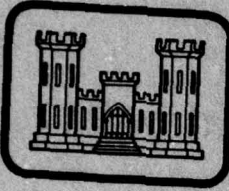


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TECHNICAL REPORT GL-79-16

EVALUATION OF EFFECTS OF PANAMA CANAL DEEPENING UPON THE STABILITY OF LA PITA HILL

by

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September 1979
Final Report

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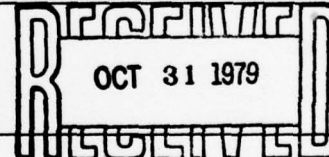
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report presents an analysis and evaluation of the stability, as well as provides design recommendations for La Pita Hill on the Panama Canal. The site was selected for study by the Panama Canal Company (PCC) based upon scheduled Canal deepening locations and stability of adjacent slopes. This report provides systematic, step-by-step guidance for preventing a massive failure of La Pita Hill caused by Canal deepening operations, i.e. blasting and (Continued)		

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20. ABSTRACT (Continued)

excavation. The results are not intended for direct extrapolation either to other sites along the Canal or to small localized failures along the slopes adjacent to La Pita Hill.

This report provides the basis for the future evaluation of slopes affected by Canal deepening but is not intended to set a precedence for the method of analysis. Any future study should be independent but should draw upon the experience gained from preceding analyses.

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PREFACE

This study was initiated by a request from the Panama Canal Company (PCC) that the U. S. Army Engineer Waterways Experiment Station (WES) prepare a work statement describing a study approach for selected slopes in the Gaillard Cut. A work statement was prepared by WES and transmitted to PCC on 1 October 1974. La Pita Hill was chosen for analysis, and authorization for the study was obtained in a letter from PCC dated 8 November 1974.

Upon completion of this study, a draft of the report was transmitted to PCC for review and comments. Since transmittal of the draft, WES and PCC have held numerous discussions. As a result of the review and discussions, several of the recommendations in this report were implemented prior to publication.

The study was conducted and this report was prepared by Mr. W. O. Miller, Rock Mechanics Applications Group (RMAG), Engineering Geology and Rock Mechanics Division (EGRMD), Geotechnical Laboratory (GL), WES. Technical assistance was provided by Mr. R. D. Bennett, RMAG; Mr. J. L. Gatz, Chief, Exploration Group, EGRMD; and Mr. G. P. Hale, Chief, Soil Testing Facility, Soil Mechanics Division (SMD), GL. The study was conducted under the direct supervision of Mr. J. S. Huie, Chief, RMAG, and Dr. D. C. Banks, Chief, EGRMD, and under the general supervision of Messrs. J. P. Sale and R. G. Ahlvin, Chief and Assistant Chief, respectively, GL. The report was reviewed by Dr. F. G. McLean, former Chief, Earthquake Engineering and Geophysics Division, GL; Dr. R. J. Lutton, Research Group, EGRMD; and Messrs. S. J. Johnson, former Special Assistant, GL; and C. L. McAnear, Chief, SMD. The study was closely coordinated with PCC personnel, particularly Mr. A. P. Mann, Chief, Civil Engineering Branch, Engineering Division, and several of his associates: Messrs. R. H. Stewart and F. A. Len-Ríos, CPT J. McCutchan, and Mrs. J. Stewart.

Directors of WES during the conduct of the study and the preparation of this report were COL G. H. Hilt, CE, COL J. L. Cannon, CE, and COL N. P. Conover, CE. Technical Director was Mr. F. R. Brown.

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CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI)
UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
feet	0.3048	metres
inches	25.4	millimetres
inches per minute	25.4	millimetres per minute
inches per second	25.4	millimetres per second
pounds (force)	4.448222	newtons
pounds (force) per square foot	47.88026	pascals
pounds (mass)	0.4535924	kilograms
pounds (mass) per cubic foot	16.01846	kilograms per cubic metre
tons (force) per square foot	95.76052	kilopascals

EVALUATION OF EFFECTS OF PANAMA CANAL DEEPENING
UPON THE STABILITY OF LA PITA HILL

PART I: INTRODUCTION

Background

1. The Bank Stability Surveillance Program (BSSP) of the Panama Canal Company (PCC) has provided data in the past several years that indicate varying degrees of stability for portions of the banks of the Panama Canal in the area of the Gaillard Cut. The BSSP data collection has been supplemented by a long-term study of the clay shale slopes during which as complete a record as possible was compiled of historical, geological, and engineering data starting from the early days of Panama Canal construction and continuing into the early to mid-1970's (Lutton and Banks, 1970; Lutton, 1975; Banks et al., 1975; Banks, 1978; and Banks, Strohm, and Lutton, in preparation). These references emphasize the continued need for concern over slope stability, especially during planning and construction of the 9-ft* deepening of the Canal.

2. It is hoped that the Canal can be deepened in the vicinity of both stable and marginally stable slopes in such a manner that slope failures will be prevented. At the same time, it is recognized that, since the deepening will affect the toe of the slopes, even the relatively minor new excavation may have a serious effect on slope stability. Additionally, since deepening by underwater blasting techniques is planned, the forces applied to the slopes by blasting and/or the change in material properties caused by the blasting may be sufficient to cause damage or even failure. These possible causes for concern led PCC to request a statement from the U. S. Army Engineer Waterways Experiment Station (WES) describing a study approach for assessing the stability of specific slopes selected by PCC and design recommendations to prevent

* A table of factors for converting U. S. customary units of measurement to metric (SI) units is found on page 4.

failure*. The study approach is illustrated in Figure 1. Upon review of the work statement, PCC selected La Pita Hill as the first area for study and authorized WES to proceed on a study of that slope.**

General Description of Study Area

3. La Pita Hill lies on the east bank of the Cunette Reach of the Panama Canal approximately between sta 1827 and sta 1837 where La Pita Ridge intersects the Canal cut.† The hill and ridge form the topographic high in the immediate area, as shown in Figure 2, rising approximately 310 ft above the present Canal bottom. Cross sections through La Pita Hill show the front slope to rise roughly 110 to 130 ft above the Canal bottom on approximately a 1.75V on 1H slope (60 deg) and then on approximately a 1V on 2.75H slope (20 deg) for the remaining 180 to 200 ft.

4. The hill has experienced a limited amount of instability in the past with at least one slide occurring on the hill and several others in the immediate vicinity (Figure 2). A description of the history, geology, and mechanics of movements in the area have been reported by Lutton (1975). The slides in this area began during the early construction and continued intermittently over a period of many years; no recent activity has been noted.

* Work Statement for PCC by WES, "Incremental Slope Designs and Development of Blasting Criteria Related to the Deepening of the Panama Canal," transmitted by letter dated 1 Oct 1974.

** Letter from Mr. R. J. Risberg, Chief, Engineering Division, PCC, Subject: Analysis and Recommendation for Stabilization of La Pita Hill, dated 8 Nov 1974.

† In this report, present (1975) Canal stationing is used. The Cunette Reach lies between the Cunette and the Empire points of intersection (PI). These points are located as follows:

<u>PI</u>	<u>Station</u>	<u>Latitude</u>	<u>Longitude</u>
Cunette	1819+57.2	9° 04' + 1119.7	79° 40' + 2788.5
Empire	1842+57.4	9° 03' + 5711.7	79° 40' + 1494.1

Azimuth of Canal center line in Cunette Reach: 321° 05' 43".

5. The planned deepening of the Canal in the vicinity of La Pita Hill caused concern over the present stability of the hill. This interest was generated by several important considerations: (a) previous slide activity in the area, (b) the large potential mass that could be involved in a massive failure, and (c) method of excavation, i.e., blasting along the toe of the hill with subsequent removal of resisting material from the toe of the slope.

Purpose

6. The purpose of this study is to provide an assessment of La Pita Hill as it presently exists and to evaluate the possibility of a major failure of the hill which could result from the proposed deepening operations in the area. In addition, if the assessment should indicate the possibility of a major failure, procedures or techniques are to be recommended for either increasing the factor of safety or controlling the amount by which it is reduced.

Scope

7. Acquisition of data for the analyses included a review of historical records, review of information gathered under the BSSP and other data of PCC and WES, taking samples in new borings, and laboratory testing to identify strength and index properties of materials encountered. The need for additional borings to identify the geologic structure more completely and for laboratory tests to determine strength parameters immediately became evident following a review of existing data from the study area.

8. Laboratory strength tests were conducted at WES on the new samples to determine the current strength parameters and compare them with peak and residual values. Because of a restricted time frame and limited funds, only those samples deemed most important to the study were tested.

9. During 1975 the Canal was deepened by blasting on the opposite bank of the Cunette Reach in the near vicinity of La Pita Hill as shown in Figure 3. Seismographic records were obtained to assist in the development of acceleration criteria for use in the analyses. In addition to the evaluation of present seismographic records, all blast records previously acquired were reviewed, and appropriate relationships of velocity versus scaled distance and acceleration versus scaled distance were developed.

10. Stability analyses of La Pita Hill were made following two different procedures. First, a semiempirical two-dimensional effective stress analysis was made to obtain an estimate of the long-term stability of the hill after deepening. Following guidance recommended by Banks et al. (1975), a failure plane was assumed and strengths were determined from back analyses of failures that had occurred within the same geologic formation (Las Cascadas). Second, to obtain an evaluation of the short-term stability of the hill, a conventional two-dimensional total stress analysis was performed using laboratory strengths partitioned along trial failure surfaces. As will be explained later, the choice of a two-dimensional analysis rather than a three-dimensional analysis was governed by an evaluation of all subsurface information currently available on the site. For the short-term analysis, the stability of La Pita Hill was determined for (a) its present conditions, (b) its condition after removal of the toe, and (c) its condition after removal of the toe with additional forces caused by average blast-induced accelerations acting uniformly upon the slope. An additional analysis was conducted using distributed accelerations imposed upon the slope.

11. Recommendations proposed in this report have been made concerning existing and future stability of the La Pita Hill and economically feasible ways for maintaining the stability against a massive failure. These recommendations should be limited to La Pita Hill per se and are not intended for extrapolation to other areas along the Canal.

PART II: GEOLOGY AND FIELD DATA

General Geology

12. La Pita Hill is composed of materials of the Las Cascadas formation, described by Woodring (1957) as being volcanic in origin and consisting principally of agglomerate and tuff. The matrix of the agglomerate consists of soft, fine-grained altered tuff and bentonitic clay. Lutton (1975) stated that the formation has been generally regarded as Oligocene (but without verification) and thought to contain four rock types: dacitic tuff breccia (also called agglomerate), tuff, welded tuff (also called ignimbrite and ash flow), and andesite. The tuff breccia, welded tuff, and andesite, while jointed, are generally stronger than the tuff. The tuff layers are generally thin (on the order of 10 ft) and soft, and at the location of previous slides, functioned as parts of the sliding surfaces. Slickensides appear to be a characteristic feature of the tuff. Geologic information determined from a review of both past and present boring logs generally confirms these descriptions. A description of the general geology at La Pita Hill has been presented by Lutton (1975).

Specific Geology

13. Strata in the hill consist of a sequence of interbedded andesites, tuffs, agglomerates, and ash flows, all dipping generally toward the Canal. Saprolitic overburden, derived from andesite, ranges in depth from zero near the Canal excavation down to a maximum of approximately 100 ft on the crest of the hill.

14. Table 1 lists the borings from which subsurface information was available for this study. Boring logs indicated the presence of numerous faults, joints, shear zones, and highly faulted areas. The approximate general locations of both confirmed and possible faults have

been indicated in Figure 3. Boring logs available at the beginning of the study indicated the possible existence of a fault paralleling the Canal that could serve as a back scarp for a potential slide mass. (The possible fault is labeled C-C in Figure 3.) The possible fault was located between borings SC-82 and ERE-18 and was indicated by the general lack of correlation of strata encountered in these two borings. Since the possible fault was located at a particularly critical location and since the geologic picture was still incomplete for a specific analysis, three additional borings were drilled by WES crews and a shallow trench was excavated by PCC crews at the La Pita Hill site.

15. The locations of the three new borings, ERE-25, ERE-26, and ERE-27, are shown in plan in Figure 3. The three new borings were located to intercept the possible fault, and to determine if it dipped toward the Canal and could thus function as the back scarp of a possible sliding mass. Boring ERE-25 was made using a 4- by 5-1/2-in. standard Diamond Core Drill Manufacturers Association (DCDMA) double-tube, swivel-head core barrel with cemented carbide insert bits. After boring ERE-25 was logged and the core evaluated, an offset boring ERE-25A was made using a 5- by 6-1/4-in. modified Denison sampler with cemented carbide insert bits to obtain undisturbed cores. Borings ERE-26 and ERE-27 were made using a 4- by 5-1/2-in. standard DCDMA double-tube, swivel-head core barrel with cemented carbide insert bits. Logs of the borings were compiled by PCC geologists and are included in Appendix A for completeness. An evaluation of the core samples and logs of the three borings did not conclusively confirm or deny the existence of any of the faults within the hill (Figure 3) although the borings did reveal numerous zones of sheared or faulted materials and provided additional geologic information about La Pita Hill. A review of all boring logs in the hill indicated a general predominance of broken or sheared zones within the weaker strata, i.e., tuffs and agglomerates. In general, the hill appears to consist of fairly competent materials (andesites and ash flows) with zones of weaker, broken, and sheared materials (tuffs and agglomerates).

16. An open-face trench (benched excavation), approximately 40 ft deep, 100 ft wide, and 200 ft long, was excavated along the side of the steep slope on the northwest side of La Pita Hill with bulldozers by PCC crews. The trench (Figure 3) was located to provide additional information concerning the existence of the possible fault. The trench was inspected by PCC geologists, who were able to determine only minor possible expressions of a fault within the overburden materials. No conclusive evidence was determined to confirm the fault.

17. Geologic cross sections (Figures 4 and 5), prepared through sta 1831+00 perpendicular to the Canal center line and sta 1835+50 skewed to the north at an angle of 67.5 deg with the Canal center line (labeled A-A and B-B, respectively, in Figure 3), show the materials to be bedded and generally continuous, with a strike of S 61° E and a dip of approximately 5° SW. The oblique section through sta 1835+50 (Figure 5) is drawn parallel to the dip of bedding.

Simplification of Geology

18. The complexities of lithological types, stratigraphy, faults, shear zones, and joints indicated in Figures 3, 4, and 5 caused difficulties in understanding the possible failure mechanics of La Pita Hill. For a stability analysis of La Pita Hill, an in-depth evaluation was required of all available data from the site.

19. An evaluation of the entire geologic picture of the La Pita Hill area revealed layered materials which, in general, possessed numerous sheared and broken zones. In some cases these zones have been termed faults to explain discontinuity of strata between borings. However, the majority of the faults within the hill are inferred faults that exhibit only minor throws and are oriented to form only a minor portion of a potential slide mass. Two faults which were inferred as major faults in the study area were evaluated both separately and jointly. One fault (designated D-D in Figure 3) strikes N 40° E and dips approximately 74° SE, passing through boring ERE-9; and the other (designated E-E in

Figure 3) strikes N 10° E and dips 60° NW, passing through boring ERE-2 (Figure 3). These two faults form a wedge-shaped prismoid which isolates the central portion of the hill from either side. The dips of these two faults are such that they extend outward and downward away from the hill and thus are not considered to contribute major or significant sliding planes for the purposes of an analysis. This observation suggests that the stability behavior of the central portion of La Pita Hill can be assessed using a two-dimensional analysis rather than a three-dimensional analysis.

20. In order to perform a two-dimensional stability analysis of La Pita Hill, the following generalizations and assumptions were necessary:

- a. Materials similar in strength properties and somewhat similar in composition and method of deposition, i.e., tuffs, agglomerates, agglomeratic tuffs, and tuffaceous agglomerates, were grouped together as tuff breccia in order to describe certain layers within the hill.
- b. Ash flows and agglomerates, which were described as ignimbrites on PCC boring logs, were grouped together as a layer of "ignimbrite" and subsequently served as a "marker" bed in describing and evaluating the geologic structure of the study area.
- c. Strata within the hill were assumed to be continuous, and discrepancies between elevations of materials in boring logs and those plotted on the analysis cross section were primarily accounted for by the offset of the borings from the section analyzed.
- d. Major faults within the hill are oriented and dipping in such a manner that it was assumed that a three-dimensional wedge-type failure was highly improbable.
- e. The section chosen for analysis (Section A-A, assumed most critical) was perpendicular to the Canal through sta 1831+00 (Figure 4), which represented the steepest ground surface profile, rather than the section skewed at 67.5 deg with the Canal (Section B-B) through sta 1835+50 (Figure 5), which represented the steepest bedding dip for the study area.

21. These assumptions, necessary to perform an analysis, are generally consistent with the overall geologic interpretation of the hill from an engineering standpoint, i.e., assumptions made do not compromise the strength parameters governing the stability of the hill. The simplified profile is shown in Figure 6.

Groundwater and Pore Pressure Conditions

BSSP data

22. Groundwater level measurements, obtained in open boreholes by the BSSP, were furnished by PCC at the beginning of the study for 10 boreholes in the immediate area of La Pita Hill. The designation and location of these boreholes are listed in Table 1.

23. The maximum and minimum levels recorded were chosen as limiting conditions for use in stability analyses. These maximum and minimum levels are shown in a section in Figure 7. To establish the section, boreholes with their appropriate water levels were projected parallel to the center line of the Canal. The ground surface profile depicted in Figure 7 represents the ground surface at each of the individual boreholes.

24. Groundwater levels and pore pressures are applicable to effective stress analysis rather than to total stress analysis. As will be discussed later, only the semiempirical analysis used effective strengths.

Recent data

25. To supplement the existing data and more precisely identify pore pressures active within the analysis area, two piezometers were placed in La Pita Hill during the recent boring program. These piezometers were placed in borings ERE-25A and ERE-27. In addition, borings ERE-25 and ERE-26 were used for open-hole water level measurements.

26. Water levels within borings ERE-25 and ERE-26 were generally consistent with the previously defined groundwater conditions plotted in Figure 7. The piezometer levels reflected in borings ERE-25A and ERE-27, however, were substantially lower than readings recorded in the open boreholes, thus indicating that a perched water table was measured in the open boreholes. The geologic information available for the hill tends to support the likelihood of a perched water table. The boring logs and interpreted geologic cross sections reveal numerous strata beneath the overburden materials that are highly broken and sheared,

thus indicating high permeabilities and the probability of somewhat free draining layers at depth.

27. The use of water levels recorded in the open boreholes, i.e. the perched water table, for defining pore pressures rather than the lower pore pressures indicated by the piezometers provides conservative assumptions with respect to the anticipated pore pressures at depth. Pore pressures associated with the upper water levels were used in the semiempirical analysis of the slope (effective stress analysis) and thus caused a more conservative (lower) factor of safety to be calculated.

Surface and Subsurface Motion Vectors

BSSP data

28. The potential of a slide at La Pita Hill, as reflected by previous activity in the area, resulted in the establishment of BSSP surface monuments and electronic distance measurement (EDM) stations in 1972 to measure both surface movement and settlement (Tables 1 and 2). In addition, one Telemac and eight plain-cased deflection boreholes were used to monitor any subsurface movement or activity (Table 1).

29. The readings furnished by PCC from each of these data sources were plotted to determine a movement history as well as total resultant vector movement. The alignment checks, made on 15 surface monuments for the purpose of detecting horizontal movement of the slope toward the Canal, have been plotted in Figure 8. Except for the one apparently erroneous or at least questionable reading (1.44 ft), the maximum recorded movement toward the Canal was 0.17 ft or approximately 2 in. A study of the movement history indicates initial movements toward the Canal with subsequent movements away from the Canal or upslope. This behavior suggests the possibility of surveying inaccuracies, especially in view of the relatively small magnitude of movements being recorded.

30. Settlement readings for the slope were made for the surface monuments mentioned previously. The total settlement and the settlement

history are plotted in Figure 9. With the exception of two readings (0.54 and 0.49 ft), the maximum recorded settlement for the 15 measurement points was 0.07 ft or approximately 0.8 in. A study of the history of the measurements indicates initial settlement with subsequent rebound, again suggesting possible surveying inaccuracies.

31. EDM's have been made from a station on the opposite bank of the Canal to six selected EDM points located on La Pita Hill. The total movement and the movement history of the measurement points are plotted in Figure 10. The maximum resultant vector movement to date has been 0.008 m or approximately 0.32 in., reported for surface monument No. 2 and for boring ERE-3. It should be noted that the alignment checks (Figure 8) reported a movement of monument No. 2 of 0.12 ft or approximately 1.4 in. A study of the EDM movement history does not reveal any trends suggesting inaccuracies. The movements reported were, however, very small and not considered to be of any significance due to their apparently random directional orientation.

32. Data furnished for the plain-cased deflection boreholes and the Telemac showed no subsurface movement or blockage.

33. The recent history of the hill, as reflected by the BSSP data collected to date, indicates that the slope is presently stable for existing conditions.

Recent data

34. During the drilling of boring ERE-25 for this study, an offset in the boring was reported at a depth of approximately 86 ft (el 253,* slightly above the overburden-andesite contact) immediately after a blast on the opposite bank of the Canal. The Survey Branch of PCC obtained readings for all plain-cased deflection boreholes at La Pita Hill to determine if the hill was involved in motion. The Survey Branch reported no movement in any of the other holes, thus suggesting the probability of hole collapse or only localized movement at boring ERE-25.

* All elevations (el) cited herein are in feet referred to mean sea level.

35. While the recent data indicate a stable slope for existing conditions, PVC pipes were placed in borings ERE-25 and ERE-26 to serve as plain-cased deflection boreholes to provide measurement points in addition to those previously established at La Pita Hill.

PART III: BLASTING DATA

General Blast Records

36. A large volume of blast data (i.e. ground acceleration and velocity measurements for known charge weights being detonated at known locations) has been collected during production blasting along the Canal, particularly for the Canal widening project in the 1960's. In addition, a smaller number of records of ground motion resulting from special calibration and quarry blasts were also available at the beginning of this study. Two velocity seismographs (Sprengnether, Model No. VS-1100) placed on La Pita Hill during the recent (1975) Canal deepening operations on the opposite bank of the Cunette Reach supplemented these previous records and provided specific information concerning the response of the hill to dynamic loadings. The instruments were placed at sta 1831+50, at offsets of 500 and 900 ft east of the Canal center line (Figure 3). For seven blasts, however, the instrument offset 900 ft was moved to sta 1838+14.7 at an offset of 642 ft west of the Canal center line to monitor accelerations being imposed by the blasting upon a concrete spillway located on the west bank of the Canal.

37. The blasting data were compiled, with PCC assistance, to determine (a) general relationships between ground motion response, in terms of acceleration and velocity, and scaled distance (range R divided by the cube root of the charge weight W , i.e. $R/W^{1/3}$); (b) the agreement between general data and those specifically collected at La Pita Hill; (c) the maximum level of ground motion (particle velocity and acceleration) to which La Pita Hill had been subjected in the past; and (d) a particle acceleration profile for La Pita Hill.

Data Reduction

38. All blast records provided to WES were systematically reduced and the results plotted to obtain appropriate relationships for velocities and accelerations versus scaled distance. The method of reducing

seismographic data currently used by PCC (and adopted by WES for this study) is a very conservative approach that yields high values of velocities and accelerations. Peak velocity and acceleration components are determined for the transverse, longitudinal, and vertical axes, and the magnitudes of the resultant velocity and acceleration vectors are computed using the peak values. The actual velocity and acceleration vectors that occurred at any given time are somewhat lower since the measured peak velocity and acceleration components rarely, if ever, occur at the same time. This approach results in an overestimation of the actual magnitude of velocities and accelerations.

39. First, all velocity data were reduced and plotted in terms of resultant particle velocity versus scaled distance as shown in Figure 11. The data all fell within a reasonably narrow band. A straight-line fit of the data, visually biased for the 1975 La Pita Hill records, provided a general guideline for anticipated velocities at various scaled distances. The La Pita Hill velocity data were shown to be in general agreement with velocity data collected elsewhere along the Canal. Secondly, acceleration data were reduced and plotted versus scaled distance as shown in Figure 12. The specific data from La Pita Hill yielded a satisfactory distribution and provided a general means of predicting the accelerations at various scaled distances. As can be seen, the acceleration data from records taken at all points along the Canal show more scatter than the velocity data and are therefore more site dependent than the velocity records. For this reason, extrapolation beyond the boundaries of measurement are more questionable. A straight-line fit of the data, again visually biased for the records obtained at La Pita Hill, provided a general guideline for anticipated accelerations at various scaled distances. Although the data are scattered somewhat, the La Pita Hill acceleration data are shown to be in general agreement with data collected elsewhere.

Data Evaluation

40. The method of computing the magnitude of the acceleration and velocity vectors was discussed in paragraph 38. It was stated that the method overestimated the actual magnitude(s) at a given time. The seismographic data were subsequently reevaluated to determine the magnitude of the actual measured accelerations as opposed to the magnitude of the computed accelerations. In a manner of speaking, the reevaluation established an appreciation of the safety factor imposed upon the stability analysis as a result of the method of data reduction. The velocities and accelerations for the recent blasts opposite La Pita Hill were recomputed, and the results are shown in Table 3. For each blast and each instrument, the velocity and acceleration magnitudes were calculated for the point in time when each of the three axes recorded a peak value; also shown are the calculated magnitudes of velocities and accelerations computed from the vectorial sum of the individual peak values. The amount of conservatism is immediately evident when comparing the values. This aspect has been discussed by Lutton (1976). Results indicate that the peak acceleration values, computed as discussed previously, average 34 percent higher than the magnitude of the maximum recorded acceleration vectors.

41. The degree of conservatism within the acceleration data developed for the analysis is further evidenced by the lack of consideration of the direction in which the acceleration vectors act. All accelerations within the analysis are imposed as horizontal loads to the slope in the downslope direction, when in fact, 68 percent of the measured peak accelerations were determined to act in the vertical direction. The remaining 32 percent were approximately evenly distributed between the transverse and longitudinal directions, suggesting that approximately 16 percent of the peak accelerations occur along a line perpendicular to the Canal. If it is assumed that half of these were directed upslope and half down, then only 8 percent of the peak accelerations measured would represent horizontal driving forces to the potential slide mass in

a direction toward the Canal. While it is recognized that vertical accelerations reduce the normal stress in the failure mass, thereby reducing the shear strength, horizontal accelerations were considered as more critical due to the driving forces imparted to the failure mass.

42. Another argument for conservatism involves blasting records indicating numerous blasts of 40,000 lb between 1000 and 2000 ft away from the centroid of the potential slide mass on the hill. The maximum of these blasts, using acceleration versus scaled distance relationships developed for the present analysis, would have caused an acceleration at the centroid of the assumed failure mass of 1.95 g's, as shown in Table 4. While the actual response of the hill to those blasts is not known, failure obviously did not occur, thus confirming the conservative nature of the acceleration versus scaled distance relationships being used. The acceleration interpretation techniques are thus recognized and proven conservative.

43. However, none of the data used in evaluating accelerations and particle velocities were taken at the toe of La Pita Hill. Thus, when blasting occurs at the toe, the possibility exists for changes in the transmitted wave forms and the transmission mechanisms due to the change in the transmission path. In addition, the relatively complex nature of the site and the recognition of the consequences of a blast-induced slide cause the interpreted conservatism within the blast data to be a matter of concern. It was therefore decided to use the accelerations computed from the vectoral sums of the individual peak values as a self-induced safety factor for the analysis.

44. At the present time the only seismographic measurements which have actually been recorded on La Pita Hill are those which were acquired specifically for this study. The maximum velocity recorded on the hill was on the seismograph located at sta 1831+00, offset 500 ft east, for blast 17 (Figure 3). The blast, located at sta 1836+50 on the west bank, had a charge weight of 2642 lb, and produced a maximum resultant velocity of 7.3 in./sec at the recording station. The subsequently computed acceleration for the blast was 0.91 g. It should be pointed

out, however, that both seismographs were placed upon the surface and the velocities measured were the velocities for only the overburden materials. Since the overburden would tend to resonate and thus amplify the velocities and the subsequently computed accelerations, it is probable that these surface measurements are somewhat higher than the average for the entire potential failure mass and their use represents yet another form of conservatism.

45. In an attempt to more precisely define and evaluate the dynamic response of La Pita Hill for stability analyses, an acceleration profile was developed. Although the general acceleration data measured for the Canal (Figure 12) were used to obtain acceleration versus scaled distance relationships, the constructed line was visually biased to represent the average of the data obtained from recent Canal deepening operations opposite La Pita Hill (Figure 3). As a means of evaluating the developed acceleration versus scaled distance relationship and establishing its validity for use in analysis, accelerations for the recent (1975) blasts at La Pita Hill were recomputed using Figure 12. The results obtained were reasonable and fell within the expected ranges, as shown in Table 5. To facilitate the stability analysis of the hill, the relationship so developed was assumed to apply to any weight charge detonated at any location. To develop a profile, it was assumed that a charge of arbitrary weight was detonated at the toe of the slope, 10 ft east of the prism line (260 ft east of the Canal center line at sta 1831+00). The resulting acceleration occurring at the centroid of the initially assumed potential slide mass was designated as being 100 percent. The corresponding acceleration of other points along the section were expressed in terms of percent of the acceleration at the centroid (Figure 13). From such a plot it is possible, as discussed later, to study the potential effects of a blast detonated at the toe of the slope in terms of a distributed acceleration using pseudostatic techniques of stability analysis.

PART IV: LABORATORY TEST RESULTS

Prior Laboratory Tests

46. At the beginning of this study, the only laboratory test results available on materials from the Las Cascadas formation were those performed on six samples by the U. S. Army Engineer Division, South Atlantic (SAD) Laboratory for the U. S. Army Engineer District, Jacksonville (1968). A summary of those results has also been published by Banks et al. (1975). The samples tested were described as agglomerate, tuff, and shales taken from boring D1 during the Atlantic-Pacific Inter-oceanic Canal feasibility studies. Results of these tests, as well as recent testing, are summarized in Table 6.

47. The SAD testing program consisted of unconfined compression and direct shear tests as well as the determination of index values. The direct shear tests were performed on remolded precut, undisturbed intact, and undisturbed precut specimens with peak and ultimate strengths being determined for each type specimen. The laboratory test reports are reproduced in Appendix B (pages B2 through B10).

Recent Laboratory Tests

48. During the recent boring program at La Pita Hill, undisturbed samples were taken in borings ERE-26, ERE-27, and ERE-25A for the purpose of laboratory testing. The sampling program was established after completion of boring ERE-25. The log and core of boring ERE-25 were studied, and selected zones of weaker and/or faulted and sheared material were chosen for sampling. Samples of these zones were obtained by using a rock bit to drill a new hole, boring ERE-25A, to desired sampling depths at an offset of 8 ft from boring ERE-25. For borings ERE-26 and ERE-27, general instructions were given the driller to sample the weaker materials, i.e., tuffs, agglomerates, as well as weathered and gouge zones. Samples from borings ERE-26 and ERE-27 were taken with a Denison core barrel, and samples in boring ERE-25A were taken with a Shelby tube

sampler. A total of 26 samples were taken in the three borings. The samples were shipped to WES in the sample tubes, after which they were extruded, visually inspected, and photographed. Within approximately 5 min the samples were placed in cardboard tubes and encapsulated in a 50/50 mixture of microcrystalline wax/paraffin and stored in a humid room to await testing.

49. Ten samples were selected by WES for laboratory testing. Sample selection was based upon the desire to establish (a) differences in strength between the various layers, (b) the similarity of strengths at different locations within the various layers of tuff, and (c) the existing peak, ultimate, and residual strength parameters for various materials. To establish differences in strength parameters between various layers, six samples of tuffaceous and agglomeratic materials, one sample of andesite, and one sample taken in a fault or shear zone within agglomeratic tuff were chosen for single-plane direct shear tests in a rock shear device. For the agglomeratic tuff sample taken from the fault zone, a multistage direct shear test was performed because of the limited amount of sample available. In addition to the strength tests, index properties (i.e., water contents, unit weights, and Atterberg limits) were determined on each test sample.

50. For each test conducted in the rock shear device, specimens approximately 0.4 ft in length were sawed from the samples. The specimens were cemented in the two halves of the shear boxes with a mixture of water and Hydro-Stone Mix, leaving approximately a 1/16-in. opening between the two halves of the boxes to allow for axial displacements under consolidation and for shear. The specimens were then consolidated under normal loads of 4, 8, and 12 tsf, for approximately 10 min. The samples were sheared to failure at a rate of 0.002 in./min after which the strain rate was increased and shear continued for approximately 10 to 12 min. The strengths that were determined represented the peak and ultimate values for each of the samples. The ultimate strength represents the strength after initial failure of intact materials. Ultimate strength is distinguished from residual strength by the amount

of displacement required. Ultimate strengths were defined as the strength occurring at a displacement of 0.42 in.; residual strength represents the minimum strength obtained after relatively large displacements or strains (i.e., displacements an order of magnitude larger than ultimate displacements (Banks et al., 1975)).

51. For the multistage direct shear test conducted on the faulted material, the sample preparation and performance of the tests were conducted as described previously. However, the strength envelope was determined using a single specimen rather than separate specimens for each normal load. For each shear strength determination the specimen was recentered and reloaded for each of the progressively higher normal loads. Pretest and/or posttest photographs for all of the samples tested in the rock shear device are shown in Appendix B, Figures B1 through B8. The laboratory test reports are presented in Appendix B (pages B13 through B44), and the test results are summarized in Table 6.

52. Three specimens of the weaker tuff layer were tested in a 3- by 3-in. direct shear box to determine the drained peak, ultimate, and residual strengths (i.e., c' and ϕ') for use in effective stress analyses. The intact specimens were trimmed to 3 by 3 by 1 in. by first roughly sawing them and then pressing them through a cutting mold. Normal loads of 4, 8, and 12 tsf were placed on the specimens. The specimens were then consolidated for approximately 24 hr, at which time it was determined from a plot of the change in specimen height versus time that consolidation was essentially complete. The specimens were inundated with distilled water 2 min after the consolidation was begun and maintained that way for the remainder of the test. The specimens were sheared at a rate of 0.00008 in./min for a total of 5 days (approximately 0.5 in. in 5 days) to obtain the peak and ultimate values. At that time, the shear rate was increased to 0.03125 in./min (0.25 in. in 8 min), and the specimens were rapidly sheared to residual. A total of 10 in. of displacement was accumulated during the rapid shear, after which the rate was reduced to 0.00008 in./min for obtaining the residual strength. The peak and ultimate values determined were $c' = 0.4$ tsf and $\phi' = 38$ deg and $c' = 0$ and $\phi' = 25$ deg, respectively. The test

results for the peak and ultimate tests have been included in Table 6, and the laboratory test report has been presented in Appendix B (page B46). The results obtained from the residual tests were erratic and did not provide suitable data for an evaluation. An inspection of the shearing surfaces after completion of the tests showed the materials to be broken without the establishment of distinct failure planes. The failures within the shear boxes had occurred diagonally through the specimens and in one case had exited through the top and bottom of the test specimen.

53. The final tests conducted were performed solely to establish the residual strength of the weaker tuff layer. The tests were conducted by shearing the specimens along precut failure planes. Precut failure planes for the tests were fabricated by trimming three sets of two 3- by 3- by 1-in. test specimens to 3 by 3 by 1/2 in. and placing them together in the direct shear boxes. The specimens were then consolidated under normal loads of 4, 8, and 12 tsf for a total of 46 hr. Again the specimens were inundated 2 min after the consolidation was begun and maintained that way for the remainder of the test. The specimens were sheared in 0.25-in. increments at a rate of 0.03125 in./min, i.e., 0.25 in. in 8 min, until a total displacement of 5.0 in. had been accumulated. At that displacement, the maximum shear stress for each increment had stabilized. The specimens were then centered, left under normal load overnight, and sheared twice the following day at a rate of 0.5 in. in 24 hr. The readings from the second shear were used for computing residual values. The residual strength for the tuff as determined from the test results was $c' = 0.0$ tsf and $\phi' = 8.3$ deg. The test results have been included in Table 6, and the laboratory test report is presented in Appendix B (page B47).

Laboratory Index Parameters

54. Laboratory index parameters, i.e., water contents, unit weights, and Atterberg limits, were determined for each sample tested. The index parameters provide a useful means of comparing materials and

establishing similarities in behaviors and properties. The results of the index tests have been included in Table 6.

55. The laboratory-determined water contents for the samples of tuff and agglomerate tested ranged from 15.7 to 29.3 percent with exception of the tuff in sample 4 from boring ERE-27. The tuff in sample 4 was highly weathered and had water contents ranging from 38.9 percent to 42.1 percent. The andesite tested exhibited lower water contents of 11.7 to 12.1 percent. The dry unit weights, with exception of sample 4 from boring ERE-27, ranged from 95.0 to 120.3 pcf for the tuffs and agglomerates and corresponded to the same specimens for which the high and low water contents were measured. The dry unit weights for sample 4 ranged from 77.5 to 79.5 pcf. The dry unit weights of the andesite were somewhat higher, ranging from 128.4 to 129.0 pcf. Laboratory test results reported by SAD for the Las Cascadas formation, as shown in Table 6, generally indicated somewhat lower water contents and higher dry densities than those determined by WES. With regard to water content and dry density, the shale samples tested by SAD appear to correlate with the tuff samples tested at WES as part of this study. The agglomerates and tuffs previously tested indicated significantly higher dry densities than the current specimens.

56. The Atterberg limits for the specimens indicated the consistency of properties within the different samples tested. As shown in Table 6, the liquid limits for the tuffs ranged from 76 to 99, the plastic limits ranged from 30 to 57, and the plastic index ranged from 40 to 58, all indicating reasonably narrow ranges of values. The liquid and plastic limits of the tuff previously tested by SAD fell within the ranges determined for the La Pita Hill samples. The agglomerate tested at WES during this study indicated a somewhat higher liquid limit, a significantly lower plastic limit, with a subsequently higher plastic index when compared with that tested by SAD, suggesting that the agglomerate tested by SAD was perhaps of different origin than that found at La Pita Hill. No limits were obtained for the andesite, due to the sample being inadvertently omitted from the testing program. A plot of

the limit parameters on a plasticity chart (Appendix B, page B59) shows half of the samples tested during this testing program below the A-line, resulting in a classification as MH materials.

Laboratory Strength Parameters

57. To establish appropriate strength parameters for use in a total stress analysis (i.e., c and ϕ), all of the peak shear stresses and all of the ultimate shear stresses obtained from the single-plane direct shear tests were plotted versus normal stresses in Figures 14 and 15, respectively. As can be noted, the peak shear strength results, Figure 14, indicated a large amount of scatter, and due to the limited number of tests performed, only general trends were indicated.

58. The ultimate shear strength plot (Figure 15) yielded somewhat more consistent data. The agglomerate tested yielded the highest strength, followed by the andesite and then the tuff. For determination of the tuff strength, an average of the shear stress values recorded for each normal load was used. In addition to the ultimate strength providing the most interpretable values, it can be shown that the ultimate strength is most applicable to the type analysis under consideration. Peak strengths are developed in very small movements and residual strengths are developed only after very large displacements, thus leaving a very broad range of displacements or strains in which ultimate strengths are applicable for use. It has been noted in Report 3 (Banks et al., 1975) that the displacements inherent within the majority of the materials along the Canal are such that current strengths for the materials can be estimated by the ultimate strength of intact specimens.

59. The assumption of ultimate strength applicability was supported by the results of the drained tests on intact specimens and the multi-stage direct shear tests on faulted and broken materials. The results of the multistage test, reported in Appendix B, pages B42-B44, indicate the same peak and ultimate values for the faulted and broken tuff sample. Since it was clearly demonstrated with the drained test that residual

strength for the material is considerably lower than the peak and ultimate values, i.e., the materials tested were not at residual strength in situ, the ultimate strength appears most applicable when failure is assumed in broken and/or faulted materials, as with this analysis.

60. As previously stated, the ultimate strength of the tuffs, shown in Figure 15, was determined by averaging the shear strengths recorded in all the tests for each normal load. The plotted results indicate ultimate shear strengths of $c = 1.0$ tsf and $\phi = 30.5$ deg for the tuffs, $c = 1.5$ tsf and $\phi = 32.6$ deg for the andesites, and $c = 2.7$ tsf and $\phi = 29.9$ deg for the agglomerates. For the purposes of analysis, the layers of tuff and tuff breccia were assumed to have the same strength, $c = 1.0$ tsf and $\phi = 30.5$ deg. In addition, the ash flow layer (ignimbrite) within the hill was assigned the same strength as agglomerate (i.e., $c = 2.7$ tsf and $\phi = 29.9$ deg) since much of the agglomerate logged in borings at La Pita Hill was described, in supplemental information provided, as being ignimbrites.

PART V: STABILITY ANALYSIS

61. The geologic structure, as previously discussed, was simplified from a rather complex structure composed of interbedded sequences of tuff, agglomerate, ash flow, andesite, and overburden crosscut by numerous joints, faults, sheared zones, and fault zones to a more simple layered system. This simplification was accomplished as described in Part II without any major compromises in lithologic interpretation.

62. Pore pressures and groundwater conditions were evaluated, as discussed in Part II, and were used to develop appropriate pore pressure parameters associated with the upper and lower limits of the interpreted groundwater levels. The pore pressure parameters were used only for the semiempirical two-dimensional effective stress analysis.

63. Strength parameters for the analyses were chosen after a comprehensive review of available data. For the semiempirical analysis, the upper and lower limits of strengths for failures along faults and through materials weakened by faults, as determined from back analyses, were obtained from Report 3 (Banks et al., 1975). In the conventional stability analysis, ultimate total strengths, as discussed in Part IV, were chosen from laboratory test results.

64. Accelerations of various magnitudes were used to determine the response of factor of safety to dynamic loads. The methods chosen for applying the accelerations, as discussed in Part III, were uniformly applied accelerations and distributed accelerations lying along developed acceleration contours.

Methods of Analysis

Semiempirical analysis

65. A semiempirical analysis was performed at the beginning of the study, prior to obtaining any supplemental geologic or water table data. At the time of the analysis, the existence of the possible fault (C-C, Figure 3) paralleling the Canal, which could potentially represent

the back scarp of a slide, had not been confirmed or disproved. This fault and the apparent bedding dip obtained from existing cross sections furnished by the PCC were used in establishing a potential failure plane exiting at the toe of the slope. The assumed failure planes for the existing condition and for the section after deepening are shown in Figure 16.

66. The semiempirical analysis was conducted in accordance with procedures used for back analyses presented in Report 3 (Banks et al., 1975). The La Pita Hill study represents the first opportunity for WES to analyze an existing stable slope and to compare the results as obtained from recommendations in Report 3 with those obtained by a more conventional approach. As reported in Report 3, the semiempirical method of analysis serves as a useful tool in obtaining rapid estimates of the factor of safety based primarily upon previous experience in similar materials. It should be pointed out that relatively few failures have been experienced in the Las Cascadas formation; therefore, the conclusions gained from back analyses are more speculative than those made, for example, in the Cucaracha formation.

67. The selection of applicable strengths for the analysis required the description or characterization of materials at La Pita Hill into an appropriate category with which experience has been gained in the back analysis of slides occurring in the Las Cascadas formation. Based upon boring logs currently available and discussions with Mr. Robert Stewart, PCC geologist, the material was considered to be such that if failure occurred the slide surfaces would be primarily along faults and in materials weakened by faults. As a result, strength parameters of $c' = 600$ psf and $\phi' = 20$ deg, and $c' = 0$ psf and $\phi' = 20$ deg were chosen as upper and lower limits from Table 5, Report 3 (Banks et al., 1975), and were applied along the entire failure surface.

68. The influence of the water table upon the factor of safety was evaluated by performing the semiempirical analysis with both the maximum and minimum levels as determined from available BSSP data. The strengths obtained from back analyses were obtained using a pore pressure

parameter r_u , defined as the ratio of the pore pressure to the total pressure at a point (Bishop, 1954). The total pressure is assumed to be the vertical pressure caused by the weight of all material vertically above the point in question, including external water if present.

Therefore,

$$r_u = u / \sum_{i=1}^n \gamma_i h_i$$

where

u = the pore pressure, psf

γ = the total unit weight of material in layer i , pcf

h = the vertical thickness of layer i , ft

Pore pressure parameters computed for the upper and lower water surfaces, $r_u = 0.32$ and $r_u = 0.23$, respectively, were used in the analysis in computing average pore pressures for the entire failure mass.

69. The analysis was performed using the WES version of the Morgenstern and Price computer program. Initially, the section was analyzed using the existing geometry to determine the current factor of safety and to evaluate the influence of the water table on the factor of safety. In the analysis, several arbitrary strengths were chosen and safety factors computed. The factors of safety (FS) were used to develop a c'/FS versus $\tan \phi'/FS$ plot. The factors of safety for $c' = 0$ psf and $\phi' = 20$ deg and $c' = 600$ psf and $\phi' = 20$ deg with the limiting pore pressure assumptions were subsequently computed as shown in Figure 17. The factors of safety so determined were as follows:

	Factors of Safety for Assumed Limiting Strength Parameters	
	Lower Limit $c' = 0$ psf, $\phi' = 20$ deg	Upper Limit $c' = 600$ psf, $\phi' = 20$ deg
Upper groundwater surface, $r_u = 0.32$	1.20	1.31
Lower groundwater surface, $r_u = 0.23$	1.25	1.38

The section was next analyzed assuming 9-ft deepening of the Canal at the toe. The results and computations of factors of safety for this condition have been shown in Figure 18. The factors of safety for this case were as follows:

	Factors of Safety for	
	Assumed Limiting Strength Parameters	
	Lower Limit $c' = 0$ psf, $\phi' = 20$ deg	Upper Limit $c' = 600$ psf, $\phi' = 20$ deg
Upper groundwater surface, $r_u = 0.32$	1.15	1.27
Lower groundwater surface, $r_u = 0.23$	1.26	1.38

70. As a final stage of the semiempirical analysis, several different accelerations were uniformly applied as horizontal forces to the slope in an effort to pseudostatically determine the response of the slope to dynamic loads. These analyses were made for the section with a 9-ft cut at the toe using the high groundwater surface, i.e., $r_u = 0.32$. Results of the analysis in terms of factor of safety versus acceleration for each of the limiting strength assumptions is presented in Figure 19. To reduce the results to a more usable form, the scaled distances, $R/W^{1/3}$, for each of the analysis accelerations were plotted versus factor of safety in Figure 20. The scaled distances were determined from the straight-line fit of the acceleration data, as described in Figure 12. As a final presentation of the results, the scaled distances determined from Figure 20, which represent a factor of safety of 1.0, were used to develop a graph of charge weight versus distance from blast to the centroid of the assumed failure mass (Figure 21). The distances and weights in Figure 21 represent minimum distances and maximum charge weights allowable for a factor of safety of 1.0.

Conventional static analysis

71. A conventional two-dimensional stability analysis was performed for La Pita Hill using the presently defined geologic profiles with appropriate laboratory determined strengths within the various strata.

72. The critical failure surface for the slope was defined by a systematic set of trial runs with the problem. Initially, a back scarp to the failure plane was assumed to be inclined at 45 deg toward the Canal and to enter the ground surface at a distance of 1000 ft from the Canal center line. A base plane for the failure surface was then assumed to be inclined along the dip of the beds toward the Canal. For the initial set of computations, the back scarp was left fixed, and the depth at which the failure plane exited the slope was varied to determine the factor of safety. The results, plotted in Figure 22, indicated two failure planes with low factors of safety. The first, possessing the lower factor of safety ($FS = 2.93$), hereafter called the upper plane, was in one of the tuff layers above the Canal water surface, and the second ($FS = 2.99$), hereafter called the lower plane, was in the more competent agglomeratic material below the bottom of the Canal. The proposed 9-ft deepening of the Canal was evaluated to determine the effect of the lower plane because of its somewhat more critical location. It was determined that the deepening operations resulted in a reduction in factor of safety of approximately 6 percent. In view of the reduction in the factor of safety and still somewhat incomplete geologic picture at the toe of the slope with the subsequent potential for daylighting weaker beds, it was decided to continue the analysis of both failure planes.

73. The next step in identifying the critical failure planes was to vary the length of the base of each of the failure planes along the strata as defined in the first step. With the locations and inclinations of the base planes fixed and with the back scarps fixed at 45 deg, as previously, the factors of safety were plotted versus distances to the back scarps (Figure 22) to determine the critical lengths of both the upper and lower failure planes.

74. Finally, with the exit elevations and base plane for each failure surface fixed, the inclinations of the back scarps were determined by a similar procedure. Factors of safety were plotted versus the locations at which the back scarps entered the slope (Figure 22) to

define the critical failure surfaces and their lowest factors of safety for the analysis. The factors of safety determined for the conditions analyzed were as follows:

	<u>Factors of Safety</u>	
	<u>Upper Plane</u>	<u>Lower Plane</u>
Prior to deepening	2.12	2.59
After deepening	2.12	2.45

Pseudostatic analysis
with uniform accelerations

75. An analysis to evaluate the influence of accelerations imposed upon the slope was conducted using the two critical failure surfaces determined with the conventional static analysis. For the purposes of analysis, the accelerations were imposed as horizontal loads upon the slope, similar to the pseudostatic method used in evaluating the effects of earthquakes upon a slope.

76. Initially, uniform accelerations were applied to the slope. The results of the analysis in terms of factor of safety versus acceleration are shown in Figure 23. To further evaluate the data, the scaled distances taken from Figure 12 for each acceleration were used, and a plot of factor of safety versus scaled distance was developed as shown in Figure 24. For the purpose of obtaining blast design data, a plot of charge weight versus distances to the centroid of the assumed failure mass was developed from the scaled distance corresponding to a factor of safety of 1.0. The plot shown in Figure 25 represents minimum distances and maximum charge weights, as with that previously developed in the semiempirical analysis.

Pseudostatic analysis
with distributed accelerations

77. The use of distributed or partitioned accelerations, within a slope being analyzed, more realistically represents the forces involved than the assumption of uniform accelerations. The hill was thus analyzed using the acceleration contours previously mentioned and shown in

Figure 13. These contours were used in distributing various assumed accelerations at the approximate centroid of the previously assumed slide mass under the assumption that the accelerations were generated by an arbitrary charge located at the toe of the slope. The distribution of the accelerations away from the centroid of the mass have been included in Figure 16 immediately beneath the surface profile.

78. The use of partitioned accelerations increased the complexity of the problem being analyzed many times. Thus, to simplify the problem and facilitate computations, equivalent uniform strengths were determined for the entire slope such that their use in a stability calculation would yield the same factor of safety as that given by the conventional analysis using the upper and lower planes. Several arbitrary strengths were assumed to develop a c/FS versus $\tan \phi/FS$ plot (Figure 26), from which equivalent uniform strengths could be determined. Thus simplified, the slope consisted of one soil mass with $c = 0$ and $\phi = 36.11$ deg. The equivalent uniform strength that was chosen for use in further analyses of both the upper and lower planes was associated with the upper, more critical failure surface.

79. The extremely high accelerations imposed upon the toe of the slope caused the majority of the solutions using the Morgenstern and Price computer program to be nonconvergent. None of the solutions involving the upper plane converged, and only two solutions for the lower plane converged. The results were, however, adequate for demonstrating the effect and the importance of using distributed accelerations for nearby blasts.

80. The results of the analysis with distributed or partitioned accelerations have been plotted in Figure 27. The nonconvergent solutions were included in the plot to aid in demonstrating the trend. The results are further reduced in Figure 28 with a plot of factor of safety versus scaled distance, which was determined by methods previously described. Finally, from the scaled distance representing a factor of safety of 1.0, a plot of charge weight versus distance to the centroid of the slide mass (Figure 29) was developed.

Results of Analyses

81. The results of the analyses show La Pita Hill to be stable against a massive failure as it presently exists by both the semi-empirical analysis and the conventional two-dimensional static analysis. The semiempirical analyses produced factors of safety ranging from 1.20 to 1.31 using the maximum pore pressure parameter and the upper and lower limits of the strength parameters. The conventional analyses, using existing total strengths, yielded factors of safety of 2.12 for an upper failure surface and 2.59 for a failure surface below the Canal bottom, prior to excavation.

82. Factors of safety computed for a section after the proposed deepening indicate a reduction in factor of safety of approximately 4 percent for the semiempirical analysis and 6 percent for the conventional analysis. After deepening, the semiempirical analysis indicated factors of safety ranging from 1.15 to 1.27 for the upper and lower limits of the strength parameters with maximum pore pressures conditions. It should be noted that the semiempirical analysis indicated no appreciable change in factors of safety after deepening for the minimum pore pressure conditions (Figures 17 and 18). The conventional analysis yielded a factor of safety of 2.45 for the lower failure surface. The upper failure surface remained at 2.12, as it was unaffected by the deepening.

83. Results of the pseudostatic analyses of the slope were highly variant depending upon the analysis technique. For a factor of safety of 1.0 the semiempirical analysis indicated the maximum allowable charge weight, assuming the blast 260 ft east of the Canal center line (at the toe of the slope, 10 ft east of the prism line), was 50 lb for the minimum strength parameters, $c' = 0$ and $\phi' = 20$ deg, and was 87 lb for the maximum strength parameters, $c' = 600$ psf and $\phi' = 20$ deg. For the conventional analysis with uniformly applied accelerations and for a blast at the same location as above, the results indicated that a maximum allowable charge weight of 165 lb for the upper failure surface

and 360 lb for the lower failure surface produced a factor of safety of 1.0. The final analysis, utilizing distributed accelerations, indicated that a maximum charge weight of 145 lb at the toe of the slope produced a factor of safety of 1.0 for the lower failure surface.

84. A copy of each of the computer runs representing the low factors of safety as well as the run demonstrating the effect of using distributed accelerations is contained in Appendix C.

Comparison of Results

Static analysis

85. Both the semiempirical and the conventional two-dimensional analyses indicated the hill to be stable against massive failure prior to and after completion of deepening with the safety factor decreasing 4 to 6 percent as a result of the excavation. The differences in the factors of safety obtained by the two methods is attributable primarily to the differences in assumptions that were inherent within each method.

86. The semiempirical analysis used effective strengths that were back-calculated to be the strength existing at the time of failure of various slides within the Las Cascadas formation. The true significance of a factor of safety can only be evaluated through much more experience and many correlations with results obtained from conventional type analyses. An additional assumption necessitated by the semiempirical effective stress analysis was the use of average r_u values in describing pore pressure conditions.

87. The conventional stability analysis used total strengths rather than effective strengths. As a result, the water table and pore pressure conditions, as they exist within the hill, were not used directly within the analysis.

88. The conventional analysis was conducted to obtain design results to base recommendations upon, while the semiempirical analysis was run to establish a base point in the analysis and to demonstrate the use of the method. The semiempirical analysis can be and was used with

no supplemental geologic or water table data to determine an approximation of the factor of safety for La Pita Hill. It is obvious in comparing the results that the semiempirical analysis is very conservative, and this should be recognized during future use of the method.

Pseudostatic analysis

89. The differences in the results obtained with the pseudostatic analyses are primarily attributable to the method of stability analysis used. The low allowable weights at the toe of the slope obtained from the semiempirical analysis are a direct result of the low factors of safety obtained for the static conditions.

90. The disparities between the two different methods applied to the conventional stability analysis are attributable to the acceleration assumptions. The assumption of a uniform acceleration implies that the blast is remote to the slope and that the acceleration distribution contours are so widely spaced that the entire potential failure mass is acted upon by an approximately uniform acceleration. On the other hand, the analysis performed with the distributed accelerations implies a blast near the slope and reflects the actual acceleration gradient or distribution with distance. The particular distributed acceleration analysis performed, however, was for one blast of arbitrary weight detonated at the toe of the slope; the contours and subsequent results of the analysis would change if an evaluation were to be made at a different location.

91. The results of the two pseudostatic analyses thus represent limiting assumptions for evaluating the dynamic response of the hill. For a blast at the toe of the slope, the distributed acceleration type analysis is more applicable. For a blast at a reasonable distance from the slope, the results obtained from the two different methods become more nearly the same, and thus the uniform acceleration assumption becomes more applicable. The two different solutions may be properly used in assessing the predicted behavior of La Pita Hill if proper recognition is given to the inherent assumptions and limitations. The choice of results to use is theoretically a function of each blast location. A

generalized evaluation of accelerations using theoretically correct acceleration distributions was not within the scope of this report.

Applicability of Results

92. The results obtained in the above stability analyses are conservative if it is assumed that (a) the geologic structure of the hill has been completely defined, (b) representative samples were obtained for laboratory testing, (c) the laboratory test results are indicative of in situ mass strength, (d) the pore pressures generated during testing duplicated in situ pore pressures that would occur during shear, and (e) the dynamic response of the hill is consistent with the acceleration assumptions. The origin of the conservatism is inherent within the accelerations used in the analysis and the high pore pressure assumptions; i.e., a conservative approach was used in obtaining acceleration data and the pore pressure conditions were maximized for the analysis by using data associated with a perched water table in the hill.

93. The highly complex nature of the slope and the complicated mode by which blast-induced accelerations are distributed, however, tend to suggest the possibility of a certain amount of uncertainty in the definition of the problem. An evaluation of previous blasts in the area of La Pita Hill, i.e., determination of maximum plateau of previous accelerations, indicates that the conservatism outweighs the uncertainties involved, since previous blasting has not generated failures at La Pita Hill even though the estimated accelerations exceeded those computed to induce failure.

94. The results are thus considered appropriate for design recommendations, and it is assumed that recommendations based upon a factor of safety of 1.0 are applicable considering the conservatism inherent within the results obtained.

PART VI: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

95. An evaluation of the current conditions of La Pita Hill indicates the hill to be stable against massive failure as it presently exists. Neither surface nor subsurface motion vectors have recorded any movements of consequence to date. Water level data for the hill indicate a perched water table at approximately the base of the overburden, with subsequently lower piezometric heads being recorded in the free draining layers of broken materials deeper within the slope.

96. The present stability against massive failure was confirmed by both the conventional total stress analysis and the semiempirical effective stress analysis. Additionally, both analyses indicated the hill to be stable after completion of the anticipated 9-ft deepening of the Canal. The deepening of the Canal was shown to reduce the factor of safety by approximately 6 percent.

97. The dynamic stability of La Pita Hill has, to an extent, been tested in the past by blasting operations in the immediate area. Although the hill was not instrumented during production and Canal widening blasts in the area, back computations for the blasts indicate that significant accelerations were imposed upon the slope during these operations. The results of the stability analyses for massive failure indicate a definite potential for instability of the hill when subjected to blast-induced accelerations. While the hill has in the past withstood higher computed accelerations than those calculated to cause failure, the effect on, or change in, material properties as a result of blasting is not known; therefore, the stability as effected by blasting is still a matter of concern. Recommendations have thus been made to control the magnitude of the accelerations imposed upon the hill during blasting operations for the current Canal deepening project.

Recommendations

98. For current design requirements, it is recommended that blasting in the vicinity of La Pita Hill be regulated or controlled so that a factor of safety of 1.0 is maintained according to the results computed by the conventional two-dimensional analysis using uniform accelerations imposed upon the failure mass. For blast design computations, the curve relating the distance from the blast to the centroid of the potential failure mass versus charge weight of the blasts for the upper failure surface (Figure 25) was used to develop the design curve shown in Figure 30. The centroid of the assumed critical slide mass is located at sta 1831+00, offset 572 ft east of the Canal center line. This centroid should be used in computations of distance to a proposed blast location. The design curve (Figure 30) represents the charge weight and distance from centroid combinations, which the analyses indicate yield a factor of safety of 1.0. Combinations of weight and distance plotted above the curve have factors of safety greater than 1.0, and those plotted beneath the curve are less than 1.0. The conservatism in the design recommendations is supported by the data points taken from Canal widening blasts at La Pita Hill plotted below the curve (Figure 30). The maximum allowable blast weights for the critical failure surface have been shown graphically in Figure 31. The contours in Figure 31 represent the minimum distances with the maximum allowable charge weights for maintaining a factor of safety of 1.0 for the hill.

99. It is recommended that during blasting operations a seismograph be placed approximately at the centroid of the failure mass, i.e., sta 1831+00, offset 572 ft east, and that particle velocities be monitored and accelerations computed. As an additional check on the blast design recommendations, the accelerations computed for the blasts should not exceed those in Figure 23 for a factor of safety of 1.0 for the upper more critical failure surface.

General Recommendations

100. In performing the preceding analyses, several areas were noted in which the addition of new or supplemental information could be used to an advantage in defining more completely the structural geology and engineering properties of La Pita Hill.

101. Subsurface information should be supplemented in the areas of fault identification and further evaluation of the geology along the toe of the slope. The hill is obviously faulted to a great extent, and the placement of future borings at the site should be made in an effort to more precisely identify the extent of faulting. The geology along the toe of La Pita Hill is perhaps the least defined with regard to stability analyses. Future borings along the toe should be extended well below the bottom of the Canal, and special efforts should be made to determine the possible existence of any beds of weak materials.

102. In addition to the need for completing the structural identification of La Pita Hill, there is a very real need for samples to be acquired for laboratory testing purposes. The Las Cascadas formation has the least information available on strength parameters of all the major formations through the Gaillard Cut. In the future, each time a boring is placed in this formation, consideration should be given to acquiring and testing samples. Through continued testing (along a more routine basis) a data bank will gradually develop that will prove valuable in studying other slopes within the formation.

103. In view of the frequency with which the slopes along the Canal are loaded dynamically, i.e., frequent blasting within the Canal, it is suggested that in addition to sampling for future conventional laboratory tests, specific samples be acquired for cyclic triaxial shear testing. Possible changes in material properties resulting from blasting should be inferred or identified and subsequently used in future slope evaluations.

104. Additionally, it is recommended that the monitoring of blasts be continued during future operations. This analysis has served

to illustrate the relative effects that blast-induced accelerations can have on a slope. For marginally safe slopes, the effects could easily be enough to cause instability, and any blasts in such areas should be monitored whenever possible.

Recommendations for Comprehensive Blasting Design

105. While the primary purpose of this report is to provide recommendations for prevention of a massive failure of La Pita Hill, the total benefit of the report will not be realized unless a series of incremental reports are completed for selected slopes along the Canal. The combined results of a series of detailed analyses, supplemented with semiempirical analyses between slopes studied in detail, would provide the data base from which detailed blasting recommendations could be developed for the Gaillard Cut.

106. A final summary report is envisioned in which results of the above recommended incremental reports are coupled with recorded blasting experience in the Canal and are systematically applied to the entire Gaillard Cut. The development of final blasting recommendations would follow the step-by-step approach, outlined below and graphically illustrated in Figure 32.

- a. Select slopes for analysis contingent upon deepening locations and stability.
- b. Incrementally evaluate and provide design recommendations for selected slopes by conventional analyses.
- c. Perform semiempirical analyses on selected slopes.
- d. Perform semiempirical analyses on areas between selected slopes.
- e. Develop conventional analysis versus semiempirical analysis relationships for extrapolation to areas between selected slopes.
- f. Obtain experience records for Canal blasting.
- g. Develop slope height/slope angle versus blast weight relationships.

- h. Plot b, c, d, and f using e and g to adjust the data and fill in the gaps.
- i. Provide final blasting recommendations determined from h.
- j. Adjust final recommendations as required by additional blasting experience.

107. Implementation of these final recommendations will provide blasting recommendations based upon experience with Canal blasting, experience with previous slides, and stability evaluations using present strength criteria and current analysis techniques. When implemented, these blasting recommendations will be readily adaptable to "fine tuning" or adjustment, as additional blasting experience is gained during the Canal deepening project.

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Table 1

Subsurface Information Available at La Pita Hill

Boring Designation	Date of Boring	Station ft*	Boring Information					Present Use
			Offset from C _L ft*	Ground Elevation ft**	Depth ft	Water Level Elevation ft		
ERE-1	19 Jun 72	1827+23	440 E	209.2	214.7	83.5	EDM† station	
ERE-2	21 Sep 59	1829+15	428 E	209.2	198.0	-	None	
ERE-3	23 Sep 59	1830+28	445 E	182.6	190.2	152.6	EDM station, plain-cased deflection borehole	
ERE-4	23 Sep 59	1830+77	493 E	207.4	208.9	(182.4)	Telemac	
ERE-4a	(23 Sep 59)	1830+78	493 E	207.8	210.0	182.8	Plain-cased deflection borehole	
ERE-5	27 Jul 72	1830+46	667 E	278.2	418.8	223.2	Plain-cased deflection borehole	
ERE-6	26 Sep 59	1832+01.5	315 E	180.2	202.9	-	None	
ERE-7	19 Sep 59	1832+00	765 E	319.5	252.0	-	None	
ERE-8	8 Oct 59	1834+80	385 E	182.8	204.0	-	None	
ERE-9	29 Sep 59	1833+80	564 E	245.5	251.0	-	None	
ERE-10	1 Oct 59	1835+60	555 E	226.4	207.0	-	None	
ERE-11	5 Oct 59	1838+45	370 E	174.0	210.0	-	None	
ERE-12	1 Oct 59	1837+65	710 E	242.6	232.0	-	None	
ERE-13	23 Sep 59	1840+54	295 E	95.9	113.0	-	None	
ERE-14	28 Sep 59	1839+00	590 E	207.5	229.0	-	None	
ERE-15	12 Jul 72	1829+05	577 E	241.3	250.2	181.0	Plain-cased deflection borehole	
ERE-18	23 Aug 72	1831+50	822 E	325.3	339.3	239.3	Plain-cased deflection borehole	
ERE-20	24 Aug 72	1832+53	562 E	251.7	280.0	161.7	Plain-cased deflection borehole	
ERE-25	22 Feb 75	1830+54	932 E	339.2	380.6	312.6	Core hole	
ERE-26	22 Mar 75	1832+47	812 E	307.8	300.2	263.0	Core hole	
ERE-27	11 Apr 75	1829+22	803 E	312.3	301.2	281.0	Piezometer	
SC-82	25 Mar 47	1832+56	1128 E	346.2	392.7	302.2	EDM station, plain-cased borehole	
LBE-19	3 Mar 73	1824+53	492 E	199.6	469.0	-	EDM station, plain-cased borehole	
CDC-16	8 Jul 74	1822+50	250 E	83.2	80.0	83.2	Corehole	
CDC-17	26 Jun 74	1827+00	250 E	83.7	60.7	83.7	Corehole	
CDC-18	28 Jun 74	1830+25	250 E	83.6	68.9	83.6	Corehole	
CDC-19	1 Jul 74	1832+00	250 E	85.0	63.5	85.0	Corehole	
CDC-20	3 Jul 74	1835+00	250 E	83.6	67.8	83.6	Corehole	
CDC-21	25 Jul 74	1838+50	250 E	83.5	62.5	83.5	Corehole	

* Present station and offset.

** Feet above mean sea level (msl).

† EDM = electronic distance measurement.

Table 2

Settlement and Alignment Monuments

Monument Designation	Station ft*	Offset from G _L ft*	Ground Elevation ft**	Present Use
0	1831+50	900.00 E	335.08	Settlement and alignment checks, and EDM ⁺ station
1	1831+50	840.00 E	333.36	Settlement and alignment checks
2	1831+50	754.37 E	291.56	Settlement and alignment checks, and EDM station
3	1831+50	724.33 E	287.98	Settlement and alignment checks
4	1831+50	694.70 E	278.96	Settlement and alignment checks
5	1831+50	666.13 E	270.36	Settlement and alignment checks
6	1831+50	632.81 E	265.67	Settlement and alignment checks, and EDM station
7	1831+50	603.69 E	251.43	Settlement and alignment checks
8	1831+50	577.94 E	245.08	Settlement and alignment checks
9	1831+50	521.78 E	208.47	Settlement and alignment checks
10	1831+50	503.76 E	207.00	Settlement and alignment checks
11	1831+50	485.01 E	203.18	Settlement and alignment checks
12	1831+50	458.80 E	191.91	Settlement and alignment checks
13	1831+50	421.67 E	184.14	Settlement and alignment checks
14	1831+50	399.78 E	180.12	Settlement and alignment checks

* Present station and offset.

** Feet above mean sea level (msl).

⊕ EDM = electronic distance measurement.

Table 3

Seismograph Data Evaluation for La Pita Hill

Blast No.	Velocity Longitudinal and Transverse Amplitudes at Maximum Value	Resultant Vector Velocity, in./sec				Resultant Vector Acceleration, g				Percentage Increase of Maximum Acceleration (with Transverse and Longitudinal at Maximum Values over Maximum Instantaneous Acceleration)
		Vertical, Transverse, and Longitudinal Amplitude at Maximum Value	Instantaneous Transverse Velocity with Amplitude at Maximum Value	Instantaneous Vertical Velocity with Amplitude at Maximum Value	Instantaneous Longitudinal Velocity with Amplitude at Maximum Value	Instantaneous Transverse, Vertical, and Longitudinal Acceleration with Maximum Value	Instantaneous Transverse Velocity at Maximum Value	Instantaneous Vertical Velocity at Maximum Value	Instantaneous Longitudinal Velocity at Maximum Value	
1	4032	2.09	1.123	0.583	1.936	0.35	0.209	0.099	0.312	12.2
2	4032	2.26	1.704	0.708	1.840	0.42	0.312	0.116	0.249	34.6
3	4032	2.27	1.710	0.916	1.563	0.36	0.025	0.175	0.316	13.9
3	3409	1.61	0.636	1.177	1.396	0.20	0.058	0.149	0.138	34.2
4	4032	4.77	4.310	1.015	2.612	0.765	0.688	0.087	0.280	11.2
4	3409	1.56	0.833	0.829	1.119	0.20	0.124	0.059	0.133	50.4
5	3409	4.11	1.353	1.340	2.911	0.44	0.221	0.114	0.319	37.9
5	4032	2.42	1.467	1.597	1.911	0.36	0.238	0.217	0.290	24.1
6	3409	2.05	1.041	1.044	1.713	0.35	0.099	0.211	0.266	31.6
6	4032	2.23	1.127	1.596	1.686	0.33	0.240	0.219	0.244	35.2
7	3409	2.90	1.451	1.016	2.619	0.30	0.089	0.101	0.282	6.4
7	4032	3.34	1.791	2.275	1.118	0.53	0.270	0.240	0.003	96.3
8	3409	1.55	0.618	0.364	1.269	0.18	0.059	0.115	0.143	25.9
8	4032	2.70	2.240	1.815	2.454	0.41	0.335	0.292	0.370	10.8
10	3409	1.92	0.921	0.790	1.586	0.20	0.094	0.083	0.165	21.2
10	4032	2.92	0.960	0.729	2.840	0.51	0.156	0.190	0.458	11.4
11	4032	3.49	2.116	2.084	3.029	0.52	0.358	0.349	0.386	34.7
12	3409	5.27	3.376	4.037	3.420	1.17	0.696	1.021	0.650	14.6
12	4032	4.16	3.835	1.859	3.751	0.55	0.508	0.248	0.500	8.3
13	4032	1.83	1.089	0.932	1.459	0.30	0.186	0.174	0.207	44.9
14	4032	5.08	2.644	0.843	2.307	0.71	0.285	0.099	0.252	149.0
14	3409	1.25	0.676	0.480	1.030	0.180	0.094	0.082	0.149	28.6
15	4032	8.89	4.927	7.168	5.196	2.12	0.799	0.528	0.612	165.3
15	3409	1.73	0.879	1.182	1.557	0.240	0.137	0.164	0.210	14.3
16	3409	1.47	1.077	0.814	1.067	0.193	0.124	0.101	0.150	28.7
16	4032	5.69	2.218	4.882	3.663	0.95	0.436	0.846	0.533	12.3
17	3409	7.33	3.530	3.379	6.753	0.91	0.488	0.91	0.776	0.0
17	4032	7.32	4.966	6.137	1.842	1.31	0.856	1.331	0.256	0.0
18	3409	1.11	0.827	0.509	1.000	0.17	0.131	0.096	0.155	9.7
18	4032	10.16	7.613	6.946	7.646	1.35	0.940	1.950	0.907	42.1
19	3409	1.02	0.632	0.836	0.851	0.16	0.097	0.145	0.137	10.3
19	4032	7.59	5.378	21.794	5.097	1.40	0.443	0.778	0.814	72.0

Average percent increase 34.0

Table 4

Production Blasts - Canal Widening

Station ft		Offset (Assumed) ft		Distance to Centroid of La Pita Hill R, ft*	Weight W, lb	$W^{1/3}$	Scaled Distance R/W ^{1/3}	Calculated Acceleration g**
Old	Present	Old	Present	R, ft*	W, lb	$W^{1/3}$	R/W ^{1/3}	g**
1647+75	1813+75	375 W	268 W	1935	20,000	27.144	71.29	0.215
1648+50	1814+50	365 W	258 W	1875	20,000	27.144	69.08	0.235
1647+50	1813+50	375 W	268 W	1950	20,000	27.144	71.84	0.212
1647+00	1813+00	375 W	268 W	1992	20,000	27.144	73.39	0.200
1645+00	1811+00	375 W	268 W	2150	250	6.300	341.27	<0.001
1646+50	1812+50	375 W	268 W	2030	20,000	27.144	74.79	0.188
1646+00	1812+00	375 W	268 W	2070	20,000	27.144	76.26	0.177
1646+00	1812+00	375 W	268 W	2070	20,000	27.144	76.26	0.177
1645+50	1811+50	375 W	268 W	2107	13,160	23.609	89.25	0.114
1659+25	1824+35	250 W	322 W	1200	10,000	21.544	55.70	0.425
1645+00	1811+00	375 W	268 W	2150	12,000	22.894	93.91	0.101
1658+80	1823+94	250 W	310 W	1212	2,160	12.927	93.76	0.102
1658+54 to 1658+60	1823+73	250 W	300 W	1217	4,125	16.038	75.88	0.181
1644+00 to 1648+65	1810+00 to 1814+65	375 W	268 W	2042	4,125	16.038	127.32	0.044
1658+35 to 1658+41	1823+60	250 W	295 W	1225	2,925	14.301	85.66	0.131
1658+16	1823+40	260 W	297 W	1240	3,000	14.423	85.97	0.128
1657+98 to 1657+92	1823+07	265 W	292 W	1255	3,051	14.504	86.53	0.126
1645+55 to 1652+27	1811+55 to 1818+27	350 W	243 W	1835	8,811	20.654	88.84	0.118
1651+56 to 1652+36	1817+56 to 1818+36	350 W	243 W	1630	1,500	11.447	142.40	0.0325
1656+00	1821+45	300 W	262 W	1363	10,000	21.544	63.27	0.300
1651+50	1817+50	350 W	243 W	1657	10,000	21.544	76.91	0.177
1648+00	1814+00	375 W	268 W	1915	500	7.937	241.28	<0.001
1653+32 to 1654+60	1819+26 to 1819+75	325 W	225 W	1483	10,000	21.544	68.84	0.237
1650+62 to 1651+73	1816+62 to 1817+73	350 W	243 W	1682	8,000	20.000	84.10	0.136
1651+56 to 1653+17	1817+56 to 1819+17	350 W	243 W	1604	9,000	20.801	77.11	0.172
1650+62	1816+62	350 W	243 W	1717	100	4.642	369.88	0.001
1650+50	1816+50	350 W	243 W	1723	5,000	17.100	100.76	0.084
1650+00	1816+00	350 W	243 W	1758	40,000	34.200	51.40	0.525
1644+55 to 1645+50	1810+55 to 1811+50	375 W	268 W	2145	8,880	20.708	103.58	0.077
1648+09 to 1649+61	1814+09 to 1815+61	350 W	243 W	1835	45,000	35.568	51.59	0.521
1642+49 to 1654+09	1808+49 to 1819+60	375 W	268 W	1883	39,000	33.91	55.53	0.427
1644+49 to 1645+53	1810+49 to 1811+53	375 W	268 W	2150	37,000	33.32	64.53	0.280
1649+65 to 1651+17	1815+65 to 1817+17	350 W	243 W	1718	46,000	35.83	47.95	0.635
1646+73 to 1648+01	1812+73 to 1814+01	375 W	268 W	1967	48,000	36.34	54.13	0.456
1651+25 to 1652+45	1817+25 to 1818+45	350 W	243 W	1635	38,000	33.62	48.63	0.613
1656+37 to 1657+45	1821+62 to 1822+62	275 W	267 W	1300	38,000	33.62	38.67	1.140
1653+93 to 1654+65	1819+53 to 1819+85	325 W	230 W	1468	40,000	34.20	42.92	0.870
1654+41 to 1654+69	1819+59 to 1819+84	325 W	237 W	1457	39,000	33.91	42.97	0.860
1652+45 to 1659+21	1818+44 to 1824+37	300 W	258 W	1373	37,000	33.32	41.21	0.960
1650+01 to 1650+69	1816+01 to 1816+69	350 W	243 W	1735	39,000	33.91	51.16	0.530
1652+85 to 1653+89	1818+85 to 1819+48	350 W	238 W	1537	39,000	33.91	45.33	0.740
1655+49 to 1656+33	1820+75 to 1821+53	300 W	260 W	1368	40,000	34.20	40.00	1.040
1659+13 to 1660+01	1824+30 to 1825+13	240 W	320 W	1180	41,000	34.48	34.22	1.580
1650+77 to 1651+73	1816+77 to 1817+73	350 W	243 W	1675	40,000	34.20	48.98	0.600

(Continued)

Note: Calculated maximum acceleration from Canal widening blasts = 1.95 g; mean acceleration = 0.43 g.

* Assumed to be at sta 1831+00, 675 ft east of Canal center line.

** From graph of acceleration versus scaled distance, Figure 12.

Table 4 (Concluded)

Station ft		Offset (Assumed) ft		Distance to Centroid of La Pita Hill R, ft	Weight W, lb	$W^{1/3}$	Scaled Distance R/W ^{1/3}	Calculated Acceleration g
Old	Present	Old	Present					
1658+17 to 1659+21	1823+38 to 1824+37	250 W	304 W	1217	36,000	33.02	36.86	1.031
1660+09 to 1660+97	1825+22 to 1827+20	225 W	330 W	1119	34,000	32.38	34.56	1.550
1651+81 to 1652+77	1817+81 to 1818+77	350 W	243 W	1605	40,000	34.20	46.93	0.680
1657+05 to 1658+09	1822+24 to 1823+24	225 W	285 W	1274	40,000	34.20	37.25	1.260
1661+05 to 1662+49	1827+32 to 1828+84	277 W	320 W	1090	40,000	34.20	31.87	1.950
1656+09 to 1656+97	1821+37 to 1822+19	275 W	275 W	1317	35,000	32.71	40.26	1.030
1655+13 to 1656+01	1820+29 to 1821+10	325 W	270 W	1405	40,000	34.20	41.08	0.970
1654+41 to 1655+05	1819+59 to 1820+20	325 W	248 W	1450	33,000	32.08	45.20	0.745
1653+85 to 1654+33	1819+40 to 1819+57	325 W	225 W	1483	34,480	32.55	45.56	0.730
1652+89 to 1653+93	1818+89 to 1819+50	350 W	243 W	1540	38,840	33.87	45.47	0.735
1651+77 to 1652+81	1817+77 to 1818+81	350 W	243 W	1613	39,210	33.97	47.48	0.650
1650+73 to 1651+77	1816+73 to 1817+77	350 W	243 W	1675	36,390	33.14	50.54	0.550
1653+00 1659+00 to 1661+50	1819+00 1824+22 to 1827+88	350 W 263 W	243 W 344 W	1565 1140	230 7,728	6.13 19.38	255.30 58.82	<0.001 0.368
1655+50 to 1656+67	1820+68 to 1821+82	300 W	263 W	1360	1,215	10.67	127.46	0.044
1650+00 to 1652+00	1816+00 to 1818+00	350 W	243 W	1693	9,000	20.80	81.39	0.150
1653+00 to 1656+00	1819+00 to 1821+20	300 W	204 W	1437	6,000	18.17	79.09	0.162
1656+23 to 1657+03	1821+39 to 1822+15	290 W	272 W	1330	20,000	27.14	49.01	0.597
1657+50 1655+00 to 1655+50	1822+66 1820+11 to 1820+64	275 W 325 W	285 W 260 W	1277 1420	22,000 20,000	28.02 27.14	45.57 52.32	0.732 0.492
1654+18 to 1654+50	1819+60 to 1819+69	325 W	230 W	1467	25,000	29.24	50.17	0.562
1654+50 1653+50	1819+69 1819+50	325 W 350 W	235 W 243 W	1455 1535	20,122 20,000	27.20 27.14	53.49 56.56	0.470 0.406
1653+00 1652+00	1819+00 1818+00	350 W 350 W	243 W 243 W	1565 1625	30,000 20,000	31.07 27.14	50.37 59.87	0.555 0.349
1653+00 1651+50	1819+00 1817+50	350 W 350 W	243 W 243 W	1565 1662	20,000 20,000	27.14 27.14	57.66 61.24	0.387 0.328
1650+00 1650+50	1816+00 1816+50	350 W 350 W	243 W 243 W	1756 1725	1,000 20,000	10.00 27.14	175.60 63.56	0.0185 0.298
1650+50	1816+50	350 W	243 W	1725	20,000	27.14	63.56	0.298

Table 5
La Pita Hill Blasts

Date	Blast No.	Station ft	Offset ft	Distance to Centroid R, ft (1831+00 675 ft E)	Weight W, lb	$W^{1/3}$	Scaled Distance $R/W^{1/3}$	Acceleration $\frac{R}{W^{1/3}}$
15 Jan 75	1	1822+50 to 1823+50	259-295 W	1248	6175	18.35	68.01	0.24
17 Jan 75	2	1823+50 to 1824+50	264-300 W	1187	5625	17.79	66.72	0.25
22 Jan 75	3	1824+50 to 1825+50	262-307 W	1135	5850	18.02	62.99	0.27
24 Jan 75	4	1825+50 to 1826+50	275-320 W	1097	6225	18.40	59.62	0.35
28 Jan 75	5	1826+50 to 1827+50	285-330 W	1065	7033	19.16	55.58	0.43
30 Jan 75	6	1827+50 to 1828+50	285-330 W	1032	5658	17.82	57.91	0.37
3 Feb 75	7	1828+50 to 1829+50	303 W	1000	5000	17.10	58.48	0.37
5 Feb 75	8	1829+50 to 1830+50	285-330 W	987	3600	15.33	64.38	0.28
	9	NO DATA AVAILABLE						
11 Feb 75	10	1831+50 to 1832+50	285-330 W	986	3575	15.29	64.49	0.28
13 Feb 75	11	1832+50 to 1833+50	285-330 W	1003	4950	17.03	58.90	0.35
14 Feb 75	12	1833+50 to 1834+50	285-330 W	1030	4167	16.09	64.01	0.29
18 Feb 75	13	1834+50 to 1835+50	312-330 W	1075	2200	13.01	82.63	0.14
19 Feb 75	14	1834+50 to 1835+50	285-303 W	1052	1867	12.31	85.46	0.13
20 Feb 75	15	1835+50 to 1836+50	295-313 W	1103	2208	13.02	84.72	0.14
21 Feb 75	16	1835+50 to 1836+50	268-286 W	1078	2009	12.62	85.42	0.13
24 Feb 75	17	1836+50 to 1837+50	250-268 W	1110	2642	13.82	80.32	0.15
25 Feb 75	18	1836+50 to 1837+50	277-295 W	1135	1800	12.16	93.34	0.10
26 Feb 75	19	1837+50 to 1838+50	245-263 W	1163	2400	13.39	86.86	0.12

Note: Maximum acceleration = 0.43 g; mean acceleration = 0.24 g.

Table 6
Summary of Laboratory Strength Test Results for the Las

Location	Boring No.	Sample No.	Depth ft	Description	Atterberg Limits			Grain Size < 2 μ %	Activity Ratio	G _s	Initial Laboratory Test Results				
					LL	PL	PI				Water Content %	Dry Density pcf	Void Ratio	Saturation %	
					South Atlantic Division Laboratory, 1968										
Route 14, Panama	D-1	2	81.7-82.9	Green volcanic agglomerate slakes to MH	60	33	27	13	2.1	2.64	11.2	148	--	--	UC
		4	101.0-102.5	White tuff slakes to MH	84	46	38	15	2.5	2.63	12.3	142	--	--	UC
		10	174.9-176.0	Agglomerate	--	--	--	--	--	2.66	7.1	155	--	--	UC
		13	230.4-231.6	Agglomerate	--	--	--	--	--	2.77	11.0	147	--	--	UC
		15	235.5-236.0	Red shale slakes to SM (considered a clay shale)	37	34	3	3	1.5	2.80	18.7	111.4	0.569	91.7	Multistage 2 in. by δ _{max} = 1
		16	237.8-240.0	Dark brown shale slakes to CH (considered a clay shale)	50†† 78* 93††	39†† 31* 35††	11†† 47* 58††	2†† 27* 41††	5.5 1.7 1.4	2.82	14.8 16.3 16.1 14.9	117.1 112.5 109.9 110.4	0.503 0.564 0.601 0.594	83.3 81.3 75.6 70.8	DDS on und by 2 in. min, δ _p
Waterways Experiment Station, 1975 (This F															
La Pita Hill	ERE-25A	6	125.0-127.0	Agglomerate, OH-5 to RH-3	102§§	22§§	80§§	--	--	--	22.4 18.3 17.5	107.4 111.3 113.8	--	--	UDS on und imately at 0.002
		8	165.8-168.3	Tuff, RH-3 to RH-1	97§§	39§§	58§§	--	--	--	24.1 24.6 25.4	104.5 104.6 102.5	--	--	UDS on und imately at 0.002
		9	169.0-171.2	Tuff, RH-3 to RH-1	82§§	34§§	48§§	--	--	--	23.4 23.5 24.5	101.6 101.6 101.2	--	--	DDS on und 3 in. by min, δ _m
	ERE-25A	11A	212.0-213.1	Tuff, RH-1 to RH-2	98§§	40§§	58§§	--	--	--	15.7 16.5 16.3	120.3 119.8 119.4	--	--	UDS on und imately at 0.002
	ERE-25A	11B	213.1-214.1	Tuff, RH-1 to RH-2	82§§	30§§	52§§	--	--	--	--	--	--	--	None
	ERE-26	3	164.6-165.3	Tuff, RH-1 to RH-2	78§§	38§§	40§§	--	--	--	16.2 16.7	118.7 114.5	--	--	UDS on und imately at 0.002
	ERE-27#	6	135.5-136.3	Tuff, RH-2 to RH-3	76§§	36§§	40§§	--	--	--	22.1	107.3	--	--	
	ERE-26	5	209.8-210.3	Tuff (fault zone), RH-2 to RH-3	--	--	--	--	--	--	21.6	99.7	--	--	Multistage approx 0.42 in.
	ERE-26	6	236.7-237.9	Andesite, RH-3 to RH-5	--	--	--	--	--	--	11.7 11.4 12.1	129.0 128.4 128.8	--	--	UDS on und imately high, at in.
	ERE-27	4	74.5-75.6	Tuff, OH-3 to RH-2	98§§	43§§	55§§	--	--	--	39.1 38.9 42.1	78.3 79.5 77.5	--	--	RDDS on und by 3 in. min, δ _m
	ERE-27	7	141.4-142.5	Tuff, RH-2 to RH-3	99§§	57§§	42§§	--	--	--	29.3 88.6 27.2	95.0 96.1 96.9	--	--	UDS on und imately high, at in.

Note: s_u = undrained shear strength; σ_n^e = effective normal stress; σ_n = total normal stress; τ_p = peak shear strength; τ_u = ultimate shear strength; τ_r = c_p = total peak cohesion intercept; φ_p = total peak angle of internal friction; c_i = effective "ultimate" cohesion intercept; φ_i = effective "ultimate" angle of internal friction; UC = unconfined compression test; RDDS = repeated drained direct shear test; δ_{max}^u = maximum displacement; DDS = drained shear test; δ_p = displacement at peak stress; * "Ultimate" = strength at displacement of about 0.3 in. † U. S. Army Engineer Division, South Atlantic, 1968. †† 3 cycles of slaking 2 min in blender. ‡ 9 cycles of slaking 2 min in blender. §§ 19 cycles of slaking 4 min in blender. § Minimum value. §§ Air dried and soaked 48 hr each, then blenderized 10 min, Banks et al., 1975 (Appendix B). # Sample added due to insufficient material in boring No. ERE-26, sample No. 3, to perform complete test.

Table 6
Results for the Las Cascadas Formation

Saturation %	Type of Test*	Shear Strength Data															
		Normal Stress			Shear Stress			Peak				Ultimate**				Residual	
		σ_u tsf	σ'_n tsf	σ_n tsf	τ_p tsf	τ_u tsf	τ_r tsf	c'_p tsf	ϕ'_p deg	c_p tsf	ϕ_p tsf	c'_u tsf	ϕ'_u deg	c_u tsf	ϕ_u tsf	c'_r tsf	ϕ'_r deg
Division Laboratory, 1968+																	
--	UC	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
--	UC	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
--	UC	57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
--	UC	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
91.7	Multistage RDDS remolded specimen, 2 in. by 2 in. by 0.5 in., precut, $\delta_{max} = 10$ in.	--	4	--	--	0.57	--	--	--	--	--	--	--	--	0.2	4.5	
83.3	DDS on undisturbed specimens, 2 in. by 2 in. by 0.57 in. at 0.001 in./min, $\delta_p = 0.03-0.2$ in.	--	9	12.5	5.54	--	7.9	24.5	--	--	0.0	34.0	--	--	--	--	
81.3		--	10	13.3	6.98	--	--	--	--	--	--	--	--	--	--	--	
75.6		--	12	13.2	8.35	--	--	--	--	--	--	--	--	--	--	--	
70.8		--	18	16.6	13.10	--	--	--	--	--	--	--	--	--	--	--	
100.0	RDDS on undisturbed precut specimens, 2 in. by 2 in. by 0.5 in., $\delta_{max} = 10$ in.	--	4	2.97	--	1.62	1.8	15.5	--	--	--	--	--	--	0.5	11.5	
100.0		--	8	3.49	--	2.70	--	--	--	--	--	--	--	--	(Minimum		
100.0		--	12	5.65	--	3.82	--	--	--	--	--	--	--	--	values)		
Station, 1975 (This Report)																	
--	UDS on undisturbed specimens, approximately 5-in. diam. by 4.8 in. high, at 0.002 in./min, $\delta_{max} = 0.42$ in.	--	--	4	7.65	4.92	--	--	--	0.0	65.2	--	--	2.1	39.8	--	--
--		--	--	8	16.87	8.71	--	--	--	--	--	--	--	--	--	--	--
--		--	--	12	26.67	9.47	--	--	--	--	--	--	--	--	--	--	--
--	UDS on undisturbed specimens, approximately 5-in. diam. by 4.8 in. high, at 0.002 in./min, $\delta_{max} = 0.42$ in.	--	--	4	13.08	4.12	--	--	--	8.7	48.3	--	--	3.6	7.6	--	--
--		--	--	8	17.27	7.09	--	--	--	--	--	--	--	--	--	--	--
--		--	--	12	22.16	5.19	--	--	--	--	--	--	--	--	--	--	--
--	DDS on undisturbed specimens, 3 in. by 3 in. by 1.0 in. at 0.00008 in./min, $\delta_{max} = 0.5$ in.	--	4	--	6.72	2.82	--	0.4	38.0	--	--	0.0	25.0	--	--	--	--
--		--	8	--	6.62	2.82	--	--	--	--	--	--	--	--	--	--	--
--		--	12	--	9.70	5.57	--	--	--	--	--	--	--	--	--	--	--
--	UDS on undisturbed specimens, approximately 5-in. diam. by 4.8 in. high, at 0.002 in./min, $\delta_{max} = 0.42$ in.	--	--	4	12.32	4.29	--	--	--	8.5	44.3	--	--	2.1	28.6	--	--
--		--	--	8	16.06	6.50	--	--	--	--	--	--	--	--	--	--	--
--		--	--	12	25.67	10.23	--	--	--	--	--	--	--	--	--	--	--
--	None	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	UDS on undisturbed specimens, approximately 4-in. diam. by 4.8-in. high, at 0.002 in./min, $\delta_{max} = 0.42$ in.	--	--	4	18.33	2.55	--	--	--	15.4	36.3	--	--	2.0	23.5	--	--
--		--	--	8	21.19	5.49	--	--	--	--	--	--	--	--	--	--	--
--		--	--	12	22.13	7.24	--	--	--	--	--	--	--	--	--	--	--
--	Multistage UDS on a faulted specimen, approximately 3.9-in. diam. by 4.8 in. high, at 0.002 in./min, $\delta_{max} = 0.42$ in.	--	--	4	3.84	3.64	--	--	--	2.6	16.5	--	--	2.6	16.5	--	--
--		--	--	8	3.90	3.90	--	--	--	--	--	--	--	--	--	--	--
--		--	--	12	6.21	6.21	--	--	--	--	--	--	--	--	--	--	--
--	UDS on undisturbed specimens, approximately 3.9-in. diam. by 4.8-in. high, at 0.002 in./min, $\delta_{max} = 0.42$ in.	--	--	4	22.05	2.53	--	--	--	0.3	63.8	--	--	1.7	31.5	--	--
--		--	--	8	16.28	6.55	--	--	--	--	--	--	--	--	--	--	--
--		--	--	12	24.45	9.10	--	--	--	--	--	--	--	--	--	--	--
--	RDDS on undisturbed specimens, 3 in. by 3 in. by 1.0 in. at 0.03125 in./min, $\delta_{max} = 0.25$ in.	--	4	--	--	--	0.70	--	--	--	--	--	--	--	0.0	8.29	
--		--	8	--	--	--	1.28	--	--	--	--	--	--	--	--	--	
--		--	12	--	--	--	1.76	--	--	--	--	--	--	--	--	--	
--	UDS on undisturbed specimens, approximately 3.8-in. diam by 4.8-in. high, at 0.002 in./min, $\delta_{max} = 0.42$ in.	--	--	4	4.40	2.30	--	--	--	10.3	28.0	--	--	1.4	13.8	--	--
--		--	--	8	14.48	3.42	--	--	--	--	--	--	--	--	--	--	--
--		--	--	12	16.60	4.23	--	--	--	--	--	--	--	--	--	--	--

* τ_p = shear strength; τ_r = residual shear strength; c'_p = effective peak cohesion intercept; ϕ'_p = effective peak angle of internal friction; c'_u = effective "ultimate" angle of internal friction; c_u = total "ultimate" cohesion intercept ϕ_u = total "ultimate" angle of internal friction. test; δ_p = displacement at peak shear stress; UDS = undrained direct shear test performed in a rock shear device.

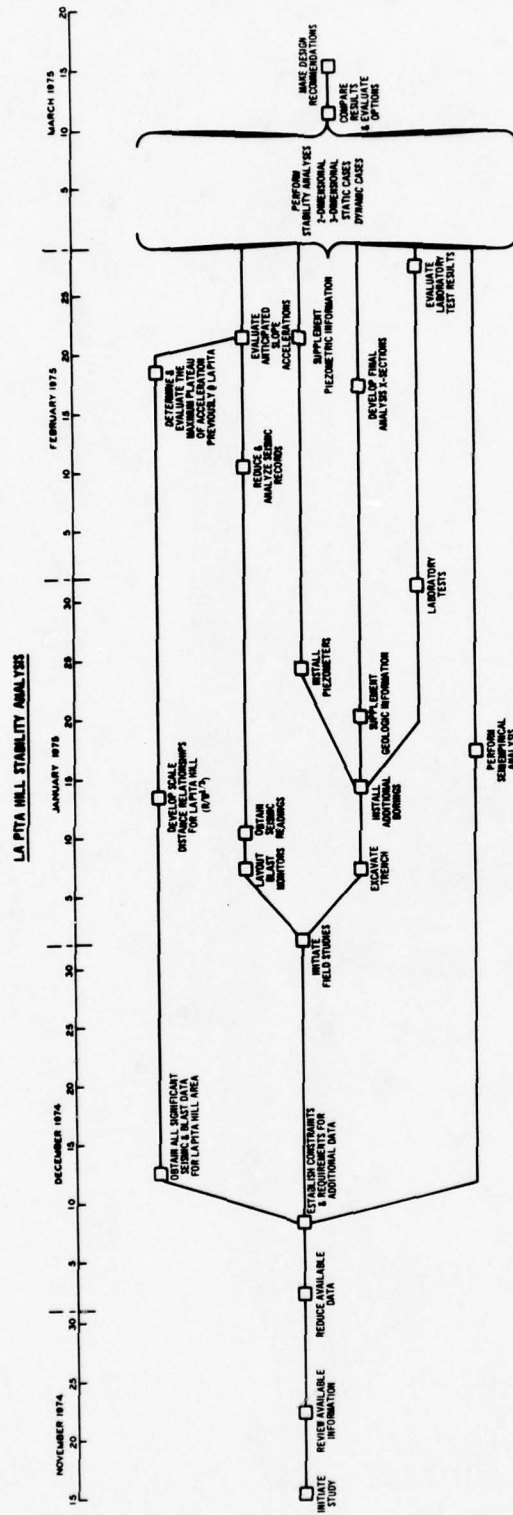


Figure 1. Critical path program of La Pita Hill stability evaluation. (The time frame indicated was extended due to a relaxation of the blasting schedule by PCC).

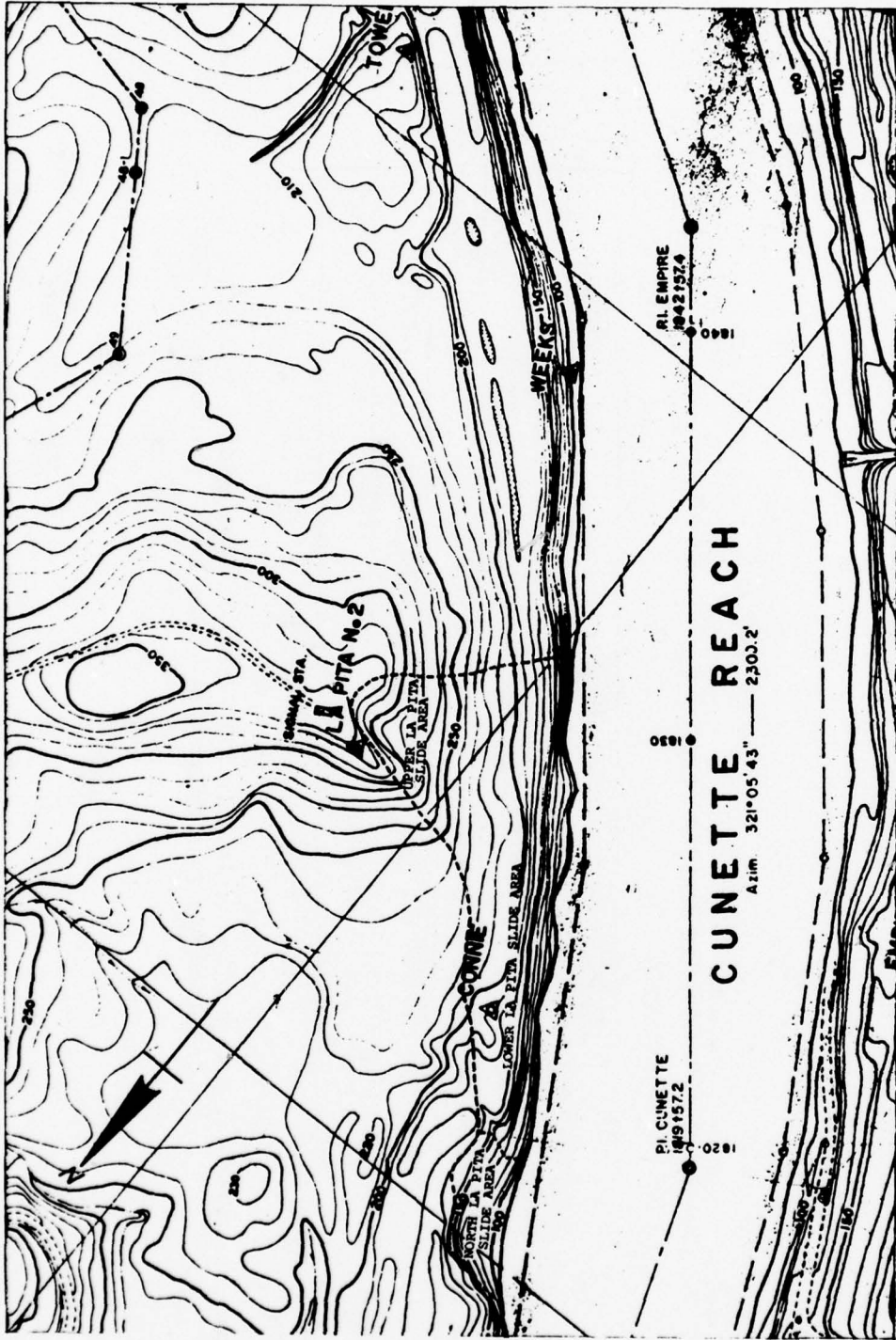


Figure 2. General plan map of La Pita Hill area showing location of previous slides

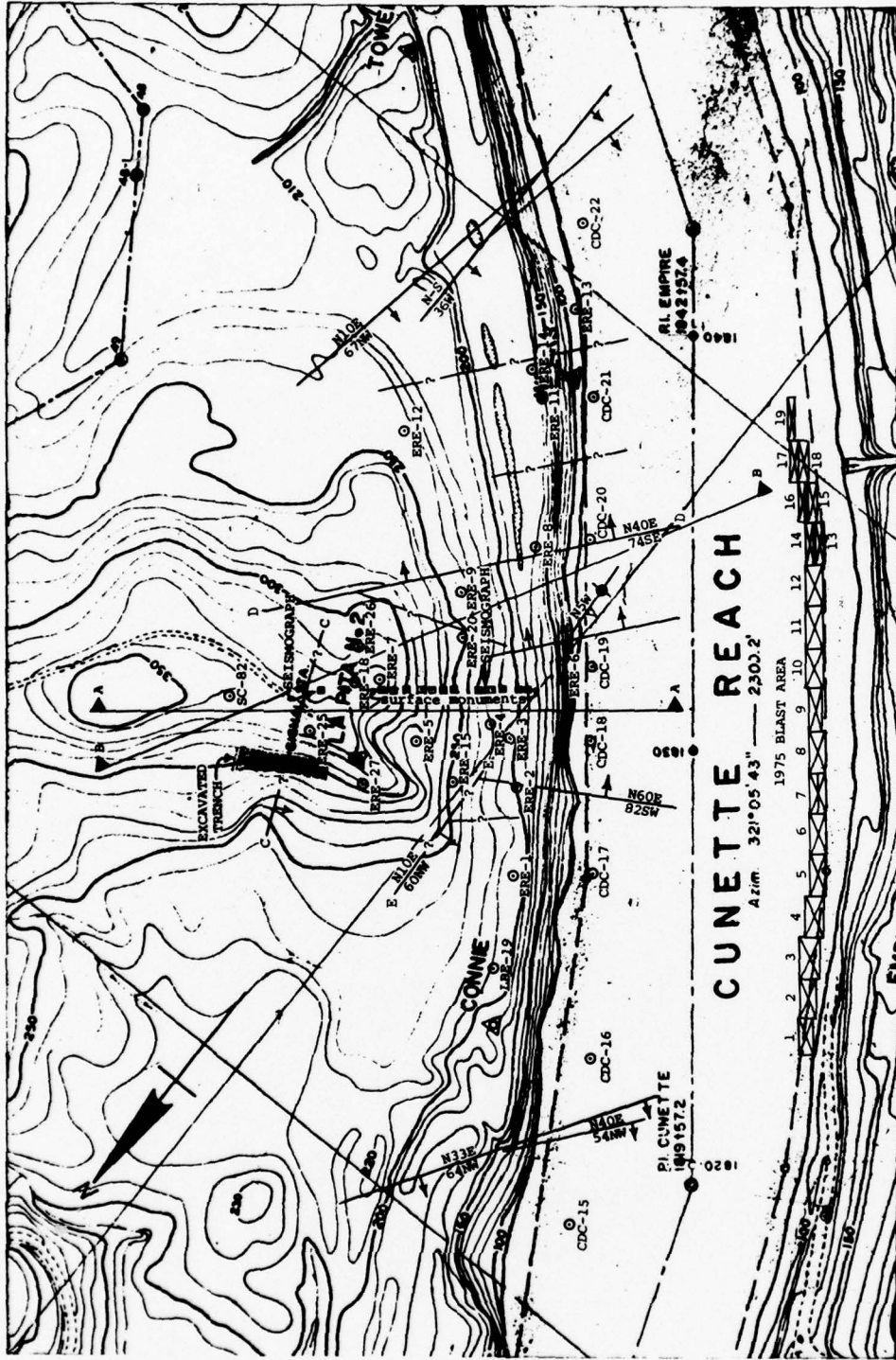


Figure 3. Plan map showing locations of borings, faults, trenches, surface monuments, and seismographs

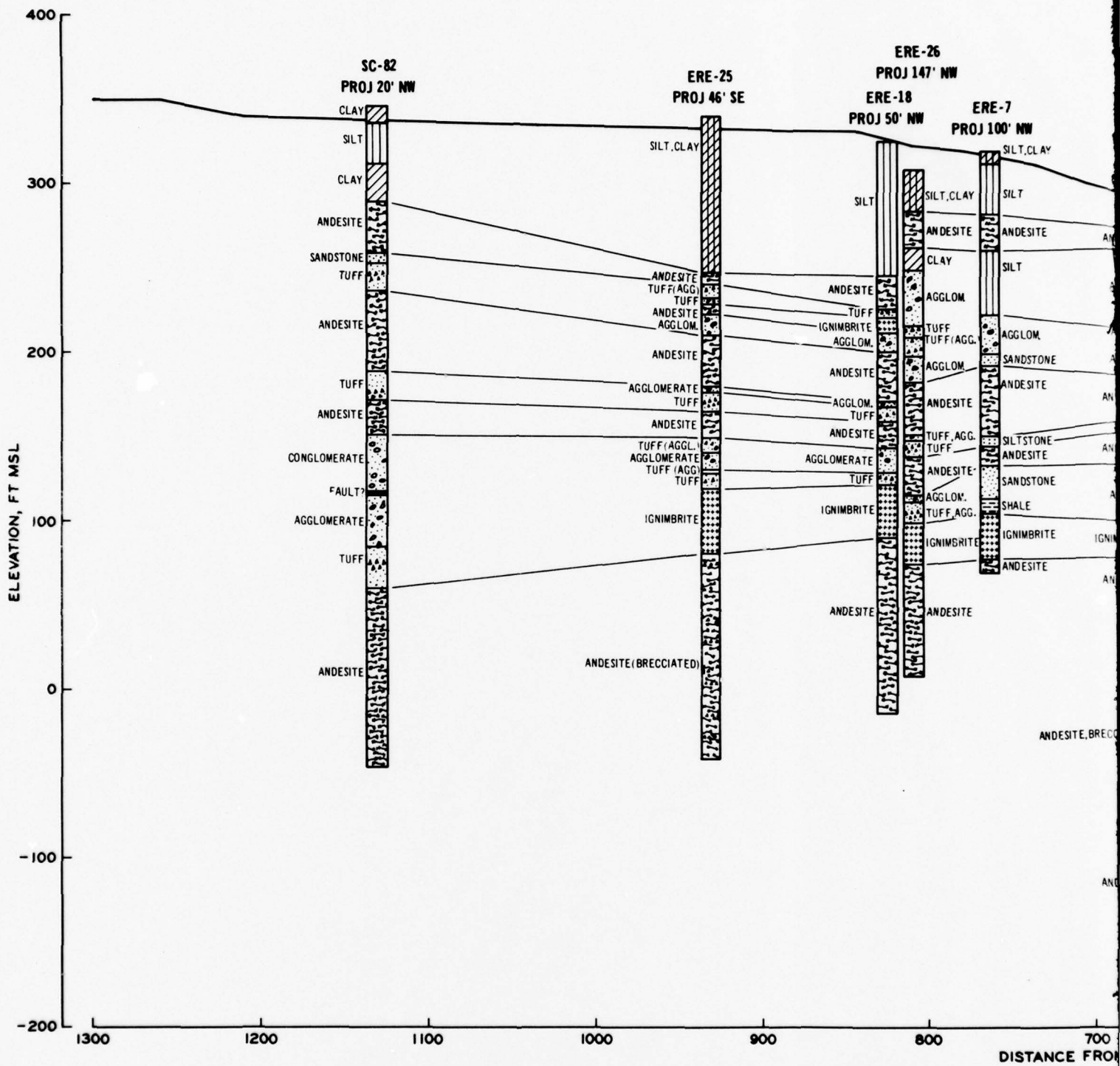
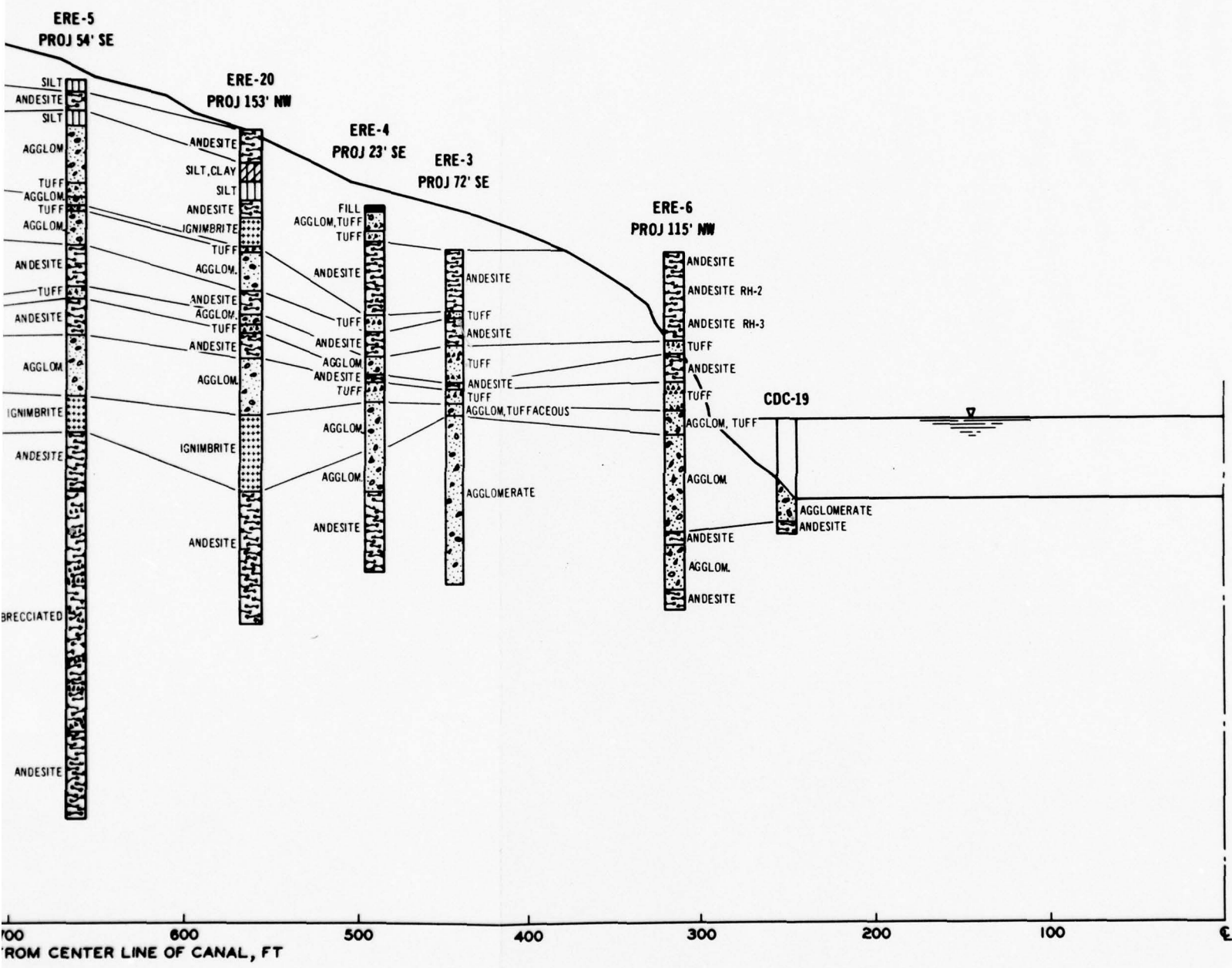
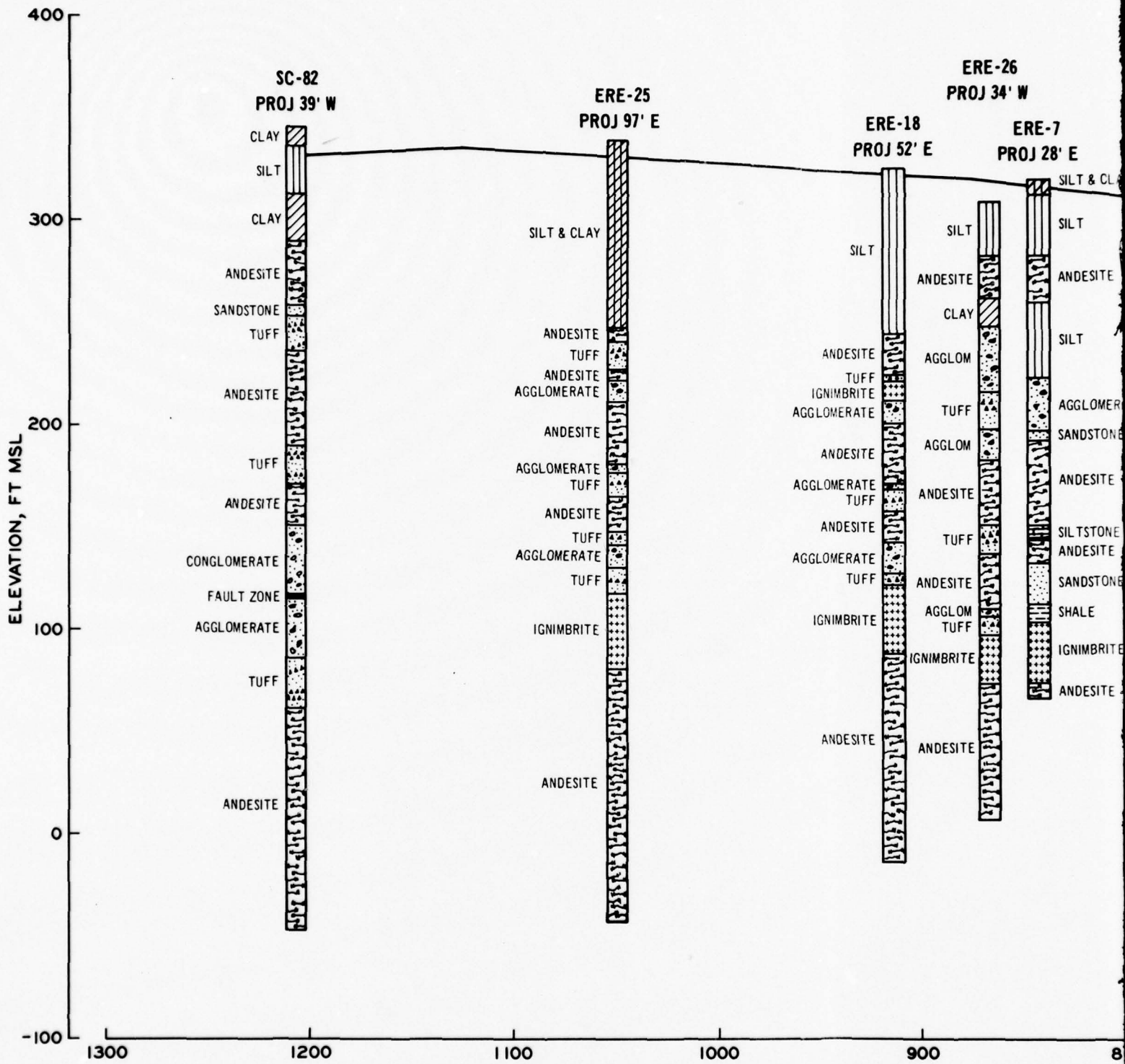


Figure 4. Geologic cross section



Section perpendicular to sta 1831+00

2



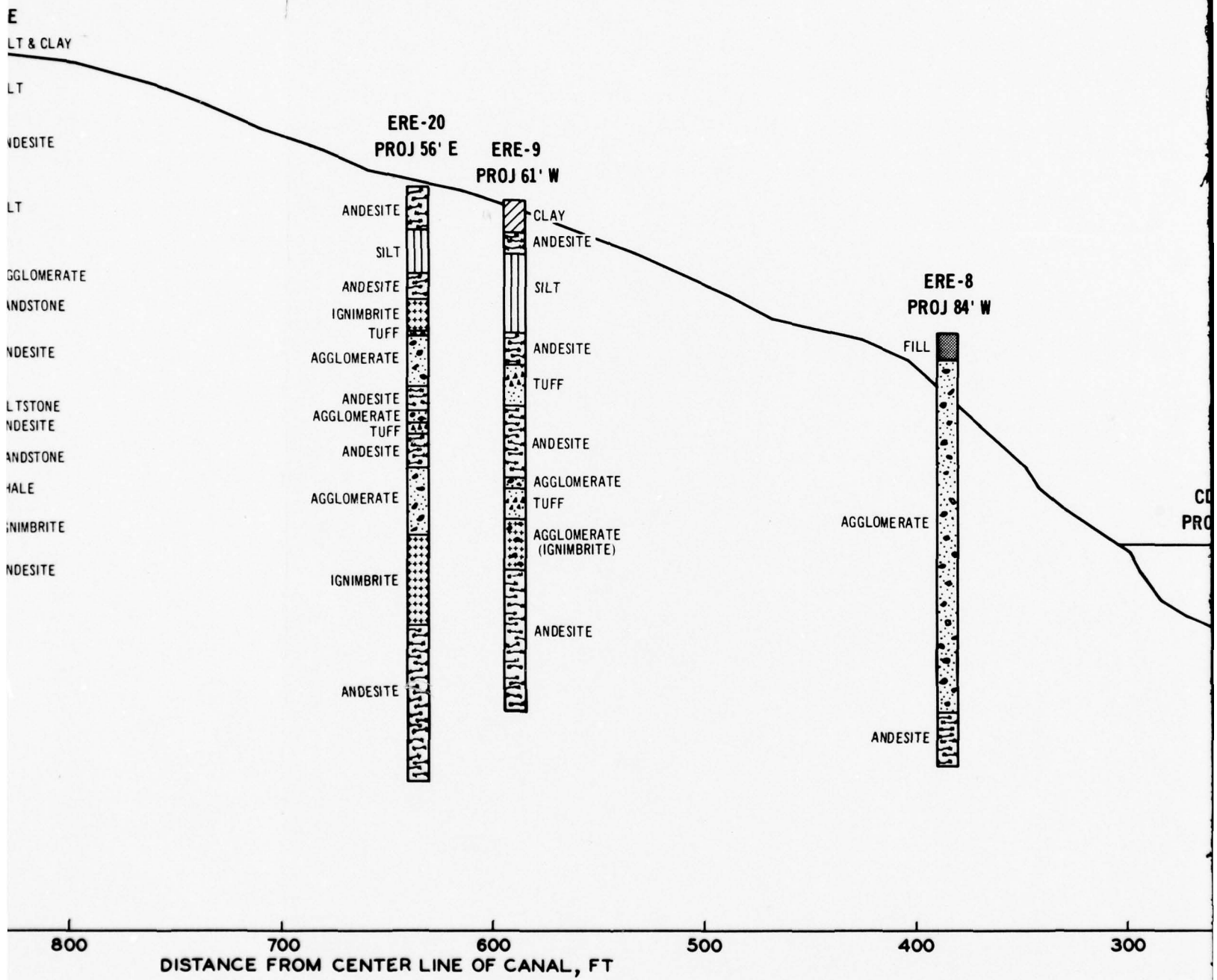


Figure 5. Oblique cross section through sta 1835+50

2

CDC-20
PROJ 50' W

IGNIMBRITE

AGGLOMERATE

300

200

100

E

3

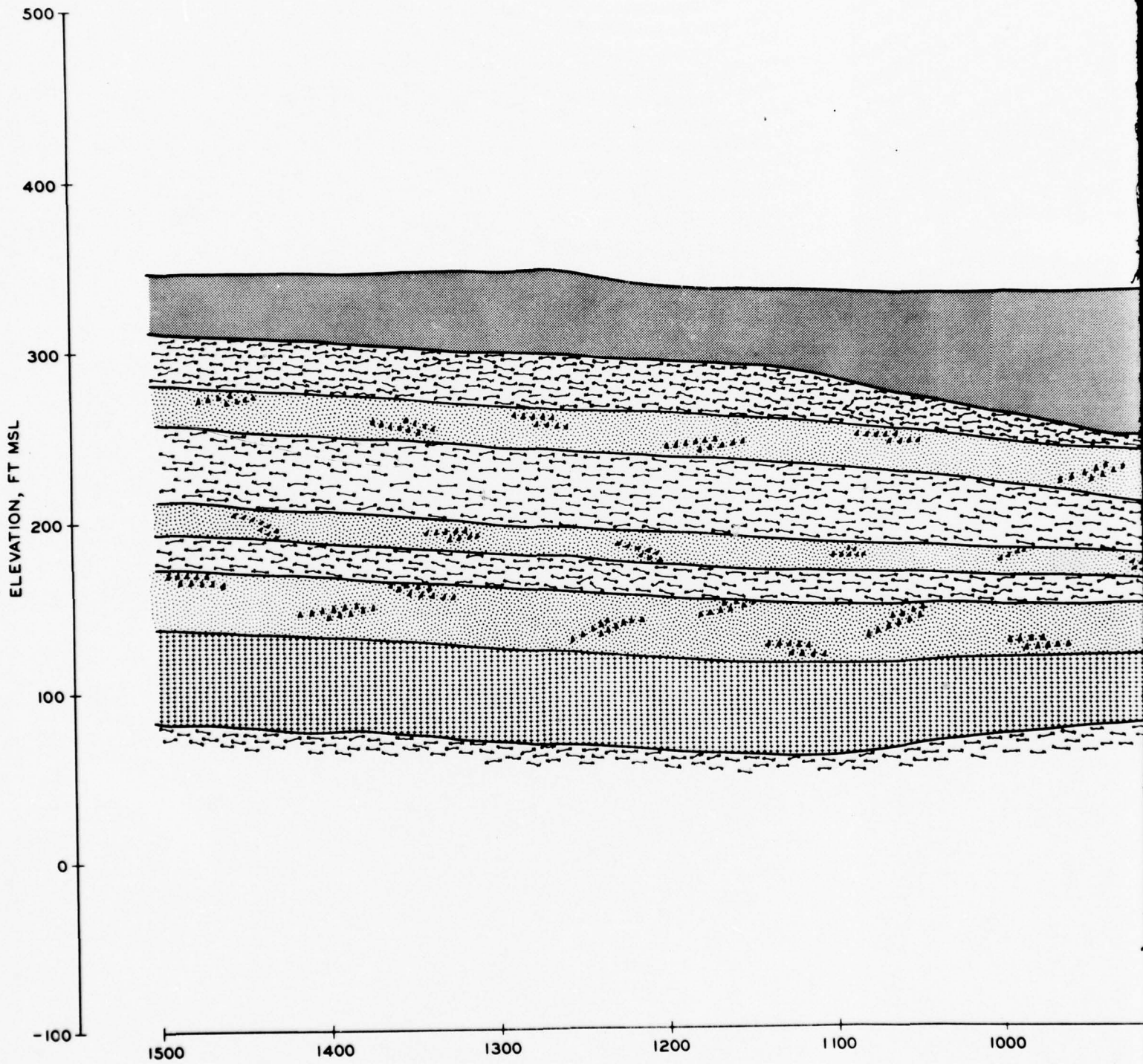
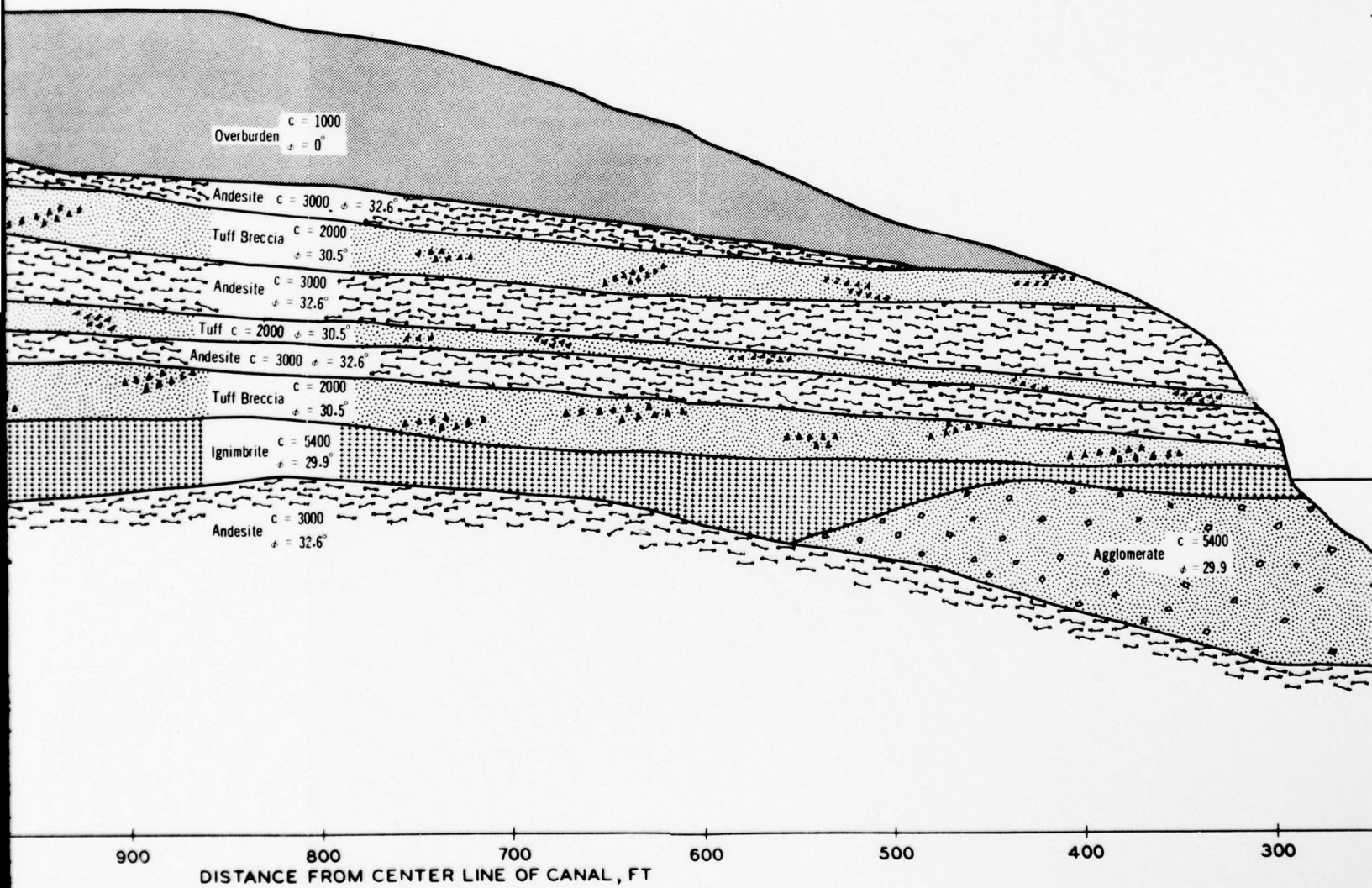
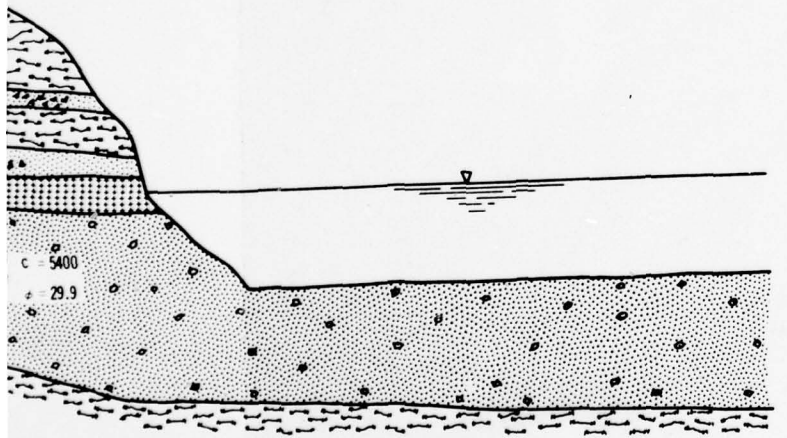


Figure 6. Simpl

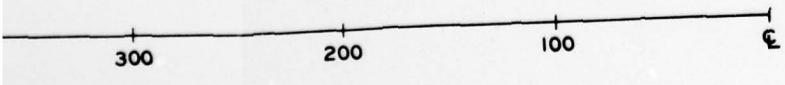


Simplified geologic cross section perpendicular to sta 1831+00

2



c 5400
29.9



3

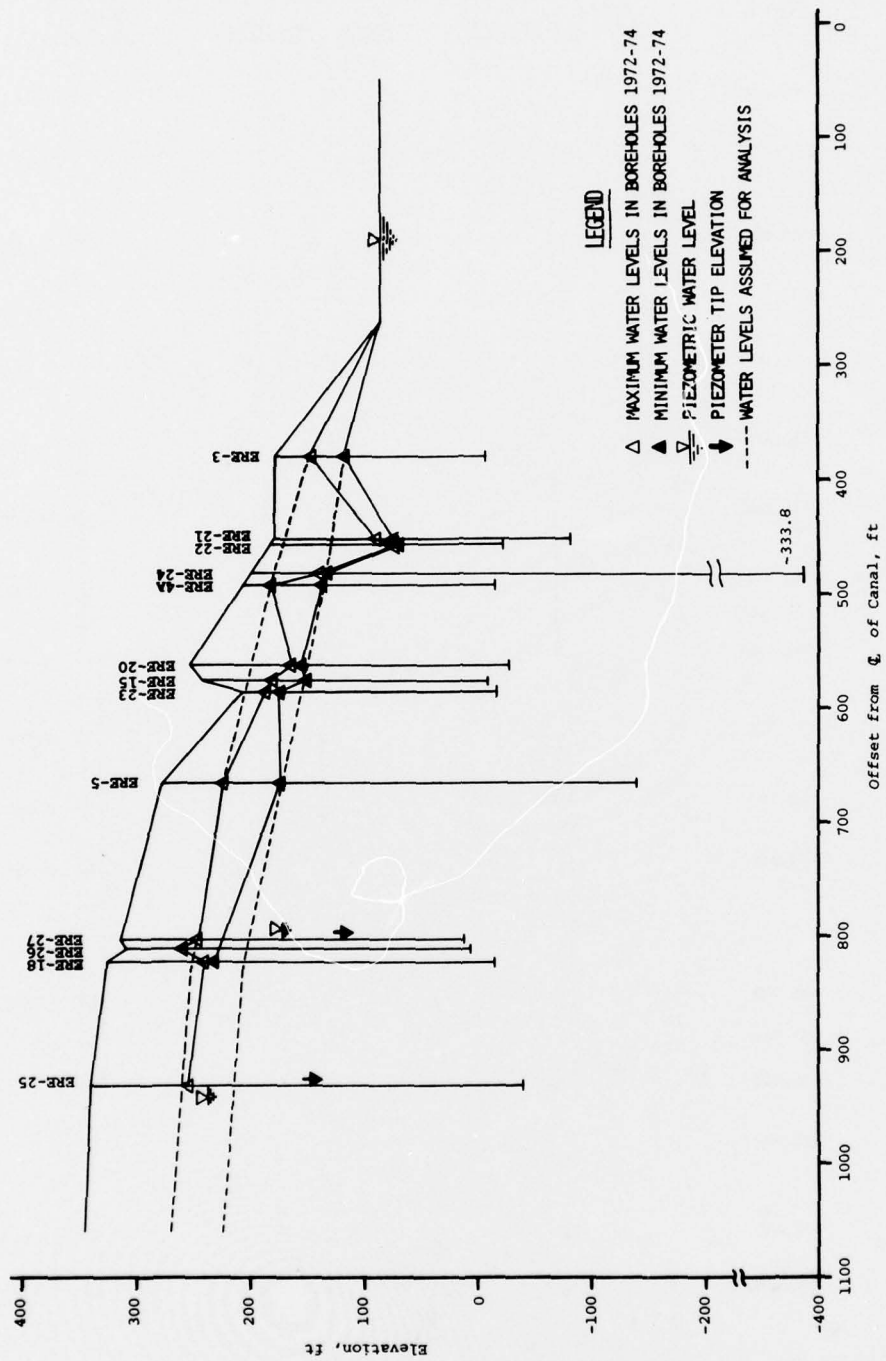


Figure 7. Projected section with maximum and minimum water levels, piezometric water levels, and water levels assumed for analysis

Monument	Initial Offset from \odot ft	Movement History				Net Horizontal Movement (ft E or W)
		from	to	from	to	
		05/06/70	05/30/73	05/30/73	05/24/74	
0	900.00E	\odot 0
1	840.0E	.	.	↑	↑	\odot 0.02E
2	754.37E				↑	\odot 0.12W
3	724.33E				↑	\odot 0.10W
4	694.70E				↑	\odot 0.17W
5	666.13E				↑	\odot 1.44W
6	632.81E				↑	\odot 0.14W
7	603.69				↓	\odot 0.05W
8	577.94E				.	\odot 0.03W
9	521.78E				↑	\odot 0.02W
10	563.76E				↑	\odot 0.01W
11	485.01E				.	\odot 0
12	458.80E				.	\odot 0
13	421.67E				.	\odot 0.01W
14	399.78E				↓	\odot 0.03W

Figure 8. Total horizontal movement and movement history for monuments at sta 1831+50

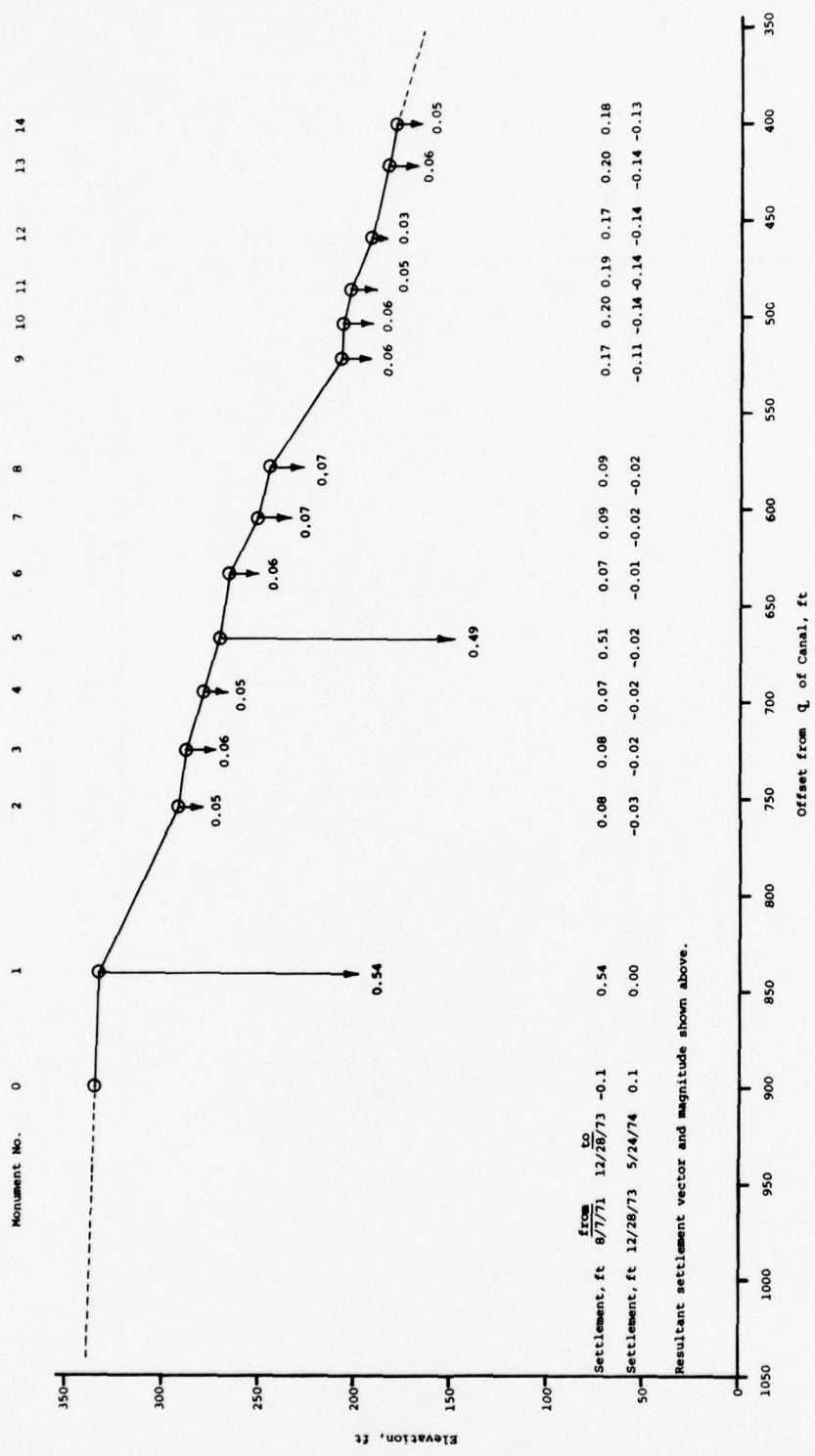


Figure 9. Total settlement and settlement history for monuments at sta 1831+50

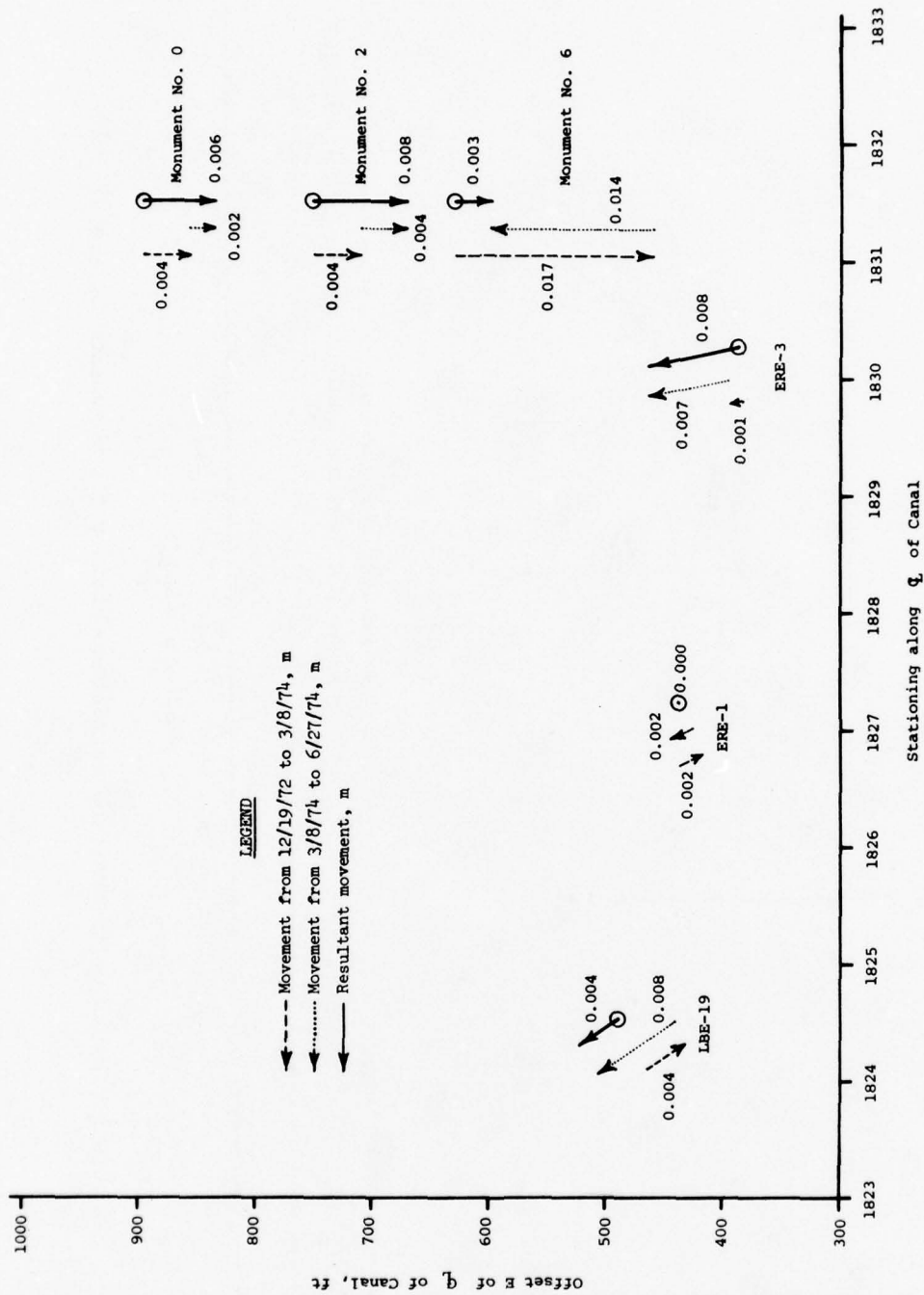


Figure 10. Plan showing movement history and resultant movements for EDM measurements

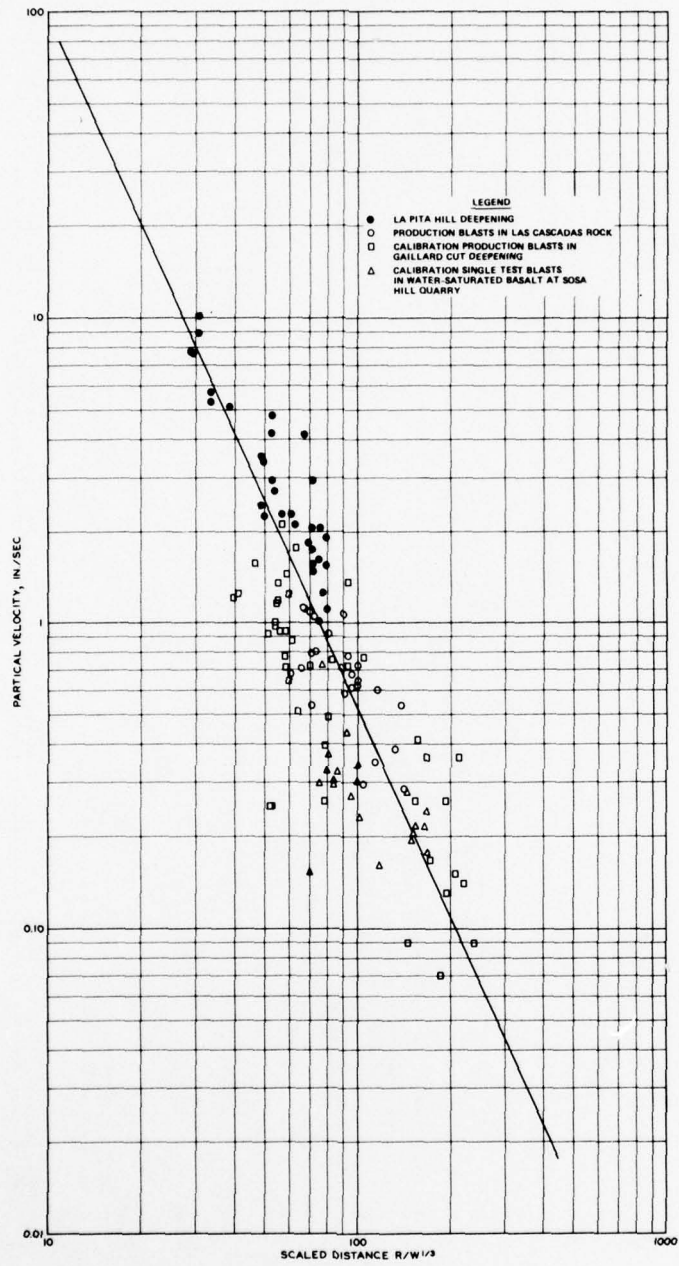


Figure 11. Resultant particle velocity versus scaled distance obtained from blast data

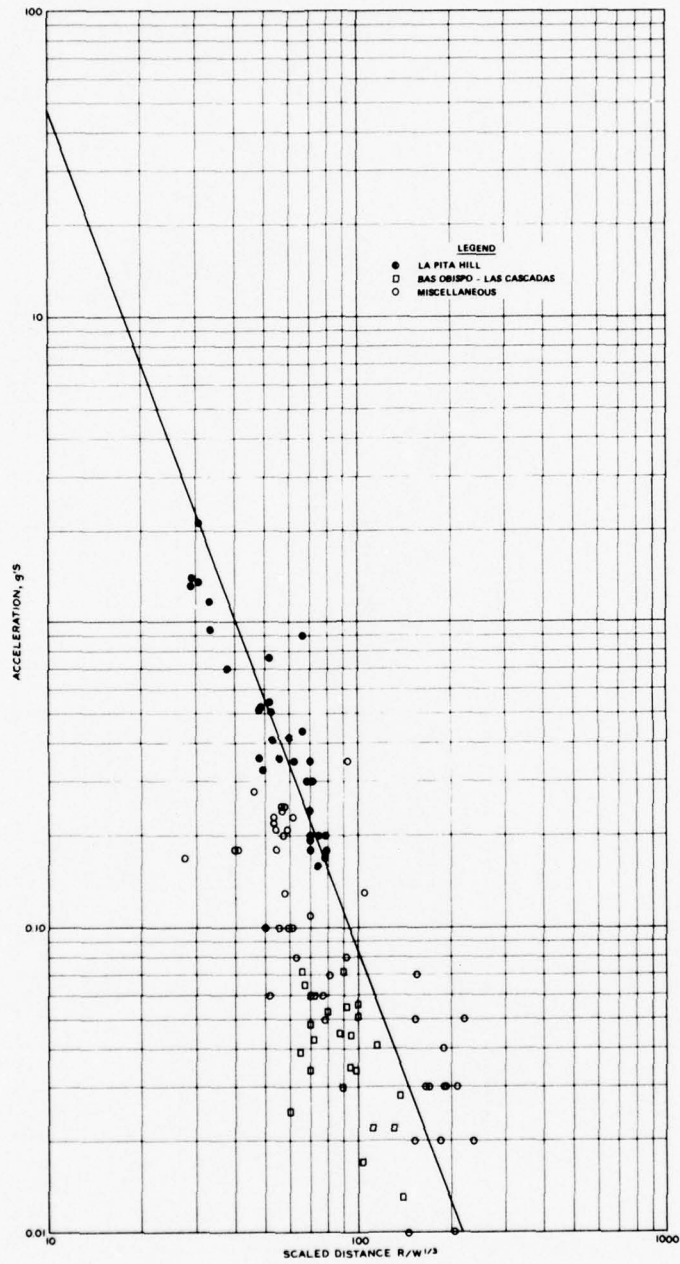


Figure 12. Resultant acceleration versus scaled distance obtained from blast area

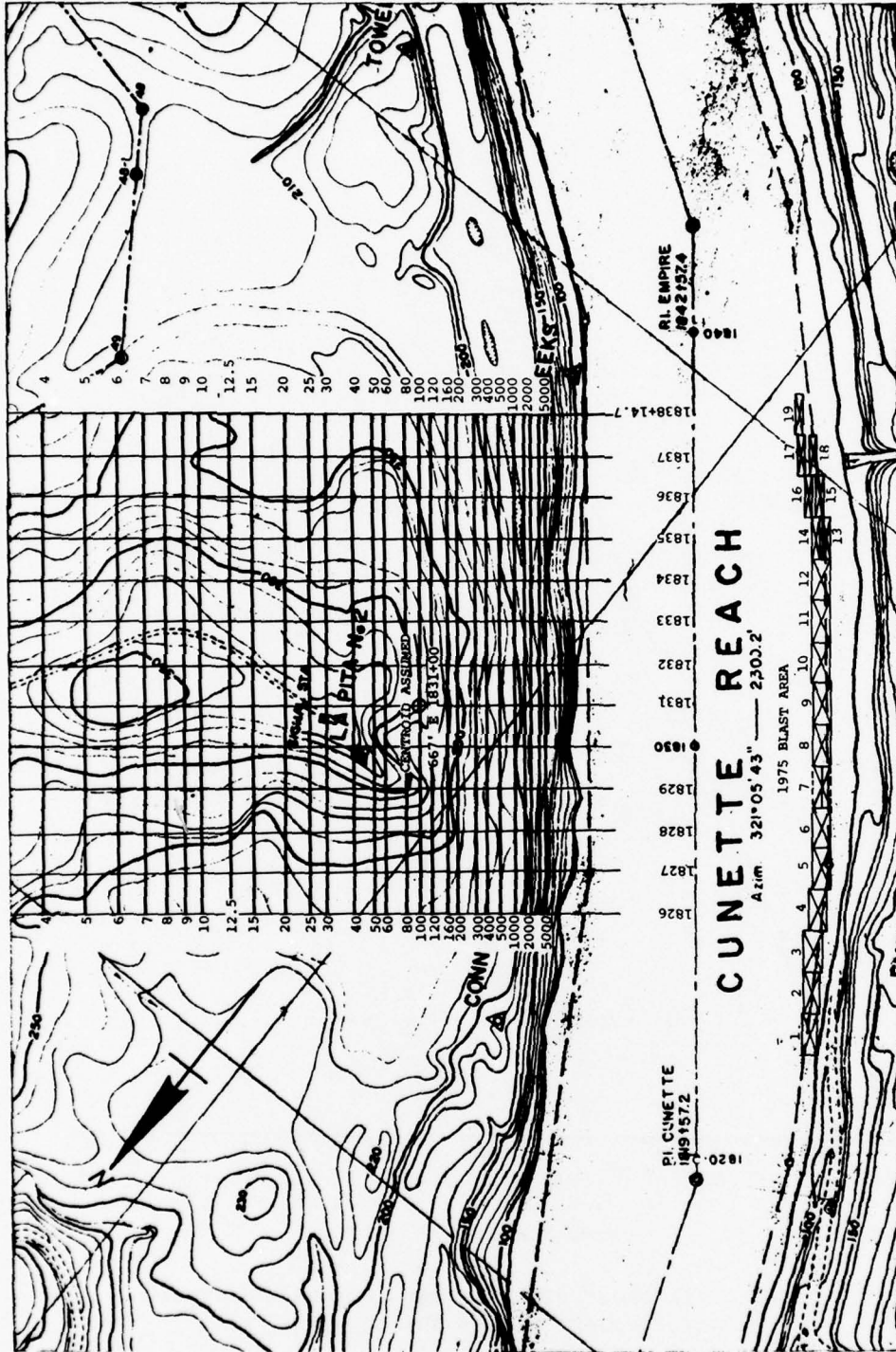


Figure 13. Plan map showing acceleration contours used for analysis (contours represent percentages of acceleration occurring at an assumed centroid)

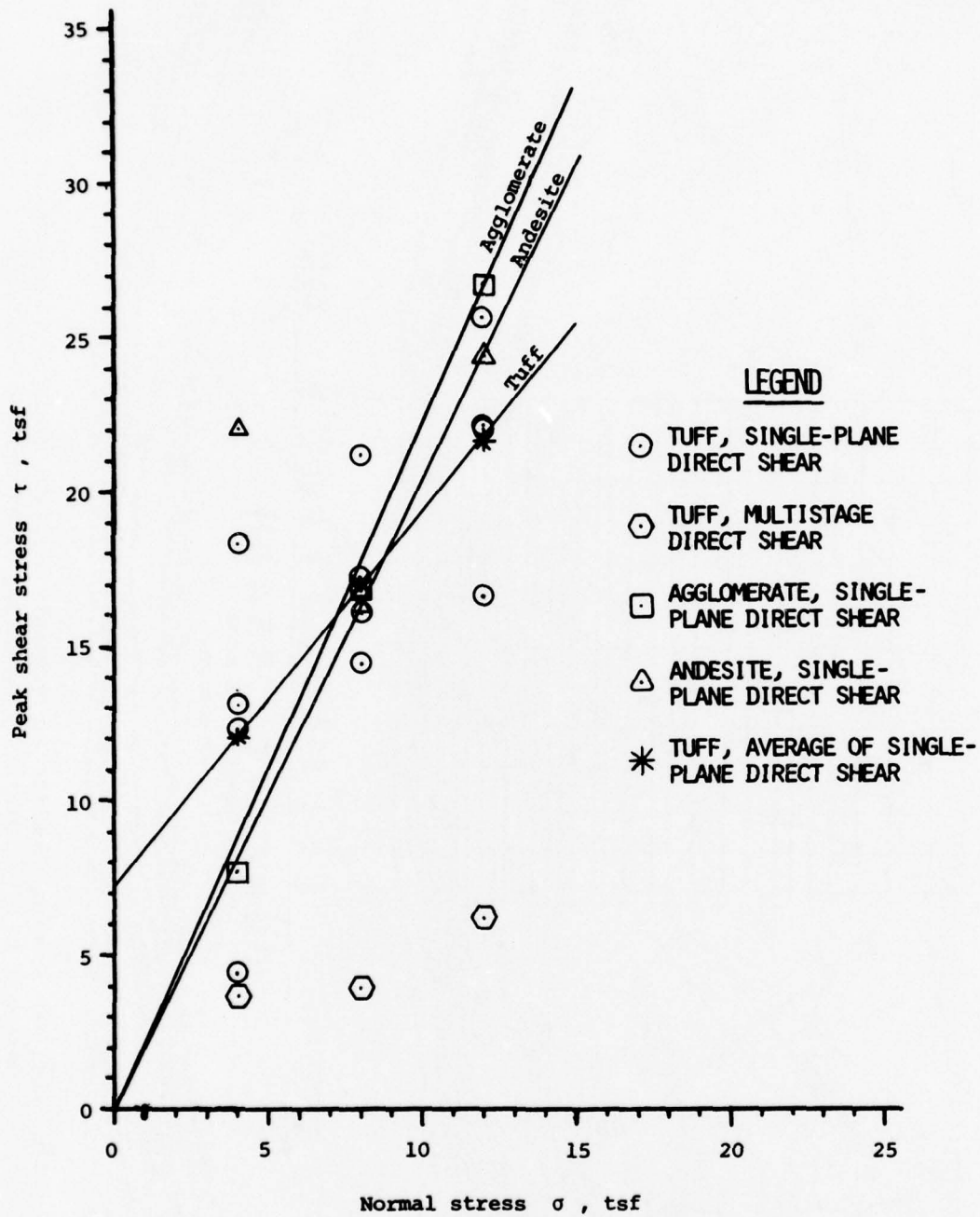


Figure 14. Peak shear stress versus normal stress for single-plane direct shear tests

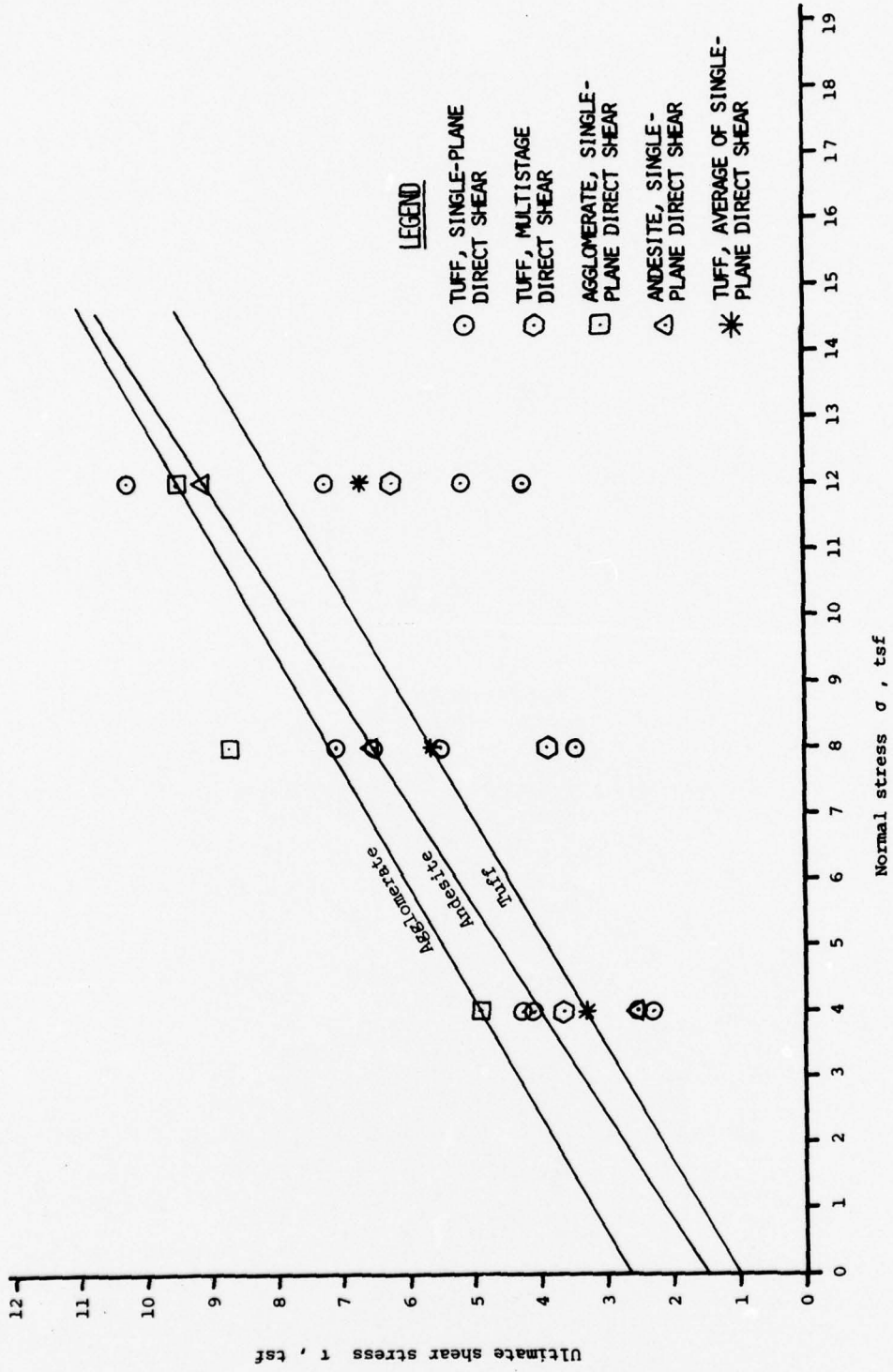


Figure 15. Ultimate shear stress versus normal stress for undrained direct shear tests

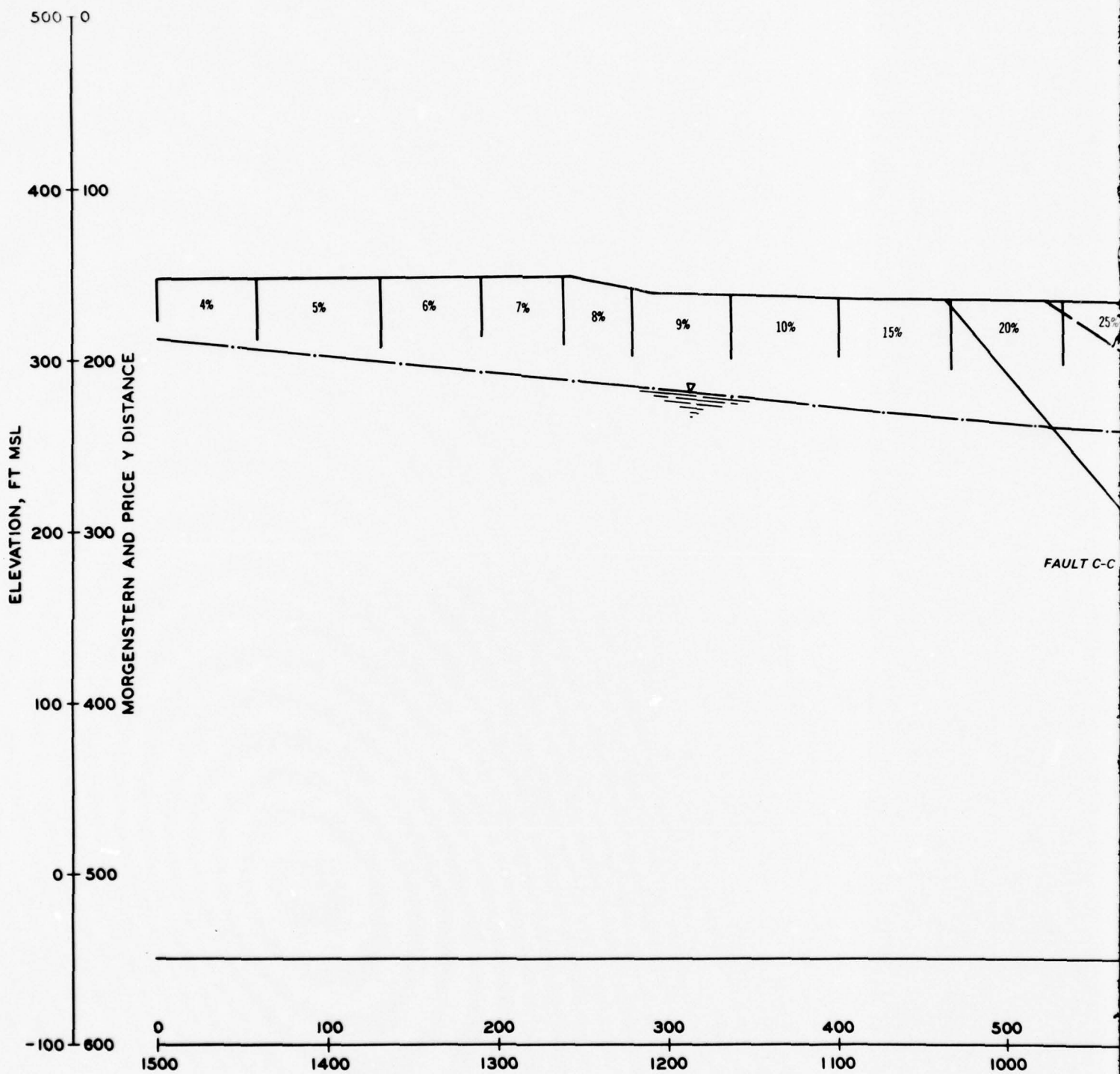
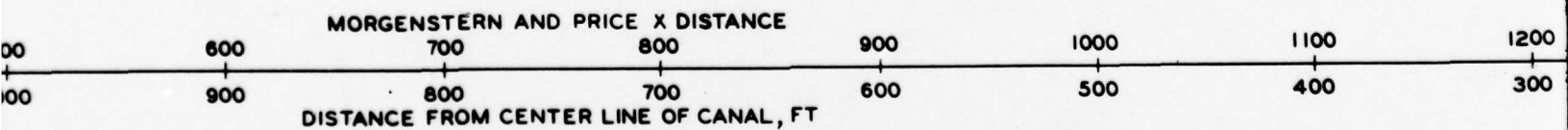
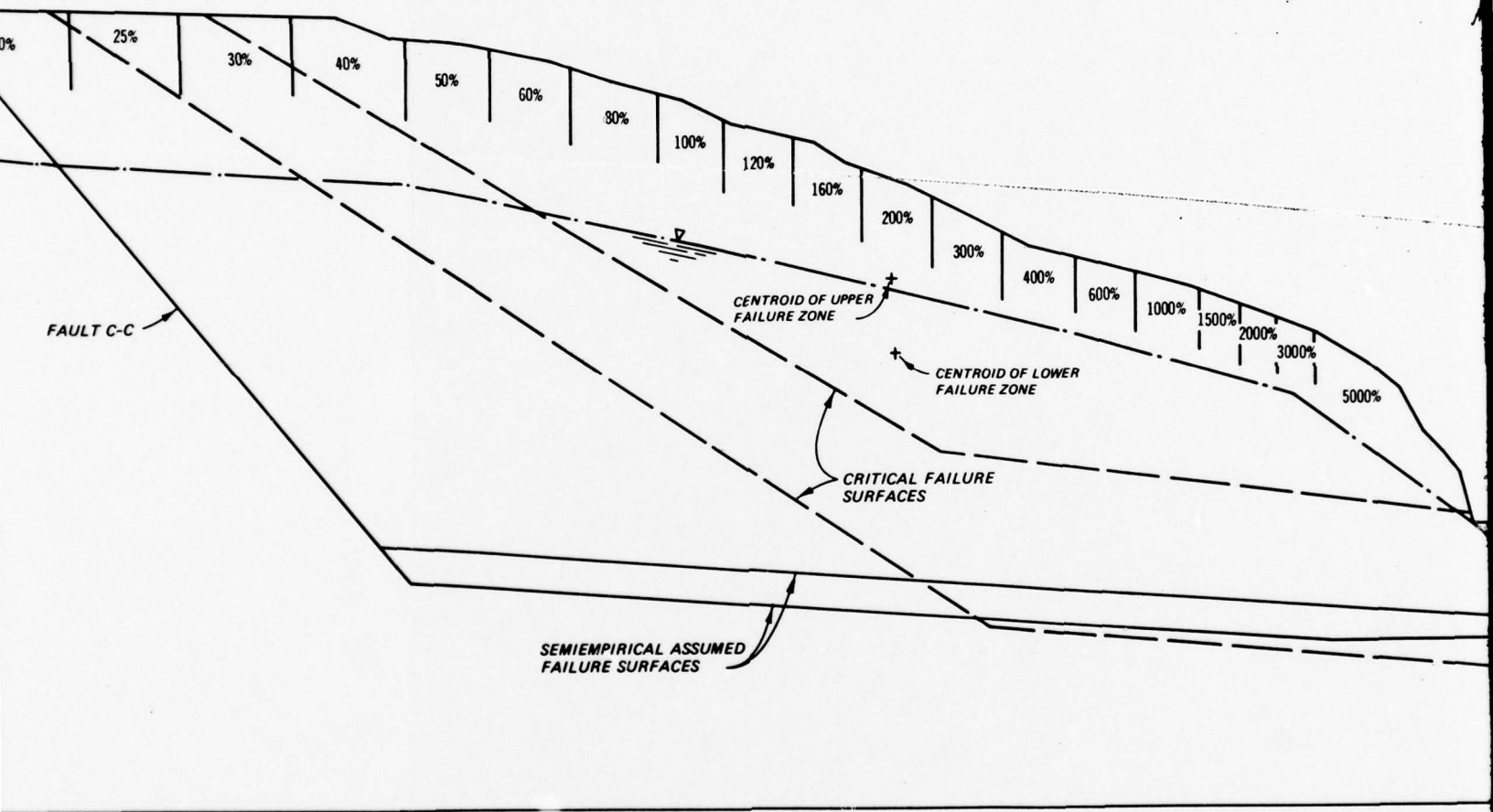
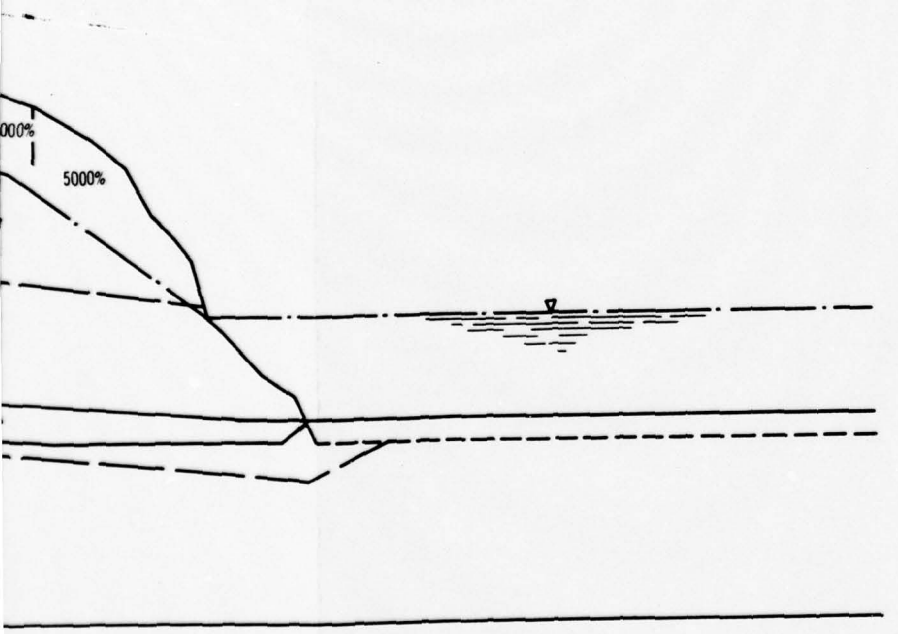


Figure 16. Semiempirical
in



semiempirical analysis cross section shown with acceleration distribution utilized in conventional analysis with distributed accelerations

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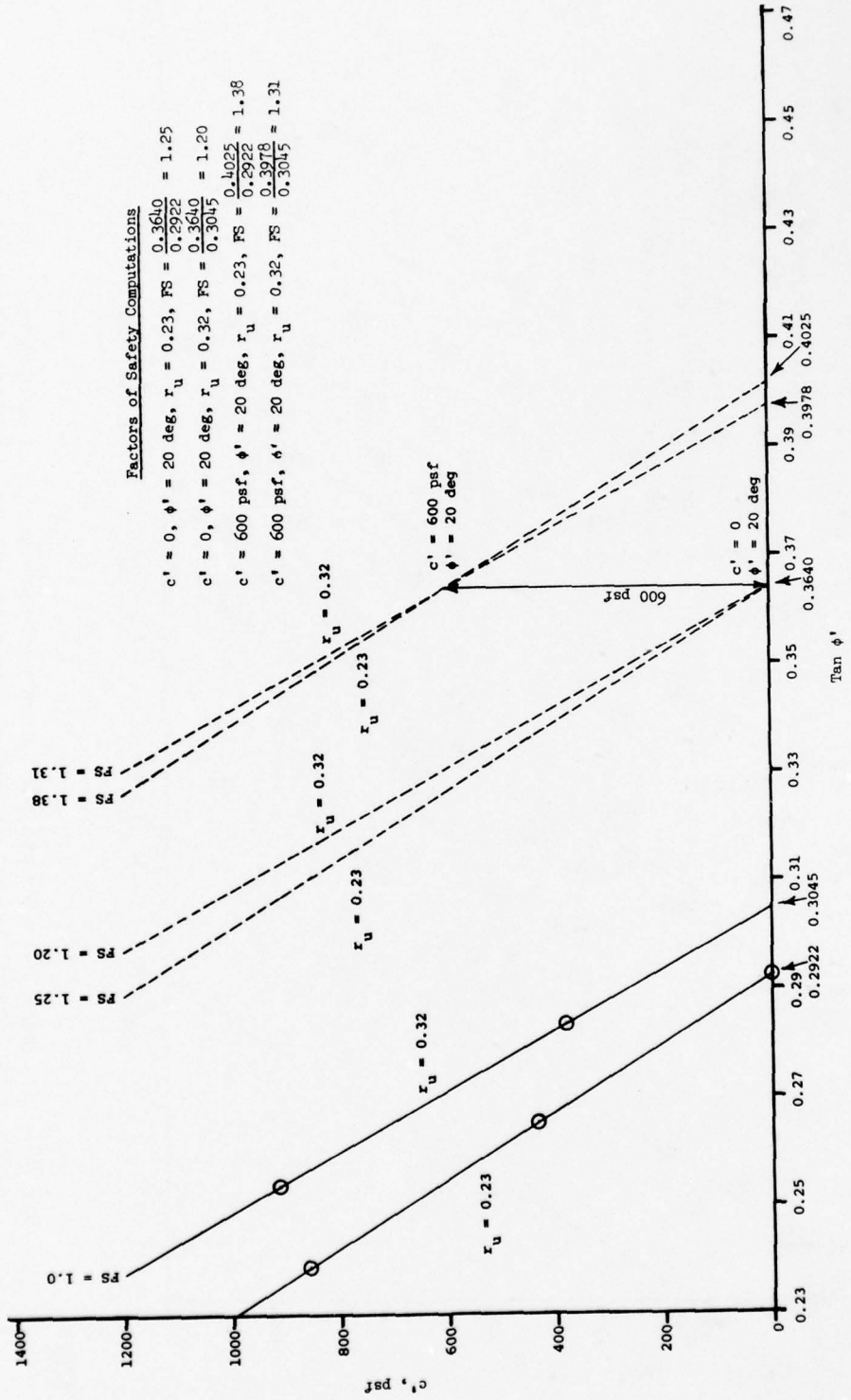


Figure 17. Strength curves used with semiempirical analysis to compute factors of safety prior to deepening for limiting pore pressure and strength assumptions

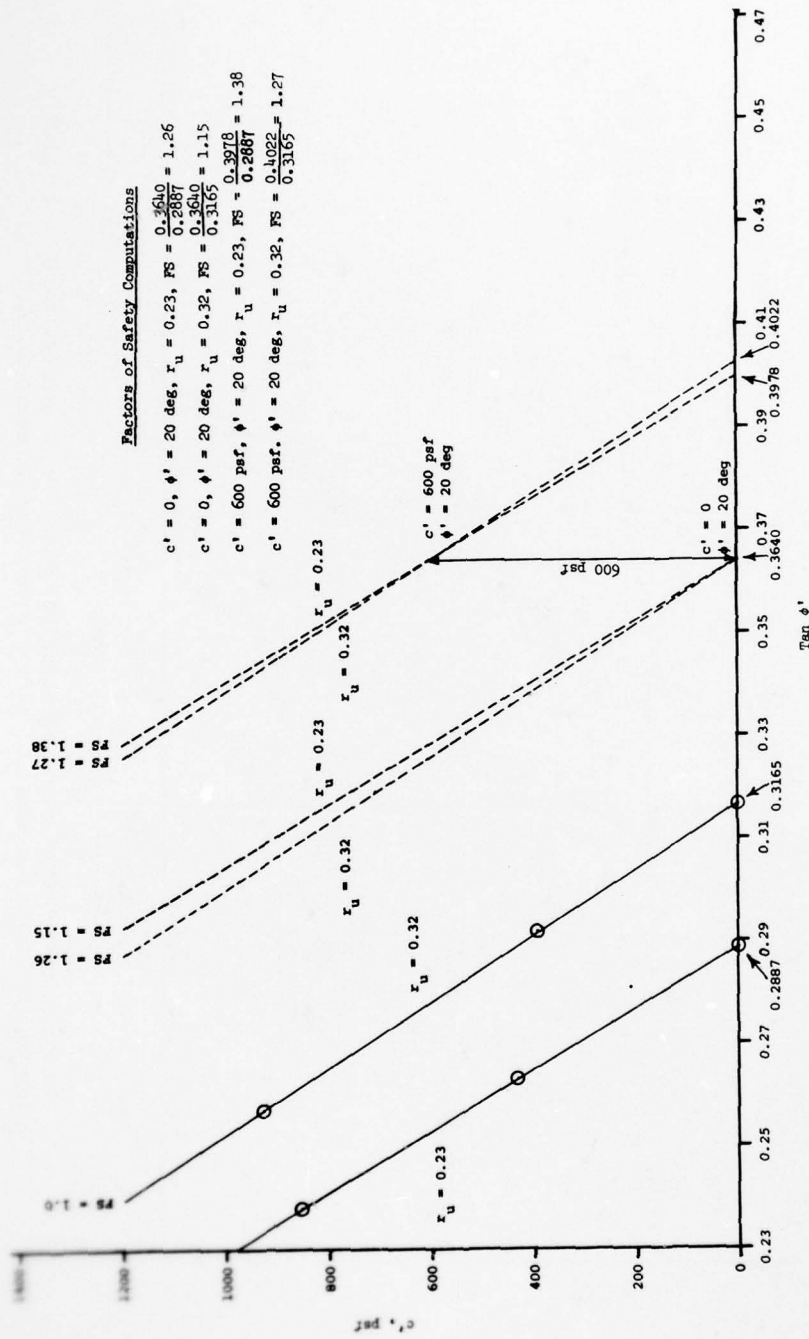


Figure 18. Strength curves used with semiempirical analysis to compute factors of safety after deepening for limiting pore pressure and strength assumptions

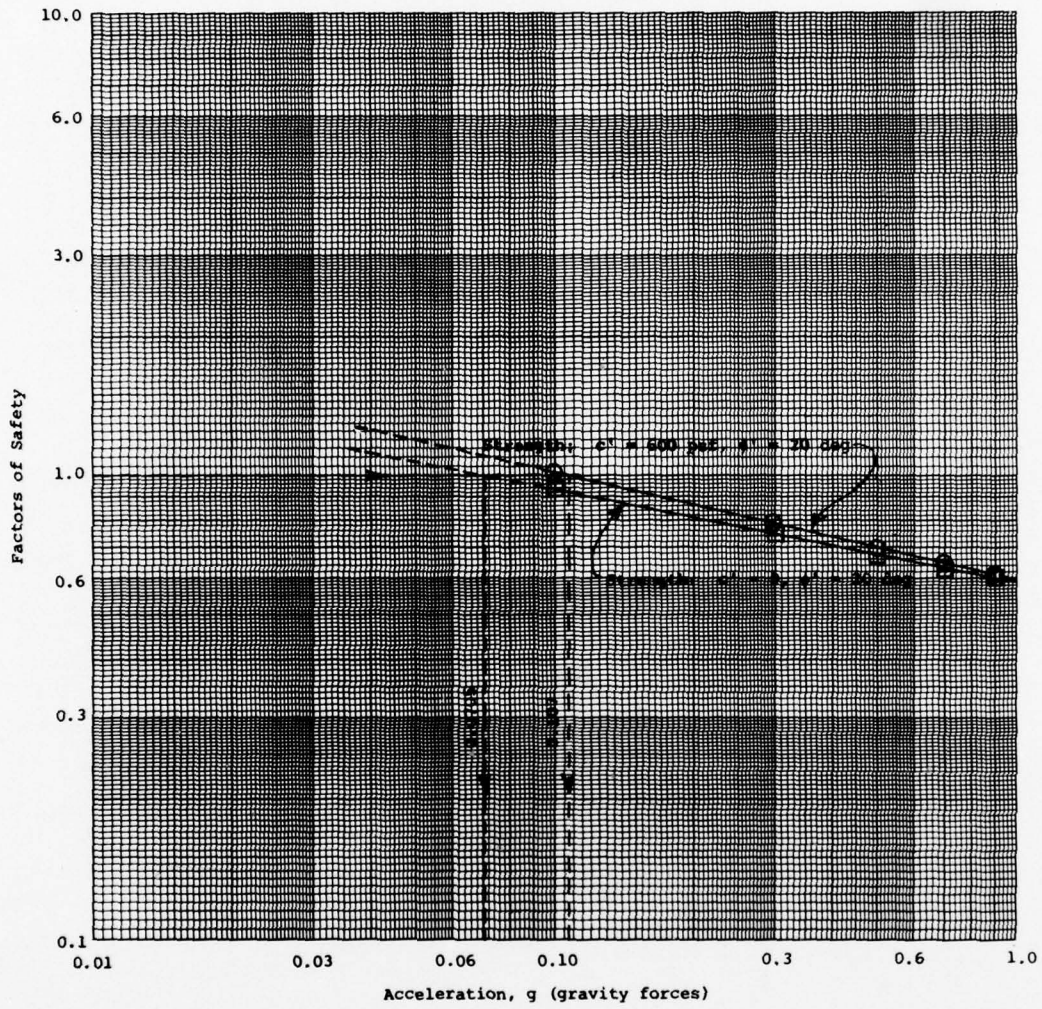


Figure 19. Factors of safety versus acceleration for semiempirical stability analysis using uniformly applied accelerations

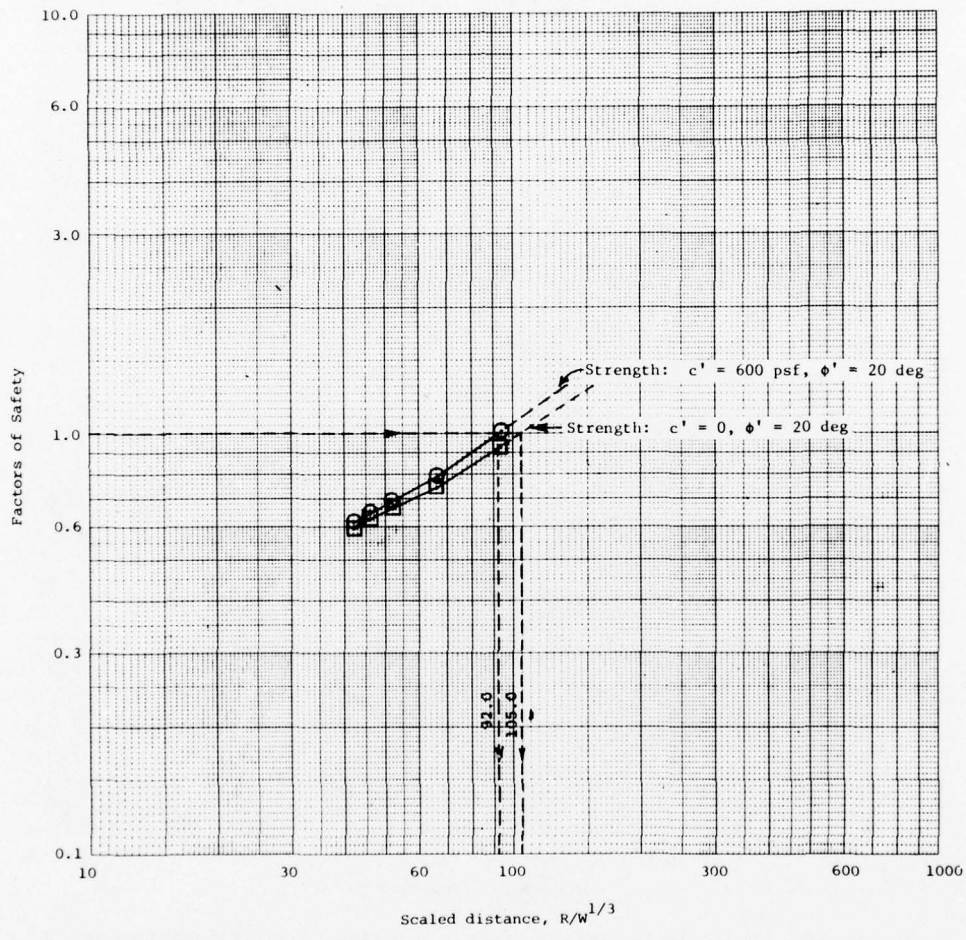


Figure 20. Factors of safety versus scaled distance for semiempirical stability analysis using uniformly applied accelerations

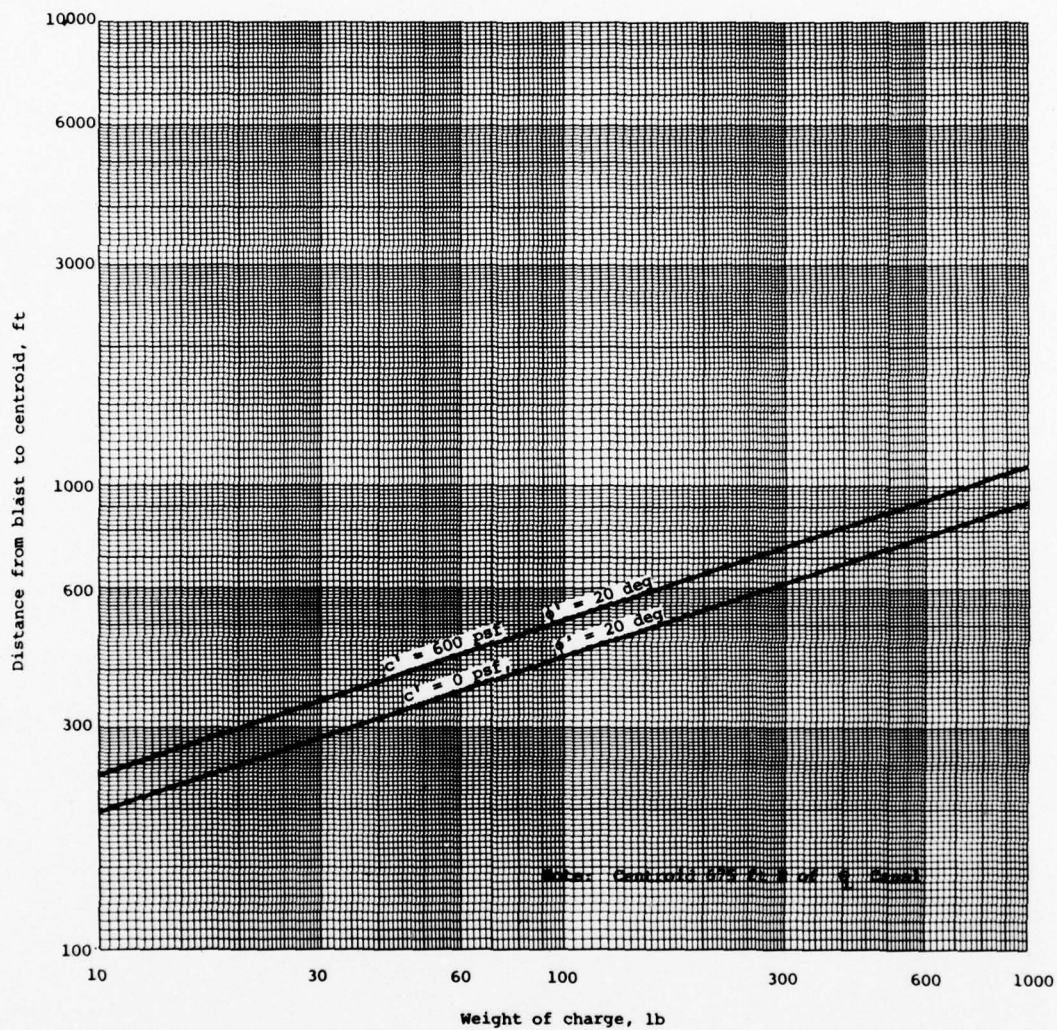


Figure 21. Relationship between distance from blast and weight of charge to maintain factor of safety of 1.0 for semiempirical analysis using uniformly applied accelerations

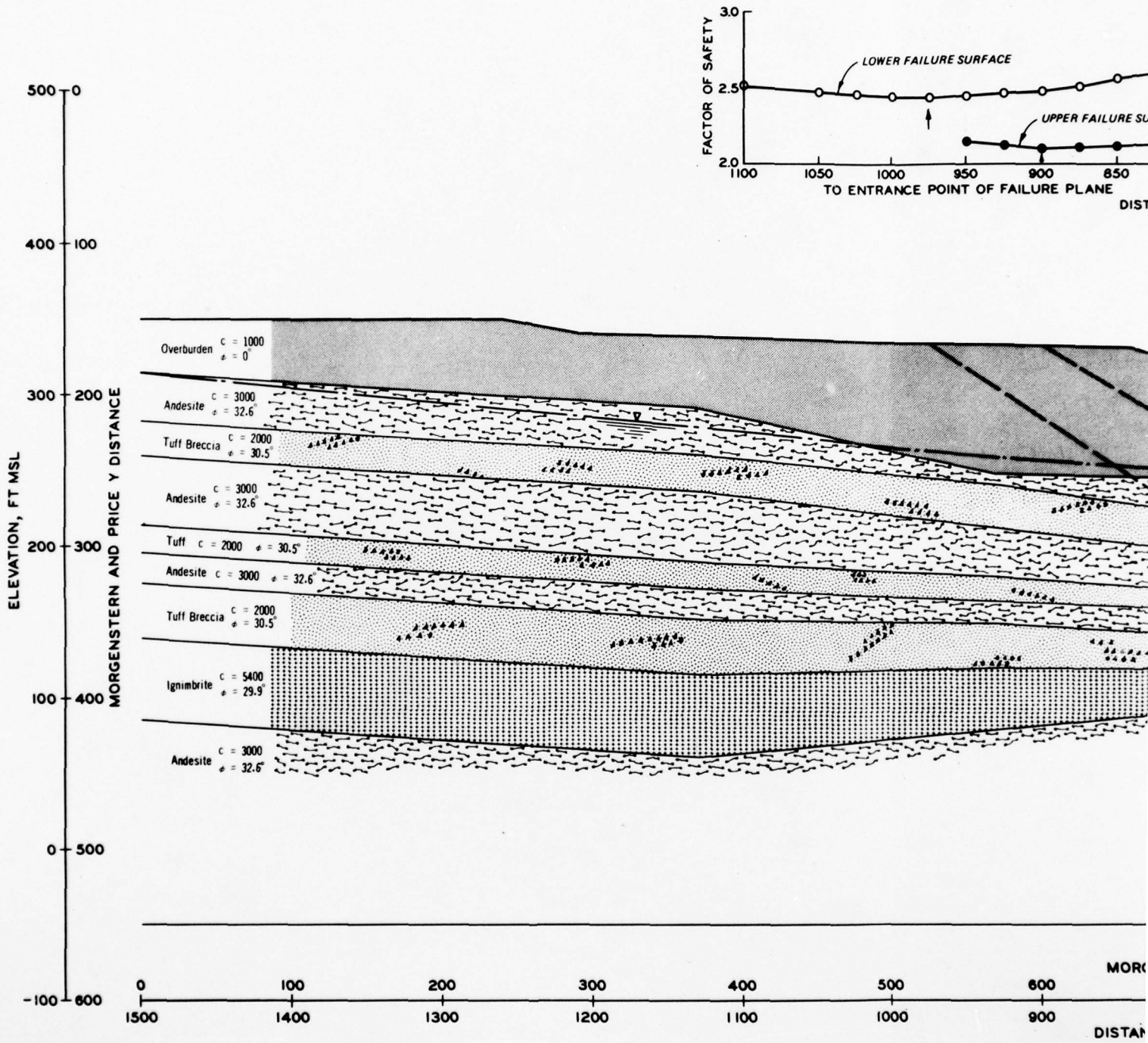
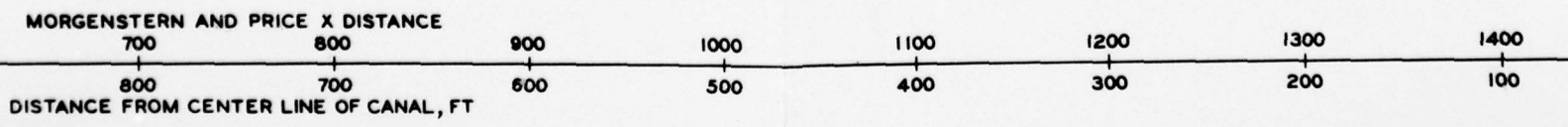
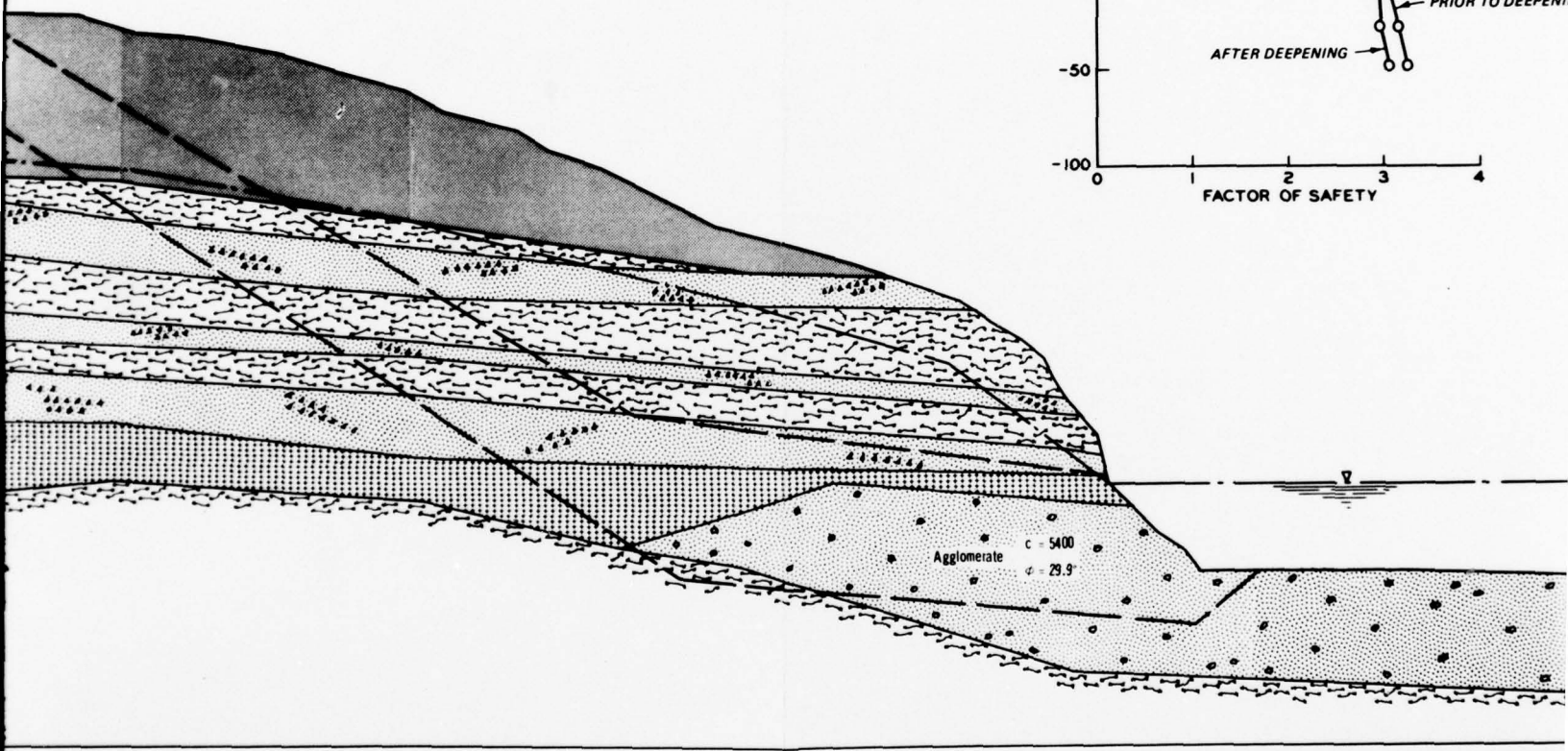
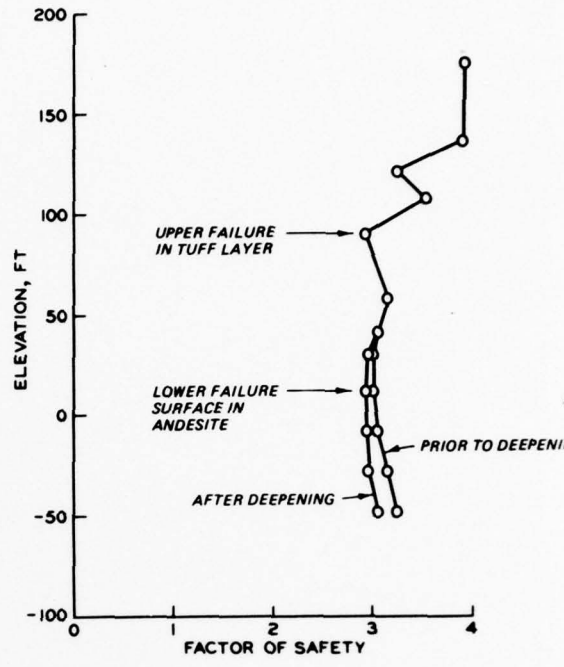
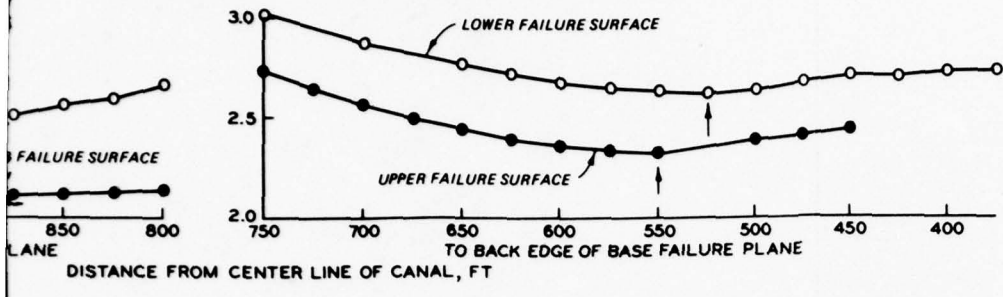
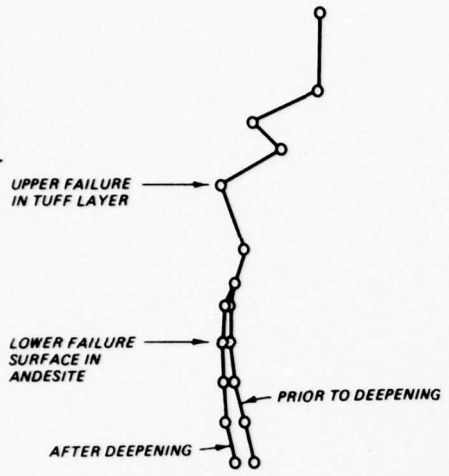


Figure 22. Conventional analysis of the Morgenstern and Price Y distance

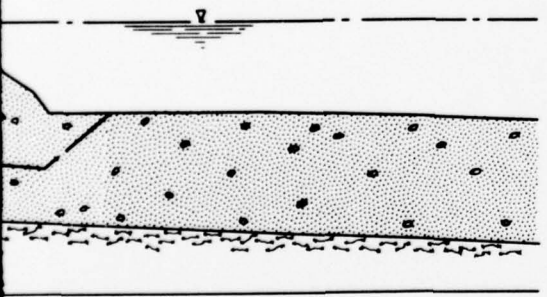


analysis cross section utilized with the WES version
 Morgenstern and Price computer program

2



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 FACTOR OF SAFETY



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 200 100 €

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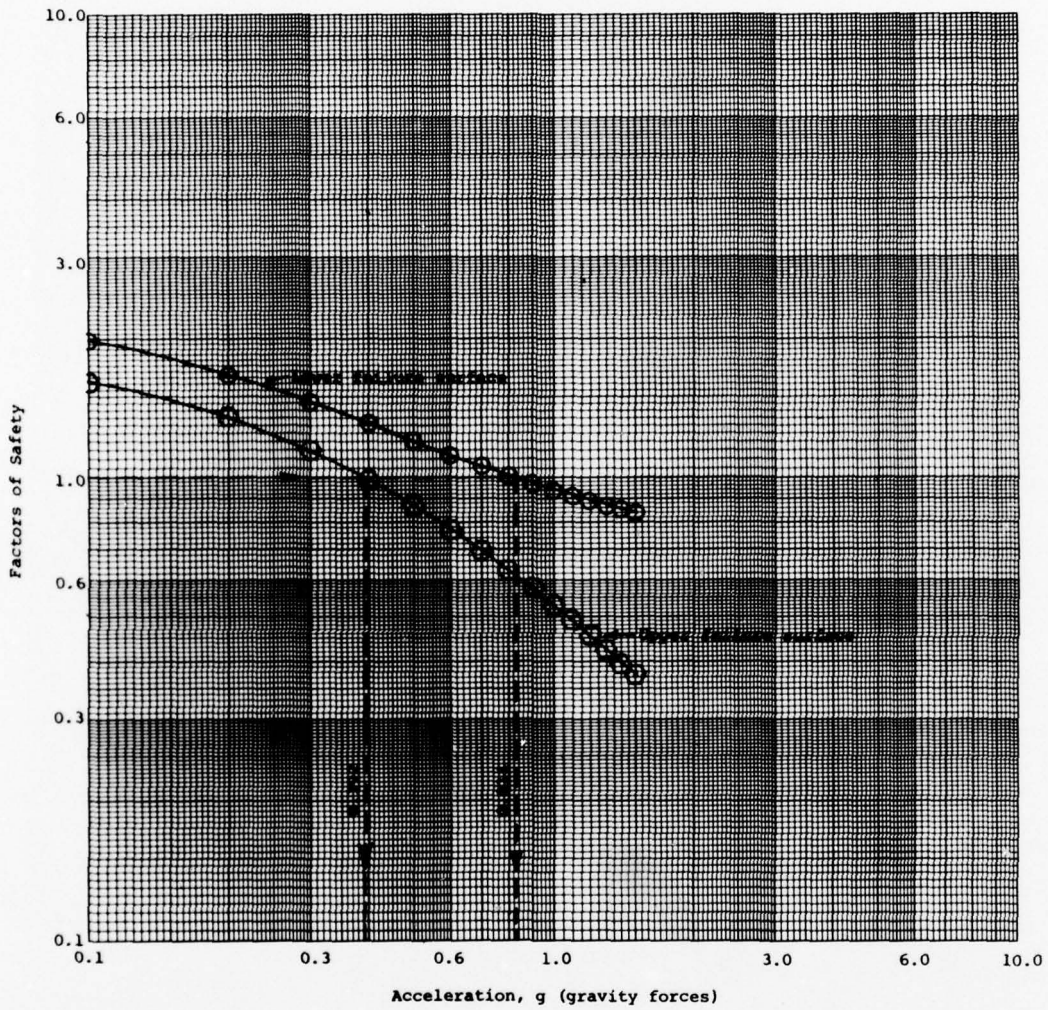


Figure 23. Factors of safety versus acceleration for conventional stability analysis using uniformly applied accelerations

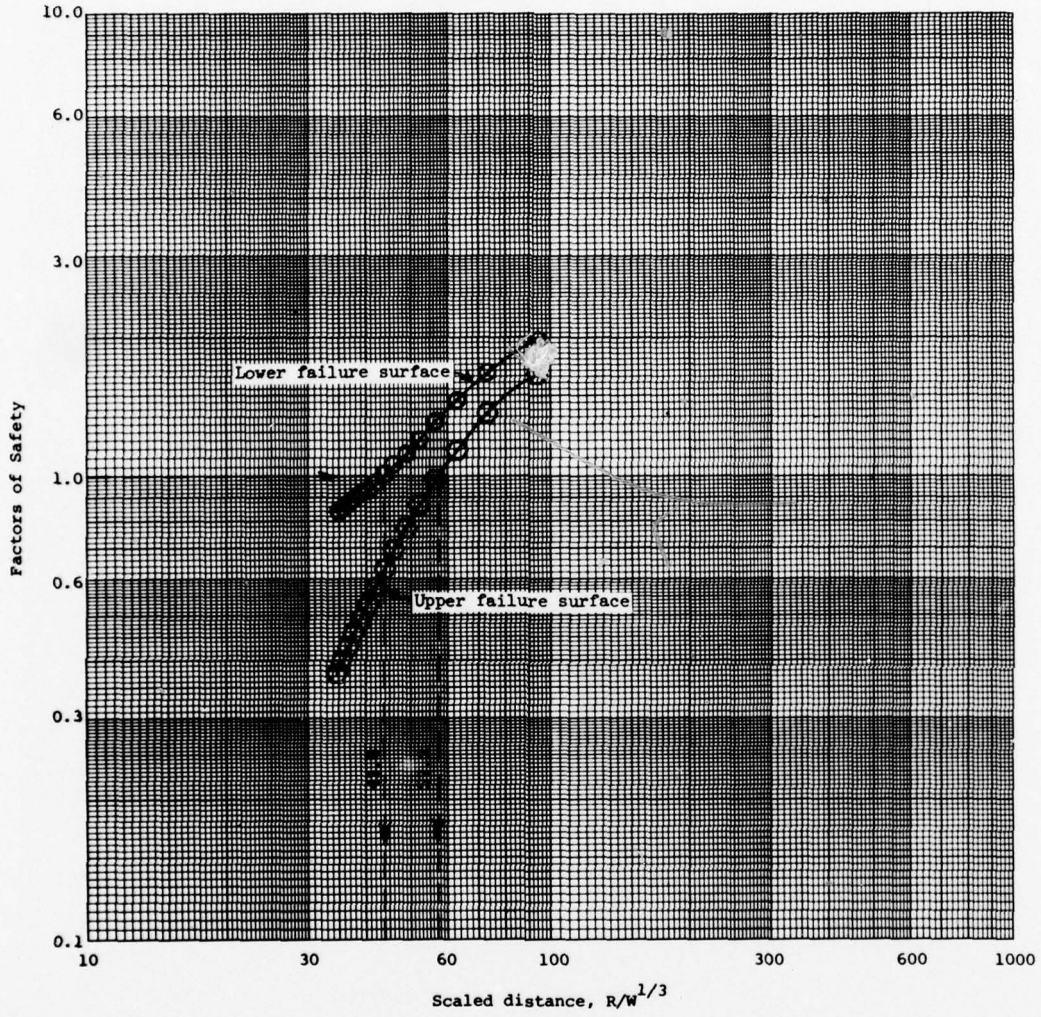


Figure 24. Factors of safety versus scaled distance for conventional stability analysis using uniformly applied accelerations

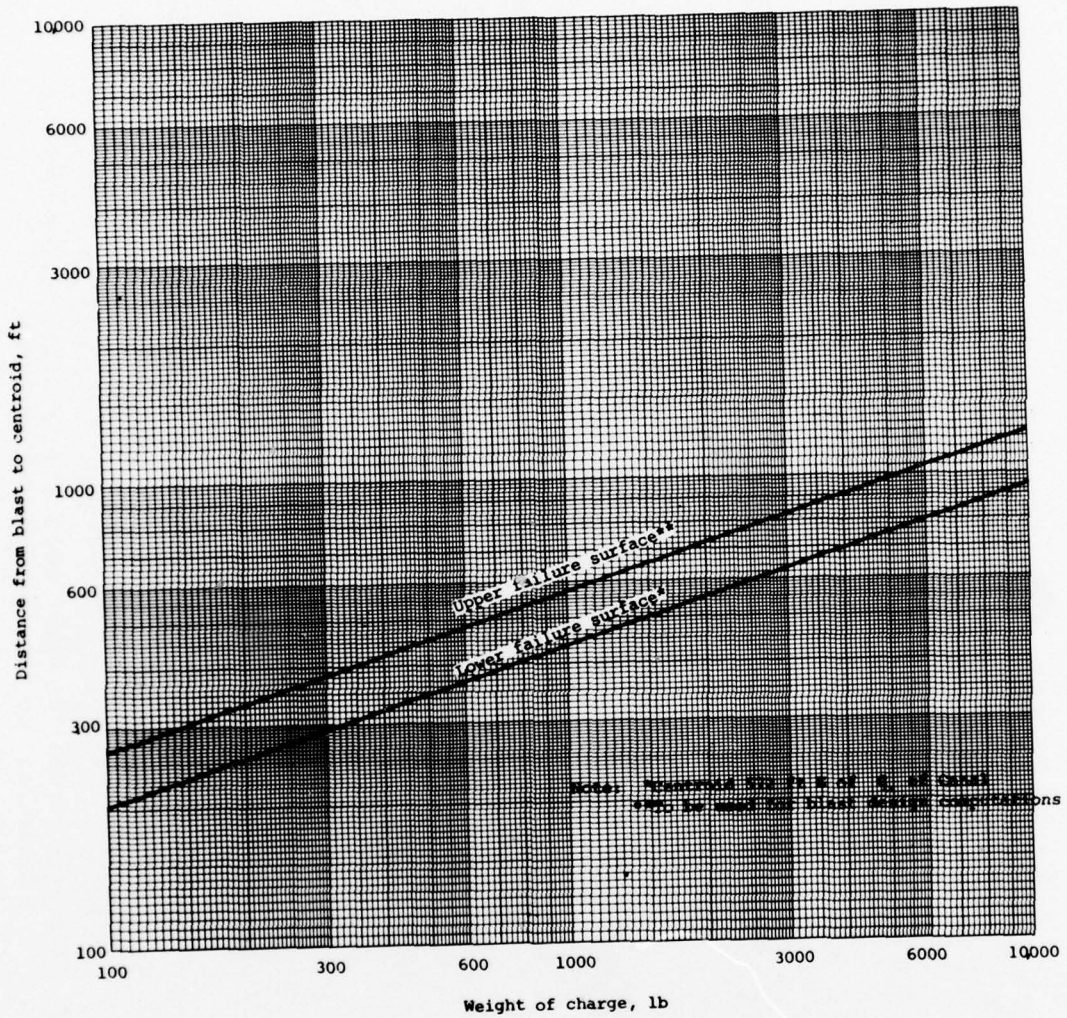


Figure 25. Relationship between distance from blast and weight of charge to maintain factor of safety of 1.0 for conventional analysis using uniformly applied accelerations

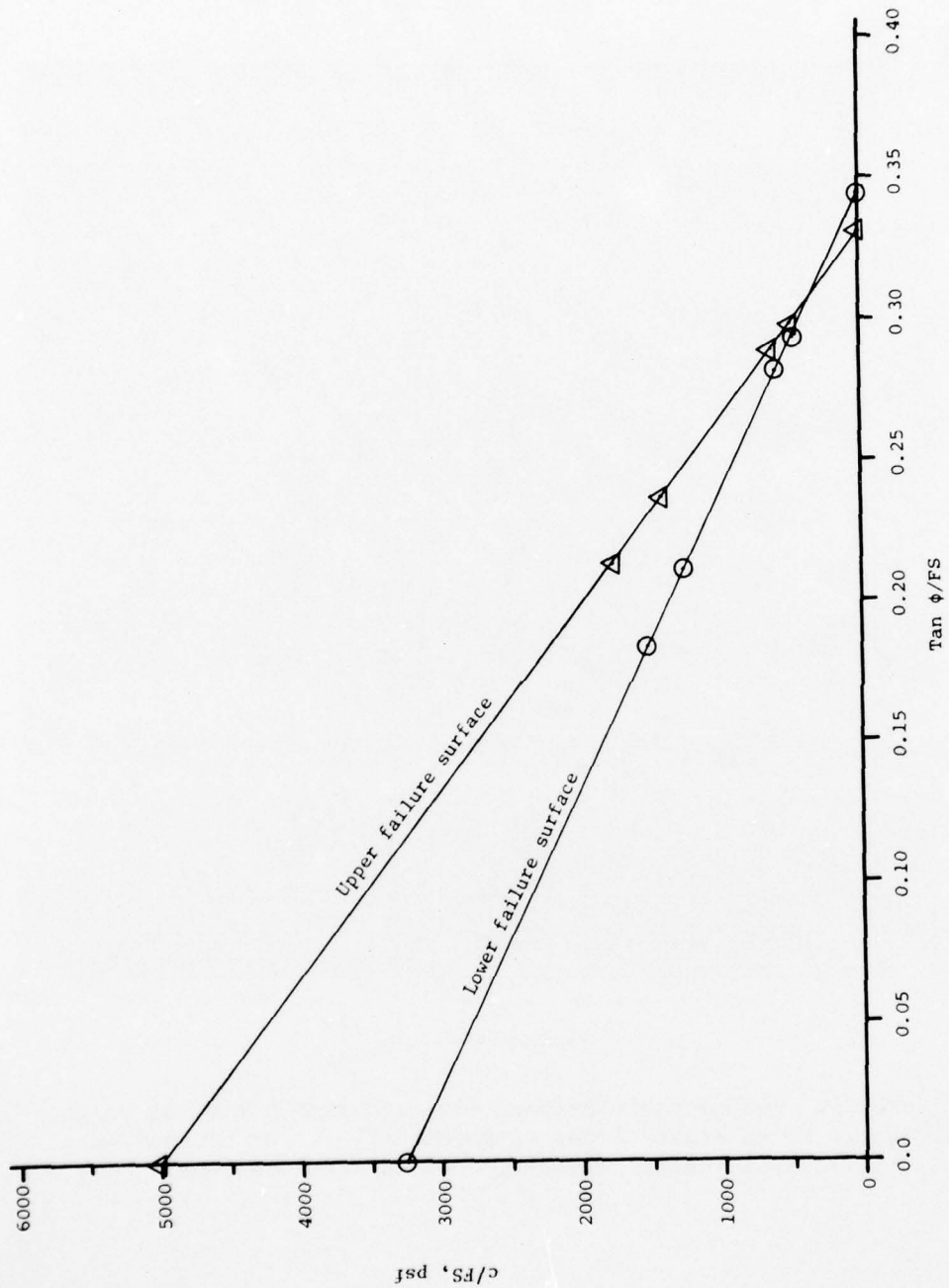


Figure 26. Strength curves for upper and lower critical failure surfaces determined in the conventional analysis

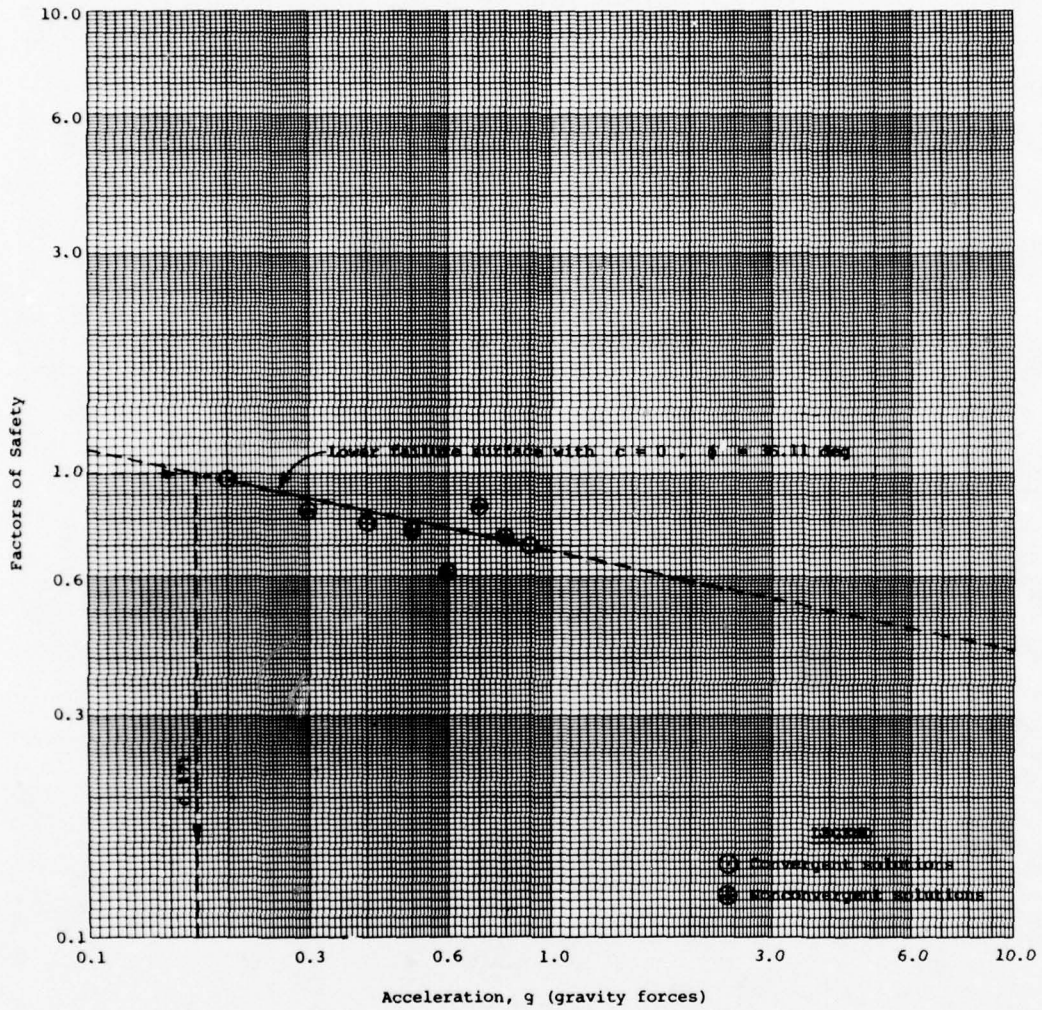


Figure 27. Factors of safety versus acceleration for conventional stability analysis using distributed accelerations

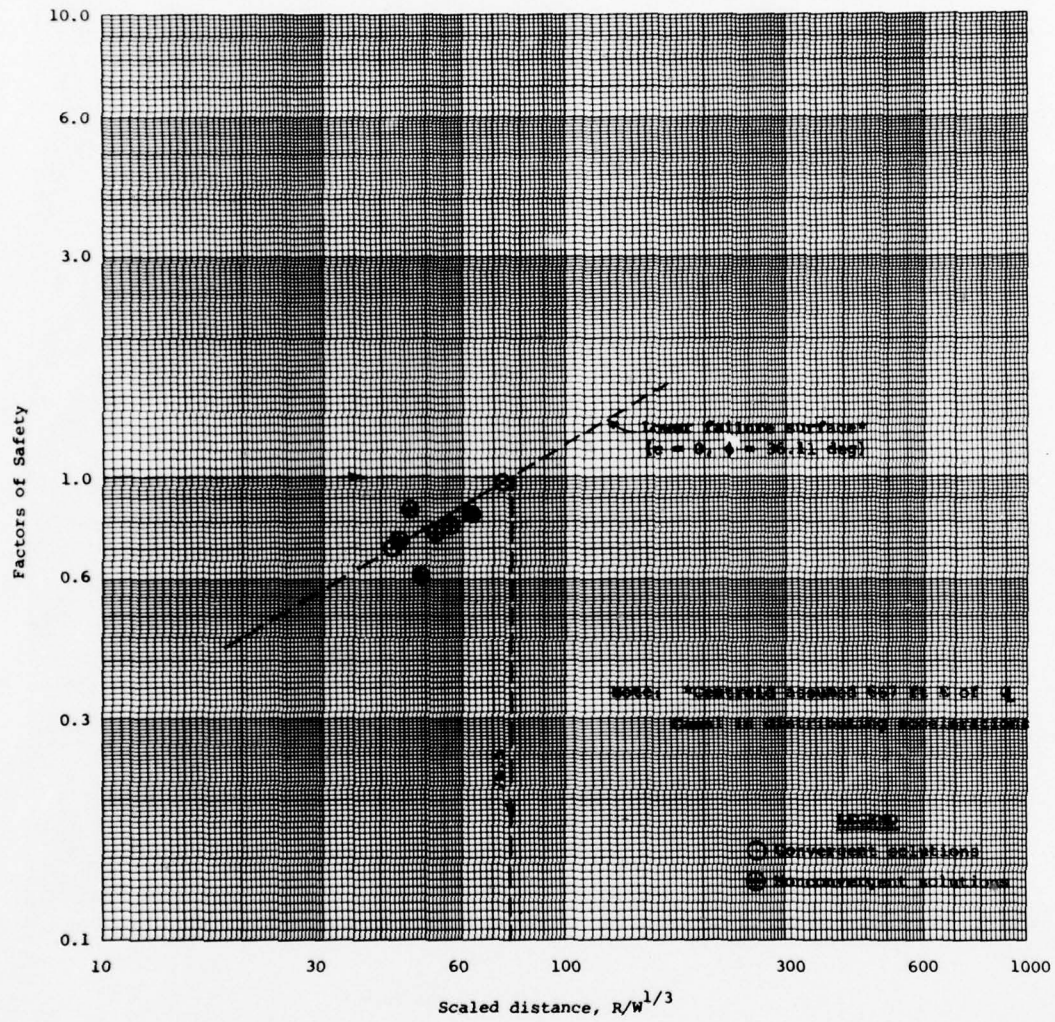


Figure 28. Factor of safety versus scaled distance for conventional stability analysis using distributed accelerations

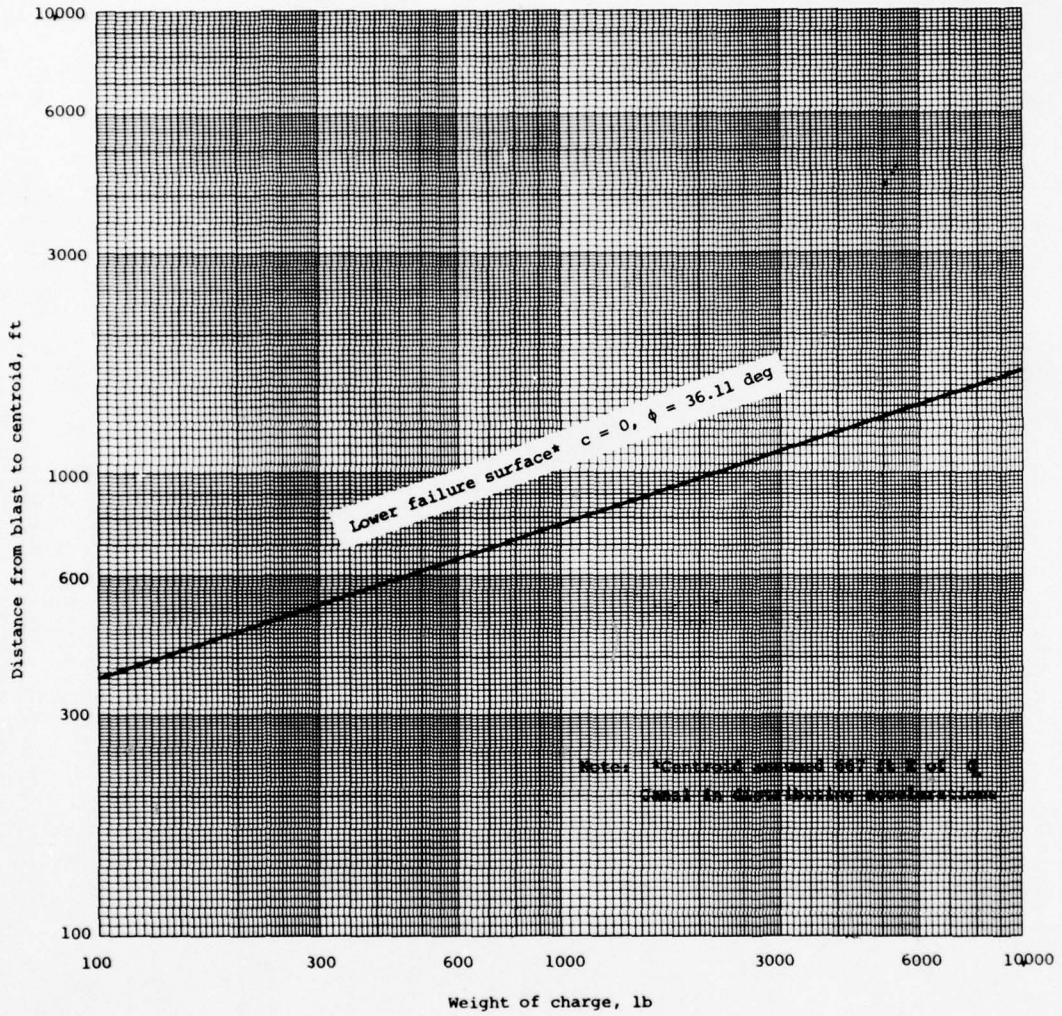


Figure 29. Relationship between distance from blast and weight of charge to maintain factor of safety of 1.0 for conventional analysis using distributed accelerations

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ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG--ETC F/G 8/6
EVALUATION OF EFFECTS OF PANAMA CANAL DEEPENING UPON THE STABIL--ETC(U)
SEP 79 W O MILLER

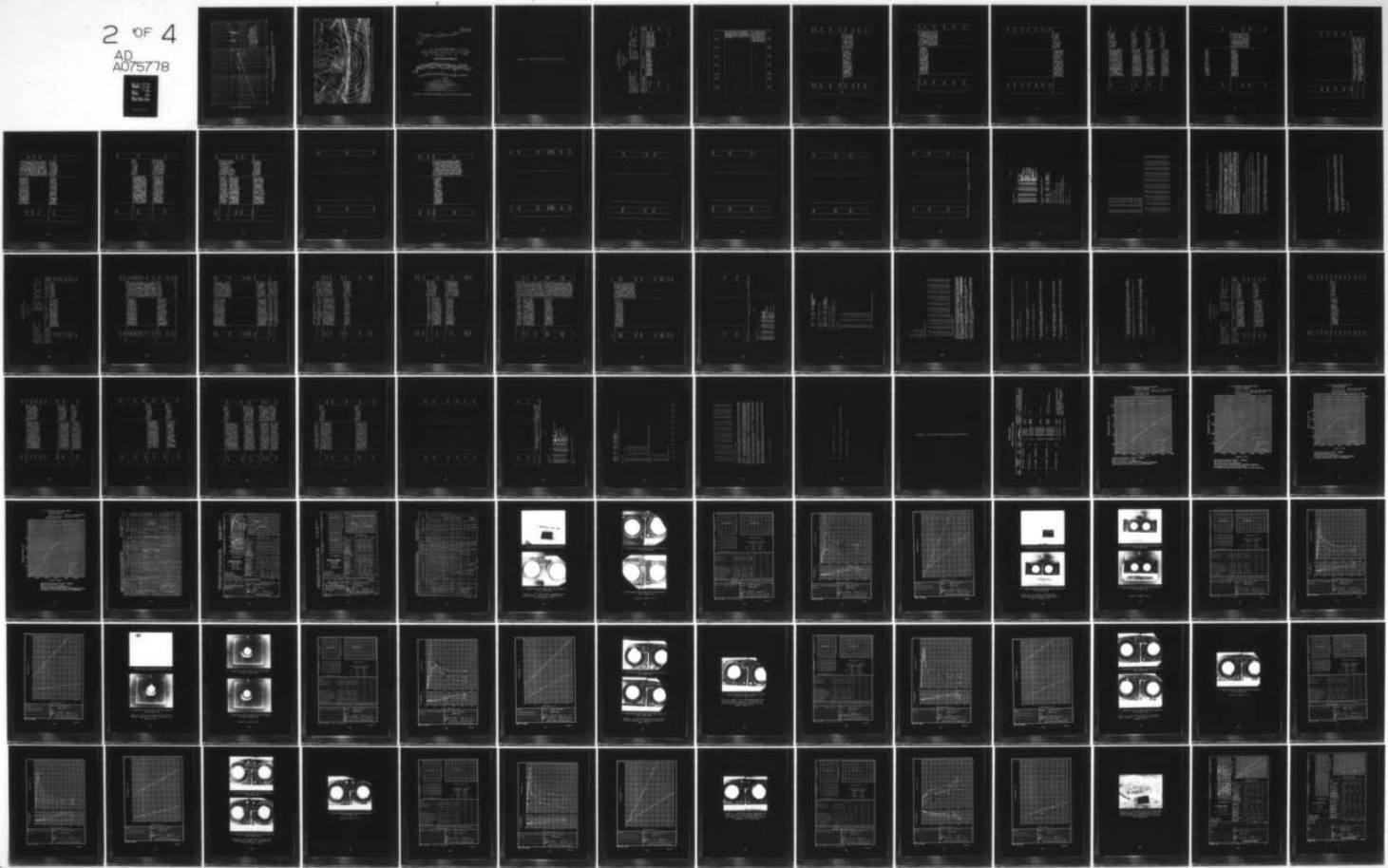
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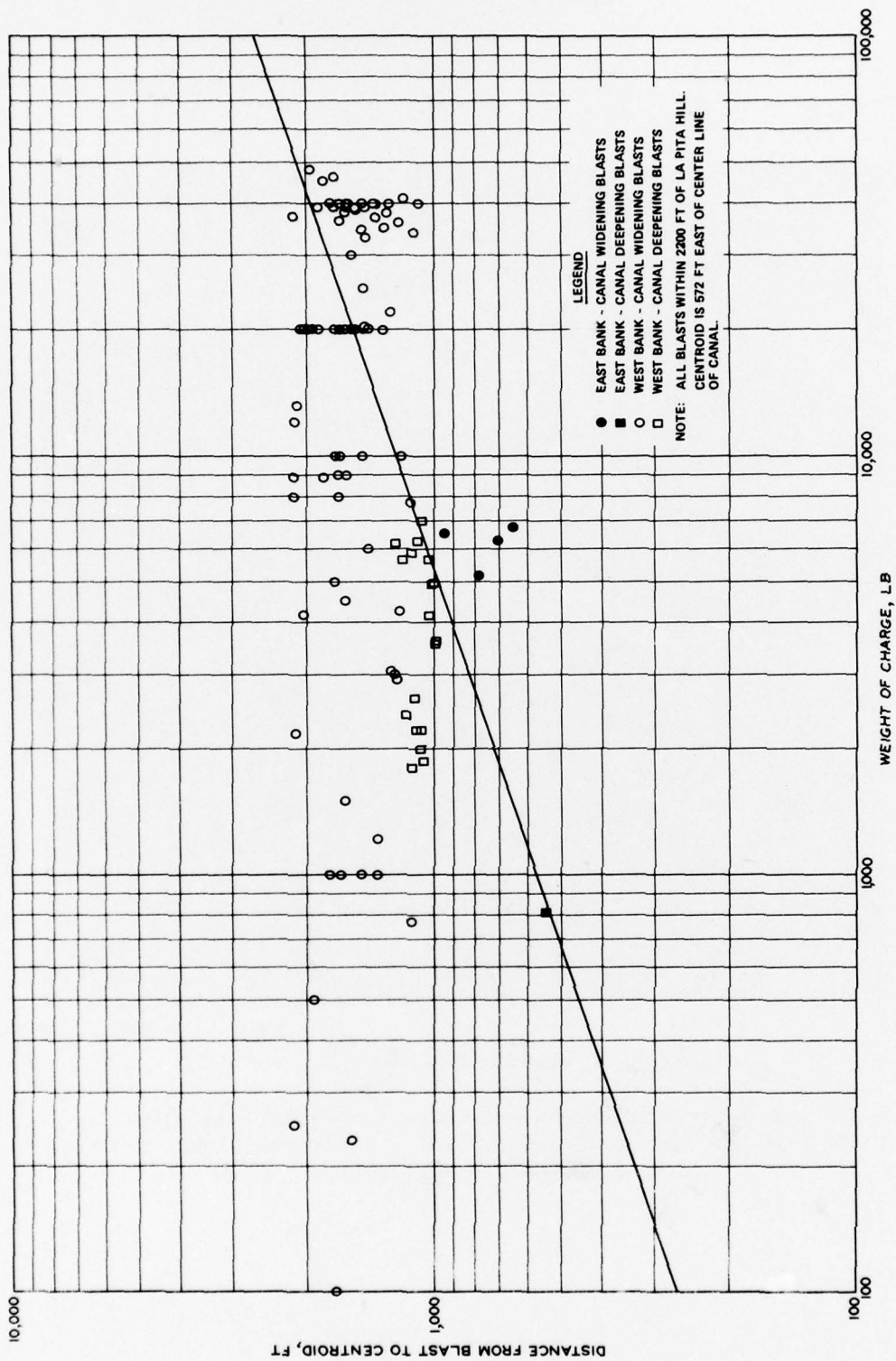


Figure 30. Design curve for regulating blasts adjacent to La Pita Hill with previous blasting experience shown

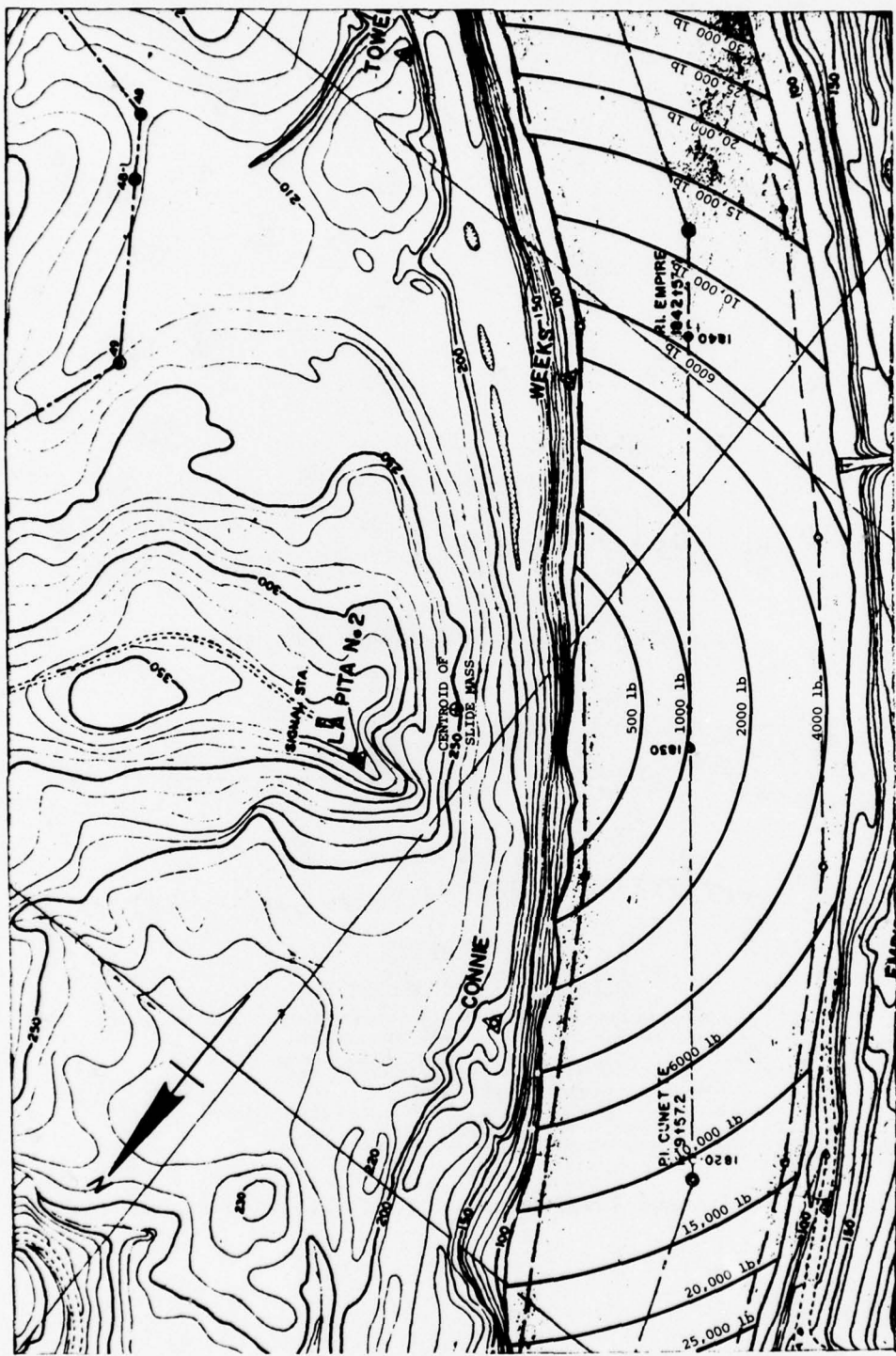


Figure 31. Plan map of La Pita Hill with blast weight regulation contours

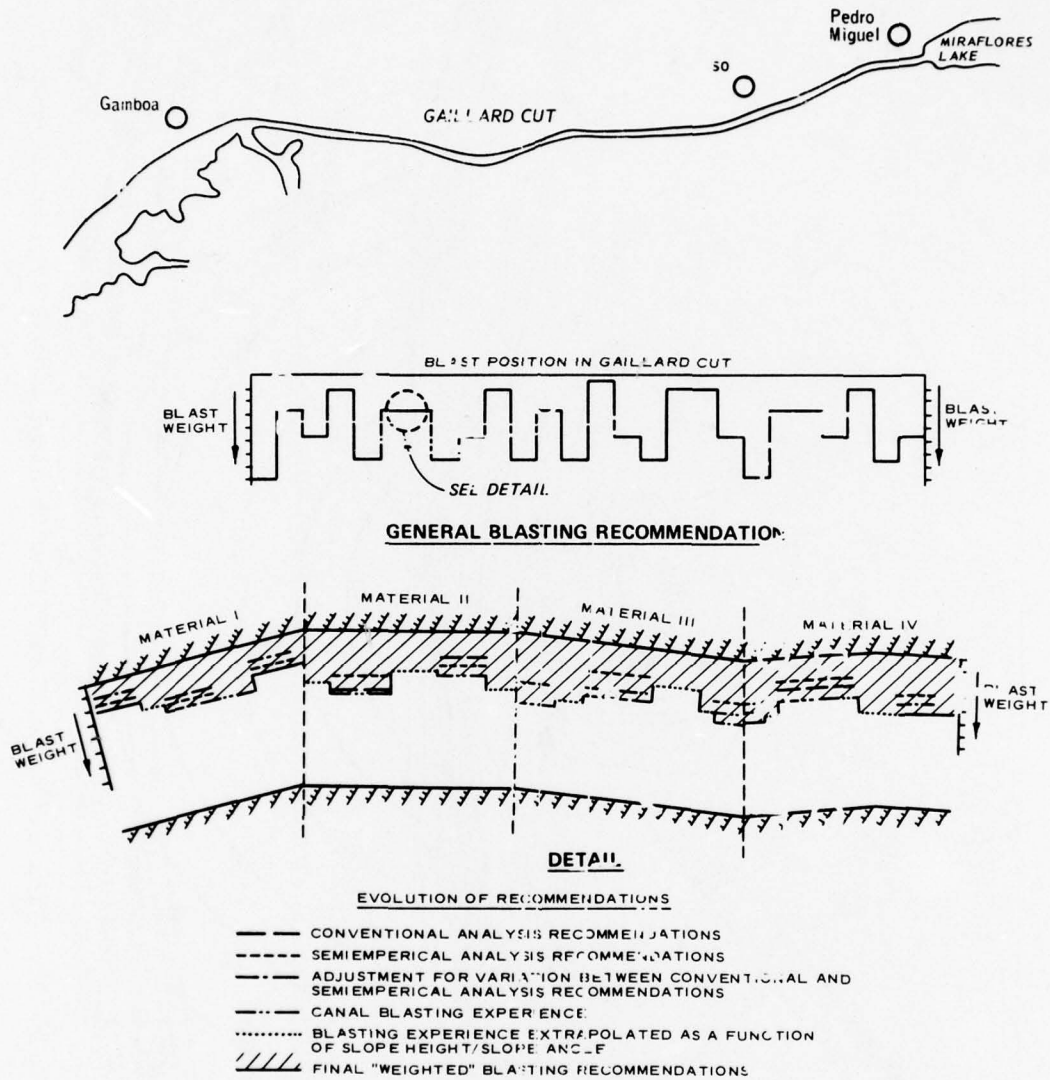


Figure 32. Envisioned development of final blasting recommendations

APPENDIX A: BORING LOGS FOR ERE-25, ERE-26, AND ERE-27

PANAMA CANAL COMPANY
ENGINEERING AND CONSTRUCTION BUREAU

GEOLOGICAL FIELD LOG

1 INCH=2 FT.

PROJECT / LA PITA HILL STUDIES FOR RES
 LOCATION / CUNETTE REACH - EAST
 COMPLETION DATE / 22 FEB. 1975
 CORE RECOVERY / 341.7 FT. 90.2 P/C
 DRILLER / C. DRANE

HOLE NO. / ERE. # 88
 GEOLOGIST / J. L. STEWART
 LATITUDE N. / 9 41 + 1244 LONGITUDE W. / 79 40' + 1619
 STATION / 1930+54 OFFSET / 932' E
 GROUND ELEVATION / 339.2 HOLE DEPTH / 380.6 FT.
 VERTICAL HOLE

ELEVATION / IN FEET	DEPTH / IN FEET	COLUMNAR SECTION	DESCRIPTION OF MATERIAL	DRILLING CHARACTERISTICS	CORE RECOVERY
339.2	0.0		SILTY CLAY, OH-2, MEDIUM SOFT OVERBURDEN, MEDIUM PLASTICITY, LOW DRY STRENGTH, MODERATE WATER CONTENT, RESIDUAL SHEAR STRENGTH, SILTY CLAY DERIVED FROM AGGLOMERATE, NORMAL WEATHERING PROCESSES, COLOR: MOTTLED RED, BROWN, + LIGHT GREY,	FROM 8.0 FT. TO 1.5 FT. DRILLED WITH TRIGGERS, NO ROTARY BIT; NO CORE RECOVERED; FROM 1.5 FT. TO 8.0 FT. PAW DRILLED DRY WITH 4" CONDITION; IN DISTURBED CONDITION; HPP200 IS 800 PSI.	
	1.5				
	8.0				2.1
331.2	8.0			4.9 FT. 75.4 P/C	2.8

11.3	SILT & CLAY, OM-2, MEDIUM SOFT OVERBURDEN, WEAK, LOW PLASTICITY, LOW DRY STRENGTH, MODERATE WATER CONTENT, RESIDUAL, SAPROLITIC SILT & CLAY, DERIVED FROM ANDESITE, BY NORMAL WEATHERING PROCESSES, CONTAINS SCATTERED SILICEOUS NODULES, COLOR- MOTTLED LIGHT & MEDIUM GREY, MEDIUM YELLOW-BROWN, SEE NOTE 12 IN SUMMARY	FROM 8.0 FT. TO 24.5 FT. PUSH DRILLED DRY WITH 4" CASING, CORE IN DISTURBED CONDITION, MHP=200 TO 400 PSI, FROM 24.5 FT. TO 29.7 FT. AS ABOVE, CORE IN DISTURBED CONDITION, MHP=200 TO 280 PSI, FROM 29.7 FT. TO 44.0 FT. AS ABOVE, CORE IN DISTURBED CONDITION, MHP=200 TO 600 PSI	2.2
14.6			2.4
17.9			2.0
21.2			2.4
24.5			2.7
26.7			1.9
29.8			1.8

33.2	0.2	
34.2	0.0	
36.2	1.1	
39.7	3.0	
43.1	1.4	
44.0	28.8 FT.	63.4 P/C
45.1		FROM 44.0 FT. TO 49.8 FT. AS ABOVE. CORE IS IN DISTURBED CONDITION. MAXIMUM STRENGTH TO 850 PSI. FROM 49.9 FT. TO 57.4 FT. DRILLED RAPIDLY & EASILY WITH X B-1/2 IN. DOUBLE TUBE, CARBOLOY BIT & WATER. CORE IN POOR FRAGMENTARY CONDITIONS.
47.8		SILTS & CLAY, OH=2, MEDIUM SOFT OVERBURDEN TO OH=3, MEDIUM HARD OVERBURDEN, WEAK TO MEDIUM STRENGTH, LOW PLASTICITY, LOW DRY STRENGTH, MODERATE WATER CONTENT, RESIDUAL SAPROLITICA SILTY CLAY, DERIVED FROM TUFF, BY NORMAL WEATHERING PROCESSES. COLOR RED-BROWN AT TOP GRADING TO MOTTLED LIGHT GREY IN BUFF IN LOWER PART. NOTE: UPPER CONTACT IS AN OLD EROSION SURFACE.
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281.8	57.4	79.2 P/C	2.8
	59.4		1.1
	62.8		3.4
	64.3		2.6
	65.8		3.5
	73.3		3.4

18.6 FT. FROM 57.4 FT. TO 74.0 FT. DRILLED RAPIDLY & EASILY WITH 4" X 5-1/2" IN DOUBLE TUBE, CARBOLOY B IT'S WATER, CORE IN POOR FRAGMENTARY CONDITION. FROM 59.4 FT. TO 69.8 FT. DRILLED DRY WITH 4" CASING. CORE IS N DISTURBED CONDITION. M.P. FROM 59.8 FT. TO 74.0 FT. AS ABOVE. CORE IN DISTURBED CONDITION. M.P. FROM 74.3 FT. TO 92.2 FT. AS ABOVE. CORE IN DISTURBED CONDITION. M.P. FROM 74.3 FT. TO 99.8 FT. AS ABOVE.

SILT, CLAY, OH=2, MEDIUM SOFT OVERBURDEN. TO OH=3, MEDIUM HARD OVERBURDEN, HEAVY TO MEDIUM STRENGTH, MODERATE PLASTICITY, LOW DRY STRENGTH, MODERATE WATER CONTENT, RESIDUAL SANDS, SILT, CLAY, DERIVED FROM ANDERITE. NORMAL WEATHERING PROCESSES, COLOR= MOTTLED DARK RED-BROWN, YELLOW-BROWN, BUFF. IN UPPER PART GRADING TO MOTTLED MEDIUM BROWN, & YELLOW-BROWN, IN LOWER PART,

76.3	24710	38.7 FT.	94.0 P/C	1.1
78.8				
81.2				
83.7				
86.2				
88.7				
91.1				
92.2				
3.0				
2.5				
2.4				
2.5				
2.4				
2.4				
2.4				

ANDESITE, OH-5, VERY HARD OVERBURDEN TO RH FROM 38.2 FT. TO 98 FT. DRILLED RAPIDLY & EASILY WITH 4 X 3-1/2 IN DOUBLE TUBE, CARBOLITE IT AN. HAIR, CORE IN GOOD CONDITION, 0.1 TO 1.5 FT. LENGTHS.

ANDESITE, OH-5, VERY HARD OVERBURDEN TO RH FROM 38.2 FT. TO 98 FT. DRILLED RAPIDLY & EASILY WITH 4 X 3-1/2 IN DOUBLE TUBE, CARBOLITE IT AN. HAIR, CORE IN GOOD CONDITION, 0.1 TO 1.5 FT. LENGTHS.

ANDESITE, OH-5, VERY HARD OVERBURDEN TO RH FROM 38.2 FT. TO 98 FT. DRILLED RAPIDLY & EASILY WITH 4 X 3-1/2 IN DOUBLE TUBE, CARBOLITE IT AN. HAIR, CORE IN GOOD CONDITION, 0.1 TO 1.5 FT. LENGTHS.

240.4	98.8 99.1	<p>TUFFS, AGGLOMERATIC, OH=3, MEDIUM HARD OVERBURDEN, TO OH=4, HARD OVERBURDEN, MODERATE STRENGTH, WEATHERED, VERY CLOSE TO CLOSE JOINTING, JOINTS CONTAIN SOFT, SOIL-LIKE MATERIAL, JOINTBLOCK CENTERS ARE HARDER + LESS WEATHERED, INDEFINITE BEDDING, FINE-TO MEDIUM-GRAINED, TUFACEOUS, VOLCANIC DEBRIS, ANDESITIC, DIACITIC, AGGLOMERATIC, CONTAINS ABUNDANT AGGLOMERATIC MATERIAL, ALTERED TO CLAY MINERALS, COBS= MOTTLED LIGHT GREY, LIGHT REDDISH TONE, + LIGHT GREY-GREEN, IN UPPER PART OR PASSING TO MOTTLED LIGHT GREY-GREEN, IN LOWER PART. NOTE/ UPPER CONTACT IS AN OLD EROSION SURFACE.</p>	86.8 PFC FROM 98.8 FT. TO 106.8 FT. DRILLED RAPIDLY + EASILY WITH X 5-1/2 IN. DOUBLE TUBE, CARBOLOY B IT + WATER, CORE IN GOOD CONDITION 0.1 TO 1.7 FT. LENGTHS.	8.7 FT.
232.5	106.7	<p>TUFFS, OH=2, MEDIUM HARD OVERBURDEN, TO OH=2, MEDIUM HARD OVERBURDEN, TO OH=2, MODERATE STRENGTH, WEATHERED, CLOSE JOINTING, JOINTS IRON-STAINED + OXIDIZED, JOINTS CONTAIN THIN CALCITE FILMS, MAJORITY BEDDING, FINE-TO MEDIUM-GRAINED, WATER-LAID, TUFACEOUS, VOLCANIC DEBRIS, ALTERED TO CLAY MINERALS, COLOR= MOTTLED DARK + MEDIUM BLUE-GREY, NOTE/ CORE HYDRATES, SHELLS + DIACITIC INTEGRATES ON EXPOSURE TO AIR.</p>	89.9 PFC FROM 106.7 FT. TO 113.8 FT. AS ABOVE, CORE IN GOOD CONDITION 0.1 TO 0.7 FT. LENGTHS.	7.1 FT.
227.7	111.5 112.8	<p>ANDESITIC, ANYGALCOIAL, OH=5, VERY HARD OVERBURDEN, TO OH=3, MEDIUM HARD ROCK, MODERATE STRENGTH, WEATHERED, CLOSE JOINTING, WITH MEDIUM SLICKENSIDES, SOME JOINTS IRON-STAINED + OXIDIZED, SOME JOINTS CONTAIN CALCITE, MEDIUM TO COARSE-GRAINED, ANYGALCOIAL, ALTERED TO CLAY MINERALS, COLOR= MOTTLED DARK + MEDIUM GREY.</p>	100.0 PFC FROM 111.5 FT. TO 116.8 FT. AS ABOVE, CORE IN GOOD CONDITION 0.1 TO 0.9 FT. LENGTHS.	4.8 FT.
222.3	116.9	<p>AGGLOMERATE, OH=5, VERY HARD OVERBURDEN, TO OH=3, MEDIUM HARD ROCK, MODERATE STRENGTH, WEATHERED, CLOSE TO MODERATE JOINTING, WITH MEDIUM SLICKENSIDES, JOINTS IRON-STAINED + OXIDIZED, MASSIVE BEDDING, ANGULAR TO SUBANGULAR, ANDESITIC, BASALTIC, FRAGMENTS, UP TO 1.5 FT. IN DIAMETER, IN A FINE-GRAINED, TUFACEOUS MATRIX.</p>	92.6 PFC FROM 116.9 FT. TO 129.8 FT. AS ABOVE, CORE IN UNDISTURBED CONDITION.	9.0 FT.

<p>IX, OF SIMILAR COMPOSITION, HIGHLY ALTERED TO CLAY MINERALS, COLOR MOTTLED LIGHT GREY, BROWN, BUFF, + MEDIUM RED-BROWN, NOTE: CORE HYDRATES, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR</p>	<p>125.9</p>	<p>ANDERITE, AMYGDALOIDAL, DMS, VERY HARD OVER BURDEN, TO RMS, MEDIUM HARD ROCK, MODERATE STRENGTH, WEATHERED, VERY CLOSE JOINTING, JOINTS IRON-STAINED + OXIDIZED, SOME JOINTS BENT MAIN CALCITE, MEDIUM TO COARSE-GRAINED, AMYG DALOIDAL, HIGHLY ALTERED TO CLAY MINERALS, COLOR MOTTLED DARK + MEDIUM GREY</p>	<p>9.0</p>
<p>FROM 129.0 FT. TO 189 FT. DRILLED SLOWLY + DIFICULTLY WITH X 5-1/2 IN. DOUBLE TUBE, CARBOL OY BIT + WATER, CORE GRD UND + BLOCKED, CORE IN GD COND. 0.1 TO 0.2 FT. LENGTHS. FROM 150.0 FT. TO 188.4 FT. 45 ARMS CARBOL OY BIT + WATER, CORE IN N GOOD CONDITION, 0.1 TO 0.2 FT. LENGTHS. FROM 188.4 FT. TO 189 FT. 45 ARMS CARBOL OY BIT + BRILLING MUD, CORE IN GOOD CONDITION, 0.1 TO 0.2 FT. LENGTHS. SEE NOTE 13 IN SUMMARY</p>	<p>210.2</p>	<p>189.1 FT. 100.0 PFC</p>	<p>7.4</p>
<p>133.3</p>	<p>129.0</p>	<p>135.8</p>	<p>3.8</p>

147.8					6.4
150.0					1.4
152.7					2.5
155.8					2.9
158.4 159.0				21.0 FT. FROM 159.0 FT. TO 160 FT. DRILLED RAPIDLY SEE NOTE 101	3.4
160.4				8.4 FT. FROM 160.4 FT. TO 169 FT. AS ABOVE, CORE I N GOOD CONDITION 0.1 TB 1.5 FT. LENGTHS.	100.0 P/C
177.0 162.2				AGGLOMERATE, CH-3, VERY HARD OVERBURDEN, STRO NG, WEATHERED, CLOSE JOINTING, SLICKENSIDED SEE NOTE 100	8.8 FT. 100.0 P/C
				AGGLOMERATE, TUFFACEOUS, RH-3, MEDIUM HARD RO CK, TO RH-4, HARD ROCK, MODERATELY STRONG TO STRONG, MODERATE JOINTING, WITH WAVY SLICKENS IDES, INDETERMINATE BEDDING, SUBANGULAR TO SU SEE NOTE 102	

145.8	<p>TUFFS, RH=9, MEDIUM HARD ROCK. TO RH=1, VERY SOFT ROCK, MEAN TO MODERATE STRENGTH, VERY CLOSE TO CLOSE JOINTINGS WITH MANY SLICKENSIDES, THIN BEDDING, BEDS DIP 16 DEGREES, FINEST TO MEDIUM GRAINED, MALKER-LAIDE TUFFACOUS, VOLCANIC DEBRIS, HIGHLY ALTERED TO CLAY MINERAL, COLOR DARK MEDIUM BROWN, IN UPPER PART GRADING TO NOTICED MEDIUM DARK GREY, AT BASE NOTE/ CORE HYDRATES, SHELLS, DISINTEGRATE ON EXPOSURE TO AIR, NOTE/ LOWER CONTACT IS B HARP, SEE NOTE 12 IN SUMMARY</p>	<p>FROM 162.2 FT. TO 168 FT. AS ABOVE, CORE IN GOOD CONDITION 0.1 TO 0.4 FT. LENGTHS. FROM 169.8 FT. TO 169 FT. DRILLED SLOWLY WITH X 8 1/2 IN. DOUBLE TUBE, DIAMOND BIT + DRILL MUD, TOO SOFT TO RETAIN IN SOME BARRELS, CORE IN N PDS, FRAGMENTARY CONDIT IONS, DROPPED CORE, GROUND SAMPLE DURING RECOVERY FROM 167.8 FT. TO 168.8 FT. DRILLED DRY WITH X 8 CARING, CORE IN DISTURBED CONDITION. FROM 168.8 FT. TO 170.0 FT. DRILLED DRY WITH DIAMOND BIT + DRILLING MUD, CORE IN DISTURBED CONDITION. FROM 170.0 FT. TO 172.7 FT. DRILLED SLOWLY WITH X 8 1/2 IN. DOUBLE TUBE, CARBOLITE BIT + DRILLING MUD, CORE IN GOOD CONDITION. 0.1 TO 0.7 FT. LENGTHS-SEE NOTE 13 IN SUMMARY</p>	<p>6.3</p>
167.8			<p>1.2</p>
170.0			<p>2.2</p>
165.5		<p>173.7</p>	<p>9.6 FT. 82.8 PFC</p>
175.4	<p>ANDESITE, AMYGDALOIDAL, RH=9, HARD ROCK, AT RONG, CLOSE TO MODERATE JOINTING, JOINTS CONTAIN CALCITE, ZEOLITE, CHLORITE, FINE TO MEDIUM GRAINED, EXTRUSIVE, AMYGDALOIDAL, ANY DOLES CONTAIN CALCITE, ZEOLITE, CHLORITE, COLOR MEDIUM TO DARK PURPLISH GREY, IN UPPER PART GRADING TO MEDIUM TAN, AT BASE.</p>	<p>FROM 173.7 FT. TO 183 FT. DRILLED RAPIDLY, EASILY WITH X 8 1/2 IN. DOUBLE TUBE, CARBOLITE BIT + DRILLING MUD, CORE IN GOOD CONDITION. 0.1 TO 1.7 FT. LENGTHS.</p>	<p>4.7</p>

185.4	185.2	191.0	193.1	16.1 FT. 93.1 PFC	9.5	
				FBOM 191.0 FT. TO 198.8 FT. AS ABOVE. CORE 1 IN GOOD CONDITION 0.1 TO 1.3 FT. LENGTHS.	7.7	
				TUFFA AGGLOMERATIC, RH=3, MEDIUM HARD ROCK, MODERATELY STRONG TO STRONG, MODERATE JOINTING, SOME JOINTS CONTAIN THIN CALCITE FILMS, THIN BEDDING, BEDS DIP 21 DEGREES, MEDIUM TO COARSE-GRAINED, WATER-WEARIED, TUFFACEOUS, VOLCANIC DEBRIS, AGGLOMERATIC, CONTAINS SCATTERED FINE AGGLOMERATIC MATERIAL, ALTERED TO CLAY MINERALS, FINER GRAINED IN UPPER PART BECOMING COARSER WITH DEPTH, COLOR DARK RED-BROWN, AT TOP GRADING TO MOTTLED DARK + MEDIUM GREY. IN LOWER PART, SOME SHELLS + DISINTEGRATES ON EXPOSURE TO AIR. NOTE: UPPER CONTACT IS AN OLD EROSION SURFACE.		
				AGGLOMERATES, RH=3, MEDIUM HARD ROCK, TO RH=4, HARD ROCK, STRONG, CLOSE TO MODERATE JOINTING, INDETERMINATE BEDDING, SUBANGULAR TO SUB-ROUNDED, ANDESITIC, BASALTIC, FRAGMENTS, UP TO 8.4 FT. IN DIAMETER, IN A COARSE-GRAINED, TUFFACEOUS MATRIX, OF SIMILAR COMPOSITION, ALTERED TO CLAY MINERALS, FINER GRAINED IN UPPER PART BECOMING COARSER WITH DEPTH, COLOR MOTTLED GREY, + GREY-GREEN, NOTE: CORE HYDRATED, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR.		
141.0	141.0	198.2	202.8	7.2 FT. 100.0 PFC	9.7	
				FBOM 198.2 FT. TO 208.8 FT. AS ABOVE. CORE 1 IN GOOD CONDITION 0.1 TO 1.2 FT. LENGTHS.		
				FBOM 208.8 FT. TO 209.8 FT. DRILLED RAPIDLY + EASILY WITH 4 X 5-1/2 IN DOUBLE TUBE, DIAMOND BIT + DRILLING MUD, CORE 1 IN GOOD CONDITION 0.1 TO 1.4 FT. LENGTHS.		

130.2	207.6	209.0	19.8 FT. 100.0 P/C	<p>TUFFA AGGLOMERATIC, RM-3, MEDIUM HARD ROCKS, MODERATE STRENGTH, CLOSE JOINTING, WITH MANY SLICKENSIDES, SOME JOINTS CONTAIN THIN CALCITE FILMS, THIN BEDDING, BEDS DIP 21 DEGREE S, MEDIUM-TO COARSE-GRAINED, WATER-LAID, TUFFACEOUS, VOLCANIC DEBRIS, AGGLOMERATIC, CONTAINS SCATTERED FINE AGGLOMERATIC MATERIALS, SEE NOTE 103</p>	5.8
137.2	212.0		8.0 FT. 100.0 P/C	<p>TUFFA, RM-1, SOFT ROCK, TO RM-2, MEDIUM SOFT ROCK, HEAVY, VERY CLOSE JOINTING, WITH PLANA R, WAVY SLICKENSIDES, THIN BEDDING, FINESTO MEDIUM-GRAINED, WATER-LAID, TUFFACEOUS, VOLCANIC DEBRIS, AGGLOMERATIC, IN LOWER PART, ALTERED TO CLAY MINERALS, FINER GRAINED IN UPPER PART BECOMING COARSER WITH DEPTH, COLOR DARK RED-BROWN, NOTE, CORE HYDRATES, SMELLS & BITING, INTEGRATES ON EXPOSURE TO AIR, NOTE, UPPER 50 FEET IS AN OLD EROSION SURFACE.</p>	6.0
116.9	216.5	220.7	6.2 FT. 71.3 P/C	<p>ASH FLOW, RM-5, HARD ROCK, TO RM-9, VERY HARD ROCK, STRONG, CLOSE TO MODERATE JOINTING, JOINTS CONTAIN CALCITE, CHLORITES, ZEOLITES, MASSIVE BEDDING, ANGULAR TO SUBANGULAR, PURICE LOUS, ANDESITE, BASALT, FRAGMENTS UP TO 12 FT. DIAMETERS, IN A TUFFACEOUS MATRIX, OF SIMILAR COMPOSITION, AN CONJUNCTION, APPARENTLY DEPOSITED IN A SEMI-MOLTEN CONDITION, HELDED TOGETHER BY OMM HEAT, COLOR, MOTTLED GREY, LIGHT GREY, PURPLISH GREY, & GREY-GREEN, SEE NOTE 12 IN SUMMARY</p>	0.4

9.0 10.0 9.6

230.4 240.4 260.0

253.4	30.4		
256.4	1.8		
258.3	1.9	38.7 FT. 98.0 P/C	
245.5	7.2		
272.5	7.0		

ANDESITES BRECCIATED, RH+4, HARD ROCK, TO R
 MSZ, VERY HARD ROCK, STRONG, DENSE, VERY CLO
 SE JOINTS, WITH PLANK + NAVY SLICKENSIDES
 SOME JOINTS OPEN, JOINTS CONTAIN CHLORITE
 ZEOLITES, CALCITE, QUARTZ, JOINTS DIP AT BAND
 ON ANGLES, FINE-GRAINED, BRECCIATED, INTRUS
 IVE COLOR, MEDIUM + DARK GREY, + BLACK
 SEE NOTE 12 IN SUMMARY

FROM 258.3 FT. TO 268
 .8 FT. DRILLED SLOWLY HIT
 H + X 5 1/2 IN. DOUBLE Y
 UBE, CARBOLOY BIT + DRILL
 ING MUD, CORE IN GOOD CON
 DITION 0.1 TO 1.2 FT
 . LENGTHS:-----FROM 268
 .8 FT. TO 299.8 FT. DR
 ILLED RAPIDLY + EASILY HIT
 H + X 5 1/2 IN. DOUBLE Y
 UBE, DIAMOND BIT + DRILL
 ING MUD, CORE IN GOOD CON
 DITION 0.1 TO 3.0 FT
 . LENGTHS:-----FROM 299
 .8 FT. TO 344.6 FT. DR
 ILLED SLOWLY + DIFFICULTLY
 WITH + X 5 1/2 IN. DOUB
 LE TUBE, DIAMOND BIT + DR
 ILLING MUD, CORE IN GOOD
 CONDITION 0.1 TO 0.8
 FT. LENGTHS:-----FROM
 344.6 FT. TO 380.6 FT
 . DRILLED RAPIDLY + EASILY
 WITH + X 5 1/2 IN. DOUB
 LE TUBE, DIAMOND BIT + DR
 ILLING MUD, CORE IN GOOD
 CONDITION 0.1 TO 1.6
 FT. LENGTHS:SEE NOTE 13
 IN SUMMARY

3.0
4.8
3.7
1.0
0.5
3.0
3.2

276.5
282.3
286.0
287.0
287.5
290.6
293.8

4.5 6.0 2.8

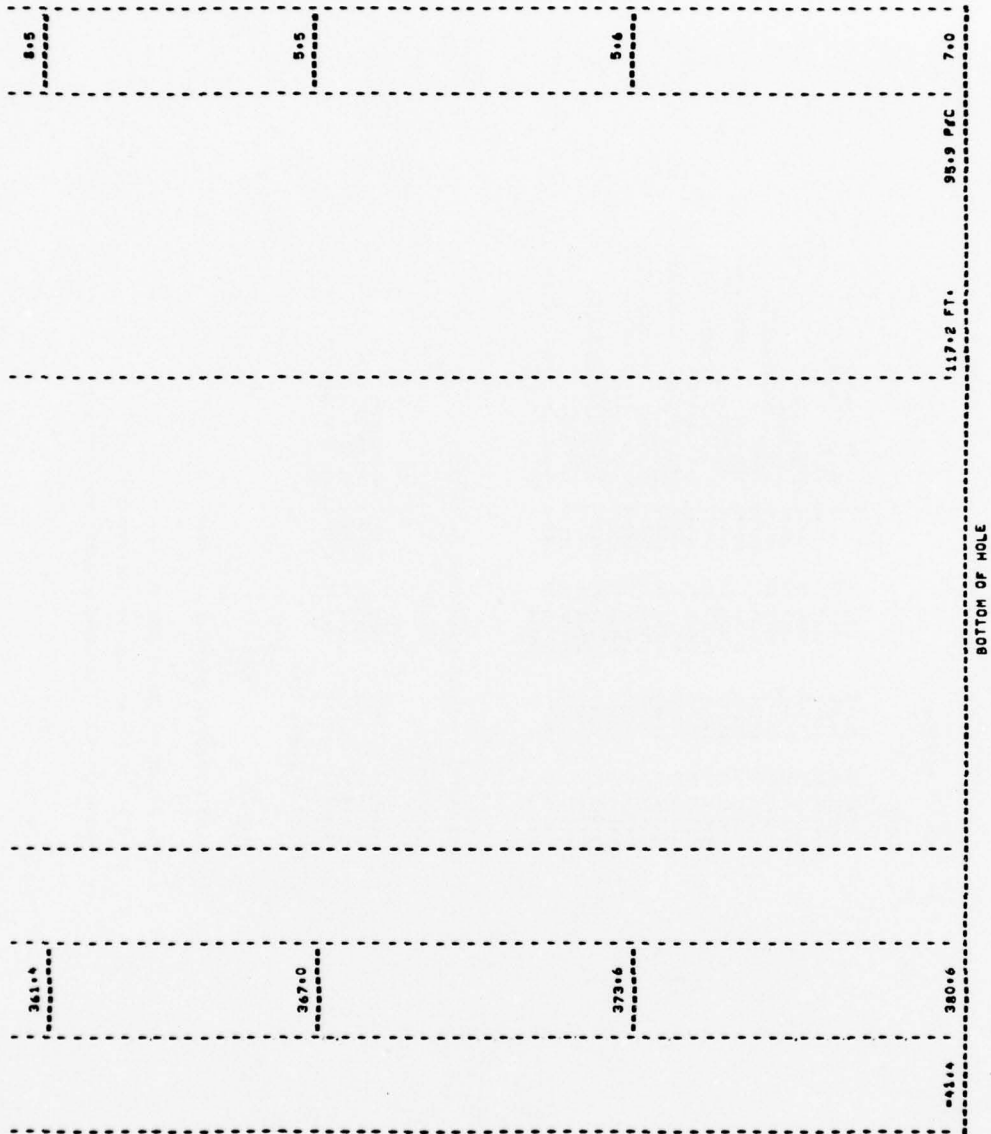
298.5 307.7 310.7

6.6
8.9
7.9

31783
32382
33181

8.9
7.8
8.1

340.0
347.8
358.9



NOTES

1. TYPE OF MATERIAL	ELEVATION	DEPTH	DEPTH	DEPTH
	339.2 TO 331.2	0.0 TO 8.0	8.0	SILT, CLAY,
	331.2 TO 295.2	8.0 TO 44.0	44.0	SILT, CLAY,
	295.2 TO 281.8	44.0 TO 57.4	57.4	SILT, CLAY,
	281.8 TO 247.0	57.4 TO 72.2	72.2	SILT, CLAY,
	247.0 TO 240.4	72.2 TO 78.8	78.8	ANDERITE,
	240.4 TO 232.5	78.8 TO 108.7	108.7	TUFF, ABOLCHERATICA,
	232.5 TO 227.7	108.7 TO 111.5	111.5	TUFF,
	227.7 TO 222.3	111.5 TO 114.5	114.5	ANDERITE, ANTDALOIDAL,
	222.3 TO 210.2	114.5 TO 128.0	128.0	ANDERITE, ANTDALOIDAL,
	210.2 TO 190.2	128.0 TO 138.0	138.0	ANDERITE, ANTDALOIDAL,
	190.2 TO 177.0	138.0 TO 148.2	148.2	ANDERITE, ANTDALOIDAL,
	177.0 TO 177.0	148.2 TO 148.2	148.2	ANDERITE, ANTDALOIDAL,
	177.0 TO 145.2	148.2 TO 173.7	173.7	TUFF, ABOLCHERATICA,
	145.2 TO 145.2	173.7 TO 173.7	173.7	TUFF, ABOLCHERATICA,
	145.2 TO 130.2	173.7 TO 198.2	198.2	TUFF, ABOLCHERATICA,
	130.2 TO 127.2	198.2 TO 208.0	208.0	ABOLCHERATICA,
	127.2 TO 114.5	208.0 TO 218.0	218.0	ABOLCHERATICA,
	114.5 TO 80.9	218.0 TO 228.7	228.7	TUFF, ABOLCHERATICA,
	80.9 TO -41.4	228.7 TO 258.3	258.3	ASH FLOW,
	-41.4 TO -41.4	258.3 TO 288.6	288.6	ANDERITE, BRECCIATED,
		288.6 TO 380.6	380.6	BOTTOM OF HOLE

2. ENGINEERING + GEOLOGICAL FORMATION CONTACTS

ELEVATION	DEPTH	DEPTH	DEPTH
339.2 TO 247.0	0.0 TO 8.0	8.0 TO 98.2	OVERBURDEN
247.0 TO 178.8	8.0 TO 160.4	160.4 TO 160.4	WEATHERED ROCK
178.8 TO -41.4	160.4 TO 380.6	380.6 TO 380.6	ROUND ROCK
339.2 TO -41.4	0.0 TO 380.6	380.6 TO 380.6	LAS CASCADAS FM

3. AMOUNT OF CASING USED

84.0 FT. OF 8" CASING
 84.0 FT. OF 6" CASING

4. AMOUNT OF PIPE OR CASING LEFT IN HOLE

84.0 FT. OF 6" CASING LEFT IN HOLE
 380.0 FT. OF PVC 2" PLASTIC PIPE INSTALLED

5. PURPOSE OF HOLE / GEOLOGIC EXPLORATION + SAMPLING

6. WATER TABLE

ELEVATION DEPTH DATE

269.0 70.2 21/ 1/75
 259.0 80.2 22/ 1/75
 267.7 71.5 23/ 1/75
 286.2 53.0 24/ 1/75
 253.8 85.4 25/ 1/75
 259.1 80.1 27/ 1/75
 278.9 60.3 28/ 1/75
 275.1 64.1 29/ 1/75
 277.0 62.2 31/ 1/75
 262.6 76.6 3/ 2/75
 296.5 42.7 8/ 2/75
 281.6 57.6 12/ 2/75
 257.0 82.2 13/ 2/75
 253.6 85.6 14/ 2/75
 281.0 58.2 15/ 2/75
 262.9 76.3 17/ 2/75
 271.6 67.6 18/ 2/75

10: CORE BOX NUMBERS AND DEPTHS

1)	0.0	7.8	2)	7.8	1316	3)	13.6	4)	20.7	26.0	8)	26.0	37.7
6)	37.7	44.7	7)	44.7	422	8)	48.2	9)	55.1	68.2	10)	60.2	65.0
11)	65.0	69.3	12)	69.3	7510	13)	75.0	14)	78.4	81.2	18)	81.2	86.2
16)	86.2	89.6	17)	89.6	9316	18)	93.6	19)	98.8	104.2	20)	104.2	109.3
21)	109.0	113.6	22)	113.6	11844	23)	118.4	24)	123.2	127.7	25)	127.7	132.5
26)	132.5	135.8	27)	135.8	14144	28)	145.7	29)	145.7	158.0	30)	150.0	155.3
31)	155.3	159.4	32)	159.4	16568	33)	165.8	34)	171.3	174.5	35)	174.5	181.3
36)	181.3	186.3	37)	186.3	19116	38)	191.6	39)	196.3	208.9	40)	200.9	205.8
41)	205.8	209.9	42)	209.9	21645	43)	216.5	44)	220.7	228.7	45)	225.7	230.4
46)	230.4	234.8	47)	234.8	23988	48)	239.8	49)	244.9	250.0	50)	250.0	252.2
51)	252.2	258.3	52)	258.3	26440	53)	264.0	54)	268.5	273.8	55)	272.8	277.2
56)	277.2	282.0	57)	282.0	28647	58)	286.7	59)	291.1	299.3	60)	295.3	299.9
61)	299.9	306.4	62)	306.4	31040	63)	310.0	64)	313.6	317.3	65)	317.3	322.3
66)	322.3	326.6	67)	326.6	33141	68)	331.1	69)	335.5	340.0	70)	340.0	344.6

71) 344.6 347.2 72) 347.8 352.9 73) 352.9 357.4 74) 357.4 361.4 75) 361.4 366.0
 76) 366.0 371.2 77) 371.2 375.8 78) 375.8 379.0 79) 379.0 380.6

11. DRILL WATER CIRCULATION LOSSES

FROM TO

50.0 85.0

12. ADDITIONAL DESCRIPTIVE INFORMATION

SILT + CLAY, DEPTH 8.0'-44.0', IS DERIVED FROM AN ANHYDRAIDAL ANDESITE. SILT + CLAY, 44.0'-57.4', THE MATERIAL FROM 50.0'-57.4' RESEMBLES WEATHERED ROCK, VERY HIGHLY ALTERED TO MONTMORILLONITIC + BENTONITIC CLAY MINERALS, CH=3, MEDIUM HARD OVERBURDEN. SILT + CLAY, 57.4'-92.2', IS ON=4 HARD OVERBURDEN, IN THE LOWER 1.0'.

ANDESITE, 92.2'-98.8', HAS STEEPLY DIPPING JOINTS IN UPPER PORTION, DIP 77 DEGREES. THIS MATERIAL IS ALL IN A SHEAR ZONE. TUFF, AGGLOMERATIC, 98.8'-106.7', HAS A SHEAR ZONE, 102.0'-104.2'. TUFF, 106.7'-111.8', HAS A SLICKENSIDED SHEAR ZONE AT 106.7', WITH GOUGE, SLICKENSIDES, DIP 25-30 DEGREES. AGGLOMERATE, 116.9'-121.9', HAS A HIGHLY ALTERED SHEAR ZONE, 121.8'-129.0'. ANDESITE, 129.0'-159.0', IS ALL A SHEAR ZONE.

TUFF, 162.2'-173.7', HAS A FAULT WITH SOFT PLASTIC GOUGE, 162.2'-170.2', A PLANAR SLICKENSIDE AT 170.2', DIPPING 9-12 DEGREES. MATERIAL IS SHEARED 170.2'-172.7', + JOINTS HAVE SOFT PLASTIC GOUGE AT 171.8', + FROM 172.4'-172.9'. TUFF, AGGLOMERATIC, 203.0'-218.0', + TUFF, 212.0'-220.7', HAVE A FAULT ZONE, 210.7'-220.7', WITH SOFT PLASTIC GOUGE, 211.3'-211.5', NUMEROUS PLANAR SLICKENSIDES + THE FAULT CONTACT AT 112.0'.

ASH FLOW, 220.7'-258.3', IS SHEARED + BROKEN, 220.7'-224.7', HAS A STEEPLY DIPPING FAULT, 73 DEGREES, AT 229.4' + SHOWING VERTICAL MOTION, IS SHEARED, BROKEN + SLICKENSIDED, 232.1'-232.3' + IS PERLITIC BELOW 232.1', (PERLITIC MATERIAL POSSIBLY FAULTED IN PLACE). ANDESITE, BRECCIATED, 258.3'-380.0', IS VERY HIGHLY SLICKENSIDED + BROKEN BELOW 286.0', BETWEEN 298.5' + 344.6'. MATERIAL IS EXTREMELY CLOSELY JOINTED, AT 275.0' THERE IS A NEAR VERTICAL, HEALED FAULT. ANDESITE, 288.2'-350.6', CONT'D., THIS IS AN OLD FAULT WITH HORIZONTAL MOTION, THE SAMPLES TAKEN FROM THIS HOLE SHOW NUMEROUS VERTICAL + NEAR VERTICAL JOINTS + BREAKS.

13. ADDITIONAL DRILLING INFORMATION

HOLE WAS CAVING BADLY, DRILLER GROUTED HOLE TO 180.0', CLEANED HOLE + STARTED DRILLING WITH MUD.

DROPPED ONE JAW FROM SLIPS IN HOLE, RECOVERED SLIP JAW WITH 5-1/2 INCH OUTER BARREL IN RUN, 168.8'-170.0'.

80 P/C WATER RETURN, 92.2'-112.8', 80 P/C RETURN 112.8'-116.9', 80 P/C RETURN 116.9'-136.8', LOST ALL DRILLING MUD RETURN AT 230.6', ADDED 3 SACS OF ABUAGEL + LIME, + GOT 100 P/C RETURN.

8 IN. FLUSH JOINT CASING CAME APART IN TWO PLACES + HAD TO BE FISHED OUT.

CORE BETWEEN 299.8' + 344.6', WAS RECOVERED IN GOOD CONDITION, BUT THE ANDESITE WAS SO CLOSELY JOINTED + SHEARED THAT IT FELL APART UPON REMOVAL FROM CORE BARREL, THE SMALLEST PIECES RECOVERED WERE LESS 0.01' IN DIAMETER.

100', JOINTS IRON-STAINED + OXIDIZED. INDETERMINATE BEDDING, ANGULAR TO SUBANGULAR, ANDESITIC, FRAGMENTED IN A FINE-GRAINED, TUFFACEOUS MATRIX, ALTERED TO CLAY MINERALS, COLOR- MOTTLED LIGHT + MEDIUM GREY-GREEN, + RED-BROWN, NOTE/ CORE HYDRATES, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR.

101. EASILY WITH + X 5-1/2 IN. DOUBLE TUBE, DIAMOND BIT + DRILLING MUD, CORE IN FAIR CONDITION 0-1
TO C14 FT. LENGTHS.

102. B-ROUNDED, ANDESITIC, BASALTIC, FRAGMENTS, UP TO 0.2 FT. DIAMETER, IN A FINE-GRAINED, TUFFACE
OUS MATRIX, OF SIMILAR COMPOSITION, ALTERED TO CLAY MINERALS, COLOR- MOTTLED GREY, GREY-
GREEN, DARK PURPLISH GREY. NOTE/ CORE HYDRATES, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR. NO
TE/ LOWER CONTACT IS SHARP.

103. ALTERED TO CLAY MINERALS, FINER GRAINED IN UPPER PART BECOMING COARSER WITH DEPTH, COLOR- MOTTLE
D DARK + MEDIUM GREY, NOTE/ CORE HYDRATES, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR. NOTE/ LO
WER CONTACT IS SHARP.

104. TE 13 IN SUMMARY

PAJAMA CANAL COMPANY
ENGINEERING AND CONSTRUCTION BUREAU

GEOLOGICAL FIELD LOG

1 INCH = 4 FT.

PROJECT / LA PITA MILL STUDIES FOR WES
 LOCATION / CUNETTE REACH - EAST
 COMPLETION DATE / 22 MAR. 1975
 CORE RECOVERY / 271.3 FT. 90% P/C
 DRILLER / C. DRAKE

HOLE NO. / IERE - 26 GEOLOGIST / J. L. STEWART
 LATITUDE N. / 9 41 + 1026 LONGITUDE W. / 79 40' + 1997
 STATION / 1832+47 OFFSET / 812' E
 GROUND ELEVATION / 307.8 HOLE DEPTH / 300.2 FT.
 VERTICAL HOLE

ELEVATION IN FEET	DEPTH IN FEET	COLUMNAR SECTION	DESCRIPTION OF MATERIAL	DRILLING CHARACTERISTICS	CORE RECOVERY
307.8	0.0		SILT, CLAY, OH-2, MEDIUM SOFT OVERBURDEN, LOW TO OH-3, MEDIUM HARD OVERBURDEN, WEAK, LOW PLASTICITY, LOW DRY STRENGTH, LOW WATER CONTENT, RESIDUAL SAPROLITIC SILT, CLAY, DERIVED FROM ANDESITE, BY NORMAL WEATHERING PROCESSES, HARDNESS INCREASES WITH DEPTH. CLAY AT TOP BECOMING SILTIER WITH DEPTH. COLOR: MOTTLED LIGHT + MEDIUM GREY, + MEDIUM YELLOW -BROWN.	FROM 0.0 FT. TO 26.9 FT. DRILLED DRY WITH 4.1" CASING, CORE IN DISTURBED CONDITION. M.P.P. 200 TO 350 PSI.	1.7
	3.4				1.8
	5.8				1.9
	8.1				2.4
	11.4				2.2
	13.7				1.0
	16.0				3.0
	19.2				

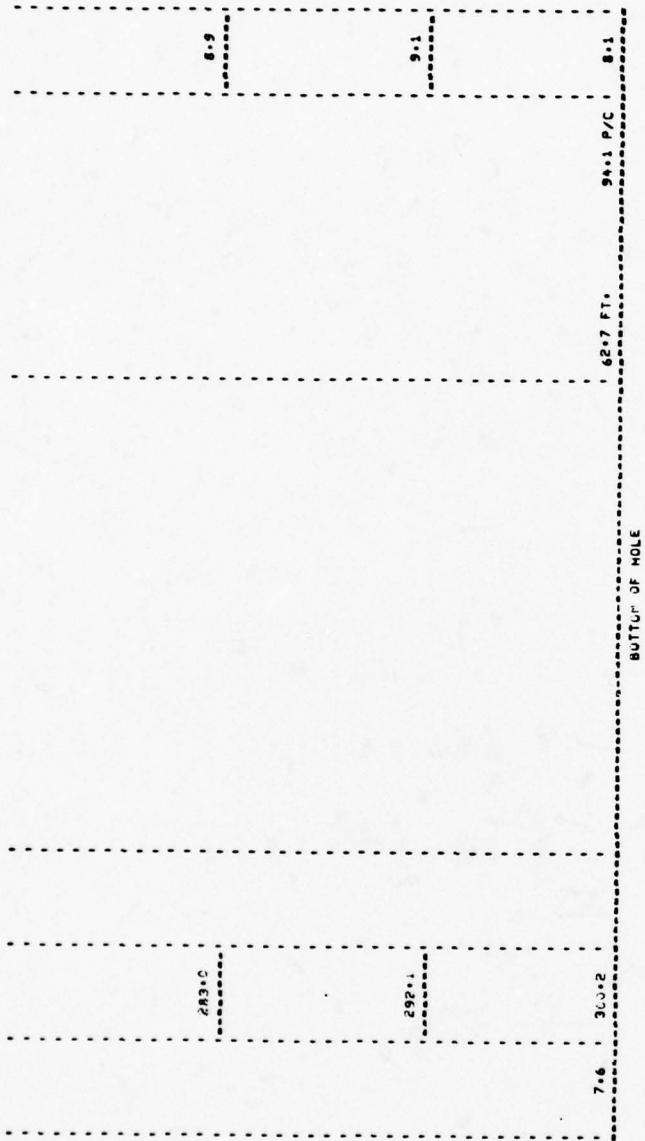
22.0					2.8
24.6					2.0
26.3	281.5	20.5 FT.	78.0 P/C	FROM 26.3 FT. TO 26.8 FT. AS ABOVE, CORE 1 N DISTURBED CONDITION. FROM 26.8 FT. TO 28.8 FT. DRILLED RAPIDLY + EASILY WITH 5" CASING + WATER, COME IN FAIR CONDITION 0.1 TO 0.4 FT. LENGTHS. FROM 28.8 FT. TO 30.7 FT. DRILLED RAPIDLY + EASILY WITH 5" CASING + WATER, COME IN FAIR CONDITION + BLOC	1.7
26.8					2.2
28.8					1.7
31.7					1.5
32.2					1.3
34.3					1.7
36.3					1.2
40.3					2.3
44.7					1.7
46.8	281.0	19.6 FT.	71.3 P/C	FROM 46.8 FT. TO 60.3 FT. DRILLED DRY WITH 5" CASINGS, CORE IN DISTURBED CONDITION.	3.3
48.3					
54.1					2.9
57.4					2.5
60.3	287.5	8.3 FT.	81.5 P/C	FROM 60.3 FT. TO 68.6 FT. DRILLED DRY WITH 5" CASINGS, CORE IN DISTURBED CONDITION.	2.3

61.6	AGGLOMERATE, UM=3, HARD OVERBURDEN, TO RM=3, HARD ROCK, STRONG, WEATHERED, VERY CLOSE TO CLOSE JOINTING, WITH HEAVY SLICKENSIDES, JOINTS IRON-STAINED, DALLIZITE, SUBANGULUM TO SUBANGULUM, CHLORITE, ZOLITE, SUBANGULUM TO SUBANGULUM, MICA, FRAGMENTS, UP TO .5 FT. IN DIAMETER, IN TUFFACEOUS MATRIX, OF SIMILAR COMPOSITION, ALTERED TO CLAY MINERALS, WEATHERING DECREASES, HARDNESS INCREASES WITH DEPTH, COLOR DARK RED-BROWN, DARK, MEDIUM GREY, COIN UPPER PART CHANGING TO MOTTLED MEDIUM GREY, DARK PURPLISH GREY, IN CENTRAL PART,	FROM 60.3 FT. TO 62 FT. DRILLED DRY WITH 1 1/2 IN. DOUBLE TUBE, CORE IN DISTURBED CONDITION, FROM 62.0 FT. TO 64.0 FT. DRILLED SLOWLY, DIFFICULTY WITH 1 1/2 IN. DOUBLE TUBE, CARBOLLOY BIT, DRILLING MUD, CORE IN GOOD CONDITION, 0.1 TO 2.0 FT. LENGTHS, FROM 64.0 FT. TO 66.0 FT. DRILLED SLOWLY, DIFFICULTY WITH 1 1/2 IN. DOUBLE TUBE, CARBOLLOY BIT, DRILLING MUD, CORE IN GOOD CONDITION, 0.1 TO 1.6 FT. LENGTHS, SEE NOTE 13 IN SUMMARY	1.3 0.8
72.2			9.8
82.0			2.4
84.4			2.4
86.9			2.4
97.1			2.4
215.5	92.3	31.1 FT. 37.2 P/C	
208.8	99.0	51.0 FT. 74.7 P/C	
100.1		FROM 92.3 FT. TO 99.0 FT. DRILLED RAPIDLY, EASILY WITH 1 1/2 IN. DOUBLE TUBE, CARBOLLOY BIT, DRILLING MUD, CORE IN GOOD CONDITION, 0.1 TO 0.4 FT. LENGTHS, A DRY-BLOCK PLUG.	7.9
205.8	102.3	2.6 FT. 86.7 P/C	
		FROM 99.0 FT. TO 102.3 FT. AS ABOVE, CORE IN FAIR CONDITION, 0.1 TO 0.4 FT. LENGTHS, SEE NOTE 103	
		FROM 102.3 FT. TO 106.0 FT. AS ABOVE, CORE IN GOOD CONDITION, 0.1 TO 0.4 FT. LENGTHS, SEE NOTE 101	
		TUFF, UM=5, VERY HARD OVERBURDEN, TO RM=3, MEDIUM HARD ROCK, MODERATE STRENGTH, WEATHERED, VERY CLOSE TO CLOSE JOINTING, WITH HEAVY SLICKENSIDES, JOINTS IRON-STAINED, WITH MANY SLICKENSIDES, JOINTS IRON-STAINED + OXIDIZED, SOME JOINTS CONTAIN CHLORITE, INDETERMINATE BEDDING, FINE TO MEDIUM-GRAINED, WATER-LAID, TUFFACEOUS, VOLCANIC DEBRIS, CONTACT SCATTERED AGGLOMERATIC MATERIAL, HIGHLY ALTERED TO CLAY MINERALS, COLOR= DARK RED-BROWN, NOTE SEE NOTE 101	
		TUFF, AGGLOMERATIC, UM=5, VERY HARD OVERBURDEN, TO RM=3, MEDIUM HARD ROCK, MODERATE STRENGTH, WEATHERED, CLOSE JOINTING, JOINTS IRON-STAINED + OXIDIZED, INDETERMINATE BEDDING, FINE TO MEDIUM-GRAINED, WATER-LAID, TUFFACEOUS, VOLCANIC DEBRIS, CONTACT SCATTERED AGGLOMERATIC MATERIAL, HIGHLY ALTERED TO CLAY MINERALS, COLOR= DARK RED-BROWN, NOTE SEE NOTE 101	
		TUFF, AGGLOMERATIC, RM=2, MEDIUM SOFT ROCK, TO RM=3, MEDIUM HARD ROCK, MODERATE STRENGTH, WEATHERED, CLOSE JOINTING, JOINTS IRON-STAINED, SOME JOINTS CONTAIN CHLORITE, INDETERMINATE BEDDING, FINE TO MEDIUM-GRAINED, WATER-LAID, TUFFACEOUS, VOLCANIC DEBRIS, CONTACT SCATTERED AGGLOMERATIC MATERIAL, HIGHLY ALTERED TO CLAY MINERALS, COLOR= DARK RED-BROWN, NOTE SEE NOTE 101	

149.5			9.9
151.1			1.6
154.4			
157.0	TUFF, AGGLOMERATIC, RM=2, MEDIUM SOFT ROCK, WEAK TO MODERATE TO RM=3, MEDIUM HARD ROCK, WEAK TO MODERATE SEE NOTE 137	28.4 FT. FROM 157.0 FT. TO 160.0 FT. DRILLED RAPIDLY + SEE NOTE 108	88.8 P/C
160.2	TUFF, RM=1, SOFT ROCK, TO RM=2, MEDIUM SOFT ROCK, WEAK, CLOSE JOINTING, WITH PLINAR + MANY SLICKENSIDES, THIN BEDDING, FINE TO MEDIUM GRAINED, WATER-LAID, TUFACEOUS, VOLCANIC DEBRIS, CONTAINS SCATTERED AGGLOMERATIC MATERIAL, HIGHLY ALTERED TO CLAY MINERALS, COLOR DARK RED-BROWN, NOTE/ CORE HYDRATES, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR. NOTE/ UP PER CONTACT IS AN OLD EROSION SURFACE.	3.2 FT. FROM 160.2 FT. TO 170.0 FT. AS ABOVE. CORE IN GOOD CONDITION 0.1 TO 1.1 FT. LENGTHS.	100.0 P/C
164.2			9.8
167.6			
170.0	ANDESITE, RM=4, HARD ROCK, TO RM=5, VERY HARD ROCK, STRONG, CLOSE TO MODERATE JOINTING, SOME SLICKENSIDING, JOINTS CONTAIN CHLORITE, ZEOLITE, CALCITE, QUARTZ, CONTAINS FLOW STRUCTURES, AMYGDALOIDAL, AMYGDULES CONTAIN CHLORITE ZEOLITE, CALCITE, COLOR= MOTTLED MEDIAN GREY, + PURPLISH GREY, NOTE/ LOWER CONTACT IS SHARP.	9.8 FT. FROM 170.0 FT. TO 186.6 FT. DRILLED SLOWLY WITH 4 X 5-1/2 IN. DOUBLE TUBE, CARBULOID BIT + WATER CORE IN GOOD CONDITION 0.1 TO 1.8 FT. LENGTHS. FROM 186.6 FT. TO 192.2 FT. DRILLED SLOWLY WITH 4 X 5-1/2 IN. DOUBLE TUBE, DIAMOND BIT + WATER, CORE IN GOOD CONDITION 0.1 TO 1.0 FT. LENGTHS.	100.0 P/C
173.8			
183.8			9.5
184.4			0.6
186.6			2.2

115.6	192.2	AGGLOMERATE, TUFACEOUS, Rm=3, MEDIUM HARD ROCK TO Rm=3, HARD ROCK, MODERATELY STRONG TO STRONG, CLOSE TO MODERATE JOINTING, WITH MANY SLICKENSIDES, INDIFFERENT BEDDING, COARSE SEE NOTE 109	26.2 FT. 100.0 P/C FROM 192.2 FT. TO 195 FT. DRILLED RAPIDLY + EASILY WITH X 5-1/2 IN DOUBLE TUBE, DIAMOND BIT SEE NOTE 110	9.2
112.0	195.8	TUFF, AGGLOMERATE, Rm=2, MEDIUM SOFT ROCK, TO Rm=3, MEDIUM HARD ROCK, NEAR TO MODERATE STRENGTH, CLOSE JOINTING, HIGHLY SLICKENSIDED, THIN BEDDING, FINE-TO COARSE-GRAINED, INTER-LAID TUFFALLOUS, VOLCANIC DEBRIS, CONTAINS SCATTERED FINE AGGLOMERATE MATERIAL, ALTERED TO CLAY MINERALS, CONTAINS EMBEDDED ESSENTIAL + BROKEN ACCIDENTAL FELDSPAR CRYSTALS. COLOR DARK RED-BROWN, NOTE/ CORE HYDRATES, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR. NOTE/ UPPER CONTACT IS AN OLD EMISSION SURFACE.	3.6 FT. 100.0 P/C FROM 195.8 FT. TO 198 FT. DRILLED RAPIDLY + EASILY WITH X 5-1/2 IN DOUBLE TUBE, DIAMOND BIT + WATER, CORE IN GOOD CONDITION 0.1 TO 1.8 FT. LENGTHS.-----FROM 198.8 FT. TO 204.6 FT. DRILLED RAPIDLY + EASILY WITH X 5-1/2 IN DOUBLE TUBE, CARBOLOY BIT + DRILLING MUD, CORE IN GOOD CONDITION 0.1 TO 1.0 FT. LENGTHS.-----FROM 204.6 FT. TO 210.7 FT. DRILLED SLOWLY + DIFFICULTLY WITH X 5-1/2 IN DOUBLE TUBE, CARBOLOY BIT + DRILLING MUD, CORE IN FAIR CONDITION 0.1 TO 0	3.0
97.1	21.17	ASH FLOW, Rm=3, HARD ROCK, TO Mm=3, VERY HARD ROCK, STRONG, CLOSE TO MODERATE JOINTING AND WITH MANY SLICKENSIDES, MASSIVE BEDDING, UNIFORM TO SUB-ANGULAR, TUFACEOUS, AGGLOMERATE, AN LIGNITE, APPARENTLY DEPOSITED IN SEMI-FLUID CONDITION, HELD TOGETHER BY OIL, HEAVY COLOR, MOTTLED, PINKISH GREY, + PURPLISH GREY, SEE NOTE 12 IN SUMMARY	14.9 FT. 100.0 P/C FROM 210.7 FT. TO 219 FT. DRILLED RAPIDLY + EASILY WITH X 5-1/2 IN DOUBLE TUBE, CARBOLOY BIT + DRILLING MUD, CORE IN GOOD CONDITION 0.1 TO 2.0 FT. LENGTHS.-----FROM 219.5 FT. TO 222 FT. DRILLED SLOWLY + DIFFICULTLY WITH X 5-1/2 IN DOUBLE TUBE, CARBOLOY BIT + DRILLING MUD, CORE IN FAIR CONDITION 0.1 TO 0.3 FT. LENGTHS.-----FROM 222.0 FT. TO 230.5 FT. DRILLED RAPIDLY + EASILY WITH X 5-1/2 IN DOUBLE TUBE, CARBOLOY BIT + DRILLING MUD, CORE IN POOR CONDITION 0.1 TO 1.8 FT. LENGTHS.-----FROM 230.5 FT. TO 233.5 FT. DRILLED RAPIDLY + EASILY WITH X 5-1/2 IN DOUBLE TUBE, CARBOLOY BIT + DRILLING MUD, CORE IN GOOD CONDITION 0.1 TO 1.9 FT. LENGTHS.	7.3 0.4
	221.3			9.0
	222.8			1.5
	230.5			6.7

74.3	233.5	21.8 FT.	95.7 P/C	233.5 FT. TO 300 FT. DRILLED RAPIDLY + EASILY WITH 4 X 8-1/2 IN DOUBLE TUBE, CORE IN GOOD CONDITION 0.1 TO 0.5 FT. LENGTHS. FROM 233.5 FT. TO 248.3 FT. DRILLED RAPIDLY + EASILY WITH 4 X 8-1/2 IN DOUBLE TUBE, CARBOLOY BIT + WATER. FROM 248.3 FT. TO 274.1 FT. DRILLED RAPIDLY + EASILY WITH 4 X 8-1/2 IN DOUBLE TUBE, CARBOLOY BIT + DRILLING MUD. FROM 274.1 FT. TO 300.2 FT. DRILLED RAPIDLY + EASILY WITH 4 X 8-1/2 IN DOUBLE TUBE, DIAMOND BIT + DRILLING MUD.	4.0 1.8
	236.7			ANDESITE, RH=3, MEDIUM HARD ROCK, TO RH=5, VERY HARD ROCK, STRONG, DENSE, CLOSE JOINTING WITH MANY SLICKENSIDES, JOINTS CONTAIN CHLORITE, ZEOLITE, CALCITE, AMYGDALOIDAL, IN UPPER PART, PARTIALLY ALTERED TO CLAY MINERAL SP. AMYGDULES CONTAIN CHLORITE ZEOLITE, CALCITE, HARDNESS INCREASES WITH DEPTH. COLOR MOTTLED GREY, SEE NOTE 12 SUMMARY	
	238.3				
	248.3				8.7
	252.2				3.9
	262.3				10.1
	266.0				3.2
	267.1				1.1
	271.3				4.2
	274.1				2.8



A31

NOTES

1. TYPE OF MATERIAL	ELEVATION	DEPTH	TYPE OF MATERIAL
	307.8 TO 281.5	0.0 TO 26.3	SILT, CLAY, ANDESITE, CLAY, SANDY AGGLOMERATE,
	281.5 TO 261.0	26.3 TO 46.8	AGGLOMERATE,
	261.0 TO 247.5	46.8 TO 60.3	AGGLOMERATE,
	247.5 TO 215.5	60.3 TO 92.3	AGGLOMERATE,
	215.5 TO 208.8	92.3 TO 99.0	TUFF, AGGLOMERATE,
	208.8 TO 205.8	99.0 TO 102.0	TUFF, AGGLOMERATE,
	205.8 TO 201.2	102.0 TO 106.6	TUFF, AGGLOMERATE,
	201.2 TO 197.7	106.6 TO 110.1	TUFF, AGGLOMERATE,
	197.7 TO 182.8	110.1 TO 125.0	AGGLOMERATE,
	182.8 TO 150.8	125.0 TO 157.0	AGGLOMERATE,
	150.8 TO 147.6	157.0 TO 160.2	AGGLOMERATE,
	147.6 TO 137.8	160.2 TO 172.0	TUFF, AGGLOMERATE,
	137.8 TO 115.6	172.0 TO 192.2	AGGLOMERATE,
	115.6 TO 112.0	192.2 TO 195.8	AGGLOMERATE, TUFFACEOUS,

112.0 TO 97.1 195.8 TO 210.7 UFFA, AGGLOMERATE,
 97.1 TO 74.3 210.7 TO 233.5 ASH FLUM,
 74.3 TO 7.6 233.5 TO 300.2 ALDESITE,
 7.6 300.2 BOTTOM OF HOLE

2. ENGINEERING + GEOLOGICAL FORMATION CONTACTS

ELEVATION	DEPTH
307.8 TO 287.5	0.0 TO 60.3 OVERBURDEN
287.5 TO 205.8	60.3 TO 102.0 WEATHERED ROCK
205.8 TO 7.6	102.0 TO 300.2 SOUND ROCK
307.8 TO 7.6	0.0 TO 300.2 LAS CASCADAS FR.

4. AMOUNT OF PIPE OR CASING LEFT IN HOLE

300.2 FT. OF PVC, 2" PLASTIC PIPE INSTALLED

5. PURPOSE OF HOLE / GEOLOGIC EXPLORATION + SAMPLING.

8. WATER TABLE

ELEVATION	DEPTH	DATE
269.2	38.6	2/ 3/75
287.6	40.2	3/ 3/75
276.0	31.8	4/ 3/75
271.6	36.2	6/ 3/75
286.6	41.2	7/ 3/75
285.2	42.6	8/ 3/75
285.2	42.6	10/ 3/75
282.9	44.9	11/ 3/75
246.1	61.7	12/ 3/75
246.1	61.7	13/ 3/75
285.9	41.9	17/ 3/75
286.2	41.6	18/ 3/75
284.8	43.0	19/ 3/75
283.3	44.5	20/ 3/75
281.8	46.0	21/ 3/75

9. THE FOLLOWING SAMPLES WERE TAKEN FOR LABORATORY TESTING PURPOSES

FROM TO

56.6 57.9
59.4 60.2
184.6 185.3
166.6 167.1
209.8 210.3
236.7 237.9

10. CORE BOX NUMBERS AND DEPTHS

11	0.0	7.3	21	7.3	13.0	31	13.0	19.2	41	19.2	24.6	51	24.6	29.2
61	29.2	34.3	71	34.3	41.0	81	41.0	48.3	91	48.3	57.0	101	57.0	61.6
111	61.6	65.9	121	65.9	70.2	131	70.2	74.3	141	74.3	79.0	151	79.0	83.0
161	83.0	86.9	171	86.9	92.3	181	92.3	98.7	191	98.7	103.0	201	103.0	106.0
211	106.0	113.0	221	113.0	117.4	231	117.4	122.0	241	122.0	127.2	251	127.2	132.0
261	132.0	136.1	271	136.1	141.2	281	141.2	146.0	291	146.0	151.1	301	151.1	155.0
311	155.0	160.0	321	160.0	164.2	331	164.2	169.3	341	169.3	174.3	351	174.3	178.2
361	178.2	183.8	371	183.8	187.2	381	187.2	192.2	391	192.2	197.2	401	197.2	202.4
411	202.4	207.4	421	207.4	211.9	431	211.9	213.8	441	213.8	219.5	451	219.5	222.9
461	222.8	227.0	471	227.0	233.0	481	233.0	237.0	491	237.0	242.0	501	242.0	246.2
511	246.2	251.8	521	251.8	256.9	531	256.9	262.0	541	262.0	266.0	551	266.0	271.7
561	271.7	276.8	571	276.8	280.5	581	280.5	284.2	591	284.2	287.6	601	287.6	292.1
611	292.1	297.0	621	297.0	300.2									

12. ADDITIONAL DESCRIPTIVE INFORMATION

ANDESITE, DEPTH 26.3'-46.8', HAS A HIGHLY ALTERED ZONE, H=2, MEDIUM SOFT, FROM 37.5'-46.8'. CLAY + SILT, 46.8'-60.3', HAS A VERY HIGH WATER CONTENT FROM 48.3'-55.7', IS ALSO SILTY AT TOP. AGGLOMERATE, 60.3'-92.3', IS ALTERED + SOFTER IN UPPER 25', HAS A OPEN-SOLID, 77.7'-79.0', HAS A SHEAR ZONE, 73.3'-74.3', + THE LO PER 150' IS SHEARED. TUFF, 92.3'-99.2', THE LOWER 40' ARE A SHEAR ZONE, FRAGMENTS ONLY RECOVERED.

AGGLOMERATE, 112.0'-125.0', IS BROKEN + SHEARED, 114.0'-115.7', HAS AN OPEN OXIDIZED SHEAR ZONE, 119.0'-122.0', THE LOWER CONTACT IS IN THE SHEAR ZONE. ANDESITE, 125.0'-157.1', IS VERY HEAVILY SHEARED, 133.0'-142.0', IS SHEARED + HAS SOME GORGE, 142.0'-143.0', + FROM 155.0'-156.2' THE CORE IS ALTERED, OXIDIZED, MEDIUM FIN KISH GREY + LIGHT GREY.

TUFF, AGGLOMERATIC, 157.0'-160.2', THE UPPER PART APPEARS REWORKED + BAKED BY CONTACT WITH ANDESITE ABOVE. TUFF, 160.2'-170.0', HAS SHEAR ZONE WITH SFT/ PLASTIC GORGE, 161.3'-163.2', 166.8'-168.8'. TUFF, AGGLOMERATIC, 195.8'-210.7', HAS A FAULT ZONE WITH SOFT, MILONITIC GORGE FROM 207.1'-210.7'.

ASH FLOW, 210.7'-232.5', IS PERLITIC IN LOWER 1.0', HAS A FAULT ZONE, 219.5'-222.0', WITH WAVY SLICKENSIDES + BLOCHITE + RED TUFF THAT HAS BEEN FAULTED IN PLACE. + UPPER PART, 222.0'-232.5', WITH SLICKENSIDES + PERLITIC AGGLOMERATE FAULTED INTO PLACE. ANDESITE, 233.0'-243.0', CONE IS BALD, BROKEN, 243.0'-266.0', 270.0'-271.3' + 276.8-283.0', MATERIAL IS SHEARED, 287.6'-300.2'.

BEGINNING ON 8 MAR. 1975, DRILLER FILLED HOLE WITH WATER EACH EVENING + TOOK WATER TABLE READING, AS USUAL, EA
CH MORNING. DRILLER NOTED FLOWING WATER IN HOLE ON 13 MAR. AT 81.7' DEPTH.

13. ADDITIONAL DRILLING INFORMATION

HOLE CAVED BECY + WAS GROUTED, 0.0'-81.7' DEPTH.

100. IN FAIR CONDITION 0.1 TO 0.4 FT. LENGTHS.-----FROM 44.7 FT. TO 46.8 FT. DRILLED DRY
WITH 4" CASING, CORE IN DISTURBED CONDITION.

101. / CORE HYDRATES, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR.

102. DRING, FINE-TO MEDIUM-GRAINED, TUFFACEOUS, VOLCANIC DEBRIS, CONTAINS SCATTERED AGGLOMERATIC M
ATERIAL, ALTERED TO CLAY MINERALS, COLOR= MOTTLED PINKISH GREY, + LIGHT + MEDIUM NOTE/ CO
RE HYDRATES, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR.

103. 0.4 FT. LENGTHS.

104. EOUS, VOLCANIC DEBRIS, CONTAINS ABUNDANT AGGLOMERATIC MATERIAL, ALTERED TO CLAY MINERALS, CO
LOR= MOTTLED LIGHT + MEDIUM GREY-GREEN, + BLUE-GREY, LOWER CONTACT IS GRADATIONAL. NOTE/
CORE HYDRATES, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR.

105. MIN CALCITE FILMS, THIN BEDDING, BEDS DIP 37 DEGREES, MEDIUM-GRAINED, WATER-LAID, TUFFACEO
US, VOLCANIC DEBRIS, ALTERED TO CLAY MINERALS, COLOR= MEDIUM GREY-GREEN, NOTE/ CORE HYDRATE
S, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR.

106. 1.4 FT. LENGTHS.

107. STRENGTH, CLOSE JOINTING, THIN BEDDING, FINE-TO COARSE-GRAINED, WATER-LAID, TUFFACEOUS, VOLCANIC DEBRIS, CONTAINS SCATTERED FINE AGGREGATE MATERIAL, ALTERED TO CLAY MINERALS, COLORED TO MOTTLED DARK RED-BROWN, + MEDIUM BLUE-GREEN, NOTE/ CORE HYDRATES, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR. NOTE/ LOWER CONTACT IS SHARP. SEE NOTE 12 IN SUMMARY

108. EASILY WITH + X 5-1/2 IN. DOUBLE TUBE, CARBOLLOY BIT + WATER, CORE IN GOOD CONDITION 0.1 TO 0.6 FT. LENGTHS.

109. -GRAINED, TUFFACEOUS, ANDESITIC, FRAGMENTS, UP TO 0.3 FT. IN DIAMETER, IN A TUFFACEOUS MATRIX OF SIMILAR COMPOSITION, PARTIALLY ALTERED TO CLAY MINERALS, FINER GRAINED IN UPPER PART BECOMING COARSER WITH DEPTH, COLOR= MOTTLED LIGHT MEDIUM + DARK GREY, RED-BROWN, + PURPLISH GREY,

110. T + WATER, CORE IN GOOD CONDITION 0.1 TO 1.0 FT. LENGTHS.

111. .7 FT. LENGTHS.

PANAMA CANAL COMPANY
ENGINEERING AND CONSTRUCTION BUREAU

GEOLOGICAL FIELD LOG

1 INCH = 4 FT.

PROJECT / LA PITA HILL STUDIES FOR WES
 LOCATION / CUNETTE REACH EAST
 COMPLETION DATE / 11 APR. 1975
 CORE RECOVERY / 281.4 FT. 93.5 P/C
 DRILLER / C. DRAKE

MOLE NO. / BERE = 27 GEOLOGIST / J. L. STEWART
 LATITUDE N. / 9 41 + 1873 LONGITUDE W. / 79 40.1 + 1808
 STATION / 1829+22 OFFSET / 803' E
 GROUND ELEVATION / 318.3 MOLE DEPTH / 301.2 FT.
 VERTICAL MOLE

ELEVATION IN FEET	DEPTH IN FEET	COLUMNAR SECTION	DESCRIPTION OF MATERIAL	DRILLING CHARACTERISTICS	CORE RECOVERY
312.3	0.3		SILT, CLAY, OH=2, MEDIUM SOFT OVERBURDEN, TO OH=3, MEDIUM HARD OVERBURDEN, WEAK, MODERATE WATER PLASTICITY, LOW DRY STRENGTH, MODERATE WATER CONTENT, RESIDUAL SAPROLITIC, SILT, CLAY, DERIVED FROM AGGLOMERATE, BY NORMAL WEATHERING PROCESSES, COLOR= MOTTLED MEDIUM RED-BROWN, YELLOW-BROWN, GREY-GREEN, BROWN, GREY, +	FROM 0.0 FT. TO 12.8 FT. DRILLED DRY WITH 1" CASING, CORE IN DISTURBED CONDITION. M.P.300 TO 525 PSI.	1.6
	8.6				3.5
300.1	12.2		SILT, CLAY, PEBBLES, COBBLES, OH=2, MEDIUM SOFT OVERBURDEN, TO OH=5, VERY HARD OVERBURDEN, WEAK TO MODERATE STRENGTH, LOW TO MODERATE WATER PLASTICITY, LOW TO MODERATE DRY STRENGTH, LOW TO MODERATE WATER CONTENT, RESIDUAL SAPROLITIC, SILT, CLAY, PEBBLES + COBBLES, DERIVED FROM ANDESITE, BY NORMAL WEATHERING PROCESSES, COLOR= MOTTLED RED-BROWN, + GREY, + SEE NOTE 12 IN SUMMARY	8.6 FT. 70.5 P/C FROM 12.2 FT. TO 38.9 FT. AS ABOVE. CORE IN DISTURBED CONDITION. M.P.550 TO 800 PSI.	3.5
	15.8				2.7
	19.6				2.7

21.9	0.9
24.3	1.9
27.8	2.9
31.3	2.2
34.6	3.2
38.1	3.1
41.6	2.8
44.5	2.1
48.0	3.4
51.5	3.5
55.0	3.5
58.5	3.4
62.0	3.5

19.6 FT. 75.7 P/C

FROM 38.1 FT. TO 68.5 FT. AS ABOVE. CORE 1 IN DISTURBED CONDITION. H4 PA400 TO 725 PSI.

SILT, OH=3, MEDIUM HARD OVERBURDEN, TO OH=4, HARD OVERBURDEN, W/ AK TO MODERATE STRENGTH, LOW PLASTICITY, LOW DRY STRENGTH, MODERATE WATER CONTENT, RESIDUAL SAPROLITIC, SILT, DERIVED FROM ANDESITE, BY NORMAL WEATHERING PROCESSES, COLOR= MOTTLED LIGHT GREY, MEDIUM BROWN, + YELLOW-BROWN,

65.5								3.2
243.8	68.5						28.4 FT.	3.0
	72.0						29.5 P/C	3.2
	75.5						81.8 FT. TO	3.2
	78.7						89.5 FT. TO	3.2
	81.8						92.1 P/C	3.1
	91.8						8.2	8.2
220.1	92.2						23.2 FT.	
	95.4						89.5 P/C	2.8
	105.2						8.1 FT.	3.8
211.3	101.0						92.1 P/C	

TUFF, AGGLOMERATIC, DM=3, MEDIUM HARD OVERBURDEN, TO RHM=3, WEAK TO MODERATE STRENGTH, HIGHLY WEATHERED, JOINTS IRON-STAINED + OXIDIZED, JOINTS CONTAIN ABUNDANT SOFT, SOIL-LIKE MATERIAL, JOINT CENTERS ARE HARDER + LESS WEATHERED, INDISTINCT BEDDINGS, FINE-GRAINED, TUFFACEOUS VOLCANIC DEBRIS, FRAGMENTAL AGGLOMERATIC MATERIAL, HIGHLY ALTERED TO CLAY MINERALS, WEATHERING DECREASES + HARDNESS INCREASES WITH DEPTH, COLOR= MOTTLED DARK + MEDIUM GREY-BROWN, + GREY, IN UPPER PART TO MOTTLED MEDIUM BROWN, GREY-GREEN, + GREY, IN LOWER PART

TUFF, DM=5, VERY HARD OVERBURDEN, TO RHM=3, MEDIUM HARD ROCK, WEAK TO MODERATE STRENGTH, WEATHERED, CLOSE JOINTING, JOINTS IRON-STAINED + OXIDIZED, JOINTS CONTAIN CALCITE, ZEOLITE, MASSIVE BEDDING, FINE-TO MEDIUM-GRAINED, WATER-LAID, TUFFACEOUS, VOLCANIC DEBRIS, CONTAINS SCATTERED AGGLOMERATIC MATERIAL, ALTERED TO CLAY MINERALS, COLOR= DARK GREY-GREEN, NOTE/ CORE HYDRATES, SHELLS + DISINTEGRATES ON EXPOSURE TO AIR. NOTE/ LOWER CONTACT IS SHARP

FAULT ZONE, DM=5, VERY HARD OVERBURDEN, TO RHM=5, VERY HARD ROCK, WEAK, WEATHERED, VERY CLOSE JOINTING, SLICKENSIDED, JOINTS IRON-STAINED + OXIDIZED, JOINTS OPEN, CHLORITIC, TUFFACEOUS, ANGESITIC, AGGLOMERATIC, FRAGMENTS, ALTERED TO CLAY MINERALS, WEATHERING DECREASES WITH DEPTH, COLOR= MOTTLED GREY-GREEN, GREY, LIGHT GREY, + GREY-BROWN, SEE NOTE 12 IN SUMMARY

110.8	5.2	
120.6	9.0	
127.3	5.8	
142.8	24.5 FT.	93.0 P/C
134.0	6.7	
141.3	7.3	
168.9	13.9 FT.	100.0 P/C
151.3	9.4	

FROM 129.5 FT. TO 143
 4.8 FT. AS ABOVE. CORE I
 IN GOOD CONDITION 0.1 TO
 1.7 FT. LENGTHS.

FROM 143.5 FT. TO 158
 14.8 FT. AS ABOVE. CORE I
 IN GOOD CONDITION 0.1 TO
 2.2 FT. LENGTHS.

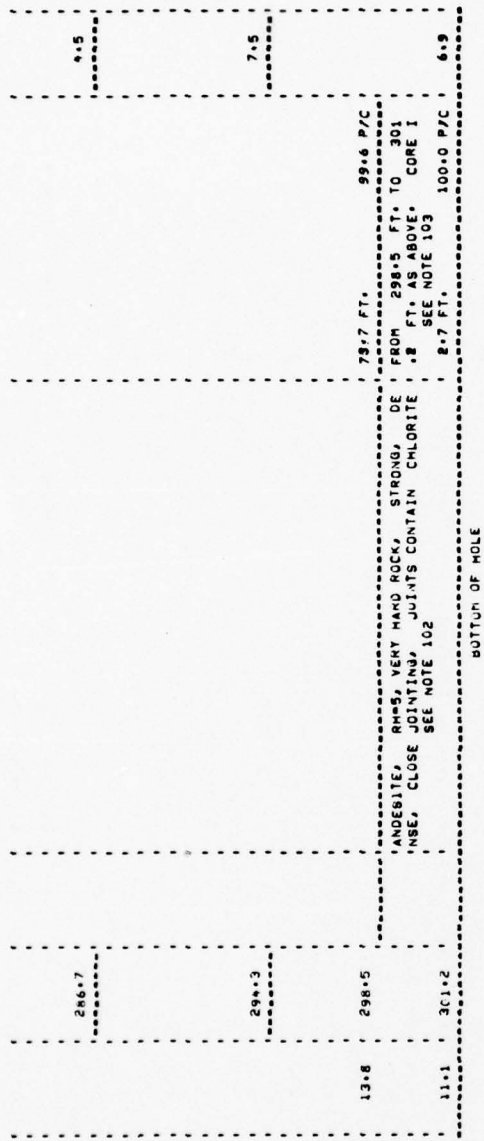
TUFF, RM=2, MEDIUM SOFT ROCK, TO RM=2 MEDI
 UM HARD ROCK, WEAK, VERT CLOSE TO CLOSE JOIN
 TING, WITH MANY SLICKENSIDES, SOME JOINTS CO
 NTAIN CALCITE, THIN BEDDING, CROSS-BEDDED
 BEDS DIP 16 DEGREES, FINE-TO MEDIUM-GRAIN
 ED, WATER-LAID, TUFFACEOUS, CALCAREOUS, CLAYE
 Y, CONTAINS SCATTERED AGGLOMERATIC DEBRIS, BRO
 KEN AT TOP, CLAY MINERALS, COLOR AT BASE RED, BRO
 WEN AT TOP, DARK GREY-GREY, DISINTEGRATES ON EXPOS
 URE TO AIR. NOTE/ LOWER CONTACT IS SHARP.

LANDESITE, ANHYDROUS, RM=3, HARD ROCK, TO
 RM=3, VERY HARD ROCK, STRONG, MODERATE JOINT
 ING, WITH MANY SLICKENSIDES, JOINTS CONTAIN
 CHLORITE, ZEPHYRUS, CALITE, FINE-TO MEDIUM-G
 GRAINED, ANHYDROUS, QUARTZ, BECOMES FINER WITH D
 EPHER, COLOR, MOTTLED, GREY, NOTE/ LOWER CO
 NTACT IS SHARP.

113.3	195.0	<p>TO CLAY MINERALS, COLOR= MOTTLED LIGHT GR EYEBLEN, + MEDIUM PURPLISH GREY, LOWER CONT ACT IS GRADATIONAL. NOTL/ CORE HYDRATES, SHELL S + DISINTEGRATES ON EXPOSURE TO AIR.</p>	8.6 FT.	94.6 P/C	10.0
	204.3	<p>ASH FLOW, R=5, VERY HARD ROCK, STRONG, CL USE JOINTING, WITH WAVY SLICKENSIDES, JOINTS BEDDING, CHERTITE, ZEOLITE, CALCITE, MASSIV FRAGMENTS, IN A TUFFACEOUS MATRIX, OF SIMILAR COMPOSITION, AN UNIFORMITY, APPARENTLY DEPOS ITED IN A SEMI-HOTTER CONDITION, FUSED TOGETHER BY OVN HEAT. COLOR= MOTTLED MEDIUM + DARK GREY, + BLACK, AT TOP GRADING TO BLACK, MOTTLED WITH DARK GREY, IN LOWER PART. LOWE R CONTACT IS GRADATIONAL. SEE NOTE 12 IN SUMMA RY</p>	3.8		3.8
	218.0				9.9
87.8	224.5	<p>AGULOMERATE, R=3, MEDIUM HARD ROCK, TO R=4 HARD ROCK, MODERATELY STRONG TO STRONG, MORE RATE JOINTING, JOINTS CONTAIN CALCITE, CHLORI TE, ZEOLITE, MASSIVE BEDDING, ANGULAR TO SUB -ROUNDED, CHLORITIC, ZEOLITIC, CALCAREOUS, ANDESITIC, BASALTIC, FRAGMENT'S, UP TO 0.8 FT IN DIAMETER, IN A TUFFACEOUS MATRIX, OF S IMILAR COMPOSITION, COLOR= MOTTLED LIGHT GR EY, GREEN, + GREY-GREEN, AT TOP, AT BASE, MOTTLED DARK RED-BROWN, DARK + MEDIUM GREE N, + GREY-GREEN, SEE NOTE 12 IN SUMMARY</p>	25.5 FT.	100.0 P/C	9.2
	227.2		FROM 224.5 FT. TO 228 4.8 FT. AS ABOVE. CORE I N GOOD CONDITION 0.1 TO 2.0 FT. LENGTHS.		10.0
	237.2				10.0

9.8
6.3
10.0
6.4
5.3
7.0

257.2
253.5
263.5
269.9
275.2
282.2



A43

NOTES

1. TYPE OF MATERIAL

ELEVATION	DEPTH	DESCRIPTION
312.3 TC	0.0 TO	SILT, CLAY, PEBBLES, COBBLES;
300.1 TC	12.2 TO	SILT, CLAY, PEBBLES, COBBLES;
278.2 TC	38.1 TO	SILT, CLAY, PEBBLES, COBBLES;
243.8 TC	68.5 TO	SILT, CLAY, PEBBLES, COBBLES;
220.1 TC	82.2 TO	SILT, CLAY, PEBBLES, COBBLES;
213.3 TC	129.0 TO	SILT, CLAY, PEBBLES, COBBLES;
182.9 TC	123.0 TO	SILT, CLAY, PEBBLES, COBBLES;
168.9 TC	143.5 TO	SILT, CLAY, PEBBLES, COBBLES;
150.1 TC	158.2 TO	SILT, CLAY, PEBBLES, COBBLES;
129.8 TC	172.2 TO	SILT, CLAY, PEBBLES, COBBLES;
125.3 TC	183.5 TO	SILT, CLAY, PEBBLES, COBBLES;
113.3 TC	189.3 TO	SILT, CLAY, PEBBLES, COBBLES;
87.8 TC	229.0 TO	SILT, CLAY, PEBBLES, COBBLES;
13.8 TC	258.2 TO	SILT, CLAY, PEBBLES, COBBLES;
11.1 TC	301.2 TO	SILT, CLAY, PEBBLES, COBBLES;

2. ENGINEERING + GEOLOGICAL FORMATION CONTACTS

ELEVATION	DEPTH	DESCRIPTION
99.6 P/C	79.7 FT.	ANDERSON
100.0 P/C	2.7 FT.	ANDERSON

312.3 TO 243.8 0.0 TO 68.5 OVERBURDEN
 243.8 TO 182.8 68.5 TO 129.5 WEATHERED ROCK
 182.8 TO 111.1 129.5 TO 301.2 SOUND ROCK
 312.3 TO 111.1 0.0 TO 301.2 LAS CASCADAS Fm.

5. PURPOSE OF HOLE / GEOLOGIC EXPLORATION, SAMPLING + PIEZOMETER INSTALLED AT 196.0' DEPTH.

8. WATER TABLE

ELEVATION	DEPTH	DATE
289.6	22.7	27/ 3/75
265.9	46.4	28/ 3/75
289.9	22.4	29/ 3/75
272.6	39.5	31/ 3/75
272.8	39.5	2/ 4/75
279.9	32.4	3/ 4/75
277.6	34.7	4/ 4/75
275.3	37.0	5/ 4/75
277.1	35.2	8/ 4/75
275.0	37.3	10/ 4/75
281.0	31.3	11/ 4/75

9. THE FOLLOWING SAMPLES WERE TAKEN FOR LABORATORY TESTING PURPOSES

FROM TO

25.8	27.3
40.1	41.1
70.5	71.5
74.5	75.5
76.0	77.0
135.5	136.3
141.4	142.5
185.3	186.5

10. CORE BOX NUMBERS AND DEPTHS

1)	0.0	8.0	2)	8.0	13.1	3)	13.1	4)	19.0	5)	19.0	25.8	5)	25.8	31.3
6)	31.3	37.5	7)	37.5	44.0	8)	44.0	48.5	9)	48.5	53.5	10)	53.5	58.0	

11)	58+0	62+5	12)	62+5	67+3	13)	67+3	71+5	14)	71+5	76+0	15)	76+0	80+0
16)	80+0	86+8	17)	86+8	91+8	18)	91+8	97+2	19)	97+2	102+2	20)	102+2	106+6
21)	106+6	111+3	22)	111+3	116+1	23)	116+1	122+0	24)	122+0	127+3	25)	127+3	132+0
26)	132+0	135+4	27)	135+4	141+3	28)	141+3	146+3	29)	146+3	151+3	30)	151+3	155+8
31)	155+8	160+5	32)	160+5	165+3	33)	165+3	170+2	34)	170+2	173+2	35)	173+2	177+9
36)	177+9	182+8	37)	182+8	188+6	38)	188+6	194+3	39)	194+3	199+3	40)	199+3	204+3
41)	204+3	208+1	42)	208+1	213+1	43)	213+1	218+0	44)	218+0	223+0	45)	223+0	227+2
46)	227+2	232+2	47)	232+2	237+2	48)	237+2	242+2	49)	242+2	246+6	50)	246+6	251+5
51)	251+5	256+0	52)	256+0	261+0	53)	261+0	266+0	54)	266+0	270+7	55)	270+7	275+2
56)	275+2	279+7	57)	279+7	283+6	58)	283+6	288+0	59)	288+0	293+0	60)	293+0	297+1
61)	297+7	301+2												

12. ADDITIONAL DESCRIPTIVE INFORMATION

SILT, CLAY, PEBBLES + COBBLES, DEPTH 12+2'-38+1', IS DERIVED FROM ANHYDALOIDAL ANDESITE, THE PEBBLES + COBBLES WHICH ARE IN THE UPPER + CENTRAL PARTS, ARE THIS ANDESITE, SILT, 38+1'-48+5', IS ALSO DERIVED FROM ANHYDALOIDAL ANDESITE. TUFF, 92+2'-101+0', HAS A JOINT WITH JOGUE AT 99+0'.

FAULT ZONE, 101+0'-129+5', MATERIAL IS BROKEN, 0+1'-0+5', 106+5'-112+9', THERE IS MYLONITIC JOGUE, 111+8'-112+9', THERE IS A HORSE OF ANHYDALOIDAL ANDESITE, 112+9'-117+7', + SOFT, PLASTIC, HIGHLY SLICKENSIDED JOGUE, 117+7'-126+0'. TUFF, 129+5'-143+4', UPPER 1+0' IS VERY AGGLOMERATIC, A SHEAR ZONE WITH SOFT, PLASTIC JOGUE, 141+0'-141+4' + MATERIAL IS GREY-GREEN BELOW 141+4', THERE ARE MANY HORIZONTAL SLICKENSIDES IN THIS MATERIAL.

TUFF, AGGLOMERATIC, 158+2'-172+2', UPPER CONTACT IS AN OLD EROSIONAL SURFACE, + IS MARKED BY IGNEOUS MATERIAL ABOVE, JOINTS HAVE HORIZONTAL SLICKENSIDES, WHERE IS SOFT, PLASTIC JOGUE IN A JOINT AT 159+8', + THERE ARE TWO AGGLOMERATIC LAYERS, 166+5'-168+2' + 170+2'-171+3'. AGGLOMERATE, 172+2'-183+5', IS A VOLCANIC CONGLOMERATE.

TUFF, 183+5'-189+9', THE UPPER CONTACT IS AN OLD EROSIONAL SURFACE, THERE IS A STEEP ANGLE JOINT WITH A PLANAR SLICKENSIDE AT 189+2' + A JOINT OR SHEAR WITH MYLONITE, 189+6'-189+9'. AGGLOMERATE, TUFFACEOUS, 189+9'-199+0', HAS UPEN, NEAR VERTICAL JOINTING, 194+3'-199+0'.

ASH FLOW, 199+0'-224+5', HAS A FRAGMENT OF ANDESITE, NOT A DIKE, APPARENTLY DEPOSITED WITH ASH FLOW, 204+8'-220+6+0', HAS NEAR VERTICAL JOINTS, 208+8'-210+7' + 221+0'-224+5', THE PERLITIC CONTENT INCREASES WITH DEPTH BUT THE LOWER 5+0' ARE PUMICEOUS + LESS PERLITIC.

AGGLOMERATE, 22+5'-298+5', THE UPPER 10+0' CONTAIN NUMEROUS PUMICEOUS, LIGHT COLORED FRAGMENTS + ARE ALSO BROKEN + SHEARED. THE AGGLOMERATE IS PREDOMINATELY ANDESITIC WITH A VERY SMALL AMOUNT OF BASALT. CORE IS BADLY BROKEN 263+5'-270+0', 273+0'-275+2', 277+5'-279+0' + 290+0'-294+0'.

100. ACT IS SHARP. SEE NOTE 12 IN SUMMARY

101. CORE IN GOOD CONDITION 0.1 TO 1.3 FT. LENGTHS.

102. ZEOCLITE, CALCITE, FINE-GRAINED, CONTAINS FLOW STRUCTURES, COLOR= MEDIUM GREY,

103. N GOOD CONDITION 0.1 TO 3.0 FT. LENGTHS.

APPENDIX B: LAS CASCADAS FORMATION LABORATORY TEST RESULTS

Route 14, Panama

Summary of sampling and testing

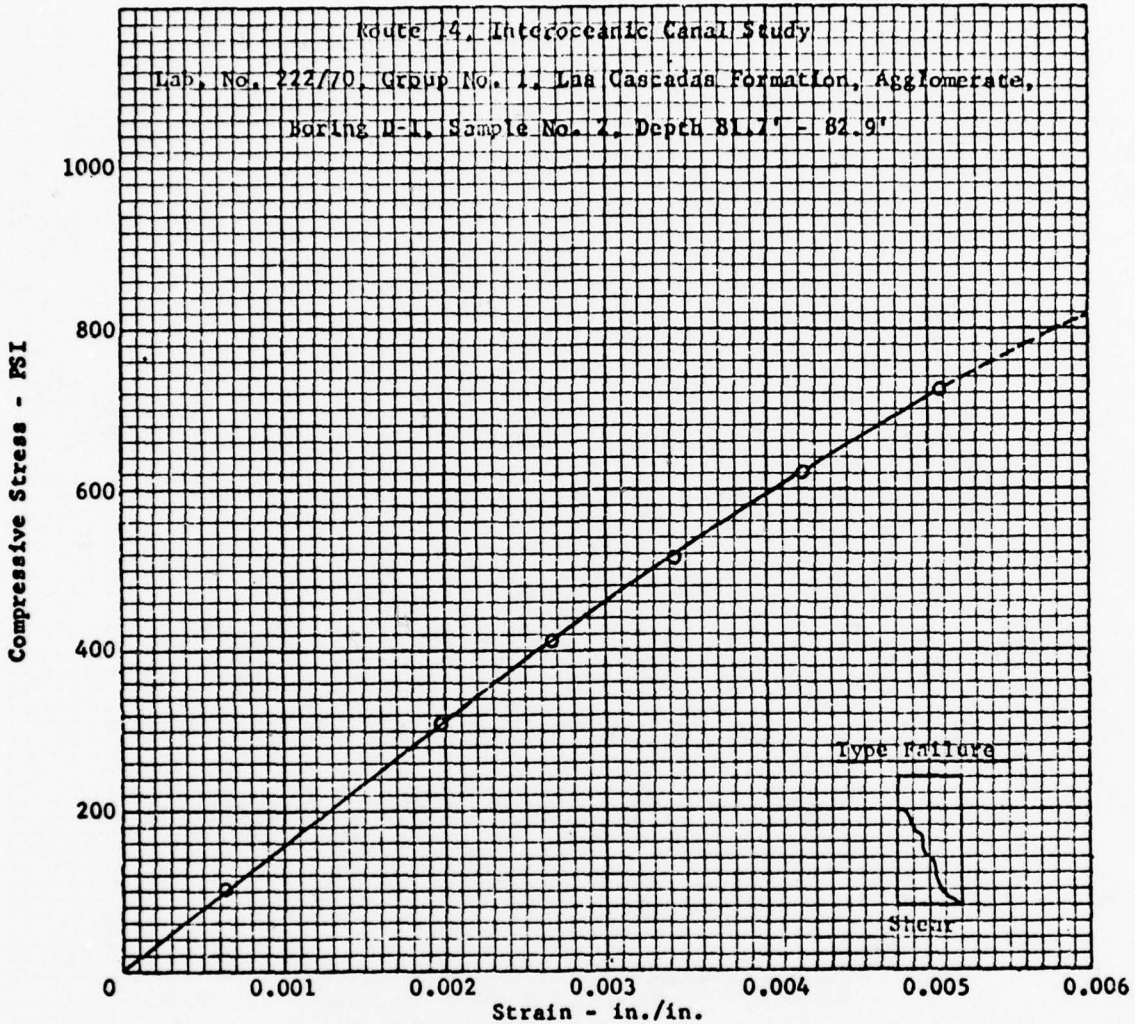
Group number	Geological formation name	Rock type	Boring number	Samples		Laboratory identification number	Scope of testing I=index, P=petrographic analyses UC=unconfined compression						
				No.	Depth								
1	Las Cascadas	Agglomerate	D-1	1	79.2-80.0	222/70	I - P - UC						
				2	81.7-82.9								
				3	88.2-89.0								
2	Las Cascadas	Tuff	D-1	4	101.0-102.5	222/72	I - UC						
				5	105.3-105.8								
				6	106.0-107.0	222/72	P						
				7	116.5-118.0								
				8	160.1-161.5	222/78	I - P - UC						
				9	164.5-166.2								
3	Las Cascadas	Agglomerate	D-1	10	174.9-176.0	222/81	I - P - UC						
				11	181.2-182.4								
				12	186.0-187.0								
				13	219.0-220.3			222/81	I - P - UC				
				14	230.4-231.6								
				15	233.7-234.7			222/81	Slaking - specific gravity.				
				16	240.8-241.9								
				17	260.5-262.0			222/83	I - P - Residual strength by multi-stage direct shear.				
				18	260.5-262.0								
				4	Las Cascadas			Agglomerate	D-1	19	235.5-236.0	222/83	I - P - Residual strength by multi-stage direct shear.
										20	237.8-240.0		
				5	Las Cascadas			Shale	D-1	21	237.8-240.0	222/84	I - Direct shear, residual direct shear. (Re-exam., I, Slaking Study, Supp. 2)
22	237.8-240.0												

II-1* (REVISED, SUPP. 2)

U. S. ARMY ENGINEER DIVISION, SOUTH ATLANTIC
DIVISION LABORATORY
MARIETTA; GEORGIA

Reqn. No. 08-123-ENG-94-68C
Work Order No. 4880

ARITHMETICAL GRAPH
Stress Strain Curve



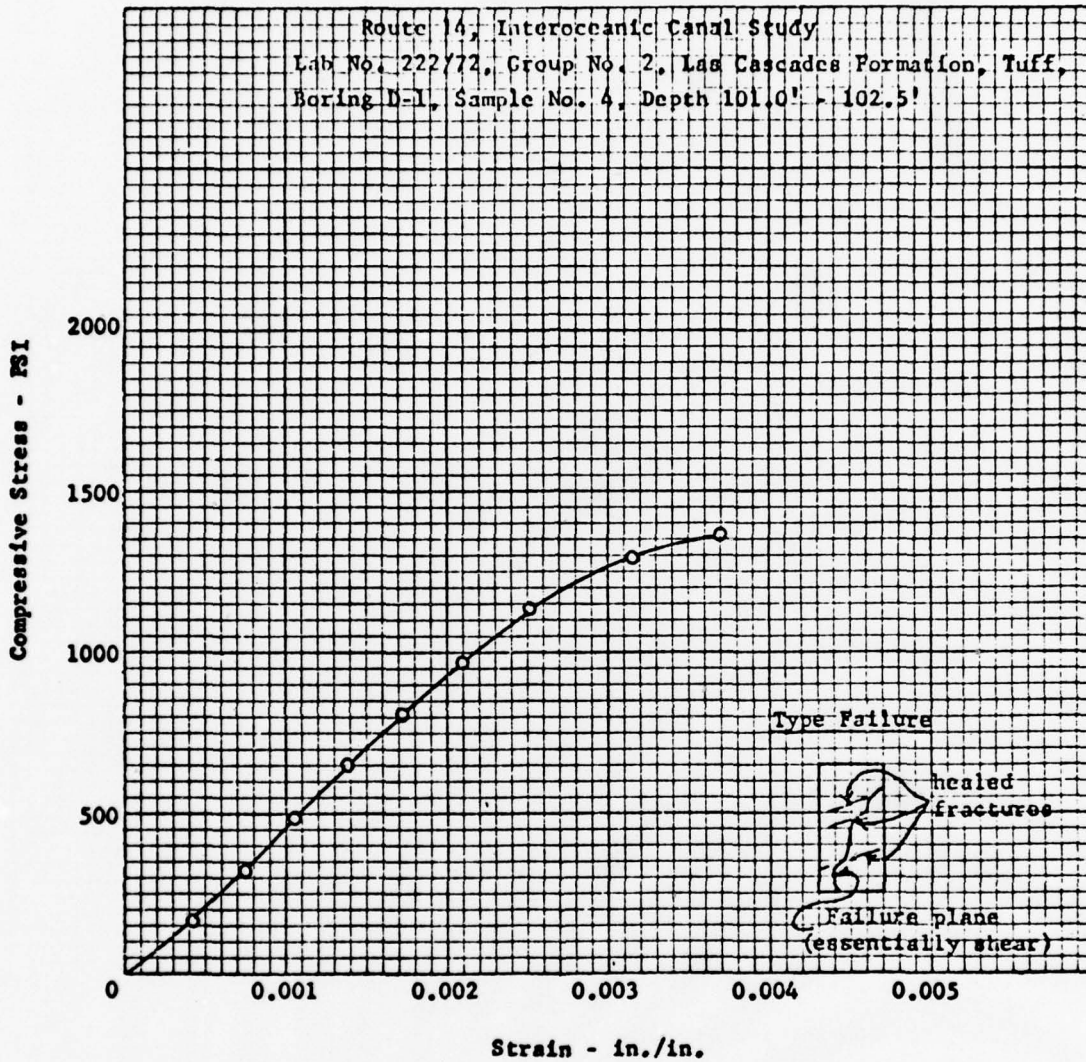
Unconfined Compressive Strength: 820 psi
Natural Water Content: 11.2%
Solid Unit Weight: 165.4 lbs/ cu.ft.
Potential Drainage Characteristic: Relatively Impervious
No indication of fractures, joints or slickensides.

U. S. ARMY ENGINEER DIVISION, SOUTH ATLANTIC
DIVISION LABORATORY
MARIETTA, GEORGIA

Reqn. No. 08-123-ENC-94-68C

ARITHMETICAL GRAPH Work Order No. 4880

Stress Strain Curve

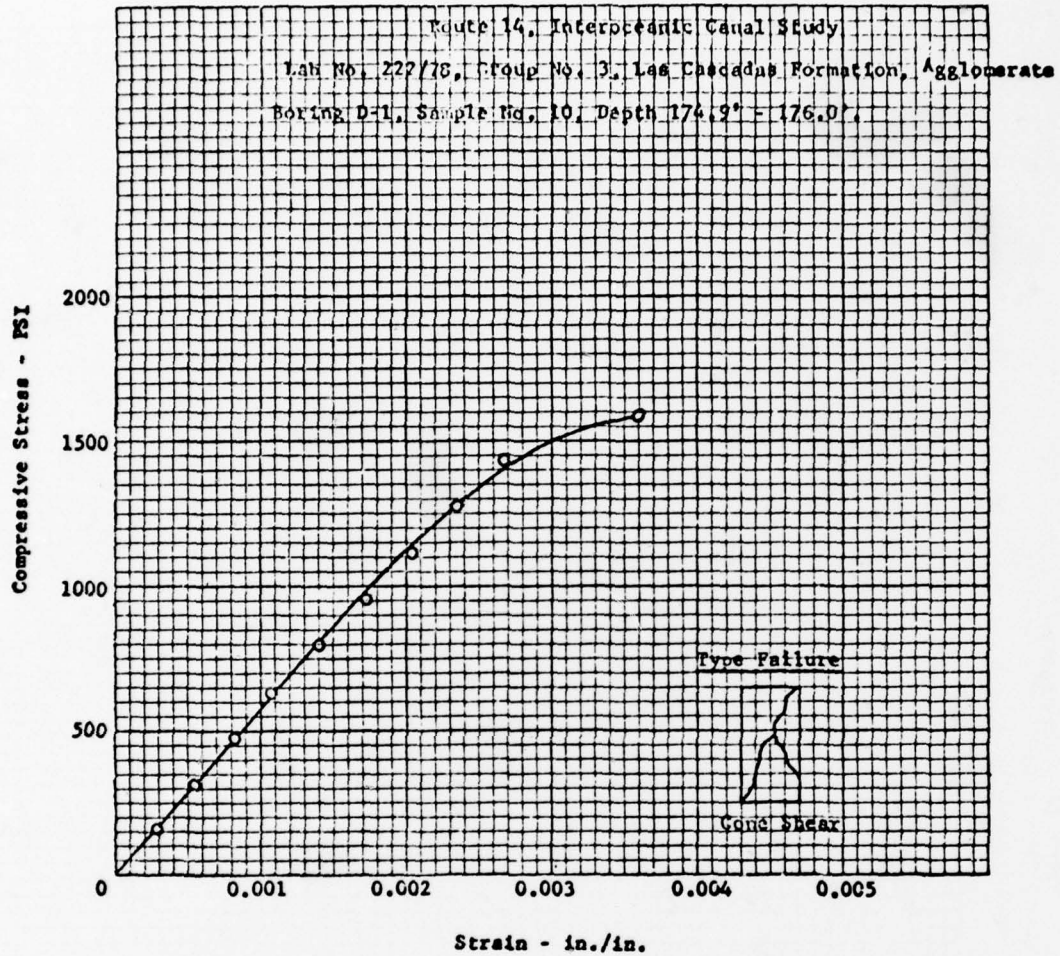


Unconfined Compressive Strength: 1370 psi
Natural Water Content: 12.3%
Solid Unit Weight: 159.1 lb/cu.ft.
Potential Drainage Characteristic: Relatively Impervious
No indication of joints or slickensides.
Compressive specimen sheared along a number of healed fractures.

U. S. ARMY ENGINEER DIVISION, SOUTH ATLANTIC
DIVISION LABORATORY
MARIETTA, GEORGIA

Reqn. No. 08-123-Eng-94-68C
Work Order No. 4880

ARITHMETICAL GRAPH
Stress Strain Curve

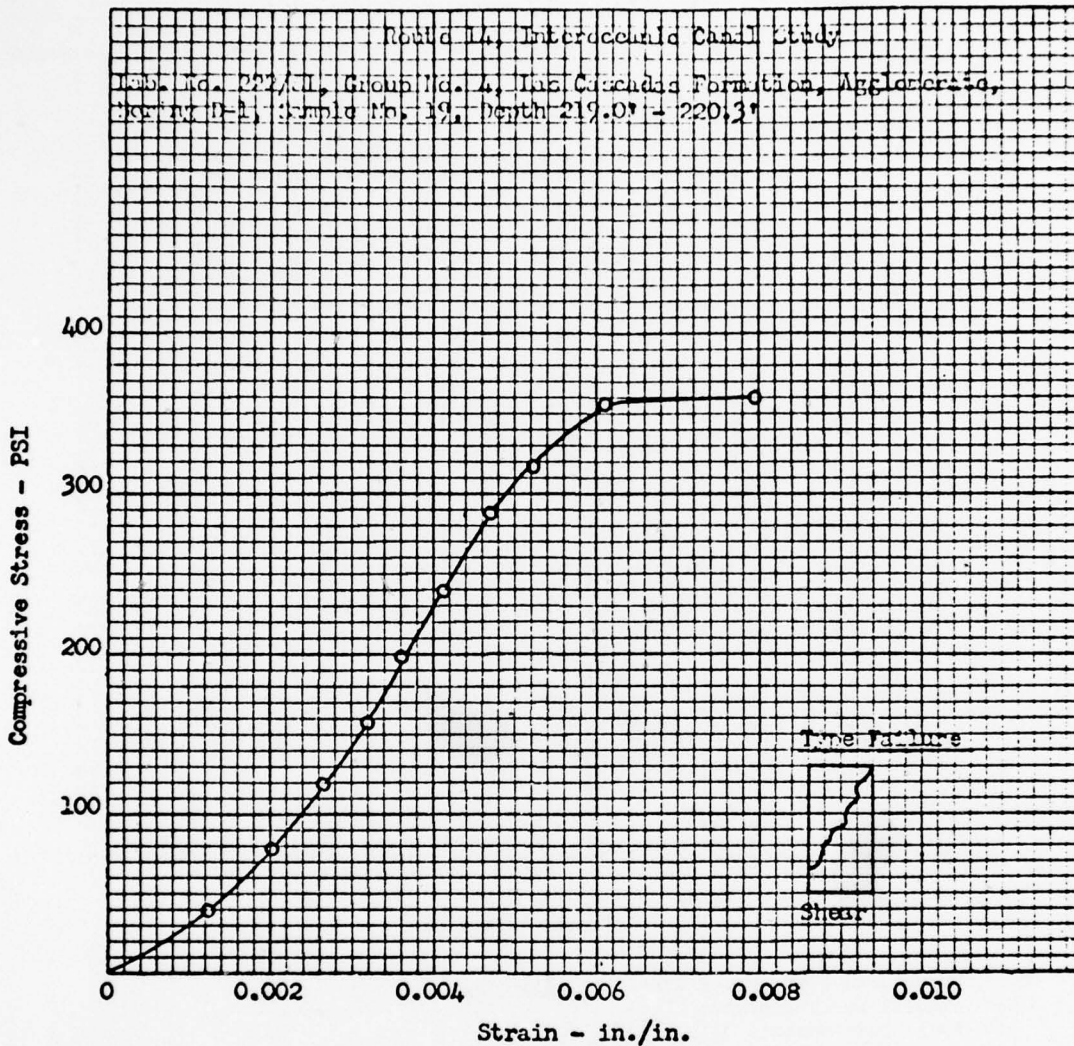


Unconfined Compressive Strength: 1580 psi
Natural Water Content: 7.1%
Solid Unit Weight: 166.6 lb/cu.ft.
Potential Drainage Characteristic: Relatively Impervious
No indication of fractures, joints or slickensides.

U. S. ARMY ENGINEER DIVISION, SOUTH ATLANTIC
DIVISION LABORATORY
MARIETTA, GEORGIA

Req. No. OC-123-EIC-94-68C
Work Order No. 4880

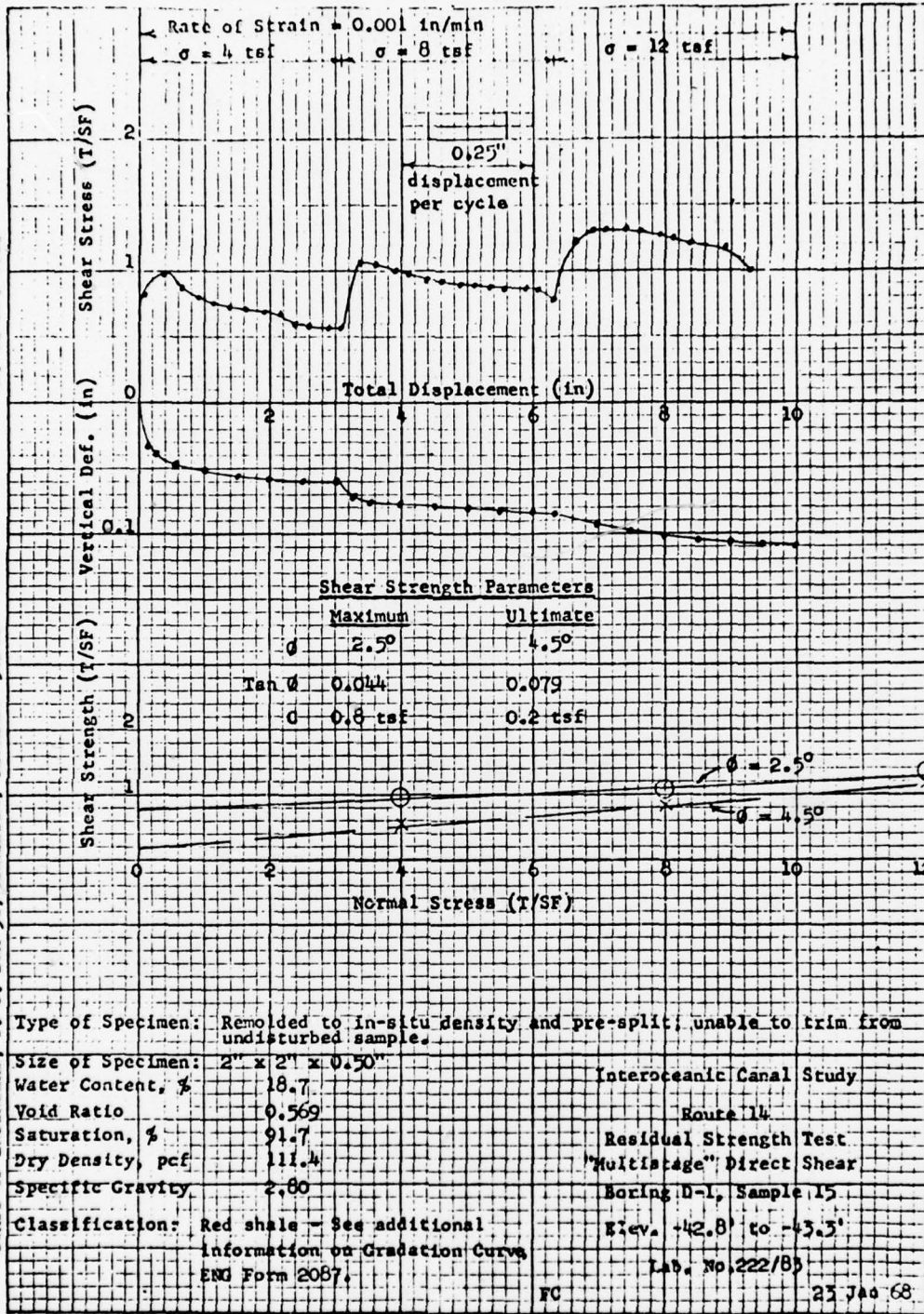
ARITHMETICAL GRAPH
STRESS STRAIN CURVE



Unconfined Compressive Strength: 360 psi
Natural Water Content: 11.0%
Solid Unit Weight: 162.9 lb./cu. ft.
Potential Drainage Characteristic: Relatively Impervious
No indication of fractures, joints or slickensides.

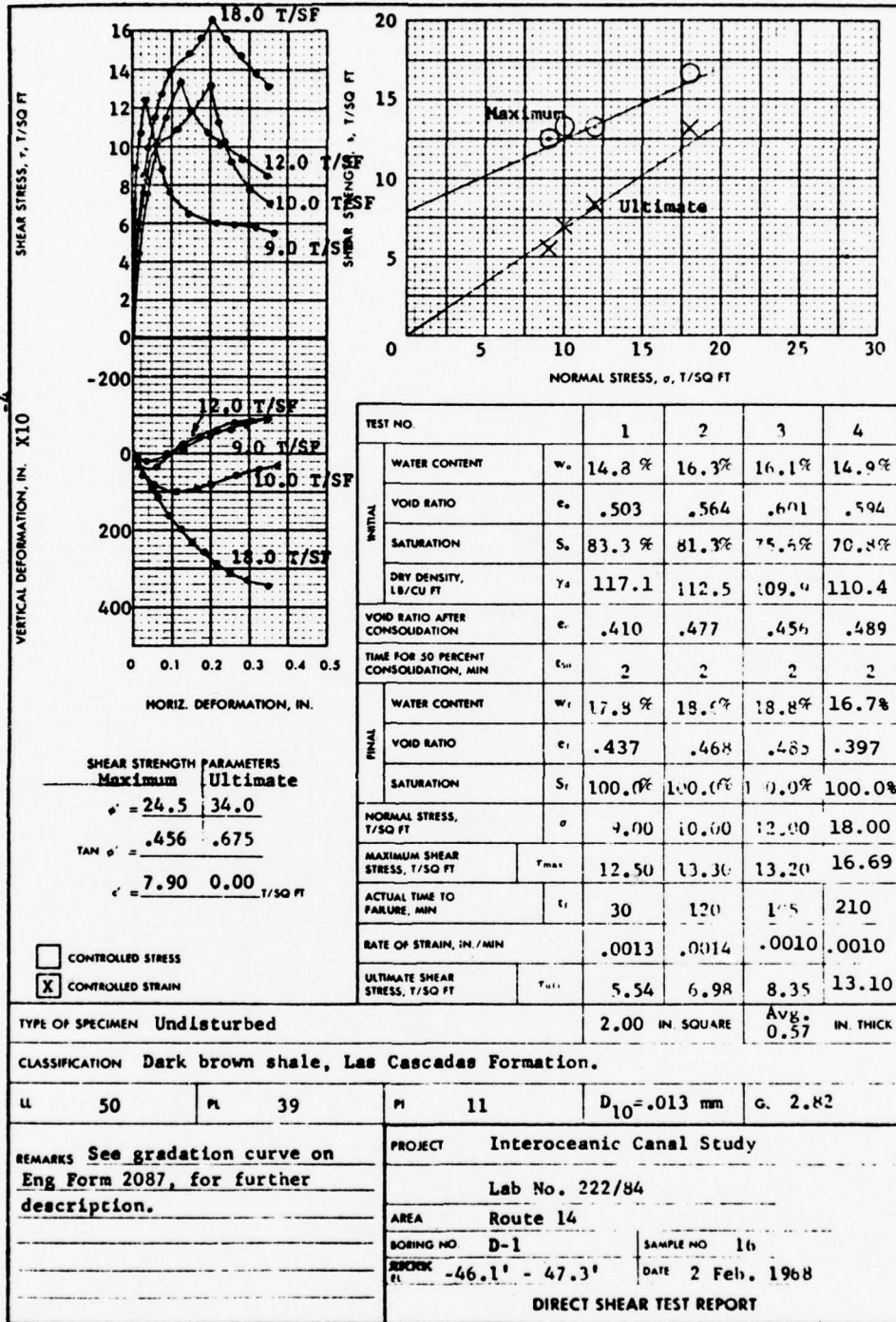
REQN. NO. 08-123-ENG-94-62C
 W. O. NO. 4980

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY,
 CORPS OF ENGINEERS, P. O. BOX 51, MARIETTA, GEORGIA 30060



REQN. NO. 08-123-ENG-94-68C
WORK ORDER NO. 4880

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, P. O. BOX 51, MARLETTA, GEORGIA 30060

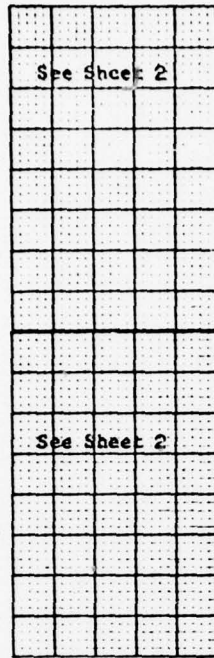


ENG FORM 2092 (REV. 11-2-1962) PREPARED BY THE ARMY CORPS OF ENGINEERS, WASHINGTON, D.C. GPO: 1968 O-714 945 PLATE IX-3

REG. NO. 08-123-ENG-9, -f2c
 U. O. NO. 4880

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY,
 CORPS OF ENGINEERS, P. O. BOX 51, MARIETTA, GEORGIA 30060

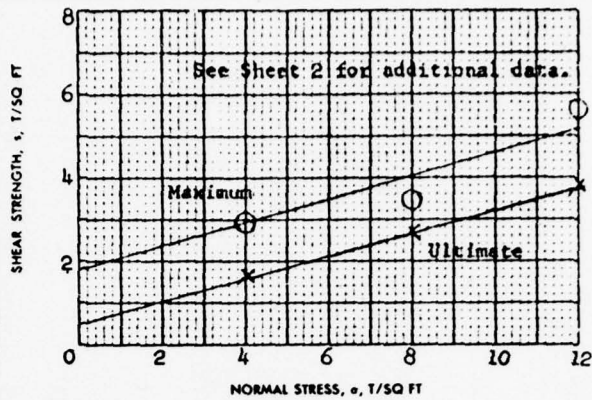
SHEAR STRESS, τ , T/SQ FT



0 0.1 0.2 0.3 0.4 0.5
 HORIZ. DEFORMATION, IN.

SHEAR STRENGTH PARAMETERS *
 Maximum Ultimate
 $\phi = 15.5^\circ \quad 15.5^\circ$
 $\tan \phi = .277 \quad .277$
 $c = 1.80 \quad 0.50$ T/SQ FT

CONTROLLED STRESS
 CONTROLLED STRAIN



TEST NO.		1	2	3	
INITIAL	WATER CONTENT	w_n 14.3%	14.5%	15.1%	%
	VOID RATIO	e_o .403	.407	.413	
	SATURATION	S_o 100.0%	100.0%	100.0%	%
	DRY DENSITY, LB/CU FT	γ_d 125.5	125.1	124.3	
VOID RATIO AFTER CONSOLIDATION		e_c .325	.309	.283	
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50} 1	1	1	
FINAL	WATER CONTENT **	w_f 19.6%	21.8%	18.6%	%
	VOID RATIO	e_f .273	.272	.213	
	SATURATION	S_f 100.0%	100.0%	100.0%	%
NORMAL STRESS, T/SQ FT		σ 4.00	8.00	12.00	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max} 2.97	3.49	5.65	
ACTUAL TIME TO FAILURE, MIN		t_f 140	240	45	
RATE OF STRAIN, IN./MIN		.001	.001	.001	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult} 1.62	2.70	3.82	

TYPE OF SPECIMEN Undisturbed - Pre-split 2.00 IN. SQUARE 0.50 IN. THICK

CLASSIFICATION Dark brown shale (see gradation curve for further description).

LL 50 PL 39 PI 11 G. 2.82

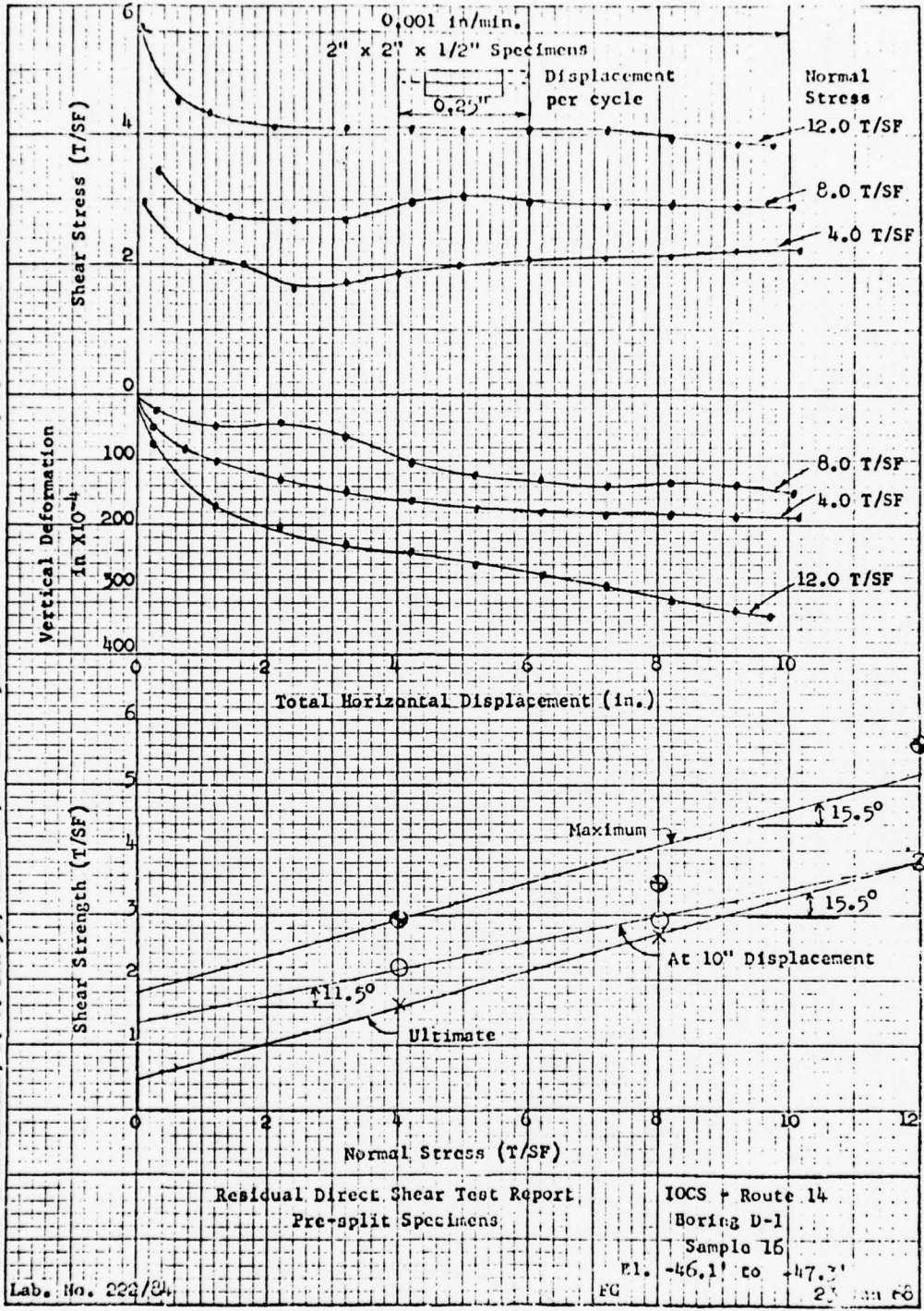
REMARKS
 1. See gradation curve on ENG Form 2087.
 2. *See sheet 2 for additional strength parameters and data.
 3. **Wt of material scraped from shear plane.

PROJECT Interoceanic Canal Study
 Lab. No. 222/84
 AREA Route 14
 BORING NO D-1 SAMPLE NO 16
 ELEVATION -46.1' to -47.3' DATE 23 Jan 1968

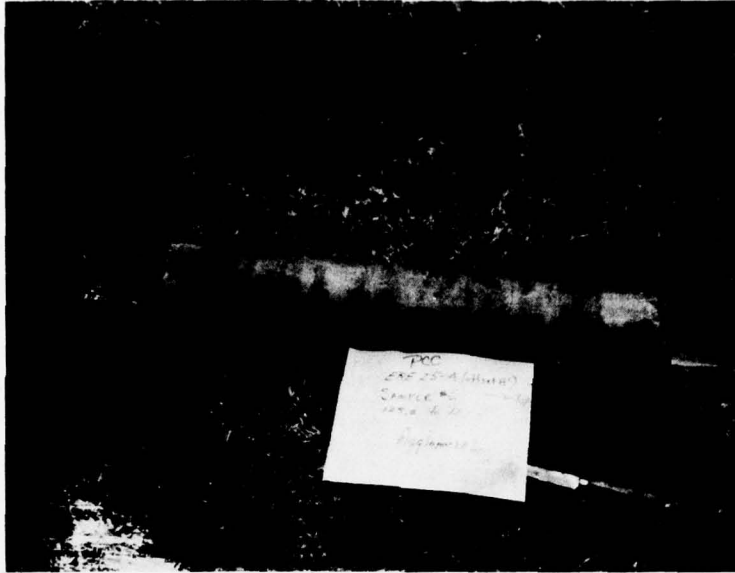
RESIDUAL DIRECT SHEAR TEST REPORT Sheet 1 of 2

RECON. NO. 08-123-ENG-94-68C
 W. O. NO. 4880

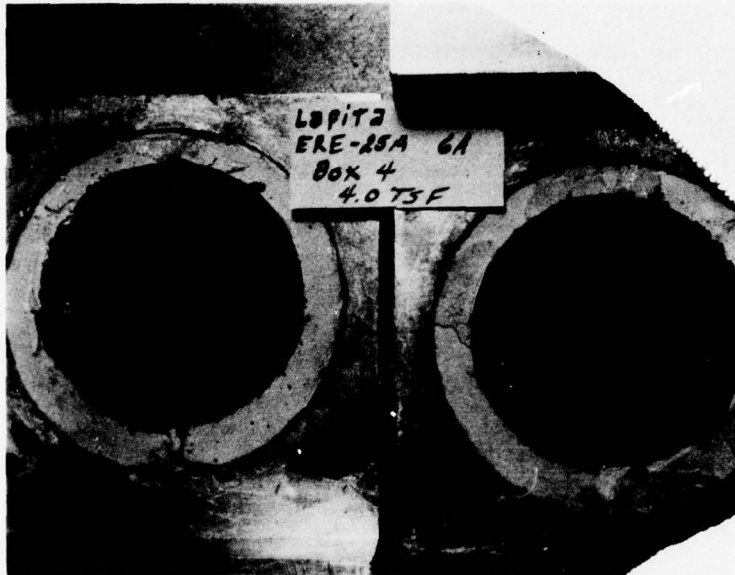
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY,
 CORPS OF ENGINEERS, P. O. BOX 51, MARIETTA, GEORGIA 30060



Sheet 2 of 2

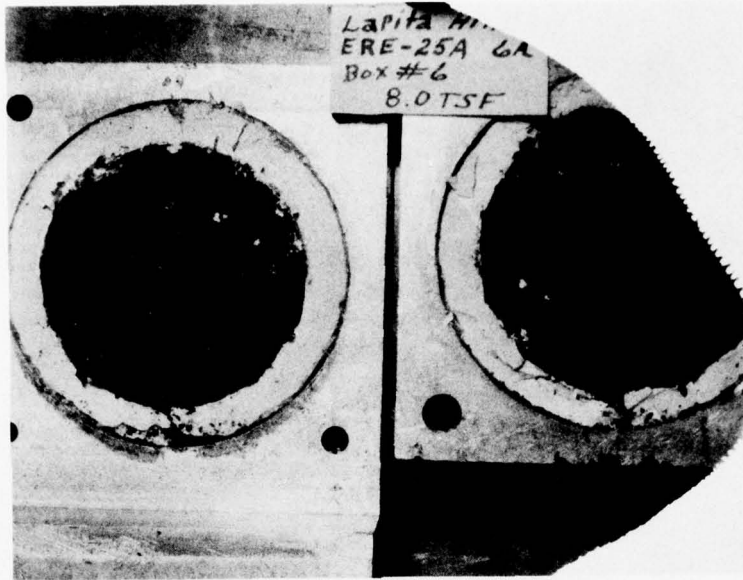


a. Immediately after extrusion from Shelby tube



b. Single-plane direct shear test after failure at
4-tsf normal load

Figure B1. La Pita Hill study, agglomerate from
boring ERE-25A, sample No. 6, depth 125.0 to
127.0 ft (sheet 1 of 2)



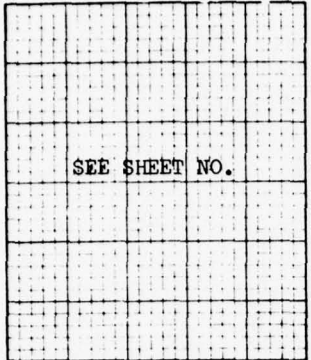
c. Single-plane direct shear test after failure at 8-tsf normal load



d. Single-plane direct shear test after failure at 12-tsf normal load

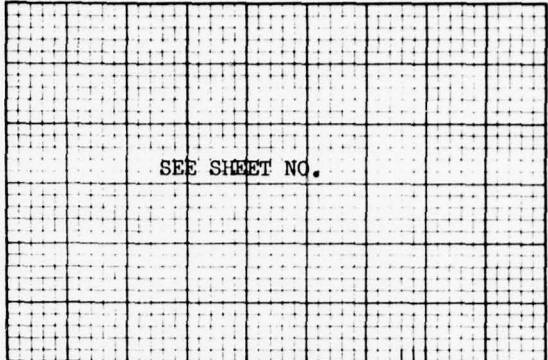
Figure B1 (sheet 2 of 2)

SHEAR STRESS τ , TSF



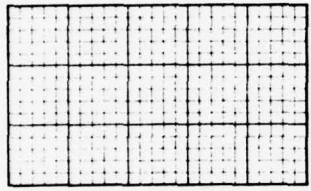
SEE SHEET NO.

SHEAR STRENGTH s , TSF



SEE SHEET NO.

NORMAL DEFORMATION,
IN. $\times 10^{-3}$



SHEAR DEFORMATION, IN. $\times 10^{-3}$

NORMAL STRESS σ , TSF

SHEAR STRENGTH PARAMETERS

	MAXIMUM	ULTIMATE
$\phi =$	65.2°	39.8°
TAN $\phi =$	2.164	0.833
$c =$	0.0	2.1 TSF

TEST NO.		1	2	3			
WET DENSITY, PCF	γ_m	131.4	131.7	133.7			
WATER CONTENT	w	22.4 %	18.3 %	17.5 %	%	%	%
NORMAL STRESS, TSF	σ	4.0	8.0	12.0			
MAXIMUM SHEAR STRESS, TSF	τ_f	7.65	16.87	26.67			
TIME TO FAILURE, MINUTES	t_f	10	11	6			
ULTIMATE SHEAR STRESS, TSF	τ_r	4.92	8.71	9.47			
INITIAL DIAMETER, IN.	D_0	4.977	4.985	4.958			
INITIAL HEIGHT, IN.	H_0						

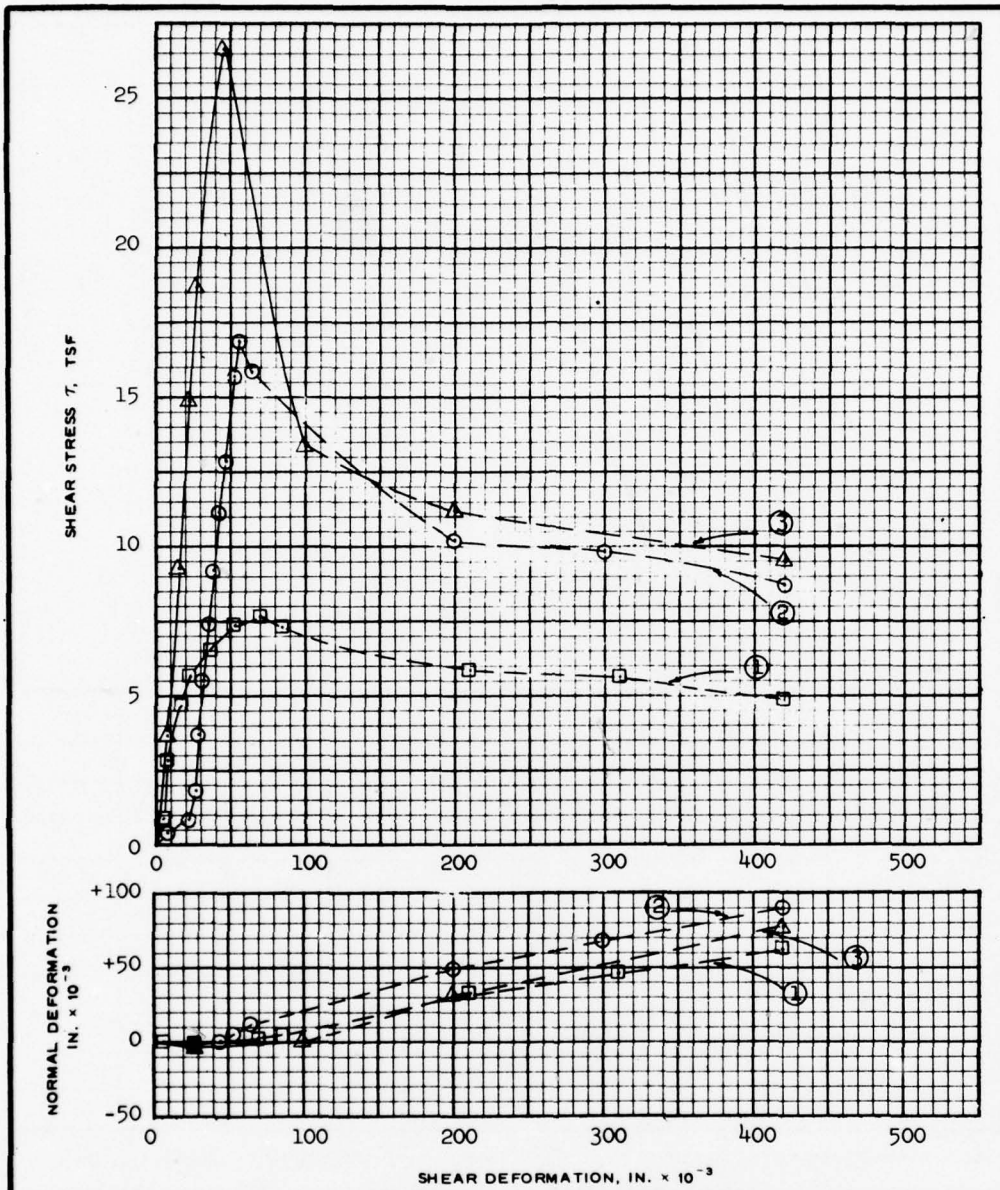
DESCRIPTION OF MATERIAL Agglomerate, OH-5, very hard overburden, to RH-3, medium hard rock (PCC)

REMARKS <u>Intact specimens</u>	PROJECT <u>LAPITA HILL STUDY</u>
	<u>PANAMA CANAL</u>
	AREA
	BORING NO. <u>ERE-25A</u> SAMPLE NO. <u>6A</u>
	DEPTH <u>125.0-127.0</u> DATE <u>31 May 1975</u>
	TES RCH <u>DIRECT SHEAR TEST REPORT (ROCK)</u>

WES FORM 1490
APR 75

EDITION OF JUN 65 IS OBSOLETE

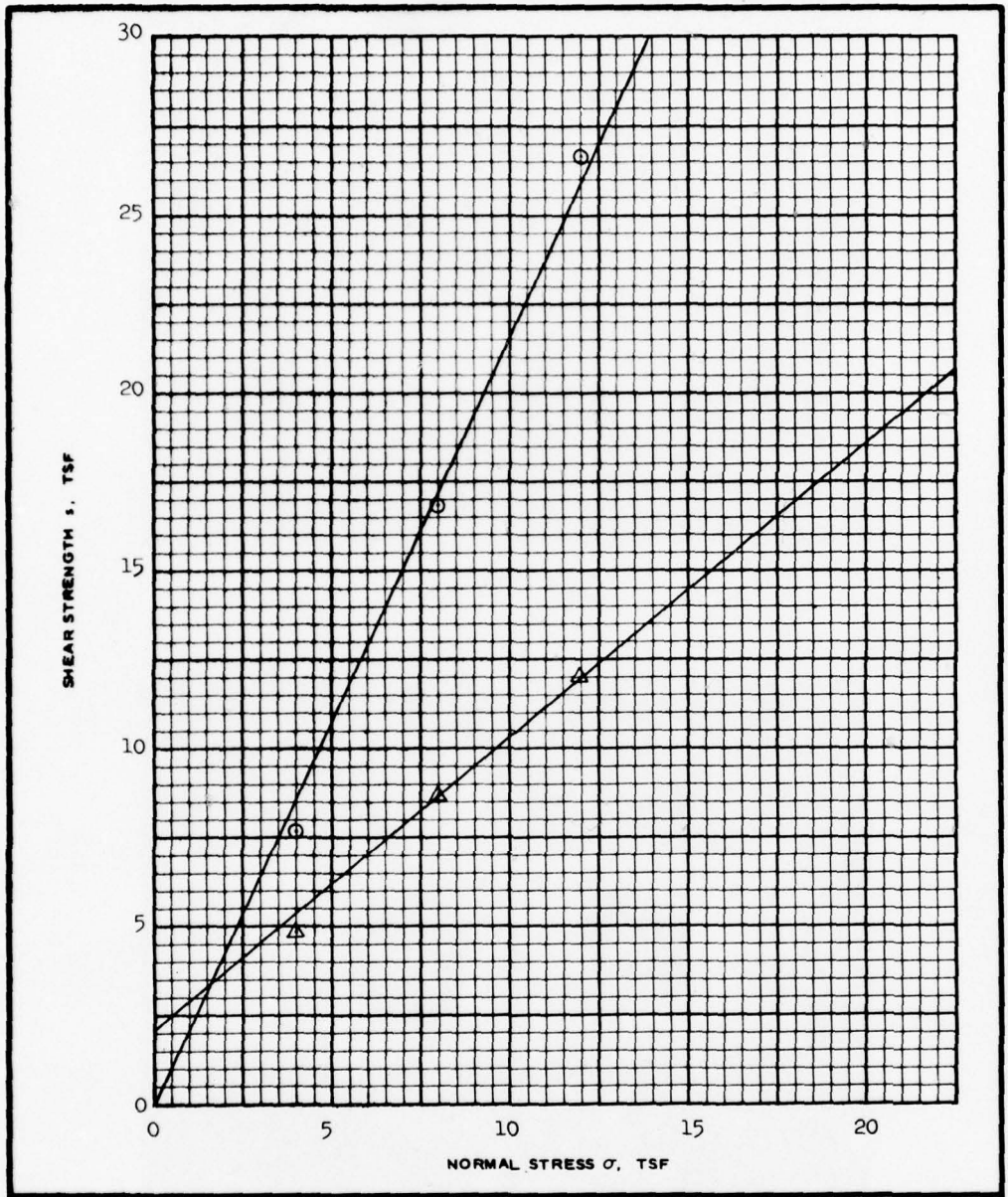
SHEET NO.



REMARKS --- Rate of deformation increased	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-25A	SAMPLE NO. 6A
DEPTH EL 125.0-127.0	DATE 31 May 1975	
DIRECT SHEAR TEST REPORT (ROCK)		

WES FORM 1490-1
MAY 78

SHEET NO.

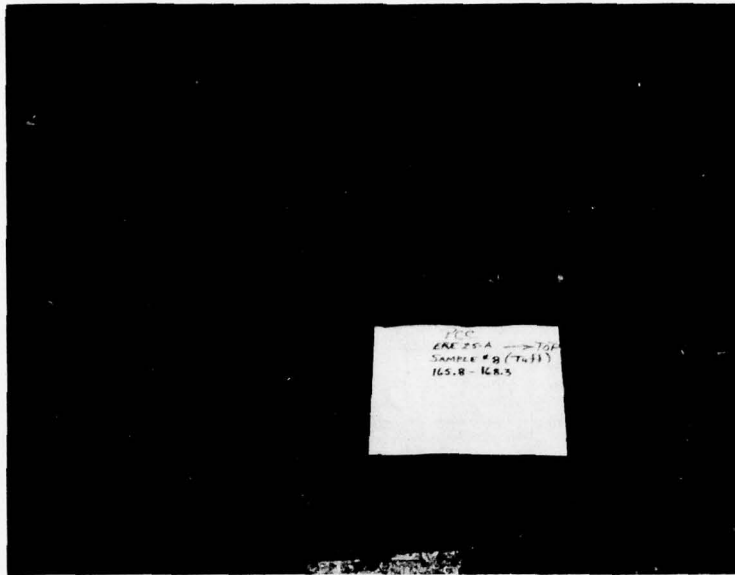


REMARKS	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-25A	SAMPLE NO. 6A
	DEPTH 125.0-127.0	DATE 31 May 1975
	DIRECT SHEAR TEST REPORT (ROCK)	

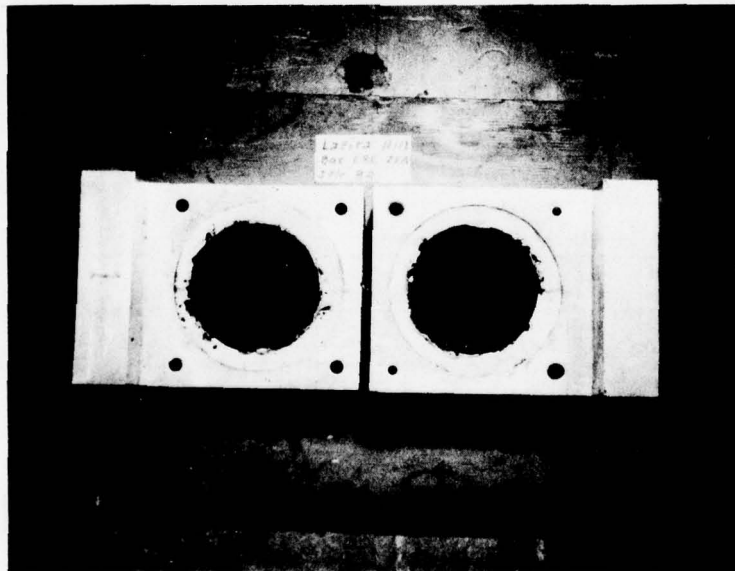
WES FORM 1490-2
MAY 75

SHEET NO.

B15

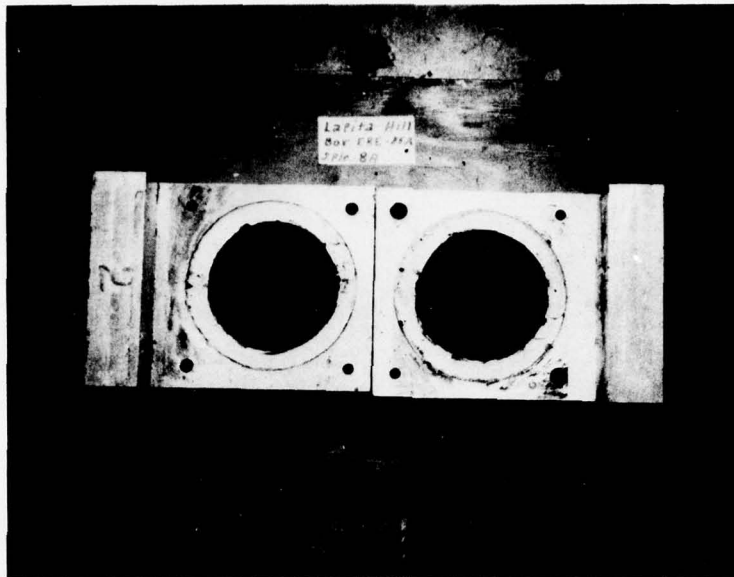


a. Immediately after extrusion from Shelby tube

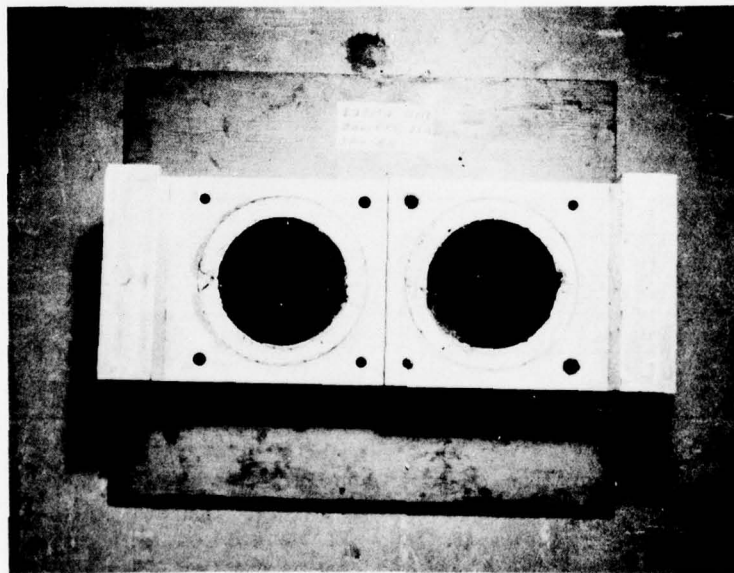


b. Single-plane direct shear test after failure at 4-tsf normal load

Figure B2. La Pita Hill study, tuff from boring ERE-25A, sample No. 8, depth 165.8 to 168.3 ft (sheet 1 of 2)



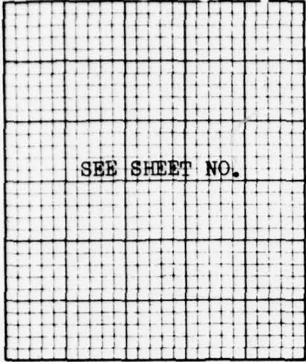
c. Single-plane direct shear test after failure at 8-ksf normal load



d. Single-plane direct shear test after failure at 12-ksf normal load

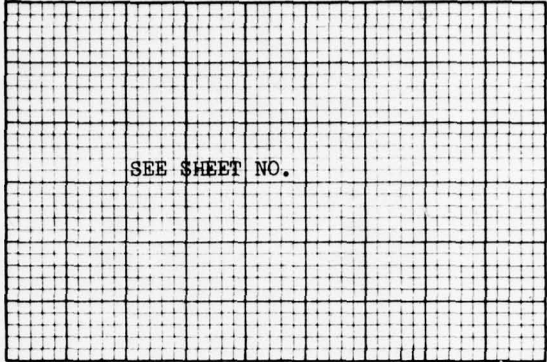
Figure B2 (sheet 2 of 2)

SHEAR STRESS τ , TSF



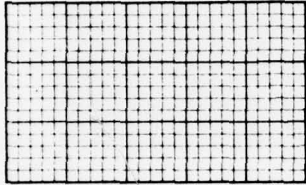
SEE SHEET NO.

SHEAR STRENGTH s , TSF



SEE SHEET NO.

NORMAL DEFORMATION,
IN. $\times 10^{-3}$



NORMAL STRESS σ , TSF

SHEAR STRENGTH PARAMETERS

	<u>MAXIMUM</u>	<u>ULTIMATE</u>
$\phi =$	<u>48.3°</u>	<u>7.6°</u>
TAN $\phi =$	<u>1.122</u>	<u>0.133</u>
$c =$	<u>8.7</u>	<u>3.6</u> TSF

SHEAR DEFORMATION, IN. $\times 10^{-3}$

TEST NO.		1	2	3			
WET DENSITY, PCF	γ_m	129.7	130.3	128.5			
WATER CONTENT	w	24.1 %	24.6 %	25.4 %	%	%	%
NORMAL STRESS, TSF	σ	4.0	8.0	12.0			
MAXIMUM SHEAR STRESS, TSF	τ_f	13.08	17.27	22.16			
TIME TO FAILURE, MINUTES	t_f	11	22	4			
ULTIMATE SHEAR STRESS, TSF	τ_r	4.12	7.09	5.19			
INITIAL DIAMETER, IN.	D_0	4.969	4.946	4.972			
INITIAL HEIGHT, IN.	H_0						

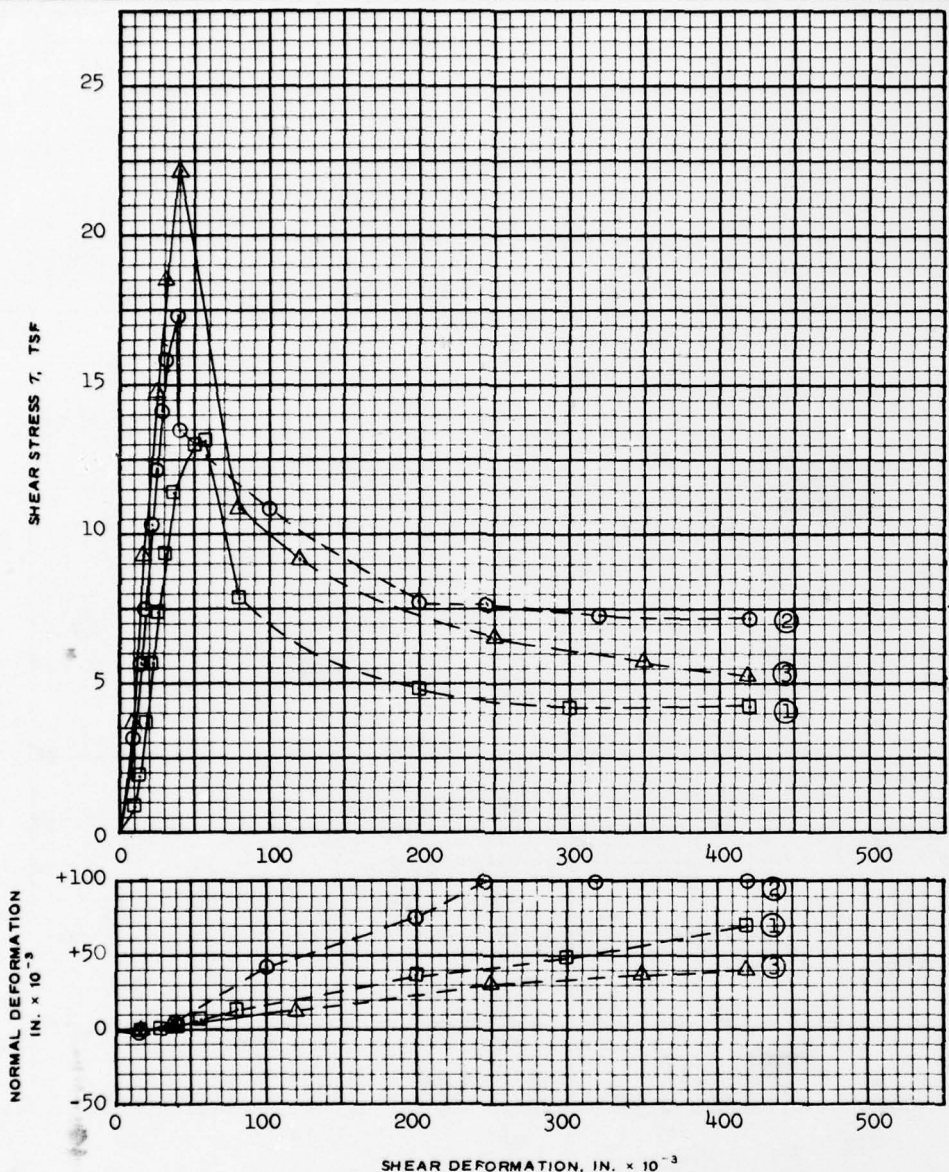
DESCRIPTION OF MATERIAL Tuff, RH-3, medium hardrock, to RH-1, very soft rock
(PCC)

REMARKS <u>Intact specimens</u>	PROJECT <u>LAPITA HILL STUDY</u> <u>PANAMA CANAL</u> AREA BORING NO. <u>ERE-25A</u> SAMPLE NO. <u>8A</u> DEPTH <u>165.8-168.3</u> DATE <u>29 May 1975</u> TEST RCH <u>DIRECT SHEAR TEST REPORT (ROCK)</u>
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WES FORM 1490
APR 75

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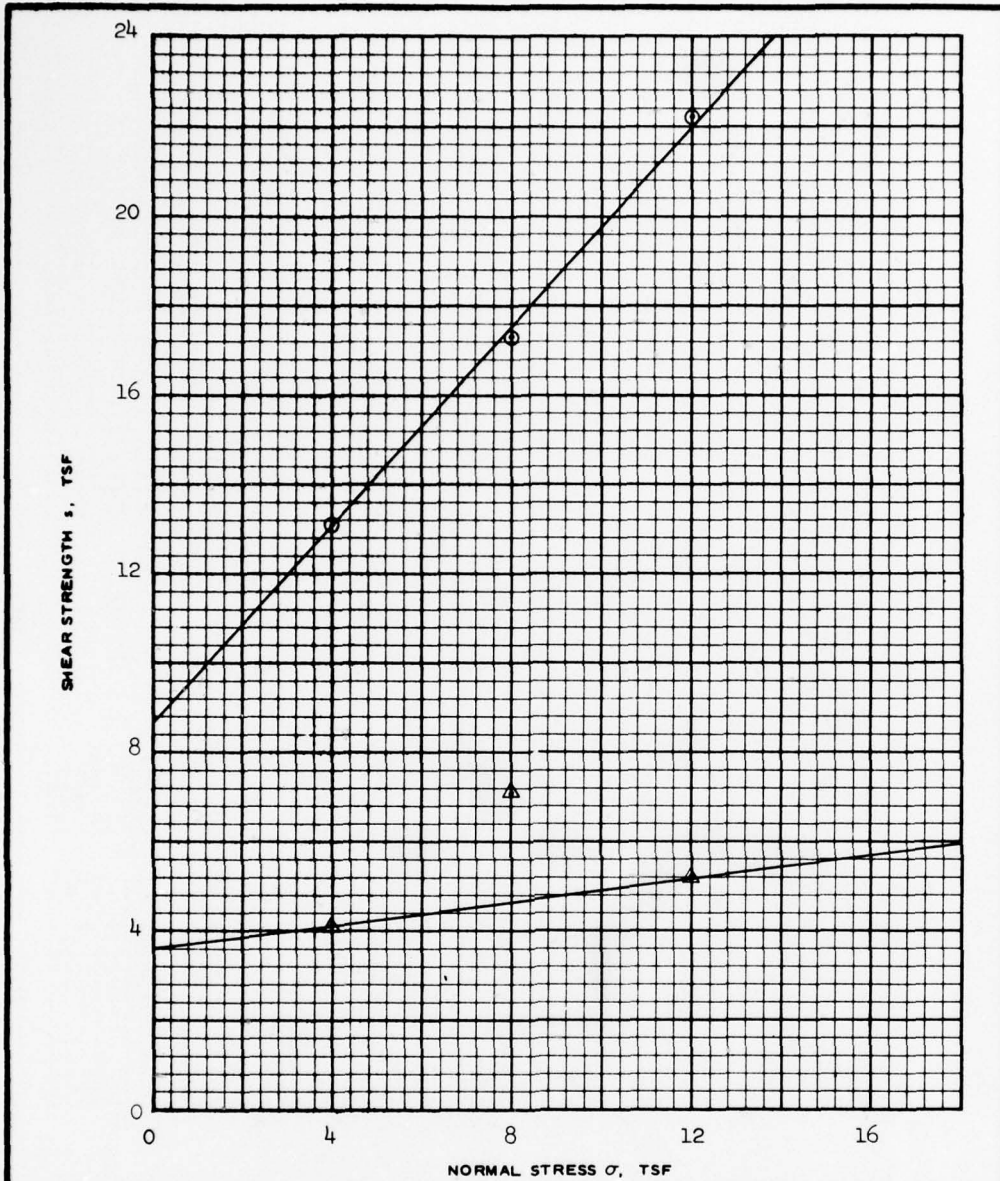
SHEET NO.



REMARKS --- Rate of deformation increased	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-25A	SAMPLE NO. 8A
	DEPTH 165.8-168.3	DATE 29 MAY 1975
DIRECT SHEAR TEST REPORT (ROCK)		

WES FORM 1490-1
MAY 76

SHEET NO.

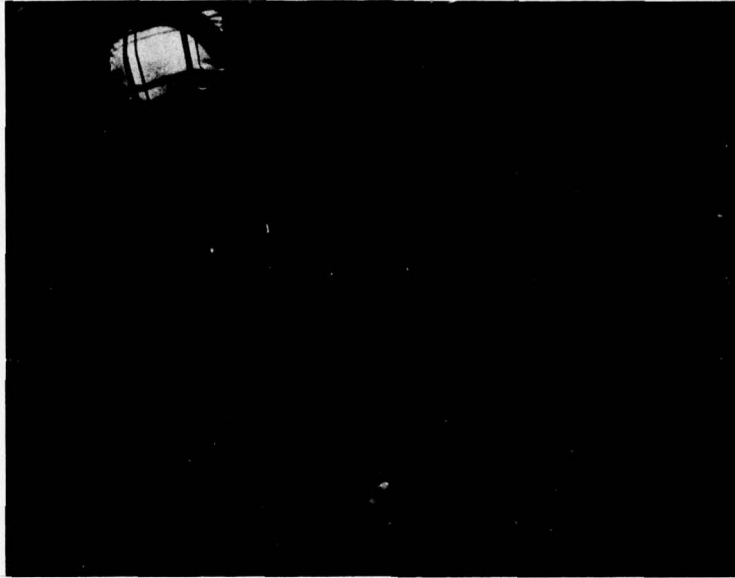


REMARKS ○ Maximum shear stress △ Ultimate shear stress	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-25A	SAMPLE NO. 8A
	DEPTH EL. 165.8-168.3	DATE 29 May 1975
	DIRECT SHEAR TEST REPORT (ROCK)	

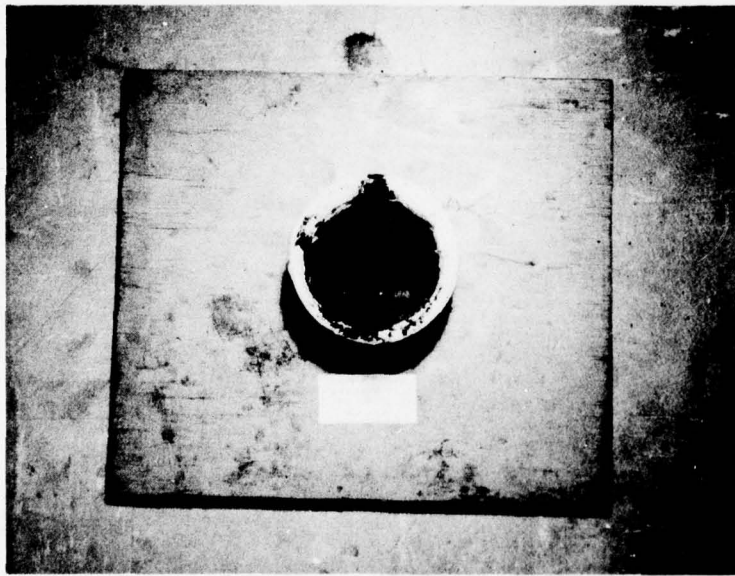
WES FORM MAY 75 1490-2

SHEET NO.

B20

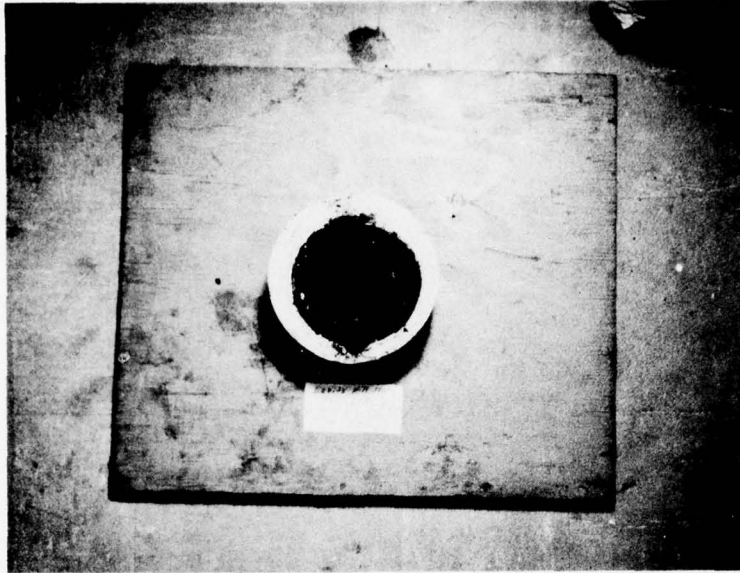


a. Immediately after extrusion from Shelby tube

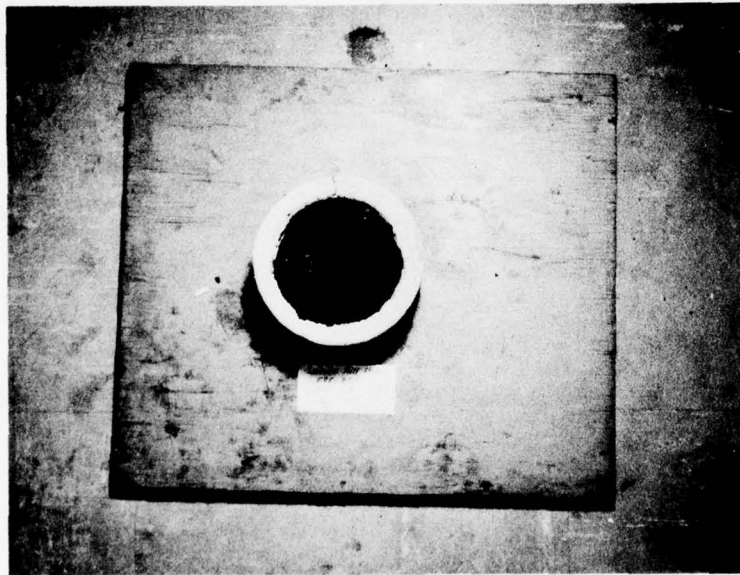


b. Single-plane direct shear test after failure at
4-tsf normal load

Figure B3. La Pita Hill study, tuff from boring
ERE-25A, sample No. 11, depth 212.0 to 214.1 ft
(sheet 1 of 2)

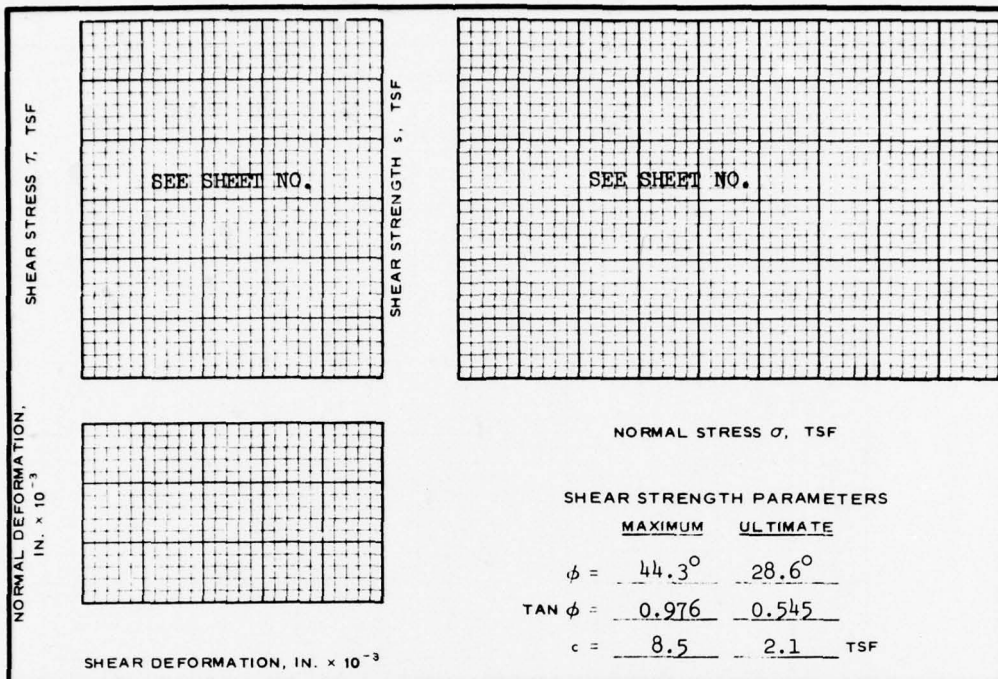


c. Single-plane direct shear test after failure
at 8-tnsf normal load



d. Single-plane direct shear test after failure
at 12-tnsf normal load

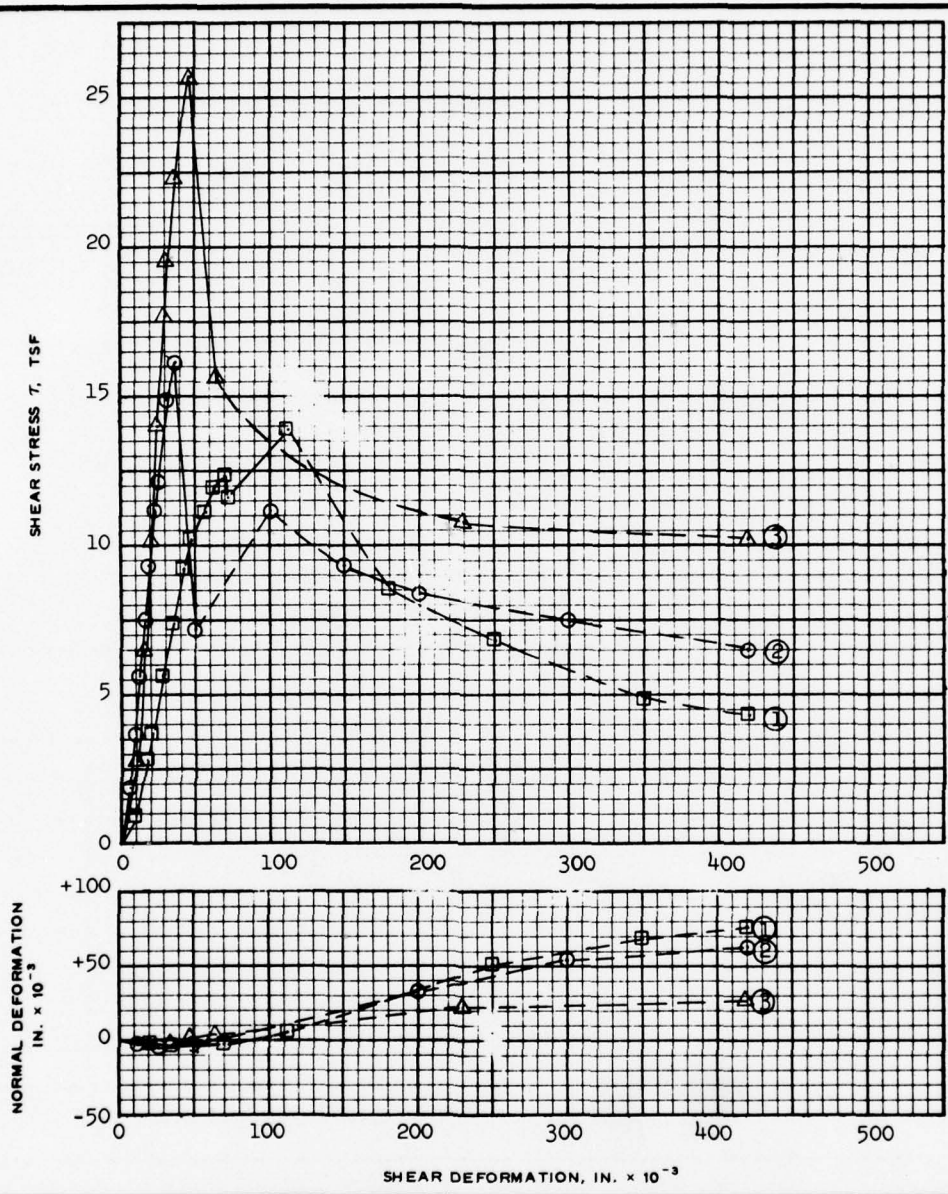
Figure B3 (sheet 2 of 2)



TEST NO.		1	2	3			
WET DENSITY, PCF	γ_m	139.2	139.6	138.9			
WATER CONTENT	w	15.7 %	16.5 %	16.3 %	%	%	%
NORMAL STRESS, TSF	σ	4.0	8.0	12.0			
MAXIMUM SHEAR STRESS, TSF	τ_f	12.32	16.06	25.67			
TIME TO FAILURE, MINUTES	t_f	8	9	15			
ULTIMATE SHEAR STRESS, TSF	τ_r	4.29	6.50	10.23			
INITIAL DIAMETER, IN.	D_o	4.979	4.955	4.965			
INITIAL HEIGHT, IN.	H_o						

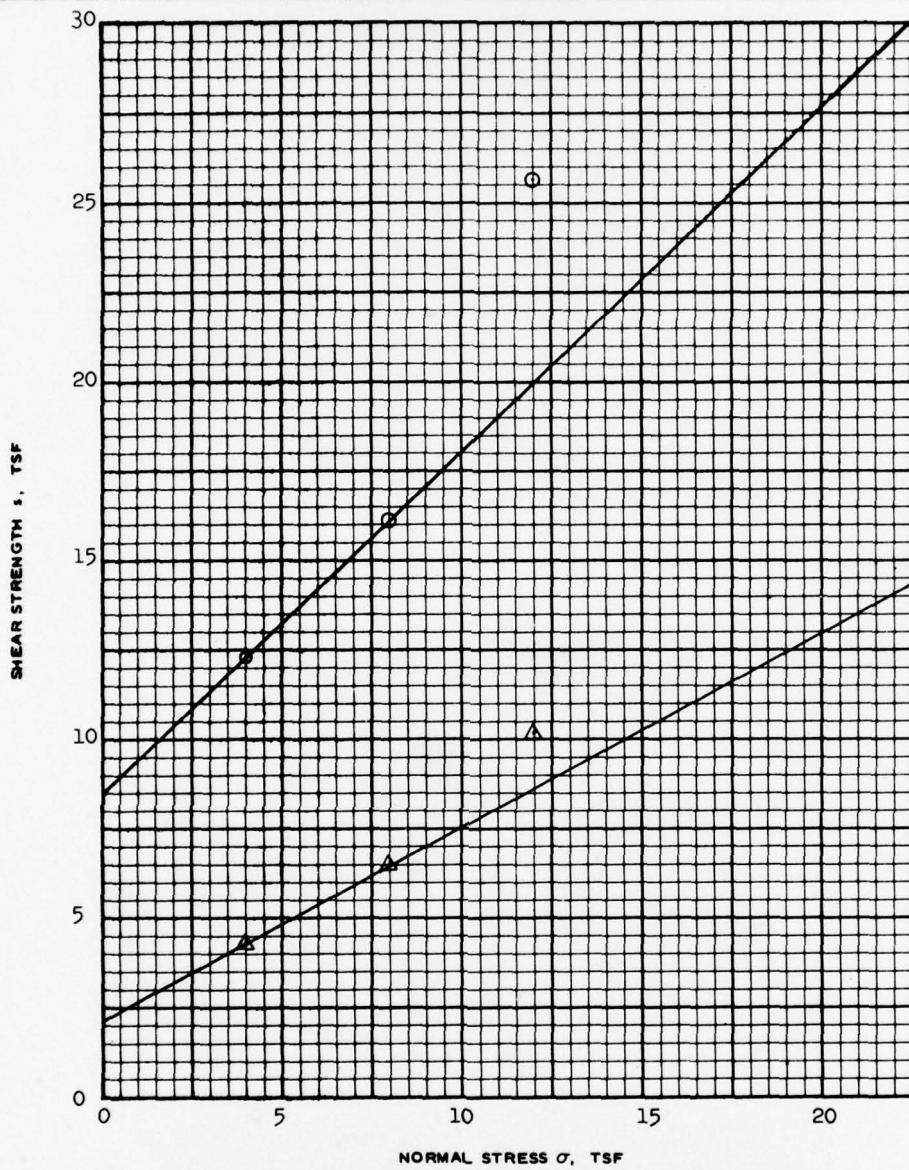
DESCRIPTION OF MATERIAL Tuff, RH-1, soft rock, to RH-2, medium soft rock (PCC)

REMARKS <u>Intact specimens</u> 	PROJECT <u>LAPITA HILL STUDY</u> <u>PANAMA CANAL</u> AREA BORING NO. <u>ERE-25A</u> SAMPLE NO. <u>11A</u> DEPTH <u>212.0-214.1</u> DATE <u>29 May 1975</u> TEST TYPE <u>RCH</u> TITLE <u>DIRECT SHEAR TEST REPORT (ROCK)</u>
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REMARKS --- Rate of deformation increased	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-25A	SAMPLE NO. 11A
DEPTH 212.0-214.1	DATE 29 May 1975	
DIRECT SHEAR TEST REPORT (ROCK)		

WES FORM 1490-1 MAY 78

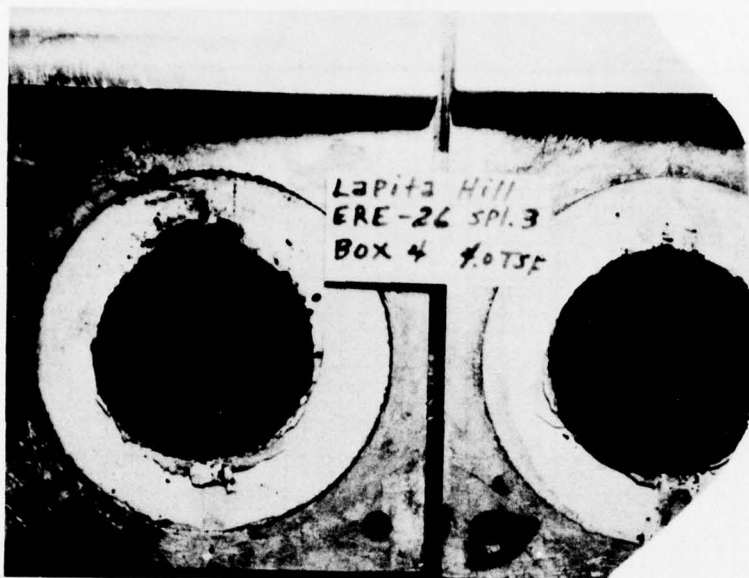


REMARKS	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-25A	SAMPLE NO. 11A
	DEPTH -EL 212.0-214.1	DATE 29 May 1975
	DIRECT SHEAR TEST REPORT (ROCK)	

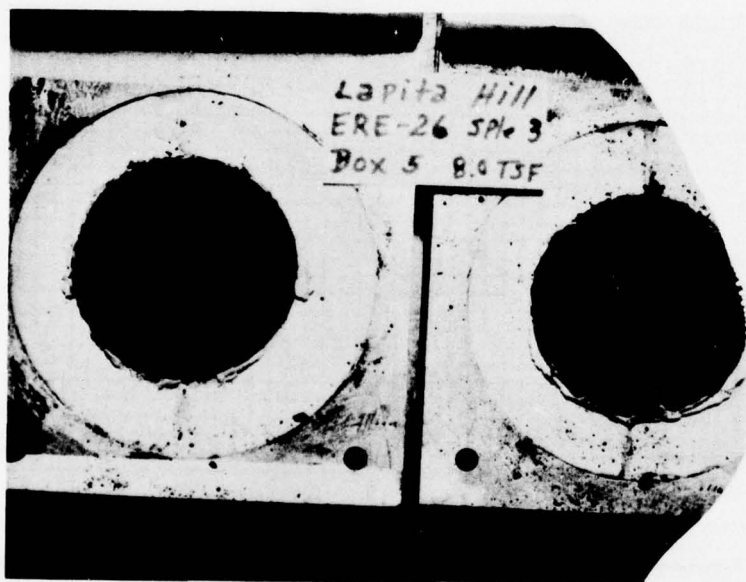
WES FORM MAY 75 1490-2

B25

SHEET NO.



a. Single-plane direct shear test after failure at 4-ton normal load



b. Single-plane direct shear test after failure at 8-ton normal load

Figure B4. La Pita Hill study, tuff from boring ERE-26, sample No. 3, depth 164.6 to 165.3 ft (sheet 1 of 2)



c. Single-plane direct shear test after failure
at 12-*tsf* normal load

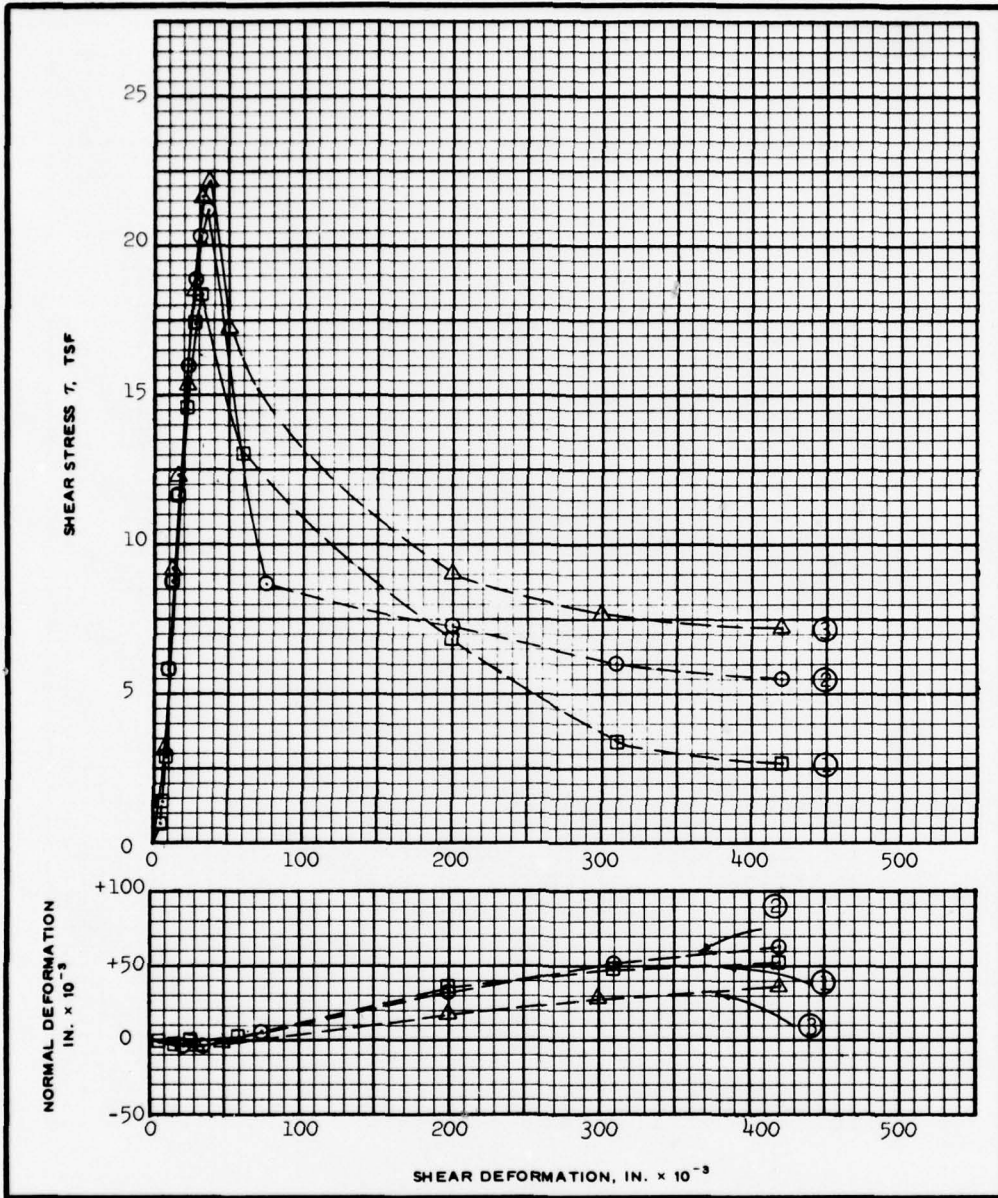
Figure B4 (sheet 2 of 2--Substituted sample tuff
from boring ERE-27, sample No. 6, depth 135.5 to
136.3 because of insufficient material in Boring
ERE-26, sample No. 3)

SHEAR STRESS τ , TSF	SEE SHEET NO.	SHEAR STRENGTH s , TSF	SEE SHEET NO.				
NORMAL DEFORMATION, IN. $\times 10^{-3}$	SEE SHEET NO.	NORMAL STRESS σ , TSF					
		SHEAR STRENGTH PARAMETERS					
		MAXIMUM	ULTIMATE				
		$\phi = 36.3^\circ$	23.5°				
		TAN $\phi = 0.735$	0.435				
		$c = 15.4$	2.0 TSF				
SHEAR DEFORMATION, IN. $\times 10^{-3}$							
TEST NO.		1	2	3			
WET DENSITY, PCF	γ_m	137.9	133.6	131.0			
WATER CONTENT	w	16.2 %	16.7 %	22.1 %	%	%	%
NORMAL STRESS, TSF	σ	4.0	8.0	12.0			
MAXIMUM SHEAR STRESS, TSF	τ_f	18.33	21.19	22.13			
TIME TO FAILURE, MINUTES	t_f	7	10	8			
ULTIMATE SHEAR STRESS, TSF	τ_r	2.55	5.49	7.24			
INITIAL DIAMETER, IN.	D_o	3.977	3.974	3.858			
INITIAL HEIGHT, IN.	H_o						
DESCRIPTION OF MATERIAL <u>Tuff, RH-1, soft rock, to RH-3, medium hard rock (PCC)</u>							
REMARKS	Intact specimens		PROJECT <u>LAPITA HILL STUDY</u>				
			PANAMA CANAL				
			AREA				
			BORING NO. <u>1 & 2 ERE-26</u>	3 ERE-27	SAMPLE NO. <u>3</u>		
			DEPTH <u>1 & 2 (164.6-165.3)</u>		DATE <u>3 June 1975</u>		
			<u>3 (135.5-136.3)</u>				
			TES <u>DIRECT SHEAR TEST REPORT (ROCK)</u>				
			RCH				

WES FORM 1490
APR 75

EDITION OF JUN 65 IS OBSOLETE

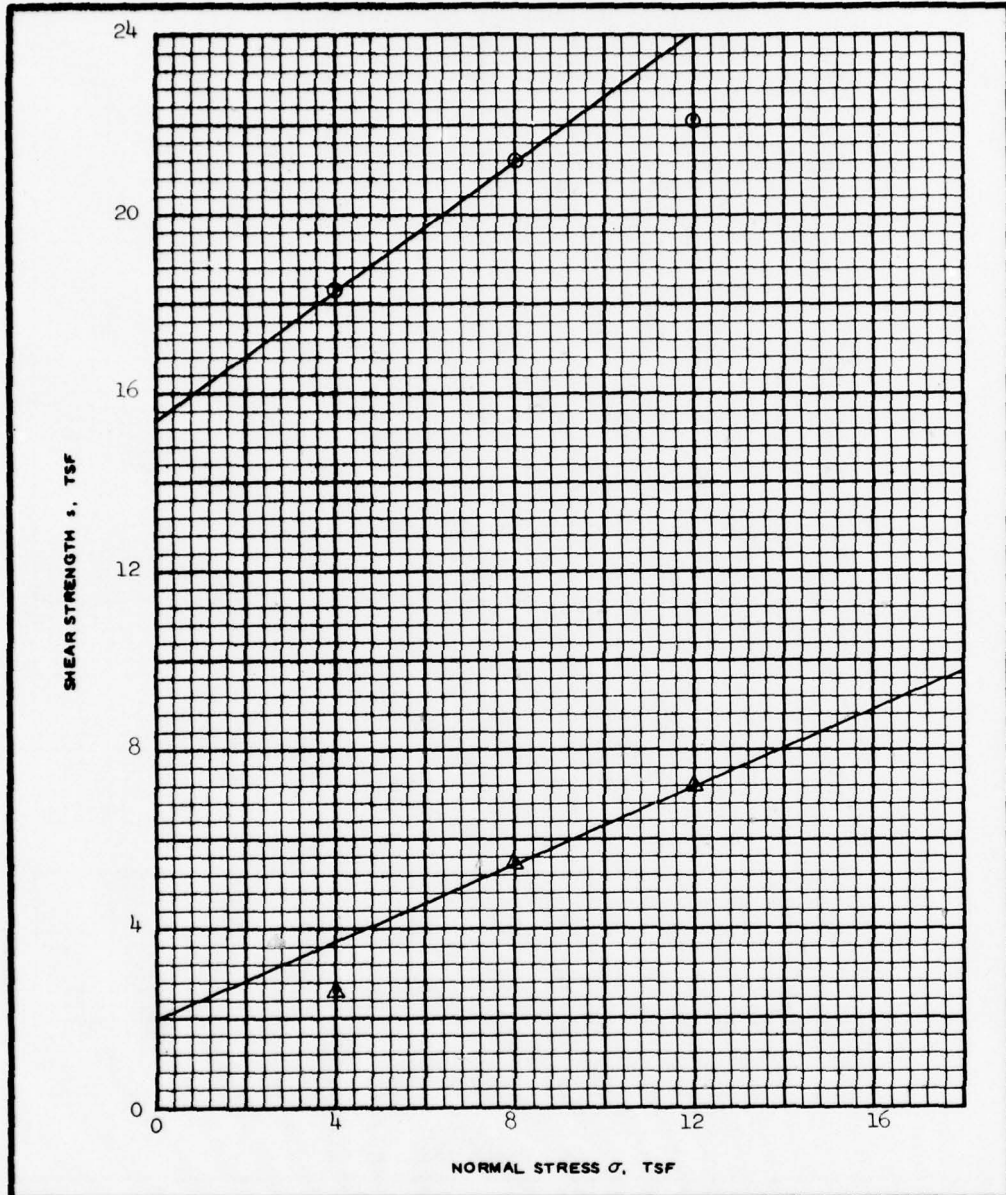
SHEET NO.



REMARKS --- Rate of deformation increased 	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA 1&2 ERE-26	SAMPLE NO. 3
	BORING NO. 3 ERE-27	6
DEPTH 1&2 (164.6-165.3)	DATE 3 June 1975	
EL. 3 (135.5-136.3)		
DIRECT SHEAR TEST REPORT (ROCK)		

WES FORM 1490-1
MAY 75

SHEET NO.

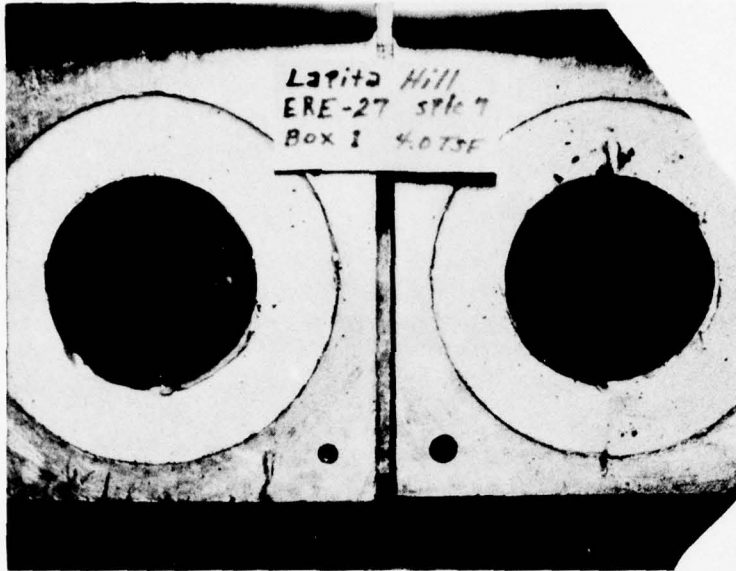


REMARKS	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. 1&2 ERE-26 3 ERE-27	SAMPLE NO. 3 6
	DEPTH 1&2 (164.6-165.3) El. 3 (135.5-136.3)	
	DATE 3 June 1975	
DIRECT SHEAR TEST REPORT (ROCK)		

WES FORM 1490-2
MAY 78

B30

SHEET NO.

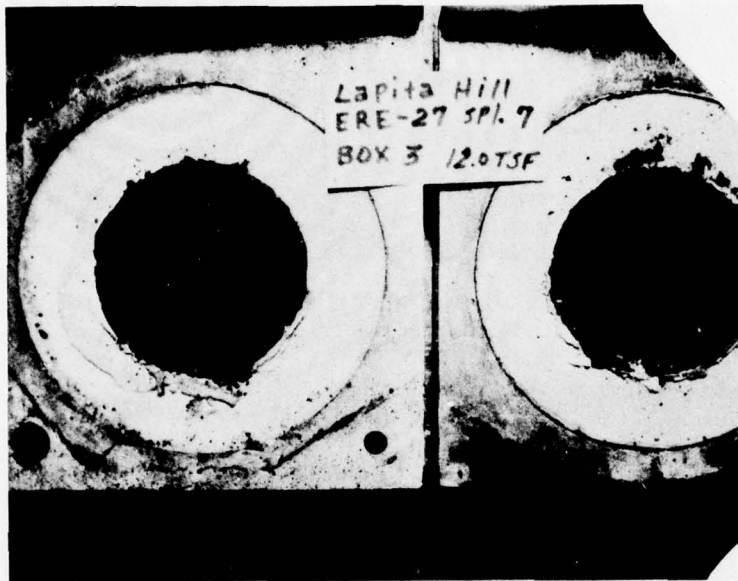


a. Single-plane direct shear test after failure at 4-tsf normal load



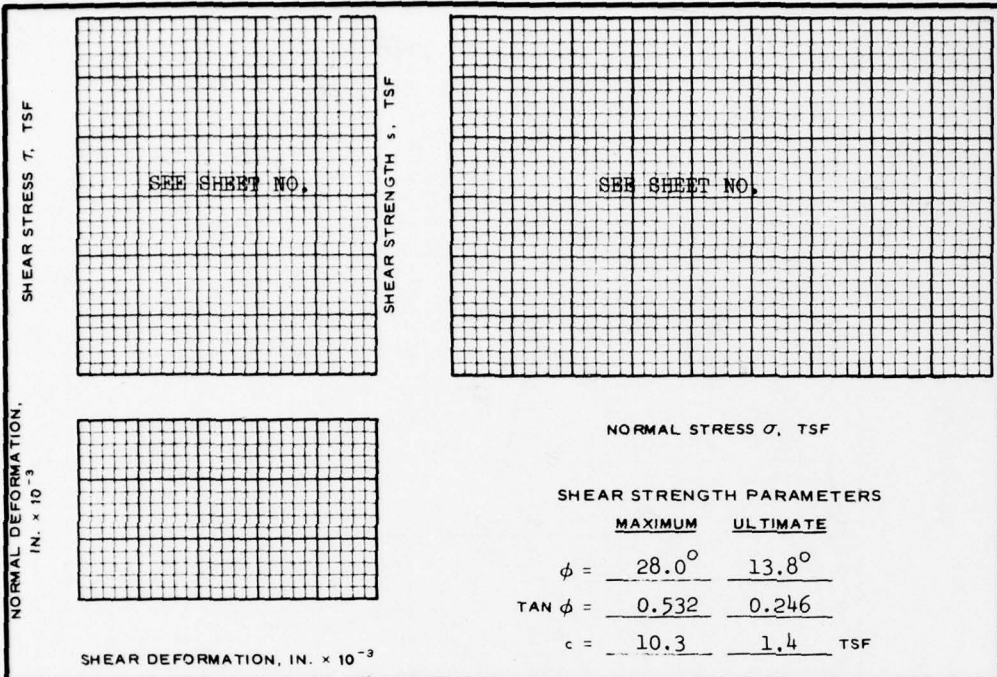
b. Single-plane direct shear test after failure at 8-tsf normal load

Figure B5. La Pita Hill study, tuff from boring ERE-27, sample No. 7, depth 141.4 to 142.5 ft (sheet 1 of 2)



c. Single-plane direct shear test after failure at
12-tsf normal load

Figure B5 (sheet 2 of 2)



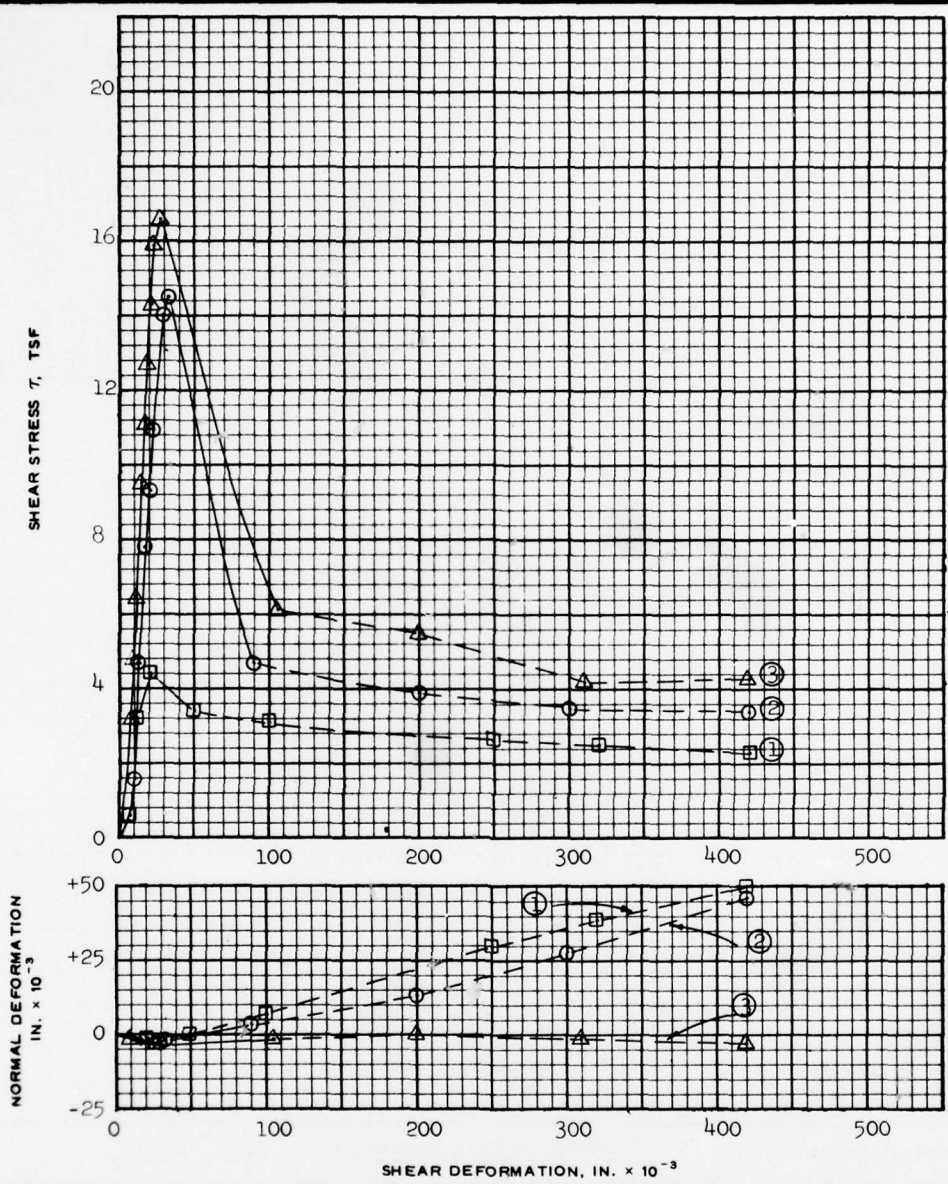
SHEAR STRENGTH PARAMETERS

	MAXIMUM	ULTIMATE
$\phi =$	<u>28.0°</u>	<u>13.8°</u>
TAN $\phi =$	<u>0.532</u>	<u>0.246</u>
$c =$	<u>10.3</u>	<u>1.4</u> TSF

TEST NO.		1	2	3			
WET DENSITY, PCF	γ_m	122.8	123.6	123.3			
WATER CONTENT	w	29.3 %	28.6 %	27.2 %	%	%	%
NORMAL STRESS, TSF	σ	4.0	8.0	12.0			
MAXIMUM SHEAR STRESS, TSF	τ_f	4.40	14.48	16.60			
TIME TO FAILURE, MINUTES	t_f	5	4	6			
ULTIMATE SHEAR STRESS, TSF	τ_u	2.30	3.42	4.23			
INITIAL DIAMETER, IN.	D_0	3.792	3.838	3.797			
INITIAL HEIGHT, IN.	H_0						

DESCRIPTION OF MATERIAL Tuff, RH-2, medium soft rock, to RH-3, medium hard rock (PCC)

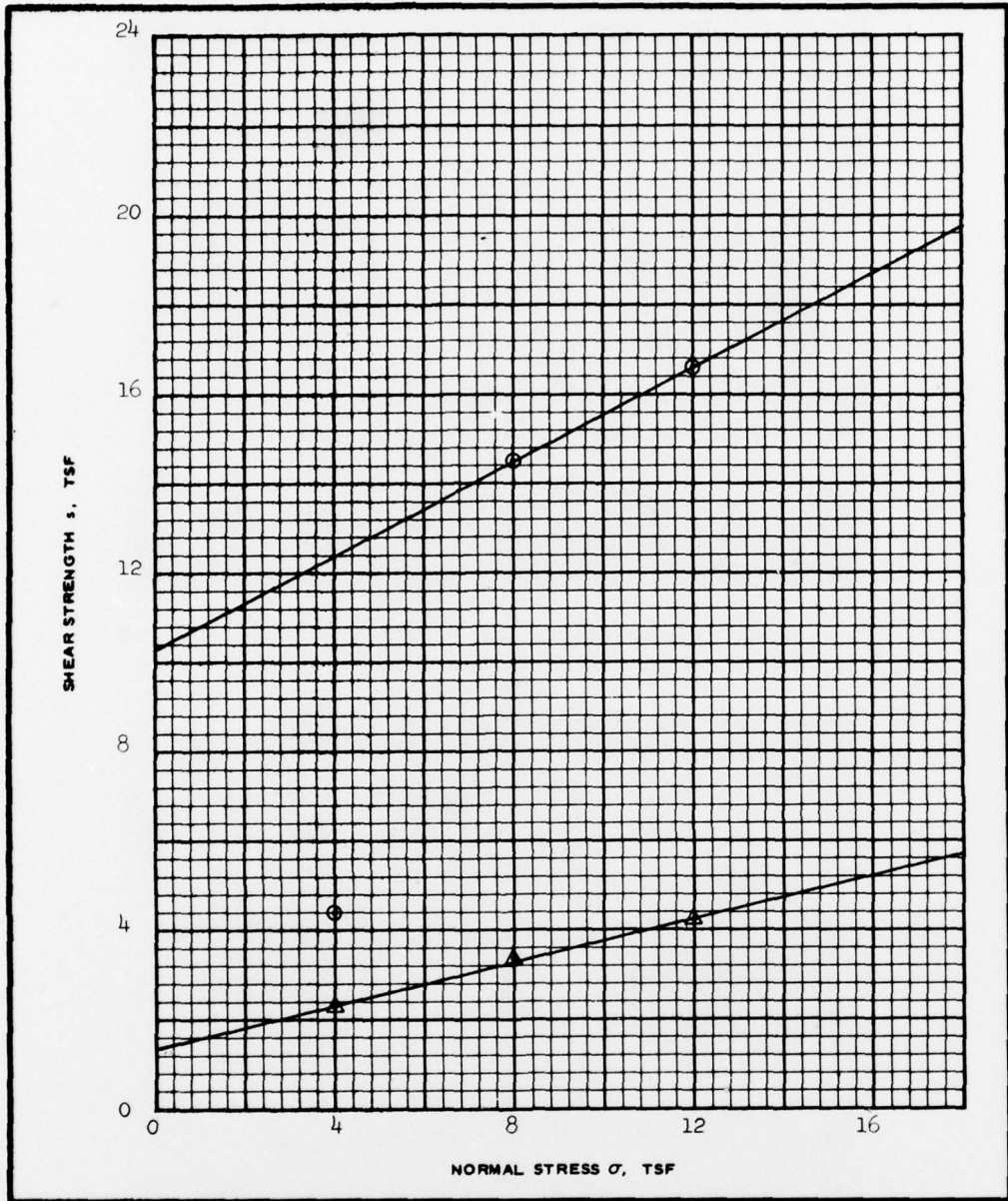
REMARKS <u>Intact specimens</u>	PROJECT <u>LAPITA HILL STUDY</u>
	<u>PANAMA CANAL</u>
	AREA
	BORING NO. <u>ERE-27</u> SAMPLE NO. <u>7</u>
	DEPTH <u>141.4-142.5</u> DATE <u>3 June 1975</u>
	TEST TYPE <u>RCH DIRECT SHEAR TEST REPORT (ROCK)</u>



REMARKS --- Rate of deformation increase	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-27	SAMPLE NO. 7
	DEPTH 141.4-142.5	DATE 3 June 1975
DIRECT SHEAR TEST REPORT (ROCK)		

485 2075 1980.1

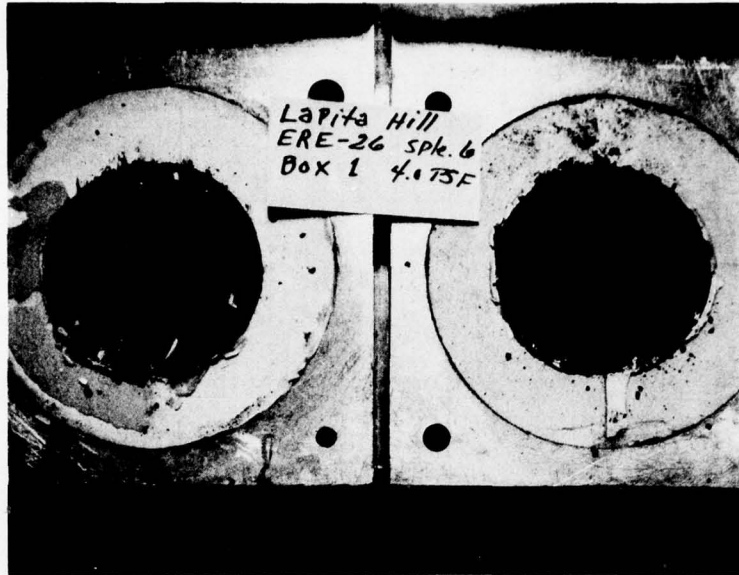
SHEET NO.



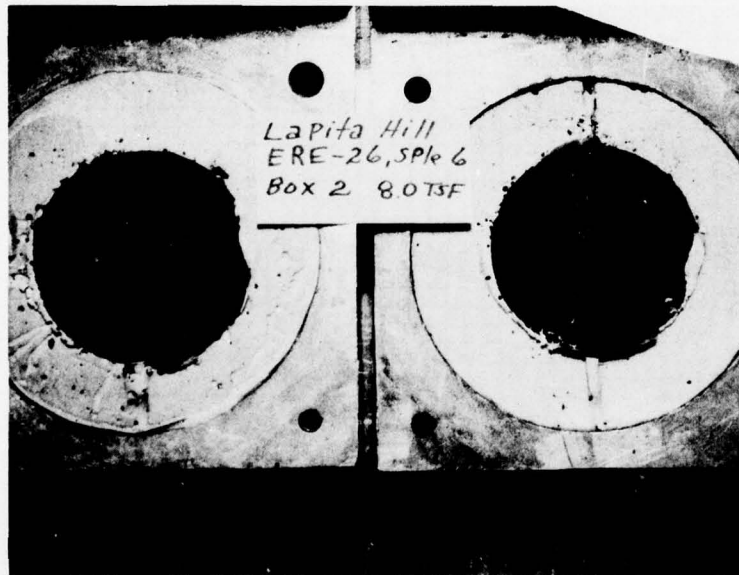
REMARKS <input type="checkbox"/> Maximum shear stress <input type="checkbox"/> Ultimate shear stress	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-27	SAMPLE NO. 7
	DEPTH 141.4-142.5	DATE 3 June 1975
DIRECT SHEAR TEST REPORT (ROCK)		

WES FORM MAY 75 1490-2

SHEET NO.

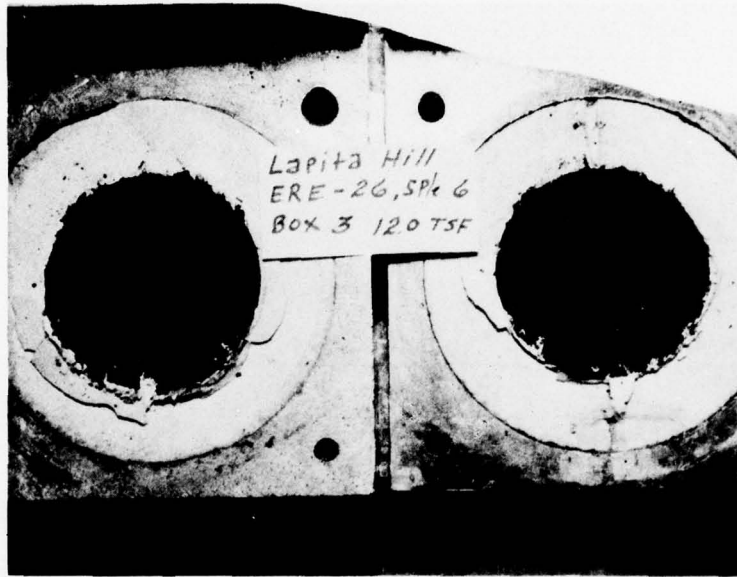


a. Single-plane direct shear test after failure at 4-tsf normal load



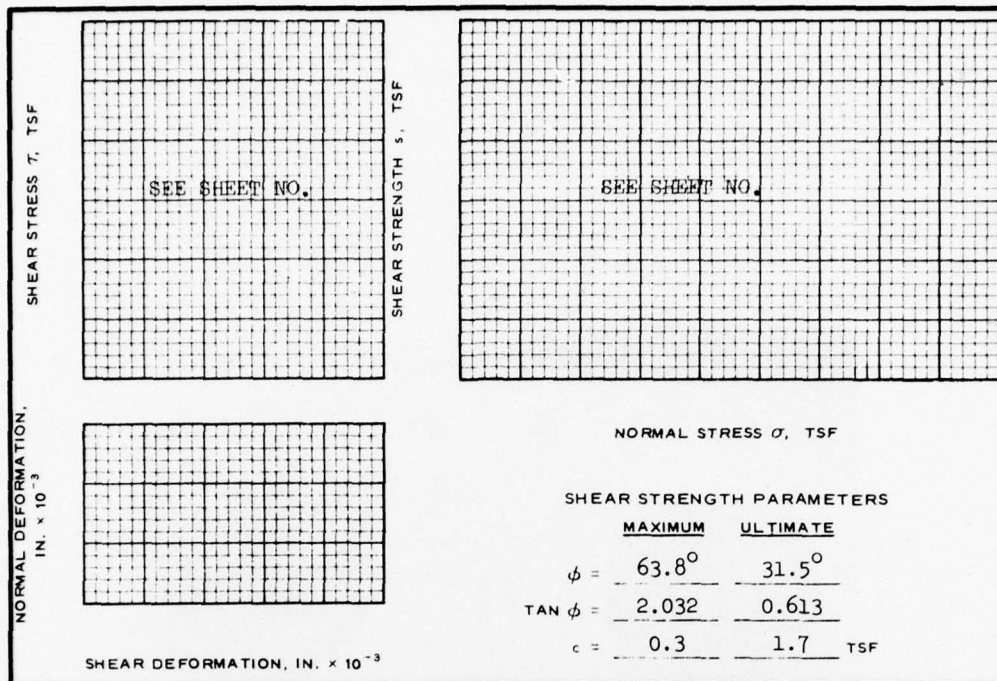
b. Single-plane direct shear test after failure at 8-tsf normal load

Figure B6. La Pita Hill study, andesite from boring ERE-26, sample No. 6, depth 236.7 to 237.9 ft (sheet 1 of 2)



c. Single-plane direct shear test after failure at
12-*tsf* normal load

Figure B6 (sheet 2 of 2)



TEST NO.		1	2	3			
WET DENSITY, PCF	γ_m	144.1	143.0	144.4			
WATER CONTENT	w	11.7 %	11.4 %	12.1 %	%	%	%
NORMAL STRESS, TSF	σ	4.0	8.0	12.0			
MAXIMUM SHEAR STRESS, TSF	τ_f	22.05	16.28	24.45			
TIME TO FAILURE, MINUTES	t_f	10	7	19			
ULTIMATE SHEAR STRESS, TSF	τ_f	2.53	6.55	9.10			
INITIAL DIAMETER, IN.	D_o	3.902	3.861	3.901			
INITIAL HEIGHT, IN.	H_o						

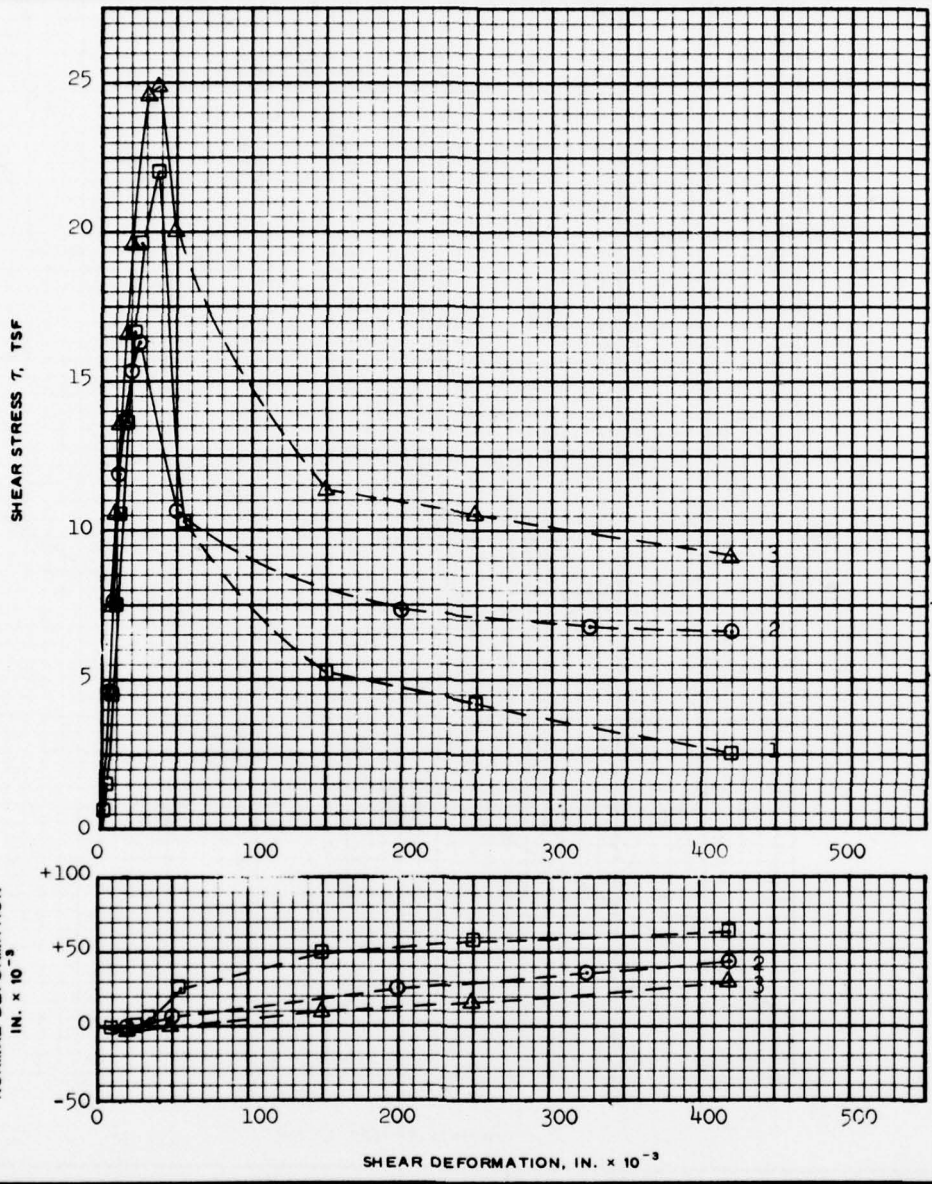
DESCRIPTION OF MATERIAL Andesite, RH-3, medium hard rock, to RH-5, very hard rock (PCC)

REMARKS <u>Intact specimens</u>	PROJECT <u>LAPITA HILL STUDY</u>
	<u>PANAMA CANAL</u>
	AREA
	BORING NO. <u>ERE-26</u> SAMPLE NO. <u>6</u>
	DEPTH <u>236.7-237.9</u> DATE <u>5 June 1975</u>
	TES
	RCH <u>DIRECT SHEAR TEST REPORT (ROCK)</u>

WES FORM APR 75 1490

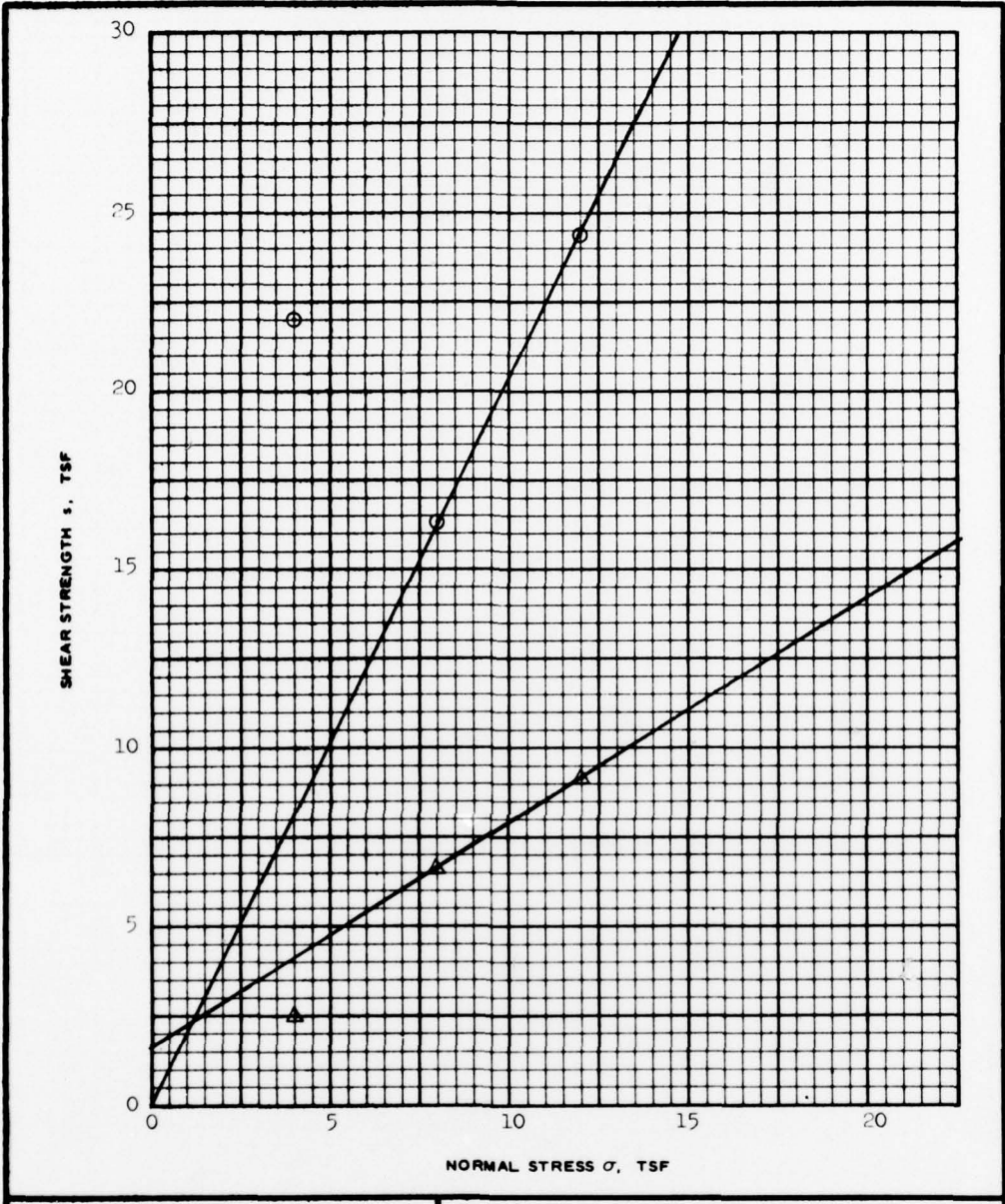
EDITION OF JUN 65 IS OBSOLETE

SHEET NO.



REMARKS --- Rate of deformation increased	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-26	SAMPLE NO. 6
DEPTH 236.7-237.9	DATE 5 June 1975	
DIRECT SHEAR TEST REPORT (ROCK)		

WES FORM MAY 75 1490-1



REMARKS	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-26	SAMPLE NO. 6
	DEPTH 236.7-237.9	DATE 5 June 1975
	DIRECT SHEAR TEST REPORT (ROCK)	

WES FORM MAY 76 1490-2

B40

SHEET NO.

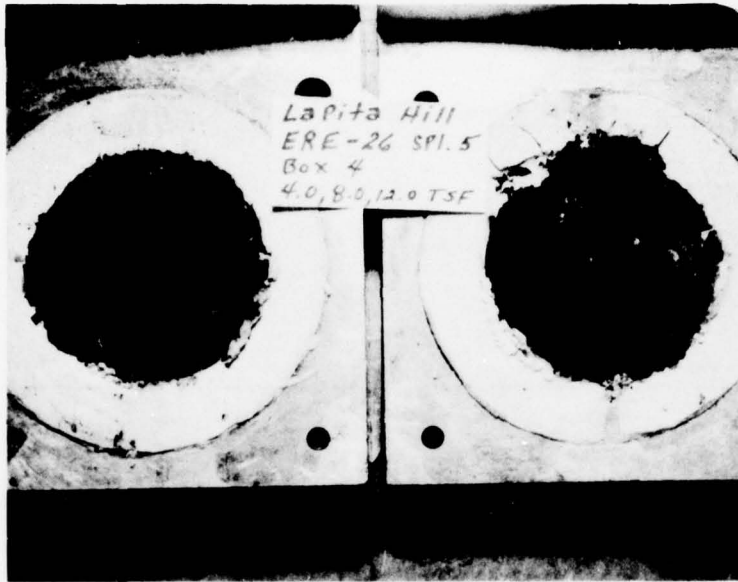
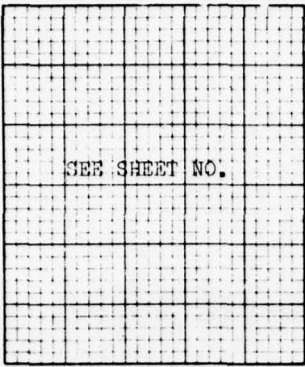


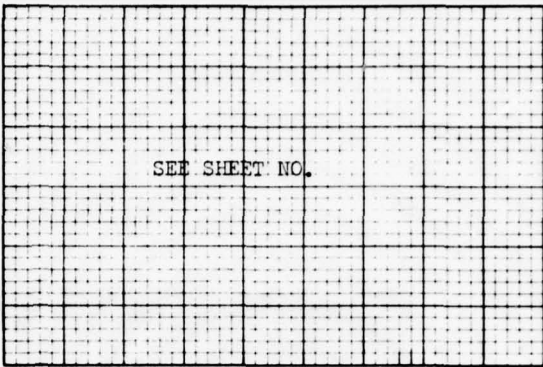
Figure B7. La Pita Hill study, agglomerate tuff (fault zone) from boring ERE-26, sample No. 5, depth 209.8 to 210.3. Multistage direct shear conducted at 4, 8, and 12 tsf

SHEAR STRESS τ , TSF



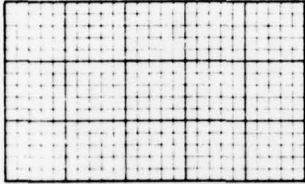
SEE SHEET NO.

SHEAR STRENGTH s , TSF



SEE SHEET NO.

NORMAL DEFORMATION,
IN. $\times 10^{-3}$



NORMAL STRESS σ , TSF

SHEAR STRENGTH PARAMETERS

	MAXIMUM	ULTIMATE
$\phi =$	<u>16.5°</u>	<u>16.5°</u>
TAN $\phi =$	<u>0.296</u>	<u>0.296</u>
$c =$	<u>2.6</u>	<u>2.6</u> TSF

SHEAR DEFORMATION, IN. $\times 10^{-3}$

TEST NO.	1	2	3				
WET DENSITY, PCF	γ_m 121.2						
WATER CONTENT	w 21.6%	%	%	%	%	%	%
NORMAL STRESS, TSF	σ 4.0	8.0	12.0				
MAXIMUM SHEAR STRESS, TSF	τ_f 3.84	3.90	6.21				
TIME TO FAILURE, MINUTES	t_f 29	49	21				
ULTIMATE SHEAR STRESS, TSF	τ_f 3.64	3.90	6.21				
INITIAL DIAMETER, IN.	D_o 3.937						
INITIAL HEIGHT, IN.	H_o						

DESCRIPTION OF MATERIAL Agglomeratic tuff (fault zone), RH-2, medium soft rock, to RH-3, medium hard rock (PCC)

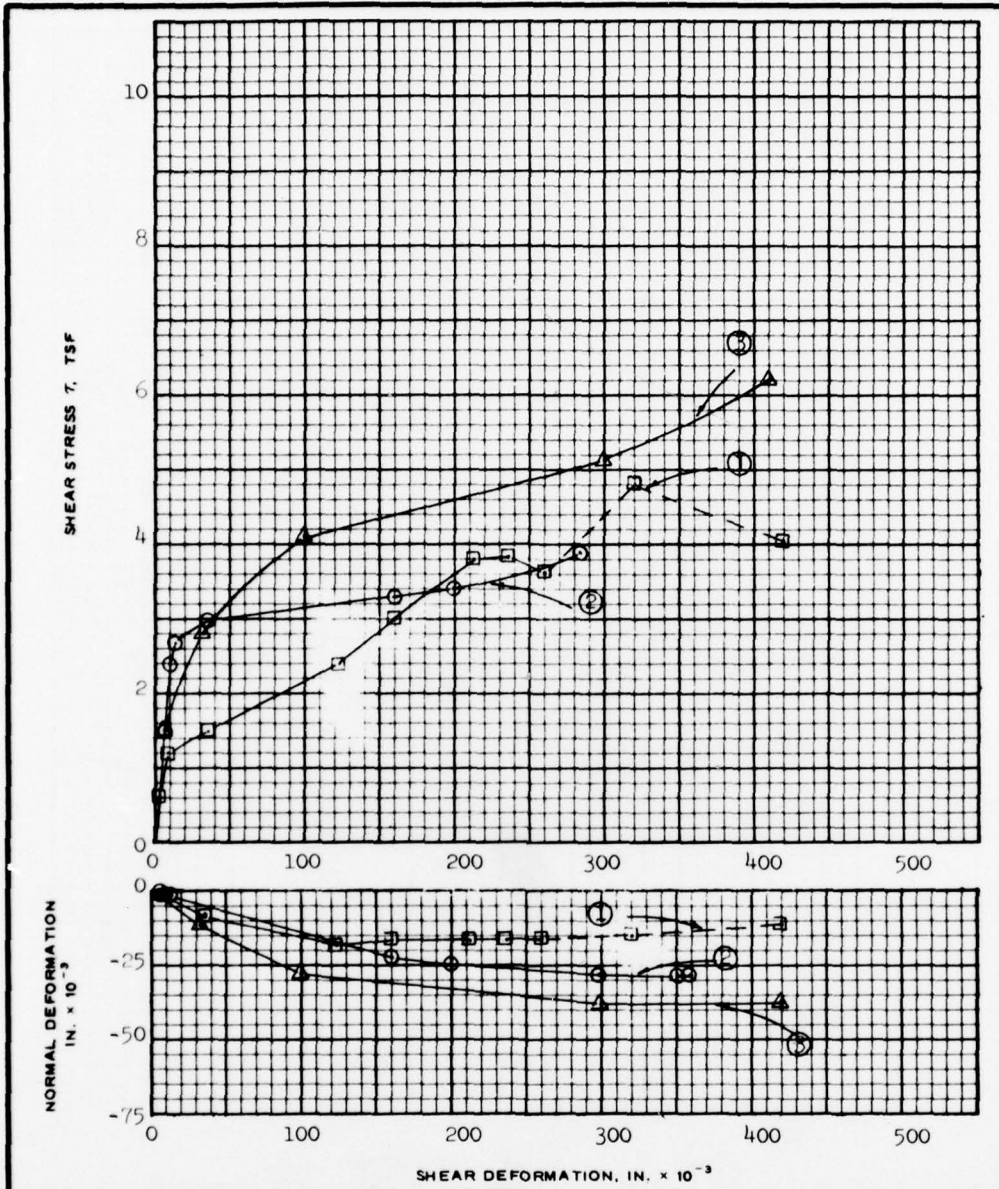
REMARKS <u>Step load</u>	PROJECT <u>LAPITA HILL STUDY</u>
	<u>PANAMA CANAL</u>
	AREA
	BORING NO. <u>ERE-26</u> SAMPLE NO. <u>5</u>
	DEPTH <u>209.8-210.3</u> DATE <u>5 June 1975</u>
	TEST <u>RCH DIRECT SHEAR TEST REPORT (ROCK)</u>

WES FORM 1490
APR 75

EDITION OF JUN 65 IS OBSOLETE

SHEET NO.

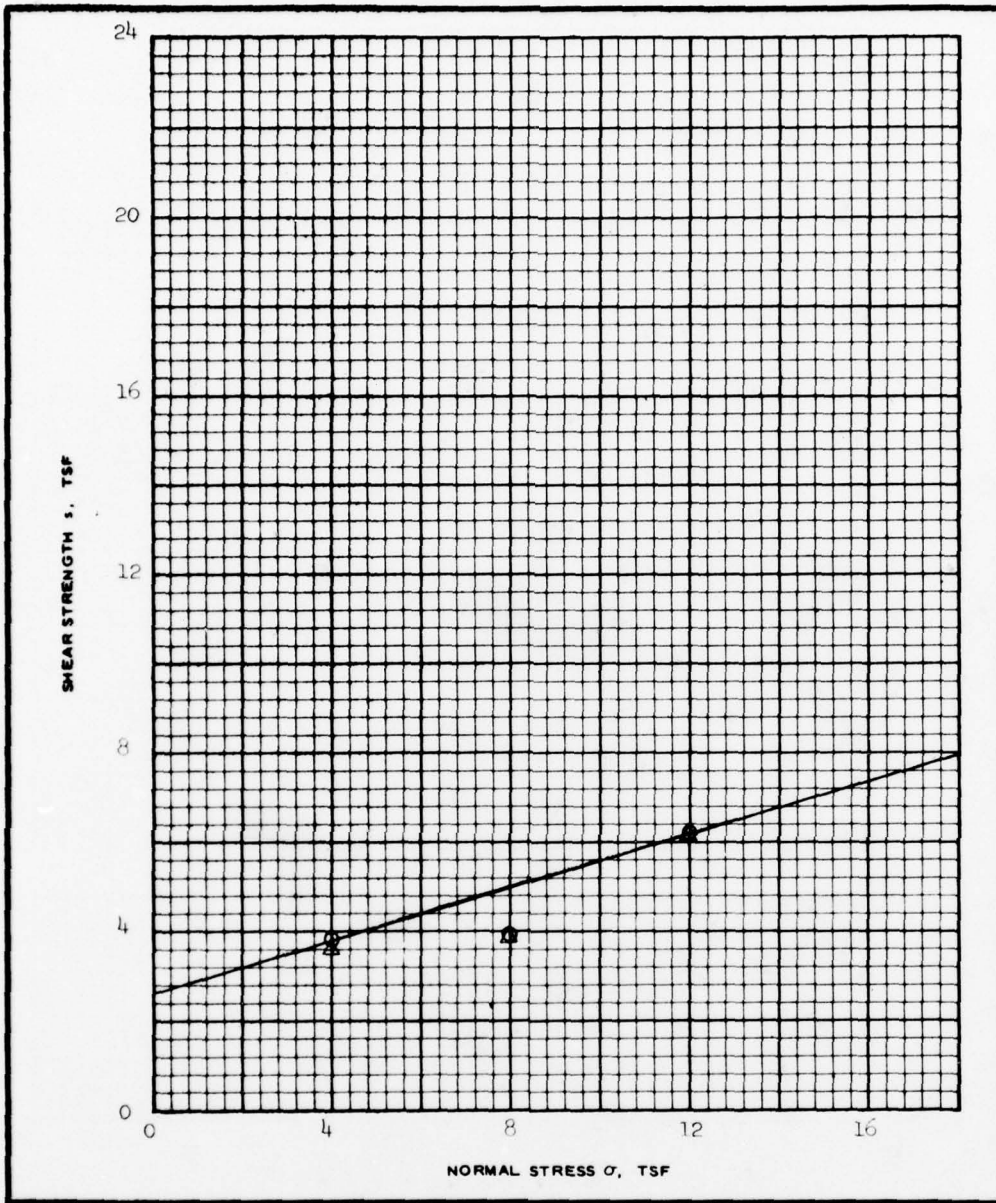
B42



REMARKS --- Rate of deformation increased	PROJECT LAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-26	SAMPLE NO. 5
	DEPTH 209.8-210.3	DATE 5 June 1975
DIRECT SHEAR TEST REPORT (ROCK)		

WES FORM MAY 75 1490-1

SHEET NO.



REMARKS ○ Maximum shear stress △ Ultimate shear stress	PROJECT IAPITA HILL STUDY	
	PANAMA CANAL	
	AREA	
	BORING NO. ERE-26	SAMPLE NO. 5
DEPTH 209.8-210.3	DATE 5 June 1975	
DIRECT SHEAR TEST REPORT (ROCK)		

WES FORM MAY 75 1490-2

SHEET NO.

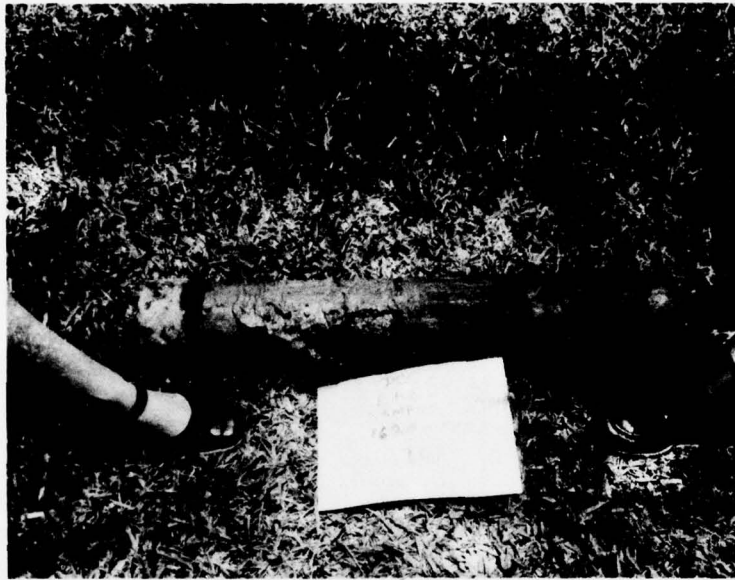
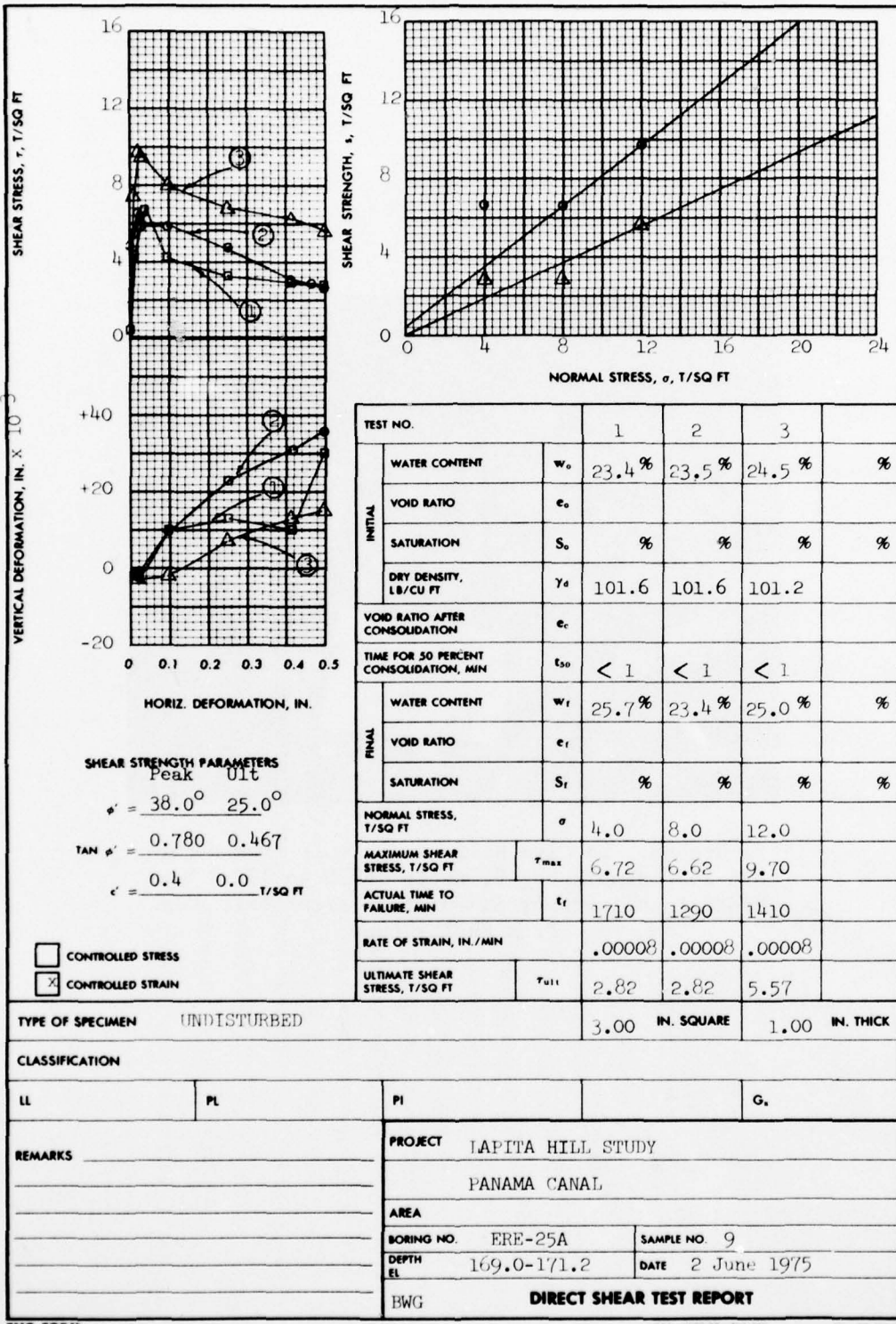


Figure B8. La Pita Hill study, tuff from boring
ERE-25A, sample No. 9, depth 169.0 to 172.1 ft.
Pretest photography immediately after extrusion
from Shelby tube



SHEAR STRENGTH PARAMETERS
 Peak ϕ Ult ϕ
 $\phi = 38.0^\circ \quad 25.0^\circ$
 $\tan \phi = 0.780 \quad 0.467$
 $c = 0.4 \quad 0.0 \quad \text{T/SQ FT}$

- CONTROLLED STRESS
- CONTROLLED STRAIN

TEST NO.		1	2	3	
INITIAL	WATER CONTENT	w_o 23.4 %	23.5 %	24.5 %	%
	VOID RATIO	e_o			
	SATURATION	S_o	%	%	%
	DRY DENSITY, LB/CU FT	γ_d 101.6	101.6	101.2	
VOID RATIO AFTER CONSOLIDATION		e_c			
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	< 1	< 1	< 1
FINAL	WATER CONTENT	w_f 25.7 %	23.4 %	25.0 %	%
	VOID RATIO	e_f			
	SATURATION	S_f	%	%	%
NORMAL STRESS, T/SQ FT		σ	4.0	8.0	12.0
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	6.72	6.62	9.70
ACTUAL TIME TO FAILURE, MIN		t_f	1710	1290	1410
RATE OF STRAIN, IN./MIN			.00008	.00008	.00008
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}	2.82	2.82	5.57

TYPE OF SPECIMEN **UNDISTURBED** 3.00 IN. SQUARE 1.00 IN. THICK

CLASSIFICATION

LL PL PI G.

REMARKS _____

PROJECT **IAPITA HILL STUDY**

PANAMA CANAL

AREA _____

BORING NO. **ERE-25A** SAMPLE NO. **9**

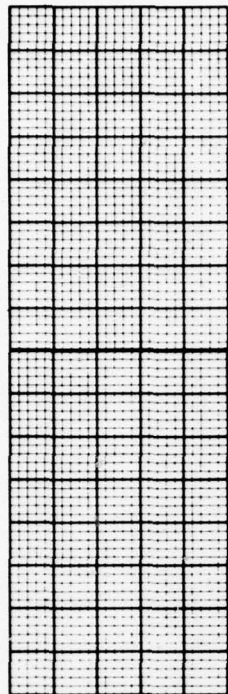
DEPTH **169.0-171.2** DATE **2 June 1975**

EL _____

BWG **DIRECT SHEAR TEST REPORT**

SHEAR STRESS, τ , T/SQ FT

VERTICAL DEFORMATION, IN.



0 0.1 0.2 0.3 0.4 0.5

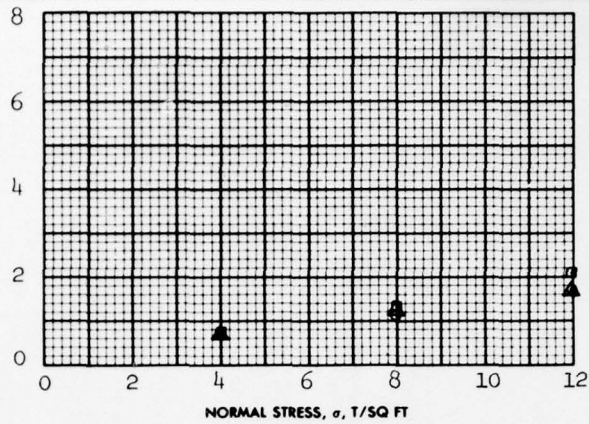
HORIZ. DEFORMATION, IN.

SHEAR STRENGTH PARAMETERS

$\phi' = 8.29^\circ$
 $\tan \phi' = 0.146$
 $c' = 0.0$ T/SQ FT

- CONTROLLED STRESS
 CONTROLLED STRAIN

SHEAR STRENGTH, τ , T/SQ FT



TEST NO.		1	2	3		
INITIAL	WATER CONTENT	w_o	39.1 %	38.9 %	42.1 %	%
	VOID RATIO	e_o				
	SATURATION	S_o	%	%	%	%
	DRY DENSITY, LB/CU FT	γ_d	78.3	79.5	77.5	
VOID RATIO AFTER CONSOLIDATION		e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}				
FINAL	WATER CONTENT	w_f	%	%	%	%
	VOID RATIO	e_f				
	SATURATION	S_f	%	%	%	%
NORMAL STRESS, T/SQ FT		σ	4.0	8.0	12.0	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}				
ACTUAL TIME TO FAILURE, MIN		t_f				
RATE OF STRAIN, IN./MIN						
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}				

TYPE OF SPECIMEN 3.01 IN. SQUARE 0.553 IN. THICK

CLASSIFICATION

LL PL PI G.

REMARKS

PROJECT LA PITA HILL STUDY
 PANAMA CANAL
 AREA
 BORING NO. ERE-27 SAMPLE NO. 4
 DEPTH EL 74.5-75.5 DATE 18 June 1975
 BWG

DIRECT SHEAR TEST REPORT

AD-A075 778

ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG--ETC F/G 8/6
EVALUATION OF EFFECTS OF PANAMA CANAL DEEPENING UPON THE STABIL--ETC(U)

UNCLASSIFIED

SEP 79 W O MILLER
WES-0L-79-16

NL

3 OF 4

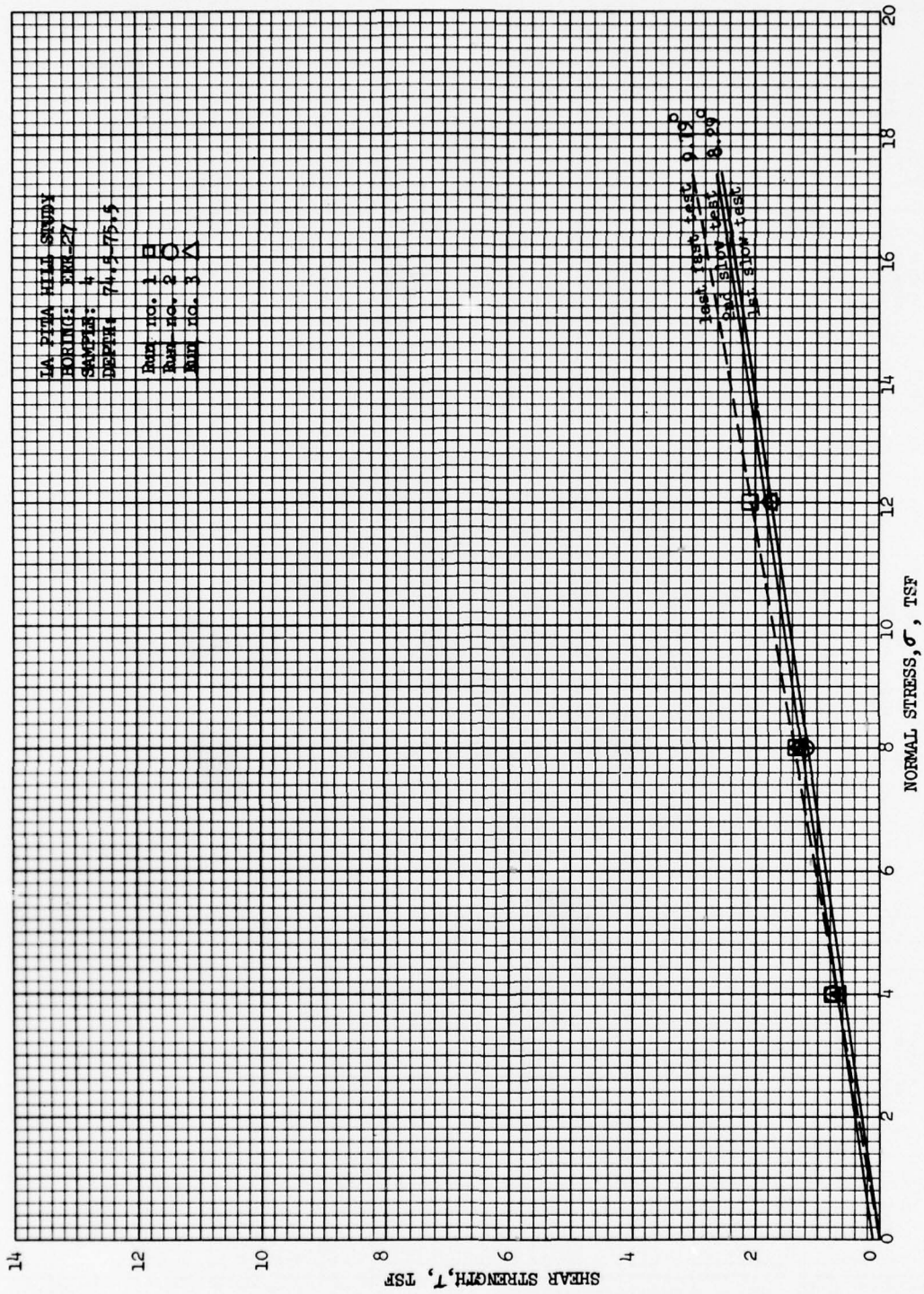
AD
A075778



LA PITA HILL STUDY
PANAMA CANAL

BORING ERE-27
SAMPLE 4
DEPTH 74.5-75.5

Run No.	σ TSF	Rate of strain in/hr	Per Run in	Accumulated in	τ TSF	Ratio τ/σ
1. (20th fast)	4	2.00 in/hr	0.25	5.00	0.77	0.19
	8	2.00 in/hr	0.25	5.00	1.34	0.17
	12	2.00 in/hr	0.25	5.00	2.08	0.17
2. (1st slow)	4	0.018 in/hr	0.3866	5.3866	0.77	0.19
	8	0.018 in/hr	0.3866	5.3866	1.18	0.15
	12	0.018 in/hr	0.3866	5.3866	1.76	0.15
3. (2nd slow)	4	0.0185 in/hr	0.4070	5.7936	0.70	0.18
	8	0.0185 in/hr	0.4070	5.7936	1.28	0.16
	12	0.0185 in/hr	0.4070	5.7936	1.76	0.20



BLENDED

LIQUID AND PLASTIC LIMIT TESTS

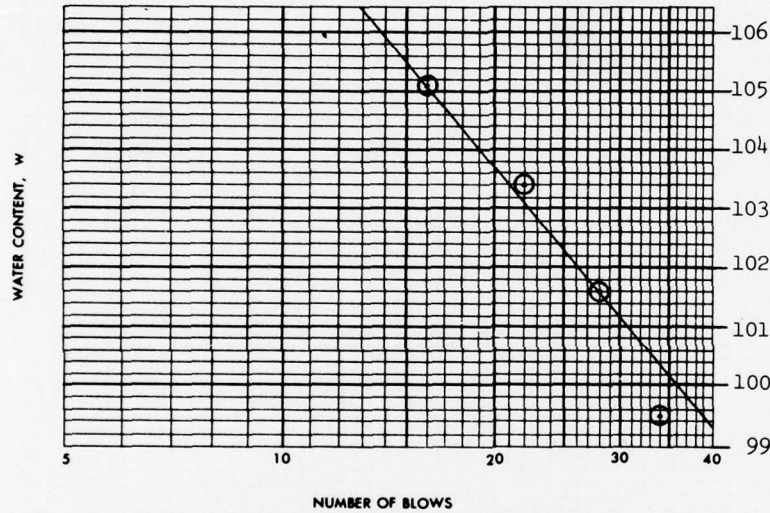
DATE 6-11-75

PROJECT La Pita Hill Study, Panama Canal

BORING NO. ERE-25A

SAMPLE NO. 6-A

LIQUID LIMIT							
RUN NO.		1	2	3	4	5	6
TARE NO.		124A	125A	174A	175		
TARE PLUS WET SOIL		27.64	24.97	30.44	33.43		
TARE PLUS DRY SOIL		19.18	17.88	24.57	26.18		
WEIGHT IN GRAMS	WATER	W _w 8.46	7.09	5.87	7.25		
	TARE	11.13	11.02	18.79	18.81		
WEIGHT IN GRAMS	DRY SOIL	W _s 8.05	6.86	5.78	7.29		
	WATER CONTENT	w 105.1	103.4	101.6	99.5		
NUMBER OF BLOWS		16	22	28	34		



LL 102.0
 PL 22.0
 PI 80.0
 Symbol from plasticity chart
CH

PLASTIC LIMIT						NATURAL WATER CONTENT
RUN NO.		1	2	3	4	
TARE NO.		147A	154A			
TARE PLUS WET SOIL		33.57	32.79			
TARE PLUS DRY SOIL		30.90	30.27			
WEIGHT IN GRAMS	WATER	W _w 2.67	2.52			
	TARE	18.90	18.88			
WEIGHT IN GRAMS	DRY SOIL	W _s 12.00	11.39			
	WATER CONTENT	w 22.3	22.1			
PLASTIC LIMIT		22.2				

REMARKS Clay CH D. Gray

Wash. on No. 40 sieve 5% coarse sand

TECHNICIAN BD

COMPUTED BY BD

CHECKED BY _____

BLENDED

LIQUID AND PLASTIC LIMIT TESTS

DATE 6-11-75

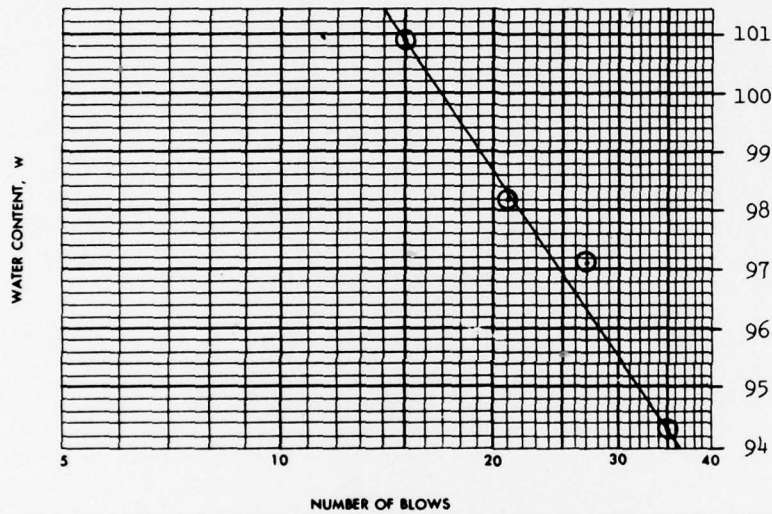
PROJECT La Pita Hill Study, Panama Canal

BORING NO. ERE-25A

SAMPLE NO. 8A

LIQUID LIMIT

RUN NO.		1	2	3	4	5	6
TARE NO.		5A	53A	73A	79A		
WEIGHT IN GRAMS	TARE PLUS WET SOIL	24.40	26.85	25.51	26.61		
	TARE PLUS DRY SOIL	17.70	19.04	18.44	19.04		
	WATER	w_w 6.70	7.81	7.07	7.58		
	TARE	11.06	11.09	11.16	11.00		
	DRY SOIL	w_s 6.64	7.95	7.28	8.04		
WATER CONTENT		w 100.9	98.2	97.1	94.3		
NUMBER OF BLOWS		15	21	27	35		



LL 97.0
 PL 39.0
 PI 58.0
 Symbol from plasticity chart
CH

PLASTIC LIMIT

RUN NO.		1	2	3	4	5	NATURAL WATER CONTENT
TARE NO.		110	131				
WEIGHT IN GRAMS	TARE PLUS WET SOIL	29.19	26.59				
	TARE PLUS DRY SOIL	24.19	22.27				
	WATER	w_w 5.00	4.32				
	TARE	11.40	11.24				
	DRY SOIL	w_s 12.79	11.03				
WATER CONTENT		w 39.1	39.2				
PLASTIC LIMIT		39.2					

REMARKS Clay (CH) D. Cherry Red

Wash on No. 40 sieve 5% coarse sand

TECHNICIAN BD

COMPUTED BY BD

CHECKED BY _____

BLENDED

LIQUID AND PLASTIC LIMIT TESTS

DATE 6-10-75

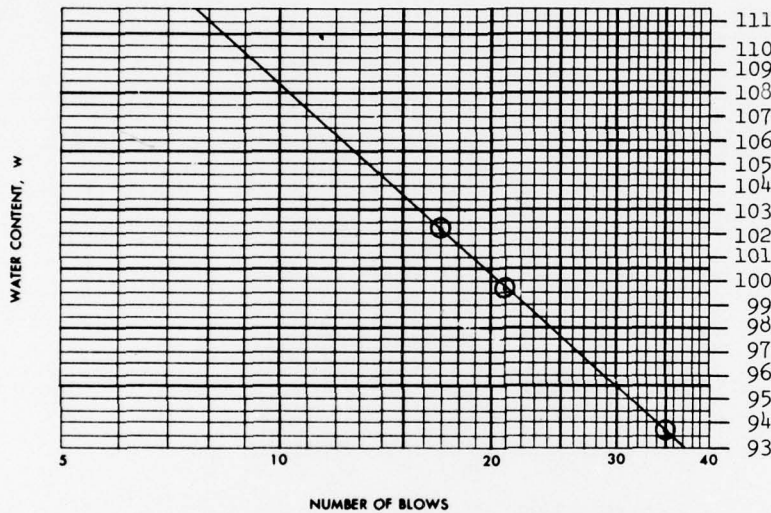
PROJECT La Pita Hill Study Panama Canal

BORING NO. ERE-25A

SAMPLE NO. 11A

LIQUID LIMIT

RUN NO.		1	2	3	4	5	6
TARE NO.		75	101	9			
WEIGHT IN GRAMS	TARE PLUS WET SOIL	22.59	22.76	25.73			
	TARE PLUS DRY SOIL	16.98	16.95	18.60			
	WATER	w_w 5.61	5.81	7.13			
	TARE	11.49	11.12	10.99			
	DRY SOIL	w_s 5.49	5.83	7.61			
WATER CONTENT		w 102.2	99.7	93.7			
NUMBER OF BLOWS		17	21	35			



LL 98.0
 PL 40.0
 PI 58.0
 Symbol from
 plasticity chart
CH

PLASTIC LIMIT

RUN NO.		1	2	3	4	5	NATURAL WATER CONTENT
TARE NO.		150A	157A				
WEIGHT IN GRAMS	TARE PLUS WET SOIL	35.11	35.52				
	TARE PLUS DRY SOIL	30.46	30.78				
	WATER	w_w 4.65	4.74				
	TARE	18.89	18.97				
	DRY SOIL	w_s 11.57	11.81				
WATER CONTENT		w 40.2	40.1				
PLASTIC LIMIT		40.2					

REMARKS Clay CH D. Red

Wash. on No. 40 sieve 6% coarse sand

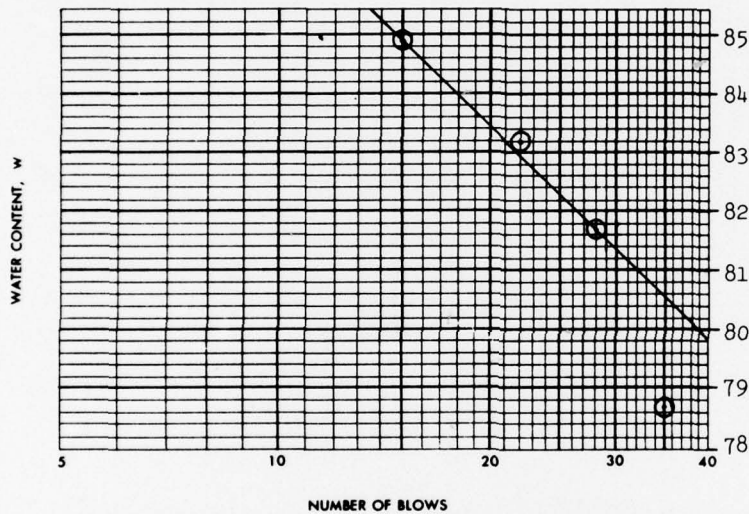
TECHNICIAN BD COMPUTED BY BD CHECKED BY _____

BLENDED

LIQUID AND PLASTIC LIMIT TESTS

PROJECT La Pita Hill Study, Panama Canal DATE _____
 BORING NO. ERE-25A SAMPLE NO. 11B

LIQUID LIMIT						
RUN NO.	1	2	3	4	5	6
TARE NO.	51A	29A	30A	53A		
TARE PLUS WET SOIL	24.87	28.26	27.33	28.10		
TARE PLUS DRY SOIL	18.48	20.50	20.13	20.61		
WEIGHT IN GRAMS WATER	w_w 6.39	7.76	7.20	7.49		
TARE	10.95	11.17	11.32	11.09		
WEIGHT IN GRAMS DRY SOIL	w_s 7.53	9.33	8.81	9.52		
WATER CONTENT	w 84.9	83.2	81.7	78.7		
NUMBER OF BLOWS	15	22	28	35		



LL 82.0
 PL 30.0
 PI 52.0
 Symbol from plasticity chart
CH

PLASTIC LIMIT						NATURAL WATER CONTENT
RUN NO.	1	2	3	4	5	
TARE NO.	130	131				
TARE PLUS WET SOIL	23.25	22.02				
TARE PLUS DRY SOIL	20.51	19.55				
WEIGHT IN GRAMS WATER	w_w 2.74	2.47				
TARE	11.31	11.24				
WEIGHT IN GRAMS DRY SOIL	w_s 9.20	8.31				
WATER CONTENT	w 29.9	29.7				
PLASTIC LIMIT	29.8					

REMARKS Clay (CH) D. Red
Wash on No. 40 sieve
 TECHNICIAN BD COMPUTED BY BD CHECKED BY _____

BLENDED

LIQUID AND PLASTIC LIMIT TESTS

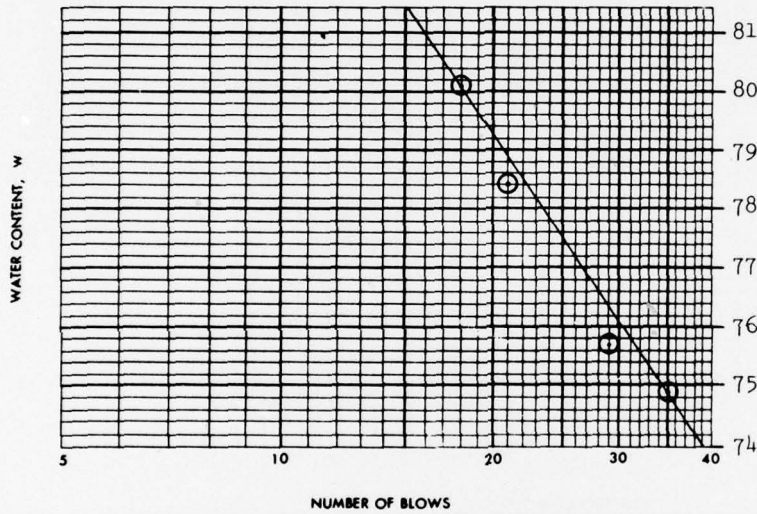
DATE 6-18-75

PROJECT La Pita Hill Study, Panama Canal

BORING NO. ERE-26

SAMPLE NO. 3

		LIQUID LIMIT					
RUN NO.		1	2	3	4	5	6
TARE NO.		66A	73A	78A	89A		
WEIGHT IN GRAMS	TARE PLUS WET SOIL	25.12	26.02	22.58	26.10		
	TARE PLUS DRY SOIL	18.96	19.49	17.62	19.67		
	WATER	w_w 6.16	6.53	4.96	6.43		
	TARE	11.27	11.16	11.07	11.08		
	DRY SOIL	w_s 7.69	8.33	6.55	8.59		
WATER CONTENT		w 80.1	78.4	75.7	74.9		
NUMBER OF BLOWS		18	21	29	35		



LL 78.0

PL 38.0

PI 40.0

Symbol from
plasticity chart

MH

		PLASTIC LIMIT					NATURAL WATER CONTENT
RUN NO.		1	2	3	4	5	
TARE NO.		140A	150A				
WEIGHT IN GRAMS	TARE PLUS WET SOIL	24.07	30.71				
	TARE PLUS DRY SOIL	20.59	27.48				
	WATER	w_w 3.48	3.23				
	TARE	11.31	18.89				
	DRY SOIL	w_s 9.28	8.59				
WATER CONTENT		w 37.5	37.6				
PLASTIC LIMIT		37.6					

REMARKS Silt Clay (MH) (WINE)

Wash on No. 40 sieve

TECHNICIAN BD

COMPUTED BY BD

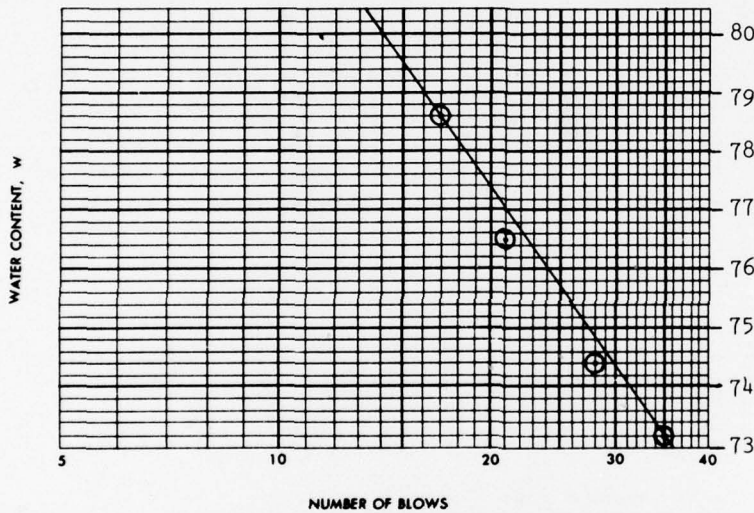
CHECKED BY _____

BLENDED

LIQUID AND PLASTIC LIMIT TESTS

PROJECT La Pita Hill Sudy, Panama Canal DATE 6-18-75
 BORING NO. ERE 27 SAMPLE NO. 6

		LIQUID LIMIT					
RUN NO.		1	2	3	4	5	6
TARE NO.		103A	110A	122A	128A		
WEIGHT IN GRAMS	TARE PLUS WET SOIL	25.22	26.35	25.33	26.05		
	TARE PLUS DRY SOIL	19.06	19.70	19.24	19.62		
	WATER	W _w 6.16	6.65	6.09	6.43		
	TARE	11.22	11.01	11.06	10.84		
	DRY SOIL	W _s 7.84	8.69	8.18	8.78		
WATER CONTENT		W 78.6	76.5	74.4	73.2		
NUMBER OF BLOWS		17	21	28	35		



LL 76.0
 PL 36.0
 PI 40.0
 Symbol from plasticity chart
MH

		PLASTIC LIMIT					NATURAL WATER CONTENT
RUN NO.		1	2	3	4	5	
TARE NO.		166A	168A				
WEIGHT IN GRAMS	TARE PLUS WET SOIL	31.93	32.14				
	TARE PLUS DRY SOIL	28.53	28.62				
	WATER	W _w 3.40	3.52				
	TARE	18.99	18.72				
	DRY SOIL	W _s 9.54	9.90				
WATER CONTENT		W 35.6	35.6				
PLASTIC LIMIT		35.6					

REMARKS Silt Clay (Wine)
Wash. on No. 40 sieve

TECHNICIAN BD COMPUTED BY BD CHECKED BY _____

ENG FORM 3838
 1 JUN 65

(EM 1110-2-1906) (TRANSLUCENT)

GPO 1966 OF-788-790

PLATE III-1

BLENDED

LIQUID AND PLASTIC LIMIT TESTS

PROJECT La Pita Hill Study, Panama Canal

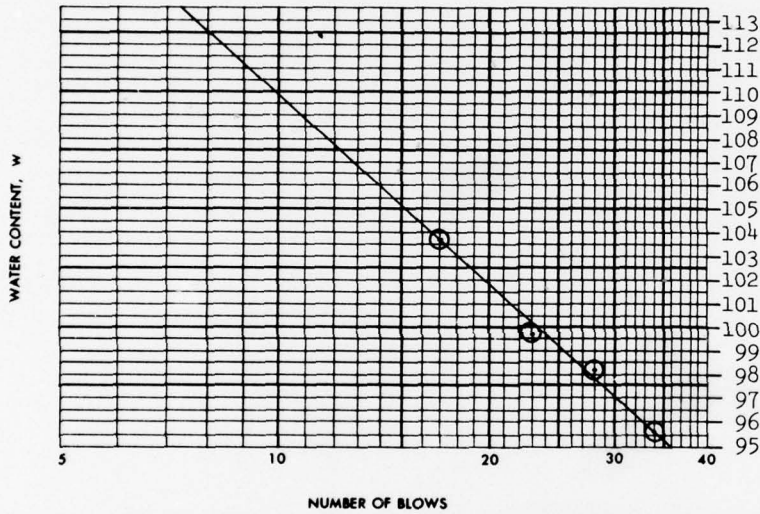
DATE _____

BORING NO. ERE-27

SAMPLE NO. 7

LIQUID LIMIT

RUN NO.		1	2	3	4	5	6
TARE NO.		153	172A	132A	113A		
WEIGHT IN GRAMS	TARE PLUS WET SOIL	20.11	26.62	18.53	19.00		
	TARE PLUS DRY SOIL	15.65	22.74	14.72	15.05		
	WATER	W _w 4.46	3.88	3.81	3.95		
	TARE	11.35	18.85	10.34	10.92		
	DRY SOIL	W _s 4.30	3.89	3.88	4.13		
WATER CONTENT		w 103.7	99.7	98.2	95.6		
NUMBER OF BLOWS		17	23	28	34		



LL 99.0
 PL 57.0
 PI 42.0
 Symbol from
 plasticity chart
MH

PLASTIC LIMIT

RUN NO.		1	2	3	4	5	NATURAL WATER CONTENT
TARE NO.		174A	131				
WEIGHT IN GRAMS	TARE PLUS WET SOIL	28.56	21.05				
	TARE PLUS DRY SOIL	25.03	17.50				
	WATER	W _w 3.53	3.55				
	TARE	18.79	11.29				
	DRY SOIL	W _s 6.24	6.21				
WATER CONTENT		w 56.6	57.2				
PLASTIC LIMIT		Avg. 56.9					

REMARKS M.H. Gray Silt
Wash. on No. 40 sieve

TECHNICIAN EH

COMPUTED BY EH

CHECKED BY _____

BLEND

LIQUID AND PLASTIC LIMIT TESTS

DATE 6-5-75

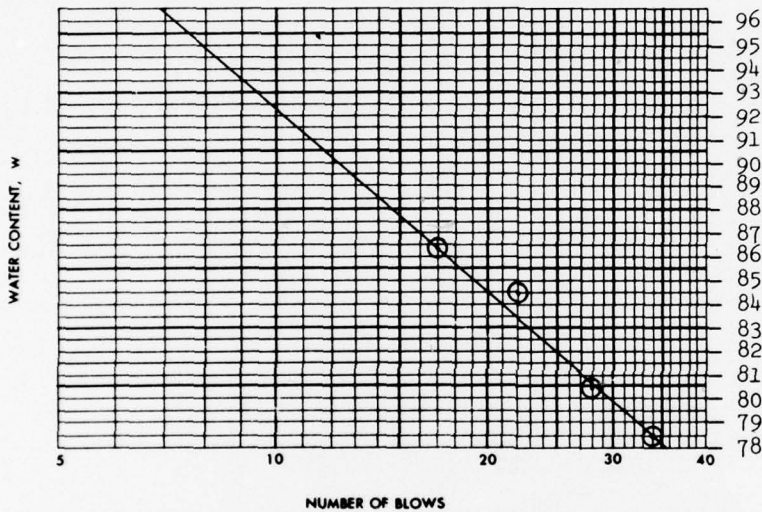
PROJECT La Pita Hill Study, Panama Canal

BORING NO. ERE-25A

SAMPLE NO. 9

LIQUID LIMIT

RUN NO.		1	2	3	4	5	6
TARE NO.		95A	95	79	62A		
WEIGHT IN GRAMS	TARE PLUS WET SOIL	20.90 ⁿ	26.00	21.94	19.75		
	TARE PLUS DRY SOIL	16.42	18.88	17.28	15.84		
	WATER	W _w	4.48	7.12	4.66	3.91	
	TARE	g	11.23	10.45	11.49	10.86	
	DRY SOIL	W _s	5.19	8.43	5.79	4.98	
WATER CONTENT		w	86.3	84.5	80.4	78.5	
NUMBER OF BLOWS			17	22	28	34	



LL 82.0
 PL 34.0
 PI 48.0
 Symbol from
 plasticity chart
CH

PLASTIC LIMIT

PLASTIC LIMIT						NATURAL WATER CONTENT	
RUN NO.		1	2	3	4	5	
TARE NO.		5-A	56				
WEIGHT IN GRAMS	TARE PLUS WET SOIL	23.91	23.16				
	TARE PLUS DRY SOIL	20.65	20.22				
	WATER	W _w	3.26	2.94			
	TARE		11.06	11.49			
	DRY SOIL	W _s	9.59	8.73			
WATER CONTENT		w	34.0	33.8			
PLASTIC LIMIT		Avg. 33.8					

REMARKS Clay CH Brown

Wash, on No. 40 sieve

TECHNICIAN EH

COMPUTED BY EH

CHECKED BY _____

BLENDED

LIQUID AND PLASTIC LIMIT TESTS

DATE 6-23-75

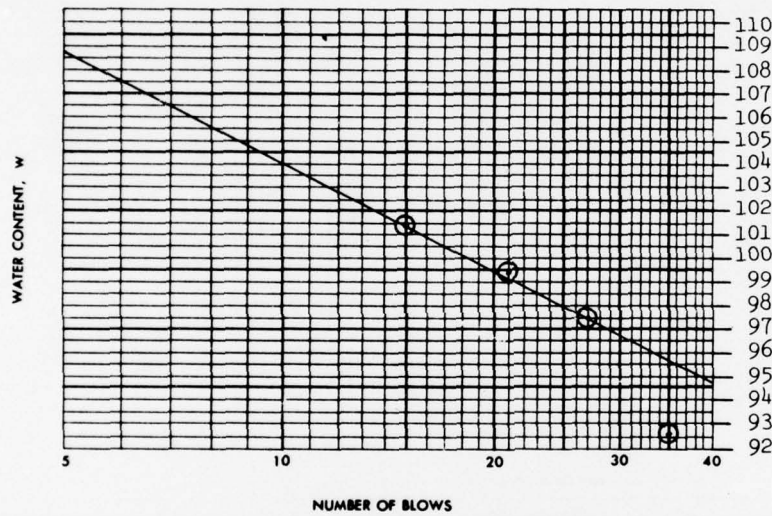
PROJECT La Pita Hill Study, Panama Canal

BORING NO. ERE -27

SAMPLE NO. 4

LIQUID LIMIT

RUN NO.		1	2	3	4	5	6
TARE NO.		52A	66A	97A	90A		
WEIGHT IN GRAMS	TARE PLUS WET SOIL	25.07	25.27	25.94	27.79		
	TARE PLUS DRY SOIL	18.04	18.29	18.63	19.65		
	WATER w_w	7.03	6.98	7.31	8.14		
	TARE	11.11	11.27	11.13	10.86		
	DRY SOIL w_s	6.93	7.02	7.50	8.79		
WATER CONTENT w	101.4	99.4	97.5	92.6			
NUMBER OF BLOWS		15	21	27	35		



PLASTIC LIMIT

RUN NO.		1	2	3	4	5	NATURAL WATER CONTENT
TARE NO.		168A	169A	101	133		
WEIGHT IN GRAMS	TARE PLUS WET SOIL	28.26	29.40	19.10	19.34		
	TARE PLUS DRY SOIL	25.38	26.23	16.47	16.76		
	WATER w_w	2.88	3.17	2.63	2.58		
	TARE	18.72	18.88	11.12	11.48		
	DRY SOIL w_s	6.66	7.35	5.35	5.28		
WATER CONTENT w	43.2	43.1	49.2	48.9			
PLASTIC LIMIT		43.2		49.1			

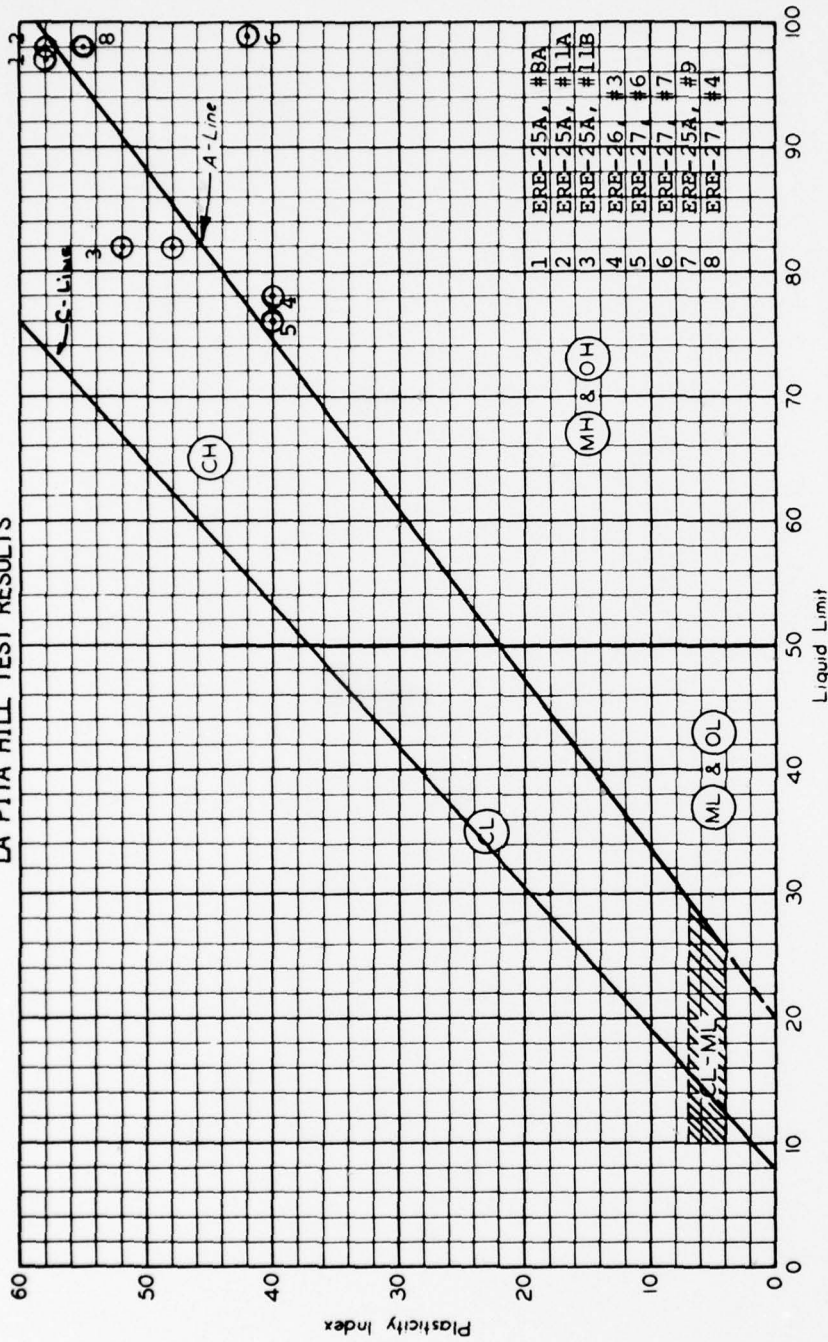
REMARKS Silt Fine Sand
Wash on No. 40 sieve

TECHNICIAN BD

COMPUTED BY BD

CHECKED BY _____

LA PITA HILL TEST RESULTS



PLASTICITY CHART

R-011953-C

APPENDIX C: EXAMPLES OF COMPUTER RUNS FOR CRITICAL SOLUTIONS

EXAMPLE NO. 1

Semiempirical Stability Analysis Section
Prior to Canal Deepening

<u>Strength</u>	<u>Pore Pressure</u>	<u>Acceleration</u>
$c' = 0, \phi' = 20 \text{ deg}$	$r_u = 0.23$	0.0
$c' = 600 \text{ psf}, \phi' = 20 \text{ deg}$	$r_u = 0.23$	0.0
$c' = 0, \phi' = 20 \text{ deg}$	$r_u = 0.32$	0.0
$c' = 600 \text{ psf}, \phi' = 20 \text{ deg}$	$r_u = 0.32$	0.0

MORGENTHAU AND PRICE METHOD OF SLOPE STABILITY ANALYSIS - SON BANKS
 LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NUMBER OF POINTS = 48

NUMBER OF LINES = 48

NUMBER OF MATERIALS = 1

YDM = 185.00

YM = 650.00

YDP = 415.00

POINT DESCRIPTION

POINT NO.	NO. LINES	X-COORDINATE	Y-COORDINATE
1	1	0	150.00
2	2	240.00	150.00
3	3	480.00	150.00
4	4	720.00	150.00
5	5	960.00	150.00
6	6	1200.00	150.00
7	7	1440.00	150.00
8	8	1680.00	150.00
9	9	1920.00	150.00
10	10	2160.00	150.00
11	11	2400.00	150.00
12	12	2640.00	150.00
13	13	2880.00	150.00
14	14	3120.00	150.00
15	15	3360.00	150.00
16	16	3600.00	150.00
17	17	3840.00	150.00
18	18	4080.00	150.00
19	19	4320.00	150.00
20	20	4560.00	150.00
21	21	4800.00	150.00
22	22	5040.00	150.00
23	23	5280.00	150.00
24	24	5520.00	150.00
25	25	5760.00	150.00
26	26	6000.00	150.00
27	27	6240.00	150.00
28	28	6480.00	150.00
29	29	6720.00	150.00
30	30	6960.00	150.00
31	31	7200.00	150.00
32	32	7440.00	150.00
33	33	7680.00	150.00
34	34	7920.00	150.00
35	35	8160.00	150.00
36	36	8400.00	150.00
37	37	8640.00	150.00
38	38	8880.00	150.00
39	39	9120.00	150.00
40	40	9360.00	150.00
41	41	9600.00	150.00
42	42	9840.00	150.00
43	43	10080.00	150.00
44	44	1115.00	351.20
45	45	1200.00	415.00
46	46	0	600.00
47	47	625.00	600.00
48	48	1500.00	600.00

LINE DESCRIPTION

LINE NO.	POINT 1	POINT 2	MATERIAL
1	1	2	1
2	2	3	1
3	3	4	1
4	4	5	1
5	5	6	1
6	6	7	1
7	7	8	1
8	8	9	1
9	9	10	1
10	10	11	1
11	11	12	1
12	12	13	1
13	13	14	1
14	14	15	1
15	15	16	1
16	16	17	1
17	17	18	1
18	18	19	1
19	19	20	1
20	20	21	1
21	21	22	1
22	22	23	1
23	23	24	1
24	24	25	1
25	25	26	1
26	26	27	1
27	27	28	1
28	28	29	1
29	29	30	1
30	30	31	1
31	31	32	1
32	32	33	1
33	33	34	1
34	34	35	1
35	35	36	1
36	36	37	1
37	37	38	1
38	39	40	0
39	40	41	0
40	41	42	0
41	42	43	0
42	43	44	0
43	44	31	0
44	31	45	0
45	4	40	1
46	40	47	1
47	46	47	1
48	47	48	1

BxA	0.	240.000000	290.000000	466.500000	658.000000	688.000000	720.000000	760.000000
Bx	790.000000	829.000000	850.000000	890.000000	905.000000	930.000000	950.000000	970.000000
BxA	490.000000	1005.000000	1070.000000	1100.000000	1125.000000	1140.000000	1158.000000	1165.000000
Bx	1170.000000	1185.000000	1190.000000	1199.000000	1202.000000	1204.000000	1205.000000	1211.000000
BxA	1271.000000	1201.000000	1240.000000	1253.000000	1360.000000	1500.000000	0.	520.000000
Bx	870.000000	893.000000	1007.000000	1119.000000	1500.000000	0.	820.000000	1500.000000
BxA	482.750000	674.008871	650.000000					
Bx	0.	240.000000	290.000000	466.500000	658.000000	688.000000	720.000000	760.000000
BxR	674.068871	870.000000	880.000000	720.000000	766.000000	795.000000	820.000000	830.000000
Bx	850.000000	890.000000	905.000000	930.000000	950.000000	970.000000	990.000000	1007.000000
BxR	1035.000000	1070.000000	1100.000000	1119.000000	1125.000000	1140.000000	1158.000000	1165.000000
Bx	1170.000000	1185.000000	1190.000000	1199.000000	1202.000000	1204.000000	1205.000000	1211.000000
BxR	1271.000000	1201.000000	1240.000000	1253.000000	1360.000000	1500.000000		
x	120.000000							
Bx	120.000000	1						
Bx	180.000000	45						
Bx	190.885714	50						
x	205.000000							
Bx	105.000000	4						
Bx	180.000000	49						
Bx	211.247420	50						
x	170.250000							
Bx	102.500000	5						
Bx	180.000000	49						
Bx	220.464762	50						
x	474.162500							
Bx	105.210141	4						
Bx	170.000000	45						
Bx	180.000000	49						
Bx	230.010477	50						
x	504.875000							
Bx	105.975045	4						
Bx	180.000000	49						
Bx	211.000000	45						
Bx	234.907419	50						
x	587.500000							
Bx	104.159265	4						
Bx	180.000000	49						
Bx	240.310457	50						
Bx	311.629936	40						
x	654.000000							
Bx	109.895560	4						
Bx	247.960783	50						
Bx	391.036186	40						
Bx	415.000000	50						
x	666.734439							
Bx	170.410330	5						
Bx	249.983310	50						
Bx	405.406250	40						
Bx	415.000000	50						
x	674.034439							
Bx	175.410330	5						
Bx	247.832991	50						
Bx	410.000000	50						
Bx	417.547046	40						
x	683.000000							
Bx	177.500000	7						
Bx	250.864515	40						
Bx	415.000000	50						
Bx	420.664474	40						
x	704.000000							

BY = 150,000000	6
BY = 254,495483	40
BY = 1,000000	0
BY = 453,740135	26
X = 743,000000	
BY = 105,500000	7
BY = 261,238708	40
BY = 412,000000	50
BY = 497,309212	46
X = 780,500000	
BY = 145,000000	8
BY = 267,722580	40
BY = 412,000000	50
BY = 544,087173	46
X = 812,000000	
BY = 205,000000	9
BY = 273,169033	40
BY = 412,000000	50
BY = 574,700661	46
X = 831,000000	
BY = 210,952381	10
BY = 275,454193	40
BY = 412,000000	50
X = 841,500000	
BY = 215,952381	10
BY = 278,812645	41
BY = 412,000000	50
X = 870,000000	
BY = 225,000000	11
BY = 282,560921	41
BY = 412,000000	50
X = 897,500000	
BY = 234,999999	12
BY = 292,072414	41
BY = 412,000000	50
X = 919,000000	
BY = 245,000000	13
BY = 297,163219	41
BY = 412,000000	50
X = 944,000000	
BY = 255,000000	14
BY = 303,082760	41
BY = 412,000000	50
X = 965,000000	
BY = 265,000000	15
BY = 308,055172	41
BY = 412,000000	50
X = 985,500000	
BY = 275,000000	16
BY = 312,909195	41
BY = 412,000000	50
X = 1001,500000	
BY = 281,410255	17
BY = 316,697700	41
BY = 412,000000	50
X = 1021,000000	
BY = 284,410255	17
BY = 322,150002	42
BY = 412,000000	50
X = 1053,500000	
BY = 295,000000	18
BY = 331,783028	42

BY = 412,000000	50
X = 1086,000000	
BY = 305,000000	19
BY = 341,417458	42
BY = 412,000000	50
X = 1109,500000	
BY = 313,799999	20
BY = 348,383930	42
BY = 412,000000	50
X = 1122,000000	
BY = 318,799999	20
BY = 352,425583	43
BY = 412,000000	50
X = 1143,500000	
BY = 325,000000	21
BY = 341,956074	43
BY = 412,000000	50
X = 1150,000000	
BY = 325,000000	22
BY = 375,197478	43
BY = 412,000000	50
X = 1163,500000	
BY = 344,999999	23
BY = 384,212791	43
BY = 412,000000	50
X = 1172,000000	
BY = 324,999999	24
BY = 390,518404	43
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X = 1209,000000	
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BY = 417,499996	43
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BY = 415,000000	30
BY = 442,000000	34
X = 1249,500000	
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BY = 415,000000	30
BY = 460,000000	36
X = 1430,000000	
BY = 415,000000	30
BY = 462,500000	37

LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NO. OF POINTS TO DESCRIBE FAILURE SURFACES	4
NO. OF FAILURE SURFACE DESCRIPTION CARDS	1
MAX. NO. OF COLUMNS TO DESCRIBE FAIL. SURF.	4
NO. OF BLOCKS OF SUBSTITUTE SOIL TYPES	3
NO. OF ALTERNATE F(x) DISTRIBUTIONS	0

FAILURE SURFACE POINTS

POINT NO.	X-COORDINATE	Y-COORDINATE	F(x)
1	0.00	682.00	423.00
	1.00	1.35	1221.00
	460.00	1.97	11.00
	1253.20	455.80	1.00

FAILURE SURFACE DESCRIPTION

SURFACE NO.	POINTS TO DESCRIBE THE SURFACE
1	1 2 3 4

SOIL DATA

NO	DET	SAT	COH	FI	W	EQ
1	132.0	132.0	0.	0.564	0.240	0.

SURFACE NUMBER 1 1 (COEFFICIENT)

SURFACE DEFINED BY	POINT	X	Y	F(X)
1- 1		467.00	164.90	1.00
2- 2		693.00	423.00	1.00
3- 3		1221.00	460.00	1.00
4- 4		1251.40	459.90	1.00

INS.IT U 0
INS.IT U 2

X-COORD.	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERY F	SMALL F	PORE PRES
482.73	7323.	7323.	3019.	3.85	0.191	0.53	1.00
483.36	7839.	7889.	3407.	3.96	0.191	0.53	1.00
525.00	96333.	96369.	60049.	17.35	0.191	0.53	1.00
526.89	102724.	102724.	71408.	17.69	0.191	0.53	1.00
650.00	95174.	95196.	65246.	22.94	0.191	0.53	1.00
659.70	103689.	103689.	71642.	31.96	0.191	0.53	1.00
674.07	123822.	123822.	84369.	37.23	0.164	0.53	1.00
675.32	125452.	125452.	85783.	37.63	0.165	0.53	1.00
678.00	129943.	129943.	88389.	41.47	0.167	0.53	1.00
682.00	134233.	134233.	92013.	41.72	0.170	0.53	1.00
683.00	131901.	131901.	90057.	37.99	0.164	0.53	1.00
720.00	112732.	112732.	77262.	27.03	0.111	0.53	1.00
766.00	90891.	90891.	62294.	11.75	0.045	0.53	1.00
795.00	81227.	81227.	55679.	1.63	0.016	0.53	1.00
823.00	69847.	69847.	47863.	-4.95	0.031	0.53	1.00
833.00	69013.	69013.	46013.	-7.36	0.033	0.53	1.00
850.00	64533.	64533.	44227.	-9.27	0.043	0.53	1.00
893.00	49633.	49633.	34169.	-24.47	0.128	0.53	1.00
909.00	48895.	48895.	33099.	-23.13	0.117	0.53	1.00
933.00	41419.	41419.	28349.	-31.96	0.168	0.53	1.00
955.00	37247.	37247.	25283.	-37.43	0.195	0.53	1.00
975.00	34221.	34221.	23454.	-37.15	0.215	0.53	1.00
994.00	31874.	31874.	21716.	-41.46	0.246	0.53	1.00
1007.00	27755.	27755.	19231.	-47.97	0.295	0.53	1.00
1035.00	17954.	17954.	13765.	-71.07	0.465	0.53	1.00
1072.00	10345.	10345.	7893.	-131.89	0.927	0.53	1.00
1107.00	47337.	47337.	32444.	-26.17	-1.845	0.53	1.00
1113.00	15203.	15203.	14669.	-69.13	-0.958	0.53	1.00
1125.00	5415.	5445.	3732.	-180.57	-13.321	0.53	1.00
1142.00	-6131.	-6135.	-4237.	217.22	9.389	0.53	1.00
1154.00	-13742.	-13792.	-9453.	351.73	3.165	0.53	1.00
1163.00	-5912.	-5942.	-4073.	437.38	4.395	0.53	1.00
1175.00	14865.	14869.	11189.	84.68	0.315	0.53	1.00
1183.00	28735.	28789.	17361.	-3.69	0.342	0.53	1.00
1192.00	3903.	3964.	25776.	17.70	0.252	0.53	1.00
1193.00	52114.	52104.	37111.	27.02	0.394	0.53	1.00
1202.00	70215.	70249.	41144.	27.40	0.466	0.53	1.00
1204.00	87028.	87024.	52647.	25.18	0.335	0.53	1.00
1205.00	94255.	94266.	64608.	25.36	0.377	0.53	1.00
1211.00	90759.	90767.	62211.	24.09	0.386	0.53	1.00
1220.00	82514.	82514.	55623.	13.93	0.611	0.53	1.00
1221.00	80925.	80929.	54664.	13.46	0.515	0.53	1.00
1231.00	60723.	60723.	41518.	13.46	0.575	0.53	1.00
1244.00	28879.	28879.	17793.	5.44	0.553	0.53	1.00
1252.88	-3.	-3.	-0.	1.	0.	0.	1.00

F = 1.246 LAMDA = 0.635(5 7 0)

SOIL DATA

NO	DET	SAT	COH	FI	RJ	EQ
1	132.0	132.0	500.0	0.361	0.280	0.

SURFACE NUMBER 1 1 (SPECIFIED)

SURFACE DEFINED BY	POINT	X	Y	F(X)
1-	1	466,50	164,80	1,00
2-	2	482,80	423,80	1,00
3-	3	1227,00	460,80	1,00
4-	4	1253,40	459,80	1,00

INS:IT U 0
INS:IT U 2

X-COORD	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PJRE PRES
482.79	-110.2	-1162.	-770.	11.11	0.695	-14.13	1.00
483.36	-90.4	-904.	-599.	17.11	0.875	-19.03	1.00
525.00	68927.	68927.	45712.	9.52	0.125	1.45	1.00
526.89	74521.	74551.	47442.	4.90	0.126	1.41	1.00
657.00	39673.	396769.	39473.	32.13	0.150	0.77	1.00
658.00	981329.	981329.	653817.	31.61	0.150	0.76	1.00
674.07	1182386.	1182386.	784158.	29.15	0.164	0.73	1.00
675.32	1198629.	1198629.	794930.	39.56	0.165	0.73	1.00
679.00	1233569.	1233569.	818101.	40.44	0.167	0.73	1.00
682.00	1286445.	1286446.	853171.	41.74	0.170	0.72	1.00
688.00	1265439.	1265409.	839219.	41.16	0.164	0.72	1.00
720.00	1047231.	1047289.	721089.	27.87	0.114	0.75	1.00
766.00	886623.	886628.	581012.	12.95	0.054	0.79	1.00
795.00	799475.	799499.	531225.	5.90	0.030	0.81	1.00
829.00	646223.	646228.	451261.	2.18	0.010	0.84	1.00
833.00	678931.	678931.	450267.	2.44	0.011	0.84	1.00
850.00	648252.	648232.	423907.	3.69	0.017	0.85	1.00
890.00	597704.	597764.	339075.	-15.13	0.087	0.92	1.00
903.00	504677.	504677.	334702.	-14.62	0.074	0.90	1.00
931.00	435052.	435052.	283526.	-21.45	0.113	0.94	1.00
959.00	398403.	398403.	262899.	-21.70	0.130	0.98	1.00
975.00	368176.	368176.	244174.	-24.58	0.142	0.97	1.00
995.00	336452.	336462.	223144.	-25.80	0.163	0.99	1.00
1007.00	308124.	308124.	203021.	-32.49	0.200	1.03	1.00
1035.00	230319.	230319.	152747.	-31.18	0.319	1.17	1.00
1072.00	136203.	136203.	91330.	-67.91	0.584	1.54	1.00
1100.00	80917.	80907.	53392.	-127.42	0.913	2.14	1.00
1119.00	48131.	48131.	31921.	-184.46	1.362	3.09	1.00
1125.00	38124.	38124.	23294.	-217.24	1.643	3.72	1.00
1142.00	25274.	25274.	15762.	-241.02	1.934	5.01	1.00
1154.00	15935.	15985.	10601.	-281.01	2.186	7.10	1.00
1169.00	22032.	22032.	14611.	-182.18	0.960	4.92	1.00
1175.00	41255.	41255.	27361.	-17.37	0.190	2.67	1.00
1183.00	53139.	53180.	35269.	7.34	0.373	2.04	1.00
1192.00	61953.	61989.	41513.	17.94	0.230	1.71	1.00
1199.00	71941.	71940.	47711.	23.99	0.335	1.41	1.00
1202.00	88734.	88734.	53848.	24.12	0.411	1.15	1.00
1204.00	104439.	104439.	62262.	23.71	0.485	0.97	1.00
1205.00	111141.	111141.	73709.	23.21	0.328	0.91	1.00
1211.00	105874.	105874.	70017.	21.23	0.539	0.89	1.00
1220.00	94277.	94277.	62538.	17.56	0.566	0.85	1.00
1221.00	92254.	92254.	61101.	17.13	0.571	0.84	1.00
1231.00	48919.	48919.	49436.	13.49	0.626	0.81	1.00
1244.00	31114.	31114.	27639.	3.14	0.522	0.84	1.00
1252.96	0.	0.	0.	0.	0.	0.	1.00

SOIL DATA

NO	WT	SAT	COH	FI	RJ	EQ
1	137.0	137.0	0.	0.364	0.320	0.

SURFACE NUMBER 1 1 (SPECIFIED)					
SURFACE DEFINED BY# POINT X Y F(X)					
1- 1		465.50	164.80		1.00
2- 2		682.80	425.80		1.00
3- 3		1221.80	460.80		1.00
4- 4		1293.20	452.80		1.00

ISIT 1-1	
NOT CONVERGING 0 1	

X-COORD.	E	X=FORCE	Y=YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
482.79	8555.	8565.	2570.	4.94	0.262	1.21	1.00
483.34	9227.	9227.	2768.	5.13	0.262	1.21	1.00
525.00	112712.	112712.	33814.	17.92	0.262	1.21	1.00
526.89	120122.	120122.	30045.	14.50	0.262	1.21	1.00
650.00	1113424.	1113424.	334027.	36.31	0.262	1.21	1.00
658.00	1212719.	1212719.	363815.	93.77	0.262	1.21	1.00
674.07	1458934.	1458984.	437695.	65.88	0.276	1.21	1.00
675.32	147885.	147885.	446655.	64.43	0.277	1.21	1.00
678.00	1521562.	1521562.	454470.	67.29	0.279	1.21	1.00
682.00	1586174.	1586194.	475898.	67.33	0.282	1.21	1.00
688.00	1581917.	1581947.	474584.	62.61	0.285	1.21	1.00
720.00	1474732.	1474732.	442419.	63.75	0.281	1.21	1.00
766.00	1389777.	1389797.	414939.	71.16	0.294	1.21	1.00
795.00	1384034.	1384034.	412210.	72.34	0.313	1.21	1.00
829.00	1399535.	1399682.	427905.	73.88	0.331	1.21	1.00
833.00	1364271.	1364251.	409275.	74.20	0.335	1.21	1.00
850.00	1383234.	1383284.	414985.	75.29	0.351	1.21	1.00
891.00	1339713.	1339713.	401913.	73.51	0.364	1.21	1.00
905.00	1381721.	1381721.	414516.	74.23	0.384	1.21	1.00
933.00	1380155.	1380165.	414090.	75.75	0.398	1.21	1.00
955.00	1397149.	1397149.	412144.	73.12	0.413	1.21	1.00
975.00	1419223.	1419223.	425767.	74.16	0.428	1.21	1.00
996.00	1437435.	1437435.	431230.	72.68	0.442	1.21	1.00
1007.00	1428668.	1428668.	425600.	71.72	0.441	1.21	1.00
1035.00	1466041.	1466051.	422092.	67.12	0.439	1.21	1.00
1072.00	1342724.	1342754.	414826.	65.38	0.436	1.21	1.00
1100.00	1341547.	1341587.	414476.	62.28	0.439	1.21	1.00
1119.00	1385974.	1385974.	415792.	57.98	0.443	1.21	1.00
1125.00	1397319.	1397319.	415195.	57.21	0.444	1.21	1.00
1142.00	1409773.	1409773.	422933.	54.92	0.457	1.21	1.00
1153.00	1432683.	1432683.	422805.	51.51	0.471	1.21	1.00
1167.00	1443024.	1443054.	433916.	37.69	0.495	1.21	1.00
1175.00	1499255.	1499265.	447780.	51.54	0.532	1.21	1.00
1183.00	1529038.	1529038.	453711.	48.90	0.571	1.21	1.00
1192.00	1554379.	1554399.	466319.	47.98	0.614	1.21	1.00
1199.00	1579271.	1579291.	473787.	45.35	0.676	1.21	1.00
1202.00	1605119.	1605119.	481535.	43.46	0.774	1.21	1.00
1204.00	1627823.	1627850.	433355.	44.75	0.915	1.21	1.00
1205.00	1637623.	1637653.	491296.	44.40	1.110	1.21	1.00
1211.00	1637944.	1637944.	491383.	43.05	1.093	1.21	1.00
1220.00	1635911.	1635981.	491794.	41.02	1.323	1.21	1.00
1221.00	1635102.	1635162.	491548.	41.73	1.358	1.21	1.00
1231.00	1623817.	1623817.	487142.	37.86	1.599	1.21	1.00
1246.00	1603131.	1603131.	483939.	31.63	3.417	1.21	1.00
1257.00	1582443.	1582443.	471731.	1.	2.	0.	1.00

F = 1.200 LAMDA = 0.300(0 20 0)

SOIL DATA

NO	WET	SAT	COH	FI	qj	EQ
1	132.0	132.0	900.0	0.364	0.520	0.

SURFACE NUMBER		1, 1 (SPECIFIED)	
SURFACE DEFINED BY:			
POINT	X	Y	F(X)
1-	469.50	164.00	1.00
2-	482.20	423.00	1.00
3-	1220.00	460.00	1.00
4-	1253.20	459.00	1.00

INS.IT	U	0
INS.IT	U	2

X-COORD.	E	X-FORCE	Y-VT	Y-VT/Y-Z	VERT F	SMALL F	PORE PRES
482.79	-1937.	-1937.	-2685.	=3.34	=0.177	-3.95	1.00
483.36	-1815.	-1815.	-2515.	=1.76	=0.192	-4.40	1.00
525.00	405.3.	4050.	5099.	=1.24	=0.818	0.99	1.00
526.89	44021.	44021.	60968.	=1.36	=0.819	0.96	1.00
650.00	56937.	56937.	78954.	=7.83	=0.836	0.43	1.00
659.00	62372.	62372.	86384.	=9.23	=0.037	0.42	1.00
674.07	76177.	76177.	105503.	=2.14	=0.909	0.40	1.00
675.32	77292.	77292.	107048.	=1.74	=0.807	0.40	1.00
679.00	79691.	79691.	110370.	=0.91	=0.804	0.39	1.00
682.00	83323.	83323.	115409.	0.25	0.001	0.39	1.00
689.00	81696.	81696.	113147.	=4.87	=0.020	0.39	1.00
720.00	61782.	61782.	85566.	=51.16	=0.209	0.43	1.00
766.00	42412.	42412.	59744.	=122.06	=0.511	0.51	1.00
795.00	36659.	36659.	57646.	=149.93	=0.650	0.54	1.00
829.00	27621.	27621.	38339.	=211.30	=0.943	0.61	1.00
833.00	27624.	27624.	38277.	=203.66	=0.942	0.61	1.00
850.00	27358.	27358.	37898.	=202.79	=0.945	0.60	1.00
890.00	19113.	19113.	20931.	=377.36	=1.820	0.86	1.00
905.00	18331.	18331.	25397.	=281.57	=1.415	0.73	1.00
933.00	13832.	13832.	19157.	=355.64	=1.870	0.86	1.00
955.00	12795.	12796.	17229.	=355.34	=1.960	0.88	1.00
975.00	12817.	12816.	17751.	=329.01	=1.900	0.85	1.00
996.00	12261.	12261.	16781.	=321.95	=1.956	0.84	1.00
1007.00	95625.	95626.	13243.	=412.27	=2.537	1.00	1.00
1035.00	28072.	28072.	30879.	=1344.12	=8.546	2.69	1.00
1072.00	-53815.	-53816.	-74533.	594.63	3.969	-0.94	1.00
1100.00	-92079.	-92079.	-127527.	269.43	1.894	-0.40	1.00
1119.00	-110525.	-110526.	-153076.	172.17	1.271	-0.27	1.00
1125.00	-11022.	-11022.	-161061.	147.87	1.108	-0.23	1.00
1142.00	-107379.	-107399.	-143745.	103.33	0.829	-0.24	1.00
1159.00	-96023.	-96023.	-132989.	67.78	0.525	-0.26	1.00
1169.00	-68274.	-68294.	-94585.	29.02	0.273	-0.41	1.00
1175.00	-26731.	-26781.	-37091.	=23.38	=0.241	-1.30	1.00
1183.00	4304.	4304.	59614.	593.99	6.849	0.07	1.00
1192.00	28833.	28853.	39960.	133.77	1.713	1.44	1.00
1199.00	55123.	55123.	75344.	84.04	1.226	0.80	1.00
1202.00	86675.	86675.	120043.	67.31	1.026	0.56	1.00
1204.00	115132.	115132.	159455.	47.54	0.993	0.45	1.00
1205.00	127318.	127318.	176322.	44.47	1.011	0.41	1.00
1211.00	122674.	122694.	16928.	33.74	0.984	0.40	1.00
1220.00	112711.	112701.	156088.	27.79	0.961	0.35	1.00
1221.00	110471.	110471.	153000.	29.91	0.964	0.38	1.00
1231.00	83473.	83478.	110615.	27.37	1.022	0.37	1.00
1246.00	37835.	37866.	52443.	5.93	0.704	0.38	1.00
1252.88	0.	0.	0.	0.	0.	0.	1.00

F =	1.301	L	AMUDA =	1.395(8	10	0)
STOP AT LINE							

EXAMPLE NO. 2

Semiempirical Stability Analysis Section
After Canal Deepening

<u>Strength</u>	<u>Pore Pressure</u>	<u>Acceleration</u>
$c' = 0, \phi' = 20 \text{ deg}$	$r_u = 0.23$	0.0
$c' = 600 \text{ psf}, \phi' = 20 \text{ deg}$	$r_u = 0.23$	0.0
$c' = 0, \phi' = 20 \text{ deg}$	$r_u = 0.32$	0.0
$c' = 600 \text{ psf}, \phi' = 20 \text{ deg}$	$r_u = 0.32$	0.0

EXAMPLE NO. 2

Semiempirical Stability Analysis Section
After Canal Deepening

<u>Strength</u>	<u>Pore Pressure</u>	<u>Acceleration</u>
$c' = 0, \phi' = 20 \text{ deg}$	$r_u = 0.23$	0.0
$c' = 600 \text{ psf}, \phi' = 20 \text{ deg}$	$r_u = 0.23$	0.0
$c' = 0, \phi' = 20 \text{ deg}$	$r_u = 0.32$	0.0
$c' = 600 \text{ psf}, \phi' = 20 \text{ deg}$	$r_u = 0.32$	0.0

MARGENSTERN AND PRICE METHOD OF SLOPE STABILITY ANALYSIS - DON BANKS
 LI PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NUMBER OF POINTS	=	48
NUMBER OF LINES	=	48
NUMBER OF MATERIALS	=	1
YDM	=	185.00
XM	=	650.00
YDP	=	415.00

POINT DESCRIPTION			
POINT NO.	NO. LINES	X-COORDINATE	Y-COORDINATE
1	1	0.	150.00
2	2	240.00	150.00
3	2	290.00	160.00
4	3	466.50	165.00
5	2	658.00	170.00
6	2	688.00	179.00
7	2	720.00	181.00
8	2	766.00	190.00
9	2	795.00	200.00
10	2	829.00	210.00
11	2	850.00	220.00
12	2	890.00	230.00
13	2	905.00	240.00
14	2	933.00	250.00
15	2	959.00	260.00
16	2	975.00	270.00
17	2	996.00	280.00
18	2	1035.00	290.00
19	2	1072.00	300.00
20	2	1100.00	310.00
21	2	1125.00	320.00
22	2	1142.00	330.00
23	2	1158.00	340.00
24	2	1169.00	350.00
25	2	1175.00	360.00
26	2	1183.00	370.00
27	2	1192.00	380.00
28	2	1199.00	390.00
29	2	1202.00	400.00
30	2	1204.00	410.00
31	4	1205.00	415.00
32	2	1211.00	420.00
33	2	1221.00	430.00
34	2	1231.00	440.00
35	2	1246.00	450.00
36	2	1253.00	460.00
37	2	1360.00	460.00
38	1	1500.00	465.00
39	1	0.	185.00
40	4	525.00	237.00
41	2	478.00	250.00
42	2	433.00	276.80
43	2	1007.00	318.00
44	2	1119.00	351.20
45	1	1500.00	415.00
46	1	0.	600.00
47	3	829.00	600.00
48	1	1500.00	600.00

LINE DESCRIPTION			
LINE NO.	POINT 1	POINT 2	MATERIAL
1	1	2	1
2	2	3	1
3	3	4	1
4	4	5	1
5	5	6	1
6	6	7	1
7	7	8	1
8	8	9	1
9	9	10	1
10	10	11	1
11	11	12	1
12	12	13	1
13	13	14	1
14	14	15	1
15	15	16	1
16	16	17	1
17	17	18	1
18	18	19	1
19	19	20	1
20	20	21	1
21	21	22	1
22	22	23	1
23	23	24	1
24	24	25	1
25	25	26	1
26	26	27	1
27	27	28	1
28	28	29	1
29	29	30	1
30	30	31	1
31	31	32	1
32	32	33	1
33	33	34	1
34	34	35	1
35	35	36	1
36	36	37	1
37	37	38	0
38	39	40	0
39	40	41	0
40	41	42	0
41	42	43	0
42	43	44	0
43	44	31	0
44	31	45	0
45	4	40	0
46	40	47	1
47	46	47	1
48	47	48	1

BY = 180.000000	6
BV = 254.495483	40
BV = 415.000000	50
BV = 450.740135	46
X = 743.000000	
BY = 185.500000	7
BV = 261.238708	40
BV = 415.000000	50
BV = 497.309212	46
X = 780.500000	
BY = 195.000000	8
BV = 267.722580	40
BV = 415.000000	50
BV = 542.087173	46
X = 812.000000	
BY = 205.000000	9
BV = 273.169033	40
BV = 415.000000	50
BV = 579.720661	46
X = 831.000000	
BY = 210.952381	10
BV = 276.454193	40
BV = 415.000000	50
X = 841.500000	
BY = 215.952381	10
BV = 278.812645	41
BV = 415.000000	50
X = 870.000000	
BY = 225.000000	11
BV = 285.560921	41
BV = 415.000000	50
X = 897.500000	
BY = 234.999998	12
BV = 292.072414	41
BV = 415.000000	50
X = 919.000000	
BY = 245.000000	13
BV = 297.163219	41
BV = 415.000000	50
X = 944.000000	
BY = 255.000000	14
BV = 303.082760	41
BV = 415.000000	50
X = 945.000000	
BY = 265.000000	15
BV = 308.055172	41
BV = 415.000000	50
X = 985.500000	
BY = 275.000000	16
BV = 312.909195	41
BV = 415.000000	50
X = 1001.500000	
BY = 281.410255	17
BV = 316.697700	41
BV = 415.000000	50
X = 1021.000000	
BY = 286.410255	17
BV = 322.150002	42
BV = 415.000000	50
X = 1053.500000	
BY = 295.000000	18
BV = 331.783928	42

BY = 415.000000	50
X = 1086.000000	
BY = 305.000000	19
BV = 341.417858	42
BV = 415.000000	50
X = 1109.500000	
BY = 313.799999	20
BV = 348.383930	42
BV = 415.000000	50
X = 1122.000000	
BY = 318.799999	20
BV = 353.425583	43
BV = 415.000000	50
X = 1133.500000	
BY = 325.000000	21
BV = 361.956978	43
BV = 415.000000	50
X = 1150.000000	
BY = 335.000000	22
BV = 374.197678	43
BV = 415.000000	50
X = 1143.500000	
BY = 344.999996	23
BV = 384.212791	43
BV = 415.000000	50
X = 1172.000000	
BY = 354.999996	24
BV = 390.518608	43
BV = 415.000000	50
X = 1179.000000	
BY = 365.000000	25
BV = 395.711628	43
BV = 415.000000	50
X = 1187.500000	
BY = 375.000000	26
BV = 402.017445	43
BV = 415.000000	50
X = 1195.500000	
BY = 385.000000	27
BV = 407.952328	43
BV = 415.000000	50
X = 1200.500000	
BY = 394.999992	28
BV = 411.661629	43
BV = 415.000000	50
X = 1203.000000	
BY = 405.000000	29
BV = 413.516281	43
BV = 415.000000	50
X = 1204.500000	
BY = 412.500000	30
BV = 414.629070	43
BV = 415.000000	50
X = 1208.000000	
BY = 415.000000	50
BV = 417.499996	31
X = 1216.000000	
BY = 415.000000	50
BV = 425.000000	32
X = 1226.000000	
BY = 415.000000	50
BV = 435.000000	33

X = 1238.500000	
BY = 415.000000	50
BV = 445.000000	34
X = 1249.500000	
BY = 415.000000	50
BV = 455.000004	35
X = 1306.500000	
BY = 415.000000	50
BV = 460.000000	36
X = 1430.000000	
BY = 415.000000	50
BV = 462.500000	37

LI PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NO. OF POINTS TO DESCRIBE FAILURE SURFACES = 10
 NO. OF FAILURE SURFACE DESCRIPTION CARDS = 6
 MAX. NO. OF COLUMNS TO DESCRIBE FAIL. SURF. = 5
 NO. OF BLOCKS OF SUBSTITUTE SOIL TYPES = 3
 NO. OF ALTERNATE F(X) DISTRIBUTIONS = 0

FAILURE SURFACE POINTS

POINT NO.	X-COORDINATE	Y-COORDINATE	F(X)
1	466.50	164.60	1.00
	0.00	695.00	440.00
	1.00	6.00	1140.00
	470.00	1.00	0.00
	1240.00	476.00	1.00
	0.00	1253.00	459.80
	1.00	0.00	695.00
	440.00	5.00	0.00
	695.00	440.00	0.50
	0.00	695.00	440.00
	0.10	6.00	695.00
	440.00	2.00	0.00
	695.00	440.00	10.00

FAILURE SURFACE DESCRIPTION

SURFACE NO.	POINTS TO DESCRIBE THE SURFACE				
	1	2	3	4	5
1	1	2	3	4	5
2	1	6	3	4	5
3	1	7	3	4	5
4	1	8	3	4	5
5	1	9	3	4	5
6	1	10	3	4	5

SOIL DATA

NO	WET	SAT	COH	FI	RU	EQ
1	135.0	135.0	0.	0.364	0.230	0.

SURFACE NUMBER 1 1 (SPECIFIED)

SURFACE DEFINED BY#	POINT	X	Y	F(X)
1-	1	466.50	164.00	1.00
2-	2	695.00	440.00	1.00
3-	3	1140.00	470.00	1.00
4-	4	1240.00	470.00	1.00
5-	5	1253.00	459.80	1.00

INS.IT 0 0
 145.IT 0 2

X-COORD.	E	Y-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
482.75	7947.	7947.	4323.	3.64	0.192	0.67	1.00
483.27	8471.	8471.	4609.	3.76	0.192	0.67	1.00
525.00	104568.	104568.	56886.	13.20	0.192	0.67	1.00
526.56	110229.	110229.	59965.	13.55	0.192	0.67	1.00
650.00	1032953.	1032953.	561933.	41.47	0.192	0.67	1.00
658.00	1125070.	1125070.	612046.	48.28	0.192	0.67	1.00
674.07	1343356.	1343356.	736794.	49.01	0.204	0.67	1.00
674.24	1345787.	1345787.	732117.	49.07	0.204	0.67	1.00
678.00	1398833.	1398833.	760974.	50.37	0.207	0.67	1.00
688.00	1541634.	1541634.	839747.	53.80	0.213	0.67	1.00
694.36	1629994.	1629994.	886728.	55.28	0.213	0.67	1.00
695.00	1638806.	1638806.	891521.	55.43	0.213	0.67	1.00
695.01	1638771.	1638771.	891502.	55.43	0.213	0.67	1.00
720.00	1486538.	1486538.	805687.	49.70	0.191	0.67	1.00
766.00	1265046.	1265046.	686193.	41.90	0.164	0.67	1.00
795.00	1167378.	1167378.	635061.	39.37	0.160	0.67	1.00
829.00	1041725.	1041725.	566705.	35.74	0.150	0.67	1.00
833.00	1033334.	1033334.	562140.	35.74	0.151	0.67	1.00
850.00	998316.	998316.	543090.	35.64	0.155	0.67	1.00
890.00	846191.	846191.	460333.	30.71	0.138	0.67	1.00
905.00	839303.	839303.	456586.	32.63	0.152	0.67	1.00
933.00	762845.	762845.	414993.	30.88	0.150	0.67	1.00
955.00	720371.	720371.	391886.	30.68	0.155	0.67	1.00
975.00	689584.	689584.	375138.	30.72	0.163	0.67	1.00
996.00	655451.	655451.	356569.	30.12	0.167	0.67	1.00
1007.00	622831.	622831.	338824.	28.58	0.160	0.67	1.00
1035.00	541507.	541507.	294583.	24.87	0.144	0.67	1.00
1072.00	441014.	441014.	239914.	20.99	0.127	0.67	1.00
1100.00	382293.	382293.	207970.	20.43	0.130	0.67	1.00
1119.00	348648.	348648.	182667.	20.95	0.139	0.67	1.00
1125.00	336310.	336310.	184043.	21.17	0.142	0.67	1.00
1140.00	327730.	327730.	178287.	23.39	0.166	0.67	1.00
1142.00	323817.	323817.	176158.	23.69	0.169	0.67	1.00
1158.00	296676.	296676.	161394.	26.30	0.202	0.67	1.00
1169.00	293786.	293786.	159822.	28.81	0.240	0.67	1.00
1175.00	311590.	311590.	169507.	30.58	0.278	0.67	1.00
1183.00	320372.	320372.	174284.	30.80	0.308	0.67	1.00
1192.00	324937.	324937.	176768.	29.82	0.331	0.67	1.00
1199.00	335071.	335071.	182281.	28.52	0.356	0.67	1.00
1202.00	354689.	354689.	192953.	27.82	0.397	0.67	1.00
1204.00	374004.	374004.	203461.	27.08	0.451	0.67	1.00
1205.00	382547.	382547.	206108.	26.61	0.484	0.67	1.00
1211.00	375578.	375578.	204317.	24.03	0.481	0.67	1.00
1221.00	361133.	361133.	196459.	19.32	0.463	0.67	1.00
1231.00	340922.	340922.	185464.	14.18	0.473	0.67	1.00
1240.00	321764.	321764.	175041.	9.42	0.392	0.67	1.00
1246.00	178138.	178138.	96908.	5.27	0.345	0.67	1.00
1252.91	-0.	-0.	-0.	0.	0.	1.00	1.00

F = 1.261 LAMBDA = 0.544(5 7 0)

SOIL DATA

NO	WET	SAT	COH	FI	RU	EQ
1	135.0	135.0	600.0	0.364	0.230	0.

SURFACE NUMBER 1, 1 (SPECIFIED)					
SURFACE DEFINED BY#		POINT	X	Y	F(X)
1-		1	466.50	164.80	1.00
2-		2	692.00	448.00	1.00
3-		3	1140.00	470.00	1.00
4-		4	1240.00	470.00	1.00
5-		5	1253.00	459.80	1.00

INS.IT 0 0
INS.IT 0 2

X-COORD.	E	X-FORCE	Y-YT	Y-Y/Y-Z	VERT F	SMALL F	POAE PRES
482.75	-1108.	-1108.	-597.	17.96	0.948	-18.38	1.00 1.00 0.
483.27	-867.	-867.	-467.	23.26	1.189	-24.47	1.00 1.00 588.30
525.00	74727.	74727.	40246.	10.50	0.153	1.70	1.00 1.00 607.40
526.56	79704.	79704.	42927.	10.89	0.154	1.66	1.00 1.00 2134.02
650.00	967094.	967094.	520853.	39.64	0.183	0.92	1.00 1.00 2191.02
658.00	1058203.	1058203.	569922.	41.47	0.184	0.91	1.00 1.00 6707.17
674.07	1274606.	1274606.	686472.	47.39	0.197	0.89	1.00 1.00 4999.85
674.24	1277020.	1277020.	687771.	47.45	0.198	0.89	1.00 1.00 7451.08
678.00	1329694.	1329694.	716140.	48.79	0.200	0.88	1.00 1.00 7455.95
688.00	1473630.	1473630.	793661.	52.30	0.207	0.87	1.00 1.00 7561.47
694.36	1559640.	1559640.	839984.	53.80	0.207	0.86	1.00 1.00 7842.26
695.00	1568422.	1568422.	844714.	53.95	0.207	0.86	1.00 1.00 8067.81
695.01	1568389.	1568389.	844696.	53.94	0.207	0.86	1.00 1.00 8090.47
720.00	1425343.	1425343.	767655.	48.15	0.185	0.88	1.00 1.00 8090.47
766.00	1219430.	1219430.	656755.	40.39	0.159	0.91	1.00 1.00 8094.28
795.00	1130326.	1130326.	608766.	38.01	0.154	0.92	1.00 1.00 7911.12
829.00	1014126.	1014126.	546183.	34.47	0.144	0.94	1.00 1.00 7661.33
833.00	1006691.	1006691.	542179.	34.50	0.145	0.94	1.00 1.00 7422.00
850.00	975514.	975514.	525388.	34.51	0.150	0.94	1.00 1.00 7371.23
890.00	832736.	832736.	446491.	29.57	0.133	0.97	1.00 1.00 7155.46
905.00	828193.	828193.	446045.	31.61	0.148	0.96	1.00 1.00 6928.69
933.00	756454.	756454.	407407.	29.85	0.145	0.98	1.00 1.00 6649.58
955.00	716879.	716879.	386093.	29.67	0.150	0.98	1.00 1.00 6397.70
975.00	688109.	688109.	370599.	29.71	0.157	0.98	1.00 1.00 6133.25
996.00	655605.	655605.	353093.	29.11	0.161	0.98	1.00 1.00 5864.61
1007.00	623909.	623909.	336022.	27.53	0.155	0.99	1.00 1.00 5598.07
1035.00	544612.	544612.	293315.	23.70	0.137	1.03	1.00 1.00 5533.52
1072.00	446007.	446007.	240208.	19.56	0.118	1.09	1.00 1.00 5369.21
1100.00	387809.	387809.	208864.	18.74	0.119	1.13	1.00 1.00 5136.16
1119.00	354025.	354025.	190869.	19.08	0.126	1.15	1.00 1.00 4884.27
1125.00	343567.	343567.	185036.	19.23	0.129	1.16	1.00 1.00 4688.06
1140.00	332230.	332230.	178931.	21.38	0.151	1.15	1.00 1.00 4626.10
1142.00	328245.	328245.	176785.	21.65	0.155	1.15	1.00 1.00 4383.53
1158.00	300179.	300179.	161669.	24.09	0.185	1.16	1.00 1.00 4347.00
1169.00	296033.	296033.	159436.	26.66	0.222	1.13	1.00 1.00 4036.50
1175.00	312619.	312619.	168369.	28.67	0.261	1.07	1.00 1.00 3726.00
1183.00	319799.	319799.	172236.	29.12	0.291	1.02	1.00 1.00 3415.50
1192.00	322377.	322377.	173625.	28.41	0.316	0.99	1.00 1.00 3105.00
1199.00	330633.	330633.	178071.	27.37	0.342	0.95	1.00 1.00 2794.50
1202.00	349080.	349080.	188006.	26.86	0.384	0.90	1.00 1.00 2484.00
1204.00	367442.	367442.	197895.	26.25	0.438	0.86	1.00 1.00 2173.50
1205.00	375505.	375505.	202238.	25.84	0.470	0.84	1.00 1.00 1863.00
1211.00	366624.	366624.	197454.	23.42	0.468	0.83	1.00 1.00 1707.75
1221.00	348918.	348918.	187919.	18.96	0.474	0.80	1.00 1.00 1624.26
1231.00	325382.	325382.	175243.	14.04	0.468	0.78	1.00 1.00 1457.28
1240.00	303128.	303128.	163258.	9.45	0.394	0.76	1.00 1.00 1290.30
1246.00	167951.	167951.	90454.	5.31	0.347	0.78	1.00 1.00 1190.11
1252.91	-0.	-0.	-0.	0.	0.	0.	1.00 1.00 977.15

F = 1.384 LAMBDA = 0.5391 4 8 0)

SOIL DATA

NO	WFT	SAT	COH	FI	RU	EQ
1	135.0	135.0	0.	0.364	0.320	0.

SURFACE NUMBER 1 - 1 (SPECIFIED)				
SURFACE DEFINED BY#	POINT	X	Y	F(X)
1-	1	466.50	164.80	1.00
2-	2	695.00	448.00	1.00
3-	3	1140.00	478.00	1.00
4-	4	1240.00	478.00	1.00
5-	5	1253.00	459.80	1.00

X-COORD.	E	X-FORCE	Y-YT	Y-Y1/Y-2	VERT F	SHALL F	PORE PRES
482.74	4597.	6597.	3988.	3.38	0.178	0.00	1.00
483.27	7033.	7033.	4291.	3.49	0.178	0.00	1.00
525.00	8681.0	8681.0	52469.	12.26	0.178	0.00	1.00
526.56	91509.	91509.	55309.	12.59	0.178	0.00	1.00
690.00	857532.	857532.	518302.	38.54	0.178	0.00	1.00
698.00	934005.	934005.	584223.	40.22	0.178	0.00	1.00
674.07	1127811.	1127811.	681661.	47.11	0.196	0.00	1.00
674.24	1129970.	1129970.	682966.	47.19	0.197	0.00	1.00
678.00	1177067.	1177067.	711432.	48.72	0.200	0.00	1.00
688.00	1305629.	1305629.	789136.	52.68	0.209	0.00	1.00
694.36	1378052.	1378052.	932910.	54.03	0.208	0.00	1.00
695.00	1389442.	1389442.	937376.	54.17	0.208	0.00	1.00
695.01	1389407.	1389407.	937395.	54.17	0.208	0.00	1.00
720.00	1234932.	1234932.	746408.	48.38	0.186	0.00	1.00
766.00	1041053.	1041053.	629224.	42.81	0.168	0.00	1.00
795.00	977101.	977101.	594570.	43.43	0.176	0.00	1.00
829.00	883258.	883258.	533851.	43.25	0.181	0.00	1.00
833.00	884224.	884224.	532649.	43.85	0.182	0.00	1.00
850.00	872719.	872719.	527481.	46.07	0.200	0.00	1.00
890.00	748349.	748349.	452913.	45.24	0.203	0.00	1.00
905.00	773992.	773993.	467810.	49.22	0.230	0.00	1.00
933.00	725929.	725929.	438780.	50.08	0.243	0.00	1.00
955.00	711570.	711570.	430081.	51.52	0.261	0.00	1.00
975.00	702921.	702921.	427982.	52.41	0.277	0.00	1.00
996.00	699684.	699684.	429897.	52.21	0.290	0.00	1.00
1007.00	673510.	673510.	407077.	51.12	0.287	0.00	1.00
1035.00	608255.	608255.	367636.	48.62	0.281	0.00	1.00
1072.00	529564.	529564.	320874.	46.19	0.279	0.00	1.00
1100.00	492651.	492651.	297764.	45.48	0.289	0.00	1.00
1119.00	479083.	479083.	287145.	44.98	0.298	0.00	1.00
1125.00	469685.	469685.	283883.	44.74	0.300	0.00	1.00
1140.00	477388.	477388.	288538.	44.43	0.315	0.00	1.00
1142.00	476119.	476119.	287772.	44.39	0.317	0.00	1.00
1158.00	470615.	470615.	284445.	43.55	0.335	0.00	1.00
1169.00	487978.	487978.	294940.	42.39	0.353	0.00	1.00
1175.00	524617.	524617.	317084.	41.38	0.376	0.00	1.00
1183.00	550522.	550522.	332742.	39.04	0.390	0.00	1.00
1192.00	570547.	570547.	344845.	35.74	0.397	0.00	1.00
1199.00	594573.	594573.	359366.	32.78	0.410	0.00	1.00
1202.00	626553.	626553.	378696.	31.28	0.447	0.00	1.00
1204.00	656605.	656605.	398859.	30.06	0.501	0.00	1.00
1205.00	669898.	669898.	404894.	29.40	0.534	0.00	1.00
1211.00	665214.	665214.	402063.	26.16	0.523	0.00	1.00
1221.00	658062.	658062.	395927.	20.55	0.514	0.00	1.00
1231.00	638723.	638723.	386051.	14.71	0.490	0.00	1.00
1240.00	621643.	621643.	375728.	9.37	0.391	0.00	1.00
1246.00	342680.	342680.	207120.	5.08	0.332	0.00	1.00
1252.91	-0.	-0.	-0.	0.	0.	1.00	1.00

F = 1.150 LAMRDA = 0.604(6 8 0)

SOIL DATA						
NO	NET	SAT	COH	FI	RIJ	EQ
1	135.0	135.0	600.0	0.364	0.320	0.

SURFACE NUMBER 1 1 (SPECIFIED)				
SURFACE DEFINED BY#	POINT	X	Y	F(X)
1-	1	464.50	164.00	1.00
2-	2	699.00	440.00	1.00
3-	3	1140.00	470.00	1.00
4-	4	1240.00	470.00	1.00
5-	5	1253.00	459.00	1.00

INS.IT	0 0
INS.IT	0 2

X-COORD.	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
482.75	-2902.	-2902.	-1796.	0.03	0.424	-5.74	1.00 1.00 0.
483.27	-2767.	-2767.	-1712.	0.69	0.444	-6.27	1.00 1.00 018.50
525.00	54566.	54566.	33766.	0.65	0.126	1.01	1.00 1.00 845.08
526.56	58487.	58487.	36193.	9.03	0.128	1.76	1.00 1.00 2969.08
650.00	776771.	776771.	480672.	35.30	0.163	0.06	1.00 1.00 3048.38
658.00	851025.	851025.	526665.	36.95	0.164	0.05	1.00 1.00 5331.72
674.07	1040122.	1040122.	643636.	44.21	0.184	0.01	1.00 1.00 9738.92
674.24	1042230.	1042230.	644941.	44.28	0.184	0.01	1.00 1.00 10366.72
678.00	1088255.	1088255.	673422.	45.87	0.188	0.01	1.00 1.00 10373.50
688.00	1214046.	1214046.	751262.	49.95	0.198	0.79	1.00 1.00 10520.31
694.36	1285060.	1285060.	795206.	51.25	0.197	0.78	1.00 1.00 10911.00
695.00	1292313.	1292313.	799694.	51.38	0.197	0.78	1.00 1.00 11224.78
695.01	1292280.	1292280.	799673.	51.38	0.197	0.78	1.00 1.00 11256.30
720.00	1150822.	1150822.	712138.	45.06	0.173	0.01	1.00 1.00 11256.30
766.00	971753.	971753.	601329.	38.96	0.153	0.04	1.00 1.00 11261.61
795.00	915552.	915552.	566552.	39.71	0.161	0.05	1.00 1.00 11006.78
829.00	830290.	830290.	513791.	39.43	0.165	0.07	1.00 1.00 10659.24
833.00	829056.	829056.	513027.	40.09	0.169	0.07	1.00 1.00 10326.26
850.00	823741.	823741.	509738.	42.57	0.185	0.06	1.00 1.00 10255.62
890.00	708711.	708711.	438556.	41.31	0.185	0.09	1.00 1.00 9955.42
905.00	734931.	734931.	454782.	45.77	0.214	0.07	1.00 1.00 9639.91
933.00	690639.	690639.	427373.	46.58	0.226	0.08	1.00 1.00 9251.00
955.00	678294.	678294.	419734.	48.16	0.244	0.07	1.00 1.00 8901.14
975.00	675845.	675845.	418218.	49.21	0.261	0.06	1.00 1.00 8533.21
996.00	668285.	668285.	413940.	49.14	0.273	0.05	1.00 1.00 8159.46
1007.00	642675.	642675.	397692.	47.96	0.269	0.06	1.00 1.00 7788.62
1035.00	578515.	578515.	357990.	45.25	0.262	0.08	1.00 1.00 7698.81
1072.00	500422.	500422.	309665.	42.68	0.258	0.91	1.00 1.00 7470.20
1100.00	462917.	462917.	286457.	42.23	0.268	0.92	1.00 1.00 7145.96
1119.00	444403.	444403.	275000.	42.07	0.279	0.92	1.00 1.00 6795.51
1125.00	438627.	438627.	271426.	41.95	0.282	0.92	1.00 1.00 6522.52
1140.00	444809.	444809.	275252.	42.18	0.299	0.90	1.00 1.00 6436.31
1142.00	443354.	443354.	274351.	42.21	0.301	0.89	1.00 1.00 6098.82
1158.00	435977.	435977.	269786.	41.97	0.323	0.88	1.00 1.00 6048.00
1169.00	451326.	451326.	279284.	41.33	0.344	0.85	1.00 1.00 5616.00
1175.00	486203.	486203.	300868.	40.66	0.370	0.81	1.00 1.00 5184.00
1183.00	509883.	509883.	315920.	38.61	0.386	0.78	1.00 1.00 4752.00
1192.00	527257.	527257.	326271.	39.56	0.395	0.75	1.00 1.00 4320.00
1199.00	548844.	548844.	339629.	32.76	0.410	0.73	1.00 1.00 3888.00
1202.00	579310.	579310.	358482.	31.33	0.448	0.71	1.00 1.00 3456.00
1204.00	608137.	608137.	376320.	30.14	0.502	0.68	1.00 1.00 3024.00
1209.00	620822.	620822.	384170.	29.49	0.536	0.67	1.00 1.00 2592.00
1211.00	613848.	613848.	379854.	26.30	0.526	0.67	1.00 1.00 2376.00
1221.00	590785.	599785.	371192.	29.73	0.518	0.65	1.00 1.00 2259.84
1231.00	570460.	579460.	358575.	14.90	0.487	0.64	1.00 1.00 2027.52
1240.00	558704.	558704.	345731.	9.53	0.397	0.63	1.00 1.00 1795.20
1246.00	308395.	308395.	190838.	5.19	0.339	0.64	1.00 1.00 1655.81
1252.91	-0.	-0.	-0.	0.	0.	0.	1.00 1.00 1359.51

F = 1.270 LAMBDA = 0.6191 7 9 01

EXAMPLE NO. 3

Semiempirical Stability Analysis Section
After Canal Deepening

<u>Strength</u>	<u>Pore Pressure</u>	<u>Acceleration</u>
$c' = 0, \phi' = 20 \text{ deg}$	$r_u = 0.32$	0.07 g
$c' = 600 \text{ psf}, \phi' = 20 \text{ deg}$	$r_u = 0.32$	0.11 g

MORGENSTERN AND PRICE METHOD OF SLOPE STABILITY ANALYSIS - DOWN BANKS
 WITH EARTHQUAKE ANALYSIS
 LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NUMBER OF POINTS = 48

NUMBER OF LINES = 48

NUMBER OF MATERIALS = 1

YBM = 105.00

XM = 650.00

YDP = 415.00

POINT DESCRIPTION

POINT NO.	NO. LINES	X-COORDINATE	Y-COORDINATE
1	1	0.	150.00
2	2	240.00	150.00
3	2	290.00	160.00
4	3	466.00	165.00
5	2	650.00	170.00
6	2	688.00	179.00
7	2	720.00	181.00
8	2	766.00	190.00
9	2	795.00	200.00
10	2	829.00	210.00
11	2	850.00	220.00
12	2	890.00	230.00
13	2	905.00	240.00
14	2	933.00	250.00
15	2	955.00	260.00
16	2	975.00	270.00
17	2	990.00	280.00
18	2	1035.00	290.00
19	2	1072.00	300.00
20	2	1100.00	310.00
21	2	1125.00	320.00
22	2	1142.00	330.00
23	2	1158.00	340.00
24	2	1169.00	350.00
25	2	1175.00	360.00
26	2	1183.00	370.00
27	2	1192.00	380.00
28	2	1199.00	390.00
29	2	1202.00	400.00
30	2	1204.00	410.00
31	4	1205.00	415.00
32	2	1211.00	420.00
33	2	1221.00	430.00
34	2	1231.00	440.00
35	2	1240.00	450.00
36	2	1253.00	460.00
37	2	1460.00	460.00
38	1	1500.00	465.00
39	1	0.	105.00
40	4	525.00	237.00
41	2	670.00	250.00
42	2	833.00	276.80
43	2	1007.00	318.00
44	2	1119.00	351.20
45	1	1500.00	415.00
46	1	0.	600.00
47	1	829.00	600.00
48	1	1500.00	600.00

LINE DESCRIPTION

LINE NO.	POINT 1	POINT 2	MATERIAL
1	1	2	1
2	2	3	1
3	3	4	1
4	4	5	1
5	5	6	1
6	6	7	1
7	7	8	1
8	8	9	1
9	9	10	1
10	10	11	1
11	11	12	1
12	12	13	1
13	13	14	1
14	14	15	1
15	15	16	1
16	16	17	1
17	17	18	1
18	18	19	1
19	19	20	1
20	20	21	1
21	21	22	1
22	22	23	1
23	23	24	1
24	24	25	1
25	25	26	1
26	26	27	1
27	27	28	1
28	28	29	1
29	29	30	1
30	30	31	1
31	31	32	1
32	32	33	1
33	33	34	1
34	34	35	1
35	35	36	1
36	36	37	1
37	37	38	1
38	39	40	0
39	40	41	0
40	41	42	0
41	42	43	0
42	43	44	0
43	44	31	0
44	31	45	0
45	4	46	1
46	40	47	1
47	46	47	1
48	47	48	1

BXA	U.	243,000000	290,000000	466,500000	658,000000	688,000000	720,000000	766,000000
BXA	792,000000	829,000000	850,000000	890,000000	905,000000	933,000000	955,000000	975,000000
BXA	990,000000	1035,000000	1072,000000	1100,000000	1125,000000	1147,000000	1158,000000	1169,000000
BXA	1172,000000	1183,000000	1192,000000	1194,000000	1202,000000	1204,000000	1205,000000	1211,000000
BXA	1221,000000	1231,000000	1246,000000	1253,000000	1360,000000	1500,000000	0,	525,000000
BXA	670,000000	833,000000	1007,000000	1114,000000	1300,000000	0,	829,000000	1500,000000
BXA	482,750000	674,088871	850,000000					
BXR	U.	243,000000	290,000000	466,500000	658,000000	688,000000	720,000000	766,000000
BXR	674,060871	678,000000	888,000000	720,000000	766,000000	795,000000	829,000000	833,000000
BXR	850,000000	892,000000	925,000000	933,000000	955,000000	975,000000	996,000000	1007,000000
BXR	1035,000000	1072,000000	1100,000000	1119,000000	1125,000000	1142,000000	1158,000000	1169,000000
BXR	1172,000000	1183,000000	1192,000000	1194,000000	1202,000000	1204,000000	1205,000000	1211,000000
BXR	1221,000000	1231,000000	1246,000000	1253,000000	1360,000000	1500,000000		
X	=	120,000000						
BY	=	1,0,000000	1					
BY	=	185,000000	49					
BY	=	190,885714	38					
X	=	265,000000						
BY	=	125,000000	2					
BY	=	185,000000	49					
BY	=	211,247620	38					
X	=	378,250000						
BY	=	102,500000	3					
BY	=	185,000000	49					
BY	=	222,464762	38					
X	=	474,629000						
BY	=	105,212141	4					
BY	=	172,000000	45					
BY	=	185,000000	49					
BY	=	234,818477	38					
X	=	503,875000						
BY	=	105,075644	4					
BY	=	185,000000	49					
BY	=	211,808500	45					
BY	=	234,907519	38					
X	=	587,500000						
BY	=	108,159269	4					
BY	=	185,000000	49					
BY	=	242,310457	39					
BY	=	311,629046	46					
X	=	654,000000						
BY	=	108,895561	4					
BY	=	247,960783	39					
BY	=	301,036486	46					
BY	=	412,000000	50					
X	=	666,034439						
BY	=	172,410332	5					
BY	=	246,983318	39					
BY	=	472,400258	46					
BY	=	412,000000	50					
X	=	676,034439						
BY	=	175,410332	5					
BY	=	244,832091	39					
BY	=	412,000000	50					
BY	=	417,347046	46					
X	=	683,000000						
BY	=	177,500000	5					
BY	=	250,864515	40					
BY	=	412,000000	50					
BY	=	428,664474	46					
X	=	704,000000						

BY	=	180.000000	6
BY	=	254.495483	40
BY	=	417.000000	50
BY	=	450.40135	46
X	=	743.000000	
BY	=	185.500000	7
BY	=	261.233709	40
BY	=	417.000000	50
BY	=	497.609212	45
X	=	780.500000	
BY	=	145.000000	8
BY	=	267.722580	40
BY	=	417.000000	50
BY	=	542.087173	46
X	=	912.000000	
BY	=	205.000000	9
BY	=	276.169333	40
BY	=	417.000000	50
BY	=	574.700661	45
X	=	831.000000	
BY	=	270.972381	10
BY	=	276.454193	40
BY	=	417.000000	50
X	=	941.000000	
BY	=	215.959301	10
BY	=	270.812645	41
BY	=	417.000000	50
X	=	970.000000	
BY	=	225.000000	11
BY	=	287.560921	41
BY	=	417.000000	50
X	=	997.500000	
BY	=	234.999990	12
BY	=	292.072414	41
BY	=	417.000000	50
X	=	919.000000	
BY	=	245.000000	13
BY	=	297.164219	41
BY	=	417.000000	50
X	=	944.000000	
BY	=	255.000000	14
BY	=	303.082760	41
BY	=	417.000000	50
X	=	965.000000	
BY	=	265.000000	15
BY	=	307.055172	41
BY	=	417.000000	50
X	=	985.500000	
BY	=	275.000000	16
BY	=	312.909195	41
BY	=	417.000000	50
X	=	1701.500000	
BY	=	281.410259	17
BY	=	316.697700	41
BY	=	417.000000	50
X	=	1721.000000	
BY	=	286.410259	17
BY	=	322.150002	42
BY	=	417.000000	50
X	=	1053.500000	
BY	=	295.000000	18
BY	=	331.783028	42

BY	=	417.000000	50
X	=	1080.000000	
BY	=	305.000000	19
BY	=	341.417258	42
BY	=	417.000000	50
X	=	1109.500000	
BY	=	313.799999	20
BY	=	348.383030	42
BY	=	417.000000	50
X	=	1122.000000	
BY	=	318.799999	20
BY	=	353.425583	43
BY	=	417.000000	50
X	=	1133.500000	
BY	=	325.000000	21
BY	=	361.956978	43
BY	=	417.000000	50
X	=	1150.000000	
BY	=	335.000000	22
BY	=	374.197678	43
BY	=	417.000000	50
X	=	1163.500000	
BY	=	344.999996	23
BY	=	384.212791	43
BY	=	417.000000	50
X	=	1172.000000	
BY	=	354.999996	24
BY	=	390.513408	43
BY	=	417.000000	50
X	=	1179.000000	
BY	=	365.000000	25
BY	=	397.711628	43
BY	=	417.000000	50
X	=	1187.500000	
BY	=	375.000000	26
BY	=	402.017445	43
BY	=	417.000000	50
X	=	1195.500000	
BY	=	385.000000	27
BY	=	407.952328	43
BY	=	417.000000	50
X	=	1200.500000	
BY	=	394.999992	28
BY	=	411.661629	43
BY	=	417.000000	50
X	=	1203.000000	
BY	=	405.000000	29
BY	=	413.516281	43
BY	=	417.000000	50
X	=	1204.500000	
BY	=	412.500000	30
BY	=	414.629070	43
BY	=	417.000000	50
X	=	1208.000000	
BY	=	415.000000	30
BY	=	417.499996	51
X	=	1216.000000	
BY	=	415.000000	50
BY	=	427.000000	32
X	=	1226.000000	
BY	=	415.000000	50
BY	=	437.000000	33
X	=	1238.500000	
BY	=	415.000000	50
BY	=	449.000000	34
X	=	1249.500000	
BY	=	415.000000	50
BY	=	457.000004	35
X	=	1306.500000	
BY	=	415.000000	50
BY	=	460.000000	36
X	=	1430.000000	
BY	=	415.000000	50
BY	=	462.500000	37

LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NO. OF POINTS TO DESCRIBE FAILURE SURFACES	5
NO. OF FAILURE SURFACE DESCRIPTION CARDS	1
MAX. NO. OF COLUMNS TO DESCRIBE FAIL. SURF.	5
NO. OF BLOCKS OF SUBSTITUTE SOIL TYPES	3
NO. OF ALTERNATE F(X) DISTRIBUTIONS	0

FAILURE SURFACE POINTS

POINT NO.	X-COORDINATE	Y-COORDINATE	F(X)
1	466.50	164.80	1.00
	0.00	695.00	440.00
	1.00	0.00	1140.00
	470.00	1.00	0.00
	1240.00	470.00	1.00
	0.00	1253.00	459.00
	1.00		

FAILURE SURFACE DESCRIPTION

SURFACE NO.	POINTS TO DESCRIBE THE SURFACE				
	1	2	3	4	5
1					

SOIL DATA

NO	WET	SAT	CUH	FI	RU	EQ
1	145.0	135.0	0.	0.364	0.420	0.070

SURFACE NUMBER 1 1 (SPECIFIED)

SURFACE DEFINED BY	POINT	X	Y	FIX
1-	1	466.00	164.80	1.00
2-	2	695.00	448.00	1.00
3-	3	1140.00	470.00	1.00
4-	4	1249.00	470.00	1.00
5-	5	1253.00	459.80	1.00

INSITT U 0
INS.IT U 2

X-COORD	E	X-FORCE	Y-VT	Y-VT/Y-Z	VERT F	SMALL F	PORE PRES
462.75	7262.	4224.	4.74	0.250	0.63	1.00	0.
463.77	7241.	4241.	4.69	0.250	0.63	1.00	818.50
525.00	95524.	95554.	55577.	17.19	0.250	0.63	845.08
526.56	100727.	100727.	56505.	17.65	0.250	0.63	2969.08
650.00	943908.	943908.	549003.	54.03	0.250	0.63	3048.38
650.00	1020084.	1020084.	507902.	56.39	0.250	0.63	9331.72
674.07	1239435.	1239436.	720890.	63.79	0.266	0.63	9738.92
674.24	1241797.	1241790.	722220.	63.87	0.266	0.63	10386.72
678.00	1293121.	1293151.	752132.	65.53	0.269	0.63	10373.50
680.00	1436397.	1436353.	833677.	69.45	0.277	0.63	10920.31
694.36	1512955.	1512956.	879977.	71.71	0.276	0.63	10911.00
695.00	1521079.	1521079.	884701.	71.89	0.276	0.63	11224.78
695.01	1521072.	1521052.	884685.	71.89	0.276	0.63	11256.30
700.00	1445599.	1445598.	816051.	71.81	0.275	0.63	11256.30
706.00	1274931.	1274901.	741518.	75.72	0.297	0.63	11261.61
795.00	1251472.	1251872.	780123.	79.86	0.325	0.63	11006.78
829.00	1203900.	1203900.	700221.	83.61	0.350	0.63	10659.24
833.00	1207404.	1207404.	702200.	84.13	0.354	0.63	10326.26
850.00	1222030.	1222029.	710766.	85.86	0.373	0.63	10255.62
890.00	1148477.	1148477.	667906.	88.28	0.396	0.63	9955.42
905.00	1193090.	1193090.	693934.	88.91	0.415	0.63	9639.91
933.00	1178265.	1178235.	685294.	88.59	0.430	0.63	9251.60
955.00	1189555.	1189555.	691878.	87.44	0.443	0.63	8901.14
975.00	1200552.	1200550.	702961.	85.45	0.452	0.63	8533.21
996.00	1222415.	1222815.	711263.	82.51	0.458	0.63	8159.46
1007.00	1207407.	1207407.	702300.	89.87	0.454	0.63	7786.62
1035.00	1169272.	1169272.	680081.	76.45	0.442	0.63	7698.81
1072.00	1125165.	1125165.	654410.	70.88	0.423	0.63	7470.20
1100.00	1113726.	1113726.	647774.	64.39	0.409	0.63	7145.96
1110.00	1112471.	1112471.	647276.	69.89	0.398	0.63	6795.51
1125.00	1112608.	1112608.	647123.	58.64	0.394	0.63	6522.52
1140.00	1133317.	1133317.	659168.	54.78	0.388	0.63	6436.31
1142.00	1133685.	1133685.	659383.	54.21	0.387	0.63	6098.82
1150.00	1140885.	1140886.	663571.	49.25	0.379	0.63	6046.00
1169.00	1166948.	1166948.	678729.	45.41	0.378	0.63	5616.00
1175.00	1206770.	1206770.	703054.	43.08	0.392	0.63	5164.00
1183.00	1240437.	1240437.	721472.	39.65	0.396	0.63	4752.00
1192.00	1266141.	1266141.	736422.	35.58	0.394	0.63	4320.00
1199.00	1294415.	1294415.	752867.	32.09	0.401	0.63	3888.00
1202.00	1328672.	1328672.	772792.	30.52	0.430	0.63	3456.00
1204.00	1360372.	1360379.	791234.	29.36	0.489	0.63	3024.00
1205.00	1374403.	1374403.	799390.	28.75	0.523	0.63	2992.00
1211.00	1371416.	1371416.	797653.	25.47	0.509	0.63	2376.00
1221.00	1363467.	1363467.	782971.	19.89	0.497	0.63	2259.84
1231.00	1348072.	1348072.	784076.	14.20	0.473	0.63	2027.52
1240.00	1331262.	1331262.	774281.	9.03	0.376	0.63	1795.20
1246.00	731753.	731938.	425715.	4.83	0.316	0.63	1655.81
1257.00	0.	0.	0.	0.	0.	1.00	1350.51

F = 0.988 LAMBDA = 0.982(8 10 0)

SOIL DATA

NO	WBT	SAF	CGH	FI	RU	EO
1	130.0	130.0	600.0	0.364	0.320	0.110

5) SURFACE NUMBER 1, 1 (SPECIFIED)

SURFACE REFINED BY	POINT	X	Y	F(X)
1-	1	466.20	164.80	1.00
2-	2	695.00	440.00	1.00
3-	3	1140.00	470.00	1.00
4-	4	1240.00	470.00	1.00
5-	5	1253.00	459.80	1.00

INS,IT 0 0
INS,IT 0 2

X-COORD	E	X-FORCE	Y-VT	Y-VT/Y-Z	VERT P	SMALL P	PORE PRES
482.75	-4280.	-4280.	-2521.	4.40	0.232	-3.89	1.00
483.27	-4154.	-4154.	-2447.	4.49	0.229	-4.16	1.00
525.00	59794.	59794.	35220.	19.81	0.288	1.79	1.00
526.56	64242.	64242.	37841.	20.31	0.288	1.74	1.00
650.00	888291.	888291.	523231.	60.31	0.279	0.87	1.00
658.00	973832.	973832.	573617.	62.91	0.279	0.85	1.00
674.07	1188526.	1188526.	700078.	70.72	0.295	0.82	1.00
674.24	1190921.	1190921.	701489.	70.80	0.295	0.82	1.00
678.00	1243206.	1243206.	732286.	92.54	0.298	0.82	1.00
688.00	1386123.	1386123.	816469.	77.07	0.305	0.80	1.00
694.16	1467749.	1467749.	864549.	79.09	0.304	0.80	1.00
695.00	1470086.	1470086.	869408.	79.29	0.304	0.80	1.00
695.01	1470065.	1470065.	869448.	79.29	0.304	0.80	1.00
700.00	1380745.	1380745.	810031.	81.55	0.313	0.81	1.00
766.00	1311586.	1311586.	772564.	88.80	0.349	0.82	1.00
795.00	1320141.	1320141.	777637.	93.69	0.380	0.81	1.00
829.00	1307317.	1307317.	770050.	97.93	0.410	0.80	1.00
833.00	1314809.	1314809.	774462.	98.35	0.414	0.80	1.00
850.00	1345858.	1345858.	792752.	99.56	0.432	0.79	1.00
890.00	1380079.	1380079.	771088.	101.36	0.454	0.79	1.00
905.00	1366497.	1366497.	804908.	180.89	0.471	0.78	1.00
933.00	1373983.	1373983.	809318.	99.39	0.482	0.77	1.00
955.00	1401514.	1401514.	825535.	97.10	0.492	0.76	1.00
978.00	1434014.	1434014.	844678.	94.07	0.498	0.75	1.00
996.00	1461155.	1461155.	860665.	90.15	0.500	0.74	1.00
1007.00	1452102.	1452102.	855385.	88.10	0.494	0.74	1.00
1035.00	1429440.	1429440.	841984.	82.61	0.478	0.74	1.00
1072.00	1404082.	1404082.	827018.	74.64	0.451	0.74	1.00
1100.00	1405199.	1405199.	827709.	67.83	0.431	0.73	1.00
1119.00	1411886.	1411886.	831644.	62.76	0.416	0.73	1.00
1125.00	1413827.	1413827.	832787.	61.08	0.410	0.73	1.00
1140.00	1439485.	1439485.	847901.	56.65	0.401	0.72	1.00
1142.00	1440465.	1440465.	848479.	55.99	0.400	0.72	1.00
1158.00	1451881.	1451881.	855203.	50.36	0.387	0.71	1.00
1169.00	1479984.	1479984.	871756.	46.13	0.384	0.70	1.00
1175.00	1522432.	1522432.	896759.	43.63	0.397	0.69	1.00
1183.00	1554356.	1554356.	915563.	40.02	0.400	0.68	1.00
1192.00	1579677.	1579677.	930478.	35.74	0.397	0.68	1.00
1199.00	1607113.	1607113.	946639.	32.24	0.403	0.67	1.00
1202.00	1640739.	1640739.	966457.	30.65	0.438	0.66	1.00
1204.00	1671896.	1671896.	984798.	29.50	0.492	0.65	1.00
1205.00	1685581.	1685581.	992859.	28.90	0.525	0.65	1.00
1211.00	1680434.	1680434.	989827.	25.60	0.512	0.65	1.00
1221.00	1668242.	1668242.	982646.	19.09	0.580	0.64	1.00
1231.00	1648087.	1648087.	970775.	14.27	0.476	0.64	1.00
1240.00	1628358.	1628358.	959975.	9.07	0.378	0.63	1.00
1246.00	894705.	894705.	527010.	4.84	0.317	0.64	1.00
1252.01	-0.	-0.	-0.	0.	0.	0.	1.00

IF = 1.004 LAMBDA = 0.589(6 8 0)

EXAMPLE NO. 4

Conventional Stability Analysis Section Prior to Canal
Deepening--Total Stress Analysis Using Laboratory
Strengths with Acceleration = 0.0

MARGENSTERN AND PRICE METHOD OF SLOPE STABILITY ANALYSIS - DON BANKS
 WITH EARTHQUAKE ANALYSIS
 LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NUMBER OF POINTS = 99

NUMBER OF LINES = 102

NUMBER OF MATERIALS = 4

YDM = 185.00

XM = 650.00

YDP = 415.00

POINT DESCRIPTION			
POINT NO.	NO. LINES	X-COORDINATE	Y-COORDINATE
1	1	0.	150.00
2	2	240.00	150.00
3	2	296.00	160.00
4	2	466.50	165.00
5	2	456.00	170.00
6	2	688.00	179.00
7	2	720.00	181.00
8	2	766.00	190.00
9	2	795.00	200.00
10	2	829.00	210.00
11	2	850.00	220.00
12	2	890.00	230.00
13	2	905.00	240.00
14	2	933.00	250.00
15	2	955.00	260.00
16	2	975.00	270.00
17	2	990.00	280.00
18	2	1035.00	290.00
19	2	1072.00	300.00
20	2	1100.00	310.00
21	2	1125.00	320.00
22	2	1142.00	330.00
23	2	1150.00	340.00
24	2	1169.00	350.00
25	2	1175.00	360.00
26	3	1183.00	370.00
27	3	1192.00	380.00
28	2	1199.00	390.00
29	3	1202.00	400.00
30	3	1204.00	410.00
31	4	1205.00	415.00
32	2	1211.00	420.00
33	2	1221.00	430.00
34	2	1231.00	440.00
35	2	1246.00	450.00
36	2	1253.00	470.50
37	2	1260.00	470.50
38	1	1500.00	470.50
39	2	0.	185.00
40	2	525.00	237.00
41	2	470.00	250.00
42	4	433.00	276.80
43	2	1407.00	310.00
44	2	1119.00	351.20
45	1	1500.00	415.00
46	2	350.00	208.50
47	2	369.00	210.00
48	4	482.50	234.50
49	2	570.00	253.00
50	2	476.00	257.00
51	3	1000.00	304.00
52	3	1193.50	307.00
53	1	0.	210.00
54	2	371.00	241.00
55	2	574.00	261.00
56	2	479.00	276.00
57	4	930.00	301.50
58	1	0.	240.00
59	2	371.00	285.00
60	2	477.00	302.00
61	2	441.00	347.50
62	4	1014.00	371.00
63	3	1133.00	375.00
64	1	0.	286.00
65	2	378.00	311.50
66	2	570.50	321.00
67	2	442.00	340.00
68	4	1137.50	365.00
69	1	0.	304.00
70	2	372.00	329.00
71	2	439.00	340.00
72	4	1153.00	376.00
73	1	0.	304.50
74	2	371.00	349.50
75	2	570.00	352.00
76	2	442.50	368.50
77	4	1101.50	396.00
78	1	0.	360.00
79	2	371.00	365.00
80	2	570.00	380.50
81	2	470.00	382.00
82	2	437.00	400.00
83	4	1199.00	410.00
84	1	0.	414.50
85	2	371.00	439.50
86	2	676.00	411.50
87	2	940.00	423.00
88	3	942.50	447.00
89	2	1157.00	413.00
90	3	1217.50	426.50
91	2	1100.00	457.00
92	2	1185.00	512.00
93	1	1500.00	527.00
94	1	0.	550.00
95	1	1500.00	550.00

LINE DESCRIPTION

LINE NO.	POINT 1	POINT 2	MATERIAL
1	1	2	1
2	2	3	1
3	3	4	1
4	4	5	1
5	5	6	1
6	6	7	1
7	7	8	1
8	8	9	1
9	9	10	1
10	10	11	1
11	11	12	1
12	12	13	1
13	13	14	1
14	14	15	1
15	15	16	1
16	16	17	1
17	17	18	1
18	18	19	1
19	19	20	1
20	52	20	2
21	20	21	2
22	21	63	2
23	23	29	3
24	22	23	3
25	23	24	3
26	24	25	3
27	25	26	3
28	26	27	2
29	27	28	3
30	28	29	3
31	29	30	2
32	30	31	4
33	31	32	4
34	32	33	4
35	33	34	4
36	34	35	4
37	35	36	4
38	36	37	4
39	37	38	4
40	38	39	4
41	39	40	1
42	40	41	3
43	41	42	3
44	42	43	3
45	43	44	3
46	44	45	3
47	45	46	3
48	46	47	2
49	47	48	2
50	48	49	2
51	49	50	2
52	50	51	2
53	51	52	2
54	52	53	3
55	53	54	3
56	54	55	3
57	55	56	3
58	56	57	3

59	54	55	2
60	55	56	2
61	56	57	2
62	57	58	2
63	58	59	2
64	59	60	3
65	60	61	3
66	61	62	3
67	62	63	3
68	63	64	2
69	64	65	2
70	65	66	2
71	66	67	2
72	67	68	2
73	68	69	4
74	69	70	4
75	70	71	4
76	71	72	1
77	72	73	4
78	73	74	4
79	74	75	3
80	75	76	3
81	76	77	3
82	77	78	3
83	78	79	4
84	79	80	4
85	80	81	3
86	81	82	3
87	82	83	3
88	83	84	3
89	84	85	0
90	85	86	0
91	86	87	0
92	87	88	0
93	88	89	0
94	89	90	0
95	90	91	0
96	91	92	0
97	92	93	0
98	93	94	0
99	94	95	0
100	95	96	0
101	96	97	0
102	97	98	0

BVA	0.	240.000000	290.000000	466.500000	658.000000	688.000000	720.000000	766.000000
BVA	295.000000	829.000000	150.000000	890.000000	999.000000	933.000000	55.000000	975.000000
BVA	996.000000	1035.000000	1072.000000	1100.000000	1125.000000	1142.000000	1158.000000	1169.000000
BVA	1175.000000	1193.000000	1192.000000	1199.000000	1202.000000	1204.000000	1205.000000	1211.000000
BVA	1221.000000	1231.000000	1246.000000	1253.000000	1360.000000	1500.000000	0.	525.000000
BVA	179.000000	833.000000	1107.000000	1119.000000	1900.000000	350.000000	369.000000	482.500000
BVA	570.000000	676.000000	1106.000000	1093.500000	0.	371.000000	274.000000	679.000000
BVA	230.000000	0.	171.000000	677.000000	641.000000	1014.000000	133.000000	0.
BVA	178.000000	570.500000	842.000000	1137.500000	0.	372.000000	839.000000	1153.000000
BVA	0.	371.000000	570.000000	842.500000	1191.500000	0.	371.000000	570.000000
BVA	176.000000	837.000000	1199.000000	0.	371.000000	676.000000	540.000000	942.500000
BVA	1057.000000	1217.500000	1109.000000	1185.000000	1900.000000	0.	1400.000000	725.913040
BVA	1050.264709	1080.777771	450.000000	0.	0.	0.	0.	0.
BVA	0.	240.000000	290.000000	466.500000	658.000000	688.000000	720.000000	766.000000
BVA	466.500000	482.500000	325.000000	570.000000	570.500000	574.000000	50.000000	658.000000
BVA	176.000000	677.000000	478.000000	679.000000	888.000000	720.000000	25.013040	766.000000
BVA	795.000000	829.000000	833.000000	817.000000	839.000000	840.000000	41.000000	842.000000
BVA	842.500000	850.000000	490.000000	905.000000	930.000000	933.000000	42.500000	955.000000
BVA	975.000000	996.000000	1100.000000	1017.000000	1009.000000	1014.000000	135.000000	1050.264709
BVA	1057.000000	1072.000000	1080.777771	1093.500000	1100.000000	1110.000000	125.000000	1133.000000
BVA	1137.500000	1142.000000	1153.000000	1158.000000	1160.000000	1175.000000	1181.500000	1183.000000
BVA	1185.000000	1192.000000	1199.000000	1202.000000	1204.000000	1205.000000	1211.000000	1217.500000
BVA	1221.000000	1231.000000	1246.000000	1253.000000	1360.000000	1500.000000	0.	0.
X	120.000000	0.	0.	0.	0.	0.	0.	0.
RY	150.000000	1	0.	0.	0.	0.	0.	0.
BV	105.000000	103	0.	0.	0.	0.	0.	0.
BV	193.057142	41	0.	0.	0.	0.	0.	0.
BV	197.310001	09	0.	0.	0.	0.	0.	0.
BV	224.086254	48	0.	0.	0.	0.	0.	0.
BV	240.086254	54	0.	0.	0.	0.	0.	0.
BV	294.095238	59	0.	0.	0.	0.	0.	0.
BV	319.064510	64	0.	0.	0.	0.	0.	0.
BV	332.586254	68	0.	0.	0.	0.	0.	0.
BV	368.086254	73	0.	0.	0.	0.	0.	0.
BV	422.586254	79	0.	0.	0.	0.	0.	0.
X	245.000000	0.	0.	0.	0.	0.	0.	0.
RY	155.000000	2	0.	0.	0.	0.	0.	0.
BV	105.000000	103	0.	0.	0.	0.	0.	0.
BV	202.792856	41	0.	0.	0.	0.	0.	0.
BV	219.186529	09	0.	0.	0.	0.	0.	0.
BV	233.857143	48	0.	0.	0.	0.	0.	0.
BV	257.057143	54	0.	0.	0.	0.	0.	0.
BV	303.876984	59	0.	0.	0.	0.	0.	0.
BV	321.000139	64	0.	0.	0.	0.	0.	0.
BV	342.357143	68	0.	0.	0.	0.	0.	0.
BV	377.057143	73	0.	0.	0.	0.	0.	0.
BV	432.357143	79	0.	0.	0.	0.	0.	0.
X	390.000000	0.	0.	0.	0.	0.	0.	0.
RY	160.849957	3	0.	0.	0.	0.	0.	0.
BV	105.000000	103	0.	0.	0.	0.	0.	0.
BV	206.485714	41	0.	0.	0.	0.	0.	0.
BV	217.029016	09	0.	0.	0.	0.	0.	0.
BV	237.563343	48	0.	0.	0.	0.	0.	0.
BV	261.563343	54	0.	0.	0.	0.	0.	0.
BV	307.587303	59	0.	0.	0.	0.	0.	0.
BV	325.505375	64	0.	0.	0.	0.	0.	0.
BV	346.163343	68	0.	0.	0.	0.	0.	0.
BV	381.563343	73	0.	0.	0.	0.	0.	0.
BV	436.063343	79	0.	0.	0.	0.	0.	0.
X	369.500000	0.	0.	0.	0.	0.	0.	0.
RY	161.969938	3	0.	0.	0.	0.	0.	0.

BV	185.000000	103
BV	209.250000	42
BV	221.884348	80
BV	240.225067	48
BV	264.225067	54
BV	310.251984	59
BV	328.159946	64
BV	348.725067	68
BV	384.225067	73
BV	438.725067	79
K	370.000000	
NY	162.266289	3
BV	185.000000	103
BV	210.215458	43
BV	229.950556	80
BV	240.932615	48
BV	264.932613	54
BV	310.960316	59
BV	328.865593	64
BV	349.432613	68
BV	384.932613	73
BV	439.432613	79
K	371.500000	
NY	162.308783	3
BV	185.000000	103
BV	210.539646	43
BV	223.112434	80
BV	241.049261	49
BV	265.060455	55
BV	311.061508	59
BV	328.966396	64
BV	349.506279	69
BV	384.966633	74
BV	439.454098	80
K	375.000000	
NY	162.407932	3
BV	185.000000	103
BV	211.295153	43
BV	223.421502	80
BV	241.394089	49
BV	265.463698	55
BV	311.297619	59
BV	329.422055	65
BV	349.550251	69
BV	384.909546	74
BV	439.132746	80
K	422.250000	
NY	163.746458	3
BV	185.000000	103
BV	221.494493	43
BV	228.310913	80
BV	246.049261	49
BV	271.196896	55
BV	313.683765	60
BV	331.044434	65
BV	350.143845	69
BV	383.844000	74
BV	434.795082	80
K	474.500000	
NY	165.208878	4
BV	185.000000	103
BV	232.773127	43

BV	233.679276	89
BV	251.197044	49
BV	272.544706	55
BV	316.262337	61
BV	333.170235	65
BV	350.800251	69
BV	362.659546	74
BV	429.998360	80
K	543.750000	
NY	165.972586	4
BV	185.000000	103
BV	235.750000	90
BV	258.992857	44
BV	254.078819	49
BV	284.851432	55
BV	317.705845	60
BV	334.360279	65
BV	351.167713	69
BV	361.998116	74
BV	427.313114	80
K	547.500000	
NY	167.114882	4
BV	185.000000	103
BV	238.911744	91
BV	246.242857	44
BV	258.389144	49
BV	286.341503	55
BV	319.864937	60
BV	336.140259	65
BV	351.717335	69
BV	361.008793	74
BV	423.296722	80
K	579.250000	
NY	167.708878	4
BV	185.000000	103
BV	240.844770	91
BV	253.009414	45
BV	260.630543	47
BV	280.892319	55
BV	320.987663	60
BV	337.865845	65
BV	352.015141	71
BV	360.503540	75
BV	421.208199	80
K	572.250000	
NY	167.761097	4
BV	185.000000	103
BV	241.014706	91
BV	253.084906	45
BV	260.827587	49
BV	280.334148	55
BV	321.122471	61
BV	337.147217	65
BV	352.136242	70
BV	360.531841	75
BV	421.024590	80
K	612.000000	
NY	168.708956	4
BV	185.000000	103
BV	244.392157	91
BV	254.584906	45
BV	266.428574	50

BV	=	294.140522	55
BV	=	121.904216	61
BV	=	330.764444	65
BV	=	154.543121	70
BV	=	181.094341	75
BV	=	417.375412	80
X	=	654.000000	
RY	=	169.695561	4
BV	=	247.968703	91
BV	=	256.169811	45
BV	=	272.428574	50
BV	=	299.218952	55
BV	=	326.043464	61
BV	=	400.473232	65
BV	=	457.886230	70
BV	=	381.688683	75
BV	=	413.519672	80
BV	=	415.000000	104
X	=	647.000000	
RY	=	172.700001	5
BV	=	249.065359	91
BV	=	256.660378	45
BV	=	274.285713	50
BV	=	300.790848	55
BV	=	327.753223	61
BV	=	341.002144	65
BV	=	357.871308	70
BV	=	381.072643	75
BV	=	412.426229	80
BV	=	415.000000	104
X	=	676.500000	
RY	=	175.549999	5
BV	=	249.872549	91
BV	=	257.063057	46
BV	=	275.642957	50
BV	=	301.939541	55
BV	=	328.418049	61
BV	=	341.388653	65
BV	=	358.448627	70
BV	=	382.055931	76
BV	=	411.535941	81
BV	=	415.000000	104
X	=	677.500000	
RY	=	175.850000	5
BV	=	249.957516	91
BV	=	257.189171	46
BV	=	275.785713	50
BV	=	302.047256	56
BV	=	328.468029	61
BV	=	341.429337	65
BV	=	358.509174	70
BV	=	382.187702	76
BV	=	414.605133	81
BV	=	415.000000	104
X	=	678.500000	
RY	=	176.150000	5
BV	=	250.066454	92
BV	=	257.315245	46
BV	=	275.928574	50
BV	=	302.141749	56
BV	=	328.558044	61
BV	=	341.470020	65

BV	=	158.569725	70
BV	=	182.279503	76
BV	=	411.675304	81
BV	=	415.000000	104
X	=	643.500000	
RY	=	177.650000	5
BV	=	250.950968	92
BV	=	257.945858	46
BV	=	276.457172	51
BV	=	302.614330	56
BV	=	328.907921	61
BV	=	341.673447	65
BV	=	358.872478	70
BV	=	382.838509	76
BV	=	412.025913	81
BV	=	415.000000	104
X	=	744.000000	
RY	=	180.000000	6
BV	=	254.495443	92
BV	=	260.531208	46
BV	=	278.939041	51
BV	=	304.551830	56
BV	=	330.342545	61
BV	=	342.507496	65
BV	=	360.413762	70
BV	=	385.130436	76
BV	=	412.463413	81
BV	=	415.000000	104
X	=	722.956520	
RY	=	181.578449	7
BV	=	257.773129	92
BV	=	267.921906	46
BV	=	284.465782	51
BV	=	308.343452	56
BV	=	331.669151	61
BV	=	343.278744	65
BV	=	361.261599	70
BV	=	387.249798	76
BV	=	414.792643	81
BV	=	415.000000	104
X	=	745.956520	
RY	=	186.078449	7
BV	=	261.749901	92
BV	=	265.022540	46
BV	=	289.802357	51
BV	=	308.517231	56
BV	=	333.278725	61
BV	=	344.214504	65
BV	=	362.654251	70
BV	=	389.821224	76
BV	=	415.000000	104
X	=	746.500000	
RY	=	195.000000	8
BV	=	267.225800	92
BV	=	270.178978	46
BV	=	286.311752	51
BV	=	311.782013	56
BV	=	335.696133	61
BV	=	345.619215	65
BV	=	364.745872	70
BV	=	393.683228	76

BV =	418.000000	104
BV =	418.027744	81
X =	412.000000	
BV =	205.000000	9
BV =	273.169033	92
BV =	274.151592	46
BV =	289.511951	51
BV =	114.759148	56
BV =	137.960555	61
BV =	148.901501	65
BV =	166.653214	70
BV =	197.204947	76
BV =	415.000000	104
BV =	421.036567	81
X =	411.000000	
BV =	210.952381	10
BV =	276.454193	92
BV =	276.547768	46
BV =	291.442730	51
BV =	116.554878	56
BV =	139.230206	61
BV =	147.674519	65
BV =	167.403673	70
BV =	199.129193	76
BV =	415.000000	104
BV =	422.368904	81
X =	415.000000	
BV =	212.857143	10
BV =	277.114449	47
BV =	277.300277	93
BV =	291.444606	51
BV =	116.932926	56
BV =	139.510132	61
BV =	147.337261	65
BV =	168.046872	70
BV =	199.776338	76
BV =	415.000000	104
BV =	422.649331	81
X =	418.000000	
BV =	214.285715	10
BV =	277.586124	47
BV =	278.073196	93
BV =	292.153369	51
BV =	117.216465	56
BV =	139.720074	61
BV =	147.959316	65
BV =	168.227524	70
BV =	400.027622	77
BV =	415.000000	104
BV =	422.859756	81
X =	419.500000	
BV =	215.000000	10
BV =	277.821964	47
BV =	278.455154	93
BV =	292.305779	51
BV =	117.358231	56
BV =	139.825047	61
BV =	148.044506	66
BV =	168.318352	70
BV =	400.069061	77
BV =	415.000000	104
BV =	422.964919	81

X =	440.500000	
BV =	215.476191	10
BV =	277.479191	47
BV =	278.709793	93
BV =	292.407372	51
BV =	117.452744	56
BV =	139.455027	61
BV =	148.153755	66
BV =	168.378902	70
BV =	400.096604	77
BV =	415.000000	104
BV =	423.117073	82
X =	441.500000	
BV =	215.952381	10
BV =	278.136414	47
BV =	278.964432	93
BV =	292.508965	51
BV =	117.510117	57
BV =	139.965012	61
BV =	148.229227	66
BV =	168.439453	70
BV =	400.124310	77
BV =	415.000000	104
BV =	423.351219	82
X =	442.250000	
BV =	216.309526	10
BV =	278.254333	47
BV =	279.155411	93
BV =	292.585159	51
BV =	117.525221	57
BV =	148.021149	62
BV =	148.269806	65
BV =	168.444443	70
BV =	400.145027	77
BV =	415.000000	104
BV =	423.526829	82
X =	446.250000	
BV =	218.214297	10
BV =	278.883236	47
BV =	280.173949	93
BV =	292.491535	51
BV =	117.606216	57
BV =	148.359558	62
BV =	148.646496	66
BV =	168.804243	70
BV =	400.255524	77
BV =	415.000000	104
BV =	424.463417	82
X =	470.000000	
BV =	225.000000	11
BV =	282.617340	47
BV =	286.221649	93
BV =	295.404365	51
BV =	118.086774	57
BV =	149.368846	62
BV =	150.764328	66
BV =	170.730027	70
BV =	400.911602	77
BV =	415.000000	104
BV =	430.024391	82
X =	497.500000	
BV =	234.999999	12

BV =	288.941040	47
BV =	293.224228	93
BV =	298.198286	51
BV =	318.643063	57
BV =	344.699431	66
BV =	353.216580	66
BV =	379.981651	71
BV =	401.671268	77
BV =	445.000000	104
BV =	436.463417	82
K =	917.500000	
NY =	244.464285	13
BV =	298.085548	47
BV =	298.317209	93
BV =	308.538860	51
BV =	319.047688	57
BV =	346.367478	62
BV =	355.000000	66
BV =	374.584072	71
BV =	402.223755	77
BV =	445.000000	104
BV =	441.146343	82
K =	931.500000	
NY =	249.464285	13
BV =	292.986785	47
BV =	301.549343	52
BV =	301.821438	94
BV =	319.330925	57
BV =	347.571911	62
BV =	356.248405	66
BV =	376.719745	71
BV =	402.610497	77
BV =	445.000000	104
BV =	444.424393	82
K =	937.750000	
NY =	252.159090	14
BV =	293.269363	47
BV =	301.754932	52
BV =	303.160713	94
BV =	319.457371	57
BV =	348.100677	62
BV =	356.805733	66
BV =	376.226768	71
BV =	402.783150	77
BV =	445.000000	104
BV =	445.887806	82
K =	948.750000	
NY =	257.159090	14
BV =	294.998844	47
BV =	302.116776	52
BV =	305.517857	94
BV =	319.679913	57
BV =	349.831383	62
BV =	357.786621	66
BV =	377.119102	71
BV =	403.087017	77
BV =	445.000000	104
BV =	445.144104	83
BV =	447.939850	85
K =	965.000000	
NY =	265.000000	15
BV =	297.553757	47

BV =	302.891314	92
BV =	309.000000	94
BV =	329.804671	57
BV =	350.406090	62
BV =	359.235668	66
BV =	378.437317	71
BV =	403.535912	77
BV =	415.000000	104
BV =	448.818775	86
BV =	450.383457	85
K =	985.500000	
NY =	275.000000	16
BV =	308.776678	47
BV =	303.325657	52
BV =	313.362867	94
BV =	328.423412	57
BV =	352.148438	62
BV =	361.063694	66
BV =	388.408296	71
BV =	404.102211	77
BV =	445.000000	104
BV =	434.231441	83
BV =	453.466164	85
K =	1001.000000	
NY =	281.282851	17
BV =	303.213871	47
BV =	303.835296	52
BV =	316.714287	94
BV =	328.736996	57
BV =	353.451775	62
BV =	369.445858	66
BV =	381.357670	71
BV =	404.538364	77
BV =	415.000000	104
BV =	429.628819	83
BV =	455.796993	85
K =	1006.500000	
NY =	282.692307	17
BV =	304.017143	51
BV =	317.892857	94
BV =	328.448267	57
BV =	353.917088	62
BV =	369.936386	66
BV =	381.803837	71
BV =	404.682390	77
BV =	415.000000	104
BV =	427.995632	83
BV =	456.624058	85
K =	1008.000000	
NY =	283.076923	17
BV =	304.868573	54
BV =	318.428570	95
BV =	328.478613	57
BV =	354.043991	62
BV =	363.878041	66
BV =	381.925518	71
BV =	404.723755	77
BV =	415.000000	104
BV =	427.558217	83
BV =	456.849625	85
K =	1011.500000	
NY =	283.974358	17

BV =	104.188572	53
BV =	110.928570	95
BV =	120.949491	57
BV =	154.340049	62
BV =	163.362164	66
BV =	182.209418	71
BV =	404.820442	77
BV =	415.000000	104
BV =	424.510918	83
BV =	457.781250	86
X =	1094.500000	
BV =	297.307093	17
BV =	104.634225	53
BV =	121.352940	50
BV =	124.020000	96
BV =	155.439934	62
BV =	164.541441	66
BV =	183.264011	71
BV =	405.179558	77
BV =	415.000000	104
BV =	422.650654	83
BV =	461.643750	86
X =	1042.642355	
BV =	292.062798	18
BV =	105.255966	53
BV =	121.462433	50
BV =	129.285214	96
BV =	156.973972	62
BV =	166.158228	66
BV =	184.734924	71
BV =	405.680450	77
BV =	415.000000	104
BV =	417.266373	83
BV =	467.520113	86
X =	1053.642355	
BV =	295.035770	18
BV =	105.633110	53
BV =	122.332100	50
BV =	139.399021	96
BV =	157.004598	62
BV =	167.139191	66
BV =	185.627254	71
BV =	405.984318	77
BV =	414.000000	83
BV =	415.000000	104
BV =	470.947613	86
X =	1044.500000	
BV =	297.922973	18
BV =	104.005714	53
BV =	122.697479	50
BV =	134.524741	96
BV =	150.324028	62
BV =	168.108240	66
BV =	184.508850	71
BV =	404.284511	77
BV =	413.630840	83
BV =	415.000000	104
BV =	474.343750	86
X =	1076.388885	
BV =	301.428940	19
BV =	106.413314	53
BV =	123.097103	58

BV =	138.944233	96
BV =	159.929853	62
BV =	169.168834	66
BV =	187.473286	71
BV =	406.612953	77
BV =	414.630840	84
BV =	415.000000	104
BV =	478.059029	86
X =	1047.136885	
BV =	304.928940	19
BV =	106.781986	53
BV =	123.458450	58
BV =	142.036137	96
BV =	160.739310	62
BV =	170.127833	66
BV =	188.345317	71
BV =	406.909912	77
BV =	415.000000	104
BV =	415.535046	84
BV =	481.418444	86
X =	1046.750000	
BV =	308.500000	20
BV =	123.781513	58
BV =	144.800476	96
BV =	161.552452	62
BV =	170.984074	66
BV =	189.125000	71
BV =	407.175415	77
BV =	415.000000	104
BV =	416.343456	84
BV =	484.421875	86
X =	1109.500000	
BV =	313.799999	21
BV =	124.210083	58
BV =	148.467621	96
BV =	162.631134	62
BV =	172.121017	66
BV =	190.159294	71
BV =	407.527622	77
BV =	415.000000	104
BV =	417.415886	84
BV =	488.406250	86
X =	1122.000000	
BV =	318.799999	21
BV =	124.630253	58
BV =	153.437840	97
BV =	163.608663	62
BV =	173.235668	66
BV =	191.173306	71
BV =	407.872929	77
BV =	415.000000	104
BV =	418.467289	84
BV =	492.312500	86
X =	1129.000000	
BV =	322.500000	22
BV =	124.865547	58
BV =	156.659462	97
BV =	164.280840	62
BV =	173.859871	66
BV =	191.741150	71
BV =	408.066296	77
BV =	415.000000	104

BV	=	419.056072	84
BV	=	494.500000	86
X	=	1135.250000	
NY	=	326.250000	23
BV	=	363.321621	97
BV	=	364.809643	62
BV	=	374.417194	66
BV	=	392.248158	71
BV	=	408.236949	77
BV	=	415.000000	104
BV	=	419.581776	84
BV	=	496.453125	86
X	=	1139.750000	
NY	=	328.750000	23
BV	=	369.247293	63
BV	=	366.596775	98
BV	=	374.816470	66
BV	=	392.413201	71
BV	=	408.363298	77
BV	=	415.000000	104
BV	=	419.960278	84
BV	=	497.859375	86
X	=	1147.500000	
NY	=	333.437500	24
BV	=	366.096900	63
BV	=	372.096775	98
BV	=	379.509592	66
BV	=	393.241890	71
BV	=	408.577367	77
BV	=	415.000000	104
BV	=	420.612148	84
BV	=	500.281250	86
X	=	1155.500000	
NY	=	338.437500	24
BV	=	366.978024	63
BV	=	376.256409	67
BV	=	377.754387	99
BV	=	393.890854	71
BV	=	408.798348	77
BV	=	415.000000	104
BV	=	421.285046	84
BV	=	502.781250	86
X	=	1163.500000	
NY	=	344.999996	25
BV	=	367.887142	63
BV	=	377.076920	67
BV	=	383.368423	99
BV	=	394.539822	71
BV	=	409.819337	77
BV	=	415.000000	104
BV	=	421.987943	84
BV	=	505.281250	86
X	=	1172.000000	
NY	=	354.999996	26
BV	=	368.791210	63
BV	=	377.948715	67
BV	=	384.335336	99
BV	=	395.229351	71
BV	=	409.254143	77
BV	=	415.000000	104
BV	=	422.672897	84
BV	=	507.937500	86

X	=	1178.250000	
NY	=	344.062500	27
BV	=	369.478824	63
BV	=	378.589741	67
BV	=	393.719299	99
BV	=	395.736359	71
BV	=	409.426796	77
BV	=	415.000000	104
BV	=	423.198597	84
BV	=	509.890625	86
X	=	1182.250000	
NY	=	369.062500	27
BV	=	369.917583	63
BV	=	379.000000	67
BV	=	396.146343	72
BV	=	396.599998	100
BV	=	409.537292	77
BV	=	415.000000	104
BV	=	423.535046	84
BV	=	511.140625	86
X	=	1184.000000	
NY	=	371.111115	28
BV	=	379.179485	67
BV	=	396.487804	72
BV	=	398.000000	100
BV	=	409.585636	77
BV	=	415.000000	104
BV	=	427.682243	84
BV	=	511.687500	86
X	=	1188.500000	
NY	=	376.111111	28
BV	=	379.641026	67
BV	=	397.365856	72
BV	=	401.599998	100
BV	=	409.709946	77
BV	=	415.000000	104
BV	=	424.068745	84
BV	=	512.166672	87
X	=	1195.500000	
NY	=	385.000000	29
BV	=	398.731709	72
BV	=	407.200001	100
BV	=	409.903313	77
BV	=	415.000000	104
BV	=	424.649532	84
BV	=	512.500000	87
X	=	1200.500000	
NY	=	394.999992	30
BV	=	399.767317	72
BV	=	410.000000	76
BV	=	411.249996	101
BV	=	415.000000	104
BV	=	425.078091	84
BV	=	512.738098	87
X	=	1203.000000	
NY	=	405.000000	31
BV	=	410.000000	78
BV	=	413.333332	101
BV	=	415.000000	104
BV	=	425.280373	84
BV	=	512.857147	87
X	=	1204.500000	

BY = 412.500000	32
BV = 414.583332	101
BV = 415.000000	104
BV = 425.406540	84
BV = 512.920574	87
X = 1208.000000	
BV = 415.000000	104
BV = 417.499996	33
BV = 425.700932	84
BV = 513.095238	87
X = 1214.250000	
BV = 415.000000	104
BV = 423.250000	34
BV = 426.226635	84
BV = 513.302040	87
X = 1219.250000	
BV = 415.000000	104
BV = 428.250000	35
BV = 513.630951	87
X = 1226.000000	
BV = 415.000000	104
BV = 435.000000	36
BV = 513.952385	87
X = 1238.500000	
BV = 415.000000	104
BV = 445.000000	37
BV = 514.547628	87
X = 1249.500000	
BV = 415.000000	104
BV = 460.250004	38
BV = 515.071476	87
X = 1306.500000	
BV = 415.000000	104
BV = 470.500000	39
BV = 517.785713	87
X = 1430.000000	
BV = 415.000000	104
BV = 470.500000	40
BV = 523.666672	87

LĀ PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NO. OF POINTS TO DESCRIBE FAILURE SURFACES = 7
 NO. OF FAILURE SURFACE DESCRIPTION CARDS = 2
 MAX. NO. OF COLUMNS TO DESCRIBE FAIL. SURF. = 4
 NO. OF BLOCKS OF SUBSTITUTE SOIL TYPES = 0
 NO. OF ALTERNATE F(X) DISTRIBUTIONS = 0

FAILURE SURFACE POINTS

POINT NO.	X-COORDINATE	Y-COORDINATE	F(X)
1	600.00	167.00	1.00
	0.00	950.00	378.00
	1.00	0.00	1205.00
	409.00	1.00	0.00
	525.00	166.00	1.00
	0.00	975.00	463.00
	1.00	0.00	1250.00
	488.00	1.00	0.00
	1285.00	459.50	1.00

FAILURE SURFACE DESCRIPTION

SURFACE NO.	POINTS TO DESCRIBE THE SURFACE						
1	1	2	3	0			
2	4	5	6	7			

SOIL DATA

NO	WET	SAT	COH	F1	RII	EQ
1	135.0	135.0	1000.0	0.	0.	0.
2	135.0	135.0	2000.0	0.580	0.	0.
3	135.0	135.0	3000.0	0.640	0.	0.
4	135.0	135.0	5400.0	0.575	0.	0.

SURFACE NUMBER 1, 1 (SPECIFIED)

SURFACE DEFINED BY#	PLANT	X	Y	F(X)
1=	1	600.00	167.00	1.00
2=	2	950.00	370.00	1.00
3=	3	1205.00	409.00	1.00

1'S.I.T 0 0
1'S.I.T 0 2

X-COORD.	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
629.84	-89.	-36.	146.47	9.309	-436.53	1.00	1.00
650.00	17887.	7197.	0.99	0.036	3.80	1.00	1.00
658.00	29280.	11780.	1.89	0.059	4.71	1.00	1.00
676.00	60046.	24490.	3.55	0.095	1.53	1.00	1.00
677.00	62788.	25262.	3.64	0.096	1.49	1.00	1.00
678.00	64750.	26051.	3.72	0.098	1.46	1.00	1.00
679.00	66732.	26848.	3.81	0.099	1.43	1.00	1.00
680.00	68661.	27644.	3.90	0.112	1.19	1.00	1.00
720.00	173030.	64616.	6.94	0.119	0.84	1.00	1.00
725.91	190096.	77661.	7.35	0.121	1.78	1.00	1.00
761.68	333844.	134316.	9.85	0.131	1.56	1.00	1.00
766.00	353170.	142095.	10.15	0.132	1.54	1.00	1.00
768.68	365363.	146997.	10.34	0.133	1.53	1.00	1.00
795.00	392040.	156050.	14.70	0.174	1.93	1.00	1.00
801.44	400454.	161115.	15.70	0.181	1.02	1.00	1.00
820.00	457520.	184078.	18.92	0.199	1.22	1.00	1.00
833.00	466419.	187656.	19.35	0.203	1.24	1.00	1.00
837.00	475379.	191261.	19.78	0.206	1.26	1.00	1.00
839.00	479885.	193073.	20.00	0.208	1.27	1.00	1.00
840.00	482144.	193882.	20.10	0.208	1.28	1.00	1.00
841.00	484408.	194693.	20.21	0.209	1.28	1.00	1.00
842.00	486676.	195505.	20.31	0.210	1.29	1.00	1.00
842.50	487811.	196262.	20.37	0.210	1.29	1.00	1.00
849.94	504044.	203115.	21.15	0.216	1.33	1.00	1.00
850.00	504931.	203150.	21.15	0.216	1.33	1.00	1.00
890.00	576110.	231780.	26.05	0.233	1.65	1.00	1.00
894.31	584703.	235245.	26.52	0.238	1.68	1.00	1.00
908.00	614200.	247116.	27.34	0.247	1.72	1.00	1.00
910.87	630475.	253661.	27.80	0.247	1.74	1.00	1.00
930.00	670416.	269730.	29.86	0.255	1.86	1.00	1.00
933.00	676933.	272352.	30.17	0.256	1.88	1.00	1.00
942.50	697066.	280702.	31.14	0.261	1.93	1.00	1.00
948.51	711348.	286199.	31.75	0.264	1.96	1.00	1.00
950.00	715022.	286830.	31.84	0.265	1.96	1.00	1.00
955.00	697959.	280811.	31.24	0.263	1.99	1.00	1.00
976.00	628117.	252712.	28.79	0.250	1.12	1.00	1.00
996.00	558222.	224591.	26.13	0.252	2.27	1.00	1.00
1006.00	525898.	211586.	24.84	0.243	1.33	1.00	1.00
1007.00	522682.	210292.	24.71	0.242	1.34	1.00	1.00
1008.00	516258.	207707.	24.46	0.240	1.36	1.00	1.00
1014.00	500250.	201267.	23.81	0.235	2.41	1.00	1.00
1035.00	433820.	174540.	21.11	0.215	2.65	1.00	1.00
1050.24	386382.	155454.	19.16	0.199	1.87	1.00	1.00
1057.00	365691.	147120.	18.30	0.192	2.98	1.00	1.00
1072.00	320139.	126802.	16.39	0.177	3.26	1.00	1.00
1080.70	293808.	114232.	15.28	0.168	1.46	1.00	1.00
1093.50	256399.	103158.	13.68	0.155	1.80	1.00	1.00
1100.00	237506.	95598.	12.87	0.149	3.94	1.00	1.00
1119.00	184188.	74105.	10.49	0.130	1.50	1.00	1.00
1125.00	167778.	67503.	9.75	0.123	1.75	1.00	1.00
1133.00	146395.	58899.	8.77	0.117	5.09	1.00	1.00
1137.50	134660.	54178.	8.21	0.112	5.29	1.00	1.00
1142.00	123117.	49534.	7.66	0.107	1.51	1.00	1.00
1153.00	95799.	36543.	6.32	0.096	1.20	1.00	1.00
1158.00	83821.	33724.	5.72	0.090	1.64	1.00	1.00
1169.00	58810.	24661.	4.42	0.081	2.68	1.00	1.00
1175.00	46341.	16645.	3.70	0.082	7.81	1.00	1.00
1181.50	34010.	11663.	2.89	0.076	1.46	1.00	1.00
1183.00	31312.	12598.	2.70	0.074	8.66	1.00	1.00
1185.00	27794.	11103.	2.45	0.071	0.23	1.00	1.00
1192.00	16164.	6503.	1.54	0.056	12.75	1.00	1.00
1196.45	9367.	3777.	0.97	0.045	14.30	1.00	1.00
1199.00	5760.	2317.	0.63	0.035	21.36	1.00	1.00
1202.00	1916.	771.	0.24	0.028	28.87	1.00	1.00
1203.77	0.	0.	0.	0.	0.	1.00	1.00

F = 2.116 LAMBDA = 0.4021 K = 7 0)

SURFACE NUMBER 2, 1 (SPECIFIED)				
SURFACE DEFINED BY#	POINT	X	Y	F(X)
4-	4	525.00	166.00	1.00
5-	5	975.00	463.00	1.00
6-	6	1250.00	488.00	1.00
7-	7	1285.00	459.50	1.00

INS.IT 0 0
INS.IT 0 2

X-COORD.	F	X-FORCE	Y-YI	Y-YI/Y-Z	VERT F	SMALL F	PORE PRES
553.79	5355.	5355.	1891.	-0.49	9.37	1.00	1.00
570.00	24860.	24860.	8779.	2.72	0.097	3.19	1.00
570.50	25653.	25653.	4059.	2.78	0.098	3.13	1.00
574.00	31524.	31524.	1133.	3.24	0.106	2.74	1.00
648.47	289427.	289427.	102211.	11.35	0.146	0.76	1.00
650.00	297392.	297392.	105021.	11.51	0.146	0.75	1.00
658.00	346758.	346758.	120339.	12.34	0.147	0.70	1.00
662.00	363860.	363860.	124497.	12.77	0.150	0.66	1.00
676.00	396398.	396398.	140663.	15.75	0.174	0.94	1.00
677.00	400878.	400878.	141577.	15.95	0.176	0.95	1.00
678.00	401503.	401503.	142497.	16.16	0.178	0.97	1.00
679.00	40124.	406124.	143423.	16.36	0.179	0.98	1.00
688.00	430399.	430399.	151996.	18.12	0.192	1.11	1.00
693.97	447373.	447373.	157990.	19.23	0.196	1.19	1.00
720.00	548975.	548975.	193870.	22.90	0.201	1.34	1.00
725.91	574483.	574483.	202879.	23.65	0.203	1.36	1.00
740.10	638637.	638637.	225535.	25.41	0.207	1.41	1.00
766.00	740394.	748394.	264292.	29.04	0.215	1.58	1.00
767.31	823442.	823442.	290799.	31.16	0.222	1.66	1.00
795.00	893649.	893649.	315592.	32.46	0.225	1.68	1.00
798.25	911977.	911977.	322065.	32.79	0.226	1.69	1.00
829.00	1071095.	1071095.	37257.	36.64	0.234	1.82	1.00
830.74	1080513.	1080523.	381587.	36.86	0.235	1.82	1.00
833.00	1094546.	1094546.	386539.	37.07	0.236	1.83	1.00
837.00	1119400.	1119400.	39337.	37.46	0.237	1.83	1.00
839.00	1131967.	1131967.	39754.	37.66	0.238	1.84	1.00
840.00	1132233.	1132233.	401967.	37.76	0.238	1.84	1.00
841.00	1144506.	1144506.	404183.	37.86	0.238	1.84	1.00
842.00	1154789.	1154789.	406401.	37.95	0.239	1.84	1.00
842.50	1153933.	1153933.	407511.	38.00	0.239	1.84	1.00
850.00	1201343.	1201343.	424254.	38.76	0.241	1.85	1.00
861.40	1409902.	1409902.	497907.	41.94	0.242	1.87	1.00
890.00	1458645.	1458645.	515120.	43.13	0.244	1.91	1.00
902.27	1529127.	1529127.	540036.	44.82	0.253	2.00	1.00
905.00	1544849.	1544869.	545571.	45.20	0.256	2.01	1.00
930.00	1692825.	1692825.	597821.	48.58	0.263	2.13	1.00
933.00	1711158.	1711158.	604296.	48.98	0.264	2.14	1.00
942.50	1769832.	1769832.	625016.	50.22	0.268	2.18	1.00
948.20	1805411.	1805411.	637581.	50.96	0.270	2.21	1.00
953.19	1836870.	1836870.	646698.	51.61	0.272	2.23	1.00
955.00	1849206.	1849206.	653047.	51.82	0.273	2.23	1.00
975.00	1987139.	1987139.	701758.	54.14	0.281	2.29	1.00
996.00	1875706.	1675706.	662476.	51.69	0.260	2.38	1.00
1006.00	1823701.	1823701.	644040.	50.50	0.276	2.41	1.00
1007.00	1814520.	1818520.	642211.	50.39	0.275	2.42	1.00
1009.00	1800170.	1800170.	638255.	50.15	0.274	2.43	1.00
1014.00	1783366.	1782356.	629439.	49.55	0.272	2.46	1.00
1035.00	1674917.	1674917.	591497.	47.05	0.264	2.58	1.00
1050.00	1599051.	1599051.	564705.	45.25	0.257	2.67	1.00
1050.26	1597775.	1597775.	564254.	45.22	0.257	2.67	1.00
1057.00	1561899.	1561899.	551585.	44.47	0.255	2.71	1.00
1072.00	1482532.	1482532.	523556.	42.81	0.249	2.81	1.00
1080.78	1436445.	1436465.	507288.	41.85	0.247	2.88	1.00
1093.50	1370278.	1370278.	483914.	40.45	0.243	2.97	1.00
1100.00	1336780.	1336780.	47094.	39.74	0.242	3.00	1.00
1119.00	1243277.	1240237.	438008.	37.66	0.238	3.09	1.00
1125.00	1211276.	1210236.	427395.	37.00	0.236	3.12	1.00
1133.00	1173611.	1170611.	413491.	36.12	0.237	3.15	1.00
1137.50	1148522.	1148542.	405622.	35.62	0.237	3.16	1.00
1142.00	1126733.	1126723.	397902.	35.12	0.237	3.18	1.00
1153.00	1074033.	1074043.	375313.	33.89	0.238	3.20	1.00
1158.00	1050543.	1050543.	370999.	33.32	0.239	3.22	1.00
1169.00	999918.	999918.	353121.	32.05	0.245	3.21	1.00
1175.00	974367.	973307.	343723.	31.33	0.259	3.17	1.00
1181.50	945479.	945479.	330896.	30.52	0.269	3.14	1.00
1183.00	939133.	939133.	331672.	30.33	0.271	3.13	1.00
1185.00	930867.	930867.	32732.	30.08	0.274	3.14	1.00
1192.00	902297.	902297.	316646.	29.16	0.284	3.14	1.00
1199.00	874794.	874784.	308930.	28.22	0.302	3.09	1.00
1202.00	863512.	863512.	304949.	27.79	0.332	3.00	1.00
1204.00	856351.	856351.	302420.	27.50	0.373	2.95	1.00
1205.00	852904.	852904.	301203.	27.35	0.397	2.86	1.00
1211.00	831788.	831788.	293746.	26.39	0.409	2.81	1.00
1217.50	808590.	808590.	284847.	25.23	0.431	2.74	1.00
1221.00	792019.	792019.	274702.	24.56	0.444	2.70	1.00
1231.00	746525.	746525.	263635.	22.51	0.486	2.58	1.00
1244.00	679475.	679475.	239443.	19.45	0.517	2.48	1.00
1250.00	652878.	652878.	231564.	18.45	0.571	2.38	1.00
1253.00	564234.	564234.	19259.	16.98	0.664	2.32	1.00
1284.30	0.	0.	0.	0.	0.	1.00	1.00

F = 2.595 LAMBDA = 0.353(7 A 0)
STOP AT LINE 5.....

EXAMPLE NO. 5

Conventional Stability Analysis Section After Canal
Deepening-Total Stress Analysis Using Laboratory
Strengths With Acceleration = 0.0

MARGENSTERN AND PRICE METHOD OF SLOPE STABILITY ANALYSIS - DON BARKS
 LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NUMBER OF POINTS	=	95
NUMBER OF LINES	=	109
NUMBER OF MATERIALS	=	4
YDM	=	185.00
XM	=	650.00
YDP	=	415.00

POINT DESCRIPTION

POINT NO.	NO. LINES	X-COORDINATE	Y-COORDINATE				
1	1	0.	190.00	60	2	477.00	302.00
2	2	240.00	190.00	61	2	841.00	357.50
3	2	290.00	140.00	62	4	1014.00	321.00
4	2	464.50	165.00	63	3	1133.00	325.00
5	2	650.00	170.00	64	1	0.	286.00
6	2	688.00	179.00	65	2	378.00	351.50
7	2	720.00	181.00	66	2	570.50	321.00
8	2	764.00	190.00	67	2	842.00	340.00
9	2	795.00	200.00	68	4	1137.50	365.00
10	2	820.00	210.00	69	1	0.	304.00
11	2	850.00	220.00	70	2	372.00	329.00
12	2	890.00	230.00	71	2	830.00	348.00
13	2	905.00	240.00	72	4	1153.00	376.00
14	2	933.00	250.00	73	1	0.	324.50
15	2	955.00	260.00	74	2	371.00	349.50
16	2	975.00	270.00	75	2	570.00	352.00
17	2	994.00	280.00	76	2	842.50	368.50
18	2	1039.00	290.00	77	4	1181.50	396.00
19	2	1072.00	300.00	78	1	0.	360.00
20	2	1100.00	310.00	79	2	371.00	385.00
21	2	1129.00	320.00	80	2	570.00	380.50
22	2	1142.00	330.00	81	2	676.00	382.00
23	2	1158.00	340.00	82	2	837.00	400.00
24	2	1169.00	350.00	83	4	1194.00	450.00
25	2	1175.00	360.00	84	1	0.	414.50
26	3	1183.00	370.00	85	2	371.00	439.50
27	3	1192.00	380.00	86	2	676.00	451.50
28	2	1199.00	390.00	87	2	840.00	423.00
29	3	1202.00	400.00	88	3	942.50	447.00
30	3	1204.00	410.00	89	2	1057.00	453.00
31	4	1205.00	415.00	90	3	1217.50	426.50
32	2	1211.00	420.00	91	2	1009.00	457.00
33	2	1221.00	430.00	92	2	1185.00	552.00
34	2	1231.00	440.00	93	1	1500.00	527.00
35	2	1246.00	450.00	94	1	0.	550.00
36	2	1253.00	470.50	95	1	1500.00	550.00
37	2	1360.00	470.50				
38	1	1500.00	470.50				
39	2	0.	165.00				
40	2	525.00	237.00				
41	2	678.00	250.00				
42	4	833.00	276.80				
43	2	1007.00	318.00				
44	2	1119.00	351.20				
45	1	1500.00	415.00				
46	2	350.00	208.50				
47	2	369.00	210.00				
48	4	488.00	234.50				
49	2	874.00	257.00				
50	3	1006.00	304.00				
51	3	1093.50	307.00				
52	1	0.	216.00				
53	2	371.00	241.00				
54	2	574.00	261.00				
55	2	679.00	276.00				
56	4	930.00	301.50				
57	1	0.	240.00				
58	2	371.00	245.00				

LINE DESCRIPTION

LINE NO.	POINT 1	POINT 2	MATERIAL
1	1	2	1
2	2	3	1
3	3	4	1
4	4	5	1
5	5	6	1
6	6	7	1
7	7	8	1
8	8	9	1
9	9	10	1
10	10	11	1
11	11	12	1
12	12	13	1
13	13	14	1
14	14	15	1
15	15	16	1
16	16	17	1
17	17	18	1
18	18	19	1
19	19	20	1
20	20	21	2
21	21	22	2
22	22	23	3
23	23	24	3
24	24	25	3
25	25	26	3
26	26	27	2
27	27	28	3
28	28	29	3
29	29	30	2
30	30	31	4
31	31	32	4
32	32	33	4
33	33	34	4
34	34	35	4
35	35	36	4
36	36	37	4
37	37	38	4
38	38	39	4
39	39	40	3
40	40	41	3
41	41	42	3
42	42	43	3
43	43	44	3
44	44	45	3
45	45	46	3
46	46	47	3
47	47	48	2
48	48	49	2
49	49	50	2
50	50	51	2
51	51	52	2
52	52	53	2
53	53	54	2
54	54	55	2
55	55	56	2
56	56	57	2
57	57	58	2
58	58	59	2
		60	2
		61	2
		62	2
		63	2

59	64	65	2
60	65	66	2
61	66	67	2
62	67	68	2
63	68	69	2
64	69	70	3
65	70	71	3
66	71	72	3
67	72	73	3
68	73	74	2
69	74	75	2
70	75	76	2
71	76	77	2
72	77	78	2
73	78	79	4
74	79	80	4
75	80	81	4
76	81	82	4
77	82	83	4
78	83	84	4
79	84	85	3
80	85	86	3
81	86	87	3
82	87	88	3
83	88	89	4
84	89	90	4
85	90	91	3
86	91	92	3
87	92	93	3
88	93	94	3
89	94	95	3
90	95	96	0
91	96	97	0
92	97	98	0
93	98	99	0
94	99	100	0
95	100	101	0
96	101	102	0
97	102		0
98			0
99			0
100			0
101			0
102			0

BVA	0.	240.000000	290.000000	466.500000	658.000000	688.000000	720.000000	766.000000
BVA	795.000000	829.000000	950.000000	890.000000	905.000000	933.000000	955.000000	975.000000
BVA	996.000000	1035.000000	1072.000000	1100.000000	1125.000000	1142.000000	1158.000000	1169.000000
BVA	1175.000000	1183.000000	1192.000000	1199.000000	1202.000000	1204.000000	1205.000000	1211.000000
BVA	1221.000000	1231.000000	1246.000000	1253.000000	1360.000000	1500.000000	0.	525.000000
BVA	678.000000	833.000000	1007.000000	1119.000000	1500.000000	350.000000	369.000000	482.500000
BVA	570.000000	676.000000	1006.000000	1093.500000	0.	371.000000	574.000000	679.000000
BVA	930.000000	0.	371.000000	677.000000	841.000000	1014.000000	1133.000000	0.
BVA	378.000000	570.500000	842.000000	1137.500000	0.	372.000000	839.000000	1153.000000
BVA	0.	371.000000	570.000000	842.500000	1181.500000	0.	371.000000	570.000000
BVA	676.000000	837.000000	1199.000000	0.	371.000000	676.000000	840.000000	942.500000
BVA	1057.000000	1217.500000	1009.000000	1185.000000	1500.000000	0.	1500.000000	725.913840
BVA	1050.264709	1080.777771	650.000000	0.	0.	0.	0.	0.
BVA	0.	240.000000	290.000000	350.000000	369.000000	371.000000	372.000000	378.000000
BVA	466.500000	482.500000	525.000000	570.000000	570.500000	574.000000	650.000000	658.000000
BVA	676.000000	677.000000	678.000000	679.000000	688.000000	720.000000	725.913040	766.000000
BVA	795.000000	829.000000	833.000000	837.000000	839.000000	840.000000	841.000000	842.000000
BVA	842.000000	850.000000	890.000000	905.000000	930.000000	933.000000	942.500000	955.000000
BVA	975.000000	996.000000	1006.000000	1007.000000	1009.000000	1014.000000	1035.000000	1050.264709
BVA	1057.000000	1072.000000	1080.777771	1093.500000	1100.000000	1119.000000	1125.000000	1133.000000
BVA	1137.500000	1142.000000	1153.000000	1158.000000	1169.000000	1175.000000	1181.500000	1183.000000
BVA	1185.000000	1192.000000	1199.000000	1202.000000	1204.000000	1205.000000	1211.000000	1217.500000
BVA	1221.000000	1231.000000	1246.000000	1253.000000	1360.000000	1500.000000	0.	0.
X	120.000000							
BY	150.000000	1						
BY	185.000000	103						
BY	193.057142	41						
BY	197.310881	89						
BY	224.086254	48						
BY	248.086254	54						
BY	294.095238	59						
BY	312.064518	64						
BY	332.586254	68						
BY	368.086254	73						
BY	422.586254	79						
X	245.000000							
BY	155.000000	2						
BY	185.000000	103						
BY	202.792856	41						
BY	212.186529	89						
BY	233.857143	48						
BY	257.857143	54						
BY	303.876984	59						
BY	321.809139	64						
BY	342.357143	68						
BY	377.857143	73						
BY	432.357143	79						
X	320.000000							
BY	160.849857	3						
BY	185.000000	103						
BY	206.485714	41						
BY	217.829016	89						
BY	237.563343	48						
BY	261.563343	54						
BY	307.587303	59						
BY	325.505375	64						
BY	346.063343	68						
BY	381.563343	73						
BY	436.063343	79						
X	359.500000							
BY	161.968838	3						

BV	=	185.000000	103
BV	=	209.250000	42
BV	=	221.881348	89
BV	=	240.225067	48
BV	=	264.225067	54
BV	=	310.251984	59
BV	=	328.159946	64
BV	=	348.725067	68
BV	=	384.225067	73
BV	=	438.725067	79
X	=	370.000000	
AY	=	162.266289	3
BV	=	185.000000	103
BV	=	210.215858	43
BV	=	222.958550	89
BV	=	240.932615	48
BV	=	264.932613	54
BV	=	310.960316	59
BV	=	328.865593	64
BV	=	349.432613	68
BV	=	384.932613	73
BV	=	439.432613	79
X	=	371.500000	
AY	=	162.308783	3
BV	=	185.000000	103
BV	=	210.539646	43
BV	=	223.112434	89
BV	=	241.049261	49
BV	=	265.060455	55
BV	=	311.061508	59
BV	=	328.966396	64
BV	=	349.506279	69
BV	=	384.988693	74
BV	=	439.454098	80
X	=	375.000000	
AY	=	162.407932	3
BV	=	185.000000	103
BV	=	211.295153	43
BV	=	223.471502	89
BV	=	241.394089	49
BV	=	265.483658	59
BV	=	311.297619	59
BV	=	329.122055	65
BV	=	349.550251	69
BV	=	384.909546	74
BV	=	439.132786	80
X	=	422.250000	
AY	=	163.746458	3
BV	=	185.000000	103
BV	=	221.494493	43
BV	=	228.318913	89
BV	=	246.049261	49
BV	=	271.196896	55
BV	=	313.683765	60
BV	=	331.044434	65
BV	=	350.143845	69
BV	=	383.841080	74
BV	=	434.795082	80
X	=	474.500000	
AY	=	165.208878	4
BV	=	185.000000	103
BV	=	232.773127	43

BV	=	233.679276	89
BV	=	251.197044	49
BV	=	277.514706	55
BV	=	316.262337	60
BV	=	333.170235	65
BV	=	350.800251	69
BV	=	382.459546	74
BV	=	429.998360	80
X	=	503.750000	
AY	=	165.972586	4
BV	=	185.000000	103
BV	=	235.750000	90
BV	=	238.992857	44
BV	=	254.078819	49
BV	=	281.051472	55
BV	=	317.705845	60
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BV	=	278.539841	51
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BV	=	330.342545	61
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BY	=	181.578449	7
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BV	=	270.178978	46
BV	=	288.311752	51
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BV	=	276.547768	46
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BV	=	347.959316	65
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BV	=	278.455154	93
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BV	=	415.000000	104
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BV	=	278.136414	47
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AV	=	216.309525	10
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BV	=	348.289806	66
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BV	=	400.145027	77
BV	=	415.000000	104
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AV	=	218.214287	10
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BV	=	348.646496	66
BV	=	368.804203	71
BV	=	400.255524	77
BV	=	415.000000	104
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AV	=	225.000000	11
BV	=	282.617340	47
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BV	=	342.368866	62
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BV	=	370.730827	71
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BV	374.584072	71
BV	402.223755	77
BV	415.000000	104
BV	441.146343	82
X	931.500000	
AY	249.464285	13
BV	292.286705	47
BV	301.549343	52
BV	301.821430	94
BV	319.330925	57
BV	347.571911	62
BV	356.248405	66
BV	375.719765	71
BV	402.610497	77
BV	415.000000	104
BV	444.424393	82
X	937.750000	
AY	252.159090	14
BV	293.269363	47
BV	301.754932	52
BV	303.160713	94
BV	319.457371	57
BV	348.100677	62
BV	356.805733	66
BV	376.226768	71
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BV	415.000000	104
BV	445.887866	82
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AY	257.159092	14
BV	294.998844	47
BV	302.116776	52
BV	305.517857	94
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BV	349.031303	62
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BV	377.119102	71
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BV	447.939850	85
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AY	265.000000	15
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BV	350.406090	62
BV	359.235668	66
BV	378.437317	71
BV	403.535912	77
BV	415.000000	104
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BV	450.383457	85
X	985.500000	
AY	275.000000	16
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BV	303.325657	52
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BV	320.423412	57
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AY	281.282051	17
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BV	303.835526	52
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BY	295.035770	18
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BV	306.005714	53
BV	322.697479	58
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BY	301.428940	19
BV	306.413334	53
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BY	308.500000	20
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BV	324.210083	58
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BY	318.799999	21
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BV	=	513.952385	87
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BV	=	517.785713	87
X	=	1430.000000	
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BV	=	470.500000	40
BV	=	523.666672	87

LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NO. OF POINTS TO DESCRIBE FAILURE SURFACES	=	7
NO. OF FAILURE SURFACE DESCRIPTION CARDS	=	2
MAX. NO. OF COLUMNS TO DESCRIBE FAIL. SURF.	=	4
NO. OF BLOCKS OF SUBSTITUTE SOIL TYPES	=	3
NO. OF ALTERNATE F(X) DISTRIBUTIONS	=	0

FAILURE SURFACE POINTS

POINT NO.	X-COORDINATE	Y-COORDINATE	F(x)
1	600.00	167.00	1.00
	0.00	950.00	378.00
	1.00	0.00	1205.00
	469.00	1.00	0.00
	925.00	166.00	1.00
	0.00	475.00	463.00
	1.00	0.00	1250.00
	468.00	1.00	0.00
	1285.00	466.50	1.00

FAILURE SURFACE DESCRIPTION

SURFACE NO.	POINTS TO DESCRIBE THE SURFACE			
	1	2	3	4
1	1	2	3	4
2	4	5	6	7

SOIL DATA

NO	WFT	SAT	GCM	FI	RU	E0
1	135.0	135.0	1000.0	0.	0.	0.
2	135.0	135.0	2000.0	0.589	0.	0.
3	135.0	135.0	3000.0	0.646	0.	0.
4	135.0	135.0	5400.0	0.575	0.	0.

SURFACE NUMBER 1 1 (SPECIFIED)						
SURFACE DEFINED BY#	POINT	X	Y	F(X)		
	1= 1	600.00	167.00	1.00		
	2= 2	950.00	376.00	1.00		
	3= 3	1200.00	609.00	1.00		
INS.IT	0 0					
INS.IT	0 2					

X-COORD.	E	X-FORCE	Y-YT	Y-YT/Y-Z	VEPT F	SMALL F	PORE PRES
629.86	-39.	-89.	-36.	140.47	9.302	-430.53	1.00 1.00 0.
650.00	17837.	17837.	7197.	0.99	0.036	3.80	1.00 1.00 0.
658.00	24230.	29230.	11780.	1.89	0.059	2.71	1.00 1.00 0.
676.00	60846.	60846.	24480.	3.55	0.055	1.53	1.00 1.00 0.
677.00	62738.	62738.	27262.	3.64	0.056	1.49	1.00 1.00 0.
678.00	64750.	64750.	20051.	3.72	0.058	1.46	1.00 1.00 0.
679.00	66732.	66732.	20848.	3.81	0.059	1.43	1.00 1.00 0.
698.00	85461.	85461.	34384.	4.58	0.112	1.19	1.00 1.00 0.
720.00	173030.	173030.	69616.	6.94	0.119	0.84	1.00 1.00 0.
725.91	193026.	193026.	77661.	7.35	0.121	0.78	1.00 1.00 0.
761.68	333844.	333844.	134316.	9.85	0.131	0.56	1.00 1.00 0.
766.00	353178.	353178.	142095.	10.15	0.132	0.54	1.00 1.00 0.
768.69	365363.	365363.	146997.	10.34	0.133	0.53	1.00 1.00 0.
795.00	392850.	392850.	154056.	14.70	0.174	0.93	1.00 1.00 0.
801.44	400454.	400454.	161115.	15.70	0.181	1.02	1.00 1.00 0.
829.00	457528.	457528.	184078.	18.92	0.199	1.22	1.00 1.00 0.
833.00	460419.	460419.	187656.	19.35	0.203	1.24	1.00 1.00 0.
837.00	475379.	475379.	191261.	19.78	0.206	1.26	1.00 1.00 0.
849.00	479835.	479835.	194073.	20.00	0.208	1.27	1.00 1.00 0.
840.00	482144.	482144.	193982.	20.10	0.208	1.28	1.00 1.00 0.
841.00	484438.	484438.	194893.	20.21	0.209	1.28	1.00 1.00 0.
842.00	486676.	486676.	195805.	20.31	0.210	1.29	1.00 1.00 0.
842.50	487811.	487811.	196262.	20.37	0.210	1.29	1.00 1.00 0.
849.94	504844.	504844.	203115.	21.15	0.216	1.33	1.00 1.00 0.
850.00	504931.	504931.	203150.	21.15	0.216	1.33	1.00 1.00 0.
890.00	576110.	576110.	231788.	26.05	0.233	1.65	1.00 1.00 0.
894.31	584733.	584733.	235245.	26.52	0.238	1.68	1.00 1.00 0.
905.00	614209.	614209.	247216.	27.34	0.247	1.72	1.00 1.00 0.
910.87	630475.	630475.	253661.	27.80	0.247	1.74	1.00 1.00 0.
930.00	670416.	670416.	269730.	29.86	0.255	1.86	1.00 1.00 0.
933.00	676933.	676933.	272352.	30.17	0.256	1.88	1.00 1.00 0.
942.50	697886.	697886.	280782.	31.14	0.261	1.93	1.00 1.00 0.
948.51	711348.	711348.	286199.	31.75	0.264	1.96	1.00 1.00 0.
950.00	715922.	715922.	288039.	31.84	0.265	1.96	1.00 1.00 0.
955.00	697959.	697959.	280811.	31.24	0.263	1.99	1.00 1.00 0.
975.00	628117.	628117.	252712.	28.79	0.259	2.12	1.00 1.00 0.
996.00	552222.	552222.	224591.	26.13	0.252	2.27	1.00 1.00 0.
1006.00	525898.	525898.	211586.	24.84	0.243	2.33	1.00 1.00 0.
1007.00	522682.	522682.	210292.	24.71	0.242	2.34	1.00 1.00 0.
1009.00	516298.	516298.	207707.	24.46	0.240	2.36	1.00 1.00 0.
1014.00	500250.	500250.	201267.	23.81	0.235	2.41	1.00 1.00 0.
1035.00	433820.	433820.	174540.	21.11	0.215	2.65	1.00 1.00 0.
1020.26	386362.	386362.	155454.	19.18	0.199	2.87	1.00 1.00 0.
1057.00	365691.	365691.	147129.	18.30	0.192	2.98	1.00 1.00 0.
1072.00	326119.	326119.	128802.	16.39	0.177	3.26	1.00 1.00 0.
1080.78	293868.	293868.	118232.	15.28	0.168	3.46	1.00 1.00 0.
1093.50	256399.	256399.	103158.	13.68	0.155	3.80	1.00 1.00 0.
1100.00	237506.	237506.	95593.	12.87	0.149	3.94	1.00 1.00 0.
1119.00	184188.	184188.	74105.	10.49	0.138	4.50	1.00 1.00 0.
1125.00	167778.	167778.	67503.	9.75	0.123	4.75	1.00 1.00 0.
1133.00	146395.	146395.	58899.	8.77	0.117	5.09	1.00 1.00 0.
1137.50	134690.	134690.	54178.	8.21	0.112	5.29	1.00 1.00 0.
1142.00	123117.	123117.	49534.	7.66	0.107	5.51	1.00 1.00 0.
1153.00	95799.	95799.	38543.	6.32	0.096	6.20	1.00 1.00 0.
1158.00	83821.	83821.	33724.	5.72	0.090	6.64	1.00 1.00 0.
1169.00	58810.	58810.	23661.	4.42	0.081	7.88	1.00 1.00 0.
1175.00	46341.	46341.	18645.	3.70	0.082	7.81	1.00 1.00 0.
1181.50	34010.	34010.	11683.	2.89	0.076	8.46	1.00 1.00 0.
1183.88	31312.	31312.	12598.	2.70	0.074	8.64	1.00 1.00 0.
1185.00	27734.	27734.	11183.	2.45	0.071	9.23	1.00 1.00 0.
1192.00	16154.	16154.	5503.	1.54	0.056	12.75	1.00 1.00 0.
1196.45	9347.	9347.	3777.	0.97	0.045	16.30	1.00 1.00 0.
1199.00	5780.	5780.	2317.	0.63	0.035	21.36	1.00 1.00 0.
1202.00	1916.	1916.	771.	0.24	0.028	23.87	1.00 1.00 0.
1203.77	0.	0.	0.	0.	0.	0.	1.00 1.00 0.

F = 2.116 LAMRDA = 0.402(6 7 0)

SURFACE NUMBER		1 (SPECIFIED)			
SURFACE DEFINED BY:		POINT	X	Y	F(X)
4-	4		525.00	166.00	1.00
5-	5		975.00	463.00	1.00
6-	6		1250.00	488.00	1.00
7-	7		1285.00	469.50	1.00

145-11 0 0
145-11 0 2

X-COORD.	E	X-FORCE	Y-YT	Y-YT/Y-Z	VEPT F	SHALL F	PORE PRES
553.70	45319	45319	4899	-1.20	-0.068	1.43	1.00
570.00	23388	23388	4754	2.34	0.083	1.20	1.00
576.50	24158	24158	4042	2.40	0.085	1.13	1.00
574.00	29869	29869	11179	2.85	0.093	1.73	1.00
648.47	28874	28874	105879	16.49	0.135	0.73	1.00
650.00	290698	290698	108803	10.64	0.135	0.72	1.00
658.00	333372	333372	124775	11.41	0.136	1.07	1.00
662.00	358106	358106	133284	11.81	0.139	1.64	1.00
674.00	389275	389275	144954	14.60	0.163	1.91	1.00
677.00	389624	389624	145829	14.87	0.164	1.92	1.00
678.00	391998	391998	146714	15.07	0.166	1.94	1.00
679.00	394366	394366	147604	15.26	0.167	1.95	1.00
688.00	414430	414430	150862	15.98	0.179	1.07	1.00
693.97	431895	431895	161651	18.02	0.184	1.15	1.00
720.00	529230	529230	192334	21.51	0.189	1.29	1.00
725.91	551223	551223	206311	22.23	0.191	1.32	1.00
746.10	611600	611600	221911	23.88	0.194	1.37	1.00
766.00	713153	713153	266920	27.34	0.202	1.53	1.00
782.31	782779	782779	292880	29.36	0.209	1.61	1.00
795.00	849074	849074	317793	30.55	0.212	1.63	1.00
798.29	866386	866386	324273	30.86	0.212	1.63	1.00
829.00	1014455	1014455	379692	34.49	0.220	1.76	1.00
836.74	1023238	1023238	382960	34.69	0.221	1.76	1.00
833.00	1036501	1036501	387944	34.89	0.222	1.77	1.00
837.00	1060066	1060066	396764	35.24	0.223	1.77	1.00
839.00	1071896	1071896	401192	35.42	0.224	1.77	1.00
846.00	1077823	1077823	404410	35.51	0.224	1.77	1.00
841.00	1083758	1083758	405631	35.60	0.224	1.77	1.00
842.00	1089701	1089701	406855	35.69	0.224	1.78	1.00
842.50	1092675	1092675	408969	35.74	0.225	1.78	1.00
850.00	1137527	1137527	426756	36.43	0.227	1.79	1.00
881.40	1334957	1334957	496650	39.34	0.227	1.80	1.00
886.00	1370933	1370933	514484	40.48	0.229	1.84	1.00
902.27	1445068	1445068	540863	42.08	0.238	1.92	1.00
905.00	1459537	1459537	544274	42.44	0.240	1.94	1.00
930.00	1594287	1594287	597461	45.64	0.246	2.06	1.00
933.00	1613252	1613252	603811	46.01	0.248	2.07	1.00
942.50	1667568	1667568	624141	47.18	0.252	2.11	1.00
944.24	1700518	1700518	624472	47.68	0.254	2.13	1.00
953.10	1729679	1729679	647388	48.49	0.256	2.15	1.00
955.00	1741211	1741211	651704	48.66	0.256	2.16	1.00
975.00	1870379	1870379	700049	50.83	0.263	2.21	1.00
996.00	1748132	1748132	654295	48.23	0.261	2.31	1.00
1006.00	1691089	1691089	632944	46.38	0.256	2.34	1.00
1007.00	1685407	1685407	631917	46.85	0.256	2.35	1.00
1009.00	1674053	1674053	625564	46.60	0.255	2.36	1.00
1014.00	1645740	1645740	615971	45.97	0.253	2.39	1.00
1035.00	1527908	1527908	571869	43.34	0.243	2.52	1.00
1050.03	1444711	1444711	540729	41.45	0.236	2.63	1.00
1050.26	1443315	1443315	540207	41.43	0.236	2.63	1.00

1057.00	1404082.	1404042.	325523.	40.65	0.233	2.68	1.00	1.00	0.
1072.00	1317294.	1317274.	491040.	18.94	0.227	1.79	1.00	1.00	0.
1088.70	1264927.	1264927.	474198.	37.95	0.224	2.87	1.00	1.00	0.
1093.50	1194572.	1194572.	447107.	16.53	0.219	1.98	1.00	1.00	0.
1100.00	1157958.	1157958.	433403.	35.82	0.218	1.02	1.00	1.00	0.
1119.00	1052514.	1052514.	193937.	13.75	0.213	1.14	1.00	1.00	0.
1125.00	1019643.	1019643.	381649.	33.11	0.211	1.19	1.00	1.00	0.
1133.00	974401.	974401.	165447.	12.26	0.212	1.24	1.00	1.00	0.
1137.50	952343.	952343.	156446.	31.79	0.212	1.27	1.00	1.00	0.
1142.00	928474.	928474.	147511.	11.31	0.211	1.29	1.00	1.00	0.
1153.00	871010.	871010.	126003.	30.16	0.212	1.35	1.00	1.00	0.
1158.00	845320.	845320.	116385.	29.63	0.212	1.38	1.00	1.00	0.
1169.00	790093.	790093.	299718.	28.48	0.218	1.42	1.00	1.00	0.
1175.00	761084.	761084.	284860.	27.83	0.230	1.38	1.00	1.00	0.
1181.50	730768.	730768.	273513.	27.11	0.230	1.37	1.00	1.00	0.
1183.00	723912.	723912.	271947.	26.94	0.241	1.37	1.00	1.00	0.
1185.00	714846.	714846.	267554.	24.71	0.243	1.38	1.00	1.00	0.
1192.00	683755.	683755.	259221.	25.90	0.252	1.41	1.00	1.00	0.
1199.00	653845.	653845.	244723.	25.05	0.268	1.38	1.00	1.00	0.
1202.00	641599.	641599.	240137.	24.67	0.295	1.78	1.00	1.00	0.
1204.00	633828.	633828.	232236.	24.48	0.331	1.22	1.00	1.00	0.
1205.00	630091.	630091.	235832.	24.26	0.352	1.11	1.00	1.00	0.
1211.00	607269.	607269.	227299.	23.36	0.362	1.07	1.00	1.00	0.
1217.50	580236.	580236.	217172.	22.21	0.379	1.99	1.00	1.00	0.
1221.00	564683.	564683.	211351.	21.52	0.389	1.95	1.00	1.00	0.
1221.00	516409.	516409.	193282.	19.35	0.418	2.63	1.00	1.00	0.
1246.00	445277.	445277.	166659.	16.09	0.428	2.76	1.00	1.00	0.
1250.00	400448.	400448.	148897.	14.33	0.545	2.48	1.00	1.00	0.
1253.00	321638.	321638.	121159.	13.08	0.817	1.25	1.00	1.00	0.
1283.11	-0.	-0.	-0.	0.	0.	1.00	1.00	1.00	0.

F = 2.446 LAMRDA * 0.3744 7 3 9)

EXAMPLE NO. 6

Conventional Stability Analysis Section After Canal
Deepening-Total Stress Analysis Using Laboratory
Strengths With Accelerations of 0.39 and 0.82
for the Upper and Lower Failure
Surface, Respectively

MARGENSTERN AND PRICE METHOD OF SLOPE STABILITY ANALYSIS - DON BANKS

WITH EARTHQUAKE ANALYSIS
 LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NUMBER OF POINTS	=	95
NUMBER OF LINES	=	102
NUMBER OF MATERIALS	=	4
YDM	=	185.00
XH	=	650.00
YHP	=	415.00

POINT DESCRIPTION

POINT NO.	NO. LINES	X-COORDINATE	Y-COORDINATE				
1	1	0.	150.00	59	2	371.00	265.00
2	2	240.00	150.00	60	2	577.00	302.00
3	2	290.00	160.00	61	2	341.00	317.50
4	2	466.50	165.00	62	4	1114.00	321.00
5	2	558.00	170.00	63	3	1133.00	325.00
6	2	588.00	179.00	64	1	0.	286.00
7	2	720.00	181.00	65	2	378.00	311.50
8	2	766.00	190.00	66	2	570.50	321.00
9	2	795.00	200.00	67	2	342.00	340.00
10	2	829.00	210.00	68	4	1137.50	365.00
11	2	950.00	220.00	69	1	0.	304.00
12	2	990.00	230.00	70	2	572.00	329.00
13	2	905.00	240.00	71	2	439.00	348.00
14	2	333.00	250.00	72	4	1153.00	376.00
15	2	755.00	260.00	73	1	0.	324.50
16	2	975.00	270.00	74	2	371.00	349.50
17	2	998.00	280.00	75	2	570.00	352.00
18	2	1035.00	290.00	76	2	342.50	368.50
19	2	1772.00	300.00	77	4	1181.50	396.00
20	2	1100.00	310.00	78	1	0.	360.00
21	2	1125.00	320.00	79	2	371.00	385.00
22	2	1142.00	330.00	80	2	570.00	380.50
23	2	1158.00	340.00	81	2	576.00	382.00
24	2	1169.00	350.00	82	2	337.00	400.00
25	2	1175.00	360.00	83	4	1199.00	410.00
26	3	1183.00	370.00	84	1	0.	414.50
27	3	1192.00	380.00	85	2	371.00	439.50
28	2	1199.00	390.00	86	2	676.00	411.50
29	3	1202.00	400.00	87	2	340.00	423.00
30	3	1204.00	410.00	88	3	742.50	447.00
31	4	1205.00	415.00	89	2	1157.00	413.00
32	2	1211.00	420.00	90	3	1217.50	426.50
33	2	1221.00	430.00	91	2	1009.00	457.00
34	2	1231.00	440.00	92	2	1185.00	512.00
35	2	1246.00	450.00	93	1	1500.00	527.00
36	2	1253.00	460.00	94	1	0.	550.00
37	2	1360.00	460.00	95	1	1500.00	550.00
38	1	1300.00	465.00				
39	2	0.	185.00				
40	2	325.00	237.00				
41	2	678.00	250.00				
42	4	333.00	276.80				
43	2	1007.00	318.00				
44	2	1119.00	351.20				
45	1	1500.00	415.00				
46	2	350.00	208.50				
47	2	369.00	210.00				
48	4	482.50	234.50				
49	2	570.00	253.00				
50	2	576.00	257.00				
51	3	1006.00	304.00				
52	3	1093.50	307.00				
53	1	0.	216.00				
54	2	371.00	241.00				
55	2	574.00	261.00				
56	2	679.00	276.00				
57	4	930.00	301.50				
58	1	0.	240.00				

LINE DESCRIPTION

LINE NO.	POINT 1	POINT 2	MATERIAL
1	1	2	1
2	2	3	1
3	3	4	1
4	4	5	1
5	5	6	1
6	6	7	1
7	7	8	1
8	8	9	1
9	9	10	1
10	10	11	1
11	11	12	1
12	12	13	1
13	13	14	1
14	14	15	1
15	15	16	1
16	16	17	1
17	17	18	1
18	18	19	1
19	19	20	2
20	20	21	2
21	21	22	2
22	22	23	3
23	23	24	3
24	24	25	3
25	25	26	3
26	26	27	2
27	27	28	3
28	28	29	3
29	29	30	2
30	30	31	4
31	31	32	4
32	32	33	4
33	33	34	4
34	34	35	4
35	35	36	4
36	36	37	4
37	37	38	4
38	38	39	4
39	39	40	3
40	40	41	3
41	41	42	3
42	42	43	3
43	43	44	3
44	44	45	3
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BYA	1175.000000	1183.000000	1192.000000	1199.000000	1202.000000	1204.000000	1205.000000	1211.000000
BYA	1221.000000	1231.000000	1246.000000	1253.000000	1360.000000	1500.000000	0.	525.000000
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BY	=	287.307693	17
BV	=	304.634285	53
BV	=	321.352940	58
BV	=	324.020000	96
BV	=	355.439934	67
BV	=	364.541401	66
BV	=	383.264011	71
BV	=	405.179558	77
BV	=	415.000000	104
BV	=	422.650654	83
BV	=	461.843750	86
X	=	1042.632355	
BY	=	292.062790	18
BV	=	305.255966	53
BV	=	321.962433	58
BV	=	329.235210	96
BV	=	356.973972	62
BV	=	366.158298	66
BV	=	384.734924	71
BV	=	405.680450	77
BV	=	415.000000	104
BV	=	417.266373	83
BV	=	467.510113	86
X	=	1053.632355	
BY	=	295.035770	18
BV	=	305.633110	53
BV	=	322.332180	58
BV	=	332.399021	96
BV	=	357.904598	62
BV	=	367.139191	66
BV	=	385.627254	71
BV	=	405.984318	77
BV	=	414.000000	83
BV	=	415.000000	104
BV	=	478.947613	86
X	=	1064.500000	
BY	=	297.922973	18
BV	=	306.005714	53
BV	=	322.697479	58
BV	=	335.524761	96
BV	=	358.824028	62
BV	=	368.108220	66
BV	=	386.508850	71
BV	=	406.284531	77
BV	=	413.630880	84
BV	=	415.000000	104
BV	=	474.343750	86
X	=	1076.388865	
BY	=	301.428940	19
BV	=	306.413334	53
BV	=	323.097103	58

BV	=	338.944233	96
BV	=	359.829853	62
BV	=	369.168434	66
BV	=	387.473286	71
BV	=	406.612953	77
BV	=	414.630880	84
BV	=	415.000000	104
BV	=	478.058029	86
X	=	1087.138885	
BY	=	304.928940	19
BV	=	306.781906	53
BV	=	323.458450	58
BV	=	342.036137	96
BV	=	360.239330	62
BV	=	370.127033	66
BV	=	388.345337	71
BV	=	406.909912	77
BV	=	415.000000	104
BV	=	415.535046	84
BV	=	481.418404	86
X	=	1096.750000	
BY	=	308.500000	20
BV	=	323.781513	58
BV	=	344.800476	96
BV	=	361.552452	62
BV	=	370.984074	66
BV	=	389.125000	71
BV	=	407.175415	77
BV	=	415.000000	104
BV	=	416.343456	84
BV	=	484.421875	86
X	=	1109.500000	
BY	=	313.799999	21
BV	=	324.210083	58
BV	=	348.467621	96
BV	=	362.631134	62
BV	=	372.121017	66
BV	=	390.159294	71
BV	=	407.527622	77
BV	=	415.000000	104
BV	=	417.415886	84
BV	=	488.406250	86
X	=	1122.000000	
BY	=	318.799999	21
BV	=	324.630253	58
BV	=	353.437840	97
BV	=	363.688663	62
BV	=	373.235668	66
BV	=	391.173306	71
BV	=	407.872929	77
BV	=	415.000000	104
BV	=	418.467289	84
BV	=	492.312500	86
X	=	1129.000000	
BY	=	322.500000	22
BV	=	324.865547	58
BV	=	358.659462	97
BV	=	364.280880	62
BV	=	373.859871	66
BV	=	391.741150	71
BV	=	408.066296	77
BV	=	415.000000	104

BV	=	419.056072	84
BY	=	494.500000	86
X	=	1135.250000	
BY	=	326.250000	23
BV	=	163.321621	97
BV	=	164.809643	62
BV	=	174.417194	64
BV	=	192.248158	71
BV	=	408.238949	77
BV	=	415.000000	104
BV	=	419.581776	84
BV	=	496.453125	86
X	=	1139.750000	
BY	=	328.750000	23
BV	=	165.247253	63
BV	=	166.596775	98
BV	=	174.818470	66
BV	=	192.613201	71
BV	=	408.363258	77
BV	=	415.000000	104
BV	=	419.960278	84
BV	=	497.859325	86
X	=	1147.500000	
BY	=	333.437500	24
BV	=	166.098900	63
BV	=	172.096775	98
BV	=	175.509552	66
BV	=	193.241890	71
BV	=	408.577347	77
BV	=	415.000000	104
BV	=	420.612148	84
BV	=	500.281250	86
X	=	1155.500000	
BY	=	338.437500	24
BV	=	166.978024	63
BV	=	176.256409	67
BV	=	177.754387	99
BV	=	193.890854	71
BV	=	408.798340	77
BV	=	415.000000	104
BV	=	421.285046	84
BV	=	502.781250	86
X	=	1163.500000	
BY	=	344.999996	25
BV	=	167.857143	64
BV	=	177.026920	67
BV	=	183.368423	99
BV	=	194.539822	71
BV	=	409.019337	77
BV	=	415.000000	104
BV	=	421.957943	84
BV	=	505.281250	86
X	=	1172.000000	
BY	=	354.999996	26
BV	=	168.791210	63
BV	=	177.948715	67
BV	=	189.333336	99
BV	=	195.229351	71
BV	=	409.254143	77
BV	=	415.000000	104
BV	=	422.472897	84
BV	=	507.937500	86

X	=	1178.250000	
BY	=	364.062500	27
BV	=	169.478024	63
BV	=	178.589741	67
BV	=	193.719299	99
BV	=	195.736359	71
BV	=	409.426796	77
BV	=	415.000000	104
BV	=	423.198597	84
BV	=	509.890625	86
X	=	1182.250000	
BY	=	369.062500	27
BV	=	169.917583	63
BV	=	179.000000	67
BV	=	196.146343	72
BV	=	198.599998	100
BV	=	409.537292	77
BV	=	415.000000	104
BV	=	423.535046	84
BV	=	511.140625	86
X	=	1184.000000	
BY	=	371.111115	28
BV	=	179.179485	67
BV	=	196.487804	72
BV	=	198.000000	100
BV	=	209.585636	77
BV	=	415.000000	104
BV	=	423.682243	84
BV	=	511.687500	86
X	=	1188.500000	
BY	=	376.111111	28
BV	=	179.641026	67
BV	=	197.365856	72
BV	=	201.599998	100
BV	=	409.709946	77
BV	=	415.000000	104
BV	=	424.060745	84
BV	=	512.166672	87
X	=	1195.500000	
BY	=	385.000000	29
BV	=	198.731709	72
BV	=	207.200001	100
BV	=	409.903313	77
BV	=	415.000000	104
BV	=	424.649532	84
BV	=	512.500000	87
X	=	1200.500000	
BY	=	394.999992	30
BV	=	199.707317	72
BV	=	210.000000	73
BV	=	411.249996	101
BV	=	415.000000	104
BV	=	425.070091	84
BV	=	512.738098	87
X	=	1203.000000	
BY	=	405.000000	31
BV	=	210.000000	73
BV	=	413.333332	101
BV	=	415.000000	104
BV	=	425.280373	84
BV	=	512.857147	87
X	=	1204.500000	

AY	=	412.500000	102
BY	=	414.583332	101
BY	=	415.000000	104
BY	=	425.406540	84
BY	=	512.928574	87
X	=	1208.000000	
AY	=	415.000000	104
BY	=	417.499996	33
BY	=	425.700932	84
BY	=	513.095238	87
X	=	1214.250000	
AY	=	415.000000	104
BY	=	423.250000	34
BY	=	426.226635	84
BY	=	513.392860	87
X	=	1219.250000	
AY	=	415.000000	104
BY	=	428.250000	35
BY	=	513.630951	87
X	=	1226.000000	
AY	=	415.000000	104
BY	=	435.000000	36
BY	=	513.952365	87
X	=	1238.500000	
AY	=	415.000000	104
BY	=	445.000000	37
BY	=	514.547623	87
X	=	1249.500000	
AY	=	415.000000	104
BY	=	455.000004	38
BY	=	515.071426	87
X	=	1306.500000	
AY	=	415.000000	104
BY	=	460.000000	39
BY	=	517.785713	87
X	=	1430.000000	
AY	=	415.000000	104
BY	=	462.500000	40
BY	=	523.666672	87

LÄ PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NO. OF POINTS TO DESCRIBE FAILURE SURFACES = 7
 NO. OF FAILURE SURFACE DESCRIPTION CARDS = 2
 MAX. NO. OF COLUMNS TO DESCRIBE FAIL. SURF. = 4
 NO. OF BLOCKS OF SUBSTITUTE SOIL TYPES = 3
 NO. OF ALTERNATE F(X) DISTRIBUTIONS = 0

FAILURE SURFACE POINTS

POINT NO.	X-COORDINATE	Y-COORDINATE	F(X)
1	600.00	167.00	1.00
	0.00	950.00	378.00
	1.00	0.00	1205.00
	409.00	1.00	0.00
	525.00	166.00	1.00
	0.00	975.00	463.00
	1.00	0.00	1250.00
	488.00	1.00	0.00
	1285.00	469.50	1.00

FAILURE SURFACE DESCRIPTION

SURFACE NO.	POINTS TO DESCRIBE THE SURFACE			
	1	2	3	4
1	1	2	3	4
2	4	5	6	7

SOIL DATA

NO	WET	SAT	COM	FI	RU	EQ
1	135.0	135.0	1000.0	0.	0.	0.390
2	135.0	135.0	2000.0	0.589	0.	0.390
3	135.0	135.0	3000.0	0.640	0.	0.390
4	135.0	135.0	5400.0	0.575	0.	0.390

SURFACE NUMBER 1, 1 (SPECIFIED)

SURFACE DEFINED BY#	POINT	X	Y	F(X)
1-	1	400.00	167.00	1.00
2-	2	950.00	378.00	1.00
3-	3	1205.00	409.00	1.00

ISS.IT 0 0
IQS.IT 0 2

X-COORD.	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
629.84	-9529.	-5529.	-4512.	-17.01	-1.081	-3.49	1.00
650.00	18135.	15135.	12351.	22.00	0.804	2.21	1.00
658.00	29175.	29175.	23809.	16.50	0.516	1.34	1.00
676.00	38904.	68904.	54229.	12.59	0.336	0.47	1.00
677.00	71370.	71370.	58241.	12.46	0.330	0.45	1.00
678.00	73863.	73863.	60275.	12.39	0.325	0.43	1.00
679.00	74383.	74383.	62332.	12.23	0.319	0.41	1.00
688.00	100288.	100288.	81839.	11.35	0.277	0.50	1.00
720.00	214056.	214056.	174679.	10.26	0.176	0.33	1.00
725.91	240311.	240311.	196104.	10.24	0.169	0.31	1.00
741.66	424370.	424370.	347937.	10.14	0.135	0.22	1.00
746.00	452031.	452031.	368078.	10.13	0.131	0.21	1.00
748.68	468213.	468213.	382083.	10.12	0.130	0.20	1.00
795.00	496818.	496818.	405426.	13.29	0.157	0.39	1.00
801.44	509239.	509239.	412298.	14.16	0.164	0.43	1.00
829.00	589085.	589085.	477455.	17.00	0.179	0.52	1.00
833.00	597643.	597643.	487703.	17.40	0.182	0.53	1.00
837.00	610309.	610309.	498040.	17.78	0.185	0.54	1.00
839.00	616684.	616684.	503241.	17.96	0.186	0.55	1.00
840.00	619881.	619881.	505890.	18.05	0.187	0.55	1.00
841.00	623085.	623085.	508465.	18.14	0.188	0.55	1.00
842.00	626296.	626296.	511086.	18.22	0.188	0.55	1.00
842.50	627904.	627904.	512398.	18.27	0.189	0.55	1.00
849.94	652048.	652048.	532100.	18.87	0.193	0.57	1.00
850.00	652154.	652154.	532187.	18.88	0.193	0.57	1.00
890.00	743191.	743191.	604477.	24.17	0.216	0.72	1.00
894.31	754496.	754496.	615702.	24.77	0.222	0.73	1.00
905.00	797209.	797209.	650558.	25.59	0.231	0.75	1.00
910.87	820766.	820766.	667782.	25.97	0.231	0.76	1.00
930.00	873844.	873844.	713096.	28.01	0.239	0.82	1.00
933.00	882578.	882578.	720223.	28.33	0.241	0.82	1.00
942.50	910747.	910747.	743210.	29.32	0.246	0.85	1.00
948.51	928904.	928904.	758027.	29.91	0.249	0.86	1.00
950.00	935591.	935591.	763484.	29.99	0.249	0.86	1.00
955.00	915540.	915540.	747122.	29.18	0.246	0.88	1.00
975.00	836181.	836181.	682361.	25.71	0.232	0.92	1.00
996.00	754294.	754294.	615538.	21.57	0.208	0.98	1.00
1006.00	719703.	719703.	584045.	19.50	0.191	1.00	1.00
1007.00	711850.	711850.	588902.	19.30	0.189	1.01	1.00
1009.00	704149.	704149.	574617.	18.89	0.185	1.02	1.00
1014.00	684918.	684918.	558924.	17.88	0.177	1.03	1.00
1035.00	604484.	604484.	493286.	13.80	0.140	1.12	1.00
1050.26	546373.	546373.	445865.	11.06	0.115	1.20	1.00
1057.00	520834.	520834.	425024.	9.91	0.104	1.23	1.00
1072.00	464176.	464176.	378789.	7.58	0.082	1.33	1.00
1080.78	431183.	431183.	351864.	6.36	0.070	1.39	1.00
1093.50	383618.	383618.	313049.	4.80	0.054	1.50	1.00
1100.00	359459.	359459.	293334.	4.09	0.047	1.54	1.00
1119.00	289491.	289491.	236238.	2.37	0.029	1.69	1.00
1125.00	267587.	267587.	218363.	2.01	0.025	1.75	1.00
1133.00	238590.	238590.	194700.	1.63	0.022	1.84	1.00
1137.58	222402.	222402.	181490.	1.45	0.020	1.88	1.00
1142.00	206295.	206295.	168346.	1.32	0.019	1.93	1.00
1153.00	167297.	167297.	136822.	1.25	0.019	2.08	1.00
1198.00	149755.	149755.	122207.	1.38	0.022	2.17	1.00
1169.00	111725.	111725.	91172.	1.94	0.035	2.39	1.00
1175.00	91473.	91473.	74646.	2.07	0.046	2.33	1.00
1181.50	78026.	78026.	57144.	1.76	0.046	2.41	1.00
1183.00	69139.	69139.	53156.	1.64	0.045	2.44	1.00
1185.00	58656.	58656.	47866.	1.48	0.043	2.55	1.00
1192.00	36251.	36251.	29882.	0.91	0.033	3.23	1.00
1196.45	22264.	22264.	18168.	0.59	0.027	3.83	1.00
1199.00	14360.	14360.	11718.	0.52	0.029	4.68	1.00
1202.00	9236.	9236.	4273.	0.39	0.046	4.76	1.00
1203.77	-0.	-0.	-0.	0.	0.	0.	1.00

F = 1.005 LAMRDA = 0.816(5 6 0)

SOIL DATA

SO	WET	SAT	COH	FI	RII	Eg
1	135.0	135.0	1000.0	0.	0.	0.820
2	135.0	135.0	2000.0	0.989	0.	0.820
3	135.0	135.0	3000.0	0.848	0.	0.820
4	135.0	135.0	5000.0	0.979	0.	0.820

SURFACE NUMBER 2, 1 (SPECIFIED)

SURFACE DEFINED BY

POINT	X	Y	F(X)
4- 4	524.00	166.00	1.00
5- 5	975.00	465.00	1.00
6- 6	1250.00	488.00	1.00
7- 7	1285.00	469.50	1.00

INS.IT 0 0
INS.IT 0 2

X-COORD.	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
553.79	6817.	6817.	3062.	22.77	1.285	4.59	1.00
570.00	43775.	43775.	24799.	15.24	0.544	1.13	1.00
570.50	45300.	45300.	25662.	15.26	0.539	1.10	1.00
574.00	56620.	56620.	32075.	15.47	0.507	0.95	1.00
648.47	565121.	565121.	320145.	27.59	0.355	0.24	1.00
650.00	580915.	580915.	329092.	27.87	0.354	0.24	1.00
658.00	667078.	667078.	377904.	29.35	0.350	0.22	1.00
662.00	712996.	712996.	408917.	30.09	0.353	0.21	1.00
676.00	807642.	807642.	457546.	35.14	0.389	0.41	1.00
677.00	814764.	814764.	461569.	35.48	0.392	0.42	1.00
678.00	821906.	821906.	468616.	35.82	0.394	0.43	1.00
679.00	829089.	829089.	469685.	36.16	0.396	0.44	1.00
688.00	895543.	895543.	507332.	39.09	0.413	0.50	1.00
693.97	941905.	941905.	533595.	40.97	0.417	0.55	1.00
720.00	1204737.	1204737.	682492.	47.63	0.419	0.65	1.00
725.91	1270628.	1270628.	719820.	49.11	0.422	0.67	1.00
740.10	1436238.	1436238.	813639.	52.54	0.427	0.71	1.00
766.00	1731959.	1731959.	981166.	59.57	0.441	0.78	1.00
782.31	1933760.	1933760.	1095488.	63.64	0.454	0.81	1.00
795.00	2114558.	2114558.	1197912.	66.06	0.458	0.83	1.00
798.25	2161746.	2161746.	1224644.	66.64	0.458	0.83	1.00
829.00	2588335.	2588335.	1466309.	73.31	0.468	0.89	1.00
830.74	2613503.	2613503.	1480613.	73.67	0.469	0.89	1.00
833.00	2649653.	2649653.	1501047.	74.04	0.470	0.90	1.00
837.00	2713735.	2713735.	1537349.	74.69	0.472	0.90	1.00
839.00	2745902.	2745902.	1555572.	75.02	0.473	0.90	1.00
840.00	2762017.	2762017.	1564701.	75.18	0.474	0.90	1.00
841.00	2778153.	2778153.	1573842.	75.33	0.474	0.90	1.00
842.00	2794310.	2794310.	1582996.	75.49	0.475	0.90	1.00
842.50	2802396.	2802396.	1587577.	75.57	0.475	0.90	1.00
850.00	2924322.	2924322.	1658648.	76.73	0.478	0.91	1.00
881.40	3460430.	3460430.	1960357.	81.56	0.470	0.95	1.00
890.00	3586906.	3586906.	2032007.	83.54	0.472	0.96	1.00
902.27	3769909.	3769909.	2135679.	86.24	0.488	0.98	1.00
905.00	3810561.	3810561.	2158709.	86.81	0.491	0.99	1.00
930.00	4194058.	4194058.	2375963.	91.86	0.498	1.03	1.00
933.00	4241541.	4241541.	2402862.	92.45	0.499	1.03	1.00
942.50	4393465.	4393465.	2488928.	94.28	0.504	1.05	1.00
948.20	4485566.	4485566.	2541104.	95.35	0.506	1.06	1.00
953.19	4567038.	4567038.	2587258.	96.27	0.508	1.07	1.00
955.00	4599875.	4599875.	2605861.	96.54	0.509	1.08	1.00
975.00	4967543.	4967543.	2814147.	99.36	0.515	1.11	1.00
996.00	5111335.	5111335.	2895606.	94.83	0.513	1.14	1.00
1006.00	5178998.	5178998.	2932805.	92.53	0.505	1.14	1.00
1007.00	5183512.	5183512.	2934495.	92.29	0.504	1.14	1.00
1009.00	5196511.	5196511.	2943859.	91.82	0.502	1.14	1.00
1014.00	5228841.	5228841.	2962174.	90.65	0.498	1.15	1.00
1035.00	5362025.	5362025.	3037624.	85.57	0.480	1.18	1.00
1050.03	5454646.	5454646.	3090094.	81.81	0.465	1.20	1.00
1050.26	5455735.	5455735.	3090711.	81.76	0.465	1.20	1.00

1057.00	5486143.	5486143.	3107937.	80.19	0.460	1.21	1.00	1.00	0.
1072.00	5551940.	5551940.	3144212.	76.64	0.446	1.22	1.00	1.00	0.
1080.78	5589074.	5589074.	3160249.	74.50	0.439	1.23	1.00	1.00	0.
1093.50	5640784.	5640784.	3195543.	71.33	0.428	1.24	1.00	1.00	0.
1100.00	5666051.	5666051.	3209857.	69.67	0.424	1.24	1.00	1.00	0.
1119.00	5734738.	5734738.	3248768.	64.63	0.408	1.24	1.00	1.00	0.
1125.00	5754904.	5754904.	3260193.	62.99	0.402	1.23	1.00	1.00	0.
1133.00	5780182.	5780182.	3274513.	60.74	0.399	1.23	1.00	1.00	0.
1137.50	5793460.	5793460.	3282834.	59.45	0.396	1.23	1.00	1.00	0.
1142.00	5806119.	5806119.	3289206.	58.14	0.392	1.22	1.00	1.00	0.
1153.00	5834183.	5834183.	3309105.	54.84	0.385	1.21	1.00	1.00	0.
1158.00	5845535.	5845535.	3311536.	53.30	0.382	1.21	1.00	1.00	0.
1169.00	5866291.	5866291.	3323294.	49.79	0.381	1.20	1.00	1.00	0.
1175.00	5873973.	5873973.	3327646.	47.77	0.394	1.19	1.00	1.00	0.
1181.50	5878665.	5878665.	3330304.	45.48	0.400	1.18	1.00	1.00	0.
1183.00	5879291.	5879291.	3330659.	44.94	0.402	1.17	1.00	1.00	0.
1185.00	5879877.	5879877.	3330991.	44.22	0.402	1.17	1.00	1.00	0.
1192.00	5879816.	5879816.	3330956.	41.63	0.405	1.17	1.00	1.00	0.
1199.00	5875957.	5875957.	3328770.	38.97	0.417	1.16	1.00	1.00	0.
1202.00	5872421.	5872421.	3326766.	37.78	0.452	1.14	1.00	1.00	0.
1204.00	5868779.	5868779.	3324703.	36.97	0.501	1.13	1.00	1.00	0.
1205.00	5866473.	5866473.	3323897.	36.56	0.531	1.13	1.00	1.00	0.
1211.00	5849159.	5849159.	3313589.	34.05	0.528	1.12	1.00	1.00	0.
1217.50	5823354.	5823354.	3298970.	31.30	0.535	1.11	1.00	1.00	0.
1221.00	5806258.	5806258.	3289285.	29.81	0.538	1.11	1.00	1.00	0.
1231.00	5745060.	5745060.	3254616.	25.48	0.551	1.09	1.00	1.00	0.
1246.00	5638701.	5638701.	3194263.	18.88	0.502	1.08	1.00	1.00	0.
1250.00	5572387.	5572387.	3158795.	17.06	0.649	1.06	1.00	1.00	0.
1253.00	4792917.	4792917.	2715220.	16.18	1.017	1.05	1.00	1.00	0.
1283.11	-7.	-7.	-4.	0.	0.	0.	1.00	1.00	0.

F = 1.000 LAMRDA = 0.5e7 7 8 0)
 STAP AT LINE 5.....

EXAMPLE NO. 7

Conventional Stability Analysis Section After Canal
Deepening--Total Stress Analysis Using A Computed
Strength with One Homogeneous Soil Mass Yielding
Equivalent Factors of Safety to That Using
Partitioned Soil Strengths

<u>Strength</u>	<u>Pore Pressure</u>	<u>Acceleration</u>
c = 0, ϕ = 36.11 deg	0.0	0.0
c = 0, ϕ = 39.95 deg	0.0	0.0

MORGENSTERN AND PRICE METHOD OF SLOPE STABILITY ANALYSIS - DON BANKS
 LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NUMBER OF POINTS = 54
 NUMBER OF LINES = 52
 NUMBER OF MATERIALS = 1

YDN = 185.00
 XM = 650.00
 YDP = 415.00

POINT DESCRIPTION

POINT NO.	NO. LINES	X-COORDINATE	Y-COORDINATE
1	1	0	120.00
2	2	240.00	150.00
3	2	290.00	180.00
4	2	460.50	185.00
5	2	656.00	170.00
6	2	686.00	179.00
7	2	720.00	181.00
8	2	760.00	190.00
9	2	795.00	200.00
10	2	829.00	210.00
11	2	850.00	220.00
12	2	890.00	230.00
13	2	905.00	240.00
14	2	935.00	250.00
15	2	950.00	260.00
16	2	975.00	270.00
17	2	990.00	280.00
18	2	1035.00	290.00
19	2	1070.00	300.00
20	2	1100.00	310.00
21	2	1125.00	320.00
22	2	1142.00	330.00
23	2	1156.00	340.00
24	2	1169.00	350.00
25	2	1175.00	360.00
26	2	1183.00	370.00
27	2	1192.00	380.00
28	2	1199.00	390.00
29	2	1202.00	400.00
30	2	1204.00	410.00
31	2	1205.00	425.00
32	2	1211.00	420.00
33	2	1221.00	430.00
34	2	1231.00	440.00
35	2	1246.00	450.00
36	2	1253.00	470.50
37	2	1360.00	470.50
38	1	1500.00	470.50
39	1	0	185.00
40	2	482.50	234.50
41	2	525.00	237.00
42	2	670.00	250.00
43	2	832.00	276.80
44	2	930.00	301.50
45	2	1007.00	328.00
46	2	1014.00	321.00
47	2	1119.00	351.20
48	2	1137.50	365.00
49	2	1153.00	376.00
50	2	1182.50	396.00
51	2	1190.00	410.00
52	1	1500.00	415.00
53	1	0	550.00
54	1	1500.00	550.00

LINE DESCRIPTION

LINE NO.	POINT 1	POINT 2	MATERIAL
1	1	2	1
2	2	3	1
3	3	4	1
4	4	5	1
5	5	6	1
6	6	7	1
7	7	8	1
8	8	9	1
9	9	10	1
10	10	11	1
11	11	12	1
12	12	13	1
13	13	14	1
14	14	15	1
15	15	16	1
16	16	17	1
17	17	18	1
18	18	19	1
19	19	20	1
20	20	21	1
21	21	22	1
22	22	23	1
23	23	24	1
24	24	25	1
25	25	26	1
26	26	27	1
27	27	28	1
28	28	29	1
29	29	30	1
30	30	31	1
31	31	32	1
32	32	33	1
33	33	34	1
34	34	35	1
35	35	36	1
36	36	37	1
37	37	38	1
38	39	40	0
39	40	41	0
40	41	42	0
41	42	43	0
42	43	44	0
43	44	45	0
44	45	46	0
45	46	47	0
46	47	48	0
47	48	49	0
48	49	50	0
49	50	51	0
50	51	31	0
51	31	52	0
52	53	54	1

BxA	0,	240,000000	290,000000	466,500000	658,000000	688,000000	720,000000	767,000000
BxA	792,000000	829,000000	850,000000	890,000000	902,000000	933,000000	952,000000	972,000000
BxA	890,000000	1035,000000	1072,000000	1100,000000	1122,000000	1142,000000	1158,000000	1167,000000
BxA	1172,000000	1183,000000	1192,000000	1199,000000	1202,000000	1204,000000	1202,000000	1212,000000
BxA	1221,000000	1231,000000	1246,000000	1253,000000	1260,000000	1260,000000	0,	482,500000
BxA	822,000000	674,000000	633,000000	630,000000	1007,000000	1014,000000	1119,000000	1137,000000
BxA	1153,000000	1181,000000	1192,000000	1200,000000	0,	1200,000000	650,000000	
BxB	0,	240,000000	290,000000	466,500000	482,200000	525,000000	650,000000	650,000000
BxB	670,000000	688,000000	720,000000	768,000000	792,000000	829,000000	833,000000	850,000000
BxB	890,000000	909,000000	930,000000	933,000000	955,000000	975,000000	998,000000	1007,000000
BxB	1011,000000	1035,000000	1072,000000	1100,000000	1119,000000	1125,000000	1137,000000	1142,000000
BxB	1152,000000	1158,000000	1164,000000	1172,000000	1181,000000	1183,000000	1192,000000	1192,000000
BxB	1202,000000	1204,000000	1205,000000	1211,000000	1221,000000	1231,000000	1246,000000	1253,000000
BxB	1260,000000	1260,000000						
X	120,000000							
BY	120,000000	1						
BY	182,000000	53						
BY	197,310881	36						
X	265,000000							
BY	125,000000	2						
BY	182,000000	53						
BY	212,186229	36						
X	378,250000							
BY	102,500000	3						
BY	182,000000	53						
BY	225,804922	36						
X	474,500000							
BY	165,208876	4						
BY	182,000000	53						
BY	234,679276	36						
X	503,750000							
BY	165,972586	4						
BY	182,000000	53						
BY	232,750000	39						
X	587,500000							
BY	168,159269	4						
BY	182,000000	53						
BY	242,310457	40						
X	684,000000							
BY	169,895561	4						
BY	247,940783	40						
BY	412,000000	54						
X	668,000000							
BY	173,000000	5						
BY	249,150326	40						
BY	412,000000	54						
X	683,000000							
BY	177,500000	5						
BY	250,864915	41						
BY	412,000000	54						
X	704,000000							
BY	180,000000	6						
BY	254,495483	41						
BY	412,000000	54						
X	743,000000							
BY	189,500000	7						
BY	261,238708	41						
BY	412,000000	54						
X	780,500000							
BY	195,000000	8						
BY	267,722580	41						

BY = 412,000000	54
X = 812,000000	
BY = 205,000000	9
BY = 273,169033	41
BY = 412,000000	54
X = 831,000000	
BY = 214,952381	10
BY = 278,454193	41
BY = 412,000000	54
X = 841,500000	
BY = 215,952381	10
BY = 278,964432	42
BY = 412,000000	54
X = 870,000000	
BY = 225,000000	11
BY = 286,221649	42
BY = 412,000000	54
X = 897,500000	
BY = 234,999996	12
BY = 293,224228	42
BY = 412,000000	54
X = 917,500000	
BY = 244,464285	13
BY = 298,317009	42
BY = 412,000000	54
X = 931,500000	
BY = 249,464285	13
BY = 301,821438	43
BY = 412,000000	54
X = 944,000000	
BY = 255,000000	14
BY = 304,500000	43
BY = 412,000000	54
X = 965,000000	
BY = 265,000000	15
BY = 309,000000	43
BY = 412,000000	54
X = 985,500000	
BY = 275,000000	16
BY = 313,392857	43
BY = 412,000000	54
X = 1001,500000	
BY = 281,410255	17
BY = 316,821438	43
BY = 412,000000	54
X = 1010,500000	
BY = 283,717949	17
BY = 319,500000	44
BY = 412,000000	54
X = 1024,500000	
BY = 287,307690	17
BY = 324,020000	45
BY = 412,000000	54
X = 1083,500000	
BY = 295,000000	18
BY = 332,360954	45
BY = 412,000000	54
X = 1084,000000	
BY = 305,000000	19
BY = 341,708572	45
BY = 412,000000	54
X = 1109,500000	

BY = 313,799999	20
BY = 348,467621	45
BY = 412,000000	54
X = 1122,000000	
BY = 318,799999	20
BY = 353,437840	46
BY = 412,000000	54
X = 1141,250000	
BY = 323,676466	21
BY = 360,337837	46
BY = 412,000000	54
X = 1139,750000	
BY = 328,676466	21
BY = 366,596775	47
BY = 412,000000	54
X = 1147,500000	
BY = 333,437500	22
BY = 372,096775	47
BY = 412,000000	54
X = 1165,500000	
BY = 339,437500	22
BY = 377,754387	48
BY = 412,000000	54
X = 1163,500000	
BY = 344,999996	23
BY = 383,368423	48
BY = 412,000000	54
X = 1172,000000	
BY = 354,999996	24
BY = 389,333336	48
BY = 412,000000	54
X = 1178,250000	
BY = 364,062500	25
BY = 393,719299	48
BY = 412,000000	54
X = 1182,250000	
BY = 369,062500	25
BY = 396,599998	49
BY = 412,000000	54
X = 1187,500000	
BY = 375,000000	26
BY = 400,799999	49
BY = 412,000000	54
X = 1195,500000	
BY = 385,000000	27
BY = 407,200001	49
BY = 412,000000	54
X = 1200,500000	
BY = 394,999999	28
BY = 411,249996	50
BY = 412,000000	54
X = 1203,000000	
BY = 405,000000	29
BY = 413,333332	50
BY = 412,000000	54
X = 1204,500000	
BY = 412,500000	30
BY = 414,583332	50
BY = 412,000000	54
X = 1208,000000	
BY = 415,000000	31
BY = 417,499996	31
X = 1216,000000	
BY = 415,000000	32
BY = 422,000000	32
X = 1226,000000	
BY = 415,000000	34
BY = 435,000000	33
X = 1238,500000	
BY = 415,000000	34
BY = 442,000000	34
X = 1249,500000	
BY = 415,000000	34
BY = 460,250004	35
X = 1306,500000	
BY = 415,000000	34
BY = 470,500000	36
X = 1430,000000	
BY = 415,000000	34
BY = 470,500000	37

LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NO. OF POINTS TO DESCRIBE FAILURE SURFACES	=	7
NO. OF FAILURE SURFACE DESCRIPTION CARDS	=	2
MAX. NO. OF COLUMNS TO DESCRIBE FAIL. SURF.	=	4
NO. OF BLOCKS OF SUBSTITUTE SOIL TYPES	=	1
NO. OF ALTERNATE F(X) DISTRIBUTIONS	=	0

FAILURE SURFACE POINTS

POINT NO.	X-COORDINATE	Y-COORDINATE	F(X)
1	600,00	167,10	1,00
	0,00	925,00	160,00
	1,00	0,00	990,00
	378,00	1,00	0,00
	1205,00	409,00	1,00
	0,00	975,00	465,00
	1,00	0,00	1290,00
	488,00	1,00	0,00
	1285,00	469,50	1,00

FAILURE SURFACE DESCRIPTION

SURFACE NO.	POINTS TO DESCRIBE THE SURFACE
1	1 3 4 6
2	2 5 6 7

SOIL DATA

NO	WEY	SAY	COH	F1	KU	EQ
1	135.0	135.0	0.	0.729	0.	0.

SURFACE NUMBER 1 : 1 (SPECIFIED)

SURFACE DEFINED BY#	POINT	X	Y	F(X)
1=	1	600.00	167.00	1.00
3=	3	950.00	378.00	1.00
4=	4	1205.00	409.00	1.00

INS,IT 0 0
INS,IT 0 2

X-COORD	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
829.00	5723.0	5723.0	2194.7	2.00	0.127	1.00	1.00
890.00	17295.0	17295.0	6628.7	3.47	0.127	1.00	1.00
888.00	23622.0	23622.0	9053.7	4.06	0.127	1.00	1.00
878.00	42205.0	42205.0	16206.7	5.66	0.149	1.00	1.00
888.00	52828.0	52828.0	20249.7	6.51	0.158	1.00	1.00
720.00	95234.0	95234.0	36500.7	8.98	0.194	1.00	1.00
761.00	169514.0	169514.0	64964.7	12.11	0.181	1.00	1.00
766.00	178208.0	178208.0	66331.7	12.44	0.181	1.00	1.00
795.00	240783.0	240783.0	92283.7	14.74	0.174	1.00	1.00
829.00	322209.0	322209.0	123489.7	17.92	0.184	1.00	1.00
833.00	332371.0	332371.0	127389.7	17.85	0.187	1.00	1.00
850.00	376178.0	376178.0	144179.7	19.28	0.197	1.00	1.00
880.00	487931.0	487931.0	187006.7	22.62	0.202	1.00	1.00
909.00	532470.0	532470.0	204076.7	23.89	0.215	1.00	1.00
930.00	608429.0	608429.0	233168.7	26.05	0.223	1.00	1.00
933.00	617820.0	617820.0	236787.7	26.31	0.223	1.00	1.00
950.00	671770.0	671770.0	257464.7	27.78	0.231	1.00	1.00
955.00	652957.0	652957.0	250254.7	27.25	0.230	1.00	1.00
975.00	580612.0	580612.0	222527.7	25.09	0.226	1.00	1.00
996.00	509617.0	509617.0	195317.7	22.71	0.219	1.00	1.00
1007.00	473977.0	473977.0	181658.7	21.43	0.210	1.00	1.00
1014.00	451864.0	451864.0	173068.7	20.62	0.204	1.00	1.00
1039.00	385975.0	385975.0	147776.7	18.18	0.185	1.00	1.00
1072.00	274165.0	274165.0	105077.7	13.94	0.150	1.00	1.00
1100.00	195191.0	195191.0	74809.7	10.79	0.125	1.00	1.00
1119.00	145158.0	145158.0	55634.7	8.69	0.107	1.00	1.00
1129.00	130016.0	130016.0	49830.7	8.04	0.101	1.00	1.00
1137.50	99948.0	99948.0	36306.7	6.70	0.091	1.00	1.00
1142.00	89685.0	89685.0	30373.7	6.22	0.087	1.00	1.00
1193.00	65923.0	65923.0	25266.7	5.07	0.077	1.00	1.00
1158.00	55757.0	55757.0	21369.7	4.56	0.072	1.00	1.00
1169.00	35327.0	35327.0	12540.7	3.51	0.064	1.00	1.00
1175.00	25879.0	25879.0	9918.7	2.95	0.065	1.00	1.00
1181.50	17343.0	17343.0	6647.7	2.29	0.060	1.00	1.00
1183.00	15886.0	15886.0	5974.7	2.14	0.059	1.00	1.00
1192.00	6850.0	6850.0	2510.7	1.18	0.043	1.00	1.00
1196.00	3113.0	3113.0	1193.7	0.70	0.033	1.00	1.00
1199.00	1912.0	1912.0	589.7	0.44	0.024	1.00	1.00
1202.00	241.0	241.0	92.7	0.15	0.018	1.00	1.00
1203.77	-0.0	-0.0	-0.0	0.0	0.0	1.00	1.00

F = 8.116 LAMBDA = 0.3637 7 8 0)

SOIL DATA

NO	WEY	SAY	COH	PI	HU	EG
1	132.0	132.0	0.	0.006	0.	0.

SURFACE NUMBER 2 1 (SPECIFIED)					
SURFACE DEFINED BY					
POINT	X	Y	Z	F(X)	
2- 2	325,00	166,00		1,00	
5- 5	975,00	463,00		1,00	
6- 6	1250,00	488,00		1,00	
7- 7	1285,00	469,90		1,00	

INS,IT	U	0	0
INS,IT	U	2	

X-COORD	E	X-FORCE	V-VY	V-VY/V=Z	VERY F	SMALL F	PORE PRES
593,70	8215,0	8215,0	3072,0	2,67	0,150	2,16	1,00
648,47	158103,0	158103,0	59111,0	1,70	0,150	2,16	1,00
690,00	162809,0	162809,0	60994,0	1,84	0,150	2,16	1,00
698,00	183626,0	183626,0	68653,0	2,61	0,150	2,16	1,00
678,00	241988,0	241988,0	90323,0	2,61	0,161	2,16	1,00
688,00	272359,0	272359,0	101828,0	1,66	0,166	2,16	1,00
720,00	382866,0	382866,0	143151,0	1,93	0,166	2,16	1,00
760,00	572646,0	572646,0	214098,0	2,58	0,175	2,16	1,00
792,00	706946,0	706946,0	264309,0	2,60	0,184	2,16	1,00
820,00	876969,0	876969,0	327726,0	3,23	0,193	2,16	1,00
833,00	897398,0	897398,0	335514,0	3,66	0,195	2,16	1,00
890,00	987011,0	987011,0	366018,0	3,71	0,203	2,16	1,00
900,00	1210818,0	1210818,0	452693,0	3,87	0,208	2,16	1,00
902,27	1282807,0	1282807,0	476008,0	3,22	0,216	2,16	1,00
905,00	1298800,0	1298800,0	485388,0	3,52	0,216	2,16	1,00
930,00	1448534,0	1448534,0	541969,0	4,32	0,224	2,16	1,00
933,00	1466924,0	1466924,0	546445,0	4,66	0,225	2,16	1,00
995,00	1603765,0	1603765,0	599606,0	4,13	0,232	2,16	1,00
995,00	1730726,0	1730726,0	647073,0	4,40	0,240	2,16	1,00
996,00	1594274,0	1594274,0	596058,0	4,18	0,239	2,16	1,00
1007,00	1524674,0	1524674,0	376036,0	4,01	0,235	2,16	1,00
1014,00	1480741,0	1480741,0	353611,0	4,28	0,232	2,16	1,00
1039,00	1390617,0	1390617,0	304961,0	4,12	0,229	2,16	1,00
1072,00	1127784,0	1127784,0	421649,0	3,55	0,213	2,16	1,00
1100,00	965937,0	965937,0	361139,0	3,10	0,207	2,16	1,00
1119,00	860466,0	860466,0	221706,0	3,57	0,206	2,16	1,00
1129,00	872956,0	872956,0	309951,0	3,12	0,209	2,16	1,00
1137,50	761963,0	761963,0	284878,0	3,21	0,208	2,16	1,00
1142,00	738859,0	738859,0	276240,0	3,90	0,209	2,16	1,00
1153,00	683919,0	683919,0	255699,0	3,14	0,212	2,16	1,00
1158,00	659680,0	659680,0	246637,0	2,81	0,213	2,16	1,00
1160,00	608563,0	608563,0	227526,0	2,97	0,223	2,16	1,00
1179,00	582585,0	582585,0	217813,0	2,63	0,236	2,16	1,00
1181,50	556340,0	556340,0	206001,0	2,10	0,247	2,16	1,00
1183,00	550923,0	550923,0	205826,0	2,97	0,250	2,16	1,00
1192,00	517309,0	517309,0	185408,0	2,14	0,264	2,16	1,00
1199,00	493708,0	493708,0	184985,0	2,41	0,283	2,16	1,00
1202,00	484578,0	484578,0	181171,0	2,05	0,311	2,16	1,00
1204,00	479164,0	479164,0	175147,0	2,78	0,349	2,16	1,00
1209,00	476710,0	476710,0	176229,0	2,63	0,372	2,16	1,00
1211,00	461899,0	461899,0	172677,0	2,61	0,382	2,16	1,00
1221,00	432834,0	432834,0	161825,0	2,48	0,406	2,16	1,00
1231,00	398511,0	398511,0	146993,0	1,88	0,430	2,16	1,00
1246,00	349219,0	349219,0	136962,0	1,91	0,423	2,16	1,00
1290,00	309511,0	309511,0	11718,0	1,68	0,521	2,16	1,00
1293,00	232781,0	232781,0	87031,0	1,71	0,786	2,16	1,00
1293,11	-0,0	-0,0	-0,0	-0,0	0,0	2,16	1,00

F =	2,446	LAMDA =	0,374	(t = 7 0)
STOP AT LINE	5,...			

EXAMPLE NO. 8

Conventional Stability Analysis Section After Canal Deepening--
Total Stress Analysis Using A Computed Strength of $c = 0$
and $\phi = 36.11$ deg for the Lower Failure Surface with
Distributed Accelerations Applied to the Failure Mass

MORGENSTERN AND PRICE METHOD OF SLOPE STABILITY ANALYSIS - DOV BANKS
 WITH EARTHQUAKE ANALYSIS
 LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NUMBER OF POINTS	=	80
NUMBER OF LINES	=	78
NUMBER OF MATERIALS	=	28
YDM	=	185.00
XM	=	650.00
YDP	=	415.00

POINT DESCRIPTION

POINT NO.	NO. LINES	X-COORDINATE	Y-COORDINATE				
1	1	0	150,00	59	2	279,50	158,00
2	2	240,00	150,00	60	2	336,00	162,00
3	2	290,00	160,00	61	2	400,00	163,00
4	2	466,50	185,00	62	2	467,50	165,00
5	2	658,00	170,00	63	2	536,00	167,00
6	2	688,00	179,00	64	2	585,50	168,00
7	2	720,00	181,00	65	2	639,00	169,50
8	2	766,00	190,00	66	2	695,00	180,00
9	2	795,00	200,00	67	2	734,50	185,00
10	2	829,00	210,00	68	2	774,50	193,00
11	2	850,00	220,00	69	2	816,00	207,00
12	2	890,00	230,00	70	2	847,00	218,00
13	2	905,00	240,00	71	2	880,00	228,00
14	2	933,00	250,00	72	2	913,50	242,50
15	2	955,00	260,00	73	2	947,00	257,00
16	2	975,00	270,00	74	2	981,50	273,00
17	2	996,00	280,00	75	2	1016,50	287,00
18	2	1035,00	290,00	76	2	1046,00	292,00
19	2	1072,00	300,00	77	2	1076,00	302,00
20	2	1100,00	310,00	78	2	1095,50	308,00
21	2	1125,00	320,00	79	2	1112,50	315,00
22	2	1142,00	330,00	80	2	1131,00	318,00
23	2	1158,00	340,00				
24	2	1169,00	350,00				
25	2	1175,00	360,00				
26	2	1183,00	370,00				
27	2	1192,00	380,00				
28	2	1199,00	390,00				
29	2	1202,00	400,00				
30	2	1204,00	410,00				
31	2	1205,00	415,00				
32	2	1211,00	420,00				
33	2	1221,00	430,00				
34	2	1231,00	440,00				
35	2	1246,00	450,00				
36	2	1253,00	470,50				
37	2	1360,00	470,50				
38	1	1500,00	470,50				
39	1	0	185,00				
40	2	482,50	284,50				
41	2	925,00	287,00				
42	2	678,00	250,00				
43	2	833,00	276,80				
44	2	930,00	301,50				
45	2	1007,00	318,00				
46	2	1014,00	321,00				
47	2	1119,00	351,20				
48	2	1137,50	365,00				
49	2	1153,00	376,00				
50	2	1181,50	396,00				
51	2	1199,00	410,00				
52	1	1500,00	415,00				
53	1	0	550,00				
54	1	1500,00	550,00				
55	2	60,00	150,00				
56	2	132,50	150,00				
57	2	191,00	150,00				
58	2	238,50	150,00				

LINE DESCRIPTION

LINE NO.	POINT 1	POINT 2	MATERIAL
1	1	55	1
2	55	56	2
3	56	57	3
4	57	58	4
5	58	2	5
6	2	59	5
7	59	3	6
8	3	60	6
9	60	61	7
10	61	4	8
11	4	62	8
12	62	63	9
13	63	64	10
14	64	65	11
15	65	5	12
16	5	6	12
17	6	66	12
18	66	7	13
19	7	67	13
20	67	8	14
21	8	68	14
22	68	9	15
23	9	69	15
24	69	10	16
25	10	70	16
26	70	11	17
27	11	71	17
28	71	12	18
29	12	13	18
30	13	72	18
31	72	14	19
32	14	73	19
33	73	15	20
34	15	16	20
35	16	74	20
36	74	17	21
37	17	75	21
38	75	18	22
39	18	76	22
40	76	19	23
41	19	77	23
42	77	78	24
43	78	20	25
44	20	79	25
45	79	21	26
46	21	80	26
47	80	22	27
48	22	23	27
49	23	24	27
50	24	25	27
51	25	26	27
52	26	27	27
53	27	28	27
54	28	29	27
55	29	30	27
56	30	31	27
57	31	32	27
58	32	33	27
59	33	34	27
60	34	35	27
61	35	36	27
62	36	37	28
63	37	38	28
64	38	40	0
65	40	41	0
66	41	42	0
67	42	43	0
68	43	44	0
69	44	45	0
70	45	46	0
71	46	47	0
72	47	48	0
73	48	49	0
74	49	50	0
75	50	51	0
76	51	31	0
77	31	52	0
78	52	54	28

BxA	0	240,000000	290,000000	466,500000	658,000000	688,000000	720,000000	766,000000
Bx	799,000000	829,000000	850,000000	890,000000	905,000000	933,000000	955,000000	975,000000
BxA	999,000000	1035,000000	1072,000000	1100,000000	1125,000000	1142,000000	1158,000000	1169,000000
BxA	1177,000000	1183,000000	1192,000000	1199,000000	1202,000000	1204,000000	1207,000000	1211,000000
BxA	1221,000000	1231,000000	1246,000000	1253,000000	1260,000000	1260,000000	0	482,500000
BxA	927,000000	878,000000	833,000000	930,000000	1007,000000	1014,000000	1119,000000	1137,500000
BxA	1159,000000	1101,500000	1199,000000	1200,000000	0	1200,000000	60,000000	132,500000
BxA	191,000000	238,500000	279,500000	338,000000	400,000000	467,500000	539,000000	585,500000
BxA	837,000000	695,000000	734,500000	774,500000	816,000000	847,000000	880,000000	913,500000
BxA	947,000000	981,500000	1016,500000	1046,000000	1076,000000	1095,500000	1112,500000	1131,000000
BxA	890,000000	600,000000	132,500000	191,000000	238,500000	240,000000	279,500000	290,000000
Bx	239,000000	900,000000	466,500000	467,500000	482,500000	525,000000	538,000000	585,500000
Bx	837,000000	620,000000	658,000000	678,000000	688,000000	695,000000	720,000000	734,500000
Bx	760,000000	774,500000	795,000000	816,000000	829,000000	833,000000	847,000000	850,000000
Bx	880,000000	890,000000	905,000000	913,500000	930,000000	933,000000	947,000000	955,000000
Bx	977,000000	981,500000	996,000000	1007,000000	1014,000000	1016,500000	1033,000000	1046,000000
Bx	1072,000000	1076,000000	1095,500000	1100,000000	1112,500000	1119,000000	1127,000000	1131,000000
Bx	1137,500000	1142,000000	1158,000000	1158,000000	1189,000000	1175,000000	1181,500000	1183,000000
Bx	1192,000000	1199,000000	1202,000000	1204,000000	1207,000000	1211,000000	1221,000000	1231,000000
Bx	1246,000000	1253,000000	1260,000000	1260,000000	1260,000000	1260,000000	1260,000000	1260,000000
X	30,000000							
Bx	1,000000	1						
Bx	189,000000	79						
Bx	180,077721	64						
X	96,250000							
Bx	170,000000	2						
Bx	180,000000	79						
Bx	195,874352	64						
X	161,750000							
Bx	170,000000	3						
Bx	180,000000	79						
Bx	201,574042	64						
X	214,750000							
Bx	170,000000	4						
Bx	180,000000	79						
Bx	207,031347	64						
X	249,250000							
Bx	170,000000	5						
Bx	180,000000	79						
Bx	209,544819	64						
X	289,750000							
Bx	174,000000	6						
Bx	180,000000	79						
Bx	211,647928	64						
X	284,750000							
Bx	170,000000	7						
Bx	180,000000	79						
Bx	219,212694	64						
X	313,000000							
Bx	181,000000	8						
Bx	180,000000	79						
Bx	217,110888	64						
X	368,000000							
Bx	182,500000	9						
Bx	180,000000	79						
Bx	224,753368	64						
X	433,250000							
Bx	184,000000	10						
Bx	180,000000	79						
Bx	229,447409	64						

X =	467,000000	
BY =	109,000000	11
BY =	185,000000	79
BY =	232,909849	64
X =	479,000000	
BY =	109,218977	12
BY =	185,000000	79
BY =	233,730970	64
X =	503,750000	
BY =	108,098393	12
BY =	185,000000	79
BY =	233,750000	69
X =	530,500000	
BY =	108,839417	12
BY =	185,000000	79
BY =	237,487319	66
X =	560,750000	
BY =	107,500000	13
BY =	185,000000	79
BY =	240,037580	66
X =	612,250000	
BY =	108,750000	14
BY =	185,000000	79
BY =	244,413399	68
X =	644,500000	
BY =	109,644733	13
BY =	185,000000	79
BY =	247,153999	66
X =	684,000000	
BY =	109,894733	13
BY =	247,960783	66
BY =	415,000000	80
X =	688,000000	
BY =	173,000000	16
BY =	249,150326	66
BY =	415,000000	80
X =	683,000000	
BY =	177,500000	16
BY =	250,864513	67
BY =	415,000000	80
X =	691,500000	
BY =	179,500000	17
BY =	252,334194	67
BY =	415,000000	80
X =	707,500000	
BY =	190,500000	18
BY =	255,100649	67
BY =	415,000000	80
X =	727,250000	
BY =	193,000000	19
BY =	258,515484	67
BY =	415,000000	80
X =	780,250000	
BY =	197,500000	20
BY =	262,492256	67
BY =	415,000000	80
X =	790,250000	
BY =	191,500000	21
BY =	265,950321	67
BY =	415,000000	80
X =	784,750000	
BY =	196,500000	22

BY =	269,457420	67
BY =	415,000000	80
X =	805,500000	
BY =	203,500000	23
BY =	272,045162	67
BY =	415,000000	80
X =	822,500000	
BY =	208,500000	24
BY =	274,984516	67
BY =	415,000000	80
X =	831,000000	
BY =	210,888887	25
BY =	276,454193	67
BY =	415,000000	80
X =	840,000000	
BY =	214,888887	25
BY =	278,582474	68
BY =	415,000000	80
X =	848,500000	
BY =	219,000000	26
BY =	280,746906	68
BY =	415,000000	80
X =	865,000000	
BY =	224,000000	27
BY =	284,948452	68
BY =	415,000000	80
X =	885,000000	
BY =	229,000000	28
BY =	290,041237	68
BY =	415,000000	80
X =	897,500000	
BY =	234,999998	29
BY =	293,224228	68
BY =	415,000000	80
X =	909,250000	
BY =	241,250000	30
BY =	295,216236	68
BY =	415,000000	80
X =	921,750000	
BY =	245,673077	31
BY =	297,399227	68
BY =	415,000000	80
X =	931,500000	
BY =	249,423077	31
BY =	301,821438	69
BY =	415,000000	80
X =	940,000000	
BY =	253,500000	32
BY =	303,642857	69
BY =	415,000000	80
X =	951,000000	
BY =	258,500000	33
BY =	305,000000	69
BY =	415,000000	80
X =	957,000000	
BY =	259,000000	34
BY =	305,000000	69
BY =	415,000000	80
X =	978,250000	
BY =	271,500000	35
BY =	311,839287	69
BY =	415,000000	80

X	=	988,750000	
BY	=	276,500000	36
X	=	314,089287	69
BY	=	417,000000	80
X	=	1001,500000	
BY	=	281,878048	37
X	=	310,821430	69
BY	=	417,000000	80
X	=	1010,500000	
BY	=	284,951218	37
X	=	317,500000	70
BY	=	417,000000	80
X	=	1015,250000	
BY	=	286,973170	37
X	=	321,399524	71
BY	=	417,000000	80
X	=	1025,750000	
BY	=	288,500000	38
X	=	324,379524	71
BY	=	417,000000	80
X	=	1040,500000	
BY	=	291,000000	39
X	=	328,621906	71
BY	=	417,000000	80
X	=	1059,000000	
BY	=	296,000000	40
X	=	333,942856	71
BY	=	417,000000	80
X	=	1074,000000	
BY	=	301,000000	41
X	=	338,257145	71
BY	=	417,000000	80
X	=	1089,750000	
BY	=	305,000000	42
X	=	341,636689	71
BY	=	417,000000	80
X	=	1097,750000	
BY	=	309,000000	43
X	=	345,088097	71
BY	=	417,000000	80
X	=	1106,250000	
BY	=	312,500000	44
X	=	347,532856	71
BY	=	417,000000	80
X	=	1115,750000	
BY	=	316,299999	45
X	=	350,265240	71
BY	=	417,000000	80
X	=	1122,000000	
BY	=	318,799999	45
X	=	353,437840	72
BY	=	417,000000	80
X	=	1128,000000	
BY	=	319,000000	46
X	=	357,913513	72
BY	=	417,000000	80
X	=	1134,250000	
BY	=	321,545456	47
X	=	362,575676	72
BY	=	417,000000	80
X	=	1139,750000	
BY	=	327,549456	47

BY	=	366,596775	73
X	=	417,000000	80
X	=	1147,500000	
BY	=	333,437580	48
X	=	372,096775	73
BY	=	417,000000	80
X	=	1155,500000	
BY	=	338,437580	48
X	=	377,754387	74
BY	=	417,000000	80
X	=	1163,500000	
BY	=	354,999996	49
X	=	383,368423	74
BY	=	417,000000	80
X	=	1172,000000	
BY	=	354,999996	50
X	=	389,333336	74
BY	=	417,000000	80
X	=	1178,250000	
BY	=	354,062580	51
X	=	393,719299	74
BY	=	417,000000	80
X	=	1182,250000	
BY	=	359,062580	51
X	=	396,599996	75
BY	=	417,000000	80
X	=	1187,500000	
BY	=	375,000000	52
X	=	400,799999	75
BY	=	417,000000	80
X	=	1195,500000	
BY	=	389,000000	53
X	=	407,200001	75
BY	=	417,000000	80
X	=	1200,500000	
BY	=	394,999992	54
X	=	411,249996	76
BY	=	417,000000	80
X	=	1203,000000	
BY	=	409,000000	55
X	=	413,333332	76
BY	=	417,000000	80
X	=	1204,500000	
BY	=	412,500000	56
X	=	414,583332	76
BY	=	417,000000	80
X	=	1208,000000	
BY	=	419,000000	80
X	=	417,499996	57
X	=	1210,000000	
BY	=	415,000000	80
X	=	425,000000	58
X	=	1226,000000	
BY	=	415,000000	80
X	=	435,000000	59
X	=	1238,500000	
BY	=	415,000000	80
X	=	445,000000	60
X	=	1249,500000	
BY	=	415,000000	80
X	=	460,250004	61
X	=	1306,500000	
BY	=	415,000000	80
X	=	470,500000	62
X	=	1430,000000	
BY	=	415,000000	80
X	=	470,500000	63

AD-A075 778

ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG--ETC F/G 8/6
EVALUATION OF EFFECTS OF PANAMA CANAL DEEPENING UPON THE STABIL--ETC(U)

UNCLASSIFIED

SEP 79 W O MILLER
WES-OL-79-16

NL

4 OF 4

AD
A075778



END
DATE
FILMED
11 -79
DDC

LA PITA HILL 2-DIMENSIONAL STABILITY ANALYSIS

NO. OF POINTS TO DESCRIBE FAILURE SURFACES = 7
 NO. OF FAILURE SURFACE DESCRIPTION CAMDS = 2
 MAXI. NO. OF COLUMNS TO DESCRIBE FAIL. SURF. = 4
 NO. OF BLOCKS OF SUBSTITUTE SOIL TYPES = 8
 NO. OF ALTERNATE F(X) DISTRIBUTIONS = 0

FAILURE SURFACE POINTS

POINT NO.	X-COORDINATE	Y-COORDINATE	F(X)
1	600,00	167,00	1,00
	0,00	525,00	166,00
	1,00	0,00	990,00
	378,00	1,00	0,00
	1209,00	409,00	1,00
	0,00	975,00	463,00
	1,00	0,00	1290,00
	468,00	1,00	0,00
	1289,00	469,50	1,00

FAILURE SURFACE DESCRIPTION

SURFACE NO.	POINTS TO DESCRIBE THE SURFACE
1	1 3 4 0
2	2 5 6 7

SOIL DATA

NO	WEY	SAY	COM	FI	RU	EO
1	139,0	139,0	0,	0,729	0,	0,010
2	139,0	139,0	0,	0,729	0,	0,010
3	139,0	139,0	0,	0,729	0,	0,010
4	139,0	139,0	0,	0,729	0,	0,028
5	139,0	139,0	0,	0,729	0,	0,028
6	139,0	139,0	0,	0,729	0,	0,020
7	139,0	139,0	0,	0,729	0,	0,030
8	139,0	139,0	0,	0,729	0,	0,030
9	139,0	139,0	0,	0,729	0,	0,040
10	139,0	139,0	0,	0,729	0,	0,050
11	139,0	139,0	0,	0,729	0,	0,060
12	139,0	139,0	0,	0,729	0,	0,080
13	139,0	139,0	0,	0,729	0,	0,100
14	139,0	139,0	0,	0,729	0,	0,120
15	139,0	139,0	0,	0,729	0,	0,160
16	139,0	139,0	0,	0,729	0,	0,200
17	139,0	139,0	0,	0,729	0,	0,240
18	139,0	139,0	0,	0,729	0,	0,320
19	139,0	139,0	0,	0,729	0,	0,400
20	139,0	139,0	0,	0,729	0,	0,600
21	139,0	139,0	0,	0,729	0,	0,800
22	139,0	139,0	0,	0,729	0,	1,200
23	139,0	139,0	0,	0,729	0,	2,000
24	139,0	139,0	0,	0,729	0,	3,000
25	139,0	139,0	0,	0,729	0,	4,000
26	139,0	139,0	0,	0,729	0,	6,000
27	139,0	139,0	0,	0,729	0,	10,000
28	139,0	139,0	0,	0,729	0,	0,

SURFACE NUMBER 2 1 (SPECIFIED)

SURFACE DEFINED BY#	POINT	X	Y	F(X)
2=	2	925,00	166,00	1,00
5=	5	975,00	463,00	1,00
6=	6	1250,00	488,00	1,00
7=	7	1285,00	469,50	1,00

INS,IT 0 0
INS,IT 0 2

X-COORD	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERY F	SMALL F	PORE PRES	
536,00	-89,	-89,	-42,	-3,22	-0,514	1,56	1,00	0,
993,79	-401,	-401,	-188,	-21,77	-1,234	1,56	1,00	0,
585,58	-1697,	-1697,	-793,	-82,91	-1,384	1,56	1,00	0,
639,00	-1936,	-1936,	-905,	-383,61	-2,347	1,56	1,00	0,
648,47	-47,	-27,	12,	-58591,32	-492,889	1,56	1,00	0,
650,00	296,	296,	138,	3640,29	46,249	1,56	1,00	0,
656,00	2089,	2049,	958,	665,82	7,947	1,56	1,00	0,
676,00	8763,	8763,	3101,	326,23	3,886	1,56	1,00	0,
688,00	9266,	9266,	4330,	289,95	3,066	1,56	1,00	0,
695,00	11089,	11089,	5181,	275,27	2,803	1,56	1,00	0,
720,00	25870,	25590,	11960,	176,82	1,731	1,56	1,00	0,
734,58	34889,	34839,	16283,	189,11	1,952	1,56	1,00	0,
766,00	67909,	67909,	31733,	180,37	1,187	1,56	1,00	0,
774,58	77473,	77473,	38209,	158,63	1,152	1,56	1,00	0,
799,00	11737,	11737,	54859,	149,44	1,090	1,56	1,00	0,
816,00	18019,	18019,	74872,	140,93	0,933	1,56	1,00	0,
829,00	19848,	19839,	92972,	136,63	0,872	1,56	1,00	0,
833,00	21110,	21110,	98666,	139,81	0,862	1,56	1,00	0,
847,00	25427,	25427,	118818,	134,04	0,835	1,56	1,00	0,
850,00	28280,	28230,	124428,	133,27	0,830	1,56	1,00	0,
880,00	39066,	39066,	18258,	130,13	0,795	1,56	1,00	0,
890,00	45399,	45399,	21499,	128,38	0,726	1,56	1,00	0,
902,27	53182,	53182,	24858,	127,28	0,720	1,56	1,00	0,
905,00	54922,	54922,	25688,	127,12	0,719	1,56	1,00	0,
913,50	60384,	60384,	28221,	126,85	0,705	1,56	1,00	0,
930,00	74593,	74593,	34866,	129,44	0,880	1,56	1,00	0,
933,00	77174,	77174,	36069,	125,30	0,677	1,56	1,00	0,
947,00	89480,	89480,	41820,	129,30	0,868	1,56	1,00	0,
955,00	10079,	10079,	47107,	124,13	0,694	1,56	1,00	0,
975,00	12949,	12949,	60319,	122,97	0,637	1,56	1,00	0,
981,50	12906,	12906,	60321,	128,42	0,674	1,56	1,00	0,
996,00	13849,	13849,	64726,	134,34	0,727	1,56	1,00	0,
1007,00	14548,	14548,	67993,	137,99	0,755	1,56	1,00	0,
1014,00	14987,	14987,	70046,	139,25	0,772	1,56	1,00	0,
1016,58	15143,	15143,	70775,	139,77	0,778	1,56	1,00	0,
1039,00	18809,	18809,	87893,	131,83	0,739	1,56	1,00	0,
1046,00	20969,	20969,	98058,	127,75	0,720	1,56	1,00	0,
1072,00	32881,	32881,	15388,	128,01	0,617	1,56	1,00	0,
1076,00	34676,	34676,	16266,	124,61	0,609	1,56	1,00	0,
1099,58	49493,	49493,	23132,	88,88	0,936	1,56	1,00	0,
1100,00	54266,	54266,	25361,	85,95	0,921	1,56	1,00	0,
1112,58	67297,	67297,	31453,	77,96	0,486	1,56	1,00	0,
1119,00	77887,	77887,	36422,	73,68	0,465	1,56	1,00	0,
1125,00	85438,	85438,	40954,	70,31	0,449	1,56	1,00	0,
1131,00	97221,	97221,	49435,	67,40	0,423	1,56	1,00	0,
1137,58	11526,	11526,	53873,	63,85	0,418	1,56	1,00	0,
1142,00	12732,	12732,	59563,	61,99	0,416	1,56	1,00	0,
1153,00	15576,	15576,	72819,	56,63	0,398	1,56	1,00	0,
1158,00	16831,	16831,	78667,	54,96	0,391	1,56	1,00	0,
1169,00	19478,	19478,	91037,	50,27	0,385	1,56	1,00	0,

1175.00	20823820	20823820	0732445	47.92	0.395	1.56	1.00	1.00	0.
1181.00	22182780	22182780	10387999	49.34	0.399	1.56	1.00	1.00	0.
1183.00	22483930	22483930	10708332	44.74	0.400	1.56	1.00	1.00	0.
1192.00	24203600	24203600	11812098	41.18	0.401	1.56	1.00	1.00	0.
1199.00	25425705	25425705	11883231	38.42	0.412	1.56	1.00	1.00	0.
1202.00	25888400	25888438	12104173	37.21	0.445	1.56	1.00	1.00	0.
1204.00	26178792	26178792	12235202	36.59	0.493	1.56	1.00	1.00	0.
1205.00	26305827	26305827	12294589	39.96	0.522	1.56	1.00	1.00	0.
1211.00	27016326	27016326	12426641	33.45	0.519	1.56	1.00	1.00	0.
1221.00	28088842	28088842	13118526	29.36	0.530	1.56	1.00	1.00	0.
1231.00	28945302	28945302	13528188	25.34	0.548	1.56	1.00	1.00	0.
1250.00	30012186	30012136	14028198	19.46	0.517	1.56	1.00	1.00	0.
1250.00	30191982	30191932	14118827	17.90	0.681	1.56	1.00	1.00	0.
1253.00	32314883	32314833	15103809	13.81	0.868	1.56	1.00	1.00	0.
1283.11	-1691.	-1691.	-790.	0.	0.	0.	1.00	1.00	0.
P = 0.472 LAMBDA = 0.467 (14 16 0)									

SDIL DATA

NO	NET	SAT	COH	FI	RU	EQ
1	133.0	133.0	0.	0.729	0.	0.018
2	133.0	133.0	0.	0.729	0.	0.020
3	133.0	133.0	0.	0.729	0.	0.020
4	133.0	133.0	0.	0.729	0.	0.020
5	133.0	133.0	0.	0.729	0.	0.030
6	133.0	133.0	0.	0.729	0.	0.030
7	133.0	133.0	0.	0.729	0.	0.046
8	133.0	133.0	0.	0.729	0.	0.050
9	133.0	133.0	0.	0.729	0.	0.060
10	133.0	133.0	0.	0.729	0.	0.080
11	133.0	133.0	0.	0.729	0.	0.090
12	133.0	133.0	0.	0.729	0.	0.120
13	133.0	133.0	0.	0.729	0.	0.150
14	133.0	133.0	0.	0.729	0.	0.180
15	133.0	133.0	0.	0.729	0.	0.240
16	133.0	133.0	0.	0.729	0.	0.300
17	133.0	133.0	0.	0.729	0.	0.360
18	133.0	133.0	0.	0.729	0.	0.480
19	133.0	133.0	0.	0.729	0.	0.600
20	133.0	133.0	0.	0.729	0.	0.900
21	133.0	133.0	0.	0.729	0.	1.200
22	133.0	133.0	0.	0.729	0.	1.800
23	133.0	133.0	0.	0.729	0.	3.000
24	133.0	133.0	0.	0.729	0.	4.500
25	133.0	133.0	0.	0.729	0.	6.000
26	133.0	133.0	0.	0.729	0.	9.000
27	133.0	133.0	0.	0.729	0.	15.000
28	133.0	133.0	0.	0.729	0.	0.

SURFACE NUMBER 2 1 (SPECIFIED)

SURFACE DEFINED BY#	POINT	X	Y	F(X)
2=	2	522,00	166,00	1,00
5=	5	975,00	465,00	1,00
6=	6	1250,00	488,00	1,00
7=	7	1285,00	469,50	1,00

NOT CONVERGING 0 *1

X-COORD	E	X-FORCE	Y-T	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
536,00	-327,0	-327,0	-98,0	=0,43	=0,069	2,43	1,00
553,79	-197,0	-197,0	-59,0	=0,25	=0,241	2,43	1,00
585,38	-878,1	-878,1	-283,4	=0,23	=0,270	2,43	1,00
639,00	-2732,7	-2732,7	-819,8	=0,33	=0,392	2,43	1,00
648,47	-2881,9	-2881,9	-864,4	=0,24	=0,492	2,43	1,00
650,00	-29066,0	-29066,0	-872,0	=0,97	=0,508	2,43	1,00
658,00	-30482,0	-30482,0	-912,9	=0,42	=0,590	2,43	1,00
678,00	-34104,0	-34104,0	-1023,1	=0,58	=0,809	2,43	1,00
688,00	-36073,0	-36073,0	-1081,6	=0,44	=0,903	2,43	1,00
695,00	-3747,1	-3747,1	-1124,1	=0,80	=0,955	2,43	1,00
720,00	-31850,0	-31850,0	-995,7	=0,87	=1,670	2,43	1,00
734,50	-28276,0	-28276,0	-648,3	=0,82	=2,338	2,43	1,00
760,00	-2877,0	-2877,0	-86,3	=4831,46	-30,773	2,43	1,00
774,50	4472,0	4472,0	1342,0	3538,39	20,702	2,43	1,00
799,00	47181,0	47181,0	14154,7	479,29	3,323	2,43	1,00
816,00	93009,0	93009,0	27903,1	328,92	2,175	2,43	1,00
829,00	139499,0	139499,0	41838,0	267,68	1,709	2,43	1,00
833,00	154050,0	154050,0	46215,0	256,67	1,630	2,43	1,00
847,00	205750,0	205750,0	61729,0	231,42	1,442	2,43	1,00
850,00	220998,0	220998,0	66299,0	225,00	1,402	2,43	1,00
860,00	379074,0	379074,0	113722,0	192,96	1,120	2,43	1,00
890,00	463841,0	463841,0	139152,0	182,27	1,030	2,43	1,00
902,27	569219,0	569219,0	170766,0	174,38	0,986	2,43	1,00
905,00	592629,0	592629,0	177889,0	173,12	0,979	2,43	1,00
913,50	666281,0	666281,0	198869,0	170,03	0,945	2,43	1,00
930,00	862922,0	862922,0	258876,0	162,24	0,880	2,43	1,00
933,00	899211,0	899211,0	269763,0	161,37	0,871	2,43	1,00
947,00	1069964,0	1069964,0	320989,0	158,67	0,846	2,43	1,00
959,00	1232424,0	1232424,0	369727,0	154,48	0,814	2,43	1,00
975,00	1644475,0	1644475,0	493343,0	149,13	0,773	2,43	1,00
981,50	1682258,0	1682258,0	504678,0	153,07	0,803	2,43	1,00
996,00	1905680,0	1905680,0	571689,0	154,00	0,833	2,43	1,00
1007,00	2071276,0	2071276,0	621383,0	153,97	0,845	2,43	1,00
1014,00	2175343,0	2175343,0	652618,0	153,74	0,892	2,43	1,00
1016,50	2212333,0	2212333,0	663707,0	153,62	0,855	2,43	1,00
1035,00	2827146,0	2827146,0	848138,0	142,27	0,797	2,43	1,00
1046,00	3190313,0	3190313,0	957094,0	137,17	0,773	2,43	1,00
1072,00	4972513,0	4972513,0	1491754,0	115,84	0,674	2,43	1,00
1076,00	5240988,0	5240988,0	1572296,0	113,81	0,668	2,43	1,00
1095,50	7375259,0	7375259,0	2212578,0	99,93	0,602	2,43	1,00
1100,00	8051938,0	8051938,0	2415462,0	96,81	0,589	2,43	1,00
1112,50	9899073,0	9899073,0	2969722,0	89,86	0,560	2,43	1,00
1119,00	11378893,0	11378893,0	3413656,0	85,73	0,541	2,43	1,00
1129,00	12728259,0	12728259,0	3818478,0	82,57	0,527	2,43	1,00
1131,00	14080644,0	14080644,0	4224187,0	79,90	0,502	2,43	1,00
1137,50	16576229,0	16576229,0	4972869,0	76,27	0,500	2,43	1,00
1142,00	18243016,0	18243016,0	5472905,0	74,05	0,500	2,43	1,00
1153,00	22176882,0	22176882,0	6653065,0	69,41	0,488	2,43	1,00
1156,00	23912401,0	23912401,0	7173720,0	67,58	0,484	2,43	1,00
1169,00	27572499,0	27572499,0	8271750,0	63,84	0,489	2,43	1,00
1175,00	29432598,0	29432598,0	8829779,0	61,86	0,510	2,43	1,00

1181.00	31311798	31311798	9693527	99.73	0.526	2.43	1.00	1.00	0.
1183.00	31720207	31720207	97184867	99.24	0.929	2.43	1.00	1.00	0.
1192.00	34106461	34106461	10231938	96.37	0.549	2.43	1.00	1.00	0.
1199.00	35790330	35790330	10738899	94.19	0.980	2.43	1.00	1.00	0.
1202.00	36450051	36450051	10935015	93.25	0.637	2.43	1.00	1.00	0.
1204.00	36837789	36837789	110513227	92.01	0.713	2.43	1.00	1.00	0.
1205.00	37013453	37013453	11104036	92.29	0.759	2.43	1.00	1.00	0.
1211.00	37990704	37990704	11899011	90.41	0.782	2.43	1.00	1.00	0.
1221.00	39458054	39458054	11937416	47.40	0.856	2.43	1.00	1.00	0.
1231.00	40881820	40881820	12204546	44.55	0.963	2.43	1.00	1.00	0.
1246.00	42181442	42181442	12654433	40.50	1.076	2.43	1.00	1.00	0.
1250.00	42448631	42448631	12734989	39.48	1.502	2.43	1.00	1.00	0.
1253.00	42690086	42690086	12807026	36.80	2.312	2.43	1.00	1.00	0.
1263.15	41073004	41073004	12821901	0.	0.	0.	1.00	1.00	0.
F =	0.836	L _M HDA	F	0.300	0	20	0)		

SOIL DATA

NO	WET	SAT	CON	FI	RU	EQ
1	135.0	135.0	0.	0.729	0.	0.020
2	135.0	135.0	0.	0.729	0.	0.020
3	135.0	135.0	0.	0.729	0.	0.030
4	135.0	135.0	0.	0.729	0.	0.030
5	135.0	135.0	0.	0.729	0.	0.040
6	135.0	135.0	0.	0.729	0.	0.040
7	135.0	135.0	0.	0.729	0.	0.050
8	135.0	135.0	0.	0.729	0.	0.060
9	135.0	135.0	0.	0.729	0.	0.080
10	135.0	135.0	0.	0.729	0.	0.100
11	135.0	135.0	0.	0.729	0.	0.120
12	135.0	135.0	0.	0.729	0.	0.160
13	135.0	135.0	0.	0.729	0.	0.200
14	135.0	135.0	0.	0.729	0.	0.240
15	135.0	135.0	0.	0.729	0.	0.320
16	135.0	135.0	0.	0.729	0.	0.400
17	135.0	135.0	0.	0.729	0.	0.480
18	135.0	135.0	0.	0.729	0.	0.640
19	135.0	135.0	0.	0.729	0.	0.800
20	135.0	135.0	0.	0.729	0.	1.200
21	135.0	135.0	0.	0.729	0.	1.600
22	135.0	135.0	0.	0.729	0.	2.400
23	135.0	135.0	0.	0.729	0.	4.000
24	135.0	135.0	0.	0.729	0.	6.000
25	135.0	135.0	0.	0.729	0.	8.000
26	135.0	135.0	0.	0.729	0.	12.000
27	135.0	135.0	0.	0.729	0.	20.000
28	135.0	135.0	0.	0.729	0.	0.

SURFACE NUMBER 2 1 (SPECIFIED)				
SURFACE DEFINED BY#	POINT	X	Y	F(x)
	2- 2	925,00	166,00	1,00
	5- 5	975,00	463,00	1,00
	6- 6	1250,00	488,00	1,00
	7- 7	1285,00	469,50	1,00

NOT CONVERGING 0 =1

X-COORD	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
936.00	-395.	-395.	-118.	=0,56	=0,889	2,43	1,00
953.79	-2492.	-2492.	-748.	=4,19	=0,237	2,43	1,00
989.98	*11184.	*11184.	*3359.	=9,93	=0,262	2,43	1,00
639.00	*31781.	*31781.	-9534.	-33,41	=0,466	2,43	1,00
646.47	*32723.	*32723.	-9817.	-46,56	=0,599	2,43	1,00
650.00	*32882.	*32882.	-9865.	-48,86	=0,621	2,43	1,00
658.08	*33783.	*33783.	-10124.	-61,67	=0,736	2,43	1,00
678.00	*36075.	*36075.	-10822.	-96,47	=1,060	2,43	1,00
685.00	*37310.	*37310.	-11193.	-114,66	=1,212	2,43	1,00
695.00	*38209.	*38209.	-11463.	-127,86	=1,302	2,43	1,00
720.00	*26667.	*26667.	-8000.	-34,52	=2,766	2,43	1,00
734.50	*19307.	*19307.	-5792.	-969,80	=4,744	2,43	1,00
766.00	20987.	20987.	6281.	946,62	6,787	2,43	1,00
774.50	32582.	32582.	9774.	670,12	4,868	2,43	1,00
799.00	94481.	94481.	28344.	389,14	2,283	2,43	1,00
816.00	160902.	160902.	48271.	240,71	1,726	2,43	1,00
829.00	226909.	226909.	67953.	229,88	1,442	2,43	1,00
833.00	247119.	247119.	74136.	219,20	1,392	2,43	1,00
847.00	320183.	320183.	96043.	283,52	1,268	2,43	1,00
850.00	341417.	341417.	102425.	199,22	1,241	2,43	1,00
880.00	561968.	561968.	168590.	177,60	1,031	2,43	1,00
890.00	678840.	678840.	203652.	169,71	0,959	2,43	1,00
902.27	824130.	824130.	247239.	163,95	0,927	2,43	1,00
905.00	856408.	856408.	256922.	163,03	0,922	2,43	1,00
913.50	947889.	947889.	287306.	180,85	0,894	2,43	1,00
930.00	1227504.	1227504.	368251.	194,90	0,840	2,43	1,00
933.00	1277248.	1277248.	383174.	194,26	0,833	2,43	1,00
947.00	1511311.	1511311.	453393.	192,40	0,813	2,43	1,00
959.00	1732947.	1732947.	519764.	148,95	0,785	2,43	1,00
975.00	2203670.	2203670.	688101.	144,70	0,750	2,43	1,00
981.50	2386522.	2386522.	715957.	145,85	0,765	2,43	1,00
996.00	2780966.	2780966.	834290.	142,20	0,769	2,43	1,00
1007.00	3073678.	3073678.	922043.	139,49	0,766	2,43	1,00
1014.00	3257331.	3257331.	977199.	137,83	0,764	2,43	1,00
1018.98	3322963.	3322963.	996769.	137,24	0,763	2,43	1,00
1035.00	4269292.	4269292.	1280788.	125,89	0,705	2,43	1,00
1046.00	4828569.	4828569.	1448577.	120,83	0,681	2,43	1,00
1072.00	7404648.	7404648.	2221394.	103,21	0,601	2,43	1,00
1076.00	7792719.	7792719.	2337819.	101,31	0,595	2,43	1,00
1095.50	10805893.	10805893.	3441768.	90,19	0,543	2,43	1,00
1100.00	11750895.	11750895.	3525257.	87,68	0,533	2,43	1,00
1112.50	14332405.	14332405.	4299722.	81,93	0,510	2,43	1,00
1119.00	16380499.	16380499.	4914150.	78,59	0,496	2,43	1,00
1125.00	18248149.	18248149.	5474445.	75,97	0,485	2,43	1,00
1131.00	20119894.	20119894.	6035968.	73,73	0,483	2,43	1,00
1137.50	23549519.	23549519.	7064856.	70,79	0,464	2,43	1,00
1142.00	25840128.	25840128.	7752038.	68,94	0,465	2,43	1,00
1153.00	31246304.	31246304.	9473891.	64,93	0,456	2,43	1,00
1158.00	33631369.	33631369.	10089411.	63,31	0,453	2,43	1,00
1169.00	38661316.	38661316.	11598395.	59,94	0,459	2,43	1,00
1175.00	41217586.	41217586.	12365276.	58,12	0,480	2,43	1,00

1181.50	43800052	43800052	13140016	96.14	0.494	2.43	1.00	1.00	0.
1183.00	44372473	44372473	13811742	99.68	0.498	2.43	1.00	1.00	0.
1192.00	47640716	47640716	14292219	52.98	0.516	2.43	1.00	1.00	0.
1199.00	49963046	49963046	14988914	90.91	0.545	2.43	1.00	1.00	0.
1202.00	50861432	50861432	15258430	50.01	0.598	2.43	1.00	1.00	0.
1204.00	51394219	51394219	15418266	49.41	0.669	2.43	1.00	1.00	0.
1205.00	51635696	51635696	15490709	49.10	0.713	2.43	1.00	1.00	0.
1211.00	52987940	52987940	15898202	47.29	0.734	2.43	1.00	1.00	0.
1221.00	55000297	55000297	16900077	44.58	0.802	2.43	1.00	1.00	0.
1231.00	56690904	56690904	17007271	41.60	0.899	2.43	1.00	1.00	0.
1246.00	58767908	58767908	17630253	37.64	1.000	2.43	1.00	1.00	0.
1250.00	59150830	59150830	17745249	36.64	1.394	2.43	1.00	1.00	0.
1253.00	59827921	59827921	17948376	33.77	2.122	2.43	1.00	1.00	0.
1263.11	56879859	56879859	17063957	0.	0.	0.	1.00	1.00	0.

F = 0.761 LHMDA = 0.300(0 20 0)

SOIL DATA

NO	WET	SAT	COM	FI	RU	EO
1	135.0	135.0	0.	0.729	0.	0.030
2	135.0	135.0	0.	0.729	0.	0.030
3	135.0	135.0	0.	0.729	0.	0.040
4	135.0	135.0	0.	0.729	0.	0.040
5	135.0	135.0	0.	0.729	0.	0.050
6	135.0	135.0	0.	0.729	0.	0.050
7	135.0	135.0	0.	0.729	0.	0.060
8	135.0	135.0	0.	0.729	0.	0.080
9	135.0	135.0	0.	0.729	0.	0.100
10	135.0	135.0	0.	0.729	0.	0.130
11	135.0	135.0	0.	0.729	0.	0.150
12	135.0	135.0	0.	0.729	0.	0.200
13	135.0	135.0	0.	0.729	0.	0.250
14	135.0	135.0	0.	0.729	0.	0.300
15	135.0	135.0	0.	0.729	0.	0.400
16	135.0	135.0	0.	0.729	0.	0.500
17	135.0	135.0	0.	0.729	0.	0.600
18	135.0	135.0	0.	0.729	0.	0.800
19	135.0	135.0	0.	0.729	0.	1.000
20	135.0	135.0	0.	0.729	0.	1.500
21	135.0	135.0	0.	0.729	0.	2.000
22	135.0	135.0	0.	0.729	0.	3.000
23	135.0	135.0	0.	0.729	0.	5.000
24	135.0	135.0	0.	0.729	0.	7.500
25	135.0	135.0	0.	0.729	0.	10.000
26	135.0	135.0	0.	0.729	0.	15.000
27	135.0	135.0	0.	0.729	0.	25.000
28	135.0	135.0	0.	0.729	0.	0.

SURFACE NUMBER 2 1 (SPECIFIED)

SURFACE DEFINED BY#	POINT	X	Y	F(x)
2=	2	525,00	160,00	1,00
5=	5	975,00	465,00	1,00
6=	6	1250,00	488,00	1,00
7=	7	1285,00	465,50	1,00

NOT CONVERGING 0 *1

X=COORD:	E	X=FORCE	Y=YT	Y=YT/Y-Z	VERT F	SMALL F	PORE PRES
536,00	-381,	-381,	-114,	=1,12	=0,179	2,43	1,00
553,70	-2074,	=2074,	=622,	=8,40	=0,476	2,43	1,00
589,90	=9092,	=9092,	=2728,	=20,12	=0,530	2,43	1,00
639,00	-24071,	=24071,	=7221,	=64,75	=0,903	2,43	1,00
648,47	=22625,	=22625,	=6788,	=96,96	=1,247	2,43	1,00
650,00	=22381,	=22381,	=6714,	=103,10	=1,310	2,43	1,00
658,00	=21053,	=21053,	=6316,	=140,50	=1,677	2,43	1,00
678,00	=17484,	=17484,	=5245,	=279,22	=3,069	2,43	1,00
688,00	=15889,	=15889,	=4877,	=383,89	=4,059	2,43	1,00
695,00	=14211,	=14211,	=4263,	=480,27	=4,891	2,43	1,00
720,00	10133,	10133,	3040,	1139,70	10,024	2,43	1,00
734,50	25656,	25656,	7697,	583,18	4,850	2,43	1,00
766,00	91105,	91105,	27331,	284,78	2,109	2,43	1,00
774,50	110043,	110043,	33013,	267,65	1,944	2,43	1,00
795,00	148554,	148554,	59564,	209,44	1,492	2,43	1,00
816,00	293531,	293531,	86059,	190,11	1,258	2,43	1,00
829,00	383497,	383497,	115019,	176,77	1,128	2,43	1,00
833,00	411627,	411627,	123488,	174,12	1,106	2,43	1,00
847,00	511693,	511693,	153496,	167,98	1,046	2,43	1,00
850,00	540173,	540173,	162052,	165,96	1,034	2,43	1,00
860,00	635842,	635842,	250753,	156,39	0,908	2,43	1,00
890,00	989178,	989178,	296753,	152,11	0,860	2,43	1,00
902,27	1179799,	1179799,	353949,	149,16	0,844	2,43	1,00
905,00	1222147,	1222147,	366644,	148,73	0,841	2,43	1,00
913,50	1355286,	1355286,	406586,	147,80	0,822	2,43	1,00
930,00	1705228,	1705228,	515568,	144,47	0,783	2,43	1,00
933,00	1769792,	1769792,	530938,	144,17	0,778	2,43	1,00
947,00	2073587,	2073587,	622076,	143,56	0,766	2,43	1,00
955,00	2357177,	2357177,	707153,	141,22	0,744	2,43	1,00
975,00	3076447,	3076447,	922934,	138,68	0,719	2,43	1,00
981,50	3231041,	3231041,	969312,	138,21	0,725	2,43	1,00
996,00	3810669,	3810669,	1143201,	132,49	0,717	2,43	1,00
1007,00	4240907,	4240907,	1272152,	128,67	0,708	2,43	1,00
1014,00	4510679,	4510679,	1353204,	126,43	0,701	2,43	1,00
1016,50	4606936,	4606936,	1381961,	125,66	0,699	2,43	1,00
1035,00	5901253,	5901253,	1770376,	115,01	0,644	2,43	1,00
1046,00	6666104,	6666104,	1999831,	110,23	0,621	2,43	1,00
1072,00	10054980,	10054980,	3016494,	95,17	0,554	2,43	1,00
1076,00	10565490,	10565490,	3189647,	93,49	0,549	2,43	1,00
1095,50	14468452,	14468452,	4340536,	84,02	0,506	2,43	1,00
1100,00	15683934,	15683934,	4705180,	81,88	0,498	2,43	1,00
1112,50	19004518,	19004518,	5701356,	76,90	0,479	2,43	1,00
1119,00	21621782,	21621782,	6488919,	74,06	0,467	2,43	1,00
1125,00	24008359,	24008359,	7402508,	71,79	0,458	2,43	1,00
1131,00	26400240,	26400240,	7920068,	69,63	0,439	2,43	1,00
1137,50	30761215,	30761215,	9228365,	67,33	0,441	2,43	1,00
1142,00	33673875,	33673875,	10102163,	65,71	0,443	2,43	1,00
1153,00	40548190,	40548190,	12364457,	62,13	0,437	2,43	1,00
1158,00	43580957,	43580957,	13074287,	60,64	0,434	2,43	1,00
1169,00	49976869,	49976869,	14993061,	57,51	0,440	2,43	1,00
1175,00	53227337,	53227337,	15968201,	55,80	0,460	2,43	1,00

1181.00	56511114.	56511114.	16953334.	53.91	0.474	2.43	1.00	1.00	0.
1183.00	57258968.	57258968.	17171696.	93.48	0.478	2.43	1.00	1.00	0.
1192.00	61394774.	61394774.	18418432.	95.89	0.495	2.43	1.00	1.00	0.
1199.00	64347771.	64347771.	19304331.	68.89	0.524	2.43	1.00	1.00	0.
1202.00	65490149.	65490129.	19647039.	48.02	0.574	2.43	1.00	1.00	0.
1204.00	66167603.	66167603.	19890281.	47.43	0.643	2.43	1.00	1.00	0.
1209.00	66474656.	66474656.	19942397.	47.13	0.684	2.43	1.00	1.00	0.
1211.00	68194098.	68194098.	20498229.	49.36	0.704	2.43	1.00	1.00	0.
1221.00	70756968.	70756968.	21427091.	42.52	0.768	2.43	1.00	1.00	0.
1231.00	72913873.	72913873.	21874167.	39.79	0.860	2.43	1.00	1.00	0.
1246.00	75567276.	75567276.	22670163.	35.89	0.954	2.43	1.00	1.00	0.
1290.00	78067229.	78067228.	27820169.	34.90	1.328	2.43	1.00	1.00	0.
1253.00	77562821.	77562821.	23268846.	31.79	1.997	2.43	1.00	1.00	0.
1283.11	72799835.	72799830.	21839951.	0.	0.	0.	1.00	1.00	0.

F = 0.57 L A H O A 0 0.300(0 20 0)

SQIL DATA

NO	WEY	SAY	COM	FI	RU	EO
1	137.0	137.0	0.	0.729	0.	0.030
2	137.0	137.0	0.	0.729	0.	0.040
3	137.0	137.0	0.	0.729	0.	0.040
4	137.0	137.0	0.	0.729	0.	0.050
5	137.0	137.0	0.	0.729	0.	0.050
6	137.0	137.0	0.	0.729	0.	0.060
7	137.0	137.0	0.	0.729	0.	0.080
8	137.0	137.0	0.	0.729	0.	0.090
9	137.0	137.0	0.	0.729	0.	0.120
10	137.0	137.0	0.	0.729	0.	0.150
11	137.0	137.0	0.	0.729	0.	0.180
12	137.0	137.0	0.	0.729	0.	0.240
13	137.0	137.0	0.	0.729	0.	0.300
14	137.0	137.0	0.	0.729	0.	0.360
15	137.0	137.0	0.	0.729	0.	0.480
16	137.0	137.0	0.	0.729	0.	0.600
17	137.0	137.0	0.	0.729	0.	0.720
18	137.0	137.0	0.	0.729	0.	0.960
19	137.0	137.0	0.	0.729	0.	1.200
20	137.0	137.0	0.	0.729	0.	1.800
21	137.0	137.0	0.	0.729	0.	2.400
22	137.0	137.0	0.	0.729	0.	3.600
23	137.0	137.0	0.	0.729	0.	6.000
24	137.0	137.0	0.	0.729	0.	9.000
25	137.0	137.0	0.	0.729	0.	12.000
26	137.0	137.0	0.	0.729	0.	18.000
27	137.0	137.0	0.	0.729	0.	30.000
28	137.0	137.0	0.	0.729	0.	0.

SURFACE NUMBER 2 ; 1 (SPECIFIED)

SURFACE DEFINED BY	POINT	X	Y	F(x)
2	2	925,00	166,80	1,00
5	5	975,60	463,00	1,00
6	6	1250,90	488,00	1,00
7	7	1285,00	469,50	1,00

NOT CONVERGING 0 *1

X-COORD	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
936.00	-813.	-813.	-244.	0.11	0.018	2.43	1.00
953.79	-5441.	-5431.	-1629.	1.86	0.105	2.43	1.00
989.98	-24975.	-24975.	-7372.	4.52	0.119	2.43	1.00
639.00	-75270.	-75270.	-22581.	16.16	0.225	2.43	1.00
646.47	-81209.	-81209.	-24363.	22.25	0.286	2.43	1.00
650.00	-82212.	-82212.	-24664.	23.27	0.296	2.43	1.00
658.00	-87665.	-87665.	-26300.	28.80	0.344	2.43	1.00
678.00	-102326.	-102326.	-30698.	42.18	0.464	2.43	1.00
688.00	-110110.	-110110.	-33033.	48.40	0.512	2.43	1.00
695.00	-115771.	-115771.	-34731.	52.67	0.536	2.43	1.00
720.00	-114441.	-114441.	-34332.	93.98	0.827	2.43	1.00
734.98	-113594.	-113594.	-34078.	124.52	1.044	2.43	1.00
766.00	-75968.	-75968.	-22791.	335.13	2.481	2.43	1.00
774.98	-65081.	-65081.	-19524.	446.90	3.246	2.43	1.00
799.00	13433.	13433.	4030.	3133.08	21.727	2.43	1.00
816.00	97683.	97683.	29305.	586.96	3.886	2.43	1.00
829.00	187600.	187600.	56280.	375.62	2.398	2.43	1.00
833.00	219847.	219847.	64754.	346.33	2.199	2.43	1.00
847.00	319929.	319929.	94779.	286.23	1.783	2.43	1.00
850.00	346141.	346141.	103842.	273.13	1.702	2.43	1.00
880.00	659389.	659389.	197802.	212.85	1.235	2.43	1.00
890.00	830979.	830979.	249294.	195.89	1.107	2.43	1.00
902.27	1044354.	1044354.	313306.	183.65	1.039	2.43	1.00
905.00	1091757.	1091757.	327527.	181.70	1.028	2.43	1.00
913.50	1240788.	1240788.	372236.	176.87	0.983	2.43	1.00
930.00	1643200.	1643200.	492960.	165.76	0.899	2.43	1.00
933.00	1717444.	1717444.	515233.	164.49	0.888	2.43	1.00
947.00	2066790.	2066790.	620037.	160.36	0.855	2.43	1.00
955.00	2403029.	2403029.	720909.	155.00	0.817	2.43	1.00
975.00	3255835.	3255835.	976750.	148.00	0.767	2.43	1.00
981.98	3449538.	3449538.	1034861.	146.79	0.770	2.43	1.00
996.00	4186387.	4186387.	1255916.	137.97	0.746	2.43	1.00
1007.00	4732814.	4732814.	1419844.	132.55	0.728	2.43	1.00
1014.00	5076265.	5076265.	1522881.	129.51	0.718	2.43	1.00
1016.98	5198125.	5198125.	1559438.	128.48	0.715	2.43	1.00
1035.00	6859032.	6859032.	2057709.	115.00	0.644	2.43	1.00
1046.00	7840207.	7840207.	2352062.	109.25	0.616	2.43	1.00
1072.00	12209977.	12209977.	3662993.	91.98	0.535	2.43	1.00
1076.00	12882211.	12882211.	3880475.	90.15	0.530	2.43	1.00
1095.50	17911491.	17911491.	5873447.	79.94	0.482	2.43	1.00
1100.00	19483589.	19483589.	5845077.	77.69	0.473	2.43	1.00
1112.98	23778415.	23778415.	7133524.	72.51	0.452	2.43	1.00
1119.00	27166561.	27166561.	8149968.	69.59	0.439	2.43	1.00
1125.00	30256199.	30256199.	9076860.	67.28	0.430	2.43	1.00
1131.00	33392612.	33392612.	10055784.	65.28	0.410	2.43	1.00
1137.50	39002064.	39002064.	11700619.	62.77	0.411	2.43	1.00
1142.00	42775270.	42775270.	12932581.	61.16	0.413	2.43	1.00
1153.00	51680601.	51680601.	15504180.	57.61	0.405	2.43	1.00
1158.00	55609400.	55609400.	16682820.	56.15	0.402	2.43	1.00
1169.00	63894984.	63894984.	19168495.	53.08	0.406	2.43	1.00
1175.00	6819803.	6819803.	20431741.	51.42	0.424	2.43	1.00

1181.50	72359772	72359772	21707932	49.58	0.436	2.43	1.00	1.00	0.
1183.00	73302693	73302693	21990808	49.16	0.439	2.43	1.00	1.00	0.
1192.00	78686308	78686308	23605893	46.65	0.454	2.43	1.00	1.00	0.
1199.00	82511769	82511769	24793551	44.71	0.479	2.43	1.00	1.00	0.
1202.00	83991636	83991636	25197491	43.86	0.524	2.43	1.00	1.00	0.
1204.00	84869270	84869270	25460781	43.29	0.586	2.43	1.00	1.00	0.
1205.00	85267043	85267043	25580113	43.00	0.624	2.43	1.00	1.00	0.
1211.00	87494674	87494674	26248402	41.29	0.641	2.43	1.80	1.00	0.
1221.00	90816253	90816253	27244876	38.52	0.696	2.43	1.00	1.00	0.
1231.00	93613429	93613429	28084029	39.86	0.775	2.43	1.00	1.00	0.
1246.00	97054913	97054913	29116474	32.05	0.852	2.43	1.00	1.00	0.
1250.00	97710606	97710606	29333182	31.08	1.182	2.43	1.80	1.00	0.
F =	0.013	L	AMDA	0.300	0.70	0			

SOIL DATA

NO	WET	SAT	COM	F1	RU	ED
1	135.0	135.0	0.	0.729	0.	0.048
2	135.0	135.0	0.	0.729	0.	0.048
3	135.0	135.0	0.	0.729	0.	0.050
4	135.0	135.0	0.	0.729	0.	0.068
5	135.0	135.0	0.	0.729	0.	0.068
6	135.0	135.0	0.	0.729	0.	0.078
7	135.0	135.0	0.	0.729	0.	0.090
8	135.0	135.0	0.	0.729	0.	0.110
9	135.0	135.0	0.	0.729	0.	0.146
10	135.0	135.0	0.	0.729	0.	0.188
11	135.0	135.0	0.	0.729	0.	0.218
12	135.0	135.0	0.	0.729	0.	0.288
13	135.0	135.0	0.	0.729	0.	0.358
14	135.0	135.0	0.	0.729	0.	0.428
15	135.0	135.0	0.	0.729	0.	0.568
16	135.0	135.0	0.	0.729	0.	0.708
17	135.0	135.0	0.	0.729	0.	0.848
18	135.0	135.0	0.	0.729	0.	1.128
19	135.0	135.0	0.	0.729	0.	1.408
20	135.0	135.0	0.	0.729	0.	2.108
21	135.0	135.0	0.	0.729	0.	2.808
22	135.0	135.0	0.	0.729	0.	4.200
23	135.0	135.0	0.	0.729	0.	7.008
24	135.0	135.0	0.	0.729	0.	10.908
25	135.0	135.0	0.	0.729	0.	14.008
26	135.0	135.0	0.	0.729	0.	21.008
27	135.0	135.0	0.	0.729	0.	35.008
28	135.0	135.0	0.	0.729	0.	0.

SURFACE NUMBER		2		1 (SPECIFIED)	
SURFACE DEFINED BY#		POINT	X	Y	F(X)
		2=	527,00	166,00	1,00
		5=	975,00	463,00	1,00
		6=	1250,00	488,00	1,00
		7=	1289,00	467,50	1,00
NOT CONVERGING		0	=1		

X-COORD	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
536,00	56,	50,	17,	21,83	3,487	2,43	1,00
553,79	1634,	1634,	490,	23,89	1,354	2,43	1,00
589,50	8172,	8172,	2457,	49,08	1,294	2,43	1,00
639,08	42296,	42296,	12689,	79,80	1,057	2,43	1,00
648,47	97484,	97484,	17245,	76,13	0,979	2,43	1,00
650,00	60090,	60090,	18015,	76,36	0,970	2,43	1,00
658,08	73996,	73996,	22199,	78,07	0,932	2,43	1,00
678,00	111493,	111493,	33444,	83,69	0,920	2,43	1,00
688,08	131400,	131400,	39420,	86,72	0,917	2,43	1,00
695,00	145877,	145877,	43763,	88,93	0,906	2,43	1,00
720,08	228783,	228733,	68620,	93,08	0,819	2,43	1,00
734,50	281568,	281568,	84470,	96,86	0,812	2,43	1,00
766,00	448224,	448224,	13867,	102,72	0,761	2,43	1,00
774,50	493870,	493870,	148161,	104,80	0,761	2,43	1,00
799,08	669402,	669402,	200820,	106,72	0,740	2,43	1,00
816,00	897756,	897756,	257327,	110,18	0,729	2,43	1,00
829,00	1018969,	1018969,	305571,	111,37	0,711	2,43	1,00
833,00	1069086,	1069086,	320726,	111,88	0,710	2,43	1,00
847,08	1248079,	1248079,	374424,	113,91	0,710	2,43	1,00
850,00	1296258,	1296258,	388877,	114,12	0,711	2,43	1,00
880,08	1795726,	1795726,	538718,	117,90	0,684	2,43	1,00
890,00	2019036,	2019036,	611711,	118,52	0,670	2,43	1,00
902,27	2341507,	2341507,	702452,	119,73	0,677	2,43	1,00
905,00	2408704,	2408704,	722611,	120,04	0,679	2,43	1,00
913,90	2619965,	2619965,	785989,	121,10	0,673	2,43	1,00
930,00	3156991,	3156991,	947097,	122,32	0,663	2,43	1,00
933,08	3298071,	3298071,	976821,	122,64	0,662	2,43	1,00
947,00	3722280,	3722280,	111684,	124,35	0,663	2,43	1,00
955,00	4140197,	4140197,	1242059,	124,28	0,655	2,43	1,00
975,00	5200163,	5200163,	1560049,	129,39	0,650	2,43	1,00
981,50	5497150,	5497150,	1649145,	123,46	0,648	2,43	1,00
996,00	6472906,	6472906,	1941872,	146,97	0,633	2,43	1,00
1007,00	7196502,	7196502,	2198951,	152,75	0,619	2,43	1,00
1014,00	7651314,	7651314,	2295394,	150,31	0,611	2,43	1,00
1016,50	7812680,	7812680,	2343804,	109,48	0,609	2,43	1,00
1035,00	9766918,	9766918,	2939075,	101,00	0,566	2,43	1,00
1046,00	10969099,	10969099,	3290730,	97,04	0,547	2,43	1,00
1072,00	15871095,	15871095,	4761329,	86,07	0,501	2,43	1,00
1076,00	1669545,	1669545,	4982864,	84,75	0,498	2,43	1,00
1095,50	2217398,	2217398,	6635220,	77,73	0,468	2,43	1,00
1100,00	23813104,	23813104,	7143931,	76,16	0,463	2,43	1,00
1112,50	28445616,	28445616,	8533685,	72,31	0,451	2,43	1,00
1119,00	32097085,	32097085,	967126,	70,19	0,443	2,43	1,00
1125,00	35350372,	35350372,	10605112,	68,43	0,437	2,43	1,00
1131,00	38690879,	38690879,	11995264,	66,87	0,420	2,43	1,00
1137,50	44618193,	44618193,	13385458,	65,03	0,426	2,43	1,00
1142,00	4863695,	4863695,	14981108,	63,75	0,430	2,43	1,00
1153,00	58010078,	58010078,	17403023,	60,75	0,427	2,43	1,00
1158,00	62159928,	62159928,	18647978,	59,46	0,426	2,43	1,00
1169,00	70911694,	70911694,	21273508,	56,65	0,434	2,43	1,00
1175,00	75359431,	75359431,	22607829,	55,08	0,454	2,43	1,00

1181.58	79852746,	79852746,	23955824,	53,31	0,469	2,43	1,00	1,00	0,
1183.08	80848720,	80848720,	24254816,	52,90	0,473	2,43	1,00	1,00	0,
1192.08	86535241,	86535241,	25960572,	50,43	0,491	2,43	1,00	1,00	0,
1199.08	90575989,	90575989,	27172782,	48,51	0,520	2,43	1,00	1,00	0,
1202.00	92139070,	92139070,	27641721,	47,66	0,570	2,43	1,00	1,00	0,
1204.00	93066083,	93066083,	27919825,	47,09	0,638	2,43	1,00	1,00	0,
1205.00	93486237,	93486237,	28045871,	46,80	0,679	2,43	1,00	1,00	0,
1211.08	99839931,	99839931,	28791979,	45,07	0,699	2,43	1,00	1,00	0,
1221.08	99353485,	99353485,	29406046,	42,27	0,763	2,43	1,00	1,00	0,
1231.08	102318218,	102318218,	30695466,	39,57	0,855	2,43	1,00	1,00	0,
1246.00	105974065,	105974065,	31792220,	35,71	0,949	2,43	1,00	1,00	0,
1250.08	106679517,	106679517,	32003859,	34,72	1,321	2,43	1,00	1,00	0,
1253.00	107627945,	107627945,	32288384,	31,96	2,008	2,43	1,00	1,00	0,
1263.11	108163997,	108163997,	31849199,	0,	0,	0,	1,00	1,00	0,

F = 0,849 L_MROA F 0,300(0 20 0)

SOIL DATA

NO	WEY	SAY	COM	F1	RU	EQ
1	133,0	133,0	0,	0,729	0,	0,048
2	133,0	133,0	0,	0,729	0,	0,058
3	133,0	133,0	0,	0,729	0,	0,068
4	133,0	133,0	0,	0,729	0,	0,068
5	133,0	133,0	0,	0,729	0,	0,078
6	133,0	133,0	0,	0,729	0,	0,088
7	133,0	133,0	0,	0,729	0,	0,100
8	133,0	133,0	0,	0,729	0,	0,120
9	133,0	133,0	0,	0,729	0,	0,160
10	133,0	133,0	0,	0,729	0,	0,200
11	133,0	133,0	0,	0,729	0,	0,240
12	133,0	133,0	0,	0,729	0,	0,328
13	133,0	133,0	0,	0,729	0,	0,400
14	133,0	133,0	0,	0,729	0,	0,480
15	133,0	133,0	0,	0,729	0,	0,640
16	133,0	133,0	0,	0,729	0,	0,800
17	133,0	133,0	0,	0,729	0,	0,960
18	133,0	133,0	0,	0,729	0,	1,280
19	133,0	133,0	0,	0,729	0,	1,600
20	133,0	133,0	0,	0,729	0,	2,400
21	133,0	133,0	0,	0,729	0,	3,200
22	133,0	133,0	0,	0,729	0,	4,800
23	133,0	133,0	0,	0,729	0,	8,000
24	133,0	133,0	0,	0,729	0,	12,000
25	133,0	133,0	0,	0,729	0,	16,000
26	133,0	133,0	0,	0,729	0,	24,000
27	133,0	133,0	0,	0,729	0,	40,000
28	133,0	133,0	0,	0,729	0,	0,

SURFACE NUMBER 2 1 (SPECIFIED)

SURFACE DEFINED BY#	POINT	X	Y	F(x)
2	2	322700	160,00	1,00
5	5	975,00	463,00	1,00
6	6	1250100	488,00	1,00
7	7	1282700	469,90	1,00

INS,IT	1	-1
INS,IT	1	0
INS,IT	1	2

X-COORD	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
936.00	-210.	-210.	-884.	-5.45	0.870	2.39	1.00
953.78	-421.	-421.	-129.	-85.68	4.857	2.39	1.00
989.98	-1278.	-1278.	-397.	-286.77	7.560	2.39	1.00
639.00	12695.	12695.	3882.	248.54	3.464	2.39	1.00
648.47	24233.	24233.	7410.	179.94	2.315	2.39	1.00
650.00	26183.	26183.	8006.	174.78	2.221	2.39	1.00
676.00	36777.	36777.	11249.	157.88	1.888	2.39	1.00
676.00	65261.	65261.	19959.	145.06	1.594	2.39	1.00
686.00	80384.	80384.	24979.	144.11	1.524	2.39	1.00
695.00	91381.	91381.	27942.	144.77	1.471	2.39	1.00
720.00	145092.	145092.	50480.	132.77	1.168	2.39	1.00
734.50	212096.	212096.	64853.	132.96	1.115	2.39	1.00
766.00	369753.	369753.	113059.	127.69	0.960	2.39	1.00
774.50	415373.	415373.	127009.	130.62	0.949	2.39	1.00
795.00	595706.	595706.	182149.	126.77	0.879	2.39	1.00
816.00	789212.	789212.	241317.	127.26	0.842	2.39	1.00
829.00	960168.	960168.	293997.	126.10	0.805	2.39	1.00
833.00	1013871.	1013871.	310011.	126.06	0.800	2.39	1.00
847.00	1204153.	1204153.	368194.	126.98	0.789	2.39	1.00
850.00	1256416.	1256416.	384174.	126.54	0.787	2.39	1.00
860.00	1798220.	1798220.	549849.	127.23	0.738	2.39	1.00
890.00	2068243.	2068243.	632407.	126.66	0.716	2.39	1.00
902.27	2403922.	2403922.	735047.	126.82	0.717	2.39	1.00
905.00	2478496.	2478496.	757850.	126.93	0.718	2.39	1.00
913.50	2712952.	2712952.	829539.	127.45	0.708	2.39	1.00
930.00	3316466.	3316466.	1014076.	127.40	0.691	2.39	1.00
933.00	3427813.	3427813.	1048122.	127.94	0.688	2.39	1.00
947.00	3951742.	3951742.	1206324.	128.95	0.686	2.39	1.00
955.00	4428771.	4428771.	1354189.	127.80	0.673	2.39	1.00
975.00	5638663.	5638663.	1724134.	127.75	0.662	2.39	1.00
981.50	5992218.	5992218.	1832241.	129.32	0.698	2.39	1.00
996.00	7159385.	7159385.	2189125.	117.45	0.635	2.39	1.00
1007.00	8024924.	8024924.	2493781.	112.92	0.618	2.39	1.00
1014.00	8568955.	8568955.	2620129.	109.72	0.608	2.39	1.00
1016.50	8761976.	8761976.	2679149.	108.77	0.605	2.39	1.00
1035.00	11144434.	11144434.	3476634.	99.22	0.556	2.39	1.00
1046.00	12591864.	12591864.	3837983.	94.86	0.535	2.39	1.00
1072.00	18452385.	18452385.	5642166.	83.03	0.483	2.39	1.00
1076.00	19341255.	19341255.	5913979.	81.64	0.480	2.39	1.00
1095.50	25978418.	25978418.	7943421.	74.30	0.444	2.39	1.00
1100.00	28022879.	28022879.	8568556.	72.68	0.442	2.39	1.00
1112.50	33608157.	33608157.	10276366.	68.74	0.428	2.39	1.00
1119.00	37964604.	37964604.	11008437.	66.59	0.420	2.39	1.00
1125.00	41937252.	41937252.	12823147.	64.81	0.414	2.39	1.00
1131.00	45918570.	45918570.	14040921.	63.23	0.397	2.39	1.00
1137.50	53119654.	53119654.	16242396.	61.39	0.402	2.39	1.00
1142.00	57929176.	57929176.	17130004.	60.12	0.406	2.39	1.00
1153.00	69280371.	69280371.	21183859.	57.14	0.402	2.39	1.00
1158.00	74288221.	74288221.	22715109.	55.86	0.400	2.39	1.00

1169.00	84849425, 84849425, 25944418,	53.08	0.406	2.39	1.00	1.00	0.
1179.00	90216783, 90216783, 275899867	51.92	0.429	2.39	1.00	1.00	0.
1181.50	95639112, 95639112, 29243571,	49.78	0.438	2.39	1.00	1.00	0.
1183.00	96841008, 96841008, 29611075,	49.37	0.441	2.39	1.00	1.00	0.
1192.00	103703243, 103703243, 31709341,	46.93	0.457	2.39	1.00	1.00	0.
1199.00	108579373, 108579373, 33200315,	45.03	0.482	2.39	1.00	1.00	0.
1202.00	110465689, 110465689, 33777094,	44.20	0.528	2.39	1.00	1.00	0.
1204.00	111984386, 111984386, 34119197,	43.62	0.591	2.39	1.00	1.00	0.
1205.00	112091388, 112091388, 34274184,	43.34	0.629	2.39	1.00	1.00	0.
1211.00	114931840, 114931840, 35142709,	41.62	0.646	2.39	1.00	1.00	0.
1221.00	119172849, 119172839, 36439479,	38.84	0.701	2.39	1.00	1.00	0.
1231.00	122792948, 122792948, 37340477,	36.15	0.781	2.39	1.00	1.00	0.
1246.00	127166977, 127166977, 38883847,	32.28	0.858	2.39	1.00	1.00	0.
1250.00	128023879, 128023879, 39145800,	31.29	1.190	2.39	1.00	1.00	0.
1253.00	299931428, 299931428, 91710032,	11.50	0.723	2.39	1.00	1.00	0.
1283.11	-1230711, -1230711, -376314,	0.	0.	0.	1.00	1.00	0.

F = 8.727 LAHDA = 0.306(1 3 1)

SDIL DATA

NO	NET	SAT	COH	F1	RU	EO
1	139.0	139.0	0.	0.729	0.	0.050
2	139.0	139.0	0.	0.729	0.	0.050
3	139.0	139.0	0.	0.729	0.	0.070
4	139.0	139.0	0.	0.729	0.	0.070
5	139.0	139.0	0.	0.729	0.	0.080
6	139.0	139.0	0.	0.729	0.	0.090
7	139.0	139.0	0.	0.729	0.	0.110
8	139.0	139.0	0.	0.729	0.	0.140
9	139.0	139.0	0.	0.729	0.	0.180
10	139.0	139.0	0.	0.729	0.	0.230
11	139.0	139.0	0.	0.729	0.	0.270
12	139.0	139.0	0.	0.729	0.	0.360
13	139.0	139.0	0.	0.729	0.	0.450
14	139.0	139.0	0.	0.729	0.	0.540
15	139.0	139.0	0.	0.729	0.	0.720
16	139.0	139.0	0.	0.729	0.	0.900
17	139.0	139.0	0.	0.729	0.	1.080
18	139.0	139.0	0.	0.729	0.	1.440
19	139.0	139.0	0.	0.729	0.	1.800
20	139.0	139.0	0.	0.729	0.	2.700
21	139.0	139.0	0.	0.729	0.	3.600
22	139.0	139.0	0.	0.729	0.	5.400
23	139.0	139.0	0.	0.729	0.	9.000
24	139.0	139.0	0.	0.729	0.	13.500
25	139.0	139.0	0.	0.729	0.	18.000
26	139.0	139.0	0.	0.729	0.	27.000
27	139.0	139.0	0.	0.729	0.	45.000
28	139.0	139.0	0.	0.729	0.	0.

SURFACE NUMBER 2 ; 1 (SPECIFIED)

SURFACE DEFINED BY#	POINT	X	Y	F(x)
2-	2	2,00	1,00	1,00
5-	5	973,00	483,00	1,00
6-	6	1250,00	488,00	1,00
7-	7	1285,00	469,50	1,00

INS,IT 1 =1
INS,IT 1 0
INS,IT 1 2

X-COORD.	E	X-FORCE	Y-YT	Y-YT/Y-Z	VERT F	SMALL F	PORE PRES
936.00	-207.	-207.	459.	46.38	1.019	2.55	1.00
953.79	-88.	-88.	25.	484.48	-2.464	2.55	1.00
989.90	404.	404.	1167	1091.07	28.765	2.55	1.00
639.00	18980.	18980.	5426.	191.82	2.674	2.55	1.00
648.47	32698.	32698.	9336.	153.66	1.977	2.55	1.00
650.00	34968.	34968.	9997.	150.56	1.913	2.55	1.00
898.00	47527.	47527.	13987.	140.38	1.676	2.55	1.00
678.00	81293.	81293.	23240.	133.65	1.469	2.55	1.00
888.00	99220.	99220.	28365.	133.99	1.417	2.55	1.00
695.00	112257.	112257.	32092.	134.97	1.374	2.55	1.00
720.00	197842.	197842.	96599.	127.03	1.117	2.55	1.00
734.50	252417.	252417.	72161.	128.08	1.074	2.55	1.00
786.00	433879.	433879.	124038.	126.63	0.938	2.55	1.00
774.50	486388.	486388.	139049.	127.81	0.928	2.55	1.00
799.00	692330.	692330.	197923.	124.90	0.866	2.55	1.00
816.00	913316.	913316.	261099.	125.94	0.834	2.55	1.00
829.00	1107841.	1107841.	316710.	125.13	0.799	2.55	1.00
833.00	1168948.	1168948.	334179.	125.18	0.795	2.55	1.00
847.00	1385484.	1385484.	398677.	125.97	0.785	2.55	1.00
850.00	1444807.	1444807.	413042.	125.79	0.784	2.55	1.00
880.00	2060019.	2060019.	588919.	127.16	0.738	2.55	1.00
890.00	2365916.	2365916.	676369.	126.74	0.716	2.55	1.00
902.27	2746192.	2746192.	785882.	127.05	0.719	2.55	1.00
905.00	2830673.	2830673.	809234.	127.19	0.719	2.55	1.00
913.50	3096277.	3096277.	885165.	127.81	0.710	2.55	1.00
930.00	3779113.	3779113.	1080374.	127.94	0.694	2.55	1.00
933.00	3905074.	3905074.	1116370.	128.11	0.691	2.55	1.00
947.00	4497884.	4497884.	1285857.	129.26	0.689	2.55	1.00
959.00	5036780.	5036780.	1439161.	128.56	0.677	2.55	1.00
975.00	6403585.	6403585.	1830659.	128.66	0.667	2.55	1.00
981.50	6813683.	6813683.	1947886.	128.08	0.662	2.55	1.00
996.00	8149101.	8149101.	2329668.	118.06	0.638	2.55	1.00
1007.00	9139442.	9139442.	2612787.	113.09	0.621	2.55	1.00
1014.00	9761916.	9761916.	2790740.	110.29	0.611	2.55	1.00
1016.50	9982769.	9982769.	2893877.	109.34	0.608	2.55	1.00
1035.00	12679389.	12679389.	3624788.	99.92	0.560	2.55	1.00
1046.00	14272409.	14272409.	4080201.	95.64	0.539	2.55	1.00
1072.00	20903020.	20903020.	5975762.	84.08	0.489	2.55	1.00
1076.00	21901873.	21901873.	6281314.	82.73	0.486	2.55	1.00
1095.50	29336322.	29336322.	8386676.	75.55	0.455	2.55	1.00
1100.00	31622886.	31622886.	9040300.	73.96	0.450	2.55	1.00
1112.50	37869572.	37869572.	10826165.	70.10	0.437	2.55	1.00
1119.00	42734749.	42734749.	12817023.	67.98	0.429	2.55	1.00
1125.00	47171286.	47171286.	13485342.	66.23	0.423	2.55	1.00
1131.00	51617591.	51617591.	14756441.	64.68	0.406	2.55	1.00
1137.50	59650389.	59650389.	17052871.	62.84	0.412	2.55	1.00
1142.00	65015480.	65015480.	18586631.	61.57	0.416	2.55	1.00
1153.00	77677734.	77677734.	22286534.	58.64	0.412	2.55	1.00
1158.00	83264011.	83264011.	23803541.	57.39	0.411	2.55	1.00

1169.00	95045110.	95045110.	27171525.	54.68	U.419	2.55	1.00	1.00	0.
1179.00	101032389.	101032389.	28883169.	53.17	U.439	2.55	1.00	1.00	0.
1181.50	107081014.	107081014.	30612353.	51.48	U.453	2.55	1.00	1.00	0.
1183.00	108421734.	108421734.	30995638.	51.08	U.456	2.55	1.00	1.00	0.
1192.00	116076584.	116076584.	33184009.	48.73	U.474	2.55	1.00	1.00	0.
1199.00	121515928.	121515928.	34739010.	46.90	U.502	2.55	1.00	1.00	0.
1202.00	123620119.	123620119.	35840557.	46.10	U.591	2.55	1.00	1.00	0.
1209.00	124888009.	124888009.	35697304.	45.55	U.617	2.55	1.00	1.00	0.
1209.50	125433593.	125433593.	35856894.	45.27	U.657	2.55	1.00	1.00	0.
1211.00	128662352.	128662352.	36764879.	43.63	U.677	2.55	1.00	1.00	0.
1221.00	133334873.	133334873.	38117814.	40.98	U.740	2.55	1.00	1.00	0.
1231.00	137331398.	137331398.	39280341.	38.44	U.831	2.55	1.00	1.00	0.
1246.00	142261648.	142261648.	40669803.	34.79	U.924	2.55	1.00	1.00	0.
1250.00	143223392.	143223392.	40944735.	33.86	1.288	2.55	1.00	1.00	0.
1253.00	372129146.	372129196.	106344407.	11.27	U.708	2.55	1.00	1.00	0.
1283.11	-405108.	-405168.	-115830.	0.	0.	0.	1.00	1.00	0.

F = 0.100 LAMBDA = 0.2861 7 9 1)

SOIL DATA

NO	NET	SAT	COH	FI	RU	EO
1	137.0	137.0	0.	0.729	0.	0.050
2	137.0	137.0	0.	0.729	0.	0.060
3	137.0	137.0	0.	0.729	0.	0.070
4	137.0	137.0	0.	0.729	0.	0.080
5	137.0	137.0	0.	0.729	0.	0.090
6	137.0	137.0	0.	0.729	0.	0.100
7	137.0	137.0	0.	0.729	0.	0.130
8	137.0	137.0	0.	0.729	0.	0.150
9	137.0	137.0	0.	0.729	0.	0.200
10	137.0	137.0	0.	0.729	0.	0.250
11	137.0	137.0	0.	0.729	0.	0.300
12	137.0	137.0	0.	0.729	0.	0.400
13	137.0	137.0	0.	0.729	0.	0.500
14	137.0	137.0	0.	0.729	0.	0.600
15	137.0	137.0	0.	0.729	0.	0.800
16	137.0	137.0	0.	0.729	0.	1.000
17	137.0	137.0	0.	0.729	0.	1.200
18	137.0	137.0	0.	0.729	0.	1.600
19	137.0	137.0	0.	0.729	0.	2.000
20	137.0	137.0	0.	0.729	0.	3.000
21	137.0	137.0	0.	0.729	0.	4.000
22	137.0	137.0	0.	0.729	0.	6.000
23	137.0	137.0	0.	0.729	0.	10.000
24	137.0	137.0	0.	0.729	0.	15.000
25	137.0	137.0	0.	0.729	0.	20.000
26	137.0	137.0	0.	0.729	0.	30.000
27	137.0	137.0	0.	0.729	0.	5000.000
28	137.0	137.0	0.	0.729	0.	0.

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Miller, Wendell O

Evaluation of effects of Panama Canal deepening upon the stability of La Pita Hill / by Wendell O. Miller. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1979.

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Prepared for The Panama Canal Company, Balboa Heights, Canal Zone.

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