Earth Mechanics

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REVISED FINAL
OAKLAND SHORE APPROACH
GEOTECHNICAL SITE CHARACTERIZATION REPORT

SAN FRANCISCO-OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

VOLUME 2A - APPENDICES
(Land Borings 98-51 through 98-60)

Prepared for

CALIFORNIA DEPARTMENT OF TRANSPORTATION

March 2001

Earth Mechanics

Fugro - Earth Mechanics
A JOINT VENTURE

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March 5, 2001
Project No. 98-42-0058/EMI Project No. 98-145

California Department of Transportation
Engineering Service Center
Office of Structural Foundations
5900 Folsom Boulevard
Sacramento, California 95819-0128

Attention: Mr. Mark Willian
Contract Manager

Final Oakland Shore Approach Geotechnical Site Characterization
SFOBB East Span Seismic Safety Project

Dear Mr. Willian:

The geologic and geotechnical studies for the San Francisco-Oakland Bay Bridge (SFOBB) East Span Seismic Safety Project are being conducted by Fugro-Earth Mechanics (a joint venture of Fugro West, Inc., and Earth Mechanics, Inc.) under California Department of Transportation (Caltrans) Contract 59A0053. The majority of the Oakland Mole exploration was conducted as part of the Phase 2, Task 5 (final site characterization phase) studies of the referenced contract, although three cone penetration test (CPT) soundings were conducted as part of the earlier Phase 1, Task 3 work scope (preliminary site characterization) of the referenced contract.

The field exploration conducted on the Oakland Mole in the Spring and Fall of 1998 as part of the referenced contract included 25 soil borings (designated in the subsurface database created for the project as 98-51 through 98-75) and 9 CPT soundings (designated as 98-16 through 98-18 and 98-101 through 98-110 [several planned locations were abandoned due to electrical interference]). A total of 53 offshore tethered Seascout CPT soundings were conducted in December 1998 during seasonal high tides on the tidal flat to the north of the Oakland Mole. Fifteen all-terrain CPT soundings were conducted on the Tidal Flat to the north of the Mole in March 1999 during low tide conditions. Two trench and two pit excavations were conducted in April 1999. In Fall 2000, 11 marine Seacalf CPT soundings were performed in the vicinity of the Oakland Shore Approach to the west and northwest of the western tip of the Mole. The Seacalf CPTs were conducted as part of the Phase 3 field investigation program.

This Oakland Shore Approach Geotechnical Site Characterization report summarizes the field exploration for the Oakland Shore Approach and describes our interpretation of the geotechnical conditions based on the information collected from the exploration. Our present interpretations are based on the field data from the borings, the results of laboratory tests completed in the onshore laboratories, and the CPT soundings.

This report is provided in four volumes. Volume 1 provides the interpretational text and illustrations. Volume 2 contains 27 appendices that provide boring logs and test data from 25 land borings on the Oakland Mole and 2 marine borings offshore from the northwest tip of the Oakland Mole. Volume 3 contains the

results of the CPT soundings conducted on land, on the northern shore of the tidal flat, and offshore to the north and west of the Oakland Mole. Volume 4 contains four documents that include a preliminary study of approach fills at the Oakland Mole, studies on lateral spreading of fills at the Oakland Mole, findings from trench and pit excavations, and the advanced geotechnical laboratory studies conducted at the University of California at Berkeley.

On behalf of the project team, we appreciate the opportunity to contribute to Caltrans' design of the new bridge to replace the existing SFOBB East Span. Please call if we can answer any questions relative to the information presented in the enclosed report.

Sincerely,

FUGRO-EARTH MECHANICS, A Joint Venture

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SAN FRANCISCO-OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

CALTRANS CONTRACT 59A0053

REVISED FINAL
OAKLAND SHORE APPROACH
GEOTECHNICAL SITE CHARACTERIZATION REPORT

VOLUME 2A - APPENDICES
(Land Borings 98-51 through 98-60)

MARCH 2001

Prepared For:

CALIFORNIA DEPARTMENT OF TRANSPORTATION
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CONTENTS

VOLUMES 2A AND 2B - APPENDICES

	Page
GEOTECHNICAL SITE CHARACTERIZATION REPORT - VOLUME 1	1
INDIVIDUAL BORING APPENDICES - VOLUMES 2A & 2B	1
Boring Appendices Collation and Plate Number Guide	1
Key to Terms and Symbols Used on the Boring Logs	2
Land Boring Logs	2
Marine Boring Logs	2
Laboratory Test Results	3
Soil Property Profiles	4
CONE PENETRATION DATA SOUNDINGS - VOLUME 3	5

PLATES

	Plate
Key to Terms and Symbols Used on Logs	A1a through c
Exploration Location Map	2.1a and b

APPENDICES

VOLUME 2A - Land Borings 98-51 Through 98-60

VOLUME 2B - Land Borings 98-61 Through 98-75, and Marine Borings 98-39 and 98-44

For boring-specific appendix plate numbers, please refer to the chart on the next page.

PLATE NUMBERING GUIDE

Contents	Volume 2A - Boring-Specific Appendices										Volume 2B - Boring-Specific Appendices															
	Land										Land														Marine	
	98-51	98-52	98-53	98-54	98-55	98-56	98-57	98-58	98-59	98-60	98-61	98-62	98-63	98-64	98-65	98-66	98-67	98-68	98-69	98-70	98-71	98-72	98-73	98-74	98-75	98-39	98-44
Summary of Field Operations																										1	1a-b
Boring Depth and Location Reference Map																										2	2
Boring Logs:																											
Single page boring logs w/soil and rock test results	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3
Single page boring logs w/CPT data																										4	4
Single page boring logs w/suspension logging data																										5	5
Multi-page boring logs w/soil and rock test results																										6a-c	6a-c
Multi-page boring logs w/CPT data																										7a-c	7a-c
Log of near-surface materials																										8	8
Field Test Results:																											
Remote vane test data	2a-k	2a-h	2a-e	2a-h	2a-l	2a-f	2a-k	2a-i	2a-h	2a-h	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	9a-d	9
Laboratory Test Results:																											
Summary of laboratory test results	3a-f	3a-c	3a-c	3a-c	3a-e	3a-d	3a-d	3a-d	3a-c	3a-d	3a-b	3a-b	3a-b	3a-b	3a-b	3	3a-b	3	3	3a-b	3a-b	3	3a-b	3	3a-b	10a-g	10a-g
Grain size distribution curves	4	4	4	4	4	4	4	4	4	4	4a-c	4a-b	4	4	4	4	4	4	4	4	4	4	4	4	4a-b	11a-c	11a-b
Plasticity chart	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	12	12
Stress-strain curves	6a-c	6	6	6	6a-b	6a-b	6a-b	6a-b	6	6a-b	6a-b	6	6	6	6	6	6	6	6	6	6	6	6	6	6	13a-c	13a-d
CRS/Incremental consolidation	7a-g	7	7a-b	7a-d	7a-e	7a-c	7a-d	7a-d	7a-b	7a-b	7a-f	7a-c	7a-d	7a-c	7a-g	7	7	7	7	7a-c	7a-b	7	7a-d	7	7a-d	14a-h	14a-i
Consolidated-undrained triaxial compression	8	8	8	8	8	8	8a-b	8	8	8	8	8	8	8a-b	8	8	8a-b	8	8	8	8	8	8	8	8	15a.1-a.2 15b.1-b.2	15
Consolidated-drained triaxial compression	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	16	16
R-value laboratory testing	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10		
Corrosion testing	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11		
Soil Property Profiles:																											
Plasticity index	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	17	17
Liquidity index	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	18	18
Soil sensitivity	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	19	19
ε_{50}	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	20	20
Preconsolidation stress	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	21	21
Direct shear test													17														
Relative density																										22	22

Testing performed

No testing performed

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VOLUME 2
INDIVIDUAL BORING DATA AND ANALYSES APPENDICES

The exploration program for the site characterization of the Oakland Shore Approach of the San Francisco-Oakland Bay Bridge (SFOBB) East Span Seismic Safety Project included 25 onshore borings (10 with in situ testing), approximately 24 land-based cone penetration test (CPT) soundings, 53 marine tethered Seascout CPT soundings, and 11 marine Seacalf CPT soundings. In addition, 2 marine borings, which were performed in the shallow water tidal flat to the north and northwest of the Mole, are relevant to the characterization of the Oakland Shore Approach of the bridge. A description of the marine exploration program is provided under separate cover in the Final Marine Geotechnical Site Characterization report[1].

GEOTECHNICAL SITE CHARACTERIZATION SYNOPSIS - VOLUME 1

A general description of the Task Order No. 5, Final Oakland Shore Approach Geotechnical Site Characterization work scope is provided in Section 1.0 of Volume 1. A description of the land exploration program (drilling and CPT testing), tethered Seascout CPT program (including equipment used and field procedures), and marine Seacalf CPT program is presented in Section 2.0. Section 3.0 includes a description of the laboratory testing equipment and procedures. The locations of the borings and CPT soundings are provided on Plate 2.1 (included in this volume for reference), and a summary of the details of the individual exploration locations and depths is provided in Table 2.1 of Volume 1.

INDIVIDUAL BORING APPENDICES - VOLUMES 2A & 2B

Individual boring appendices are provided for each of the 27 borings (25 land borings and 2 marine borings). Each boring appendix includes boring logs and various in situ, downhole, and laboratory data.

Boring Appendices Collation and Plate Number Guide

A table is provided at the end of the Volume 2 Table of Contents that shows the plate titles and numbers included in each boring-specific appendix. The individual appendix plates are numbered with the boring number and a sequential number (e.g., 98-51.4, 98-51.5a, etc.).

[1] Fugro-Earth Mechanics (2001), *Final Marine Geotechnical Site Characterization, San Francisco-Oakland Bay Bridge East Span Seismic Safety Project, Volume 1*, FWI Job No. 98-42-0054, prepared for California Department of Transportation, March 5.

Key to Terms and Symbols Used on the Boring Logs

A description of the terms and symbols used on the logs is provided on Plates A1a through A1c that follow this introductory text.

Land Boring Logs

The boring logs for each boring provide: lithology descriptions, sampling depths, descriptions of the soil characteristics, and plotted in situ, remote vane, and laboratory test data.

Sampler types are shown on the Key to Terms and Symbols Used on Logs (Plates A1a through A1c). The following nomenclature applies to the information in the blow count column of the log: a) "PUSH" denotes thin-wall tube pushed samples; b) "WOH" denotes samplers advanced by the weight of the drill string; and c) numerical values indicate either standard penetration test (SPT) N-values or California modified sampler blow counts. Additional description of the blow count and sampler nomenclature is provided on Plates A1a through A1c.

The center column of the log provides water content, plastic limit, liquid limit, percent passing the number 200 sieve, and density measurements (presented as total unit weights). In addition to the direct measurements of density, below El. 0 (mean sea level [MSL]) the logs show the theoretical unit weight based on the measured water content, an assumed specific gravity of 2.7, and an assumed 100-percent saturation.

The right-hand column presents the results of the undrained shear strength measurements conducted on samples recovered from the borings as well as in situ, remote vane measurements. Undrained shear strengths measured on remolded samples are also included in the plotted data.

Marine Boring Logs

The boring logs for each marine boring provide lithology descriptions, show sampling depths, contain descriptions of the soil and provide plotted remote vane, laboratory, and downhole geophysical test data. The appendices include three single-page boring logs (the data for the entire depth of the borings are shown on one page) that show geotechnical test data, downhole geophysical data, and CPT data, respectively. In addition to the single-page logs, multiple-page logs that show geotechnical test data and CPT data are provided at an expanded depth scale. Also included in the marine boring appendices is a geotechnical test data log of the near-surface sediments with an expanded undrained shear strength scale.

Geotechnical Test Data Logs. Sampler types are shown on the Key to Terms and Symbols Used on Logs (Plates A1b and A1c). The following nomenclature applies to the information in the blow count column of the log: a) "PUSH" denotes thin-wall tube samples pushed with the weight of the drill pipe; b) "WOH" denotes liner samplers advanced by the

weight of the down-hole hammer; c) values such as 18 designate either SPT N-values or California modified sampler; d) 50/7.5 centimeters (cm) is an SPT N-value; and e) 30/60 cm is a downhole, wireline hammer blow count. Additional description of the blow count and sampler nomenclature is provided on Plates A1b and A1c.

The center column of the log provides water content, plastic limit, liquid limit, percent passing the number 200 sieve, and density measurements (presented as submerged unit weights). In addition to the direct measurements of density, the logs also show the theoretical submerged unit weight based on the measured water content, an assumed specific gravity of 2.7, and an assumed 100-percent saturation.

The right-hand column presents the results of the undrained shear strength measurements conducted on samples recovered from the borings as well as the strengths measured in situ using the Halibut and Dolphin remote vane tools. The range of undrained shear strengths that are calculated from CPT cone tip resistances (corrected for unequal end area effects) also are shown based on cone bearing capacity (N_k values) of 12 and 15. Undrained shear strengths measured on remolded samples also are included in the plotted data.

CPT Logs. The in situ CPTs were conducted downhole using the Dolphin system. This downhole in situ tool has a maximum stroke (or test length) of 3 meters. Data are acquired in 3-meter-long increments or until the CPT meets refusal. The CPT intervals were interspersed with soil sampling. The CPT intervals are shown on the right of the logs for those borings.

The CPT logs for each boring with CPT data provide graphical plots of the data versus depth below mudline (or bay bottom). Data that are shown include: a) tip resistance in megapascals (MPa), b) sleeve friction in MPa, c) excess pore pressure readings in MPa, and d) friction ratio in percent.

Downhole Geophysical Logs. The geophysical tests for Borings 98-39 and 98-44 included compression and shear wave velocity (Vp and Vs, respectively) measurements. The data from those downhole measurements are provided on a separate downhole geophysical log that presents the measured downhole geophysical data.

Laboratory Test Results

The offshore and onshore laboratory test results are incorporated in the individual boring appendices. In addition to the test data plotted on the geotechnical test data logs, the appendices include the following information (where relevant):

- Remote vane test data
- Tabulated summary of test results

- Grain size distribution curves
- Plasticity chart showing the Atterberg limit data
- Plotted stress-strain curves from unconsolidated-undrained (UU) triaxial compression tests
- Plotted consolidation test results including axial strain and coefficient of consolidation versus effective vertical stress
- Plotted consolidated-undrained triaxial compression test results including consolidation curves, stress path, stress-strain curves, pore water pressure-strain curves, and obliquity-strain curves
- Plotted consolidated-drained triaxial compression test results including stress-strain curves and Mohr circles
- R-value test data (land borings)
- Corrosion testing results (land borings)

In addition to the static test results presented herein, the results of cyclic tests conducted on samples of Young Bay Mud recovered from the land borings are provided under separate cover in Volume 4.

Soil Property Profiles

Where data are available, the following soil properties are plotted versus depth:

- Plasticity Index (Liquid Limit minus Plastic Limit)
- Liquidity Index ([water content minus Plastic Limit] divided by Plasticity Index)
- Soil Sensitivity (undisturbed shear strength divided by remolded shear strength)
- ε_{50} (strain at 50 percent of the failure stress in UU triaxial tests)
- Preconsolidation Pressure - The interpreted preconsolidation pressure profiles show interpreted preconsolidation pressures from consolidation tests and estimated preconsolidation pressures from the in situ CPT data. Also shown on those plots are the calculated effective overburden pressure and isochrones of calculated overconsolidation ratios (OCR).
- Relative Density from CPT test data (marine borings)

CONE PENETRATION DATA SYNOPSIS – VOLUME 3

CPT soundings were performed on land using full-sized cones deployed from truck-mounted and all-terrain-vehicle- (ATV-) mounted cone penetration test (CPT) rigs. Tethered Seascout CPT soundings were performed over water using a miniature cone deployed from a workboat to the north of the Mole. Marine Seacalf soundings were performed using Fugro's wheel drive CPT system deployed from a barge.

Logs of the CPT soundings including graphical plots of tip resistance, sleeve friction, pore pressure, and seismic velocity measurements (where relevant) are presented in Volume 3 of this report. In addition to the CPT data, correlations with undrained shear strength, preconsolidation stress, and relative density are included for the track-mounted and ATV-mounted CPT soundings. Laboratory test results have been included for two ATV-mounted CPT locations (99C-17 and 99C-14) where sampling was performed. The Seacalf CPT sounding logs include estimates of undrained shear strength interpreted from CPT tip resistance for fine-grained layers.

SOIL TYPES

- Well graded GRAVEL (GW)
- Poorly graded GRAVEL (GP)
- GRAVEL with sand (GP or GW)
- GRAVEL with clay (GP or GW)
- Clayey GRAVEL (GC)
- GRAVEL with silt (GP or GW)
- Silty GRAVEL (GM)
- Well graded SAND (SW)
- Poorly graded SAND (SP)
- SAND with gravel (SP or SW)
- SAND with clay (SP-SC)
- Clayey SAND (SC)
- Silty SAND (SM)
- SAND with silt (SP-SM)
- Fat CLAY(CH)
- Sandy fat CLAY (CH)
- Lean CLAY (CL)
- Sandy lean CLAY (CL)
- Silty CLAY (CL-ML)
- Elastic SILT (MH)
- SILT (ML)
- Sandy SILT (ML)
- Highly plastic ORGANICS (OH)
- Low plasticity ORGANICS (OL)
- SANDSTONE (Rx)
- SILTSTONE (Rx)
- CLAYSTONE (Rx)
- Interbedded Rock Strata (Rx)
- CONGLOMERATE (Rx)
- PAVEMENT

SAMPLERS

- Thin Walled 7.5 cm Tube
- 5.7 cm Driven Tube
- Offshore Liner
- Modified California Liner
- SPT
- Rock Core (Interior symbol represents percent recovery)
- Bulk Bag

CLASSIFICATION TESTS AND BLOW COUNTS

- ■ PERCENT PASSING 0.075 mm SIEVE
- ● WATER CONTENT (%)
- □ TOTAL UNIT WEIGHT (kN/m^3)
- ○ THEORETICAL TOTAL UNIT WEIGHT (kN/m^3)
- PLASTIC LIMIT ---------- LIQUID LIMIT
- EQUIVALENT SPT BLOW COUNT

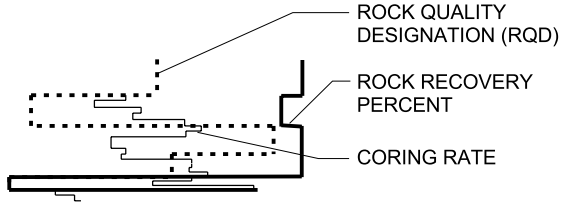
STRENGTH TESTS

- ⊗ POCKET PENETROMETER
- TORVANE
- REMOTE VANE
- ◆ MINIATURE VANE (◇ RESIDUAL VANE)
- ▲ UNCONSOLIDATED UNDRAINED TRIAXIAL
- SWEDISH FALL CONE
- UNCONFINED COMPRESSION (SOIL)
- POINT LOAD TEST (INTACT SPECIMEN)
- POINT LOAD TEST (ALONG WEAK PLANE)
- ■ UNCONFINED COMPRESSION (ROCK)

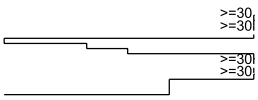
△◇ (Open symbols indicate remolded tests)
+ Strength Exceeds Capacity of Measuring Device

PCPT (Nk = 12 to 15)

ROCK QUALITY AND CORING RATE



FRACTURE DENSITY



KEY TO TERMS AND SYMBOLS USED ON LAND BORING LOGS

SFOBB East Span Seismic Safety Project

PLATE A1a

SOIL TYPES

- Well graded GRAVEL (GW)
- Poorly graded GRAVEL (GP)
- GRAVEL with sand (GP or GW)
- GRAVEL with clay (GP or GW)
- Clayey GRAVEL (GC)
- GRAVEL with silt (GP or GW)
- Silty GRAVEL (GM)
- Well graded SAND (SW)
- Poorly graded SAND (SP)
- SAND with gravel (SP or SW)
- SAND with clay (SP-SC)
- Clayey SAND (SC)
- Silty SAND (SM)
- SAND with silt (SP-SM)
- Fat CLAY(CH)
- Sandy fat CLAY (CH)
- Lean CLAY (CL)
- Sandy lean CLAY (CL)
- Silty CLAY (CL-ML)
- Elastic SILT (MH)
- SILT (ML)
- Sandy SILT (ML)
- Highly plastic ORGANICS (OH)
- Low plasticity ORGANICS (OL)
- SANDSTONE (Rx)
- SILTSTONE (Rx)
- CLAYSTONE (Rx)
- Interbedded Rock Strata (Rx)
- CONGLOMERATE (Rx)
- PAVEMENT

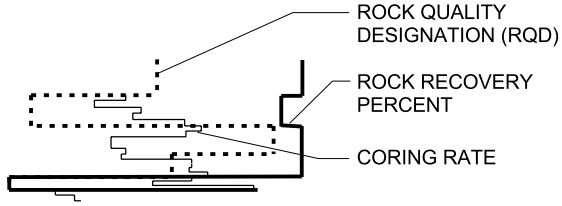
SAMPLERS

- Thin Walled 7.5 cm Tube
- 5.7 cm Driven Tube
- Offshore Liner
- Modified California Liner
- SPT
- Rock Core (Interior symbol represents percent recovery)
- Bulk Bag

CLASSIFICATION TESTS AND BLOW COUNTS

- ■ PERCENT PASSING 0.075 mm SIEVE
- ● WATER CONTENT (%)
- □ SUBMERGED UNIT WEIGHT (kN/m^3)
- ○ THEORETICAL SUBMERGED UNIT WEIGHT (kNm^3)
- PLASTIC LIMIT ---------- LIQUID LIMIT
- EQUIVALENT SPT BLOW COUNT

ROCK QUALITY AND CORING RATE



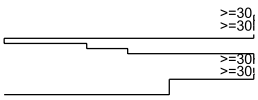
STRENGTH TESTS

- ⊗ POCKET PENETROMETER
- TORVANE
- REMOTE VANE
- ◆ MINIATURE VANE (◇ RESIDUAL VANE)
- ▲ UNCONSOLIDATED UNDRAINED TRIAXIAL
- SWEDISH FALL CONE
- UNCONFINED COMPRESSION (SOIL)
- POINT LOAD TEST (INTACT SPECIMEN)
- POINT LOAD TEST (ALONG WEAK PLANE)
- ■ UNCONFINED COMPRESSION (ROCK)

△◇ (Open symbols indicate remolded tests)
+ Strength Exceeds Capacity of Measuring Device

PCPT (Nk = 12 to 15)

FRACTURE DENSITY



KEY TO TERMS AND SYMBOLS USED ON MARINE BORING LOGS

SFOBB East Span Seismic Safety Project

PLATE A1b

TUBE AND LINER SAMPLERS

WOH	Liner sample advanced with the weight of an 80 kg hammer.
PUSH or SAVE	Pushed thin-walled 7.5cm-tube.
15/60cm	Number of blows required to produce the indicated penetration using a 5.7 cm tube sampler. The sampler was driven with an 80 kg downhole hammer dropped approximately 1.5 m.

SPT AND MODIFIED CALIFORNIA LINER SAMPLERS

Samplers were driven with a 63.5 kg hammer dropped approximately 760 mm.

20	Number of blows to produce 30 cm of penetration after the initial 15 cm of seating.
86/28cm	Number of blows required to produce the indicated penetration after an initial 15 cm seating.
Ref/8cm	50 blows produced the indicated penetration during the initial 15 cm interval.

SOIL GRAIN SIZE

U.S. STANDARD SIEVE

8"	3"	3/4"	4	10	40	200		
BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		
152	76.2	19.1	4.76	2.00	0.420	0.074		0.002

SOIL GRAIN SIZE IN MILLIMETERS

STRENGTH OF COHESIVE SOILS

Consistency	Undrained Shear Strength, kPa
Very Soft	less than 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very Stiff	100 to 200
Hard	greater than 200

DENSITY OF GRANULAR SOILS

Descriptive Term	Relative Density (%)*
Very Loose	less than 15
Loose	15 to 35
Medium Dense	35 to 65
Dense	65 to 85
Very Dense	greater than 85

*Estimated from sampler driving record and PCPT tip resistance.

SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the ease of breaking along these planes.
Fissured	Containing shrinkage or relief crack, often filled with fine sand or silt, usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 3 mm thick extending through the sample.
Seam	Inclusion 3 mm to 75 mm thick extending through the sample.
Layer	Inclusion greater than 75 mm thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil types.
Interlayered	Soil sample composed of alternating layers of different soil types.
Intermixed	Soil sample composed of pockets of different soil types and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.

KEY TO TERMS AND SYMBOLS USED ON LOGS

SFOBB East Span Seismic Safety Project

Field6.apr,Fld.MetricKey2, CBD, 10/33/YY
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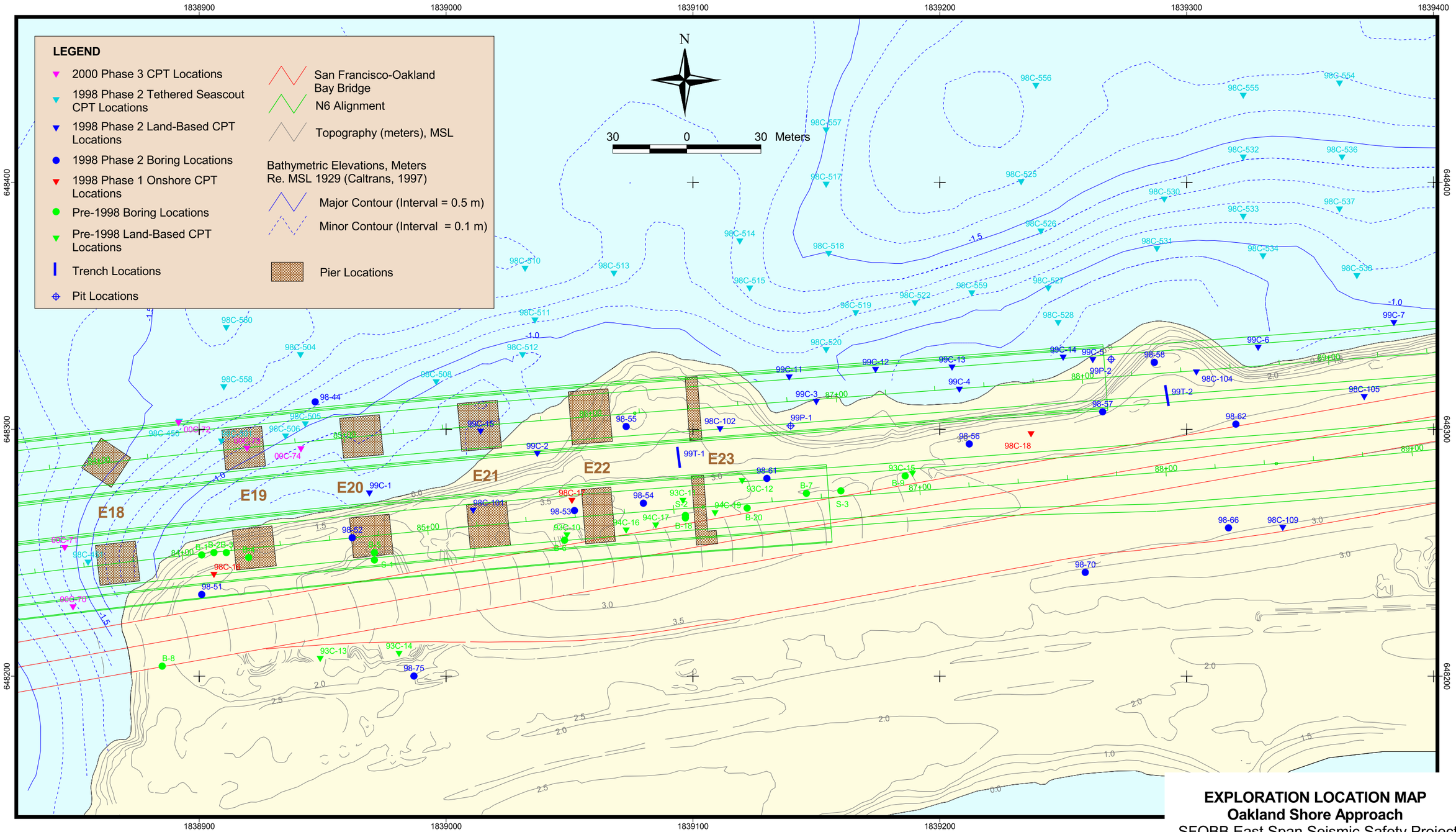
Earth Mechanics

FUGRO



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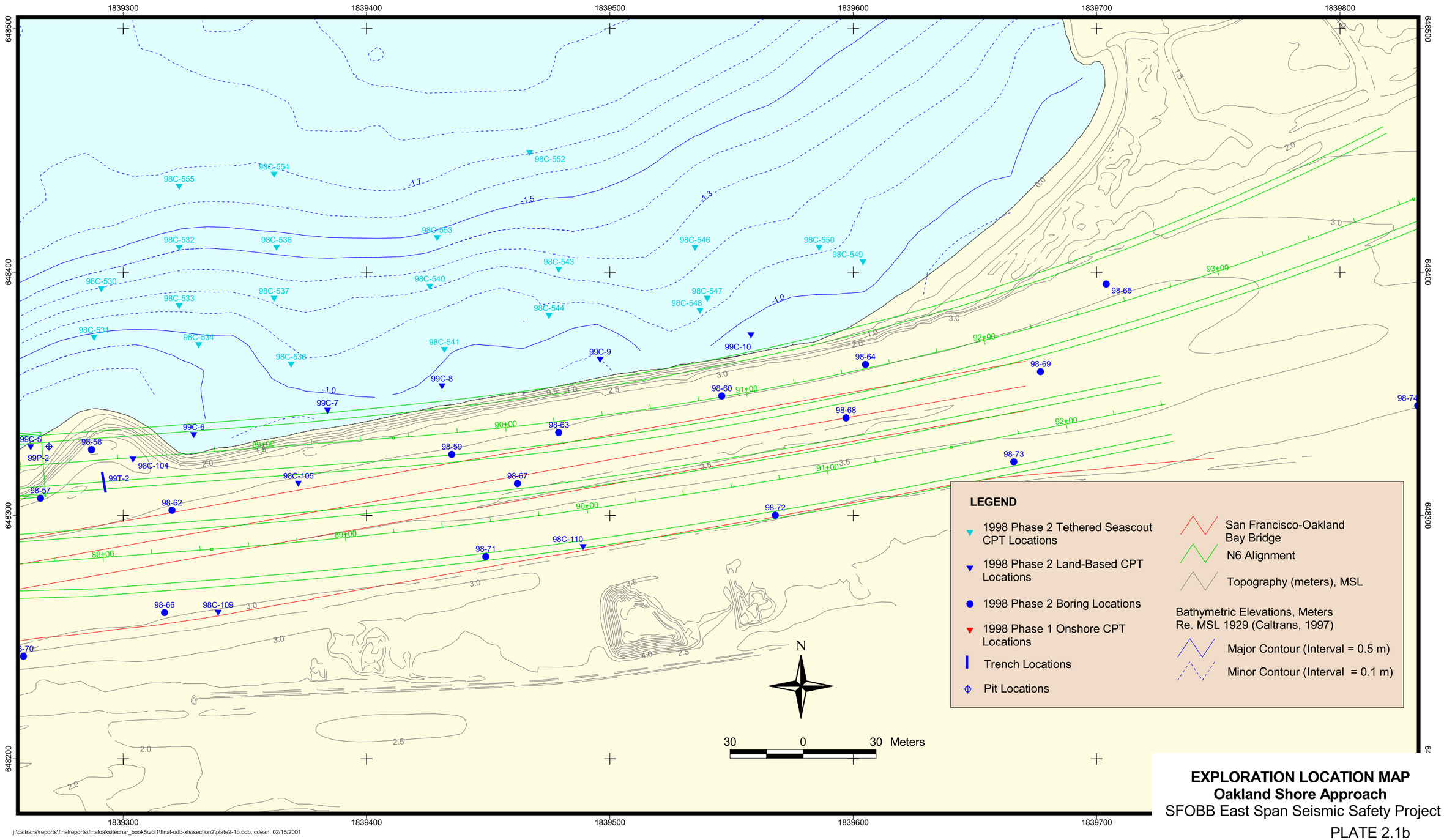
EXPLORATION LOCATION MAP
Oakland Shore Approach
SFOBB East Span Seismic Safety Project

PLATE 2.1a



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EXPLORATION LOCATION MAP
Oakland Shore Approach
SFOBB East Span Seismic Safety Project
PLATE 2.1b

LAND BORING 98-51

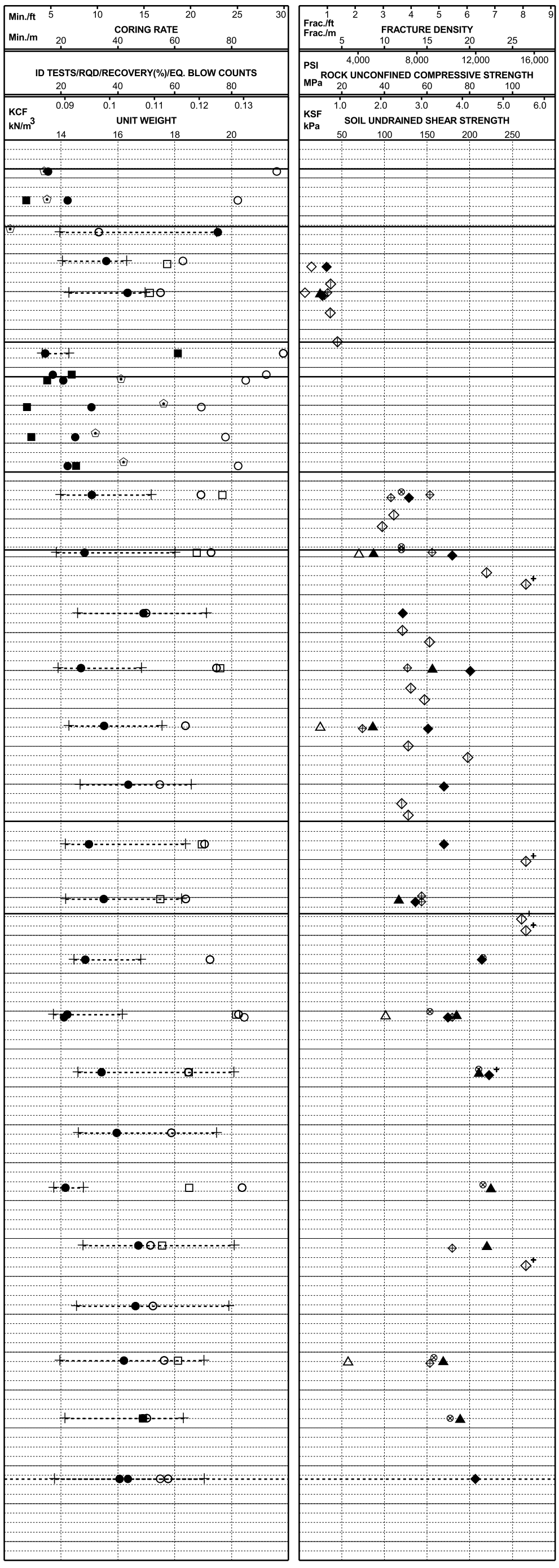
PROJECT NO:	98-42-0058	**START DATE:**	10/20/98	**DRILLER:**	Pitcher Drilling Company
BORING:	98-51 (17m right of E. Sta. 84+06)	**COMPLETION DATE:**	10/22/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838901 N648233
CA State Plane Zone 3, NAD83, Meters

GROUND ELEVATION: 1.2m (MSL)

Stratum No.	Material Description	Blow Count
I	Silty GRAVEL with sand (GM), medium dense to dense, brown (1.5m) (1.2m)	BAG
II	Fine GRAVEL with silt and sand (GW-GM), medium dense, brown -fine to coarse sand with gravel, at 1.7m (4.6m)	14, 15
III	Fat CLAY (CH), firm, olive gray - with shell fragments -dark gray, with silt partings, at 4.6m -with silt pockets, 6.1m to 8.2m -lean clay, 6.1m to 7.0m (10.7m)	2, PUSH, PUSH, NR
IV	Sandy Lean CLAY (CL), very stiff, greenish gray -intermixed sand and clay, at 12.2m (12.5m)	SAVE, PUSH
V	Fine SAND with silt (SP-SM), dense to very dense, brownish yellow -with many clay pockets and seams, at 12.5m -greenish gray below 15.2m -mottled with yellowish brown, at 15.2m -with many clay pockets at 17.1m (17.5m)	41, 56, 32, 42
VI	Fat CLAY (CH), very stiff, greenish gray -with black organic pockets and silt pockets, at 18.6m (21.6m)	PUSH
VII	Fat CLAY (CH), very stiff, greenish gray -with silt pockets, and a few calcareous nodules, at 21.3m -with silt seams and partings and a few shell fragments, at 27.7m -with silty fine sand pockets and partings, at 30.8m -with a few silt pockets at 33.8m (36.0m)	PUSH, SAVE, PUSH, PUSH, SAVE
VIII	Fat CLAY (CH), very stiff, greenish gray -with silt pockets, desiccated pockets and organic pockets, at 36.6m -interlayered, greenish gray and olive gray, with silt partings and pockets, at 39.9m (40.8m)	PUSH, PUSH
IX	Fat CLAY (CH), hard, greenish gray -with silt pockets and partings, at 46.0m -with brownish yellow mottling and slickensides, at 49.1m -sandy lean clay, 53.9m to 56.4m -with sand seams and a trace of gravel, at 55.2m -sand layer, 56.4m to 56.7m -with shell fragments at 58.2m -with many silt pockets at 67.4m -with organic pockets at 70.4m	SAVE, PUSH, SAVE, PUSH, PUSH, SAVE, PUSH, PUSH, SAVE

TOTAL DEPTH: 70.7m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-51

SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

Report Date: 03/13/99

PLATE 98-51.1

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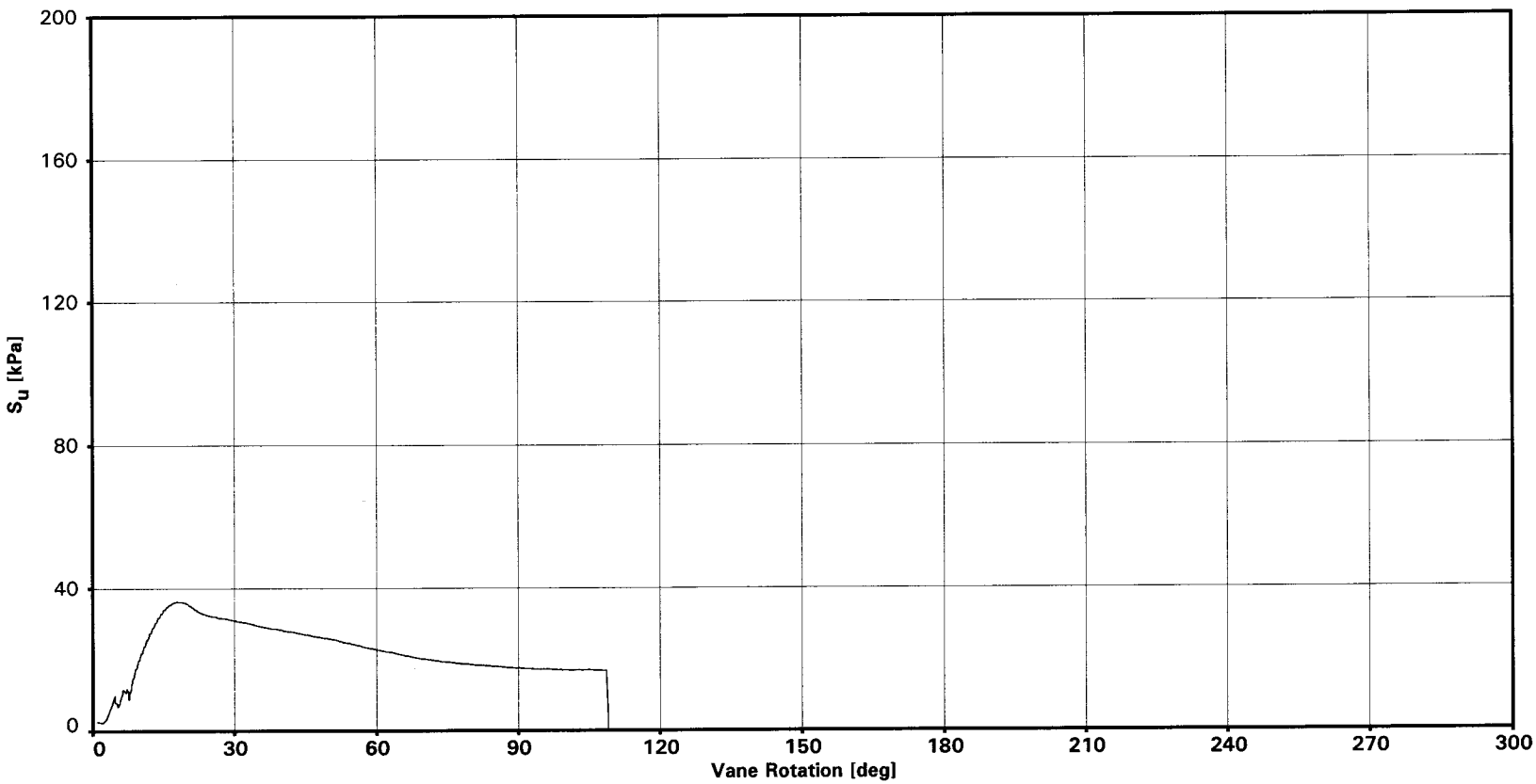
SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 9.1m
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

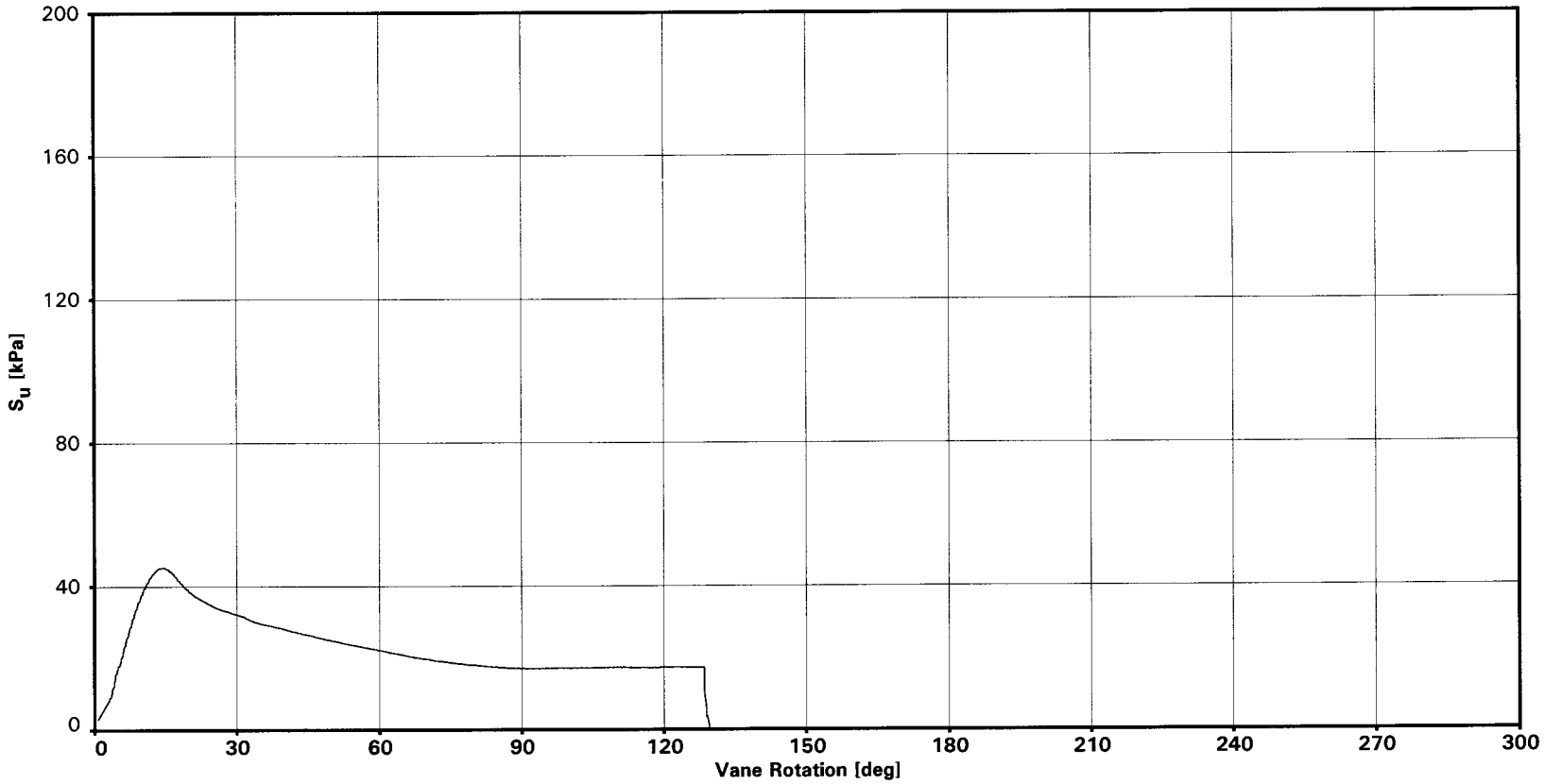
FUGRO

PLATE 98-51.2a

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 10.7m
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

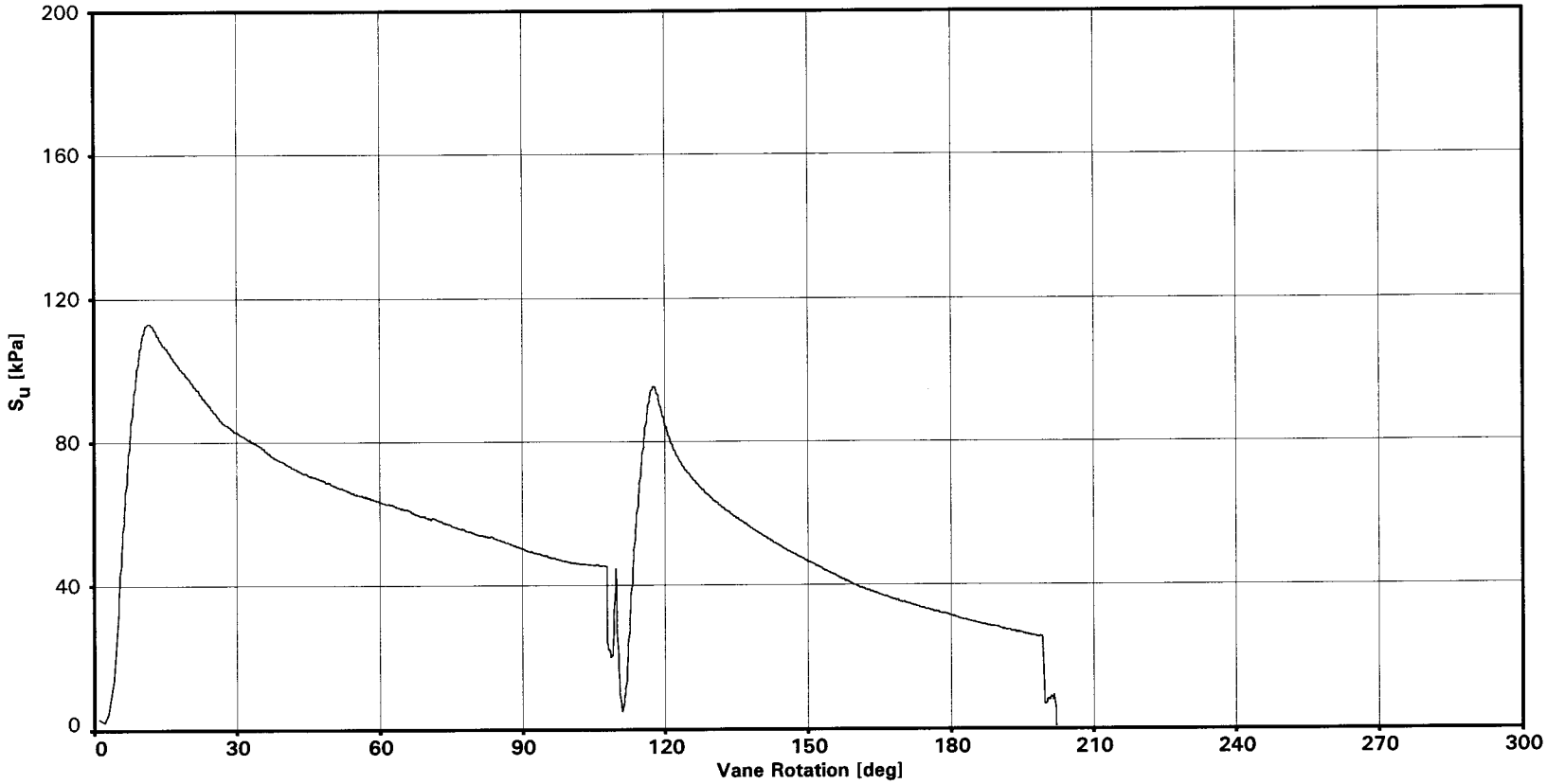
FUGRO

PLATE 98-51.2b

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 19.8m and 20.4m
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-51.2c

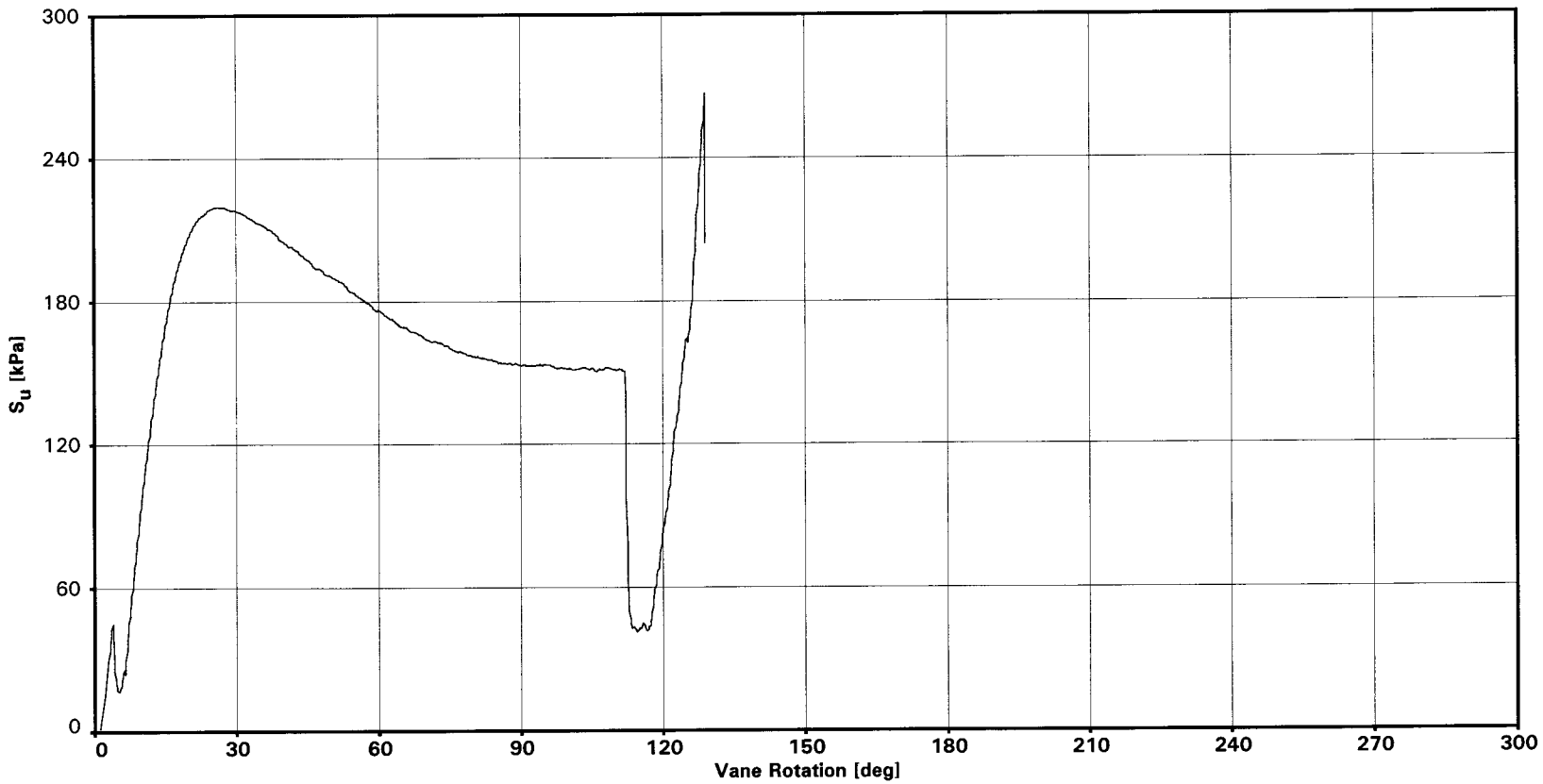
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



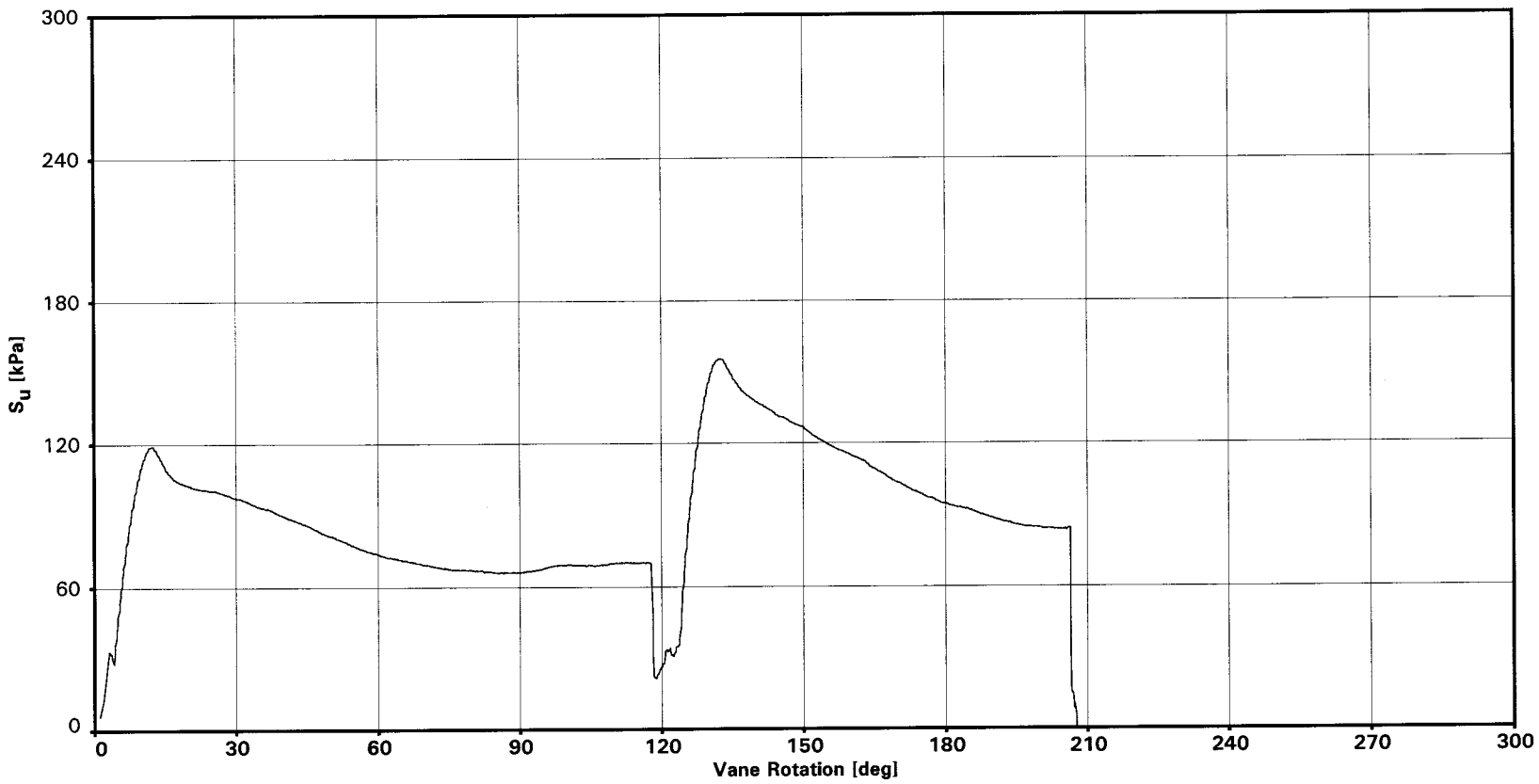
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 22.9m and 23.5m
Boring 98-51
SFOBB East Span Seismic Safety Project

PLATE 98-51.2d

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 25.9m and 26.5m
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

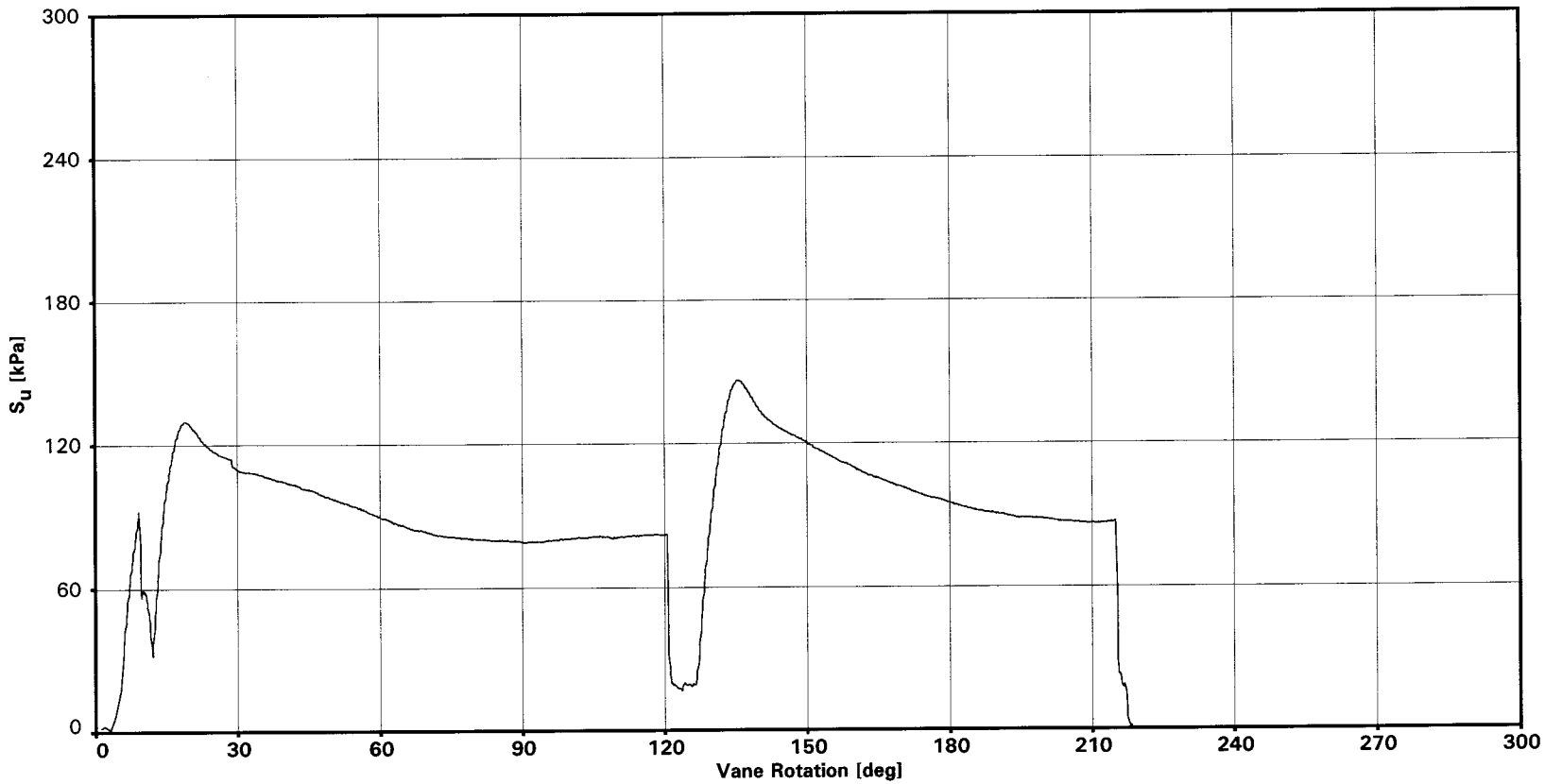
FUGRO

PLATE 98-51.2e

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 29.0m and 29.6m
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

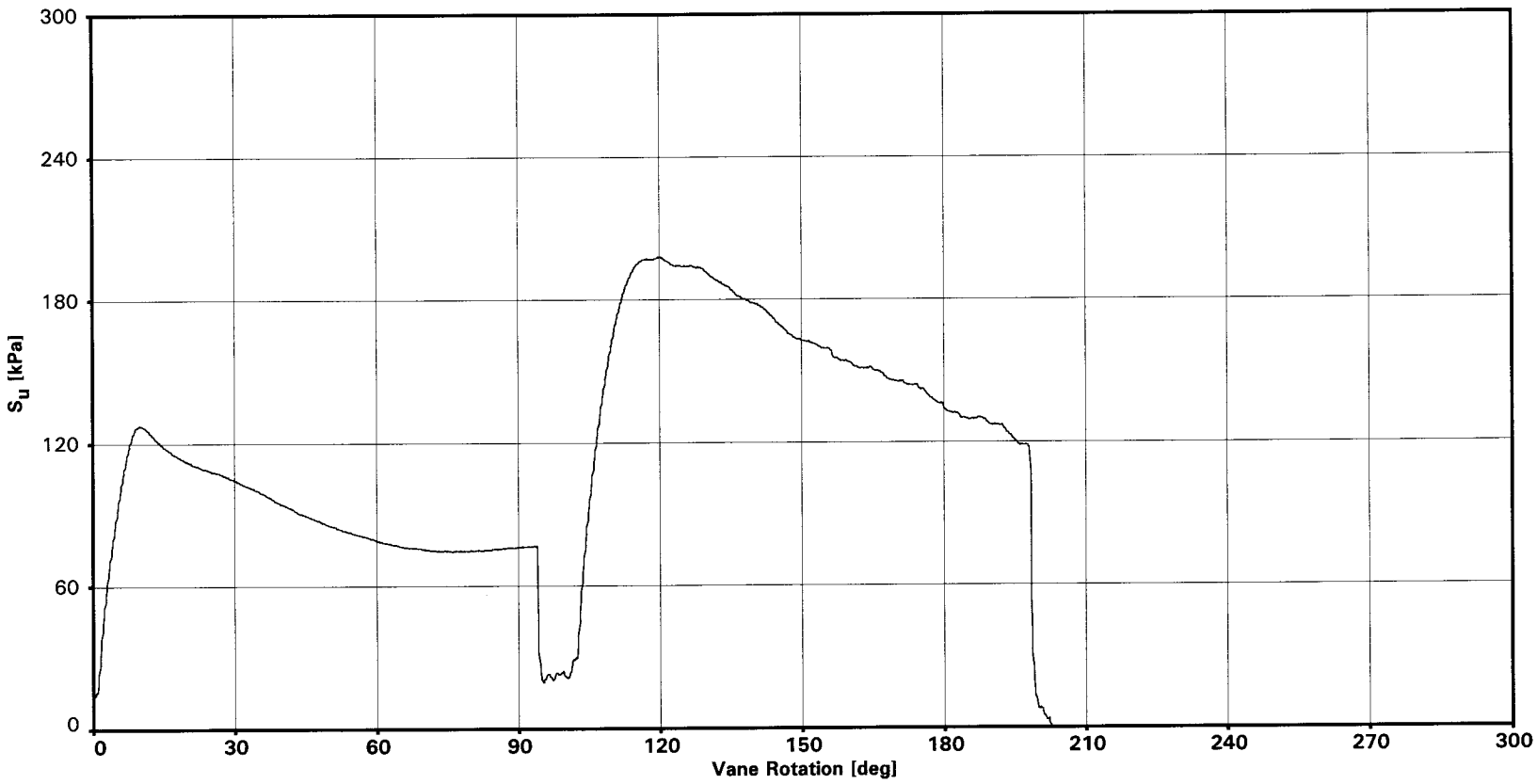
FUGRO

PLATE 98-51.2f

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 32.0m and 32.6m
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

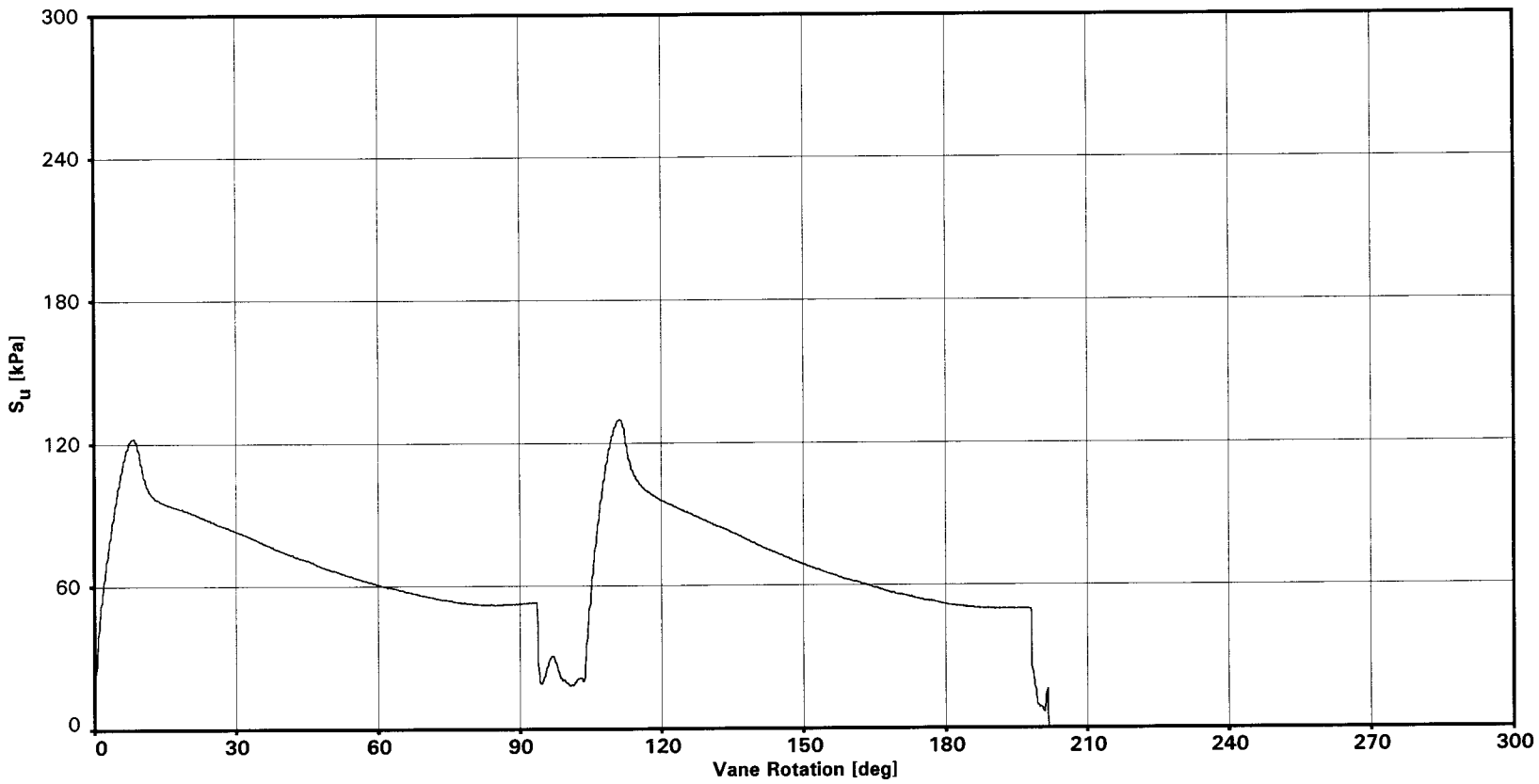
FUGRO

PLATE 98-51.2g

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 35.1m and 35.7m
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

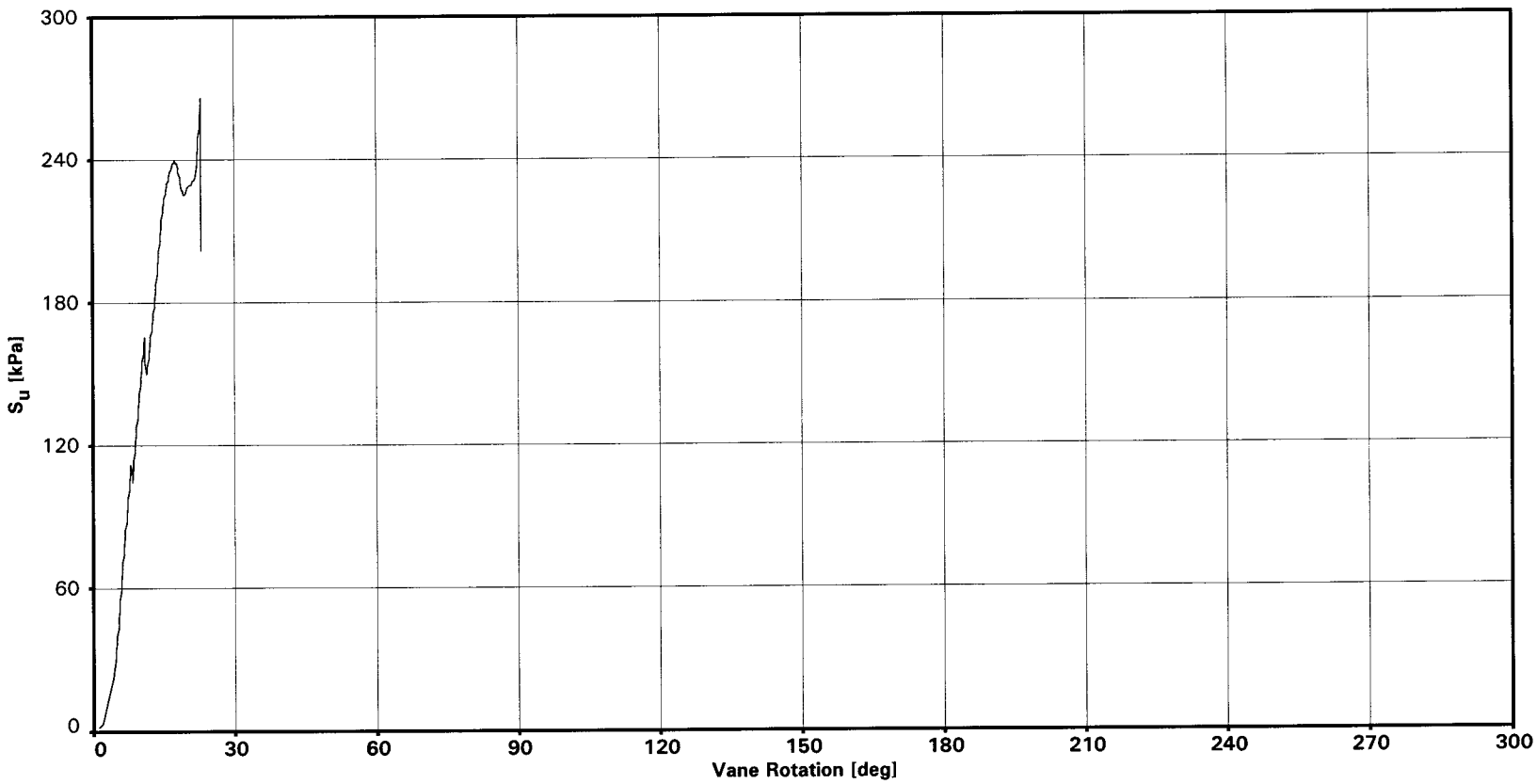
FUGRO

PLATE 98-51.2h

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 38.1m
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

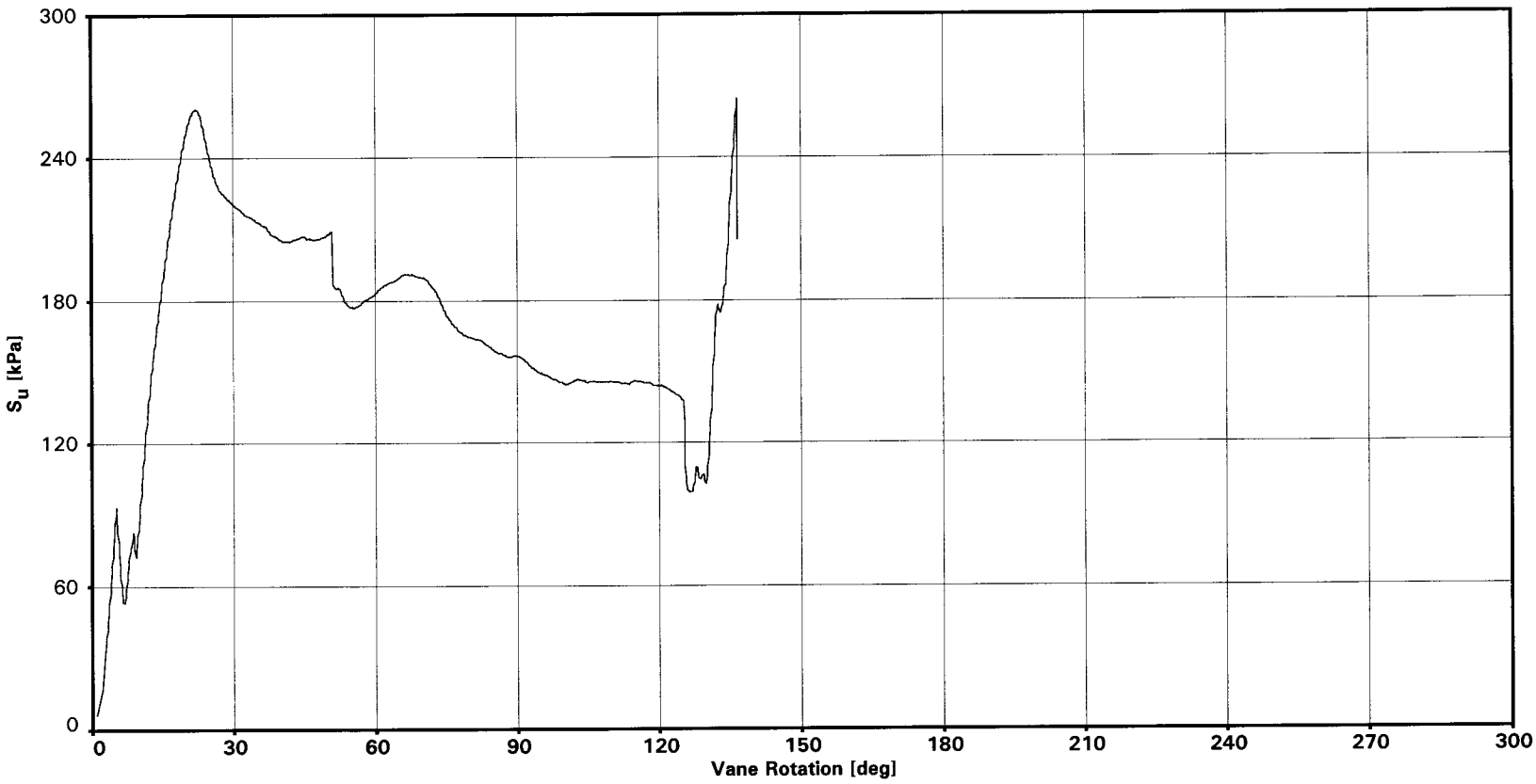
FUGRO

PLATE 98-51.2i

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 41.1m and 41.8m
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

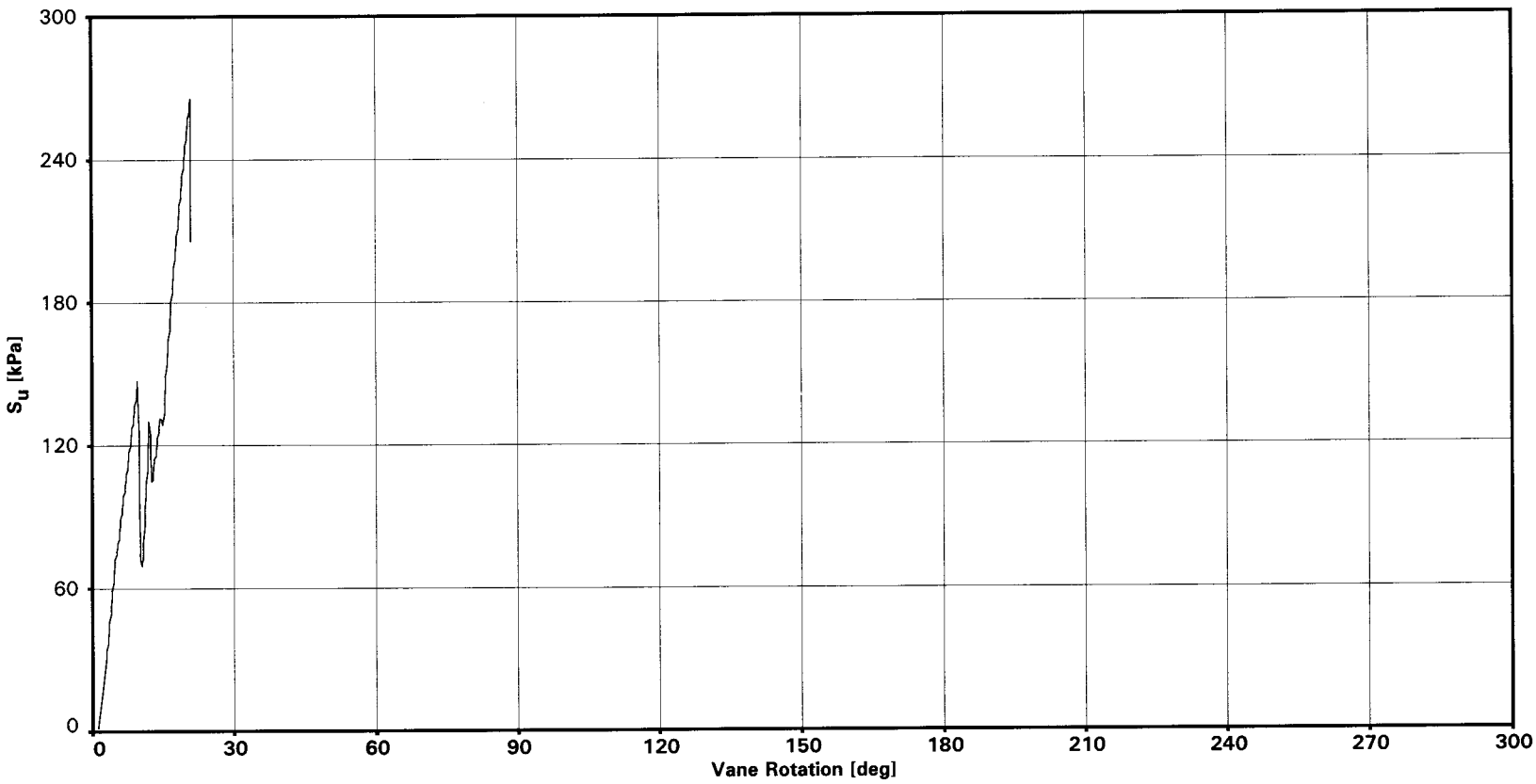
FUGRO

PLATE 98-51.2j

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 59.4m
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-51.2k

98-51		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
1.7	1	15																									
3.2	2	22					8																				
4.9	3	75	75	20	1.00																						
6.4	4	36	43	21	0.67																						2.75
6.6	5					17.7																					
6.7	6							31.6			32.0	14.2															
7.6	400													36.9													
8.1	8	43	50	23	0.76	17.1		33.5			27.1	6.9			24.4		1.2										
8.2	9							29.7																			
9.1	401													36.4													
10.7	402													45.0													
11.2	10	47	50	21	0.88																					C	
11.3	11	14	23	14	0.10		61																				
12.4	12	17					24																				
12.7	13	21					15																				

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-51		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
14.1	14	31					8																				
15.7	15	25					9																				
17.2	16	22					25																				
18.6	17								119.7																		
18.7	18	31	52	20	0.34	19.7		153.2																			2.71
18.9	19							107.7			128.7																
19.8	403													111.1													
20.4	404													97.2													
21.5	20								119.7																		
21.6	21								119.7																		
21.8	22	28	60	18	0.23	18.8		155.6							87.1	70.0	1.1										
21.9	23										179.5																
22.9	405													219.8													
23.5	406													265.7+													
24.9	24	45	66	25	0.50																					C	

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-51		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
25.0	25	49	71	26	0.51						121.3																
25.9	407													121.1													
26.5	408													152.7													
27.9	27	27	48	19	0.27	19.6		126.9							156.0		1.2										
28.0	28										200.5																
29.0	409													130.7													
29.6	410													147.0													
30.9	30	35	56	23	0.37										86.2	24.5	3.7										
31.1	31							74.2			151.0																
32.0	411													127.8													
32.6	412													197.7													
34.0	32	44	66	27	0.43																					C	
34.1	33										169.5																
35.1	413													120.2													
35.7	414													127.8													

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-51		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
37.2	35	30	64	22	0.19	18.9					169.5																
38.1	415													265.7+													
39.9	36							143.6																			
40.1	37	35	63	22	0.32	17.5									116.7		3.0										
40.2	38							143.6			136.1																
41.1	416													260.9+													
41.8	417													265.7+													
43.2	39	26	42	19	0.29				215.5																	C	
43.3	40	28	48	25	0.16						214.1																
46.0	41								153.2																		
46.2	42	22	42	17	0.20	20.2									184.6	101.2	2.6										
46.3	43	21						179.6			174.5																
49.1	44								210.3																		
49.2	45	34	81	26	0.15	18.5									211.0		0.6										
49.4	46										222.8+																

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Identification Tests
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c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

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RC = Resonant Column
CS = Cyclic Simple Shear

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Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-51		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
52.3	47	37	76	27	0.21																					C	
52.4	48	40	75	26	0.27																						
55.2	49								215.5																		
55.3	50	21	28	18	0.38	18.5									224.7		2.6										
58.4	52	47	81	28	0.36	17.6									220.3		1.3										
58.5	53							179.6																			
59.4	418													265.7+													
61.5	54	46	79	27	0.36																					C	
61.6	55	46	79	26	0.38																						
64.3	56								158.0																		
64.5	57	42	70	20	0.44	18.1									168.9	57.3	2.4										
64.6	58							153.2																			
67.5	61	49	63	22	0.65	16.9			177.2						188.9		1.9										
70.6	62	31	68	27	0.11																					C	
70.7	63	41	71	18	0.43						206.7																

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

SFOBB Task Order No. 5
Project No. 98-42-0058

98-51		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
70.7	63	43																									

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

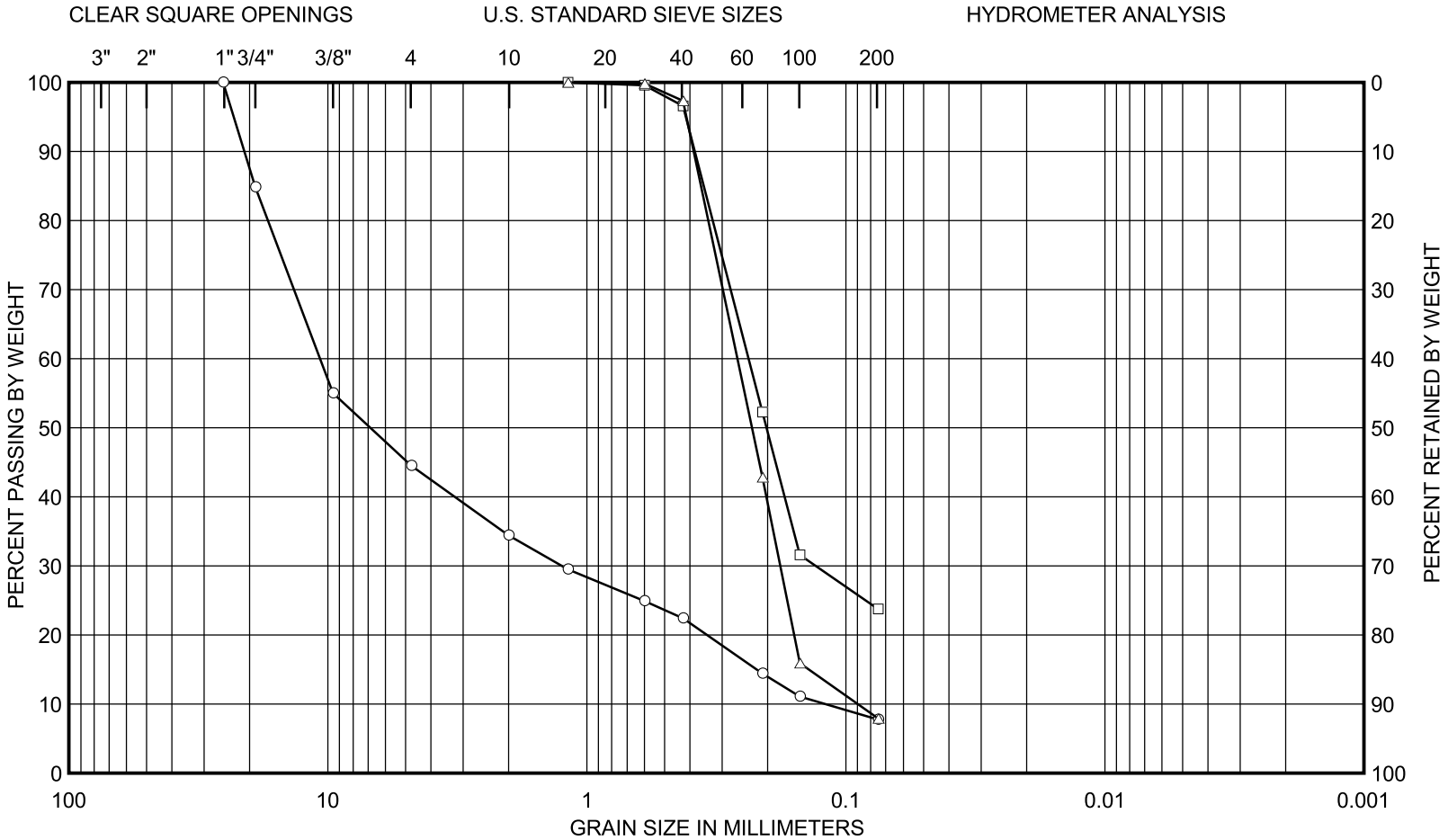
SUMMARY OF LABORATORY TEST RESULTS
Boring 98-51
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-51.3f

c:\snfco-oak\odb\8.5x11\98-51sumf.odb



GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
2	3.2	○——○	FINE GRAVEL (GW-GM) with silt, fine to coarse sand, and coarse gravel	1.2	89.3	6.8
12	12.4	□——□	FINE SAND (SP) with many large clay pockets			0.20
14	14.1	△——△	FINE SAND (SP-SM) with silt	1.4	2.9	0.23

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-51
SFOBB East Span Seismic Safety Project

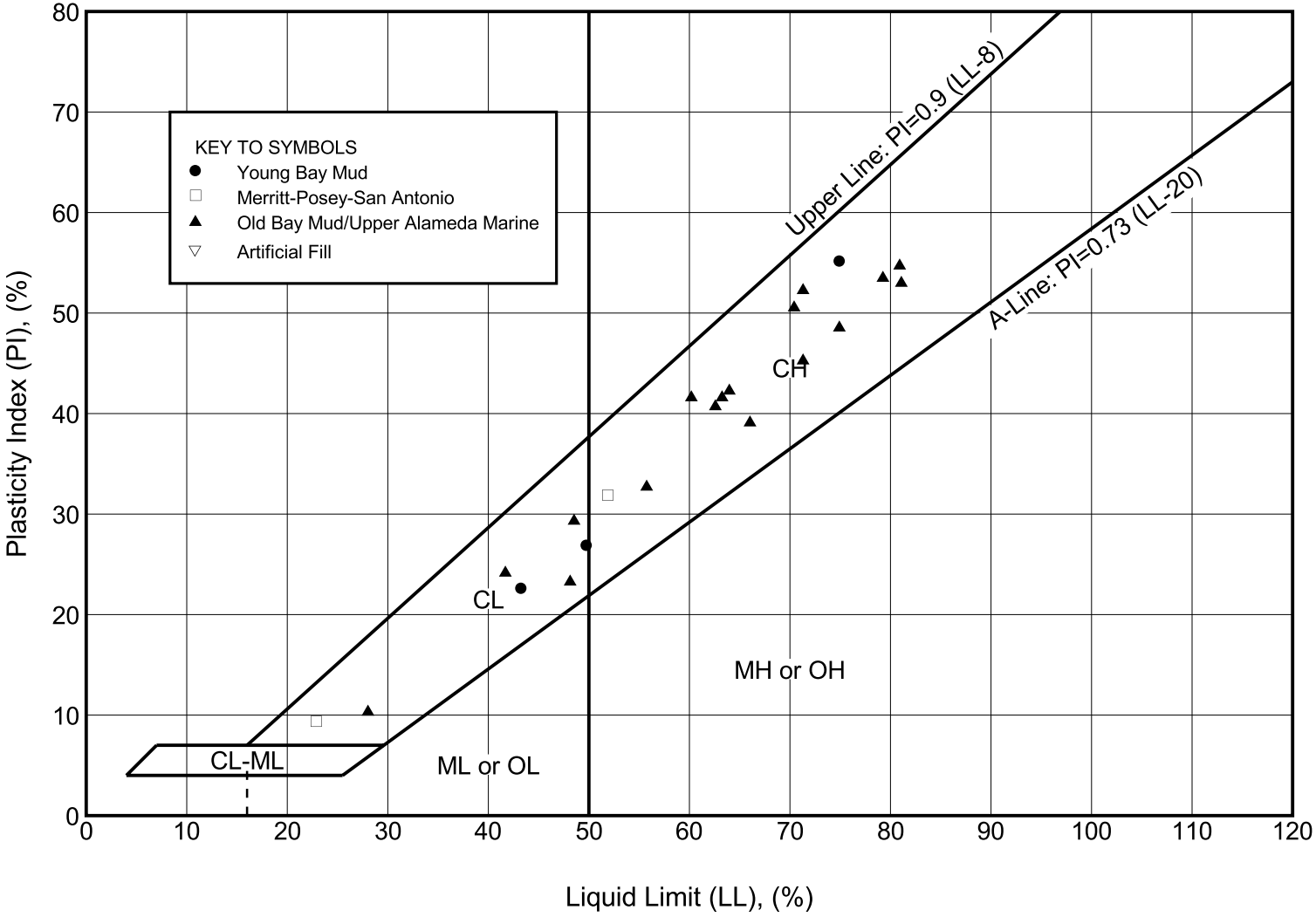
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-51.4

c:\snfco-oak\odb\8.5x11\9851grn.odb



PLASTICITY CHART
Boring 98-51
SFOBB East Span Seismic Safety Project

i:\caltrans\ 03/77/YY
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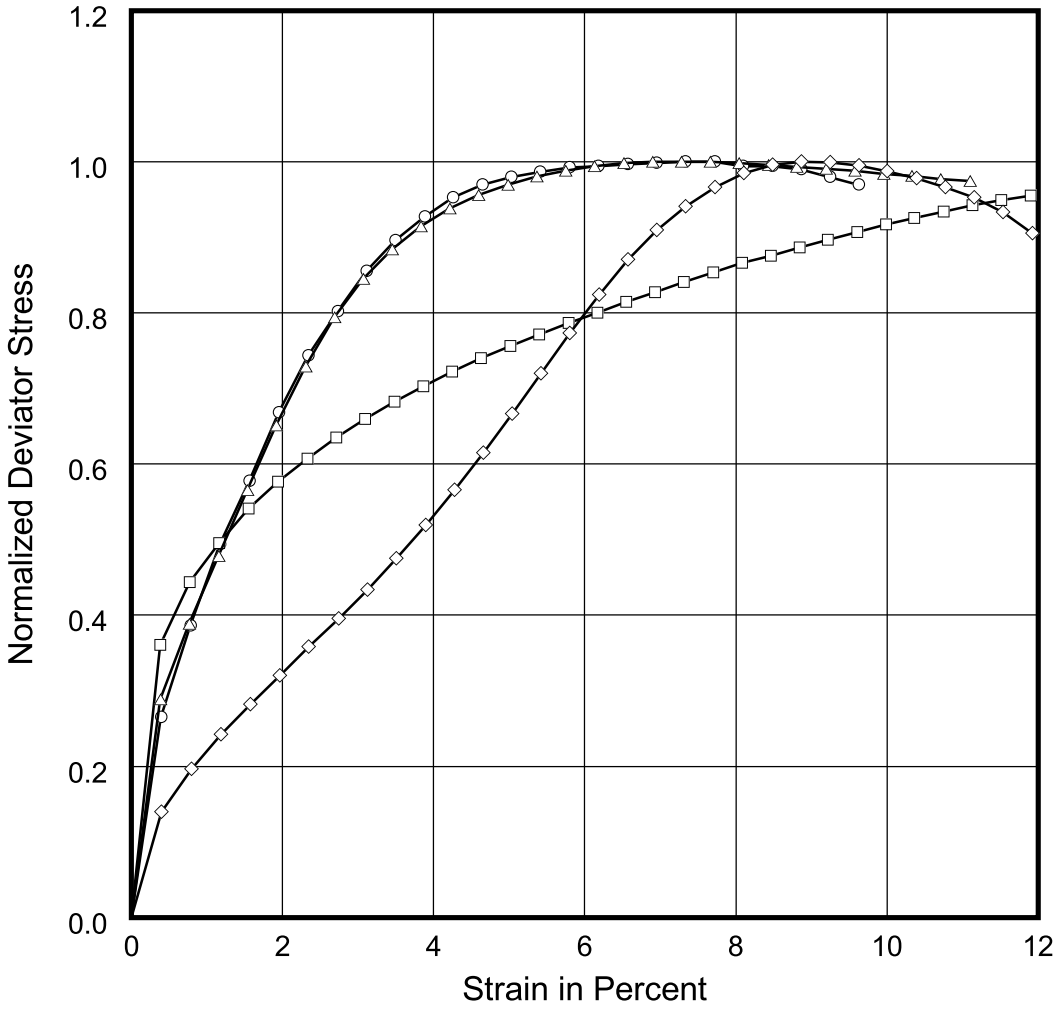
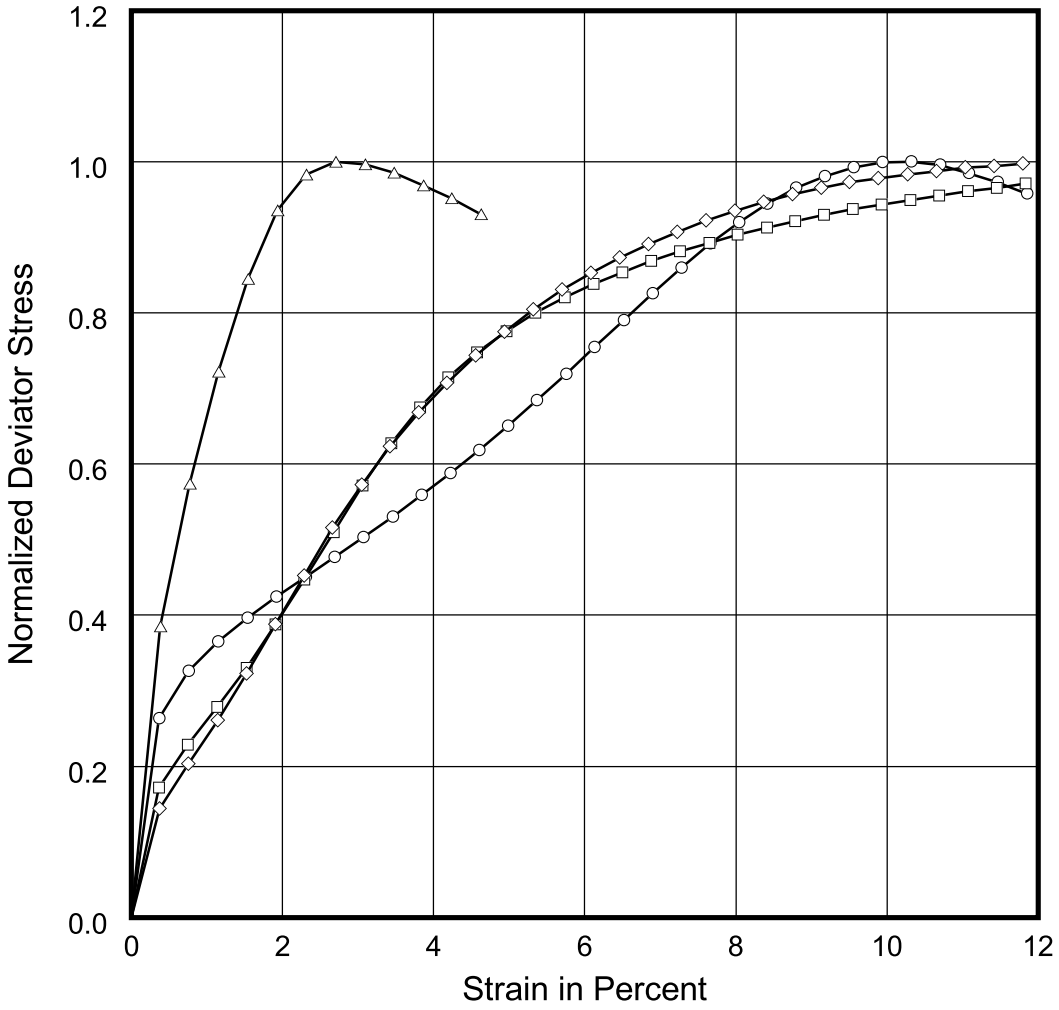


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○	8	8.1	UU	172	49	1.2
□	22	21.8	UU	758	174	1.1
△	27	27.9	UU	862	312	1.2
◇	30	30.9	UU	931	172	3.7

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-51
SFOBB East Span Seismic Safety Project



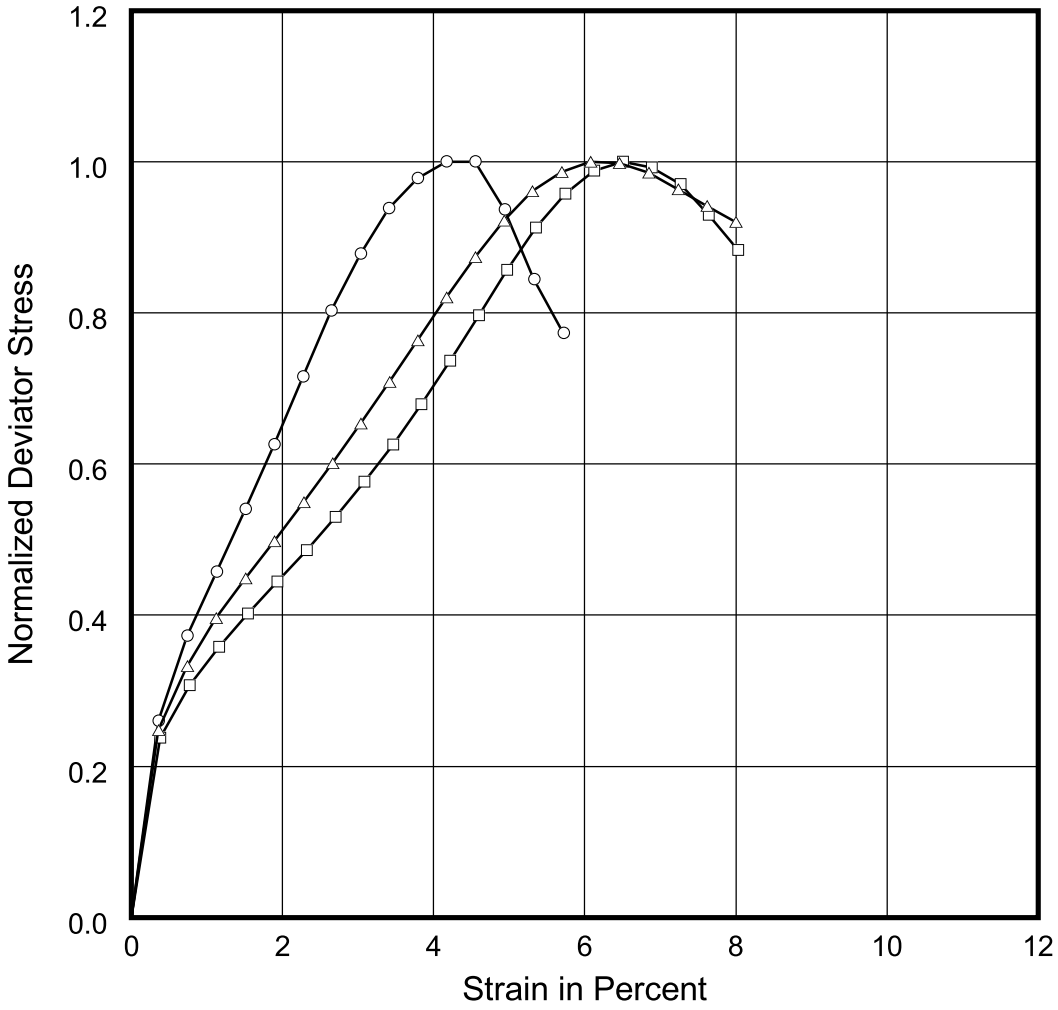
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
⊙——○	37	40.1	UU	1103	233	3.0
⊡——□	42	46.2	UU	1207	369	2.6
△——△	45	49.2	UU	1275	422	0.6
◇——◇	50	55.3	UU	1379	449	2.6

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-51
SFOBB East Span Seismic Safety Project

PLATE 98-51.6b

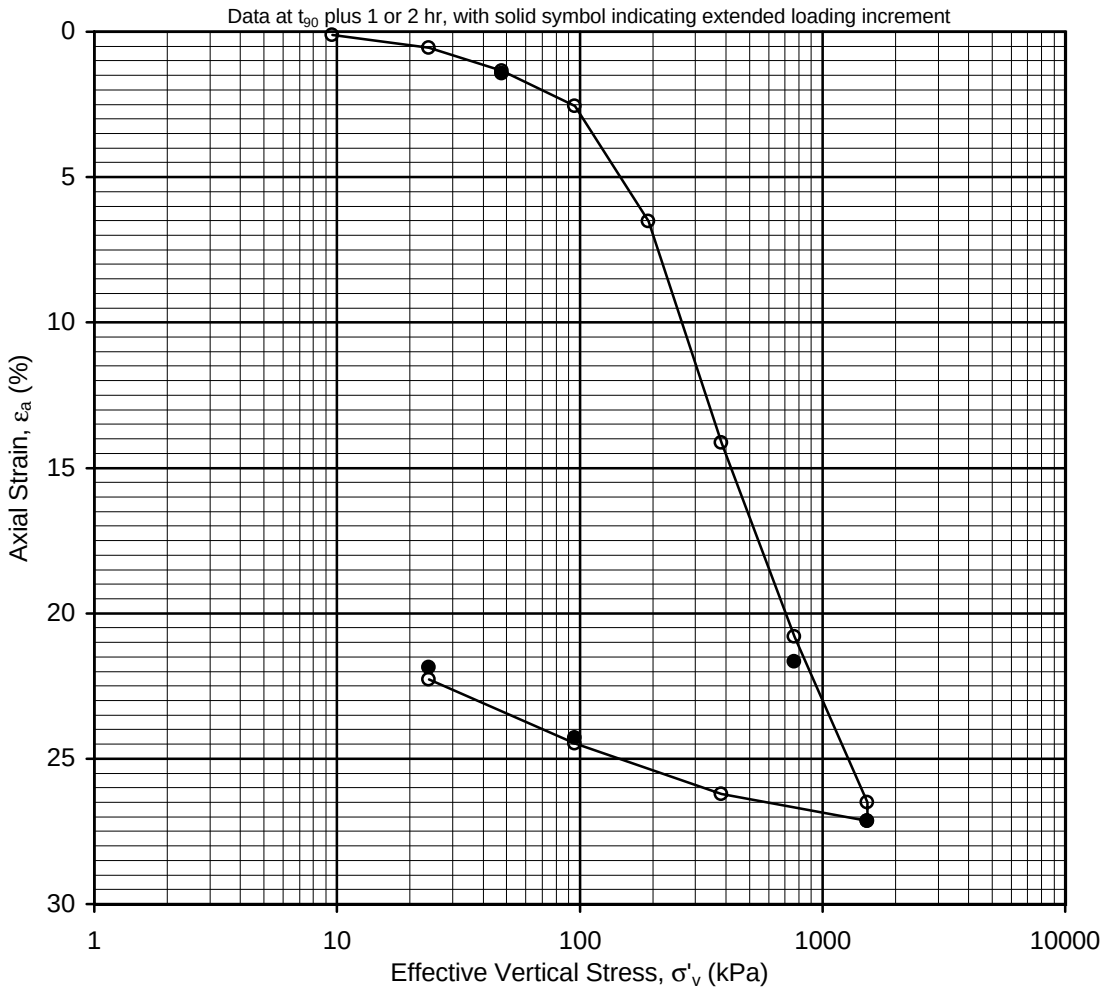


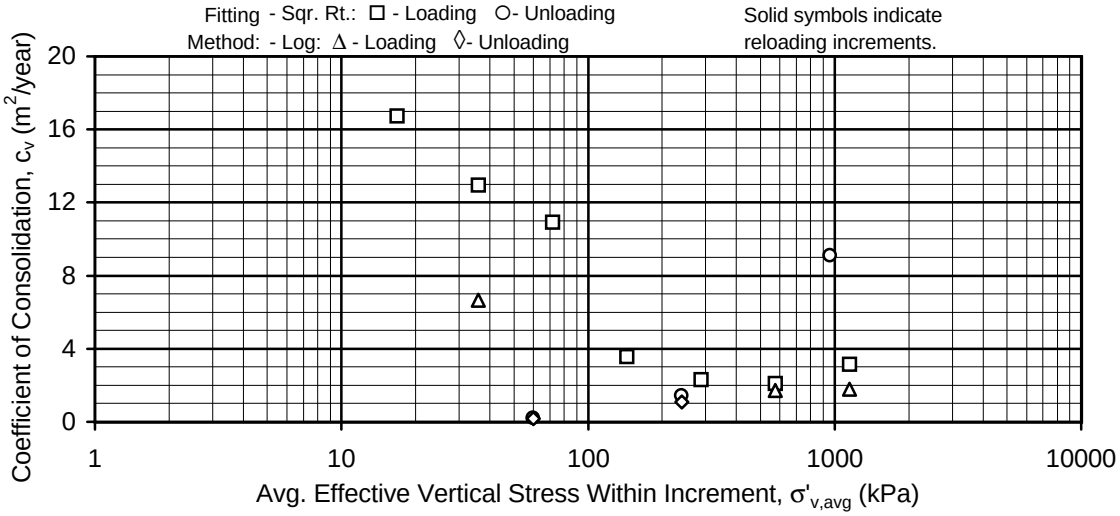
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	52	58.4	UU	1448	441	1.3
□——□	57	64.5	UU	1551	338	2.4
△——△	61	67.5	UU	1620	378	1.9

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

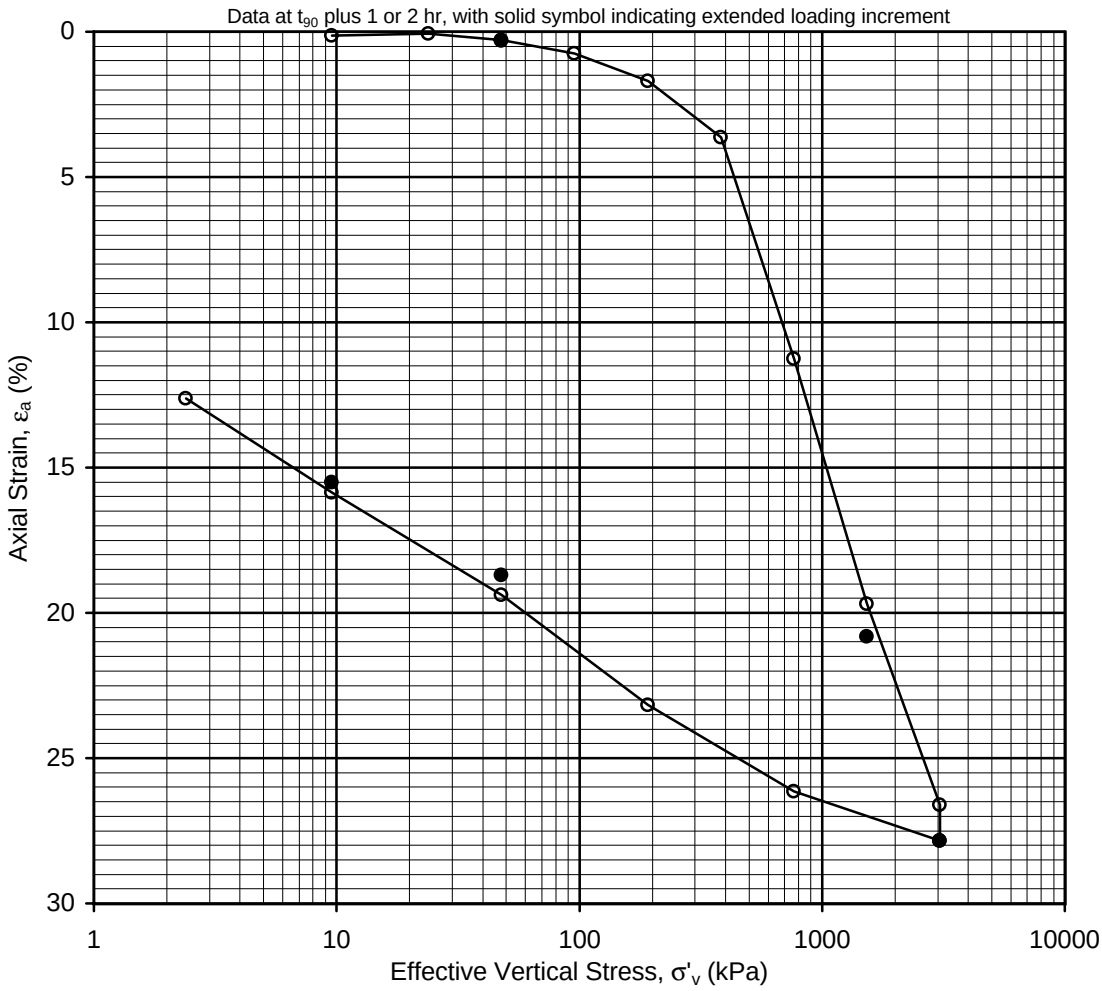
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-51
SFOBB East Span Seismic Safety Project

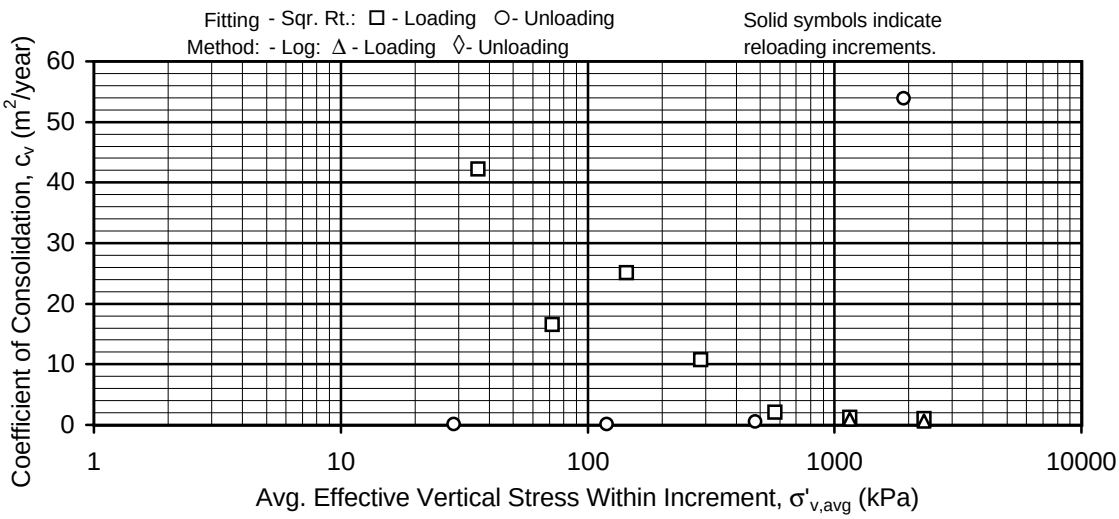




INCREMENTAL CONSOLIDATION TEST RESULTS

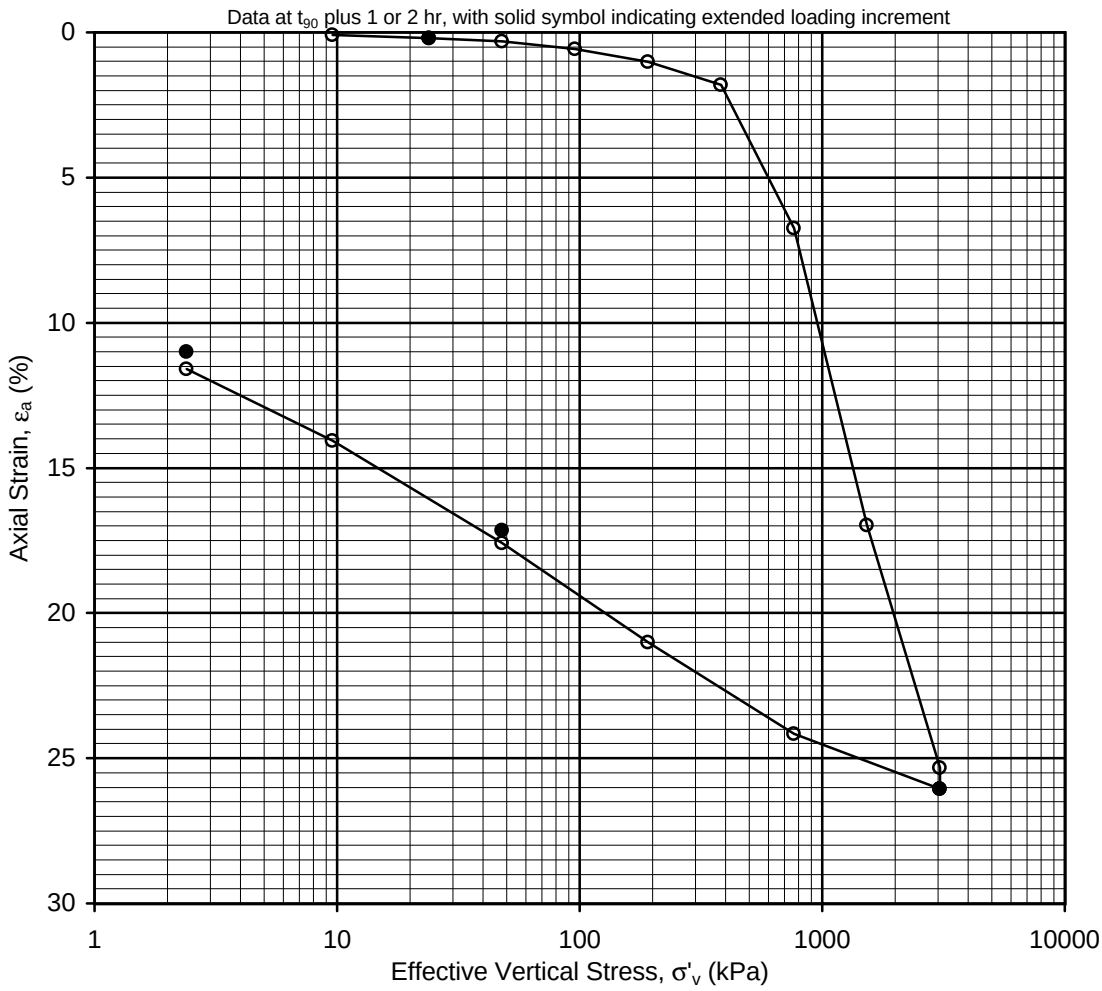
Sample No. 10 - Depth: 10.9m
Boring 98-51
SFOBB East Span Seismic Safety Project

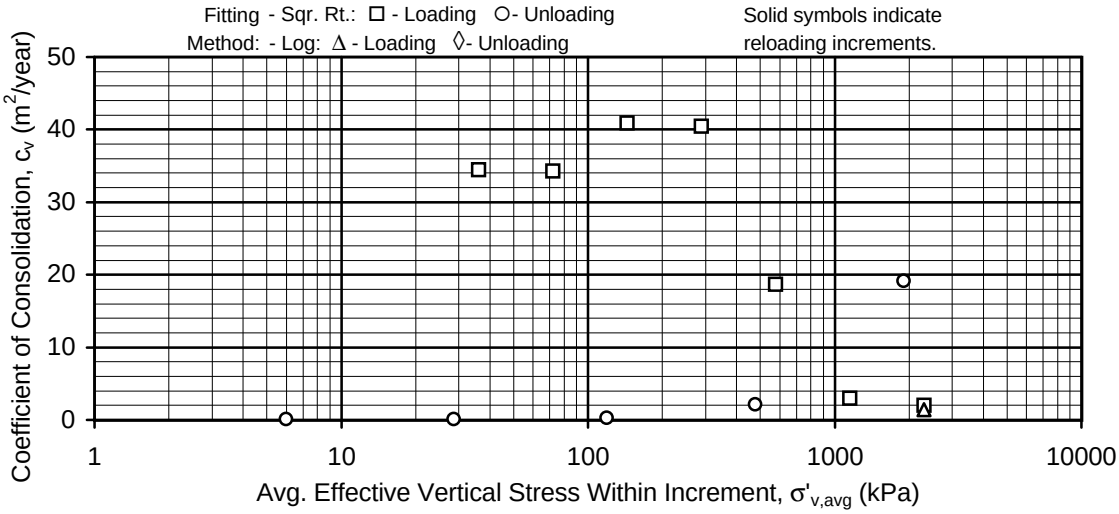




INCREMENTAL CONSOLIDATION TEST RESULTS

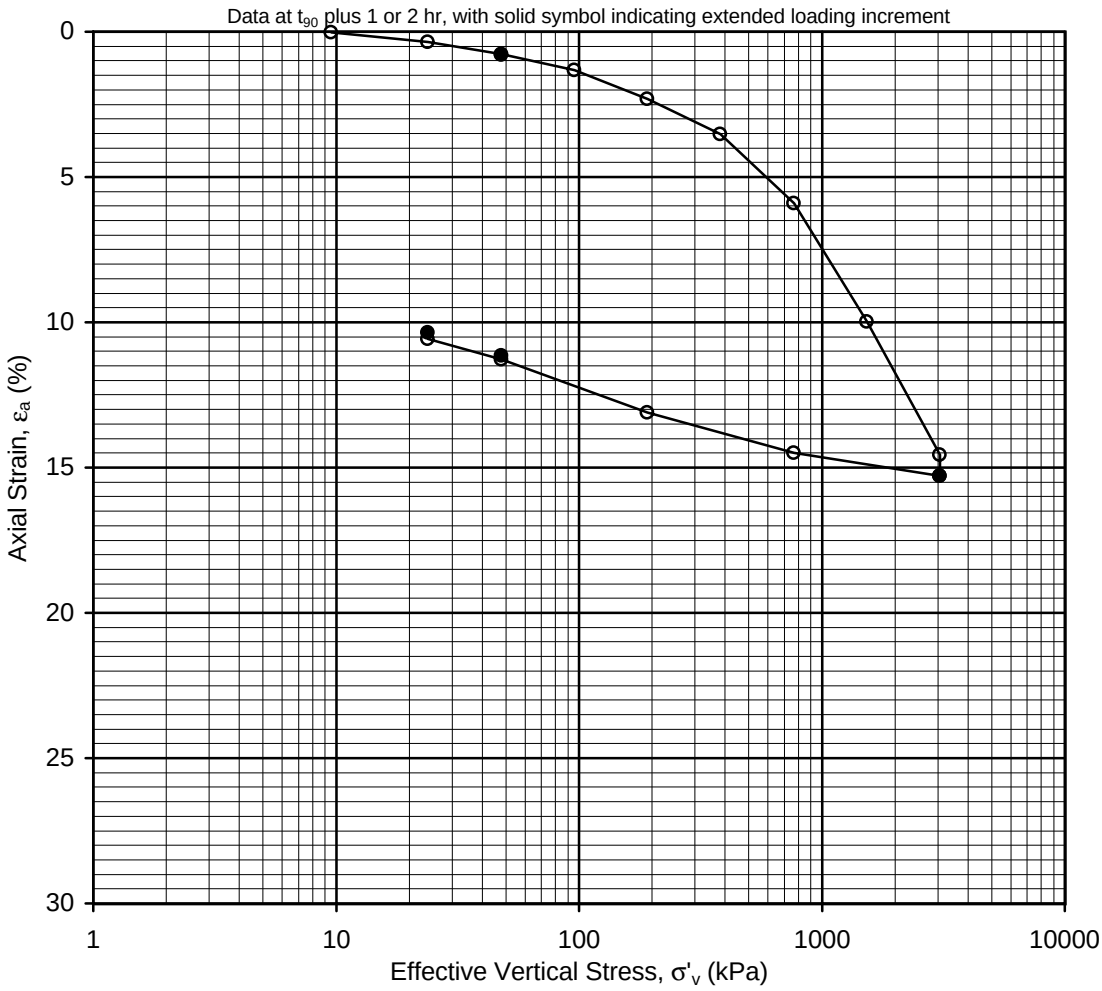
Sample No. 24 - Depth: 24.8m
Boring 98-51
SFOBB East Span Seismic Safety Project

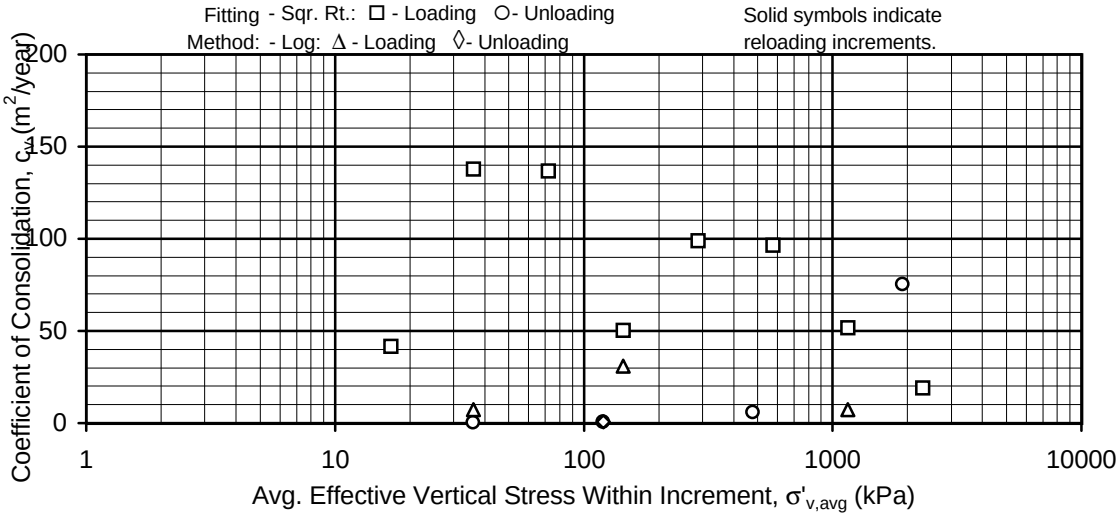




INCREMENTAL CONSOLIDATION TEST RESULTS

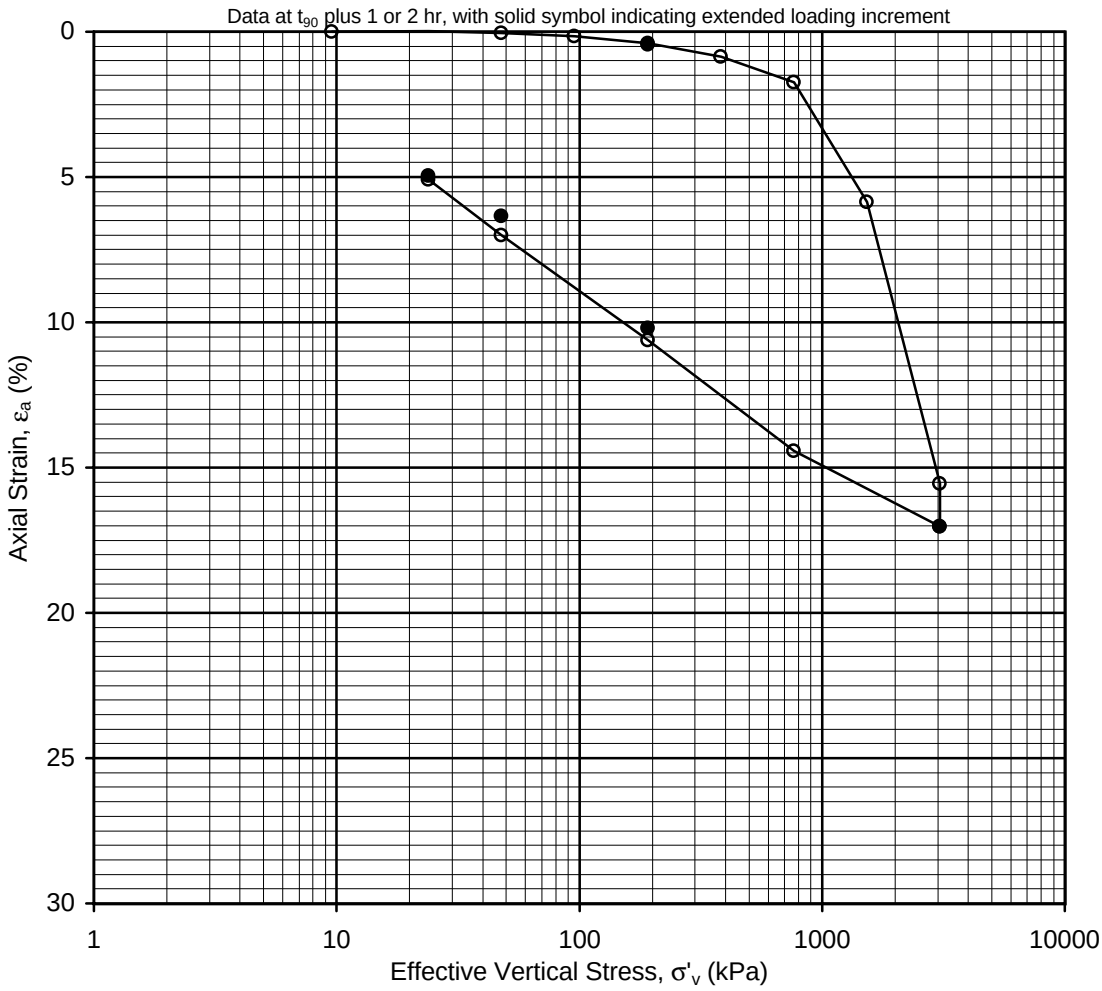
Sample No. 32 - Depth: 33.8m
Boring 98-51
SFOBB East Span Seismic Safety Project

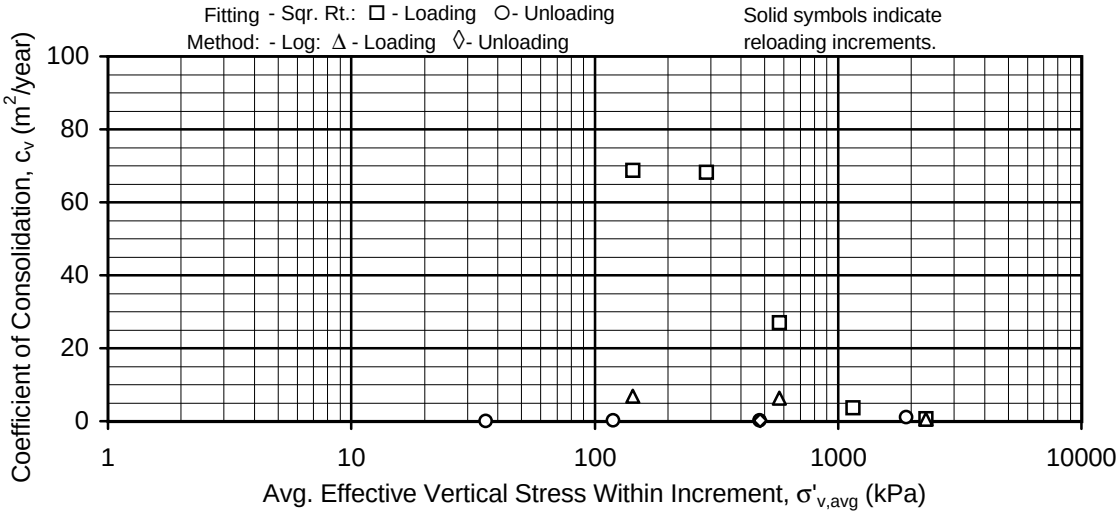




INCREMENTAL CONSOLIDATION TEST RESULTS

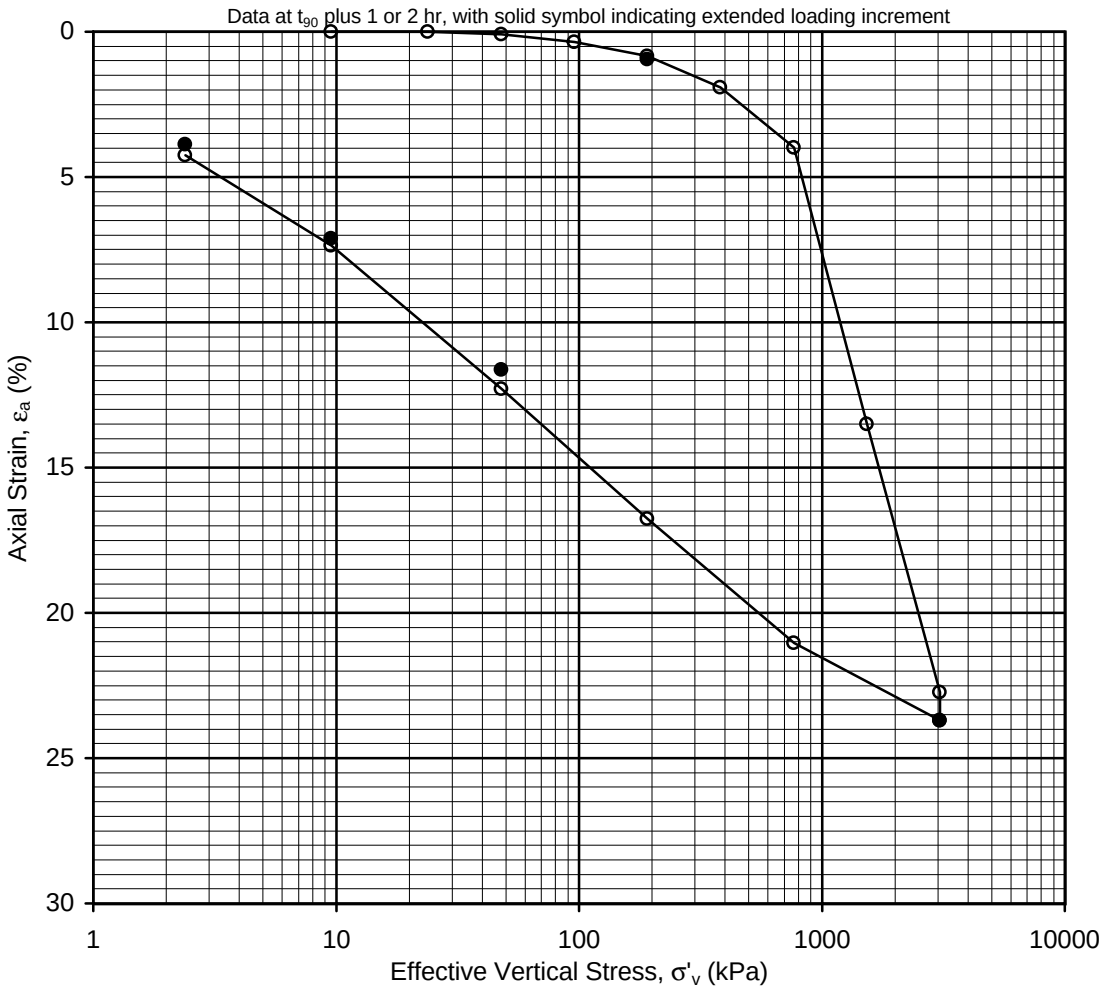
Sample No. 39 - Depth: 42.9m
Boring 98-51
SFOBB East Span Seismic Safety Project

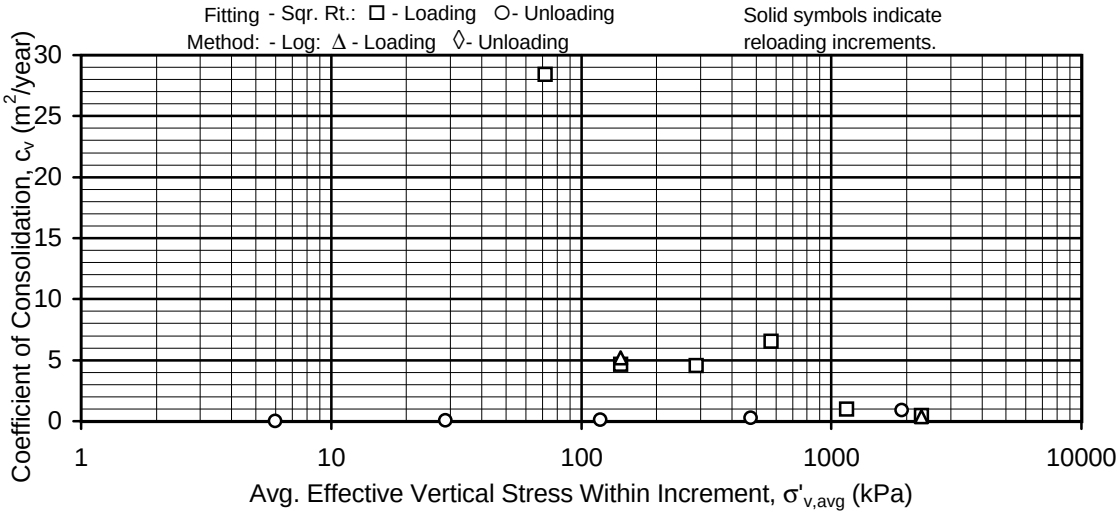




INCREMENTAL CONSOLIDATION TEST RESULTS

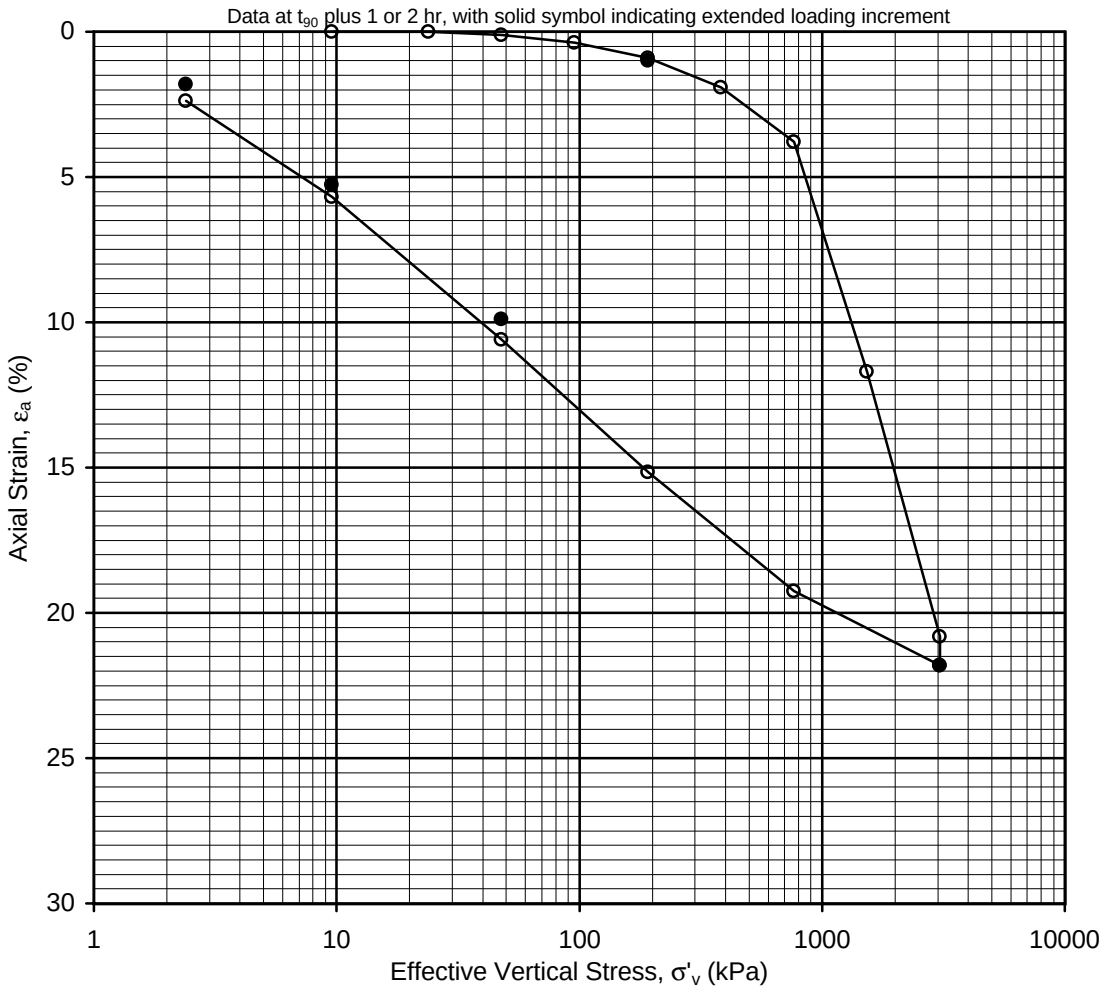
Sample No. 47 - Depth: 49.2m
Boring 98-51
SFOBB East Span Seismic Safety Project

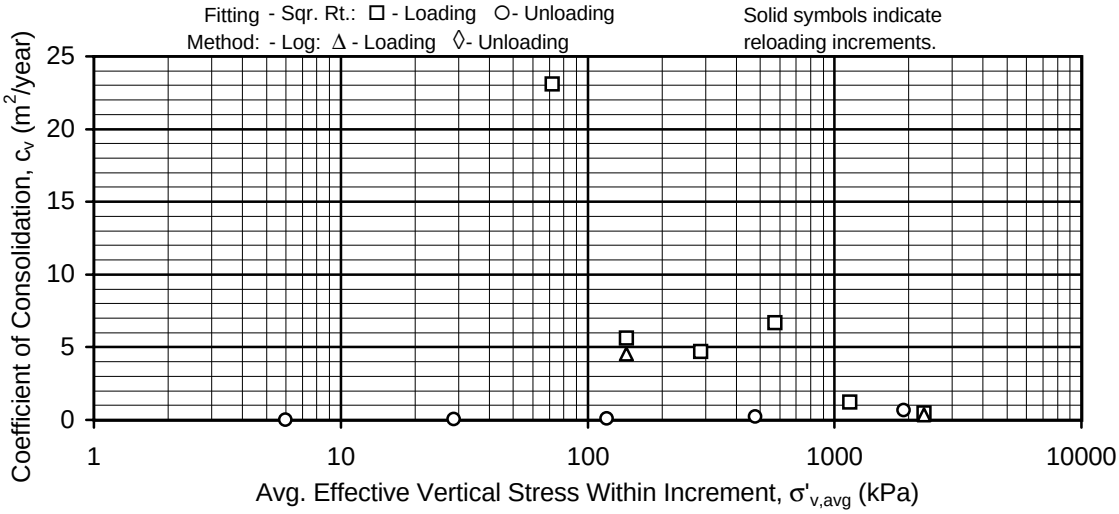




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 54 - Depth: 61.5m
Boring 98-51
SFOBB East Span Seismic Safety Project





INCREMENTAL CONSOLIDATION TEST RESULTS

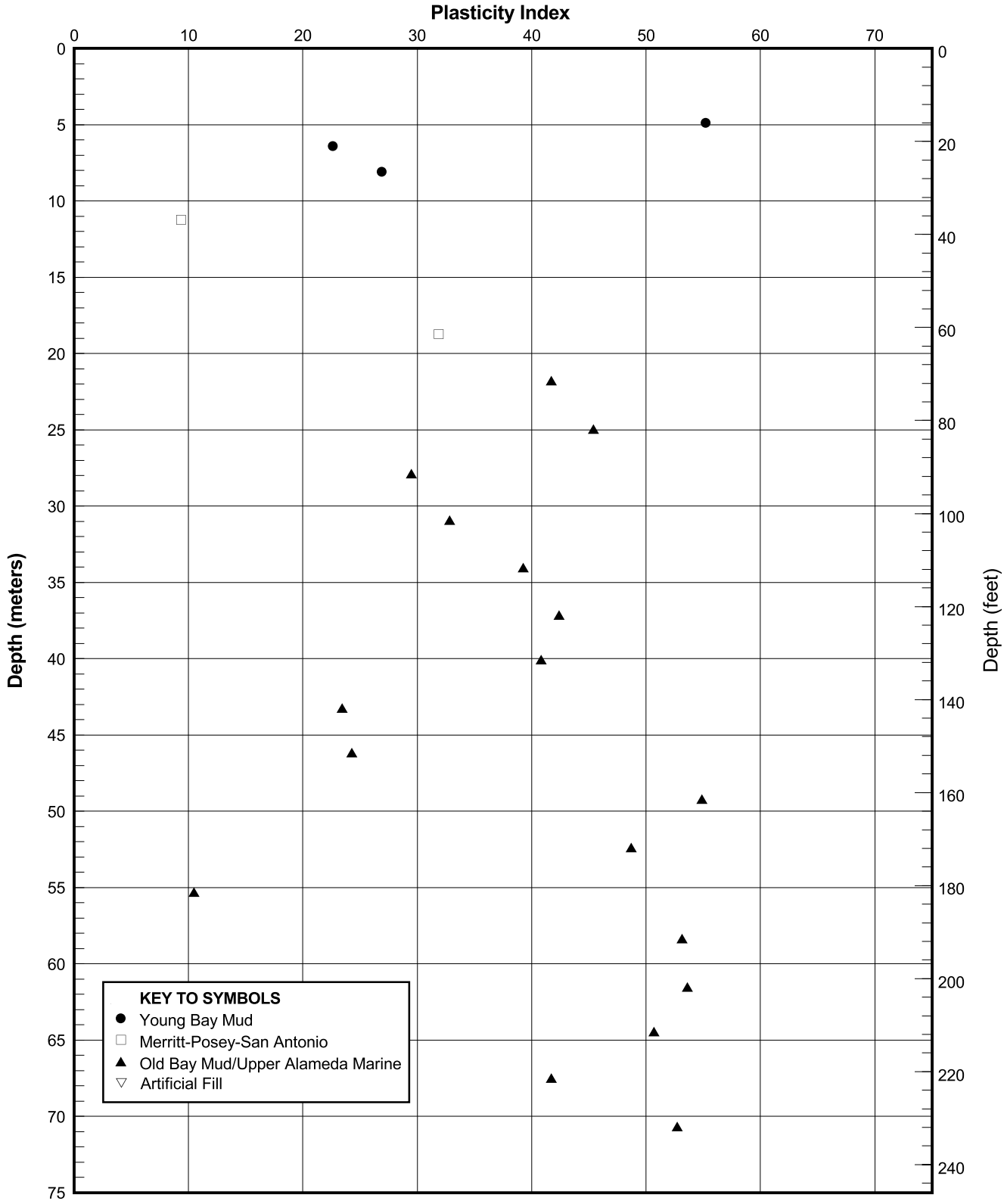
Sample No. 62 - Depth: 70.3m
Boring 98-51
SFOBB East Span Seismic Safety Project

No Consolidated-Undrained Triaxial Compression Testing Performed For This Boring

No Consolidated-Drained Triaxial Compression Testing Performed For This Boring

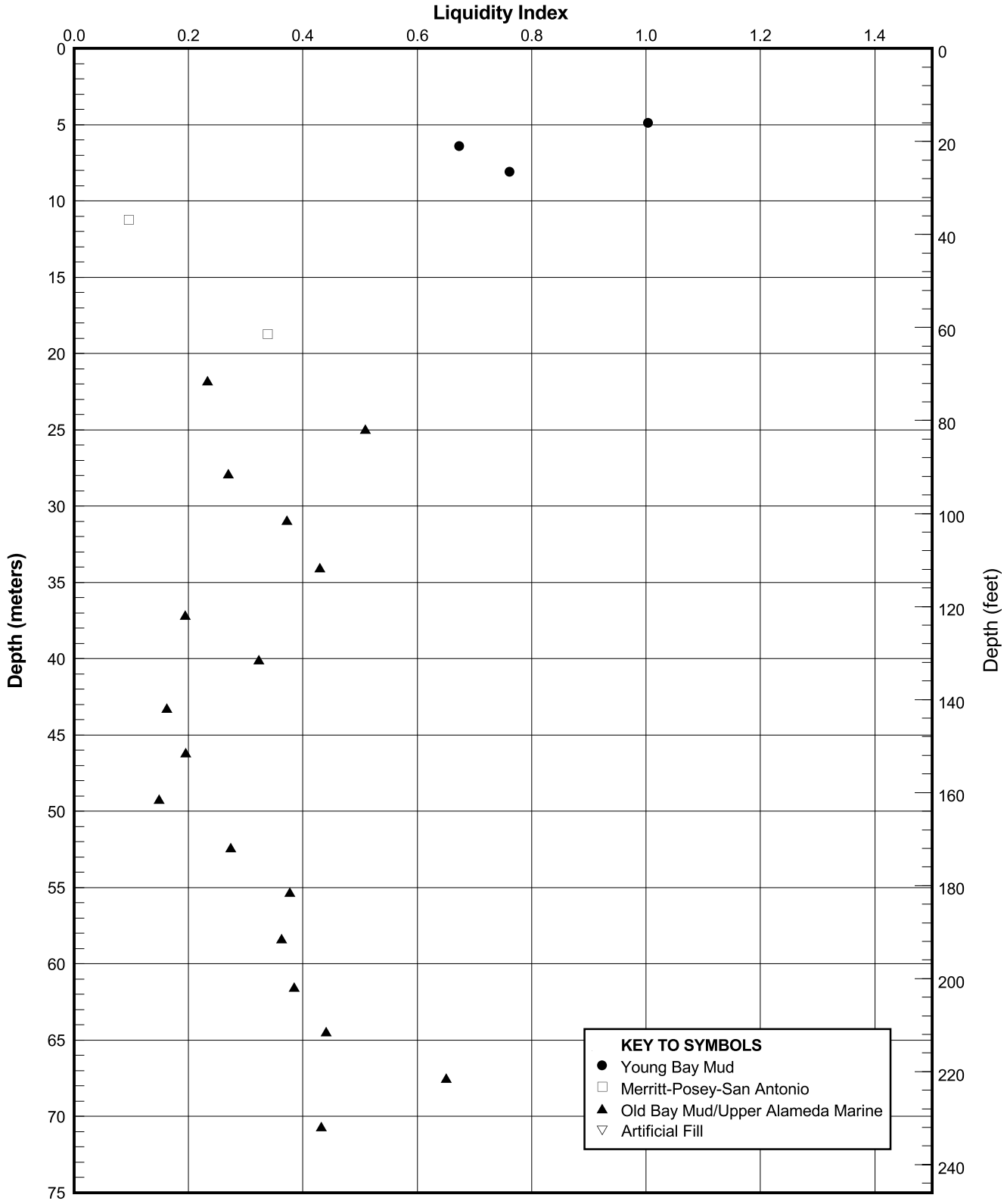
No R-Value Laboratory Testing Performed For This Boring

No Corrosion Testing Performed For This Boring



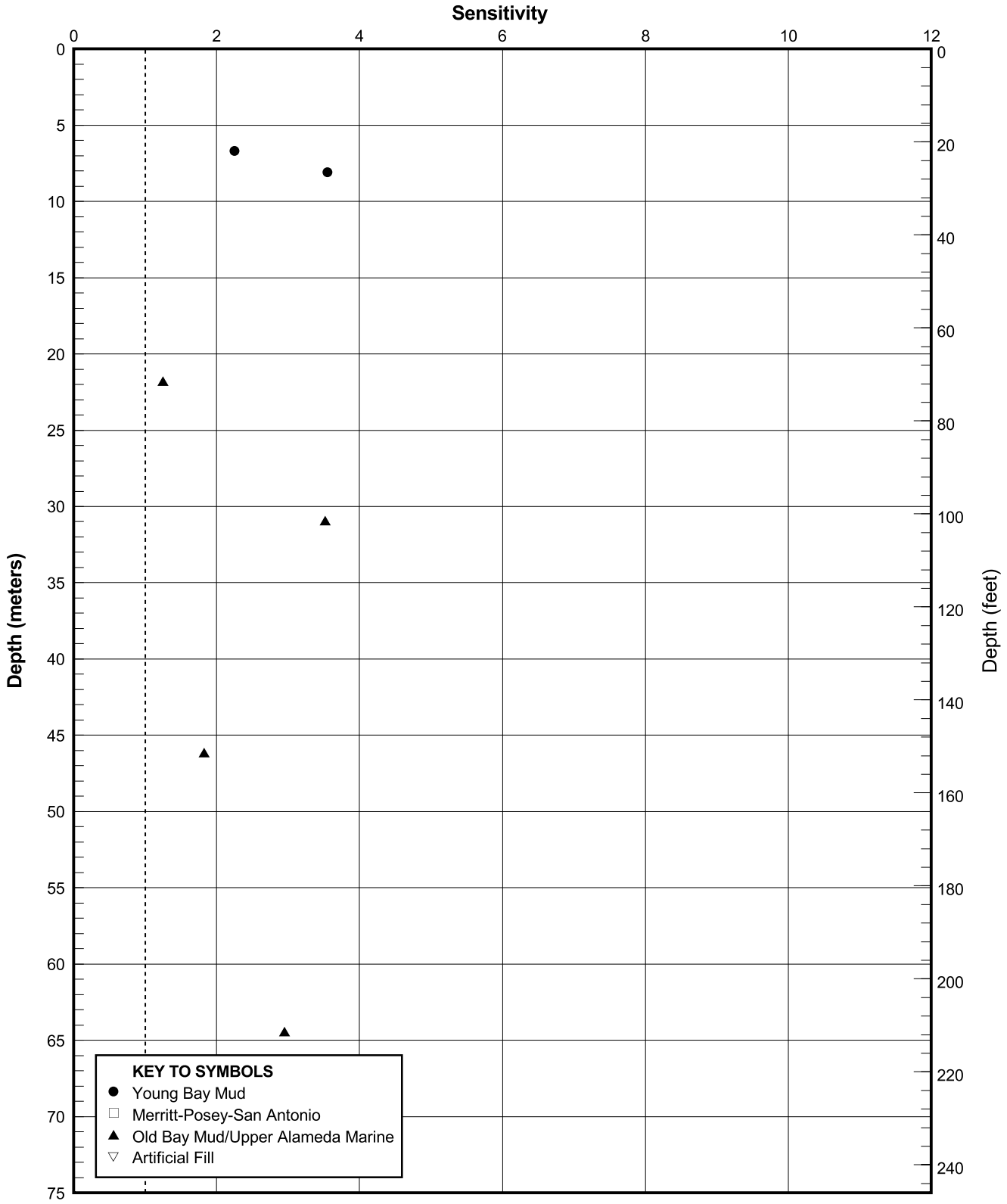
PLASTICITY INDEX PROFILE
Boring 98-51
SFOBB East Span Seismic Safety Project

PLATE 98-51.12



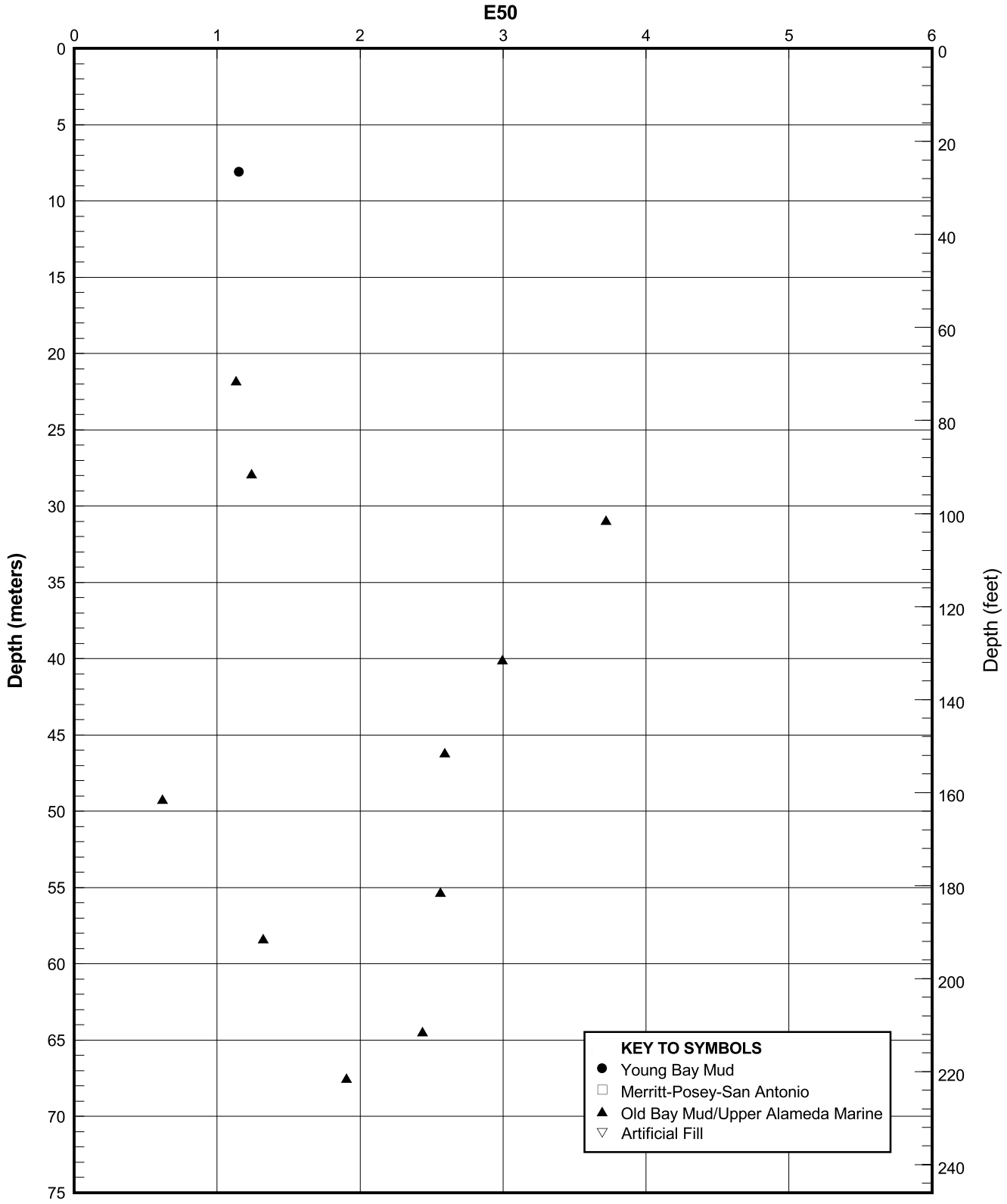
LIQUIDITY INDEX PROFILE
Boring 98-51
SFOBB East Span Seismic Safety Project

PLATE 98-51.13



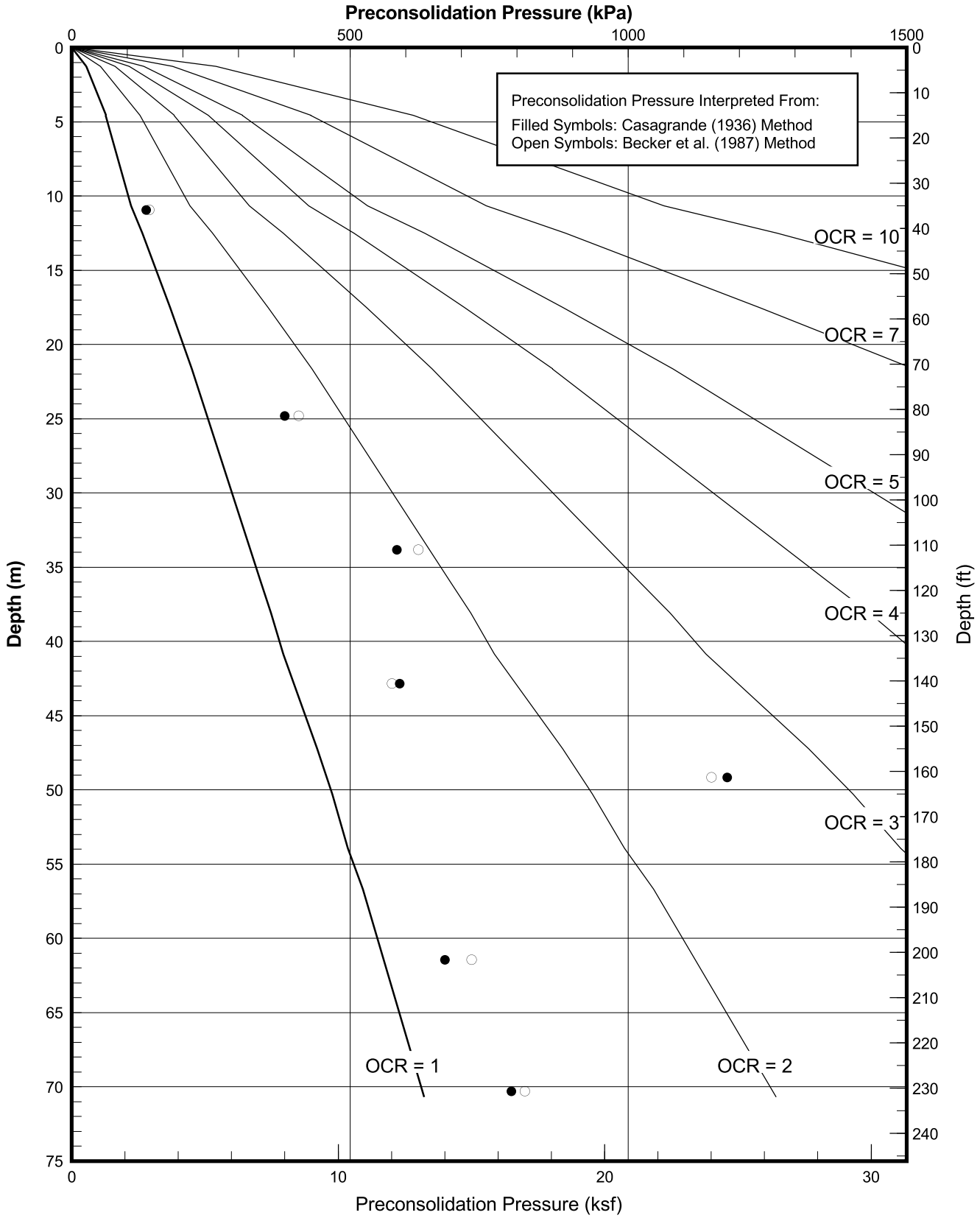
SENSITIVITY PROFILE
Boring 98-51
SFOBB East Span Seismic Safety Project

PLATE 98-51.14



E50 PROFILE
Boring 98-51
SFOBB East Span Seismic Safety Project

PLATE 98-51.15



PRECONSOLIDATION PRESSURE INTERPRETED FROM LABORATORY DATA

Boring 98-51

SFOBB East Span Seismic Safety Project

PLATE 98-51.16

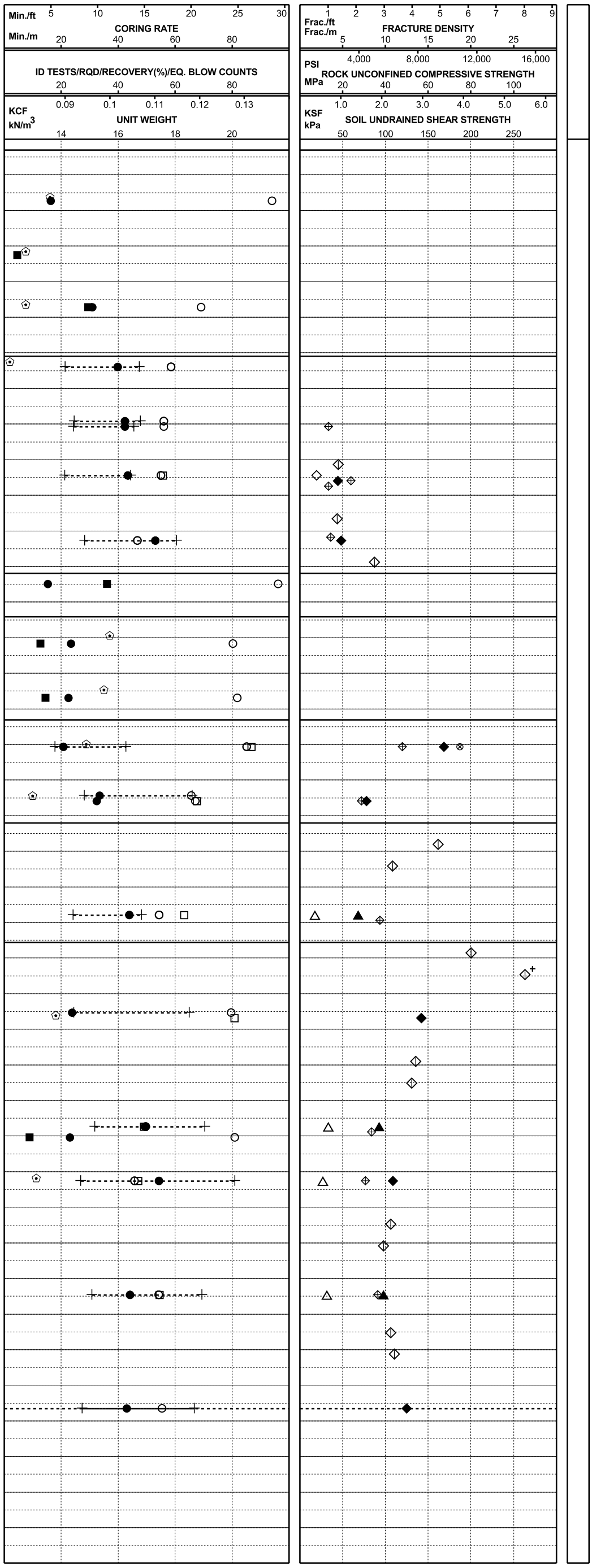
LAND BORING 98-52

PROJECT NO:	98-42-0058	**START DATE:**	10/12/98	**DRILLER:**	Pitcher Drilling Company
BORING:	98-52 (Centerline E. Sta. 84+69)	**COMPLETION DATE:**	10/12/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838962 N648256
CA State Plane Zone 3, NAD83, Meters

GROUND ELEVATION: 1.7m (MSL)

Material Description	Blow Count	Stratum No.
PAVEMENT, 0.1m Asphalt Concrete over 0.2m of Aggregate Base (0.3m)		I
GRAVEL with sand (GW), loose to medium dense, brown		
-medium to coarse sand with gravel, at 1.7m (1.7m)	16	
	12	II
-gray, silty fine sand with fine to coarse gravel and clay pockets, below 4.6m (6.1m)	12	
Fat CLAY (CH), firm to stiff, olive gray	3	
-with shells and shell fragments		
-lean clay to 10.1m	PUSH	
-with a few silt pockets, a few silty fine sand pockets, and an H2S odor, at 9.4m	PUSH	III
-with a few silt pockets at 11.0m (12.2m)	SAVE	
-Clayey SAND (SC), dense, greenish gray	PUSH	
-with fat clay seams at 12.2m (13.4m)		IV
Silty Fine SAND (SM), dense, yellowish brown		
-with clay pockets at 12.2m	37	
-with black organic pockets and clay partings, at 15.2m (16.3m)	35	V
Fat CLAY (CH), stiff to very stiff, greenish gray		
-lean clay with many sand pockets, to 17.7m	46	
(19.2m)	16	VI
Fat CLAY (CH), stiff to very stiff, greenish gray		
-with organic pockets, silt partings, silty fine sand pockets and desiccated pockets, at 21.6m (22.6m)	PUSH	VII
Fat CLAY (CH), very stiff, greenish gray		
-with sand pockets at 23.8m		
-with gas blisters and black organic pockets, at 24.7m	29	
-with organic pockets and sand pockets, at 27.7m	PUSH	
-dense, greenish gray, fine sand with silt, 27.9m to 28.5m		
-with organic pockets and shell fragments, at 29.3m	18	VIII
-with silt partings at 32.3m	PUSH	
-gray below, 35.1m	SAVE	
TOTAL DEPTH: 35.7m BACKFILLED WITH: Cement Grout		



LOG OF BORING AND TEST RESULTS

BORING 98-52

SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

Report Date: 03/13/99

PLATE 98-52.1

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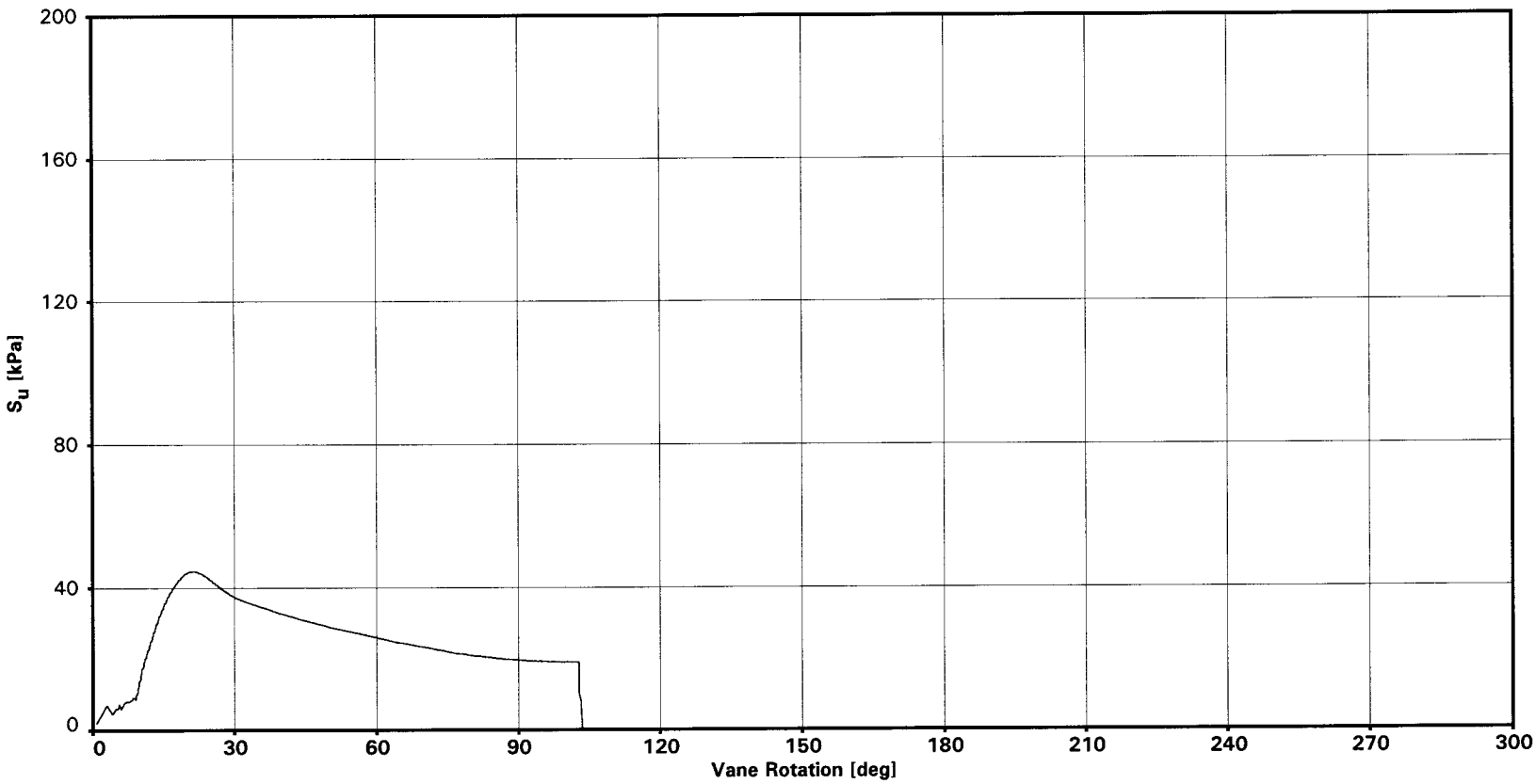
SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 9.1m
Boring 98-52
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-52.2a

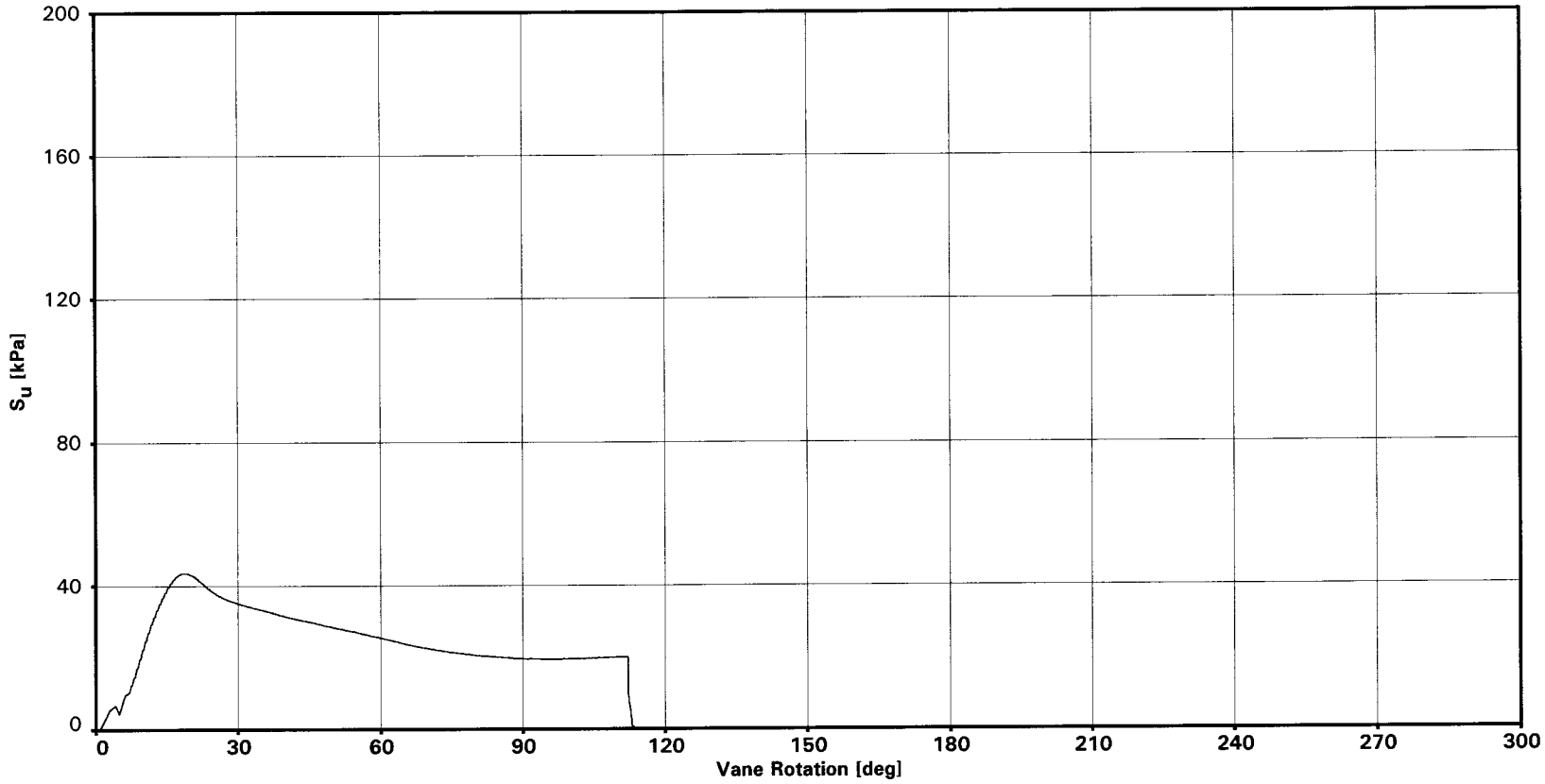
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 10.7m
Boring 98-52
SFOBB East Span Seismic Safety Project

PLATE 98-52.2b

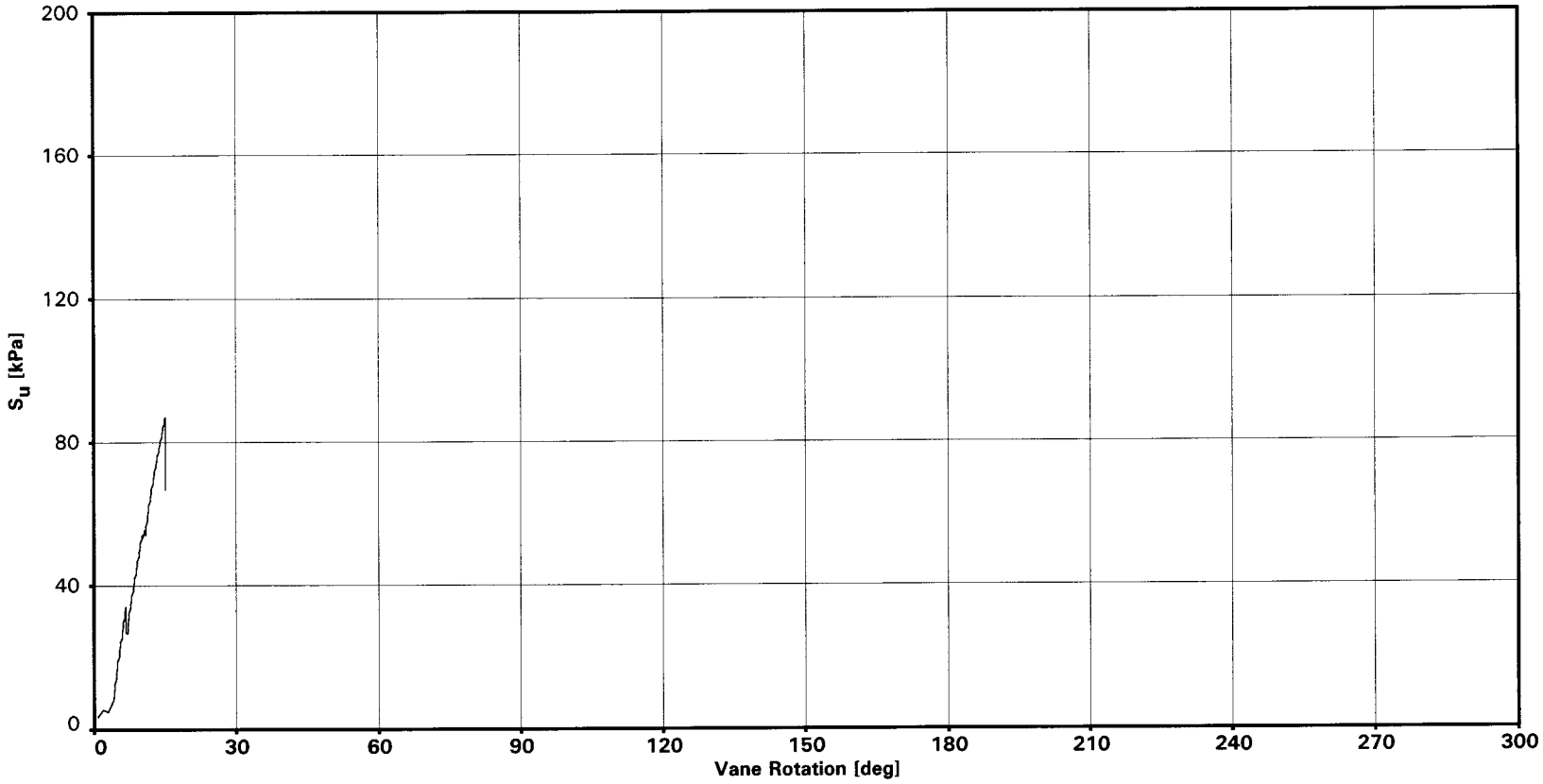
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 12.2m
Boring 98-52
SFOBB East Span Seismic Safety Project

PLATE 98-52.2c

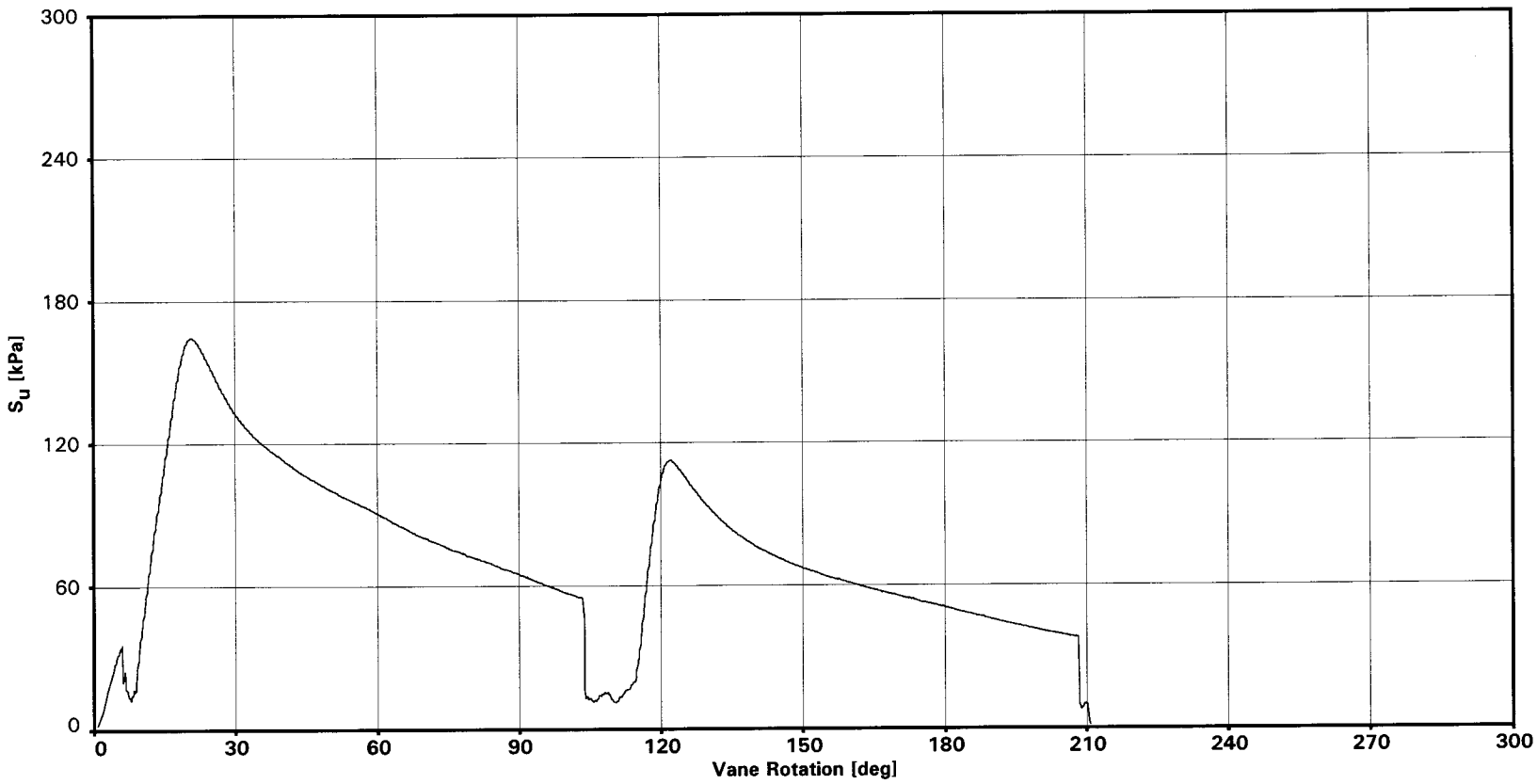
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



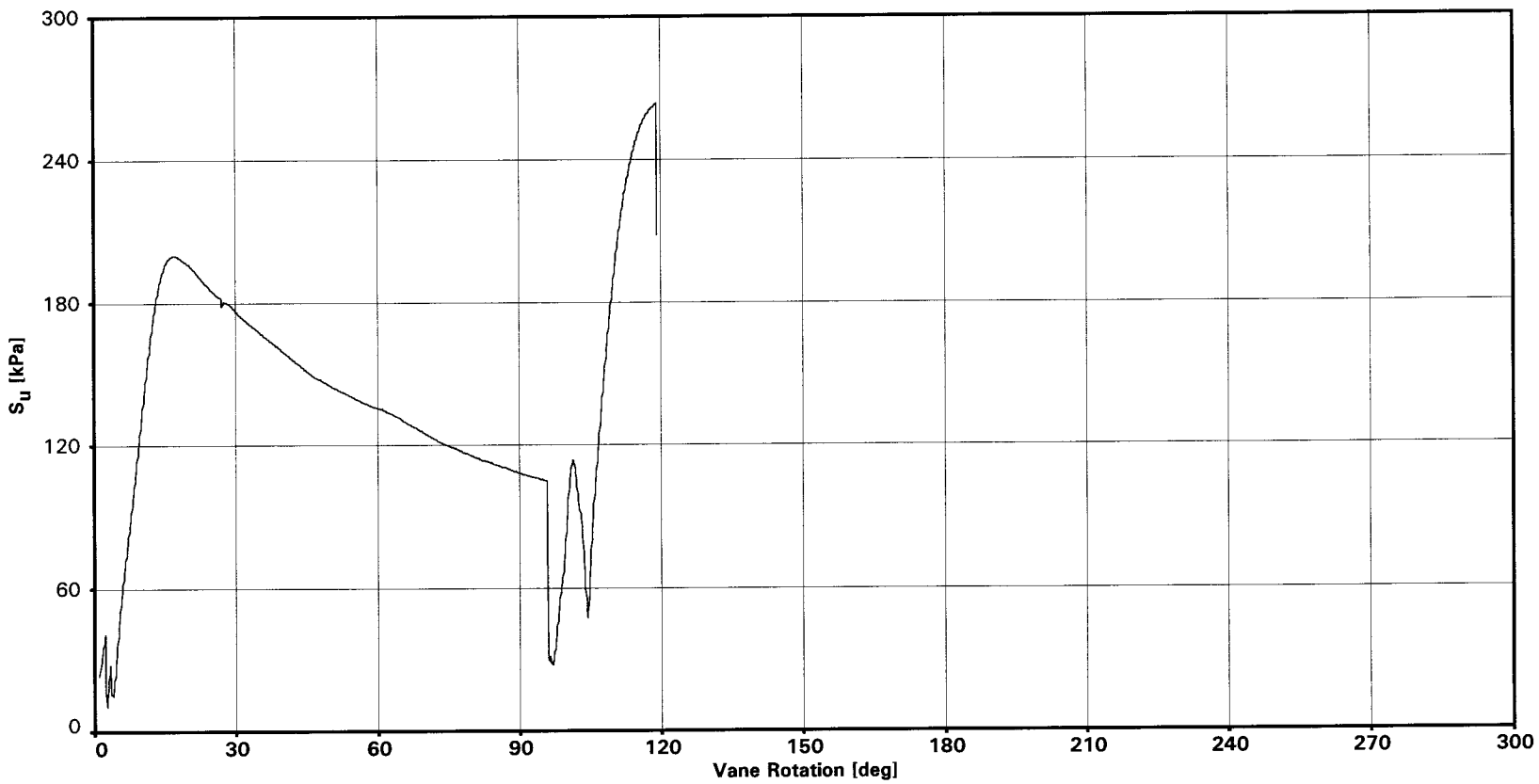
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 19.8m and 20.4m
Boring 98-52
SFOBB East Span Seismic Safety Project

PLATE 98-52.2d

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 22.9m and 23.5m
Boring 98-52
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-52.2e

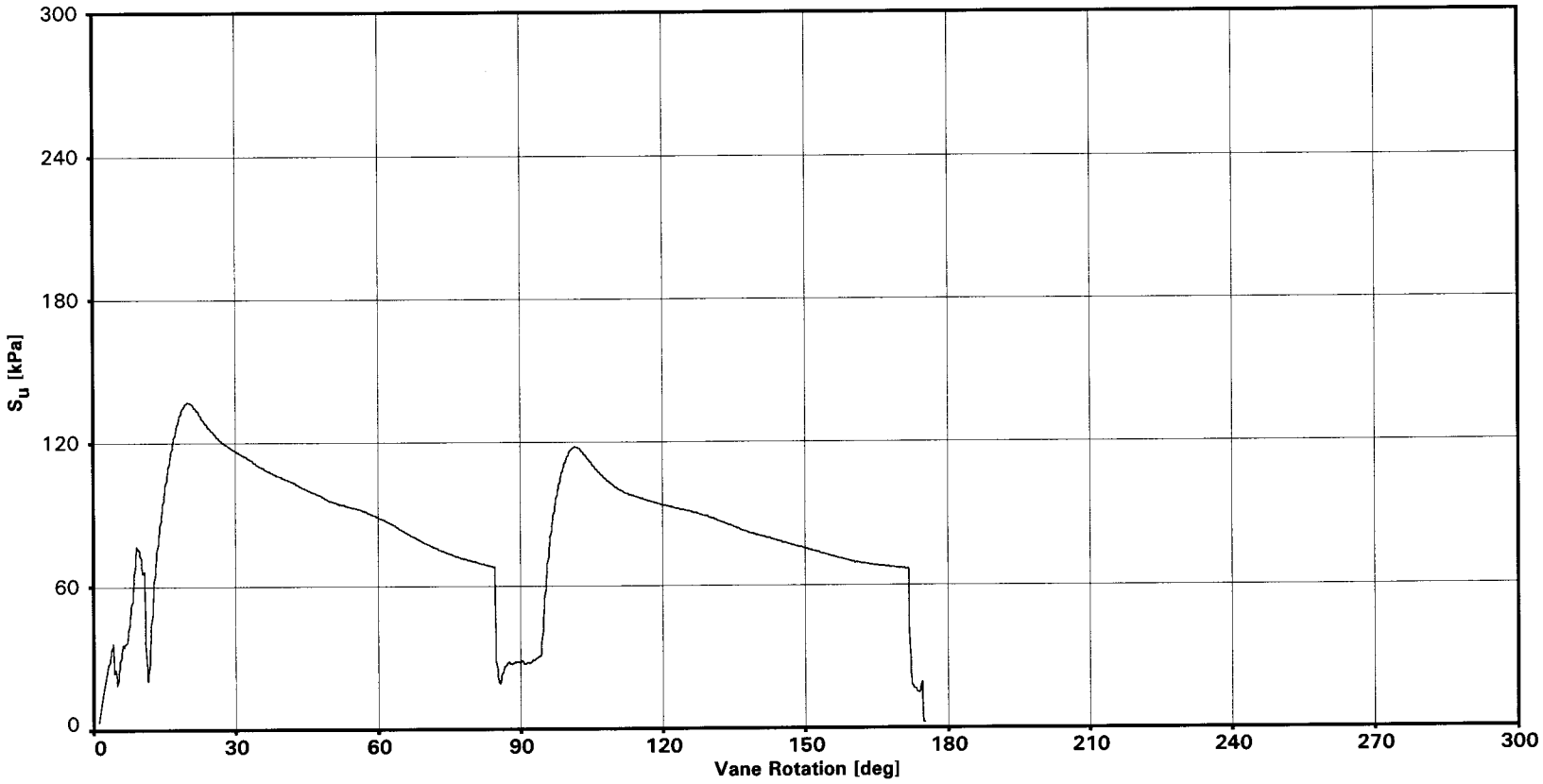
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



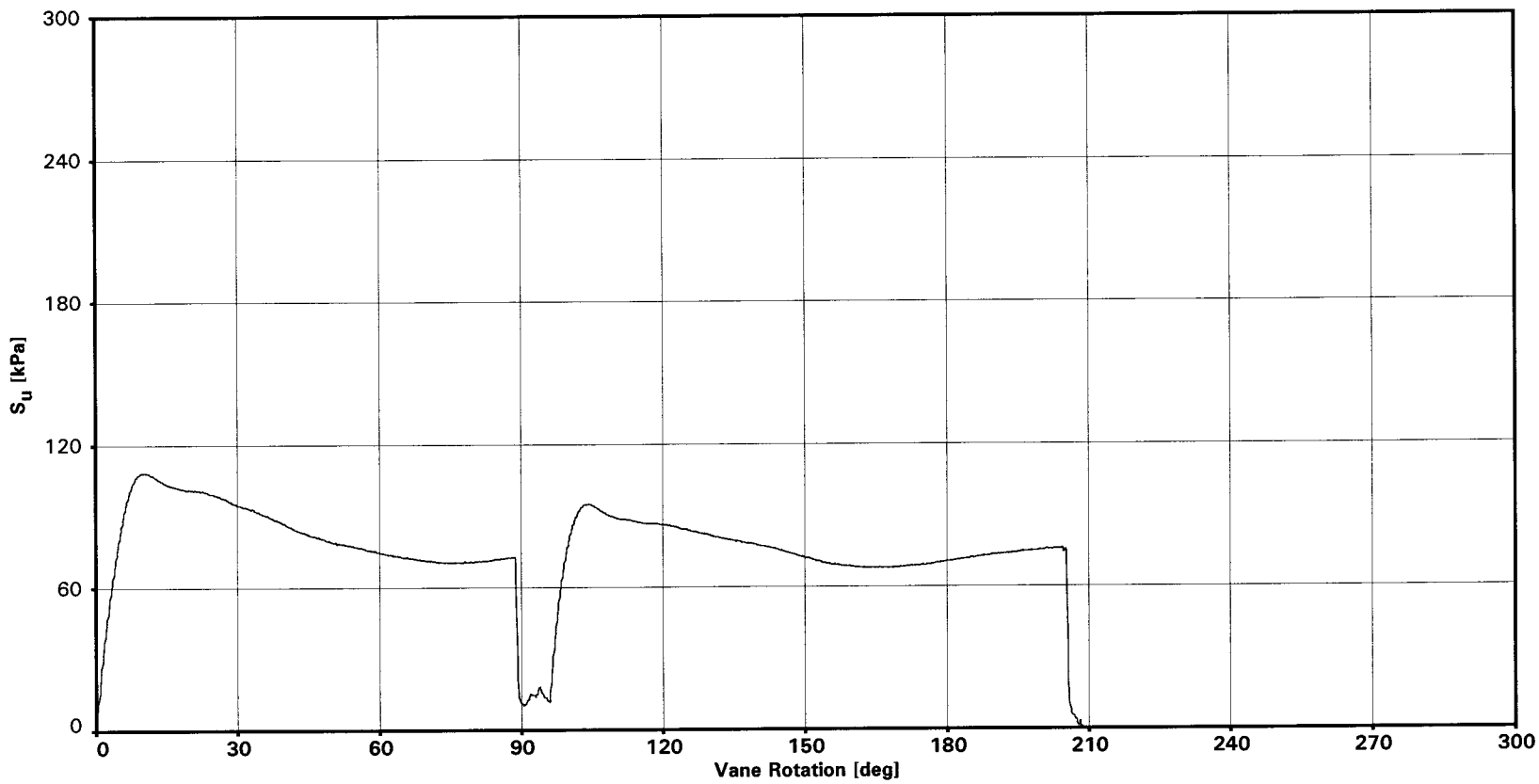
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 25.9m and 26.5m
Boring 98-52
SFOBB East Span Seismic Safety Project

PLATE 98-52.2f

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 30.5m and 31.1m
Boring 98-52
SFOBB East Span Seismic Safety Project

Earth Mechanics

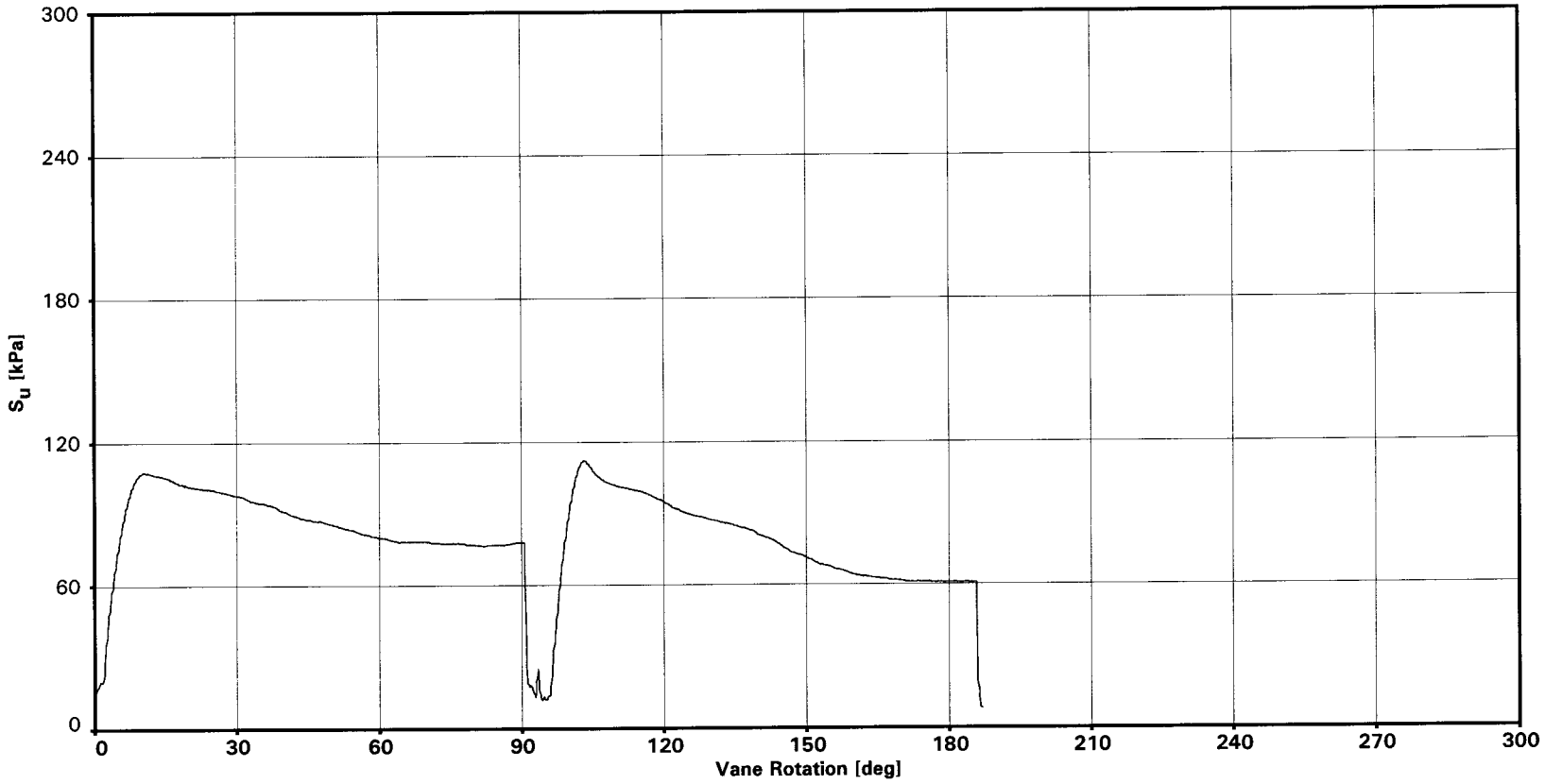
FUGRO

PLATE 98-52.2g

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 33.5m and 34.1m
Boring 98-52
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-52.2h

SFOBB Task Order No. 5
Project No. 98-42-0058

98-52		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
1.7	1	16																									
3.3	2						4																				2.68
4.7	3	31					29																				
6.4	4	40	48	21	0.70																						
7.9	5	42	48	25	0.76																						2.72
8.1	6	42	46	24	0.84			33.5																			
9.1	400													45.0													
9.4	7	43	45	21	0.95	17.6																					
9.6	8							59.9			44.6	19.6															
9.8	9							33.5																			
10.7	401													43.6													
11.2	10							35.9																			
11.3	11	53	61	28	0.77						48.3																
11.9	402													87.1													
12.5	13	15					36																				

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-52
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-52.3a

c:\snfco-oak\odb\8.5x11\98-52suma.odb

SFOBB Task Order No. 5
Project No. 98-42-0058

98-52		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
14.2	14	23					13																				2.73
15.7	15	23					14																				
17.1	17	21	43	18	0.11	20.7		119.7	186.9		168.3																
18.4	19	33	66	28	0.14																						
18.6	20	32				18.8		71.8			78.0																
19.8	403													161.8													
20.4	404													108.2													
21.8	22	44	48	24	0.82	18.3									68.1	17.4	3.9										
21.9	23							93.4																			
22.9	405													200.1													
23.5	406													263.3+													
24.5	24	24	65	25																							
24.7	25					20.1		141.2			142.3																
25.9	407													135.5													
26.4	27	49	71	32	0.45	16.9									92.6		2.6										

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-52
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-52.3b

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SFOBB Task Order No. 5
Project No. 98-42-0058

98-52		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
26.5	408													130.7													
27.7	27															32.9											
27.9	28							83.8																			
28.0	29	23					9																				
29.3	31	54	81	27	0.51	16.7		76.6			108.9					26.7											
30.5	409													106.3													
31.1	410													97.7													
32.5	34	44	70	31	0.34	17.4		91.0							97.6	31.4	1.9										
33.5	411													106.3													
34.1	412													110.6													
35.6	36	45	65	24	0.52																					C	
35.7	37	43	67	27	0.39						125.0																

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-52
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-52.3c

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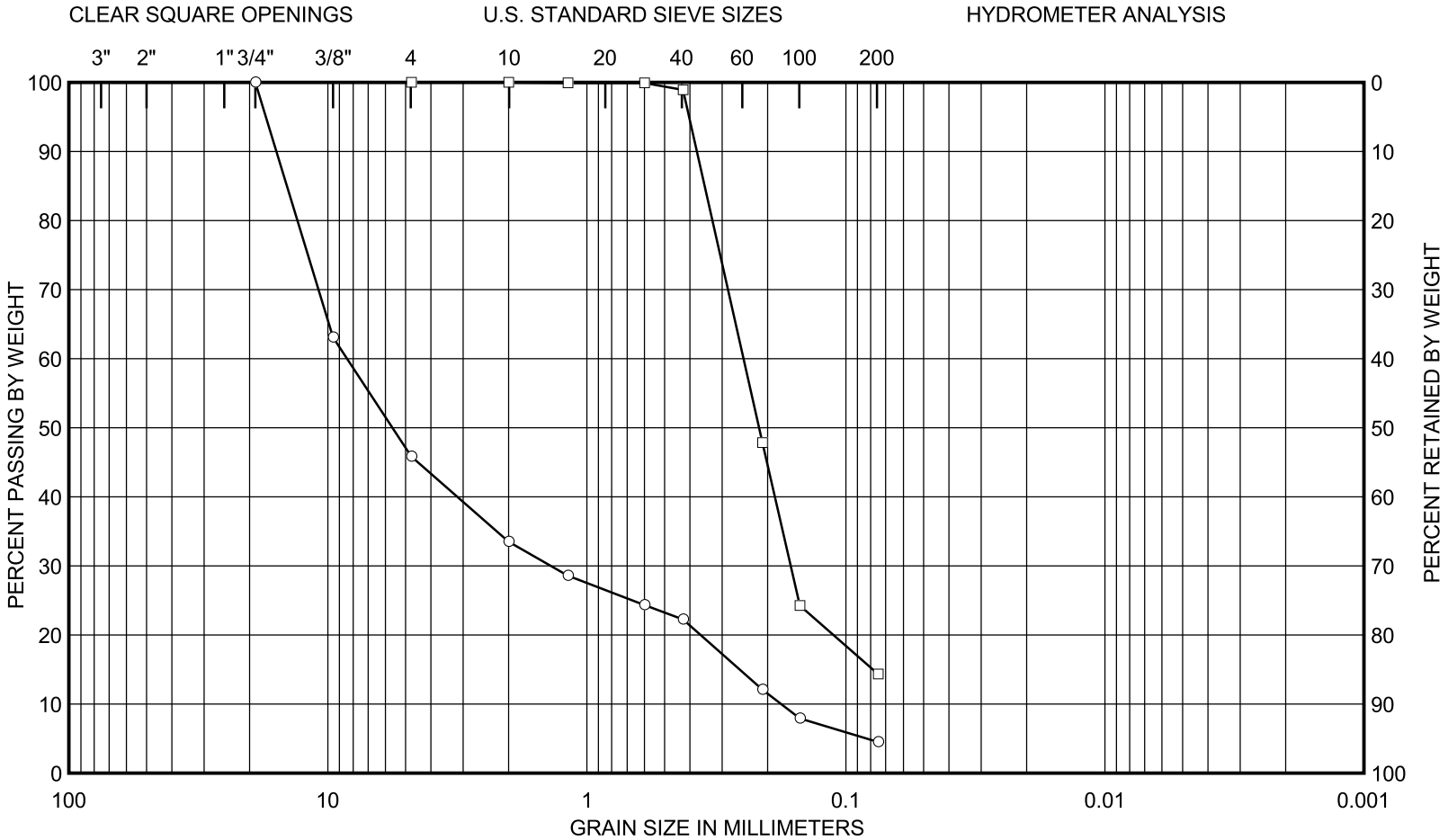

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
2	3.3	○——○	FINE GRAVEL (GW) with fine to coarse sand	1.3	47.4	5.6
15	15.7	□——□	SILTY FINE SAND (SM) with clay partings			0.22

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-52
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-52.4

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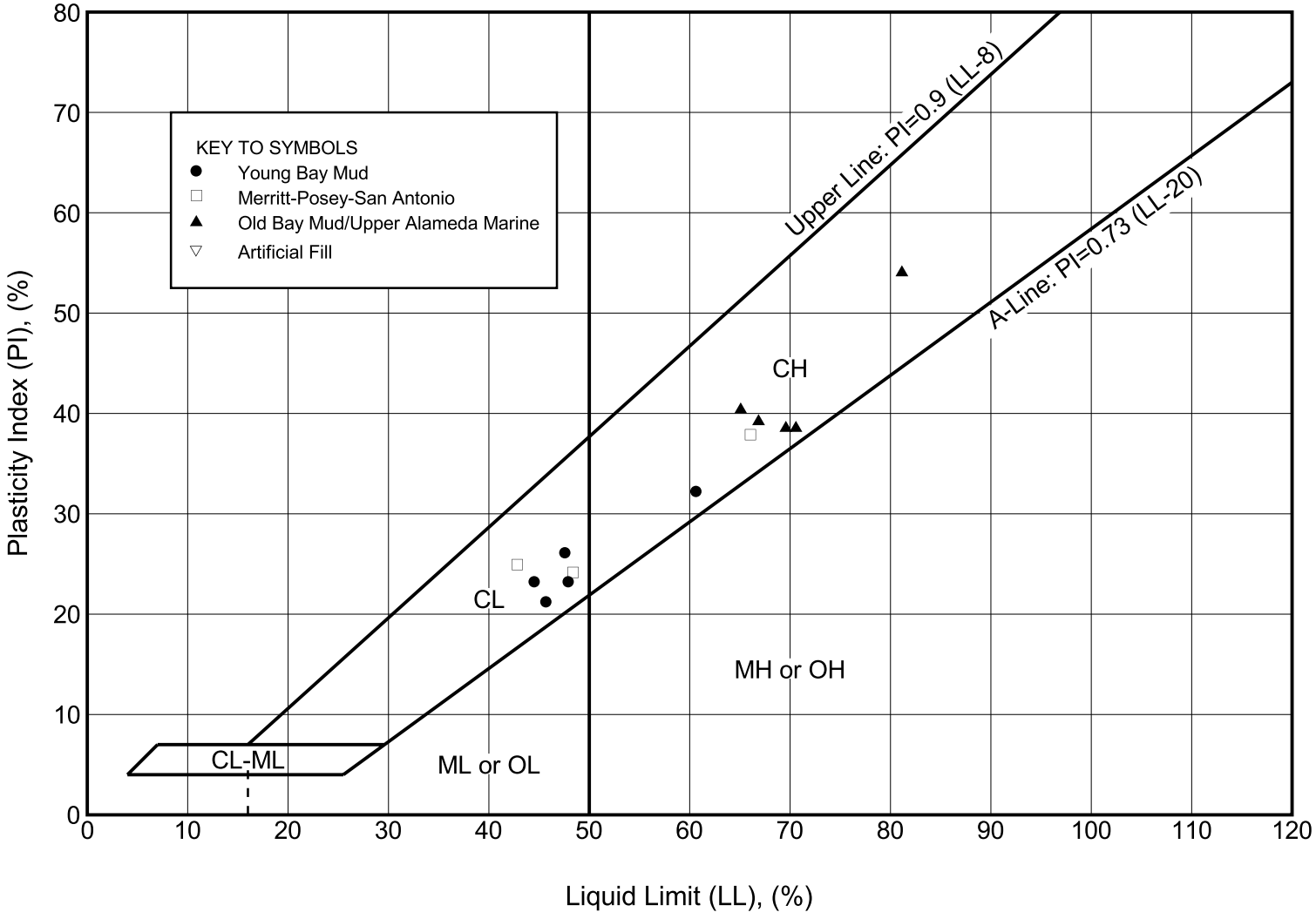

PLASTICITY CHART
Boring 98-52
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-52.5

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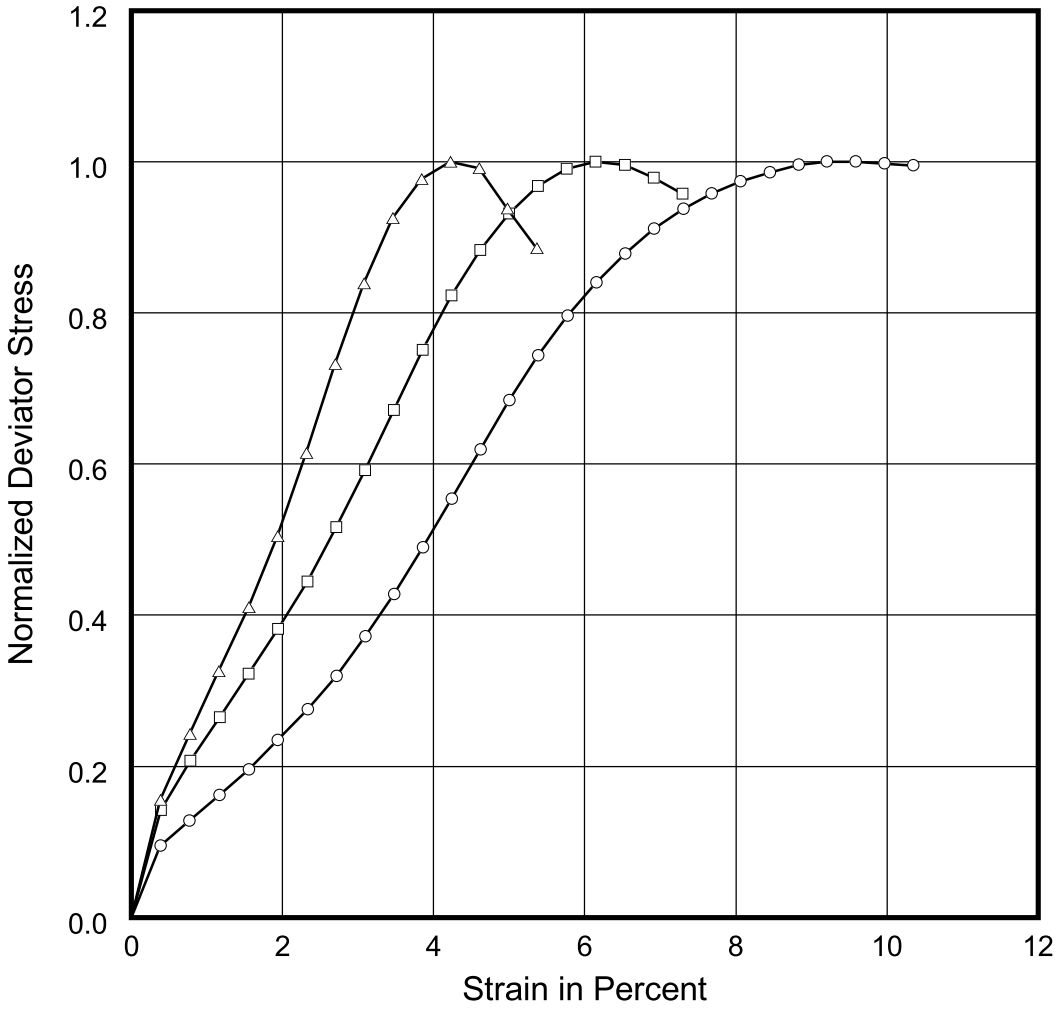

Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
⊙——○	22	21.8	UU	758	136	3.9
⊡——□	27	27.7	UU	862	185	2.6
△——△	34	32.5	UU	896	195	1.9

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-52
SFOBB East Span Seismic Safety Project

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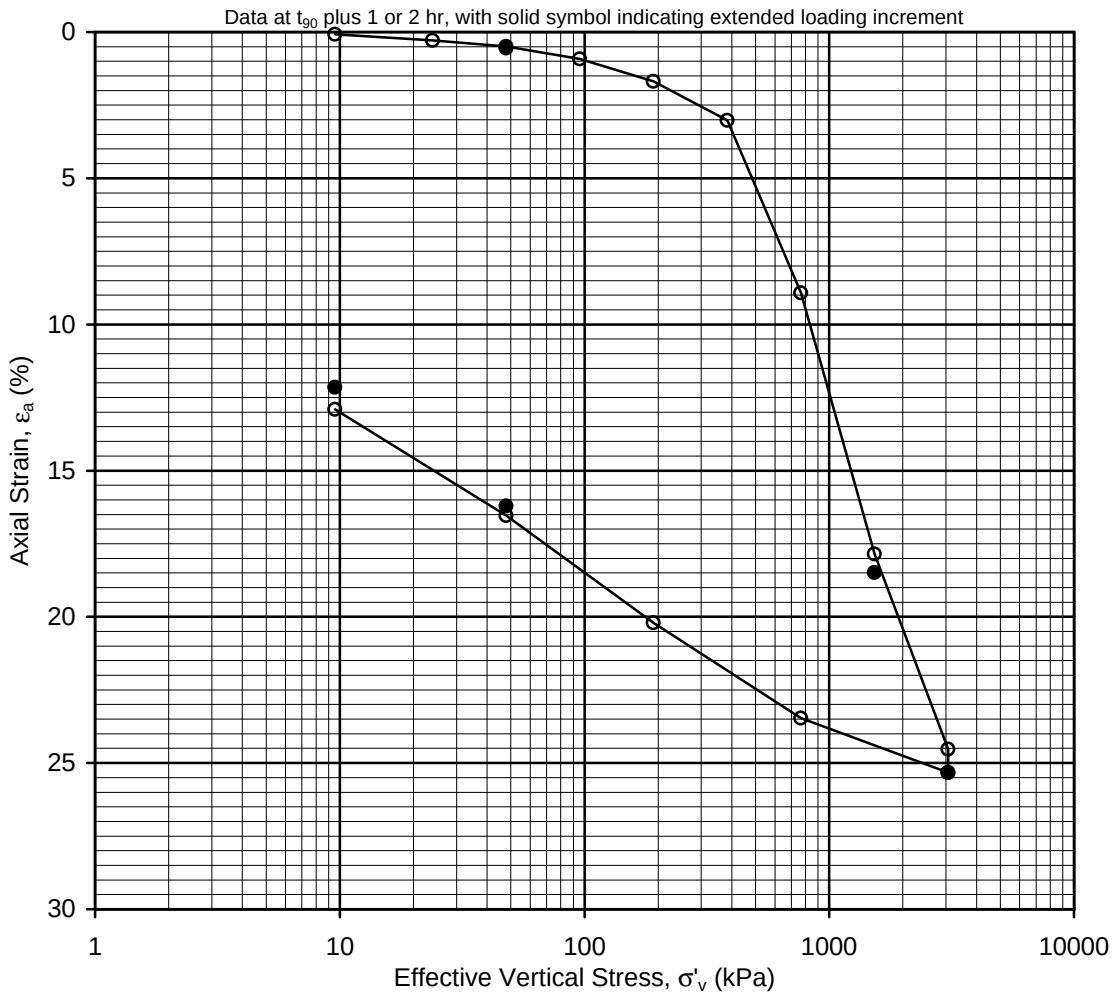
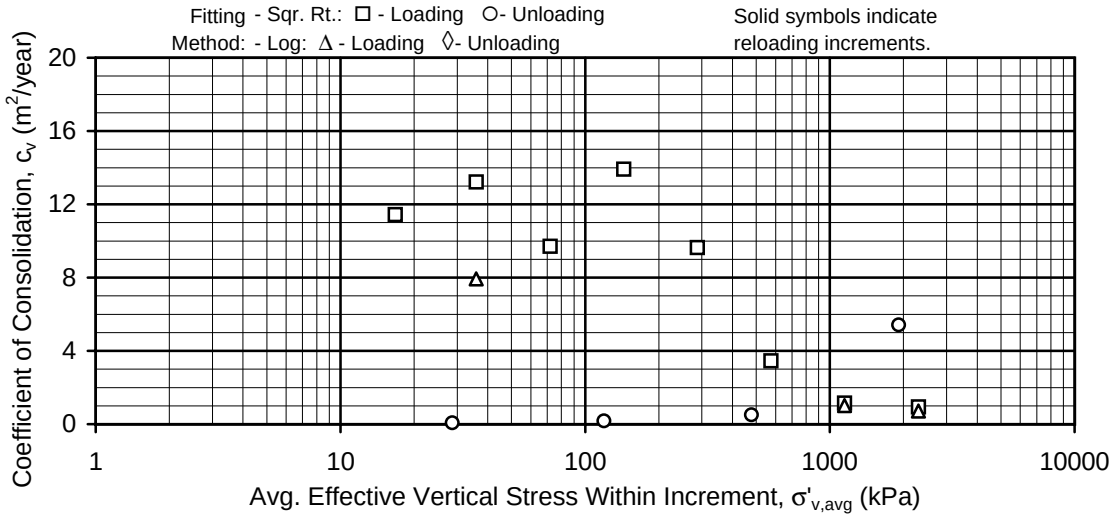




INCREMENTAL CONSOLIDATION TEST RESULTS

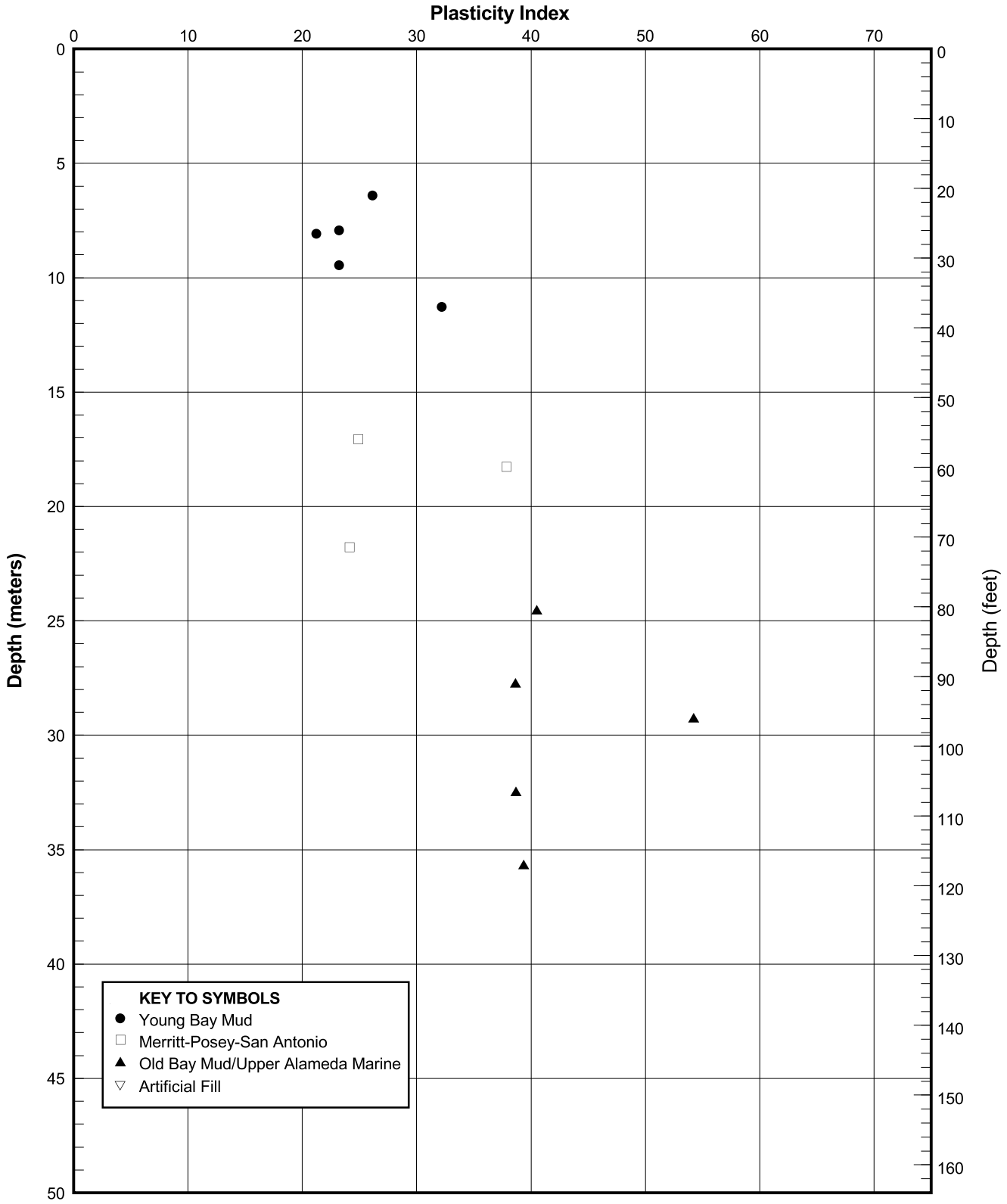
Sample No. 36 - Depth: 35.5m
Boring 98-52
SFOBB East Span Seismic Safety Project

No Consolidated-Undrained Triaxial Compression Testing Performed For This Boring

No Consolidated-Drained Triaxial Compression Testing Performed For This Boring

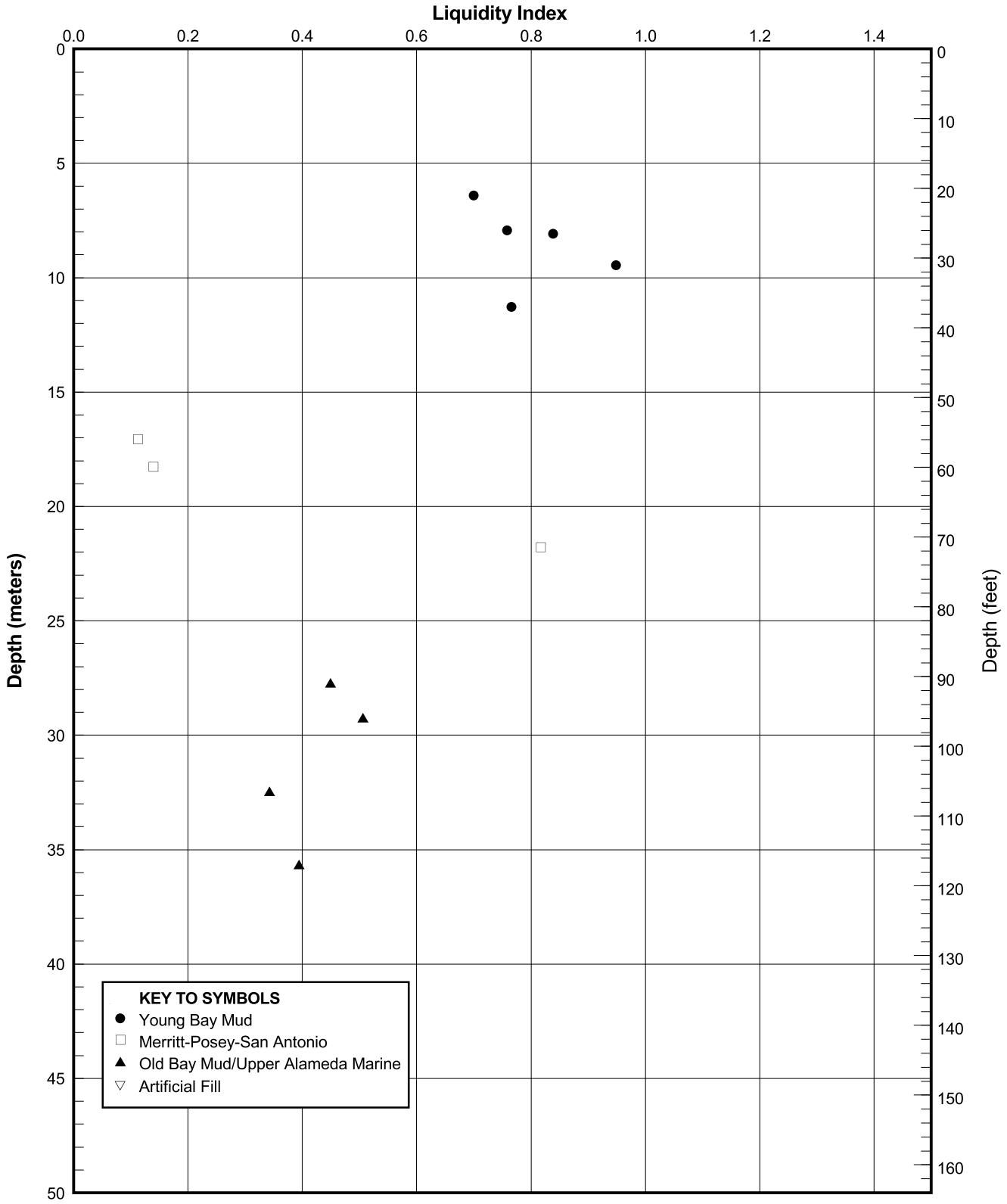
No R-Value Laboratory Testing Performed For This Boring

No Corrosion Testing Performed For This Boring



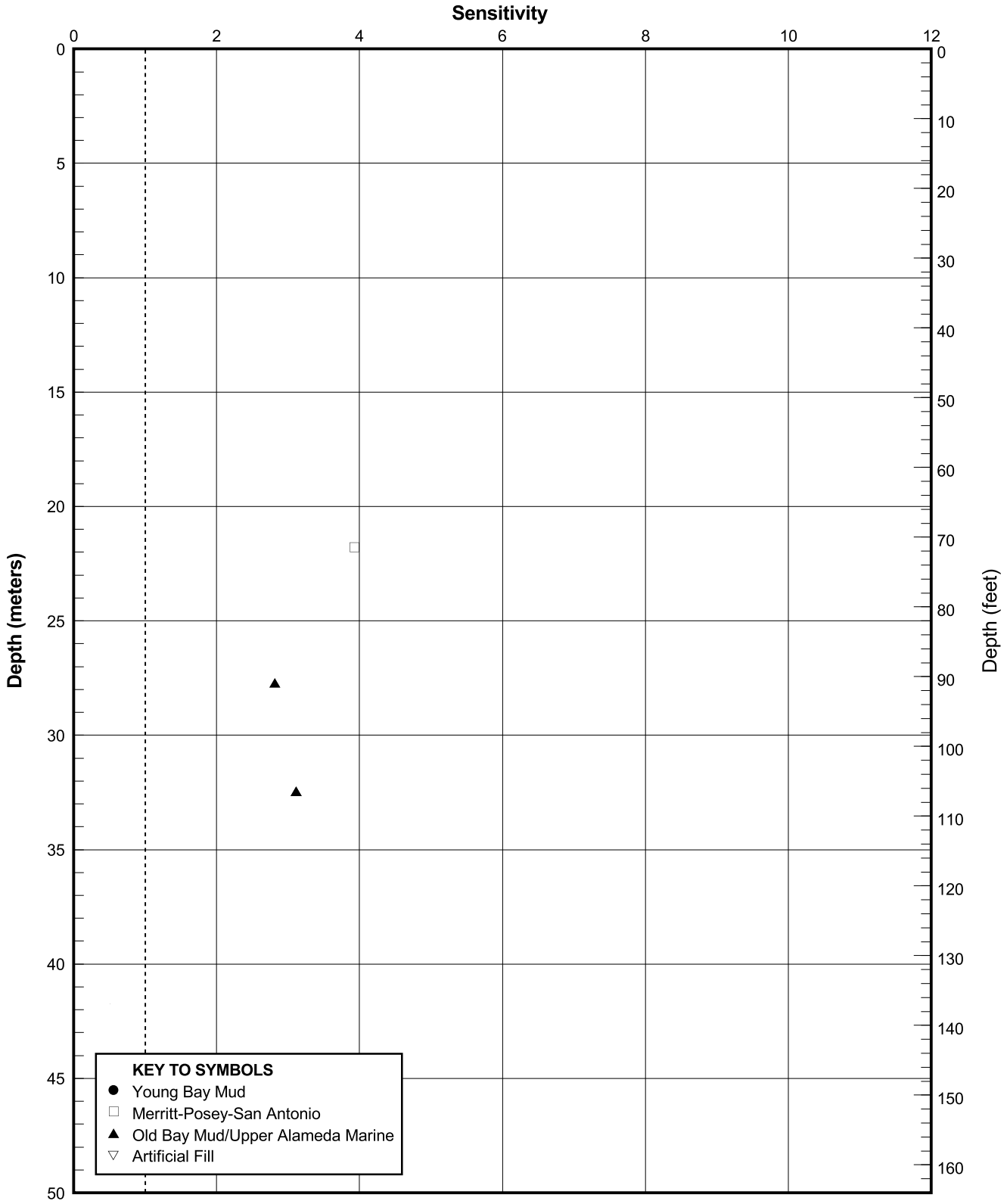
PLASTICITY INDEX PROFILE
Boring 98-52
SFOBB East Span Seismic Safety Project

PLATE 98-52.12



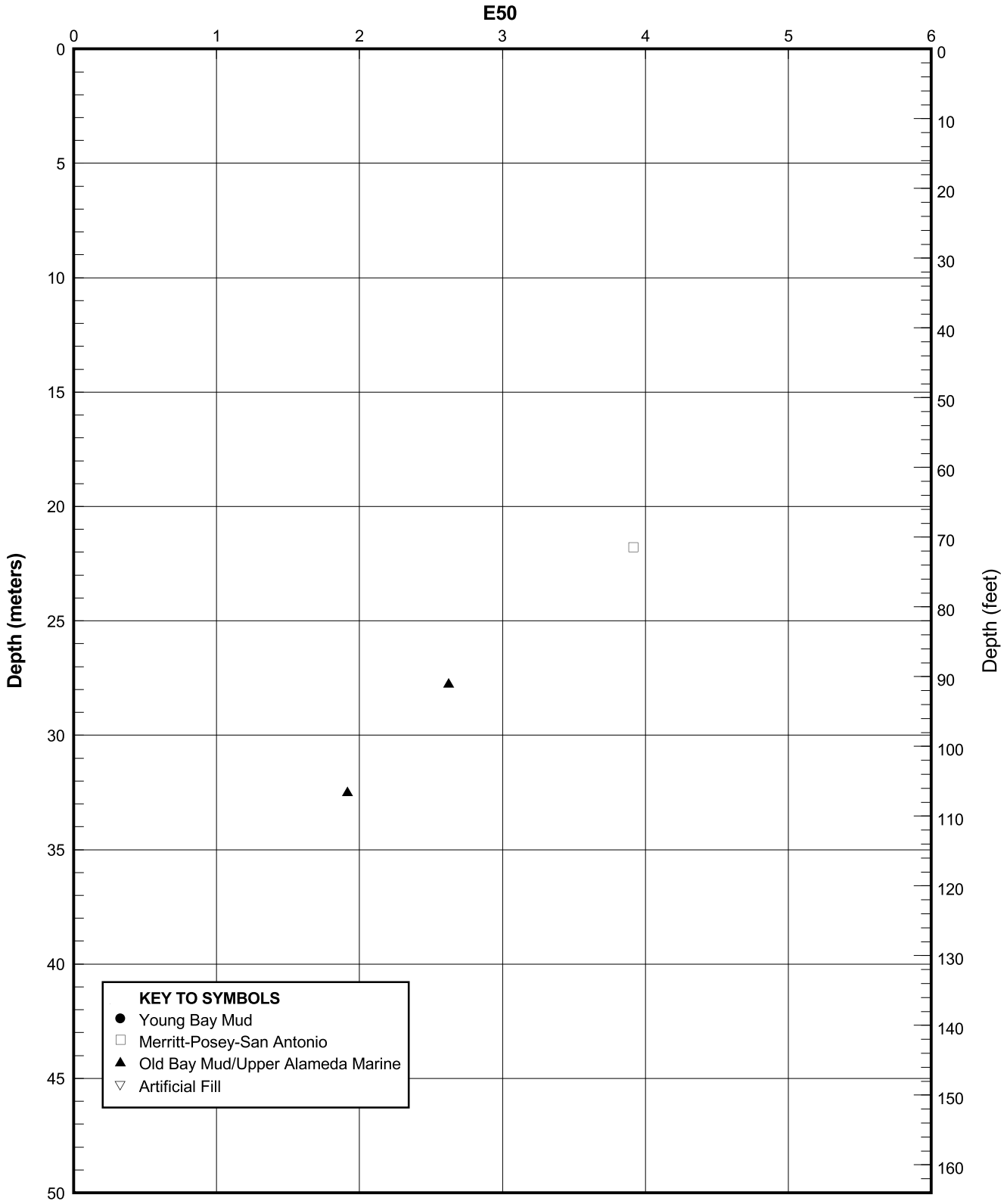
LIQUIDITY INDEX PROFILE
Boring 98-52
SFOBB East Span Seismic Safety Project

PLATE 98-52.13



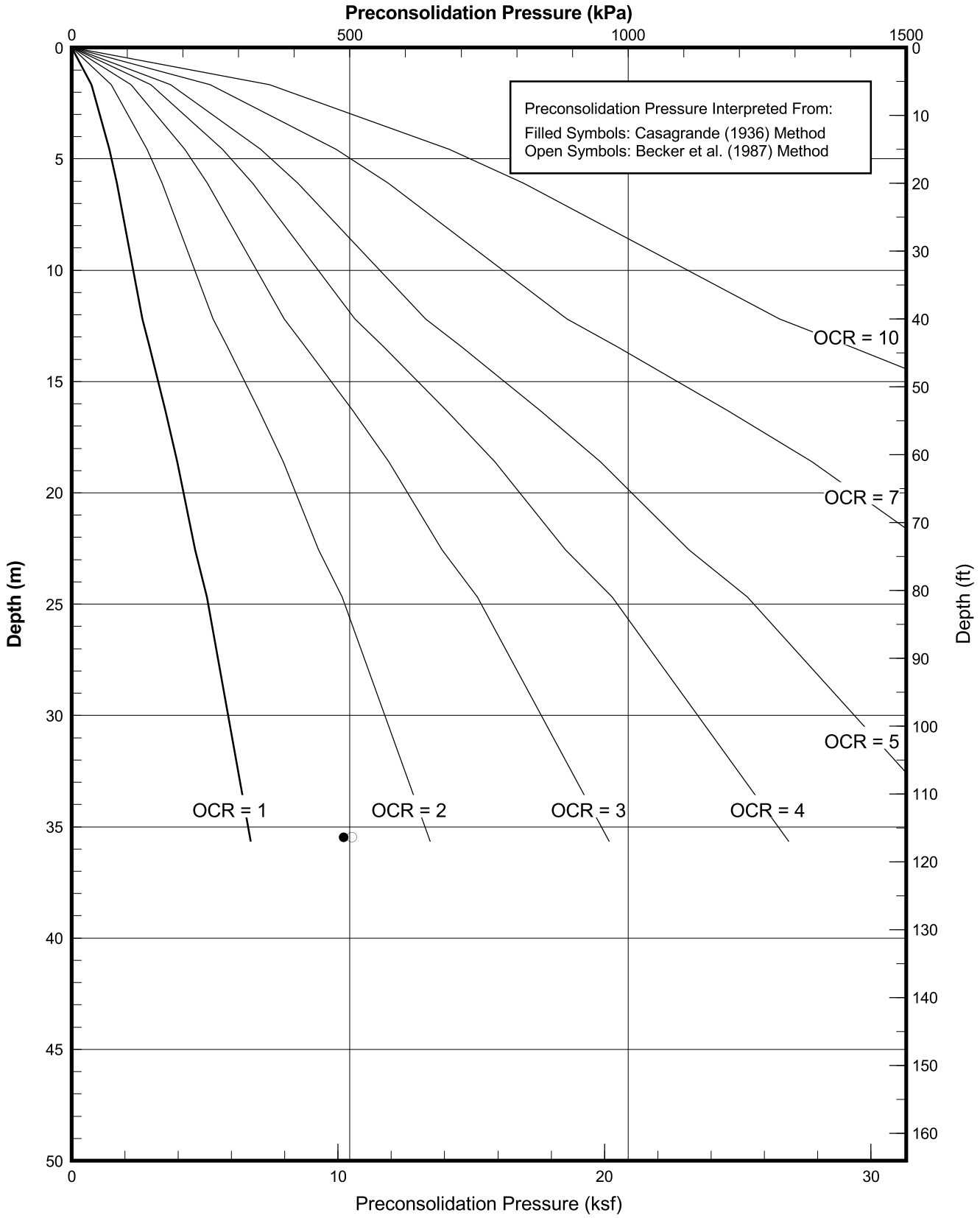
SENSITIVITY PROFILE
Boring 98-52
SFOBB East Span Seismic Safety Project

PLATE 98-52.14



E50 PROFILE
Boring 98-52
SFOBB East Span Seismic Safety Project

PLATE 98-52.15



PRECONSOLIDATION PRESSURE INTERPRETED FROM LABORATORY DATA

Boring 98-52

SFOBB East Span Seismic Safety Project

PLATE 98-52.16

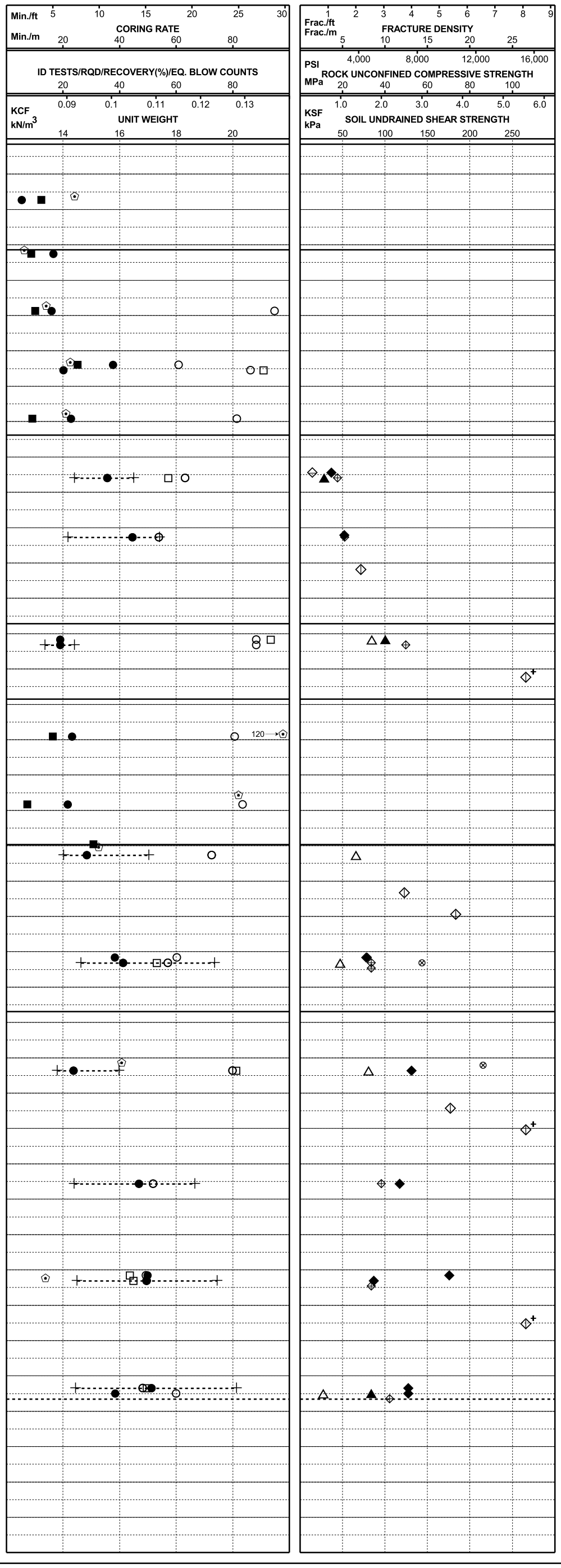
LAND BORING 98-53

PROJECT NO:	98-42-0058	**START DATE:**	10/2/98	**DRILLER:**	Pitcher Drilling Company
BORING:	98-53 (3m left of E. Sta. 85+60)	**COMPLETION DATE:**	10/3/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1839052 N648267
CA State Plane Zone 3, NAD83, Meters

GROUND ELEVATION: 3.6m (MSL)

Elevation, m.	Depth, m.	Soil Type	Sampler	Blow Count	Material Description	Stratum No.
					Pavement, Asphalt Concrete over Aggregate Base (0.2m)	I
3	1				Silty Fine SAND (SM), medium dense, brown, dry to moist	
2	2			24	-silty fine gravel with sand and concrete fragments, at 1.7m	II
1	3			10	(3.1m)	
					Fine SAND with silt (SP-SM) medium dense, olive gray (3.6m)	
0	4				-moist at 3.2m -with angular gravel, to 5.0m	
-1	5			14	-olive gray to brown at 4.9m	III
-2	6					
-3	7			36	-with silty sand seams, at 6.4m -with a sandy clay layer at 6.7m	
-4	8			21	-with shell fragments at 7.8m (8.4m)	
-5	9				Fat CLAY (CH), firm to stiff, gray -with shell fragments -lean clay to 10.1m	
-6	10			PUSH	-with silt pockets at 9.4m	
-7	11			SAVE	-with silty fine sand pockets, at 11.0m	IV
-8	12					
-9	13				(13.7m)	
-10	14			PUSH	Sandy Lean Clay (CL), very stiff, greenish gray -with silt pockets and fine sand, at 14.0m	V
-11	15				(15.8m)	
-12	16				Silty Fine SAND (SM), very dense, greenish gray	
-13	17			50/15cm	-with clay pockets, 16.8m to 18.9m -with silt pockets at 16.8m	VI
-14	18					
-15	19			82	-sand with silt, at 18.5m -with sandy clay below, 19.2m	
-16	20			52	-silty fine sand with clay pockets at 19.8m (20.0m)	
-17	21				Fat CLAY (CH),stiff to very stiff, greenish gray to gray -with a fine sand seam and sand pockets, at 20.1m	VII
-18	22					
-19	23			PUSH	-with gas blisters, organic pockets, and black staining, at 23.2m	
-20	24				(24.7m)	
-21	25				Fat CLAY (CH), very stiff to hard, greenish gray	
-22	26			65	-sandy clay with sand partings and pockets, at 26.2m	
-23	27					
-24	28					
-25	29			SAVE	-with sand pockets and a few organic pockets, at 29.3m	VIII
-26	30					
-27	31					
-28	32			22	-with organic pockets and a few silt pockets, at 32.3m	
-29	33					
-30	34					
-31	35			PUSH	-with silty fine sand pockets and organic pockets, at 35.4m	
-32	36				TOTAL DEPTH: 35.7m BACKFILLED WITH: Cement Grout	
-33	37					
-34	38					
-35	39					
-36						



LOG OF BORING AND TEST RESULTS

BORING 98-53

SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

Report Date: 03/13/99

PLATE 98-53.1

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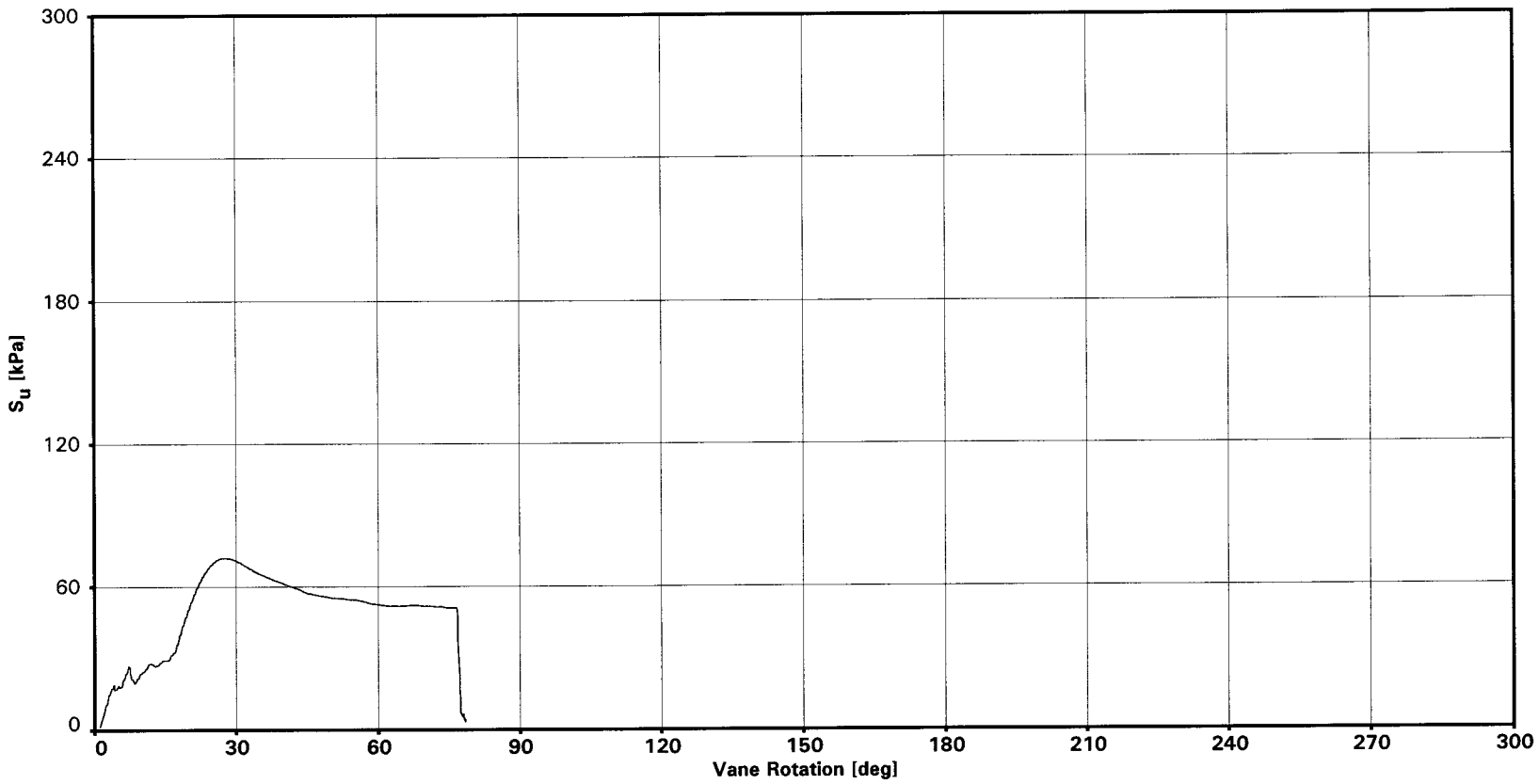
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 12.2m
Boring 98-53
SFOBB East Span Seismic Safety Project

PLATE 98-53.2a

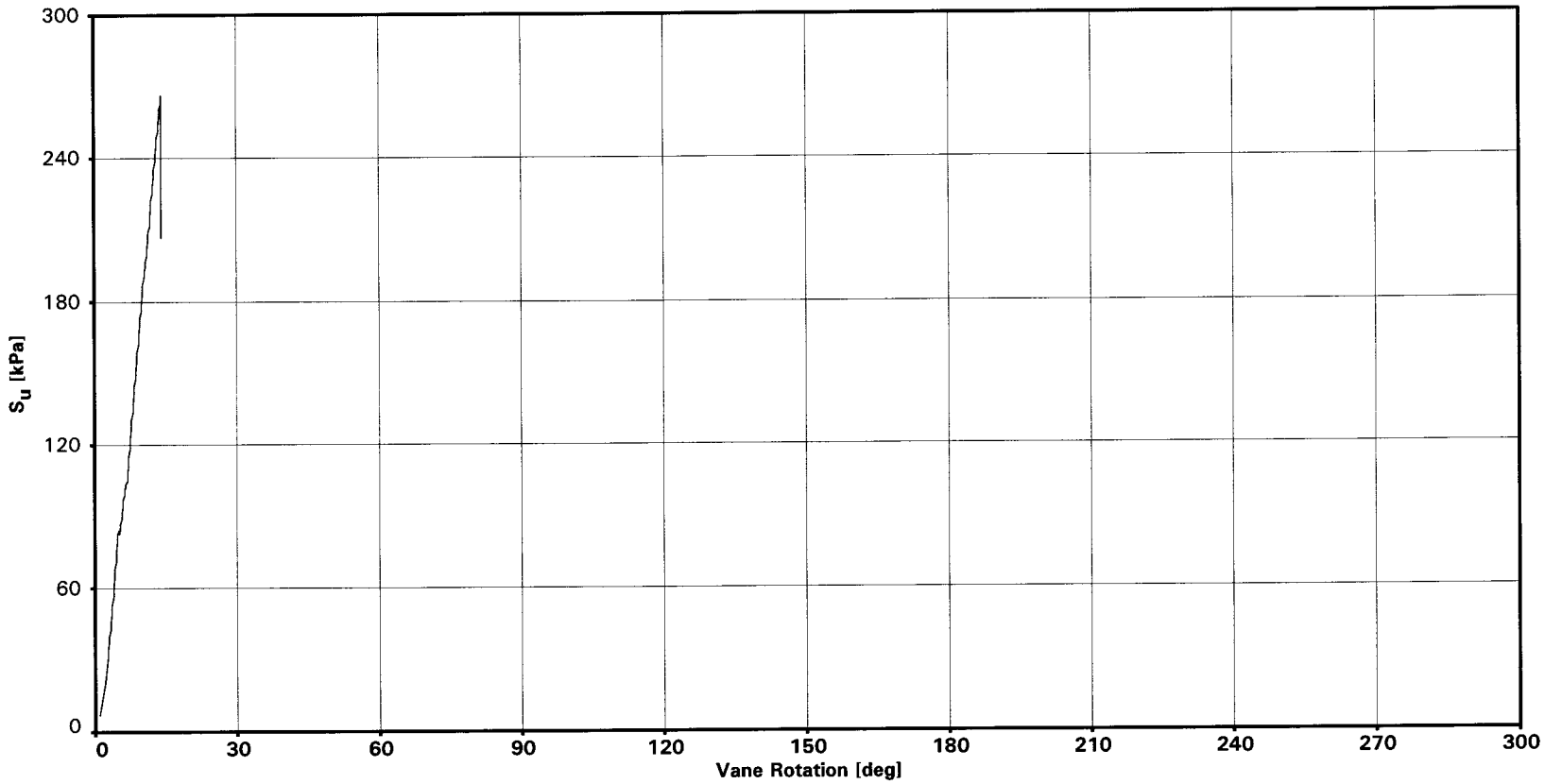
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



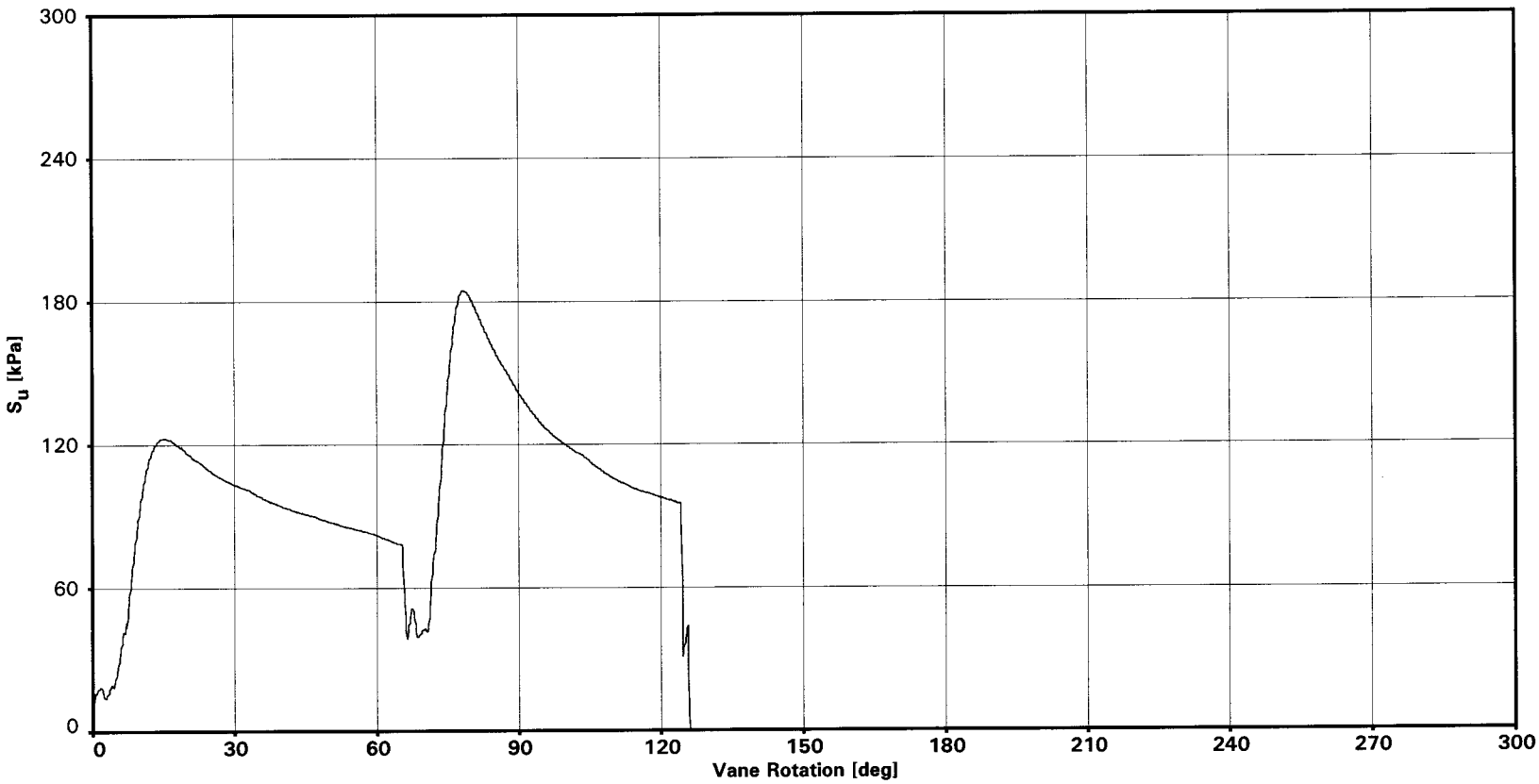
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 15.2m
Boring 98-53
SFOBB East Span Seismic Safety Project

PLATE 98-53.2b

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 21.3m and 21.9m
Boring 98-53
SFOBB East Span Seismic Safety Project

Earth Mechanics

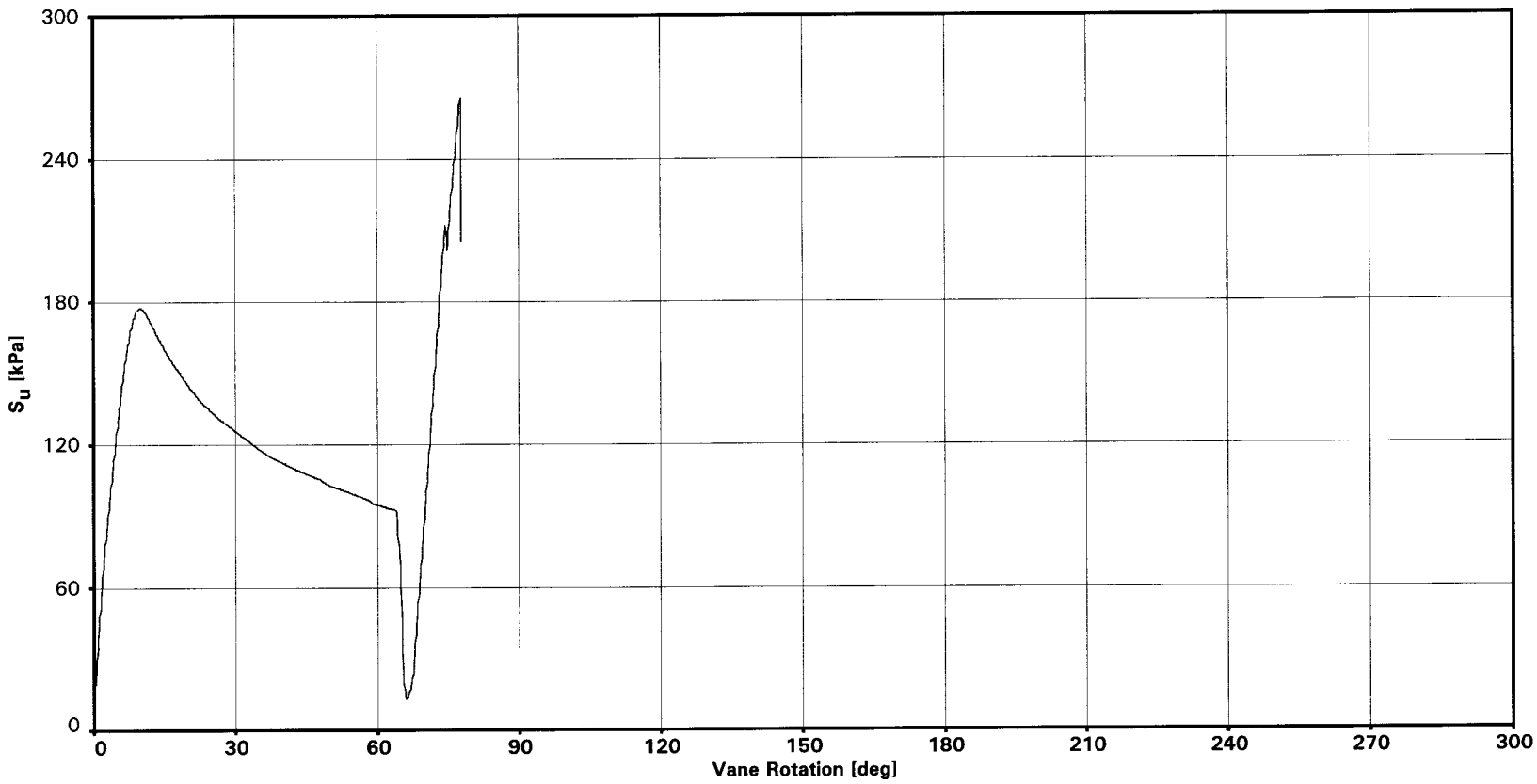
FUGRO

PLATE 98-53.2c

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 27.4m and 28.0m
Boring 98-53
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-53.2d

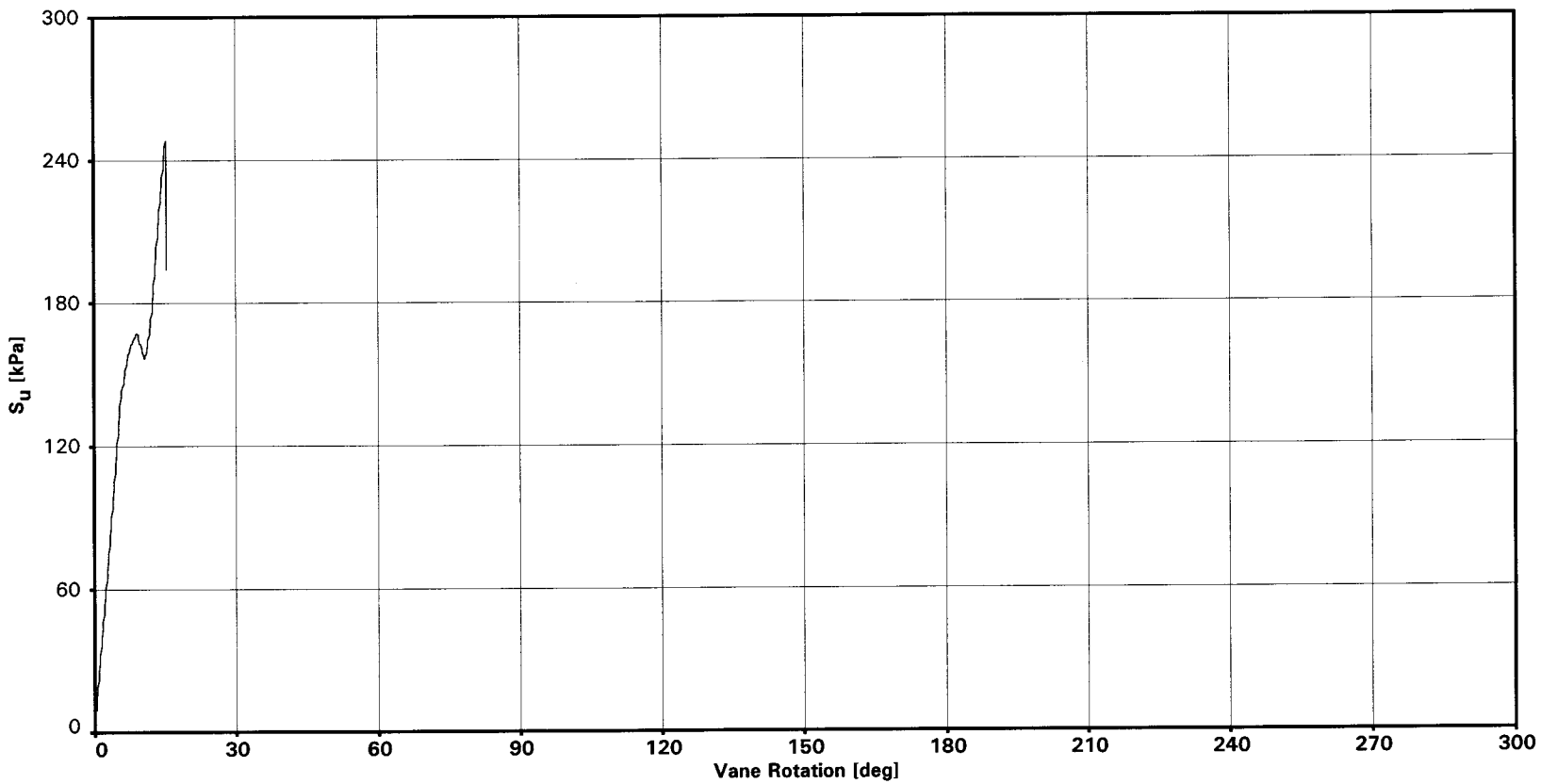
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 33.5m
Boring 98-53
SFOBB East Span Seismic Safety Project

PLATE 98-53.2e

SFOBB Task Order No. 5
Project No. 98-42-0058

98-53		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
1.5	300																										
1.7	1	5					12																				
3.3	3	17					9																				
4.9	4	16					10																				2.73
6.4	5	38					25																				
6.6	6	20				21.1																					
7.9	7	23					9																				
9.4	9										36.8		14.4														
9.6	10	36	45	24	0.55	17.7		44.0							28.2		1.1										
11.2	12	43	48	20	0.85						52.0															C	2.75
11.3	13	45	54	22	0.70			52.7																			
12.2	400													71.3													
14.2	15					21.3									100.5	84.4	1.1										
14.3	16	19	24	14	0.50			124.5																			
15.2	401													265.7+													

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-53
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-53.3a

c:\snfco-oak\odb\8.5x11\98-53suma.odb

SFOBB Task Order No. 5
Project No. 98-42-0058

98-53		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
16.9	17	23					16																				
18.8	18	22					7																				2.74
20.0	19						31																				
20.3	21	28	50	20	0.27											65.6											
21.3	402													122.6													
21.9	403													183.4													
23.2	22	38						79.0			78.0																
23.3	23	41	74	26	0.31	17.3		83.8	143.6							46.9											
23.5	24							83.8																			
26.2	26								215.5																		
26.4	27	24	40	18	0.26	20.1					131.2					80.6											
27.4	404													177.2													
28.0	405													265.7+													
29.5	28	51	77	24	0.52																					C	
29.6	29	47	67	24	0.53			95.8			117.6																

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-53
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-53.3b

c:\snfco-oak\odb\8.5x11\98-53sumb.odb

SFOBB Task Order No. 5
Project No. 98-42-0058

98-53		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
32.2	30	50				16.4					175.8																
32.3	31	49	75	25	0.49	16.5					86.6																
32.5	32							83.8																			
33.5	406													265.7+													
35.4	34	51	81	25	0.47	17.0					127.5																
35.5	35	38									127.5				83.9	27.3	0.7										
35.7	36							105.3																			

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

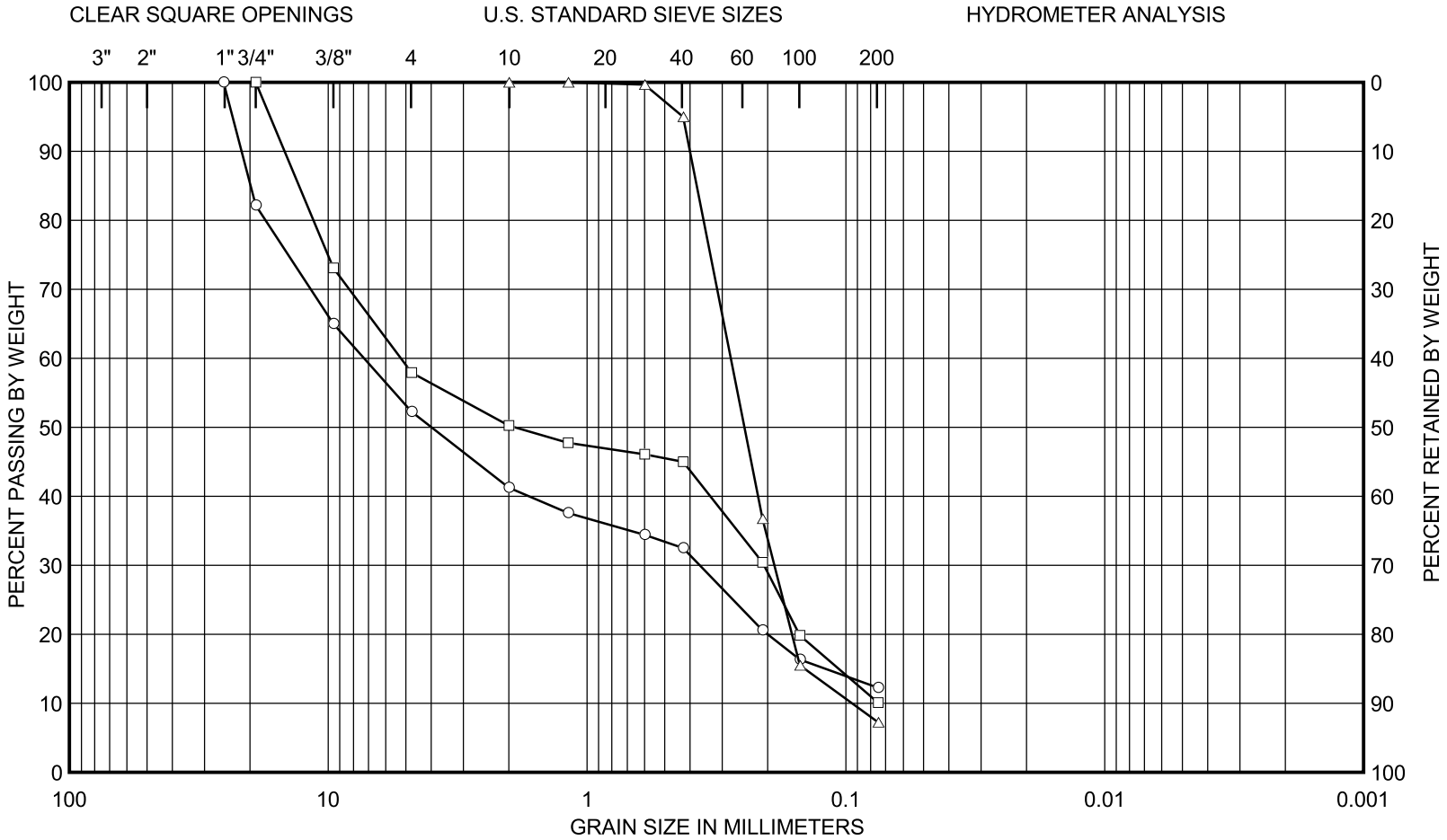
SUMMARY OF LABORATORY TEST RESULTS
Boring 98-53
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-53.3c

c:\snfco-oak\odb\8.5x11\98-53sumc.odb



GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
1	1.7	○——○	SILTY FINE GRAVEL (GM) with fine to coarse sand and coarse gravel			4.0
4	4.9	□——□	FINE SAND (SP-SM) with silt, fine gravel and a trace of medium to coarse sand			1.9
18	18.8	△——△	FINE SAND (SP-SM) with silt	1.4	2.9	0.25

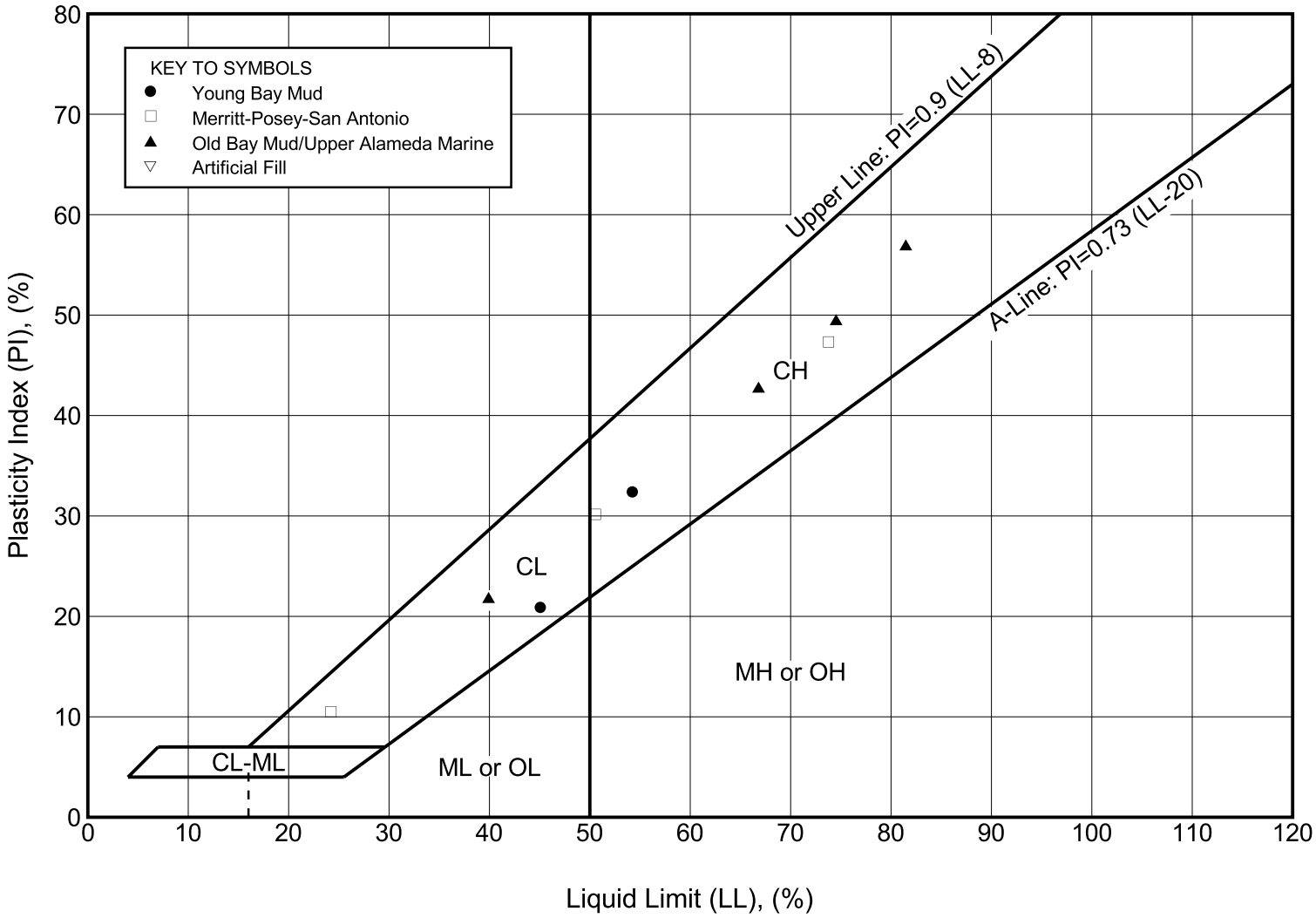
GRAIN SIZE DISTRIBUTION CURVES
Boring 98-53
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

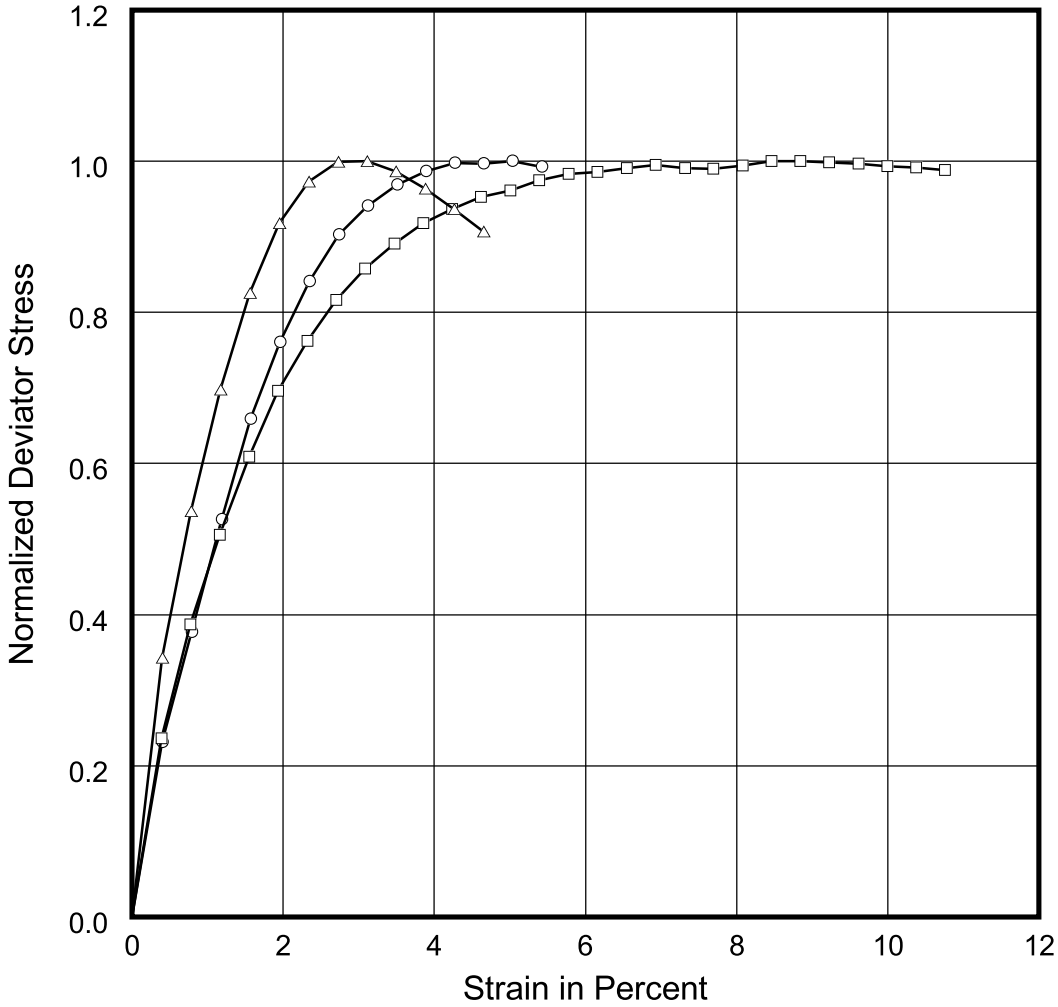
PLATE 98-53.4



PLASTICITY CHART
Boring 98-53
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

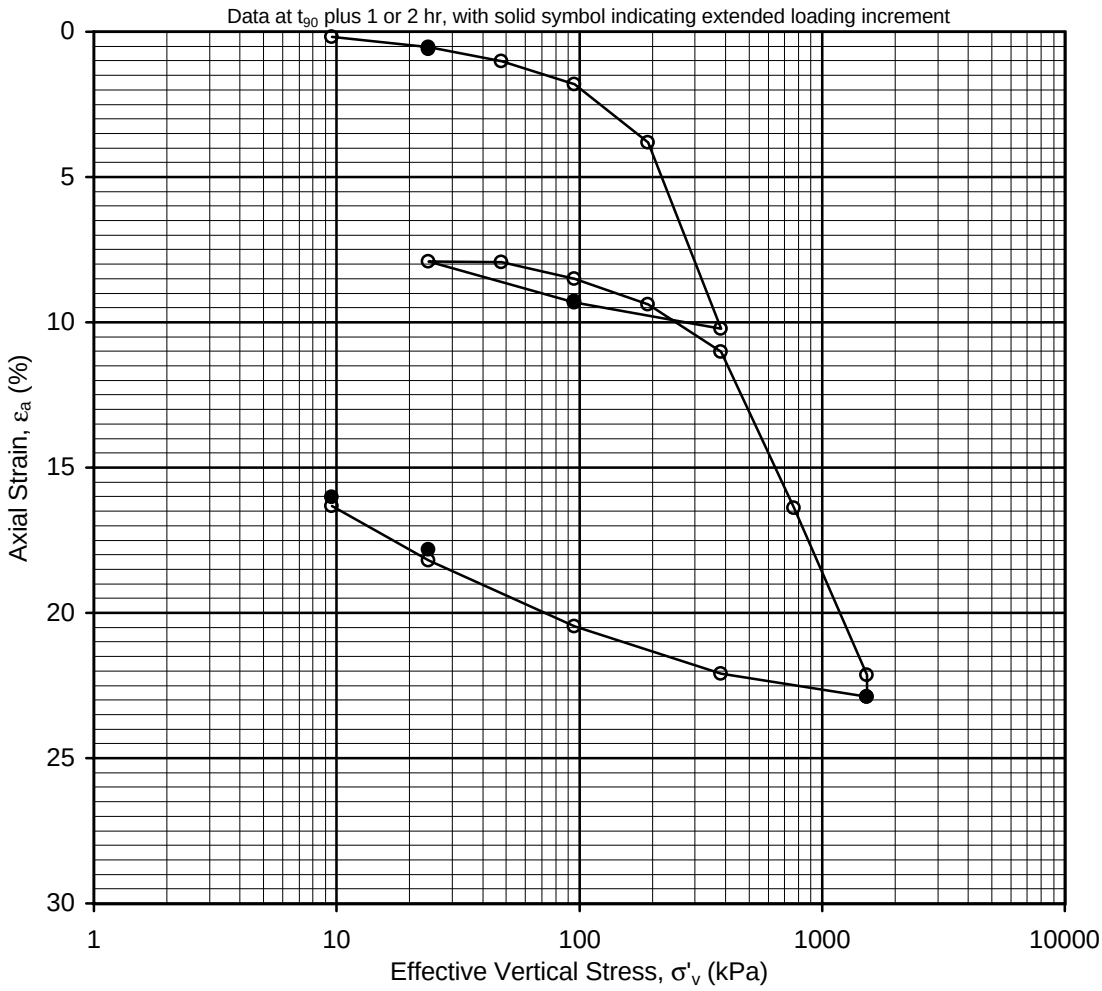


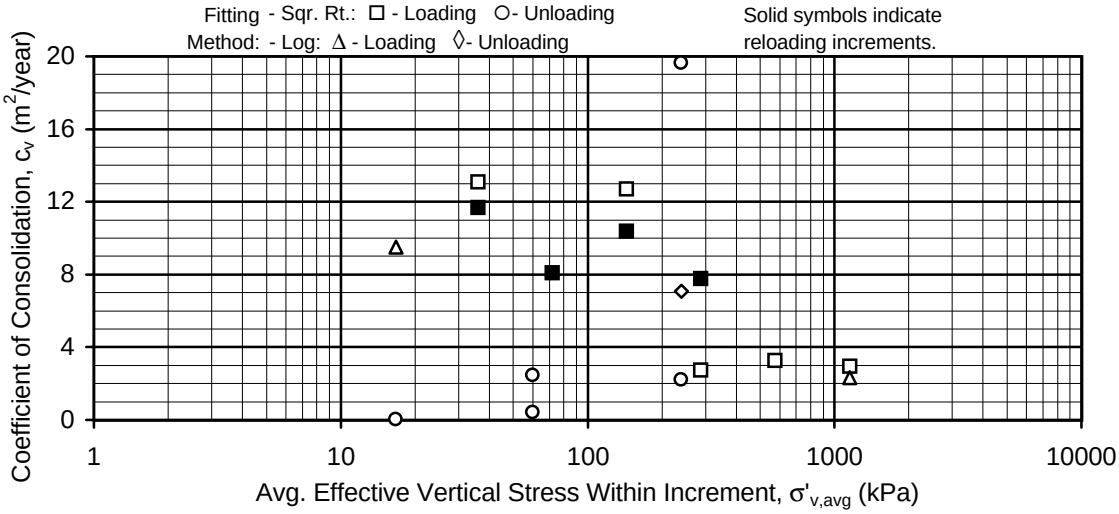
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	10	9.6	UU	207	56	1.1
□——□	15	14.2	UU	689	201	1.1
△——△	35	35.5	UU	1103	168	0.7

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

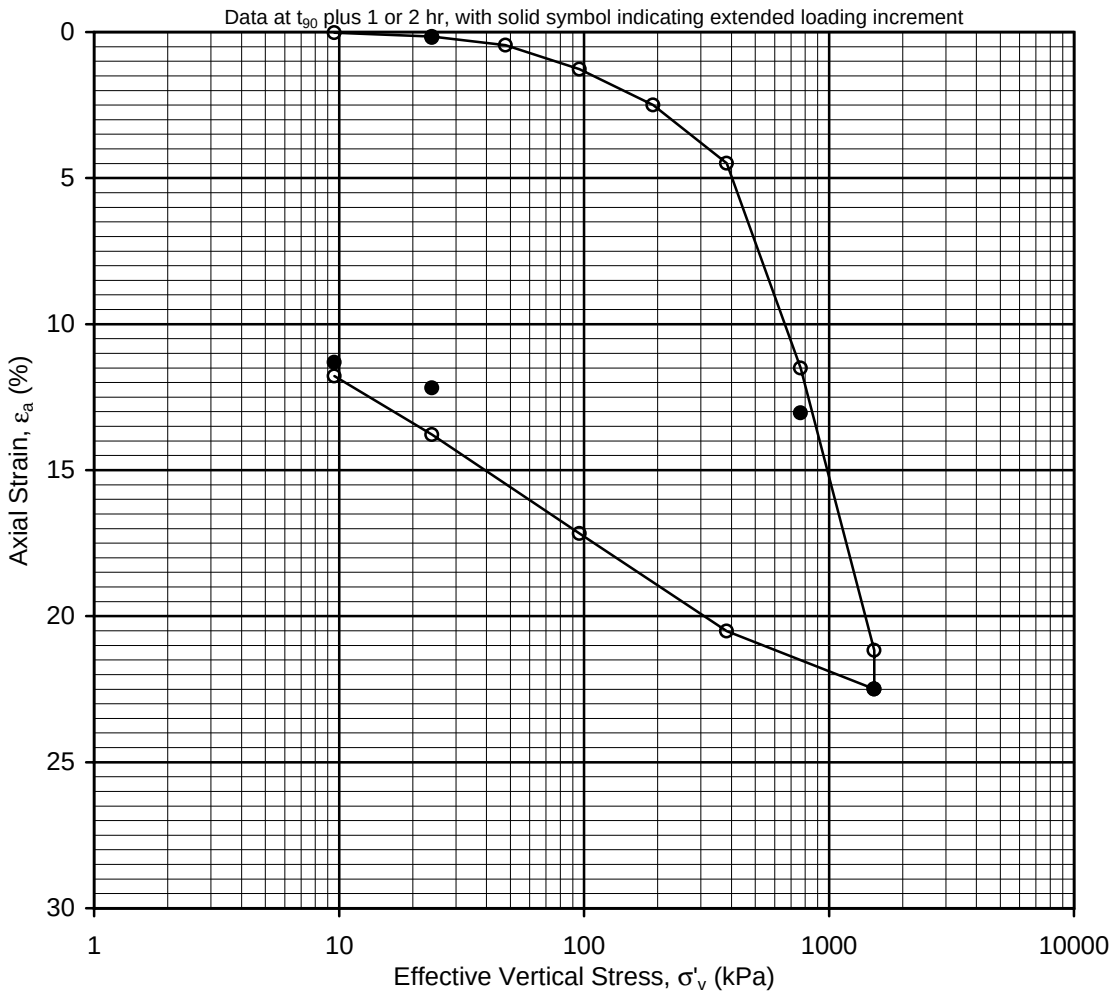
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-53
SFOBB East Span Seismic Safety Project

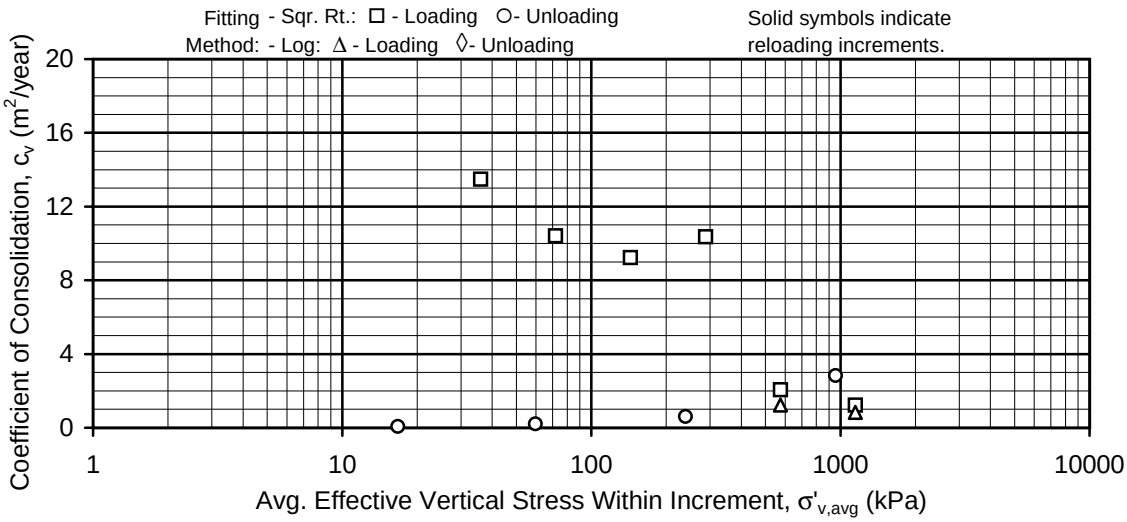




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 12 - Depth: 11.2m
Boring 98-53
SFOBB East Span Seismic Safety Project





INCREMENTAL CONSOLIDATION TEST RESULTS

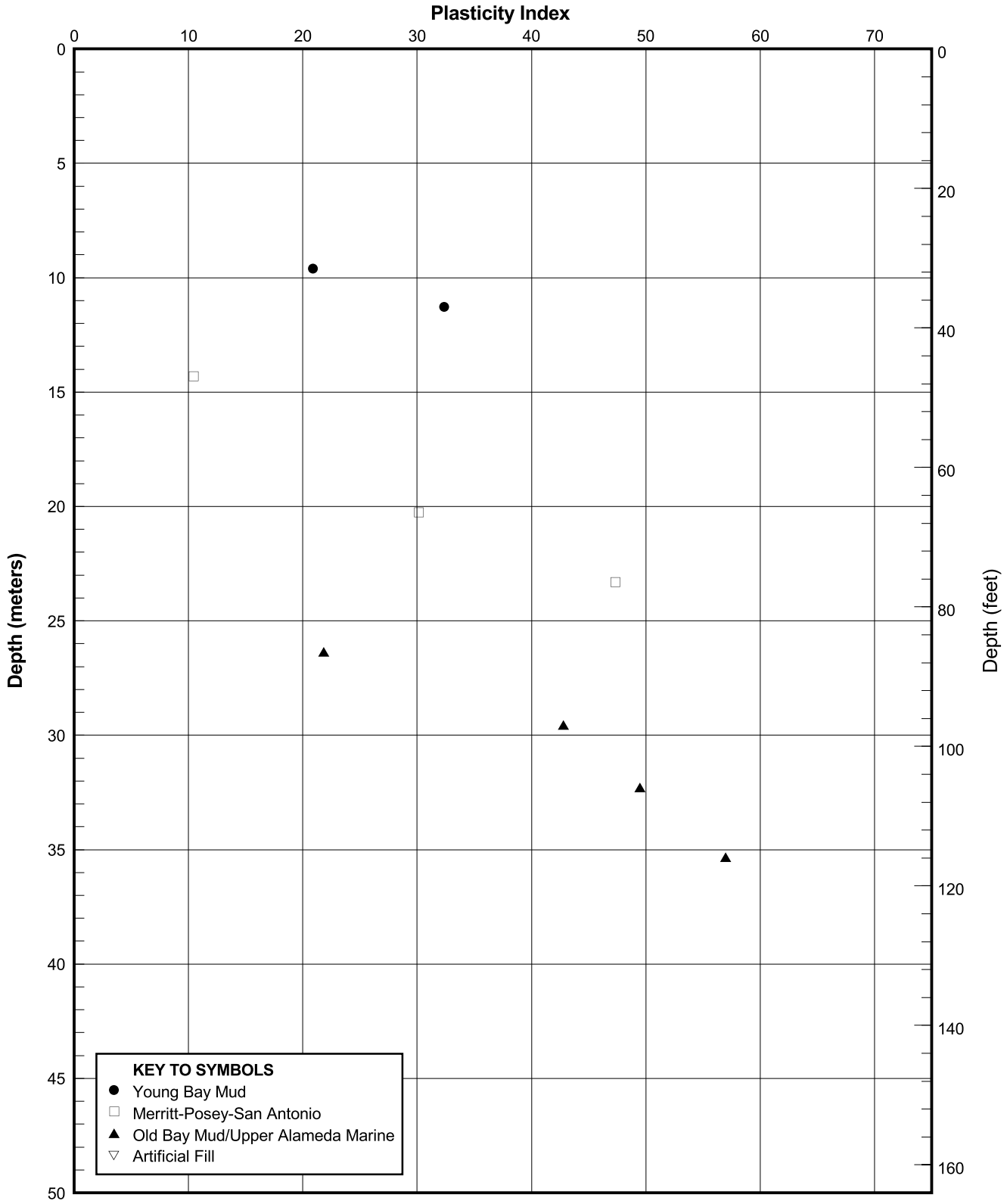
Sample No. 28 - Depth: 29.5m
Boring 98-53
SFOBB East Span Seismic Safety Project

No Consolidated-Undrained Triaxial Compression Testing Performed For This Boring

No Consolidated-Drained Triaxial Compression Testing Performed For This Boring

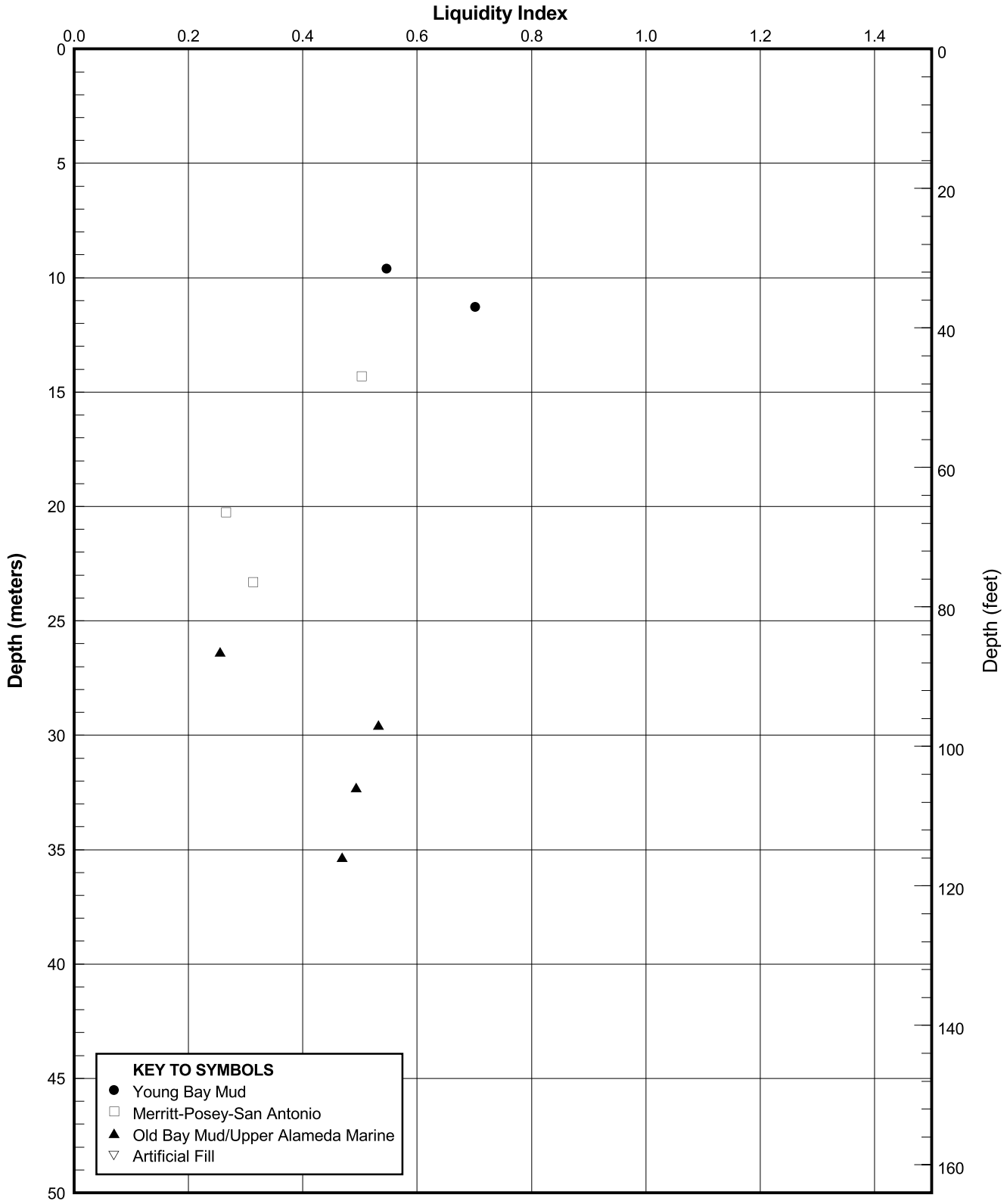
No R-Value Laboratory Testing Performed For This Boring

No Corrosion Testing Performed For This Boring



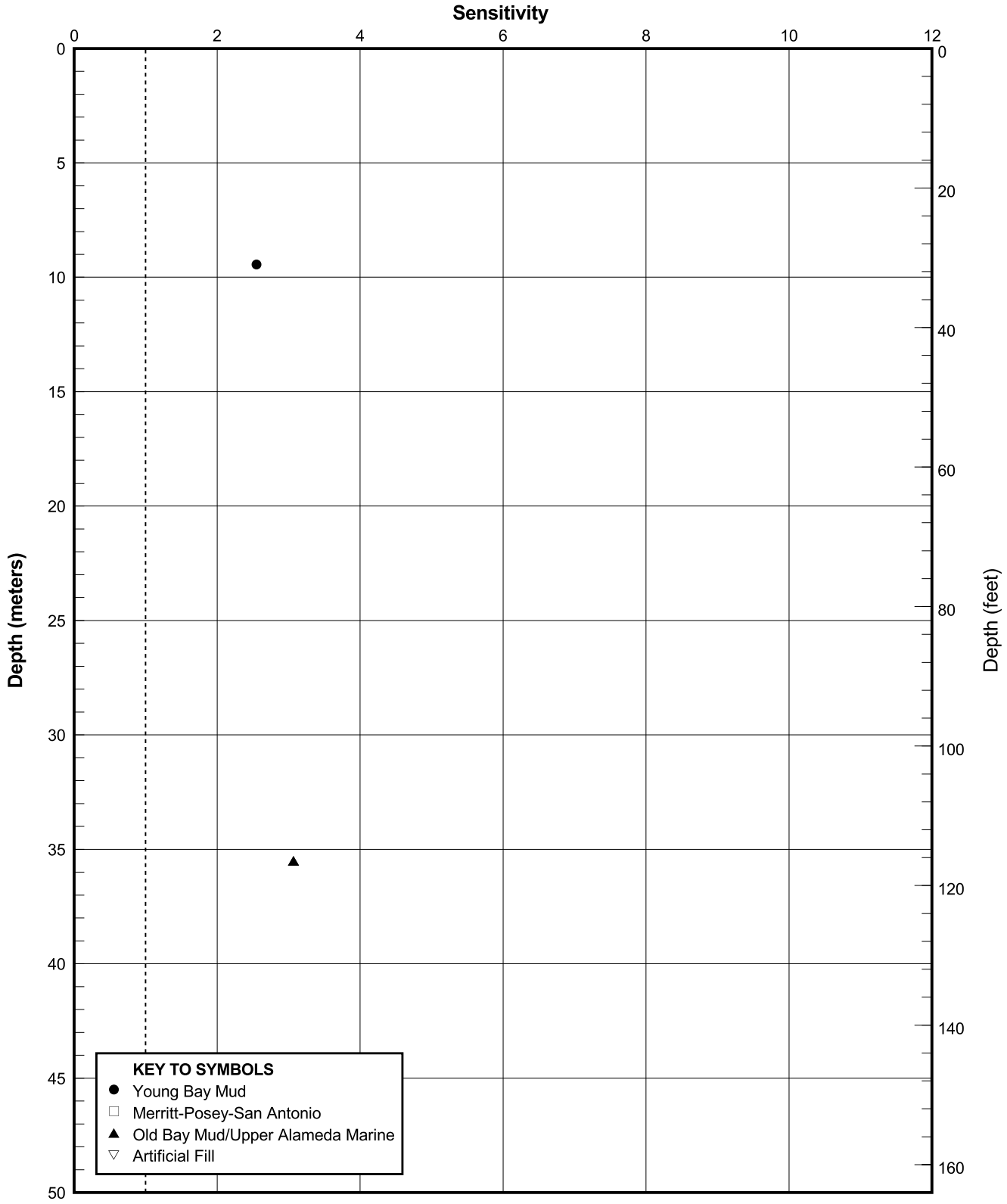
PLASTICITY INDEX PROFILE
Boring 98-53
SFOBB East Span Seismic Safety Project

PLATE 98-53.12



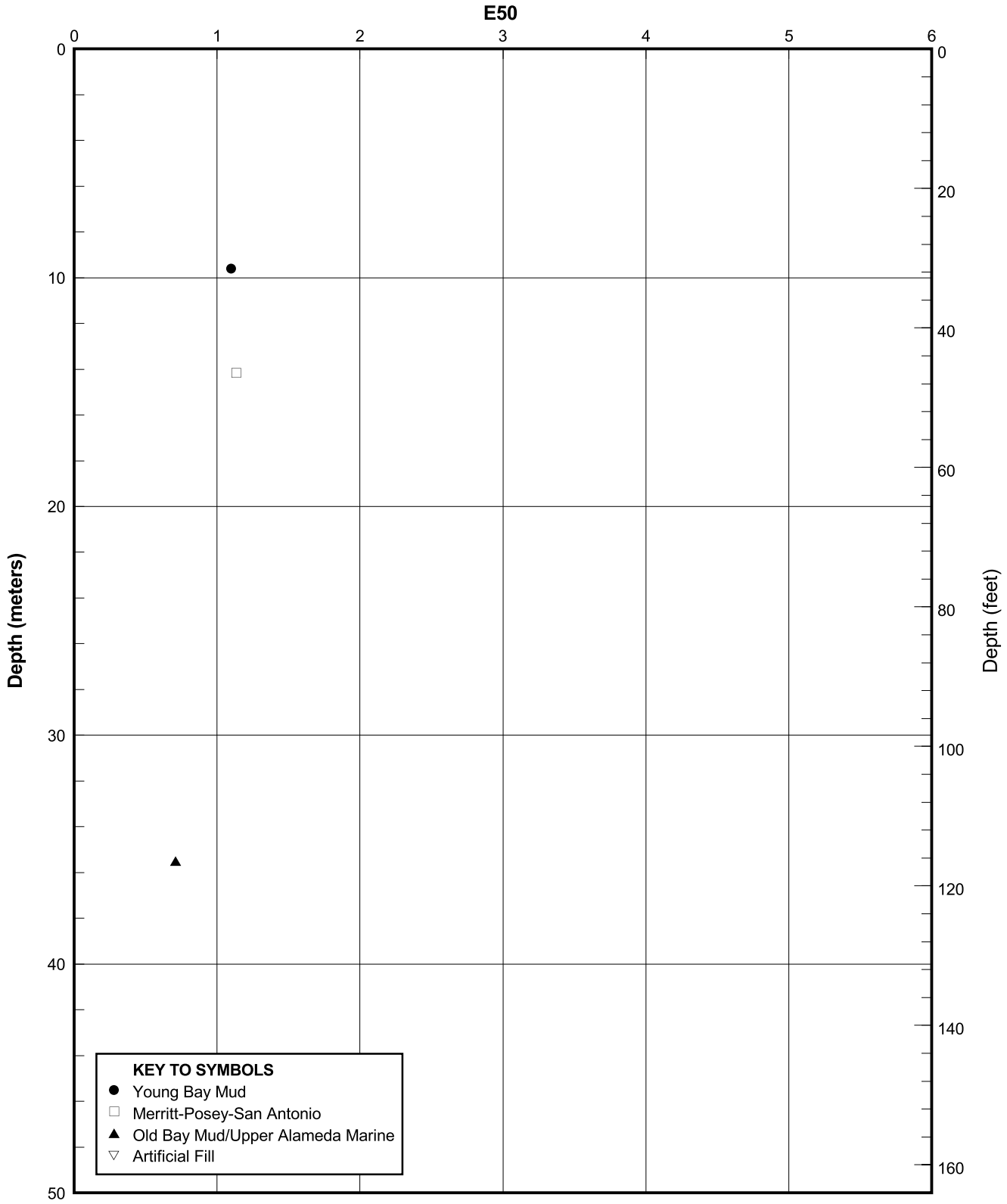
LIQUIDITY INDEX PROFILE
Boring 98-53
SFOBB East Span Seismic Safety Project

PLATE 98-53.13



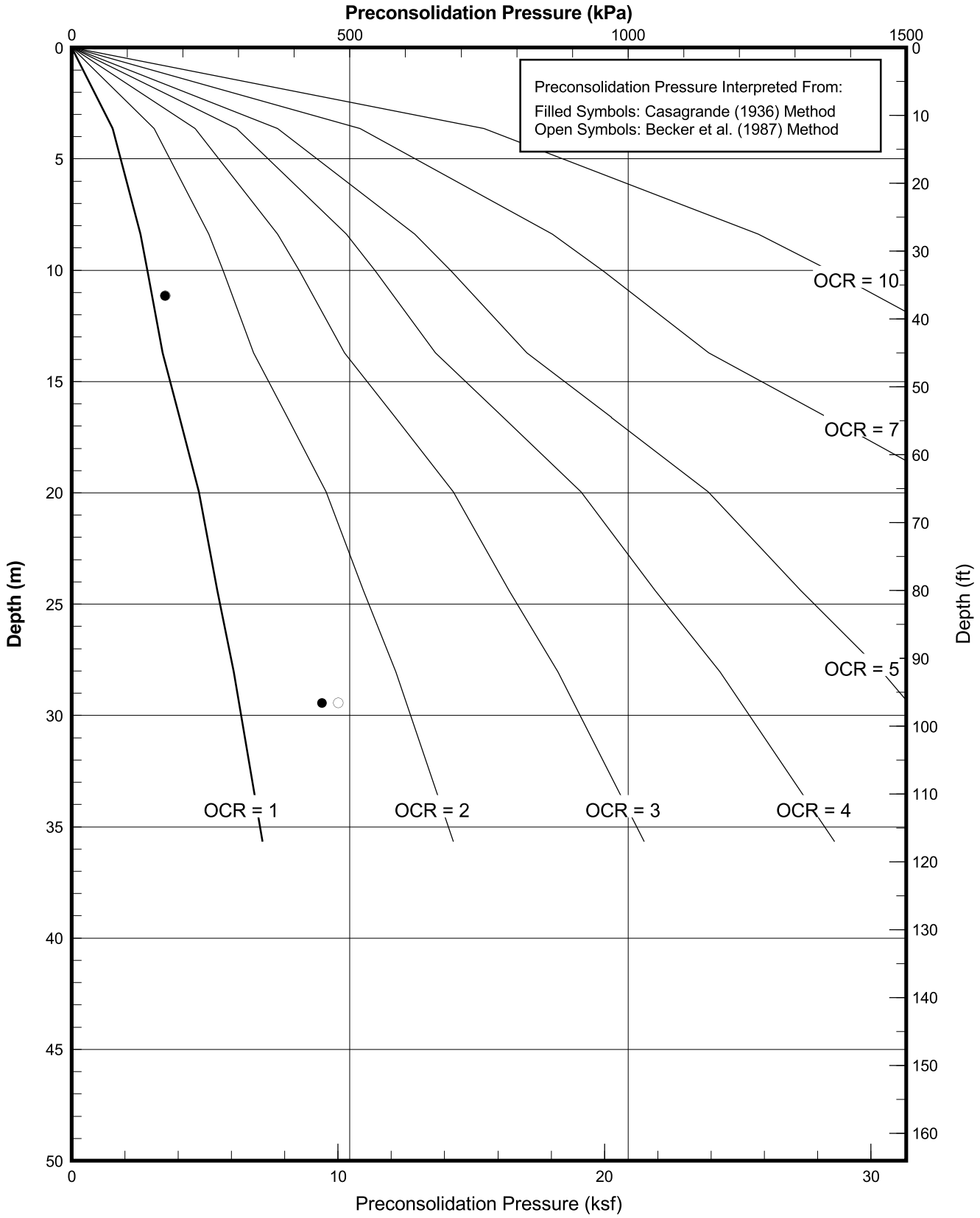
SENSITIVITY PROFILE
Boring 98-53
SFOBB East Span Seismic Safety Project

PLATE 98-53.14



E50 PROFILE
Boring 98-53
SFOBB East Span Seismic Safety Project

PLATE 98-53.15



PRECONSOLIDATION PRESSURE INTERPRETED FROM LABORATORY DATA

Boring 98-53

SFOBB East Span Seismic Safety Project

PLATE 98-53.16

LAND BORING 98-54

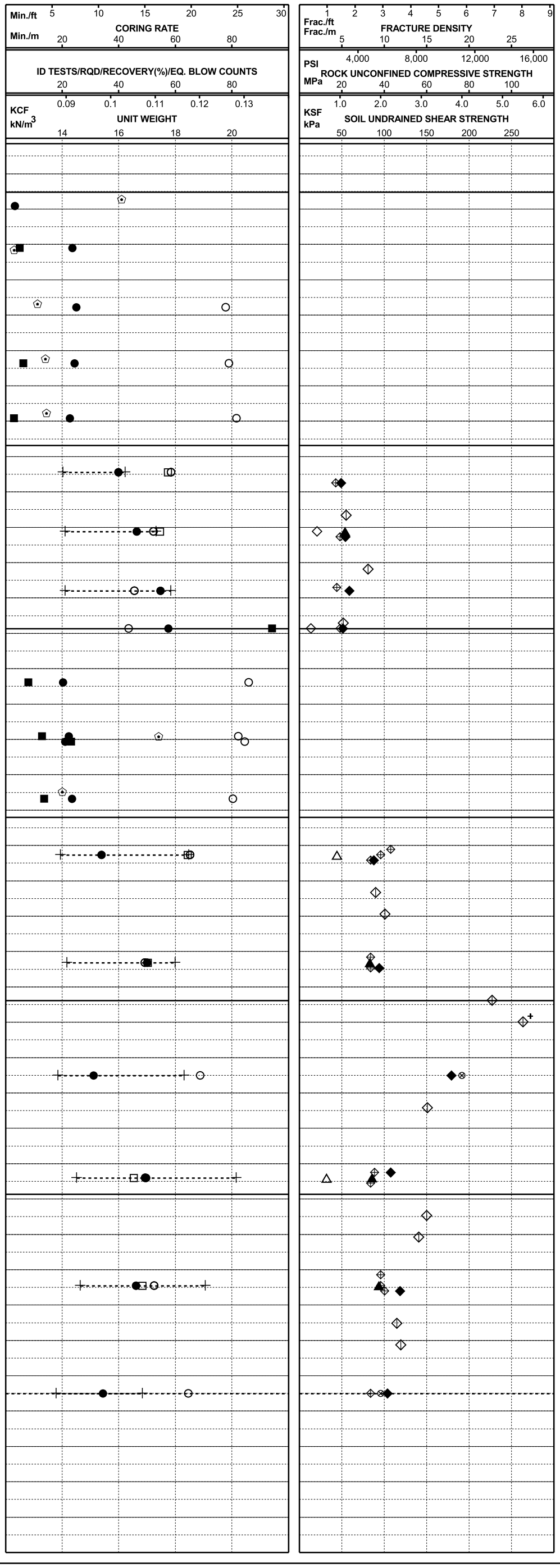
PROJECT NO:	98-42-0058	**START DATE:**	10/16/98	**DRILLER:**	Pitcher Drilling Company
BORING:	98-54 (3m left of E. Sta. 85+88)	**COMPLETION DATE:**	10/17/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1839080 N648270
CA State Plane Zone 3, NAD83, Meters

GROUND ELEVATION: 3.4m (MSL)

Material Description	Blow Count	Stratum No.
PAVEMENT, 0.1m Asphalt Concrete over Aggregate Base (0.2m)		I
Silty Fine SAND (SM), medium dense to dense, light brown, moist -with fine gravel -dense to very dense cemented fine sand with silt (lime treated base), below 1.2m (1.5m)	BAG 41	II
Fine SAND with silt (SP-SM), medium dense, light brown -dense and moist, at 1.8m -gray, and with shell fragments, below 3.0m -very loose at 3.0m (3.4m) -with a trace of gravel, at 4.6m (8.7m)	3 18 14 23	III
Fat CLAY (CH), firm to stiff, olive gray -with shell fragments -lean clay to 10.1m -with silt pockets at 9.4m -with silt pockets, sand partings, gas blisters, and an H2S odor, at 11.0m -with shells at 12.2m -with organic pockets and sand pockets, at 13.7m (13.9m)	PUSH PUSH SAVE PUSH	IV
Fine SAND with silt (SP-SM), dense to very dense, greenish gray -clayey sand, to 14.9m -silty fine sand, below 16.5m -brown, with clay pockets, 17.1m to 17.7m -with clay seams and pockets, below 18.3m (19.2m)	PUSH 54 20	V
Fat CLAY (CH), stiff to very stiff, greenish gray -sandy clay to 19.8m -with gas blisters at 20.1m -with gas blisters, a few organic pockets, and slickensides, at 23.2m (24.4m)	PUSH PUSH	VI
Fat CLAY (CH), very stiff to hard, greenish gray -with a few sand pockets and partings, a few shell fragments and calcareous nodules, at 26.2m -with organic pockets, 29.0m to 32.6m -with sand seams, and silt seams and partings, at 29.3m (29.9m)	SAVE PUSH	VII
Fat CLAY (CH), very stiff, greenish gray -with silt pockets, sand pockets, and a few organic pockets, below 32.3m -with shell fragments and many silty fine sand pockets, at 35.4m	PUSH SAVE	VIII

TOTAL DEPTH: 35.7m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-54

SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-54.1

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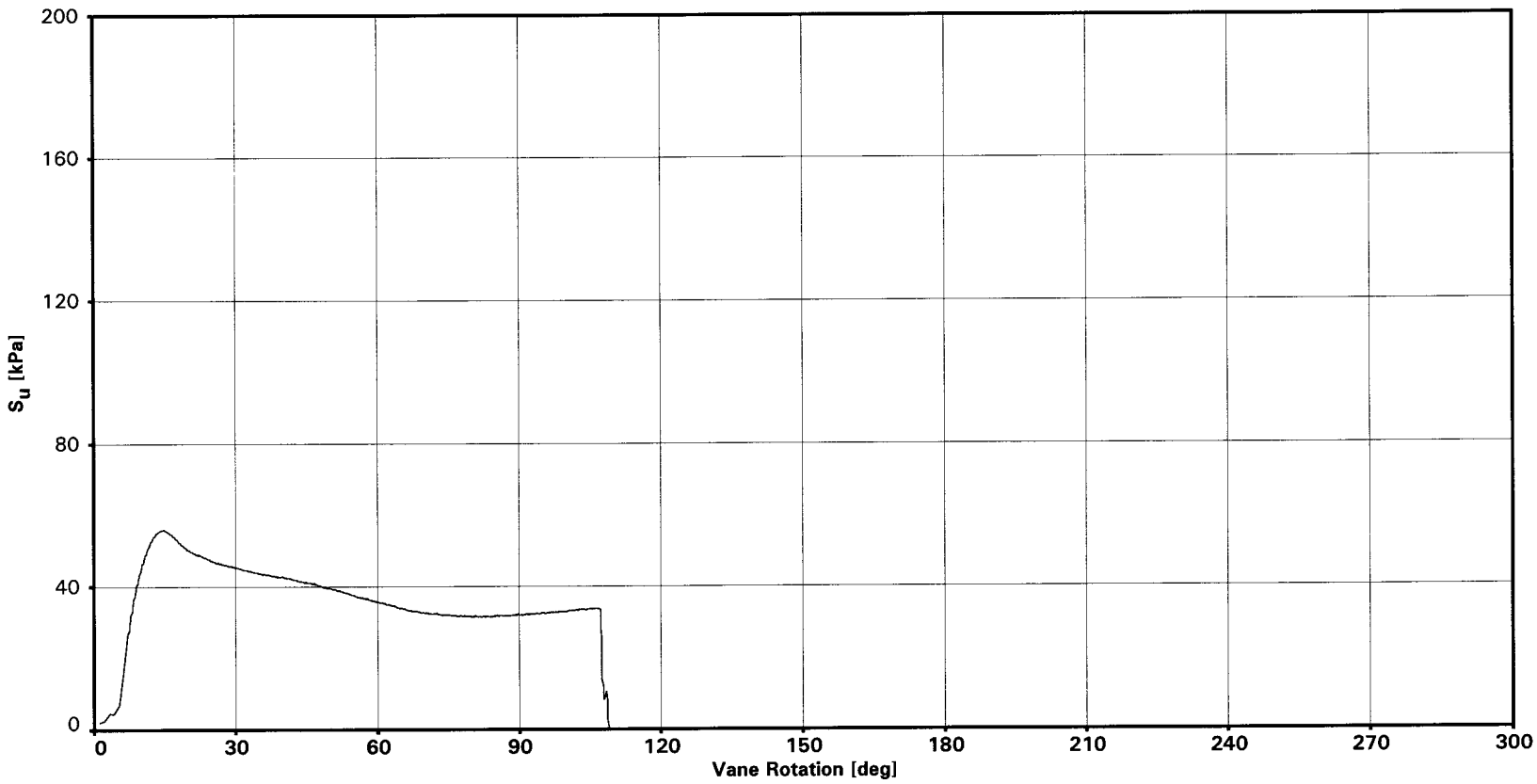
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 10.7m
Boring 98-54
SFOBB East Span Seismic Safety Project

PLATE 98-54.2a

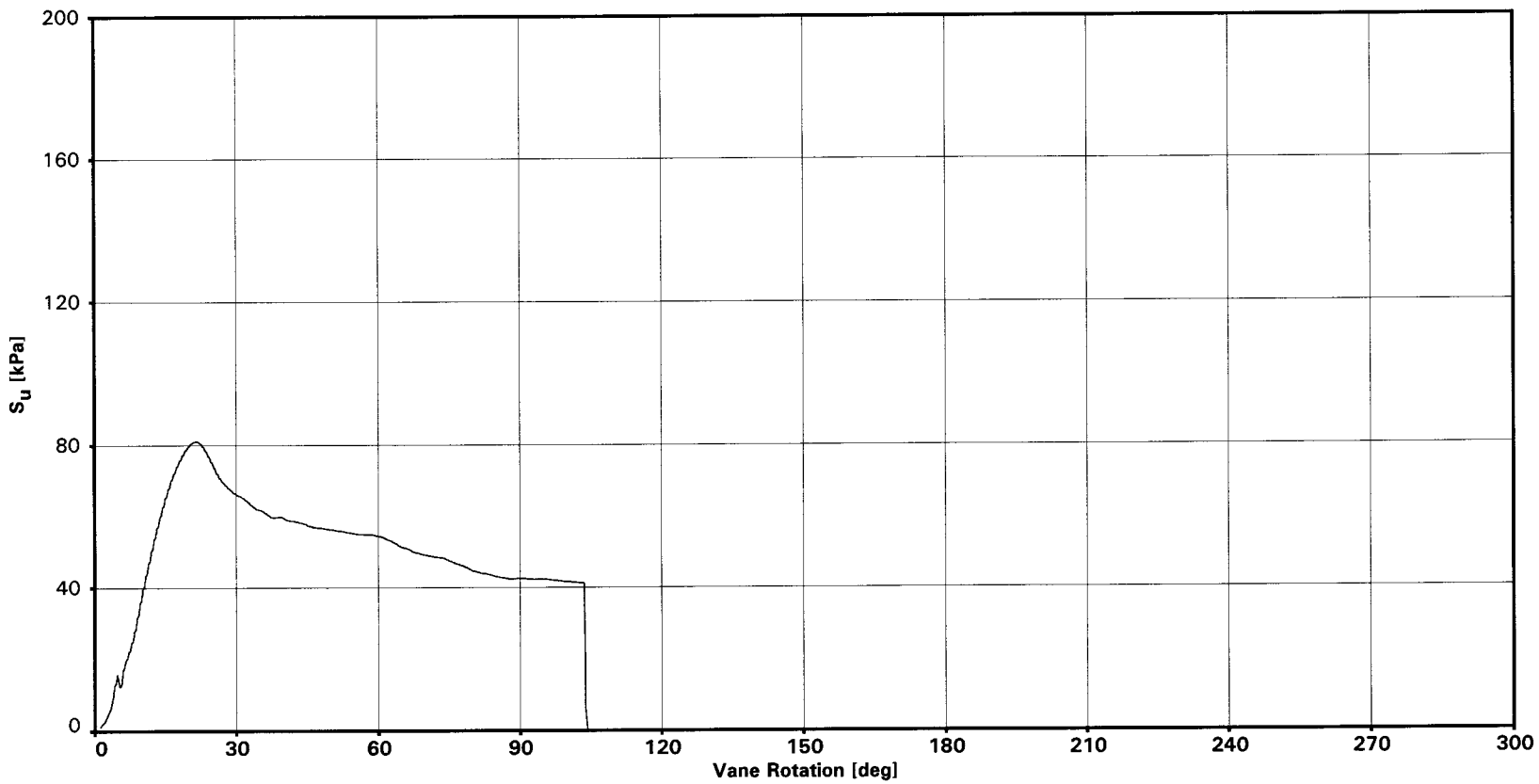
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



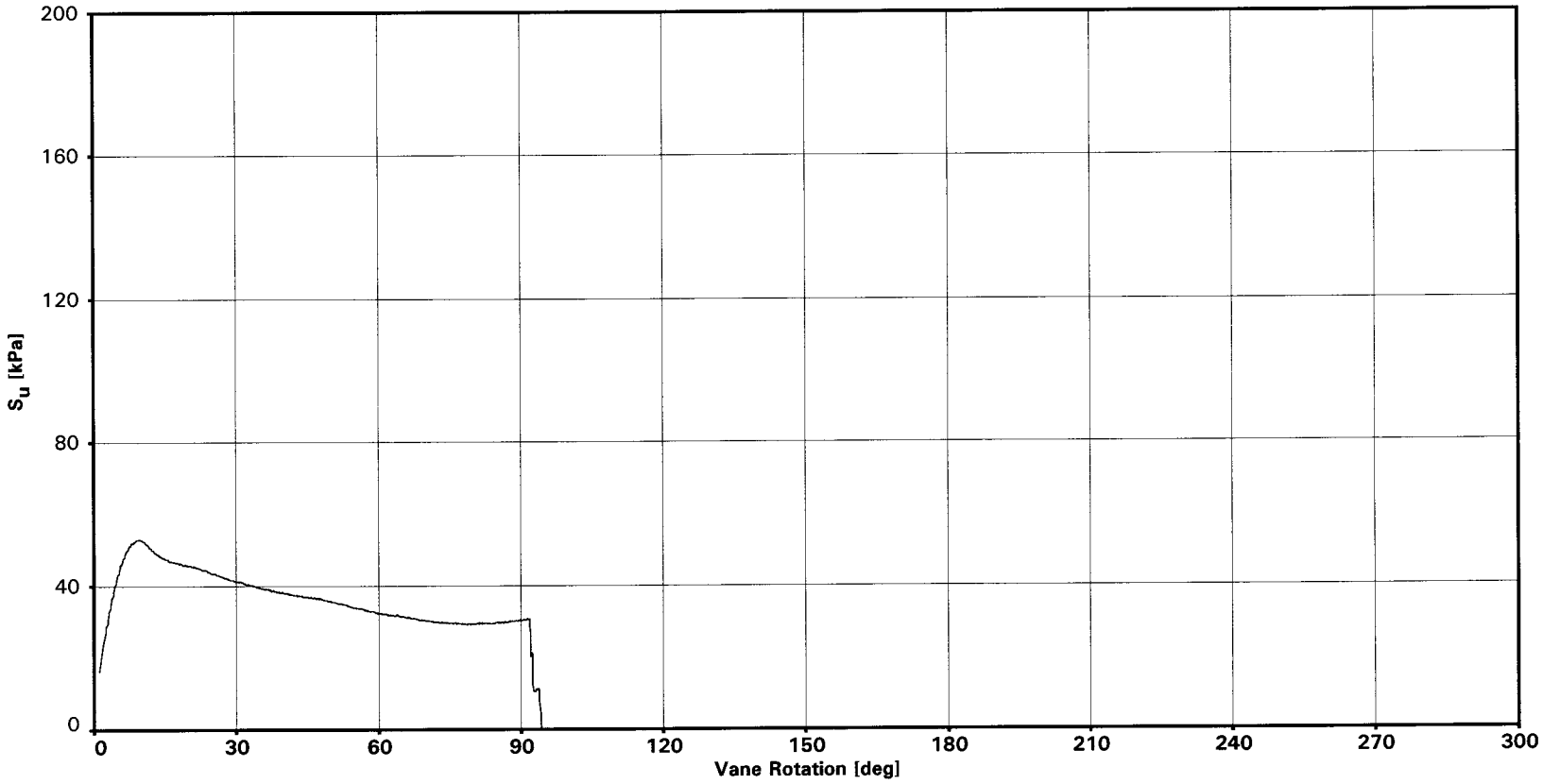
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 12.2m
Boring 98-54
SFOBB East Span Seismic Safety Project

PLATE 98-54.2b

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 13.7m
Boring 98-54
SFOBB East Span Seismic Safety Project

Earth Mechanics

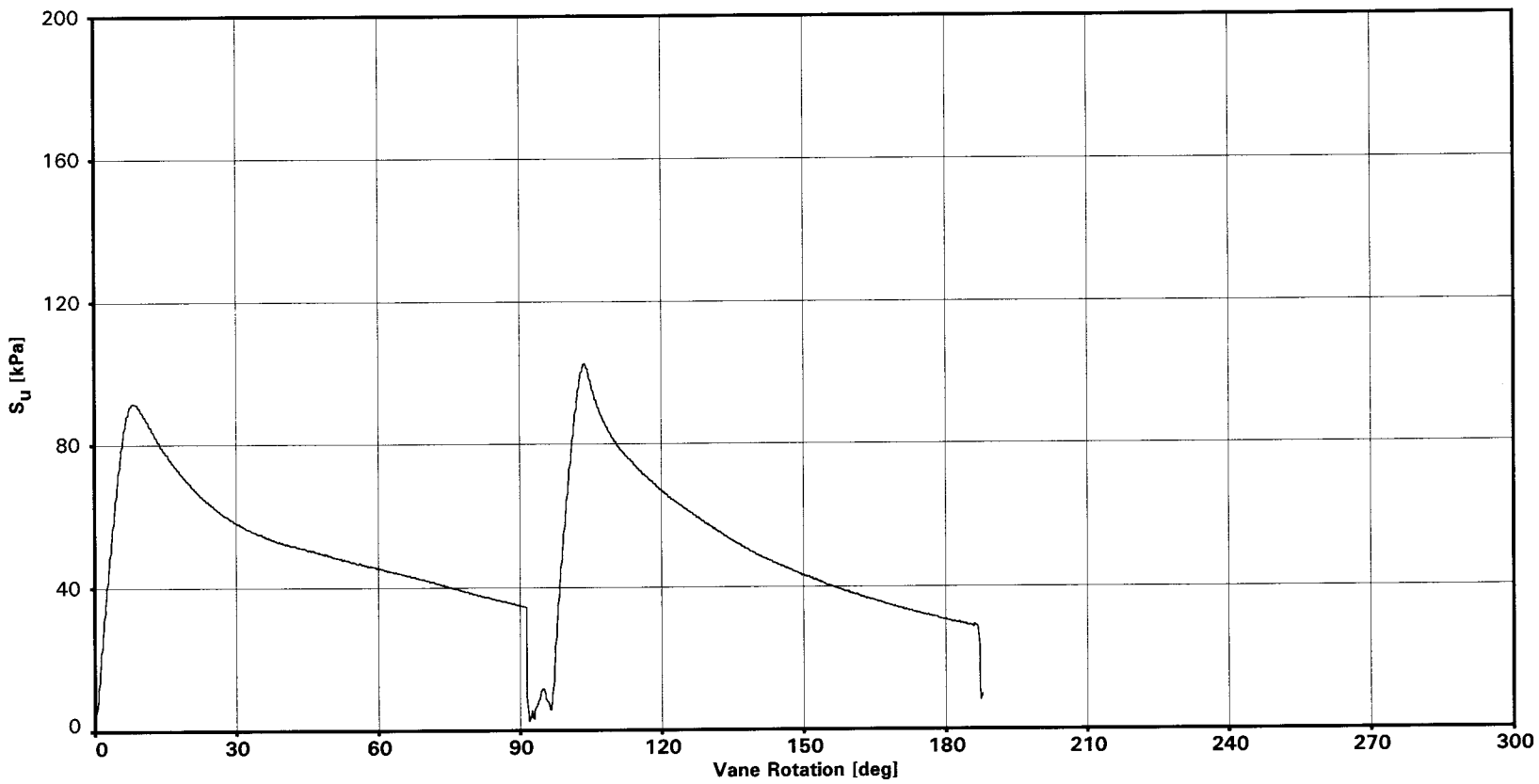
FUGRO

PLATE 98-54.2c

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 21.3m and 21.9m
Boring 98-54
SFOBB East Span Seismic Safety Project

Earth Mechanics

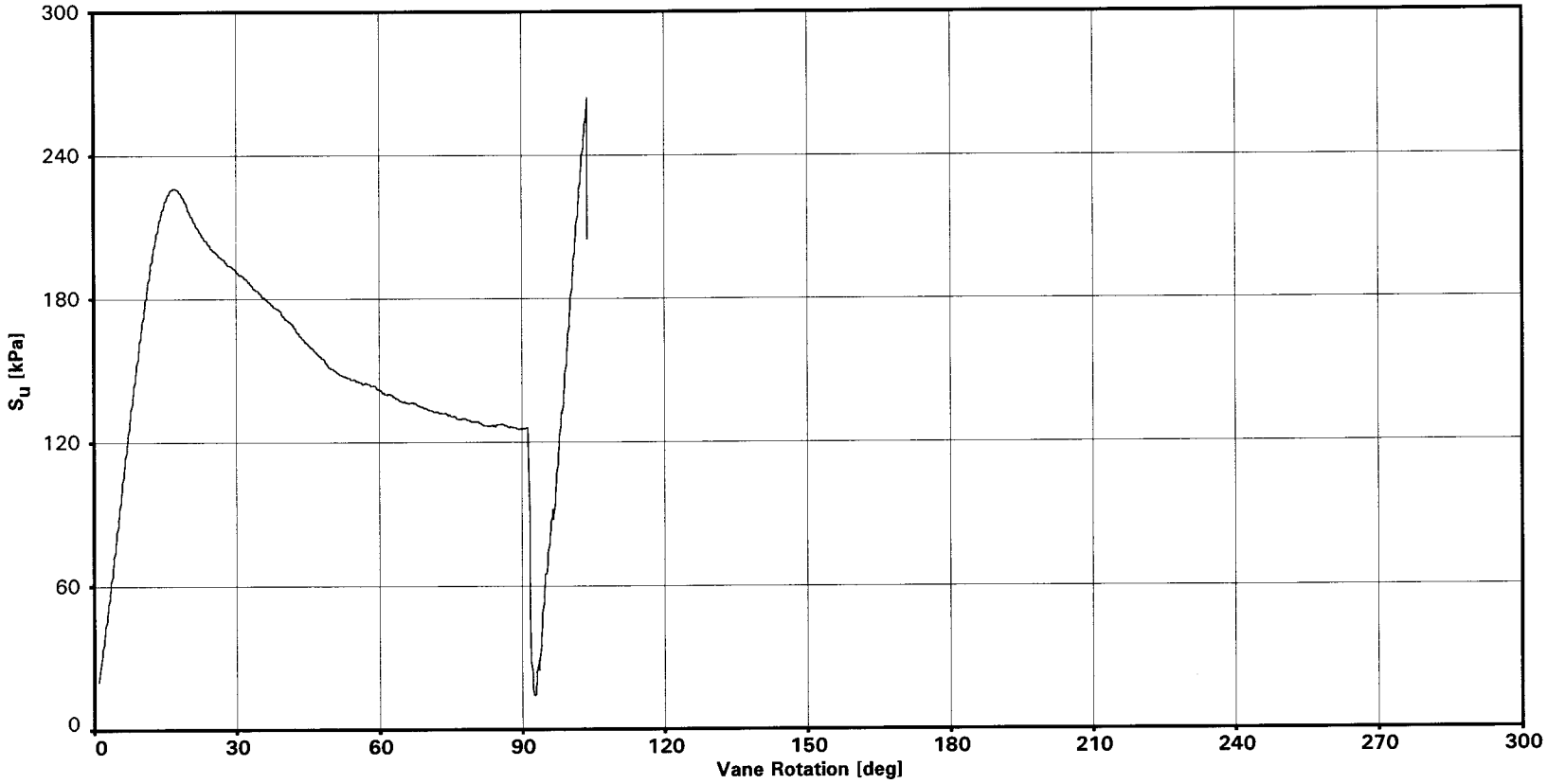
FUGRO

PLATE 98-54.2d

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 24.4m and 25.0m
Boring 98-54
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-54.2e

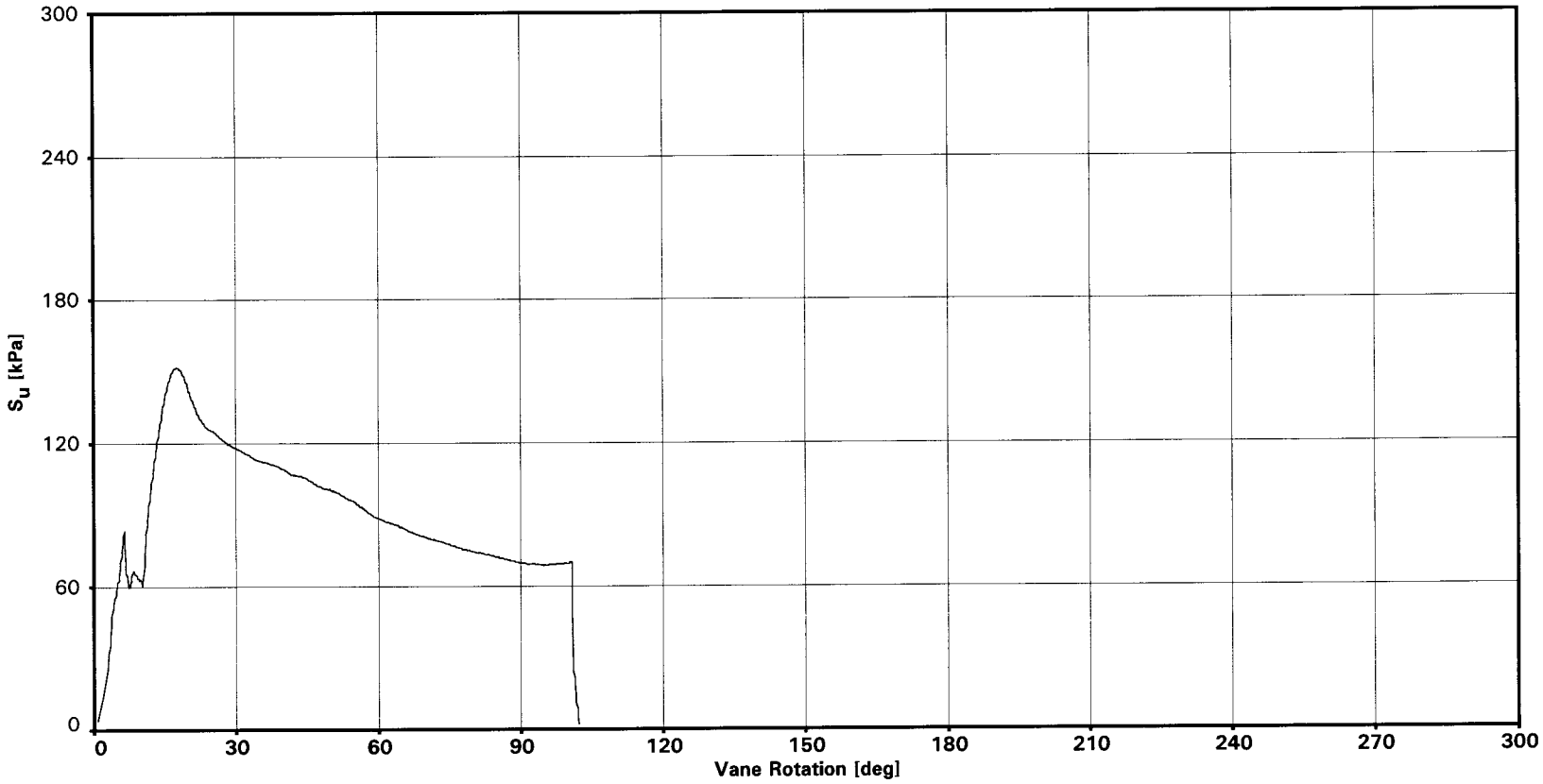
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 27.4m
Boring 98-54
SFOBB East Span Seismic Safety Project

PLATE 98-54.2f

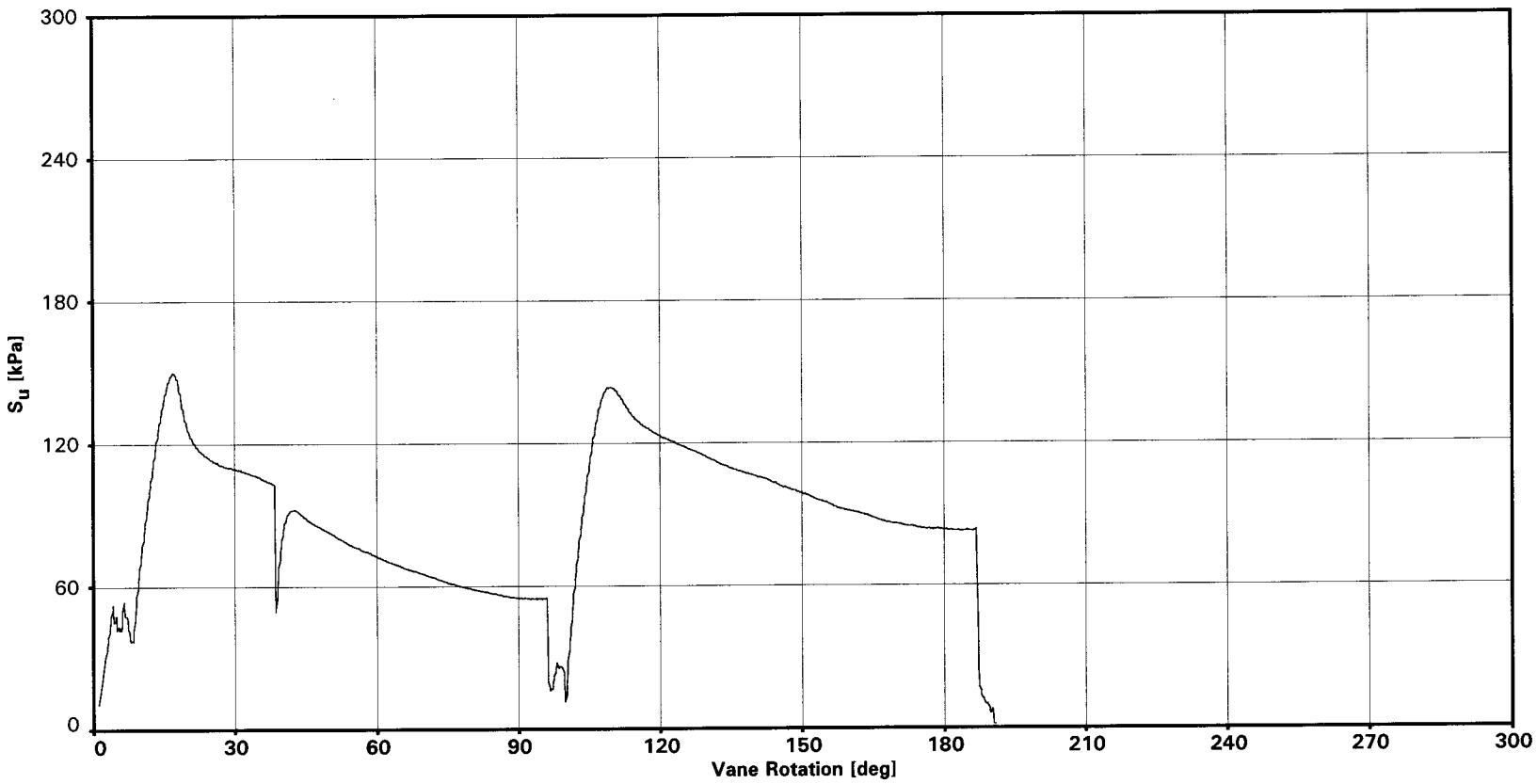
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 30.5m and 31.1m
Boring 98-54
SFOBB East Span Seismic Safety Project

PLATE 98-54.2g

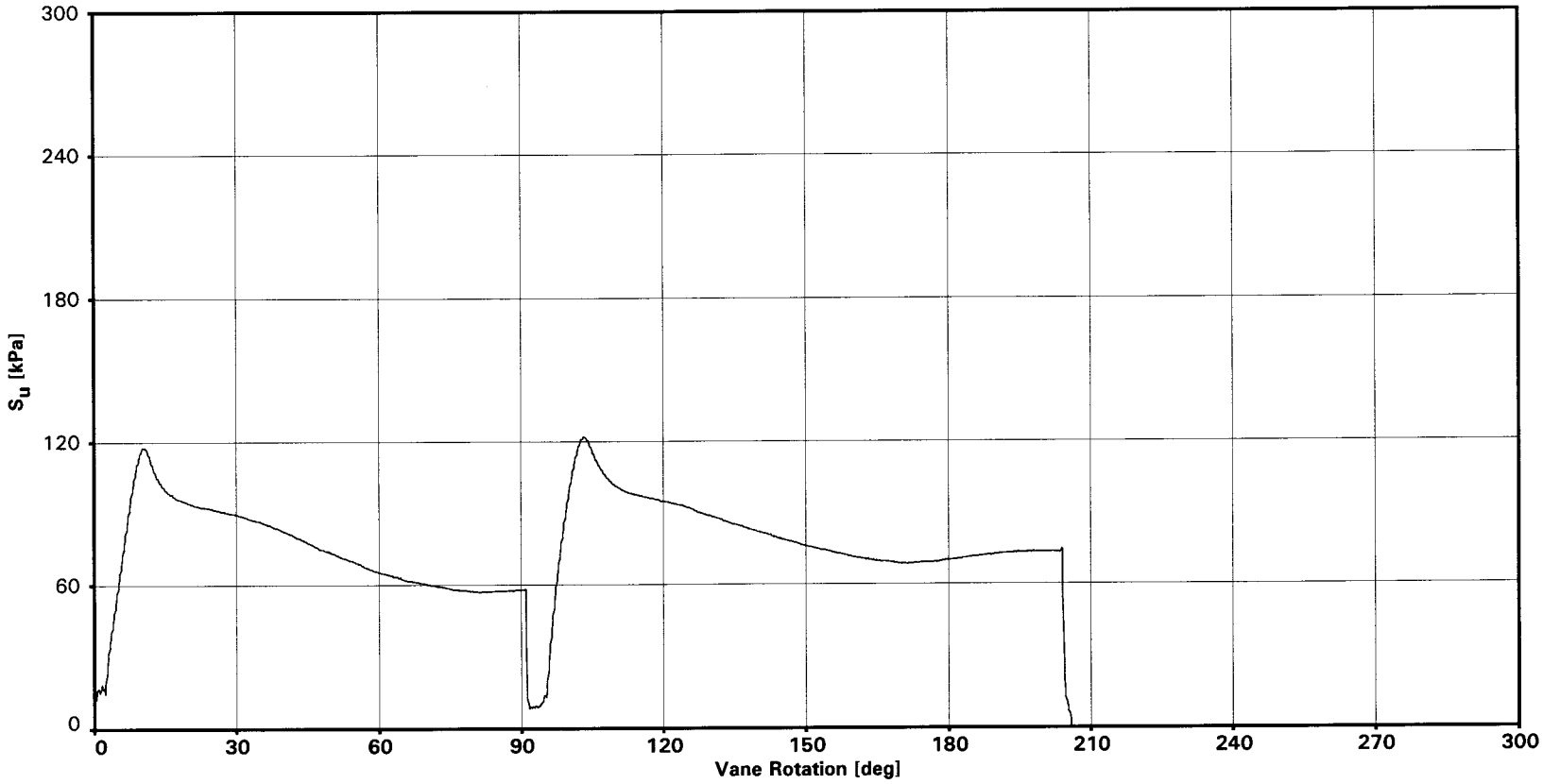
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 33.5m and 34.1m
Boring 98-54
SFOBB East Span Seismic Safety Project

PLATE 98-54.2h

SFOBB Task Order No. 5
Project No. 98-42-0058

98-54		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
1.9	1	3																									
3.1	2	24					5																			H	
4.8	3	25																									2.69
6.4	4	24					6																			H	
7.9	5	23					3																				
9.4	7	40	42	20	0.88	17.7																					
9.8	8							43.1			49.1																
10.7	400													55.1													
10.8	9																										2.73
11.1	11	46	53	21	0.79	17.5						20.7			54.1		0.8										
11.3	12							47.9			54.5																
12.2	401													80.9													
12.7	13	53	59	22	0.86			44.0																		C	
12.8	14	55	59	21	0.90						59.2																
13.7	402													51.7													

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-54
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-54.3a

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SFOBB Task Order No. 5
Project No. 98-42-0058

98-54		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
13.9	15	57					94	47.9			51.4	13.5															2.72
15.4	16	20					8																				
16.9	17	22					13																				
17.1	18	21					23																				
18.7	19	23					14																				
20.1	20							107.7																			
20.3	21	34	65	20	0.32	18.4		95.8								44.3											
20.4	22							83.8			87.9																
21.3	403													90.0													
21.9	404													101.0													
23.2	23							83.8																			
23.3	24	50	60	22	0.74	17.0									83.3		0.9										
23.5	25							83.8			94.1																
24.4	405													227.0+													
25.0	406													263.3+													

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-54
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-54.3b

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98-54		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
26.4	26	23	37	13	0.43				191.5		179.5															C	
26.5	27	31	63	19	0.28				191.5		179.5																
27.4	407													150.8													
29.3	28							88.6			107.7																
29.4	29	50	82	25	0.43	16.5									85.8	31.7	1.4										
29.6	30							83.8																			
30.5	408													149.9													
31.1	409													140.8													
32.2	31							95.8																			
32.5	33	46	71	27	0.44	16.8		95.8							93.9		1.4										
32.6	34							100.5			118.8																
33.5	410													114.9													
34.1	411													119.7													
35.4	35		48	18																						C	
35.5	36	34	49	18	0.54			83.8	95.8		103.9																

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

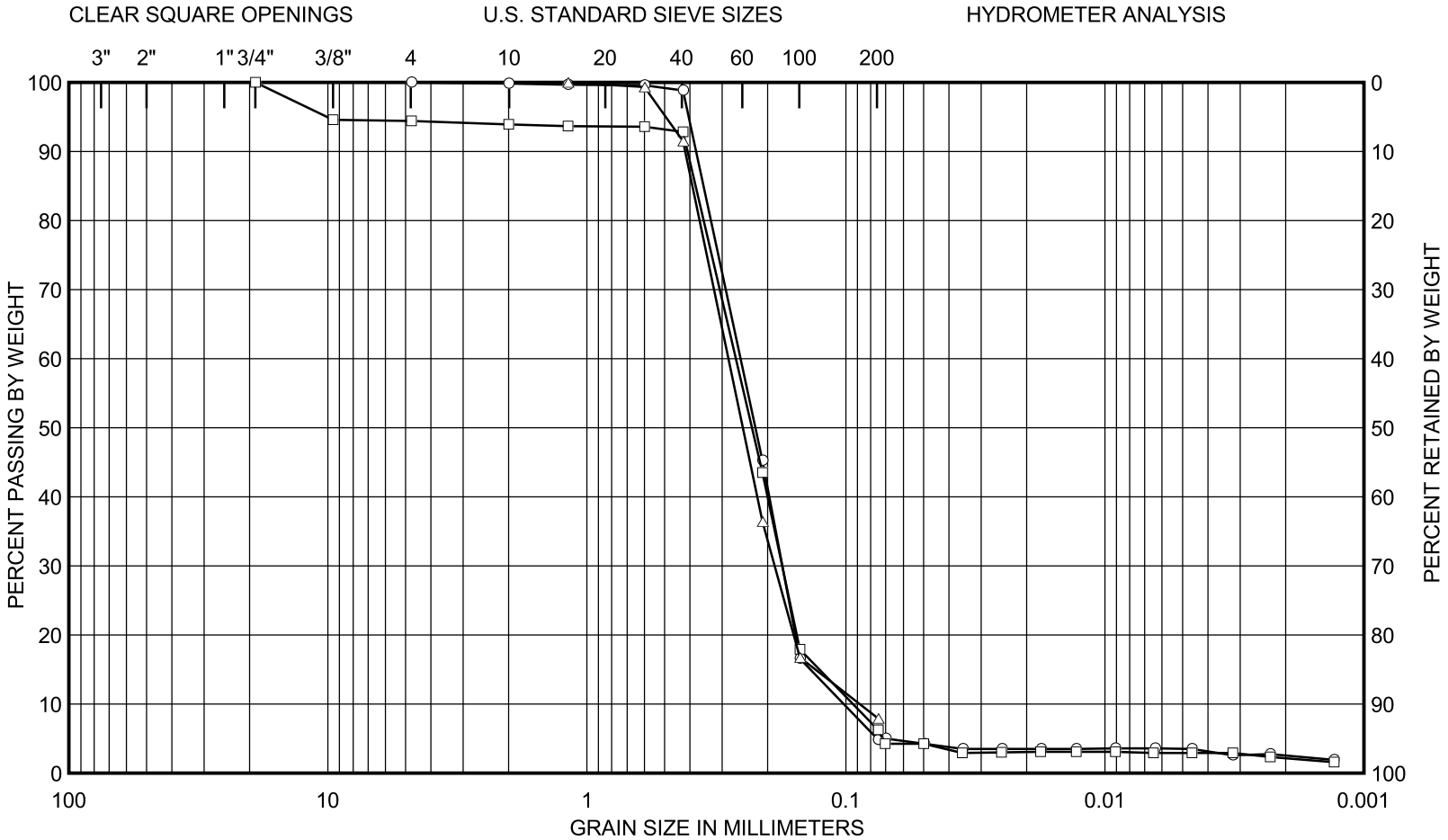
+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-54
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-54.3c



GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
2	3.1	○——○	FINE SAND (SP-SM) with silt	1.2	2.5	0.22
4	6.4	□——□	FINE SAND (SP-SM) with silt	1.2	2.8	0.23
16	15.4	△——△	FINE SAND (SP-SM) with silt	1.4	3.2	0.25

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-54
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-54.4

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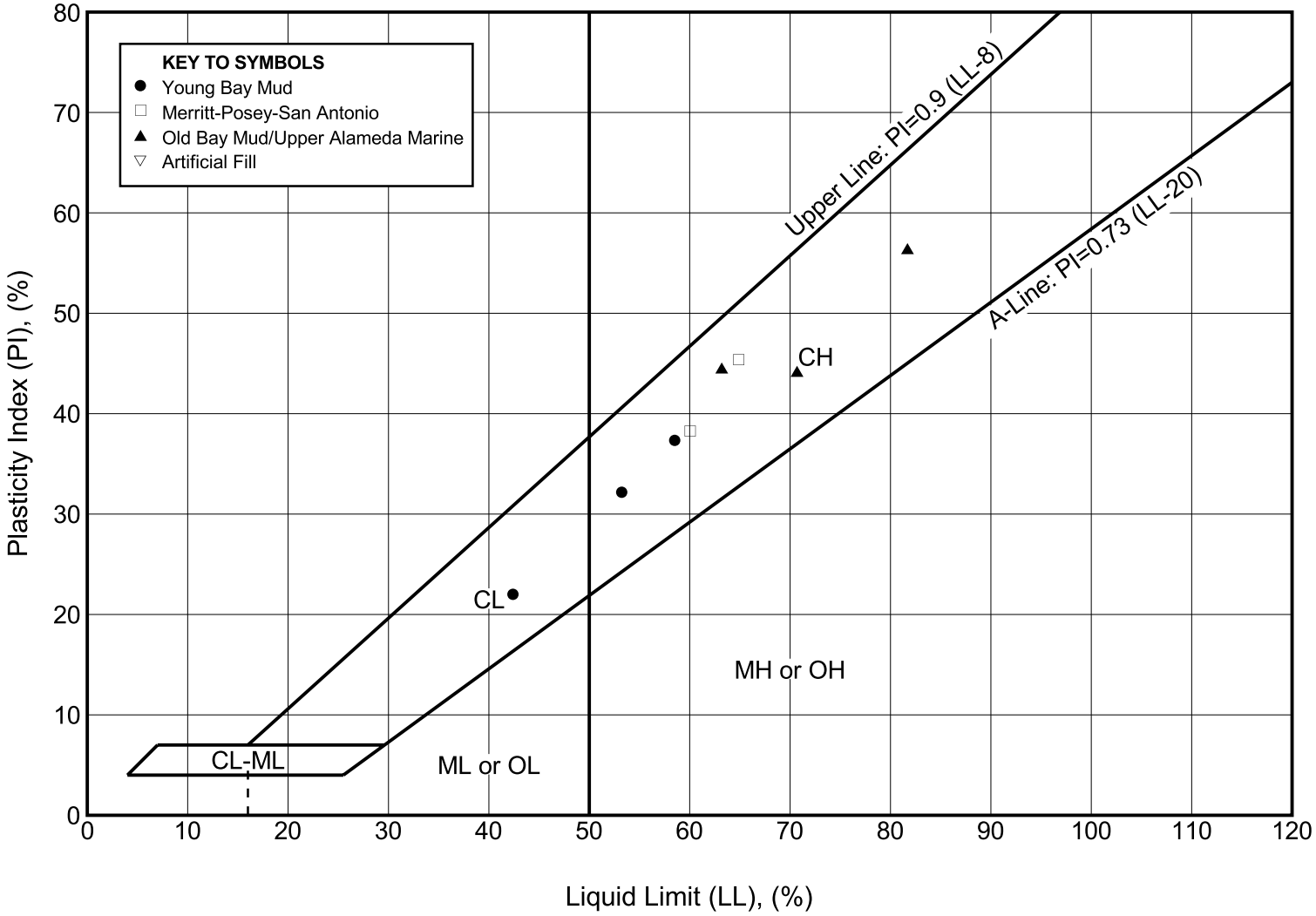

PLASTICITY CHART
Boring 98-54
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-54.5

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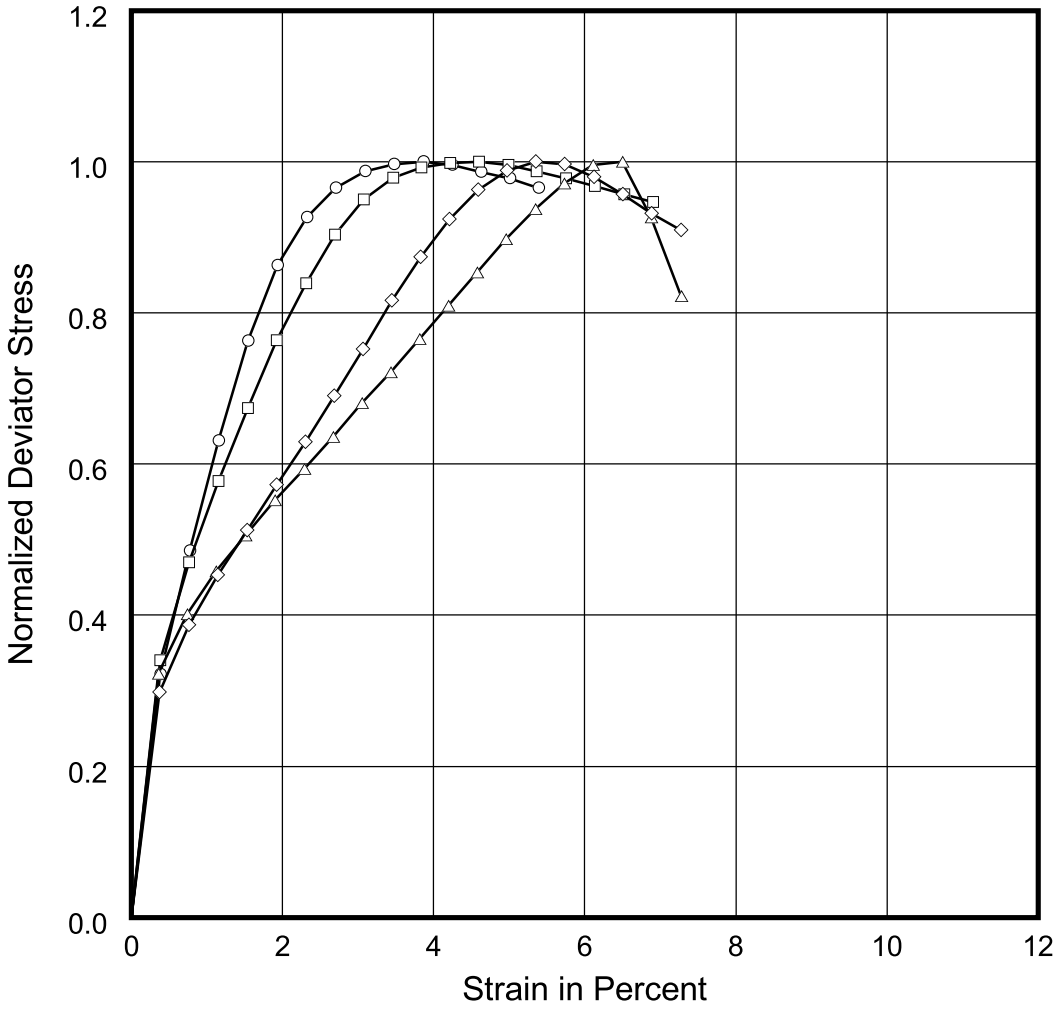
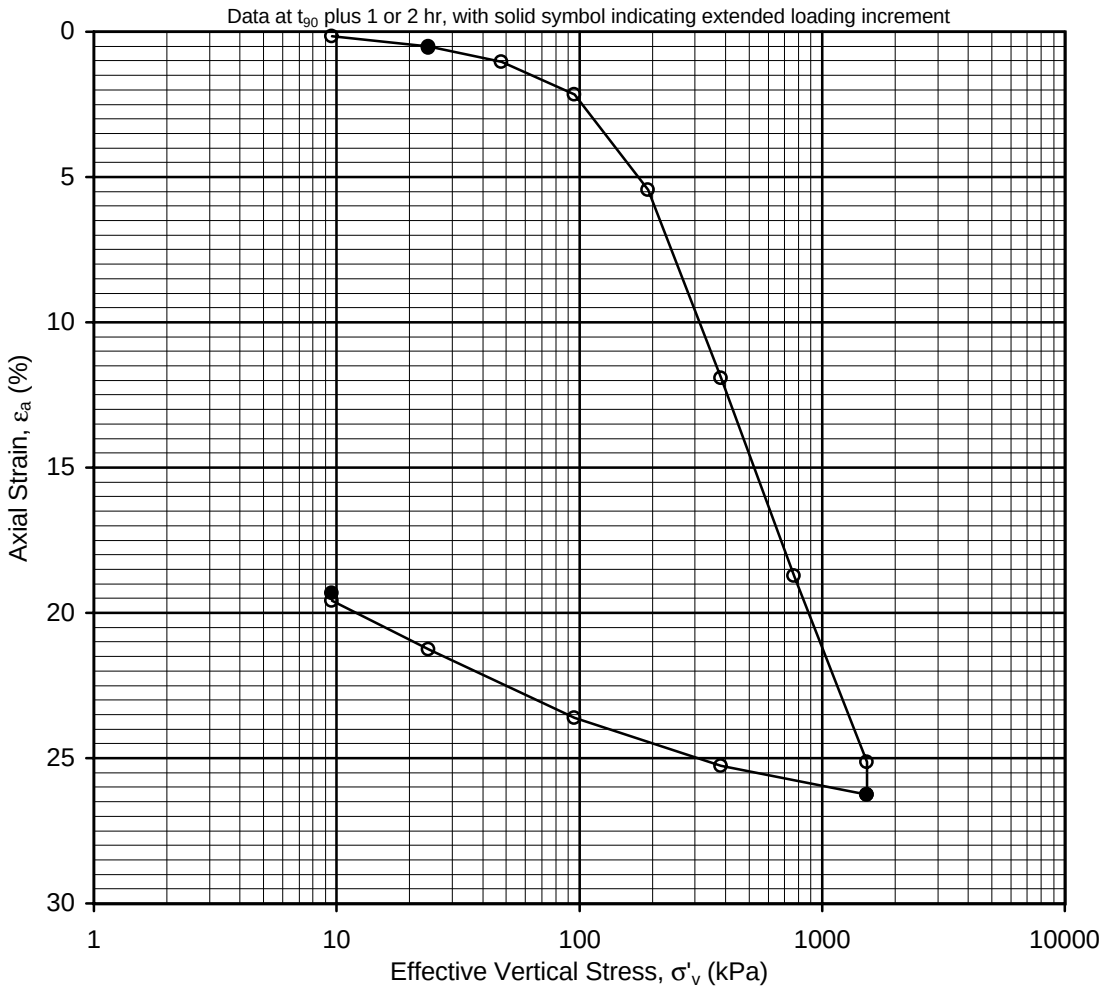


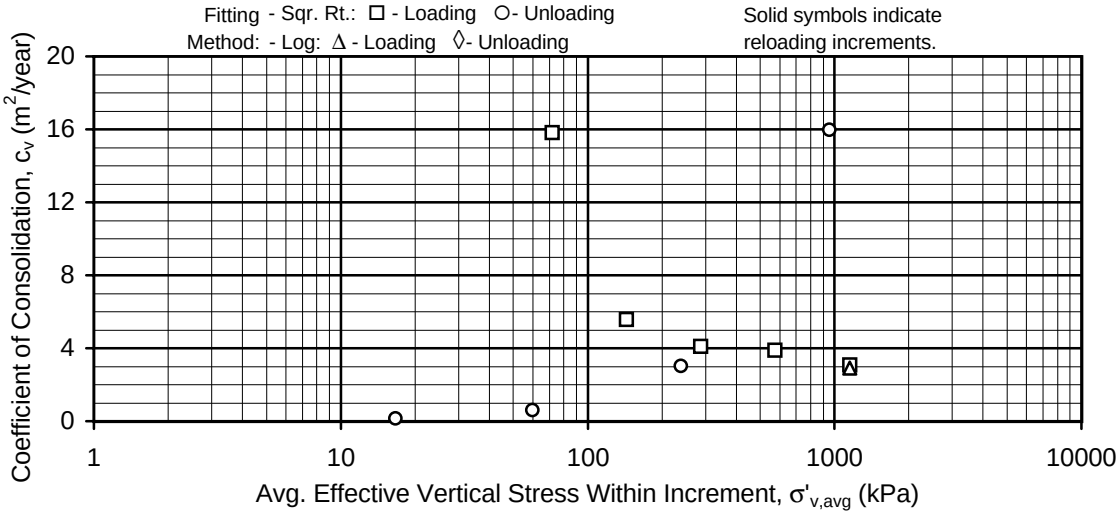
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○	11	11.1	UU	207	108	0.8
□	24	23.3	UU	793	167	0.9
△	29	29.4	UU	827	171	1.4
◇	33	32.5	UU	896	188	1.4

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

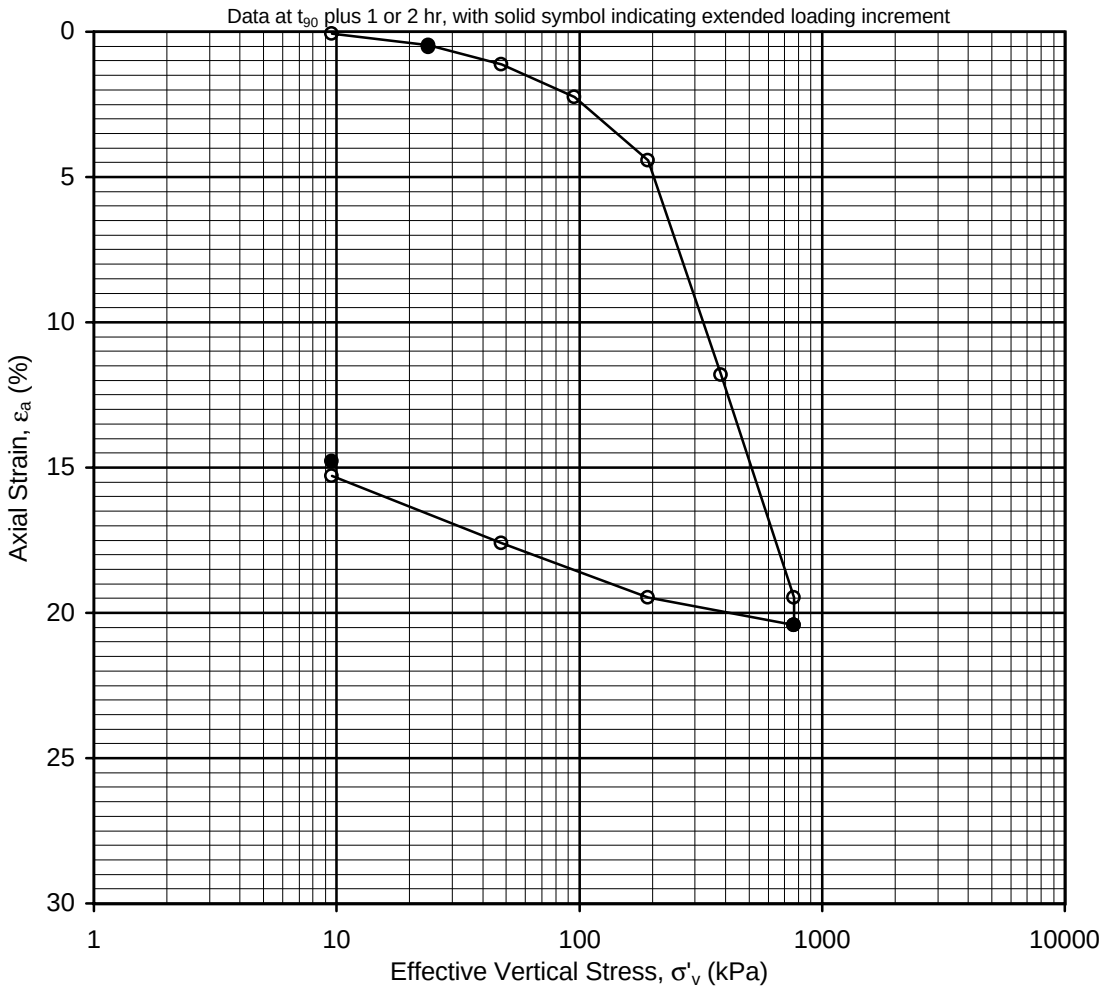
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-54
SFOBB East Span Seismic Safety Project

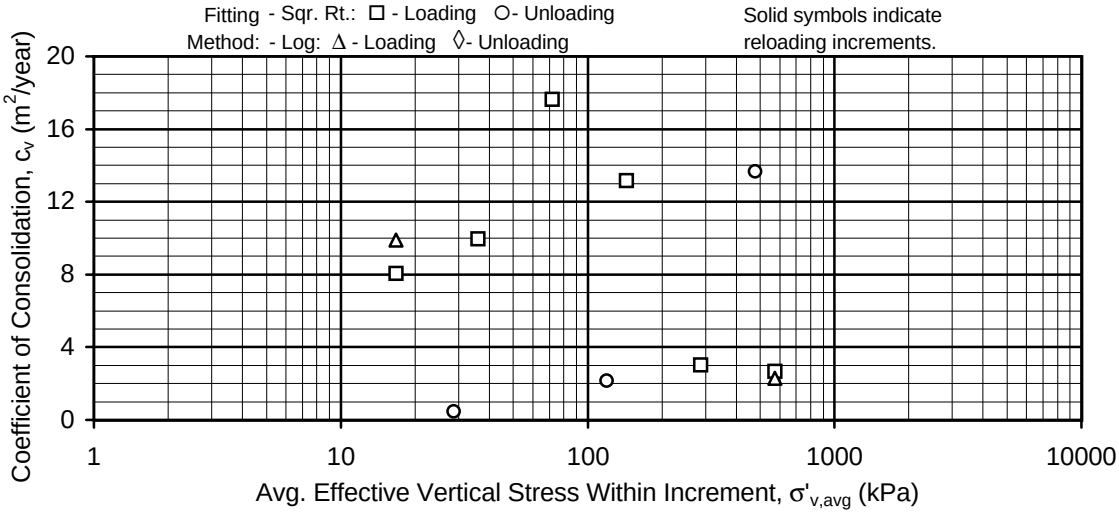




INCREMENTAL CONSOLIDATION TEST RESULTS

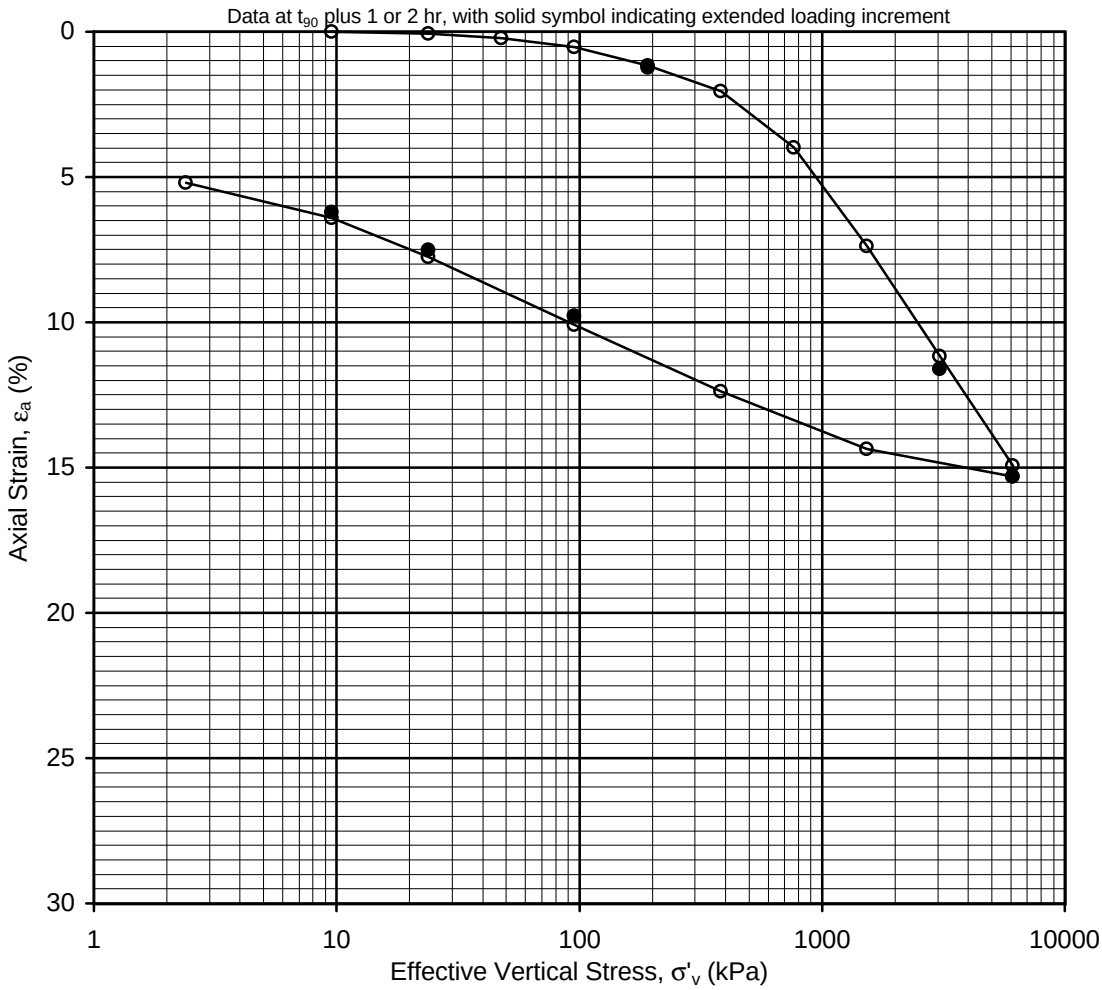
Sample No. 13A (Horizontal Loading) - Depth: 12.9m
Boring 98-54
SFOBB East Span Seismic Safety Project

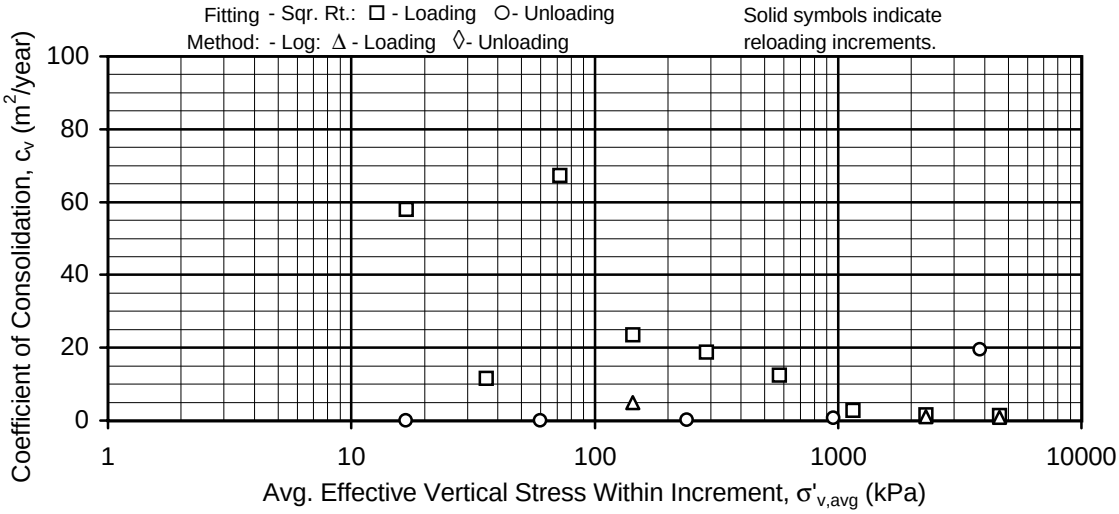




INCREMENTAL CONSOLIDATION TEST RESULTS

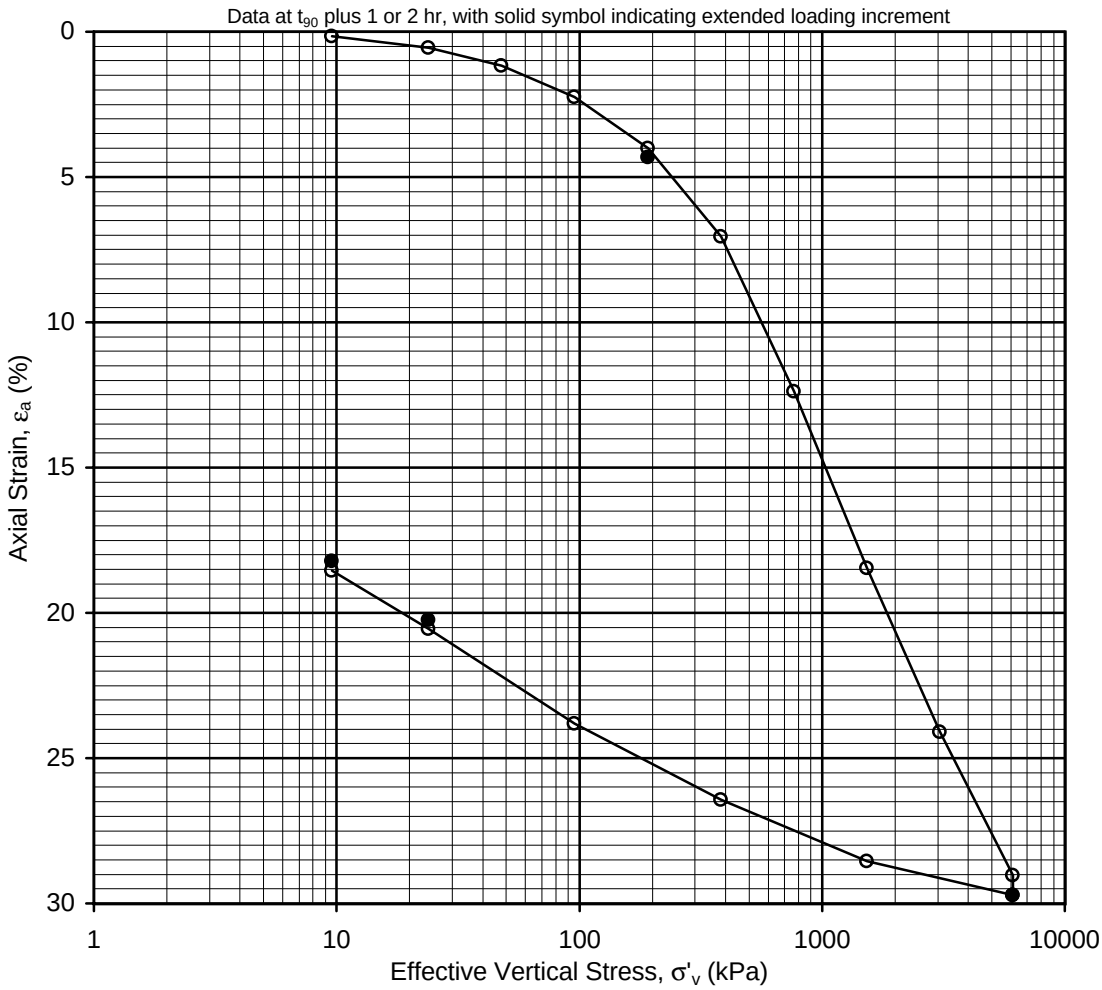
Sample No. 13B - Depth: 12.9m
Boring 98-54
SFOBB East Span Seismic Safety Project

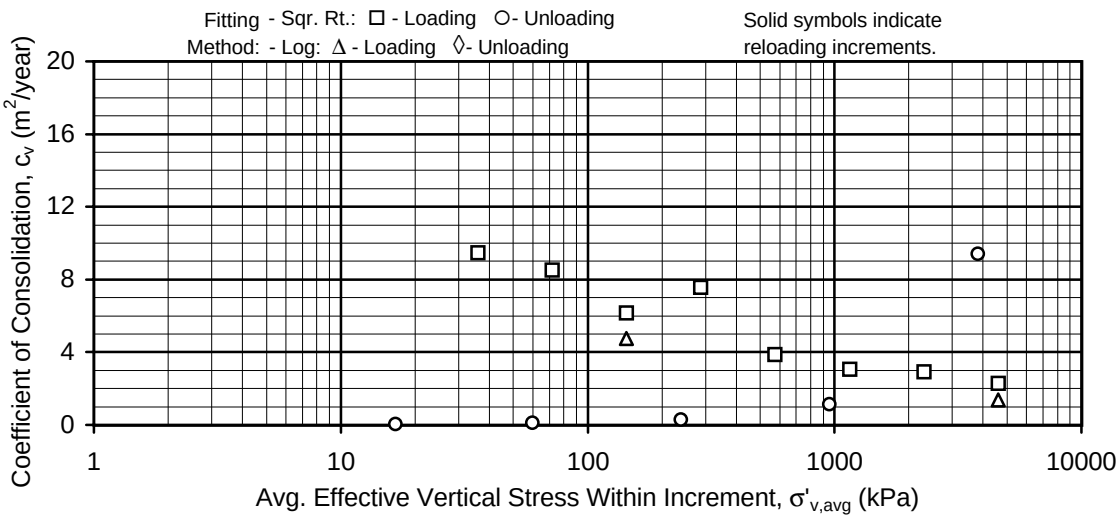




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 26 - Depth: 26.3m
Boring 98-54
SFOBB East Span Seismic Safety Project





INCREMENTAL CONSOLIDATION TEST RESULTS

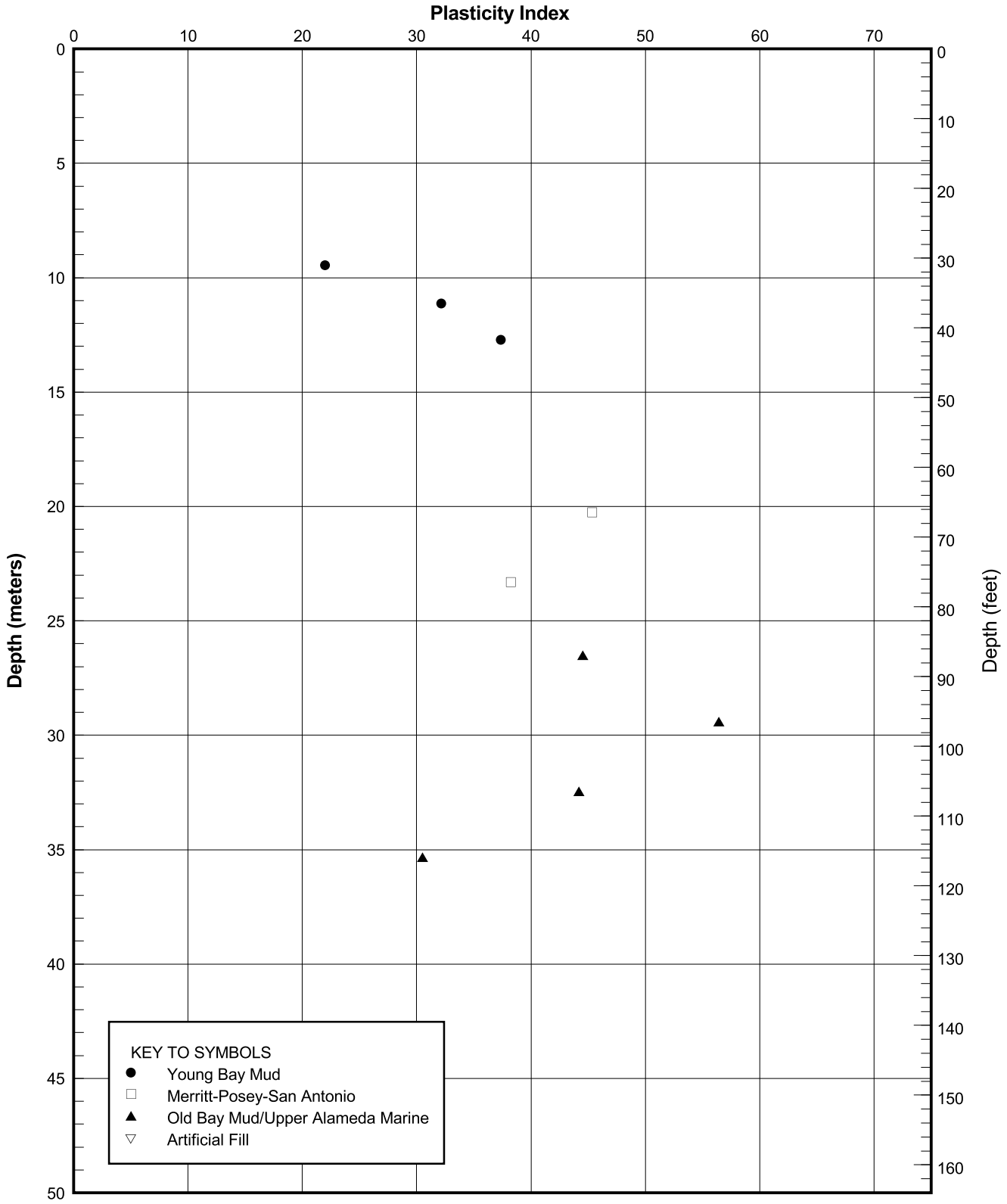
Sample No. 35 - Depth: 35.4m
Boring 98-54
SFOBB East Span Seismic Safety Project

No Consolidated-Undrained Triaxial Compression Testing Performed For This Boring

No Consolidated-Drained Triaxial Compression Testing Performed For This Boring

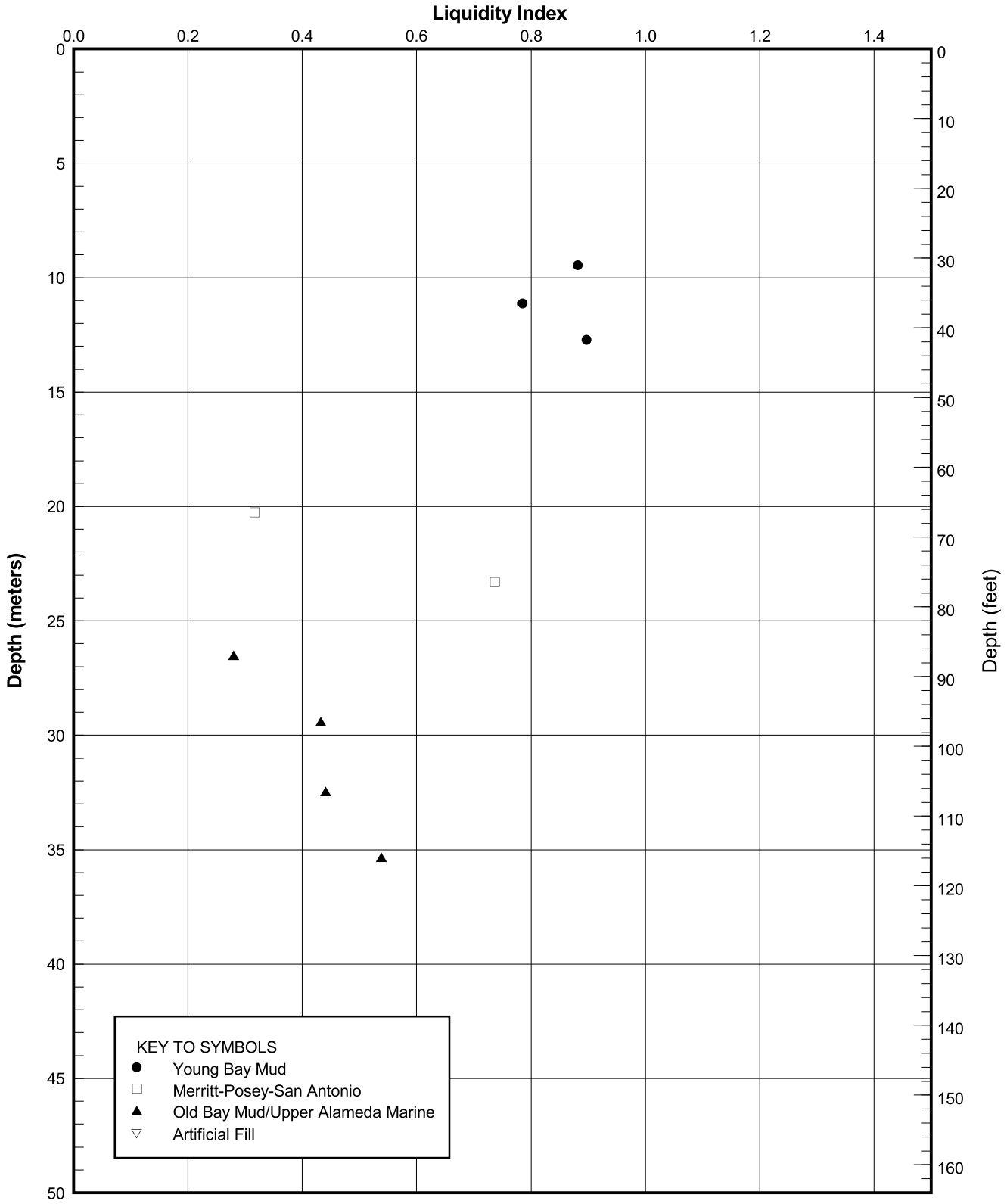
No R-Value Laboratory Testing Performed For This Boring

No Corrosion Testing Performed For This Boring



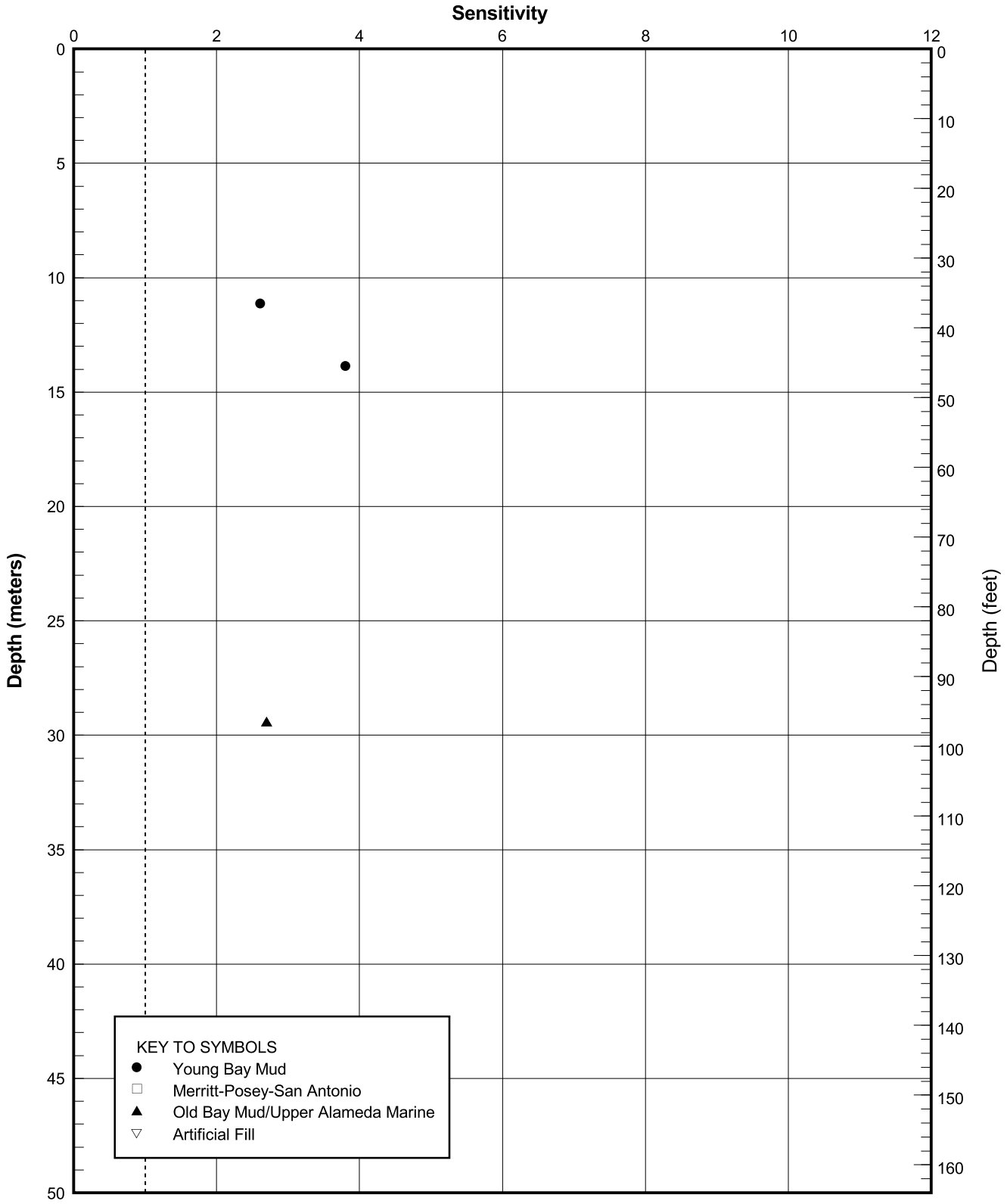
PLASTICITY INDEX PROFILE
Boring 98-54
SFOBB East Span Seismic Safety Project

PLATE 98-54.12



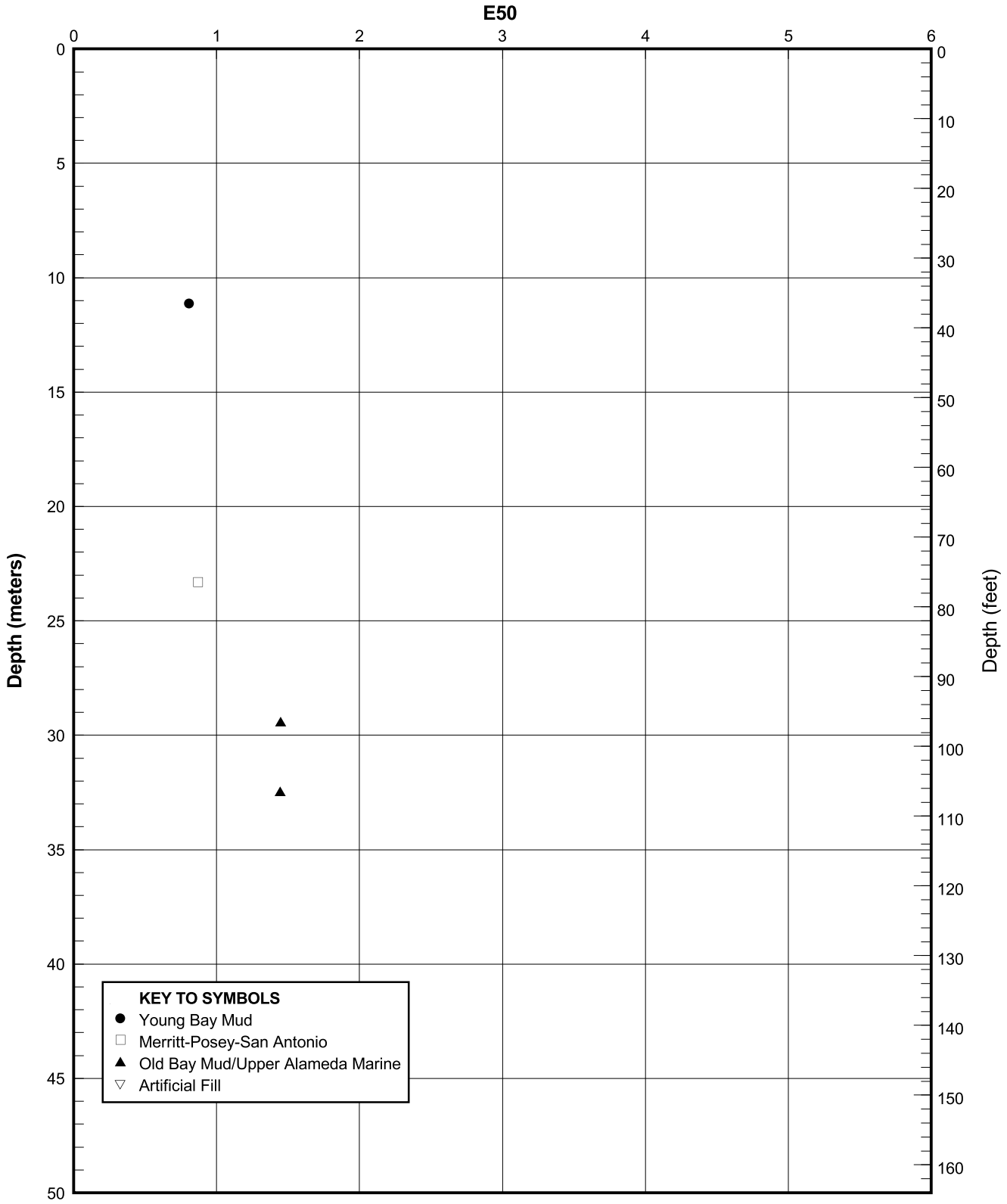
LIQUIDITY INDEX PROFILE
Boring 98-54
SFOBB East Span Seismic Safety Project

PLATE 98-54.13



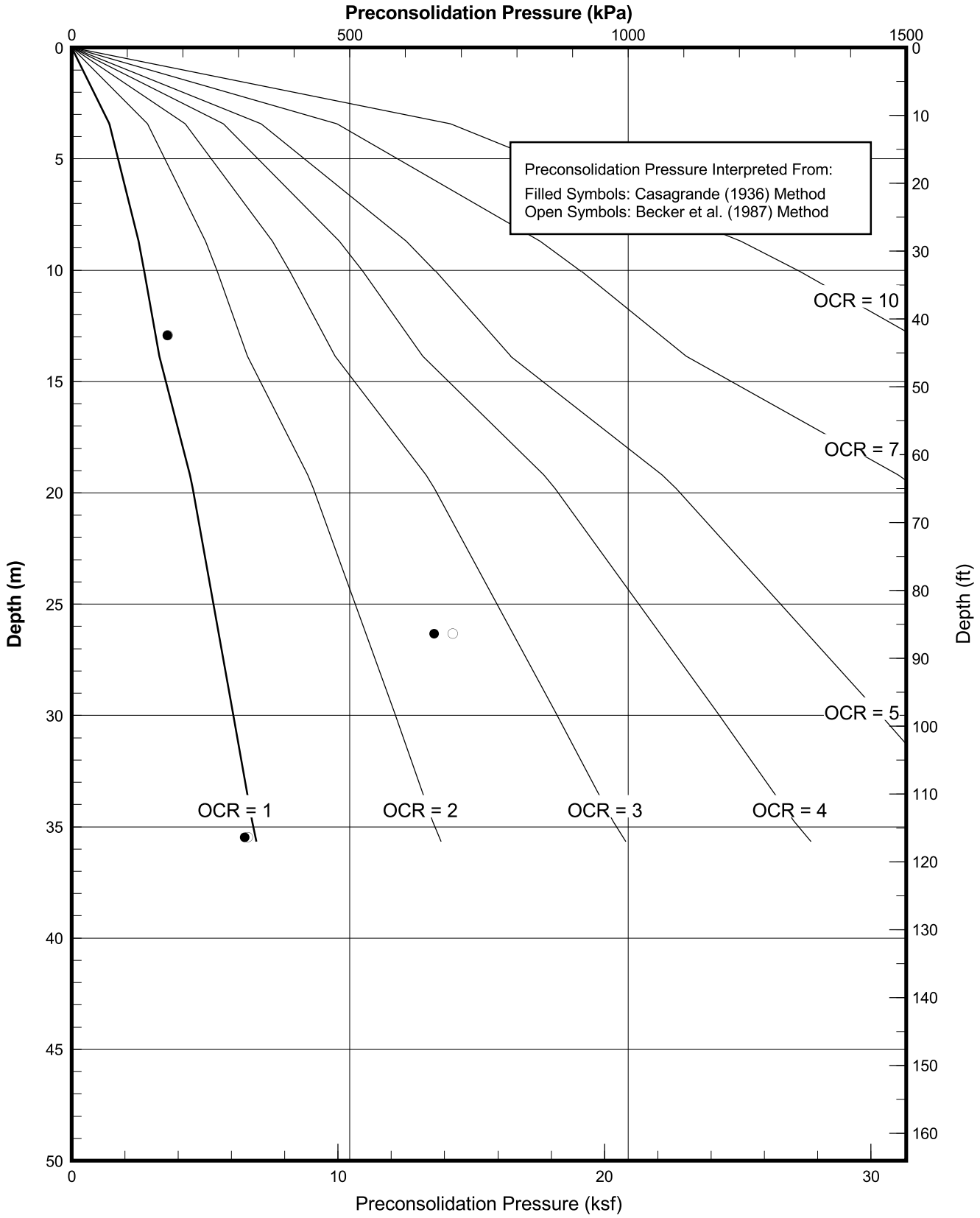
SENSITIVITY PROFILE
Boring 98-54
SFOBB East Span Seismic Safety Project

PLATE 98-54.14



E50 PROFILE
Boring 98-54
SFOBB East Span Seismic Safety Project

PLATE 98-54.15



PRECONSOLIDATION PRESSURE INTERPRETED FROM LABORATORY DATA

Boring 98-54

SFOBB East Span Seismic Safety Project

PLATE 98-54.16

LAND BORING 98-55

PROJECT NO:	98-42-0058	**START DATE:**	10/13/98	**DRILLER:**	Pitcher Drilling Company
BORING:	98-55 (5m right of W. Sta. 88+14)	**COMPLETION DATE:**	10/15/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1839073 N648301
CA State Plane Zone 3, NAD83, Meters

GROUND ELEVATION: 3.6m (MSL)

Depth (m)	Elevation (m)	Blow Count	Material Description	Stratum
0	3.6		Silty Fine SAND (SM), loose, brown	I
2	1.6	3	-with fine gravel and clay pockets, at 1.5m (2.6m)	
2.6	1.0		GRAVEL with sand (GW), very dense, gray to white ▽ (3.6m)	II
3.6	0		-with cobbles and boulders, 2.6m to 3.0m	
4	-0.4	63	-stiff to very stiff, gray, lean clay with shell fragments, a trace of gravel, and fat clay pockets, below 5.5m	
6	-2.4	9	(6.6m)	
6.6	-3.0		Fat CLAY (CH), firm to stiff, olive gray	III
8	-4.4	PUSH	-with shell fragments -lean clay to 8.5m -with many silt pockets, silt seams, and organic pockets, at 7.9m	
10	-6.4	PUSH	-with organic pockets and a few silt pockets, at 9.4m	
12	-8.4	SAVE		
12	-8.4	PUSH	-dark greenish gray below 12.2m	
14	-10.4	PUSH	-with a few silty fine sand pockets, at 14.0m (15.5m)	
16	-12.4	SAVE	Fine SAND with silt (SP-SM), very dense, greenish gray	IV
16	-12.4	51	(17.4m)	
18	-14.4		Fat CLAY (CH), stiff, greenish gray	V
18	-14.4	16	-with organic pockets -with gas blisters at 18.6m	
22	-18.4	PUSH	-with silt pockets and a few silty fine sand pockets, at 21.6m (24.4m)	
24	-20.4	31	Fat CLAY (CH), very stiff, greenish gray	VI
26	-22.4		-lean clay to 26.8m -with desiccated pockets and calcareous nodules, at 24.4m -with sand seams and layers, 25.3m to 26.2m	
28	-24.4	PUSH	-with sand seams and pockets, and organic partings, at 27.7m	
30	-26.4	16	-with silt partings and organic partings, at 30.5m	
34	-30.4	SAVE	-with silt pockets and a few shell fragments, at 33.8m (35.4m)	
36	-32.4		Fat CLAY (CH), very stiff to hard, greenish gray	VII
36	-32.4	PUSH	-with many silt pockets, and many silty fine sand pockets, at 36.9m	
40	-36.4	PUSH	-with silt partings, organic pockets and olive gray mottling, at 39.9m (40.8m)	
42	-38.4		Fat CLAY (CH), hard, greenish gray	VIII
42	-38.4	SAVE	-lean clay to 47.2m -with slickensides to 49.4m -with silt partings at 43.0m -sandy lean clay at 43.3m	
46	-42.4	PUSH	-with many silt seams and layers, at 45.7m	
48	-44.4	PUSH	-with yellow brown mottling, at 49.1m	
52	-48.4	SAVE	-sandy lean clay, 51.5m to 52.7m	
56	-52.4	PUSH	-with sand pockets, a few silt partings and organic pockets, at 55.2m	
58	-54.4	PUSH	-with shell fragments and slickensides, at 58.2m	
62	-58.4	SAVE	-with a few sand partings at 61.3m	

TOTAL DEPTH: 61.6m BACKFILLED WITH: Cement Grout

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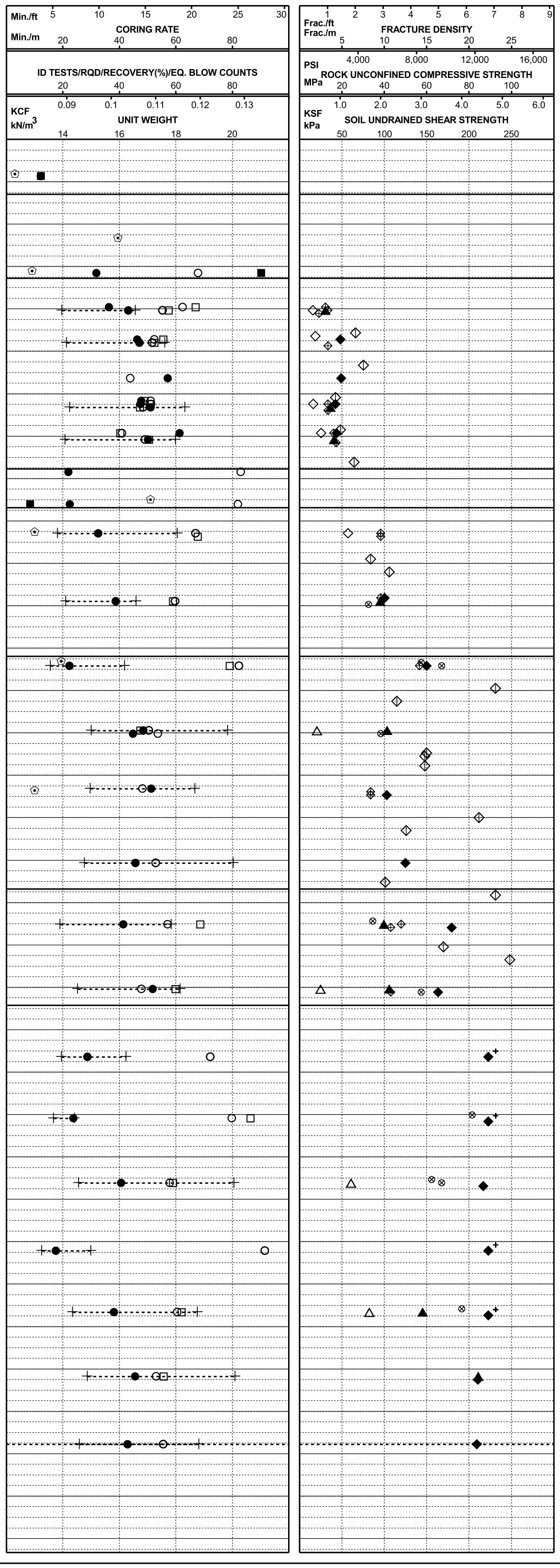


LOG OF BORING AND TEST RESULTS

BORING 98-55

SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

Report Date: 03/10/99

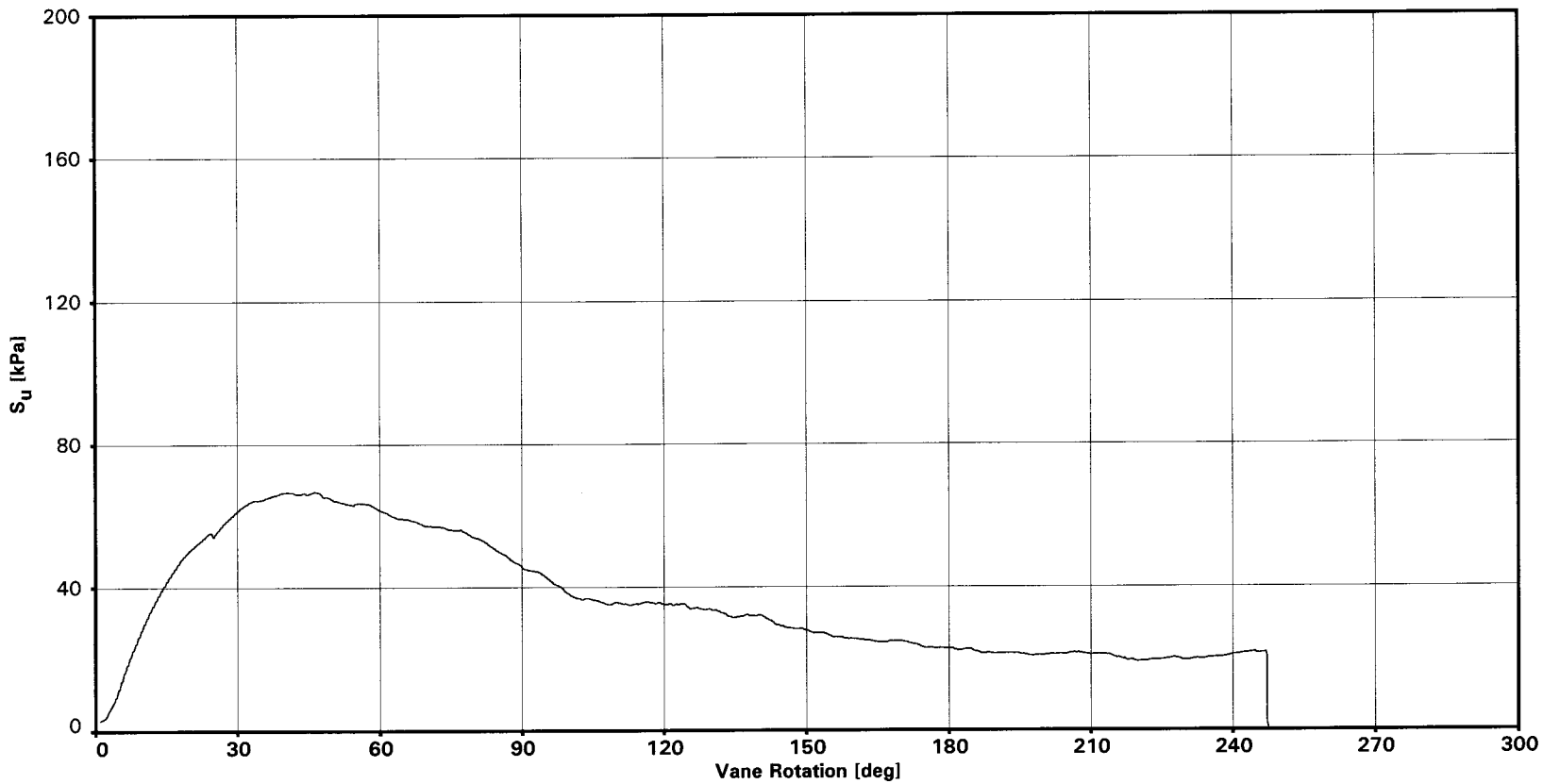
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 9.1m
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.2a

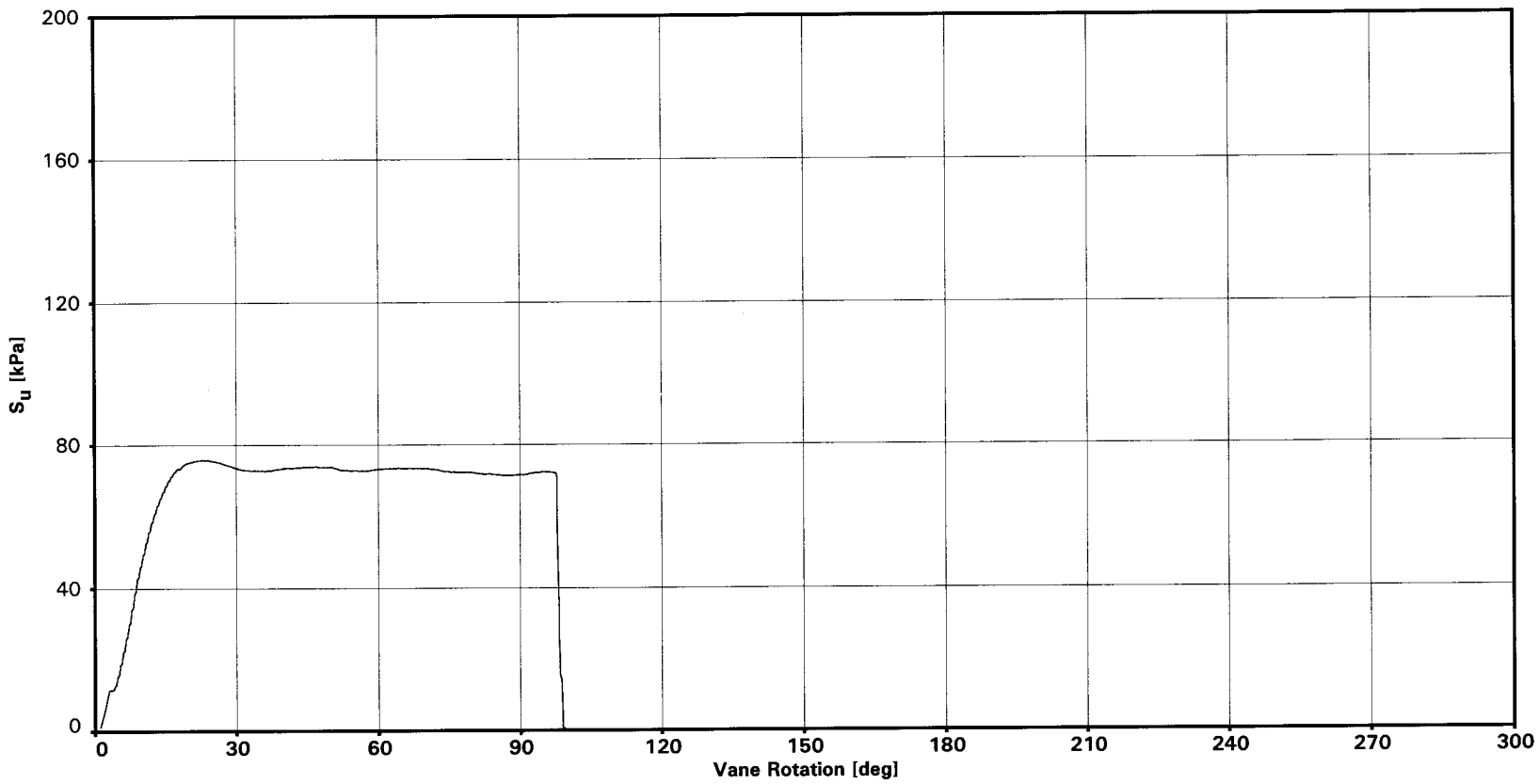
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 10.7m
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.2b

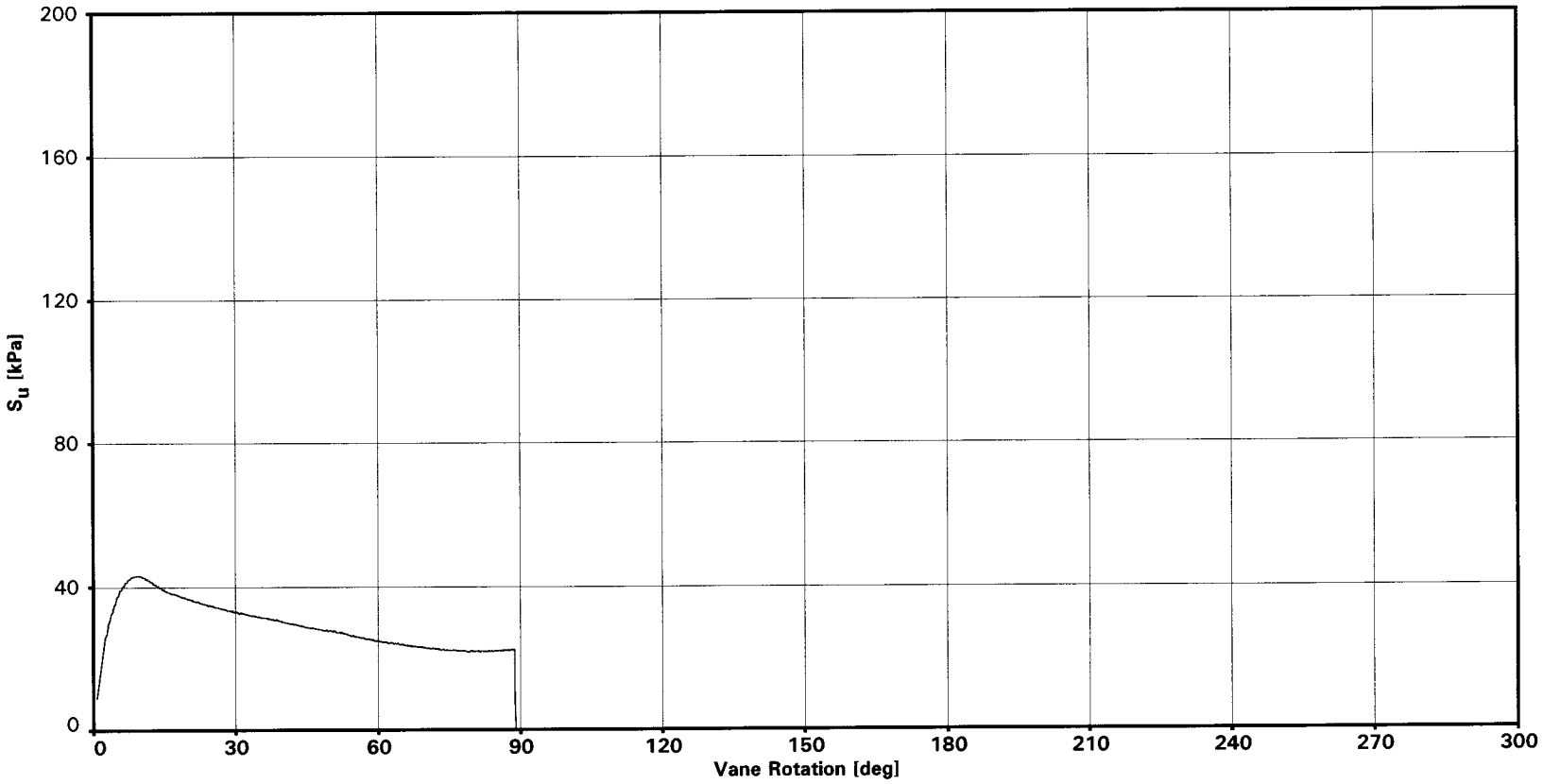
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



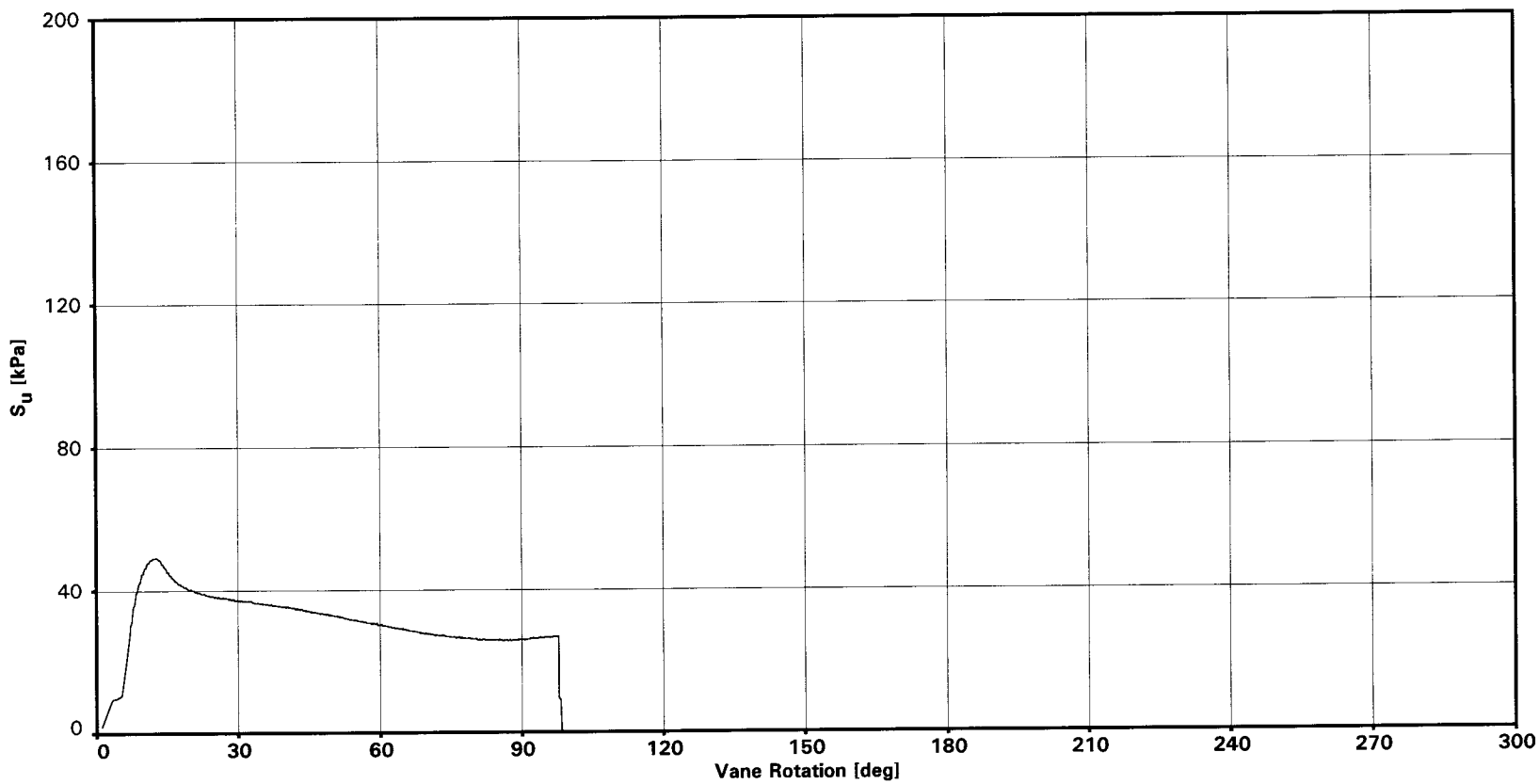
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 12.2m
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.2c

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 13.7m
Boring 98-55
SFOBB East Span Seismic Safety Project

Earth Mechanics

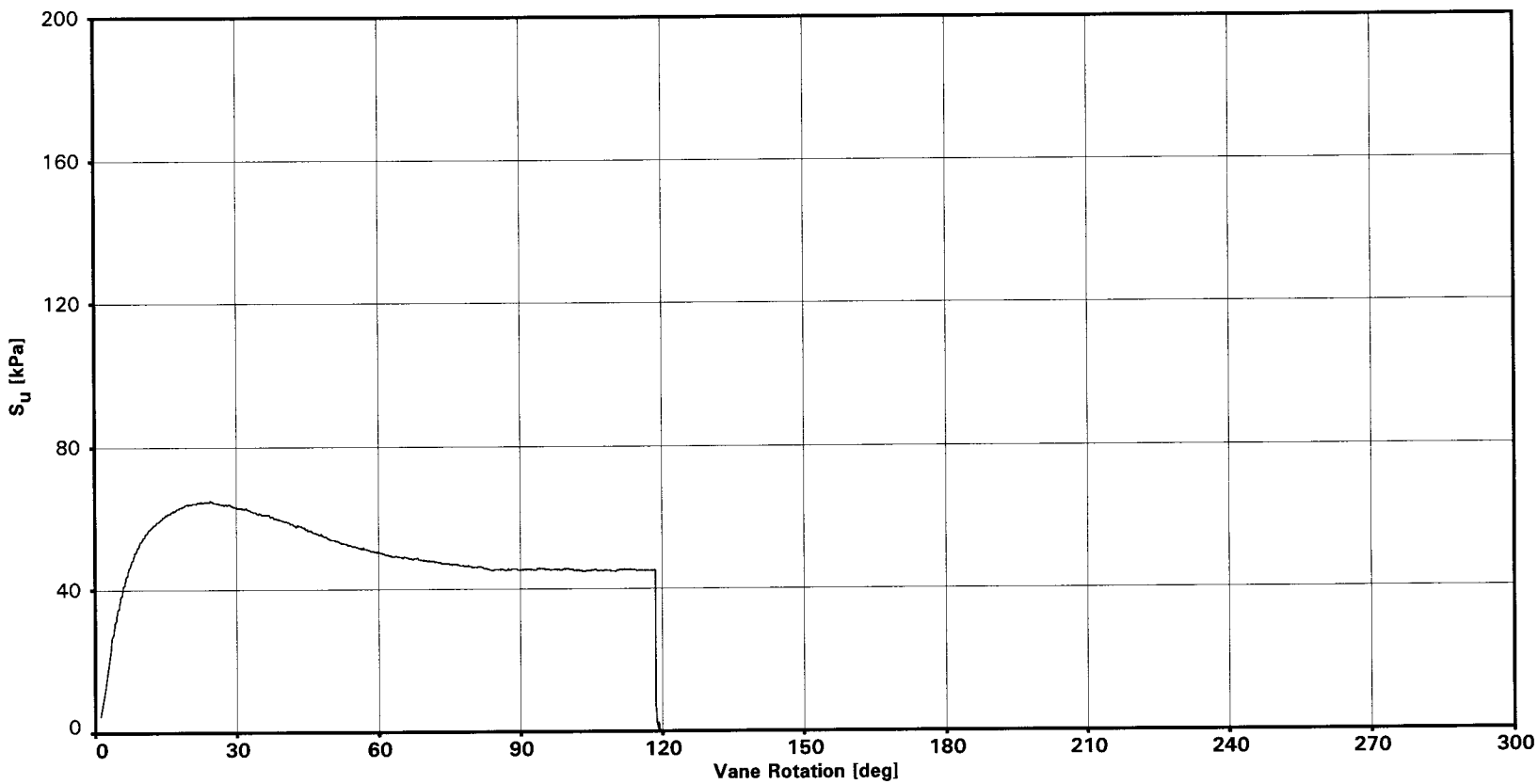
FUGRO

PLATE 98-55.2d

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 15.2m
Boring 98-55
SFOBB East Span Seismic Safety Project

Earth Mechanics

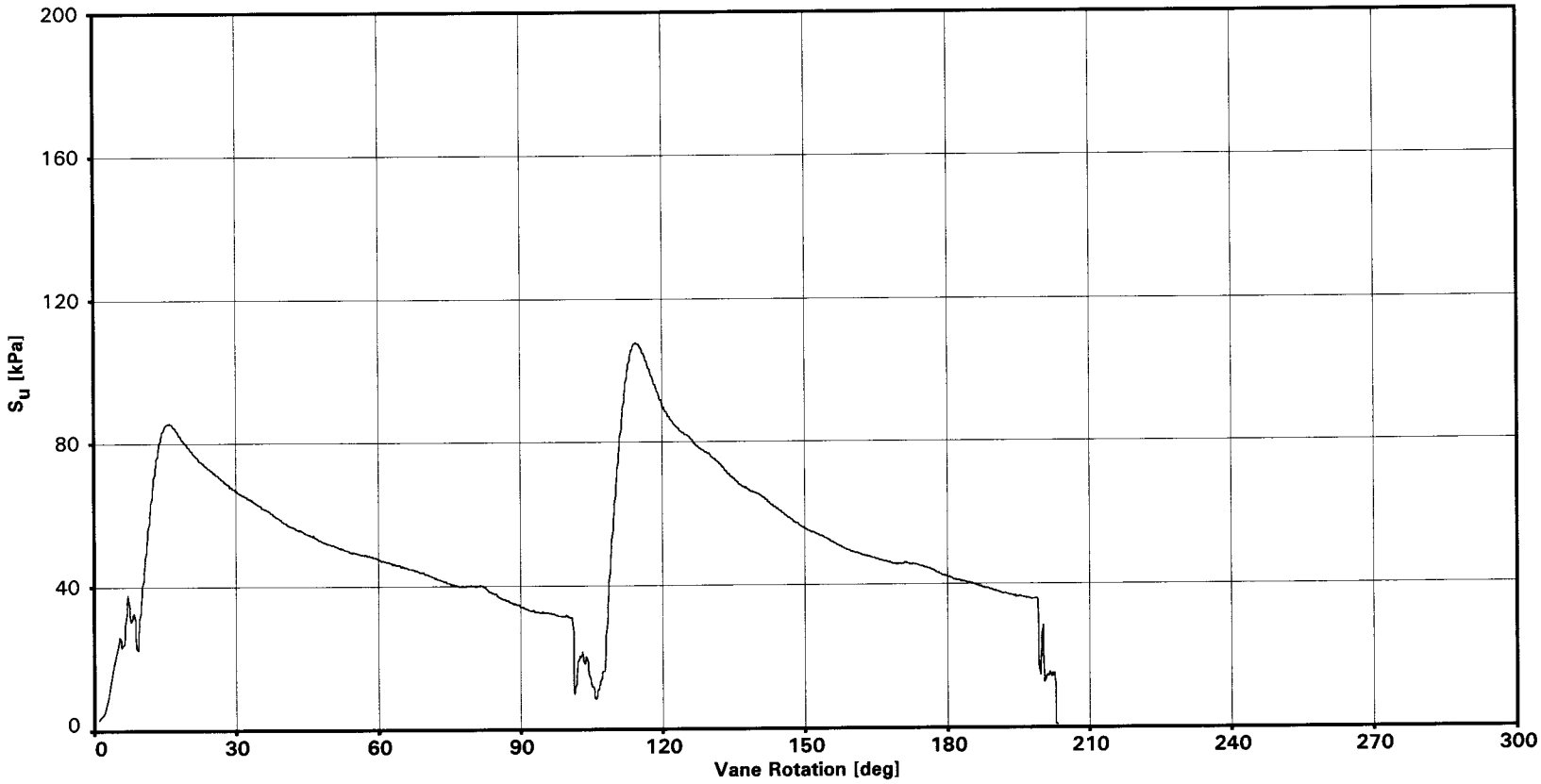
FUGRO

PLATE 98-55.2e

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 19.8m and 20.4m
Boring 98-55
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-55.2f

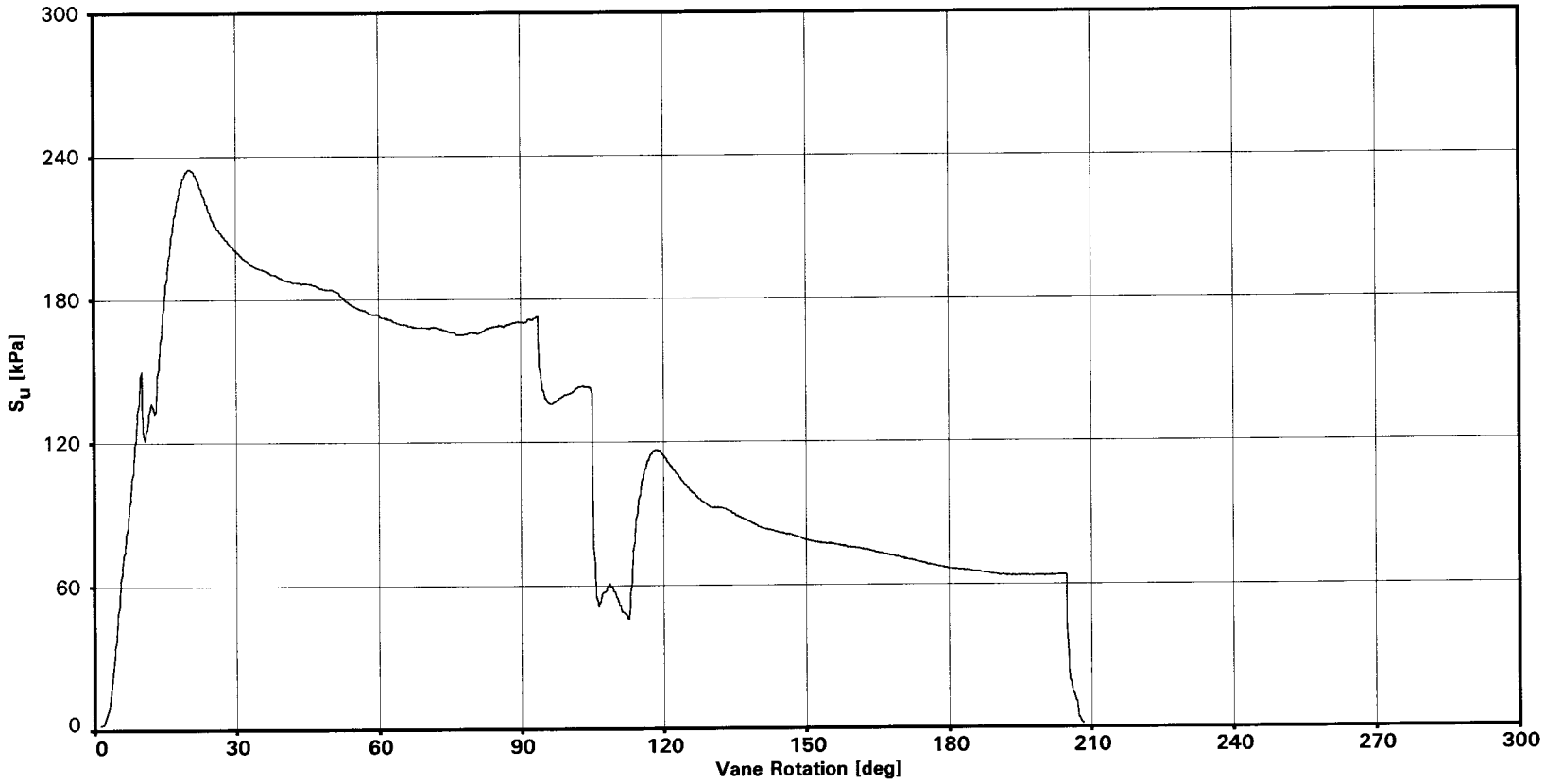
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 25.9m and 26.5m
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.2g

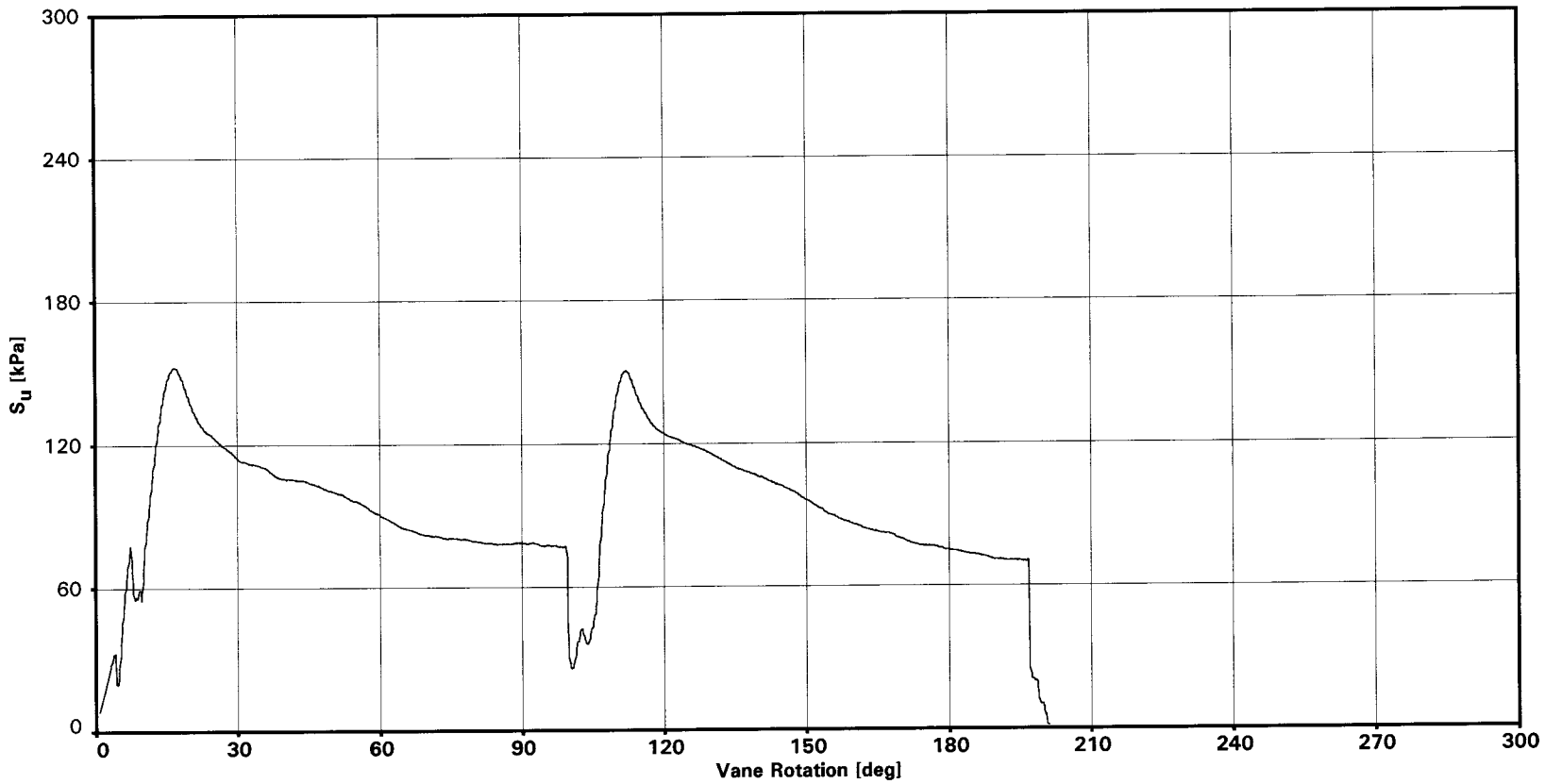
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



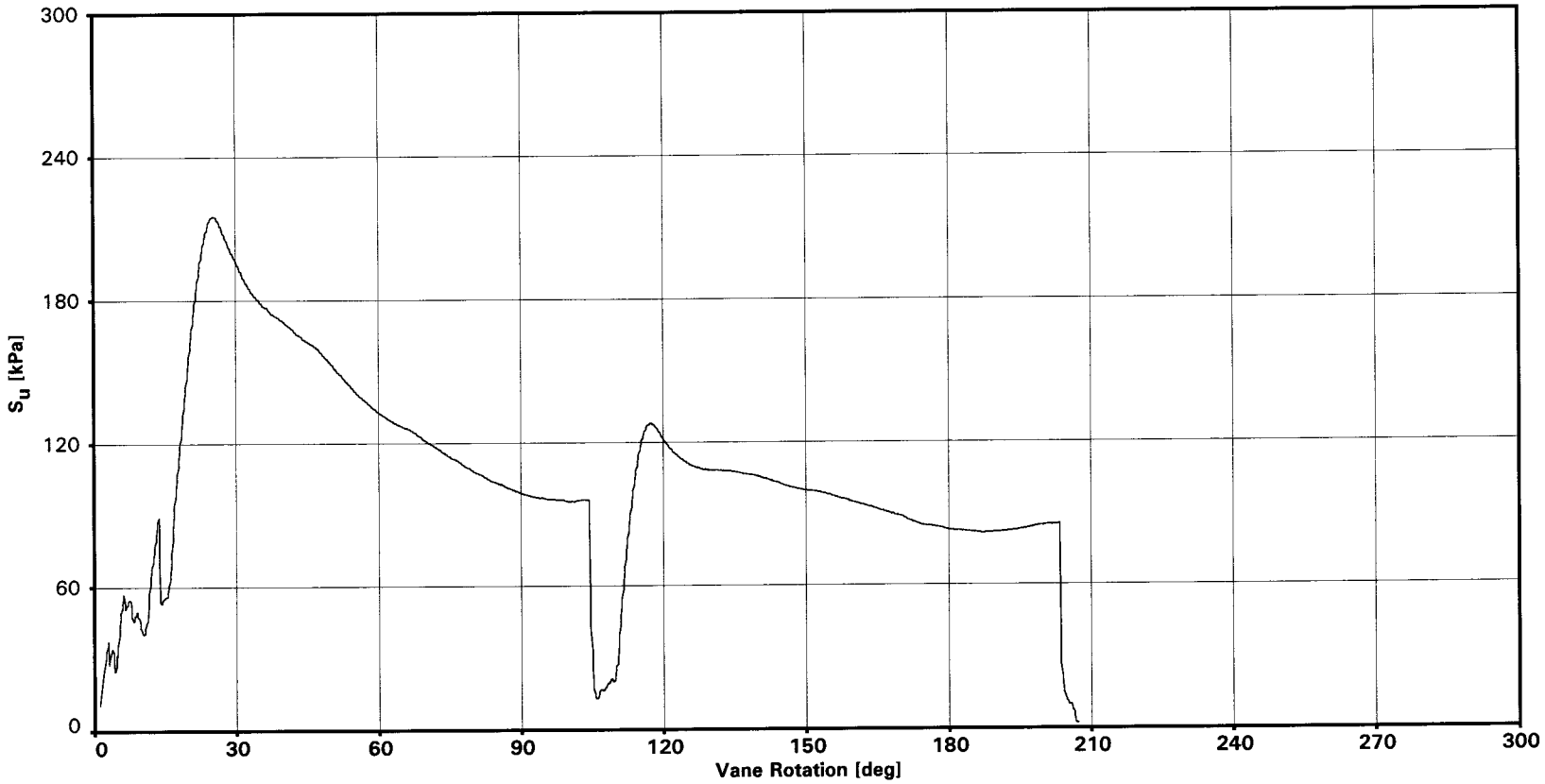
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 29.0m and 29.6m
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.2h

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 32.0m and 32.6m
Boring 98-55
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-55.2i

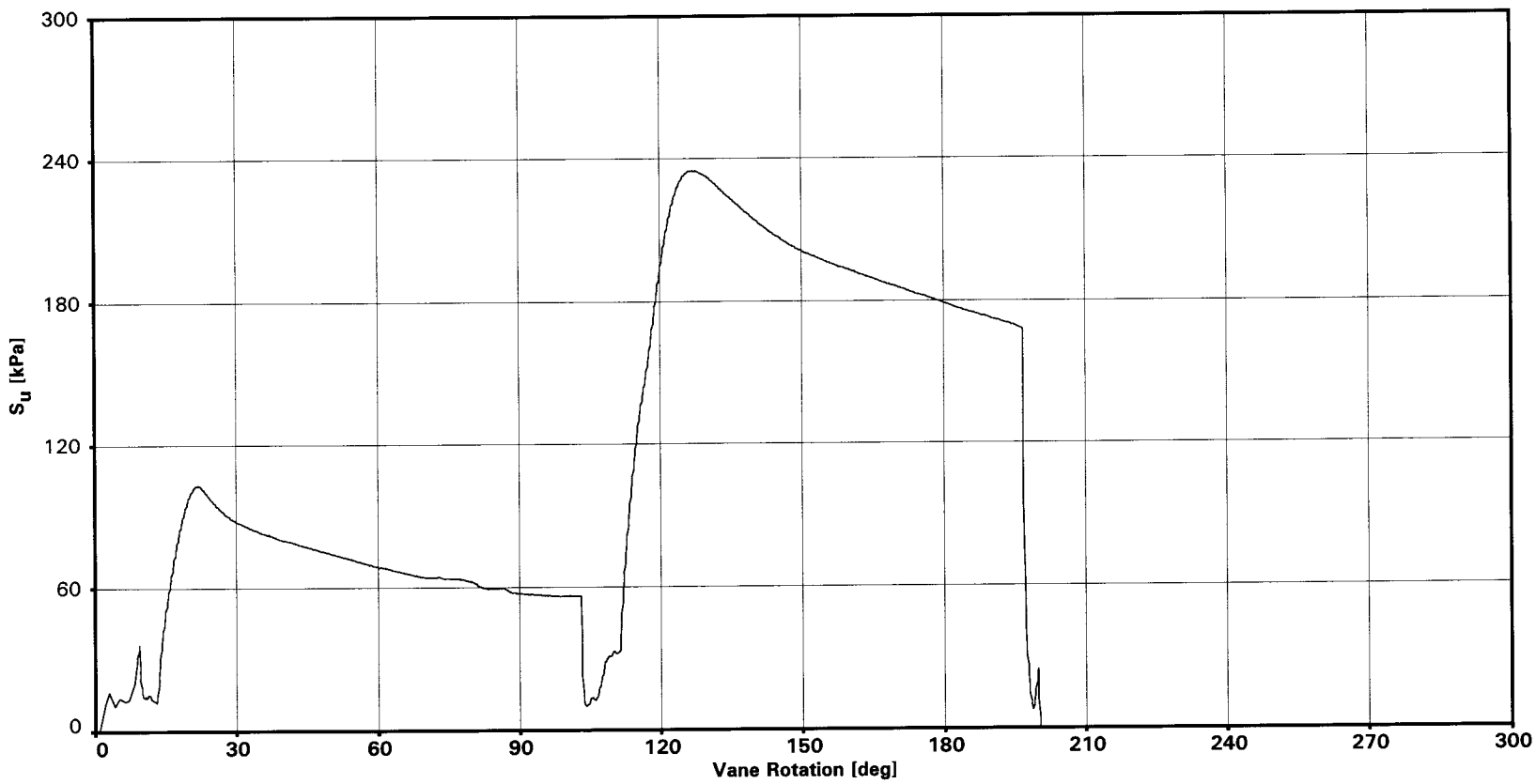
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



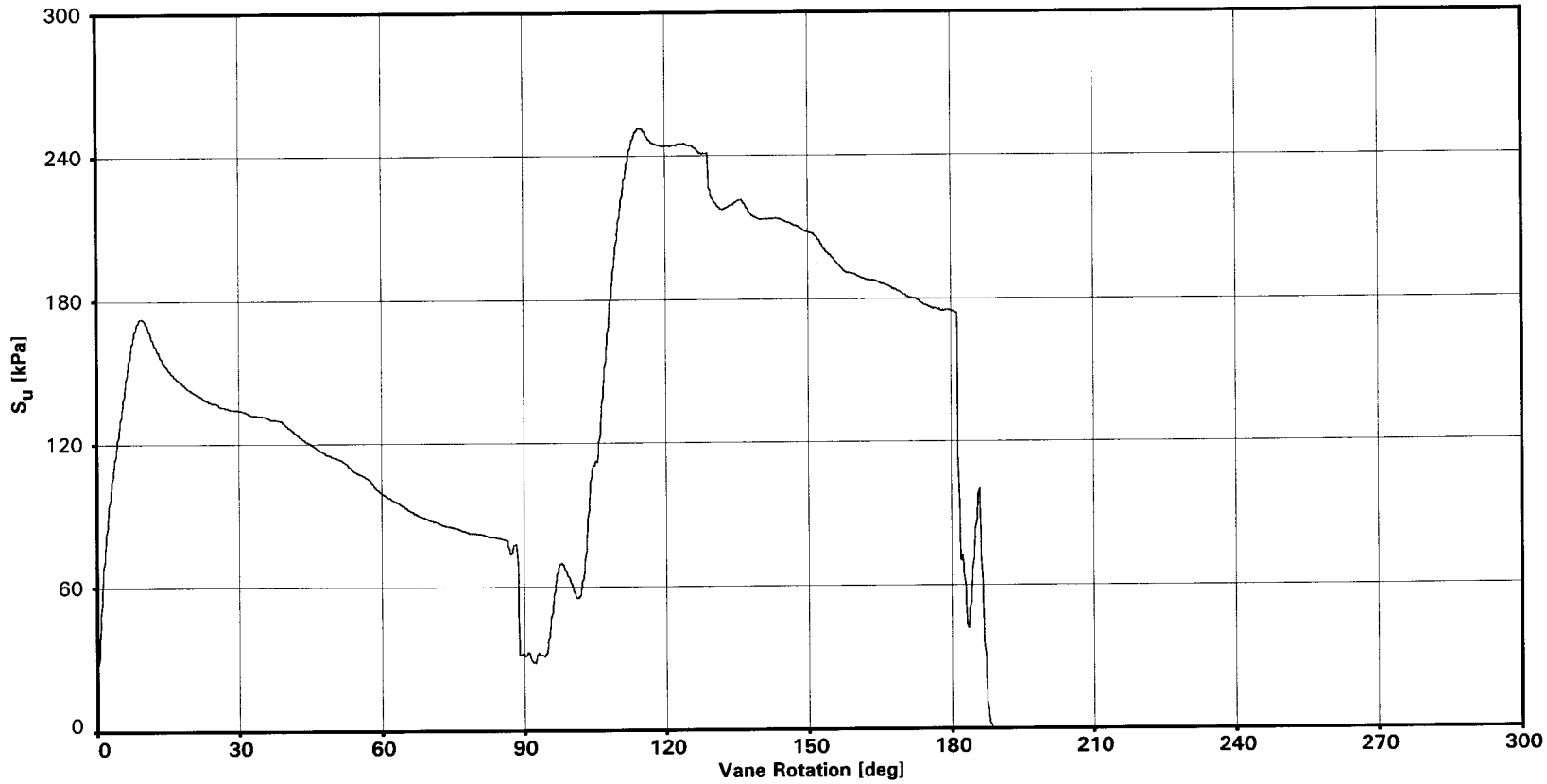
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 35.1m and 35.7m
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.2j

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 38.1m and 38.7m
Boring 98-55
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-55.2k

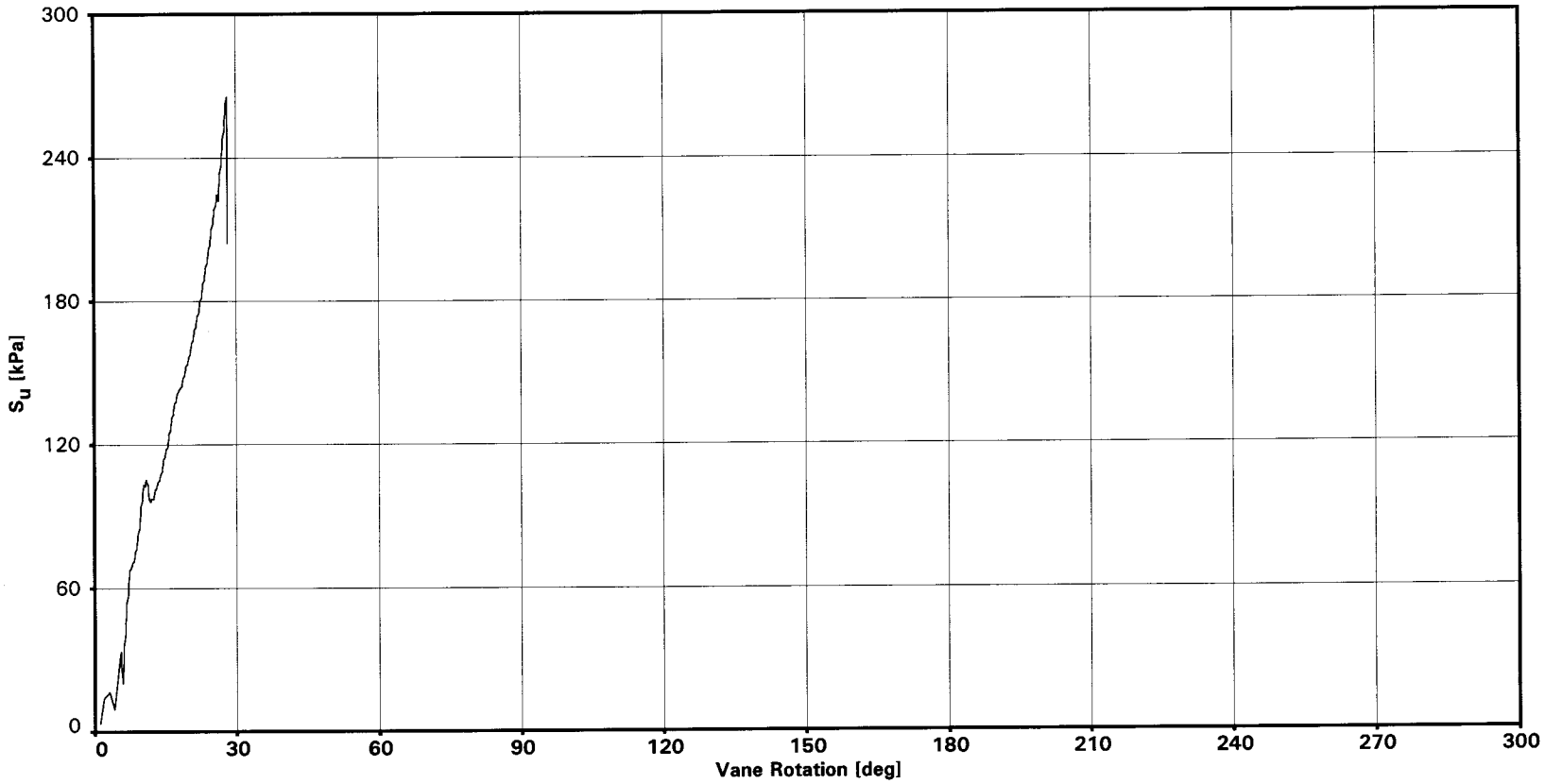
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 41.1m
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.2I

SFOBB Task Order No. 5
Project No. 98-42-0058

98-55		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
1.7	1	12					12																				
6.3	3	32					90																			H	
7.9	4	36	36	24	1.03	18.7		30.6																			
8.1	5	43	46	20	0.90	17.7		33.5				15.7			30.4		1.2										
8.2	6							23.0																			
9.1	400													66.1													
9.4	7	46				17.5		47.9			48.3	18.5															
9.6	8	47	56	21	0.74	17.2																					
9.8	9							33.5																			
10.7	401													75.2													
11.3	11	57									49.0																
12.2	402													42.1													
12.3	12	48				16.9																					2.72
12.5	13	47				17.1		33.5			42.4	16.2															
12.6	14	51	63	23	0.70	16.7									36.4		2.5										

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-55
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-55.3a

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98-55		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
12.8	15							33.5																			
13.7	403													48.4													
13.9	16	61				16.0		40.2			43.7	25.2															
14.0	17	36	71	29	0.17																						
14.2	18	50	60	21	0.75	17.0									40.5		1.6										
14.3	19							43.1																			
15.2	404													64.2													
15.7	21	22																									
17.2	22	22					8																				
18.6	24	32	61	18	0.34			95.8				56.9															
18.7	25					18.8		95.8																			
19.8	405													83.8													
20.4	406													105.8													
21.5	26	40	50	22	0.67																					C	2.73
21.6	27							95.8			100.5																

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-55
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

SFOBB Task Order No. 5
Project No. 98-42-0058

98-55		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
21.8	28	39	46	21	0.70	17.9									95.1		0.9										
21.9	29								81.4																		
24.7	31								143.6																		
24.8	32	22	42	16	0.25	19.9		141.2	167.6		149.8																
25.9	407													231.3+													
26.5	408													114.9													
27.9	34	48	78	30	0.38	16.7									103.3	20.3	0.7										
28.0	35	45							95.8																		
29.0	409													149.9													
29.1	410													147.9													
29.6	411													147.9													
30.6	36	51	67	30	0.58																						2.71
30.8	37							83.8																			
30.9	38							83.8			102.8																
32.0	412													211.6													

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-55
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-55.3c

SFOBB Task Order No. 5
Project No. 98-42-0058

98-55		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
32.6	413													125.9													
34.0	39	45	63	25	0.54																					C	
34.1	40	46	80	28	0.34						125.0																
35.1	414													101.0													
35.7	415													231.3+													
36.9	41								86.2																		
37.0	42	41	58	19	0.56	18.9		119.7							99.3		0.9										
37.2	43							107.7			179.5																
38.1	416													170.0													
38.7	417													248.0+													
40.1	45	52	62	25	0.73	18.0									105.7	24.5	3.2										
40.2	46							107.7	143.6		163.4																
43.2	47	32	51	21	0.40																					C	
43.3	48	29	42	20	0.40						222.8+																
46.0	49								203.5																		

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-55
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-55.3d

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SFOBB Task Order No. 5
Project No. 98-42-0058

98-55		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
46.2	50	24	24	17	0.93	20.6																					
46.3	51										222.8+																
49.1	52								155.6																		
49.2	53	41	81	26	0.27	17.9			167.6							60.4											
49.4	54										216.6																
52.3	55	16	31	12	0.21																					C	
52.4	56	17	30	13	0.28						222.8+																
55.2	57								191.5																		
55.3	58	38	68	23	0.33	18.2									145.3	82.0	0.7										
55.5	59										222.8+																
58.4	61	45	81	29	0.32	17.6									210.9		1.3										
58.5	62										210.4																
61.5	63	42	68	25	0.40																					C	
61.6	64	43	68	26	0.40						209.2																

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

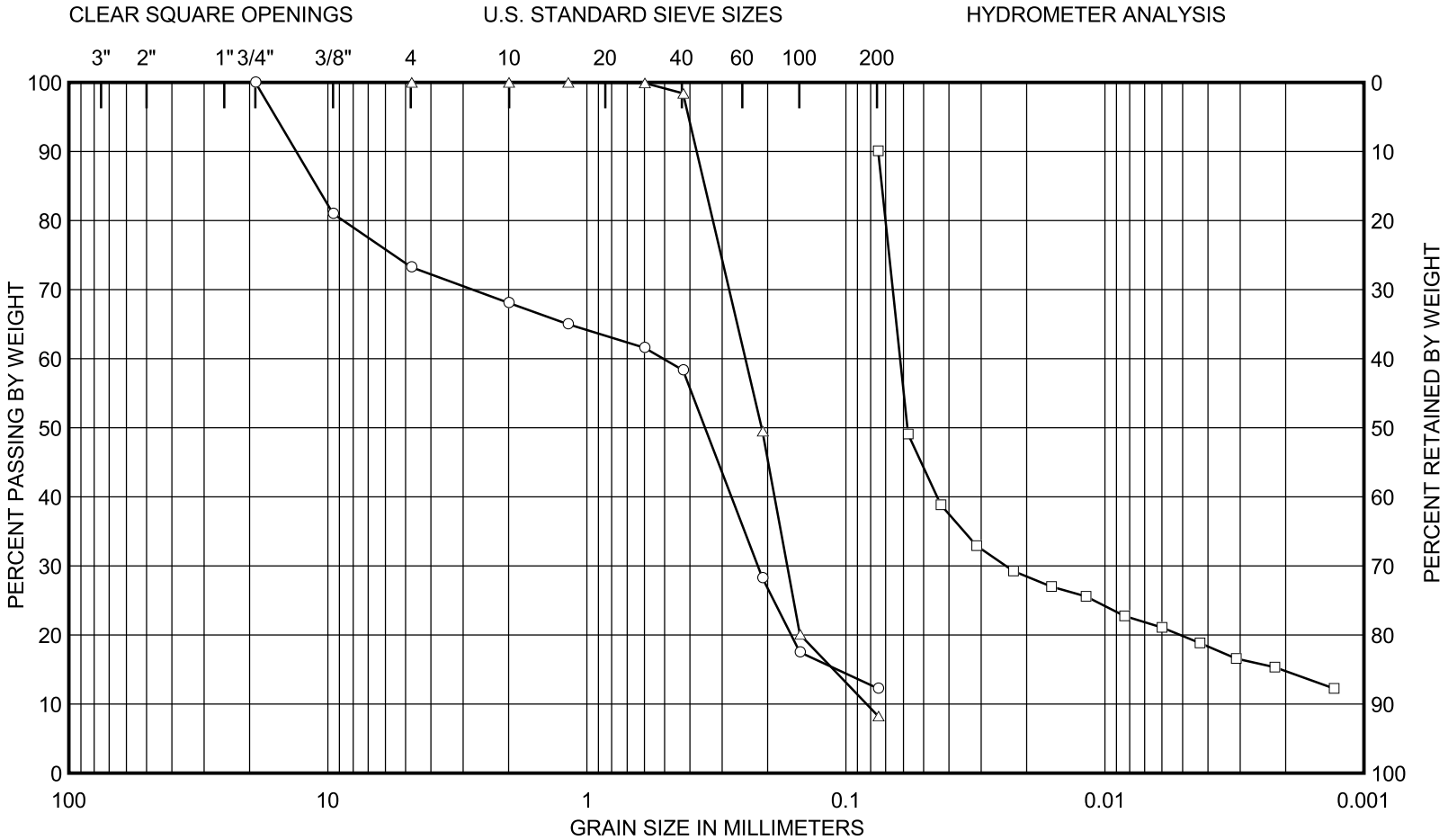
+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-55
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-55.3e



GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
1	1.7	○——○	SILTY FINE SAND (SM) with fine gravel and a trace of medium sand			0.35
3	6.3	□——□	LEAN CLAY (CL)			0.058
22	17.2	△——△	FINE SAND (SP-SM) with silt	1.4	2.9	0.21

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-55
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-55.4

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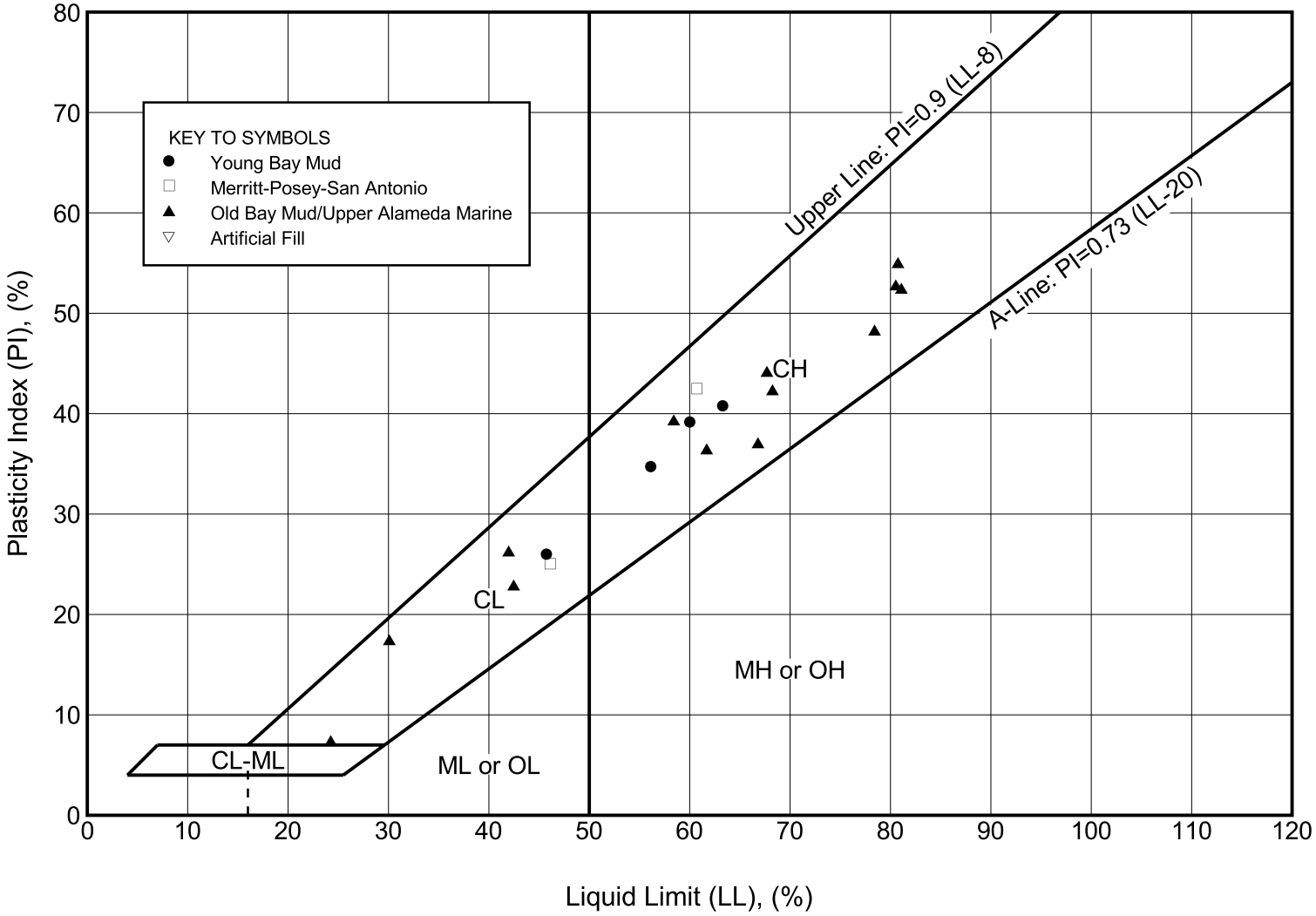

PLASTICITY CHART
Boring 98-55
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-55.5

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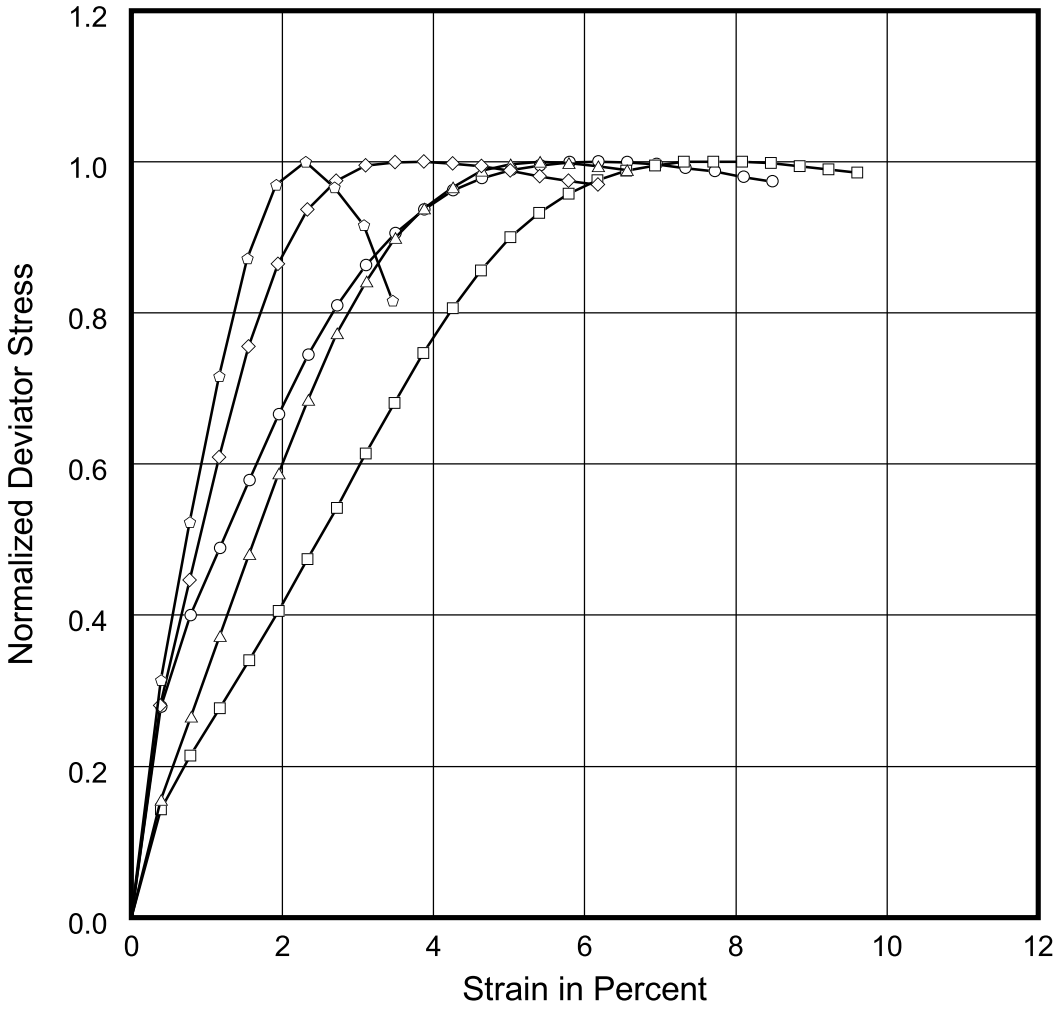


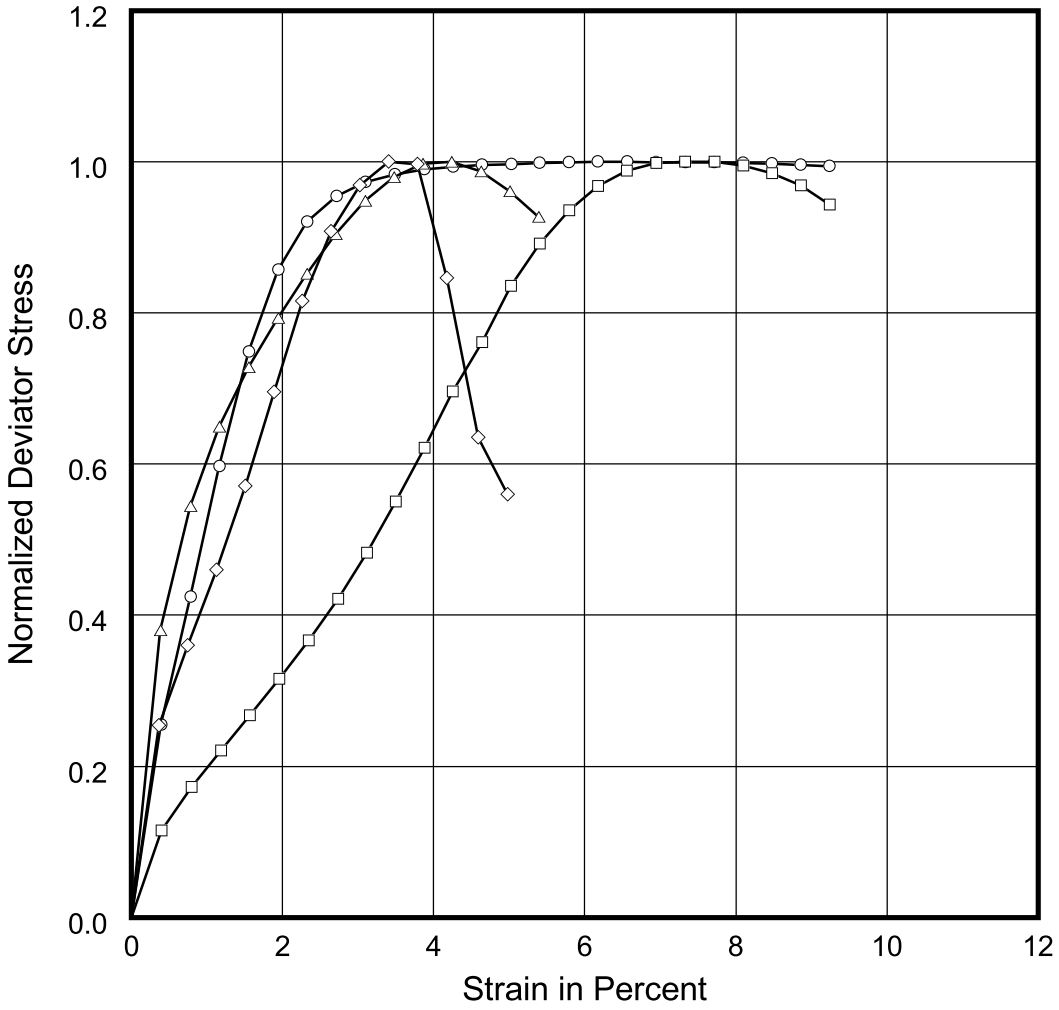
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	5	8.1	UU	152	61	1.2
	14	12.6	UU	241	73	2.5
	18	14.2	UU	276	81	1.6
	28	21.8	UU	758	190	0.9
	34	27.9	UU	862	207	0.7

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.6a



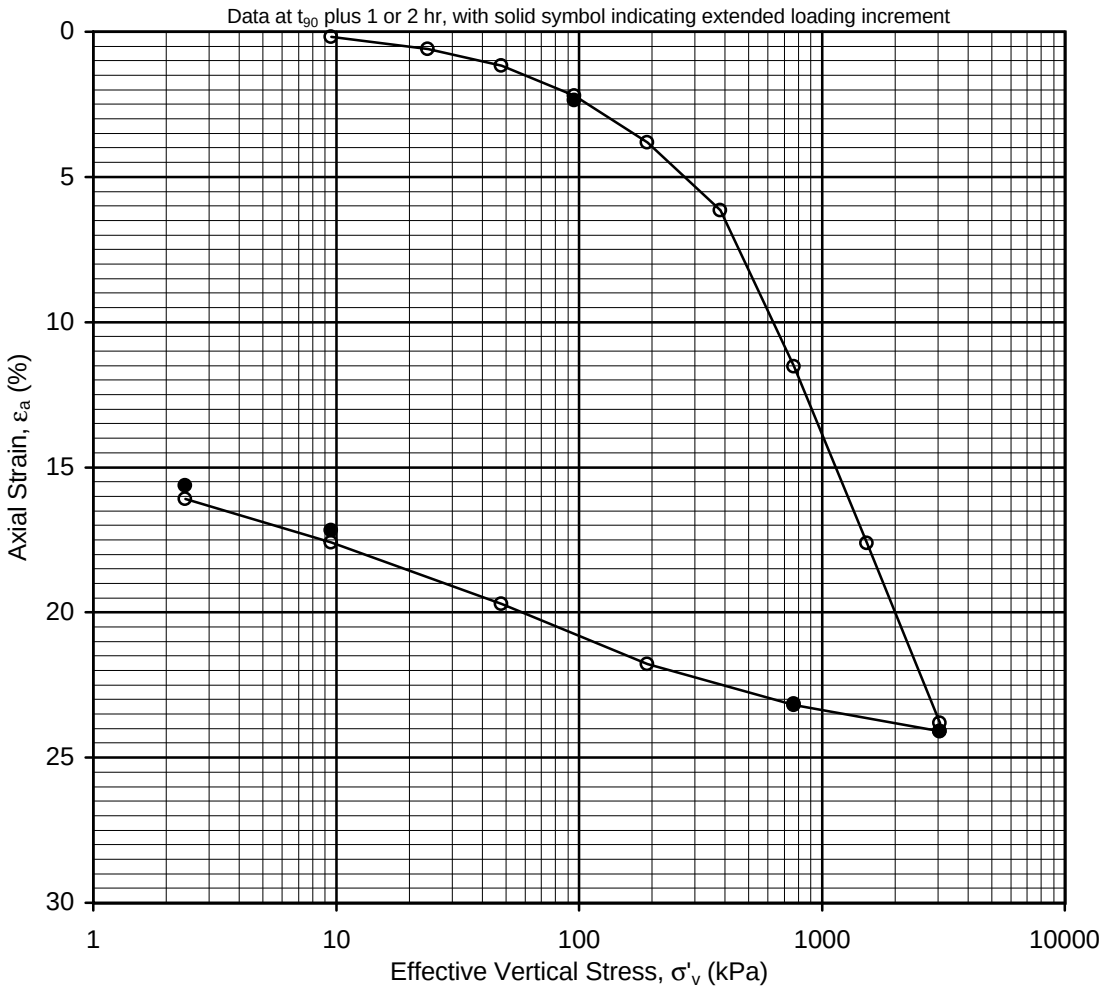
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	42	37.0	UU	1034	199	0.9
□—□	45	40.1	UU	1103	211	3.2
△—△	58	55.3	UU	1379	291	0.7
◇—◇	61	58.4	UU	1448	422	1.3

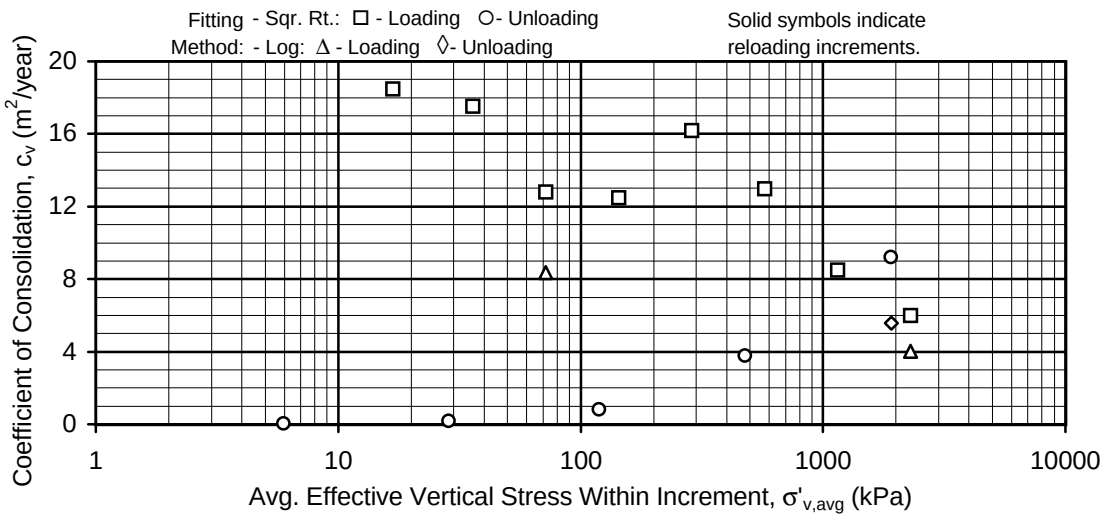
Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-55
SFOBB East Span Seismic Safety Project

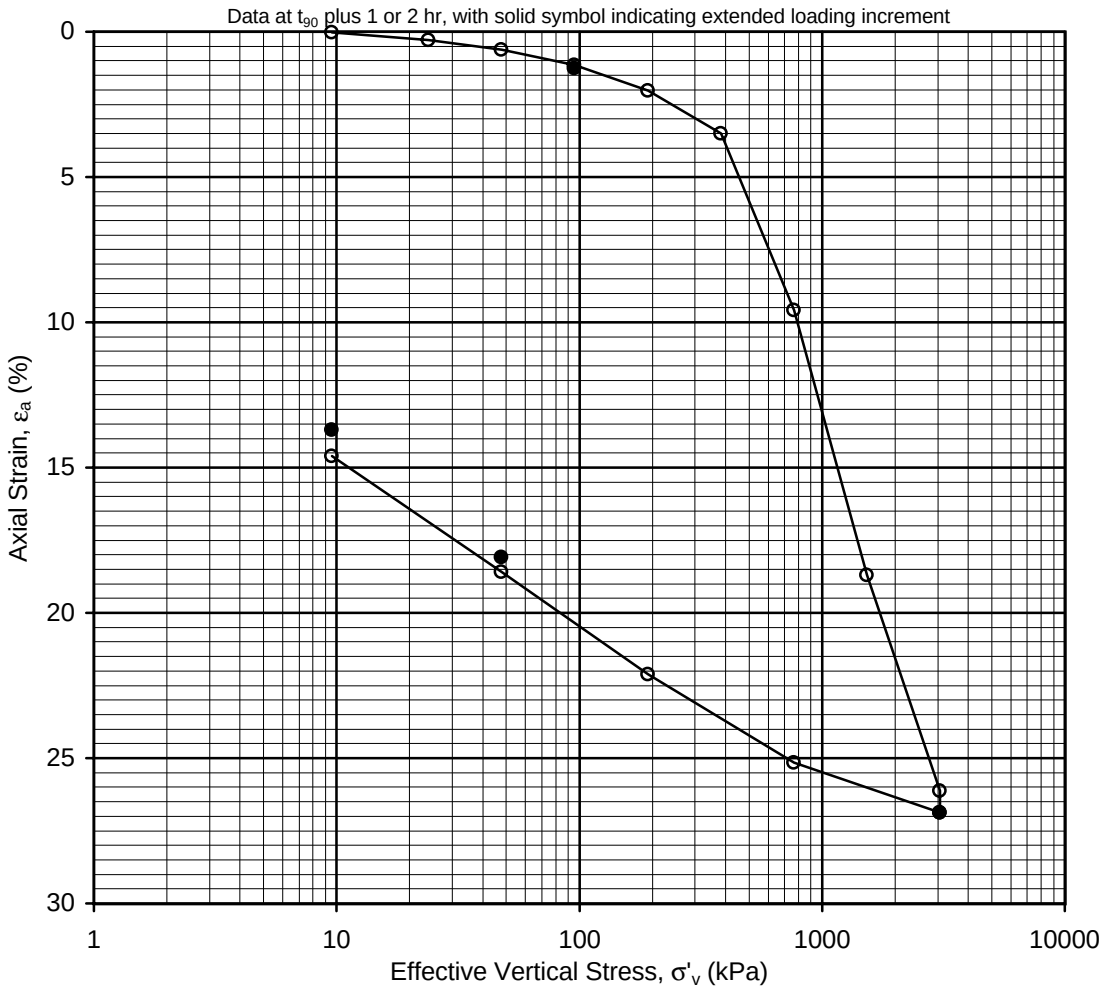
PLATE 98-55.6b

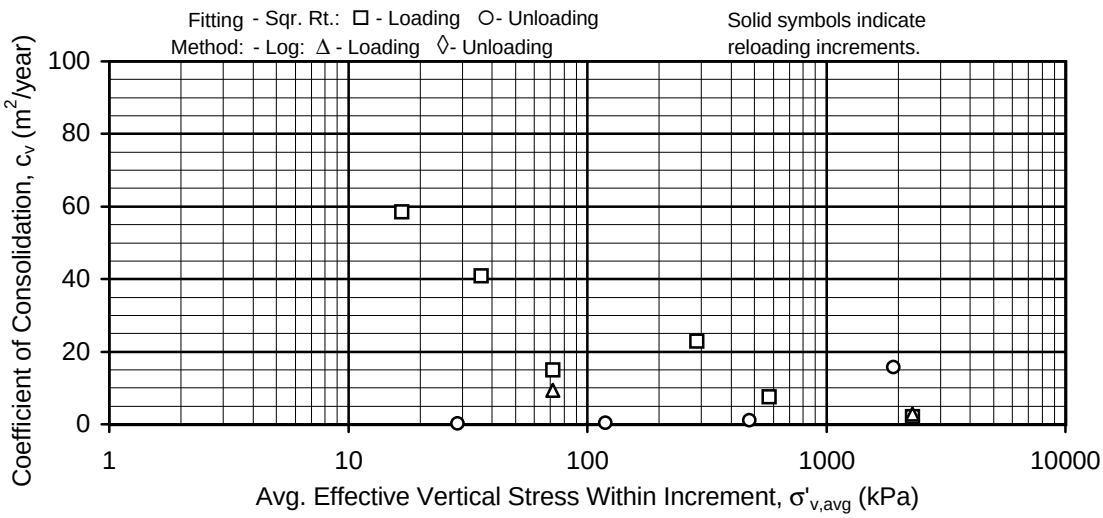




INCREMENTAL CONSOLIDATION TEST RESULTS

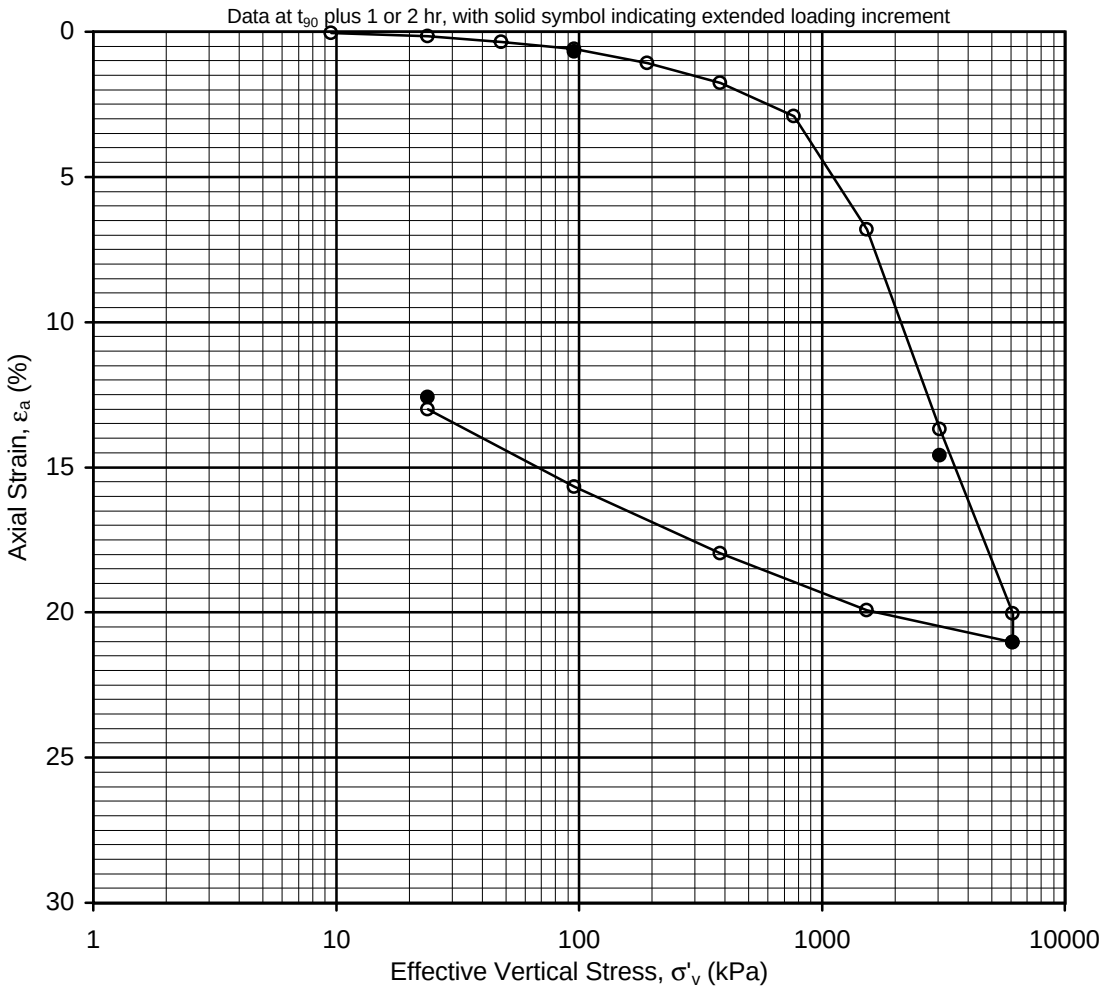
Sample No. 26 - Depth: 21.5m
Boring 98-55
SFOBB East Span Seismic Safety Project

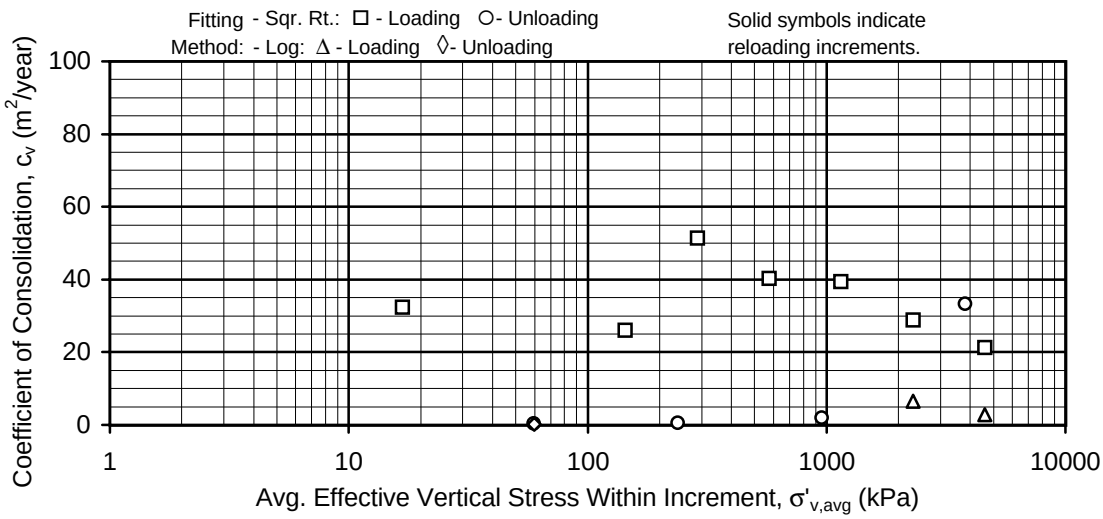




INCREMENTAL CONSOLIDATION TEST RESULTS

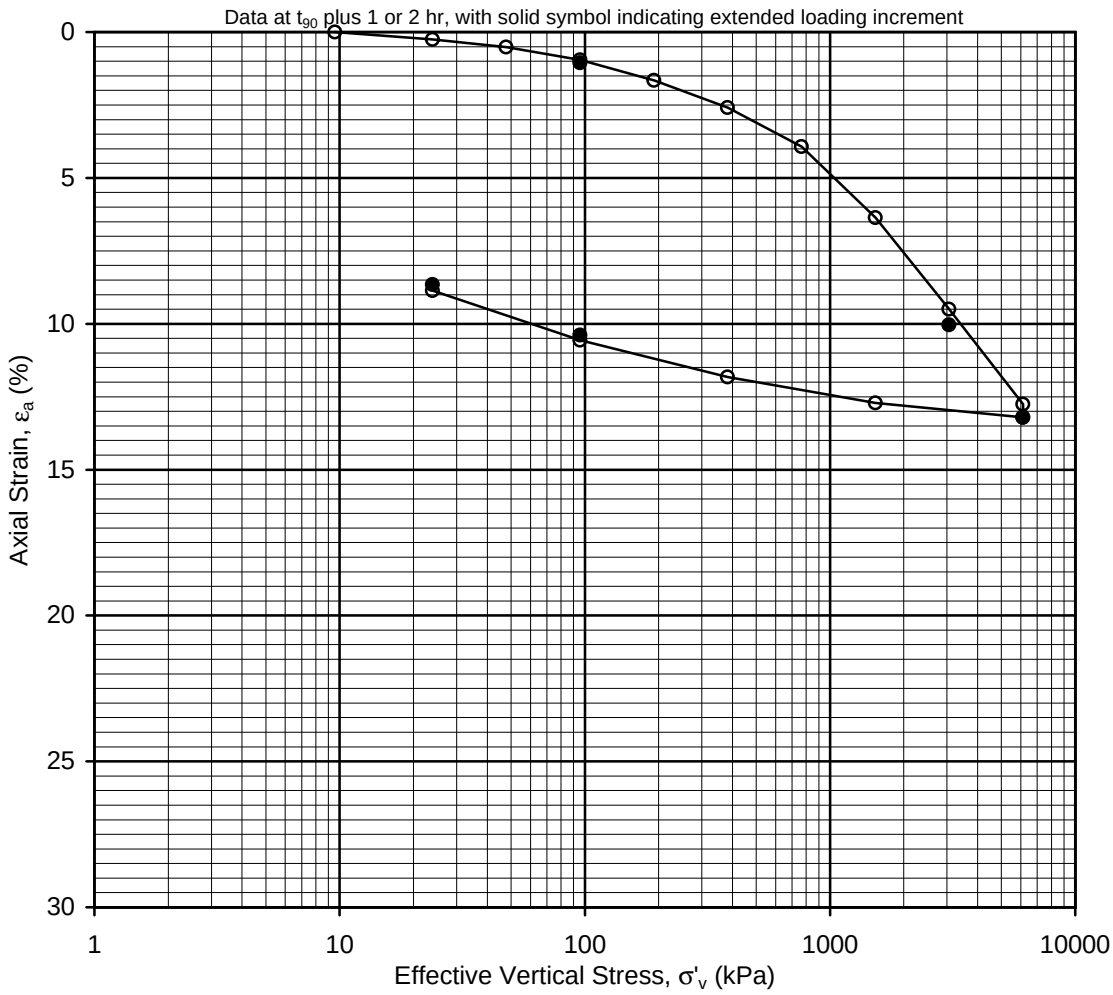
Sample No. 39 - Depth: 34.0m
Boring 98-55
SFOBB East Span Seismic Safety Project

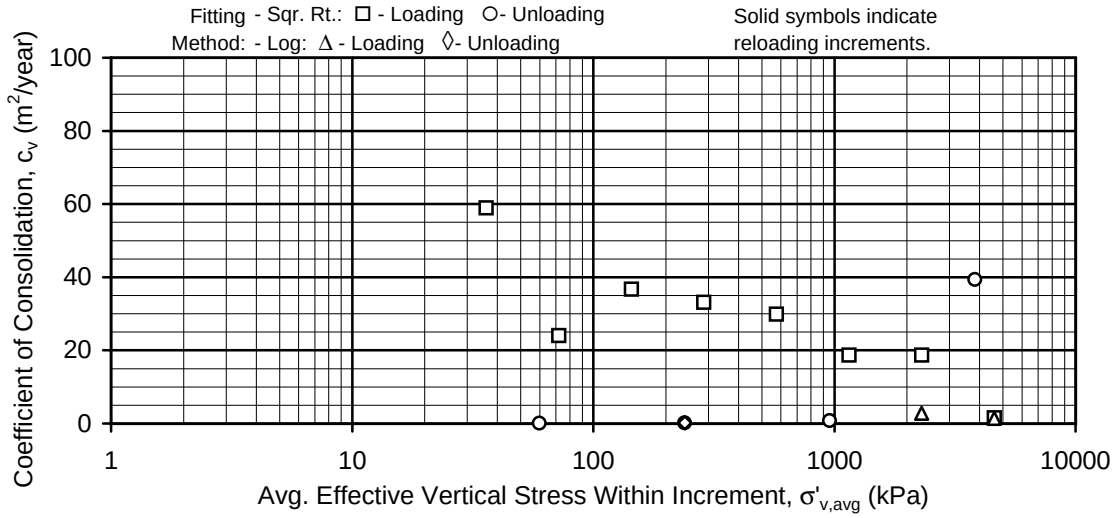




INCREMENTAL CONSOLIDATION TEST RESULTS

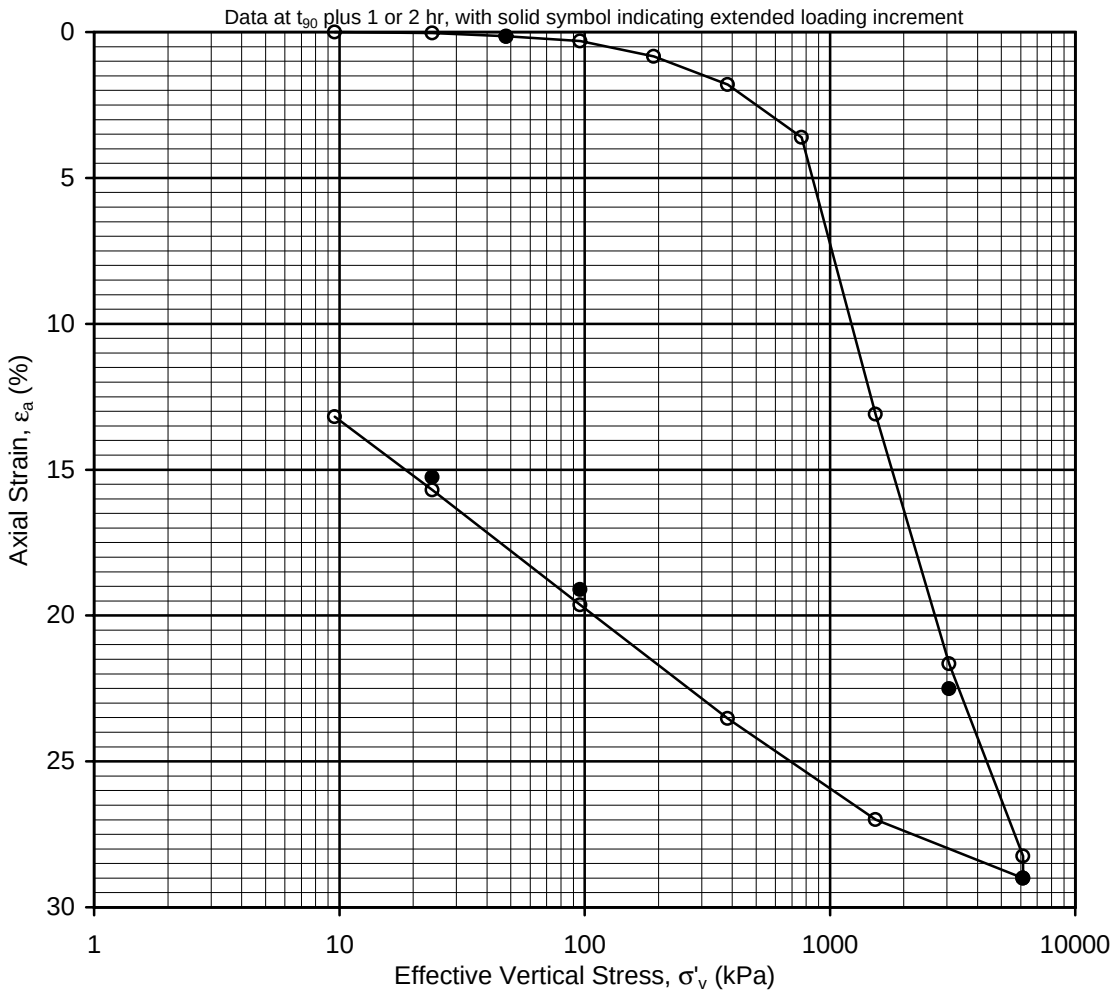
Sample No. 47 - Depth: 43.1m
Boring 98-55
SFOBB East Span Seismic Safety Project

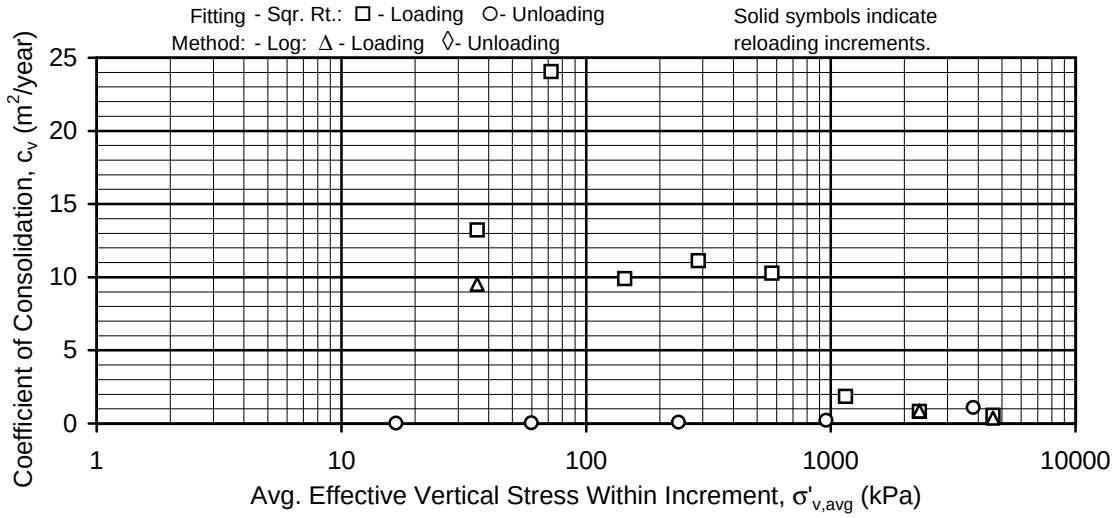




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 55 - Depth: 52.3m
Boring 98-55
SFOBB East Span Seismic Safety Project





INCREMENTAL CONSOLIDATION TEST RESULTS

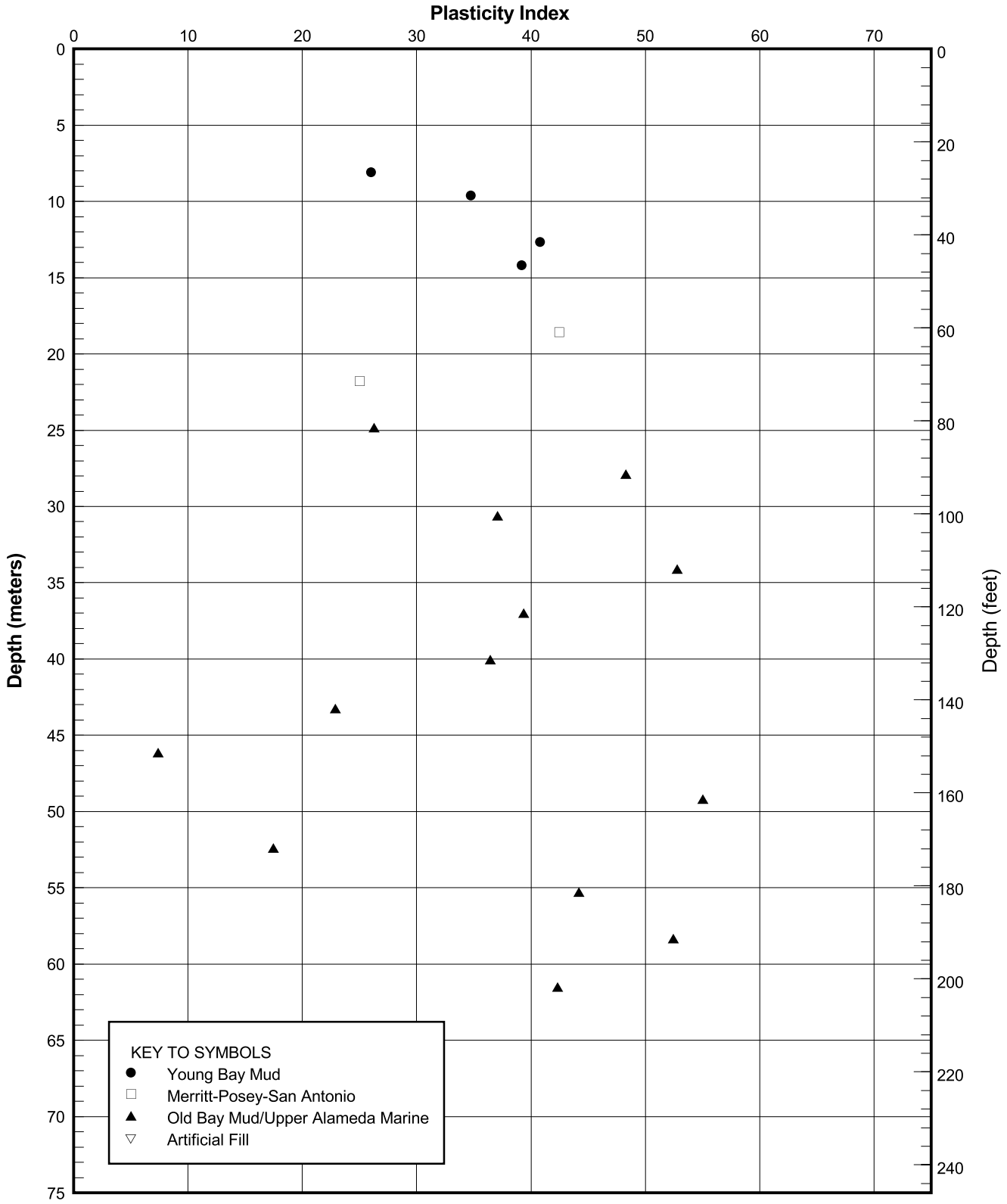
Sample No. 63 - Depth: 61.4m
Boring 98-55
SFOBB East Span Seismic Safety Project

No Consolidated-Undrained Triaxial Compression Testing Performed For This Boring

No Consolidated-Drained Triaxial Compression Testing Performed For This Boring

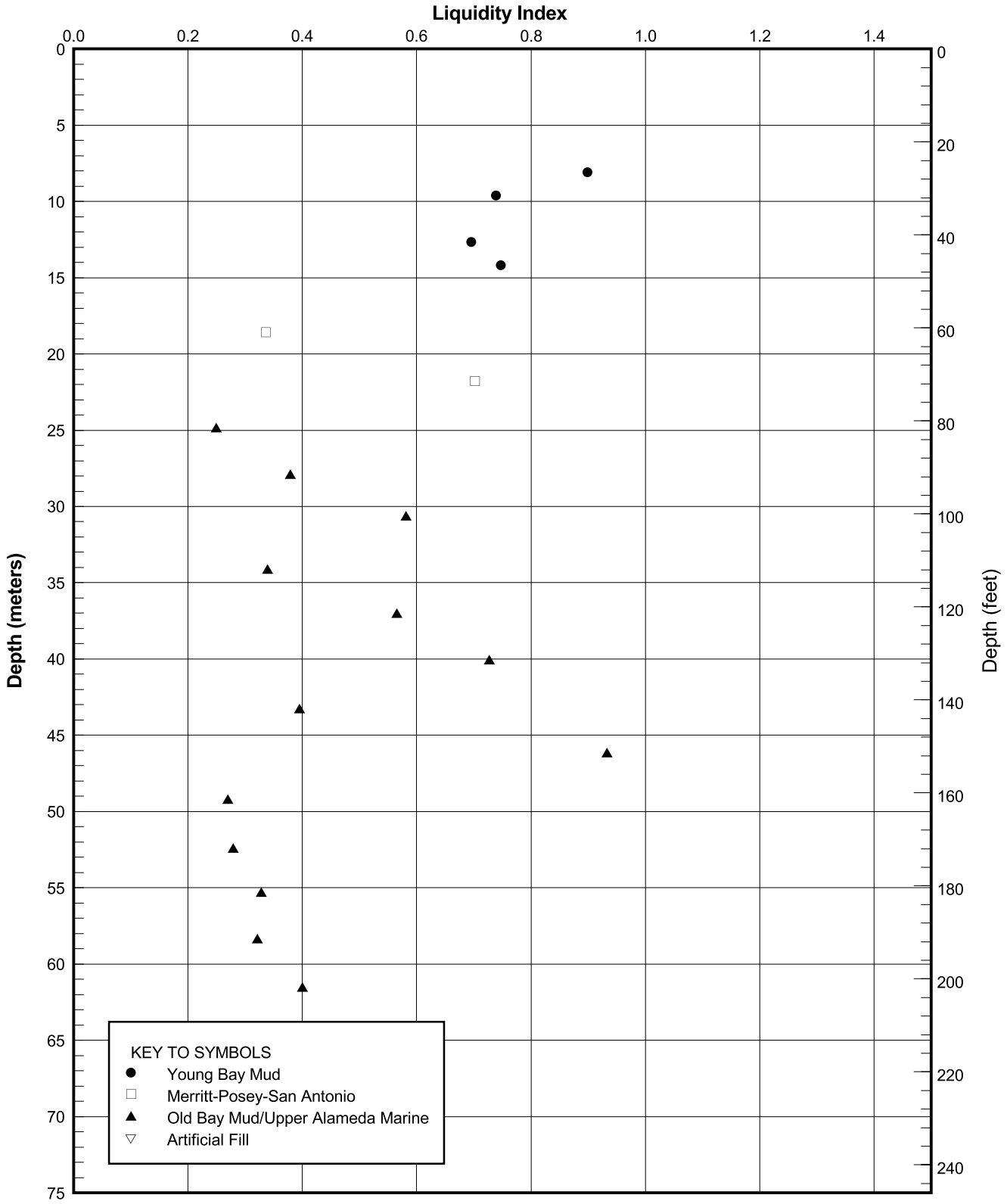
No R-Value Laboratory Testing Performed For This Boring

No Corrosion Testing Performed For This Boring



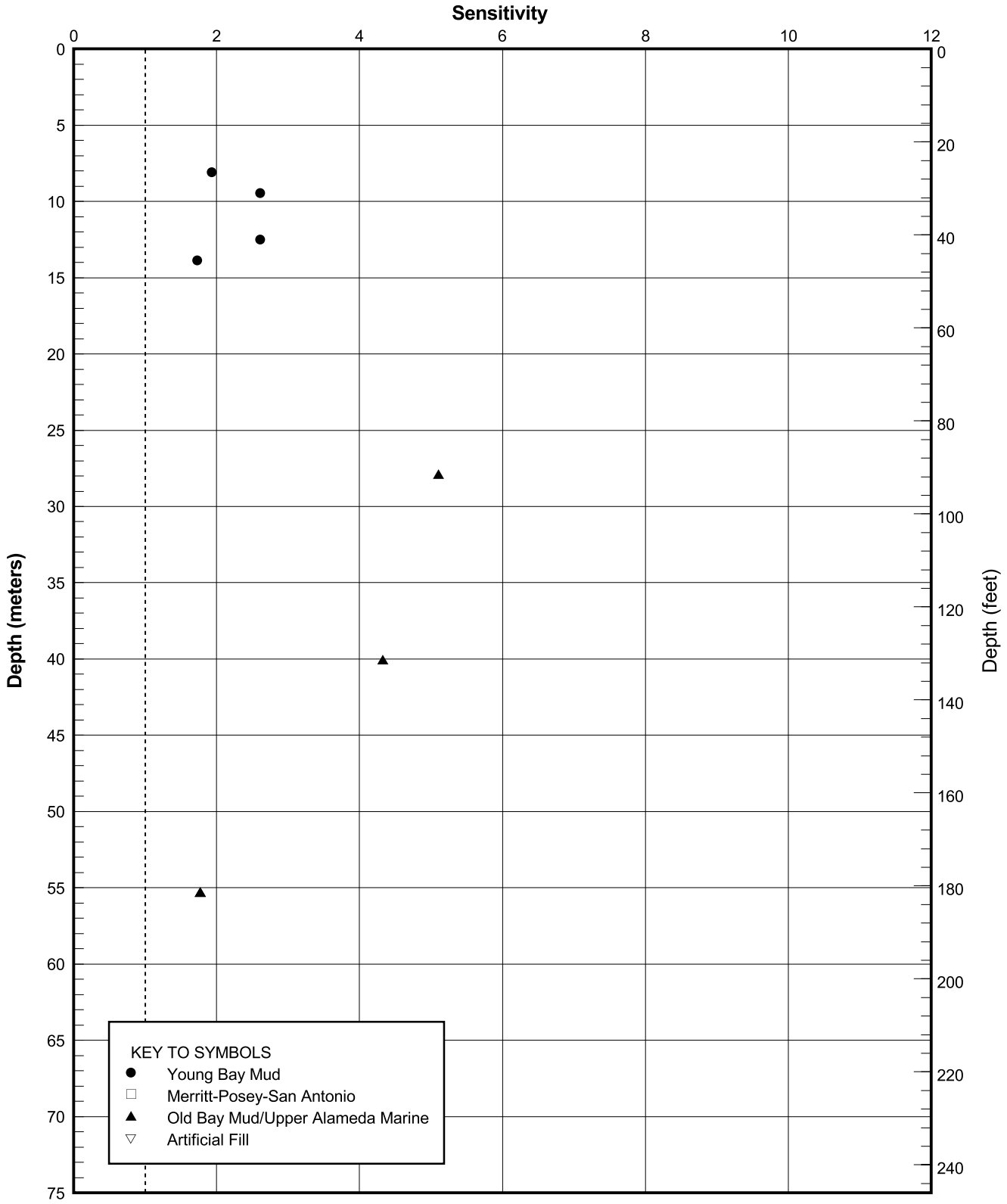
PLASTICITY INDEX PROFILE
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.12



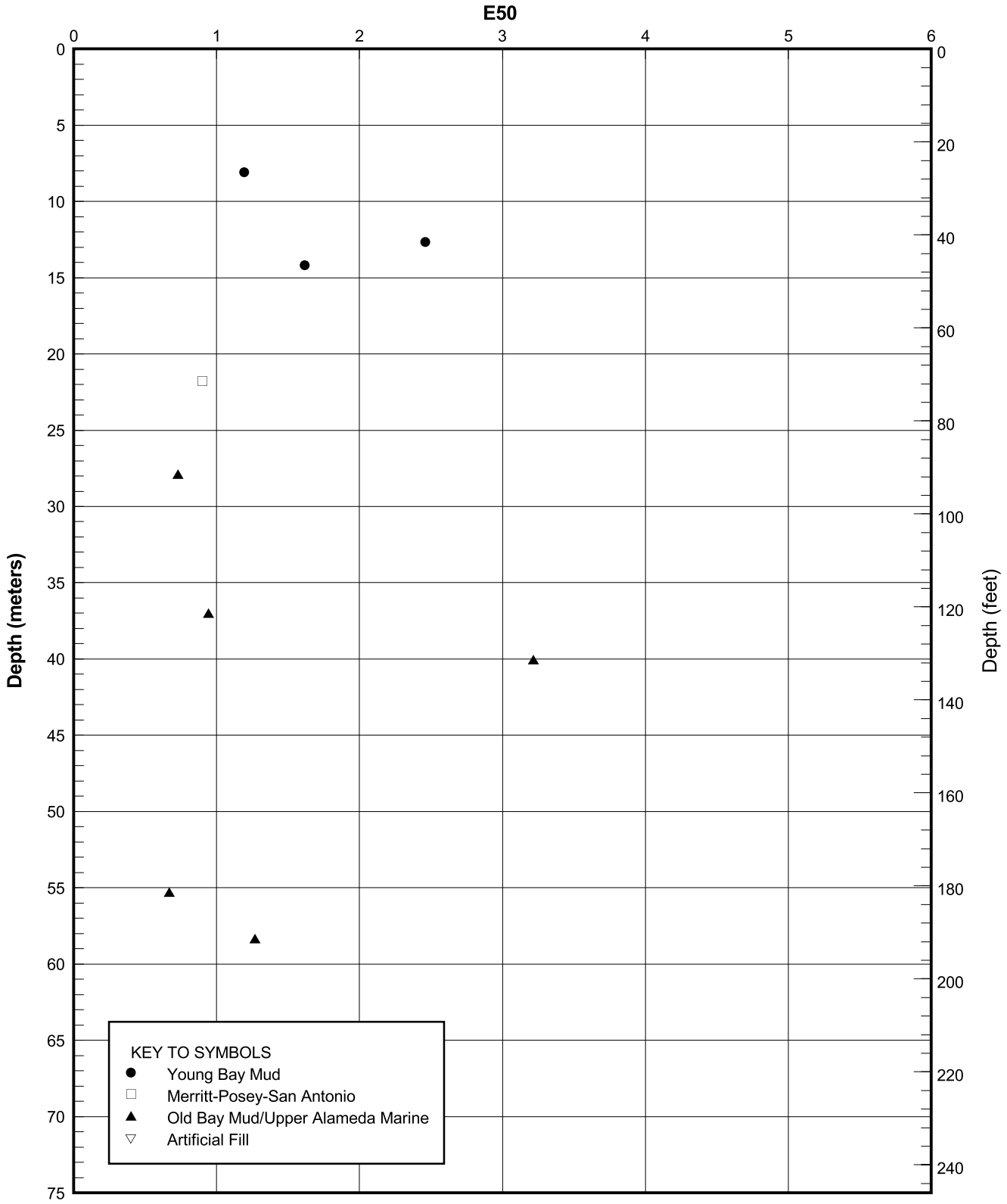
LIQUIDITY INDEX PROFILE
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.13



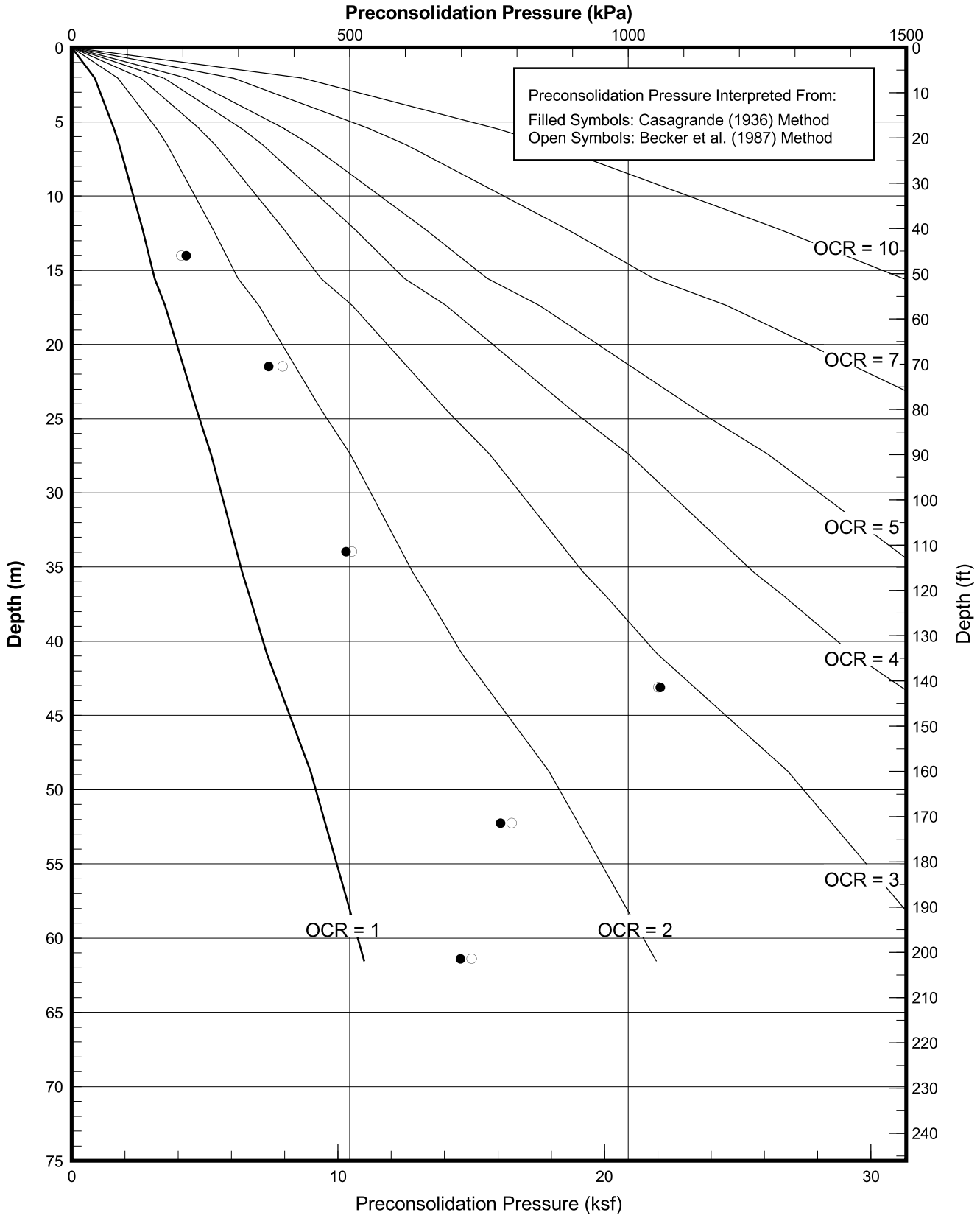
SENSITIVITY PROFILE
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.14



E50 PROFILE
Boring 98-55
SFOBB East Span Seismic Safety Project

PLATE 98-55.15



PRECONSOLIDATION PRESSURE INTERPRETED FROM LABORATORY DATA

Boring 98-55

SFOBB East Span Seismic Safety Project

PLATE 98-55.16

LAND BORING 98-56

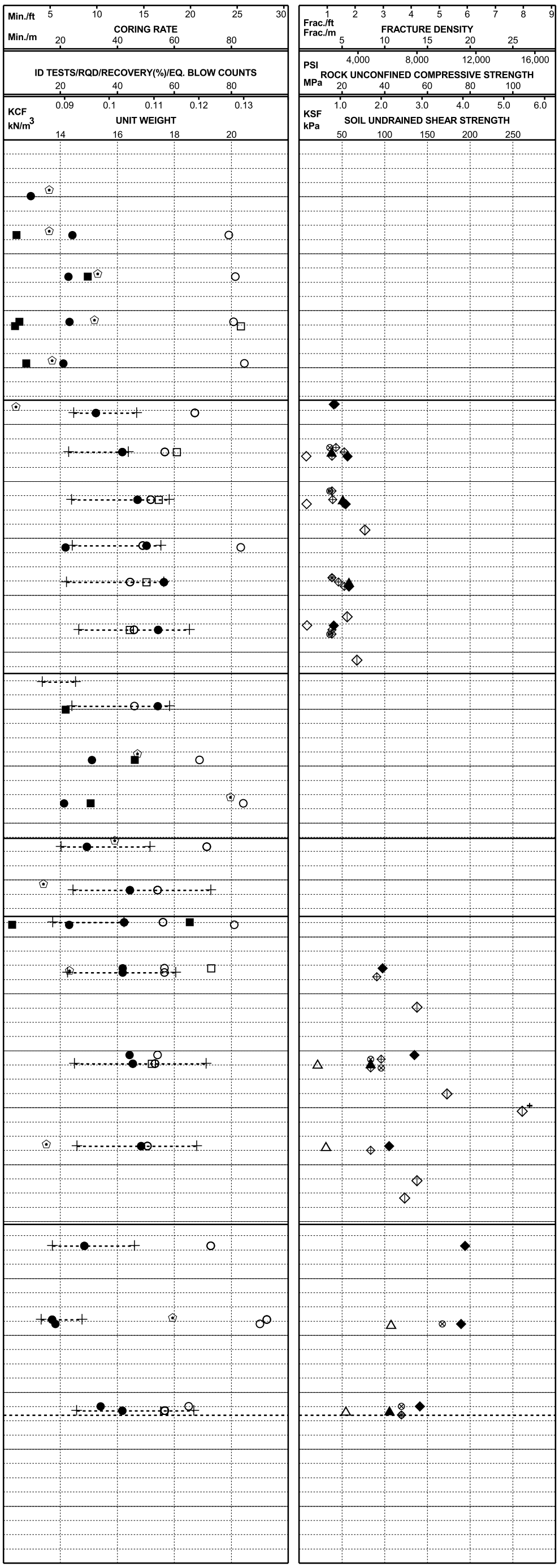
PROJECT NO:	98-42-0058	**START DATE:**	9/30/98	**DRILLER:**	Pitcher Drilling Company
BORING:	98-56 (17m left of E. Sta. 87+21)	**COMPLETION DATE:**	10/1/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1839212 N648294
CA State Plane Zone 3, NAD83, Meters

GROUND ELEVATION: 3.1m (MSL)

MATERIAL DESCRIPTION	BLOW COUNT	STRATUM NO.
Fine SAND with silt (SP-SM), medium dense, brown -moist to 2.5m		I
-with a silt pocket at 2.0m	16	
-wet below 3.0m (3.1m) -with shell fragments, below 3.0m -gray to dark gray, 3.7m to 7.8m	16	
-silty fine sand with clay pockets at 4.7m -with a clay seam at 4.9m -fat clay, 5.0m to 5.3m	33	
	51	
-olive gray to gray, below 7.8m (9.1m)	17	
Fat CLAY (CH), firm to stiff, olive gray -with shell fragments -dark gray to black at 9.1m -lean clay to 11.5m	7	II
-with silt pockets at 11.0m	PUSH	
-with fine sand at 12.5m	PUSH	
-gray fine sand with silt, 14.0m to 14.8m	SAVE	
-with organic pockets and a few silt pockets, at 15.5m	PUSH	
-with gas blisters at 17.1m	PUSH	
-with shell fragments at 18.6m (18.7m)	SAVE	
Clayey Fine SAND (SC), dense, greenish gray -sandy lean clay, 19.1m to 19.8m -fat clay layer at 19.8m	PUSH	III
-with clay pockets at 21.6m	47	
-with a sandy clay seam at 23.2m (24.5m)	73/30cm	
Fat CLAY (CH), very stiff, greenish gray -with many sand pockets at 24.5m -with a sand layer at 25.6m	39	IV
-mottled reddish-brown with black staining, at 26.1m (27.3m)	14	
Fat CLAY (CH), very stiff, greenish gray -sandy lean clay at 27.4m -dense, greenish gray, fine sand, 27.6m to 27.9m	PUSH	V
-with brown organic pockets, and fine sand pockets and partings, at 29.3m	37	
-with sand pockets, organic pockets, and silt pockets and partings, at 32.3m	PUSH	
-with silt pockets and sand pockets, below 35.1m (38.1m)	24	
Lean CLAY (CL), very stiff to hard, greenish gray -with silt pockets and sand pockets, at 38.4m	SAVE	VI
-with organic pockets and silt pockets, at 41.5m	87/30cm	
-fat clay with silt pockets, below 43.9m	PUSH	

TOTAL DEPTH: 44.8m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-56

SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

Report Date: 03/13/99

PLATE 98-56.1

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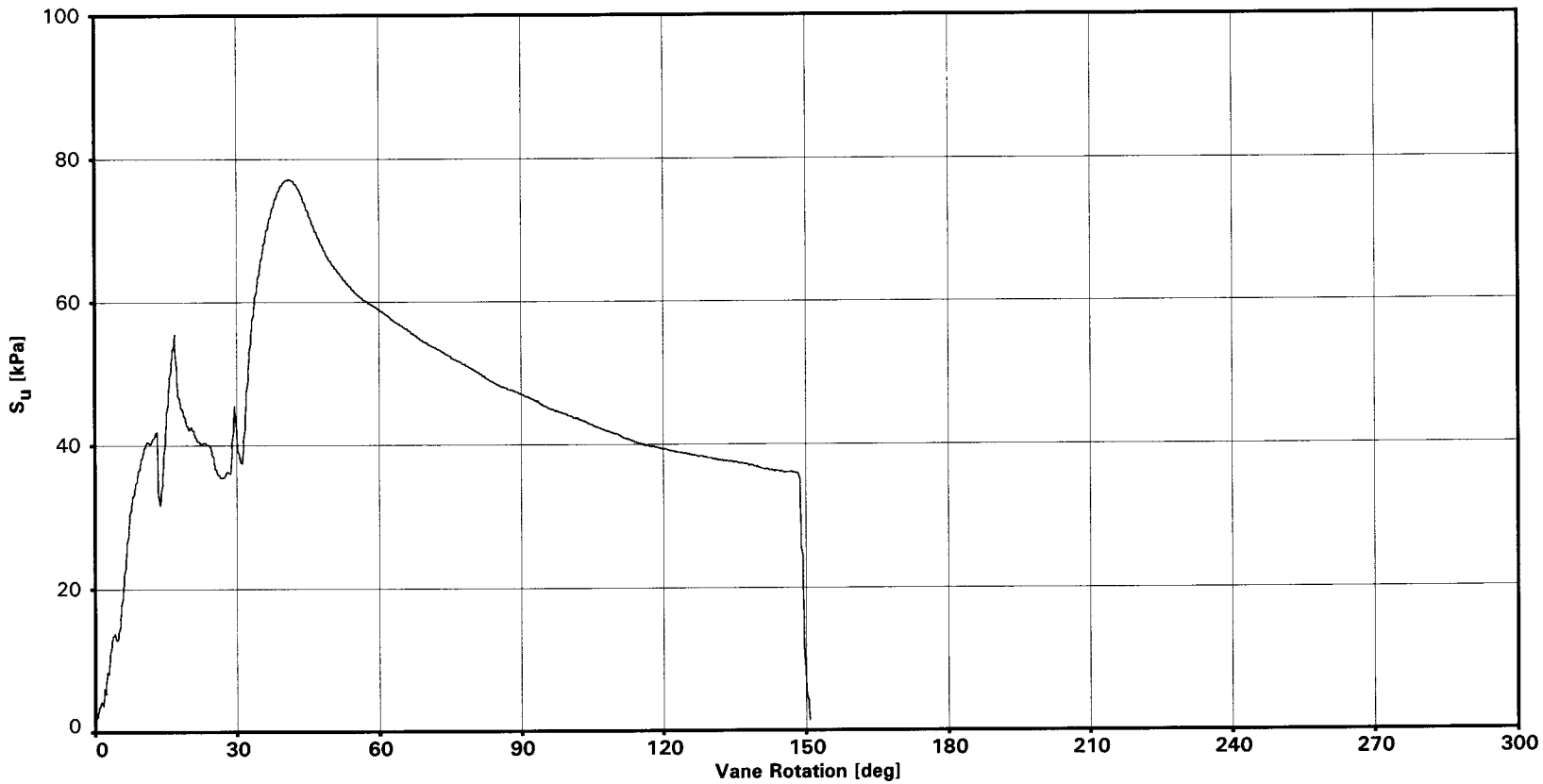
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 13.7m
Boring 98-56
SFOBB East Span Seismic Safety Project

PLATE 98-56.2a

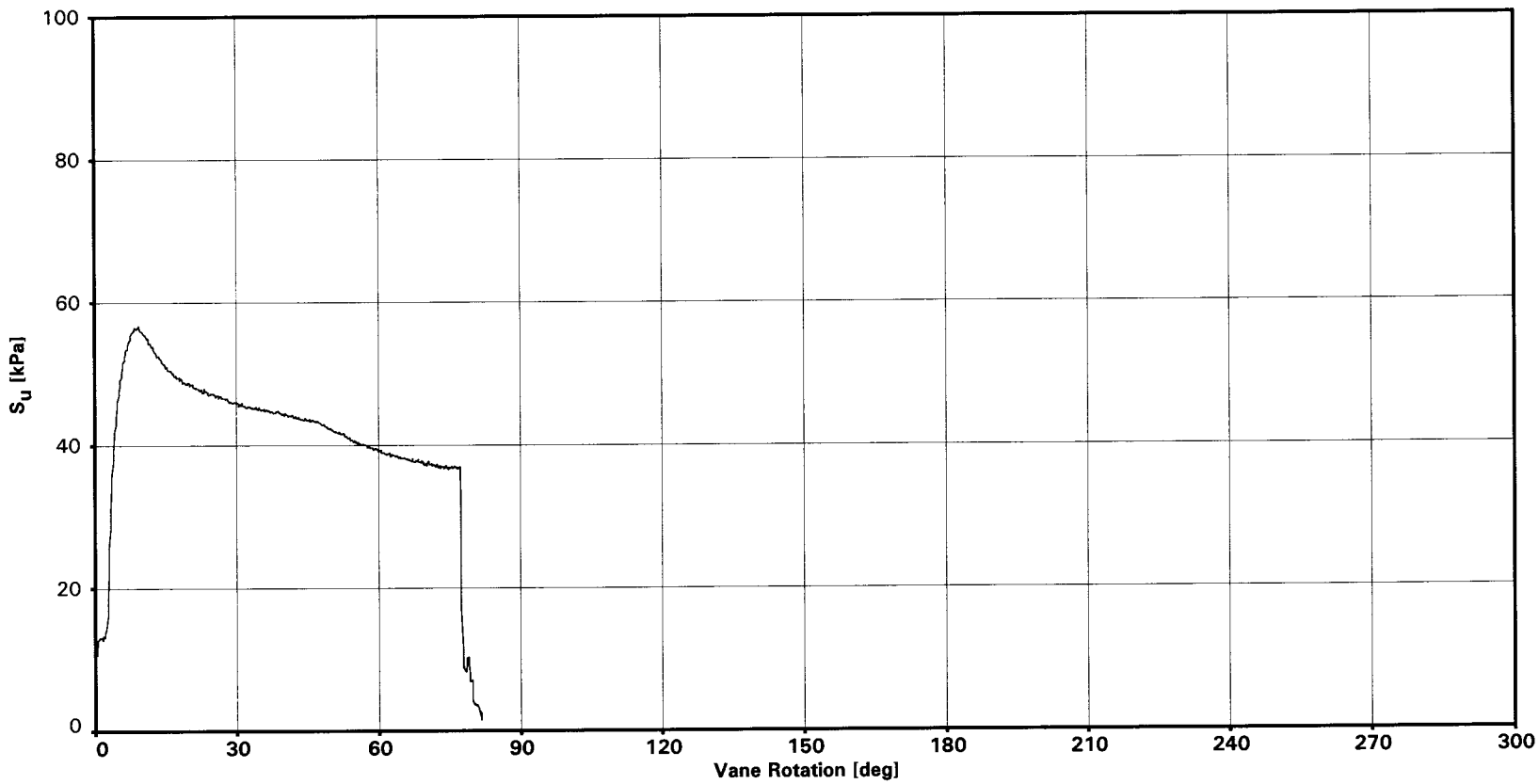
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 16.8m
Boring 98-56
SFOBB East Span Seismic Safety Project

PLATE 98-56.2b

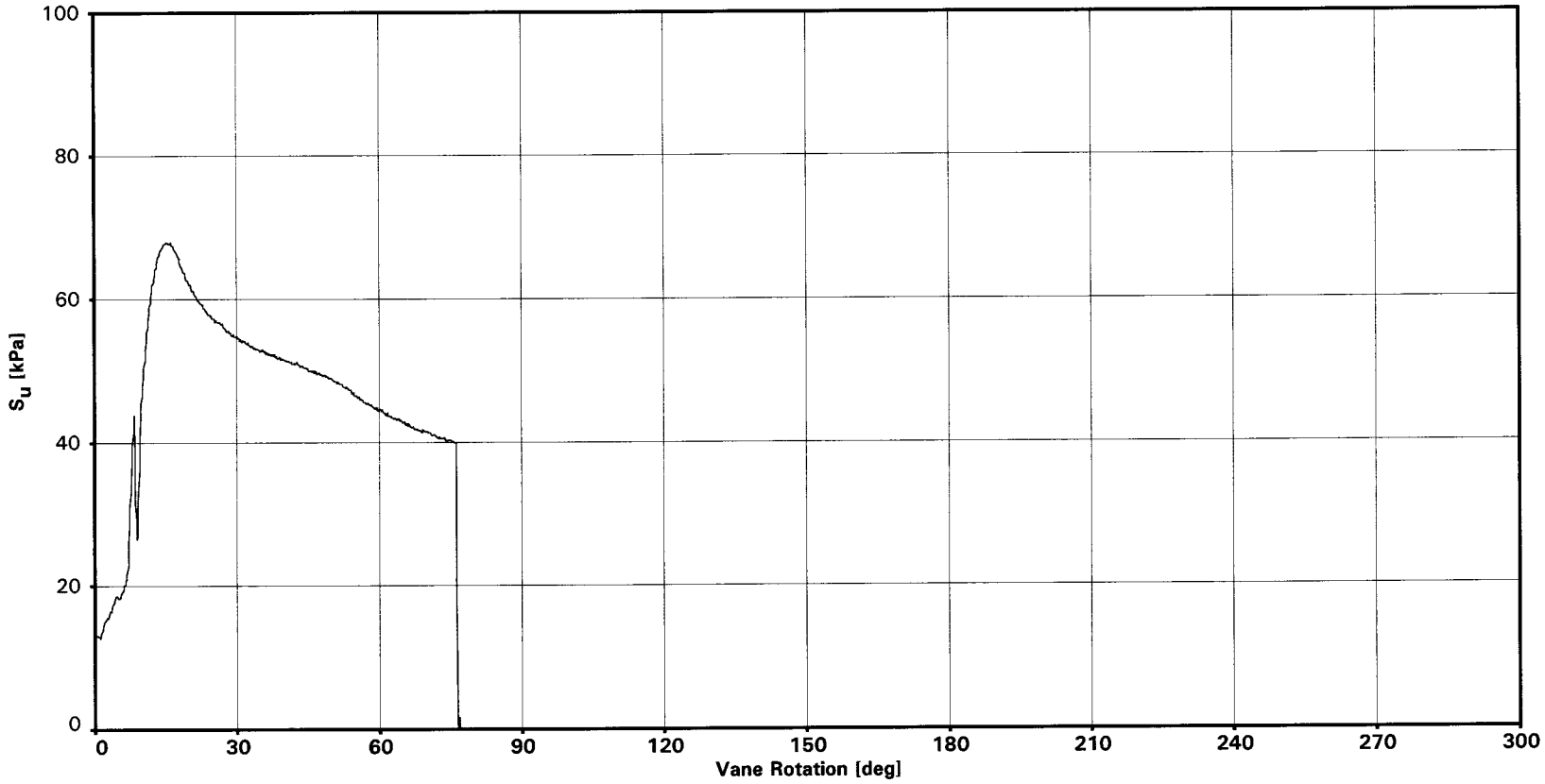
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 18.3m
Boring 98-56
SFOBB East Span Seismic Safety Project

PLATE 98-56.2c

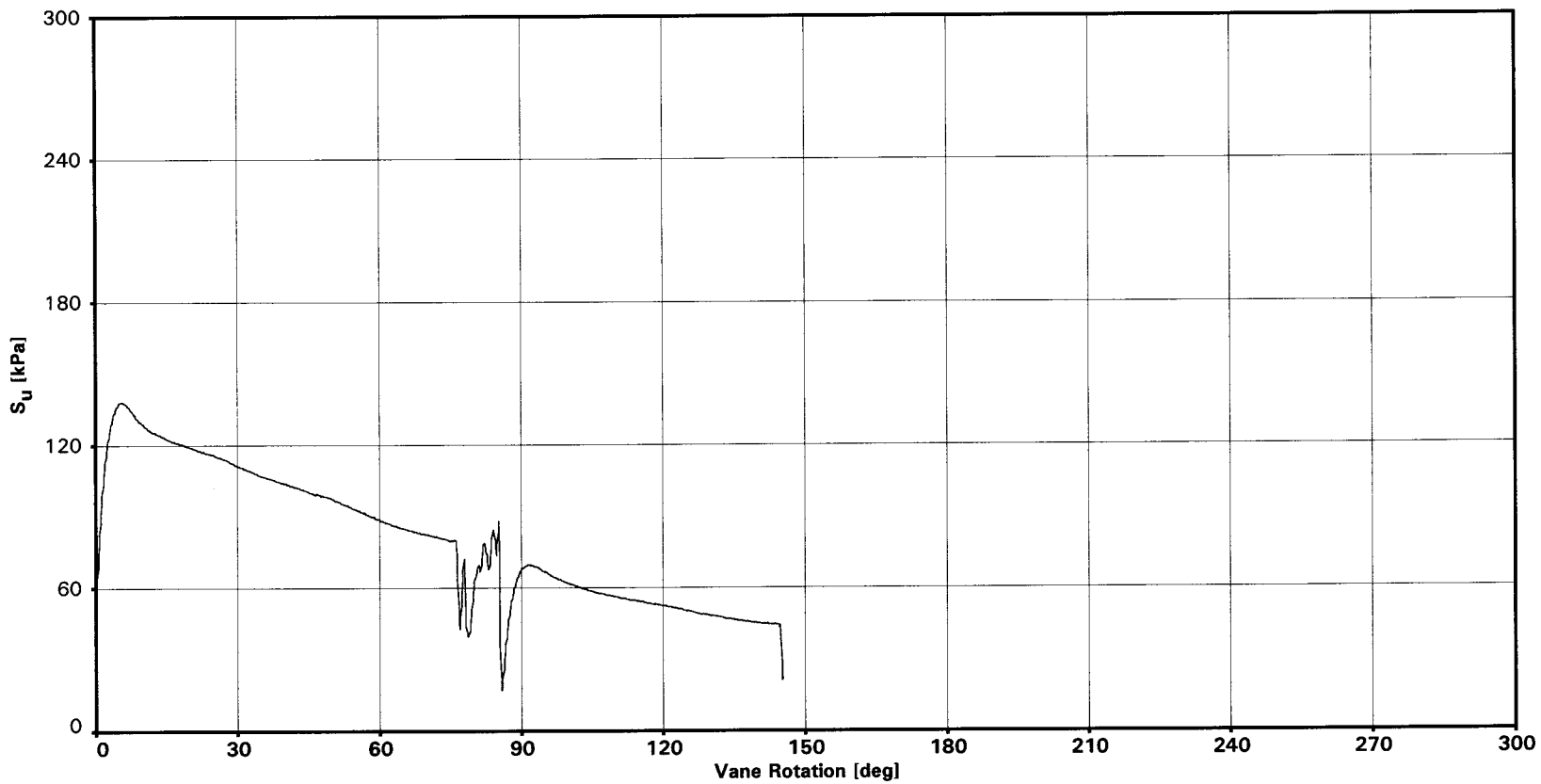
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 30.5m
Boring 98-56
SFOBB East Span Seismic Safety Project

PLATE 98-56.2d

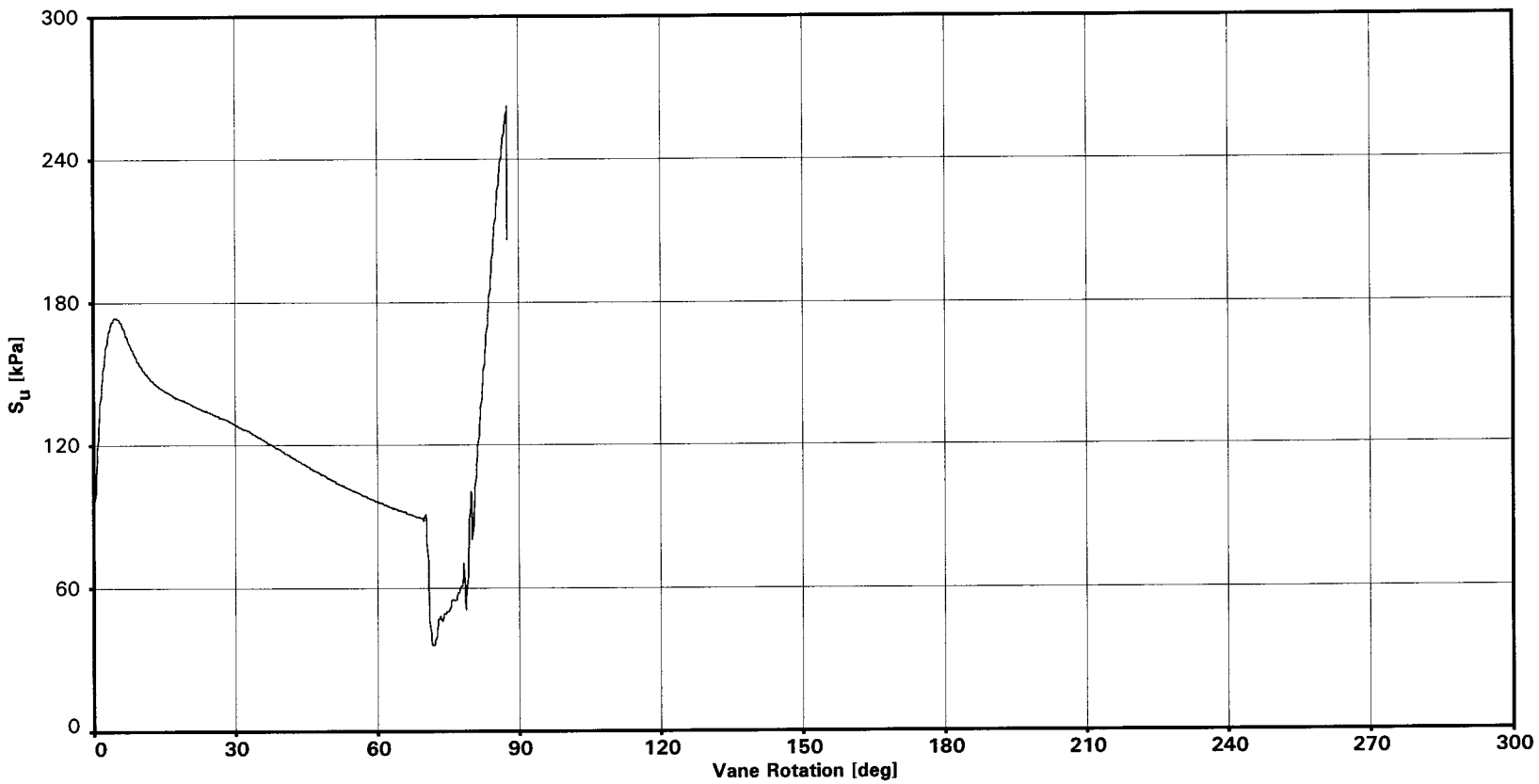
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



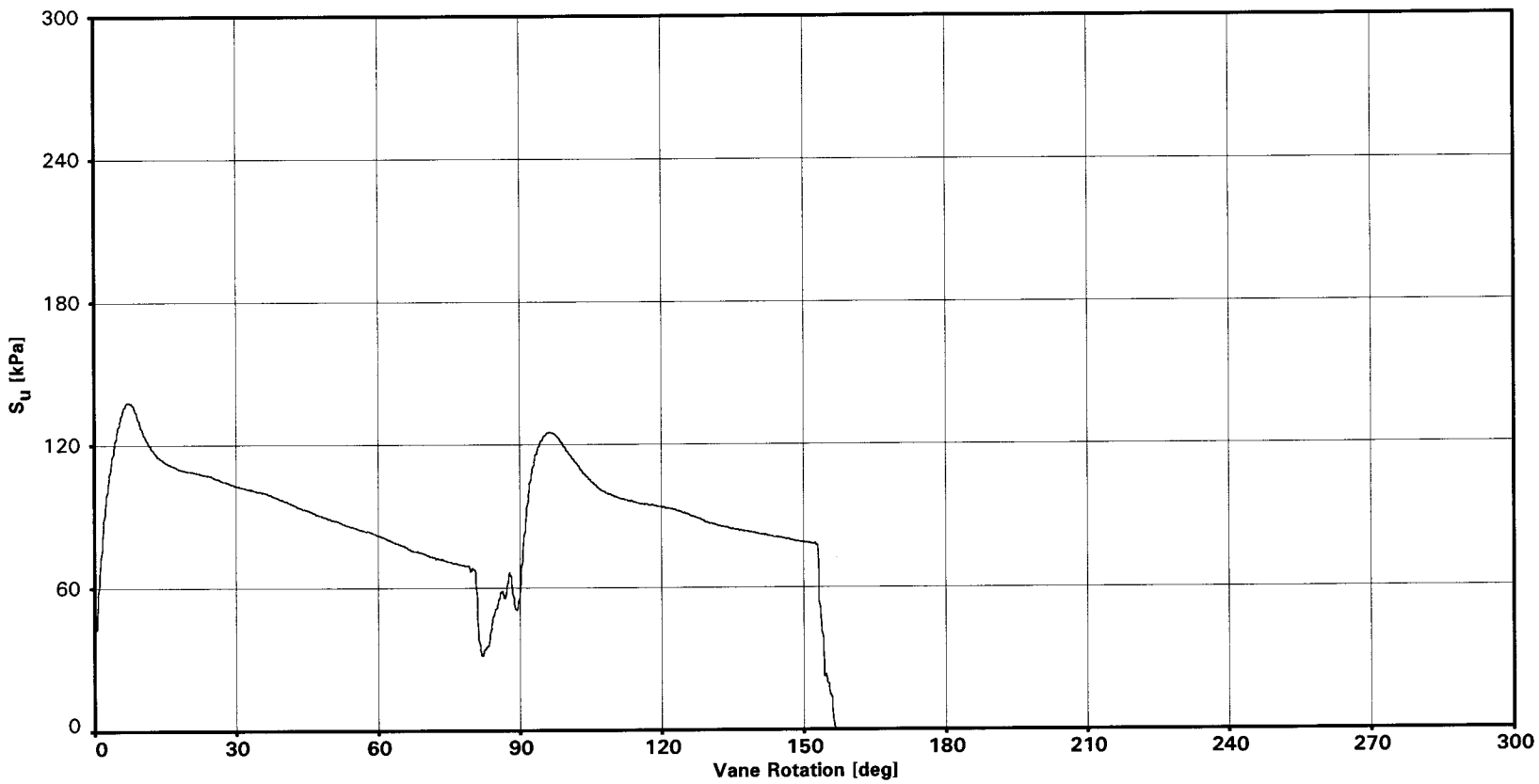
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 33.5m and 34.1m
Boring 98-56
SFOBB East Span Seismic Safety Project

PLATE 98-56.2e

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 36.6m and 37.2m
Boring 98-56
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-56.2f

SFOBB Task Order No. 5
Project No. 98-42-0058

98-56		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
2.0	1	9																									
3.4	2	24					4																				
4.8	3	23					30																			H	2.68
6.4	4	23					5																				
6.6	5					20.3	4																				
7.9	6	21					8																				
9.3	7							42.1			40.5																
9.6	9	32	47	25	0.34																						
10.8	10							43.1	35.9																		
11.0	11	42	44	23	0.89	18.1		52.7							38.0		2.1										
11.1	12							38.3			56.5	8.3															
12.3	13							38.3	35.9																		
12.6	15	47	58	24	0.67	17.4		39.3							50.9		1.9										
12.8	16							52.7			54.5	8.7															
13.7	400													77.1													

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-56
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-56.3a

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SFOBB Task Order No. 5
Project No. 98-42-0058

98-56		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
14.3	17	50	55	24	0.83																					C	2.74
14.3	18	22																									
15.4	19							38.3	38.3																		
15.5	20	56	56	22	0.99	17.0		46.0							58.2		0.7										
15.7	21							52.7			58.4																
16.8	401													56.0													
17.1	23										40.5	9.2															
17.2	24	54	65	27	0.71	16.4		38.3																			
17.4	25							38.3	35.9																		
18.3	402													67.5													
19.1	27		25	14																							
19.9	29	54	58	24	0.87																						
20.0	30						22																				
21.8	31	31					46																				
23.3	32	21					31																			H	2.74

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

\+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-56
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-56.3b

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98-56		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
24.8	33	29	52	20	0.29																						
26.4	34	44	73	24	0.41																						
27.5	35	42	42	17	1.00		65																				
27.6	36	23					3																				
29.1	37					19.3					97.8																
29.3	38	42	61	23	0.50																						
29.4	39							91.0																			
30.5	403													137.9													
32.2	40	44									134.9																
32.3	41							95.8	83.8																		
32.5	42	45	71	25	0.44	17.2									83.8	21.4	0.5										
32.6	43							83.8	95.8																		
33.5	404													172.8													
34.1	405													260.9+													
35.4	45	48	68	26	0.53						105.2					31.3											

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-56
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-56.3c

SFOBB Task Order No. 5
Project No. 98-42-0058

98-56		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
35.5	46							83.8																			
36.6	406													137.9													
37.2	407													123.5													
38.8	47	27	50	19	0.25																					C	
38.9	48	28	46	17	0.38						194.3																
41.5	50	17	28	13	0.25																						
41.6	51	18							167.6		189.4					107.3											
44.5	52	34							119.7		141.1																
44.7	53	42	67	26	0.39	17.6									105.9	54.6	3.3										
44.8	54							119.7	119.7																		

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-56
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-56.3d

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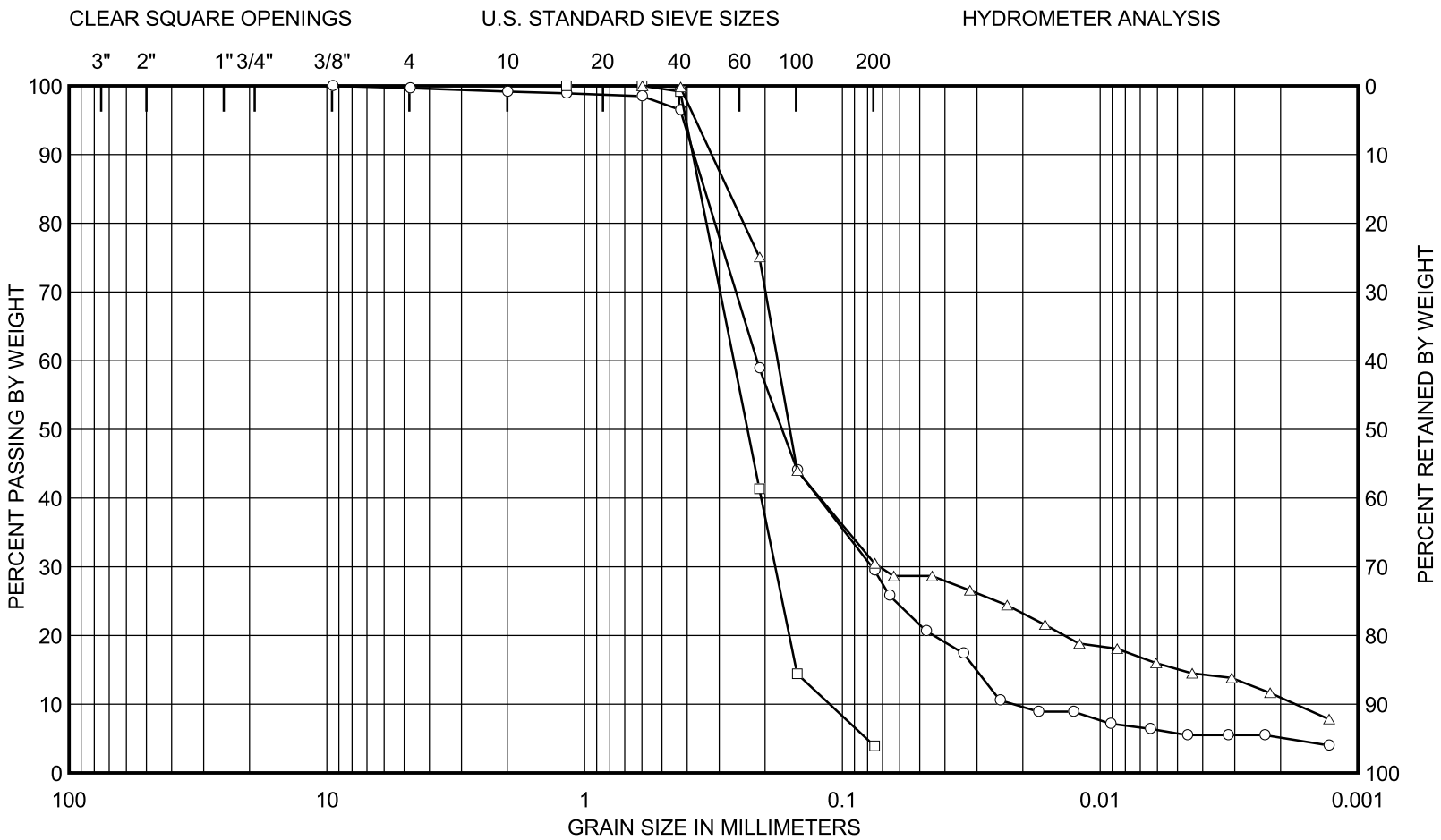

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
3	4.8	○——○	SILTY FINE SAND (SM)			0.17
5	6.6	□——□	FINE SAND (SP)	1.1	2.4	0.23
32	23.3	△——△	SILTY FINE SAND (SM)			0.16

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-56
SFOBB East Span Seismic Safety Project

PLATE 98-56.4

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

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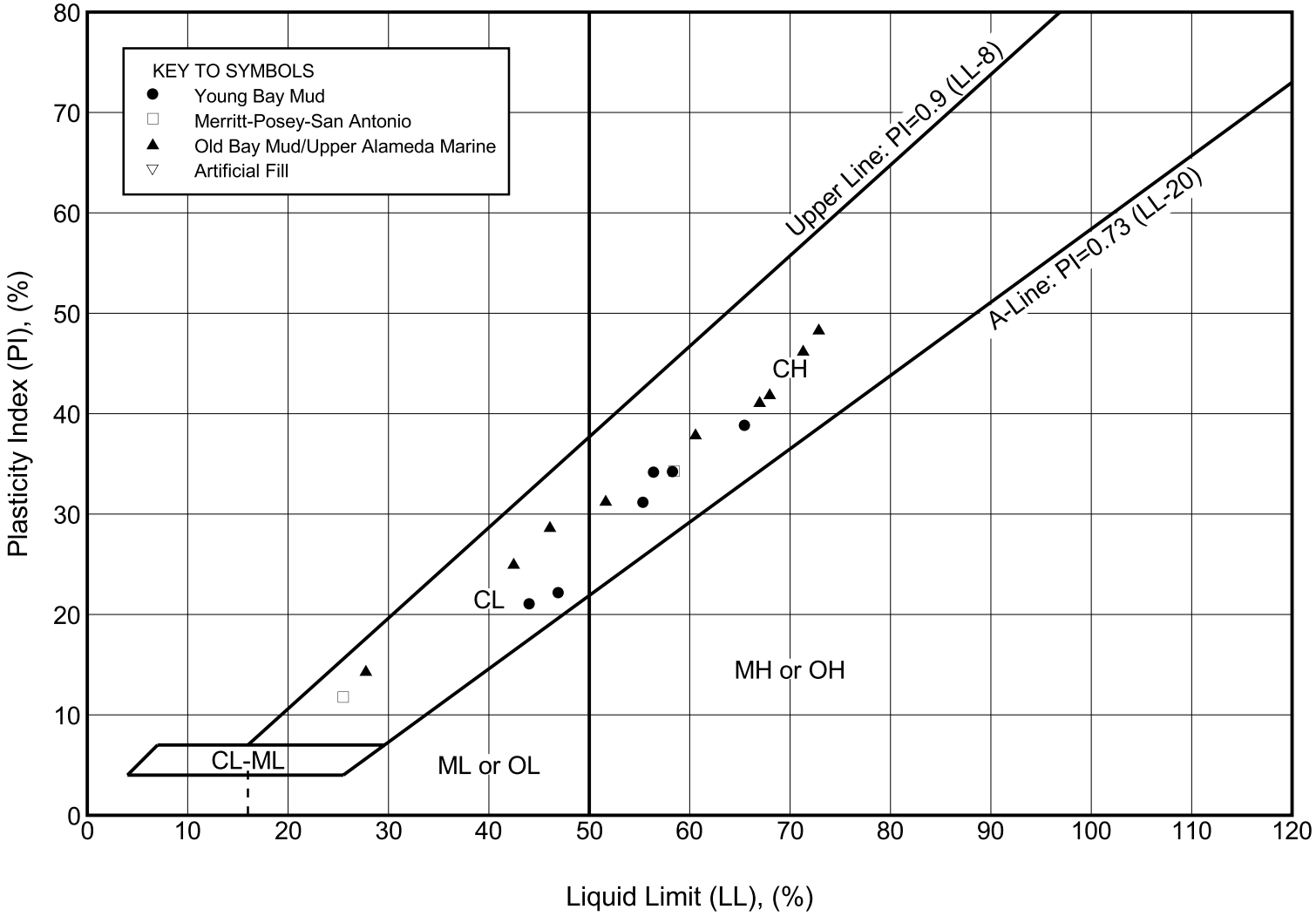

PLASTICITY CHART
Boring 98-56
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-56.5

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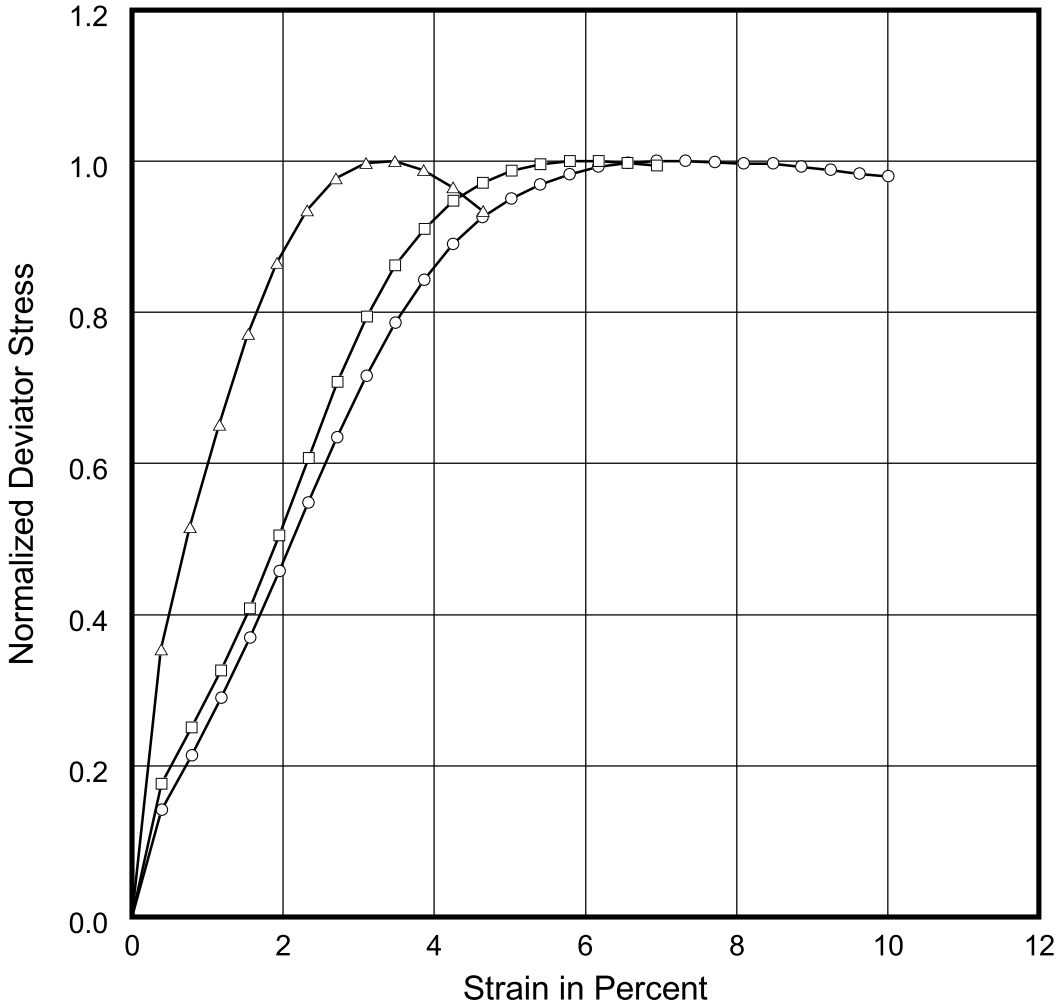
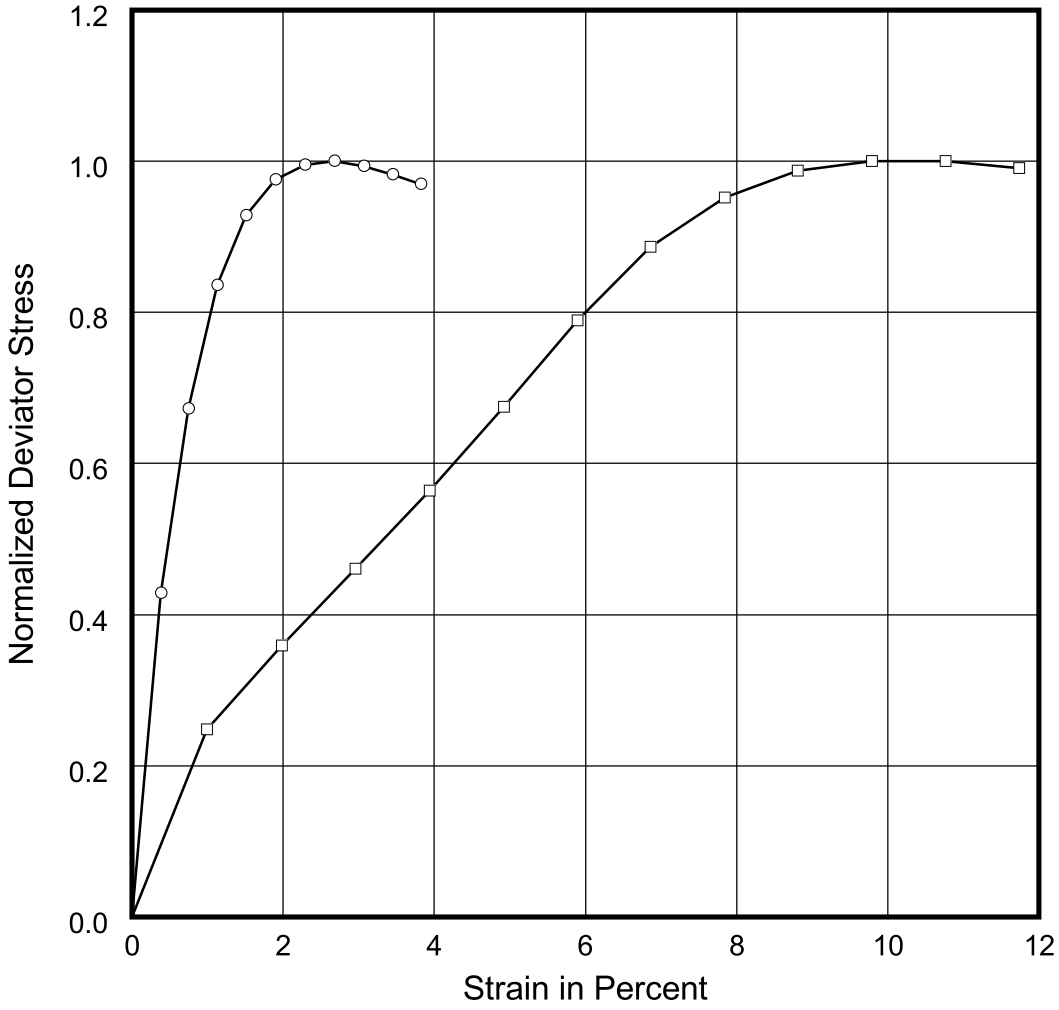


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	11	11.0	UU	276	76	2.1
□——□	15	12.6	UU	276	102	1.9
△——△	20	15.7	UU	276	116	0.7

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-56
SFOBB East Span Seismic Safety Project



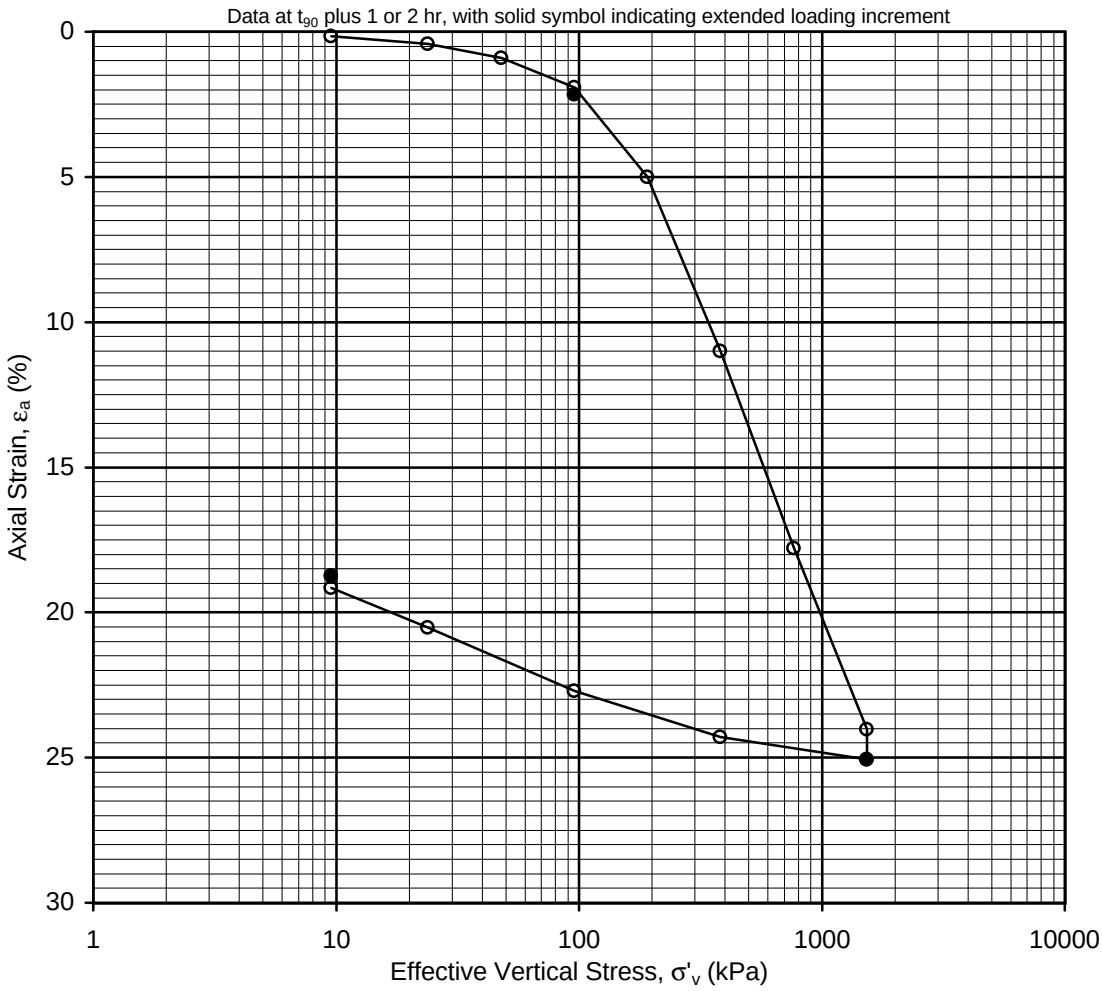
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	42	32.5	UU	1000	168	0.5
□——□	53	44.7	UU	1345	212	3.3

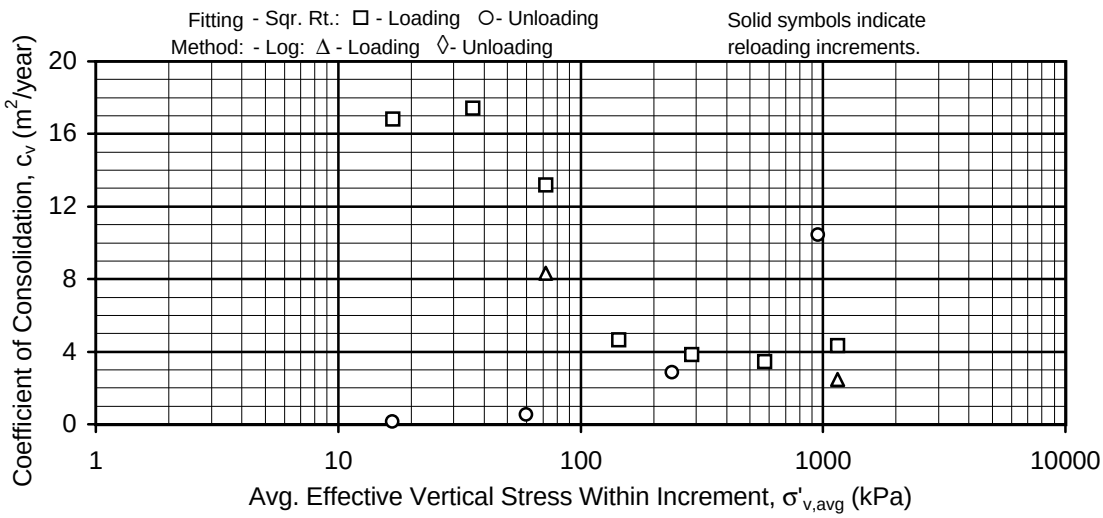
Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-56
SFOBB East Span Seismic Safety Project

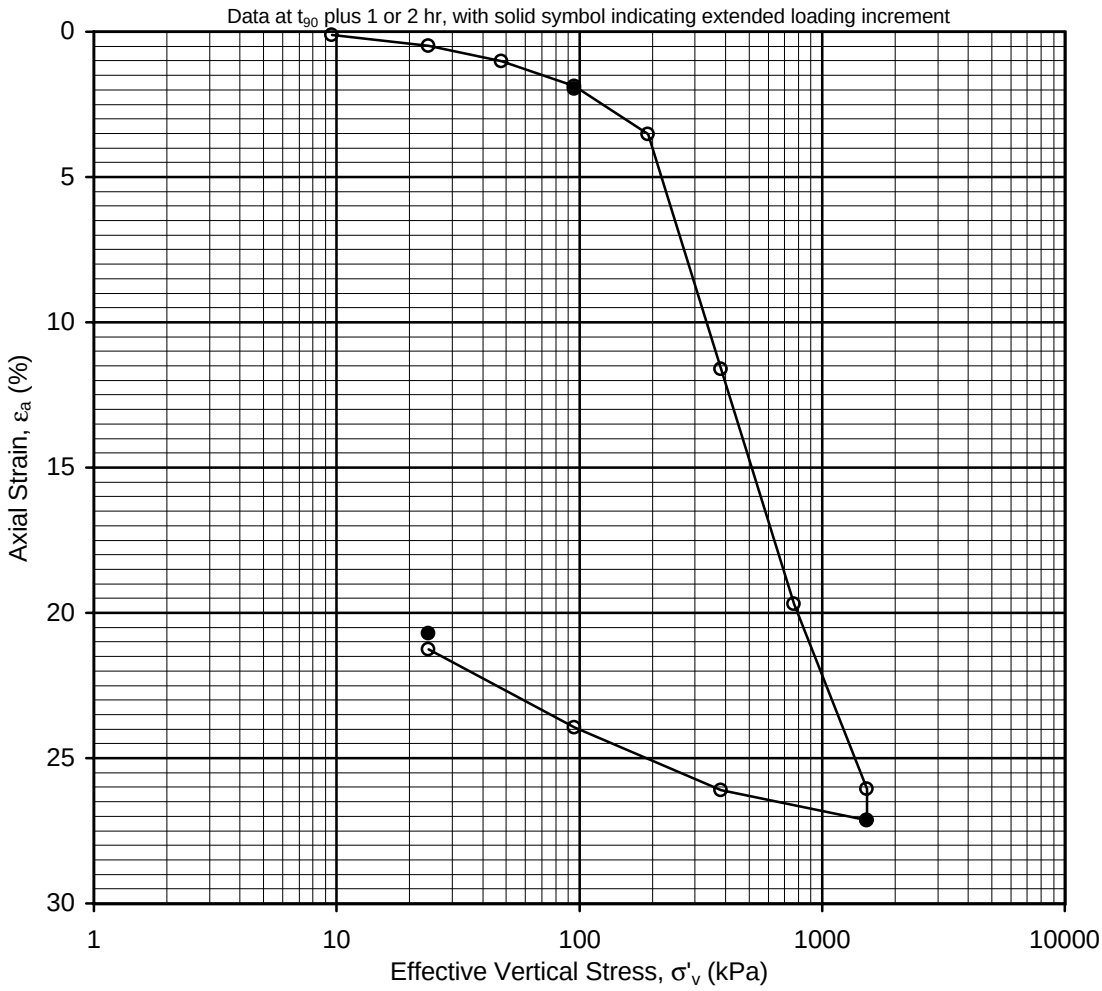
PLATE 98-56.6b

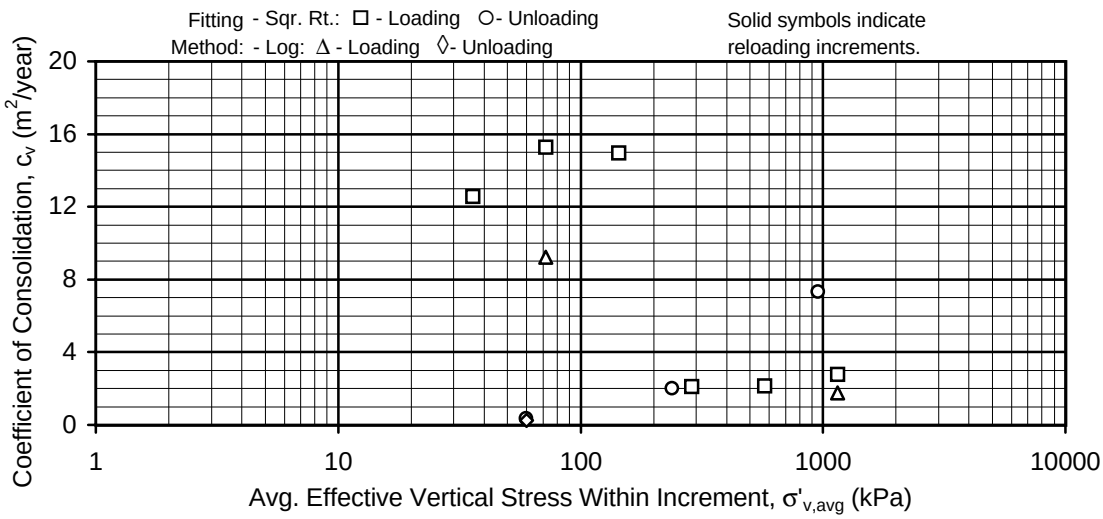




INCREMENTAL CONSOLIDATION TEST RESULTS

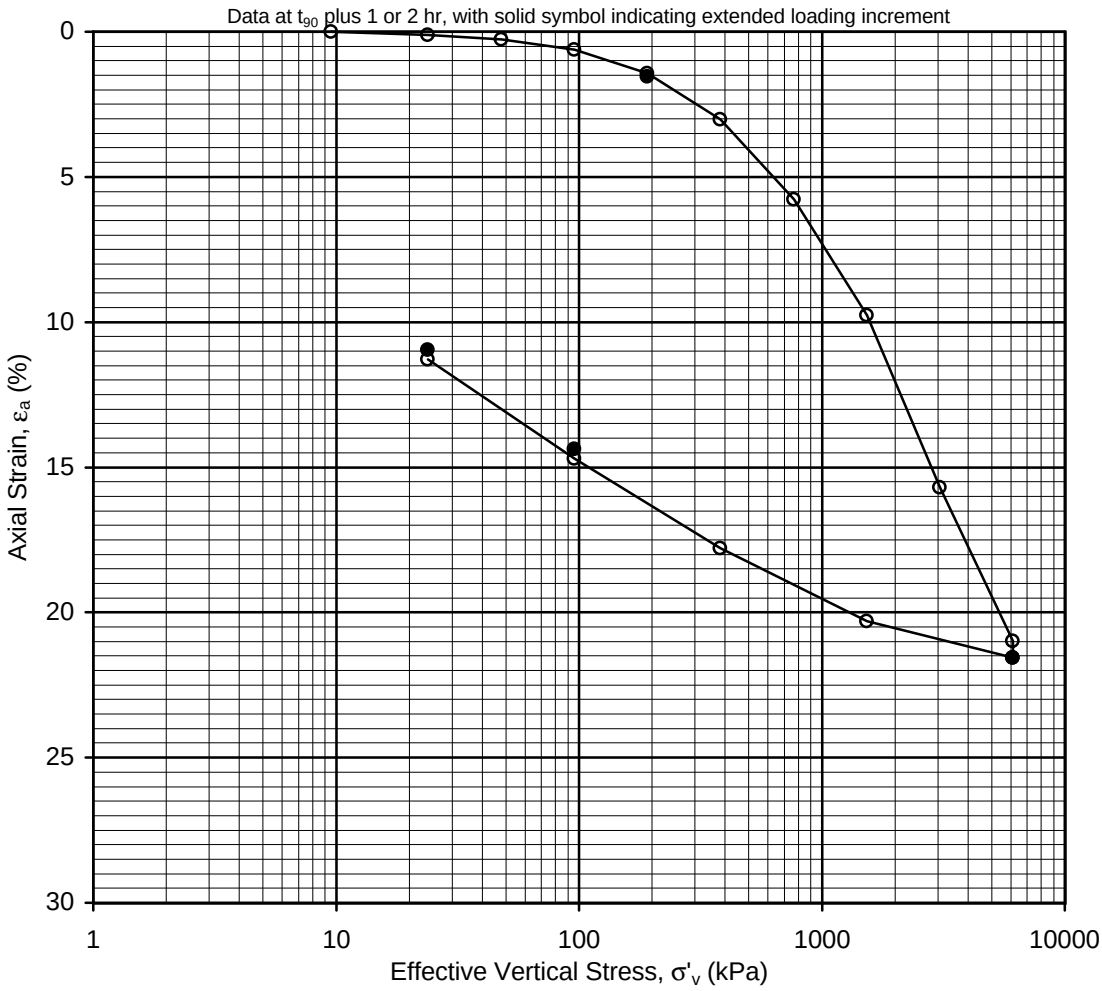
Sample No. 17A - Depth: 13.9m
Boring 98-56
SFOBB East Span Seismic Safety Project

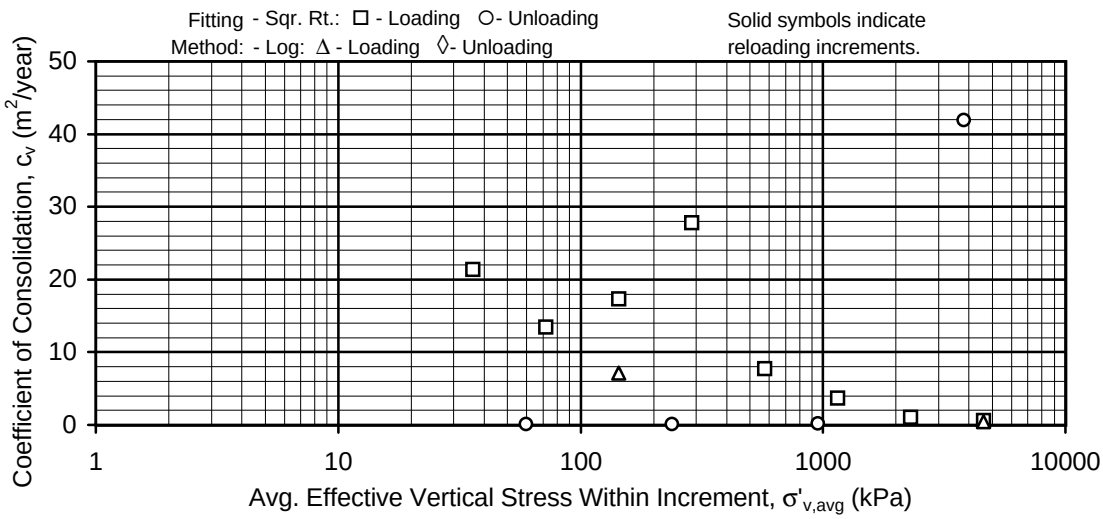




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 17B (Horizontal Loading) - Depth: 13.8m
Boring 98-56
SFOBB East Span Seismic Safety Project





INCREMENTAL CONSOLIDATION TEST RESULTS

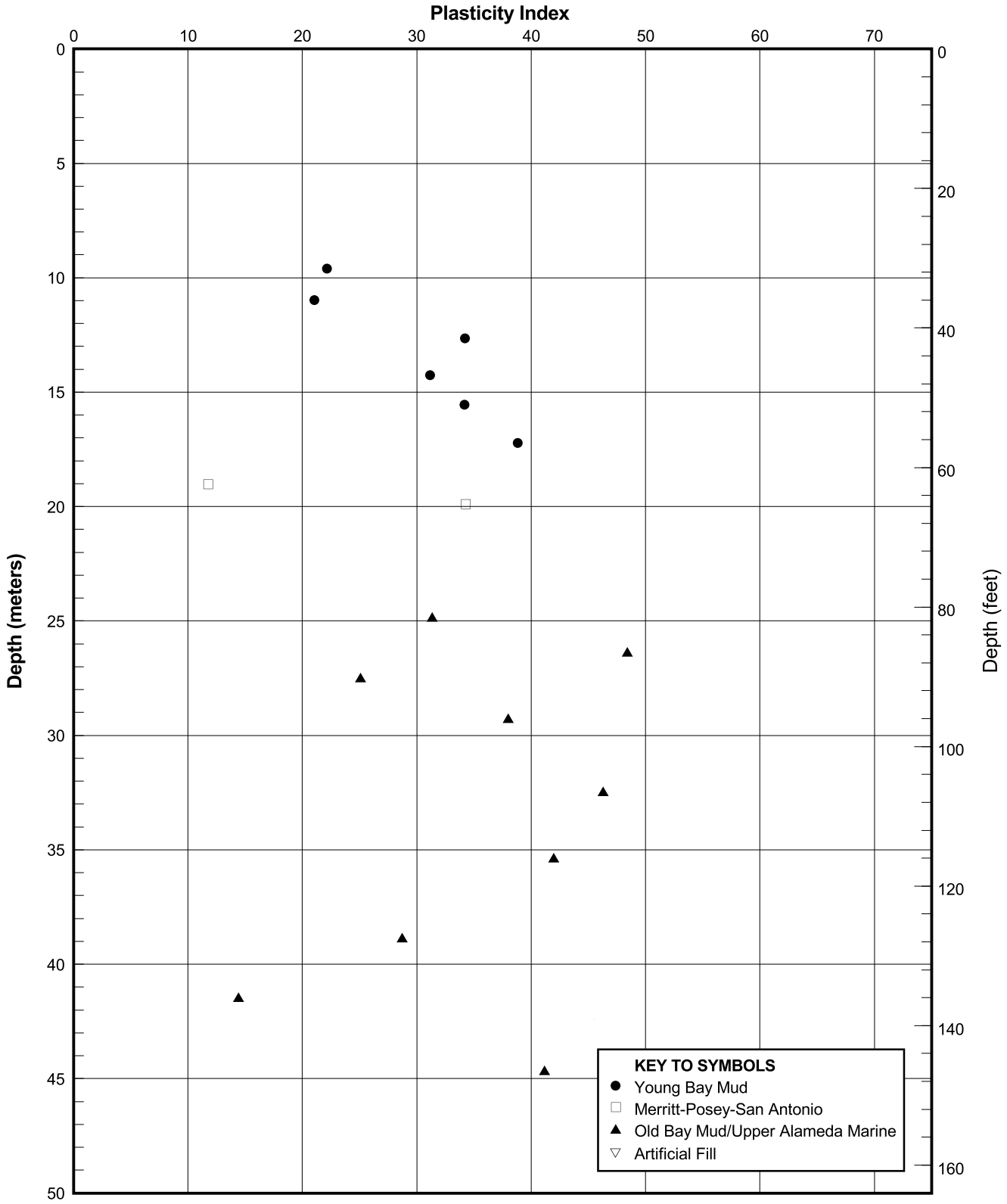
Sample No. 47 - Depth: 38.6m
Boring 98-56
SFOBB East Span Seismic Safety Project

No Consolidated-Undrained Triaxial Compression Testing Performed For This Boring

No Consolidated-Drained Triaxial Compression Testing Performed For This Boring

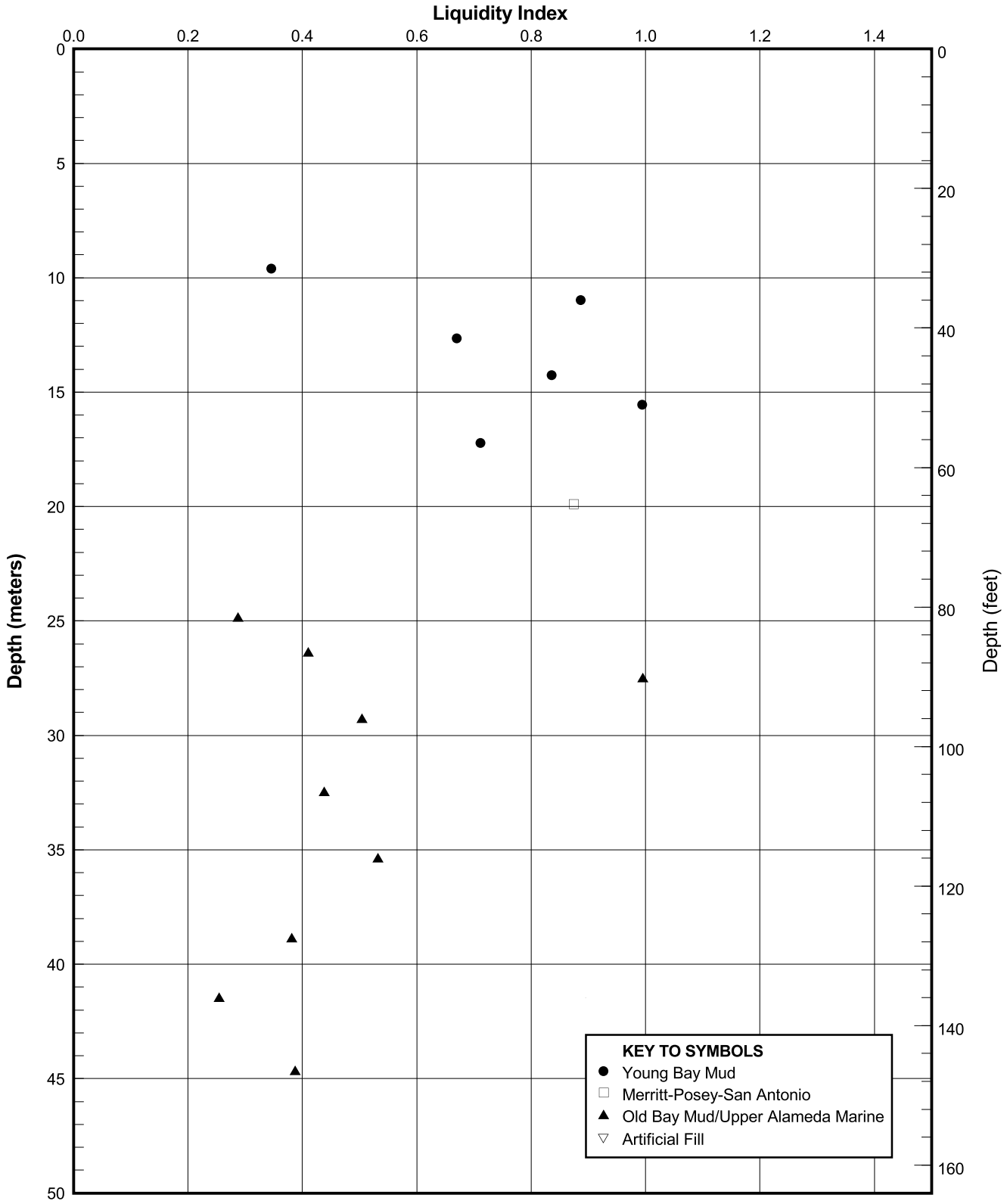
No R-Value Laboratory Testing Performed For This Boring

No Corrosion Testing Performed For This Boring



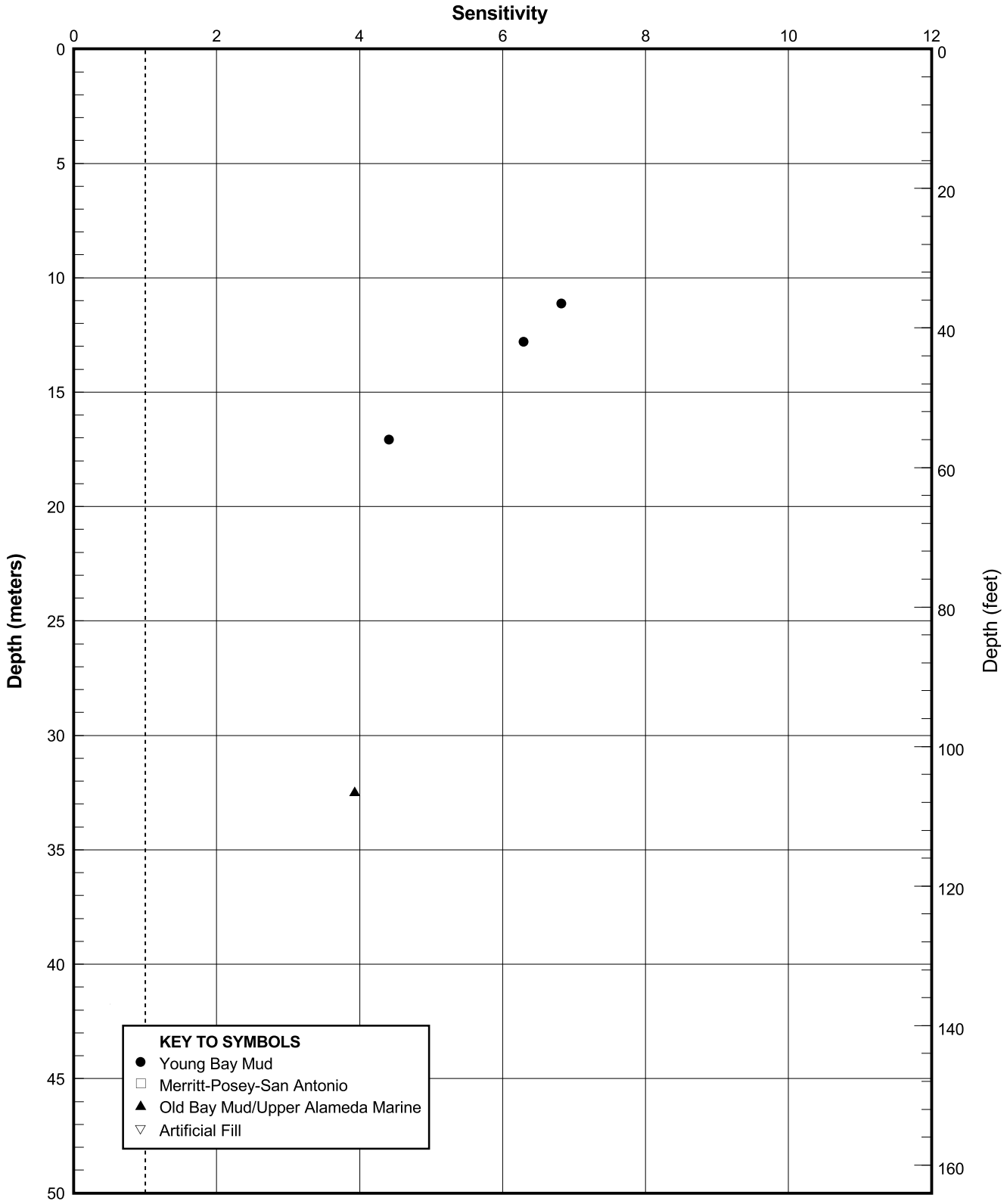
PLASTICITY INDEX PROFILE
Boring 98-56
SFOBB East Span Seismic Safety Project

PLATE 98-56.12



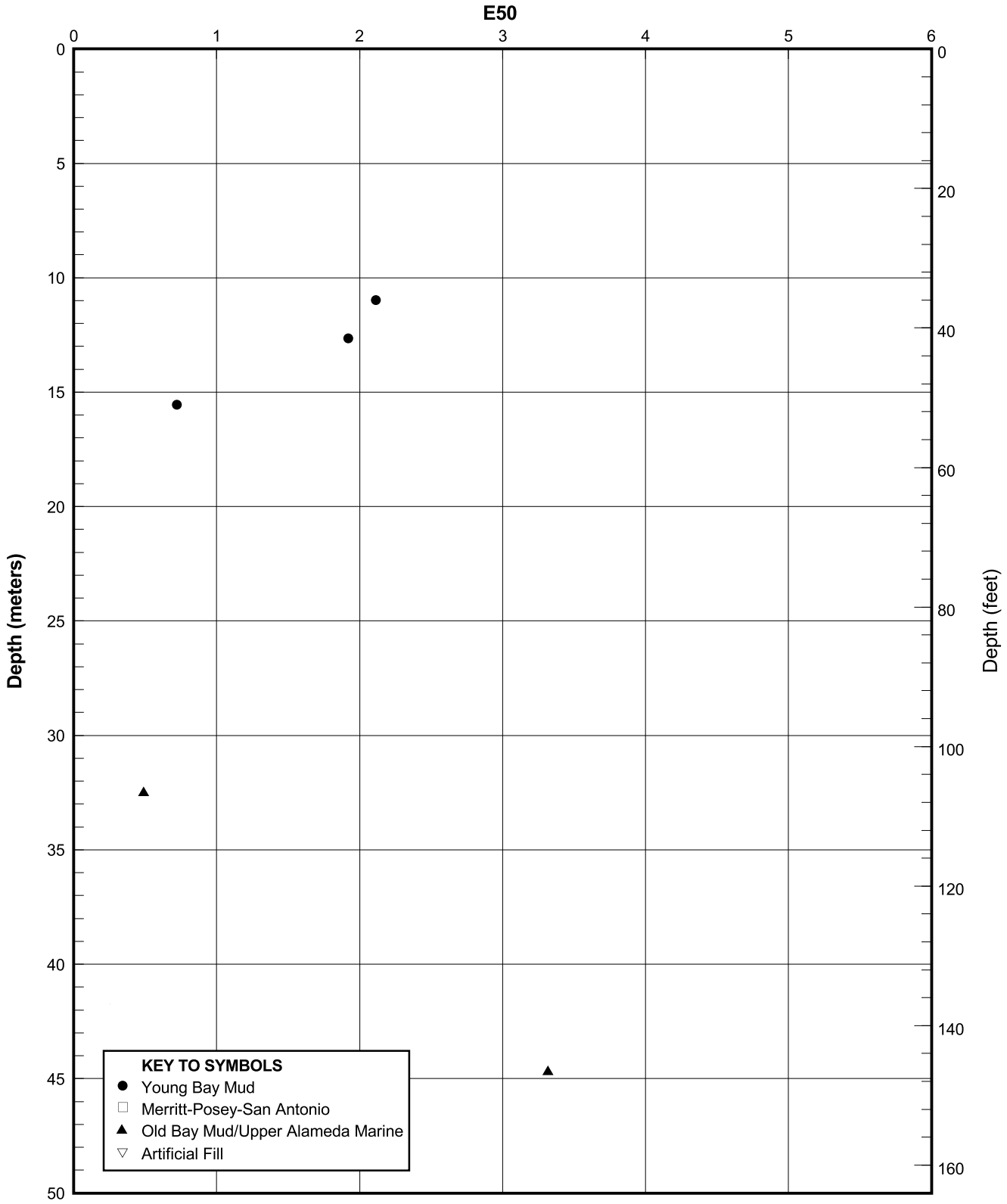
LIQUIDITY INDEX PROFILE
Boring 98-56
SFOBB East Span Seismic Safety Project

PLATE 98-56.13



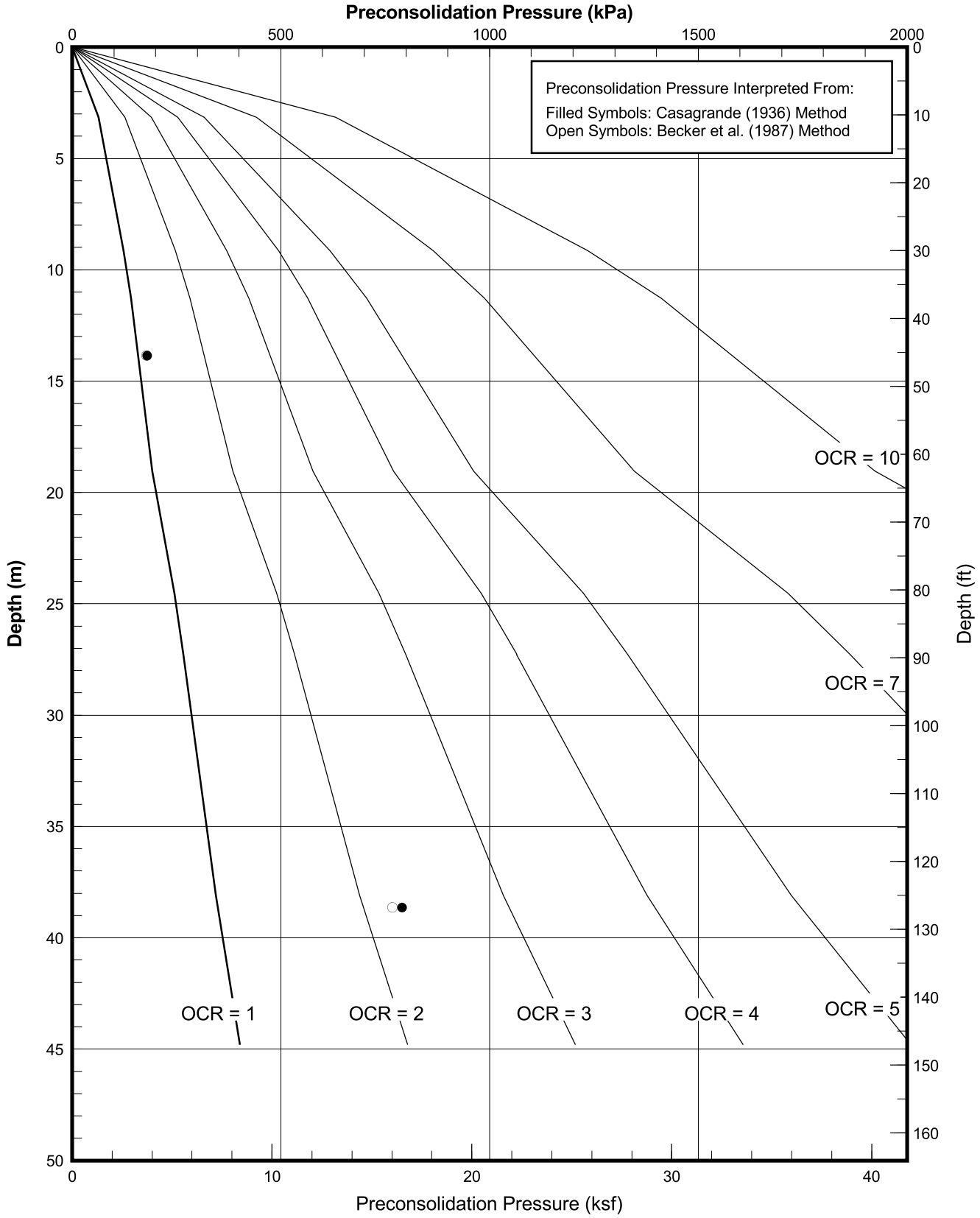
SENSITIVITY PROFILE
Boring 98-56
SFOBB East Span Seismic Safety Project

PLATE 98-56.14



E50 PROFILE
Boring 98-56
SFOBB East Span Seismic Safety Project

PLATE 98-56.15



PRECONSOLIDATION PRESSURE INTERPRETED FROM LABORATORY DATA

Boring 98-56

SFOBB East Span Seismic Safety Project

PLATE 98-56.16

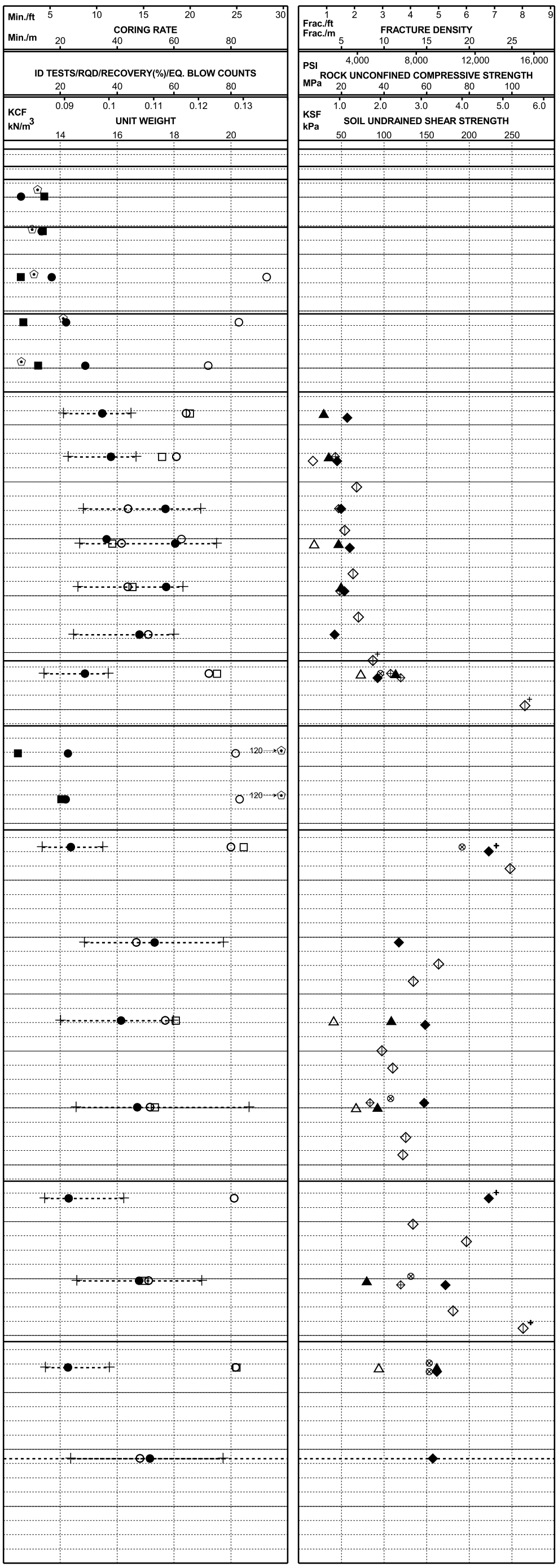
LAND BORING 98-57

PROJECT NO:	98-42-0058	**START DATE:**	10/17/98	**DRILLER:**	Pitcher Drilling Company
BORING:	98-57 (14m right of W. Sta. 88+07)	**COMPLETION DATE:**	10/20/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1839266.37 N648307.37
CA State Plane Zone 3, NAD83, Meters

GROUND ELEVATION: 3.5m (MSL)

Elevation, m.	Depth, m.	Blow Count	Material Description	Stratum No.
		BAG	PAVEMENT, 3 Asphalt Concrete over 8 of Aggregate Base (0.3m)	I
			Silty Fine SAND with gravel (SM), medium dense to dense, brown (0.9m)	II
2	2	12	Lean CLAY with sand (CL), stiff, brown (1.4m) -with concrete and brick fragments	III
		10	Silty Fine SAND with gravel (SM), medium dense, light brown -with a few clay pockets and a few shell fragments, at 1.5m (3.0m)	IV
0	4	17	Silty Fine GRAVEL with sand (GM), loose to medium dense, brown (3.5m) -gravel is angular, fractured sandstone -coarse gravel with silt and clay pockets, at 4.6m (6.1m)	V
-2	6	21	Fine SAND with silt (SP-SM), medium dense, greenish gray -with shell fragments	VI
-4	8	10	-silty fine sand below 7.6m (8.8m)	
-6	10	PUSH	Fat CLAY (CH), firm to stiff, olive gray -with shells and shell fragments, to 12.8m -lean clay to 11.3m -with silt pockets at 9.1m	VII
		PUSH	-with a few silt pockets at 11.0m	
-8	12	SAVE		
-10	14	PUSH	-silty fine sand with clay pockets, 13.9m to 14.0m -with organic pockets and an H2S odor, at 14.2m	
-12	16	PUSH	-with gas blisters at 15.5m	
		SAVE	-with sand partings and a few shell fragments, at 17.1m	
-14	18		(18.3m)	
-16	20	PUSH	Fat CLAY (CH), very stiff, greenish gray -with sand partings, sand pockets and gas blisters, at 18.6m (20.6m)	VIII
-18	22	50/15cm	Fine SAND with silt (SP-SM), very dense, gray to greenish gray -mottled with brownish yellow at 21.3m	IX
-20	24	50/15cm	-silty fine sand below 22.9m -with a clay seam and an H2S odor, at 22.9m (24.2m)	
-22	26	PUSH	Fat CLAY (CH), very stiff, greenish gray -very stiff to hard lean clay, to 27.1m -with silt pockets, silt seams, sand pockets, and sand seams, at 24.7m	X
-24	28	SAVE	-with shell fragments at 27.7m	
-26	30	PUSH	-with silt and sand pockets, at 30.8m	
-28	32			
-30	34	PUSH	-with brown oxidation staining, sand pockets, and slickensides, at 33.8m	
-32	36		(36.6m)	
-34	38	SAVE	Fat CLAY (CH), very stiff, greenish gray -very stiff to hard lean clay, to 39.0m -with sand pockets at 36.9m	XI
-36	40	PUSH	-with brown streaks, and gas blisters, at 39.9m	
-38	42		(42.2m)	
-40	44	PUSH	Fat CLAY (CH), very stiff, olive gray -lean clay to 44.2m -greenish gray and with silt seams and layers, at 43.0m	XII
-42	46	SAVE	-with silt pockets at 46.0m	
-44	48		TOTAL DEPTH: 46.3m BACKFILLED WITH: Cement Grout	
-46				



LOG OF BORING AND TEST RESULTS

BORING 98-57

SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

Report Date: 03/10/99

PLATE 98-57.1

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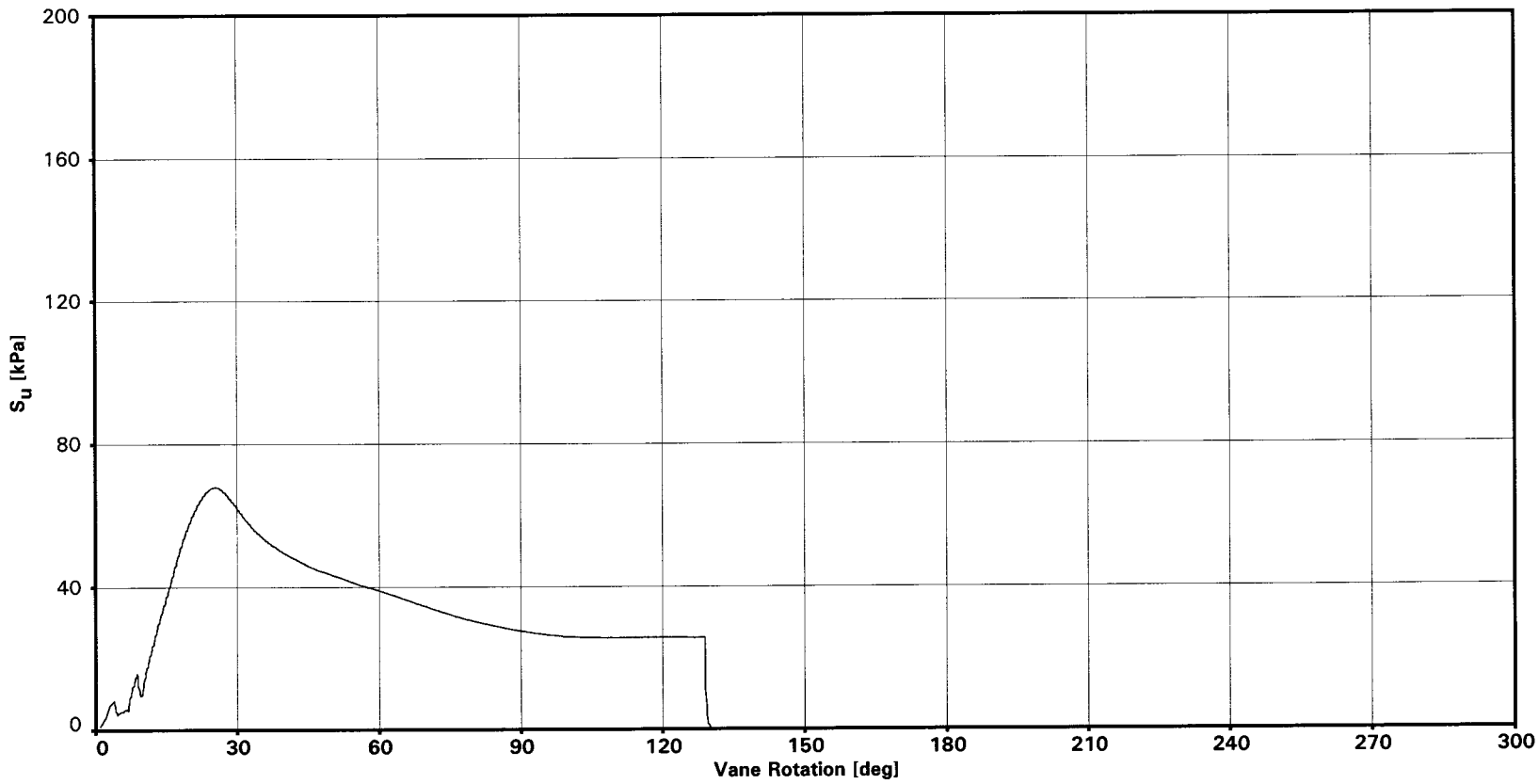
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



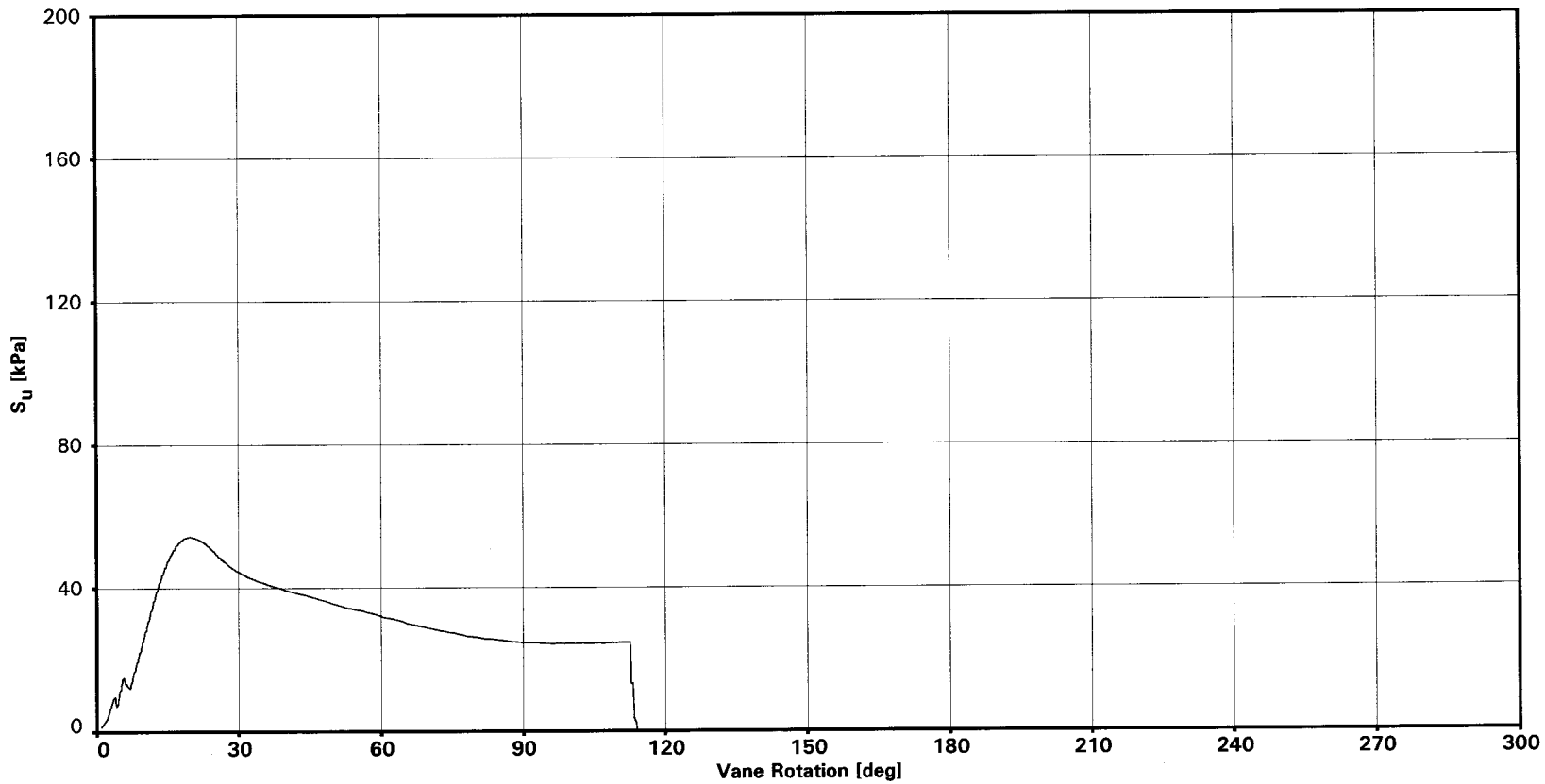
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 12.2m
Boring 98-57
SFOBB East Span Seismic Safety Project

PLATE 98-57.2a

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 13.7m
Boring 98-57
SFOBB East Span Seismic Safety Project

Earth Mechanics

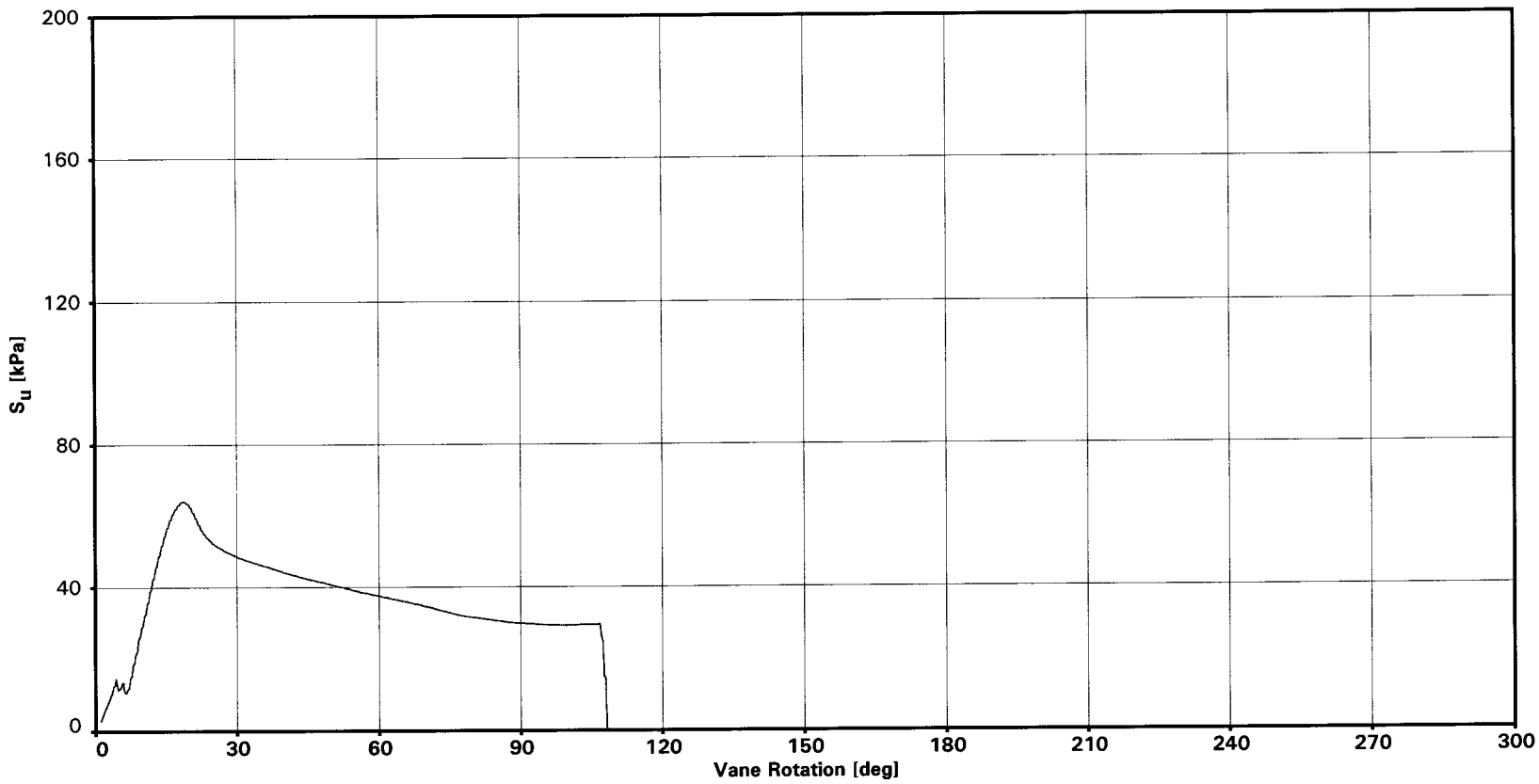
FUGRO

PLATE 98-57.2b

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 15.2m
Boring 98-57
SFOBB East Span Seismic Safety Project

Earth Mechanics

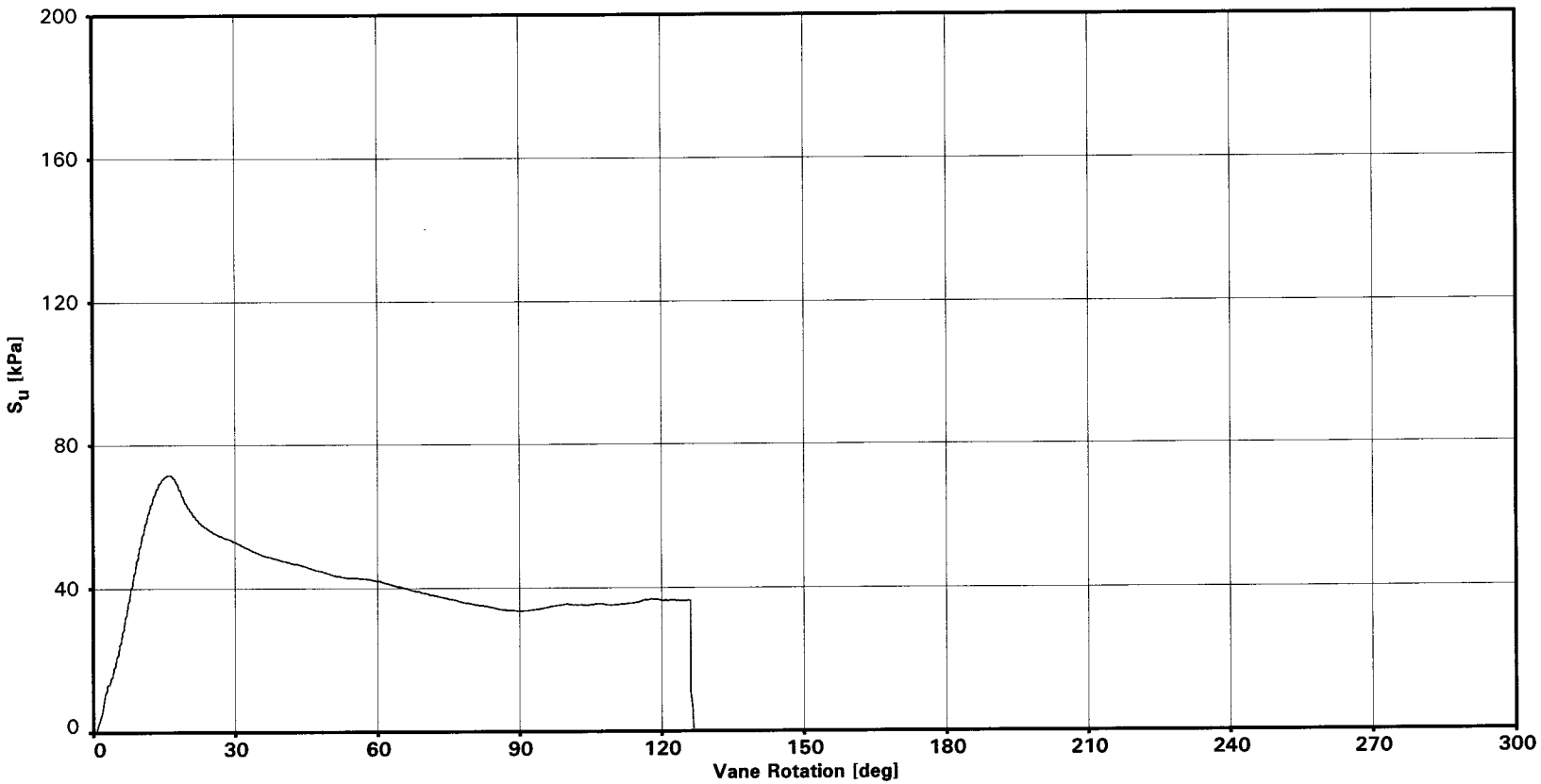
FUGRO

PLATE 98-57.2c

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 16.8m
Boring 98-57
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-57.2d

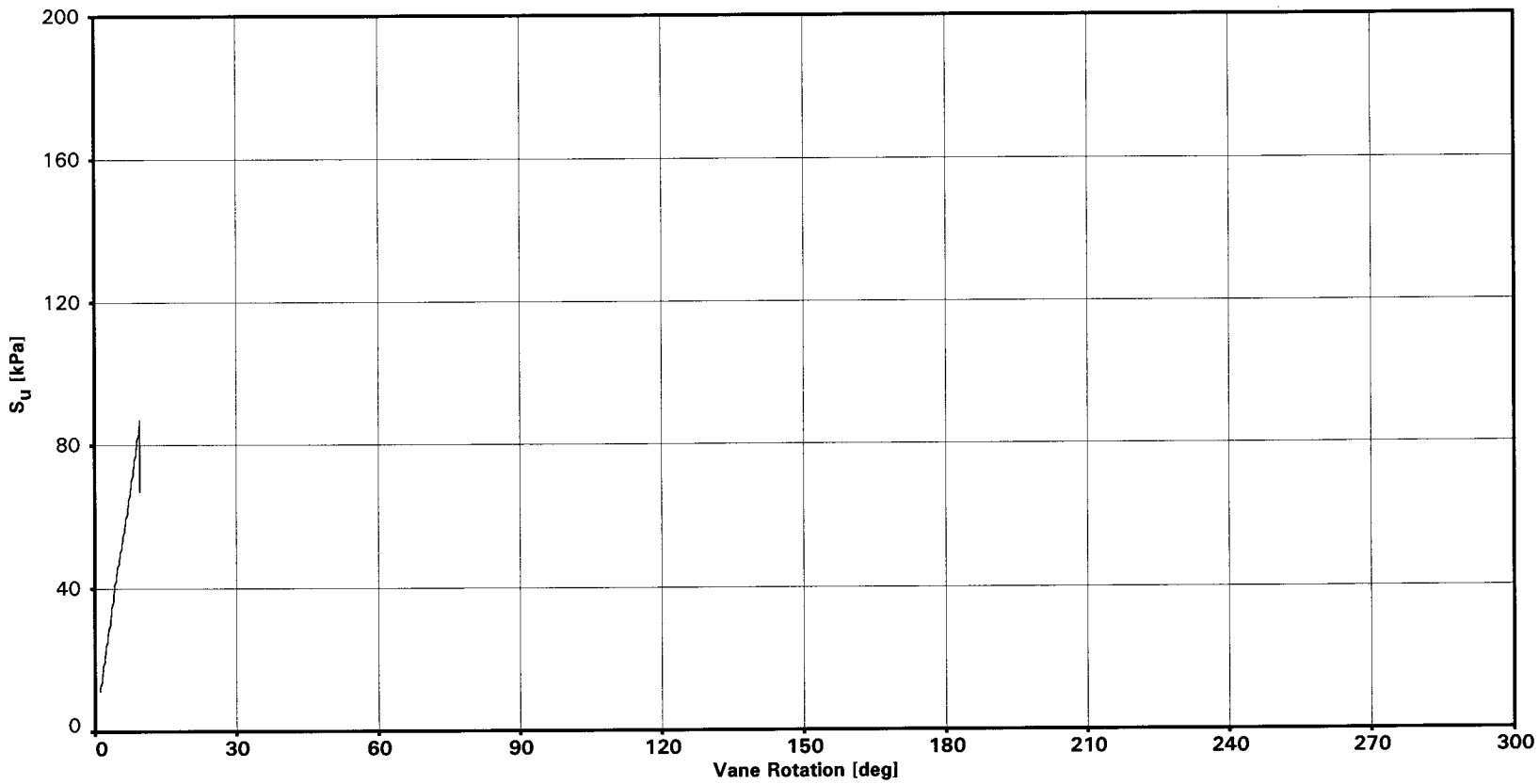
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 18.3m
Boring 98-57
SFOBB East Span Seismic Safety Project

PLATE 98-57.2e

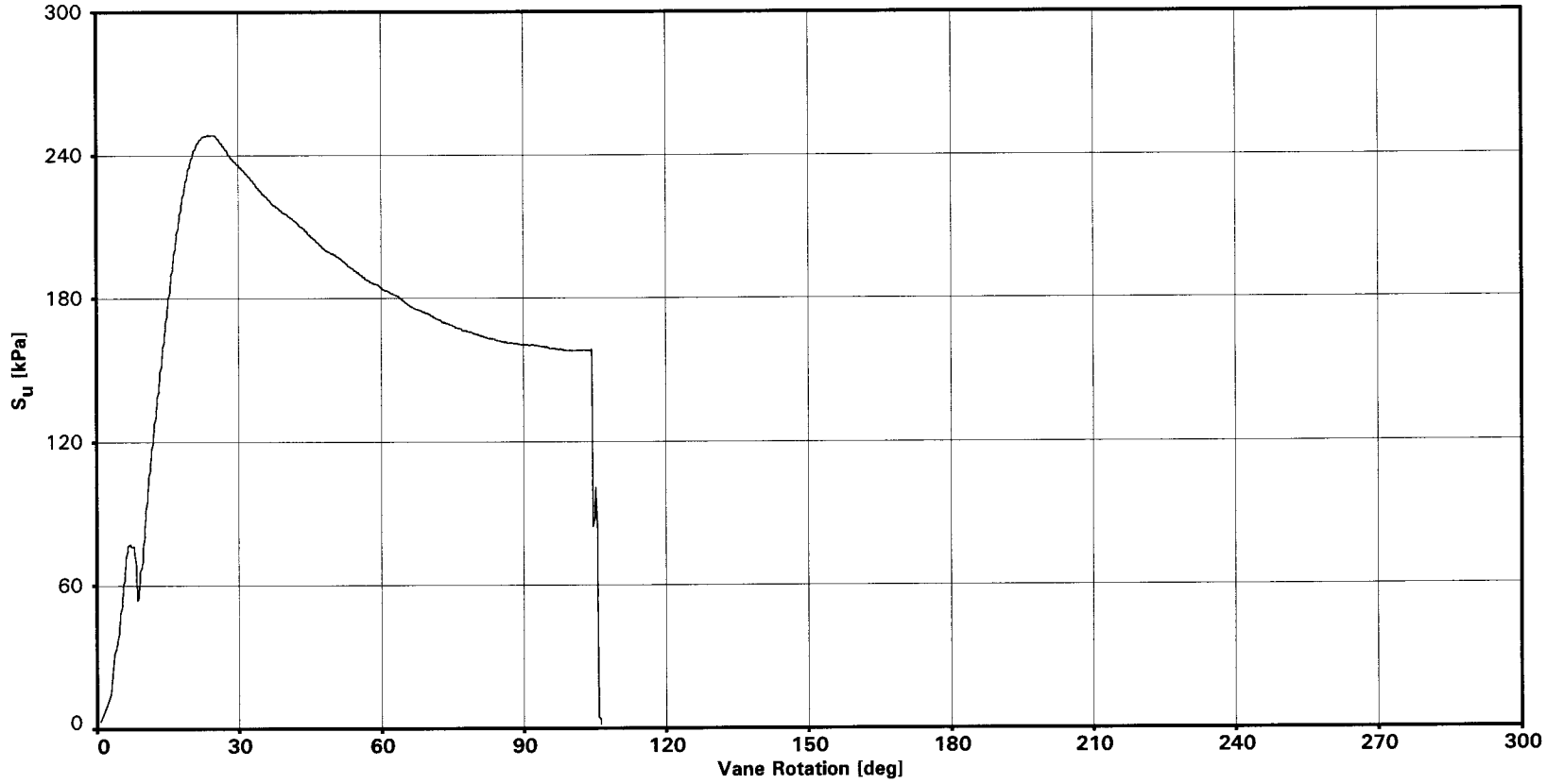
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 25.6m
Boring 98-57
SFOBB East Span Seismic Safety Project

PLATE 98-57.2f

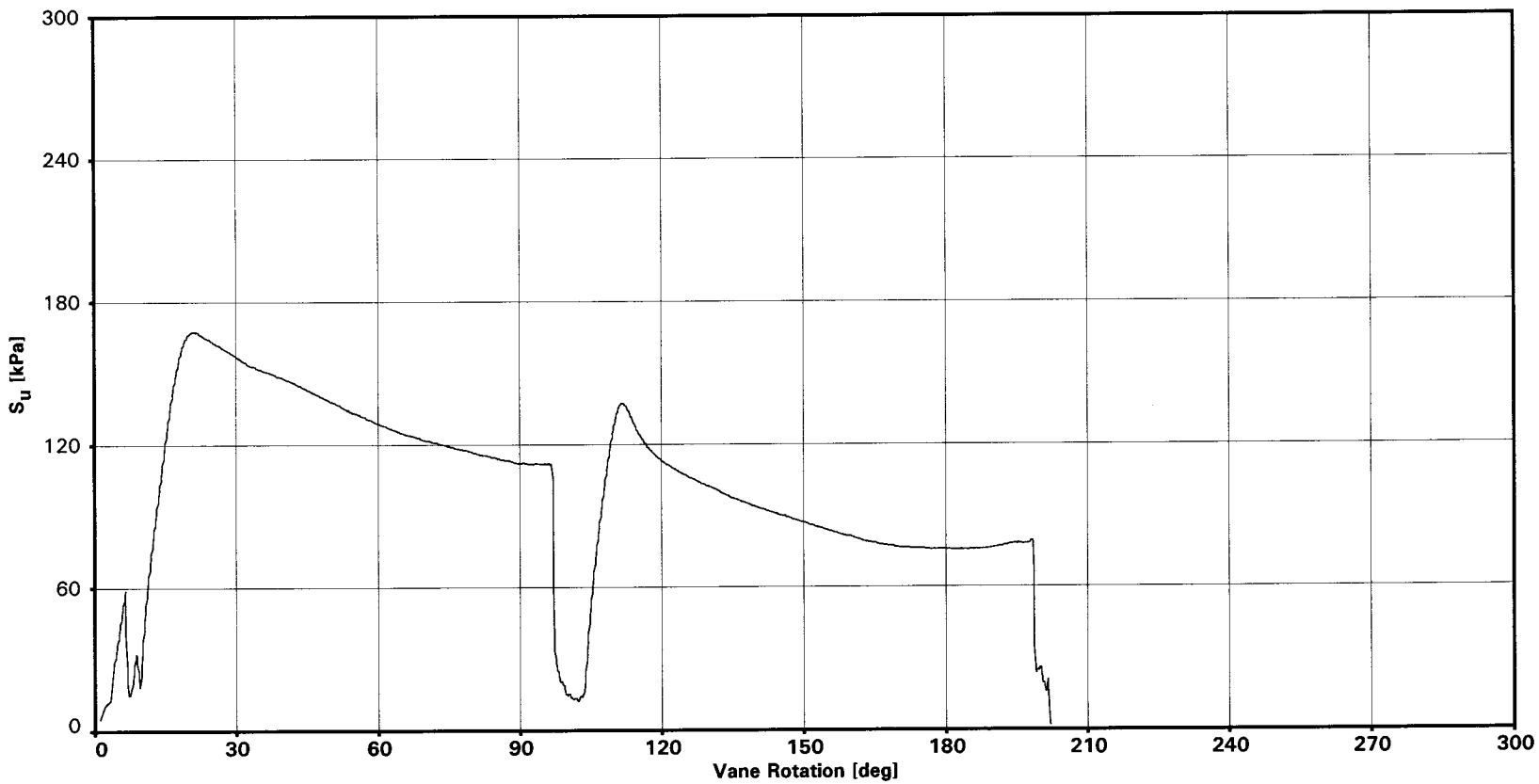
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



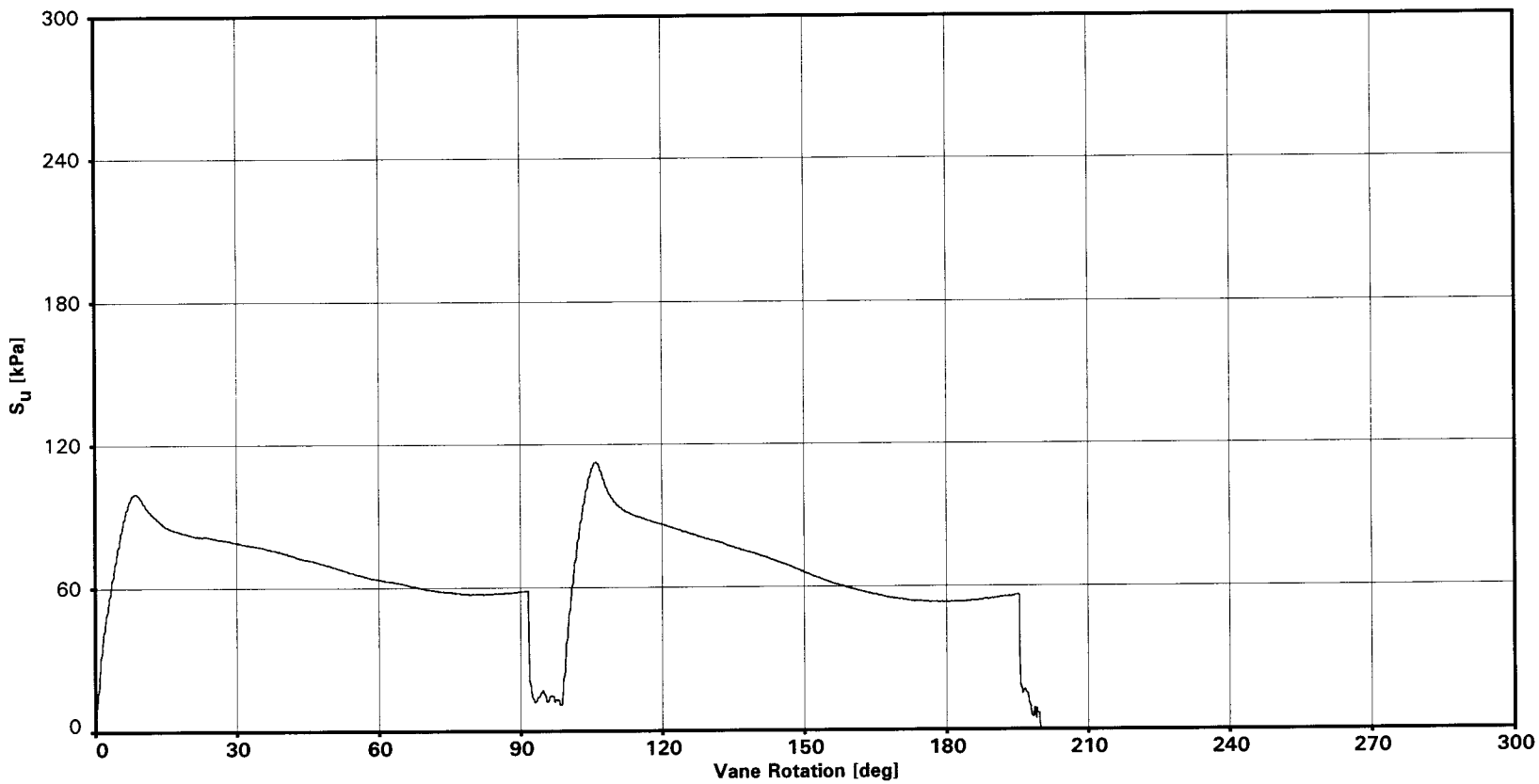
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 29.0m and 29.6m
Boring 98-57
SFOBB East Span Seismic Safety Project

PLATE 98-57.2g

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 32.0m and 32.6m
Boring 98-57
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-57.2h

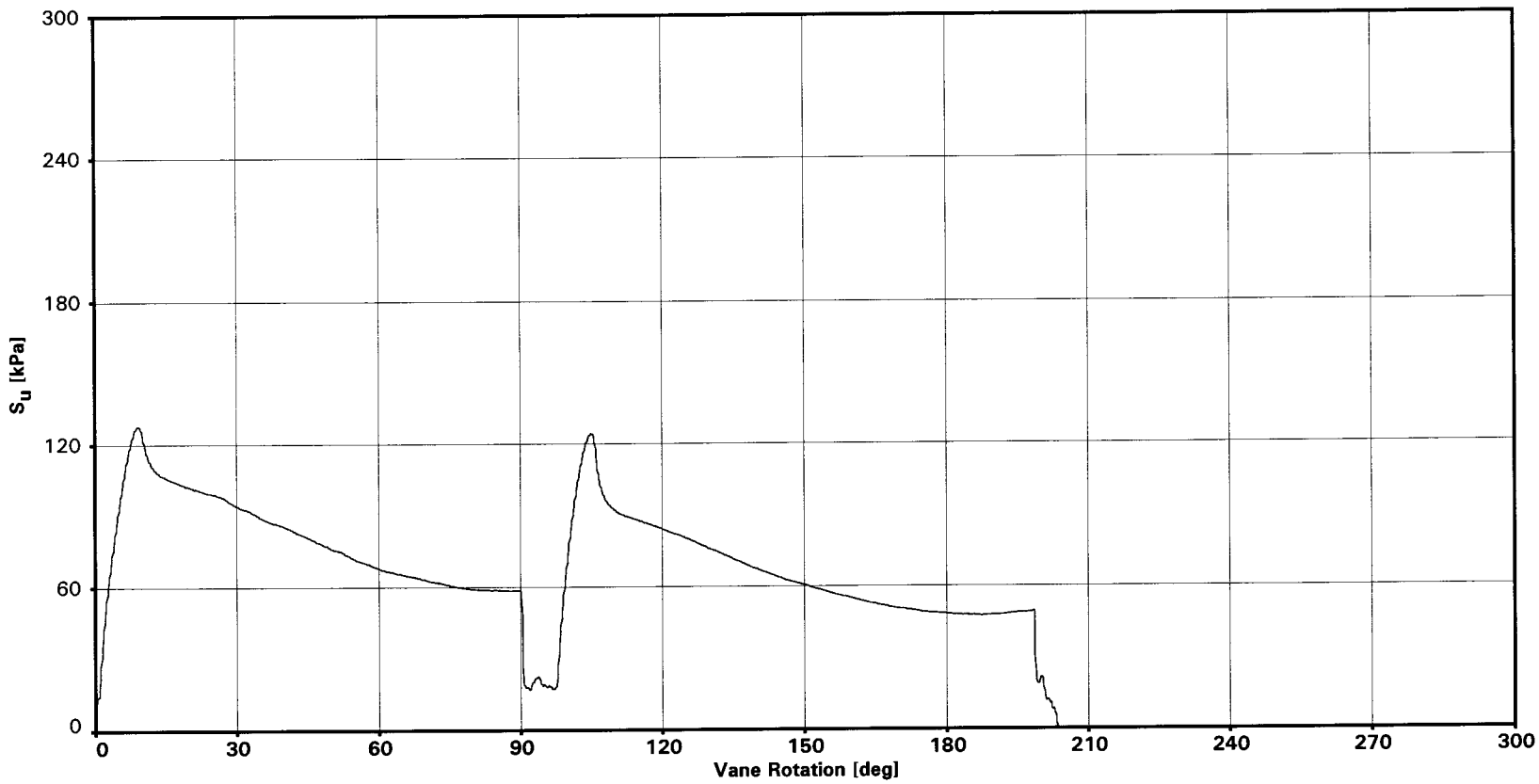
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



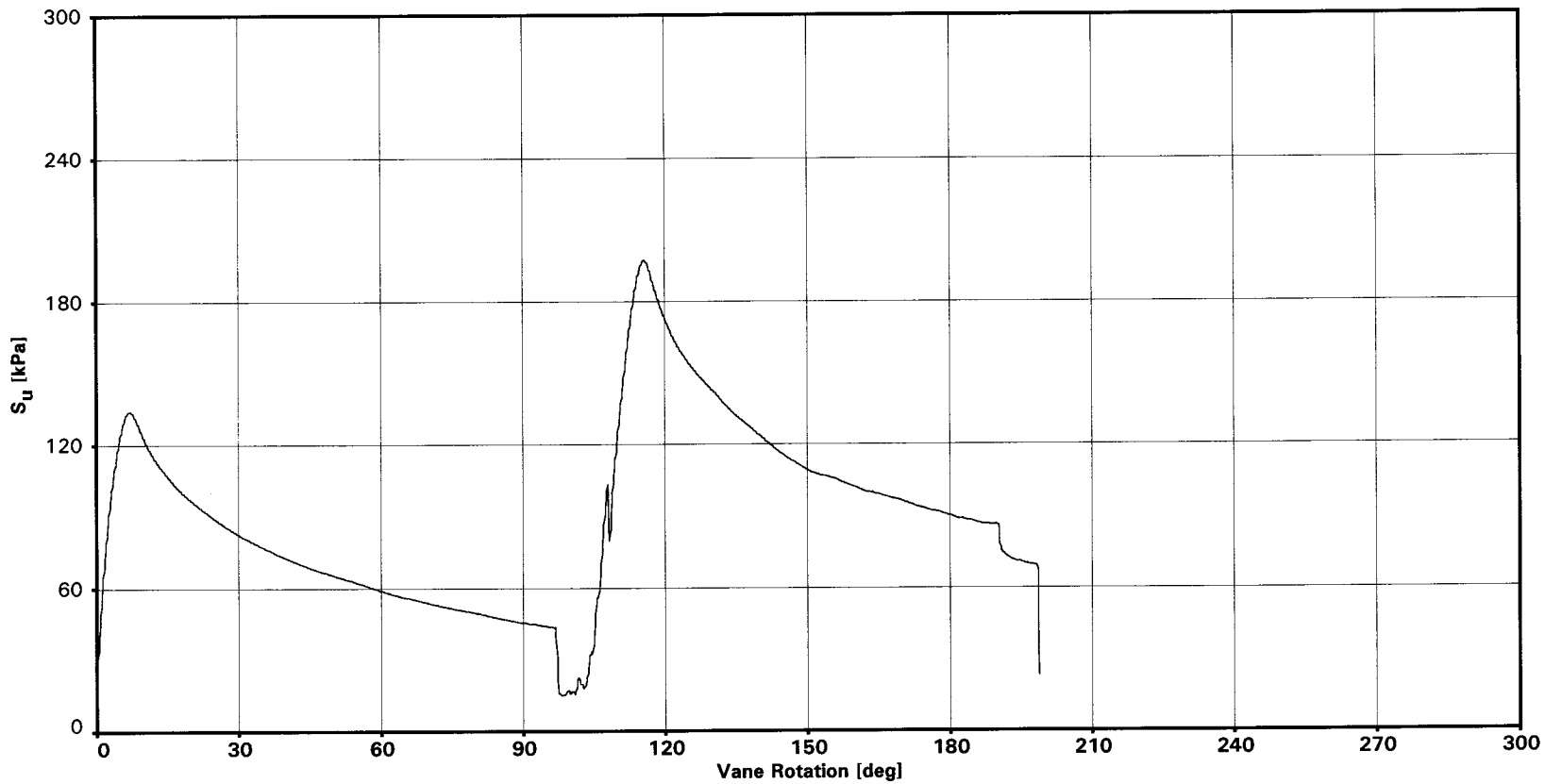
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 35.1m and 35.7m
Boring 98-57
SFOBB East Span Seismic Safety Project

PLATE 98-57.2i

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 38.1m and 38.7m
Boring 98-57
SFOBB East Span Seismic Safety Project

Earth Mechanics

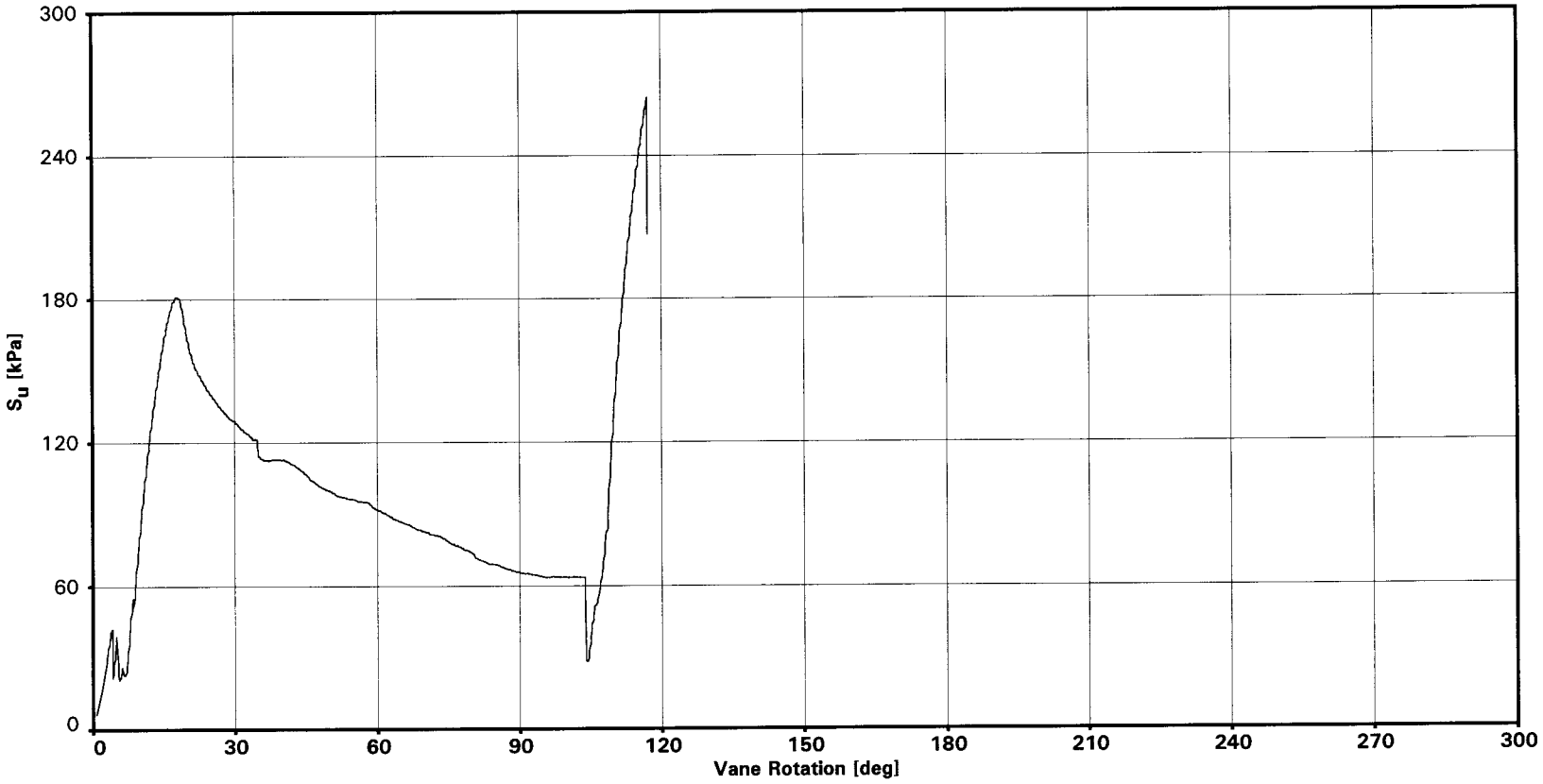
FUGRO

PLATE 98-57.2j

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 41.1m and 41.8m
Boring 98-57
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-57.2k

SFOBB Task Order No. 5
Project No. 98-42-0058

98-57		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
1.1	300																										
2.0	1	6					14																				
3.2	2	13					14																				
4.8	3	17					6																				
6.4	4	22					7																				
7.9	5	29					12																				2.69
9.6	7	35	45	21	0.57	18.5									29.4		1.3										
9.8	8										56.8																
11.1	10	38	47	23	0.62	17.6		43.1							35.3		1.1										2.73
11.3	11										45.2	16.7															
12.2	400													68.0													
13.0	13	57	69	28	0.70			46.9			49.8																
13.7	401													54.1													
14.0	14	36																									2.69
14.2	15	60	75	27	0.69	15.8									46.9	17.9	2.4										

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-57
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-57.3a

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SFOBB Task Order No. 5
Project No. 98-42-0058

98-57		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
14.3	16										59.9																
15.2	402													63.7													
15.7	18	57	63	26	0.83	16.5									49.8		1.8										
15.8	19							47.9			53.7																
16.8	403													69.9													
17.3	20	52	57	22	0.87																					C, K	
17.4	21	48	60	25	0.65						42.1																
18.3	404													87.1													
18.7	23	29	37	14	0.63	19.5		107.7	95.8						113.8	72.8	2.2										
18.9	24							119.7			92.6																
19.8	405													263.3+													
21.5	25	23					5																				
23.2	26	22					20																				2.70
24.8	28	24	35	14	0.46	20.4			191.5																		
25.0	29										222.8+																

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-57
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-57.3b

c:\snfco-oak\current\odb\98-57sumb.odb

SFOBB Task Order No. 5
Project No. 98-42-0058

98-57		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
25.6	406													248.0+													
28.1	30	49	66	25	0.59																					C	2.74
28.2	31	53	77	29	0.50						117.6																
29.0	407													164.2													
29.6	408													134.5													
30.9	33	41	60	20	0.53	18.1									108.7	40.8	2.0										
31.1	34										148.5																
32.0	409													97.7													
32.6	410													110.1													
33.7	35								107.7																		
33.8	36							83.8			147.3																
34.0	37	47	87	26	0.35	17.3									92.5	67.2	0.4										
35.1	411													125.4													
35.7	412													122.1													
37.1	38	20	44	15	0.16																					C	

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-57
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-57.3c

SFOBB Task Order No. 5
Project No. 98-42-0058

98-57		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
37.2	39	23	42	15	0.30						222.8+																
38.1	413													134.1													
38.7	414													196.8													
39.9	40								131.7																		
40.1	41	48	70	26	0.50	16.9									79.9		0.5										
40.2	42							119.7			172.0																
41.1	415													181.0													
41.8	416													263.3+													
43.0	43								153.2																		
43.1	44	23	37	15	0.35	20.2									162.0	93.7	1.1										
43.3	45								153.2		162.1																
46.2	46	50	82	24	0.44																					C	
46.3	47	51	77	24	0.52						157.2																

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-57
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-57.3d

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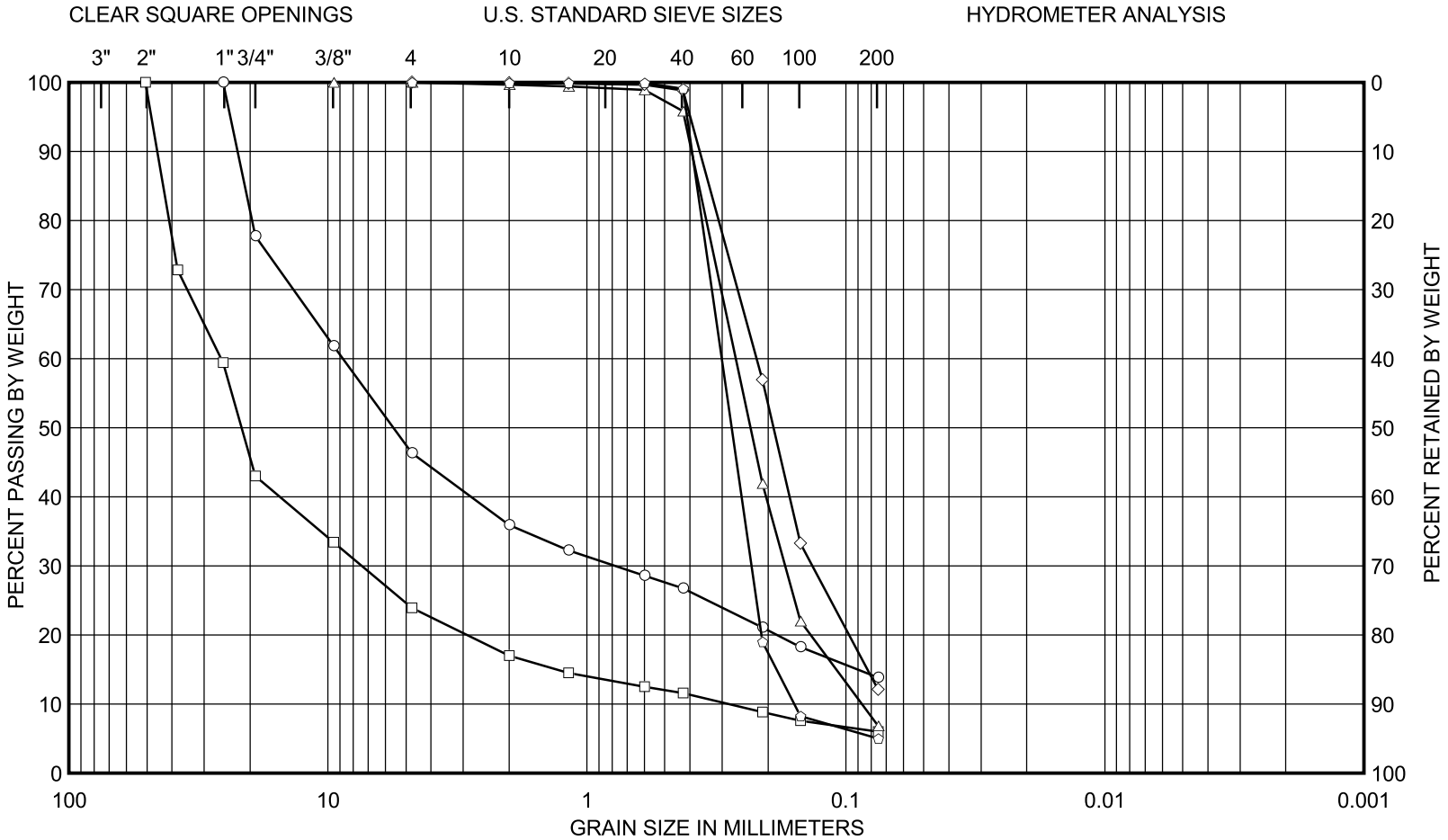

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
2	3.2	○——○	SILTY FINE GRAVEL (GM) with coarse gravel and fine to coarse sand			5.6
3	4.8	□——□	COARSE GRAVEL (GP-GM) with silt, fine gravel and fine to coarse sand	7.5	91.1	21.5
4	6.4	△——△	FINE SAND (SP-SM) with silt	1.3	3.1	0.23
5	7.9	◇——◇	FINE SAND (SP-SM) with silt			0.19
25	21.5	⬠——⬠	FINE SAND (SP-SM) with silt	1.1	1.9	0.28

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-57

SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-57.4

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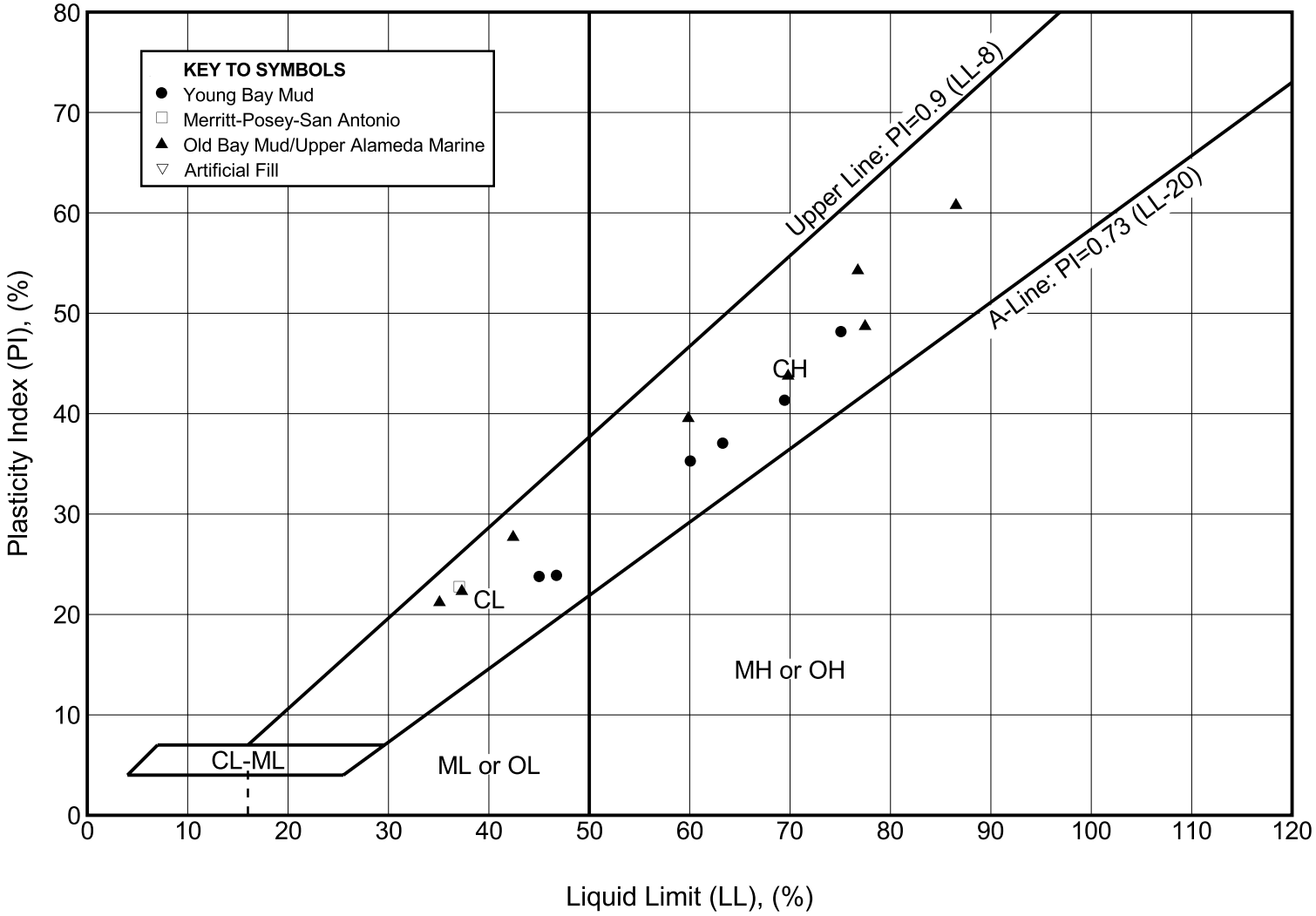

PLASTICITY CHART
Boring 98-57
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-57.5

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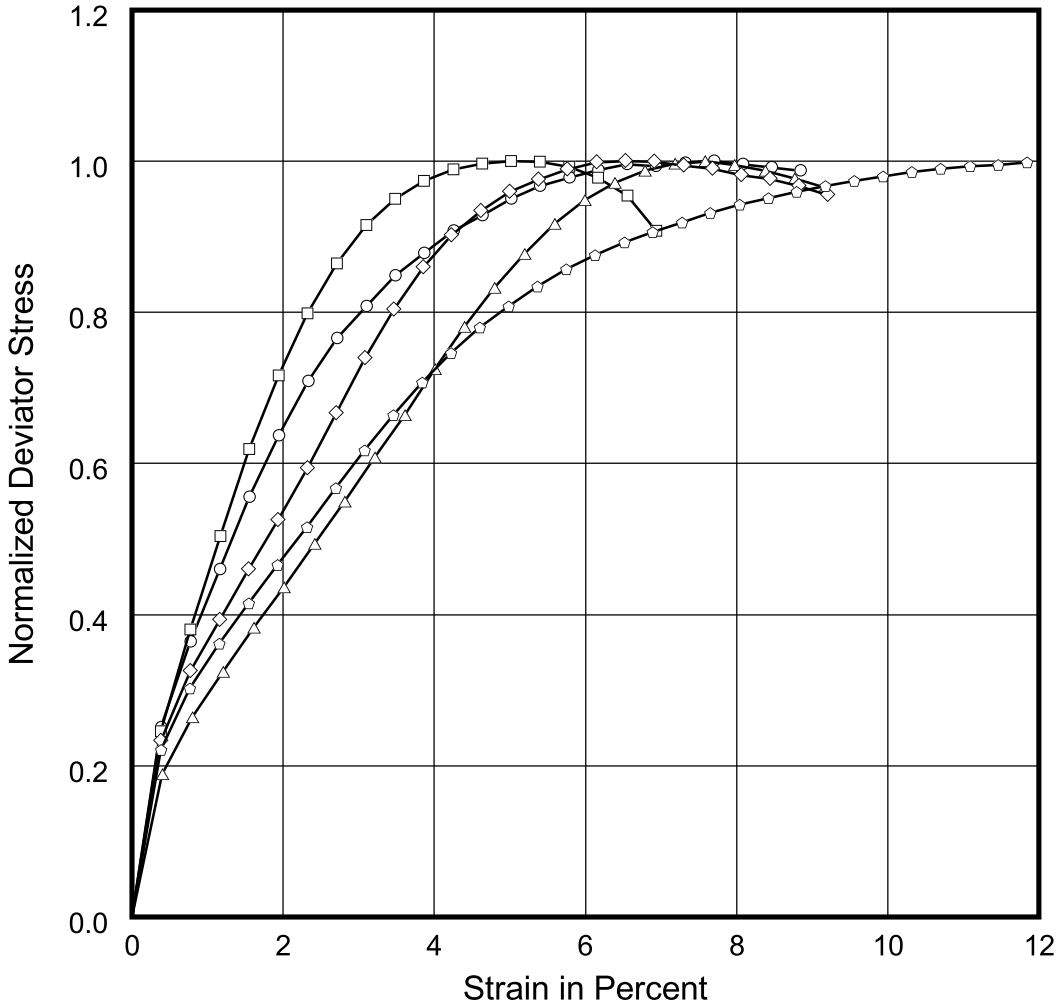
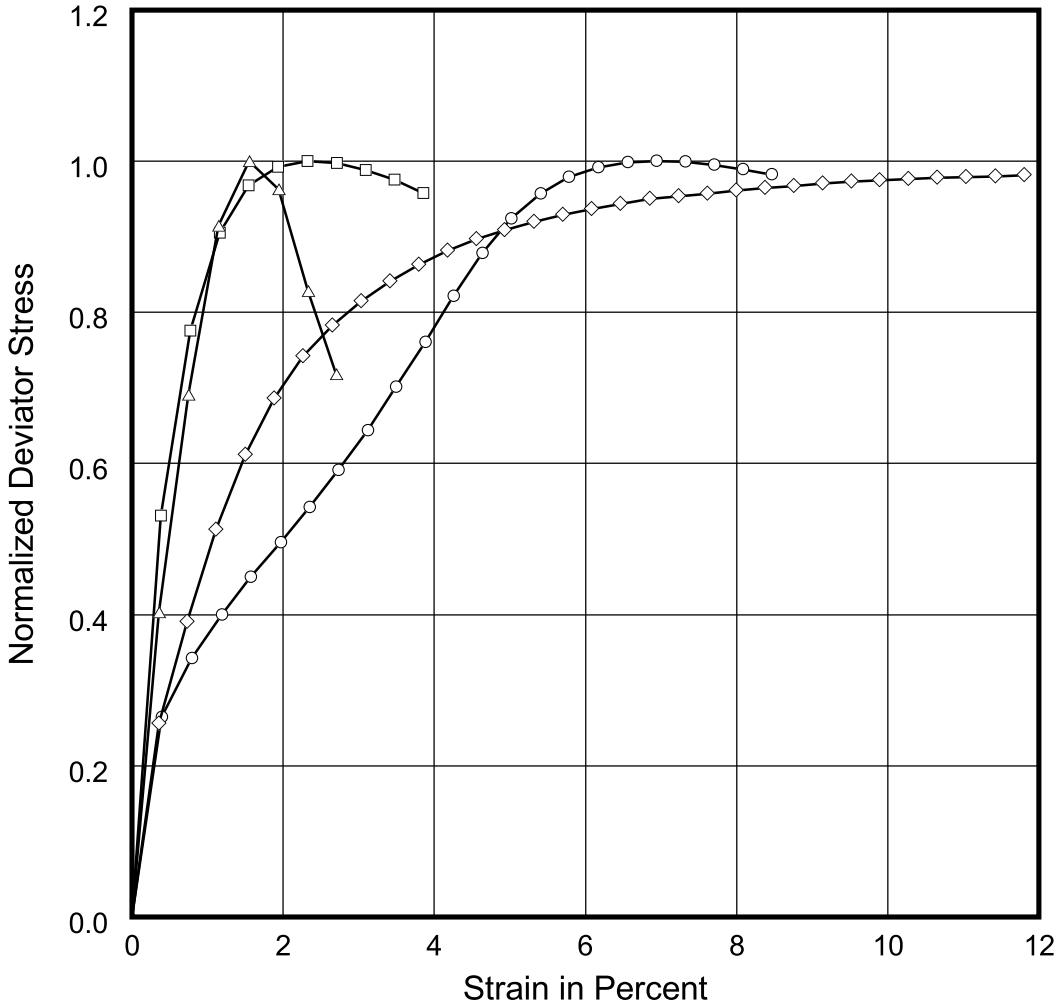


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	7	9.6	UU	172	59	1.3
	10	11.1	UU	207	71	1.1
	15	14.2	UU	276	94	2.4
	18	15.7	UU	310	100	1.8
	23	18.7	UU	345	228	2.2

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-57
SFOBB East Span Seismic Safety Project

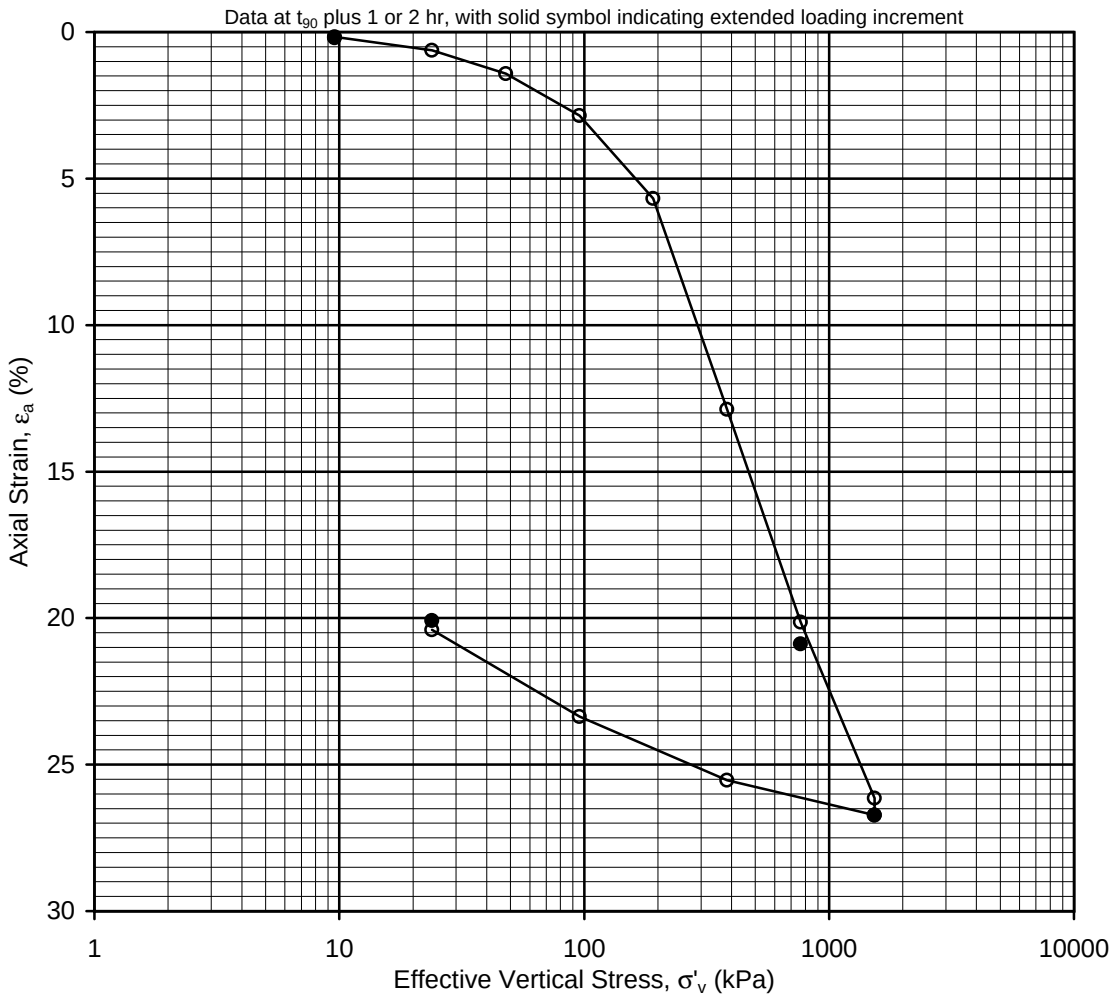


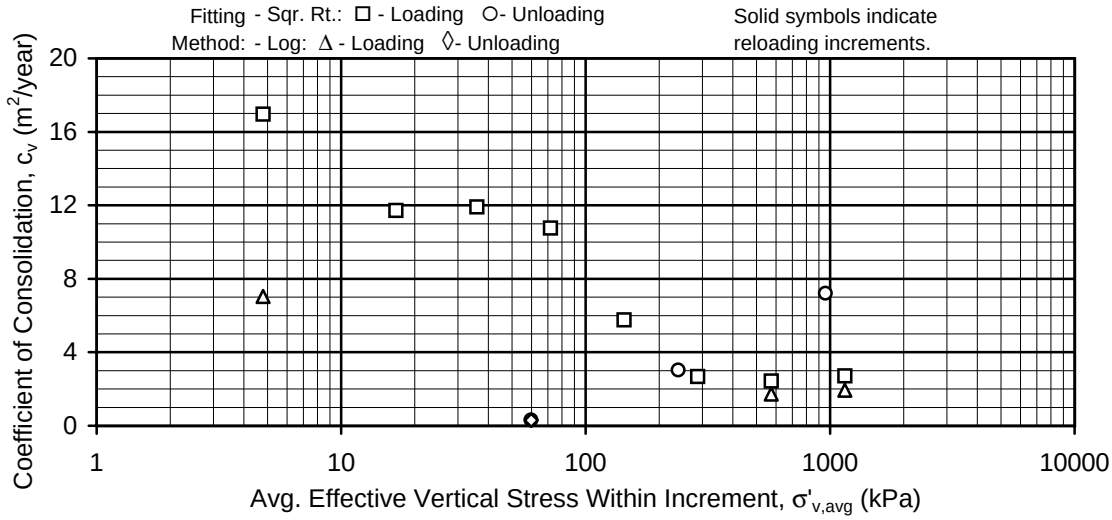
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	33	30.9	UU	931	218	2.0
□—□	37	34.0	UU	965	185	0.4
△—△	41	40.1	UU	1103	160	0.5
◇—◇	44	43.1	UU	1172	324	1.1

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

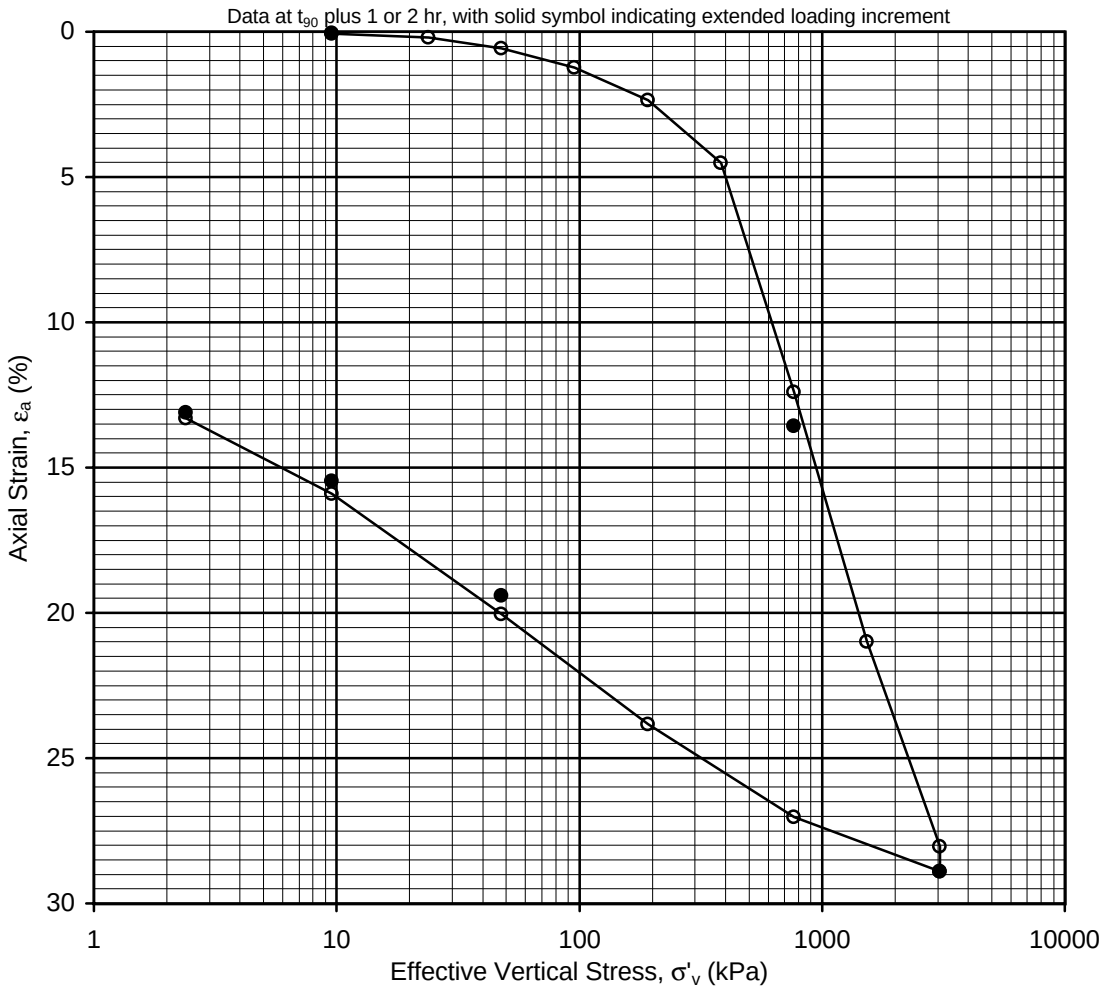
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-57
SFOBB East Span Seismic Safety Project

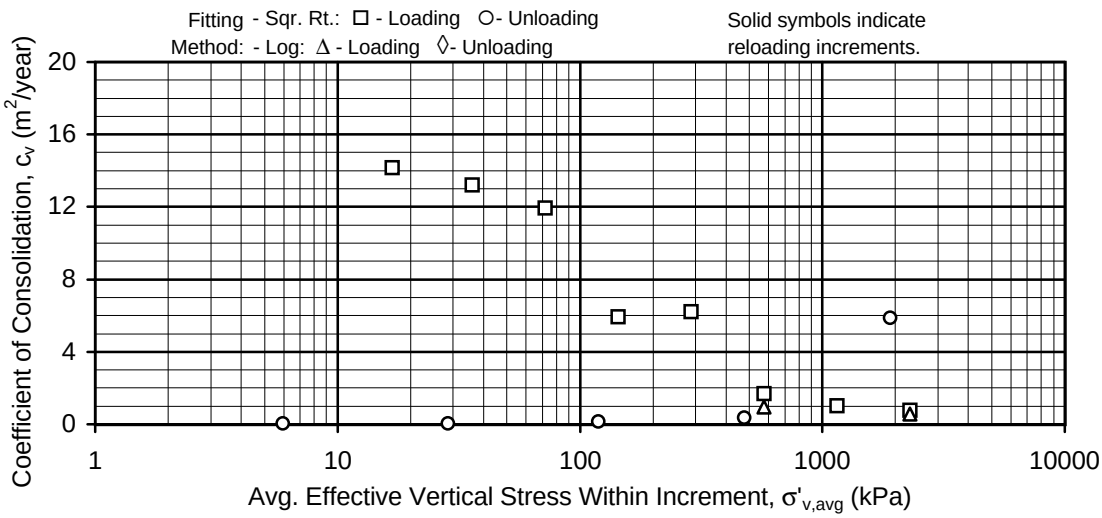




INCREMENTAL CONSOLIDATION TEST RESULTS

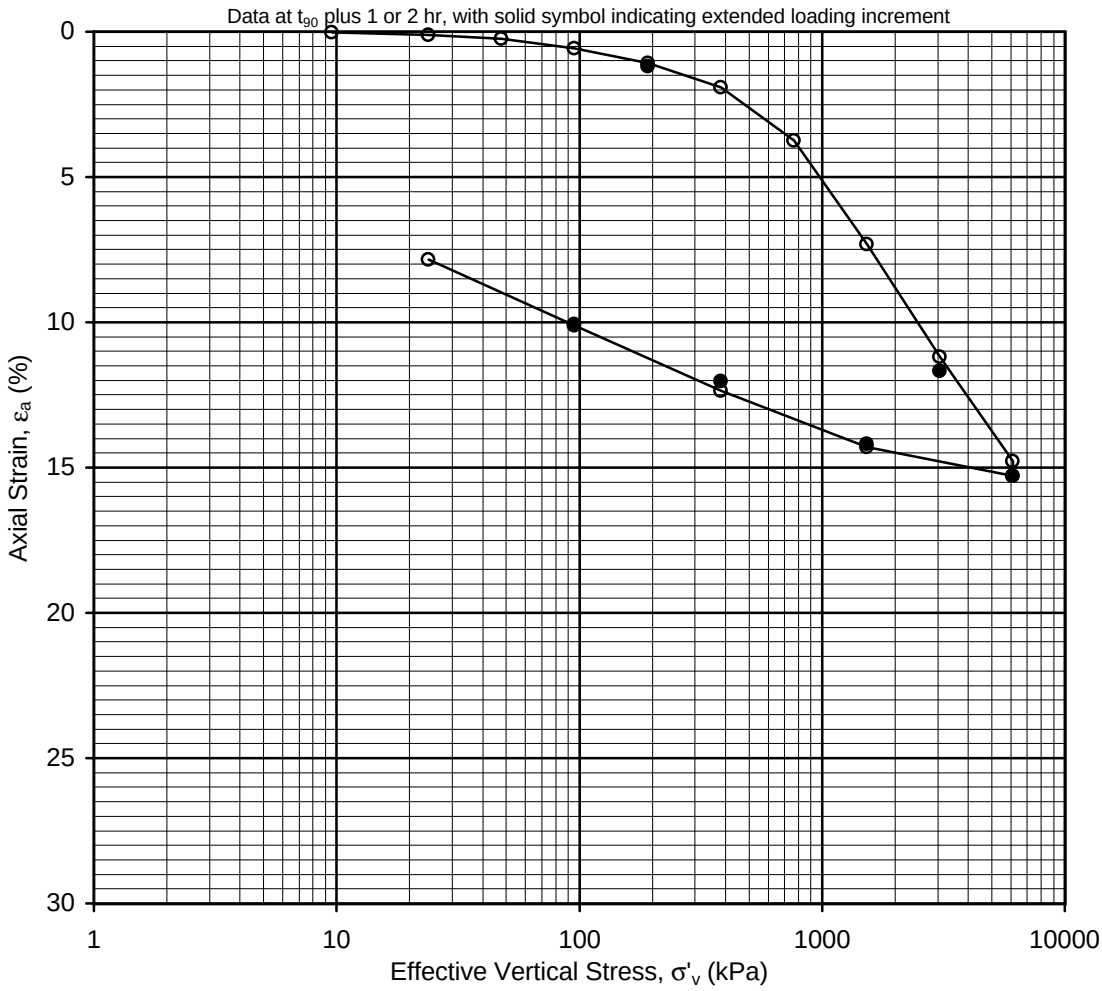
Sample No. 20 - Depth: 17.2m
Boring 98-57
SFOBB East Span Seismic Safety Project

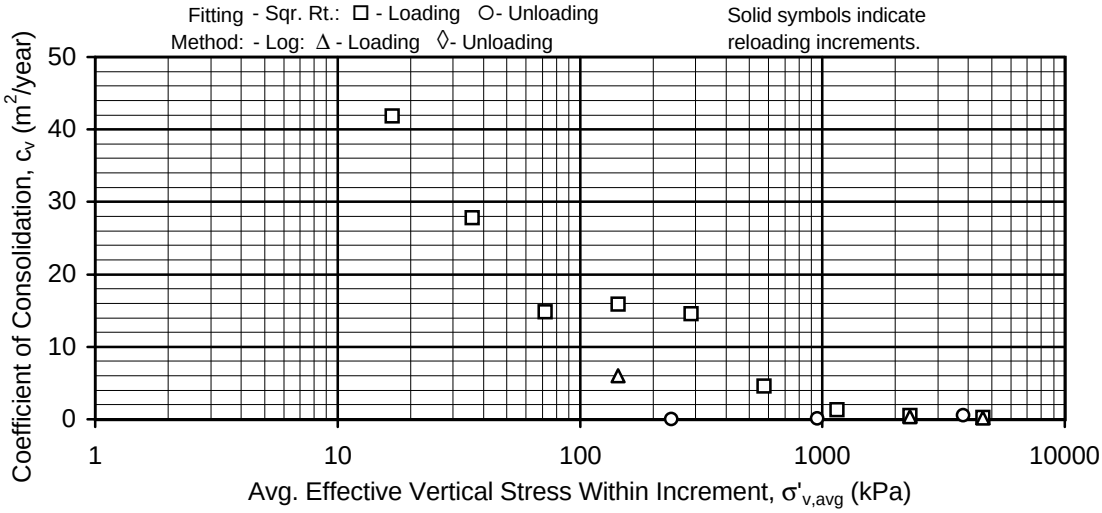




INCREMENTAL CONSOLIDATION TEST RESULTS

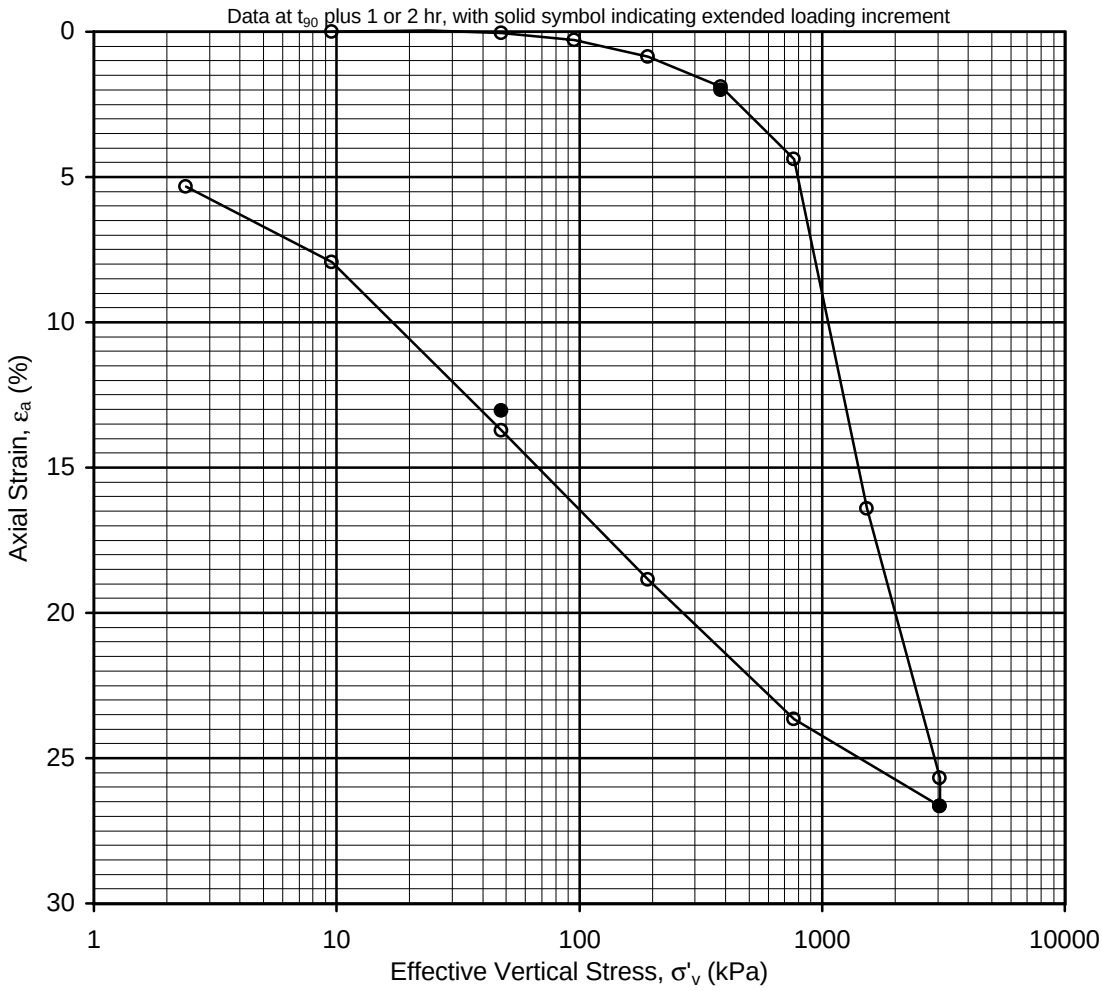
Sample No. 30 - Depth: 28.1m
Boring 98-57
SFOBB East Span Seismic Safety Project

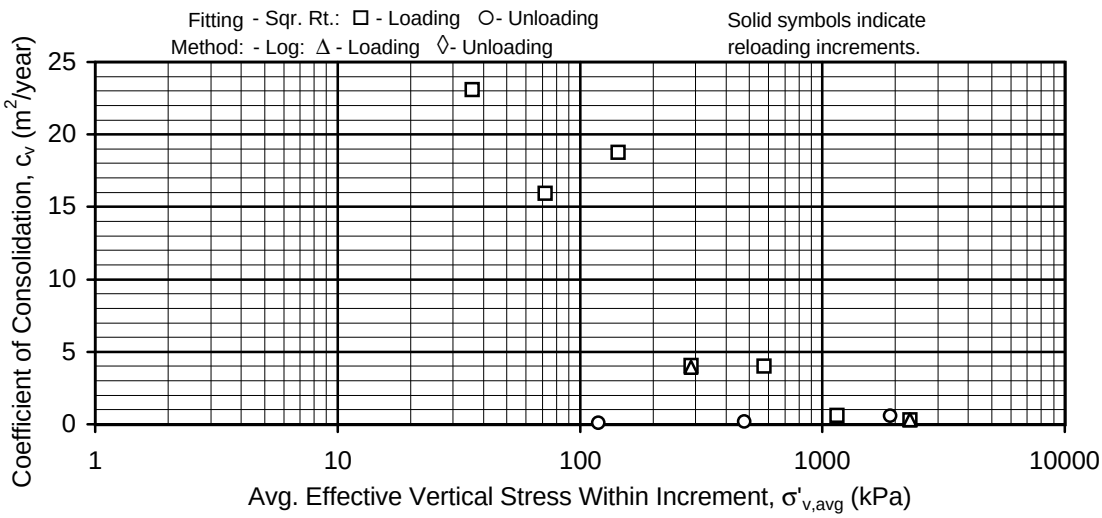




INCREMENTAL CONSOLIDATION TEST RESULTS

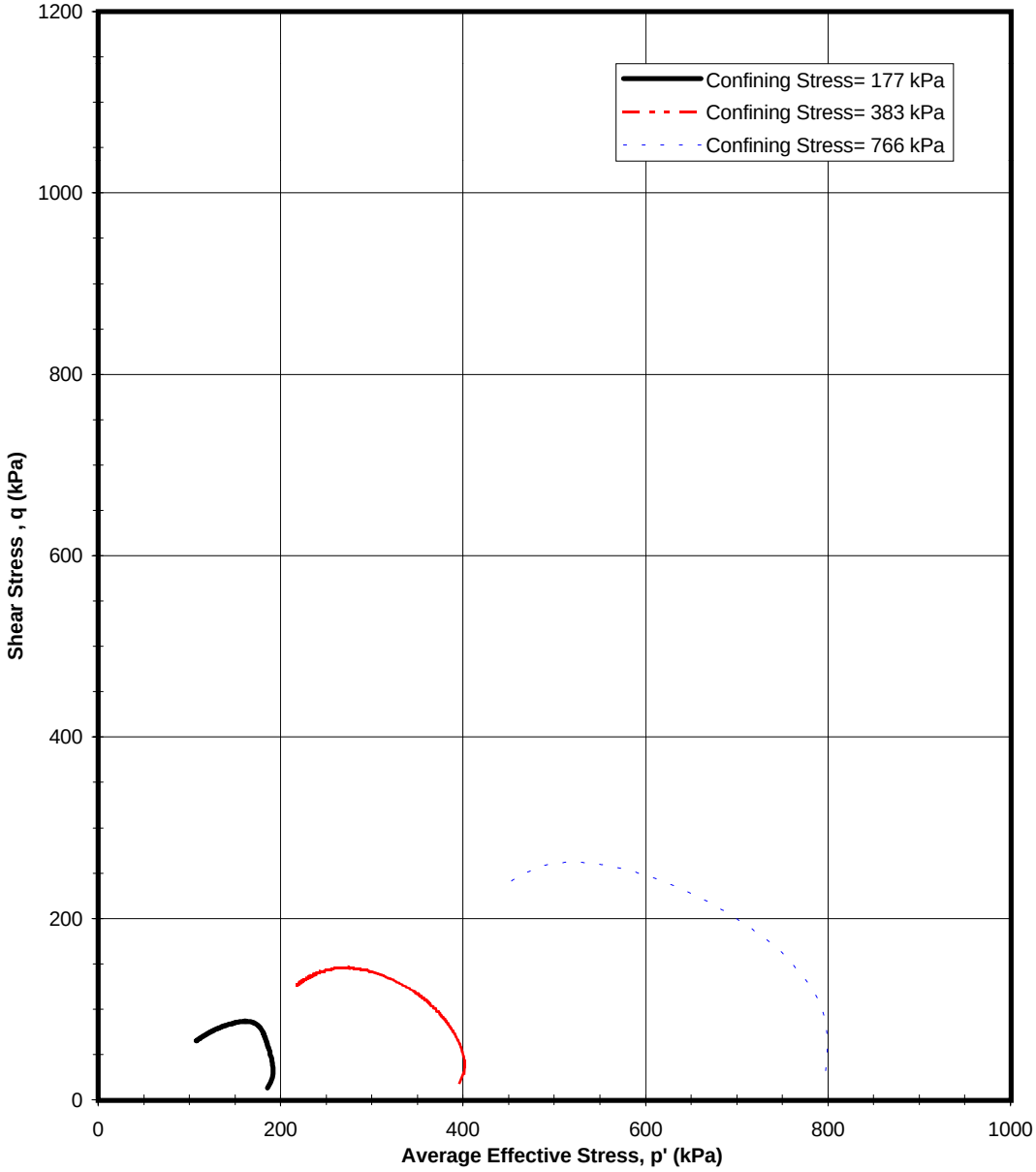
Sample No. 38 - Depth: 37.0m
Boring 98-57
SFOBB East Span Seismic Safety Project





INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 46 - Depth: 46.0m
Boring 98-57
SFOBB East Span Seismic Safety Project



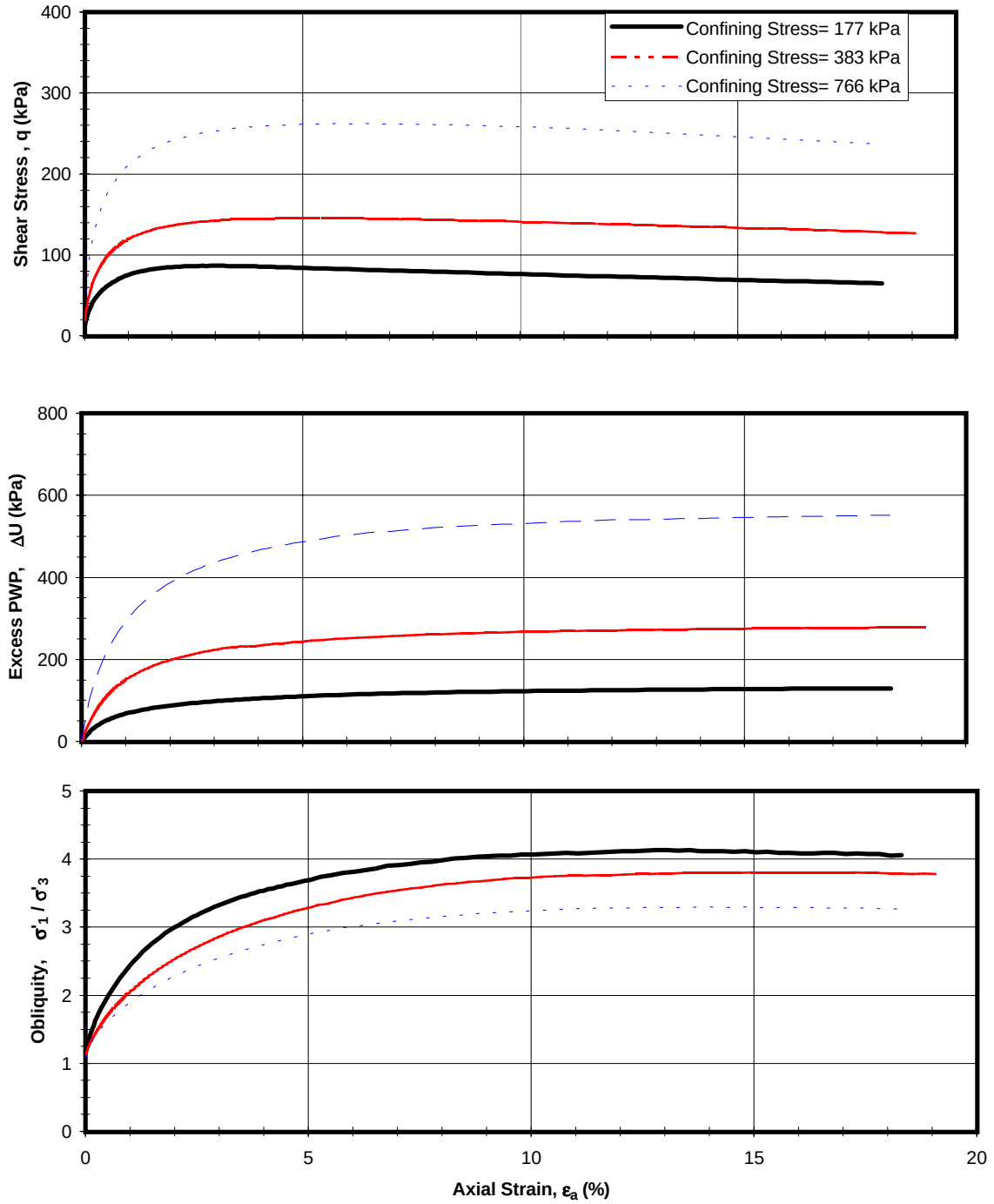
CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 20 - Depth: 16.9m

Boring 98-57

SFOBB East Span Seismic Safety Project

PLATE 98-57.8a



CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 20 - Depth: 16.9m

Boring 98-57

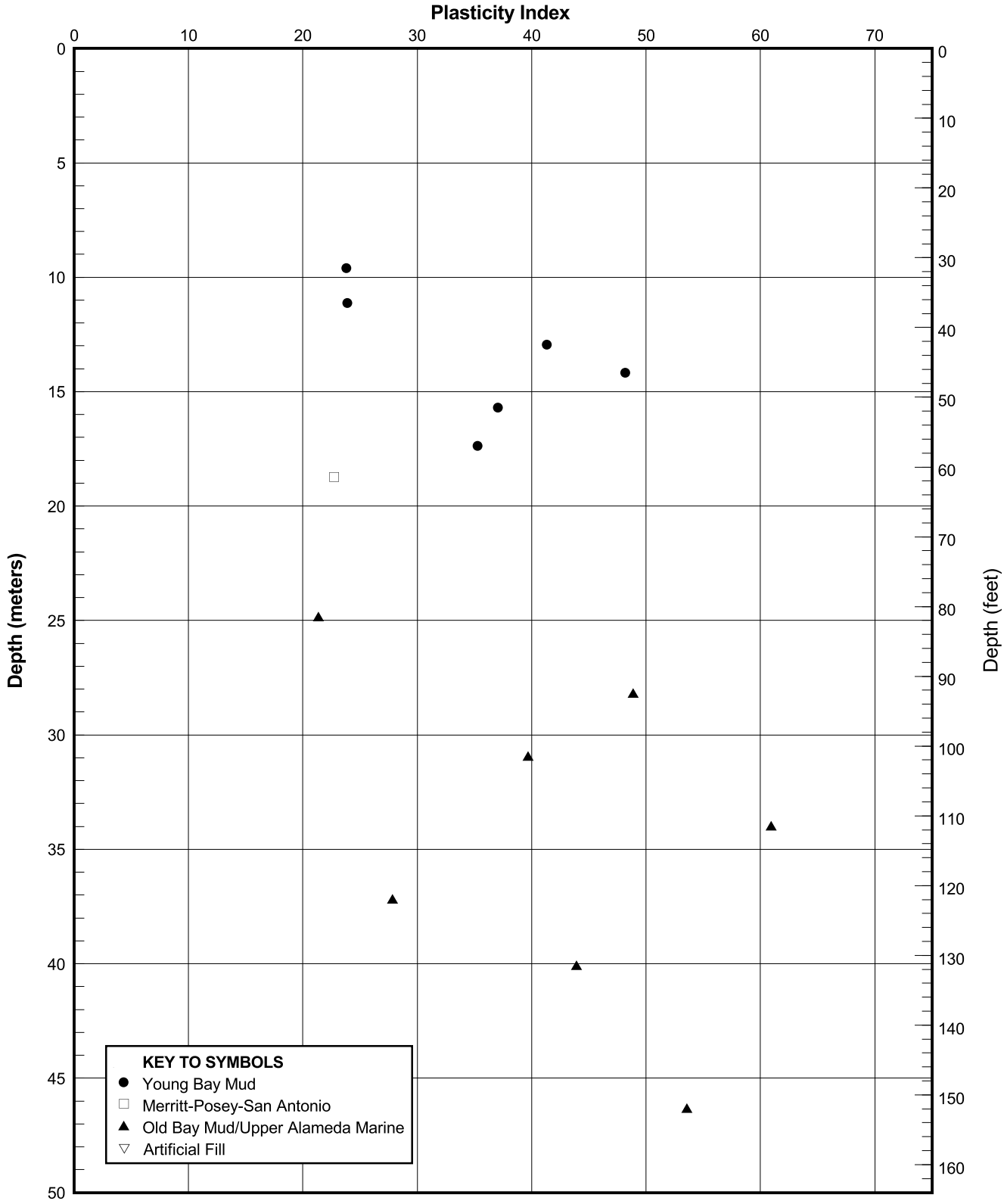
SFOBB East Span Seismic Safety Project

PLATE 98-57.8b

No Consolidated-Drained Triaxial Compression Testing Performed For This Boring

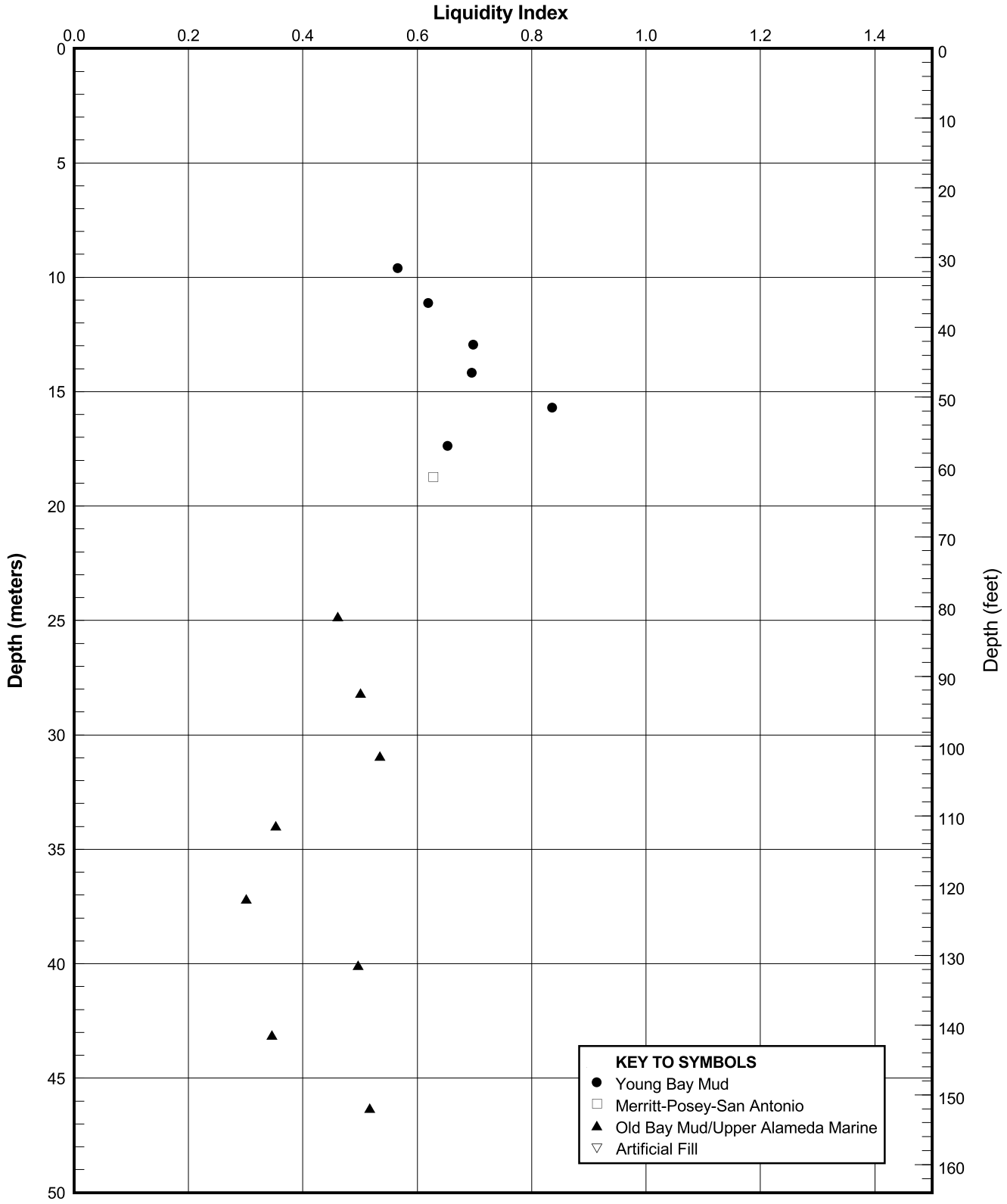
No R-Value Laboratory Testing Performed For This Boring

No Corrosion Testing Performed For This Boring



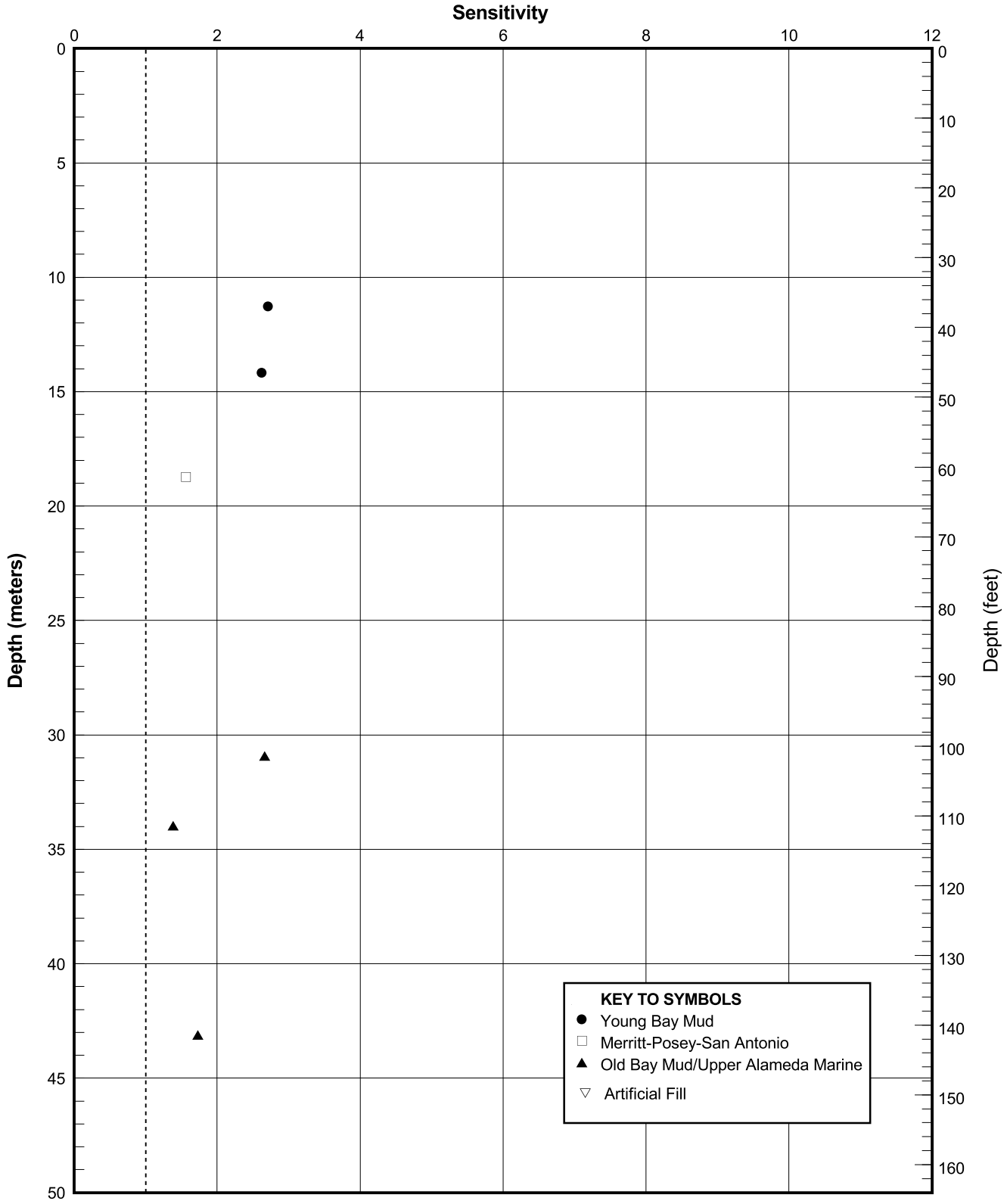
PLASTICITY INDEX PROFILE
Boring 98-57
SFOBB East Span Seismic Safety Project

PLATE 98-57.12



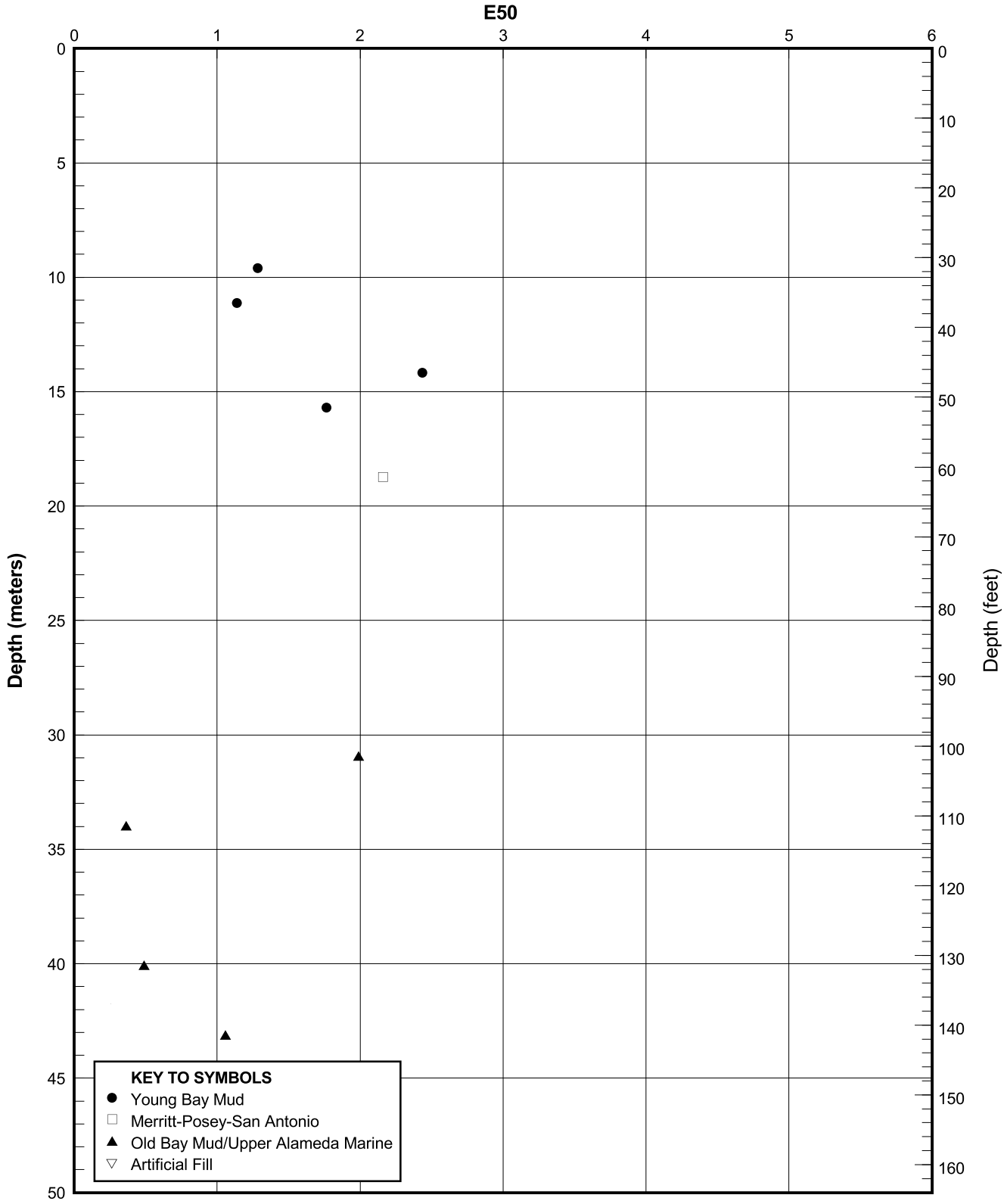
LIQUIDITY INDEX PROFILE
Boring 98-57
SFOBB East Span Seismic Safety Project

PLATE 98-57.13



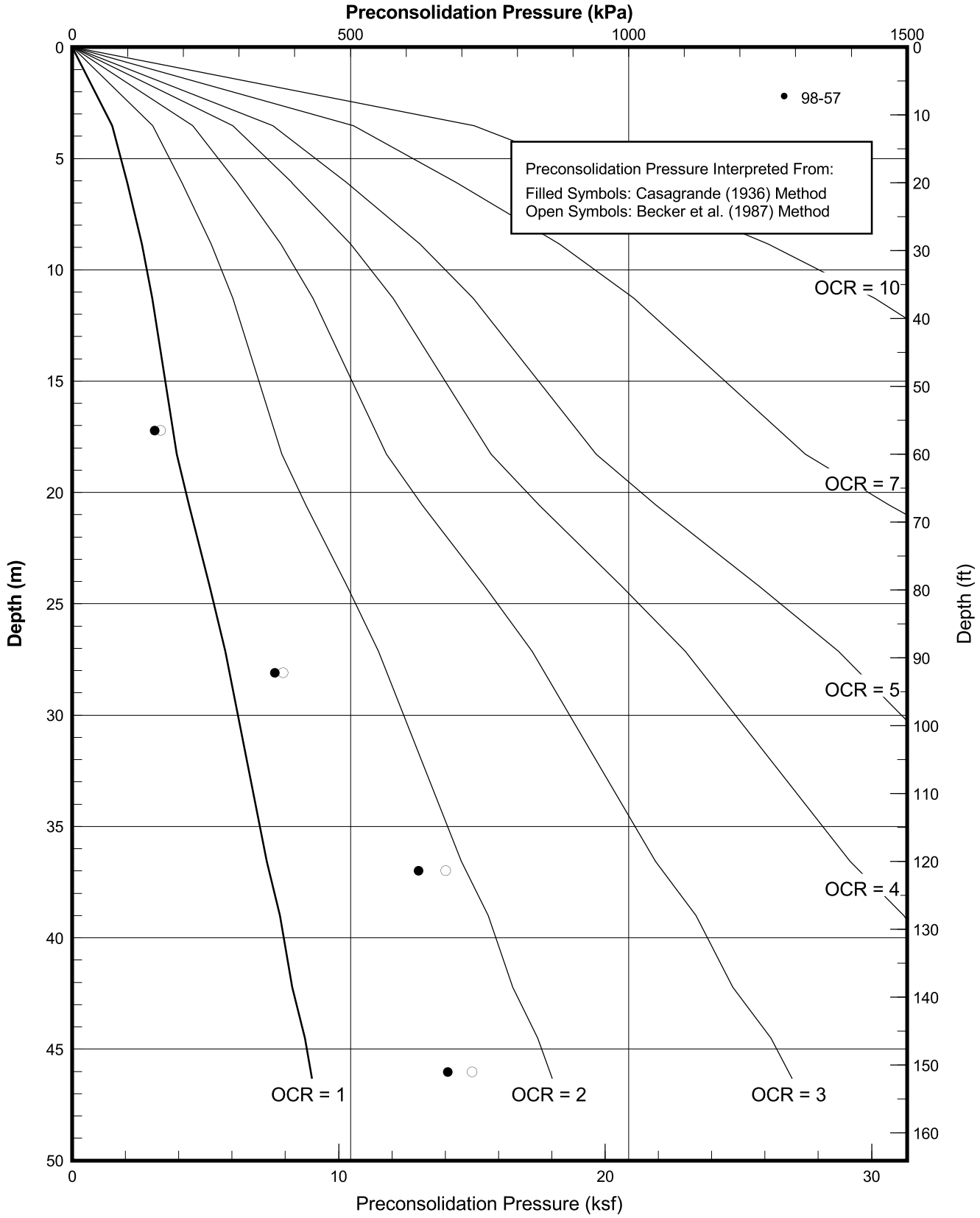
SENSITIVITY PROFILE
Boring 98-57
SFOBB East Span Seismic Safety Project

PLATE 98-57.14



E50 PROFILE
Boring 98-57
SFOBB East Span Seismic Safety Project

PLATE 98-57.15



PRECONSOLIDATION PRESSURE INTERPRETED FROM LABORATORY DATA

Boring 98-57

SFOBB East Span Seismic Safety Project

PLATE 98-57.16

LAND BORING 98-58

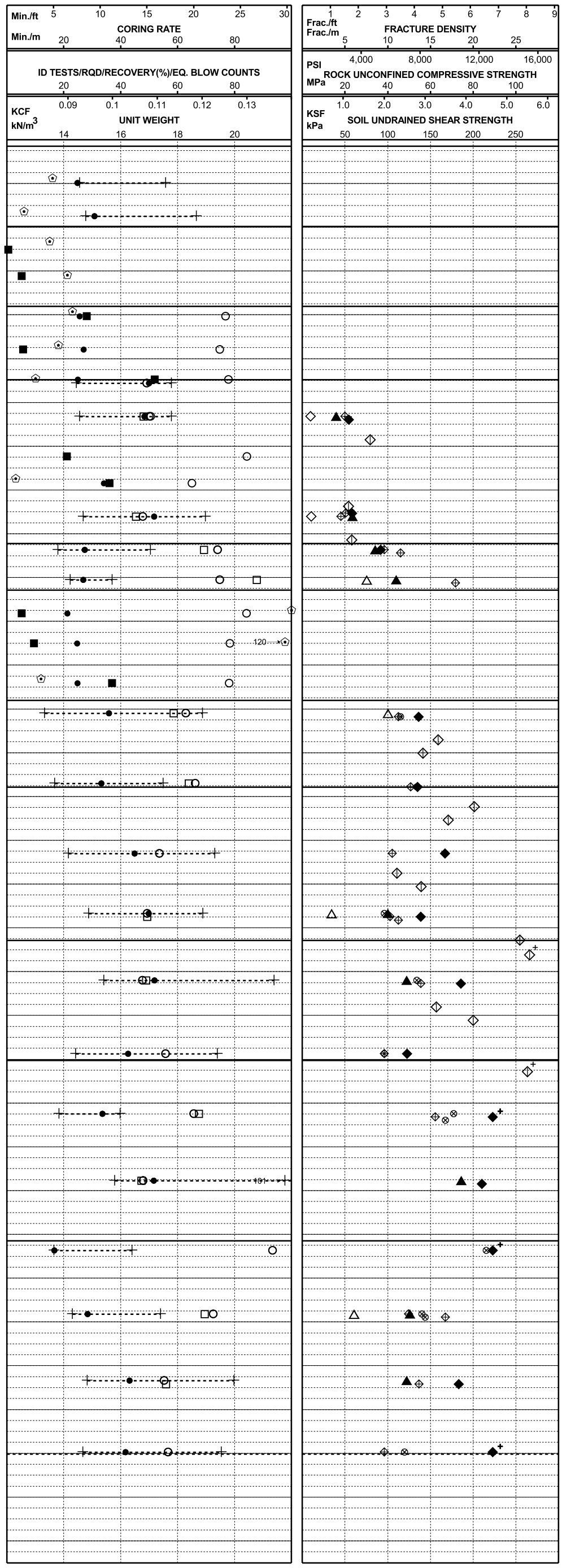
PROJECT NO:	98-42-0058	**START DATE:**	10/23/98	**DRILLER:**	Pitcher Drilling Company
BORING:	98-58 (5m left of W. Sta. 88+29)	**COMPLETION DATE:**	10/30/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1839287 N648327
CA State Plane Zone 3, NAD83, Meters

GROUND ELEVATION: 3.9m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
					PAVEMENT, 0.15m Asphalt Concrete over 0.15m of Aggregate Base (0.3m)	I
2	2			16	Fat CLAY with gravel (CH), stiff to very stiff, brown -with sand pockets	II
				6	-with shell fragments at 3.0m (4.0m) ▽ (3.9m)	
0	4			15	Fine GRAVEL with sand (GW), medium dense, dark gray -with coarse gravel at 5.0m -with a black sand layer at 5.2m	III
-2	6			34	-coarse gravel and silt at 6.2m (7.6m)	
-4	8			23	Silty Fine SAND (SM), medium dense, greenish gray -with coarse gravel at 8.1m	IV
-6	10			18	-with clay pockets and shell fragments, at 9.1m	
				10	-with clay pockets at 10.7m (11.0m)	
-8	12			PUSH	Fat CLAY (CH), firm to stiff, olive gray -with shell fragments -dark gray at 11.0m -with silt pockets at 12.5m	V
-10	14			SAVE	-silty fine sand, 14.2m to 14.5m -clayey sand, 14.5m to 15.8m	
-12	16			3		
-14	18			PUSH	-with gas blisters at 17.1m (18.4m)	
-16	20			PUSH PUSH	Fat CLAY (CH), very stiff, greenish gray -with many sand pockets to 18.9m -with organic pockets, sand pockets, calcareous nodules and slickensides, at 20.1m (20.6m)	VI
-18	22			50/15cm	Fine SAND with silt (SP-SM), very dense, greenish gray	VII
-20	24			50/15cm 12	-clayey sand below 24.4m (25.6m)	
-22	26			PUSH	Fat CLAY (CH), very stiff, greenish gray -with gas blisters and slickensides, at 26.2m	VIII
-24	28				-with sand pockets, silt pockets and calcareous nodules, at 29.3m (29.6m)	
-26	30			PUSH	Fat CLAY (CH), very stiff, greenish gray	IX
-28	32			SAVE	-with a few sand pockets at 32.3m	
-30	34					
-32	36			PUSH	-with silt pockets and partings, at 35.4m (36.6m)	
-34	38			PUSH	Fat CLAY (CH), very stiff to hard, greenish gray -with reddish brown oxidation staining, at 38.4m	X
-36	40					
-38	42			SAVE	-with many organic pockets and a few sand pockets, at 41.5m (42.1m)	
-40	44			PUSH	Fat CLAY (CH), very stiff to hard, greenish gray -with sand pockets, calcareous nodules and gas blisters, at 44.5m	XI
-42	46					
-44	48			PUSH	-with organic pockets and partings and reddish brown oxidation staining, at 47.5m (50.3m)	
-46	50			SAVE	Fat CLAY (CH), very stiff to hard, greenish gray -lean clay to 52.7m	XII
-48	52					
-50	54			PUSH	-with sand pockets, a few silt pockets, and slickensides, at 53.6m	
-52	56					
-54	58			PUSH	-with a few silt partings and a few shell fragments, at 56.7m	
-56	60			SAVE	-with a few shell fragments at 59.7m	
-58	62					
-60	64					

TOTAL DEPTH: 60.0m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-58

SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

Report Date: 03/11/99

PLATE 98-58.1

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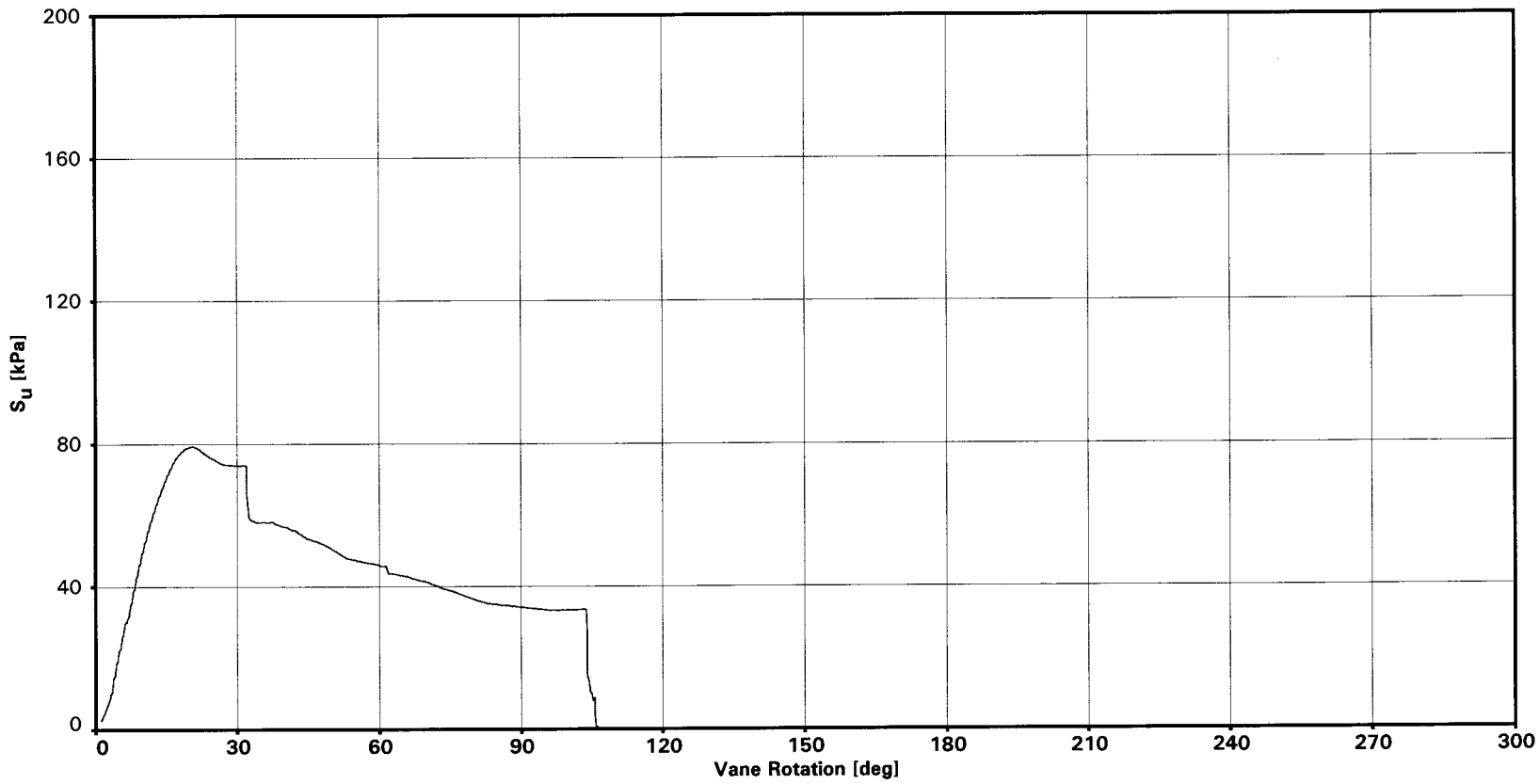
SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 13.7m
Boring 98-58
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-58.2a

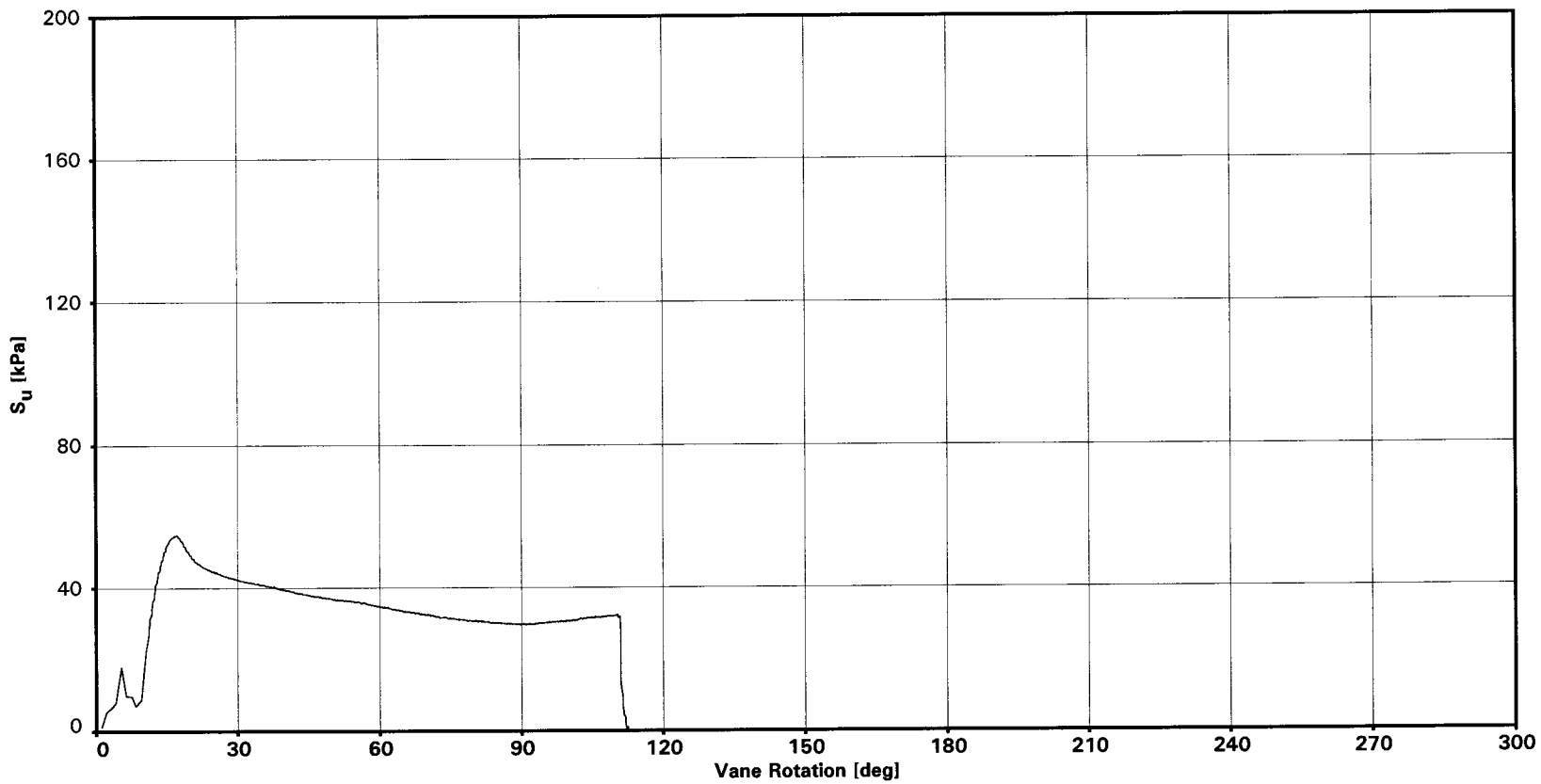
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 16.8m
Boring 98-58
SFOBB East Span Seismic Safety Project

PLATE 98-58.2b

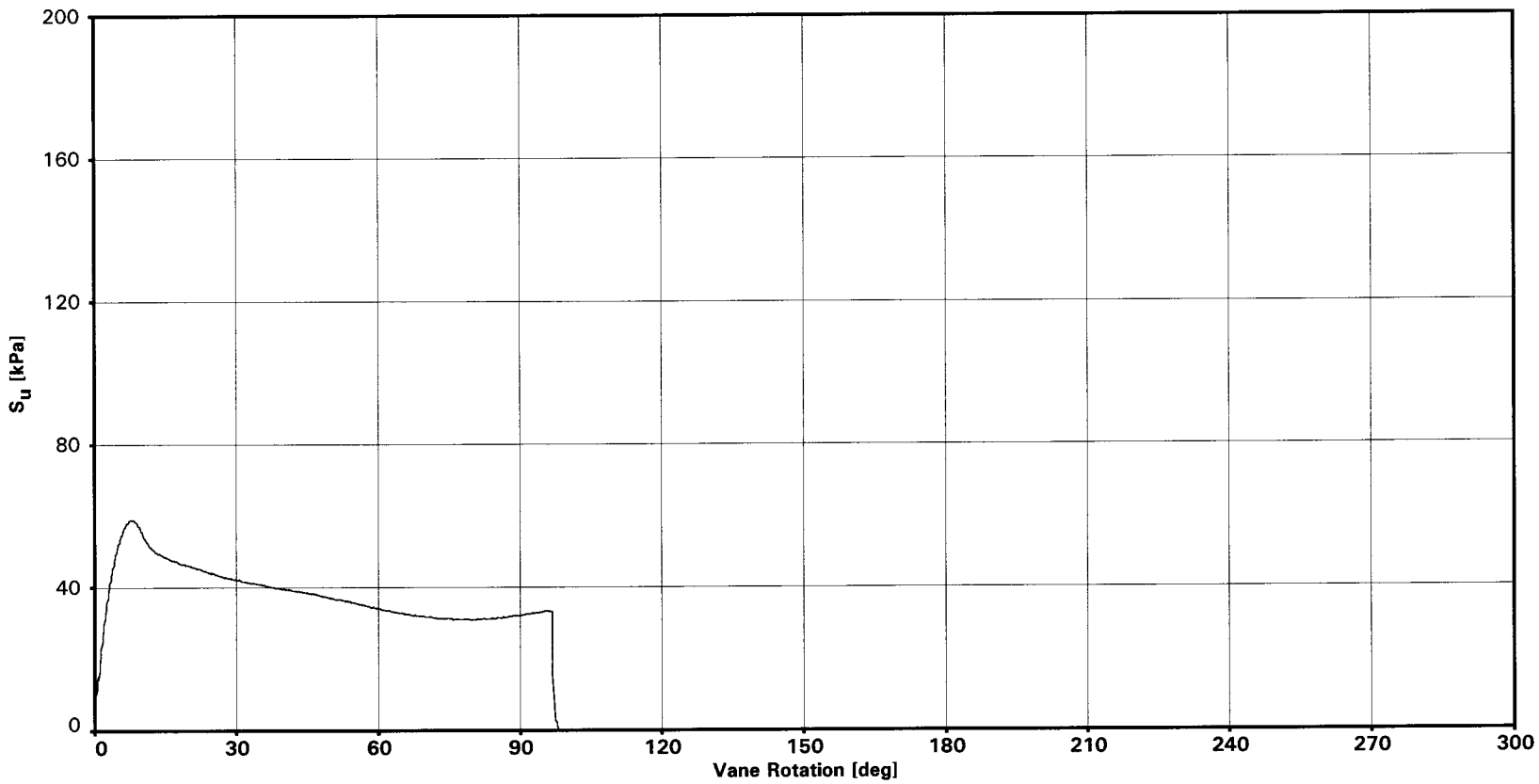
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



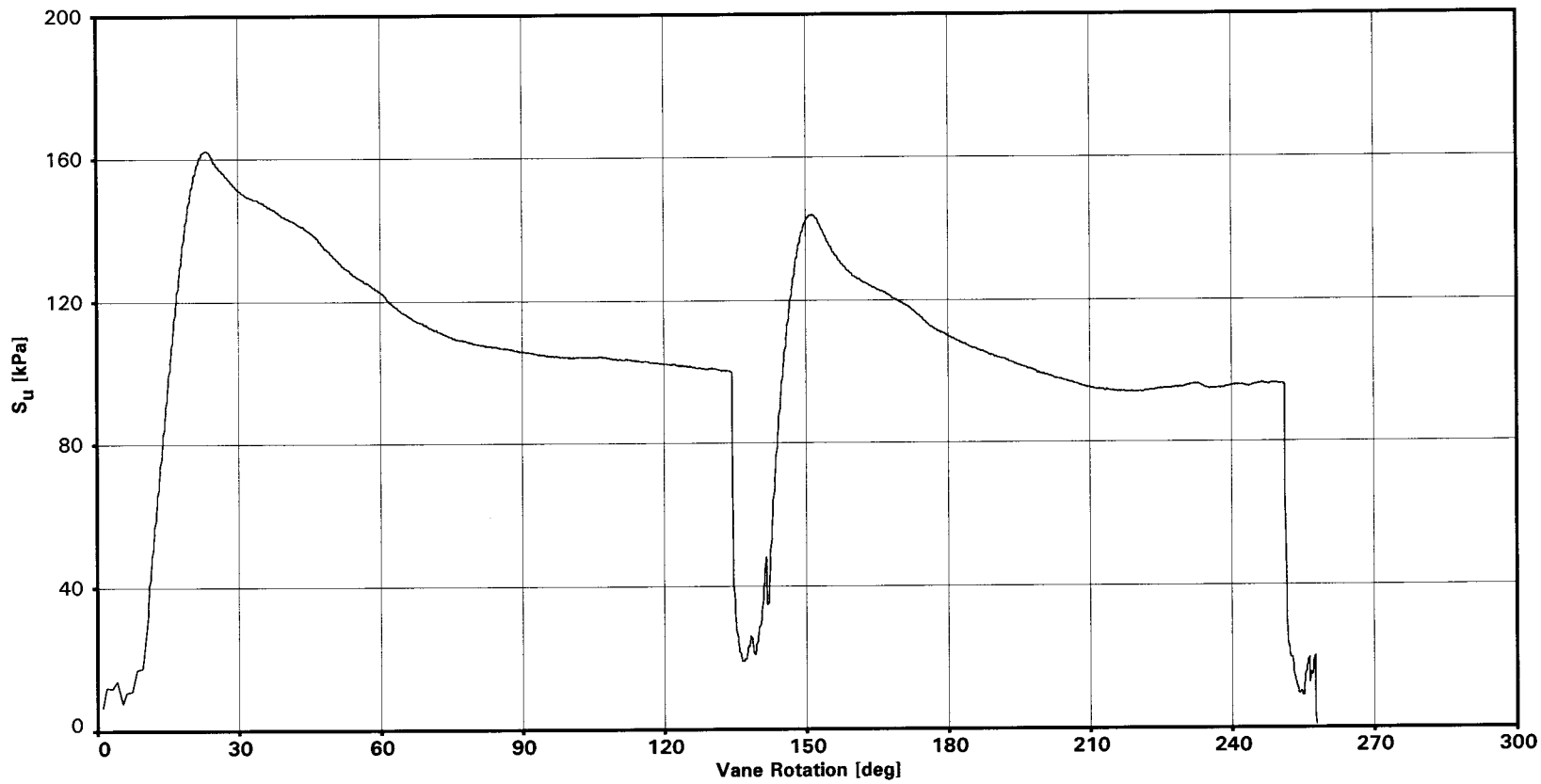
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 18.3m
Boring 98-58
SFOBB East Span Seismic Safety Project

PLATE 98-58.2c

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 27.4m and 28.0m
Boring 98-58
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-58.2d

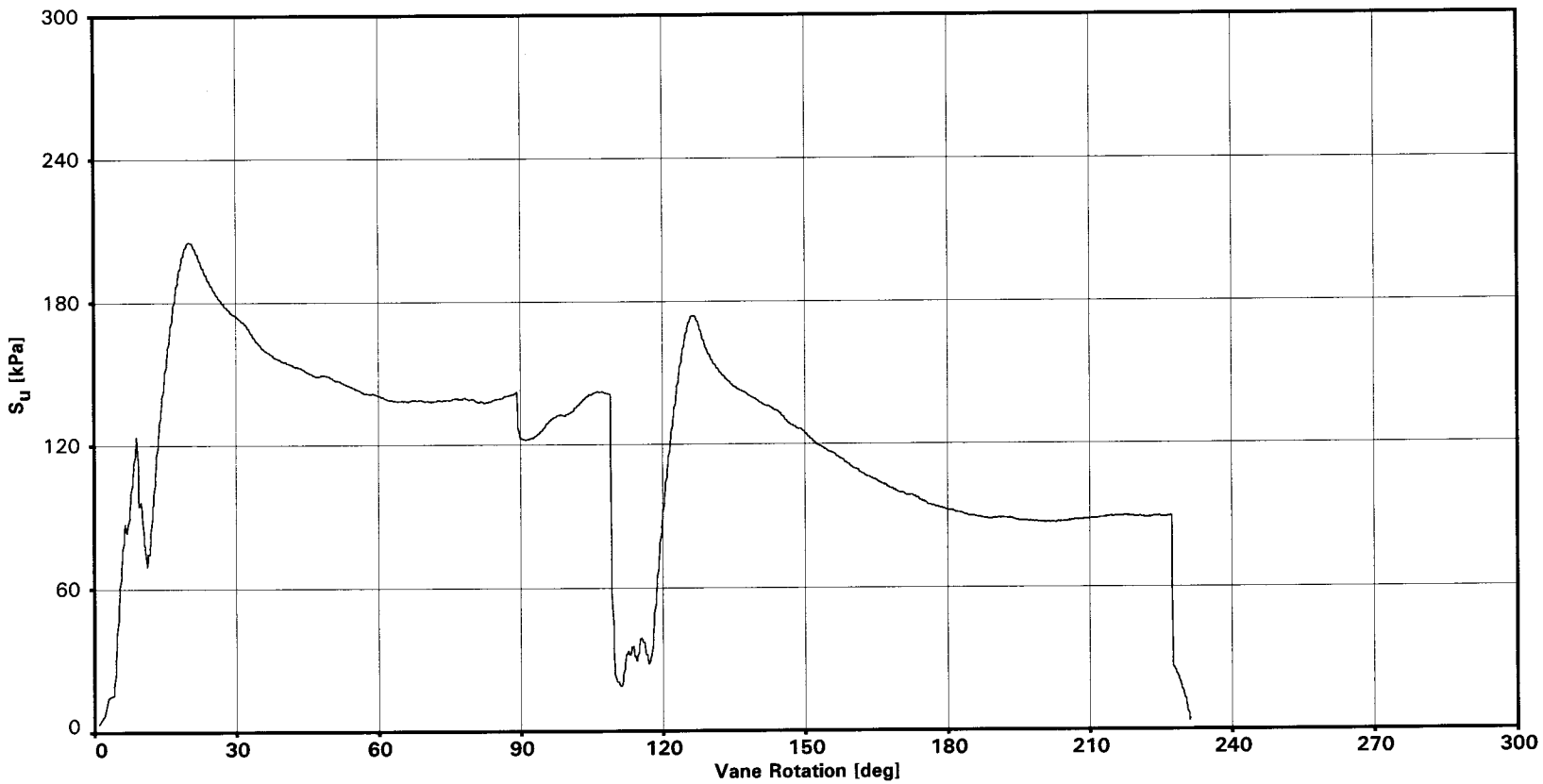
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 30.5m and 31.1m
Boring 98-58
SFOBB East Span Seismic Safety Project

PLATE 98-58.2e

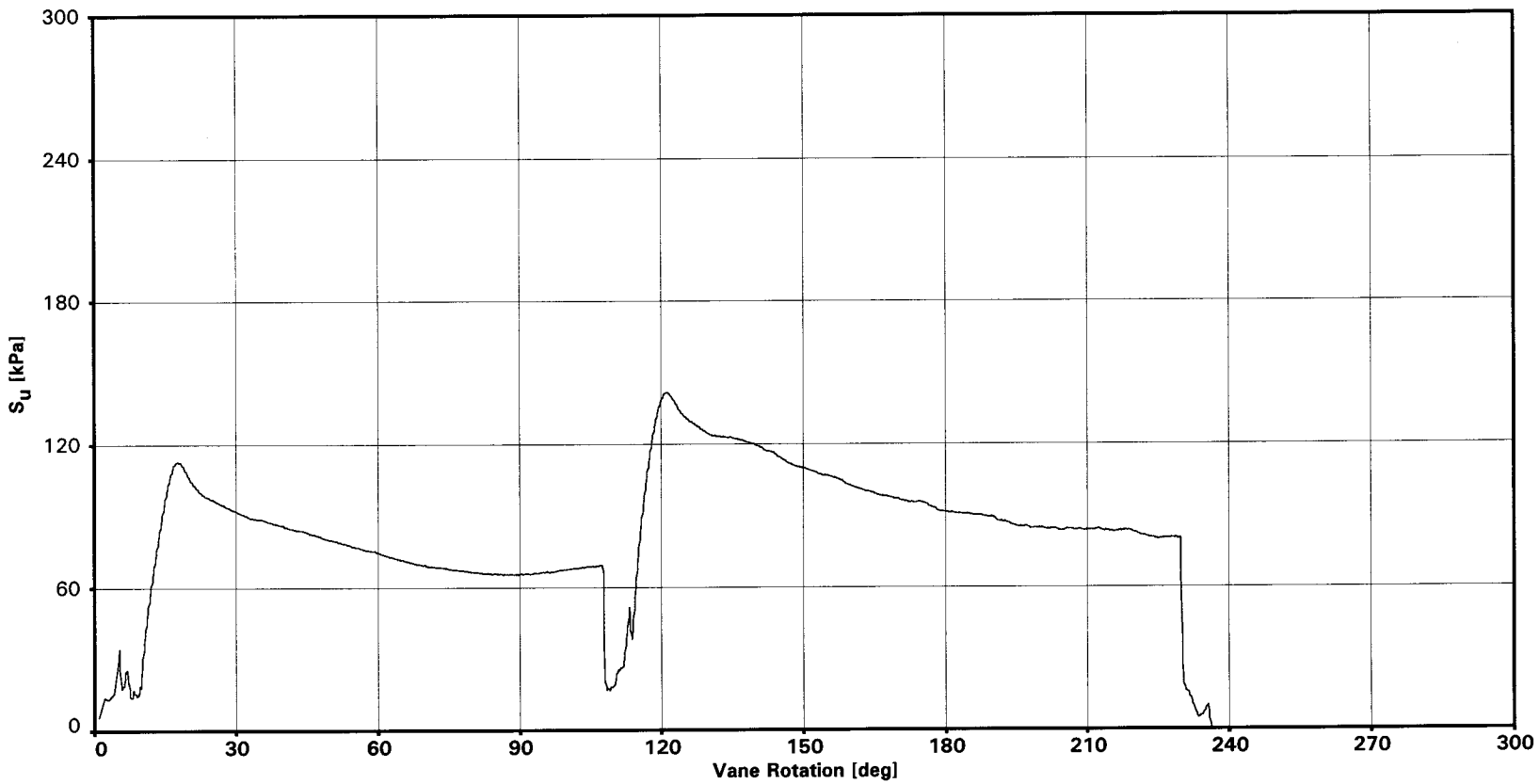
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 33.5m and 34.1m
Boring 98-58
SFOBB East Span Seismic Safety Project

PLATE 98-58.2f

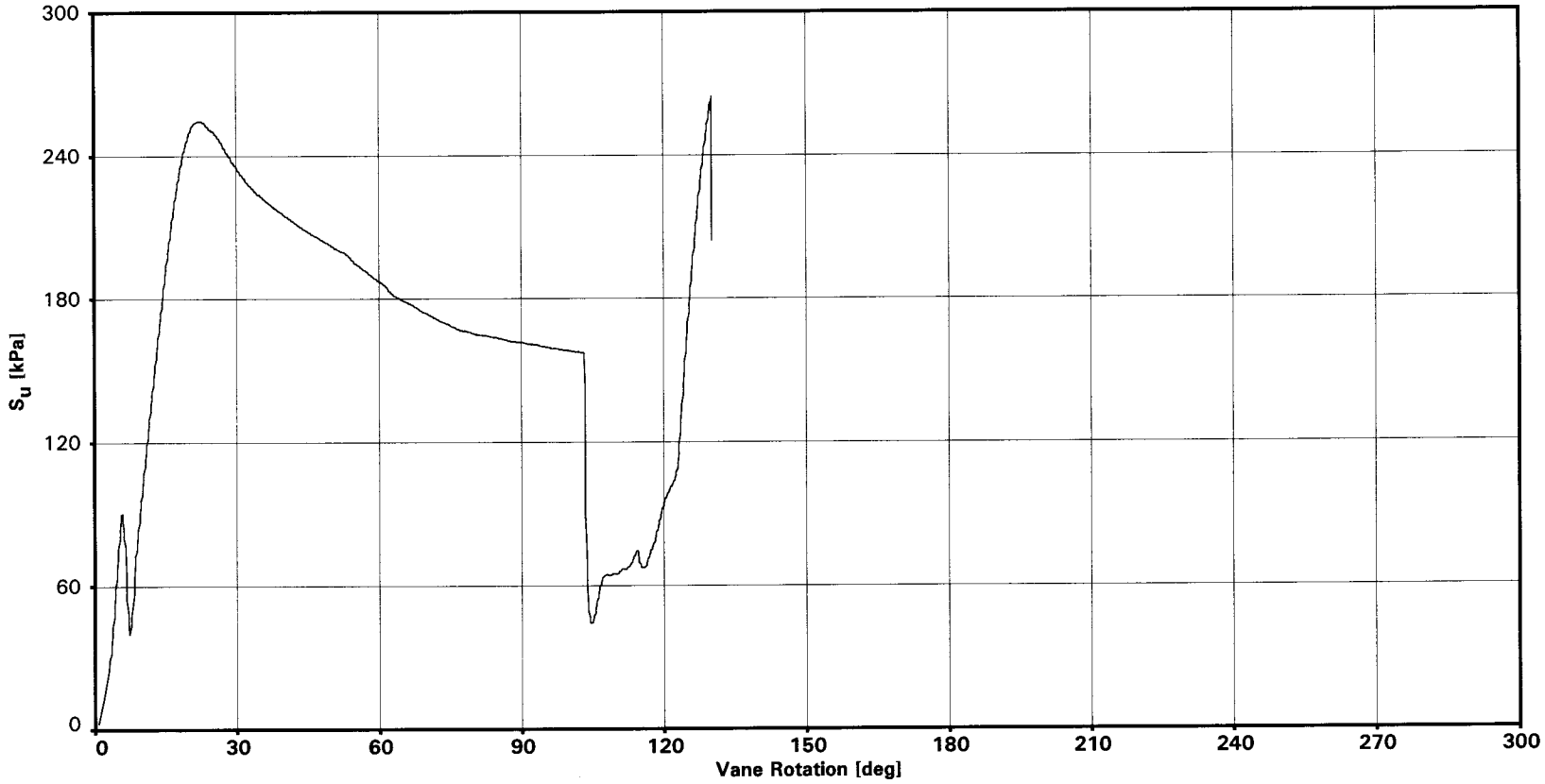
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 36.6m and 37.2m
Boring 98-58
SFOBB East Span Seismic Safety Project

PLATE 98-58.2g

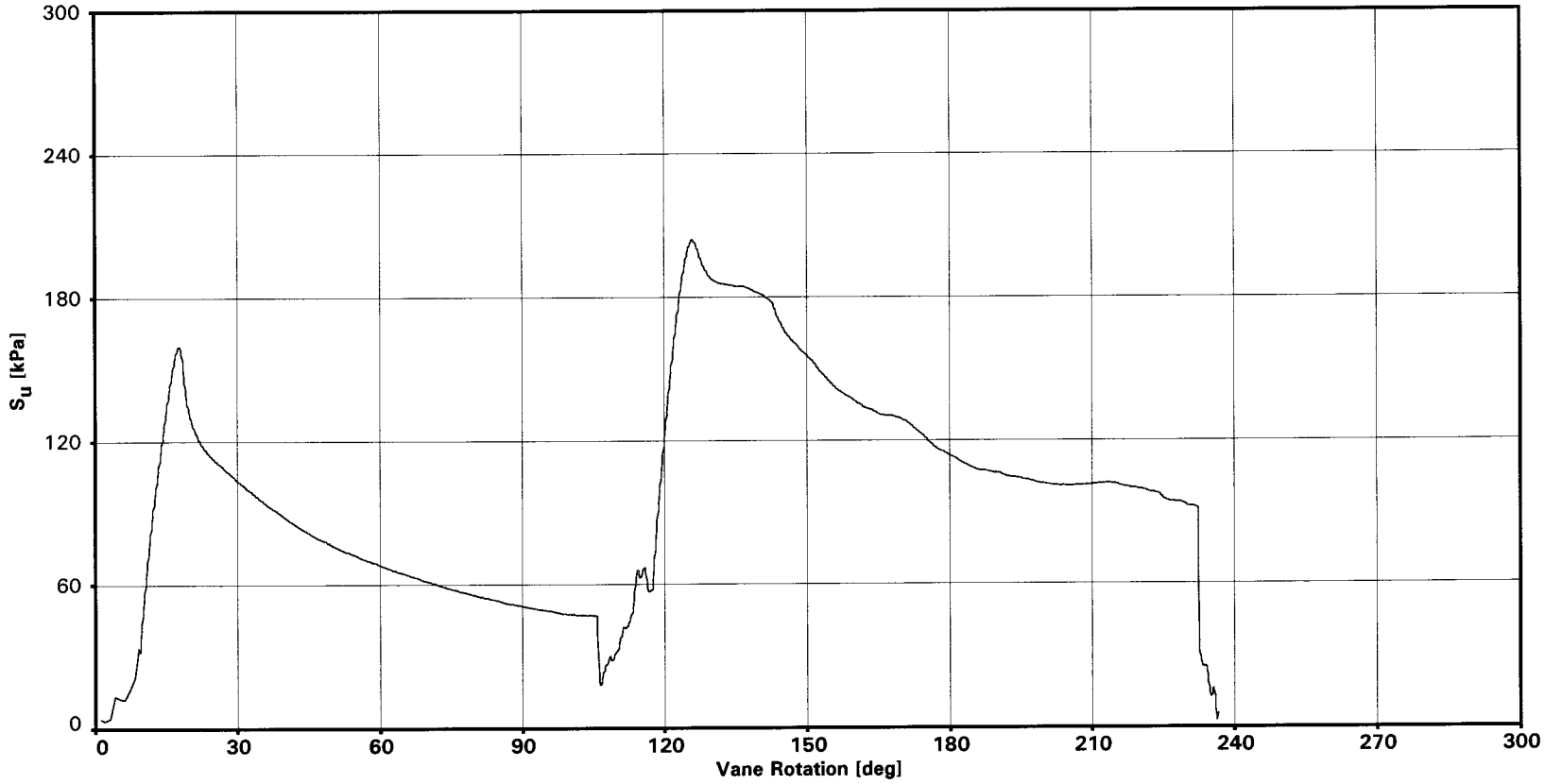
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 39.6m and 40.2m
Boring 98-58
SFOBB East Span Seismic Safety Project

PLATE 98-58.2h

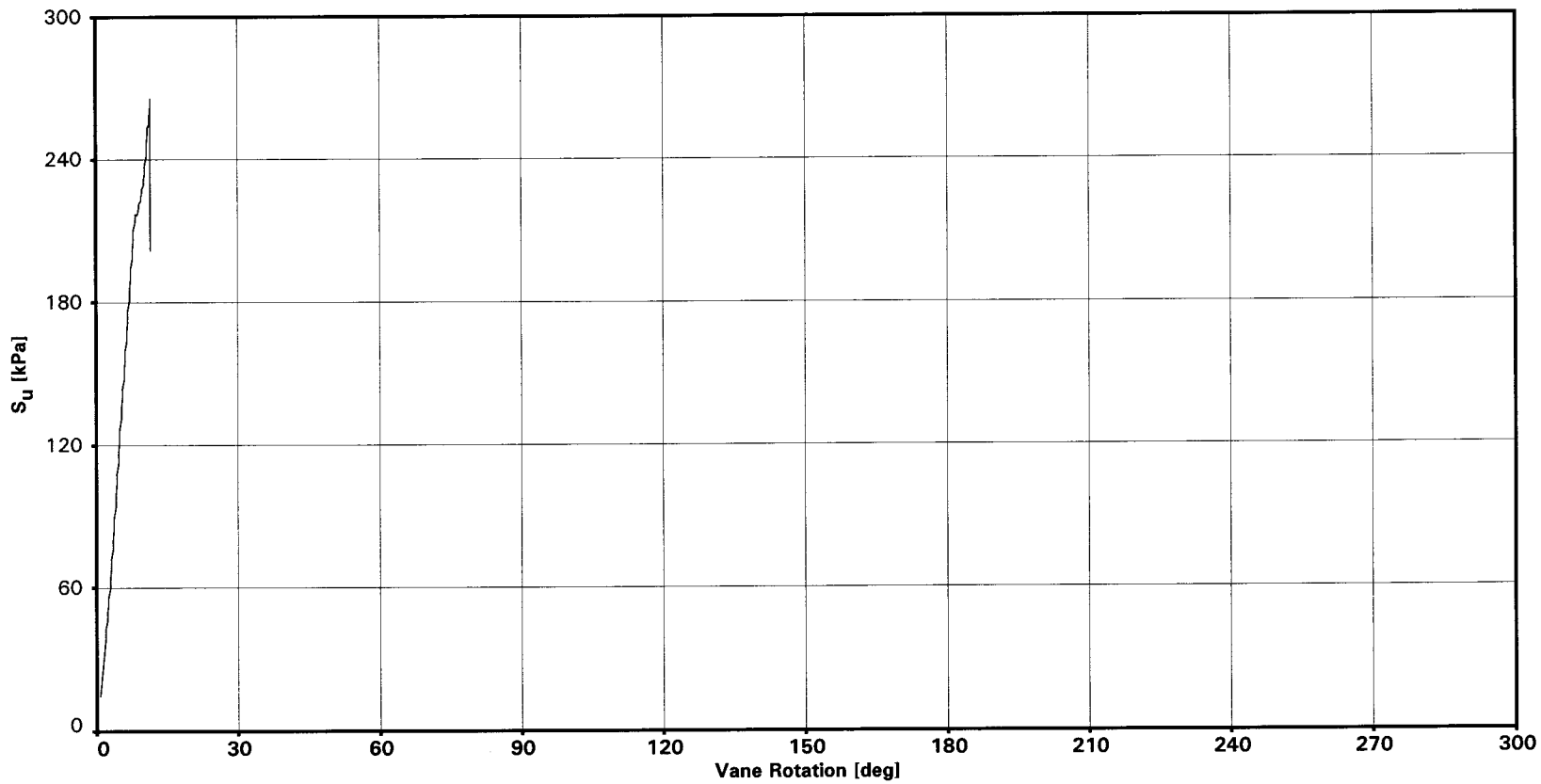
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 42.7m and 43.3m
Boring 98-58
SFOBB East Span Seismic Safety Project

PLATE 98-58.2i

SFOBB Task Order No. 5
Project No. 98-42-0058

98-58		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
2.0	1	25	56	26																							2.67
3.5	2	31	67	28	0.07																						
5.0	3						0																				
6.2	4						5																				
8.1	5	26					28																				
9.6	6	27					6																				2.65
11.0	8	25					52																				
11.1	9	50	58	24	0.76																						
12.6	12	48	58	26	0.70	16.8		49.8							39.7		3.3										
12.8	13							53.6		53.6	54.3	9.5															
13.7	400													79.5													
14.5	15	21					21																				
15.7	16	34					36																				2.69
16.8	401													54.1													
17.1	18							50.8		56.5	58.3	10.3															

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-58
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-58.3a

SFOBB Task Order No. 5
Project No. 98-42-0058

98-58		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
17.2	19	52	70	27	0.58	16.5		45.0							58.5		0.9										
18.3	402													57.9													
18.7	22	27	51	18	0.29	18.9		95.8			91.6				85.4		0.7										
18.9	23							114.9																			
20.1	25	27	37	22	0.31	20.8									109.8	75.4	2.4										
20.3	26							179.6																			
21.6	27	21					5																				
23.0	28	25					9																				2.69
24.8	29	25					37																				
26.2	31	36	69	13	0.41	17.8										100.4											
26.4	32							112.5	114.9		136.1																
27.4	403													159.0													
28.0	404													141.2													
29.4	34	33	55	17	0.43	18.4																					
29.6	35							126.9	134.1		134.9																

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-58
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-58.3b

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SFOBB Task Order No. 5
Project No. 98-42-0058

98-58		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
30.5	405													201.6													
31.1	406													170.9													
32.5	36	49	72	23	0.53																					C	
32.6	37	45	73	22	0.45			105.3			167.1																
33.5	407													110.6													
34.1	408													139.3													
35.4	39	50	69	29	0.52				95.8						100.3	34.2	2.1										
35.5	40					16.9		102.9			138.6																
35.7	41							112.5																			
36.6	409													254.7+													
37.2	410													263.3+													
38.4	43	52	94	34	0.29	16.9			134.1						122.0		0.6										
38.6	44							138.9			185.6																
39.6	411													157.0													
40.2	412													200.1													

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-58
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-58.3c

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SFOBB Task Order No. 5
Project No. 98-42-0058

98-58		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
41.8	46	43	74	24	0.37			95.8	95.8		122.5															C	
42.7	413													263.3+													
44.5	48	34	40	18	0.70	18.7			177.2																		
44.7	49							155.6			222.8+																
44.8	50								167.6																		
47.5	52	52	101	38	0.22	16.7									186.2		1.4										
47.7	53										210.4																
50.7	55	17	44	17					215.5		222.8+															C	
53.6	57	28	54	23	0.17	18.9		124.5	140.2						125.9	60.3	1.3										
53.8	58							167.6	143.6																		
56.7	60	43	80	28	0.29										122.3		3.0										
56.8	61					17.6		136.5			183.2																
60.0	63	42	75	27	0.31			95.8	119.7		222.8+															C	

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

\+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-58
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-58.3d

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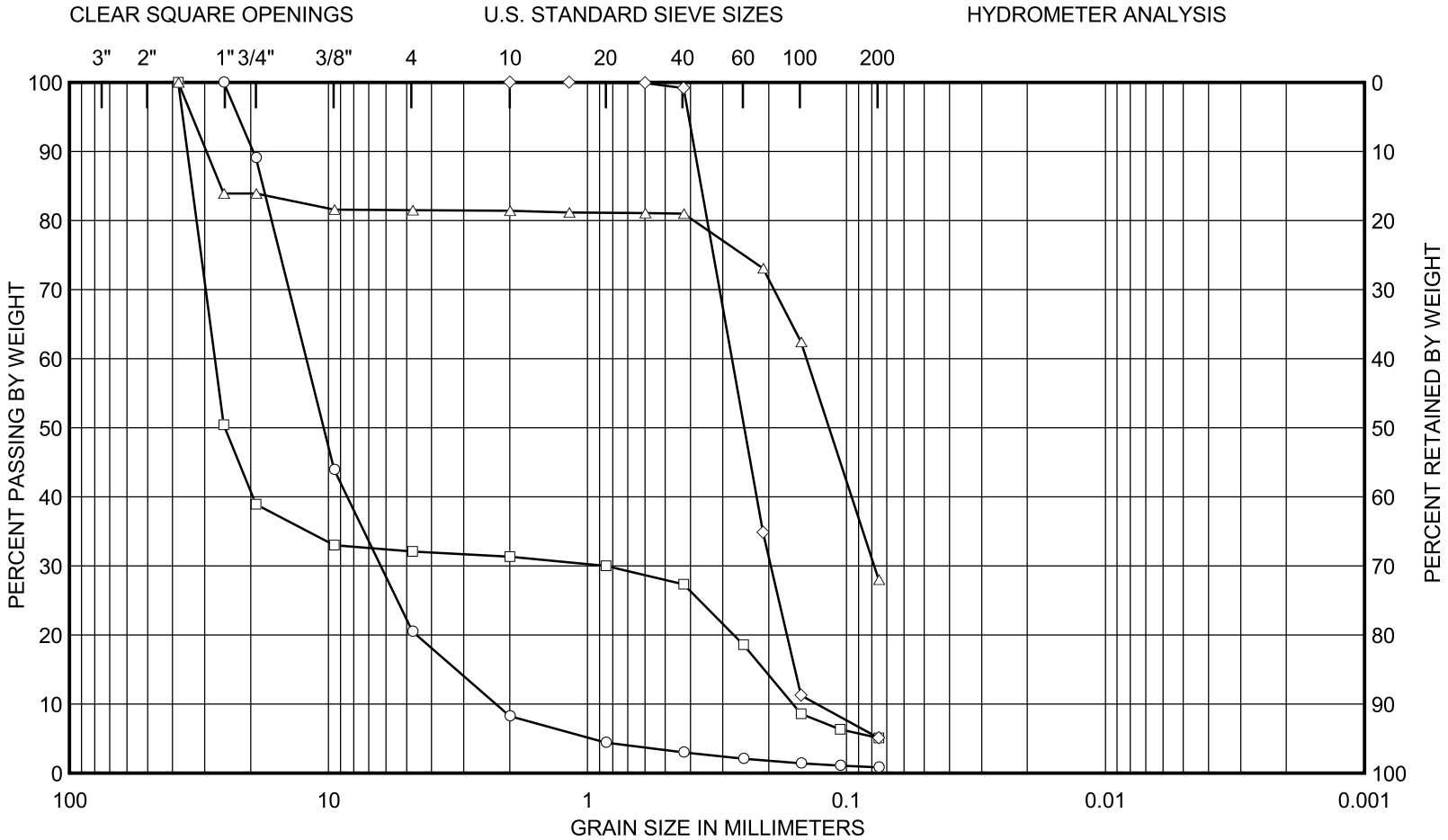

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
3	5.0	○——○	Fine GRAVEL (GW) with sand and a trace of coarse gravel	1.4	5.4	10.5
4	6.2	□——□	Coarse GRAVEL (GP-GM) with silt, fine sand, and a trace of fine gravel	0.2	170.5	25.1
5	8.1	△——△	Silty Fine SAND (SM) with coarse gravel			0.12
27	21.6	◇——◇	Fine SAND (SP-SM) with silt	1.1	2.1	0.25

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-58
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-58.4

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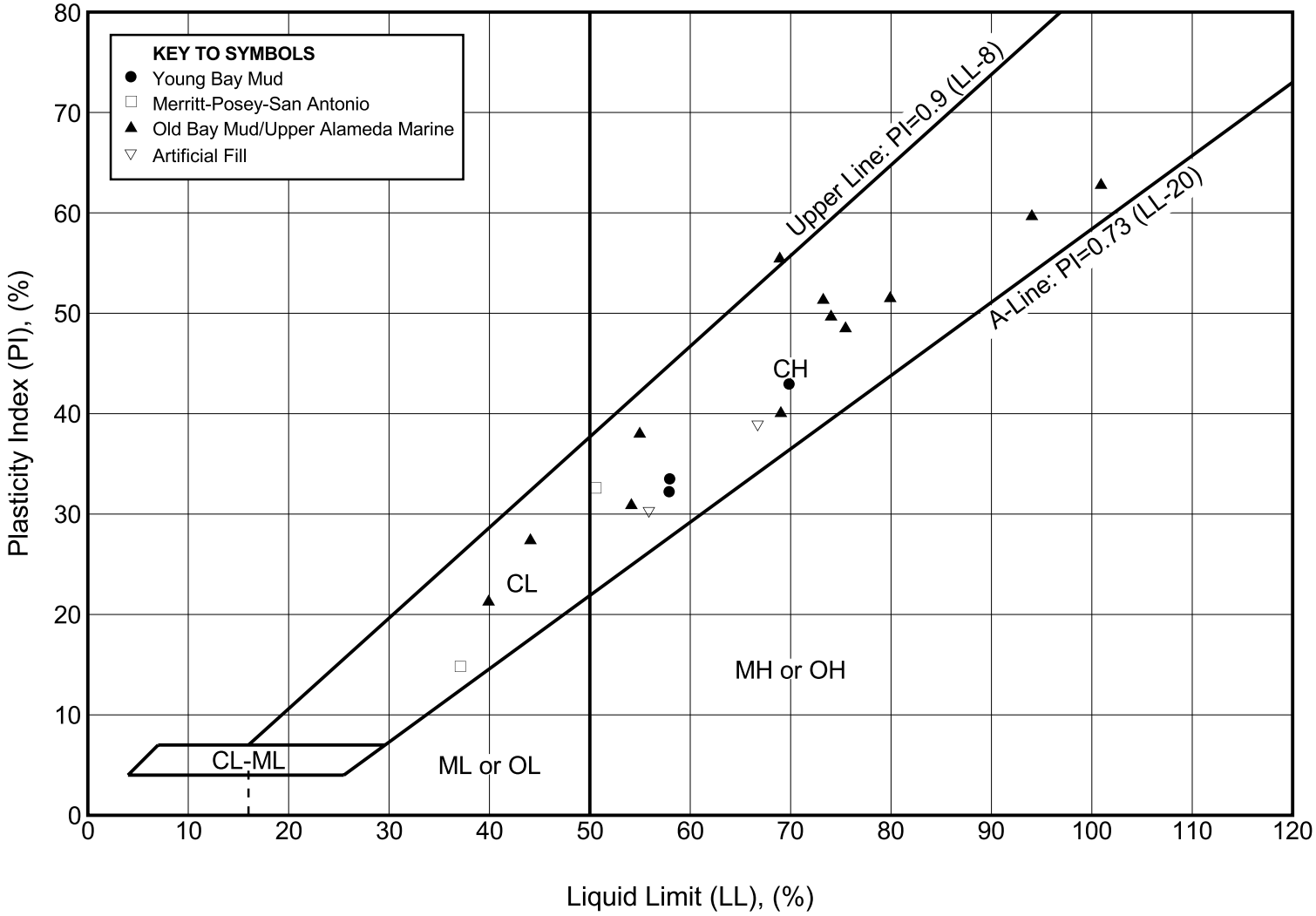

PLASTICITY CHART
Boring 98-58
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-58.5

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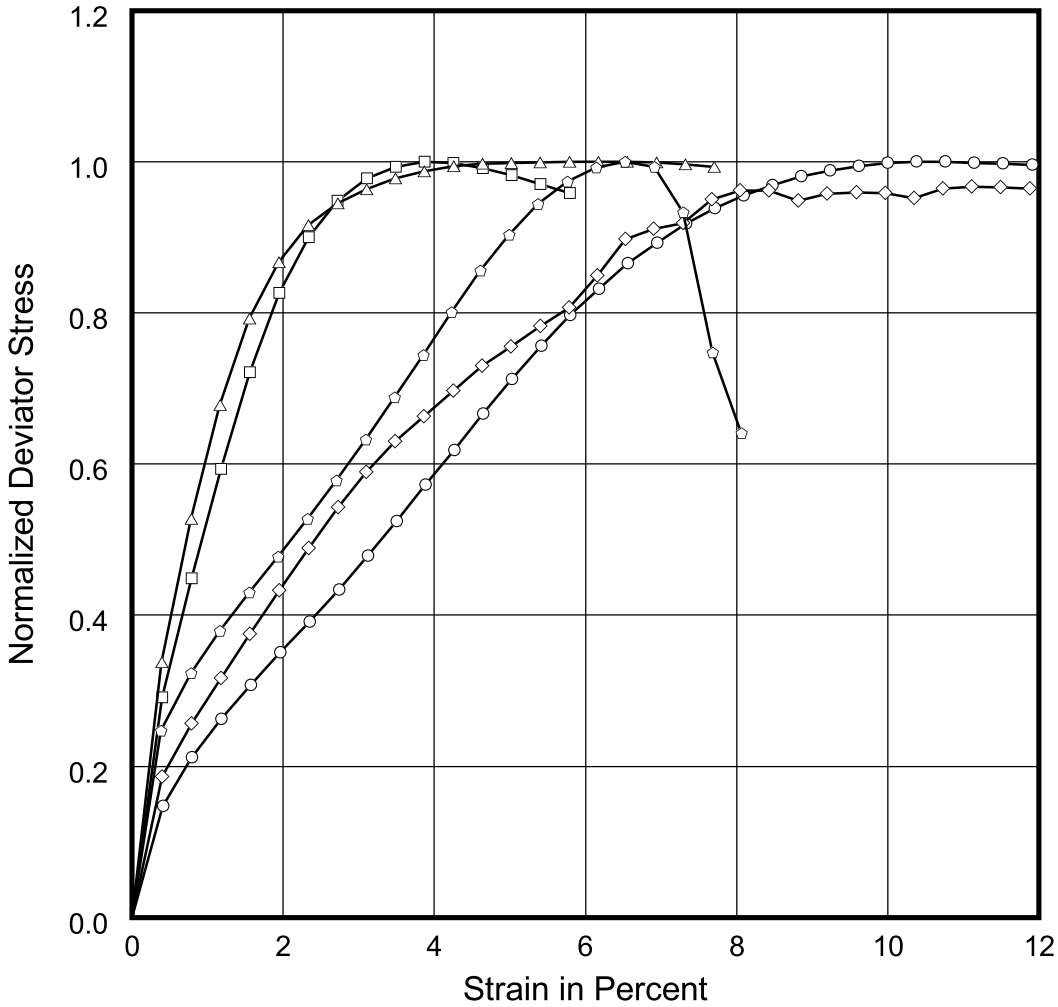
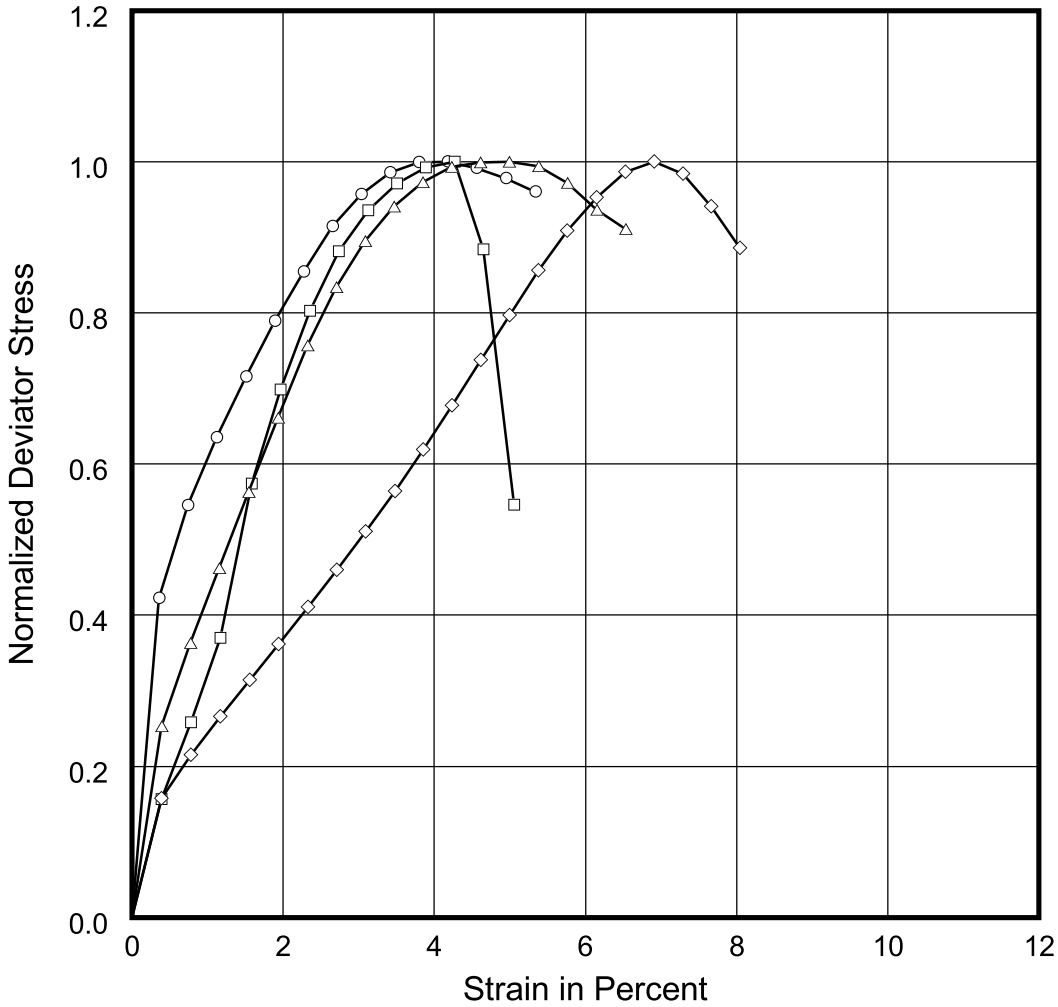


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	12	12.6	UU	241	80	3.2
	19	17.2	UU	345	117	0.9
	22	18.7	UU	689	171	0.7
	25	20.1	UU	689	220	2.4
	39	35.4	UU	1000	201	2.1

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-58
SFOBB East Span Seismic Safety Project

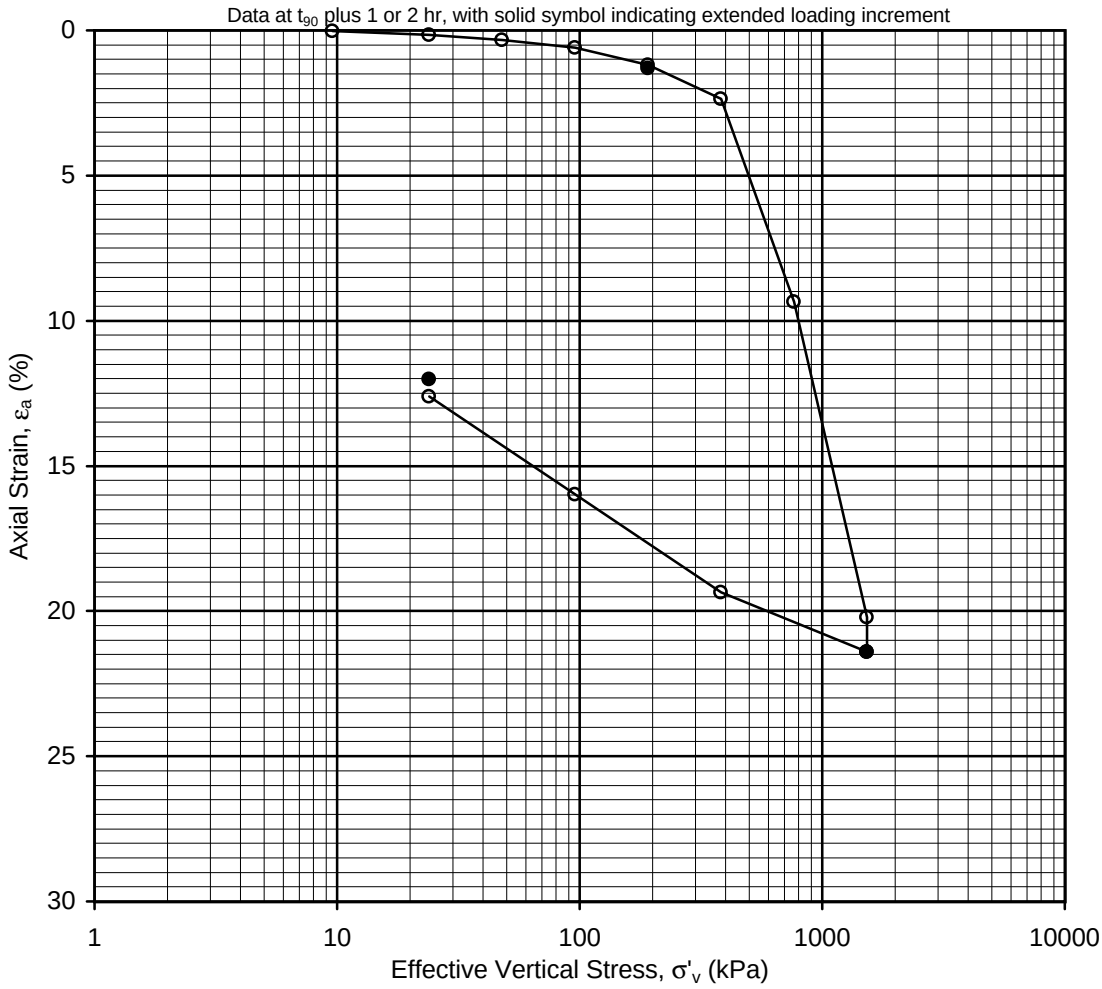


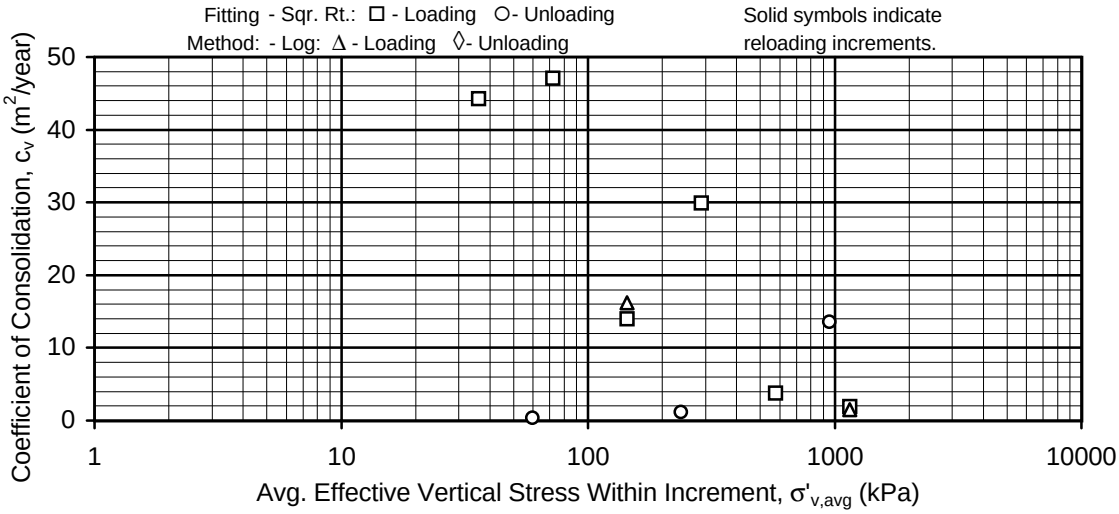
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	43	38.4	UU	1069	244	0.6
□—□	52	47.5	UU	1241	372	1.4
△—△	57	53.6	UU	1344	252	1.3
◇—◇	60	56.7	UU	1413	245	3.0

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

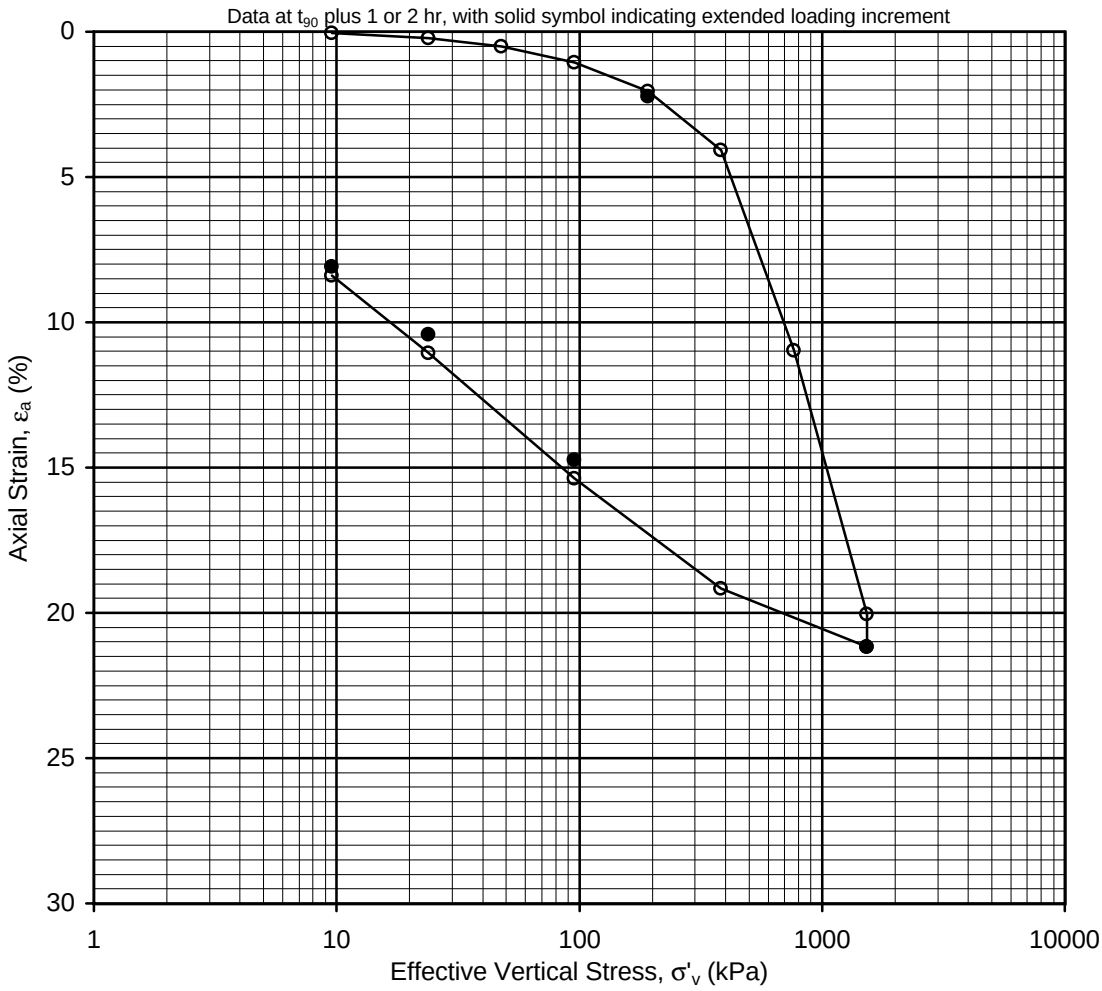
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-58
SFOBB East Span Seismic Safety Project

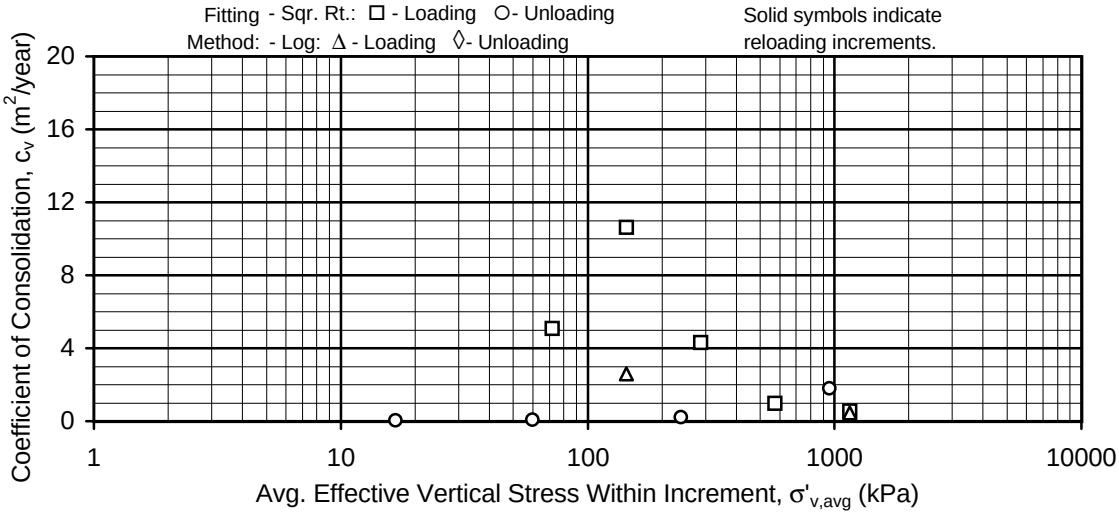




INCREMENTAL CONSOLIDATION TEST RESULTS

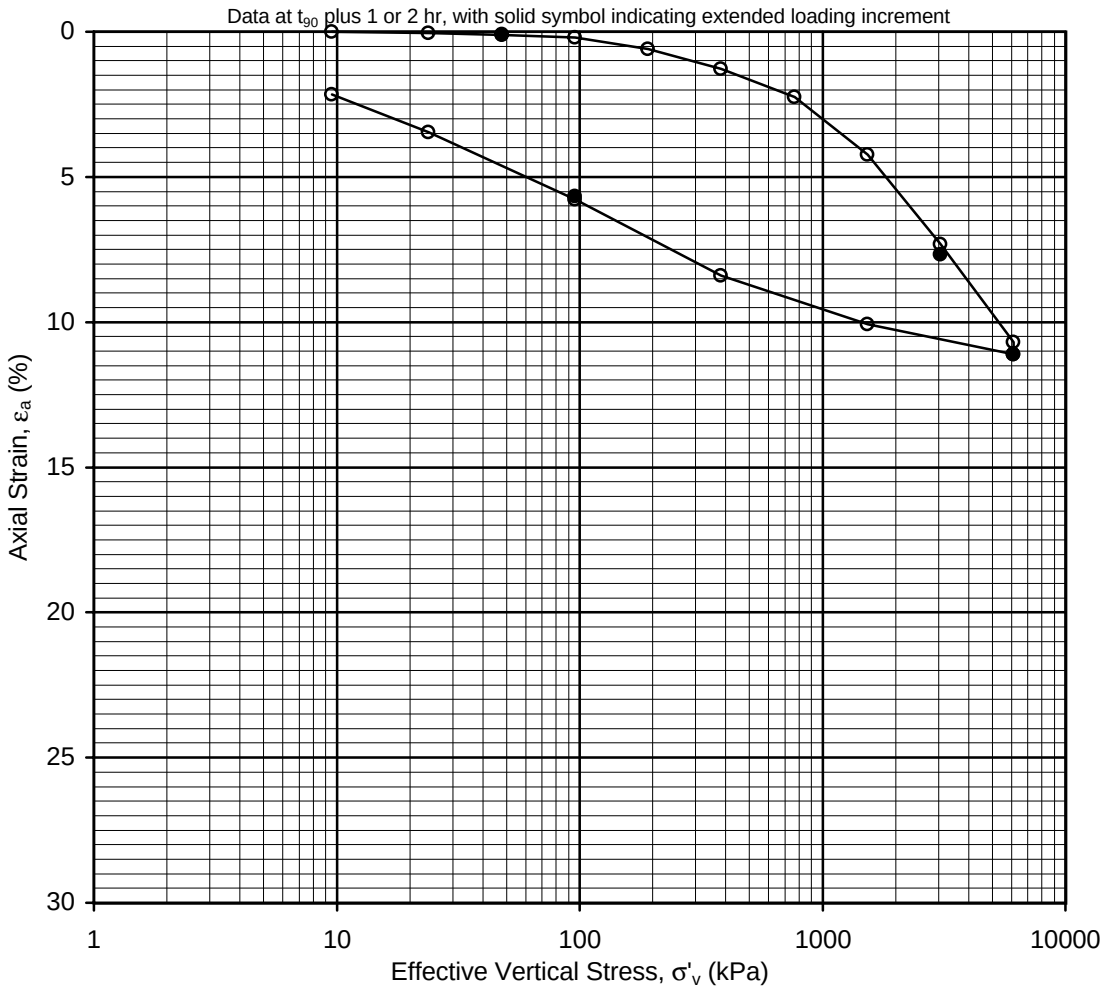
Sample No. 36 - Depth: 32.5m
Boring 98-57
SFOBB East Span Seismic Safety Project

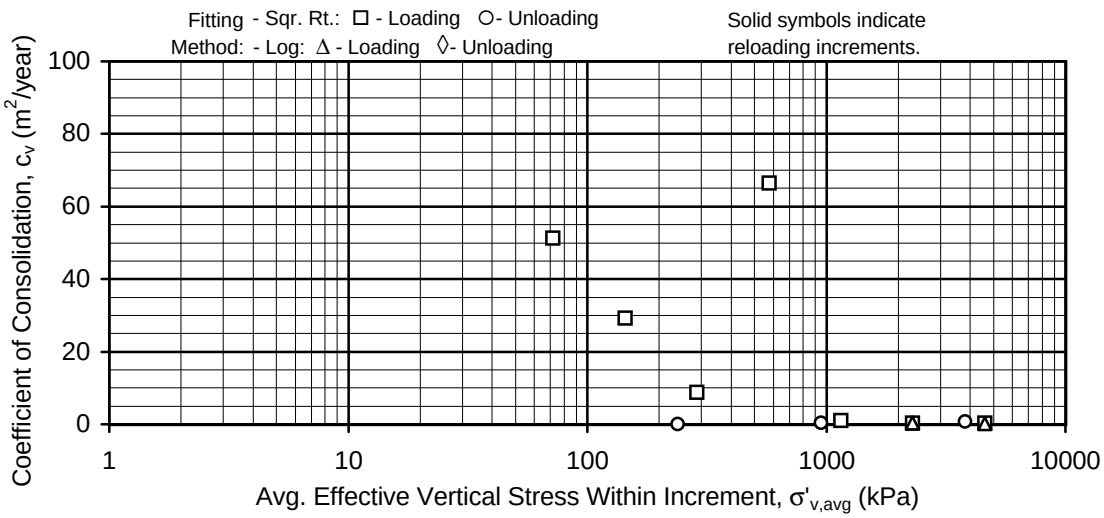




INCREMENTAL CONSOLIDATION TEST RESULTS

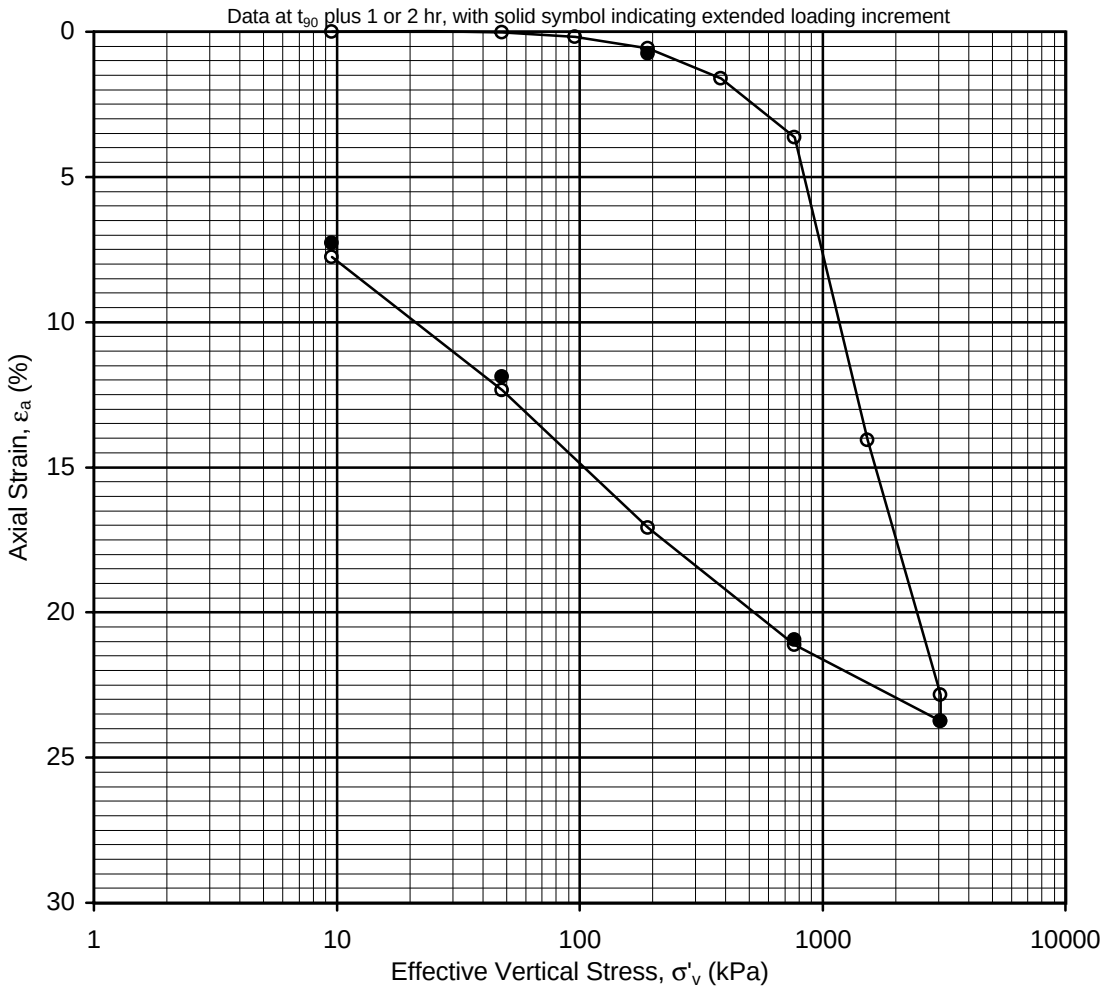
Sample No. 46 - Depth: 41.7m
Boring 98-58
SFOBB East Span Seismic Safety Project

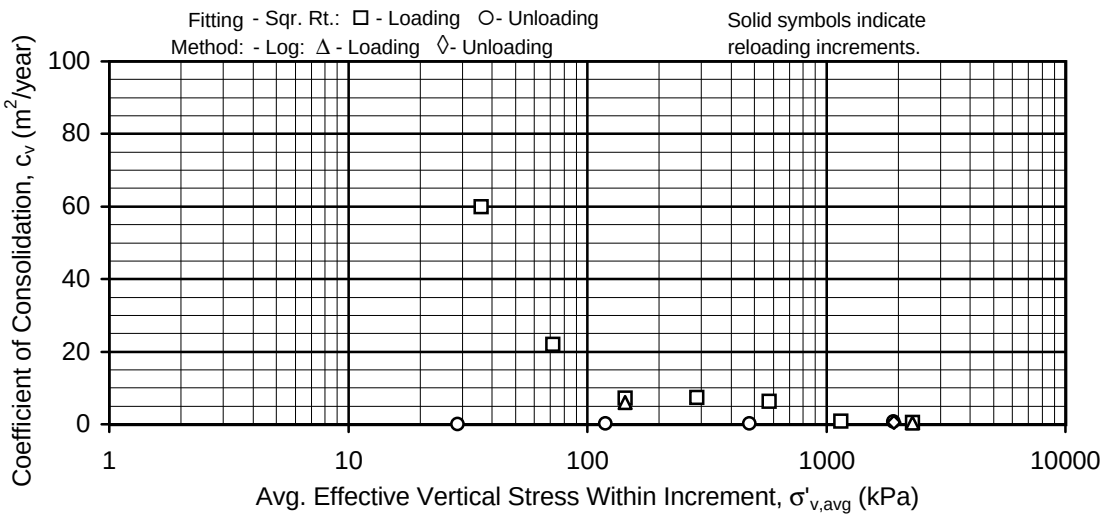




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 55 - Depth: 50.7m
Boring 98-58
SFOBB East Span Seismic Safety Project





INCREMENTAL CONSOLIDATION TEST RESULTS

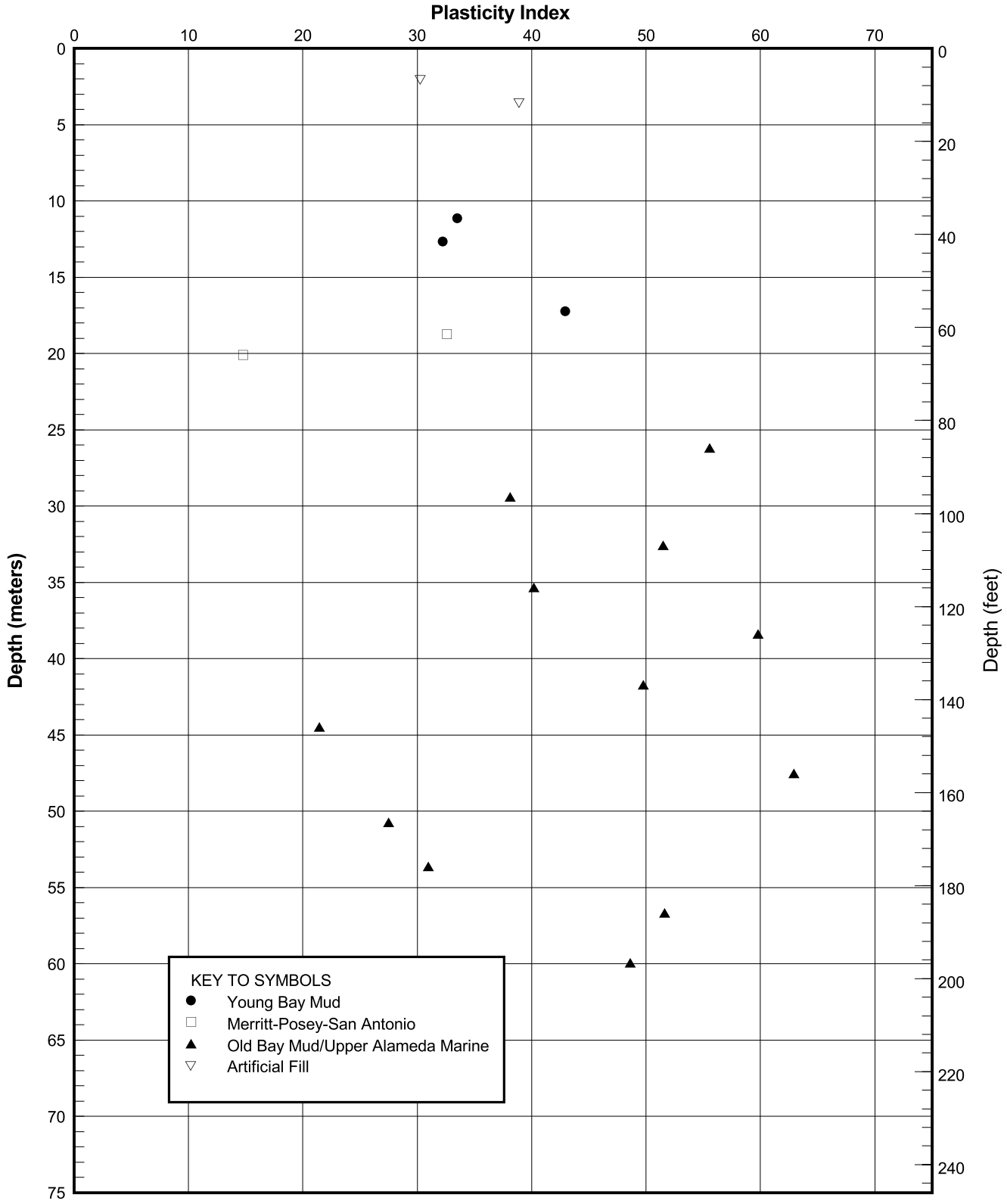
Sample No. 63 - Depth: 59.9m
Boring 98-58
SFOBB East Span Seismic Safety Project

No Consolidated-Undrained Triaxial Compression Testing Performed For This Boring

No Consolidated-Drained Triaxial Compression Testing Performed For This Boring

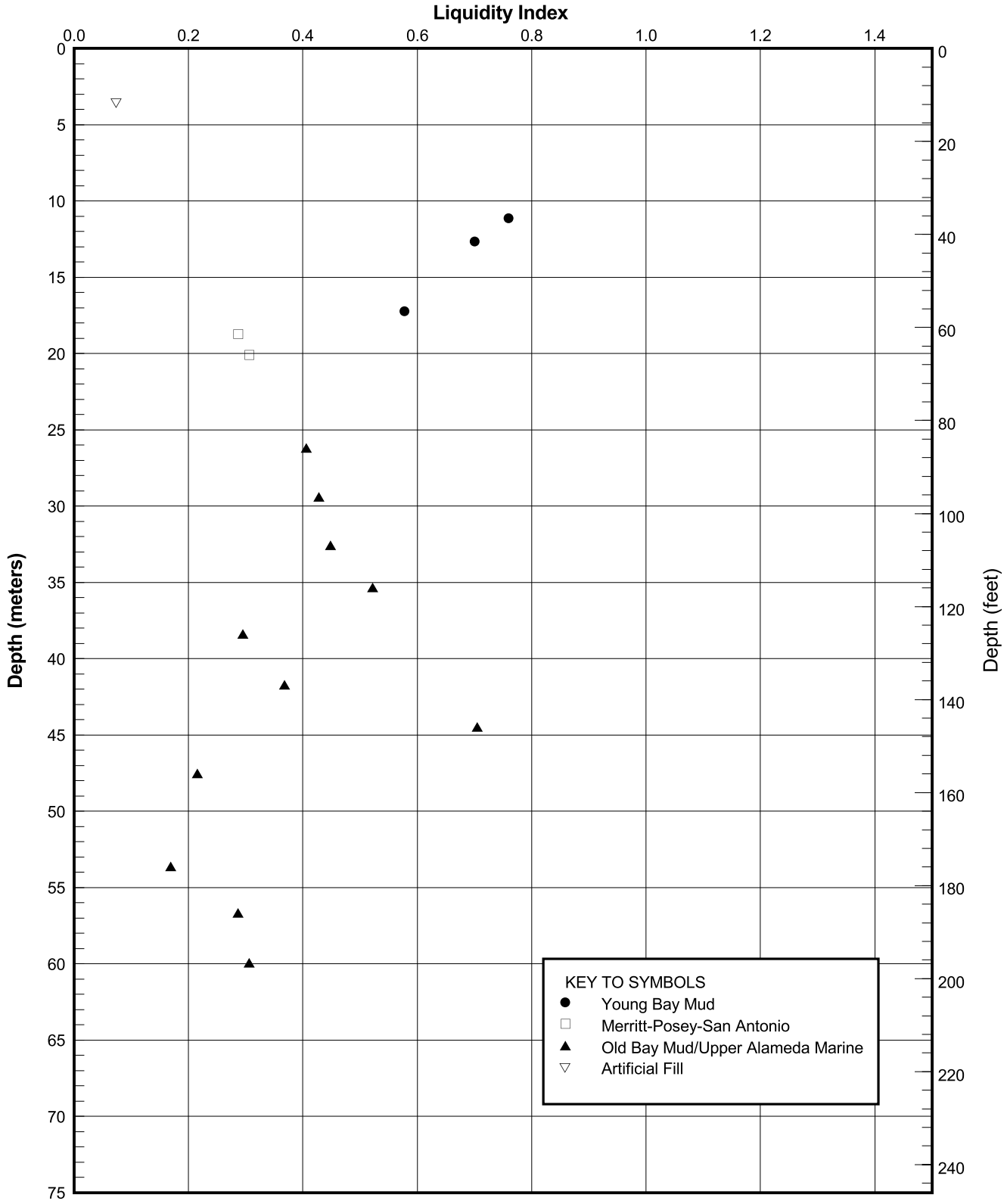
No R-Value Laboratory Testing Performed For This Boring

No Corrosion Testing Performed For This Boring



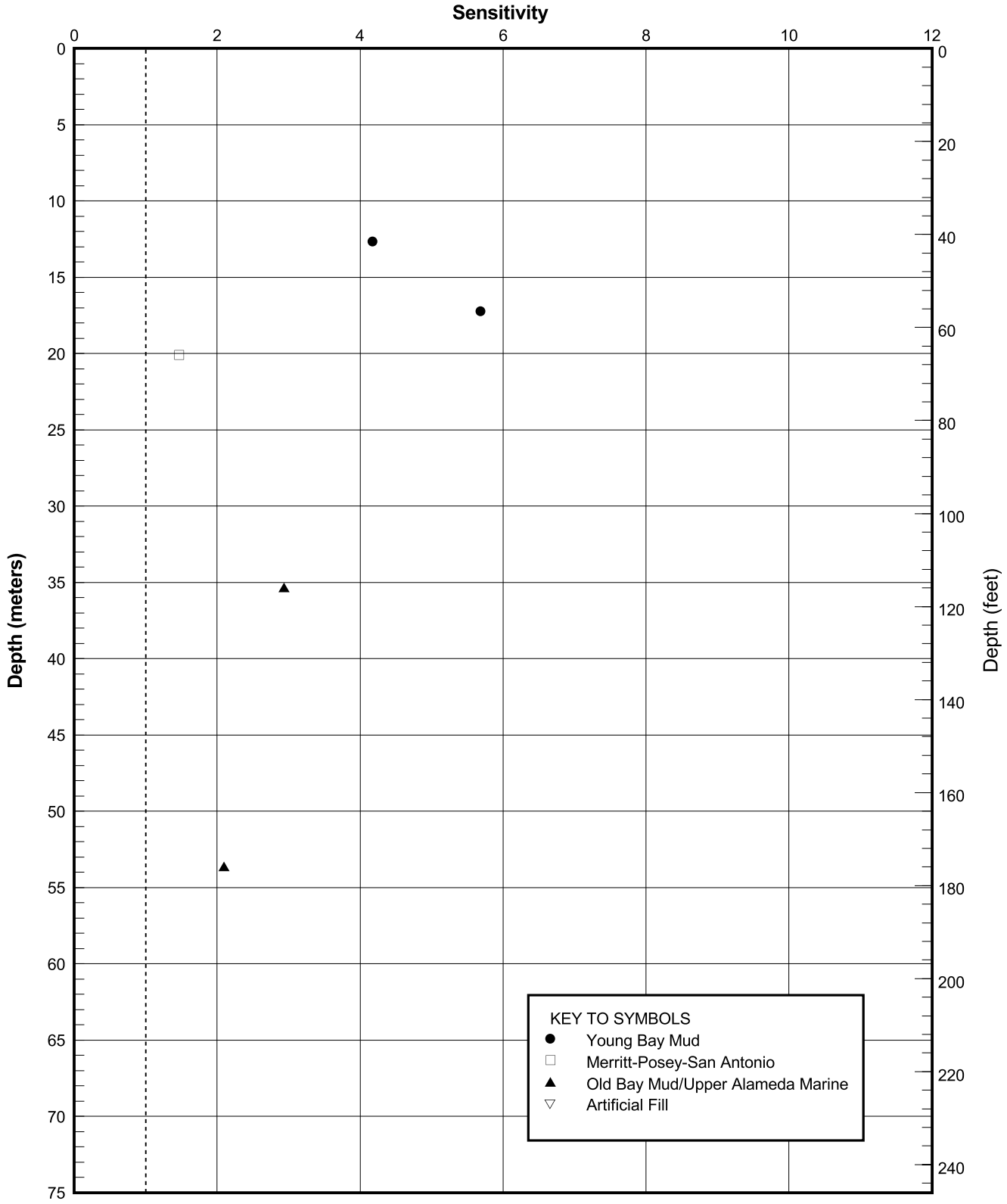
PLASTICITY INDEX PROFILE
Boring 98-58
SFOBB East Span Seismic Safety Project

PLATE 98-58.12



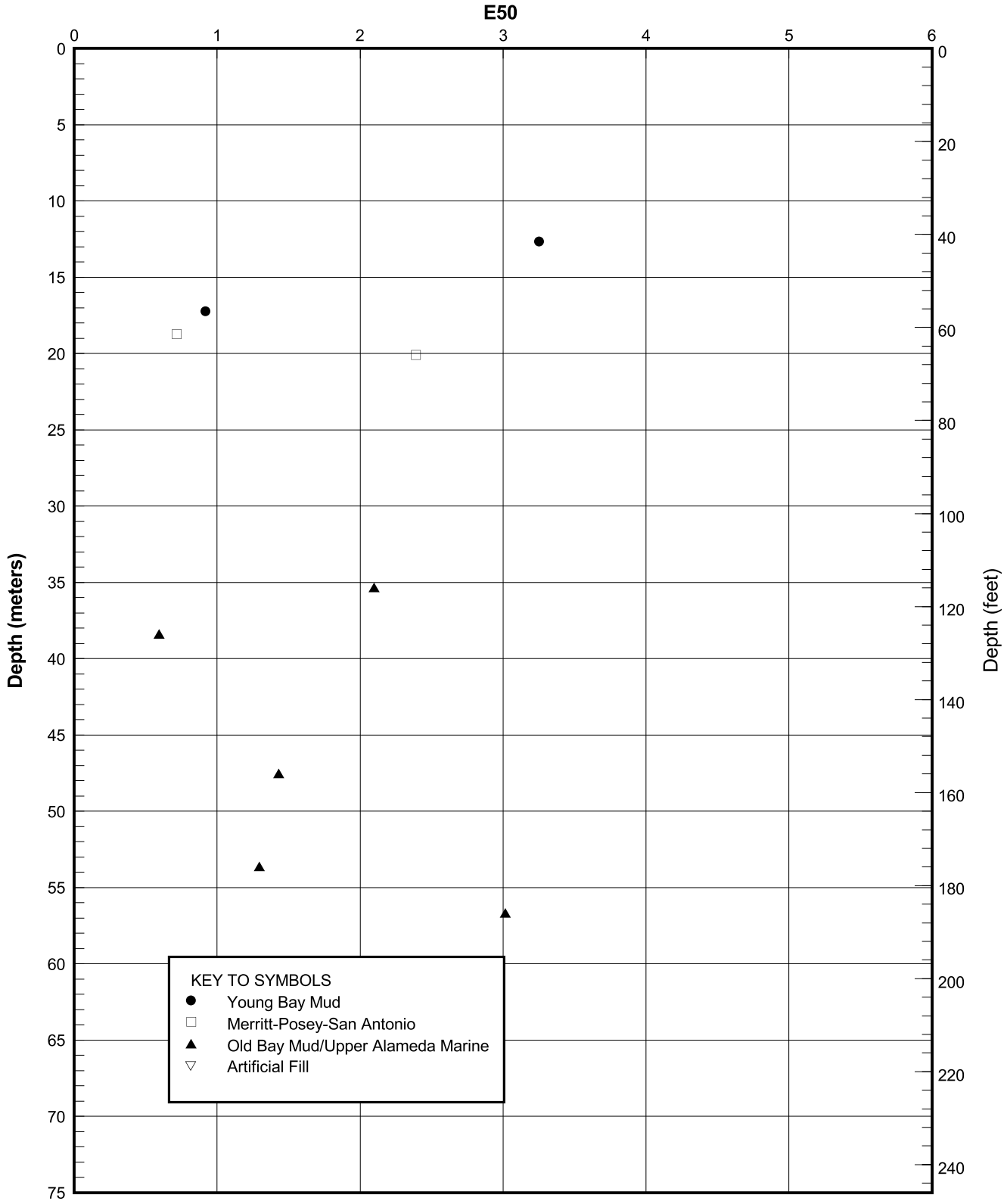
LIQUIDITY INDEX PROFILE
Boring 98-58
SFOBB East Span Seismic Safety Project

PLATE 98-58.13



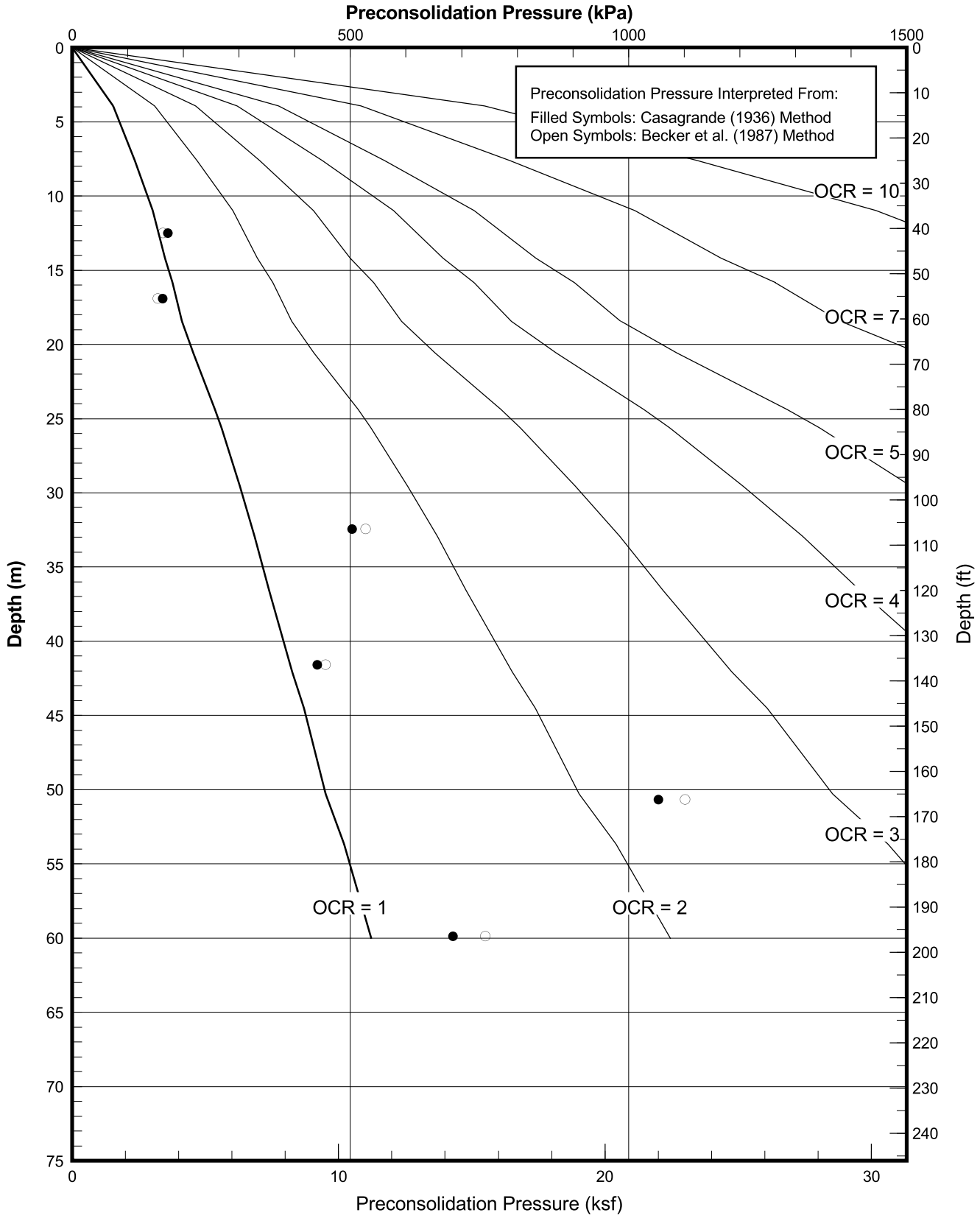
SENSITIVITY PROFILE
Boring 98-58
SFOBB East Span Seismic Safety Project

PLATE 98-58.14



E50 PROFILE
Boring 98-58
SFOBB East Span Seismic Safety Project

PLATE 98-58.15



PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-58

SFOBB East Span Seismic Safety Project

PLATE 98-58.16

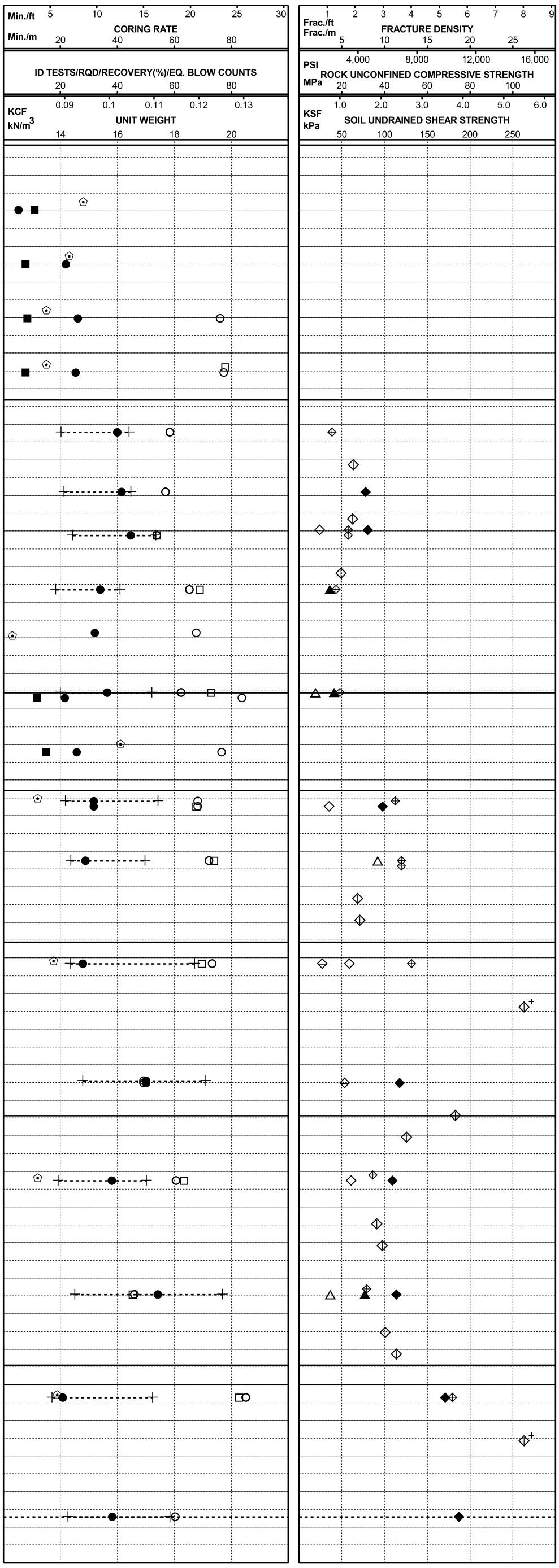
LAND BORING 98-59

PROJECT NO:	98-42-0058	**START DATE:**	10/7/98	**DRILLER:**	Pitcher Drilling Company
BORING:	98-59 (9m right of W. Sta. 89+77)	**COMPLETION DATE:**	10/9/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1839435 N648325
CA State Plane Zone 3, NAD83, Meters

GROUND ELEVATION: 3.5m (MSL)

Elevation, m.	Depth, m.	Soil Type	Sampler	Blow Count	Material Description	Stratum No.
					PAVEMENT, Asphalt Concrete over Aggregate Base (0.2m)	I
					Fine SAND with silt (SP-SM), medium dense, brown	
				28	-moist at 1.8m	
				23	▽ (3.5m)	II
				15	-greenish gray below 4.6m -with shell fragments at 4.6m	
				24	(7.3m)	
				PUSH	Fat CLAY (CH), firm to stiff, olive gray -with shell fragments -lean clay to 10.4m -with fine sand seams, 7.9m to 9.8m	III
				SAVE		
				PUSH	-with an H2S odor, 10.7m to 12.8m -with silt pockets, mica, and gas blisters, at 11.0m	
				PUSH	-with sand pockets and partings, below 12.5m	
				3	(15.5m)	
				PUSH	Silty Fine SAND (SM), dense, gray -with clay pockets and seams, and shell fragments, at 15.5m	IV
				41	-with clay pockets at 17.1m	
				19	(18.3m)	
					Fat Clay (CH), stiff to very stiff, greenish gray	V
				PUSH	-with sandy silt pockets, a few sand pockets, and gas blisters, at 20.1m	
				28	(22.6m)	
					Fat CLAY (CH), very stiff, greenish gray -with shell fragments, brown mottling, and a few calcareous nodules, at 23.2m	VI
				SAVE	-with sand pockets and a few shell fragments, at 26.2m	
				19	(27.4m)	
					Fat CLAY (CH), very stiff, greenish gray	VII
					-with silty sand pockets and calcareous nodules, at 29.3m	
				PUSH	-with a few silty sand pockets at 32.3m	
				30	(34.4m)	
					Fat CLAY (CH), very stiff to hard, greenish gray -with a few organic pockets and a few silt pockets, at 35.1m	VIII
				SAVE	-with fine sand partings at 38.4m	
					TOTAL DEPTH: 38.7m BACKFILLED WITH: Cement Grout	



LOG OF BORING AND TEST RESULTS

BORING 98-59

SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

Report Date: 03/11/99

PLATE 98-59.1

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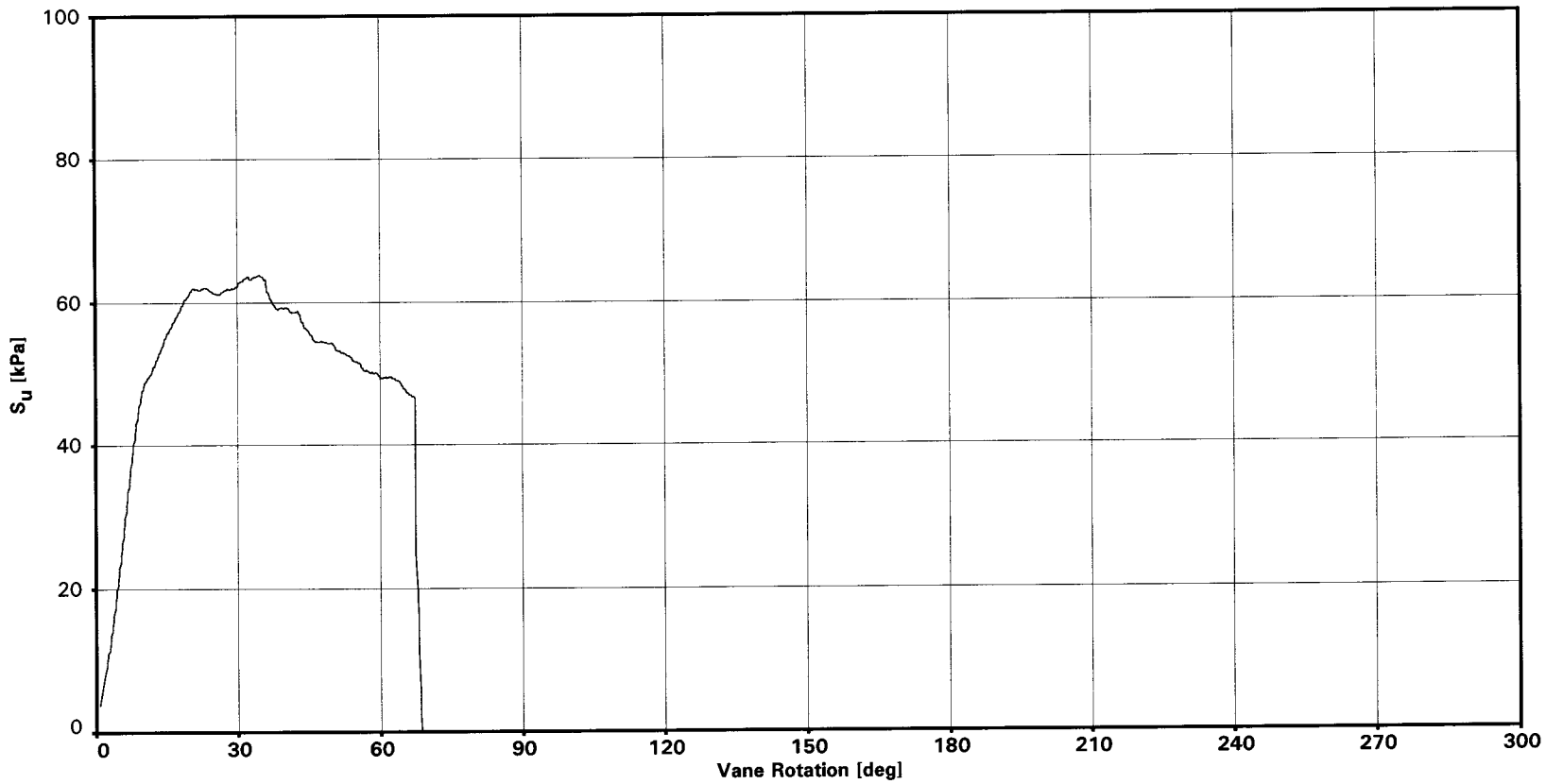
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 9.1m
Boring 98-59
SFOBB East Span Seismic Safety Project

PLATE 98-59.2a

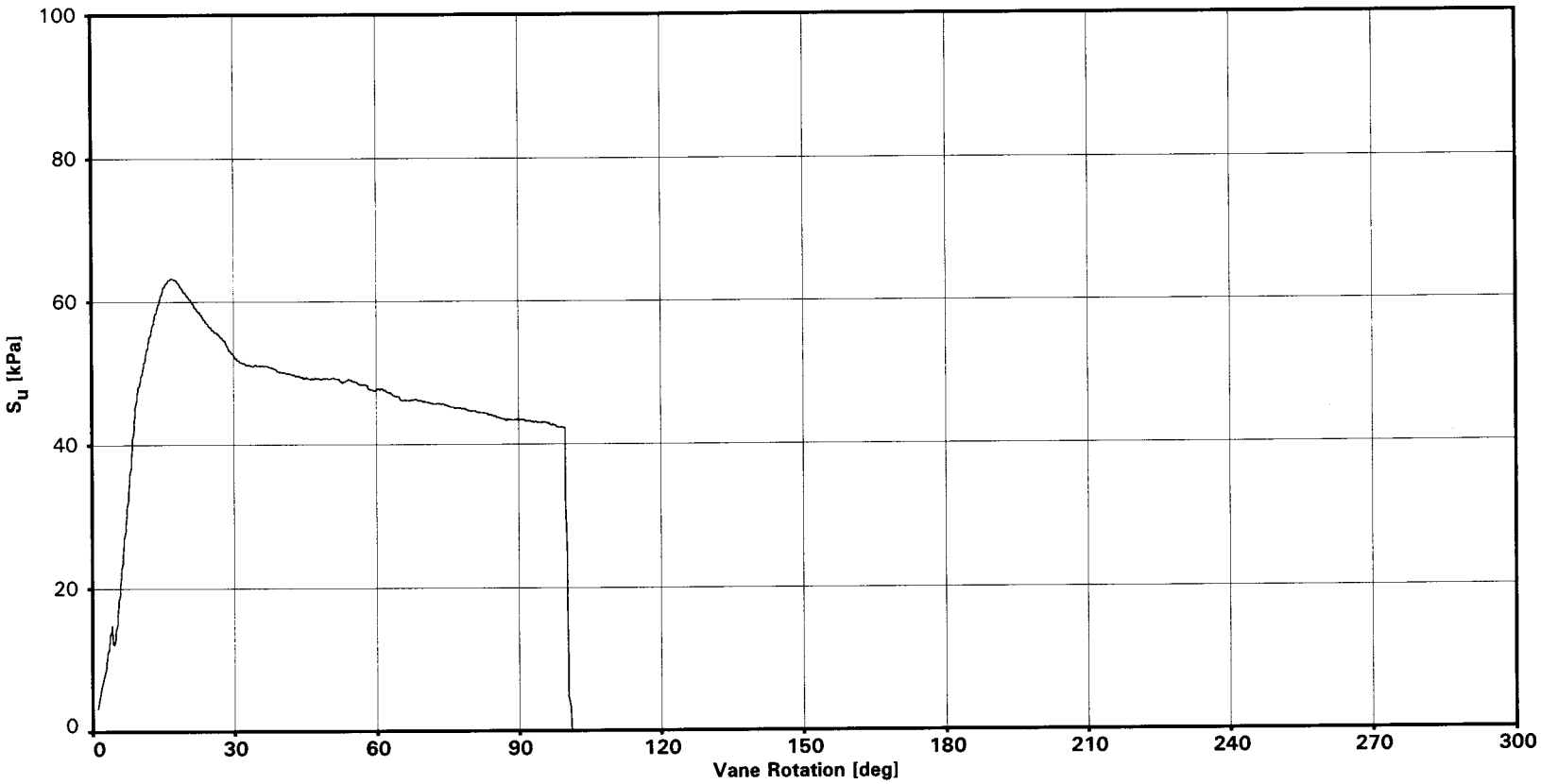
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



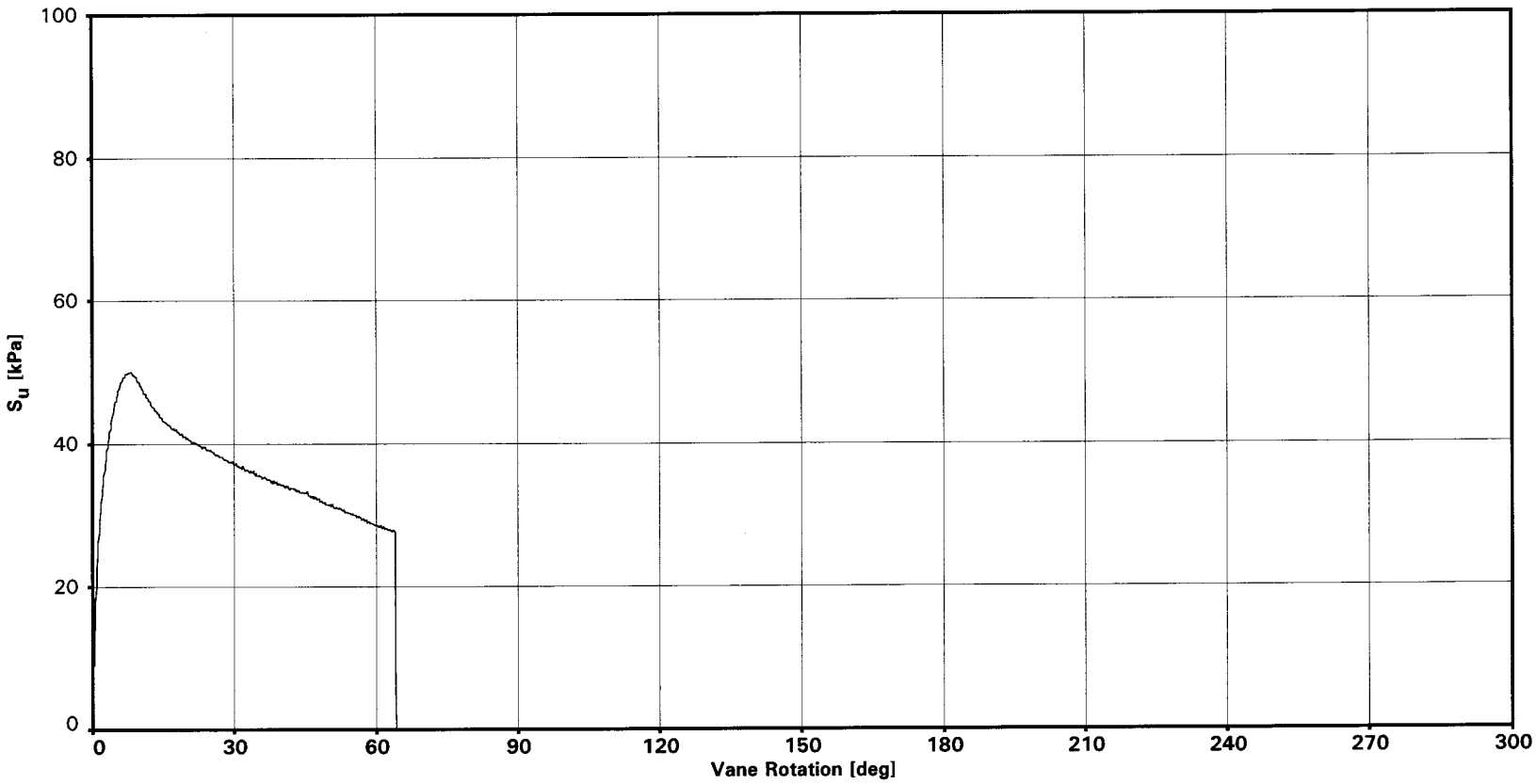
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 10.7m
Boring 98-59
SFOBB East Span Seismic Safety Project

PLATE 98-59.2b

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 12.2m
Boring 98-59
SFOBB East Span Seismic Safety Project

Earth Mechanics

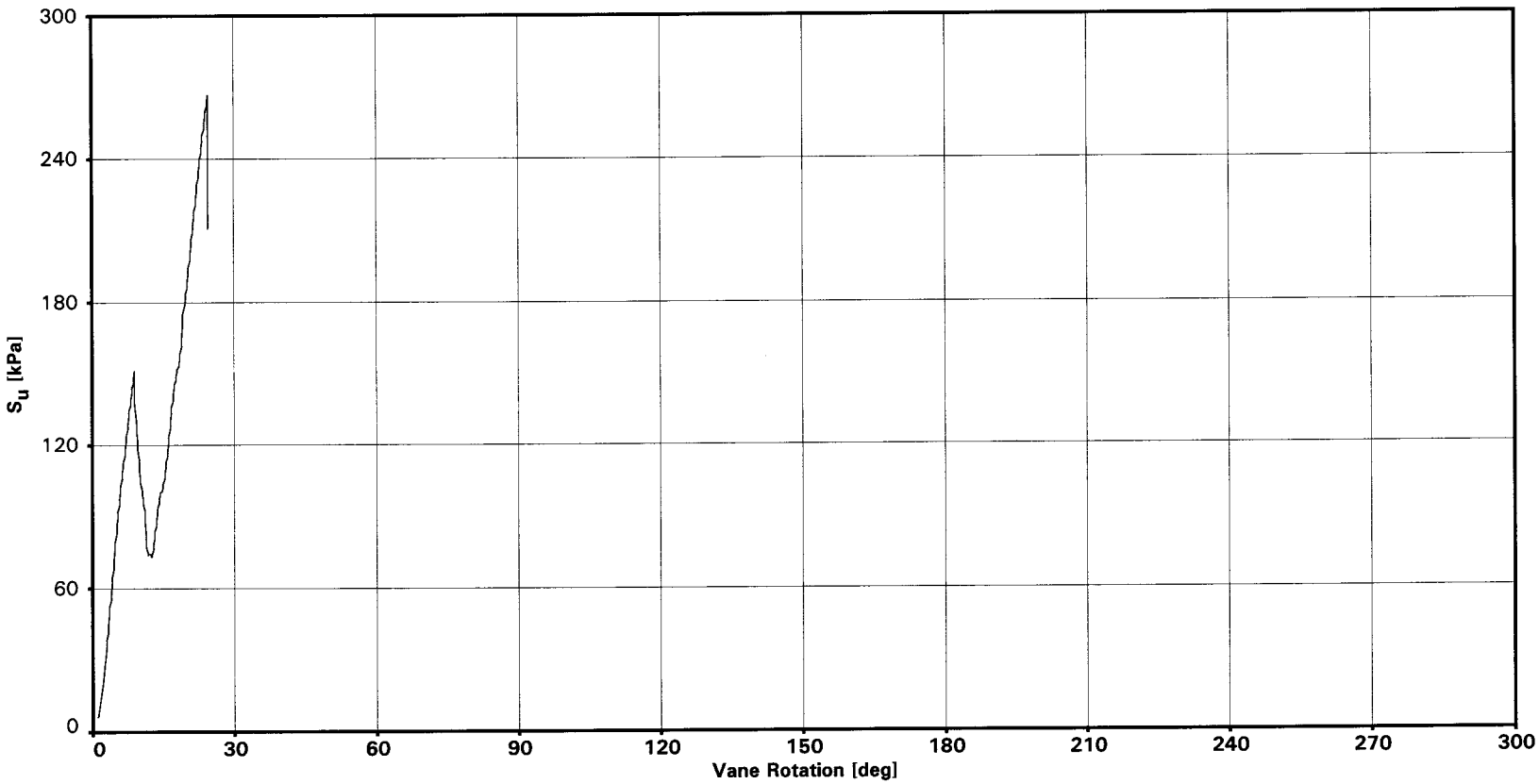
FUGRO

PLATE 98-59.2c

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 24.4m
Boring 98-59
SFOBB East Span Seismic Safety Project

Earth Mechanics

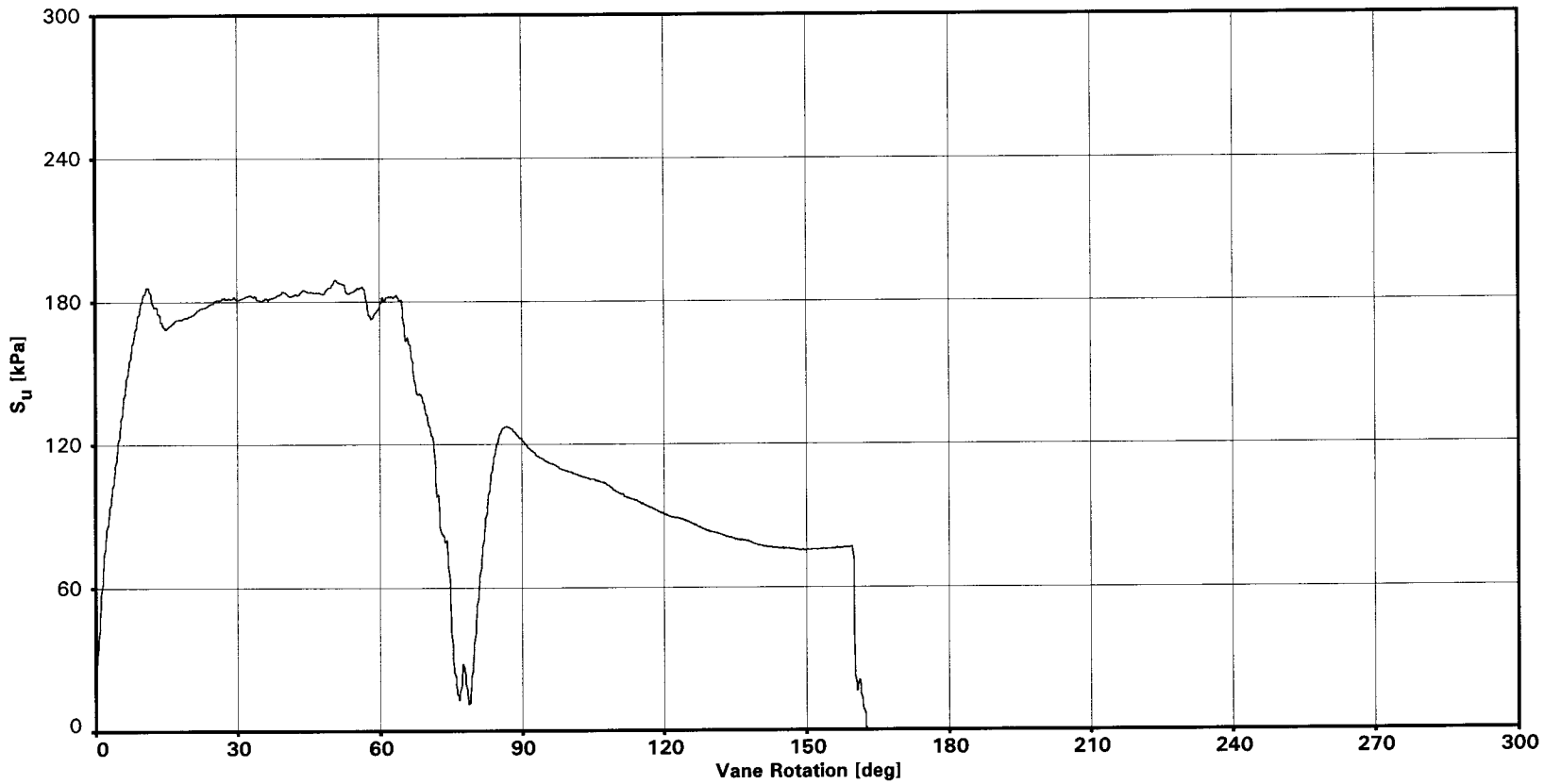
FUGRO

PLATE 98-59.2d

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 27.4m and 28.0m
Boring 98-59
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-59.2e

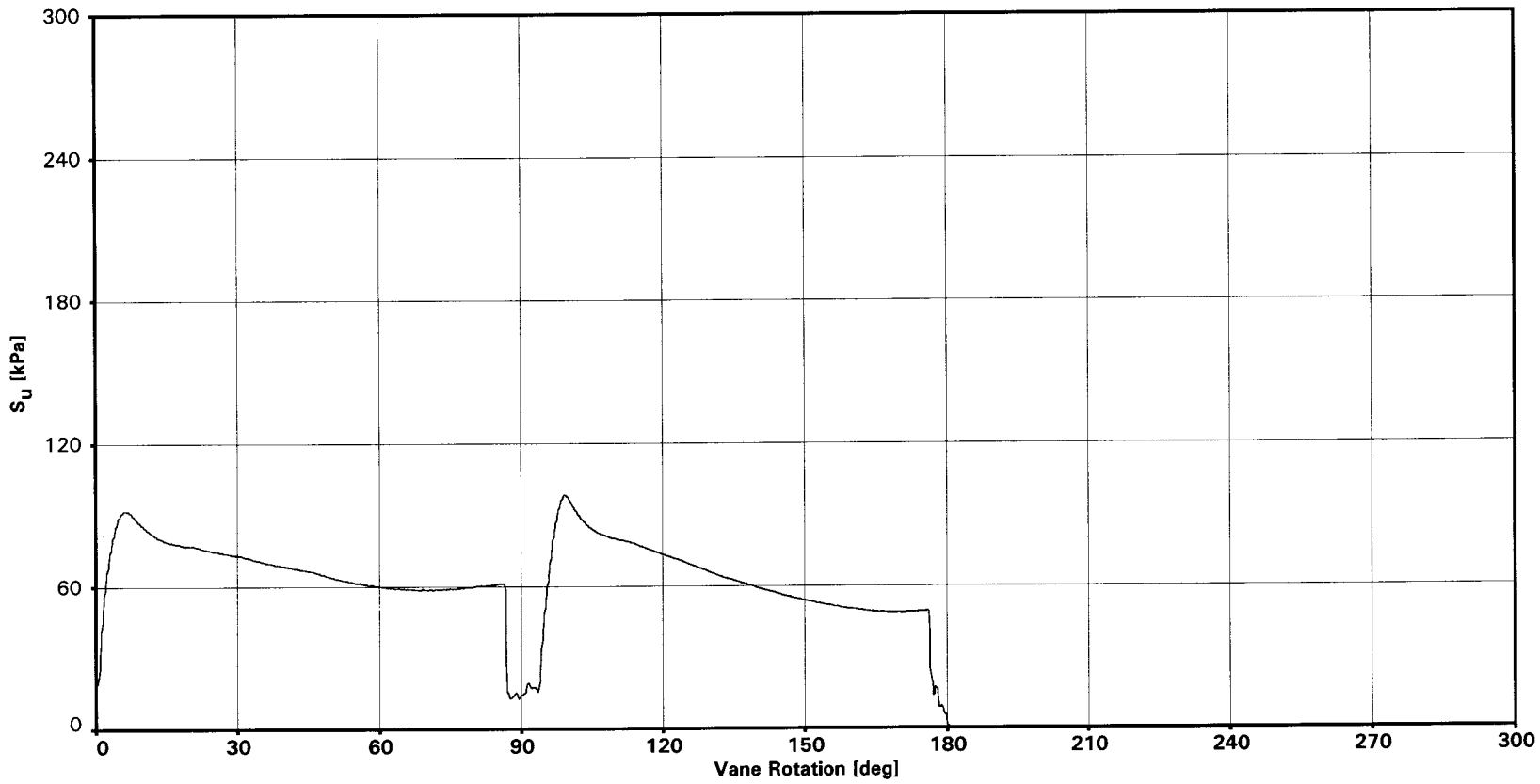
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 30.5m and 31.1m
Boring 98-59
SFOBB East Span Seismic Safety Project

PLATE 98-59.2f

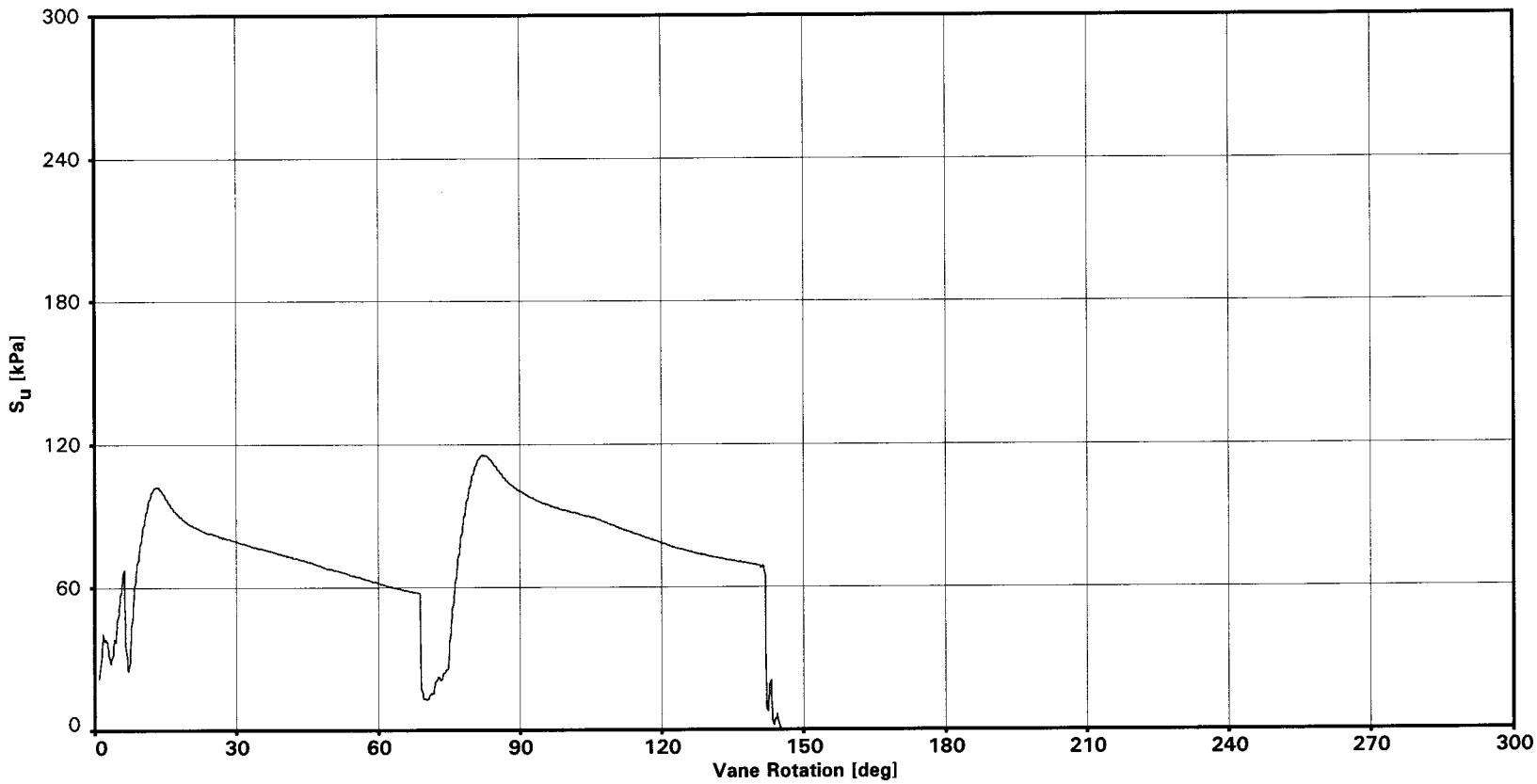
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



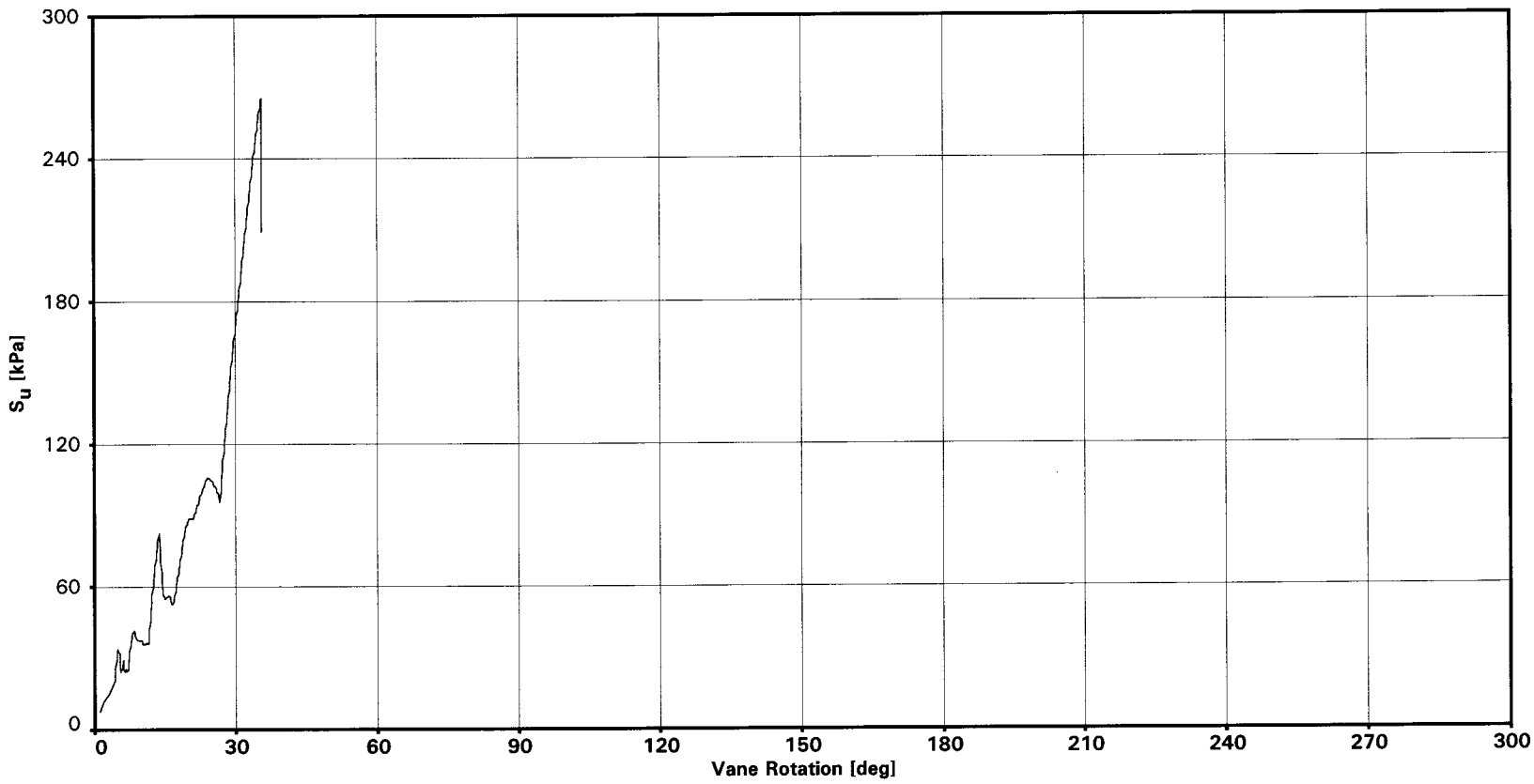
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 33.5m and 34.1m
Boring 98-59
SFOBB East Span Seismic Safety Project

PLATE 98-59.2g

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 36.6m
Boring 98-59
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-59.2h

SFOBB Task Order No. 5
Project No. 98-42-0058

98-59		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
2.0	1	5					11																				
3.5	2	22					8																				2.69
5.0	3	26					8																				
6.4	4					19.8												10.1	47								
6.6	5	25					8																				
8.2	7	40	44	20	0.82			38.3																			
9.1	400													63.2													
9.9	9	41	45	21	0.86						77.9																2.74
10.7	401													62.7													
11.0	11							57.5			80.2	23.9															
11.1	12	45	54	24	0.69	17.4		57.5																			
12.2	402													48.8													
12.6	15	34	41	18	0.68	18.9		43.1							36.0		1.1										
12.8	16	34	21	15	3.54																						
13.9	17	32																									

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-59
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-59.3a

c:\snfco-oak\current\odb\98-59suma.odb

SFOBB Task Order No. 5
Project No. 98-42-0058

98-59		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
15.5	18	36	52	20	0.51	19.3		47.9							40.9	18.8	1.1										
15.7	19	21					12																				
17.2	20	26					15																			H	2.76
18.6	21	32	54	22	0.30			112.5																			
18.7	22					18.8					97.8	35.1															
20.3	24	29	50	24	0.19	19.4		119.7								91.5											
20.4	25							119.7																			
21.3	403													68.5													
21.9	404													70.9													
23.2	26	28	67	23	0.10	18.9		131.7				58.7	26.9														2.73
24.4	405													263.3+													
26.5	28	50	71	28	0.51																					C	
26.5	29										117.6		53.2														
27.4	407													182.9													
28.0	408													125.4													

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-59
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-59.3b

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SFOBB Task Order No. 5
Project No. 98-42-0058

98-59		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
29.1	30							86.2																			
29.3	31	38	50	19	0.60	18.3					108.9	60.7															
30.5	409													91.0													
31.1	410													97.2													
32.3	33							79.0																			
32.5	34	54	77	25	0.56	16.5					113.9				77.0	36.4	0.8										
33.5	411													100.5													
34.1	412													114.0													
35.4	36	21	53	17	0.10	20.3		179.6			170.8																
36.6	413													263.3+													
38.6	38	34	55	21	0.39																					C	
38.7	39	38	59	23	0.43						186.9																

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

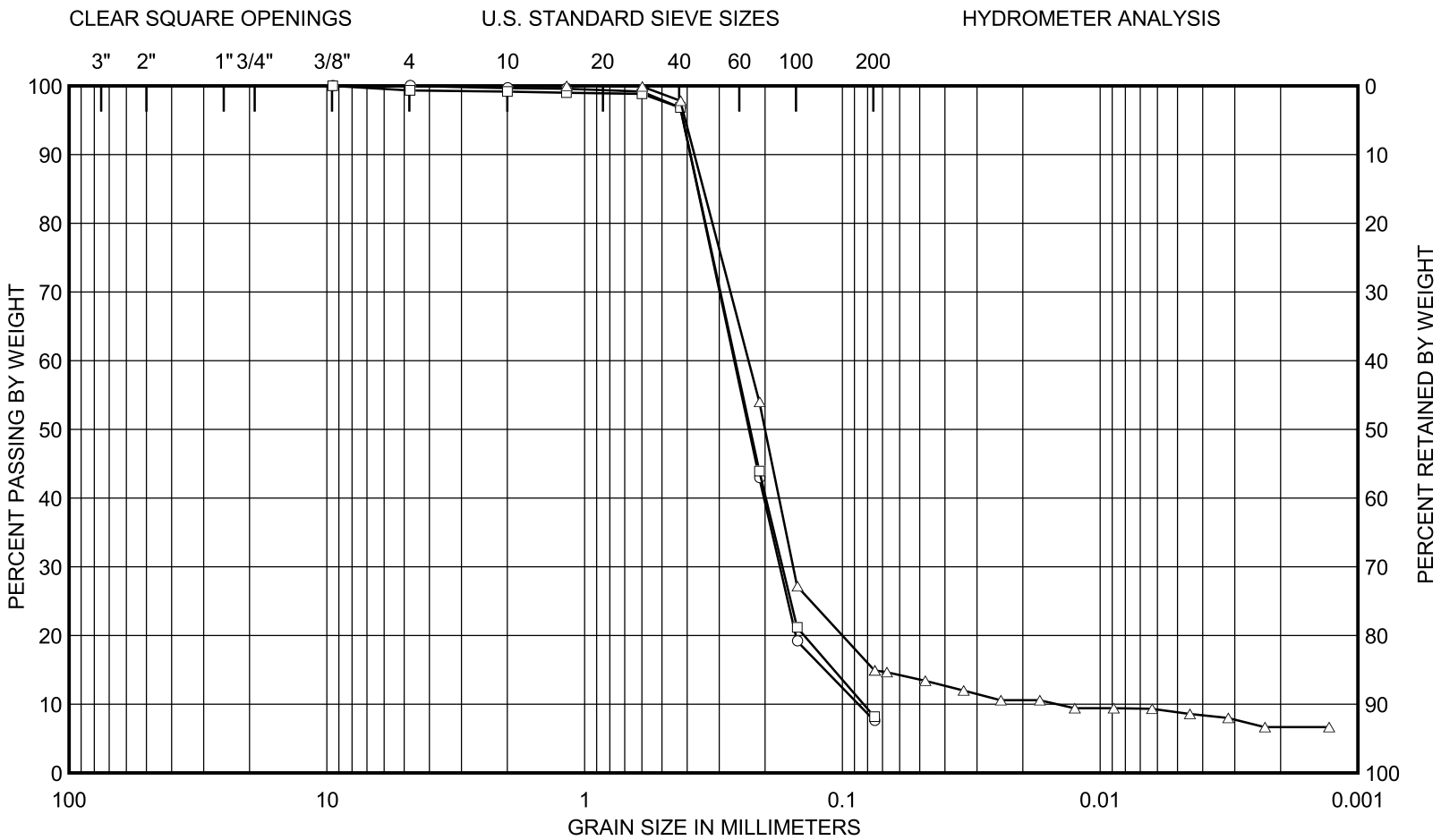
SUMMARY OF LABORATORY TEST RESULTS
Boring 98-59
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-59.3c

c:\snfco-oak\current\odb\98-59sumc.odb



GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
2	3.5	○——○	FINE SAND (SP-SM) with silt	1.3	3.0	0.23
3	5.0	□——□	FINE SAND (SP-SM) with silt	1.4	3.2	0.23
20	17.2	△——△	SILTY FINE SAND (SM)			0.20

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-59
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

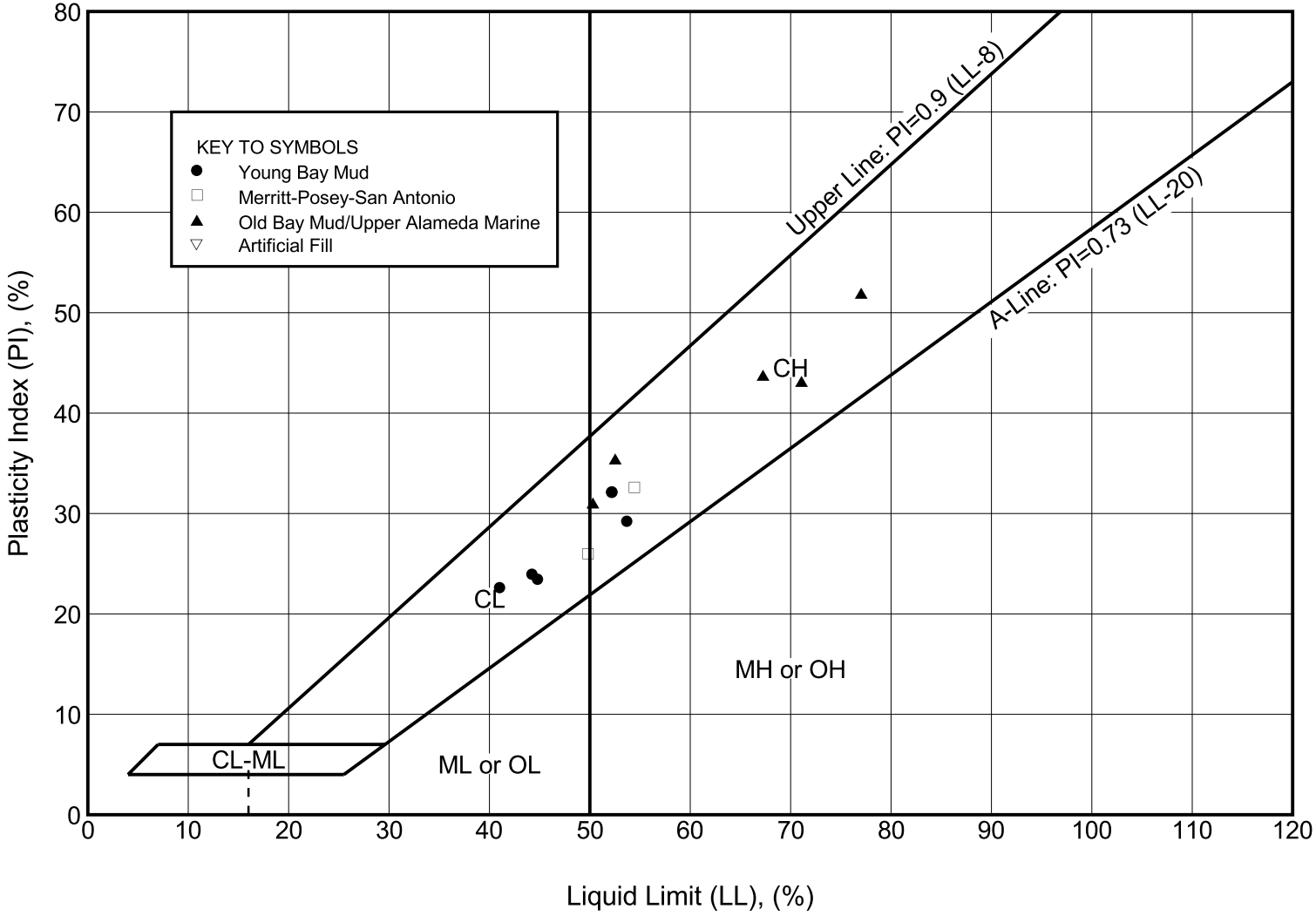
Earth Mechanics

FUGRO

PLATE 98-59.4

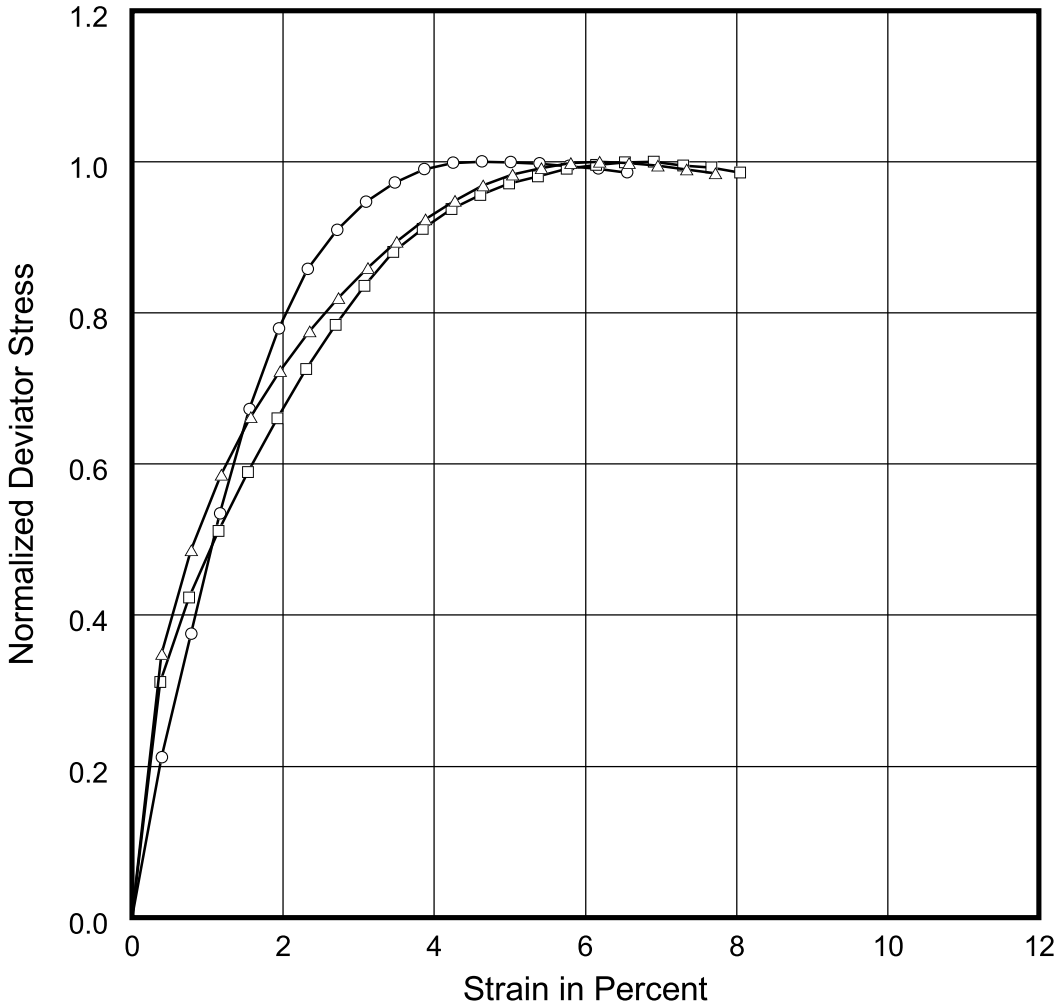
i:\caltrans\98-59 02/22/YY

c:\snfco-oak\current\odb\9859grm.odb



PLASTICITY CHART
Boring 98-59
SFOBB East Span Seismic Safety Project

i:\caltrans\ 03/55/YY
c:\snfco-oak\current\odb\9859pla.odb



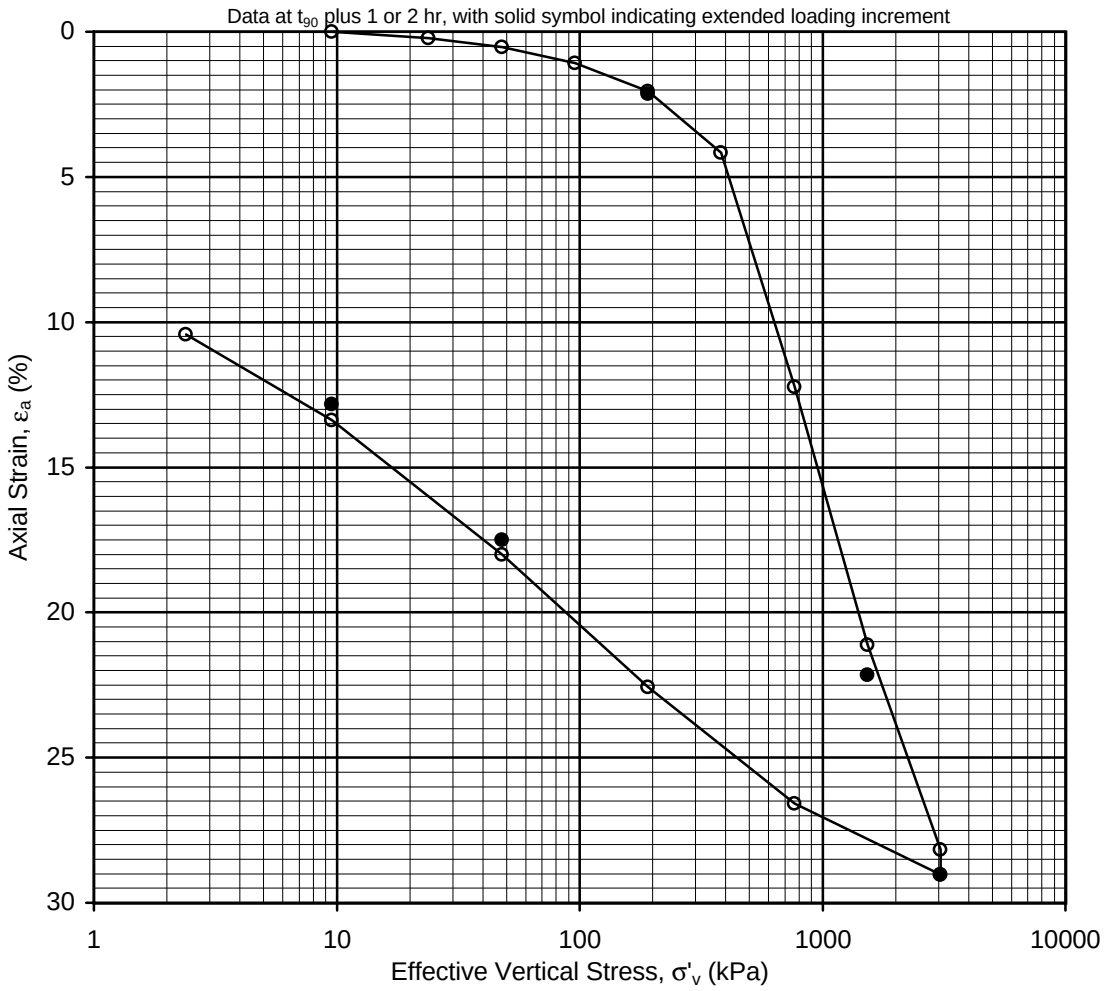
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	15	12.6	UU	241	72	1.1
□——□	18	15.5	UU	345	82	1.1
△——△	34	32.5	UU	931	154	0.8

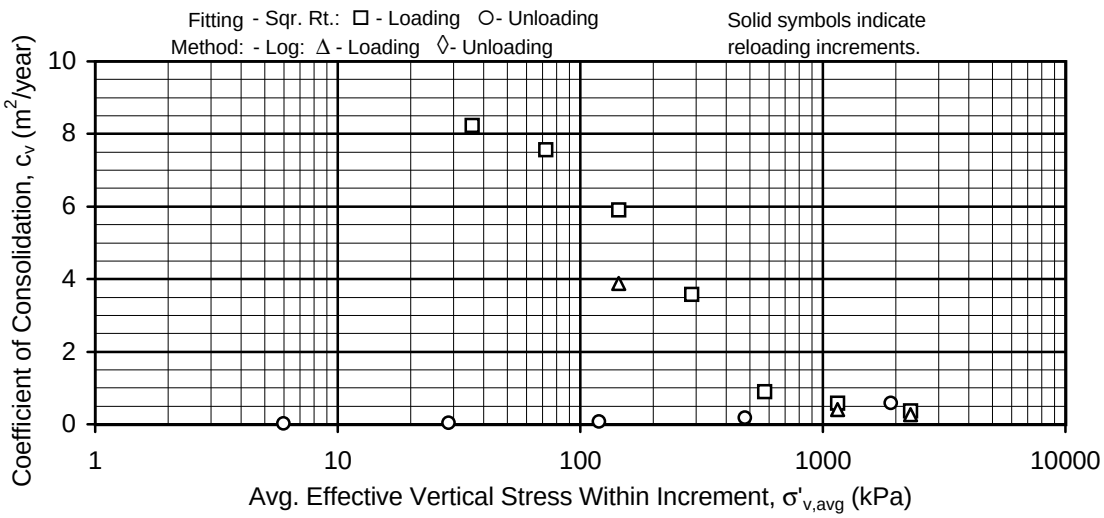
Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-59
SFOBB East Span Seismic Safety Project

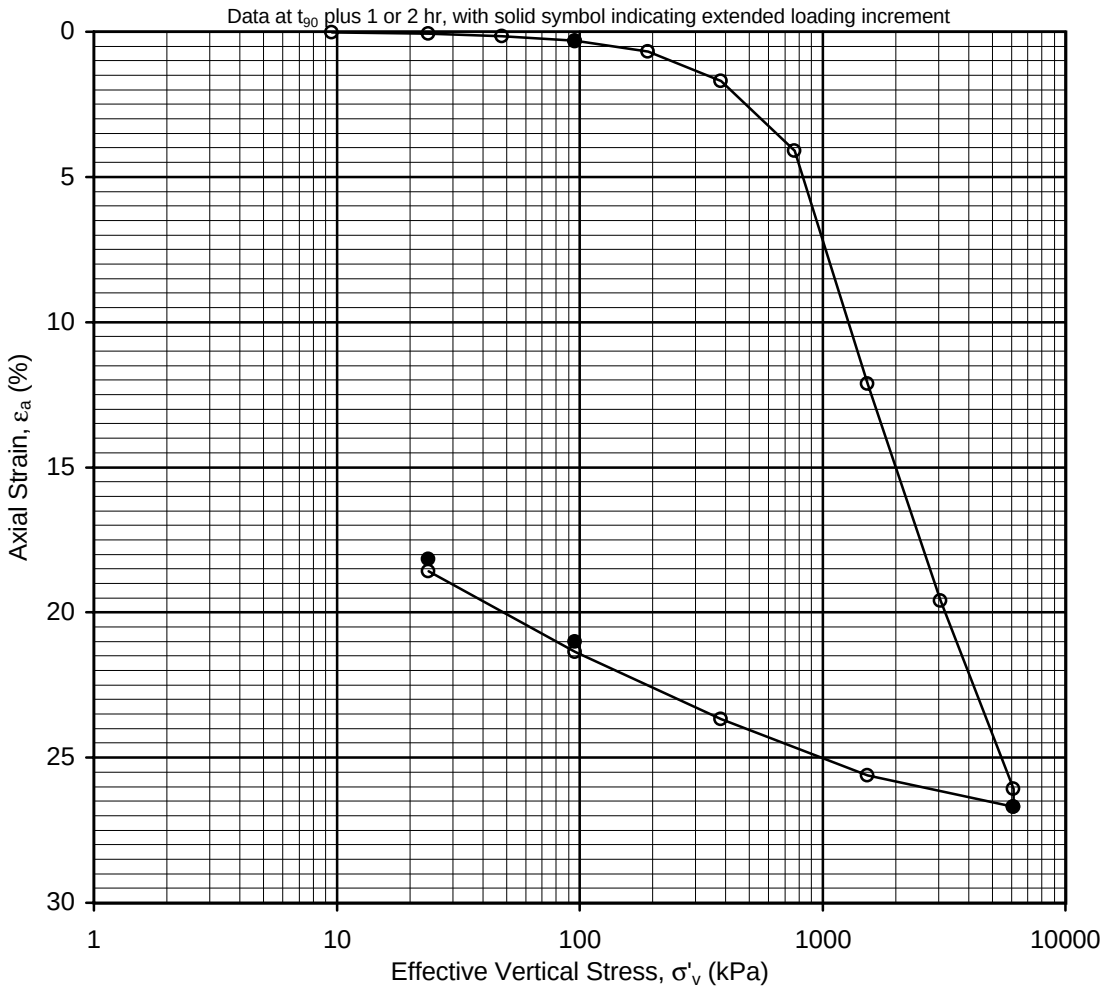
PLATE 98-59.6

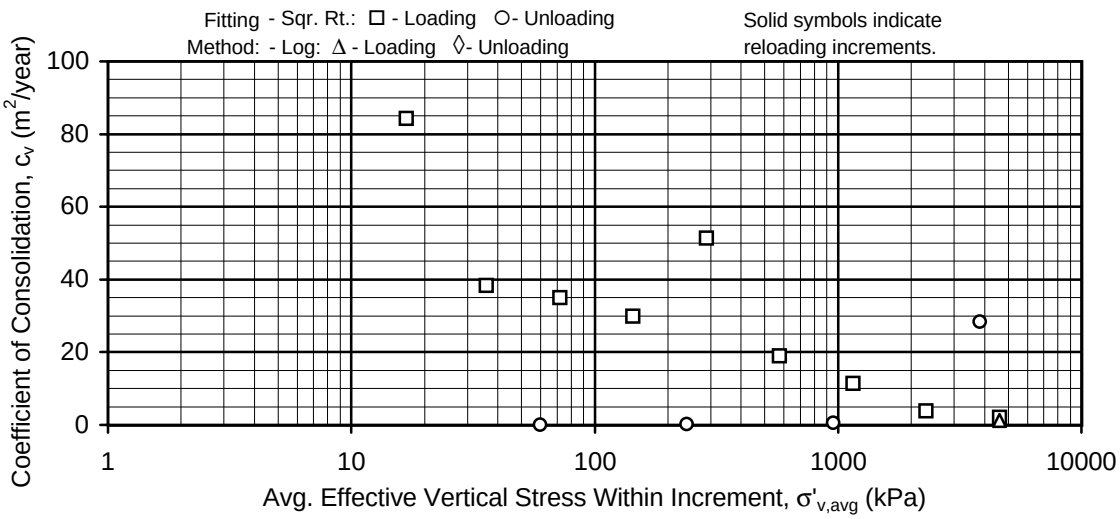




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 28 - Depth: 26.4m
Boring 98-59
SFOBB East Span Seismic Safety Project

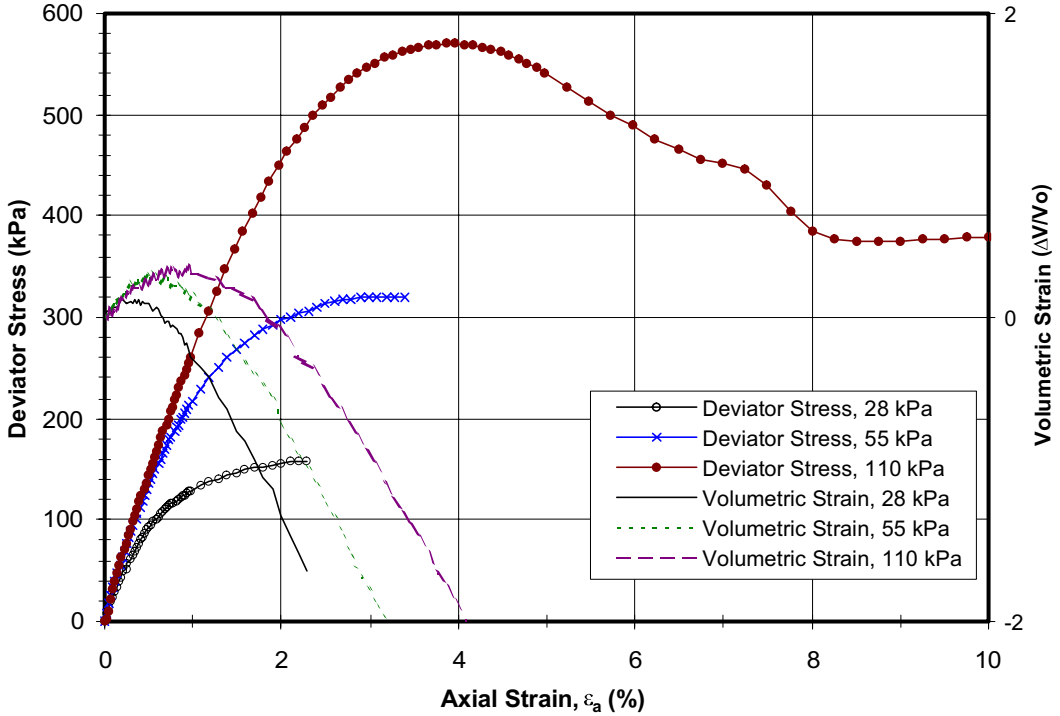


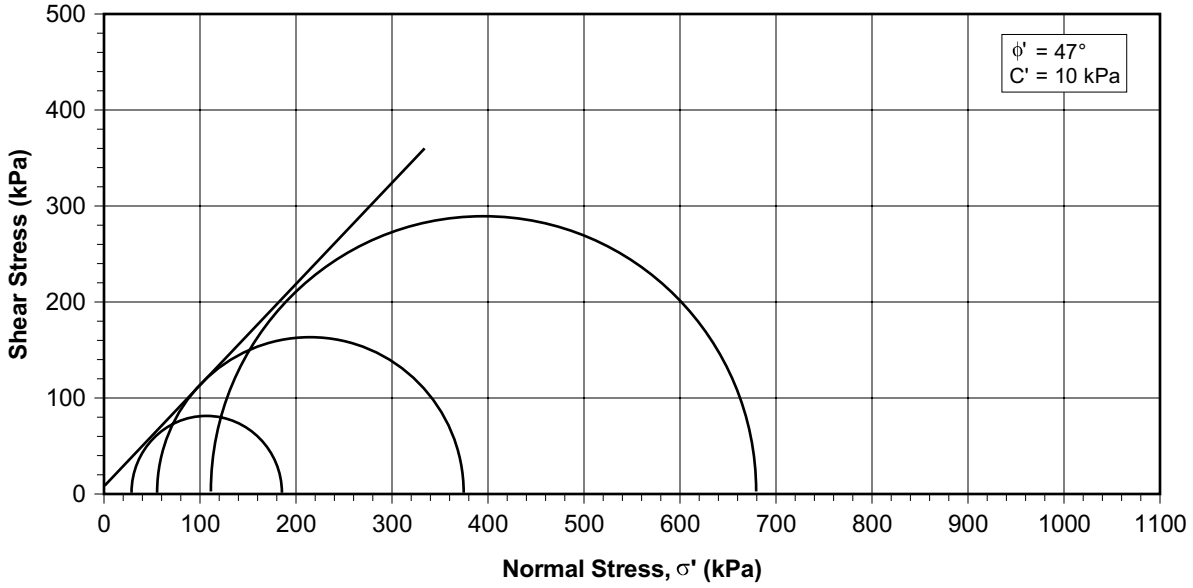


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 38 - Depth: 38.5m
Boring 98-59
SFOBB East Span Seismic Safety Project

No Consolidated-Undrained Triaxial Compression Testing Performed For This Boring





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 4 - Depth: 6.4m

Boring 98-59

SFOBB East Span Seismic Safety Project

PLATE 98-59.9

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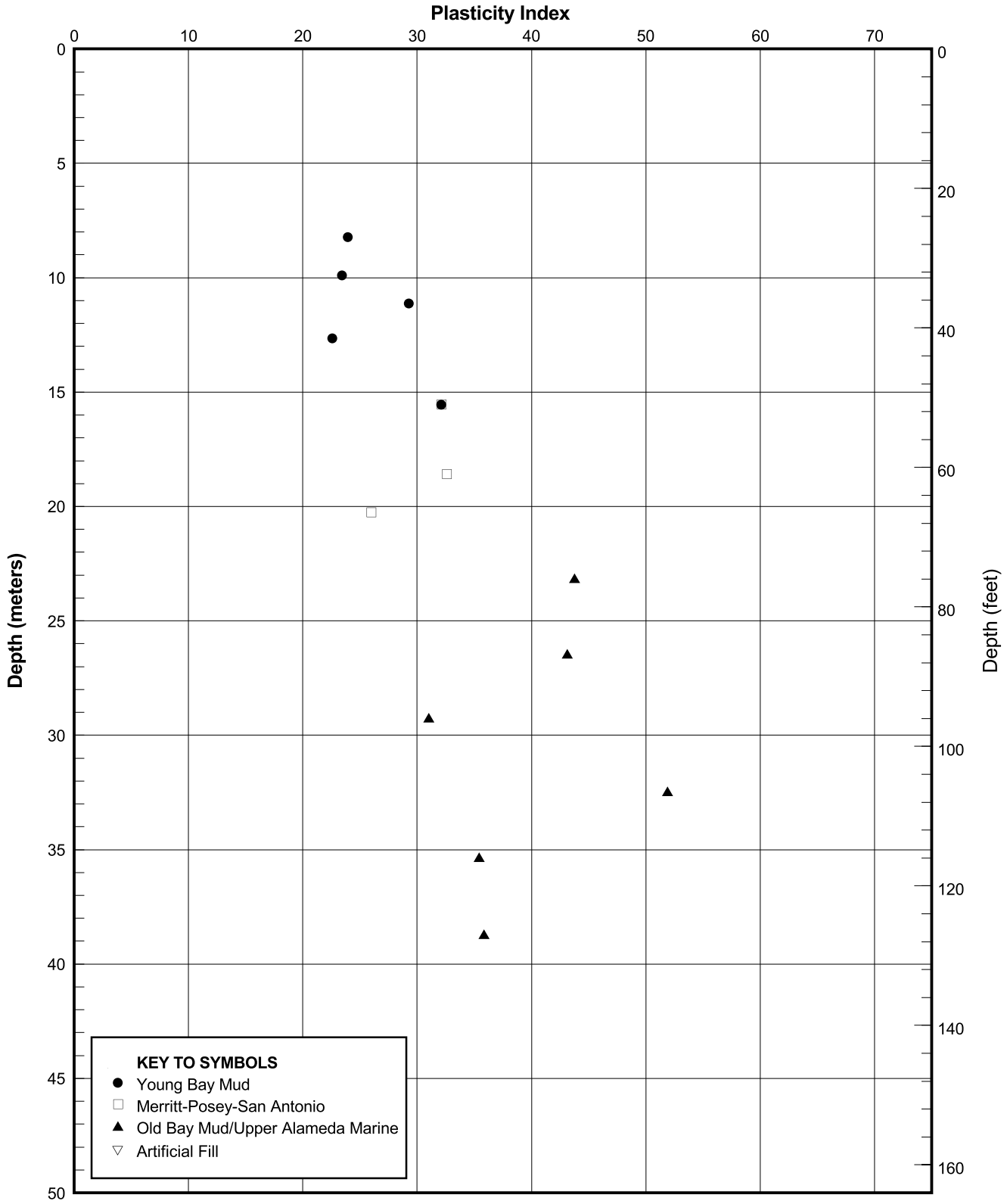
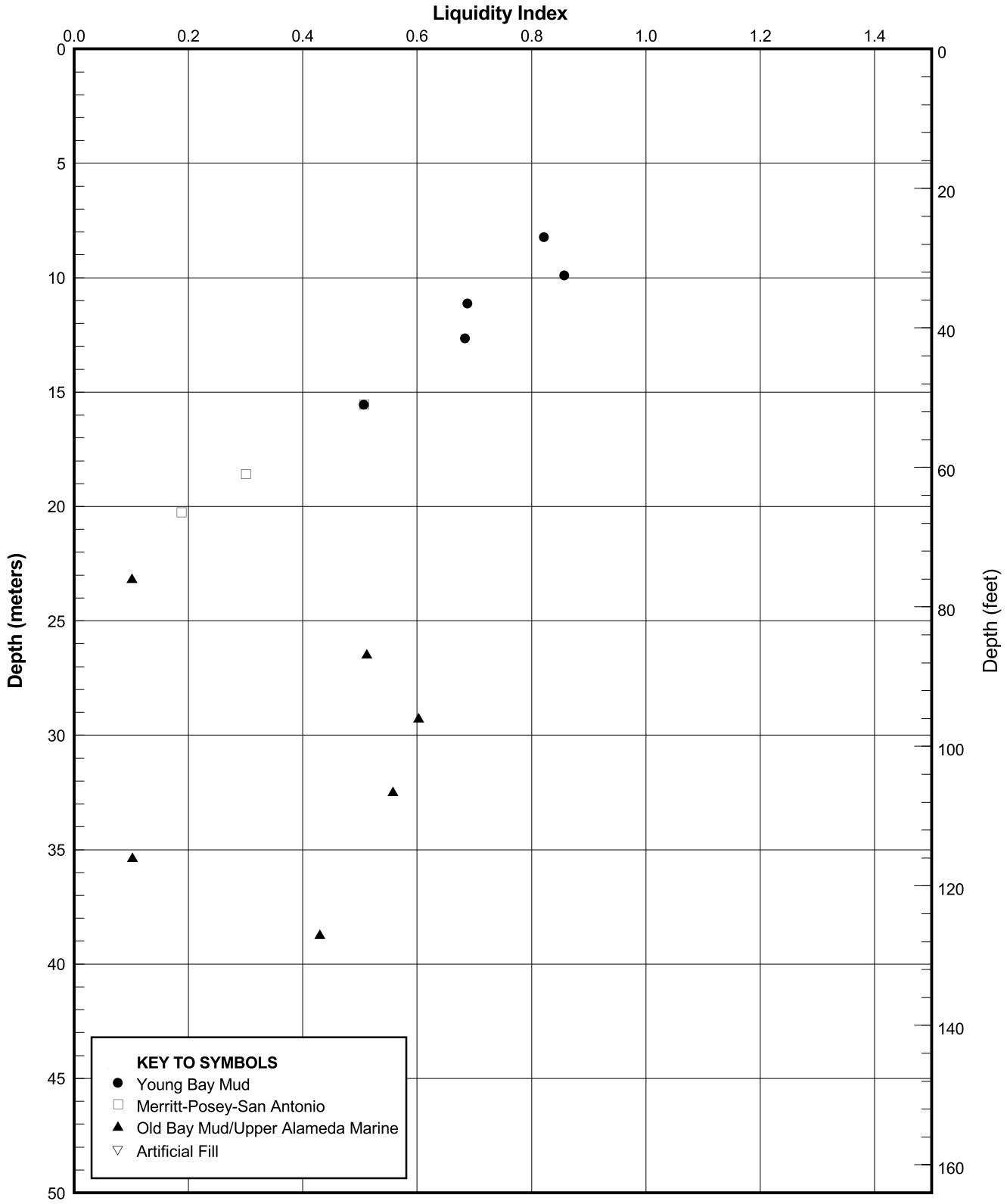
No R-Value Laboratory Testing Performed For This Boring

No Corrosion Testing Performed For This Boring



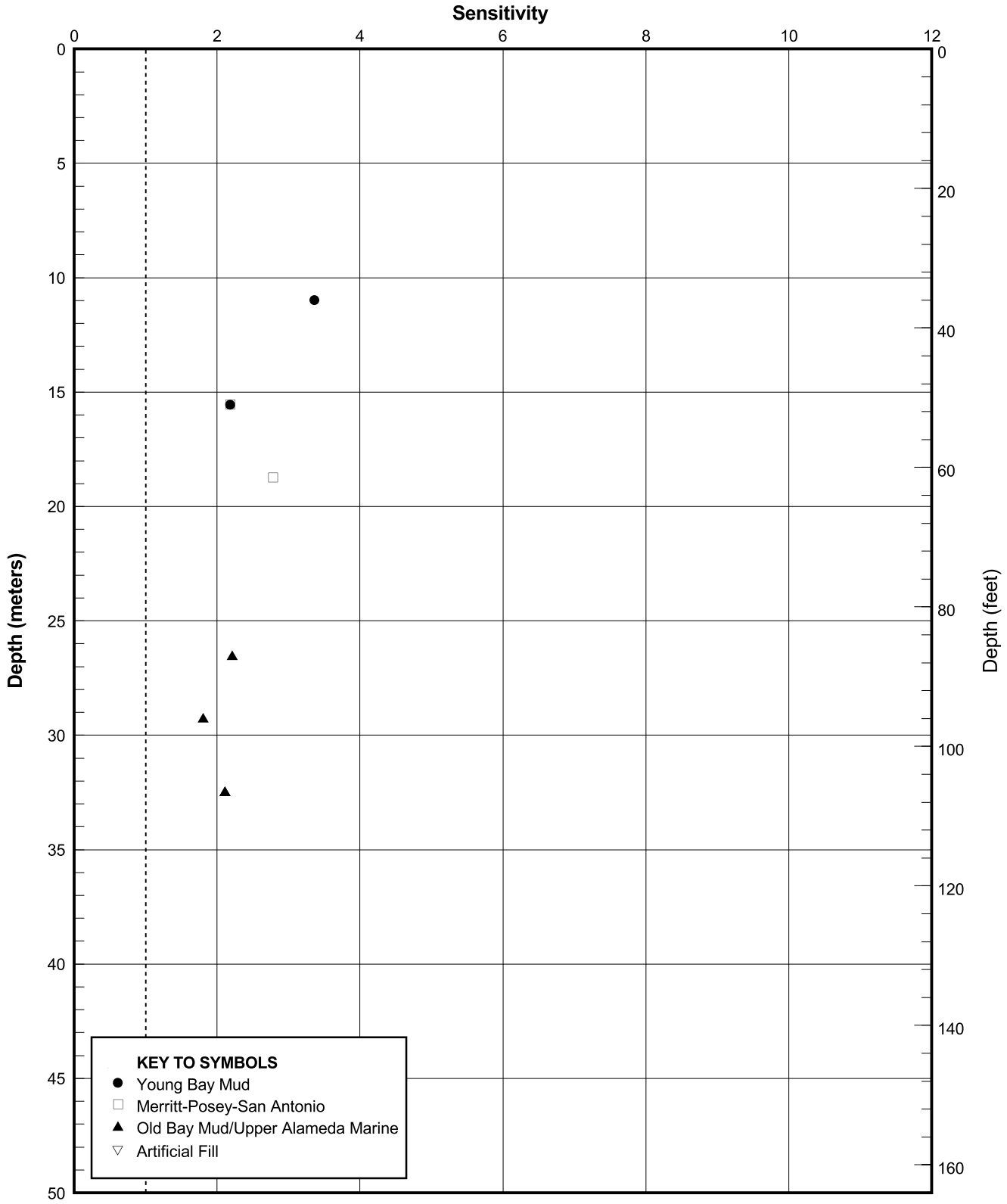
PLASTICITY INDEX PROFILE
Boring 98-59
SFOBB East Span Seismic Safety Project

PLATE 98-59.12



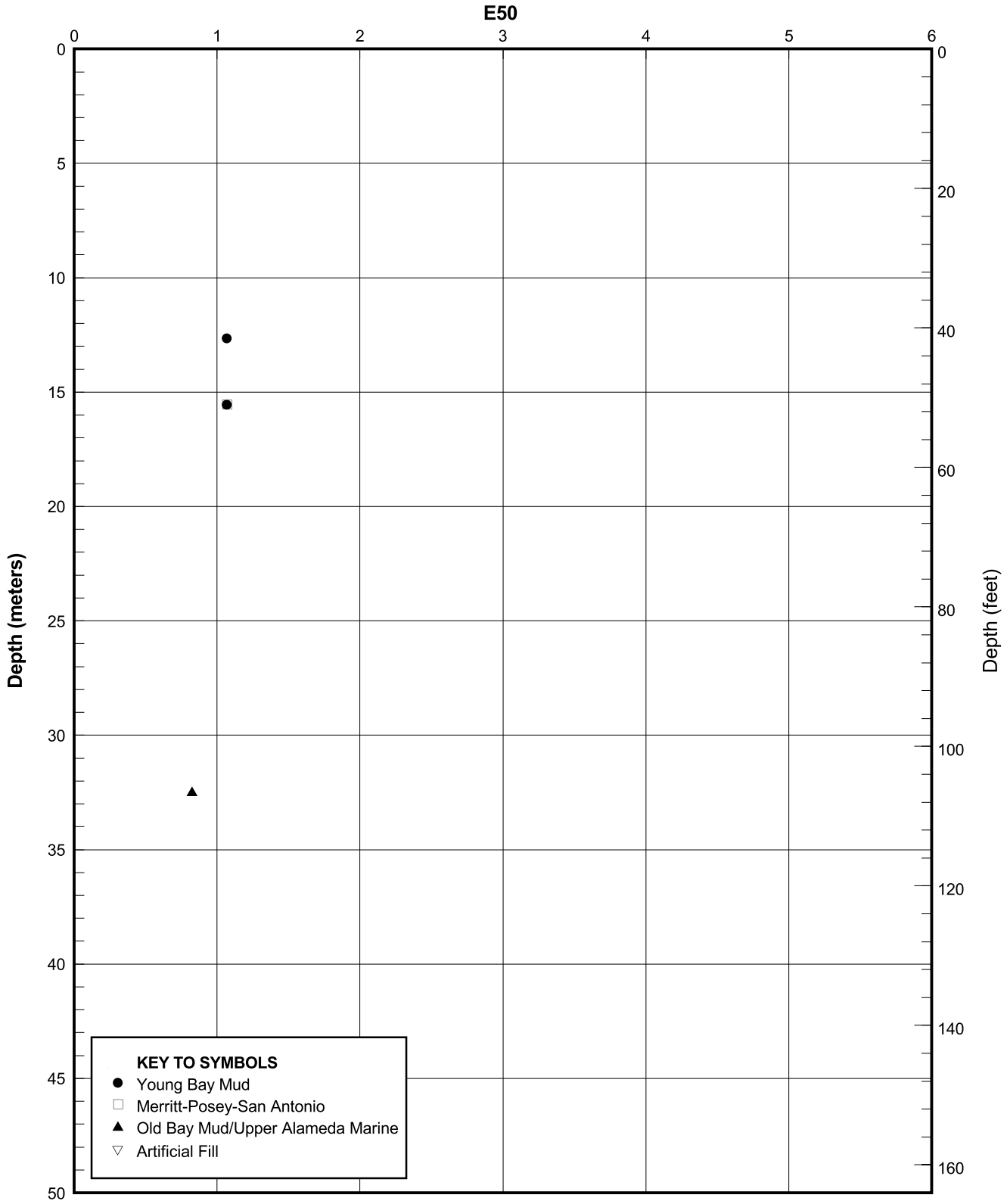
LIQUIDITY INDEX PROFILE
Boring 98-59
SFOBB East Span Seismic Safety Project

PLATE 98-59.13



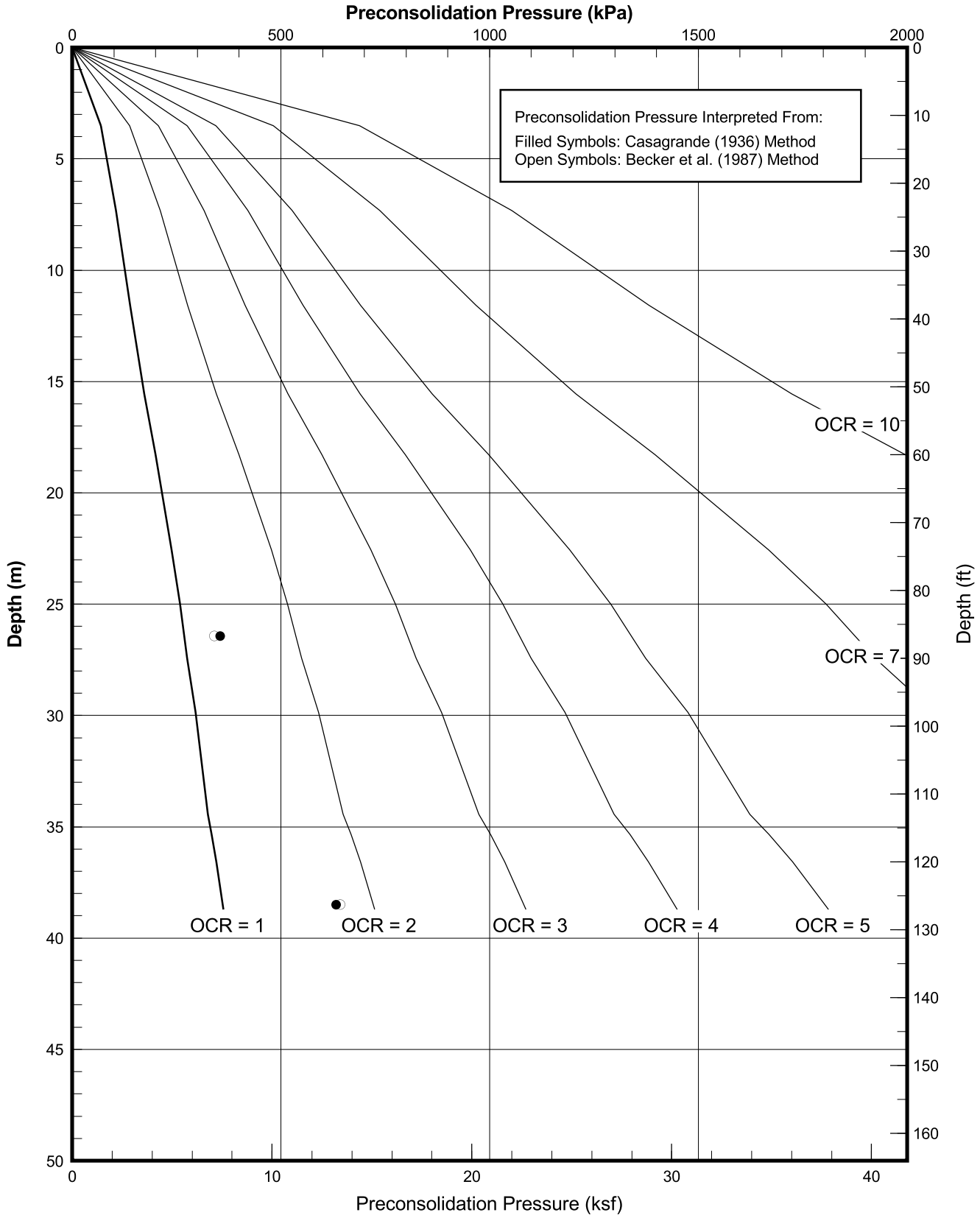
SENSITIVITY PROFILE
Boring 98-59
SFOBB East Span Seismic Safety Project

PLATE 98-59.14



E50 PROFILE
Boring 98-59
SFOBB East Span Seismic Safety Project

PLATE 98-59.15



PRECONSOLIDATION PRESSURE INTERPRETED FROM LABORATORY DATA

Boring 98-59

SFOBB East Span Seismic Safety Project

PLATE 98-59.16

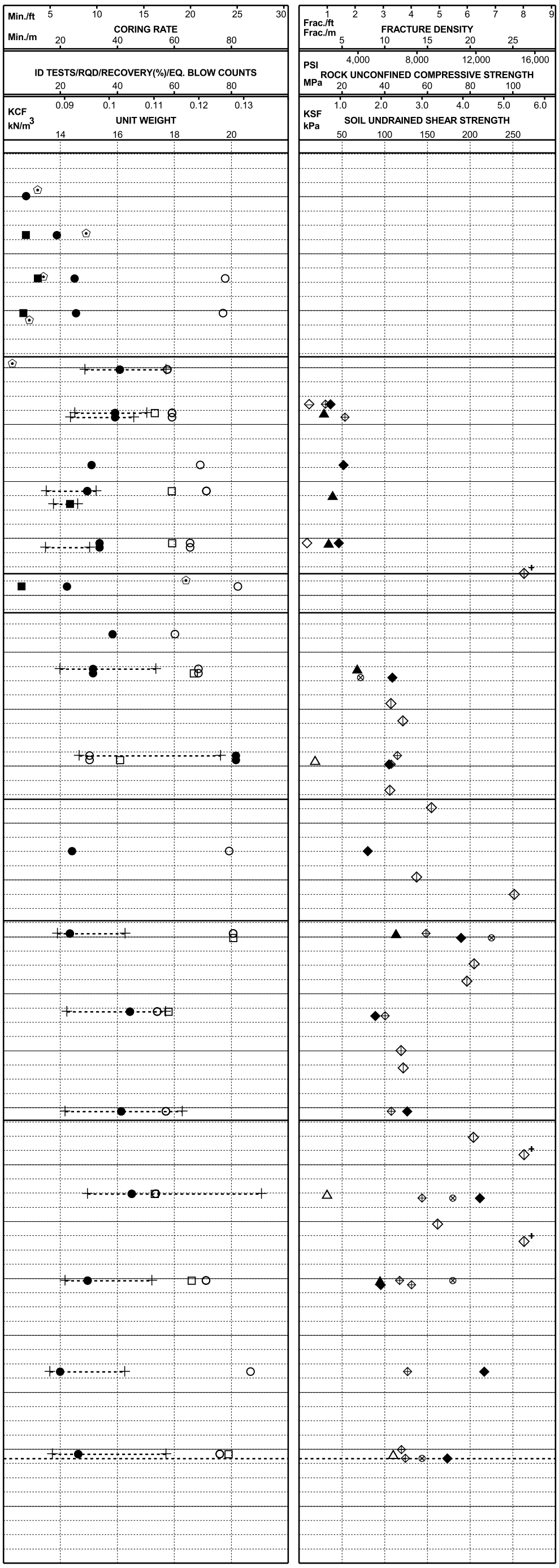
LAND BORING 98-60

PROJECT NO:	98-42-0058	**START DATE:**	11/3/98	**DRILLER:**	Pitcher Drilling Company
BORING:	98-60 (Centerline W. Sta. 90+89)	**COMPLETION DATE:**	11/6/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1839546 N648349
CA State Plane Zone 3, NAD83, Meters

GROUND ELEVATION: 3.4m (MSL)

Elevation, m.	Depth, m.	Blow Count	Material Description	Stratum No.
			PAVEMENT, 0.2m Asphalt Concrete over 0.3m Concrete (0.5m)	I
2	2	BAG	Fine SAND with silt (SP-SM), medium dense, brown -moist to 3.0m	
		12	-with clayey sand pockets at 1.5m	
0	4	29	-with shell fragments at 3.2m (3.4m)	II
		14	-gray below 4.6m	
-2	6	9	-with shell fragments, at 6.1m (7.6m)	
-4	8	3	Fat CLAY (CH), firm to stiff, olive gray -dark gray and with sand, at 7.9m	
-6	10	PUSH	-with shells, sand pockets and silt pockets, at 9.4m -lean clay below 10.1m	
-8	12	SAVE	-sandy lean clay with an H2S odor, at 11.0m	III
		PUSH	-with many sand pockets, at 12.2m -clayey sand, 12.5m to 12.8m	
-10	14	PUSH	-with many sand pockets, partings and a few shell fragments, at 14.0m (15.2m)	
-12	16	64	Fine SAND with silt (SP-SM), very dense, olive gray (16.6m)	IV
-14	18	PUSH	Fat CLAY (CH), very stiff, greenish gray to gray -with many sand pockets at 17.1m	
-16	20	PUSH	-with gas blisters and a few black stains, at 18.6m	V
-18	22	PUSH	-with organic pockets, at 21.6m (23.2m)	
-20	24		Fat CLAY (CH), very stiff, greenish gray	
-22	26	SAVE	(27.4m)	VI
-24	28	PUSH	Fat CLAY (CH), very stiff to hard, greenish gray -lean clay to 29.0m	
-26	30	PUSH	-with sand pockets, below 30.5m	VII
-28	32			
-30	34	SAVE	(34.4m)	
-32	36		Fat CLAY (CH), very stiff to hard, greenish gray	
-34	38	PUSH	-greenish gray and with organic stains and gas blisters, at 36.9m	
-36	40	PUSH	-with silt partings at 39.9m	VIII
-38	42			
-40	44	SAVE	-with organic stains at 43.0m	
-42	46	PUSH	-with silt pockets at 46.0m	
-44	48		TOTAL DEPTH: 46.3m BACKFILLED WITH: Cement Grout	
-46				



LOG OF BORING AND TEST RESULTS

BORING 98-60

SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

Report Date: 03/13/99

PLATE 98-60.1

c:\snfco-oak\odb\11x17\98-60m.odb

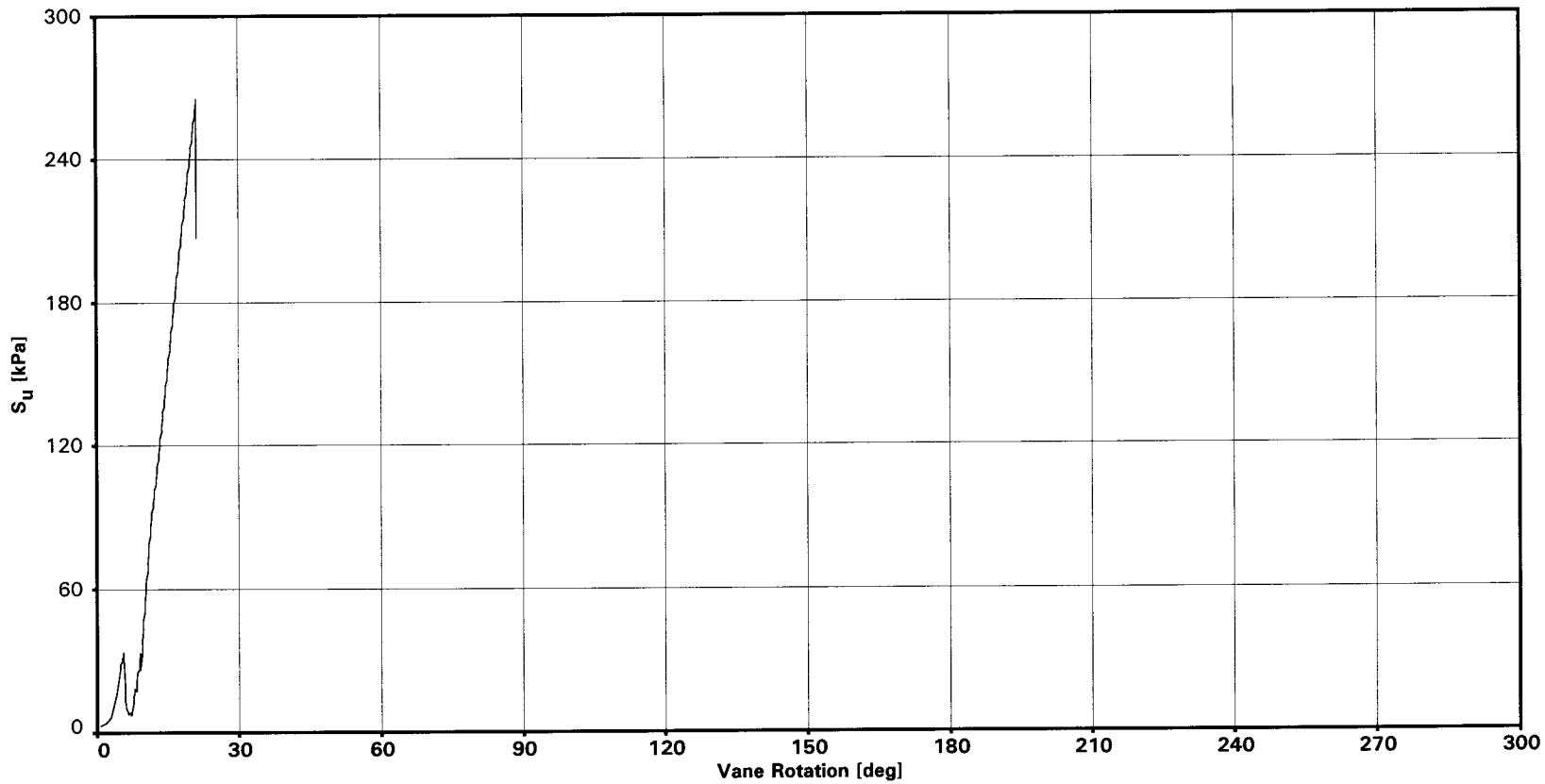
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 15.2m
Boring 98-60
SFOBB East Span Seismic Safety Project

PLATE 98-60.2a

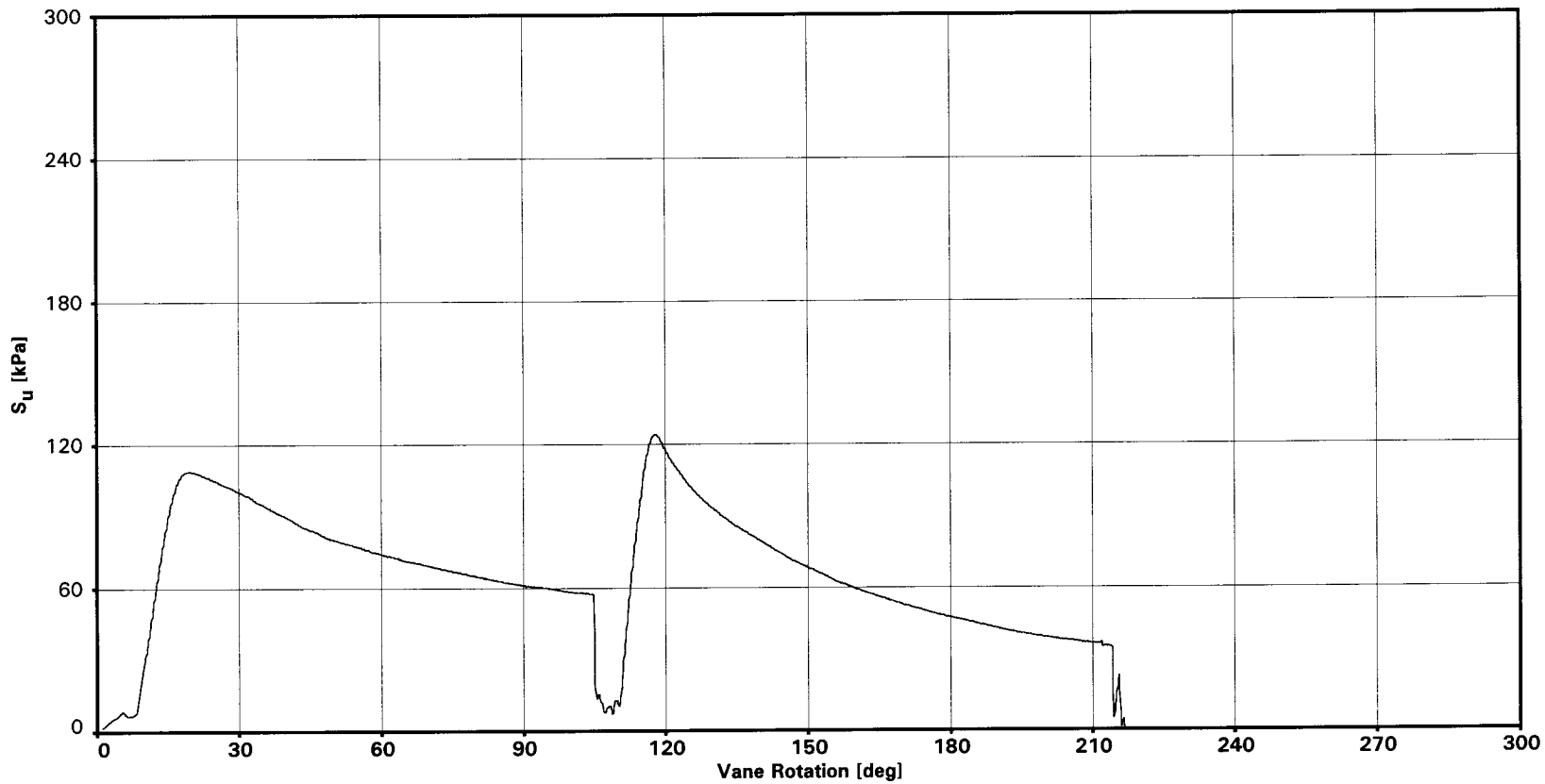
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



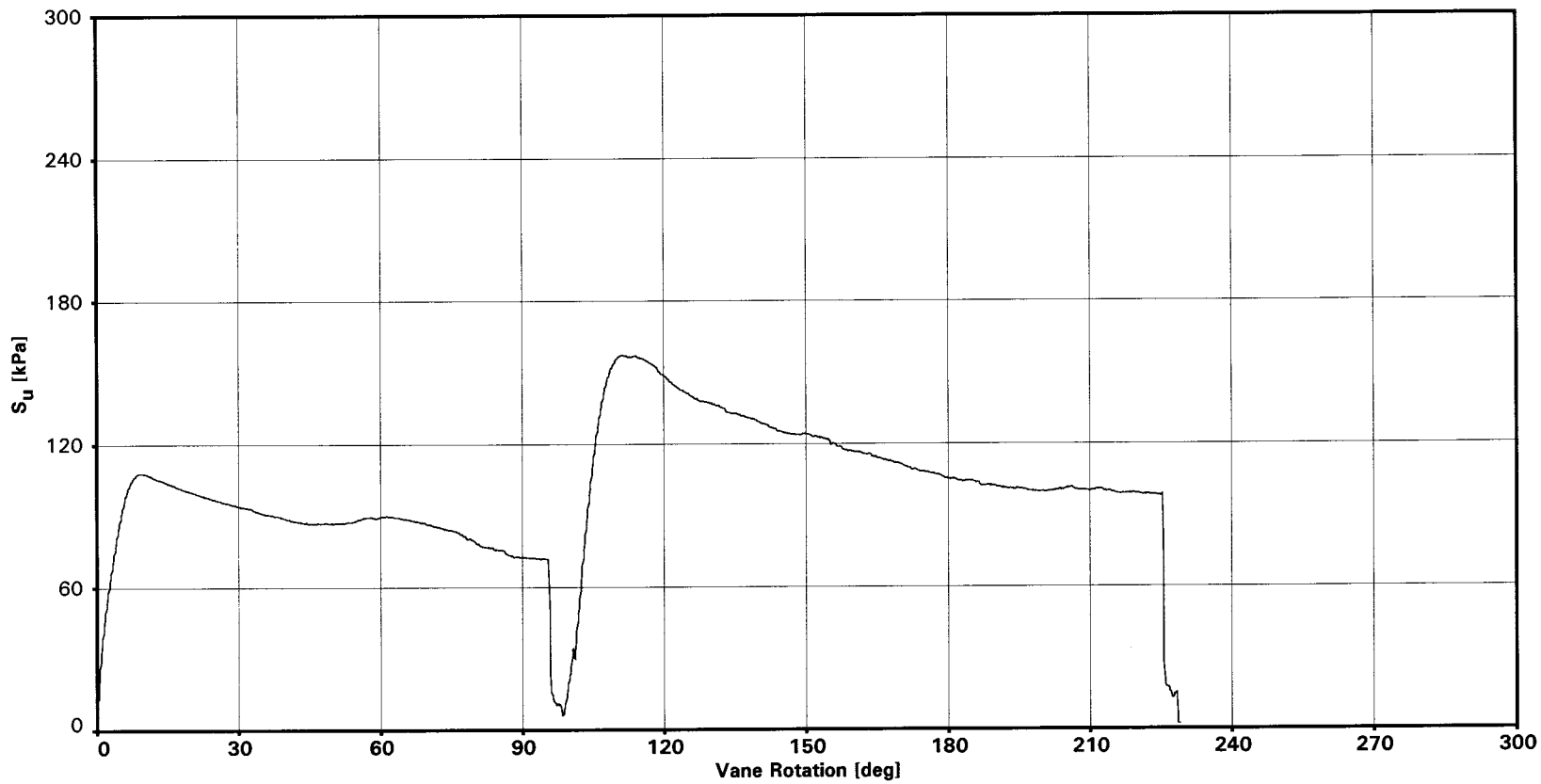
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 19.8m and 20.4m
Boring 98-60
SFOBB East Span Seismic Safety Project

PLATE 98-60.2b

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 22.9m and 23.5m
Boring 98-60
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-60.2c

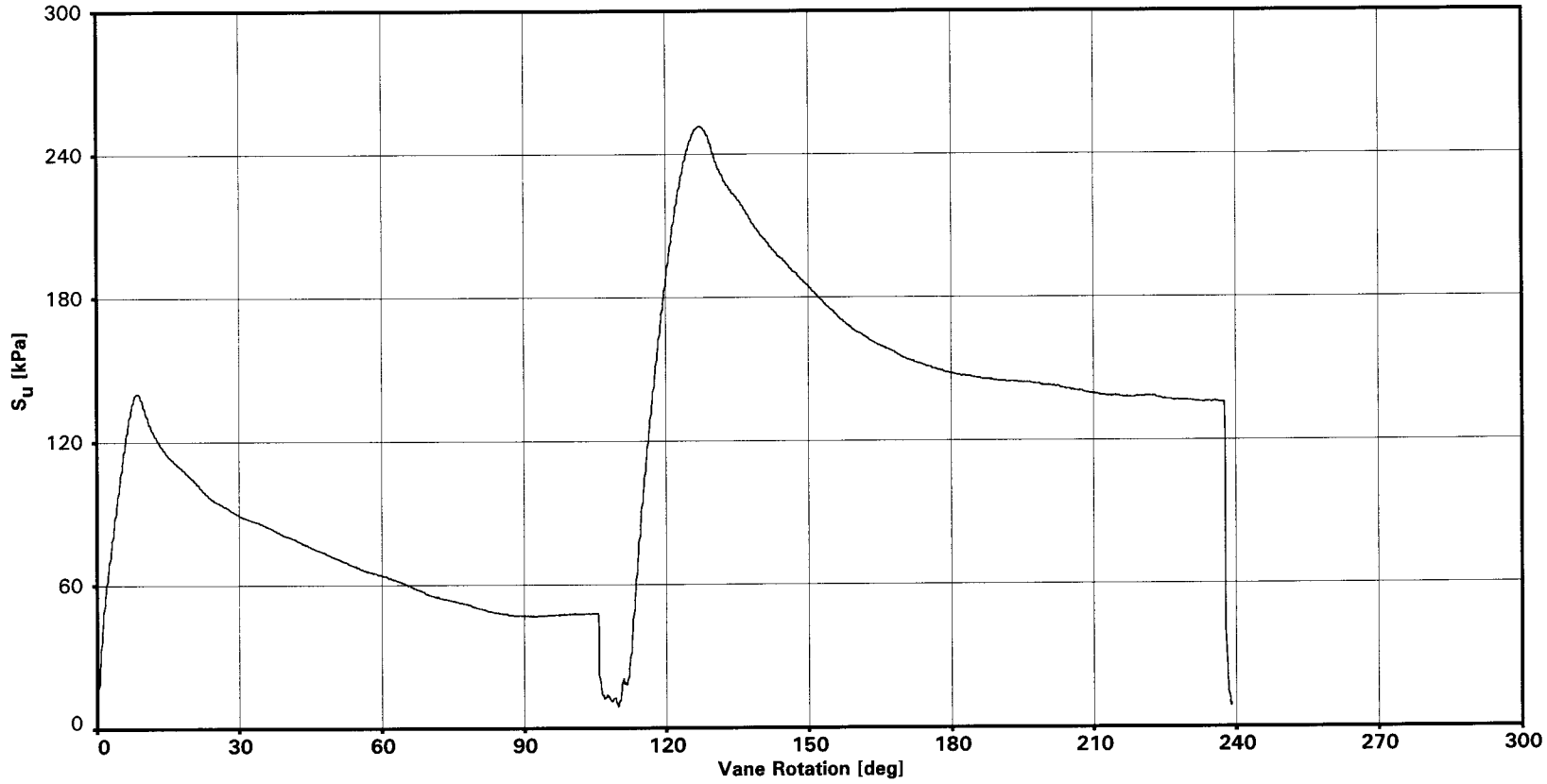
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



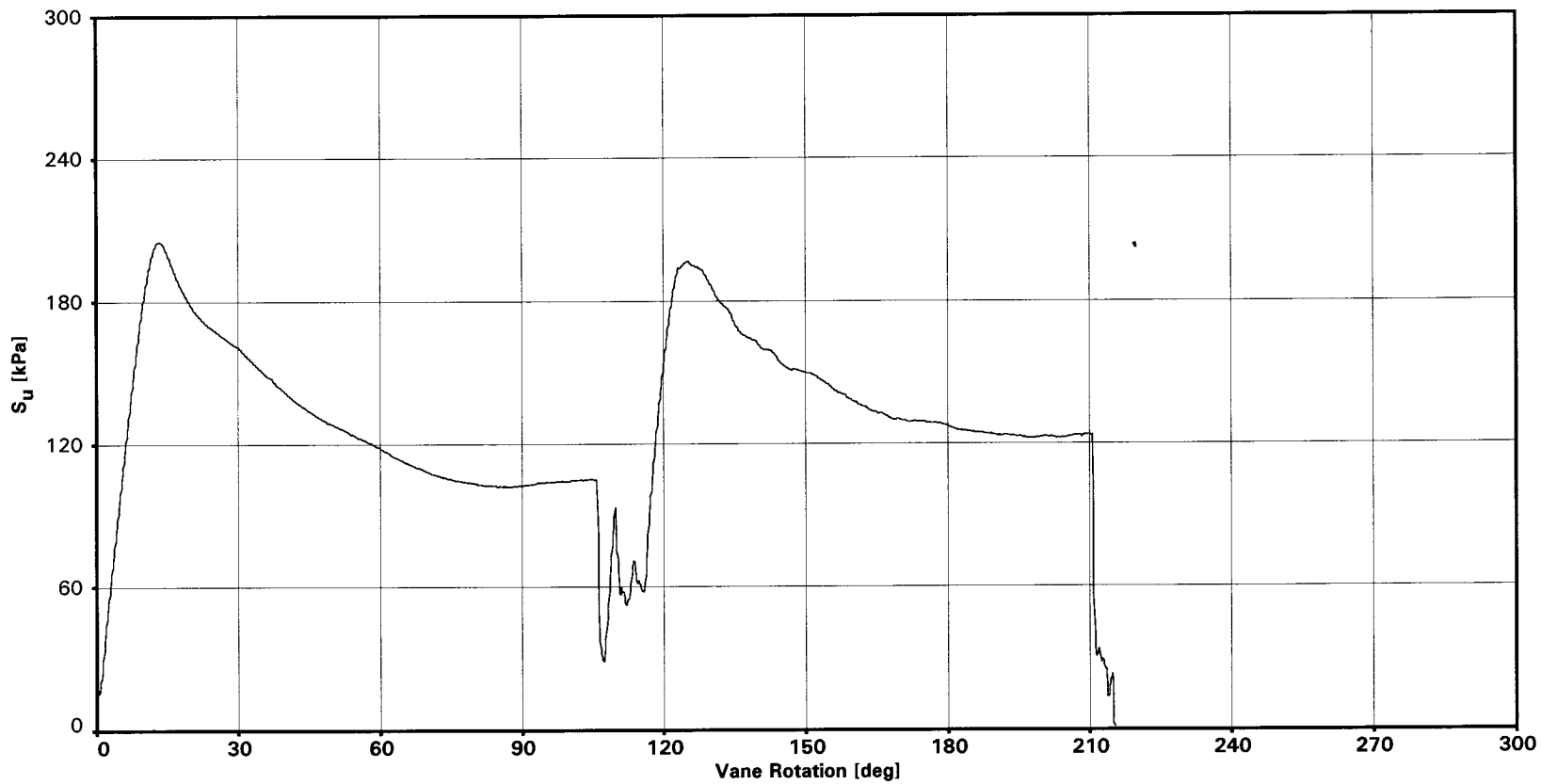
REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 25.9m and 26.5m
Boring 98-60
SFOBB East Span Seismic Safety Project

PLATE 98-60.2d

SFOBB Task Order No. 5
Project No. 98-42-0058

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 29.0m and 29.6m
Boring 98-60
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-60.2e

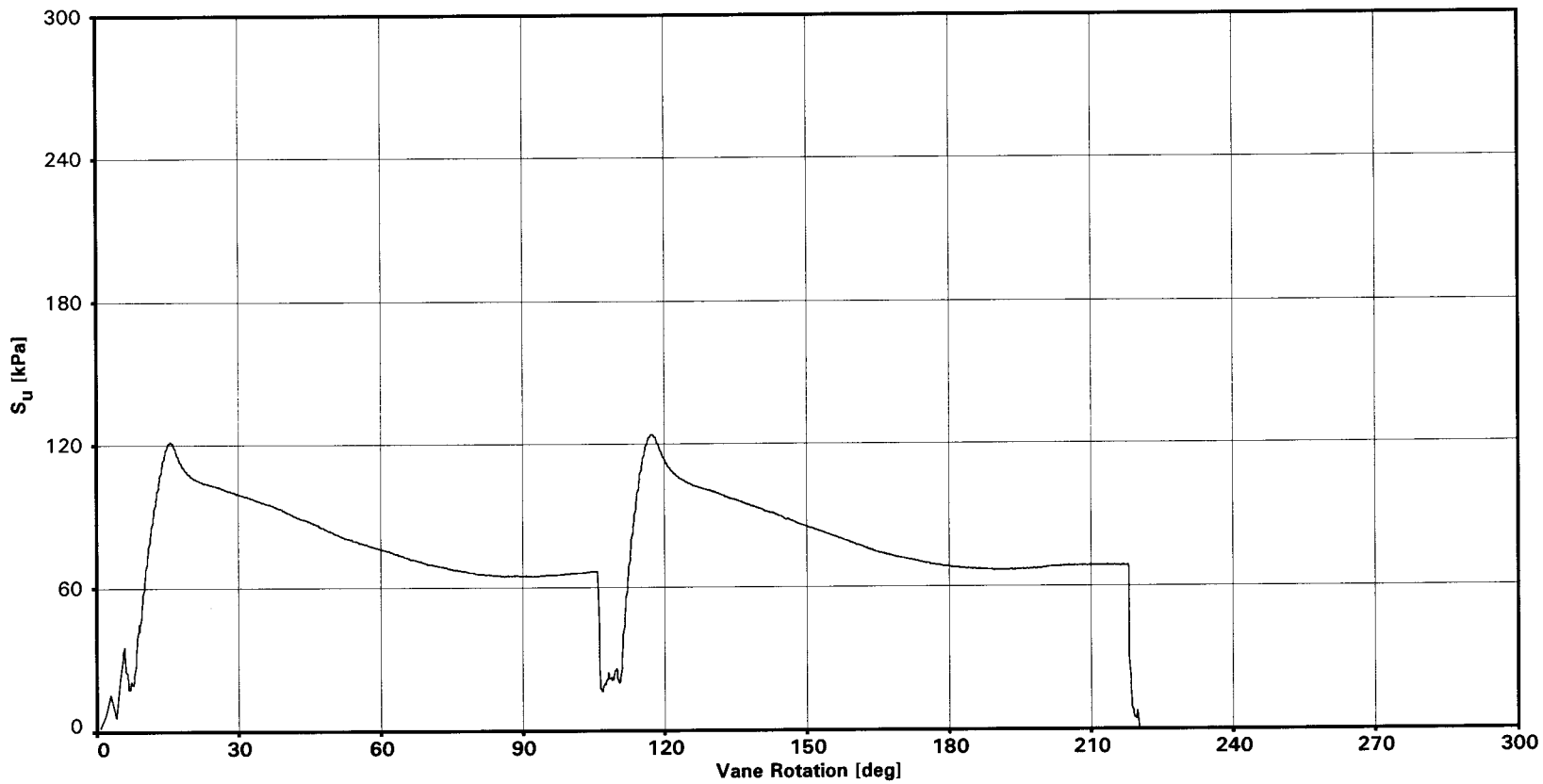
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 32.0m and 32.6m
Boring 98-60
SFOBB East Span Seismic Safety Project

PLATE 98-60.2f

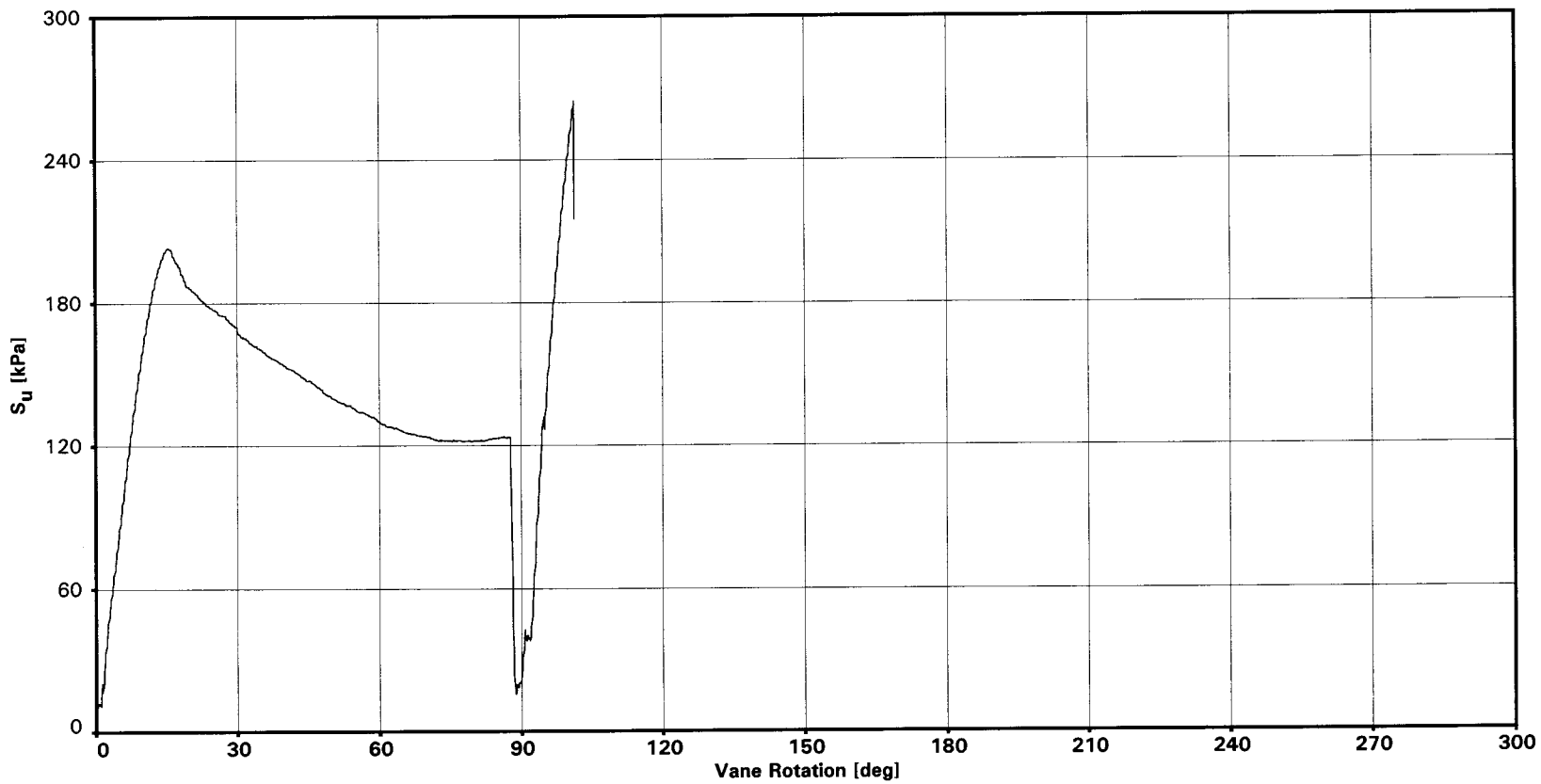
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 35.1m and 35.7m
Boring 98-60
SFOBB East Span Seismic Safety Project

PLATE 98-60.2g

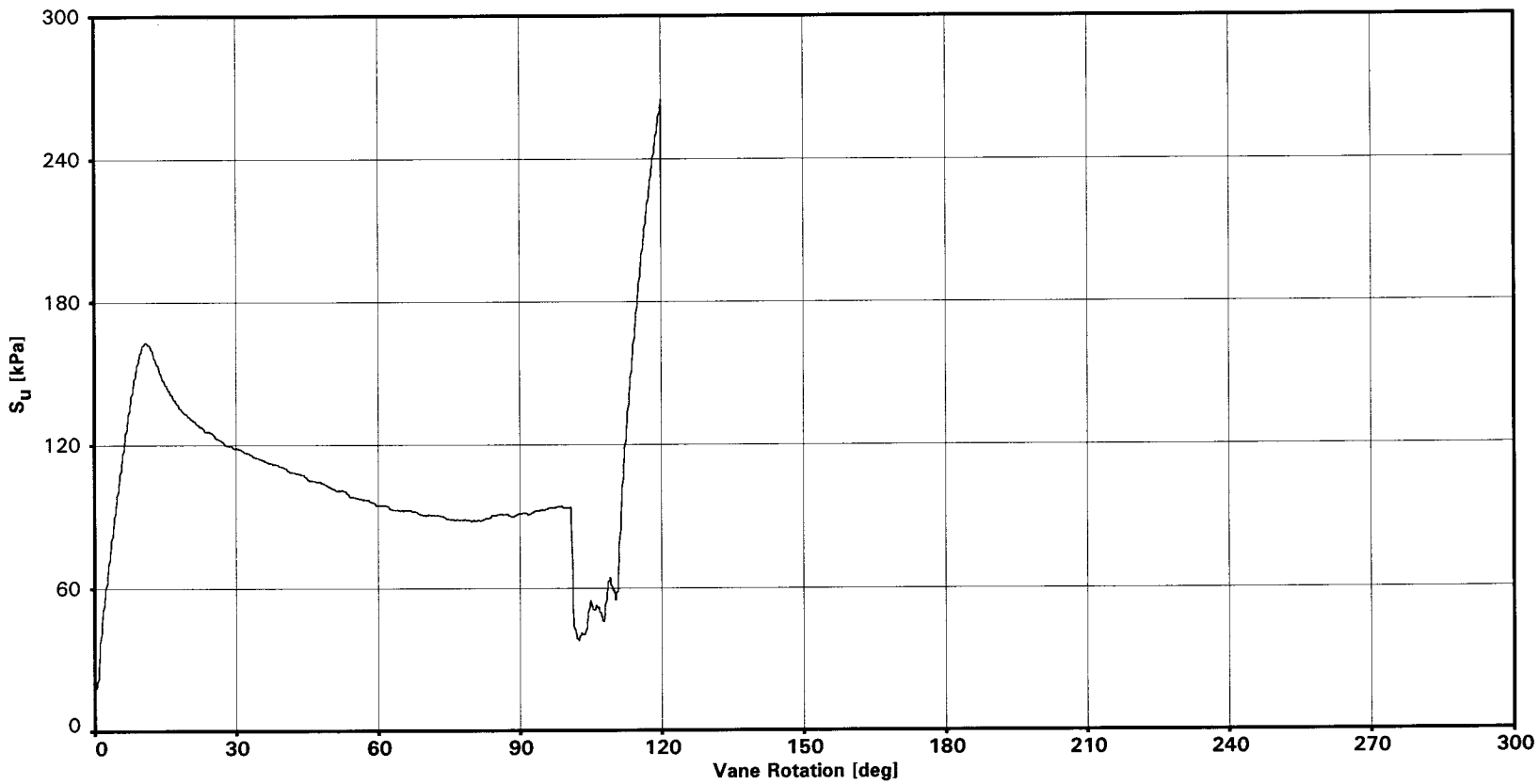
SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 38.1m and 38.7m
Boring 98-60
SFOBB East Span Seismic Safety Project

PLATE 98-60.2h

SFOBB Task Order No. 5
Project No. 98-42-0058

98-60		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
1.5	300																										
2.0	1	8																									
3.4	2	19					8																				
4.9	3	25					12																				2.70
6.1	4	25					7																				
8.1	5	41	57	29	0.42																						
9.3	6							30.6			36.5		11.6														
9.6	8	39	50	25	0.55	17.3									29.0		1.5										
9.8	9	39	46	24	0.70			53.6																			
11.4	10	31									52.0																
12.3	11	29	33	15	0.81	17.9																					
12.5	12														39.3		1.6										
12.8	13		26	18			23																				
14.2	16					17.9					46.3	9.3			34.5		1.1										
14.3	17	34	30	15	1.21																						

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

\+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-60
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-60.3a

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98-60		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
15.2	400													263.3+													
15.7	18	22					6																				
17.4	20	38																									
18.6	21	31	54	20	0.34										67.8		0.6										
18.7	22					18.7																					
18.9	23								71.8		108.9																
19.8	401													107.3													
20.4	402													121.1													
21.6	24	82	76	27	1.11			114.9																			
21.8	25					16.1										18.3											2.69
21.9	26							107.7			105.2																
22.9	403													106.3													
23.5	404													154.7													
25.0	27	24									80.1																
25.9	405													137.4													

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

\+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-60
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

SFOBB Task Order No. 5
Project No. 98-42-0058

98-60		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
26.5	406													251.8+													
27.9	29	23	43	19	0.18			148.4							113.2		1.5										
28.0	30					20.1			225.0		189.4																
29.0	407													204.9													
29.6	408													196.3													
30.6	31	44	57	22	0.64	17.8																					
30.8	32							100.5			89.1																
32.0	409													119.2													
32.6	410													121.6													
34.1	33	41	63	22	0.47			107.7			126.3															C	
35.1	411													204.0													
35.7	412													263.3+													
37.0	35	45	91	30	0.25	17.3										32.4											
37.2	36							143.6	179.6		211.6																
38.1	413													161.8													

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-60
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-60.3c

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SFOBB Task Order No. 5
Project No. 98-42-0058

98-60		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		CORROSIVITY TESTS				COMPACTION TESTS		ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	TUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	R (o-cm)	pH	Cl (ppm)	SO4 (ppm)	Max DD (kN/m3)	OMC (%)		
38.7	414													263.3+													
40.1	38	29	52	22	0.25	18.6		117.3	179.6						94.9		4.3										
40.2	39							131.7			95.3																
43.3	40	20	43	16	0.13			126.9			216.6															C	
46.0	41							119.7																			
46.2	42	26	57	17	0.22	19.9										109.8											
46.3	43							124.5	143.6		173.3																

Identification Tests
MC = Moisture Content
LL = Liquid Limit
PL = Plastic Limit
LI = Liquidity Index

Identification Tests
TUW = Total Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

Corrosivity Tests
R = Resistivity (ohm-cm)
pH = pH
Cl = Chloride Content
SO4 = Sulfate Content

Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

\+ Soil : Strength exceeds capacity of measuring device
Rock: Sample broke along discontinuity; (Intact sample would have greater strength)

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-60
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-60.3d

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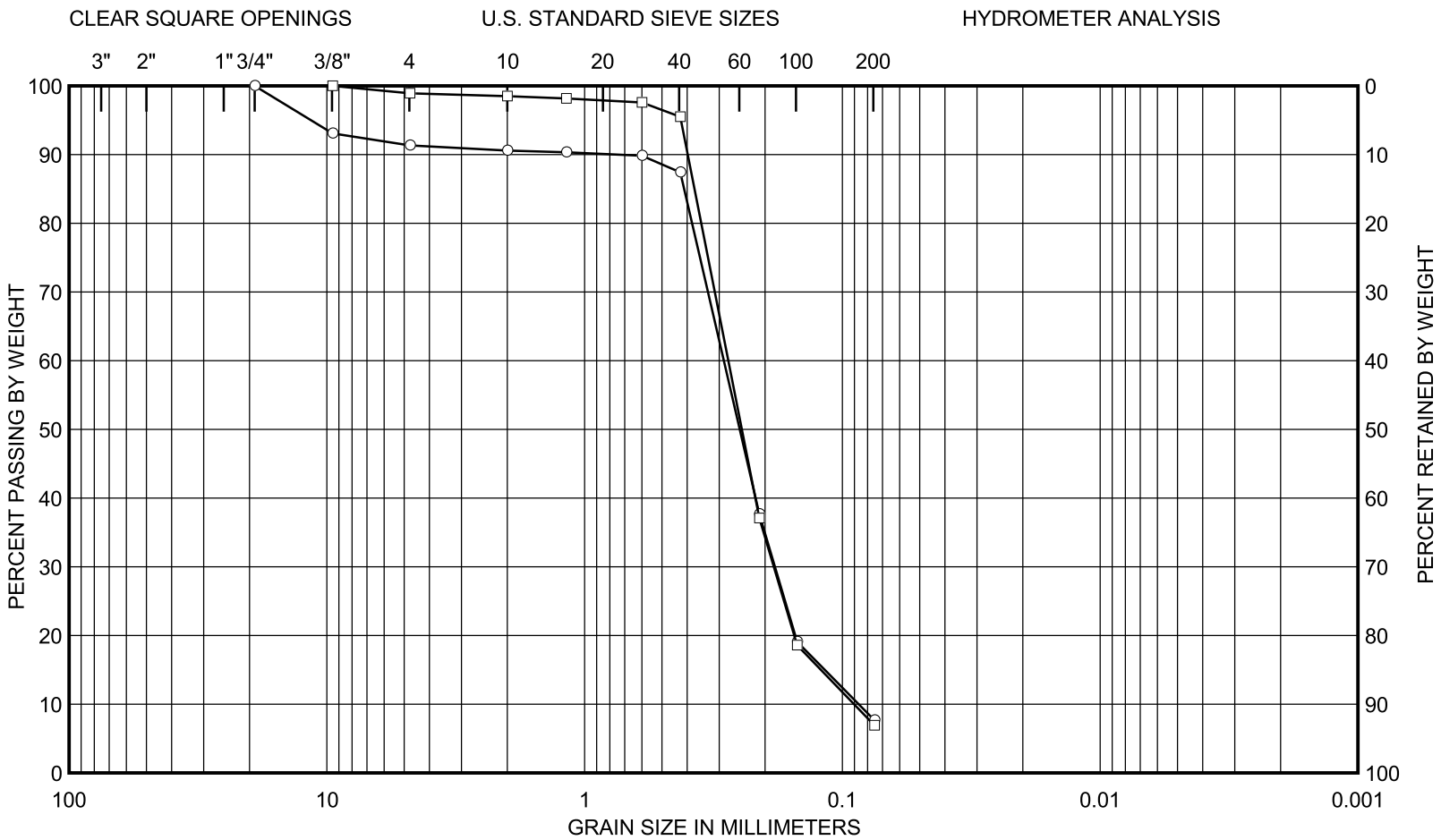

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
2	3.4	○——○	FINE SAND (SP-SM) with silt	1.3	3.3	0.25
4	6.1	□——□	FINE SAND (SP-SM) with silt	1.4	3.1	0.25

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-60
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0058

Earth Mechanics

FUGRO

PLATE 98-60.4

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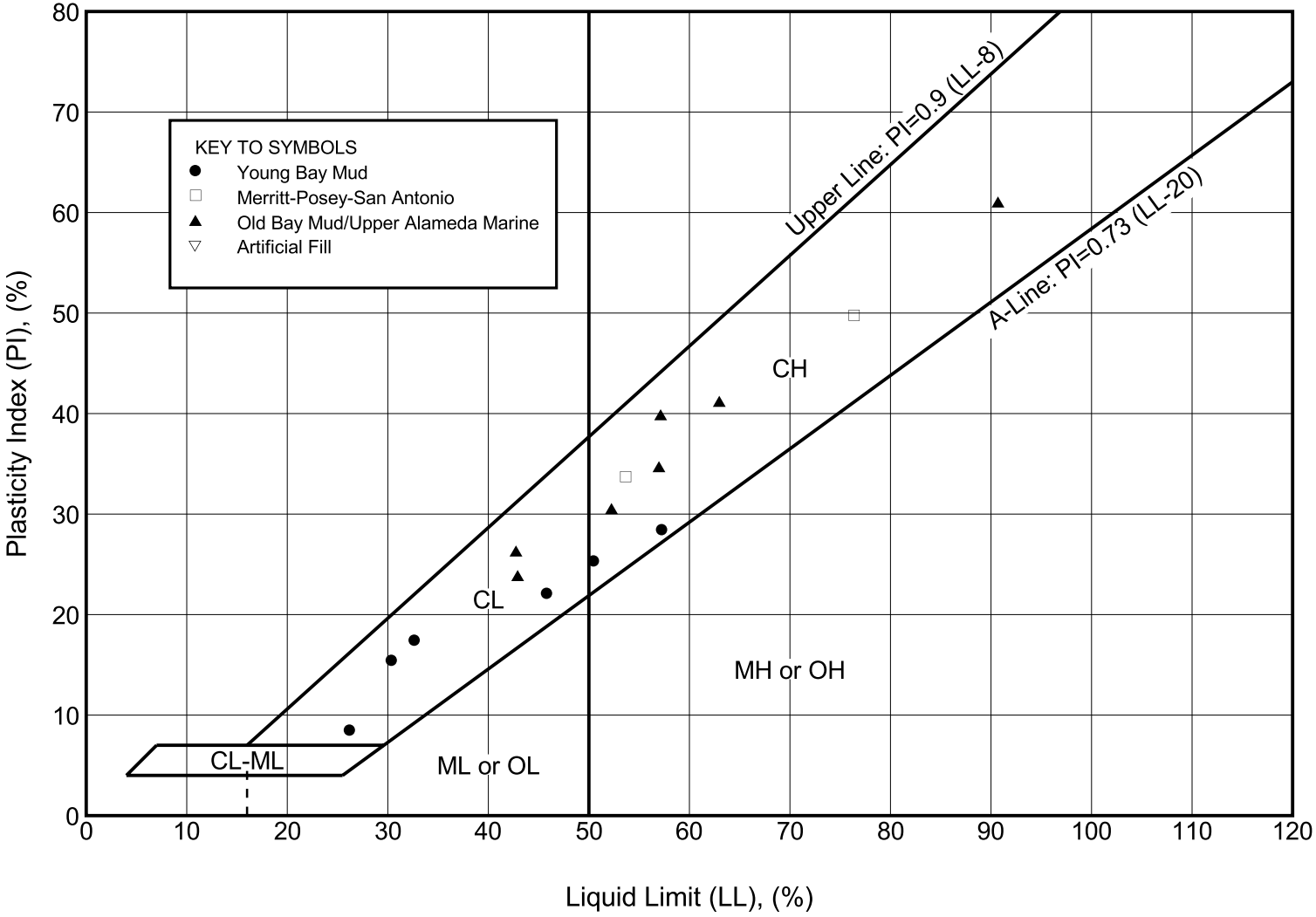

PLASTICITY CHART
Boring 98-60
SFOBB East Span Seismic Safety Project

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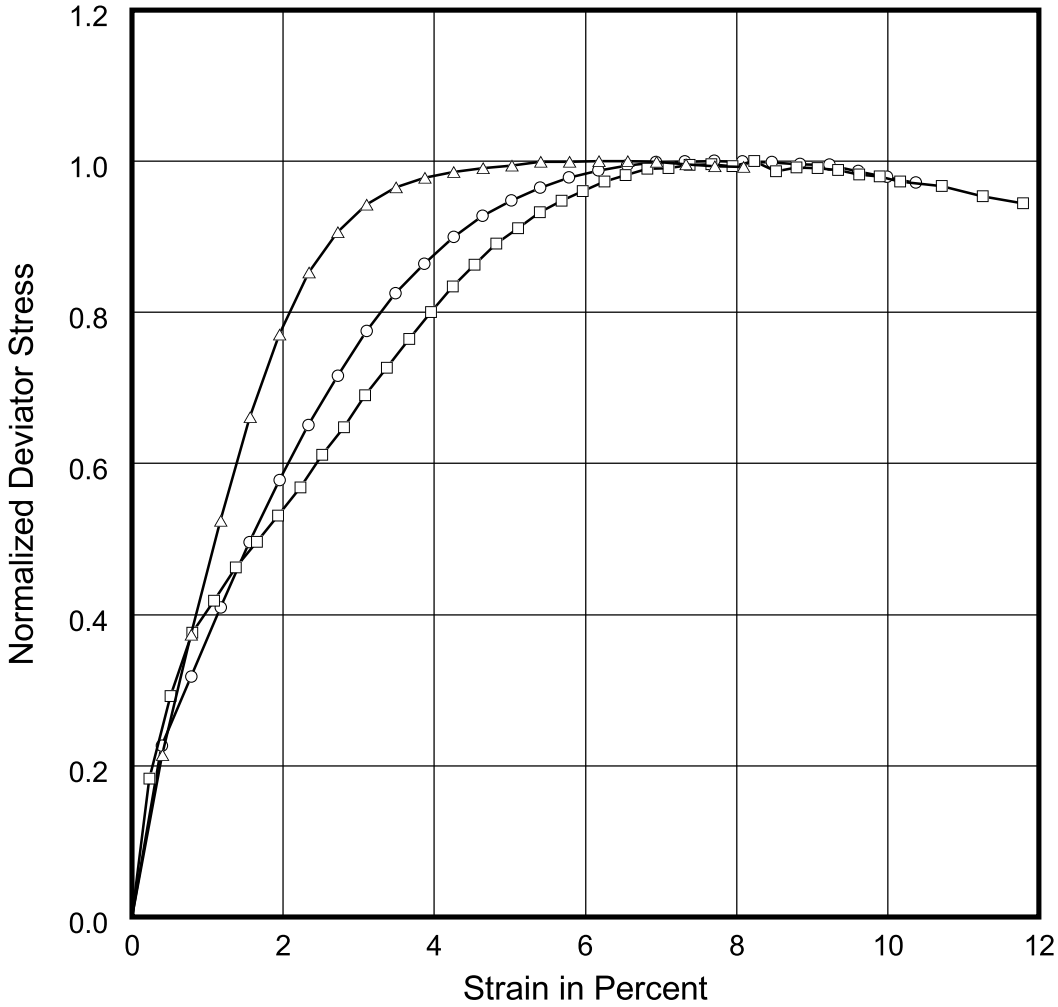
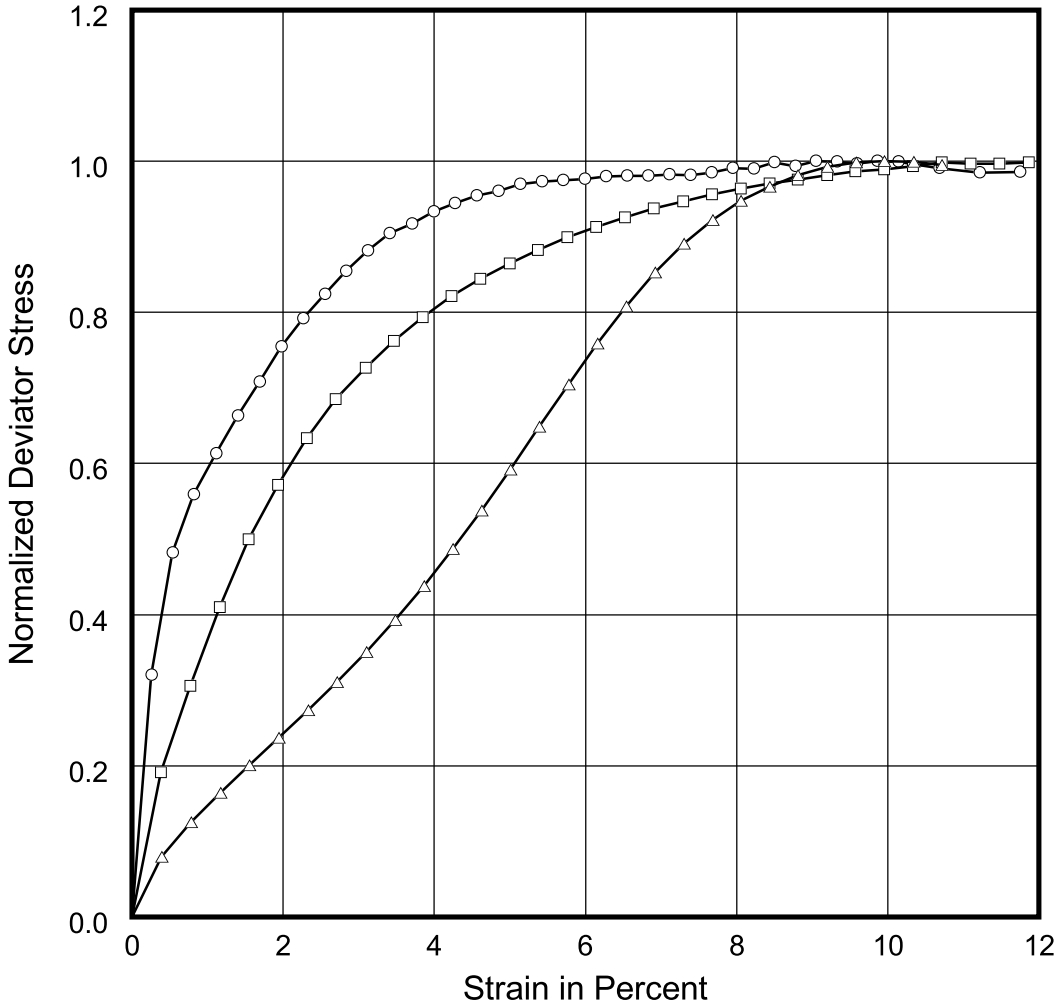


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	8	9.6	UU	172	58	1.5
□——□	12	12.5	UU	241	79	1.6
△——△	16	14.2	UU	276	69	1.1

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-60
SFOBB East Span Seismic Safety Project



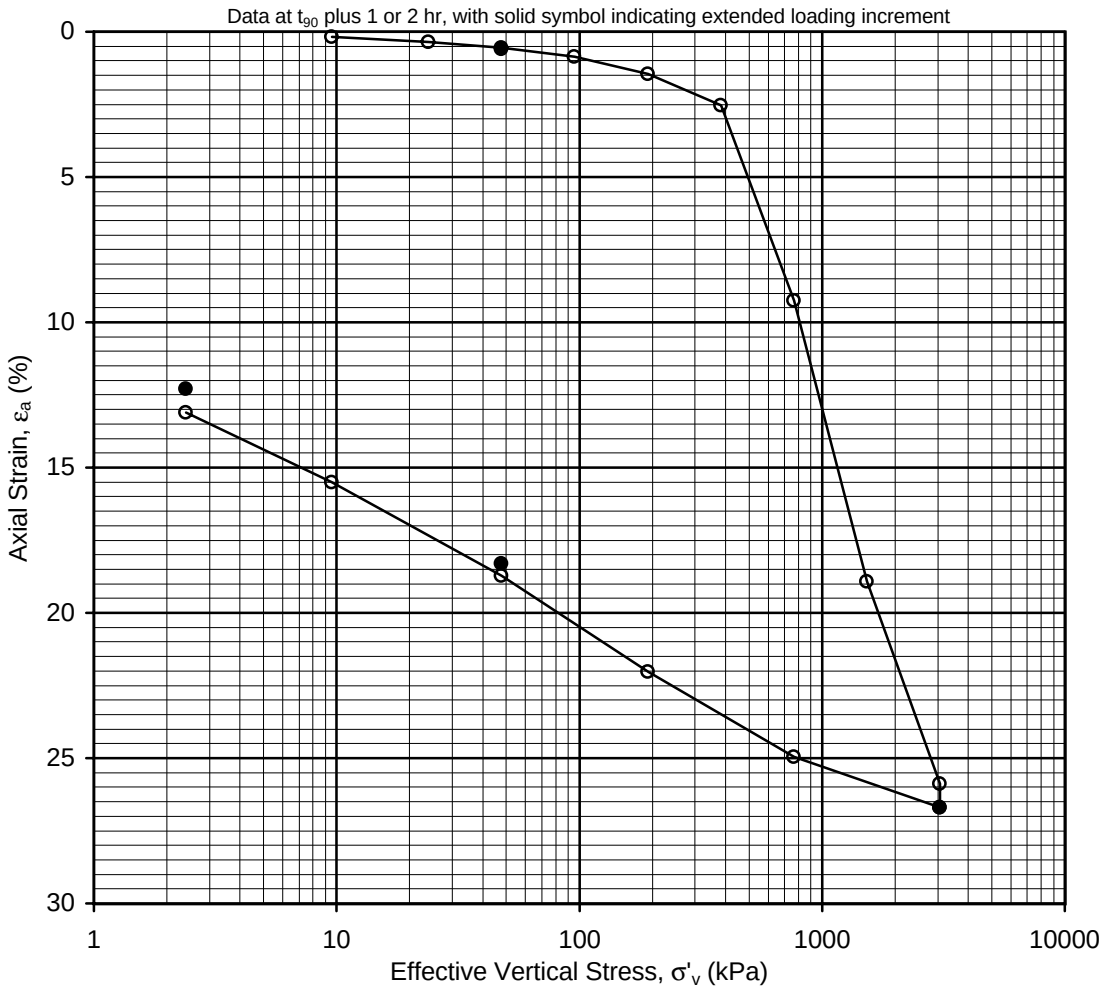
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	21	18.6	UU	689	136	0.6
□——□	29	27.9	UU	862	226	1.5
△——△	38	40.1	UU	1103	190	4.3

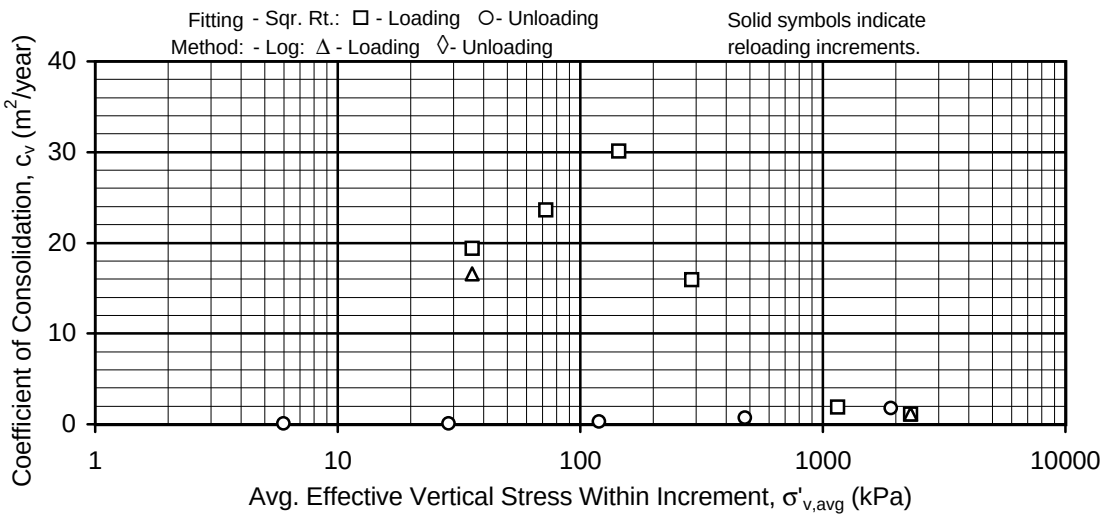
Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-60
SFOBB East Span Seismic Safety Project

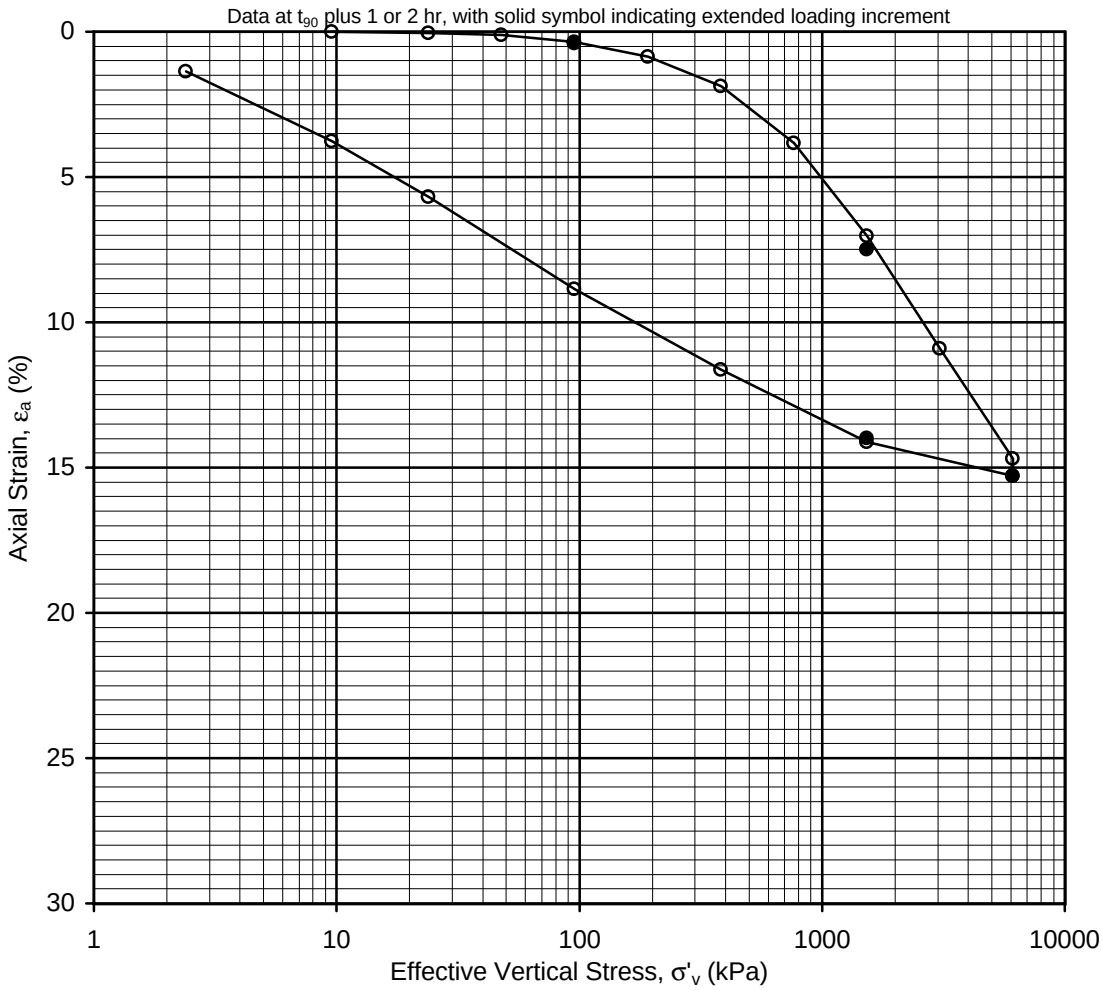
PLATE 98-60.6b

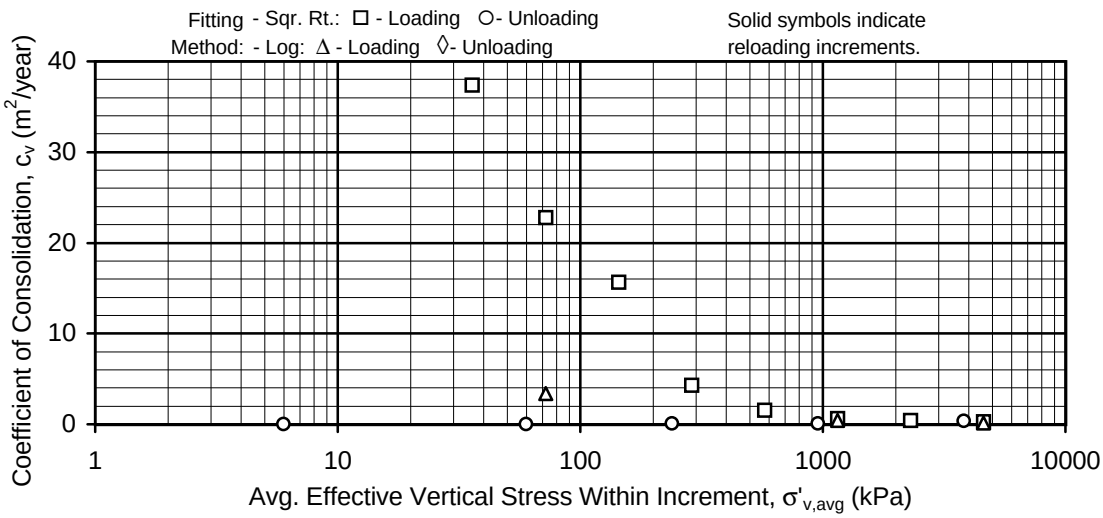




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 33 - Depth: 34.1m
Boring 98-60
SFOBB East Span Seismic Safety Project





INCREMENTAL CONSOLIDATION TEST RESULTS

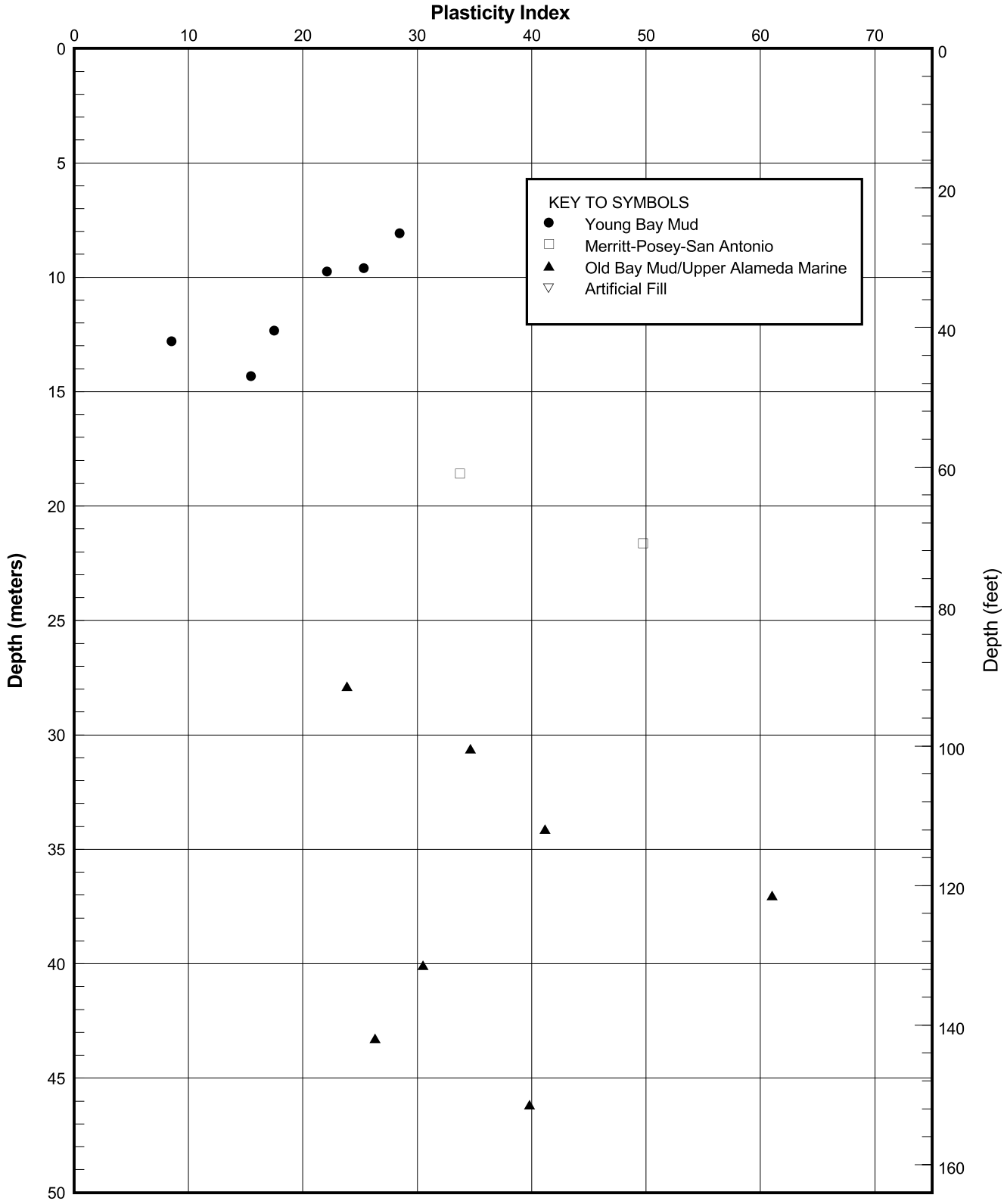
Sample No. 40 - Depth: 43.3m
Boring 98-60
SFOBB East Span Seismic Safety Project

No Consolidated-Undrained Triaxial Compression Testing Performed For This Boring

No Consolidated-Drained Triaxial Compression Testing Performed For This Boring

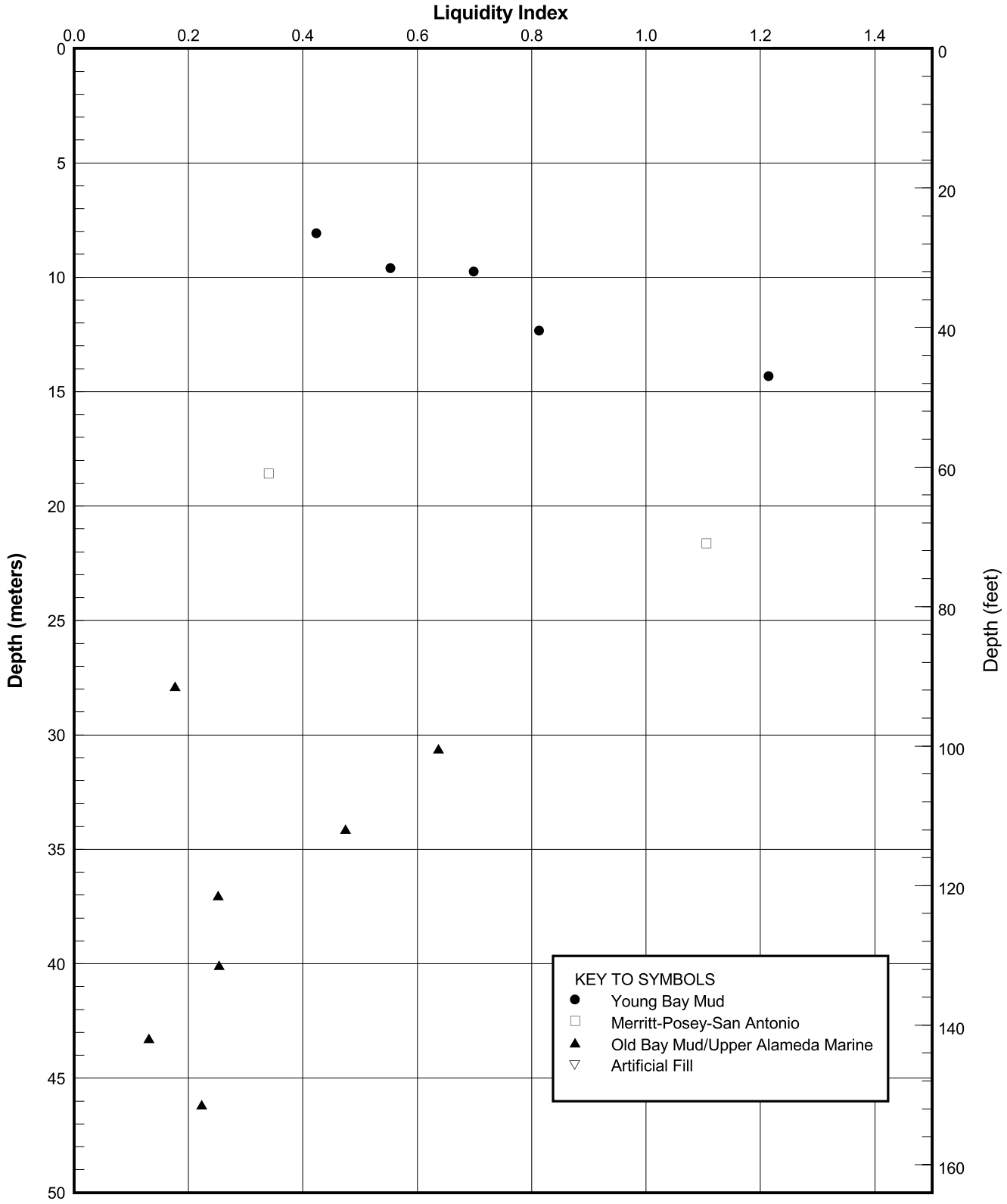
No R-Value Laboratory Testing Performed For This Boring

No Corrosion Testing Performed For This Boring



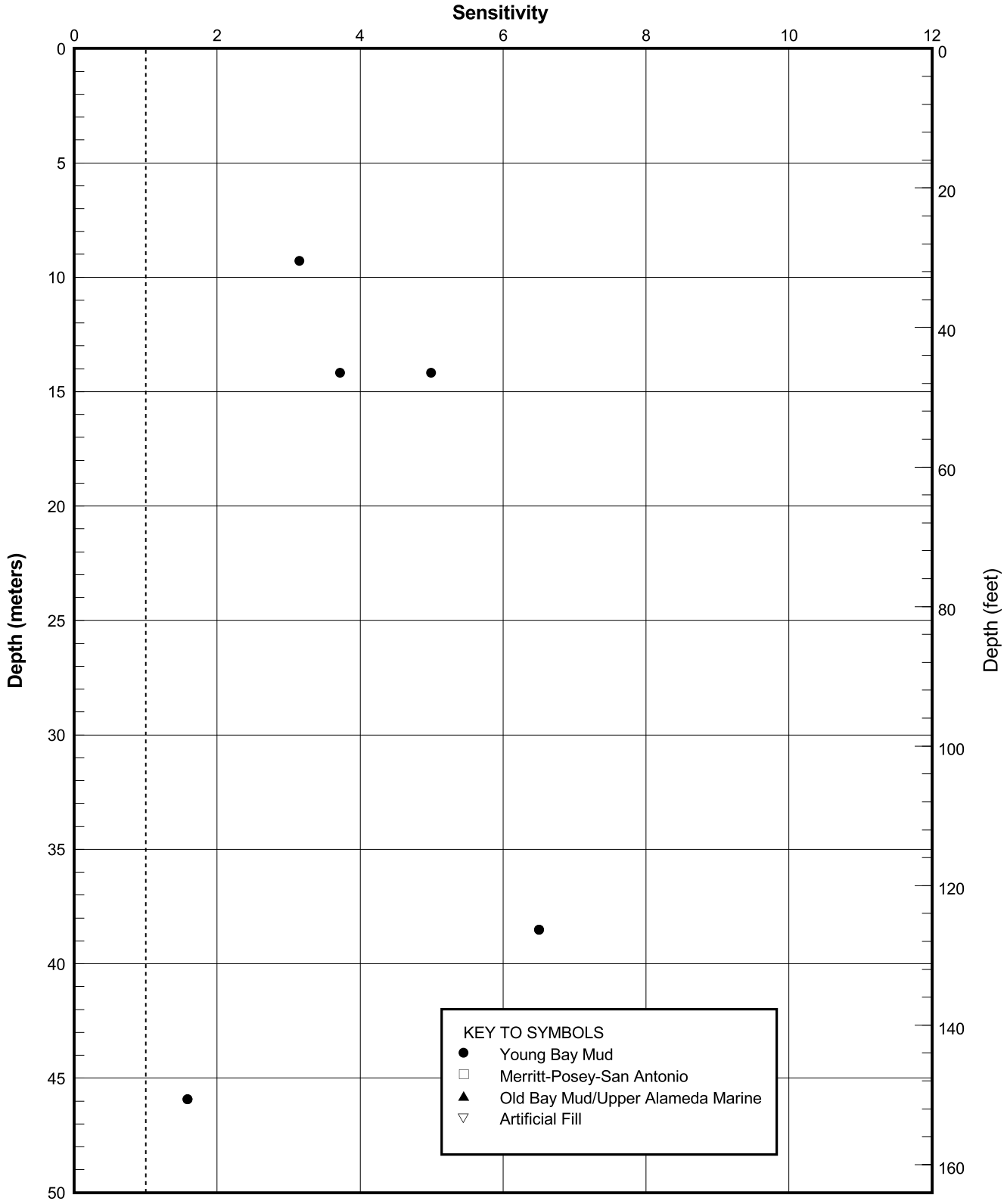
PLASTICITY INDEX PROFILE
Boring 98-60
SFOBB East Span Seismic Safety Project

PLATE 98-60.12



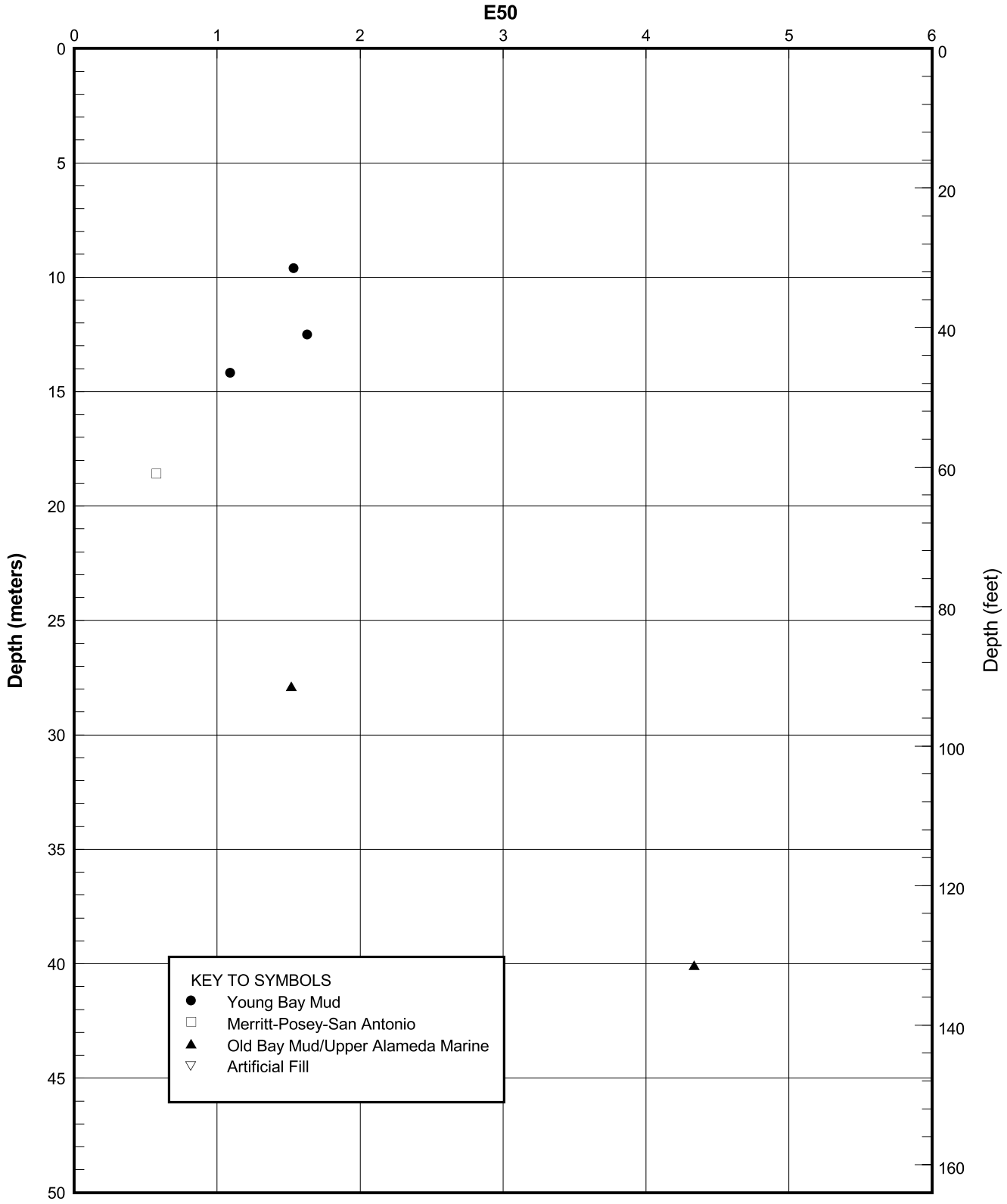
LIQUIDITY INDEX PROFILE
Boring 98-60
SFOBB East Span Seismic Safety Project

PLATE 98-60.13



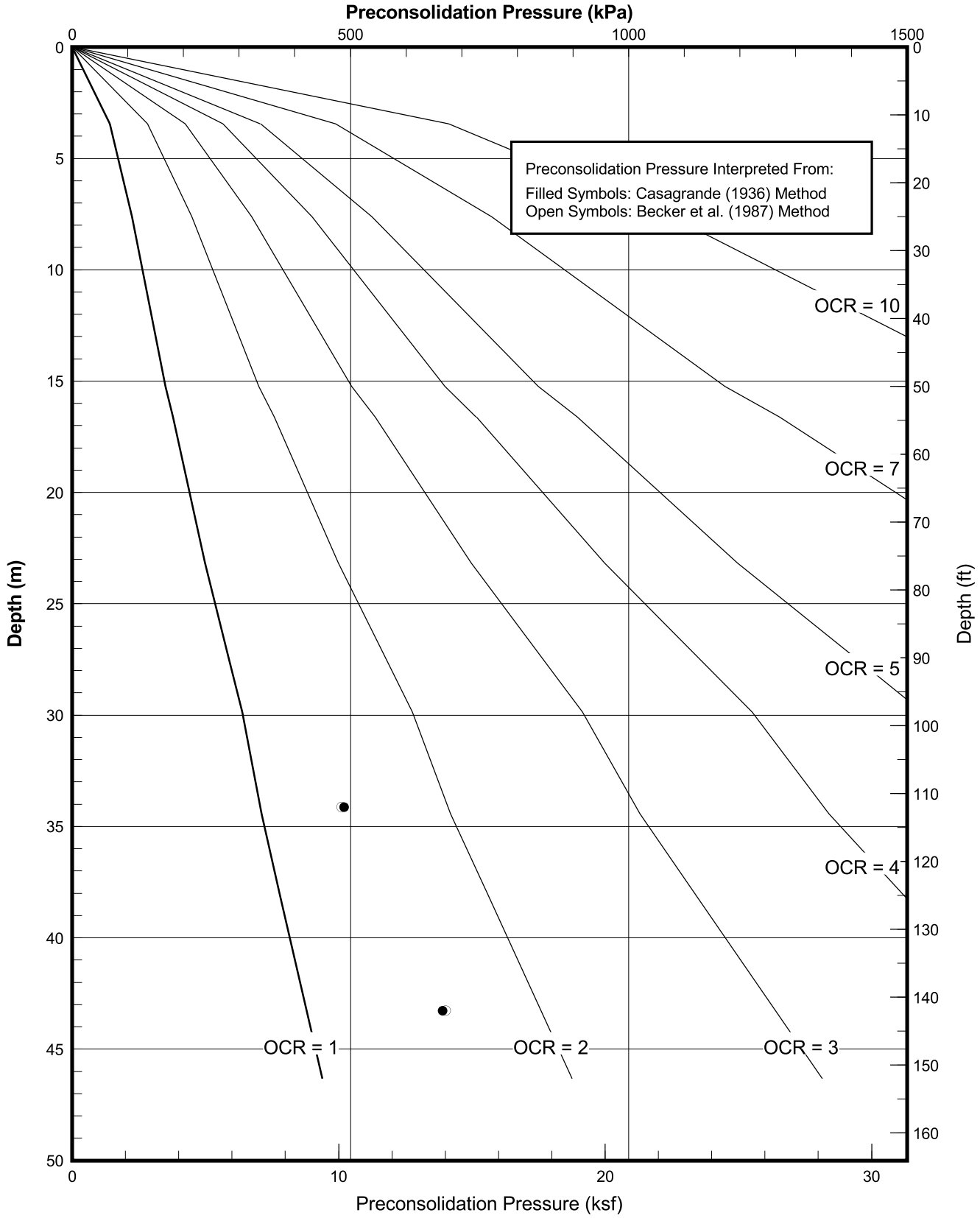
SENSITIVITY PROFILE
Boring 98-60
SFOBB East Span Seismic Safety Project

PLATE 98-60.14



E50 PROFILE
Boring 98-60
SFOBB East Span Seismic Safety Project

PLATE 98-60.15



PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-60

SFOBB East Span Seismic Safety Project

PLATE 98-60.16