Pa'ina Hawaii LLC

Promoting Agriculture in Hawaii *PO Box 30542 Honolulu, HI 96820*

NOV 30 2005

DNMS

Anthony Gaines
Sr. Health Physicist
Division of Nuclear Materials Safety
611 Ryan Plaza Dr., Suite 400
Arlington, TX 76011-4005

Mr. Gaines,

On behalf of Pa'ina Hawaii, I am pleased to submit a copy of the **"GEOTECHNICAL REPORT- Pa'ina Hawai'I Irradiation Facility-Project No. 05-0072.001"** performed by Weidig Geoanalysts.

This report will be used by the architect and construction engineers to design the foundations for the building and irradiator.

Thank you for your time.

Regards,

Andrew E. Buchan
RSO/Production Manager

ML# 053460276

GEOTECHNICAL REPORT

PĀ'INA HAWAI'I IRRADIATION FACILITY
192 Palekona Street
Honolulu, Hawai'i

Weidig Geoanalysts Project No. 05-0072.001

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GEOTECHNICAL REPORT
PĀʻINA HAWAIʻI IRRADIATION FACILITY
192 PALEKONA STREET
HONOLULU, HAWAIʻI

Project No: 05-0072.001

Date: September 14, 2005

Prepared for:

Pāʻina Hawaiʻi, Inc.
Attn: Michael Kohn
P. O. Box 31264
Honolulu, Hawaiʻi 96820

Prepared by:

Weidig Geoanalysts
1200 College Walk, Suite 121
Honolulu, Hawaiʻi 96817

Authored by:

Paul C. Weidig
Licensed Professional Engineer No. 8,047-C

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September 14, 2005

Project No. 05-0072.001

To: Pā'ina Hawai'i, Inc.
P. O. Box 31264
Honolulu, Hawai'i 96820

Attn: Michael Kohn

Subject: Geotechnical Investigation
Pā'ina Hawai'i Irradiation Facility
192 Palekona Street
Honolulu, Hawai'i

Attached is our report of the geotechnical study we conducted for your new facility near Honolulu International Airport. The principal conclusions and recommendations are as follow:

- Your property is underlain by an eight-foot-thick zone of fill consisting of silty sand and gravel that was placed to create the airport and surrounding industrial tracts. The upper three feet of the fill is generally compact to dense, but the remainder is soft or very loose. The fill overlies typically very loose to semicompact gravelly sand lagoonal sediments to a depth of about 24.5 feet, below which are storm surge deposits composed of a dense, silty, gravelly sand to the maximum depth explored, about 36.5 feet. Ground water was intercepted at an average depth of about eight feet, near the contact between the fill and the marine soils.

- The proposed building should be supported on conventional spread foundations based at a comparatively shallow depth in recompacted, preexisting fill. The proposed irradiation chamber can be supported upon a reinforced concrete mat founded on lagoonal deposits. The chamber excavation should be shored with sheet piles to facilitate construction. The new concrete slab-on-grade floor, loading dock and pavement system should be supported on recompacted surficial soils, new fill. Specific recommendations are presented in the report.

- We should be retained to inspect the foundation excavations as well as to test and observe any earthwork.

If you have any questions regarding this report, or if we can be of assistance to you in any other way, please do not hesitate to call. Mahalo for this opportunity to be of service.

Respectfully submitted,

Paul C. Weidig

Paul C. Weidig, P.E.
President

PCW/lr/05-0072.001

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INTRODUCTION

Purpose

A geotechnical investigation has been conducted for a new produce irradiation facility for Pāʻina Hawaiʻi. The subject property is situated at 192 Palekona Street in the airport industrial district of Honolulu. The purposes of this study have been to gather information on the nature, distribution and characteristics of the subsurface earth materials and ground water conditions at the site, and to prepare specific recommendations for use in project design and construction.

Scope

The scope of this investigation is described in our proposal of August 5, 2005. On August 12, 2005, our field engineer conducted a reconnaissance of the property and mapped the locations of five test borings that were drilled and sampled to a maximum depth of about 36.5 feet. Our field engineer logged, classified and recovered relatively undisturbed samples of the earth materials drawn from selected vertical intervals in each boring. Ground water level observations were recorded during and after completion of the borings, which were backfilled with tamped soil following exploration. In addition, bulk samples of the surficial soils were recovered from shallow test pits.

The samples retrieved from the borings were transported to our office for laboratory testing and further classification. The laboratory testing program comprised determinations of natural moisture content, dry unit weight, gradation, direct shear strength, compaction properties and pavement subgrade quality.

This report contains our findings regarding site soil, ground water and other geologic conditions; conclusions pertaining to expansive soils, bearing capacity, settlement, pavement subgrade quality, excavation and foundation conditions; and, recommendations for site preparation, foundations, floor support, drainage, subsurface chamber design, pavement design, drainage and erosion control.

A detailed description of the field exploration program is presented in Appendix A. The location of the project site is shown in relationship to surrounding landmarks and cultural features on Plate No. A1, Vicinity Map. The approximate locations of the test borings are depicted in relationship to a plan of the proposed building and the property lines on Plate No. A2, Site Plan. Geotechnical descriptions and related data recorded during the field exploration phase of our study are displayed on Plates No. A3 through A7, Logs of Borings. A key to the soil symbols and identification criteria used on the logs is presented on Plate No. A8, Unified Soil Classification System.

The results of the natural moisture content and dry unit weight tests are posted on the Logs of Borings, on which are also indicated the types of other laboratory tests conducted on corresponding samples. The remaining laboratory test data are contained in Appendix B. The results of the gradation tests are illustrated on Plate No. B1, Mechanical Sieve Analysis Test Data. Summaries of the strength tests appear on Plates No. B2 through B4, Direct Shear Test Data. The results of the laboratory compaction test are illustrated on Plate No. B5, Proctor Compaction Test Data. The results of the pavement subgrade quality tests are portrayed on Plate No. B6, California Bearing Ratio Test Data. References consulted during the course of this investigation are listed in Appendix C.

Project Description

According to preliminary plans, the project will consist of a split one- and two-storey, preengineered, steel-frame building, "L" shaped in plan view and measuring approximately 64 feet by 116 feet overall; and, approximately 5,800 square feet of paved parking area in addition to a loading zone at the front of the building (Vernon Associates, 2005). The new structure will house a chiller, incoming storage space, two offices, a restroom, an equipment room, an operations corridor and a treatment area which will include an 81" by 95" by 22-foot-deep pool composed of inner and outer steel tanks. The tanks are fabricated of 0.25-inch-thick steel plate and structural "I" beams. The assembly is tested for leakage off-site prior to delivery and installation. After the pool is installed, the gaps between the inner and outer tank walls are filled with concrete. The bottom of the pool will be 18.5 feet below floor level. The nominal dimensions of the required excavation for the pool will approach 10 feet by 12 feet in plan view and 20 feet in depth. When filled with water, the pool will weigh about 63.25 tons, plus an estimated 21.25 tons accounting for the foundation slab.

FINDINGS

Site Description

As shown on Plates No. A1 and A2, the subject property is a rectangular parcel encompassing approximately 14,880 square feet of flat terrain on the southwest side of Palekona Street (State of Hawai'i, 1996). The site is open and vacant, and sustains a sparse growth of stunted volunteer grasses and weeds. The perimeter of the lot is bordered by chain link fencing.

Geologic Setting

The property lies on "reclaimed" land overlying Ke'ehi Lagoon marine sediments and pelagic coral reefs (Stearns, 1935). The marine sediments include storm surge deposits which consist of broken coral. The artificial fill overlying the lagoonal deposits is composed primarily of dredged material which were placed to create the airport and contiguous areas beginning in 1938 (Foote, *et al.*, 1972).

Earth Materials

The borings disclosed surficial soils typically consisting of light brown, silty to gravelly, fine to medium coralline sand (Unified Soil Classification: SM) and pale gray adobe clay (CH) extending to an average depth of about eight feet. These soils are identified as preexisting fill. Their consistency generally is compact to dense within about three feet of the ground surface, but it decreases sharply to loose or soft below this level, and the moisture content increases rapidly from dry near the ground surface to very wet near the base of the fill.

Below the fill, a deposit of pale yellowish-gray to light gray or gray-brown, saturated, very loose to semicompact, gravelly, fine to medium, coralline sand (SP) was found to a depth of about 24 feet. These soils are recognized as lagoonal sediments.

Underlying the gravelly sand horizon, a sequence of tan to buff, saturated, very dense, silty, gravelly, fine to coarse, coralline sand (GM) was penetrated to the maximum depth explored, approximately 36.5 feet. Further subsurface details are presented on Plates No. A3 through A8.

Ground Water

Each test boring was checked for the presence of ground water during and at intervals following drilling. Stabilized ground water levels were measured at approximate depths ranging between 7.8 and 8.6 feet below grade, near the contact between the fill and immediately underlying marine soils.

CONCLUSIONS

Expansive Soils

Gradation tests conducted on selected samples of the native soils indicate that they are composed of about 13 to 40 percent gravel, 49 to 82 percent sand, and less than 12 percent silt or clay. These tests confirm that the soils are predominantly granular and nonexpansive.

Most of the preexisting fill is also indicated to be granular and nonexpansive. The single exception is the pocket of plastic adobe clay discovered below a depth of about three feet in Boring No. B4. But because the clay deposit is situated just above the ground water table, it lies within the zone of constant moisture, so its expansion potential is marginal. Expansive soils can swell or heave when they absorb moisture, and shrink or contract when they lose moisture. In light of the foregoing, no special precautions intended to counteract the detrimental effects of soil swelling appear necessary on this site.

Bearing Capacity

The results of this investigation indicate that the preexisting fill within three feet of the ground surface can support directly-applied loads of light to intermediate magnitude. Laboratory direct shear strength tests conducted on selected samples of these soils yielded an internal friction angle of about 33.3° and a slight cohesion value of approximately 190 pounds per square foot, as shown on Plate No. B2. The internal friction angle is a measure of soil grittiness, while the cohesion component is a measure of soil stickiness.

The fill below a depth of three feet, however, is much weaker and is significantly compressible. Similar direct shear tests completed on selected samples of fill recovered between depths of about three and eight feet yielded an internal friction angle of just 13.5° and a cohesion value on the order of 305 pounds per square foot for these soils, as shown on Plate No. B3.

Direct shear tests performed on selected samples of the lagoonal deposits suggest that they are completely cohesionless and are characterized by an internal friction angle of about 35.4°, as illustrated on Plate No. B4. These results indicate that the lagoonal deposits can support directly-applies structural loads of a least intermediate intensity.

Settlement

Foundation settlement magnitudes can be estimated by the modulus of vertical subgrade reaction, which is fixed for a particular range of loading conditions. Laboratory test data indicate that the minimum value for this modulus is on the order of 38 pounds per cubic inch for the upper preexisting fill, suggesting that it can be expected to compress up to one inch under a uniform loading on the order of 5,400 pounds per square foot. The minimum subgrade modulus for the lower fill, however, is much lower and is calculated at only 12 pounds per cubic inch. This means that the lower fill could compress about one inch under an applied uniform load near 1,700 pounds per square foot. The allowable bearing values that can be assigned to foundations based in the upper fill are governed by the compressibility of the immediately underlying soils.

Analogously, the minimum subgrade modulus associated with the lagoonal deposits is computed at about 53 pounds per cubic inch. This suggests that the undisturbed soils below the fill are likely to compress about one inch under an applied uniform load approaching 7,600 pounds per square foot.

If new foundations are designed in accordance with the recommendations of this report, we expect a maximum total foundation settlement of 0.50 inch, and a maximum differential settlement 0.25inch between any two adjacent foundations. If the proposed irradiation chamber is constructed as recommended below, we predict that it will settle not more than 0.25 inch. All settlements are expected to be "instantaneous" and to occur immediately upon load application.

Compaction Properties

Laboratory compaction tests revealed that the native soils can be compacted to a maximum dry density of 122.2 pounds per cubic foot at a corresponding optimum moisture content of 11.8 percent, as shown on Plate No. B5. The in-place moisture contents of the surficial soils at the time of our investigation appear to be higher than the optimum moisture contents.

Pavement Subgrade Quality

California Bearing Ratio ("CBR") tests, the results of which appear on Plate No. B6, yielded a minimum adjusted CBR value of 51 and a trivial swell value of 0.001 percent. These values indicate that the pavement subgrade qualities of the preexisting surficial fill are excellent and will require only minimal pavement section thicknesses.

Excavation Conditions

The preexisting fill and underlying lagoonal deposits cannot remain standing on stable slopes at an inclination steeper than 1.8 horizontal t 1.0 vertical (56 percent) below the ground water table. Creating such excavations would cause the excavations to extend beyond the south property line. In addition, very extensive backfilling would be required to close the remaining excavation once the irradiation chamber is seated at foundation level. We have concluded that the chamber excavation should be shored with sheet piles to facilitate construction. Removal of the enclosed soils should be attainable with conventional excavation equipment.

Foundation Conditions

Our study indicates that the proposed building can be supported upon conventional spread foundations based at a comparatively shallow depth in recompacted, preexisting fill. The proposed irradiation chamber can be supported upon a reinforced concrete mat founded on lagoonal deposits. We have also concluded that the proposed concrete slab-on-grade floor, loading dock and pavement system can be supported on recompacted surficial soils, new fill that is processed, placed and compacted as recommended below, or a combination of those materials.

RECOMMENDATIONS

Site Preparation and Grading

Clearing and Grubbing - All surficial vegetation should be stripped off the lot. Rubble, rubbish and rock fragments over four inches in largest dimension should also be removed from the new building and pavement sites. All debris should be hauled away to an approved disposal area in accordance with Honolulu City and County ordinances. Excavations and depressions resulting from clearing and grubbing operations should be dug out to firm soil and backfilled with suitable materials in accordance with the following recommendations.

Subgrade Preparation - Exposed soil surfaces within the proposed building pad, loading dock and parking areas should be scarified to a depth of six inches, brought to at least the optimum moisture content and compacted to not less than 95 percent relative compaction, in accordance with ASTM Designation D 1557-91. Inability to achieve the stipulated minimum level of compaction should be used as a field criterion to identify areas of loose or disturbed soils that should be overexcavated and replaced with engineered fill, processed, placed and compacted as described below; or, stabilized in accordance with the recommendations of the project geotechnical engineer.

Fill Material - Prior to use, all intended fill materials should be approved by the project geotechnical engineer. On-site soils may be reused as new fill if they are processed to remove rubble, rubbish, vegetation, rock fragments of hard, irreducible lumps over four inches in maximum size and other objectionable substances.

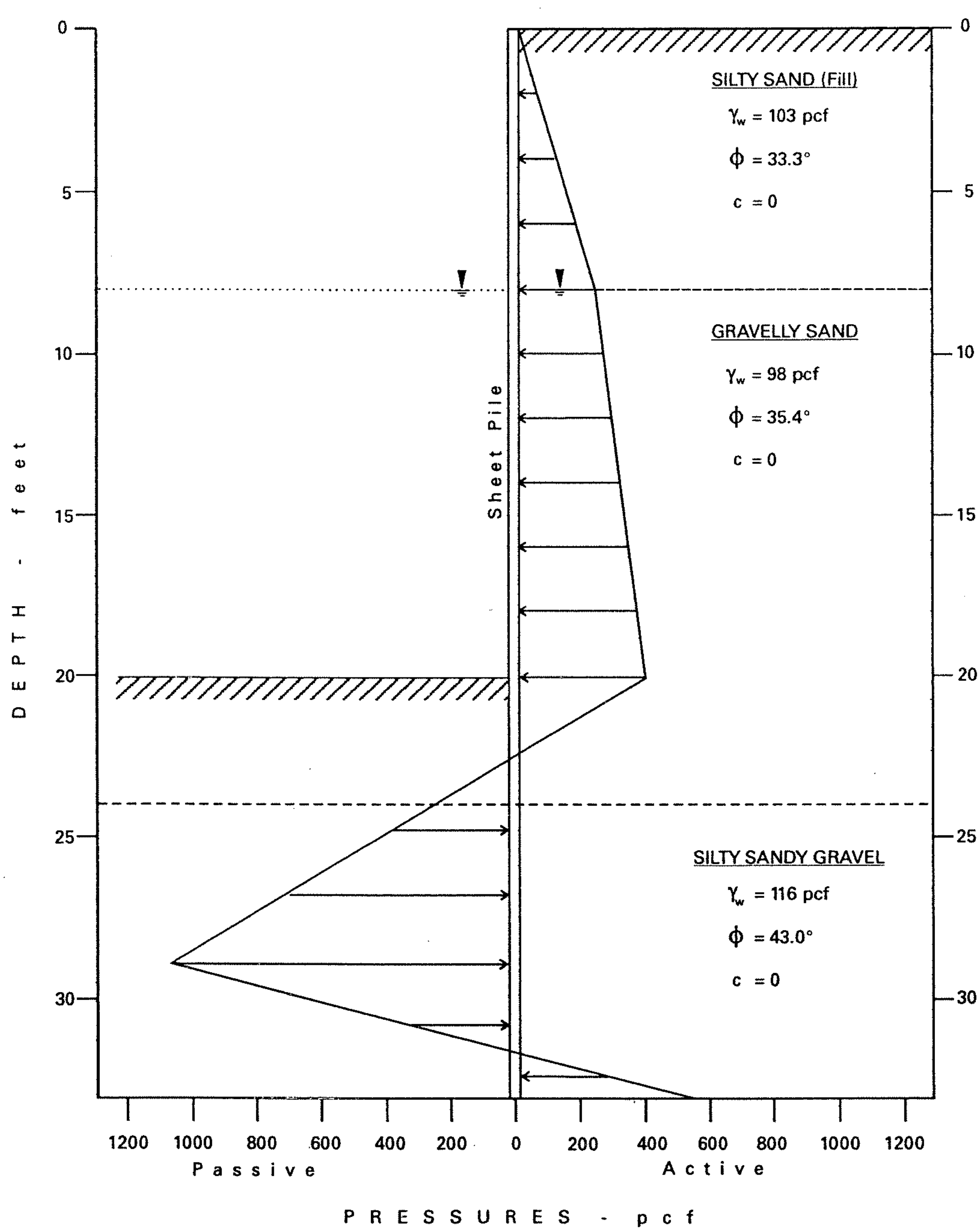
If required, imported soils should conform to the same criteria but in addition they should have a plasticity index not exceeding 20 when tested in accordance with ASTM Designation D 4318-84, at least 20 percent of the particles passing the No. 100 sieve, when tested in accordance with ASTM Designation D 422-90, a minimum CBR of 30 when tested in accordance with ASTM Designation D 1883-94, and a maximum swell of 1.5 percent when tested in accordance with ASTM Designation D 4546-90.

Fill Placement and Compaction - All fill material should be placed in horizontal lifts not exceeding eight inches in loose thickness. Each lift should be brought to at least the optimum moisture content and compacted to not less than 95 percent relative compaction, per ASTM Designation D 1557-91. All earthwork operations should be observed and the soils tested by the project geotechnical engineer or his representative. The further recommendations of this report are contingent upon adherence to this and the previous recommendations.

Irradiation Chamber

The excavation for the irradiation chamber should be shored with sheet piles that are designed in accordance with the pressure diagram shown on the following page. Interlocking, steel PZ sections are recommended. At least eight inches of clearance should be provided between the inner sheet pile and outer chamber wall surfaces. Approximately 760 pounds per square foot of buoyant pressure will be exerted against the bottom surface of the chamber when it reaches foundation level. Ground water displaced by sinking the chamber should be controlled by pumping as the chamber is lowered.

The sheet piles should be left in place as additional protection of the chamber walls and to facilitate backfilling. The gaps remaining between the interior sheet pile and outer chamber wall surfaces should be closed with lean tremie concrete having a minimum ultimate compressive strength of 1,000 pounds per square inch. At and below the planned foundation level, the soils can easily support the anticipated unit mat pressure of 2,350 pounds per square foot.


SILTY SAND (Fill)
γw = 103 pcf
ϕ = 33.3°
c = 0
GRAVELLY SAND
γw = 98 pcf
ϕ = 35.4°
c = 0
SILTY SANDY GRAVEL
γw = 116 pcf
ϕ = 43.0°
c = 0
Sheet Pile
DEPTH - feet
0
5
10
15
20
25
30
1200 1000 800 600 400 200 0 200 400 600 800 1000 1200
Passive
Active
PRESSURES - pcf

The chamber walls should be designed to withstand full soil and hydrostatic pressures. "At-rest" soil pressures, both aerial and buoyant, will be exerted against the vertical chamber walls because they are rigid, unyielding elements. Therefore, above a depth of eight feet, the chamber walls should be designed to resist an equivalent "at-rest" fluid pressure of 47 pounds per cubic foot, and below this level they should be designed to resist combined equivalent "at-rest" fluid and hydrostatic pressures of 78 pounds per cubic foot.

Building Foundations

The new building should be supported upon conventional, reinforced continuous and isolated concrete footings bearing in recompacted, preexisting fill that is tested, inspected and approved by the project geotechnical engineer. All foundations should have a minimum width of 16 inches and should be based at – *and not below* – a depth of 18 inches below existing grade. All foundations should be thoroughly clean and dry prior to placement of reinforcing steel and concrete. Forming is likely to be required to prevent collapse of the foundation trench walls. In such a event, gaps remaining between the vertical faces of the foundations and the trench walls after the forms have been stripped should be backfilled with compacted fill, as recommended above. The soils exposed at foundation level should be brought to at least the optimum moisture content and compacted to not less than 95 percent relative compaction, in accordance with ASTM Designation D 1557-91.

Foundations so established should be designed for maximum allowable bearing values of 1,400 pounds per square foot for dead load, 2,100 pounds per square foot for dead plus permanently-applied live ("real") load, or 2,800 pounds per square foot for total load, including the effect of either seismic or wind forces. These values carry safety factors of 3.0, 2.0 and 1.5, respectively. A total of 25 percent of the weight of foundation concrete extending below lowest adjacent finished pad grade should be added to the net loads at that level to account for the difference in weight between structural concrete and soil.

Foundation resistance to horizontal displacement will be provided by passive earth pressures and sliding friction. Passive earth resistance should be assumed to act as an equivalent fluid weighing 285 pounds per cubic foot exerted any appropriate vertical foundation face. Sliding friction should be assumed to act along any appropriate horizontal foundation face remaining in contact with the underlying recompacted fill and should be computed at 0.37 times the applied "real" load. These values carry a safety factor of 1.2. If resistive components are combined, the larger should be reduced by half.

Foundation resistance to uplift forces will be provided by the weight of foundation concrete; soil resistance developed along shear planes extending from the outer foundation edges and upward at 65° from the horizontal; and, the weight of soil overlying the pullout envelope enclosed by the foundation edges, shear planes and finished grade. The weight of foundation concrete should be assumed at 125 pounds per cubic foot, the weight of soil within the pullout envelope should be assumed at 83 pounds per cubic foot, and the resistance acting along the shear planes defining the pullout envelope should be assumed at 130 pounds per square foot. These values also carry a safety factor of 1.2.

A site profile corresponding to S_E per Section 1629,Table 16-J of the *Uniform Building Code* (1997) should be for earthquake design considerations.

Concrete Slabs

Building Floor - The new concrete slab-on-grade interior floor should be at least 4.5inches thick. The minimum recommended slab thickness is critical and must be stringently controlled. Each slab should be underlain by a capillary break consisting of a blanket of crushed rock at least four inches thick. This material should be "3B fine" drain rock, conforming to ASTM C33-90, No.67 gradation. If enhanced protection against termite invasion is desired, a four-inch-thick blanket of basaltic termite barrier sand could be installed instead of the capillary break. In either case, an impervious membrane at least six mils thick should be installed above the capillary break zone. A course of damp, clean sand about two inches thick over the membrane is suggested to assist in protecting the membrane from punctures during construction, and to enhance curing of the overlying slab concrete.

The floor slab should be reinforced with at least 6" x 6" WF 1.6 x WF 1.6 galvanized welded wire mesh or minimum No. 3 deformed steel bars set on maximum18-inch centers in each direction. All reinforcing should be positioned at slab middepth.

Loading Dock - The new service area slab should be at least 6.0 inches thick. The minimum recommended slab thickness is critical and must be stringently controlled. It should be underlain be a section of aggregate base course at least six inches thick. The base course should be spread in a single lift, brought to at least the optimum moisture content, and compacted t not less than 95 percent relative density, per ASTM Designation D1557-91.

Construction joints consisting of ruled notches spaced on ten-foot centers are recommended for the loading dock pavement. The dock slab should be reinforced with minimum No. 4 deformed steel bars set on maximum 18-inch centers in each direction. All reinforcing should be positioned at slab middepth.

Pavement Design

Given a minimum CBR of 51, the structural section for the new parking area should consist of the following, referenced to *Standard Specifications*, City and County of Honolulu:

2.5 inches medium No. 3 asphalt concrete, per Section 34.2D
6.0 inches 1.5-inch maximum size aggregate base course, per Section 31.2

The aggregate base should be spread in a single lift, brought to at least the optimum moisture content, and compacted to not less than 95 percent relative density, in accordance with ASTM Designation D 1557-91.

Drainage and Erosion Control

Discharge from the building roof as well as runoff from the pavement and other exterior flatwork areas should be directed away from the foundation lines. Runoff onto areas where soils remain exposed should be dispersed to avoid points of concentrated flow and subsequent erosion.

Supplemental Services

Weidig Geoanalysts should be retained to review the construction plans and specifications to determine whether the recommendations contained in this report are adequately reflected in those documents. The results of our review would be described in writing. Weidig Geoanalysts also should be retained to test and observe the earthwork construction, and to inspect the foundation excavations.

LIMITATIONS

This report has been prepared for the exclusive use of Pā'ina Hawai'i, Inc., and its designated agents. The information contained in this report is intended for the project described. If any part of the project concept is changed, or if subsurface conditions different from those described in this report are discovered during construction, then the information presented herein shall be considered invalid, unless the changes are reviewed, and any supplemental or revised recommendations issued in writing by Weidig Geoanalysts.

Site conditions and cultural features described in the text are those existing at the time of our field reconnaissance and exploration on August 12, 2005, and may not necessarily be representative of such conditions at other places and times. Similarly, the test borings represent subsurface conditions at the times and locations indicated; it is not warranted that they are representative of such conditions at other locations and times. The locations of the test borings are referenced to a document titled: *Plot Plan, Proposed Facility for Pa'ina Hawaii, LLC, Honolulu, Hawaii*, Sheet A (scale: ⅛" = 1'-0"), dated August 1, 2005, and are to be considered approximate only.

Services performed by Weidig Geoanalysts conform to generally accepted practices of other consultants who undertake similar studies at the same time and in the same geographical area as does our firm. No other warranty is expressed or implied.

APPENDIX A

Field Exploration

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APPENDIX A

Field Exploration

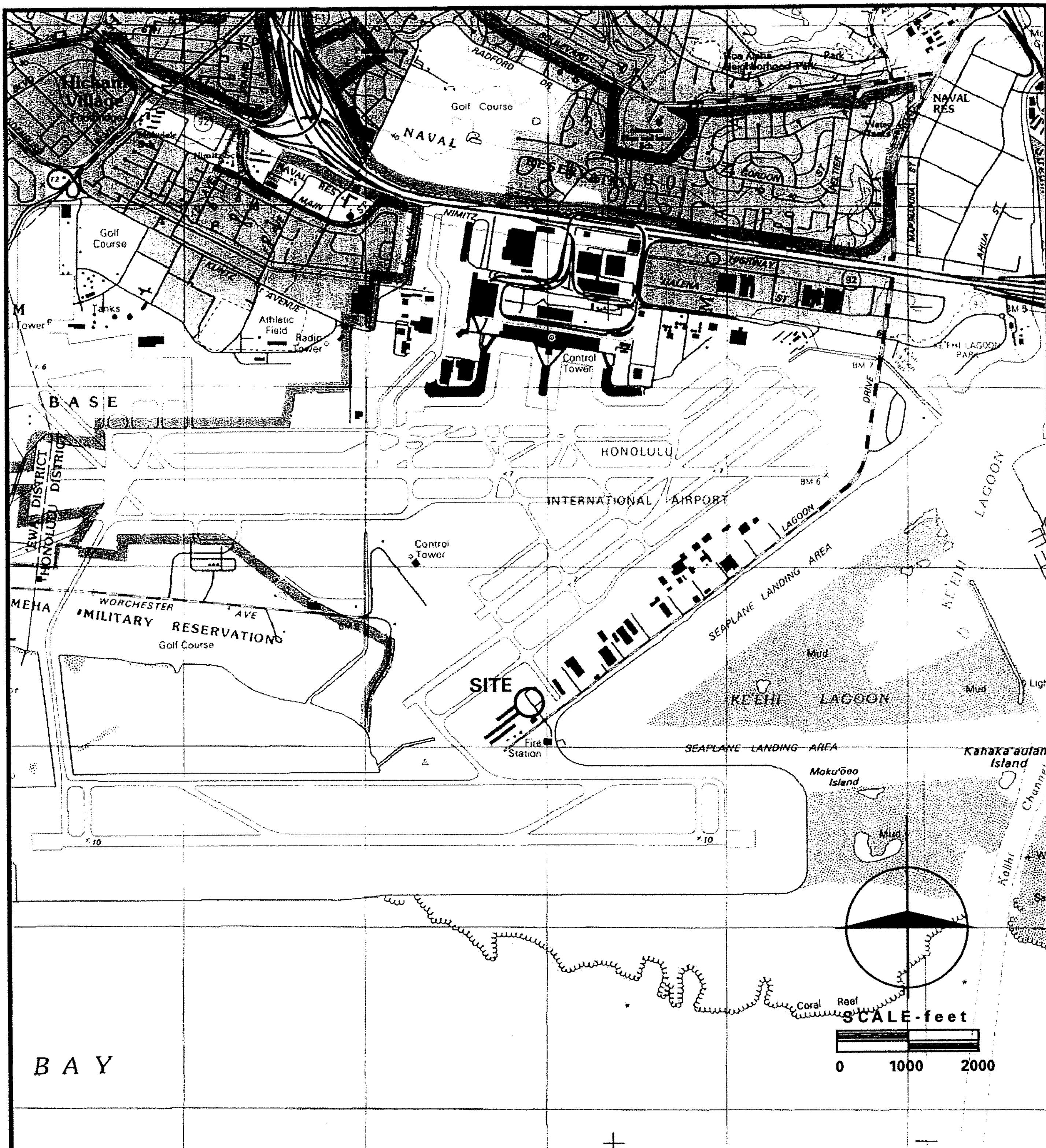
On August 12, 2005, our field engineer conducted a reconnaissance of the site and surrounding vicinity. The location of the project is shown in relationship to surrounding landmarks and cultural features on Plate No. A1, Vicinity Map.

Our geotechnical exploration program was conducted under the supervision of our field engineer, who logged, classified, and recovered relatively undisturbed samples of the earth materials drawn from selected vertical intervals in each of five test borings. The approximate locations of the test borings are depicted in relationship to a plan of the proposed building and the property lines on Plate No. A2, Site Plan.

The borings were advanced to a maximum depth of approximately 36.5 feet below existing ground surface, by means of a Mobile B59 drill rig equipped with 6.0-inch-O.D. (3.5-inch-I.D.) continuous, hollow-stem, flight augers. At selected vertical intervals in each boring, relatively undisturbed samples of the earth materials were obtained by means of a 3.0-inch O.D. (2.5-inch I.D.) split-barrel sampler containing stacks of thin-walled, brass rings, each one inch deep. The sampler was advanced by hammer blows produced by a 140-pound hammer freely falling 30 inches, in accordance with ASTM Designation D 1586-84. The number of blows required to drive the sampler a total distance of 18 inches was recorded, and the sum of the hammer blows for the second and third six-inch increments, or blow count, was recorded for each drive. The blow counts recorded for the split-barrel sampler are approximately twice those of the corresponding "Standard Penetration" blow counts. The samples were sealed in moisture-proof containers and transported in shock-resistant cases to our laboratory for further classification and testing.

The earth materials were classified by color, texture, consistency, tactile moisture, and other relevant characteristics. The field classifications were recorded on the field logs, which were edited for final presentation. Ground water level observations were made during drilling and upon completion of the borings, which were backfilled with tamped soil after exploration.

The Logs of Borings are depicted on Plates No. A3 through A7. A key to the soils symbols and identification criteria used on the logs is presented on Plate No. A8, Unified Soil Classification System.

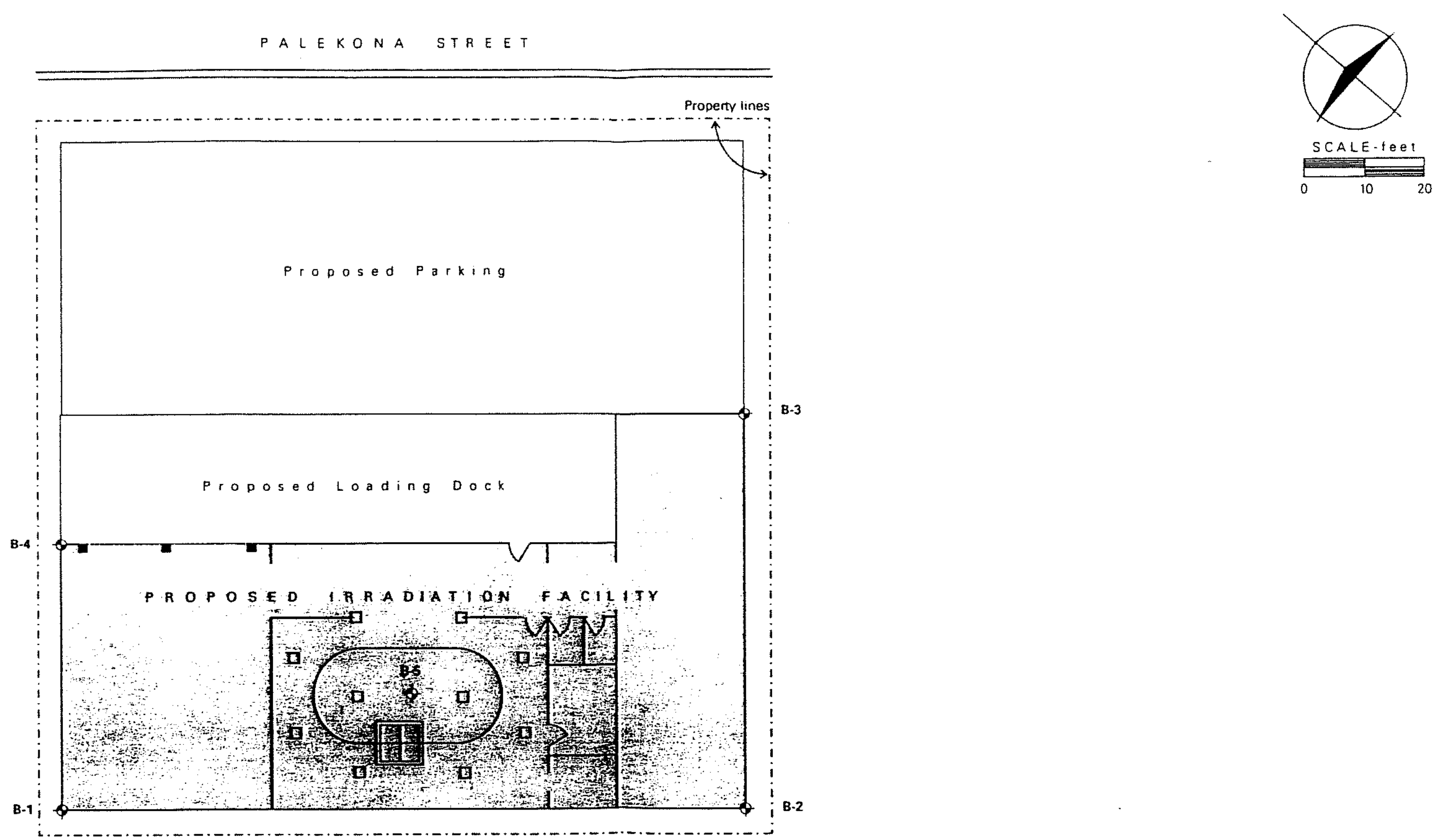


Base: United States Geological Survey, 1999, *Pearl Harbor Quadrangle, Hawai`i - Honolulu Co., Island of O`ahu, 7.5 Minute Series (Topographic)*

VICINITY MAP

WEIDIG *Geoanalysts*	**PĀ`INA HAWAI`I IRRADIATION FACILITY** 192 Palekona Street Honolulu, Hawai`i
DATE: September, 2005	PROJECT NO. 05-0072.001

PLATE NO. A1



WEIDIG Geoanalysts

Bases: Vernon Associates - Clarence A. Vernon, Architect, *Plot Plan* and *Floor Plan, Proposed Facility for Pa'ina Hawaii, LLC, Honolulu, Hawaii, Sheets A and B* (various scales), dated August 1, 2005.

SITE PLAN

PĀ'INA HAWAI'I IRRADIATION FACILITY
192 Palekona Street
Honolulu, Hawai'i

DATE: September, 2005 | PROJECT NO. 05-0072.001

PLATE NO. A2

BORING LOCATION: See Site Plan	DRILLER: Valley Well Drilling	BORING NO. B-1
BORING ELEVATION:	LOGGED BY: Berwin Chow	
DATE DRILLED: August 12, 2005	TYPE DRILL RIG: Mobile B59/ 64" hollow augers	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	UNCONFINED STRENGTH (ksf)	PLASTICITY INDEX (%)	BLOW COUNT (Blows per foot)	SAMPLE TYPE AND NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	GEOTECHNICAL DESCRIPTION
	95	17.2			28	SB-1			SM	**SILTY SAND**, light brown, dry, semicompact, fine to medium sand, with scattered fine to medium coralline gravel - Fill -
DS	74	42.9			11	SB-2	5			very wet, loose
	103	23.2			22	SB-3			SP	**GRAVELLY SAND**, pale yellowish-gray, saturated, semi-compact, fine to medium gravel, fine to coarse sand, coralline, poorly graded
SA	88	32.2			14	SB-4	10			loose
	87	35.4			12	SB-5	15			light gray
	88	29.9			24	SB-6	20			semicompact
										Bottom of Boring No. B-1 @ 21.5 ft. Stabilized ground water level measured @ 8.4 ft.
							25			

SAMPLE TYPE

BK - Bulk
CB - Core Barrel
DN - Denison Sampler
SB - Split Barrel
SP - Standard Penetration
ST - Shelby Tube

OTHER LABORATORY TESTS

AL - Atterberg Limits
CN - Consolidation
DS - Direct Shear Strength
PR - Proctor Compaction
SA - Sieve Analysis
TX - Triaxial Compression

LOG OF BORING

WEIDIG Geoanalysts

PĀ`INA HAWAI`I IRRADIATION FACILITY
192 Palekona Street
Honolulu, Hawai`i

DATE: September, 2005 | PROJECT NO. 05-0072.001

PLATE NO. A3

BORING LOCATION: See Site Plan	DRILLER: Valley Well Drilling	**BORING NO. B-2**
BORING ELEVATION:	LOGGED BY: Berwin Chow	
DATE DRILLED: August 12, 2005	TYPE DRILL RIG: Mobile B59/ 64" hollow augers	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	UNCONFINED STRENGTH (ksf)	PLASTICITY INDEX (%)	BLOW COUNT (Blows per foot)	SAMPLE TYPE AND NUMBER	DEPTH IN FEET	UNIFIED SOIL CLASSIFICATION	GEOTECHNICAL DESCRIPTION
								SM	**SILTY SAND**, light brown, dry, compact, fine to medium sand, with scattered fine to medium coralline gravel - Fill -
	68	21.9			47	SB-1			
	73	43.9			9	SB-2	5		very wet, very loose
	73	27.3			33	SB-3		SP	**GRAVELLY SAND**, pale yellowish-gray, saturated, compact, fine to medium gravel, fine to coarse sand, coralline, poorly graded
	90	29.5			46	SB-4	10		
SA	86	38.4			11	SB-5	15		light gray, very loose, slightly silty
	65	42.1			4	SB-6	20		
							25		Bottom of Boring No. B-2 @ 21.5 ft. Stabilized ground water level measured @ 8.6 ft.

SAMPLE TYPE

BK - Bulk
CB - Core Barrel
DN - Denison Sampler
SB - Split Barrel
SP - Standard Penetration
ST - Shelby Tube

OTHER LABORATORY TESTS

AL - Atterberg Limits
CN - Consolidation
DS - Direct Shear Strength
PR - Proctor Compaction
SA - Sieve Analysis
TX - Triaxial Compression

LOG OF BORING

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192 Palekona Street
Honolulu, Hawai`i

DATE: September, 2005 | PROJECT NO. 05-0072.001

PLATE NO. A4

BORING LOCATION: See Site Plan	DRILLER: Valley Well Drilling	**BORING NO. B-3**
BORING ELEVATION:	LOGGED BY: Berwin Chow	
DATE DRILLED: August 12, 2005	TYPE DRILL RIG: Mobile B59/ 64" hollow augers	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	UNCONFINED STRENGTH (ksf)	PLASTICITY INDEX (%)	BLOW COUNT (Blows per foot)	SAMPLE TYPE AND NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	GEOTECHNICAL DESCRIPTION
	68	21.9			51	SB-1			SM	**SILTY SAND**, light brown, dry, compact, fine to medium sand, with scattered fine to medium coralline gravel - Fill -
	73	43.9			12	SB-2	5			very wet, loose
	73	27.3			38	SB-3			SP	**GRAVELLY SAND**, pale yellowish-gray, saturated, compact, fine to medium gravel, fine to coarse sand, coralline, poorly graded
	90	29.5			57	SB-4	10			
	86	38.4			41	SB-5	15			light gray
	65	42.1			18	SB-6	20			loose
							25			Bottom of Boring No. B-3 @ 21.5 ft. Stabilized ground water level measured @ 8.0 ft.

SAMPLE TYPE

BK - Bulk
CB - Core Barrel
DN - Denison Sampler
SB - Split Barrel
SP - Standard Penetration
ST - Shelby Tube

OTHER LABORATORY TESTS

AL - Atterberg Limits
CN - Consolidation
DS - Direct Shear Strength
PR - Proctor Compaction
SA - Sieve Analysis
TX - Triaxial Compression

LOG OF BORING

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PROJECT NO. 05-0072.001

PLATE NO. A5

BORING LOCATION: See Site Plan	DRILLER: Valley Well Drilling	BORING NO. B-4
BORING ELEVATION:	LOGGED BY: Berwin Chow	
DATE DRILLED: August 12, 2005	TYPE DRILL RIG: Mobile B59/ 64" hollow augers	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	UNCONFINED STRENGTH (ksf)	PLASTICITY INDEX (%)	BLOW COUNT (Blows per foot)	SAMPLE TYPE AND NUMBER	DEPTH IN FEET	UNIFIED SOIL CLASSIFICATION	GEOTECHNICAL DESCRIPTION
	68	21.9			98	SB-1		SM	**SILTY SAND**, light brown, moist, dense, fine to medium sand, with scattered fine to medium coralline gravel - Fill -
DS	73	43.9			8	SB-2	5	CH	**CLAY**, very pale gray to white, very wet, soft
	73	27.3			62	SB-3		SP	**GRAVELLY SAND**, pale yellowish-gray, saturated, compact, fine to medium gravel, fine to coarse sand, coralline, poorly graded
	90	29.5			21	SB-4	10		semicompact
	86	38.4			22	SB-5	15		light gray to light gray-brown
	65	42.1			26	SB-6	20		
							25		Bottom of Boring No. B-4 @ 21.5 ft. Stabilized ground water level measured @ 7.8 ft.

SAMPLE TYPE

BK - Bulk
CB - Core Barrel
DN - Denison Sampler
SB - Split Barrel
SP - Standard Penetration
ST - Shelby Tube

OTHER LABORATORY TESTS

AL - Atterberg Limits
CN - Consolidation
DS - Direct Shear Strength
PR - Proctor Compaction
SA - Sieve Analysis
TX - Triaxial Compression

LOG OF BORING

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BORING LOCATION: See Site Plan	DRILLER: Valley Well Drilling	**BORING NO. B-5**
BORING ELEVATION:	LOGGED BY: Berwin Chow	
DATE DRILLED: August 12, 2005	TYPE DRILL RIG: Mobile B59 / 6" hollow augers	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	UNCONFINED STRENGTH (ksf)	PLASTICITY INDEX (%)	BLOW COUNT (Blows per foot)	SAMPLE TYPE AND NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	GEOTECHNICAL DESCRIPTION
	88	28.8			117	SB-1			SM	**GRAVELLY SAND**, light brown, moist, dense, fine to medium sand, with scattered fine to medium coralline gravel - Fill -
SA	71	22.3			21	SB-2	5			semicompact
	94	252			25	SB-3				wet
									SP	**GRAVELLY SAND**, pale yellowish-gray, saturated, compact, fine to medium gravel, fine to coarse sand, coralline, poorly graded
	110	12.2			44	SB-4	10			
DS	82	37.8			9	SB-5	15			light gray to light gray-brown, very loose
	82	24.9			23	SB-6	20			light brown, semicompact
	91	26.9			120	SB-7	25		GM	**SILTY, GRAVELLY SAND**, tan to buff, saturated, very dense, fine to medium gravel, fine to coarse sand, coralline, poorly graded, incipiently cemented
	93	27.7			92	SB-8	30			
	85	34.7			104	SB-9	35			
										Bottom of Boring No. B-5 @ 36.5 ft. Stabilized ground water level measured @ 8.6 ft.
							40			

SAMPLE TYPE

BK - Bulk
CB - Core Barrel
DN - Denison Sampler
SB - Split Barrel
SP - Standard Penetration
ST - Shelby Tube

OTHER LABORATORY TESTS

AL - Atterberg Limits
CN - Consolidation
DS - Direct Shear Strength
SA - Sieve Analysis
SS - Shrink/Swell
UC - Unconfined Compression

LOG OF BORING

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PLATE NO. A7

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			ICON	CODE	
COARSE-GRAINED SOILS More than 50% of material is larger than the No. 200 Sieve	**GRAVEL AND GRAVELLY SOILS** Less than 50% of coarse fraction passes the No. 4 Sieve	**CLEAN GRAVELS** Less than 12% of fine fraction passes the No. 200 Sieve		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		SILTY OR CLAYEY GRAVELS At least 12% of fine fraction passes the No. 200 Sieve		GM	Silty gravels, gravel-sand-silt mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
	SAND AND SANDY SOILS Less than 50% of coarse fraction passes the No. 4 Sieve	**CLEAN SANDS** Less than 12% of fine fraction passes the No. 200 Sieve		SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
		SILTY OR CLAYEY SANDS At least 12% of fine fraction passes the No. 200 Sieve		SM	Silty sands, sand-silt mixtures
				SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than the No. 200 Sieve	**SILTS AND CLAYS** Liquid Limit is less than 50	Plasticity index is above "A" Line		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		Plasticity index is below "A" Line		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or slightly plastic clayey silts
				OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid Limit is greater than 50	Plasticity index is above "A" Line		CH	Inorganic clays of high plasticity
		Plasticity index is below "A" Line		MH	Inorganic silts, micaceous or diatomaceous fine sands or silty soils
				OH	Organic clays of medium to high plasticity, organic silts
				Pt	Peat, humus, marsh soils with high organic content

UNIFIED SOIL CLASSIFICATION SYSTEM

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PLATE NO. A8

APPENDIX B

Laboratory Testing

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APPENDIX B

Laboratory Testing

The laboratory testing program included determinations of natural moisture content, dry unit weight, gradation, direct shear strength, compaction properties and pavement subgrade quality.

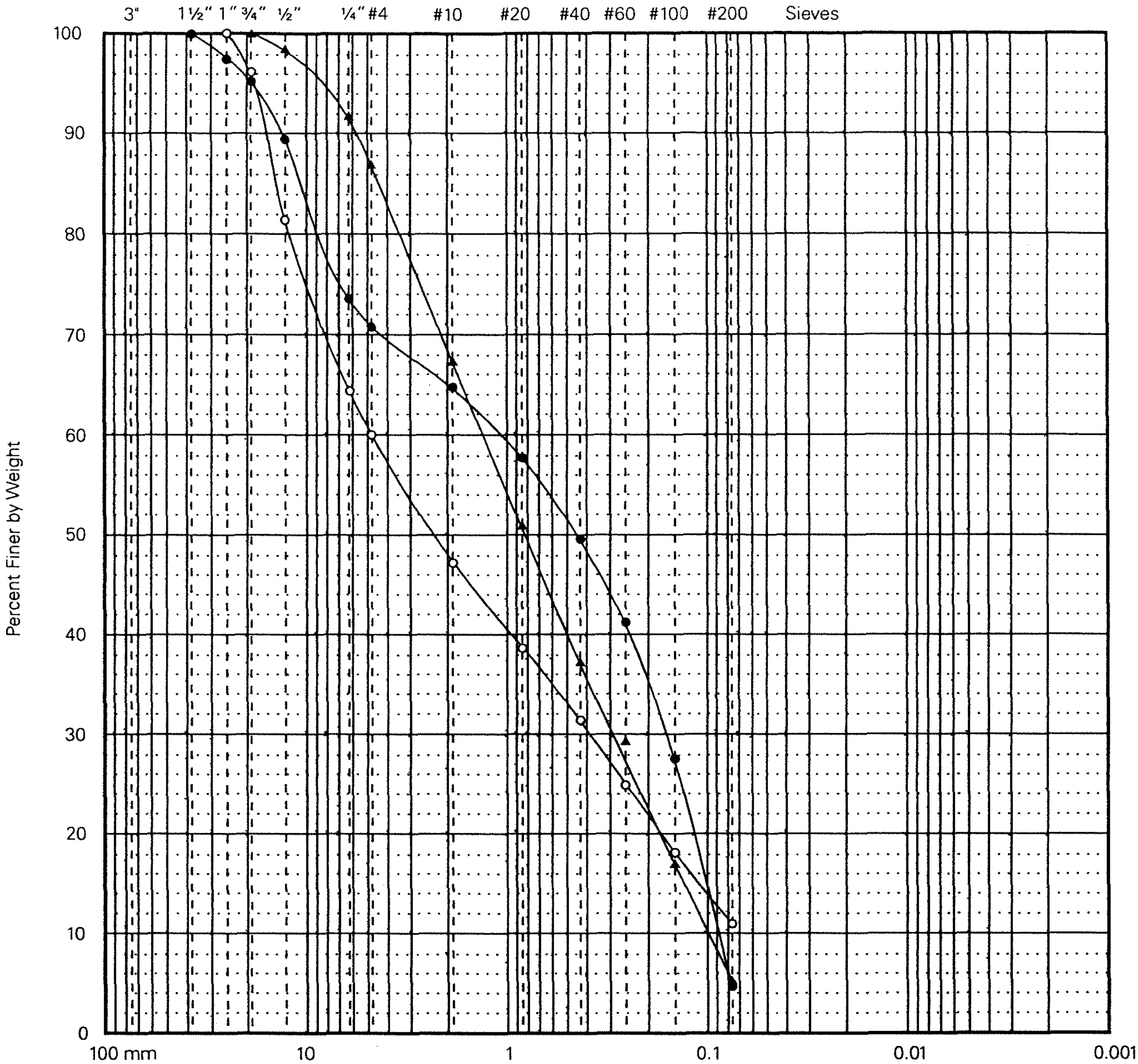
Natural moisture content tests (ASTM Designation D 2216-92) and dry unit weight tests (ASTM Designation D 2937-94) were conducted on selected samples of the earth materials recovered from each test boring. The results are posted on the Logs of Borings, opposite the depth appropriate to each sample.

Gradation tests (ASTM Designation D 422-90) were completed on selected samples of the subsurface granular soils to assess their particle size distribution. The results are illustrated on Plate No. B1, Mechanical Sieve Analysis Test Data.

Consolidated, drained direct shear tests (ASTM Designation D 3080-90) were performed at normal pressures of 1,000, 2,000 and 3,000 pounds per square foot on selected samples of the preexisting fill and underlying native soils to evaluate their internal strength characteristics. The results are summarized on Plates No. B2 through B4, Direct Shear Test Data.

A Proctor compaction test (ASTM Designation D1557-91, Method "A") was conducted on a bulk sample of the anticipated pavement subgrade soil to investigate its remolded moisture content and dry unit weight phase relationships. The results are portrayed on Plate No. 5, Proctor Compaction Test Data.

California Bearing Ratio tests (ASTM Designation D 1883-94) were completed on a bulk sample of the anticipated pavement subgrade soil to determine its pavement subgrade quality characteristics. The results are shown on Plate No. B6, California Bearing Ratio Test Data.



GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		

Point Code	Boring No.	Sample No.	Depth (ft)	Dry Unit Weight (pcf)	Moisture Content (%)	Gravel (%)	Sand (%)	Silt / Clay (%)
●	B-1	SB-4	10.0	88	32.2	29.8	66.0	4.2
o	B-2	SB-5	15.0	86	38.4	40.0	48.7	11.3
▲	B-5	SB-2	4.0	71	44.3	13.0	81.6	5.4

MECHANICAL SIEVE ANALYSIS TEST DATA

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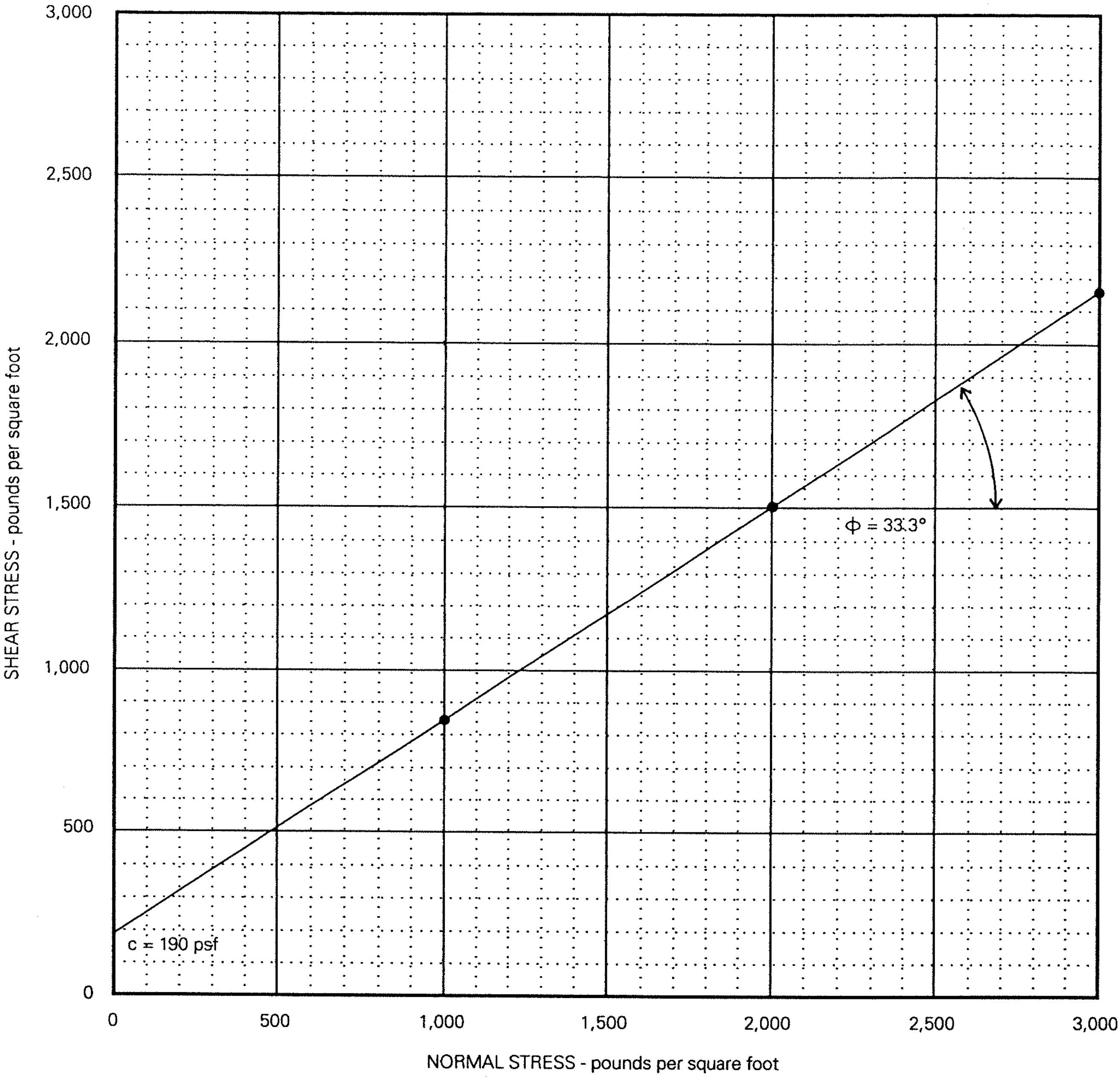
PROJECT NO. 05-0072.001

PLATE NO. B1



Boring No.	Sample No.	Depth (ft)	Dry Unit Weight (pcf)	Moisture Content (%)	Normal Stress (psf)	Shear Stress (psf)
B-1	SB-2	4.0	75	41.3	1,000	845
B-1	SB-2	4.0	74	44.2	2,000	1,505
B-1	SB-2	4.0	72	45.6	3,000	2,160

DIRECT SHEAR TEST DATA

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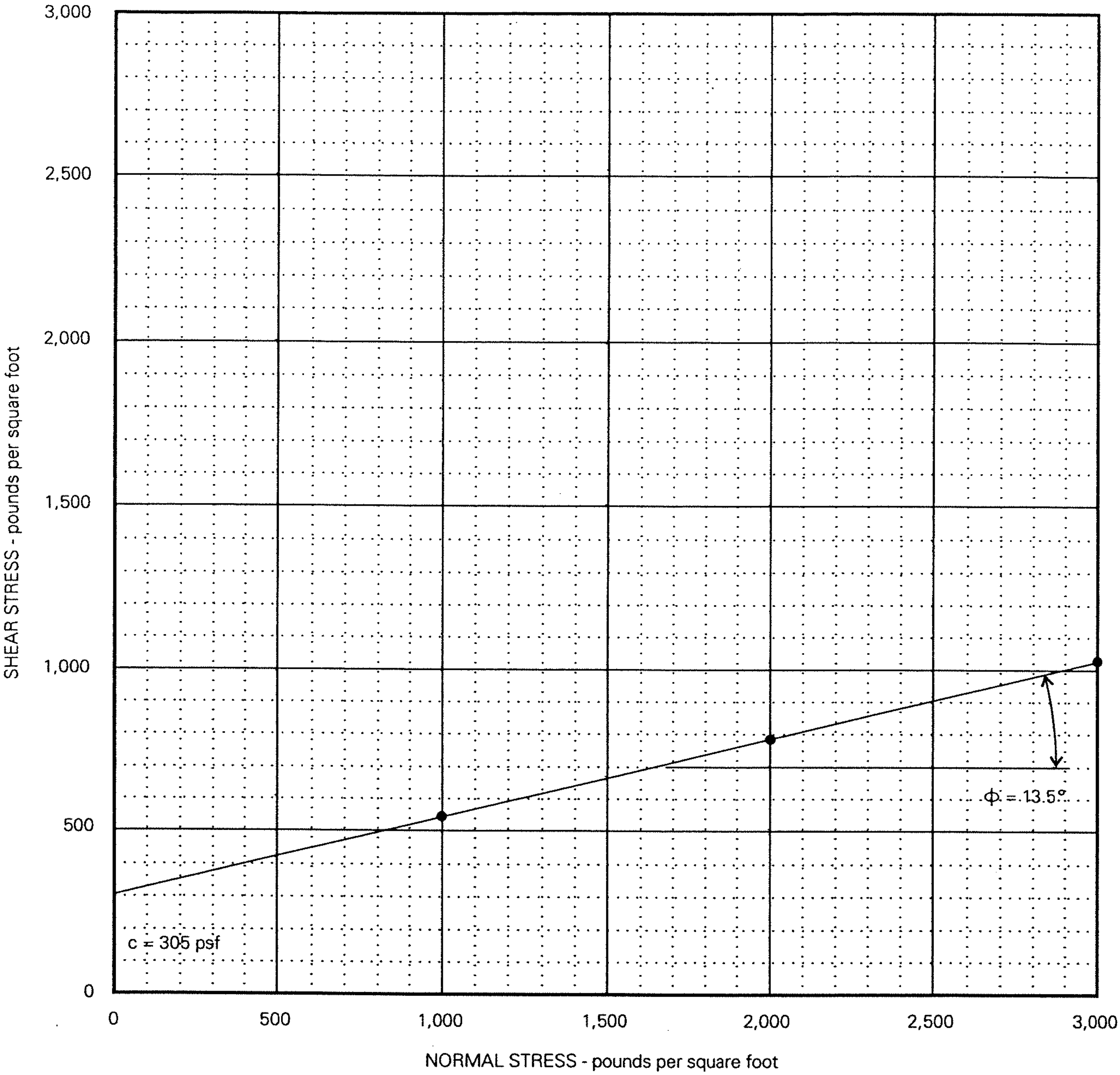
PLATE NO. B2



Boring No.	Sample No.	Depth (ft)	Dry Unit Weight (pcf)	Moisture Content (%)	Normal Stress (psf)	Shear Stress (psf)
B-4	SB-2	4.0	75	44.3	1,000	545
B-4	SB-2	4.0	76	41.2	2,000	785
B-4	SB-2	4.0	76	38.3	3,000	1,025

DIRECT SHEAR TEST DATA

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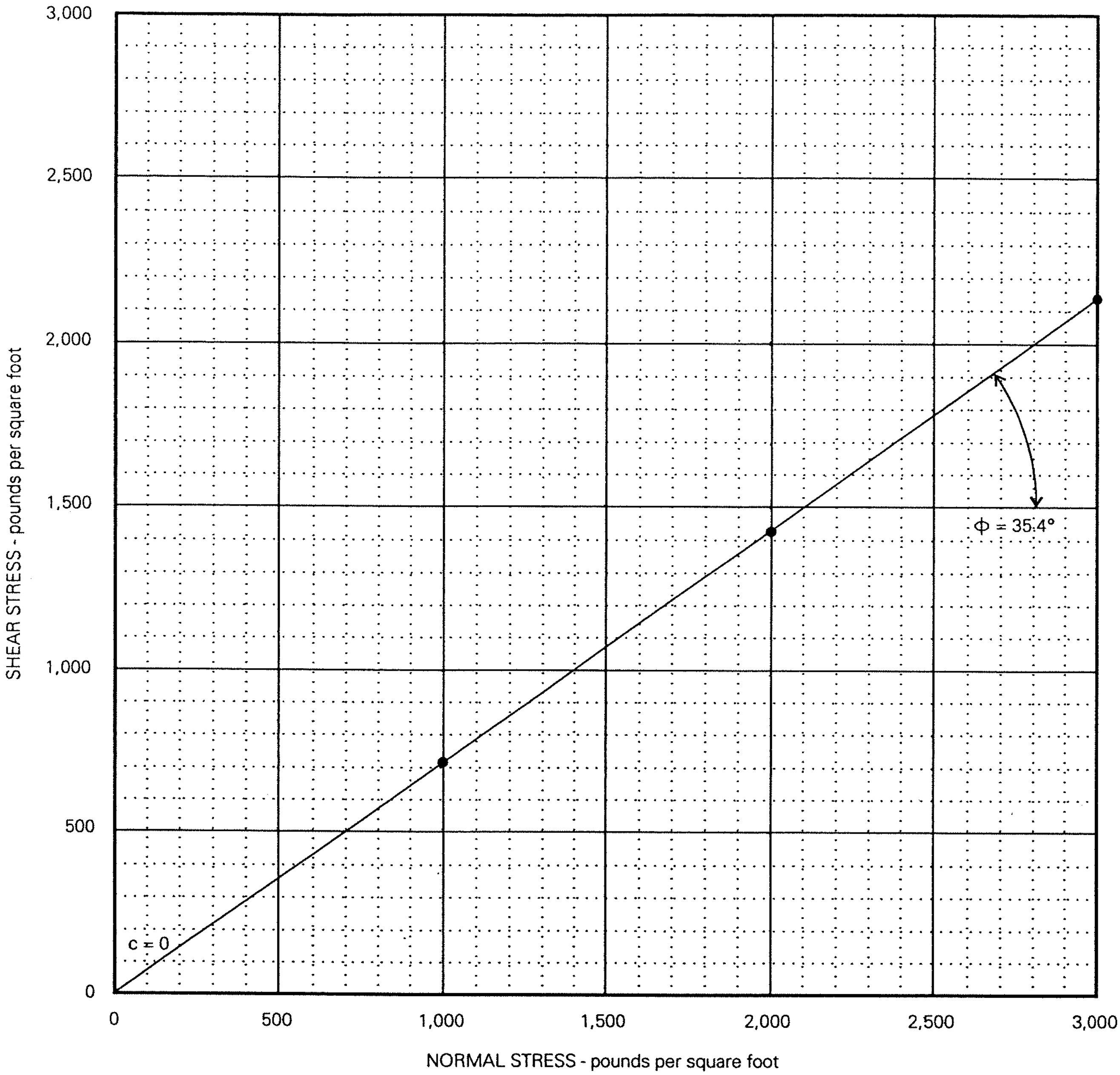
PLATE NO. B3



Boring No.	Sample No.	Depth (ft)	Dry Unit Weight (pcf)	Moisture Content (%)	Normal Stress (psf)	Shear Stress (psf)
B-5	SB-5	15.0	75	44.3	1,000	710
B-5	SB-5	15.0	76	41.2	2,000	1,420
B-5	SB-5	15.0	76	38.3	3,000	2,130

DIRECT SHEAR TEST DATA

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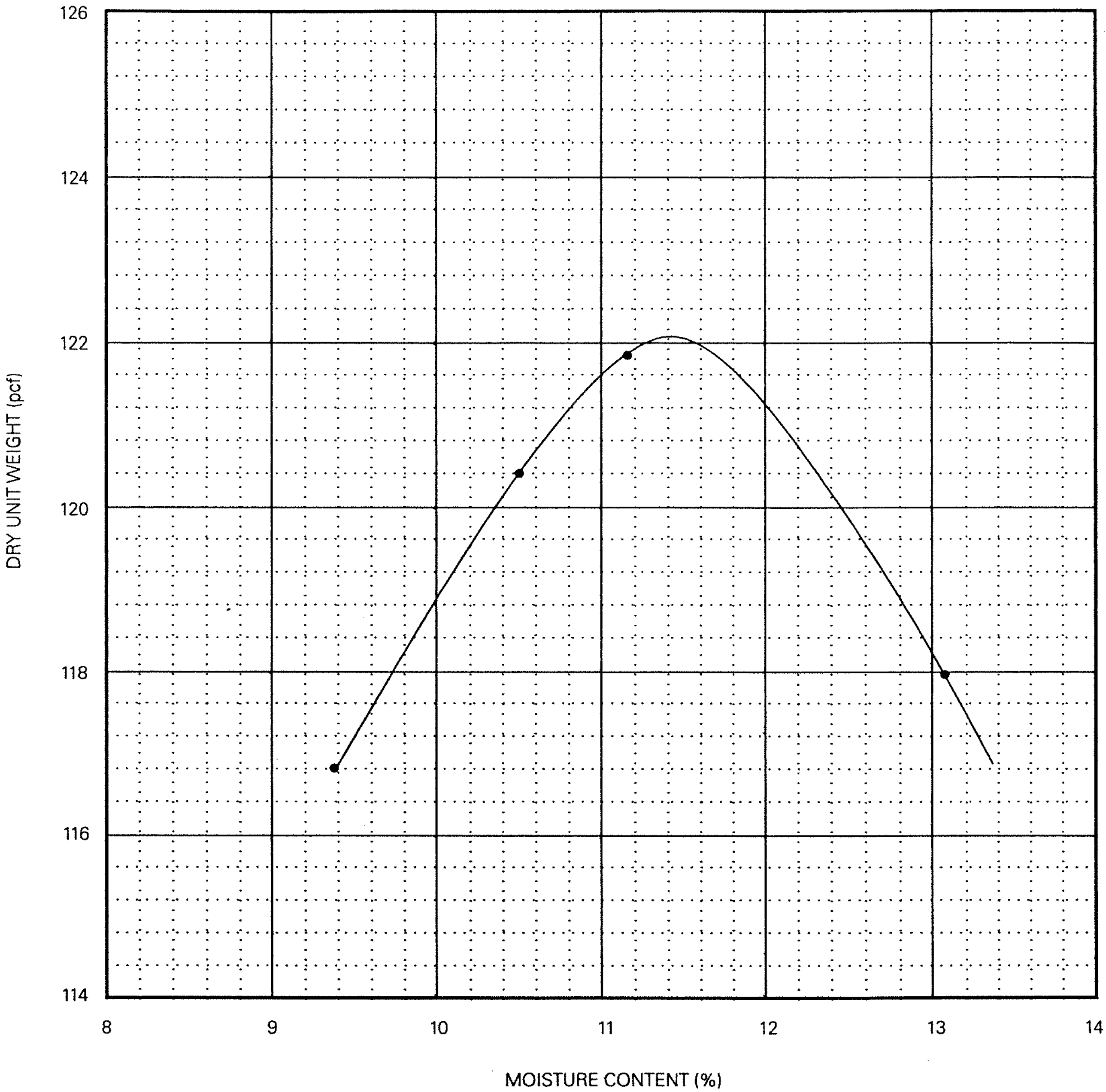
PLATE NO. B4



Boring No.	Sample No.	Depth (ft)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
B-6	BK-1	0.5'-1.5'	122.2	11.1

PROCTOR COMPACTION TEST DATA

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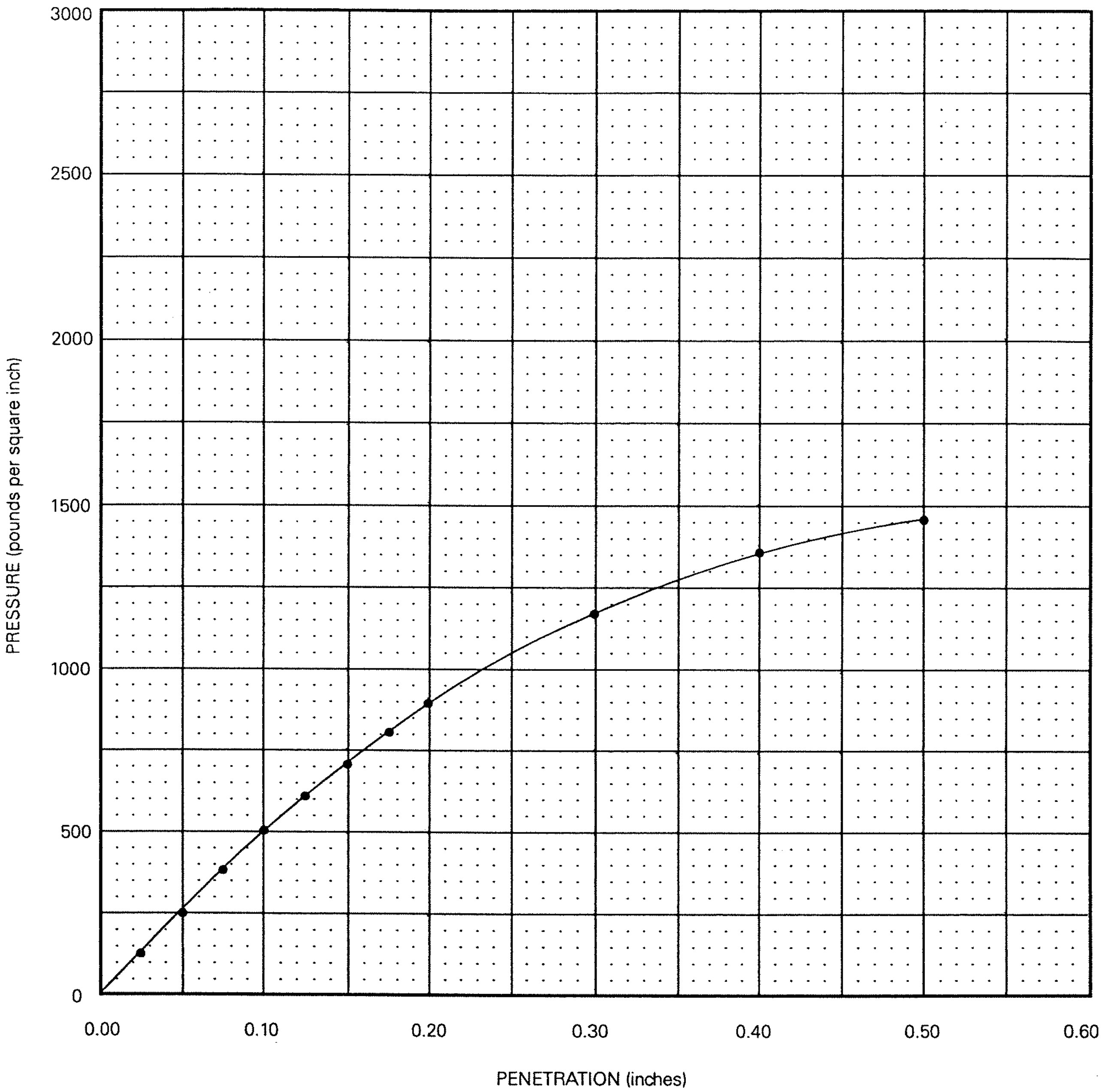
PLATE NO. B5



Boring No.	Sample No.	Depth (ft)	Values before Soaking		Values after Soaking		Expansion (%)	California Bearing Ratios	
			Dry Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	Moisture Content (%)		At 0.1 inch Penetration	At 0.2 inch Penetration
B-7	BK-1	0.5 - 1.5'	112.7	11.9	112.9	12.8	0.001	51	60

CALIFORNIA BEARING RATIO TEST DATA

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PLATE NO. B6

APPENDIX C

References

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APPENDIX C

References

1. State of Hawaiʻi, Department of Taxation, 1996, *Tax Maps Bureau Tax Map Key 1-1-76:09* (scale: 1"= 60').

2. Stearns, H. T., and Vakšvik, K. N., 1935, *Geology and Ground-Water Resources of the Island of Oʻahu, Hawaiʻi*, United States Geological Survey Bulletin 2.

3. United States Geological Survey, 1999, *Pearl Harbor Quadrangle, Hawaiʻi - Honolulu Co., Island of Oʻahu, 7.5-Minute Series (Topographic)* (scale: 1:24,000).

4. Vernon Associates - Clarence A. Vernon, Architect, *Plot Plan* and *Floor Plan, Proposed Facility forPaʻina Hawaii, LLC, Honolulu, Hawaii*, Sheets A and B (various scales), dated August 1, 2005.

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