FOUNDATION INVESTIGATION
PROPOSED APARTMENT BUILDINGS
KANEOHE, OAHU, HAWAII
TMK: 4-5-50-26
for
WALTER ZANE REALTY CORP.

May 24, 1973

W.O. 191

ERNEST K. HIRATA & ASSOCIATES, INC.

ERNEST K. HIRATA & ASSOCIATES, INC.
Soils and Foundation Engineering
1157 South King Street • Honolulu, Hawaii 96814 • Phone 531-5733

May 23, 1973
W.O. 191

Walter Zane Realty Corp.
c/o Kim, Kimura, Lee, Associates, Inc.
1806 South King Street
Honolulu, Hawaii 96814

Gentlemen:

Our report, "Foundation Investigation, Proposed Apartment Buildings, Kaneohe, Oahu, Hawaii, TMK: 4-5-50-26," dated May 23, 1973, our Work Order 191 is enclosed.

This is the report requested by you and planned in cooperation with Kim, Kimura, Lee, Associates, Inc., Structural Engineers.

The exploratory borings indicate that the onsite soils consist of a dark brown, stiff, silty clay. The silty clay grades to a grayish brown to mottled orange color with depth. Boring 5 indicated that the subsurface soil becomes medium stiff with higher moisture contents at depths of 10 feet and greater.

The site was found to be feasible for the proposed development. Conventional shallow foundations may be used to support the proposed structures. Precaution should be taken for Bldg. "D" since portions of the building will be both cut and fill. Our report provides recommendations for the proposed development.

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

Ernest K. Hirata

EKH:gk

FOUNDATION INVESTIGATION
PROPOSED APARTMENT BUILDINGS
KANEOHE, OAHU, HAWAII
TMK: 4-5-50-26

INTRODUCTION

This report presents the results of our foundation investigation performed on the subject property. The purpose of this investigation was to determine the nature of the soils underlying the site, to ascertain their engineering properties, and to provide recommendations for foundation design, floor slabs, and paving.

This investigation included drilling 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. Also attached is an Appendix which describes the laboratory testing procedures.

STRUCTURAL CONSIDERATIONS

Information concerning the proposed development was furnished by Kim, Kimura, Lee, Associates, Inc., Structural Engineers.

The proposed development will consist of four apartment buildings, three stories in height. The proposed structures

will be constructed of reinforced concrete with masonry block walls. Structural loads will be primarily supported by bearing walls with some pier type columns. The maximum load on the bearing walls will be approximately 5000 pounds per linear foot, while the maximum pier column load will be on the order of 23 kips.

SITE CONDITIONS

The property is located on the makai side of Kamehameha Highway near the intersection with Likelike Highway. Approximately a 16 foot difference in elevation exists between the Highway and the subject property. The site drains from the front to the rear of the property with a slope gradient of approximately five percent.

At the time of our investigation, several wood frame buildings were found on the site along with numerous trees. A thick growth of vegetation was found along the rear of the property.

FIELD EXPLORATION

The site was explored on April 23 and 24, 1973 by drilling five exploratory test borings with a truck mounted rotary drill rig. The borings varied in depth from 15 to 20 feet. The boring locations are shown on the Site Plan, and the soils encountered are logged on Plates A1 through A5.

The soils were continuously logged by our field engineer and classified by visual examination in accordance with the Unified Soil Classification System.

Undisturbed and bag samples were recovered from the borings for laboratory testing. Undisturbed samples were obtained by driving a thin walled steel sampler with a 140 pound hammer from a height of 30 inches. The required blow count for each six inches of penetration is shown on the enclosed "Boring Logs".

SOIL CONDITIONS

Topographically, the onsite soils were developed from colluvium and alluvium deposits placed on fans and terraces from the weathering of the Koolau Mountains.

The exploratory borings indicate that the onsite soils consist of a dark brown, stiff, silty clay. The silty clay graded to a grayish brown to mottled orange color with depth. Boring 5 indicated that the subsurface soil becomes medium stiff with higher moisture contents at depths of 10 feet and greater.

Groundwater was not encountered in any of the exploratory borings down to the depths drilled.

RECOMMENDATIONS

General

The site was found to be feasible for the proposed development. Conventional shallow foundations may be used to support the proposed structures.

Foundations

Conventional spread footings may be used to support the structures. The proposed elevations indicate that Bldgs. "A" and "C" will primarily be in cut, and we therefore recommend that footings be founded on the undisturbed ground. An allowable bearing value of 3500 PSF may be used for both wall and pier footings.

Bldg. "B" will be entirely on fill, and we recommend that an allowable bearing value of 2000 PSF be used for foundation design.

Bldg. "D" will be in both cut and fill as approximately 9.5 feet of fill will be placed along the eastern edge of the pad. We recommend that the cut portion of the pad be over-excavated a total of three feet then recompacted to 90 percent of the maximum relative density. In addition, the compacted fill for Bldg. "D" should be completed first, and construction

of the building started last. This will help to allow any possible settlement to occur under the filled area prior to construction.

Footings under all buildings should be embedded a minimum of 18 inches below finished adjacent grade.

Lateral Design

The bearing values indicated above are for the total of dead and frequently applied live loads, and may be increased by one-third for short duration loading which includes the effect of wind or seismic forces. Resistance to lateral loading may be provided by friction acting at the base of foundations. An allowable coefficient of friction of 0.4 may be used with the dead load forces.

Floor Slabs and Paving

Prior to placing slabs-on-grade or paving, the existing grade should be scarified to a depth of 6 inches, moistened as required to obtain optimum moisture content, and recompacted to 90 percent of the maximum dry density as determined by ASTM D-1557-70T.

We recommend that the flexible pavement design be based on 2 inches of asphaltic concrete with 6 inches of base course material having a CBR value of 85% or greater compacted to 100%.

The surface soils are considered slight to moderately expansive. Prior to placement of concrete, the subgrade should be thoroughly wetted. A six inch layer of crushed rock should be placed under all slabs on grade.

Inspection

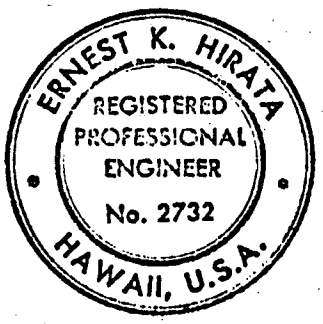
It is recommended that all footings be inspected by a qualified soils engineer prior to placing concrete or steel. Any fill which is placed should be inspected and tested. Any import of fill material should be inspected by us to ascertain that the engineering properties meet our recommendations for foundation design.

Limitations

The boring logs indicate the approximate subsurface soil conditions encountered only at those locations where the borings were made and may not represent conditions at other locations.

During construction, should subsurface conditions differ from those encountered in the borings, we should be advised immediately in order to review and to revise our recommedations.

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.



Respectfully submitted,

Ernest K. Hirata & Associates, Inc.

Ernest K. Hirata

Ernest K. Hirata P.E. 2732

Enc: Appendix of Laboratory Testing
Log of Borings Plates A1 through A5
Consolidation Test Report Plates B1 through B5
Site Plan

EKH:gk

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 Atterburg 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 the Modified AASHO T-180.

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 0.03 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 ultimate value is taken to determine the shear strength parameters.

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B1 DRIVING WT. 140 lb. DATE OF DRILLING 4-23-7

SURFACE ELEV. 77 ± DROP 30 in. W.O. 191

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									FILL - Sandy SILT - Light brown, slightly moist, stiff with coral fragments.
	x		11 21 30	70.8	52.3				Silty CLAY (MH) - Dark brown, moist, stiff, grading grayish brown from 4 ft.
5	x		14 20 28	78.1	43.7		52.5°	0.95 KSF	
	x		11 21 23	69.2	52.7				Mottled orange color from 9 feet.
10									
15	x		12 22 30	70.7	47.4				Grading stiff to hard from 15 to 17 feet.
	x		11 9 12	71.9	49.9				
20									End boring at 20 feet.
25									
30									Plate A1

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BORING LOG

BORING NO. B2 DRIVING WT. 140 lb. DATE OF DRILLING 4-23-7

SURFACE ELEV. 75 ± DROP 30 in. W.O. 191

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									Silty CLAY (MH) - Brown, moist, stiff to hard.
	x		17 33 48	86.2	43.2		32°	2.47 KSF	
5									Grading grayish brown from 4 feet.
	x		16 22 24	81.7	37.0				Mottled orange color at 7 feet.
	x		13 19 20	78.2	44.1				
10									
	x		12 13 12	79.2	42.7				
15									End boring at 15 feet.
20									
25									
30									

Plate A2

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BORING LOG

BORING NO. B3 DRIVING WT. 140 lb. DATE OF DRILLING 4-23-73

SURFACE ELEV. 78 ± DROP 30 in. W.O. 191

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									Silty CLAY (MH) - Brown, slightly moist, stiff.
	x		15 24 22	76.1	40.9				
5	x		16 26 29	79.5	41.8				Mottled orange color from 5 feet.
10	x		15 25 27	79.6	40.8		52.5°	1.75 KSF	Grading to dark brown color from 11 feet.
15	x		13 19 20	78.7	44.2				
	x		14 14 15	74.8	46.4				
20									End boring at 20 feet.
25									
30									Plate A3

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B4 DRIVING WT. 140 lb. DATE OF DRILLING 140 lb.

SURFACE ELEV. 72 ± DROP 30 in. W.O. 191

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									Silty CLAY (MH) - Brown, slightly moist, stiff.
	x		18 27 28	77.9	42.1				
5									Mottled orange color at 3.5 feet.
	x		18 23 24	80.8	42.9				Mottled gray color from 6 feet.
	x		15 14 18	92.3	22.4				
10									
	x		12 15 16	78.1	44.8				
15									End boring at 15 feet.
20									
25									
30									Plate A4

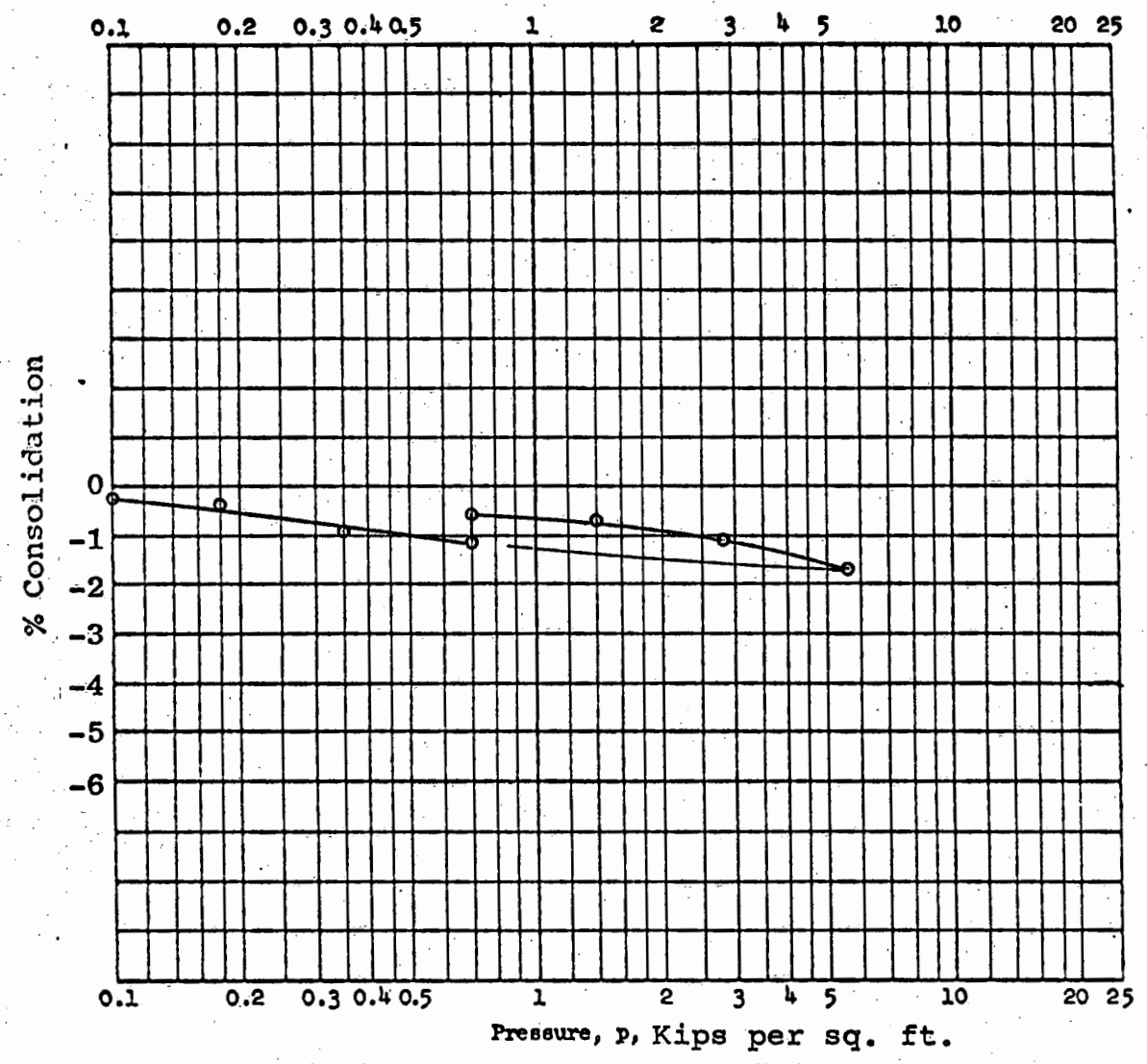
ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B5 DRIVING WT. 140 lb. DATE OF DRILLING 4-24-73

SURFACE ELEV. 71 ± DROP 30 in. W.O. 191

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									Silty CLAY (MH) - Orangish brown, slightly moist, stiff.
	x		17 21 21	83.0	38.6				
5	x		10 11 13	76.4	38.7				Grading brown to mottled gray color from 7 feet.
10	x		8 9 10	70.5	50.6				Moist at 10 feet.
15	x		6 6 7	66.6	56.7				
	x		8 11 13	61.0	61.9		UNCONFINE 3630	PSF	
20									End boring at 20 feet.
25									
30									Plate A5



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	52.7 %	w_f	56.0 %
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	69.2 lb/ft^3		
Classification MH		k_{20} at e_o =	× 10$^-$ cm/sec		
LL	G_s	Project Apartment Buildings - Kaneohe			
PL	D_{10}	Walter Zane Realty			
Remarks Water added at 700		Area W.O. 191			
PSF		Boring No. B1		Sample No.	
		Depth El 9'		Date 5-9-73	
		CONSOLIDATION TEST REPORT			

ENG FORM 2090
1 MAY 63

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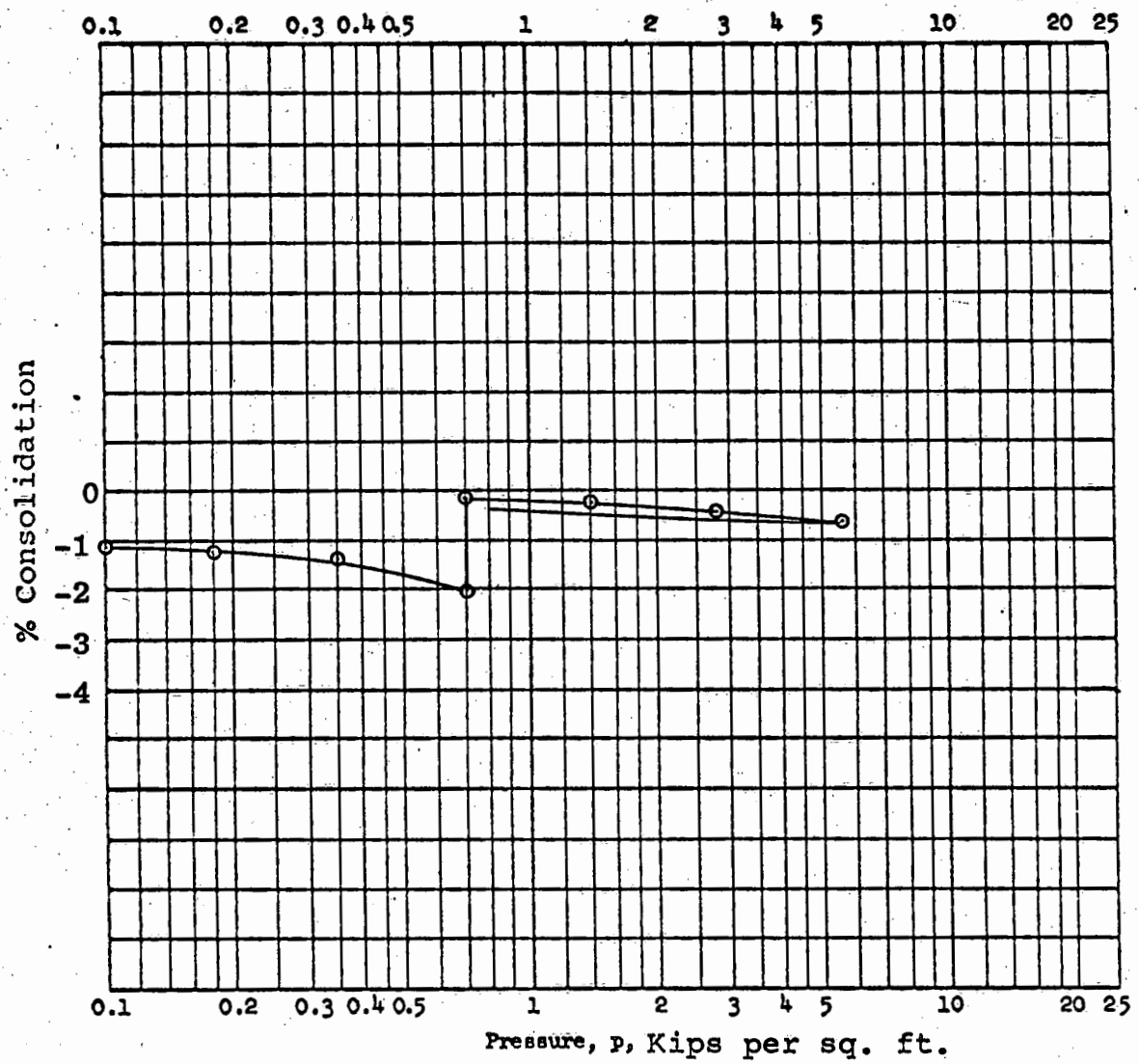
Plate B1



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	42.1 %	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	77.9 lb/ft^3		
Classification MH		k_{20} at e_o =	$\times 10^{-}$ cm/sec		
LL	G_s	Project Apartment Buildings - Kaneohe			
PL	D_{10}	Walter Zane Realty			
Remarks Water added at 700		Area W.O. 191			
PSF		Boring No. B4		Sample No.	
		Depth / El 3'		Date 5-2-73	
		CONSOLIDATION TEST REPORT			

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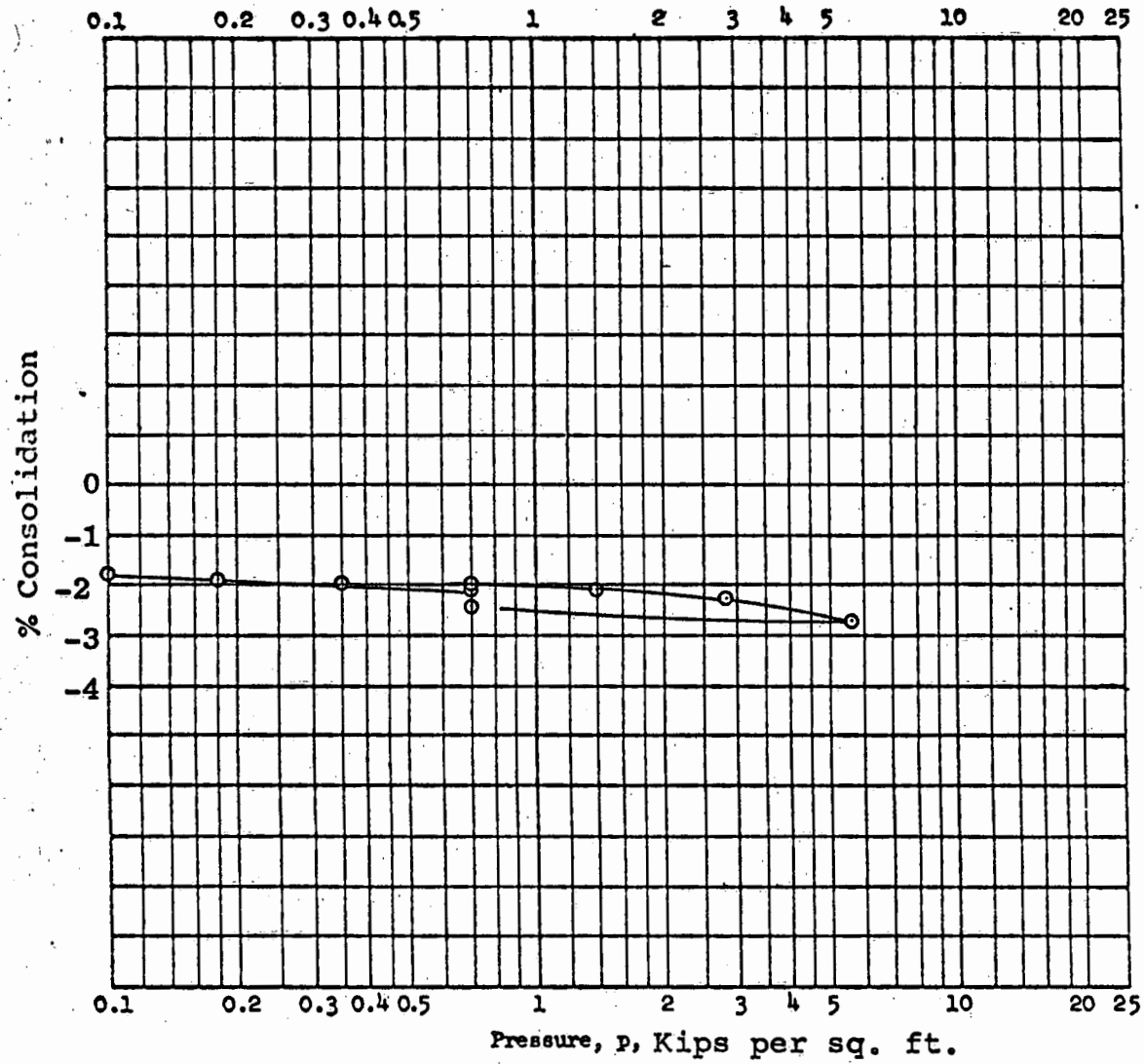
Plate B2



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	38.6 %	w_f	34.7 %
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	83.0 lb/ft^3		
Classification MH		k_{20} at e_o =	x 10$^-$ cm/sec		
LL	G_s	Project Apartment Buildings - Kaneohe			
PL	D_{10}	Walter Zane Realty			
Remarks Water added at 700		Area W.O. 191			
PSF		Boring No. B5		Sample No.	
		Depth / El 3'		Date 4-26-73	
		CONSOLIDATION TEST REPORT			

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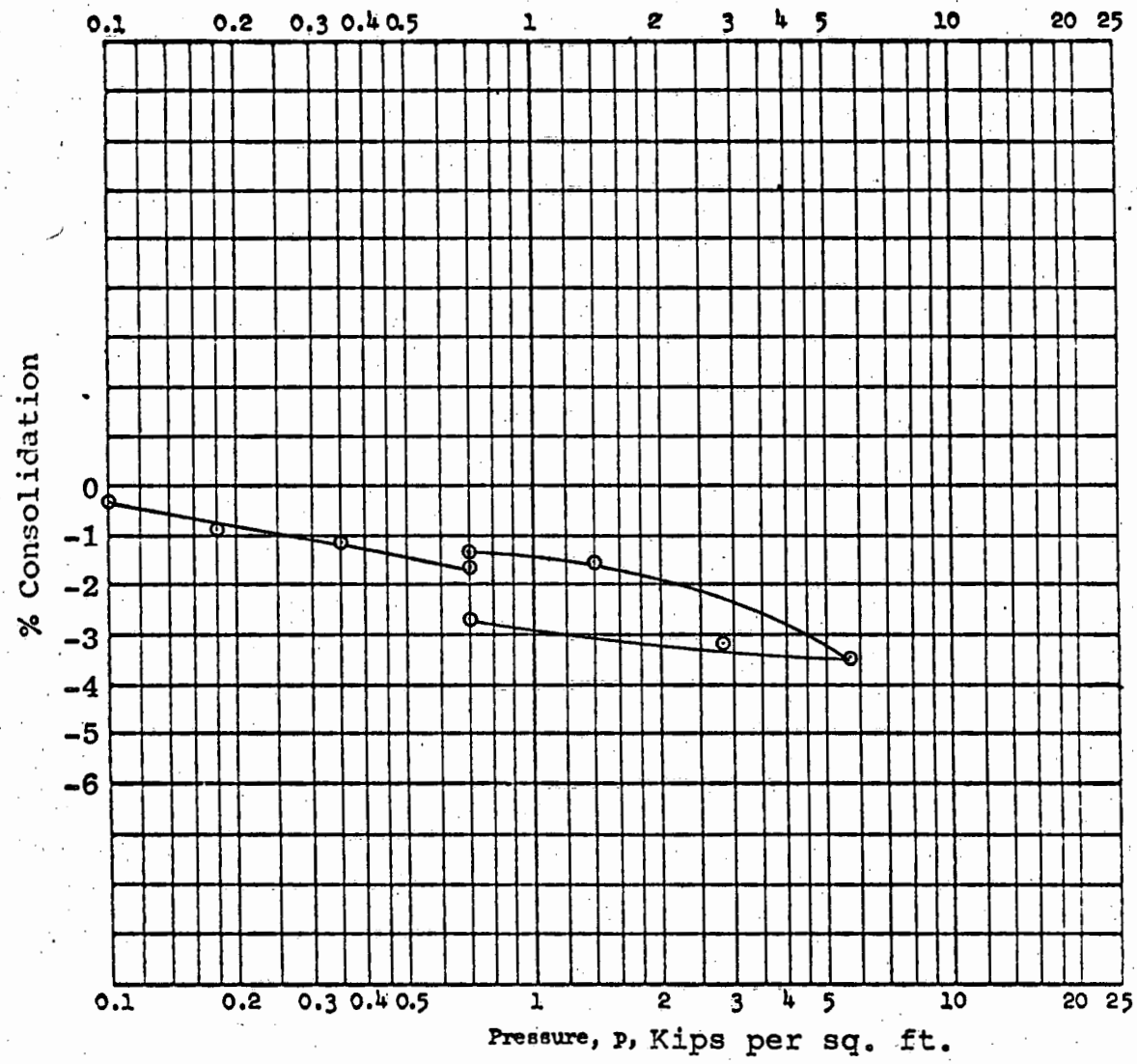
Plate B3



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	50.6 %	w_f	53.6 %
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	70.5 lb/ft^3		
Classification MH		k_{20} at e_o =	x 10$^-$ cm/sec		
LL	G_s				
PL	D_{10}				
Remarks: Water added at 700 PSF		Project: Apartment Buildings - Kaneohe Walter Zane Realty Area: W.O. 191 Boring No. B5 Sample No. Depth / El 10' Date 4-30-73			

CONSOLIDATION TEST REPORT

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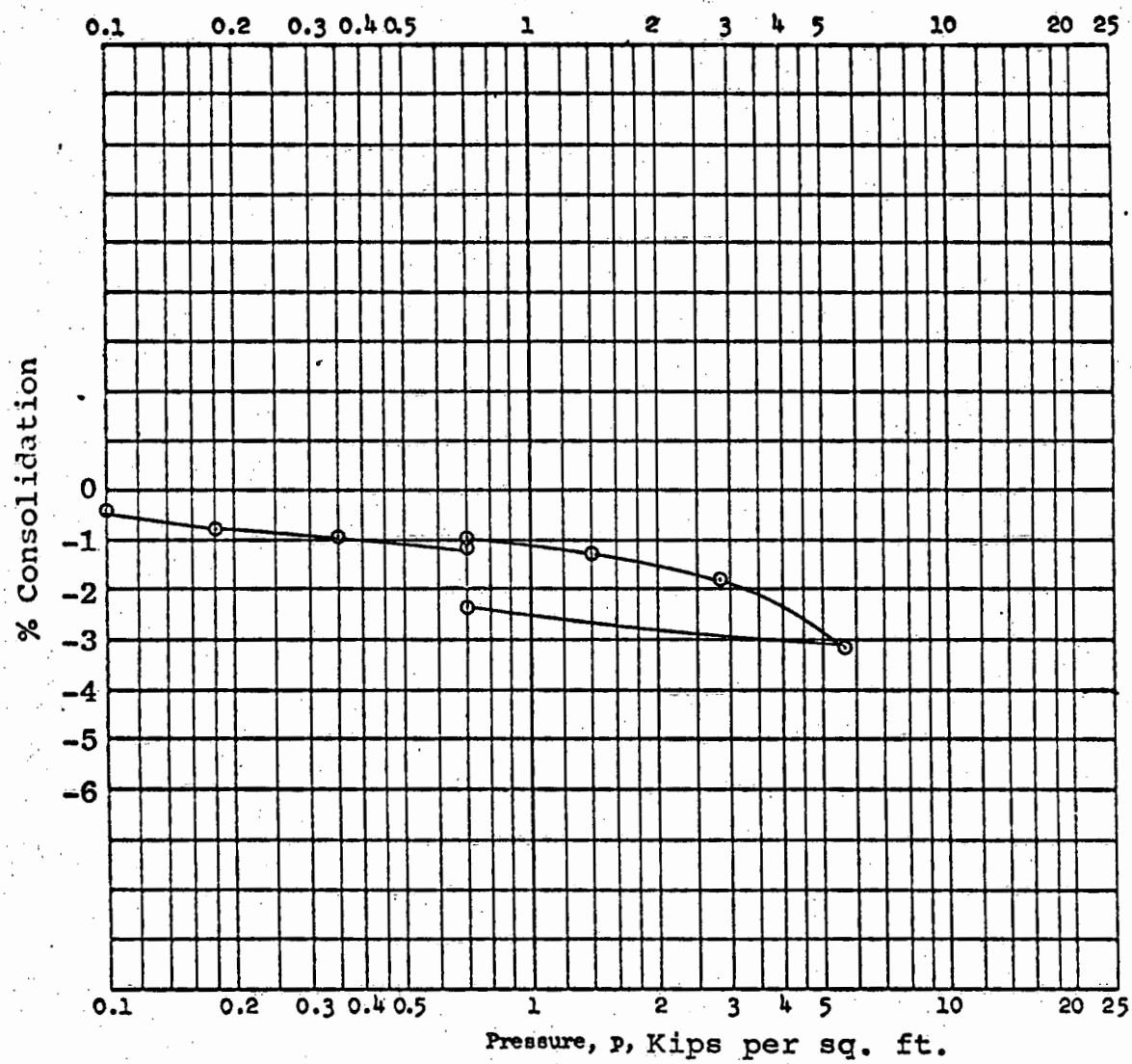
Plate B4



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	56.7 %	w_f	60.6 %
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	66.6 lb/ft^3		
Classification MH		k_{20} at e_o =	× 10$^-$ cm/sec		
LL	G_s	Project Apartment Buildings - Kaneohe			
PL	D_{10}	Walter Zane Realty			
Remarks Water added at 700		Area W.O. 191			
PSF		Boring No. B5		Sample No.	
		Depth El 15'		Date 5-2-73	
		CONSOLIDATION TEST REPORT			

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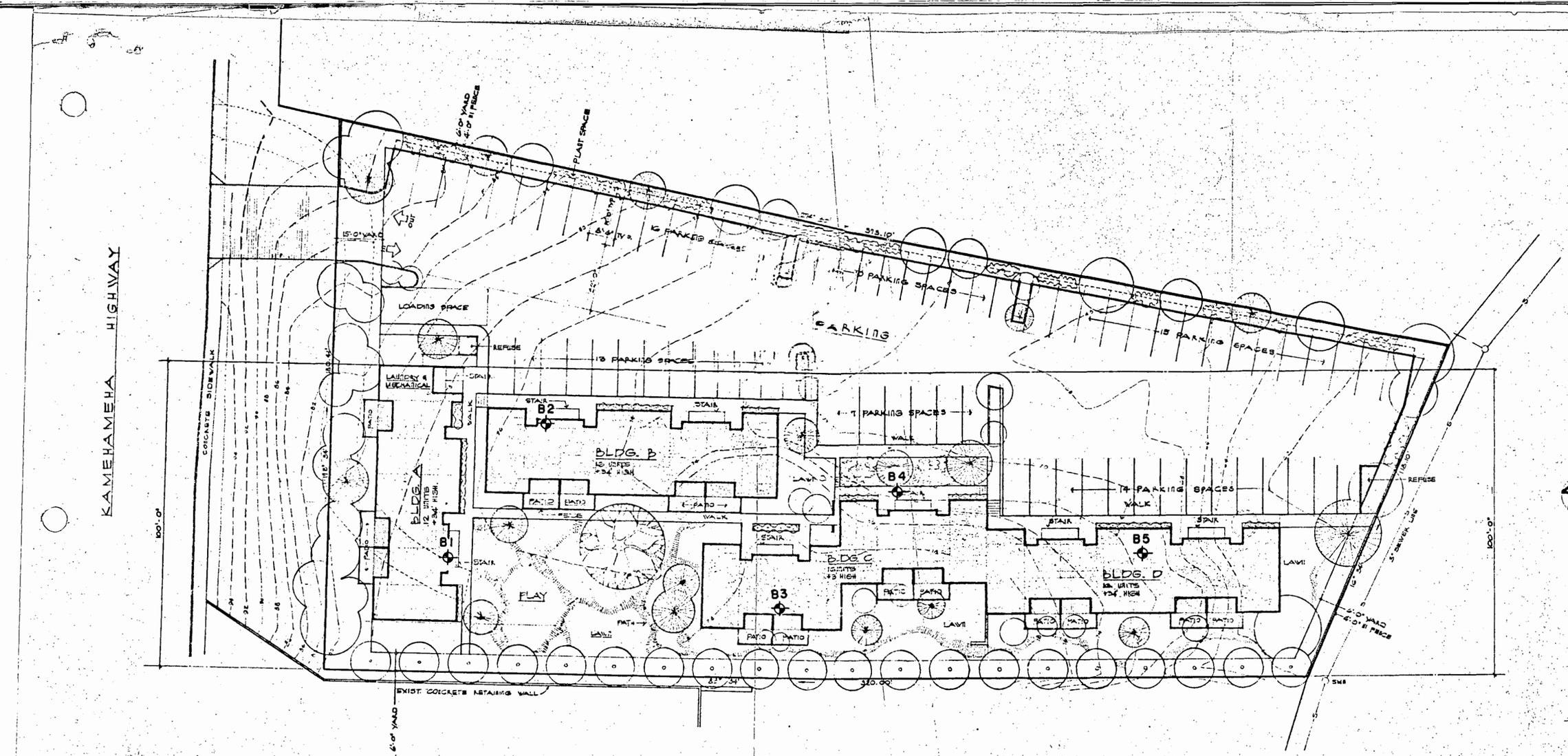
Plate B5



SITE PLAN
SCALE: 1/16" = 1'-0"

60 - 2 BEDROOM APARTMENT UNITS
75 - PARKING SPACES
1 - LOADING SPACE

⌖ Approx. Location of Borings

PROPOSED APARTMENT BUILDINGS - KANEOHE, OAHU, HAWAII

TMK : 4 - 5 - 50 : 26

HARRY M. NAKATA, A. I. A., ARCHITECT
Jun. 9, 1972

ERNEST K. HIRATA & ASSOCIATES, INC.
Soils and Foundation Engineering
1157 South King Street Honolulu, Hawaii

Date May 11, 1973 W.O. 191