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REPORT
SOILS INVESTIGATION
MAKAKILO DRIVE V

MAKAKILO, OAHU,
STATE OF HAWAII

for

FINANCE REALTY COMPANY, LTD.

SUNN, LOW, TOM & HARA, INC.
Civil Engineers

March 31, 1975
Project No. H-0034-F

SOILS INTERNATIONAL
Consulting Foundation Engineers & Geologists

MUNICIPAL REFERENCE & RECORDS CENTER

WITHDRAWN

City Hall Annex, 555 Bishop Street
Honolulu, Hawaii 96813

SOILS INTERNATIONAL

CONSULTING FOUNDATION ENGINEERS AND GEOLOGISTS • 2828 Paa Street, Suite 1150, Honolulu, Hawaii 96819 (808) 839-9071
A CORPORATION

HAWAII DIVISION

Honolulu, Hawaii
March 31, 1975

Project No. H-0034-F

Finance Realty Company, Ltd.
P. O. Box 3979
Honolulu, Hawaii 96813

Attention: Mr. Ranceford Yoshida

Gentlemen:

This report presents the data, and pavement design recommendations for the proposed Makakilo Drive Extension V, Stations 102+30 to 135+30, to be located in Makakilo, Oahu, State of Hawaii. The location of the site, relative to the existing streets and landmarks, is shown on the Vicinity Map Plate 1, attached to this report.

SCOPE OF WORK

The investigation included 20 backhoe test pits, from which bulk samples of representative soil types were obtained, laboratory tests on representative samples and finally calculations and recommendations for pavement design, in accordance with the Standards of the City and County of Honolulu.

SITE CONDITIONS

At the time of this investigation, a 16 foot wide portion of the proposed roadway, from station 102+30 to approximately 129+50, had been cleared of vegetation and debris. The remaining portion of the roadway was covered with dense brush and weeds. Elevations range from 897 to 965 feet over the length of the roadway.

FIELD AND LABORATORY INVESTIGATION

The subsurface conditions were explored by means of 20 backhoe pits at the locations shown on Plates 2A, 2B and 2C. The logs of the test pits are presented on Plates 3-A and 3-B, attached.

Representative samples of the subgrade soils were tested to determine classification, expansion and California Bearing Ratio characteristics. These test results are presented on Plate 4, attached.

CONCLUSIONS AND RECOMMENDATIONS

For medium traffic with maximum single axle loads of 24,000 pounds, the pavement design should be based upon the type of soil encountered at the subgrade. Recommended pavement sections for typical soils encountered are as follows:

Subgrade Soil	A. C.	Base	Select Borrow	Borrow
Basalt	2"	6"	0"	0"
Sand (decomposed basalt)	2"	6"	6"	12"
Silt, with sand	2"	6"	6"	6"
Silt (decomposed basalt)	2"	6"	6"	12"
Clay	2"	6"	6"	12"

All basecourse, select borrow, borrow and the subgrade to a depth of 6 inches minimum, shall be compacted to at least ninety-five (95) percent of the maximum dry density as determined by the ASTM D - 1557. Determination of the areas of pavement section shall be made during construction, as the limits of the various soil types are exposed.

Expansive soil to a depth of 8 inches, under sidewalks shall be removed and replaced with non-expansive, compacted soil. The subgrade under sidewalks shall also be pre-saturated prior to the placement of the concrete.

INSPECTION

During the progress of construction, so as to achieve the desired results, it is recommended that the Soils Engineer be present to observe the construction operations, to determine areas of each pavement section and to make tests to indicate compliance with the compaction requirements.

REMARKS

Areas between and beyond explorations are assumed to be consistent with those sampled and tested. While no major changes in strata depths or thicknesses are anticipated, it should be realized that the depths to various soil and/or rock layers will vary over the site, as indicated by the findings.

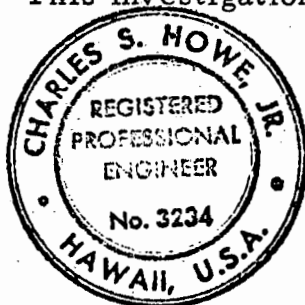
This report has been compiled for the exclusive use of Finance Realty Company, Ltd. It shall not be transferred to or used by a third party or to another project without consent and/or thorough review by this facility.

Should the project be delayed beyond the period of one year from the date of this report, the report shall be reviewed to consider possible changed conditions.

Unless otherwise advised, samples obtained in this investigation will be retained for a period of one month.

This investigation was made in accordance with generally accepted engineering procedures and included such field and laboratory tests considered necessary in the circumstances. In the opinion of the undersigned, the accompanying report has been substantiated by mathematical data in conformity with generally accepted engineering principles and presents fairly the design information requested by your organization.

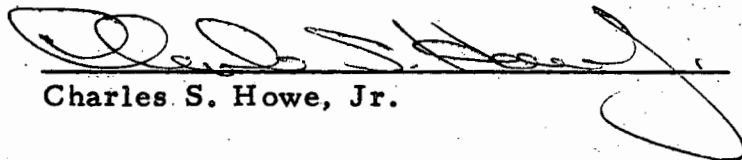
This investigation was performed by me or under my supervision.



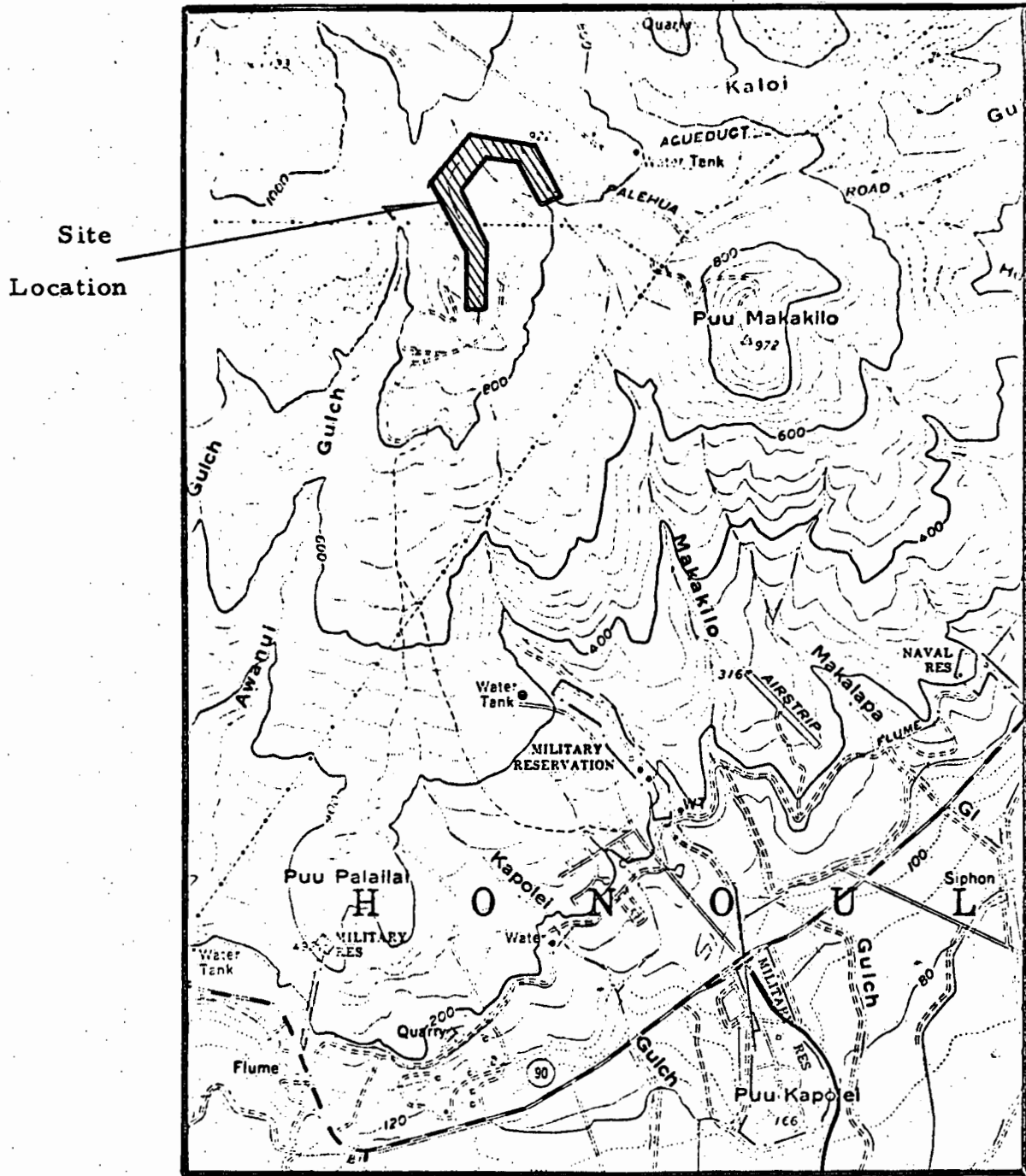
LSS/RDC/CSH/rlk

Very truly yours,

SOILS INTERNATIONAL


Charles S. Howe, Jr.

VICINITY MAP



0 2000 4000
SCALE IN FEET

REFERENCE

USGS Topographic Survey
Ewa, Oahu Quadrangle
Dated 1962

MAKAKILO DRIVE V

PLATE NO 1

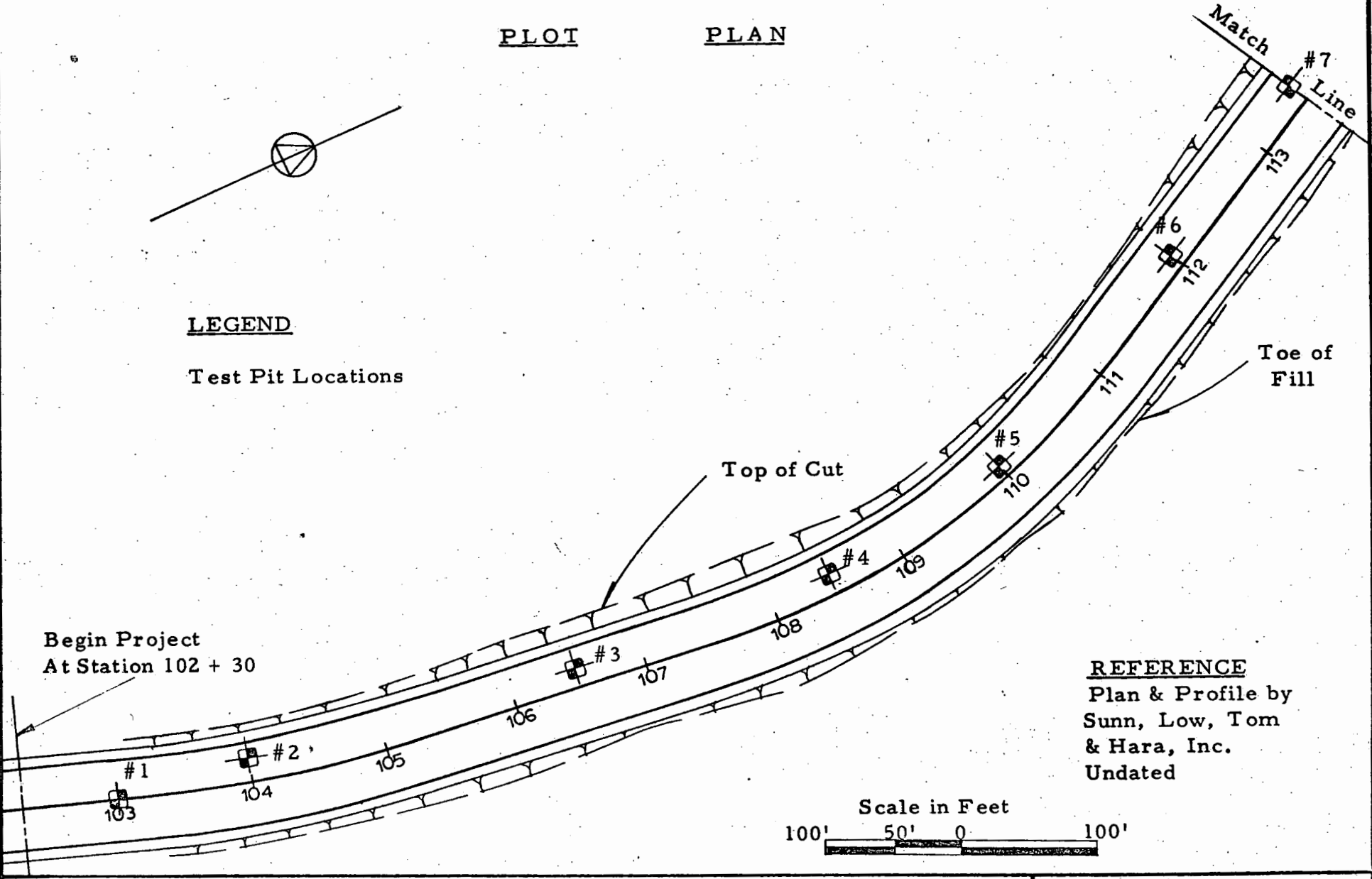
SOILS INTERNATIONAL

FILE NO H-0034-F

PLOT PLAN

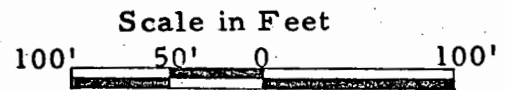
LEGEND

Test Pit Locations



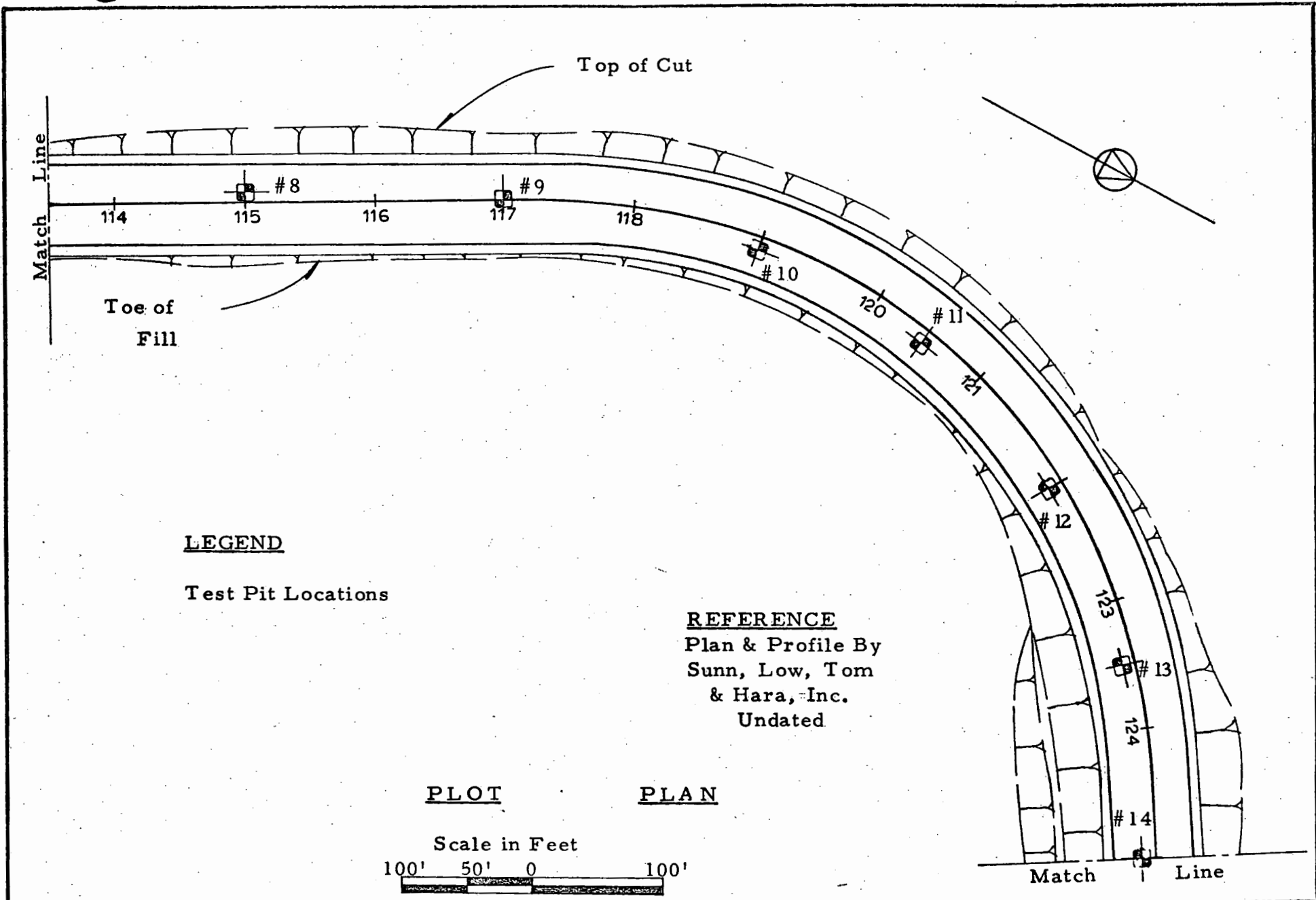
Begin Project
At Station 102 + 30

REFERENCE
Plan & Profile by
Sunn, Low, Tom
& Hara, Inc.
Undated



MAKAKILO DRIVE V
SOILS INTERNATIONAL

PLATE NO. 2-A
FILE NO. H-0034-F

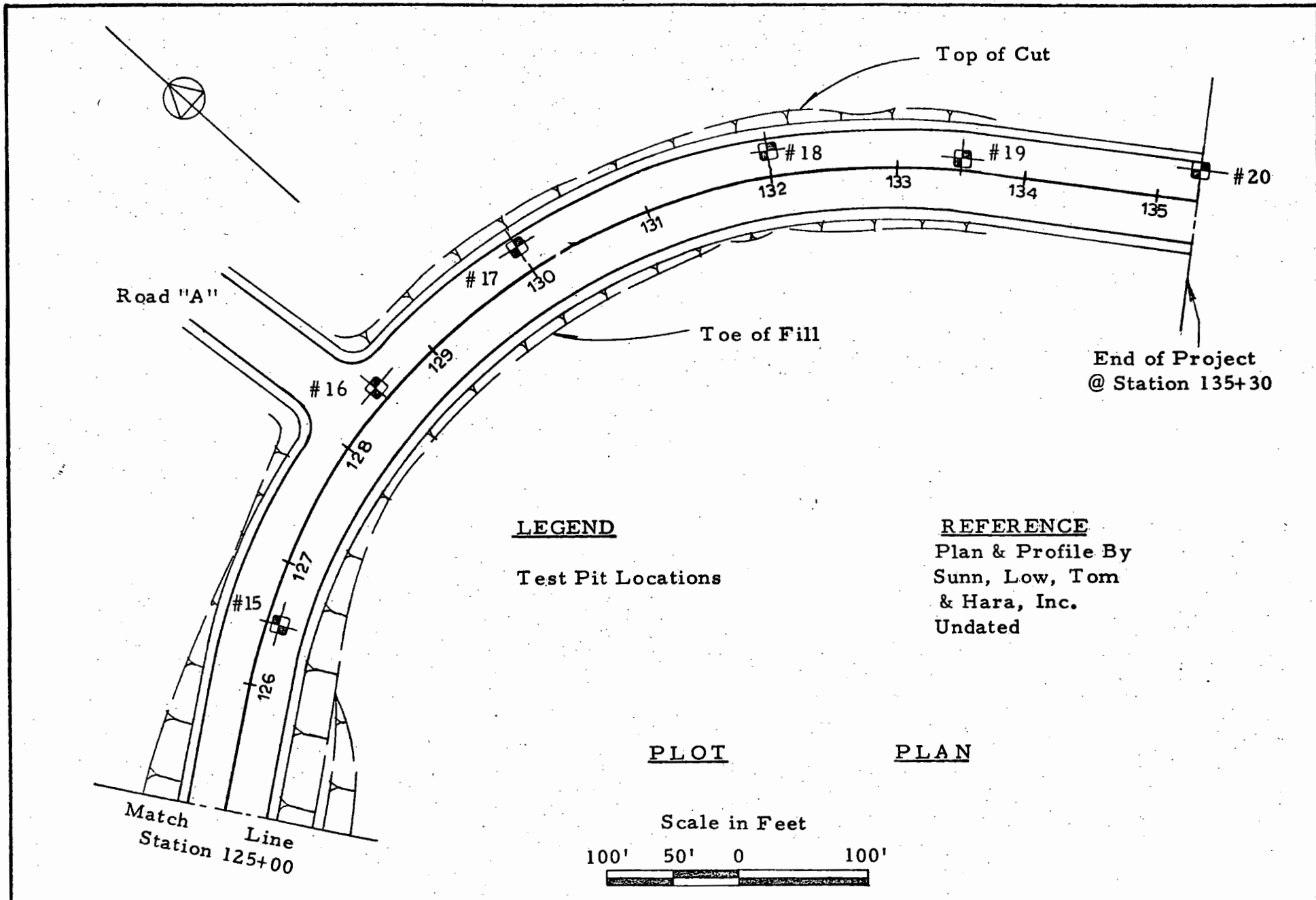


MAKAKILO DRIVE V

SOILS INTERNATIONAL

PLATE NO. 2-B

FILE NO. H-0034-F



MAKAKILO DRIVE V

PLATE NO. 2-C

SOILS INTERNATIONAL

FILE NO. H-0034-F

LOG OF TEST PITS

Test Pit No. 1

Sta 103+00 Elev 917'

0' - 3.0' CLAY, silty, red-brn
3.0' - 5.5' SILT, fine sand, dk-brn
5.5' - 7.0' BASALT, decomposed,
with silt seams

Test Pit No. 2

Sta 105+00 Elev 926'

0' - 5' CLAY, silty, red-brn
5' - 6' SAND, (decomposed
basalt), very silty with
gravel

Test Pit No. 3

Sta 106+50 Elev 931'

0' - 3' CLAY, silty red-brn
3' - 4' BASALT, weathered,
fractured with silt
seams

Test Pit No. 4

Sta 108+50 Elev 933'

0' - 5' CLAY, silty, red-brn
5' - 7' SILT, with fine sand,
7' - 8' SAND, (decomposed
basalt), very silty with
gravel

Test Pit No. 5

Sta 110+00 Elev 933'

0' - 3' SILT, with fine sand,
red-brown
3' - 6' SILT, with fine sand,
red-brown

Test Pit No. 6

Sta 113+00 Elev 937'

0' - 3' SILT, clayey with fine
sand, red-brown
3' - 6' SILT, clayey with fine
sand, red-brown

Test Pit No. 7

Sta 113+50 Elev 945'

0' - 3' CLAY, silty, red-brn
3' - 7' CLAY, silty, greyish-
red-brown
7' - 8' BASALT, weathered,
fractured

Test Pit No. 8

Sta 115+00 Elev 952'

0' - 2' CLAY, silty, red-brn
2' - 6' CLAY, silty, dark red-
brown
6' - 9' CLAY, with decomposed
basalt
9' - 11' SAND, (decomposed basalt)
very silty, with gravel

Test Pit No. 9

Sta 117+00 Elev 955'

0' - 3' CLAY, silty, red-brn
3' - 6' CLAY, silty greyish-red-
brown
6' - 8' CLAY with decomposed
basalt
8' - 9' SAND, (decomposed basalt)
very silty, with gravel

Test Pit No. 10

Sta 119+00 Elev 954'

0' - 3' CLAY, silty, red-grey
3' - 6' SILT, (decomposed basalt)
very sandy with gravel,
light grey

LOG OF TEST PITS

Test Pit No. 11

Sta 120+50 Elev 955'
0' - 6' CLAY, silty, red-brown

Test Pit No. 16

Sta 128+50 Elev 961'
0' - 5' CLAY, silty, dark red-brown
5' - 8' CLAY, with boulders

Test Pit No. 12

Sta 122+00 Elev 955'
0' - 3' CLAY, silty red-brown

Test Pit No. 17

Sta 130+00 Elev 953'
0' - 8' CLAY, silty red-brown

Test Pit No. 13

Sta 123+50 Elev 958'
0' - 2' CLAY, silty red-brn
2' - 3' CLAY, with decomposed basalt

Test Pit No. 18

Sta 132+00 Elev 936'
0' - 6' CLAY, silty, red-brn
6' - 8' CLAY, with boulders
8' - 8.5' BASALT, weathered, fractured.

Test Pit No. 14

Sta 125+00 Elev 961'
0' - 3' CLAY, silty with fine sand, red-brown

Test Pit No. 19

Sta 133+50 Elev 920'
0' - 5' CLAY, silty, red-brown
5' - 6' CLAY, silty, dark-red-brown

Test Pit No. 15

Sta 126+50 Elev 961'
0' - 3' CLAY, silty, with fine sand, red-brown and grey

Test Pit No. 20

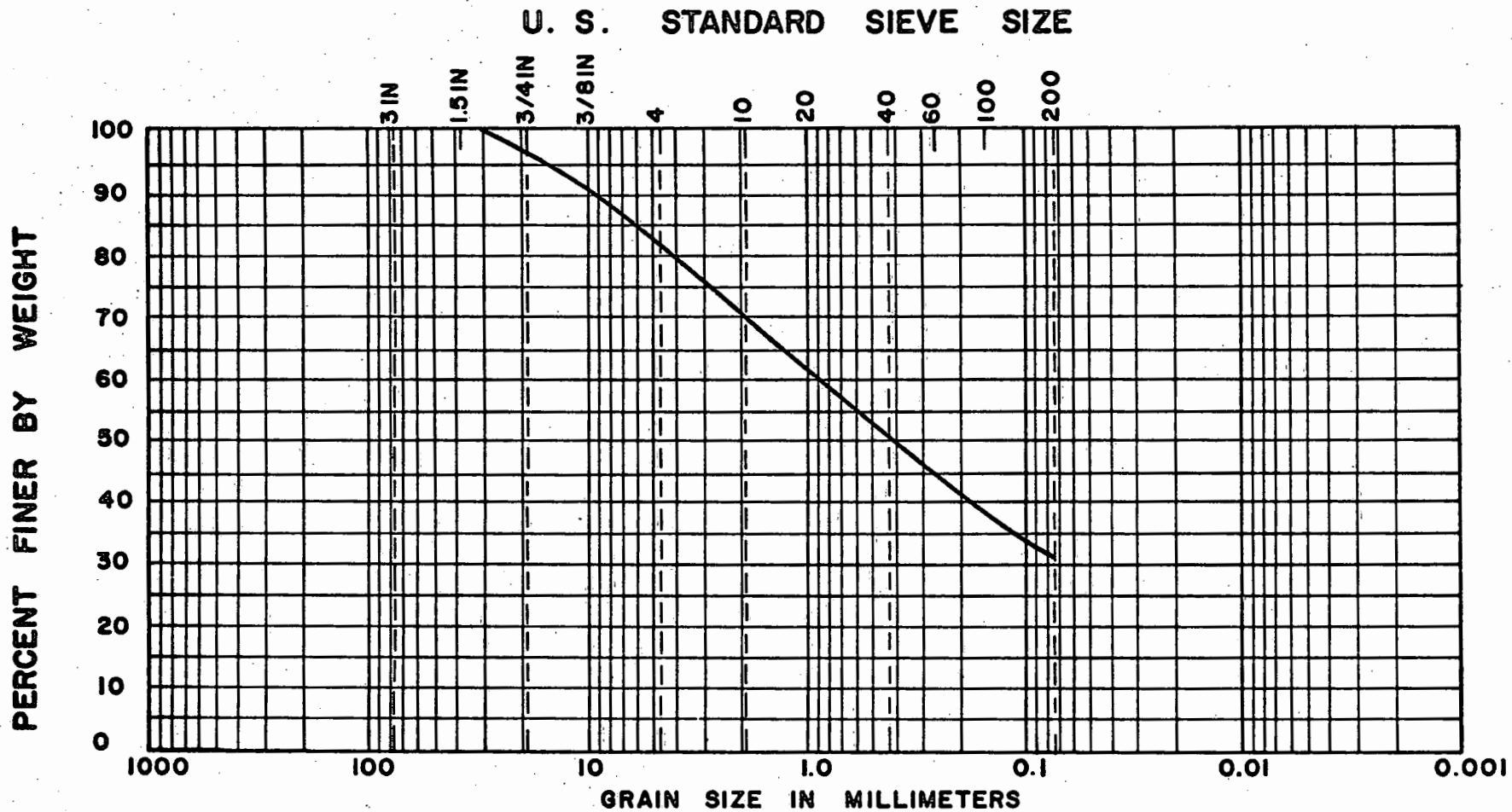
Sta 135+50 Elev 903'
0' - 3' CLAY, silty, red-brown
3' - 8' CLAY, with decomposed basalt

NOTE: Test Pits excavated March 5, 1975, No groundwater encountered in any test pits at that time.

SUMMARY OF LABORATORY TESTS

Location	T.P. 2 105+00	T.P. 4 108+50	T.P. 10 119+00	T.P. 14 125+00
Soil Description	SAND(de- composed basalt, very silty with gravels	SILT, with fine sand & gravel	SILT, de- composed basalt, very sandy with gravels	CLAY, silty with fine sand
CBR	4.5	7.2	3.1	3.4
Expansion, %	4.9	3.5	5.9	3.1
Moisture Content, %	23.4	25.2	25.6	21.8
Dry Density, lbs/ft ³	93.0	95.0	93.0	92.0
Liquid Limit, %	41.6	41.1	43.4	38.5
Plasticity Index, %	8.0	12.0	13.9	21.3

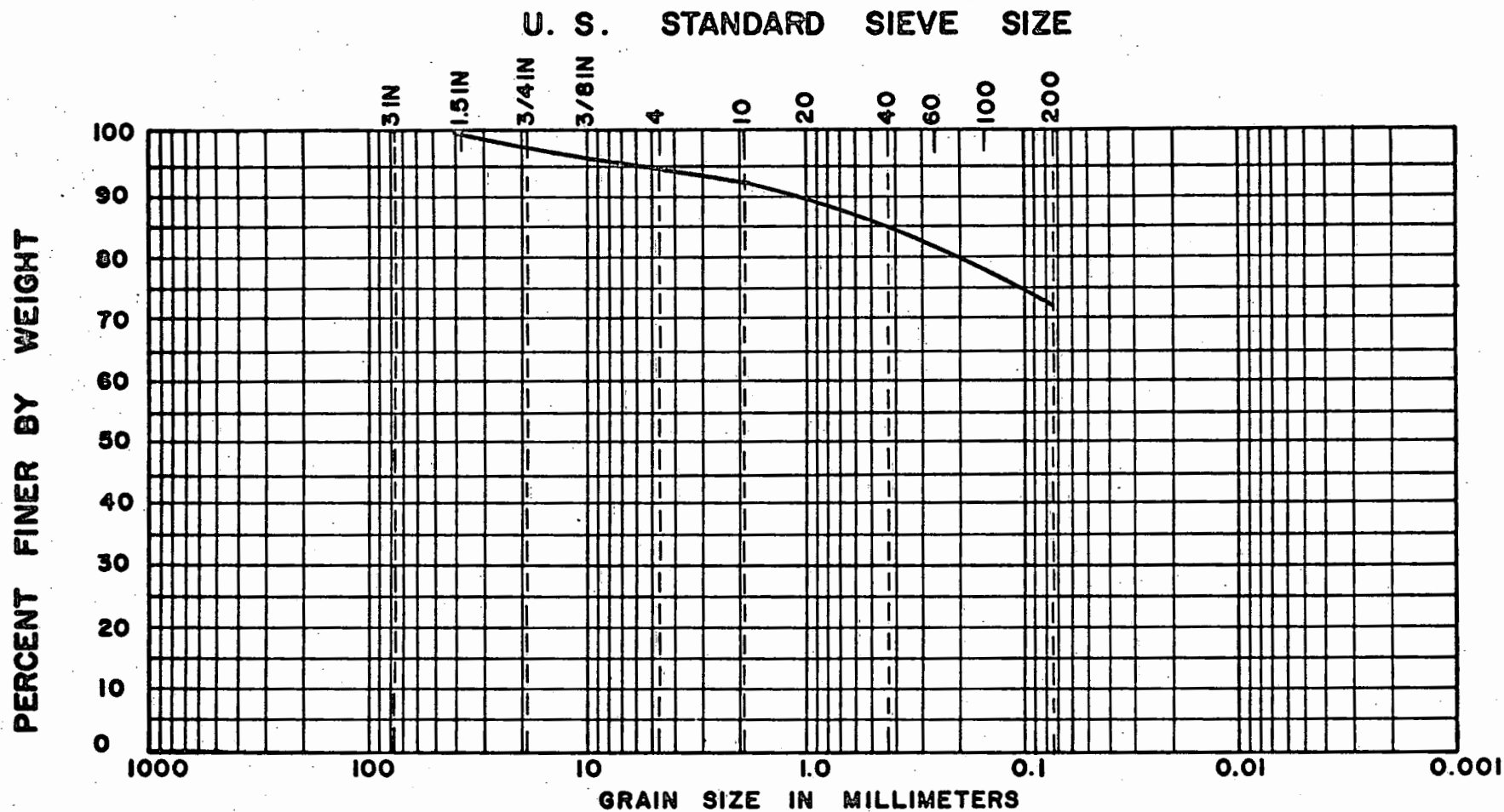
Sieve Analysis: See attached plates



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	CO	MEDIUM	FINE	

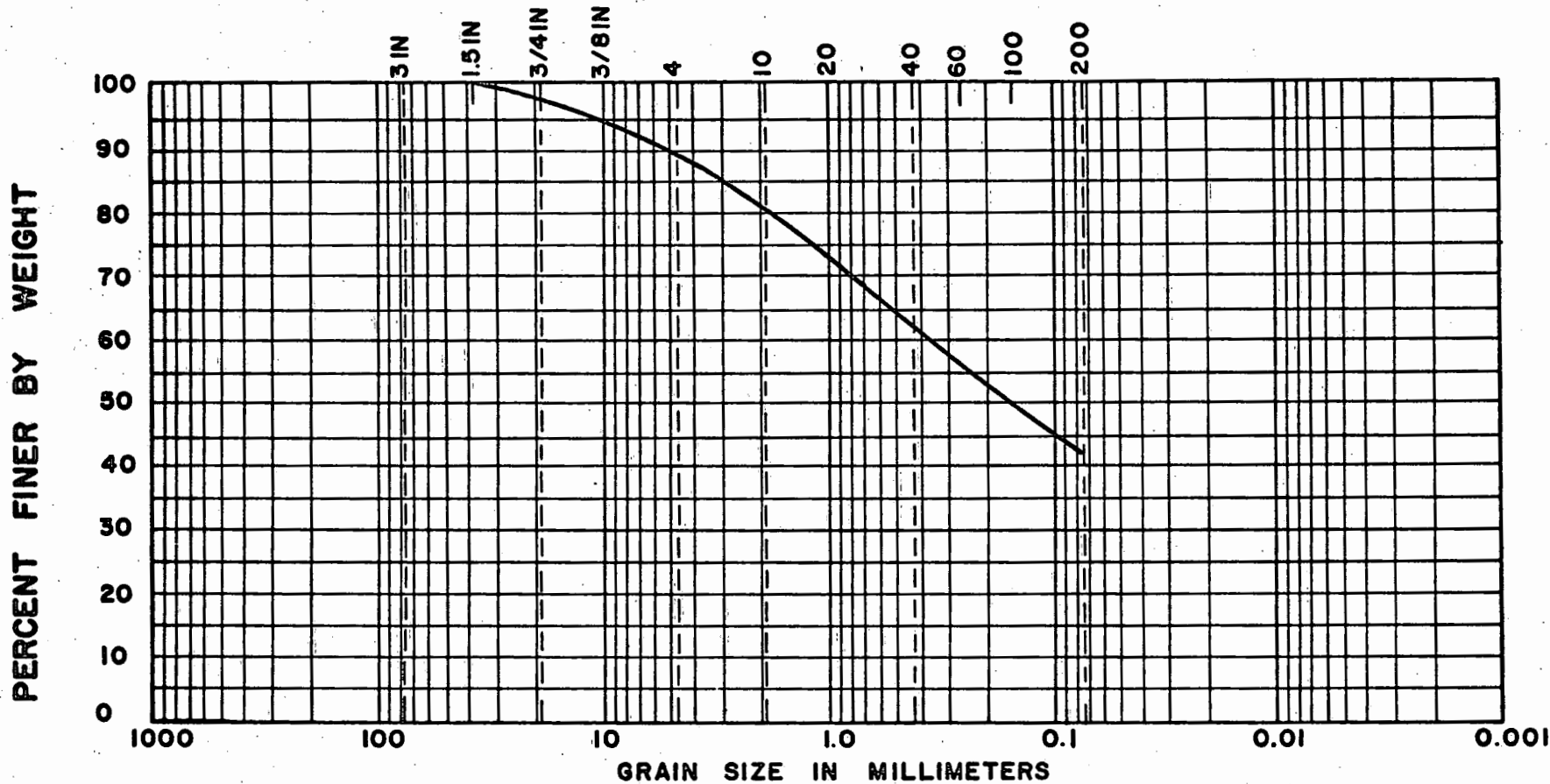
LOCATION	DEPTH	CLASSIFICATION				NAT.WC	LL	PL	PI
Test Pit No. 2	5.5'	SM	SAND, (Decomposed Basalt), very silty, with gravel			27.1%	41.6	33.6	8.0

MAKAKILO DRIVE V SOILS INTERNATIONAL	PLATE NO 5 FILE NO H-0034-F
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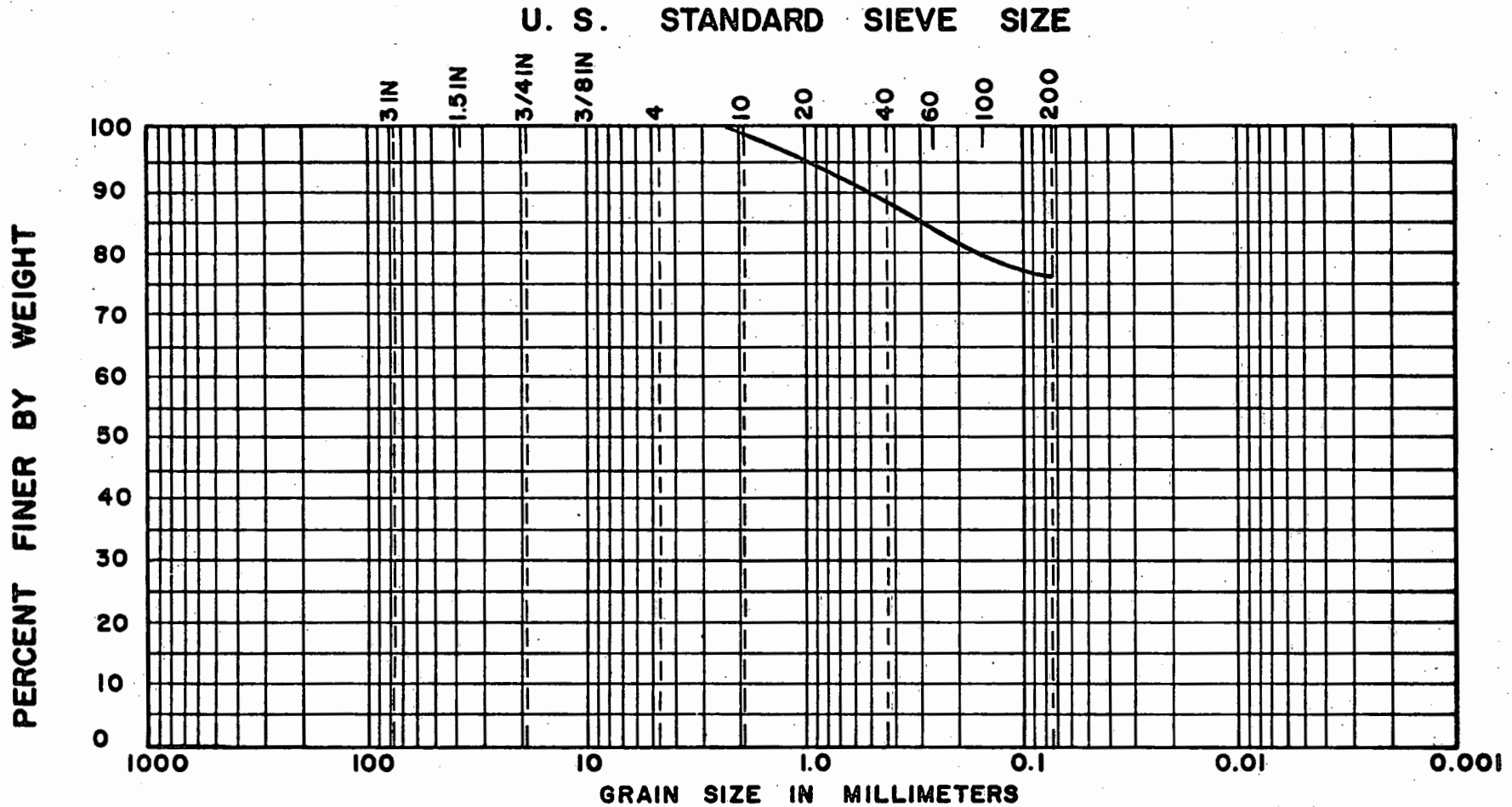


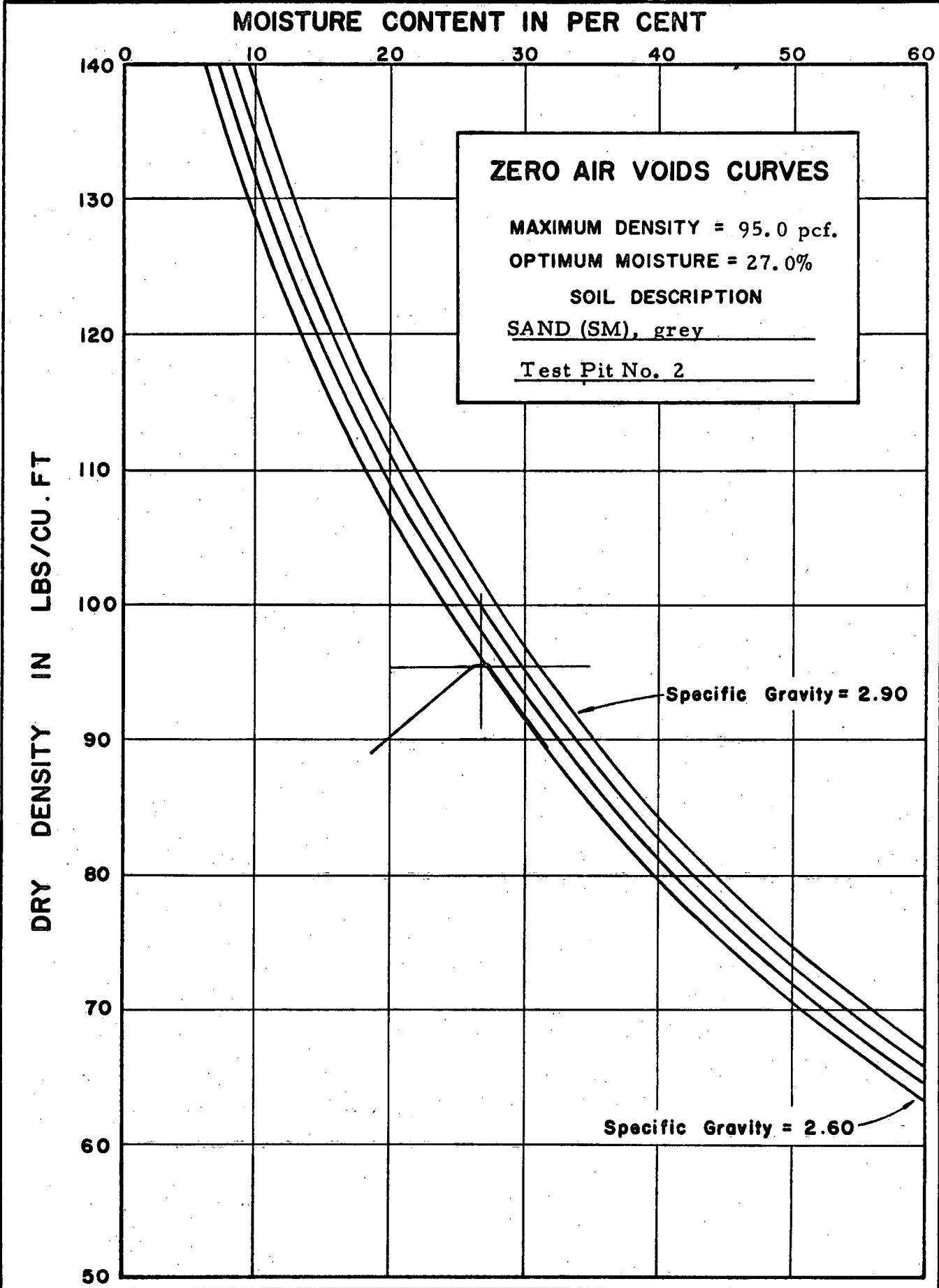
COBBLES		GRAVEL		SAND			SILT OR CLAY				
		COARSE	FINE	CO	MEDIUM	FINE					
LOCATION	DEPTH	CLASSIFICATION					NAT.WC	LL	PL	PI	
Test Pit No. 4	5.0'	ML	SILT, with fine sand and a few gravels, red-brown					30.6	41.1	29.1	12.0
MAKAKILO DRIVE V							PLATE NO 6				
SOILS INTERNATIONAL							FILE NO H-0034-F				

U. S. STANDARD SIEVE SIZE

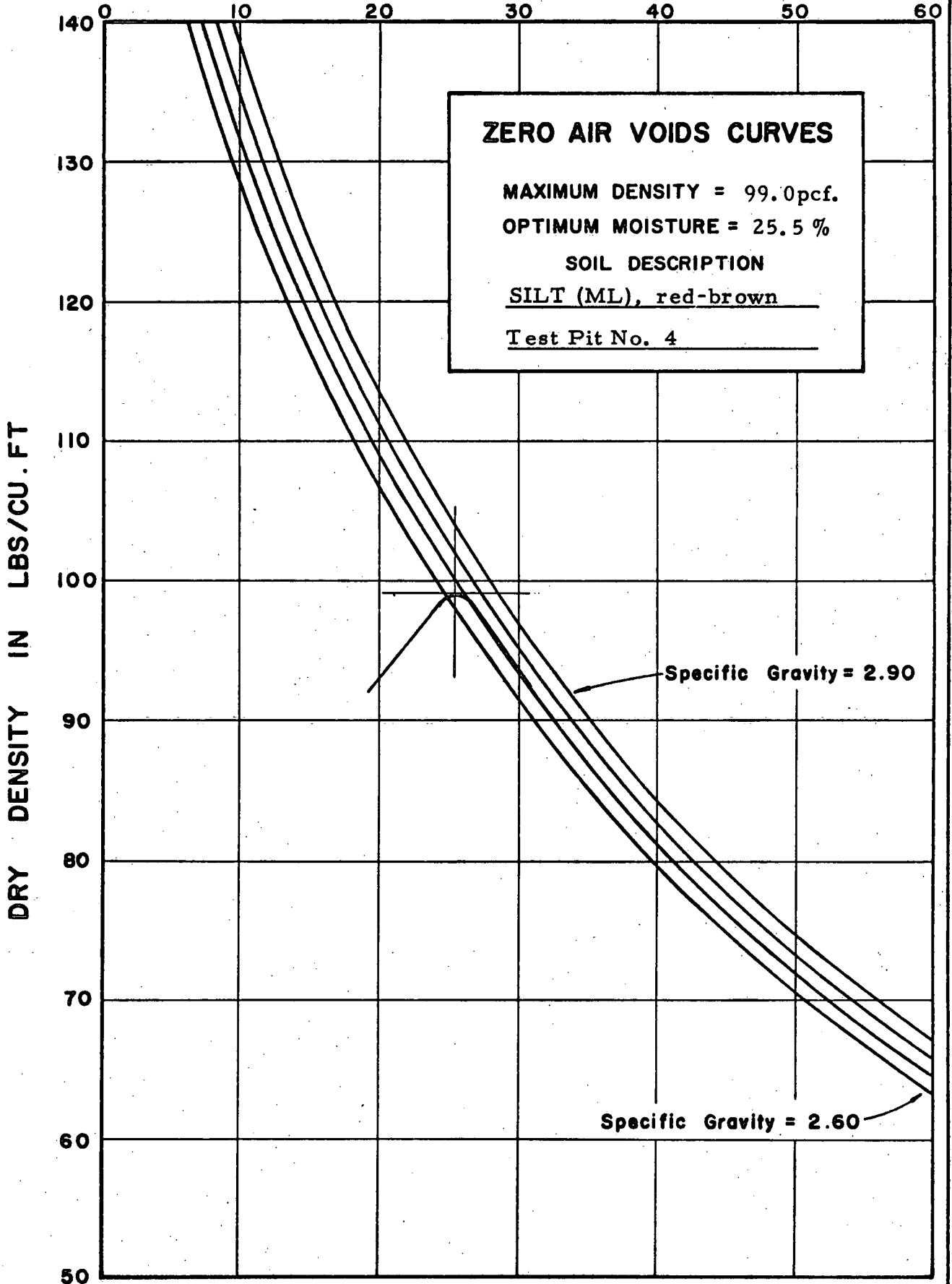


COBBLES		GRAVEL		SAND			SILT OR CLAY				
		COARSE	FINE	CO	MEDIUM	FINE					
LOCATION	DEPTH	CLASSIFICATION					NAT.WC	LL	PL	PI	
Test Pit No. 10	3.0'	ML	SILT, (decomposed basalt), very sandy with gravel					31.4	43.4	39.5	13.9
MAKAKILO DRIVE V							PLATE NO 7				
SOILS INTERNATIONAL							FILE NOH-0034-F				

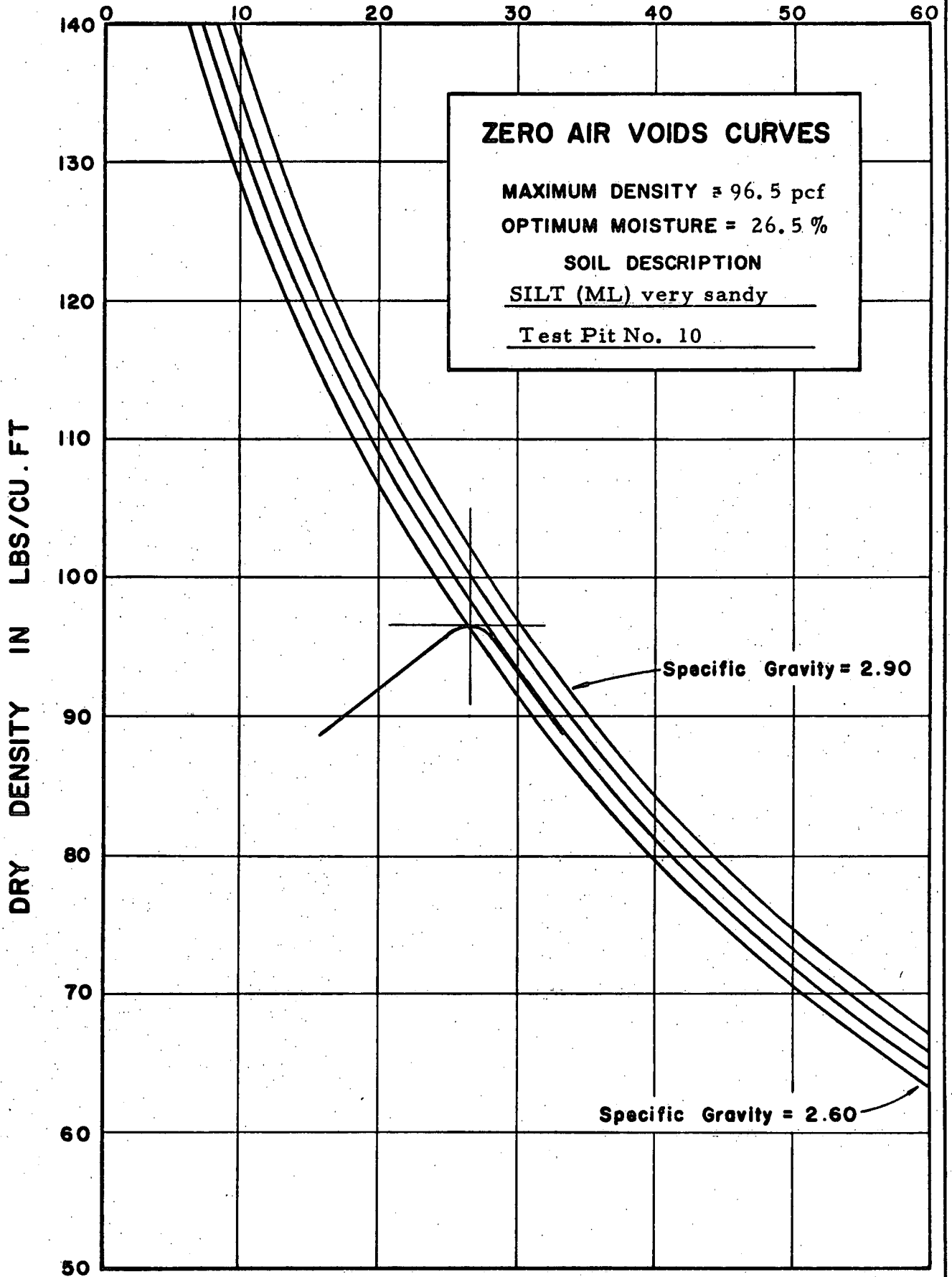




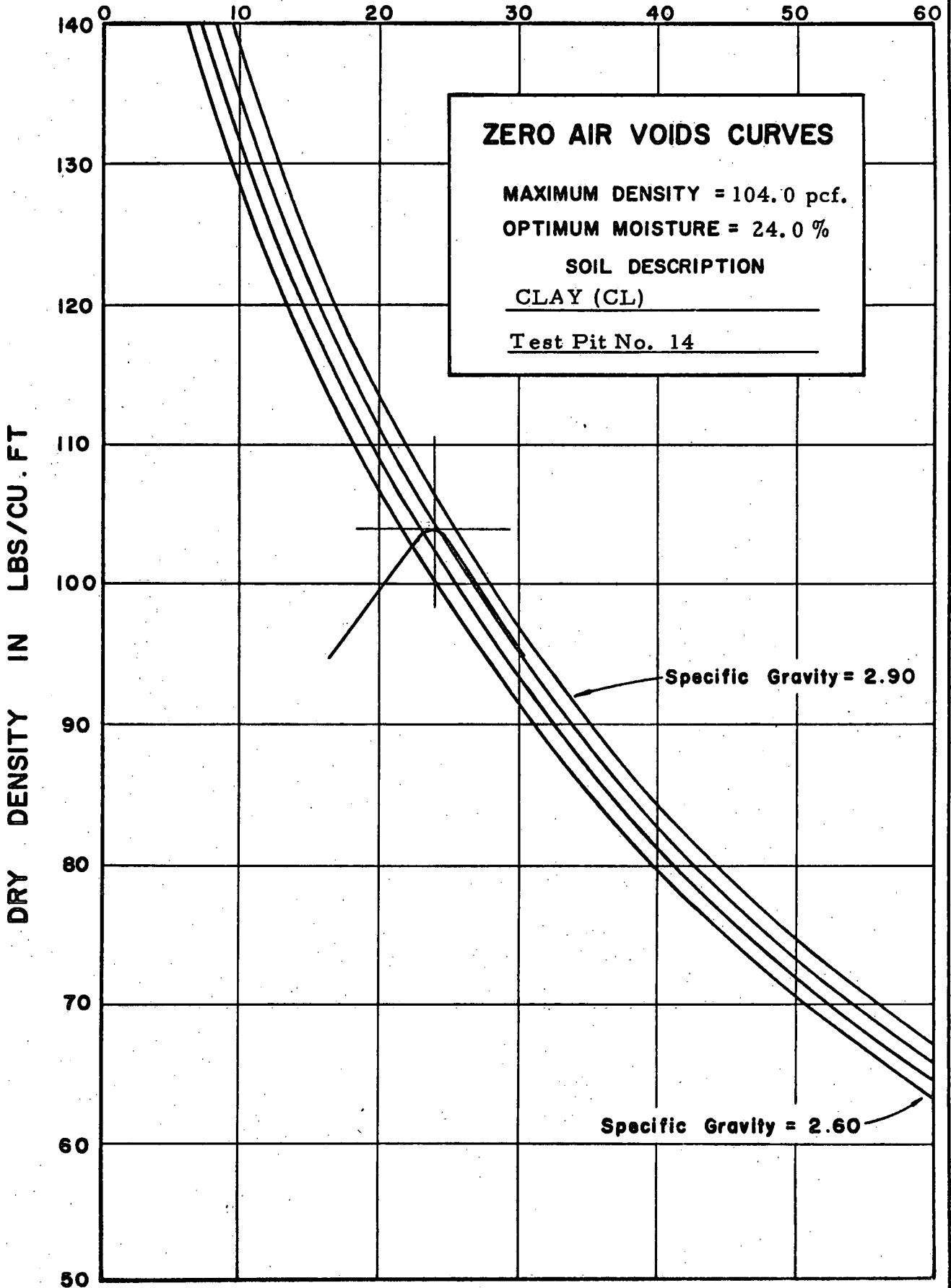
MOISTURE CONTENT IN PER CENT



MOISTURE CONTENT IN PER CENT



MOISTURE CONTENT IN PER CENT



ZERO AIR VOIDS CURVES

MAXIMUM DENSITY = 104.0 pcf.

OPTIMUM MOISTURE = 24.0 %

SOIL DESCRIPTION

CLAY (CL)

Test Pit No. 14

Specific Gravity = 2.90

Specific Gravity = 2.60

SOILS INTERNATIONAL

CONSULTING FOUNDATION ENGINEERS AND GEOLOGISTS • 2828 Paa Street, Suite 1150, Honolulu, Hawaii 96819 (808) 839-9071
A CORPORATION

HAWAII DIVISION

Honolulu, Hawaii
April 17, 1975

Project No. H-0034-F

Finance Realty Company, Ltd.
P. O. Box 3979
Honolulu, Hawaii 96813

Attention: Mr. Ranceford Yoshida

Addendum No. 1
Report, Soils Investigation
Makakilo Drive V,
Station 102+30 to Station 135+30
Makakilo, Oahu, State of Hawaii

Gentlemen:

As requested by you, we have correlated the field and laboratory results with the proposed roadway profile to determine the pavement subgrade soils for pavement design.

Based upon our report dated March 31, 1975, and the roadway plans the following pavement section should be used:

Station	Pavement Type
102+30 to 109+80	IV (Clay)
109+80 to 113+30	III (Silt with sand)
113+30 to 122+00	IV (Clay)
122+00 to 126+50	* (Fill to be placed)
126+50 to 135+30	IV (Clay)

The pavement types are based upon the City and County of Honolulu "Design of Flexible Pavement for Residential Subdivision", dated March 15, 1972. (See attached sheet)

Pavement design for fill areas shall be based upon the types of material used in the uppermost three (3) feet of the subgrade.

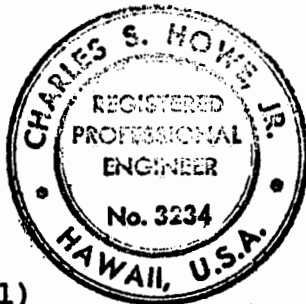
During construction, inspection of cuts and fills should be under the supervision of either the Soils Engineer or the City and County

of Honolulu, and any variation from the above mentioned pavement type soils should be noted for possible modifications in the pavement design.

Since all soil samples tested show expansion values exceeding three (3) percent, six (6) inches of select borrow should be used under sidewalks. For fill areas where the subgrade soils have expansion values of less than three (3) percent, no select borrow is required under sidewalks.

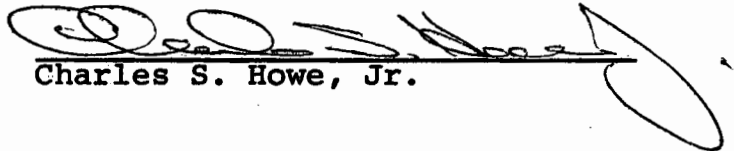
Very truly yours,

SOILS INTERNATIONAL



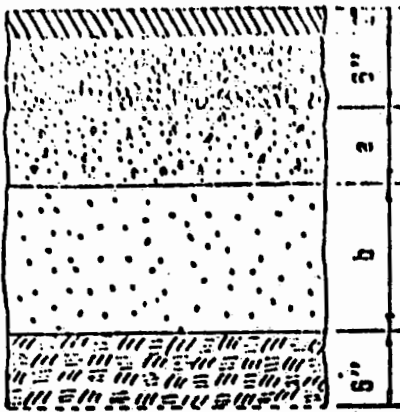
LSS/CSH/rlk

Enclosure (1)


Charles S. Howe, Jr.

DESIGN OF FLEXIBLE PAVEMENT

(for Residential Subdivision)



Asphalt concrete pavement. (Sec. 34)

Base Course - compacted to field CBR of 85%. Crusher run rock or limestone. Crushed rock or limestone w/filler. (Sec. 31)

Select Borrow Sub-base - compacted to 95% of maximum density. Crusher run wastes, mudrock, coral sand, cinders. (Sec. 30)

Borrow - compacted to 95% of maximum density. (Sec. 15)

Subgrade - compacted to 95% of maximum density for 6" minimum depth. (Sec. 12 & 29)

For sections noted above refer to Standard Specifications for Public Works Construction of the Department of Public Works, City and County of Honolulu.

PAVEMENT DETAIL

(not to scale)

TYPE	EXPANSION VALUE OF SUBGRADE (%)	CBR VALUE OF SUBGRADE (%)	^a SELECT BORROW	^b BORROW	TOTAL PAVEMENT THICKNESS*
1	0.0 to 1.0	> 12.0	NONE	NONE	8"
2	1.1 to 3.0	8.1 to 12.0	6"	NONE	14"
3	3.1 to 4.5	5.1 to 8.0	6"	6"	20"
4	4.6 to 6.0	3.1 to 5.0	6"	12"	26"
5	6.1 to 7.0	2.1 to 3.0	6"	18"	32"
	> 7.0	0.0 to 2.0	Soils Engineer to submit pavement design for specific conditions		

TABLE I

*Use greater thickness obtained from either expansion value or CBR value of subgrade soil. CBR refers to California Bearing Ratio.

NOTES:

1. Use 2 1/2" A.C. pavement in business and industrial areas. All other requirements for select borrow, borrow and subgrade shall conform with the above table.
2. For road grades exceeding 12%, replace A.C. and base course with 6" concrete pavement with 6x6-6/6 galvanized wire mesh. (Sec. 37) Subgrade and subbase requirements remain unchanged.
3. Pavement design on above table based on the following:
 - a. Traffic designation - Medium traffic
 - b. Loading - Maximum single axle load of 24,000 pounds
4. Equivalent substitution between asphalt, base material, select borrow and borrow may be made with approval.
5. Determination of CBR and expansion values of the subgrade soil shall conform with the requirements of ASTM Designation: D 1883, with the modification that the surcharge weight on the specimens for the test shall be 10 pounds.

REVISED:	3/15/72	<i>[Signature]</i>
	DATE	<i>[Signature]</i>
APPROVED:	R. Clay	2/29/72
	for DIR. & CHIEF ENGINEER	DATE
	<i>[Signature]</i>	2/28/72
	CHIEF DIV. OF ENG.	DATE

DEPARTMENT OF PUBLIC WORKS
CITY & COUNTY OF HONOLULU
DIVISION OF ENGINEERING

DESIGN STANDARD
FLEXIBLE PAVEMENTS