April 12, 1968

MR. GEOFFREY W. FAIRFAX
1210 Ward Avenue
Honolulu, Hawaii 96814

Dear Mr. Fairfax:

RE: Shopping Center Development
Kaneohe, Koolaupoko, Oahu, Hawaii
Tax Map Key: 4-6-02
Preliminary Soil Exploration

In accordance with your request, eight of the nine borings were made at
the site for the proposed shopping center development in Kaneohe, Koolaupoko,
Oahu, Hawaii. Boring No. 4 was not made because of lack of entry permit
from residents at the site.

PRELIMINARY FIELD EXPLORATION AND LABORATORY TESTS

The borings were drilled with 3-in. augers thru surface soils 9 to 25 ft
deep and drilled with "BX" diamond coring bit 5 ft into rock in Boring
Nos. 3 and 9. Exploratory samples were recovered with 2-in. thin-wall
tube and standard split spoon samplers driven with a 140-lb hammer falling
30 inches.

Soil samples were visually identified and tentatively classified in the
field. Samples were tested in the laboratory and field identifications
and classifications were then reviewed and modified to conform with the
"Unified Soil Classification System."

Laboratory tests included: natural moisture content, Atterberg limits,
gradation, specific gravity, AASHO T-180-57 density, expansion and CBR.
The results of these tests will be submitted at a later date.

GENERAL SITE AND SOIL CONDITIONS

The site lies east of Kamehameha Highway and south of the new Lilipuna
Road. The area lies on a low topographic ridge with an undulating surface.
The drainage is generally to the northeast but the gradient is very slight.
so that water tends to pond in low areas, particularly near the southeast portion of the proposed building site. Surface water is conducted under Kam Highway by a 24-in. culvert at old Liliopuna Road and by another culvert approximately 350 ft south of old Liliopuna Road. These culverts discharge on and across the building site. Water stands at the inlet and outlet of both culverts.

The south end of the project area is occupied by a fenced yard for a contractor's grading equipment, small houses with grass plots and chicken coops, a large three-story frame house, some trees and bananas. The north end is mostly open, grass covered field with some scattered houses, sheds and small trees.

In general, the subsoils appear to be a rock formation overlain with about 7 to 25 ft of overburden. The overburden soils are probably alluvial, stiff clays except in the vicinity of the natural drainage channels. At these locations, the soils are soft and the water table is close to the ground surface.

For more detailed descriptions, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

General

It is assumed that light, long span, one-story structures will be placed on the site.

Except for the drainageways that cross the site, the soils are stiff and the building footings may be placed directly on the stiff soils.

The existing surface drainage system will be a civil engineering problem and a civil engineer is recommended.

Site Preparation

The soils at the existing drainageways next to the old Liliopuna Road and the south end of the site are wet or saturated.

In the drainageway next to the old Liliopuna Road, Boring Nos. 3 and 7 show the water level close to the surface. A trench should be cut thru the center of the drainageway down to rock to drain the area. Lateral drains should also be cut in a herringbone pattern for drainage of the area.
The top 3 to 5 ft of soft material should be removed.

In the drainageway at the south end of the site, Boring Nos. 5 and 9 show a fairly stiff crust with some softer underlying material. Soft material within the ditch itself should be removed.

The open trenches thru the existing drainageways will allow the soils to consolidate. After clearing and grubbing and removing of the soft surface soils, a permanent subdrainage system should be installed in the open trenches. The subdrainage system consists of a perforated pipe backfilled with filter rock. See attached sketch. The site can then be graded and filled with select borrow material.

To minimize settlements of the floor slab of the building because of consolidation, a 6 to 10-ft surcharge is recommended over the existing drainageways. The surcharge load should be installed after the area is cleared and brought up to final grade and before the start of the building. Settlement gages and level readings can be taken to determine when much of the primary settlements have taken place and the surcharge load may be removed. It is estimated that the surcharge load may be removed after about 3 or 4 months.

**Building Foundations**

1. All footing excavations should extend to stiff material.

2. Where soft material is encountered, the soft material should be removed and backfilled with granular material S4C (3/4 in. to 0 in.) or the local base course rock. The granular material should be compacted in thin lifts not exceeding 6 in. in compacted thickness.

   The widths of the excavations thru soft material should be beyond lines extending 30 degrees outward from the vertical from the bottom edges of the footings. See attached sketch.

3. Bearing values of 2000 p.s.f. are recommended.

4. Deep, well-reinforced grade beams about 2 to 3 ft are recommended around the perimeter of the building.

5. The floor slab should be separated from the grade beams.
6. A base course of 6 in. is recommended below the floor slab. The base course should be granular material. To minimize the effect of capillary action, minimum size of material should be not smaller than 1/4 inch.

Parking Lot Grading

1. The surface of the subgrade to the parking lot should be shaped to grade. If the subgrade is not rolled and shaped to drain, water will pond in low spots below the pavement and base course. Bird baths and alligator cracking will eventually show up at the surface.

Low spots at subgrade level should have weepholes into catch basins at low spots.

2. The site should be graded to shed water away from the buildings.

3. A base course of 12 in. in thickness is recommended below a surface course of 2 in. of asphaltic concrete.

Attached are the boring logs, Boring Location Plan and sketch showing details on a typical subdrain and footings in soft ground.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Walter Lum
Professional Engineer
Hawaii No. 619
PROPOSED SPECIFICATION FOR EARTHWORK

SHOPPING CENTER DEVELOPMENT

KANEHOE, Koolaupoko, Oahu, Hawaii

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 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 or soft material along the bottom and the sides of natural drainageways shall be stripped down to stiff natural ground and shaped to drain before the placement of fills.

Subdrains and laterals shall be placed along the natural drainageways before the construction of fills.
Materials

Fill materials shall consist of on-site soils or material approved by the Soil Engineer. The fill material should be select borrow with no particles larger than 6 in. in diameter, no more than 40% gravel (#4 sieve to 3 in. sieve sizes), and the plasticity index of less than 12.

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.

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.

Unforeseen Conditions

If unforeseen or undetected critical soil conditions such as soft spots or seepage water are encountered during the field operations, corrective measures shall be made in the field as they are detected.
**Boring Log**

**PROJECT**
SHOPPING CENTER DEVELOPMENT

**LOCATION**
KANEHO, OAHU

**HAMMER:**
- **Weight:** 140 lb
- **Drop:** 20" S
- **Type:** 2" O.D. THIN WALL TUBE
- **Sampler:** 2.55 - 2" STANDARD SPLIT SPOON

**Boring No.**
WALTER LUM ASSOC

**Date:** 4/3/68

**Type of Boring**
AUGER

**Diam.**
8.71'

**Elev.**

**Drill Bit**
ROCK BIT

**Water Level:** 14.5'

**Time:** 3:30 PM

**Date:** 4/3/68

**Penetration Data**

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<th>Sampler 1-B</th>
<th>Sampler 1-C</th>
<th>Sampler 1-D</th>
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**STANDARD PENETRATION WALL TUBE TEST**

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

**Notes:**
- MEDIUM BROWN SILTY CLAY WITH ORGANIC MATERIALS (ROOTS, GRASS)
- STIFF TO VERY STIFF BROWN SILTY CLAY
- STIFF TO VERY STIFF BROWN & GRAY CLAYEY SILT (DECOMPOSED ROCK)
- VERY STIFF TAN & REDDISH BROWN CLAYEY SILT (DECOMPOSED ROCK)
- VERY STIFF TO HARD BROWN CLAYEY SILT & DECOMPOSED ROCK
- VERY DENSE BOULDERS & LAVA ROCK

**Elevation Estimated From Contour Plan**

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**Elevation:**

- 1.5 ft
- 2.5 ft
- 3.5 ft

**Elevation:**

- Estimated from Contour Plan

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**WALTER LUM ASSOCIATES**

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931
Boring Log

**SHOPPING CENTER DEVELOPMENT**

**LOCATION**
KANEHOE, OAHU

**PROJECT**

<table>
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<tr>
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<th>Description</th>
<th>Depth (Ft.)</th>
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<th>Sample No.</th>
<th>Liquid Limit</th>
<th>Water Cont.</th>
<th>Unconf. Comp.</th>
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<td>2-B 43</td>
<td>2-C 53</td>
<td>2-D 47/43</td>
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<td>2-F 57</td>
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**STIFF TO VERY STIFF MOTTLED BROWN SILTY CLAY W/ TRACES OF DECOMPOSED ROCK**

**MEDIUM REDDISH BROWN & GRAY SILTY CLAY W/ DECOMPOSED ROCK**

**SOFT TO MEDIUM BROWN, TAN & GRAY SILTY CLAY W/ DECOMPOSED ROCK**

**VERY STIFF TO HARD BROWN GRAY & BLACK CLAYEY SILT (DECOMPOSED ROCK)**

*ELEVATIONS ESTIMATED FROM CONTOUR PLAN*
# Boring Log

**Project:** Shopping Center Development  
**Location:** Kaneohe, Oahu

**Hammer:**  
- **Type:** Auger  
- **Weight:** 140 lb  
- **Drop:** 30 ft

**Sampler:**  
- **Type:** Rock Bit

**Driller:** W. Lum Associates  
**Date:** 4/5/68  
**Datum:** 0.2 ft  
**Time:** 4:30 PM

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<td>3-E</td>
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- **Vane Shear:** 6'5' %
- **Blows:** 2 blows per foot
- **Blows/0.5 ft:** 196

**Penetration Data:**
- **Standard Penetration Test (SPT):**
- **Wall Tube Sample:**

**Description:**
- **Very Soft to Soft Brown Silty Clay w/ Organics Materials (Roots):**
- **Very Soft to Soft Gray Brown Silty Clay & Decomposed Rock:**
- **Stiff to Very Stiff Reddish Brown Clay & Gray Clayey Silt (Decomposed Rock):**
- **Very Dense Blue Lava Rock:**

**Notes:**
- *Elevations estimated from contour plans*
# Boring Log

**PROJECT**
SHOPPING CENTER DEVELOPMENT

**LOCATION**
KANEHOA, OAHU

**HAMMER**
Weight: 140 lb
Drop: 3.0'

**SAMPLER**
2" 5 - 2" O.D. THIN WALL TUBE
2" 55 - 3" STANDARD SPLIT SPOON

**LOCATION**

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<th>Plastic Limit</th>
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**ELEVATIONS ESTIMATED FROM CONTOUR PLANS**

**DESIGNATION**
MEDIUM BROWN SILTY CLAY W. SOME SAND & GRAVEL

**STIFF REDDISH BROWN SILTY CLAY W/ DECOMPOSED ROCK**

**SORT TO MEDIUM BROWN & BLACK SILTY CLAY W/ TRACES OF DECOMPOSED ROCK & WOOD**

**SORT TO STIFF GRAY SILT CLAY W/ GRAVEL & DECOMPOSED ROCK**

**DEVERSE TO VERY DENSE Boulders OR Lava Rock**

**PENETRATION DATA**

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<th>Blows Per Foot</th>
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<td>3/5</td>
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**ORIGINAL PENETRATION DATA**

- **Standard Penetration Test**
- **Wall Tube Penetration Test**
- **Sampler Penetration Test**
Boring Log

**PROJECT**: SHOPPING CENTER DEVELOPMENT

**LOCATION**: KANEHOA, OAHU

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

**SAMPLER**: 2 3/8 - 2' STANDARD SPLIT SPOON

** bore log details**

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<th>Soil Classification</th>
<th>Description</th>
<th>Sample No.</th>
<th>Liquid Limit</th>
<th>Water Cont.</th>
<th>Plastic Limit</th>
<th>Unconf. Comp.</th>
<th>Vane Shear</th>
<th>P.S.F.</th>
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**PENETRATION DATA**

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<td>40 BLOWS/0.5</td>
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**ELEVATIONS ESTIMATED FROM CONTOUR PLANS**
**Boring Log**

**PROJECT**

**LOCATION**

**HAMMER:**
- **Weight:** 110 lbs.
- **Drop:** 30 ft.

**SAMPLER:**
- **2" x 6" Standard Split Spoon**

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**DESCRIPTION**

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<th>Depth (ft)</th>
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**ELEVATIONS ESTIMATED FROM CONTOUR PLAN**

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**WALTER LUM ASSOCIATES**

3030 WAIKALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-921
**Boring Log**

**PROJECT:** SHOPPING CENTER DEVELOPMENT

**LOCATION:** KANELOE, OAHU

**HAMMER:**
- Weight: 120 lb
- Drop: 30'

**SAMPLER:**
- Type: 2" 45-2 Standard Split Spoon

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<td>DENSE TO VERY VERY Boulders OR. LAVA ROCK</td>
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**ELEVATIONS ESTIMATED FROM COUTOUR PLAN**
**Boring Log**

**SHOPPING CENTER DEVELOPMENT**

**LOCATION** KANEHOE, OAHU

**TYPICAL BORING DATA**

- **Weight**: 140 #
- **Drop**: 30'
- **Sampler**: 2' 55 - 2' STANDARD SPLIT SPOON
- **Water Level**: 2.0'
- **Elev.**: 85'
- **Date**: 4/2/68

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<th>Unconf. Comp.</th>
<th>Penetration Data</th>
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<tbody>
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<td>MEDIUM STIFF BROWN Silty Clay</td>
<td>0' - 4'</td>
<td>D-A</td>
<td>41</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
<td>3 BLOWS PER FOOT</td>
</tr>
<tr>
<td>MEDIUM TO STIFF REDDISH BROWN Silty Clay</td>
<td>4' - 5'</td>
<td>D-B</td>
<td>53</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 BLOWS PER FOOT</td>
</tr>
<tr>
<td>MEDIUM REDDISH BROWN Silty Clay</td>
<td>5' - 6'</td>
<td>D-C</td>
<td>75</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7/8&quot; - 7/8&quot;</td>
</tr>
<tr>
<td>STIFF GRAY SILTY CLAY W/ ORGANIC MATERIALS</td>
<td>6' - 7'</td>
<td>D-D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOFT TO MEDIUM GRAY SILTY CLAY W/ DECOMPOSED GRAVEL</td>
<td>7' - 8'</td>
<td>D-E</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>STIFF BROWN GRAY CLAYET SILT W/ DECOMPOSED ROCK</td>
<td>8' - 15'</td>
<td>D-F</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>MEDIUM DENSE TO DENSE MOTTLED BROWN GRAY SILT (DECOMPOSED ROCK)</td>
<td>15' - 20'</td>
<td>D-G</td>
<td>34</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VERY DENSE BROWN LAVA ROCK</td>
<td>20'</td>
<td>D-H</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CORED = 5.0'</td>
</tr>
</tbody>
</table>

---

**ELELATIONS ESTIMATED FROM CONTOUR PLAN**

**WALTER LUM ASSOCIATES**

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931
### 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>GRADEING ANALYSIS</th>
<th>ATTERBERG LIMITS</th>
<th>UNIFIED SOIL CLASSIFICATION</th>
<th>SPECIFIC GRAVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4.5' - 5.5'</td>
<td>MOTTLED BROWN CLAYEY Silt W/D EACMP ROCK</td>
<td></td>
<td>NATURAL</td>
<td>MH</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.5' - 8.6'</td>
<td>DARK BROWN ORGANIC/ CLAY W/ROOTS</td>
<td></td>
<td>NATURAL</td>
<td>OH</td>
<td></td>
</tr>
</tbody>
</table>

#### GRADEING 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></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### ATTERBERG LIMITS

<table>
<thead>
<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>
<th>Specific Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>119</td>
<td>55</td>
<td>60</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td>HIGH</td>
<td></td>
</tr>
<tr>
<td>Natural</td>
<td>117</td>
<td>30</td>
<td>67</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td></td>
</tr>
</tbody>
</table>

#### UNIFIED SOIL CLASSIFICATION

| MH                          | OH                          |

#### EXPANSION AND CBR TESTS

(Surcharge-51 P.S.F.)

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

#### COMPACTION TEST

(AASHO T-180-57 Method)

<table>
<thead>
<tr>
<th>Dry to Wet or Wet to Dry Max. Dry Density (P.C.F.)</th>
<th>Optimum Moisture (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*INDICATES SAMPLE TESTED TAKEN ADJACENT TO BORING NUMBER*
TABLE I - 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>GRADEING ANALYSIS</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>7</td>
<td>6'-6.5'</td>
<td>MOTTLED</td>
<td>REDDISH-TAN</td>
<td>NATURAL Natural</td>
<td>MH</td>
<td>2.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td></td>
<td>CLEVEY SILT</td>
<td>WEDECOMP, ROCK</td>
<td>SLOW-MED.</td>
<td>MH-CH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td></td>
<td>MOTTLED</td>
<td>BROWN</td>
<td>MEDIUM</td>
<td>CM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>SURFACE</td>
<td>SILTY CLAY</td>
<td>ORGANIC CLAY</td>
<td>MEDIUM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>6'-8'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Indicates sample tested taken adjacent to boring number.
JOB: SHOPPING CENTER DEVELOPMENT

LOCATION: KANEHOE, Koolaupoko, Oahu, Hawaii

Plastic Index

Liquid Limit

"A" LINE

CL

CH

ML

MH & GH

CL ~ ML

8-A

7-C

5-D

B-A

B-C

INDICATES SAMPLE TESTED ADJACENT TO BORING NUMBER

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

PROJECT: SHOPPING CENTER DEVELOPMENT
LOCATION: KANEHOE, KUALOAPOKO, OAHU, HAWAII
SAMPLE NO: 8 SURFACE
SAMPLE DESCRIPTION: MOTTLED BROWN SILTY CLAY W/SAND & GRAVEL

MAX DRY DENSITY = 104.7pcf
OPTIMUM WATER CONTENT = 16.6%
ZERO AIR Voids CURVE
SPECIFIC GRAVITY = 2.59

WATER CONTENT (%)

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

BY __________ DATE __________
COMPACTED FILL

WET GROUND

STIFF MATL

COARSE FILTER:
S4C .... 50%
BASE COURSE ROCK 50%

FILTER ROCK
S4C

PERFORATED PIPE
G" Ø ASBESTOS OR METAL

TYPICAL SUBDRAIN

NO SCALE

SOFT

STIFF MATL

FOOTINGS IN SOFT GROUND

NO SCALE