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FEASIBILITY INVESTIGATION

SEICHO-NO-IE PROJECT

AHUIMANU, OAHU, HAWAII

TMK: 4-7-60: 28

for

SEICHO-NO-IE HAWAII

W. O. 81-815

September 1, 1981

FH

ERNEST K. HIRATA & ASSOCIATES, INC.

MUNICIPAL REFERENCE & RECORDS CENTER
City & County of Honolulu
City Hall Annex, 558 S. King Street
Honolulu, Hawaii 96813



ERNEST K. HIRATA & ASSOCIATES, INC.

Soils and Foundation Engineering

905 Makahiki Way, Makai Suite • Honolulu, Hawaii 96826 • Phone 941-5055

September 1, 1981
W. O. 81-815

Seicho-no-Ie Hawaii
1333 Matlock Avenue
Honolulu, Hawaii 96814

Attention: Mr. Ronald T. Nakata

Gentlemen:

Our report, "Feasibility Investigation, Seicho-no-Ie Project, Ahuimanu, Oahu, Hawaii, TMK: 4-7-60: 28", dated September 1, 1981, our Work Order 81-815 is enclosed.

The previous Grading Plan indicates that portions of the site lay in a former drainage way which has been subsequently filled. Our exploratory borings confirm the existence of fill and found that subsurface soil conditions are variable. Underlying the surface fill in the previously high areas is a stiff silty clay down to the maximum depths drilled. The surface fill in the areas of the former drainage way is underlain by soft alluvial deposits. Plate 1 presents a cross section of the approximate subsurface soil profile.

Settlement calculations were performed based on assumed loadings and conditions. A summary of the settlement analyses is presented in the body of this report.

With the exception of the northeast portion of the property, the site is feasible for the construction of low rise structures. Conventional shallow foundations, such as spread footings or mat foundations may be used to support the structures. Recommendations for development of the site are presented in this report.

We appreciate this opportunity to be of service. Should you have any questions concerning this report, please feel free to call on us.

Very truly yours,

Ernest K. Hirata & Associates, Inc.


Ernest K. Hirata President

EKH:yk

FEASIBILITY INVESTIGATION

SEICHO-NO-IE PROJECT

AHUIMANU, OAHU, HAWAII

TMK: 4-7-60: 28

INTRODUCTION

This report presents the results of our feasibility investigation performed for the Seicho-no-Ie project in Ahuimanu. The purpose of this investigation was to determine the nature of the soils underlying the site, to ascertain their engineering properties, to determine the quality and condition of the existing fill, to determine if individual areas are suitable for construction, and to provide preliminary design information.

This investigation included drilling five exploratory test borings, obtaining representative soil samples, laboratory testing and analysis, and the preparation of this report. The exploratory boring locations are shown on the enclosed Site Plan, Plate 2. Also attached is an Appendix which describes the laboratory testing procedures.

PROJECT CONSIDERATIONS

The proposed project will consist of a complex of church/classroom facilities with structures approximately 2 to 3 stories in height with possible basements.

Building locations have not been finalized due to the uncertainty of subsurface soil conditions. However, we understand that preliminary layouts include a driveway from Hui Aeko Place leading to a two story parking structure along Kahekili Highway. One of the parking levels may be designed as a basement or partial basement. An earth berm is proposed between Kahekili Highway and the parking structure to serve as a noise barrier.

Preliminary plans also include a two to three story chapel structure in the central portion of the site along with classroom buildings and minister's quarters situated over the remainder of the property.

SITE CONDITIONS

The project site encompasses approximately 2.5 acres of land located at the southwest corner of the intersection of Kahekili Highway and Hui Iwa Street in Ahuimanu. Access to the site is provided from Hui Aeko Place located at the southeast corner of the property.

The site is situated approximately 4 to 6 feet above Kahekili Highway. Total relief over the project area is approximately 12 feet with drainage flowing in a northerly direction. The site is presently vacant and covered with a moderate growth of vegetation.

A previous Grading Plan of the property, provided by the owner,

indicates that a considerable amount of fill has been placed over the site. With the exception of a strip along the northwest corner of the site, the remainder of the property has been filled as much as 16 feet.

FIELD EXPLORATION

The site was explored from August 10th through 12th, 1981 by drilling five exploratory test borings with a truck mounted rotary drilling machine. The borings varied in depth from 15 to 25 feet. The soils were continuously logged by our field engineer and classified by visual examination in accordance with the Unified Soil Classification System. The boring locations are shown on Plate 2, and the soils encountered are logged on Plates A1 through A5.

Undisturbed and bag samples were recovered from the borings for laboratory testing and analyses. Undisturbed samples were obtained by driving a 3 inch O.D. thin-walled split tube sampler with a 140 pound hammer from a height of 30 inches. The required blow count for twelve inches of penetration is shown on the enclosed Boring Logs.

SOIL CONDITIONS

Based on a review of the previous Grading Plan, the eastern portion of the project site appears to lie within a former drainage way. A high knoll lies within the drainage way

causing a separation of the main flow.

Our exploratory borings generally confirmed the thickness of the surface fill layer in the drainage way as well as in the higher areas located in the southwest corner.

Our exploratory borings indicate that the surface soil covering the site is fill consisting of a mottled brown to orange brown silty clay with weathered gravels. The silty clay is in a stiff to medium stiff condition and ranges in thickness from 2.5 to 17 feet.

The surface fill in borings B1 and B3, located in the higher areas and on the knoll, is underlain by a mottled orange brown silty clay with weathered gravels. The silty clay is in a stiff to medium stiff condition down to the maximum depths drilled.

Borings B2, B4, and B5, located in the former drainage way, encountered gray clayey silts and silty clays underlying the surface fill. These soils are in a soft to firm condition with decomposed vegetation encountered in portions of the strata. The thickness of the clayey silts and silty clays range from 11.5 to 14.5 feet.

Borings B2 and B5 encountered a mottled orange brown clayey silt with weathered gravels and cobbles at depths of 21.5 and 23.5 feet, respectively. The clayey silts are in a firm

to medium stiff condition down to the maximum depths drilled. Plate 1 presents a cross section of the approximate subsurface soil profile.

Borings B2, B4, and B5 encountered groundwater at depths ranging from 9.3 to 16.8 feet below existing ground.

CONCLUSIONS AND PRELIMINARY RECOMMENDATIONS

A review of the Soil Survey prepared by the U. S. Department of Agriculture identifies the soil series in this area as a Hanalei Silty Clay encountered on stream bottoms and flood plains. This series of soil can be found in small areas of very deep well drained alluvium soils and are underlain by peat, muck, or massive marine clays.

The previous Grading Plan indicated that portions of the site lay in a former drainage way which had subsequently been filled. Our exploratory borings confirmed the existence of the fill and found that subsurface soil conditions are variable.

The surface fill consists of a stiff to medium stiff silty clay with weathered gravels. The average relative compaction of the fill was approximately 83 percent with an average insitu moisture content of 50 percent.

The thickness of the surface fill in the previously high areas ranged from 2.5 to 4 feet at borings B3 and B1, respectively. Underlying the surface fill was a mottled orange brown silty clay in a stiff condition down to the maximum depths drilled.

Fill thicknesses of 7 to 17 feet were encountered in the former drainage way, identified by boring locations B2, B4, and B5. Underlying the surface fill were soft alluvial deposits

consisting of gray organic clayey silts and silty clays.

Based on the results of our exploratory borings and understanding of the type and location of structures proposed, four types or cases of soil conditions can be anticipated for foundation considerations. Although structural loads were not available, settlement analyses were performed for each of the four cases assuming bearing values of 1500 and 2000 PSF on a 5 foot square column footing and a 3 foot wide wall footing.

The following presents a summary of the anticipated settlements using the assumptions stated above. The boring numbers or comments enclosed in the parenthesis for each case indicates the location at which that particular soil condition occurs.

SUMMARY OF SETTLEMENT ANALYSES

	<u>1500 PSF</u>	<u>2000 PSF</u>
Case I: Shallow fill underlain by stiff silty clays (B1 & B3)	1/8" ~ 3/8"	3/8" ~ 1/2"
Case II: Thick fill underlain by soft deposits (B4 & B5)	1/8" ~ 1/4"	1/4" ~ 3/8"
Case III: Shallow fill underlain by soft deposits (B2)	1/2" ~ 7/8"	3/4" ~ 1-1/4"
Case IV: Soft clayey silts and silty clays (Removal of 5 feet of fill at B2)	1" ~ 1-1/8"	1-5/8" ~ 2-3/4"

The summary of settlement analyses indicate that for Cases III and IV, anticipated settlements may cause structural distress to buildings. During preliminary planning for the church facilities, placement of structures in the northeast portion should be avoided due to settlement problems.

Consideration should be given to placement of structures in the southern and western portions of the site. The anticipated settlements for low rise structures founded in these areas are generally within tolerable limits. Low rise structures are generally defined as limited to two stories in height with relatively light structural loads.

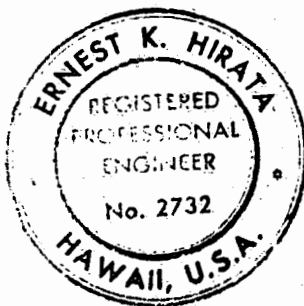
Excavations or fill placements under structures should generally be avoided. Excavations would cause footings to be placed closer to the underlying soft deposits resulting in larger settlements. Placement of structural fill would impose additional loads on the soft desoposits resulting in larger settlements.

An earth berm may be constructed as a noise barrier provided no structures are placed over the fill. Localized settlements within the berm should be anticipated due to the underlying soft deposits. Although onsite soils may be used in the construction of the berm, difficulty will be encountered in achieving proper compaction of 90 percent due to the high insitu moisture contents. Air drying of the soil may be difficult due to the relative high rainfall of the area.

Conventional shallow foundations, such as spread footings or mat foundations, may be used to support structures founded on the existing surface fill located in the southern and western portions of the site. Footings may be designed for a preliminary bearing value of 1500 pounds per square foot. Footings should be kept as high as possible.

For design of floor slabs, we recommend that a four inch cushion of crushed rock, such as S4C, be placed beneath all slabs on grade. Slabs which will be provided with a floor covering should be protected by a polyethelene plastic vapor barrier.

Since the subsurface soil conditions were found to be variable, additional exploratory borings are recommended at actual building locations for determination of final design recommendations.



Respectfully submitted,

Ernest K. Hirata & Associates, Inc.


Ernest K. Hirata P.E. 2732

EKH:yk

Enc: Appendix of Laboratory Testing
Boring Locations Plates A1 through A5
Consolidation Tests Plates B1 through B6
Laboratory Test Results Plate C
CBR Stress-Penetration Curve Plate D
Cross Section A-A Plate 1
Site Plan Plate 2

APPENDIX OF LABORATORY TESTING

Classification

The field classification is verified in the laboratory, also in accordance with the Unified Soil Classification System. Laboratory classification is determined by both visual examination and Atterberg Limit Tests according to ASTM D423 and D424. The final classification is shown on the Boring Logs.

Moisture-Density

The field moisture content and dry unit weight are determined for each of the undisturbed soil samples. The information is useful in providing a gross picture of the soil consistency between borings and any local variations. The dry unit weight is determined in pounds per cubic foot while the moisture content is determined as a percentage of the dry unit weight. These samples are obtained from a 3" O.D. split tube sampler.

Consolidation

Settlement predictions of the soil's behavior under load are made on the basis of the consolidation tests. Loads are applied in several increments in a geometric progression, and the resulting deformations are recorded at selected time intervals. Porous stones are placed in contact with the top and bottom of each specimen having an inside diameter of 2.40 inches and a height of 1 inch to permit addition and

release of pore fluid. Results of undisturbed and remolded samples are plotted on the Consolidation Test Report.

Compaction Tests

Compaction tests were performed on bag samples to determine the optimum moisture content at which each type of proposed fill material compacts to 100% density. The tests were performed according to ASTM D-1557-78.

Swell Tests

Swell tests were performed to determine the expansiveness of the onsite surface soils. The tests were performed on undisturbed ring and remolded samples taking a one inch high specimen under different surcharge loads.

Shear Tests

Shear tests are performed in the Direct Shear Machine which is of the strain control type. The rate of deformation is approximately 0.02 inches per minute. Each sample is sheared under varying confining loads in order to determine the Coulomb shear strength parameters, cohesion and angle of internal friction. Eighty percent of the maximum value is taken to determine the shear strength parameters.



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BORING LOG

W.O. 81-815

BORING NO. B1

DRIVING WT. 140 lb.

DATE OF DRILLING 8-12-81

SURFACE ELEV. 100.5±*

DROP 30 in.

WATER LEVEL None

DEPTH (FEET)	GRAPH SYMBOL	UNIFIED SOIL CLASSIFICATION	BLOWS/FT.	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	RELATIVE COMPACTION (%)	DESCRIPTION
0		MH	119	74.5	47.0	84.2	FILL-Silty clay, brown, moist, stiff, with weathered gravels.
5		MH	32	63.3	62.4		Silty CLAY-Mottled orange brown, moist, stiff, with weathered gravels.
10			41	61.9	65.2		Grading to mottled grayish brown color from 8.5 feet.
15			22	60.9	66.4		Grading medium stiff and siltier from 14.5 feet.
20			15	61.4	67.0		End boring at 20 feet.
25							*Elevations based on Grading Plan provided by owner.
30							



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BORING LOG

W.O. 81-815

BORING NO. B2

DRIVING WT. 140 lb.

DATE OF DRILLING 8-10-81

SURFACE ELEV. 96.0±

DROP 30 in.

WATER LEVEL @ 9.3 feet

DEPTH (FEET)	GRAPH SYMBOL	UNIFIED SOIL CLASSIFICATION	BLOWS/FT.	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	RELATIVE COMPACTION (%)	DESCRIPTION
0		MH					FILL-Silty clay, mottled brown, moist, stiff to medium stiff, with weathered gravels.
			56	74.0	49.0	83.6	
5							Clayey SILT-Dark gray, moist, firm, organic, with decomposed wood fragments.
		OL	24	61.0	61.7		
10		MH	17	50.8	87.9		Silty CLAY-Grayish brown, moist, firm to medium stiff.
15		OL	7	20.3	232.5		Clayey SILT-Dark gray, moist, firm to soft, organic, with decomposed leaves and wood fragments.
20		MH	13	60.0	61.9		Silty CLAY-Gray, moist, firm to soft.
25		ML-MH	33	70.1	58.1		Clayey SILT-Mottled orange brown, moist, stiff to medium stiff, with weathered gravels and cobbles.
30							End boring at 25 feet.



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BORING LOG

W.O. 81-815

BORING NO. B3

DRIVING WT. 140 lb.

DATE OF DRILLING 8-12-81

SURFACE ELEV. 100.0±

DROP 30 in.

WATER LEVEL None

DEPTH (FEET)	GRAPH SYMBOL	UNIFIED SOIL CLASSIFICATION	BLOWS/FT.	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	RELATIVE COMPACTION (%)	DESCRIPTION
0		MH					FILL-Silty clay, brown, moist, stiff with weathered gravels.
			64	72.8	51.0	82.3	
		MH					Silty CLAY-Mottled orange brown, moist, stiff, with weathered gravels.
5			49	73.6	49.2		
			36	66.4	58.9		Grading to grayish brown color from 10 feet.
10			20	60.5	66.1		
15							End boring at 15 feet.
20							
25							
30							



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BORING LOG

W.O. 81-815

BORING NO. B4

DRIVING WT. 140 lb.

DATE OF DRILLING 8-10-81

SURFACE ELEV. 103.0±

DROP 30 in.

WATER LEVEL @ 16.8 feet

DEPTH (FEET)	GRAPH SYMBOL	UNIFIED SOIL CLASSIFICATION	BLOWS/FT.	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	RELATIVE COMPACTION (%)	DESCRIPTION
0		MH					FILL-Silty clay, mottled orange brown, moist, medium stiff to stiff, with weathered gravels and cobbles.
			36	71.6	52.0	80.9	
5			44	77.0	46.6	87.0	Grading stiff from 5.5 feet.
			33	70.9	51.3	80.1	
10							Grading soft from 13 feet.
			11	65.5	55.1		
15							
▽							
		OL					Clayey SILT-Dark gray, moist, soft, organic.
20		MH	8	60.3	67.8		Silty CLAY-Gray, moist, soft.
			9	57.9	73.9		
25							End boring at 25 feet.
30							



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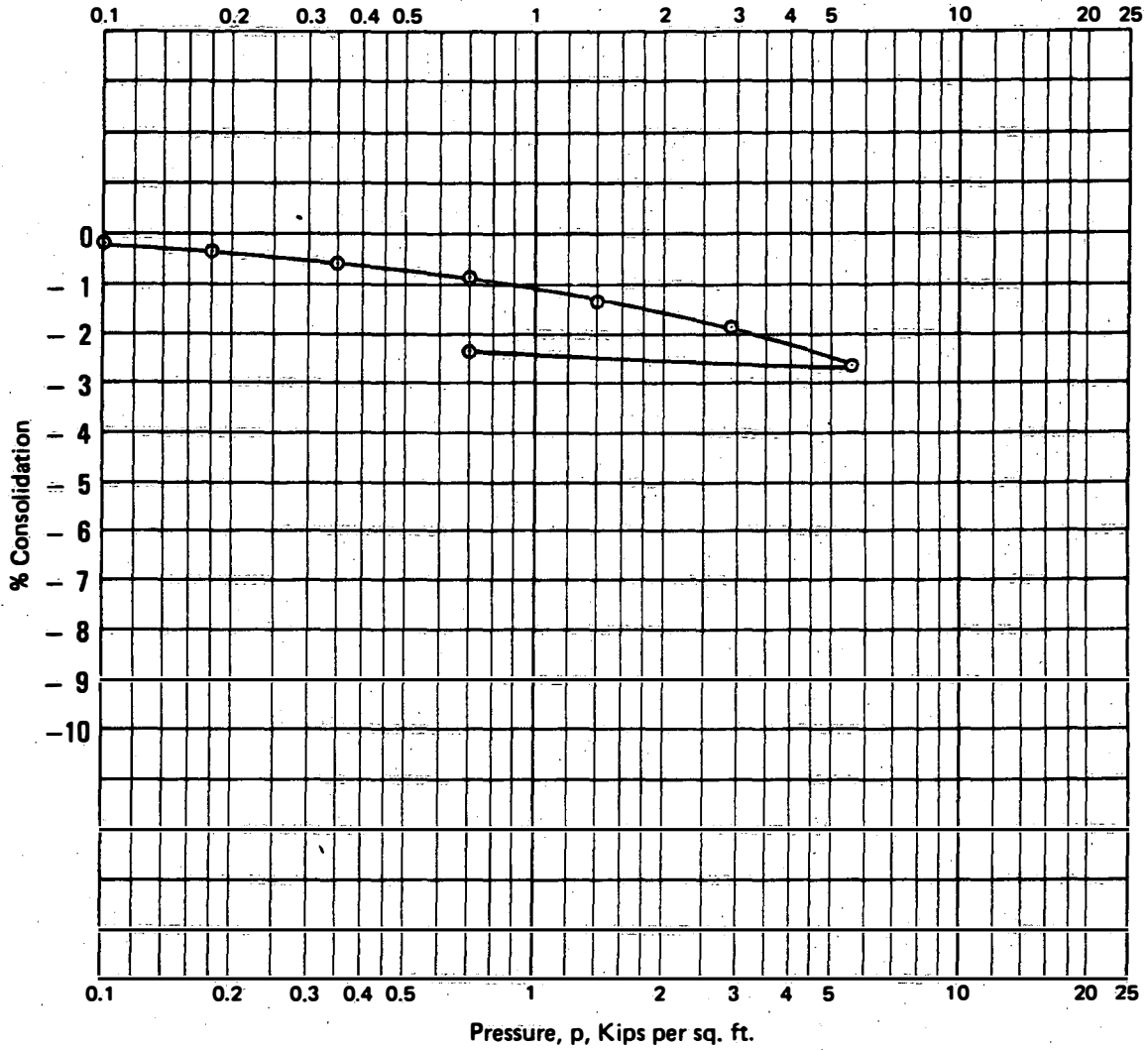
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BORING LOG

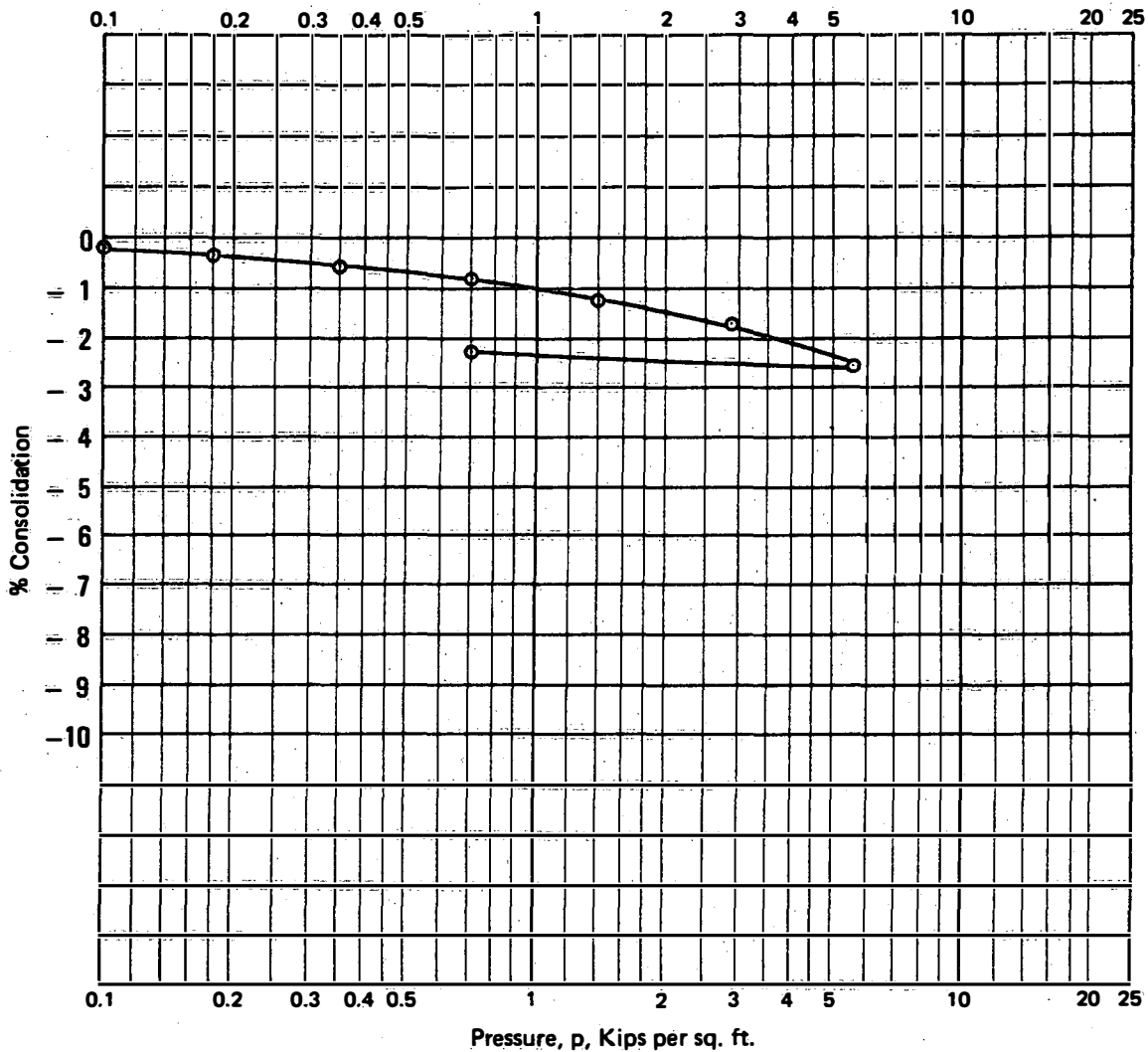
W.O. 81-815

BORING NO. B5 DRIVING WT. 140 lb. DATE OF DRILLING 8-10-81
 SURFACE ELEV. 101.0± DROP 30 in. WATER LEVEL @ 13 feet

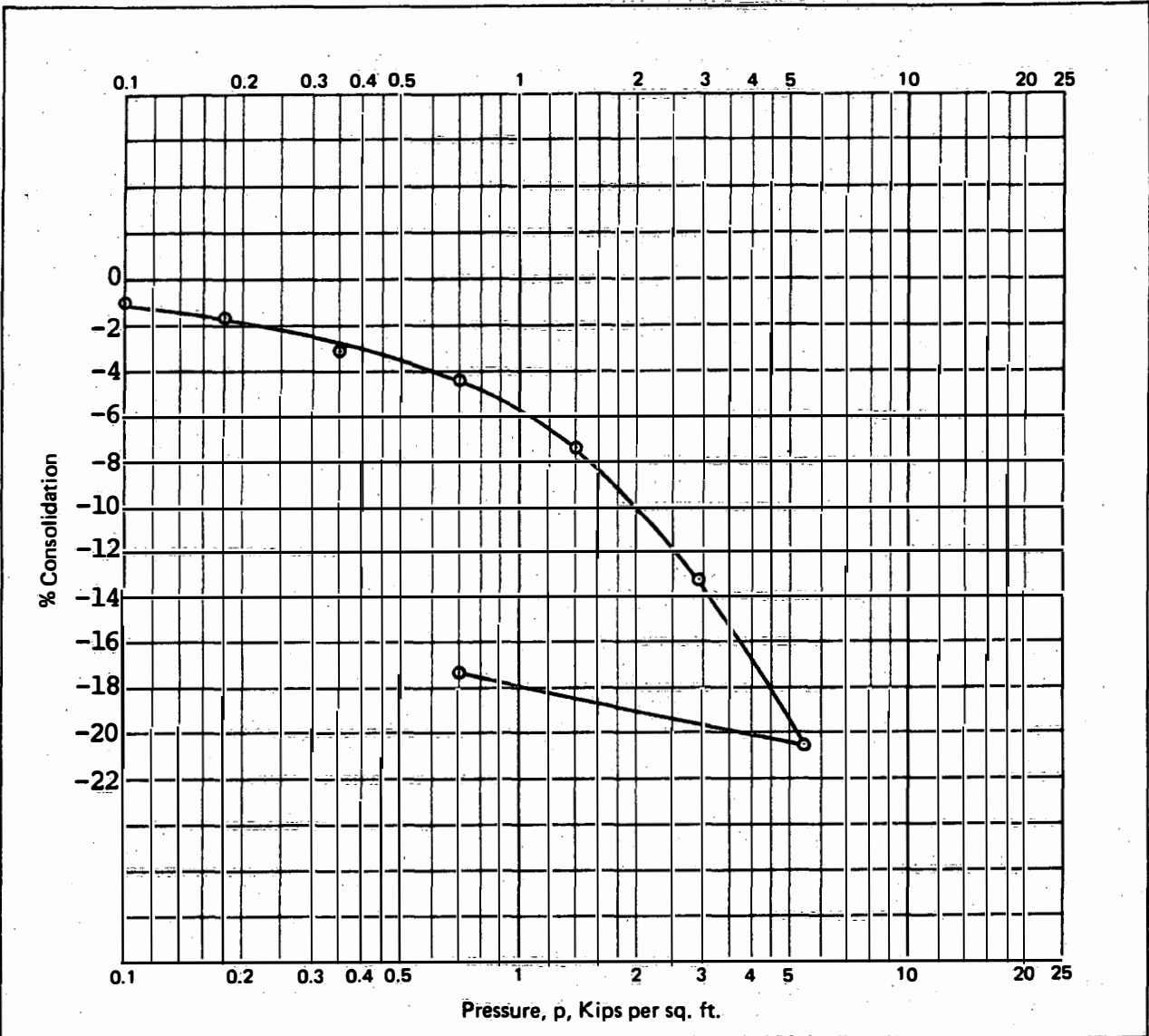
DEPTH (FEET)	GRAPH SYMBOL	UNIFIED SOIL CLASSIFICATION	BLOWS/FT.	DRY DENSITY (PCF.)	MOISTURE CONTENT (%)	RELATIVE COMPACTION (%)	DESCRIPTION
0		MH					FILL-Silty clay, mottled orange brown, moist, stiff to medium stiff, with weathered gravels.
			32	72.5	50.9	81.9	
5			46	72.5	51.7	81.9	
			17	72.7	48.6	82.1	
10							
▽		OL					Clayey SILT-Dark gray, moist, soft, organic.
		MH	10	62.1	66.2		Silty CLAY-Gray, moist, firm to medium stiff.
15		OL					Clayey SILT-Dark gray, moist, soft, organic.
			11	41.2	113.1		
20							
		ML-MH	12	62.7	65.7		Clayey SILT-Mottled orange brown, moist, firm, with weathered cobbles and gravels.
25							End boring at 25 feet.
30							



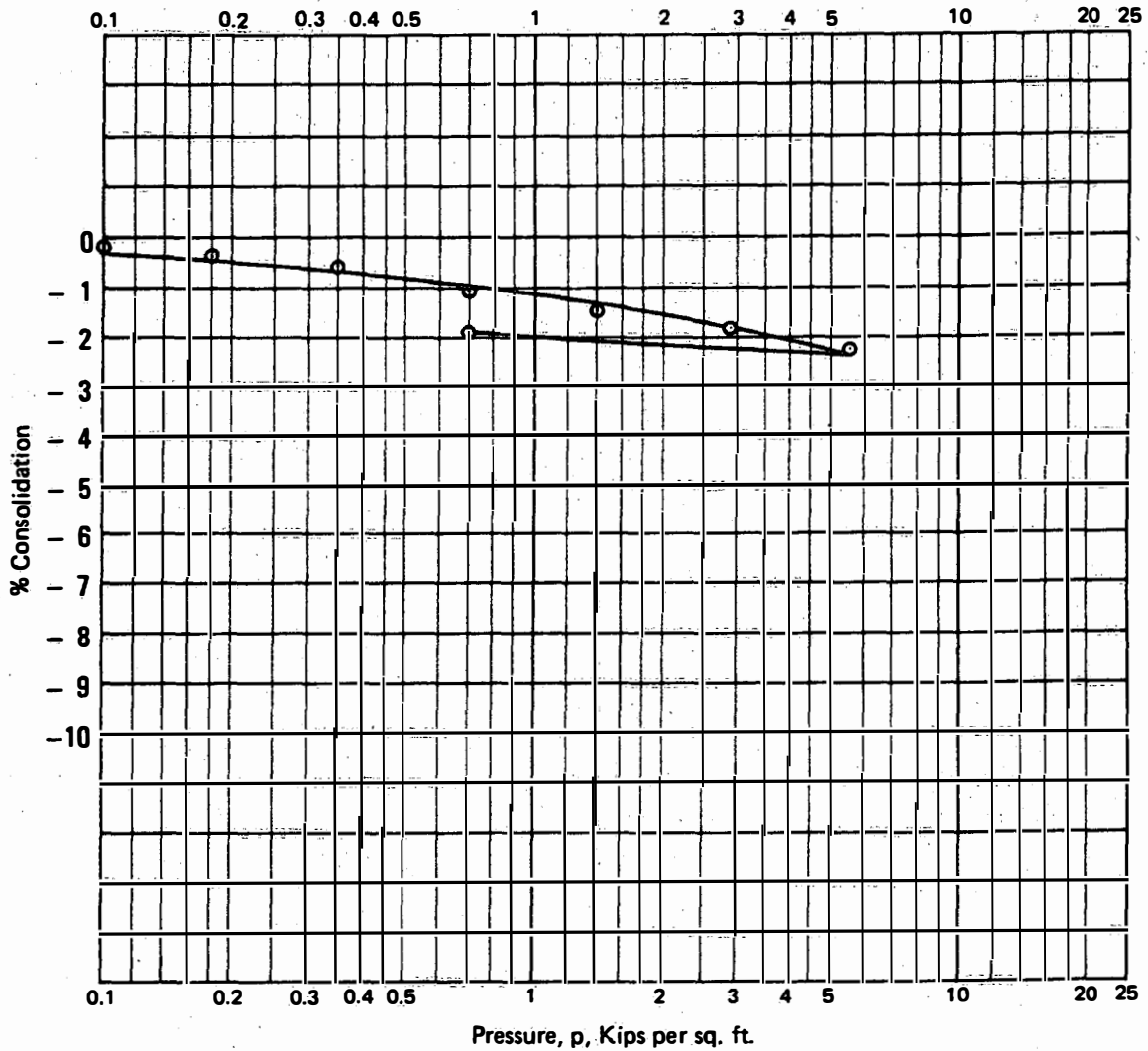
Type of Specimen	Undisturbed		Before Test		After Test						
Diam	2.40	in.	Ht	1.0	in.	Water Content, w_0	62.4	%	w_f	59.6	%
Overburden Pressure, p_0			T/sq ft		Void Ratio, e_0			e_f			
Preconsol. Pressure, p_c			T/sq ft		Saturation, s_0			%	s_f		
Compression Index, c_c					Dry Density, γ_d	63.3	lb/ft ³				
Classification	MH										
LL			Project		Seicho-no-Ie Project						
PL					Ahuimanu, Oahu						
Remarks			W.O.		81-815						
			Boring No.	B1	Sample No.						
			Depth	4'	Date	8-14-81					
CONSOLIDATION TEST REPORT											



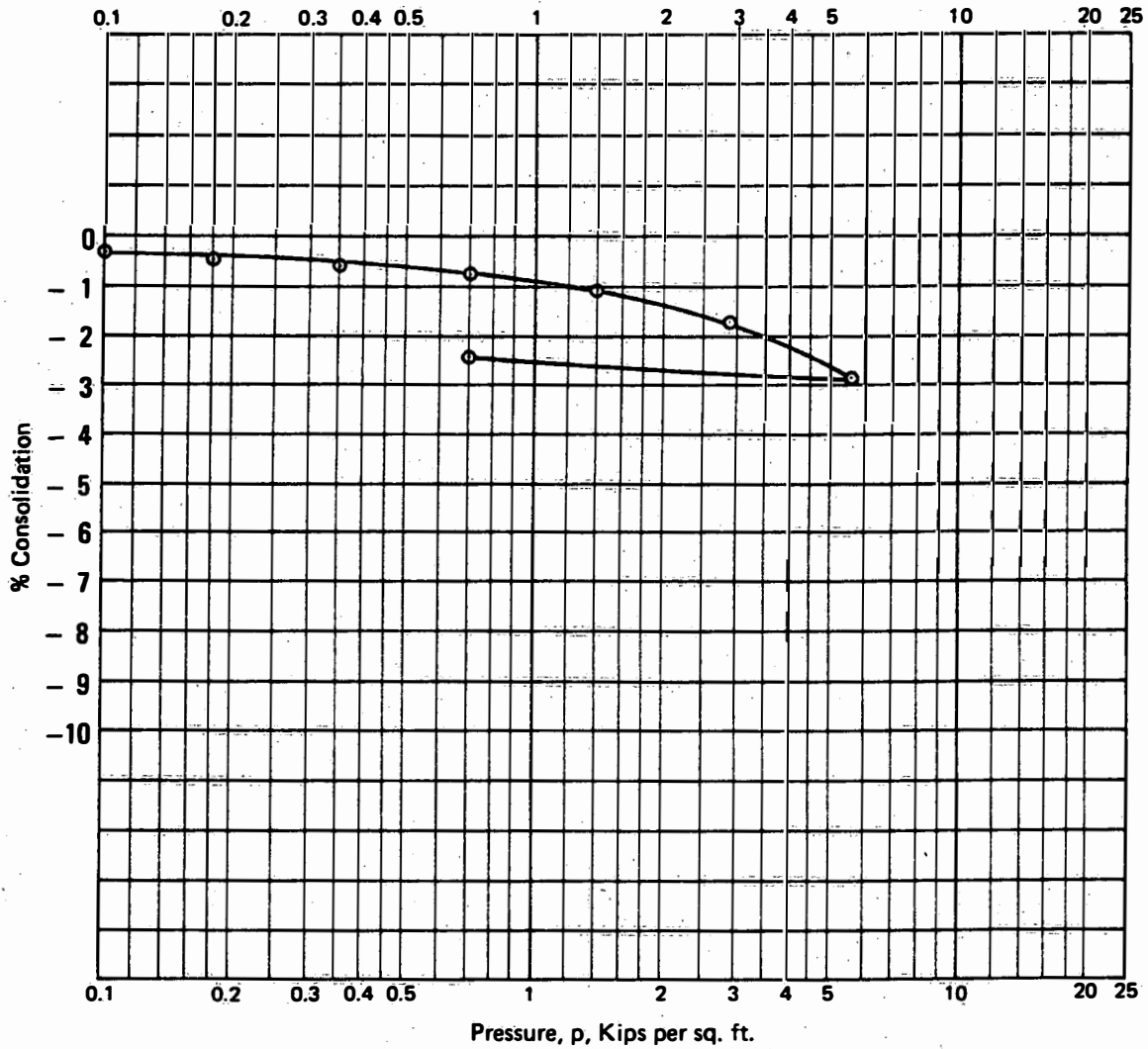
Type of Specimen	Undisturbed		Before Test		After Test						
Diam	2.40	in.	Ht	1.0	in.	Water Content, w_0	49.0	%	w_f	47.2	%
Overburden Pressure, p_0			T/sq ft		Void Ratio, e_0			e_f			
Preconsol. Pressure, p_c			T/sq ft		Saturation, s_0			%	s_f		
Compression Index, c_c					Dry Density, γ_d	74.0	lb/ft ³				
Classification	FILL										
LL			Project Seicho-no-Ie Project								
PL			Ahuimanu, Oahu								
Remarks			W.O. 81-815								
			Boring No. B2			Sample No.					
			Depth 2'			Date 8-17-81					
CONSOLIDATION TEST REPORT											



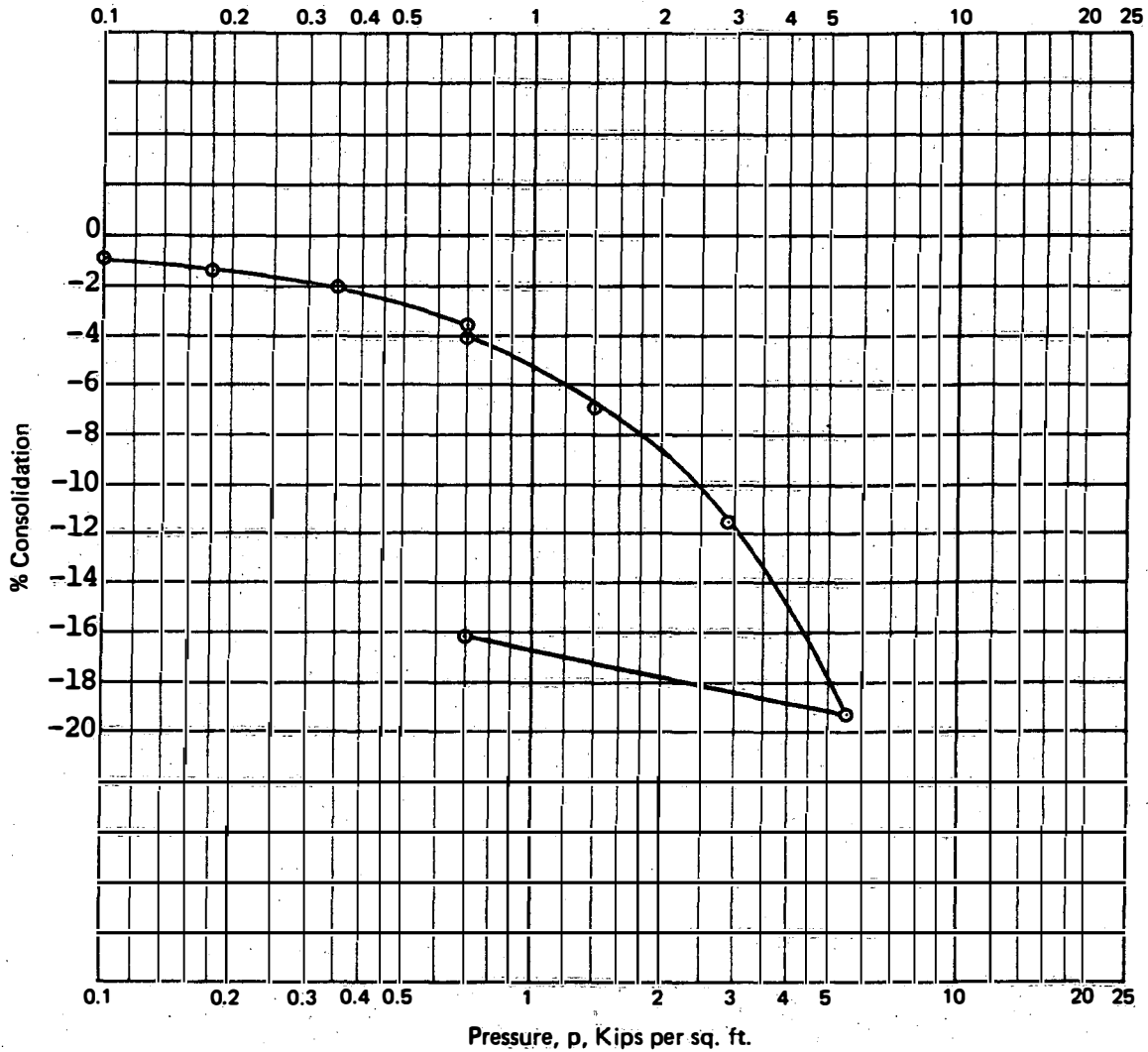
Type of Specimen Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_0	87.9 %	w_f	90.9 %
Overburden Pressure, p_0	T/sq ft	Void Ratio, e_0		e_f	
Preconsol. Pressure, p_c	T/sq ft	Saturation, s_0	%	s_f	%
Compression Index, c_c		Dry Density, γ_d	50.8 lb/ft ³		
Classification MH		Project Seicho-no-Ie Project			
LL		Ahuimanu, Oahu			
PL		W.O. 81-815			
Remarks Water added at 700 PSF		Boring No. B2	Sample No.		
		Depth 10'	Date 8-17-81		
CONSOLIDATION TEST REPORT					



Type of Specimen		Before Test		After Test			
Diam	2.40 in.	Ht	1.0 in.	Water Content, w_o	33.5 %	w_f	32.2 %
Overburden Pressure, p_o		T/sq ft		Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c		T/sq ft		Saturation, s_o		s_f	
Compression Index, c_c		Dry Density, γ_d		79.7	lb/ft ³		
Classification	FILL						
LL		Project	Seicho-no-Ie Project				
PL			Ahuimanu, Oahu				
Remarks		W.O.	81-815				
		Boring No.	B4	Sample No.			
		Depth	Surface	Date	8-18-81		
CONSOLIDATION TEST REPORT							



Type of Specimen Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	46.6 %	w_f	45.5 %
Overburden Pressure, p_o	T/sq ft	Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c	T/sq ft	Saturation, s_o		s_f	
Compression Index, c_c		Dry Density, γ_d	77.0 lb/ft ³		
Classification FILL		Project Seicho-no-Ie Project			
LL		Ahuimanu, Oahu			
PL		W.O. 81-815			
Remarks		Boring No. B4	Sample No.		
		Depth 5'	Date 8-13-81		
CONSOLIDATION TEST REPORT					



Type of Specimen	Undisturbed		Before Test		After Test		
Diam	2.40 in.	Ht	1.0 in.	Water Content, w_0	113.1 %	w_f	95.5 %
Overburden Pressure, p_0		T/sq ft		Void Ratio, e_0		e_f	
Preconsol. Pressure, p_c		T/sq ft		Saturation, s_0		s_f	
Compression Index, c_c				Dry Density, γ_d	41.2 lb/ft ³		
Classification	OL						
LL			Project Seicho-no-Ie Project				
PL			Ahuimanu, Oahu				
Remarks	Water added at 700 PSF		W.O. 81-815				
			Boring No. B5	Sample No.			
			Depth 18'	Date 8-17-81			
CONSOLIDATION TEST REPORT							

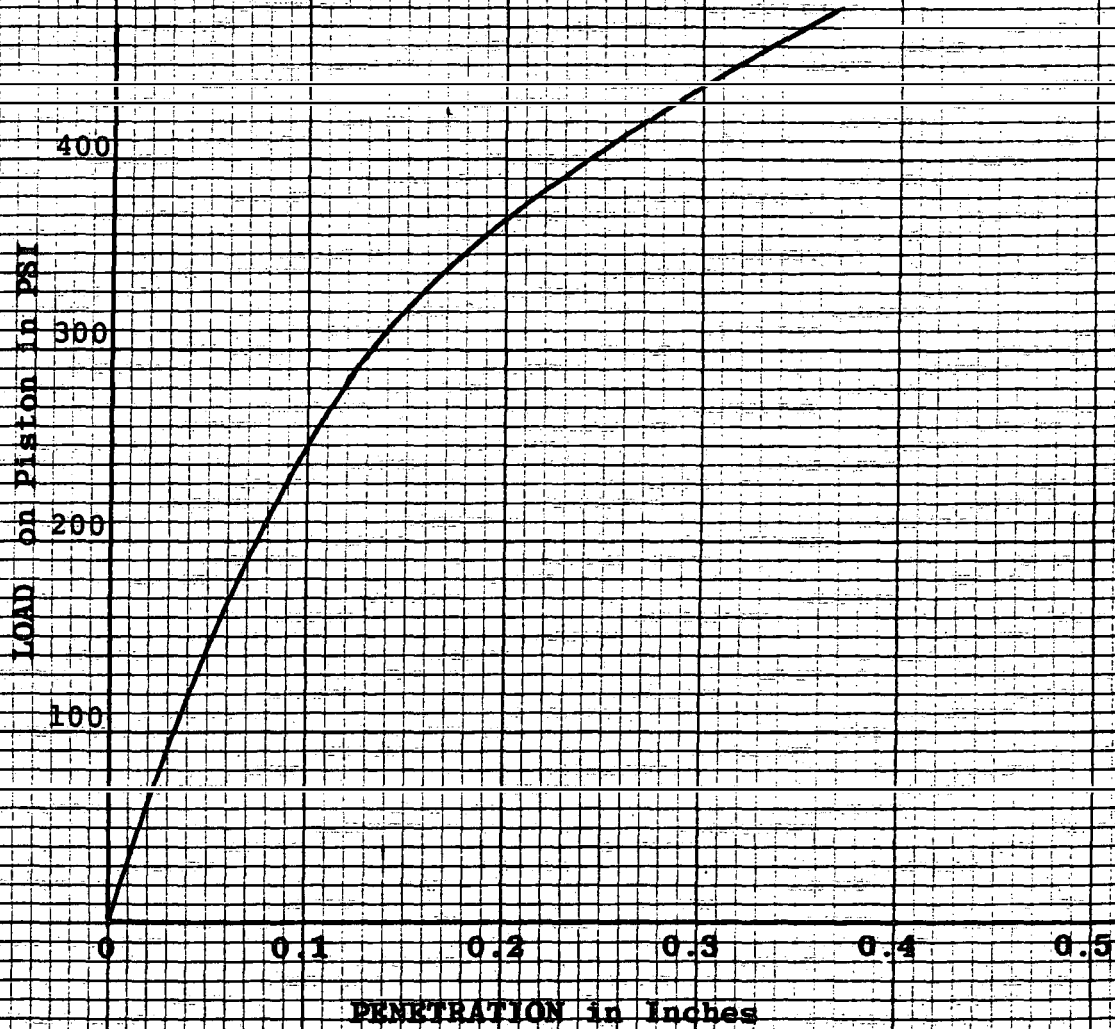
LABORATORY TEST RESULTS

Project: Seicho-no-Ie Project

W.O. 81-815

Boring or Test Pit No.	B1	B3	B4	B4	B5
Depth (ft.)	1	2	Surface	2	4
Atterburg Limit Tests					
Liquid Limit			58		
Plastic Limit			55		
Plasticity Index			3		
Soil Classification	MH	MH	MH	MH	MH
Expansion @ 90 PSF					
Natural	0	2.0%			
Remolded			1.0%		
Expansion @ PSF					
Natural					
Remolded					
Unconfine Stress (PSF)		5984		4299	2992
Proctor					
Max. Dry Unit Wt. (PCF)			88.5		
Optimum Water (%)			33.5		
Wet Density In-Place (PCF)	109.5	110.0		108.8	110.0
Moisture In-Place (%)	47.0	51.0		52.0	51.7
Dry Unit Wt. In-Place (PCF)	74.5	72.8		71.6	72.5

CBR STRESS-PENETRATION CURVE



Soil Description: Mottled brown Silty CLAY

Location: B4 @ Surface

Max. Density = 88.5 PCF

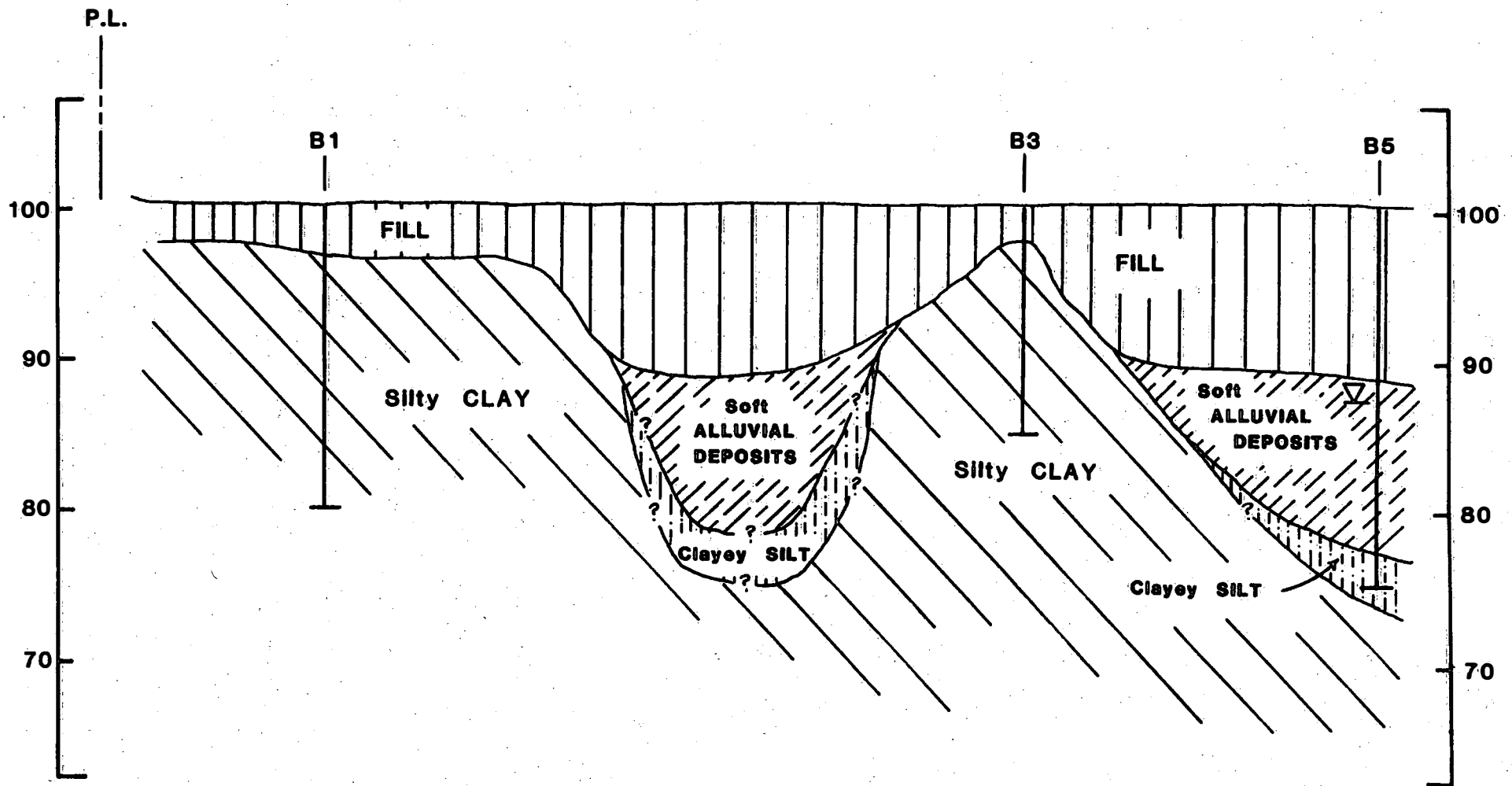
W.O. 81-815

Opt. Moisture = 33.5%

Swell = 0.68

CBR @ 0.1 = 25

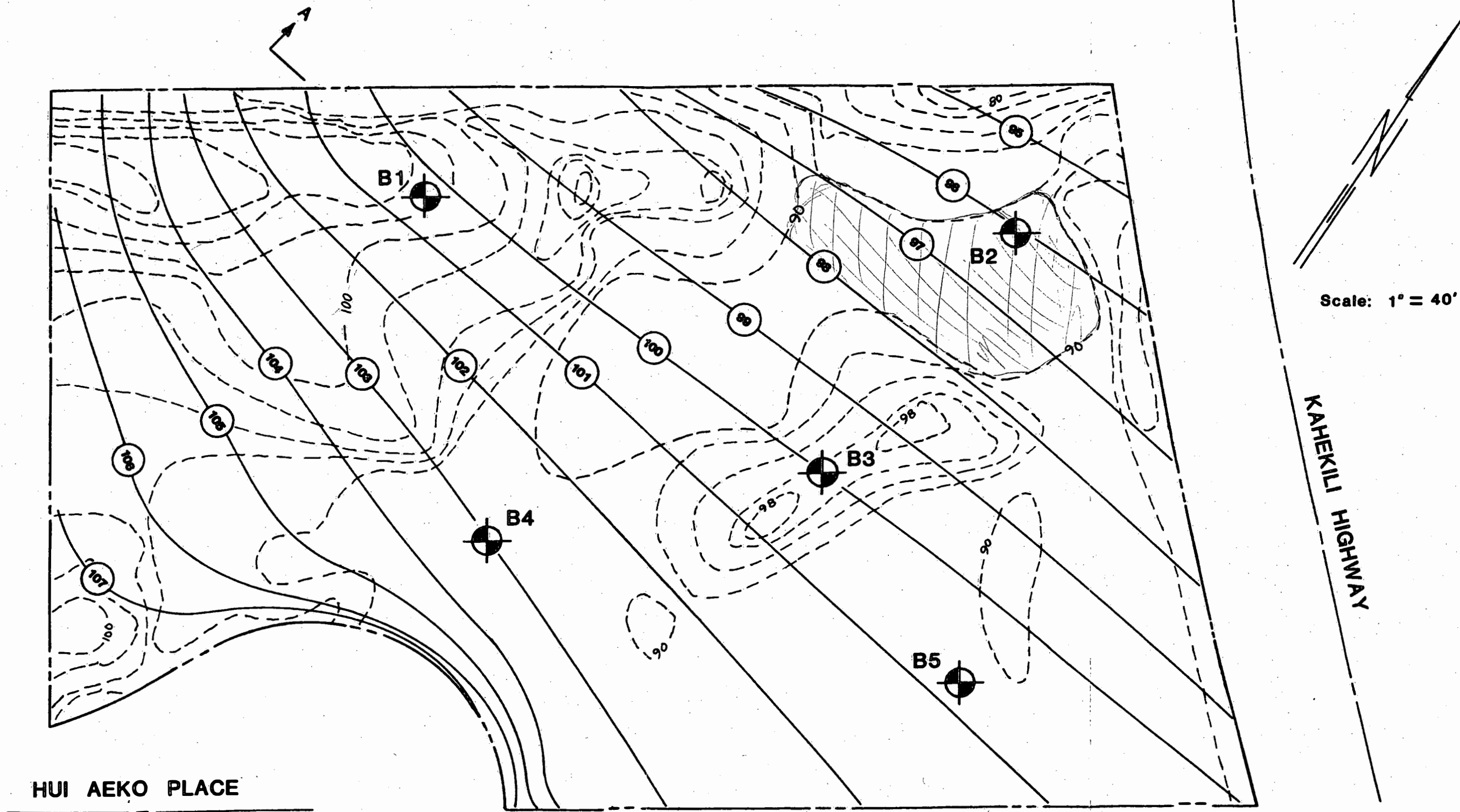
Plate: D



CROSS SECTION A-A

Scale: Horiz. 1" = 40'
 Vert. 1" = 10'

HUI IWA STREET



Scale: 1" = 40'

KAHAKILI HIGHWAY

HUI AEKO PLACE

- Finish Contour Lines
- - - Former Contour Lines
- ⊕ Approximate Location of Borings

SITE PLAN