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No 219

KALUANUI UNIT 2 & PART OF UNIT 3 PRELIMINARY SOIL REPORT
(for apartment & resort development)

HAWAII KAI, MAUNALUA, OAHU, HAWAII

To:
KAISER HAWAII KAI DEVELOPMENT COMPANY

By:
WALTER LUM ASSOCIATES, INC.
CIVIL ENGINEERS
February 7, 1967

MUNICIPAL REFERENCE RECORDS CENTER
City & County of Honolulu
City Hall Annex, 358 S. King Street
Honolulu, Hawaii 96813
WITHDRAWN

WALTER LUM ASSOCIATES, INC.

CIVIL, STRUCTURAL, SOILS ENGINEERS

WALTER LUM
EDWARD WATANABE
EZRA KOIKE

1019-A UNIVERSITY AVENUE • HONOLULU, HAWAII • PHONE 990-471

February 7, 1967

MR. BARRY OKUDA
Kaiser Hawaii Kai Development Co.
P. O. Box 2997
Honolulu, Hawaii 96802

Dear Mr. Okuda:

Subject: Kaluanui Unit 2 & Part of Unit 3
Preliminary Soil Report
(for apartment and resort development)
Chapter 23, Revised Ordinances of Honolulu,
1961 As Amended

In accordance with your request, a preliminary soil exploration was made for the proposed grading in Kaluanui Unit 2 & Part of Unit 3 at Hawaii Kai, Maunaloa, Oahu, Hawaii.

The proposed freeway will divide the site into 2 parts. The portion makai of the freeway will be Kaluanui Unit 2 and the portion mauka of the freeway will be a part of Unit 3.

Twelve exploratory borings were made at the site. The site is generally level makai of the proposed freeway and slopes gradually upward toward Kaluanui Ridge mauka of the freeway. A natural drainageway or pond covers a portion of Unit 2. At the time of the exploration, most of the site was being used for stockpiling dredged materials. The underlying soil conditions can be generalized as mainly 1 to 4 ft of fill underlain by dark gray clay, silty sand to dense sand near the ponds and 3 to 8 ft of medium to stiff, silty clay underlain by dense black sand in the upper areas toward Kaluanui Ridge.

From the field exploration and laboratory test results, it is our opinion that the site may be filled for the proposed apartment and resort development. If material is imported or stockpiled material is used for the construction of fills, the borrow material should be tested and approved by the soil engineer.

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

MR. BARRY OKUDA, February 7, 1967

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All work should be done in accordance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended and the recommendations contained herein.

Light structures up to about 2 stories can be supported either on stiff existing ground or on properly compacted fills. For multi-story or heavy structures, additional soil investigation should be made.

The report includes a boring location plan, boring logs, laboratory tests and recommendations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.



Ezra Koike
Professional Engineer
Hawaii No. 1450

EK:vi

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KALUANUI UNIT 2 & PART OF UNIT 3 PRELIMINARY SOIL REPORT
(for apartment & resort development)

HAWAII KAI, MAUNALUA, OAHU, HAWAII

SCOPE OF EXPLORATION

The purpose of this exploration was to determine soil conditions of the proposed site, Kaluanui Unit 2 & part of Unit 3 at Hawaii Kai, Maunaloa, Oahu, Hawaii, for apartment & resort development.

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

FIELD EXPLORATION

Twelve exploratory borings were made at the site. The locations of these borings are shown on the Boring Location Plan. Descriptions of the underlying soils are shown on the Boring Logs Nos. 1 thru 12.

Both disturbed and exploratory thin-wall-tube samples were taken during the boring operation. Soil samples were visually identified and tentatively classified in the field. In the laboratory, they were subjected to appropriate tests. The field identifications and classifications were then reviewed and modified to conform with the results of the laboratory tests in accordance with the "Unified Soil Classification System."

LABORATORY TESTS

Laboratory tests included: in-place natural density, moisture content and unconfined compression; Atterberg limits; specific gravity; gradation; expansion; CBR and consolidation.

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

A summary of the results of the laboratory tests is given in Tables IA thru IC.

SITE CONDITIONS

The proposed project site is located at the foot of Kaluanui Ridge. The proposed freeway will divide the site into 2 parts. The portion makai of the freeway will be Kaluanui Unit 2 and the portion mauka of the freeway will be a part of Kaluanui Unit 3.

The existing topography for Kaluanui Unit 2 is generally flat, about elevation 5 ft. There are several small ponds or drainageways within the site. The elevation of the water level is about elevation 1 ft.

The existing topography in Unit 3 generally slopes upward from the proposed freeway toward Kaluanui Ridge.

At the time of the field explorations, much of the site was used for stockpiling dredged material from Kuapa Pond. The stockpile area is outlined on the Boring Location Plan. The heights of the stockpile vary from 6 to 10 feet. Part of the site is overgrown with brush. Boulders were found scattered around the site.

SOIL CONDITIONS

The soil conditions encountered at the site can be generalized as follows:

1. Kaluanui Unit 2 (Makai of the Freeway)

The surface soils may be described as 1 to 4 ft of fill underlain with dark gray clay. Below the clay was silty sand and dense sand.

In the ponds, the water is about 1 to 4 ft deep over about 2 to 5 ft of soft mud. Underlying the mud is medium, gray, silty clay with sand and coral fragments, below which is black sand.

2. Portion of Kaluanui Unit 3 (Mauka of the Freeway)

The surface soils in the higher areas were mainly medium to stiff, silty clay underlain with dense black sand. Coral was encountered at Boring #2. A rock formation or boulder was encountered at Borings #9, #11 and #12.

DISCUSSION AND RECOMMENDATIONS

Fill

The present plan is to fill the ponds and to construct low fills up to elevation 8 ft for Kaluanui Unit 2 and fills up to about 20 ft in height for Kaluanui Unit 3.

Fill in Ponds

Before filling the existing ponds, the ponds should be drained with ditches or subdrained with pipes discharging to the open waterways of Kuapa Pond. Fills up to elevation +3 ft may be constructed in either of the following manner:

1. Remove the soft pond mud by dredging and replace with granular material (preferably by dredging) up to about elevation +3 ft.
2. Use granular material (6 in. minus sizes) up to about elevation +3 ft. The material may be either crushed rock or dredged coral with the minus No. 200 sieve sizes less than 15%. Mud waves or mud pockets that are formed should be removed.

Surface settlements will be quite variable if alternate 2 is used. Alternate 1 would be the preferred method of filling the pond.

After placing the material up to about elevation +3 ft, the entire surface of the working platform area should be proof-rolled with heavy vibratory equipment. All soft spots that are detected should be dug out and replaced with select material.

Settlement gages should be installed and periodic level readings taken to observe the progressive movements, particularly if Method 2 is used.

General Fill

The construction of the proposed fills above elevation +3 ft should be done in accordance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended.

1. All stockpiled materials on the site should be removed to the original stiff ground.
2. All vegetation on the site should be removed.

3. All soft material at the surface should be scarified, recompact and shaped to drain.
4. All hard spots along the existing haul road should be scarified and recompact to match the densities of the surrounding soils.
5. The stockpiled materials vary from pile to pile. The material to be used for the construction of fills should be selected and tested by the soil engineer. The better materials should be used within the top two feet of the finished grade.
6. Fill should be placed in approximately level layers starting at the lower end of the fill and working upward.
7. Fill should be compacted in thin layers to at least 90% of AASHTO T-180-57 density.

Slopes

Cut slopes of $1\frac{1}{2}$ horizontal to 1 vertical or flatter would be preferable. Slope ratios for cuts in rock may be about $\frac{1}{2}$ to 1 and preferably $\frac{3}{4}$ to 1. Fill slopes should be 2 horizontal to 1 or flatter.

If slope heights greater than 20 ft are considered, 8-ft-wide benches should be placed at height intervals of about 15 ft in both cuts and fills to satisfy the City and County of Honolulu's grading ordinance.

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

Slope planting is recommended on cut and fill slopes to minimize erosion. For additional information, see the attached "Proposed Specification for Planting."

Drainage

Runoff from rainstorms would be rapid on the portion of the proposed site located on the slope of Kaluanui Ridge and drainage for runoff water should be controlled.

Foundations

Recommendations for construction are:

1. All underground utilities should be placed after the fills are constructed and before the construction of houses. Flexible connections are recommended especially where lines cross structures and where lines pass from compressible to stiff ground.
2. In the lower areas, the construction of surface structures should be delayed until the settlement readings indicate that much of the primary settlement has taken place and the estimated remaining settlement can be tolerated according to the limits defined by the designer for the structures and utilities.

3. Bearing values for a given soil usually vary with the sizes and depths of the footings. For light, short span structures placed directly on compacted fill, the following values may be used:
 - a. About 2000 p.s.f. in the areas mauka of the existing ponds, generally above the existing elevation +5 ft.
 - b. About 1000 p.s.f. in the lower areas generally where the existing surface elevation is below +5 ft. To minimize the effects of differential settlements, the use of deep grade beams is recommended around the perimeter walls and under bearing walls. The footings should be placed as close to the surface as practicable.
4. For heavy structures or structures of 3 or more stories in height, additional soil investigation should be made.
5. Because of the downhill creep effect, some settlement may occur near the tops of slopes. Therefore, for slopes about 15 ft or higher, buildings should be placed about 15 to 20 ft from the tops of slopes.
6. Construction of retaining walls on side slopes should be avoided unless the underlying materials are of a stiff to hard consistency.

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

Roadway

If select material is used within the top 2 ft of finished grade, the pavement thickness for the light residential traffic anticipated may be estimated as follows:

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

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

It is recommended that the subgrades of roadways be shaped to drain. Outlets should be placed at low points of roadway profiles to avoid water pocketing by running bleeder pipes into catch basins at low points of the subgrade.

PROPOSED SPECIFICATION FOR EARTHWORK

KALUANUI UNIT 2 & PART OF UNIT 3

General Description

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

Clearing, Grubbing and Preparing Areas to be Filled

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

The existing ponds shall be drained or subdrained with outlets to the open waterways of Kuapa Pond.

All topsoil and stockpiled soils shall be removed to the original stiff ground. All topsoil encountered at finish grade shall be scarified and recompactd.

All hard surfaces along the existing access roads shall be scarified down to stiff soils to match the densities of the surrounding soils.

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 cutting steps into the hillside and compacting the fill into these steps. Ground slopes which are flatter than 5 horizontal to 1 vertical shall be benched when considered necessary by the Soil Engineer.

Materials

Fill material in the ponds shall be granular materials (6 in. minus sizes) up to about elevation +3 ft. The material may be either crushed rock or dredged coral with the minus No. 200 sieve sizes less than 15%.

Fill material above elevation +3 ft shall consist of soils approved by the Soil Engineer. The soils shall contain no more than a trace of organic matter and no particles larger than 6 in. in diameter. Also, it shall contain no more than 10% cobbles larger than gravel and smaller than 6 in. in diameter. Fill material placed in the top 2 ft of fills shall contain no more than 30% gravel and any material larger than gravel.

Placing, Spreading and Compacting Fill Material

Fill in Ponds

Alternate 1, the soft pond mud shall be removed by dredging and replaced with granular material. Alternate 2, the granular material shall be rolled into place and any mud waves or mud pockets that are formed shall be removed. The granular fill in ponds shall be brought up to about elevation +3 ft and rolled with heavy equipment. The entire surface of the working platform area shall then be proof-rolled with heavy vibratory compactors. All soft spots that are detected shall then be dug out and replaced with select material.

General Fill

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 uniformity of moisture content in each layer.

No rock or cobbles shall be allowed to nest and all voids between rocks must be carefully filled and compacted with small stones or earth.

When the moisture content of the fill material is below that specified by the Soil Engineer, water shall be added until the moisture content is as specified and assures a thorough bonding during the compacting process.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to not less than 90% of maximum density in accordance with AASHO Test No. T-180-57 or other density tests which will obtain comparable results. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers. Rollers shall be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is at the specified moisture content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to insure that the desired density has been obtained.

Field density tests of the compaction of each layer of fill shall be made by the Soil Engineer. Where sheepsfoot rollers are used, soil may be disturbed to a depth of several inches; therefore, density readings shall be taken below the disturbed surface as often as necessary as determined by the Soil Engineer. When these readings indicate that the density of any layer of fill or portion thereof is below the required 90% density, the particular 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.

Soil Engineering Services

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

Rainy Weather

No fill material shall be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests by the Soil Engineer indicate that the moisture content and density are as previously specified.

PROPOSED SPECIFICATION FOR PLANTING

KALUANUI UNIT 2 & PART OF UNIT 3

Planting materials shall be hunnan grass, buffalo grass, and manienie. In damp areas where manienie will not thrive, hunnan grass shall be planted and in shaded areas, buffalo grass shall be planted.

Planting materials shall be obtained by digging up luxuriant growths from areas that are free of seeds, roots, plants, and grasses that are objectionable. Plant and water within 24 hours after digging from original growing position.

Grasses for planting shall be in approximately 4 in. runners. Planting shall be done in staggered rows 12 in. apart over topsoiled areas. After planting, cover with additional 1/2 in. topsoil. Flat areas shall be rolled with a lawn roller. Water soon after planting, continue daily until growth is sufficient that complete cover has been achieved. In any area where grasses do not become established, runners shall be replanted.

Apply 10-10-2 fertilizer after 2 to 3 months at the rate of 800 lb per acre. Initial maintenance shall be continued until stabilization has been reached.

PROPOSED SPECIFICATION FOR BASE COURSE

KALUANUI UNIT 2 & PART OF UNIT 3

Materials

The base course for use under floor slabs shall consist of clean crushed rock, gravel, coral, cinders or other material as approved by the Soil Engineer. It shall be free from adobe, organic matter, and other such deleterious substances.

Grading

The base course material shall have the following gradation:

<u>Sieve</u>	<u>% Passing</u>
2" Sq.	100%
#4	0

Compacting

The base course material shall be thoroughly compacted with vibratory or other approved equipment.

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3

LOCATION HAWAII KAI, MAUNALUA, OAHU, HAWAII

BORING NO. 1 Sheet No. _____ of _____

Driller WALTER LUM ASSOC. Date 11-24-66

Field Party MANIFOLD, MAESHIRO, MAKAULA

Type of Boring AUGER (MOBILE) Diam. 3"

Elev. 5' ± * Datum _____

HAMMER:

Weight 140 LB.

Drop 30"

SAMPLER: 2" O.D. THIN WALL TUBE

Water Level 5.0'

Time 10:00AM

Date 11-29-66

PENETRATION DATA

DESCRIPTION	Depth (Fr.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Split Spoon Sampler				2" o.d. thin Wall Tube Sampler			
									Blows Per Foot				Blows/0.5'			
									0	10	20	30	40			
DENSE BROWN SANDY GRAVELS w/ CORAL FRAGMENTS (FILL)			I-A	108	13	96	13000	—							8/5	15/5
SOFT, DARK GRAY, CLAY w/ SHELLS			I-B	106	56	68	2600	1050							2/5	3/5
LOOSE GRAY SILTY SAND w/ CORAL FRAGMENTS			I-C	115	39	83	1550	—							3/5	4/5
			I-D			(NO RECOVERY)									50/5	
DENSE, SLIGHTLY CEMENTED WHITE SAND			I-E			(NO RECOVERY)									30/5	

* ELEVATION ESTIMATED FROM GRADING PLAN

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3

LOCATION HAWAII-KAI, MAUNALUA, OAHU, HAWAII

BORING NO. 2 Sheet No. _____ of _____

Driller WALTER LUM ASSOC. Date 11-29-66

Field Party MANIFOLD, MAESHICO, MAKAULA

Type of Boring AUGER(MOBILE) Diam. 3"

Elev. 5' ± * Datum _____

HAMMER:

Weight 140 LB.

Drop 30"

SAMPLER: 2" O.D. THIN WALL TUBE

Water Level	<u>1.1'</u>			
Time	<u>12:45 P.M.</u>			
Date	<u>12-8-66</u>			

PENETRATION DATA

DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA	
									Standard Split Spoon Sampler	2" o.d. thin Wall Tube Sampler
									Blows Per Foot	Blows/0.5'
VERY STIFF, BROWN, SANDY CLAY W/ SOME GRAVEL MEDIUM DENSE, BLACK SILTY SAND CORAL			2-A	100	20	83	12900	-		
			2-B	103	54 46	67	-	-		
			2-C	121	30	93	-	-		
			2-D	-	40	-	-	-		

* ELEVATION ESTIMATED FROM GRADING PLAN

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3

LOCATION HAWAII-KAI, MAUNALUA, OAHU, HAWAII

BORING NO. 3 Sheet No. _____ of _____

Driller WALTER LUM ASSOC. Date 11-29-66

Field Party MANIFOLD, MAESHIRO, MAKAULA

Type of Boring AUGER(MOBILE) Diam. 3"

Elev. 7' ± * Datum _____

HAMMER:

Weight 140 LB.

Drop 30"

SAMPLER: 2" O.D. THIN WALL TUBE

Water Level 5.5'

Time 2:30 PM

Date 11-29-66

PENETRATION DATA

DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Split Spoon Sampler				2" o.d. thin Wall Tube Sampler		
									Blows Per Foot				Blows/0.5'		
									0	10	20	30	40		
STIFF BROWN SILTY CLAY w/ CORAL FRAGMENTS			3-A	113	19	95	-	-						10/5	15/5
MEDIUM, GRAY CLAY			3-B	109	49	68	3200	-						2/5	3/5
MEDIUM, GRAY SILTY SAND w/ SHELLS & CORAL FRAGMENTS			3-C	122	36	90	2200	-						5/5	7/5
			3-D	(NO RECOVERY)										50/0	
DENSE, WHITE SAND w/ CORAL FRAGMENTS			3-E	(NO RECOVERY)										50/0	

* ELEVATION ESTIMATED FROM GRADING PLAN

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3

LOCATION HAWAI-KAI, MAUNALUA, OAHU, HAWAII

BORING NO. 4 Sheet No. _____ of _____

Driller WALTER LUM ASSOC. Date 12-6-66

Field Party MANIFOLD, MAESHIRO, MAKAJULA

Type of Boring AUGER McCULLOCH Diam. 3"

Elev. 17' ± * Datum _____

HAMMER:

Weight 10 LB. SLEDGE HAMMER

Drop _____

SAMPLER: 2" O.D. THIN WALL TUBE

Water Level NOT ENCOUNTERED

Time _____

Date 12-6-66

PENETRATION DATA

DESCRIPTION	Depth (ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Split Spoon Sampler				2" o.d. thin Wall Tube Sampler	
									Blows Per Foot					Blows/0.5'
									0	10	20	30	40	
STIFF TO VERY STIFF, BROWN SILTY CLAY			4-A	113	38	82	4150	-						15/5'
VERY STIFF, LIGHT BROWN SANDY SILT w/ DECOMPOSED ROCK	5		4-B	-	22	-	-	-						25/5'
DENSE, BLACK SAND			4-C	108	11	97	-	-						29/5'

* ELEVATION ESTIMATED FROM GRADING PLAN

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3

LOCATION HAWAII-KAI, MAUNALUA, OAHU, HAWAII

BORING NO. 5 Sheet No. _____ of _____

Driller WALTER LUM ASSOC. Date 12-8-66

Field Party MANIFOLD, MAKALLA, MAESHIRO

Type of Boring AUGER (MOBILE) Diam. 3"

Elev. 9' ± * Datum _____

HAMMER:

Weight 10 LB. SLEDGE HAMMER

Drop _____

SAMPLER: 2" O.D. THIN WALL TUBE

Water Level 6.0'

Time 12:30 P.M.

Date 12-8-66

PENETRATION DATA

DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Split Spoon Sampler		2" o.d. thin Wall Tube Sampler	
									Blows Per Foot	0 10 20 30 40	Blows/0.5'	Blows/0.5'
MEDIUM, BROWN SILTY CLAY w/ SOME DECOMPOSED ROCK	0 - 3	EL. = 9' ± *	5-A	107	39	77	-	1900			3/5	4/5
	3 - 5		5-B	110	34	82	-	-			15/5	25/5
MEDIUM TO STIFF GRAY SILTY CLAY w/ SAND	5 - 8		5-C	119	29	92	-	-			4/5	4/5
	8 - 10		5-D	139	23	113	-	-			25/4	
DENSE, SLIGHTLY CEMENTED BLACK SAND	10 - 15											

* ELEVATION ESTIMATED FROM GRADING PLAN

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3

LOCATION HAWAII-KAI, MAUNALUA, OAHU, HAWAII

BORING NO. 6 Sheet No. _____ of _____

Driller WALTER LUM ASSOC. Date 12-1-66

Field Party MAESHIRO, MAKAULA, MAKISHI

Type of Boring Auger (MOBILE) Diam. 3"

Elev. 3' ± * Datum _____

HAMMER:

Weight 140 LB.

Drop 30"

SAMPLER: 2" O.D. THIN WALL TUBE

Water Level 3.2'

Time 1:10 P.M.

Date 12-8-66

PENETRATION DATA

DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Split Spoon Sampler				2" o.d. thin Wall Tube Sampler			
									Blows Per Foot				Blows/0.5'			
									0	10	20	30	40			
MEDIUM TO STIFF, DARK BROWN SILTY CLAY w/ SAND & ROOTS (FILL)	3		6-A	119	32	90	3800	-							2/5	3/5
	5		6-B	123	34	92	4150	-							2/5	3/5
MEDIUM TO STIFF, BLACK SILTY CLAY w/ SOME SAND & CORAL FRAGMENTS	10		6-C	111	76/40	63	-	-							3/5	4/5
	10		6-D	121	38	88	-	-							2/5	4/5
DENSE SLIGHTLY CEMENTED BLACK, SAND	15		6-E	130	25	104	-	-							25/5	

* ELEVATION ESTIMATED FROM GRADING PLAN

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3
 LOCATION HAWAII-KAI, MAUNALUA, OAHU, HAWAII

BORING NO. 7 Sheet No. _____ of _____
 Driller WALTER LUM ASSOC. Date 12-8-66
 Field Party MANIFOLD, MAESHIRO, MAKAULA
 Type of Boring AUGER (McCULLOCH) Diam. 3"
 Elev. 15' ± * Datum _____

HAMMER:
 Weight 10 LB. SLEDGE HAMMER
 Drop _____
 SAMPLER: 2" O.D. THIN WALL TUBE

Water Level	<u>5.0'</u>			
Time	<u>3:30 P.M.</u>			
Date	<u>12-8-66</u>			

PENETRATION DATA

DESCRIPTION	Depth (ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Split Spoon Sampler			2" o.d. thin Wall Tube Sampler		
									Blows Per Foot	0	10	20	30	40
SOFT TO MEDIUM, DARK BROWN SILTY CLAY			7-A	107	41	76	780	-					2/5	2/5
			7-B	107	41	76	3600	-					4/5	4/5
MEDIUM TO STIFF, DARK BROWN SILTY CLAY W/ TRACES OF SAND			7-C	118	34	88	-	-					9/5	12/5
STIFF, DARK BROWN SILTY CLAY W/ SAND														
DENSE, BLACK SAND														

* ELEVATION ESTIMATED FROM GRADING PLAN

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3

LOCATION HAWAII-KAI, MAUNALUA, OAHU, HAWAII

BORING NO. 8 Sheet No. _____ of _____

Driller WALTER LUM ASSOC. Date 12-1-66

Field Party MAESHIRO, MAKAULA

Type of Boring AUGER (MOBILE) Diam. 3"

Elev. 3' ± * Datum _____

HAMMER:

Weight 140 LB.

Drop 30"

2" O.D. THIN WALL TUBE

SAMPLER: 2" O.D. SPLIT SPOON

Water Level 3.2'

Time 1:15 PM.

Date 12-8-66

PENETRATION DATA

DESCRIPTION	Depth (ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Split Spoon Sampler				2" o.d. thin Wall Tube Sampler		
									Blows Per Foot				Blows/0.5'		
									0	10	20	30	40		
EL = 3' ± VERY STIFF, BROWN SANDY SILT W/ GRAVEL (FILL)			8-A	124	18	105	8300	—							12/5' 14/5'
SOFT, GRAY, SANDY SILT W/ CORAL FRAGMENTS															
VERY SOFT, GRAY CLAY W/ SOME SAND	5		8-B	101	81	56	—	230							1/0'
VERY STIFF GRAY SILTY CLAY W/ BLACK SAND & CORAL FRAGMENTS	10		8-C	—	71	—	—	—							
DENSE, BLACK SAND W/ CORAL FRAGMENTS	15		8-D	—	38	—	—	—							8/5' 20/3'

* ELEVATION ESTIMATED FROM GRADING PLAN

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3
 LOCATION HAWAIIKAI, MAUNALUA, OAHU, HAWAII

BORING NO. 9 Sheet No. _____ of _____

Driller WALTER LUM ASSOC. Date 12-8-66

Field Party MANIFOLD, MAESHIRO, MAKAULA

Type of Boring AUGER (McCulloch) Diam. 3"

Elev. 40' ± * Datum _____

HAMMER:

Weight 10 LB. SLEDGE HAMMER

Drop _____

SAMPLER: 2" O.D. THIN WALL TUBE

Water Level	<u>NOT ENCOUNTERED</u>		
Time			
Date	<u>12-8-66</u>		

PENETRATION DATA

DESCRIPTION	Depth (ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Split Spoon Sampler				2" o.d. thin Wall Tube Sampler	
									Blows Per Foot				Blows/0.5'	
									0	10	20	30	40	
VERY STIFF, BROWN CLAYEY SAND W/ DECOMPOSED ROCK		EL. = 40' ±	9-A	113	11	103	-	-						25/3'
ROCK OR BOULDER			9-B	105	35	78	-	-						25/5'

* ELEVATION ESTIMATED FROM GRADING PLAN

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3

LOCATION HAWAII-KAI, MAUNALUA, OAHU, HAWAII

BORING NO. 10 Sheet No. _____ of _____

Driller WALTER LUM ASSOC Date 12-6-66

Field Party MANIFOLD, MAESHIRO, MAKAILA

Type of Boring AUGER (McCULLOCH) Diam. 3"

Elev. 3' ± * Datum _____

HAMMER:

Weight 10 LB. SLEDGE HAMMER

Drop _____

SAMPLER: 2" O.D. THIN WALL TUBE

Water Level	<u>3.1'</u>			
Time	<u>1:00 P.M.</u>			
Date	<u>12-8-66</u>			

PENETRATION DATA

DESCRIPTION	Depth (ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Split Spoon Sampler			2" o.d. thin Wall Tube Sampler			
									Blows Per Foot	0	10	20	30	40	Blows/0.5'
EL. = 3' ± *															
STIFF, BROWN SILTY CLAY w/ CORAL FRAGMENTS (FILL)	5		10-A	119	18	101	3600	-							10/5' 12/5'
			10-B	115	28	90	2600	-							12/5' 15/5'
SOFT, GRAY, CLAY w/ SAND & CORAL FRAGMENTS			10-C	99	77	56	500	-							3/5' 4/5'
MEDIUM, SILTY CLAY w/ BLACK SAND & CORAL FRAGMENTS			10-D	112	58	71	1300	-							5/5' 6/5'
DENSE, BLACK, SAND	15														

* ELEVATION ESTIMATED FROM GRADING PLAN

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3
 LOCATION HAWAII KAI, MAUNALUA, OAHU, HAWAII

BORING NO. 11 Sheet No. _____ of _____

Driller WALTER LUM ASSOC. Date 12-2-66

Field Party MAESHIRO, MAKAULA, MAKISHI

Type of Boring ALIGER (McCULLOCH) Diam. 3"

Elev. 5' ± * Datum _____

HAMMER:
 Weight _____
 Drop _____
 SAMPLER: _____

Water Level NOT ENCOUNTERED
 Time _____
 Date 12-2-66

PENETRATION DATA

DESCRIPTION	Depth (ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Split Spoon Sampler				2" o.d. thin Wall Tube Sampler		
									Blows Per Foot				Blows/0.5'		
									0	10	20	30	40		

STIFF BROWN SILTY CLAY w/ GRAVEL
 ROCK OR BOULDER

EL. = 5' ± *



* ELEVATION ESTIMATED FROM GRADING PLAN

Boring Log

PROJECT KALUANUI UNIT 2 & PART OF UNIT 3
 LOCATION HAWAII KAI, MAUNALUA, OAHU, HAWAII

BORING NO. 12 Sheet No. _____ of _____
 Driller WALTER LUM ASSOC. Date 12-2-66
 Field Party MAESHIRO, MAKAULA, MAKISHI
 Type of Boring AUGER (MOBILE) Diam. 3"
 Elev. 6' ± * Datum _____

HAMMER:
 Weight 140 LB.
 Drop 30"
 SAMPLER: 2" O.D. THIN WALL TUBE

Water Level NONE
 Time _____
 Date 12-2-66

PENETRATION DATA

DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	Standard Split Spoon Sampler		2" o.d. thin Wall Tube Sampler	
									Blows Per Foot	Blows Per Foot	Blows/0.5'	Blows/0.5'
STIFF BROWN SILTY CLAY W/ ROCK ROCK OR BOULDER NOTE: 3 HOLES ATTEMPTED WITH SIMILAR RESULTS	5 10 15 20 25 30 35 40 45 50		12-A	104	—	—	—	—			5/5	12/5

* ELEVATION ESTIMATED FROM GRADING PLAN

KALUANUI UNIT 2 & PART OF UNIT 3

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	1	1	2	2	2
SAMPLE NO.	B	C	A	B	C
DEPTH BELOW SURFACE	3'-4'	6'-7'	SURFACE	3'-4'	6'-7'
DESCRIPTION	DARK GRAY CLAY W/ SHELL	GRAY SILTY SAND W/CORAL FRAGMENTS	BROWN SANDY CLAY W/ SOME GRAVELS	BROWN CLAY	BLACK SILTY SAND
GRADING ANALYSIS (% Passing)					
Sieve					
1"	100	100	100	100	100
½"	76.3	97.8	97.8	100	100
#4	66.6	90.7	90.7	99.5	99.5
#10	61.5	85.1	85.1	97.5	97.5
#20	57.4	78.8	78.8	91.4	91.4
#40	52.8	72.0	72.0	80.4	80.4
#100	28.4	57.0	57.0	55.9	55.9
#200	18.4	49.5	49.5	38.1	38.1
ATTERBERG LIMITS					
Air Dried or Natural	NATURAL			NATURAL	
Liquid Limit	67			68	
Plastic Limit	30			32	
Plasticity Index	37			36	
Dilatancy	NONE			NONE	
Toughness	MEDIUM HIGH			HIGH	
Dry Strength	MEDIUM HIGH			MEDIUM HIGH	
UNIFIED SOIL CLASSIFICATION	CH	SM	SC	CH	SM
SPECIFIC GRAVITY					
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)					
Molding Moisture Content, %			15.6		
Molding Dry Density, P.C.F.			109.4		
Swell upon saturation, %			1.6		
CBR at 0.1" Penetration (%)			45.6		
COMPACTION TEST (AASHTO T-180-57 Method)					
Dry to Wet or Wet to Dry					
Max. Dry Density (P.C.F.)					
Optimum Moisture (%)					

KALUANUI UNIT 2 & PART OF UNIT 3

TABLE I B - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	3	3	4	6	8
SAMPLE NO.	C	CONSOLIDATION	A	CONSOLIDATION	B
DEPTH BELOW SURFACE	6'-7'	3'-4'	SURFACE	3'-4'	5'-6'
DESCRIPTION	GRAY, SILTY SAND w/ CORAL FRAGMENTS	GRAY CLAY	BROWN SILTY CLAY	DARK BROWN SILTY CLAY w/ ROOTS	GRAY CLAY w/ SOME SAND
GRADING ANALYSIS					
(% Passing)					
Sieve					
1"	100		100		
½"	98.2		96.4		
#4	92.9		95.6		
#10	86.0		95.0		
#20	76.3		93.6		
#40	65.2		92.5		
#100	27.7		90.1		
#200	14.8		88.5		
ATTERBERG LIMITS					
Air Dried or Natural		NATURAL		NATURAL	NATURAL
Liquid Limit		68		71	93
Plastic Limit		30		29	30
Plasticity Index		38		42	63
Dilatancy		VERY SLOW		VERY SLOW	NONE
Toughness		HIGH		HIGH	HIGH
Dry Strength		HIGH		MEDIUM-HIGH	HIGH
UNIFIED SOIL CLASSIFICATION					
	SM	CH	MH	CH	CH
SPECIFIC GRAVITY					
		2.76		2.87	
EXPANSION AND CBR TESTS					
(Surcharge-51 P.S.F.)					
Molding Moisture Content, %			-		
Molding Dry Density, P.C.F.			-		
Swell upon saturation, %			0.8		
CBR at 0.1" Penetration (%)			58.0		
COMPACTION TEST					
(AASHO T-180-57 Method)					
Dry to Wet or Wet to Dry					
Max. Dry Density (P.C.F.)					
Optimum Moisture (%)					

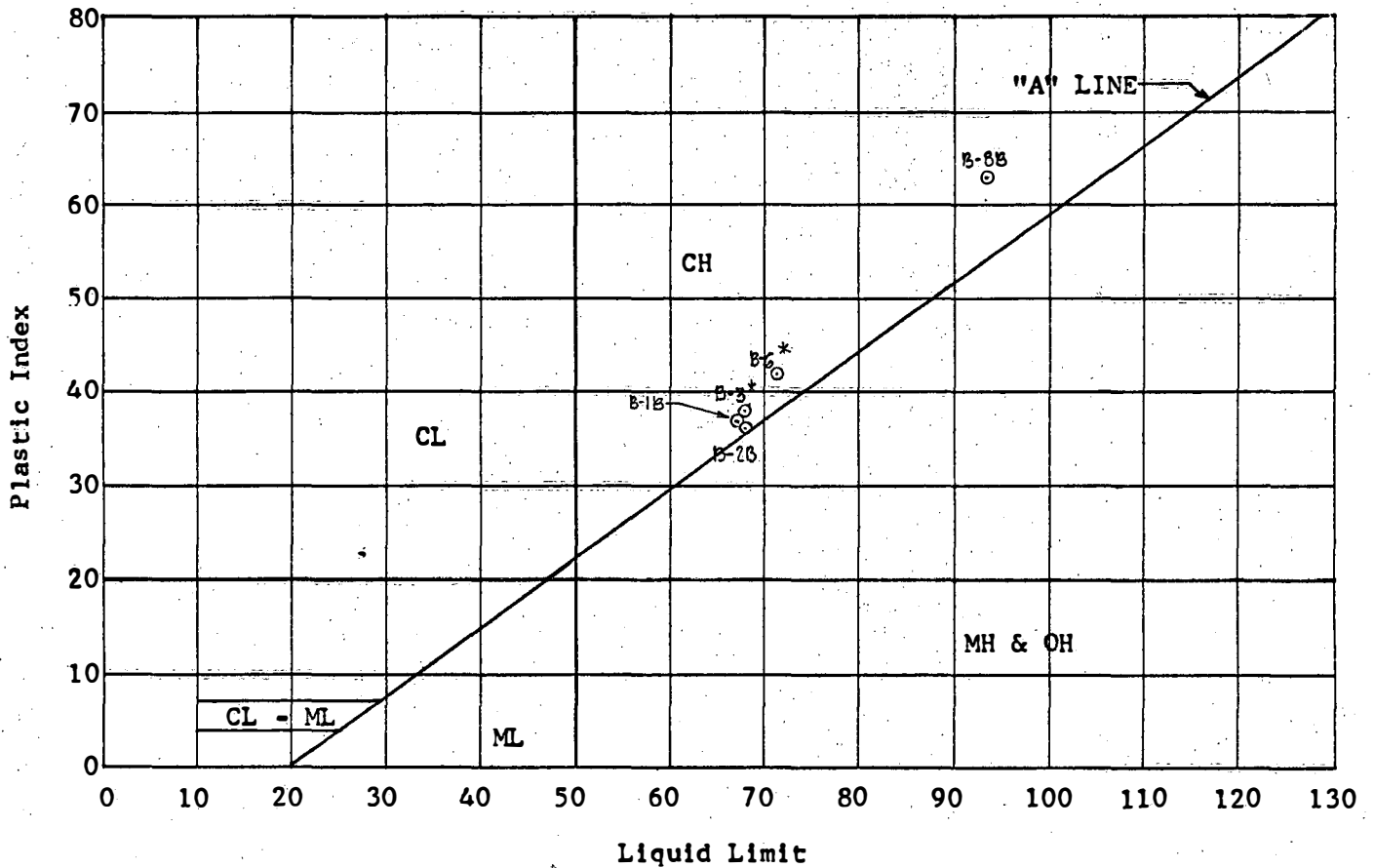
KALUANUI UNIT 2 & PART OF UNIT 3

TABLE I.C - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	<u>9</u>				
SAMPLE NO.	<u>A</u>				
DEPTH BELOW SURFACE	<u>SURFACE</u>				
DESCRIPTION	<u>BROWN CLAYEY SAND W/DECOMP. ROCK</u>				
GRADING ANALYSIS (% Passing)					
Sieve					
1"	<u>94.8</u>				
1/2"	<u>79.8</u>				
#4	<u>70.3</u>				
#10	<u>62.3</u>				
#20	<u>51.0</u>				
#40	<u>42.8</u>				
#100	<u>31.0</u>				
#200	<u>25.4</u>				
ATTERBERG LIMITS					
Air Dried or Natural					
Liquid Limit					
Plastic Limit					
Plasticity Index					
Dilatancy					
Toughness					
Dry Strength					
UNIFIED SOIL CLASSIFICATION	<u>SC</u>				
SPECIFIC GRAVITY					
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)					
Molding Moisture Content, %					
Molding Dry Density, P.C.F.					
Swell upon saturation, %					
CBR at 0.1" Penetration (%)					
COMPACTION TEST (AASHO T-180-57 Method <u> </u>)					
Dry to Wet or Wet to Dry					
Max. Dry Density (P.C.F.)					
Optimum Moisture (%)					

JOB: KALUANUI UNIT 2 & PART OF UNIT 3

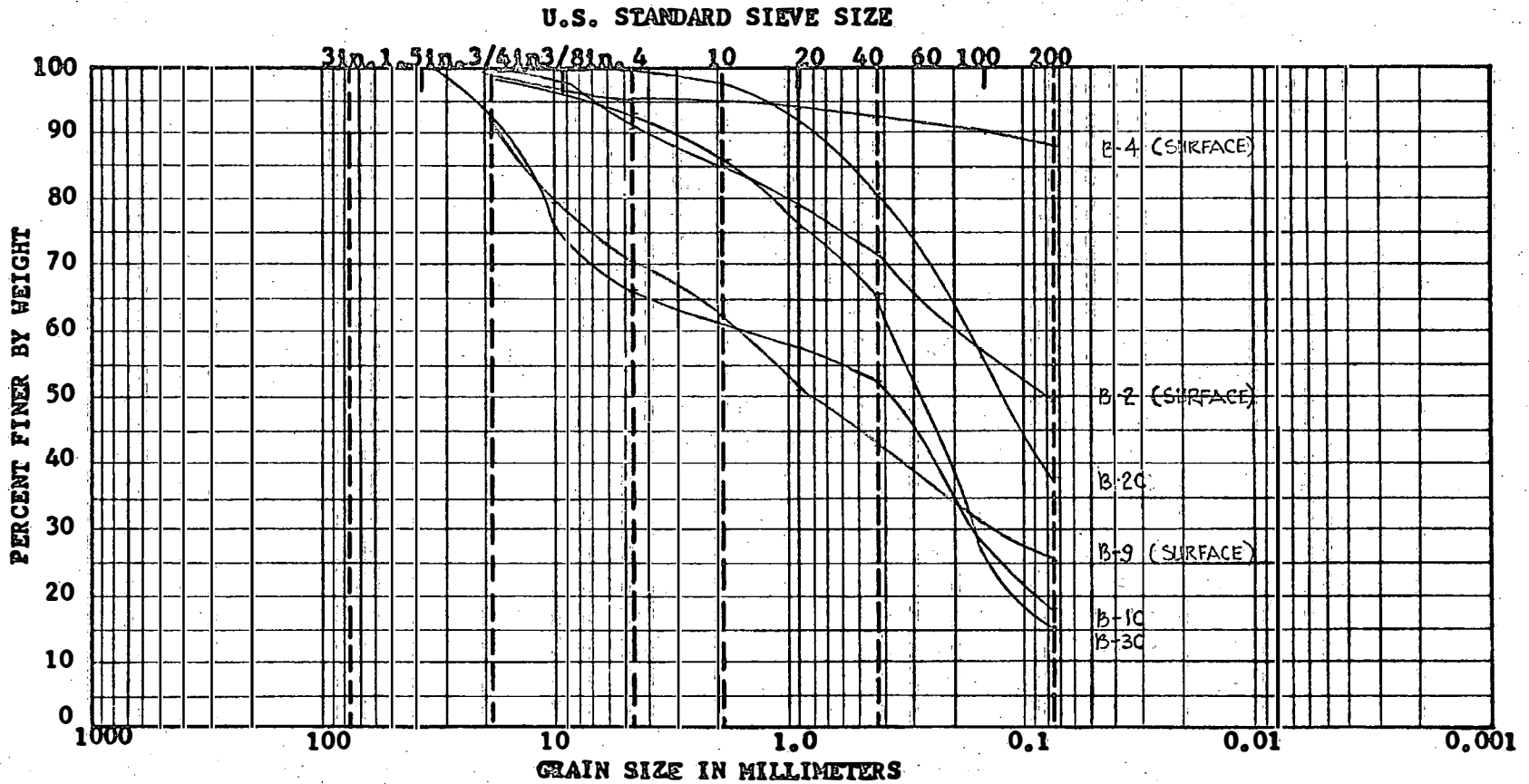
LOCATION: HAWAII KAI, MAUNALUA, OAHU, HAWAII



PLASTICITY CHART

* CONSOLIDATION SOIL SAMPLE

PROJECT: KALUANUI UNIT 2 & PART OF UNIT 3
 LOCATION: HAWAII-KAI, MAUNALUA, OAHU, HAWAII



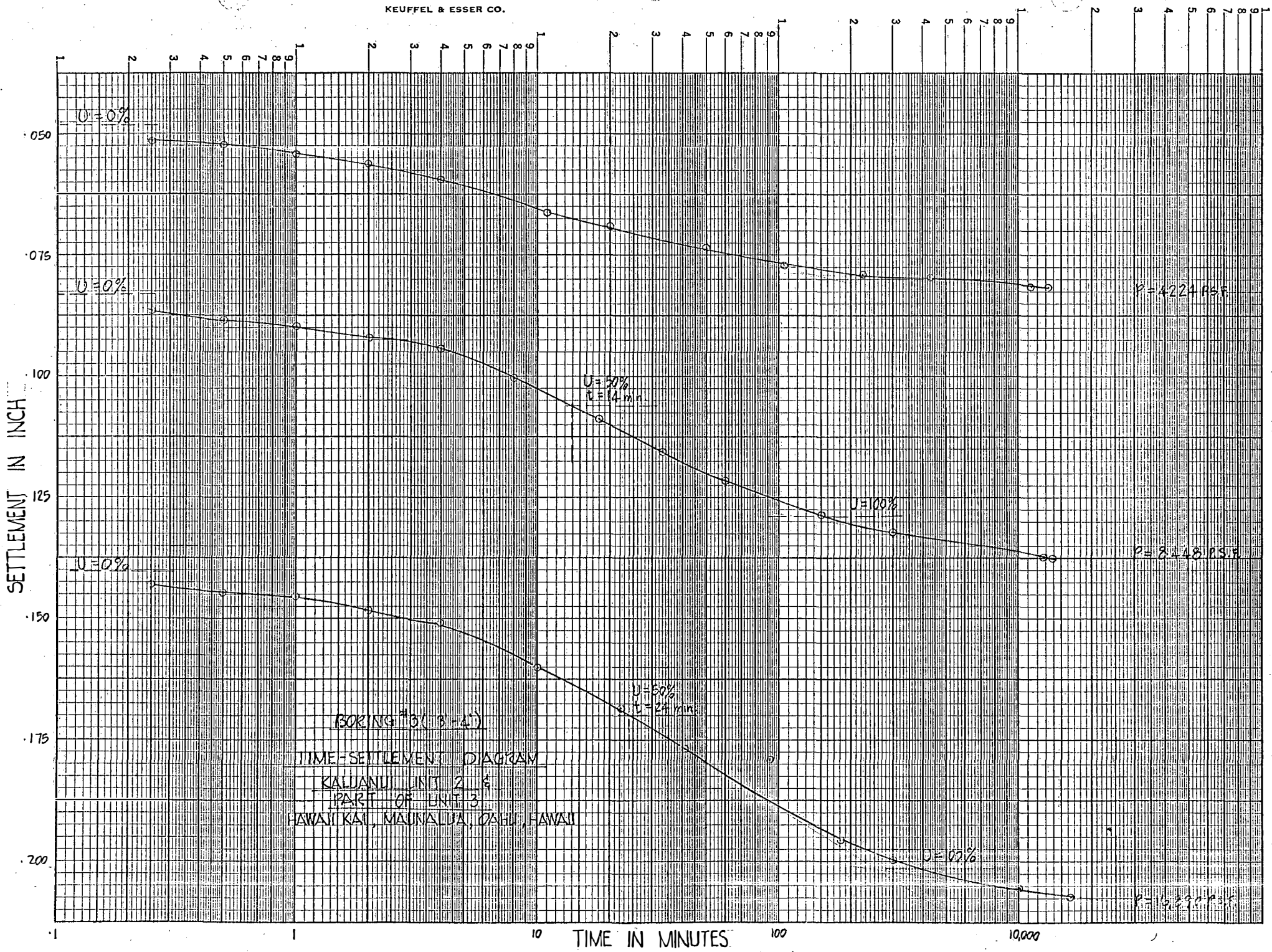
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRADATION CURVE

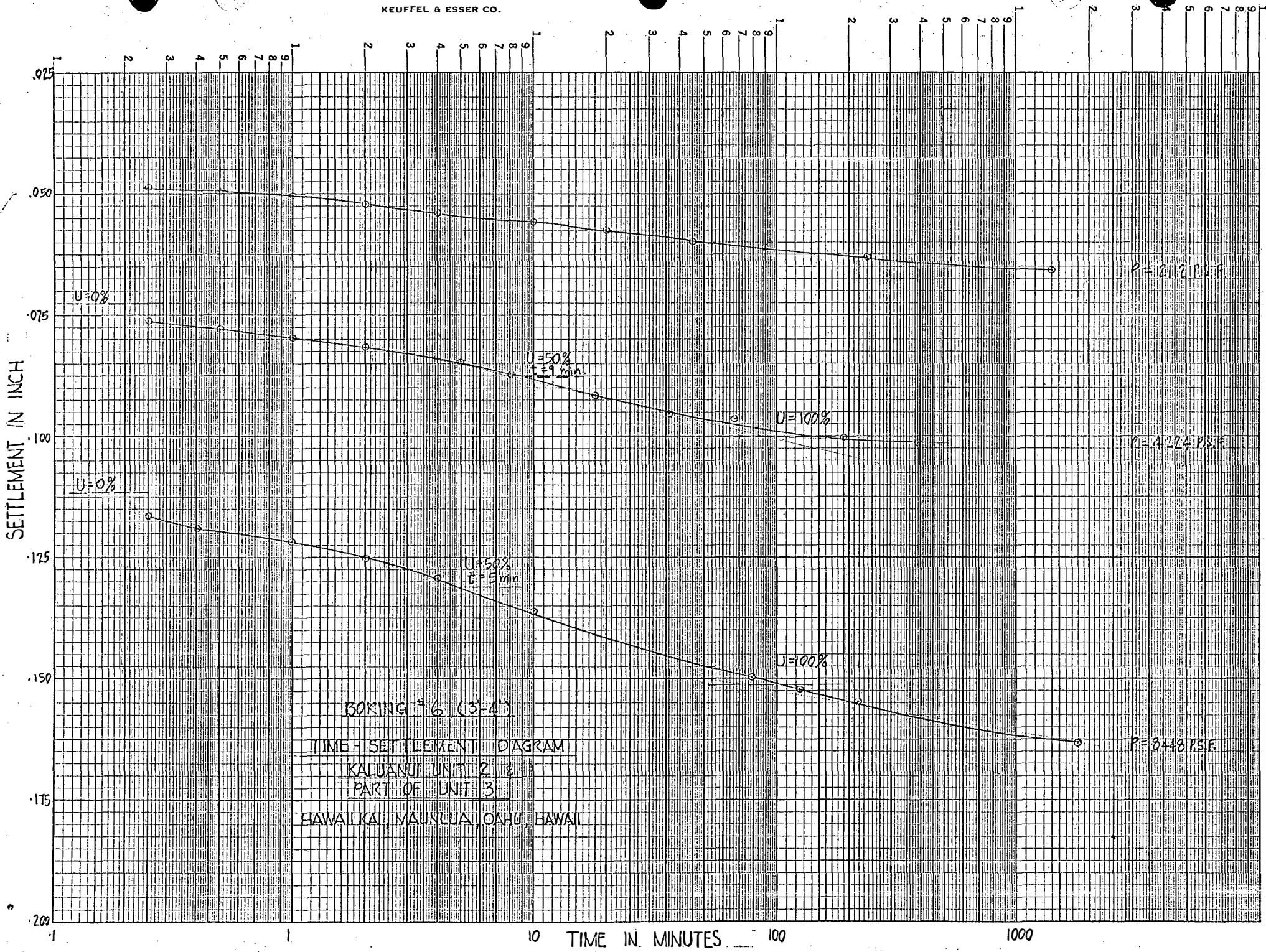
DRAWN BY : BW.

PROJECT: KALUANUI II; Box. #3; Depth 3'-4'

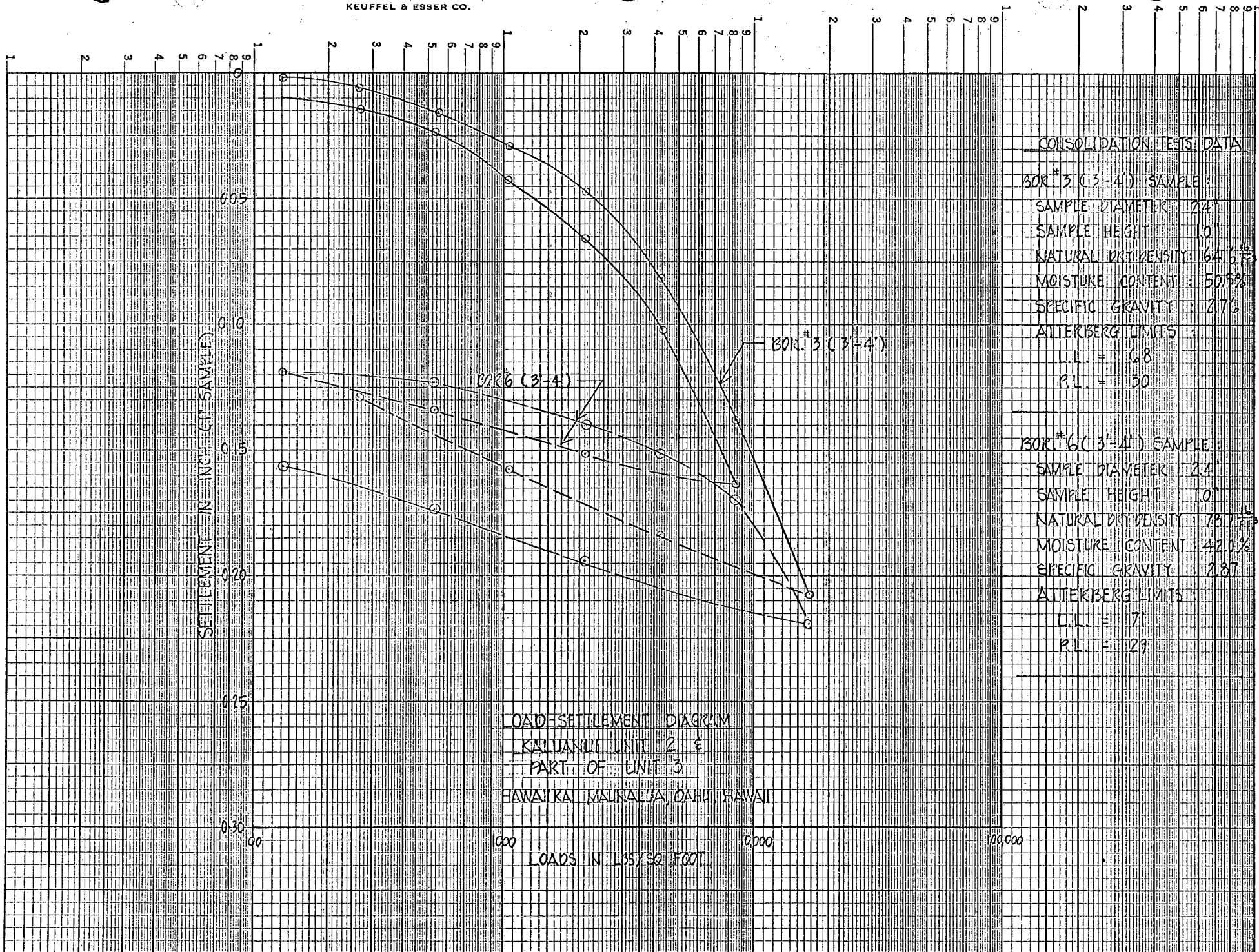
K&E SEMI-LOGARITHMIC 46 6210
5 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.



BOREING #3 (3'-4')
 TIME-SETTLEMENT DIAGRAM
 KALUANUI UNIT 2 & 6
 PART OF UNIT 3
 HAWAII KAI, MAUNALOA, OAHU, HAWAII



BORING #6 (3'-4")
 TIME-SETTLEMENT DIAGRAM
 KALUANUI UNIT 2 &
 PART OF UNIT 3
 HAWAIIKI, MAUNUAA, OAHU, HAWAII



GENERAL TESTING METHODS

EXPLORATORY BORINGS AND SAMPLING

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

ASTM Designation: D 1452-63T

Method for thin wall tube sampling of
soils (Tentative)

ASTM Designation: D 1587-63T

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

ASTM Designation: D 1586-64T

LABORATORY TESTING

Grading Analysis

Sieve analysis of fine and coarse
aggregates

AASHO Designation: T 27-60

Amount of material finer than
No. 200 sieve in aggregate

AASHO Designation: T 11-60

Atterberg Limits

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

AASHO Designation: T 89-60

Determining the plastic limit of soils

AASHO Designation: T 90-56

Calculating the plasticity index of
soils

AASHO Designation: T 91-54

Specific Gravity

Specific gravity of soils
Modified as follows: 500 ML Pycnometer

AASHO Designation: T 100-60

Expansion and CBR Tests

Expansion test and California Bearing
Ratio (CBR)

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

Compaction Test

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

AASHO Designation: T 180-57

Unified Soil Classification

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