HARDING-LAWSON ASSOCIATES

FOUNDATION INVESTIGATION
PEARL RIDGE DEVELOPMENT, PARCEL 4
KALAUAO, OAHU, HAWAII

H-LA Job No. 3934,001.06

Prepared for

Oceanic Properties, Inc.
20th Floor
Financial Plaza of the Pacific
Honolulu, Hawaii

by

Donald G. Gray

Donald L. Schreuder
Civil Engineer - 2531

Harding-Lawson Associates
1259 South Beretania Street
Honolulu, Hawaii 96814
537-3352

April 19, 1973

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I INTRODUCTION

This report presents the results of our foundation investigation for Parcel 4 of Oceanic Properties' Pearl Ridge Development. The site is a 3.4 acre parcel bounded on the west by Koauka Loop, along the northeast by the H-1 Freeway and along the east by Kalauao Stream. The configuration of the development and the approximate topography of the site are shown on the Site Plan, Plate 1.

The development will consist of two 19-story apartment buildings with an adjacent six level parking structure. All three buildings will be constructed of reinforced concrete. The apartment buildings will be about 70 by 115 feet in plan dimensions. The parking structure will be about 120 by 205 feet in plan dimensions.

Structural loads of the apartment towers will be carried primarily by transverse bearing walls. Dead plus live wall loads will range from 36 to 64 kips per lineal foot at the foundation level. The more heavily loaded walls will be located near the ends of the building. Structural support for the parking garage will be provided through a system of columns imposing dead plus live loads of up to 865 kips.

The site has been graded for a previously proposed development. Additional grading will be required to develop pads for the planned buildings. Up to ten feet of excavation will be required in the area of the parking garage and in the north corner of building No. 1. Grading for building No. 2 will include five feet of cut at the north end and up to six feet of fill at the south end.

The scope of our work, as outlined in our proposal dated March 2, 1973, was to evaluate subsurface conditions at the site in order to develop conclusions and recommendations regarding

1. Appropriate foundation types for the buildings and soil criteria necessary for foundation design
2. Foundation settlement behavior
3. Grading and backfill procedures
4. Backfill pressures and proper back-drainage for retaining walls
5. Pavement design
6. Construction problems as they relate to site grading and foundation installation

We obtained data on subsurface conditions at the site by drilling and sampling test borings and performing tests on the samples in our laboratory. A detailed discussion of the field exploration and laboratory testing program, along with the logs of the borings and laboratory test data, are presented in Appendix A.

II SUMMARY

1. The site is underlain by stiff clayey silt which has resulted from deep weathering of old basalt lava flows. The soil ranges from very strong and relatively incompressible near the surface to strong and slightly compressible at greater depths. It is underlain by basalt bedrock at depths of 72 to more than 90 feet below the existing surface.

2. The apartment towers can be supported on either grid (strip footings connected by rigid grade beams) or mat foundations designed to distribute structural loads and "even out" differential settlements. Either of these foundation schemes should reduce differential settlements between adjacent load-bearing walls to approximately 1/4 inch. Cost should determine which is more suitable.

3. Shallow spread footings will provide adequate support for the parking structure. Total settlements will be on the order of one inch and differential settlements between adjacent columns should be less that 1/4 inch.

4. Our investigation indicates that no unusual or difficult excavation problems will be encountered. The on-site soils can be excavated with conventional medium-duty, construction equipment. The on-site soils are slightly expansive but will be suitable for reuse as compacted fill and for pavement and slab support provided they are properly moisture conditioned.

III SURFACE AND SUBSURFACE CONDITIONS

A. Site Conditions

The site is a gently sloping area which has been previously graded to form several wide, level terraces. There is an existing 1 1/2 to 1 cut slope about 15 feet high along the northeast boundary of the site and a steep slope (near vertical in places) along the boundary between the apartments and the playfield to the east. A dense growth of weeds and brush covers the surface in the south portion of the site. The north portion has only a sparse grass cover.

B. Soil Conditions

Our investigation indicates that the site is underlain by stiff, clayey silt residual soil over basalt bedrock. The surface of the bedrock at the boring locations varies from a depth of 72 feet to over 90 feet below the existing surface.

The residual soil is the product of deep weathering of old basalt flows and it contains weathered basalt cobbles and boulders. It varies from very strong and relatively incompressible at the surface to strong and slightly compressible at greater depths. The silt exhibits a slight to moderate expansion potential (i.e. it tends to shrink and swell upon drying and wetting).

Fill was not encountered in the borings; however, there appears to be some fill on the slopes between the terraces and on along the east boundary of the site. Stockpiles of soil, boulders and debris have been placed in the south portion of the site (on the terraces south of Borings 1 and 3).

C. Ground Water

Free water stabilized in Borings 2 and 3 at depths of 53 and 47 below the existing surface. The third deep boring caved before the stabilized water level could be measured. Ground water was not encountered in the shallower borings drilled in the parking structure.

IV DISCUSSION AND CONCLUSIONS

Our analysis of the site indicates that settlement behavior will be the most significant factor in determining the appropriate foundation type for the buildings. The soil is strong enough to support the planned loads on a shallow foundation system; however, predicted settlements and the settlement tolerance of the buildings must be considered when selecting the foundation scheme.

We analyzed the behavior of (1) conventional spread footings, (2) a mat foundation and (3) a grid foundation consisting of strip footings and connecting grade beams.

Settlements of conventional spread footings would range up to four inches beneath the heavier interior walls. Differential settlements between adjacent footings would be up to about 1/2 inch.

Settlements of a mat foundation imposing a uniform pressure of 2,800 pounds per square foot on the underlying soil would range from about 2 1/2 inches at the center to 1 1/2 inches at the extreme ends of the building. Settlement behavior of the grid foundation system would be similar to that of the mat. Both the mat and grid foundations would distribute the stresses in a manner which would tend to "even out" the settlements between unequally loaded walls and between the center and ends of the building. We judge that either of these designs will limit differential settlements between adjacent load-bearing walls to 1/4 inch or less.

The parking structure can be supported on conventional spread footings. We have calculated that the settlement of column footings should be on the order of one inch and that differential settlements between columns would be less than 1/4 inch.

Settlements could be reduced to negligible values by supporting the buildings on end-bearing piles which gain support on the underlying bedrock. Our previous work in the area indicates that a drilled, cast-in-place concrete, friction pile foundation would not reduce building settlements since the loads would be transferred to the slightly more compressible deeper soil.

Based on our discussions with your structural engineer, T. Y. Lin, Hawaii, we conclude that the apartment towers can best be supported on either a mat or rigid grid type foundation. Shallow spread footings appear to be the most suitable foundation for the parking structure. We have presented recommendations for these foundation types.

The soil which blankets the site is slightly expansive. The expansion potential can be controlled by compacting the soil at, or slightly above, the optimum moisture content and maintaining it at this moisture until it is covered by pavements or slabs.

V RECOMMENDATIONS

A. Site Preparation and Grading

Grass and other surface vegetation should be cleared from the areas to be graded. Existing stockpiles of fill should be removed to stiff natural ground. Where fill will be placed, the natural surface should be scarified, moisture conditioned and compacted to 90 percent relative compaction.[1] Fill should be placed in thin lifts, moisture conditioned to a moisture content slightly above optimum[2] and compacted to 90 percent relative compaction.

Excavations in the tower and parking structure area can be made with conventional equipment (say, medium sized bulldozer tractors, backhoes, etc.). The excavation material will be suitable for reuse as compacted fill when rocks over four inches in maximum dimension have been removed.

B. Foundations

Foundations can be designed using the following limiting criteria

Allowable Bearing Pressures

Dead plus reduced live loads.......... 5000 psf

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1. Relative compaction refers to the dry density of the compacted material expressed as a percentage of the maximum dry density of the same material determined by the ASTM D1557-70(C) procedure.

2. Optimum moisture content is the moisture content by weight which corresponds to the maximum dry density determined by the ASTM D1557-70(C) procedure.

Total design loads, including
wind and seismic forces.............. 7500 psf

Resistance to Lateral Loads

Friction factor....................... 0.4

Passive pressure...................... 2000 psf*

*Neglect passive pressure in the top foot. Structural backfill should be compacted to 90 percent relative compaction.

Spread footings should be bottomed in natural soil at least two feet below lowest adjacent, finished grade and should be at least 18 inches wide.

The mat or grid foundations supporting the apartment towers should be well reinforced to evenly distribute structural loads and to span local areas of nonuniform support. The mat or grid foundations should be bottomed at least two feet below the existing natural ground surface. The edge of the mat or perimeter members of the grid should be bottomed at least four feet below the lowest adjacent finished ground surface. In addition, we recommend that the perimeter of the foundation for Building 2 be bottomed no higher than elevation +54 feet to reduce the risk of settlement due to creep of the adjacent slope.

The subgrade for the mat foundation should be scarified to a depth of six inches, moisture conditioned to a moisture content above optimum and compacted with a smooth wheel roller to at least 95 percent relative compaction.

If a slab-on-grade floor is used in conjunction with the grid foundation scheme, it should be underlain by a capillary moisture break consisting of six inches of free-draining, crushed rock graded as follows

Sieve Size	Percent Passing
3/4 inch	100
No. 4	0 - 5
No. 200	0 - 3

Locally available crushed rock, commercially designated as 3B-Fine, meets the above requirements. An impervious membrane should be placed between the rock and the slab to provide a moisture vapor barrier.

We judge that a mat foundation would be sufficiently thick to block the penetration of moisture and moisture vapor, and that the rock and membrane can be eliminated if this scheme is used.

C. Retaining Walls

Retaining wall footings should be designed according to the criteria recommended for spread foundations in Section V-B. Free-standing retaining walls with level backfills should be designed to withstand an equivalent fluid pressure of 35 pounds per cubic foot. Retaining walls which support a sloping back-fill should be designed for equivalent fluid pressures of 45 pounds per cubic foot.

Retaining walls should be provided with weep holes and backdrains to prevent the buildup of hydrostatic pressure.

Backdrains should consist of a free-draining, crushed rock blanket, eight inches thick, placed behind the lower half of the wall. The drain rock should conform to the gradation specified in Section V-B for the free-draining rock beneath slab floors.

Structural backfill behind the retaining walls should be placed in thin lifts, moisture conditioned and compacted to 90 percent relative compaction. Methods or equipment which would impose excessive lateral stresses on the wall should not be used.

D. Asphalt Pavements

We recommend a pavement section in the parking and driveway areas of two inches of asphalt concrete over six inches of aggregate base. The subgrade should be prepared by scarifying to a depth of six inches, moisture conditioning to slightly above the optimum moisture content and compacting with a smooth wheel roller to at least 95 percent relative compaction. The subgrade should be dense and nonyielding and should be maintained in a moist condition until base rock is placed.

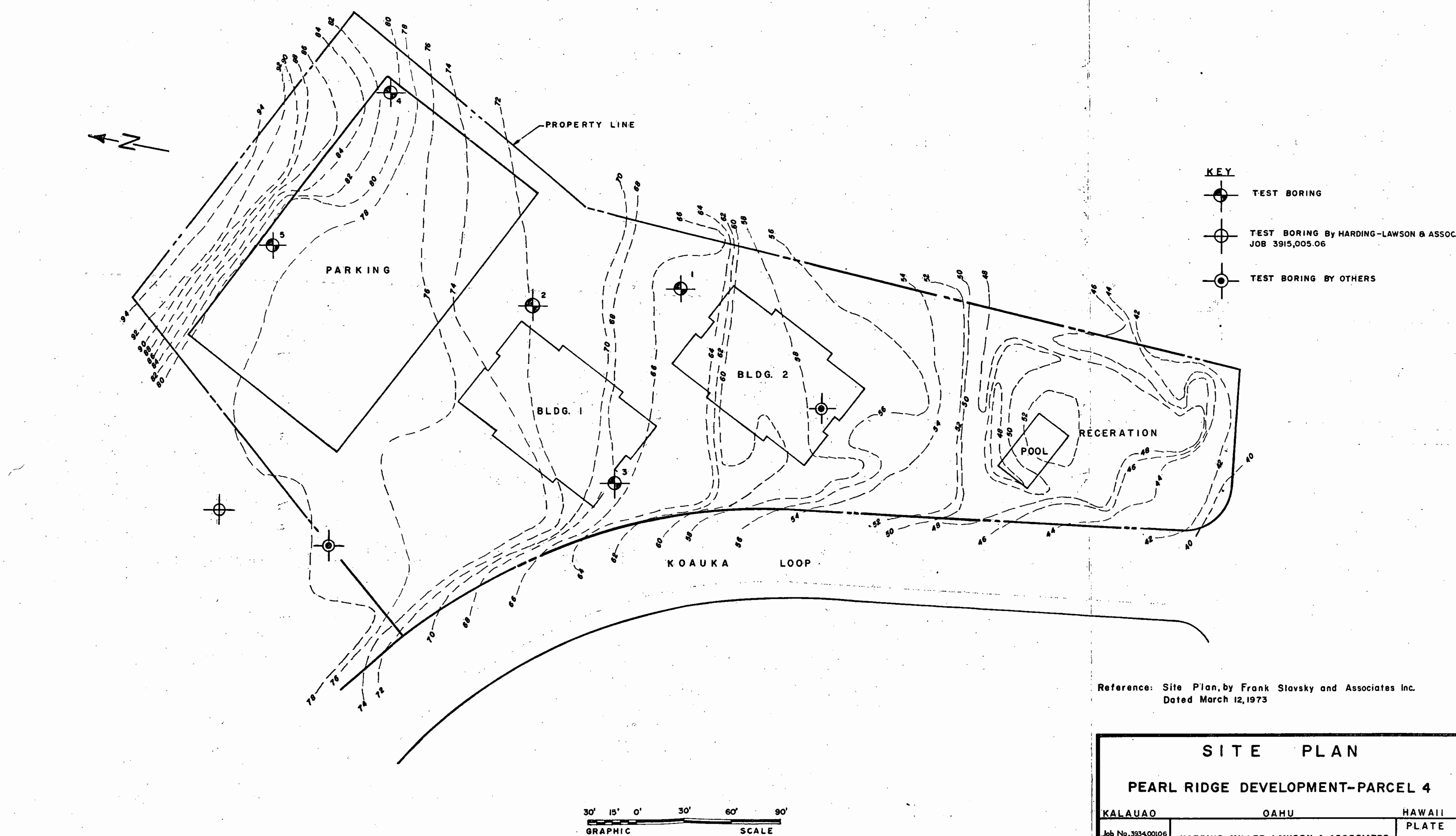
Aggregate base should be moisture conditioned and compacted to at least 95 percent relative compaction. Aggregate base should conform to the City and County of Honolulu's Standard Specifications for Public Works Construction, dated November 1968.

VI REVIEW OF PLANS AND CONSTRUCTION INSPECTION

We recommend that we review the foundation and grading plans and specifications to correlate the actual design with the intent of our recommendations.

We recommend that we intermittently inspect the site preparation, placement and compaction of fill, installation of foundations and construction of pavements. This inspection will permit us to detect unanticipated field conditions that might require special treatment or modification of our recommendations.

VII ILLUSTRATIONS



Reference: Site Plan, by Frank Slavsky and Associates Inc.
Dated March 12, 1973

SITE PLAN

PEARL RIDGE DEVELOPMENT-PARCEL 4

KALAUAO OAHU HAWAII

Job No. 3934,001.06
Designed ——
Drawn E.J.H
Checked D.G.G
Approved D.G.G
Date 3-26-73
Scale 1" = 60'

HARDING, MILLER, LAWSON & ASSOCIATES
Consulting Engineers

PLATE
1

FIELD EXPLORATION AND LABORATORY DATA

A. Field Exploration

We explored subsurface conditions at the site by drilling five test borings with truck-mounted, flight auger equipment. Three of the borings were drilled in the area of the apartment towers to depths between 90 and 101 feet. Two borings were drilled in the area of the parking structure to depths of 36 feet. The field work was performed between March 15 and March 21, 1973. The location of the borings are shown on the Site Plan, Plate 1.

The borings were logged by our engineer who obtained core samples from the borings for examination and laboratory tests. Core samples of the soil were taken using a 2.4 inch I.D. split barrel sampler driven with a 300 pound hammer falling 30 inches. The dates of the drilling, sample depths and soil classifications are presented on the Boring Logs, Plates 2 through 5. The soils are described on the boring logs in accordance with the Unified Soil Classification System shown on Plate 6.

B. Laboratory Tests

The core samples from the borings were re-examined in our laboratory to verify their field classification and to select appropriate samples for testing. The laboratory program included moisture content/dry density, strength, consolidation and classification tests. The consolidation test data are presented on Plates 7 through 9. The classification tests are presented on the Plasticity Chart, Plate 10. The remaining test data are presented on the boring logs in the manner described by the Key to Test Data, Plate 6.

LOG OF BORING 1

Equipment: Flight Auger

Elevation: 65.0** Date: 3-15-73

Laboratory Tests	Blows / foot *	Moisture Content (%)	Dry Density (pcf)
LL 54, PI 19	34		
Tx 7690(1000)	54	34.4	83
	55	41.0	77
	40		
	28	48.5	74
	30		
	20		
	45	45.3	77
	35		
	52		
	25		
	25		
	32		
	20	58.0	66
	19		
	26		
	40		
	53		
	39/1"		

Depth (ft): 0 – 160

Mottled Brown Clayey Silt (MH)
very stiff, moist, with abundant deeply weathered basalt gravels and cobbles

Dark Brown and Grey Clayey Silt (MH)
very stiff, wet

Mottled Brown Clayey Silt (MH)
very stiff, wet with abundant deeply weathered basalt cobbles

Red-Brown Clayey Silt (MH)
very stiff, wet

Mottled Brown Clayey Silt (MH)
stiff, wet, with abundant deeply weathered basalt cobbles

Dark Brown and Orange Clayey Silt (MH)
stiff, saturated with moderately weathered basalt fragments

rock fragments becoming hard and silt content decreasing

Brown Basalt
low hardness, weak

Boring caved before water level stabilized

* Blow counts converted to equivalent standard penetration test data

** MSL Datum

Job No. 3934,00106
Designed E.J.H
Drawn E.J.H
Checked D.G.G
Approved D.G.G
Date 3-30-73
Scale NONE

HARDING, MILLER, LAWSON & ASSOCIATES
Consulting Engineers

LOG OF BORING 1

PEARL RIDGE DEVELOPMENT-PARCEL 4

KALAUAO OAHU HAWAII

PLATE 2

PRINTED ON DATAPRINT NO. 1??

LOG OF BORING 2

Equipment: Flight Auger
Elevation: 72.0 Date: 3-15-73

Laboratory Tests	Blows / foot	Moisture Content (%)	Dry Density (pcf)
Tx 11,750(1000)	45	33.6	76
	52		
Tx 2910(1000)	37	42.5	79
	20		
	22		
	28		
	19	47.2	74
	55		
	33		
	28	49.4	73
CONSOL	43		
	23		
	16		
	14		
	25		
	20		
	24		
	38		
	33		
	54		
	42		

Mottled Brown Clayey Silt (MH)
very stiff, moist, with abundant deeply weathered basalt gravels and cobbles

Dark Brown Clayey Silt (MH)
stiff, wet

Mottled Brown Clayey Silt (MH)
stiff, wet, with abundant deeply weathered basalt cobbles

∇ Water level 3-20-73
medium stiff from 55' to 70'

Grey-Brown Basalt
low hardness, weak
deeply weathered

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155, 160

Job No. 3934,001.05	HARDING, MILLER, LAWSON & ASSOCIATES — Consulting Engineers
Designed E.J.H	
Drawn E.J.H	
Checked D.G.G	
Approved D.G.G	
Date 3-30-73	
Scale NONE	

LOG OF BORING 2
PEARL RIDGE DEVELOPMENT-PARCEL 4

KALAUAO OAHU HAWAII

PLATE 3

PRINTED ON DATAPRINT NO. 102

LOG OF BORING 3

Equipment: Flight Auger
Elevation: 67.0 Date: 3-20-73

Laboratory Tests	Blows / foot	Moisture Content (%)	Dry Density (pcf)	Depth (ft)
	59			
	60			
	37	47.3	73	
Tx 2280(1470)	37	36.6	77	
CONSOL LL51 PI16 Tx 3150(2000)	33	36.0	88	
	33			
	32			
	44			
Tx 1550(4000)	36	47.5	75	
	38			
	16			
	28			
	26			
	35			
	31			
	19			
	37			80
	41			85
	52			

Mottled Brown Clayey Silt (MH)
very stiff, dry, with abundant deeply weathered basalt cobbles
moist at 4'

Dark Brown and Grey Clayey Silt (MH)
very stiff, wet

Mottled Brown Clayey Silt (MH)
very stiff, wet, with abundant deeply weathered basalt cobbles

Dark Brown and Grey Clayey Silt (MH)
very stiff, wet

Mottled Brown Clayey Silt (MH)
very stiff, wet, with abundant deeply weathered basalt cobbles

▽ Water level 3-21-73

stiff from 50'

very stiff from 85'

Depth scale (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155, 160

Job No. 3934,001.06
Designed E.J.H
Drawn E.J.H
Checked D.G.G
Approved D.G.G
Date 3-30-73
Scale NONE

HARDING, MILLER, LAWSON & ASSOCIATES
Consulting Engineers

LOG OF BORING 3
PEARL RIDGE DEVELOPMENT-PARCEL 4
KALAUAO OAHU HAWAII

PLATE 4

PRINTED ON DATAPRINT NO. 100

LOG OF BORING 4

Equipment: Flight Auger
Elevation: 81.0 Date: 3-21-73

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)
	60		
CONSOL	68		
	51	41.1	79
	54		
	41		
	27	39.2	79
	28		
	69/7"		

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35

Mottled Brown Clayey Silt (MH) very stiff, moist, with abundant deeply weathered basalt gravels and cobbles

(no free water encountered)

LOG OF BORING 5

Equipment: Flight Auger
Elevation: 79.0 Date: 3-21-73

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)
	62		
UC 5150	37	34.6	88
	43		
	34	44.4	75
	43		
	20		
Tx 1190(3000)	28	56.0	67
	28		

Depth ft: 0, 5, 10, 15, 20, 25, 30, 35

Mottled Brown Clayey Silt (MH) very stiff, moist, with abundant deeply weathered basalt cobbles

Dark Brown Clayey Silt (MH) very stiff, moist

Mottled Brown Clayey Silt (MH) very stiff, wet, with abundant gravels and cobbles

stiff from 25'

(no free water encountered)

Job No. 3934,001.06
Designed E.J.H
Drawn E.J.H
Checked D.G.G
Approved D.G.G
Date 3-30-73
Scale NONE

HARDING, MILLER, LAWSON & ASSOCIATES
Consulting Engineers

LOG OF BORING 4 & 5

PEARL RIDGE DEVELOPMENT—PARCEL 4

KALAUAO OAHU HAWAII

PLATE 5

PRINTED ON DATAPRINT NO. 110

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS MORE THAN HALF IS LARGER THAN #200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL - SAND - CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND - SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN HALF IS SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM

			Shear Strength, psf	Confining Pressure, psf	
Consol — Consolidation		*Tx	320	(2600)	Unconsolidated Undrained Triaxial
LL — Liquid Limit (in %)		TxCU	320	(2600)	Consolidated Undrained Triaxial
PL — Plastic Limit (in %)		DS	2750	(2000)	Consolidated Drained Direct Shear
G_s — Specific Gravity		FVS	470		Field Vane Shear
SA — Sieve Analysis		*UC	2000		Unconfined Compression
"Undisturbed" Sample		LVS	700		Laboratory Vane Shear
Bulk Sample					

Notes: (1) All strength tests on 2.8" or 2.4" diameter samples unless otherwise indicated.

(2) * Indicates 1.4" diameter sample.

KEY TO TEST DATA

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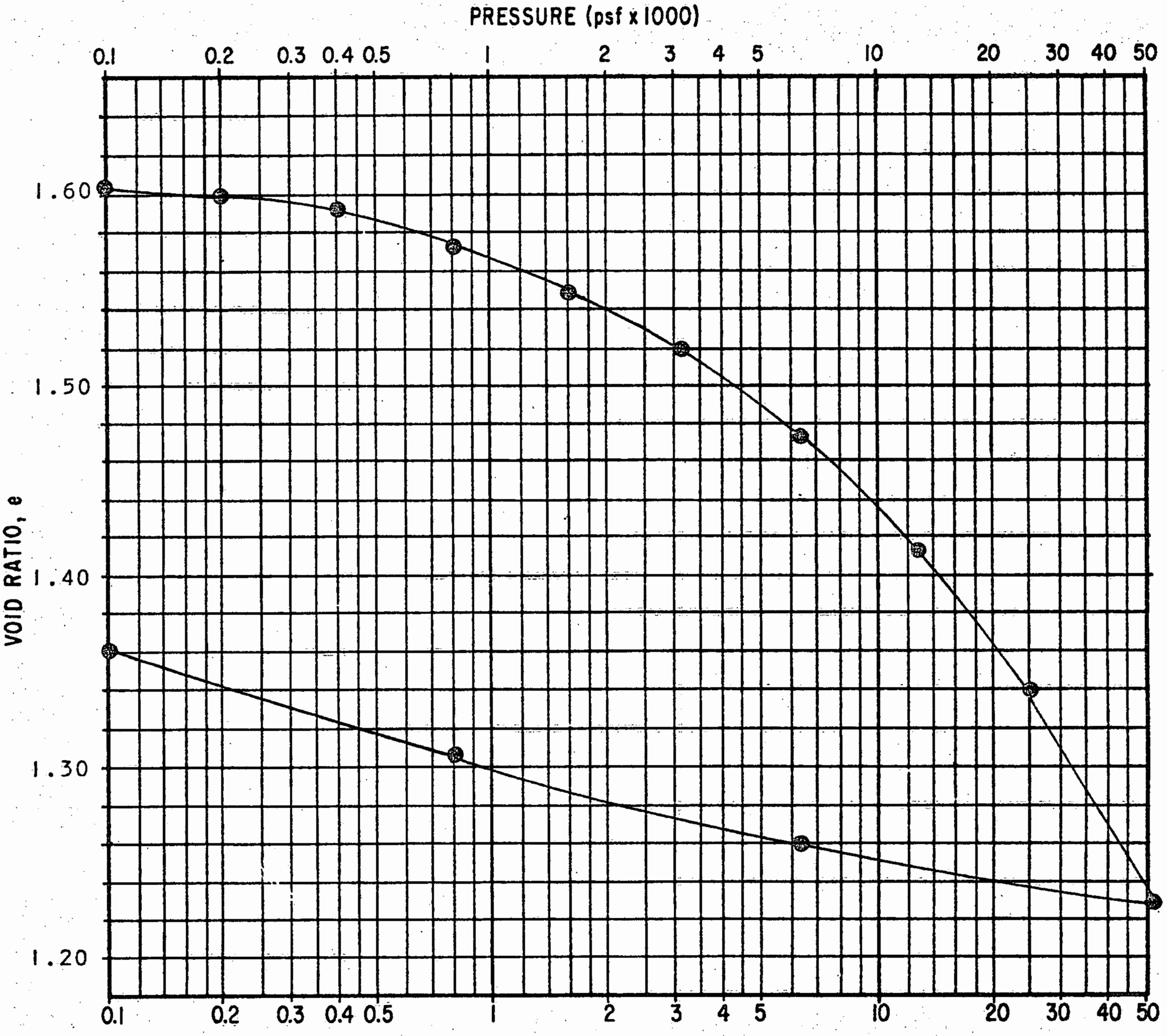
Job No: 3934,001 Appr: DG/jc Date 4/17/73

SOIL CLASSIFICATION CHART
AND
KEY TO TEST DATA

Pearl Ridge Development
Parcel 4

PLATE
6



Type of Specimen Undisturbed		Before Test			After Test	
Diameter (in.) 2.43	Height (in.) 0.80	Moisture Content	w_o	53.8 %	w_f	46.5 %
Overburden Press., P_o	5400 psf	Void Ratio	e_o	1.611	e_f	1.360
Preconsol. Press., P_c	- - psf	Saturation	S_o	100 %	S_f	100 %
Compression Index, C_c	.35	Dry Density	γ_d	72 pcf	γ_d	79 pcf

LL - -	PL - -	PI - -	G_s 3.0 (assumed)
Classification Mottled Brown Clayey Silt (MH)		Source Boring 2 @ 50.3'	

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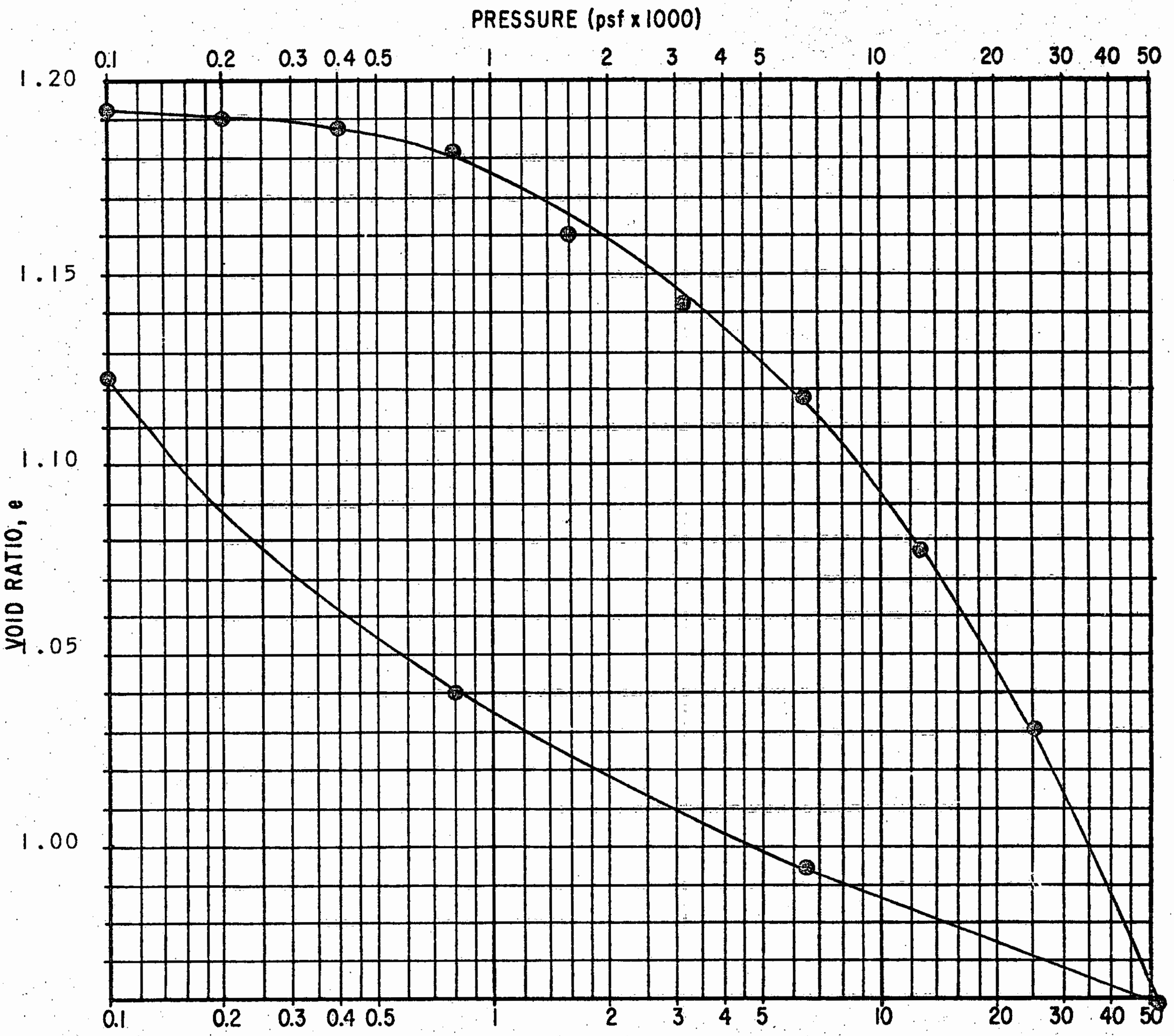
CONSOLIDATION TEST REPORT

Pearl Ridge Development
Parcel 4

PLATE 7



Type of Specimen Undisturbed		Before Test			After Test	
Diameter (in.) 2.43	Height (in.) 0.80	Moisture Content	w_o	35.9 %	w_f	38.5 %
Overburden Press., P_o	2200 psf	Void Ratio	e_o	1.195	e_f	1.125
Preconsol. Press., P_c	- - psf	Saturation	S_o	89 %	S_f	100 %
Compression Index, C_c	.11	Dry Density	γ_d	84 pcf	γ_d	86 pcf

LL 51	PL 35	PI 16	G_s 2.95 (assumed)

Classification Dark Brown Clayey Silt (MH)

Source Boring 3 @ 20.0'

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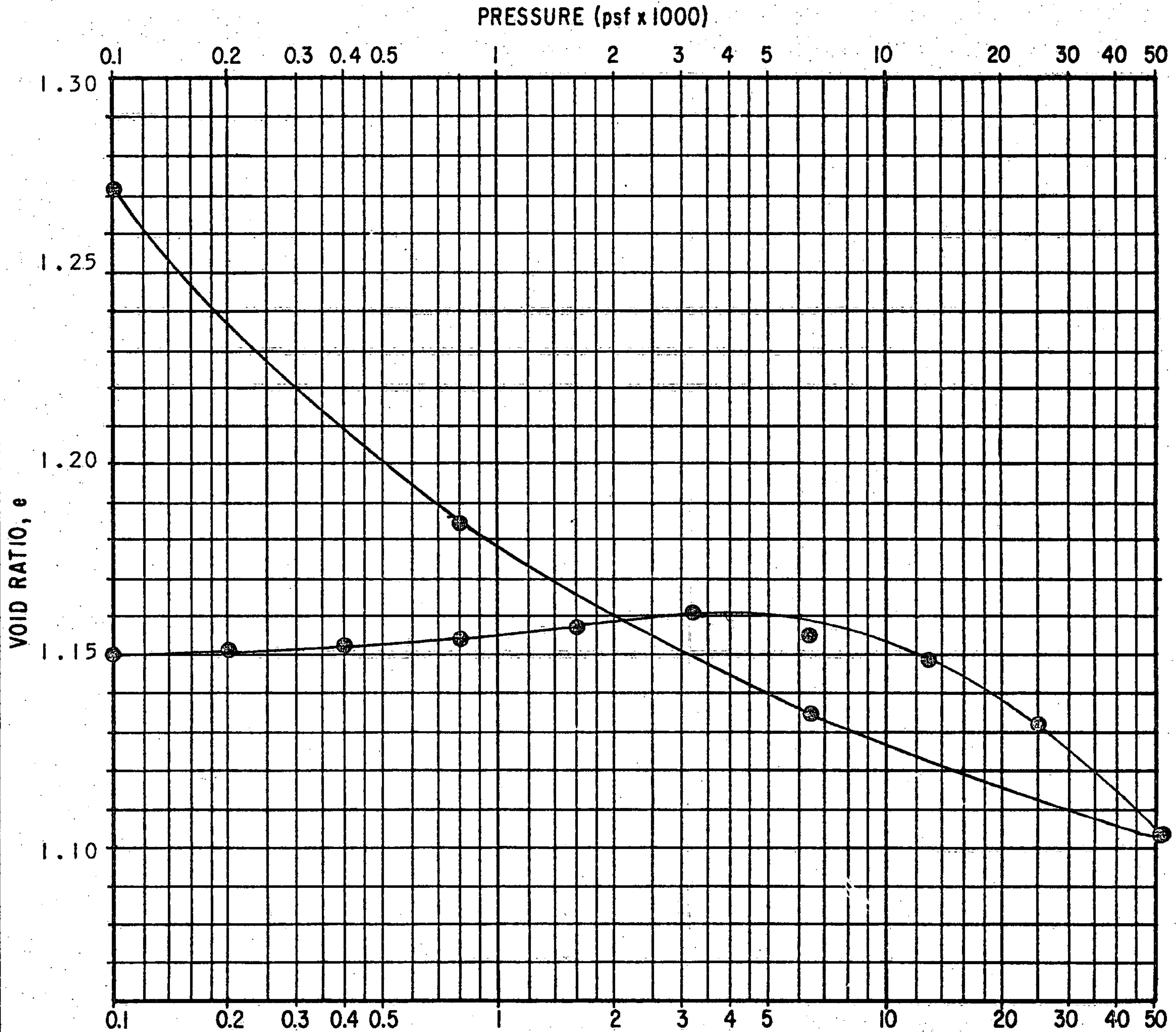
CONSOLIDATION TEST REPORT

Pearl Ridge Development

Parcel 4

PLATE 8



Type of Specimen	Undisturbed			Before Test			After Test	
Diameter (in.) 2.43	Height (in.) 0.80			Moisture Content	w_o	31.4 %	w_f	45.7 %
Overburden Press., P_o	460	psf		Void Ratio	e_o	1.150	e_f	1.272
Preconsol. Press., P_c	- -	psf		Saturation	S_o	76 %	S_f	100 %
Compression Index, C_c	- -			Dry Density	γ_d	81 pcf	γ_d	76 pcf
LL - -	PL - -			PI - -		G_s 2.78 (assumed)		
Classification	Mottled Brown Clayey Silt (MH)			Source	Boring 4 @ 4.4'			

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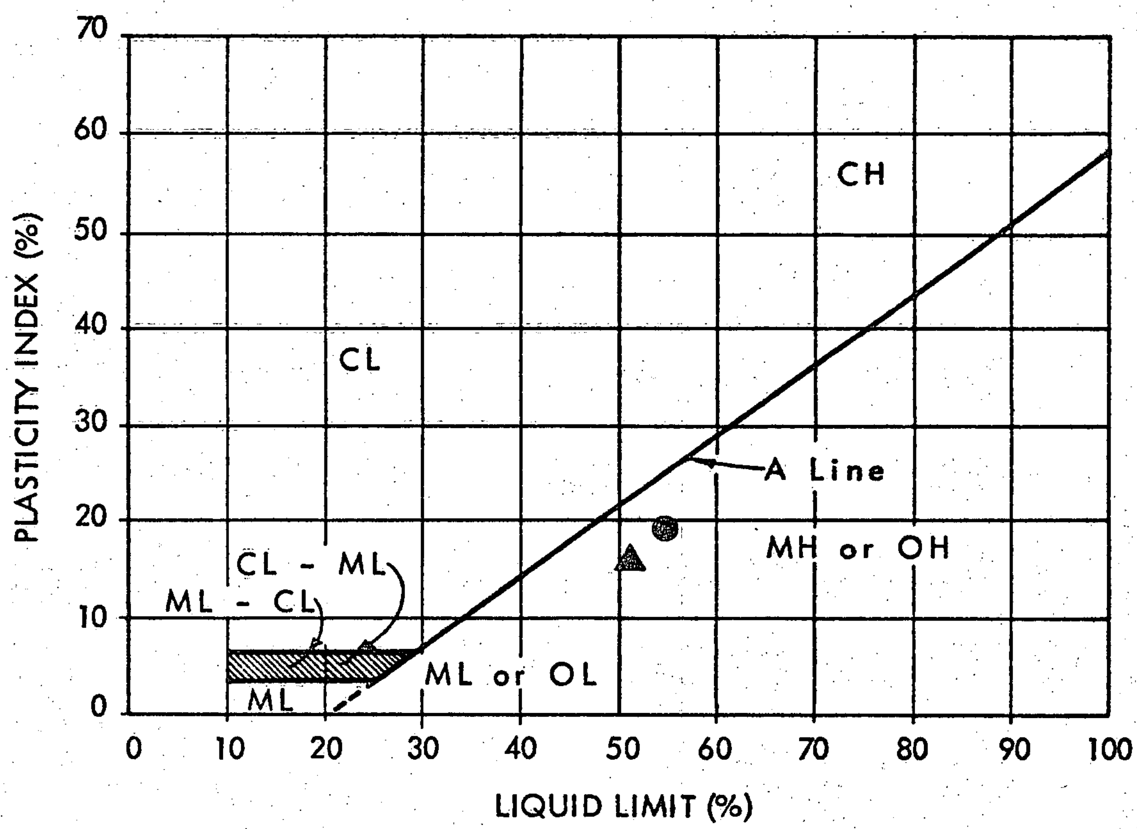
CONSOLIDATION TEST REPORT
Pearl Ridge Development
Parcel 4

PLATE 9

Job No: 3934,001 Appr: DG/jc Date 4/17/73



Symbol	Classification and Source	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
●	Mottled Brown Clayey Silt (MH) Boring 1 @ 2.5'	54	35	19	
▲	Dark Brown Clayey Silt (MH) Boring 2 @ 20'	51	35	16	

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PLASTICITY CHART

Pearl Ridge Development
Parcel 4

PLATE
10

DISTRIBUTION

4 copies	Oceanic Properties, Inc. 20th Floor Financial Plaza of the Pacific Honolulu, Hawaii Attention: Mr. William deVos
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4/24/73 cc: F. Slavsky; Austin, Smith & Associates - sm

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HARDING-LAWSON ASSOCIATES *Consulting Engineers and Geologists*
1259 South Beretania Street, Honolulu, Hawaii 96814 • (808) 537-3352 • Telex 723560

DONALD L. SCHREUDER
Civil Engineer
Associate-in-Charge

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April 19, 1973
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Oceanic Properties, Inc.
20th Floor
Financial Plaza of the Pacific
Honolulu, Hawaii

Attention: Mr. William deVos

Gentlemen:

This letter transmits four copies of our foundation investigation report for Parcel 4 of your Pearl Ridge development.

We conclude that the planned buildings can be supported on a shallow foundation system of spread footings for the parking structure and grid or mat type foundations for the 19-story towers. The grid or mat foundations are required to distribute building loads and reduce settlement to acceptable values.

We discussed our conclusions and recommendations as they were developed with your Structural Engineer, T. Y. Linn, Hawaii. We will continue to consult with them and other members of the design team during development of the foundation and grading plan.

Yours very truly,

HARDING-LAWSON ASSOCIATES

Donald L Schreuder by DLS

Donald L. Schreuder
Civil Engineer - 2531

DLS/jc
cc: T. Y. Lin, Hawaii, Incorporated
1272 South King Street
Honolulu, Hawaii
Enclosed: One copy of report

ROUTE ASA ENGINEERS HONOLULU HAWAII
TO: DSA, RLS, CST, ...

Wm. A. de Vos
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1259 South Beretania Street, Honolulu, Hawaii 96814 • (808) 537-3352 • Telex 723560

DONALD L. SCHREUDER
Civil Engineer
Associate-in-Charge

May 4, 1973
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AUSTIN, SMITH & ASSOCIATES, INC.
Honolulu, Hawaii 96813

Oceanic Properties Inc.
20th Floor
Financial Plaza of the Pacific
Honolulu, Hawaii 96813

Attention: Mr. William deVos

Gentlemen:

Re: Pearl Ridge Development
Parcel 4
Kalauao, Oahu, Hawaii

This letter presents supplementary recommendations regarding site grading at your Pearl Ridge project, Parcel 4, discussed with Mr. Ken Kurokawa of Austin-Smith and Associates on May 1, 1973. Our Foundation Investigation report for the project was submitted on April 19, 1973.

The cut-slope along the north boundary of the site (between the proposed parking structure and the H-1 Freeway) will be stable at 1 1/2:1 (1 1/2 horizontal to 1 vertical). The slope should be provided with an intermediate bench, eight feet wide, where it is higher than 15 feet.

Fill-slopes should be no steeper than 2:1. In addition, fills placed on existing slopes which are steeper than 5:1 should be started on a level bench and continuously benched into the existing sloping surface as the fill progresses. This is particularly important if fills are placed on or near the top of the existing slope along the east boundary of the site. This slope is near vertical in places and appears to have had fill pushed over it during previous grading. If grading

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Remarks

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is planned for this area, the old fill should be removed and the slope should be reconstructed to 1 1/2:1 in cut areas and 2:1 if fill is placed on it.

Very truly yours,

HARDING-LAWSON ASSOCIATES

Donald L. Schreuder,
Civil Engineer - 2531

DLS/jc
cc: Austin-Smith and Associates
745 Fort Street, Suite 900
Honolulu, Hawaii 96813
Attention: Mr. Ken Kurokawa