MOMILANI SUBURB UNIT XII - PRELIMINARY SOIL REPORT
(for residential development)

MANANA-UKA & WAIMANO, EWA, OAHU, HAWAII

TAX MAP KEY: 9-7-24: 1

To:
PARK ENGINEERING, INCORPORATED

By:
WALTER LUM ASSOCIATES, INCORPORATED
CIVIL, STRUCTURAL, SOILS ENGINEERS
March 28, 1968
Gentlemen:

Subject: Momilani Suburb Unit XII
Preliminary Soil Report
(for residential development)
Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended

In accordance with your request, a preliminary soil exploration was made at the proposed residential development site for the Momilani Suburb Unit XII at Manana-Uka & Waimano, Ewa, Oahu, Hawaii, Tax Map Key: 9-7-24: 1.

From the field exploration and laboratory test results, it is our opinion that the site may be used for a residential housing development. Houses can be supported either directly on stiff existing ground or on properly compacted fills constructed from suitable on-site soils or approved borrow material.

Unforeseen or undetected conditions such as soft spots or seepage water may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

All 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 and recommendations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Ezra Koike
Professional Engineer
Hawaii No. 1450

EK:vi
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCOPE OF EXPLORATION</td>
<td>1</td>
</tr>
<tr>
<td>FIELD EXPLORATION</td>
<td>1</td>
</tr>
<tr>
<td>LABORATORY TESTS</td>
<td>2</td>
</tr>
<tr>
<td>SITE AND SOIL CONDITIONS</td>
<td>2</td>
</tr>
<tr>
<td>DISCUSSION AND RECOMMENDATIONS</td>
<td>3</td>
</tr>
</tbody>
</table>

PROPOSED SPECIFICATION FOR EARTHWORK

APPENDICES:

A. BORING LOCATION PLAN  - Figure 1
B. LOGS OF BORINGS - Borings Nos. 1 thru 8
C. SUMMARY OF LABORATORY TEST RESULTS - Tables IA and IB
D. PLASTICITY CHART
E. MOISTURE-DENSITY CURVES
F. LOGS OF BORINGS FROM MOMILANI SUBURB UNIT XI
G. LABORATORY TEST RESULTS FROM MOMILANI SUBURB UNIT VI
H. GENERAL TESTING METHODS
I. LIMITATIONS
MOMILANI SUBURB UNIT XII - PRELIMINARY SOIL REPORT
(for residential development)

MANANA-UKA & WAIMANO, EWA, OAHU, HAWAII

TAX MAP KEY:  9-7-24: 1

SCOPE OF EXPLORATION
The purpose of this exploration was to determine soil conditions of the
proposed site, Momilani Suburb Unit XII at Manana-Uka & Waimano, Ewa, Oahu, Hawaii, for residential development.

This report includes field exploration, laboratory tests and recommendations
regarding the soils at the site.

FIELD EXPLORATION
Eight borings were made at the site. The locations of these borings and
three nearby borings made previously for Momilani Suburb Unit XI are
shown on Figure 1, Boring Location Plan. Descriptions of the underlying
soils are shown on Boring Logs Nos. 1 thru 8. Also attached are the logs
of three borings made for the Unit XI soil report.

Borings were made with a 3-in. diameter auger using clay and rock-type
bits. Samples were recovered with a standard split spoon sampler and
2-in. thin-wall tube sampler driven with a 140-lb hammer falling 30
inches.
Soil samples were visually identified and tentatively classified in the field. In the laboratory, they were subjected to appropriate tests. The field identifications and classifications were then reviewed and modified to conform with the results of the laboratory tests in accordance with the "Unified Soil Classification System."

LABORATORY TESTS

Laboratory tests included: natural density, moisture content and unconfined compression; Atterberg limits; specific gravity; gradation; 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 and IB.

Also attached are the summary of laboratory test results, plasticity chart and the AASHO T-180-57 moisture-density curves from Momilani Suburb Unit VI.

SITE AND SOIL CONDITIONS

The project is located at the northeast corner of the intersection of Waimano Home Road and Komo Mal Drive and is bordered on the east by Momilani Suburb Unit XI.

The site is an abandoned cane field covered with grass and scattered sugar cane. The existing ground generally slopes down toward Komo Mal Drive and Unit XI at about 5 to 10 percent grades.
Along the eastern boundary, the ground slopes toward a natural drainageway in Unit XI.

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

A surface layer about 1 to 6 ft of medium to stiff, reddish-brown silty clays underlain by stiff to very stiff, reddish-brown and mottled brown, silty clays with decomposed rock to about 10 to 15 ft, the depths drilled.

Water was not noticed within the depths drilled during the field explorations.

For more detailed descriptions, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

In general, the present plan is to construct fills up to about 15 to 20 ft in thickness along the lower areas. The fill materials will generally come from on-site and from Momilani Suburb Unit VI. The soils in Unit VI have been previously identified in a soil report for Momilani Suburb Unit VI, dated August 4, 1967.

The proposed grading at this time is to use cut or fill slopes of less than about 20 ft in height.

In the opinion of the Soil Engineer, the on-site soils have, in general, sufficient strength to support the fills and the light residential structures proposed.
Unforeseen or undetected conditions such as soft spots or seepage water may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

**Fills**

In general, the proposed borrow materials from Maili Suburb Unit VI and the on-site soils are suitable for the construction of the proposed fills. The construction of the proposed fills 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. Topsoil and stockpiled soils should be either (a) stripped to stiff natural ground or (b) scarified and recompacted before the placement of fills.

2. All hard surfaces along existing access roads should be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

3. Where fills are proposed, the bottom and the sides of natural drainageways should be stripped down to stiff natural ground or scarified and recompacted before the placement of fills.

4. Before the placement of fills, subdrain laterals should be placed in a herringbone pattern that ties into the proposed subdrain line along the bottom of the natural drainageway in Unit XI. The final locations of subdrains should be determined in the field after clearing and grubbing.
5. All fills should be constructed in approximately level layers starting at the lower end and working upward.

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

Slopes
Cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

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

For protection against erosion during construction, it is recommended that runoff water from rainstorms be controlled by berms or other approved methods.

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

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

Foundations
If earthwork is carried out as specified, the stiff natural ground and properly constructed fill should develop adequate bearing values to support the proposed light residential structures. Recommendations for foundation construction are:
1. For light residential structures, conventional types of house foundations such as slab-on-ground construction or post-and-beam construction may be used.

2. Bearing values for a given soil usually vary with the size and depth of the footings. For light residential structures, bearing values of 1500 p.s.f. on compacted fills and 2000 p.s.f. on stiff natural ground may be used.

3. Because of the downhill creep effect of soils on a slope, some settlement may occur near the tops of slopes. Therefore, for slopes of about 15 ft or higher, buildings should be placed about 15 ft from the tops of slopes. This distance may be reduced for lower slope heights, e.g., 10 ft for 10-ft-high slopes, but in no case closer than 5 ft from the top of a slope.

4. Construction of retaining walls on side slopes should be avoided unless the underlying materials are very stiff or hard.

5. Good surface drainage away from the foundations of the proposed structures should be maintained.

**Roadways**

In general, a rough estimate of the roadway pavement thickness for the light residential traffic anticipated is as follows:
1. Wearing course - 2 in. asphaltic concrete.

2. Base course - 6 in. base course over a prepared subgrade.

Local adjustments regarding subbase requirements can be made in the field in accordance with the design standards of the City and County of Honolulu as the various soil conditions are encountered at subgrade levels.

It is recommended that subgrades 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 catch basins that are placed in these low areas.
PROPOSED SPECIFICATION FOR EARTHWORK
MOMILANI SUBURB UNIT XII

General Description

This item shall consist of all 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 all subsidiary work necessary to complete the grading.

Clearing, Grubbing and Preparing Areas to be Filled

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

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

All 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.

Where fills are proposed, all loose material along the bottom and the sides of natural drainageways shall be stripped down to stiff natural ground and recompacted to match the density of the surrounding soils before the placement of fills.

Subdrain laterals shall be placed along the side of the natural drainageway near the eastern boundary before the construction of fills. The subdrains shall tie into the proposed subdrain line in Momilani Suburb Unit XI. The final 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 soils from Molokai Suburb Unit VI and on-site soils approved by the Soil Engineer and identified in the soil reports accepted by the F.H.A. The soils shall contain no more than a trace of organic matter and no particles larger than 6 in. in diameter. Also, it shall contain no more than 40% gravel (#4 sieve to 3 in. sieve sizes) and no more than 10% cobbles larger than gravel and smaller than 6 in. in diameter. Fill material placed in the top 2 ft of fills shall contain no more than 30% gravel and any material larger than 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 moisture content within each layer.

No rocks or cobbles shall be allowed to nest and all voids between rocks must be carefully filled and compacted with small stones or earth.
When the moisture content of the fill material is below that specified by the Soil Engineer, water shall be added until the moisture content is as specified and assures a thorough bonding during the compacting process.

When the moisture content of the material is above that specified by the Soil Engineer, the fill material shall be aerated by blading or by other satisfactory methods until the moisture content is as specified.

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 at the specified moisture 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 by the Soil Engineer of the compaction of each layer of 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 as determined by the Soil Engineer. 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 excavation shall be used in the fill and all unsuitable material from excavation shall be disposed of.

Unforeseen Conditions

If unforeseen or undetected critical soil conditions such as soft spots or seepage water are encountered during the field operation, additional investigations shall be made by the Soil Engineer. Corrective measures shall be evaluated and field adjustments shall be made in these areas.

Soil Engineering Services

The Soil Engineer shall observe the filling and compacting operations and make necessary tests in accordance with the specifications.

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 by the Soil Engineer indicate that the moisture content and density are as previously specified.
FIGURE 1
BORING LOCATION PLAN
MOMILANI SUBURB UNIT XII
WAHANA-UKA & WAIMAND, EWA, OAHU, HAWAII
WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
MARCH 1968
**Boring Log**

**Project:** MOMILANI SUBURB UNIT XII  
**Location:** MANANA-UKA & WAIMANO EWA, OAHU, HAWAII

**Hammer:** TMK: 9-7-24:1  
**Weight:** 140 lbs  
**Drop:** 30"  
**Sampler:** 2" 4" - 2" O.D. THIN WALL TUBE  
**Sampler:** 2" 45 - 2" STANDARD SPLIT SPOON

**Hammer:**  
**Weight:** 140 lbs  
**Drop:** 30"  
**Sampler:** 2" 4" - 2" O.D. THIN WALL TUBE  
**Sampler:** 2" 45 - 2" STANDARD SPLIT SPOON

---

**Penetration Data**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Wet Density (pcf)</th>
<th>Moist. Cont.</th>
<th>Unit Weight (pcf)</th>
<th>Vane Shear (psf)</th>
<th>Blows/0.5'</th>
</tr>
</thead>
<tbody>
<tr>
<td>2'5</td>
<td>I-A</td>
<td>103</td>
<td>28</td>
<td>80</td>
<td>11.840</td>
<td>-</td>
</tr>
<tr>
<td>2'6</td>
<td>I-B</td>
<td>113</td>
<td>30</td>
<td>87</td>
<td>1280</td>
<td>-</td>
</tr>
<tr>
<td>2'7</td>
<td>I-C</td>
<td>116</td>
<td>32</td>
<td>88</td>
<td>9900</td>
<td>-</td>
</tr>
<tr>
<td>2'8</td>
<td>I-D</td>
<td>32</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2'9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

**Soil Classification:**  
MH

**Description:**  
STIFF TO VERY STIFF  
REDISH BROWN  
SILTY CLAY

**Very Stiff:**  
REDISH BROWN  
CLAYEY SILT  
*WITH TRACES OF DECOMPOSED ROCK*

**Elevation Estimated from Topo Map**

---

**Notes:**  
- Elev. 328' ± 2"  
- Water Level: NOT NOTICED  
- Time: 3-13-68  
- Date: 3-13-68
**Boring Log**

**PROJECT**
MOMILANI SUBURB UNIT XII

**LOCATION**
MANANA-UKA & WAIMANO
HOLE: OAHU, HAWAII

**HAMMER:**
TMK: 9.7 - 24:1

**Weight:** 140#

**Drop:** 30°

**SAMPLER:**
2.5" - 2" O.D. THIN WALL TUBE.
2.65" - 2" STANDARD SPLIT SPOON

---

**LOCATION:** MANANA-UKA & WAIMANO

**ELEVATION:** 33.6' ±

**ELEVATION ESTIMATED FROM TOPO MAP**

**Penetration Data**

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>DESCRIPTION</th>
<th>Sample No.</th>
<th>P.C.F.</th>
<th>% Stiff</th>
<th>P.C.F.</th>
<th>% Compl.</th>
<th>Resistance</th>
<th>Representative Value</th>
<th>Blows Per Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH</td>
<td>MEDIUM DARK REDESSISH BROWN SILTY CLAY</td>
<td>2-A 122 34 91 44</td>
<td>4/5</td>
<td>4/5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td>STIFF TO VERY STIFF DARK REDESSISH BROWN SILTY CLAY</td>
<td>2-C 122 33 92 8840</td>
<td>7/5</td>
<td>13/5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td>VERY STIFF TO HARD DARK BROWN SILTY CLAY</td>
<td>2-D</td>
<td>32</td>
<td>-</td>
<td>10/5</td>
<td>17/5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**BORING NO.** 7

**Sheet No.** 1

**Driller:** WALTER LUM

**Date:** MARCH 14, 1969

**Field Party:** MAESHIRO, SAM FONG

**Type of Boring:** AUGER (MINUTEMAN) Diam. 3"

**Elev. 33.6' ±**

**Datum:**

**Drill Bit:** CLAY BIT

**Water Level:** NOT NOTICED

**Time:**

**Date:** 3-14-69

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

**Blows Per Foot: 0 10 20 30 40**
**Boring Log**

**PROJECT**  
MOMILANI SUBURB UNIT XII

**LOCATION**  
MANANA - UKA & WAIMANO  
EWA, OAHU, HAWAII

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

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

---

**Penetration Data**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3-A</td>
<td>108</td>
<td>26</td>
<td>490</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3-B</td>
<td>107</td>
<td>34</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>3-C</td>
<td>109</td>
<td>40</td>
<td>12200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>3-D</td>
<td>107</td>
<td>37</td>
<td>7600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ELEVATION ESTIMATED FROM TOPO MAP**
**Boring Log**

**PROJECT**  
MOMILANI SUBURB UNIT XII

**LOCATION**  
MANANA-UKA & WAIMANO, EWA, OAHU, HAWAII

**HAMMER**  
TMK: 9-7-24:1

**Weight**  
140#

**Drop**  
30" 

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

---

**United Soil Classification**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4-A</td>
<td>124</td>
<td>31</td>
<td>95</td>
<td>7280</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-B</td>
<td>113</td>
<td>31</td>
<td>86</td>
<td>10,300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-C</td>
<td>113</td>
<td>35</td>
<td>84</td>
<td>2600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-D</td>
<td>10</td>
<td></td>
<td>NO</td>
<td>RECOVERY</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ELEVATION** = 335' ± 2" 

**MH**  
MEDIUM TO STIFF  
REDDISH BROWN  
Silty Clay

**MH**  
STIFF TO VERY STIFF  
BROWN  
Silty Clay

**Rock or Boulder**

---

*ELEVATION ESTIMATED FROM TOPO MAP*
Boring Log

PROJECT: MOKILANI SUBURB UNIT XII
LOCATION: MANANA-UKA & WAIMANO

HAMMER: T.M.K. 9-7-24:1
Weight: 140 lbs
Drop: 30".

SAMPLER: 2" O.D. THIN WALL TUBE

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>344' +</td>
<td>5-A</td>
<td>111</td>
<td>34</td>
<td>83</td>
<td>5040</td>
<td>-</td>
<td>1/5</td>
<td>4/5</td>
</tr>
<tr>
<td>349'</td>
<td>5-B</td>
<td>126</td>
<td>27</td>
<td>99</td>
<td>7500</td>
<td>-</td>
<td>10/5</td>
<td>23/5</td>
</tr>
<tr>
<td>354'</td>
<td>5-C</td>
<td>125</td>
<td>36</td>
<td>90</td>
<td>8500</td>
<td>-</td>
<td>7/5</td>
<td>23/5</td>
</tr>
<tr>
<td>359'</td>
<td>5-D</td>
<td>117</td>
<td>32</td>
<td>88</td>
<td>3900</td>
<td>-</td>
<td>10/5</td>
<td>23/5</td>
</tr>
</tbody>
</table>

* ELEVATION ESTIMATED FROM TOPO. MAP

Remarks:
- Hamer: T.M.K.
- Weight: 140 lbs
- Drop: 30"
- Sampler: 2" O.D. THIN WALL TUBE

Penetration Data

ELEV. = 344' + 0

MH: Stiff, reddish brown silty clay

MH: Very stiff, brown silty clay

MH: Very stiff, mottled reddish brown clayey silt (decomposed rock)

End of Boring @ 15' depth

* Elevation estimated from topo. map

Driller: WALTER LUM ASSOC.
Date: FEB. 23, 1966
Field Party: HASHIDA, GLORY
Type of Boring: AUGER/MOBILE
Diam: 3"
# Boring Log

**Project:** MOMILANI SUBURB UNIT XII  
**Location:** MANANA-UKA & WAIMANO  
**Driller:** WALTER LUM ASSOC.  
**Date:** FEB. 20, 1968  
**Field Party:** NELSON, GLORY  
**Type of Boring:** AUGER (MOBILE)  
**Diam.:** 3"  
**Elev.:** 304' 1"  
**Datum:**  

**Weight:** 140 #  
**Drop:** 30"  
**Sampler:** 2" O.D. THIN WALL TUBE  

## Penetration Data

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>14</td>
<td>34</td>
<td>85</td>
<td>4470</td>
<td></td>
<td></td>
<td>0</td>
<td>4 BLOWS/05&quot;</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>123</td>
<td>28</td>
<td>100</td>
<td>10,040</td>
<td></td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>0</td>
<td>107</td>
<td>30</td>
<td>82</td>
<td>5,100</td>
<td></td>
<td></td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>0</td>
<td>94</td>
<td>36</td>
<td>69</td>
<td></td>
<td></td>
<td></td>
<td>40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **STIFF, REDDISH BROWN SILTY CLAY**  
- **MEDIUM TO STIFF LIGHT REDDISH TAN CLAYY SILT WITH DECOMP. ROCK**  
- **MEDIUM MOTTLED GRAYISH BROWN CLAYY SILT WITH DECOMP. ROCK**  
- **END OF BORING @ 16' DEPTH**

* ELEVATION ESTIMATED FROM TOPO MAP
Boring Log

**PROJECT**  
MOMILANI SUBURB UNIT XII

**LOCATION**  
MANANA-UKA & WAIMANO  
EWA, OAHU, HAWAII

**HAMMER:**  
T.M.K. 9-7-24:1

**Weight:**  
12 lb. SLEDGE HAMMER

**Drop:**  

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

---

**Penetration Data**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>324'</td>
<td>32</td>
<td>80</td>
<td>3330</td>
<td>&gt;1900</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**SYSTEM CLASSIFICATION**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>UNIFIED CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>STIFF TO VERY STIFF REDDISH BROWN SILTY CLAY</td>
<td>MH</td>
</tr>
<tr>
<td>STIFF TO VERY STIFF REDDISH BROWN SILTY CLAY WITH TRACES OF GRAY DECOMP. ROCK</td>
<td>MH</td>
</tr>
<tr>
<td>STIFF TO VERY STIFF REDDISH BROWN SILTY CLAY WITH TRACES OF GRAY DECOMPOSED ROCK</td>
<td>MH</td>
</tr>
</tbody>
</table>

**END OF BORING @ 16' DEPTH.**

*ELEVATION ESTIMATED FROM TOPO MAP.*
**Boring Log**

**PROJECT**  
MOMILANI SUBURB UNIT XII

**LOCATION**  
MANANA-UKA & WAIMANO  
EWA, OAHU, HAWAII

**HAMMER:**  
T.M.K. 9-7-24:1

**Weight** 14.0 #  
**Drop** 30"  
**Type of Boring** AUGER  
**Diam.** 3"

**LOCATION**  
EWA, OAHU, HAWAII

**Date**  FEB. 13, 1968  
**Field Party** NELSON, GLORY

**Weight** 140 #  
**Drop** 30 ; ,

**SAIPER:**  
2 "O.D. STANDARD SPLIT SPOON  
2 "O.D. THIN WALL TUBE

---

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ELEV. = 327 ± 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
<tr>
<td>MH</td>
<td>5</td>
</tr>
<tr>
<td>Stiff reddish brown silty clay</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ELEV. = 327 ± 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>30</td>
</tr>
<tr>
<td>MH</td>
<td>15</td>
</tr>
<tr>
<td>Stiff mottled brown &amp; gray silty clay (decomposed rock)</td>
<td></td>
</tr>
</tbody>
</table>

**END OF BORING @ 16' DEPTH**

* ELEVATION ESTIMATED FROM TOPO MAP.
## 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>A</td>
<td>A</td>
<td>0'-1'</td>
<td>Reddish Brown Clay</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>5'-6'</td>
<td>Reddish Brown Clay</td>
</tr>
<tr>
<td>C</td>
<td>C</td>
<td>10'-11'</td>
<td>Reddish Brown Clay</td>
</tr>
<tr>
<td>D</td>
<td>D</td>
<td>15'-16'</td>
<td>Tan Clay</td>
</tr>
</tbody>
</table>

### Gradation Analysis

<table>
<thead>
<tr>
<th>Sieve</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>90.0</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>100</td>
<td>90.0</td>
<td>90.0</td>
<td>80.0</td>
</tr>
<tr>
<td>#4</td>
<td>100</td>
<td>90.0</td>
<td>90.0</td>
<td>80.0</td>
</tr>
<tr>
<td>#10</td>
<td>100</td>
<td>90.0</td>
<td>90.0</td>
<td>80.0</td>
</tr>
<tr>
<td>#20</td>
<td>90.0</td>
<td>80.0</td>
<td>80.0</td>
<td>70.0</td>
</tr>
<tr>
<td>#40</td>
<td>80.0</td>
<td>70.0</td>
<td>70.0</td>
<td>60.0</td>
</tr>
<tr>
<td>#100</td>
<td>70.0</td>
<td>60.0</td>
<td>60.0</td>
<td>50.0</td>
</tr>
<tr>
<td>#200</td>
<td>60.0</td>
<td>50.0</td>
<td>50.0</td>
<td>40.0</td>
</tr>
</tbody>
</table>

### Atterberg Limits

<table>
<thead>
<tr>
<th></th>
<th>Natural</th>
<th>Natural</th>
<th>Natural</th>
<th>Natural</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Dried</td>
<td>53</td>
<td>66</td>
<td>55</td>
<td>62</td>
<td>73</td>
</tr>
<tr>
<td>Liquid</td>
<td>1.0</td>
<td>0.9</td>
<td>1.0</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Plastic</td>
<td>3.8</td>
<td>3.3</td>
<td>3.7</td>
<td>3.3</td>
<td>3.7</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>75</td>
<td>63</td>
<td>63</td>
<td>51</td>
<td>30</td>
</tr>
</tbody>
</table>

### Unified Soil Classification

<table>
<thead>
<tr>
<th></th>
<th>CH</th>
<th>MH</th>
<th>MH</th>
<th>MH</th>
<th>MH</th>
</tr>
</thead>
</table>

### Specific Gravity

<table>
<thead>
<tr>
<th></th>
<th>2.86</th>
</tr>
</thead>
</table>

### Expansion and CBR Tests

<table>
<thead>
<tr>
<th>Parameter</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molding Moisture Content, %</td>
<td>24.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molding Dry Density, P.C.F.</td>
<td>98.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swell upon saturation, %</td>
<td>2.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBR at 0.1&quot; Penetration</td>
<td>11.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Compaction Test

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry to Wet or Wet to Dry</td>
<td></td>
<td>Wet to Dry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Dry Density (P.C.F.)</td>
<td>100.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>26.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

WALTER LUM ASSOCIATES
CIVIL, STRUCTURAL, SOILS ENGINEERS
### TABLE 15 - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>( )</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMPLE NO.</td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>SURFACE</td>
<td>0-5'</td>
<td>5-10'</td>
<td>10-15'</td>
<td></td>
</tr>
</tbody>
</table>

**DESCRIPTION**
- REDDISH-BROWN
- REDDISH-BROWN
- SILT CLAY
- REDDISH TAN
- DECOMP. ROCK
- W/DECOMP. ROCK

**GRADING ANALYSIS** (% Passing)

<table>
<thead>
<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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>100</td>
<td>99.1</td>
<td>98.8</td>
<td>98.7</td>
<td>98.6</td>
<td>98.3</td>
<td>98.0</td>
</tr>
</tbody>
</table>

**ATTERBERG LIMITS**

<table>
<thead>
<tr>
<th></th>
<th>Air Dried or Natural</th>
<th>Natural</th>
<th>Natural</th>
<th>Natural</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Limit</td>
<td>59</td>
<td>69</td>
<td>54</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Plastic Limit</td>
<td>27</td>
<td>34</td>
<td>35</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>27</td>
<td>25</td>
<td>19</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>SLOW</th>
<th>SLOW-MED</th>
<th>SLOW-MED</th>
<th>MEDIUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dilatancy</td>
<td>SLOW</td>
<td>SLOW-MED</td>
<td>SLOW-MED</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>Toughness</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td>SLIGHT-MED</td>
<td>SLIGHT</td>
</tr>
<tr>
<td>Dry Strength</td>
<td>SLIGHT-MED</td>
<td>MEDIUM</td>
<td>SLIGHT-MED</td>
<td>SLIGHT</td>
</tr>
</tbody>
</table>

**UNIFIED SOIL CLASSIFICATION**

- MH

**SPECIFIC GRAVITY**

- 2.66

**EXPANSION AND CBR TESTS**

(Surcharge-51 P.S.F.)

<table>
<thead>
<tr>
<th></th>
<th>28.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molding Moisture Content, %</td>
<td></td>
</tr>
<tr>
<td>Molding Dry Density, P.C.F.</td>
<td>96.1</td>
</tr>
<tr>
<td>Swell upon saturation, %</td>
<td>0.1</td>
</tr>
<tr>
<td>CBR at 0.1&quot; Penetration</td>
<td>7.3</td>
</tr>
</tbody>
</table>

**COMPACTION TEST**

(AASHO T-180-57 Method)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry to Wet or Wet to Dry</td>
<td>WET TO DRY</td>
</tr>
<tr>
<td>Max. Dry Density (P.C.F.)</td>
<td>96.1</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>28.9</td>
</tr>
</tbody>
</table>

**WALTER LUM ASSOCIATES**

**CIVIL, STRUCTURAL, SOILS ENGINEERS**
JOB: MOMILANI SUBURB - UNIT XII

LOCATION: MANANA-UKA & WAIMANO, EWA, OAHU, HAWAII

PLASTICITY CHART

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

PROJECT: MOMILANI SUBURB - UNIT XII
LOCATION: MANANA-UKA & WAIMANO, EWA, OAHU, HAWAII
SAMPLE NO: S-A SURFACE
SAMPLE DESCRIPTION: REDDISH-BROWN CLAY

DENSITY (P.C.F.)

130
120
110
100
90
80
70
60

WATER CONTENT (%)

0 10 20 30 40 50 60

MAX. DRY DENSITY - 108.0 P.C.F.
ZERO AIR VOIDS CURVE
SPECIFIC GRAVITY - 2.66

OPTIMUM MOISTURE CONTENT - 26.9%
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: MOMILANI SUBURB, UNIT VII
LOCATION: MANANA-IKA & WAIMANO, EWA, OAHU, HAWAII
SAMPLE NO: C-A SURFACE
SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY

WATER CONTENT (%)

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
LOGS OF BORINGS FROM

MOMILANI SUBURB UNIT XI
### Boring Log

**PROJECT:** MOMILANI SUBURB UNIT XI  
**LOCATION:** MANANA-UKA & WAIMANO EWA, OAHU, HAWAII  
**HAMMER:** TMK: 9-7.24:1  
**Weight:** 140#  
**Drop:** 30"  
**SAMPLER:** 2" O.D. THIN WALL TUBE

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CH-MH</td>
<td>STIFF, REDDISH BROWN SILTY CLAY W/ CLAY STREAKS</td>
<td>2.8</td>
<td>2-A</td>
<td>122</td>
<td>31</td>
<td>93</td>
<td>7020</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.6</td>
<td>2-B</td>
<td>123</td>
<td>31</td>
<td>94</td>
<td>6240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>STIFF, REDDISH BROWN &amp; GRAY CLAY</td>
<td>2.4</td>
<td>2-C</td>
<td></td>
<td>36</td>
<td></td>
<td>3900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td>STIFF, BROWN &amp; GRAY CLAYEY SILT (DECOMPOSED ROCK)</td>
<td>13.6</td>
<td>2-D</td>
<td>103</td>
<td>54</td>
<td>67</td>
<td>3380 2000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Penetration Data**

<table>
<thead>
<tr>
<th>Blows Per Foot</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/6</td>
<td>3/5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5/6</td>
<td>8/5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4/5</td>
<td>7/5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3/5</td>
<td>7/5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**PROJECT** MCMILANI SUBURB UNIT XI

**LOCATION** EWA, OAHU, HAWAII

**HAMMER:** TMK: 9-7-24:1

**Weight:** 140 #

**Drop:** 30 "

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

---

**Penetration Data**

<table>
<thead>
<tr>
<th>Unit Classification</th>
<th>Description</th>
<th>ELEV. = 318'4&quot; *</th>
<th>Sample No.</th>
<th>Wet Dens.</th>
<th>P.C.F.</th>
<th>Moist. Cont.</th>
<th>Dry Dens.</th>
<th>P.C.F.</th>
<th>Unit Weigt. Comp.</th>
<th>Sampled</th>
<th>Vane Shear</th>
<th>Blows Per Foot</th>
<th>Blows/0.5'</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH</td>
<td>STIFF REDDISH BROWN SILTY CLAY</td>
<td>7-A</td>
<td>111</td>
<td>34</td>
<td>83</td>
<td>13000</td>
<td>-</td>
<td>7-A</td>
<td>111</td>
<td>34</td>
<td>83</td>
<td>13000</td>
<td>-</td>
</tr>
<tr>
<td>MH</td>
<td>MEDIUM TO STIFF, REDDISH BROWN &amp; GRAYISH BROWN SILTY CLAY</td>
<td>7-B</td>
<td>105</td>
<td>59</td>
<td>76</td>
<td>3740</td>
<td>-</td>
<td>7-B</td>
<td>105</td>
<td>59</td>
<td>76</td>
<td>3740</td>
<td>-</td>
</tr>
<tr>
<td>MH</td>
<td>MEDIUM TO STIFF, REDDISH BROWN SILTY CLAY</td>
<td>7-C</td>
<td>111</td>
<td>40</td>
<td>79</td>
<td>7020</td>
<td>-</td>
<td>7-C</td>
<td>111</td>
<td>40</td>
<td>79</td>
<td>7020</td>
<td>-</td>
</tr>
<tr>
<td>MH</td>
<td>STIFF TANNISH BROWN SILTY CLAY</td>
<td>7-D</td>
<td>118</td>
<td>29</td>
<td>91</td>
<td>-</td>
<td>-</td>
<td>7-D</td>
<td>118</td>
<td>29</td>
<td>91</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

---

* ELEVATION ESTIMATED FROM CONTOUR PLAN

---

END OF BORING @ 16'
### Boring Log

**PROJECT**
MOMILANI SUBURB UNIT XI

**LOCATION**
EWA, OAHU, HAWAII

**HAMMER**
TMK: 9-7-24:1

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

### BORING DATA

<table>
<thead>
<tr>
<th>Description</th>
<th>Sample No.</th>
<th>P.C.F.</th>
<th>Moist.</th>
<th>Drill Bit</th>
<th>Unit</th>
<th>Vane S.I.</th>
<th>Blows/Per Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12-A</td>
<td>121</td>
<td>31</td>
<td>30</td>
<td></td>
<td>6060</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12-B</td>
<td>111</td>
<td>39</td>
<td>30</td>
<td></td>
<td>5200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12-C</td>
<td>10</td>
<td>30</td>
<td>30</td>
<td></td>
<td>18,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12-D</td>
<td>119</td>
<td>39</td>
<td>30</td>
<td></td>
<td>18,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**END OF BORING @ 16'**

---

* ELEVATION ESTIMATED FROM CONTOUR PLAN
LABORATORY TEST RESULTS FROM

MOMILANI SUBURB UNIT VI
**MOMILANI SUBURB UNIT VI**

**MANANA-UKA & WAIMANO, EWA, OAHU, HAWAII**

**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>
<th>GRADING ANALYSIS (%) Passing</th>
<th>ATTERBERG LIMITS</th>
<th>UNIFIED SOIL CLASSIFICATION</th>
<th>SPECIFIC GRAVITY</th>
<th>EXPANSION AND CBR TESTS</th>
<th>COMPACTION TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A*</td>
<td>SURFACE</td>
<td>REDDISH BROWN Silty Clay</td>
<td>100</td>
<td>NATURAL</td>
<td>MH</td>
<td>2.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A*</td>
<td>SURFACE</td>
<td>REDDISH BROWN Silty Clay</td>
<td>100</td>
<td>NATURAL</td>
<td>MH</td>
<td>2.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3'-3.5'</td>
<td>REDDISH BROWN Silty Clay</td>
<td>99.9</td>
<td>NATURAL</td>
<td>MH</td>
<td>2.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6'-7'</td>
<td>REDDISH BROWN Silty Clay</td>
<td>99.7</td>
<td>NATURAL</td>
<td>MH</td>
<td>2.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9'-10'</td>
<td>REDDISH BROWN Silty Clay</td>
<td>99.4</td>
<td>NATURAL</td>
<td>MH</td>
<td>2.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12'-15'</td>
<td>REDDISH BROWN Silty Clay</td>
<td>98.7</td>
<td>NATURAL</td>
<td>MH</td>
<td>2.68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*DISTURBED SURFACE SAMPLE TAKEN ADJACENT TO BORING*
**MOMILANI SUBURB UNIT VI**
MANANA-UKA & MAIAMO, EWALOA, OAHU, HAWAII

**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>
<th>GRADING ANALYSIS (% Passing)</th>
<th>ATTERBERG LIMITS</th>
<th>UNIFIED SOIL CLASSIFICATION</th>
<th>SPECIFIC GRAVITY</th>
<th>EXPANSION AND CBR TESTS</th>
<th>COMPACTION TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>15'-16'</td>
<td>REDDISH BROWN &amp; GRAY SILTY CLAY W/DECOMP. ROCK</td>
<td>F 100</td>
<td>NATURAL 75</td>
<td>MH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></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>5'-6'</td>
<td>DARK REDDISH BROWN SILTY CLAY</td>
<td>A* 100</td>
<td>NATURAL 57</td>
<td>MH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></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>10'-11'</td>
<td>LIGHT REDDISH BROWN SILTY CLAY</td>
<td>B 99.7</td>
<td>NATURAL 66</td>
<td>MH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></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>15'-15.5'</td>
<td>BROWN SILTY CLAY</td>
<td>C 98.9</td>
<td>NATURAL 67</td>
<td>MH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></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></td>
<td>MOTTLED BROWN DECOMP. ROCK</td>
<td>D 98.5</td>
<td>NATURAL 40</td>
<td>ML</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*DISTURBED SURFACE SAMPLE TAKEN ADJACENT TO BORING*

**WALTER LUM ASSOCIATES**
CIVIL, STRUCTURAL, SOILS ENGINEERS
JOB: MOMILANI SUBURB UNIT VI

LOCATION: MANANA-UKA & WAIMANO, EWA, OAHU, HAWAII

---

PLASTICITY CHART

* DISTURBED SURFACE SAMPLE TAKEN ADJACENT TO BORING

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

PROJECT: MOMILANI SUBURB UNIT VI
LOCATION: MANANA-UKA & WAIMANO, EWA, OAHU, HAWAII
SAMPLE NO: 1-A (SURFACE)
SAMPLE DESCRIPTION: REDDISH BROWN, SILTY CLAY

MAX. DRY DENSITY = 98.5 PCF

ZERO AIR VOID CURVE

SPECIFIC GRAVITY = 2.63

OPTIMUM MOISTURE CONTENT = 23.7%

WATER CONTENT (%)
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: MORMILAN SUBDIVISION - UNIT V
LOCATION: NAMANANA-UHAKWA & WAIMAHI, EWA, OAHU, HAWAII
SAMPLE NO: 4-A (SURFACE)
SAMPLE DESCRIPTION: DARK REDISH BROWN, SILTY CLAY

WATER CONTENT (%)

MAX. DRY DENSITY = 99.5 PCF

SPECIFIC GRAVITY = 2.82
GENERAL TESTING METHODS

EXPLORATORY BORINGS AND SAMPLING

Method for soil investigation and sampling by auger borings (Tentative)

Method for thin wall tube sampling of soils (Tentative)

Method for penetration test and split barrel sampling of soils (Tentative)

ASTM Designation: D 1452-63T

ASTM Designation: D 1587-63T

ASTM Designation: D 1586-64T

LABORATORY TESTING

Grading Analysis

Sieve analysis of fine and coarse aggregates

Amount of material finer than No. 200 sieve in aggregate

AASHO Designation: T 27-60

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.

Determining the plastic limit of soils

Calculating the plasticity index of soils

AASHO Designation: T 89-60

AASHO Designation: T 90-56

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

ASTM Designation: D 1587-63T

ASTM Designation: D 1586-64T

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

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

The exploratory borings describe the subsurface conditions only at the vertical lines where the borings were made. If, during construction between or below borings, subsurface conditions much different from those encountered in the exploratory holes are observed or encountered, or appear to be present beneath or beyond excavations, we would be advised at once so that we can observe and review these conditions and reconsider our recommendations where necessary. The owner and architect or engineer should make certain that the recommendations in this report, together with those which may be given subsequently, are incorporated into the plans and further that these recommendations are properly carried out during construction. To assist the owner and architect or engineer in this respect, it is recommended that we be retained to review plans and specifications and to observe the compaction of structural fill, the driving of piles and the preparation of ground for the foundations.