GOLF COURSE SUBDIVISION UNIT NO. 1
PRELIMINARY SOIL REPORT
MAUNALUA, OAHU, HAWAII
TAX MAP KEY: 3-9-11

To:
KAISER-AETNA

WITHDRAWN

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
SEPTEMBER 9, 1970
KAISER-AETNA
P. O. Box 2997
Honolulu, Hawaii  96802

Gentlemen:

Subject:  Golf Course Subdivision Unit No. 1
Preliminary Soil Report
(for site grading design purposes).
Maunalua, Oahu, Hawaii
Tax Map Key:  3-9-11
Chapter 23, Revised Ordinances of
Honolulu, 1961 As Amended

The Resort Division area consists of resort, apartment and residential subdivisions.

In accordance with your request, preliminary soil explorations were made to cover the general area. This report concerns only the preliminary soil explorations at the site for the proposed Golf Course Subdivision Unit No. 1, Maunalua, Oahu, Hawaii.

The borings generally indicated varying soil conditions with tan sandy and clayey silts in the western portion; shallow reddish-brown clayey silts and silty clays underlain by lava rock in the central portion; and gray-brown plastic clay (adobe) underlain by lava rock at the east end.

Much of the site is covered with stockpile material of gray sandy clay with localized pockets of gray clay (dredged materials).

Some grading and filling of the site are contemplated. The earthwork should be done in accordance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended and the recommendations contained herein.

The 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:rmf
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GOLF COURSE SUBDIVISION UNIT NO. 1
PRELIMINARY SOIL REPORT

MAUNALUA, OAHU, HAWAII
TAX MAP KEY: 3-9-11

SCOPE OF EXPLORATION

The Resort Division area consists of resort, apartment and residential subdivisions. This report concerns only the preliminary soil explorations at the site for the proposed Golf Course Subdivision Unit No. 1 at Maunalua, Oahu, Hawaii. The limits of this area are shown on Figure 1. The purpose of this exploration was to determine general soil conditions for site grading and residential building foundation design purposes.

This report includes field exploration, laboratory tests and general recommendations for site grading and light building foundation design.

FIELD EXPLORATION

Twenty-two borings were made at the site. The locations of these borings are shown on Figure 1, Boring Location Plan. Also attached are the logs of 3 borings made for Golf Course Subdivision Unit No. 2.

The borings were made with 3 and 4-in. diameter augers using tungsten carbide bits. Soil samples were recovered with a standard split spoon driven with a 140-lb hammer falling 30 inches.
Soil samples were visually observed and subjected to appropriate tests in the laboratory. Based on visual observations and laboratory tests, the soil descriptions in the boring logs are generally made in accordance with the "Unified Soil Classification System."

LABORATORY TESTS

Laboratory tests for on-site soils included: natural water contents, Atterberg limits, specific gravity, sieve 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 IC.

GENERAL SITE CONDITIONS

The proposed subdivision site is about 1,000 to 2,000 ft north of Kalanianale Highway and extends from the vicinity of Ehuakai Street to the area north of Wawamalu Bridge. The site slopes generally down toward the east at about a 1 to 7% gradient. Wawamalu Stream out of Kalama Valley cuts thru the middle of the site in a north-south direction, while a tributary out of Mauuwai crosses the east end. Several abandoned houses, sheds and pig pens were noted along Ehuakai Street at the west end of the property. Most of the west portion is covered with dense kiawe, brush and tall grass. The central portion of the area has been cleared of kiawe and stockpiled with 4 to 5 ft of gray sandy clay with localized pockets of gray clay (dredged materials). Rock outcrops were noted at the east end of the site.
INTERPRETATION OF SOIL CONDITIONS

From the field explorations, the soils at the site may be described as follows:

West Section
Surface layers of tan or brown sandy and clayey silts with decomposed mudrock generally underlain by reddish-brown silty clay and clayey silt to about 10 to 16 ft, the depths drilled.

Central Section
Surface layers of up to 4 ft of reddish-brown silty clay and clayey silt underlain by lava rock to about 10 to 20 ft, the depths drilled.

East Section
A surface layer of about 6 ft of gray-brown plastic clay (adobe) underlain by lava rock and mudrock to about 10 to 15 ft, the depths drilled.

Water was not noted in the borings during the field explorations.

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

DISCUSSION AND RECOMMENDATIONS

The proposed plan is to remove the stockpiled material and grade the site for subdivision development with fills generally less than about 10 ft in height.
Site Grading

All surface vegetation and miscellaneous debris should be cleared and removed prior to site filling. Localized soft pockets encountered during site preparations should be excavated and backfilled with compacted select material. Provisions to drain the site should be included during and after the completion of filling operations.

Grading work should be done in general conformance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended.

For the construction of fills, the following is recommended:

1. Rubble, loose boulders and unsuitable materials should be removed.

2. The stockpiles of dredged materials should be removed. Loose surface soils should generally be removed or scarified and recompacted before the placement of fills.

3. Old cesspools should be accurately located on the grading plan and backfilled before any grading work is started.
4. Hard surfaces along existing access roads should be scarified down to stiff soils and recompacted to match the density of the surrounding soils.

5. Loose surface soils along the sides and bottom of natural drainageways should be removed where fills are contemplated.

Subdrains should be placed in a herringbone pattern along the bottom of natural drainageways or dips before the placement of fills.

6. Fill material may be approved on-site or borrow soils. If practicable, fill material imported to the site should be select soils with a plasticity index generally less than 20.

7. Fills should be constructed in approximately level layers starting at the lower end and working 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 be continually keyed into the stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

8. Fills should be laid in 6-in. compacted layers with a relative density of at least 90% of AASHO T-180-57 density.

9. If clay (adobe) soils are used for fills, they should be placed preferably below 2 ft of finish grades, well above the ground water level and several feet from the face of fill slopes. See sketch attached, Figure 2. Adobe fill should be kept less than 10 ft in height and preferably less than 8 ft.

10. If boulders are proposed to be used in the construction of fills, they should generally be placed along the toe sections of fill slopes and outside of probable building sites.
Before placing any boulders, the subgrade should be stripped to stiff natural ground and shaped to drain. A layer of granular filter material should be placed on the subgrade and the boulders placed on the filter layer. The void spaces between boulders should be filled with granular material. A blanket of filter material should be placed against the boulders before any earth fills are placed against the boulders. See attached sketch, Figure 3.

Slopes

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

For low cuts thru mixtures of rock and clinkers, slope ratios of 1-1/2 horizontal to 1 vertical or flatter may be used.

For low cuts (less than 5+ ft in height) in rock that is fairly homogeneous, slope ratios of 3/4 horizontal to 1 vertical or flatter may be used.

If slope heights (top to toe) of greater than 15 ft are considered, 8-ft wide benches should be placed at height intervals of about 15 ft in both cuts and fills.

For protection against erosion, the runoff from rainstorms should be diverted by berms or ditches away from slopes whenever practicable.
The surface of fill slopes should be compacted by cat-tracking or with a sheepfoot roller.

In general, slope planting is recommended on cut and fill slopes to minimize erosion.

**Foundations**

Light residential structures may be constructed at the site.

For heavy or long-span or multiple-story structures, foundation explorations should be made at each building site to evaluate the ground conditions before foundations are designed.

The following may be used as a guide for foundation design for light residential structures:

1. Bearing values for a given soil vary with the size and depth of footings. For light, one and 2-story, short-span structures, bearing values of about 2000 p.s.f. may be used.

2. Any portion of a building that is over an old cesspool should be designed to span the cesspool.

3. If soft spots or pockets of loose material are encountered in footing excavations or below a building area, they should be
excavated and replaced with compacted
select on-site or borrow soils.

3. Foundation design adjustments must be made
if adobe soils are encountered or imported.
Care should be taken that there is at least
2 ft of compacted select material below
building footings in adobe areas.

4. Concrete slab on ground should be placed
over a base course of 4 in. of well-graded
gravel less than 3/4 in. and greater than
1/4 in. in size. The subgrade should be
compacted and shaped to a level surface or
to drain, if practicable, and generally
should be kept slightly higher than the
finish grade outside of the building.

5. In general, buildings and structures should
be placed about 15 ft from the tops of slopes.

6. Construction of retaining walls on slopes
should generally be avoided.

7. Good surface drainage away from the foundation
of structures should be maintained and the site
should be graded at all times to prevent ponding
of water.
Roadway

In general, a rough estimate of the roadway pavement thickness for the light residential 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 as ground conditions are exposed at subgrade levels. The subgrade thickness will depend upon the type of material within the top 2 ft of subgrade.

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 through the walls of catch basins which are placed in these low areas.

Utilities

Although the probability of differential settlements in localized areas is slight in this area, utilities should be placed after the fills are constructed. Utility lines should be designed with flexible joints, particularly where lines are connected to structures. Gravity flow lines should be made as steep as practicable.
Unforeseen or undetected conditions may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.
PROPOSED SPECIFICATION FOR EARTHWORK
GOLF COURSE SUBDIVISION UNIT NO. 1

General Description
This item shall consist of clearing and grubbing, removing of existing structures, preparing of land to be filled, excavating and filling of the land, spreading, compacting and testing of the fill, and subsidiary work necessary to complete the grading.

Clearing, Grubbing and Preparing Areas to be Filled
Vegetation, concrete slabs and rubbish shall be removed and disposed of, leaving the disturbed area with a neat, debris-free appearance.

Vegetable matter shall be removed from the surface upon which fill is to be placed. Topsoil and stockpiled soils shall be (1) stripped to stiff natural ground or (2) scarified and recompacted before the placement of fills. Topsoil encountered at finish grade shall be scarified and recompacted.

Hard surfaces along the existing access roads shall be scarified down to stiff soils and recompacted to match the density of the surrounding soil before the placement of fills.

Cesspools shall be flagged in the field and accurately located on the plans and backfilled before any grading work is started. The procedure for backfilling of cesspools follows in the section "Backfilling of Old Cesspools".
Where fills are proposed in sidehill areas and gullies, loose material along the bottom and the sides shall be stripped down to stiff natural ground before the placement of fills. New fills shall be keyed into the stiff natural ground.

Subdrains shall be placed along the bottom and sides of the natural drainageways before the construction of fills. The locations of subdrains should be determined in the field after clearing and grubbing.

Where fills are made on sloping areas steeper than 5 horizontal to 1 vertical, the ground at the toe of the slope shall be benched to a generally level condition. As the fill is brought up, it shall be continually keyed into the stiff natural ground by the cutting of steps into the hillside and compacting the fill into these steps. Ground slopes which are flatter than 5 horizontal to 1 vertical shall be benched when considered necessary by the Soil Engineer.

Materials

Fill materials shall consist of approved on-site or borrow soils. The soils shall contain no more than a trace of organic matter. Fill material imported to the site shall be select soils with a plasticity index less than 20.

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.
No rocks or cobbles shall be allowed to nest and voids between rocks must 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 thoroughly compacted to no less than 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 near the optimum water content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to insure the obtainment of 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.

**Backfilling of Old Cesspools**

The following procedures shall be followed for backfilling:

1. **Sludge Removal**

   Remove the sludge from the bottom of the old cesspool by (a) pumping or (b) by clamshell or any other suitable way. The material shall be disposed of away from the site. The completeness of removal shall be verified by probing and shall be less than 12 in. at the bottom.

2. **Granular Fill (below 3 ft from finish grade)**

   Use granular material, graded from 6 to 0 inches. The fines passing the No. 200 sieve shall be less than 10%. The materials shall be placed in thin layers (12 in. maximum) and compacted with vibratory equipment to 90% of AASHO T-180-57 density. Ramming each layer into place with a clamshell bucket will be allowed. The granular fill shall be wetted before placement into the cesspools. Sufficient compaction tests shall be conducted to verify that 90% compaction is obtained by the construction method selected.
(3) **Top 3 Ft of Fill**

Linings encountered in the cesspools within the top 3 ft from finish grade shall be removed. The fill within the top 3 ft from finish grade shall be constructed from on-site soil in thin layers (6-in. compacted thickness) to 90% of AASHO T-180-57 density. The material at finish grade shall blend with the surrounding soil.

**Excavation**

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

**Boulder Fills**

If boulders are proposed to be used in the construction of fills, they shall be placed along the toe section of slopes and at locations indicated on the plan. The subgrade shall be stripped to stiff natural ground and shaped to drain. A layer of granular filter material shall be placed on it. All voids between boulders shall be filled with smaller granular soils. A blanket of filter material shall be placed against the boulder fill before construction of earth fills behind or above the boulders.

**Unforeseen Conditions**

If unforeseen or undetected critical soil conditions such as soft spots are encountered during the field operation, corrective measures shall be made in the field as they are detected.
Rainy Weather

No fill material shall 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

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 limits or sieve analysis test results.
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- **Description**: MEDIUM, TAN, DECOMPOSED MUDDY Silt
- **Sample**: 2" STANDARD SPLIT SPOON
- **Elevation**: 112' + 3" (Estimated from Contour Plan)
- **Driller**: WALTER LUM ASSOCIATES
- **Date**: JUNE 5, 1970
- **Field Party**: LUNING, MAESHIRO
- **Type of Boring**: AUGER (A.M.)
- **Diam.**: 4"
WALTER LUM ASSOCIATES

Boring Log

GOLF COURSE SUBDIVISION UNIT NO. 1

LOCATION: MAUNALUA, OAHU, HAWAII

TAX MAP KEY: 3-9-11

HAMMER:

- Weight: 140 lbs
- Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

**BORING No. 37**

**DATE:** JUNE 5, 1970

**FIELD PARTY:** LUNING, MAESHIRO

**DRILLER:** WALTER LUM ASSOC

**TYPE OF BORING:** AUGER (ACKER)

**DIAMETER:** 4"

**ELEVATION:** 94' 6"

**DRILL BIT:** T.C. DRAG

**WATER LEVEL:** NOT NOTICED

**DATE:** 6-5-70

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**END OF BORING @ 16.5'**

*ELEVATION ESTIMATED FROM CONTOUR PLAN*
# Boring Log

**GOLF COURSE**  
**SUBDIVISION UNIT NO. 1**  
**LOCATION**  
**MAUNALUA, OAHU, HAWAII**  
**TAX MAP KEY:** 3-9-11

**HAMMER:**  
**Weight:** 140\#  
**Drop:** 30”

**SAMPLER:** 2” x 2” STANDARD SPLIT SPOON

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**ELEV. = 77.1’**

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**END OF BORING @ 14.5’**

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* ELEVATION ESTIMATED FROM CONTOUR PLAN.
### Boring Log

**Golf Course Subdivision Unit No. 1**

**Location:** Maunalua, Oahu, Hawaii

**TAX MAP KEY:** 3-9-11

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

**Sampler:** 2.5" - 2" Standard Split Spoon

---

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**Elevation Estimation:** Elevation estimated from contour plan.

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**Notes:**
- **Elev. datum:** 40 ft
- **Drill bit:** T.C. Rock
- **Water level:** Not noticed
- **Date:** 6-4-70

---

**Standard Penetration Test**

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**Additional Information:**
- **Type of Boring:** Auger (AB-JR)
- **Driller:** Luning, Meyer
- **Date:** June 4, 1970
### Boring Log

**GOLF COURSE**

**PROJECT**
SUBDIVISION UNIT NO. 1

**LOCATION**
MAUNALUA, OAHU, HAWAII

**TAX MAP KEY:** 3-9-11

**Driller:**
LUNING, MEYER

**Type of Boring:**
AUGER (AS-JR)

**Hammer:**

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

**Sampler:** 2"-4" STANDARD SPLIT SPOON

**Elevation Estimated from Contour Plan**

**Standard Penetration Test**

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<th>Sample No.</th>
<th>Wet Density (p.c.f.)</th>
<th>Water Cont. (%)</th>
<th>Dry Density (p.c.f.)</th>
<th>Unconfined Compressibility (p.s.f.)</th>
<th>Penetration (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>66' 6&quot;</td>
<td><strong>STIFF, TAN, CLAYEY SILT W/ SAND</strong></td>
<td>10</td>
<td>40-A</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>66' 6&quot;</td>
<td><strong>STIFF, TAN W/ WHITE STREAKS, CLAYEY SILT</strong></td>
<td>5</td>
<td>40-B</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>66' 6&quot;</td>
<td><strong>STIFF, MOTILED TAN, CLAYEY SILT W/ DECOMPOSED MUDROCK</strong></td>
<td>10</td>
<td>40-C</td>
<td>32</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>66' 6&quot;</td>
<td><strong>STIFF, REDDISH BROWN, CLAYEY SILT</strong></td>
<td>15</td>
<td>40-D</td>
<td>35</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**END OF BORING @ 16.5'**

**Date:** JUNE 4, 1970

**Time:** 10:30 AM
Boring Log

GOLF COURSE

SUBDIVISION UNIT NO. 1

LOCATION MAUNALUA, OAHU, HAWAII

TAX MAP KEY: 3-9-11

BORING NO. 113

Driller WALTER LUM ASSOC. Date JUNE 23, 1970

Field Party PANG, MAKAULA

Type of Boring AUGER (CONCRETE) Diam. 4"

Elev. 14' ± Datum

Drop T.C. DRAG

Water Level NOT NOTICED

Date 6-23-70

SAMPLER: 2" STANDARD SPLIT SPOON

---

HAMMER:

Weight 140#

Drop 30"

---

ELEVATION ESTIMATED FROM CONTOUR PLAN
**Boring Log**

**GOLF COURSE**

**SUBDIVISION UNIT NO. 1**

**LOCATION**

MAUNALUA, OAHU, HAWAII

**TAX MAP KEY:** 3-9-11

**HAMMER:**

Weight: 140 #
Drop: 30"

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**ELEV. 14' 2"**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth (ft)</th>
<th>Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>114-A</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>114-B</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>114-C</td>
<td>84</td>
<td></td>
</tr>
</tbody>
</table>

**DESCRIPTION**

- (CH) STIFF, DARK GRAY CLAY W/ ROOTS & GYPSUM CRYSTALS
- (CH) STIFF, MOTTLED BROWN, CLAYEY SILT W/ DECOMPOSED ROCK, PUKA PUKA ROCK
- (CH) STIFF, TAN CLAY W/ DECOMPOSED ROCK, ROCK
- END OF BORING @ 11.5'

**Standard Penetration Test (N Blows per foot)**

<table>
<thead>
<tr>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
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<tbody>
<tr>
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**ELEVATION ESTIMATED FROM CONTOUR PLAN**
**Boring Log**

**GOLF COURSE**

**PROJECT** SUBDIVISION UNIT NO. 1

**LOCATION** MAUNALUA, OAHU, HAWAII

**TAX MAP KEY:** 3-9-11

**WALTER LUM ASSOCIATES**

303 P WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

**BORING NO.** 115  **Sheet No.**  **of**

**Driller** WALTER LUM ASSOC.  **Date** JUNE 23, 1970

**Field Party** PANG, MAKALUA

**Type of Boring** AUGER (CONCRETE)  **Diam.** 4"  

**Elev.** 13' 4"  **Datum**

**Drill Bit** T.C. DRAG

**Water Level NOT NOTICED**

**Time**

**Date** 6-23-70

**HAMMER:**

Weight 140 lbs  
Drop 30"

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**Penetration Data**

<table>
<thead>
<tr>
<th>Unified Classification</th>
<th>Description</th>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Wet Density (p.c.f.)</th>
<th>Water Cont. %</th>
<th>Dry Density (p.c.f.)</th>
<th>Unconf. Comp.</th>
<th>P.S.F.</th>
<th>Penetration Test</th>
<th>N (Blows per foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(CH)</td>
<td>STIFF, DRY GRASS, ROOTS</td>
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<td>115-A</td>
<td>-</td>
<td>29</td>
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<td>-</td>
<td>1</td>
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<td>0</td>
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<tr>
<td></td>
<td>PUKA PUKA ROCK</td>
<td>B</td>
<td></td>
<td>115-B</td>
<td>NO RECOVERY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15/0</td>
</tr>
<tr>
<td></td>
<td>GRAY BLUE, DECOMPOSED ROCK, TAN ORANGE BROWN, SANDY SILT</td>
<td>10</td>
<td></td>
<td>115-C</td>
<td>ROCK FRAG.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>15/0</td>
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<tr>
<td></td>
<td>PUKA PUKA ROCK</td>
<td>10</td>
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<td>115-D</td>
<td>NO RECOVERY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20/0</td>
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</table>

**Elevation Estimated from Contour Plan**

*
**Boring Log**
- **GOLF COURSE**
- **SUBDIVISION UNIT NO. 1**
- **LOCATION**: MAUNALUA, OAHU, HAWAII
- **TAX MAP KEY**: 3-9-11

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

<table>
<thead>
<tr>
<th>Unit Identification</th>
<th>Drill Bit T.C.</th>
<th>Datum</th>
<th>Standard Penetration Test</th>
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<tbody>
<tr>
<td>ELEV. = 13' ± 3&quot;</td>
<td>0</td>
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</tr>
<tr>
<td>(ML) STIFF, REDDISH BROWN, CLAYEY SILT</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU'KA PU'KA ROCK</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>END OF BORING @ 10.0'</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

*ELEVATION ESTIMATED FROM CONTOUR PLAN*
**Boring Log**

**GOLF COURSE**

**PROJECT**

**SUBDIVISION UNIT NO. 1**

**LOCATION**

MAUNALUA, OAHU, HAWAII

**TAX MAP KEY:** 3-9-11

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**BORING NO.:** 120

**Sheet No.:** of 6

**Driller:** WALTER LUM ASSOCIATES

**Date:** JUNE 18, 1970

**Field Party:** PANG MAKAULA

**Type of Boring:** AUGER (CONCRETE)

**Diam.:** 4"

**Elev.:** 15' 4"

**Datum:**

**Drill Bit:** T.C. ROCK

**Water Level:** NOT NOTICED

**Time:**

**Date:** 6-18-70

---

**PENETRATION DATA**

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<tbody>
<tr>
<td>CH</td>
<td>STIFF, DARK GRAY BROWN CLAY</td>
<td>5</td>
<td>120-B</td>
<td>67</td>
<td>4.6</td>
<td>2.8</td>
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<td></td>
<td></td>
<td>37.5'</td>
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<tr>
<td>TAN, DECOMPOSED MUDROCK</td>
<td>10</td>
<td>120-C</td>
<td>NO RECOVERY</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

**END OF BORING AT 10'**

---

**ELEVATION ESTIMATED FROM CONTOUR PLAN**

---

**PENETRATION DATA**

<table>
<thead>
<tr>
<th>Standard Penetration Test</th>
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</thead>
<tbody>
<tr>
<td>N (Blows per foot)</td>
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<td>0</td>
</tr>
</tbody>
</table>

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**ELEVATION ESTIMATED FROM CONTOUR PLAN**
## Boring Log

**PROJECT**
GOLF COURSE SUBDIVISION UNIT NO. 1

**LOCATION**
MAUNALUA, OAHU, HAWAII

**TAX MAP KEY:** 3-9-11

---

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

**SAMPLER:** 2" STANDARD SPLIT SPoon

---

**ELEVATION:** 20' ± 0'

---

### PENETRATION DATA

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Penetration Test</th>
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<tbody>
<tr>
<td>121-A</td>
<td>23</td>
</tr>
<tr>
<td>121-B</td>
<td>NO RECOVERY</td>
</tr>
<tr>
<td>121-C</td>
<td>NO RECOVERY</td>
</tr>
</tbody>
</table>

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**Standard Penetration Test**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>15/0</td>
<td>HAMMER</td>
<td>REBOUNDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20/0</td>
<td>HAMMER</td>
<td>REBOUNDS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**DESCRIPTION:**
- STIFF REDDISH BROWN, SILTY CLAY W/ TRACES OF DECOMPOSED ROCK
- PUKA PUKA ROCK
- END OF BORING @ 10'

---

**ELEVATION ESTIMATED FROM CONTOUR PLAN**
**Boring Log**

**PROJECT**
GOLF COURSE

**LOCATION**
MAUNALUA, OAHU, HAWAII

**TAX MAP KEY**
3-9-11

---

**HAMMER:**

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

**SAMPLER:**
2" STANDARD SPLIT SPOON

---

**TAX MAP KEY:**
3--9-11
Type of Boring
AUGER (CONCRETE)
Diam.: 4"  
Elev.: 21' ± Datum

---

**PENETRATION DATA**

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Water Cont.</th>
<th>Dry Dent.</th>
<th>Unconf. Comp.</th>
<th>Vane Shear</th>
<th>Standard Penetration Test</th>
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<tbody>
<tr>
<td>ML</td>
<td></td>
<td>122A</td>
<td>22</td>
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- **ELEVATION ESTIMATED FROM CONTOUR PLAN**

---

**ELEVATION:**

- **Estimated from Contour Plan**

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**ELEVATION:**

- **ELEVATION:**

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**Date:**
JUNE 22, 1970

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**BORE NO.:**
122

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**BOATING NO.:**
122

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**BOATING NO.:**
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**BOATING NO.:**
122
Boring Log

**GOLF COURSE**

**SUBDIVISION UNIT NO. 1**

**MAUNALUA, OAHU, HAWAII**

**TAX MAP KEY:** 3-9-11

**PROJECT**

- Driller: WALTER LUM ASSOCIATES
- Date: JUNE 22, 1970
- Field Party: LUNING, MAESHIRO
- Type of Boring: AUGER (MOBILE)
- Diam.: 3"
- Elev.: 31' 2" Datum
- Drill Bit: T.C. DRAG
- Water Level: NOT NOTICED
- Date: 6-22-70

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

<table>
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<tbody>
<tr>
<td>ML</td>
<td>STIFF RED CLAYEY SILT</td>
<td>ELEV. 31' 2&quot; 0</td>
<td>124A</td>
<td>19</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>PUKA PUKA ROCK</td>
<td></td>
<td>124B</td>
<td>NO RECOVERY</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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**ELEVATION ESTIMATED FROM CONTOUR PLAN**
### Boring Log

**PROJECT**  
GOLF COURSE SUBDIVISION UNIT NO. 1

**LOCATION**  
MAUNALUA, OAHU, HAWAII

**TAX MAP KEY:** 3-9-11

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**ELEVATION ESTIMATED FROM CONTOUR PLAN**

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<table>
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<tbody>
<tr>
<td>(ML)</td>
<td>MEDIUM, REDDISH BROWN, SILTY CLAY</td>
<td>S</td>
<td>125-A</td>
<td>20</td>
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<td>0</td>
<td>10</td>
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<tr>
<td></td>
<td>LAVA ROCK</td>
<td>10</td>
<td>125-B</td>
<td>ROCK FRAGMENTS</td>
<td>20/6</td>
<td><strong>HAMMER BOUNCES</strong></td>
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<tr>
<td></td>
<td>END OF BORING @ 10.5 feet</td>
<td>15</td>
<td>125-C</td>
<td>ROCK FRAGMENTS</td>
<td>40/3</td>
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</table>

---

**Standard Penetration Test**

- **Penetration Data**
  - **Type of Boring** AUGER (B-30-1)
  - **Diam.** 4"
  - **Elev.** 27' 6" x
  - **Datum**
  - **Hammer:** T.C. ROCK
  - **Water Level** NOT NOTICED
  - **Date:** 7/15/70
Boring Log

**GOLF COURSE**

**PROJECT**
SUBDIVISION UNIT NO. 1

**LOCATION**
Maunalua, Oahu, Hawaii

**Tax Map Key:** 3-9-11

**HAMMER:**

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**BORING NO.** 126  
**Date:** 5-15-70

**Type of Boring** AUGER (CONICAL)
**Diam.** 4"

**DEPTH**

<table>
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<tr>
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<tbody>
<tr>
<td>0</td>
<td>126A</td>
<td>30</td>
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<tr>
<td>5</td>
<td>126B</td>
<td>-</td>
<td>ROCK FRAGMENTS -</td>
<td></td>
<td></td>
<td></td>
<td>HAMMER BOUNCES -</td>
</tr>
<tr>
<td>10</td>
<td>126C</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td>HAMMER BOUNCES 35/2'</td>
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<tr>
<td>15</td>
<td>126D</td>
<td>-</td>
<td>ROCK FRAGMENT -</td>
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<tr>
<td>20 to 40</td>
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<td>END OF BORING @ 15 1/2'</td>
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**ELEVATION:**

- ELEV. 37 1/2' ±

**PENETRATION DATA**

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<th>Standard Penetration Test</th>
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<tr>
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</table>

**Hammers Bounces**

- 30/1'
- 35/2'
- 30/0'

---

**LOCATION:**
MAKaula, MAESHiRO

**Elev.** 37 1/2'

**Datum:**

**Water Level:**

**NOTICED**

**Date:** 5-15-70

---

**SAMPLER:**

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**UNIT & GRADE**

- MEDIUM, REDDISH BROWN CLAYEY Silt

**END OF BORING @ 15 1/2'**

---

**ELEVATION:**

- Estimated from contour plan
Boring Log

**GOLF COURSE**

**PROJECT**
SUBDIVISION UNIT NO. 1

**LOCATION**
Maunalua, Oahu, Hawaii

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

**SAAMPER:**
2" STANDARD SPLIT SPOON

---

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<tbody>
<tr>
<td>(CH)</td>
<td>RED-BROWN CLAY STIFF, MOTTLED BROWN SILTY CLAY W/TRACES OF SAND &amp; DECOMPOSED ROCK</td>
<td>0</td>
<td>127A</td>
<td>32</td>
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<td></td>
</tr>
<tr>
<td>(MH)</td>
<td>PUKA PUKA ROCK (LAVA ROCK) END OF BORING @ 15'±</td>
<td>5</td>
<td>127B</td>
<td>ROCK FRAGMENTS</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>HAMMER BOUNCES</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>127C</td>
<td>17</td>
<td>-</td>
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<td>HAMMER BOUNCES</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>127D</td>
<td>ROCK FRAGMENT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>HAMMER BOUNCES</td>
</tr>
</tbody>
</table>

* ELEVATION ESTIMATED FROM CONTOUR PLAN
**Boring Log**

**GOLF COURSE**

**PROJECT:** SUBDIVISION UNIT NO. 1  
**LOCATION:** MAUNALUA, OAHU, HAWAII

**TAX MAP KEY:** 3-9-11

---

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**BORING NO.** 129  
**Driller:** WALTER LUM ASSOC.  
**Date:** JUNE 15, 1970  
**Field Party:** LUNING, MAESHIRO

**Type of Boring:** AUGER (MOBILE MINITURMAN)  
**Dia.:** 3"  
**Elev.:** 59'-10"  
**Datum:**  
**Drill Bit:** T.C. ROCK  
**Water Level:** NOT NOTICED  
**Time:**  
**Date:** 6-15-70

---

**UNIFIED SOIL CLASSIFICATION**

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<td>18</td>
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<tr>
<td>5</td>
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<td>ROCK</td>
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<tr>
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<td>ROCK</td>
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**ELEVATION ESTIMATED FROM CONTOUR PLAN**
# Boring Log

**GOlf Course**

**SUBDIVISION UNIT NO. 1**

**LOCATION**
MAUNALUA, OAHU, HAWAII

**TAX MAP KEY**
3-9-11

---

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

**SAMPLER:**
2" STANDARD SPLIT SPOON

---

**LOCATION**
MAUNALUA, OAHU, HAWAII

---

**TAX MAP KEY:**
3-9-11

---

**HAMMER:**
- Type or Boring: AUGER (MOBILE)
- Diameter: 3"
- Datum: 56' 

**DRILL BIT:**
- Type: T.C. DRAG

---

**WATER LEVEL NOT NOTED**

---

**DATE:**
JUNE 22, 1970

---

**ELEV. 56'**

---

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**END OF BORING 2.5'**

---

* ELEVATION ESTIMATED FROM CONTOUR PLAN
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<tbody>
<tr>
<td>MH-HL</td>
<td>STIFF, REDDISH BROWN, CLAYEY SILT</td>
<td>0</td>
<td>131-A</td>
<td>17</td>
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<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>26.5</td>
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<tr>
<td></td>
<td>PUKA PUKA ROCK</td>
<td>5</td>
<td>131-B</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>15.0</td>
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<tr>
<td></td>
<td></td>
<td>10</td>
<td>131-C</td>
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<td></td>
<td>VOLCANIC CINDERS OR PUKA PUKA ROCK</td>
<td>15</td>
<td>131-D</td>
<td>.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td></td>
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<td>25.5</td>
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<td>END OF BORING @ 21'</td>
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</tr>
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* ELEVATION ESTIMATED FROM CONTOUR PLAN

**NOTICED**

**TIME**

**DATE** 6-12-70

**PENETRATION DATA**

**BORED NO. 131**

**DRILLER** WALTER LUM ASSOC

**DATE** JUNE 12, 1970

**FIELD PARTY** ASATO, MAKALUA

**TYPE OF BORING** AUGER (CONCRETE)

**DIAMETER** 4"
**Boring Log**

**GOLF COURSE**

**PROJECT** SUBDIVISION UNIT NO. 1

**LOCATION** MAUNALUA, OAHU, HAWAII

**TAX MAP KEY:** 3-9-11

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**PENETRATION DATA**

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>M1</td>
<td>STIFF BROWN, SILTY CLAY W/ DECOMPOSED ROCK</td>
<td>132A</td>
<td>18</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
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<td>NO RECOVERY</td>
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<td></td>
<td></td>
<td>132C</td>
<td>NO RECOVERY</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>132D</td>
<td>NO RECOVERY</td>
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* ELEVATION ESTIMATED FROM CONTOUR PLAN

---

**BORING NO. 132**

**Driller:** WALTER LUM ASSOC.

**Date:** JUNE 15, 1970

**Field Party:** ASATO MACAULA

**Type of Boring:** AUGER (CONCORDE)

**Diam.:** 4"

**Elev.:** 58' + 24"

**Datum:**

**Water Level:** NOT NOTICED

**Time:**

**Date:** 6-15-70

---

**PUKA PUKA ROCK**

**END OF BORING 151'**
**Boring Log**

**GOLF COURSE**

**SUBDIVISION UNIT NO. 1**

**LOCATION**

MAUNALUA, OAHU, HAWAII

**TAX MAP KEY:** 3-9-11

**HAMMER:**

- **Weight:** 140 *
- **Drop:** 30”

**SAMPLER:** 2” STANDARD SPLIT SPOON

---

**BORING NO.** 133  
**Date:** JUNE 10, 1970

**FIELD PARTY** MAKALUA, ASATO

**Driller** WALTER LUM ASSOC.

**Type of Boring** AUGER (CONCRETE)

**Diam.** 4’

**Elev.** 60’ ± *

**Datum**

**Drill Bit** T.C. DRAG

**Water Level** NOT NOTED

**Time**

**Date** 6-10-70

**PENETRATION DATA**

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<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>(MH)</td>
<td></td>
<td>VERY STIFF NOTTED BROWN CLAYEY SILT  W/ TRACES OF DECOMPOSED ROCK</td>
<td></td>
<td>195.A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TAN. CLAYEY SILT W/ MUDROCK</td>
<td></td>
<td>195.B</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
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<td></td>
<td>VOLCANIC WINDERS</td>
<td></td>
<td>195.C</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>END OF BORING C 11.3</td>
<td></td>
<td></td>
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</table>

---

* -- ELEVATION ESTIMATED FROM CONTOUR PLAN

---

---
Boring Log

**GOLF COURSE**

**SUBDIVISION UNIT NO. 1**

**LOCATION** MAUNALUA, OAHU, HAWAII

**TAX MAP KEY:** 3-9-11

**HAMMER:**
- Weight: 140#
- Drop: 90"

**SAMPLER:** 2" STANDARD SPLIT SPOON

**BORING NO.** 134

**Driller** WALTER LUM ASSOC.

**Date** JUNE 10, 1970

**Type of Boring** AUGER (CONCRETE)

**Diam.** 4"

**Elev.** 56' 8"

**Datum** ---

**Drill Bit** T.C. DRAG

**Water Level** HOT

**Time** ---

**Date** 6/10/70

**LOCATION** MAUNALUA, OAHU, HAWAII

**Field Party** MAKALUA, AGATO

**TAX MAP KEY:** 3-9-11

**PROJECT:** ---

---

### PENETRATION DATA

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<th>Standard Penetration Test: N (Blows per foot)</th>
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<tr>
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</tr>
</tbody>
</table>

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**ELEVATION ESTIMATED FROM CONTOUR PLAN**

---

### DESCRIPTION

- **STIFF, BROWN CLAYEY SILT W/TRACES OF DECOMPOSED ROCK & SOME GRAVEL**

---

- **MUDROCK**

---

- **END OF BORING & 10’**

---

- **HAMMER BOUNCES**

---

* ELEVATION ESTIMATED FROM CONTOUR PLAN
# TABLE I.A - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
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<th>39</th>
<th>113</th>
<th>119</th>
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<tbody>
<tr>
<td>SAMPLE NO.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>10'-11.5'</td>
<td>SURFACE</td>
<td>SURFACE</td>
<td>0'-0.8'</td>
</tr>
</tbody>
</table>

| DESCRIPTION | BROWN CLAYEY SILT | BROWN SANDY SILT | GRAY CLAY | REDDISH BROWN CLAYEY SILT |

### GRAIN-SIZE ANALYSIS

(\% Passing)

<table>
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<tr>
<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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<tbody>
<tr>
<td>1&quot;</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1/2&quot;</td>
<td>98.5</td>
<td>99.8</td>
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<tr>
<td>#4</td>
<td>94.7</td>
<td>89.5</td>
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<td></td>
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<td></td>
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<tr>
<td>#10</td>
<td>90.3</td>
<td>99.7</td>
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<td>#20</td>
<td>89.2</td>
<td>99.5</td>
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<td>#40</td>
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<td>99.1</td>
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<td>#100</td>
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<td>#200</td>
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<td>95.6</td>
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### ATTERBERG LIMITS

Air Dried or Natural

| Liquid Limit | 66 | 77 | 16 |
| Plastic Limit | 53 | 74 | 30 |
| Plasticity Index | 73 | 53 | 18 |

Dilatancy

- SLOW

- MEDIUM

- NONE

- MEDIUM

Toughness

- HIGH

- MEDIUM

- HIGH

- MEDIUM

Dry Strength

- SLIGHT-MED

- MEDIUM

- MEDIUM

### UNIFIED SOIL CLASSIFICATION

- MEDIUM

### APPARENT SPECIFIC GRAVITY

- 2.83

### 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

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<thead>
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<th>24.3</th>
<th>25.9</th>
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### 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 (%)

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<thead>
<tr>
<th>A</th>
<th>DRY TO WET</th>
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<td>90.9</td>
<td>28.4</td>
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### REMARKS:

Date 9-10-70 by BJ
# GOLF COURSE SUBDIVISION - UNIT 1

## TABLE 1.B - SUMMARY OF LABORATORY TEST RESULTS

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<tr>
<th>BORING NO.</th>
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<th>124</th>
<th>132</th>
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<tbody>
<tr>
<td>SAMPLE NO.</td>
<td>A</td>
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</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>0'-1.5'</td>
<td>SURFACE</td>
<td>SURFACE</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>REDDISH BROWN</td>
<td>CLAYEY SILT</td>
<td>CLAYEY SILT</td>
</tr>
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### GRAIN-SIZE ANALYSIS (% Passing)

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<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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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td>96.9</td>
<td>96.1</td>
<td>94.9</td>
<td>93.4</td>
<td>92.0</td>
<td>71.2</td>
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</tbody>
</table>

### ATTERBERG LIMITS

| | Air Dried or Natural | Liquid Limit | Plastic Limit | Plasticity Index |
| | NATURAL | NATURAL | NATURAL |
| | 89 | 48 | 51 |
| | 71 | 31 | 38 |
| | 62 | 17 | 18 |

<table>
<thead>
<tr>
<th>Dilatancy</th>
<th>Toughness</th>
<th>Dry Strength</th>
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</thead>
<tbody>
<tr>
<td>NONE</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>SLOW</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>SLOW</td>
<td>MEDIUM</td>
<td>SLIGHT-MED</td>
</tr>
</tbody>
</table>

### UNIFIED SOIL CLASSIFICATION

| | CH | ML | MH |
| | 2.99 | |

### APPARENT SPECIFIC GRAVITY

| | 2.99 |

### 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>
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</thead>
<tbody>
<tr>
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<td>30.7</td>
<td>96.5</td>
<td>0.9</td>
<td>12.5</td>
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### MOISTURE-DENSITY RELATIONS OF SOILS

<table>
<thead>
<tr>
<th>AASHO T-180-57 Method</th>
<th>Dry to Wet or Wet to Dry</th>
<th>Max. Dry Density (P.C.F.)</th>
<th>Optimum Moisture (%)</th>
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<tbody>
<tr>
<td></td>
<td>DRY TO WET</td>
<td>16.3</td>
<td>45.7</td>
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### REMARKS:

Date 9-10-70  By BJ
## TABLE I.C - SUMMARY OF LABORATORY TEST RESULTS

### Sample No. Stockpile Area

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<td>Sample No.</td>
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<td>SURFACE</td>
<td>SURFACE</td>
<td>SURFACE</td>
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<td>Depth Below Surface</td>
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<td>Description</td>
<td>SANDY CLAY WITH SHELLS</td>
<td>SANDY CLAY WITH SHELLS</td>
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<td>SANDY CLAY WITH SHELLS</td>
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### Grain-Size Analysis (% Passing)

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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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<tbody>
<tr>
<td>100</td>
<td>96.4</td>
<td>100</td>
<td>94.6</td>
<td>96.6</td>
<td>92.4</td>
<td>90.0</td>
<td>85.6</td>
<td>79.5</td>
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### Atterberg Limits

<table>
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<tr>
<th>Air Dried or Natural</th>
<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
<th>Dilatancy</th>
<th>Toughness</th>
<th>Dry Strength</th>
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<tbody>
<tr>
<td>NATURAL</td>
<td>44</td>
<td>22</td>
<td>24</td>
<td>SLOW</td>
<td>MEDIUM</td>
<td>SLIGHT-MED</td>
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<tr>
<td>Liquid Limit</td>
<td>53</td>
<td>22</td>
<td>24</td>
<td>SLOW</td>
<td>MEDIUM</td>
<td>SLIGHT-MED</td>
</tr>
<tr>
<td>Plastic Limit</td>
<td>44</td>
<td>22</td>
<td>24</td>
<td>QUICK</td>
<td>MEDIUM</td>
<td>SLIGHT-MED</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>56</td>
<td>22</td>
<td>24</td>
<td>QUICK</td>
<td>MEDIUM</td>
<td>SLIGHT-MED</td>
</tr>
</tbody>
</table>

### Unified Soil Classification

| CL | CL |

### Apparent Specific Gravity

| 2.96 |

### 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>22.0</td>
<td>102.9</td>
<td>1.5</td>
<td>15.0</td>
<td>242</td>
</tr>
<tr>
<td>242</td>
<td>102.3</td>
<td>1.1</td>
<td>13.4</td>
<td></td>
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</table>

### Moisture-Density Relations of Soils

<table>
<thead>
<tr>
<th>A</th>
<th>Dry to Wet</th>
</tr>
</thead>
<tbody>
<tr>
<td>101.5</td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td></td>
</tr>
</tbody>
</table>

### Remarks:

Date: 9-15-70  By: JT
PLASTICITY CHART

PROJECT: GOLF COURSE SUBDIVISION - UNIT 1
LOCATION: MAUNALUA, OAHU, HAWAII

DATE 9-15-70 BY B.T.
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: GOLF COURSE SUBDIVISION-UNIT 1

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO.: 39 - SURFACE

SAMPLE DESCRIPTION: BROWN SANDY SILT

AGGREGATE: 0.4" MINUS
MOLD SIZE: 4" X 4.59"
HAMMER: 10 LBS., 18" DROP
LAYERS: 5
BLOWS: 25 PER LAYER

MAXIMUM DRY DENSITY - 90.9 P.C.F.

OPTIMUM MOISTURE CONTENT - 18.40%}

ZERO AIR VOIDS CURVE
SPECIFIC GRAVITY - 2.83

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

DATE 8-7-70 BY S.T.
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: GOLF COURSE SUBDIVISION - UNIT I

LOCATION: MAUNAWI, OAHU, HAWAII

SAMPLE NO: 124 - SURFACE

SAMPLE DESCRIPTION: REDDISH BROWN CLAYEY SILT WITH SAND

MAXIMUM DRY DENSITY: 95.0 P.C.F.

OPTIMUM MOISTURE CONTENT: 26.1% 

ZERO AIRVOIDS CURVE

SPECIFIC GRAVITY: 2.99

DATE: 8-1-10

AGGREGATE: 3/4" MINUS
MOLD SIZE: 4" X 4.59" 
HAMMER: 100 LBS 18" DROP
LAYERS: 5
BLOWS: 75 PER LAYER

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: GOLF COURSE SUBDIVISION - UNIT 1

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO.: B

SAMPLE DESCRIPTION: GRAY SANDY CLAY W/ SHELLS

AGGREGATE: 1/4" MINIMUM
MOLD SIZE: 4" X 4.59"
HAMMER: 10 LBS. 15" DROP
LAYERS: 6
BLOWS: 25 PER LAYER

MAX. DRY DENSITY: 101.5 P.C.F.

ZERO AIR voids CURVE
SPECIFIC GRAVITY: 2.90

TABLE:

<table>
<thead>
<tr>
<th>WATER CONTENT (%)</th>
<th>DRY DENSITY (P.C.F.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>110</td>
</tr>
<tr>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>30</td>
<td>90</td>
</tr>
<tr>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>50</td>
<td>70</td>
</tr>
<tr>
<td>60</td>
<td>60</td>
</tr>
</tbody>
</table>

DATE: 8-12-70
BY: S.T.

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

PROJECT: GOLF COURSE SUBDIVISION - UNIT I

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO.: 29 - SURFACE

SAMPLE DESCRIPTION: BROWN SANDY Silt

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>70</td>
<td>29</td>
</tr>
<tr>
<td>0.050</td>
<td>150</td>
<td>47</td>
</tr>
<tr>
<td>0.075</td>
<td>200</td>
<td>61</td>
</tr>
<tr>
<td>0.100</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>0.125</td>
<td>400</td>
<td>135</td>
</tr>
<tr>
<td>0.150</td>
<td>510</td>
<td>170</td>
</tr>
<tr>
<td>0.175</td>
<td>590</td>
<td>197</td>
</tr>
<tr>
<td>0.200</td>
<td>650</td>
<td>217</td>
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<tr>
<td>0.250</td>
<td>750</td>
<td>260</td>
</tr>
<tr>
<td>0.300</td>
<td>860</td>
<td>283</td>
</tr>
<tr>
<td>0.350</td>
<td>910</td>
<td>319</td>
</tr>
<tr>
<td>0.400</td>
<td>1000</td>
<td>325</td>
</tr>
<tr>
<td>0.450</td>
<td>1100</td>
<td>340</td>
</tr>
<tr>
<td>0.500</td>
<td>1215</td>
<td>420</td>
</tr>
</tbody>
</table>

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LBS.

HAMMER DROP 16"

No. OF BLOWS 50/USER

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %: 24.3

MOLDING DRY DENSITY, PCF. 93.0

CBR @ 0.1" PENETRATION 14.5

DATE 6-17-69 BY P. B. M.

DATE 4-10-70 BY C. I.
CBR TEST

PROJECT: GOLF COURSE SUBDIVISION - UNIT 1

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO: 115 - SURFACE

SAMPLE DESCRIPTION: GRAY CLAY

TEST RESULTS:

MOLDING MOISTURE, %: 25.9
MOLDING DRY DENSITY, P.C.F.: 96.7

CBR @ 0.1" PENETRATION: 1.6

DATE 8.1.10 BY C.M.

DATE 8.12.10 BY ST.
CBR TEST

PROJECT: GOLF COURSE SUBDIVISION - UNIT I

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO: 12A SURFACE

SAMPLE DESCRIPTION: REDDISH BROWN CLAYEY SILT WITH SAND

TEST RESULTS:

MOLDING MOISTURE, %: 30.7
MOLDING DRY DENSITY, P.C.F.: 96.5
CBR @ 0.1" PENETRATION: 12.5

DATE: 8-6-70 BY R.M.

DATE: 8-11-70 BY S.T.
CBR TEST

PROJECT: GOLF COURSE SUBDIVISION - UNIT 1

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO: 132 - SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT

TEST RESULTS:

MOLDING MOISTURE, %: 21.4

MOLDING DRY DENSITY, P.C.F.: 96.4

CBR @ 0.1" PENETRATION: 12.9

DATE 8-5-10 BY R.M.

DATE 8-11-10 BY S.T.

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

PROJECT: GOLF COURSE SUBDIVISION - UNIT 1

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO: A
SAMPLE DESCRIPTION: GRAY SANDY CLAY W/ SHELLS

TEST RESULTS:

MOLDING MOISTURE, \%: 22.0
MOLDING DRY DENSITY, P.C.F.: 107.9
CBR @ 0.1" PENETRATION: 13.0

DATE 8-7-10  BY  C.M.
DATE 8-12-10  BY  S.T.
CBR TEST

PROJECT: [GOLF COURSE SUBDIVISION - UNIT 1]

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO: B

SAMPLE DESCRIPTION: GRAY SANDY CLAY W/ SHELLS

TEST RESULTS:

MOLDING MOISTURE, %: 24.2
MOLDING DRY DENSITY, P.G.F: 102.3
CBR @ 0.1" PENETRATION: 13.4

DATE: 8-11-70 BY CM.

DATE: 8-17-70 BY ST.
LOGS OF BORINGS

FROM

"GOLF COURSE SUBDIVISION UNIT NO. 2"

REPORT DATED SEPTEMBER 19, 1970
**Boring Log**

**PROJECT:** GOLF COURSE SUBDIVISION UNIT NO. 2  
**LOCATION:** MAUNALUA, OAHU, HAWAII  
**TAX MAP KEY:** 3-9-11

<table>
<thead>
<tr>
<th>HAMMER:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight:</td>
<td>140 lb</td>
</tr>
<tr>
<td>Drop:</td>
<td>30&quot;</td>
</tr>
<tr>
<td>SAMPLER:</td>
<td>2&quot; STANDARD SPLIT SPOON</td>
</tr>
</tbody>
</table>

**BORING NO. 32**  
Driller: WALTER LUM  
Date: JUNE 8, 1970  
Field Party: LUNING, MAESHIRO  
Type of Boring: AUGER (FACE)  
Diam.: 4"  
Elev.: 80'  
Drill Bit: T.C. DRAG  
Water Level: NOT NOTICED  
Time:  
Date: 6-8-70

| PENETRATION DATA |
|------------------|------------------|
| N (Blows per foot) | Standard Penetration Test |
| 0 | | |
| 10 | | |
| 20 | | |
| 30 | | |

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>DESCRIPTION</th>
<th>ELEV. = 80'</th>
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</thead>
<tbody>
<tr>
<td>MH</td>
<td>STIFF, TAN SANDY SILT w/MUDROCK</td>
<td></td>
</tr>
</tbody>
</table>

**END OF BORING AT 16.5'**

ELEVATION ESTIMATED FROM CONTOUR PLAN.
Boring Log  
GOLF COURSE  
SUBDIVISION UNIT NO. 2  
LOCATION MAUNALUA, OAHU, HAWAII  
TAX MAP KEY: 3-9-11  

HAMMER:  
Weight 140 lb  
Drop 30"  

SAMPLER: 2" STANDARD SPLIT SPOON  

<table>
<thead>
<tr>
<th>Unified Soil Classification</th>
<th>DESCRIPTION</th>
<th>ELEV. = 100'</th>
<th>Depth (ft)</th>
<th>Sampler</th>
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<tbody>
<tr>
<td>STIFF, TAN. SANDY SILT &amp; MUDROCK</td>
<td>END OF BORING @ 15.7'</td>
<td>34-A</td>
<td>20</td>
<td></td>
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<tr>
<td>PUKA, PUKA ROCK</td>
<td></td>
<td>34-B</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>34-C</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>34-D</td>
<td>23</td>
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<table>
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<tr>
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<tbody>
<tr>
<td>34-A</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>34-B</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34-C</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>34-D</td>
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</table>

ELEVATION ESTIMATED FROM CONTOUR PLAN
**Boring Log**

**GOLF COURSE**

**PROJECT**
SURDIVISION UNIT NO. 2

**LOCATION**
MAUNALUA, OAHU, HAWAII

**TAX MAP KEY:** 3-9-11

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**UNIFIED SOIL CLASSIFICATION**

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<tbody>
<tr>
<td>(ML) MEDIUM, TAN, CLAYEY SILT W/ MUDROCK</td>
<td>99±</td>
<td>5</td>
<td>35-A</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MH MEDIUM TO STIFF, BROWN, CLAYEY SILT W/ SAND</td>
<td>27±</td>
<td>10</td>
<td>35-B</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>END OF BORING @ 160</td>
<td>16±</td>
<td>15</td>
<td>35-C</td>
<td>28</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>

**ELEVATION ESTIMATED FROM CONTOUR PLAN**
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
AASHO Designation: T 180-57

Compaction Test

Moisture-Density relations of soils using a 10# rammer and an 18" drop
Designation E-3 from "Earth Manual" by the United States Department of the Interior Bureau of Reclamation

Unified Soil Classification

ASTM Designation: D 1452-63T

AASHO Designation: T 27-60

AASHO Designation: T 11-60

AASHO Designation: T 89-60

AASHO Designation: T 90-56

AASHO Designation: T 91-54

AASHO Designation: T 100-60

Section VIII - TM 5-530 "Materials Testing" by Headquarters, Dept. of the Army
AASHO Designation: T 180-57

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.
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.

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.
FIGURE 2
TYPICAL SLOPE TREATMENT
FOR CUTS & FILLS IN ADOBE
GOLF COURSE SUBDIVISION UNIT NO. 1

MAUNALUA, OAHU, HAWAII
TAX MAP KEY: 3-9-11

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

FILL voids between boulders with granular soils.

18" filter material (well-graded granular material 3/4" maximum to dust sizes, less than 10% passing no. 200 sieve.)

SECTION

NOT TO SCALE

FIGURE 3

PROPOSED BOULDER FILL

GOLF COURSE SUBDIVISION UNIT NO. 1

MAUNALUA, OAHU, HAWAII

TAX MAP KEY: 3-9-11

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