ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE
SOIL EXPLORATION REPORT

WAIAWA & WAIPIO, EWA, OAHU, HAWAII
TAX MAP KEY: 9-4-08 & 9-6-02 & 03

To:
COMMUNITY PLANNING, INC.

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

NOVEMBER 4, 1974

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

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November 4, 1974

MR. GEORGE HOUGHTAILING
Community Planning, Inc.
700 Bishop Street, Suite 608
Honolulu, Hawaii 96813

Gentlemen:

Subject: Entrance Roadway to Leeward Community College
Soil Exploration Report
(for roadway grading and pavement thickness design purposes)
Waiawa & Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08 & 9-6-02 & 03

Transmitted herewith is our soil exploration report for roadway grading and pavement thickness design purposes for the Entrance Roadway to Leeward Community College at Waiawa & Waipio, Ewa, Oahu, Hawaii.

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

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By Ezra Koike
Ezra Koike

EK:rmf

C O N T E N T S

ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE
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WAIAWA & WAIPIO, EWA, OAHU, HAWAII
TAX MAP KEY: 9-4-08 & 9-6-02 & 03

SCOPE OF EXPLORATION

The purpose of this exploration was to evaluate general soil conditions for roadway grading and pavement thickness design considerations for the Entrance Roadway to Leeward Community College at Waiawa and Waipio, Ewa, Oahu, Hawaii.

This report includes field exploration, laboratory test results, general recommendations for roadway grading and pavement thickness design considerations and limitations.

FIELD EXPLORATION

Five borings were made along the proposed roadway alignment. Also, attached for reference are logs of 10 borings drilled for the Waiawa Street Improvement District (preliminary studies in May and June 1971) and 6 borings from "Leeward Village Apartments," report dated April 15, 1971. The approximate boring locations are shown on the Boring Location Sketch.

Borings were made with 3 and 4-in. diameter augers using finger type bits. Soil samples were recovered with 2-in. thin-wall tubes and 2-in. standard split spoon samplers driven with a 140-lb hammer falling 30 inches.

LABORATORY TESTS

Laboratory tests included: natural water content, unconfined compression, Atterberg limit, AASHO T-180-73I density, specific gravity and CBR.

A summary of laboratory test results are attached. Also attached are laboratory test results for Waiawa Street Improvement District Studies.

SOIL CLASSIFICATION SYSTEM

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

GEOLOGIC AND SOIL DESCRIPTIONS BY OTHERS

From a review of geologic literature and the U. S. Soil Conservation Service maps of the area, the soils generally described by others are as follows:

Stearns, H. T. and U. S. Geological Survey, "Geologic and Topographic Map of Island of Oahu," 1938:

Ra - Unconsolidated noncalcareous deposits, chiefly younger alluvium

Pa - Consolidated noncalcareous deposits, chiefly older alluvium

U. S. Soil Conservation Service, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii," August 1972:

WzA - Waipahu silty clay, 0 to 2% slopes, "CL" - Unified Soil Classification

WzC - Waipahu silty clay, 6 to 12% slopes, "CL" - Unified Soil Classification

Ph - Pearl Harbor clay, nearly level, "CH" & "Pt" - Unified Soil Classification

GENERAL SITE CONDITIONS

The proposed Entrance Roadway to Leeward Community College is located about 1,000 ft south of the intersection of Farrington Highway and

Waipio Point Access Road. The roadway extends from Waipio Point Access Road in a northeasterly direction for about 3,200 ft towards the south side of Leeward Community College.

A classroom building and two hot-houses are located near the property line at the western end of the proposed roadway.

Portions of the route follow existing unimproved roadways and the remainder generally crosses rolling topography that is covered with trees and brush.

Watercress and taro farms are located on the south or makai side of the proposed roadway. The proposed roadway is generally about 75 to 150 ft from the edge of the watercress and taro patches and marshy ground. However, between about Sta. 6+00 to Sta. 9+00, the edge of marshy ground may be closer than 20 to 30 ft from the proposed roadway. The section near Sta. 31+00 may be about 50 ft from the edge of the watercress farms.

Underground utility lines were noted along portions of the proposed alignment.

Some stockpiles of trash were noted along the cane haul road at the western portion for the proposed roadway. Stockpiles of rock and soil were noted between Sta. 8+00 and Sta. 12+00 of the proposed roadway.

INTERPRETATION OF SOIL CONDITIONS

From the field exploration and laboratory test results, the soils along the proposed roadway vary considerably and may be approximated as follows:

About Sta. 00+00 to Sta. 5+50

A surface layer, about 3 to 4 ft, of stiff clayey silt (MH soil), then stiff to hard clay (CH soil) to about 8 to 13 ft, then dense silty sand (SM) to about 31 ft, the maximum depth drilled in Boring No. C.

Water was not noted in the borings between these stations during the field exploration.

About Sta. 5+50 to Sta. 13+00

The makai or south side of the proposed roadway may be located near the edge of some marshy ground.

Along the center and mauka (northern) side of the roadway, Boring Nos. 2 and 3 (Waiawa Street Improvement District Studies) generally indicated medium to stiff silty clays. A soft pocket was noted in Boring No. 4 (Waiawa Street Improvement District Studies) at about 9 to 14-ft depths.

Water was noted at about 14 to 16-ft depths in the borings between these stations during the field explorations.

<u>About Sta. 13+00 to Sta. 19+00</u>

A layer about 15 to 20 ft thick of medium to stiff silty clays and clayey silts (MH soils) with pockets of clay and silty sand or gravels. Some soft pockets may occur towards the western portion (Sta. 13+00 to 15+00).

Water was noted at about 9 to 17-ft depths in the borings between these stations during the field explorations.

<u>About Sta. 19+00 to Sta. 24+00</u>

A surface layer about 4 to 20 ft or more of stiff to hard clayey silt (MH soil) underlain with silty sand and decomposed rock to about 18 ft. Below this: stiff clayey silt to about 36 ft, the maximum depth drilled in Boring No. D.

Clay (CH soil) was noted in Boring No. 5 (Leeward Village Apartments report) from the surface to about 4-ft depth.

Water was not noted in the borings between these stations during the field explorations.

About Sta. 24+00 to About Sta. 32+00 (End of Roadway)

A surface layer about 6 to 13 ft of stiff clayey silt and silty clay (MH soil) underlain with sand or gravelly soils to about 9 to 21 ft. Below this: stiff silty clay to about 31 ft, the maximum depth drilled in Boring No. 20 (Leeward Village Apartments report).

A soft or medium soil pocket was noted in Boring No. 20 at about 3 to 8-ft depths.

Water was noted in the borings between these stations at about 8 to 18-ft depths during the field explorations.

Variations to the above soil conditions are to be expected between borings and in localized areas. For more detailed descriptions of soils encountered in the borings, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

The proposed plan is to construct an Entrance Roadway from the Waipio Point Access Road towards Leeward Community College, a distance of about 3,200 ft.

The roadway is generally planned in cuts and fills of about 5 to 30 ft.

The topography and soil conditions vary along the proposed road alignment.

Utility lines are known to cross the proposed roadway alignment. The contractor should refer to the plans for utilities and should proceed with caution wherever utilities are suspected.

A general discussion of the soil features and grading contemplated along the proposed roadway may be roughly broken down by various sections as follows:

<u>Sta. 0+00 (Beginning of Roadway) to Sta. 5+50</u>

The borings generally indicated 3 to 4 ft of clayey silts over about 4 to 10-ft thick "CH" clays, then dense silty sands to 20-ft depths or more.

The roadway is planned mostly in cut along this section.

Retaining walls (about 8 to 12-ft heights) and slopes (about 5 to 30 ft in height) are proposed.

Because some existing structures are located near the tops of the proposed slopes and retaining walls in this section, development should be carefully planned and designed. The contractor should take precautions in his construction procedures in this area so as to minimize damages to existing structures and ground features.

For the design of retaining walls in this section, clay "CH" soils in the upper layers should be removed and replaced with select material behind the retaining walls to form a buttress (see Figure 1).

Clay soils encountered at the bottoms of wall footing excavations should be removed to a depth of about 2 ft and replaced with compacted select material.

Low slopes (6 ft or less in height) in clay soils may be designed at 3 horizontal to 1 vertical or flatter slopes; otherwise, the outer portion of the slopes should be removed and replaced with a buttress fill of select materials (see Figure 1).

<u>About Sta. 5+50 to Sta. 13+00</u>

The makai (south) side of the proposed roadway in the vicinity of Sta. 6+00 to Sta. 9+00 may be located near the edge of some marshy ground. Pockets of "muck" or soft organic soils may be encountered in this section. Provisions should be made for removal of soft pockets and reconstruction with fairly well-graded granular materials.

Stockpiles of soil and rock were noted from about Sta. 8+00 to Sta. 12+00. The loose materials should be removed down to stiff natural ground before placement of fills.

Cuts and fills of about 5 to 10 ft are contemplated along this section.

In general, slopes of about 2 horizontal to 1 vertical or flatter should be used. If practicable, 3 to 1 or flatter fill slopes would be preferable in the vicinity of marshy ground.

About Sta. 13+00 to Sta. 19+00

The borings generally indicated medium to stiff silty clay to about 15 to 20-ft depths. Some soft soil pockets may be encountered towards the western portion, Sta. 13+00 to Sta. 15+00.

Cuts and fills of about 5 to 10 ft are planned along this section.

The alignment follows alongside portions of an existing roadway that may be on an embankment. Fills are generally planned on the makai side of the roadway.

After clearing and grubbing, drainage and subdrainage of low spots should be done before fill construction. The loose outer portions of the existing road embankment should be stripped and the new fills keyed into stiff ground.

Slopes of about 2 horizontal to 1 vertical or flatter may be considered.

<u>About Sta. 19+00 to Sta. 24+00</u>

The borings generally indicated a stiff to hard layer about 5 to 20 ft or more thick underlain with silty sand and decomposed rock to about 18 ft around Sta. 21+00 to Sta. 22+00. Below the sandy and decomposed rock layers appear to be clayey silts to about 30-ft or more depths.

Preliminary sketches indicate cuts of about 10 to 20 ft from Sta. 19+00 to Sta. 23+00.

On the left side of the roadway cut, a concrete retaining wall is proposed about 8 to 12 ft high and about 350 ft in length.

The retaining wall footings should be located on the stiff underlying material.

About Sta. 24+00 to Sta. 31+47 (End of Roadway)

The borings generally indicated a stiff layer about 20 ft or more in thickness with layers or pockets of silty sand, gravels or decomposed rock.

Cuts and fills of about 5 to 10 ft are contemplated.

Slopes of about 2 horizontal to 1 vertical or flatter should be used.

A proposed sewer line about 20 ft deep is planned near the toe of the proposed roadway fill slope near Sta. 31+00.

If practicable, the sewer line should be moved away from the toe of slope a distance so that the toe of fill slope will be below a line drawn upward at a 2:1 ratio or flatter from the invert of the sewer line.

If relocation of the sewer line is impracticable, the design and installation of the sewer line should be done with caution. Because construction of the sewer line would disturb the medium to stiff in-situ soils, some lateral movements toward the trench may occur. To minimize lateral movement, backfill of trenching should be done with care. The contractor should work in short, well-braced sections and backfill the trenches as soon as practicable. The backfill above the pipes should be compacted in thin lifts to 90% of AASHO T-180-73I density.

Site Grading

Selected on-site or approved off-site borrow soils may be considered for the fill construction. Site grading, particularly construction of fills, should be done as early as practicable to allow the ground to adjust to the new load conditions before pavement construction.

Work in the vicinity of existing utilities, particularly gas and fuel oil lines, should be coordinated with the respective utilities to minimize damages or interference with their operations.

Grading work should be done in accordance with the Revised Ordinances of Honolulu, 1969 As Amended; and as recommended below:

1. The area should be cleared and grubbed. Surface vegetation, rubbish, debris and

abandoned structures should generally be cleared and removed prior to site filling.

2. Topsoil and stockpiled soils should be stripped to stiff natural ground before the placement of fills. Loose surface soils at finish grade should be scarified and recompacted.

3. Soft spots or "CH" clay pockets encountered during site preparation should be excavated and replaced with select material compacted in thin lifts.

Pockets of "muck" or soft organic material may be encountered in the vicinity of about Sta. 6+00 to Sta. 10+00. Provisions should be made for removal of soft pockets and backfilling with selected materials. Below ground water level and to about 4 ft above water level, selected fill material should be fairly well-graded granular material. Above that, selected general fills may be considered.

4. Hard surfaces along the existing roads and in localized areas should be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

5. Where fills are proposed in sidehill areas and across the natural drainageways, loose material along the bottom and sides should be stripped down to stiff natural ground or scarified and recompacted before the placement of fills.

   A blanket of filter rock should be placed along the bottom and sides of the natural drainageway before the placement of fills. Subdrains should be placed to drain the low spots. The locations of subdrains should be determined in the field after clearing and grubbing.

6. Thin sidehill fills (sliver fills) on sloping areas should be avoided.

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 continually be keyed into the stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

8. Old cesspools or pits should be located on the grading plan and backfilled before grading work is started. The recommended procedure for backfilling is outlined in the attached "Proposed Specification for Earthwork."

   Existing artesian wells encountered on the site should be accurately located. The Board of Water Supply should be notified before capping off a well.

9. If boulders are proposed to be used in the construction of fills, they should be generally

placed along the toe section of the fill slope. Before placing any boulders, the subgrade should be stripped to stiff natural ground and shaped to drain. A transition layer of select granular material (6 in. to dust sizes) should be placed on the subgrade and the boulders placed on the select material. A transition layer of select granular material should also be placed against the boulders before earth fills are placed against the boulders. Earth fill may be used in void spaces between boulders. See attached sketch, Figure 2.

10. Fills should be laid in 6-in. compacted layers. The top 2 ft of fill should be compacted to a density of at least 95% of AASHO T-180-73I density and below this to at least 90%.

11. Provisions to drain the site should be included during and after the completion of filling operations.

Slopes

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

To minimize erosion, the runoff from rainstorms should be diverted away from slopes by berms or ditches whenever practicable.

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.

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

Where plastic "CH" clays are encountered at the site, slope ratios generally about 3 horizontal to 1 vertical or flatter should be used for slopes less than about 6 ft in height; otherwise, slope adjustments such as use of buttress fill should be considered.

A buttress fill should be used for slope cuts greater than 6 ft in height in "CH" soils. When practicable, the base of the buttress fill should extend thru the "CH" clay down to older alluvium or sandy material. The buttress fill may be constructed with selected soils. See Figure 1.

Retaining Walls

In general, retaining walls should be designed with good drainage provisions along the back and base of the wall.

The backfill of the wall should be constructed with fairly well-graded granular soils.

Subdrains should be placed along the base of the walls and daylighted at low points. Outlet areas should be blanketed with filter rock to minimize plugging the outlets.

The excavation for walls should be made preferably after the site has been graded and compacted and prior to the start of paving construction.

The bottoms of walls should rest on stiff natural ground or on compacted select material.

Where clay "CH" soils occur in the upper layers in back of retaining walls, the clay soils should be removed and replaced with selected materials to form a buttress (see Figure 1). Soft or clay (CH) soil pockets at the bottoms of footing excavations should be removed and replaced with well-graded granular material or low grade concrete.

For lateral earth pressures, assuming a select well-drained backfill and drains are provided, an equivalent fluid pressure of about 45 p.c.f. may be used for a level backfill. For a sloping backfill, the lateral pressure should be increased according to earth pressure charts by Terzaghi & Peck, or other similar accepted theory. In addition, lateral earth pressures should be added for anticipated vehicular loads or other surcharge loads.

The center of pressure should be considered to act somewhat above the lower third of the triangular fluid pressure diagram, assuming that subdrainage and drainage of the backfill are provided.

Bearing values of about 2500 p.s.f. may be used for retaining wall foundations resting on stiff natural ground. The bearing values may be somewhat increased for toe pressures.

For sliding resistance between the base and subgrade, a coefficient of friction of 0.40 may be used provided the base of the wall is well drained, and there is sufficient (2 times the base) stiff material in front of the toe of the wall.

Roadway Pavement Thickness Design

In general, based on the City and County of Honolulu design standard for flexible pavement for automobile traffic and drained subgrade conditions, the roadway pavement sections may be estimated as follows:

1. Wearing course - 2-in. asphaltic concrete (residential).

   2-1/2-in. asphaltic concrete (business and industrial).

2. Base course - 6-in. base course.

3. Subbase course - 6-in. select borrow over a prepared subgrade.

   (0 in. over rocky or sandy soil)

4. Borrow - 18-in. borrow over clay, "CH" soils (CBR < 3, Expansion > 6).

Suggested preliminary pavement sections along various portions of the roadway for design and estimating purposes are shown on the Boring Location Sketch.

The need for a select borrow subbase or a borrow fill course will depend upon the actual material used in the construction. Thickness of the subbase should be determined by testing the soils exposed at subgrade level during construction.

Provisions should be made in the contract documents to allow for field adjustments regarding the select borrow subbase and borrow material requirements in accordance with the design standards of the City and County of Honolulu. In fill areas, the use of select soils within the top 2 to 3 ft of the subgrade may reduce the thickness of or eliminate the need for the select borrow subbase or borrow courses.

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.

<u>Unforeseen Conditions</u>

Because of the variability of soil deposits, site improvements, design and construction techniques, conditions may be encountered that cannot be foreseen with even the most exhaustive studies of site and project conditions. These unforeseen conditions should be recognized when encountered and then evaluated so that the designs or the construction methods may be modified accordingly, if necessary.

Unforeseen or undetected conditions such as soft spots, existing utility trenches, underground structures, boulders, expansive soil pockets or seepage water, etc., may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

PROPOSED SPECIFICATION FOR EARTHWORK

ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

General Description

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

Clearing, Grubbing and Preparing Areas to be Filled

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

Topsoil and stockpiled soils shall be stripped to stiff natural ground before the placement of fills. Loose surface soils 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.

Soft spots or pockets of "muck" or soft organic material shall be excavated and replaced with selected materials. Below ground water level and to about 4 ft above water level, selected fill material shall be fairly well-graded granular material. Above that, selected general fills may be considered.

Where fills are proposed in sidehill areas and gullies, loose material along the bottoms 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 bottoms 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 soils engineer.

Materials

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

Borrow soils shall be select soils with rock sizes generally less than 6-in. maximum size and a plasticity index generally less than 20. Material placed in the top 6 in. of fills shall be generally less than 3-in. maximum in size.

Select granular material for buttress fills shall generally be fairly well-graded granular material generally less than 6-in. maximum size and plasticity index less than 20.

Select granular material for subdrains shall generally be less than 1-1/2-in. maximum size, with about 90% passing the 1-in. sieve. The material shall be well-graded with less than about 5% passing the No. 200 sieve.

Selected granular material for fills below ground water and for backfill of trench above the subdrain filter rock shall generally be well graded, less than 1-1/2-in. maximum size and less than 15% passing the No. 200 sieve.

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 blade-mixed during the spreading to attain uniformity of material and water content within each layer.

Rocks or cobbles shall not be allowed to nest, and voids between rocks must be 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 is slightly on the wet side of optimum to minimize expansion.

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 approaches, but is on the wet side of the optimum.

After each layer has been placed, mixed and spread evenly, it shall be compacted to 90% of maximum density in accordance with AASHO Test No. T-180-73I or other comparable density tests. For fills in roadway areas, the top 2 ft of fill shall be compacted to 95% of the maximum density.

Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers which shall be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is at the specified water content. The rolling of each layer shall be continuous over the area and the roller shall make sufficient passes to obtain the desired density.

Field density tests shall be made to get an indication of the compaction of the fill. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density readings shall be taken 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 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.

<u>Backfilling of Old Cesspools or Pits</u>

The following procedures shall be followed for backfilling:

(1) <u>Sludge Removal</u>

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

(2) <u>Granular Fill (below 3 ft from finish grade)</u>

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-180-73I density. Ramming each layer into place with a clamshell bucket will be allowed. The granular fill shall be wetted before placement into the cesspools or pits. Sufficient compaction tests shall be conducted to verify that 90% compaction is obtained by the construction method selected.

(3) <u>Top 3 Ft of Fill</u>

Linings encountered in the cesspools or pits 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-180-73I 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.

Slope Adjustments

Where plastic "CH" clays are encountered and where slopes greater than 6 ft are proposed, the outer portions of the slopes shall be constructed with select materials.

If pockets of clay soils are encountered in slope excavations, the slopes shall be adjusted by use of flatter slopes or by removal of the clay "CH" pockets and reconstruction of the slopes with select materials. The actual remedial measures will depend upon field conditions.

Boulder Fills

If boulders are used in the construction of fills, they shall be generally placed along the toe section of slopes. The subgrade shall be stripped to stiff natural ground, shaped to drain and a transition layer of select granular material (6 in. to dust sizes) shall be placed on it. A transition layer of select granular material shall be placed against the boulders before earth fills are placed against the boulders. Earth fills may be used in void spaces between boulders.

Unforeseen Conditions

If unforeseen or undetected soil conditions such as soft spots, existing utility trenches, underground structures, boulders, expansive soil pockets or seepage water are encountered during the field operations, 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

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

Symbols

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

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

Where no parenthesis "MH" is used, the soil sample was classified from either the Atterberg limit or grain-size analysis test results.

ENTR. TO LEEWARD COMM COLLEGE

WALTER LUM ASSOCIATES, INC.

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii

BORING NO. A Sheet No. ___ of ___

Driller: W. LUM ASSOC., INC. Date: AUG. 8, 1974

Field Party: RADOVICH, KAJ, OSHIRO

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

Elev. 46'±* Datum —

Drill Bit: T.C. DRAG

Water Level: NOT NOTICED
Time: —
Date: 8-8-74

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2"SS - 2" STANDARD SPLIT SPOON; 3"S - 3" O.D. THIN WALL TUBE

Unified Soil Classification	DESCRIPTION (ELEV. = 46'±* 20)	Depth (Ft.)	Sampler	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot)	3" O.D. Thin Wall Tube Sampler Blows/0.5'
(MH)	STIFF, BROWN SILTY CLAY		2"SS	A-A	–	21	–	–	–		
CH	STIFF, BROWN CLAY	5	3"S	A-B	–	25; γ_W = 111; γ_D = 89	–	4580	–		4/0.5' 5/0.5'
		10	3"S	A-C	26	29; γ_W = 119; γ_D = 92	55	5830	–		9/0.5' 13/0.5'
(SM)	DENSE MOTTLED GRAY-BROWN SILTY SAND	15	2"SS	A-D	–	43	–	–	–		40/0.5'
(SM)	DENSE, TAN WHITE SILTY SAND W/CORAL	20	2"SS	A-E	–	22	–	–	–		
	END OF BORING @ 21.5' 8-8-74										

NOTE
γ_W = WET DENSITY, P.C.F.
γ_D = DRY DENSITY, P.C.F.

* Elevation estimated from topographic survey map by R. M. Towill Corporation

ENTR. TO LEEWARD COMM COLLEGE

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. B Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: AUG. 14, 1974
Field Party: RADOVICH, KAU
Type of Boring: AUGER (VERSA DRILL) Diam.: 4"
Elev.: 45'±* Datum: —
Drill Bit: T.C. DRAG
Water Level: NOT NOTICED
Time: —
Date: 8-14-74

ELEV. = 45'±*

Unified Soil Classification	Description	Depth (Ft.)	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Penetration Data: Standard Penetration Test N (Blows per foot)
(MH)	STIFF, LIGHT BROWN CLAYEY SILT	0	B-A	—	22	—	—	—	
CH	STIFF, BROWN CLAY	5	B-B	26	23	55	—	—	
		10	B-C	—	34	—	—	—	43/0.5'
(SM)	DENSE, BROWN SILTY SAND W/SOME DECOMPOSED ROCK	15	B-D	—	40	—	—	—	44
(MH)	STIFF, TAN SANDY SILT W/CORAL	20			65				
(SM)	MEDIUM DENSITY, WHITE SILTY SAND W/CORAL		B-E	—	29	—	—	—	
	END OF BORING @ 21.5' 8-14-74								

* Elevation estimated from topographic survey map by R. M. Towill Corporation

EHTR. TO LEEWARD COMM. COLLEGE

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii

BORING NO. C Sheet No. ____ of ____

Driller: W. LUM ASSOC., INC. Date: AUG. 8

Field Party: RADOVICH, KAU, OSHIRO

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

Elev. 46'± * Datum —

Drill Bit: T.C. DRAG

HAMMER:
Weight: 140#
Drop: 30"

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

Water Level	NOT NOTICED			
Time	—			
Date	8-8-74			

ELEV. = 46'± *

Unified Soil Classification	Description	Depth (Ft.)	Sampler	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot)	2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
(MH)	STIFF, BROWN CLAYEY SILT	0	2"SS	C-A	—	20	—	—	—		
GH	STIFF, MOTTLED BROWN CLAY	5	2"S	C-B	—	23 γ_W = 108 γ_D = 88	—	—	—		8/0.5' 12/0.5'
		10	2"SS	C-C	31	23	56	—	—	50	
(SM)	DENSE, BROWN & GRAY SILTY SAND W/ SOME DECOMPOSED ROCK	15	2"SS	C-D	—	28	—	—	—	33/0.5'	
		20	2"SS	C-E	—	34	—	—	—	40/0.4'	
(SM)	DENSE, TAN WHITE SILTY SAND W/CORAL	25	2"SS	C-F	—	11	—	—	—	47/0.5'	
	END OF BORING @ 31' 8-9-74	30	2"SS	C-G	—	11	—	—	—	25/0.5'	

* Elevation estimated from topographic survey map by R. M. Towill Corporation

NOTE
γ_W = WET DENSITY, P.C.F.
γ_D = DRY DENSITY, P.C.F.

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii

BORING NO. D Sheet No. ____ of ____

Driller: W. LUM ASSOC., INC. Date: AUG. 9 & 12, 1974

Field Party: RADOVICH, KAU, OSHIRO

Type of Boring: AUGER (MOBILE MINUTEMAN & VERSA DRILL) Diam. 3" & 4"

Elev. 52'± * Datum: —

Drill Bit: T.C. DRAG

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

Water Level	NOT NOTICED			
Time	—			
Date	8-12-74			

Unified Soil Classification	DESCRIPTION (ELEV. = 52'± * 0)	Depth (Ft.)	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot)
(ML)	STIFF, BROWN SANDY SILT W/SOME DECOMPOSED ROCK		D-A	-	25	-	-	-	45
(MH)	STIFF, MOTTLED BROWN CLAYEY SILT W/ DECOMPOSED ROCK	5	D-B	-	36	-	-	-	
		10	D-C	-	32	-	-	-	41
MH	STIFF, MOTTLED BROWN CLAYEY SILT W/ GRAY CLAY POCKETS & TRACES OF DECOMPOSED ROCK	15	D-D	38	42	66	-	-	55
(MH)	STIFF, BROWN CLAYEY SILT W/GRAY CLAY POCKETS	20	D-E	-	48	-	-	-	
		25	D-F	-	42	-	-	-	
MH	STIFF, MOTTLED BROWN CLAYEY SILT	30	D-G	40	42	56	-	-	
(MH)	STIFF, BROWN CLAYEY SILT	35	D-H	-	45	-	-	-	

END OF BORING @ 36.5'
8-12-74

* Elevation estimated from topographic survey map by R. M. Towill Corporation

ENTR. TO LEEWARD COMM. COLLEGE

WALTER LUM ASSOCIATES, INC.

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii

BORING NO. E   Sheet No. ____ of ____

Driller: W. LUM ASSOC., INC.   Date: AUG. 12, 1974

Field Party: RADOVICH, KAU

Type of Boring: AUGER (VERSA DRILL)   Diam.: 4"

Elev.: 16'± *   Datum: —

Drill Bit: T.C. DRAG

HAMMER:

Weight: 140#

Drop: 30"

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

Water Level	Time	Date
15.0'	2:30 PM	8-12-74

ELEV. = 16'± * 20

Unified Soil Classification	Description	Depth (Ft.)	Sampler	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot) 0 10 20 30 40	2" O.D. Thin Wall Tube Sampler Blows/0.5'
(MH)	STIFF, MOTTLED BROWN SILTY CLAY W/ SOME SAND & ROOTS		2"SS	E-A	–	26	–	–	–		
(MH)	STIFF, MOTTLED BROWN SILTY CLAY W/ DECOMPOSED ROCK	5	2"SS	E-B	–	30	–	–	–		
(MH)	STIFF, MOTTLED BROWN CLAYEY SILT W/GRAY, CLAY POCKETS	10	2"SS	E-C	–	49	–	–	–		
			WATER 8-12-74								
(MH)	STIFF, MOTTLED BROWN CLAYEY SILT W/ SOME SAND	15	2"SS	E-D	–	45	–	–	–		
(MH)	STIFF, MOTTLED BROWN CLAYEY SILT W/ DECOMPOSED ROCK	20	2"S	E-E	–	51 γ_W = 111 γ_D = 73	–	6150	–		15/0.5' 5/0.2'

END OF BORING @ 20.7' 8-12-74

NOTE
γ_W = WET DENSITY, P.C.F.
γ_D = DRY DENSITY, P.C.F.

* Elevation estimated from topographic survey map by R. M. Towill Corporation

ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	A	B	B	
SAMPLE NO.	C	B	E (TOP	
DEPTH BELOW SURFACE	10'-11'	5'-6.5'	20'-21.5'	
DESCRIPTION	BROWN CLAY	BROWN CLAY	TAN SANDY SILT W/CORAL	
GRAIN-SIZE ANALYSIS				
(% Passing)				
Sieve				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	
Liquid Limit	55	55		
Plastic Limit	26	26	NON-PLASTIC	
Plasticity Index	29	29		
Dilatancy	MEDIUM	SLOW		
Toughness	MEDIUM	MED.-HIGH		
Dry Strength	MED.-HIGH	MED.-HIGH		
UNIFIED SOIL CLASSIFICATION	CH	CH	(MH)	
APPARENT SPECIFIC GRAVITY				
CBR TEST				
(Surcharge-51 P.S.F.)				
Molding Moisture, %				
Molding Dry Density, P.C.F.				
Swell upon saturation, %				
CBR at 0.1" Penetration				
MOISTURE-DENSITY RELATIONS OF SOILS				
(AASHO T-180-73I, Method ___)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

REMARKS:

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

Date 9-13-74 By RJ

3-1273

ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

TABLE IB - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	C	C	D	D
SAMPLE NO.		C	D	G
DEPTH BELOW SURFACE	SURFACE	10'-11.5'	15'-16.5'	30'-31.5'
DESCRIPTION	BROWN SILTY CLAY	MOTTLED BROWN CLAY	MOTTLED BROWN CLAYEY SILT W/GRAY CLAY POCKETS	MOTTLED BROWN CLAYEY SILT
GRAIN-SIZE ANALYSIS (% Passing) Sieve				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	NATURAL
Liquid Limit	53	56	66	56
Plastic Limit	29	25	38	40
Plasticity Index	24	31	28	16
Dilatancy	MEDIUM	SLOW-MED.	MEDIUM	MEDIUM
Toughness	MEDIUM	MED.-HIGH	MEDIUM	MEDIUM
Dry Strength	MED.-HIGH	HIGH	MED.-HIGH	SLIGHT-MED.
UNIFIED SOIL CLASSIFICATION	MH-CH	CH	MH	MH
APPARENT SPECIFIC GRAVITY	2.79			
CBR TEST (Surcharge-51 P.S.F.)				
Molding Moisture, %	27.7			
Molding Dry Density, P.C.F.	91.7			
Swell upon saturation, %	1.4			
CBR at 0.1" Penetration	17.4			
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-73I, Method___)	A			
Dry to Wet or Wet to Dry	DRY TO WET			
Max. Dry Density (P.C.F.)	96			
Optimum Moisture (%)	27			

REMARKS:

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

Date 9-13-74 By RJT

3-1273

ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

TABLE IC - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	E			
SAMPLE NO.				
DEPTH BELOW SURFACE	SURFACE			
DESCRIPTION	MOTTLED BROWN SILTY CLAY			
GRAIN-SIZE ANALYSIS				
(% Passing)				
Sieve 1½"				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL			
Liquid Limit	59			
Plastic Limit	34			
Plasticity Index	25			
Dilatancy	MEDIUM			
Toughness	MED.-HIGH			
Dry Strength	MED.-HIGH			
UNIFIED SOIL CLASSIFICATION	MH			
APPARENT SPECIFIC GRAVITY	2.83			
CBR TEST				
(Surcharge-51 P.S.F.)				
Molding Moisture, %	28.5			
Molding Dry Density, P.C.F.	90.0			
Swell upon saturation, %	4.3			
CBR at 0.1" Penetration	3.2			
MOISTURE-DENSITY RELATIONS OF SOILS				
(AASHO T-180-73I, Method ___)	A			
Dry to Wet or Wet to Dry	DRY TO WET			
Max. Dry Density (P.C.F.)	91			
Optimum Moisture (%)	31			

REMARKS:

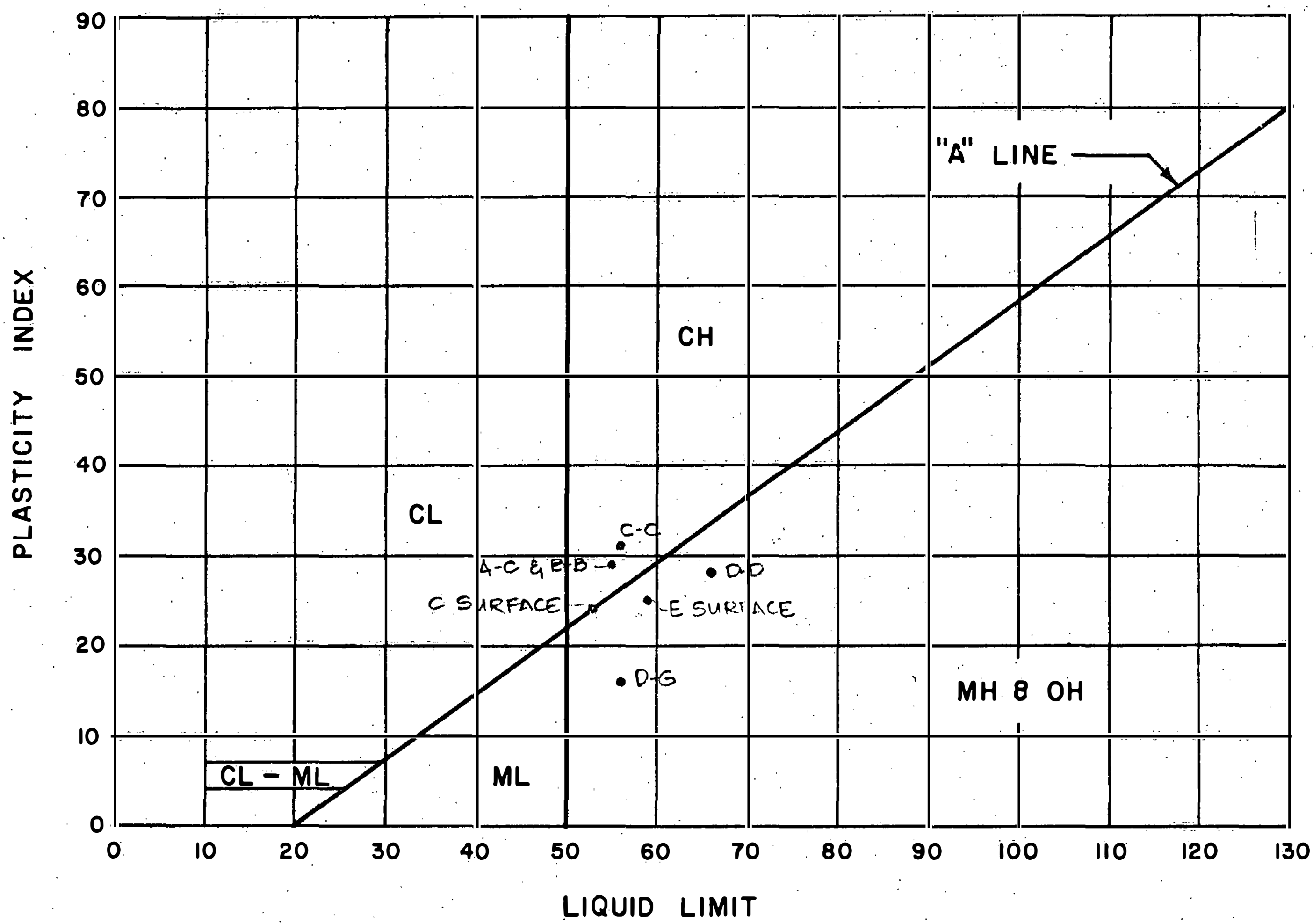
WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 9-13-74 By BT

3-1273

PLASTICITY CHART

PROJECT: ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE
LOCATION: WAIAWA & WAIPIO, EWA, OAHU, HAWAII



DATE 9-13-74 BY BT

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

8-872

MOISTURE–DENSITY CURVE (AASHO T-180-73I, METHOD A)

PROJECT: ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

AGGREGATE: 1/4" MINUS

LOCATION: WAIAWA & WAIPIO, EWA, OAHU, HAWAII

MOLD SIZE: 4"ϕ x 4.584" HIGH

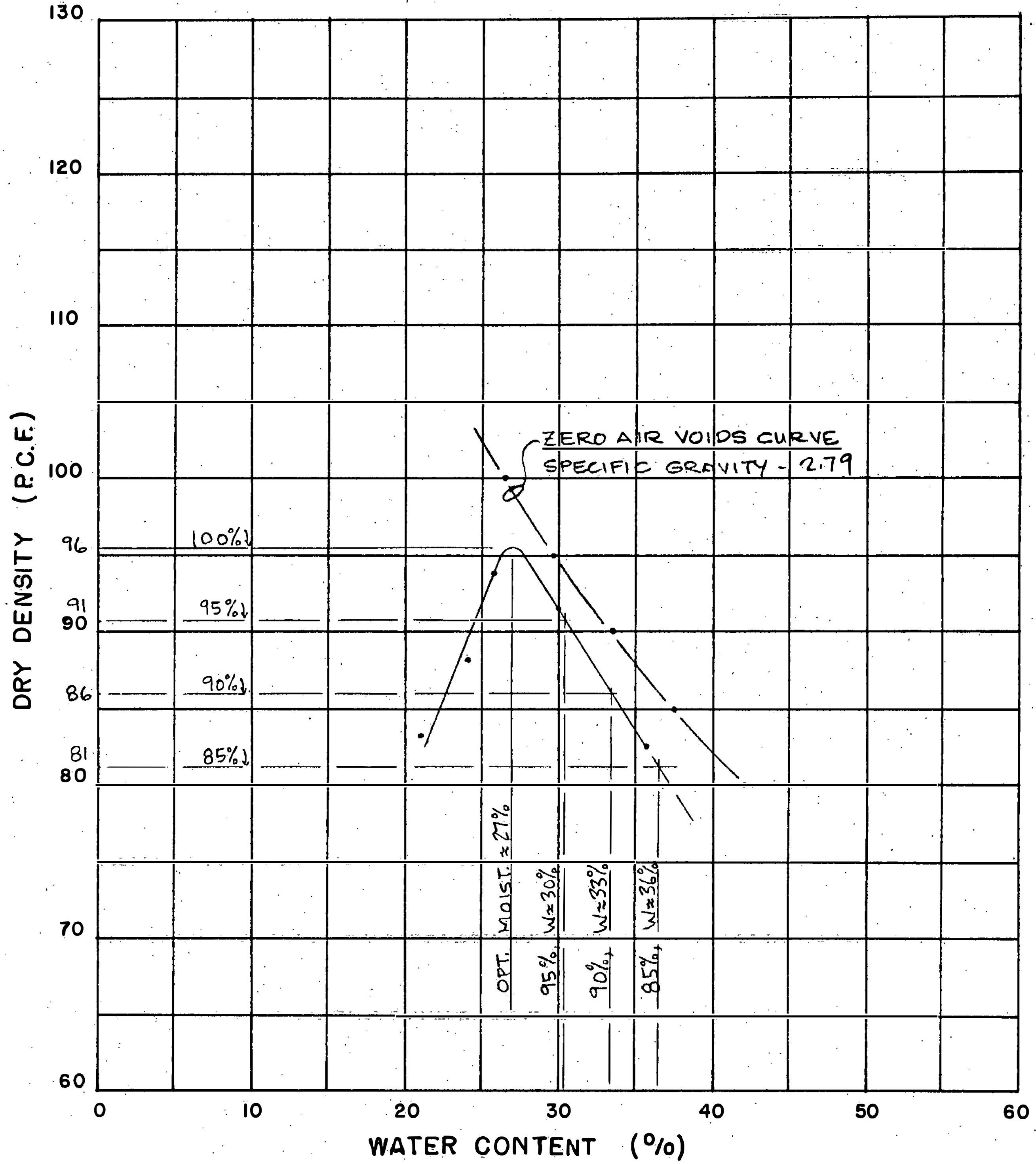
HAMMER: 10 LBS. 18" DROP

SAMPLE NO.: C SURFACE

LAYERS: 5

SAMPLE DESCRIPTION: BROWN SILTY CLAY

BLOWS: 56/LAYER



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

DATE 8-14-74 BY C.H.

9-470

MOISTURE-DENSITY CURVE (AASHO T-180-73I, METHOD A)

PROJECT: ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

LOCATION: WAIAWA & WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO.: E SURFACE

SAMPLE DESCRIPTION: MOTTLED BROWN SILTY CLAY

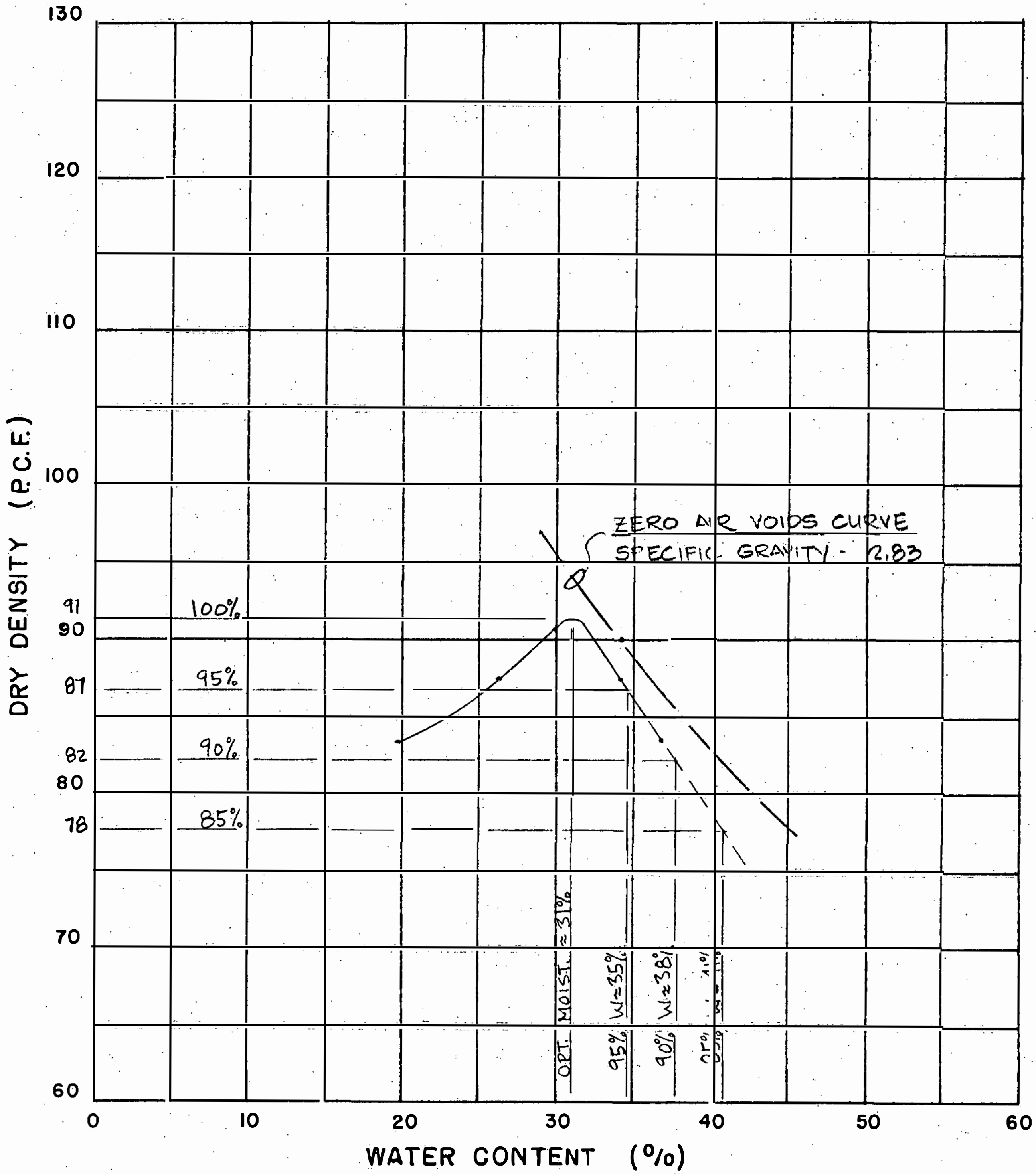
AGGREGATE: 1/4" MINUS

MOLD SIZE: 4"φ x 4.584" HIGH

HAMMER: 10 LBS, 18" DROP

LAYERS: 5

BLOWS: 25/LAYER



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

DATE 8-22-74 BY C.H.

9-470

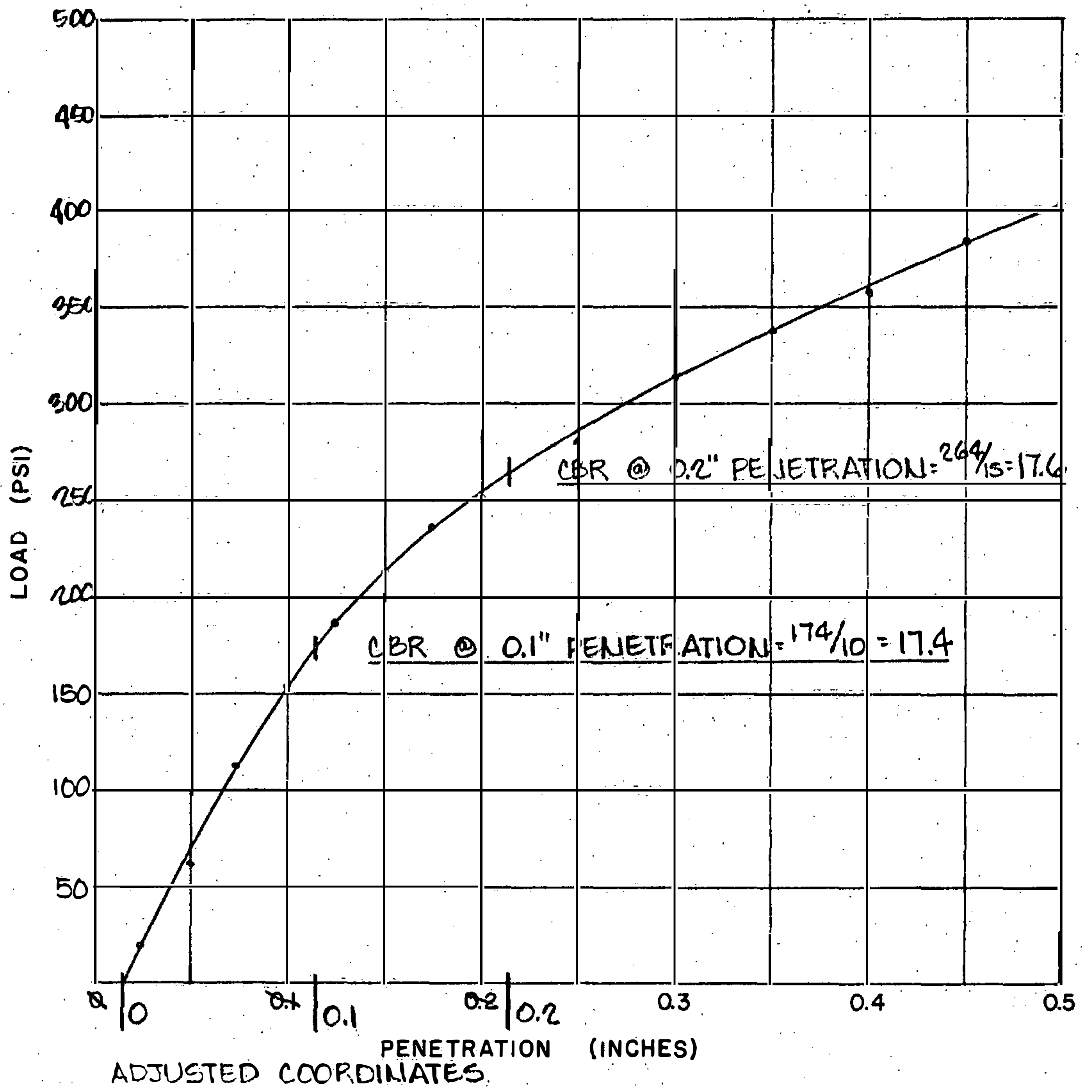
CBR TEST

PROJECT: ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

LOCATION: WAIAWA & WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO: C SURFACE

SAMPLE DESCRIPTION: BROWN SILTY CLAY



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS.)	LOAD (PSI)
0.025	60	20
0.050	190	63
0.075	340	113
0.100	460	153
0.125	560	187
0.150	640	213
0.175	710	237
0.200	750	250
0.250	840	280
0.300	940	313
0.350	1010	337
0.400	1070	357
0.450	1150	383
0.500	1210	403

AGGREGATE 1/4" MINUS
HAMMER WEIGHT 10 LBS.
HAMMER DROP 18 INS.
No. OF BLOWS 56/LAYER
No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 27.7
MOLDING DRY DENSITY, P.C.F. 91.7
CBR @ 0.1" PENETRATION 17.4
DAYS SOAKED 4

DATE 8-21-74 BY CL
DATE 8-22-74 BY NI

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

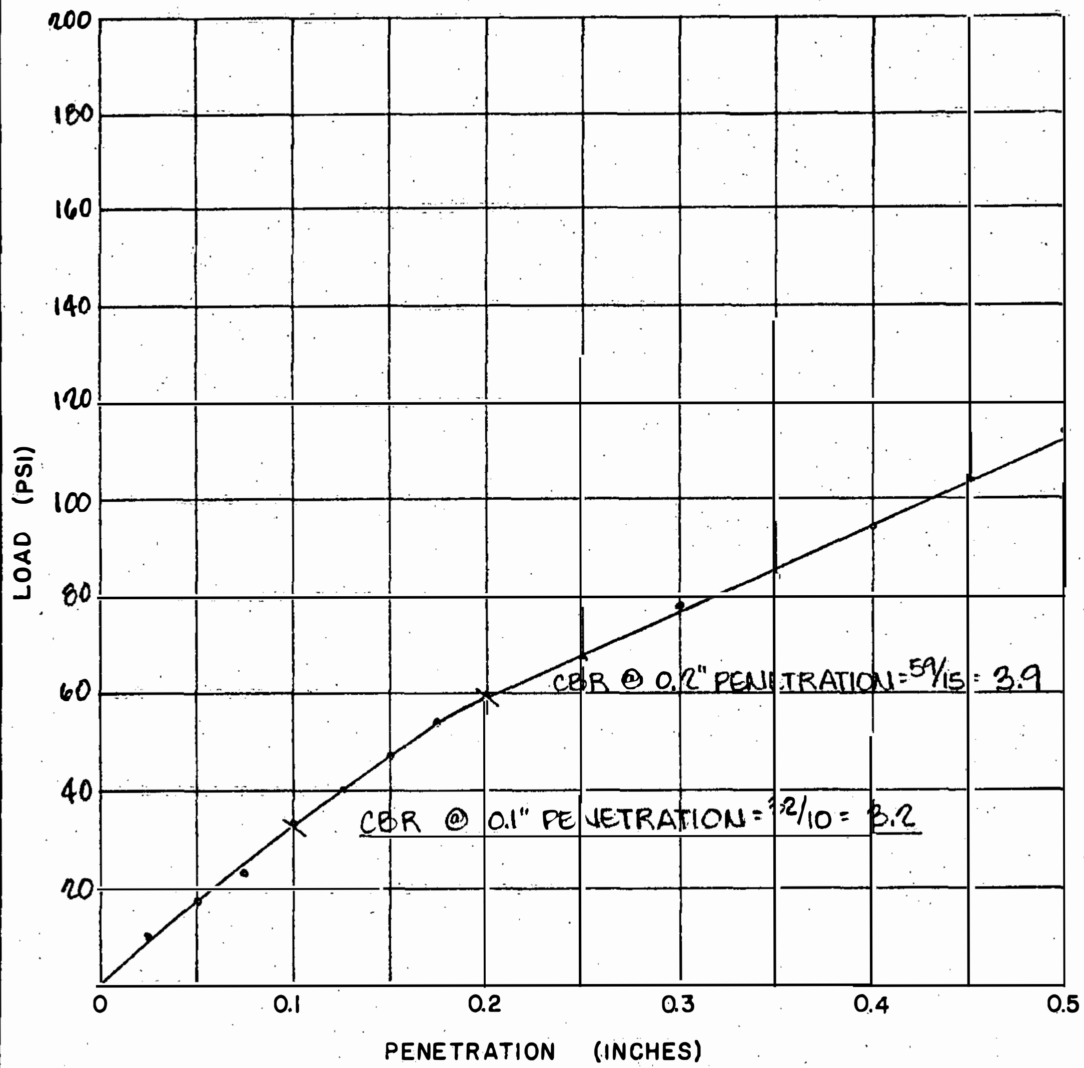
CBR TEST

PROJECT: ENTRANCE ROADWAY TO LEEWARD COMMUNITY COLLEGE

LOCATION: WAIAWA & WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO: E SURFACE

SAMPLE DESCRIPTION: MOTTLED BROWN SILTY CLAY



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS)	LOAD (PSI)
0.025	29	10
0.050	50	17
0.075	70	23
0.100	100	33
0.125	119	40
0.150	141	47
0.175	161	54
0.200	177	59
0.250	201	67
0.300	223	78
0.350	253	84
0.400	283	94
0.450	311	104
0.500	341	114

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LBS.

HAMMER DROP 18 INS.

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, % 28.5

MOLDING DRY DENSITY, P.C.F. 90.0

CBR @ 0.1" PENETRATION 3.2

DAYS SOAKED 4

DATE 8-21-74 BY CL

DATE 8-22-74 BY NI

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

10-170

LOGS OF BORINGS AND LABORATORY TEST RESULTS

FROM

WAIAWA STREET IMPROVEMENT DISTRICT

(STUDIES IN MAY & JUNE 1971)

AND

LOGS OF BORINGS

FROM

"LEEWARD VILLAGE APARTMENTS"

REPORT DATED APRIL 15, 1971

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08 & 9-6-02 & 03

HAMMER:
Weight: 140#
Drop: 30"

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

BORING NO. 1 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: MAY 4, 1971
Field Party: GLORY, KAKU
Type of Boring: AUGER (MOBILE B-40) Diam. 6" (HOLLOW STEM)
Elev. 47'± * Datum: –
Drill Bit: T.C. DRAG
Water Level: NOT NOTICED
Time: –
Date: 5-4-71

Unified Soil Classification	Description (ELEV. = 47'± *)	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot)	2" O.D. Thin Wall Tube Blows/0.5'
(MH)	STIFF, BROWN SILTY CLAY W/ CORAL FRAGMENTS	0	2" SS	1-A	–	26	–	–	–		
CL	STIFF, BROWN CLAY	5	2" S	1-B	108	27 LL PL	85 40 26	12480	–		4/.5' 10/.5'
CH	STIFF, BROWN CLAY & TRACES OF DECOMPOSED ROCK	10	2" SS	1-C	–	28 LL PL	– 58 27	–	–	44	
(SM)	DENSE, MOTTLED BROWN SILTY SAND & DECOMPOSED ROCK	15	2" SS	1-D	–	23	–	–	–	20/.1' HAMMER BOUNCES	
(SM)	STIFF, MOTTLED GRAY SILTY SAND W/ DECOMPOSED ROCK	20	2" SS	1-E	–	41	–	–	–	32/.5'	
	END OF BORING @ 21'										

*ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08 & 9-6-02 & 03

HAMMER:
Weight: 140#
Drop: 30"

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

BORING NO. 2 Sheet No. ____ of ____

Driller: W. LUM ASSOC., INC. Date: JUNE 8, 1971

Field Party: MAESHIRO, TSUKAZAKI

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

Elev. 17'± * Datum —

Drill Bit: T.C. DRAG

Water Level	16'			
Time	11:15 AM			
Date	6-8-71			

Unified Soil Classification	DESCRIPTION ELEV. = 17'± *	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	2" O.D. THIN WALL TUBE BLOWS/0.5'
(MH)	STIFF, BROWN SILTY CLAY W/ TRACES OF DECOMPOSED ROCK	0	2" S	2-A	105	32	79	>13,000	-		3/.5' 4/.5' 4/.5'
		5	2" SS	2-B	-	41	-	-	-		
		10	2" SS	2-C	-	45	-	-	-		
	WATER 6-8-71	15	2" SS	2-D	-	38	-	-	-		
	END OF BORING @ 21.5'	20	2" SS	2-E	-	37	-	-	-		

* ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

BORING NO. 3 Sheet No. ____ of ____

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

Driller: W. LUM ASSOC., INC. Date: JUNE 7, 1971

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-08 & 9-6-02 & 03

Field Party: MAESHIRO, TSUKAZAKI

Type of Boring: AUGER (MOBILE B-30) Diam. 4"

Elev. 21'± * Datum —

Drill Bit: T.C. DRAG

HAMMER:
Weight: 140#
Drop: 30"

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

Water Level: 14'
Time: 11:00 AM
Date: 6-7-71

Unified Soil Classification	DESCRIPTION ELEV. = 21'± *	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 2" O.D. THIN WALL TUBE BLOWS/0.5'
CH	STIFF, REDDISH BROWN CLAY	0	2" SS	3-A	-	28 LL-52 PL-26	-	-	-	6/.5'	
ML	SOFT TO MEDIUM MOTTLED BROWN CLAYEY SILT W/ TRACES OF DECOMPOSED ROCK	5	2" S	3-B	107	38 LL-48 PL-30	77	-	-		1/.5' 2/.5'
		10	2" SS	3-C	-	38	-	-	-		
(MH)	STIFF, MOTTLED BROWN SILTY CLAY W/ TRACES OF DECOMPOSED ROCK		WATER 6-7-71								
		15	2" SS	3-D	-	33	-	-	-		
		20	2" SS	3-E	-	34	-	-	-		
	END OF BORING @ 21.5'										

* ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

BORING NO. 4 Sheet No. ____ of ____

PROJECT WAIAWA ST. IMPROVEMENT DISTRICT

Driller W. LUM ASSOC., INC. Date JUNE 4, 1971

LOCATION Waiawa & Waipio, Ewa, Oahu, Hawaii

Field Party MAESHIRO, TSUKAZAKI

Tax Map Key: 9-4-08 & 9-6-02 & 03

Type of Boring AUGER (MOBILE B-30) Diam. 4"

Elev. 20'± * Datum —

HAMMER:

Weight 140#

Drop 30"

Drill Bit T.C. DRAG

Water Level	15.1'			
Time	3:15 PM			
Date	6-4-71			

SAMPLER: 2" STANDARD SPLIT SPOON

Unified Soil Classification	DESCRIPTION ELEV. = 20'± *	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA Standard Penetration Test N (Blows per foot) 0 10 20 30 40
MH-CH	STIFF, REDDISH BROWN SILTY CLAY W/ TRACES OF DECOMPOSED ROCK	0		4-A	-	31 LL 50 PL 28	-	-	-	
(MH)	STIFF, BROWN CLAYEY SILT W/ GRAVEL	5		4-B	-	23 22	-	-	-	
MH-CH	SOFT, BROWN SILTY CLAY W/ TRACES OF DECOMPOSED ROCK	10		4-C	-	41 LL 52 PL 28	-	-	-	
(MH)	STIFF, MOTTLED BROWN CLAYEY SILT W/ DECOMPOSED ROCK	15	WATER 6-4-71	4-D	-	53	-	-	-	
		20		4-E	-	51	-	-	-	
	END OF BORING @ 21.5'									

* ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08 & 9-6-02 & 03

HAMMER:
Weight: 140#
Drop: 30"

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

BORING NO. 5 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: MAY 4, 1971
Field Party: GLORY, KAKU
Type of Boring: AUGER (MOBILE B-40) Diam.: 6" (HOLLOW STEM)
Elev.: 22' ± * Datum: —
Drill Bit: T.C. DRAG

Water Level	15.5'			
Time	10:00 AM			
Date	5-5-71			

Unified Soil Classification	Description (ELEV. = 22' ± *)	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot)	2" O.D. Thin Wall Tube Blows/0.5'
(MH)	STIFF, BROWN CLAYEY SILT W/ TRACES OF DECOMPOSED ROCK	0	2" SS	5-A	-	23	-	-	-		
(MH)	STIFF, BROWN SILTY CLAY	5	2" S	5-B	111	22	91	-	-		4/.5' 8/.5'
(MH)	STIFF, BROWN CLAYEY SILT	10	2" S	5-C	113	40	81	9620	-		6/.5' 9/.5'
(MH)	WATER 5-5-71; STIFF, MOTTLED BROWN CLAYEY SILT W/ DECOMPOSED ROCK	15	2" S	5-D	116	51	77	1820	500		4/.5' 7/.5'
	END OF BORING @ 21.5'	20	2" S	5-E	116	54	75	1300	500		2/.5' 3/.5' 5/.5'

* ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

BORING NO. 6 Sheet No. ____ of ____

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

Driller: W. LUM ASSOC., INC. Date: MAY 5, 1971

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08 & 9-6-02 & 03

Field Party: GLORY, KAKU

Type of Boring: AUGER (MOBILE B-40) Diam.: 6" (HOLLOW STEM)

Elev.: 23'± * Datum: —

Drill Bit: T.C. DRAG

HAMMER:
Weight: 140#
Drop: 30"

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

Water Level: 17'
Time: –
Date: 5-5-71

Unified Soil Classification	DESCRIPTION ELEV. = 23'± *	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot)	2" O.D. THIN WALL TUBE BLOWS/0.5'
(MH)	STIFF, MOTTLED BROWN SILTY CLAY W/ DECOMPOSED ROCK	0–5	2"S	6-A	105	33	79	4420	–		3/.5 6/.5'
		5	2"SS	6-B	–	28	–	–	–		
		10	2"S	6-C	117	31	89	4060	–		10/.5'
(MH)	STIFF, MOTTLED GRAY-BROWN SILTY CLAY	15	2"SS WATER 5-5-71	6-D	–	62	–	–	–		
(SM)	MOTTLED BROWN SILTY SAND W/ DECOMPOSED ROCK	20	2"S	6-E	111	52	73	1040	-		3/.5' 5/.5'
	END OF BORING @ 21'										

* ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

BORING NO. 7 Sheet No. ____ of ____

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08 & 9-6-02 & 03

Driller: W. LUM ASSOC., INC. Date: MAY 5, 1971

Field Party: GLORY, KAKU

Type of Boring: AUGER (MOBILE B-30) Diam. 4"

Elev. 57' ± * Datum —

Drill Bit: T.C. DRAG

HAMMER:
Weight: 140#
Drop: 30"

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

Water Level	NOT NOTICED			
Time	—			
Date	5-5-71			

PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40; 2" O.D. THIN WALL TUBE BLOWS/0.5'

ELEV. = 57' ± 7 *

Unified Soil Classification	Description	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	2" O.D. Thin Wall Tube Blows/0.5'
(MH)	STIFF, MOTTLED BROWN SILTY CLAY & DECOMPOSED ROCK	0	2"SS	7-A	–	35	–	–	–	
(SM)	STIFF, BROWN SILTY SAND & CEMENTED SAND	5	2"S	7-B	–	36	–	–	–	10/.5'
(SM)	STIFF, MOTTLED BROWN SILTY SAND	10	2"SS	7-C	–	30	–	–	–	
(GM)	STIFF, MOTTLED BROWN SILTY GRAVEL, DECOMPOSED ROCK & SAND	15	2"SS	7-D	–	29	–	–	–	
		20	2"SS	7-E	–	51 LL - 66 PL - 38	–	–	–	
MH	STIFF, BROWN CLAYEY SILT W/TRACES OF DECOMPOSED ROCK	25	2"SS	7-F	–	46	–	–	–	
	END OF BORING @ 31.5'	30	2"SS	7-G	–	48 LL - 48 PL - 38	–	–	–	

* ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIAWA ST. I PROVEMENT DISTRICT

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08 & 9-6-02 & 03

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 8 Sheet No. ____ of ____

Driller: W. LUM ASSOC., INC. Date: JUNE 7, 1971

Field Party: MAESHIRO, TSUKAZAKI

Type of Boring: AUGER (MOBILE B-30) Diam. 4"

Elev. 28'± * Datum: –

Drill Bit: T.C. DRAG

Water Level	18.0'			
Time	4:15 PM			
Date	6-7-71			

Unified Soil Classification	Description (ELEV. = 28'± ? *)	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot)
(MH)	STIFF, MOTTLED BROWN CLAYEY SILT W/ GRAVEL & SAND	0		8-A	–	25	–	–	–	
		5		8-B	–	33	–	–	–	27/3'
(SM)	MEDIUM DENSITY, MOTTLED BROWN SILTY SAND	10		8-C	–	43	–	–	–	
(MH)	MEDIUM, MOTTLED BROWN SILTY CLAY	15	WATER 6-7-71	8-D	–	54	–	–	–	
		20		8-E	–	50	–	–	–	
	END OF BORING @ 21.5'									

*ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08 & 9-6-02 & 03

HAMMER:
Weight: 140#
Drop: 30"

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

BORING NO. 2 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: JUNE 4, 1971
Field Party: MAESHIRO, TSUKAZAKI
Type of Boring: AUGER (MOBILE B-30) Diam. 4"
Elev. 23'± * Datum: –
Drill Bit: T.C. DRAG

Water Level	NOT NOTICED			
Time	–			
Date	6-4-71			

Unified Soil Classification	DESCRIPTION (ELEV. = 23'± *)	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40 / 2" O.D. THIN WALL TUBE BLOWS/0.5'
(MH)	REDDISH BROWN SILTY CLAY	0	2"SS	2-A	–	21	–	–	–	
		5	2"S	2-B	NO RECOVERY. NOTE: LOST TUBE IN HOLE					
MH	STIFF, BROWN SILTY CLAY W/TRACES OF DECOMPOSED ROCK	10	2"SS	2-C	–	32	–	–	–	40/.5'
		15	2"SS	2-D	–	47	–	–	–	
	END OF BORING @ 21.5'	20	2"SS	2-E	–	48	–	–	–	

*ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

LOCATION: Waiawa & Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08 & 9-6-02 & 03

HAMMER:
Weight: 140#
Drop: 30"

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

BORING NO. 10 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: JUNE 7, 1971
Field Party: MAESHIRO, TSUKAZAKI
Type of Boring: AUGER (MOBILE B-30) Diam. 4"
Elev. 23'± * Datum: —
Drill Bit: T.C. DRAG

Water Level	13'			
Time	2:15 PM			
Date	6-7-71			

Unified Soil Classification	DESCRIPTION (ELEV. = 23'± *)	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot)	2" O.D. THIN WALL TUBE BLOWS/0.5'
	COBBLES & A.C.	0									
(ML-MH)	STIFF, BROWN SILTY CLAY W/SAND		2"SS	10-A	-	22	-	-	-		
		5	2"S	10-B	106	24	85	>13,000	-		7/.5' 9/.5'
(MH)	STIFF, BROWN CLAYEY SILT W/ DECOMPOSED ROCK & SILTY SAND POCKETS	10	2"SS	10-C	-	39	-	-	-		
			WATER 6-7-71								
		15	2"SS	10-D	-	47	-	-	-		
		20	2"SS	10-E	-	41	-	-	-		
	END OF BORING @ 21.5'										

*ELEVATION ESTIMATED FROM TOPO MAP

WAIAWA ST. IMPROVEMENT DISTRICT

TABLE IA - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	1	1	3	3
SAMPLE NO.	B	C	A	B
DEPTH BELOW SURFACE	5'-6'	10'-11.5'	0.5'-1.5'	5'-6'
DESCRIPTION	BROWN CLAY	BROWN CLAY W/TRACES OF DECOMP. ROCK	REDDISH-BROWN CLAY	MOTTLED BROWN CLAYEY SILT W/TRACES OF DECOMP. ROCK
GRAIN-SIZE ANALYSIS				
(% Passing)				
Sieve				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	NATURAL
Liquid Limit	49	58	52	48
Plastic Limit	26	27	26	30
Plasticity Index	23	31	26	18
Dilatancy	NONE-SLOW	NONE-SLOW	NONE-SLOW	SLOW-MED.
Toughness	MED.-HIGH	MED.-HIGH	MED.-HIGH	MED.-HIGH
Dry Strength	MEDIUM	MED.-HIGH	MED.-HIGH	SLIGHT-MED.
UNIFIED SOIL CLASSIFICATION	CL	CH	CH	ML
APPARENT SPECIFIC GRAVITY				
EXPANSION AND CBR TESTS				
(Surcharge-51 P.S.F.)				
Molding Moisture, %				
Molding Dry Density, P.C.F.				
Swell upon saturation, %				
CBR at 0.1" Penetration				
MOISTURE-DENSITY RELATIONS OF SOILS				
(AASHO T-180-57 Method___)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

REMARKS:

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

Date 6-28-71 By B.T.

WAIAWA ST. IMPROVEMENT DISTRICT

TABLE I B - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	4	4	7	7
SAMPLE NO.	A	C		E
DEPTH BELOW SURFACE	1'-2.5'	10'-11.5'	SURFACE *	20'-21.5
DESCRIPTION	REDDISH-BROWN SILTY CLAY W/TRACES OF DECOMP. ROCK	BROWN SILTY CLAY W/TRACES OF DECOMP. ROCK	MOTTLED BROWN SILTY CLAY & DECOMP. ROCK	BROWN CLAYEY SILT W/TRACES OF DECOMP. ROCK
GRAIN-SIZE ANALYSIS				
(% Passing)				
Sieve				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	NATURAL
Liquid Limit	50	52	57	66
Plastic Limit	28	28	32	38
Plasticity Index	22	24	25	28
Dilatancy	MEDIUM	NONE-SLOW	NONE-SLOW	SLOW-MED.
Toughness	MEDIUM	MED.-HIGH	MED.-HIGH	MEDIUM
Dry Strength	MED.-HIGH	MED.-HIGH	MED.-HIGH	MEDIUM
UNIFIED SOIL CLASSIFICATION	MH-CH	MH-CH	MH	MH
APPARENT SPECIFIC GRAVITY				
EXPANSION AND CBR TESTS				
(Surcharge-51 P.S.F.)				
Molding Moisture, %			29.1	
Molding Dry Density, P.C.F.			94.7	
Swell upon saturation, %			1.2	
CBR at 0.1" Penetration			14.2	
MOISTURE-DENSITY RELATIONS OF SOILS				
(AASHO T-180-57 Method ___)			A	
Dry to Wet or Wet to Dry			WET TO DRY	
Max. Dry Density (P.C.F.)			96.2	
Optimum Moisture (%)			27.0	

REMARKS:

* Indicates surface samples tested taken adjacent to boring number.

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

Date 6-28-71 By B.T.

WAIAWA ST IMPROVEMENT DISTRICT

TABLE IC - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	7	8		
SAMPLE NO.	G			
DEPTH BELOW SURFACE	30'-31.5'	SURFACE *		
DESCRIPTION	BROWN CLAYEY SILT W/TRACES OF DECOMP. ROCK	MOTTLED BROWN SILTY CLAY W/SAND		
GRAIN-SIZE ANALYSIS				
(% Passing)				
Sieve				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL		
Liquid Limit	58	50		
Plastic Limit	38	29		
Plasticity Index	20	21		
Dilatancy	MEDIUM	QUICK		
Toughness	MEDIUM	SLIGHT-MED.		
Dry Strength	SLIGHT-MED.	MEDIUM		
UNIFIED SOIL CLASSIFICATION	MH	ML-CL		
APPARENT SPECIFIC GRAVITY		2.77		
EXPANSION AND CBR TESTS				
(Surcharge-51 P.S.F.)				
Molding Moisture, %		24.8		
Molding Dry Density, P.C.F.		95.7		
Swell upon saturation, %		1.5		
CBR at 0.1" Penetration		19.2		
MOISTURE-DENSITY RELATIONS OF SOILS				
(AASHO T-180-57 Method ___)		A		
Dry to Wet or Wet to Dry		DRY TO WET		
Max. Dry Density (P.C.F.)		95.2		
Optimum Moisture (%)		24.3		

REMARKS:

* Indicates surface sample tested taken adjacent to boring number.

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

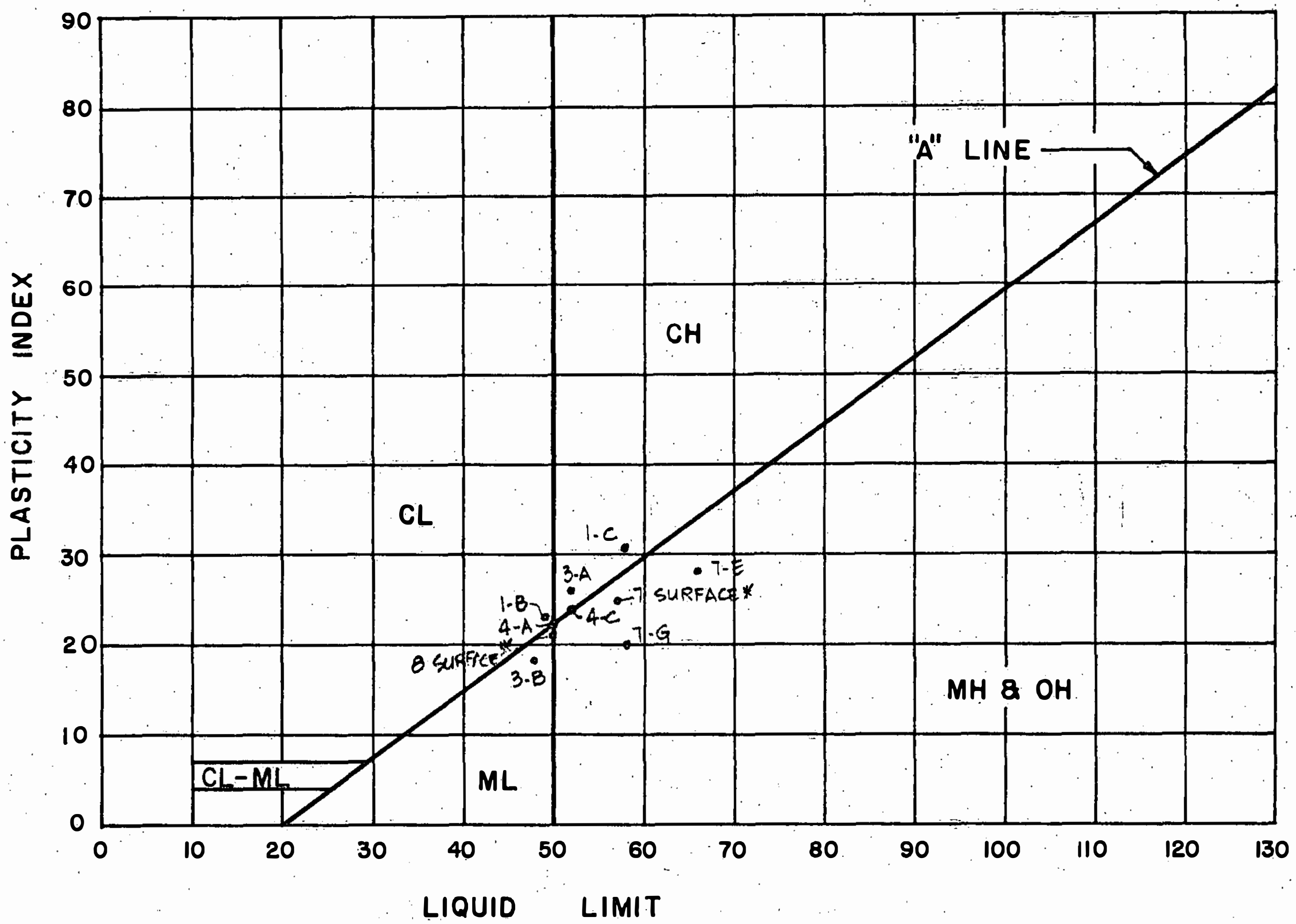
Date 6-28-71 By B.T.

3-470

PLASTICITY CHART

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

LOCATION: WAIAWA & WAIPIO, EWA, OAHU, HAWAII



* Indicates surface samples tested taken adjacent to boring numbers.

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

DATE 6-28-71 BY BT

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

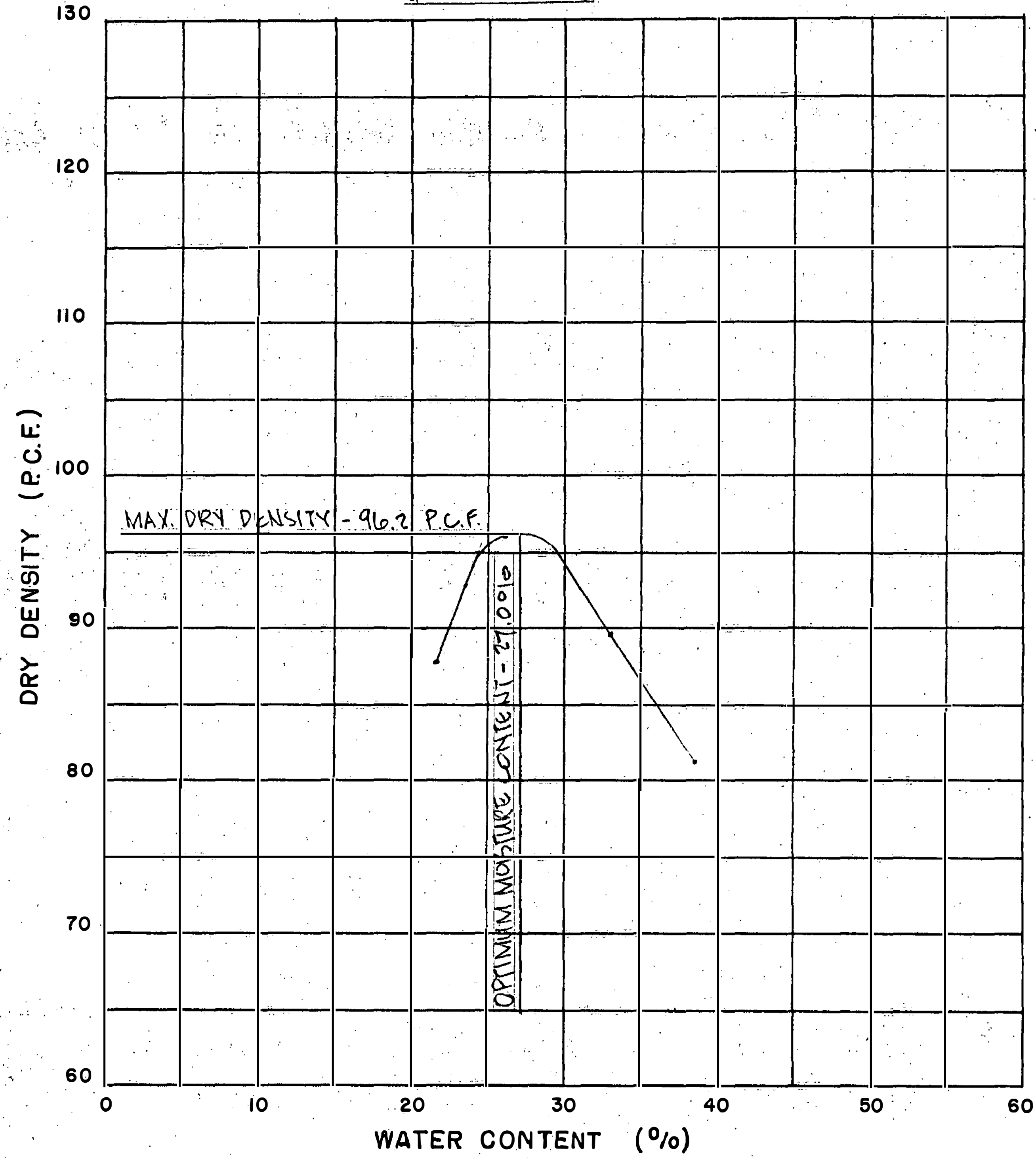
PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

LOCATION: WAIAWA & WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO.: 7 SURFACE

SAMPLE DESCRIPTION: MOTTLED BROWN SILTY CLAY & DECOMP. ROCK

AGGREGATE: 1/4" MINUS
MOLD SIZE: 4" ϕ 4.59"
HAMMER: 10LBS, 18" DROP
LAYERS: 5
BLOWS: 25/LAYER



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

DATE 6-8-71 BY B.T.

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

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

LOCATION: WAIAWA & WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO.: 8 SURFACE

SAMPLE DESCRIPTION: MOTTLED BROWN SILTY CLAY W/SAND

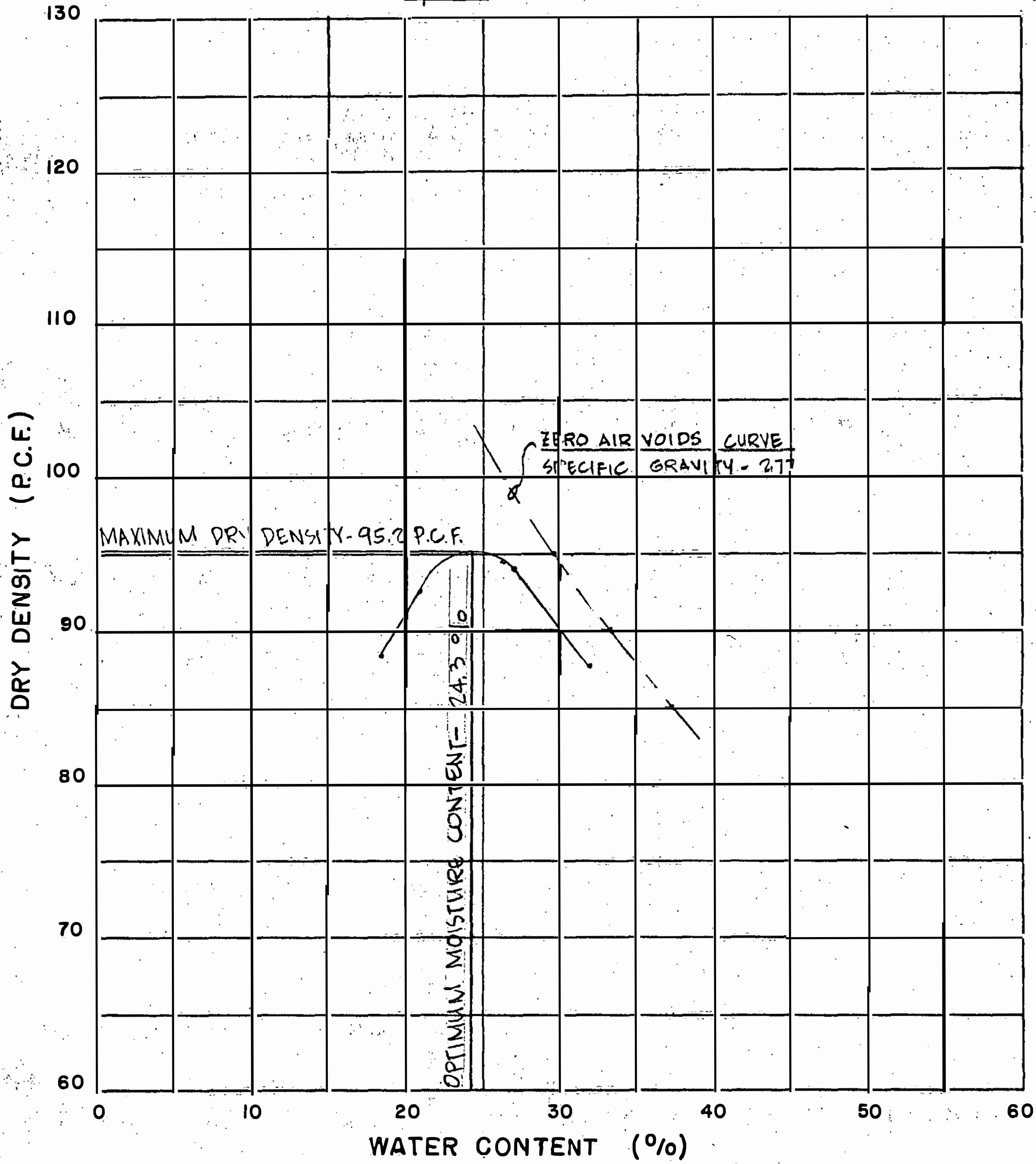
AGGREGATE: 1/4" MINUS

MOLD SIZE: 4" φ 4.59"

HAMMER: 10 LBS., 18" DROP

LAYERS: 5

BLOWS: 25/LAYER



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

DATE 6-15-71 BY ST

9-470

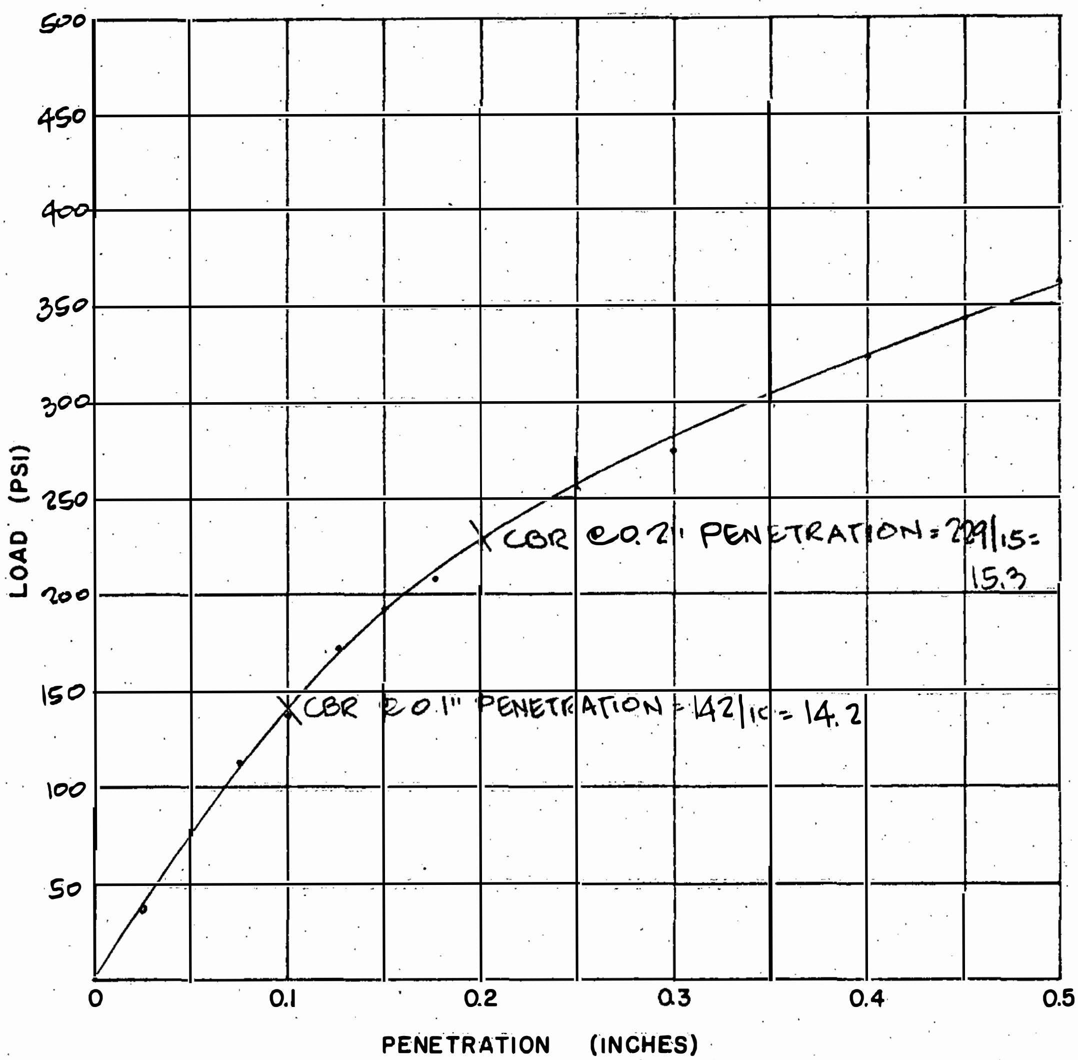
CBR TEST

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

LOCATION: WAIAWA & WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO: 7 SURFACE

SAMPLE DESCRIPTION: MOTTLED BROWN SILTY CLAY & DECOMP. ROCK



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS.)	LOAD (PSI)
0.025	115	38
0.050	230	77
0.075	335	112
0.100	415	138
0.125	515	172
0.150	580	193
0.175	625	208
0.200	685	228
0.250	760	253
0.300	825	275
0.350	895	298
0.400	965	322
0.450	1025	342
0.500	1085	362

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LBS.

HAMMER DROP 18"

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 29.1

MOLDING DRY DENSITY, P.C.F. 94.7

CBR @ 0.1" PENETRATION 14.2

DAYS SOAKED 5

DATE 6-7-71 BY MO

DATE 6-14-71 BY ST

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

10-470

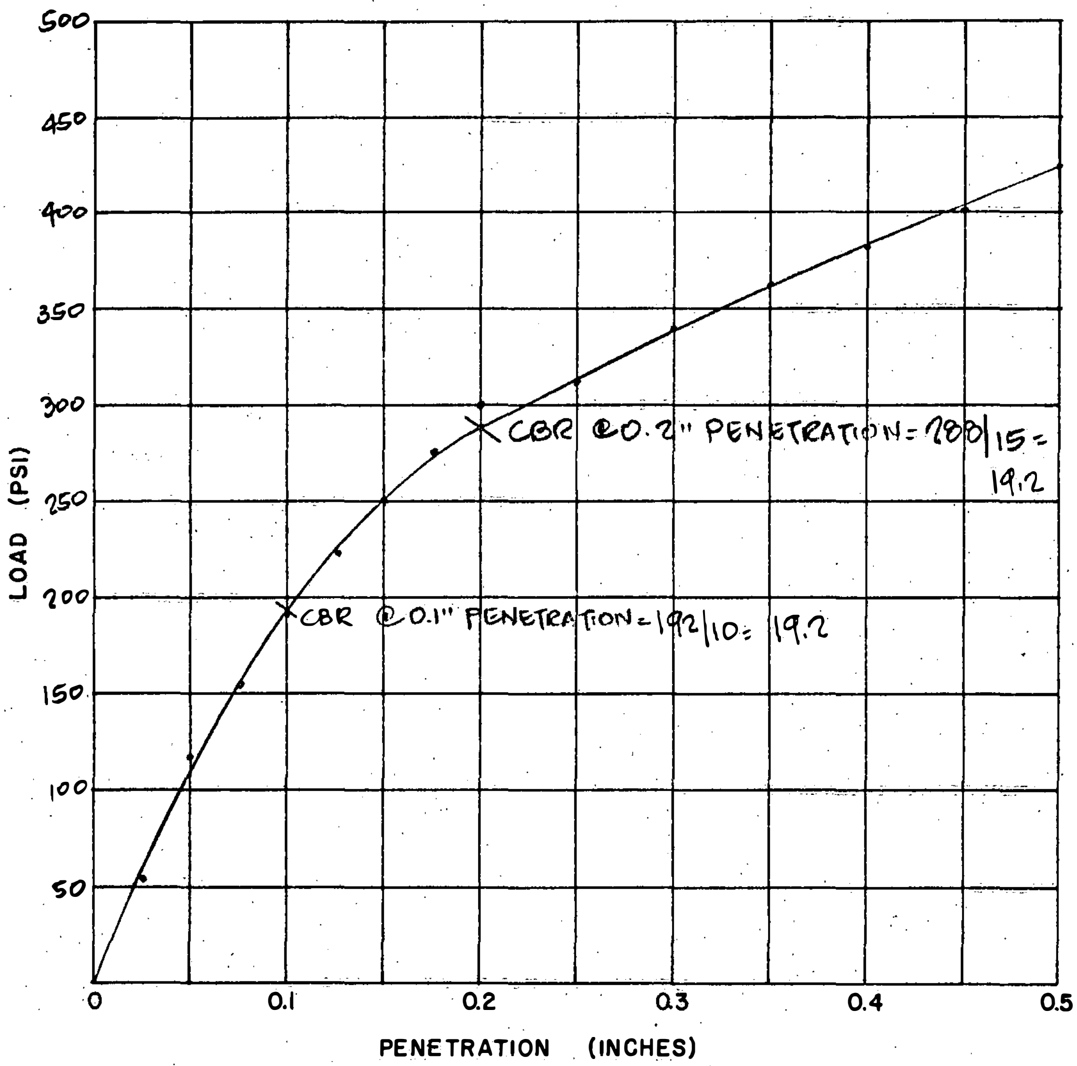
CBR TEST

PROJECT: WAIAWA ST. IMPROVEMENT DISTRICT

LOCATION: WAIAWA & WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO: 8 SURFACE

SAMPLE DESCRIPTION: MOTTLED BROWN SILTY CLAY W/SAND



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS.)	LOAD (PSI)
0.025	160	53
0.050	350	117
0.075	460	153
0.100	570	190
0.125	670	223
0.150	750	250
0.175	830	277
0.200	900	300
0.250	940	313
0.300	1020	340
0.350	1090	363
0.400	1150	383
0.450	1200	400
0.500	1280	427

AGGREGATE ¼" MINUS
HAMMER WEIGHT 10 LBS.
HAMMER DROP 18"
No. OF BLOWS 56/LAYER
No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 24.8
MOLDING DRY DENSITY, P.C.F. 95.7
CBR @ 0.1" PENETRATION 19.2
DAYS SOAKED 5

DATE 6-9-71 BY MO
DATE 6-15-71 BY ST

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

10-470

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: LEEWARD VILLAGE APARTMENTS

LOCATION: Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-08: Por. of 23

HAMMER:

Weight: 140 #

Drop: 30"

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

BORING NO. 1 Sheet No. ____ of ____

Driller: WALTER LUM ASSOC. INC. Date: JAN. 5, 1971

Field Party: GLORY, MAKAULA, MARU

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

Elev. 23' ± * Datum —

Drill Bit: T.C. DRAG

Water Level: NOT NOTICED

Time: -

Date: 1-5-71

Unified Soil Classification	DESCRIPTION ELEV. = 23' ± ? *	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot) 0 10 20 30 40	2" O.D. THIN WALL TUBE BLOWS/0.5'
(MH)	MEDIUM, REDDISH BROWN, SILTY CLAY W/CORAL FRAG. NOTE: HIT BOULDERS @ 0.9' MOVED BORING 5 TIMES	0	2" SS	1-A	-	25	-	-	-	4/.4'	10/.1'
(MH)	REDDISH BROWN, SILTY CLAY & BOULDERS (FILL)	5	2" SS	1-B	-	26	-	-	-		
(MH)	STIFF, BROWN, SILTY CLAY	10	2" SS	1-C	-	30 27	-	-	-		
		15	2" S	1-D	110	52	72	4890	600 1000		2/.5' 4/.5' 6/.5'
	END OF BORING @ 16.5'										

*Elev. Estimated from Topo Map by Park Engineering, Inc.

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: LEEWARD VILLAGE APARTMENTS

LOCATION: Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08: Por. of 23

HAMMER:
Weight: 140#
Drop: 30"

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

BORING NO. 3 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: JAN. 8, 1971
Field Party: MAESHIRO, MAKAULA, OSHIRO
Type of Boring: AUGER (ACKER ACE) Diam. 3"
Elev. 15' ± * Datum ____
Drill Bit: T.C. DRAG

Water Level	9'			
Time	3:30 PM			
Date	1-8-71			

Unified Soil Classification	DESCRIPTION ELEV. = 15' ± 7 *	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 2" O.D. THIN WALL TUBE, BLOWS/0.5'
(MH)	MEDIUM, MOTTLED BROWN, SILTY CLAY W/DEC. ROCK & TRACES OF GRAVEL (FILL)	0	2"S	3-A	104	33	78	4680	-		2/.5' 3/.5'
(MH)	STIFF, BROWN, SILTY CLAY (FILL)	5	2"SS	3-B	-	33	-	-	-		
	WATER 1-8-71										
(MH)	SOFT, BROWN & BLACK, SILTY CLAY W/TRACES OF ASHES (FILL)	10	2"S	3-C	114	43	80	1400	-		1/.5' 1/.5'
(CH)	MEDIUM, MOTTLED BROWN & GRAY, CLAY W/ROOTS	15	2"SS	3-D	-	40	-	-	-		
(CH)	MEDIUM, MOTTLED BROWN & GRAY, CLAY W/SAND & GRAVEL	20	2"S	3-E	108	50 50	72	1300	-		2/.5' 3/.5'
(SM)	MEDIUM, BROWN, SILTY SAND										
(MH)	STIFF, MOTTLED BROWN & GRAY, SILTY CLAY W/SAND	25	2"SS	3-F	-	55	-	-	-		
	END OF BORING @ 26.5'										

*Elev. Estimated from Topo Map by Park Engineering, Inc.

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: LEEWARD VILLAGE APARTMENTS

LOCATION: Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-08: Por. of 23

HAMMER:

Weight: 140#

Drop: 30"

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

BORING NO. 5 Sheet No. ____ of ____

Driller: W. LUM ASSOC., INC. Date: JAN. 8, 1971

Field Party: MEYER, KAKU

Type of Boring: AUGER (AUGER ACE) Diam. 4"

Elev. 58'± * Datum ____

Drill Bit: T.C. DRAG

Water Level: NOT NOTICED

Time: —

Date: 1-8-71

Unified Soil Classification	DESCRIPTION (ELEV. = 58'± *)	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot)	2" O.D. THIN WALL TUBE BLOWS/0.5'
(CH)	SOFT TO MEDIUM, BROWN, CLAY	0	2"S	5-A	113	40	81	5820	-		HYDRAULIC PUSH/1.0'
		5	2"SS	5-B	-	31	-	-	-		60
	BROWN, DECOMPOSED ROCK (SOME CRUSHES TO SILTY SAND)	10	2"SS	5-C	-	35	-	-	-		
(MH)	STIFF, BROWN, CLAYEY SILT W/SAND (DECOMPOSED ROCK)	15	2"SS	5-D	-	30	-	-	-		
(MH)	STIFF, BROWN, SANDY SILT (DECOMPOSED ROCK)					40					
	END OF BORING @ 16.5'										

*Elev. Estimated from Topo Map by Park Engineering, Inc.

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: LEEWARD VILLAGE APARTMENTS

LOCATION: Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08: Por. of 23

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 7 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: JAN. 8, 1971
Field Party: MEYER, KAKU
Type of Boring: AUGER (ACKER ACE) Diam. 4"
Elev. 48'± * Datum: ——
Drill Bit: T. C. DRAG

Water Level	NOT NOTICED			
Time	—			
Date	1-8-71			

Unified Soil Classification	DESCRIPTION (ELEV. = 48'± *)	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Penetration Test N (Blows per foot)
(MH)	STIFF, BROWN, SILTY CLAY	0		7-A	–	28 / 22	–	–	–	
(ML)	STIFF, LIGHT BROWN, CLAYEY SILT w/SAND									
	REDDISH BROWN, DECOMPOSED LAVA ROCK	5		7-B	–	21 / 16 / 26	–	–	–	12/.5' ; 27/.5'
(MH)	STIFF, BROWN, SILTY CLAY									
		10		7-C	–	20	–	–	–	42
(MH)	BROWN, CLAYEY SILT (DECOMPOSED ROCK)									
		15		7-D	–	34	–	–	–	67
	END OF BORING @ 16.5'									

*Elev. Estimated from Topo Map by Park Engineering, Inc.

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: LEEWARD VILLAGE APARTMENTS

LOCATION: Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-08: Por. of 23

HAMMER:

Weight: 140#

Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 8 Sheet No. ____ of ____

Driller: W. LUM ASSOC., INC. Date: JAN. 7, 1971

Field Party: MEYER, KAKU

Type of Boring: AUGER (MOBILE B-40) Diam. 6"

Elev. 30'± * Datum ____

Drill Bit: FINGER TYPE

Water Level	NOT NOTICED			
Time	—			
Date	1-7-71			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA Standard Penetration Test N (Blows per foot) 0 10 20 30 40
	ELEV. = 30'± *	0								
(MH)	STIFF, BROWN, SILTY CLAY			8-A	-	28 28	-	-	-	
ML	STIFF, MOTTLED BROWN, CLAYEY SILT W/SAND	5		8-B	-	27	-	-	-	
	STIFF, BROWN, SANDY CLAY									
(ML)	STIFF, BROWN, SANDY SILT	10		8-C	-	40	-	-	-	45
(MH)	STIFF, BROWN, SANDY SILT W/CLAY POCKETS	15		8-D	-	48	-	-	-	
		20		8-E	-	51	-	-	-	
	END OF BORING @ 21.5'									

*Elev. Estimated from Topo Map by Park Engineering, Inc.

WALTER LUM ASSOCIATES, INC.

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: LEEWARD VILLAGE APARTMENTS

LOCATION: Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-08: Por. of 23

HAMMER:
Weight: 140#
Drop: 30"

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

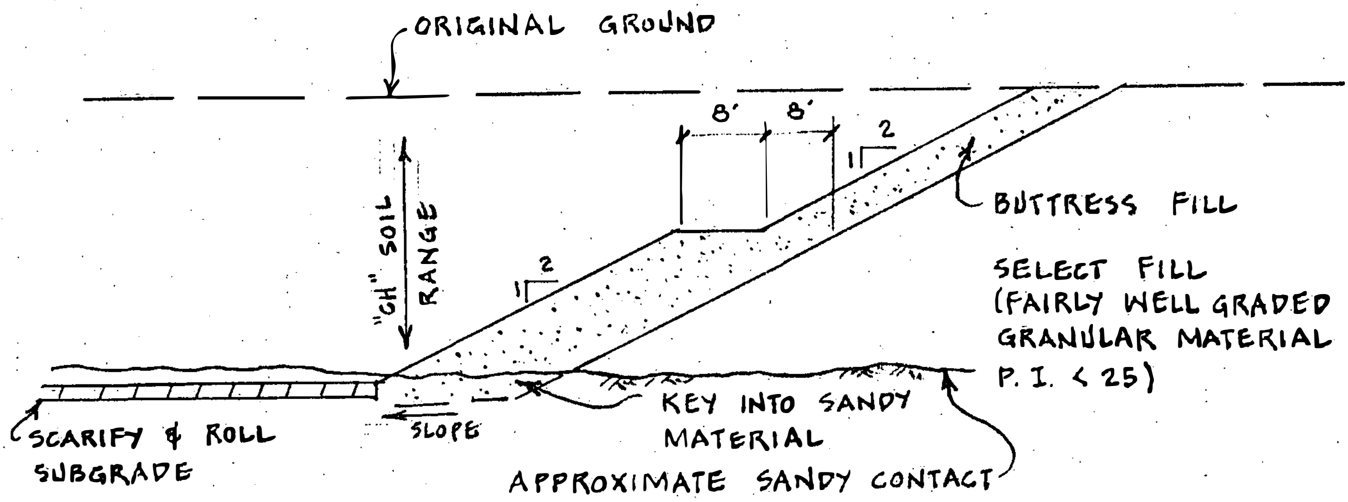
BORING NO. 20 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: JAN. 14, 1971
Field Party: GLORY . KAKU
Type of Boring: AUGER (CONCORE AS JR) Diam. 3"
Elev. 13'± * Datum ____
Drill Bit: T.C. DRAG

Water Level: 8'
Time:
Date: 1-14-71

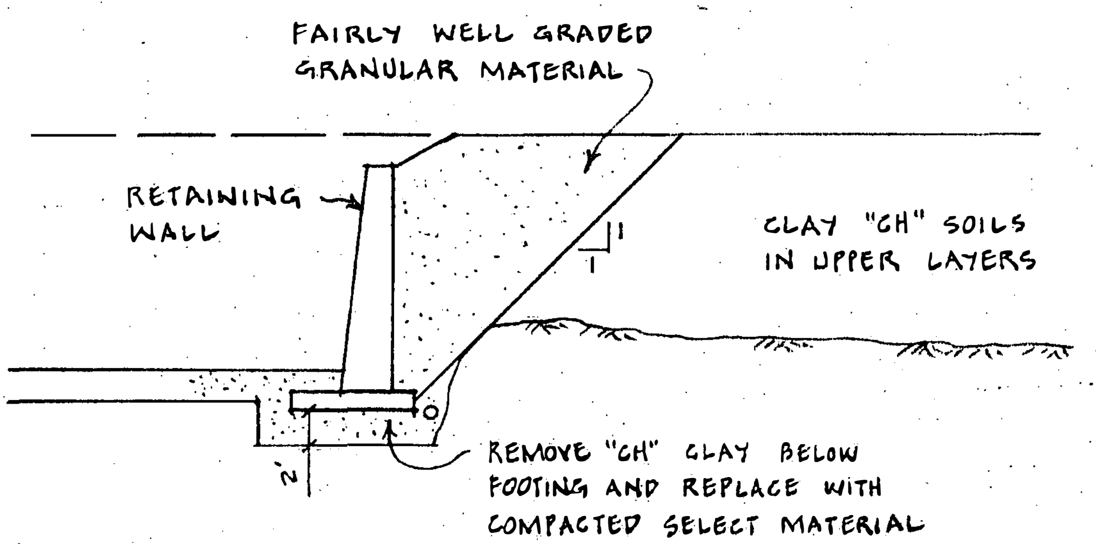
Unified Soil Classification	DESCRIPTION ELEV. = 13'± *	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 2" O.D. THIN WALL TUBE BLOWS/0.5
(MH)	STIFF, BROWN, SILTY CLAY W/ DECOMPOSED ROCK & ORGANIC MATTER	0	2"SS	20-A	-	40	-	-	-		
(MH)	SOFT, BROWN, SILTY CLAY W/ TRACES OF SAND	5	2"S	20-B	110	50	74	2180	-		PUSH/.5' 2/.5 7/.5
(MH)	STIFF, MOTTLED BROWN & GRAY, SILTY CLAY W/ SAND	10	2"SS	20-C	-	55	-	-	-		
	DECOMPOSED ROCK & GRAVEL W/ POCKETS OF CLAYEY SILT & SAND	15	2"S	20-D	112	40	75	-	-		10/.7'
(MH)	STIFF, BROWN, SILTY CLAY	20	2"SS	20-E	-	50 59	-	-	-		
(MH)	STIFF, MOTTLED BROWN, SILTY CLAY W/SAND	25	2"SS	20-F	-	48	-	-	-		
(MH)	STIFF, MOTTLED BROWN & GRAY, SILTY CLAY	30	2"SS	20-G	-	50	-	-	-		

END OF BORING @ 31.5'

*Elev. Estimated from Topo Map by Park Engineering, Inc.



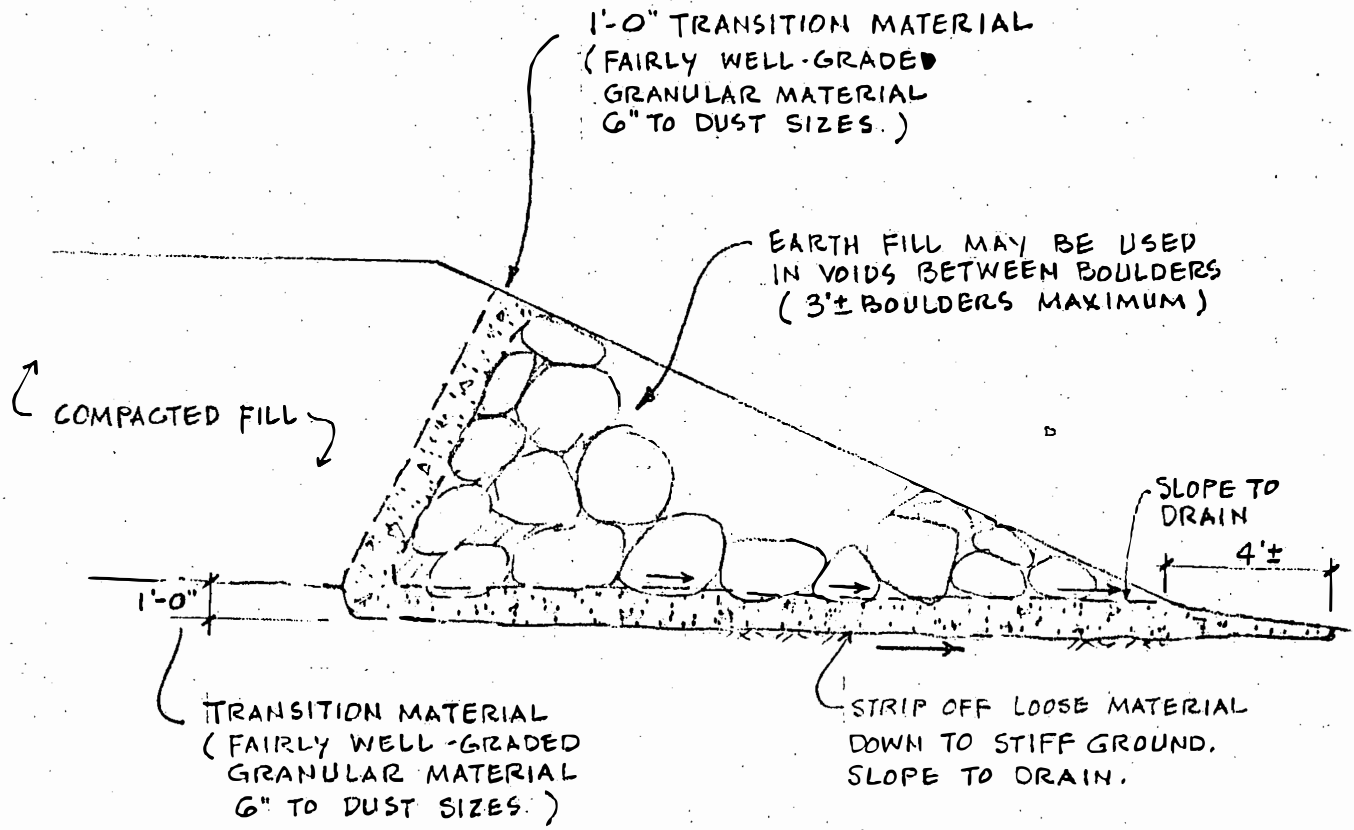
SECTION
NOT TO SCALE



SECTION
NOT TO SCALE

FIGURE 1
PROPOSED SLOPE ADJUSTMENTS
IN "CH" MATERIAL
ENTRANCE ROADWAY TO
LEEWARD COMMUNITY COLLEGE
WAIAWA & WAIPIO, EWA, OAHU, HAWAII

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



SCHEMATIC SECTION

NOT TO SCALE

FIGURE 2

SCHEMATIC SECTION · BOULDER FILL

ENTRANCE ROADWAY TO

LEEWARD COMMUNITY COLLEGE

WAIAWA & WAIPIO, EWA, OAHU, HAWAII

TAX MAP KEY: 9-4-08 & 9-6-02 & 03

WALTER LUM ASSOCIATES, INC.

CIVIL, STRUCTURAL, SOILS ENGINEERS

1-22-74

LIMITATIONS

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

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

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

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.