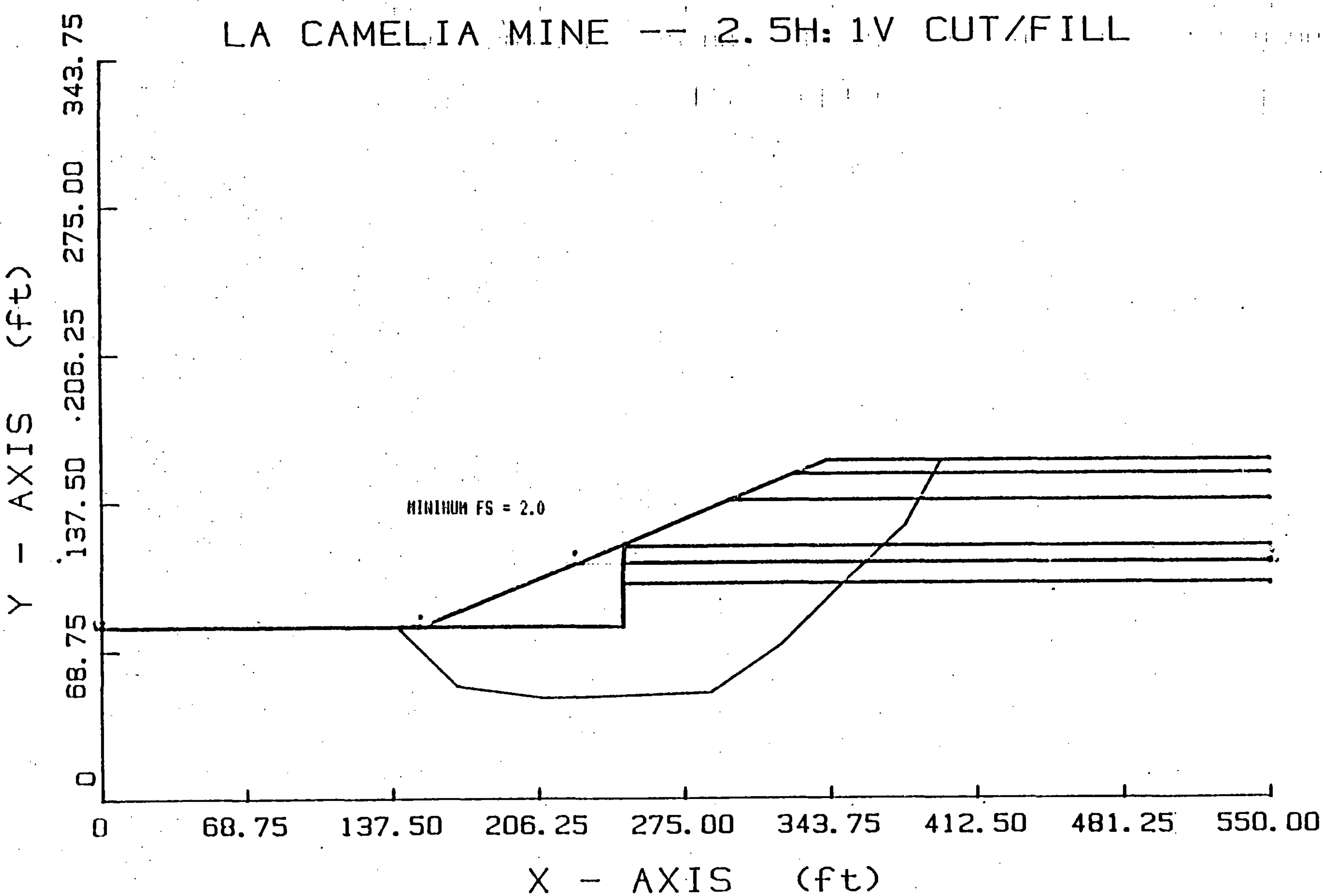

FIGURE 6.16 CRITICAL FAILURE SURFACE OF A
LA CAMELIA MINE RECLAIMED CUT/FILL SLOPE

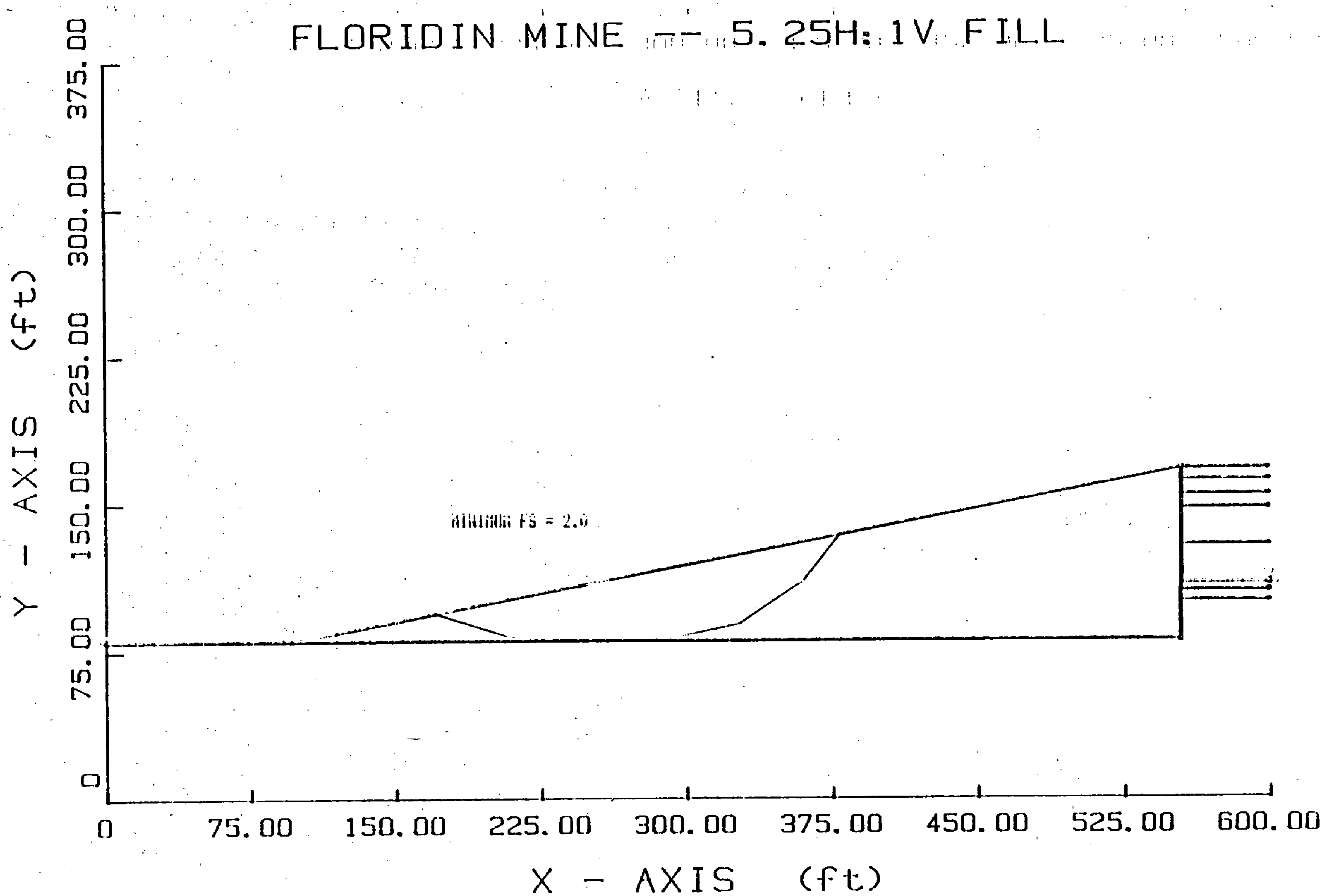

FIGURE 5.17 CRITICAL FAILURE SURFACE OF A FLORIDIN MINE RECLAIMED FILL SLOPE

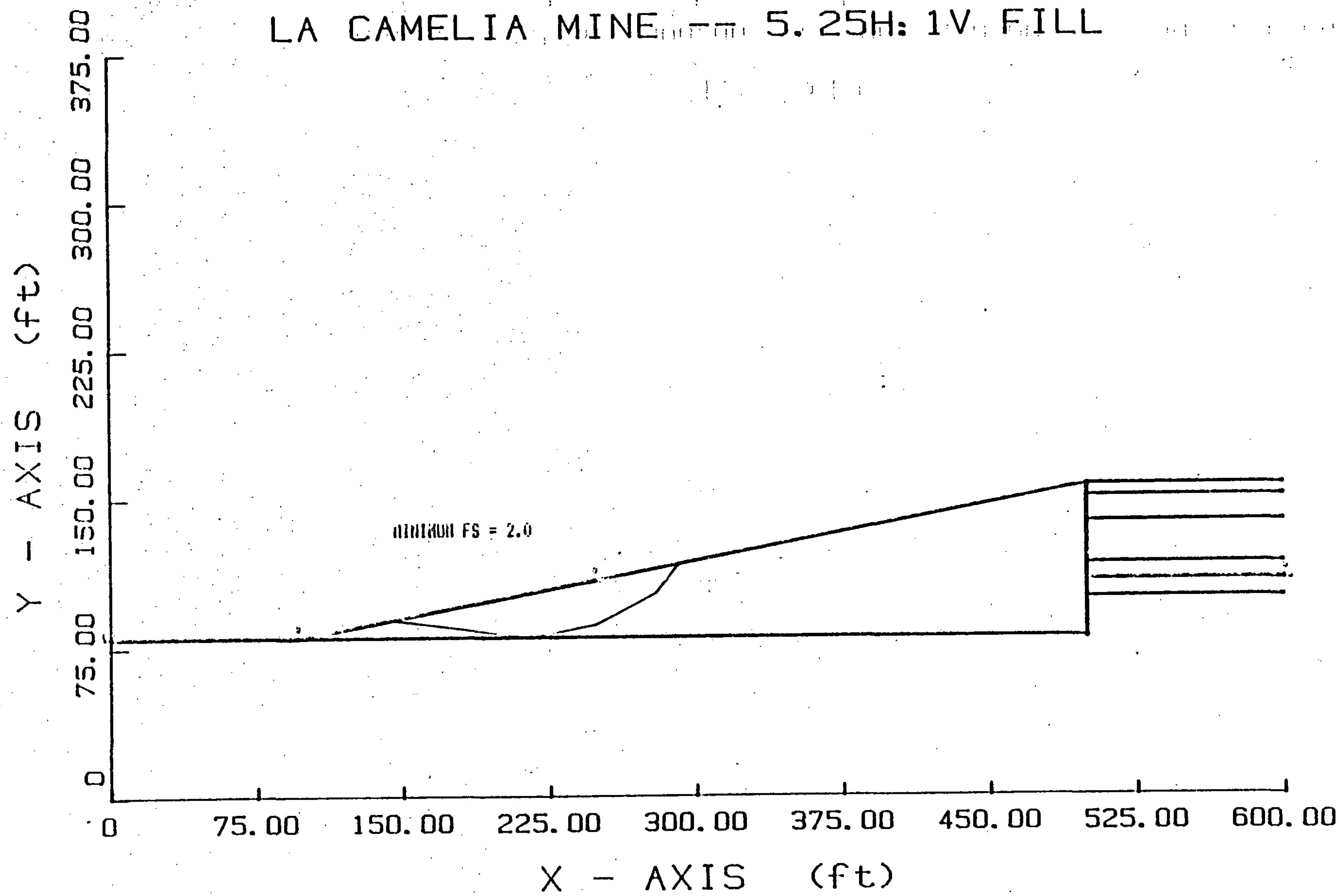

FIGURE 6.19 CRITICAL FAILURE SURFACE OF A
LA CAMELIA MINE RECLAIMED FILL SLOPE

CHAPTER VII
CONCLUSIONS

Analyses of the existing highwalls produced factor of safety values of approximately 1.0, which are consistent with observations of distressed highwalls with cracks and shallow slope failures below the line of seepage. This in turn provided confidence in our input parameters and method of stability analyses. From these engineering observations and the presented stable reclamation slopes that are steeper than the present 4H:1V standard, it is apparent that these sites could be reclaimed at a slope steeper than 4H:1V while maintaining a minimum factor of safety of 2.0. A variety of highwall reclamation scenarios were examined and maximum slopes for a factor of safety of 2.0 provided. However, this study does not account for other factors such as erosion (especially in the zone of seepage), maintenance, and safety of people and livestock. Also, these conclusions are site specific.

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APPENDIX A

OUNDING DATA IN FILE CPT136 7-1-88 10:41

NGINEER : Beth Gross LOCATION : FLORIDIN 1

ONE ID : 15-205 JOB : 1

niversity of Florida - Department of Civil Engineering

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	20.2	0.02	0.09	0.0
0.10	32.7	0.04	0.12	0.0
0.15	41.9	0.07	0.17	0.0
0.20	49.7	0.09	0.18	0.0
0.25	50.8	0.18	0.30	0.0
0.30	86.9	0.31	0.35	0.0
0.35	123.5	0.89	0.72	0.1
0.40	132.9	2.54	1.90	0.1
0.45	156.9	4.62	2.76	0.1
0.50	200.0	5.51	2.75	0.1
0.55	239.3	5.54	2.41	0.1
0.60	275.9	2.46	0.89	0.1
0.65	309.7	2.82	0.91	0.1
0.70	317.7	4.12	1.29	0.1
0.75	262.9	5.75	2.18	0.1
0.80	215.3	6.61	3.06	0.1
0.85	209.2	6.55	3.13	0.1
0.90	225.7	6.58	3.34	0.1
0.95	171.1	6.92	4.04	0.1
1.00	139.9	6.70	4.78	0.1
1.05	125.9	7.21	5.73	0.1
1.10	135.9	6.43	4.72	0.2
1.15	178.0	5.08	2.85	0.2
1.20	230.2	3.42	1.48	0.2
1.25	256.7	3.20	1.19	0.2
1.30	264.8	3.04	1.14	0.2
1.35	285.0	3.30	1.15	0.2
1.40	277.5	3.83	1.38	0.2
1.45	270.5	3.84	1.41	0.2
1.50	278.5	3.08	1.10	0.2
1.55	282.9	2.76	0.97	0.2
1.60	287.2	1.65	0.57	0.2
1.65	268.5	2.12	0.78	0.2
1.70	270.4	2.15	0.79	0.2
1.75	263.0	2.37	0.90	0.2
1.80	252.8	3.27	1.29	0.2
1.85	228.5	3.66	1.65	0.2
1.90	217.6	3.14	1.44	0.2
1.95	212.1	2.60	1.22	0.2
2.00	193.7	3.48	1.79	0.2

FIGURE A-1-a. CONE PENETRATION SOUNDING

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
2.05	134.4	4.71	2.55	0.2
2.10	172.3	4.96	2.57	0.2
2.15	171.5	4.55	2.65	0.2
2.20	176.4	3.92	2.21	0.2
2.25	176.5	2.63	1.48	0.2
2.30	181.1	2.70	1.48	0.2
2.35	176.8	3.30	1.86	0.2
2.40	164.5	3.42	2.07	0.2
2.45	161.8	3.35	2.07	0.2
2.50	149.2	3.94	2.63	0.2
2.55	128.8	4.37	3.39	0.2
2.60	132.2	2.49	1.88	0.2
2.65	133.0	3.45	2.59	0.2
2.70	120.7	5.17	4.28	0.2
2.75	96.2	5.51	5.82	0.2
2.80	99.0	6.42	6.48	0.1
2.85	129.5	6.70	5.17	0.1
2.90	134.9	7.00	5.19	0.1
2.95	120.6	6.55	5.43	0.1
3.00	133.7	5.62	4.19	0.1
3.05	195.1	4.36	2.23	0.1
3.10	253.7	4.83	1.90	0.1
3.15	207.6	6.54	3.15	0.1
3.20	178.9	6.10	3.40	0.1
3.25	182.0	6.39	3.50	0.0
3.30	131.5	6.40	4.86	0.0
3.35	129.0	6.51	5.04	0.0
3.40	136.9	5.20	3.79	0.0
3.45	202.9	5.12	2.52	0.0
3.50	202.3	6.29	3.10	0.0
3.55	174.2	6.75	3.87	0.0
3.60	159.0	3.88	2.43	0.0
3.65	173.0	3.90	2.25	0.0
3.70	181.9	3.63	1.99	0.0
3.75	219.2	3.90	1.77	0.0
3.80	210.0	4.78	2.27	0.0
3.85	206.4	5.00	2.42	0.0
3.90	218.1	5.83	2.67	0.0
3.95	166.9	7.30	4.37	0.0
4.00	151.3	6.86	4.53	0.0
4.05	170.2	6.04	3.55	0.0
4.10	151.9	4.56	3.00	0.0
4.15	179.1	2.93	1.63	0.0
4.20	180.6	2.41	1.33	0.0
4.25	144.2	2.52	1.74	0.0
4.30	121.3	2.60	2.14	0.0
4.35	122.1	1.91	1.56	0.0
4.40	128.6	1.19	0.91	0.0
4.45	136.3	0.99	0.72	0.0
4.50	139.2	1.39	1.00	0.0

SOUNDING DATA IN FILE CPT136 7-1-86 10:41

ENGINEER : Beth Gross LOCATION : FLORIDIN 1

CONE ID : 15-205 JOB : 1

University of Florida - Department of Civil Engineering

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	20.2	0.02	0.09	0.0
0.10	32.7	0.04	0.12	0.0
0.15	41.9	0.07	0.17	0.0
0.20	49.7	0.09	0.18	0.0
0.25	60.8	0.18	0.30	0.0
0.30	86.9	0.31	0.35	0.0
0.35	123.5	0.89	0.72	0.1
0.40	132.9	2.54	1.90	0.1
0.45	166.9	4.62	2.76	0.1
0.50	200.0	5.51	2.75	0.1
0.55	229.3	5.54	2.41	0.1
0.60	275.9	2.46	0.89	0.1
0.65	309.7	2.82	0.91	0.1
0.70	317.7	4.12	1.29	0.1
0.75	262.9	5.75	2.18	0.1
0.80	215.3	6.61	3.06	0.1
0.85	209.2	6.55	3.13	0.1
0.90	205.7	6.88	3.34	0.1
0.95	171.1	6.92	4.04	0.1
1.00	139.9	6.70	4.78	0.1
1.05	125.9	7.21	5.73	0.1
1.10	135.9	6.43	4.72	0.2
1.15	178.0	5.08	2.85	0.2
1.20	230.2	3.42	1.48	0.2
1.25	266.7	3.20	1.19	0.2
1.30	264.8	3.04	1.14	0.2
1.35	285.0	3.30	1.15	0.2
1.40	277.5	3.83	1.38	0.2
1.45	270.5	3.84	1.41	0.2
1.50	278.5	3.08	1.10	0.2
1.55	282.9	2.76	0.97	0.2
1.60	287.2	1.65	0.57	0.2
1.65	268.5	2.12	0.78	0.2
1.70	270.4	2.15	0.79	0.2
1.75	263.0	2.37	0.90	0.2
1.80	252.8	3.27	1.29	0.2
1.85	220.6	3.66	1.65	0.2
1.90	217.6	3.14	1.44	0.2
1.95	212.1	2.60	1.22	0.2
2.00	193.7	3.48	1.79	0.2

FIGURE A-1-a. CONE PENETRATION SOUNDING

CPT136

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
2.05	184.4	4.71	2.55	0.2
2.10	172.3	4.96	2.87	0.2
2.15	171.5	4.55	2.65	0.2
2.20	176.4	3.92	2.21	0.2
2.25	176.5	2.63	1.46	0.2
2.30	181.1	2.70	1.48	0.2
2.35	176.8	3.30	1.86	0.2
2.40	164.5	3.42	2.07	0.2
2.45	161.8	3.36	2.07	0.2
2.50	149.2	3.94	2.63	0.2
2.55	128.8	4.37	3.39	0.2
2.60	132.2	2.49	1.88	0.2
2.65	133.0	3.45	2.59	0.2
2.70	120.7	5.17	4.28	0.2
2.75	96.2	5.61	5.82	0.2
2.80	99.0	6.42	6.48	0.1
2.85	129.5	6.70	5.17	0.1
2.90	134.9	7.00	5.19	0.1
2.95	120.6	6.55	5.43	0.1
3.00	133.7	5.62	4.19	0.1
3.05	195.1	4.36	2.23	0.1
3.10	253.7	4.83	1.90	0.1
3.15	207.6	6.54	3.15	0.1
3.20	178.9	6.10	3.40	0.1
3.25	182.0	6.38	3.50	0.0
3.30	131.5	6.40	4.86	0.0
3.35	129.0	6.51	5.04	0.0
3.40	136.9	5.20	3.79	0.0
3.45	202.9	5.12	2.52	0.0
3.50	202.3	6.28	3.10	0.0
3.55	174.2	6.76	3.87	0.0
3.60	159.0	3.88	2.43	0.0
3.65	173.0	3.90	2.25	0.0
3.70	181.9	3.63	1.99	0.0
3.75	219.2	3.90	1.77	0.0
3.80	210.0	4.78	2.27	0.0
3.85	206.4	5.00	2.42	0.0
3.90	218.1	5.83	2.67	0.0
3.95	166.9	7.30	4.37	0.0
4.00	151.3	6.86	4.53	0.0
4.05	170.2	6.04	3.55	0.0
4.10	151.9	4.56	3.00	0.0
4.15	179.1	2.93	1.63	0.0
4.20	180.6	2.41	1.33	0.0
4.25	144.2	2.52	1.74	0.0
4.30	121.3	2.60	2.14	0.0
4.35	122.1	1.91	1.56	0.0
4.40	128.6	1.18	0.91	0.0
4.45	136.3	0.99	0.72	0.0
4.50	139.2	1.39	1.00	0.0

CPT136 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
4.55	138.3	1.96	1.41	0.0
4.60	134.6	0.89	0.66	0.0
4.65	136.8	1.57	1.14	0.0
4.70	70.8	1.26	1.77	0.0
4.75	138.0	1.13	0.81	0.0
4.80	138.4	0.89	0.63	0.0
4.85	135.0	0.73	0.54	0.0
4.90	129.3	0.77	0.59	0.0
4.95	125.5	0.75	0.59	0.0
5.00	122.0	0.66	0.54	0.0
5.05	116.7	0.58	0.50	0.0
5.10	114.1	0.62	0.54	0.0
5.15	109.8	0.64	0.58	0.0
5.20	109.3	0.92	0.84	0.0
5.25	119.5	1.05	0.87	0.0
5.30	126.4	0.99	0.78	0.0
5.35	136.3	0.79	0.58	0.0
5.40	143.1	0.53	0.37	0.0
5.45	142.4	0.47	0.32	0.0
5.50	134.2	0.35	0.25	0.0
5.55	130.4	0.28	0.21	0.0
5.60	127.4	0.35	0.27	0.0
5.65	132.4	0.30	0.22	0.0
5.70	138.3	0.62	0.44	0.0
5.75	148.5	0.61	0.40	0.0
5.80	170.2	0.39	0.22	0.0
5.85	172.3	0.41	0.23	0.0
5.90	154.9	0.38	0.24	0.0
5.95	139.9	0.28	0.20	0.0
6.00	128.0	0.61	0.47	0.0
6.05	97.6	0.95	0.97	0.0
6.10	59.4	2.08	3.49	0.0
6.15	39.0	2.49	6.37	0.0
6.20	27.3	1.83	6.69	0.0
6.25	23.6	1.31	5.56	0.0
6.30	21.8	1.02	4.68	0.0
6.35	21.5	0.88	4.09	0.0
6.40	22.5	0.99	4.41	0.0
6.45	23.5	1.03	4.40	0.0
6.50	23.5	1.08	4.58	0.0
6.55	23.5	1.85	7.87	0.0
6.60	40.3	2.11	5.22	0.0
6.65	48.6	1.10	2.26	0.0
6.70	55.0	0.92	1.67	0.0
6.75	62.3	1.03	1.65	0.0
6.80	69.0	0.85	1.23	0.0
6.85	71.4	0.51	0.71	0.0
6.90	71.0	0.41	0.58	0.0
6.95	66.6	0.47	0.70	0.0
7.00	63.1	0.43	0.67	0.0

CPT136 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
7.05	56.7	0.51	0.86	0.0
7.10	55.8	0.54	0.94	0.0
7.15	54.2	0.82	1.51	0.0
7.20	50.0	1.04	2.07	0.0
7.25	41.8	0.71	1.70	0.0
7.30	29.5	0.65	2.18	0.0
7.35	20.2	0.35	1.72	0.0
7.40	17.4	0.18	1.00	0.0
7.45	15.9	0.49	3.08	0.0
7.50	16.8	0.88	4.66	0.0
7.55	19.0	0.92	4.82	-0.0
7.60	17.6	0.50	2.81	-0.0
7.65	16.7	0.33	1.95	-0.0
7.70	16.0	0.32	1.99	-0.0
7.75	15.3	0.31	1.98	-0.0
7.80	15.2	0.24	1.56	-0.0
7.85	14.9	0.23	1.56	-0.0
7.90	15.3	0.30	1.97	-0.0
7.95	16.0	0.39	2.41	-0.0
8.00	16.7	0.44	2.64	-0.0
8.05	17.3	0.44	2.54	-0.0
8.10	17.3	0.50	2.86	-0.0
8.15	17.3	0.46	2.67	-0.0
8.20	17.2	0.42	2.45	-0.0
8.25	17.6	0.37	2.07	-0.0
8.30	19.1	0.47	2.45	-0.0
8.35	21.5	0.55	2.54	-0.0
8.40	20.9	0.68	3.25	-0.0
8.45	22.0	0.74	3.37	-0.0
8.50	24.2	0.66	2.72	-0.0
8.55	21.4	0.55	2.57	-0.0
8.60	21.5	0.40	1.86	-0.0
8.65	22.5	0.36	1.59	-0.0
8.70	23.5	0.42	1.76	-0.0
8.75	24.9	0.44	1.77	-0.0
8.80	26.2	0.44	1.66	-0.0
8.85	28.2	0.59	2.10	-0.0
8.90	28.2	0.59	2.08	-0.0
8.95	27.5	0.66	2.39	-0.0
9.00	27.7	0.69	2.47	-0.0
9.05	27.2	0.65	2.38	-0.0
9.10	27.2	0.59	2.18	-0.0
9.15	27.6	0.62	2.25	-0.0
9.20	27.8	0.61	2.21	-0.0
9.25	26.6	0.63	2.37	-0.0
9.30	25.7	0.62	2.40	-0.0
9.35	24.2	0.61	2.50	-0.0
9.40	22.7	0.49	2.15	-0.0
9.45	21.3	0.41	1.91	-0.0
9.50	21.5	0.40	1.86	-0.0

CPT136 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
9.55	21.7	0.43	1.99	-0.0
9.60	21.4	0.45	2.08	-0.0
9.65	20.2	0.51	2.52	-0.0
9.70	20.1	0.46	2.26	-0.0
9.75	19.9	0.46	2.31	-0.0
9.80	20.0	0.46	2.27	-0.0
9.85	19.8	0.47	2.37	-0.0
9.90	19.7	0.53	2.70	-0.0
9.95	18.7	0.54	2.88	-0.0
10.00	18.7	0.53	2.85	-0.0
10.05	18.6	0.56	3.00	-0.0
10.10	19.3	0.62	3.19	-0.0
10.15	18.7	0.53	2.82	-0.0
10.20	18.1	0.45	2.48	-0.0
10.25	17.3	0.39	2.23	-0.0
10.30	16.7	0.46	2.75	-0.0
10.35	16.1	0.44	2.73	-0.0
10.40	15.9	0.46	2.91	-0.0
10.45	16.3	0.44	2.67	-0.0
10.50	15.9	0.39	2.42	-0.0
10.55	15.9	0.41	2.59	-0.0
10.60	16.1	0.48	2.99	-0.0
10.65	18.2	0.52	2.85	-0.0
10.70	17.3	0.59	3.41	-0.0
10.75	17.7	0.60	3.40	-0.0
10.80	17.6	0.56	3.18	-0.0
10.85	18.6	0.57	3.06	-0.0
10.90	18.7	0.59	3.15	-0.0
10.95	18.7	0.59	3.16	-0.0
11.00	17.7	0.61	3.42	-0.0
11.05	17.7	0.71	4.02	-0.0
11.10	18.9	0.73	3.86	-0.0
11.15	18.6	0.66	3.53	-0.0
11.20	18.0	0.66	3.65	-0.0
11.25	18.7	0.60	3.22	-0.0
11.30	17.3	0.74	4.26	-0.0
11.35	17.3	0.67	3.87	-0.0
11.40	16.0	0.61	3.80	-0.0
11.45	16.0	0.62	3.84	-0.0
11.50	16.7	0.58	3.45	-0.0
11.55	16.0	0.49	3.05	-0.0
11.60	14.7	0.45	3.04	-0.0
11.65	14.7	0.46	3.13	-0.0
11.70	15.2	0.52	3.43	-0.0
11.75	16.0	0.60	3.74	-0.0
11.80	17.4	0.67	3.85	-0.0
11.85	15.9	0.83	5.23	-0.0
11.90	25.2	0.83	3.30	-0.0
11.95	25.9	0.94	3.64	-0.0
12.00	54.0	0.78	1.44	-0.0

CPT135 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
12.05	84.7	0.77	0.91	-0.0
12.10	80.0	1.03	1.28	-0.0
12.15	69.3	1.73	2.49	-0.0
12.20	59.5	1.91	3.20	-0.0
12.25	58.0	1.98	3.41	-0.0
12.30	60.1	1.93	3.21	-0.0
12.35	55.3	2.02	3.65	-0.0
12.40	69.3	1.75	2.52	-0.0
12.45	102.2	1.35	1.32	-0.0
12.50	110.5	0.92	0.82	-0.0
12.55	96.9	1.24	1.27	-0.0
12.60	66.1	1.38	2.08	-0.0
12.65	44.0	1.37	3.10	-0.0
12.70	36.5	1.23	3.37	-0.0
12.75	24.2	0.79	3.28	-0.0
12.80	19.5	0.51	2.61	-0.0
12.85	17.5	0.77	4.39	-0.0
12.90	27.2	0.97	3.56	-0.0
12.95	29.6	1.16	3.93	-0.0
13.00	21.5	0.73	3.37	-0.0
13.05	17.5	0.28	1.60	-0.0
13.10	17.3	0.28	1.63	-0.0
13.15	17.0	0.25	1.47	-0.0
13.20	17.3	0.35	1.99	-0.0
13.25	24.9	1.25	5.01	-0.0
13.30	30.9	1.10	3.54	-0.0
13.35	18.7	0.66	3.51	-0.0
13.40	44.0	1.20	2.72	-0.0
13.45	42.0	1.06	2.53	-0.0
13.50	70.3	1.55	2.20	-0.0
13.55	44.2	1.63	3.67	-0.0
13.60	26.1	0.93	3.56	-0.0
13.65	44.2	1.07	2.42	-0.0
13.70	37.0	1.22	3.28	-0.0
13.75	21.4	0.49	2.29	-0.0
13.80	24.1	0.69	2.84	-0.0
13.85	28.0	0.88	3.15	-0.0
13.90	18.7	0.46	2.48	-0.0
13.95	19.0	0.40	2.10	-0.0
14.00	17.9	0.26	1.45	-0.0
14.05	18.7	0.25	1.33	-0.0
14.10	21.3	1.08	5.06	-0.0
14.15	34.3	0.92	2.67	-0.0
14.20	18.0	0.81	4.48	-0.0
14.25	31.7	0.74	2.32	-0.0
14.30	20.8	1.03	4.97	-0.0
14.35	28.1	0.81	2.86	-0.0
14.40	25.9	0.79	2.95	-0.0
14.45	22.8	0.83	3.65	-0.0
14.50	24.0	1.58	6.60	-0.0

CPT136 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
14.55	34.5	1.43	4.15	-0.0
14.60	23.8	0.66	2.77	-0.0
14.65	26.9	0.25	0.94	-0.0
14.70	64.9	0.87	1.34	-0.0
14.75	39.3	1.92	4.89	-0.0
14.80	37.7	1.53	4.04	-0.0
14.85	24.2	0.36	1.48	-0.0
14.90	24.4	0.75	3.06	-0.0
14.95	35.7	1.12	3.12	-0.0
15.00	31.1	1.08	3.47	-0.0
15.05	25.2	0.57	2.24	-0.0
15.10	18.4	0.46	2.51	-0.0
15.15	22.8	0.52	2.28	-0.0
15.20	23.0	0.44	1.92	-0.0
15.25	18.8	0.40	2.12	-0.0
15.30	28.2	0.61	2.15	-0.0
15.35	42.6	1.43	3.36	-0.0
15.40	62.2	2.54	4.07	-0.0
15.45	65.0	2.36	3.62	-0.0
15.50	50.3	2.03	4.04	-0.0
15.55	43.3	1.67	3.85	-0.0
15.60	36.8	0.89	2.41	-0.0
15.65	32.8	0.82	2.50	-0.0
15.70	28.5	1.37	4.80	-0.0
15.75	27.6	1.28	4.64	-0.0
15.80	34.9	0.48	1.36	-0.0
15.85	37.4	0.58	1.54	-0.0
15.90	36.9	0.89	2.41	-0.0
15.95	35.5	0.48	1.36	-0.0
16.00	40.5	0.83	2.06	-0.0
16.05	36.4	0.78	2.13	-0.0
16.10	36.3	0.71	1.96	-0.0
16.15	36.4	1.05	2.88	-0.0
16.20	37.6	0.47	1.25	-0.0
16.25	39.2	0.53	1.34	-0.0
16.30	35.7	0.47	1.30	-0.0
16.35	35.6	0.48	1.35	-0.0
16.40	33.7	0.65	1.92	-0.0
16.45	30.9	0.47	1.52	-0.0
16.50	33.2	0.30	0.89	-0.0
16.55	36.4	0.43	1.17	-0.0
16.60	34.9	0.28	0.79	-0.0
16.65	35.0	0.46	1.32	-0.0
16.70	35.0	0.87	2.48	-0.0
16.75	36.7	0.51	1.38	-0.0
16.80	44.6	0.93	2.08	-0.0
16.85	47.8	1.19	2.49	-0.0
16.90	62.3	0.90	1.43	-0.0
16.95	66.5	1.08	1.62	-0.0
17.00	53.9	1.06	1.95	-0.0

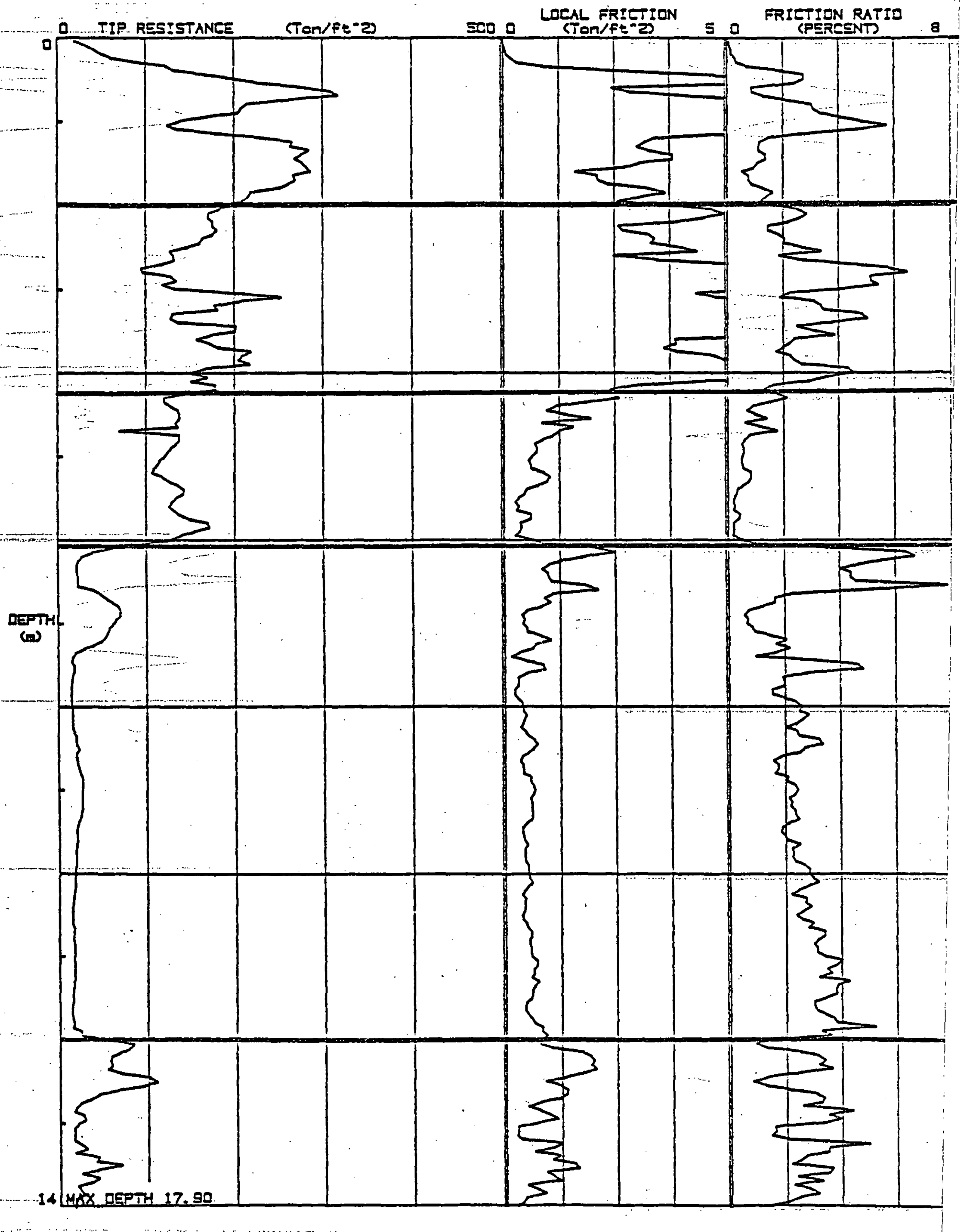
CPT136 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
17.05	44.4	0.85	1.90	-0.0
17.10	41.4	0.62	1.49	-0.0
17.15	43.6	0.83	1.90	-0.0
17.20	40.5	0.88	2.16	-0.0
17.25	38.1	0.90	2.35	-0.0
17.30	37.0	0.92	2.48	-0.0
17.35	31.2	0.98	3.15	-0.0
17.40	30.8	0.99	3.22	-0.0
17.45	34.1	1.15	3.35	-0.0
17.50	44.5	1.31	2.94	-0.0
17.55	43.7	1.17	2.68	-0.0
17.60	30.8	0.89	2.87	-0.0
17.65	23.9	0.10	0.42	-0.0
17.70	20.9	0.58	2.76	-0.0
17.75	20.6	0.22	1.08	-0.0
17.80	24.1	1.91	7.95	-0.0
17.85	82.4?0000000000000000??0000000000000000?			-0.0
17.90	241.7?0000000000000000??0000000000000000?			-0.0

FIGURE A-1-6. CONE PENETRATION PROFILE

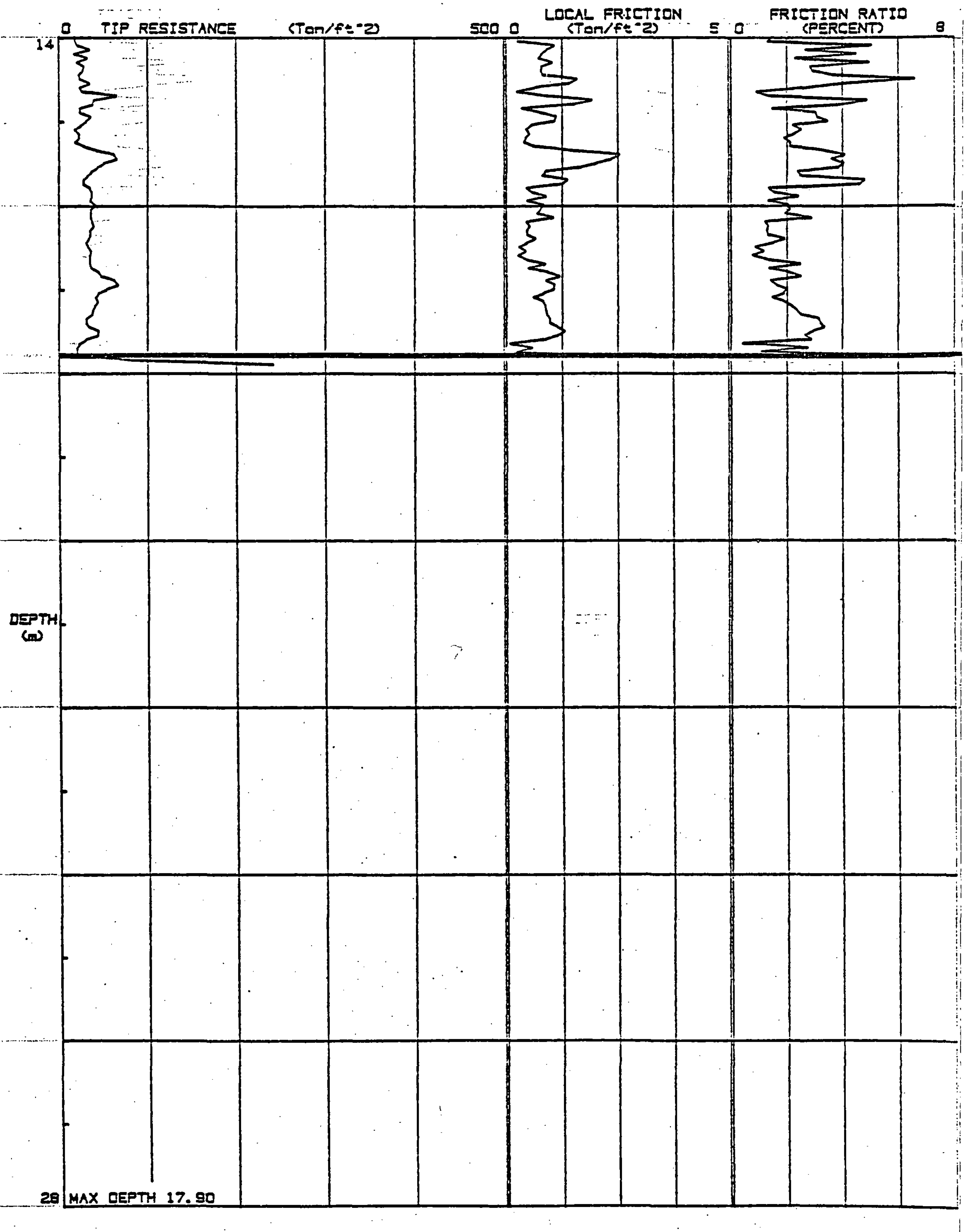
JOB : 1
DATE : 07/01/86 10:41
LOCATION : FLORIDIN 1
FILE # : CPT136

A.9



JOB : 1
DATE : 07/01/86 10:41
LOCATION : FLORIDIN 1
FILE # : CPT136

A.10



SOUNDING DATA IN FILE CPT137 7-1-86 13:34

ENGINEER : Beth Gross LOCATION : FLORIDIN 2

CONE ID : 15-205 JOB : 2

University of Florida - Department of Civil Engineering

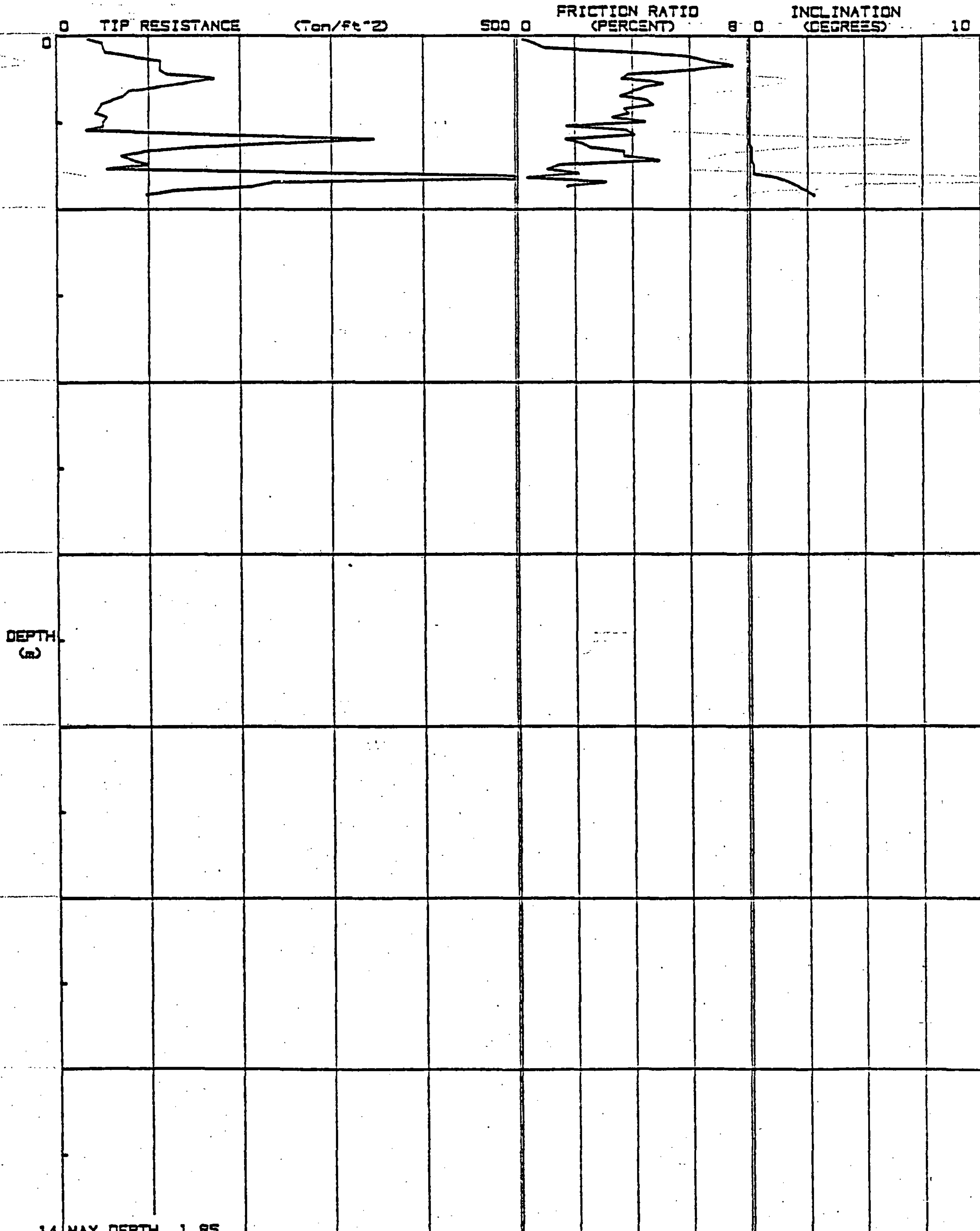
DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	33.9	-0.07	0.20	-0.0
0.10	49.8	0.31	0.62	-0.0
0.15	50.9	0.49	0.95	-0.0
0.20	53.1	2.10	3.95	-0.0
0.25	81.6	4.94	6.05	-0.0
0.30	113.3	7.49	6.60	-0.0
0.35	112.8	8.47	7.50	-0.0
0.40	112.6	6.99	6.20	-0.0
0.45	119.9	4.59	3.82	-0.0
0.50	172.0	6.27	3.64	-0.0
0.55	141.3	7.17	5.07	-0.0
0.60	108.1	4.74	4.38	-0.0
0.65	78.1	3.13	4.00	-0.0
0.70	72.7	2.61	3.58	-0.0
0.75	60.6	2.74	4.51	-0.0
0.80	48.8	2.30	4.72	-0.0
0.85	45.5	1.69	3.71	-0.0
0.90	42.5	1.65	3.87	-0.0
0.95	54.4	1.80	3.31	-0.0
1.00	51.0	2.27	4.45	-0.0
1.05	51.1	0.88	1.72	-0.0
1.10	32.7	-1.24	3.80	-0.0
1.15	155.7	6.34	4.06	-0.0
1.20	346.7	5.84	1.68	0.0
1.25	236.9	5.44	2.29	0.0
1.30	149.9	3.83	2.55	0.1
1.35	93.6	3.48	3.71	0.1
1.40	70.5	2.63	3.73	0.1
1.45	82.3	4.07	4.94	0.1
1.50	100.1	1.44	1.44	0.2
1.55	54.9	-0.58	1.06	0.2
1.60	321.0	6.83	2.12	0.2
1.65	586.5	2.06	0.35	1.2
1.70	236.3	7.32	3.09	1.7
1.75	214.1	3.78	1.76	2.1
1.80	125.0?0000000000000000??0000000000000000?			2.5
1.85	99.0?0000000000000000??0000000000000000?			2.8

FIGURE A-2-a. CONE PENETRATION SOUNDING

FIGURE A-2-5. CONE PENETRATION PROFILE

JOB : 2
DATE : 07/01/86 13:34
LOCATION : FLORIDIN 2
FILE # : CPT137

A.12



SOUNDING DATA IN FILE CPT139   07/01/86 14:287

ENGINEER : Beth Gross   LOCATION: FLORIDIN 3

CONE ID : 15-205   JOB

University of Florida - Department of Civil Engineering

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	7.6	-0.01	0.14	-0.0
0.10	5.9	0.00	0.02	-0.0
0.15	8.8	0.00	0.02	-0.0
0.20	10.5	-0.00	0.05	-0.0
0.25	13.0	-0.00	0.00	-0.0
0.30	15.8	-0.02	0.15	-0.0
0.35	15.8	-0.01	0.07	-0.0
0.40	16.1	-0.03	0.18	-0.0
0.45	19.0	-0.00	0.04	-0.0
0.50	19.8	-0.02	0.11	-0.0
0.55	17.2	-0.04	0.21	-0.0
0.60	12.5	-0.03	0.24	-0.0
0.65	10.3	-0.02	0.19	-0.0
0.70	9.5	-0.03	0.27	-0.0
0.75	11.1	-0.02	0.15	-0.0
0.80	11.7	-0.04	0.34	-0.0
0.85	11.0	-0.04	0.36	-0.0
0.90	10.3	-0.03	0.26	-0.0
0.95	11.6	0.25	2.13	-0.0
1.00	12.7	0.33	2.57	-0.0
1.05	13.1	0.44	3.36	-0.0
1.10	11.7	0.52	4.46	-0.0
1.15	11.0	0.56	5.05	-0.0
1.20	11.2	0.39	3.46	-0.0
1.25	14.2	0.40	2.83	-0.0
1.30	15.8	0.40	2.50	-0.0
1.35	17.0	0.45	2.63	-0.0
1.40	17.2	0.30	1.76	-0.0
1.45	18.5	0.46	2.51	-0.0
1.50	19.9	0.55	2.75	-0.0
1.55	19.1	0.54	2.81	-0.0
1.60	21.1	0.15	0.71	-0.0
1.65	23.8	-0.00	0.00	-0.0
1.70	22.9	0.08	0.36	-0.0
1.75	21.9	0.19	0.88	-0.0
1.80	19.2	0.56	2.89	-0.0
1.85	17.2	0.88	5.14	-0.0
1.90	16.4	0.62	3.79	-0.0
1.95	17.2	0.59	3.42	-0.0
2.00	14.9	0.62	4.15	-0.0

FIGURE A-3-a. CONE PENETRATION SOUNDING.

CPT139 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
2.05	10.8	0.42	3.90	-0.0
2.10	7.8	0.10	1.24	-0.0
2.15	5.5	0.03	0.53	-0.0
2.20	4.7	-0.03	0.70	-0.0
2.25	3.5	-0.03	0.98	-0.0
2.30	4.7	0.05	1.01	-0.0
2.35	7.1	0.16	2.25	-0.0
2.40	8.3	0.24	2.89	-0.0
2.45	7.6	0.35	4.65	-0.0
2.50	7.2	0.19	2.57	-0.0
2.55	5.5	0.19	3.52	-0.0
2.60	6.2	-0.00	0.02	-0.0
2.65	5.7	-0.01	0.21	-0.0
2.70	5.0	-0.02	0.33	0.0
2.75	5.0	-0.02	0.40	-0.0
2.80	6.8	0.00	0.11	-0.0
2.85	8.1	0.04	0.50	0.0
2.90	7.9	0.21	2.66	0.0
2.95	8.9	0.38	4.31	0.0
3.00	9.5	0.31	3.22	0.0
3.05	11.9	0.20	1.70	0.0
3.10	8.3	0.32	3.80	0.0
3.15	6.1	0.25	4.02	0.0
3.20	6.9	0.25	3.63	0.0
3.25	11.5	0.19	1.68	0.0
3.30	13.0	0.32	2.47	0.0
3.35	13.0	0.57	4.38	0.0
3.40	11.8	0.41	3.49	0.0
3.45	13.9	0.55	3.98	0.0
3.50	14.5	0.81	5.59	0.0
3.55	14.7	0.80	5.40	0.0
3.60	12.1	0.61	5.07	0.0
3.65	7.3	0.34	4.67	0.0
3.70	4.2	0.04	0.86	0.0
3.75	0.8	0.04	5.25	0.0
3.80	0.2	0.05	22.80	0.0
3.85	-0.5	0.05	11.45	0.0
3.90	-0.4	0.04	8.99	0.0
3.95	-0.7	-0.57	83.93	0.0
4.00	49.8	-0.72	1.45	0.0
4.05	90.0	-1.10	1.22	-0.0
4.10	227.8	-0.58	0.25	-0.0
4.15	221.2	0.46	0.20	-0.0
4.20	214.2	1.78	0.83	-0.0
4.25	173.7	0.51	0.29	-0.0
4.30	108.0	0.08	0.07	-0.0
4.35	75.2	-1.04	1.38	-0.0
4.40	24.2	-1.33	5.48	-0.0
4.45	19.7	-1.32	6.73	-0.0
4.50	16.2	-1.33	8.15	-0.0

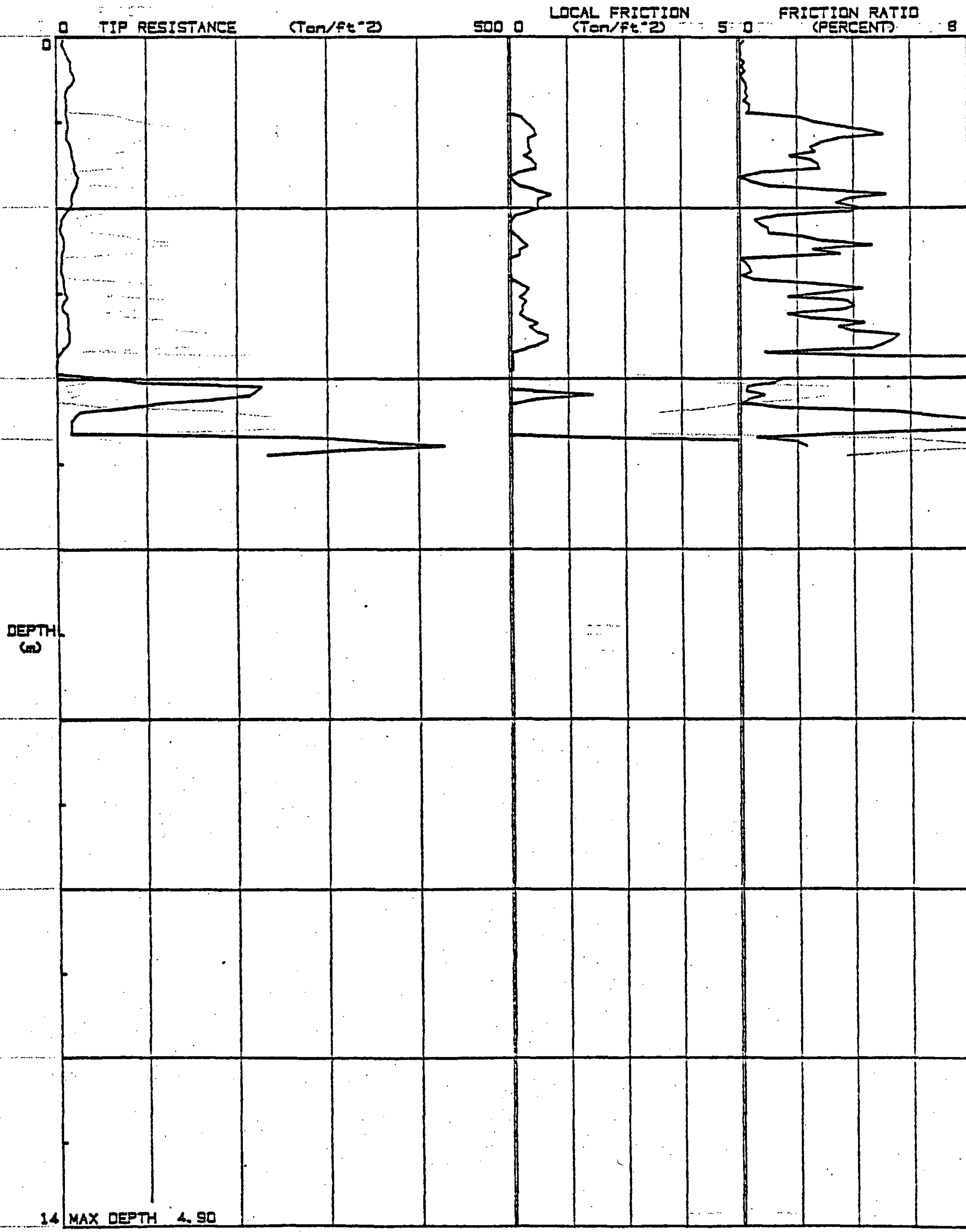
CPT139 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
4.55	15.7	-1.32	8.44	-0.0
4.60	15.7	-1.46	9.31	-0.0
4.65	15.0	-0.68	4.51	-0.0
4.70	289.7	1.62	0.56	-0.0
4.75	346.2	7.11	2.04	0.2
4.80	429.2	9.97	2.32	0.4
4.85	306.7?0000000000000000??0000000000000000?			0.4
4.90	234.3?0000000000000000??0000000000000000?			0.4

FIGURE A-3-b. CONE PENETRATION PROFILE

JOB : 3
DATE : 07/01/86 14:29
LOCATION : FLORIDIN 3
FILE # : CPT139

A.16



SOUNDING DATA IN FILE CPT142 07/01/86 15:150

ENGINEER : Beth Gross LOCATION : FLORIDIN 4

CONE ID : 15-205 JOB : 4

University of Florida - Department of Civil Engineering

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	12.5	-0.03	0.21	-0.0
0.10	22.8	-0.03	0.11	-0.0
0.15	30.2	0.26	0.85	-0.0
0.20	38.3	1.31	3.41	-0.0
0.25	46.4	1.51	3.24	-0.0
0.30	47.3	1.30	2.75	-0.0
0.35	44.6	1.22	2.74	-0.0
0.40	41.2	1.17	2.83	-3.0
0.45	36.9	1.04	2.81	-0.0
0.50	33.5	0.84	2.51	-0.0
0.55	31.1	0.85	2.71	-0.0
0.60	30.3	0.95	3.11	-0.0
0.65	29.5	0.91	3.08	-0.0
0.70	27.5	0.97	3.53	-0.0
0.75	26.9	1.11	4.11	-0.0
0.80	25.5	1.18	4.64	-0.0
0.85	24.9	1.25	4.99	-0.0
0.90	24.3	1.33	5.49	-0.0
0.95	25.4	1.52	5.96	-0.0
1.00	27.6	1.72	6.23	-0.0
1.05	28.4	1.79	6.32	-0.0
1.10	29.7	1.85	6.24	-0.0
1.15	30.2	2.19	7.24	-0.0
1.20	30.9	2.39	7.71	-0.0
1.25	31.8	2.49	7.82	-0.0
1.30	31.8	2.56	8.03	-0.0
1.35	31.5	2.60	8.25	-0.0
1.40	31.0	2.63	8.49	-0.0
1.45	30.9	2.65	8.59	-0.0
1.50	29.8	1.53	5.14	-0.0
1.55	29.0	1.67	5.77	-0.0
1.60	29.5	1.67	5.67	-0.0
1.65	37.7	2.23	5.92	-0.0
1.70	50.4	2.94	5.83	-0.0
1.75	57.4	3.25	5.65	-0.0
1.80	59.6	3.63	6.08	-0.0
1.85	64.3	3.94	6.13	-0.0
1.90	68.5	4.24	6.18	-0.0
1.95	67.7	4.47	6.60	-0.0
2.00	65.2	4.26	6.53	-2.0

FIGURE A-4-a. CONE PENETRATION SOUNDING

CPT142 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
2.05	64.8	4.06	6.25	-0.0
2.10	64.5	3.74	5.80	-0.0
2.15	64.2	3.61	5.62	-0.0
2.20	63.6	3.37	5.29	-0.0
2.25	63.4	3.57	5.63	-0.0
2.30	64.1	3.67	5.72	-0.0
2.35	67.0	4.21	6.28	-0.0
2.40	70.5	4.59	6.51	-0.0
2.45	69.0	4.61	6.68	-0.0
2.50	67.4	4.39	6.50	-0.0
2.55	67.5	4.34	6.43	-0.0
2.60	66.2	4.12	6.22	-0.0
2.65	63.5	4.07	6.41	-0.0
2.70	61.5	3.96	6.43	0.0
2.75	58.8	3.44	5.85	0.0
2.80	53.8	3.22	5.99	0.0
2.85	52.0	2.97	5.71	0.0
2.90	51.3	2.88	5.60	0.0
2.95	56.1	3.40	6.05	0.0
3.00	58.5	3.37	5.76	0.0
3.05	55.2	3.02	5.47	0.0
3.10	53.0	2.90	5.47	0.0
3.15	51.3	2.55	4.96	0.0
3.20	50.6	2.48	4.90	0.0
3.25	50.9	2.64	5.18	0.0
3.30	53.7	2.78	5.18	0.0
3.35	61.5	3.53	5.73	0.0
3.40	64.3	3.83	5.96	0.0
3.45	86.8	3.53	4.06	0.0
3.50	144.0	1.03	0.71	0.0
3.55	144.5	3.16	2.18	0.0
3.60	63.7	3.67	5.76	0.0
3.65	143.2	3.20	2.23	0.0
3.70	177.2	2.60	1.46	0.0
3.75	183.2	2.80	1.52	0.0
3.80	176.4	2.60	1.47	0.0
3.85	165.7	2.44	1.47	0.0
3.90	158.6	2.52	1.58	0.0
3.95	157.2	3.07	1.95	0.0
4.00	134.2	3.96	2.94	0.0
4.05	116.1	4.88	4.19	0.0
4.10	100.4	4.99	4.97	0.0
4.15	91.5	4.28	4.67	0.0
4.20	117.2	3.94	3.35	0.0
4.25	112.7	4.05	3.59	0.0
4.30	97.5	4.26	4.37	0.0
4.35	78.1	3.54	4.53	0.0
4.40	89.7	3.31	3.68	0.0
4.45	94.3	3.53	3.74	0.0
4.50	77.9	3.62	4.64	0.0

CPT142 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
4.55	85.8	2.94	3.43	0.0
4.60	100.3	3.13	3.12	0.0
4.65	99.7	3.31	3.32	0.0
4.70	90.7	3.73	4.11	0.0
4.75	83.2	3.44	4.13	0.0
4.80	72.4	3.51	4.85	0.0
4.85	81.9	3.14	3.83	0.0
4.90	95.2	2.81	2.94	0.0
4.95	104.7	2.37	2.26	0.0
5.00	119.8	2.22	1.85	0.0
5.05	136.4	2.06	1.50	0.0
5.10	138.4	2.74	1.97	0.0
5.15	118.7	3.41	2.87	0.0
5.20	121.7	3.11	2.56	0.0
5.25	137.9	2.45	1.77	0.0
5.30	155.2	2.32	1.49	0.0
5.35	129.2	3.31	2.56	0.0
5.40	112.7	4.45	3.94	0.0
5.45	94.3	4.31	4.57	0.0
5.50	96.2	3.72	3.86	0.0
5.55	115.3	2.20	1.90	0.0
5.60	122.8	2.51	2.04	0.0
5.65	110.1	3.31	3.00	0.0
5.70	110.4	2.10	1.90	0.0
5.75	124.4	1.53	1.23	0.0
5.80	126.8	1.89	1.49	0.0
5.85	126.3	2.47	1.95	0.0
5.90	115.6	2.68	2.31	0.0
5.95	105.2	2.27	2.15	0.0
6.00	107.2	2.26	2.11	0.0
6.05	107.5	2.44	2.27	0.0
6.10	94.7	2.73	2.88	0.0
6.15	93.6	2.37	2.53	0.0
6.20	101.6	1.49	1.46	0.0
6.25	104.1	1.10	1.05	0.0
6.30	101.5	1.29	1.27	0.0
6.35	94.0	1.93	2.05	0.0
6.40	83.2	2.14	2.57	0.0
6.45	81.4	1.83	2.24	0.0
6.50	87.7	1.54	1.75	0.0
6.55	96.9	1.14	1.17	0.0
6.60	98.9	1.52	1.54	0.0
6.65	89.4	1.99	2.23	0.0
6.70	87.4	1.83	2.08	0.0
6.75	96.7	1.35	1.39	0.0
6.80	98.2	1.34	1.36	0.0
6.85	107.2	1.03	0.95	0.0
6.90	118.0	0.99	0.83	0.0
6.95	114.5	0.96	0.84	0.0
7.00	109.2	0.95	0.86	0.0

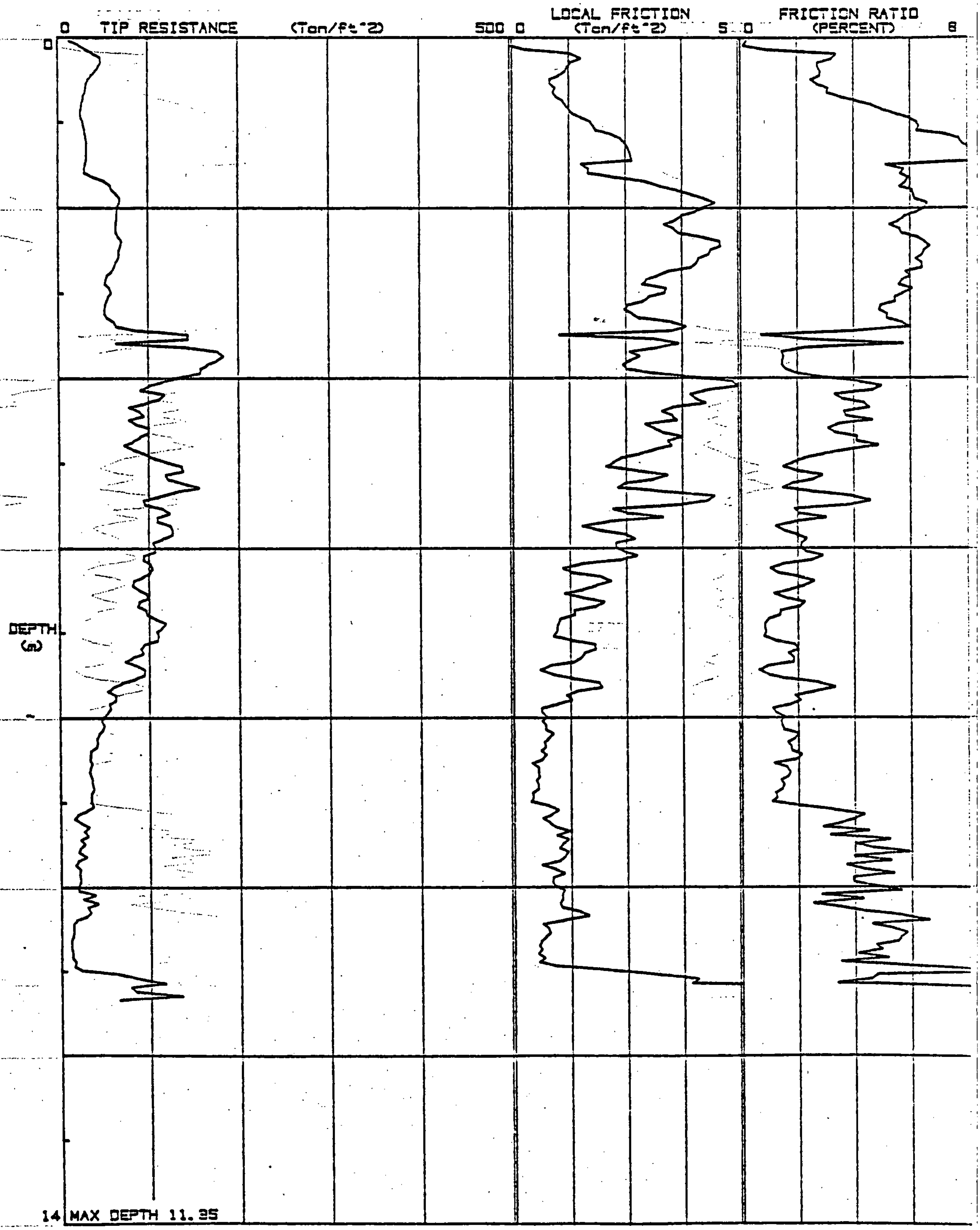
CPT142 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
7.05	110.5	0.88	0.79	0.0
7.10	108.8	1.26	1.15	0.0
7.15	94.3	1.79	1.89	0.0
7.20	90.7	1.81	2.00	0.0
7.25	93.4	1.57	1.67	0.0
7.30	81.2	1.50	1.84	0.0
7.35	73.0	1.35	1.84	0.0
7.40	86.0	0.79	0.92	0.0
7.45	94.6	0.60	0.63	0.0
7.50	94.7	0.85	0.89	0.0
7.55	84.7	1.28	1.51	0.0
7.60	68.7	1.88	2.73	0.0
7.65	58.5	1.94	3.31	0.0
7.70	52.9	1.38	2.61	0.0
7.75	61.4	1.17	1.90	0.0
7.80	61.0	1.27	2.07	0.0
7.85	54.7	0.97	1.77	0.0
7.90	55.7	0.62	1.11	0.0
7.95	52.4	0.63	1.20	0.0
8.00	48.1	0.72	1.49	0.0
8.05	45.5	0.63	1.39	0.0
8.10	48.6	0.70	1.44	0.0
8.15	46.6	0.70	1.50	0.0
8.20	42.8	0.86	2.01	0.0
8.25	40.5	0.77	1.89	0.0
8.30	41.2	0.68	1.64	0.0
8.35	39.9	0.70	1.74	0.0
8.40	34.2	0.61	1.78	0.0
8.45	33.1	0.70	2.11	0.0
8.50	32.5	0.63	1.93	0.0
8.55	34.9	0.41	1.16	0.0
8.60	33.1	0.53	1.60	0.0
8.65	32.3	0.55	1.70	0.0
8.70	34.2	0.56	1.64	0.0
8.75	35.6	0.50	1.39	0.0
8.80	36.1	0.54	1.49	0.0
8.85	37.1	0.53	1.42	0.0
8.90	34.5	0.42	1.20	0.0
8.95	34.3	0.43	1.24	0.0
9.00	34.4	0.37	1.08	0.0
9.05	36.4	0.76	2.08	0.0
9.10	29.7	0.97	3.25	0.0
9.15	19.4	0.84	4.32	-0.0
9.20	15.8	0.64	4.02	-0.0
9.25	22.0	0.78	3.55	0.0
9.30	31.0	0.90	2.89	0.0
9.35	26.8	1.20	4.48	0.0
9.40	30.0	0.95	3.15	0.0
9.45	22.8	1.19	5.22	0.0
9.50	26.3	1.07	4.08	0.0

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
9.55	21.6	1.00	4.62	0.0
9.60	20.0	1.18	5.91	0.0
9.65	27.7	1.11	3.98	-0.2
9.70	19.2	1.01	5.26	-0.2
9.75	16.7	0.62	3.72	-0.2
9.80	20.9	0.90	4.30	-0.2
9.85	20.4	1.09	5.35	-0.2
9.90	21.9	0.86	3.94	-0.2
9.95	21.3	0.84	3.95	-0.2
10.00	19.2	0.90	4.70	-0.2
10.05	19.4	1.09	5.62	-0.2
10.10	37.3	1.05	2.81	-0.2
10.15	24.9	1.06	4.27	-0.2
10.20	33.8	1.01	2.53	-0.2
10.25	29.4	1.05	3.56	-0.2
10.30	32.5	1.43	4.38	-0.2
10.35	28.4	1.62	5.72	-0.2
10.40	16.7	1.10	6.60	-0.2
10.45	13.6	0.63	4.61	-0.2
10.50	13.9	0.74	5.33	-0.2
10.55	13.4	0.78	5.81	-0.2
10.60	12.2	0.69	5.63	-0.2
10.65	10.7	0.59	5.52	-0.2
10.70	11.3	0.54	4.75	-0.2
10.75	11.9	0.59	4.93	-0.2
10.80	12.6	0.52	4.13	-0.2
10.85	12.5	0.65	5.15	-0.2
10.90	15.8	0.55	3.52	-0.2
10.95	14.5	0.90	6.22	-0.2
11.00	22.1	2.15	9.71	-0.2
11.05	66.4	3.16	4.76	-0.2
11.10	88.6	4.06	4.58	-0.2
11.15	115.9	3.93	3.39	-0.2
11.20	77.9	8.15	10.46	-0.2
11.25	83.2	10.03	12.04	-0.2
11.30	134.3?0000000000000000??0000000000000000?			-0.2
11.35	65.0?0000000000000000??0000000000000000?			-0.2

FIGURE A-4-6. CONE PENETRATION PROFILE

JOB : 4
DATE : 07/01/86 15:15
LOCATION : FLORIDIN 4
FILE # : CPT142



SOUNDING DATA IN FILE CPT144 07/02/86 07:470

ENGINEER : Beth Gross LOCATION : FLORIDIN 5

CONE ID : 15-205 JOB : 5

University of Florida - Department of Civil Engineering

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	53.2	-0.03	0.06	0.0
0.10	134.9	-0.06	0.04	0.0
0.15	134.6	-0.11	0.08	0.1
0.20	115.2	0.36	0.31	0.1
0.25	100.4	0.84	0.83	0.1
0.30	93.2	0.37	0.40	0.1
0.35	66.5	0.49	0.74	0.1
0.40	49.8	0.68	1.37	0.1
0.45	44.1	2.00	4.52	0.1
0.50	54.2	1.85	3.41	0.1
0.55	71.5	1.21	1.68	0.1
0.60	75.2	1.94	2.58	0.1
0.65	61.6	1.95	3.16	0.1
0.70	42.0	1.81	4.31	0.1
0.75	41.7	1.88	4.50	0.1
0.80	41.2	1.69	4.10	0.1
0.85	35.4	1.57	4.43	0.1
0.90	34.5	1.50	4.35	0.1
0.95	34.1	1.65	4.83	0.1
1.00	34.1	1.47	4.32	0.2
1.05	40.2	1.64	4.07	0.2
1.10	53.5	1.18	2.21	0.2
1.15	45.1	1.57	3.47	0.2
1.20	42.4	1.81	4.27	0.1
1.25	35.4	1.53	4.31	0.1
1.30	34.8	1.45	4.16	0.1
1.35	34.8	1.37	3.92	0.1
1.40	33.5	1.28	3.82	0.1
1.45	31.1	1.09	3.51	0.1
1.50	32.1	0.79	2.47	0.1
1.55	30.8	0.54	1.74	0.1
1.60	27.8	0.54	1.93	0.1
1.65	26.6	0.32	1.18	0.1
1.70	28.7	0.22	0.77	0.1
1.75	30.8	0.17	0.55	0.1
1.80	33.4	0.13	0.38	0.1
1.85	36.9	0.08	0.23	0.1
1.90	36.3	0.03	0.09	0.1
1.95	34.8	0.10	0.27	0.1
2.00	31.1	0.21	0.67	0.1

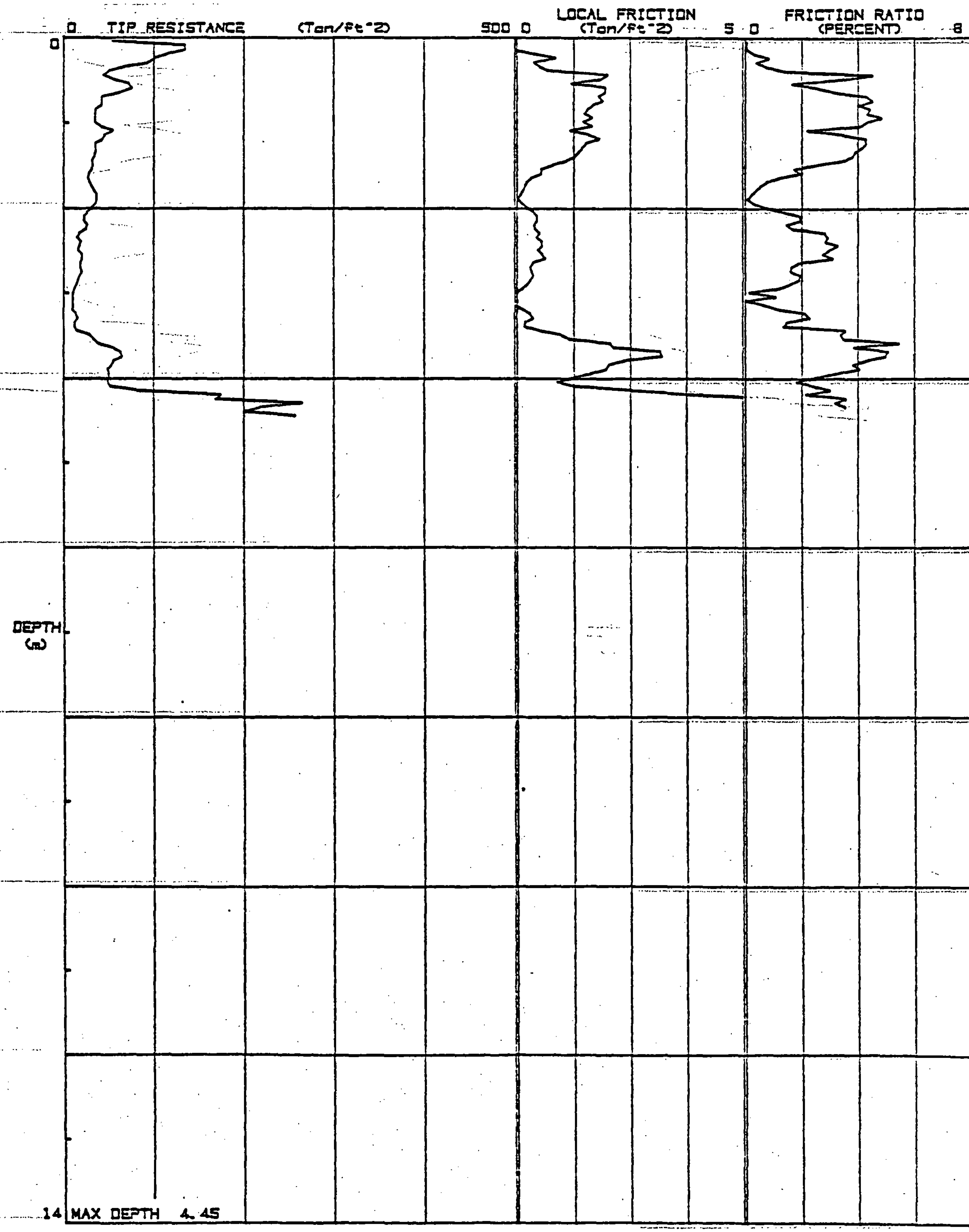
FIGURE A-5-a. CONE PENETRATION SOUNDING

CPT144 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
2.05	26.2	0.36	1.38	0.1
2.10	22.8	0.44	1.93	0.1
2.15	22.0	0.44	1.98	0.1
2.20	25.5	0.38	1.48	0.1
2.25	23.9	0.40	1.67	0.1
2.30	17.2	0.49	2.83	0.2
2.35	14.5	0.43	2.93	0.2
2.40	18.8	0.54	2.85	0.2
2.45	17.1	0.56	3.28	0.2
2.50	15.8	0.47	2.99	0.2
2.55	19.8	0.55	2.77	0.2
2.60	19.9	0.62	3.10	0.2
2.65	18.1	0.35	1.91	0.2
2.70	17.8	0.29	1.64	0.2
2.75	19.8	0.32	1.60	0.2
2.80	17.8	0.35	1.94	0.2
2.85	15.9	0.30	1.90	0.2
2.90	14.1	0.23	1.60	0.2
2.95	11.8	0.14	1.21	0.2
3.00	10.3	0.02	0.17	0.2
3.05	9.6	-0.10	1.07	0.2
3.10	9.6	-0.00	0.07	0.2
3.15	9.6	-0.06	0.64	0.2
3.20	9.3	0.11	1.18	0.2
3.25	13.1	0.28	2.12	0.2
3.30	15.5	0.35	2.28	0.2
3.35	12.5	0.18	1.48	0.2
3.40	11.7	0.16	1.37	0.2
3.45	14.4	0.51	3.56	0.2
3.50	28.5	0.97	3.40	0.2
3.55	32.8	1.15	3.50	0.2
3.60	37.6	2.05	5.44	0.2
3.65	54.6	2.12	3.87	0.2
3.70	62.7	3.17	5.05	0.2
3.75	64.3	3.21	4.98	0.3
3.80	55.0	2.37	4.31	0.3
3.85	52.5	2.02	3.84	0.3
3.90	48.4	1.96	4.05	0.3
3.95	49.8	1.64	3.29	0.3
4.00	49.2	1.22	2.47	0.3
4.05	48.5	0.88	1.81	0.3
4.10	51.5	1.25	2.42	0.3
4.15	82.7	2.50	3.01	0.3
4.20	174.8	3.81	2.18	0.4
4.25	169.1	6.04	3.57	0.4
4.30	265.3	8.53	3.21	0.4
4.35	218.3	7.73	3.54	0.4
4.40	200.8?0000000000000000??000000000000000?			0.3
4.45	256.4?000000000000000000??000000000000000?			0.4

FIGURE A-5-6. CONE PENETRATION PROFILE

JOB : 3
DATE : 07/02/86 07:47
LOCATION : FLORIDIN 5
FILE # : CPT144



SOUNDING DATA IN FILE CPT146 07/02/86 14:140

ENGINEER : Beth Gross LOCATION : LA CAMELIA 1

CONE ID : 15-205 JOB : 6

University of Florida - Department of Civil Engineering

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	12.7	0.01	0.09	-0.0
0.10	28.1	0.01	0.04	0.0
0.15	41.2	0.00	0.01	0.0
0.20	46.7	0.0	0.0	0.0
0.25	42.7	-0.01	0.03	0.0
0.30	29.4	0.24	0.82	0.0
0.35	20.4	0.31	1.52	0.0
0.40	18.1	0.41	2.23	0.0
0.45	17.9	0.65	3.62	0.0
0.50	19.5	0.98	5.00	0.0
0.55	22.2	1.21	5.44	0.0
0.60	23.9	1.38	5.75	0.0
0.65	26.6	1.51	5.68	0.0
0.70	30.3	1.37	4.52	0.0
0.75	32.5	1.59	4.89	0.0
0.80	32.7	1.87	5.72	0.0
0.85	33.1	2.01	6.06	0.0
0.90	34.3	2.07	6.02	0.0
0.95	33.5	2.04	6.09	0.0
1.00	33.2	2.07	6.24	0.0
1.05	33.3	2.09	6.29	0.0
1.10	33.0	2.07	6.26	0.0
1.15	32.3	2.01	6.20	0.0
1.20	31.9	1.97	6.18	0.0
1.25	30.5	1.96	6.41	0.0
1.30	30.3	1.95	6.44	0.0
1.35	29.3	2.04	6.96	0.0
1.40	29.8	2.13	7.15	0.0
1.45	31.2	2.24	7.18	0.0
1.50	34.5	2.45	7.10	0.0
1.55	39.6	2.46	6.21	0.0
1.60	41.4	2.87	6.93	0.0
1.65	44.4	3.48	7.85	0.0
1.70	47.1	3.22	6.84	0.0
1.75	56.7	4.39	7.74	0.0
1.80	68.0	5.34	7.84	0.0
1.85	73.9	5.66	7.65	0.0
1.90	76.8	5.89	7.66	0.0
1.95	75.3	6.00	7.96	0.0
2.00	77.4	6.34	8.18	0.0

FIGURE A-6-a. CONE PENETRATION SOUNDING

CPT146 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
2.05	71.1	6.01	8.45	0.0
2.10	76.7	6.08	7.92	0.0
2.15	79.8	6.02	7.54	0.0
2.20	75.5	5.82	7.71	0.0
2.25	71.8	5.22	7.27	0.0
2.30	74.8	5.59	7.46	0.0
2.35	76.3	5.77	7.56	0.0
2.40	78.3	5.76	7.36	0.0
2.45	77.7	5.86	7.54	0.0
2.50	73.8	5.14	6.96	0.0
2.55	74.1	5.26	7.09	0.0
2.60	75.8	5.93	7.82	0.0
2.65	81.6	6.63	8.12	0.0
2.70	80.1	5.41	6.75	0.0
2.75	75.9	5.75	7.58	0.0
2.80	80.8	5.80	7.17	0.0
2.85	73.8	5.29	7.16	0.1
2.90	69.9	5.03	7.20	0.1
2.95	69.1	5.14	7.42	0.1
3.00	68.9	5.07	7.35	0.0
3.05	65.9	4.81	7.30	0.1
3.10	64.7	4.97	7.68	0.1
3.15	66.1	5.29	7.99	0.1
3.20	67.1	5.40	8.04	0.0
3.25	68.5	5.33	7.77	0.0
3.30	71.3	5.56	7.80	0.1
3.35	71.4	5.39	7.54	0.0
3.40	66.3	5.16	7.77	0.1
3.45	61.9	5.28	8.52	0.1
3.50	61.8	5.17	8.35	0.1
3.55	61.7	5.45	8.83	0.1
3.60	67.2	6.00	8.92	0.1
3.65	73.4	6.65	9.05	0.1
3.70	72.5	6.06	8.35	0.2
3.75	69.6	6.39	9.18	0.2
3.80	65.8	5.93	9.00	0.2
3.85	68.5	5.67	8.27	0.2
3.90	67.1	5.58	8.31	0.2
3.95	75.2	5.72	7.61	0.2
4.00	80.4	5.90	7.33	0.2
4.05	79.7	4.93	6.19	0.2
4.10	73.0	5.17	7.07	0.2
4.15	89.0	4.06	4.56	0.2
4.20	109.4	3.18	2.90	0.2
4.25	127.9	2.54	1.99	0.2
4.30	132.4	3.10	2.34	0.2
4.35	106.7	4.27	4.00	0.2
4.40	83.8	4.92	5.87	0.2
4.45	75.3	4.90	6.50	0.2
4.50	59.7	3.93	6.58	0.2

CPT146 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
4.55	57.8	3.88	6.70	0.2
4.60	77.8	4.03	5.17	0.2
4.65	71.5	4.19	5.85	0.2
4.70	81.1	3.01	3.71	0.2
4.75	84.3	2.76	3.27	0.2
4.80	103.8	3.98	3.83	0.2
4.85	97.5	4.58	4.69	0.2
4.90	74.6	4.60	6.15	0.2
4.95	80.7	4.88	6.04	0.2
5.00	82.9	4.81	5.80	0.2
5.05	86.9	4.68	5.38	0.2
5.10	144.2	5.33	3.69	0.2
5.15	105.5	4.62	4.38	0.2
5.20	114.1	4.05	3.55	0.2
5.25	170.4	4.33	2.53	0.2
5.30	161.1	5.82	3.61	0.2
5.35	140.2	5.88	4.19	0.2
5.40	109.7	6.57	5.99	0.2
5.45	127.0	5.14	4.05	0.2
5.50	118.4	5.47	4.61	0.2
5.55	116.0	5.66	4.87	0.2
5.60	81.5	5.06	6.19	0.2
5.65	63.6	4.46	7.01	0.2
5.70	92.3	3.83	4.15	0.3
5.75	97.3	4.14	4.25	0.3
5.80	63.9	3.77	5.89	0.3
5.85	51.5	3.14	6.10	0.3
5.90	52.5	2.64	5.02	0.3
5.95	116.3	1.67	1.43	0.3
6.00	118.7	1.78	1.50	0.3
6.05	83.4	2.66	3.18	0.3
6.10	67.7	2.57	3.78	0.3
6.15	55.9	1.80	3.21	0.3
6.20	63.1	1.09	1.73	0.3
6.25	55.3	1.24	2.23	0.4
6.30	44.7	1.33	2.97	0.4
6.35	44.5	1.35	3.02	0.4
6.40	42.8	1.20	2.79	0.4
6.45	37.9	1.28	3.38	0.4
6.50	40.2	1.20	2.97	0.4
6.55	41.7	1.30	3.10	0.4
6.60	48.0	1.37	2.84	0.4
6.65	49.1	1.28	2.60	0.4
6.70	46.8	0.84	1.79	0.4
6.75	48.2	0.77	1.60	0.4
6.80	40.8	1.09	2.66	0.4
6.85	33.1	1.36	4.09	0.4
6.90	27.8	1.32	4.73	0.4
6.95	31.8	1.27	3.99	0.4
7.00	35.6	1.19	3.35	0.4

CPT146 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
7.05	36.8	1.15	3.13	0.4
7.10	37.3	1.18	3.17	0.4
7.15	40.2	1.24	3.07	0.4
7.20	40.0	1.21	3.02	0.4
7.25	38.6	1.17	3.03	0.4
7.30	36.6	0.93	2.52	0.4
7.35	35.2	0.94	2.66	0.4
7.40	35.5	0.95	2.67	0.4
7.45	34.5	0.91	2.64	0.4
7.50	34.5	1.09	3.15	0.4
7.55	33.2	1.12	3.37	0.4
7.60	32.0	1.18	3.69	0.4
7.65	31.4	1.29	4.11	0.4
7.70	30.5	1.15	3.78	0.4
7.75	30.8	1.34	4.33	0.5
7.80	29.5	1.41	4.78	0.5
7.85	31.2	1.27	4.07	0.5
7.90	35.2	1.26	3.59	0.5
7.95	37.7	1.33	3.52	0.5
8.00	34.6	1.32	3.80	0.5
8.05	30.7	1.28	4.18	0.5
8.10	30.3	1.28	4.21	0.5
8.15	25.7	1.40	5.45	0.5
8.20	20.3	1.01	4.95	0.5
8.25	18.5	1.20	6.48	0.6
8.30	20.8	1.34	6.45	0.6
8.35	27.1	1.56	5.76	0.6
8.40	33.5	1.39	4.14	0.6
8.45	24.6	1.19	4.83	0.6
8.50	19.8	0.95	4.81	0.6
8.55	22.1	1.06	4.80	0.6
8.60	19.1	1.03	5.41	0.6
8.65	17.2	0.96	5.60	0.6
8.70	15.5	0.96	6.18	0.6
8.75	13.2	0.90	6.78	0.6
8.80	10.0	0.82	8.14	0.6
8.85	7.5	0.72	9.66	0.6
8.90	6.1	0.57	9.36	0.6
8.95	7.2	0.52	7.23	0.6
9.00	8.5	0.64	7.52	0.6
9.05	9.9	0.67	6.81	0.6
9.10	9.6	0.59	6.12	0.6
9.15	8.7	0.52	6.00	0.6
9.20	11.7	0.69	5.90	0.6
9.25	17.3	0.68	3.95	0.6
9.30	19.0	0.83	4.37	0.6
9.35	19.4	0.96	4.92	0.6
9.40	21.4	1.01	4.69	0.6
9.45	22.1	1.03	4.65	0.6
9.50	24.6	1.02	4.15	0.6

CPT146 :

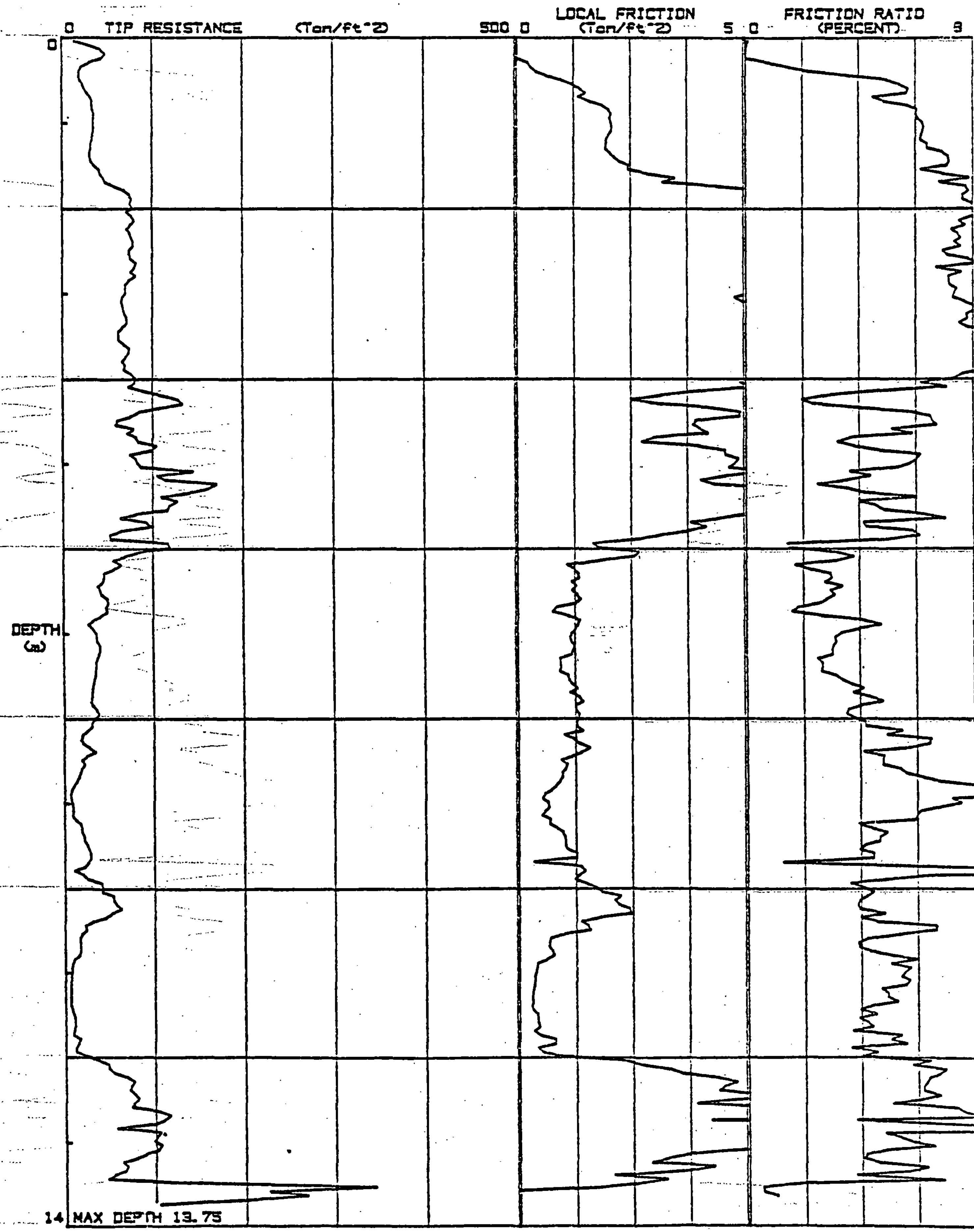
DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
9.55	26.6	1.06	3.98	0.6
9.60	28.4	1.26	4.44	0.6
9.65	28.1	1.25	4.45	0.6
9.70	25.0	0.33	1.25	0.6
9.75	22.5	1.37	6.07	0.6
9.80	10.9	1.45	13.32	0.6
9.85	19.8	1.33	6.75	0.6
9.90	25.0	1.24	4.97	0.6
9.95	40.2	1.47	3.65	0.6
10.00	41.0	1.69	4.11	0.6
10.05	40.8	1.81	4.43	0.6
10.10	52.9	2.22	4.20	0.6
10.15	53.6	2.11	3.94	0.6
10.20	56.3	2.18	3.88	0.6
10.25	61.1	2.41	3.95	0.6
10.30	51.2	2.46	4.81	0.6
10.35	44.9	1.79	3.99	0.7
10.40	30.1	1.38	4.59	0.7
10.45	22.6	1.51	6.67	0.7
10.50	23.5	1.56	6.64	0.7
10.55	18.6	1.00	5.37	0.7
10.60	16.3	0.69	4.25	0.7
10.65	16.8	0.66	3.92	0.7
10.70	16.4	0.65	3.94	0.7
10.75	16.8	0.72	4.30	0.7
10.80	15.1	0.76	5.03	0.7
10.85	10.1	0.60	5.91	0.7
10.90	7.9	0.40	5.07	0.7
10.95	6.7	0.38	5.72	0.7
11.00	6.5	0.36	5.55	0.7
11.05	6.0	0.33	5.43	0.7
11.10	5.9	0.33	5.70	0.7
11.15	6.0	0.34	5.60	0.7
11.20	6.6	0.31	4.75	0.7
11.25	5.9	0.29	4.93	0.7
11.30	5.7	0.28	4.95	0.7
11.35	5.6	0.30	5.27	0.7
11.40	6.1	0.27	4.38	0.7
11.45	7.5	0.30	3.97	0.7
11.50	8.7	0.39	4.51	0.7
11.55	10.4	0.41	3.93	0.7
11.60	10.0	0.42	4.22	0.7
11.65	10.0	0.44	4.38	0.7
11.70	8.8	0.33	3.70	0.7
11.75	8.1	0.44	5.39	0.7
11.80	15.4	0.78	5.03	0.7
11.85	14.0	0.78	5.58	0.7
11.90	11.4	0.42	3.66	0.8
11.95	11.2	0.51	4.54	0.8
12.00	22.5	0.91	4.01	0.8

CPT146 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
12.05	35.9	2.32	6.45	0.8
12.10	46.7	2.72	5.82	0.7
12.15	48.0	3.34	6.96	0.7
12.20	53.2	3.59	6.75	0.7
12.25	68.0	4.37	6.41	0.7
12.30	75.5	4.78	6.32	0.7
12.35	72.8	4.52	6.20	0.8
12.40	71.1	4.40	6.18	0.8
12.45	76.7	5.18	6.75	0.8
12.50	80.6	4.96	6.15	0.8
12.55	76.2	3.92	5.13	0.8
12.60	74.0	5.48	7.40	0.8
12.65	104.0	7.94	7.63	0.8
12.70	116.0	9.65	8.31	0.8
12.75	110.0	4.23	3.84	0.8
12.80	100.2	7.95	7.93	0.8
12.85	56.8	6.15	10.81	0.8
12.90	105.2	5.10	4.84	0.8
12.95	101.8	5.48	5.38	0.8
13.00	98.6	5.68	5.76	0.8
13.05	106.0	6.95	6.55	0.9
13.10	103.3	5.03	4.86	0.9
13.15	89.7	3.74	4.17	0.9
13.20	79.5	3.25	4.08	0.8
13.25	63.1	2.91	4.61	0.7
13.30	67.8	4.28	6.31	0.7
13.35	66.0	3.75	5.68	0.7
13.40	54.0	2.07	3.83	0.7
13.45	46.7	3.23	6.91	0.7
13.50	128.7	2.60	2.02	0.6
13.55	344.2	1.73	0.50	0.5
13.60	226.3	-1.19	0.52	0.4
13.65	268.2	-2.64	0.98	0.3
13.70	204.1?000000000000000??000000000000000?			0.2
13.75	105.0?000000000000000??000000000000000?			0.2

FIGURE A-6-6. CONE PENETRATION PROFILE

DATE : 07/02/86 14:14
LOCATION : LA CAMELIA 1
FILE # : CPT146



SOUNDING DATA IN FILE CPT148 07/02/86 15:450

ENGINEER : Beth Gross LOCATION : LA CAMELIA 2

CONE ID : 15-205 JOB : 7[illegible]

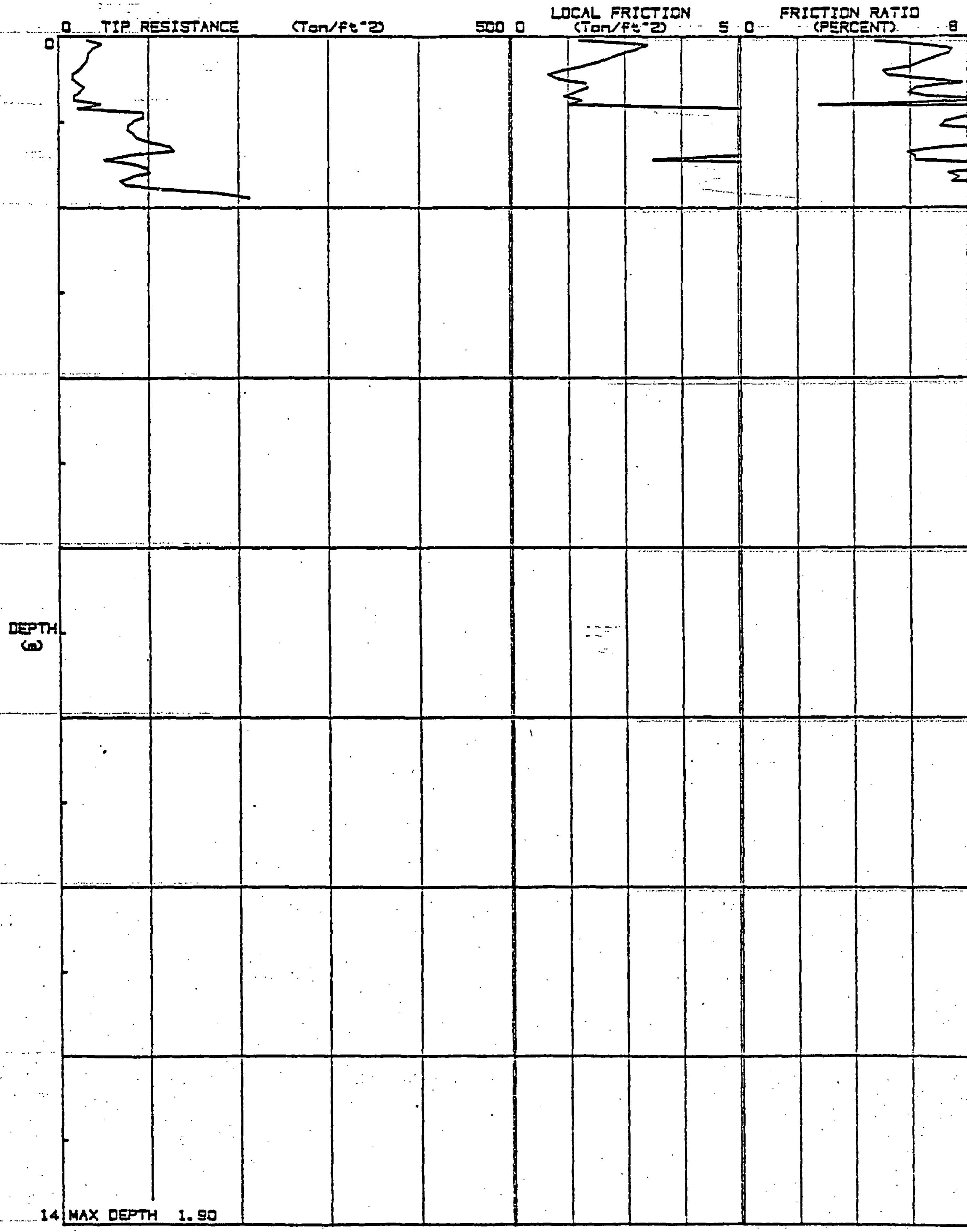
University of Florida - Department of Civil Engineering

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	31.3	1.49	4.74	-0.0
0.10	46.4	3.01	6.48	0.0
0.15	37.4	2.79	7.44	0.0
0.20	33.4	2.45	7.33	0.0
0.25	32.1	2.20	6.86	0.0
0.30	30.7	1.96	6.37	0.0
0.35	26.7	1.60	6.01	0.0
0.40	22.3	1.13	5.05	0.0
0.45	15.7	0.82	5.20	0.0
0.50	15.7	1.02	6.48	0.0
0.55	20.9	1.63	7.79	0.0
0.60	27.2	1.68	6.18	0.0
0.65	23.9	1.42	5.96	0.0
0.70	17.8	1.17	6.58	0.0
0.75	17.2	1.55	9.03	0.0
0.80	46.1	1.28	2.77	0.0
0.85	21.1	5.19	24.56	0.0
0.90	94.6	8.60	9.08	0.0
0.95	94.3	7.34	7.78	0.0
1.00	82.9	5.98	7.21	0.0
1.05	76.9	5.44	7.07	0.0
1.10	76.9	6.53	8.48	0.0
1.15	83.1	7.85	9.44	0.0
1.20	87.1	8.65	9.93	0.0
1.25	102.8	9.84	9.57	0.0
1.30	123.9	9.00	7.26	0.0
1.35	127.5	7.56	5.92	0.0
1.40	76.2	4.70	6.17	0.0
1.45	50.3	3.12	6.19	0.0
1.50	79.7	7.04	8.84	0.0
1.55	97.8	8.89	9.09	0.0
1.60	101.6	7.48	7.35	0.0
1.65	81.8	6.30	7.70	0.0
1.70	68.6	5.13	7.47	0.0
1.75	74.9	7.32	9.77	0.0
1.80	115.5	10.81	9.35	0.0
1.85	182.2?0000000000000000??0000000000000000?			0.0
1.90	211.6?0000000000000000??0000000000000000?			0.0

FIGURE A-7-a. CONE PENETRATION SOUNDING

DATE : 07/02/86 15:45
LOCATION : LA CAMELIA 2
FILE # : CPT148

A.34



SOUNDING DATA IN FILE CPT150 07/03/86 07:360

ENGINEER : Beth Gross LOCATION : LA CAMELIA 3

CONE ID : 15-205 JOB : 8

University of Florida - Department of Civil Engineering

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	30.6	-0.02	0.06	0.0
0.10	63.5	-0.00	0.01	0.0
0.15	93.2	-0.00	0.00	0.0
0.20	112.4	0.06	0.05	0.2
0.25	123.8	0.24	0.19	0.2
0.30	131.2	0.33	0.25	0.2
0.35	123.8	0.30	0.24	0.2
0.40	110.9	0.23	0.20	0.2
0.45	94.9	0.16	0.16	0.2
0.50	80.0	0.18	0.22	0.2
0.55	62.6	0.46	0.73	0.2
0.60	47.2	0.66	1.39	0.2
0.65	38.8	0.85	2.19	0.2
0.70	34.0	0.94	2.76	0.2
0.75	31.8	0.95	3.00	0.2
0.80	31.3	1.01	3.23	0.2
0.85	31.0	1.09	3.52	0.2
0.90	31.3	1.19	3.80	0.2
0.95	32.2	1.23	3.82	0.2
1.00	33.3	1.35	4.05	0.2
1.05	34.0	1.46	4.29	0.2
1.10	35.1	1.50	4.26	0.2
1.15	37.4	1.54	4.13	0.2
1.20	39.4	1.53	3.87	0.2
1.25	38.0	1.54	4.06	0.2
1.30	37.2	1.70	4.57	0.2
1.35	37.6	1.83	4.86	0.2
1.40	39.4	1.95	4.95	0.2
1.45	39.4	2.11	5.34	0.2
1.50	40.7	2.15	5.29	0.2
1.55	43.5	2.26	5.19	0.2
1.60	43.9	2.09	4.74	0.2
1.65	43.1	2.67	6.19	0.2
1.70	43.8	2.88	6.58	0.2
1.75	45.5	3.35	7.36	0.2
1.80	54.1	3.64	6.72	0.2
1.85	73.5	3.76	5.11	0.2
1.90	87.4	3.32	3.79	0.2
1.95	81.7	3.56	4.35	0.2
2.00	86.9	4.17	4.79	0.2

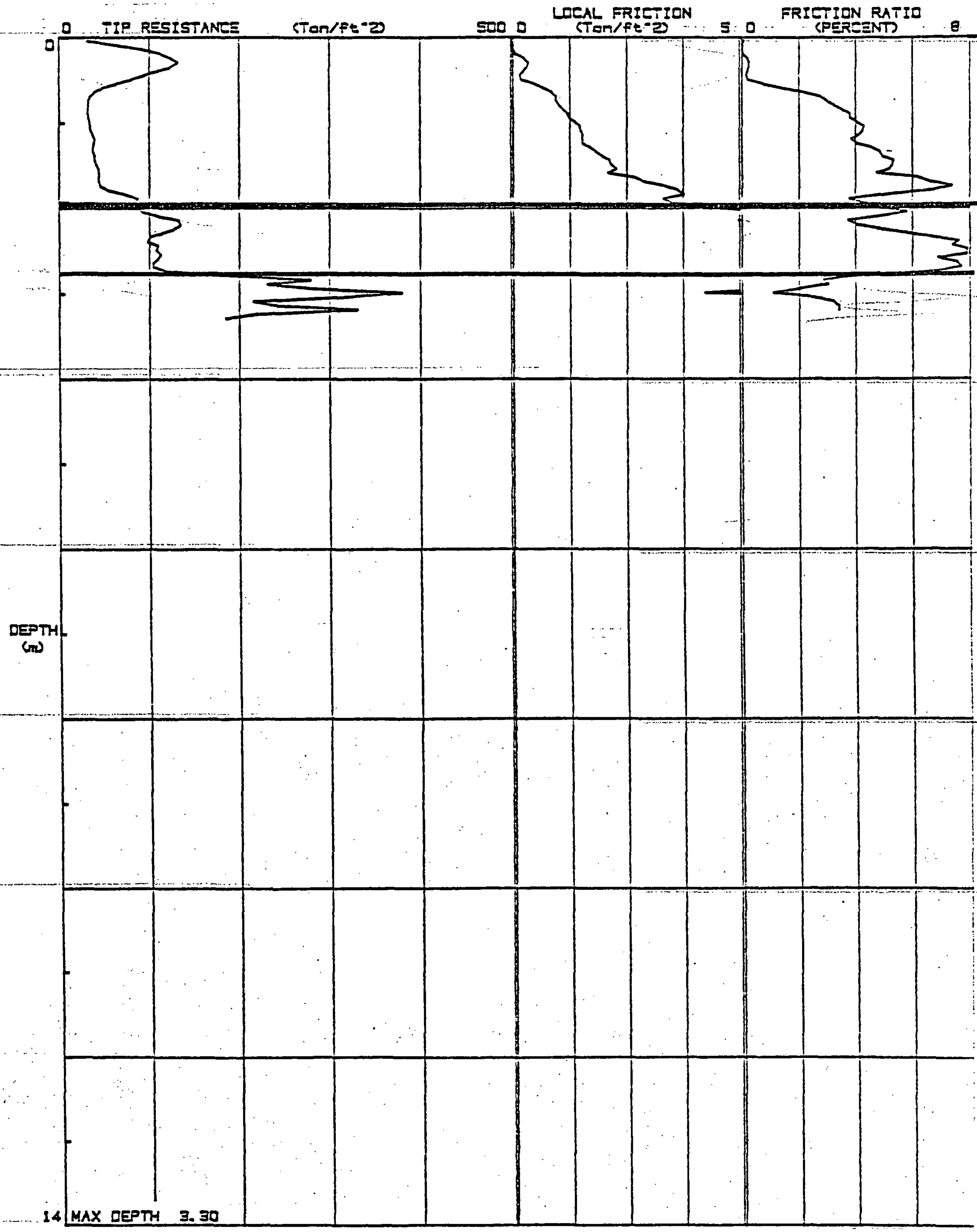
FIGURE A-8-a. CONE PENETRATION SOUNDING

CPT150 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
2.05	92.1	5.35	5.80	0.2
2.10	109.5	5.36	4.89	0.2
2.15	132.6	4.98	3.75	0.2
2.20	134.6	5.43	4.03	0.2
2.25	127.2	6.04	4.75	0.2
2.30	114.0	6.56	5.75	0.2
2.35	100.5	6.70	6.66	0.3
2.40	97.9	7.44	7.59	0.3
2.45	109.2	8.08	7.40	0.3
2.50	108.3	8.57	7.91	0.3
2.55	112.9	8.91	7.89	0.3
2.60	109.9	7.59	6.90	0.3
2.65	105.1	7.96	7.57	0.3
2.70	105.3	8.11	7.69	0.3
2.75	121.1	8.38	6.92	0.3
2.80	187.4	7.51	4.01	0.3
2.85	280.2	8.03	2.86	0.3
2.90	231.3	6.99	3.02	0.3
2.95	280.4	5.76	2.05	0.3
3.00	380.5	4.22	1.10	0.3
3.05	318.7	7.70	2.41	0.3
3.10	215.5	6.95	3.22	0.3
3.15	239.3	8.14	3.40	0.3
2.20	331.4	11.43	3.44	0.3
3.25	216.5?0000000000000000??0000000000000000?			0.3
3.30	185.8?0000000000000000??0000000000000000?			0.3

FIGURE A-8-b. CONE PENETRATION PROFILE

JOB : 8
DATE : 07/03/86 07:36
LOCATION : LA CAMELIA 3
FILE # : CPT150



SOUNDING DATA IN FILE CPT151 07/03/86 08:180

ENGINEER : Beth Gross LOCATION : LA CAMELIA 4

CONE ID : 15-205 JOB : 9

University of Florida - Department of Civil Engineering

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	24.5	0.07	0.29	-0.0
0.10	58.7	0.28	0.48	-0.0
0.15	90.2	1.06	1.18	-0.0
0.20	103.3	2.15	2.08	-0.0
0.25	106.3	3.41	3.20	-0.0
0.30	107.1	4.30	4.01	-0.0
0.35	125.9	3.99	3.17	-0.0
0.40	164.0	2.74	1.66	-0.0
0.45	196.8	1.73	0.87	-0.0
0.50	221.0	1.87	0.84	-0.0
0.55	217.0	3.16	1.45	-0.0
0.60	196.9	5.79	2.94	-0.0
0.65	176.4	6.51	3.69	-0.0
0.70	156.4	5.27	3.36	-0.0
0.75	133.6	5.61	4.19	-0.0
0.80	119.9	5.99	4.99	-0.0
0.85	102.7	5.83	5.67	-0.0
0.90	111.2	5.23	4.70	-0.0
0.95	119.6	4.52	3.77	-0.0
1.00	128.4	4.77	3.71	-0.0
1.05	136.9	5.05	3.68	-0.0
1.10	153.4	6.04	3.93	-0.0
1.15	134.1	7.37	5.49	-0.0
1.20	105.6	6.84	6.47	-0.0
1.25	86.1	5.86	6.80	-0.0
1.30	97.5	6.63	6.80	-0.0
1.35	104.1	6.48	6.22	-0.0
1.40	88.8	5.57	6.27	-0.0
1.45	78.9	5.41	6.84	-0.0
1.50	78.5	4.52	5.75	-0.0
1.55	94.8	3.91	4.12	-0.0
1.60	106.0	4.01	3.78	-0.0
1.65	83.2	4.60	5.52	-0.0
1.70	78.9	4.77	6.04	-0.0
1.75	79.0	4.84	6.12	-0.0
1.80	91.9	4.62	5.02	-0.0
1.85	109.6	3.97	3.62	-0.0
1.90	102.3	3.59	3.51	-0.0
1.95	80.4	4.18	5.19	-0.0
2.00	66.9	3.72	5.56	-0.0

FIGURE A-9-a. CONE PENETRATION SOUNDING

CPT151 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
2.05	59.4	3.35	5.63	-0.0
2.10	63.4	2.13	3.36	-0.0
2.15	73.6	1.20	1.63	-0.0
2.20	83.0	1.31	1.57	-0.0
2.25	92.5	1.32	1.43	-0.0
2.30	88.2	1.32	1.49	-0.0
2.35	86.7	1.62	1.87	-0.0
2.40	92.1	1.42	1.53	-0.0
2.45	91.3	1.33	1.45	-0.0
2.50	99.8	1.21	1.21	-0.0
2.55	109.5	1.23	1.12	-0.0
2.60	111.2	1.53	1.37	-0.0
2.65	102.9	2.32	2.25	-0.0
2.70	90.3	2.16	2.39	-0.0
2.75	68.4	2.76	4.03	-0.0
2.80	65.0	3.17	4.87	-0.0
2.85	61.6	2.91	4.73	-0.0
2.90	58.2	2.62	4.50	-0.0
2.95	42.4	1.88	4.42	-0.0
3.00	37.7	1.70	4.51	-0.0
3.05	36.8	1.30	3.53	-0.0
3.10	38.0	1.62	4.25	-0.0
3.15	39.7	1.61	4.06	-0.0
3.20	41.0	1.78	4.34	-0.0
3.25	45.7	1.98	4.32	-0.0
3.30	51.9	2.57	4.95	-0.0
3.35	51.9	2.82	5.43	-0.0
3.40	54.0	2.79	5.15	-0.0
3.45	47.0	2.26	4.80	-0.0
3.50	35.5	1.51	4.25	-0.0
3.55	29.3	1.05	3.59	-0.0
3.60	26.3	0.85	3.22	-0.0
3.65	24.6	0.73	2.95	-0.0
3.70	24.0	0.62	2.59	-0.0
3.75	23.3	0.67	2.88	-0.0
3.80	24.3	0.66	2.71	-0.0
3.85	25.8	0.80	3.11	-0.0
3.90	25.4	0.73	2.85	-0.0
3.95	22.9	0.63	2.76	-0.0
4.00	22.3	0.63	2.80	-0.0
4.05	22.6	0.64	2.83	-0.0
4.10	21.5	0.75	3.51	-0.0
4.15	23.3	0.72	3.09	-0.0
4.20	22.0	0.75	3.40	-0.0
4.25	22.2	1.07	4.79	-0.0
4.30	32.9	1.34	4.07	-0.0
4.35	27.6	1.28	4.65	-0.0
4.40	23.1	0.98	4.26	-0.0
4.45	20.7	0.67	3.22	-0.0
4.50	20.1	0.60	2.97	-0.0

CPT151 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
4.55	20.7	0.55	2.65	-0.0
4.60	21.3	0.60	2.80	-0.0
4.65	23.5	1.06	4.51	-0.0
4.70	24.9	1.66	6.67	-0.0
4.75	25.1	1.81	7.21	-0.0
4.80	27.5	1.78	6.48	-0.0
4.85	29.6	1.75	5.90	-0.0
4.90	31.5	1.83	5.80	-0.0
4.95	30.1	2.00	6.63	-0.0
5.00	30.2	1.59	5.27	-0.0
5.05	31.8	1.80	5.66	-0.0
5.10	34.2	1.45	4.22	-0.0
5.15	31.6	1.62	5.12	-0.0
5.20	54.6	3.02	5.53	-0.0
5.25	54.6	2.70	4.93	-0.0
5.30	49.6	1.97	3.98	-0.0
5.35	77.7	1.78	2.28	-0.0
5.40	66.9	1.92	2.87	-0.0
5.45	43.0	2.13	4.94	-0.0
5.50	50.5	1.81	3.58	-0.0
5.55	41.0	1.56	3.80	-0.0
5.60	31.7	1.12	3.53	-0.0
5.65	53.3	1.59	2.98	-0.0
5.70	38.5	1.09	2.84	-0.0
5.75	46.6	1.39	2.98	-0.0
5.80	57.8	1.80	3.11	-0.0
5.85	42.1	1.78	4.22	-0.0
5.90	41.1	1.09	2.66	-0.0
5.95	56.6	1.77	3.11	-0.0
6.00	41.2	1.90	4.61	-0.0
6.05	45.3	1.96	4.09	-0.0
6.10	49.9	1.14	2.28	-0.0
6.15	52.0	1.40	2.70	-0.0
6.20	45.0	1.40	3.11	-0.0
6.25	45.0	1.12	2.47	-0.0
6.30	43.3	0.97	2.24	-0.0
6.35	45.1	0.89	1.96	-0.0
6.40	34.7	0.89	2.56	-0.0
6.45	32.6	1.04	3.18	-0.0
6.50	34.4	0.94	2.74	-0.0
6.55	33.0	0.98	2.97	-0.0
6.60	32.4	0.79	2.44	-0.0
6.65	28.2	0.98	3.46	-0.0
6.70	28.3	0.89	3.14	-0.0
6.75	26.1	0.66	2.51	-0.0
6.80	20.7	0.56	2.72	-0.0
6.85	22.7	0.60	2.65	-0.0
6.90	23.3	0.60	2.55	-0.0
6.95	20.7	0.57	2.74	-0.0
7.00	23.3	0.60	2.57	-0.0

CPT151 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
7.05	23.2	0.52	2.25	-0.0
7.10	23.4	0.45	1.91	-0.0
7.15	26.9	0.54	1.99	-0.0
7.20	29.4	0.77	2.62	-0.0
7.25	26.8	0.50	1.85	-0.0
7.30	23.2	0.36	1.54	-0.0
7.35	24.2	0.36	1.49	-0.0
7.40	24.1	0.44	1.83	-0.0
7.45	24.4	0.45	1.84	-0.0
7.50	23.2	0.51	2.18	-0.0
7.55	21.6	0.57	2.61	-0.0
7.60	20.9	0.52	2.47	-0.0
7.65	20.9	0.50	2.41	-0.0
7.70	21.1	0.58	2.76	-0.0
7.75	20.7	0.56	2.69	-0.0
7.80	20.7	0.55	2.65	-0.0
7.85	20.4	0.56	2.76	-0.0
7.90	20.0	0.49	2.46	-0.0
7.95	20.0	0.47	2.34	-0.0
8.00	20.7	0.52	2.52	-0.0
8.05	20.7	0.42	2.03	-0.0
8.10	21.2	0.43	2.01	-0.0
8.15	21.8	0.47	2.13	-0.0
8.20	22.0	0.50	2.25	-0.0
8.25	23.2	0.48	2.06	-0.0
8.30	24.4	0.47	1.94	-0.0
8.35	24.9	0.41	1.66	-0.0
8.40	24.7	0.39	1.56	-0.0
8.45	24.7	0.42	1.69	-0.0
8.50	24.8	0.42	1.67	-0.0
8.55	26.0	0.50	1.93	-0.0
8.60	27.0	0.45	1.64	-0.0
8.65	28.0	0.48	1.69	-0.0
8.70	27.7	0.48	1.74	-0.0
8.75	23.5	0.54	2.29	-0.0
8.80	20.7	0.44	2.12	-0.0
8.85	18.6	0.36	1.93	-0.0
8.90	17.6	0.37	2.08	-0.0
8.95	17.0	0.36	2.10	-0.0
9.00	16.0	0.29	1.78	-0.0
9.05	15.4	0.15	0.99	-0.0
9.10	15.1	0.39	2.55	-0.0
9.15	18.3	0.88	4.80	-0.0
9.20	31.4	1.08	3.43	-0.0
9.25	40.9	1.04	2.54	-0.0
9.30	39.9	1.15	2.87	-0.0
9.35	39.6	1.23	3.10	-0.0
9.40	37.6	1.28	3.41	-0.0
9.45	34.2	1.23	3.59	-0.0
9.50	42.1	1.24	2.93	-0.0

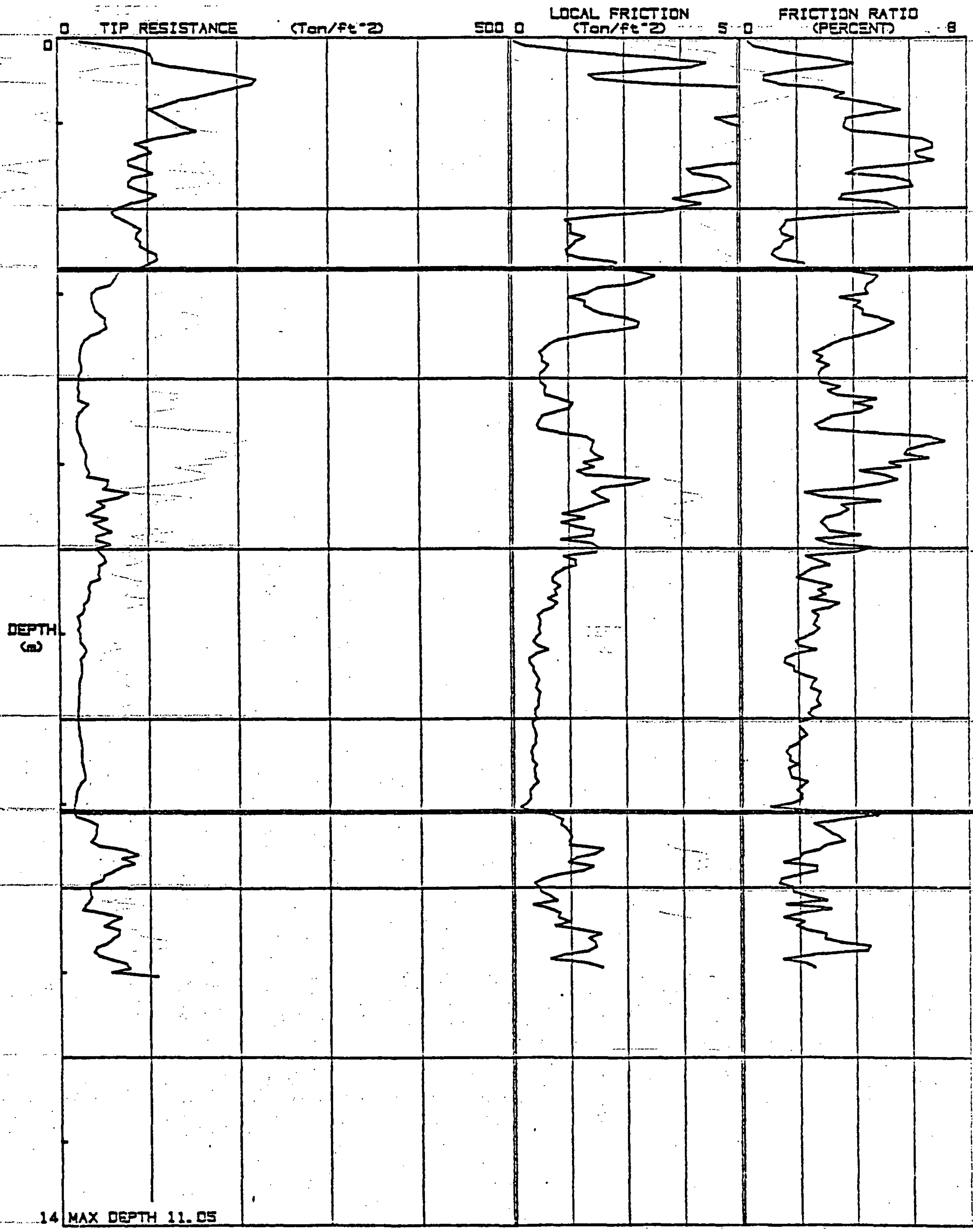
CPT151 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
9.55	71.8	1.96	2.73	-0.0
9.60	86.2	1.82	2.11	-0.0
9.65	68.7	1.38	2.00	-0.0
9.70	82.8	1.22	1.46	-0.0
9.75	67.0	1.75	2.61	-0.0
9.80	58.7	1.54	2.62	-0.0
9.85	48.5	0.96	1.97	-0.0
9.90	46.2	0.63	1.36	-0.0
9.95	34.4	0.45	1.29	-0.0
10.00	31.7	0.55	1.74	-0.0
10.05	33.0	0.59	1.78	-0.0
10.10	34.2	0.78	2.28	-0.0
10.15	31.7	0.94	2.96	-0.0
10.20	27.4	0.42	1.53	-0.0
10.25	24.6	0.76	3.10	-0.0
10.30	48.3	1.01	2.08	-0.0
10.35	66.8	0.97	1.45	-0.0
10.40	55.7	1.20	2.15	-0.0
10.45	48.3	0.91	1.89	-0.0
10.50	64.7	1.45	2.24	-0.0
10.55	64.8	1.91	2.94	-0.0
10.60	57.4	1.65	2.88	-0.0
10.65	51.8	1.78	3.43	-0.0
10.70	40.4	1.82	4.49	-0.0
10.75	37.2	1.64	4.40	-0.0
10.80	42.2	1.05	2.48	-0.0
10.85	56.1	0.80	1.42	-0.0
10.90	73.0	1.64	2.24	-0.0
10.95	76.9	1.94	2.51	-0.0
11.00	56.9?0000000000000000??0000000000000000?			-0.0
11.05	108.2?0000000000000000??0000000000000000?			-0.0

FIGURE A-[illegible]. CONE PENETRATION PROFILE

JOB : [illegible]
DATE : 07/03/86 09:18
LOCATION : LA CAMELIA 4
FILE # : CPT151

A.43



SOUNDING DATA IN FILE CPT152 07/03/86 09:490

ENGINEER : Beth Gross LOCATION : LA CAMELIA 5

CONE ID : 15-205 JOB : 10

University of Florida - Department of Civil Engineering

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	13.0	0.01	0.09	-0.0
0.10	28.6	0.04	0.14	-0.0
0.15	44.9	0.54	1.21	-0.0
0.20	48.2	0.78	1.61	-0.0
0.25	46.8	1.02	2.17	-0.0
0.30	47.3	1.28	2.70	-0.0
0.35	46.8	1.22	2.61	-0.0
0.40	40.0	0.65	1.63	-0.0
0.45	67.1	0.52	0.76	-0.0
0.50	92.3	0.39	0.42	-0.0
0.55	82.2	0.46	0.56	-0.0
0.60	86.2	0.38	0.44	-0.0
0.65	98.5	0.19	0.19	-0.0
0.70	103.6	0.22	0.21	-0.0
0.75	87.2	0.24	0.27	-0.0
0.80	71.5	0.26	0.35	-0.0
0.85	56.4	0.34	0.60	-0.0
0.90	46.1	0.31	0.67	-0.0
0.95	43.5	0.12	0.28	-0.0
1.00	53.5	0.10	0.18	-0.0
1.05	57.4	0.07	0.11	-0.0
1.10	55.5	0.04	0.07	-0.0
1.15	52.3	0.04	0.07	-0.0
1.20	41.9	-0.04	0.09	-0.0
1.25	32.0	-0.05	0.17	-0.0
1.30	25.0	-0.07	0.29	-0.0
1.35	20.4	-0.06	0.29	-0.0
1.40	16.1	-0.07	0.42	-0.0
1.45	16.1	-0.08	0.50	-0.0
1.50	23.9	-0.08	0.34	-0.0
1.55	23.8	-0.09	0.36	-0.0
1.60	19.0	-0.10	0.50	-0.0
1.65	17.6	-0.09	0.50	-0.0
1.70	21.2	-0.09	0.44	-0.0
1.75	8.2	-0.08	1.00	-0.0
1.80	17.5	-0.09	0.54	0.0
1.85	14.2	-0.08	0.59	0.0
1.90	11.4	-0.08	0.72	0.0
1.95	8.7	-0.08	0.94	0.0
2.00	6.1	-0.08	1.32	0.0

FIGURE A-10-a. CONE PENETRATION SOUNDING

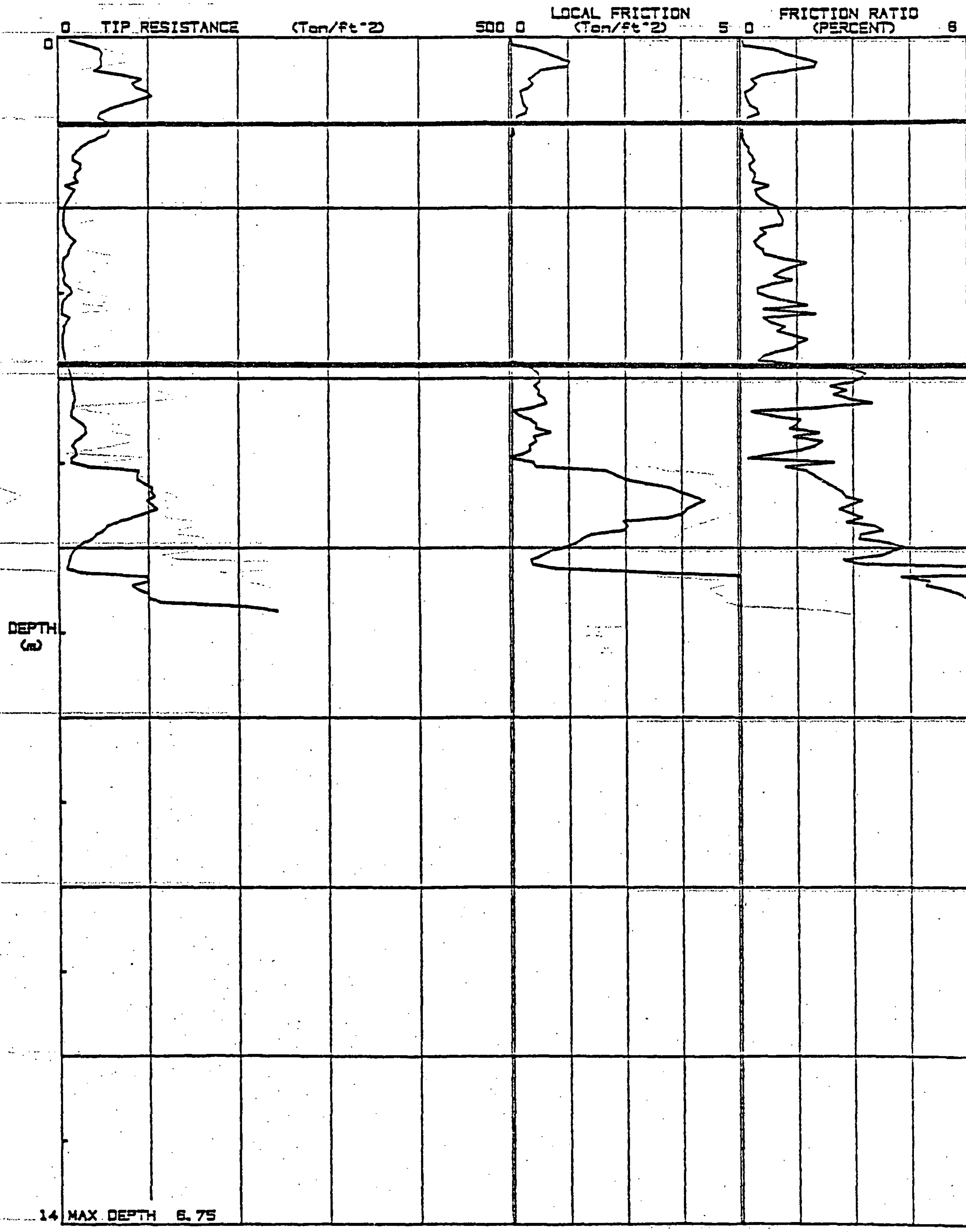
CPT152 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
2.05	6.0	-0.08	1.35	0.0
2.10	5.5	-0.08	1.45	0.0
2.15	5.4	-0.08	1.52	0.0
2.20	5.5	-0.08	1.48	0.0
2.25	7.4	-0.05	0.73	0.0
2.30	9.2	-0.08	0.88	0.0
2.35	12.9	-0.09	0.67	0.0
2.40	18.3	-0.09	0.50	0.0
2.45	14.2	-0.08	0.58	0.0
2.50	11.9	-0.10	0.80	0.0
2.55	11.2	-0.10	0.86	0.0
2.60	6.5	-0.10	1.48	0.0
2.65	4.7	-0.11	2.32	0.0
2.70	4.7	-0.09	1.83	0.0
2.75	6.1	-0.09	1.42	0.0
2.80	7.2	-0.09	1.19	0.0
2.85	5.3	-0.10	1.80	0.0
2.90	7.4	-0.08	1.10	0.0
2.95	13.0	-0.08	0.63	0.0
3.00	15.3	-0.10	0.62	0.0
3.05	9.6	-0.10	0.99	0.0
3.10	5.5	-0.09	1.72	0.0
3.15	4.0	-0.09	2.35	0.0
3.20	3.4	-0.03	0.83	0.0
3.25	3.6	-0.09	2.65	0.0
3.30	11.5	-0.09	0.82	0.0
3.35	8.8	-0.09	1.06	0.0
3.40	6.1	-0.10	1.58	0.0
3.45	6.7	-0.09	1.32	0.0
3.50	4.4	-0.08	1.86	0.0
3.55	4.0	-0.10	2.35	0.0
3.60	4.7	-0.10	2.03	0.0
3.65	5.2	-0.10	1.87	0.0
3.70	6.0	-0.07	1.23	0.0
3.75	6.7	-0.05	0.81	0.0
3.80	8.3	-0.05	0.65	0.0
3.85	10.3	0.23	2.24	0.0
3.90	11.6	0.46	3.98	0.0
3.95	12.8	0.57	4.44	0.0
4.00	14.2	0.61	4.30	0.0
4.05	14.9	0.60	4.01	0.0
4.10	15.6	0.50	3.21	0.0
4.15	15.6	0.58	3.74	0.0
4.20	17.4	0.58	3.32	0.0
4.25	18.3	0.71	3.86	0.0
4.30	16.3	0.76	4.67	0.0
4.35	15.7	0.48	3.02	0.0
4.40	13.5	0.05	0.38	0.0
4.45	13.4	0.15	1.09	0.0
4.50	19.0	0.40	2.11	0.0

CPT152 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
4.55	26.0	0.52	1.99	0.0
4.60	29.3	0.52	1.76	0.0
4.65	30.2	0.84	2.78	0.0
4.70	25.2	0.48	1.89	0.0
4.75	18.4	0.53	2.88	0.0
4.80	14.8	0.39	2.65	0.0
4.85	18.3	0.40	2.19	0.0
4.90	19.5	0.23	1.18	0.0
4.95	14.1	-0.04	0.28	0.0
5.00	13.9	0.46	3.32	0.0
5.05	32.8	0.53	1.61	0.0
5.10	88.7	2.08	2.34	0.0
5.15	87.0	2.28	2.62	0.0
5.20	87.6	2.48	2.83	0.0
5.25	94.9	2.93	3.09	0.0
5.30	103.9	3.51	3.38	0.0
5.35	103.1	3.71	3.60	0.0
5.40	106.6	3.98	3.73	0.0
5.45	98.4	4.24	4.30	0.0
5.50	104.2	4.05	3.88	0.0
5.55	109.3	3.86	3.53	0.0
5.60	96.0	3.78	3.93	0.0
5.65	80.3	3.47	4.31	0.0
5.70	65.2	2.46	3.78	0.0
5.75	53.1	2.54	4.77	0.0
5.80	48.7	2.45	5.03	0.0
5.85	40.8	1.74	4.26	0.0
5.90	36.8	1.55	4.21	0.0
5.95	27.1	1.43	5.27	0.0
6.00	20.1	1.16	5.76	0.0
6.05	15.6	0.83	5.34	0.0
6.10	12.8	0.64	4.97	0.0
6.15	11.5	0.42	3.68	0.0
6.20	10.1	0.44	4.30	0.0
6.25	8.5	0.86	10.10	0.0
6.30	23.9	3.09	12.90	0.0
6.35	97.3	5.55	5.70	0.0
6.40	100.7	6.72	6.68	-0.0
6.45	81.6	5.37	6.58	-0.0
6.50	87.9	6.32	7.18	-0.0
6.55	100.1	7.71	7.70	-0.0
6.60	100.6	8.00	7.94	-0.0
6.65	112.5	10.72	9.52	-0.0
6.70	207.8?0000000000000000??0000000000000000?			-0.0
6.75	242.0?0000000000000000??0000000000000000?			-0.0

DATE : 07/03/86 09:49
LOCATION : LA CAMELIA 5
FILE # : CPT152



SOUNDING DATA IN FILE CPT:53 07/03/86 10:240

ENGINEER : Beth Gross LOCATION : LA CAMELIA 6

CONE ID : 15-205 JOB : 11

University of Florida - Department of Civil Engineering

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
0.05	26.5	1.51	5.69	0.0
0.10	42.1	2.37	5.62	0.1
0.15	40.3	3.13	7.76	0.1
0.20	38.6	3.23	8.37	0.1
0.25	34.0	2.33	6.83	0.1
0.30	29.2	1.76	6.03	0.1
0.35	33.0	2.23	6.74	0.1
0.40	39.0	2.75	7.04	0.1
0.45	51.0	3.61	7.07	0.1
0.50	46.2	3.30	7.14	0.1
0.55	40.4	3.05	7.54	0.1
0.60	46.2	3.04	6.57	0.1
0.65	60.5	2.37	3.91	0.1
0.70	50.9	2.06	4.05	0.1
0.75	41.4	2.03	4.90	0.1
0.80	30.8	1.74	5.65	0.1
0.85	25.8	1.82	7.02	0.1
0.90	29.4	2.06	7.00	0.1
0.95	40.0	2.52	6.29	0.1
1.00	46.3	2.77	5.99	0.1
1.05	42.6	2.84	6.66	0.2
1.10	37.4	2.62	7.01	0.2
1.15	36.5	2.29	6.27	0.2
1.20	38.9	2.21	5.68	0.2
1.25	38.7	1.90	4.90	0.2
1.30	31.9	1.74	5.45	0.2
1.35	23.9	1.22	5.11	0.2
1.40	21.4	1.18	5.52	0.2
1.45	18.4	1.02	5.54	0.2
1.50	16.4	0.96	5.86	0.2
1.55	18.1	1.04	5.72	0.1
1.60	19.6	1.14	5.78	0.1
1.65	18.4	0.92	4.97	0.1
1.70	15.7	0.87	5.55	0.1
1.75	13.6	0.87	6.43	0.1
1.80	13.0	0.87	6.74	0.1
1.85	12.7	0.87	6.85	0.1
1.90	12.8	0.82	6.38	0.1
1.95	11.6	0.81	7.00	0.1
2.00	9.9	0.71	7.14	0.1

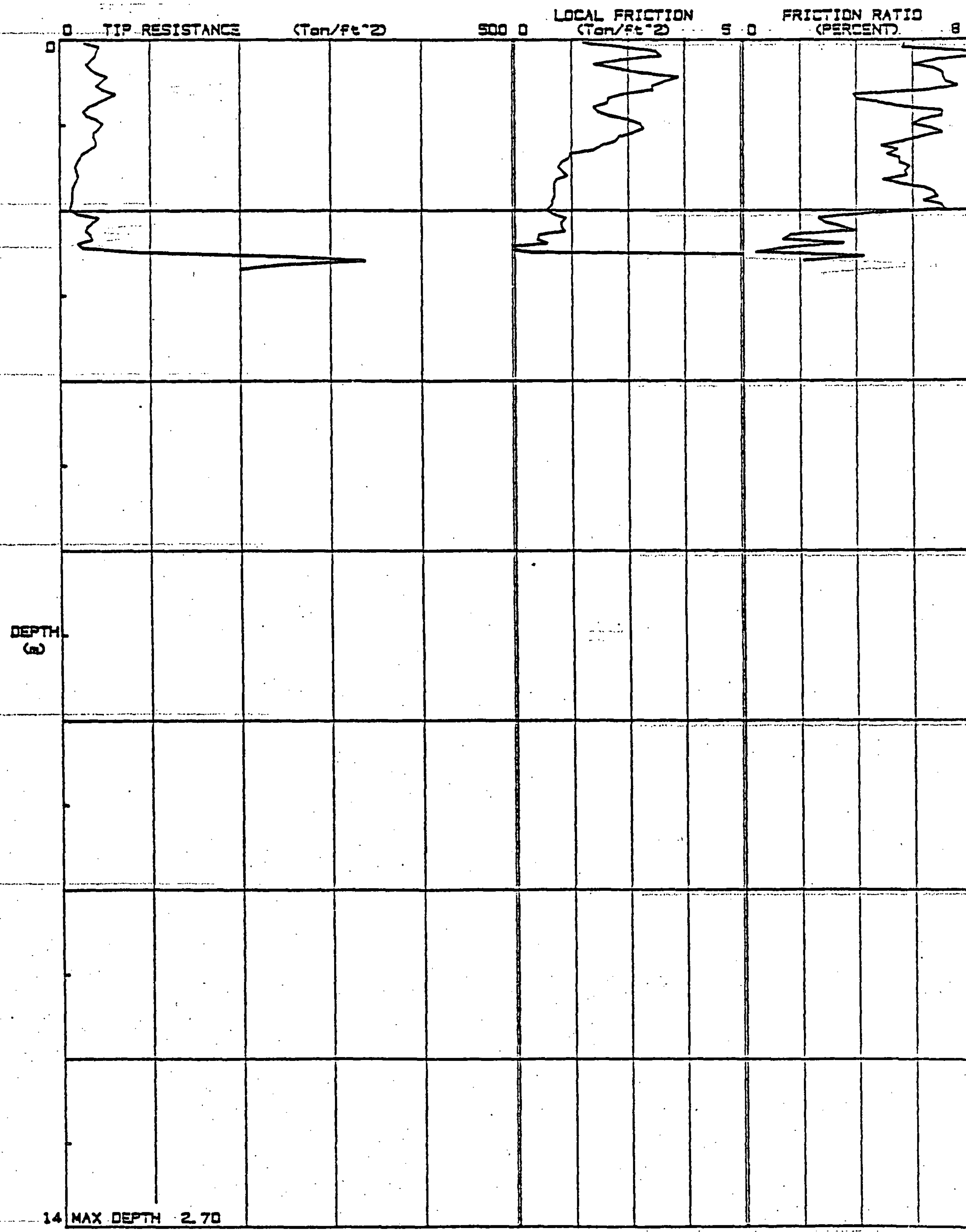
FIGURE A-11-a. CONE PENETRATION SOUNDING

CPT153 :

DEPTH (METERS)	TIP RESISTANCE (Ton/ft^2)	LOCAL FRICTION (Ton/ft^2)	FRICTION RATIO (PERCENT)	INCLINATION (DEGREES)
2.05	18.8	0.82	4.38	0.1
2.10	41.4	1.11	2.67	0.1
2.15	35.6	1.03	2.88	0.1
2.20	30.1	1.04	3.45	0.2
2.25	27.6	1.09	3.91	0.2
2.30	32.7	0.54	1.64	0.2
2.35	34.8	0.49	1.40	0.2
2.40	19.8	0.70	3.55	0.2
2.45	24.6	-0.36	1.46	0.2
2.50	79.2	0.37	0.46	0.2
2.55	249.5	10.69	4.28	0.2
2.60	338.1	7.34	2.16	0.2
2.65	241.5?000030000300000??000000000000000?			0.2
2.70	200.6?0000000000000000??0000003000000000?			0.2

DATE : 07/03/86 10:24
LOCATION : LA CAMELIA 6
FILE # : CPT153

A.50



IOWA BOREHOLE SHEAR TEST DATA -- LA CAMELIA MINE

LA CAMELIA SITE 1 -- 25 FOOT HIGHWALL -- TEST 1

TEST PERFORMED IN SOIL LAYER 2 ABOUT 20 FEET BELOW THE GROUND SURFACE. THE VERTICAL FACE OF THE BOREHOLE WAS SHEARED AFTER INSERTING 2.4 FEET OF ROD INTO THE BOREHOLE.

NORMAL STRESS (psf)	SHEAR STRESS (psf)	COHESION (psf)	FRICTION ANGLE (deg)
964.8	799.2	12.	39.
1299.	1079.		
1669.	1375.		

FIGURE A-12-a. IOWA BOREHOLE SHEAR TEST DATA

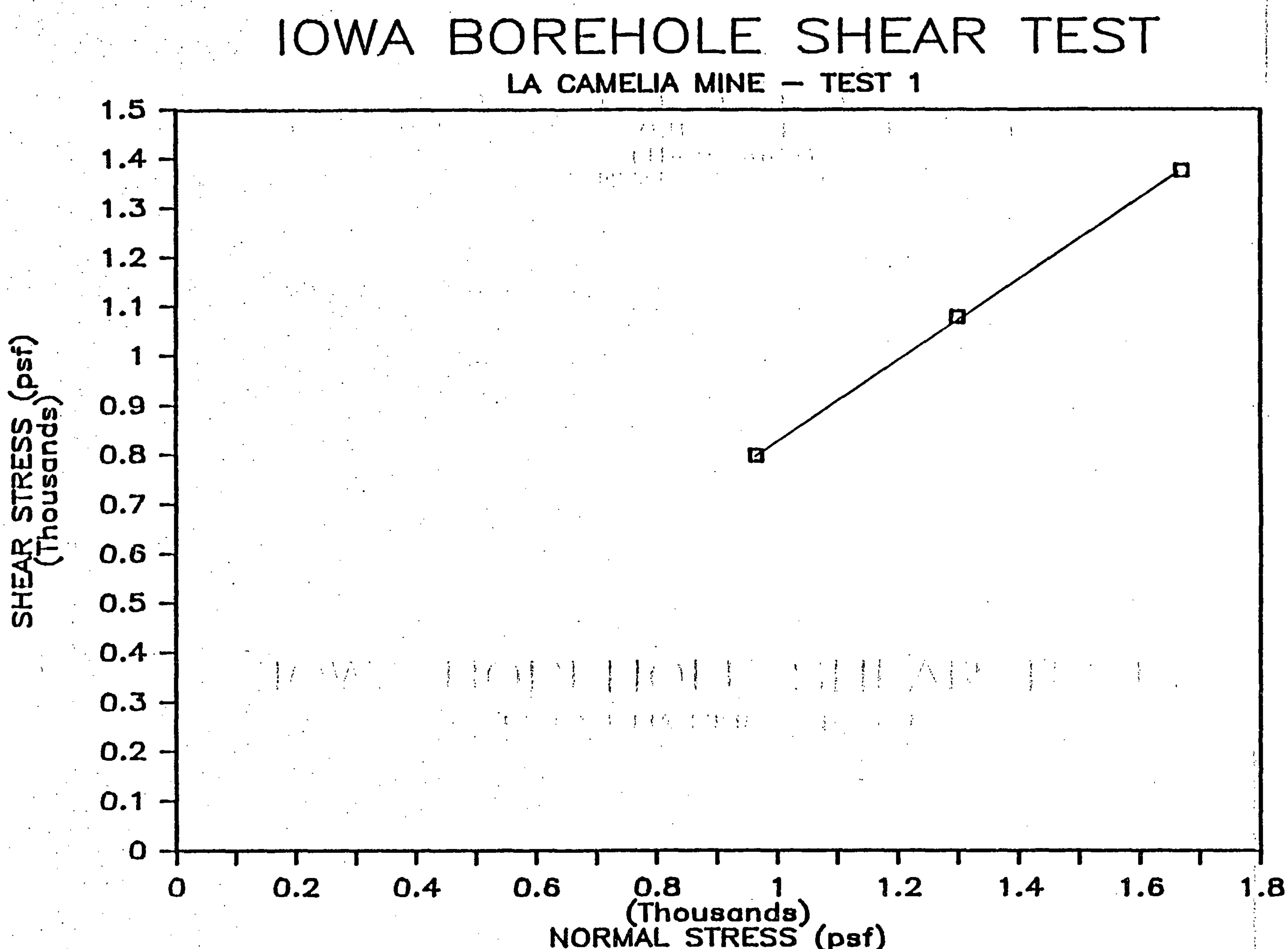


FIGURE A-12-b. IOWA BOREHOLE SHEAR TEST PLOT

IOWA BOREHOLE SHEAR TEST DATA -- LA CAMELIA MINE

LA CAMELIA SITE 1 -- 25 FOOT HIGHWALL -- TEST 2

TEST PERFORMED IN SOIL LAYER 2 ABOUT 20 FEET BELOW THE GROUND SURFACE. THE HORIZONTAL FACE OF THE BOREHOLE WAS SHEARED AFTER INSERTING 1.5 FEET OF ROD INTO THE BOREHOLE.

NORMAL STRESS (psf)	SHEAR STRESS (psf)	COHESION (psf)	FRICTION ANGLE (deg)
743.0	446.4	490.	5.6
1113.	596.2		
1483.	632.2		

FIGURE A-13-a. IOWA BOREHOLE SHEAR TEST DATA

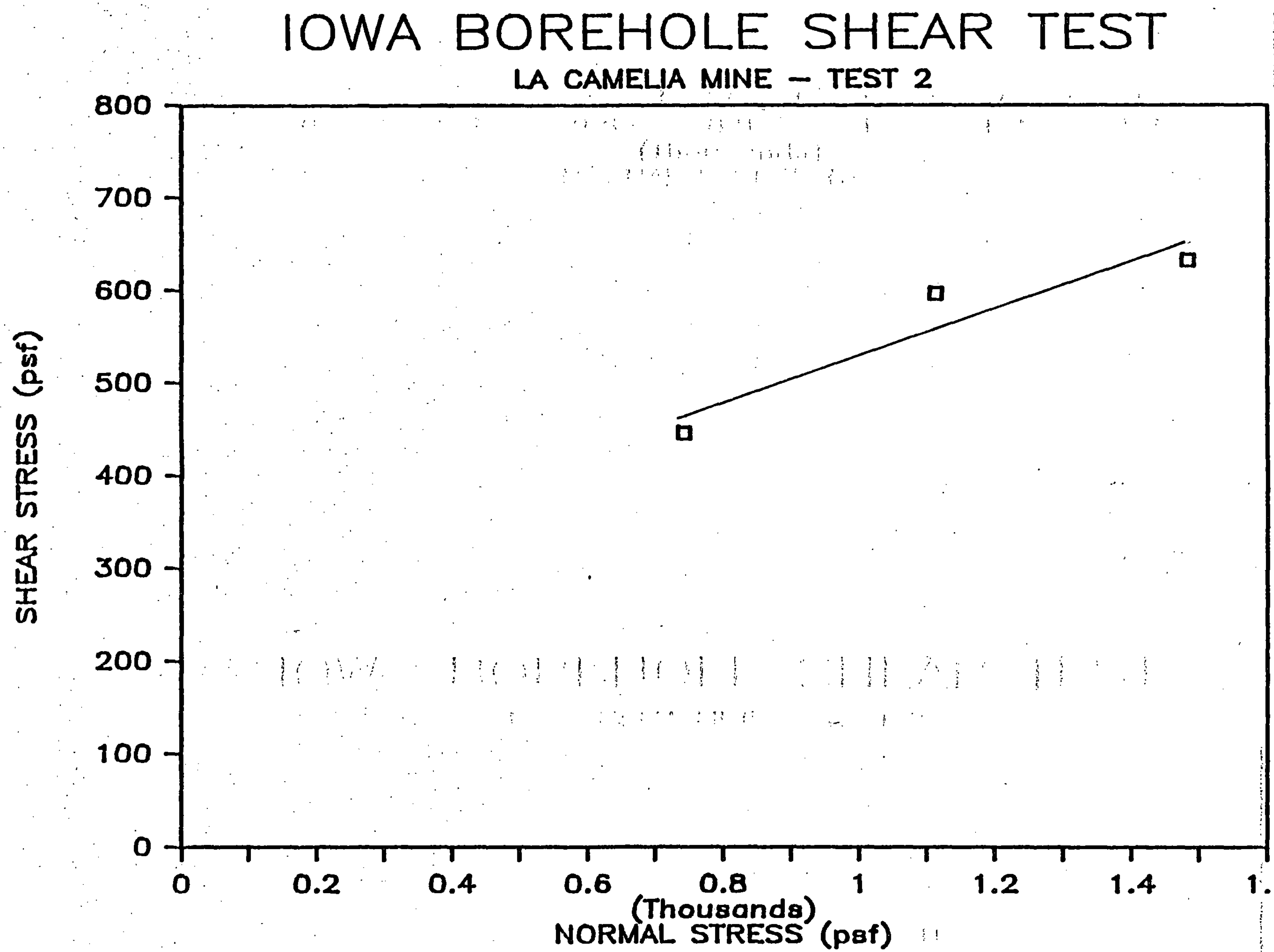


FIGURE A-13-b. IOWA BOREHOLE SHEAR TEST PLOT

IOWA BOREHOLE SHEAR TEST DATA -- LA CAMELIA MINE

LA CAMELIA SITE 1 -- 25 FOOT HIGHWALL -- TEST 3

TEST PERFORMED IN SOIL LAYER 2 ABOUT 20 FEET BELOW THE GROUND SURFACE. THE VERTICAL FACE OF THE BOREHOLE WAS SHEARED AFTER INSERTING 4.5 FEET OF ROD INTO THE BOREHOLE.

NORMAL STRESS (psf)	SHEAR STRESS (psf)	COHESION (psf)	FRICTION ANGLE (deg)
761.8	540.0	60.	35.
1113.	817.9		
1483.	1133.		
1858.	1338.		

FIGURE A-14-a. IOWA BOREHOLE SHEAR TEST DATA

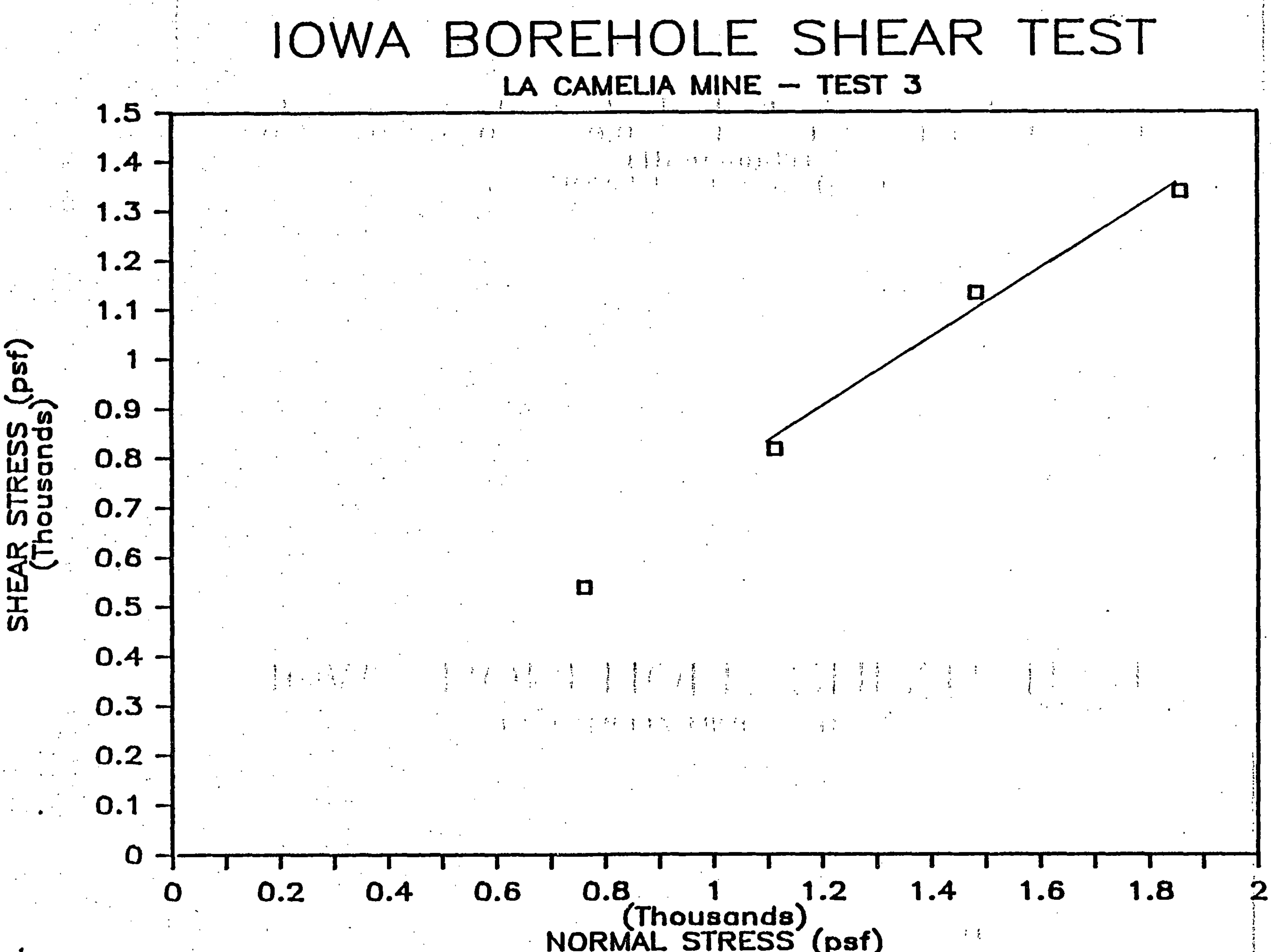


FIGURE A-14-6. IOWA BOREHOLE SHEAR TEST PLOT

IOWA BOREHOLE SHEAR TEST DATA -- LA CAMELIA MINE

LA CAMELIA SITE 2 -- 9 FOOT HIGHWALL -- TEST 4

TEST PERFORMED IN SOIL LAYER 2 ABOUT 6 FEET BELOW THE GROUND SURFACE. THE VERTICAL FACE OF THE BOREHOLE WAS SHEARED AFTER INSERTING .5 FEET OF ROD INTO THE BOREHOLE.

NORMAL STRESS (psf)	SHEAR STRESS (psf)	COHESION (psf)	FRICTION ANGLE (deg)
595.6	447.1	102.	36.
965.1	799.6		
1299.	1041.		

FIGURE A-15-a. IOWA BOREHOLE SHEAR TEST DATA

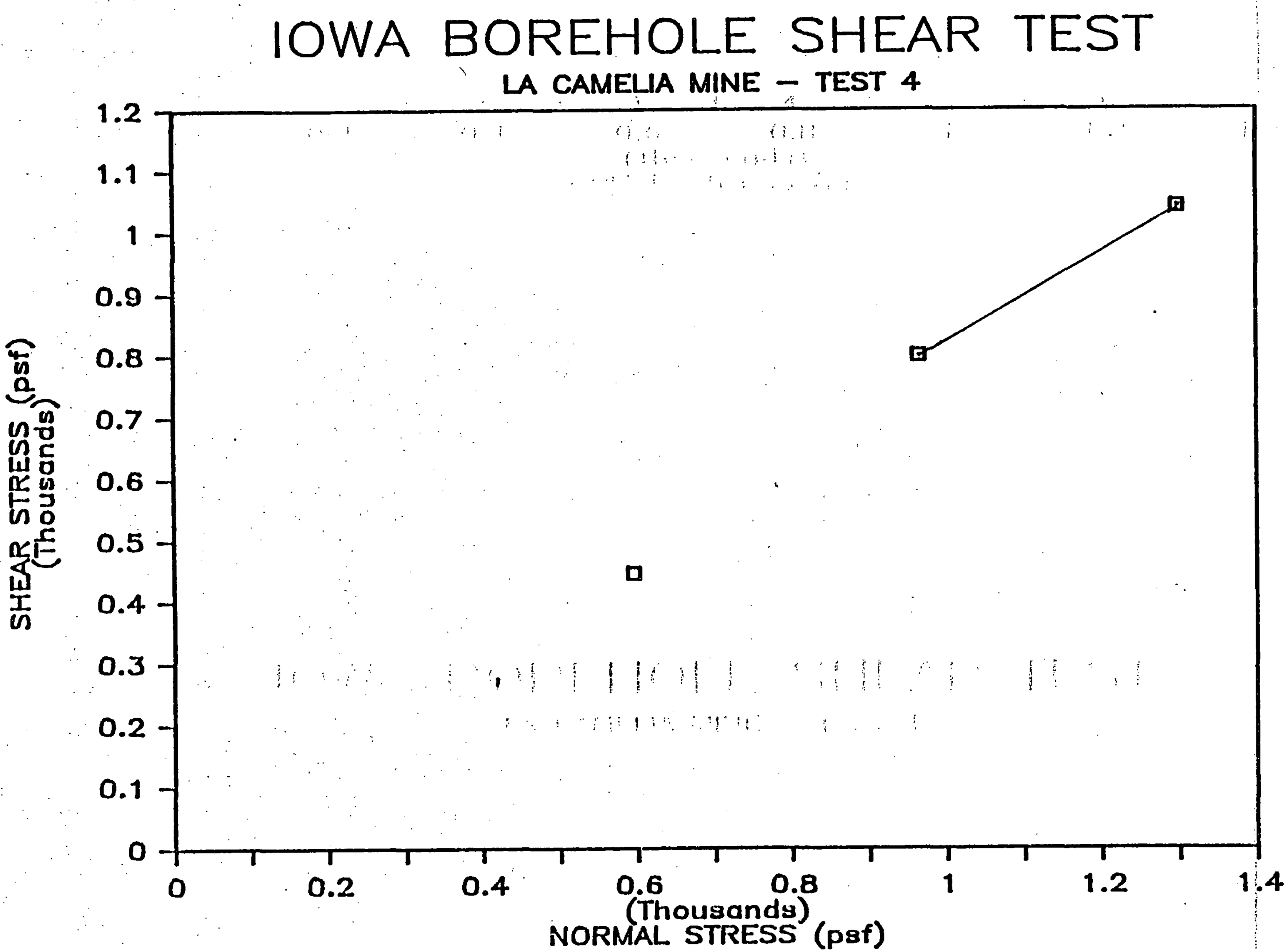


FIGURE A-15-b. IOWA BOREHOLE SHEAR TEST PLOT

BULK DENSITY TEST DATA -- FLORIDIN MINE

H2O: 27.4 - 27.0 C, 27.2 C avg.
Parrifin Gs: .896 -.925 @15 C, .9105 C avg.
Bulk Density @ 25 C

SOIL	DESCRIPTION	Sample (grams)	Sample + Wax (grams)	Sample in Water (grams)	Bulk Density (Kg/m3)	Bulk Density (pcf)	Input Density (pcf)
Floridin	red-orange	160.2	166.8	81	2032.427	126.8803	126.2
Layer 1	sandy silt to clayey silt	124.5	131	62.2	2012.130	125.6131	
Floridin	grey and orange varved	140.6	151.1	59.2	1743.377	108.8354	108.1
Layer 2	clayey silt to silty clay	78	85.3	33	1755.250	109.5767	
		46.7	50	18.7	1681.559	104.9763	
		53.2	56.1	22.5	1743.115	108.8191	
Floridin	red-orange	113.2	116.2	48.1	1740.831	108.6765	107.1
Layer 3	sandy silt to clayey silt	76.6	79.3	31.2	1691.350	105.5875	
Floridin	orange and grey mottled	93	95.9	32.9	1549.501	96.73219	97.4
Layer 4	sens. fine grained to clay	32.3	33.6	11	1520.373	94.91377	
		108.5	111.8	40.1	1588.388	99.15985	
		48.6	50.1	17.8	1580.112	98.64320	
Floridin	grey silty clay mottled with	96.5	98.4	41.5	1754.549	109.5329	109.4
Layer 5	little orange silty clay	59.4	61.1	25.5	1754.893	109.5544	
Floridin	white-grey rock with some	25.3	26.3	10.3	1691.984	105.6271	108.7
Layer 6	varved blue silty clay, shells	87.8	89.7	38.7	1788.917	111.6784	
Floridin	blue-grey to dark grey	88.1	90.5	40.1	1838.198	114.7549	114.7
Layer 7	friable silty clay	123.4	127.9	56	1836.651	114.6583	
Floridin	blue-grey	71.8	73.2	24.7	1523.701	95.12154	95.5
Layer 8	varved silty clay	100.4	102	35.1	1536.014	95.89021	

FIGURE A-16-a. BULK DENSITY TEST DATA

BULK DENSITY TEST DATA — LA CAMELIA MINE

H_2O: 27.4 - 27.0 C, 27.2 C avg.
Parrifin Gs: .896 -.925 @15 C, .9105 C avg.
Bulk Density @ 25 C

SOIL	DESCRIPTION	Sample (grams)	Sample + Wax (grams)	Sample in Water (grams)	Bulk Density (Kg/m3)	Bulk Density (pcf)	Input Density (pcf)
La Camelia Layer 1	red-orange sandy silt to clayey silt	57.9	59.4	28.8	1993.008	124.4194	122.6
		90.8	92.8	43.8	1933.433	120.7002	
La Camelia Layer 2	mottled red, orange, white-grey clayey silt to silty clay	76.9	78.1	36.9	1921.650	119.9646	122.5
		133.3	135.5	66.8	2004.229	125.1199	
La Camelia Layer 3	white-grey with red, orange silty clay	164.2	168	81.2	1980.494	123.6381	122.0
		128	130.9	61.5	1926.523	120.2689	
La Camelia Layer 4	mottled white-grey clay with red sens. fine grained	148.6	152.5	69.9	1890.962	118.0489	119.5
		154.4	156.8	74.8	1938.869	121.0396	
La Camelia Layer 5	white-grey varved clay to silty clay	126.5	129	55.7	1786.860	111.5500	111.2
		104.1	107	46.2	1800.667	112.4120	
	wetter white-grey varved clay to silty clay	89.8	91.3	38.7	1756.450	109.6516	
La Camelia Layer 6	blue-grey varved silty clay	80.9	82.2	27.9	1524.924	95.19793	94.8
		145.1	148.5	49.2	1513.172	94.46423	

FIGURE A-16-6. BULK DENSITY TEST DATA

DIRECT SHEAR TEST DATA -- FLORIDIN MINE

Location	Soil Description	Normal Stress (psf)	Shear Stress (psf)	Cohesion (psf)	Friction Angle (deg)
Floridin Layer 1	red-orange sandy silt to clayey silt	451.8	284.8	150.	22.3
		625.3	456.0		
Floridin Layer 2	grey and orange varved clayey silt to silty clay	942.7	1539.	1450.	7.3
		1116.	1892.		
		1276.	1267.		
		1436.	1710.		
Floridin Layer 3	red-orange sandy silt to clayey silt	1105.	3020.	2150.	30.4
		1280.	2681.		
Floridin Layer 4	orange and grey mottled sens. fine grained to clay	870.0	1881.	1450.	21.3
		1116.	1824.		
		1362.	1949.		
Floridin Layer 5	grey silty clay mottled with little orange silty clay	1256.	1436.	1300.	16.0
		2657.	2289.		
Floridin Layer 6	white-grey rock with some varved blue silty clay, shells	3080.	4560.	4100.	7.0
		3237.	4419.		
Floridin Layer 7	blue-grey to dark grey friable silty clay, black organics	2589.	3294.	3000.	7.5
		3093.	3456.		
	soaked sample	2802.	2073.	1700.	7.6
Floridin Layer 8	blue-grey varved silty clay	3080.	5363.	5100.	7.3
		3080.	5622.		
		3891.	5548.		
	soaked sample	3080.	3100.	2700.	7.4
		3237.	3179.		

FIGURE A-17-a. FLORIDIN MINE DIRECT SHEAR TEST DATA

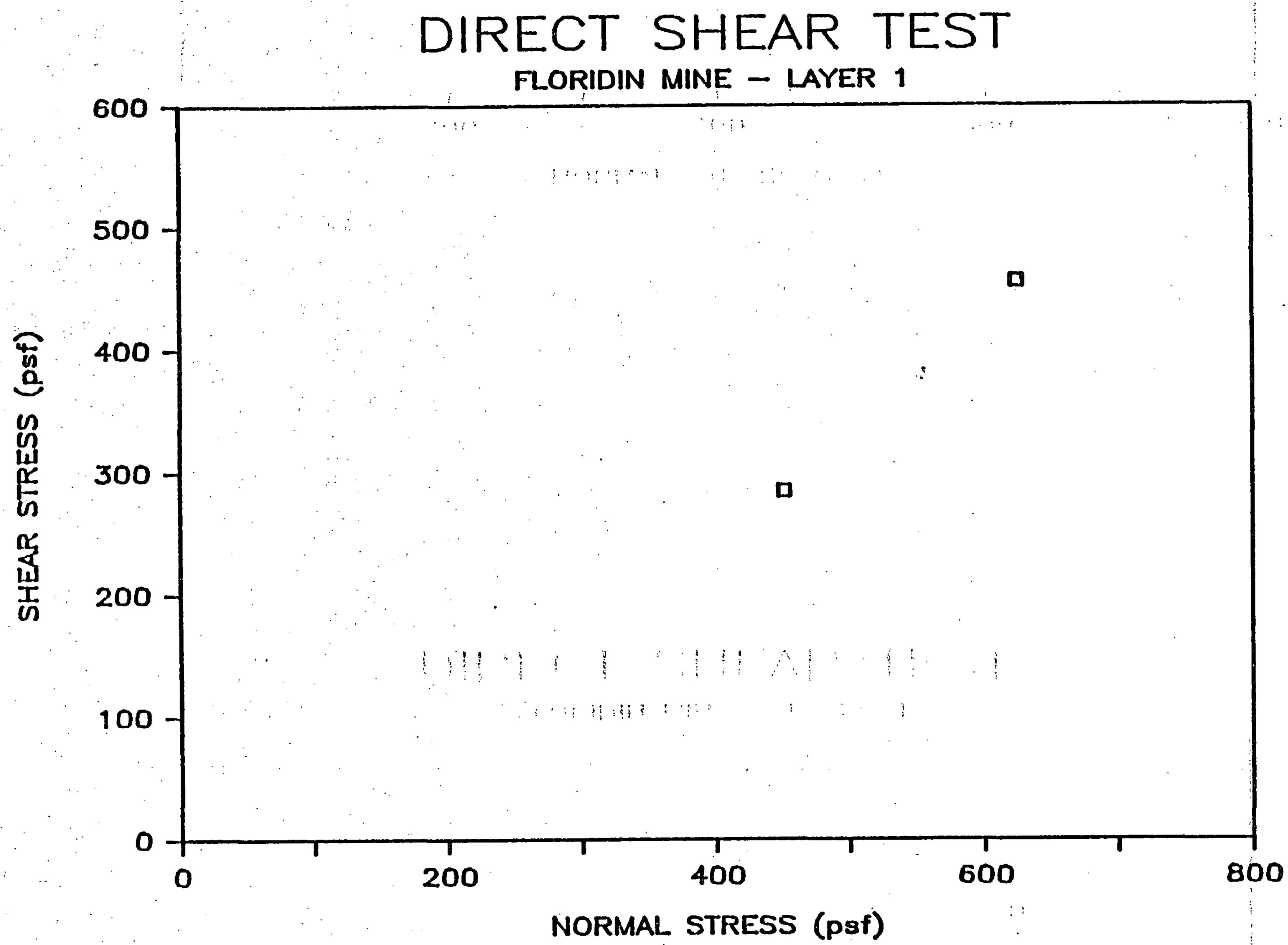


FIGURE A-17-b. FLORIDIN MINE DIRECT SHEAR TEST PLOT

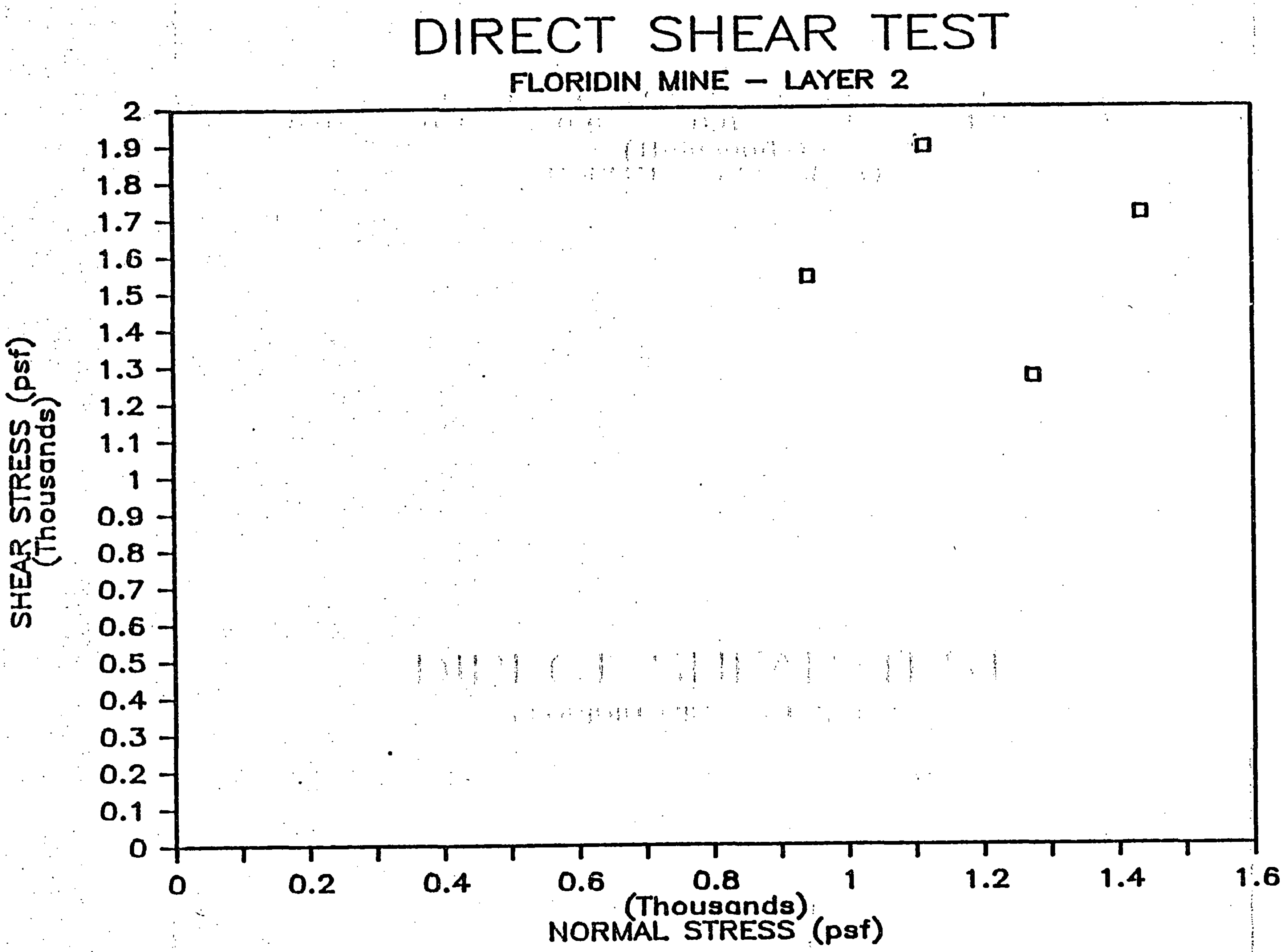


FIGURE A-17-c. FLORIDIN MINE DIRECT SHEAR TEST PLOT

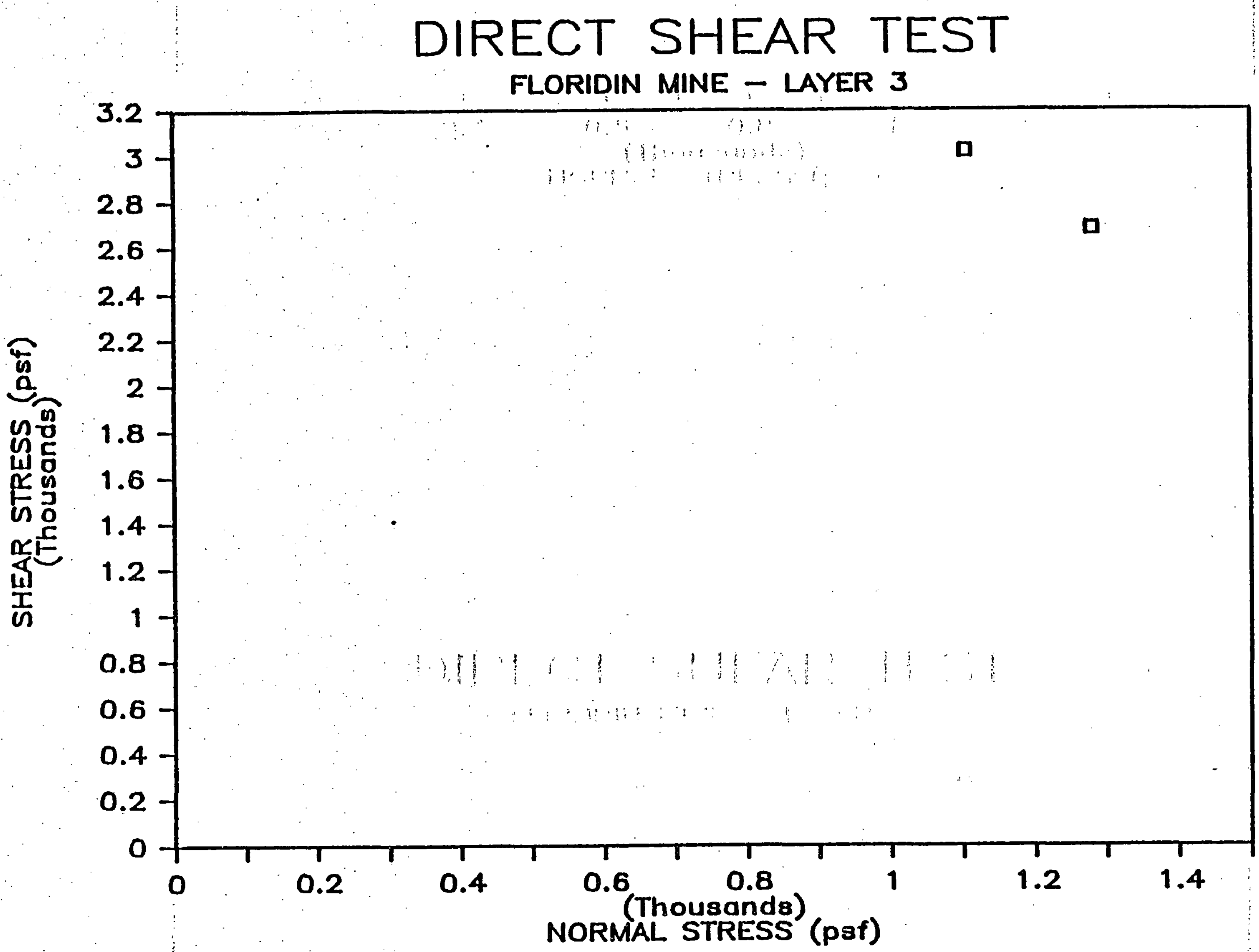


FIGURE A-17-d. FLORIDIN MINE DIRECT SHEAR TEST PLOT

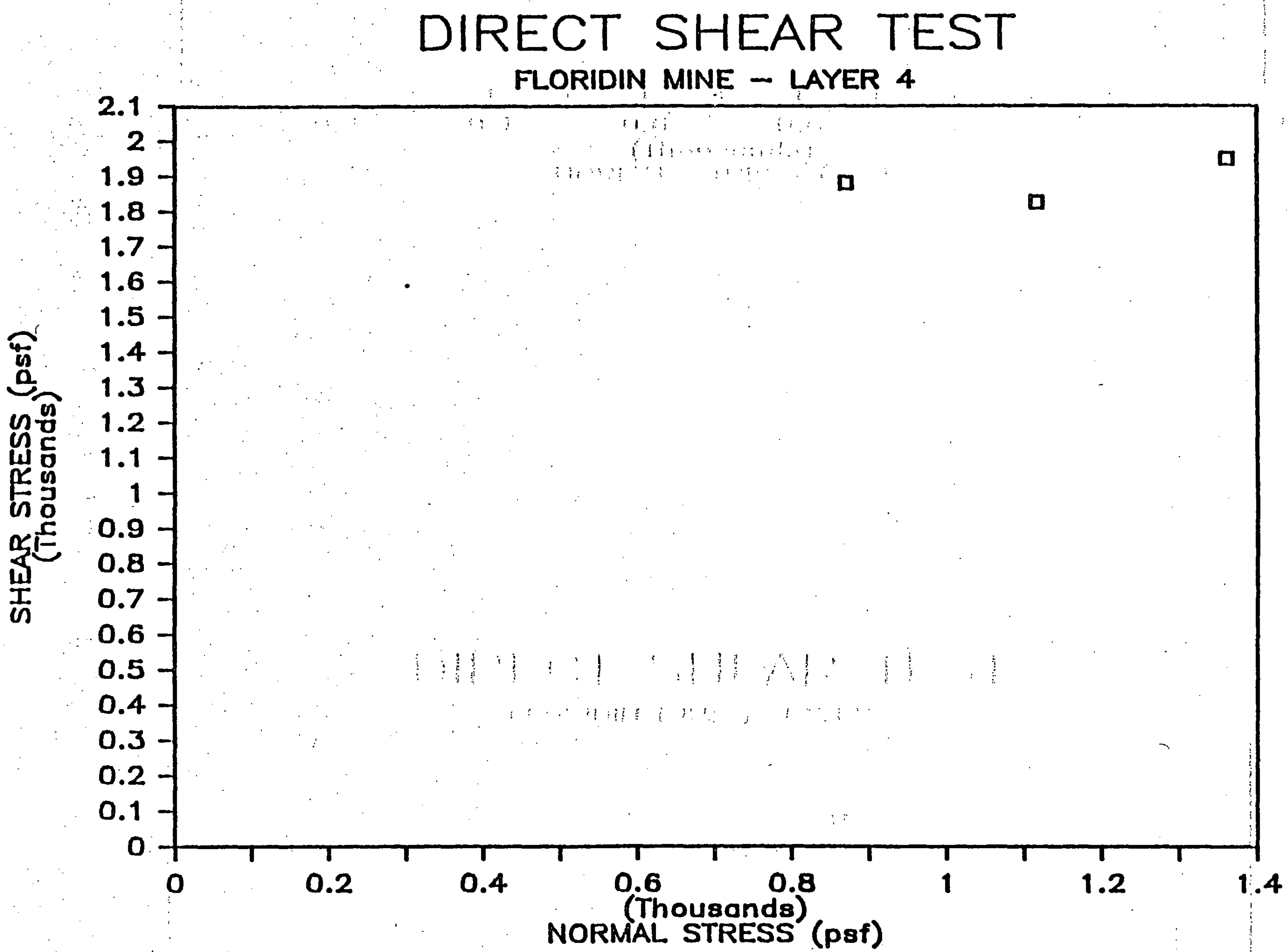


FIGURE A-17-e. FLORIDIN MINE DIRECT SHEAR TEST PLOT

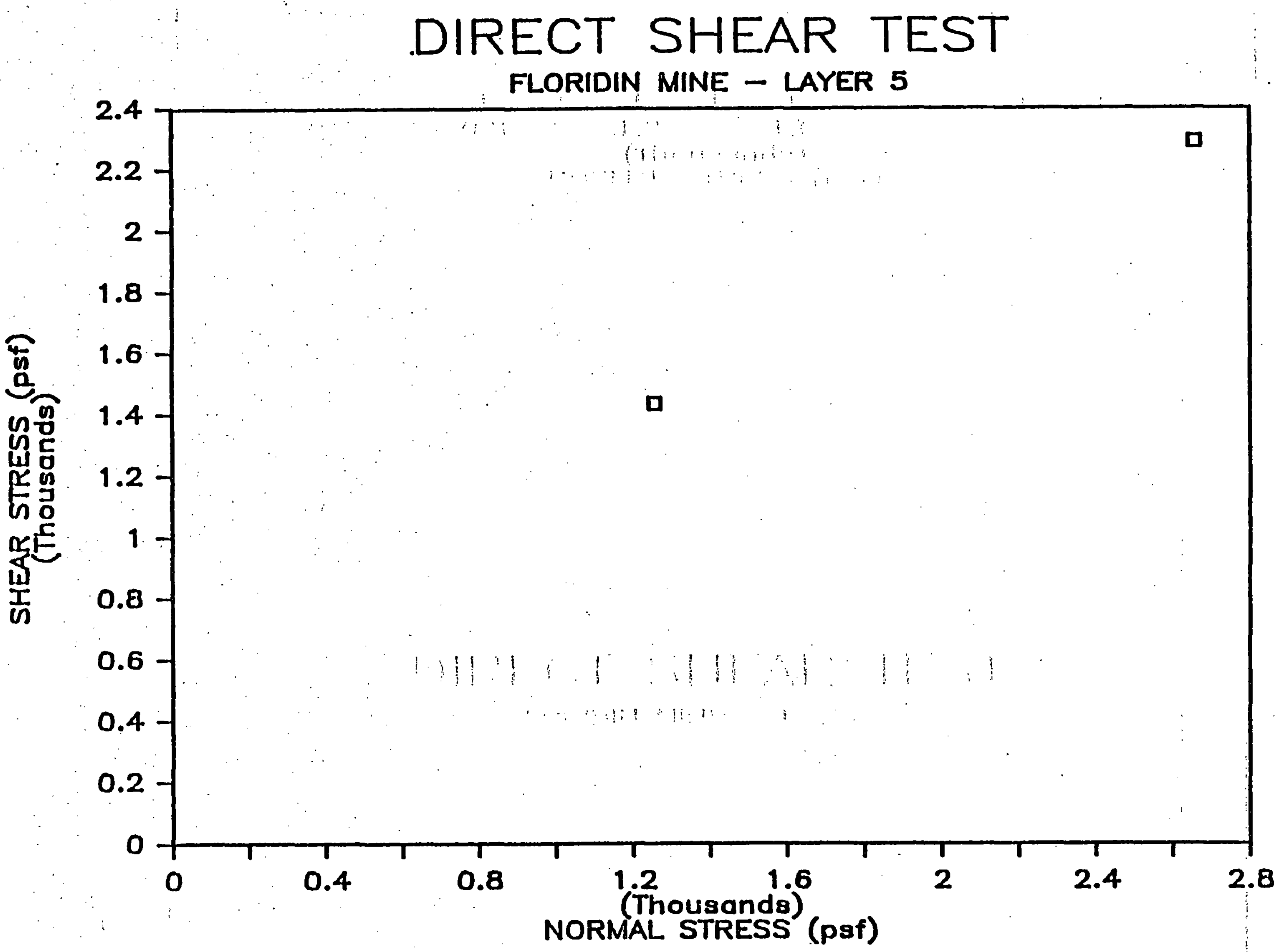


FIGURE A-17-1. FLORIDIN MINE DIRECT SHEAR TEST PLOT

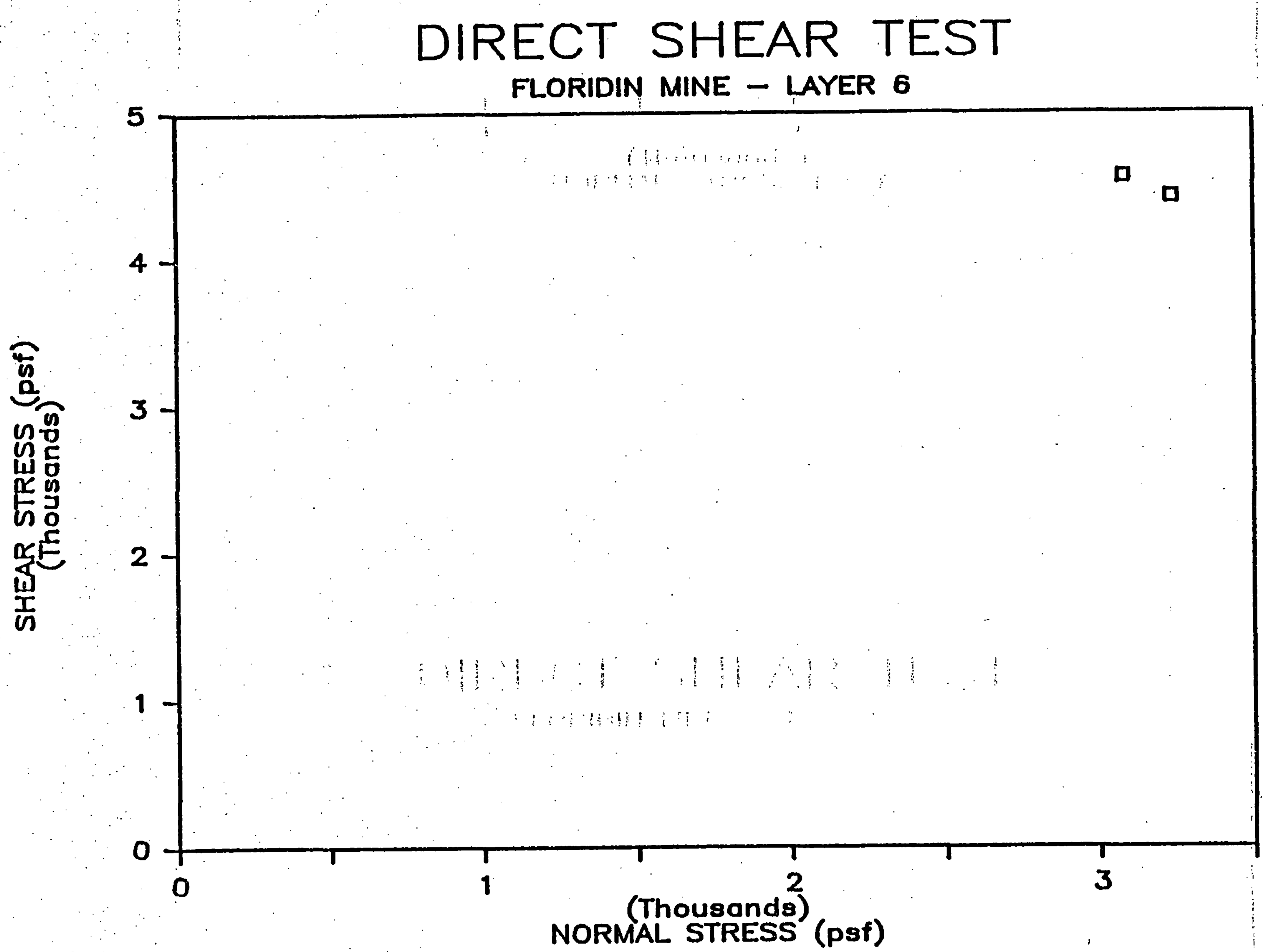


FIGURE A-17-g. FLORIDIN MINE DIRECT SHEAR TEST PLOT

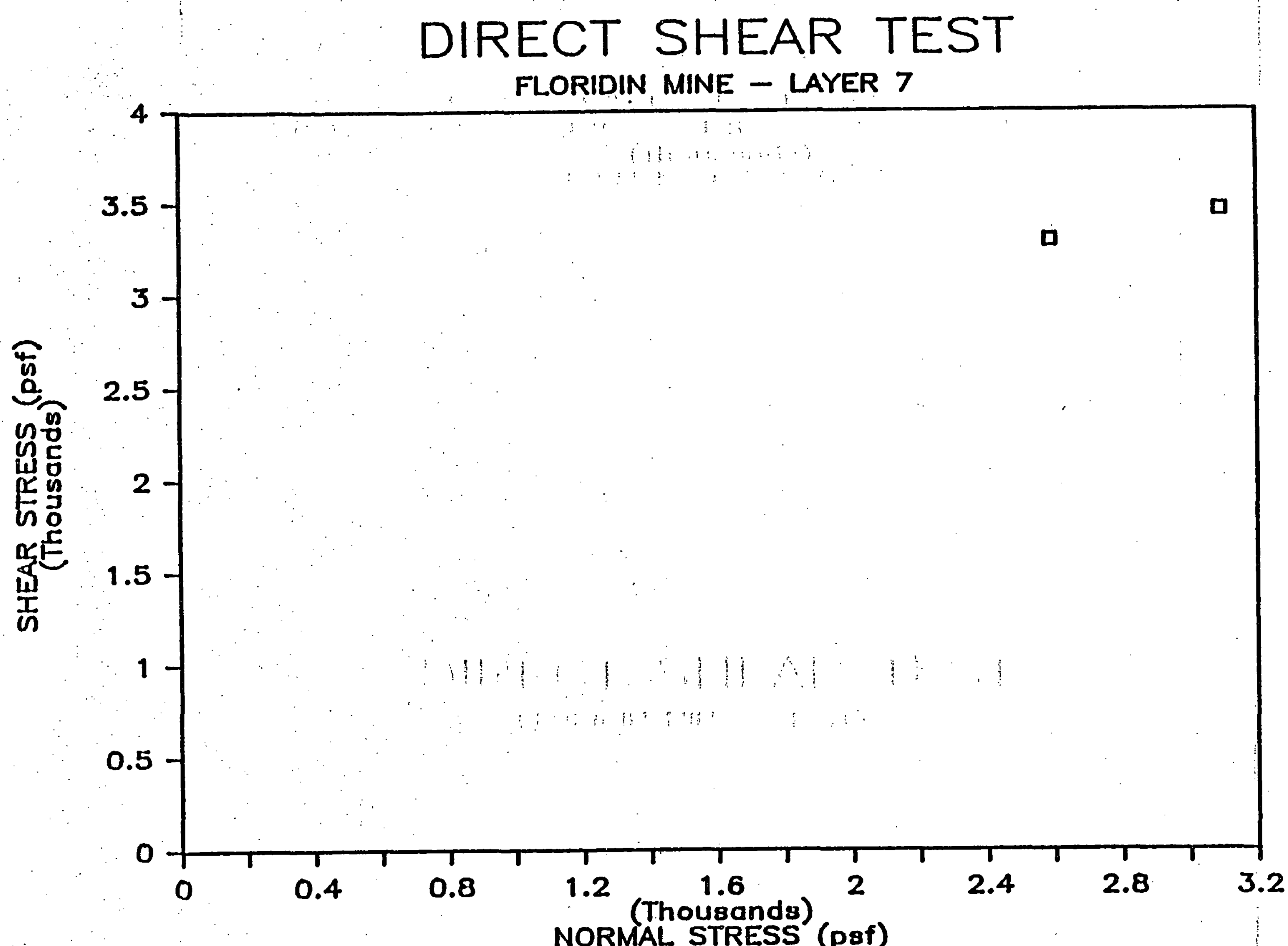


FIGURE A-17-6. FLORIDIN MINE DIRECT SHEAR TEST PLOT

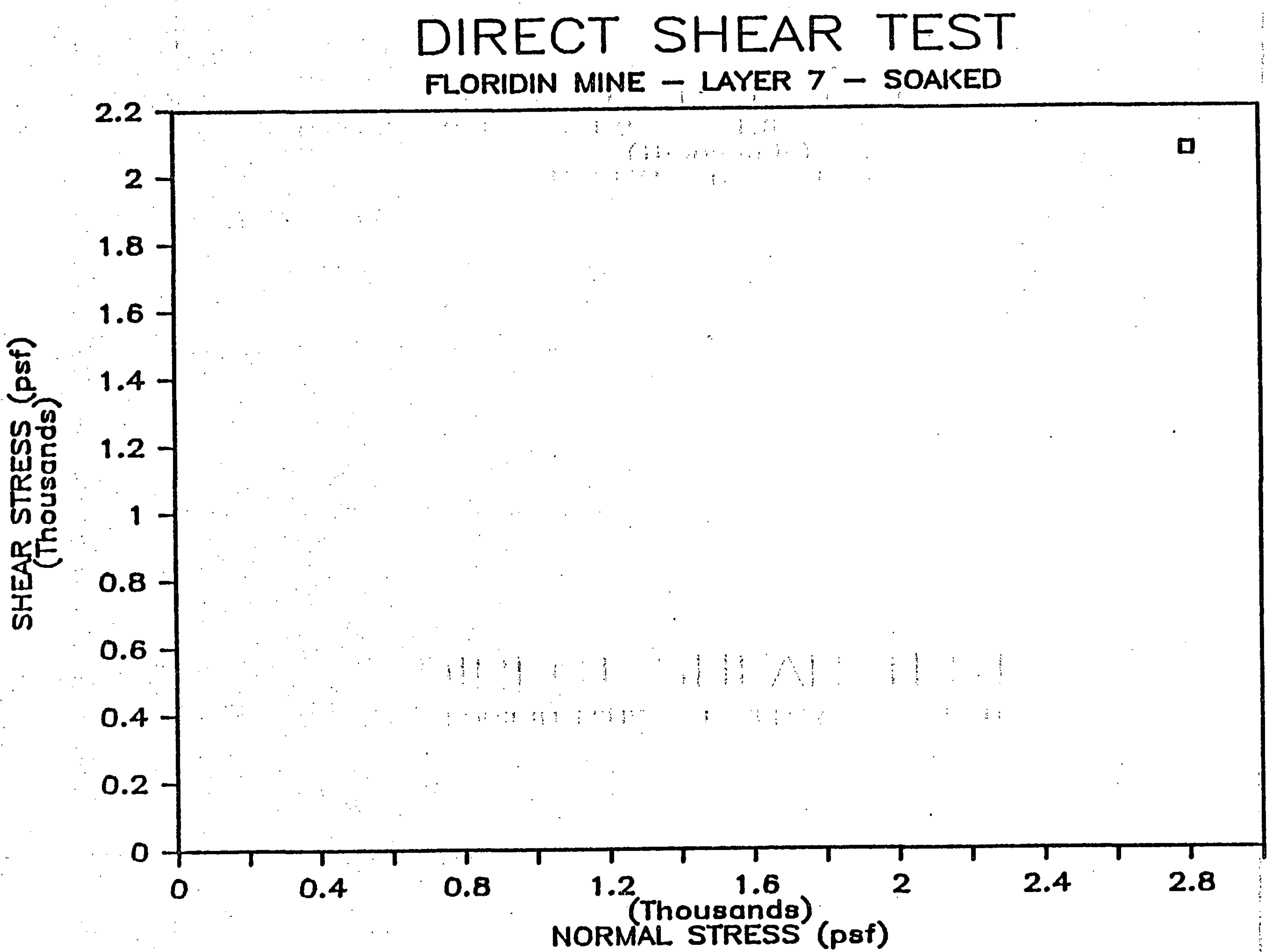


FIGURE A-17-1. FLORIDIN MINE DIRECT SHEAR TEST PLOT

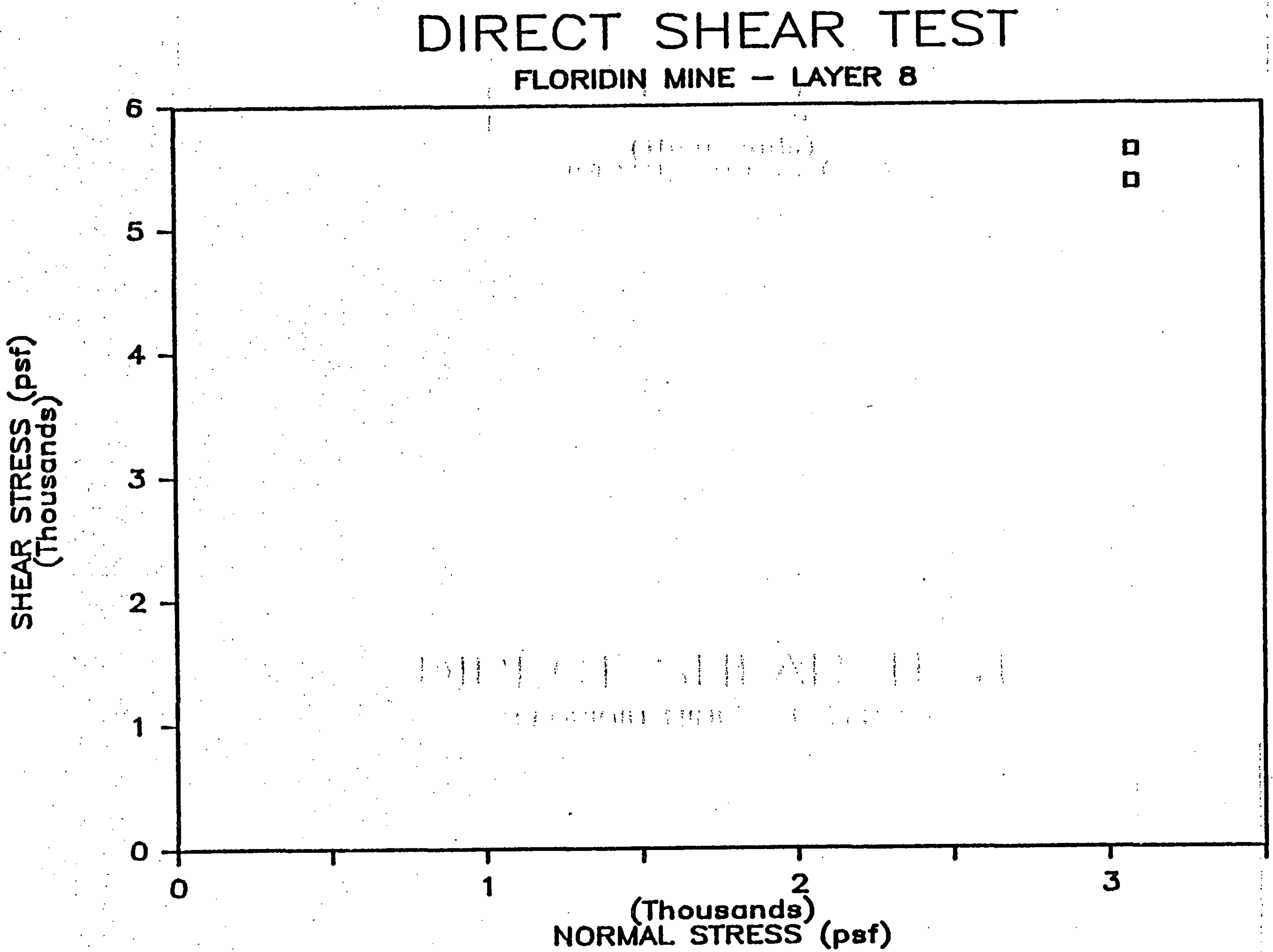


FIGURE A-17-j. FLORIDIN MINE DIRECT SHEAR TEST PLOT

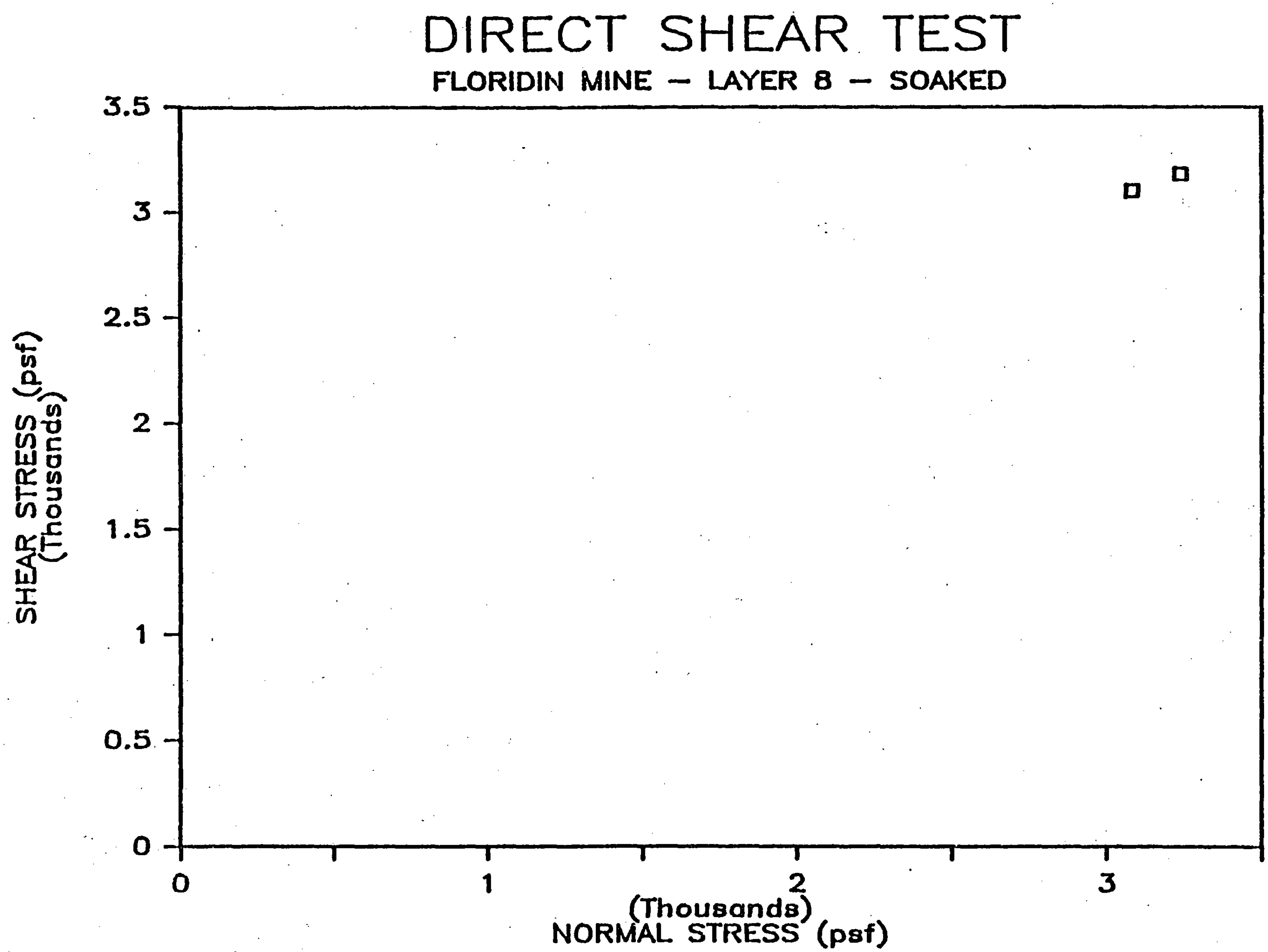


FIGURE A-17-K. FLORIDIN MINE DIRECT SHEAR TEST PLOT

DIRECT SHEAR TEST DATA -- LA CAMELIA MINE

Location	Soil Description	Normal Stress (psf)	Shear Stress (psf)	Cohesion (psf)	Friction Angle (deg)
La Camelia Layer 1	red-orange sandy silt to clayey silt	459.6	1140.	1150.	36.2
		534.2	1288.		
		637.2	1754.		
		945.3	2303.		
La Camelia Layer 2	mottled red, orange, white-grey clayey silt to silty clay	783.5	3000.	500.	35.0
La Camelia Layer 3	white-grey with red, orange silty clay	1607.	2496.	3200.	15.8
		1607.	3819.		
		2418.	3773.		
		2589.	4525.		
		3080.	4240		
		3080.	4423.		
La Camelia Layer 4	mottled white-grey clay with red sens. fine grained	3571.	1379.	800.	12.3
		3571.	1778.		
La Camelia Layer 5	white-grey varved clay to silty clay	3237.	4009.	3600.	11.3
		3891.	4377.		
	soaked sample	3891.	3671.		
La Camelia Layer 6	blue-grey varved silty clay	3080.	5363.	5100.	7.3
		3080.	5622.		
		3891.	5548.		
	soaked sample	3080.	3100.	2700.	7.4
		3237.	3179.		

FIGURE A-18-a. LA CAMELIA MINE DIRECT SHEAR TEST DATA

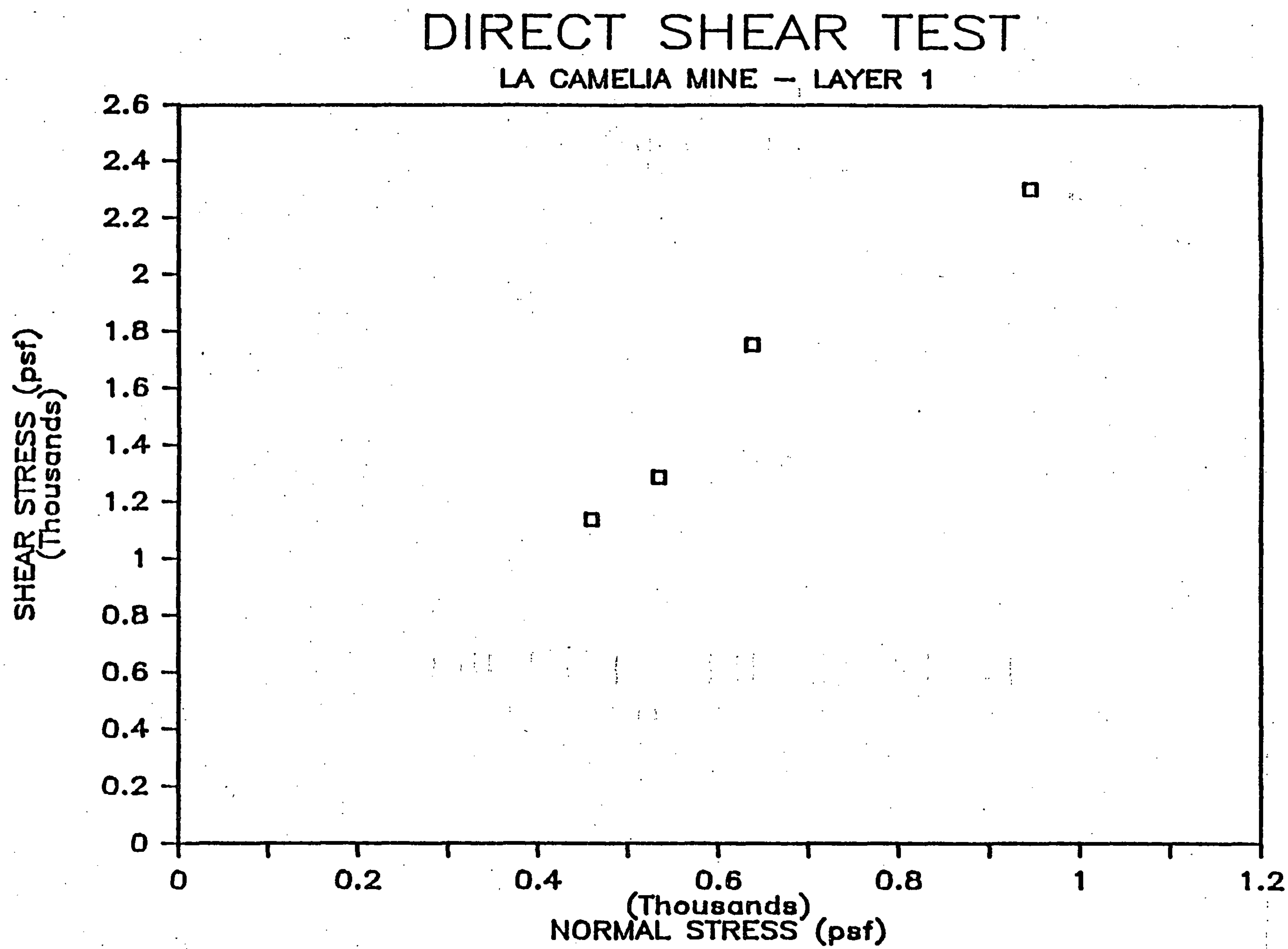


FIGURE A-18-6. LA CAMELIA MINE DIRECT SHEAR TEST PLOT

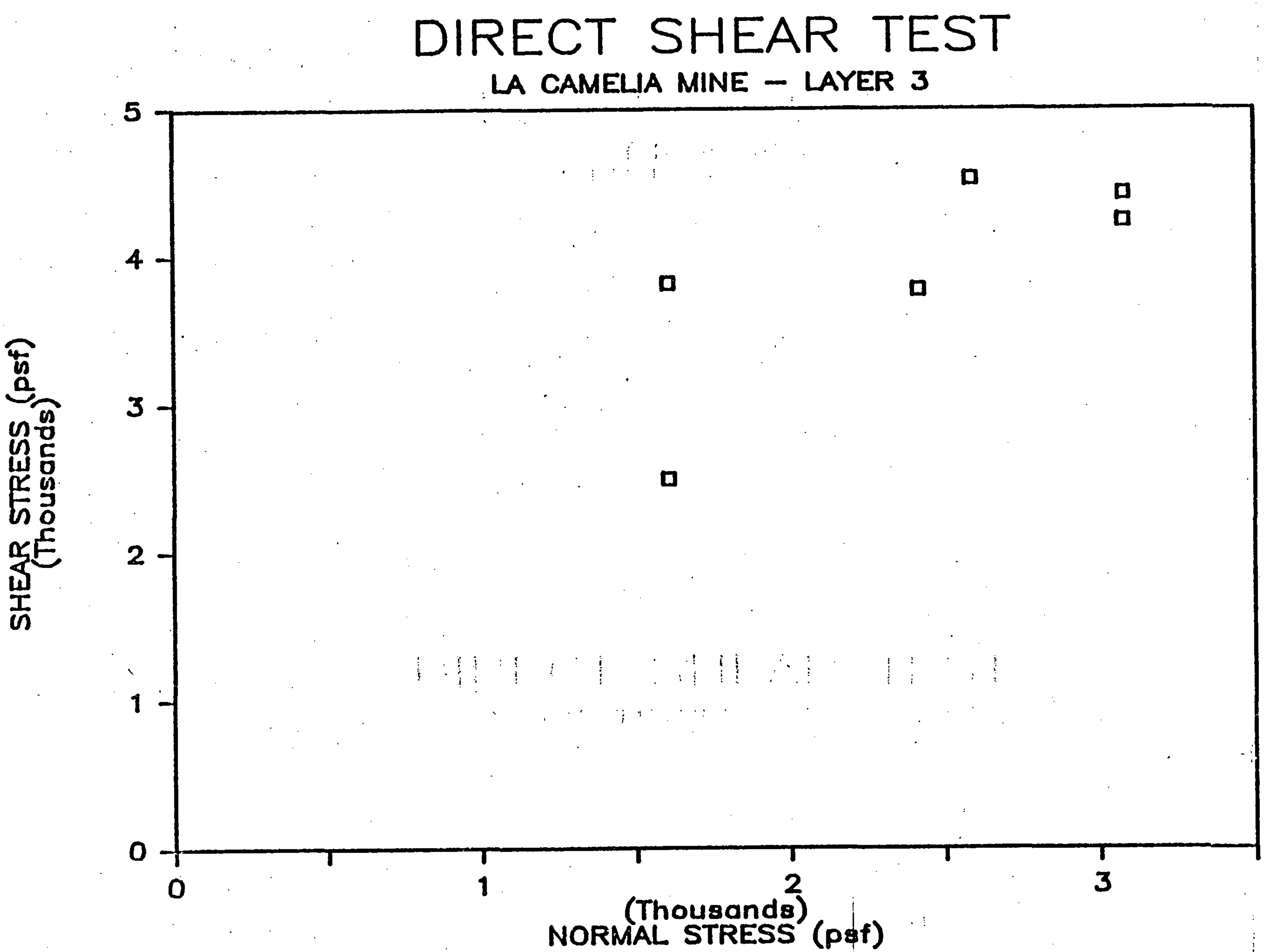


FIGURE A-10-d. LA CAMELIA MINE DIRECT SHEAR TEST PLOT

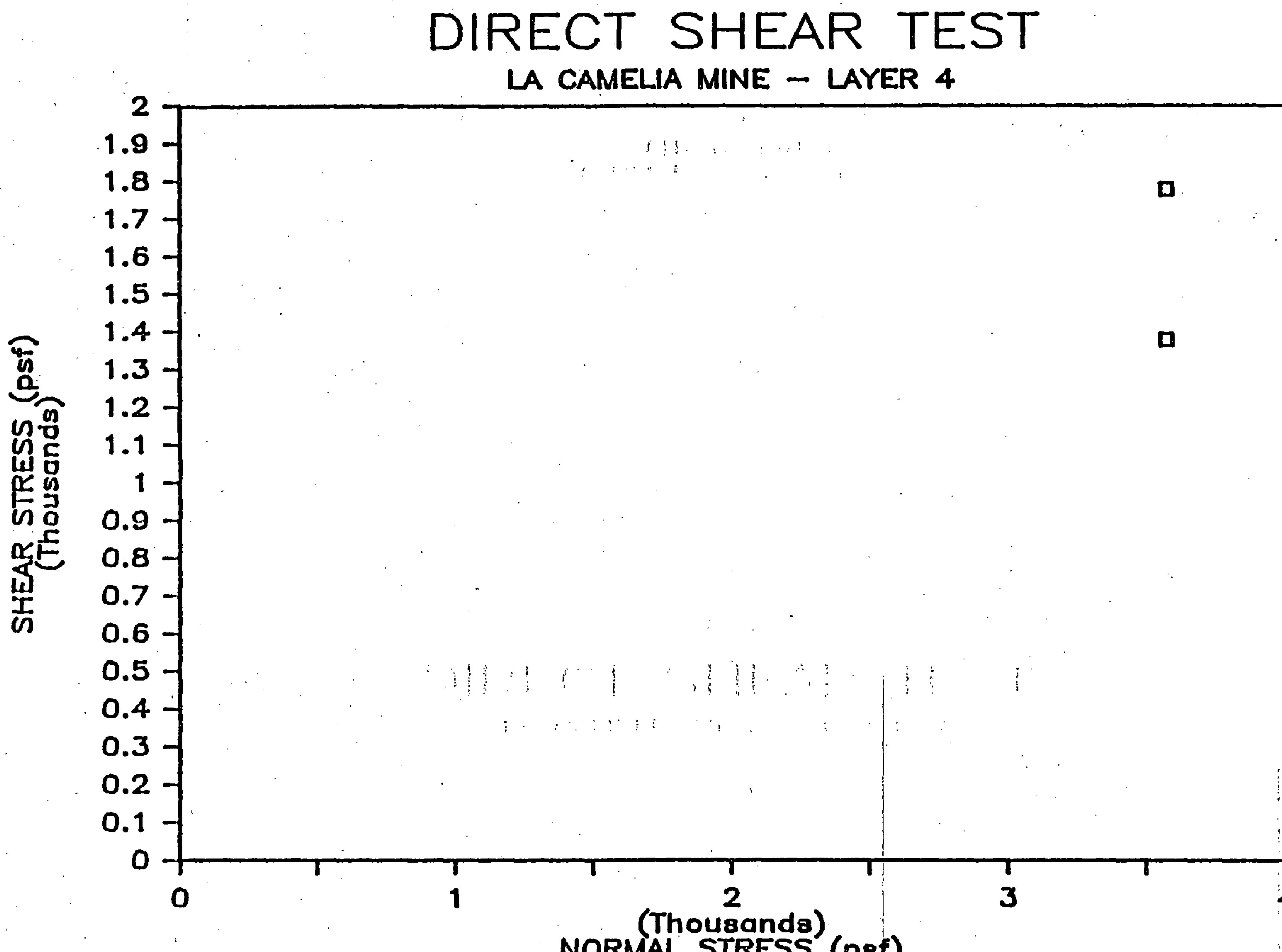


FIGURE A-18-c. LA CAMELIA MINE DIRECT SHEAR TEST PLOT

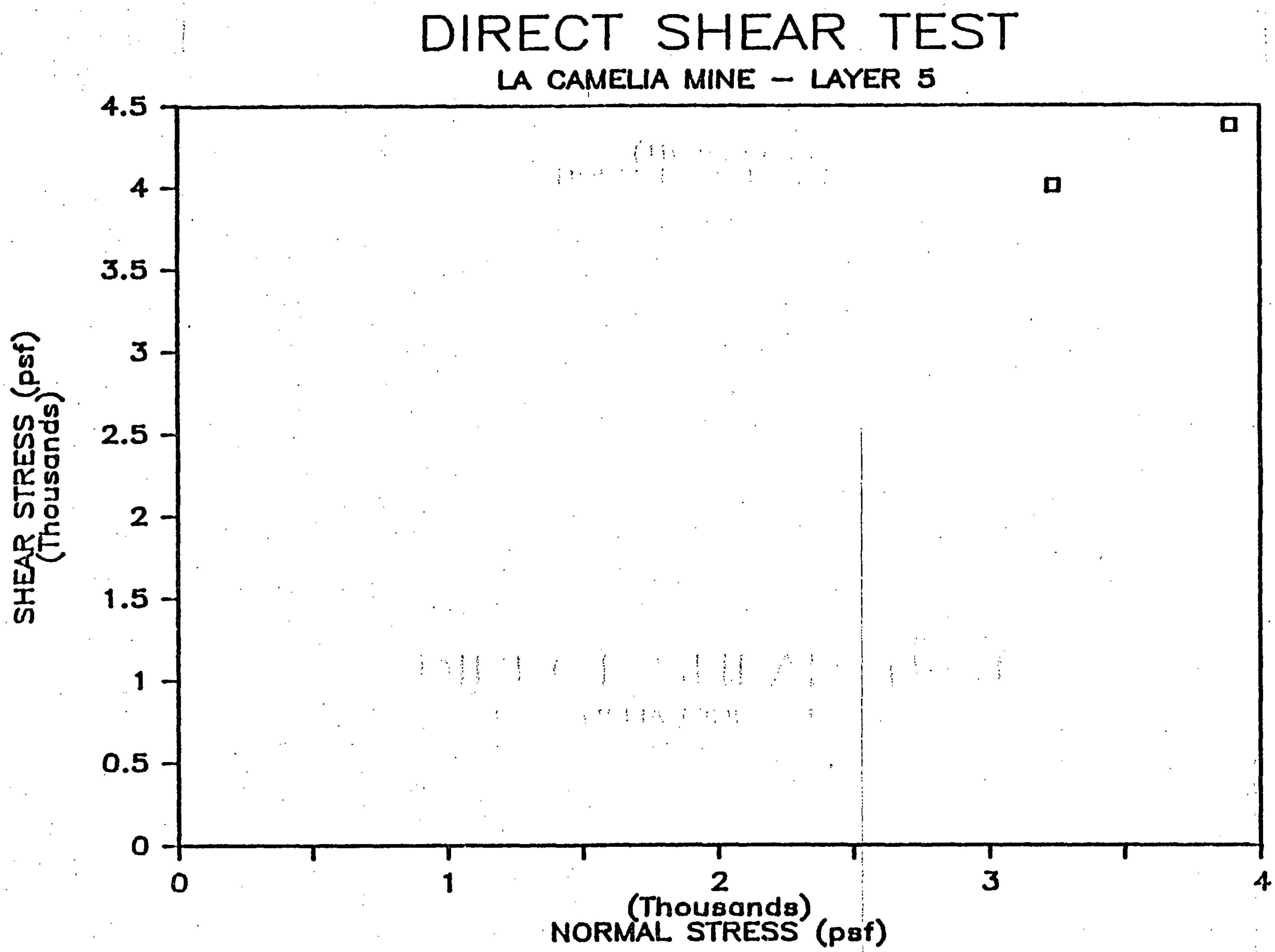


FIGURE A-18-f. LA CAMELIA MINE DIRECT SHEAR TEST PLOT

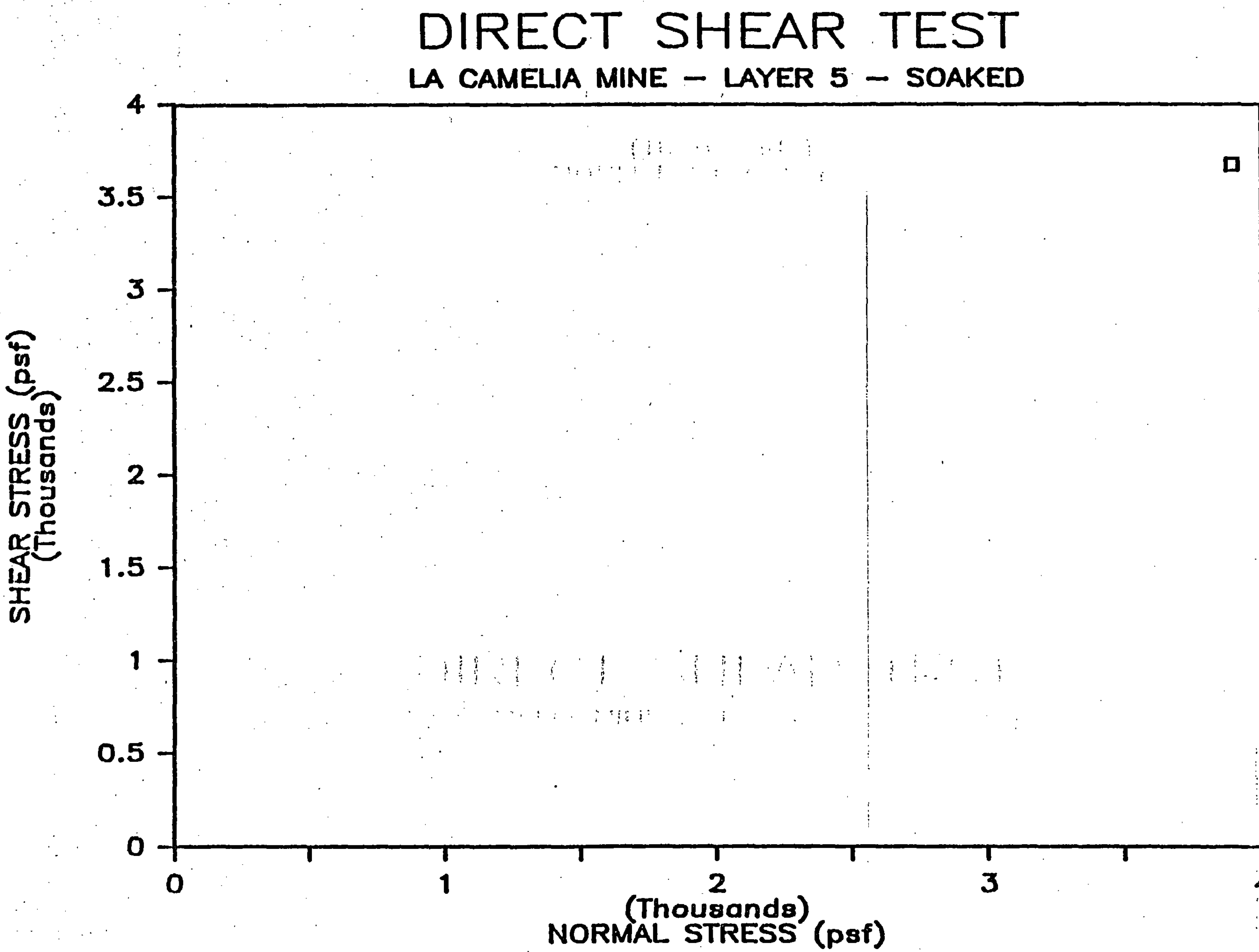


FIGURE A-18-g. LA CAMELIA MINE DIRECT SHEAR TEST PLOT

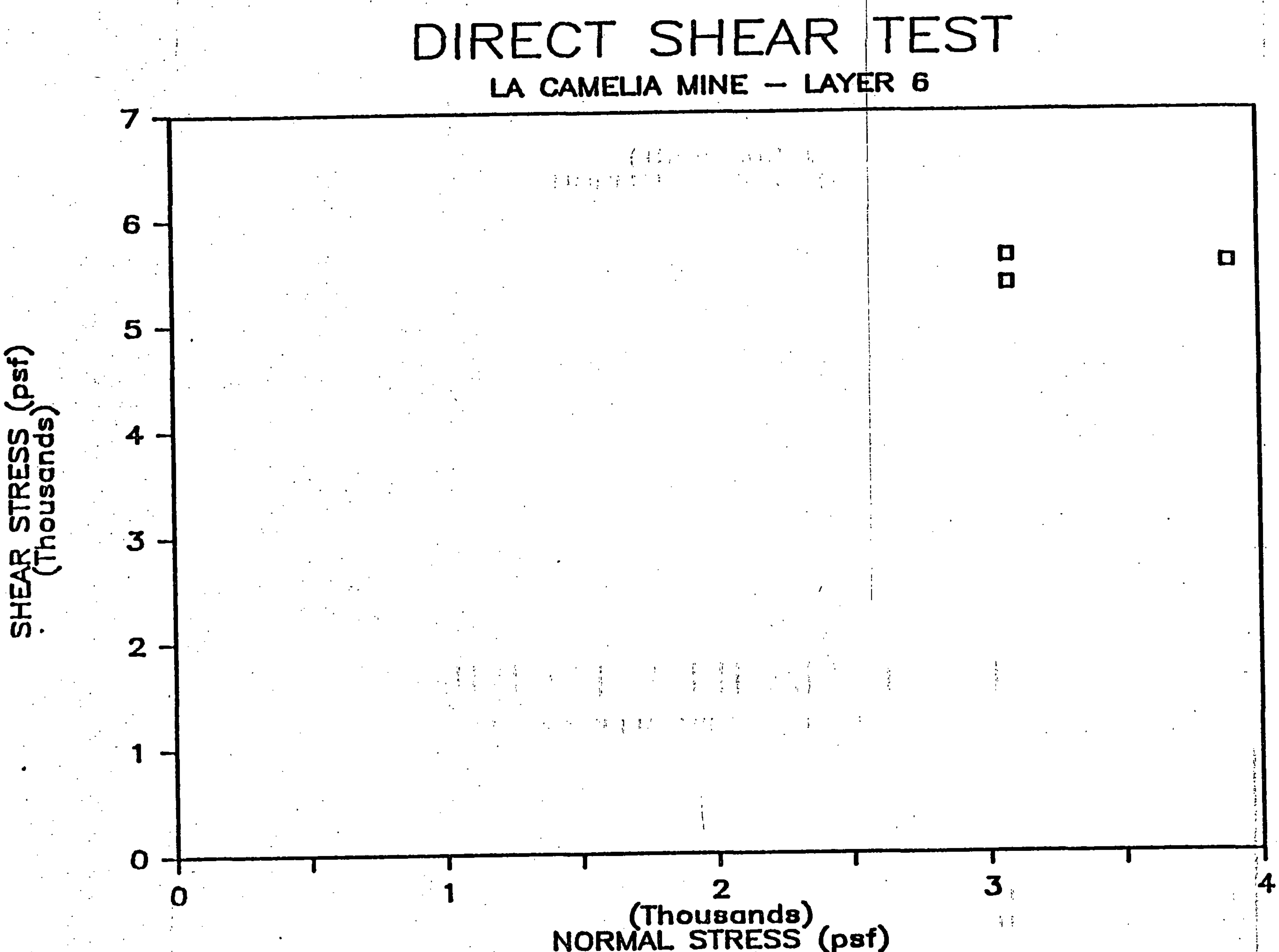


FIGURE A-18-h. LA CAMELIA MINE DIRECT SHEAR TEST PLOT

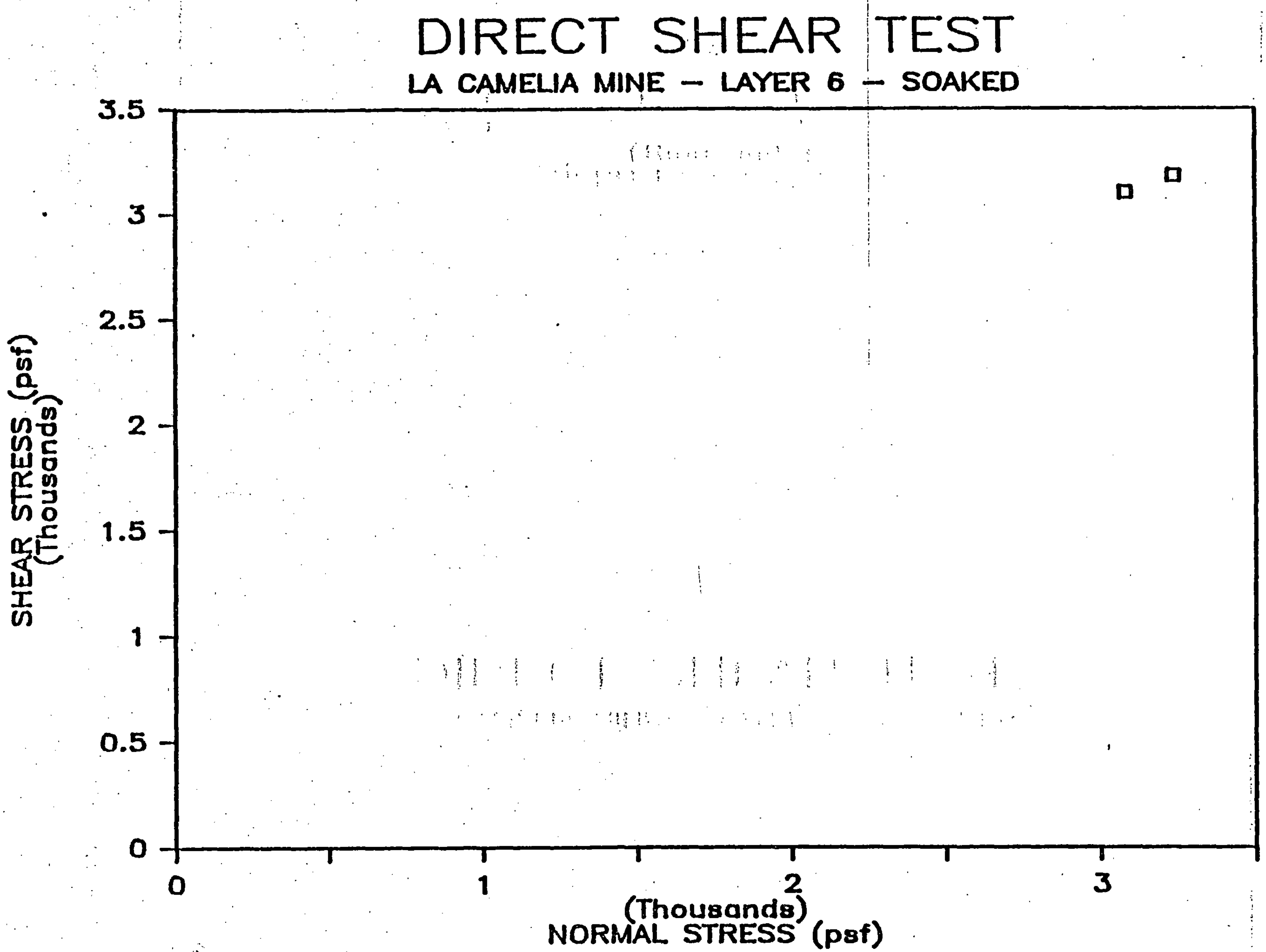


FIGURE A-18-1. LA CAMELIA MINE DIRECT SHEAR TEST PLOT

APPENDIX B

GEOLOGY

Introduction

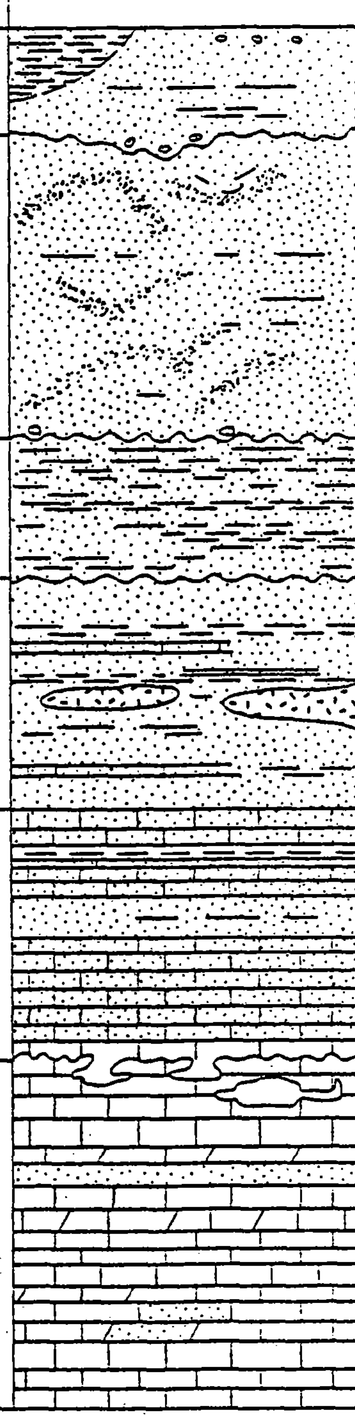
The Meigs-Attapulgus-Quincy district, a large area of industrial mineral deposits that covers all of Gadsden County and part of Leon County, Florida and extends into Georiga, has been the leading producer of fuller's earth in the United States since it was first mined in 1895. The extent of this area is shown in Figure B-1. The poor geologic conditions of this region -- caused by surficial weathering, residium deposits, downward bed displacements brought about by the solution of carbonate rocks, and vertical and lateral gradations of rock types -- are obstacles to geologists who try to obtain detailed lithologic and stratigraphic relationships in this area. Consequently, the extent of the formation containing fuller's earth can only be determined by geologic inference.

Stratigraphy

The upper stratum of the Meigs-Attapulgus-Quincy district, shown in Figure B-2, show considerable variation across the district.

Pleistocene and Holocene deposits. The surficial Pleistocene and Holocene deposits are of alluvial and eolian origin and consist of sand, silt, and muck. Among the most

FIGURE B-1 MEIGS-ATTAPULGUS-QUINCY DISTRICT
(from Patterson, 1972)



SERIES	FORMATION	THICKNESS (FEET)	DESCRIPTION
Holocene and Pleistocene		0-60	Alluvial and eolian deposits of sand, silt, and muck
Miocene	Miccosukee Formation as used by Hendry and Yon (1967)	0-80	Reddish-brown, brown, and yellowish-brown clay, medium to coarse sand, and thin kaolinitic clay beds; crossbedded; contains channel-fill deposits and lenticular units of quartz gravel; marine fossils absent but contains *Callianassa* borings locally
	Jackson Bluff Formation as used by Hendry and Sproul (1966)	0-20	Greenish-gray and brown sandy clays and clayey sands; contains abundant marine fossils
	Hawthorn Formation	100-275	Fine to medium quartz sand and clayey silt; contains fuller's earth and other clays and scattered very sandy limestone beds; locally contains minor pelletal and secondary phosphate, opal concretions, and irregular masses of opal
	Tampa Limestone	25-250	Light-gray and light-grayish-brown very sandy limestone, quartz sand, and thin clay beds; locally contains minor dolomitic sandy limestone and, in places, massive white limestone occurs in lower part; Foraminifera rare
Oligocene	Suwannee Limestone	24-230	Light-yellow to light-brown crystalline limestone containing much dolomitic limestone and scattered beds of dolomite; white crystalline limestone occurs in upper part locally; minor quantities of white quartz sand is present in some beds, and opal and chert masses are common; Foraminifera locally abundant

FIGURE B-2 SOIL STRATIGRAPHY IN THE MEIGS-ATTAPULGUS-QUINCY DISTRICT (from Patterson, 1972) montmorillonite, which is in turn a weathering product of the unstable attapulgite.

Attapulgite, also known as palygorskite, was named for the fuller's earth found near Attapulgus, Georiga. Probably the thickest and most widespread deposit of attapulgite in the world is found in the Meigs-Attapulgus-Quincy district. The horizontally bedded attapulgite was formed in shallow marine lagoons or tidal flats and may have originated as an alteration product of volcanic ash from Miocene eruptions in southern Texas or from weathered materials carried by streams.

No attapulgite sample has been analyzed that does not contain quartz. Dolomite and montmorillonite occur with attapulgite almost as commonly. It is likely that much of the montmorillonite and some of the kaolinite of the younger beds was once attapulgite, as attapulgite is very unstable in the zone of weathering, especially in an acid environment.

The fuller's earth deposits are mined by stripping away the overburden -- Pleistocene sand deposits and the Miccosukee Formation -- to the Hawthorne Formation, where fuller's earth is found, using bulldozers, scrapers, and draglines. Most of the material can be removed with a bulldozer, but the limestone and cemented sandstone found in the southern part of the Meigs-Attapulgus-Quincy district must be blasted before it can be removed. This mining process leaves highwalls that can be as much as 100 feet tall. In this study, the typical fuller's earth deposit

Formation in several areas.

Jackson Bluff Formation. The Jackson Bluff formation is found in the southern part of the district near Lake Talquin and consists of greenish-grey and brown sandy clays and clayey sands containing very abundant marine mollusk shells. This formation is about 20 feet thick at the southern border of the Meigs-Attapulgus-Quincy district and wedges out a few miles to the north.

Hawthorn Formation. The Hawthorn Formation was named for beds of phosphatic sandstone, sands, ferruginous gravels, and greenish clays exposed at Hawthorne, Florida. All of the valuable fuller's earth deposits in the Meigs-Attapulgus-Quincy district are found in this formation. Like the Miccosukee Formation, it is also a formation with variable characteristics. The Hawthorn Formation, one of the the most misunderstood formational units in the southeastern United States, has been the dumping ground for alluvial, terrestrial, marine, deltaic, and prodeltaic beds. It consists principally of fine- to medium- grained quartz sands with much silt and clay, minor carbonate beds, and traces of phosphatic material. Carbonate beds are mainly very sandy limestone and lie above fuller's earth in the area south of Attapulgus, Georiga. Most of the carbonate beds are no more than five feet thick and are interbedded with sand. The majority of phosphate is found in pelletal grains and fish teeth and bones. Fuller's earth is deposited in irregular lenticular units and discontinuous beds. Petrified tree trunks and vertebrate fossils have been located above the fuller's earth deposits in mines near Quincy and Midway, Florida.

Fuller's Earth

One of the thickest and most widespread deposits of fuller's earth in the United States is located in the Meigs-Attapulgus-Quincy district. The term "fuller's earth" has no genetic or mineralogical significance -- it refers to a clay or earthy material that has certain uses. The term was first applied in ancient times to fine-grained earthy material used in cleansing and fulling wool. Today, fuller's earth includes earthy material used commercially as an absorbant for greases, oils, water, chemicals, and other undesirable materials; in making insecticides and fungicides; in drilling mud; as a soil conditioner; as pet litter; and as an ingredient in many types of fillers, extenders, carriers, dilutents, bleaching materials, and other products.

The fuller's earth found in this district is deposited in large lenticular units and discontinuous beds. In the southern part of the Meigs-Attapulgus-Quincy district, attapulgite is the dominant mineral found in fuller's earth; in the northern region, montmorillonite is dominant. Small amounts of montmorillonite, quartz, dolomite, calcite, phosphate pellets, and feldspar are found in the fuller's earth in the southern part of the district. Kaolinite occurs in the upper part of fuller's earth deposits that are under a shallow overburden as a weathering product of extensive deposits up to 60 feet thick are those associated with former shorelines, indicating the higher level of the seas during the Pleistocene Epoch. Much of the Holcene deposits are found under the broad, heavily vegetated flood plains of the rivers. Silt and muck are present in swampy sinkhole depressions scattered throughout the district.

Miccosukee Formation. The Miccosukee Formation is a heterogeneous complex of sediments up to 80 feet thick that shows physical features that are characteristic of deltaic deposits such as channel cuts and fills, irregular and variable bedding in the vertical sections, lenticular deposits of sand and clay, crossbedded sands, interbedding of montmorillonite and kaolinite clays and alluvial sands, and the presence of land vertebrate fossils.

It is difficult to identify the upper and lower contacts of the Miccosukee Formation. Locating the upper boundary is further complicated by the weathered profile of the Miccosukee Formation, often 10 to 15 feet deep. The principal criterion used in defining the lower contact is the upper limit of beds having definite marine characteristics. The distinguishing differences are the presence of pelletal phosphate, carbonate rock, fuller's earth, or marine fossils in the Hawthorn Formation and their absence in the Miccosukee Formation. These formations are also separated by the larger size of sand grains and more abundant white kaolin layers of the Miccosukee Formation. Coarse sand, gravel, and cobbles in channel-fill deposits are found in the lower Miccosukee consisted of two layers -- totaling no more than 20 feet thick and separated by sandy beds -- located under about 60 feet of overburden.