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HARDING, MILLER, LAWSON & ASSOCIATES

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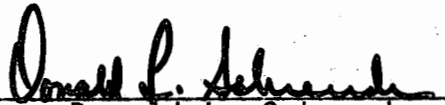
SOIL INVESTIGATION
MAILI SANDS SUBDIVISION
LUALUALEI, WAIANAE, OAHU, HAWAII

HML&A Job No. 3904,012.06

Prepared for

Lear Siegler Properties, Inc.
Suite 1112, 700 Bishop Street
Honolulu, Hawaii 96813

by


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Honolulu, Hawaii 96814

August 24, 1972

MUNICIPAL REFERENCE & RECORDS CENTER
City & County of Honolulu
City Hall Annex, 558 S. King Street
Honolulu, Hawaii 96813

WITHDRAWN

I INTRODUCTION

This report presents the results of the soil investigation we performed for the proposed Maili Sands Subdivision. The site is approximately 30-acres in size and is located just east of Farrington Highway in Maili. It is bounded on the north by St. John's Road and along the east by the Maili Stream, as shown on the Site Plan, Plate 1.

The property is relatively flat and low; in the past it has been subject to flooding during severe rain storms. It is planned to raise the site several feet by filling so that it will drain toward the Maili Stream. We understand new fill will range up to about six feet deep. Fills along the stream will be shallow and will not extend closer than about 15 feet to the top-of-bank. The development will include about 161-single family dwellings, along with access roads and utilities.

The purpose of the investigation was to explore subsurface conditions at the property and to develop conclusions and recommendations regarding

1. Site preparation, proper placement of fill material and required degree of compaction.
2. Most suitable building foundation type and soil criteria necessary for foundation design.
3. Settlement behavior of fills and foundations.
4. Flexible pavement design.

SITE CONDITIONS

Approximately two-thirds of the property is covered with heavy grass, brush and trees. The open area, which is adjacent

to the canal, contains scattered debris and rubbish including old car bodies.

Subsurface conditions were explored by drilling 11 borings, ranging from 14 to 17 feet in depth. The borings mainly encountered sand and coral, blanketed with a relatively thin layer of silt about one to three feet thick over most of the site. Along the edge of the Maili Stream, however, there is a varying thickness of silt fill ranging up to 13 feet at the points explored. A detailed description of the soils is presented on the Logs of Borings, Plates 2 to 7. The soils are classified in accordance with the Unified Soil Classification System, Plate 8.

Three borings, drilled adjacent to the Maili Stream by the U. S. Department of Agriculture, Soil Conservation Service, encountered soils similar to those found in the borings drilled for this investigation; that is, silts, sands and coral. The locations of these borings are shown on Plate 1.

Selected, undisturbed samples of the soil were tested in our laboratory to measure various physical properties. The laboratory program included moisture content/dry density, strength, compressibility, and classification tests. The test results are presented on the boring logs adjacent to the sample tested and are explained on the Key to Test Data, Plate 8. In addition, consolidation test and classification test data are presented on Plates 9 and 10.

CONCLUSIONS

Based on the results of our investigation, we conclude that the site is well suited for the proposed method of development and use. The planned dwellings can be supported on spread footings bottomed in property compacted fill. There will be

some settlement as the existing site soils consolidate under the weight of the new fill; however, the consolidation will occur quickly and will be essentially complete by the time grading is finished.

DISCUSSION AND RECOMMENDATIONS

Grading

All weeds, brush, trees, rubbish and debris should be cleared and removed from the site. Stripping should extend an inch or two below the existing surface so that principal root growth is removed. The exposed surface should be scarified to a depth of six inches, moisture conditioned and compacted to at least 90 percent relative compaction.* Subsequent lifts of import fill, which we understand will be coral, should be spread in thin layers, moisture conditioned and rolled with a sheepsfoot or vibratory roller to achieve at least 90 percent relative compaction. Suggested specifications for site preparation and grading are included in Appendix A.

The most compressible soils were encountered along the edge of the Maili Stream, where fills were placed during realignment of the stream channel. We recommend that the fill along the stream be completed early in the grading program in order to allow settlement in this area to occur before surface improvements are started. We estimate that fill settlements will range up to about seven inches. For fill quantity calculations, we suggest you consider an average settlement of three inches over the entire site. Almost all of the settlement should take place during construction, or within two weeks after grading has been completed.

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

Foundations

The buildings can be supported on spread footings bottomed in properly compacted fill. The footing sizes will be dictated by minimum allowable code requirements rather than bearing pressures. Footings should be bottomed at least eight inches below lowest adjacent final grade. Footings underlain by 18 inches of compacted fill should not settle significantly.

Sewer Installation

Graded aggregate cradling should be satisfactory for sewer lines installed in natural soil or compacted fill. The cradling material, and its placement, should conform to the requirements of the City and County Sewer Division.

Pavement Design

The flexible pavement thickness will depend on the supporting capacity and expansion characteristics of the subgrade soil; we should design the pavement section when the source of the import fill is known and tests can be performed on it. Based on our experience with coral fill, and on the assumption that traffic in the subdivision will be light, we suggest a preliminary pavement design of two inches of asphalt concrete over six inches of aggregate base.

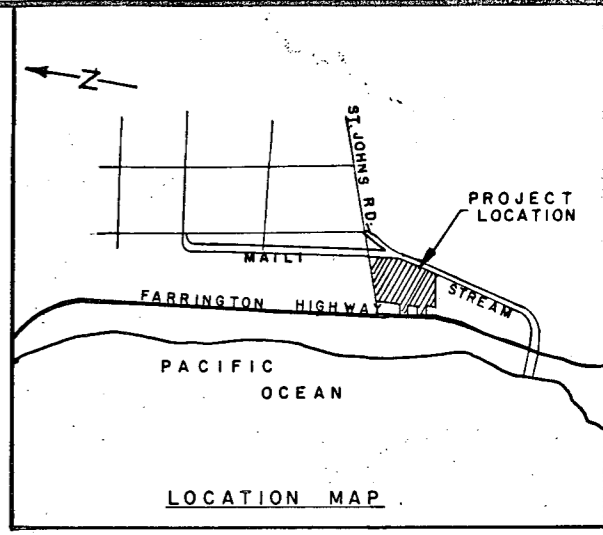
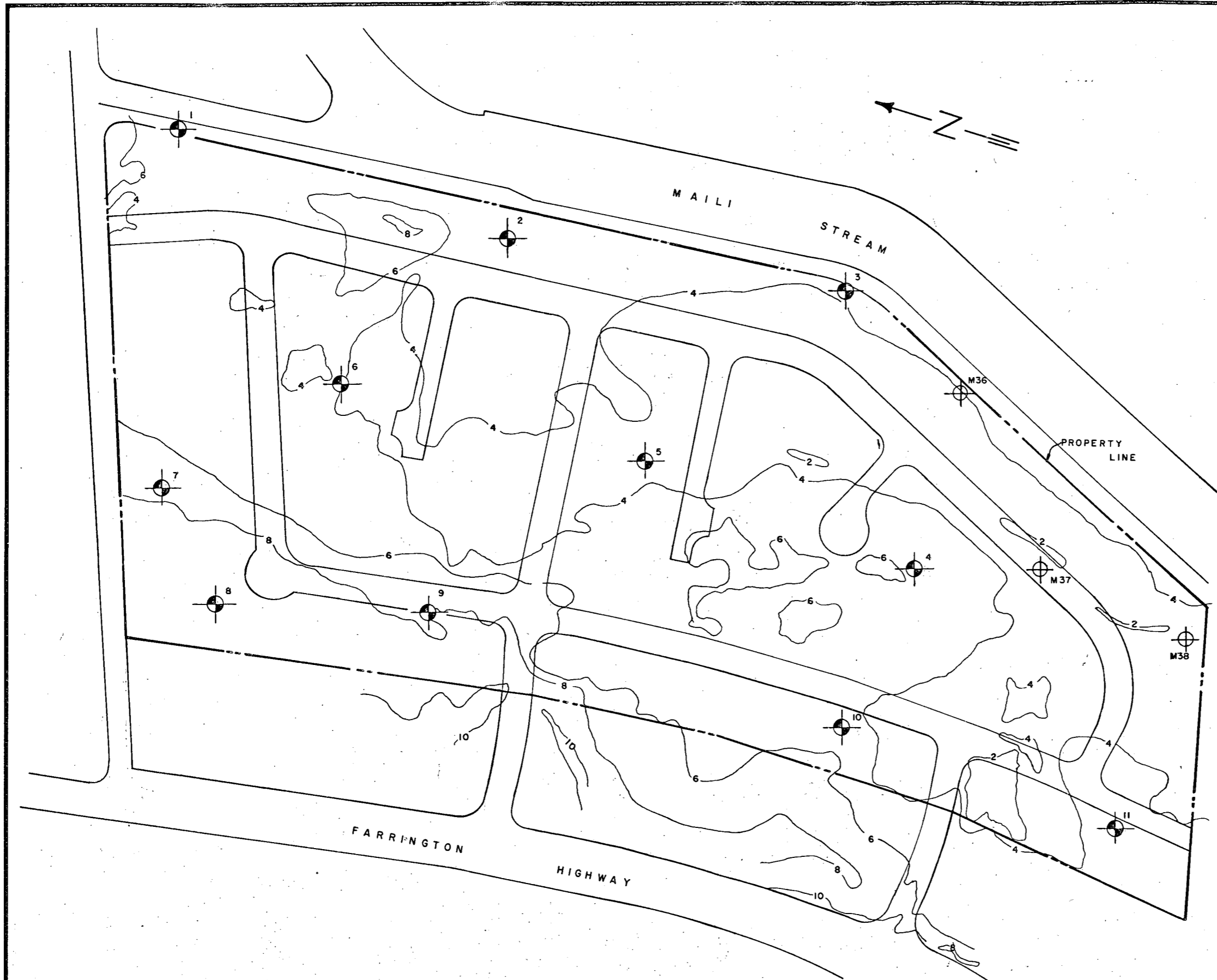
The subgrade should be prepared by scarifying to a depth of six inches, moisture conditioning and rolling to achieve a relative compaction of 95 percent. The aggregate base should also be moisture conditioned and compacted to 95 percent relative compaction. In addition, aggregate base should conform to the requirements of the City and County of Honolulu.



Inspection

We should inspect the site preparation and grading and the installation of footings. If you wish, we could review the grading and foundation plans to correlate them with the intent of our recommendations.

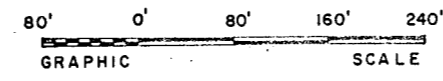
PLATES


1	Site Plan
2 through 7	Logs of Borings
8	Key to Test Data
9	Consolidation Test
10	Classification Test Data



-  TEST BORING BY, HARDING, MILLER, LAWSON & ASSOC.
-  TEST BORING BY, SOIL CONSERVATION SERVICE.

Reference: Preliminary Layout Maili Sands Subdivision, by VTN Pacific. No Date.



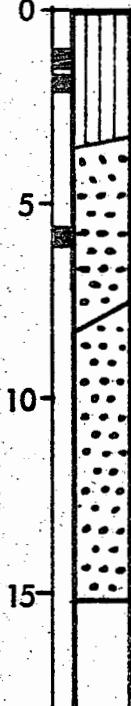
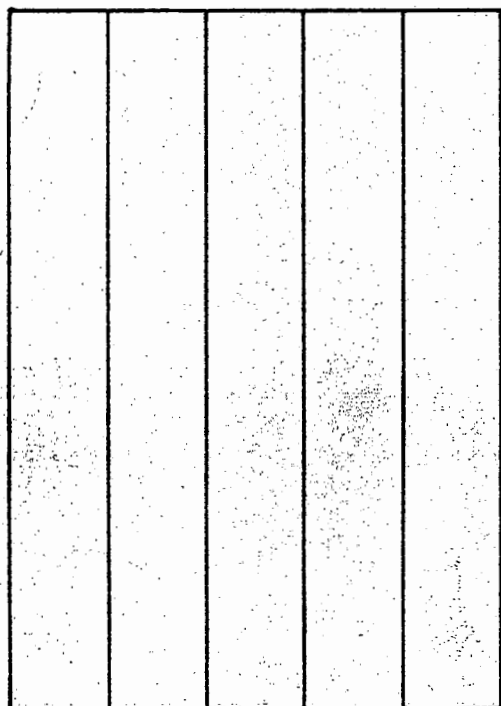
▲			
▲			
▲			
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Rev.	Description	Date	By
SITE PLAN			
MAILI SANDS SUBDIVISION			
LUALUALEI	WAIANAE	OAHU	HAWAII
Job No. 3904.012.06 Designed _____ Drawn E. J. H. Checked D. G. S. Approved D. G. S. Date 8-17-72 Scale 1" = 160'			HARDING, MILLER, LAWSON & ASSOCIATES Consulting Engineers  1

LOG OF BORING 1

Shear Strength (lbs/sq ft)

Moisture Content (%)
Dry Density (pcf)
Depth (ft)
Sample

Equipment 4" Flight Auger
Elevation 5.3 Date 8/8/72



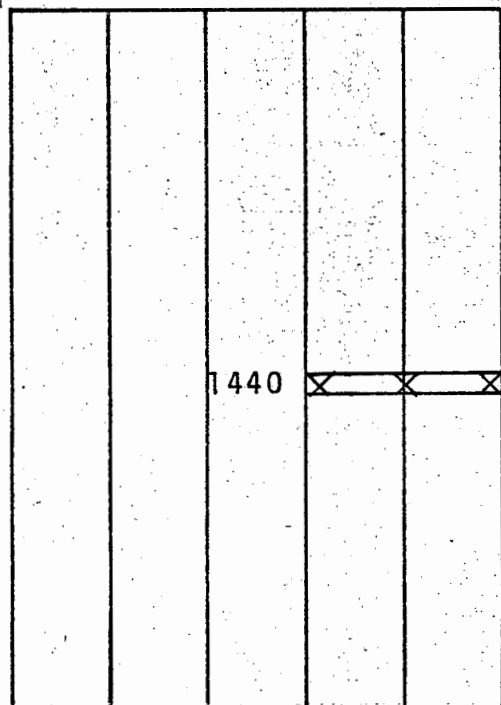
GREY-BROWN SANDY SILT (ML) stiff, moist, with rock fragments
 WATER LEVEL 8-8-72
 LIGHT GREY SAND (SP) medium dense, saturated silty sand, dense
 LIGHT BROWN SAND (SP) hard, saturated, highly cemented, medium grained

FILL

LOG OF BORING 2

Equipment 4" Flight Auger
Elevation 5.0 Date 8-8-72

10,000
8,000
6,000
4,000
2,000
0



GREY-BROWN SANDY SILT (ML) stiff, moist
 GREY SANDY SILT (ML) stiff, moist
 WATER LEVEL 8-8-72 soft at 4'
 LIGHT GREY & WHITE CORAL hard, moderately strong
 LIGHT BROWN SILTY SAND (SM) dense, saturated, slightly cemented

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Consulting Engineers

Job No: 3904,012. Appr: BAC/ja Date 8-28-72

LOG OF BORING 1 & 2

MAILI SANDS
Lualualei, Waianae,
Oahu, Hawaii

PLATE

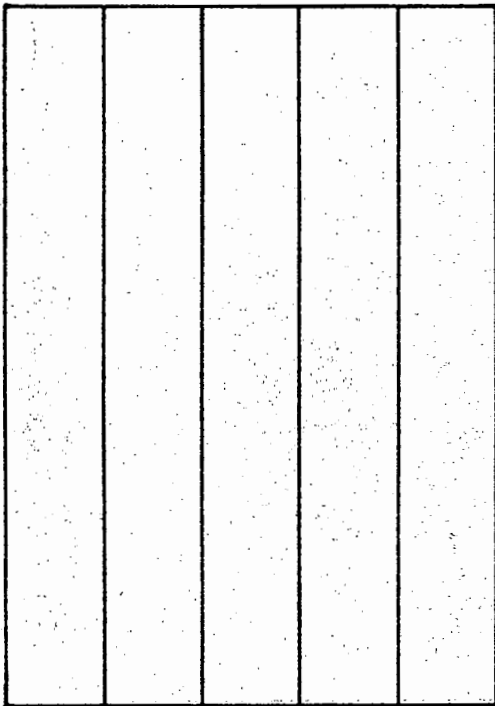
2

Shear Strength (lbs/sq ft)

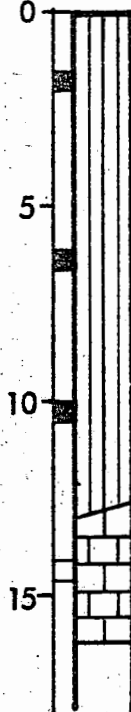
Moisture Content (%)
Dry Density (pcf)
Depth (ft)
Sample

LOG OF BORING 3

Equipment 4" Flight Auger
Elevation 5.0 Date 8/8/72



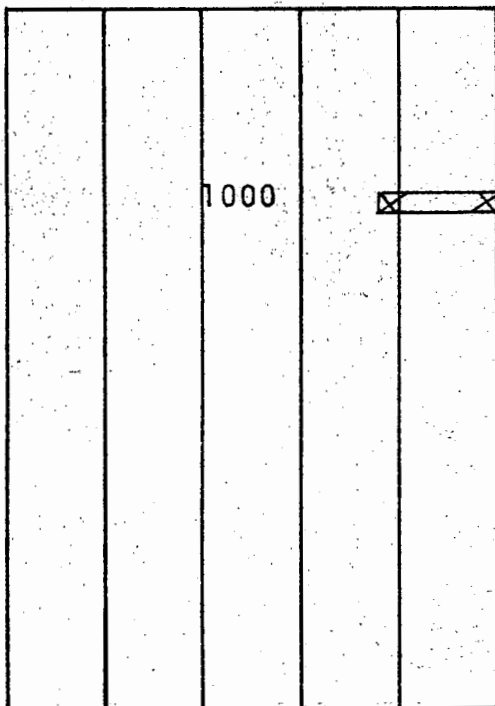
36.5 87



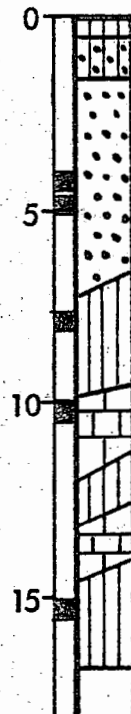
GREY SANDY SILT (ML)
stiff, moist
wet at 1.0 with occasional rock fragments
WATER LEVEL 8-8-72
becoming soft at 3'
with abundant rock fragments from 8'
WHITE CORAL
moderately hard, moderately strong

FILL

10,000
8,000
6,000
4,000
2,000
0



1000 29.0 81



LOG OF BORING 4

Equipment 4" Flight Auger
Elevation 5.7 Date 8/9/72

DARK BROWN SANDY SILT (ML)
soft, dry, with roots
BROWN SILTY SAND (SM)
loose, dry, with coral fragments
WATER LEVEL 8-9-72
WHITE SAND (SP)
medium dense, wet, medium grained, with shell fragments
GREY SANDY SILT (ML)
soft, saturated
WHITE CORAL
moderately hard, moderately strong
LIGHT BROWN SANDY SILT (ML)
medium stiff, saturated
WHITE CORAL
moderately hard, moderately strong
LIGHT BROWN SILT (ML)
stiff, saturated

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Consulting Engineers

Job No: 3904,012 Appr: BAC/ja Date 8/28/72

LOG OF BORING 3 & 4

MAILI SANDS
Lualualei, Waianae,
Oahu, Hawaii

PLATE

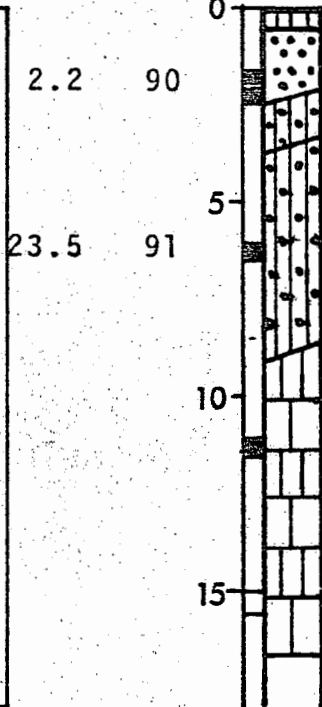
3

LOG OF BORING 7

Shear Strength (lbs/sq ft)

Moisture Content (%)
 Dry Density (pcf)
 Depth (ft)
 Sample

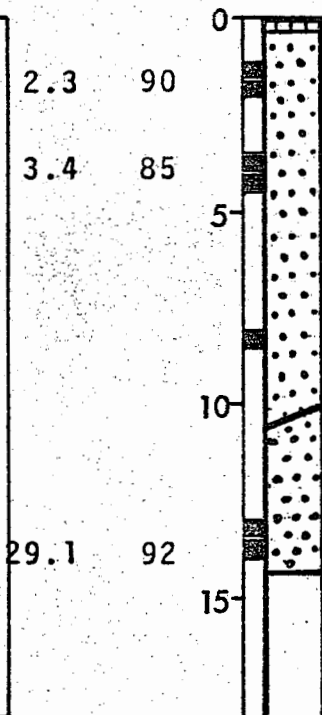
Equipment 4" Flight Auger
 Elevation 7.5 Date _____



BROWN SANDY SILT (ML)
 soft, dry
 WHITE SAND (SP)
 medium dense dry
 LIGHT BROWN SILTY SAND (SM)
 medium dense, dry, slightly cemented
 WHITE SILTY SAND (SM)
 dense, wet with occasional coral fragments
 WATER LEVEL 8-9-72
 WHITE CORAL
 moderately hard, moderately strong, with abundant sand pockets

LOG OF BORING 8

Equipment 4" Flight Auger
 Elevation 9 Date 8-9-72



BROWN SANDY SILT (ML)
 soft, dry, with roots
 LIGHT BROWN SAND (SP)
 medium dense, dry, with abundant roots to 2.0, medium grained
 moist at 6'
 dense at 7'
 WHITE SAND (SP)
 medium dense, wet, with occasional coral fragments
 WATER LEVEL 8-9-72

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Job No: 3904, 012.06 Appr: BAC/ja Date 8-18-72

LOG OF BORING 7 & 8

MAILI SANDS
 Lualualei, Waianae,
 Oahu, Hawaii

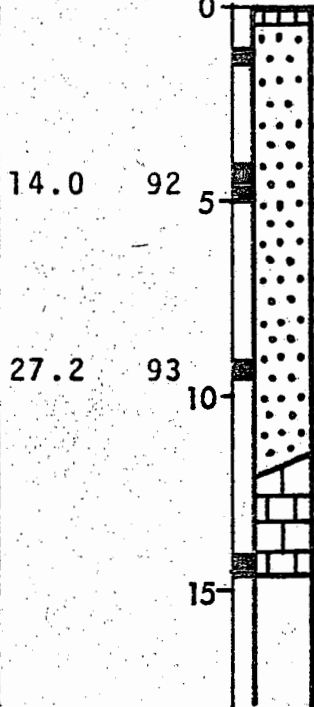
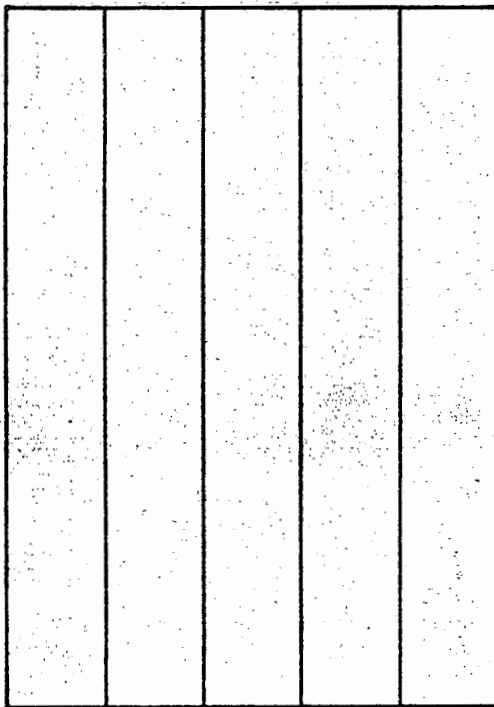
PLATE

5

LOG OF BORING 9

Equipment 4" Flight Auger
 Elevation 6.5 Date 8-9-72

Moisture Content (%)
 Dry Density (pcf)
 Depth (ft)
 Sample

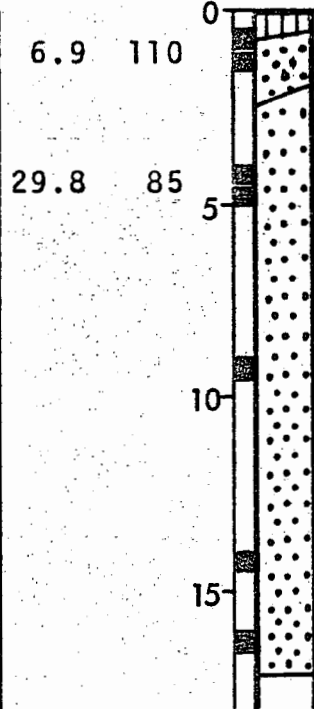
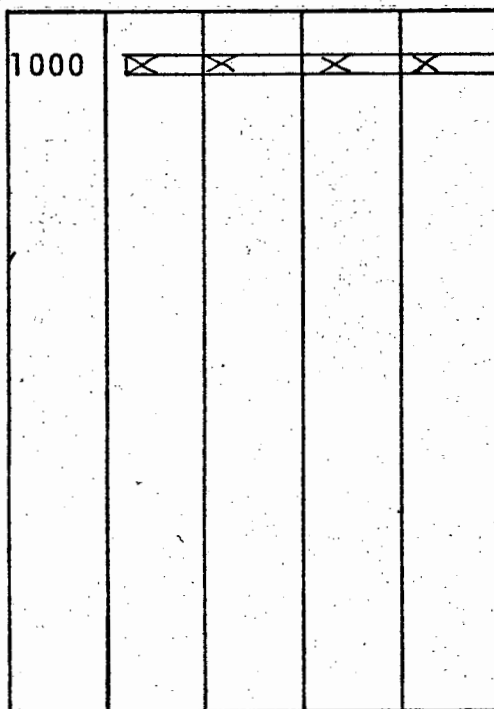


0 BROWN SANDY SILT (ML)
 soft, dry, with roots
 LIGHT BROWN SAND (SP)
 medium dense, dry with roots to 1', medium grained
 moist at 4'
 slightly cemented at 5'
 WATER LEVEL 8-9-72
 becoming dense @ 9'
 WHITE CORAL
 moderately hard, moderately strong
 hard @ 14'

LOG OF BORING 10

Equipment 4" Flight Auger
 Elevation 6.0 Date 8/10/72

10,000
 8,000
 6,000
 4,000
 2,000
 0



0 BROWN SANDY SILT (ML)
 soft, dry with roots
 BROWN SAND (SP)
 medium dense, dry with roots to 1.5, medium grained, slightly cemented at 1.5
 WATER LEVEL 8-10-72
 WHITE SAND (SP)
 medium dense, moist, medium grained
 with occasional coral fragments

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Job No: 3904, 012, 06 Appr: BK/ja Date 8/18/72

LOG OF BORING 9 & 10

MAILI SANDS
 Lualualei, Waianae,
 Oahu, Hawaii

PLATE

6

Shear Strength (lbs/sq ft)

Moisture Content (%)

Dry Density (pcf)

Depth (ft)

Sample

LOG OF BORING II

Equipment 4" Flight Auger

Elevation 4.5 Date 8/10/72

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19.9 89



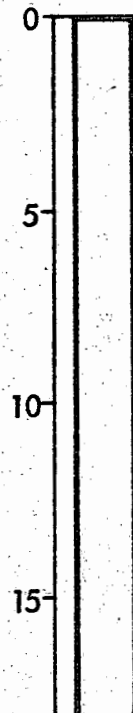
BROWN SANDY SILT (ML)
soft, dry, with roots
WHITE CORAL
hard, moderately strong
WHITE SAND (SP)
loose, moist, medium grained
WATER LEVEL 8-10-72
WHITE CORAL
moderately hard, moderately strong
WHITE SAND (SP)
loose, saturated, medium grained
WHITE CORAL
moderately hard, moderately strong

LOG OF

Equipment _____

Elevation _____ Date _____

--	--	--	--	--



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LOG OF BORING II

MAILI SANDS
Luaualei, Waianae,
Oahu, Hawaii

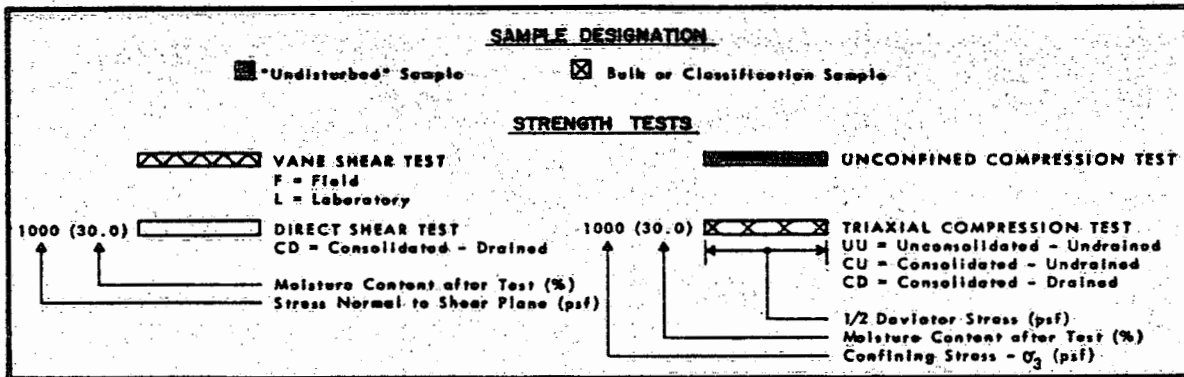
PLATE

7

Job No: 3904,012 Appr: BMC/ja Date 8-28-72

MAJOR DIVISIONS					TYPICAL NAMES
COARSE GRAINED SOILS MORE THAN HALF IS LARGER THAN #200 SIEVE	GRAVELS	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	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 DIATOMACEOUS 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



KEY TO TEST DATA

HARDING, MILLER, LAWSON & ASSOCIATES



Consulting Engineers

Job No: 3904,012 Appr: DGG/ja Date 8/25/72

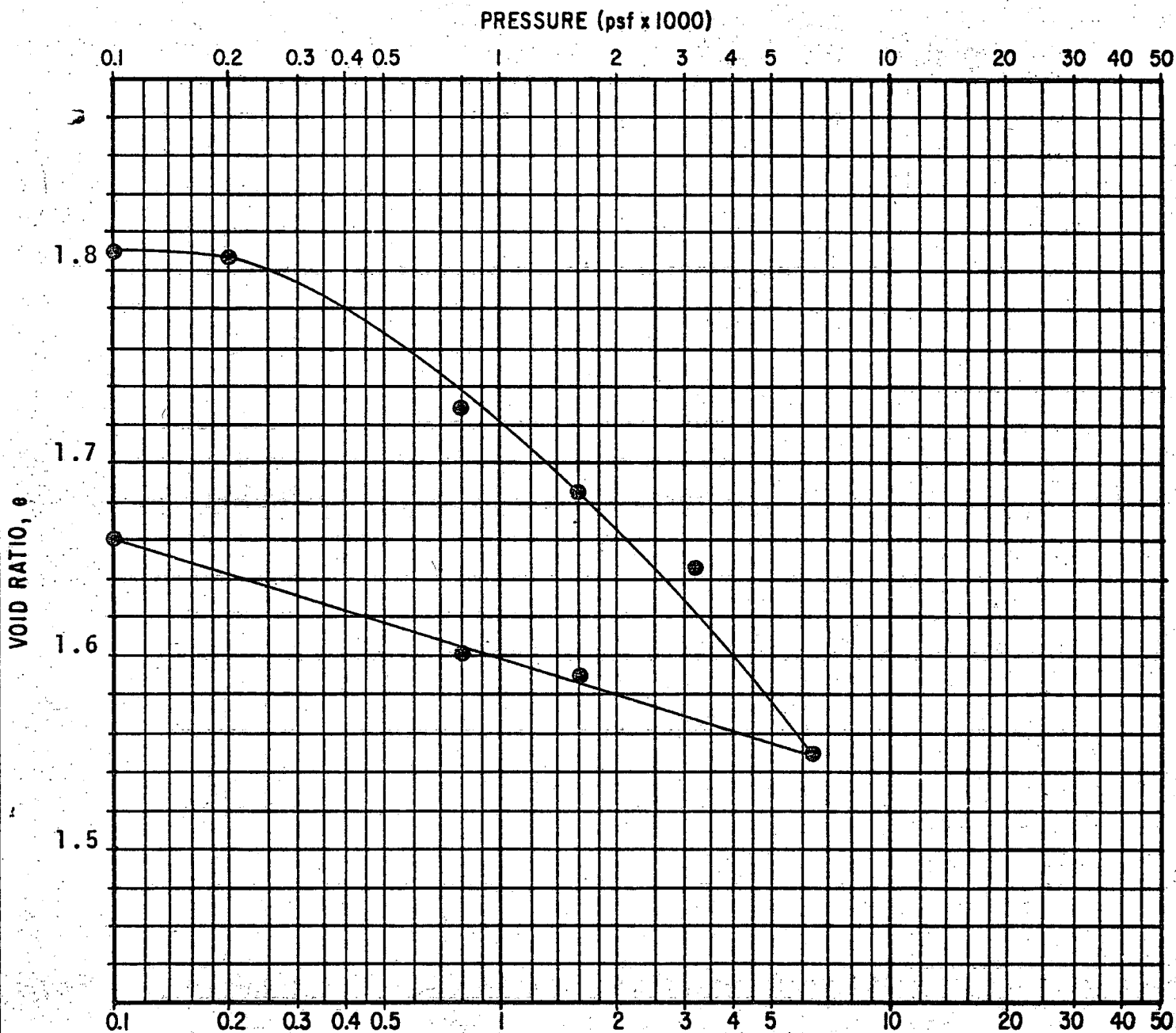
SOIL CLASSIFICATION CHART

**AND
KEY TO TEST DATA**

MAILI SANDS SUBDIVISION

PLATE

8



Type of Specimen	Undisturbed		Before Test			After Test		
Diameter (in.)	2.43	Height (in.)	.800	Moisture Content	w_o	64.9%	w_f	62.5%
Overburden Press., P_o	100 psf		Void Ratio	e_o	1.82	e_f	1.66	
Preconsol. Press., P_c	200 psf		Saturation	S_o	94.5%	S_f	100%	
Compression Index, C_c	0.22		Dry Density	γ_d	59.0 pcf	γ_d	62.6 pcf	
LL	55	PL	35	PI	20	G_s	2.65 (assumed)	
Classification	DARK BROWN SILT (MH)			Source Boring 6 at 1.0				

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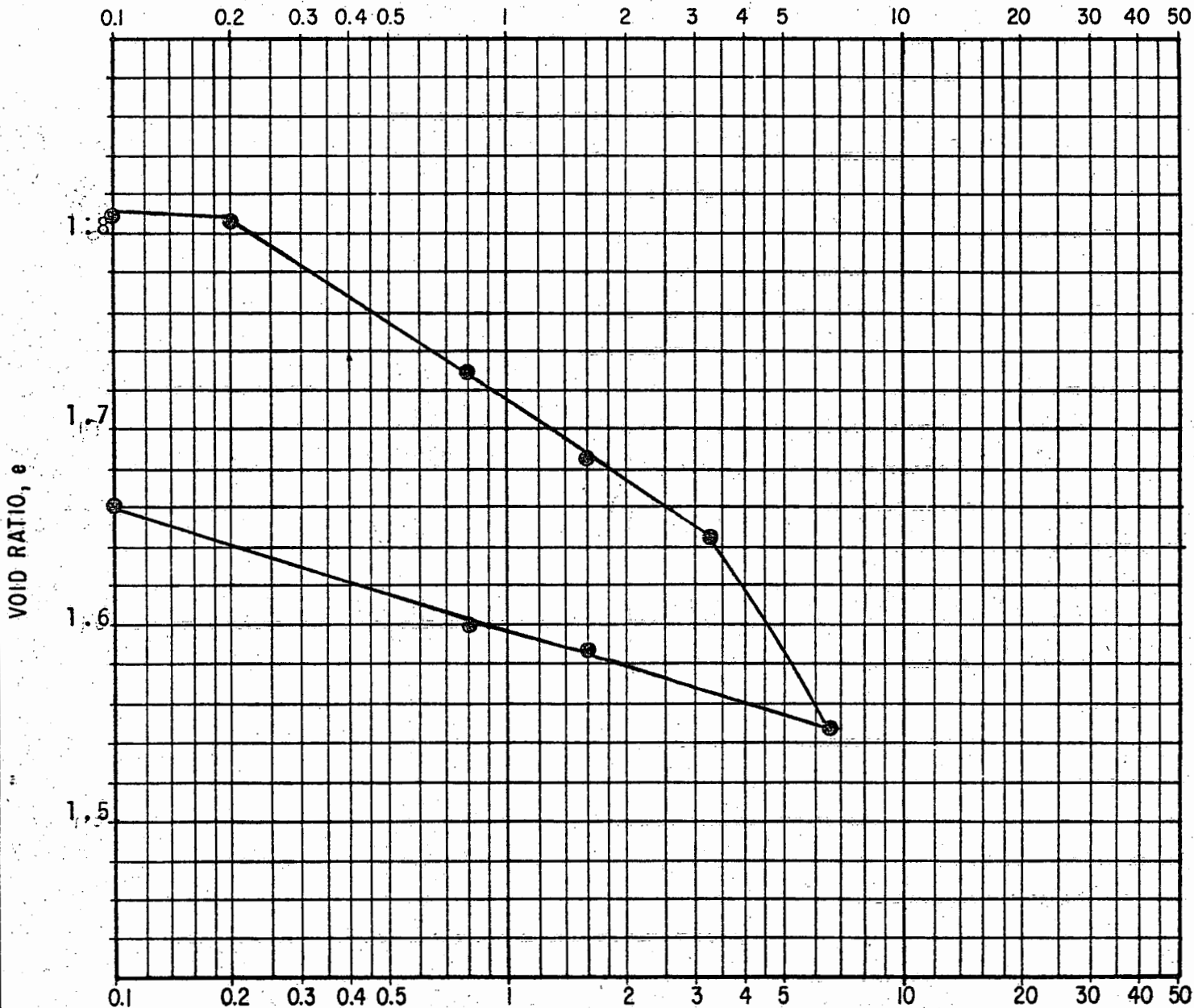
Job No: 3904.12 Appr: SAC / ja Date 8/28/72

CONSOLIDATION TEST REPORT
 MAILI SANDS
 Lualualei, Waianae,
 Oahu, Hawaii

PLATE
9

RF-30

PRESSURE (psf x 1000)



Type of Specimen		Undisturbed		Before Test		After Test	
Diameter (in.)	2.43	Height (in.)	.800	Moisture Content	w _o 64.9%	w _f	62.5 %
Overburden Press., P _o	100	psf		Void Ratio	e _o 1.82	e _f	1.66
Preconsol. Press., P _c	200	psf		Saturation	S _o 94.5 %	S _f	100 %
Compression Index, C _c	0.135			Dry Density	γ _d 59.0 pcf	γ _d	62.6 pcf
LL	55	PL	35	PI	20	G _s	2.65 (assumed)
Classification				Grey clay, stiff			
				Source Boring 6 at 1.0			

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Consulting Engineers



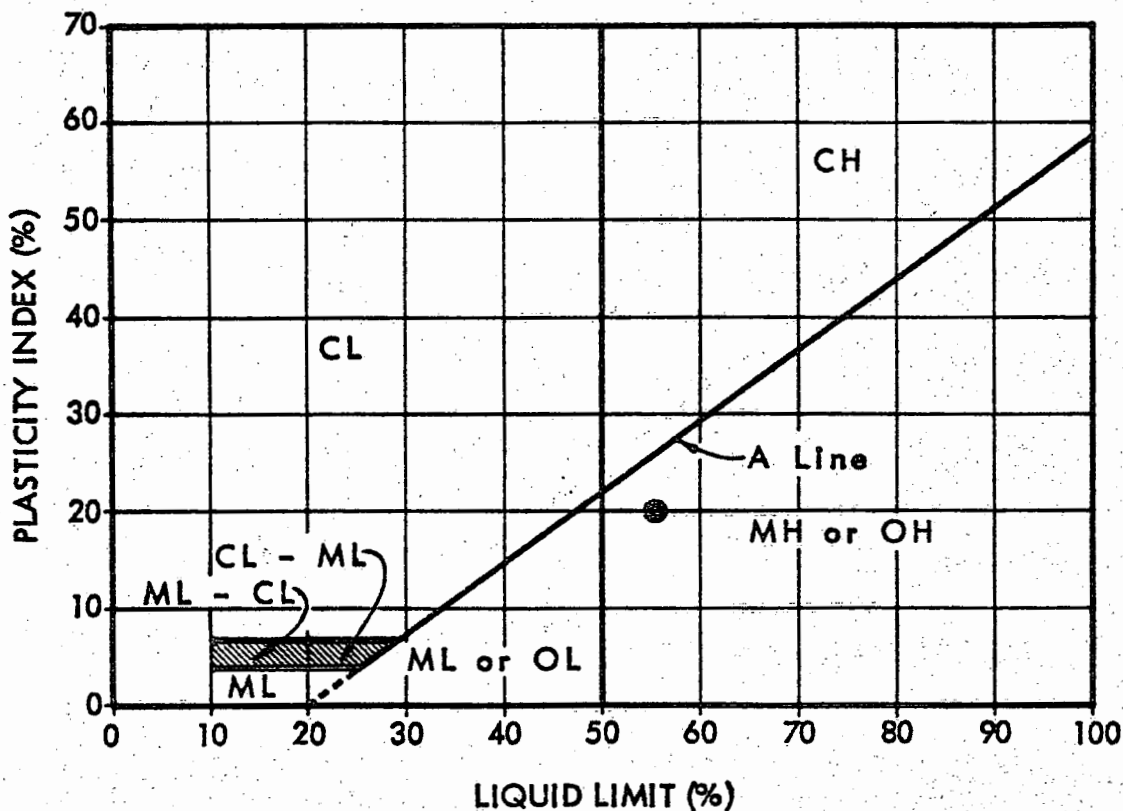
CONSOLIDATION TEST REPORT

MAILI SANDS
 Lualualei, Waianae,
 Oahu, Hawaii

PLATE

9

Job No 3904-12 Appr: *[Signature]* / ja Date: 8/28/72



Symbol	Classification and Source	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
●	DARK BROWN SANDY SILT (MH) Boring 6 @ 1.0	55	35	20	----

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Consulting Engineers

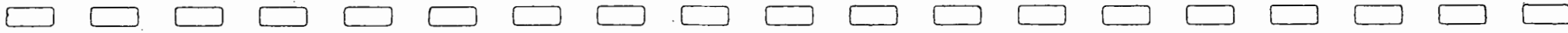
PLASTICITY CHART
MAILI SANDS SUBDIVISION
Lualualei, Waiane,
Oahu, Hawaii

PLATE
10

Job No: 3904, 012 Appr: RCG / ja Date: 8/25/72

Appendix A

EARTHWORK SPECIFICATIONS



1.0 GENERAL

1.1 Scope

The work done under these specifications shall include clearing, stripping and removal of unsuitable materials, preparation of natural soils and the excavation, placement and compaction of on-site and imported fill materials as shown on the plans.

1.2 Percent Compaction

As referred to in these specifications, "relative compaction" is the in-place dry density of the soil expressed as a percentage of the maximum dry density of the same material determined in accordance with the ASTM D1557-70(C) test method.

1.3 Dust Abatement

The Contractor shall furnish, transport and apply water as required to minimize dust.

1.4 Erosion

The Contractor shall remove soil and debris eroded from the site and deposited on/in roads, drainage facilities and adjacent property.

2.0 SITE PREPARATION

2.1 Clearing

The areas to be graded shall be cleared of all brush, trees and debris. This material shall be removed from the site.

2.2 Stripping

The upper one or two inches of natural soils containing grass, roots and other vegetation shall be stripped from

all areas to be graded and removed from the site. This material is not to be reused as compacted fill.

2.3 Overexcavation

In areas to be filled, localized overexcavation of soft loose soils may be required as directed by the Soil Engineer. Generally, the excavated material will be suitable for reuse as compacted fill.

2.4 Moisture Conditioning and Recompaction

In fill areas, the soils exposed by stripping and excavation shall be scarified to a depth of at least six inches, moisture conditioned to a moisture content suitable for compaction and compacted with sheepsfoot rollers or other approved equipment to obtain at least 90 percent relative compaction.

2.5 Approval

After stripping and overexcavation and before placing or replacing fill, the Contractor shall obtain the Soil Engineer's approval of the site preparation in each area to be filled.

3.0 FILL MATERIAL

3.1 On-Site Material

On-site soil can be used for fill material provided it is free of debris, organic material and rocks over six inches in maximum dimension. Unsuitable material encountered in excavations shall be removed from the site.

3.2 Imported Material

Imported material shall be free from organic matter and debris and shall conform to the following gradation:

<u>Size</u>	<u>Percent Passing</u>
4 inches	100
1-1/2 inches	60 - 100

The Contractor shall submit a representative sample of import material to the Soil Engineer for laboratory tests, at least two days prior to hauling. All import material must be approved by the Soil Engineer prior to hauling to the site.

4.0 COMPACTED FILL

4.1 Placement and Compaction

Approved fill material shall be placed in layers eight inches or less in loose thickness and moisture conditioned as necessary to achieve a moisture content suitable for compaction. Fill material shall be compacted with vibratory or sheepfoot rollers to obtain at least 90 percent relative compaction.

4.2 Recompaction

Where test results or performance of the fill indicate that the moisture content is not suitable, or insufficient compaction has been obtained, the fill shall be reconditioned and recompacted to the required density prior to placing additional fill material. The Contractor shall be responsible for placing and compacting approved fill material in accordance with these specifications. If the Contractor fails to meet the compaction requirements, he shall stop hauling or reduce his rate of haul, furnish additional spreading, watering and/or compaction equipment, or make any other adjustments necessary to produce a satisfactory compacted fill. When the work is stopped by rain, filling shall not resume until the Soil Engineer has verified that the moisture content

and density of the fill surface are satisfactory.

4.3 Drainage

During construction, all fill surfaces shall be sloped to provide positive surface drainage and to prevent ponding of water. If it appears that rainy weather is imminent, the Contractor shall roll the surface with smooth rollers or rubber-tired equipment to seal the surface against excessive infiltration of water. Temporary surface drains and ditches shall be provided by the Contractor as necessary to expedite runoff and/or prevent erosion.

5.0 SLOPES AND FINAL GRADING

5.1 Final Slopes

Upon completion of the compacted fill, all loose material shall be removed from the slopes and the slopes shall be trimmed or compacted to expose a dense, uniform surface.

5.2 Final Grading

All fill surfaces shall be graded to uniform slopes in accordance with the grades shown on the drawings so as to drain readily. All surfaces should be graded smooth, low spots filled in and rolled with rubber-tired equipment to seal the surface against infiltration of water.

6.0 STRUCTURAL AND UTILITY TRENCH BACKFILL

6.1 Backfill Material

Backfill material shall conform to the requirements for general site fill as specified in Section 3.0.

6.2 Compaction

Backfill material shall be placed in horizontal uniform

layers six inches or less in loose thickness, moisture conditioned to a moisture content suitable for compaction, and compacted to at least 90 percent relative compaction.

DISTRIBUTION

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