AIEA LANI ESTATES - PRELIMINARY SOIL REPORT

AIEA HEIGHTS, EWA, OAHU, HAWAII
TAX MAP KEY: 9-9-07: 1

FOR REFERENCE
not to be taken from this room

To:
JAMES K. TSUGAWA AND ASSOCIATES

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
MAY 12, 1972

MUNICIPAL REFERENCE & RECORDS CENTER
City & County of Honolulu
City Hall Annex, 558 S. King Street
Honolulu, Hawaii 96813
May 12, 1972

JAMES K. TSUGAWA & ASSOCIATES  
210 Ward Avenue, Suite 118  
Honolulu, Hawaii 96814

Gentlemen:

Subject: Aiea Lani Estates  
Preliminary Soil Report  
(for site grading and foundation design purposes)  
Aiea Heights, Ewa, Oahu, Hawaii  
Tax Map Key: 9-9-07: 1

Transmitted herewith is our preliminary soil exploration report for site grading and foundation design purposes for light, 2-story residential structures for the proposed Aiea Lani Estates at Aiea Heights, Ewa, Oahu, Hawaii.

This report includes a Boring Location Plan, boring logs, laboratory test results, recommendations and limitations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Ezra Koike  
Professional Engineer  
Hawaii No. 1450

EK: vl
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AIEA LANI ESTATES - PRELIMINARY SOIL REPORT

AIEA HEIGHTS, EWA, OAHU, HAWAII
TAX MAP KEY: 9-9-07: 1

SCOPE OF EXPLORATION

The purpose of this exploration was to determine general soil conditions for site grading and foundation design purposes for light, 2-story residential structures for the proposed Aiea Lani Estates, Aiea Heights, Ewa, Oahu, Hawaii.

This report includes field explorations, laboratory tests and general recommendations for site grading and preliminary foundation design considerations.

FIELD EXPLORATION

Twenty exploratory borings were made at the site. The locations of these borings are shown on the Boring Location Plan. Descriptions of the underlying soils encountered are shown on the boring logs.

Borings were made with 3-in. diameter augers using clay and finger type bits. Soil samples were recovered with 2-in. diameter thin-wall tube samplers and a standard split spoon sampler driven with a 140-lb hammer falling 30 inches.

LABORATORY TESTS

Laboratory tests included: natural water content and density, unconfined compression, Atterberg limit, grain-size analysis, AASHO T-180-57 density, expansion and CBR.
A list of the standard field and laboratory test methods used for this project is given in the Appendix.

A summary of the laboratory test results is given in Tables IA thru IE.

SOIL CLASSIFICATION SYSTEM
Soil samples were visually observed and subjected to appropriate tests in the laboratory. Based on visual observations and laboratory test data, the soil descriptions given on the boring logs are generally made in accordance with the "Unified Soil Classification System."

GENERAL SITE CONDITIONS
The proposed site is located along the west side of the Aiea Heights Road about 1-1/2 miles northeast of H-1 freeway.

The site is generally situated on a ridge that runs in a north-south direction. The ridge slopes down toward the south at about 2 to 8% gradient with local variations. The side slopes vary from about 10 to 80% down toward the east and west. Some gullies and swales were also noted on the side slopes.

Shrubs, trees and weeds cover most of the site.

Narrow trails were noted on the site.

An existing water reservoir is located adjacent to the southeast corner of the site.

Existing cut slopes of about 1-1/4 horizontal to 1 vertical ratio were noted along the eastern boundary next to Aiea Heights Road.
INTERPRETATION OF SOIL CONDITIONS

From the field exploration and laboratory test results, the soils may be generally described as follows:

A surface layer about 2 to 4 ft of medium brown clayey silt underlain by mottled brown and gray clayey silts with traces of decomposed rock to about 16 ft, the depths drilled.

Water was not noticed in the borings during the field exploration.

For more detailed descriptions of soils encountered in the borings, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

In general, the present plan is to grade the central portion of the site along the top of the ridge for access roads and parking areas. Cuts and fills generally less than 15 ft in height are planned.

Light, 2-story wood-frame residential structures are proposed generally along the east and west sides of the ridge. Minimum grading is contemplated at the building sites. Post and beam type foundations are considered along sloping areas.

The proposed buildings indicated near the fairly steep slopes next to Aiea Heights Road should generally be relocated away from the tops of slopes or otherwise adjusted.
Site Grading

Because portions of the site are located on sloping areas, grading should be designed to generally avoid fills over areas steeper than about 3 horizontal to 1 vertical and to avoid thin sliver fills on sloping areas.

Before fills are placed in gullies or natural drainageways, trenches should be cut in a herringbone pattern and subdrains placed in trenches to provide drainage paths. The locations of subdrains should be determined in the field after clearing and grubbing.

Where fills are proposed, the area should be cleared and grubbed, drained and localized soft spots removed.

Provision to drain the site should be included during and after the filling operation.

In general, the on-site soils may be used for the construction of the proposed fills. Grading work should be done as required by the F.H.A. Data Sheet 79-G; Revised Ordinances of Honolulu, 1961 As Amended; and as recommended below:

1. The area should be cleared and grubbed.
   Surface vegetation and miscellaneous debris should be cleared and removed prior to site filling.
2. Topsoil and stockpiled soils should be either 
   (a) stripped to stiff natural ground or (b) 
   scarified and recompacted before the placement 
   of fills.

3. Localized soft pockets encountered during the 
   site preparations should be excavated and back- 
   filled with compacted select material.

4. Hard surfaces should be scarified down to 
   stiff soils and recompacted to match the density 
   of the surrounding soil.

5. Where fills are proposed on sidehill areas, 
   gullies and in drainage ditches, loose material 
   of the bottom and sides should be stripped down 
   to stiff natural ground before the placement of 
   fills. New fills should be keyed into the 
   stiff natural ground.

6. Fills should be constructed in approximately 
   level layers starting at the lower end and work- 
   ing upward. Where fills are made on sloping 
   areas steeper than about 5 horizontal to 1 
   vertical, the ground at the toe of the fill 
   should be benched to a generally level 
   condition. As the fill is brought up, it 
   should continually be keyed into the stiff
natural ground by cutting steps into the slopes and compacting the fill into these steps.

9. Fills should be laid in 6-in. compacted layers to 90% of the maximum density determined by the AASHO T-180-57 test method.

Slopes
In general, cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

In general, fills should be avoided on sloping areas steeper than about 3 horizontal to 1 vertical.

In cuts and fills, if slope heights of greater than 15 ft are considered, 8-ft-wide benches should be placed at height intervals of about 15 ft.

The surface of fill slopes should be compacted by cat-tracking or with a sheepsfoot roller.

Slope planting is recommended on cut and fill slopes to minimize slope erosion.

Slope adjustments or other precautions may be necessary if seepage zones or soft spots are encountered in localized areas.
Foundations

For the proposed light, 2-story structures, slab-on-ground foundations may be used for those lots that are away from sloping ground.

Next to or along the top of sloping ground, structures should be designed as a raft that will float as a unit on post-and-beam foundations that can be re-leveled should settlements occur.

The surface of side slopes tends to creep. To minimize the effects of surface creep, the foot blocks should be supported on short piles 6 to 8 ft long. The foot blocks should be tied together up and down the slope. (See Figure 1.)

The units should be made as small as practicable with floating foundations.

Odd shapes and split levels should be minimized or designed to float as a unit.

The use of masonry walls should be used with care and designed to tolerate surface creep of the ground.

Other general recommendations for foundation design, particularly for buildings away from sloping areas, are as follows:

1. Footings may be placed on existing stiff ground or on well-compacted fill.
2. Soft pockets and pockets of loose material encountered at the bottom of footing excavations should be removed and backfilled with select material.

3. The bottom of footing excavations should be recompacted before pouring of concrete.

4. Bearing values of about 1,500 p.s.f. are recommended.

5. To minimize effects of differential settlements, deep grade beams are recommended, particularly around the perimeter of the building.

6. Because of downhill creep effect of soils on the slope, structural footings should generally be placed about 15 ft from the tops of the slopes.

7. Construction of retaining walls along the tops of the slopes should be avoided.

8. Good surface drainage away from the foundations of the proposed structure should be maintained and the site should be graded at all times to prevent the ponding of water.
Concrete Slabs on Ground

For concrete slabs on ground, a base course of 4 in. of well-graded gravel less than 3/4-in. and greater than 1/4-in. in size is recommended.

The subgrade should be compacted and shaped to drain. The elevation of the subgrade should be kept higher than the surrounding ground outside the building whenever practicable.

Underground Utilities

Underground utilities should be placed after the fills are constructed.

The bottoms of utility trenches should be daylighted and graded to shed water. The backfill and drainage of these utility trenches should be carefully designed.

Flexible connections should be used.

Roadway

In general, a rough estimate of the roadway pavement thickness for the light automobile traffic anticipated is as follows:

2. Base course - 6-in. base course over a prepared subgrade.
Provisions should be made in the contract documents to allow for local adjustments regarding subbase requirements in the field in accordance with the design standards of the City and County of Honolulu. In fill areas, the use of select soils within the top 2 to 3 ft of the subgrade may reduce the thickness of or eliminate the need for the subbase course.

The subgrade should be compacted and shaped to drain. To avoid the ponding of water and softening of the subgrade at low points, weep holes should be placed at subgrade levels thru the walls of the catch basins which are placed in these low areas.

Unforeseen Conditions
Unforeseen or undetected conditions such as soft spots, seepage water, expansive soil pockets or creep zones may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.
PROPOSED SPECIFICATION FOR EARTHWORK

ATEA LANI ESTATES

General Description

This item shall consist of clearing and grubbing, preparing of land to be filled, excavating and filling of the land, spreading, compacting and testing of the fill, and subsidiary work necessary for grading the site.

Clearing, Grubbing and Preparing Areas to be Filled

Vegetation, rubbish and miscellaneous material shall be removed and disposed of, leaving the disturbed area with a neat, debris-free appearance.

Topsoil and stockpiled soils shall be (1) stripped to stiff natural ground or (2) scarified and recompressed before the placement of fills. Loose surface soils encountered at finish grade shall be scarified and recompressed.

Hard surfaces shall be scarified down to stiff soils and recompressed to match the density of the surrounding soil.

The bottom and sides of gullies or natural drainageways shall be stripped down to stiff natural ground before the placement of fills.

Trenches shall be cut in a herringbone pattern and subdrains shall be placed in the trenches to provide drainage paths for the bottom of the drainageway.
Materials

Fill material shall consist of selected on-site soils or approved borrow soils. The soils shall contain no more than a trace of organic and deleterious matter.

Borrow soils shall be select soils generally less than 3-in. maximum size, with more than 30% fines and a plasticity index generally less than 20.

Fill material placed in the top 2 ft of fills shall contain less than 30% gravel.

Placing, Spreading and Compacting Fill Material

The selected fill material shall be placed in level layers which, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and thoroughly blade-mixed during the spreading to insure uniformity of material and water content within each layer.

Rocks or cobbles shall not be allowed to nest, and voids between rocks shall be carefully filled and compacted with small stones or earth.

When the water content of the fill material is well below the optimum for compacting purposes, water shall be added until the water content assures a thorough bonding during the compacting process.

When the water content of the material is well above the optimum for compacting purposes, the fill material shall be aerated by blading or by other satisfactory methods until the water content is near the optimum.
After each layer has been placed, mixed and spread evenly, it shall be compacted to 90% of maximum density in accordance with AASHO Test No. T-180-57 or other comparable density tests. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers which shall be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is at the specified water content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to obtain the desired density.

Field density tests shall be made to get an indication of the compaction of the fill. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density readings shall be taken as often as necessary in the compacted material below the disturbed surface. When these readings indicate that the density of any layer of fill or portion thereof is below the required 90% density, that layer or portion shall be reworked until the required density has been obtained.

The fill operation shall be continued in 6-in. compacted layers, as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

Excavation

Suitable material from the excavation shall be used in the fill and unsuitable material from the excavation shall be disposed of.
Unforeseen Conditions

If unforeseen or undetected critical soil conditions such as soft spots, seepage water, creep zones or expansive soil pockets are encountered, corrective measures shall be made in the field as they are detected.

Rainy Weather

Fill material shall not be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests indicate that the water content and density are as previously specified.
BORING LOGS

The stratification lines shown on each of the boring logs represent the approximate boundary between soil types and the transition may be gradual.

Symbols

Symbols used generally are in accordance with the Unified Soil Classification System.

Where a parenthesis "(MH)" is used, the soil sample was classified by visual observation of the sample recovered.

Where no parenthesis "MH" is used, the soil sample was classified from either the Atterberg limit or sieve analysis test results.
# Boring Log

**PROJECT:** AIEA LANI ESTATES  
**LOCATION:** Aiea Heights, Ewa, Oahu, Hawaii  
**Tax Map Key:** 9-9-07: 1  

---

**HAMMER:**  
- **Weight:** 140#  
- **Drop:** 30"  
- **SAMPLER:** 2" 5/8: 2" STANDARD SPLIT SPOON  

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**LOCATION**  
Aiea Heights, Ewa, Oahu, Hawaii

**Datum**  
---

**ELEVATION:** 801 ± 2'  

**DESCRIPTION**  

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**END OF BORING @ 11'**  

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**ELEVATION:** ESTIMATED FROM GRADING PLAN PANGED FEB. 4, 1972
## Boring Log

**PROJECT:** AIEA LANI ESTATES  
**LOCATION:** Aiea Heights, Ewa, Oahu, Hawaii  
**Tax Map Key:** 9-9-07: 1

| HAMMER: |  
| --- | ---  
| Weight | 140#  
| Drop | 30"  
| SAMPLER: | 2" S-2" O.D. THIN WALL TUBE  
| | 2" SS-2" STANDARD SPLIT SPOON  

### Soil Classification

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**ELEVATION ESTIMATED FROM GRADING PLAN DATED FEB. 4, 1972**
Boring Log

PROJECT: AIEA LANI ESTATES

LOCATION: Aiea Heights, Ewa, Oahu, Hawaii

Tax Map Key: 9-9-07:1

HAMMER:
- Weight: 140#
- Drop: 30"

SAMPLER:
- 2" S. 2" O.D. THIN WALL TUBE
- 2" SS. 2" STANDARD SPLIT SPOON

ELEV.: 818' 1/2

Penetration Data

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<tr>
<td>(MH)</td>
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<td>Clayey silt w/ decomposed rock &amp; roots</td>
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<td>4-A</td>
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**ELEVATION ESTIMATED FROM GRADING PLAN DATED FEB. 4, 1972**

**Boring Log**

**PROJECT** AIEA LANI ESTATES

**LOCATION** Aiea Heights, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-9-07: 1

**HAMMER:**
- Weight: 140*
- Drop: 20"

**SAMPLER:**
- 2" 1/2" O.D. Thin Wall Tube
- 2" 1/4" Standard Split Spoon

**BORING NO. 4**
- Sheet No. 1 of 4
- Driller W. Lum Ass., Inc.
- Date: April 26, 1972
- Field Party: Glory Rapovich
- Type of Boring: Auger (Acker)
- Diam.: 3"" (Acker)
- Elev.: 808 1/2
- Datum: 1/2
- Drill Bit: Clay
- Water Level: N.E.T. Noticed
- Time: —
- Date: 4-26-72

**Penetration Data**

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**Notes:**

- Elevation estimated from grading plan dated Feb. 4, 1972.
## Boring Log

**PROJECT**  AIEA LANI ESTATES  

**LOCATION**  Aiea Heights, Ewa, Oahu, Hawaii  

**Tax Map Key:**  9-9-07:1  

**HAMMER:**  
- **Weight:** 140#  
- **Drop:** 20"  

**SAMPLER:**  
- **2" S.S. 2" STANDARD SPLIT SPOON**  

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### Soil Classification

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*ELEVATION ESTIMATED FROM GRADING PLAN DATED FEB. 4, 1972*
**Boring Log**

**PROJECT**  AIEA LANI ESTATES  
**LOCATION**  Aiea Heights, Ewa, Oahu, Hawaii  
**Tax Map Key:**  9-9-07:1

**HAMMER:**  
- **Weight:** 140#  
- **Drop:** 90"  
- **2" S. - 2" O.D. THIN WALL TUBE**  
- **2" SS. 2" STANDARD SPLIT SPOON**

**SAMPLER:**

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<td>(MH)</td>
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<td>STIFF, REDDISH BROWN CLAYET SILT</td>
<td>2.5</td>
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**ELEVATION ESTIMATED FROM GRADING PLAN DATED PEB. 4, 1972**

*Standard Penetration Test*
**Boring Log**

**PROJECT** AIEA LANI ESTATES  
**LOCATION** Aiea Heights, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-9-07: 1

| HAMMER: |  
| --- | --- |
| **Weight** | 140° |
| **Drop** | 30° |

**SAMPLER:**  
2" 5. 2" O.D. THIN WALL TUBE  
2" 65: 2" STANDARD SPLIT SPOON

| PENETRATION DATA |  
| --- | --- |
| **Location** |  
| **Classification** | **Description** | **Depth (ft)** | **Sample No.** | **WC P.C.F.** | **WC Content** | **Dense P.C.F.** | **Granular Comp.** | **Vane Shear** | **P.S.F.** | **Penetration Test** |

- **ELEV. = 804' + 2 4**
  - **Stiff, Dark reddish brown clayey silt w/ roots**  
  - **MH**
  - **Stiff, red**  
  - **Clayey silt**  
  - **MH**
  - **Stiff, reddish brown clayey silt w/ gray clay streaks**  
  - **MH**
  - **End of boring 8.10.5'**

**ELEVATION ESTIMATED FROM GRADING PLAN DATED FEB. 4, 1972**
WALTER LUM ASSOCIATES, INC.

Boring Log

PROJECT: AIEA LANI ESTATES
LOCATION: Aiea Heights, Ewa, Oahu, Hawaii
Tax Map Key: 9-9-07: 1

BOILING NO. 8 Sheet No. of
BOILING NO. 8 Sheet No. of
Driller W. LUM ASSOC., INC. Date APR. 21, 1972
Field Party GLORY RADOVICH
Type of Boring AUGER (ACKER
Diam. 3"
Elev. 81' 1" Datum
Drill Bit CLAY

HAMMER:
Weight 140 #
Drop 30"

SAMPLER:
2" 5-2" O.D. THIN WALL TUBE
2" 55-2" STANDARD SPLIT SPOON

LOCATION: Aiea Heights, Ewa, Oahu, Hawaii
Field Party: GLORY RADOVICH
Type of Boring: AUGER (ACKER)
Diam.: 3"

Elev. 81' 1" Datum:

DRILL BIT:
CLAY

WATER LEVEL:
NOT NOTED

TIME:

DATE: 4-21-72

SAMPLER:
2" O.D. THIN WALL TUBE

PENETRATION DATA
Standard Penetration Test:
2" O.D. THIN WALL TUBE SAMPLER
N (Blows per foot)
Standard Penetration Test:
2" O.D. THIN WALL TUBE SAMPLER
N (Blows per foot)

ELEVATION ESTIMATED FROM GRADING PLAN.
DATED: FEB. 4, 1972
Boring Log

PROJECT: AIEA LANI ESTATES
LOCATION: Aiea Heights, Ewa, Oahu, Hawaii
Tax Map Key: 9-9-07: 1

HAMMER: 140 lbs
Weight: 30 lbs
Drop: 2" S. 2" O.D. THIN WALL TUBE
SAMPLER: 2" S. 2" STANDARD SPLIT SPOON

Driller: GLORY, RADOVICH
Drill Bit: CLAY

<table>
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<tr>
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<th>Description</th>
<th>ELEV. = 825' ± 2'</th>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Wet Dens.</th>
<th>P.C.F.</th>
<th>Water Cont.</th>
<th>Penetration Test</th>
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<tr>
<td>(MH)</td>
<td>STIFF, DARK REDDISH BROWN CLAYEY SILT W/ROOTS</td>
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* ELEVATION ESTIMATED FROM GrADING PLAN
DATED: FEB. 4, 1972
**Boring Log**

**PROJECT**
AIEA LANI ESTATES

**LOCATION**
Aiea Heights, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-9-07: 1

**HAMMER:**
Weight: 140 lb
Drop: 30"

**SAMPLER:**
2" S. 2" D.O.T. THIN WALL TUBE
2" S & 2" STANDARD SPLIT SPOON

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<th>Description</th>
<th>Depth (ft)</th>
<th>Sample</th>
<th>Sample No.</th>
<th>Wet D.</th>
<th>Wet Cont.</th>
<th>Dry D.</th>
<th>P.C.F.</th>
<th>Void S.</th>
<th>V.S.</th>
<th>N (Blows per foot)</th>
<th>S.E.C.</th>
<th>Standard Penetration Test</th>
<th>Penetration Data</th>
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**ELEVATION ESTIMATED FROM GRADING PLAN**
**DATER: FEB. 4, 1972**
Boring Log

PROJECT: AIEA LANI ESTATES
LOCATION: Aiea Heights, Ewa, Oahu, Hawaii
Tax Map Key: 9-9-07: 1

HAMMER:
Weight: 140 lbs
Drop: 30

SAMPER:
2" 6' 2" O.D. THIN WALL TUBE
2" 5'S 2" STANDARD SPLIT SPOON

BORING NO. 11
Driller: W. LUM ASSOCIATES, INC.
Date: APR. 26, 1972

Field Party: MAKALUA, KAKU
Type of Boring: AUGER (MOBILE), DIAM. 3"

Elev.:
Datum:
Date: 4-26-72

Water Level:
NOTED
Time:

PENETRATION DATA

Penetration Test
2" O.D. THIN WALL TUBE
Sample
SAMPLER

ELEV. = B 70' 2" 2' 4"

STIFF, BROWN
CLAYEY SILT W/ROOTS

STIFF, MOTTLED RED
TAN 1 GRAY
CLAYEY SILT

MEDIUM, MOTTLED BROWN
CLAYEY SILT W/ DECOMPOSED ROCK

MEDIUM, RED & DARK GRAY
CLAYEY SILT

END OF BORING 11.5

UNITED SOIL CLASSIFICATION
DESCRIPTION

Sample
Sample No.
West. Dist.
P.C.F.
Water Cont.
Dry Dist.
P.C.F.
Unusual Comp.
Vane Shear Test

0
10
20
30
40

N (Blows per foot)

Blows / 0.5'

4/5 - 4/5'

4/5 - 4/5'

4/5 - 4/5'

4/5 - 4/5'

ELEVATION ESTIMATED
FROM GRADING PLAN
DATED FEB. 4, 1972
Boring Log

PROJECT: AIEA LANI ESTATES
LOCATION: Aiea Heights, Ewa, Oahu, Hawaii
Tax Map Key: 9-9-07: 1

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER:
2" 5: 2" O.D. THIN WALL TUBE
2" 55: 2" STANDARD SPLIT SPOON

BORING NO. 12  Sheet No. of
Driller: W. LUM ASSOC. INC Date: APR. 25, 1972
Field Party: MAKAULA, KAKU
Type of Boring: AUGER (MOBILE)
Elev. 821' 4"
Datum
Date: 4-25-72

Penetration Data

United Soil Classification

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<td>12 BLOWS/5'</td>
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ELEVATION ESTIMATED FROM GRADING PLAN
DATED FEB. 4, 1972
### Boring Log

**PROJECT**  
AIEA LANI ESTATES

**LOCATION**  
Aiea Heights, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-9-07: 1

**HAMMER:**
- **Weight:** 140 lbs
- **Drop:** 30 ft

**SAMPLER:**
- **2" S. 2" O.D. THIN WALL TUBE**
- **2" SS. 2" STANDARD SPLIT SPOON**

---

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<th>Depth (ft)</th>
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<td>2.5</td>
<td>13-A</td>
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<td>10</td>
<td>13-C</td>
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<td>15</td>
<td>13-D</td>
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*ELEVATION ESTIMATED FROM GRADING PLAN DATED FEB. 4, 1972*
**Boring Log**

**PROJECT** AIEA LANI ESTATES  
**LOCATION** Aiea Heights, Ewa, Oahu, Hawaii  
**Tax Map Key:** 9-9-07:1  

**HAMMER:**  
- **Weight:** 140#  
- **Drop:** 30"  

**SAMPLER:**  
- **2" S. 2" D. THIN WALL TUBE**  
- **2" S. 2" STANDARD SPLIT SPOON**

<table>
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<tr>
<th>Depth (Ft.)</th>
<th>Sample No.</th>
<th>Water P.C.F.</th>
<th>Water Cont. %</th>
<th>Dry Den. P.C.F.</th>
<th>Unconf. Comp. P.C.F.</th>
<th>Vane Shear</th>
<th>N (Blows per foot)</th>
<th>PENETRATION DATA</th>
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<td>8.5 - 10.5</td>
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<td>12 - 13.5</td>
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<td>8950</td>
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<td>40 BLOWS/0.5'</td>
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<td>58</td>
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**ELEVATION ESTIMATED FROM GRADING PLAN DATED FEB 4, 1972**
### Boring Log

**PROJECT**  
AIEA LANI ESTATES

**LOCATION**  
Aiea Heights, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-9-07: 1

**HAMMER:**
- Weight: 140 lbs
- Drop: 30"

**SAMPLER:**
- 2" x 2" O.D. THIN WALL TUBE
- 2" 66.7" STANDARD SPLIT SPOON

### PENETRATION DATA

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<th>DESCRIPTION</th>
<th>ELEV.</th>
<th>SAMPLE no.</th>
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**ELEVATION ESTIMATED FROM GRADING PLAN DATED FEB. 4, 1972**
**Boring Log**

**PROJECT**  AIEA LANI ESTATES

**LOCATION**  Aiea Heights, Ewa, Oahu, Hawaii

**Tax Map Key:**  9-9-07: 1

**WALTER LUM ASSOCIATES, INC.**

2039 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-9791

**BORING NO.**  1G  
** Sheet No.**  of  

**Driller**  W. LUM ASSOC., INC.  
**Date**  APR. 21, 1972

**Field Party:**  GLORY, RADOVICH  
**Type of Boring:**  AUGER (ACKER)  
**Diam.**  3"  

**Elev.**  148'  
**Datum**  

**Drill Bit:**  CLAY

**LOCATION:**  AIEA LANI ESTATES

**Tax Map Key:**  9-9-07: 1

**Tax Map Key:**  9-9-07: 1

**Type or Boring Method:**  2" O.D. THIN WALL TUBE

**Date:**  4-21-72

---

### PENETRATION DATA

<table>
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<tr>
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<td>8200</td>
<td>0.5</td>
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**ELEVATION ESTIMATED FROM GRADE PLANS**

**DATED:**  FEB. 4, 1972
**Boring Log**

**PROJECT**: AIEA LANI ESTATES  
**LOCATION**: Aiea Heights, Ewa, Oahu, Hawaii  
**Tax Map Key**: 9-9-07: 1

---

**HAMMER:**
- **Weight**: 140 #
- **Drop**: 30"

**SAMPLER:**
- **2" S-2" OR THIN WALL TUBE**  
- **2" SS-2" STANDARD SPLIT SPOON**

---

**LOCATION:**
- **Elevation**: 784' + 2"  
- **Driller**: H. LUM ASSOC., INC.
- **Date of Drilling**: APR. 18, 1972
- **Field Party**: GLORY, RADOVICH, TSUKAZAKI
- **Type of Boring**: AUGER (MOBILE)
- **Drill Bit**: CLAY
- **Elev.**: 784' + 2"

---

**PENETRATION DATA**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Standard Penetration Test (N/ft)</th>
<th>2&quot; O.D. Thin Wall Tube Sampler</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>G.5'</td>
<td>10</td>
<td>12.5'</td>
</tr>
<tr>
<td>15</td>
<td>G.5'</td>
<td>15</td>
<td>17.5'</td>
</tr>
</tbody>
</table>

---

**SOIL DESCRIPTION**

- **MH**: Stiff, reddish brown clayey silt  
- **MH**: Stiff, mottled red & gray clayey silt  
- **MH**: Stiff, mottled gray & red clayey silt  
- **END OF BORING & 0 G.5'**

---

**ELEVATION**: Estimated from grading plan.  
**Dated**: Feb. 4, 1972
**Boring Log**

- **PROJECT:** AIEA LANI ESTATES
- **LOCATION:** Aiea Heights, Ewa, Oahu, Hawaii
  - Tax Map Key: 9-9-07: 1
- **HAMMER:**
  - Weight: 140 lb
  - Drop: 30"  
- **SAMPLER:**
  - 2" x 2" O.D. THIN WALL TUBE
  - 2" x 2" STANDARD SPLIT SPOON

<table>
<thead>
<tr>
<th>Unified Soil Classification</th>
<th>Description</th>
<th>ELEV. = 783' + 2'</th>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Water Cont.</th>
<th>Dr. Cont.</th>
<th>Uncert. Comp.</th>
<th>Vane Shear</th>
<th>Penetration Test</th>
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</thead>
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<tr>
<td>(MH)</td>
<td>SOFT, REDDISH BROWN CLAY/SILT W/ROOTS</td>
<td>0</td>
<td>2.5</td>
<td>I-B-A</td>
<td>111</td>
<td>4.9</td>
<td>4.7</td>
<td>1850</td>
<td>-</td>
<td>3/5' 6/5'</td>
</tr>
<tr>
<td>(MH)</td>
<td>STIFF, REDDISH BROWN CLAY/SILT W/ROOTS</td>
<td>5</td>
<td>2.5</td>
<td>I-B-B</td>
<td>52</td>
<td>4.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(MH)</td>
<td>STIFF, MOTLED RED CLAY/SILT</td>
<td>5</td>
<td>2.5</td>
<td>I-B-C</td>
<td>52</td>
<td>-</td>
<td>73</td>
<td>4270</td>
<td>-</td>
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<tr>
<td>(MH)</td>
<td>STIFF, MOTLED RED X GRAY CLAY/SILT</td>
<td>10</td>
<td>2.5</td>
<td>I-B-D</td>
<td>111</td>
<td>5.2</td>
<td>79</td>
<td>4270</td>
<td>-</td>
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- **ELEVATION ESTIMATED FROM GRADING PLAN DATED FEB. 4, 1972**
**PROJECT**
AIEA LANI ESTATES

**LOCATION**
Aiea Heights, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-9-07:1

---

**BOURING NO.** 19

**DATE:** 4-28-72

---

**HARMER:**

- Weight: 10 lb. SLEDGE HAMMER
- Drop: 

---

**SAMPLER:** 2" O.D. THIN WALL TUBE

---

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</thead>
<tbody>
<tr>
<td>(MH)</td>
<td>Stiff reddish brown clayey silt</td>
<td>19.0</td>
<td>19:A</td>
<td>19</td>
<td>0.42</td>
<td>10.4</td>
<td>119.48</td>
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<tr>
<td>(MH)</td>
<td>Stiff mottled brown clayey silt w/ decomposed rock</td>
<td>19.5</td>
<td>19:B</td>
<td>114</td>
<td>0.37</td>
<td>83</td>
<td></td>
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<tr>
<td>(MH)</td>
<td>Gray &amp; reddish brown decomposed rock (some crushes to clayey silt)</td>
<td>20.0</td>
<td>19:C</td>
<td>119</td>
<td>0.35</td>
<td>88.45</td>
<td>918.48</td>
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<tr>
<td>(MH)</td>
<td>Stiff red &amp; purple clayey silt</td>
<td>25.0</td>
<td>19:D</td>
<td>103</td>
<td>0.40</td>
<td>82</td>
<td>933.00</td>
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</tr>
</tbody>
</table>

---

**ELEVATION:**

- 804.7' + 0.0

---

**PENETRATION DATA**

- 10 lb. SLEDGE HAMMER
- 19.0 ft. BORING
- 19.5 ft. BORING
- 20.0 ft. BORING
- 25.0 ft. BORING

---

**ELEVATION ESTIMATED FROM GRADING PLAN DATED FEB. 4, 1972**
### Boring Log

**Project:** Aiea Lani Estates  
**Location:** Aiea Heights, Ewa, Oahu, Hawaii  
**Tax Map Key:** 9-9-07: 1

**Hammer:**  
**Weight:**  
**Drop:**

**Sampler:**

<table>
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<tr>
<th>Sample No.</th>
<th>Weight</th>
<th>Weight Gain</th>
<th>Drop</th>
<th>Type of Borin</th>
<th>Datum</th>
<th>Water Level</th>
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<tr>
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<tr>
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<td>3</td>
<td></td>
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</tbody>
</table>

### Penetration Data

<table>
<thead>
<tr>
<th>Sample</th>
<th>Total Penetration (ft)</th>
<th>Standard Penetration Test</th>
<th>N ( blows per foot )</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

**Description:**  
- BROWN, CLAYET, SILT  
- REDDISH BROWN, CLAYET, SILT  
- TAN DECOMPOSED ROCK, CLAYET, SILT  
- BLUE GRAY, DECOMPOSED ROCK, CLAYET, SILT  
- GRAY WHITE, DECOMPOSED ROCK, CLAYET, SILT  
- CORDES OR BOULBERS  
- R.M. ROAD  
- BOTTOM OF SLOPE 84°15'
<table>
<thead>
<tr>
<th>Depth (Ft)</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Unconfined Compressibility P.S.F.</th>
<th>Unconfined Compressibility P.S.F.</th>
<th>Penetration Data</th>
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</thead>
<tbody>
<tr>
<td>2.5</td>
<td>10%</td>
<td>15%</td>
<td>1220</td>
<td></td>
<td>4/10 5/15</td>
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<tr>
<td>2.55</td>
<td>20-A</td>
<td>40%</td>
<td>49</td>
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</tr>
<tr>
<td>2.55</td>
<td>20-B</td>
<td>55%</td>
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</tr>
<tr>
<td>2.55</td>
<td>20-C</td>
<td>60%</td>
<td>6610</td>
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<td>5/15 5/15</td>
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<td>2.55</td>
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* ELEVATION ESTIMATED FROM GRADING PLAN DATED FEB. 4, 1972
TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SURFACE 10'-11'</td>
<td>BROWN MOTTLED CLAY Silt GRAY &amp; RED CLAY Silt W/ROOTS CLAY Silt WITRACES OF DECOMP. ROCK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GRAIN-SIZE ANALYSIS (% Passing)</th>
<th>1</th>
<th>1</th>
<th>2</th>
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</thead>
<tbody>
<tr>
<td>Sieve 1&quot;</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#10</td>
<td>100</td>
<td></td>
<td></td>
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<tr>
<td>#20</td>
<td>100</td>
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<tr>
<td>#40</td>
<td>99.9</td>
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<tr>
<td>#200</td>
<td>99.7</td>
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<table>
<thead>
<tr>
<th>ATTERBEG LIMITS</th>
<th>NATURAL</th>
<th>NATURAL</th>
<th>NATURAL</th>
<th>NATURAL</th>
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</thead>
<tbody>
<tr>
<td>Air Dried or Natural Liquid Limit</td>
<td>64</td>
<td>102</td>
<td>121</td>
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<tr>
<td>Plastic Limit</td>
<td>30</td>
<td>53</td>
<td>56</td>
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<td>Plasticity Index</td>
<td>30</td>
<td>49</td>
<td>35</td>
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<thead>
<tr>
<th>UNIFIED SOIL CLASSIFICATION</th>
<th>MH</th>
<th>MH</th>
<th>MH</th>
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| APPARENT SPECIFIC GRAVITY | 8.14 |     |     |

<table>
<thead>
<tr>
<th>EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)</th>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Molding Moisture, %</td>
<td>81.9</td>
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</tr>
<tr>
<td>Molding Dry Density, P.C.F.</td>
<td>73.0</td>
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<tr>
<td>Swell upon saturation, %</td>
<td>0.7</td>
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<td></td>
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<tr>
<td>CBR at 0.1&quot; Penetration</td>
<td>7.3</td>
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<table>
<thead>
<tr>
<th>MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-57 Method)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry to Wet or Wet to Dry</td>
<td>WET TO DRY</td>
<td></td>
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<tr>
<td>Max. Dry Density (P.C.F.)</td>
<td>91.0</td>
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<td>Optimum Moisture (%)</td>
<td>32.5</td>
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| REMARKS: |     |     |     |

Date 5-8-72 By R.T.
## TABLE I.B - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>4</td>
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<td>SURFACE</td>
<td>BORING</td>
</tr>
<tr>
<td></td>
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<td>5'-6.5'</td>
<td>BROWN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BROWN</td>
<td>CLAYEN SILT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W/ROOTS</td>
<td>W/ROOTS</td>
</tr>
<tr>
<td></td>
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<td>DECOMP. ROCK</td>
<td>W/ROOTS</td>
</tr>
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<td></td>
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<td>10'-10.5'</td>
<td>REDISH</td>
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<td>BROWN</td>
<td>CLAYEN SILT</td>
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<td></td>
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<td>CLAYEN SILT</td>
<td>W/ROOTS</td>
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<td>W/ROOTS</td>
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<td></td>
<td></td>
<td>DECOMP. ROCK</td>
<td>W/ROOTS</td>
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### GRAIN-SIZE ANALYSIS (% Passing)

<table>
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<th>Sieve</th>
<th>1&quot;</th>
<th>1/2&quot;</th>
<th>#4</th>
<th>#10</th>
<th>#20</th>
<th>#40</th>
<th>#100</th>
<th>#200</th>
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</tr>
</tbody>
</table>

### ATTERBERG LIMITS

- **Air Dried or Natural Liquid Limit:**
  - Natural: 69
  - Natural: 69
  - Natural: 69

- **Plastic Limit:**
  - Natural: 48
  - Natural: 49
  - Natural: 51

- **Plasticity Index:**
  - Natural: 21
  - Natural: 14
  - Natural: 27

- **Dilatancy:**
  - Quick: Slight-Med.
  - Quick: Slight-Med.

- **Toughness:**
  - Slight-Med.
  - Slight-Med.
  - Slight-Med.

- **Dry Strength:**
  - Slight-Med.
  - Slight-Med.
  - Slight-Med.

### UNIFIED SOIL CLASSIFICATION

- MH
- MH
- MH

### APPARENT SPECIFIC GRAVITY

- **Expansion and CBR Tests**
  - **(Surcharge-51 P.S.F.)**
    - Molding Moisture, %: 40.3
    - Molding Dry Density, P.C.F.: 81.7
    - Swell upon saturation, %: 0.3
    - CBR at 0.1" Penetration: 11.0

### MOISTURE-DENSITY RELATIONS OF SOILS

- **(AASHO T-180-57 Method)**

### REMARKS:

**WALTER LUM ASSOCIATES, INC.**

**CIVIL, STRUCTURAL, SOILS ENGINEERS**

Date 5-8-70  By BT
## Table I.C - Summary of Laboratory Test Results

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Sample No.</th>
<th>Depth Below Surface</th>
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<tr>
<td></td>
<td></td>
<td>Surface (5'-6.5')</td>
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<tr>
<td></td>
<td></td>
<td>Reddish Brown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mottled Brown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clayey Silt w/gray</td>
</tr>
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<td></td>
<td></td>
<td>Clayey Silt</td>
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<td>Clayey Silt</td>
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<td>Clayey Silt</td>
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</table>

### Grain-Size Analysis (% Passing)

<table>
<thead>
<tr>
<th>Sieve</th>
<th>14</th>
<th>14</th>
<th>15</th>
<th>16</th>
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<tbody>
<tr>
<td>1&quot;</td>
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<tr>
<td>1/2&quot;</td>
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<td>#4</td>
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### Atterberg Limits

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<th>Natural</th>
<th>Natural</th>
<th>Natural</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Dried or Natural</td>
<td>55</td>
<td>64</td>
<td>96</td>
<td>60</td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>46</td>
<td>53</td>
<td>45</td>
<td>53</td>
</tr>
<tr>
<td>Plastic Limit</td>
<td>9</td>
<td>31</td>
<td>51</td>
<td>22</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>QUICK</td>
<td>MED. QUICK</td>
<td>MEDIUM</td>
<td>MED. QUICK</td>
</tr>
</tbody>
</table>

### Unified Soil Classification

- Atterberg Limits: Natural, Natural, Natural, Natural
- Air Dried or Natural: 55, 64, 96, 60
- Liquid Limit: 46, 53, 45, 53
- Plastic Limit: 9, 31, 51, 22
- Plasticity Index: QUICK, MED. QUICK, MEDIUM, MED. QUICK

### Apparent Specific Gravity

- MH

### Expansion and CBR Tests

<table>
<thead>
<tr>
<th>Surcharge-51 P.S.F.</th>
<th>Molding Moisture, %</th>
<th>Molding Dry Density, P.C.F.</th>
<th>Swell upon Saturation, %</th>
<th>CBR at 0.1&quot; Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>34.1</td>
<td>24.3</td>
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<td>26.3</td>
</tr>
</tbody>
</table>

### Moisture-Density Relations of Soils

- AASHO T-180-57 Method
- Dry to Wet or Wet to Dry
- Max. Dry Density (P.C.F.)
- Optimum Moisture (%)

### Remarks:

Date: 5-8-74  By: [Signature]
## TABLE I.D - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>B (TOP)</td>
<td>5'-6.5'</td>
<td>REDDISH</td>
</tr>
<tr>
<td>18</td>
<td>SURFACE</td>
<td></td>
<td>BROWN</td>
</tr>
<tr>
<td>19</td>
<td>SURFACE</td>
<td></td>
<td>CLAYEY SILT</td>
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</tbody>
</table>

### GRAIN-SIZE ANALYSIS

<table>
<thead>
<tr>
<th>Sieve</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td></td>
</tr>
<tr>
<td>#10</td>
<td></td>
</tr>
<tr>
<td>#20</td>
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<td>#40</td>
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</tr>
<tr>
<td>#100</td>
<td></td>
</tr>
<tr>
<td>#200</td>
<td></td>
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</table>

### ATTERBERG LIMITS

<table>
<thead>
<tr>
<th>Property</th>
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<th>18</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Dried or Natural Liquid Limit</td>
<td>90</td>
<td>76</td>
<td>70</td>
</tr>
<tr>
<td>Plastic Limit</td>
<td>31</td>
<td>29</td>
<td>21</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dilatancy</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>Toughness</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>Dry Strength</td>
<td>SLIGHT-MED</td>
<td>SLIGHT-MED</td>
<td>SLIGHT-MED</td>
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</table>

### UNIFIED SOIL CLASSIFICATION

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>MH</th>
<th>MH</th>
<th>MH</th>
</tr>
</thead>
</table>

### APPARENT SPECIFIC GRAVITY

<table>
<thead>
<tr>
<th>Expansion and CBR Tests</th>
<th>Surcharge-51 P.S.F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molding Moisture, %</td>
<td>40.2</td>
</tr>
<tr>
<td>Molding Dry Density, P.C.F.</td>
<td>81.4</td>
</tr>
<tr>
<td>Swell upon saturation, %</td>
<td>0.7</td>
</tr>
<tr>
<td>CBR at 0.1&quot; Penetration</td>
<td>12.2</td>
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</tbody>
</table>

### MOISTURE-DENSITY RELATIONS OF SOILS

<table>
<thead>
<tr>
<th>AASHO T-180-57 Method</th>
<th>Dry to Wet or Wet to Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max. Dry Density (P.C.F.)</td>
</tr>
</tbody>
</table>

### REMARKS:

Date 5-8-72 By BT
# Table 1.5 - Summary of Laboratory Test Results

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>20</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample No.</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>Depth Below Surface</td>
<td>0.5'-1.5'</td>
<td>10'-11'</td>
</tr>
</tbody>
</table>
| Description | Brown
Clayey Silt | Motilled
Brown,
Red & Gray
Wet Roots
Clayey Silt |

## Grain-Size Analysis

<table>
<thead>
<tr>
<th>Sieve</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td></td>
</tr>
<tr>
<td>#10</td>
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<td></td>
</tr>
<tr>
<td>#100</td>
<td></td>
</tr>
<tr>
<td>#200</td>
<td></td>
</tr>
</tbody>
</table>

## Atterberg Limits

- **Air Dried or Natural**
- **Liquid Limit**
- **Plastic Limit**
- **Plasticity Index**
  - Dilatancy
  - Toughness
  - Dry Strength

<table>
<thead>
<tr>
<th></th>
<th>Natural</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drying</td>
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<td>18</td>
</tr>
<tr>
<td>Plastic</td>
<td>45</td>
<td>52</td>
</tr>
<tr>
<td>Index</td>
<td>24</td>
<td>60</td>
</tr>
<tr>
<td>Dilatancy</td>
<td>Quick</td>
<td>Medium</td>
</tr>
<tr>
<td>Toughness</td>
<td>Slight</td>
<td>Medium</td>
</tr>
<tr>
<td>Dry</td>
<td>Slight-Med</td>
<td>Medium</td>
</tr>
</tbody>
</table>

## Unified Soil Classification

- **Apparent Specific Gravity**: MH

## Expansion and CBR Tests

- **(Surcharge-51 P.S.F.)**
- **Molding Moisture, %**
- **Molding Dry Density, P.C.F.**
- **Swell upon saturation, %**
- **CBR at 0.1" Penetration**

## Moisture-Density Relations of Soils

- **(AASHTO T-180-57 Method)**
- **Dry to Wet or Wet to Dry**
- **Max. Dry Density (P.C.F.)**
- **Optimum Moisture (%)**

## Remarks:

- Date: 5-8-72
- By: DJT

Walter Lum Associates, Inc.
Civil, Structural, Soils Engineers
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: AIEA LANI ESTATES

LOCATION: AIEA HEIGHTS, EWA, OAHU, HAWAII

SAMPLE NO.: 1 SURFACE

SAMPLE DESCRIPTION: BROWN CLAYEY SILT W/ROOTS

AGGREGATE: 1/4" MINUS
MOLD SIZE: 4" X 4.5" HINGED
HAMMER: 10LB, 18" DROP
LAYERS: 5
BLOWS: 28 LAYER

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

DATE 4-24-72 BY SK
CBR TEST

PROJECT: AIEA LANI ESTATES

LOCATION: AIEA HEIGHTS, EWA, OAHU, HAWAII

SAMPLE NO: SURFACE

SAMPLE DESCRIPTION: BROWN CLAYEY SILT W/ROOTS

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.025</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>0.050</td>
<td>482</td>
<td>96</td>
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<tr>
<td>0.075</td>
<td>307</td>
<td>61</td>
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<tr>
<td>0.100</td>
<td>542</td>
<td>108</td>
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<tr>
<td>0.125</td>
<td>1068</td>
<td>213</td>
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<tr>
<td>0.150</td>
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<td>140</td>
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<tr>
<td>0.175</td>
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<td>0.200</td>
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<td>209</td>
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<td>0.250</td>
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<td>41</td>
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<td>0.400</td>
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<td>288</td>
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<tr>
<td>0.450</td>
<td>1524</td>
<td>305</td>
</tr>
<tr>
<td>0.500</td>
<td>1574</td>
<td>315</td>
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</tbody>
</table>

AGGREGATE 3/4" MINUS
HAMMER WEIGHT 10 LBS.
HAMMER DROP 18''
No. OF BLOWS 100
No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, % 21.9
MOLDING DRY DENSITY, P.C.F. 930
CBR @ 0.1" PENETRATION 7.3
DAYS SOAKED 4

DATE 6-21-72  BY  M0
DATE 5-1-72  BY  SK

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
CBR TEST

PROJECT: AIEA LANI ESTATES
LOCATION: AIEA HEIGHTS, EWA, OAHU, HAWAII
SAMPLE NO: 4 SURFACE
SAMPLE DESCRIPTION: BROWN CLAYEY SILT W/ROOTS

TEST RESULTS:
MOLDING MOISTURE, %: 40.3
MOLDING DRY DENSITY, P.C.F.: 81.7
CBR @ 0.1" PENETRATION: 11.0
DAYS SOAKED: 4

DATE 4-29-72 BY F.M.
DATE 5-4-72 BY S.K.

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.025</td>
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<td>23</td>
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<tr>
<td>0.050</td>
<td>160</td>
<td>53</td>
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<tr>
<td>0.075</td>
<td>235</td>
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<tr>
<td>0.125</td>
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<td>0.150</td>
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<td>165</td>
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<td>0.175</td>
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<td>250</td>
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<td>0.350</td>
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<tr>
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<td>1000</td>
<td>333</td>
</tr>
<tr>
<td>0.500</td>
<td>1040</td>
<td>347</td>
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</tbody>
</table>

AGGREGATE 1/4" MISHUS
HAMMER WEIGHT 10LBS
HAMMER DROP 18"
No. OF BLOWS 60 LAYER
No. OF LAYERS 6

WALTER LUM ASSOCIATES, INC.
CIVIL STRUCTURAL SOILS ENGINEERS
CBR TEST

PROJECT: AIEA LANI ESTATES

LOCATION: AIEA HEIGHTS, EWA, OAHU, HAWAII

SAMPLE NO: 14 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT

TEST RESULTS:

MOLDING MOISTURE, %: 3.61
MOLDING DRY DENSITY, P.C.F: 64.3
CBR @ 0.1" PENETRATION: 26.5
PAYS SOAKED: 4

DATE 4.29.72 BY LT

DATE 5.4.72 BY SK

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
CBR TEST

PROJECT: AIEA LANI ESTATES

LOCATION: AIEA HEIGHTS, EWA, OAHU, HAWAII

SAMPLE NO: 18 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT W/ROOTS

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.025</td>
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<tr>
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<td>300</td>
</tr>
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<td>965</td>
<td>321</td>
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<td>1040</td>
<td>347</td>
</tr>
<tr>
<td>0.500</td>
<td>1090</td>
<td>363</td>
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</tbody>
</table>

AGGREGATE 3/4" MINUS
HAMMER WEIGHT 100 LBS
HAMMER DROP 18"
No. OF BLOWS 98 LAYERS
No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %: 40.2
MOLDING DRY DENSITY, P.C.F: 81.4
CBR @ 0.1" PENETRATION: 12.2
DAYS SOAKED: 4

DATE 4-22-72 BY FM
DATE 4-27-72 BY SK

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
CBR TEST

PROJECT: AIEA LANI ESTATES
LOCATION: AIEA HEIGHTS, EWA, OAHU, HAWAII
SAMPLE NO: 19 SURFACE
SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT

TEST RESULTS:

MOLDING MOISTURE, %: 38.0
MOLDING DRY DENSITY, P.C.F.: 83.9
CBR @ 0.1" PENETRATION: 23.0
DAYS SOAKED: 5

DATE 4.20.72 BY W4
DATE 5.2.72 BY SK

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>80</td>
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</tr>
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</tr>
<tr>
<td>0.125</td>
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</tr>
<tr>
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</tr>
<tr>
<td>0.200</td>
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</tr>
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</tr>
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</tr>
<tr>
<td>0.350</td>
<td>1010</td>
<td>337</td>
</tr>
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<td>340</td>
</tr>
<tr>
<td>0.450</td>
<td>1040</td>
<td>345</td>
</tr>
<tr>
<td>0.500</td>
<td>990</td>
<td>330</td>
</tr>
</tbody>
</table>

AGGREGATE 1/4" MINUS
HAMMER WEIGHT 10 LBS
HAMMER DROP 10"
No. OF BLOWS SUBAYER
No. OF LAYERS 5

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
GENERAL TESTING METHODS

EXPLORATORY BORINGS AND SAMPLING

Method for soil investigation and sampling by auger borings (Tentative)  
ASTM Designation: D 1452-63T

Method for thin wall tube sampling of soils (Tentative)  
ASTM Designation: D 1587-63T

Method for penetration test and split barrel sampling of soils (Tentative)  
ASTM Designation: D 1586-64T

LABORATORY TESTING

Grading Analysis

Sieve analysis of fine and coarse aggregates  
AASHO Designation: T 27-60

Amount of material finer than No. 200 sieve in aggregate  
AASHO Designation: T 11-60

Atterberg Limits

Determining the liquid limit of soils Modified as follows: Substitute Casagrande grooving tool. Tests conducted from natural moisture content unless noted otherwise.  
AASHO Designation: T 89-60

Determining the plastic limit of soils  
AASHO Designation: T 90-56

Calculating the plasticity index of soils  
AASHO Designation: T 91-54

Specific Gravity

Specific gravity of soils Modified as follows: 500 ML Pycnometer  
AASHO Designation: T 100-60

Expansion and CBR Tests

Expansion test and California Bearing Ratio (CBR)  
Section VIII - TM 5-530 "Materials Testing" by Headquarters, Dept. of the Army

Compaction Test

Moisture-Density relations of soils using a 10# rammer and an 18" drop  
AASHO Designation: T 180-57

Unified Soil Classification

Designation E-3 from "Earth Manual" by the United States Department of the Interior Bureau of Reclamation
GENERAL TESTING METHODS

Consolidation Test

Laboratory Shear Test

Laboratory shear test using the Torvane

Chapter IX
"Soil Testing for Engineers"
by T. William Lambe
The Massachusetts Institute of Technology

Brochure by Soiltest, Inc.
FIGURE 1
SUGGESTED FOOTINGS
NEXT TO OR ALONG TOP OF BANK
AIEA LANI ESTATES
AIEA HEIGHTS, EWA, OAHU, HAWAII
TMK 9-9-071

WITHIN 10' FROM TOP OF SLOPE
REBAR TIES ASPHALT OR OIL WRAPPING TO MINIMIZE CORROSION.

SECTION
NOT TO SCALE
LIMITATIONS

In general, soil formations are commonly erratic and rarely uniform or regular. The boring logs indicate the approximate subsurface soil conditions encountered only at the drill holes where the borings were made at the times designated on the logs and may not represent conditions at other locations or at other dates. Soil conditions and water levels may change with the passage of time and construction methods or improvements at the site.

During construction, should subsurface conditions much different from those in the borings be observed, encountered, or otherwise indicated, we should be advised immediately to review or reconsider our recommendations in light of the new developments.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes, plan changes, or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the recommendations considering the time lapse and the changed conditions.

Our professional services were performed, findings obtained and recommendations prepared in accordance with generally accepted engineering practices. This warranty is in lieu of all other warranties expressed or implied.