REPORT

to

GENTRY, HAWAII, LTD.

Honolulu, Hawaii

on

SOILS INVESTIGATION

for

HEEIA LANDING AREA 6 STOCKPILE

Heeia, Oahu, Hawaii

TMK: 4-6-16: 1

by

GJ HAWAII, LTD.

807 Ilaniwai Street

Honolulu, Hawaii 96813

SEPTEMBER, 1973

GJH GJ HAWAII, LTD.
807 ILANIWAI STREET • HONOLULU, HAWAII 96813 • PHONE (808) 523-1661
Consultants in the Applied Earth Sciences

File No. R3-0039-H1
27 September 1973

Gentry Hawaii, Ltd.
146 Hekili Street
Kailua, Oahu, Hawaii 96734

Attention: Mr. Harvey Gerwig

Subject: Heeia Landing Area 6 Stockpile
Heeia, Oahu, Hawaii
SOILS INVESTIGATION

Gentlemen:

Transmitted herein are the results of the Soils Investigation accomplished for the Heeia Landing Area 6 Stockpile project. This report was accomplished in accordance with a request from Mr. Harvey Gerwig.

Area 6 Stockpile lies in the Northwest portion of the Heeia Landing project, and is bounded at one extreme by Kamehameha Highway (see Figure 1, Site Plan and Location of Test Borings).

This report was prepared utilizing information obtained from three previous Soils Investigations. These investigations were (a) a preliminary soils reconnaisance performed by Walter Lum and Associates dated 7 June 1971, (b) a preliminary soils investigation by Gribaldo, Jones-Hawaii, Ltd. dated 15 November 1973, and (c) a soils investigation for the Heeia Landing Sewage Lift Station by Gribaldo, Jones-Hawaii, Ltd. dated 19 July 1973.

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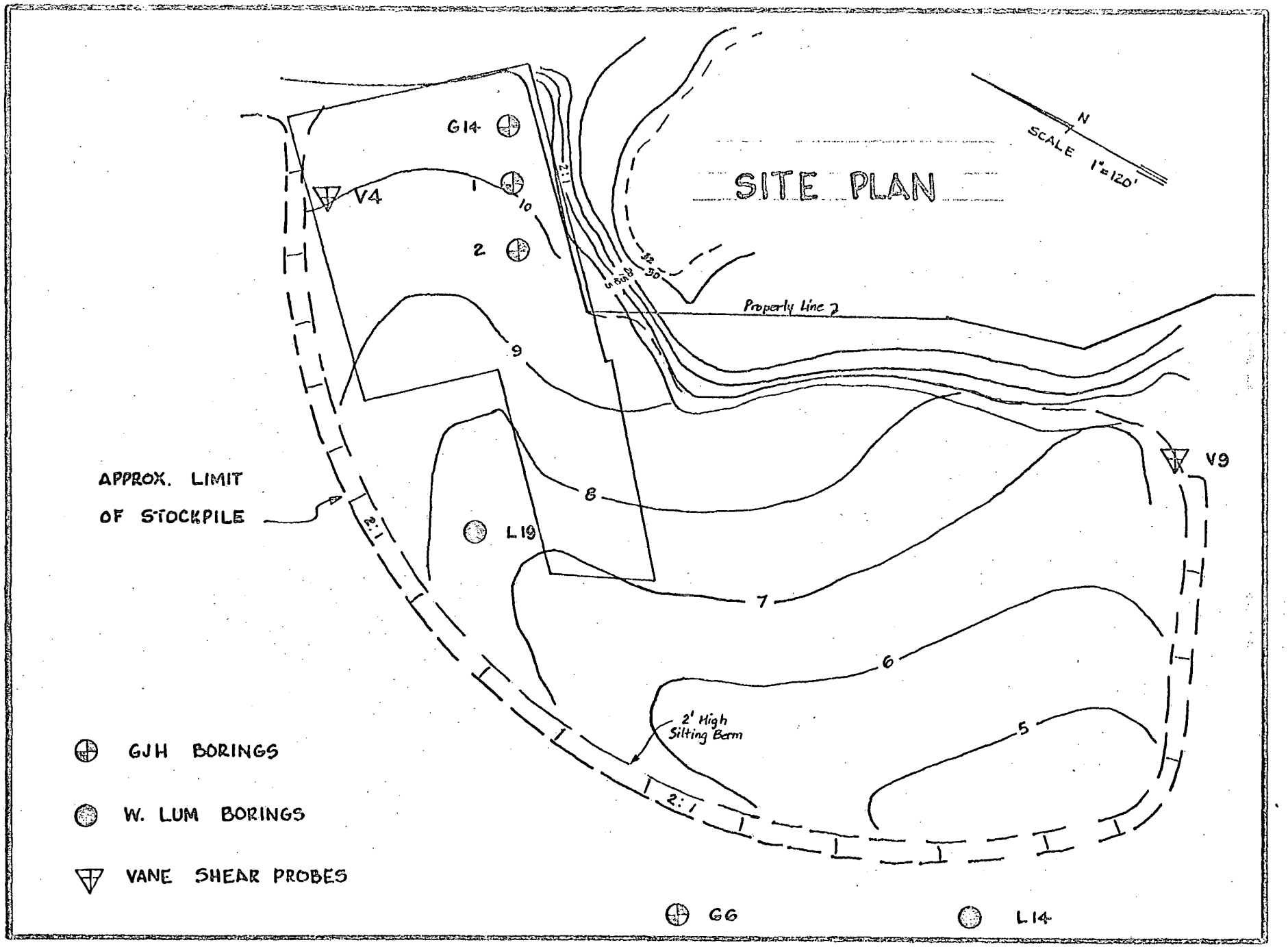


Figure 1 - Site Plan and Locations of Test Borings

Copies of appropriate boring logs and laboratory test data are attached in the appendix of this report.

Existing Site Conditions

The portion of the site encompassed by Area 6 Stockpile presently exists as unimproved meadowland that has in part been subjected to grazing. The Northwestern boundary of Area 6 is bounded by a dirt road at an approximate average height of six feet above the meadowland. The meadowland is covered by a fairly dense growth of "California" grass.

Subsurface Soil Conditions

The major portion of Area 6 Stockpile is underlain by less than ten feet of soft clays that are in turn underlain by stiff soils. The upper one to two feet of soils are somewhat stiffer than those immediately below them. The groundwater table was encountered within two feet of the existing ground surface.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

1. We believe that the proposed Heeia Landing Area 6 Stockpile may be developed to support structures, roads, and appurtenances.

2. The method of development we believe to be appropriate for Heeia Landing Area 6 Stockpile is the generation of a pad of fill over the existing native soils. This pad would be utilized to (a) provide bridging over the native soils, (b) provide a surcharge type load over the native soils, and (c) provide a firm base upon which to construct facilities.

3. The variance in existing surface conditions over Area 6, and height of fill to be placed will result in different compaction requirements over the area.

4. Generally, in Area 6, where the final design grade is less than six feet above the existing ground elevation, both the standing grass and grass root mat should be removed. Where the final design grade is more than six feet above the existing ground elevation, only the standing grass need be removed. Existing subsurface, and surface soil conditions may necessitate modification to the above criteria.

5. Where the fill abuts slope banks, all grass, both standing and root mat, must be removed from the existing banks.

6. The degree of compaction obtained in Area 6 will be dependant upon the in-situ density of the existing surface materials.

The degree of compaction required will be as high as can be attained without causing damage to the underlying subsurface soils. It is anticipated that the amount of compaction possible will increase with increasing lifts of fill.

7. The top four feet of fill should have a relative compaction of 90%. In roadway areas 95% relative compaction for the upper two feet of fill should be attained.

8. We recommend that all construction equipment be as light as possible, and that the use of vibratory equipment be prohibited. With the use of lightweight construction equipment, we anticipate that a working fill pad between one and three feet thick will initially be required across substantial portions of Area 6. The exact thickness of the working pad will be determined by field observations, soil conditions, and the actual contruction equipment utilized by the contractor. The compaction requirements specified are not a function of the type of contruction equipment utilized. The working pad should be constructed as a wave extending outward from the firm bank.

9. Hauling equipment must utilize designated haul roads and bypasses. Heavily loaded equipment should not be driven onto portions that have been filled. Grading and compaction equipment should not be operated with sudden reverses or stops in Stockpile Area No. 6.

10. Should soft areas or excessive pumping be encountered,

work should immediately stop in these areas until the Soils Engineer has been notified, and recommendations for correcting these areas have been given.

11. Loose stockpile heights should not exceed three feet in Area 6 unless authorized by the Soils Engineer. Further, no materials should be stockpiled adjacent to slopes.

12. Samples of material proposed for fill should be submitted to the Soils Engineer no less than four working days before its intended jobsite use.

13. Following completion of filling operations, settlement markers should be installed, and periodic readings taken to evaluate settlements of the subsurface soils.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations for this report are based upon the assumption that the soils conditions do not deviate from those disclosed in the borings. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, GJ Hawaii, Ltd. should be notified so that supplemental recommendations can be given.

2. This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are called to the attention of the Architect and Engineers for the project and incorporated into the plans, and that the necessary steps are taken to see that the Contractors and Subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside of our control. Therefore, this report is subject to review and should not be relied

upon after a period of one year.

Very truly yours,

GJ HAWAII, LTD.

William M. McMorrow, P.E.
President

Copies: 2 to William Hee and Associates (Attn: W. Hee)
5 to Gentry Hawaii, Ltd. (Attn: H. Gerwig)

APPENDIX

Logs of Borings by GJH

Logs of Borings by Walter Lum & Assoc.

Logs of Swedish Vane Shear Probes

Consolidation Curves

File No. R3-0039-H1
27 September 1973

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt.
				▽Boring No. 1		
0				⩧Grass mat		
	1-1		2	Dark grey Silty CLAY with organics, saturated, soft (OH)* (Torvane = 625 p.s.f.)	80.6	36.3
5	1-2		15	(Grading to stiff, less Clay) (Torvane = 625 p.s.f.)	64.2	57.4
10	1-3		19	(Grading to brown color with seams of blue-grey) (Torvane = 1625 p.s.f.) (Direct shear: ϕ=7°, c=1630 psf)	67.6	46.1
15	1-4		30	Dark grey-brown CLAY with traces of Silt, some mottling, saturated, hard (OH) (Torvane = 1375 p.s.f.)	48.7	80.1
20	1-5		50	(Grading to grey-black color with shells, very hard) (Torvane = 1500 p.s.f.) (Direct shear: ϕ=37°, c=740 psf)	60.2	47.5
25	1-6		40	(Grading to hard) (Torvane = 2250 p.s.f.)	60.0	60.5

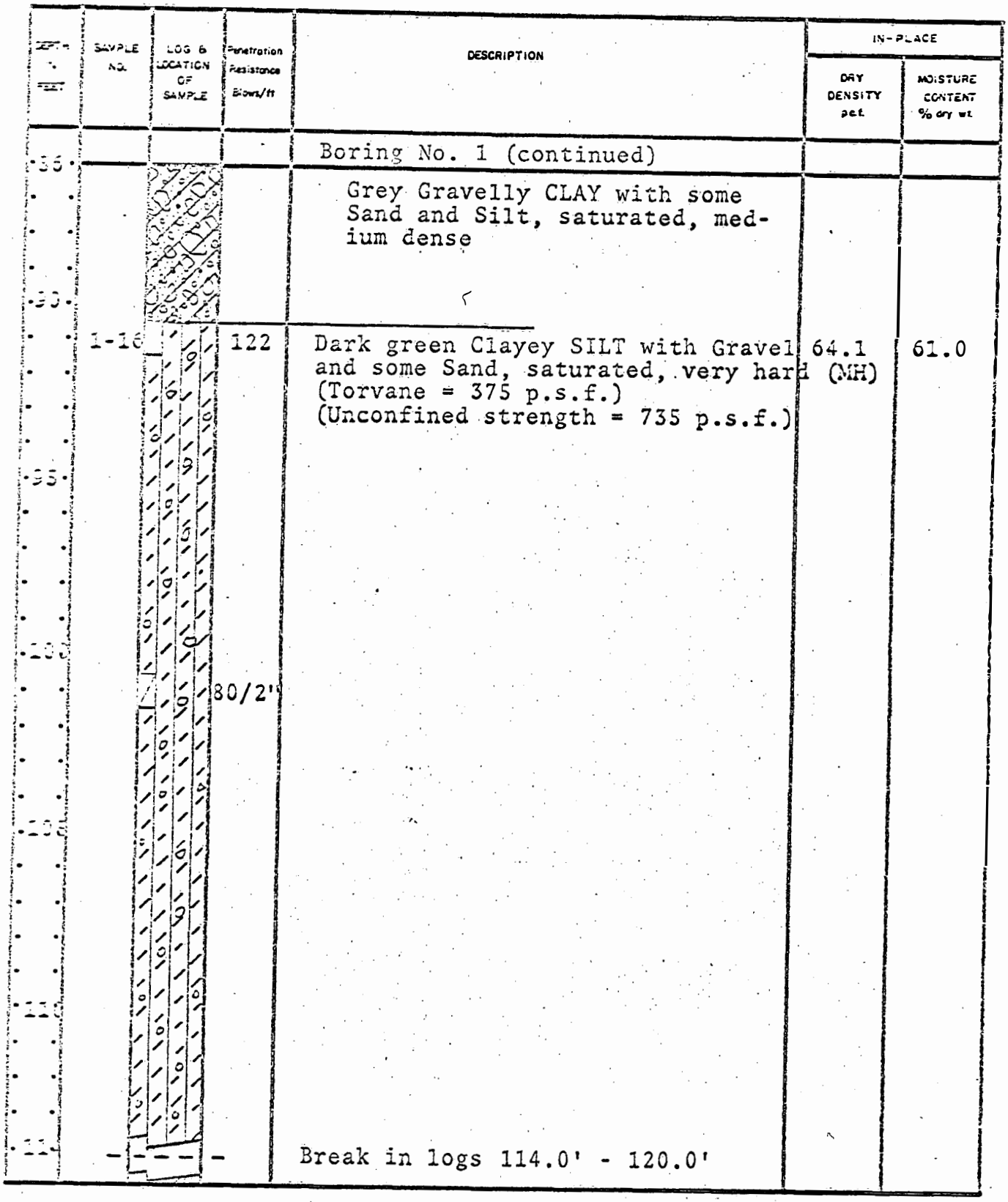
Figure 2 - Log of Boring No 1

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring No. 1 (continued)		
30				Dark grey/black CLAY with traces of Silt, saturated, hard (OH)		
	1-7		35	Blue-grey Silty CLAY with organics saturated, very stiff (OL) (Torvane = 2375 p.s.f.)	68.4	43.8
35	1-8		21	White Silty CLAY with fine coral Sand and seams of blue-grey soft Silty CLAY, organics and shells, saturated, soft (CL) (Torvane = 500 p.s.f.) (Direct shear: ϕ = 31°. c = 150 p.s.f.)	85.0	37.2
40	1-9		24	(Torvane = 500 p.s.f.) (Unconfined strength = 351 p.s.f.)	82.6	38.0
				Grey/white Sandy SILT with a Clay binder and traces of Rock fragments, saturated, hard (ML)		
45	1-10		42	(Torvane = 1250 p.s.f.)	85.4	34.5
50	1-11		80	(Grading to very hard) (Torvane = 1000 p.s.f.) (Direct shear: ϕ = 35°, c = 600 p.s.f.)	83.0	37.8
55	1-12		120	Light grey Clayey SILT with some fine Sand, saturated, soft (ML) (Torvane = 1125 p.s.f.)	76.5	33.1

Figure 2a - Log of Boring 1 (continued)

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring No. 1 (continued)		
55				Light grey Clayey SILT, some fine Sand, saturated, soft (ML)		
60						
65	1-13		100/4"	Light grey Sandy SILT with a Clay binder, saturated, very dense (ML) (Torvane = 750 p.s.f.) (Unconfined strength = 1290 p.s.f.)	92.5	31.3
70	1-14		40/2'		88.0	30.7
				Dark grey GRAVEL with Sand and some Silt in a Clay binder, saturated, very dense (GW)		
75						
80	1-15		28	Grey Gravelly CLAY with some Sand and Silt, saturated, medium dense	58.4	65.0
84						

Figure 2b - Log of Boring 1 (continued)



DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring No. 1 (continued)		
90				Grey Gravelly CLAY with some Sand and Silt, saturated, medium dense		
	1-16		122	Dark green Clayey SILT with Gravel and some Sand, saturated, very hard (MH) (Torvane = 375 p.s.f.) (Unconfined strength = 735 p.s.f.)	64.1	61.0
95						
100			80/2"			
105						
110						
114				Break in logs 114.0' - 120.0'		

Figure 2c - Log of Test Boring 1 (continued)

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring No. 1 (continued)		
120				Dark green Clayey SILT with Gravel and some Sand, saturated, very hard (MH)		
125						
130				Boring Terminated at 130'		

Figure 2d - Log of Test Boring 1 (continued)

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt.
				▽ Boring No. 2		
0				Grass mat,		
			5	Dark grey Silty CLAY with organics, saturated, soft (OH)		
5	2-1		13	(Torvane = 1125 p.s.f.)	58.9	64.8
				Dark grey CLAY with some mottled Rocks, saturated, stiff (OH)		
10	2-2		20	(Grading to blue-green with some Silt, very stiff (Torvane = 1500 p.s.f.)	60.0	69.0
15	2-3		22	(Grading to blue-grey with a trace of Sand and Silt, saturated (Torvane = 1750 p.s.f.) (Direct shear: ϕ = 20°, c = 950 p.s.f.)	58.1	68.3
20	2-4		30	(Grading to hard, Silt increasing) (Torvane = 2500 p.s.f.)	61.2	63.3
25	2-5		56	(Torvane=1875 psf)	57.6	62.8
				Dark grey Silty CLAY with numerous shells and Coral fragments, saturated, very hard (OH)		
28						

Figure 3 - Log of Test Boring 2

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt.
				Boring No. 2 (continued)		
30	2-6		64	Dark grey Silty CLAY with numerous shells and Coral fragments, saturated, stiff (OH) (Grading to fewer shells) (Torvane = 1000 p.s.f.)	52.6	74.2
35	2-7		86	Dark grey GRAVEL-CLAY mixture, saturated, dense (GC) (Torvane = 375 p.s.f.)	83.5	34.8
40						
45	2-8		30	White Clayey SILT with fine Sand, saturated, hard (MH) (Torvane = 1150 p.s.f.)	83.5	41.2
50						
			48			
55						

Figure 3a - Log to Test Boring 2 (continued)

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt.
				Boring No. 2 (continued)		
55				White Clayey, SILT with fine Sand, saturated, hard (MH)		
60						
65			43			
70						
75						
			48	Sandy CLAY, saturated, very hard		
80						
84						

Figure 3b - Log of Test Boring 2 (continued)

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt.
				Boring No. 2 (continued)		
85				Sandy CLAY, saturated, very hard		
90						
95	2-9		17	Silty CLAY, stiff		
100				Boring Terminated at 100'		

Figure 3c - Log of Test Boring 2 (continued)

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring No. G6		
0				▽ Reddish brown Clayey SILT with organics, medium stiff, wet		
	6-1		4	Mottled rust/grey Silty CLAY, medium stiff, wet (OH)		
5			2	Grey Clayey SAND with fine Gravel and Rocks, loose, wet (SC)		
	6-2		2	Grey Silty SAND with shell fragments and coarse Sand, loose, saturated (SM)	69.3	55.7
10			4	(Grading to medium stiff)		
15	6-3		4	Grey very fine Sandy SILT with slight Clay binder, soft to medium stiff, saturated (ML)		
20	6-4		5	(At 20.0', grading to more Clay binder)		
25				Black very fine SAND, loose, saturated (SP)		
28						

Figure No. 7 - Log of Test Boring No. G6

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt.
				Boring No. G6 (continued)		
30				Black very fine SAND, loose, saturated (SP)		
	6-5		9		54.1	79.5
				Brownish grey Clayey SILT with fine Sand, medium stiff to stiff, saturated (OH)		
35						
40						
	6-6		5	(Grading to medium stiff)	59.2	66.7
43						
53				Break in logs 43' - 53'		
55						
60						
				(At 62.0', grading to very hard)		
	6-7		53/3"			
				Boring Terminated at 63'		

Figure No. 7a - Log of Test Boring No. G6 (continued)

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring No. G14		
0				Mottled brown/rust Silty CLAY, medium stiff, wet (OH)		
			5	▽		
	14-1		3	Grey Silty CLAY, soft, saturated (OH)	61.1	62.7
5						
	14-2		20	(At 5.0', very stiff)	59.5	70.7
				Mottled brown/blue Silty CLAY, very stiff, saturated		
10						
	14-3		18		55.6	75.1
15						
			21			
	14-4		30	Brown Silty CLAY, very stiff, saturated (OH)		
				Coarse black SAND, dense, saturated (SP)		
				Grey Sandy CLAY, very stiff (SC)		
20						
	14-5		25	Bluish grey Silty CLAY, very stiff, saturated (OH)		
25						
				Grey Silty CLAY with small organic traces, very stiff (OH)		
28						

Figure No. 15 - Log of Test Boring No. G14

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf.	IN-PLACE MOISTURE CONTENT % dry wt.
				Boring G14 (continued)		
25				Grey Silty CLAY with small traces of organics (OH)		
30	14-6		30	(At 30.0', traces of Rock fragments)		
35						
38			50	GRAVEL-SAND mixture with Rock, very dense		
				Boring Terminated at 38.5'		

Figure No. 15a - Log of Test Boring No. G14 - continued

27 September 1973

WALTER LUM ASSOCIATES, INC.

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

Boring Log

PROJECT: CROWN TERRACE - TRACT 2 UNIT 3

LOCATION: Heeia, Koolaupoko, Oahu, Hawaii

HAMMER:
Weight: 10# SLEDGE HAMMER
Drop:

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

BORING NO. 14 Sheet No. ____ of ____

Driller: W. LUM ASSOC., INC. Date: MAY 14, 19

Field Party: MAESHIRO, KAKU

Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 5"

Elev.: 110'± * Datum: -

Drill Bit: T.C. DRAG

Water Level: NOT NOTICED
Time: -
Date: 5-14-71

Unified Soil Classification	DESCRIPTION ELEV.: 110'± ? *	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 10# SLEDGE HAMMER BLOWS/FT.
(M.H.)	MEDIUM TO STIFF, BROWN, CLAYEY SILT	0	2"ϕ	14-A	100	45	69	3700	1500 1700		5/.5' 7/.5'
		5	2"ϕ	14-B	98	50	65	11,100			18/.5' 24/.5'
(M.H.)	STIFF, BROWN & GRAY SILTY CLAY	10	2"ϕϕ	14-C		50					20/.5'
		15	2"ϕϕ	14-D		53					30/.5'
	END OF BORING @ 20.5'	20	2"ϕϕ	14-E		54					40/.5'

* ELEVATION ESTIMATED FROM TOPO MAP

File No. R3-0039-H1
27 September 1973

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: HEEIA LOWLANDS
LOCATION: Heeia, Koolaupoko, Oahu, Hawaii
Tax Map Key: 4-6-16

HAMMER: Weight 140# Drop 30"
SAMPLER: 2"ϕ - 2" O.D. THIN WALL TUBE; 2"ϕ - 2" STANDARD SPLIT SPOON

BORING NO. 10 Sheet No. _____ of _____
Driller WALTER LUM ASSOC. Date SEPT. 21, 1973
Field Party MEYER, MAKAULA
Type of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"
Elev. 1'± * Datum _____
Drill Bit FINGER TYPE
Water Level 0.4'
Time 11:45 AM
Date 9-21-70

Unified Soil Classification	DESCRIPTION ELEV. = 1'± ? *	Depth (Ft.)	Sampler	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 PENETRATION TEST "N" Blows Per Foot (0 10 20 30 40)	2" O.D. THIN WALL TUBE BLOWS/I.F.
(OH-CH)	SOFT, GRAY & BROWN ORGANIC CLAY	0	2"ϕ SS	10-A	-	81 LL= 115 PL= 44	-	-	-		
(SM)	SOFT, GRAY SILTY SAND W/SHELLS	5	2"ϕ S	10-B	105	80	58	-	60 100		HAND PUSH/1.6"
(MH)	MEDIUM, GRAY & BROWN, CLAYEY SILT (DECOMPOSED ROCK)	10	2"ϕ SS	10-C	-	71	-	-	-		
CH	MEDIUM, GRAY & BROWN CLAY W/TRACES OF DECOMPOSED ROCK	15	2"ϕ	10-D	98	94 LL= 155 PL= 38	52	-	800 840		1.5" 3.5"
(MH)	MEDIUM TO STIFF, GRAY & BROWN SILTY CLAY (SLIGHTLY ORGANIC)	20	2"ϕ SS	10-E	-	81 72	-	-	-		
(OH)	STIFF, GRAY ORGANIC SILT W/WOOD PIECES	25	2"ϕ SS	10-F	-	107	-	-	-		
	END OF BORING @ 26.5'										

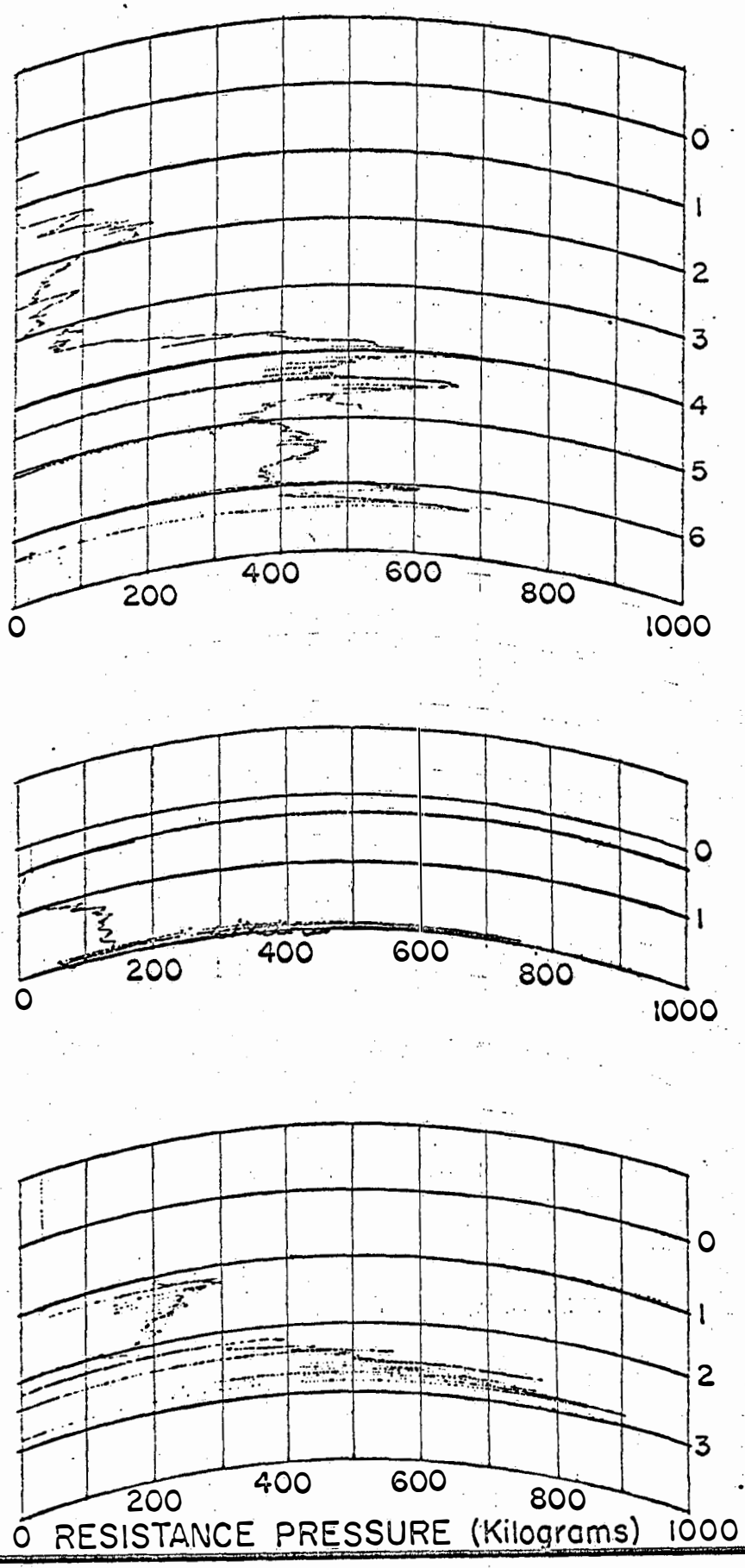


Figure No. 20 - Logs of Swedish Vane Shear Probes No. 4, 5, & 6

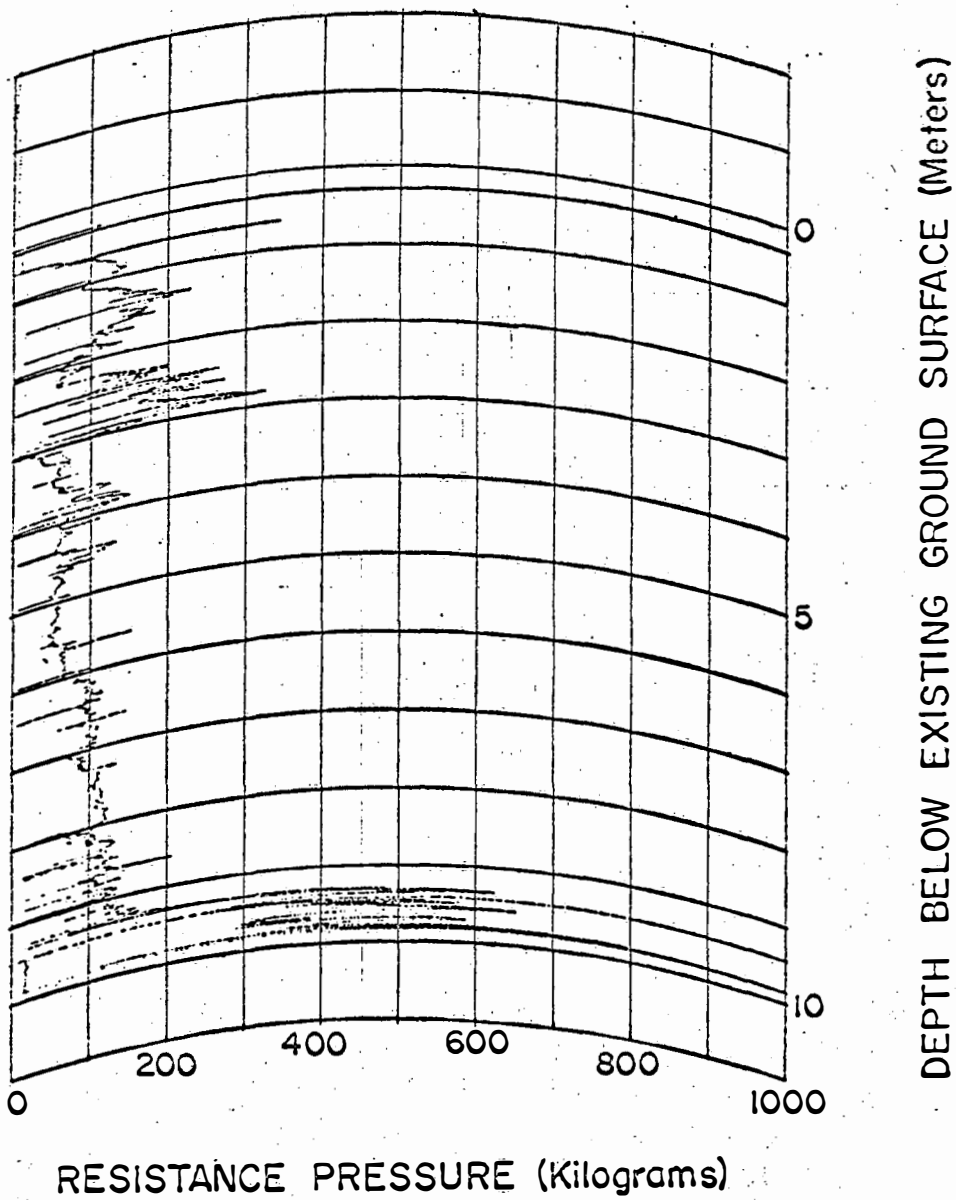


Figure No. 23 - Log of Swedish Vane Shear Probe No. 9

CONSOLIDATION CURVE

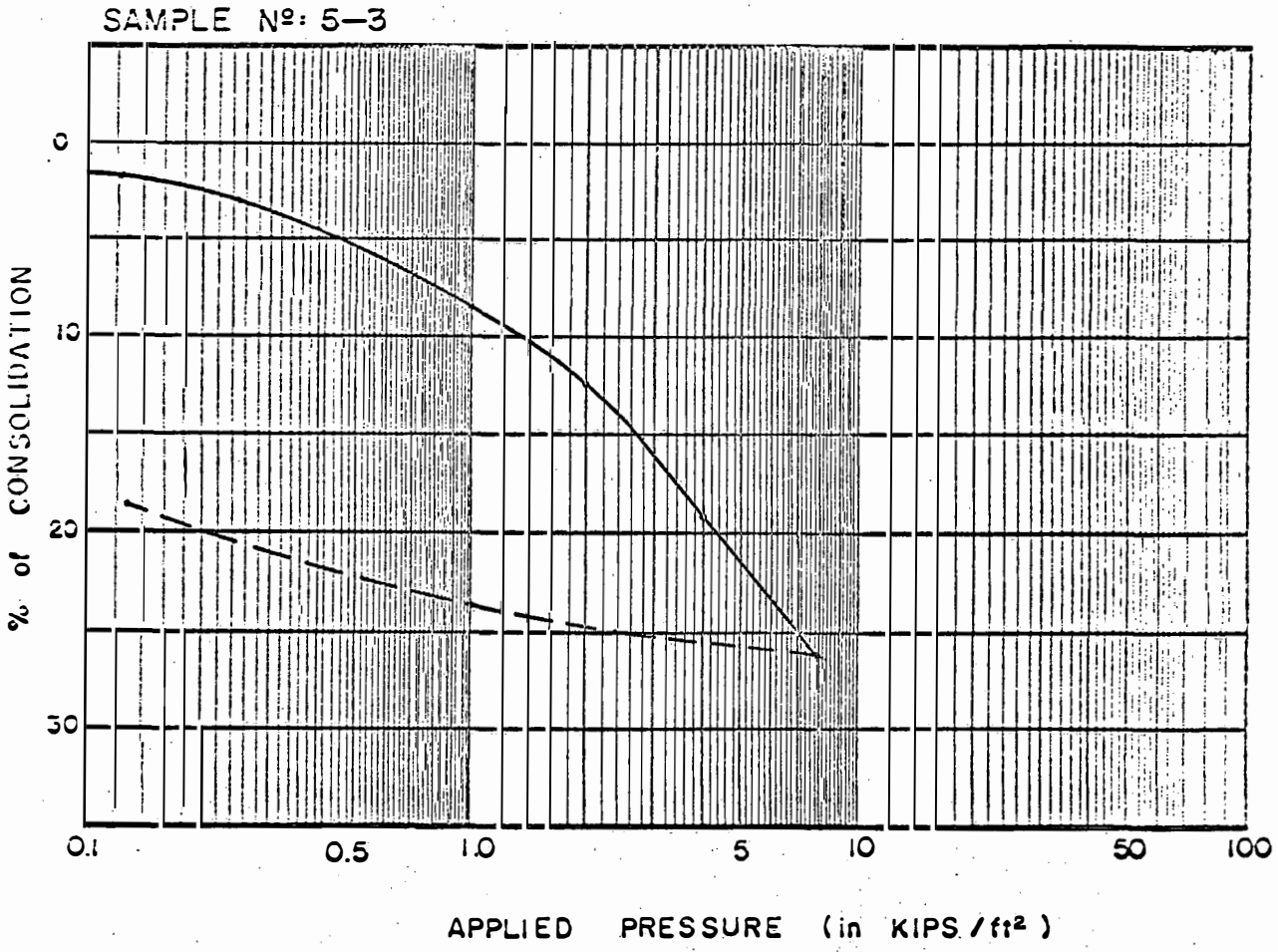


Figure No. 36 - Consolidation Curve for Sample No. 5-3

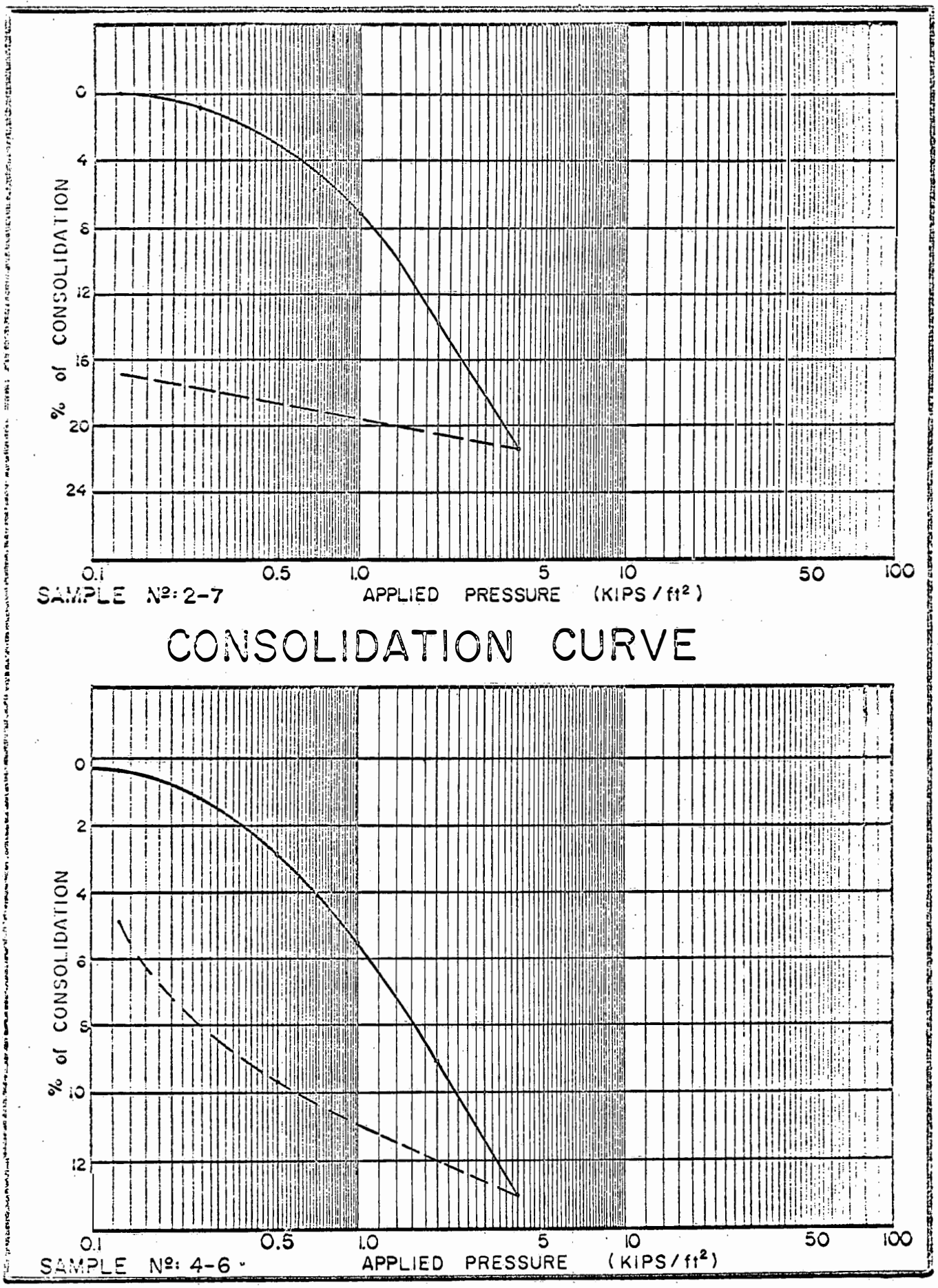


Figure No. 35 - Consolidation Curves for Samples No. 2-7 & 4-6

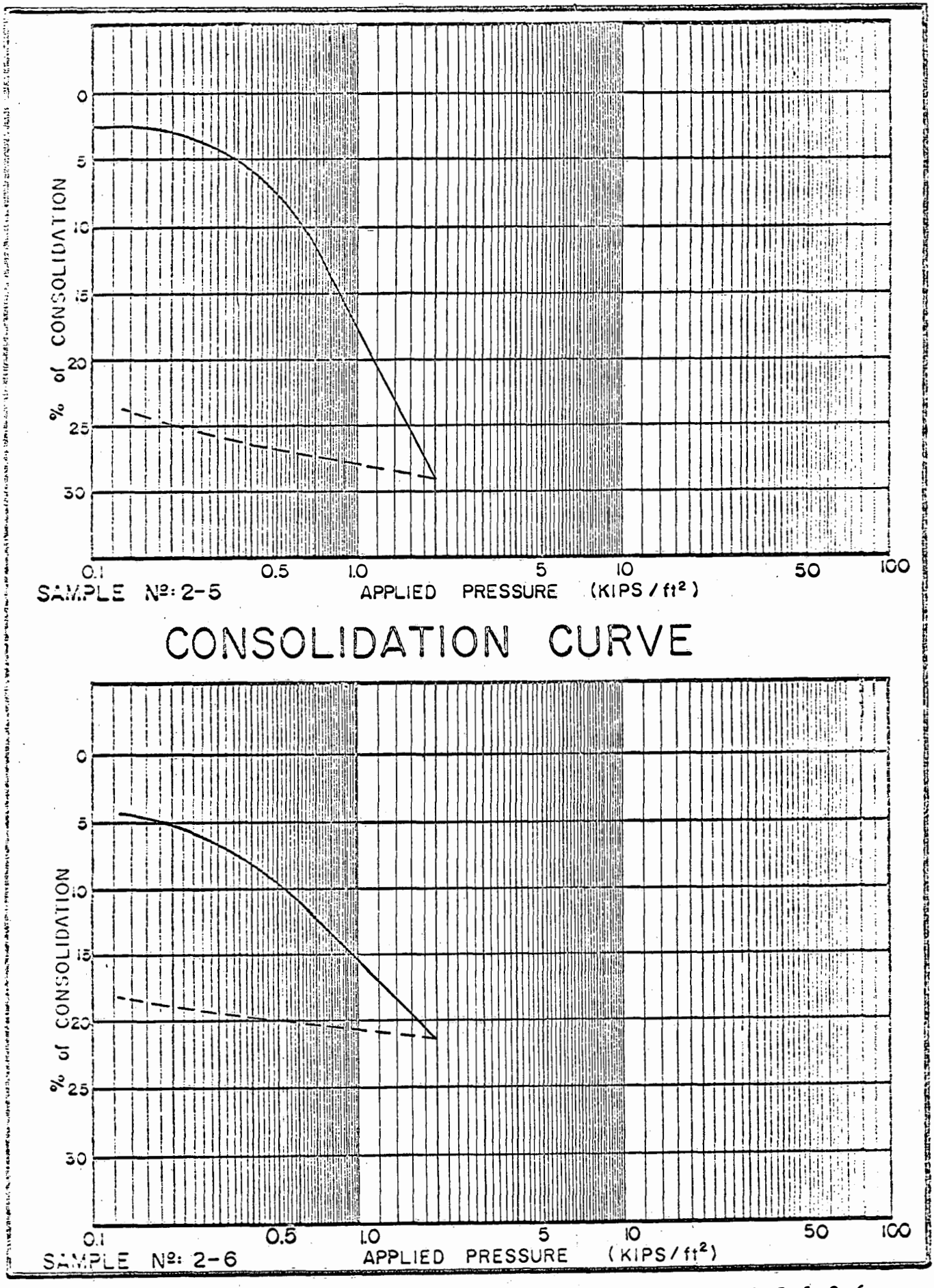


Figure No. 34 - Consolidation Curves for Samples No. 2-5 & 2-6

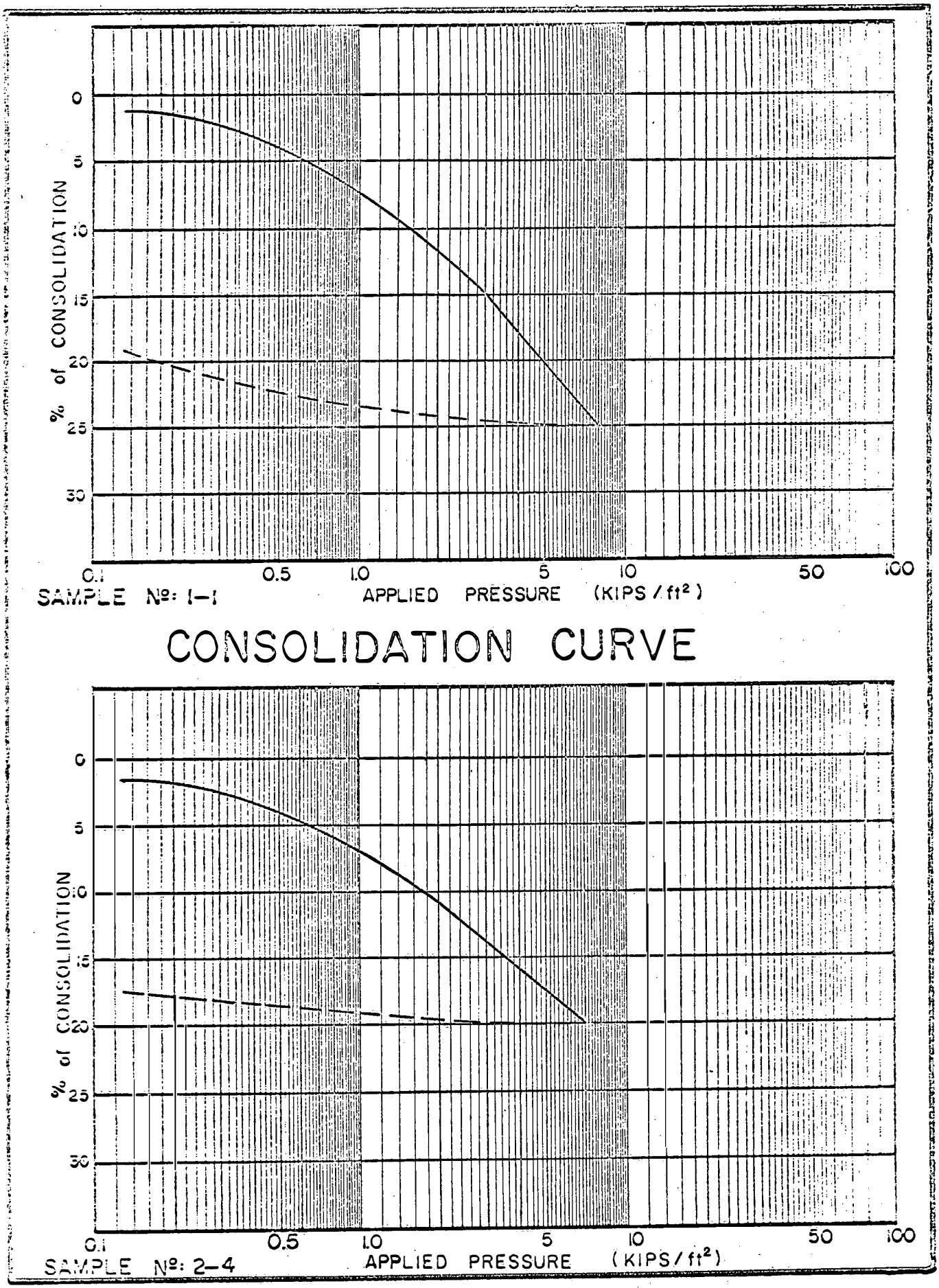


Figure No. 33 - Consolidation Curves for Samples No. 1-1 & 2-4