SUBSURFACE INVESTIGATION

PROPOSED SITE DEVELOPMENT IN CHURCH AREA
WAIPAHU, OAHU, HAWAII

FOR

CROWN CORPORATION

Dames & Moore Job No. 9581-002-11

ANCHORAGE
ATLANTA
CHICAGO
CINCINNATI
DENVER
FAIRBANKS
HONOLULU
HOUSTON
WASHINGTON, D. C.
LOS ANGELES
NEW YORK
PHOENIX
PORTLAND
SALT LAKE CITY
SAN FRANCISCO
SANTA BARBARA
SEATTLE

DAMES & MOORE

CONSULTANTS IN THE ENVIRONMENTAL AND APPLIED EARTH SCIENCES

CALGARY
GUAM
JAKARTA
JOHANNESBURG
LAGOS
LONDON
MADRID
VANCOUVER, B. C.
PERTH
SEOUL
SINGAPORE
SYDNEY
TEHRAN
TORONTO
TOKYO

2875 SOUTH KING STREET · HONOLULU, HAWAII 96814 · (808) 946-1455
CABLE: DAMEMORE
TELEX: 63-4100

March 8, 1974

Crown Corporation
1600 Kapiolani Boulevard
17th Floor
Honolulu, Hawaii 96814

Attention: Mr. Henry Gomes

Gentlemen:

Enclosed herewith are four copies of our report entitled "Subsurface Investigation, Proposed Site Development in Church area, Waipahu, Oahu, Hawaii for Crown Corporation".

This investigation is performed in general accordance with the second item in our proposal dated December 5, 1973, which was accepted on December 26, 1973. For convenient reference, a brief summary of our recommendations is presented on the first page of the report, and our findings are discussed in detail in the body of the report. A description of our field exploration procedures and the results of our laboratory testing program are presented in the Appendix.

Samples of subsurface materials recovered at the site, which were not used in laboratory testing, are being stored in our office for possible future inspection and examination. Generally, these samples would be stored for a period of six months from the date of this report, after which time the samples are discarded. However, the period of storage may be extended at your request.

It has been a pleasure performing this investigation for you. Should you have any questions concerning the contents of this report, please contact us.

Yours very truly,

DAMES & MOORE

Howard Schirmer Jr.

Howard Schirmer, Jr.

HAS:WWC:gn
cc: William Hee & Associates, Inc. (2)

SUBSURFACE INVESTIGATION

PROPOSED SITE DEVELOPMENT IN CHURCH AREA

WAIPAHU, OAHU, HAWAII

FOR

CROWN CORPORATION

SUMMARY

From the soils standpoint, the former church site can be developed for the proposed residential/light industrial use; however, there are some significant problems which must be overcome. The anticipated major site problems include potential large differential and long-term settlements, due to soft compressible subsoils.

Site grading will require stripping of approximately six inches of topsoil in most areas. Final mass fill grade should be designed to maintain desired surface gradients after settlement is complete.

INTRODUCTION

This report presents the results of our subsurface investigation for the parcel of land being considered for development at the southwestern end of Mokuola Street in Waipahu, Oahu, Hawaii, which is presently used by the Waipahu United Church of Christ. The general location of the site is shown on the Map of Area, Plate 1.

The purpose of this investigation was to evaluate subsurface conditions at the parcel and to provide design information for the proposed site development for future residential and/or light industrial use.

It is our understanding that this parcel of land would be graded to become a part of a 30-acre development. The site grade would range up to about Elevation 14 and loads from light industrial building would probably be 500 pounds per square foot of building areas. Roadways and related buried utilities would be constructed to serve the future improvement.

SITE CONDITIONS

The topography of the site is relatively level, with a range of elevations from approximately 9 feet to 11 feet above Mean Sea Level. The southern third of the site has an embankment of approximately three feet above the remainder of ground surface. The site is being occupied by a one-story, block-tile building (church); two quonset huts and a one-story, wood-frame house. Approximately two-thirds of the site is covered with short lawn grass and other cultivated vegetation while the remainder of the ground surface is nearly bare. Monkeypod, banyan, halekoa, fruit and flower trees are scattered throughtout the site.

During heavy showers at the site, it was observed that water ponded in the area between the playground and the church building near the existing house. As a consequence, this area and surrounding areas nearby became very wet and soft.

The site is located in the area of geologically recent stream and marine deposits overlying soils of volcanic origin. The subsurface conditions at the site were physically investigated by drilling three borings at the locations shown on the Plot Plan, Plate 2. A more detailed description of our field exploration and the results of laboratory tests are contained in the Appendix of this report.

From our exploration, the subsurface conditions may be described as consisting of a surface layer of artificial fill over a thick deposit of soft marine clayey silt which in turn is underlain by residual soils of volcanic origin. The artificial fill at the ground surface is a layer of reddish-brown silt about 3 feet to 10 feet thick and is generally soft to medium stiff. The soft marine clayey silt deposit is very compressible, slightly organic, dark gray in color and extends to depths of about 45 feet. The soft clayey silt stratum is underlain by a moderately stiff to stiff residual soil, which extends to the maximum depth of our borings.

The water level was measured in all three borings and was found to vary considerably during the course of a day. A slight artesian groundwater condition was encountered in that each penetrated the soft silt layer boring, and the hydraulic head elevated water to about 0.7 feet above the existing ground level (measured in the casing for the borings). After the casing was removed from the borings, the water level dropped to about 1.5 feet below ground surface or about Elevation 9. It is believed that the actual water surface in the existing fill would be encountered at about Elevation 6. The higher measured level is believed to have been influenced by the artesian pressure near the base of the borings.

DISCUSSIONS AND RECOMMENDATIONS

From a foundation standpoint, it is believed that the site may be feasibly developed for the proposed residential and/or light industrial use. Large potential differential settlements occurring over the long term comprises the major foundation problems anticipated. These problems may be, in part, overcome by a carefully executed grading and surcharging program. It is our understanding that this parcel of land will be a part of the over-all planned development. Therefore, our discussions and recommendations regarding site grading, surcharge programs and potential settlements are presented in more detail in the report covering the overall site development. Only the general discussions and recommendations related to this particular parcel are presented in the following paragraphs.

ANTICIPATED SETTLEMENTS

Large settlements at the site are anticipated due to the presence of the extensive deposit of compressible soft clayey silt underlying the site. The amounts of settlements resulting from site grading will vary generally with the fill thickness required and the thickness of underlying compressible silt.

For example, in areas of relatively thick proposed fill, as in the vicinity of Boring D, where fill would be about 4 feet and compressible soil about 40 feet thick, settlement on the order of 1½ feet is anticipated. The rate of settlement would be relatively slow because of the composition of the compressible soils. It is believed that only about 45 percent of the settlement will occur within 6 months after the fill is placed.

Generally, for a tentative design grade of Elevation 14, the anticipated total settlements would range from 12 inches to 20 inches, due to the weight of new fill required to grade the area. Additional settlements of 5 inches to 8 inches are anticipated due to loads from light industrial use.

SURCHARGE PROGRAMS

One way of reducing the potential adverse effects of continuing long-term settlements is to surcharge the site immediately after mass grading. We recommend that a surcharge fill with a height of at least five feet be placed over the entire parcel. It is expected that a five-foot surcharge over the final site grade will produce in six months to a year a settlement nearly equivalent to the total settlement anticipated under the mass fill loads. However, for the additional settlements anticipated due to loading under light industrial use, additional surcharge loads would be required. It would be desirable to define imposed building loads and building limits so that the extent of additional surcharge loads could be minimized.

It is also recommended that settlement gauges be placed in selected locations and the changes in their elevations be observed to monitor the actual settlement pattern during and after construction. Preliminary recommendations regarding the location, placement and tentative schedule for reading of such settlement gauges were presented in our letter dated February 13, 1974.

EARTHWORK

It is recommended that prior to grading, the entire area be stripped of vegetation and topsoil. For much of the site, a removal of six inches of the surface materials would be sufficient. The entire area to be developed should be proof-rolled after stripping with a roller weighing at least 30 tons. The soft spots disclosed during proof-rolling should be repaired by replacing all soft soils with compacted fill.

The exact extent of grading is not yet known. It is anticipated that the final grade would be about Elevation 14. However, the final construction grades should be so selected to provide adequate compensation for the potential settlement. As long-term settlements are anticipated, it is conceivable that the area will continue to subside slowly under the weight of the existing fill and structures.

Drainage requirements may dictate that more fill be placed in one location than in the other to preserve surface gradients. Consultation has been provided to the civil engineer for the preliminary grading of the site. Generally, the construction of underground utilities should be delayed as much as practical as differential settlement would tend to cause damage to these lines.

Anticipated settlement, foundation construction, and other pertinent information will be discussed further in the forthcoming soils and site investigation report which would cover the entire development.

- oOo -

The following Plates and Appendix are attached and complete this report.

Plate 1 - Map of Area

Plate 2 - Plot Plan

Appendix - Field Exploration and Laboratory Testing

Respectfully submitted,

DAMES & MOORE

Howard Schirmer Jr.

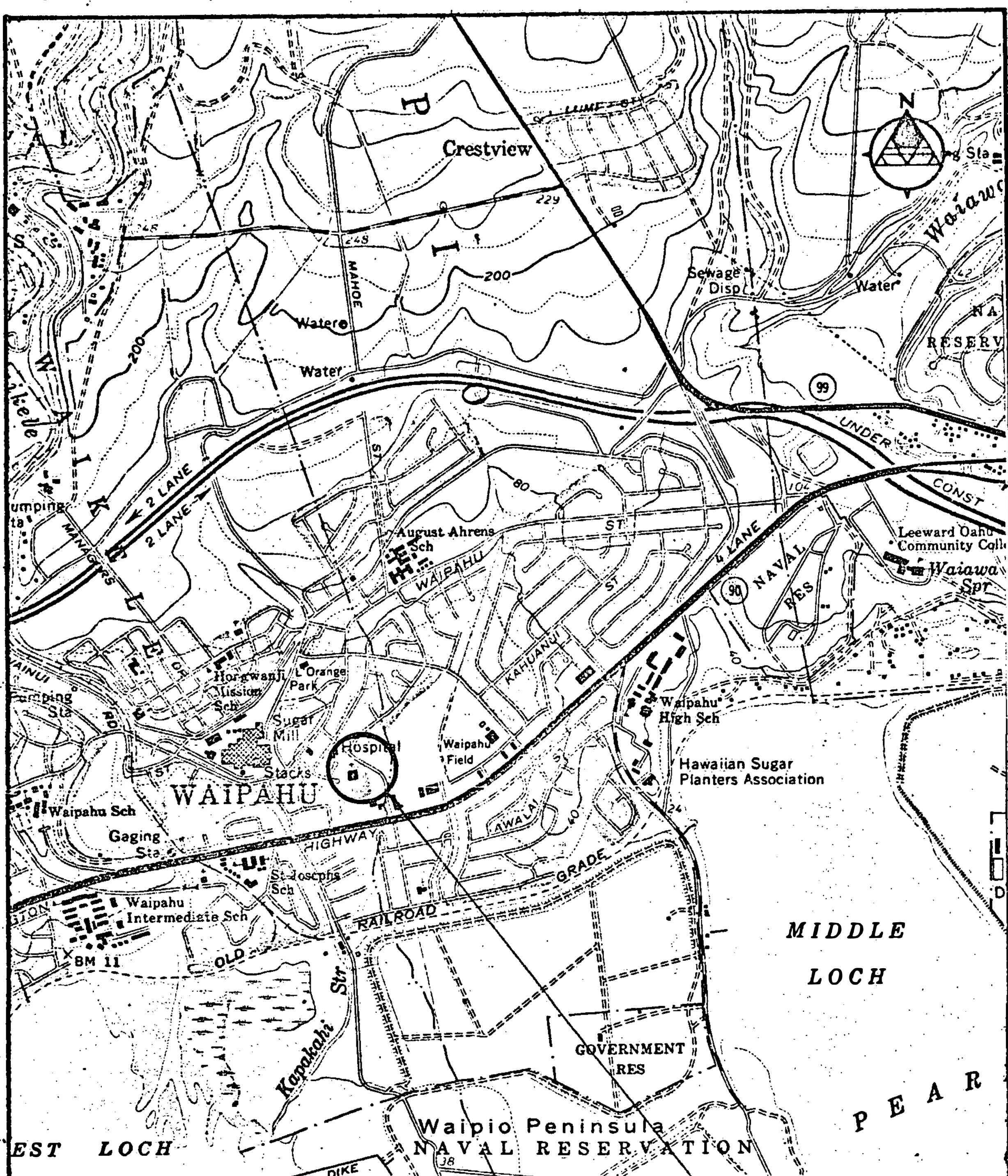
Howard Schirmer, Jr.

HOWARD SCHIRMER, JR.
REGISTERED
ENGINEER
No. 2228
HAWAII, U.S.A.

WORK

Howard Schirmer Jr.

Cuss No. 43298



GENERAL LOCATION OF SITE AS SHOWN ON PLOT PLAN

MAP OF AREA

SCALE 1:24000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

REFERENCE:
U.S.G.S. TOPOGRAPHIC MAP
WAIPAHU, HAWAII
DATED 1968

DAMES & MOORE

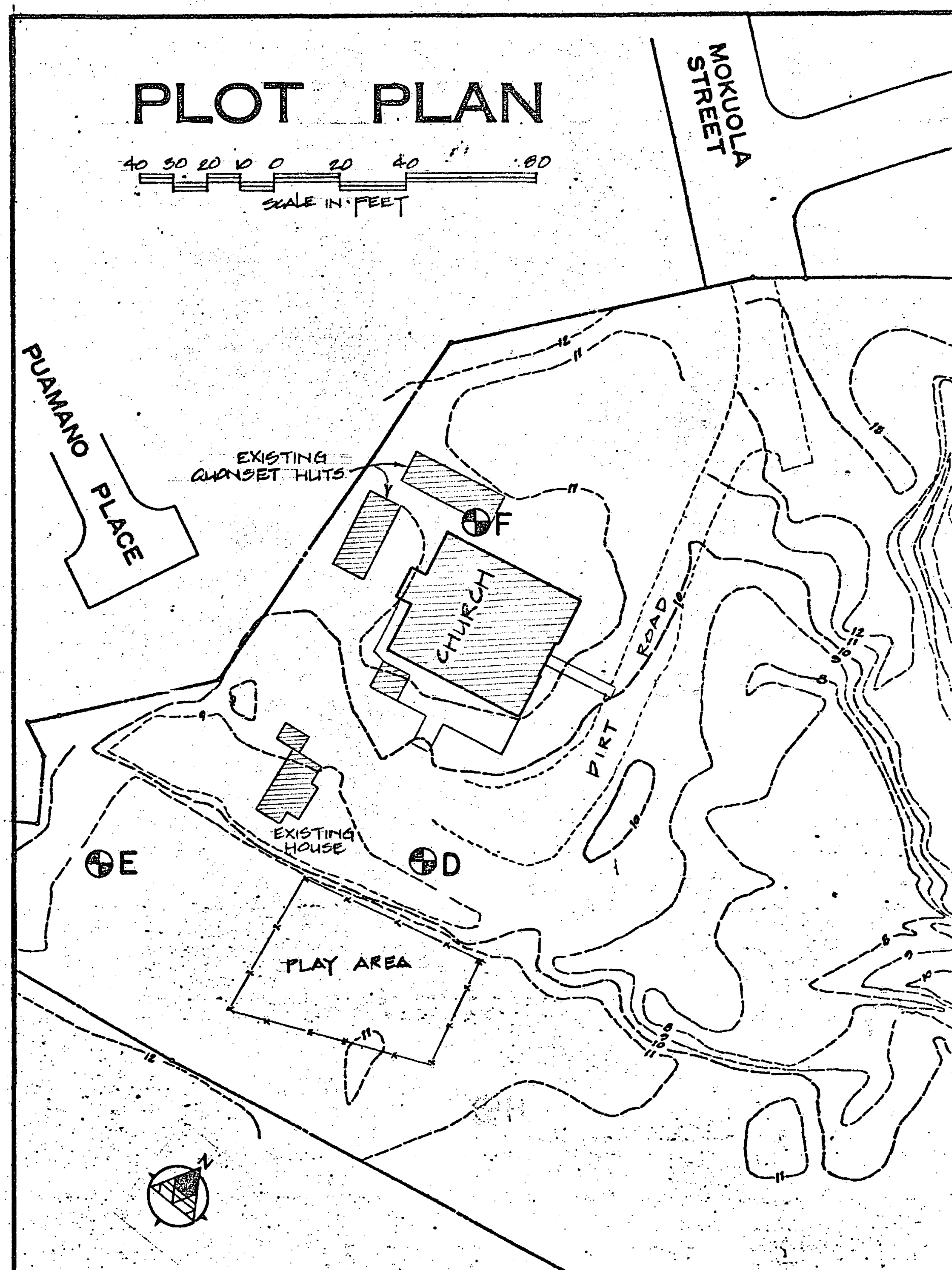
PLATE 1

REVISIONS BY DATE

FILE 9581-002

DATE 8.74 CHECKED BY SKC

946.7 (REV. 6-61)



REFERENCE:
TOPOGRAPHIC AND CONTOUR MAP OF
CROWN CENTER, WAIPAHU
BY WILLIAM HEE & ASSOC., INC.
DATED DECEMBER 17, 1973, REVISED

DAMES & MOORE
PLATE 2

APPENDIX

FIELD EXPLORATION AND LABORATORY TESTING

FIELD EXPLORATION

The subsurface soil conditions beneath the site were investigated by drilling three borings at the locations shown on the Plot Plan, Plate 2. The depth of borings ranged from 36.5 feet to 51.5 feet, and extended to what was believed to be residual silty soils formed from decomposed volcanics. All borings were drilled using a truck-mounted, power-driven, rotary wash-type rig from our subcontractor, Continental Drilling Company.

All explorations were performed under the technical supervision of one of our engineers, who classified the various materials encountered including samples extracted from the borings. Relatively undisturbed samples were obtained using the sampling equipment illustrated on Exhibits A-1 and A-2. Descriptions of the materials encountered are presented on the Logs of Borings, Plates A-1A through A-1C. The soils were classified in accordance with the Unified Soil Classification System, as described on Plate A-2.

Water level readings were taken in each boring for a period of time and some artesian condition observed. The water levels observed, presented on the Logs of Borings, are those taken after the borings completed and the effect of the drilling water had dissipated.

LABORATORY TESTING

Selected undisturbed samples were subjected to laboratory tests to determine their physical characteristics, including strength, compressibility properties, and dry densities. Descriptions of the various laboratory tests and their results are presented below.

Atterberg Limits - An Atterberg Limits determination was conducted to aid in classifying the soil. The results of the test are presented below.

BORING NO.	DEPTH (ft.)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	UNIFIED SOIL CLASSIFICATION
E	6	79.0	49.0	30.0	MH

Triaxial Tests - Triaxial strength tests were performed on relatively undisturbed samples of residual stiff silt to evaluate strength characteristics. Descriptions of the testing procedure and the equipment employed are presented in Exhibit A-3. The tests were performed under unconsolidated-undrained conditions at the natural moisture content as described in the exhibit except that the confining pressures imposed on the sample were increased in three increments during the test. Three corresponding valves of peak compressive stresses were obtained. The results of these strength tests are tabulated below.

BORING NO.	DEPTH (ft.)	CONFINING PRESSURE (psf)	PEAK COMPRESSIVE STRESS (psf)
E	50.8	1,500	1,560
E	50.8	2,500	1,780
E	50.8	3,500	1,940
F	35.0	1,000	950
F	35.0	2,000	970
F	35.0	3,000	1,000

Consolidation Tests - Consolidation tests were performed on samples of the compressible material, and the results are presented on Plate A-3. The test results were used to evaluate probable settlement under anticipated fill loadings. The tests were performed in accordance with the procedure described on Exhibit A-4, Method of Performing Consolidation Tests.

Moisture and Dry Density Tests - Moisture and dry density tests were performed for correlation purposes. Borings at the appropriate depths.

- oOo -

The following Plates and Exhibits are attached and complete this Appendix.

Exhibit A-1 - Soil Sampler, Type U

Exhibit A-2 - Piston Sampler

Exhibit A-3 - Method of Performing Unconfined Compression and Triaxial Compression Tests

Exhibit A-4 - Method of Performing Consolidation Tests

Plate A-1A - Log of Borings, Boring D

Plate A-1B - Log of Borings, Boring E

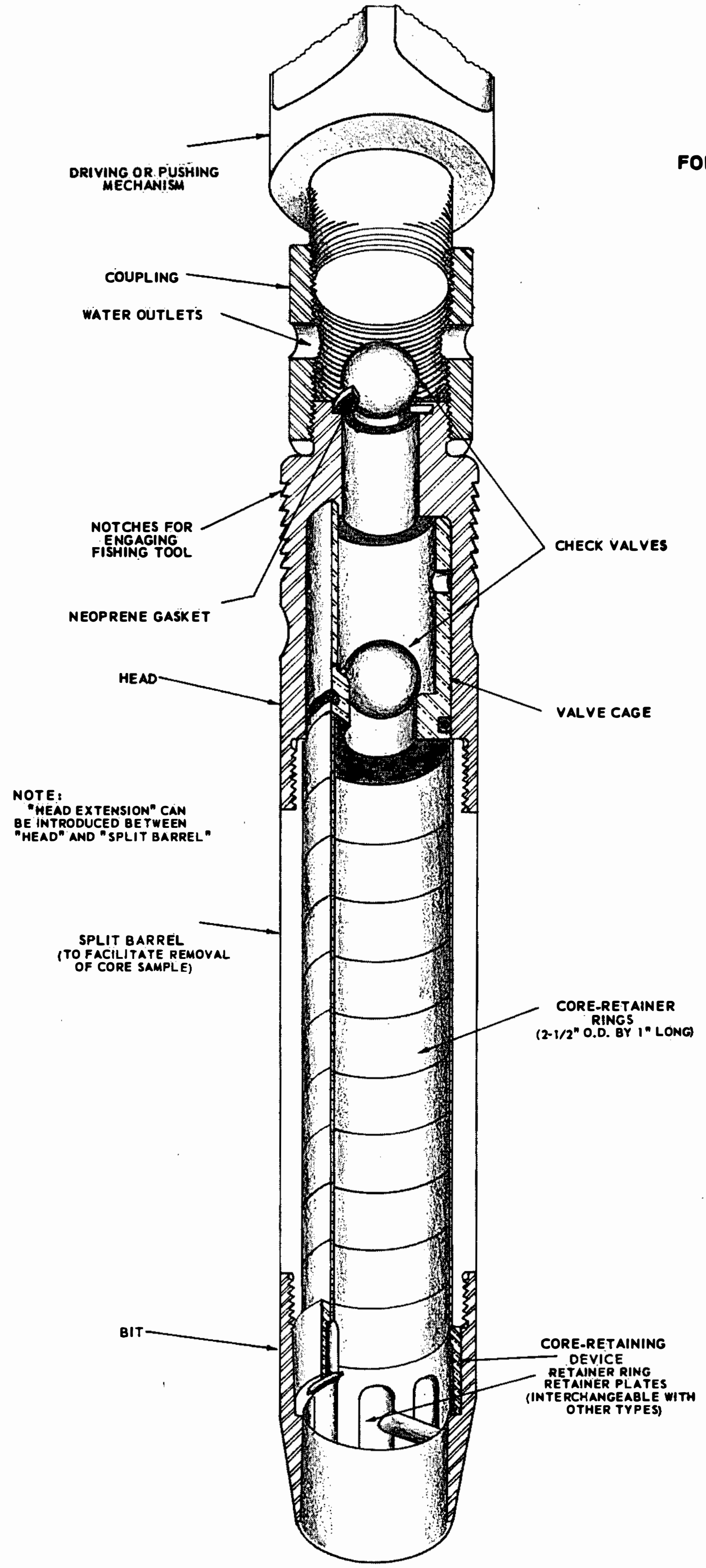
Plate A-1C - Log of Borings, Boring F

Plate A-2 - Unified Soil Classification System

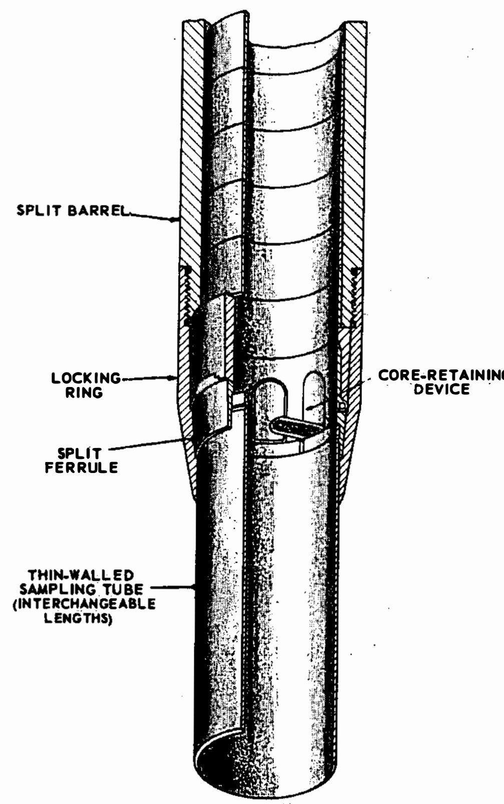
Plate A-3 - Consolidation Test Data

SOIL SAMPLER TYPE U

FOR SOILS DIFFICULT TO RETAIN IN SAMPLER



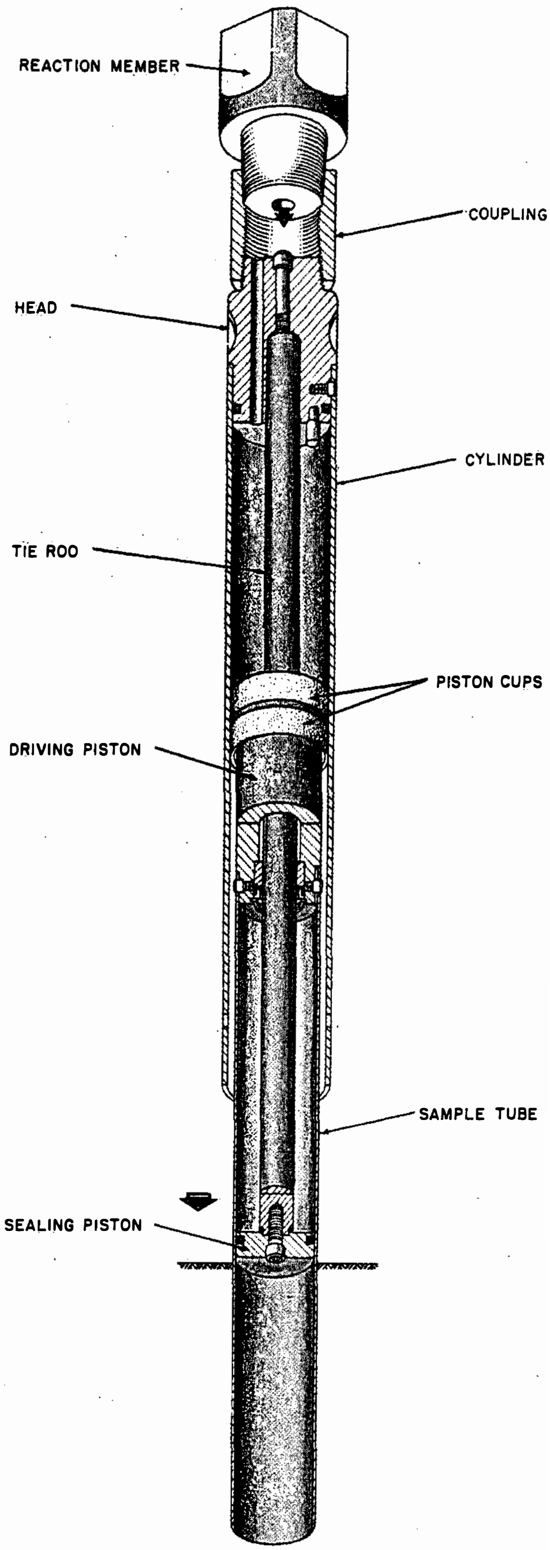
ALTERNATE ATTACHMENTS



417.9 (5-68)

DAMES & MOORE

Exhibit A-1



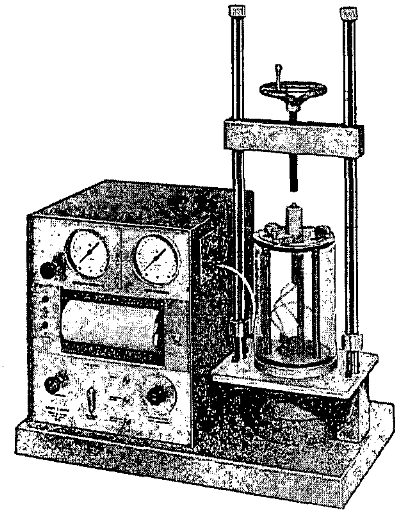
PISTON SAMPLER

THE DAMES & MOORE PISTON SAMPLER HAS BEEN DEVELOPED TO OBTAIN SAMPLES OF SOFT SOILS WITH A MINIMUM OF DISTURBANCE. THE MOST SIGNIFICANT FEATURES ARE THE SEALING PISTON WHICH CONFINES THE SOIL DURING SAMPLING AND THE SAMPLE TUBE WHICH HAS A WALL THICKNESS OF ONLY 0.042 INCHES.

AT THE START OF THE SAMPLING, THE LOWER END OF THE SAMPLE TUBE IS ADJACENT TO THE SEALING PISTON AT THE BOTTOM OF AN EXPLORATION TEST BORING. THE SEALING PISTON, CYLINDER, HEAD, AND REACTION MEMBER REMAIN STATIONARY DURING SAMPLING. COMPRESSED AIR, COMPRESSED NITROGEN, OR WASH WATER ARE FORCED INTO THE CYLINDER THROUGH THE SAMPLING RODS FROM THE DRILLING EQUIPMENT. THE DRIVING PISTON MOVES THE SAMPLE TUBE DOWNWARD INTO THE SOIL.

METHODS OF PERFORMING UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS

THE SHEARING STRENGTHS OF SOILS ARE DETERMINED FROM THE RESULTS OF UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS. IN TRIAXIAL COMPRESSION TESTS THE TEST METHOD AND THE MAGNITUDE OF THE CONFINING PRESSURE ARE CHOSEN TO SIMULATE ANTICIPATED FIELD CONDITIONS.



TRIAXIAL COMPRESSION TEST UNIT

UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS ARE PERFORMED ON UNDISTURBED OR REMOLDED SAMPLES OF SOIL APPROXIMATELY SIX INCHES IN LENGTH AND TWO AND ONE-HALF INCHES IN DIAMETER. THE TESTS ARE RUN EITHER STRAIN-CONTROLLED OR STRESS-CONTROLLED. IN A STRAIN-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO A CONSTANT RATE OF DEFLECTION AND THE RESULTING STRESSES ARE RECORDED. IN A STRESS-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO EQUAL INCREMENTS OF LOAD WITH EACH INCREMENT BEING MAINTAINED UNTIL AN EQUILIBRIUM CONDITION WITH RESPECT TO STRAIN IS ACHIEVED.

YIELD, PEAK, OR ULTIMATE STRESSES ARE DETERMINED FROM THE STRESS-STRAIN PLOT FOR EACH SAMPLE AND THE PRINCIPAL STRESSES ARE EVALUATED. THE PRINCIPAL STRESSES ARE PLOTTED ON A MOHR'S CIRCLE DIAGRAM TO DETERMINE THE SHEARING STRENGTH OF THE SOIL TYPE BEING TESTED.

UNCONFINED COMPRESSION TESTS CAN BE PERFORMED ONLY ON SAMPLES WITH SUFFICIENT COHESION SO THAT THE SOIL WILL STAND AS AN UNSUPPORTED CYLINDER. THESE TESTS MAY BE RUN AT NATURAL MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SOILS.

IN A TRIAXIAL COMPRESSION TEST THE SAMPLE IS ENCASED IN A RUBBER MEMBRANE, PLACED IN A TEST CHAMBER, AND SUBJECTED TO A CONFINING PRESSURE THROUGHOUT THE DURATION OF THE TEST. NORMALLY, THIS CONFINING PRESSURE IS MAINTAINED AT A CONSTANT LEVEL, ALTHOUGH FOR SPECIAL TESTS IT MAY BE VARIED IN RELATION TO THE MEASURED STRESSES. TRIAXIAL COMPRESSION TESTS MAY BE RUN ON SOILS AT FIELD MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SAMPLES. THE TESTS ARE PERFORMED IN ONE OF THE FOLLOWING WAYS:

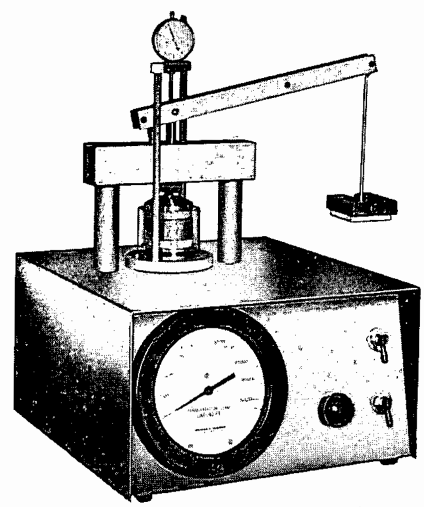
> UNCONSOLIDATED-UNDRAINED: THE CONFINING PRESSURE IS IMPOSED ON THE SAMPLE AT THE START OF THE TEST. NO DRAINAGE IS PERMITTED AND THE STRESSES WHICH ARE MEASURED REPRESENT THE SUM OF THE INTERGRANULAR STRESSES AND PORE WATER PRESSURES.
>
> CONSOLIDATED-UNDRAINED: THE SAMPLE IS ALLOWED TO CONSOLIDATE FULLY UNDER THE APPLIED CONFINING PRESSURE PRIOR TO THE START OF THE TEST. THE VOLUME CHANGE IS DETERMINED BY MEASURING THE WATER AND/OR AIR EXPELLED DURING CONSOLIDATION. NO DRAINAGE IS PERMITTED DURING THE TEST AND THE STRESSES WHICH ARE MEASURED ARE THE SAME AS FOR THE UNCONSOLIDATED-UNDRAINED TEST.
>
> DRAINED: THE INTERGRANULAR STRESSES IN A SAMPLE MAY BE MEASURED BY PERFORMING A DRAINED, OR SLOW, TEST. IN THIS TEST THE SAMPLE IS FULLY SATURATED AND CONSOLIDATED PRIOR TO THE START OF THE TEST. DURING THE TEST, DRAINAGE IS PERMITTED AND THE TEST IS PERFORMED AT A SLOW ENOUGH RATE TO PREVENT THE BUILDUP OF PORE WATER PRESSURES. THE RESULTING STRESSES WHICH ARE MEASURED REPRESENT ONLY THE INTERGRANULAR STRESSES. THESE TESTS ARE USUALLY PERFORMED ON SAMPLES OF GENERALLY NON-COHESIVE SOILS, ALTHOUGH THE TEST PROCEDURE IS APPLICABLE TO COHESIVE SOILS IF A SUFFICIENTLY SLOW TEST RATE IS USED.

AN ALTERNATE MEANS OF OBTAINING THE DATA RESULTING FROM THE DRAINED TEST IS TO PERFORM AN UNDRAINED TEST IN WHICH SPECIAL EQUIPMENT IS USED TO MEASURE THE PORE WATER PRESSURES. THE DIFFERENCES BETWEEN THE TOTAL STRESSES AND THE PORE WATER PRESSURES MEASURED ARE THE INTERGRANULAR STRESSES.

METHOD OF PERFORMING CONSOLIDATION TESTS

CONSOLIDATION TESTS ARE PERFORMED TO EVALUATE THE VOLUME CHANGES OF SOILS SUBJECTED TO INCREASED LOADS. TIME-CONSOLIDATION AND PRESSURE-CONSOLIDATION CURVES MAY BE PLOTTED FROM THE DATA OBTAINED IN THE TESTS. ENGINEERING ANALYSES BASED ON THESE CURVES PERMIT ESTIMATES TO BE MADE OF THE PROBABLE MAGNITUDE AND RATE OF SETTLEMENT OF THE TESTED SOILS UNDER APPLIED LOADS.

EACH SAMPLE IS TESTED WITHIN BRASS RINGS TWO AND ONE-HALF INCHES IN DIAMETER AND ONE INCH IN LENGTH. UNDISTURBED SAMPLES OF IN-PLACE SOILS ARE TESTED IN RINGS TAKEN FROM THE SAMPLING DEVICE IN WHICH THE SAMPLES WERE OBTAINED. LOOSE SAMPLES OF SOILS TO BE USED IN CONSTRUCTING EARTH FILLS ARE COMPACTED IN RINGS TO PREDETERMINED CONDITIONS AND TESTED.



DEAD LOAD-PNEUMATIC CONSOLIDOMETER

IN TESTING, THE SAMPLE IS RIGIDLY CONFINED LATERALLY BY THE BRASS RING. AXIAL LOADS ARE TRANSMITTED TO THE ENDS OF THE SAMPLE BY POROUS DISKS. THE DISKS ALLOW DRAINAGE OF THE LOADED SAMPLE. THE AXIAL COMPRESSION OR EXPANSION OF THE SAMPLE IS MEASURED BY A MICROMETER DIAL INDICATOR AT APPROPRIATE TIME INTERVALS AFTER EACH LOAD INCREMENT IS APPLIED. EACH LOAD IS ORDINARILY TWICE THE PRECEDING LOAD. THE INCREMENTS ARE SELECTED TO OBTAIN CONSOLIDATION DATA REPRESENTING THE FIELD LOADING CONDITIONS FOR WHICH THE TEST IS BEING PERFORMED. EACH LOAD INCREMENT IS ALLOWED TO ACT OVER AN INTERVAL OF TIME DEPENDENT ON THE TYPE AND EXTENT OF THE SOIL IN THE FIELD.

FORM NO. 417.3 (Rev. 4-61)

FILE 9581-002
BY [illegible] DATE 2-4-74
CHECKED BY [illegible] DATE

REVISIONS
BY DATE
BY DATE
PLATE OF

BORING D

SURFACE ELEVATION 11 FEET
MSL DATUM

Moisture Content in %	Dry Density in PCF	Blows/Ft. on Sampler	Core and % Recovery	Samples and/or Cores	Depth in Feet	Letter Symbol	Description
					0	MH	Reddish brown silt with gravel, soft to medium stiff (fill)
							▽-Water level at 0750 hours on 1-15-74
							Boulder
		5		■			
					5		
		8		■			
					10		
		1		■		MH-OH	Black clayey silt with decayed vegetation, very soft
61	71	150 PSI		■ *		MH	Black clayey silt, very soft
					15		
		200 PSI		■ *			Grades with some shells
					20		
68	60	150 PSI		■ *			
							Some decayed vegetation
					25		
		100 PSI		■ *			
					30		
124	38	125 PSI		■ *			
					35		
		200 PSI		■ *			
					40	MH	Brown clayey silt with occasional gravel, medium stiff
51	71	11		■			
					45		
		83/11"		□			Boulder
							Grades stiff
		37		■	50		

Boring completed at 50.5 feet on 1-11-74

LOG OF BORINGS

NOTES:
■ -Depth at which undisturbed sample was taken
⊠ -Depth at which disturbed sample was taken
□ -Depth at which sample was lost during extraction
I -Depth and length of core run
Driving Energy- 300 -lb weight dropping 30 inches
* - Piston Sampler

FILE 9581-002
BY [illegible] DATE 2-11-74
CHECKED BY SKC DATE

REVISIONS
BY ___ DATE ___
BY ___ DATE ___
PLATE ___ OF ___

BORING E

SURFACE ELEVATION 9 ± FEET
MSL DATUM

MOISTURE CONTENT IN %	DRY DENSITY IN PCF	BLOWS/FT. ON SAMPLER	CORE AND % RECOVERY	SAMPLES AND/OR CORES	DEPTH IN FEET	LETTER SYMBOL	DESCRIPTION
					0	ML-MH	BROWN CLAYEY SILT, SOFT (FILL) WATER LEVEL AT 0710 HOURS ON 1-8-74
						MH	REDDISH BROWN CLAYEY SILT, SOFT TO MEDIUM STIFF OCCASIONAL GRAVEL AND ROOTS (FILL)
		6		■			
						MH-OH	DARK GRAY CLAYEY SILT WITH ROOTS, SOFT
					5		
74	58	1		■			
						MH	DARK GRAY CLAYEY SILT, VERY SOFT
63	64	250 PSI		■*	10		GRADES SANDY WITH SHELLS
86	52	300 PSI		■*	15		
					20		
		2		■			
80	59	250 PSI		■*	25		
		200 PSI		□*	30		
					35		COLORS BLACK GRADES CLAYEY
73	89	2		■			
					40		
		7		■			
						MH	BROWN CLAYEY SILT, STIFF
45	79	11		■	45		
26	95	15		■	50		

BORING COMPLETED AT 51.5 FEET ON 1-8-74

LOG OF BORINGS

NOTES:
■ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
☒ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
□ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
I -DEPTH AND LENGTH OF CORE RUN
DRIVING ENERGY- 300 -LB WEIGHT DROPPING 30 INCHES
* - PISTON SAMPLER

DAMES & MOORE

466.12 (4-64)

No. 9581-002
BY HW DATE 2-11-74
CHECKED BY WE DATE

REVISIONS
BY DATE
BY DATE

BORING F

SURFACE ELEVATION 11 FEET
MSL DATUM

Moisture Content in %	Dry Density in PCF	Blows/Ft. on Sampler	Core and % Recovery	Samples and/or Cores	Depth in Feet	Letter Symbol	Description
						MH	BROWN CLAYEY SILT WITH SOME COBBLES, MEDIUM STIFF (FILL)
							WATER LEVEL AT 1000 HOURS ON 1-10-74
		7		■			GRADES SOFT TO MEDIUM STIFF, COLORS REDDISH BROWN
					5	MH-PT	BLACK CLAYEY SILT WITH WOOD AND DECOMPOSED VEGETATION, SOFT
194	24	3		■			
						MH	DARK GRAY CLAYEY SILT, VERY SOFT TO SOFT
44	64	250 PSI		■*	10		GRADES SANDY
55	68	250 PSI		■*	15		GRADES CLAYEY
		100 PSI		■*	20		GRADES WITH SHELL FRAGMENTS
65	63	200 PSI		■*	25		
						MH	BROWN CLAYEY SILT, MEDIUM STIFF
49	76	15		■	30		
30	88	19		■	35		

BORING COMPLETED AT 36.5 FEET ON 1-10-74

LOG OF BORINGS

NOTES:
■ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
☒ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
☐ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
I -DEPTH AND LENGTH OF CORE RUN
DRIVING ENERGY- 300 -LB WEIGHT DROPPING 30 INCHES
* - PISTON SAMPLER

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50 % OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50 % OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
MORE THAN 50 % OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICTY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTES:

1. DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE CLASSIFICATIONS.
2. WHEN SHOWN ON THE BORING LOGS, THE FOLLOWING TERMS ARE USED TO DESCRIBE THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE COMPACTNESS OF COHESIONLESS SOILS.

COHESIVE SOILS

	(APPROXIMATE SHEARING STRENGTH IN KSF)
VERY SOFT	LESS THAN .25
SOFT	0.25 TO 0.5
MEDIUM STIFF	0.5 TO 1.0
STIFF	1.0 TO 2.0
VERY STIFF	2.0 TO 4.0
HARD	GREATER THAN 4.0

COHESIONLESS SOILS

VERY LOOSE
LOOSE
MEDIUM DENSE
DENSE
VERY DENSE

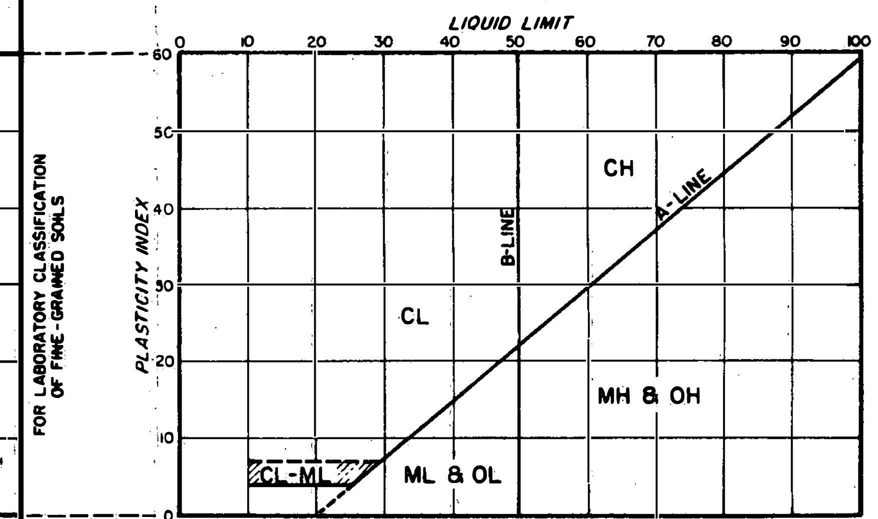
THESE ARE USUALLY BASED ON AN EXAMINATION OF SOIL SAMPLES, PENETRATION RESISTANCE, AND SOIL DENSITY DATA.

GRADATION CHART

MATERIAL SIZE	PARTICLE SIZE			
	LOWER LIMIT		UPPER LIMIT	
	MILLIMETERS	SIEVE SIZE*	MILLIMETERS	SIEVE SIZE*
SAND				
FINE	.074	#200*	0.42	#40*
MEDIUM	0.42	#40*	2.00	#10*
COARSE	2.00	#10*	4.76	#4*
GRAVEL				
FINE	4.76	#4*	19.1	3/4" •
COARSE	19.1	3/4" •	76.2	3" •
COBBLES	76.2	3" •	304.8	12 •
BOULDERS	304.8	12 •	914.4	36"

* U.S. STANDARD • CLEAR SQUARE OPENINGS

PLASTICITY CHART



SAMPLES

- INDICATES UNDISTURBED SAMPLE
- INDICATES DISTURBED SAMPLE
- INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- INDICATES LENGTH OF CORING RUN

NOTE:
DEFINITIONS OF ANY ADDITIONAL DATA REGARDING SAMPLES ARE ENTERED ON THE FIRST LOG ON WHICH THE DATA APPEAR.

UNIFIED SOIL CLASSIFICATION SYSTEM

DAMES & MOORE

PLATE A-2

6.2 (REV. 3-65)

BY ______ DATE ______

CHECKED BY SKC

FILE 9581-002

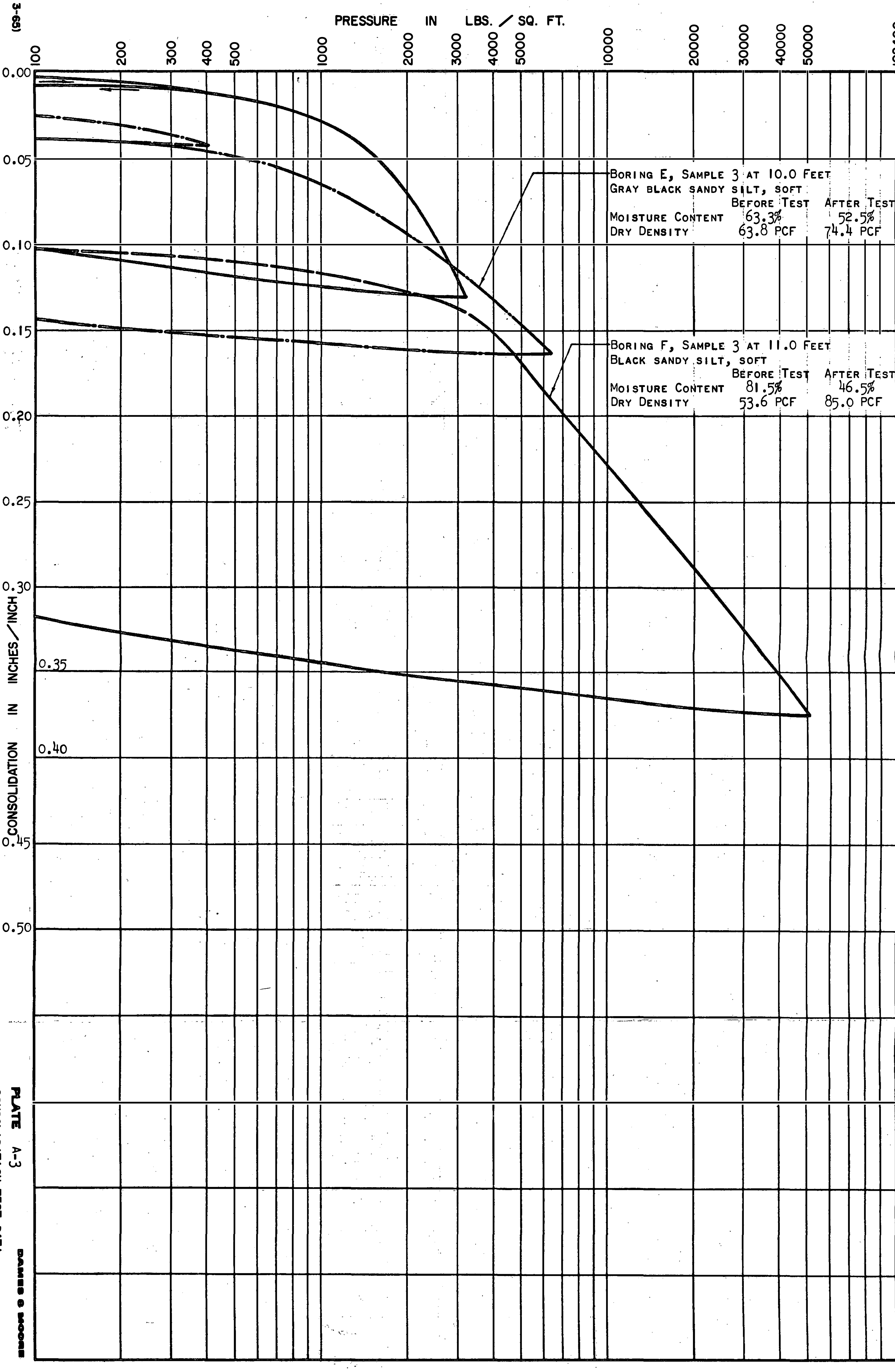


PLATE A-3

CONSOLIDATION TEST DATA

DAMES & MOORE