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WAIPAHU ESTATES UNIT 3-2 - PRELIMINARY SOIL REPORT

WAIPIO, EWA, OAHU, HAWAII
TAX MAP KEY: 9-4-02: POR. 7

TA710.3
H3
H64
No. 560

FOR REFERENCE

not to be taken from this room

To:
COMMUNITY PLANNING, INCORPORATED

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

OCTOBER 11, 1971

MUNICIPAL REFERENCE RECORDS CENTER
City & County of Honolulu
City Hall Annex, 505 S. King Street
Honolulu, Hawaii 96813

WITHDRAWN

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

WALTER LUM
EDWARD WATANABE
EZRA KOIKE

3030 WAIALAE AVE., HONOLULU, HAWAII 96816 • TEL. 737-7931

October 11, 1971

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

Dear Mr. Houghtailing:

Subject: Waipahu Estates Unit 3-2
Preliminary Soil Report
(for residential development)
Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-02: Por. 7

In accordance with your request, soil explorations were made to determine general soil conditions at the proposed residential development site for Waipahu Estates Unit 3-2 at Waipio, Ewa, Oahu, Hawaii.

The surface soils at the site may be generally described as stiff reddish-brown clayey silts and silty clays to about 6 to 13-ft depths, underlain by decomposed rocks and boulders to about 15 to 20 ft, the depths drilled.

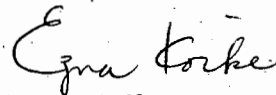
The proposed light residential houses may be supported either directly on stiff existing ground or on compacted fills constructed from on-site soils.

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

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

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.



Ezra Koike
Professional Engineer
Hawaii No. 1450

EK:rmf

C O N T E N T S

	<u>Page</u>
SCOPE OF EXPLORATION	1
FIELD EXPLORATION	1
LABORATORY TESTS	1
SOIL CLASSIFICATION SYSTEM	2
GENERAL SITE CONDITIONS	2
INTERPRETATION OF SOIL CONDITIONS	2
DISCUSSION AND RECOMMENDATIONS	3

PROPOSED SPECIFICATION FOR EARTHWORK

APPENDICES:

- A. BORING LOCATION PLAN
- B. LOGS OF BORINGS - Boring Nos. 1 thru 8
- C. SUMMARY OF LABORATORY TEST RESULTS - Tables IA and IB
- D. PLASTICITY CHART
- E. MOISTURE-DENSITY CURVE
- F. CBR TEST
- G. LOGS OF BORINGS AND LABORATORY TEST RESULTS FROM "WAIPAHU ESTATES UNIT 3-1"
- H. GENERAL TESTING METHODS
- I. LIMITATIONS
- J. PROPOSED BOULDER FILL - Figure 1

WAIPAHU ESTATES UNIT 3-2 - PRELIMINARY SOIL REPORT

WAIPIO, EWA, OAHU, HAWAII
TAX MAP KEY: 9-4-02: POR. 7

SCOPE OF EXPLORATION

The purpose of this exploration was to determine general soil conditions for residential development for the proposed Waipahu Estates Unit 3-2.

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

FIELD EXPLORATION

Eight exploratory borings were made at the site. The approximate locations of these borings are shown on the Boring Location Plan. Descriptions of the underlying soils encountered are shown on Boring Logs Nos. 1 thru 8. Also attached are logs of borings and laboratory test results from Waipahu Estates Unit 3-1.

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

LABORATORY TESTS

Laboratory tests included: natural water content and density, unconfined compression, laboratory vane shear, Atterberg limit, sieve analysis, AASHO T-180-57 density, expansion and CBR.

A list of the standard field and laboratory test methods used for this project is given in the Appendix.

A summary of the laboratory test results is given in Tables IA and IB.

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."

GENERAL SITE CONDITIONS

The proposed site is located along the south edge of the Interstate H-1 freeway and 3/4 mile north of the Oahu Sugar Mill at Waipahu, Oahu, Hawaii.

The site is a sugar cane field crossed by haul roads. A lined irrigation ditch cuts across the northern 1/3 of the site.

The existing ground is relatively flat with gentle slopes at about a 5% grade sloping downward to the south with localized variations.

INTERPRETATION OF SOIL CONDITIONS

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

Stiff reddish-brown clayey silts and silty clays to about 6 to 13-ft depths, underlain by decomposed rocks and boulders to about 15 to 20 ft, the depths drilled.

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

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

DISCUSSION AND RECOMMENDATIONS

In general, the present plan is to clear and grade the site for residential development. The proposed grading is to use cut and fill slopes of generally less than 10 to 15 ft in height.

In the opinion of the Soil Engineer, the on-site soils, in general, have sufficient strength to support the fills and proposed light residential structures, provided the site is cleared and grubbed, drained and localized soft spots are removed.

Decomposed rocks were encountered at about 6 to 13-ft depths in some borings. Because of the shallow depths to decomposed rocks, boulders will probably be found interspersed over the site. The closer an excavation approaches decomposed rocks, the greater will be the quantity of boulders. Boulders may be used to construct fill slopes outside of house lots. See Figure 1.

Site Grading

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

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

1. The area should be cleared and grubbed.
2. Topsoil and stockpiled soils should be either
(a) stripped to stiff natural ground or (b)
scarified and recompactd before the placement
of fills.
3. The bottom and sides of irrigation ditches
should be stripped down to stiff natural ground
or scarified and recompactd before the placement
of fills.
4. Hard surfaces along existing haul roads should
be scarified down to stiff soils and recompactd
to match the density of the surrounding soil.

5. Fills should be constructed in approximately level layers starting at the lower end and working upward. Where fills are made on sloping areas steeper than about 5 horizontal to 1 vertical, the ground at the toe of the fill should be benched to a generally level condition. As the fill is brought up, it should be keyed continually into the stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.
6. Fills should be laid in 6-in. compacted layers to 90% of the maximum density determined by the AASHO T-180-57 test method.

Slopes

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

If slope heights (top to toe) of greater than 15 ft are considered, 8-ft-wide benches should be placed at about 15 to 20-ft height intervals.

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

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

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.

Foundations

If earthwork is carried out as specified, the stiff natural ground and compacted fills should develop adequate bearing values to support the proposed light residential structures.

For light one and 2-story houses, differential settlements will probably be negligible and within the settlement tolerances of residential structures.

General recommendations for foundation construction are as follows:

1. For the proposed light one-story residential structures, conventional house foundations such as slab-on-ground construction or post-and-beam construction may be used.

2. Bearing values for a given soil usually vary with the size and depth of footings. For light, one and 2-story structures, bearing values of about 2000 p.s.f. may be used.
3. Soft spots or pockets of loose material encountered in footing excavations or below the building area should be excavated, and the excavation backfilled with well-graded granular material such as S4C or other approved material.
4. Concrete slabs on ground should be placed over a base course of 4 in. of well-graded gravel less than 3/4-in. and greater than 1/4-in. in size. The subgrade should be compacted and shaped to a level surface or to drain, if practicable, and generally should be kept slightly higher than the finish grade outside the building.
5. Because of the downhill creep effect of soils on a slope, some settlements may occur near the tops of slopes. Buildings should generally be placed about 15 ft from the tops of slopes.

This distance may be reduced for lower slope heights, e.g., 10 ft for 10-ft high slopes, but generally not closer than 5 ft from the top of any slope.

6. Construction of retaining walls on slopes should generally be avoided.
7. Good surface drainage away from the foundation of structures should be maintained and the site should be graded at all times to prevent the ponding of water.

Roadway

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

1. Wearing course - 2-in. asphaltic concrete.
2. Base course - 6-in. base course over a prepared subgrade.

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

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

Utilities

Utilities should be placed after the fills are constructed. Utility lines should be designed with flexible joints, particularly where lines are connected to structures.

Unforeseen Conditions

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

PROPOSED SPECIFICATION FOR EARTHWORK

WAIPAHU ESTATES UNIT 3-2

General Description

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

Clearing, Grubbing and Preparing Areas to be Filled

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

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

The bottom and sides of irrigation ditches shall be stripped down to stiff natural ground or scarified and recompactd before the placement of fills.

Cane haul roads shall be scarified and recompactd to match the density of the surrounding soil.

Materials

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

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

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

Placing, Spreading and Compacting Fill Material

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

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

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

When the water content of the material is well above the optimum for compacting purposes, the fill material shall be aerated by blading or by other satisfactory methods until the water content is near the optimum.

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

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

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

Excavation

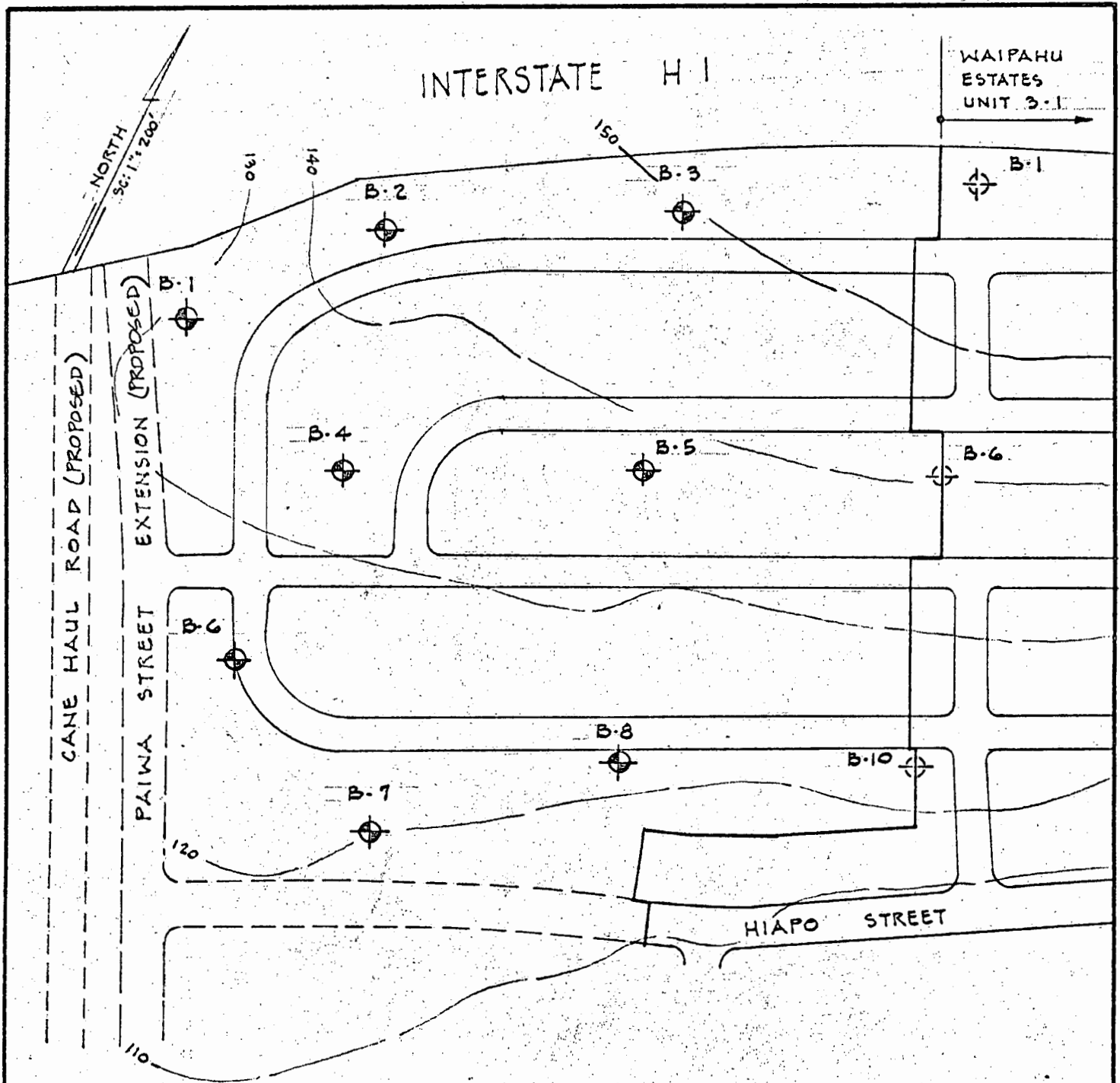
Suitable material from excavation shall be used in the fill and unsuitable material from excavation shall be disposed of.

Unforeseen Conditions

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

Rainy Weather

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



LEGEND:



BORING FOR THIS PROJECT.



BORING FOR "WAIPAHO ESTATES
UNIT 3-1". DATED OCT. 11, 1971.

BORING LOCATION PLAN
WAIPAHO ESTATES UNIT 3-2
WAIPAHO, EWA, OAHU, HAWAII
TAX MAP KEY: 9-4-02; POR. 7

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

SEPT., 1971

BORING LOGS

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

Symbols

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

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

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

Boring Log

PROJECT WAIPAHA ESTATES UNIT 3-2LOCATION Waipio, Ewa, Oahu, HawaiiTax Map Key: 9-4-02: Por. 7

HAMMER:

Weight 140#Drop 30"

SAMPLER:

2" S - 2" O.D. THIN WALL TUBE2" SS - 2" STANDARD SPLIT SPOONBORING NO. 1

Sheet No. _____ of _____

Driller W. LUMASSOO, INC.Date AUG. 30, 1971Field Party MAESHIRO, METERType of Boring AUGER (MOBILE MINUTEMAN)Diam. 3"Elev. 131' ± *

Datum _____

Drill Bit FINGER TYPEWater Level NOT NOTICED

Time _____

Date 8-30-71

PENETRATION DATA

Standard
Penetration Test

N (Blows per foot)

0 10 20 30 40

Unified
Soil
Classification

DESCRIPTION

ELEV. = 131' ± *

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.

(ML)

MEDIUM TO STIFF
REDDISH BROWN
CLAYEY SILT

2" S

1-A

120

28

28

24

1

1700

1700

3/5' 7/5'

(MH)

STIFF, REDDISH BROWN
CLAYEY SILT

2" S

1-B

117

21

23

13000

-

14/5' 15/5'

(MH)

MEDIUM TO STIFF
REDDISH BROWN & GRAY
SILTY CLAY W/
DECOMPOSED ROCK

2" SS

1-D

-

32

-

-

-

END OF BORING @ 16.5'

* ELEVATION ESTIMATED
FROM CONTOUR PLAN

BORING NO. 2 Sheet No. of

Driller W. LUM & ASSOC., INC. Date AUG. 20, 1971

Field Party MAESHIRO, TSUKAZAKI

Type of Boring AUGER (ACKER) Diam. 4"

Elev. 142' ± * Datum ---

Drill Bit T.C. DRAG

Water Level	NOT NOTICED			
-------------	-------------	--	--	--

Time	-				
------	---	--	--	--	--

Date	8-20-71				
------	---------	--	--	--	--

* ELEVATION ESTIMATED FROM CONTOUR PLAN

Boring Log

PROJECT WAIPAHU ESTATES UNIT 3-2BORING NO. 3 Sheet No. of LOCATION Waipio, Ewa, Oahu, HawaiiDriller W. LUM & ASSOC., INC. Date AUG. 20, 1971Tax Map Key: 9-4-02: Por. 7Field Party KAKU, GLORYType of Boring AUGER (13-30) Diam. 4"Elev. 150' ± * Datum Drill Bit T.C. DRAG

HAMMER:

Weight 140*Drop 30"Water Level NOT NOTICEDTime Date 8-20-71SAMPLER: 2" S.S. - 2" STANDARD SPLIT SPOON
2" S. - 2" O.D. THIN WALL TUBE

PENETRATION DATA

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					2" O.D. THIN WALL TUBE SAMPLER
										N (Blows per foot)					
	ELEV. = 150' ± 2 *	0								0	10	20	30	40	BLows/0.5'
(ML)	STIFF REDDISH BROWN CLAYEY SILT W/ TRACES OF ROOTS	2' 3.5		3-A	-	20	-	-	-						
	NOTE: USED WATER TO AID DRILLING														
(ML)	STIFF REDDISH BROWN CLAYEY SILT W/ TRACES OF CANE ASH	2' 5		3-B	118	32	87	7670	-						61.5, 61.3
(MH)	STIFF MOTTLED REDDISH BROWN & GRAY CLAYEY SILT W/ DECOMPOSED ROCK & ROOTS	2' 6.5		3-C	-	36	-	-	-						
(MH)	STIFF REDDISH BROWN SILTY CLAY	2' 5		3-D	116	33	87	-	-						71.5, 71.4
	BROWN SILTY CLAY														
	GRAY, DECOMPOSED ROCK	2' 5.5		3-E	-	34	-	-	-						21.5, 20.1
	END OF BORING @ 20.6'														
* ELEVATION ESTIMATED FROM CONTOUR PLAN															

*ELEVATION ESTIMATED FROM CONTOUR PLAN

Boring Log

PROJECT WAIPAHU ESTATES UNIT 3-2LOCATION Waipio, Ewa, Oahu, HawaiiTax Map Key: 9-4-02: Por. 7

HAMMER:

Weight 140#Drop 30"2" S. 2" O.D. THIN WALL TUBESAMPLER: 2" S.S. 2" STANDARD SPLIT SPOONBORING NO. 4 Sheet No. of Driller W. LUM ASSOC., INC. Date AUG. 24 & 25, 1971Field Party MEYER, KAKUType of Boring AUGER (MOBILE MINUTE MAN) Diam. 3"Elev. 133' ± *Datum Drill Bit FINGER TYPEWater Level NOT NOTICEDTime Date 8-25-71

PENETRATION DATA

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.	Standard Penetration Test					2" O.D. THIN WALL TUBE SAMPLER
	ELEV. = 133' ± 2 *	0								N (Blows per foot)					BLOWS/0.5'
										0	10	20	30	40	
(ML)	MEDIUM, REDDISH BROWN CLAYEY SILT		2"SS	4-A	-	32	-	-	-						
(ML)	STIFF, BROWN CLAYEY SILT	5	2"SS	4-B	120	31	72	5100	-						10/5'
	MOTTLED BROWN & GRAY DECOMPOSED ROCK W/TRACES OF BROWN, SILTY CLAY	10	2"SS	4-C	-	40	-	-	-						
(MH)	STIFF, BROWN CLAYEY SILT					32									
(MH)	STIFF, REDDISH BROWN CLAYEY SILT	15	2"SS	4-D	-	20	-	-	-						
	END OF BORING @ 16.5'														
* ELEVATION ESTIMATED FROM CONTOUR PLAN															

* ELEVATION ESTIMATED FROM CONTOUR PLAN

Boring Log

PROJECT WAIPAHU ESTATES UNIT 3-2LOCATION Waipio, Ewa, Oahu, HawaiiTax Map Key: 9-4-02: Por. 7

HAMMER:

Weight 140 #Drop 30"

SAMPLER:

2" S.S. - STANDARD SPLIT SPOON
2" S. 2" O.D. THIN WALL TUBEBORING NO. 5 Sheet No. of Driller W. LUM & ASSOC., INC. Date AUG. 20, 1971Field Party KAKU, GLORYType of Boring AUGER (B-30) Diam. 4"Elev. 138' ± * Datum Drill Bit T.C. DRAGWater Level NOT NOTICEDTime Date 8-20-71

PENETRATION DATA

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

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.	Standard Penetration Test	2" O.D. THIN WALL TUBE SAMPLER
	ELEV. = 138' ± *	0									
(ML)	SOFT, REDDISH BROWN CLAYEY SILT	2' 5.5	SS	S-A	-	26	-	-	-	1/5	
(ML)	STIFF, REDDISH BROWN CLAYEY SILT W/ TRACES OF ROOTS	2' 5	SS	S-B	117	26	72	-	-	4/5	
	NOTE: USED WATER TO AID DRILLING										
	STIFF, BROWN CLAYEY SILT	10	TH	S-C	-	43	-	-	-	4/5	6/5 7/5
(MH)	STIFF, TAN & REDDISH BROWN CLAYEY SILT W/ DECOMPOSED ROCK & TRACES OF ROOTS	2' 5.5	TH	S-D	-	32	-	4520	-	3/5	3/5
(MH)	STIFF, REDDISH BROWN SILTY CLAY W/ TRACES OF DECOMPOSED ROCK	2' 5	TH	S-E	-	46	-	-	-		
	MOTTLED GRAY & BROWN DECOMPOSED ROCK & CLAY POCKETS	20	TH								
	END OF BORING @ 21.5'										

* ELEVATION ESTIMATED FROM CONTOUR PLAN

Boring Log

PROJECT WAIPAHO ESTATES UNIT 3-2LOCATION Waipio, Ewa, Oahu, HawaiiTax Map Key: 9-4-02: Por. 7

HAMMER:

Weight 140#Drop 30"2" S. 2" O.D. THIN WALL TUBE

SAMPLER:

2" S. 2" STANDARD SPLIT SPOONBORING NO. 6 Sheet No. of Driller W. LUM ASSOC., INC. Date AUG. 26, 1971Field Party MEYER, KAKU, TSUKAZAKIType of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"Elev. 126' ± * Datum Drill Bit T.C. DRAGWater Level NOT NOTICEDTime Date 8-26-71

PENETRATION DATA

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					2" O.D. THIN WALL TUBE SAMPLER
										Standard Penetration Test					
ELEV. = 126' ± 3' * 0										N (Blows per foot)					BLOWS/0.5'
										0	10	20	30	40	
(ML-CL)	SOFT, REDDISH BROWN SILTY CLAY w/ROOTS	0	2" S	G-A	111	30	86	1720	500 800						1/5' 1/5'
(MH)	STIFF, BROWN SILTY CLAY w/TRACES OF DECOMPOSED ROCK	5	2" S	G-B	-	31	-	-	-						
(MH)	SOFT, MOTTLED BROWN CLAYEY SILT w/ DECOMPOSED ROCK	10	2" S	G-C	95	48	64	2080	550 900						1/5' 2/5'
	GRAY, LAVA (PUKA PUKA) ROCK w/TRACES OF DECOMPOSED ROCK.	15	2" S	G-D	-	18	-	-	-						45/5'
	END OF BORING @ 14'														
* ELEVATION ESTIMATED FROM CONTOUR PLAN															

* ELEVATION ESTIMATED FROM CONTOUR PLAN

Boring Log

PROJECT WAIPAHU ESTATES UNIT 3-2LOCATION Waipio, Ewa, Oahu, HawaiiTax Map Key: 9-4-02: Por. 7

HAMMER:

Weight 140*Drop 30"

2" S - 2" O.D. THIN WALL TUBE

SAMPLER: 2" SS - 2" STANDARD SPLIT SPOONBORING NO. 7 Sheet No. of Driller W. LUM ASSOC., INC. Date AUG. 26, 1971Field Party MEYER, KAKU, TSUKAZAKIType of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"Elev. 120' ± * Datum Drill Bit T.C. DRAGWater Level NOT NOTICEDTime Date 8-26-71

PENETRATION DATA

Standard
Penetration Test2" O.D.
THIN WALL
TUBE SAMPLER

N (Blows per foot)

0 10 20 30 40 BLOWS/0.5'

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				
	ELEV. <u>120' ± *</u>													
ML:CL	SOFT, REDDISH BROWN CLAYEY SILT w/ROOTS	0	2" S	7-A	105 LL-42 PL-26	36	77	1960	600					1/5' 1/5'
(ML)	STIFF, REDDISH BROWN CLAYEY SILT	5	2" S	7-B	115	37	84	5100	-					6/5' 6/5'
ML	STIFF, BROWN CLAYEY SILT w/TRACES OF DECOMPOSED ROCK	10	2" SS	7-C	-	23 LL-48 PL-34	-	-	-					
	DECOMPOSED ROCK (SOME CRUSHES TO SILTY SAND)	15	2" SS	7-D	-	38	-	-	-				10/5'	21/1'
	END OF BORING @ 16.1'													

* ELEVATION ESTIMATED
FROM CONTOUR PLAN

Boring Log

PROJECT WAIPAHU ESTATES UNIT 3-2LOCATION Waipio, Ewa, Oahu, HawaiiTax Map Key: 9-4-02: Por. 7

HAMMER:

Weight 40 #Drop 30"

SAMPLER:

2" SS. - 2" STANDARD SPLIT SPOON
2" S 2" O.D. THIN WALL TUBEBORING NO. 8 Sheet No. of Driller W. LUM & ASSOC., INC. Date AUG. 20, 1971Field Party MAESHIRO, TSUKAZAKIType of Boring AUGER (ACIER) Diam. 4"Elev. 122' ± * Datum Drill Bit T.C. DRAGWater Level NOT NOTICEDTime Date 8-20-71

PENETRATION DATA

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

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.	Standard Penetration Test	2" O.D. THIN WALL TUBE SAMPLER
	ELEV. = 122 ± 7 *										
(ML)	STIFF REDDISH BROWN CLAYEY SILT W/ TRACES OF ROOTS, CORAL & SAND (FILL?)	2' 5.5"	I	B-A	-	107	-	-	-		
(ML)	STIFF REDDISH BROWN CLAYEY SILT	5' 2' 14"	I	B-B	120	27	75	8010	-		81.5, 161.5
	COBBLE OR BOULDER		○ ○ ○								
(MH)	MEDIUM TO STIFF MOTTLED BROWN, CLAYEY SILT W/ TRACES OF DECOMPOSED ROCK	10' 2' 5"	I	B-C	112	38	81	4740	-		31.5, 41.5
	BOULDER		○ ○ ○								
	GRAY & BROWN, DECOMPOSED ROCK	15' 2' 5.5"	I	B-D	-	35	-	-	-		301.2
	END OF BORING @ 15.2'										

* ELEVATION ESTIMATED FROM CONTOUR PLAN

WAIPAHU ESTATES - UNIT 3-2

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	<u>2</u>	<u>2</u>	<u>2</u>	
SAMPLE NO.		<u>C</u>	<u>E</u>	
DEPTH BELOW SURFACE	<u>SURFACE</u>	<u>10'-11'</u>	<u>20'-21.5'</u>	
	<u>REDDISH-BROWN</u>	<u>BROWN</u>	<u>BROWN & TAN</u>	
	<u>CLAYEY SILT</u>	<u>CLAYEY SILT</u>	<u>CLAYEY SILT</u>	
	<u>W/TRACES OF</u>	<u>W/TRACES OF</u>	<u>W/TRACES OF</u>	
DESCRIPTION	<u>DECOMP. ROCK</u>	<u>DECOMP. ROCK</u>	<u>DECOMP. ROCK</u>	
	<u>& CORAL</u>			
GRAIN-SIZE ANALYSIS				
(% Passing)				
Sieve				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	<u>NATURAL</u>	<u>NATURAL</u>	<u>NATURAL</u>	
Liquid Limit	<u>41</u>	<u>50</u>	<u>61</u>	
Plastic Limit	<u>26</u>	<u>33</u>	<u>40</u>	
Plasticity Index	<u>15</u>	<u>17</u>	<u>21</u>	
Dilatancy	<u>QUICK</u>	<u>QUICK</u>	<u>SLOW-MED.</u>	
Toughness	<u>SLIGHT-MED.</u>	<u>SLIGHT</u>	<u>MEDIUM</u>	
Dry Strength	<u>SLIGHT-MED.</u>	<u>SLIGHT-MED.</u>	<u>SLIGHT-MED.</u>	
UNIFIED SOIL CLASSIFICATION	<u>ML-CL</u>	<u>ML-MH</u>	<u>MH</u>	
APPARENT SPECIFIC GRAVITY	<u>2.94</u>			
EXPANSION AND CBR TESTS				
(Surcharge-51 P.S.F.)				
Molding Moisture, %	<u>25.2</u>			
Molding Dry Density, P.C.F.	<u>101.5</u>			
Swell upon saturation, %	<u>0.4</u>			
CBR at 0.1" Penetration	<u>11.7</u>			
MOISTURE-DENSITY RELATIONS OF SOILS				
(AASHTO T-180-57 Method)	<u>A</u>			
Dry to Wet or Wet to Dry	<u>DRY TO WET</u>			
Max. Dry Density (P.C.F.)	<u>103.5</u>			
Optimum Moisture (%)	<u>23.1</u>			

REMARKS:

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

Date 10-7-71 By B.T.

WAIPAHU ESTATES UNIT 3-2

TABLE 1B - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	<u>7</u>	<u>7</u>		
SAMPLE NO.	<u>A</u>	<u>C</u>		
DEPTH BELOW SURFACE	<u>0'-1'</u>	<u>10'-11.5'</u>		
DESCRIPTION	<u>REDDISH-BROWN CLAYEY SILT W/ROOTS</u>	<u>BROWN CLAYEY SILT W/TRACES OF DECOMP. ROCK</u>		
GRAIN-SIZE ANALYSIS				
(% Passing)				
Sieve				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	<u>NATURAL</u>	<u>NATURAL</u>		
Liquid Limit	<u>42</u>	<u>48</u>		
Plastic Limit	<u>26</u>	<u>34</u>		
Plasticity Index	<u>16</u>	<u>14</u>		
Dilatancy	<u>QUICK</u>	<u>QUICK</u>		
Toughness	<u>SLIGHT</u>	<u>SLIGHT</u>		
Dry Strength	<u>MEDIUM</u>	<u>SLIGHT-MED.</u>		
UNIFIED SOIL CLASSIFICATION	<u>ML-CL</u>	<u>ML</u>		
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				
(AASHTO T-180-57 Method)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

REMARKS:

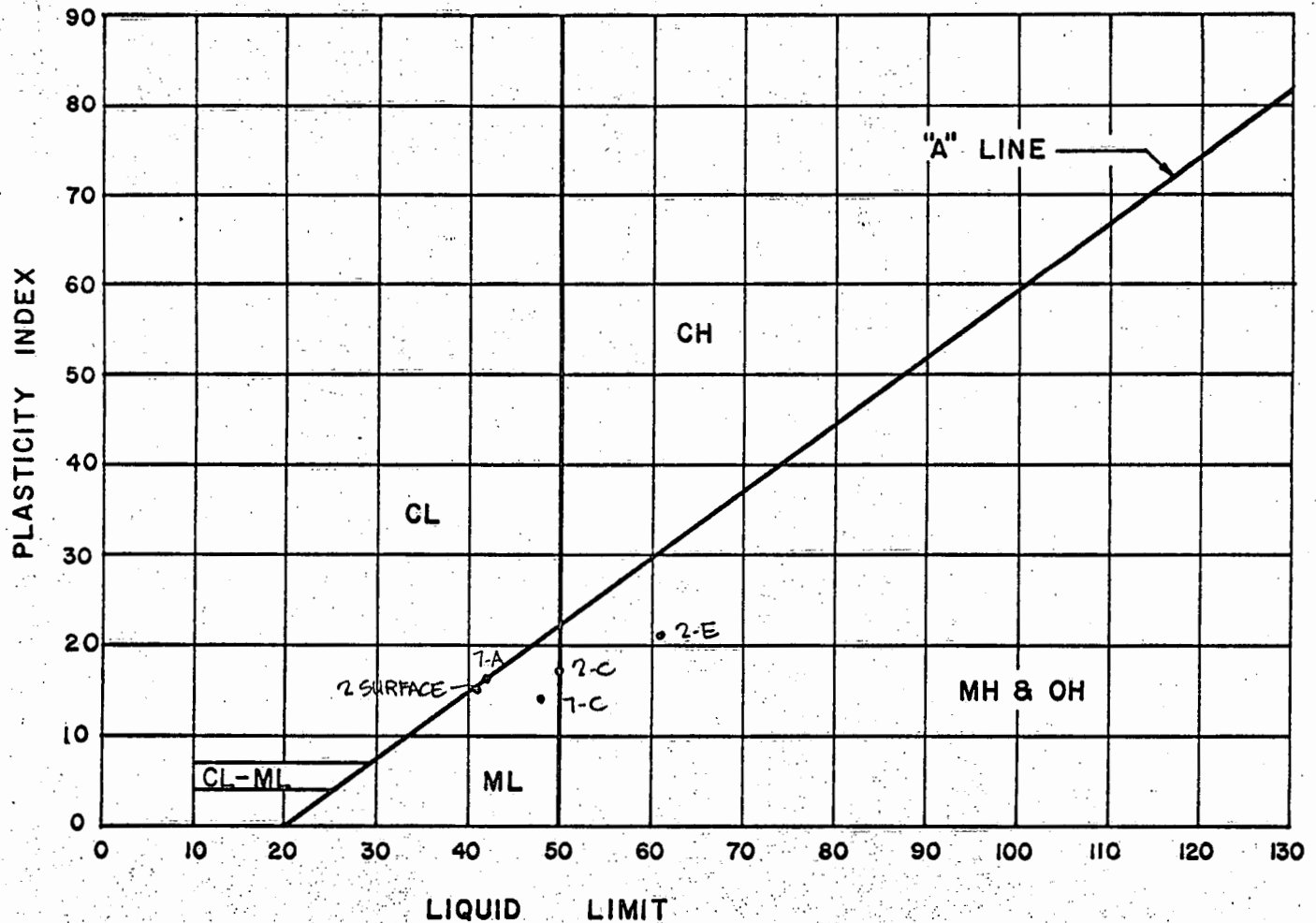
WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 10-7-71 By B.T.

PLASTICITY CHART

PROJECT: WAIPAHU ESTATES, UNIT 3-2

LOCATION: WAIPIO, EWA, OAHU, HAWAII



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

DATE 10-7-71 BY BT

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

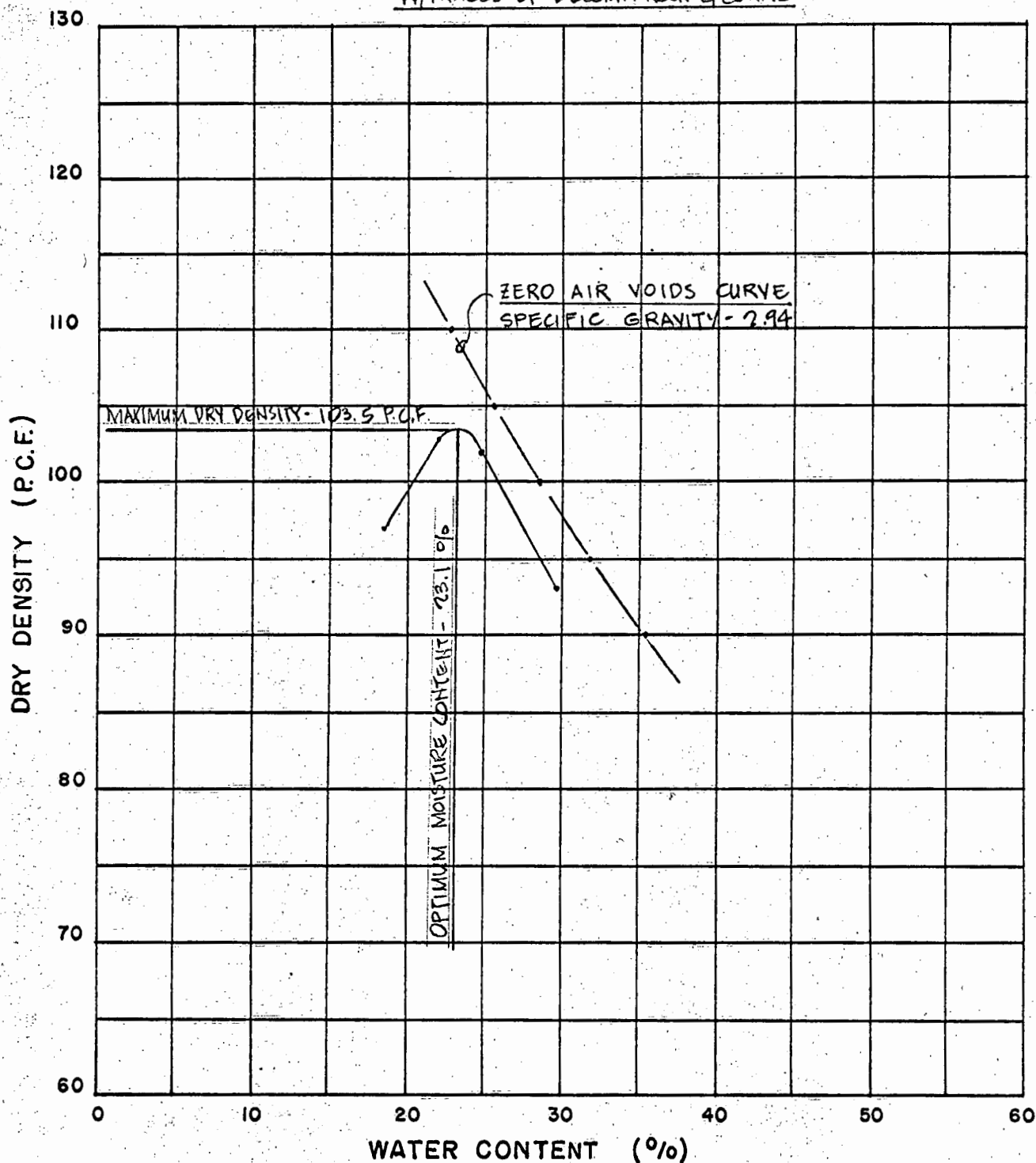
PROJECT: WAIPAHU ESTATES, UNIT 3-2

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO.: 2 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT
W/ TRACES OF DECOMP. ROCK & CORAL

AGGREGATE: 1/4" MINUS
 MOLD SIZE: 4" + 4.75" HIGH
 HAMMER: 10 LBS., 18" DROP
 LAYERS: 5
 BLOWS: 25/LAYER



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

DATE 10-1-71 BY SK

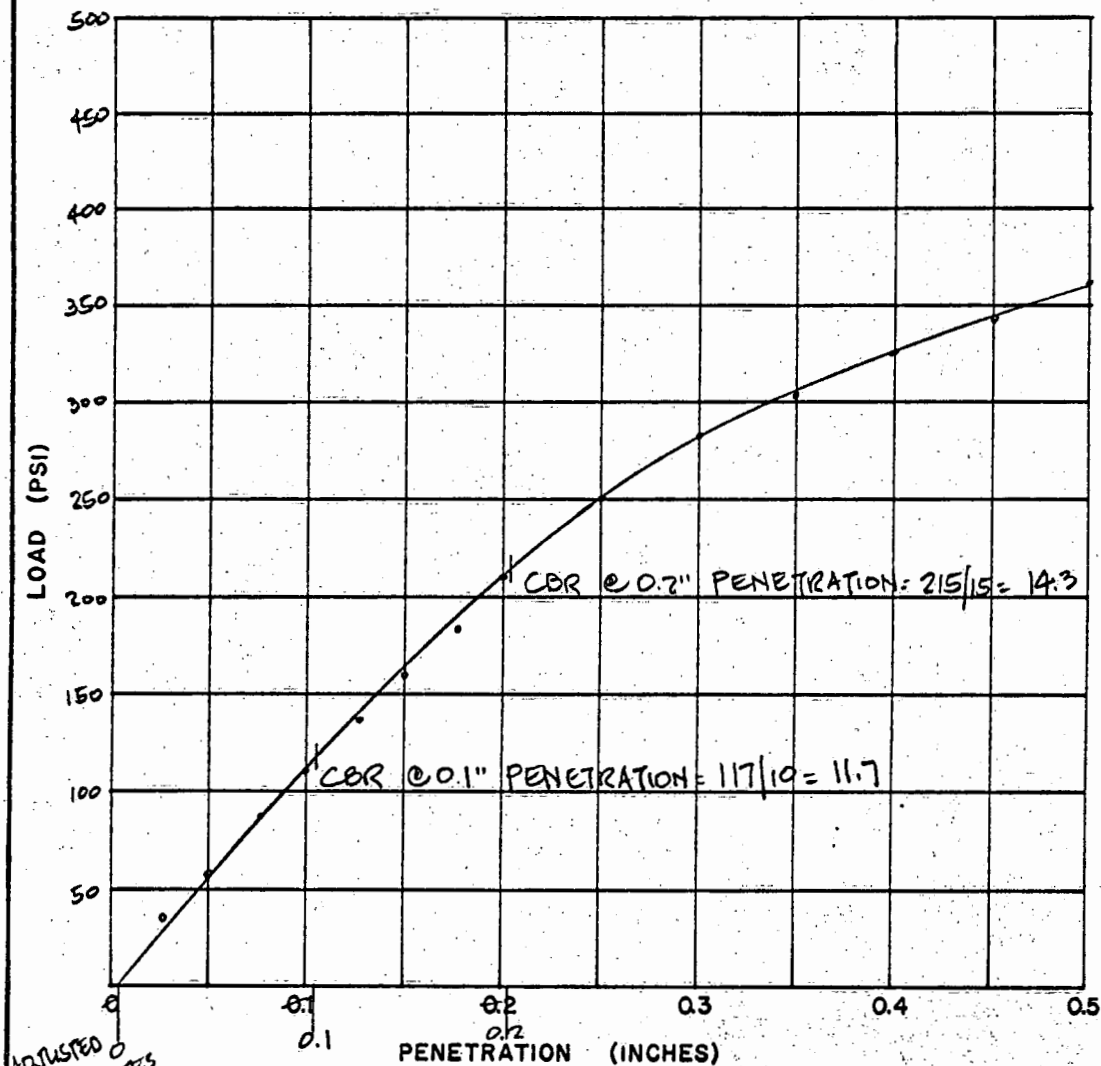
CBR TEST

PROJECT: WAIPAHU ESTATES, UNIT 3-2

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO: 2 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT
W/ TRACES OF DECOMP. ROCK & CORAL



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS)	LOAD (PSI)
0.025	105	35
0.050	175	58
0.075	260	87
0.100	330	110
0.125	410	137
0.150	480	160
0.175	550	183
0.200	630	210
0.250	750	250
0.300	850	283
0.350	910	303
0.400	980	327
0.450	1030	343
0.500	1090	363

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LBS.

HAMMER DROP 18"

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, % 25.2

MOLDING DRY DENSITY, P.C.F. 101.5

CBR @ 0.1" PENETRATION 11.7

DAYS SOAKED 4

DATE 10-1-71 BY MO

DATE 10-6-71 BY SK

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

LOGS OF BORINGS

AND LABORATORY TEST RESULTS

FROM

"WAIPAHU ESTATES UNIT 3-1"

DATED OCTOBER 11, 1971

Boring Log

PROJECT WAIPAHU ESTATES UNIT 3-1LOCATION Waipio, Ewa, Oahu, HawaiiTax Map Key: 9-4-07: 11 & 24

HAMMER:

Weight 140 #Drop 30"2" SS - 2" STANDARD SPLIT SPOONSAMPLER: 2" S. - 2" O.D. THIN WALL TUBEBORING NO. 1 Sheet No. of Driller W. LUM ASSOC., INC. Date 8-18-71Field Party KAKU & GLODYType of Boring AUGER (B-30) Diam. 4"Elev. 155' ± * Datum Drill Bit J.C. DRAGWater Level NOT NOTICEDTime Date 8-18-71

PENETRATION DATA

Unified Soil Classification	DESCRIPTION	Depth (F.)	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					2" O.D. THIN WALL TUBE SAMPLER	
										N (Blows per foot)						
										0	10	20	30	40	13 BLOWS / 0.5'	
(ML-GC)	STIFF REDDISH BROWN SILTY CLAY NOTE: USED WATER TO AID DRILLING	2' 5.5"		1-A	-	21	-	-	-							
	BROWN & REDDISH BROWN SILTY CLAY (CUTTINGS)	2' 5"		1-B	122	31	73	7700	-						13/5'	
(ML)	STIFF REDDISH BROWN CLAYEY SILT W/ BLACK MATTER	2' 5.5"		1-C	-	27	28	-	-							
(ML)	STIFF BROWN CLAYEY SILT W/ TRACES OF DECOMPOSED ROCK															
(MH)	STIFF MOTTLED BROWN & GRAY CLAYEY SILT W/ TRACES OF DEG. ROCK	2' 5"		1-D	104	41	74	5100	-						3/5', 4/5'	
	END OF BORING @ 16.0'															

*ELEVATION ESTIMATED FROM CONTOUR PLAN

Boring Log

PROJECT WAIPAHU ESTATES UNIT 3-1LOCATION Waipio, Ewa, Oahu, HawaiiTax Map Key: 9-4-07: 11 & 24

HAMMER:

Weight 140 #Drop 30"

SAMPLER:

2" S.S. 2" STANDARD SPLIT SPOON
5. 2" O.D. THIN WALL TUBEBORING NO. G Sheet No. of Driller W. LUM & ASSOC., INC. Date AUG. 18 & 19, 1971Field Party MAESHIRO, TSUKAZAKIType of Boring AUGER (ACKER) Diam. 4"Elev. 140' ± * Datum Drill Bit T.C. DRAGWater Level NOT
NOTICEDTime Date 8-19-71

PENETRATION DATA

Standard
Penetration Test2" O.D.
THIN WALL
TUBE SAMPLER

N (Blows per foot)

0 10 20 30 40 BLOWS/0.5'

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.	Standard Penetration Test N (Blows per foot)	2" O.D. THIN WALL TUBE SAMPLER N (Blows per foot)
	ELEV. = 140' ±										
(ML-CL)	STIFF, REDDISH BROWN SILTY CLAY W/ ROOTS	2' 5.5"		G-A	-	17	-	-	-		
ML	STIFF, BROWN CLAYEY SILT	2' 5"		G-B	114	27	88	-	-		8/5, 15/5
	COBBLE	10									
ML	STIFF REDDISH BROWN SILTY CLAY W/ TRACES OF DECOMPOSED ROCK	2' 5.5"		G-C	-	27	-	-	-		
	GRAY, LAVA (PUKA PUKA) ROCK CUTTINGS	2' 5.5"		G-D	-	-	-	-	-		40/5
	GRAY W/ RED DECOMPOSED ROCK	20									
	END OF BORING @ 21.5'	21.5'		G-E	-	42	-	-	-		

* ELEVATION ESTIMATED
FROM CONTOUR PLAN

ROUGH DRILLING

ROUGH DRILLING

Boring Log

PROJECT WAIPAHU ESTATES UNIT 3-1LOCATION Waipio, Ewa, Oahu, HawaiiTax Map Key: 9-4-07: 11 & 24

HAMMER:

Weight 140 #Drop 30"SAMPLER: 2" S.S. - 2" STANDARD SPLIT SPOON
2" S. 2" O.D. THIN WALL TUBEBORING NO. 10 Sheet No. of Driller W. LUM & ASSOC., INC. Date AUG. 10, 1971Field Party MAESHIRO, TSUKAZAKIType of Boring AUGER (ACKER ACE) Diam. 4"Elev. 122' ± * Datum Drill Bit T.C. DRAGWater Level NOT NOTICEDTime Date 8-10-71

PENETRATION DATA

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

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.	Standard Penetration Test	2" O.D. THIN WALL TUBE SAMPLER
	ELEV. = 122' ± *										
(ML-CL)	STIFF REDDISH BROWN SILTY-CLAY W/ ROOTS	2' 5.5"		10-A	-	20	-	-	-		
(MH)	STIFF, RED. BROWN SILTY CLAY	2' 5"		10-B	110	26	87	4840	-		8/5, 13/5
	DECOMPOSED GRAY LAVA ROCK (PUKA-PUKA)										
	GRAY W/ RED DECOMPOSED ROCK (SOME CRUSHES TO SILTY SAND)	2' 5.5"		10-C	-	37	-	-	-		
	GRAY W/ BROWN DECOMPOSED ROCK	2' 5"		10-D	-	33	-	-	-		
	END OF BORING @ 16.5'										

* ELEVATION ESTIMATED FROM CONTOUR PLAN

WAIPAHU ESTATES - UNIT 3-1

TABLE I.A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	4	4	6
SAMPLE NO.	B	B	
DEPTH BELOW SURFACE	SURFACE	5'-5.5	SURFACE
DESCRIPTION	REDDISH-BROWN CLAYEY SILT	BROWN CLAYEY SILT	REDDISH-BROWN SILTY CLAY
GRAIN-SIZE ANALYSIS (% Passing)			
Sieve			
1"			100
1/2"			100
#4			99.9
#10			99.5
#20			98.8
#40			97.2
#100			94.6
#200			93.0
ATTERBERG LIMITS			
Air Dried or Natural	NATURAL	NATURAL	NATURAL
Liquid Limit	32	51	42
Plastic Limit	27	38	25
Plasticity Index	5	13	17
Dilatancy	QUICK	QUICK	MEDIUM
Toughness	MEDIUM	SLIGHT	MEDIUM
Dry Strength	SLIGHT-MED	SLIGHT-MED	MEDIUM
UNIFIED SOIL CLASSIFICATION	ML	MH	ML-CL
APPARENT SPECIFIC GRAVITY	2.91		2.92
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)			
Molding Moisture, %	22.5		23.3
Molding Dry Density, P.C.F.	100.5		103.8
Swell upon saturation, %	1.0		0.3
CBR at 0.1" Penetration	25.0		13.3
MOISTURE-DENSITY RELATIONS OF SOILS (AASHTO T-180-57 Method)			
Dry to Wet or Wet to Dry	A		A
Max. Dry Density (P.C.F.)	DRY TO WET		DRY TO WET
Optimum Moisture (%)	101.5		103.2
	23.8		23.9

REMARKS:

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

Date 9.27.71 By BT

WAIPAHU ESTATES - UNIT 3-1

TABLE 1B - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	<u>6</u>	<u>6</u>		
SAMPLE NO.	<u>B</u>	<u>C</u>		
DEPTH BELOW SURFACE	<u>5'-6'</u>	<u>10'-11.5'</u>		
DESCRIPTION	<u>BROWN CLAYEY SILT</u>	<u>REDDISH-BROWN SILTY CLAY W/TRACES OF DECOMP. ROCK</u>		
GRAIN-SIZE ANALYSIS				
(% Passing)				
Sieve				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	<u>NATURAL</u>	<u>NATURAL</u>		
Liquid Limit	<u>47</u>	<u>49</u>		
Plastic Limit	<u>35</u>	<u>28</u>		
Plasticity Index	<u>12</u>	<u>21</u>		
Dilatancy	<u>SLOW-MED.</u>	<u>MEDIUM</u>		
Toughness	<u>SLIGHT</u>	<u>MEDIUM</u>		
Dry Strength	<u>SLIGHT-MED.</u>	<u>MEDIUM</u>		
UNIFIED SOIL CLASSIFICATION	<u>ML</u>	<u>ML</u>		
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				
(AASHTO T-180-57 Method <u> </u>)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

REMARKS:

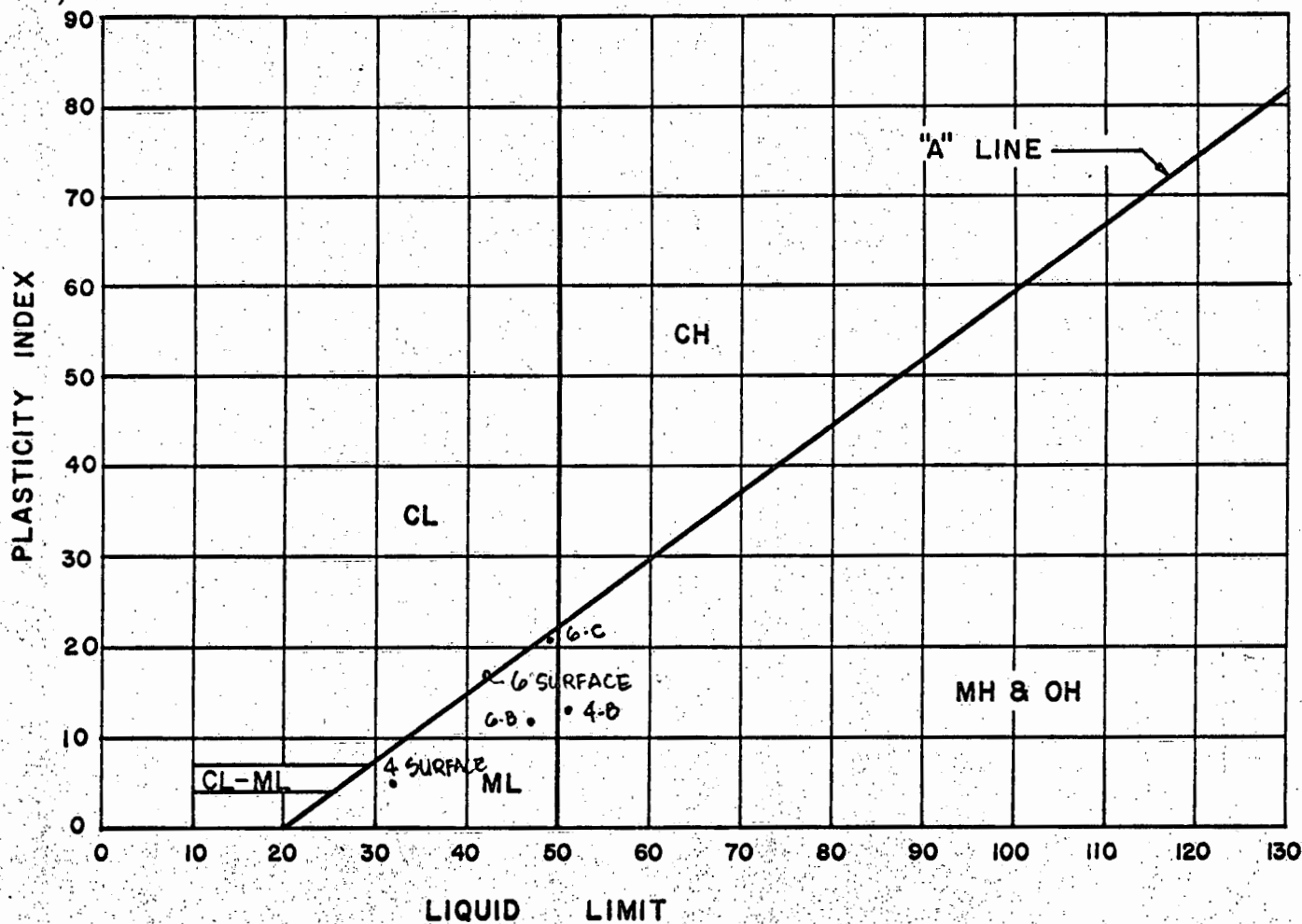
WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 9-27-71 By B.T.

PLASTICITY CHART

PROJECT: WAIPAHU ESTATES - UNIT 3-1

LOCATION: WAIPIO, EWA, OAHU, HAWAII



DATE 9-27-71 BY BT

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

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

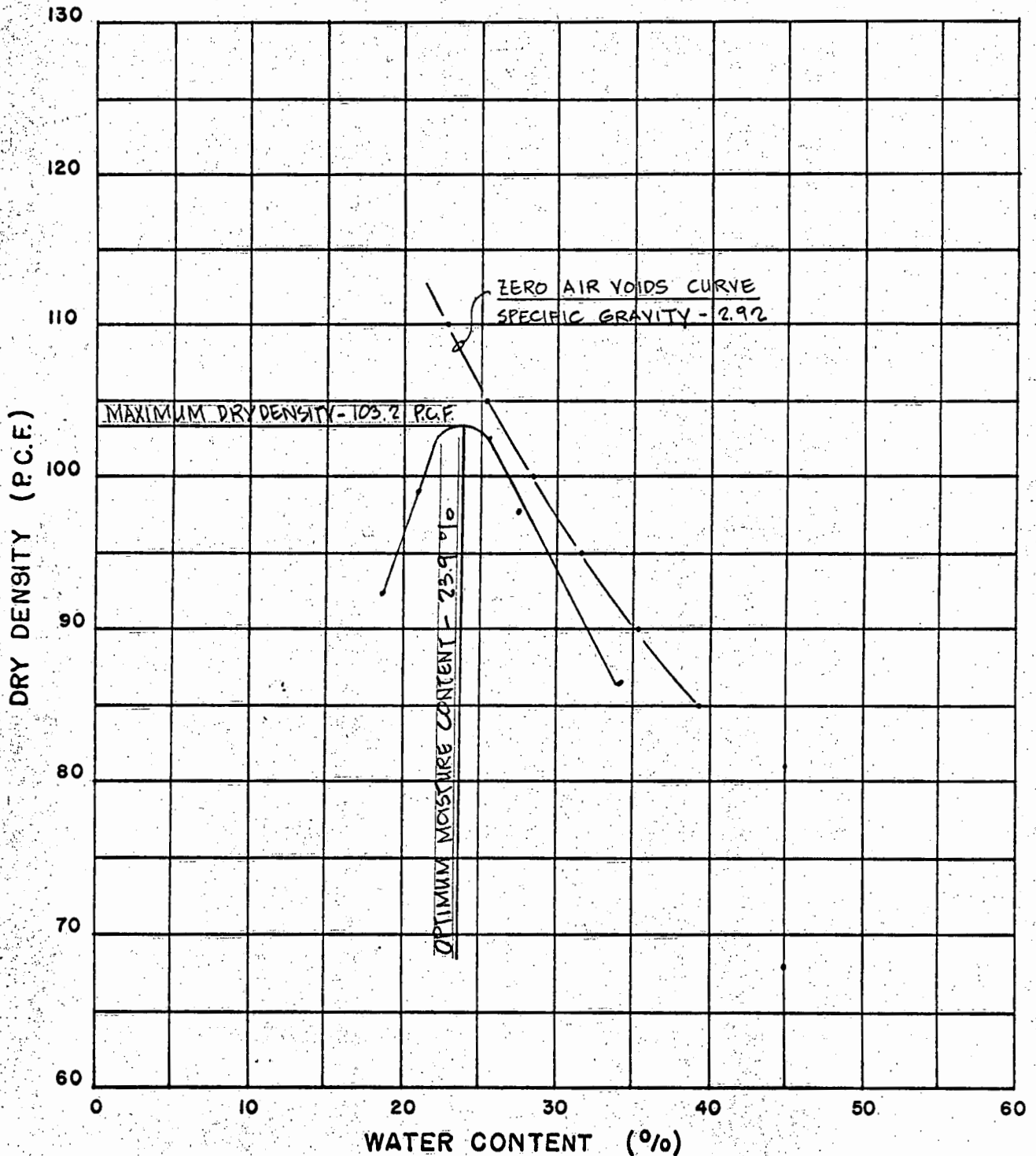
PROJECT: WAIPAHU ESTATES - UNIT 3-1

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO.: 6 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY

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



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

DATE 9-21-71 BY SK

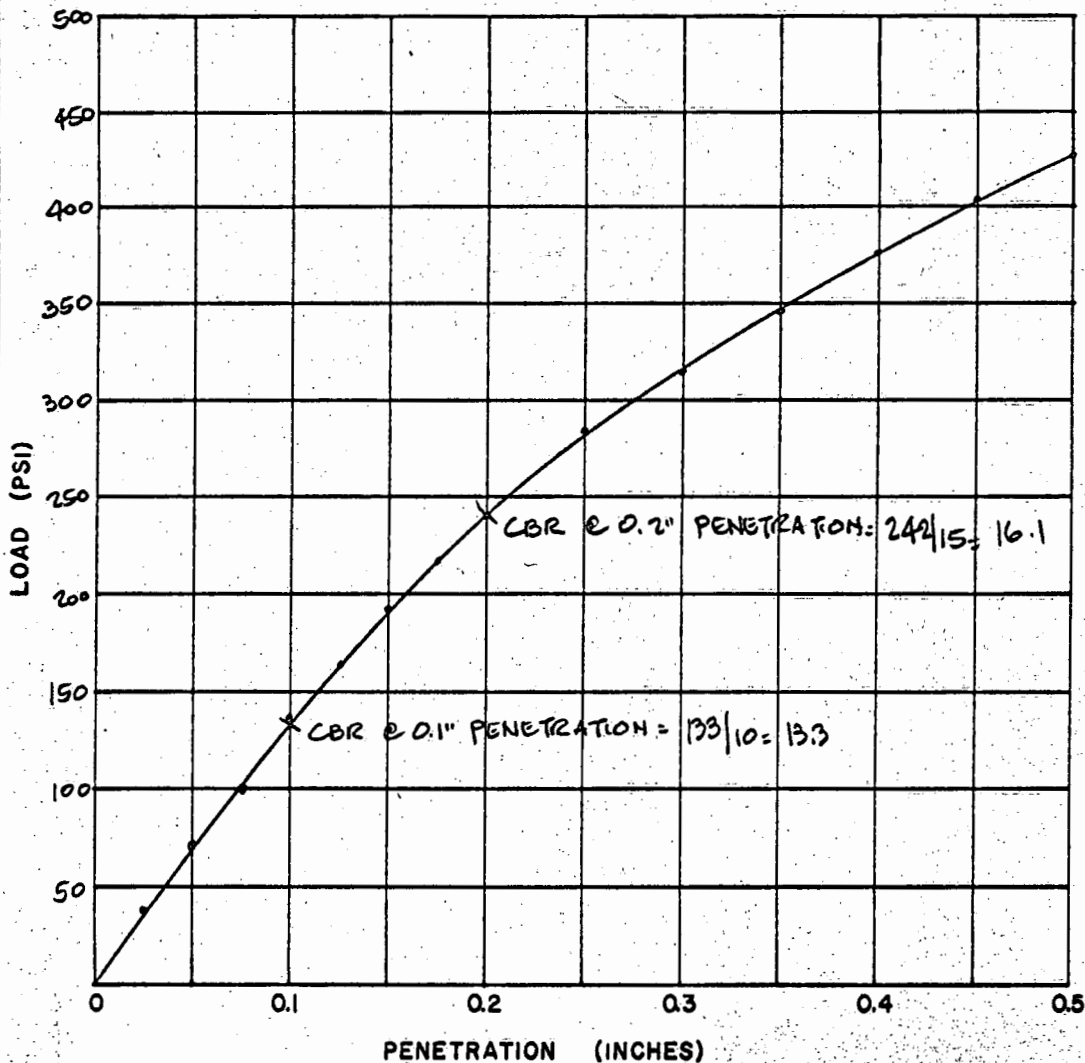
CBR TEST

PROJECT: WAI PAHU ESTATES - UNIT 3-1

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO: 6 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS)	LOAD (PSI)
0.025	110	37
0.050	210	70
0.075	300	100
0.100	410	137
0.125	490	163
0.150	580	193
0.175	650	217
0.200	720	240
0.250	850	283
0.300	945	315
0.350	1040	347
0.400	1130	377
0.450	1210	403
0.500	1280	427

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

TEST RESULTS:

MOLDING MOISTURE, % 23.3
MOLDING DRY DENSITY, P.C.F. 103.8
CBR @ 0.1" PENETRATION 13.3
DAYS SOAKED 4

DATE 9-14-71 BY AF
DATE 9-20-71 BY SK

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

GENERAL TESTING METHODS

EXPLORATORY BORINGS AND SAMPLING

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

ASTM Designation: D 1452-63T

Method for thin wall tube sampling of
soils (Tentative)

ASTM Designation: D 1587-63T

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

ASTM Designation: D 1586-64T

LABORATORY TESTING

Grading Analysis

Sieve analysis of fine and coarse
aggregates

AASHTO Designation: T 27-60

Amount of material finer than
No. 200 sieve in aggregate

AASHTO Designation: T 11-60

Atterberg Limits

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

AASHTO Designation: T 89-60

Determining the plastic limit of soils

AASHTO Designation: T 90-56

Calculating the plasticity index of
soils

AASHTO Designation: T 91-54

Specific Gravity

Specific gravity of soils
Modified as follows: 500 ML Pycnometer

AASHTO Designation: T 100-60

Expansion and CBR Tests

Expansion test and California Bearing
Ratio (CBR)

Section VIII - TM 5-530
"Materials Testing" by Headquarters,
Dept. of the Army

Compaction Test

Moisture-Density relations of soils
using a 10# rammer and an 18" drop

AASHTO Designation: T 180-57

Unified Soil Classification

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

GENERAL TESTING METHODS

Consolidation Test

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

Laboratory Shear Test

Laboratory shear test using
the Torvane

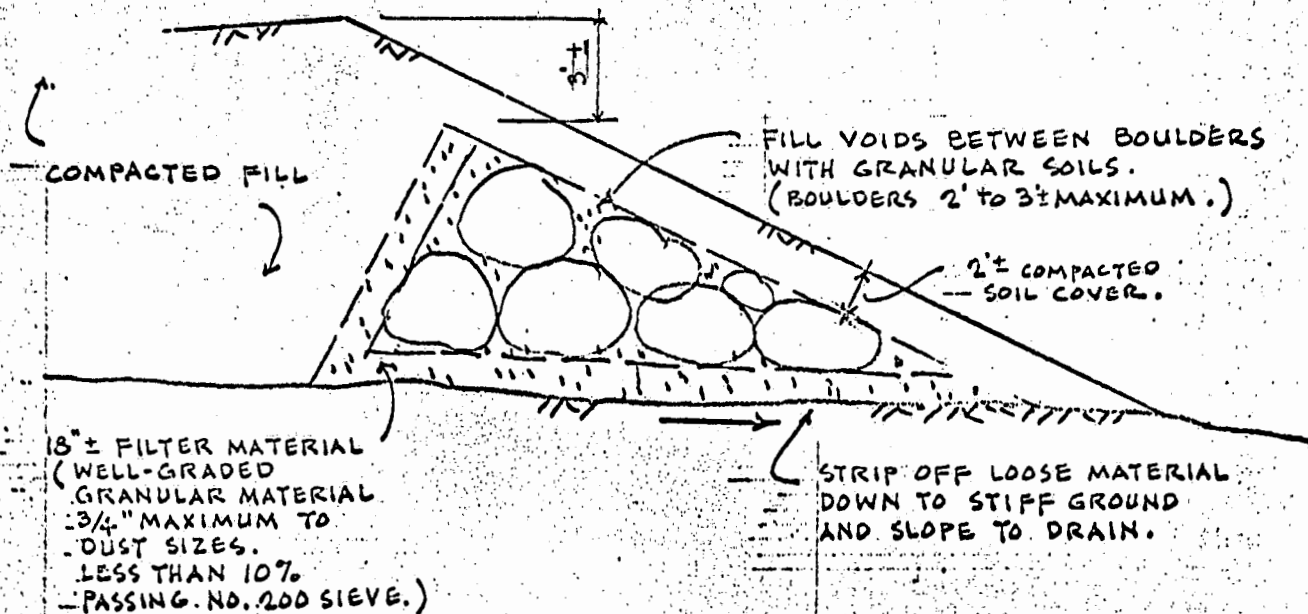
Brochure by Soiltest, Inc.

LIMITATIONS

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

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

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



SECTION

NOT TO SCALE

FIGURE 1

PROPOSED BOULDER FILL

WAIPAHU ESTATES UNIT 3-2

WAIPIO, EWA, OAHU, HAWAII