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FINAL MARINE GEOTECHNICAL SITE CHARACTERIZATION

SAN FRANCISCO-OAKLAND BAY BRIDGE EAST SPAN SEISMIC SAFETY PROJECT

VOLUME 2E - APPENDICES
(Borings 98-33 through 98-38)

Prepared for

CALIFORNIA DEPARTMENT OF TRANSPORTATION

March 2001

Earth Mechanics

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March 5, 2001
Project No. 98-42-0054

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 Marine 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 marine exploration borings were conducted in 1998 as part of the Task 3 preliminary site exploration and testing (Phase 1) and Task 5 final site characterization studies (Phases 2 and 3) of the referenced contract. In addition, two-dimensional (2-D) and three-dimensional (3-D) marine geophysical surveys were conducted as part of Task 1 (initial site characterization, geophysical survey phase) of the referenced contract. Additional exploration (Phase 3) including cone penetration test (CPT) soundings, multi-beam bathymetry, and a supplemental 2-D geophysical survey were conducted in 2000 as part of Task 5.

The interpretation of the site and subsurface characteristics beneath the marine portion of the bridge alignment are provided in Volume 1 of this Final Marine Geotechnical Site Characterization report. The interpretations presented in Volume 1 are based on the field data (including extensive in situ testing, soil sampling, rock coring, and downhole geophysical logging) from the 44 marine borings, 77 CPT soundings, the results of laboratory tests completed in the onshore laboratories, and the integration of those data with prior Caltrans' marine borings and the interpretation of the 2-D and 3-D geophysical surveys.

The Preliminary Marine Geotechnical Site Characterization report containing Phase 1 data and preliminary site characterization information was submitted in June 1998. Volume 1 of the Final Marine Geotechnical Site Characterization Report, which contained revisions to the preliminary interpretations, was provided in draft on February 1, 2000. Volume 2 of the Final Marine Geotechnical Site Characterization Report (including only data from the Phase 2 site investigations) was submitted in draft in 1999. The Phase 3 site investigations were performed in August and September 2000. During the finalization of this report, all pertinent data from the preliminary (Phase 1) and final (Phases 2 and 3) marine site characterization activities were compiled into Volume 2 of this report. This Final Marine Geotechnical Site Characterization report thus completely supersedes the Preliminary Marine Geotechnical Site Characterization report, dated June 1998. The report is a stand-alone submittal that includes all data collected and the most recent interpretations of site characterization in the marine areas of the project.

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California Department of Transportation
March 5, 2001 (Fugro 98-42-0054)

Because of the size of the data set, Volume 2 of this report has been bound into eight volumes, designated as Volumes 2A thorough 2H. Boring logs and data from each of the 44 marine borings are presented in Volumes 2A through 2G. Those data are organized into boring-specific compilations for each of the 14 Phase 1 borings (Volumes 2A and 2B) and 30 Phase 2 borings (Volumes 2C through 2G). Logs of the 77 CPT soundings performed during Phase 3 are presented in Volume 2H.

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

FINAL MARINE GEOTECHNICAL SITE CHARACTERIZATION

VOLUME 2E - APPENDICES
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MARCH 2001

Prepared For:

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- Single-Page, Seacalf CPT Logs Include Profiles of:
  - Cone sleeve friction
  - Cone tip resistance
  - Friction ratio
  - Pore water pressure
  - Undrained shear strength

Testing performed

Log provided

No testing performed

No log provided

APPENDIX PLATE NUMBERING REFERENCE GUIDE

VOLUME 2
INDIVIDUAL BORING DATA AND CPT SOUNDING APPENDICES

The San Francisco-Oakland Bay Bridge (SFOBB) East Span Seismic Safety Project marine geotechnical site exploration included 44 borings and 77 Seacalf CPT soundings. The marine drilling was completed using offshore drilling equipment and wire-line sampling, in situ testing, and downhole tools. In addition, 49 tethered Seascout CPT soundings were conducted adjacent to the boring locations to characterize the near-surface materials.

GEOTECHNICAL SITE CHARACTERIZATION SYNOPSIS - VOLUME 1

A general description of Task Order Nos. 3 and 5, the Marine Site Characterization work scope, is provided in Section 1.0 of Volume 1. A description of the marine exploration and subsequent laboratory testing procedures is included in Section 3.0. The locations of the borings are provided on Plate A-1, and a summary of the details of the individual exploration locations and depths is provided in Table 3.1 of Volume 1.

INDIVIDUAL BORING APPENDICES - VOLUMES 2A THROUGH 2G

Individual boring appendices are provided for each of the 44 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., 98-28.4, 98-28.5a, etc.).

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 A-2a and A-2b in Volumes 2A through 2G.

Summary of Field Operations and Location/Depth Information

A description of the progress of the individual borings and a chart showing boring location, coordinates, depths (mudline, top of rock, bottom of borings, etc.), and corresponding elevations (re: Mean Sea Level [MSL] datum, as specified by Caltrans) are included at the beginning of each boring appendix.

Boring Logs

The boring logs for each marine boring provide lithology descriptions, show sampling depths, contain descriptions of the soil and rock characteristics, 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, CPT data, and downhole geophysical 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 A-2a and A-2b in Volumes 2A through 2G). 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 Standard Penetration Test (SPT) N-values or California modified sampler; d) 50/7.5cm is a SPT N-value; and e) 30/60cm is a downhole, wireline hammer blow count. Additional description of the blow count and sampler nomenclature is provided on Plates A-2a and A-2b of Volumes 2A through 2G.

Rock coring data also are tabulated in the Blow Count column. Those data, such as 100-35, provide recovery and Rock Quality Designation (RQD) data for the individual core runs.

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. In rock intervals, the recovery, RQD, and coring rate are plotted in the center column of the log.

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.

In rock intervals, the unconfined compressive strength measured in unconfined tests and estimated from point load tests are plotted in the right-hand column. Fracture density also is plotted in the rock intervals.

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 geotechnical test data logs and CPT logs.

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. Downhole geophysical tests were conducted in 41 of the 44 marine borings. That testing included:

a) Compression and shear wave (Vp and Vs, respectively) (except for Borings 98-19, 98-45, and 98-48);

b) Natural gamma (only Borings 98-1 through 98-3 and 98-5 through 98-12);

c) Resistivity (only Borings 98-2, 98-3, and 98-5 through 98-12);

d) Caliper (borehole diameter) (only Borings 98-1 through 98-12 and 98-21 through 98-24); and

e) Acoustic Televiewer (only Borings 98-1 through 98-5 and 98-21 through 98-24).

The Acoustic Televiewer logs are provided under separate covers in Volume 1 of Fugro-EM (1998d) and Volume 1 of Fugro-EM (2001h).

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
- Stress-strain curves from unconsolidated-undrained (UU) triaxial compression tests

- Consolidation test results including axial strain and coefficient of consolidation versus effective vertical stress
- Consolidated-undrained triaxial compression test results including consolidation curves, stress path, stress-strain curves, pore water pressure-strain curves, and obliquity-strain curves
- Consolidated-drained triaxial compression test results including stress-strain curves and Mohr circles

In addition to the laboratory test results presented herein, the results of laboratory tests conducted on rock samples are provided under separate cover in Volume 4 of Fugro-EM (1998d) and Volume 2 of Fugro-EM (2001h). Also, the results of the cyclic tests conducted on samples recovered from the marine borings are provided under separate cover in Volume 3 of Fugro-EM (1998d).

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)

CPT DATA APPENDIX - VOLUME 2H

Summary of Field Operations

A description of the progress of the Seacalf CPT operations is presented before the CPT data plots in Volume 2H as Plates A-2a through A-2w.

CPT Sounding Results

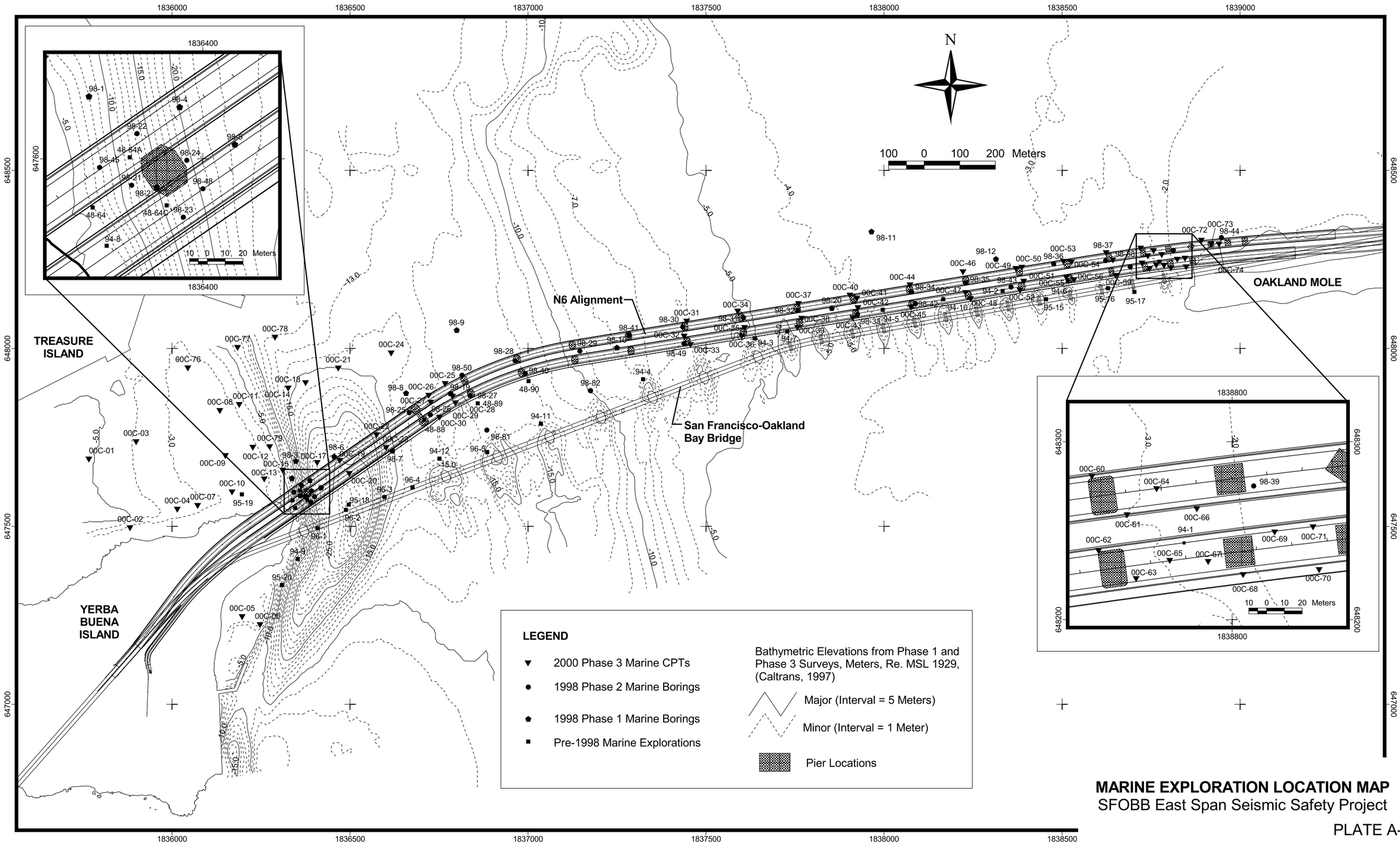
The results of the 77 marine CPT soundings are presented in Volume 2H of this report. The CPT logs provide graphical plots versus depth showing:

- Tip resistance in MPa
- Sleeve friction in MPa
- Friction ratio in percent
- Pore pressure in MPa

In addition, the sounding logs show the range of undrained shear strengths that are calculated from CPT tip resistances (corrected for unequal area effects) based on cone bearing capacity factors (N_k) of 12 and 15.

Earth Mechanics

FUGRO



MARINE EXPLORATION LOCATION MAP
SFOBB East Span Seismic Safety Project

PLATE A-1

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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)
- ROCK FRAGMENTS (Rx)

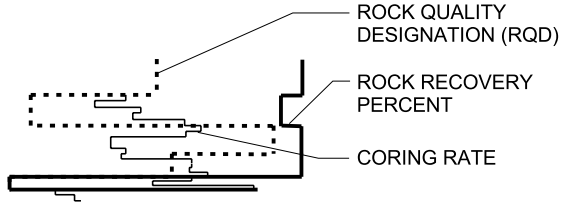
SAMPLERS

- 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 (kN/m^3)
- PLASTIC LIMIT ---------- LIQUID LIMIT
- EQUIVALENT SPT BLOW COUNT

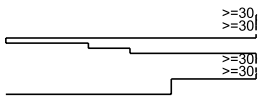
ROCK QUALITY AND CORING RATE



STRENGTH TESTS

- POCKET PENETROMETER
- TORVANE
- REMOTE VANE
- MINIATURE VANE (RESIDUAL VANE)
- UNCONSOLIDATED UNDRAINED TRIAXIAL
- SWEDISH FALL CONE
- UNCONFINED COMPRESSION (SOIL)
- (Open symbols indicate remolded tests)
- Interpreted From CPT Data (Nk = 12 to 15)
- POINT LOAD TEST (INTACT SPECIMEN)
- POINT LOAD TEST (ALONG WEAK PLANE)
- UNCONFINED COMPRESSION (ROCK)
- Soil - Strength Exceeds Capacity of Measuring Device
  Rock - Sample Broke Along Discontinuity, Intact Sample Would Have Greater Strength

FRACTURE DENSITY



KEY TO TERMS AND SYMBOLS USED ON LOGS

SFOBB East Span Seismic Safety Project

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 above deck 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.

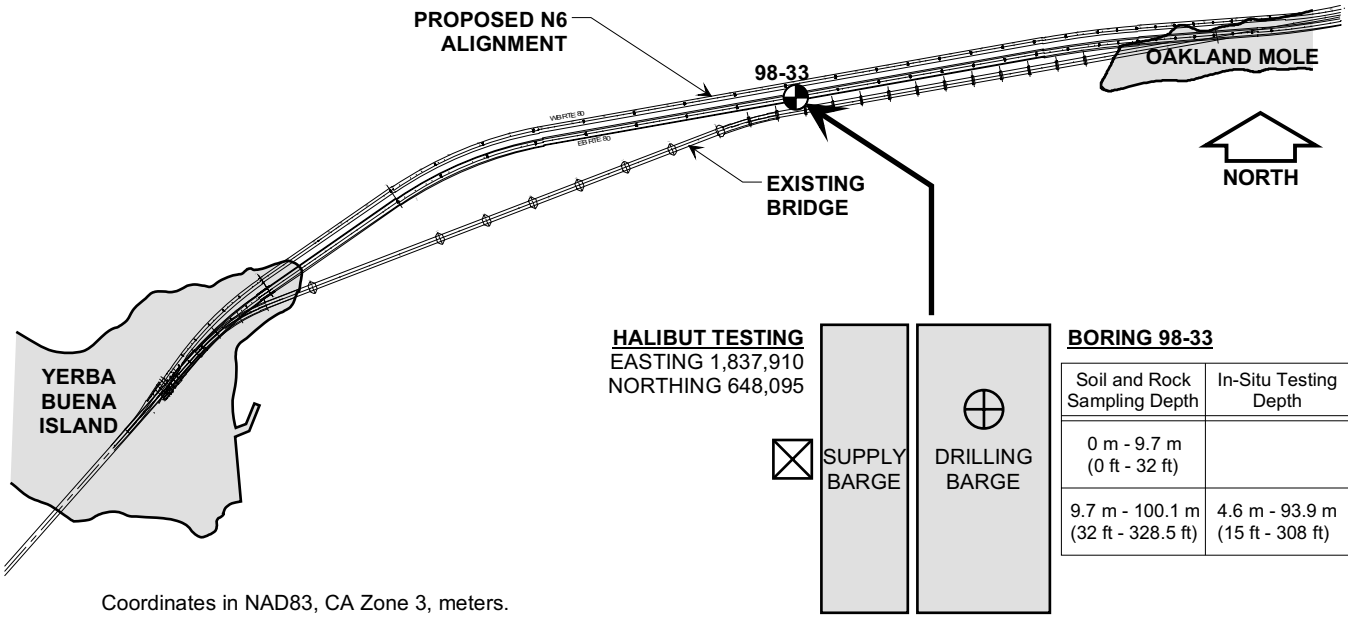
KEY TO TERMS AND SYMBOLS USED ON LOGS

SFOBB East Span Seismic Safety Project

BORING 98-33

Date	Time From	Time To	Description of Activity
September 15, 1998	0000	0245	Move barge to location 98-33. Set 4 anchors and 2 spuds.
	0245	0330	Rig up for drilling.
	0330	0425	Lower pipe to mudline. Measure water depth of 3.1m (10.3 ft) using bottom sensor. Current tide level is approximately –0.6m (-2.1 ft) MSL. Calculate mudline elevation of –3.8m (-12.4 ft) MSL.
	0425	0745	Drill and sample from mudline to 9.7m (32 ft).
	0745	0840	Pull drill pipe to deck and reposition barge.
	0840	1200	Set casing. Drive stinger to 8.5m (28 ft). Lower drill pipe to mudline.
	****	****	
	0840	1230	Rig up Halibut vane equipment. Perform Halibut vane shear testing from 0.6m (2 ft) to 3.7m (12 ft).
	****	****	
	1200	2400	Drill, sample, and CPT testing from mudline to 33.5m (110 ft).
September 16, 1998	0000	0930	Drill, sample, and CPT testing from 33.5m (110 ft) to 55.5m (182 ft).
	0930	1130	Drill, sample, and CPT testing from 55.5m (182 ft) to 68.9m (226 ft).
	1130	1200	Survey offset boring location.
	1200	2400	Drill, sample, and CPT testing from 68.9m (226 ft) to 97.6m (320 ft).
September 17, 1998	0000	0150	Drill, sample, and CPT testing from 97.6m (320 ft) to 100.1m (328.5 ft).
	0150	0250	Pull drill pipe to deck.
	0250	0520	P- and S-wave velocity logging from 93.6m (307 ft) to 8.5m (28 ft). Mix and circulate cement grout.
	0520	0750	Lower N-rod. Grout hole 98-33.
	0750	0900	Pull N-rod to deck.
	0900	1200	Pull casing to deck.
	1200	1430	Pull 4 anchors, 2 spuds, and move barge to location 98-34.

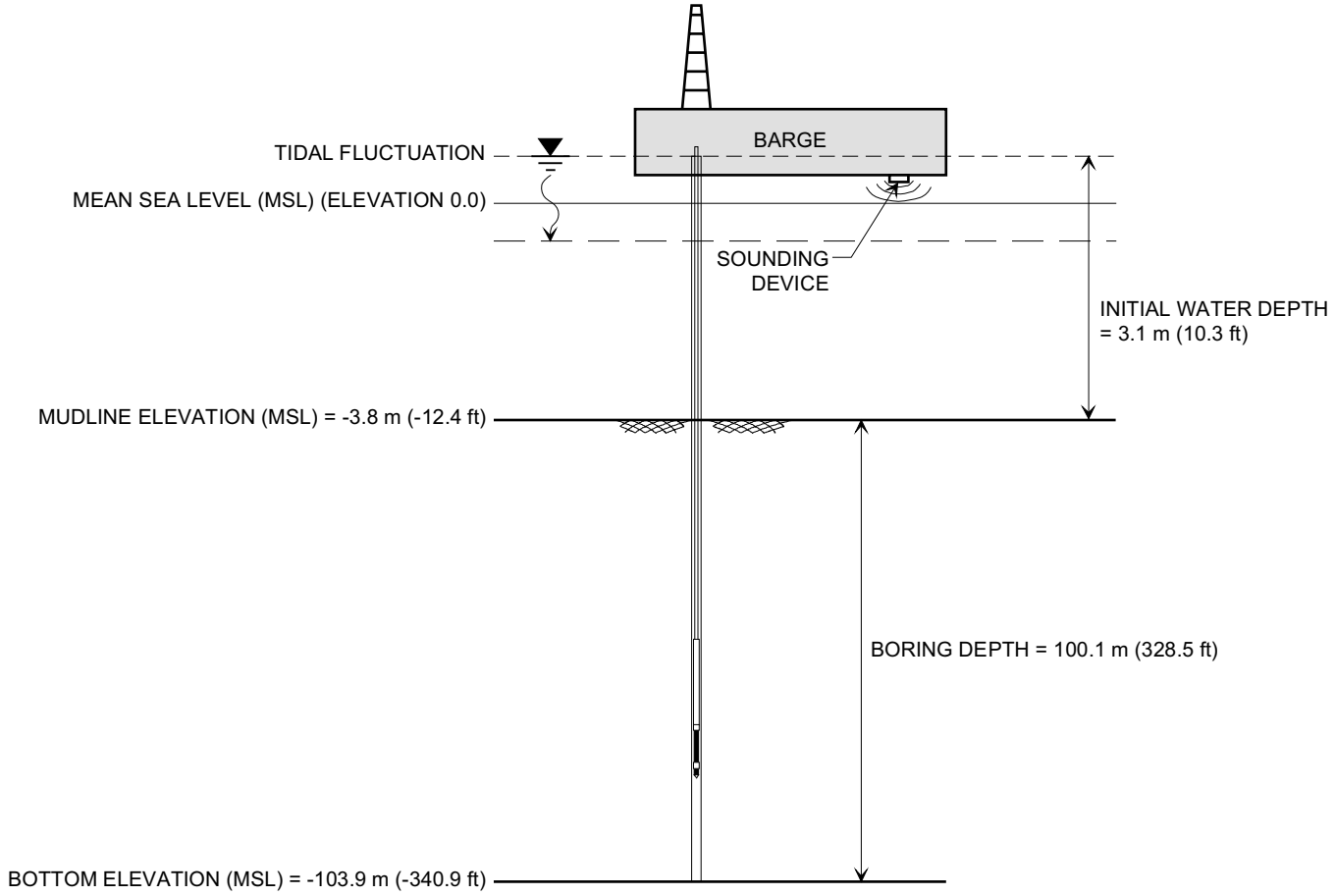
SUMMARY OF FIELD OPERATIONS
Boring 98-33
SFOBB East Span Seismic Safety Project



BORING 98-33

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 9.7 m (0 ft - 32 ft)		E = 1,837,931 N = 648,094
9.7 m - 100.1 m (32 ft - 328.5 ft)	4.6 m - 93.9 m (15 ft - 308 ft)	E = 1,837,925 N = 648,095

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-33
SFOBB East Span Seismic Safety Project

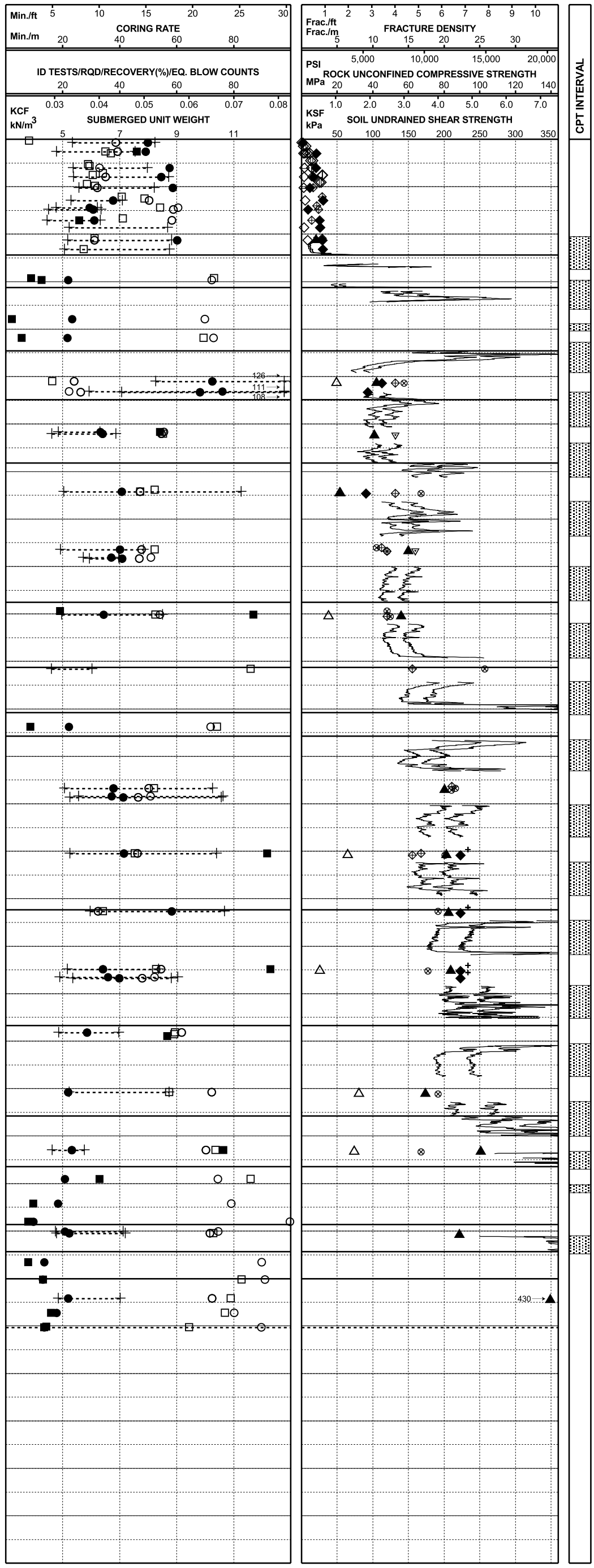
PROJECT NO:	98-42-0054	**START DATE:**	9/15/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-33 (Skyway Frame 2)	**COMPLETION DATE:**	9/17/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837925 N648095
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

Stratum	Material Description	Blow Count
I	Fat CLAY (CH), soft to firm , gray -very soft to 1.2m See Plate 98-33.6 for detailed stratigraphy (9.8m)	WOH, WOH, WOH, WOH, WOH, WOH, 10/45cm, PUSH, PUSH, PUSH, PUSH
II	Fine SAND with silt (SP-SM), loose to medium dense, gray -firm clay layer, 10.5m to 10.8m -firm clay below 12.2m (12.5m)	PUSH
III	Fine SAND (SP), very dense, gray -with a stiff clay layer, 12.8m to 13.7m -with clay layers at 17.4m and 17.7m (17.8m)	22/60cm, 30/30cm
IV	Fat CLAY (CH), very stiff, gray -stiff to very stiff dark brown organic clay, with a few gray clay pockets, below 20.1m (21.9m)	PUSH, SAVE
V	Fat CLAY (CH), very stiff, gray -with shells, shell fragments, and many sandy silt pockets, below 24.4m (27.3m)	PUSH
VI	Fat CLAY (CH), very stiff, gray -greenish gray to 29.9m -with sandy silt seams to 28.3m -slightly desiccated, with sandy silt pockets and grayish brown mottling, at 29.6m -with a few shell fragments and silt pockets, at 34.1m -with many silt pockets, 34.4m to 35.4m (39.0m)	PUSH, PUSH, SAVE
VII	Fat CLAY (CH), very stiff, gray -silty fine sand layer, with clay seams and pockets, at 39.6m -with sand pockets and organic pockets, at 39.9m (44.5m)	PUSH
VIII	Lean CLAY (CL), hard to very stiff, greenish gray -with silt pockets and partings at 44.5m -with a sand layer at 47.7m (48.3m)	30/15cm
IX	Fine SAND with silt (SP-SM), dense, greenish gray (50.3m)	30/15cm
X	Fat CLAY (CH), hard, olive gray -greenish gray to 55.5m -with desiccated pockets and slickensides, at 54.6m -with a few silty sand pockets and a few organic pockets, at 60.0m (64.9m)	PUSH, SAVE, PUSH, PUSH
XI	Fat CLAY (CH), hard, olive gray -with silt partings to 70.1m -with dessicated pockets at 64.9m -with silt seams below 69.5m -with silt pockets, 69.5m to 70.1m -with sand seams below 71.9m (74.7m)	PUSH, PUSH, SAVE
XII	Lean CLAY (CL), hard, gray -with many silty sand seams at 75.0m -sandy silt with clay seams, 75.3m to 76.4m -dark gray, with many organic pockets, at 79.9m (82.3m)	PUSH, PUSH
XIII	Lean CLAY (CL), hard, olive gray to gray -with silt layers at 83.5m and 84.0m -with sand and silt seams at 85.0m -dense sand layer, 85.5m to 85.8m (86.6m)	PUSH
XIV	Silty Fine SAND (SM), dense, dark gray -with a clay layer at 88.7m -fine to medium sand, with silt and fine gravel, at 89.6m -fine gravel with silt and sand, below 91.1m (91.4m)	30/20cm, 30/15cm, 30/15cm
XV	Lean CLAY (CL), hard, greenish gray (93.7m)	PUSH
XVI	Medium to Coarse SAND (SW-SM) with silt and gravel (96.0m)	30/15cm
XVII	Silty Fine to Medium SAND (SM) with coarse sand and fine gravel, very dense, gray -hard, yellowish brown lean clay layer with gravel and silt pockets, 97.5m to 98.1m -with a few clay pockets, 98.8m to 100.0m -yellowish brown silty fine to medium sand below 100.1m	30/15cm, 30/15cm, 30/15cm, 30/15cm

TOTAL DEPTH: 100.1m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-33

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

PLATE 98-33.3

PROJECT NO:	98-42-0054	**START DATE:**	9/15/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-33 (Skyway Frame 2)	**COMPLETION DATE:**	9/17/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837925 N648095
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

Elevation, m.	Depth, m.	Blow Count	Material Description	Stratum No.
-4		WOH, WOH, WOH, WOH, WOH, WOH, 10/45cm, PUSH, PUSH, PUSH, PUSH	Fat CLAY (CH), soft to firm , gray -very soft to 1.2m See Plate 98-33.6 for detailed stratigraphy (9.8m)	I
-16	12	PUSH	Fine SAND with silt (SP-SM), loose to medium dense, gray (12.5m)	II
-20	16	22/60cm, 30/30cm	Fine SAND (SP), very dense, gray -with a stiff clay layer, 12.8m to 13.7m -with silt at 16.8m -with clay layers at 17.4m and 17.7m (17.8m)	III
-24	20	PUSH, SAVE	Fat CLAY (CH), very stiff, gray -stiff to very stiff dark brown organic clay, with a few gray clay pockets, below 20.1m (21.9m)	IV
-28	24	PUSH	Fat CLAY (CH), very stiff, gray -with shells, shell fragments, and many sandy silt pockets, below 24.4m (27.3m)	V
-32, -36, -40	28, 32, 36	PUSH, PUSH, SAVE	Fat CLAY (CH), very stiff, gray -greenish gray to 29.9m -with sandy silt seams to 28.3m -slightly desiccated, with sandy silt pockets and grayish brown mottling, at 29.6m -with a few shell fragments and silt pockets, at 34.1m -with many silt pockets, 34.4m to 35.4m (39.0m)	VI
-44	40	PUSH	Fat CLAY (CH), very stiff, gray -silty fine sand layer, with clay seams and pockets, at 39.6m -with sand pockets and organic pockets, at 39.9m (44.5m)	VII
-48	44	30/15cm	Lean CLAY (CL), hard to very stiff, greenish gray -with a sand layer at 47.7m (48.3m)	VIII
-52	48	30/15cm	Fine SAND with silt (SP-SM), dense, greenish gray (50.3m)	IX
-56, -60, -64, -68	52, 56, 60, 64	PUSH, SAVE, PUSH, PUSH	Fat CLAY (CH), hard, olive gray -greenish gray to 55.5m -with desiccated pockets and slickensides, at 54.6m -with a few silty sand pockets and a few organic pockets, at 60.0m (64.9m)	X
-72, -76	68, 72	PUSH, SAVE	Fat CLAY (CH), hard, olive gray -with silt partings to 70.1m -with dessicated pockets at 64.9m -with silt seams below 69.5m -with silt pockets, 69.5m to 70.1m -with sand seams below 71.9m (74.7m)	XI
-80, -84	76, 80	PUSH, PUSH	Lean CLAY (CL), hard, gray -with many silty sand seams at 75.0m -sandy silt with clay seams, 75.3m to 76.4m -dark gray, with many organic pockets, at 79.9m (82.3m)	XII
-88	84	PUSH	Lean CLAY (CL), hard, olive gray to gray -with silt layers at 83.5m and 84.0m -with sand and silt seams at 85.0m -dense sand layer, 85.5m to 85.8m (86.6m)	XIII
-92	88	30/20cm, 30/15cm, 30/15cm	Silty Fine SAND (SM), dense, dark gray -fine gravel with silt and sand, below 91.1m (91.4m)	XIV
-96	92	PUSH	Lean CLAY (CL), hard, greenish gray (93.7m)	XV
-100	96	30/15cm, 30/15cm	Medium to Coarse SAND (SW-SM) with silt and gravel (96.0m)	XVI
-104	100	30/15cm, 30/15cm, 30/15cm	Silty Fine to Medium SAND (SM) with coarse sand and fine gravel, very dense, gray -hard, yellowish brown lean clay layer with gravel and silt pockets, 97.5m to 98.1m	XVII
-108, -112, -116, -120	104, 108, 112, 116		TOTAL DEPTH: 100.1m BACKFILLED WITH: Cement Grout	

LOG OF BORING AND TEST RESULTS

BORING 98-33

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

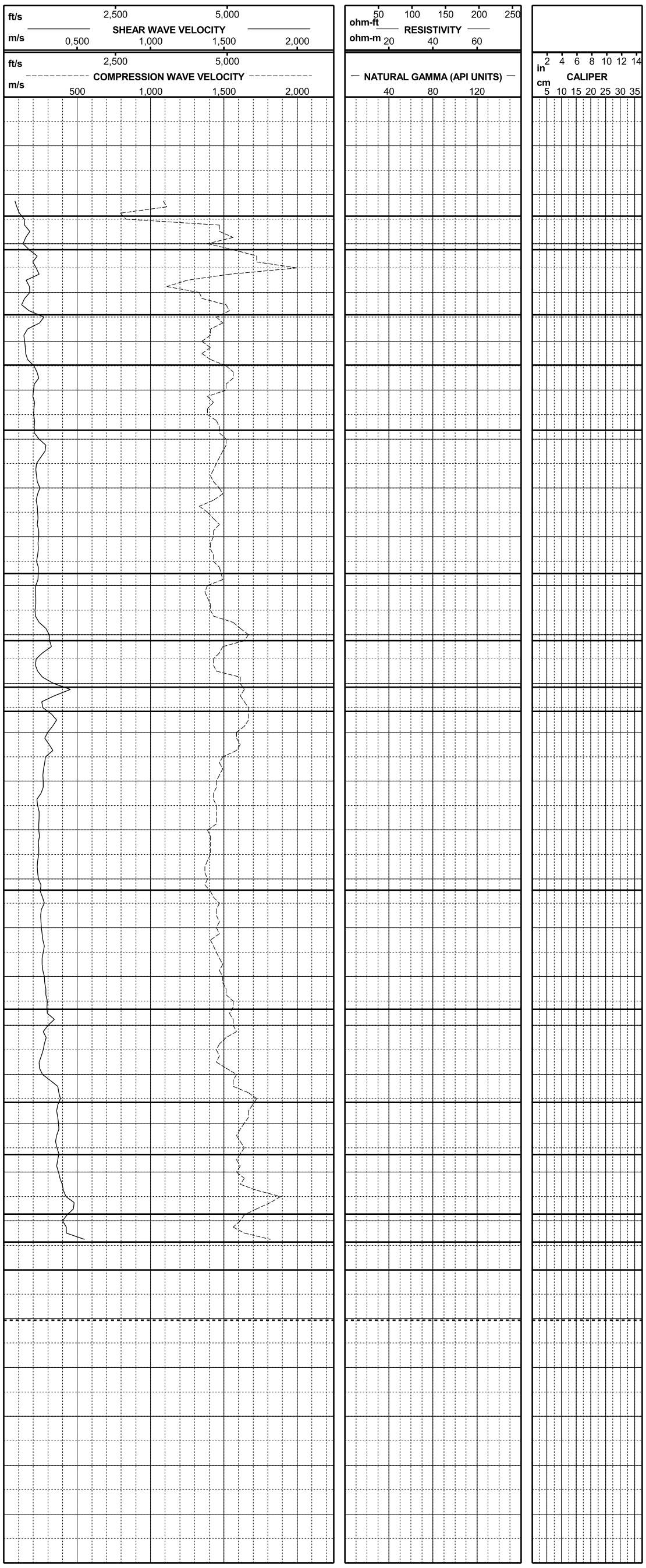
PLATE 98-33.4

PROJECT NO:	98-42-0054	**START DATE:**	9/15/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-33 (Skyway Frame 2)	**COMPLETION DATE:**	9/17/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837925 N648095
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4		WOH	Fat CLAY (CH), soft to firm , gray	I
		WOH		
		WOH		
		WOH		
-8	4	WOH	See Plate 98-33.6 for detailed stratigraphy	
		WOH		
		10/45cm		
		PUSH		
		PUSH		
-12	8	PUSH		
		PUSH	(9.8m)	
			Fine SAND with silt (SP-SM), loose to medium dense, gray (12.5m)	II
-16	12	PUSH		
			Fine SAND (SP), very dense, gray -with a stiff clay layer, 12.8m to 13.7m	III
		22/60cm		
-20	16	30/30cm	(17.8m)	
			Fat CLAY (CH), very stiff, gray -stiff to very stiff dark brown organic clay, with a few gray clay pockets, below 20.1m	IV
-24	20	PUSH		
		SAVE	(21.9m)	
			Fat CLAY (CH), very stiff, gray -with shells, shell fragments, and many sandy silt pockets, below 24.4m	V
-28	24	PUSH	(27.3m)	
			Fat CLAY (CH), very stiff, gray -greenish gray to 29.9m -with sandy silt seams to 28.3m -slightly desiccated, with sandy silt pockets and grayish brown mottling, at 29.6m	VI
-32	28	PUSH		
-36	32		-with a few shell fragments and silt pockets, at 34.1m -with many silt pockets, 34.4m to 35.4m	
		PUSH		
		SAVE		
-40	36		(39.0m)	
-44	40	PUSH	Fat CLAY (CH), very stiff, gray -silty fine sand layer, with clay seams and pockets, at 39.6m -with sand pockets and organic pockets, at 39.9m	VII
-48	44	30/15cm	(44.5m)	
			Lean CLAY (CL), hard to very stiff, greenish gray -with silt pockets and partings at 44.5m -with a sand layer at 47.7m (48.3m)	VIII
-52	48	30/15cm	Fine SAND with silt (SP-SM), dense, greenish gray (50.3m)	IX
-56	52		Fat CLAY (CH), hard, olive gray -greenish gray to 55.5m	X
		PUSH	-with desiccated pockets and slickensides, at 54.6m	
		SAVE		
-60	56			
-64	60	PUSH	-with a few silty sand pockets and a few organic pockets, at 60.0m	
			(64.9m)	
-68	64	PUSH	Fat CLAY (CH), hard, olive gray -with silt partings to 70.1m -with dessicated pockets at 64.9m	XI
-72	68		-with silt seams below 69.5m -with silt pockets, 69.5m to 70.1m	
		PUSH		
		SAVE		
-76	72		-with sand seams below 71.9m (74.7m)	
-80	76	PUSH	Lean CLAY (CL), hard, gray -with many silty sand seams at 75.0m -sandy silt with clay seams, 75.3m to 76.4m	XII
-84	80	PUSH	-dark gray, with many organic pockets, at 79.9m (82.3m)	
-88	84	PUSH	Lean CLAY (CL), hard, olive gray to gray -with silt layers at 83.5m and 84.0m -with sand and silt seams at 85.0m -dense sand layer, 85.5m to 85.8m (86.6m)	XIII
-92	88	30/20cm	Silty Fine SAND (SM), dense, dark gray -with a clay layer at 88.7m -fine to medium sand, with silt and fine gravel, at 89.6m -fine gravel with silt and sand, below 91.1m (91.4m)	XIV
		30/15cm		
		30/15cm		
-96	92	PUSH	Lean CLAY (CL), hard, greenish gray (93.7m)	XV
		30/15cm	Medium to Coarse SAND (SW-SM) with silt and gravel (96.0m)	XVI
-100	96	30/15cm	Silty Fine to Medium SAND (SM) with coarse sand and fine gravel, very dense, gray -hard, yellowish brown lean clay layer with gravel and silt pockets, 97.5m to 98.1m -with a few clay pockets, 98.8m to 100.0m -yellowish brown silty fine to medium sand below 100.1m	XVII
		30/15cm		
		30/15cm		
-104	100	30/15cm		
-108	104		TOTAL DEPTH: 100.1m BACKFILLED WITH: Cement Grout	
-112	108			
-116	112			
-120	116			



LOG OF BORING AND TEST RESULTS

BORING 98-33

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

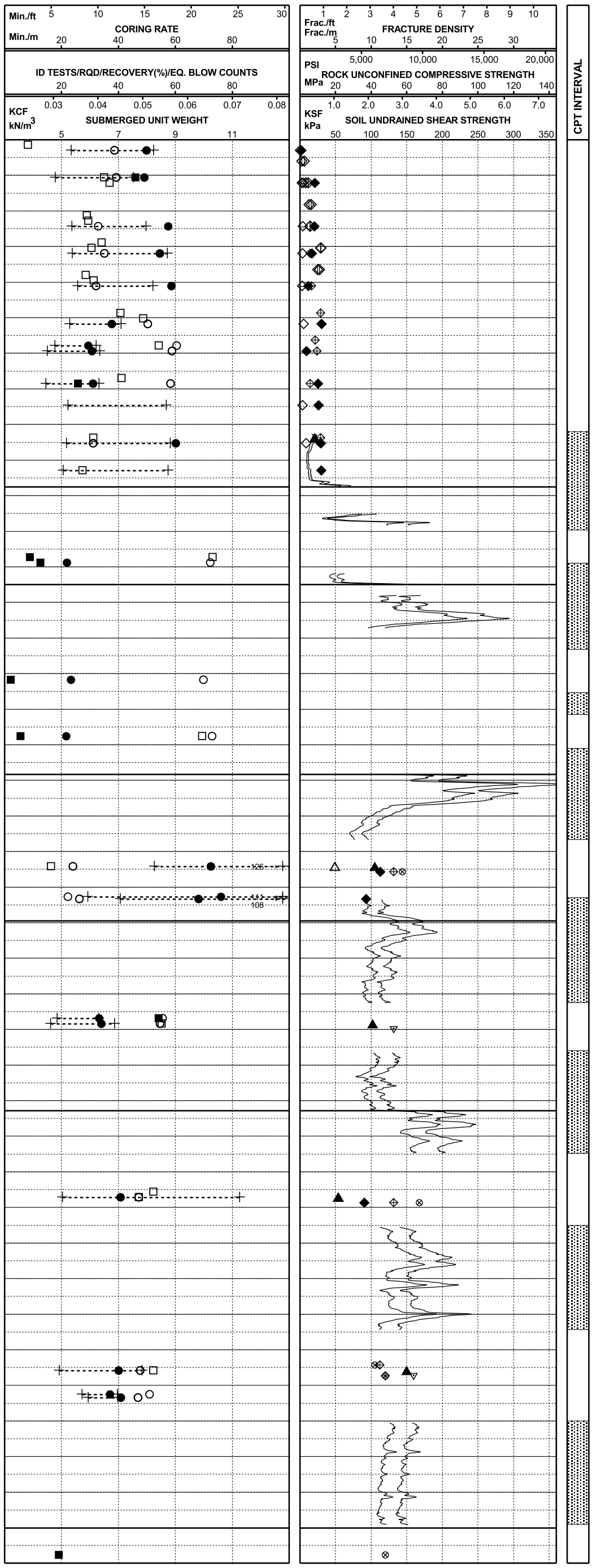
PLATE 98-33.5

PROJECT NO:	98-42-0054	**START DATE:**	9/15/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-33 (Skyway Frame 2)	**COMPLETION DATE:**	9/17/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837925 N648095
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

Stratum No.	Material Description	Blow Count
I	Fat CLAY (CH), soft to firm , gray -very soft to 1.2m -with many shell fragments to 1.2m -with silt pockets to 2.4m -with an H2S odor, 0.9m to 4.3m -with a few shell fragments at 3.0m -with many shells and shell fragments, and a few silt pockets, at 4.0m -with silty sand pockets, 4.6m to 7.0m -with silty sand seams and a few shell fragments at 5.8m -with a few silt pockets below 8.2m (9.8m)	WOH, WOH, WOH, WOH, WOH, WOH, 10/45cm, PUSH, PUSH, PUSH, PUSH
II	Fine SAND with silt (SP-SM), loose to medium dense, gray -firm clay layer, 10.5m to 10.8m -with clay pockets and a few cemented pockets, at 11.6m -firm clay below 12.2m (12.5m)	PUSH
III	Fine SAND (SP), very dense, gray -with a stiff clay layer, 12.8m to 13.7m -with silt at 16.8m -with clay layers at 17.4m and 17.7m (17.8m)	22/60cm, 30/30cm
IV	Fat CLAY (CH), very stiff, gray -stiff to very stiff dark brown organic clay, with a few gray clay pockets, below 20.1m (21.9m)	PUSH, SAVE
V	Fat CLAY (CH), very stiff, gray -with shells, shell fragments, and many sandy silt pockets, below 24.4m (27.3m)	PUSH
VI	Fat CLAY (CH), very stiff, gray -greenish gray to 29.9m -with sandy silt seams to 28.3m -slightly desiccated, with sandy silt pockets and grayish brown mottling, at 29.6m -with a few shell fragments and silt pockets, at 34.1m -with many silt pockets, 34.4m to 35.4m (39.0m)	PUSH, PUSH, SAVE
VII	Fat CLAY (CH), very stiff, gray -silty fine sand layer, with clay seams and pockets, at 39.6m -with sand pockets and organic pockets, at 39.9m	PUSH



LOG OF BORING AND TEST RESULTS

BORING 98-33

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

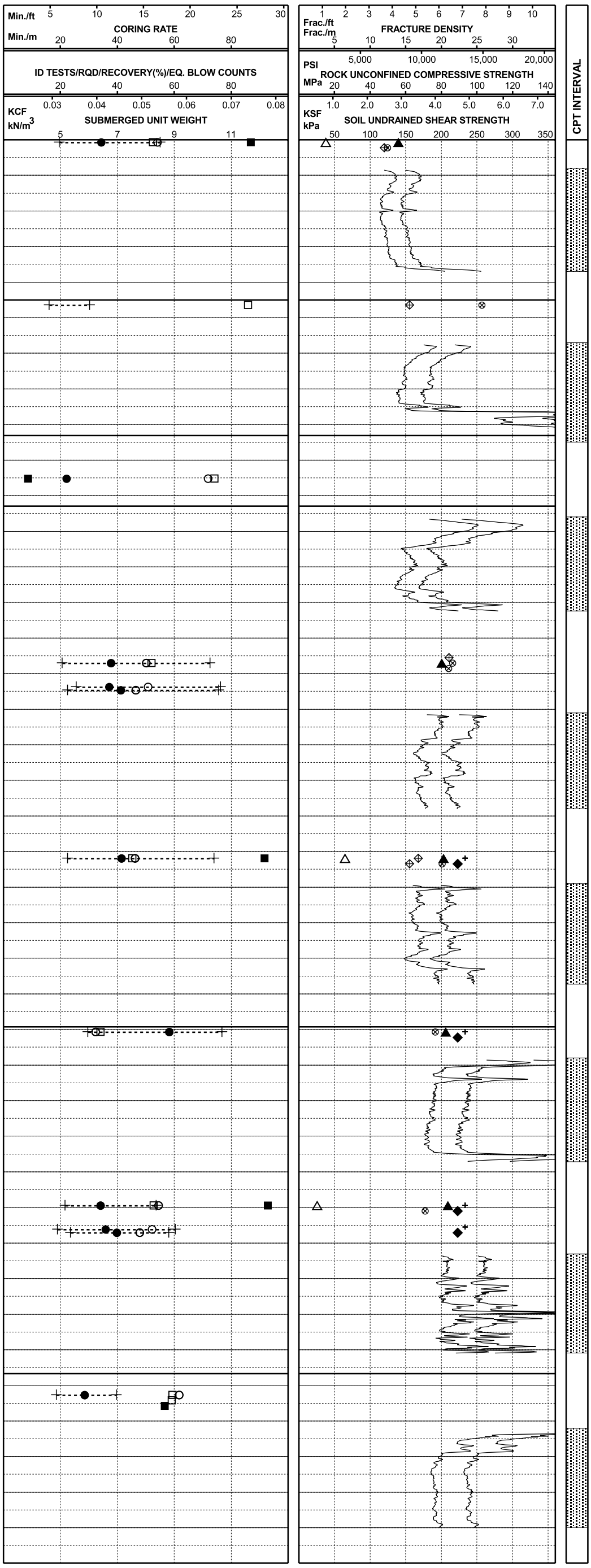
PLATE 98-33.6a

PROJECT NO:	98-42-0054	**START DATE:**	9/15/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-33 (Skyway Frame 2)	**COMPLETION DATE:**	9/17/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837925 N648095
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

Elevation, m.	Depth, m.	Sampler	Blow Count	Material Description	Stratum No.
-44			PUSH	Fat CLAY (CH), very stiff, gray	VII
-48			30/15cm	Lean CLAY (CL), hard to very stiff, greenish gray -with silt pockets and partings at 44.5m -with a sand layer at 47.7m (48.3m)	VIII
-52			30/15cm	Fine SAND with silt (SP-SM), dense, greenish gray (50.3m)	IX
-54			PUSH SAVE	Fat CLAY (CH), hard, olive gray -greenish gray to 55.5m -with desiccated pockets and slickensides, at 54.6m	X
-64			PUSH	-with a few silty sand pockets and a few organic pockets, at 60.0m (64.9m)	
-69			PUSH	Fat CLAY (CH), hard, olive gray -with silt partings to 70.1m -with dessicated pockets at 64.9m -with silt seams below 69.5m -with silt pockets, 69.5m to 70.1m -with sand seams below 71.9m (74.7m)	XI
-79			PUSH	Lean CLAY (CL), hard, gray -with many silty sand seams at 75.0m -sandy silt with clay seams, 75.3m to 76.4m	XII
-83			PUSH	-dark gray, with many organic pockets, at 79.9m	



LOG OF BORING AND TEST RESULTS

BORING 98-33

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

PLATE 98-33.6b

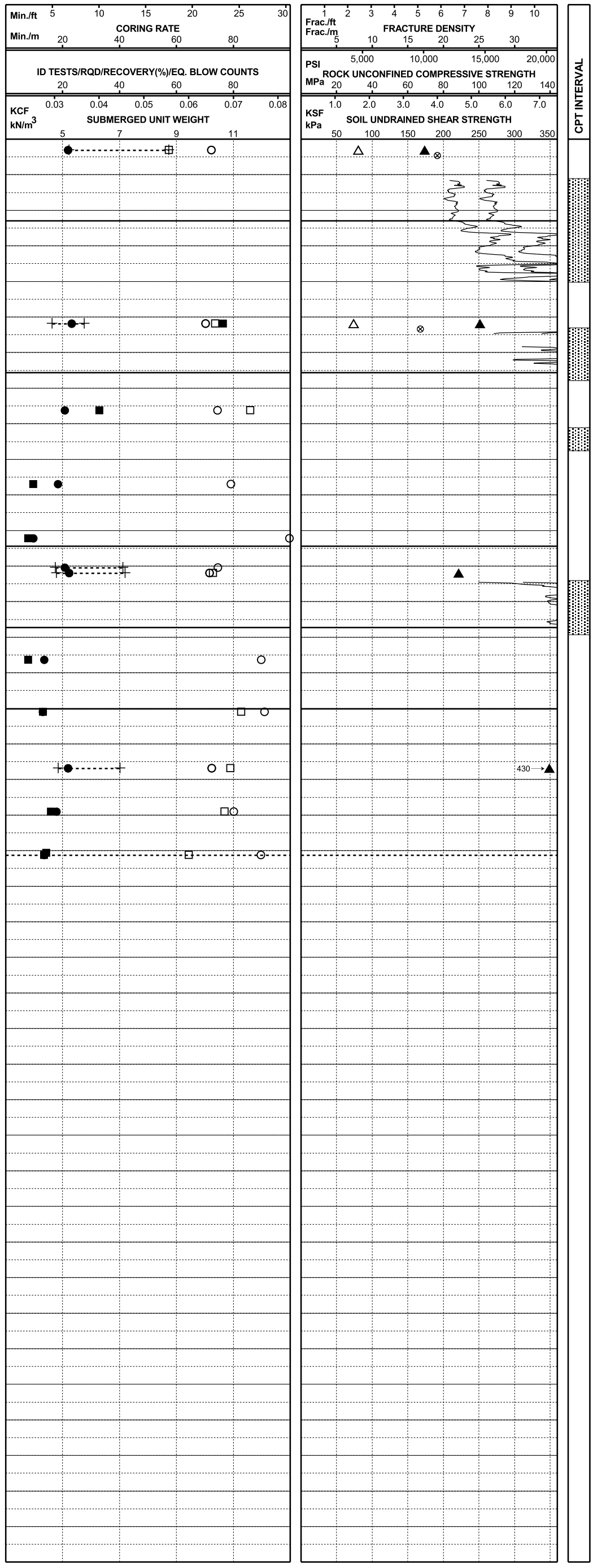
PROJECT NO:	98-42-0054	**START DATE:**	9/15/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-33 (Skyway Frame 2)	**COMPLETION DATE:**	9/17/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837925 N648095
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

Stratum No.	Material Description	Blow Count / Sampler
XII	Lean CLAY (CL), hard, gray (82.3m)	PUSH
XIII	Lean CLAY (CL), hard, olive gray to gray -with silt layers at 83.5m and 84.0m -with sand and silt seams at 85.0m -dense sand layer, 85.5m to 85.8m (86.6m)	PUSH
XIV	Silty Fine SAND (SM), dense, dark gray -with a clay layer at 88.7m -fine to medium sand, with silt and fine gravel, at 89.6m -fine gravel with silt and sand, below 91.1m (91.4m)	30/20cm; 30/15cm; 30/15cm
XV	Lean CLAY (CL), hard, greenish gray (93.7m)	PUSH
XVI	Medium to Coarse SAND (SW-SM) with silt and gravel (96.0m)	30/15cm
XVII	Silty Fine to Medium SAND (SM) with coarse sand and fine gravel, very dense, gray -hard, yellowish brown lean clay layer with gravel and silt pockets, 97.5m to 98.1m -with a few clay pockets, 98.8m to 100.0m -yellowish brown silty fine to medium sand below 100.1m	30/15cm; 30/15cm; 30/15cm

TOTAL DEPTH: 100.1m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-33

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

PLATE 98-33.6c

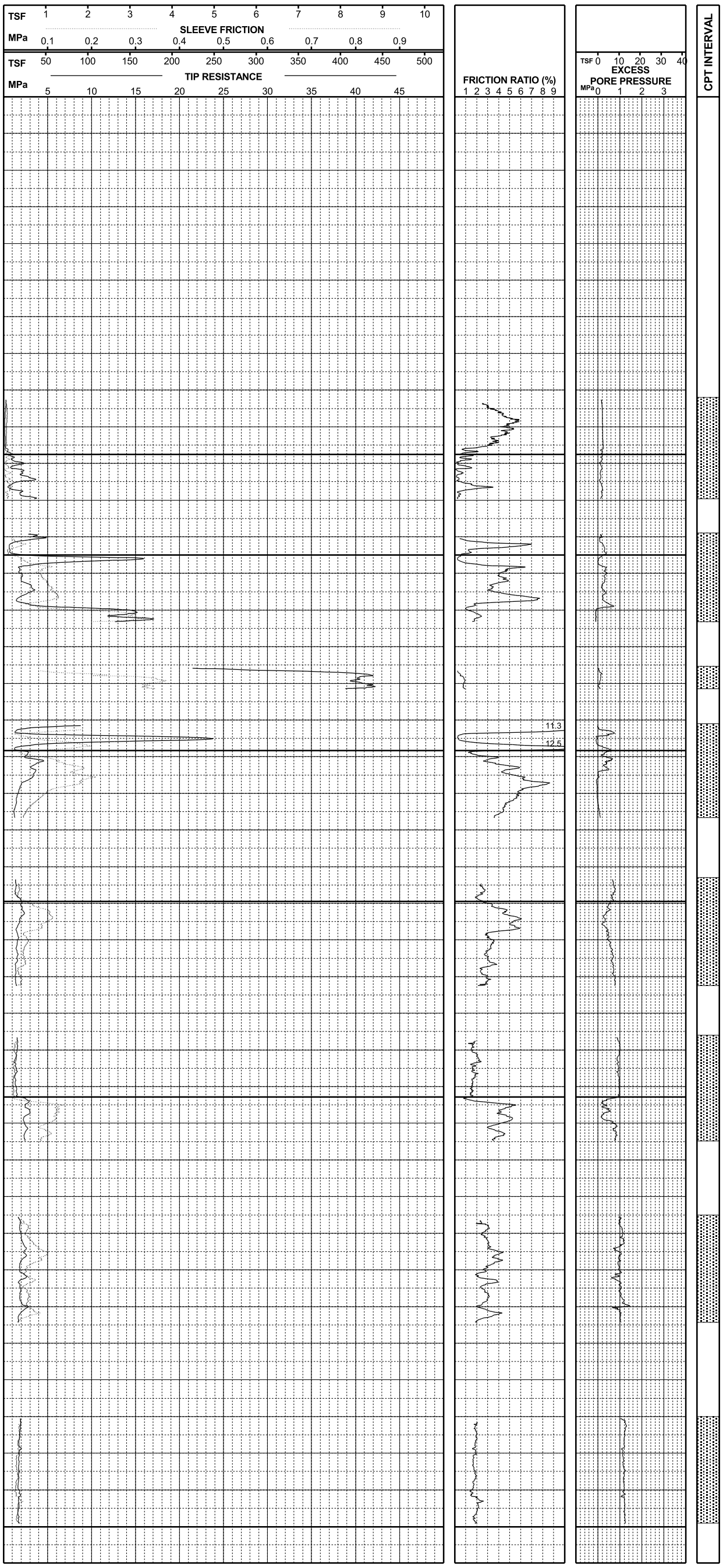
PROJECT NO:	98-42-0054	**START DATE:**	9/15/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-33 (Skyway Frame 2)	**COMPLETION DATE:**	9/17/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837925 N648095
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

Stratum No.	Material Description
I	Fat CLAY (CH), soft to firm , gray -very soft to 1.2m -with many shell fragments to 1.2m -with silt pockets to 2.4m -with an H2S odor, 0.9m to 4.3m -with a few shell fragments at 3.0m -with many shells and shell fragments, and a few silt pockets, at 4.0m -with silty sand pockets, 4.6m to 7.0m -with silty sand seams and a few shell fragments at 5.8m -with a few silt pockets below 8.2m (9.8m)
II	Fine SAND with silt (SP-SM), loose to medium dense, gray -firm clay layer, 10.5m to 10.8m -with clay pockets and a few cemented pockets, at 11.6m -firm clay below 12.2m (12.5m)
III	Fine SAND (SP), very dense, gray -with a stiff clay layer, 12.8m to 13.7m -with silt at 16.8m -with clay layers at 17.4m and 17.7m (17.8m)
IV	Fat CLAY (CH), very stiff, gray -stiff to very stiff dark brown organic clay, with a few gray clay pockets, below 20.1m (21.9m)
V	Fat CLAY (CH), very stiff, gray -with shells, shell fragments, and many sandy silt pockets, below 24.4m (27.3m)
VI	Fat CLAY (CH), very stiff, gray -greenish gray to 29.9m -with sandy silt seams to 28.3m -slightly desiccated, with sandy silt pockets and grayish brown mottling, at 29.6m -with a few shell fragments and silt pockets, at 34.1m -with many silt pockets, 34.4m to 35.4m (39.0m)
VII	Fat CLAY (CH), very stiff, gray -silty fine sand layer, with clay seams and pockets, at 39.6m

Blow count: WOH, WOH, WOH, WOH, WOH, WOH, 10/45cm, PUSH, PUSH, PUSH, PUSH, PUSH, 22/60cm, 30/30cm, PUSH, SAVE, PUSH, PUSH, PUSH, PUSH, SAVE, PUSH



LOG OF BORING AND TEST RESULTS

BORING 98-33

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

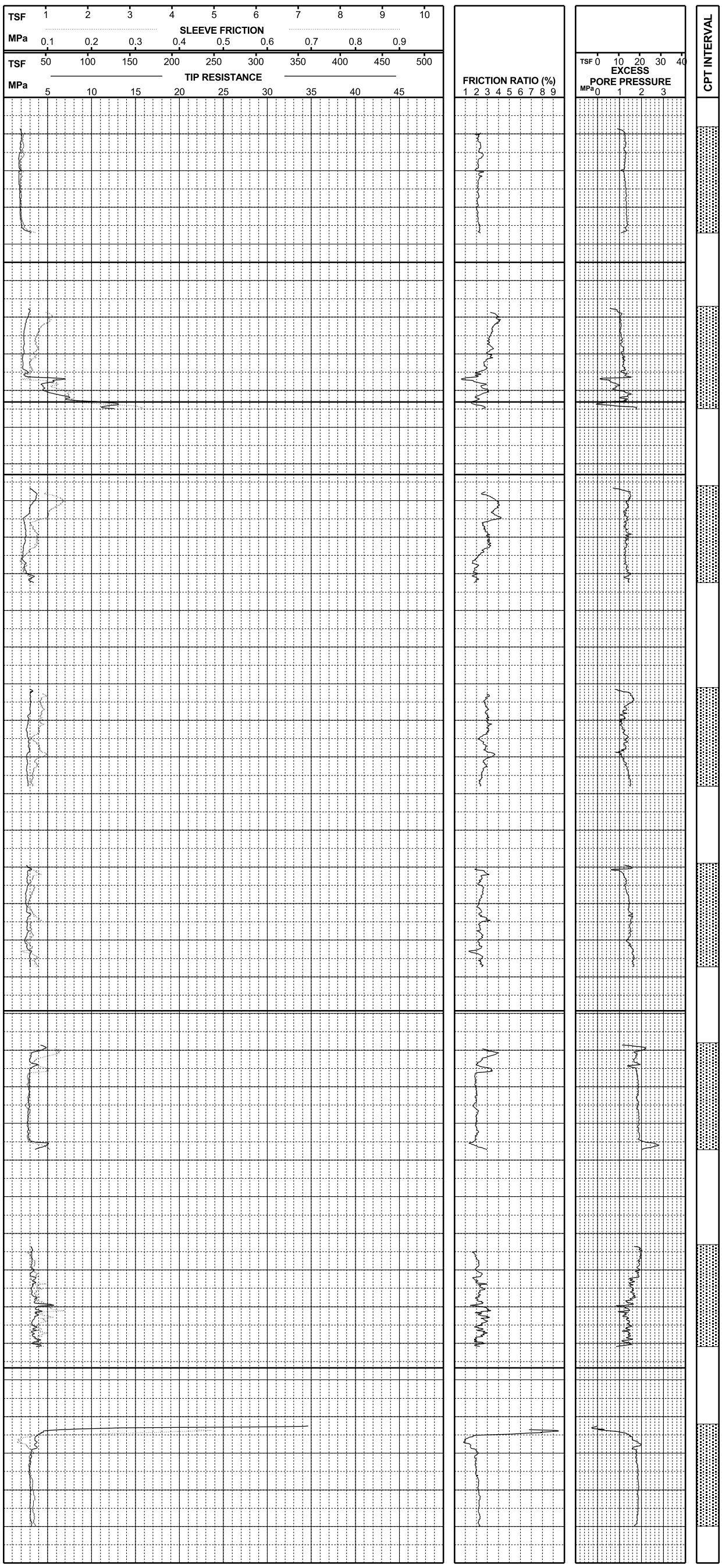
PLATE 98-33.7a

PROJECT NO:	98-42-0054	**START DATE:**	9/15/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-33 (Skyway Frame 2)	**COMPLETION DATE:**	9/17/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837925 N648095
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-44	41		PUSH	Fat CLAY (CH), very stiff, gray -with sand pockets and organic pockets, at 39.9m (44.5m)	VII
-48	45		30/15cm	Lean CLAY (CL), hard to very stiff, greenish gray -with silt pockets and partings at 44.5m -with a sand layer at 47.7m (48.3m)	VIII
-52	49		30/15cm	Fine SAND with silt (SP-SM), dense, greenish gray (50.3m)	IX
-54	51			Fat CLAY (CH), hard, olive gray -greenish gray to 55.5m	X
-58	54		PUSH	-with desiccated pockets and slickensides, at 54.6m	
-59	55		SAVE		
-64	60		PUSH	-with a few silty sand pockets and a few organic pockets, at 60.0m (64.9m)	
-69	65		PUSH	Fat CLAY (CH), hard, olive gray -with silt partings to 70.1m -with dessicated pockets at 64.9m	XI
-73	69			-with silt seams below 69.5m	
-74	70		PUSH SAVE	-with silt pockets, 69.5m to 70.1m	
-78	72			-with sand seams below 71.9m (74.7m)	
-79	75		PUSH	Lean CLAY (CL), hard, gray -with many silty sand seams at 75.0m -sandy silt with clay seams, 75.3m to 76.4m	XII
-83	79		PUSH	-dark gray, with many organic pockets, at 79.9m	



LOG OF BORING AND TEST RESULTS

BORING 98-33

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

PLATE 98-33.7b

PROJECT NO:	98-42-0054	**START DATE:**	9/15/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-33 (Skyway Frame 2)	**COMPLETION DATE:**	9/17/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

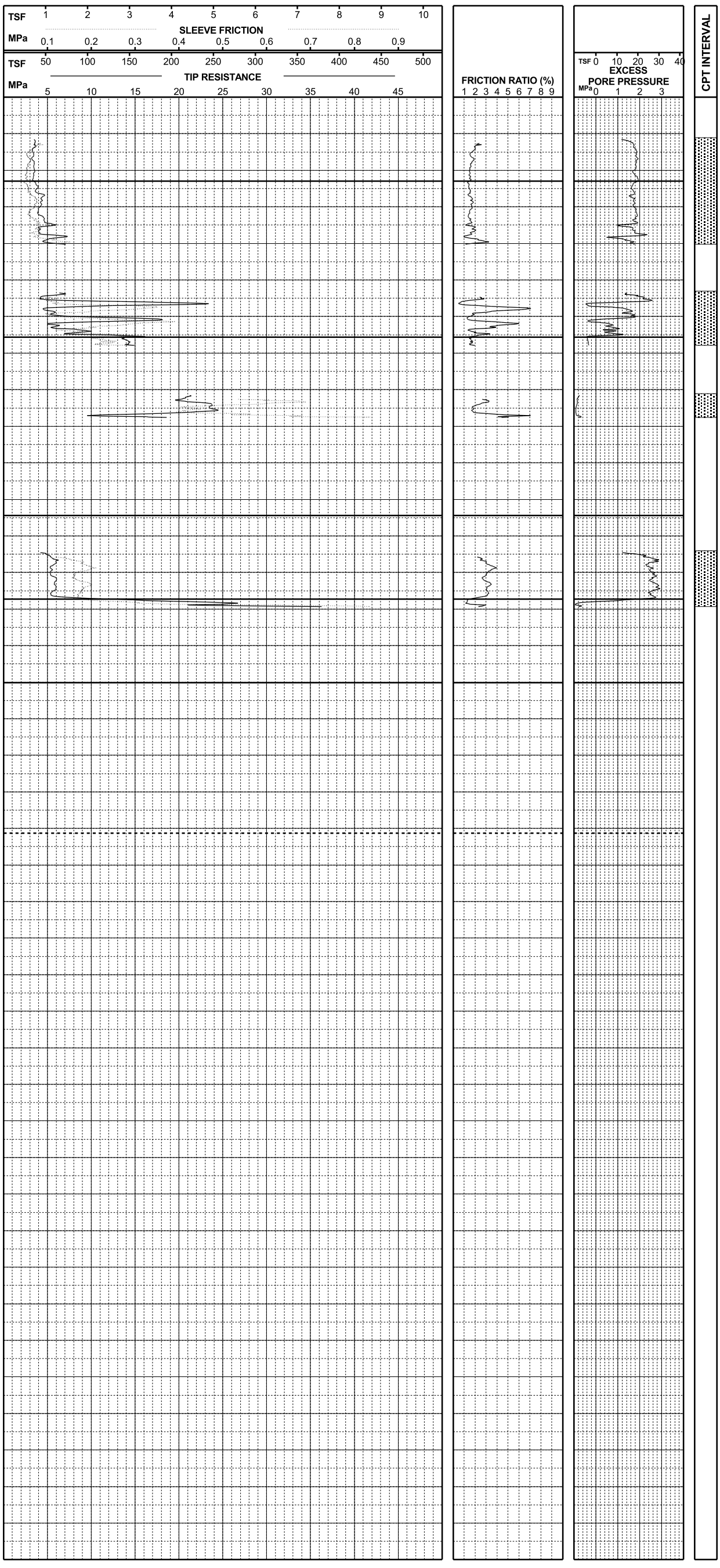
Coordinates: E1837925 N648095
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

ELEVATION, m. / DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-84 / 81 / -85 / 82 / -86		PUSH	Lean CLAY (CL), hard, gray (82.3m)	XII
83 / -87 / 84 / -88 / 85 / -89 / 86 / -90		PUSH	Lean CLAY (CL), hard, olive gray to gray -with silt layers at 83.5m and 84.0m -with sand and silt seams at 85.0m -dense sand layer, 85.5m to 85.8m (86.6m)	XIII
87 / -91 / 88 / -92 / 89 / -93 / 90 / -94 / 91 / -95	30/20cm 30/15cm 30/15cm		Silty Fine SAND (SM), dense, dark gray -with a clay layer at 88.7m -fine to medium sand, with silt and fine gravel, at 89.6m -fine gravel with silt and sand, below 91.1m (91.4m)	XIV
92 / -96 / 93 / -97		PUSH	Lean CLAY (CL), hard, greenish gray (93.7m)	XV
94 / -98 / 95 / -99	30/15cm		Medium to Coarse SAND (SW-SM) with silt and gravel (96.0m)	XVI
96 / -100 / 97 / -101 / 98 / -102 / 99 / -103 / 100 / -104	30/15cm 30/15cm 30/15cm 30/15cm		Silty Fine to Medium SAND (SM) with coarse sand and fine gravel, very dense, gray -hard, yellowish brown lean clay layer with gravel and silt pockets, 97.5m to 98.1m -with a few clay pockets, 98.8m to 100.0m -yellowish brown silty fine to medium sand below 100.1m	XVII

TOTAL DEPTH: 100.1m

BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-33

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

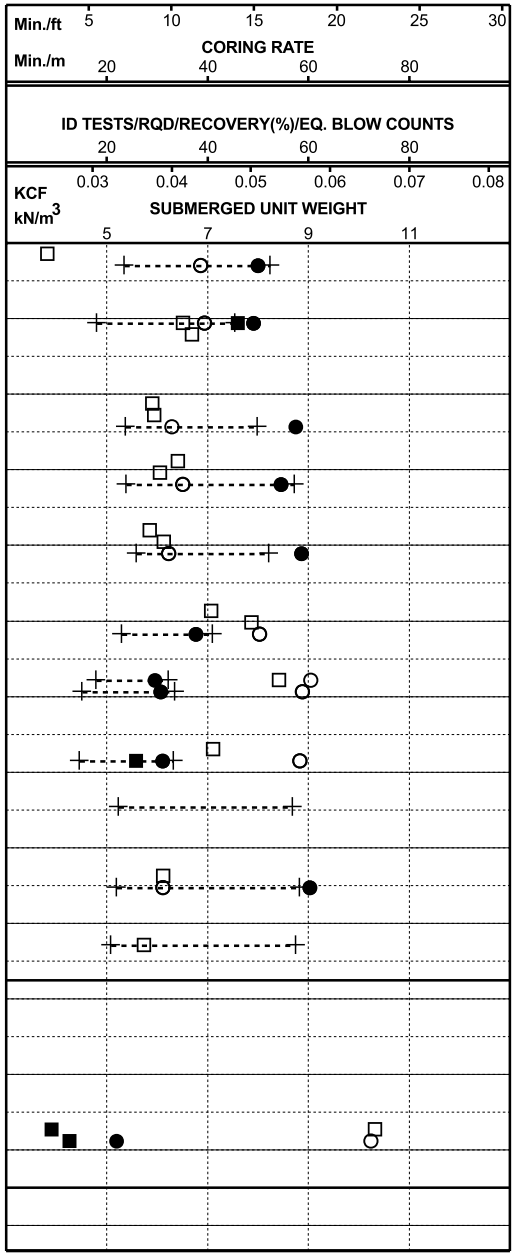
PLATE 98-33.7c

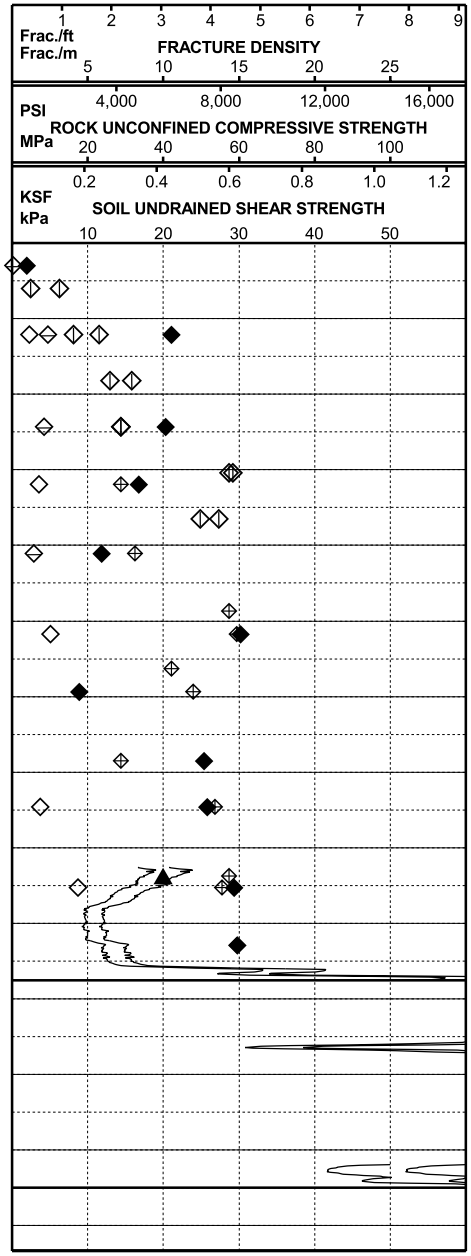
PROJECT NO:	98-42-0054	**START DATE:**	9/15/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-33 (Skyway Frame 2)	**COMPLETION DATE:**	9/17/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837925 N648095
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4				WOH	Fat CLAY (CH), soft to firm , gray -very soft to 1.2m -with many shell fragments to 1.2m -with silt pockets to 2.4m -with an H2S odor, 0.9m to 4.3m	I
-5	1			WOH		
-6	2			WOH		
-7	3			WOH	-with a few shell fragments at 3.0m	
-8	4			WOH	-with many shells and shell fragments, and a few silt pockets, at 4.0m -with silty sand pockets, 4.6m to 7.0m	
-9	5			WOH	-with silty sand seams and a few shell fragments at 5.8m	
-10	6			10/45cm		
-11	7			PUSH PUSH		
-12	8			PUSH	-with a few silt pockets below 8.2m	
-13	9			PUSH	(9.8m)	
-14	10				Fine SAND with silt (SP-SM), loose to medium dense, gray -firm clay layer, 10.5m to 10.8m	II
-15	11			PUSH	-with clay pockets and a few cemented pockets, at 11.6m	
-16	12				-firm clay below 12.2m (12.5m)	
-17	13				Fine SAND (SP), very dense, gray -with a stiff clay layer, 12.8m to 13.7m	III





CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-33

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

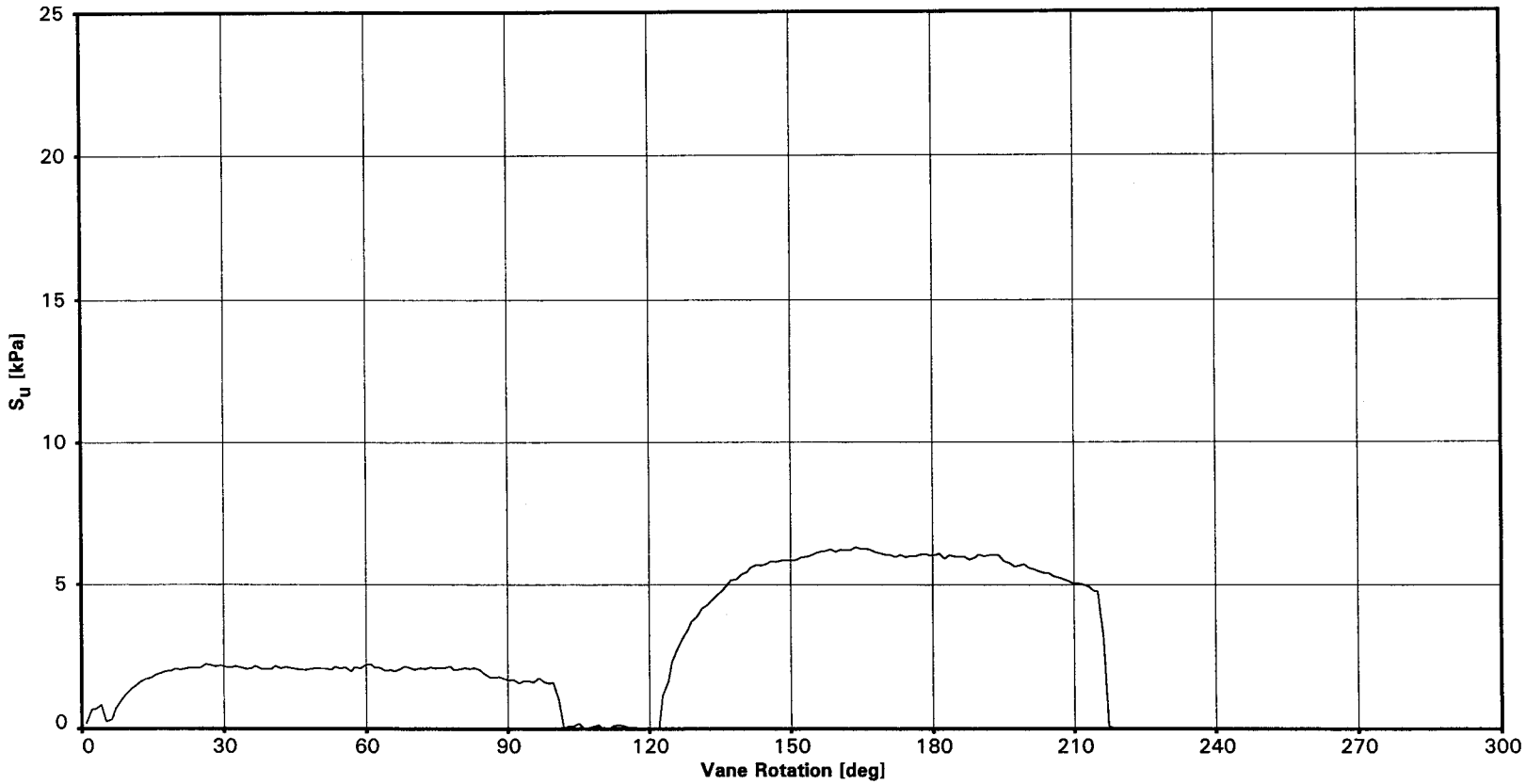
FUGRO

PLATE 98-33.8

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 0.6m
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

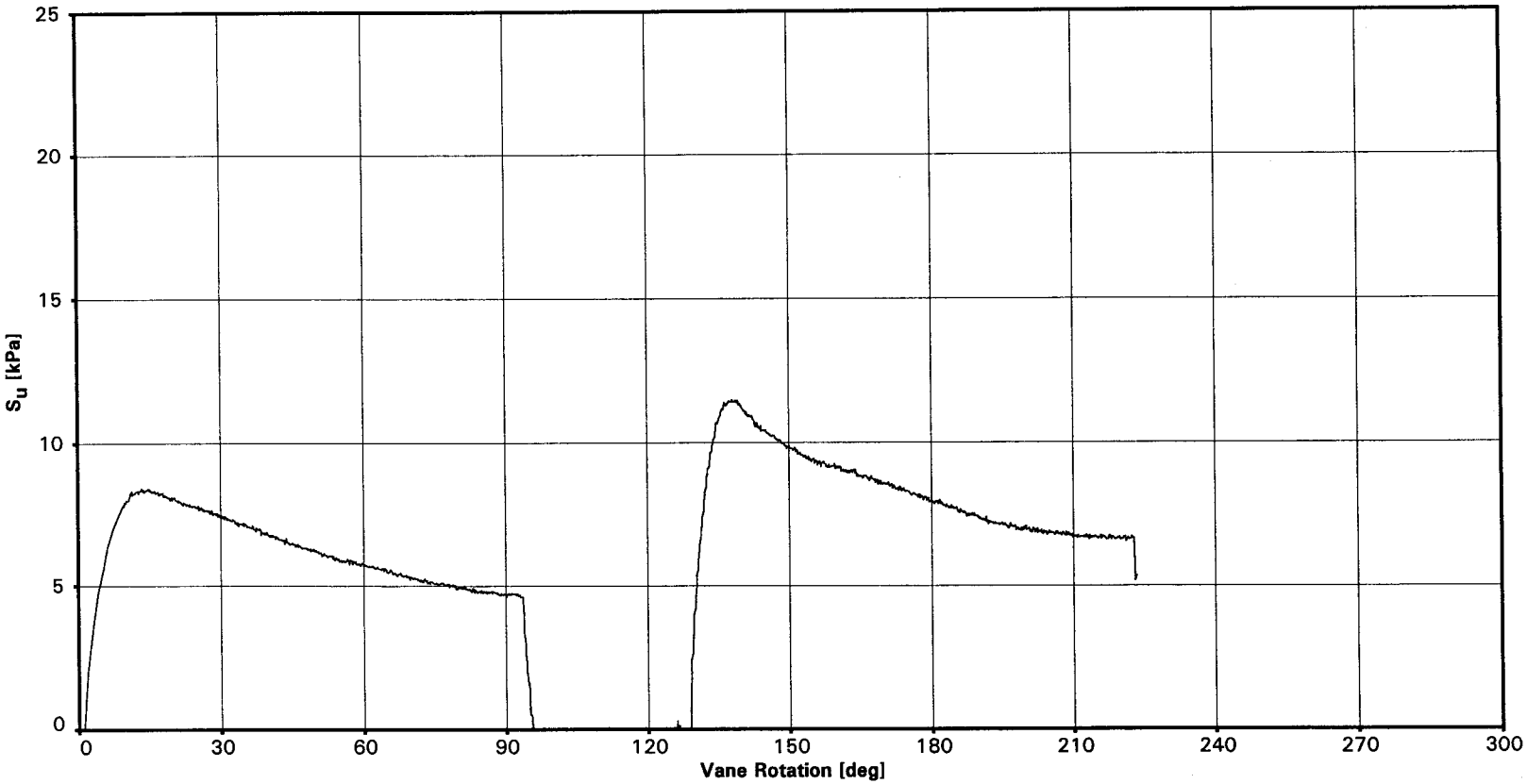
FUGRO

PLATE 98-33.9a

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.2m
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

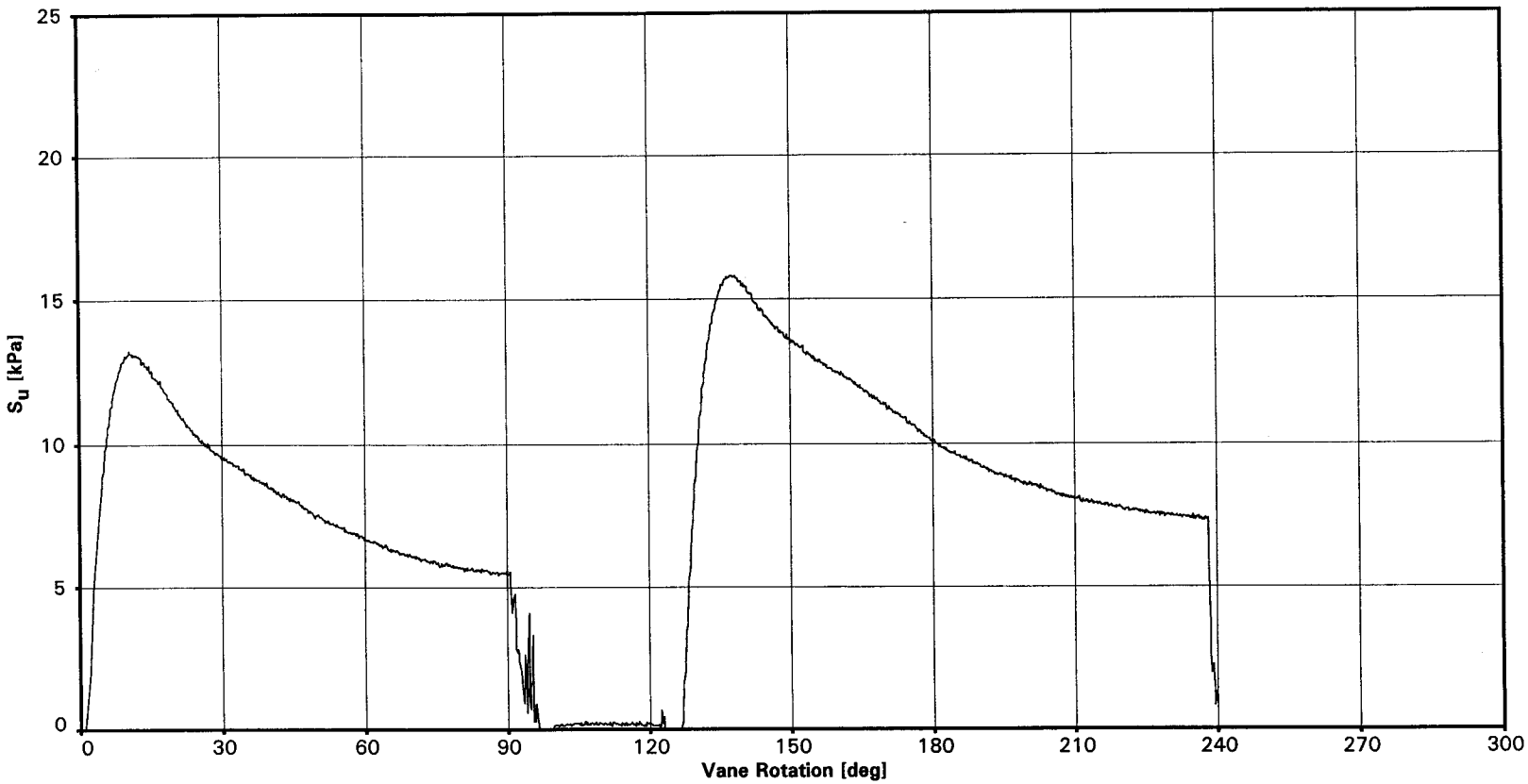
FUGRO

PLATE 98-33.9b

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.8m
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

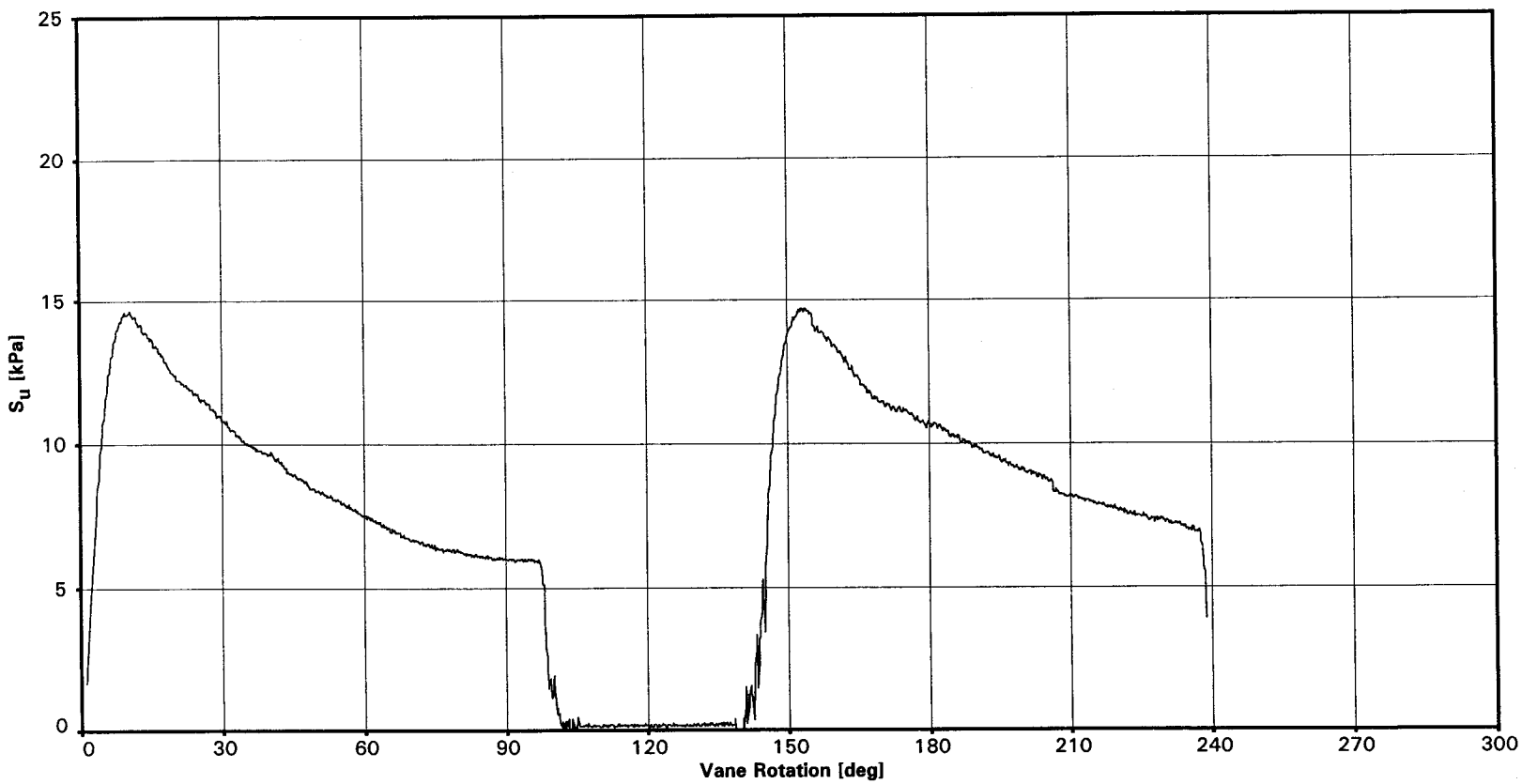
FUGRO

PLATE 98-33.9c

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 2.4m
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

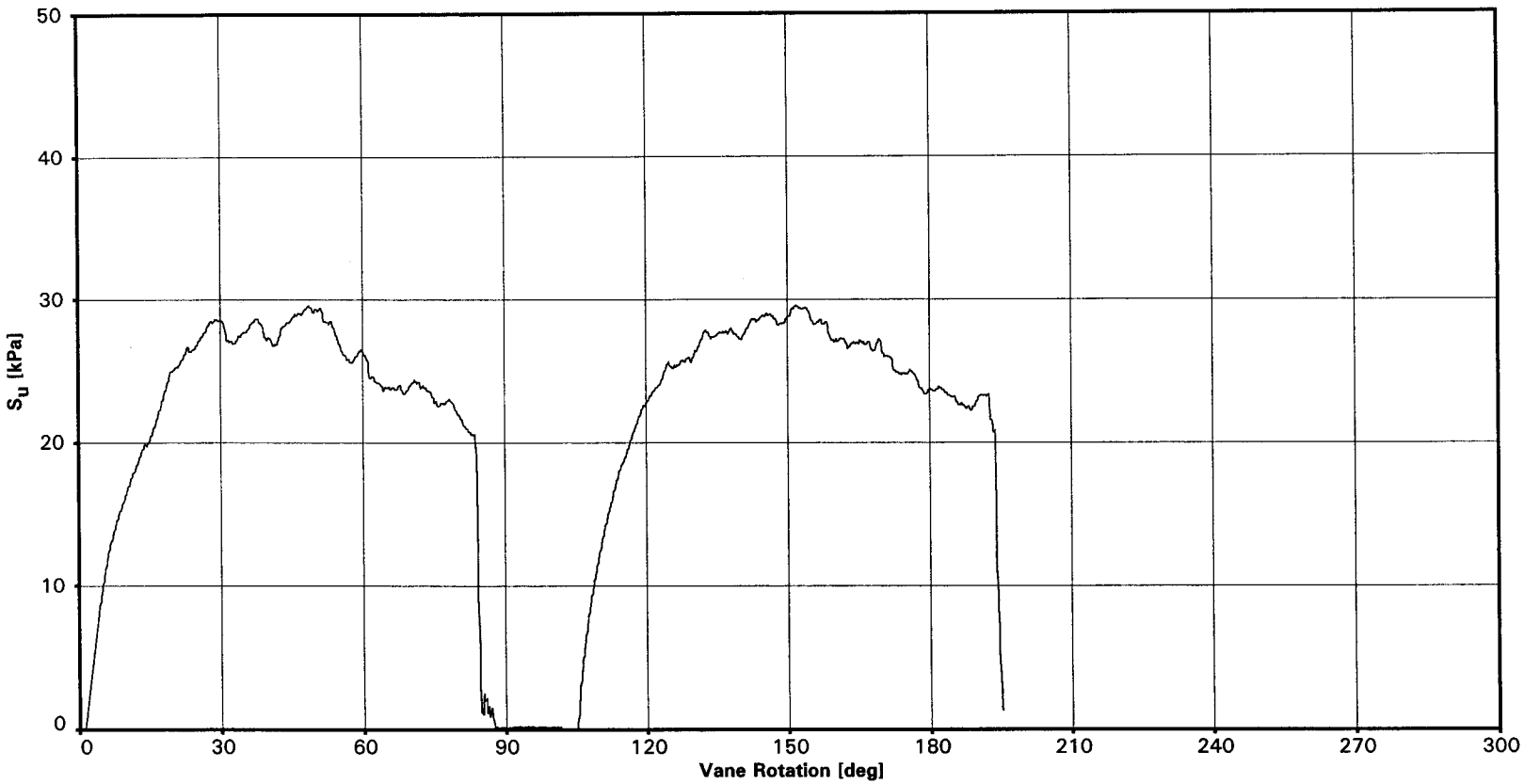
FUGRO

PLATE 98-33.9d

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.0m
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

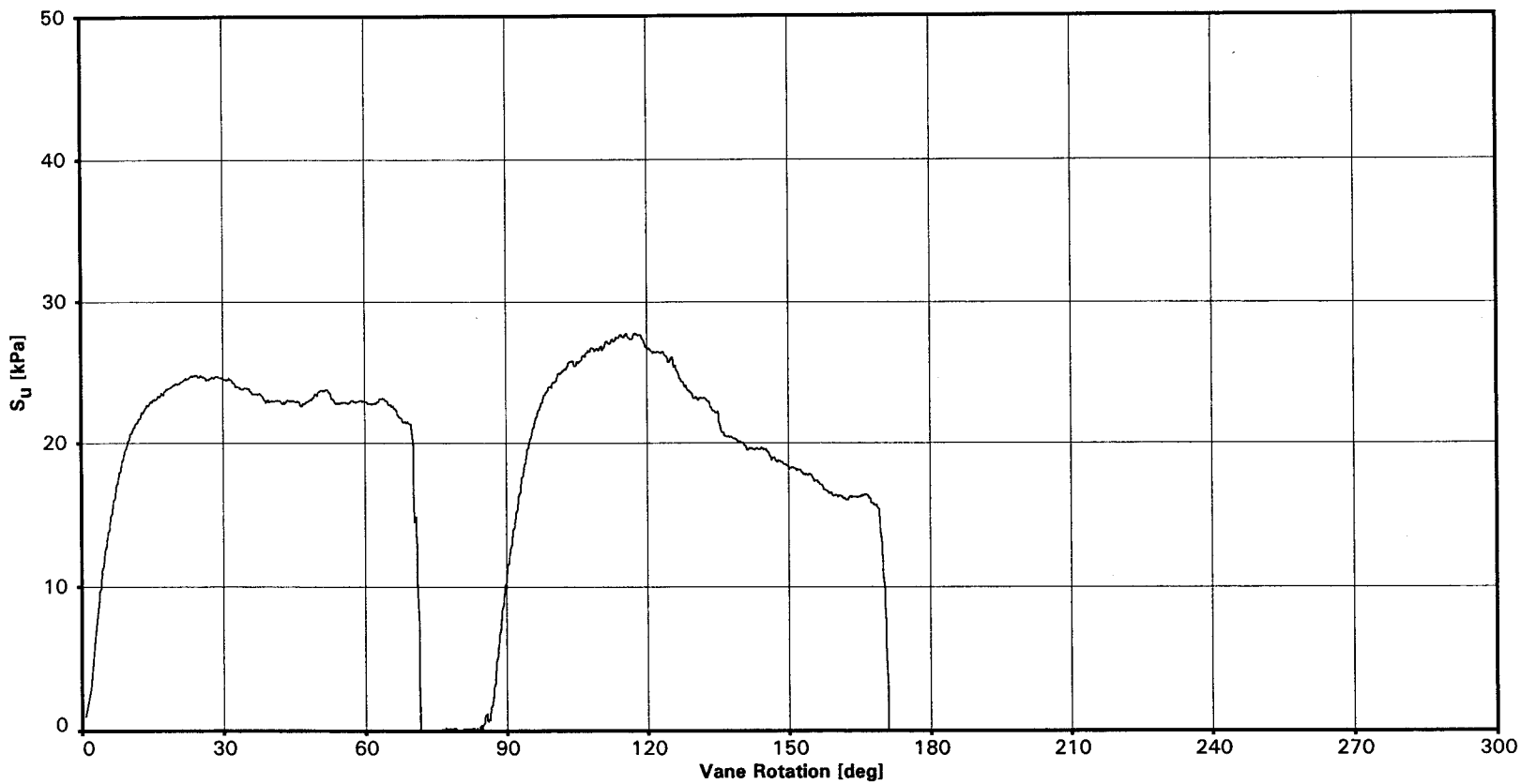
FUGRO

PLATE 98-33.9e

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.7m
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-33.9f

98-33		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
0.2	1					3.8																				
0.3	2	50	52	23	0.91						1.9		0.1													
0.6	500													2.4												
0.6	501													6.2												
1.1	3	49	45	18	1.13	6.5	46																	H		
1.2	4					6.7					21.0	2.3	4.7													
1.2	502													8.1												
1.2	503													11.5												
1.8	504													12.9												
1.8	505													15.8												
2.1	5					5.9																				
2.3	6					5.9																				
2.4	7	57	50	24	1.29						20.3		4.2													
2.4	506													14.4												
2.4	507													14.4												

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-33		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
2.9	8					6.4																				
3.0	9					6.0																				
3.0	508													28.7												
3.0	509													29.2												
3.2	10	55	57	24	0.92			14.4			16.8	3.6														
3.7	510													24.9												
3.7	511													27.3												
3.8	11					5.8																				
4.0	12					6.1																				
4.1	13	59	52	26	1.24			16.3			11.8		2.8													
4.9	14					7.1		28.7																		
5.0	15					7.9																				
5.2	16	38	41	23	0.81			29.7			30.3	5.1														
5.6	17							21.1																		
5.8	18	29	32	18	0.80	8.4																		C		

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

Identification Tests
SUW = Submerged Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
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CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-33		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
5.9	19	31	34	15	0.84			23.9			8.9															
6.7	20					7.1																				
6.9	21	31	33	15	0.88		26	14.4			25.4															
7.5	22		57	22				26.8			25.8	3.7														
8.4	23					6.1		28.7							19.9		0.5									
8.5	24	60	58	22	1.05			27.8			29.4	8.7														
9.3	25		58	21		5.7		29.7			29.8															
11.7	27					10.3	9											9.6	40							
11.9	28	22					12																			
15.2	29	23					2																			
16.8	30	22				9.9	5																			
20.4	32	72	126	53	0.27	4.6									104.9	48.6	0.9									11
20.6	33							131.7	143.6		112.6															
21.3	34	76	111	29	0.57																			C,H	2.62	
21.3	35	68	108	41	0.41						92.8															

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-33		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
24.7	36	33	33	19	1.00		54																	C		
24.8	37	34	39	16	0.78	8.5									101.6		3.1									
25.0	38									132.1																
29.6	39					8.2																				
29.7	40	41	83	20	0.32	7.7									53.9	53.2	0.4									
29.9	41							131.7	167.6		90.3															
34.4	42							112.5	105.3																	
34.6	43	40	48	19	0.71	8.2									149.4		0.7									
34.7	44							119.7	119.7	159.9																
35.3	45	37	40	27	0.78																			C		
35.4	46	41	40	30	1.09																					
39.8	300						19		119.7																	
40.1	48	34	55	20	0.41	8.3	87								139.1	37.6	2.5							H		
40.2	49							119.7	124.5																	
44.7	50		30	16		11.6		155.6	257.0																	

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-33		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
49.5	51	22				10.4	9																			
54.6	52							210.7																		
54.7	53	38	73	21	0.33	8.2			216.1						199.9		0.4									
54.9	54								210.3																	
55.4	55	37	76	26	0.23																			C		
55.5	56	41	76	23	0.35																					
60.2	58	41	74	23	0.36	7.5	92	167.6							202.7	64.6	0.7							H		
60.4	59							155.6	201.1		222.8															
65.1	61	58	77	30	0.60	6.4			191.5						205.6		0.5									
65.2	62										222.8															
70.0	64	34	54	22	0.38	8.3	93								209.0	25.2	1.4							H		
70.1	65								177.2		222.8															
70.6	66	36	61	19	0.41																			C,K		
70.7	67	40	58	24	0.47						222.8															
75.3	68	29	40	19	0.47	8.9																				

Identification Tests
MC = Moisture Content
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Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-33		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
75.4	69					8.9																				
75.6	70						57																			
80.3	72	22	57	22		8.7									173.4	80.4	0.6									
80.5	73								191.5																	
85.2	75	23	28	16	0.60	10.4	76								251.0	73.4	2.0							H		
85.3	76								167.6																	
87.6	77	21				11.6	33																			
89.7	78	18					10																			
91.2	79	10					8																			
92.0	81	21	41	18	0.13																			C		
92.2	82	22	42	18	0.18	10.3									220.7		1.0									
94.6	83	13					8																			
96.1	84	13				11.3	13																			
97.7	85	22	40	19	0.15	10.9									430.3		3.0									
98.9	86	18				10.7	16																			

Identification Tests
MC = Moisture Content
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Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
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Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-33		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
100.1	87						14																			
100.1	88	14				9.4	13																			

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

Identification Tests
SUW = Submerged Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
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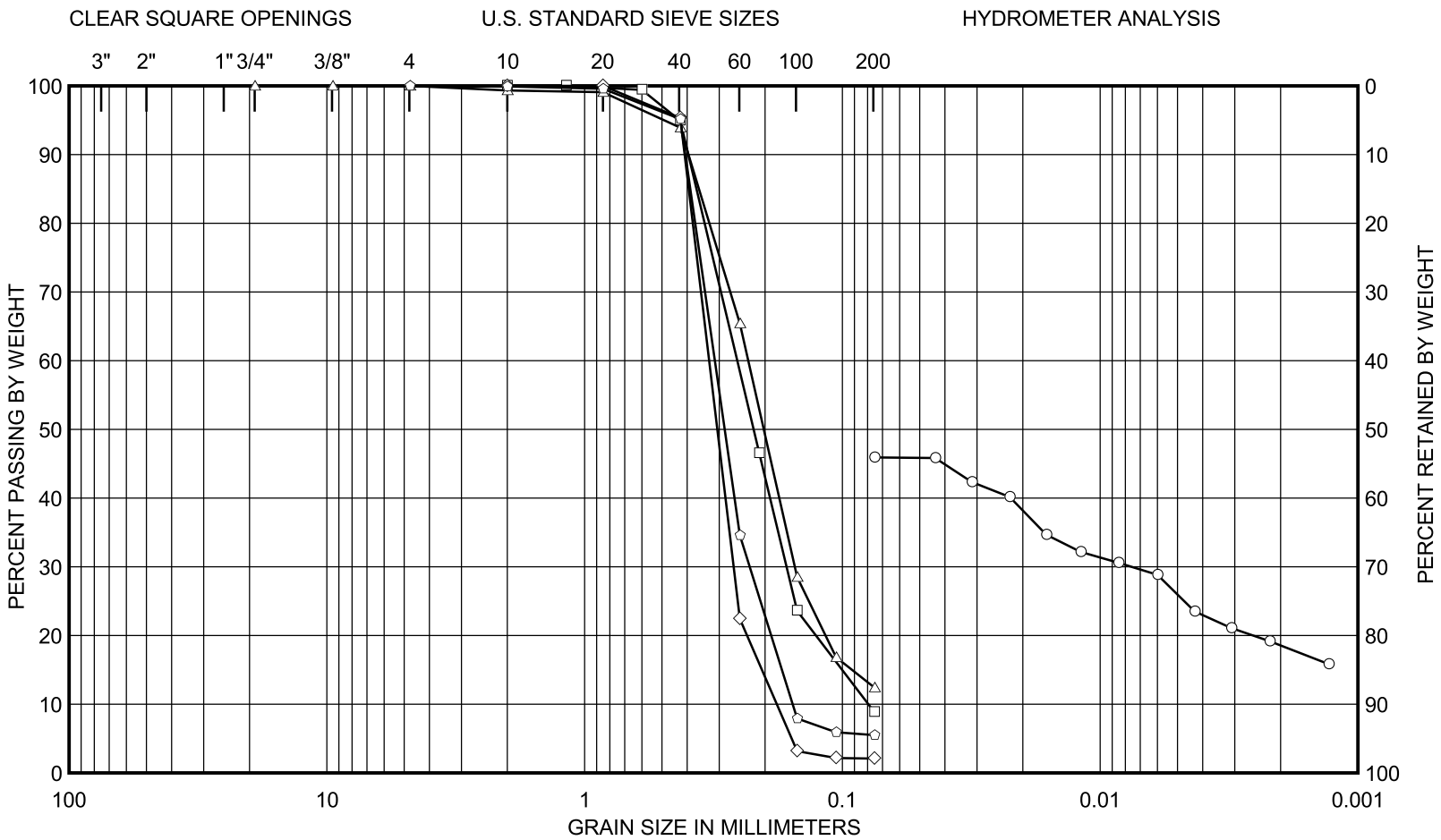
Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-33
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO



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

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
3	1.1	○——○	Fat CLAY (CH) with many shell fragments			
27	11.7	□——□	FINE SAND (SP-SM) with clay pockets and silt	1.3	3.2	0.22
28	11.9	△——△	SILTY FINE SAND (SM)			0.20
29	15.2	◇——◇	FINE SAND (SP)	1.2	1.8	0.31
30	16.8	⬠——⬠	FINE SAND (SP-SM) with silt	1.1	2.0	0.29

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-33

SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-33.11a

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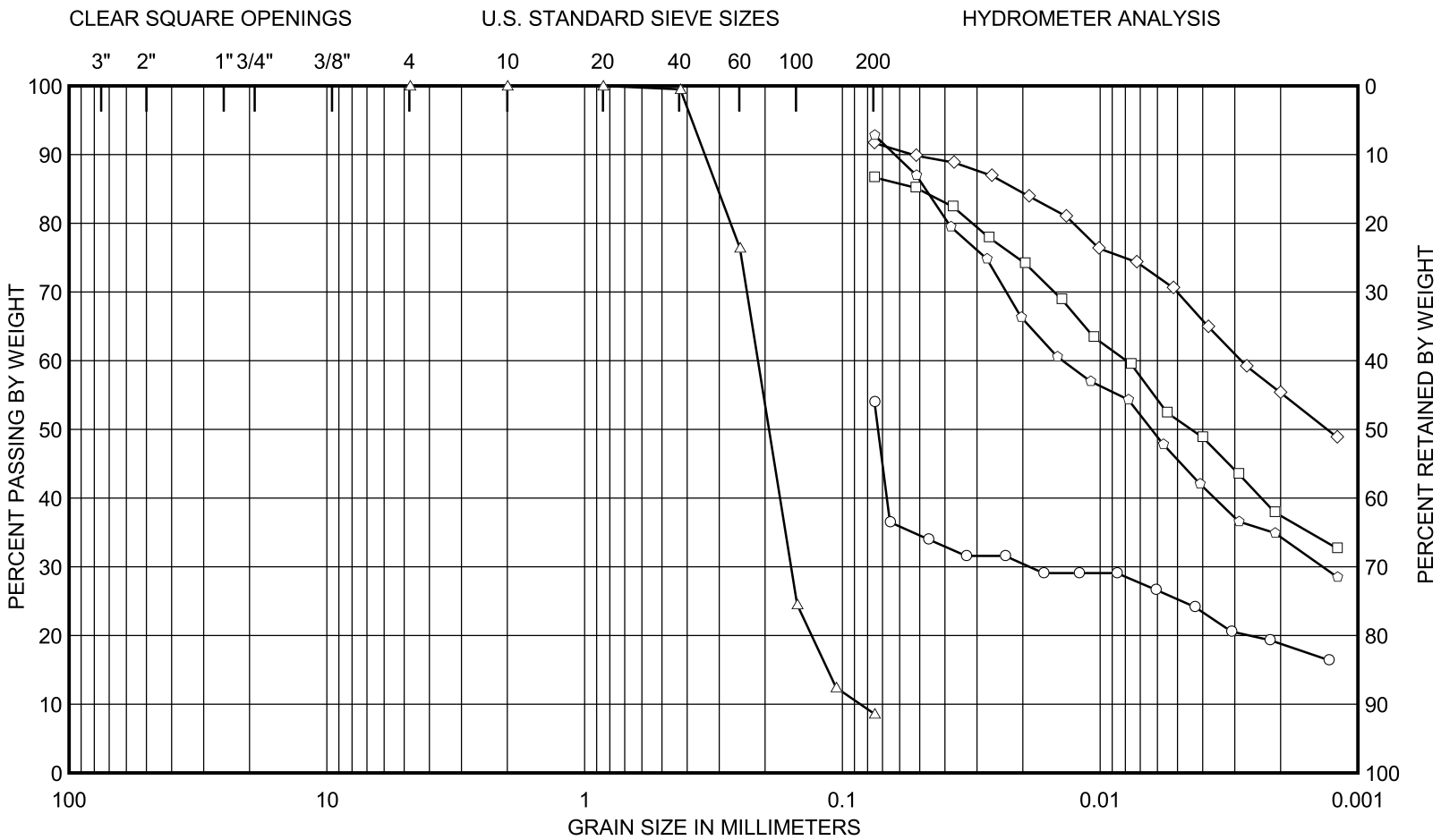

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
36	24.7	○——○	Fat CLAY (CH) with shell fragments and many sandy silt pockets			0.073
48	40.1	□——□	FAT CLAY (CH) with sand pockets and organic pockets			0.0044
51	49.5	△——△	FINE SAND (SP-SM) with silt	1.4	2.5	0.19
58	60.2	◇——◇	FAT CLAY (CH) with a few silty sand and organic pockets			0.0013
64	70.0	⬠——⬠	FAT CLAY (CH)			0.0063

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-33

SFOBB East Span Seismic Safety Project

PLATE 98-33.11b

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

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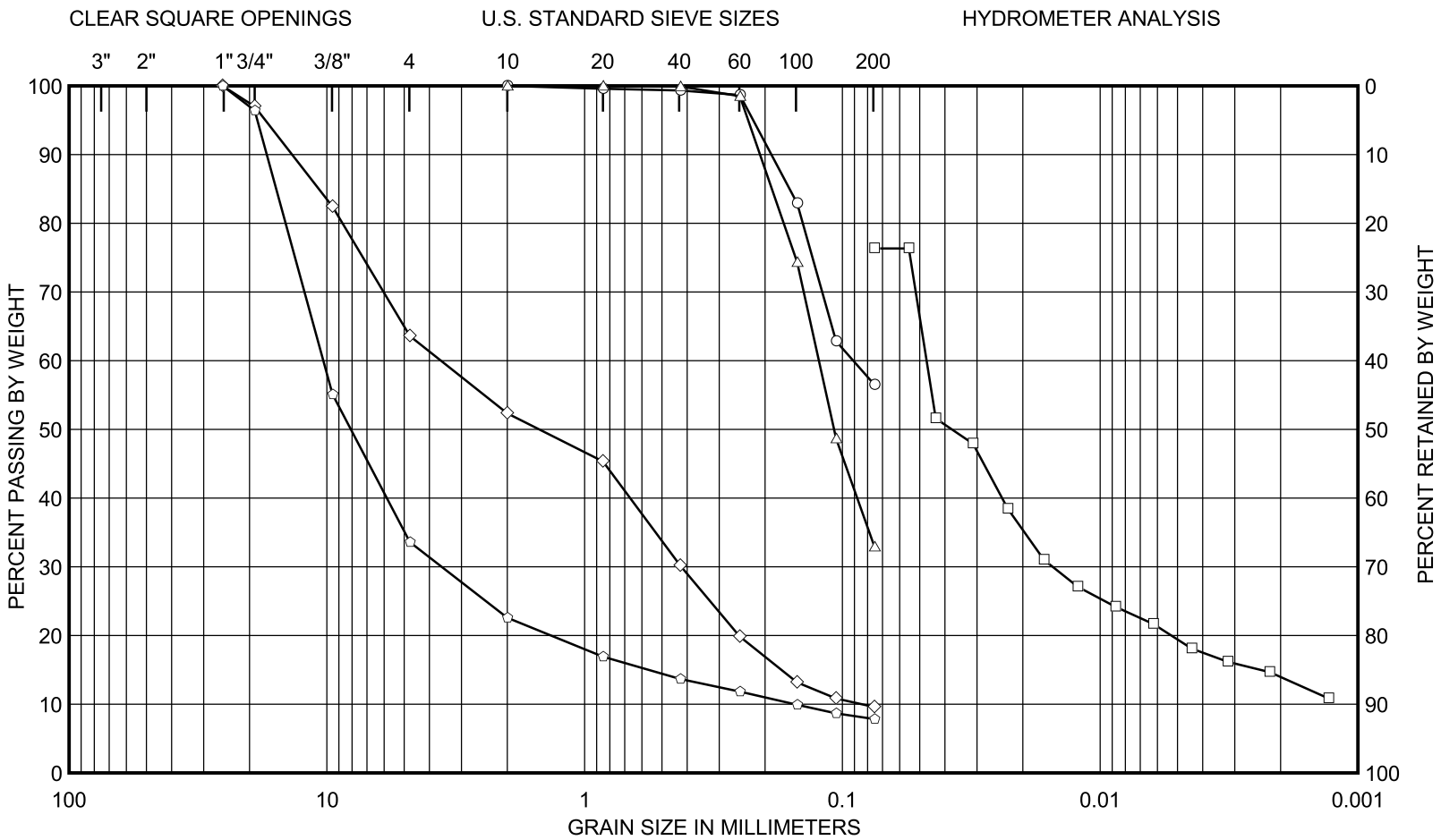

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
70	75.6	○——○	SANDY SILT (ML) with clay seams			
75	85.2	□——□	LEAN CLAY (CL) with sand and with silt seams			0.038
77	87.6	△——△	SILTY FINE SAND (SM)			0.11
78	89.7	◇——◇	FINE TO MEDIUM SAND (SP-SM) with silt, fine gravel and coarse sand	0.6	42.8	1.5
79	91.2	⬠——⬠	FINE GRAVEL (GP-GM) with silt and sand	8.0	67.1	8.1

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-33

SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-33.11c

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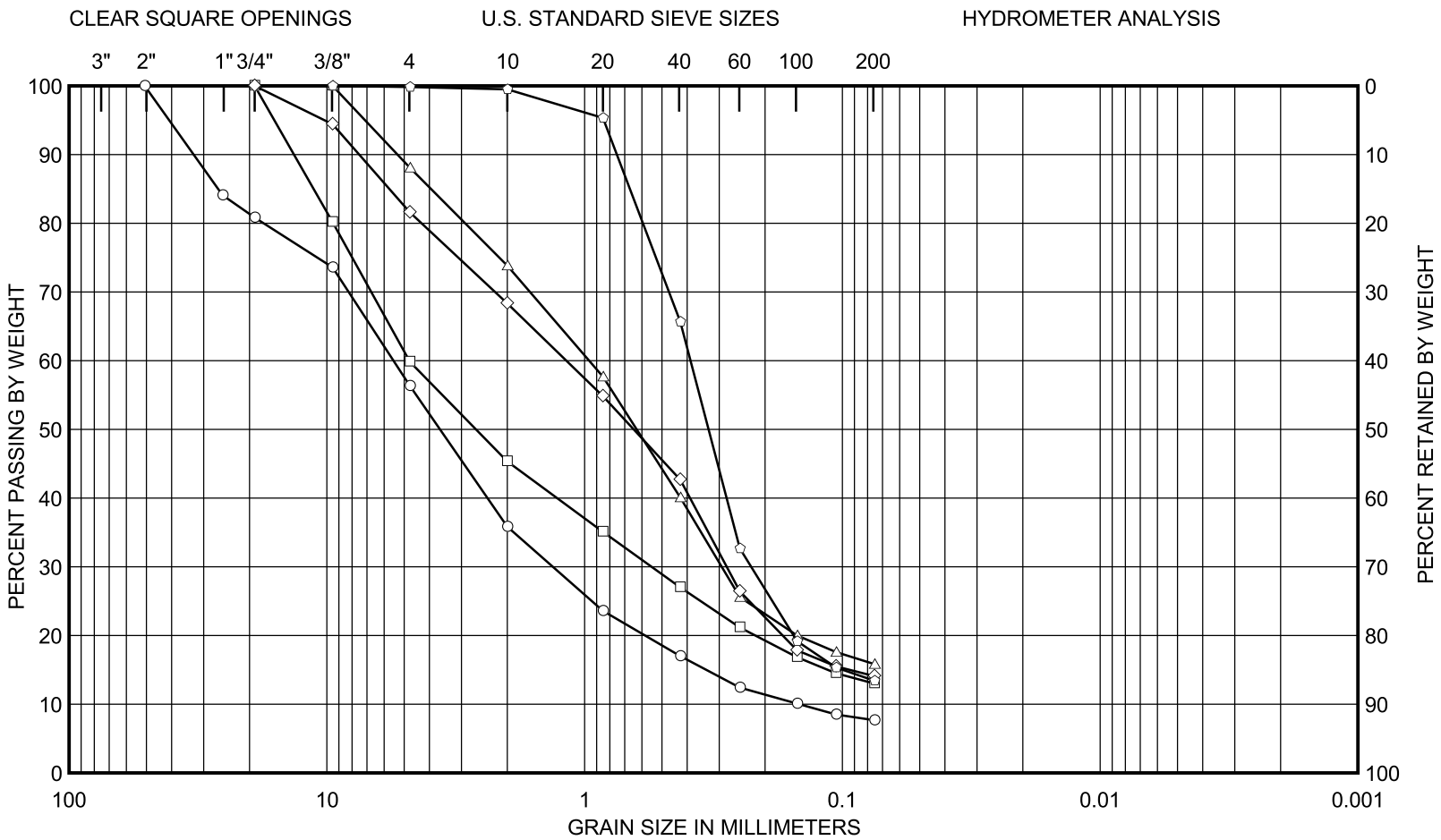

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
83	94.6	○——○	MEDIUM TO COARSE SAND (SW-SM) with silt and fine to coarse gravel	2.2	37.6	3.6
84	96.1	□——□	SILTY FINE SAND (SM) with medium to coarse sand and fine gravel			2.6
86	98.9	△——△	SILTY FINE TO MEDIUM SAND (SM) with coarse sand and fine gravel			0.63
87	100.1	◇——◇	SILTY FINE SAND (SM) with medium to coarse sand and fine gravel			0.65
88	100.1	⬠——⬠	SILTY FINE TO MEDIUM SAND (SM)			0.33

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-33

SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-33.11d

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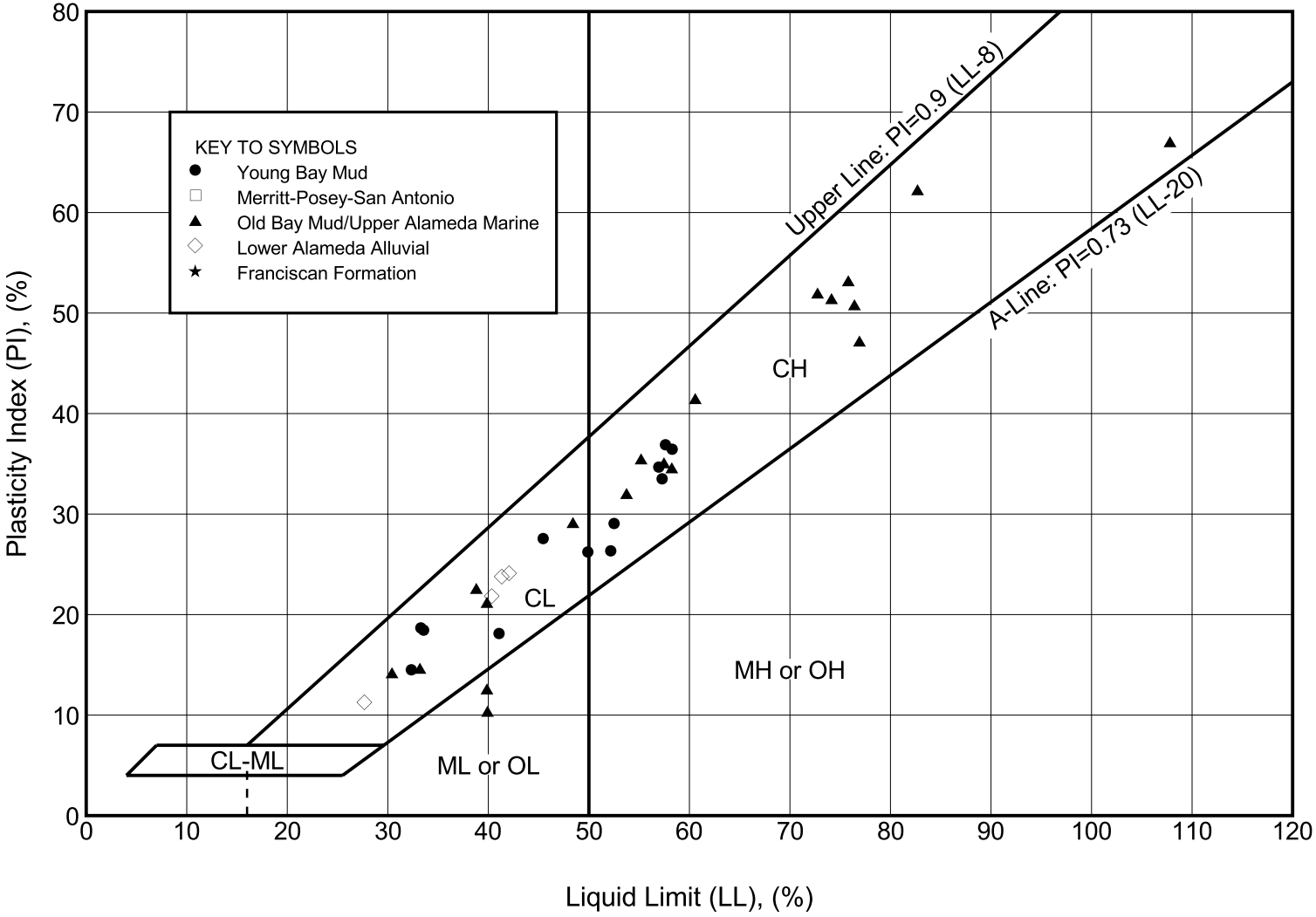

PLASTICITY CHART
Boring 98-33
SFOBB East Span Seismic Safety Project

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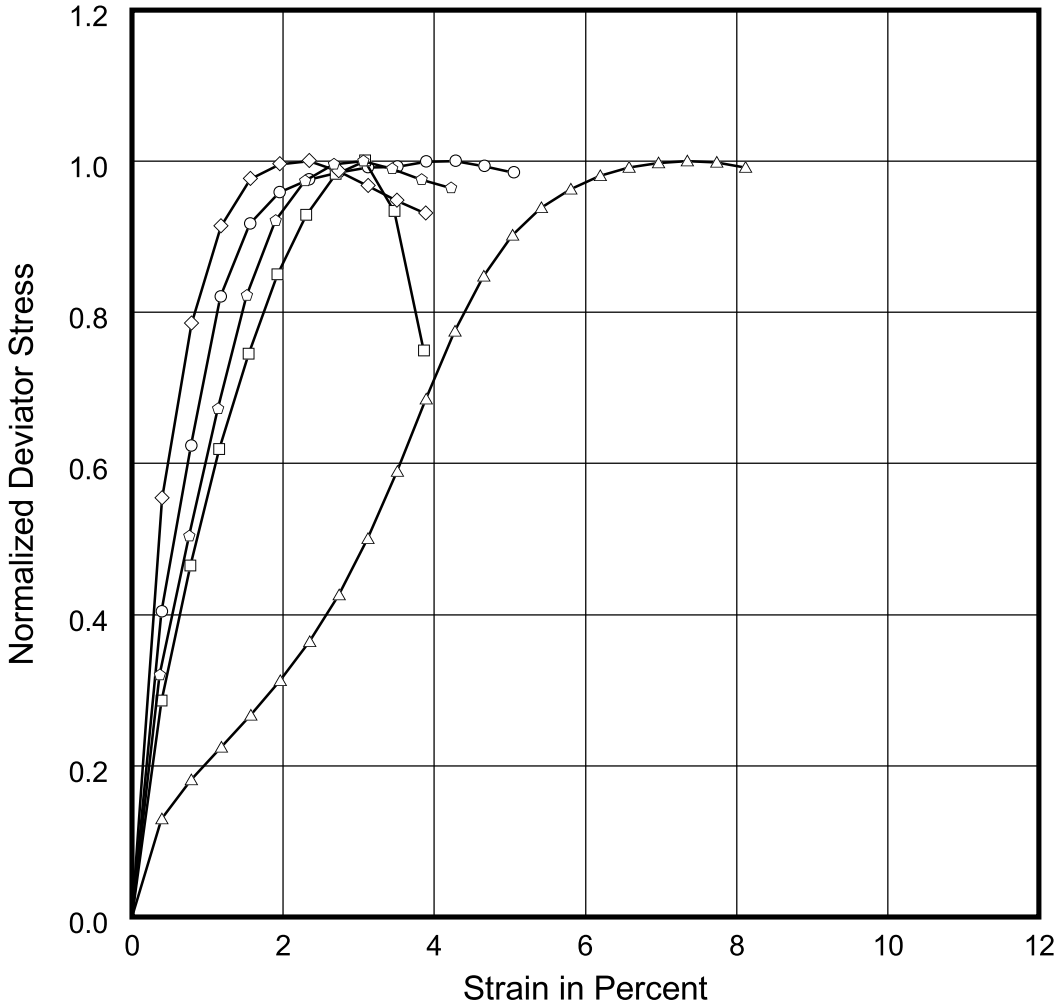
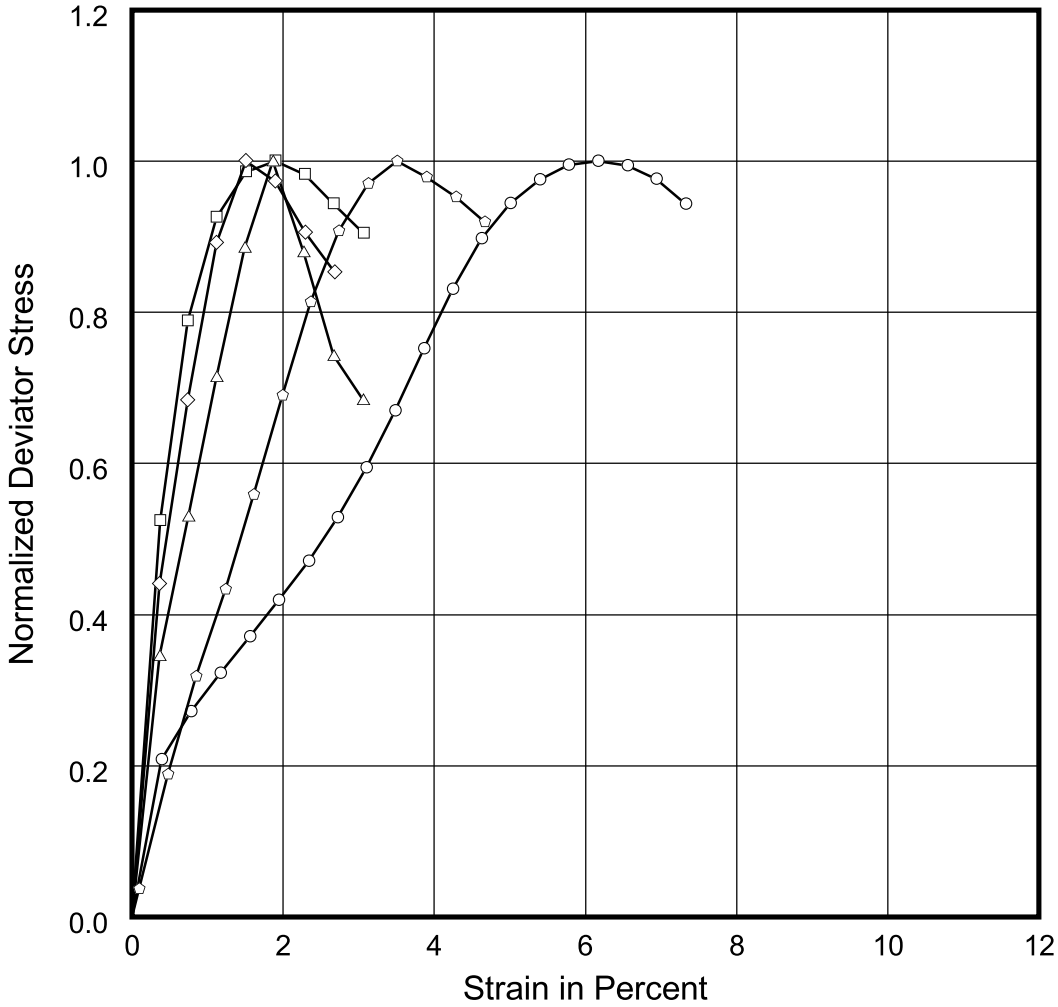


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	23	8.4	UU	207	40	0.5
	32	20.4	UU	827	210	0.9
	37	24.8	UU	827	203	3.1
	40	29.7	UU	827	108	0.4
	43	34.6	UU	862	299	0.7

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-33
SFOBB East Span Seismic Safety Project

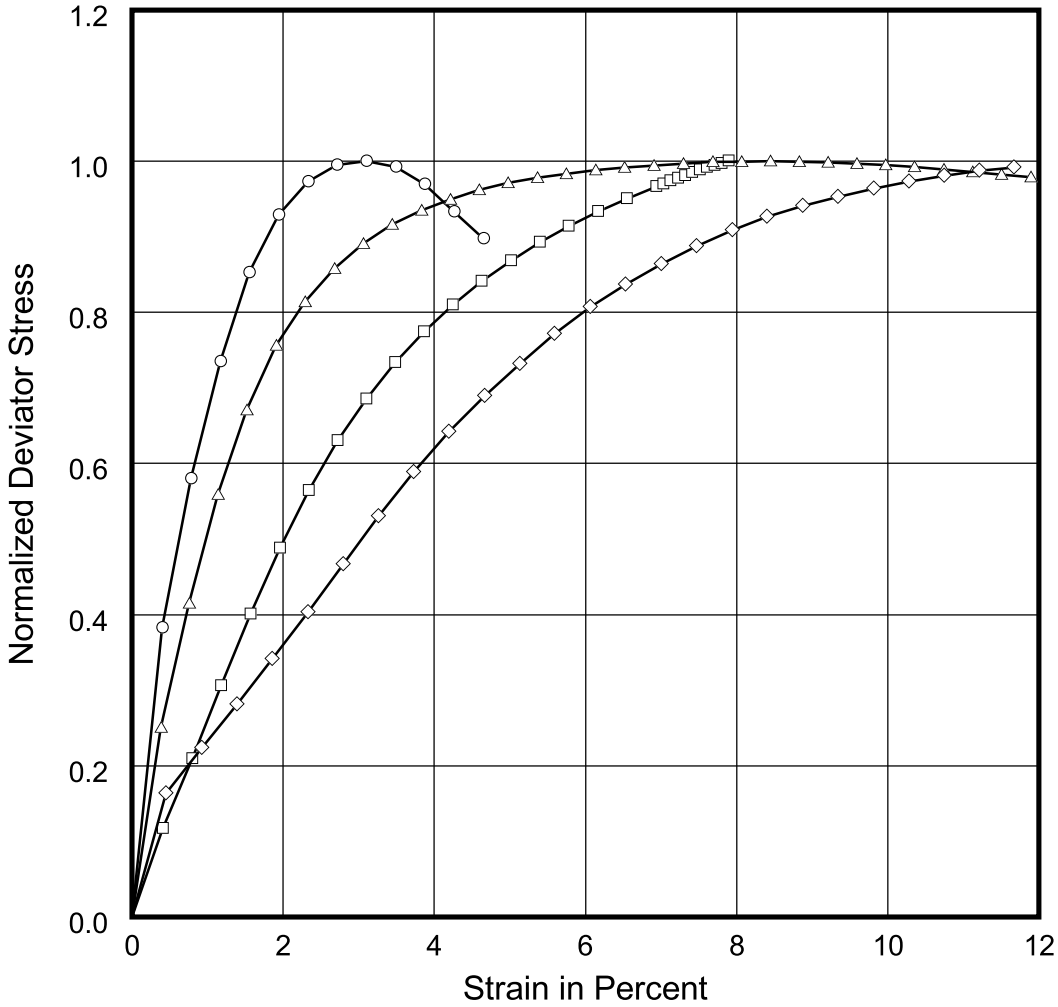


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	48	40.1	UU	896	278	2.5
	53	54.7	UU	1241	400	0.4
	58	60.2	UU	1379	405	0.7
	61	65.1	UU	1482	411	0.5
	64	70.0	UU	1586	418	1.4

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-33
SFOBB East Span Seismic Safety Project

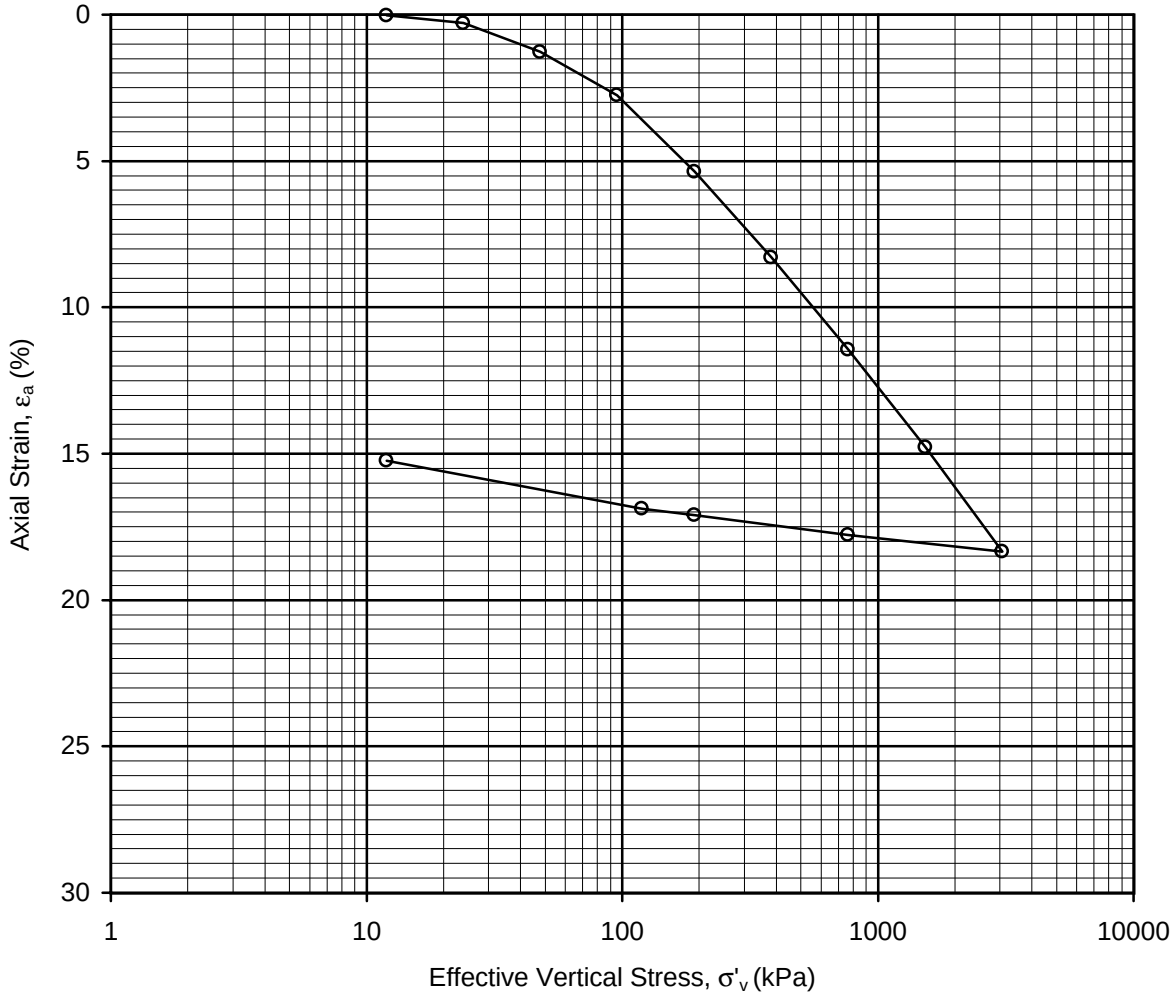


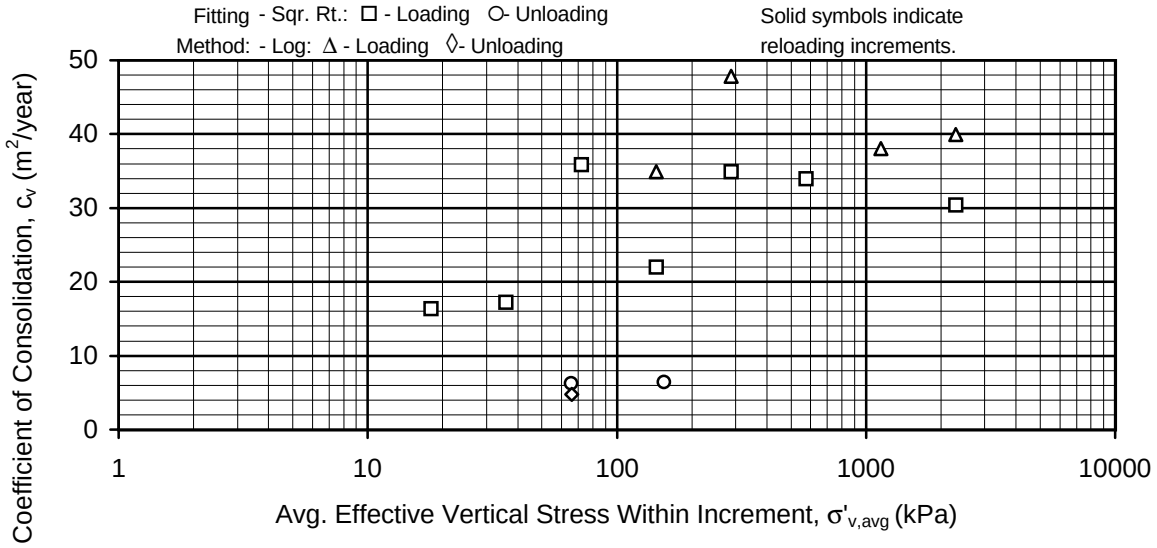
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	72	80.3	UU	1827	347	0.6
□——□	75	85.2	UU	1930	502	2.0
△——△	82	92.2	UU	2068	441	1.0
◇——◇	85	97.7	UU	2206	861	3.0

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

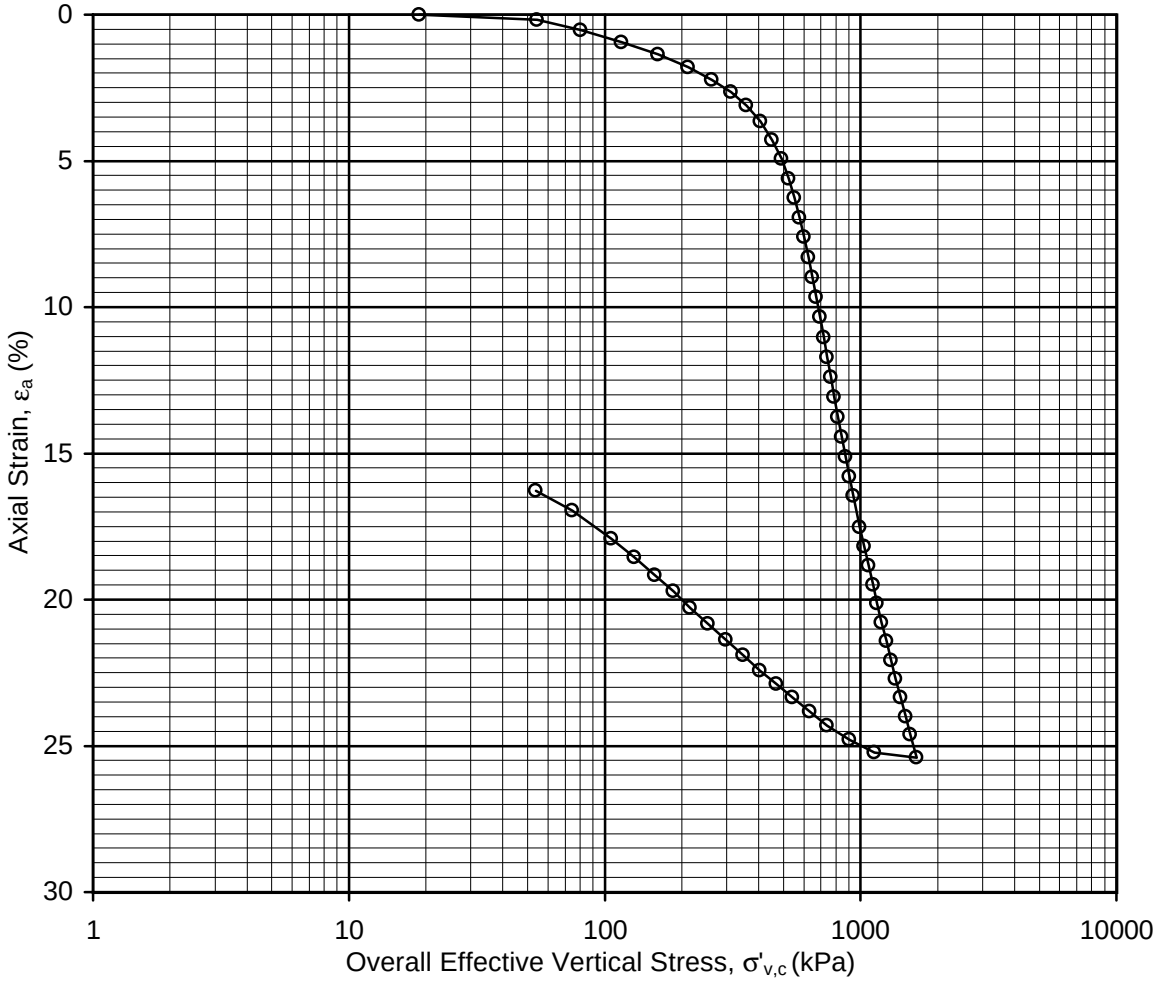
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-33
SFOBB East Span Seismic Safety Project

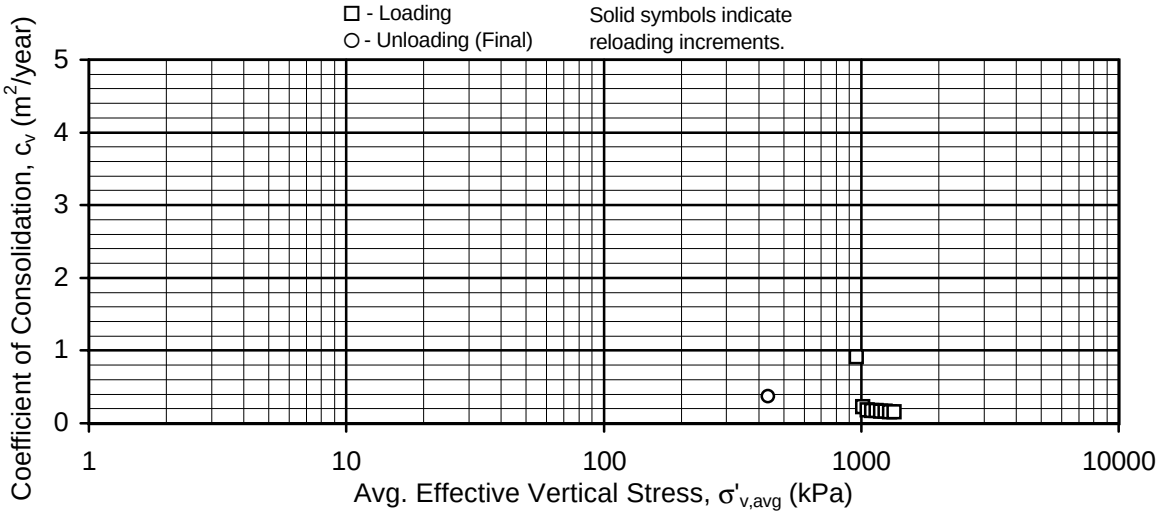




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 18 - Depth: 5.8m
Boring 98-33
SFOBB East Span Seismic Safety Project

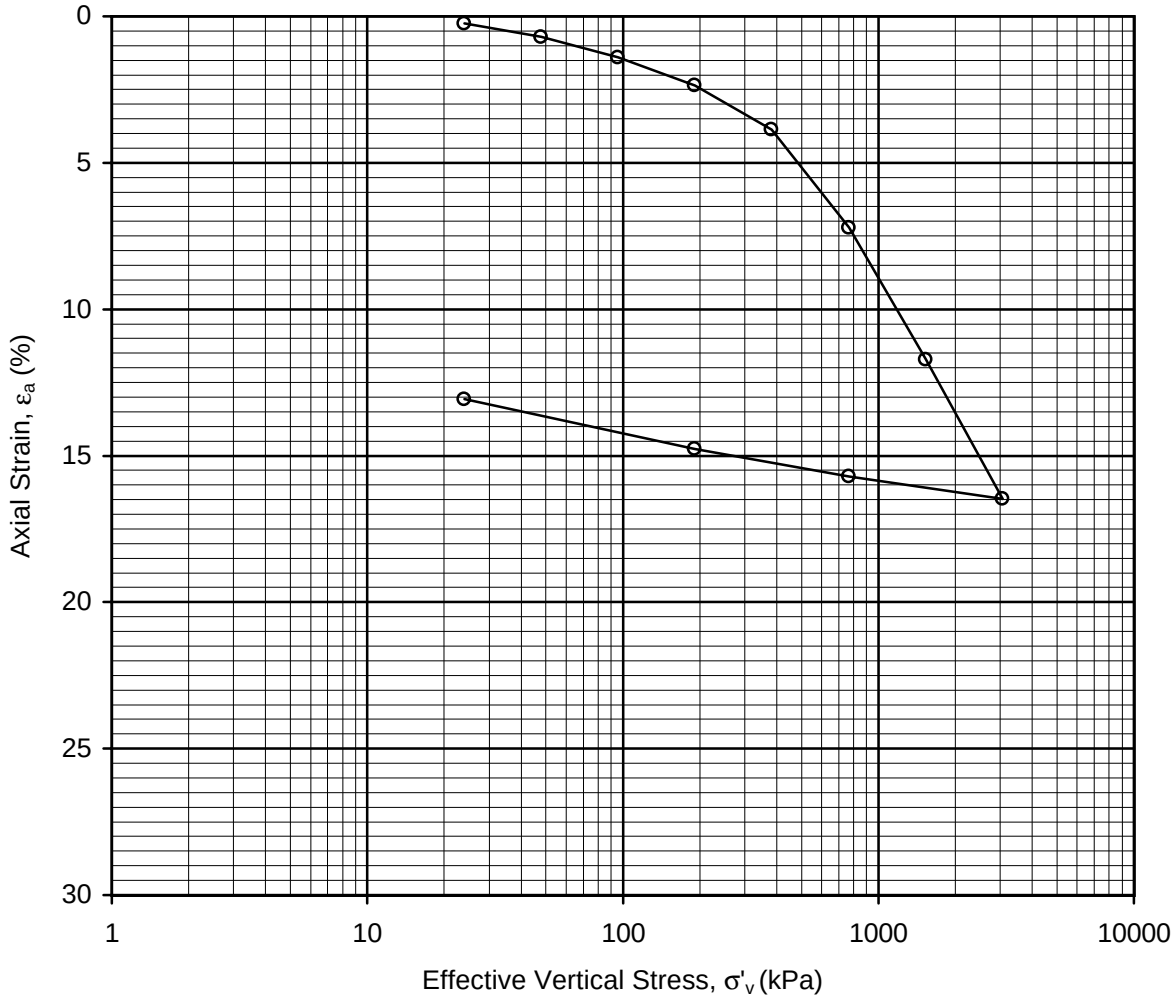


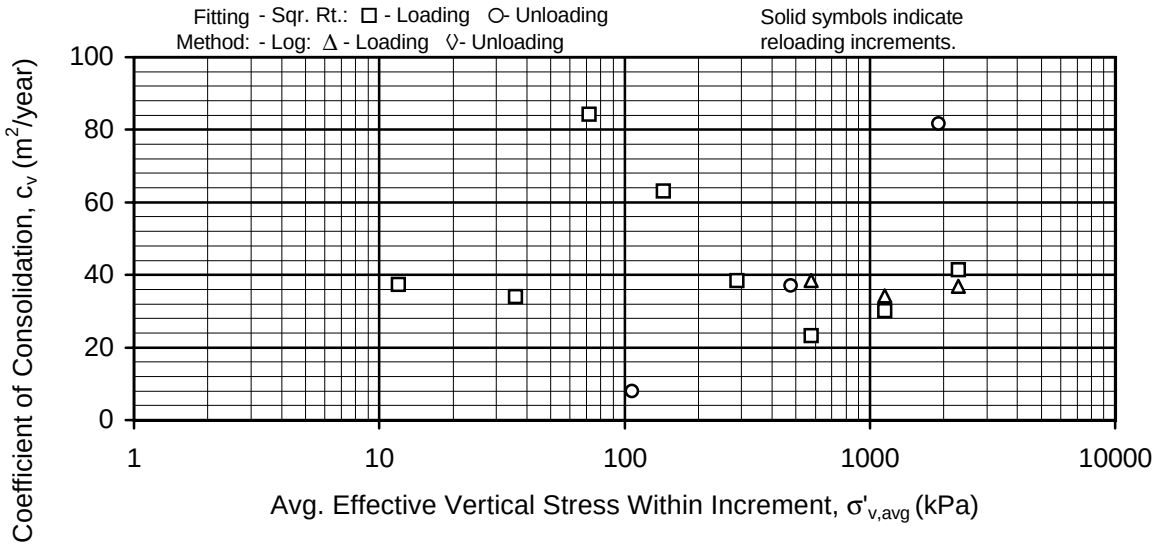


CRS CONSOLIDATION TEST RESULTS

Sample No. 34 - Depth: 21.3m
Boring 98-33
SFOBB East Span Seismic Safety Project

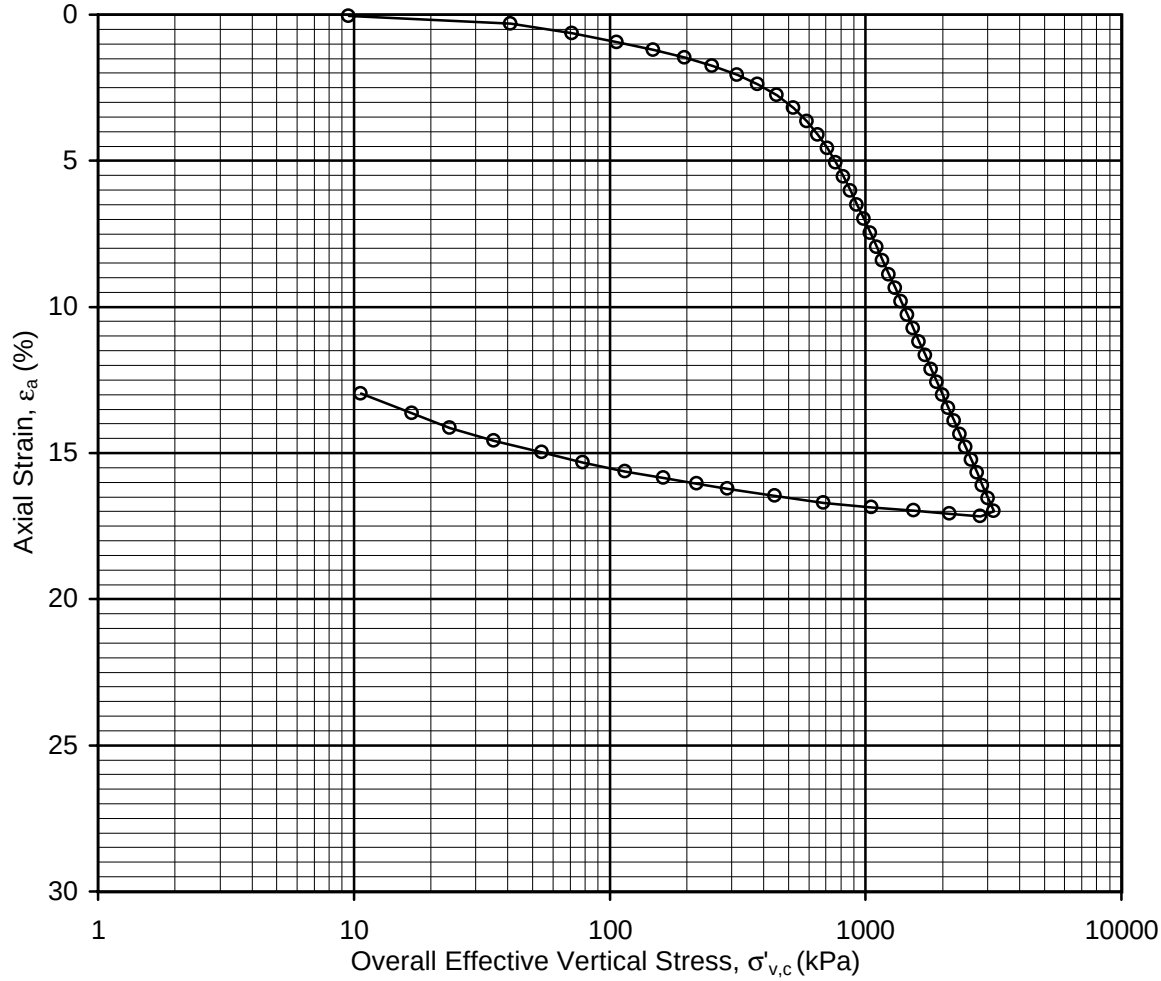
PLATE 98-33.14b

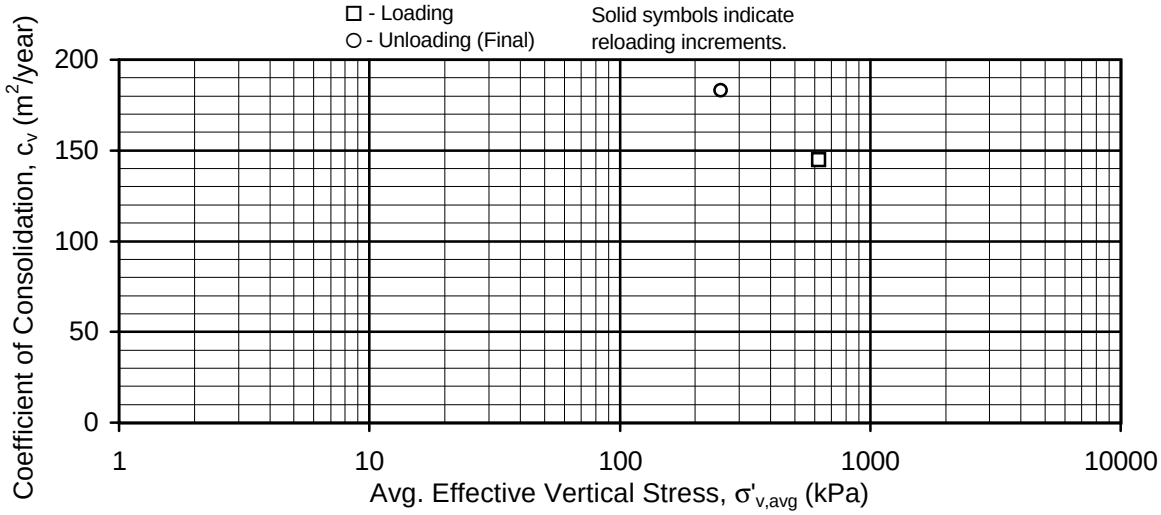




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 36 - Depth: 24.7m
Boring 98-33
SFOBB East Span Seismic Safety Project

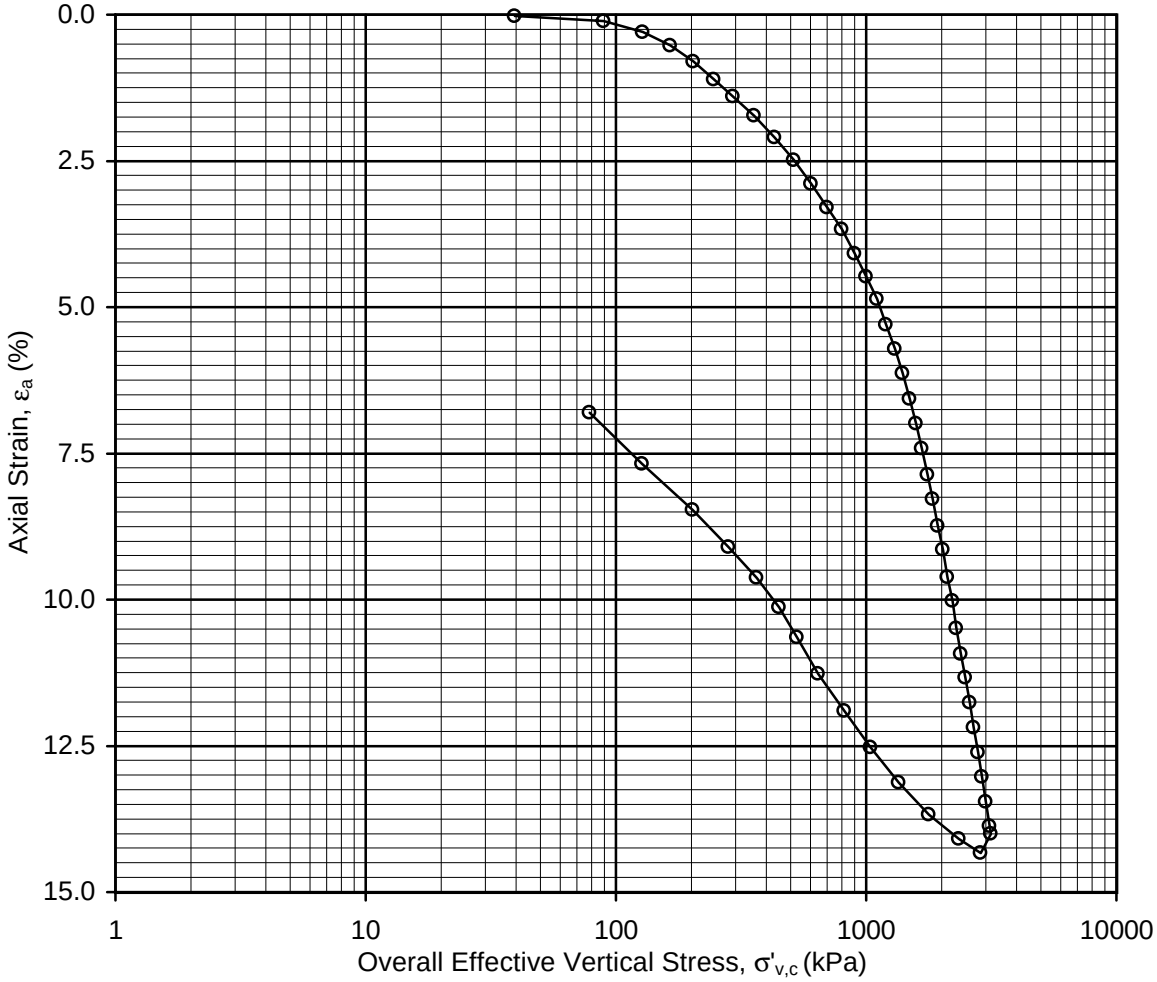


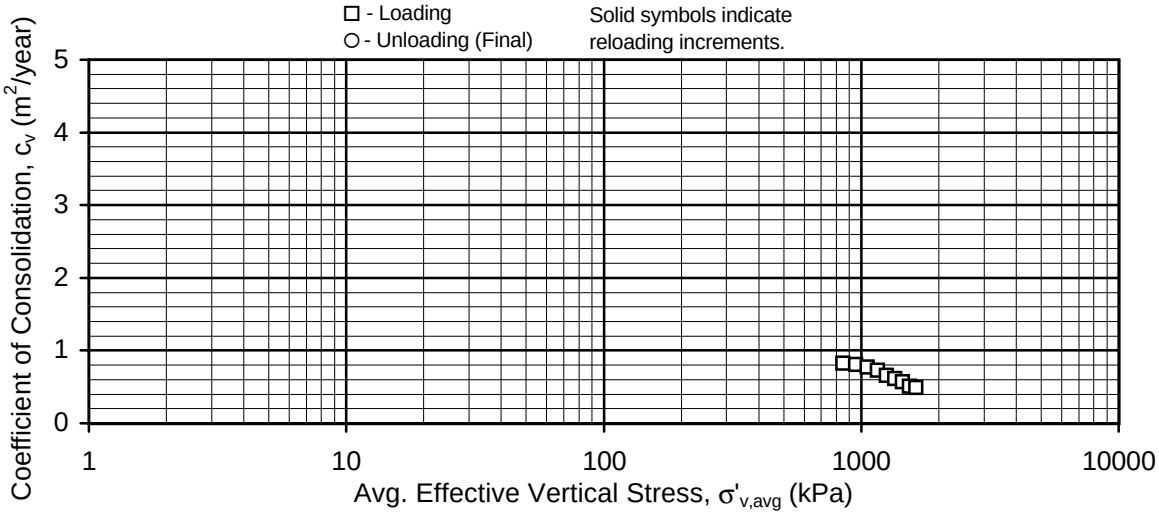


CRS CONSOLIDATION TEST RESULTS

Sample No. 45 - Depth: 35.3m
Boring 98-33
SFOBB East Span Seismic Safety Project

PLATE 98-33.14d

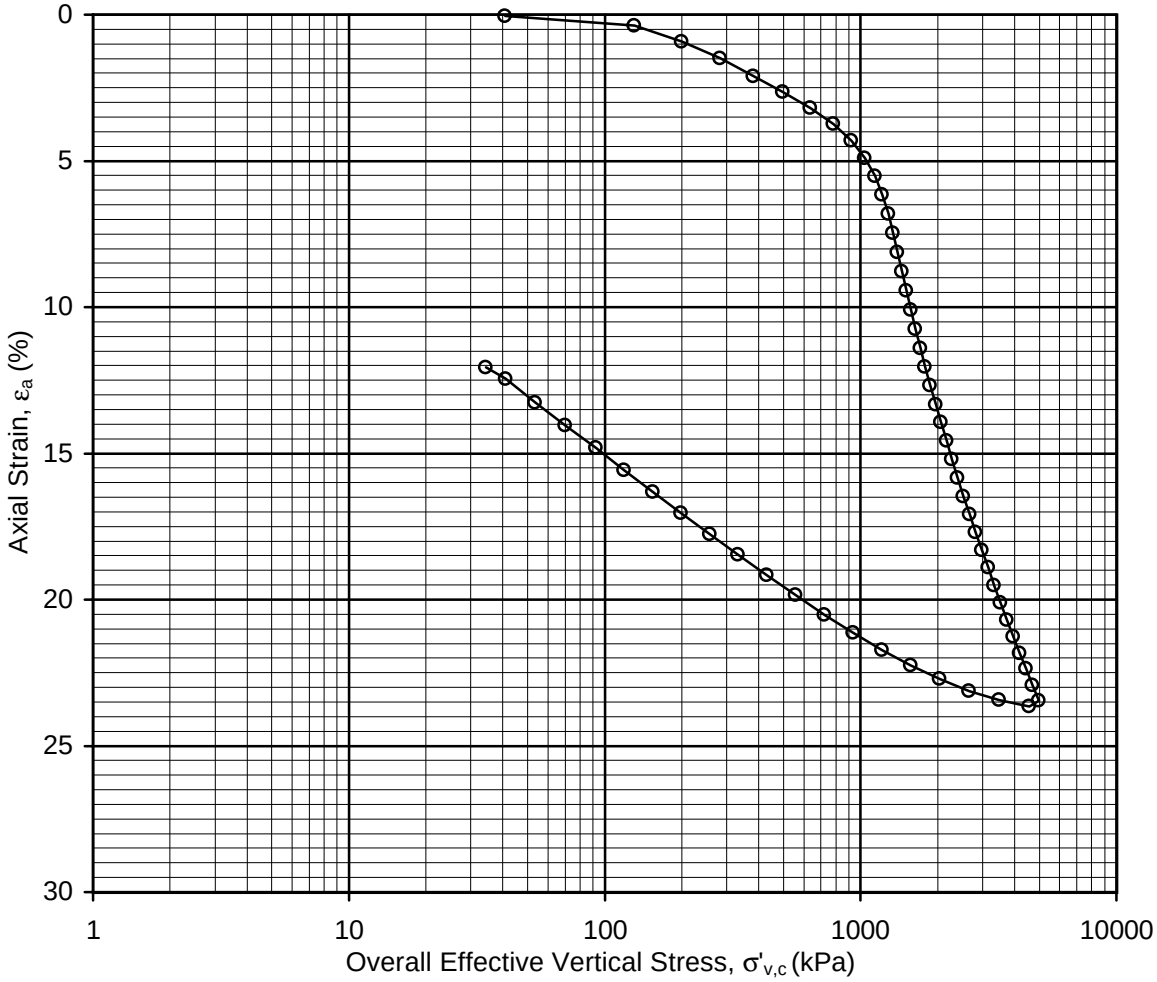


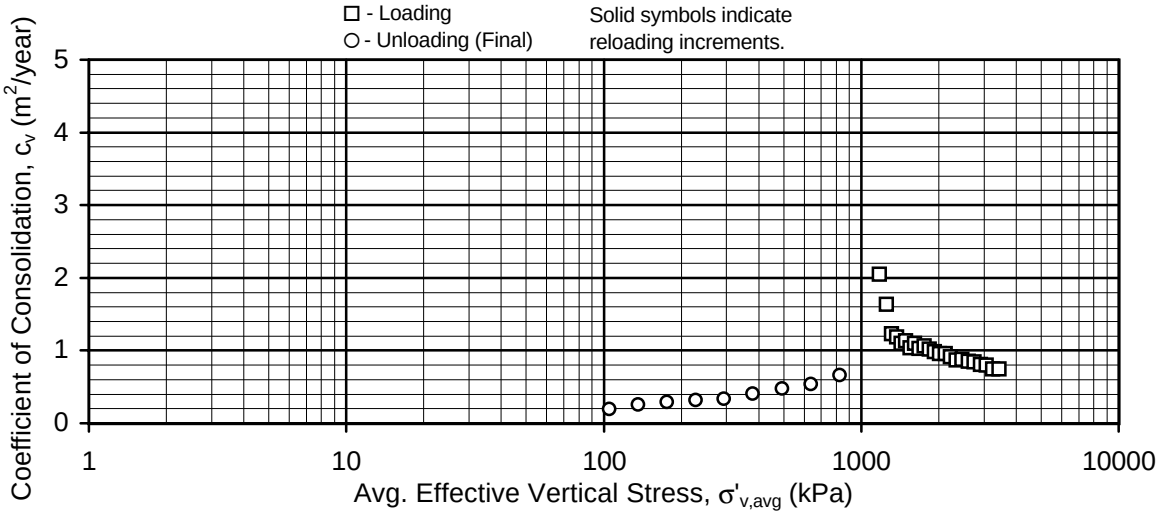


CRS CONSOLIDATION TEST RESULTS

Sample No. 55 - Depth: 55.4m
Boring 98-33
SFOBB East Span Seismic Safety Project

PLATE 98-33.14e

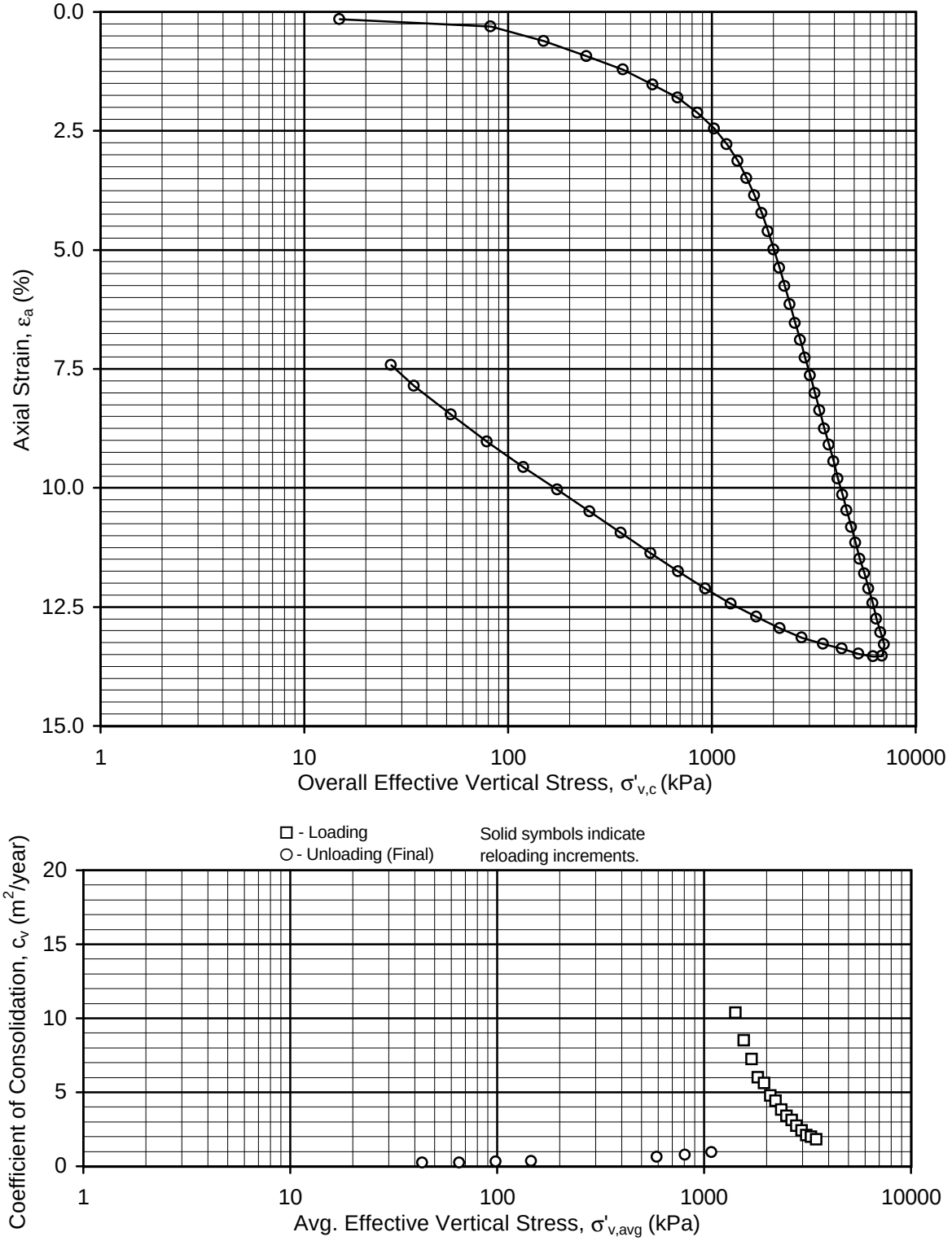




CRS CONSOLIDATION TEST RESULTS

Sample No.66 - Depth: 70.6m
Boring 98-33
SFOBB East Span Seismic Safety Project

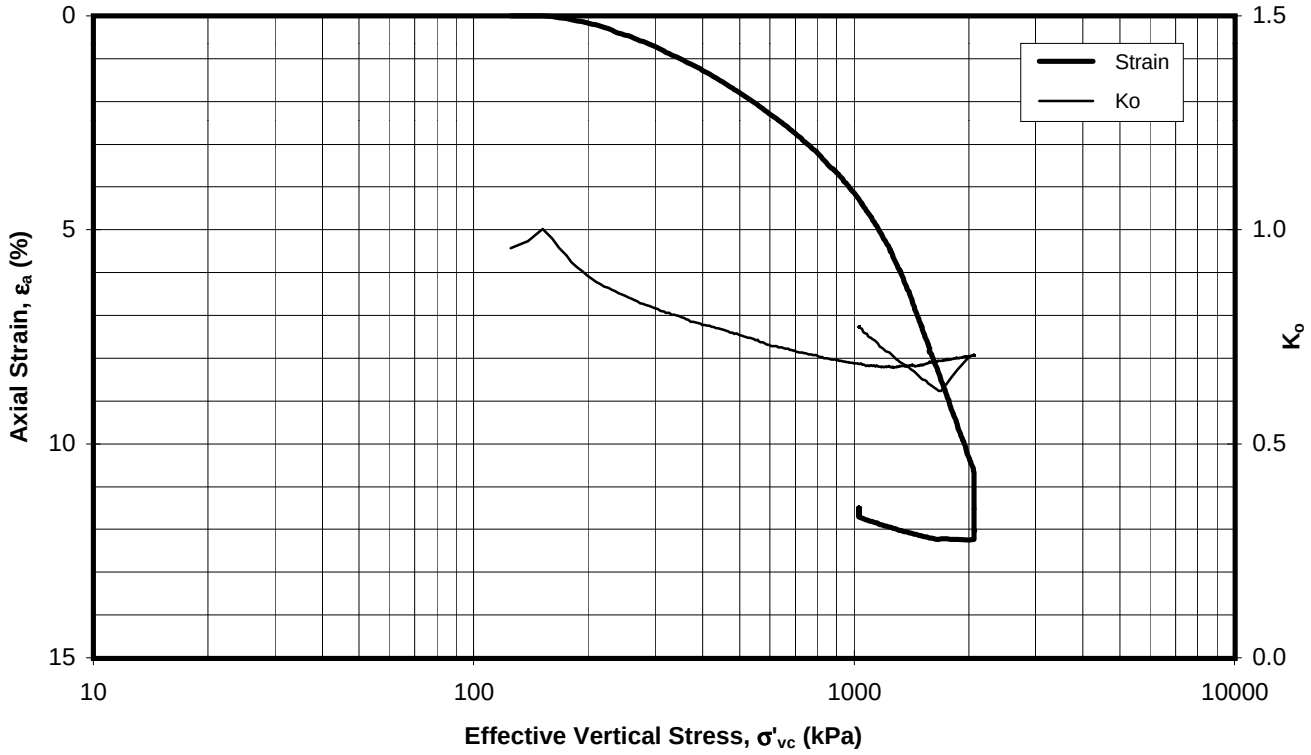
PLATE 98-33.14f

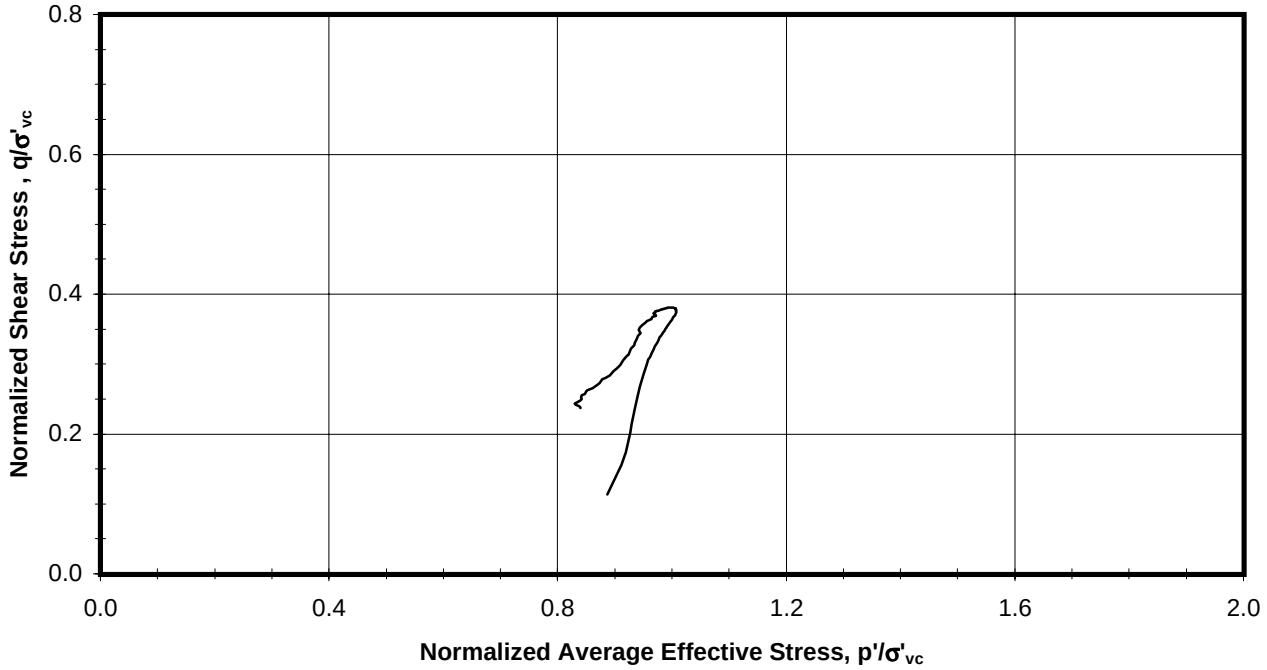


CRS CONSOLIDATION TEST RESULTS

Sample No. 81 - Depth: 92.1m
Boring 98-33
SFOBB East Span Seismic Safety Project

PLATE 98-33.14g



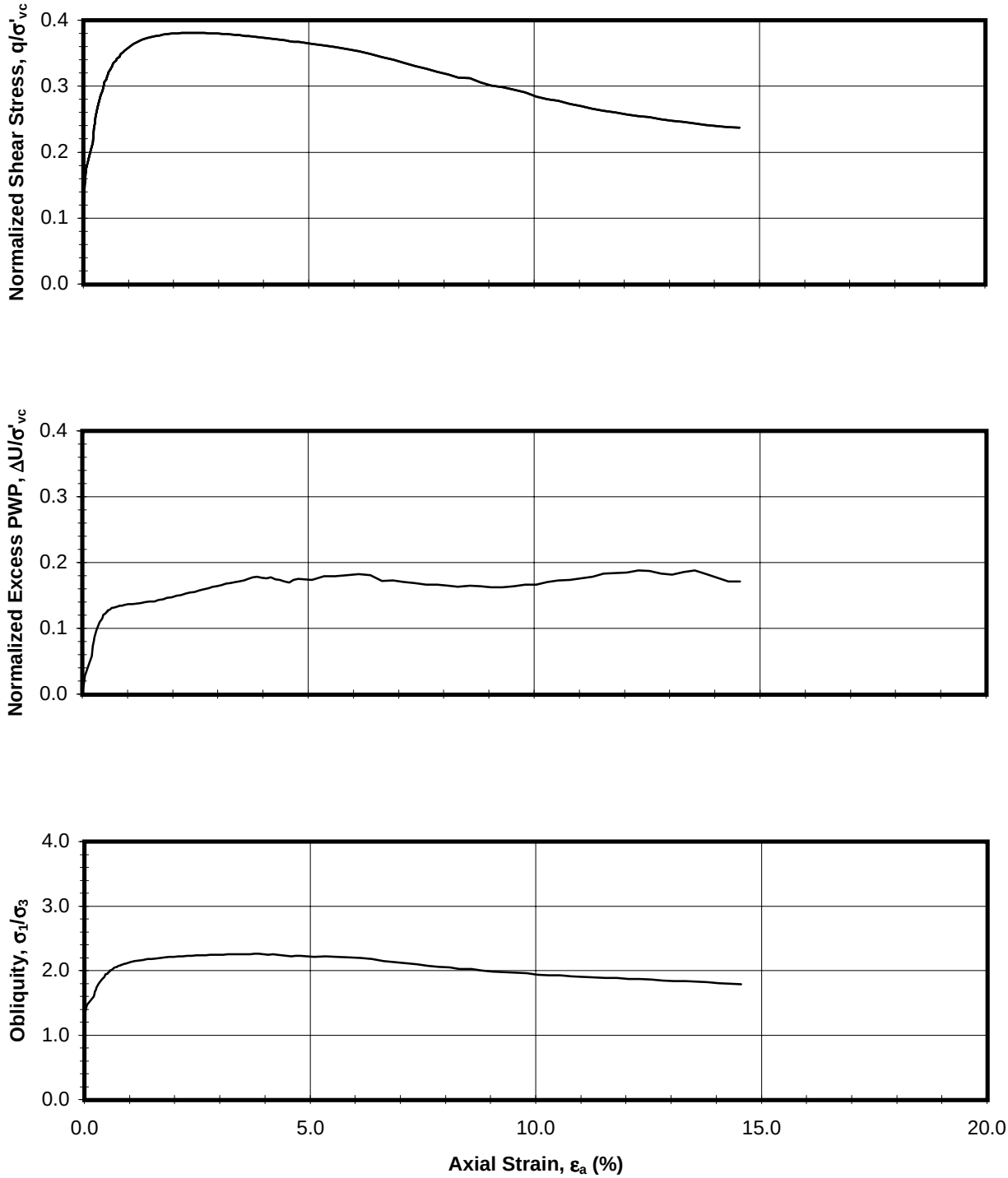


Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 66 - Depth: 70.6m

Boring 98-33

SFOBB East Span Seismic Safety Project

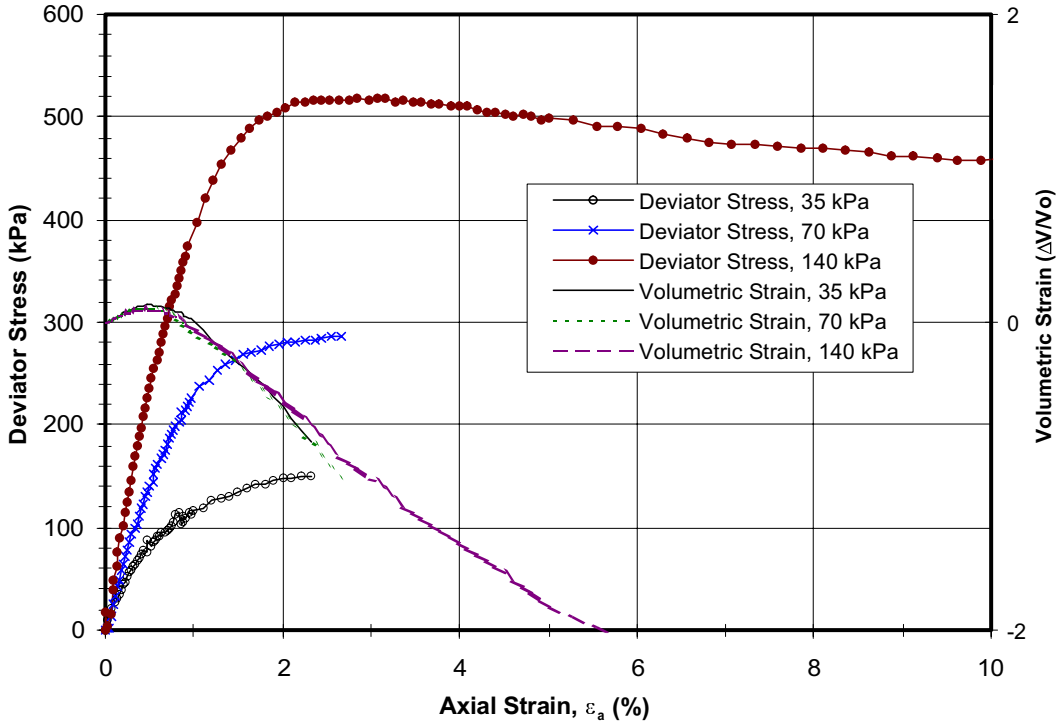


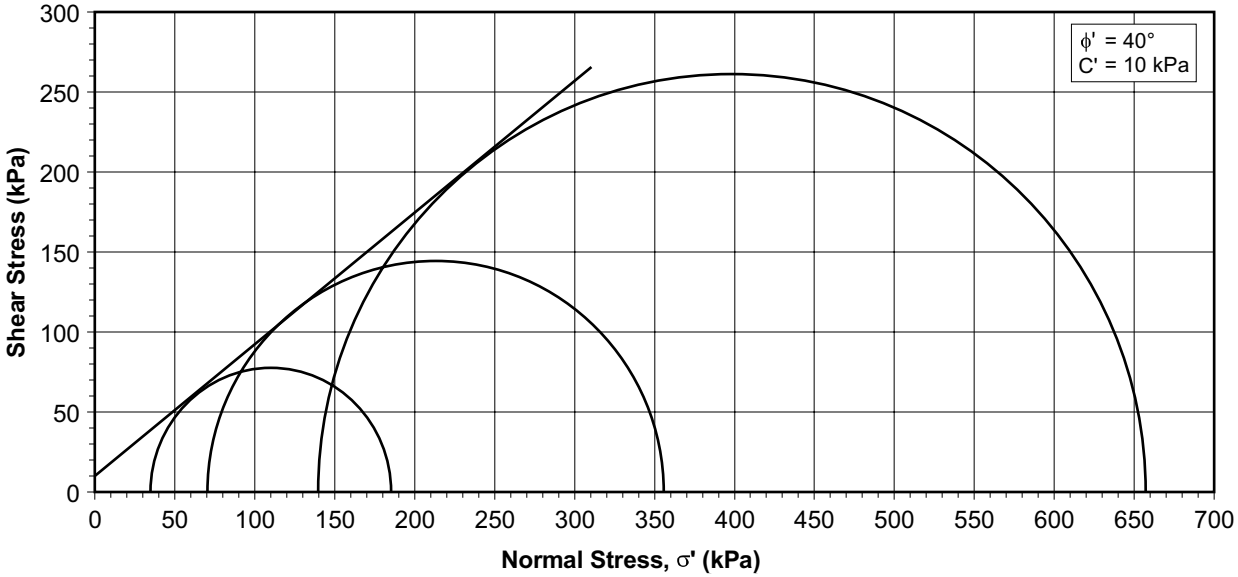
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 66 - Depth: 70.6m

Boring 98-33

SFOBB East Span Seismic Safety Project





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 27 - Depth: 11.7m

Boring 98-33

SFOBB East Span Seismic Safety Project

PLATE 98-33.16

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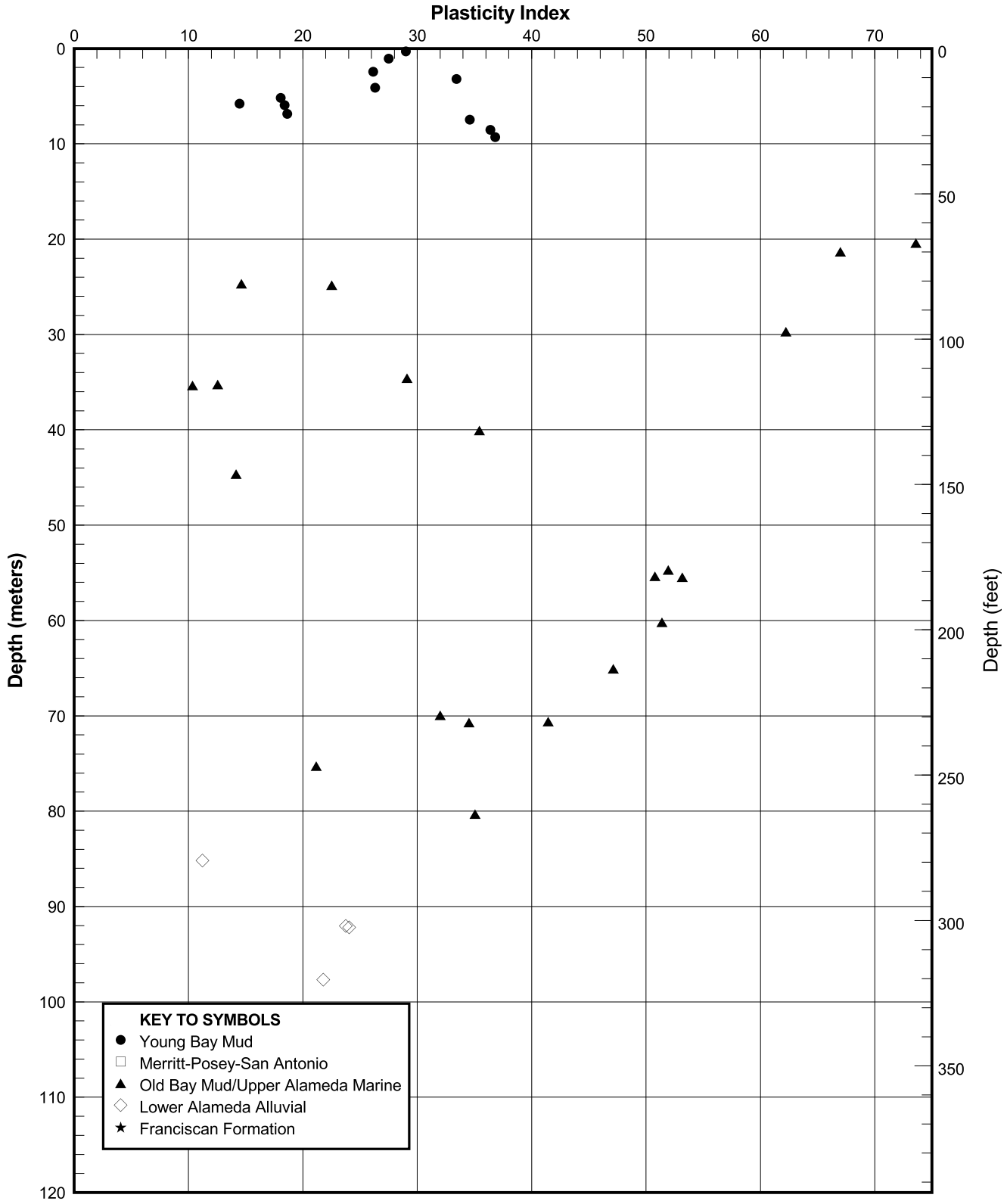
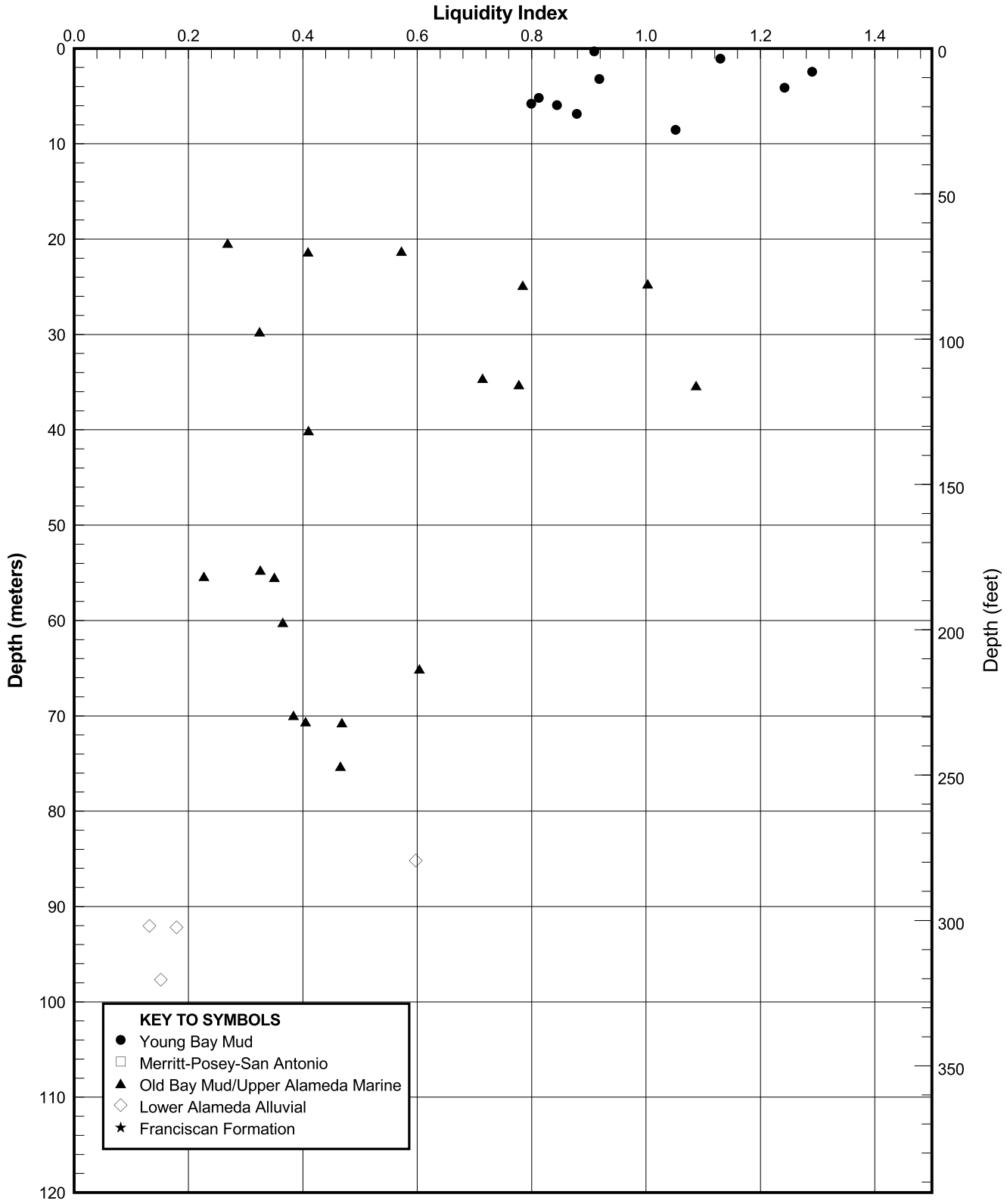


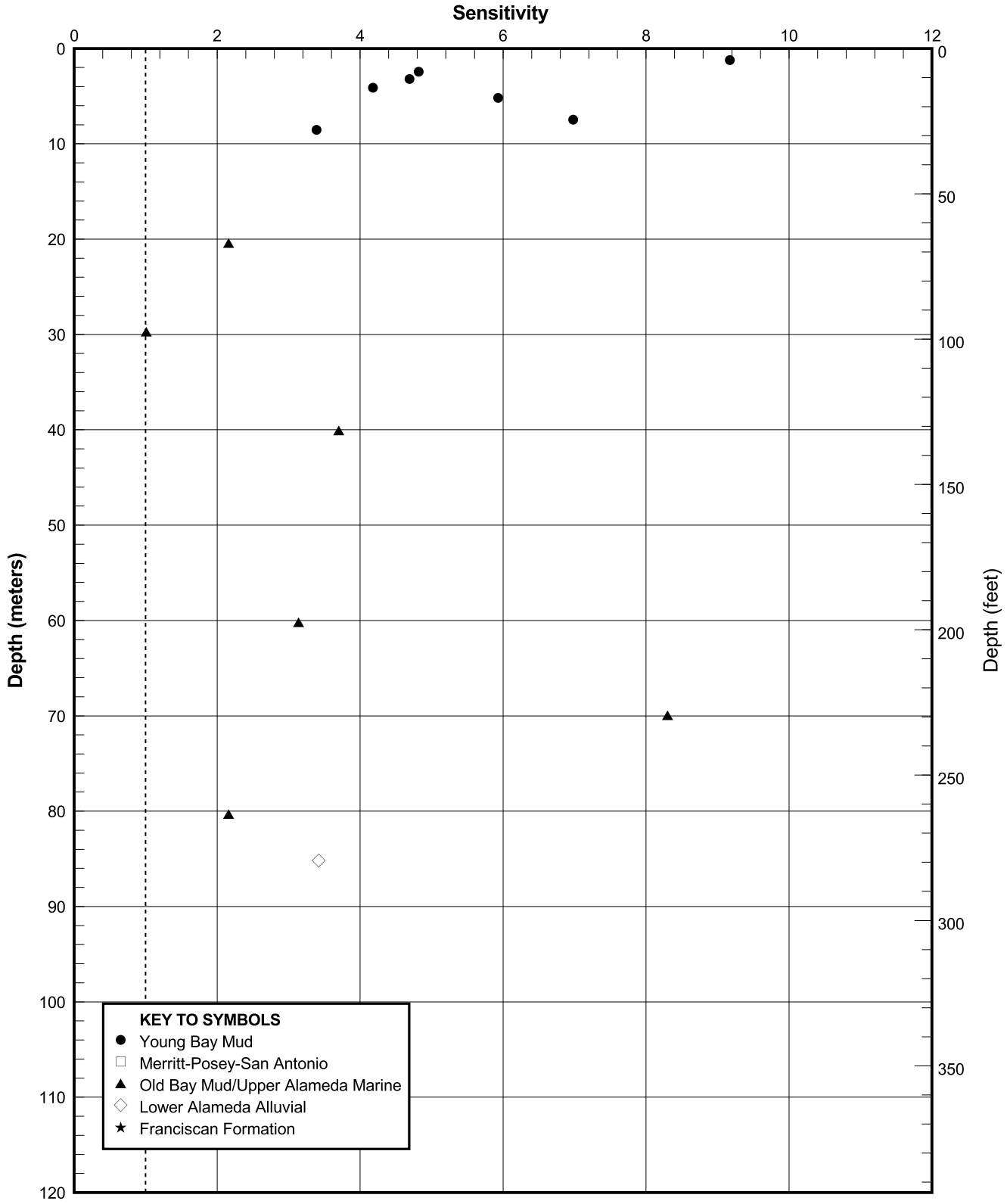
PLASTICITY INDEX PROFILE
Boring 98-33
SFOBB East Span Seismic Safety Project

PLATE 98-33.17



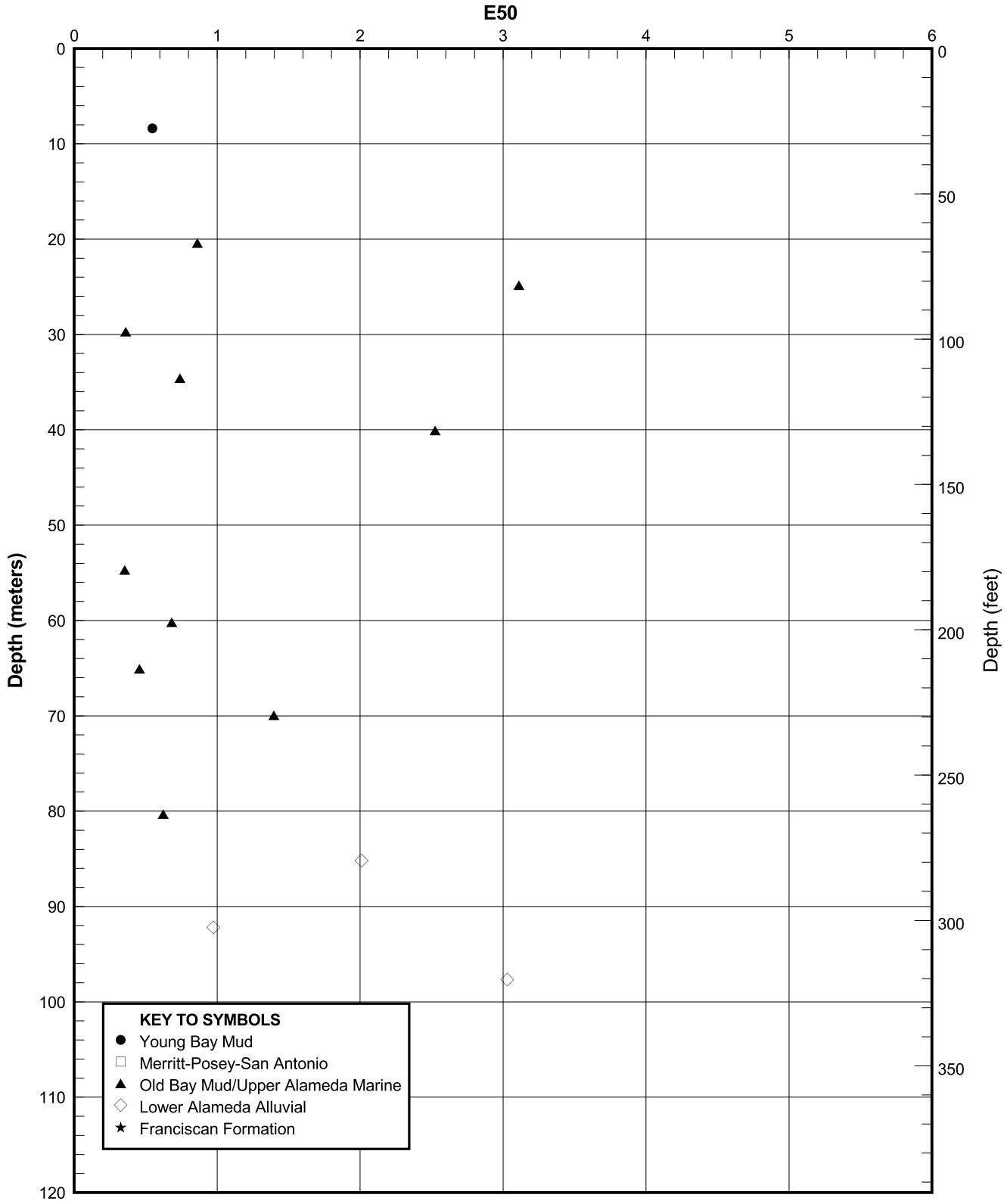
LIQUIDITY INDEX PROFILE
Boring 98-33
SFOBB East Span Seismic Safety Project

PLATE 98-33.18



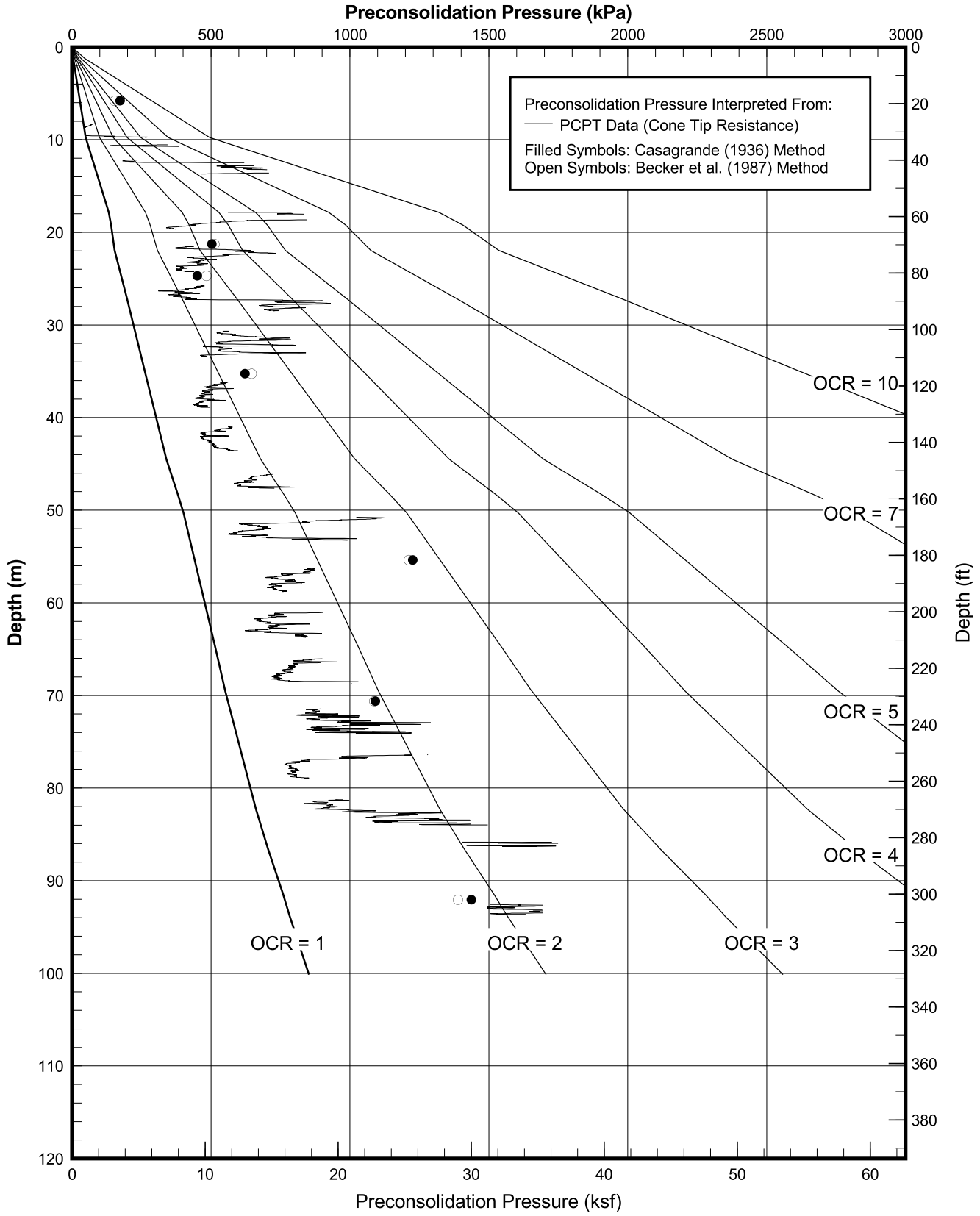
SENSITIVITY PROFILE
Boring 98-33
SFOBB East Span Seismic Safety Project

PLATE 98-33.19



E50 PROFILE
Boring 98-33
SFOBB East Span Seismic Safety Project

PLATE 98-33.20

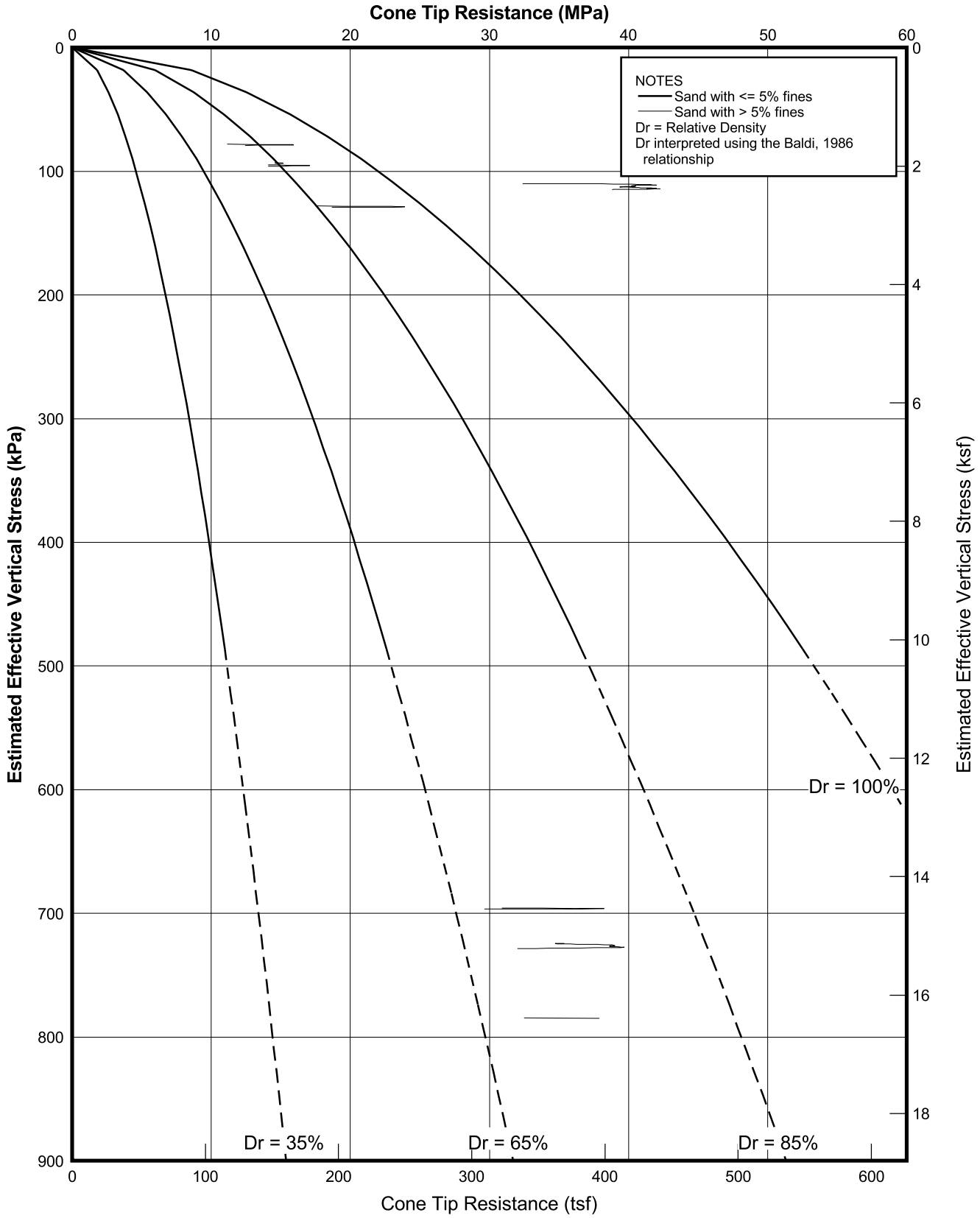


PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-33

SFOBB East Span Seismic Safety Project

PLATE 98-33.21



RELATIVE DENSITY INTERPRETED FROM CPT DATA

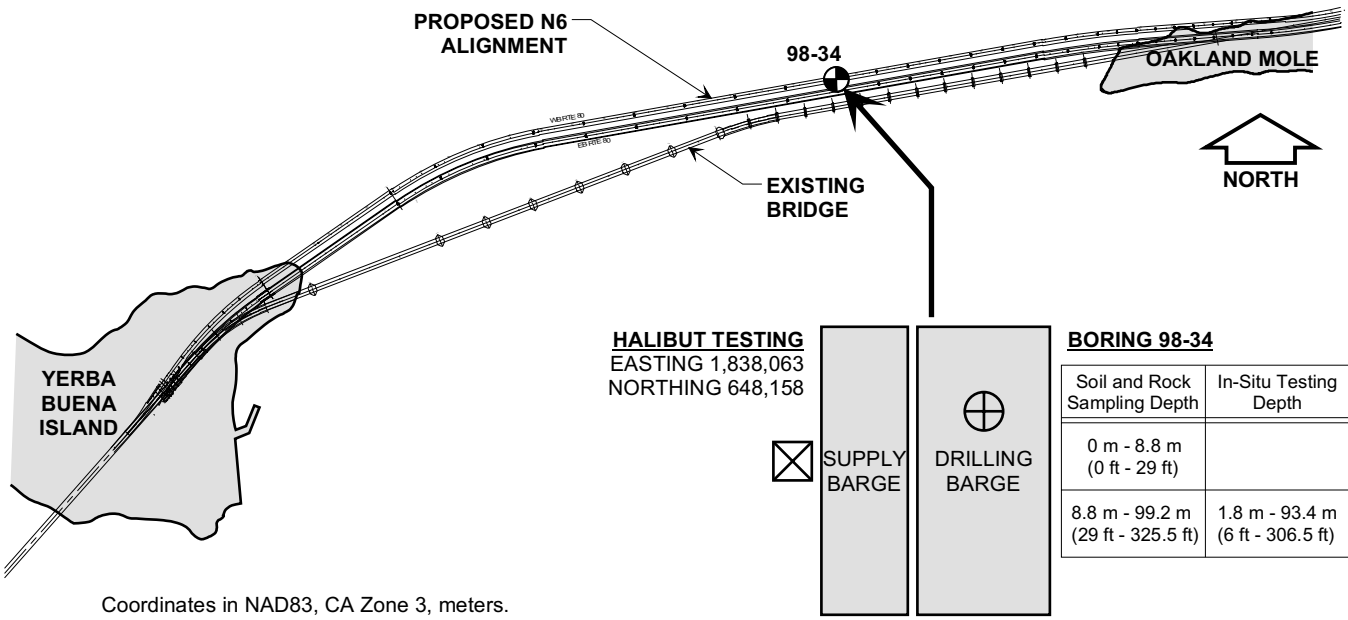
Boring 98-33

SFOBB East Span Seismic Safety Project

BORING 98-34

Date	Time From	Time To	Description of Activity
September 17, 1998	1200	1430	Move barge to location 98-34. Set 4 anchors and 2 spuds.
	1430	1500	Rig-up for drilling.
	1500	1525	Lower drill pipe to mudline.
	1525	1635	Measure water depth of 3.5m (11.6 ft) using bottom sensor. Current tide level is approximately –0.3m (-0.9 ft) MSL. Calculate mudline elevation of –3.8m (-12.5 ft) MSL.
	****	****	
	1525	1800	Rig up Halibut equipment. Perform Halibut vane shear testing from 0.6m (2 ft) to 2.4m (8 ft).
	****	****	
	1635	1930	Drill and sample from mudline to 8.8m (29 ft).
	1930	2000	Clean and change mechanical pawls on push sampler.
	2000	2030	Pull drill pipe to deck.
	****	****	
	2030	2130	Halibut vane shear testing from 3.0m (10 ft) to 4.3m (14 ft).
	****	****	
	2030	2400	Set casing.
September 18, 1998	0000	0400	Set casing. Drive stinger to 8.8m (29 ft).
	0400	0700	Mix drilling mud and rig-up for drilling.
	0700	0730	Perform CPT pipe test.
	0730	0800	Perform maintenance on generator.
	0800	2400	Drill, sample, and CPT testing from 1.8m (6 ft) to 54.6m (179 ft).
September 19, 1998	0000	1310	Drill, sample, and CPT testing from 54.6m (179 ft) to 93.3m (306) ft.
	1310	1420	Cone tool stuck in piston. Retrieve tool.
	1420	1600	Drill, sample, and CPT testing from 93.3m (306 ft) to 99.2m (325.5 ft).
	1600	1650	Pull drill pipe to deck.
	1650	1840	P- and S-wave velocity logging from 94.2m (309 ft) to 7.9m (26 ft).
	1840	2100	Pull slip joint to deck.
	2100	2400	P- and S-wave velocity logging from 7.9m (26 ft) to 2.4m (8ft).
September 20, 1998	0000	0430	Lower N-rod. Mix and circulate cement. Grout hole 98-34.
	0430	0600	Pull N-rod and casing to deck.
	0600	0910	Pull 2 spuds, 4 anchors, and move barge to location 98-35.

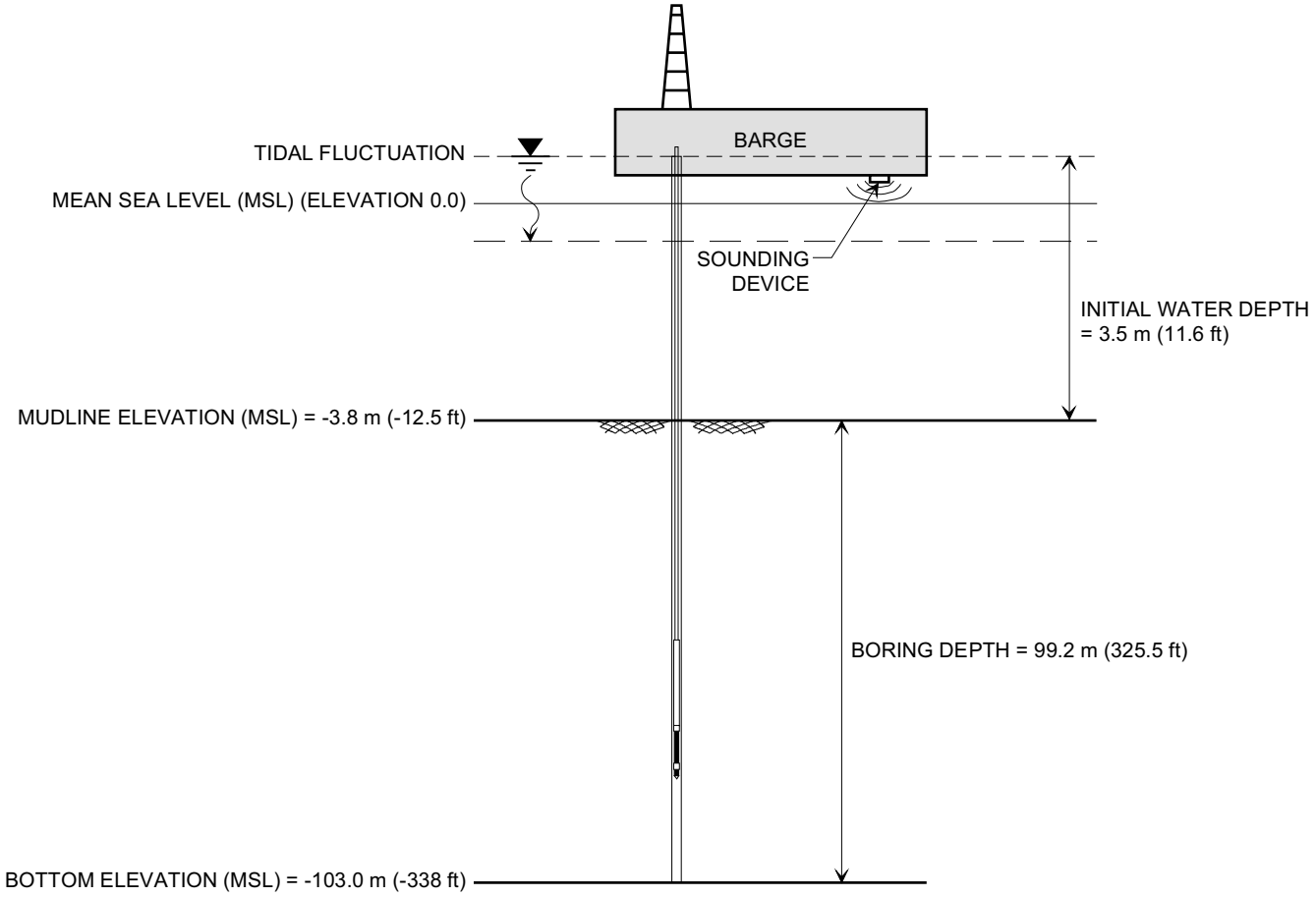
SUMMARY OF FIELD OPERATIONS
Boring 98-34
SFOBB East Span Seismic Safety Project



BORING 98-34

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 8.8 m (0 ft - 29 ft)		E = 1,838,081 N = 648,162
8.8 m - 99.2 m (29 ft - 325.5 ft)	1.8 m - 93.4 m (6 ft - 306.5 ft)	E = 1,838,077 N = 648,158

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-34
SFOBB East Span Seismic Safety Project

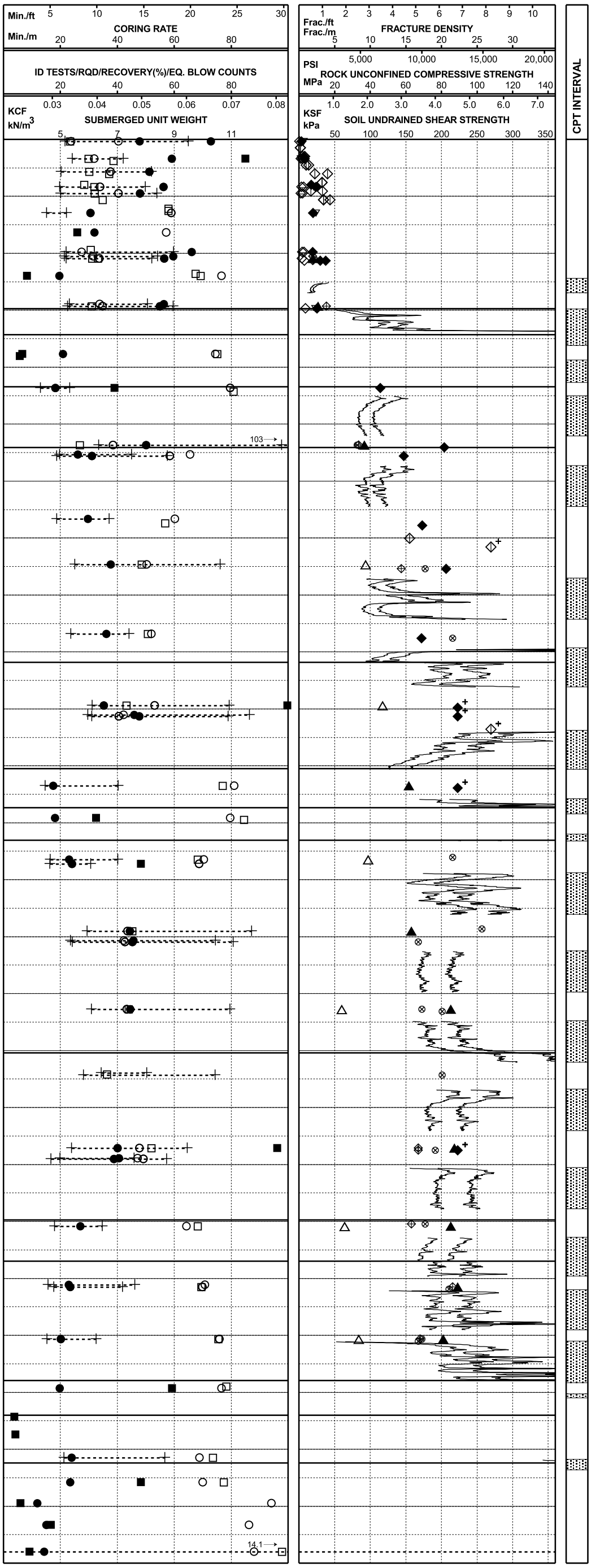
PROJECT NO:	98-42-0054	**START DATE:**	9/17/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-34 (Skyway Frame 3)	**COMPLETION DATE:**	9/20/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838077 N648158
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

Stratum No.	Material Description	Blow Count
I	Fat CLAY (CH), soft to firm, olive gray -very soft to 1.8m -with shell fragments to 4.3m -with many sand pockets at 0.3m -with silt pockets, 0.9m to 4.3m -with many shells and a few sand pockets, at 2.1m -with many shells and an H2S odor, at 4.0m -with many sand pockets and seams at 4.6m -intermixed sand and clay at 6.4m -with a few silt pockets and shell fragments, at 8.2m -dense fine sand with silt, a few clay pockets, and a few shell fragments, 9.1m to 10.1m -with a few shell fragments, and a few silt and sand pockets, at 11.3m (11.9m)	WOH, WOH, WOH, WOH, WOH, WOH, PUSH, 7/60cm, PUSH, PUSH, PUSH, PUSH
II	Fat CLAY (CH), stiff to very stiff, olive gray (13.7m)	
III	Fine SAND (SP-SM) with silt, very dense, gray -with a few clay pockets at 15.2m (17.4m)	47/30cm
IV	Fat CLAY (CH), stiff to very stiff, gray -very stiff sandy lean clay, with many fine sand seams and pockets, to 18.9m -with many large organic pockets, partings, and seams at 21.0m (21.6m)	45/35cm, PUSH SAVE
V	Fat CLAY (CH), very stiff, gray -desiccated to 24.4m -greenish gray, with a few shell fragments, at 21.9m -with many large sandy silt pockets and shell fragments, at 26.8m -greenish gray, with a few gas blisters and desiccated brown pockets, at 29.6m -with silt layers at 32.0m and 32.6m -lean olive gray clay below 34.4m -with a sand layer at 35.7m (36.7m)	PUSH, PUSH, PUSH, PUSH
VI	Fat CLAY (CH), hard, greenish gray -desiccated, with organic pockets and slickensides, at 39.9m (44.2m)	PUSH, PUSH SAVE
VII	Lean CLAY (CL), hard, greenish gray -with organic partings at 45.4m (46.9m)	PUSH
VIII	Silty fine SAND (SM), dense to very dense, greenish gray -with a clay layer at 47.2m (49.2m)	30/25cm
IX	Fat CLAY (CH), hard, greenish gray to gray -with silt pockets at 50.3m -with a sandy lean clay layer at 50.6m -with silt seams, 52.4m to 54.3m -with organic pockets and silt partings, at 55.5m -with a few shell fragments and a few sand and organic pockets, at 61.0m (64.2m)	PUSH, PUSH SAVE, PUSH
X	Fat CLAY (CH), hard, dark greenish gray -light gray, desiccated lean clay at 65.5m -with silt pockets and partings, a few organic pockets, light gray bands, and a few shell fragments, at 70.4m (75.9m)	30/15cm, PUSH SAVE
XI	Lean CLAY (CL), hard, dark greenish gray -with silt pockets at 76.5m (78.8m)	PUSH
XII	Lean CLAY (CL), hard, greenish gray -with silt seams and pockets, and many organic pockets, at 80.5m (87.2m)	PUSH, PUSH
XIII	Sandy SILT (ML), very dense, gray (89.6m)	30/20cm
XIV	Fine to Coarse GRAVEL with medium to coarse sand (GW), very dense, dark greenish gray -with a few clay pockets and a trace of fine sand, at 90.8m -hard gray fat clay below 91.7m (93.0m)	30/15cm, 30/20cm, 30/25cm
XV	Medium SAND (SW-SM) with silt and fine gravel, very dense, yellowish to reddish brown -dense, light gray, oxidized, silty fine to medium sand, to 94.3m -with coarse sand at 95.7m -silty fine to medium sand with coarse sand, at 97.2m -coarse sand with medium sand and fine gravel, at 99.1m	PUSH, 30/10cm, 30/10cm, 30/15cm

TOTAL DEPTH: 99.2m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-34

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

PLATE 98-34.3

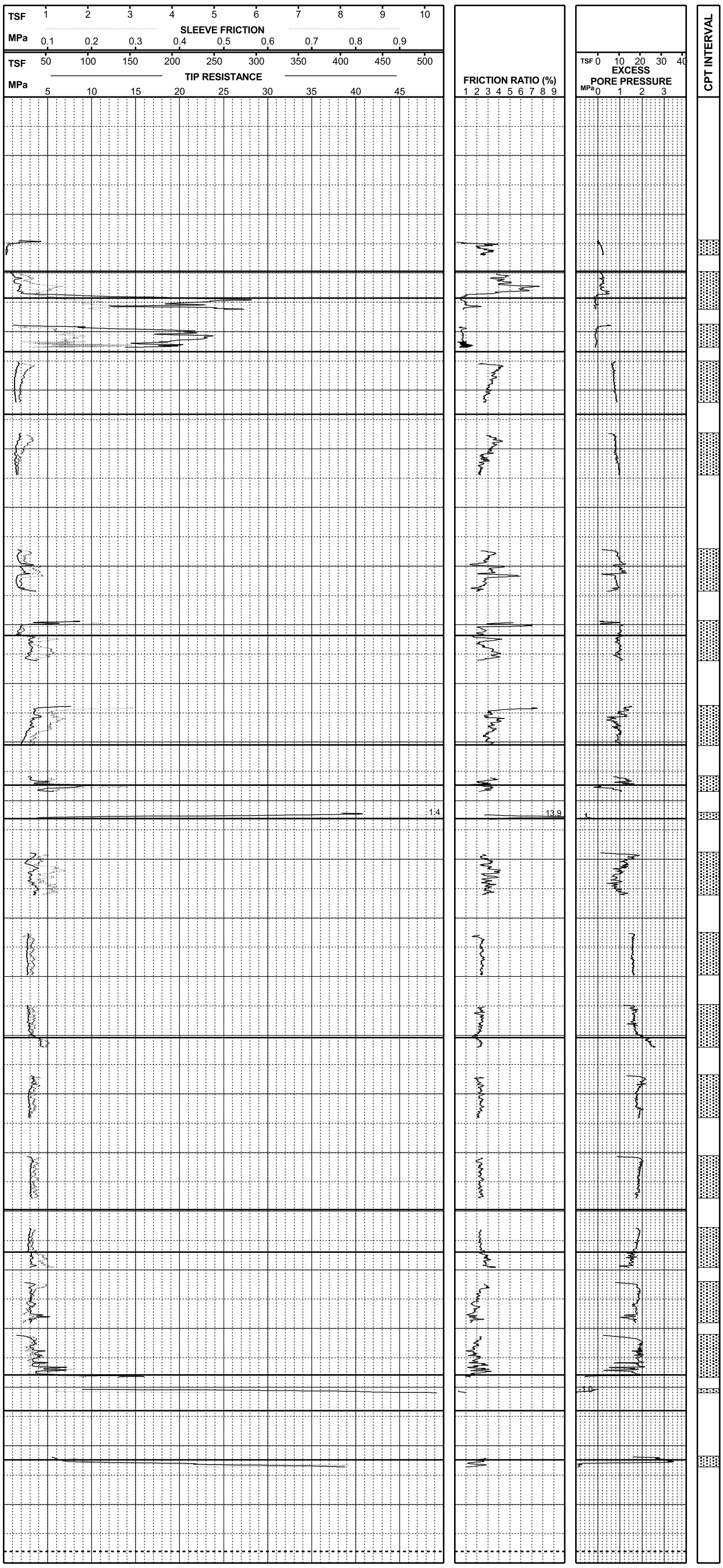
PROJECT NO:	98-42-0054	**START DATE:**	9/17/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-34 (Skyway Frame 3)	**COMPLETION DATE:**	9/20/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838077 N648158
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

Elevation, m.	Depth, m.	Blow Count / Sampler	Material Description	Stratum No.
-4		WOH	Fat CLAY (CH), soft to firm, olive gray	I
		WOH	-very soft to 1.8m	
		WOH	See Plate 98-34.6 for detailed stratigraphy	
		WOH		
-8	4	WOH		
		WOH		
		PUSH	-intermixed sand and clay at 6.4m	
-12	8	7/60cm PUSH		
		PUSH	-dense fine sand with silt, a few clay pockets, and a few shell fragments, 9.1m to 10.1m (11.9m)	
-16	12	PUSH	Fat CLAY (CH), stiff to very stiff, olive gray (13.7m)	II
-20	16	47/30cm	Fine SAND (SP-SM) with silt, very dense, gray -with a few clay pockets at 15.2m (17.4m)	III
-24	20	45/35cm PUSH SAVE	Fat CLAY (CH), stiff to very stiff, gray -very stiff sandy lean clay, with many fine sand seams and pockets, to 18.9m -with many large organic pockets, partings, and seams at 21.0m (21.6m)	IV
-28	24		Fat CLAY (CH), very stiff, gray -desiccated to 24.4m -greenish gray, with a few shell fragments, at 21.9m	V
-32	28	PUSH	-with many large sandy silt pockets and shell fragments, at 26.8m	
-36	32	PUSH	-greenish gray, with a few gas blisters and desiccated brown pockets, at 29.6m -with silt layers at 32.0m and 32.6m	
-40	36	PUSH	-lean olive gray clay below 34.4m -with a sand layer at 35.7m (36.7m)	
-44	40	PUSH PUSH SAVE	Fat CLAY (CH), hard, greenish gray -desiccated, with organic pockets and slickensides, at 39.9m (44.2m)	VI
-48	44	PUSH	Lean CLAY (CL), hard, greenish gray -with organic partings at 45.4m (46.9m)	VII
-52	48	30/25cm	Silty fine SAND (SM), dense to very dense, greenish gray (49.2m)	VIII
-56	52	PUSH	Fat CLAY (CH), hard, greenish gray to gray -with silt pockets at 50.3m -with a sandy lean clay layer at 50.6m -with silt seams, 52.4m to 54.3m	IX
-60	56	PUSH SAVE	-with organic pockets and silt partings, at 55.5m	
-64	60	PUSH	-with a few shell fragments and a few sand and organic pockets, at 61.0m (64.2m)	
-68	64	30/15cm	Fat CLAY (CH), hard, dark greenish gray -light gray, desiccated lean clay at 65.5m	X
-72	68		-with silt pockets and partings, a few organic pockets, light gray bands, and a few shell fragments, at 70.4m (75.9m)	
-76	72	PUSH SAVE		
-80	76	PUSH	Lean CLAY (CL), hard, dark greenish gray -with silt pockets at 76.5m (78.8m)	XI
-84	80	PUSH	Lean CLAY (CL), hard, greenish gray -with silt seams and pockets, and many organic pockets, at 80.5m	XII
-88	84	PUSH		
-92	88	30/20cm	Sandy SILT (ML), very dense, gray (89.6m)	XIII
-96	92	30/15cm 30/20cm 30/25cm	Fine to Coarse GRAVEL with medium to coarse sand (GW), very dense, dark greenish gray -hard gray fat clay below 91.7m (93.0m)	XIV
-100	96	PUSH 30/10cm 30/10cm 30/15cm	Medium SAND (SW-SM) with silt and fine gravel, very dense, yellowish to reddish brown -dense, light gray, oxidized, silty fine to medium sand, to 94.3m	XV

TOTAL DEPTH: 99.2m
BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-34

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

PLATE 98-34.4

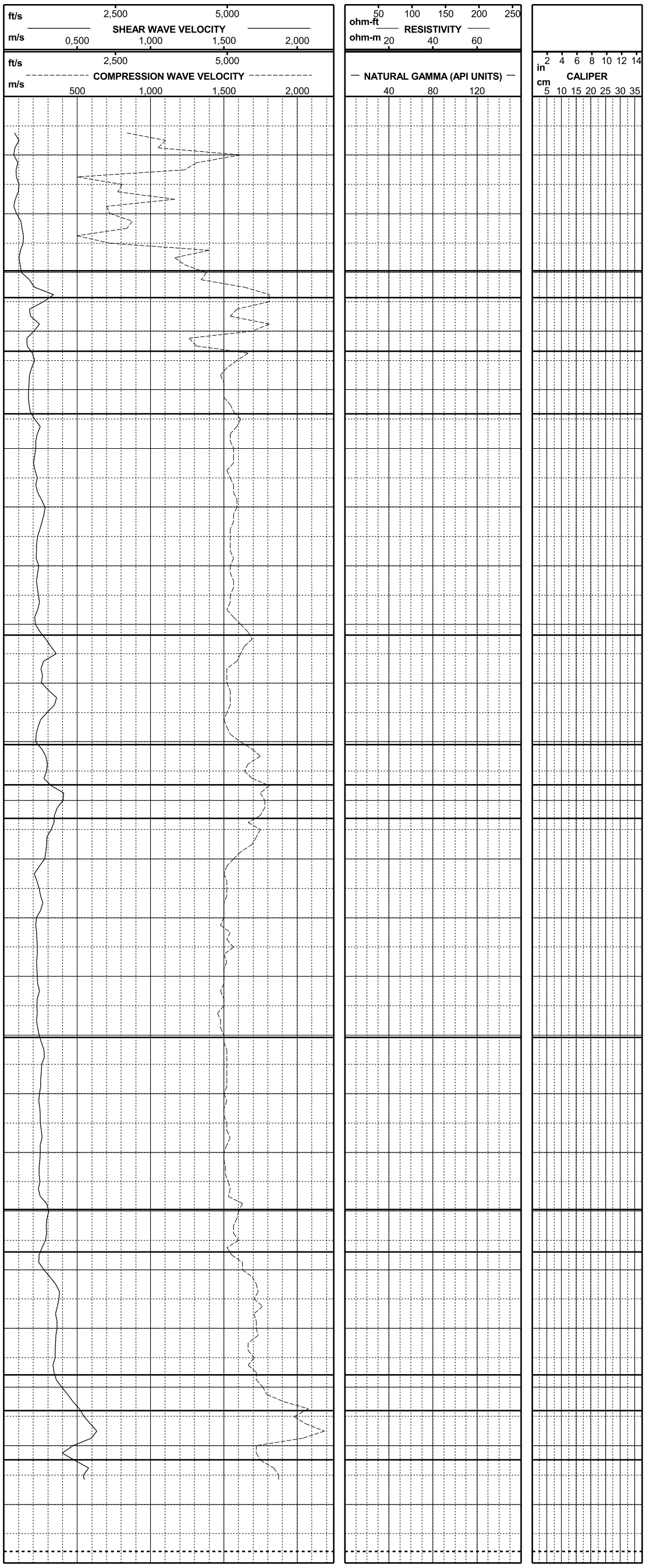
PROJECT NO:	98-42-0054	**START DATE:**	9/17/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-34 (Skyway Frame 3)	**COMPLETION DATE:**	9/20/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838077 N648158
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4			WOH	Fat CLAY (CH), soft to firm, olive gray	I
			WOH		
			WOH		
			WOH		
-8	4		WOH	See Plate 98-34.6 for detailed stratigraphy	
			WOH		
			PUSH		
-12	8		7/60cm		
			PUSH	-dense fine sand with silt, a few clay pockets, and a few shell fragments, 9.1m to 10.1m	
			PUSH		
-16	12		PUSH	(11.9m)	
				Fat CLAY (CH), stiff to very stiff, olive gray (13.7m)	II
-20	16		47/30cm	Fine SAND (SP-SM) with silt, very dense, gray -with a few clay pockets at 15.2m (17.4m)	III
-24	20		45/35cm	Fat CLAY (CH), stiff to very stiff, gray -very stiff sandy lean clay, with many fine sand seams and pockets, to 18.9m (21.6m)	IV
-28	24		PUSH SAVE	Fat CLAY (CH), very stiff, gray -desiccated to 24.4m -greenish gray, with a few shell fragments, at 21.9m	V
-32	28		PUSH	-with many large sandy silt pockets and shell fragments, at 26.8m	
-36	32		PUSH	-greenish gray, with a few gas blisters and desiccated brown pockets, at 29.6m	
-40	36		PUSH	-with silt layers at 32.0m and 32.6m -lean olive gray clay below 34.4m -with a sand layer at 35.7m (36.7m)	
-44	40		PUSH	Fat CLAY (CH), hard, greenish gray	VI
			PUSH SAVE	-desiccated, with organic pockets and slickensides, at 39.9m (44.2m)	
-48	44		PUSH	Lean CLAY (CL), hard, greenish gray -with organic partings at 45.4m (46.9m)	VII
-52	48		30/25cm	Silty fine SAND (SM), dense to very dense, greenish gray -with a clay layer at 47.2m (49.2m)	VIII
-56	52		PUSH	Fat CLAY (CH), hard, greenish gray to gray -with silt pockets at 50.3m -with a sandy lean clay layer at 50.6m -with silt seams, 52.4m to 54.3m	IX
-60	56		PUSH SAVE	-with organic pockets and silt partings, at 55.5m	
-64	60		PUSH	-with a few shell fragments and a few sand and organic pockets, at 61.0m (64.2m)	
-68	64		30/15cm	Fat CLAY (CH), hard, dark greenish gray -light gray, desiccated lean clay at 65.5m	X
-72	68			-with silt pockets and partings, a few organic pockets, light gray bands, and a few shell fragments, at 70.4m	
-76	72		PUSH SAVE	(75.9m)	
-80	76		PUSH	Lean CLAY (CL), hard, dark greenish gray -with silt pockets at 76.5m (78.8m)	XI
-84	80		PUSH	Lean CLAY (CL), hard, greenish gray -with silt seams and pockets, and many organic pockets, at 80.5m	XII
-88	84		PUSH	(87.2m)	
-92	88		30/20cm	Sandy SILT (ML), very dense, gray (89.6m)	XIII
			30/15cm	Fine to Coarse GRAVEL with medium to coarse sand (GW), very dense, dark greenish gray	XIV
-96	92		30/20cm	-hard gray fat clay below 91.7m (93.0m)	
			30/25cm		
-100	96		PUSH	Medium SAND (SW-SM) with silt and fine gravel, very dense, yellowish to reddish brown -dense, light gray, oxidized, silty fine to medium sand, to 94.3m -with coarse sand at 95.7m -silty fine to medium sand with coarse sand, at 97.2m -coarse sand with medium sand and fine gravel, at 99.1m	XV
			30/10cm		
			30/10cm		
			30/15cm		

TOTAL DEPTH: 99.2m
BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-34

SFOBB East Span Seismic Safety Project

Report Date: 05/07/99

FUGRO

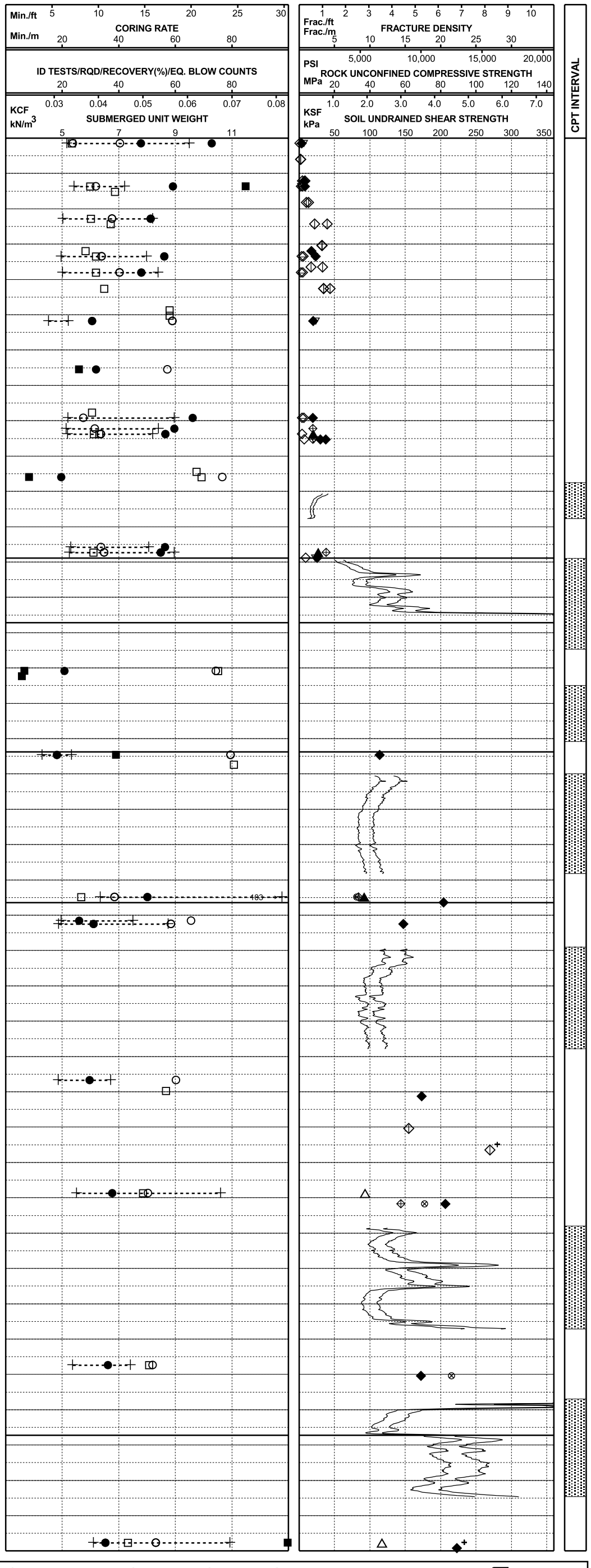
PLATE 98-34.5

PROJECT NO:	98-42-0054	**START DATE:**	9/17/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-34 (Skyway Frame 3)	**COMPLETION DATE:**	9/20/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838077 N648158
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4		WOH	Fat CLAY (CH), soft to firm, olive gray	I
			-very soft to 1.8m	
			-with shell fragments to 4.3m	
-5	1	WOH	-with many sand pockets at 0.3m	
			-with silt pockets, 0.9m to 4.3m	
-6	2	WOH	-with many shells and a few sand pockets, at 2.1m	
-7	3	WOH		
-8	4	WOH	-with many shells and an H2S odor, at 4.0m	
			-with many sand pockets and seams at 4.6m	
-9	5	WOH		
-10	6	PUSH	-intermixed sand and clay at 6.4m	
-11	7	7/60cm		
-12	8	PUSH PUSH	-with a few silt pockets and shell fragments, at 8.2m	
-13	9	PUSH	-dense fine sand with silt, a few clay pockets, and a few shell fragments, 9.1m to 10.1m	
-14	10			
-15	11	PUSH	-with a few shell fragments, and a few silt and sand pockets, at 11.3m (11.9m)	
-16	12		Fat CLAY (CH), stiff to very stiff, olive gray	II
-17	13		(13.7m)	
-18	14		Fine SAND (SP-SM) with silt, very dense, gray	III
-19	15	47/30cm	-with a few clay pockets at 15.2m	
-20	16			
-21	17		(17.4m)	
-22	18	45/35cm	Fat CLAY (CH), stiff to very stiff, gray	IV
			-very stiff sandy lean clay, with many fine sand seams and pockets, to 18.9m	
-23	19			
-24	20			
-25	21	PUSH	-with many large organic pockets, partings, and seams at 21.0m (21.6m)	
-26	22	SAVE	Fat CLAY (CH), very stiff, gray	V
			-desiccated to 24.4m	
			-greenish gray, with a few shell fragments, at 21.9m	
-27	23			
-28	24			
-29	25			
-30	26			
-31	27	PUSH	-with many large sandy silt pockets and shell fragments, at 26.8m	
-32	28			
-33	29		-greenish gray, with a few gas blisters and desiccated brown pockets, at 29.6m	
-34	30	PUSH		
-35	31			
-36	32		-with silt layers at 32.0m and 32.6m	
-37	33			
-38	34		-lean olive gray clay below 34.4m	
-39	35	PUSH		
-40	36		-with a sand layer at 35.7m (36.7m)	
-41	37		Fat CLAY (CH), hard, greenish gray	VI
-42	38	PUSH		
-43	39	PUSH SAVE	-desiccated, with organic pockets and slickensides, at 39.9m	



LOG OF BORING AND TEST RESULTS

BORING 98-34

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

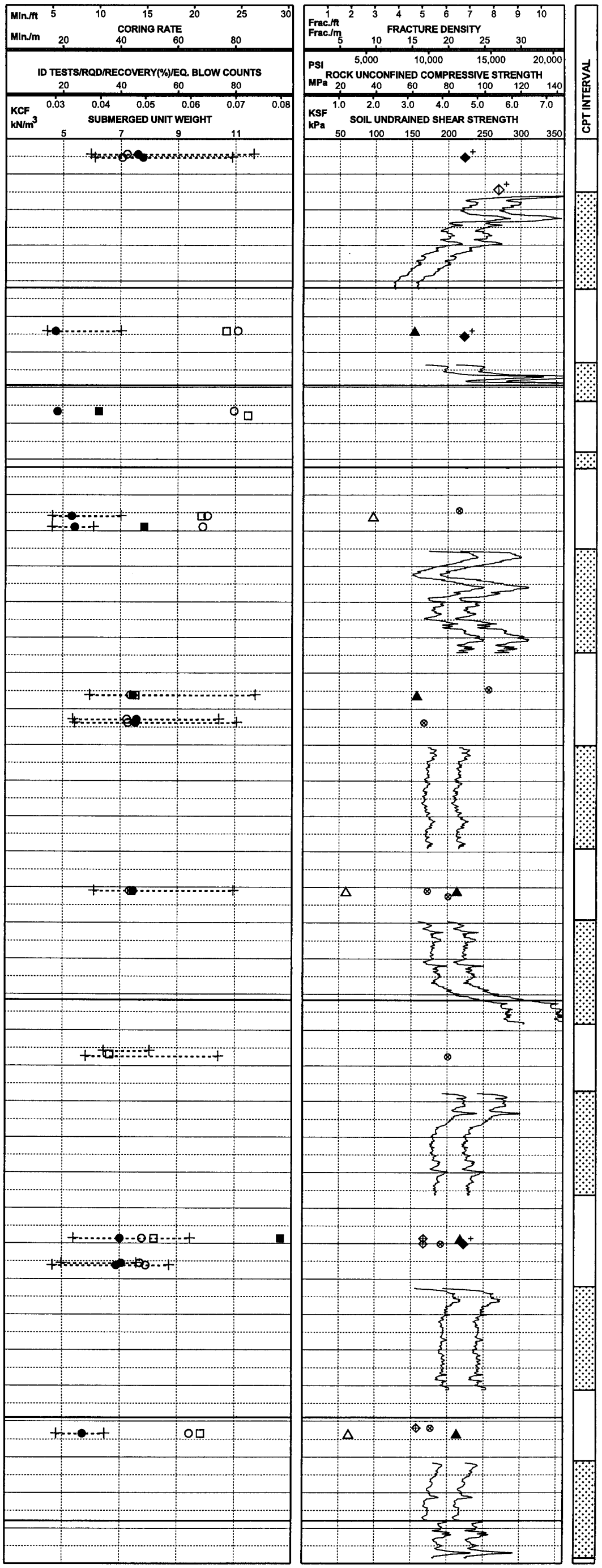
PLATE 98-34.6a

PROJECT NO:	98-42-0054	**START DATE:**	9/17/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-34 (Skyway Frame 3)	**COMPLETION DATE:**	9/20/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838077 N648158
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

Elevation, m.	Depth, m.	Blow Count	Material Description	Stratum No.
-44	41–44	SAVE	Fat CLAY (CH), hard, greenish gray (44.2m)	VI
-48	45–47	PUSH	Lean CLAY (CL), hard, greenish gray -with organic partings at 45.4m (46.9m)	VII
-51	47–49	30/25cm	Silty fine SAND (SM), dense to very dense, greenish gray -with a clay layer at 47.2m (49.2m)	VIII
-53	50–64	PUSH PUSH SAVE PUSH	Fat CLAY (CH), hard, greenish gray to gray -with silt pockets at 50.3m -with a sandy lean clay layer at 50.6m -with silt seams, 52.4m to 54.3m -with organic pockets and silt partings, at 55.5m -with a few shell fragments and a few sand and organic pockets, at 61.0m (64.2m)	IX
-68	65–67	30/15cm	Fat CLAY (CH), hard, dark greenish gray -light gray, desiccated lean clay at 65.5m	
-74	68–75	PUSH SAVE	-with silt pockets and partings, a few organic pockets, light gray bands, and a few shell fragments, at 70.4m (75.9m)	X
-80	76–78	PUSH	Lean CLAY (CL), hard, dark greenish gray -with silt pockets at 76.5m (78.8m)	XI
-83	79		Lean CLAY (CL), hard, greenish gray	XII



LOG OF BORING AND TEST RESULTS

BORING 98-34

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

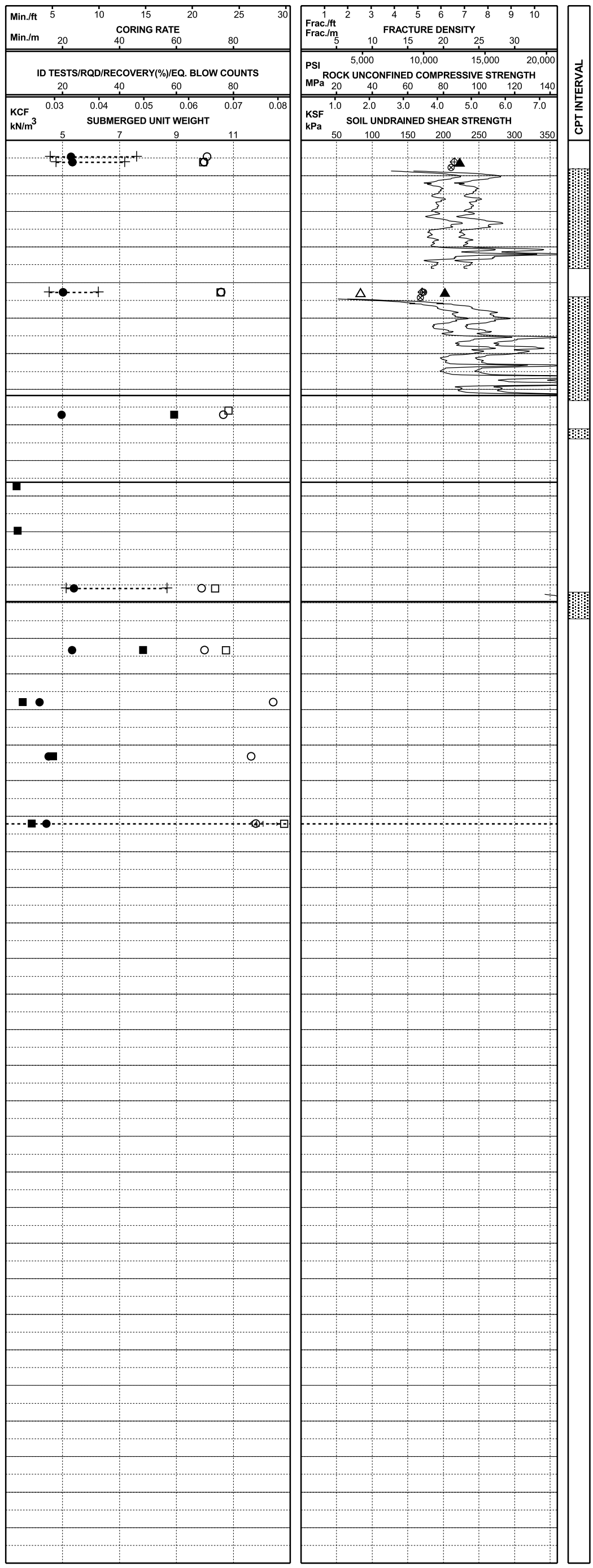
PLATE 98-34.6b

PROJECT NO:	98-42-0054	**START DATE:**	9/17/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-34 (Skyway Frame 3)	**COMPLETION DATE:**	9/20/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838077 N648158
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.	BLOW COUNT
Lean CLAY (CL), hard, greenish gray -with silt seams and pockets, and many organic pockets, at 80.5m (87.2m)	XII	PUSH PUSH
Sandy SILT (ML), very dense, gray (89.6m)	XIII	30/20cm
Fine to Coarse GRAVEL with medium to coarse sand (GW), very dense, dark greenish gray -with a few clay pockets and a trace of fine sand, at 90.8m -hard gray fat clay below 91.7m (93.0m)	XIV	30/15cm 30/20cm 30/25cm
Medium SAND (SW-SM) with silt and fine gravel, very dense, yellowish to reddish brown -dense, light gray, oxidized, silty fine to medium sand, to 94.3m -with coarse sand at 95.7m -silty fine to medium sand with coarse sand, at 97.2m -coarse sand with medium sand and fine gravel, at 99.1m TOTAL DEPTH: 99.2m BACKFILLED WITH: Cement Grout	XV	PUSH 30/10cm 30/10cm 30/15cm



LOG OF BORING AND TEST RESULTS

BORING 98-34

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

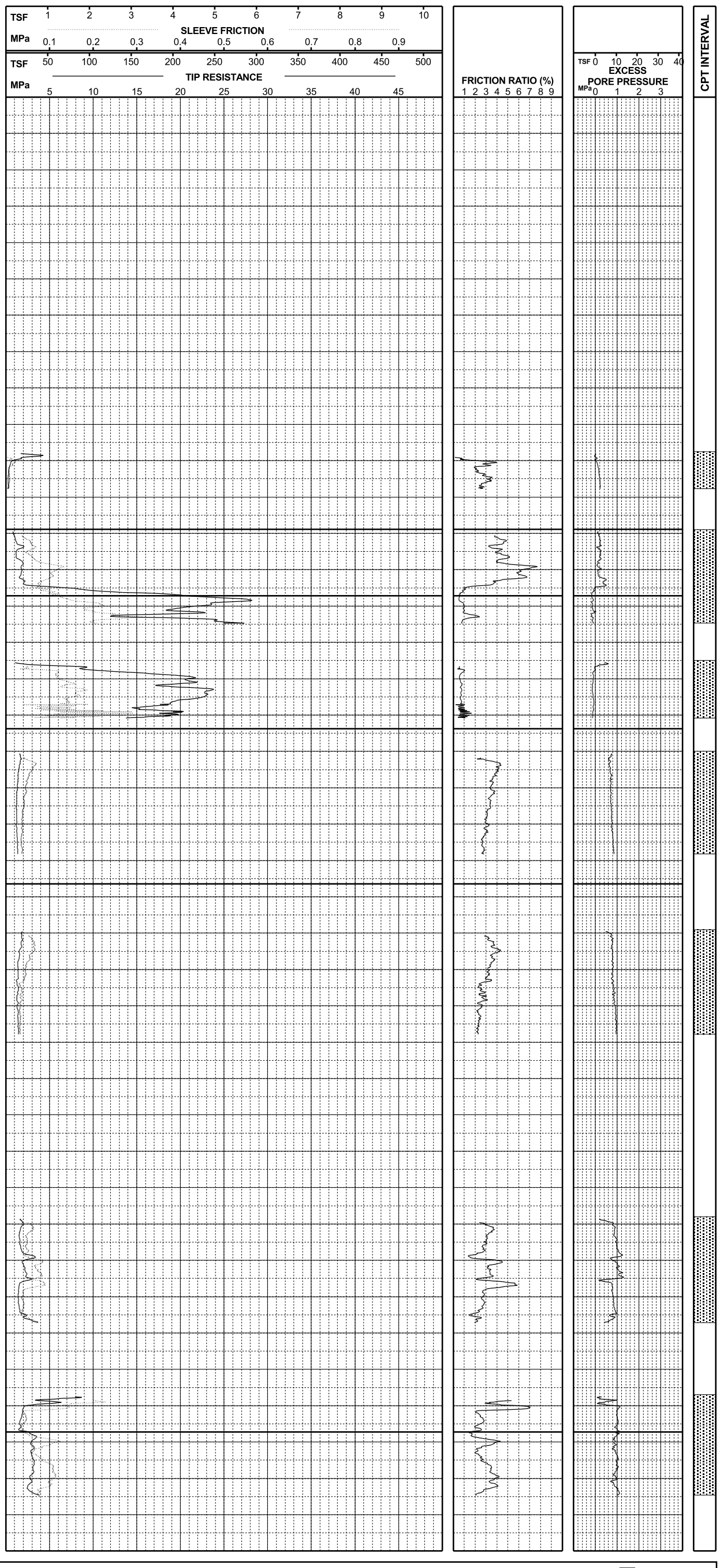
PLATE 98-34.6c

PROJECT NO:	98-42-0054	**START DATE:**	9/17/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-34 (Skyway Frame 3)	**COMPLETION DATE:**	9/20/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838077 N648158
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4			WOH	Fat CLAY (CH), soft to firm, olive gray -very soft to 1.8m -with shell fragments to 4.3m	I
-5	1		WOH	-with many sand pockets at 0.3m -with silt pockets, 0.9m to 4.3m	
-6	2		WOH	-with many shells and a few sand pockets, at 2.1m	
-7	3		WOH		
-8	4		WOH	-with many shells and an H2S odor, at 4.0m -with many sand pockets and seams at 4.6m	
-9	5		WOH		
-10	6		PUSH	-intermixed sand and clay at 6.4m	
-11	7		7/60cm		
-12	8		PUSH PUSH	-with a few silt pockets and shell fragments, at 8.2m -dense fine sand with silt, a few clay pockets, and a few shell fragments, 9.1m to 10.1m	
-13	9		PUSH		
-14	10				
-15	11		PUSH	-with a few shell fragments, and a few silt and sand pockets, at 11.3m (11.9m)	
-16	12			Fat CLAY (CH), stiff to very stiff, olive gray (13.7m)	II
-17	13				
-18	14			Fine SAND (SP-SM) with silt, very dense, gray	III
-19	15		47/30cm	-with a few clay pockets at 15.2m	
-20	16				
-21	17			(17.4m)	
-22	18		45/35cm	Fat CLAY (CH), stiff to very stiff, gray -very stiff sandy lean clay, with many fine sand seams and pockets, to 18.9m	IV
-23	19				
-24	20				
-25	21		PUSH	-with many large organic pockets, partings, and seams at 21.0m (21.6m)	
-26	22		SAVE	Fat CLAY (CH), very stiff, gray -desiccated to 24.4m -greenish gray, with a few shell fragments, at 21.9m	V
-27	23				
-28	24				
-29	25				
-30	26				
-31	27		PUSH	-with many large sandy silt pockets and shell fragments, at 26.8m	
-32	28				
-33	29			-greenish gray, with a few gas blisters and desiccated brown pockets, at 29.6m	
-34	30		PUSH		
-35	31				
-36	32			-with silt layers at 32.0m and 32.6m	
-37	33				
-38	34			-lean olive gray clay below 34.4m	
-39	35		PUSH	-with a sand layer at 35.7m	
-40	36			(36.7m)	
-41	37			Fat CLAY (CH), hard, greenish gray	VI
-42	38		PUSH		
-43	39		PUSH SAVE	-desiccated, with organic pockets and slickensides, at 39.9m	



LOG OF BORING AND TEST RESULTS

BORING 98-34

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

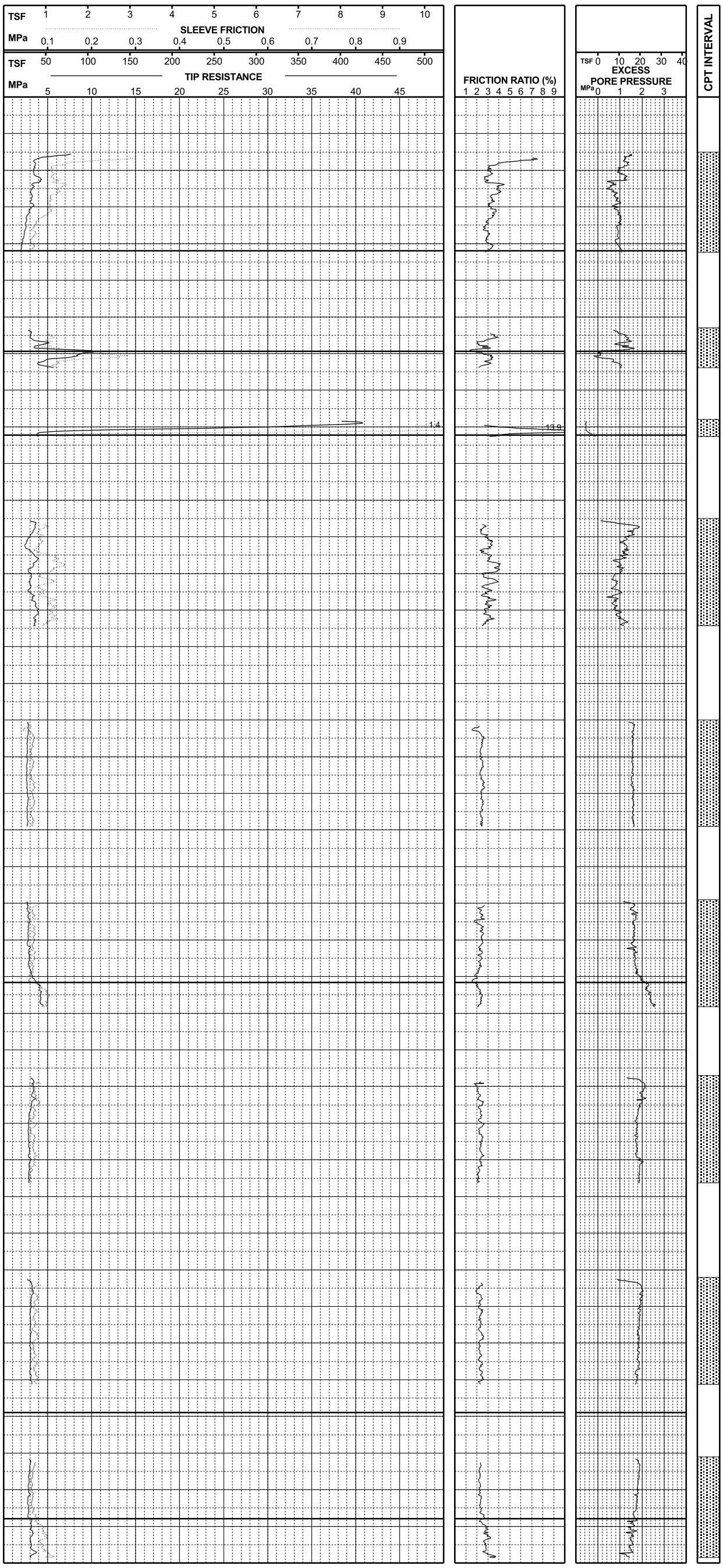
PLATE 98-34.7a

PROJECT NO:	98-42-0054	**START DATE:**	9/17/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-34 (Skyway Frame 3)	**COMPLETION DATE:**	9/20/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838077 N648158
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
SAVE	Fat CLAY (CH), hard, greenish gray (44.2m)	VI
PUSH	Lean CLAY (CL), hard, greenish gray -with organic partings at 45.4m (46.9m)	VII
30/25cm	Silty fine SAND (SM), dense to very dense, greenish gray -with a clay layer at 47.2m (49.2m)	VIII
PUSH	Fat CLAY (CH), hard, greenish gray to gray -with silt pockets at 50.3m -with a sandy lean clay layer at 50.6m	IX
	-with silt seams, 52.4m to 54.3m	
PUSH SAVE	-with organic pockets and silt partings, at 55.5m	
PUSH	-with a few shell fragments and a few sand and organic pockets, at 61.0m (64.2m)	
30/15cm	Fat CLAY (CH), hard, dark greenish gray -light gray, desiccated lean clay at 65.5m	X
PUSH SAVE	-with silt pockets and partings, a few organic pockets, light gray bands, and a few shell fragments, at 70.4m (75.9m)	
PUSH	Lean CLAY (CL), hard, dark greenish gray -with silt pockets at 76.5m (78.8m)	XI
	Lean CLAY (CL), hard, greenish gray	XII



LOG OF BORING AND TEST RESULTS

BORING 98-34

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

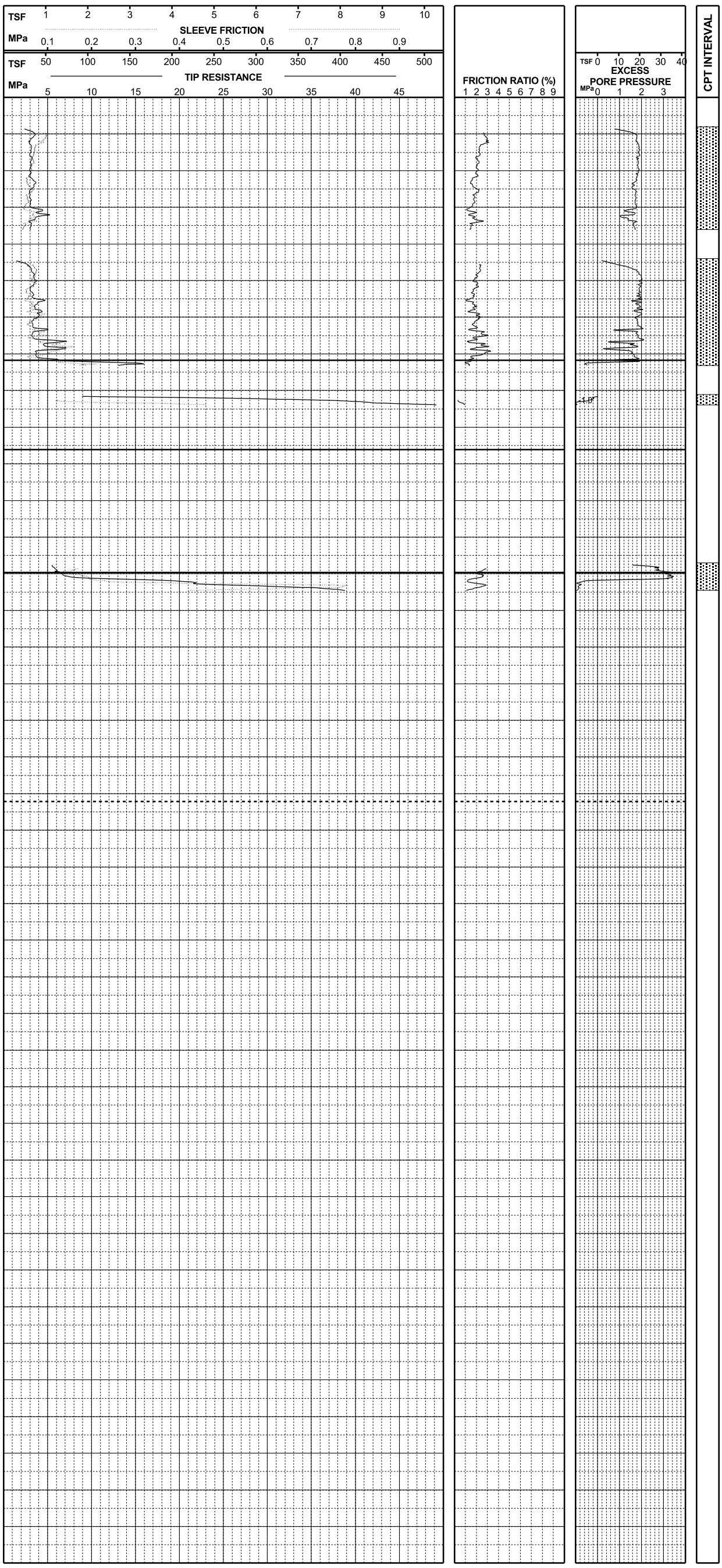
PLATE 98-34.7b

PROJECT NO:	98-42-0054	**START DATE:**	9/17/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-34 (Skyway Frame 3)	**COMPLETION DATE:**	9/20/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838077 N648158
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-84	81			PUSH	Lean CLAY (CL), hard, greenish gray -with silt seams and pockets, and many organic pockets, at 80.5m	XII
-85	82					
-86	83					
-87	84			PUSH		
-88	85					
-89	86					
-90	87				(87.2m)	
-91	88			30/20cm	Sandy SILT (ML), very dense, gray	XIII
-92	89					
-93	90			30/15cm	(89.6m)	
-94	91			30/20cm	Fine to Coarse GRAVEL with medium to coarse sand (GW), very dense, dark greenish gray -with a few clay pockets and a trace of fine sand, at 90.8m	XIV
-95	92				-hard gray fat clay below 91.7m	
-96	93			30/25cm	(93.0m)	
-97	94			PUSH	Medium SAND (SW-SM) with silt and fine gravel, very dense, yellowish to reddish brown -dense, light gray, oxidized, silty fine to medium sand, to 94.3m	XV
-98	95					
-99	96			30/10cm	-with coarse sand at 95.7m	
-100	97					
-101	98			30/10cm	-silty fine to medium sand with coarse sand, at 97.2m	
-102	99				-coarse sand with medium sand and fine gravel, at 99.1m	
-103	100			30/15cm	TOTAL DEPTH: 99.2m	
-104	101				BACKFILLED WITH: Cement Grout	
-105	102					
-106	103					
-107	104					
-108	105					
-109	106					
-110	107					
-111	108					
-112	109					
-113	110					
-114	111					
-115	112					
-116	113					
-117	114					
-118	115					
-119	116					
-120	117					
-121	118					
-122	119					
-123						



LOG OF BORING AND TEST RESULTS

BORING 98-34

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

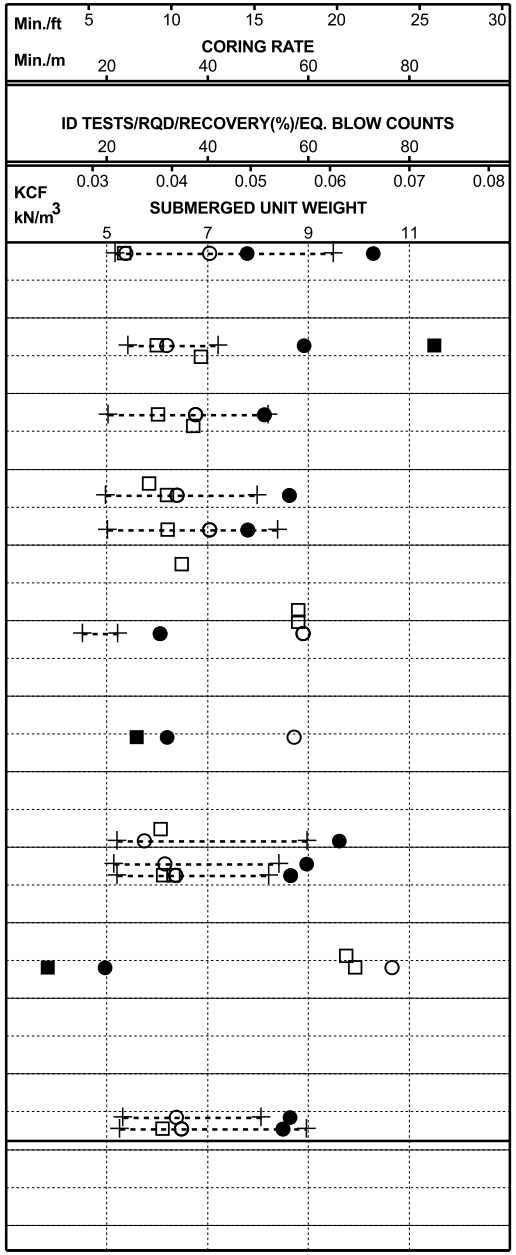
PLATE 98-34.7c

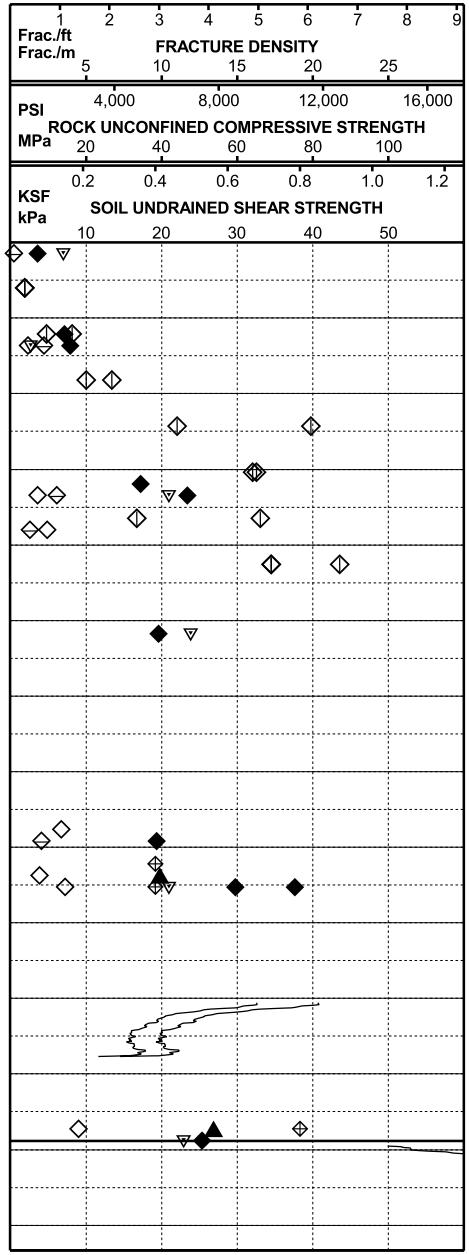
PROJECT NO:	98-42-0054	**START DATE:**	9/17/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-34 (Skyway Frame 3)	**COMPLETION DATE:**	9/20/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838077 N648158
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.8m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4				WOH	Fat CLAY (CH), soft to firm, olive gray -very soft to 1.8m -with shell fragments to 4.3m -with many sand pockets at 0.3m	I
-5	1			WOH	-with silt pockets, 0.9m to 4.3m	
-6	2			WOH	-with many shells and a few sand pockets, at 2.1m	
-7	3			WOH		
-8	4			WOH	-with many shells and an H2S odor, at 4.0m -with many sand pockets and seams at 4.6m	
-9	5			WOH		
-10	6			PUSH	-intermixed sand and clay at 6.4m	
-11	7			7/60cm		
-12	8			PUSH PUSH	-with a few silt pockets and shell fragments, at 8.2m	
-13	9			PUSH	-dense fine sand with silt, a few clay pockets, and a few shell fragments, 9.1m to 10.1m	
-14	10					
-15	11			PUSH	-with a few shell fragments, and a few silt and sand pockets, at 11.3m (11.9m)	
-16	12				Fat CLAY (CH), stiff to very stiff, olive gray	II
-17	13					





CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-34

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

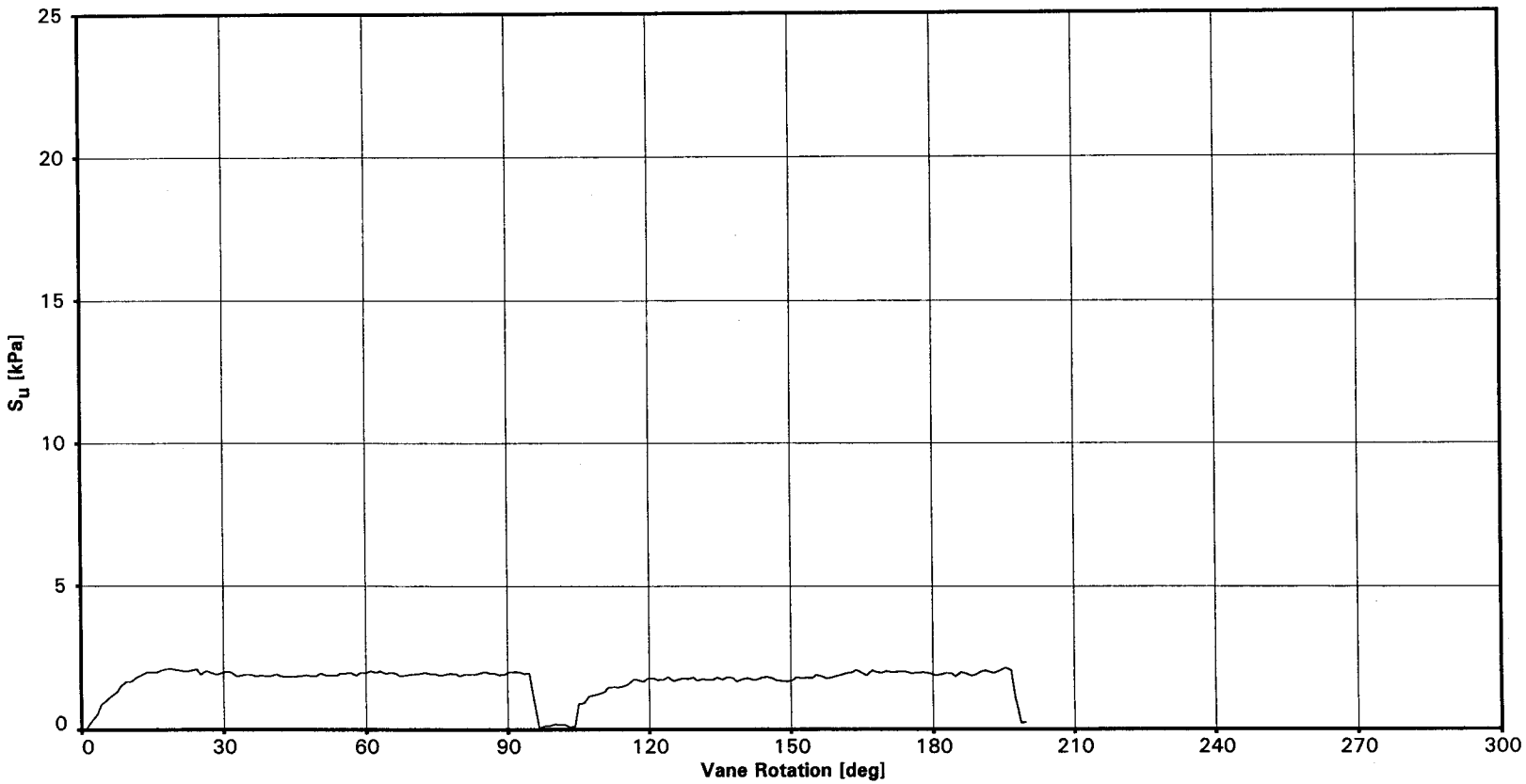
FUGRO

PLATE 98-34.8

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 0.6m
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

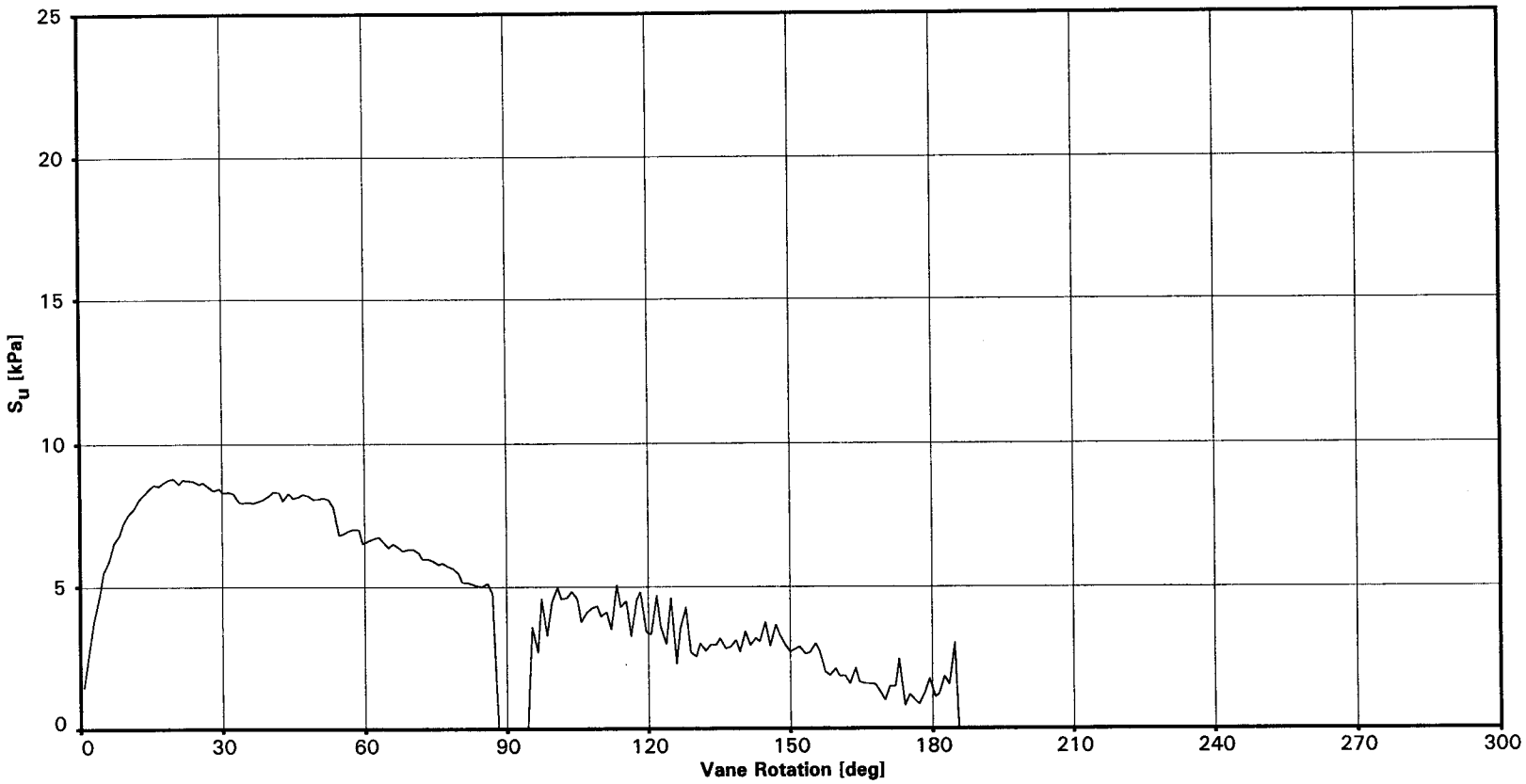
FUGRO

PLATE 98-34.9a

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.2m
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

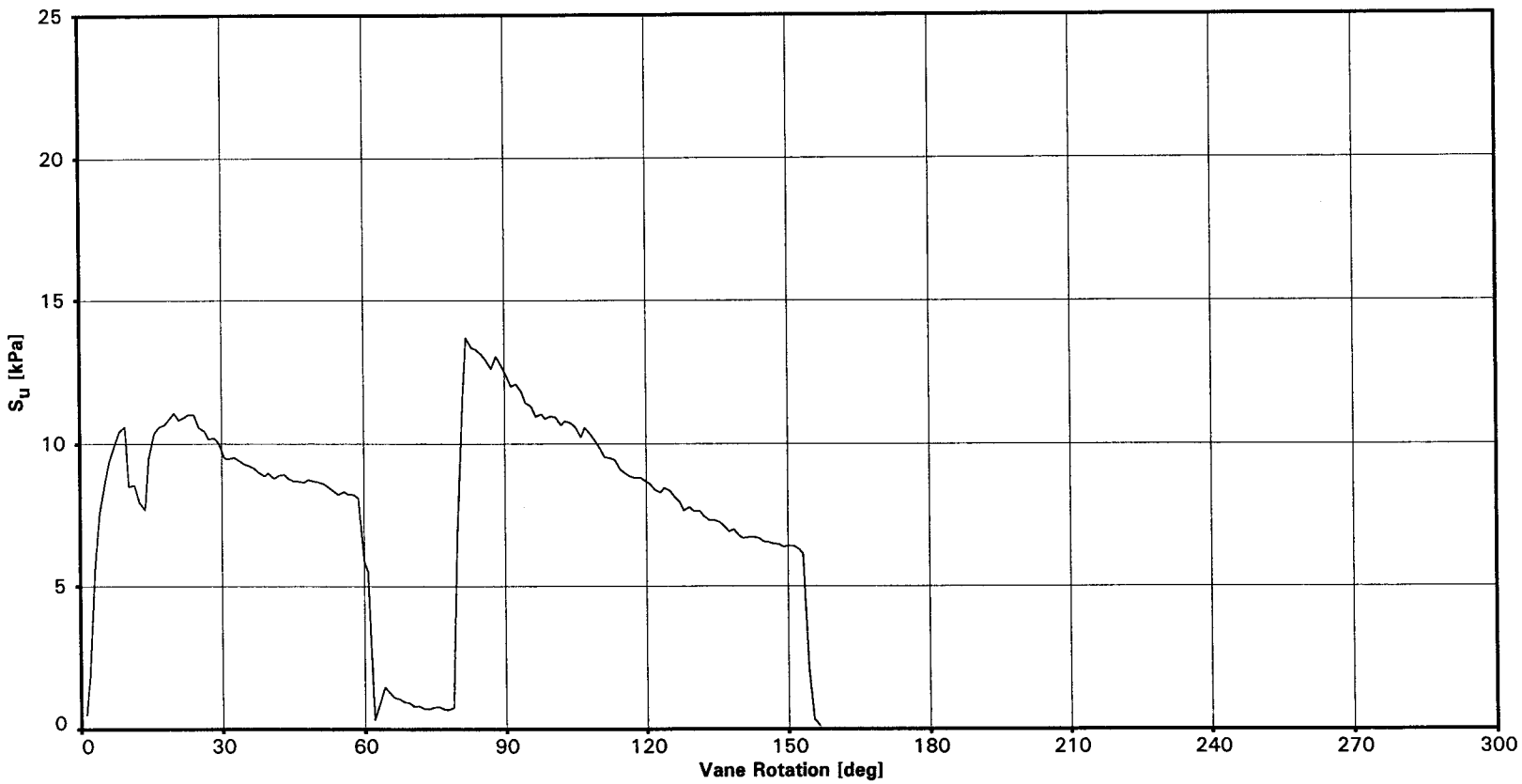
FUGRO

PLATE 98-34.9b

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.8m
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

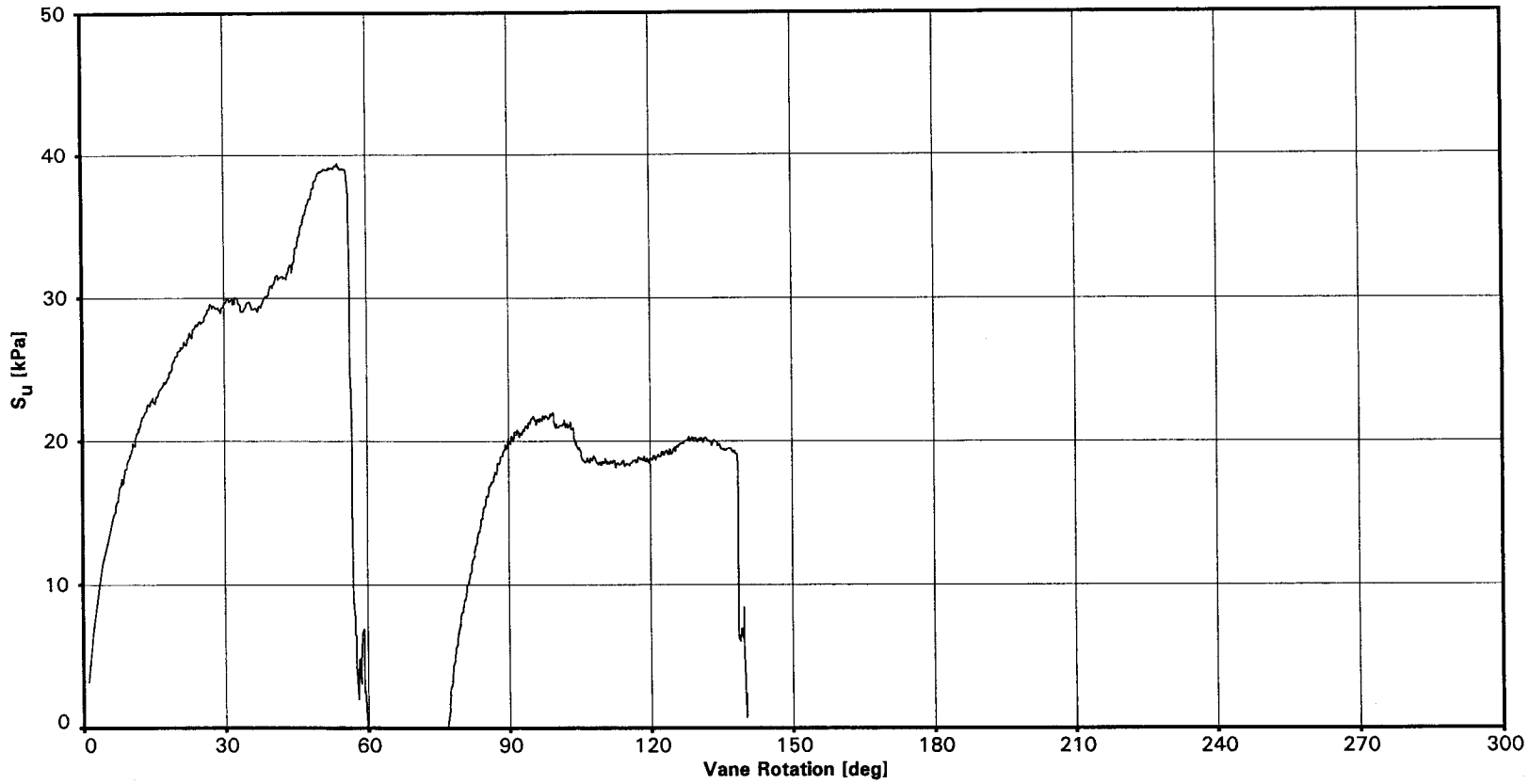
FUGRO

PLATE 98-34.9c

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 2.4m
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

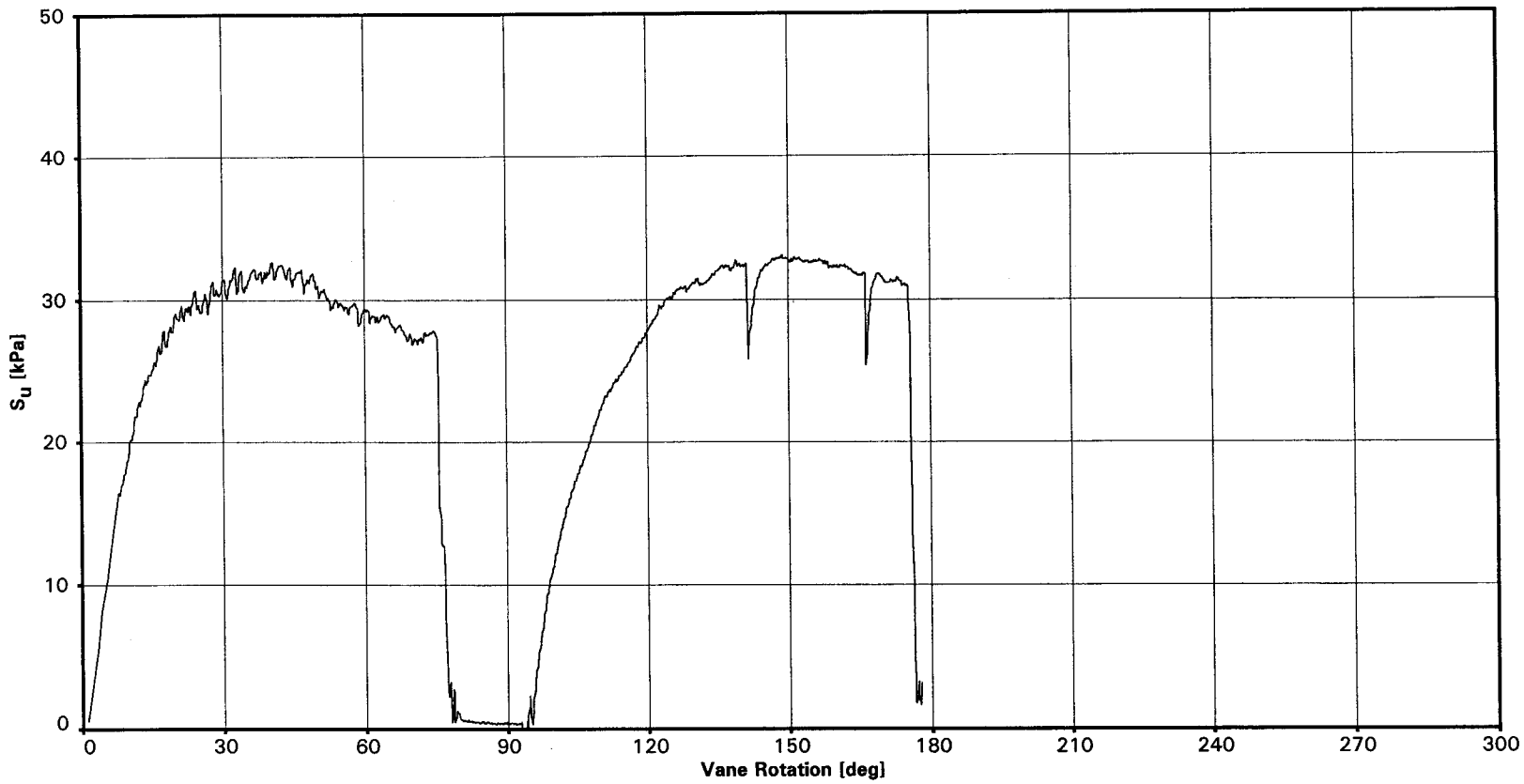
FUGRO

PLATE 98-34.9d

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.0m
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

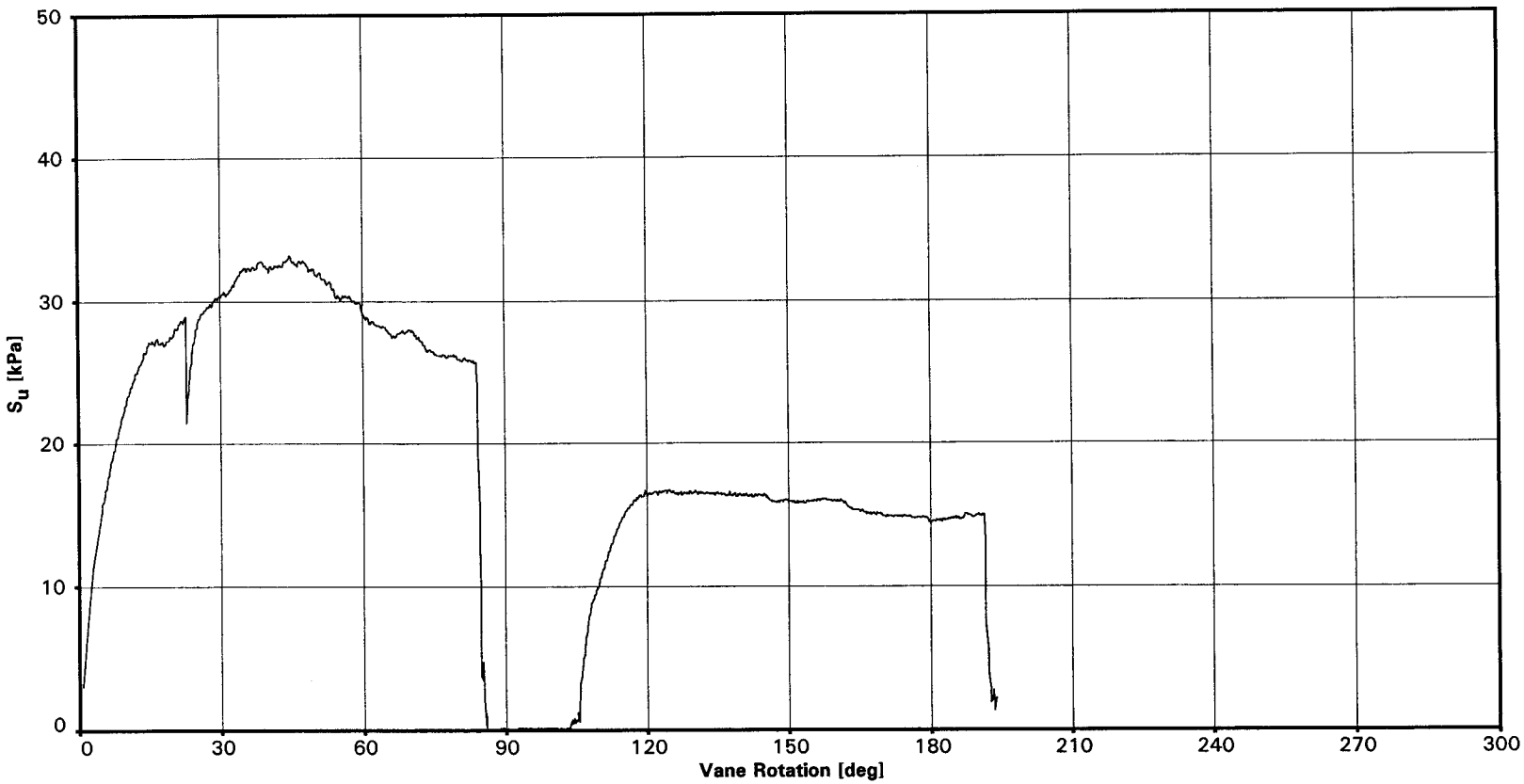
FUGRO

PLATE 98-34.9e

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.7m
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

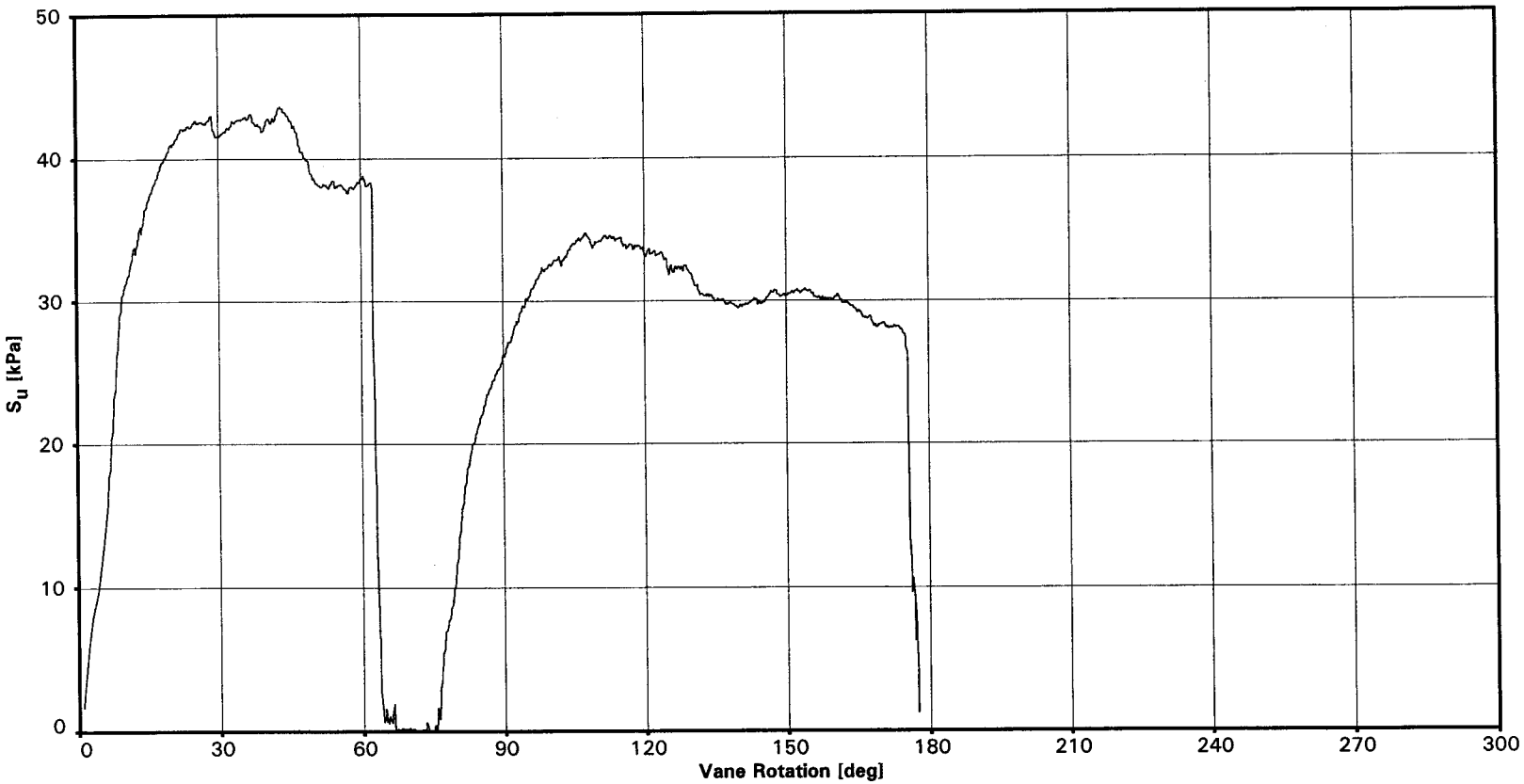
FUGRO

PLATE 98-34.9f

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 4.3m
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

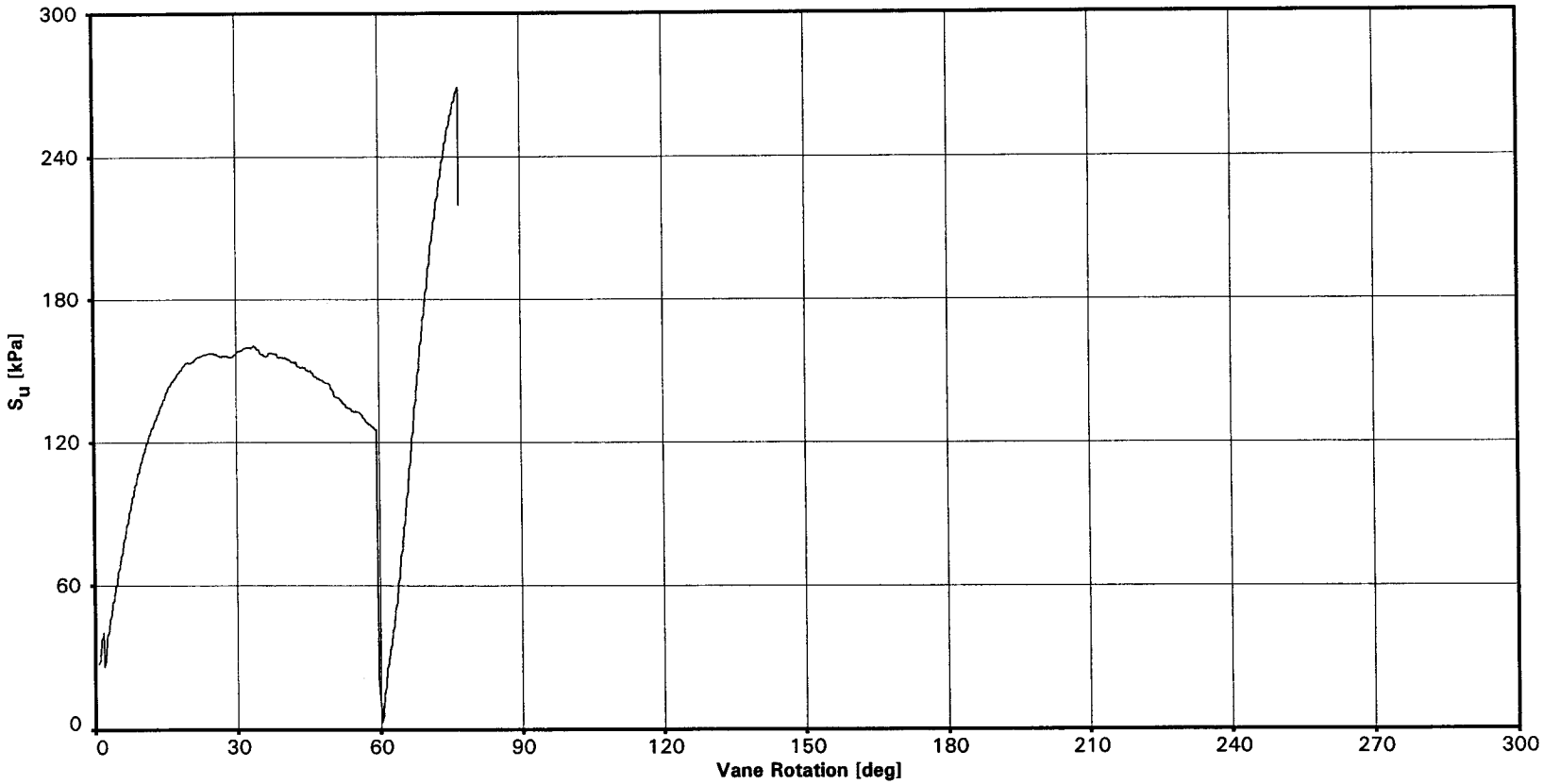
FUGRO

PLATE 98-34.9g

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 28.0m and 28.7m
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

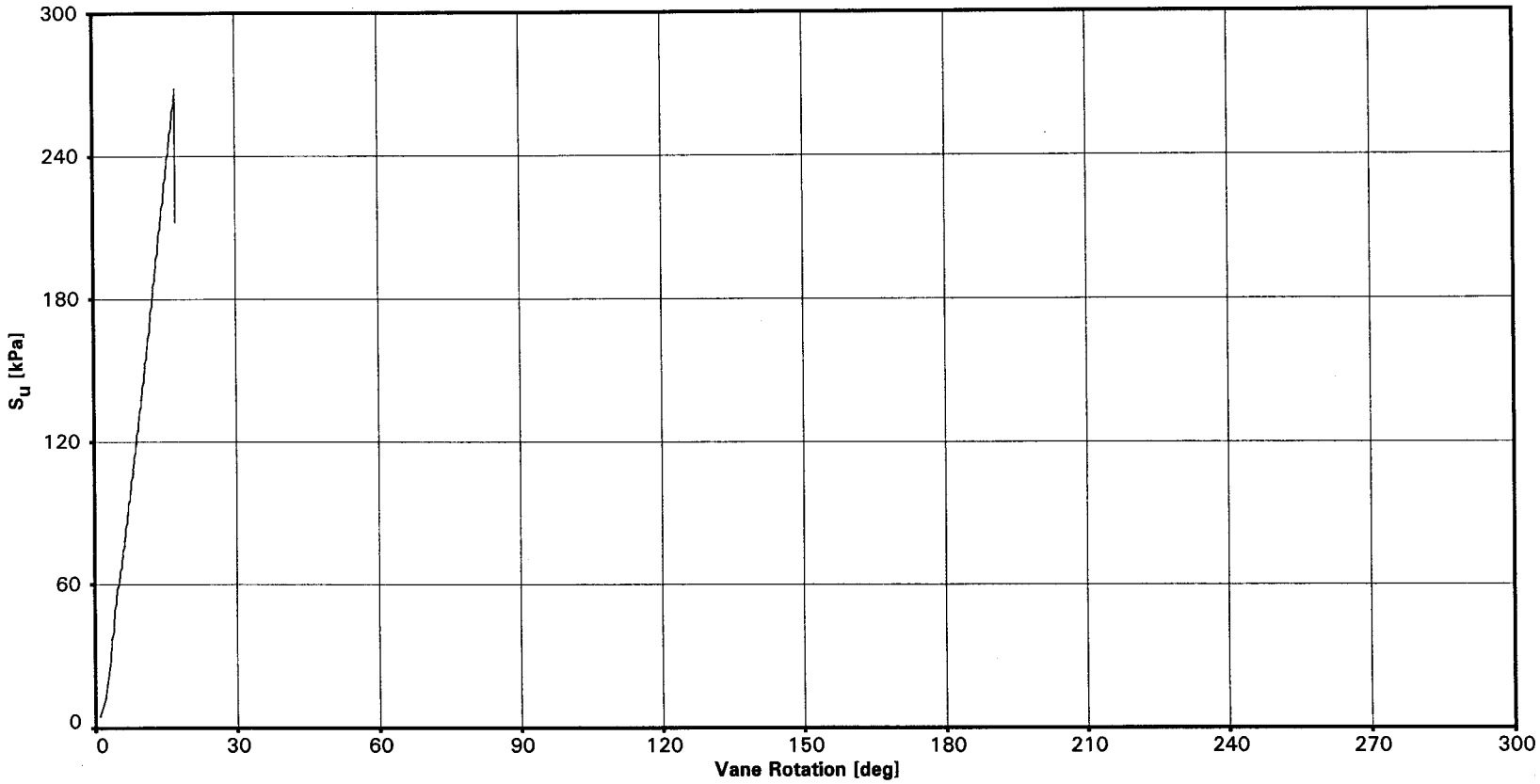
FUGRO

PLATE 98-34.9h

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 41.5m
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-34.9i

98-34		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
0.2	1	48				5.3					3.6		0.5													
0.2	1	73	65	22	1.18					7.1																
0.6	500													1.9												
0.6	501													1.9												
1.2	2										7.1															
1.2	402													4.8												
1.2	502													8.1												
1.4	3	59	42	24	1.95	6.0	85			2.8	7.9	2.3	4.5											H		
1.5	4					6.9																				
1.8	503													10.1												
1.8	504													13.4												
2.3	6	51	52	20	0.97	6.0																				
2.4	7					6.7																				
2.4	505													39.7												
2.4	506													22.0												

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-34		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
3.0	507													32.1												
3.0	508													32.6												
3.2	9					5.8					17.2															
3.4	10	56	50	20	1.21	6.2				21.1	23.5	3.6	6.2													
3.7	403													16.8												
3.7	509													33.0												
3.8	11	48	54	20	0.82	6.2						4.8	2.6													
4.3	13					6.5																				
4.3	404													34.5												
4.3	510													43.6												
4.3	511													34.5												
4.9	14					8.8																				
5.0	15					8.8																				
5.2	16	31	15	22						23.9	19.6															
6.6	17	32					26																			

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-34		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
7.8	19					6.1																				
7.9	20	66	60	22	1.17						19.3	6.8	4.1													
8.2	23	60	54	21	1.17			19.2																		
8.4	21	56	52	22	1.14	6.3						3.8			19.7		1.5									
8.4	24					6.1																				
8.5	22							19.2			37.6	7.2														
8.5	25									21.1	29.8															
9.4	26					9.7																				
9.6	27	20				9.9	8																			
11.6	28	56	51	23	1.21																			C		
11.7	29	55	60	23	0.87	6.1		38.3							26.8		1.0									
11.9	30									23.0	25.4	9.0														
15.1	31	21				10.5	7											9.6	42							
15.2	32						6																			
17.5	33	18	23	13	0.49		39				113.9															

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-34		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
17.7	35					11.1																				
21.5	37	50	103	34	0.24	5.7		83.8	81.4						91.7		0.7									9
21.6	38										204.2															
22.2	39	26	45	20	0.25																			C,K	2.74	
22.3	40	31	58	19	0.31						147.3															
26.7	44	30	37	19	0.59																					
27.0	42					8.7																				
27.1	43										173.3															
28.0	400													155.1												
28.7	405													269.6												
29.9	45	38	76	25	0.24	7.9										93.1										
30.2	47							143.6	177.2		206.7															
34.7	48	36	44	24	0.61	8.1																				
35.1	50								215.5		172.0															
39.8	52	35	79	31	0.08	7.3	100									117.0								H		

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-34		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
39.9	53										222.8															
40.4	54	46	87	30	0.28																			C	2.75	
40.5	55	48	79	31	0.35						222.8															
41.5	401													269.6												
45.4	57	17	40	15	0.11	10.7									154.3		0.9									
45.6	58										222.8															
47.7	59	18					32																		2.71	
47.8	60					11.4																				
50.4	61								215.5																	
50.6	62	23	40	17	0.27	9.8										96.7										
50.9	63	24	31	16	0.53		48																			
55.5	64								257.0																	
55.6	65	44	87	29	0.26	7.5									157.7		0.3									
56.3	67	46	75	24	0.43																			C	2.76	
56.4	68	45	81	24	0.37				167.6																	

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-34		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
61.1	70	44	80	31	0.28	7.4			172.4						213.3	59.7	0.9									
61.3	71								201.1																	
65.6	72		50	34																						
65.7	73					6.6																				
65.7	74		74	28					201.1																	
70.9	76	40	65	24	0.39	8.2	96	167.6							218.3		1.8							H		
71.0	77							167.6	191.5		222.8															
71.6	78	41	46	20	0.79																			C	2.76	
71.6	79	39	57	17	0.54																					
76.2	80							158.0	177.2																	
76.4	81	27	35	18	0.53	9.8									213.3	64.0	0.9									
80.5	83	23	46	16	0.23																			C		
80.6	84	23	42	18	0.23	9.9		215.5							222.8		0.8									
80.8	85								210.7																	
84.3	87	20	33	15	0.27	10.5		170.0	172.4						202.2	83.5	0.8									

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-34		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
84.4	88								167.6																	
87.6	89					10.8																				
87.7	90	20					59																			
89.7	91						4																			
91.0	92						4																			
92.6	94	24	57	21	0.07	10.4																				
94.3	95	23				10.7	48																			
95.8	96	12					6																			
97.3	97	15					17																			
99.2	98	14				14.1	9																			

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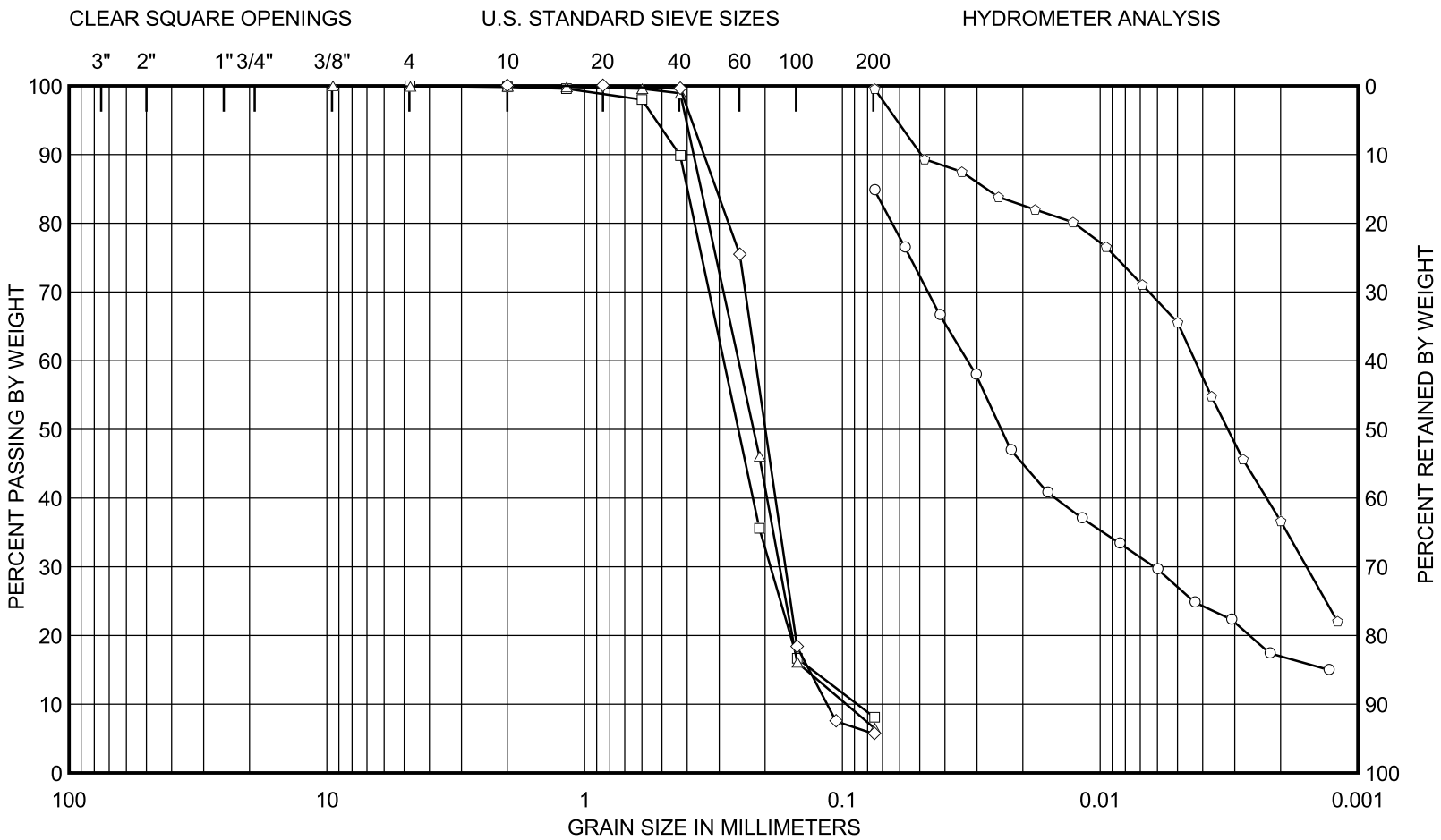
SUMMARY OF LABORATORY TEST RESULTS
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO



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

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
3	1.4	○——○	FAT CLAY (CH) with shell fragments and many sand pockets			0.024
27	9.6	□——□	FINE SAND (SP-SM) with silt and a trace of medium sand	1.4	3.3	0.25
31	15.1	△——△	FINE SAND (SP-SM) with silt	1.3	2.6	0.22
32	15.2	◇——◇	FINE SAND (SP-SM) with silt and a few clay pockets	1.1	1.9	0.20
52	39.8	⬠——⬠	FAT CLAY (CH)			0.0032

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-34

SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-34.11a

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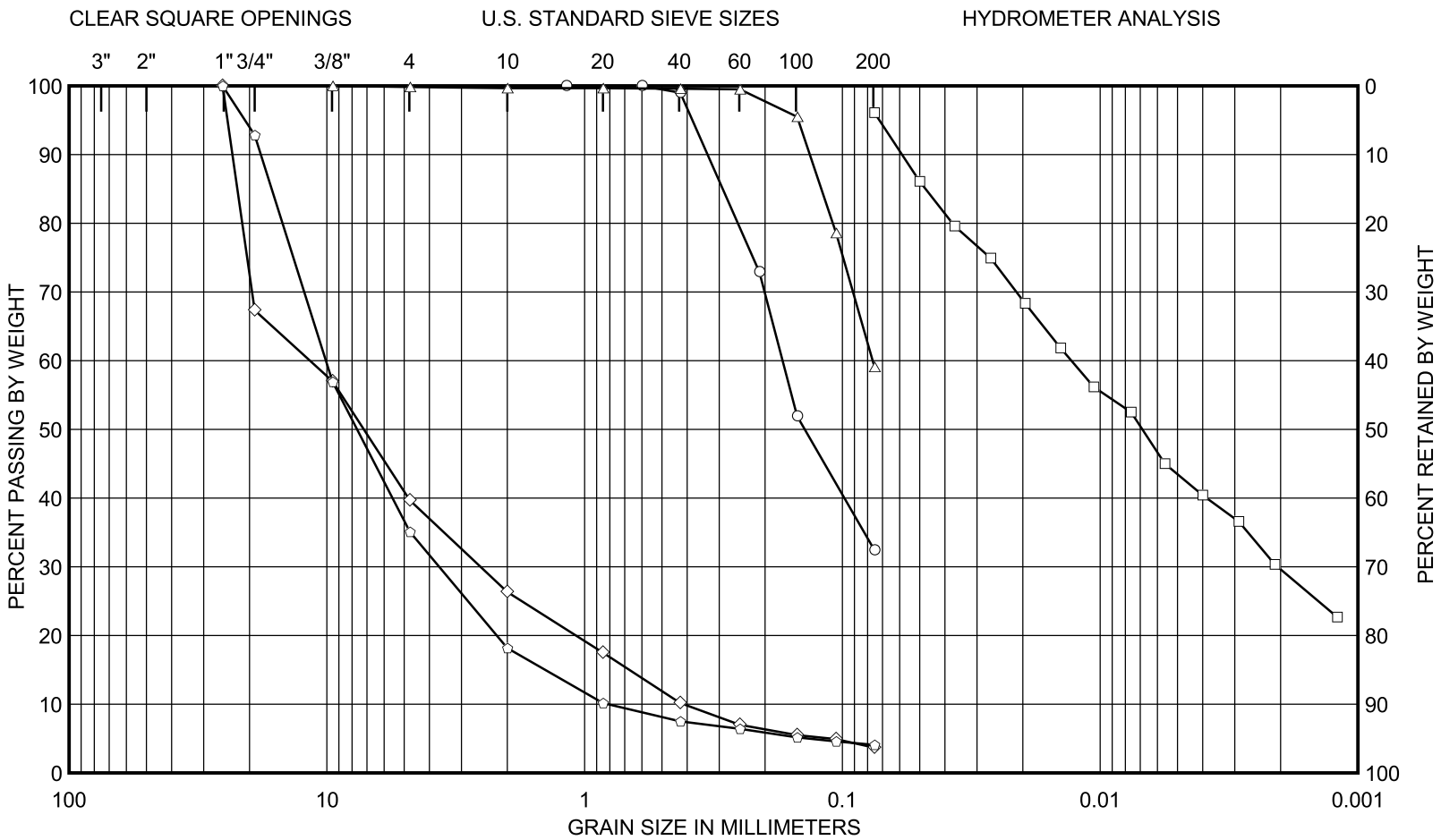

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
59	47.7	○——○	SILTY FINE SAND (SM)			0.14
76	70.9	□——□	FAT CLAY (CH)			0.0069
90	87.7	△——△	SANDY SILT (ML)			
91	89.7	◇——◇	FINE TO COARSE GRAVEL (GW) with medium to coarse sand	1.3	28.4	7.2
92	91.0	⬠——⬠	FINE GRAVEL (GW) with medium to coarse sand	1.6	12.5	7.6

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-34

SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-34.11b

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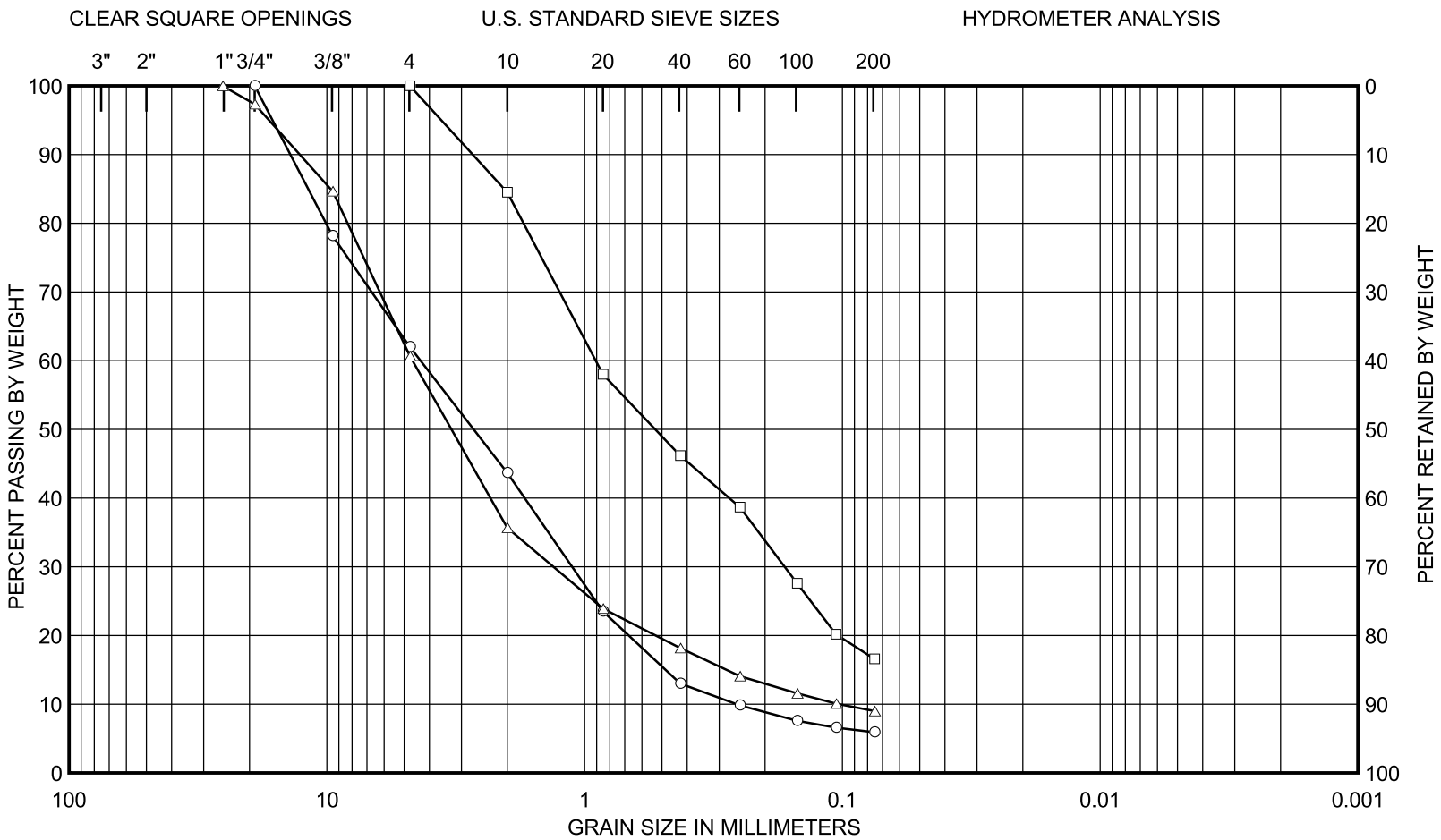

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
96	95.8	○——○	MEDIUM SAND (SW-SM) with silt, coarse sand, fine gravel and a trace of fine sand	1.1	16.7	2.7
97	97.3	□——□	SILTY FINE TO MEDIUM SAND (SM) with coarse sand			0.53
98	99.2	△——△	COARSE SAND (SW-SM) with silt, medium sand, fine gravel and a trace of fine sand	3.7	45.1	3.3

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-34
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-34.11c

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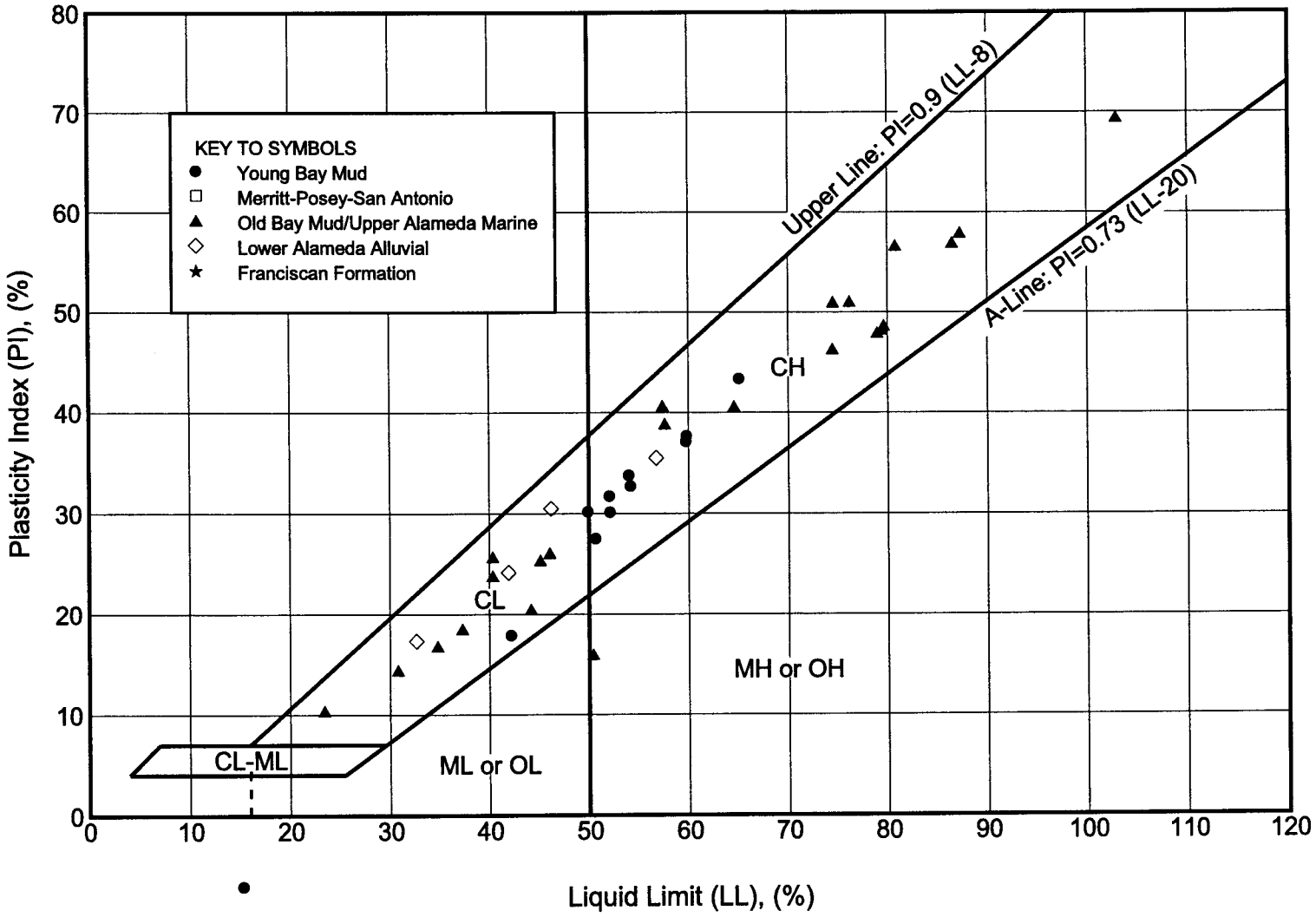
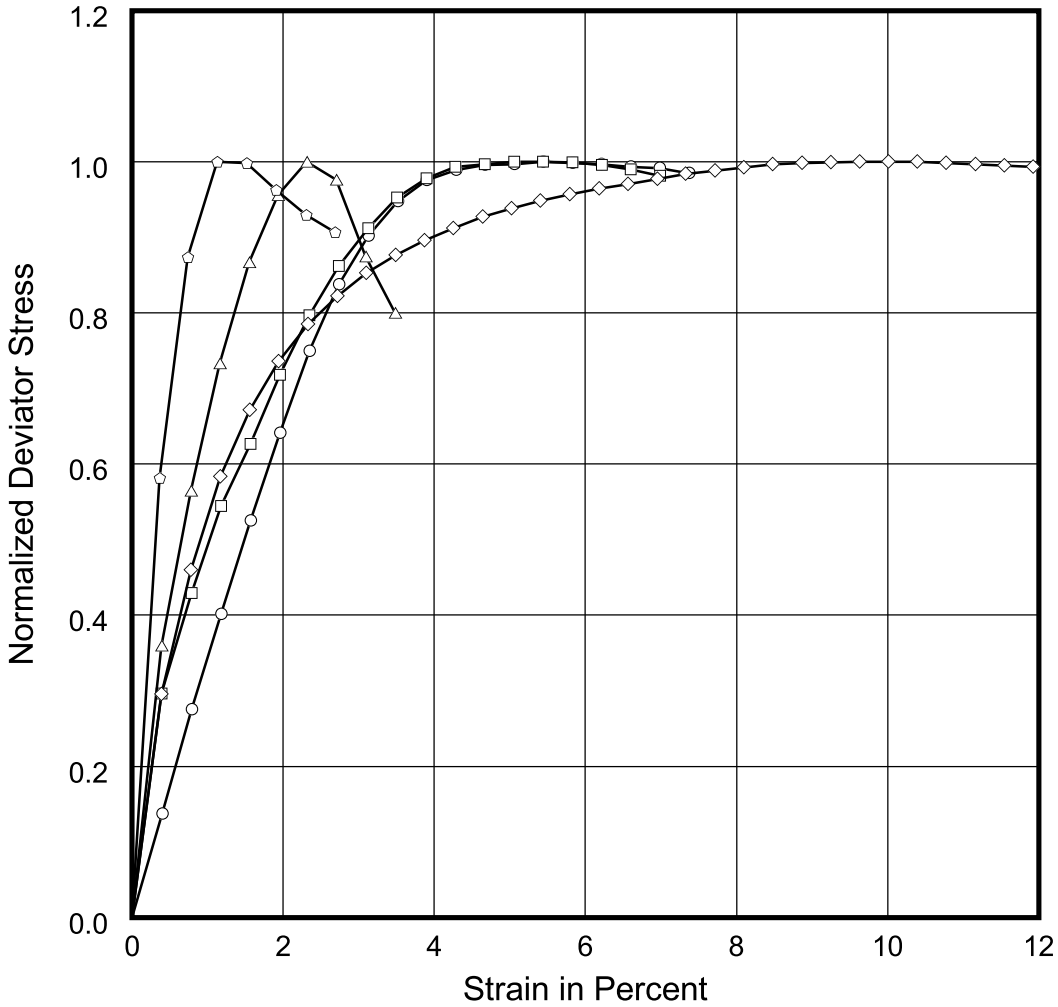


PLASTICITY CHART
Boring 98-34
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

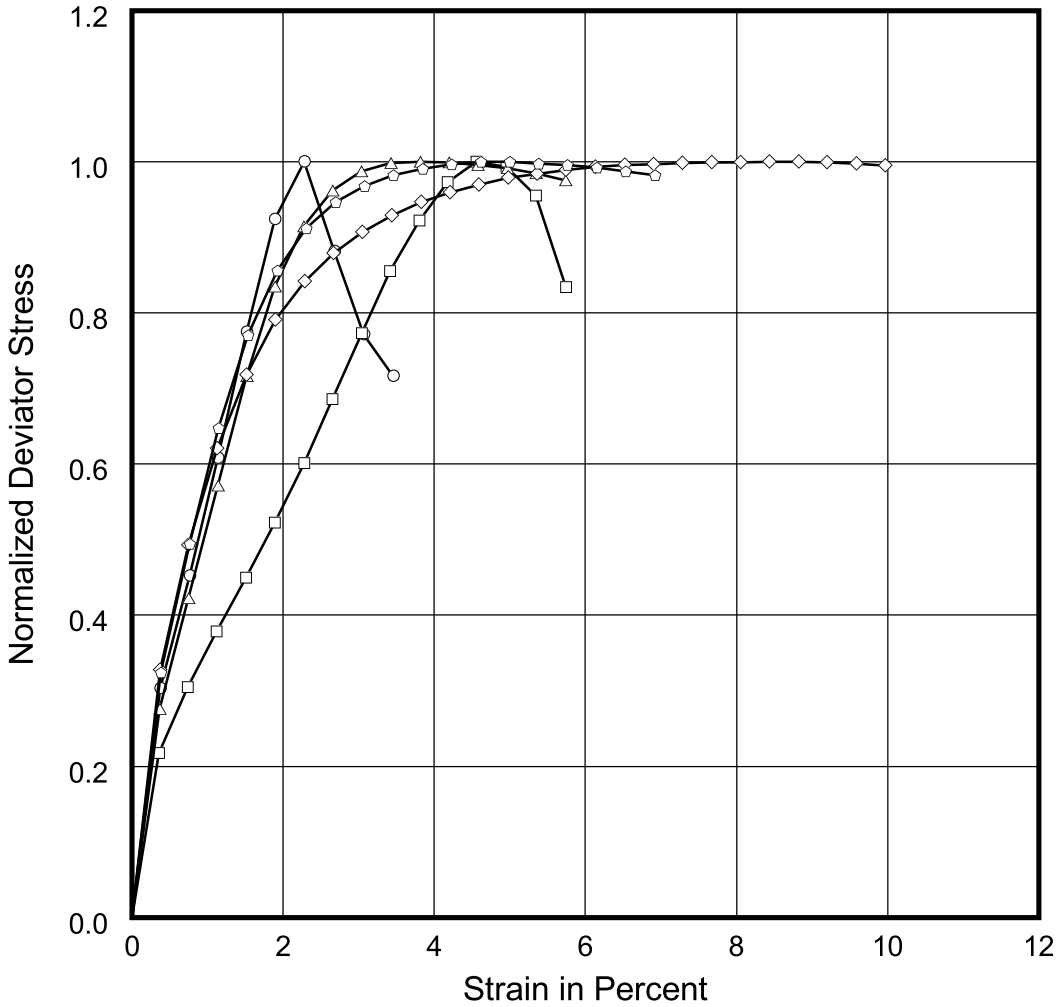


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	21	8.4	UU	207	39	1.5
	29	11.7	UU	276	54	1.0
	37	21.5	UU	827	183	0.7
	57	45.4	UU	1034	309	0.9
	65	55.6	UU	1241	315	0.3

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-34
SFOBB East Span Seismic Safety Project

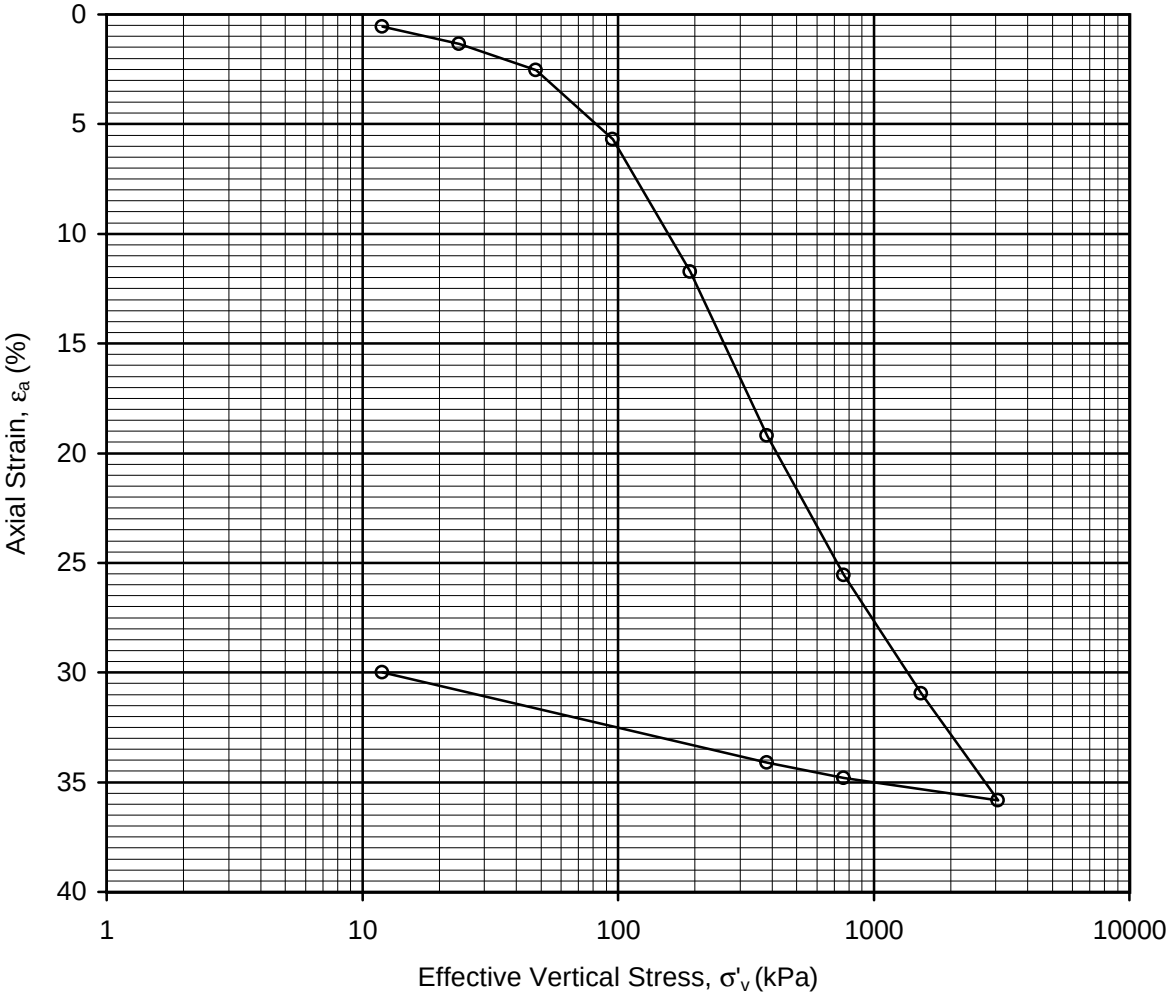


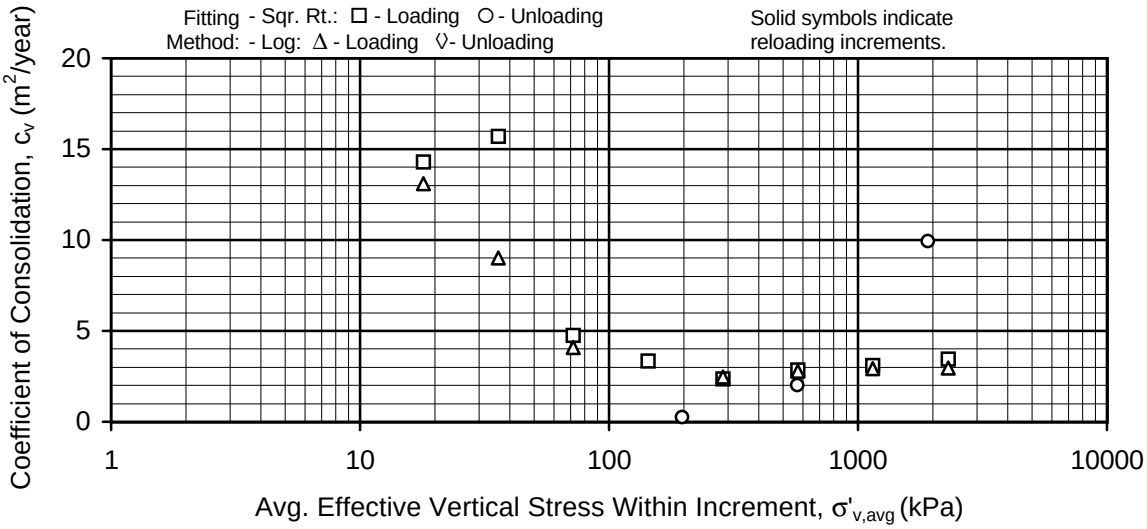
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○	70	61.1	UU	1379	426	0.9
□	76	70.9	UU	1586	437	1.8
△	81	76.4	UU	1724	427	0.9
◇	84	80.6	UU	1827	446	0.8
⬠	87	84.3	UU	1896	405	0.8

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

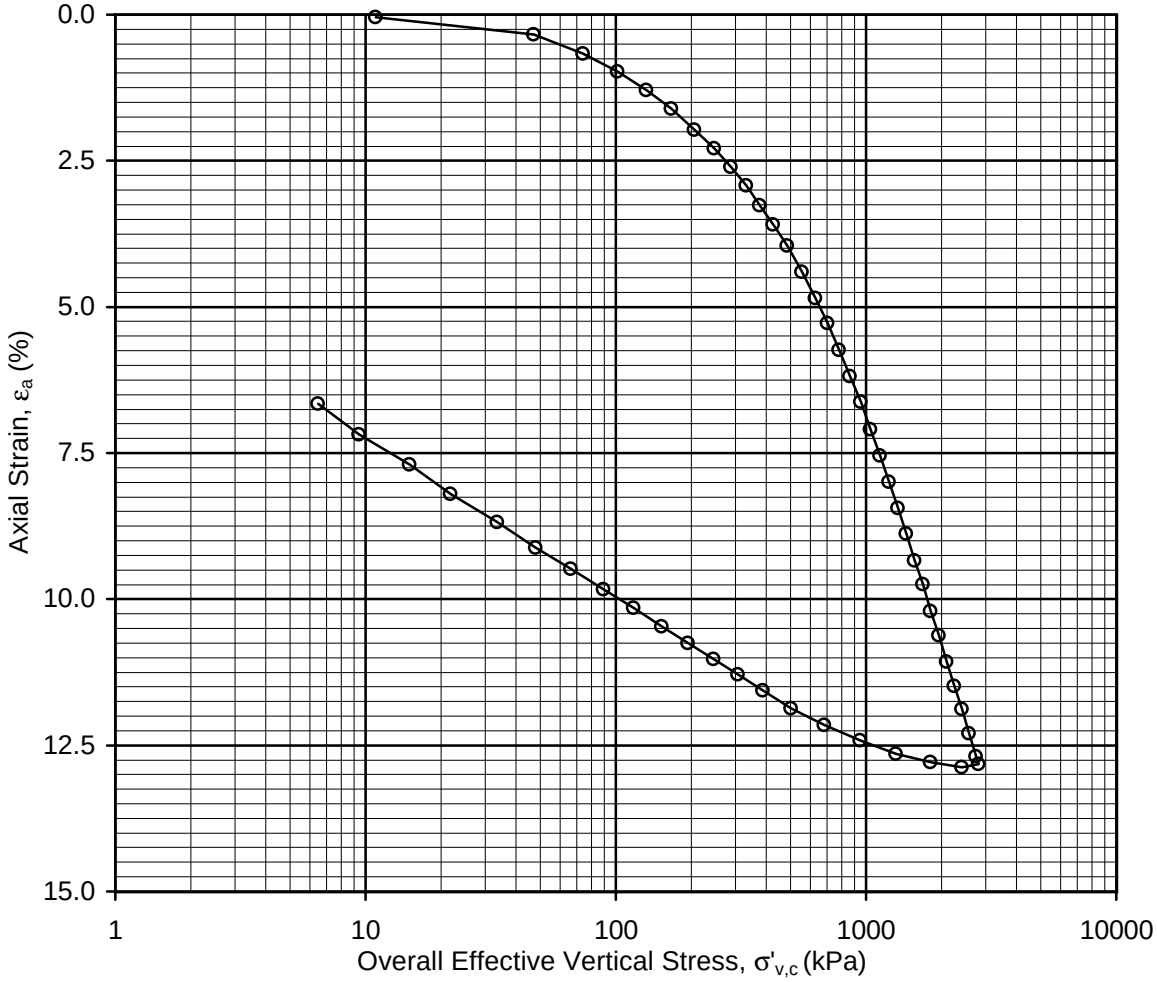
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-34
SFOBB East Span Seismic Safety Project

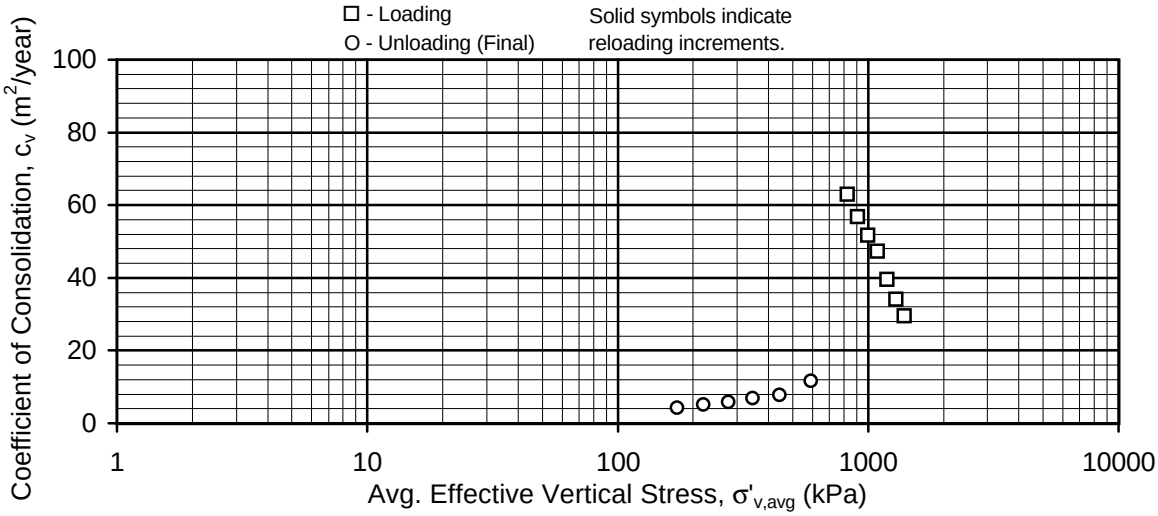




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 28 - Depth: 11.6m
Boring 98-34
SFOBB East Span Seismic Safety Project

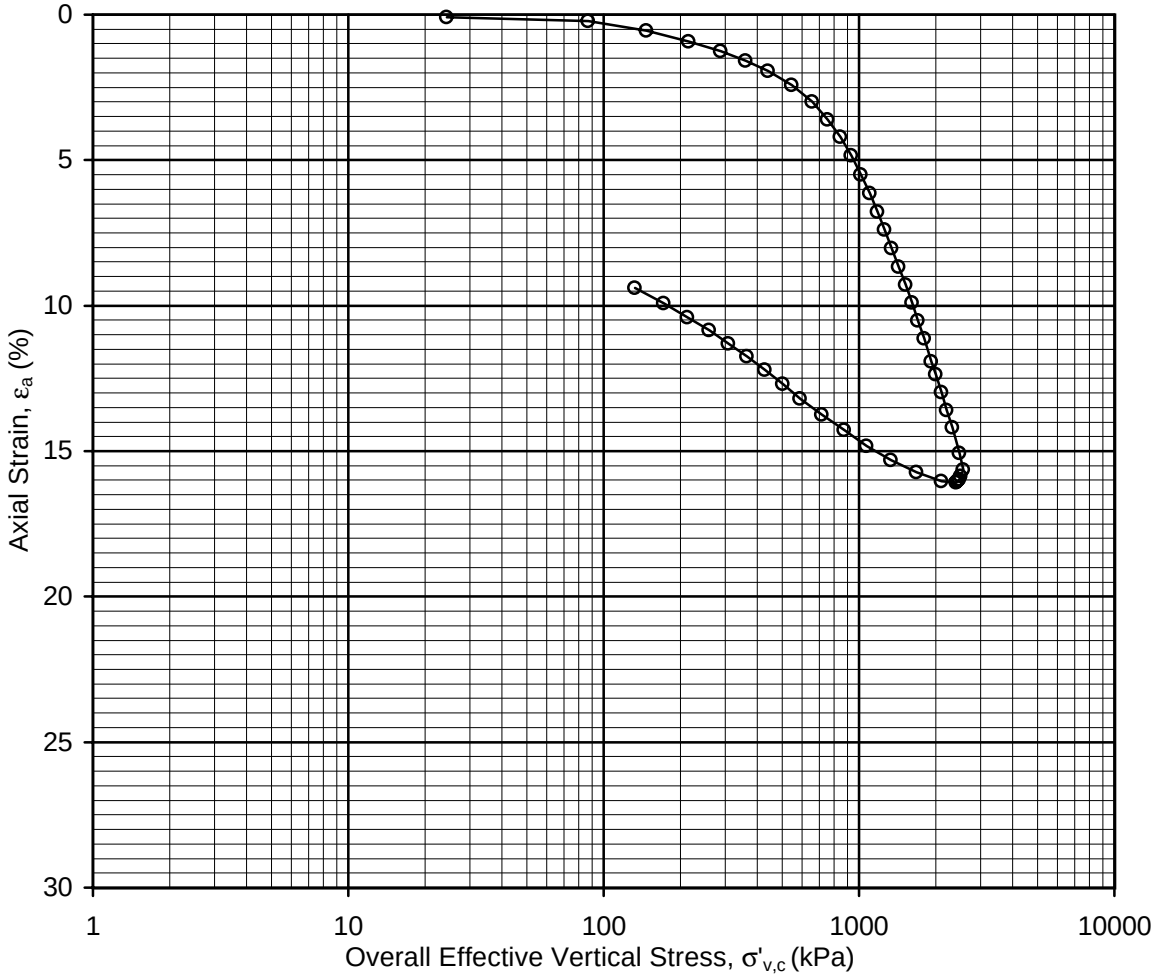


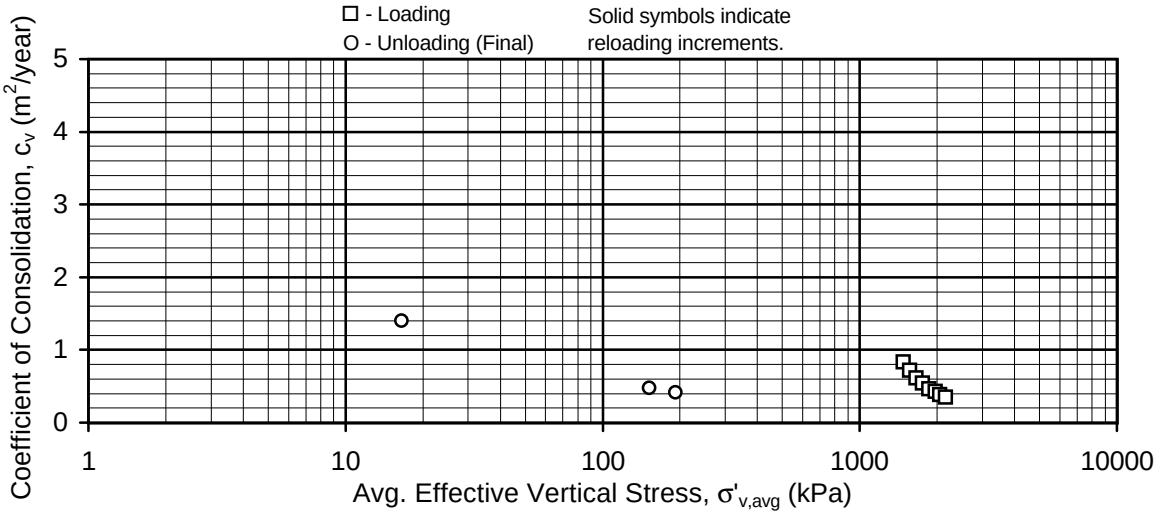


CRS CONSOLIDATION TEST RESULTS

Sample No. 39 - Depth: 22.2m
Boring 98-34
SFOBB East Span Seismic Safety Project

PLATE 98-34.14b

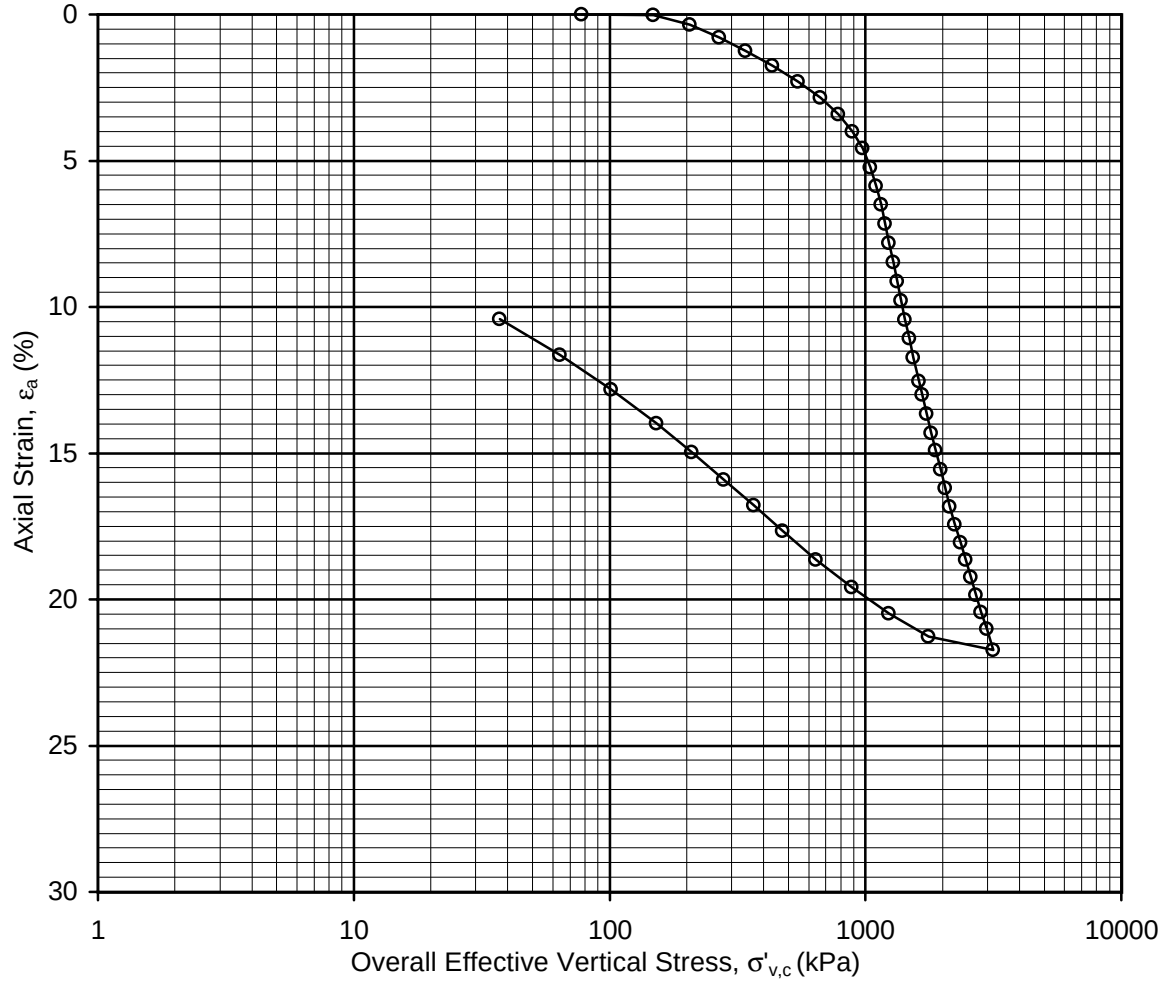


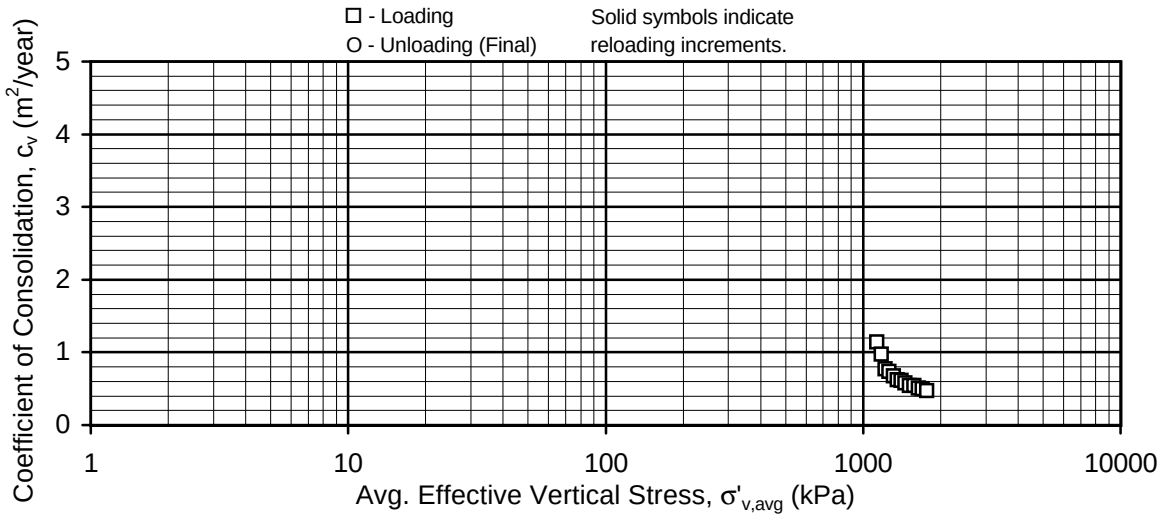


CRS CONSOLIDATION TEST RESULTS

Sample No. 54 - Depth: 40.5m
Boring 98-34
SFOBB East Span Seismic Safety Project

PLATE 98-34.14c

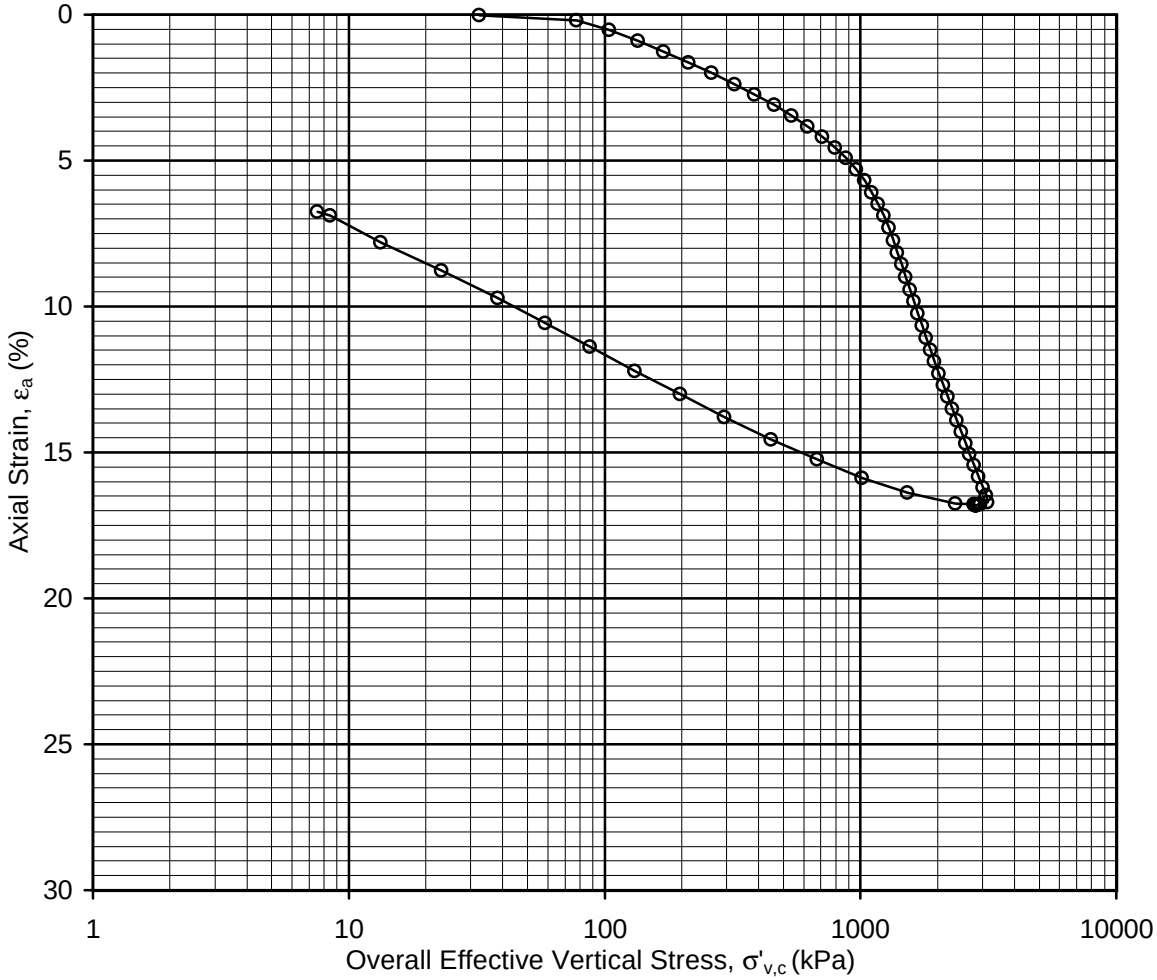


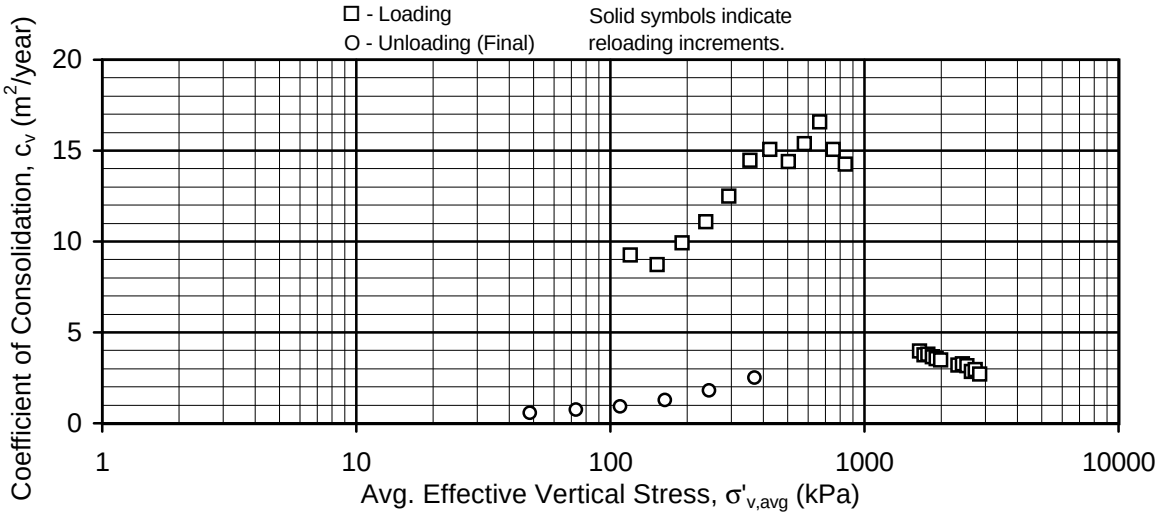


CRS CONSOLIDATION TEST RESULTS

Sample No. 67 - Depth: 56.3m
Boring 98-34
SFOBB East Span Seismic Safety Project

PLATE 98-34.14d

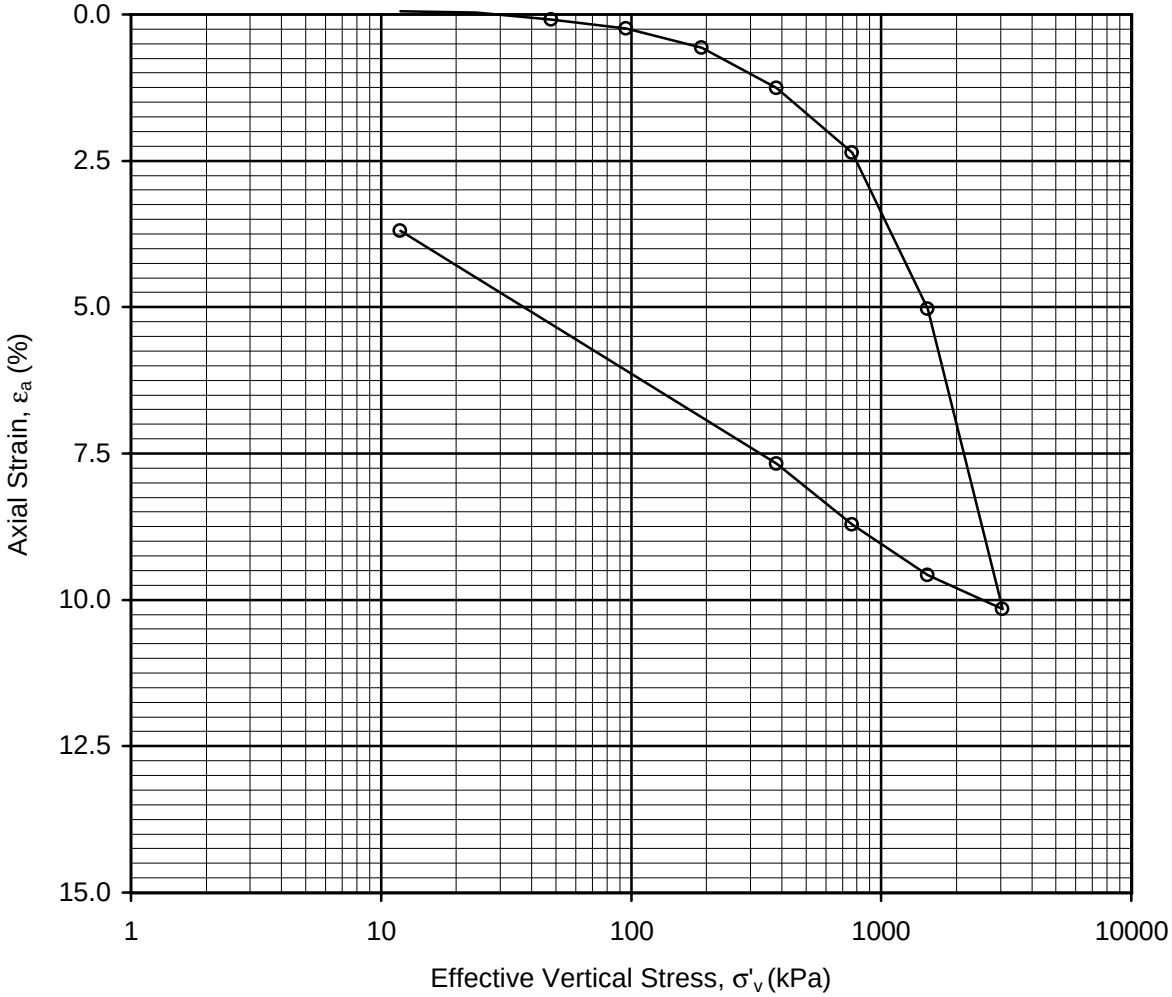


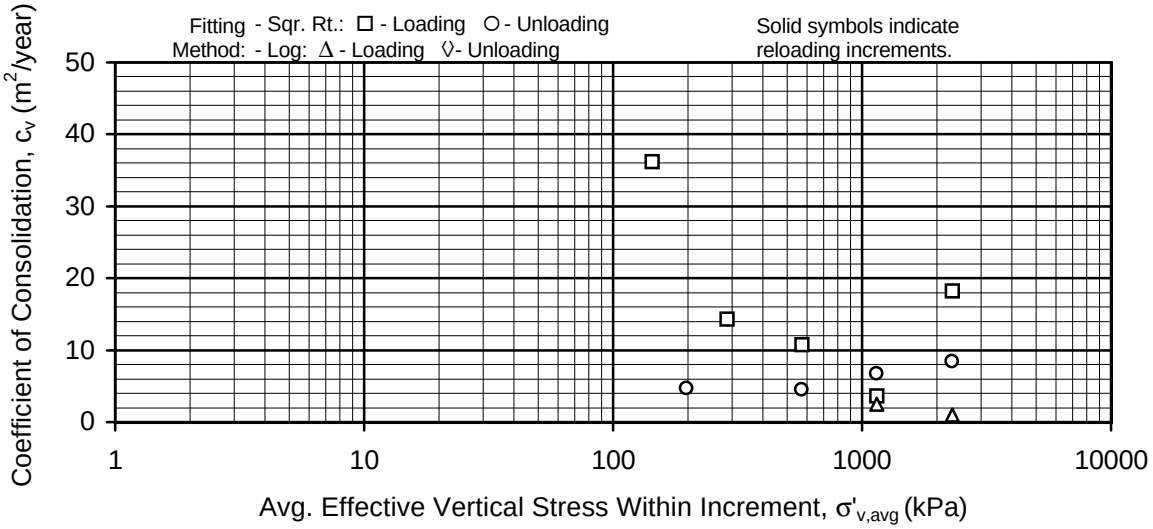


CRS CONSOLIDATION TEST RESULTS

Sample No. 78 - Depth: 71.6m
Boring 98-34
SFOBB East Span Seismic Safety Project

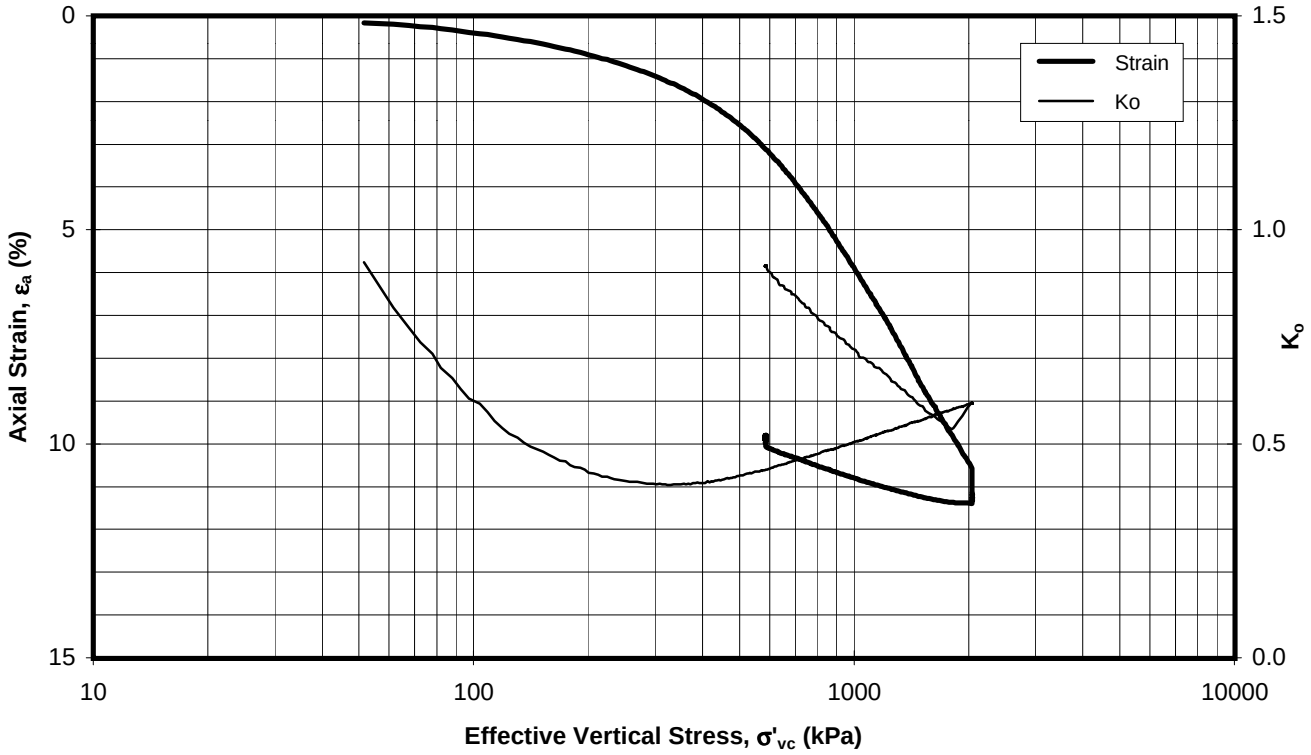
PLATE 98-34.14e

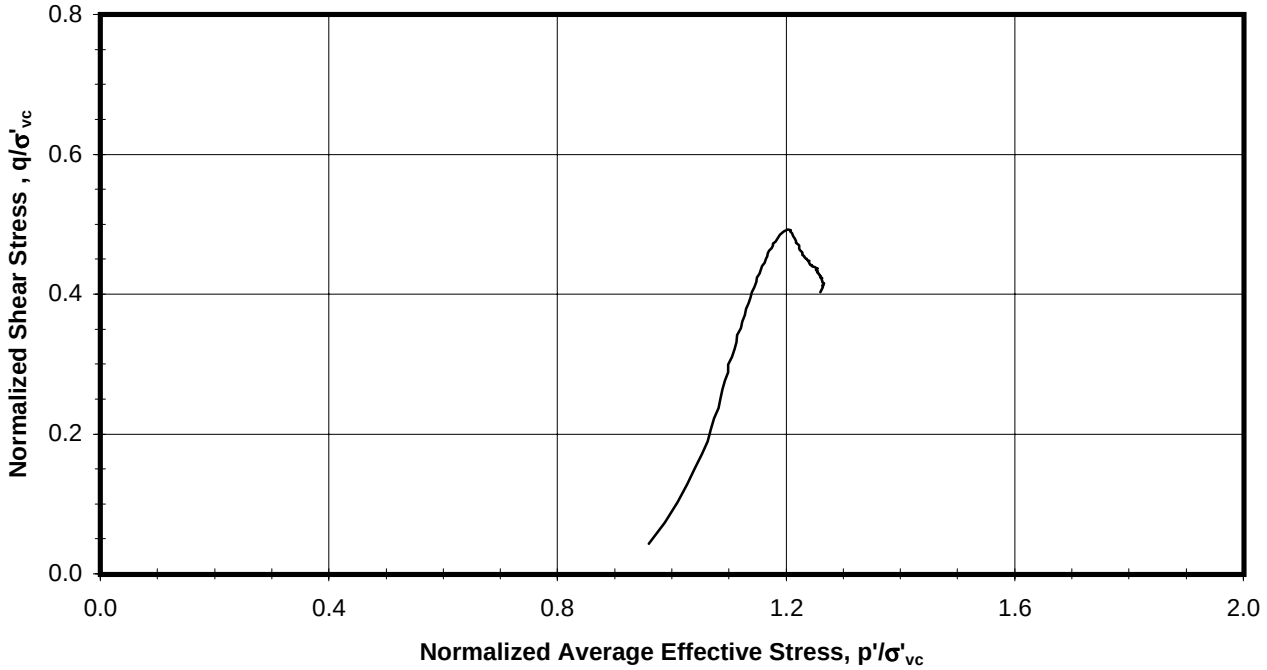




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No.83 - Depth: 80.5m
Boring 98-34
SFOBB East Span Seismic Safety Project





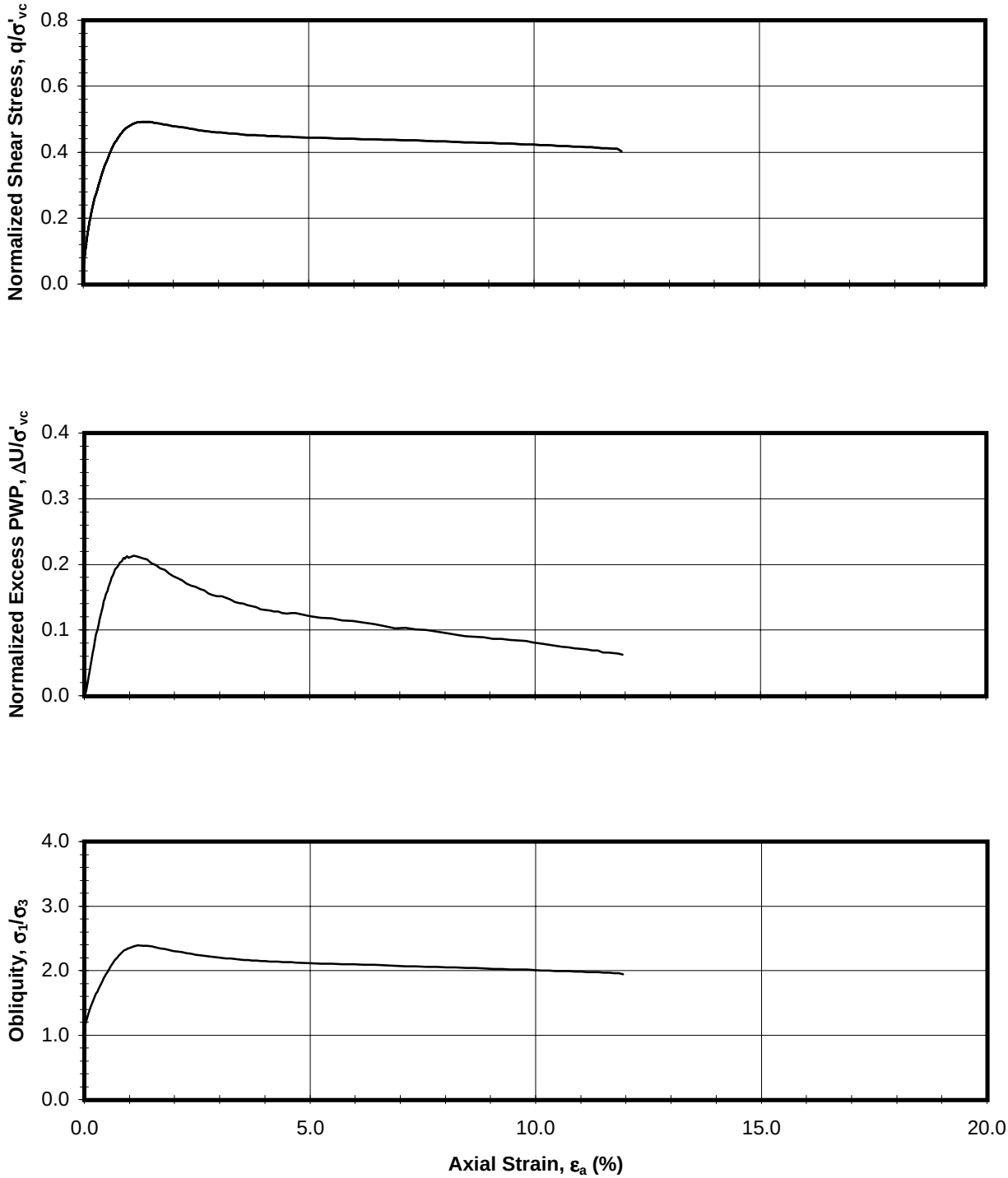
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 39 - Depth: 22.1m

Boring 98-34

SFOBB East Span Seismic Safety Project

PLATE 98-34.15.1

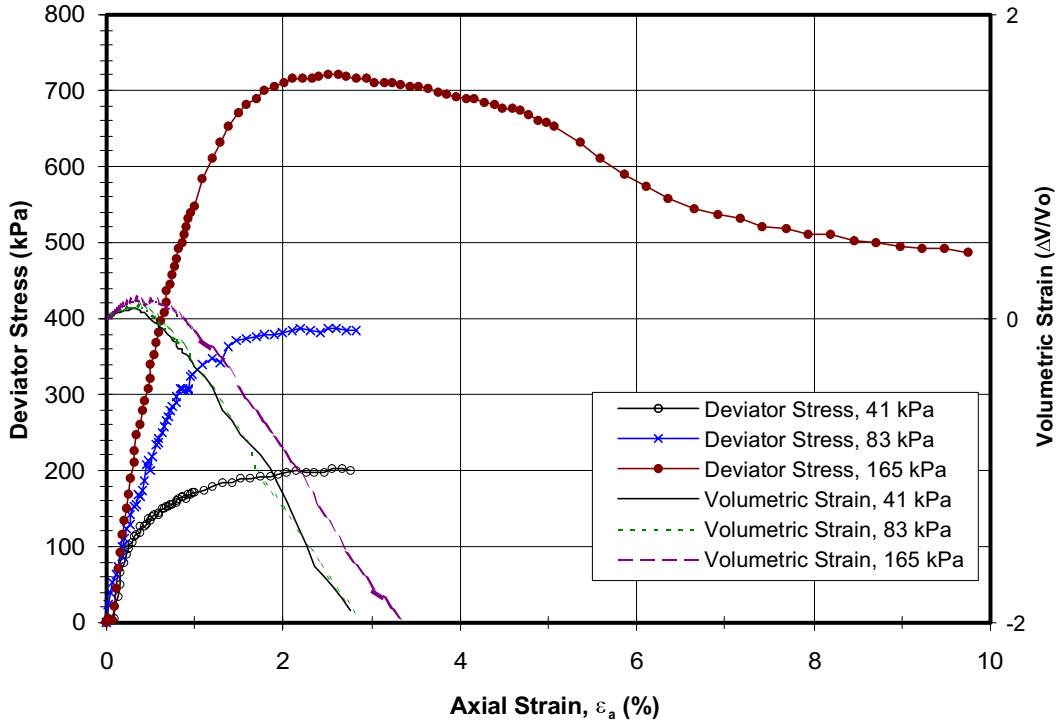


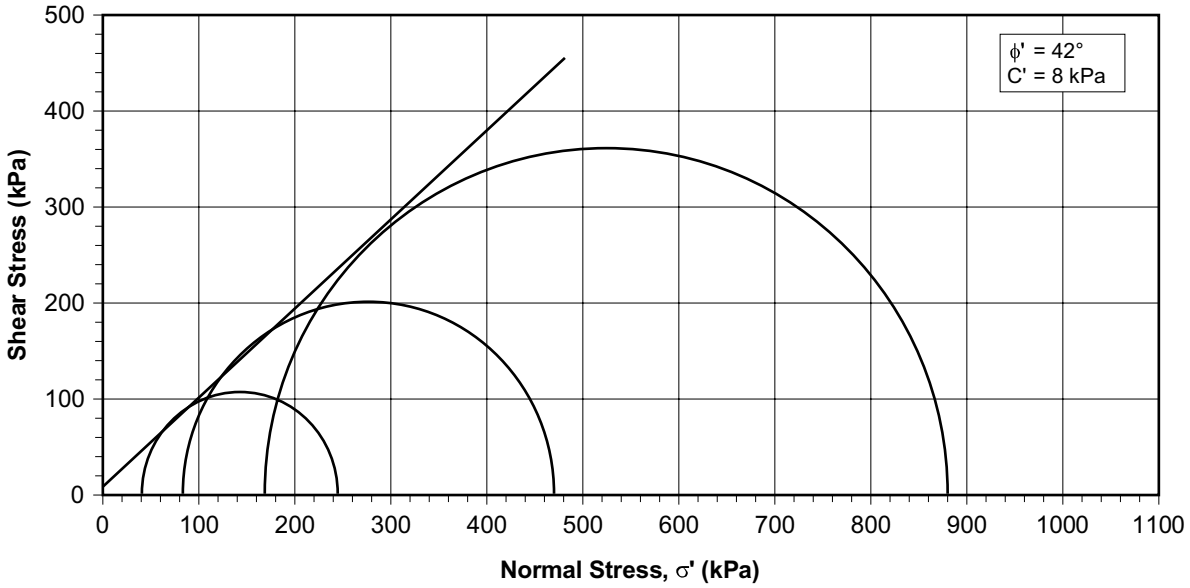
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 39 - Depth: 22.1m

Boring 98-34

SFOBB East Span Seismic Safety Project





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 31 - Depth: 15.1m

Boring 98-34

SFOBB East Span Seismic Safety Project

PLATE 98-34.16

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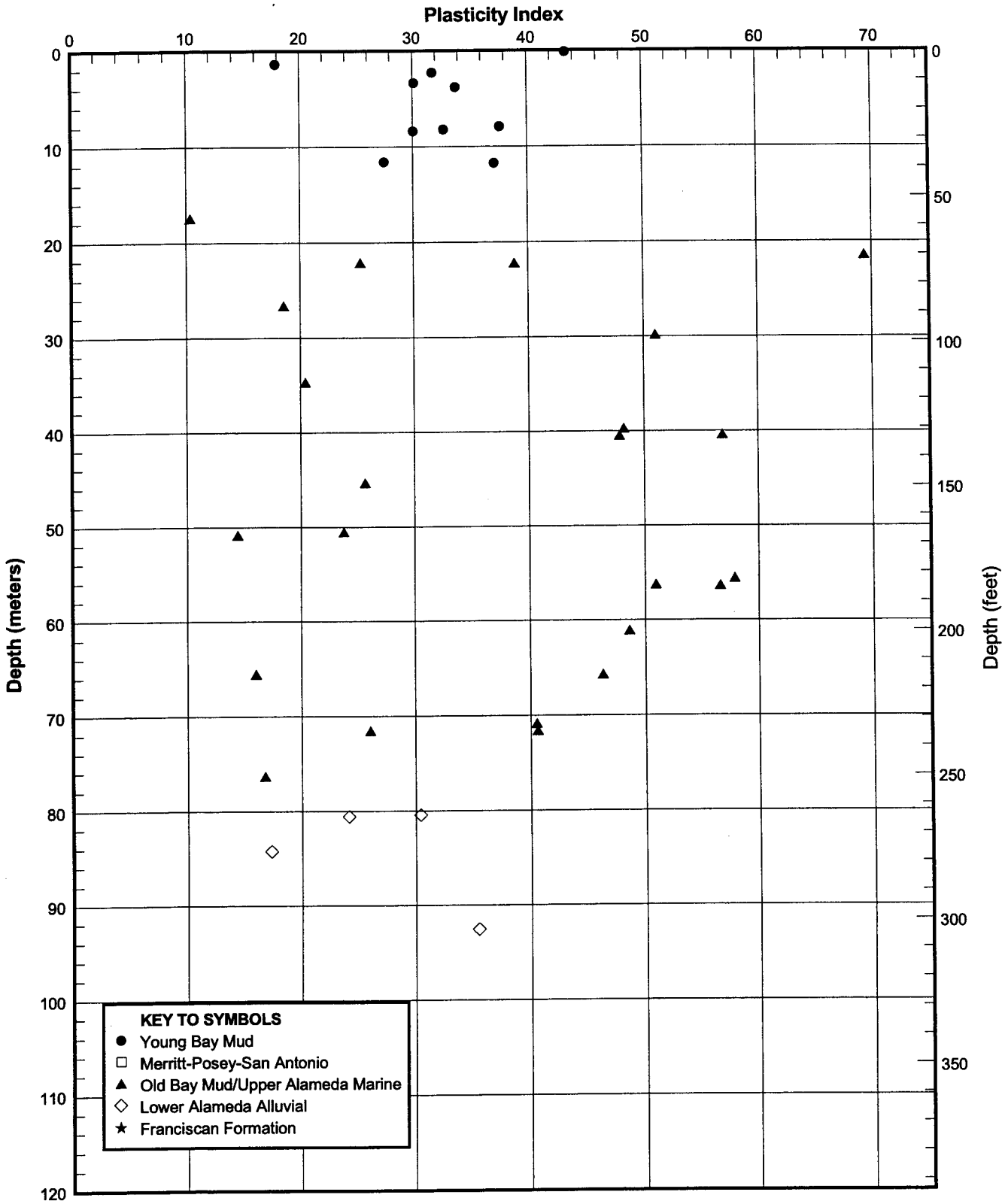
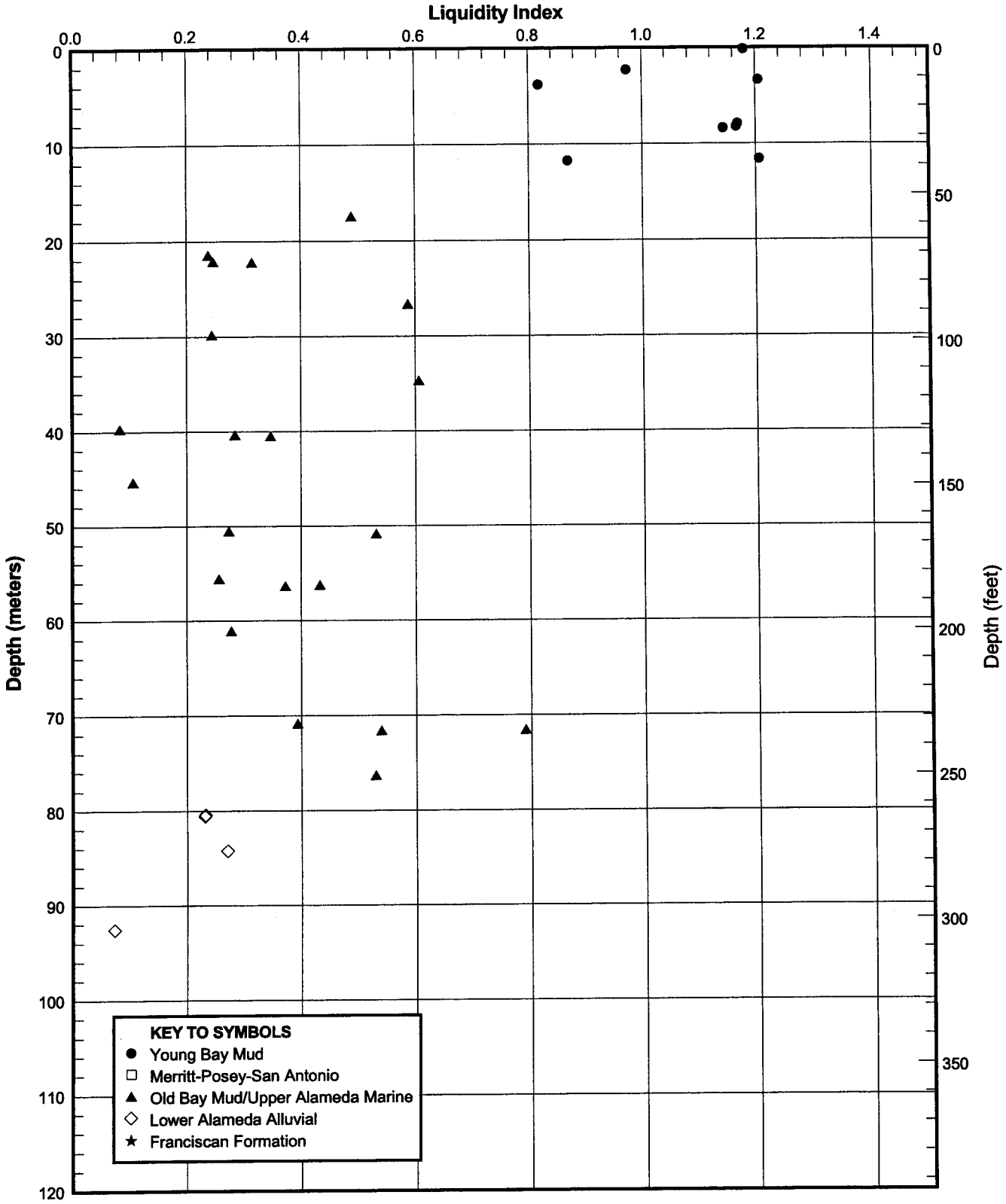
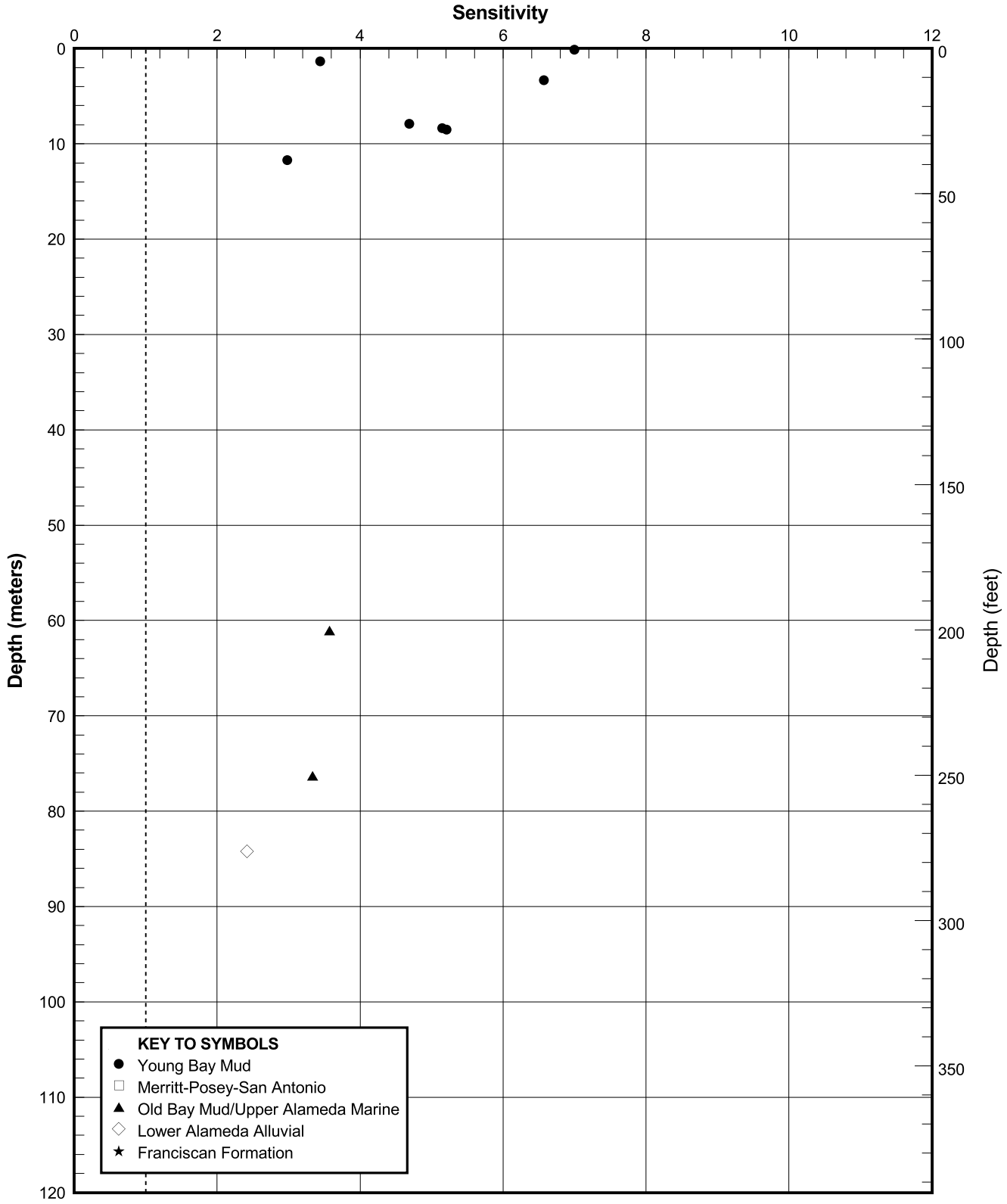


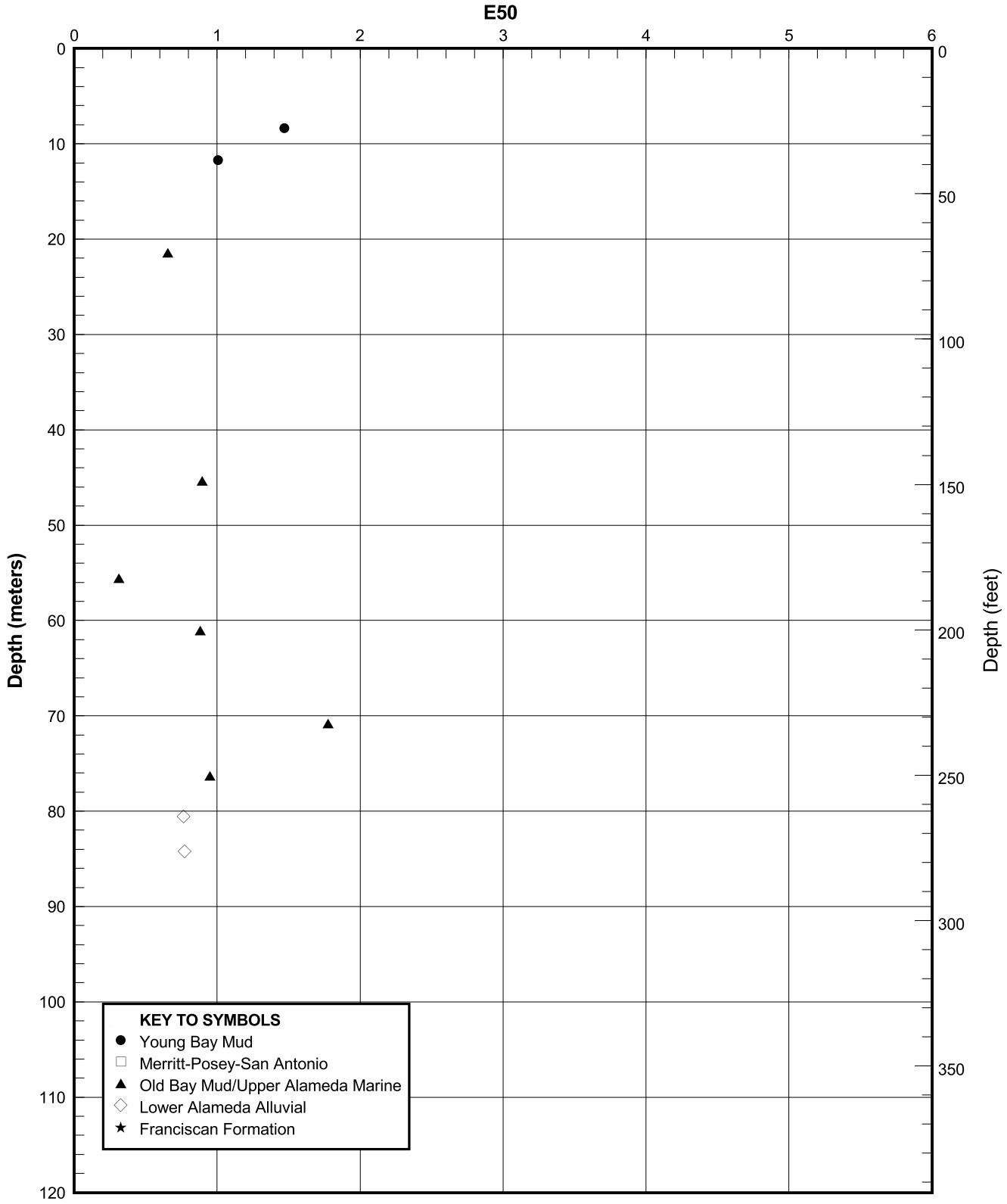
PLASTICITY INDEX PROFILE
Boring 98-34
SFOBB East Span Seismic Safety Project



LIQUIDITY INDEX PROFILE
Boring 98-34
SFOBB East Span Seismic Safety Project

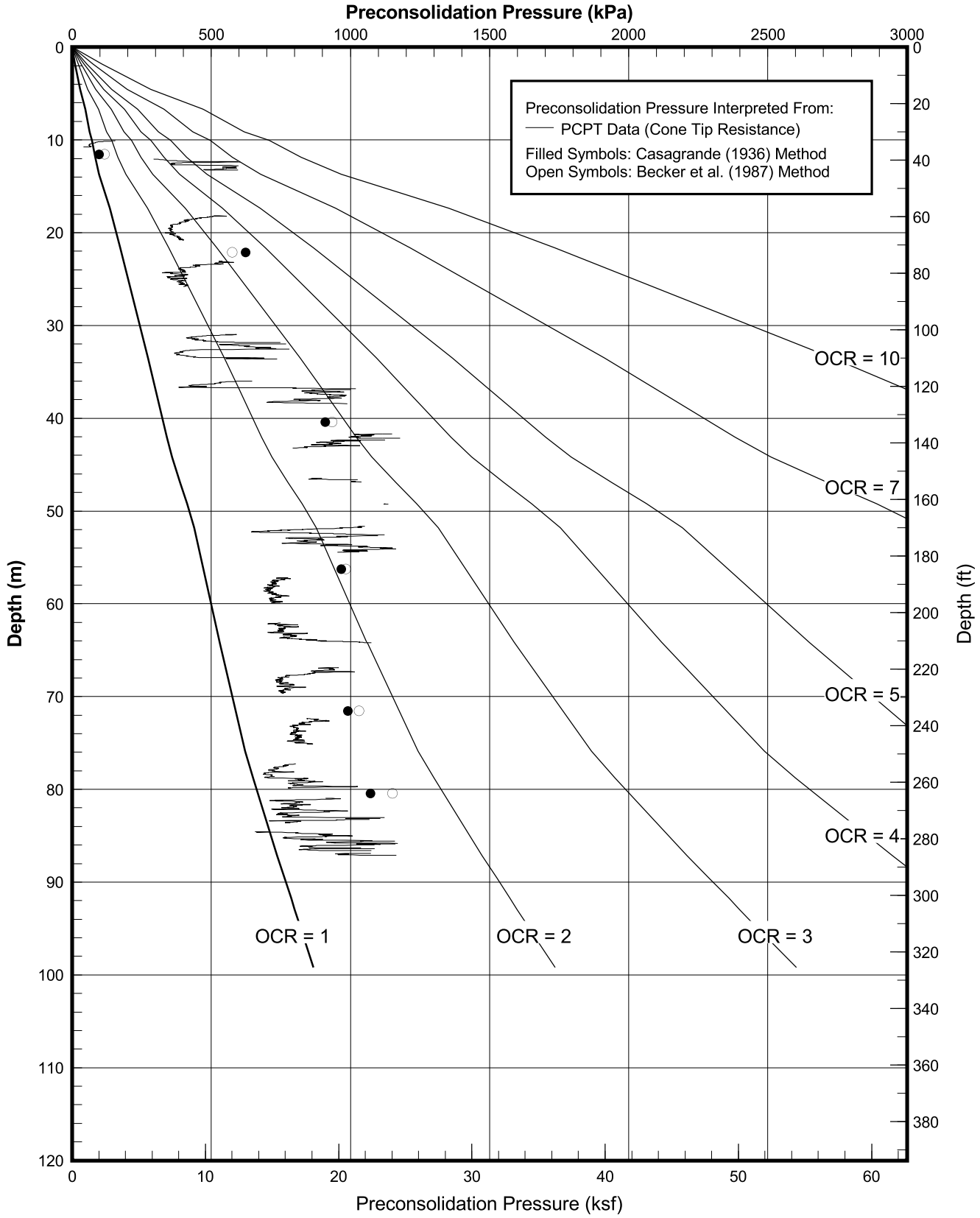


SENSITIVITY PROFILE
Boring 98-34
SFOBB East Span Seismic Safety Project



E50 PROFILE
Boring 98-34
SFOBB East Span Seismic Safety Project

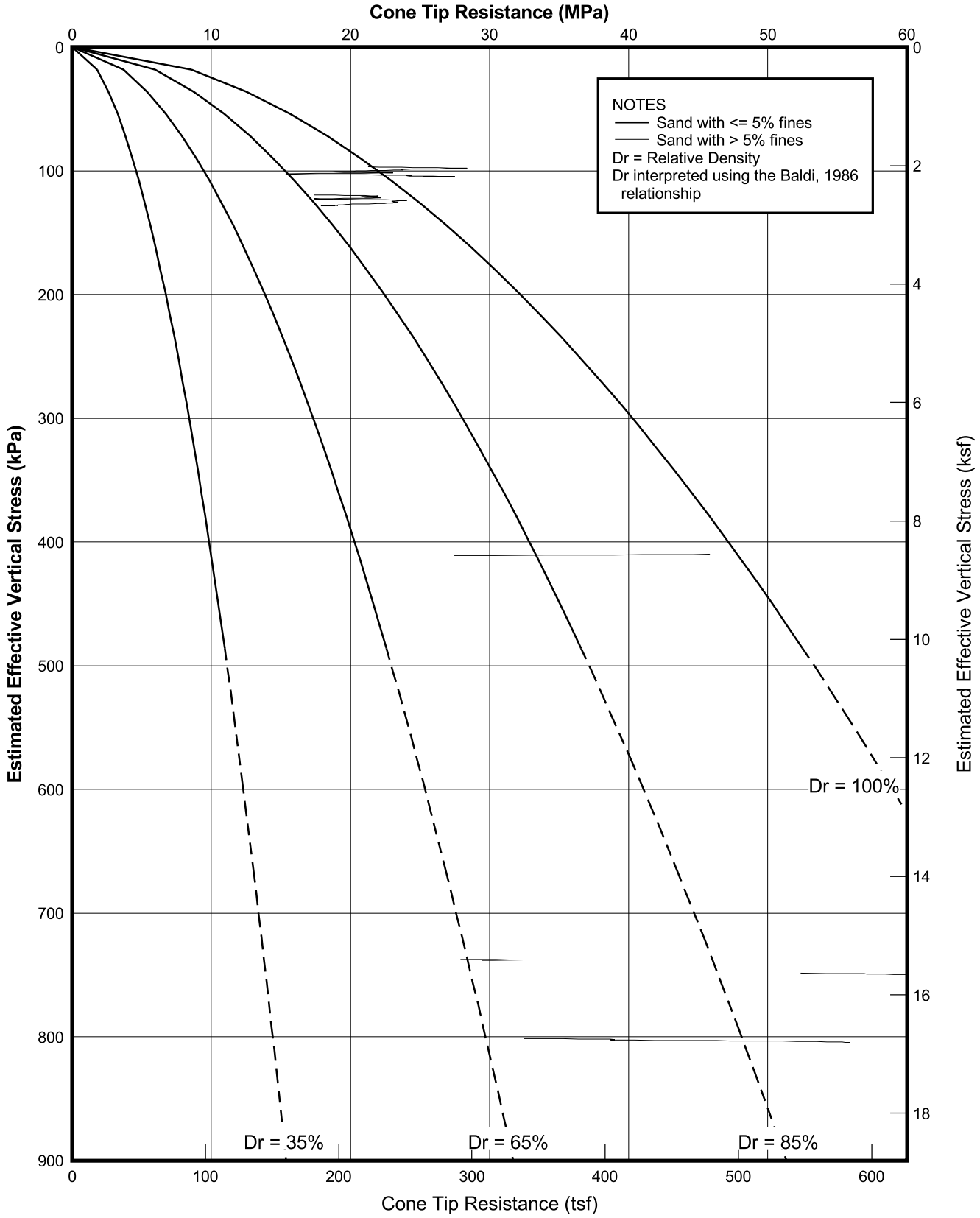
PLATE 98-34.20



PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-34

SFOBB East Span Seismic Safety Project



RELATIVE DENSITY INTERPRETED FROM CPT DATA

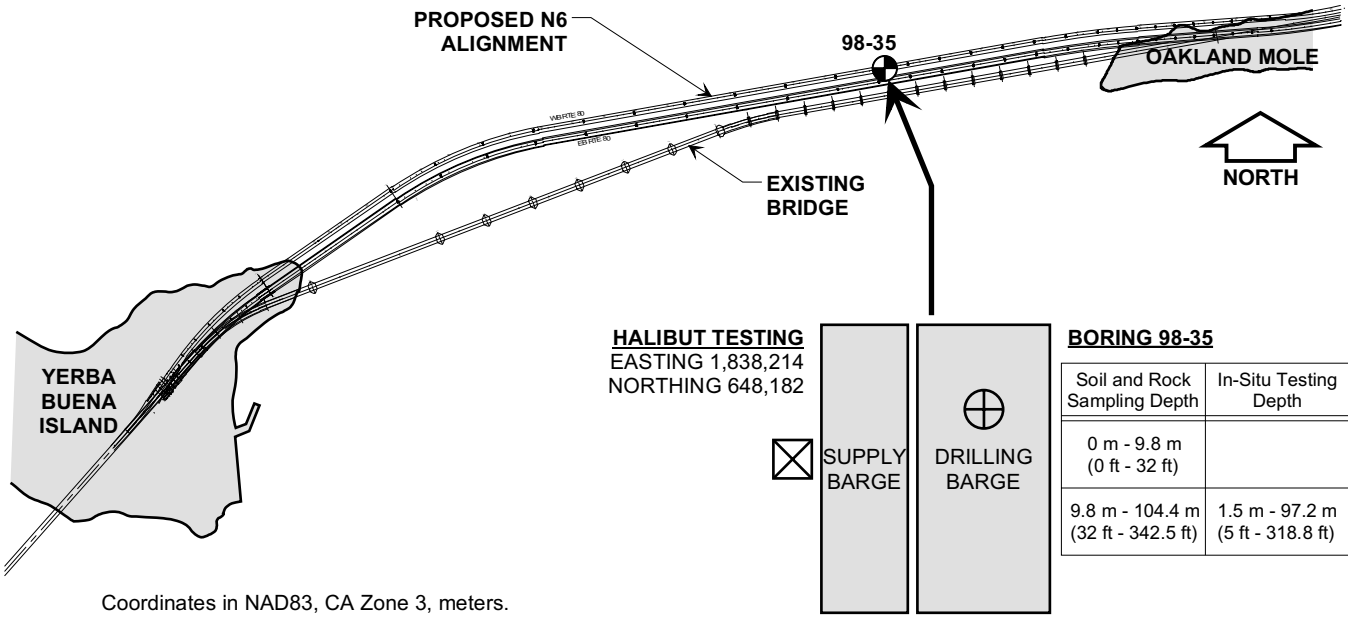
Boring 98-34

SFOBB East Span Seismic Safety Project

BORING 98-35

Date	Time From	Time To	Description of Activity
September 20, 1998	0700	0910	Move barge to location 98-35. Set 4 anchors and 2 spuds.
	0910	0945	Rig up for drilling.
	0945	1000	Lower drill pipe to mudline.
	1000	1015	Measure water depth of 3.7m (12 ft) using bottom sensor. Current tide level is approximately 0.1m (0.3 ft) MSL. Calculate mudline elevation of -3.6m (-11.7 ft) MSL.
	1015	1200	Drill and sample from mudline to 9.8m (32 ft).
	1200	1230	Pull drill pipe to deck.
	1230	1300	Reposition barge.
	****	****	
	1300	1800	Rig up Halibut vane equipment. Halibut vane shear testing from 0.6m (2 ft) to 3.7m (12 ft).
	****	****	
	1300	2030	Set casing. Drive stinger to 8.8m (29 ft).
	2030	2130	Change piston in thruster.
	2130	2200	Perform CPT pipe test.
	2200	2400	Drill, sample, and CPT testing from mudline to 13.7m (45 ft).
September 21, 1998	0000	2200	Drill, sample, and CPT testing from 13.7m (45 ft) to 82.3m (270 ft).
	2200	2230	Damaged O-rings on latch sub. Low flow in CPT test at 80.5m (264 ft). Change CPT latch sub and flow valve in metering cylinder.
	2230	2400	Drill, sample, and CPT testing from 82.3m (270 ft) to 88.4m (290 ft).
September 22, 1998	0000	0300	No flow during CPT test. Change RMU and flow meter.
	0300	0700	Drill, sample, and CPT testing from 88.4 m (290 ft) to 104.4m (342.5 ft).
	0700	0850	Pull drill pipe to deck.
	0850	1130	P- and S-wave velocity logging from 99.0m (324.8 ft) to 9.0m (29.5 ft).
	1130	1530	Lower N-rod. Mix and circulate cement. Grout hole 98-35.
	1530	1550	Pull N-rod to deck.
	1550	1800	Pull casing to deck.
	1800	2000	Pull 2 spuds, 4 anchors, and move barge to location 98-36.

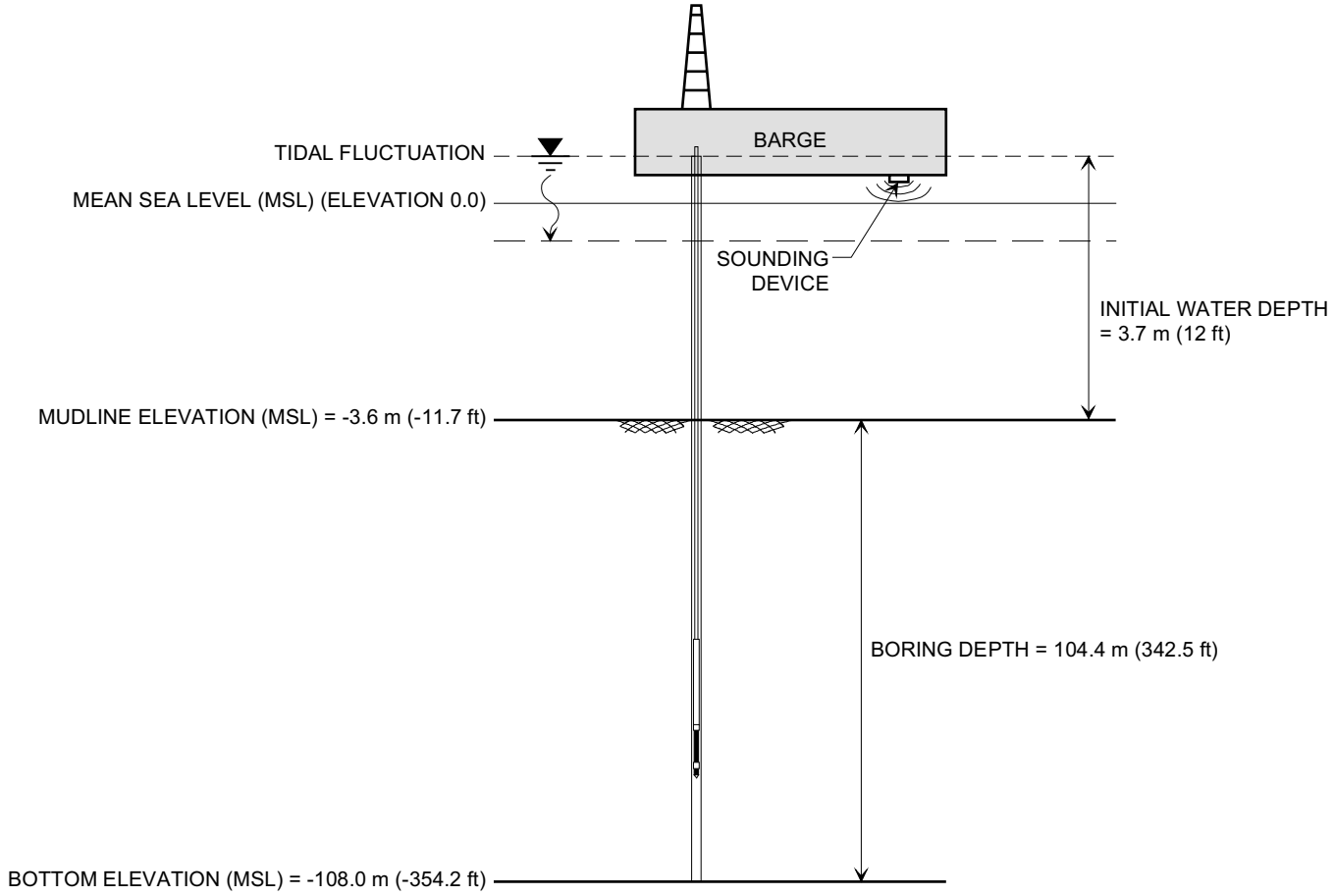
SUMMARY OF FIELD OPERATIONS
Boring 98-35
SFOBB East Span Seismic Safety Project



BORING 98-35

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 9.8 m (0 ft - 32 ft)		E = 1,838,227 N = 648,183
9.8 m - 104.4 m (32 ft - 342.5 ft)	1.5 m - 97.2 m (5 ft - 318.8 ft)	E = 1,838,229 N = 648,183

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-35
SFOBB East Span Seismic Safety Project

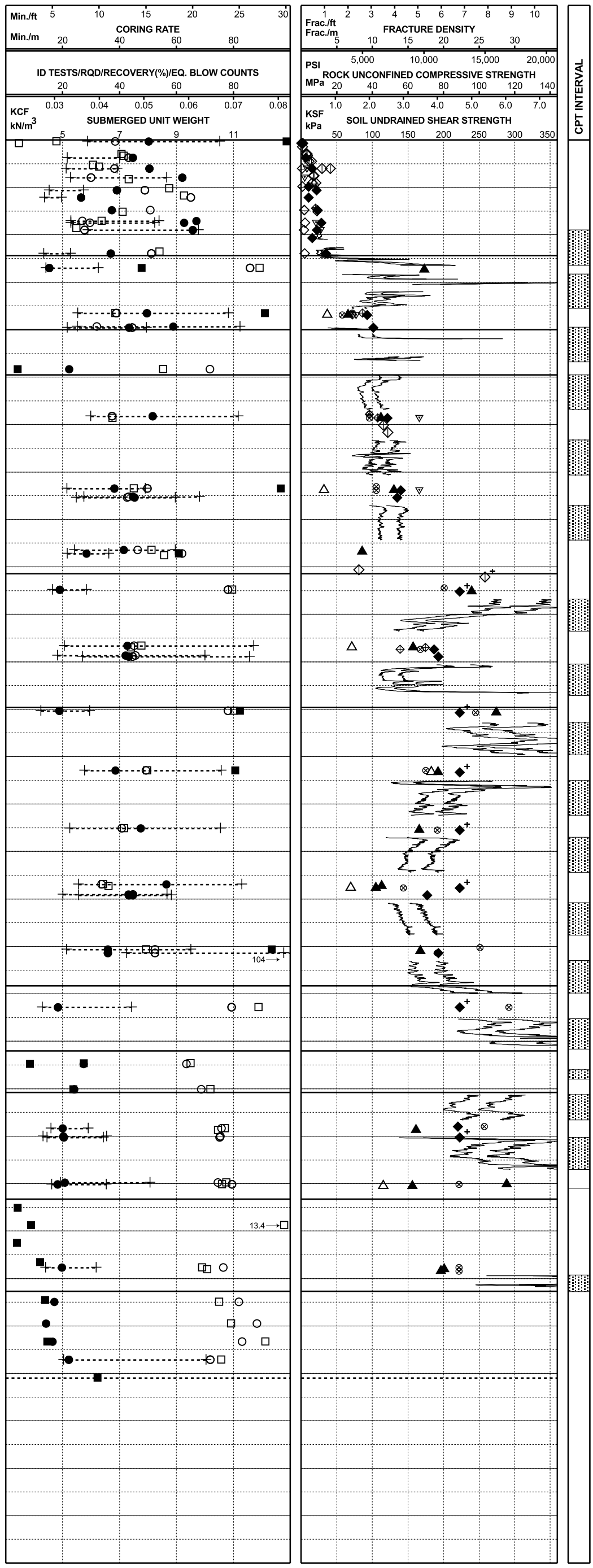
PROJECT NO:	98-42-0054	**START DATE:**	9/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-35 (Skyway Frame - 3)	**COMPLETION DATE:**	9/22/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838229 N648183
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.6m (MSL)

Stratum	Material Description	Blow Count
I	Fat CLAY (CH), very soft to firm, olive gray -with many shells and shell fragments to 5.2m -with silt seams and pockets at 1.2m See Plate 98-35.6 for detailed stratigraphy -with a sand layer, 5.5m to 5.9m -with a very dense sand layer, 8.4m to 9.1m (9.8m)	WOH, WOH, WOH, WOH, WOH, WOH, 18/60cm, 16/60cm, PUSH, PUSH, PUSH
II	Fat CLAY (CH), stiff to very stiff, dark greenish gray -with sandy lean clay at 10.7m -silt layer, 11.7m to 12.0m -dense to very dense sand layer, 12.2m to 12.8m (16.0m)	30/25cm, PUSH, SAVE
III	Fine with Medium SAND (SP), dense, gray -clay layer, 16.5m to 16.8m -clay layer, 18.3m to 18.6m (19.8m)	PUSH
IV	Fat CLAY (CH), very stiff, dark greenish gray -with organic pockets and a few silt pockets, at 23.2m -with silt partings, pockets, seams, and a few shell fragments, at 29.3m -with many shells and shell fragments at 34.4m -silt layer with clay pockets, 34.7m to 35.1m (36.6m)	PUSH, PUSH, SAVE, PUSH
V	Fat CLAY (CH), very stiff to hard, gray -greenish gray to 43.6m -with many sand pockets and partings, fine gravel, a few calcareous nodules, and organic pockets, at 37.8m -with oxidized pockets at 42.7m -with a sand layer, 46.6m to 46.9m (47.9m)	PUSH, PUSH, SAVE, PUSH
VI	Fat CLAY (CH), hard to very stiff, gray -greenish gray to 53.3m -slightly desiccated, with many silty fine sand pockets and calcareous nodules, at 47.9m -with sand, slickensides, and silt pockets, at 53.0m -with a few silt pockets at 57.9m -with silt partings and pockets and desiccated light brown seams, at 68.3m -with many organic pockets at 68.4m (71.3m)	PUSH, PUSH, PUSH, SAVE, PUSH
VII	Lean CLAY (CL), hard, greenish gray -with a sand layer at 75.9m (76.8m)	PUSH
VIII	Silty Fine SAND (SM), very dense, greenish gray -with a clay layer at 78.5m (80.3m)	PUSH, 30/20cm
IX	Lean CLAY with sand (CL), hard, greenish gray -with silt pockets at 83.2m -light gray, with yellowish brown oxidation stains and a trace of fine gravel, at 87.8m (89.3m)	PUSH, SAVE, PUSH
X	Fine to coarse SAND (SW) with fine gravel, very dense, gray -with a few clay pockets, 89.9m to 91.7m -dark greenish gray fine to coarse sand, with fine gravel and silty clay pockets, at 94.5m -hard, greenish gray sandy lean clay layer, with sand and organic pockets, 94.9m to 95.9m -hard, sandy lean clay layer below 96.5m (97.1m)	PUSH, 30/10cm, 30/10cm, 30/15cm, PUSH
XI	Silty Fine to Coarse SAND (SM) with fine gravel, very dense, gray to yellowish brown -interlayered sand and hard clay, with a few silt seams, 99.7m to 101.2m -hard, light olive gray to greenish gray clay, with silt and reddish brown mottling, 101.2m to 103.3m -orange brown silty fine sand, with medium and coarse sand, fine gravel and clay pockets, below 103.3m	PUSH, 30/15cm, 30/15cm, 30/30cm, 30/15cm

TOTAL DEPTH: 104.4m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-35

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

PLATE 98-35.3

PROJECT NO:	98-42-0054	**START DATE:**	9/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-35 (Skyway Frame - 3)	**COMPLETION DATE:**	9/22/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838229 N648183
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.6m (MSL)

Elevation, m.	Depth, m.	Sampler	Blow Count	Material Description	Stratum No.
-4			WOH	Fat CLAY (CH), very soft to firm, olive gray	I
			WOH	See Plate 98-35.6 for detailed stratigraphy	
			WOH		
			WOH		
	4		WOH		
-8			WOH	-with a sand layer, 5.5m to 5.9m	
			18/60cm		
			16/60cm		
	8		PUSH		
-12			PUSH	-with a very dense sand layer, 8.4m to 9.1m (9.8m)	
			PUSH		
			30/25cm	Fat CLAY (CH), stiff to very stiff, dark greenish gray	II
	12			-silt layer, 11.7m to 12.0m	
-16				-dense to very dense sand layer, 12.2m to 12.8m (16.0m)	
			PUSH		
	16		SAVE		
-20				Fine with Medium SAND (SP), dense, gray	III
				-clay layer, 16.5m to 16.8m	
				-clay layer, 18.3m to 18.6m (19.8m)	
			PUSH		
	20			Fat CLAY (CH), very stiff, dark greenish gray	IV
-24				-with organic pockets and a few silt pockets, at 23.2m	
			PUSH		
	24				
-28					
	28			-with silt partings, pockets, seams, and a few shell fragments, at 29.3m	
-32			PUSH		
			SAVE		
	32			-with many shells and shell fragments at 34.4m	
-36				-silt layer with clay pockets, 34.7m to 35.1m (36.6m)	
			PUSH		
-40	36			Fat CLAY (CH), very stiff to hard, gray	V
			PUSH	-greenish gray to 43.6m	
				-with many sand pockets and partings, fine gravel, a few calcareous nodules, and organic pockets, at 37.8m	
-44	40				
			PUSH	-with oxidized pockets at 42.7m	
			SAVE		
-48	44			-with a sand layer, 46.6m to 46.9m (47.9m)	
			PUSH		
-52	48			Fat CLAY (CH), hard to very stiff, gray	VI
				-greenish gray to 53.3m	
				-slightly desiccated, with many silty fine sand pockets and calcareous nodules, at 47.9m	
-56	52		PUSH	-with sand, slickensides, and silt pockets, at 53.0m	
-60	56				
			PUSH	-with a few silt pockets at 57.9m	
-64	60				
			PUSH		
			SAVE		
-68	64				
				-with silt partings and pockets and desiccated light brown seams, at 68.3m	
-72	68		PUSH	-with many organic pockets at 68.4m (71.3m)	
				Lean CLAY (CL), hard, greenish gray	VII
-76	72		PUSH		
				-with a sand layer at 75.9m (76.8m)	
-80	76			Silty Fine SAND (SM), very dense, greenish gray	VIII
			PUSH	-with a clay layer at 78.5m (80.3m)	
-84	80		30/20cm	Lean CLAY with sand (CL), hard, greenish gray	IX
				-with silt pockets at 83.2m	
			PUSH		
			SAVE		
-88	84			-light gray, with yellowish brown oxidation stains and a trace of fine gravel, at 87.8m (89.3m)	
-92	88		PUSH		
			PUSH	Fine to coarse SAND (SW) with fine gravel, very dense, gray	X
			30/10cm		
-96	92		30/10cm	-hard, greenish gray sandy lean clay layer, with sand and organic pockets, 94.9m to 95.9m	
			30/15cm		
			PUSH	-hard, sandy lean clay layer below 96.5m (97.1m)	
-100	96				
			PUSH	Silty Fine to Coarse SAND (SM) with fine gravel, very dense, gray to yellowish brown	XI
-104	100		30/15cm		
			30/15cm	-hard, light olive gray to greenish gray clay, with silt and reddish brown mottling, 101.2m to 103.3m	
			30/30cm		
-108	104		30/15cm		
				TOTAL DEPTH: 104.4m	
				BACKFILLED WITH: Cement Grout	
-112	108				
-116	112				
-120	116				

LOG OF BORING AND TEST RESULTS

BORING 98-35

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

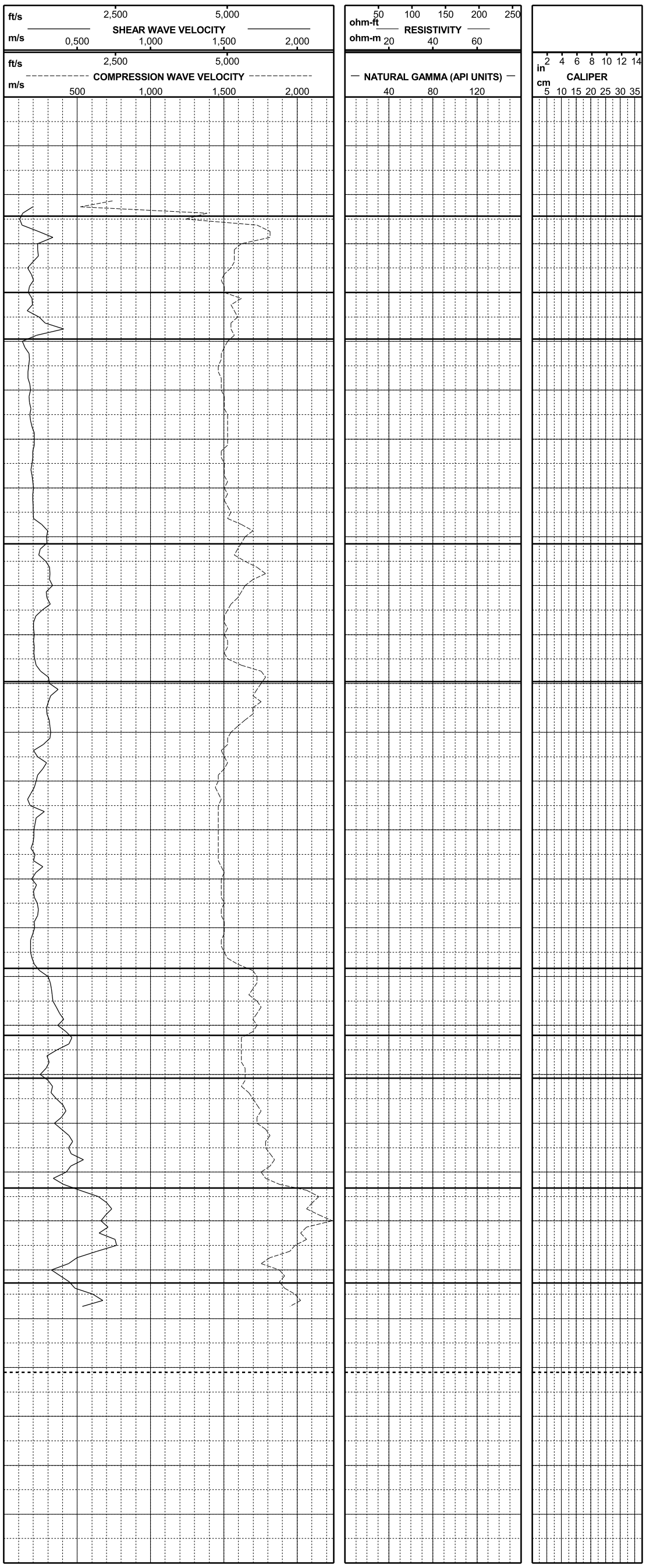
PLATE 98-35.4

PROJECT NO:	98-42-0054	**START DATE:**	9/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-35 (Skyway Frame - 3)	**COMPLETION DATE:**	9/22/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838229 N648183
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.6m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4		WOH	Fat CLAY (CH), very soft to firm, olive gray	I
		WOH	See Plate 98-35.6 for detailed stratigraphy	
		WOH		
		WOH		
	4	WOH		
-8		WOH		
		18/60cm	-with a sand layer, 5.5m to 5.9m	
		16/60cm		
		PUSH		
	8	PUSH	-with a very dense sand layer, 8.4m to 9.1m	
-12		PUSH	(9.8m)	
		30/25cm	Fat CLAY (CH), stiff to very stiff, dark greenish gray	II
	12		-silt layer, 11.7m to 12.0m	
-16			-dense to very dense sand layer, 12.2m to 12.8m	
		PUSH		
	16	SAVE	(16.0m)	
-20			Fine with Medium SAND (SP), dense, gray	III
			-clay layer, 16.5m to 16.8m	
			-clay layer, 18.3m to 18.6m	
		PUSH	(19.8m)	
	20		Fat CLAY (CH), very stiff, dark greenish gray	IV
-24				
		PUSH	-with organic pockets and a few silt pockets, at 23.2m	
	24			
-28				
	28		-with silt partings, pockets, seams, and a few shell fragments, at 29.3m	
-32		PUSH SAVE		
	32			
-36				
		PUSH	-with many shells and shell fragments at 34.4m	
			-silt layer with clay pockets, 34.7m to 35.1m	
	36		(36.6m)	
-40		PUSH	Fat CLAY (CH), very stiff to hard, gray	V
			-greenish gray to 43.6m	
			-with many sand pockets and partings, fine gravel, a few calcareous nodules, and organic pockets, at 37.8m	
-44	40			
		PUSH SAVE	-with oxidized pockets at 42.7m	
-48	44			
			-with a sand layer, 46.6m to 46.9m	
			(47.9m)	
-52	48	PUSH	Fat CLAY (CH), hard to very stiff, gray	VI
			-greenish gray to 53.3m	
			-slightly desiccated, with many silty fine sand pockets and calcareous nodules, at 47.9m	
-56	52	PUSH	-with sand, slickensides, and silt pockets, at 53.0m	
-60	56			
		PUSH	-with a few silt pockets at 57.9m	
-64	60			
		PUSH SAVE		
-68	64			
-72	68	PUSH	-with silt partings and pockets and desiccated light brown seams, at 68.3m	
			-with many organic pockets at 68.4m	
			(71.3m)	
-76	72	PUSH	Lean CLAY (CL), hard, greenish gray	VII
	76		-with a sand layer at 75.9m	
			(76.8m)	
-80		PUSH	Silty Fine SAND (SM), very dense, greenish gray	VIII
			-with a clay layer at 78.5m	
	80	30/20cm	(80.3m)	
-84			Lean CLAY with sand (CL), hard, greenish gray	IX
		PUSH SAVE	-with silt pockets at 83.2m	
-88	84			
			-light gray, with yellowish brown oxidation stains and a trace of fine gravel, at 87.8m	
-92	88	PUSH	(89.3m)	
		PUSH	Fine to coarse SAND (SW) with fine gravel, very dense, gray	X
		30/10cm		
-96	92	30/10cm	-dark greenish gray fine to coarse sand, with fine gravel and silty clay pockets, at 94.5m	
		30/15cm	-hard, greenish gray sandy lean clay layer, with sand and organic pockets, 94.9m to 95.9m	
	96	PUSH		
-100			-hard, sandy lean clay layer below 96.5m	
			(97.1m)	
		PUSH	Silty Fine to Coarse SAND (SM) with fine gravel, very dense, gray to yellowish brown	XI
		30/15cm	-interlayered sand and hard clay, with a few silt seams, 99.7m to 101.2m	
-104	100	30/15cm	-hard, light olive gray to greenish gray clay, with silt and reddish brown mottling, 101.2m to 103.3m	
		30/30cm	-orange brown silty fine sand, with medium and coarse sand, fine gravel and clay pockets, below 103.3m	
-108	104	30/15cm		
			TOTAL DEPTH: 104.4m	
			BACKFILLED WITH: Cement Grout	
-112	108			
-116	112			
-120	116			



LOG OF BORING AND TEST RESULTS

BORING 98-35

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

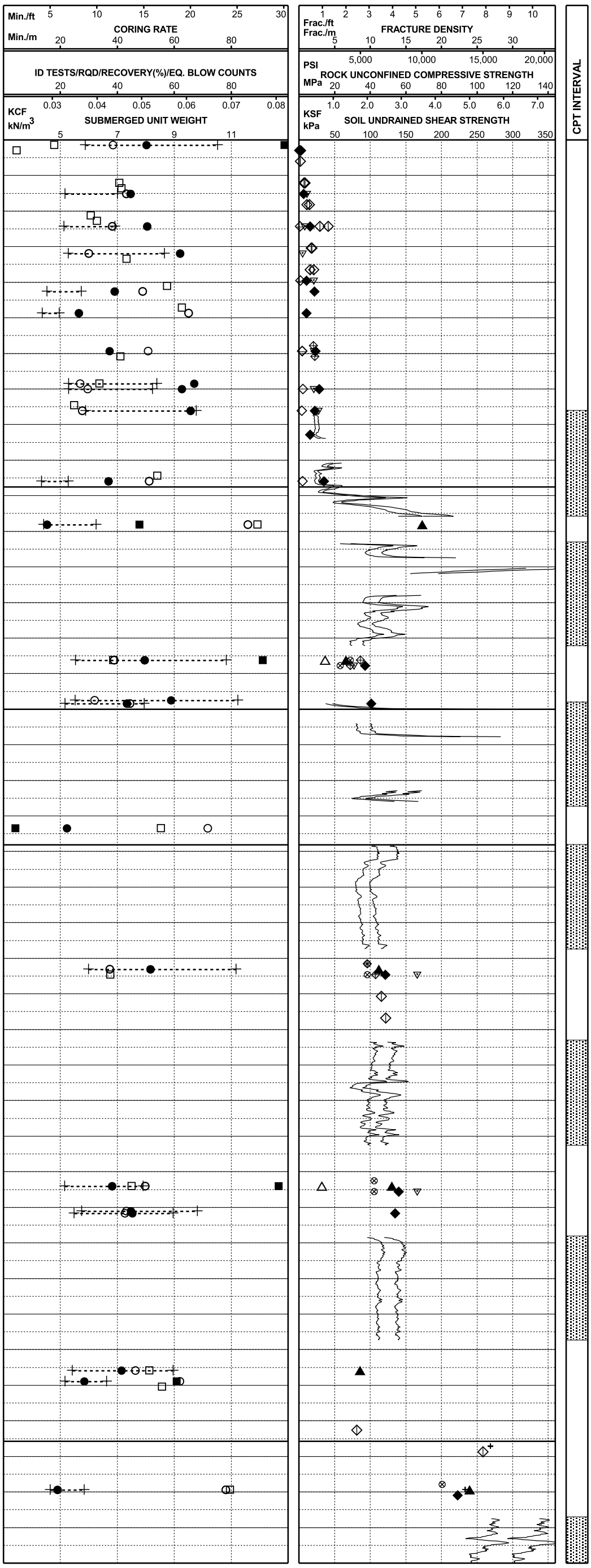
PLATE 98-35.5

PROJECT NO:	98-42-0054	**START DATE:**	9/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-35 (Skyway Frame - 3)	**COMPLETION DATE:**	9/22/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838229 N648183
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.6m (MSL)

Elevation, m.	Depth, m.	Blow Count	Material Description	Stratum No.
-4	1	WOH	Fat CLAY (CH), very soft to firm, olive gray -with many shells and shell fragments to 5.2m	I
-5	2	WOH	-with silt seams and pockets at 1.2m	
-6	3	WOH		
-7	4	WOH		
-8	5	WOH	-with silt pockets and partings, many sand seams and layers, and an H2S odor, at 4.9m	
-9	6	18/60cm	-with a sand layer, 5.5m to 5.9m -with a few shell fragments, 5.5m to 6.1m -gray below 5.9m	
-10	7	16/60cm	-with many sand seams and partings at 6.1m -with a few silt pockets at 6.7m	
-11	8	PUSH		
-12	9	PUSH	-intermixed sand and clay at 8.2m -with a very dense sand layer, 8.4m to 9.1m	
-13	10	PUSH	-with gas blisters and many silty sand pockets, at 9.4m (9.8m)	
-14	11	30/25cm	Fat CLAY (CH), stiff to very stiff, dark greenish gray -with sandy lean clay at 10.7m	II
-15	12		-silt layer, 11.7m to 12.0m -dense to very dense sand layer, 12.2m to 12.8m	
-16	13		-with a silt layer at 13.1m	
-17	14			
-18	15	PUSH	-with a few silt pockets at 14.6m	
-19	16	SAVE	(16.0m)	
-20	17		Fine with Medium SAND (SP), dense, gray -with clay seams and layers -clay layer, 16.5m to 16.8m	III
-21	18		-with a clay layer at 17.4m	
-22	19		-clay layer, 18.3m to 18.6m	
-23	20	PUSH	(19.8m)	
-24	21		Fat CLAY (CH), very stiff, dark greenish gray	IV
-25	22			
-26	23	PUSH	-with organic pockets and a few silt pockets, at 23.2m	
-27	24			
-28	25			
-29	26			
-30	27			
-31	28			
-32	29	PUSH	-with silt partings, pockets, seams, and a few shell fragments, at 29.3m	
-33	30	SAVE		
-34	31			
-35	32			
-36	33			
-37	34			
-38	35	PUSH	-with many shells and shell fragments at 34.4m -silt layer with clay pockets, 34.7m to 35.1m	
-39	36			
-40	37		(36.6m) Fat CLAY (CH), very stiff to hard, gray -greenish gray to 43.6m	V
-41	38	PUSH	-with many sand pockets and partings, fine gravel, a few calcareous nodules, and organic pockets, at 37.8m	
-42	39			
-43				



LOG OF BORING AND TEST RESULTS

BORING 98-35

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

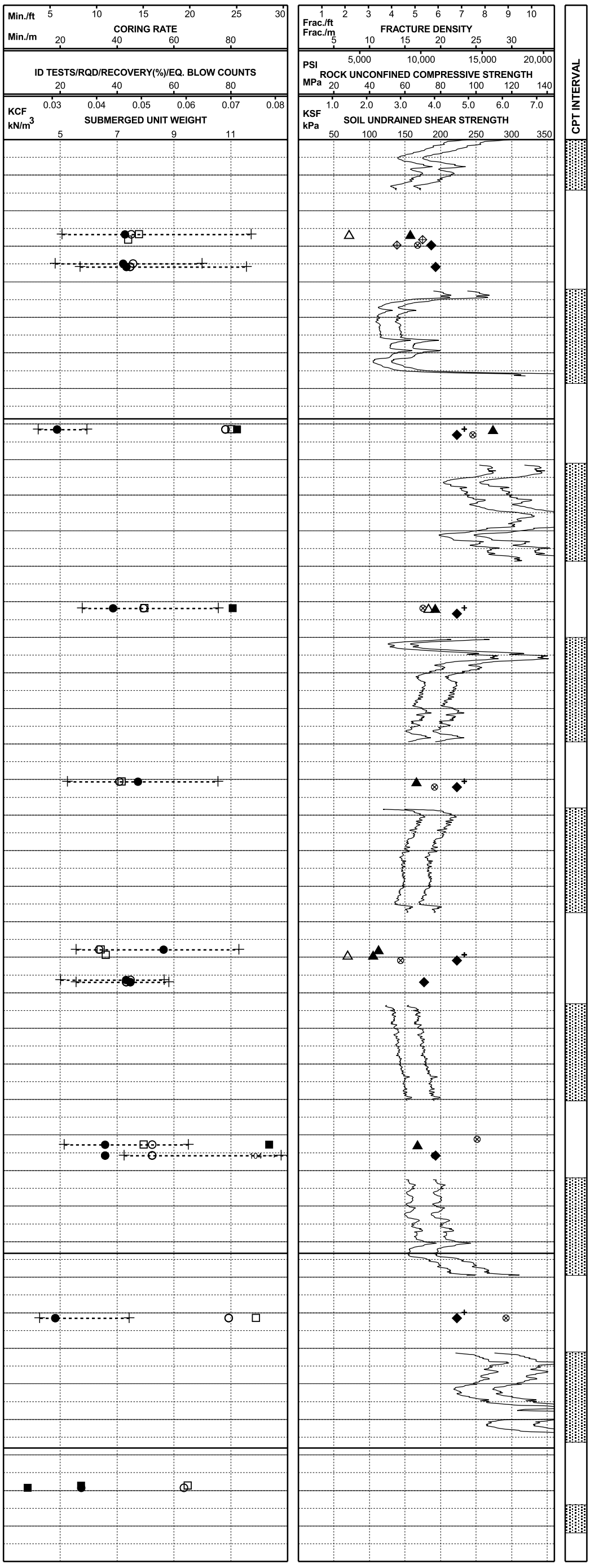
PLATE 98-35.6a

PROJECT NO:	98-42-0054	**START DATE:**	9/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-35 (Skyway Frame - 3)	**COMPLETION DATE:**	9/22/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838229 N648183
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.6m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-44	41				Fat CLAY (CH), very stiff to hard, gray	V
-45	42					
-46	43			PUSH	-with oxidized pockets at 42.7m	
-47	44			SAVE		
-48	45					
-49	46					
-50	47				-with a sand layer, 46.6m to 46.9m	
-51	48			PUSH	(47.9m) Fat CLAY (CH), hard to very stiff, gray -greenish gray to 53.3m -slightly desiccated, with many silty fine sand pockets and calcareous nodules, at 47.9m	VI
-52	49					
-53	50					
-54	51					
-55	52					
-56	53			PUSH	-with sand, slickensides, and silt pockets, at 53.0m	
-57	54					
-58	55					
-59	56					
-60	57					
-61	58			PUSH	-with a few silt pockets at 57.9m	
-62	59					
-63	60					
-64	61					
-65	62					
-66	63			PUSH		
-67	64			SAVE		
-68	65					
-69	66					
-70	67					
-71	68			PUSH	-with silt partings and pockets and desiccated light brown seams, at 68.3m -with many organic pockets at 68.4m	
-72	69					
-73	70					
-74	71				(71.3m)	
-75	72				Lean CLAY (CL), hard, greenish gray	VII
-76	73			PUSH		
-77	74					
-78	75					
-79	76				-with a sand layer at 75.9m	
-80					(76.8m)	
-81	77				Silty Fine SAND (SM), very dense, greenish gray	VIII
-82	78			PUSH	-with a clay layer at 78.5m	
-83	79		30/20cm			



LOG OF BORING AND TEST RESULTS

BORING 98-35

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

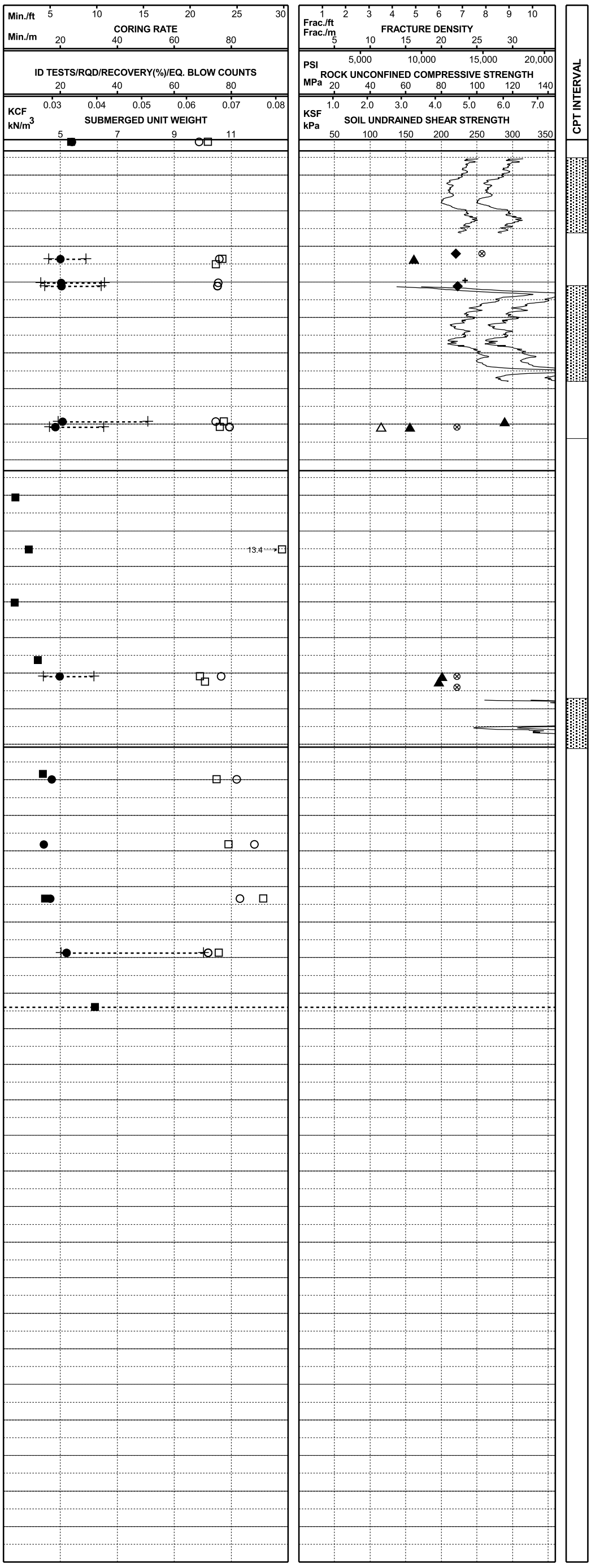
PLATE 98-35.6b

PROJECT NO:	98-42-0054	**START DATE:**	9/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-35 (Skyway Frame - 3)	**COMPLETION DATE:**	9/22/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838229 N648183
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.6m (MSL)

Elevation, m.	Depth, m.	Soil Type	Sampler	Blow Count	Material Description	Stratum No.
				30/20cm	Silty Fine SAND (SM), very dense, greenish gray (80.3m)	VIII
-84	81				Lean CLAY with sand (CL), hard, greenish gray	
-85	82					
-86	83			PUSH	-with silt pockets at 83.2m	
-87	84			SAVE		
-88	85					IX
-89	86					
-90	87					
-91	88			PUSH	-light gray, with yellowish brown oxidation stains and a trace of fine gravel, at 87.8m	
-92	89				(89.3m)	
-93	90			PUSH	Fine to coarse SAND (SW) with fine gravel, very dense, gray -with a few clay pockets, 89.9m to 91.7m	
-94	91					
-95	92			30/10cm	-with silt at 91.4m	
-96	93			30/10cm		X
-97	94					
-98	95			30/15cm	-dark greenish gray fine to coarse sand, with fine gravel and silty clay pockets, at 94.5m	
-99	96			PUSH	-hard, greenish gray sandy lean clay layer, with sand and organic pockets, 94.9m to 95.9m	
-100	97				-hard, sandy lean clay layer below 96.5m (97.1m)	
-101	98			PUSH	Silty Fine to Coarse SAND (SM) with fine gravel, very dense, gray to yellowish brown	
-102	99					
-103	100			30/15cm	-interlayered sand and hard clay, with a few silt seams, 99.7m to 101.2m	
-104	101			30/15cm	-hard, light olive gray to greenish gray clay, with silt and reddish brown mottling, 101.2m to 103.3m	XI
-105	102					
-106	103			30/30cm	-orange brown silty fine sand, with medium and coarse sand, fine gravel and clay pockets, below 103.3m	
-107	104					
-108				30/15cm	TOTAL DEPTH: 104.4m BACKFILLED WITH: Cement Grout	
-109	105					
-110	106					
-111	107					
-112	108					
-113	109					
-114	110					
-115	111					
-116	112					
-117	113					
-118	114					
-119	115					
-120	116					
-121	117					
-122	118					
-123	119					



LOG OF BORING AND TEST RESULTS

BORING 98-35

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

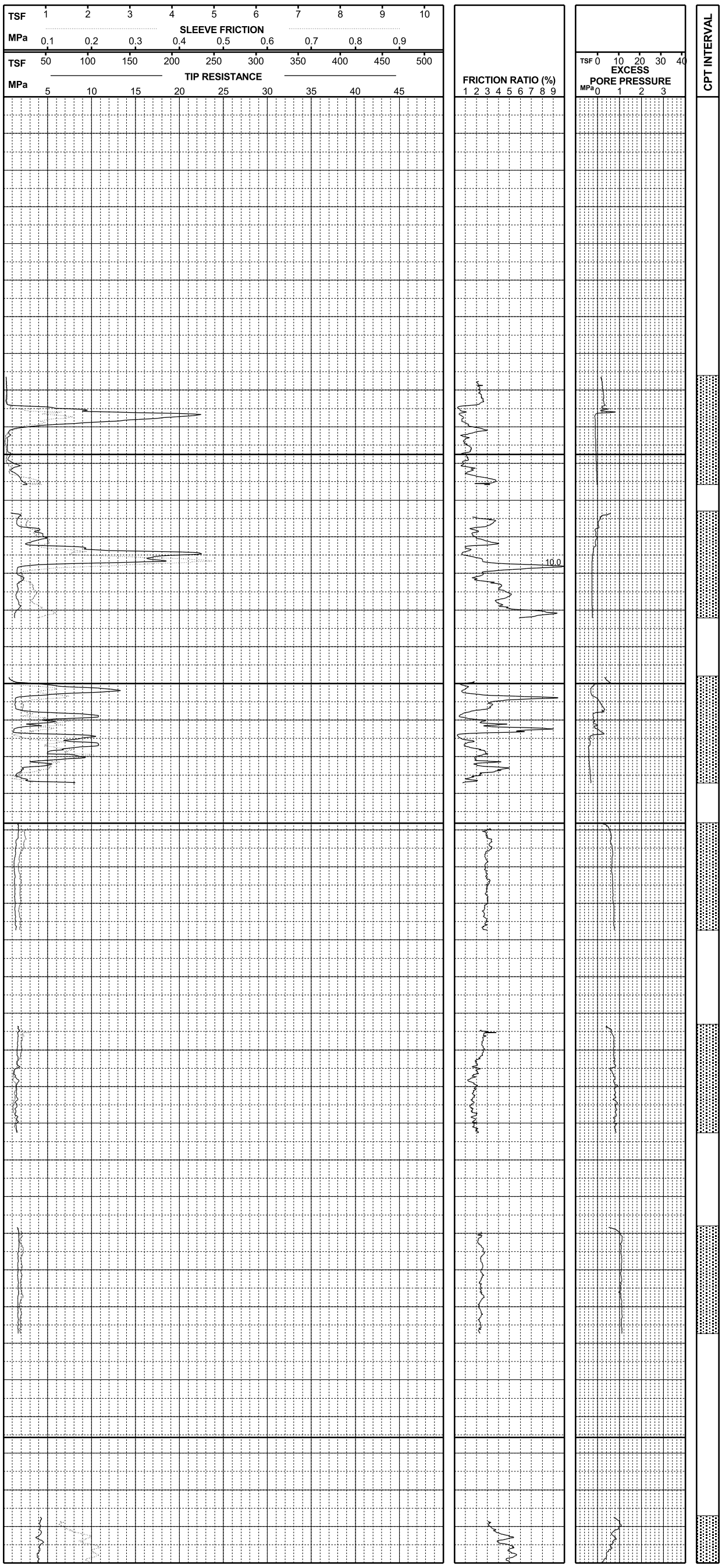
PLATE 98-35.6c

PROJECT NO:	98-42-0054	**START DATE:**	9/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-35 (Skyway Frame - 3)	**COMPLETION DATE:**	9/22/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838229 N648183
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.6m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4	1		WOH	Fat CLAY (CH), very soft to firm, olive gray	I
-5	2		WOH	-with many shells and shell fragments to 5.2m -with silt seams and pockets at 1.2m	
-6	3		WOH		
-7	4		WOH		
-8	5		WOH	-with silt pockets and partings, many sand seams and layers, and an H2S odor, at 4.9m	
-9	6		18/60cm	-with a sand layer, 5.5m to 5.9m -with a few shell fragments, 5.5m to 6.1m	
-10	7		16/60cm	-gray below 5.9m -with many sand seams and partings at 6.1m	
-11	8		PUSH	-with a few silt pockets at 6.7m	
-12	9		PUSH	-intermixed sand and clay at 8.2m -with a very dense sand layer, 8.4m to 9.1m	
-13	10		PUSH	-with gas blisters and many silty sand pockets, at 9.4m (9.8m)	
-14	11		30/25cm	Fat CLAY (CH), stiff to very stiff, dark greenish gray -with sandy lean clay at 10.7m	II
-15	12			-silt layer, 11.7m to 12.0m -dense to very dense sand layer, 12.2m to 12.8m	
-16	13			-with a silt layer at 13.1m	
-17	14				
-18	15		PUSH	-with a few silt pockets at 14.6m	
-19	16		SAVE	(16.0m)	
-20	17			Fine with Medium SAND (SP), dense, gray -with clay seams and layers -clay layer, 16.5m to 16.8m	III
-21	18			-with a clay layer at 17.4m	
-22	19			-clay layer, 18.3m to 18.6m	
-23	20		PUSH	(19.8m)	
-24	21			Fat CLAY (CH), very stiff, dark greenish gray	IV
-25	22				
-26	23		PUSH	-with organic pockets and a few silt pockets, at 23.2m	
-27	24				
-28	25				
-29	26				
-30	27				
-31	28				
-32	29		PUSH	-with silt partings, pockets, seams, and a few shell fragments, at 29.3m	
-33	30		SAVE		
-34	31				
-35	32				
-36	33				
-37	34			-with many shells and shell fragments at 34.4m	
-38	35		PUSH	-silt layer with clay pockets, 34.7m to 35.1m	
-39	36			(36.6m)	
-40	37			Fat CLAY (CH), very stiff to hard, gray -greenish gray to 43.6m	V
-41	38		PUSH	-with many sand pockets and partings, fine gravel, a few calcareous nodules, and organic pockets, at 37.8m	
-42	39				
-43					



LOG OF BORING AND TEST RESULTS

BORING 98-35

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

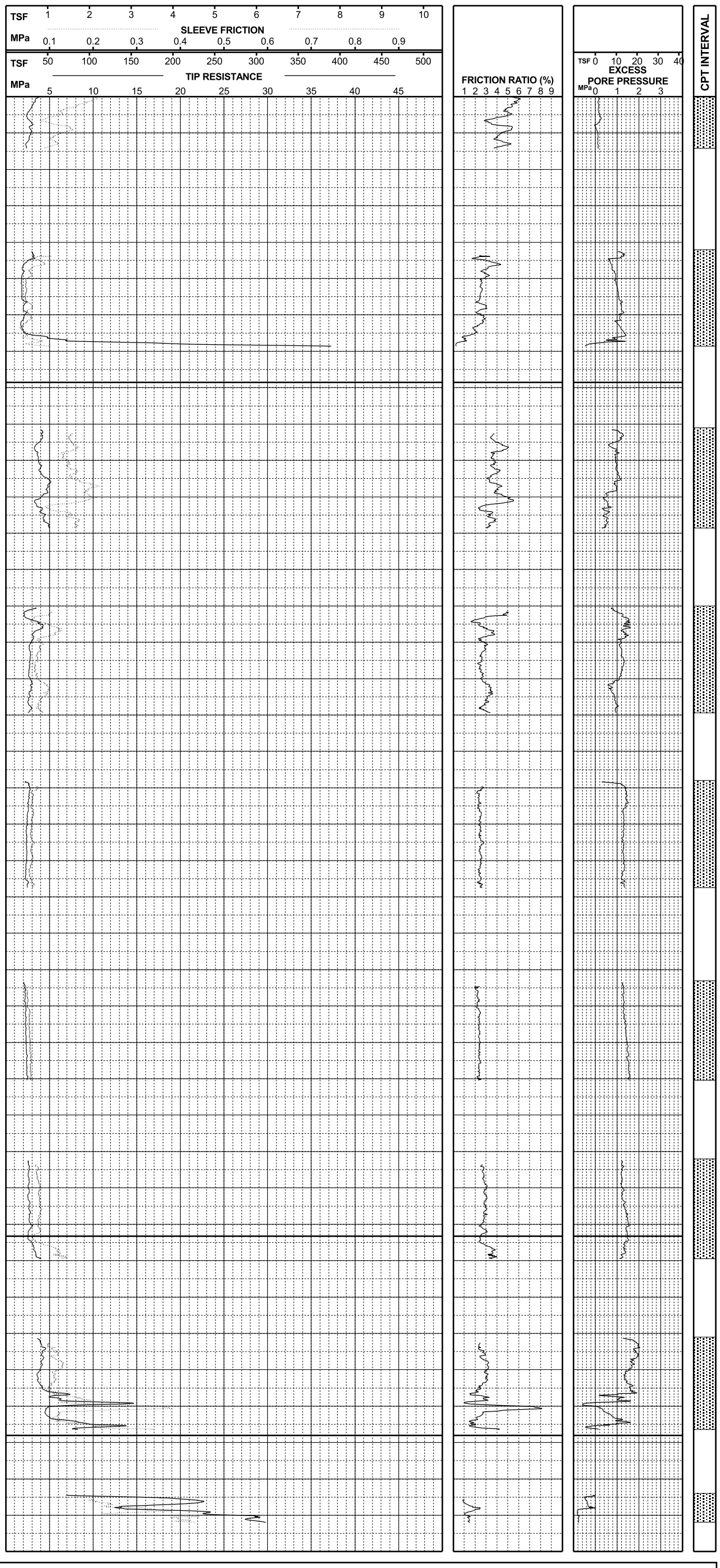
PLATE 98-35.7a

PROJECT NO:	98-42-0054	**START DATE:**	9/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-35 (Skyway Frame - 3)	**COMPLETION DATE:**	9/22/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838229 N648183
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.6m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-44	41			Fat CLAY (CH), very stiff to hard, gray	V
-45	42				
-46	43		PUSH	-with oxidized pockets at 42.7m	
-47	44		SAVE		
-48	45				
-49	46				
-50	47			-with a sand layer, 46.6m to 46.9m	
-51	48		PUSH	(47.9m) Fat CLAY (CH), hard to very stiff, gray -greenish gray to 53.3m -slightly desiccated, with many silty fine sand pockets and calcareous nodules, at 47.9m	VI
-52	49				
-53	50				
-54	51				
-55	52				
-56	53		PUSH	-with sand, slickensides, and silt pockets, at 53.0m	
-57	54				
-58	55				
-59	56				
-60	57				
-61	58		PUSH	-with a few silt pockets at 57.9m	
-62	59				
-63	60				
-64	61				
-65	62				
-66	63		PUSH		
-67	64		SAVE		
-68	65				
-69	66				
-70	67				
-71	68		PUSH	-with silt partings and pockets and desiccated light brown seams, at 68.3m -with many organic pockets at 68.4m	
-72	69				
-73	70				
-74	71			(71.3m)	
-75	72			Lean CLAY (CL), hard, greenish gray	VII
-76	73		PUSH		
-77	74				
-78	75				
-79	76			-with a sand layer at 75.9m	
-80	77			(76.8m)	
-81	78		PUSH	Silty Fine SAND (SM), very dense, greenish gray	VIII
-82	79			-with a clay layer at 78.5m	
-83			30/20cm		



LOG OF BORING AND TEST RESULTS

BORING 98-35

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

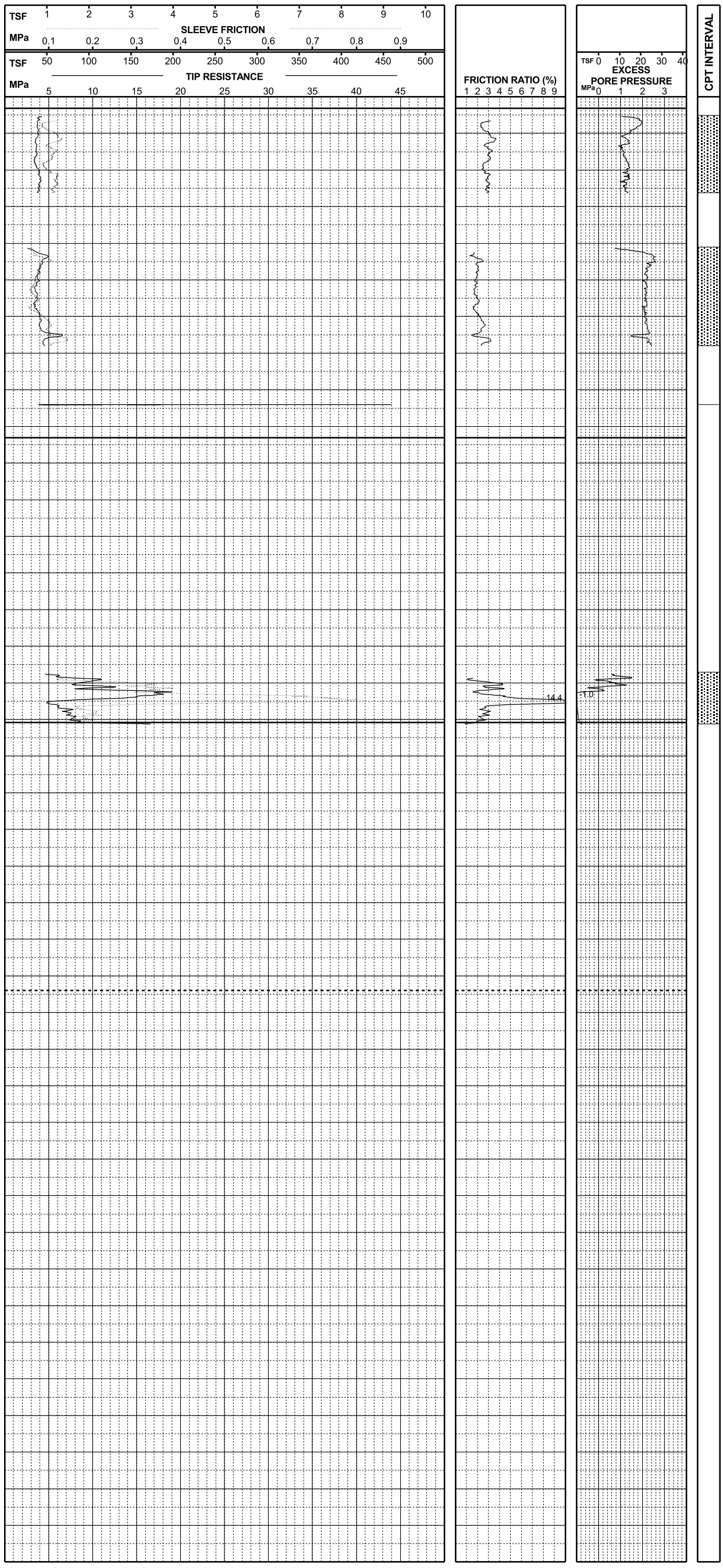
PLATE 98-35.7b

PROJECT NO:	98-42-0054	**START DATE:**	9/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-35 (Skyway Frame - 3)	**COMPLETION DATE:**	9/22/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838229 N648183
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.6m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
			30/20cm	Silty Fine SAND (SM), very dense, greenish gray (80.3m)	VIII
-84	81			Lean CLAY with sand (CL), hard, greenish gray	
-85	82				
-86	83		PUSH	-with silt pockets at 83.2m	
-87	84		SAVE		
-88	85				IX
-89	86				
-90	87				
-91	88		PUSH	-light gray, with yellowish brown oxidation stains and a trace of fine gravel, at 87.8m	
-92	89			(89.3m)	
-93	90		PUSH	Fine to coarse SAND (SW) with fine gravel, very dense, gray -with a few clay pockets, 89.9m to 91.7m	
-94	91				
-95	92		30/10cm	-with silt at 91.4m	
-96	93		30/10cm		X
-97	94			-dark greenish gray fine to coarse sand, with fine gravel and silty clay pockets, at 94.5m	
-98	95		30/15cm		
-99	96		PUSH	-hard, greenish gray sandy lean clay layer, with sand and organic pockets, 94.9m to 95.9m	
-100	97			-hard, sandy lean clay layer below 96.5m (97.1m)	
-101	98		PUSH	Silty Fine to Coarse SAND (SM) with fine gravel, very dense, gray to yellowish brown	
-102	99				
-103	100		30/15cm	-interlayered sand and hard clay, with a few silt seams, 99.7m to 101.2m	
-104	101		30/15cm	-hard, light olive gray to greenish gray clay, with silt and reddish brown mottling, 101.2m to 103.3m	XI
-105	102				
-106	103		30/30cm	-orange brown silty fine sand, with medium and coarse sand, fine gravel and clay pockets, below 103.3m	
-107	104				
-108	105		30/15cm	TOTAL DEPTH: 104.4m BACKFILLED WITH: Cement Grout	
-109	106				
-110	107				
-111	108				
-112	109				
-113	110				
-114	111				
-115	112				
-116	113				
-117	114				
-118	115				
-119	116				
-120	117				
-121	118				
-122	119				
-123					



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-35

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

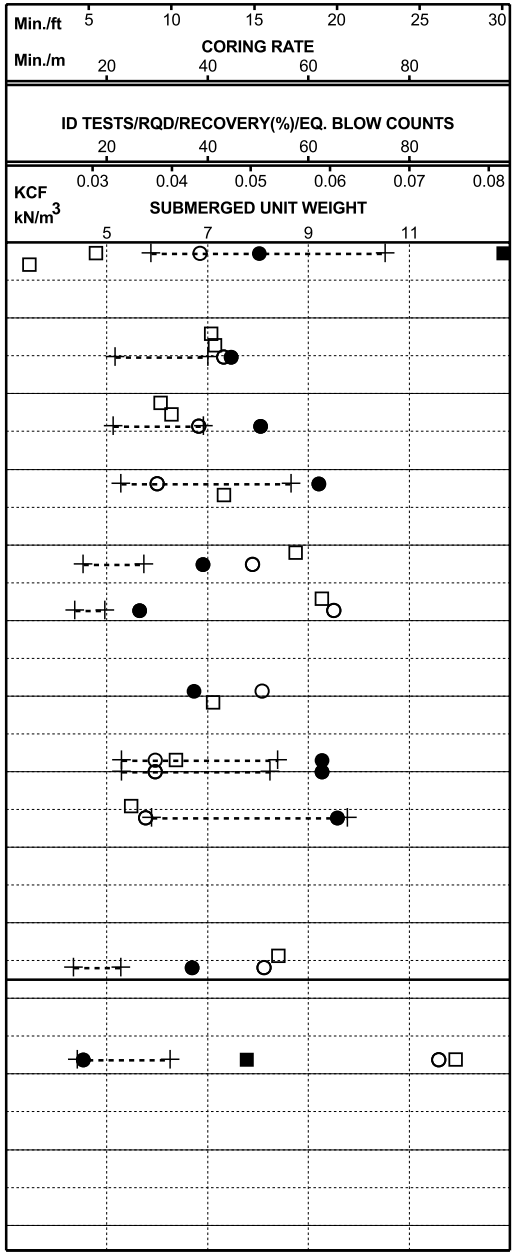
PLATE 98-35.7c

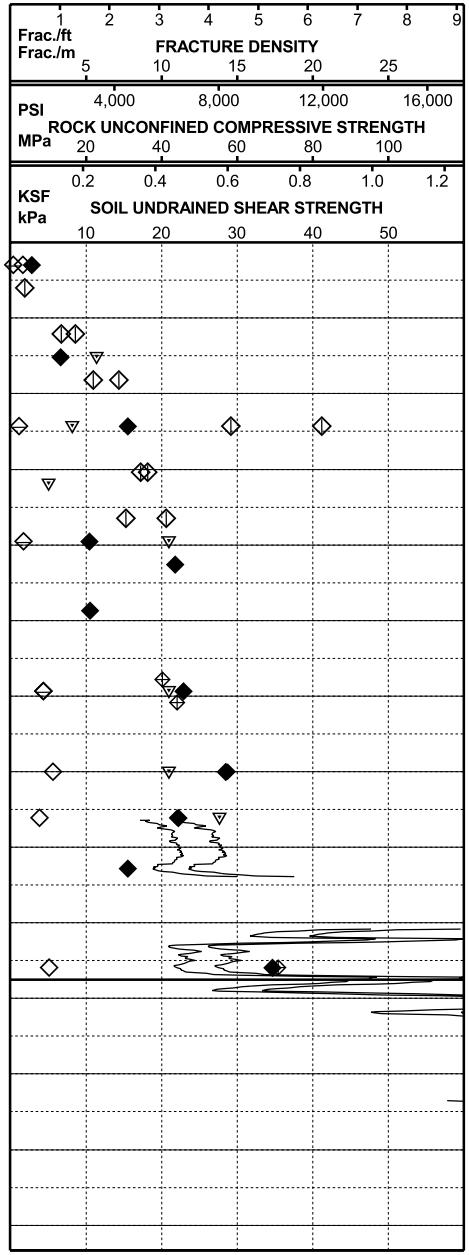
PROJECT NO:	98-42-0054	**START DATE:**	9/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-35 (Skyway Frame - 3)	**COMPLETION DATE:**	9/22/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838229 N648183
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.6m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4				WOH	Fat CLAY (CH), very soft to firm, olive gray -with many shells and shell fragments to 5.2m	I
	1			WOH	-with silt seams and pockets at 1.2m	
-5						
	2			WOH		
-6						
	3			WOH		
-7						
	4			WOH		
-8				WOH	-with silt pockets and partings, many sand seams and layers, and an H2S odor, at 4.9m	
	5					
-9					-with a sand layer, 5.5m to 5.9m	
	6			18/60cm	-with a few shell fragments, 5.5m to 6.1m -gray below 5.9m	
-10					-with many sand seams and partings at 6.1m	
	7			16/60cm	-with a few silt pockets at 6.7m	
-11				PUSH		
	8					
-12				PUSH	-intermixed sand and clay at 8.2m -with a very dense sand layer, 8.4m to 9.1m	
	9					
-13				PUSH	-with gas blisters and many silty sand pockets, at 9.4m (9.8m)	
	10				Fat CLAY (CH), stiff to very stiff, dark greenish gray	II
-14						
	11			30/25cm	-with sandy lean clay at 10.7m	
-15						
	12				-silt layer, 11.7m to 12.0m -dense to very dense sand layer, 12.2m to 12.8m	
-16						
	13				-with a silt layer at 13.1m	





CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-35

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

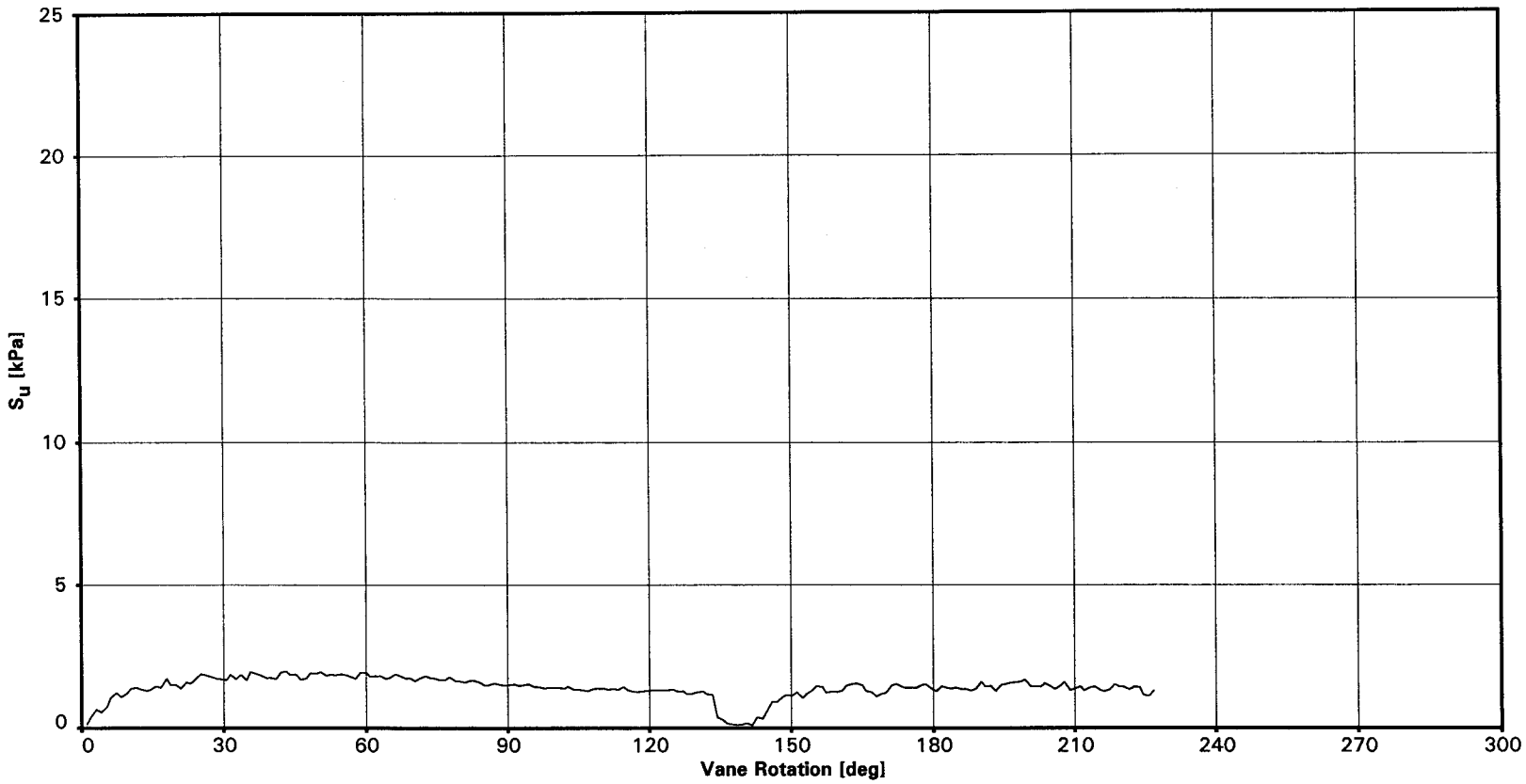
FUGRO

PLATE 98-35.8

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 0.6m
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

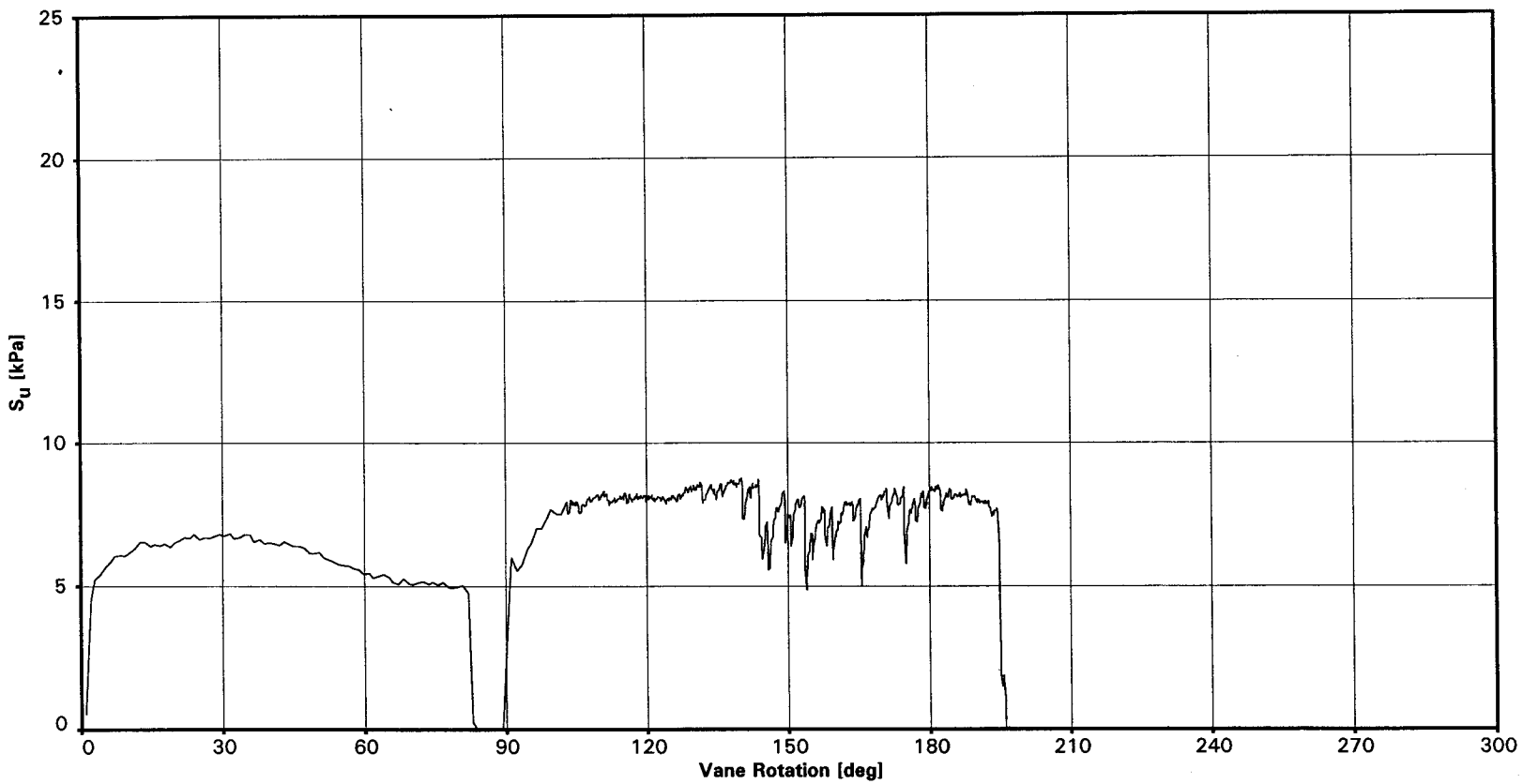
FUGRO

PLATE 98-35.9a

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.2m
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

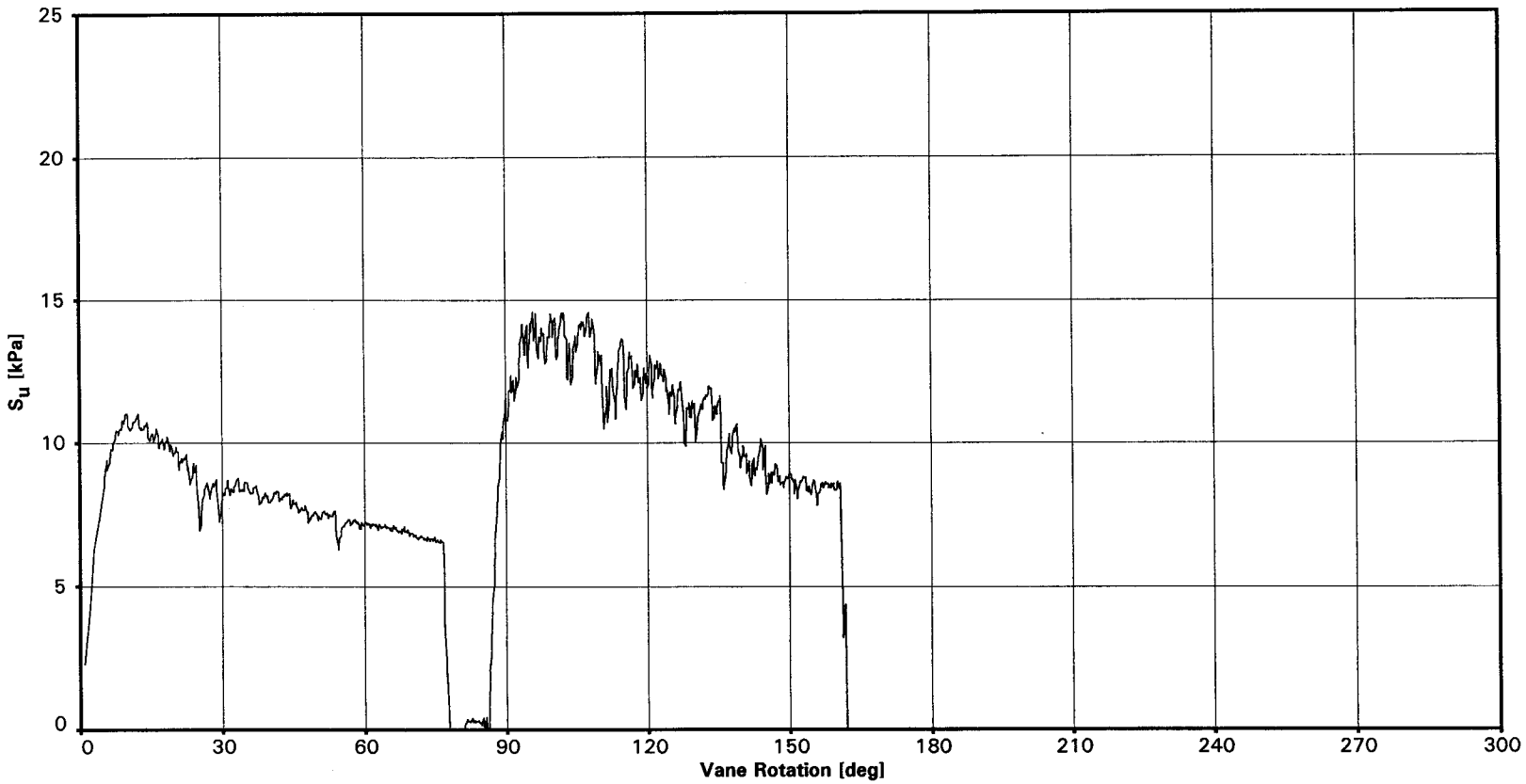
PLATE 98-35.9b

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)

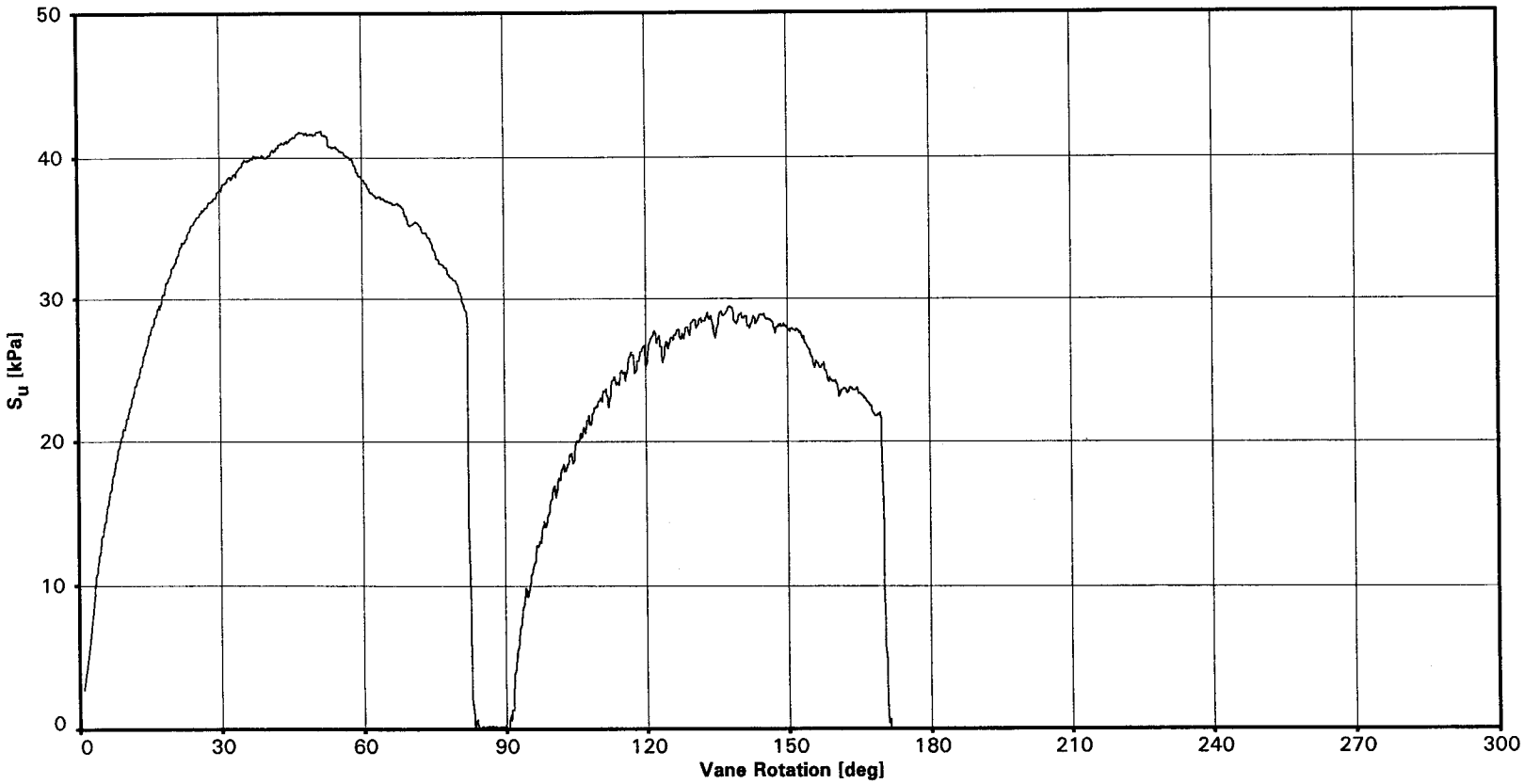


REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.8m
Boring 98-35
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 2.4m
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

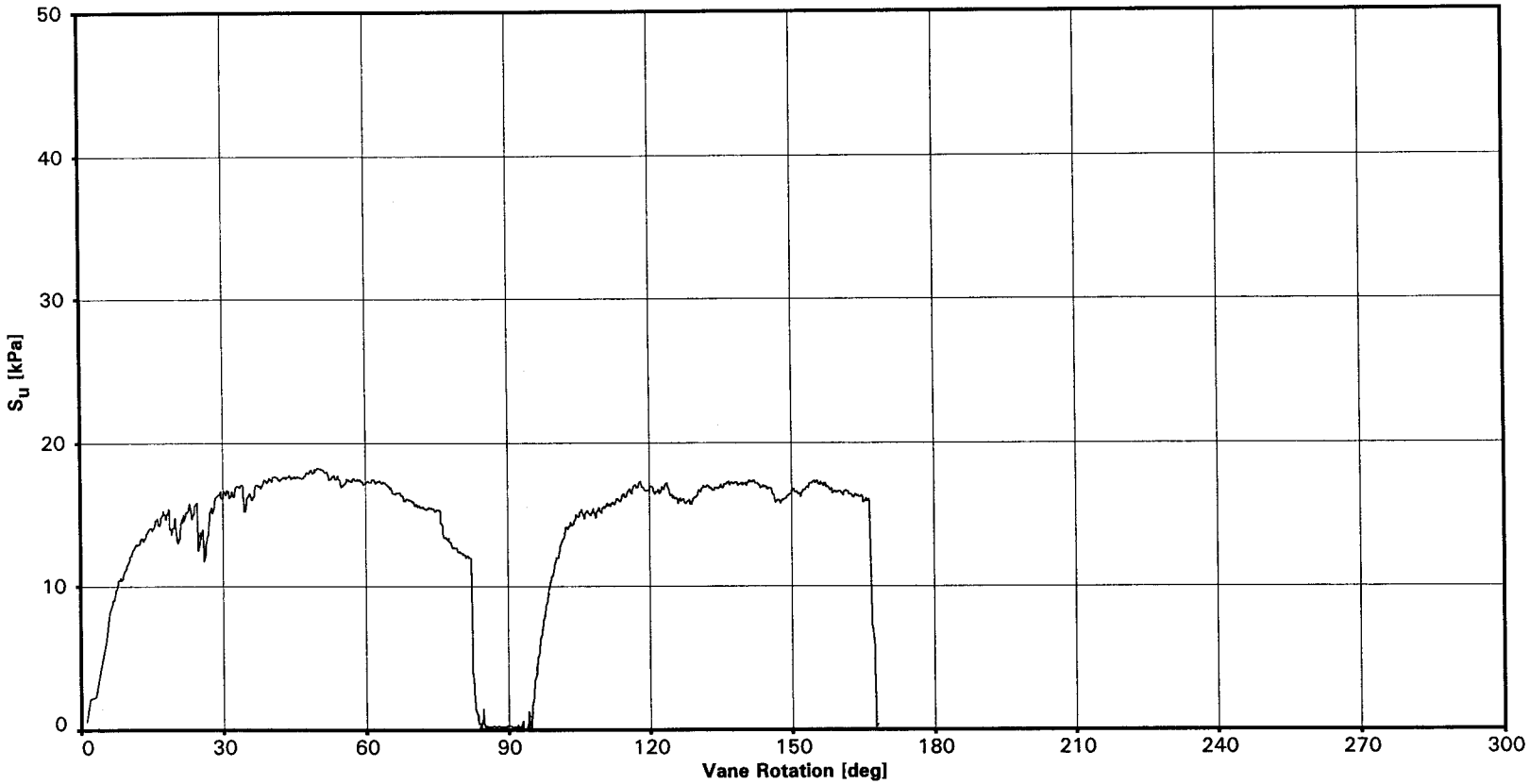
FUGRO

PLATE 98-35.9d

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.0m
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

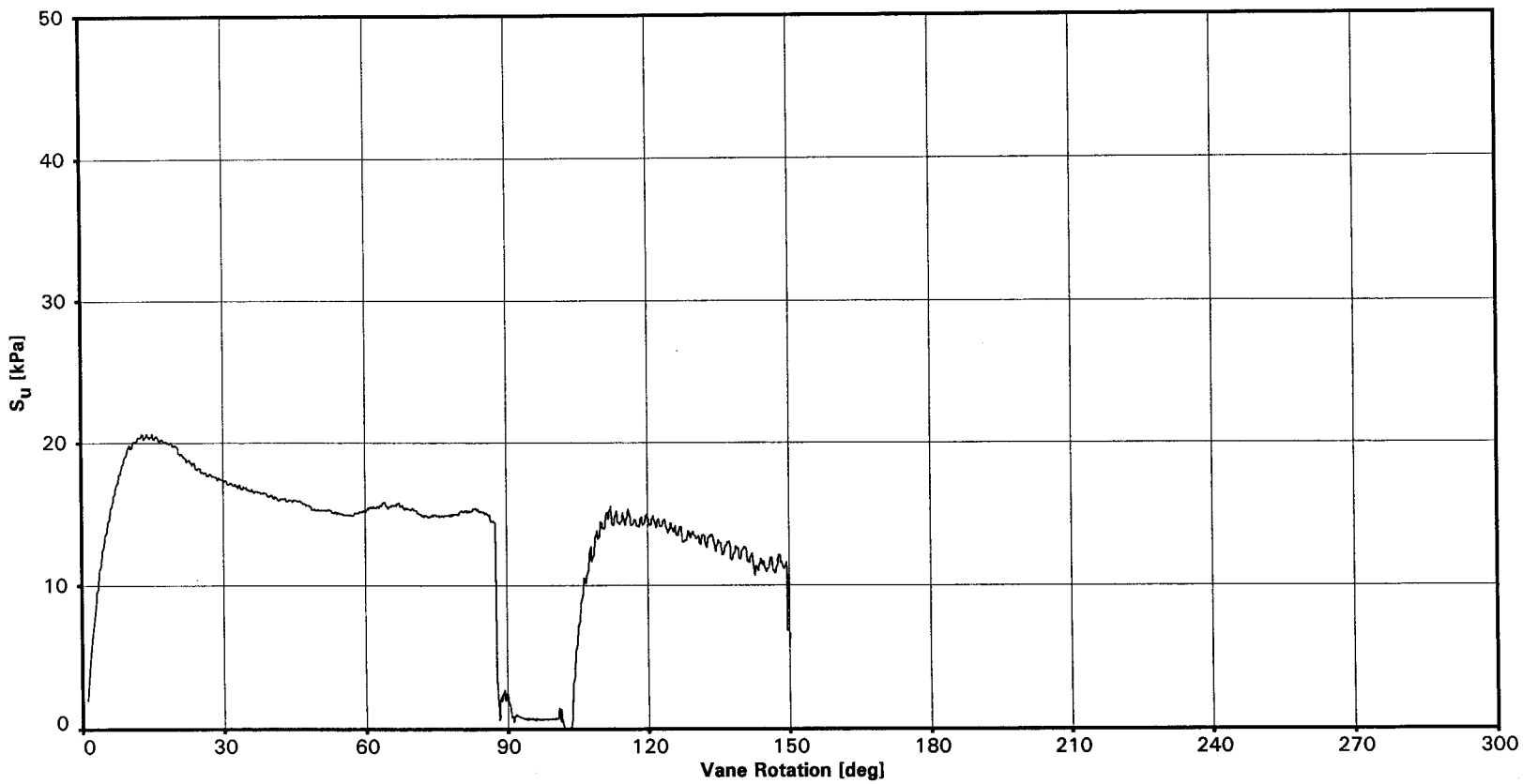
FUGRO

PLATE 98-35.9e

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.7m
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

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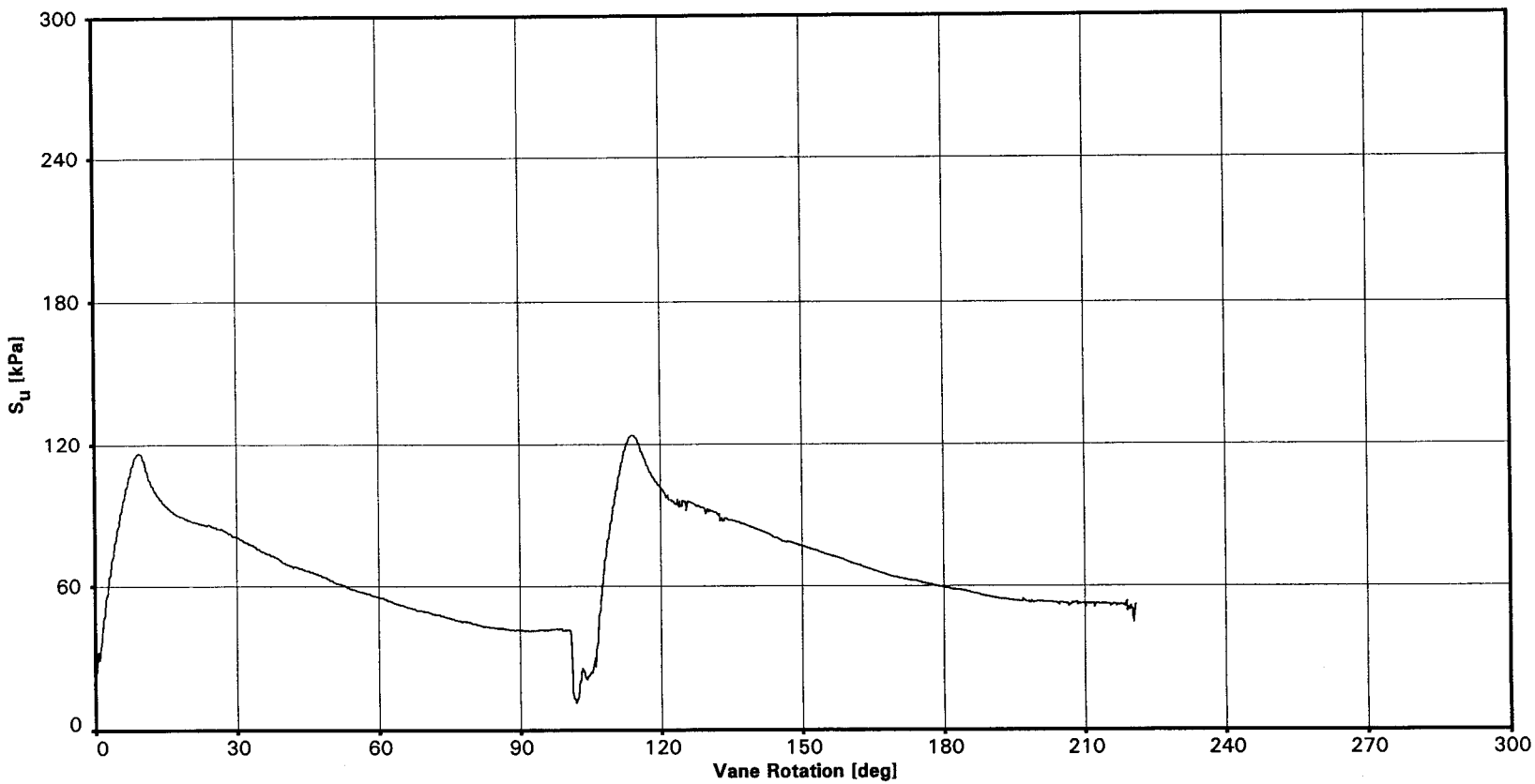
PLATE 98-35.9f

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 23.5m and 24.1m
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SFOBB East Span Seismic Safety Project

Earth Mechanics

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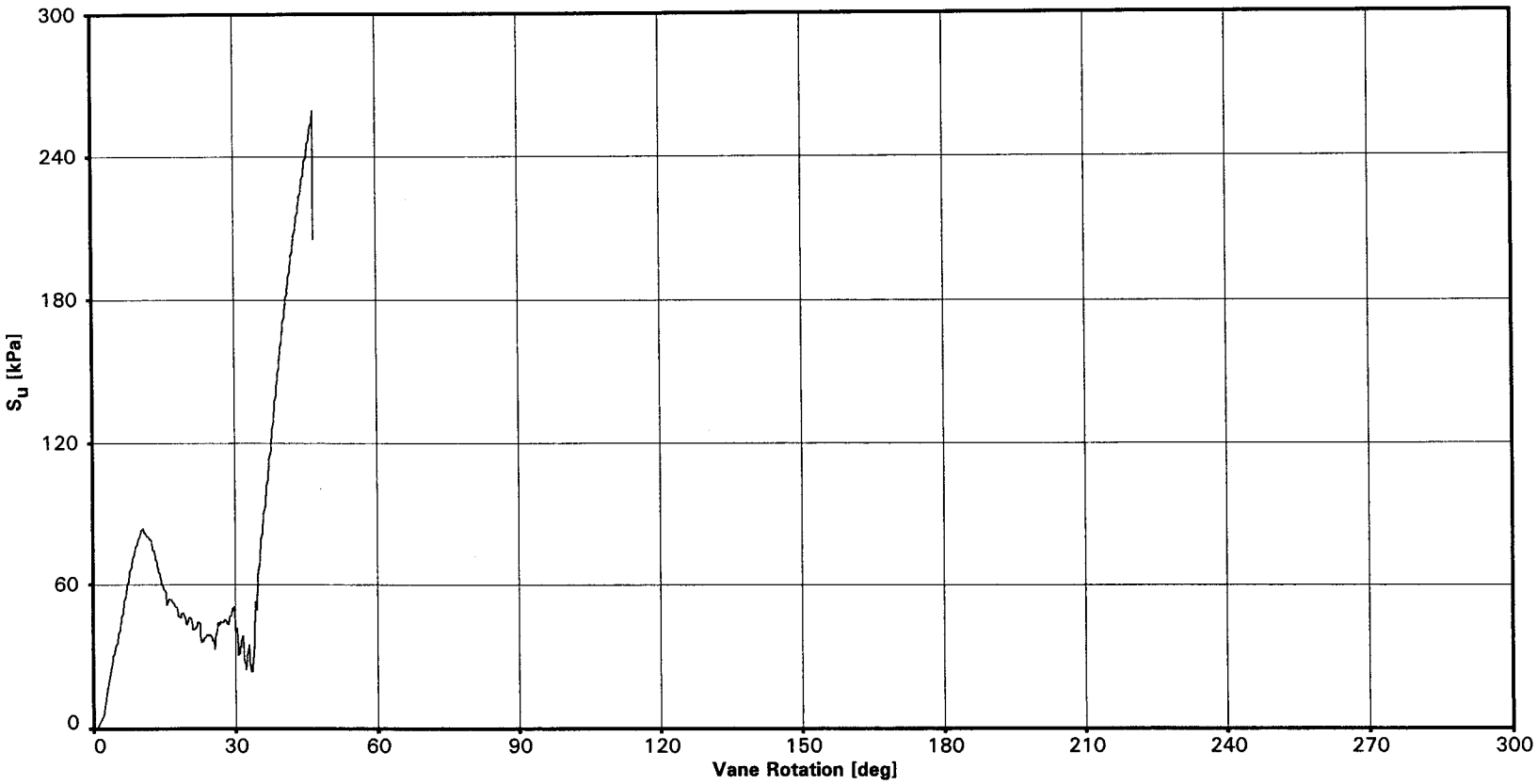
PLATE 98-35.9g

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 35.7m and 36.3m
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

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PLATE 98-35.9h

98-35		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
0.2	1	50	75	29	0.46	4.8	99																	H		
0.3	2					3.5					2.8	1.7	0.4													
0.6	500													1.9												
1.2	3					7.1																				
1.2	501													6.7												
1.2	503													8.6												
1.4	4					7.1																				
1.5	5	45	40	22	1.24					11.5	6.6															
1.8	504													11.0												
1.8	505													14.4												
2.1	6					6.1																				
2.3	7					6.3																				
2.4	8	50	39	21	1.62					8.2	15.6		1.1													
2.4	506													41.2												
2.4	507													29.2												

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-35		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
3.0	508													18.2												
3.0	509													17.2												
3.2	10	62	57	23	1.16					5.2																
3.4	11					7.3																				
3.7	510													20.6												
3.7	511													15.3												
4.0	12									21.1	10.4		1.8													
4.1	13					8.7																				
4.3	14	39	27	15	1.96						21.8															
4.7	15					9.3																				
4.9	16	26	20	14	2.11						10.6															
5.8	17							20.1																		
5.9	18	37								21.1	22.9	4.4	4.4													
6.1	19					7.1		22.0																		
6.9	21	67	54	23	1.42	6.4																		C	2.53	

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-35		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
7.0	22	63	53	23	1.34			28.7		21.1	28.5	5.6														
7.5	23					5.5																				
7.6	24	66	68	29	0.94			22.0		27.8	22.3	3.8														
8.3	25										15.6															
9.4	27					8.4																				
9.6	28	37	23	13	2.48			35.4			34.7	5.1														
10.8	29	15	33	14	0.05	11.9	48								172.3		2.8									
14.6	30	50	78	25	0.46	6.9	91	86.2	71.8						65.5	36.6	0.4							H		
14.8	31							71.8	57.5	77.6	92.8															
15.8	32	59	82	25	0.59																			C	2.74	
15.8	33	43	50	22	0.78						101.5															
19.4	34	22				8.5	4																			
23.2	35							95.8	95.8																	
23.3	36	52	82	30	0.41										111.5		0.4									
23.5	37					6.7		107.7	95.8	166.6	121.3															

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-35		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
24.1	400													115.4												
24.7	401													121.6												
29.3	38								105.3																	
29.4	39	38	49	22	0.60	7.5	97								129.7	31.9	0.8							H		
29.6	40								105.3	166.6	139.9															
30.1	41	45	68	28	0.42																			C	2.77	
30.2	42	45	60	25	0.58						134.9															
34.6	43	41	60	24	0.48	8.1									85.2		3.4									
34.9	45	28	36	22	0.45		61																			
35.1	46					8.6																				
36.3	402													80.9												
36.9	403													258.6												
37.8	47								201.1																	
37.9	48	19	28	17	0.20	10.9									239.3		0.9									
38.1	49										222.8															

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

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98-35		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
42.7	50	43	87	21	0.33	7.8									156.8	70.9	0.6									
42.8	51					7.4		174.8																		
43.0	52							138.9	167.6		186.9															
43.5	53	42	70	18	0.46																			C	2.76	
43.6	54	43	86	27	0.28						193.1															
48.2	56	19	30	12	0.38	11.0	82								273.5		0.6									
48.3	57								245.3		222.8															
53.2	59	39	76	28	0.22	8.0	81		175.2						191.8	182.7	0.6							H		
53.3	60										222.8															
58.1	62	47	76	23	0.47	7.2									165.5		0.5									
58.2	63								191.5		222.8															
62.8	64	56	83	26	0.54	6.4									112.4		0.4									
62.9	65					6.6									104.6	69.3	0.3									
63.1	66								143.6		222.8															
63.6	67	43	57	20	0.63																			C	2.76	

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-35		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
63.7	68	45	58	26	0.58						177.0															
68.1	69								251.4																	
68.3	70	36	65	22	0.33	7.9	93								167.0		2.1							H		
68.6	72	36	104	43					191.5		193.1															13
73.2	73	18	44	13	0.17	11.9			292.1		222.8															
77.9	74					9.5	27											38.3	33							
77.9	75	27					8																			
80.1	76	24				10.2	24																			
83.2	77								257.1		220.3															
83.4	78	20	29	16	0.31	10.7									160.9		2.2									
83.5	79					10.4																				
84.0	80	20	36	13	0.31																			C,K	2.72	
84.1	81	20	34	15	0.29						222.8															
87.9	82	21	51	19	0.04	10.7									288.3		0.4									
88.1	83	18	35	16	0.10	10.6			222.0						155.6	115.2	1.1									

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

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98-35		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)			
90.1	85						4																			
91.5	86					13.4	9																			
93.0	87						4																			
94.6	88						12																			
95.1	89	20	32	14	0.31	9.9			222.0						200.5		3.6									
95.3	90					10.1									195.9		3.1									
95.4	91								222.0																	
97.8	92						14																			
98.0	93	17				10.5																				
99.8	94	14				10.9																				
101.3	95	16				12.1	15																			
102.9	96	22	70	20	0.04	10.6																				
104.4	98						32																			

Identification Tests
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics

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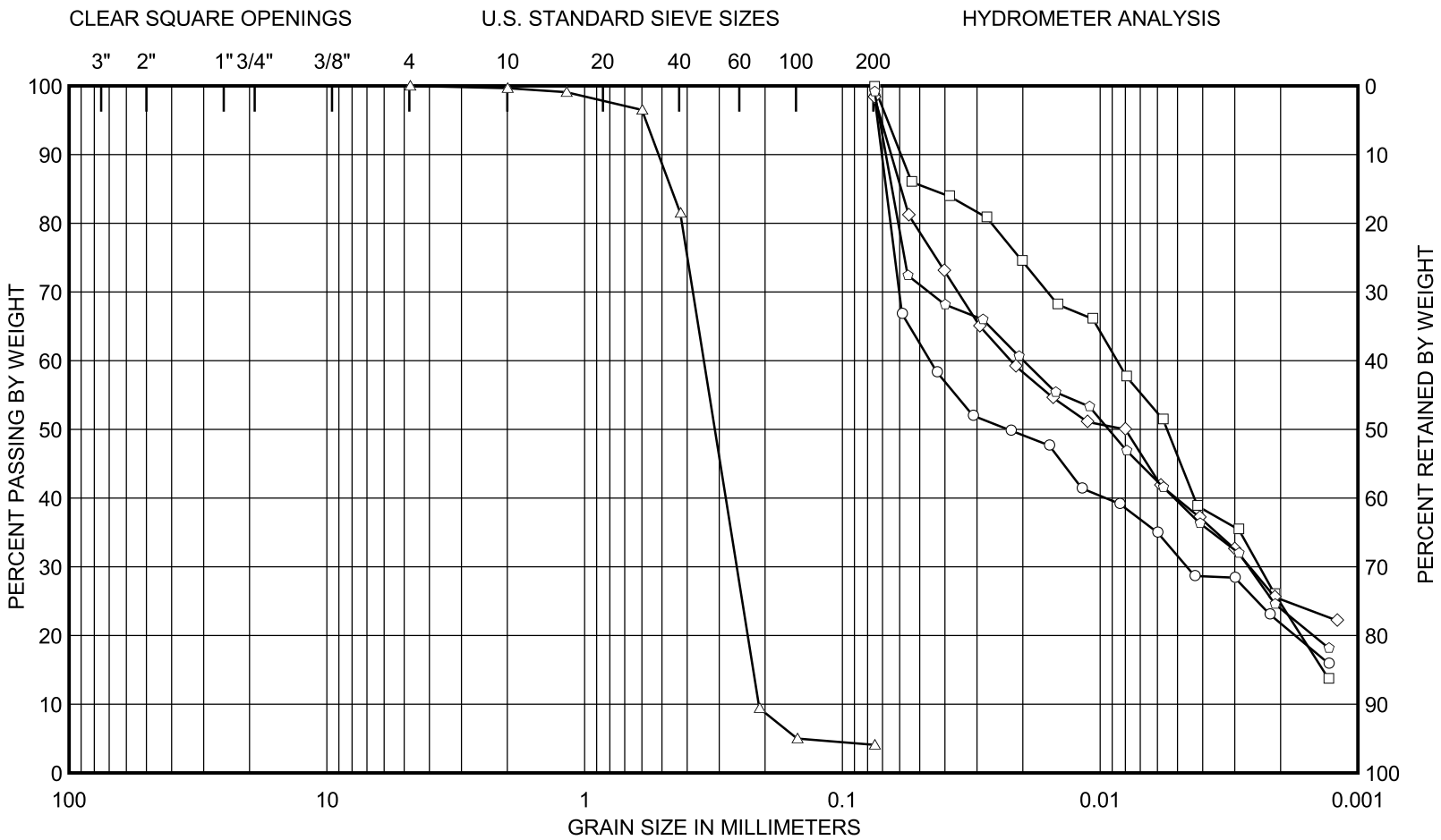

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
1	0.2	○——○	FAT CLAY (CH) with many shells and shell fragments			0.023
30	14.6	□——□	FAT CLAY (CH) with a few silt pockets			0.0055
34	19.4	△——△	FINE SAND (SP) with medium sand	0.9	1.6	0.31
39	29.4	◇——◇	FAT CLAY (CH) with silt pockets, partings and seams, and a few shell fragments			0.0080
59	53.2	⬠——⬠	FAT CLAY (CH) with sand and with silt pockets			0.0093

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-35

SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

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PLATE 98-35.11a

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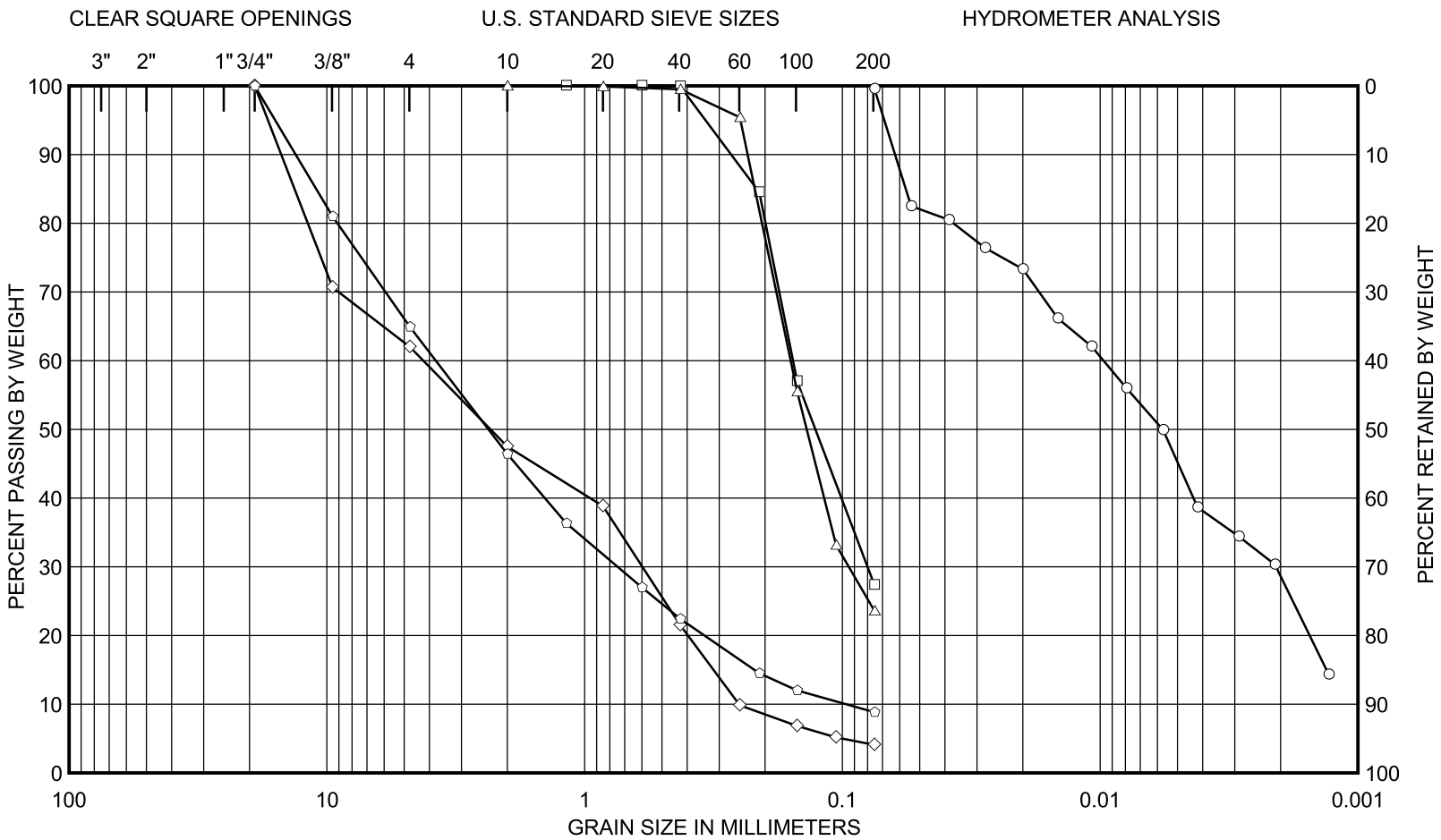

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
70	68.3	○——○	FAT CLAY (CH) with many organic pockets			0.0057
74	77.9	□——□	SILTY FINE SAND (SM)			0.13
76	80.1	△——△	SILTY FINE SAND (SM)			0.14
85	90.1	◇——◇	FINE TO COARSE SAND (SP) with fine gravel	0.3	16.7	2.3
86	91.5	⬠——⬠	FINE TO COARSE SAND (SP-SM) with silt and fine gravel	1.5	38.8	2.4

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-35

SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-35.11b

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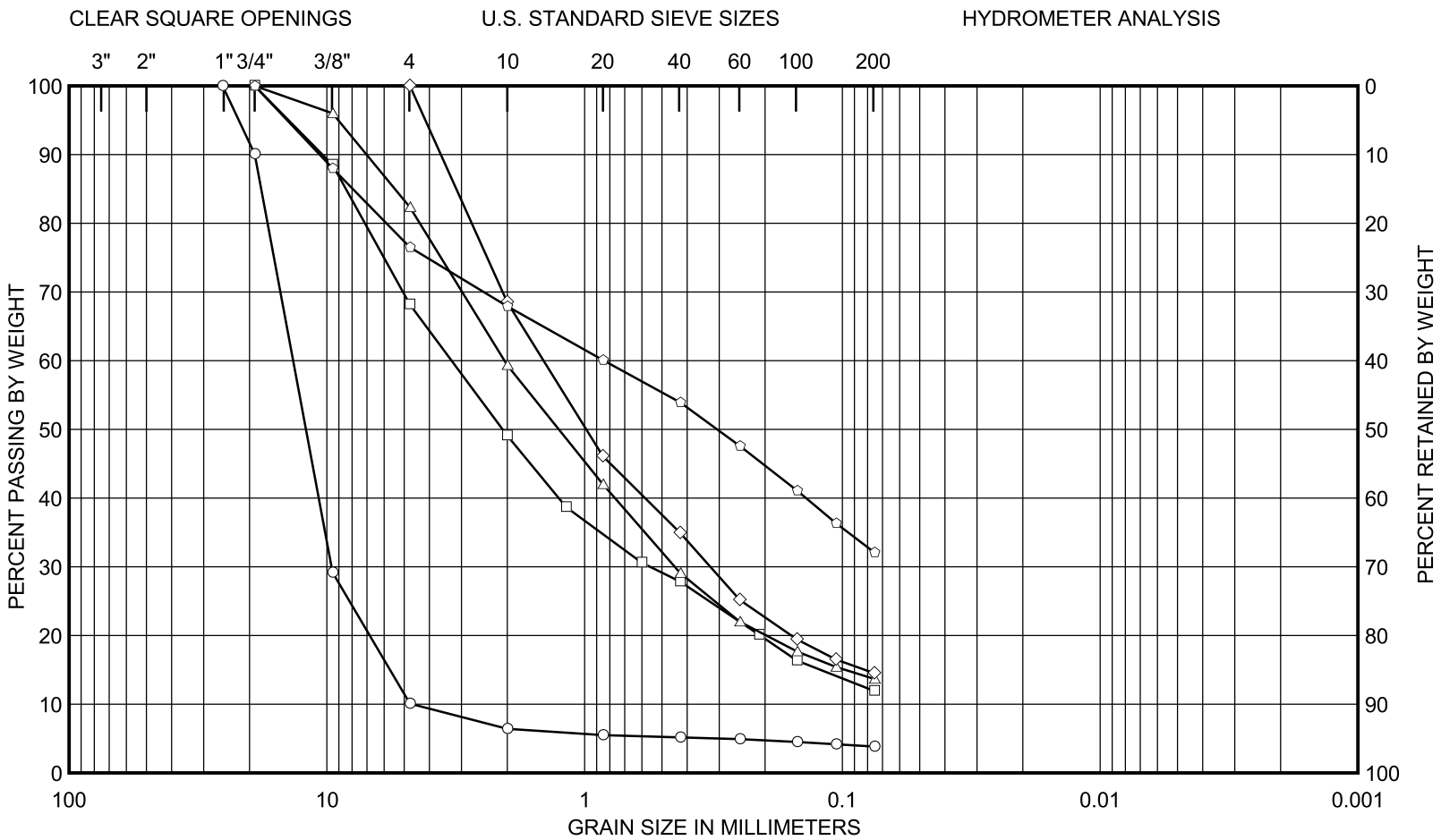

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
87	93.0	○——○	FINE GRAVEL (GP) with sand	1.5	2.9	12.1
88	94.6	□——□	FINE TO COARSE SAND (SW-SM) with silt and fine gravel			2.1
92	97.8	△——△	SILTY FINE TO COARSE SAND (SM) with fine gravel			1.3
95	101.3	◇——◇	SILTY FINE TO COARSE SAND (SM)			0.99
98	104.4	⬠——⬠	SILTY FINE SAND (SM) with fine gravel and medium and coarse sand			0.31

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-35

SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-35.11c

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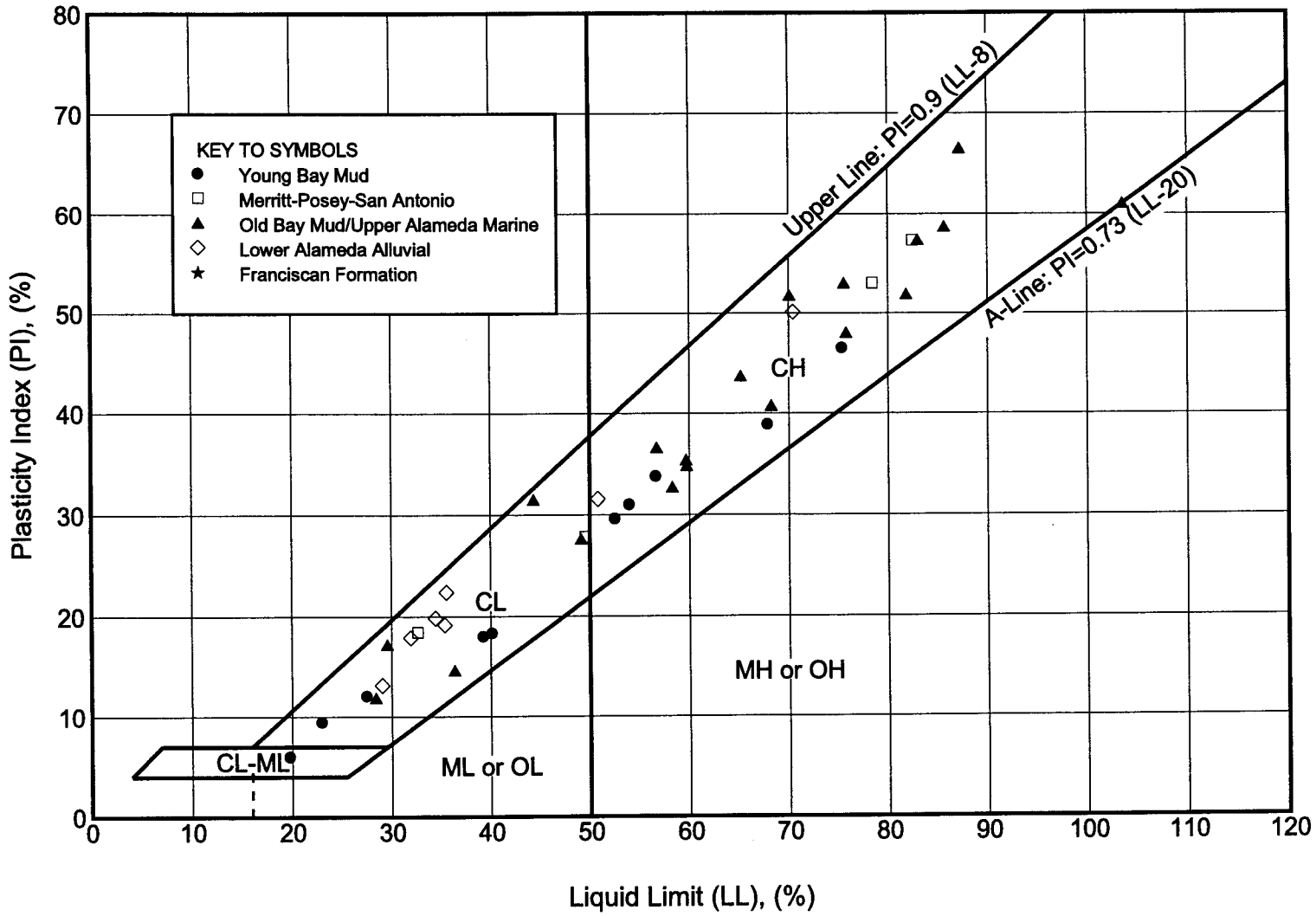
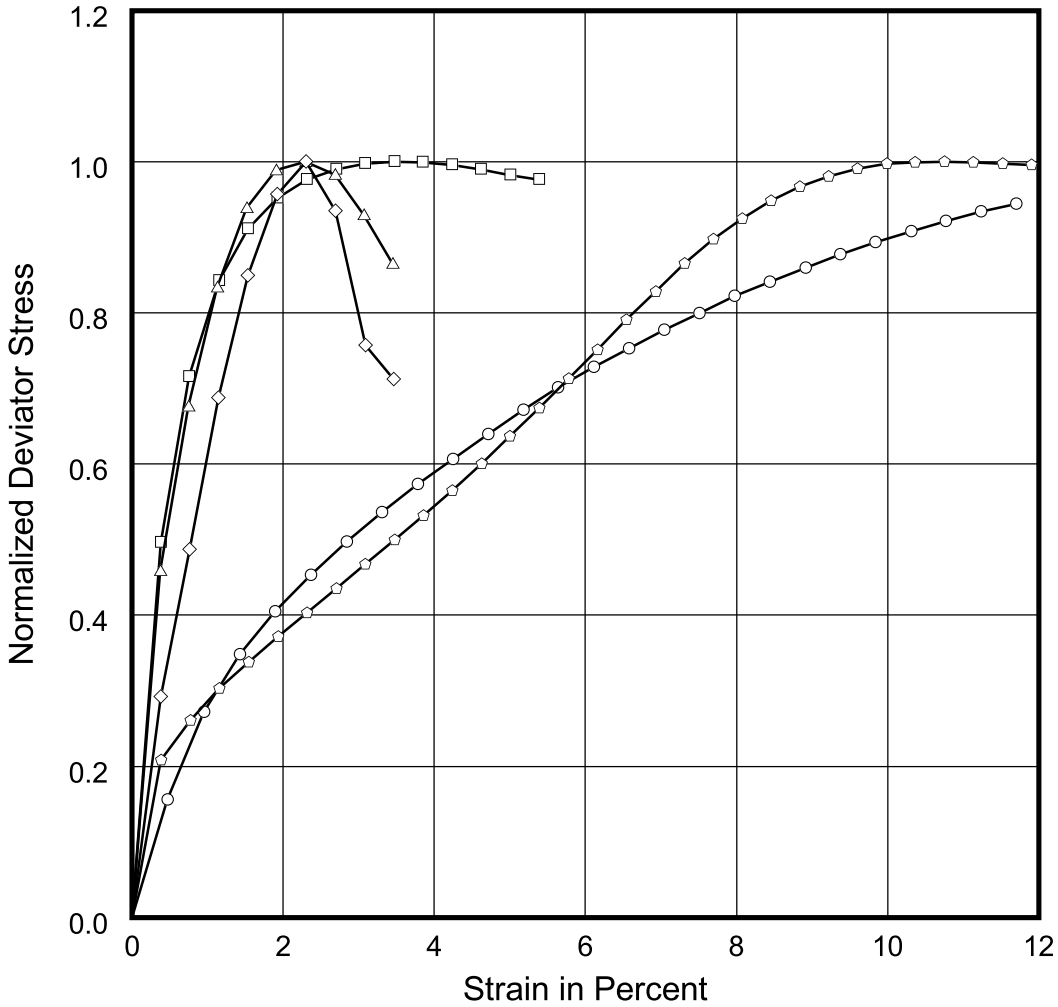


PLASTICITY CHART
Boring 98-35
SFOBB East Span Seismic Safety Project

Earth Mechanics
FUGRO

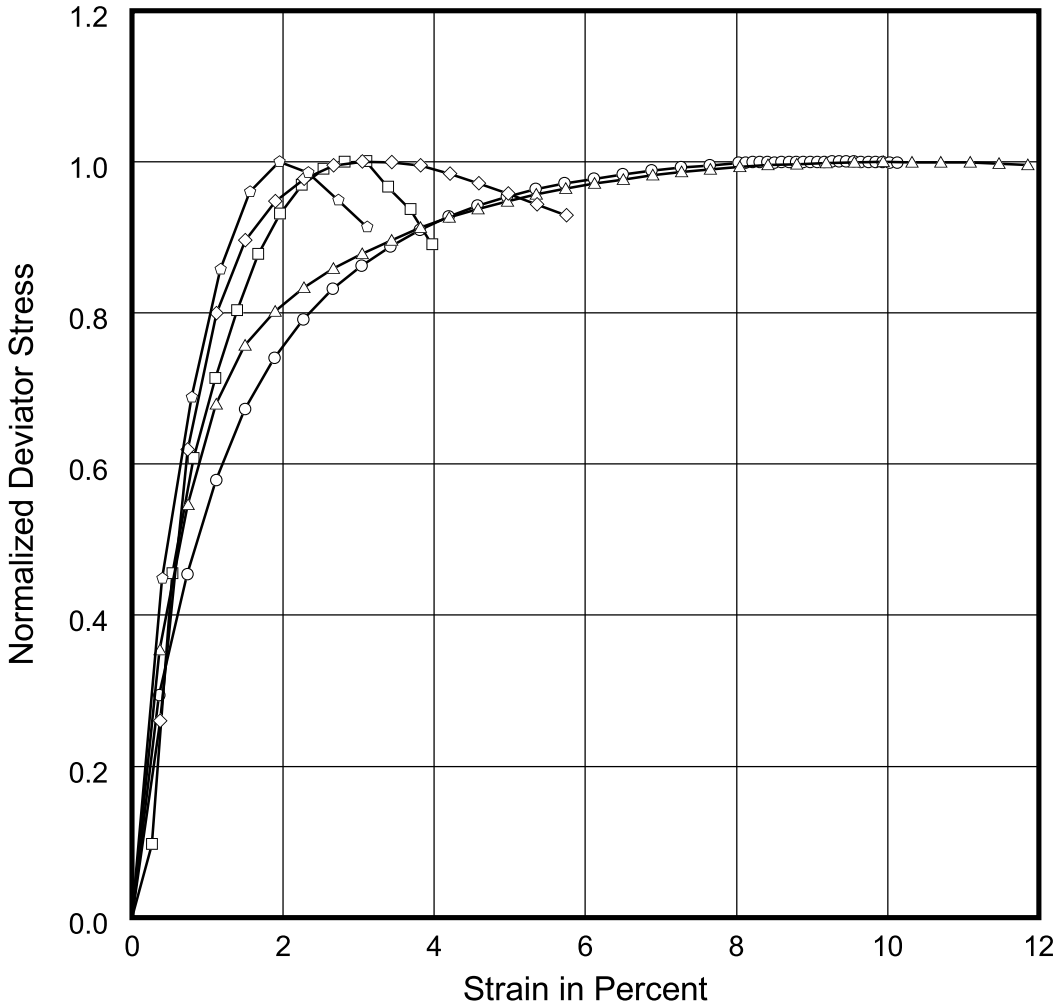


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	29	10.8	UU	827	345	2.8
	30	14.6	UU	827	131	0.4
	36	23.3	UU	827	223	0.4
	39	29.4	UU	931	259	0.8
	43	34.6	UU	1103	170	3.4

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-35
SFOBB East Span Seismic Safety Project

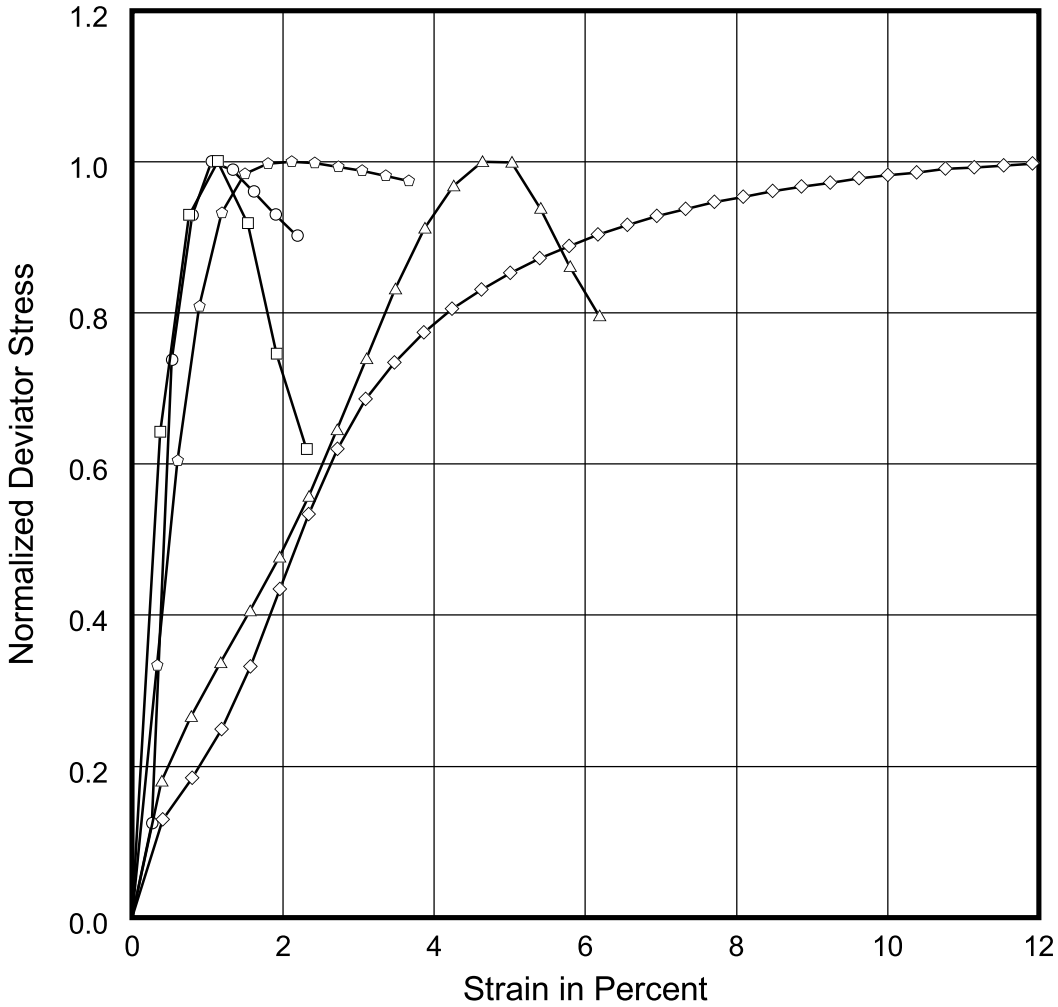


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	48	37.9	UU	1138	479	0.9
	50	42.7	UU	1379	314	0.6
	56	48.2	UU	1379	547	0.6
	59	53.2	UU	1551	384	0.6
	62	58.1	UU	1655	331	0.5

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-35
SFOBB East Span Seismic Safety Project

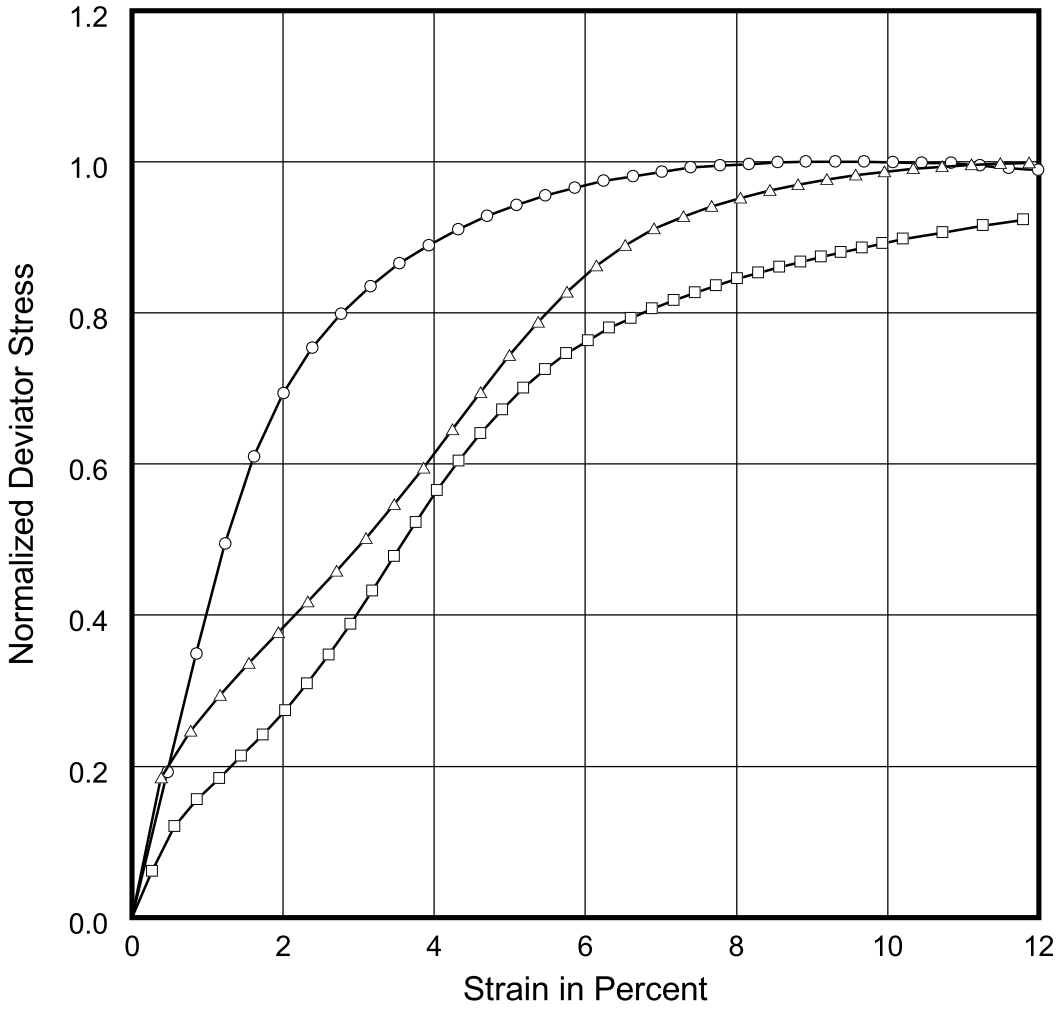


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	64	62.8	UU	1724	225	0.4
	65	62.9	UU	1758	209	0.3
	70	68.3	UU	1896	334	2.1
	78	83.4	UU	2068	322	2.2
	82	87.9	UU	2241	577	0.4

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-35
SFOBB East Span Seismic Safety Project

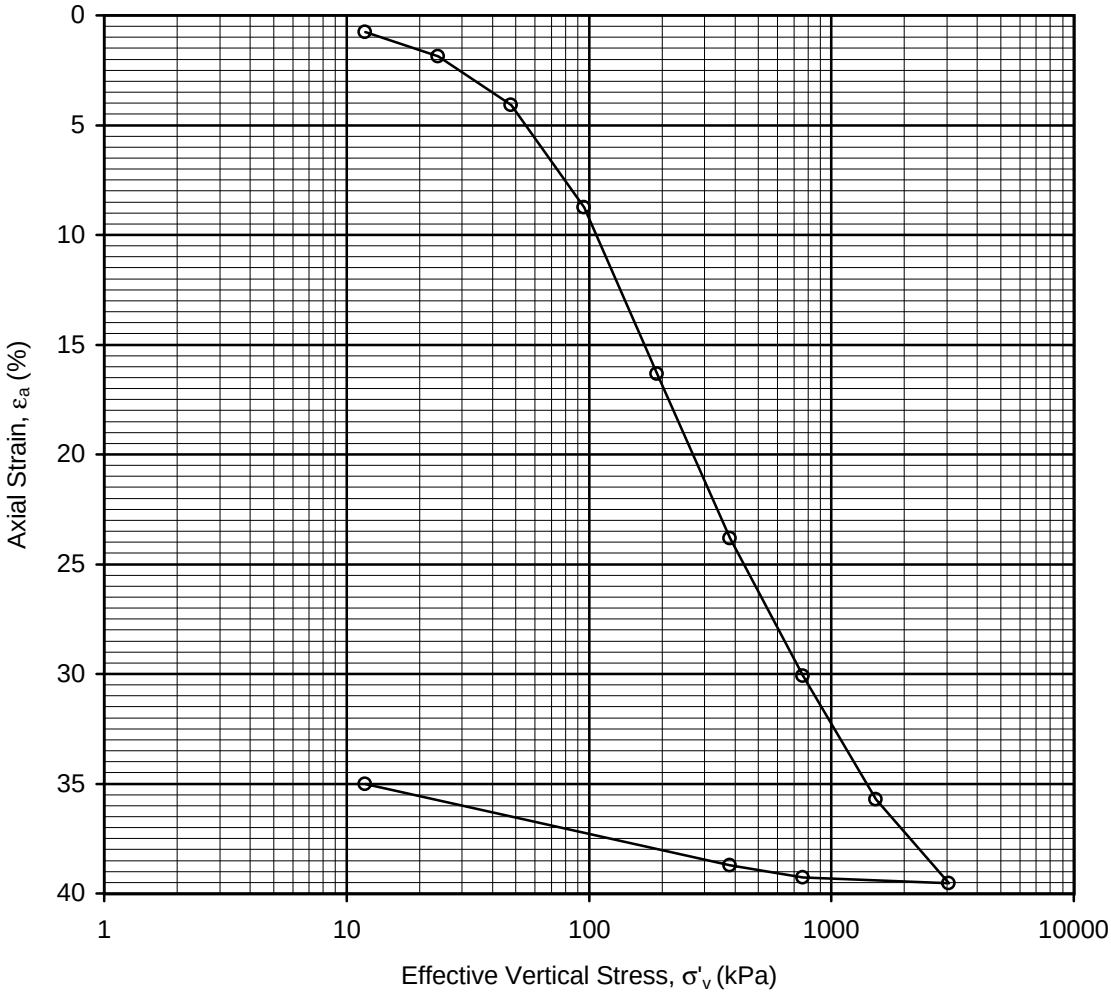


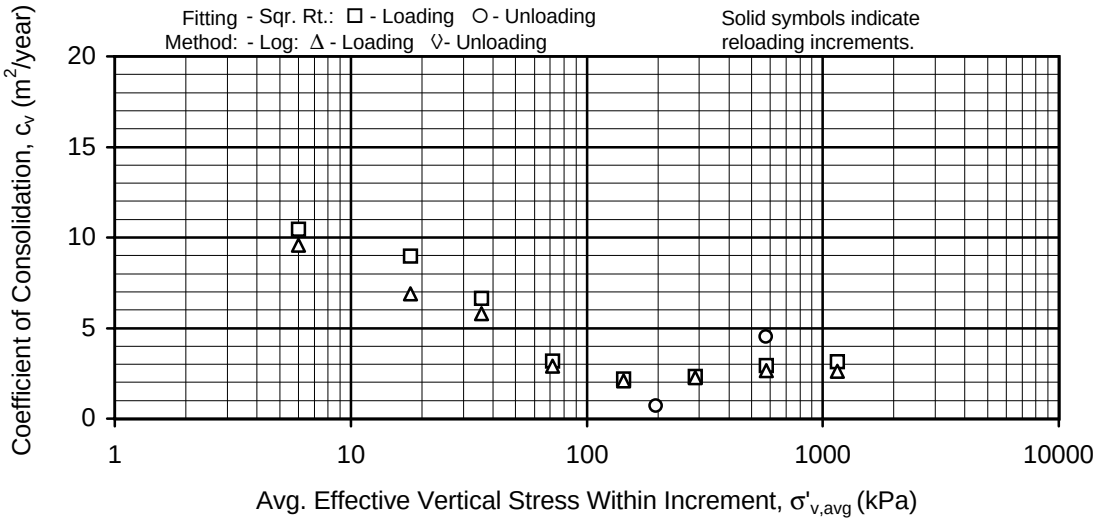
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	83	88.1	UU	2068	311	1.1
□—□	89	95.1	UU	2413	401	3.6
△—△	90	95.3	UU	2413	392	3.1

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

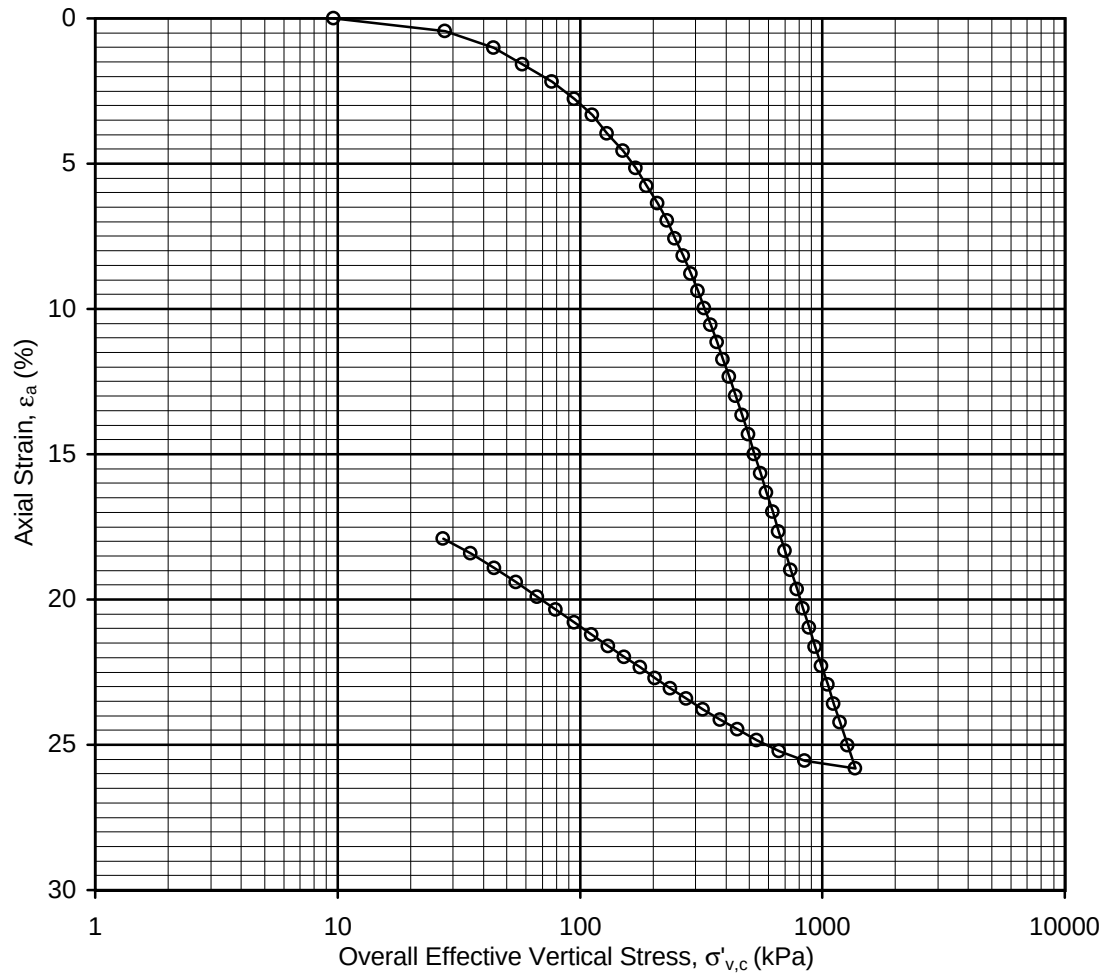
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-35
SFOBB East Span Seismic Safety Project

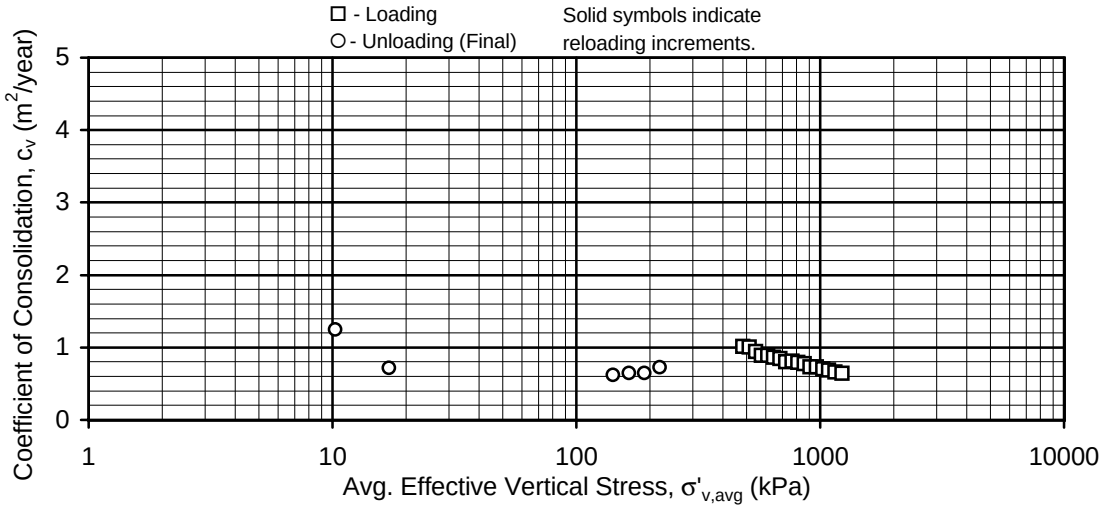




INCREMENTAL CONSOLIDATION TEST RESULTS

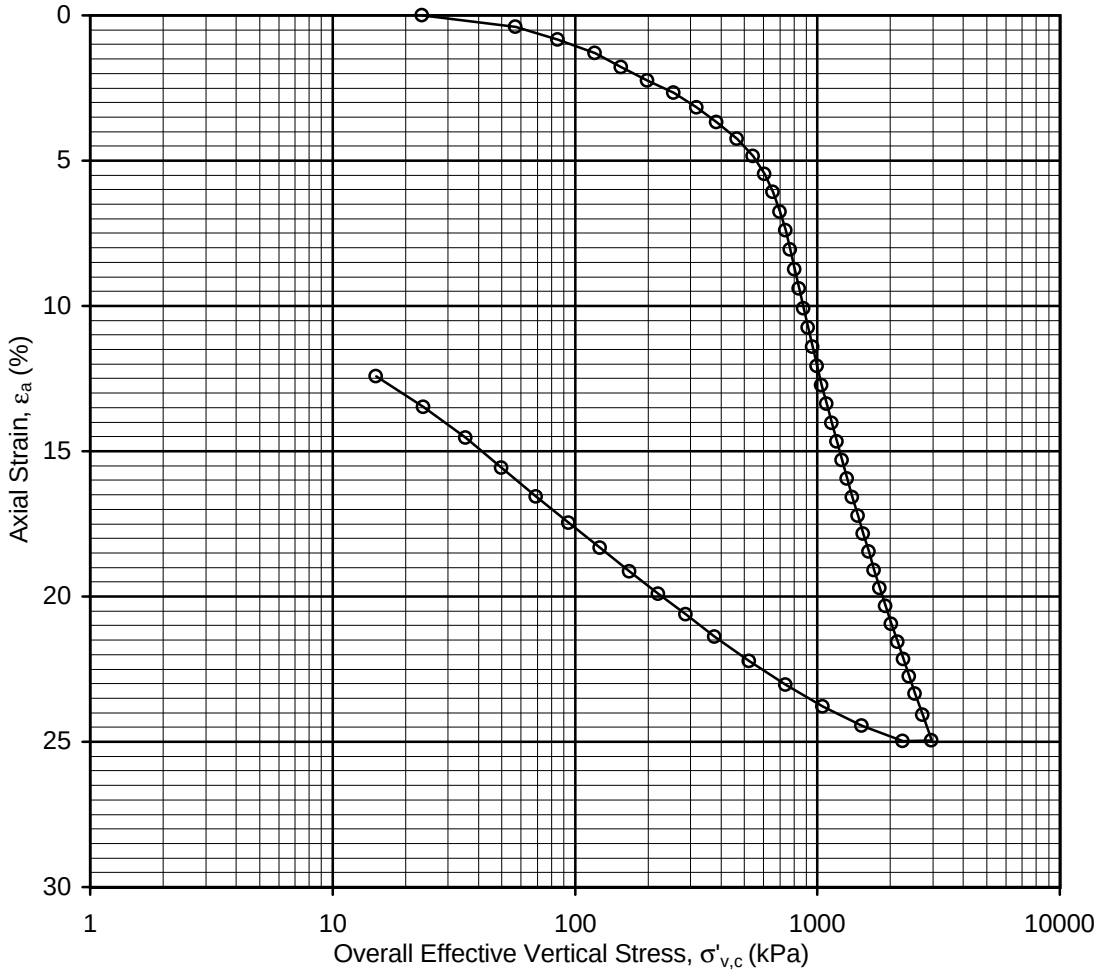
Sample No. 21 - Depth: 6.9m
Boring 98-35
SFOBB East Span Seismic Safety Project

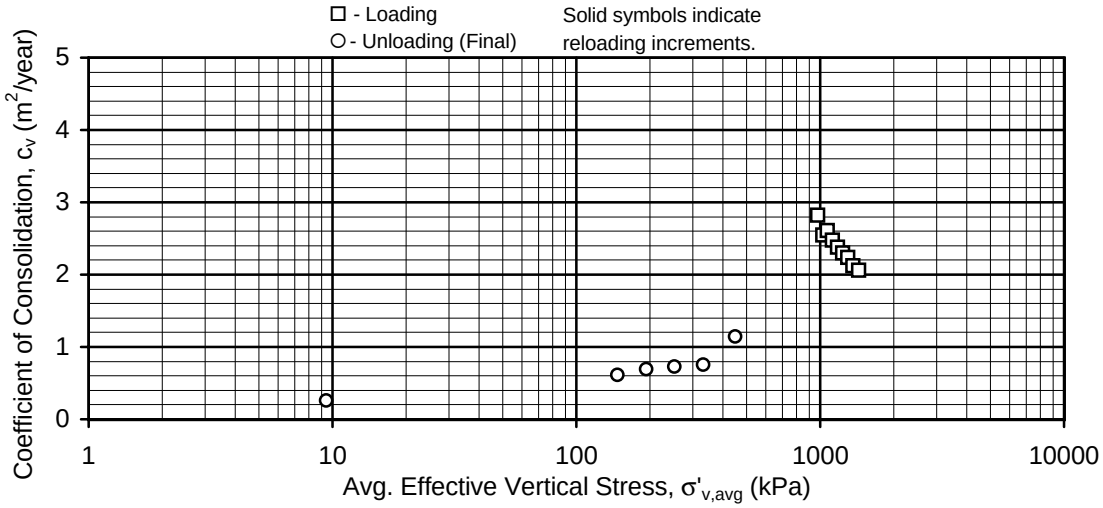




CRS CONSOLIDATION TEST RESULTS

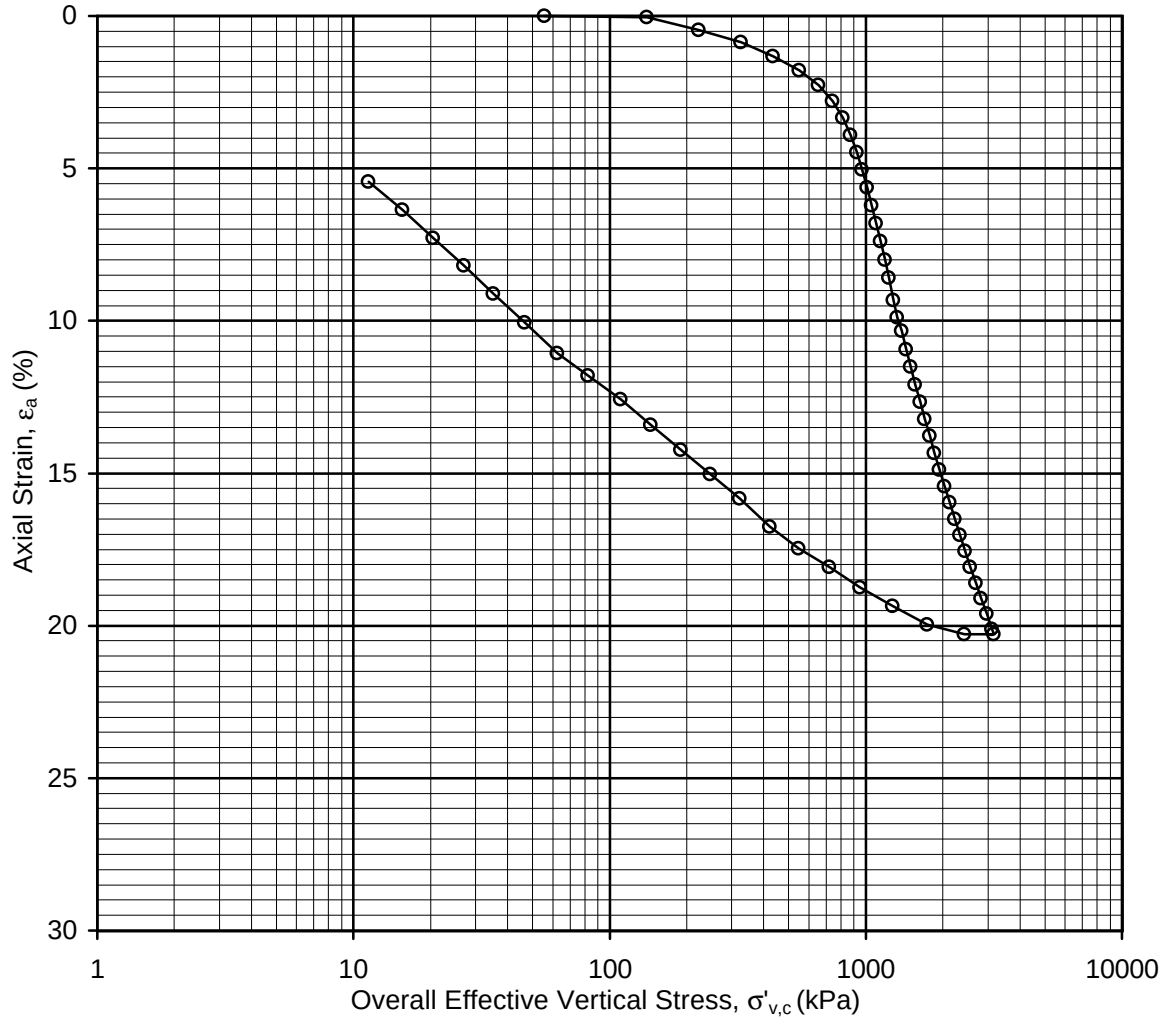
Sample No. 32 - Depth: 15.8m
Boring 98-35
SFOBB East Span Seismic Safety Project

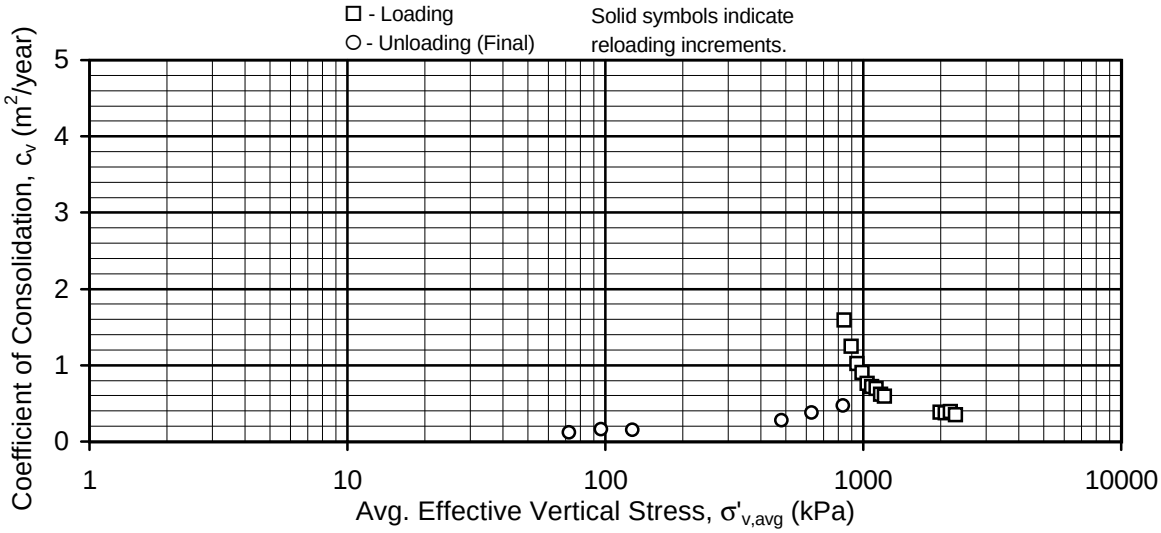




CRS CONSOLIDATION TEST RESULTS

Sample No. 41 - Depth: 30.1m
Boring 98-35
SFOBB East Span Seismic Safety Project

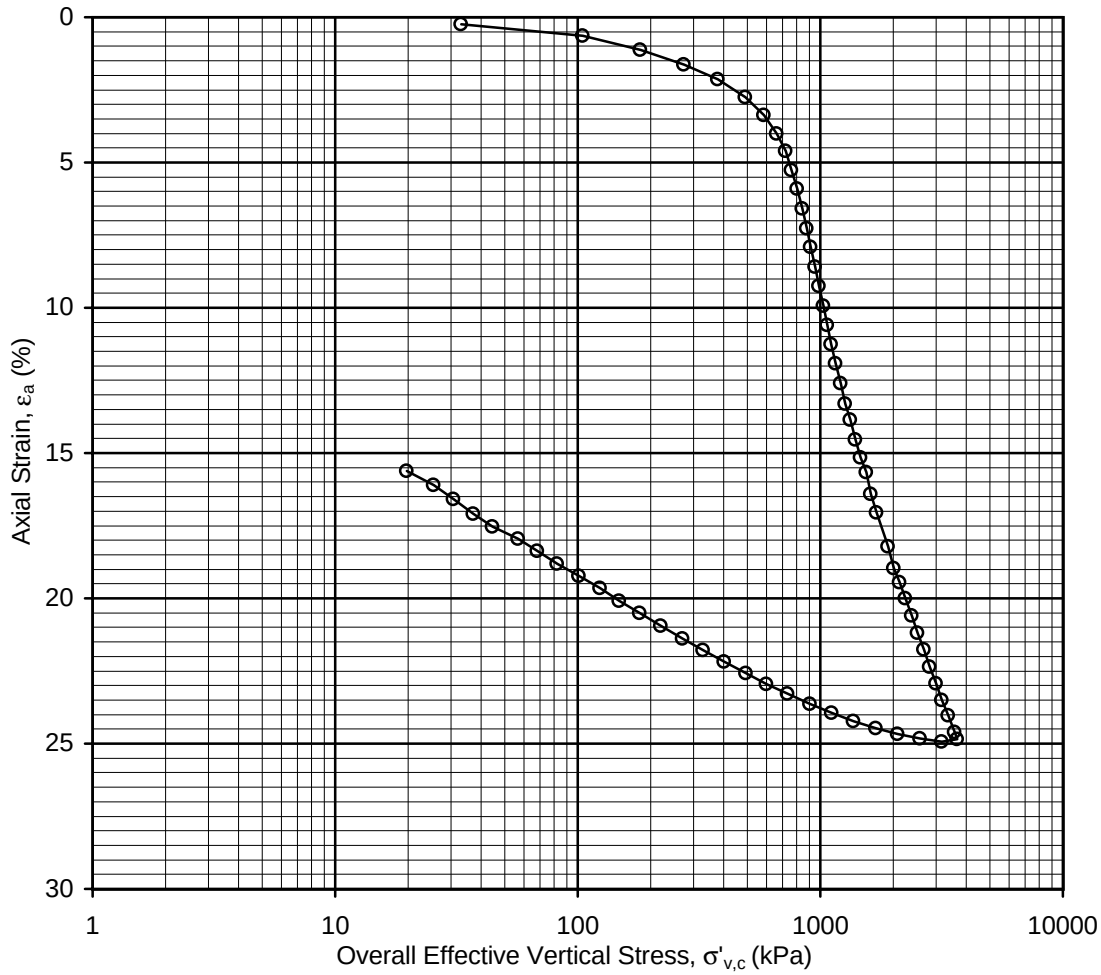


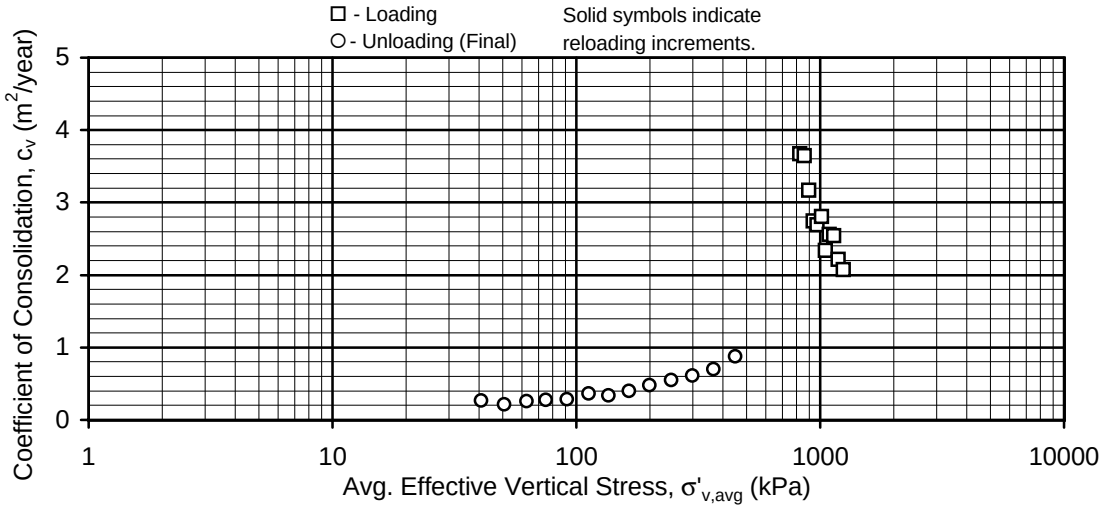


CRS CONSOLIDATION TEST RESULTS

Sample No. 53 - Depth: 43.5m
Boring 98-35
SFOBB East Span Seismic Safety Project

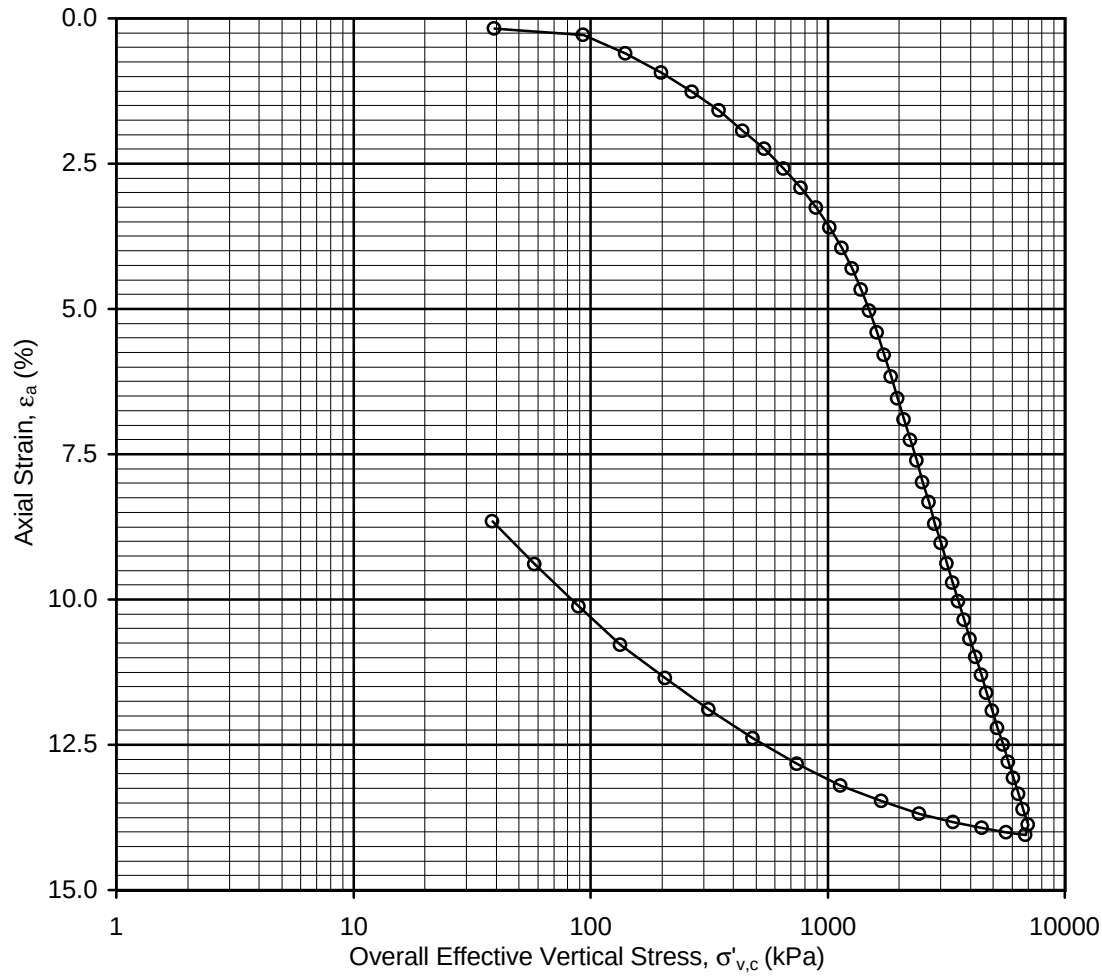
PLATE 98-35.14d

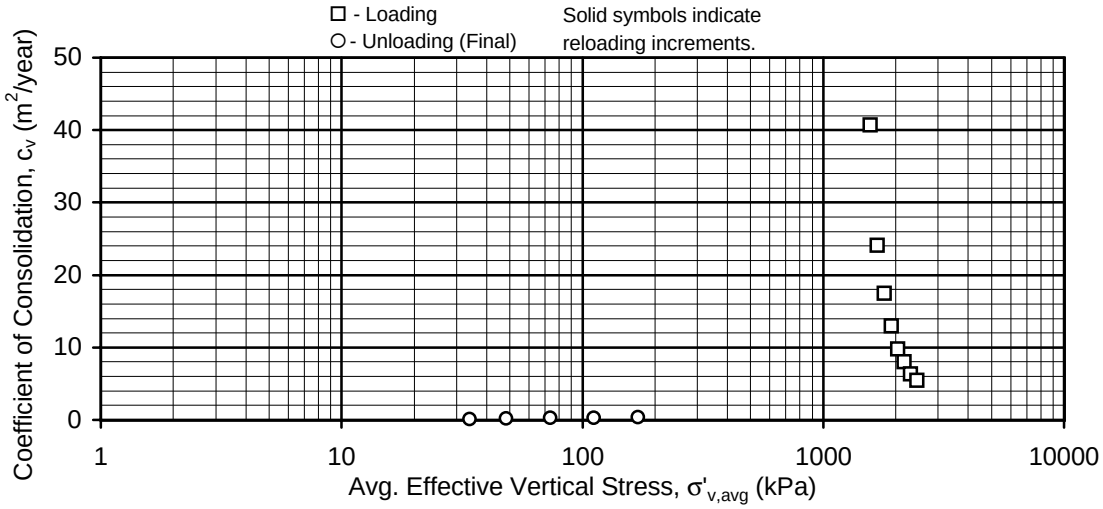




CRS CONSOLIDATION TEST RESULTS

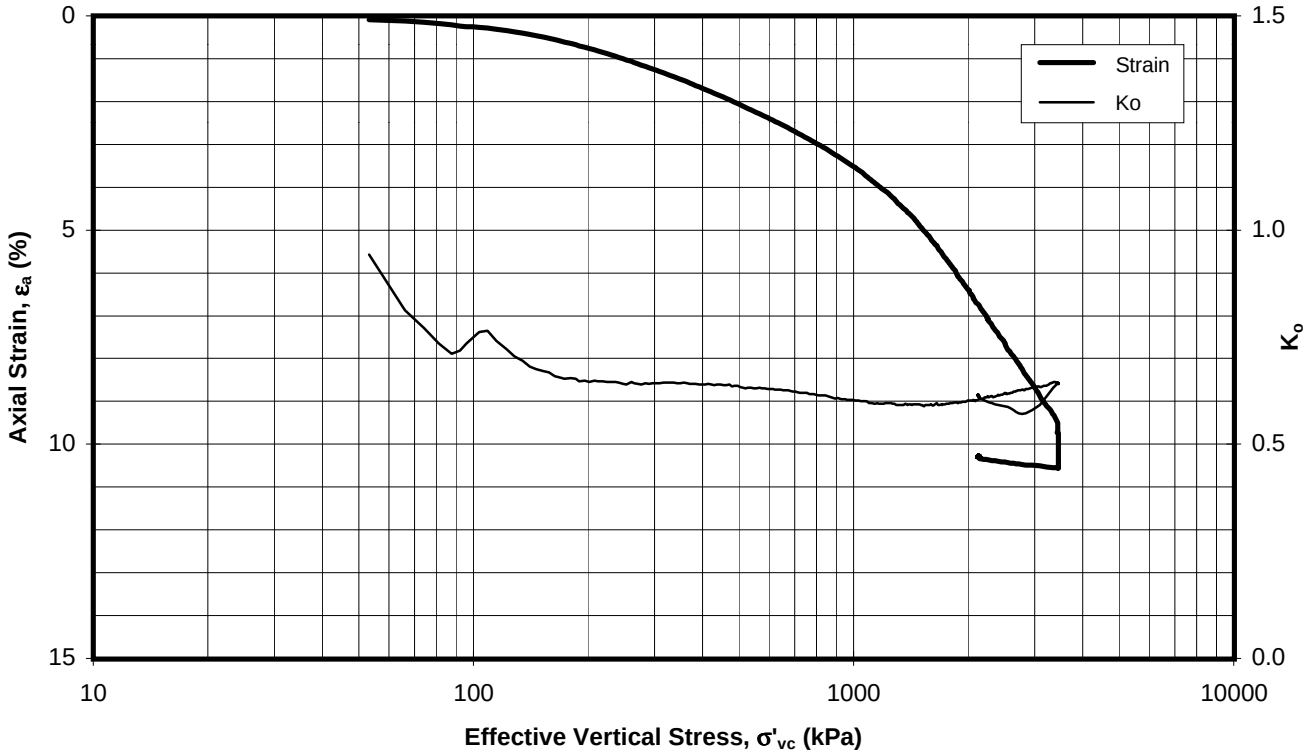
Sample No. 67 - Depth: 63.6m
Boring 98-35
SFOBB East Span Seismic Safety Project

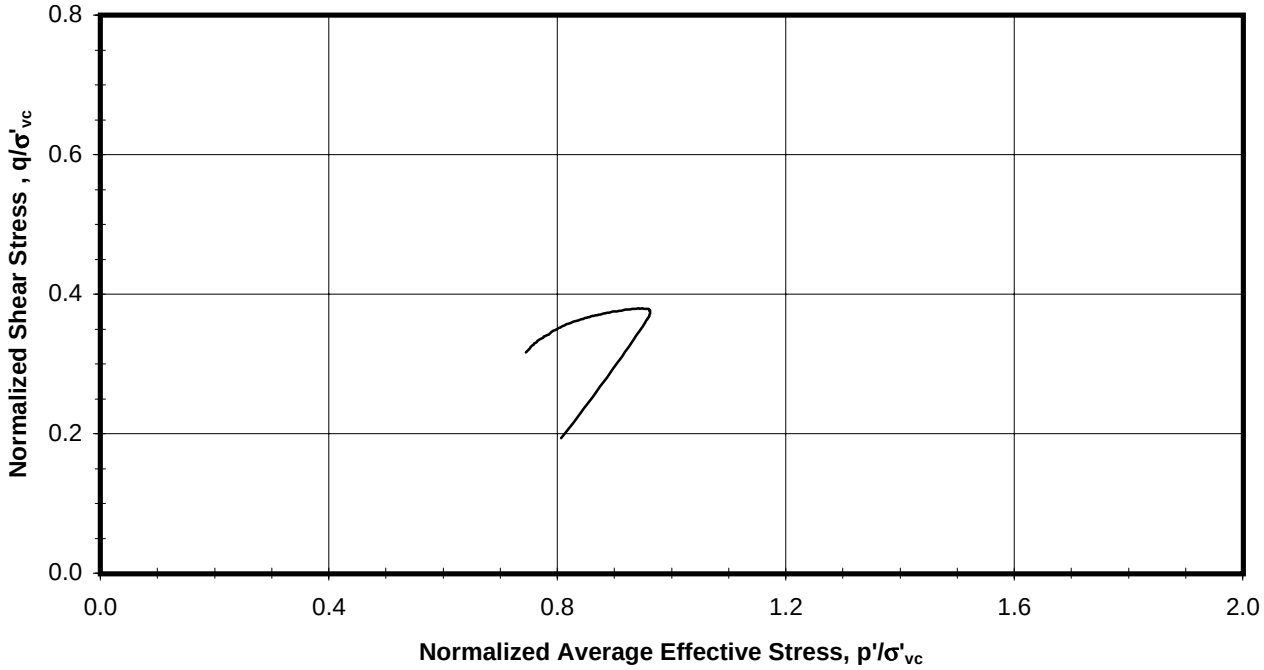




CRS CONSOLIDATION TEST RESULTS

Sample No. 80 - Depth: 84.0m
Boring 98-35
SFOBB East Span Seismic Safety Project





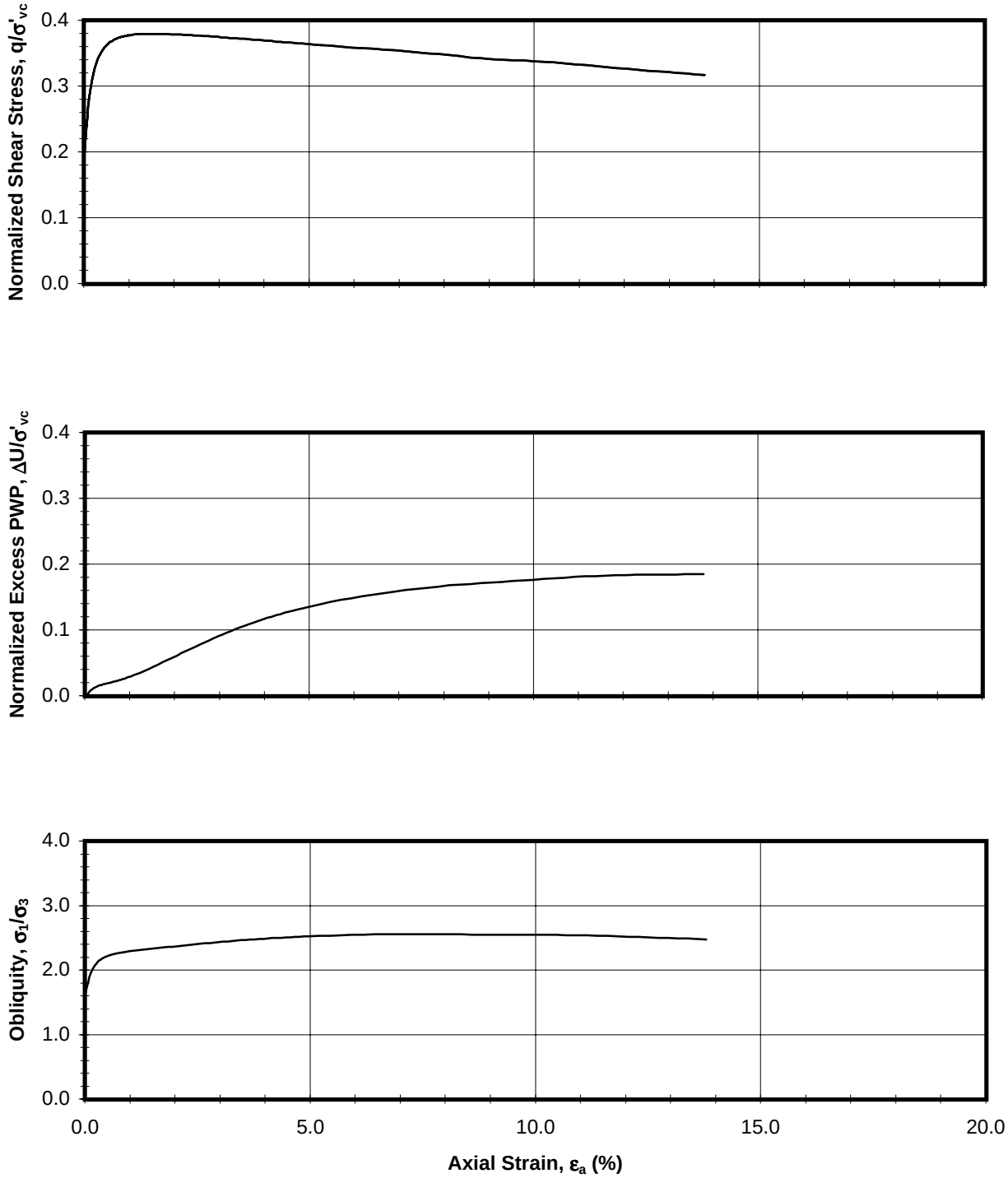
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 80 - Depth: 84.0m

Boring 98-35

SFOBB East Span Seismic Safety Project

PLATE 98-35.15.1

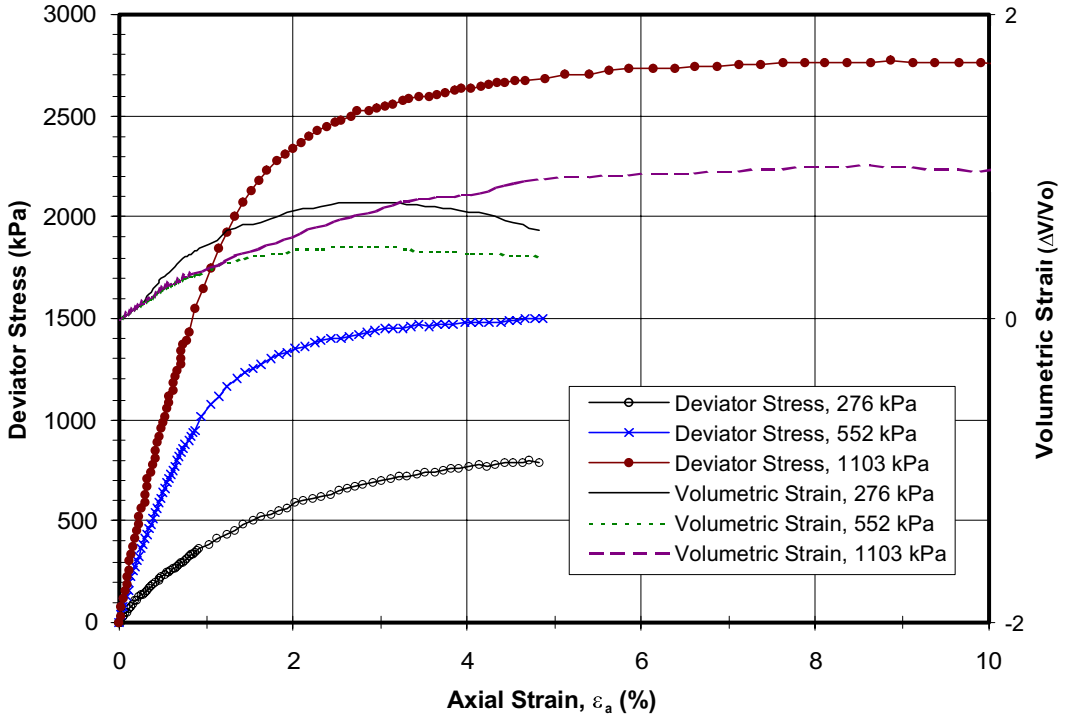


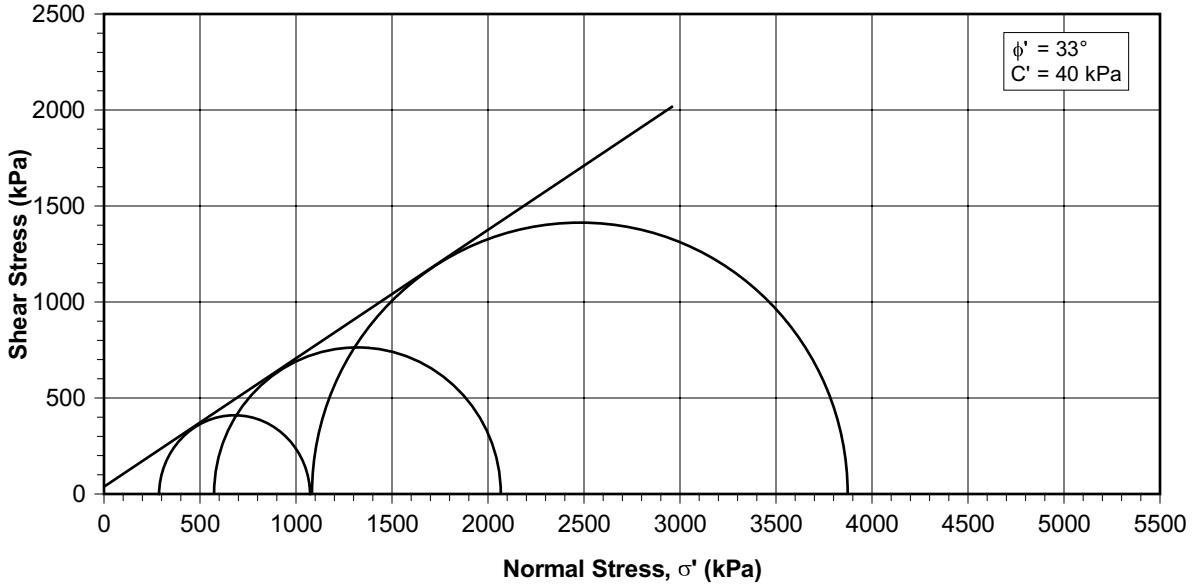
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 80 - Depth: 84.0m

Boring 98-35

SFOBB East Span Seismic Safety Project





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 74 - Depth: 77.9m

Boring 98-35

SFOBB East Span Seismic Safety Project

PLATE 98-35.16

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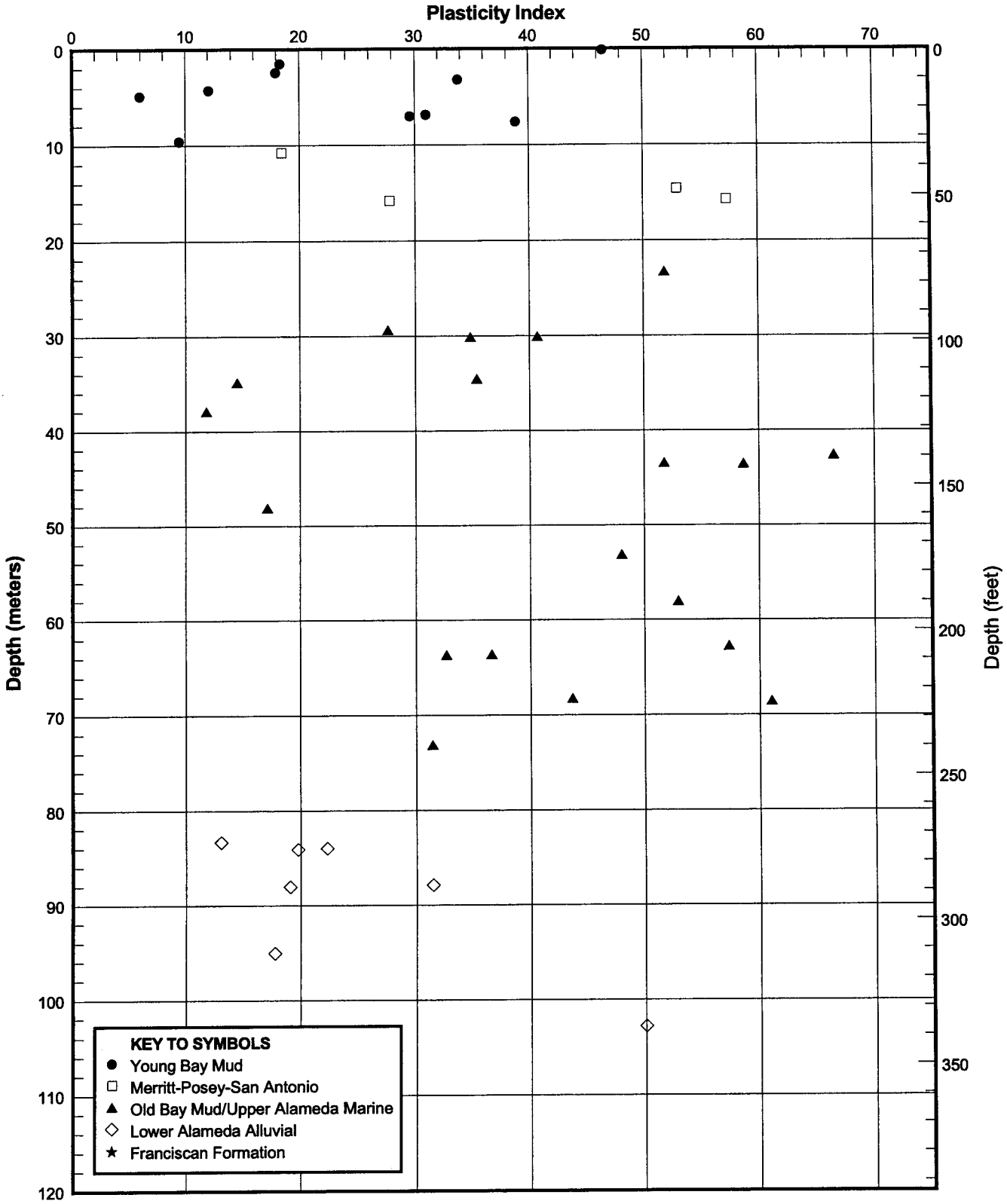
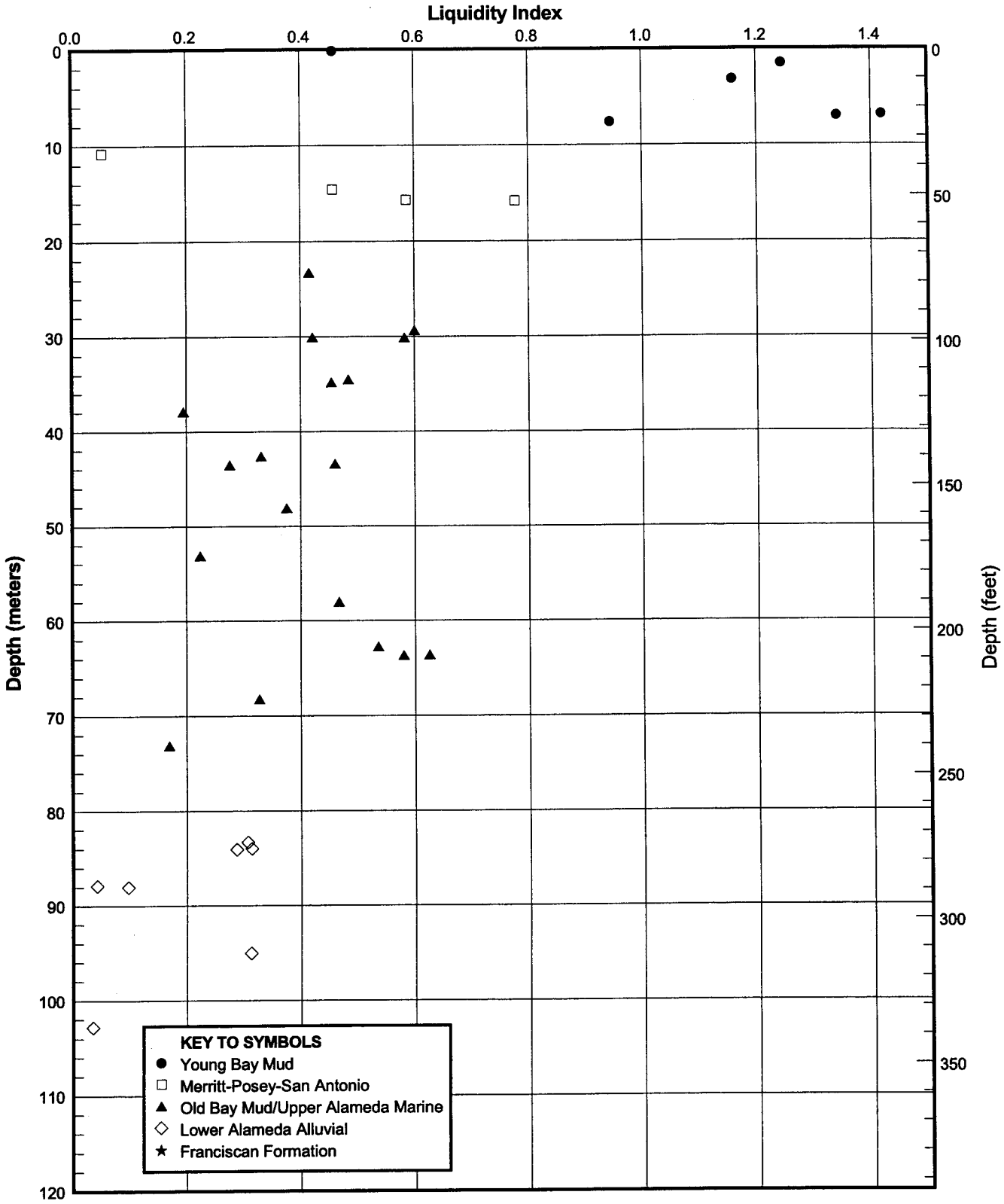
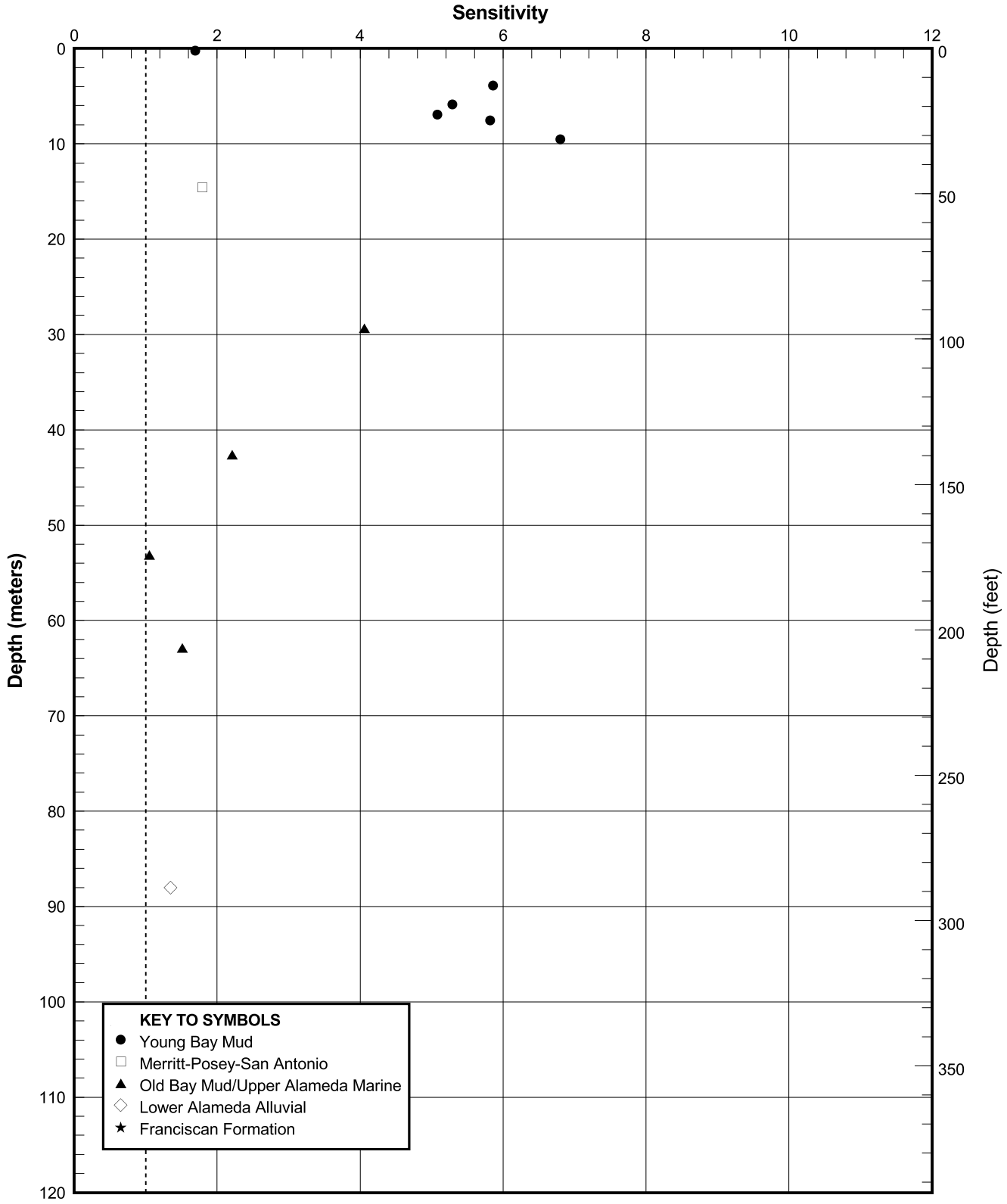


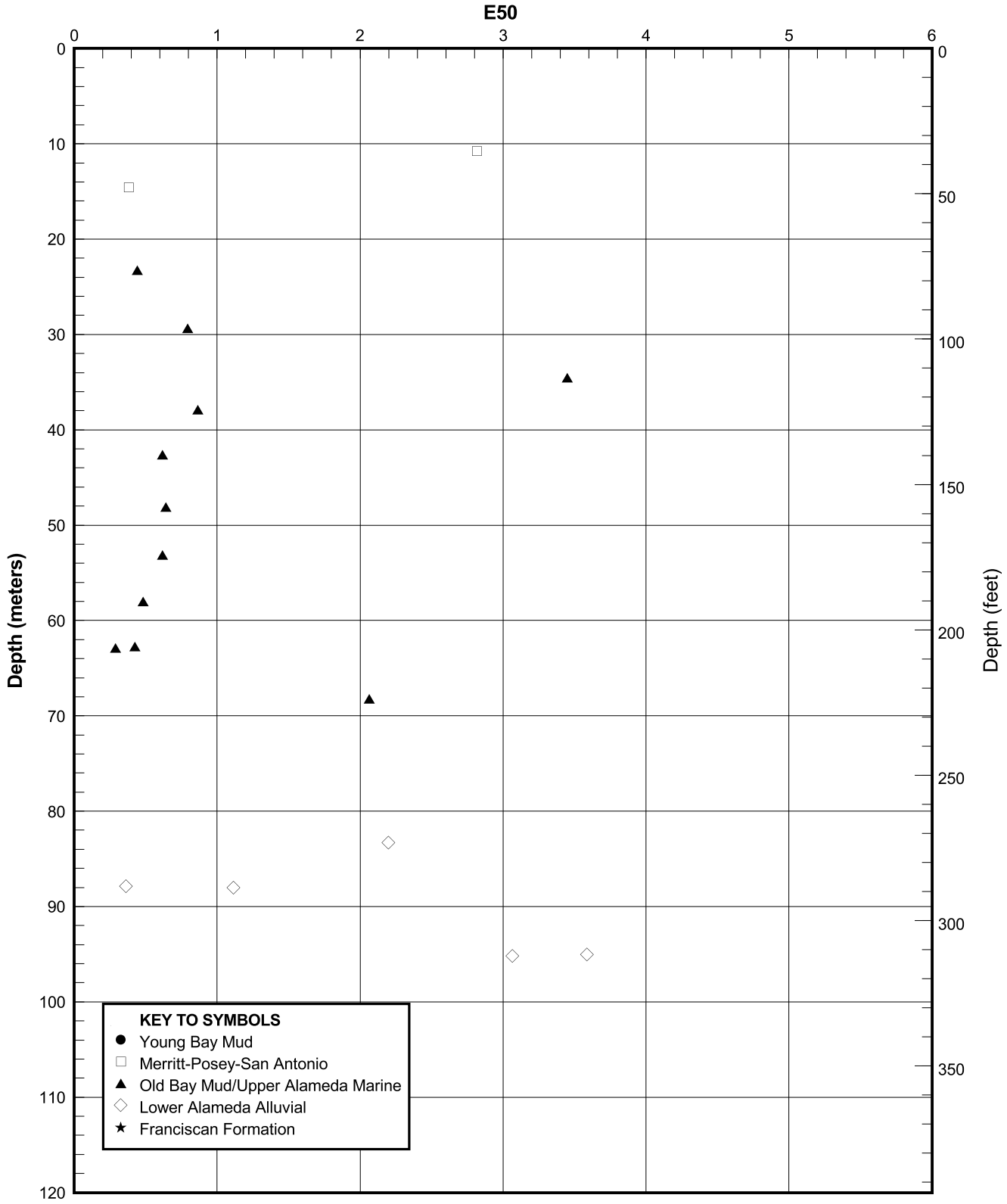
PLASTICITY INDEX PROFILE
Boring 98-35
SFOBB East Span Seismic Safety Project



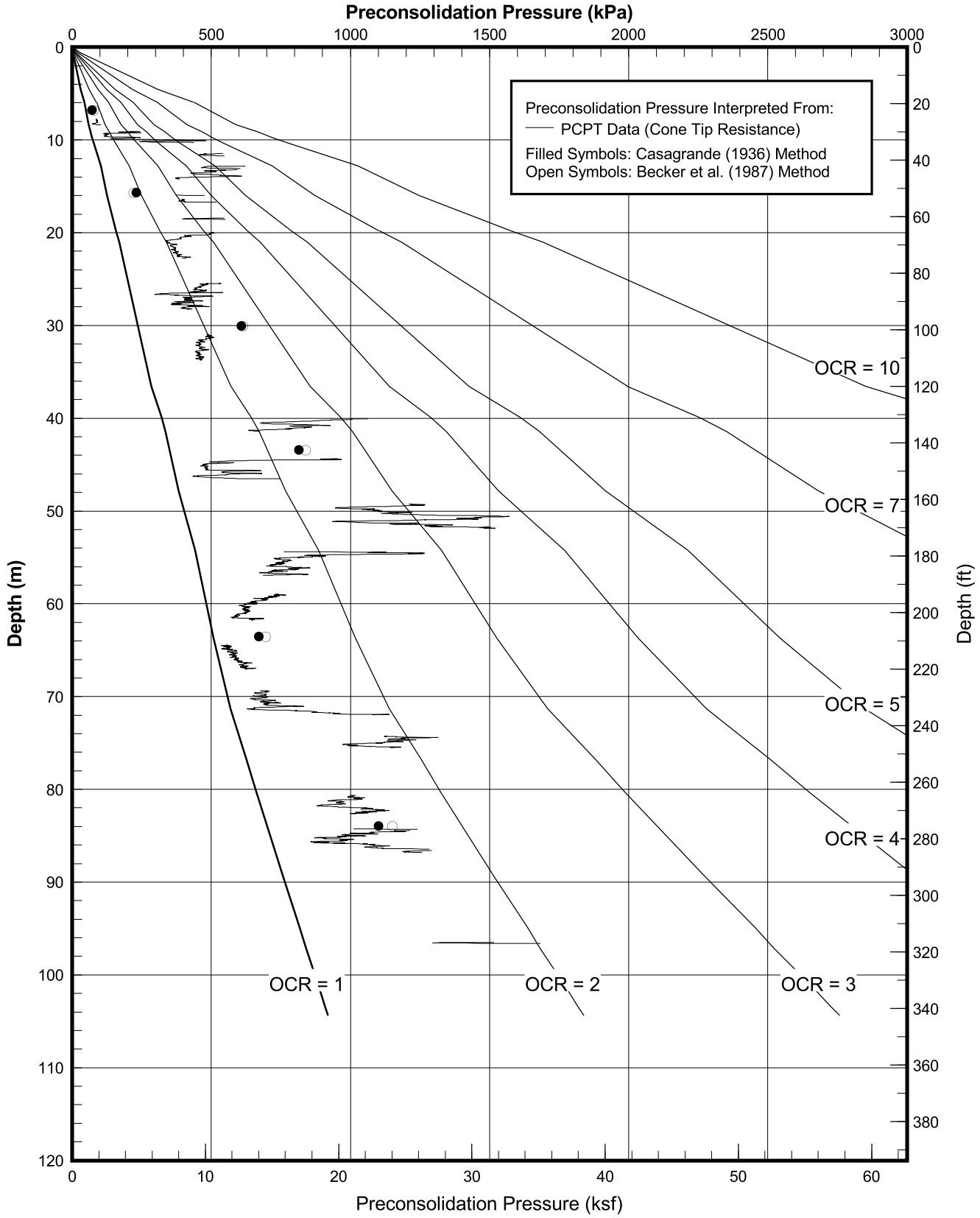
LIQUIDITY INDEX PROFILE
Boring 98-35
SFOBB East Span Seismic Safety Project



SENSITIVITY PROFILE
Boring 98-35
SFOBB East Span Seismic Safety Project



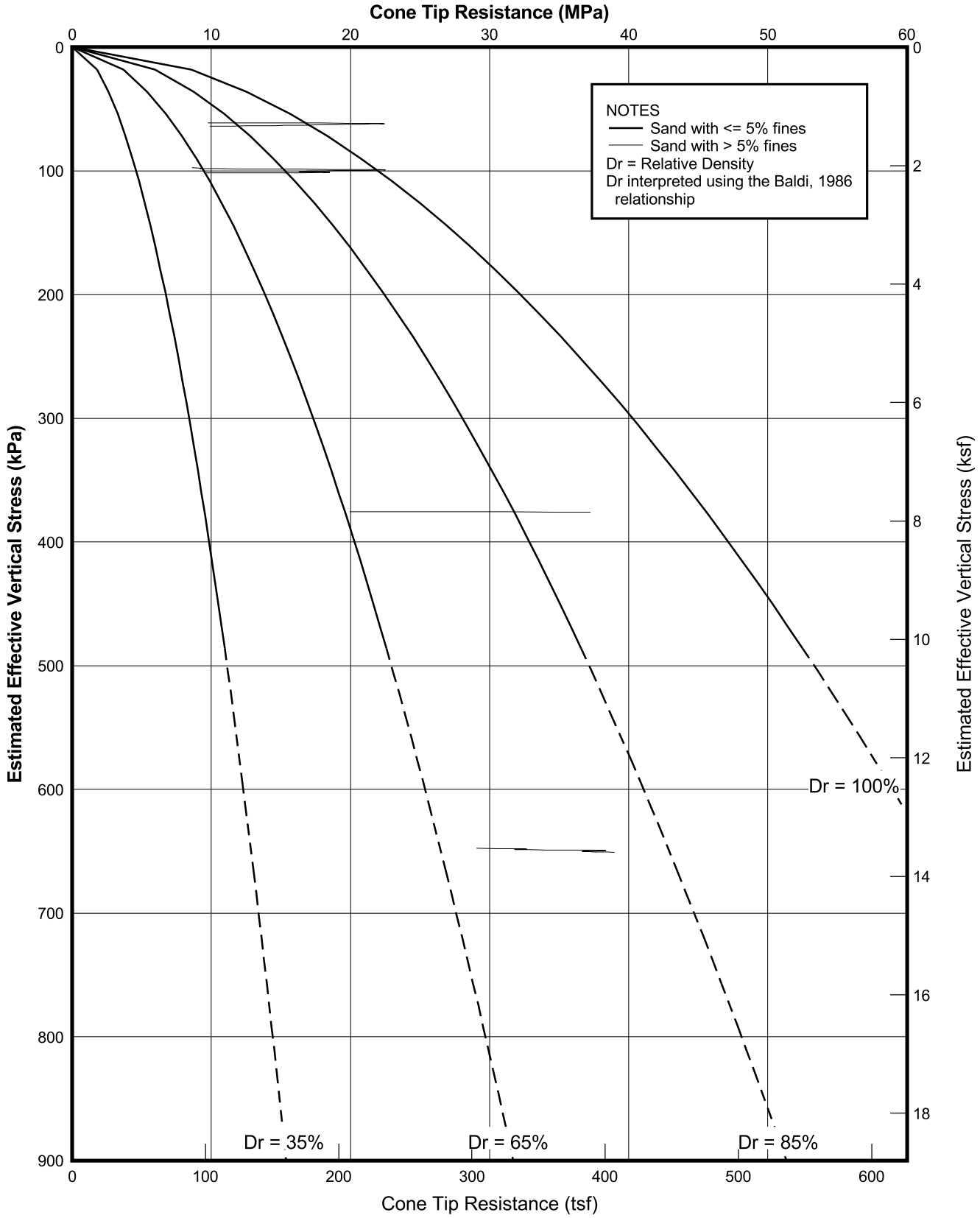
E50 PROFILE
Boring 98-35
SFOBB East Span Seismic Safety Project



PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-35

SFOBB East Span Seismic Safety Project



RELATIVE DENSITY INTERPRETED FROM CPT DATA

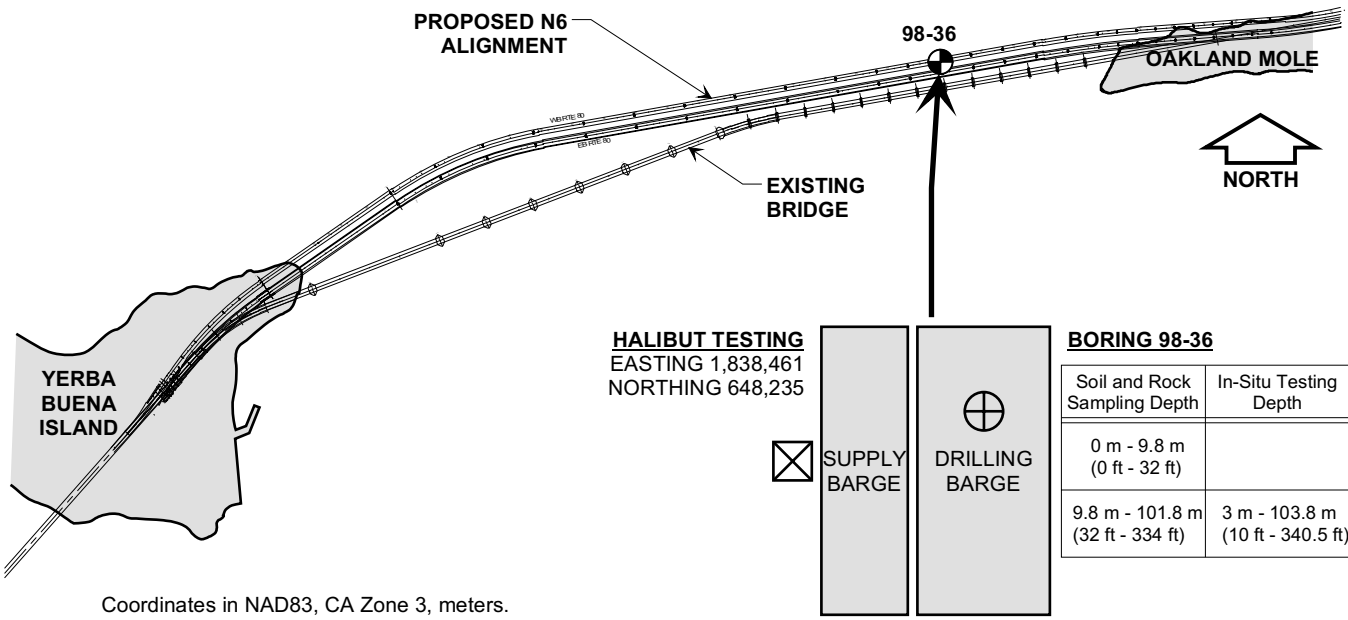
Boring 98-35

SFOBB East Span Seismic Safety Project

BORING 98-36

Date	Time From	Time To	Description of Activity
September 22, 1998	1800	2000	Move barge to location 98-36. Set 4 anchors and 2 spuds.
	2000	2100	Rig up for drilling and halibut testing. Lower drill pipe to mudline.
	2100	2115	Measure water depth of 2.5m (8.2 ft) using bottom sensor. Current tide level is approximately -0.6m (-1.8 ft) MSL. Calculate mudline elevation of –3.0m (-10 ft) MSL.
	2115	2400	Drill and sample from mudline to 9.8m (32 ft).
	****	****	
	2130	2400	Halibut vane shear testing from 0.6m (2 ft) to 2.4m (8 ft).
	****	****	
September 23, 1998	0000	0015	Pull drill pipe to deck.
	0015	0030	Reposition barge.
	****	****	
	0015	0315	Halibut vane shear testing at 3.0m (10 ft) and 3.7m (12 ft).
	****	****	
	0030	1100	Set casing. Drive stinger to 8.5m (28 ft).
	1100	1120	Rig up for drilling. Lower drill pipe to mudline.
	1120	1200	Perform CPT pipe test.
	1200	2400	Drill, sample, and CPT testing from mudline to 37.8m (124 ft).
September 24, 1998	0000	1815	Drill, sample, and CPT testing from 37.8m (124 ft) to 103.9m (341 ft).
	1815	1915	Pull drill pipe to deck.
	1915	2120	P- and S-wave velocity logging from 96.0m (315 ft) to 9.4m (31 ft).
	2120	2400	Lower N-rod. Mix and circulate cement.
September 25, 1998	0000	0115	Grout hole 98-36.
	0115	0230	Pull N-rod to deck.
	0230	0505	Pull casing to deck.
	0505	0615	Clean and secure equipment.
	0615	0800	Pull 2 spuds, 4 anchors, and travel to CS Marine yard at Mare Island.

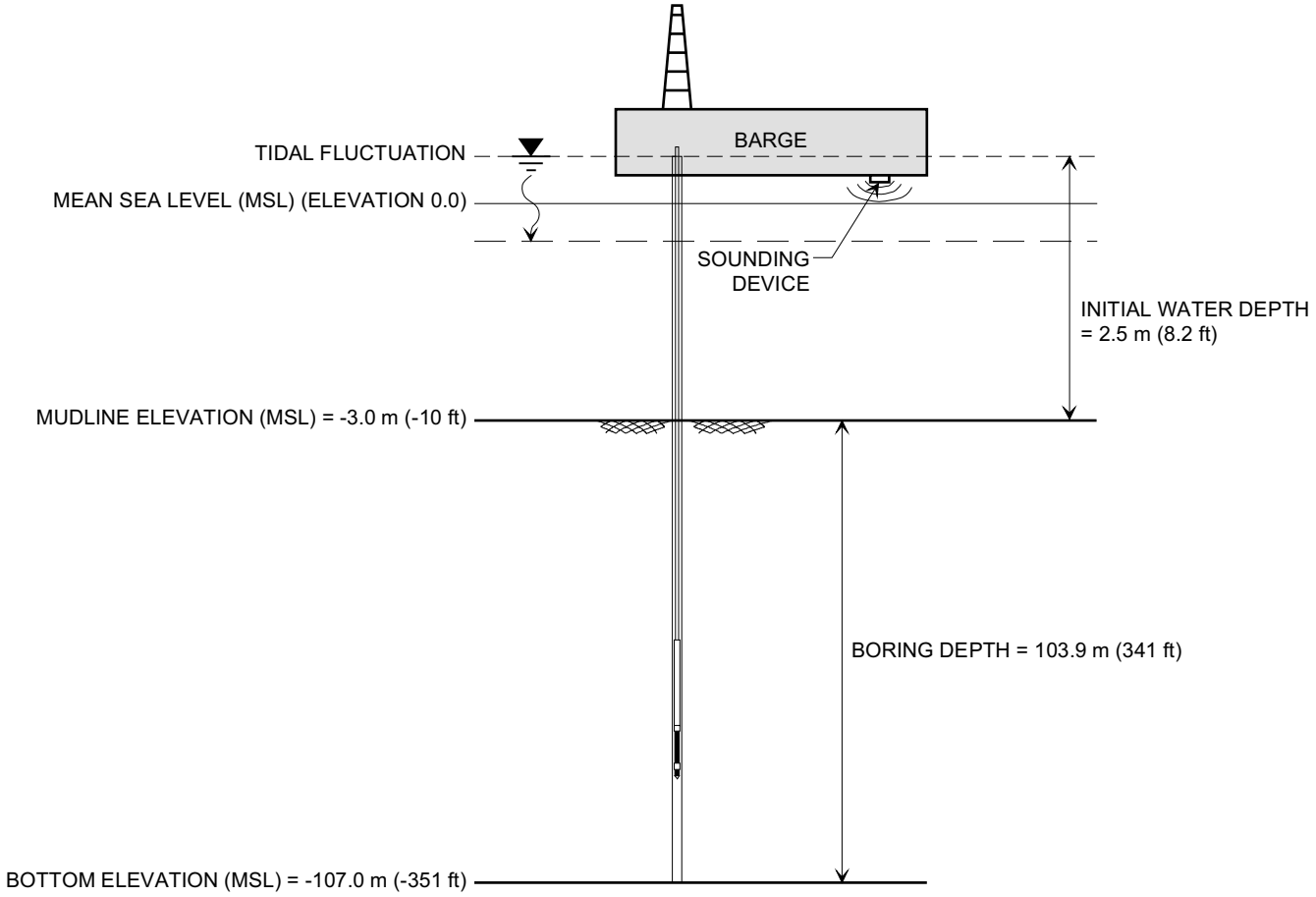
SUMMARY OF FIELD OPERATIONS
Boring 98-36
SFOBB East Span Seismic Safety Project



BORING 98-36

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 9.8 m (0 ft - 32 ft)		E = 1,838,470 N = 648,236
9.8 m - 101.8 m (32 ft - 334 ft)	3 m - 103.8 m (10 ft - 340.5 ft)	E = 1,838,476 N = 648,237

Coordinates in NAD83, CA Zone 3, meters.



DEPTH AND LOCATION REFERENCE MAP
Boring 98-36
SFOBB East Span Seismic Safety Project

PLATE 98-36.2

9842\0054loc.dsf(0,36)

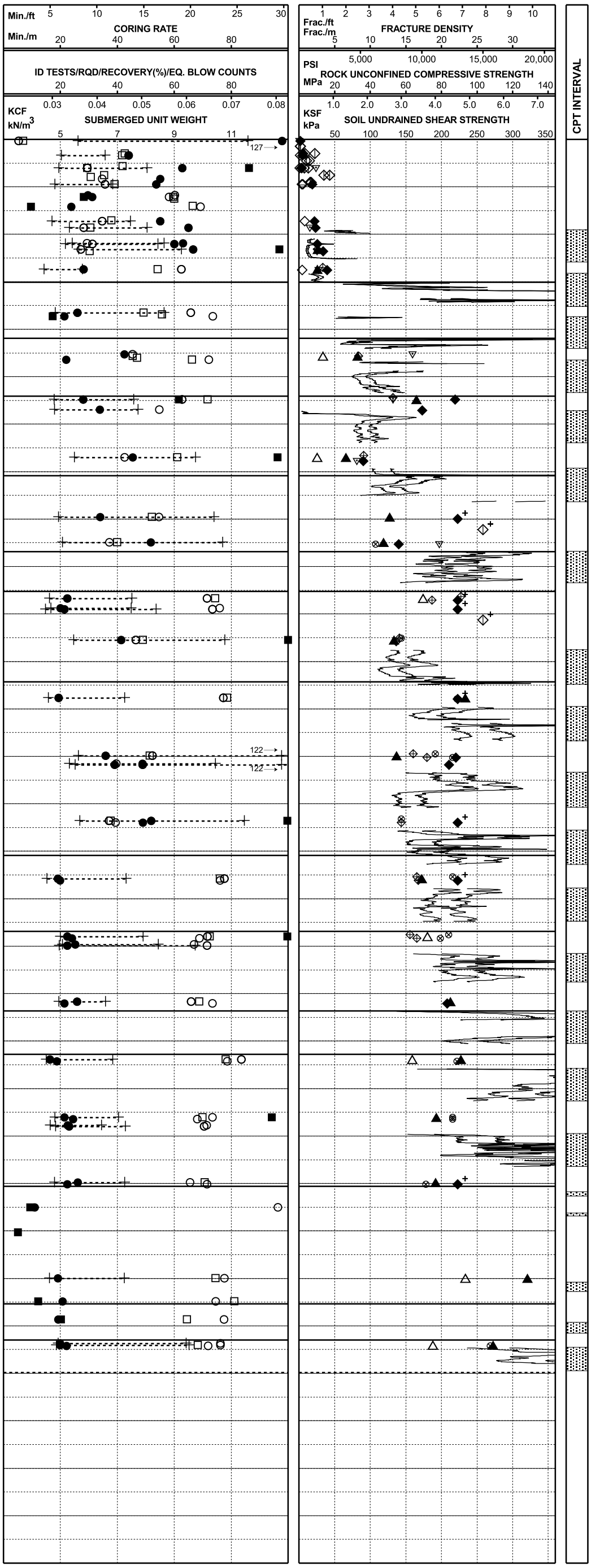
PROJECT NO:	98-42-0054	**START DATE:**	9/22/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-36 (Skyway - Frame 4)	**COMPLETION DATE:**	9/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838476 N648237
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.0m (MSL)

Stratum No.	Material Description	Blow Count
I	Fat CLAY (CH), very soft to firm, dark gray to olive gray -with sand pockets and silt seams at 1.2m -gray silty fine to fine sand with clay pockets and seams, 4.6m to 5.8m See Plate 98-36.6 for detailed stratigraphy -sand layer, 7.9m to 8.4m -with a silt layer at 8.8m -sand layer, 10.1m to 10.4m (12.0m)	WOH, WOH, WOH, WOH, WOH, WOH, 30/35cm, 9/75cm, PUSH, SAVE, PUSH, PUSH
II	Interlayered Silty Fine SAND (SM), dense, gray, and Fat CLAY (CH), very stiff, gray (16.8m)	PUSH
III	Fat CLAY (CH), stiff to very stiff, gray -with sand layers at 16.9m and 17.4m -very dense gray sand, 18.4m to 18.7m -very dense sand with clay seams, 18.9m to 19.5m (21.6m)	PUSH
IV	Fat CLAY (CH), very stiff, gray -greenish gray lean clay to 23.8m -with organic pockets and many sand seams, at 21.6m -with many silty fine sand partings and pockets at 26.8m -with a sand layer at 28.3m (28.3m)	PUSH, SAVE, PUSH
V	Fat CLAY (CH), hard to very stiff, gray -greenish gray to 32.0m -silt layer, 30.0m to 30.5m -with many silty fine sand partings and pockets, at 31.7m -with many silt pockets at 33.8m (34.7m)	PUSH, PUSH
VI	Fat CLAY (CH), hard to very stiff, greenish gray -with silt seams and reddish brown mottling (38.1m)	
VII	Fat CLAY (CH), hard to very stiff, greenish gray to olive gray -greenish gray to 39.6m -with silt pockets at 38.7m (45.7m)	PUSH, SAVE, PUSH
VIII	Fat CLAY (CH), hard to very stiff, greenish gray -lean clay with silt and sand partings and pockets, and fine gravel, to 47.1m -with reddish brown mottling to 57.0m -with many silt pockets and trace gravel, at 47.2m -with silt layers at 49.1m and 49.4m -with a sand layer at 49.5m -with silt pockets and partings at 51.8m -with slickensides and silt pockets at 57.3m -with silt seams and layers below 58.5m (60.4m)	PUSH, PUSH, SAVE, PUSH
IX	Lean to Fat CLAY (CL/CH), hard, greenish gray -with many silt pockets at 62.2m (66.8m)	PUSH
X	Fat CLAY (CH), hard, yellowish brown -lean, with light gray mottling, to 67.4m -with sand seams, 69.2m to 70.1m -greenish gray, with silt partings and seams, many silty fine sand seams, and organic pockets, at 72.5m (73.5m)	PUSH, SAVE, PUSH
XI	Lean CLAY (CL), hard, greenish gray -sand with clay layers, 74.2m to 75.6m (77.1m)	
XII	Lean CLAY (CL), hard, yellowish brown with light gray mottling -with silty sand pockets and seams, organic pockets, and a few gravel pockets, at 77.4m -with reddish brown mottling and many silt pockets, 82.0m to 83.2m -with sand layers at 85.3m and 86.0m -yellowish red, with silty fine sand pockets, at 87.8m (88.2m)	PUSH, SAVE, PUSH
XIII	Fine to Coarse SAND (SW-SM) with silt and fine gravel, dense to very dense, yellowish red -fine gravel, with sand and coarse gravel, at 92.0m -hard lean clay, with iron oxide staining, silty fine sand partings and fine gravel pockets, 95.7m to 96.3m (98.1m)	30/15cm, 30/30cm, PUSH, 30/15cm
XIV	Silty Fine SAND (SM), dense to very dense, yellowish red -with medium sand at 99.4m -with clay layers below 100.0m (101.2m)	30/20cm
XV	Fat CLAY (CH), hard, brown -slickensided, with many calcareous pockets, and a few organic pockets, at 101.5m -sand below 103.8m	PUSH

TOTAL DEPTH: 103.9m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-36

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

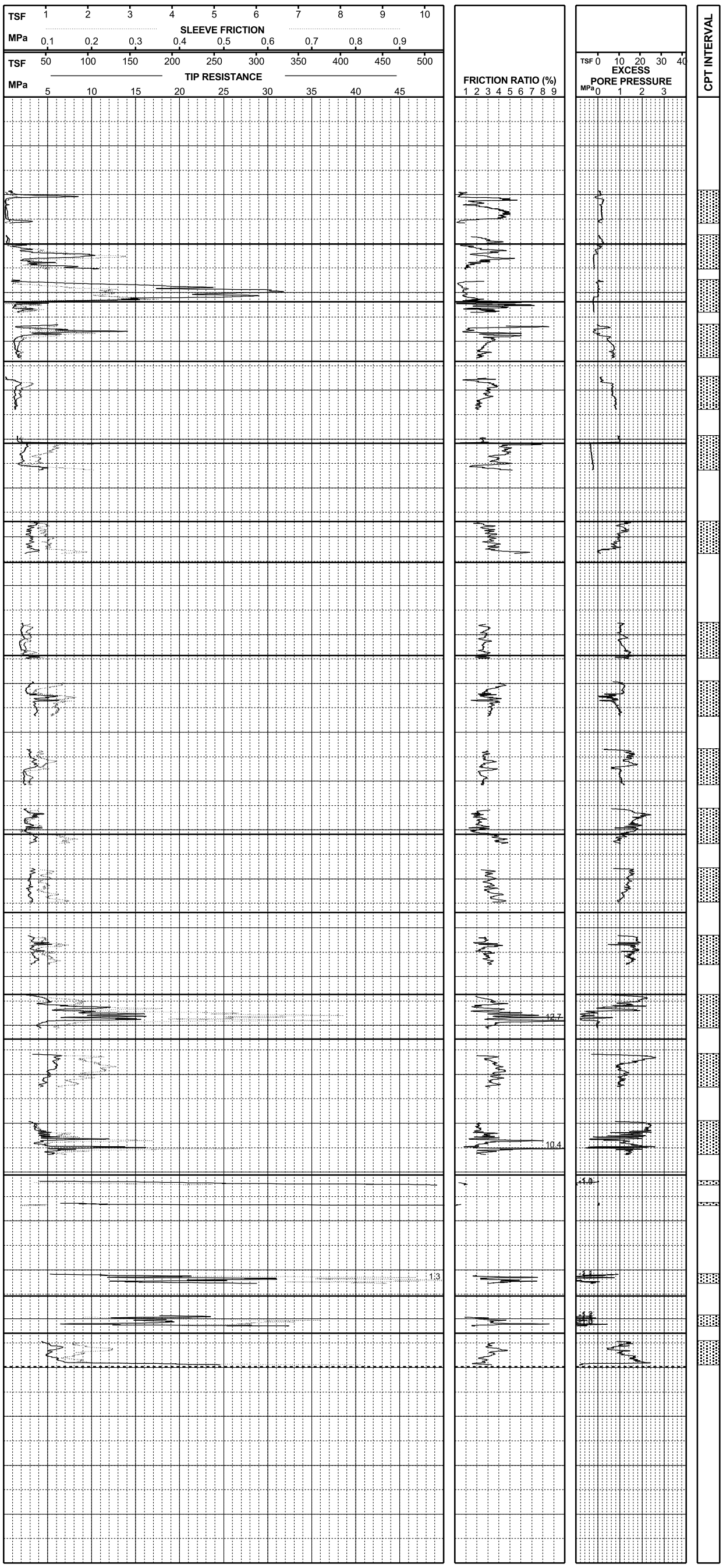
PROJECT NO:	98-42-0054	**START DATE:**	9/22/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-36 (Skyway - Frame 4)	**COMPLETION DATE:**	9/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838476 N648237
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.0m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Fat CLAY (CH), very soft to firm, dark gray to olive gray See Plate 98-36.6 for detailed stratigraphy -gray silty fine to fine sand with clay pockets and seams, 4.6m to 5.8m -sand layer, 7.9m to 8.4m -sand layer, 10.1m to 10.4m (12.0m)	I
Interlayered Silty Fine SAND (SM), dense, gray, and Fat CLAY (CH), very stiff, gray (16.8m)	II
Fat CLAY (CH), stiff to very stiff, gray -with sand layers at 16.9m and 17.4m -very dense gray sand, 18.4m to 18.7m -very dense sand with clay seams, 18.9m to 19.5m (21.6m)	III
Fat CLAY (CH), very stiff, gray -greenish gray lean clay to 23.8m -with a sand layer at 28.3m (28.3m)	IV
Fat CLAY (CH), hard to very stiff, gray -greenish gray to 32.0m -silt layer, 30.0m to 30.5m -with many silty fine sand partings and pockets, at 31.7m -with many silt pockets at 33.8m (34.7m)	V
Fat CLAY (CH), hard to very stiff, greenish gray (38.1m)	VI
Fat CLAY (CH), hard to very stiff, greenish gray to olive gray -greenish gray to 39.6m -with silt pockets at 38.7m (45.7m)	VII
Fat CLAY (CH), hard to very stiff, greenish gray -lean clay with silt and sand partings and pockets, and fine gravel, to 47.1m -with reddish brown mottling to 57.0m -with many silt pockets and trace gravel, at 47.2m -with silt layers at 49.1m and 49.4m -with a sand layer at 49.5m -with silt pockets and partings at 51.8m -with slickensides and silt pockets at 57.3m -with silt seams and layers below 58.5m (60.4m)	VIII
Lean to Fat CLAY (CL/CH), hard, greenish gray -with many silt pockets at 62.2m (66.8m)	IX
Fat CLAY (CH), hard, yellowish brown -lean, with light gray mottling, to 67.4m -with sand seams, 69.2m to 70.1m (73.5m)	X
Lean CLAY (CL), hard, greenish gray -sand with clay layers, 74.2m to 75.6m (77.1m)	XI
Lean CLAY (CL), hard, yellowish brown with light gray mottling -with silty sand pockets and seams, organic pockets, and a few gravel pockets, at 77.4m -with reddish brown mottling and many silt pockets, 82.0m to 83.2m -with sand layers at 85.3m and 86.0m -yellowish red, with silty fine sand pockets, at 87.8m (88.2m)	XII
Fine to Coarse SAND (SW-SM) with silt and fine gravel, dense to very dense, yellowish red -fine gravel, with sand and coarse gravel, at 92.0m -hard lean clay, with iron oxide staining, silty fine sand partings and fine gravel pockets, 95.7m to 96.3m -with clay layers at 96.6m and 96.9m (98.1m)	XIII
Silty Fine SAND (SM), dense to very dense, yellowish red (101.2m)	XIV
Fat CLAY (CH), hard, brown -sand below 103.8m	XV

TOTAL DEPTH: 103.9m
BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-36

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

PLATE 98-36.4

PROJECT NO:	98-42-0054	**START DATE:**	9/22/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-36 (Skyway - Frame 4)	**COMPLETION DATE:**	9/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

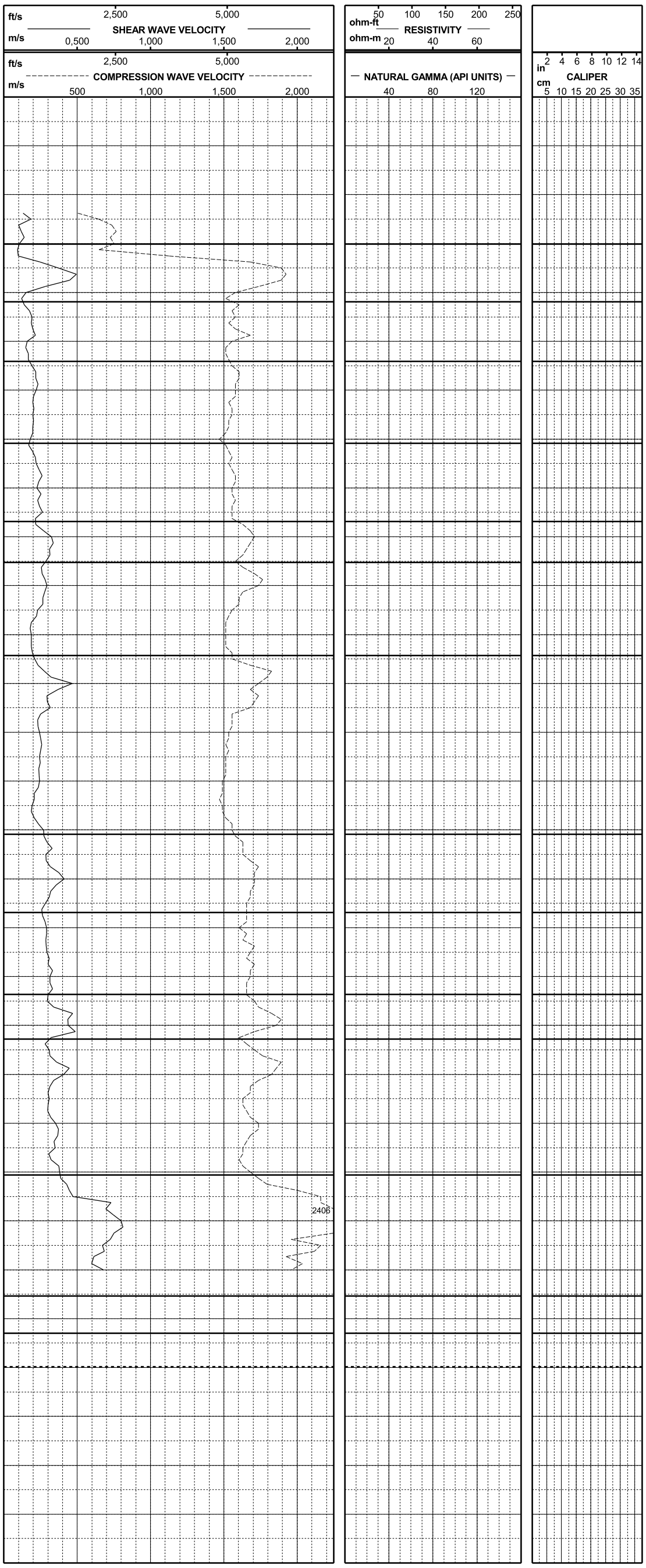
Coordinates: E1838476 N648237
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.0m (MSL)

STRATUM NO.	MATERIAL DESCRIPTION
I	Fat CLAY (CH), very soft to firm, dark gray to olive gray -gray silty fine to fine sand with clay pockets and seams, 4.6m to 5.8m -sand layer, 7.9m to 8.4m -sand layer, 10.1m to 10.4m (12.0m)
II	Interlayered Silty Fine SAND (SM), dense, gray, and Fat CLAY (CH), very stiff, gray -clay with sand seams, 13.4m to 13.7m -very dense fine sand below 15.1m (16.8m)
III	Fat CLAY (CH), stiff to very stiff, gray -very dense gray sand, 18.4m to 18.7m -very dense sand with clay seams, 18.9m to 19.5m (21.6m)
IV	Fat CLAY (CH), very stiff, gray See Plate 98-36.6 for detailed stratigraphy (28.3m)
V	Fat CLAY (CH), hard to very stiff, gray -silt layer, 30.0m to 30.5m (34.7m)
VI	Fat CLAY (CH), hard to very stiff, greenish gray (38.1m)
VII	Fat CLAY (CH), hard to very stiff, greenish gray to olive gray -greenish gray to 39.6m -with silt pockets at 38.7m (45.7m)
VIII	Fat CLAY (CH), hard to very stiff, greenish gray -lean clay with silt and sand partings and pockets, and fine gravel, to 47.1m -with reddish brown mottling to 57.0m -with many silt pockets and trace gravel, at 47.2m -with silt layers at 49.1m and 49.4m -with a sand layer at 49.5m -with silt pockets and partings at 51.8m -with slickensides and silt pockets at 57.3m -with silt seams and layers below 58.5m (60.4m)
IX	Lean to Fat CLAY (CL/CH), hard, greenish gray -with many silt pockets at 62.2m (66.8m)
X	Fat CLAY (CH), hard, yellowish brown -lean, with light gray mottling, to 67.4m -with sand seams, 69.2m to 70.1m -greenish gray, with silt partings and seams, many silty fine sand seams, and organic pockets, at 72.5m (73.5m)
XI	Lean CLAY (CL), hard, greenish gray -sand with clay layers, 74.2m to 75.6m (77.1m)
XII	Lean CLAY (CL), hard, yellowish brown with light gray mottling -with silty sand pockets and seams, organic pockets, and a few gravel pockets, at 77.4m -with reddish brown mottling and many silt pockets, 82.0m to 83.2m -with sand layers at 85.3m and 86.0m -yellowish red, with silty fine sand pockets, at 87.8m (88.2m)
XIII	Fine to Coarse SAND (SW-SM) with silt and fine gravel, dense to very dense, yellowish red -fine gravel, with sand and coarse gravel, at 92.0m -hard lean clay, with iron oxide staining, silty fine sand partings and fine gravel pockets, 95.7m to 96.3m -with clay layers at 96.6m and 96.9m -silty, with clay at 97.8m (98.1m)
XIV	Silty Fine SAND (SM), dense to very dense, yellowish red -with medium sand at 99.4m (101.2m)
XV	Fat CLAY (CH), hard, brown -slickensided, with many calcareous pockets, and a few organic pockets, at 101.5m -sand below 103.8m

TOTAL DEPTH: 103.9m

BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-36

SFOBB East Span Seismic Safety Project

Report Date: 05/06/99

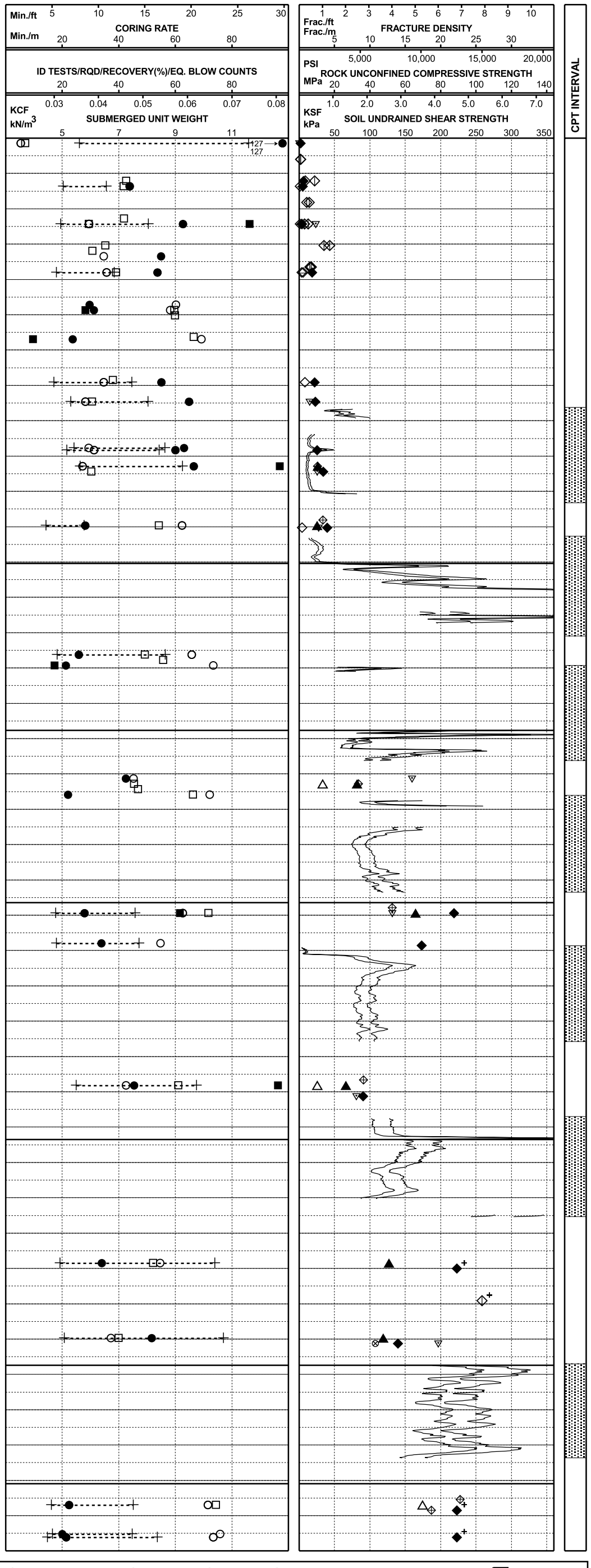
PLATE 98-36.5

PROJECT NO:	98-42-0054	**START DATE:**	9/22/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-36 (Skyway - Frame 4)	**COMPLETION DATE:**	9/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838476 N648237
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.0m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), very soft to firm, dark gray to olive gray -with shells and shell fragments to 3.4m	I
-4	1	WOH	-with sand pockets and silt seams at 1.2m	
-5	2	WOH	-with silt pockets at 2.1m	
-6	3	WOH		
-7	4	WOH	-with sand pockets at 3.7m	
-8	5	WOH	-gray silty fine to fine sand with clay pockets and seams, 4.6m to 5.8m -with an H2S odor at 4.6m	
-9	6	30/35cm		
-10	7	9/75cm	-with sand pockets at 6.7m	
-11	8	PUSH	-sand layer, 7.9m to 8.4m	
-12	9	SAVE	-with a silt layer at 8.8m -with a few silt pockets at 9.1m	
-13	10	PUSH	-sand layer, 10.1m to 10.4m	
-14	11	PUSH	-with many silty fine sand seams and pockets at 10.7m (12.0m)	
-15	12		Interlayered Silty Fine SAND (SM), dense, gray, and Fat CLAY (CH), very stiff, gray	II
-16	13		-clay with sand seams, to 12.8m	
-17	14		-clay with sand seams, 13.4m to 13.7m	
-18	15	PUSH	-clay with sand seams and pockets, 14.3m to 14.8m -sand with clay pockets at 14.8m -very dense fine sand below 15.1m	
-19	16		(16.8m)	
-20	17		Fat CLAY (CH), stiff to very stiff, gray -with sand layers at 16.9m and 17.4m	III
-21	18	PUSH	-very dense gray sand, 18.4m to 18.7m	
-22	19		-very dense sand with clay seams, 18.9m to 19.5m	
-23	20			
-24	21		(21.6m)	
-25	22	PUSH	Fat CLAY (CH), very stiff, gray -greenish gray lean clay to 23.8m	IV
-26	23	SAVE	-with organic pockets and many sand seams, at 21.6m	
-27	24			
-28	25			
-29	26			
-30	27	PUSH	-with many silty fine sand partings and pockets at 26.8m	
-31	28		-with a sand layer at 28.3m (28.3m)	
-32	29		Fat CLAY (CH), hard to very stiff, gray -greenish gray to 32.0m	V
-33	30		-silt layer, 30.0m to 30.5m	
-34	31			
-35	32	PUSH	-with many silty fine sand partings and pockets, at 31.7m	
-36	33			
-37	34	PUSH	-with many silt pockets at 33.8m (34.7m)	
-38	35		Fat CLAY (CH), hard to very stiff, greenish gray -with silt seams and reddish brown mottling	VI
-39	36			
-40	37			
-41	38		(38.1m)	
-42	39	PUSH SAVE	Fat CLAY (CH), hard to very stiff, greenish gray to olive gray -greenish gray to 39.6m -with silt pockets at 38.7m	VII
-43				



LOG OF BORING AND TEST RESULTS

BORING 98-36

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

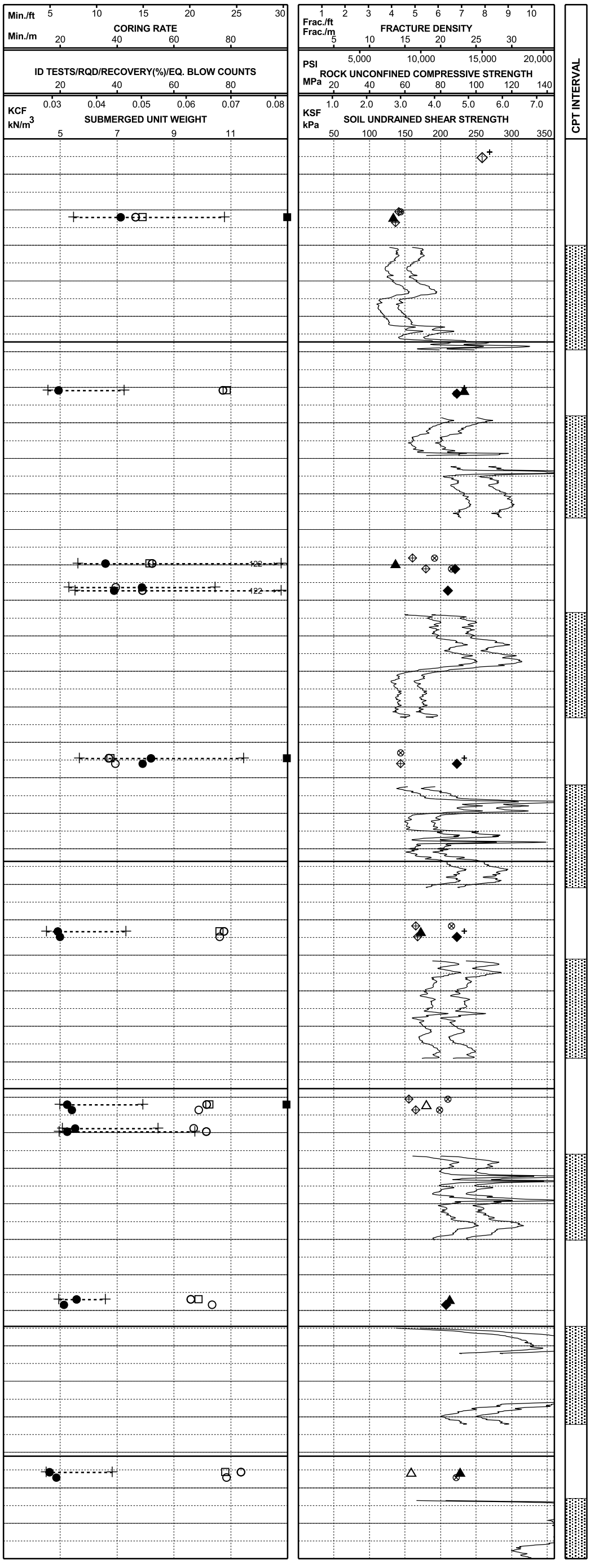
PLATE 98-36.6a

PROJECT NO:	98-42-0054	**START DATE:**	9/22/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-36 (Skyway - Frame 4)	**COMPLETION DATE:**	9/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838476 N648237
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.0m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-44	41			Fat CLAY (CH), hard to very stiff, greenish gray to olive gray	VII
-45	42		PUSH		
-46	43				
-47	44				
-48	45			(45.7m)	
-49	46			Fat CLAY (CH), hard to very stiff, greenish gray -lean clay with silt and sand partings and pockets, and fine gravel, to 47.1m -with reddish brown mottling to 57.0m -with many silt pockets and trace gravel, at 47.2m	VIII
-50	47		PUSH		
-51	48				
-52	49			-with silt layers at 49.1m and 49.4m -with a sand layer at 49.5m	
-53	50				
-54	51				
-55	52		PUSH SAVE	-with silt pockets and partings at 51.8m	
-56	53				
-57	54				
-58	55				
-59	56				
-60	57		PUSH	-with slickensides and silt pockets at 57.3m	
-61	58			-with silt seams and layers below 58.5m	
-62	59				
-63	60			(60.4m)	
-64	61			Lean to Fat CLAY (CL/CH), hard, greenish gray	IX
-65	62		PUSH	-with many silt pockets at 62.2m	
-66	63				
-67	64				
-68	65				
-69	66			(66.8m)	
-70	67		PUSH SAVE	Fat CLAY (CH), hard, yellowish brown -lean, with light gray mottling, to 67.4m	X
-71	68				
-72	69			-with sand seams, 69.2m to 70.1m	
-73	70				
-74	71				
-75	72		PUSH	-greenish gray, with silt partings and seams, many silty fine sand seams, and organic pockets, at 72.5m	
-76	73			(73.5m)	
-77	74			Lean CLAY (CL), hard, greenish gray -sand with clay layers, 74.2m to 75.6m	XI
-78	75				
-79	76				
-80	77			(77.1m)	
-81	78		PUSH	Lean CLAY (CL), hard, yellowish brown with light gray mottling -with silty sand pockets and seams, organic pockets, and a few gravel pockets, at 77.4m	XII
-82	79				
-83					



LOG OF BORING AND TEST RESULTS

BORING 98-36

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

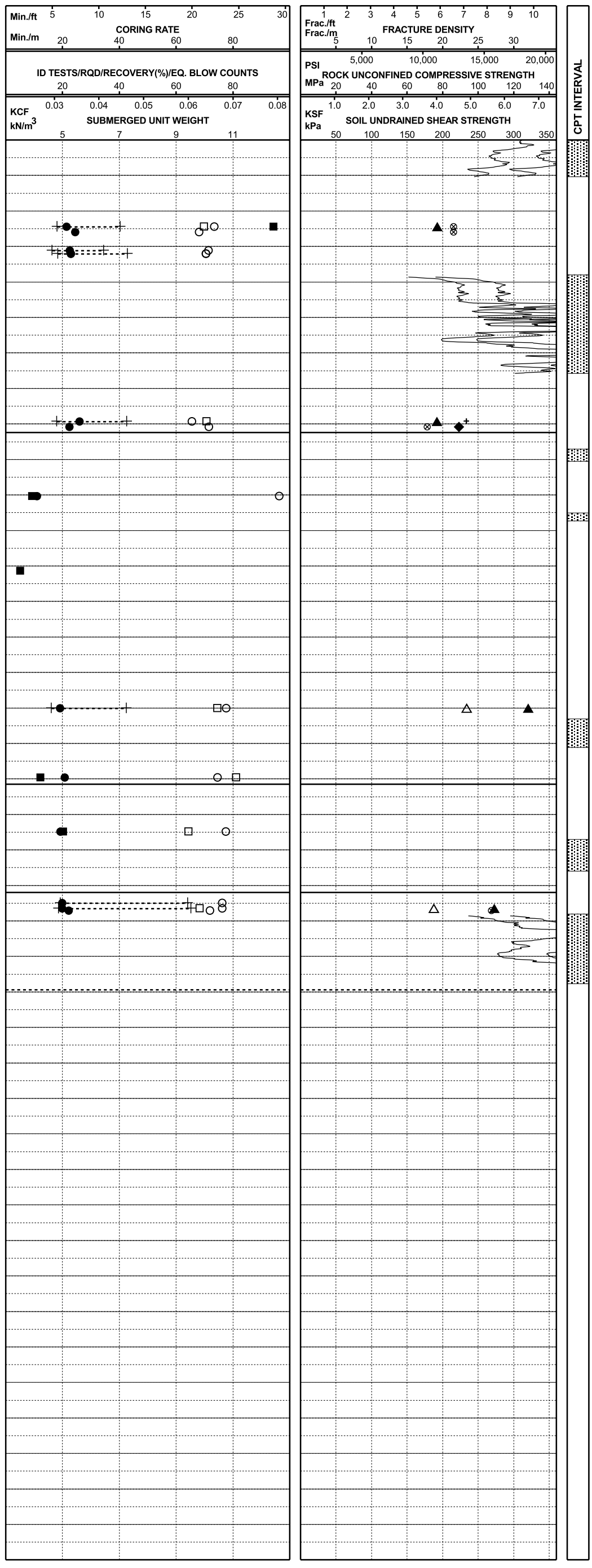
PLATE 98-36.6b

PROJECT NO:	98-42-0054	**START DATE:**	9/22/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-36 (Skyway - Frame 4)	**COMPLETION DATE:**	9/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838476 N648237
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.0m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
				Lean CLAY (CL), hard, yellowish brown with light gray mottling	XII
-84	81				
-85	82		PUSH	-with reddish brown mottling and many silt pockets, 82.0m to 83.2m	
-86	83		SAVE		
-87	84				
-88	85			-with sand layers at 85.3m and 86.0m	
-89	86				
-90	87				
-91	88		PUSH	-yellowish red, with silty fine sand pockets, at 87.8m (88.2m)	
				Fine to Coarse SAND (SW-SM) with silt and fine gravel, dense to very dense, yellowish red	XIII
-92	89				
-93	90		30/15cm		
-94	91				
-95	92		30/30cm	-fine gravel, with sand and coarse gravel, at 92.0m	
-96	93				
-97	94				
-98	95				
-99	96		PUSH	-hard lean clay, with iron oxide staining, silty fine sand partings and fine gravel pockets, 95.7m to 96.3m	
-100	97			-with clay layers at 96.6m and 96.9m	
-101	98		30/15cm	-silty, with clay at 97.8m (98.1m)	
				Silty Fine SAND (SM), dense to very dense, yellowish red	XIV
-102	99		30/20cm	-with medium sand at 99.4m	
-103	100			-with clay layers below 100.0m	
-104	101			(101.2m)	
			PUSH	Fat CLAY (CH), hard, brown	XV
-105	102			-slickensided, with many calcareous pockets, and a few organic pockets, at 101.5m	
-106	103			-sand below 103.8m	
-107	104			TOTAL DEPTH: 103.9m BACKFILLED WITH: Cement Grout	
-108	105				
-109	106				
-110	107				
-111	108				
-112	109				
-113	110				
-114	111				
-115	112				
-116	113				
-117	114				
-118	115				
-119	116				
-120	117				
-121	118				
-122	119				
-123					



LOG OF BORING AND TEST RESULTS

BORING 98-36

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

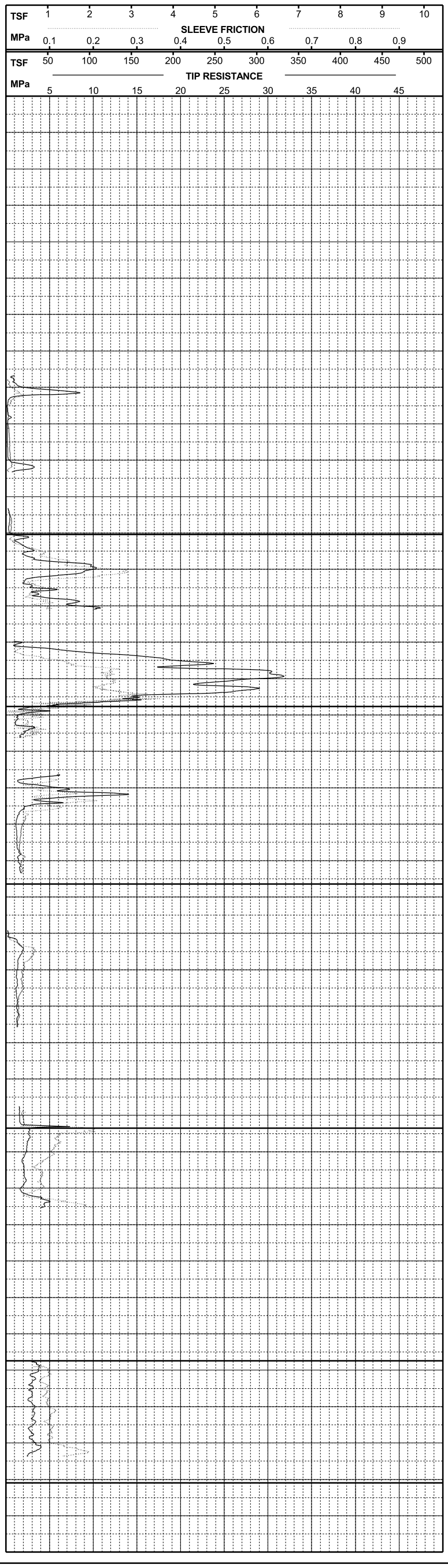
PLATE 98-36.6c

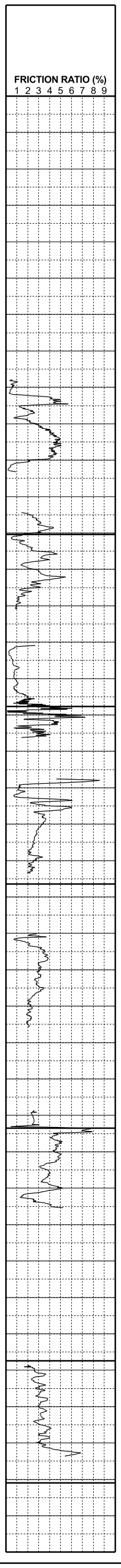
PROJECT NO:	98-42-0054	**START DATE:**	9/22/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-36 (Skyway - Frame 4)	**COMPLETION DATE:**	9/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

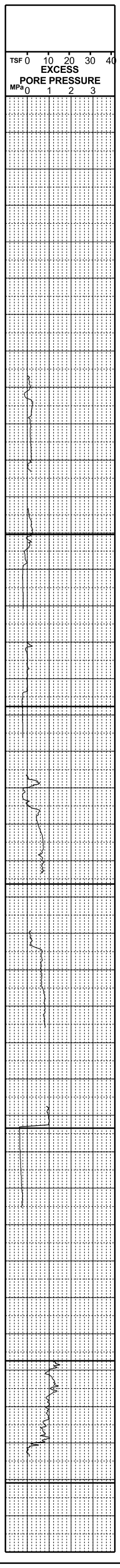
Coordinates: E1838476 N648237
CA State Plane Zone 3, NAD83, Meters

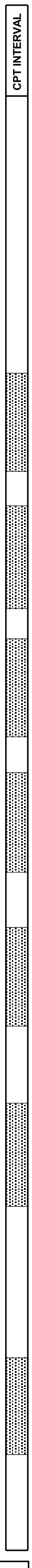
MUDLINE ELEVATION: -3.0m (MSL)

Elevation, m.	Depth, m.	Blow Count	Material Description	Stratum No.
		WOH	Fat CLAY (CH), very soft to firm, dark gray to olive gray	I
-4	1	WOH	-with shells and shell fragments to 3.4m -with sand pockets and silt seams at 1.2m	
-5	2	WOH	-with silt pockets at 2.1m	
-6	3	WOH		
-7	4	WOH	-with sand pockets at 3.7m	
-8	5	WOH	-gray silty fine to fine sand with clay pockets and seams, 4.6m to 5.8m -with an H2S odor at 4.6m	
-9	6	30/35cm		
-10	7	9/75cm	-with sand pockets at 6.7m	
-11	8	PUSH	-sand layer, 7.9m to 8.4m	
-12	9	SAVE	-with a silt layer at 8.8m -with a few silt pockets at 9.1m	
-13	10	PUSH	-sand layer, 10.1m to 10.4m	
-14	11	PUSH	-with many silty fine sand seams and pockets at 10.7m	
-15	12		(12.0m)	
-16	13		Interlayered Silty Fine SAND (SM), dense, gray, and Fat CLAY (CH), very stiff, gray -clay with sand seams, to 12.8m -clay with sand seams, 13.4m to 13.7m	II
-17	14	PUSH	-clay with sand seams and pockets, 14.3m to 14.8m -sand with clay pockets at 14.8m	
-18	15		-very dense fine sand below 15.1m	
-19	16		(16.8m)	
-20	17		Fat CLAY (CH), stiff to very stiff, gray -with sand layers at 16.9m and 17.4m	III
-21	18	PUSH		
-22	19		-very dense gray sand, 18.4m to 18.7m -very dense sand with clay seams, 18.9m to 19.5m	
-23	20			
-24	21		(21.6m)	
-25	22	PUSH	Fat CLAY (CH), very stiff, gray -greenish gray lean clay to 23.8m	IV
-26	23	SAVE	-with organic pockets and many sand seams, at 21.6m	
-27	24			
-28	25			
-29	26			
-30	27	PUSH	-with many silty fine sand partings and pockets at 26.8m	
-31	28		-with a sand layer at 28.3m (28.3m)	
-32	29		Fat CLAY (CH), hard to very stiff, gray -greenish gray to 32.0m	V
-33	30		-silt layer, 30.0m to 30.5m	
-34	31			
-35	32	PUSH	-with many silty fine sand partings and pockets, at 31.7m	
-36	33			
-37	34	PUSH	-with many silt pockets at 33.8m (34.7m)	
-38	35		Fat CLAY (CH), hard to very stiff, greenish gray -with silt seams and reddish brown mottling	VI
-39	36			
-40	37			
-41	38		(38.1m)	
-42	39	PUSH SAVE	Fat CLAY (CH), hard to very stiff, greenish gray to olive gray -greenish gray to 39.6m -with silt pockets at 38.7m	VII
-43				









LOG OF BORING AND TEST RESULTS

BORING 98-36

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

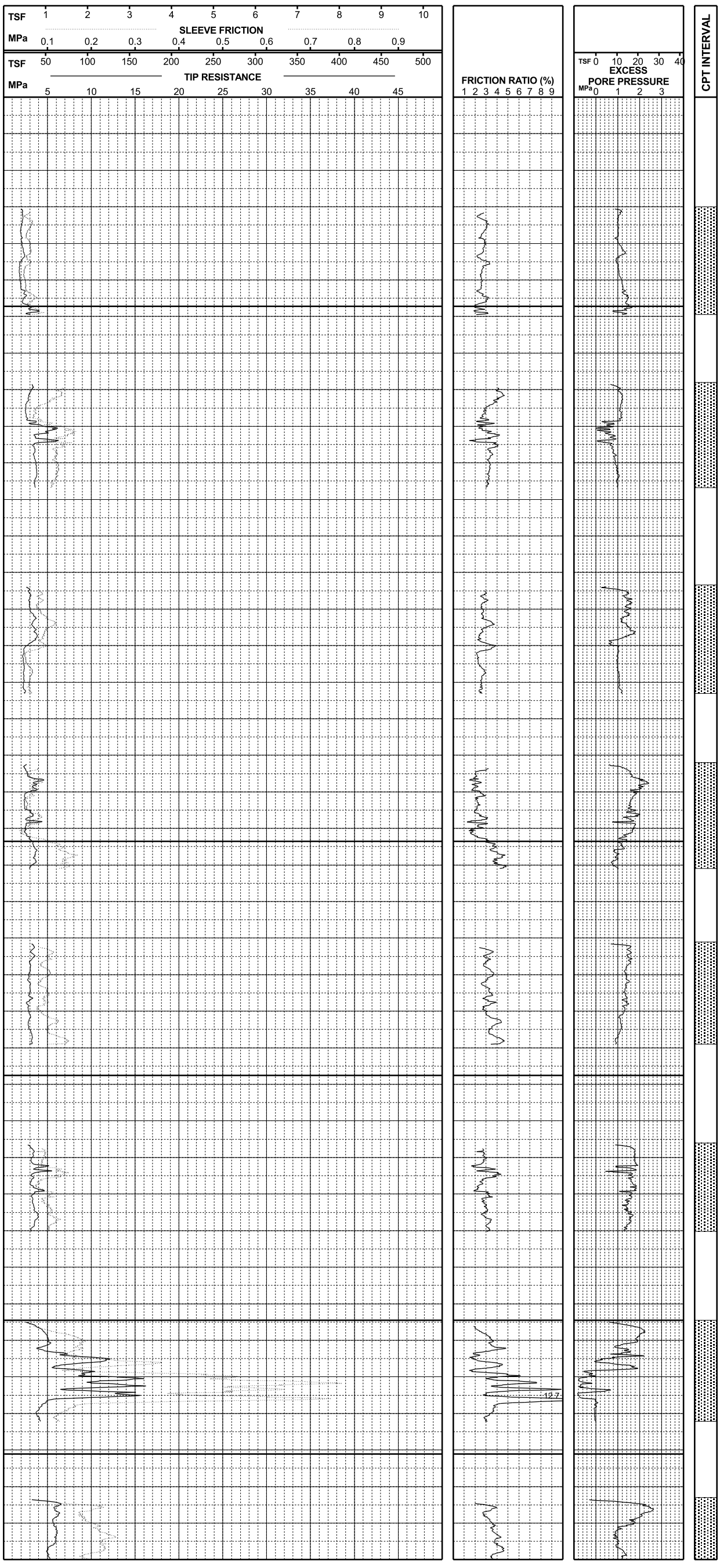
PLATE 98-36.7a

PROJECT NO:	98-42-0054	**START DATE:**	9/22/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-36 (Skyway - Frame 4)	**COMPLETION DATE:**	9/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838476 N648237
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.0m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-44	41			Fat CLAY (CH), hard to very stiff, greenish gray to olive gray	VII
-45	42		PUSH		
-46	43				
-47	44				
-48	45			(45.7m)	
-49	46			Fat CLAY (CH), hard to very stiff, greenish gray -lean clay with silt and sand partings and pockets, and fine gravel, to 47.1m -with reddish brown mottling to 57.0m -with many silt pockets and trace gravel, at 47.2m	VIII
-50	47		PUSH		
-51	48				
-52	49			-with silt layers at 49.1m and 49.4m -with a sand layer at 49.5m	
-53	50				
-54	51				
-55	52		PUSH SAVE	-with silt pockets and partings at 51.8m	
-56	53				
-57	54				
-58	55				
-59	56				
-60	57		PUSH	-with slickensides and silt pockets at 57.3m	
-61	58			-with silt seams and layers below 58.5m	
-62	59				
-63	60			(60.4m)	
-64	61			Lean to Fat CLAY (CL/CH), hard, greenish gray	IX
-65	62		PUSH	-with many silt pockets at 62.2m	
-66	63				
-67	64				
-68	65				
-69	66			(66.8m)	
-70	67		PUSH SAVE	Fat CLAY (CH), hard, yellowish brown -lean, with light gray mottling, to 67.4m	X
-71	68				
-72	69			-with sand seams, 69.2m to 70.1m	
-73	70				
-74	71				
-75	72		PUSH	-greenish gray, with silt partings and seams, many silty fine sand seams, and organic pockets, at 72.5m	
-76	73			(73.5m)	
-77	74			Lean CLAY (CL), hard, greenish gray -sand with clay layers, 74.2m to 75.6m	XI
-78	75				
-79	76				
-80	77			(77.1m)	
-81	78		PUSH	Lean CLAY (CL), hard, yellowish brown with light gray mottling -with silty sand pockets and seams, organic pockets, and a few gravel pockets, at 77.4m	XII
-82	79				
-83					



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-36

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

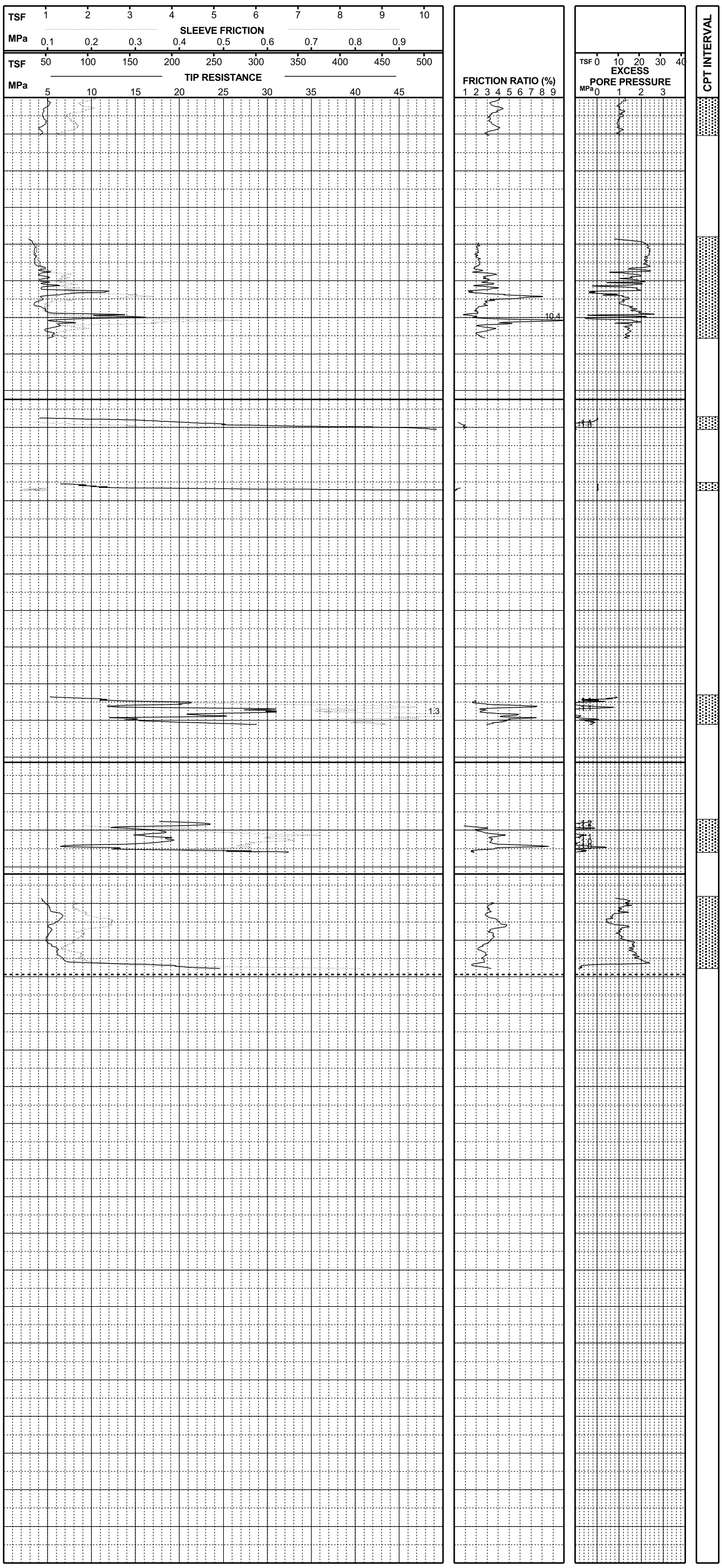
PLATE 98-36.7b

PROJECT NO:	98-42-0054	**START DATE:**	9/22/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-36 (Skyway - Frame 4)	**COMPLETION DATE:**	9/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838476 N648237
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.0m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
				Lean CLAY (CL), hard, yellowish brown with light gray mottling	XII
-84	81				
-85	82		PUSH	-with reddish brown mottling and many silt pockets, 82.0m to 83.2m	
-86	83		SAVE		
-87	84				
-88	85			-with sand layers at 85.3m and 86.0m	
-89	86				
-90	87				
-91	88		PUSH	-yellowish red, with silty fine sand pockets, at 87.8m (88.2m)	
-92	89			Fine to Coarse SAND (SW-SM) with silt and fine gravel, dense to very dense, yellowish red	XIII
-93	90		30/15cm		
-94	91				
-95	92		30/30cm	-fine gravel, with sand and coarse gravel, at 92.0m	
-96	93				
-97	94				
-98	95			-hard lean clay, with iron oxide staining, silty fine sand partings and fine gravel pockets, 95.7m to 96.3m	
-99	96		PUSH		
-100	97			-with clay layers at 96.6m and 96.9m	
-101	98		30/15cm	-silty, with clay at 97.8m (98.1m)	
-102	99			Silty Fine SAND (SM), dense to very dense, yellowish red	XIV
-103	100		30/20cm	-with medium sand at 99.4m	
-104	101			-with clay layers below 100.0m (101.2m)	
-105	102		PUSH	Fat CLAY (CH), hard, brown -slickensided, with many calcareous pockets, and a few organic pockets, at 101.5m	XV
-106	103			-sand below 103.8m	
-107	104			TOTAL DEPTH: 103.9m	
-108	105			BACKFILLED WITH: Cement Grout	
-109	106				
-110	107				
-111	108				
-112	109				
-113	110				
-114	111				
-115	112				
-116	113				
-117	114				
-118	115				
-119	116				
-120	117				
-121	118				
-122	119				
-123					



LOG OF BORING AND TEST RESULTS

BORING 98-36

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

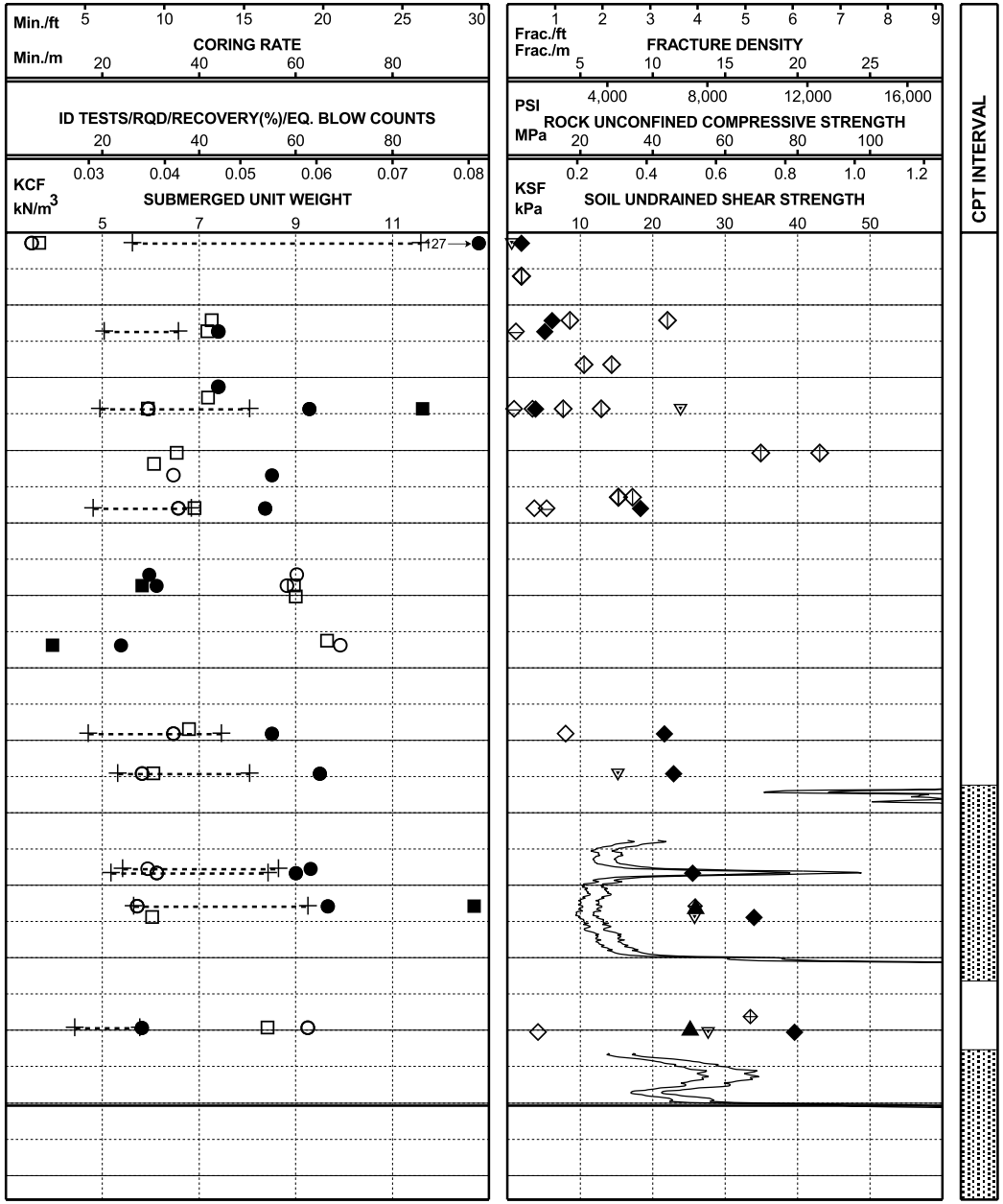
PLATE 98-36.7c

PROJECT NO:	98-42-0054	**START DATE:**	9/22/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-36 (Skyway - Frame 4)	**COMPLETION DATE:**	9/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838476 N648237
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.0m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), very soft to firm, dark gray to olive gray -with shells and shell fragments to 3.4m	I
-4	1	WOH	-with sand pockets and silt seams at 1.2m	
-5	2	WOH	-with silt pockets at 2.1m	
-6	3	WOH		
-7	4	WOH	-with sand pockets at 3.7m	
-8	5	WOH	-gray silty fine to fine sand with clay pockets and seams, 4.6m to 5.8m -with an H2S odor at 4.6m	
-9	6	30/35cm		
-10	7	9/75cm	-with sand pockets at 6.7m	
-11	8	PUSH	-sand layer, 7.9m to 8.4m	
-12	9	SAVE	-with a silt layer at 8.8m -with a few silt pockets at 9.1m	
-13	10	PUSH	-sand layer, 10.1m to 10.4m	
-14	11	PUSH	-with many silty fine sand seams and pockets at 10.7m	
-15	12		(12.0m)	
-16	13		Interlayered Silty Fine SAND (SM), dense, gray, and Fat CLAY (CH), very stiff, gray -clay with sand seams, to 12.8m	II



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-36

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

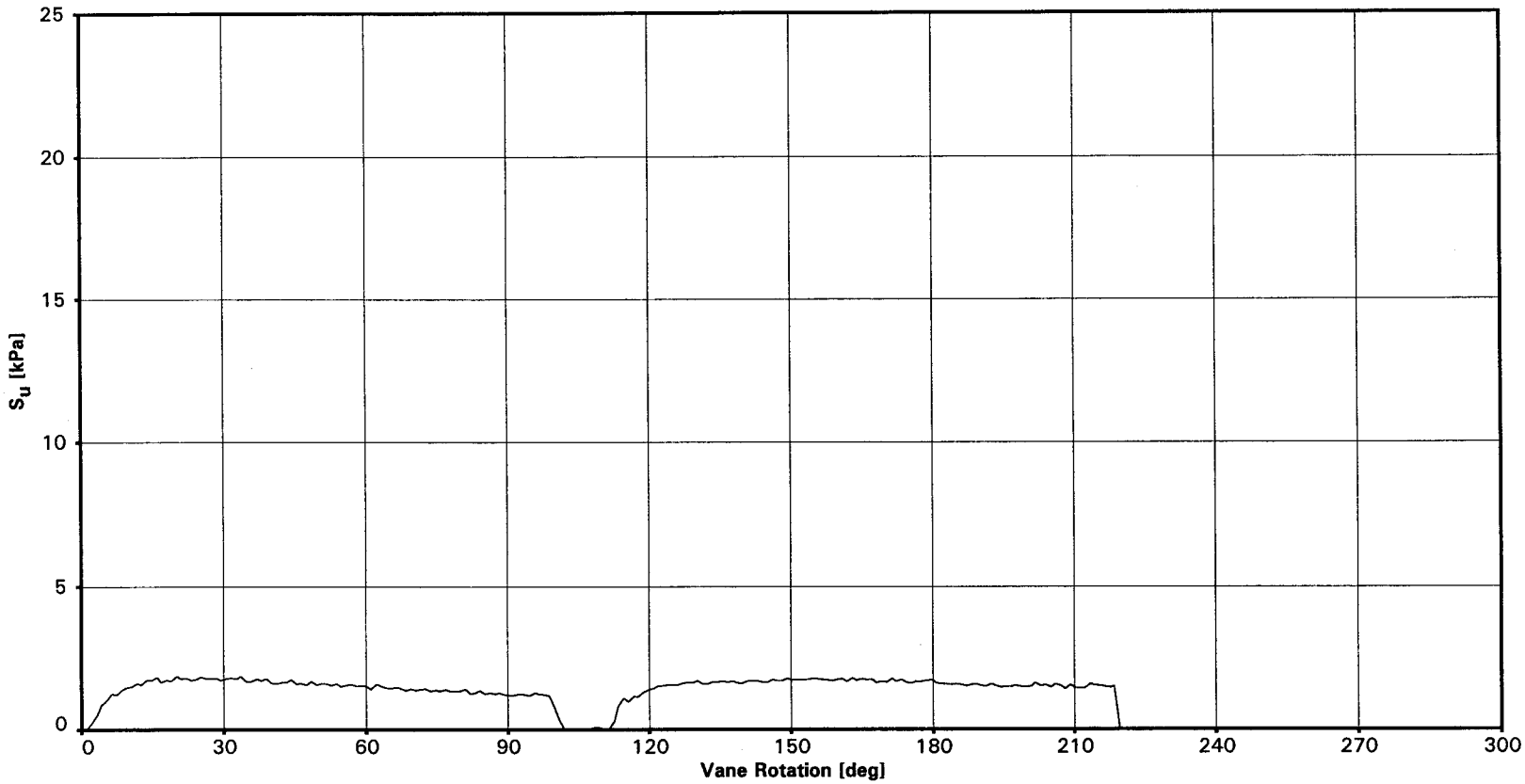
FUGRO

PLATE 98-36.8

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 0.6m
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

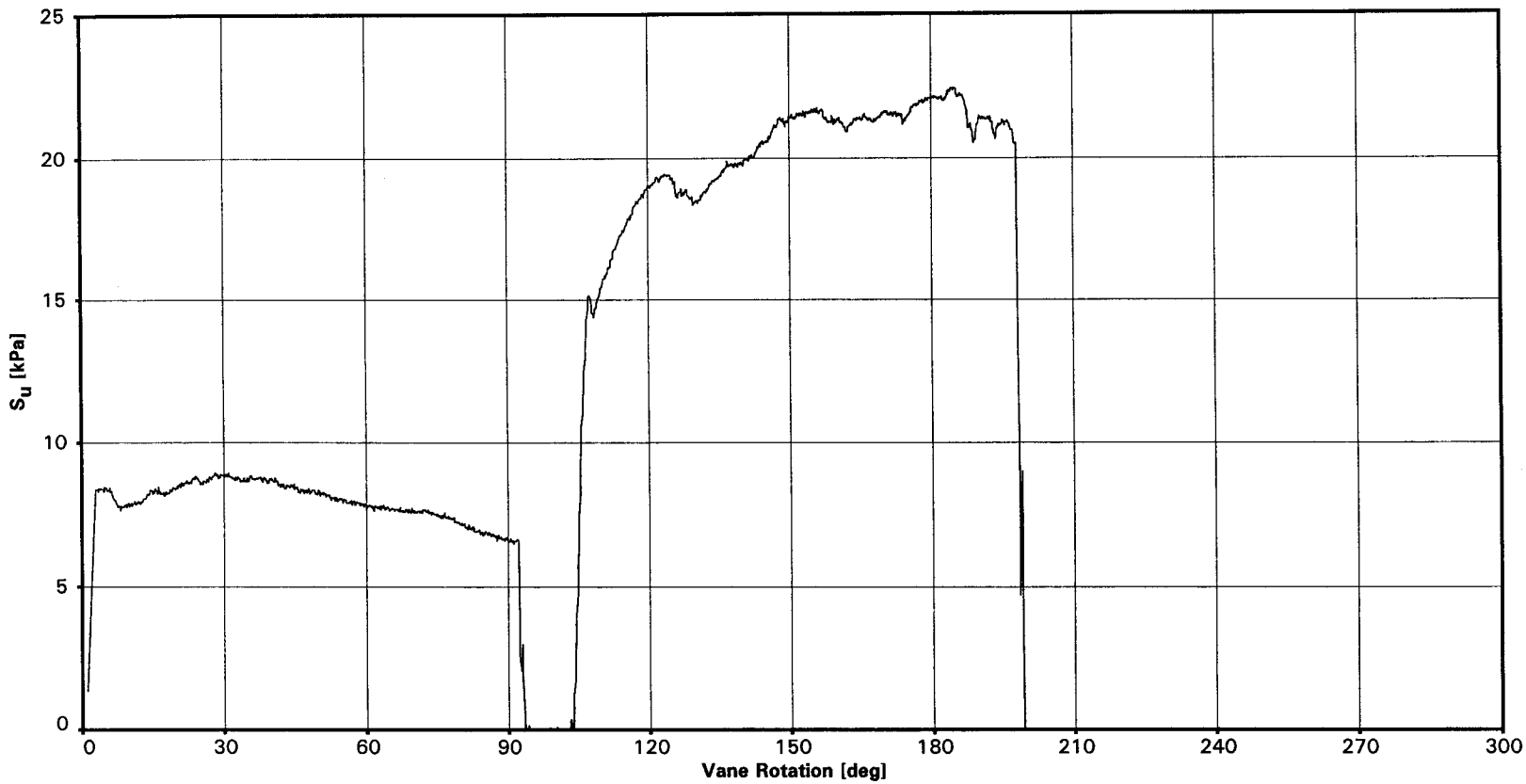
FUGRO

PLATE 98-36.9a

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.2m
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

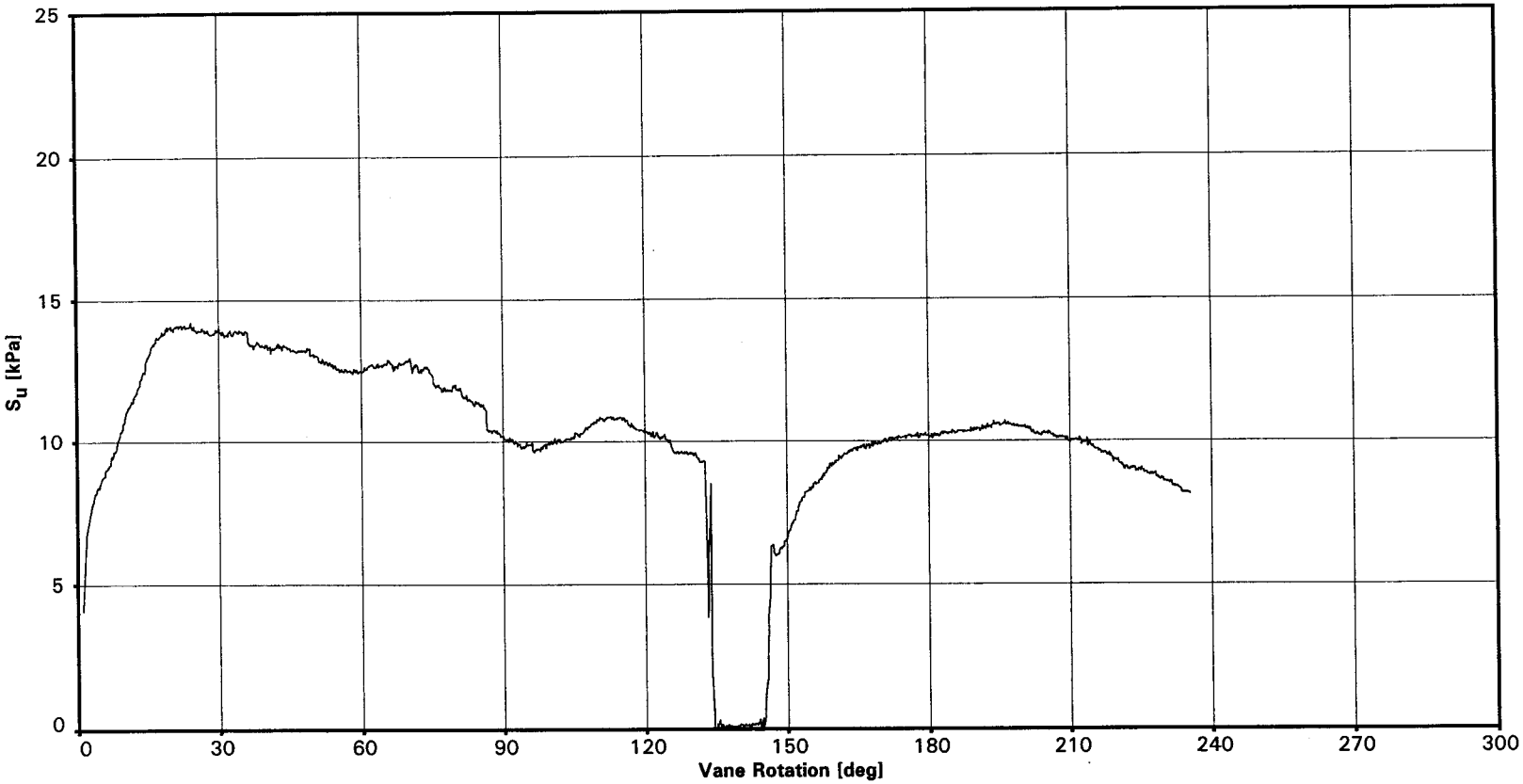
FUGRO

PLATE 98-36.9b

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.8m
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

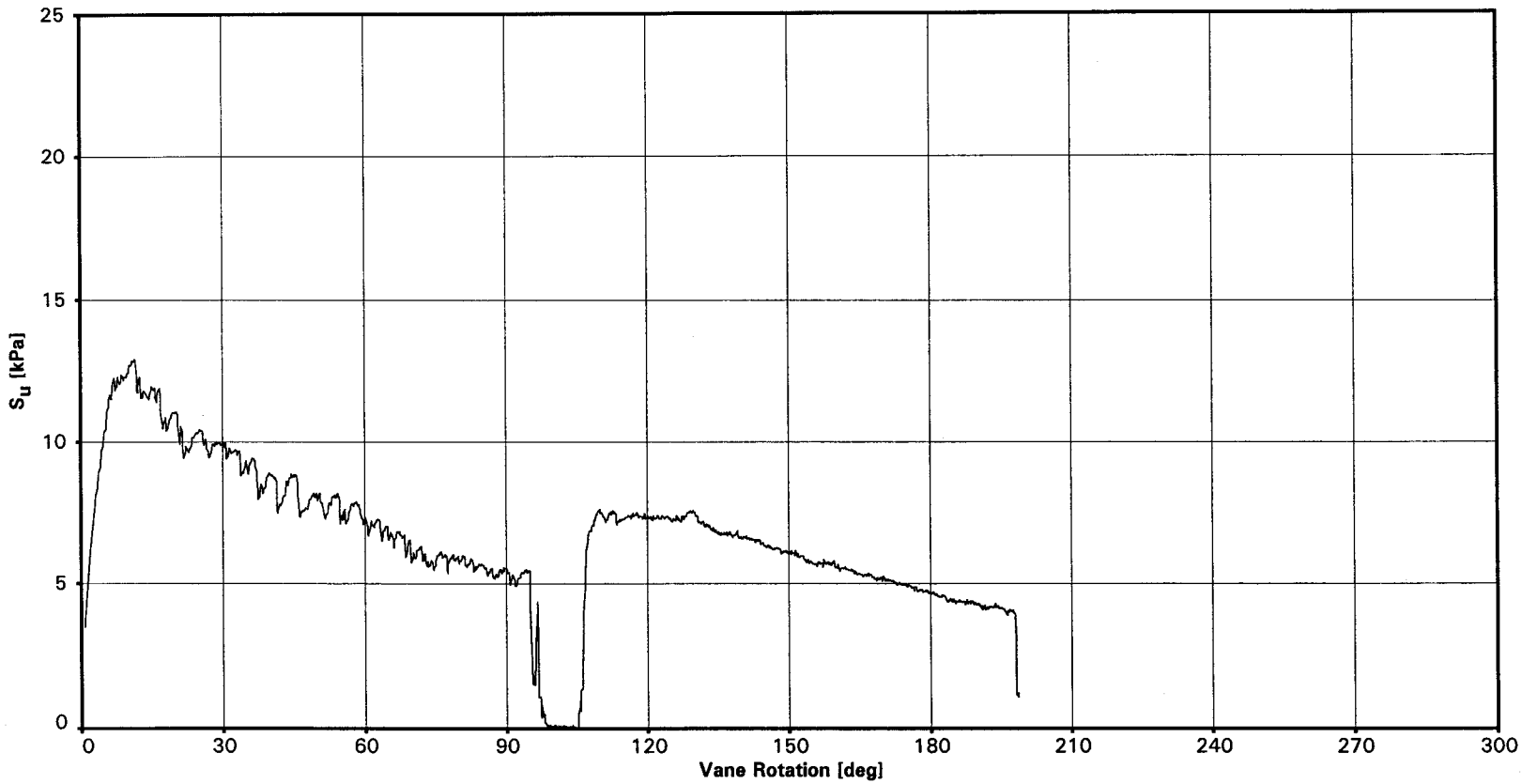
FUGRO

PLATE 98-36.9c

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 2.4m
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

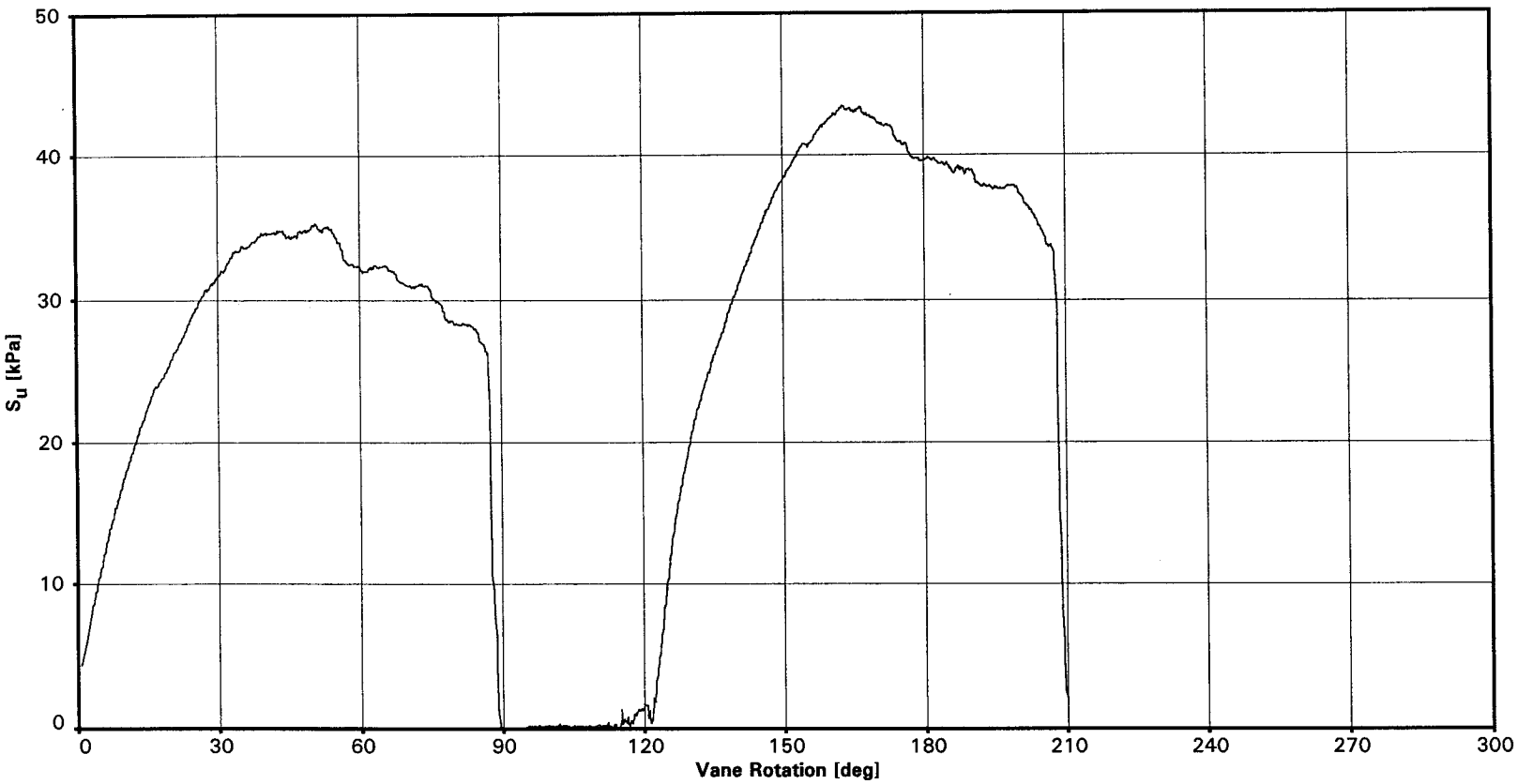
FUGRO

PLATE 98-36.9d

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.0m
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

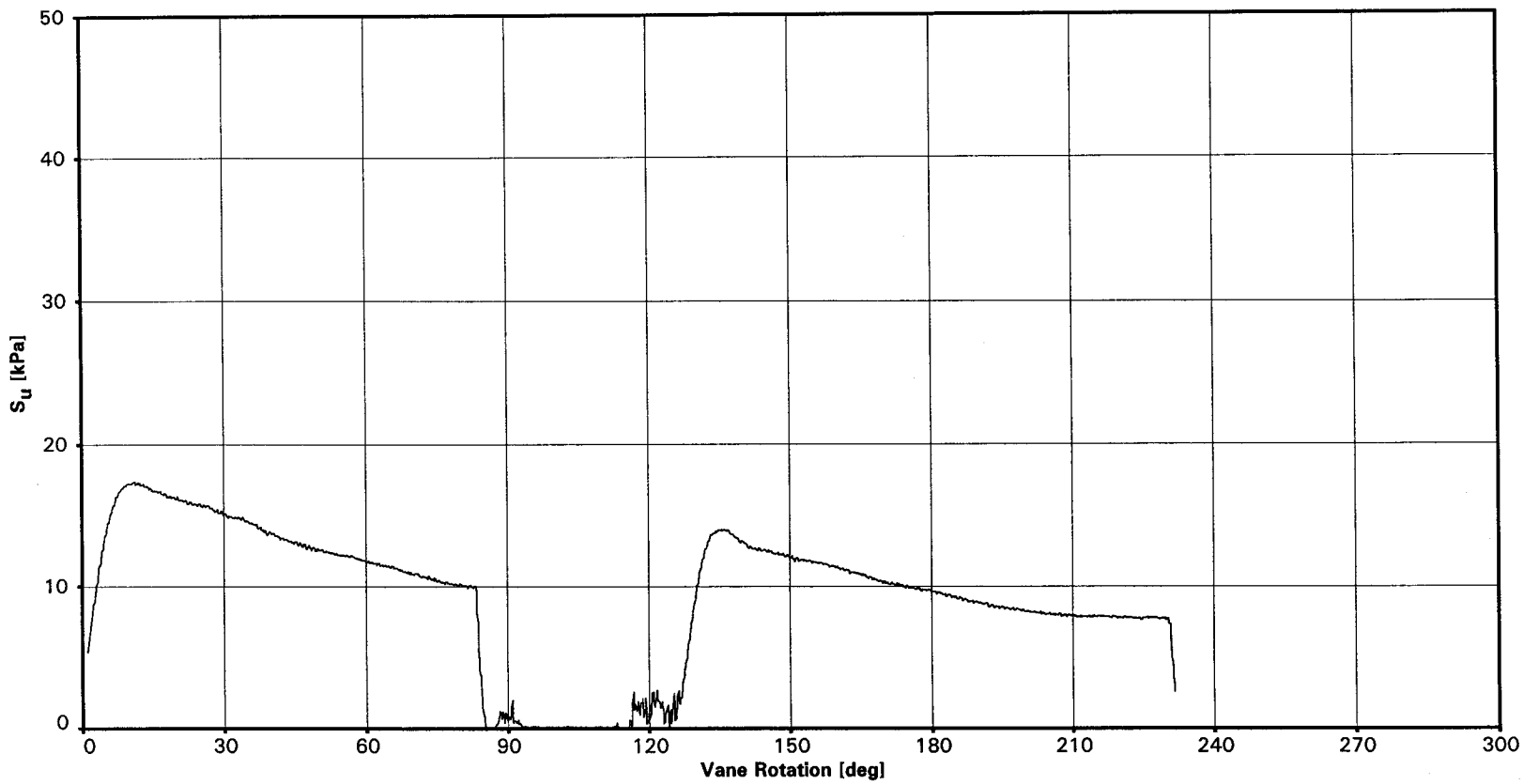
FUGRO

PLATE 98-36.9e

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.7m
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

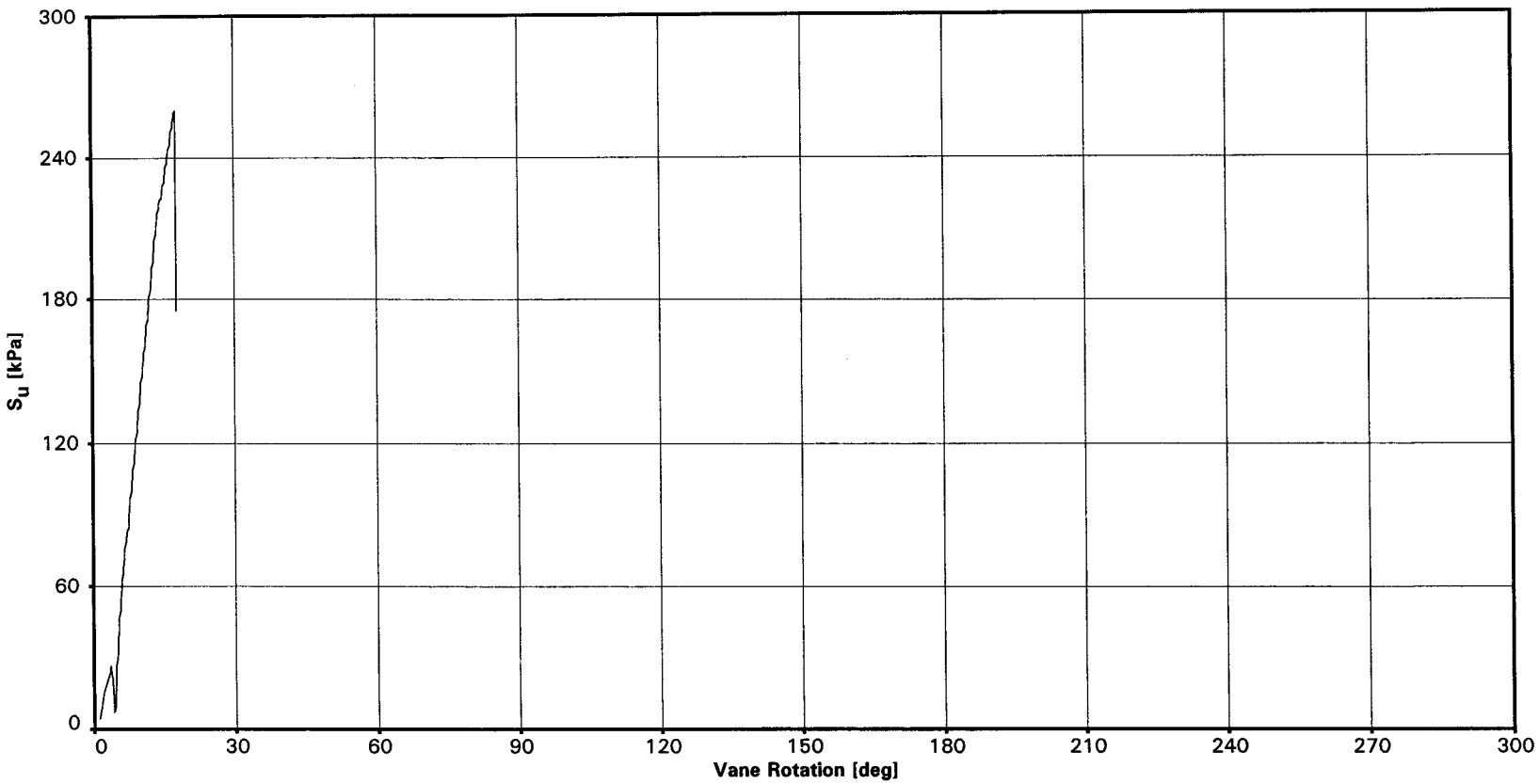
FUGRO

PLATE 98-36.9f

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 32.9m
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-36.9g

98-36		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)		
0.2	1	127	86	26	1.68	3.7				0.7	1.9														
0.6	500													1.9											
0.6	501													1.9											
1.2	2					7.3					6.1														
1.2	402													22.0											
1.2	502													8.6											
1.4	3	44	36	20	1.53	7.2					5.1		1.1												
1.8	504													14.4											
1.8	505													10.5											
2.3	6					7.2																			
2.4	7	63	51	20	1.39	5.9	86			23.9	3.8	3.4	0.9											H	
2.4	403													7.7											
2.4	506													12.9											
3.0	8					6.5																			
3.0	508													35.0											

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-36		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)		
3.0	509													43.1											
3.2	9					6.1																			
3.4	10	55																							
3.7	404													15.3											
3.7	510													17.2											
3.7	511													15.3											
3.8	11	54	38	18	1.74	6.9					18.3	3.7	5.4												
4.7	12	30																							
4.9	13	31				9.0	28																		
5.0	14					9.0																			
5.6	15					9.6																			
5.7	16	24					10																		
6.9	18					6.8																			
6.9	19	55	45	17	1.38						21.6	8.0													
7.5	20	65	50	23	1.53	6.1				15.3	22.9														

Identification Tests
MC = Moisture Content
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phi = Effective Angle of Friction

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-36		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)		
8.8	21	63	56	24	1.20																			C,K	2.75
8.8	22	60	54	22	1.17						25.5														
9.3	23	67	63	26	1.11		97	25.9							25.9		0.9							H	
9.4	24					6.0				25.9	34.0														
10.8	25							33.5																	
11.0	26	28	28	14	1.02	8.4									25.1		1.1								
11.0	27									27.8	39.6	4.2													
14.6	28	26	57	18	0.20	7.9																			
14.8	29					8.6																			
14.9	30	21					17																		
18.1	34	42								159.9															
18.3	31					7.5		83.8							81.4	33.1	0.9								
18.4	32					7.7																			
18.6	33	22				9.6																			
21.8	35							131.7																	

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-36		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)		
21.9	36	28	46	18	0.36	10.2	62			132.1	219.1				164.2		2.0							H	
22.8	37	34	47	18	0.54																			C	2.71
22.9	38										173.3														
26.7	39							91.0																	
26.8	40	45	68	25	0.48	9.1	96								65.5	25.2	0.7							H	
27.1	42									81.4	90.3														
31.9	44	34	74	19	0.27	8.2									126.7		0.3								
32.0	45										222.8														
32.9	400													258.6											
34.0	47	52	77	21	0.55	7.0									118.3		0.8								
34.1	48								107.7	197.3	139.9														
38.6	49							227.4																	
38.7	50	22	45	16	0.21	10.4										174.1									
38.9	51							186.7			222.8														
39.5	52	20	45	17	0.12																			C	2.72

Identification Tests
MC = Moisture Content
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-36		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)		
39.6	53	21	54	15	0.17						222.8														
40.5	401													258.6											
42.1	54							141.2	143.6																
42.2	55	41	78	25	0.31	7.9	100								133.0		0.3							H	
42.4	56							136.5																	
47.1	58	19	43	16	0.13	10.8									232.8		1.0								
47.2	59								222.0		222.8														
51.8	60							160.4	191.5																
52.0	61	36	122	26	0.10	8.1									136.2		0.4								
52.1	62							179.6	215.5		220.3														
52.6	63	49	75	23	0.50																			C	2.75
52.7	64	39	122	25	0.14						210.4														
57.3	65								143.6																
57.5	66	52	85	27	0.43	6.8	100																	H	
57.6	67	49						143.6			222.8														

Identification Tests
MC = Moisture Content
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Identification Tests
SUW = Submerged Unit Weight
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Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
phi = Effective Angle of Friction

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-36		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)		
62.2	68							165.2	215.5																
62.3	69	19	43	15	0.14	10.6									171.8		0.6								
62.5	70	20						167.6			222.8														
67.1	71							155.6	210.3																
67.2	72	22	49	20	0.08	10.2	100									180.0								H	
67.4	73	24						165.2	198.6																
67.9	74	25	54	21	0.13																			C	
68.0	75	22	67	20	0.06																				
72.7	77	26	36	20	0.38	9.9									212.2		3.4								
72.8	78	21									207.9														
77.6	80	16	38	15	0.05	10.8									226.9	158.6	0.7								
77.7	81	19							222.0																
82.4	83	21	40	18	0.14	10.0	94		215.5						192.1		0.8							H	
82.6	84	24							215.5																
83.1	85	22	35	16	0.33																			C	2.71

Identification Tests
MC = Moisture Content
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Identification Tests
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K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-36		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	SPECIFIC GRAVITY
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)		
83.2	86	23	43	18	0.19																				
87.9	88	26	43	18	0.32	10.1									191.4		3.3								
88.1	89	22							178.2		222.8														
90.0	90	11					9																		
92.1	91						5																		
96.0	92	19	43	16	0.11	10.4									320.1	233.6	1.8								
98.0	94	21				11.1	12																		
99.5	95	19				9.4	20																		
101.5	96	20	64	19	0.01																			C	
101.7	97	20	65	19	0.03	9.8									272.2	187.6	0.4								
101.7	98	22							268.7																

Identification Tests
MC = Moisture Content
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LI = Liquidity Index

Identification Tests
SUW = Submerged Unit Weight
Fines = % Passing No. 200 Sieve

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
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Additional Tests
H = Hydrometer
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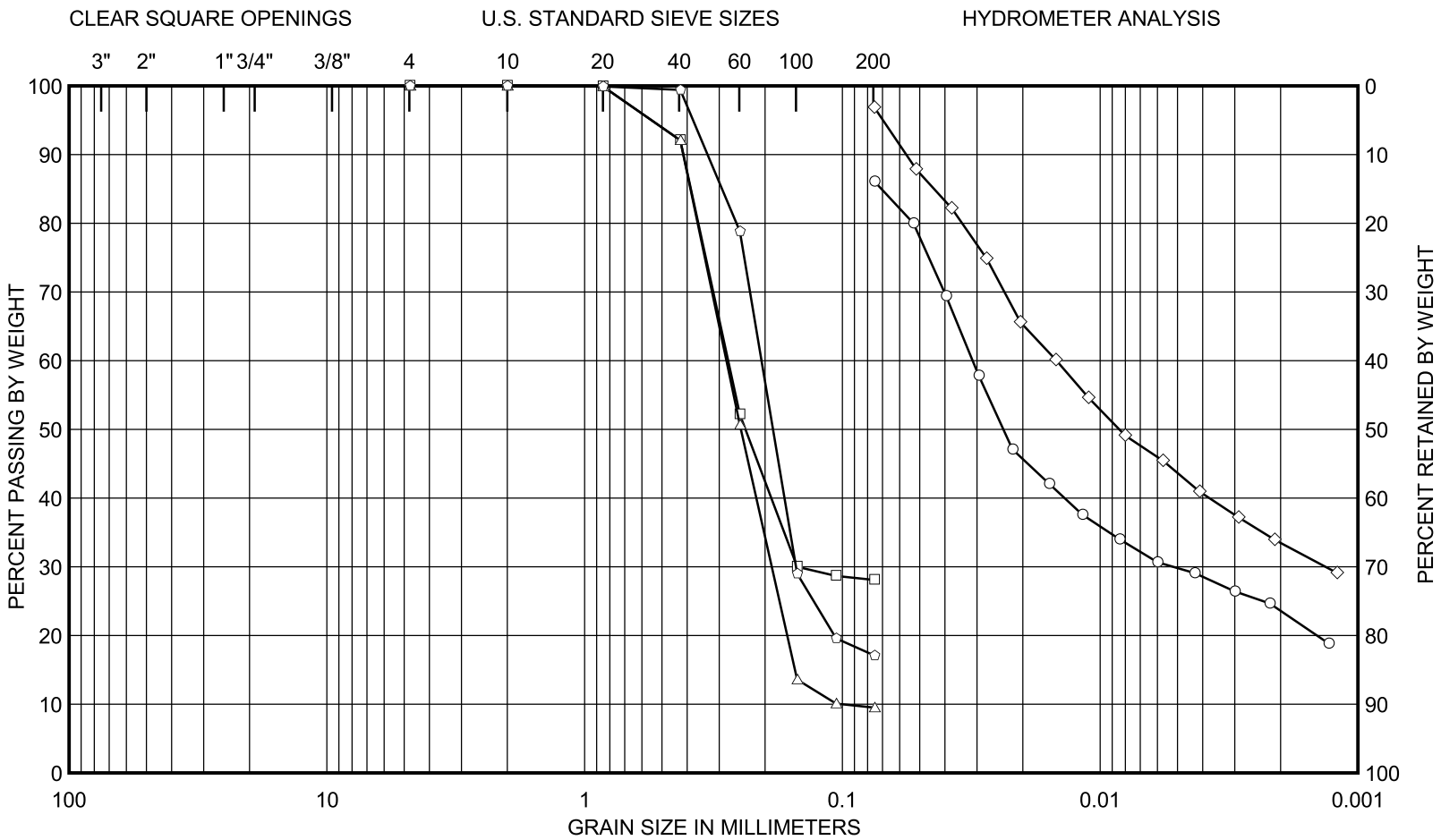
Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO



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

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
7	2.4	○——○	FAT CLAY (CH) with silt pockets and many shells and shell fragments			0.024
13	4.9	□——□	SILTY FINE SAND (SM) with clay seams and pockets			0.24
16	5.7	△——△	FINE SAND (SP-SM) with silt and a trace of medium sand	1.3	2.8	0.25
23	9.3	◇——◇	FAT CLAY (CH) with a few silt pockets			0.0084
30	14.9	⬠——⬠	SITY FINE SAND (SM) with clay pockets			0.19

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-36

SFOBB East Span Seismic Safety Project

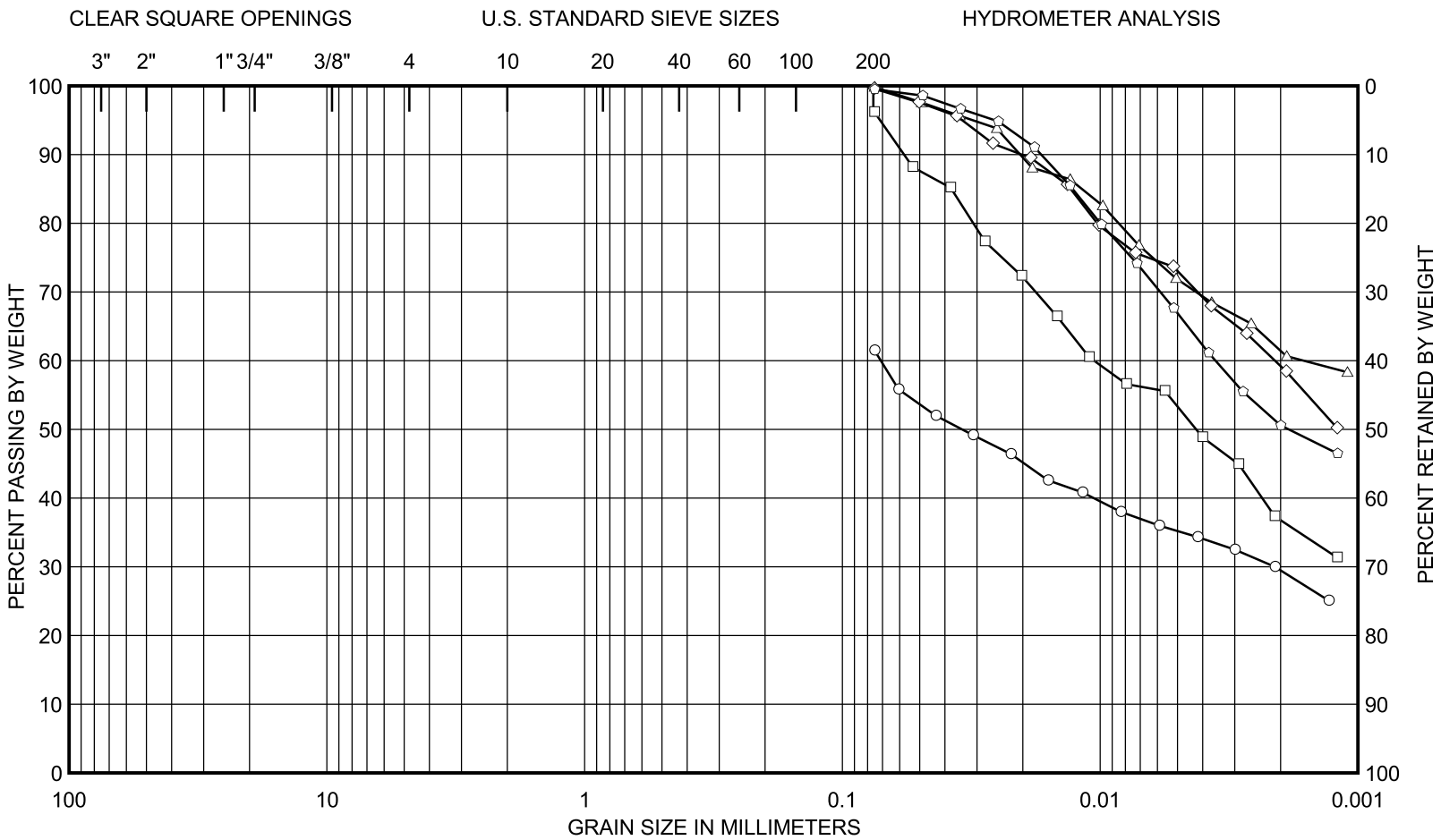
SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-36.11a

i:\caltrans\98-36 04/55/YY



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

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
36	21.9	○——○	LEAN CLAY (CL) with many sand seams			0.034
40	26.8	□——□	FAT CLAY (CH) with many silty sand pockets and partings			0.0042
55	42.2	△——△	FAT CLAY (CH)			0.011
66	57.5	◇——◇	FAT CLAY (CH) with silt pockets			0.0013
72	67.2	⬠——⬠	LEAN CLAY (CL)			0.0019

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-36

SFOBB East Span Seismic Safety Project

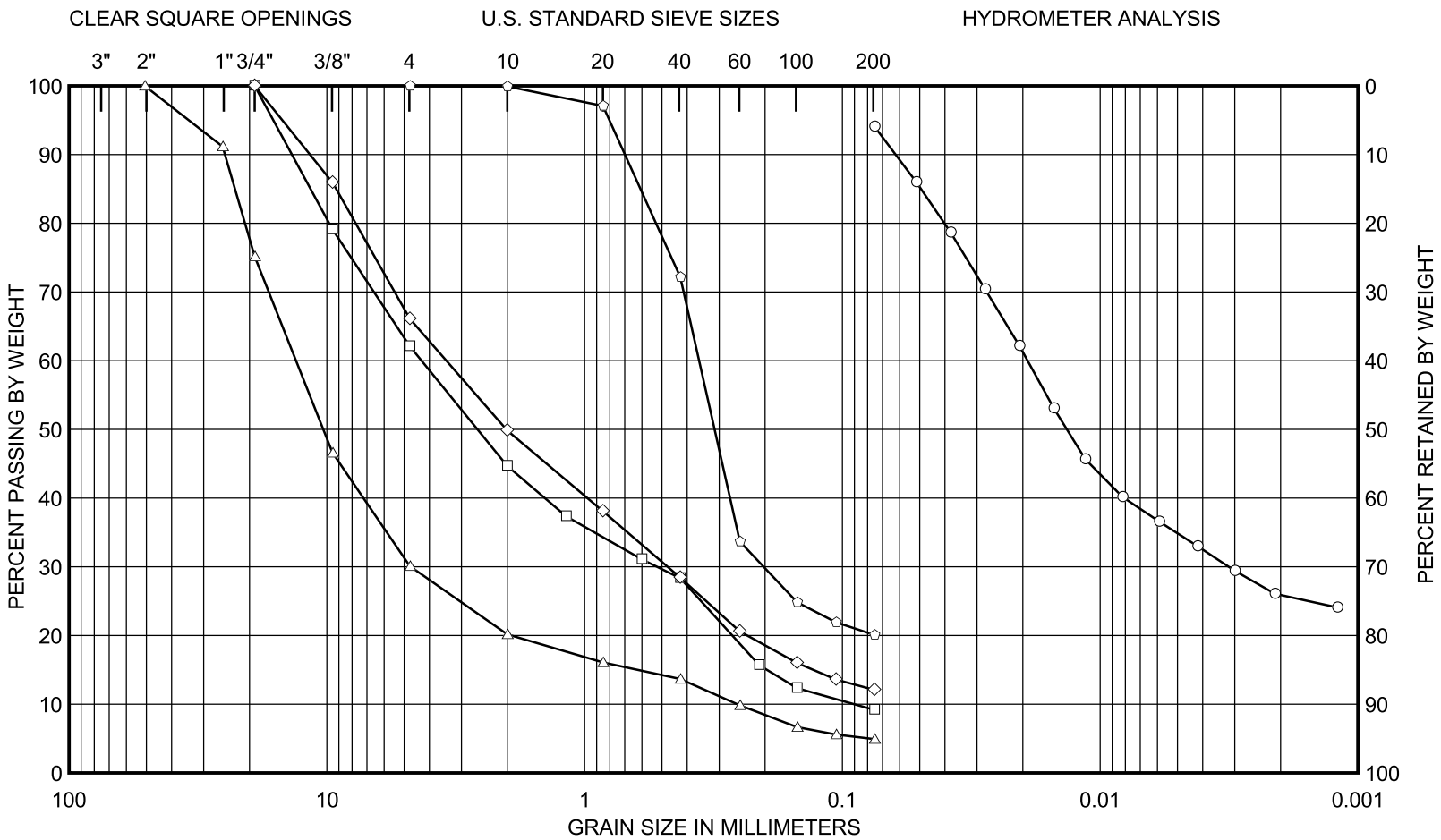
SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-36.11b

i:\caltrans\98-36 04/44/YY



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

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
83	82.4	○——○	LEAN CLAY (CL) with many silt pockets			0.013
90	90.0	□——□	FINE TO COARSE SAND (SP-SM) with silt and fine gravel	0.7	47.7	2.6
91	92.1	△——△	FINE GRAVEL (GP) with sand and coarse gravel	6.5	51.3	10.3
94	98.0	◇——◇	SILTY FINE TO COARSE SAND (SM) with clay and fine gravel			2.0
95	99.5	⬠——⬠	SILTY FINE SAND (SM) with medium sand			0.31

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-36

SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-36.11c

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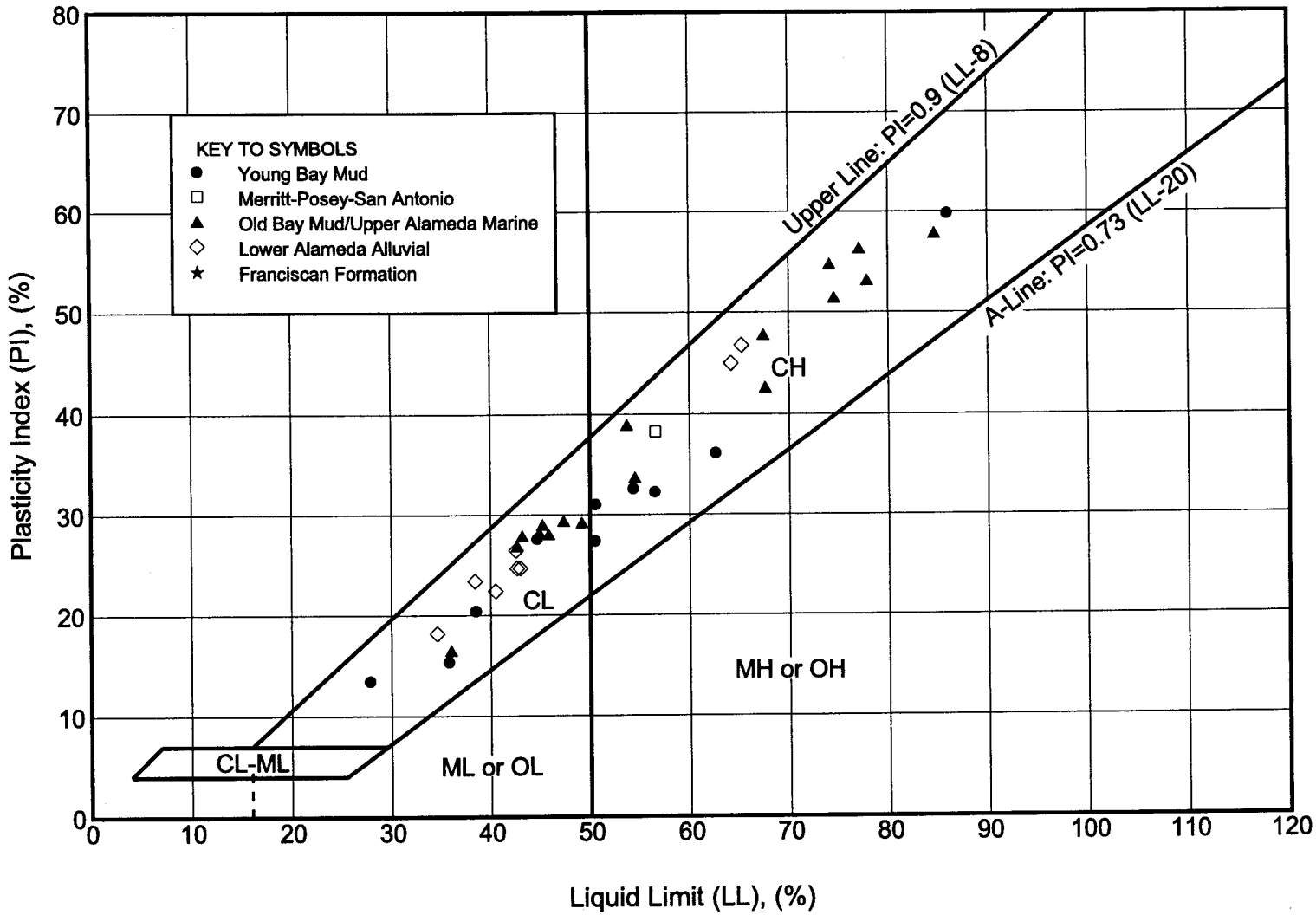
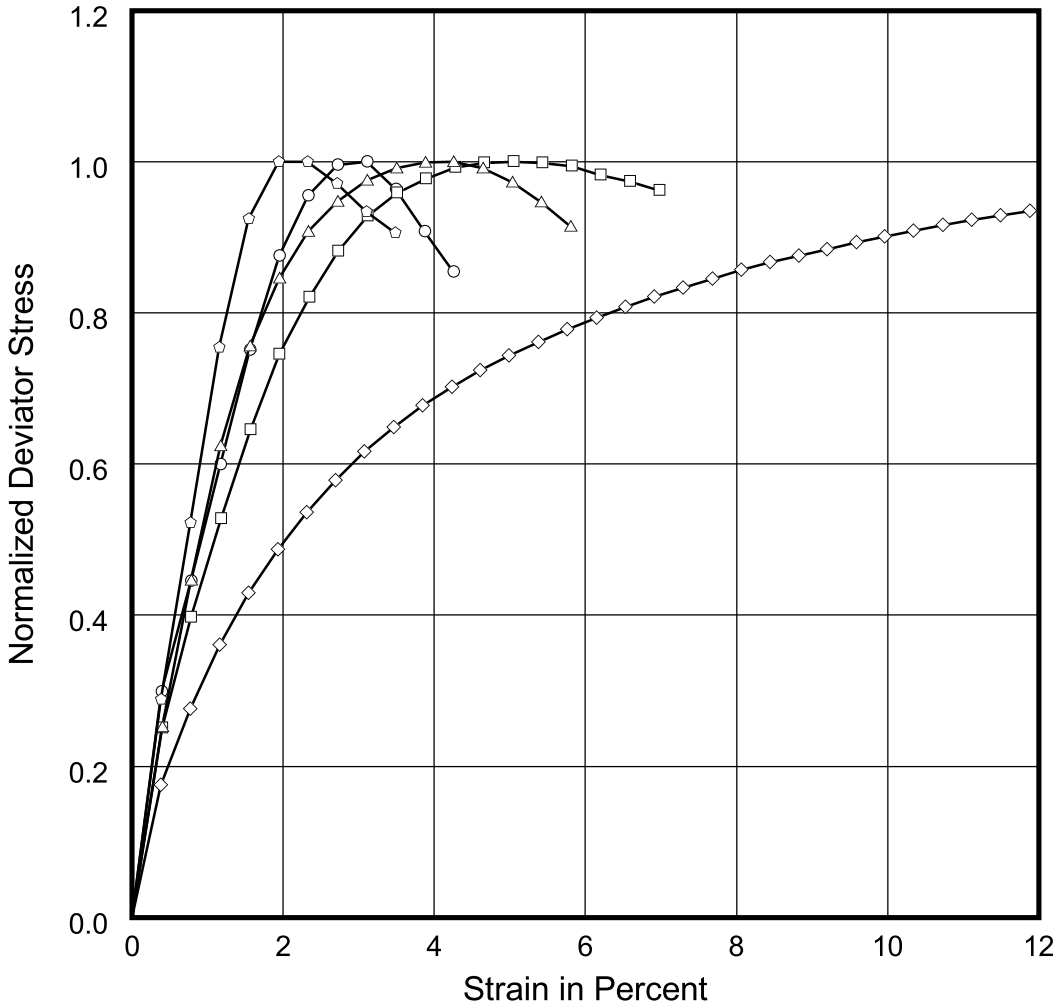


PLASTICITY CHART
Boring 98-36
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

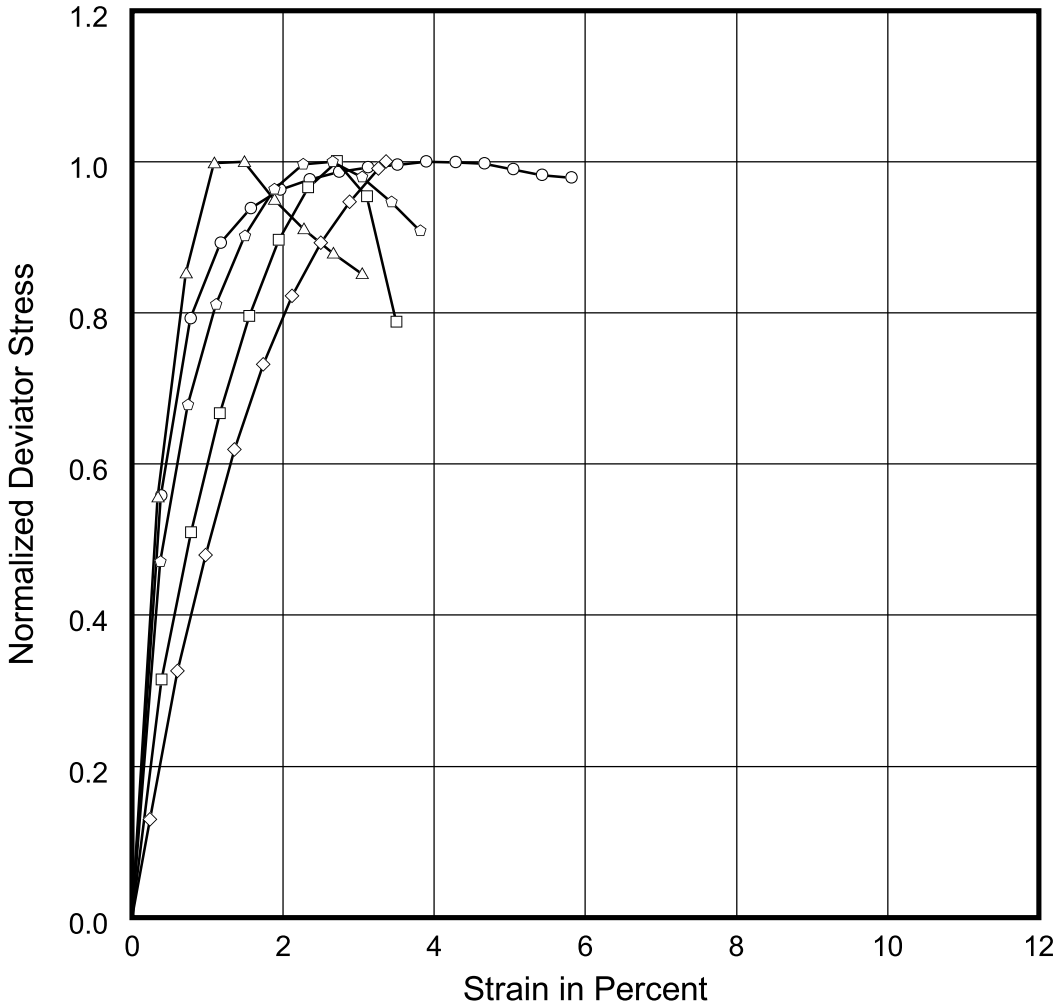


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	23	9.3	UU	207	52	0.9
	26	11.0	UU	241	50	1.1
	31	18.3	UU	827	163	0.9
	36	21.9	UU	827	328	2.0
	40	26.8	UU	896	131	0.7

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-36
SFOBB East Span Seismic Safety Project

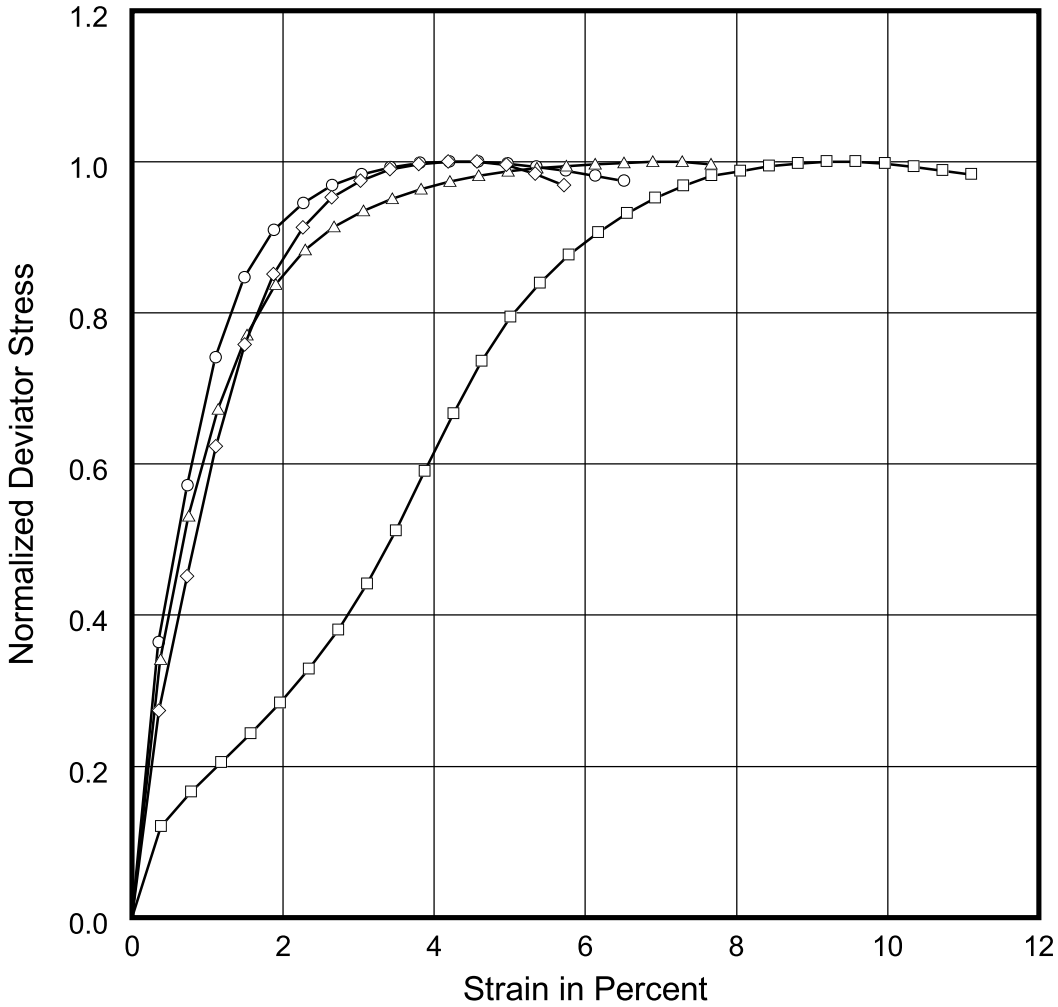


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○	44	31.9	UU	1000	253	0.3
□	47	34.0	UU	1034	237	0.8
△	55	42.2	UU	1241	266	0.3
◇	58	47.1	UU	1310	466	1.0
⬠	61	52.0	UU	1448	272	0.4

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-36
SFOBB East Span Seismic Safety Project

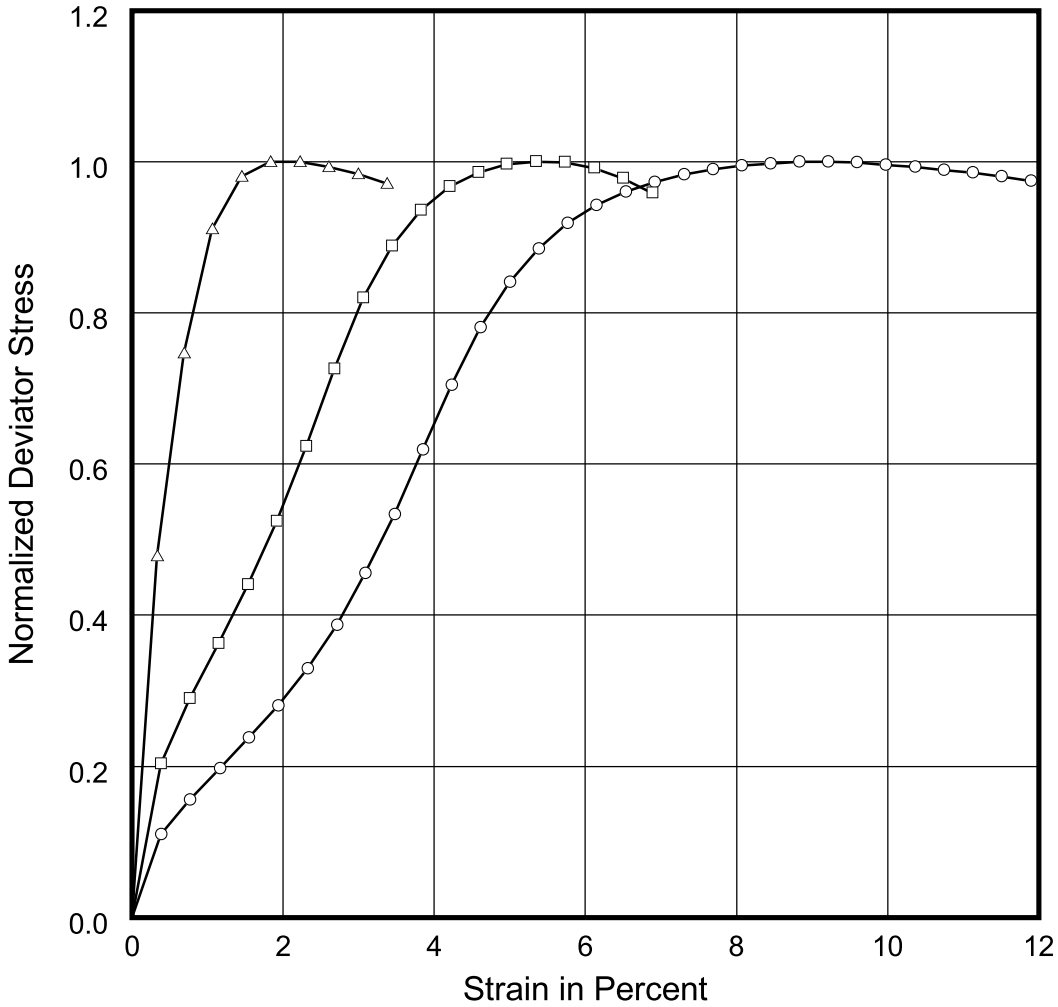


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○	69	62.3	UU	1655	344	0.6
□	77	72.7	UU	1930	424	3.4
△	80	77.6	UU	1999	454	0.7
◇	83	82.4	UU	2137	384	0.8

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-36
SFOBB East Span Seismic Safety Project

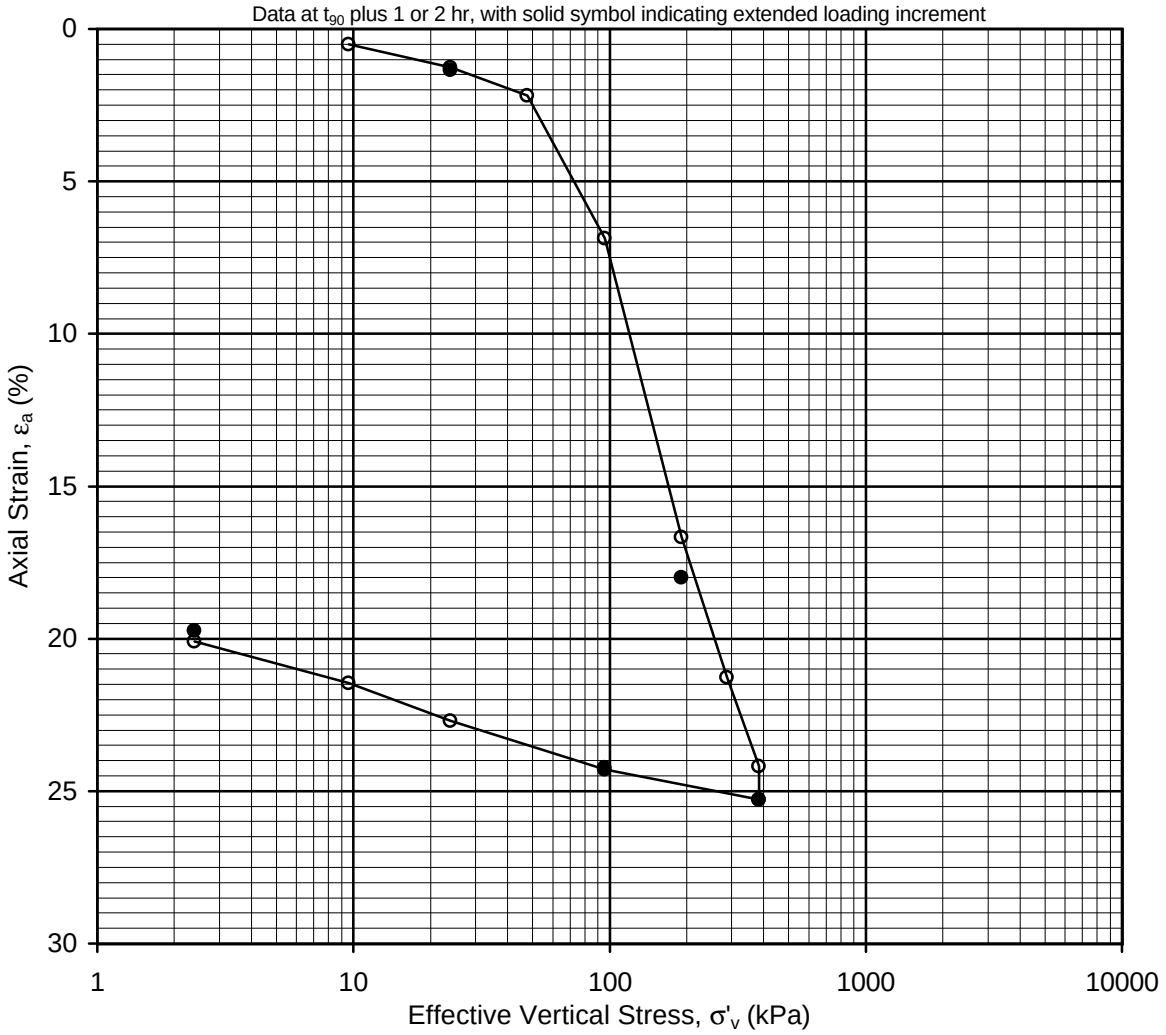


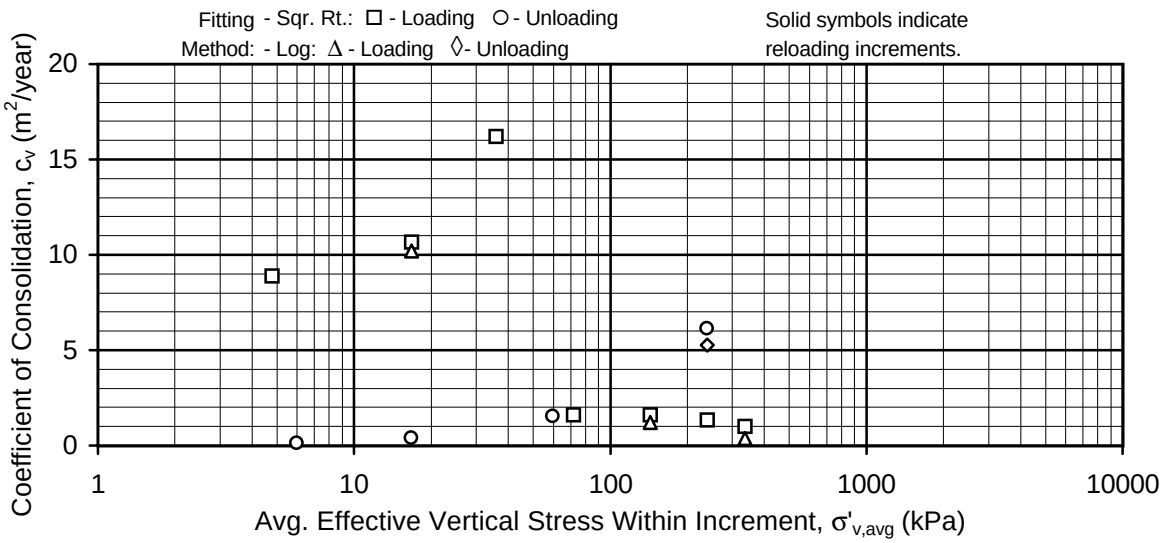
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	88	87.9	UU	2344	383	3.3
□—□	92	96.0	UU	2482	640	1.8
△—△	97	101.7	UU	2482	544	0.4

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

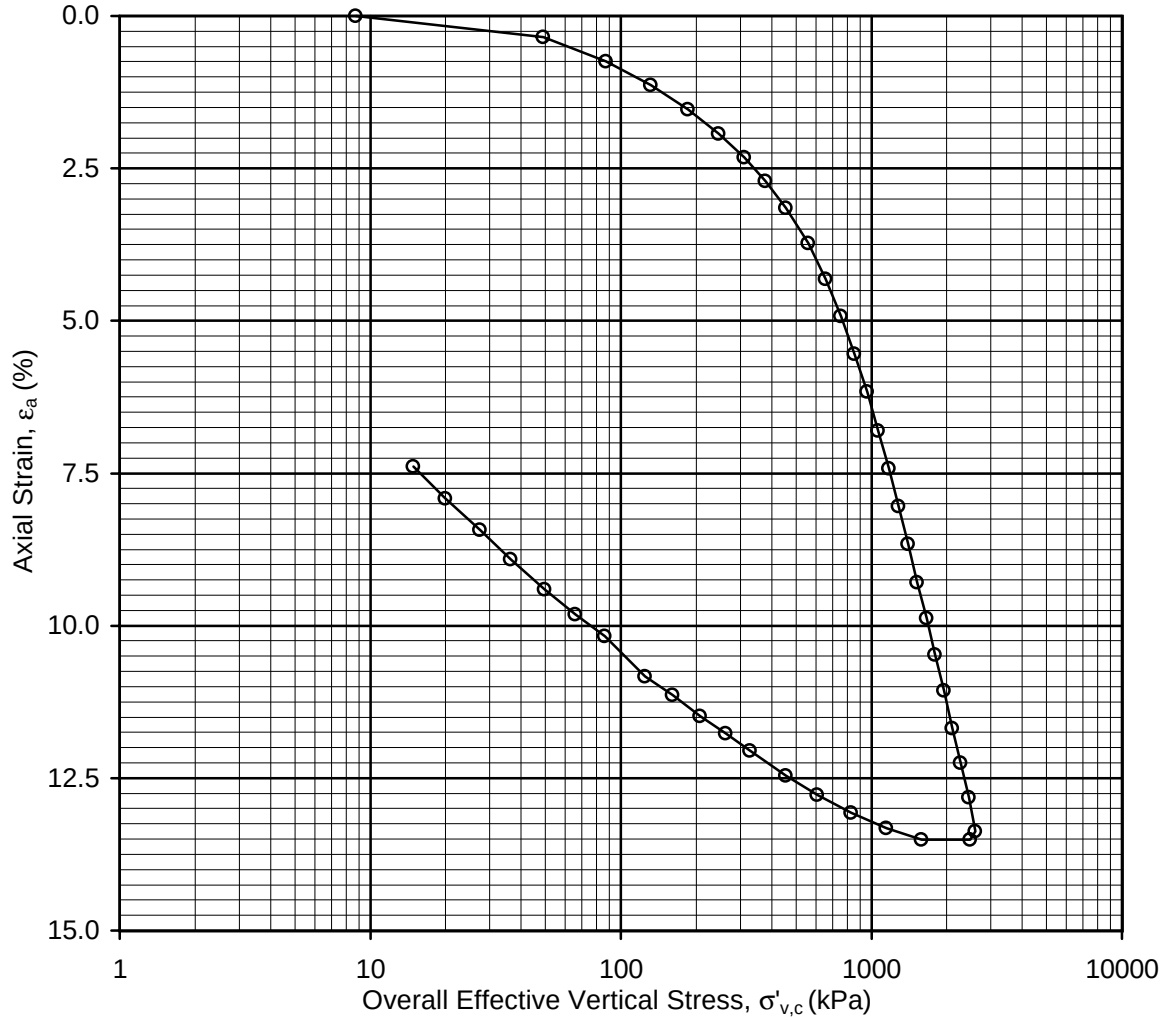
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-36
SFOBB East Span Seismic Safety Project

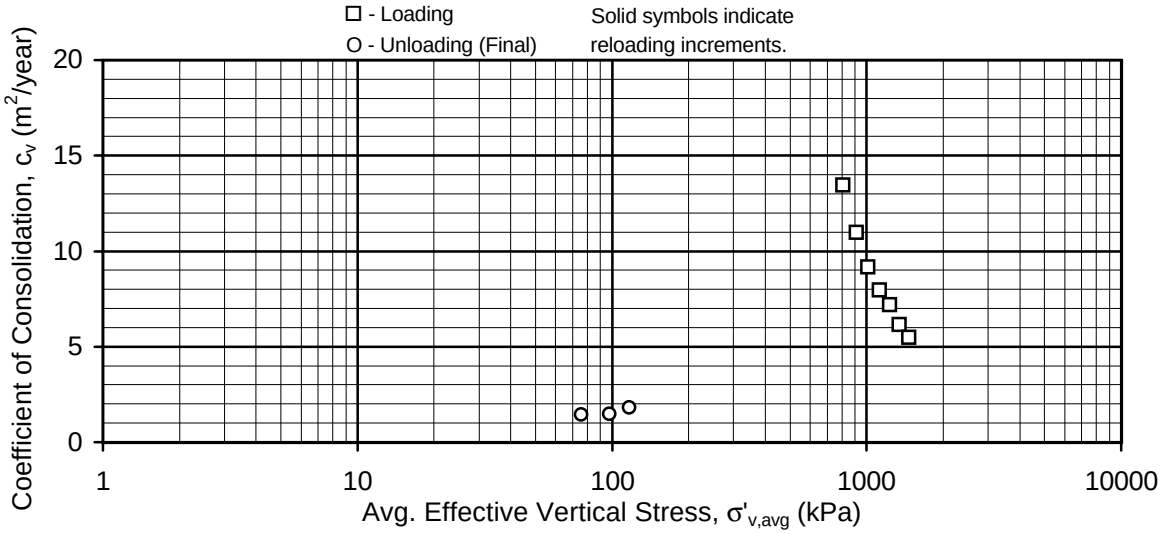




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 21 - Depth: 8.8m
Boring 98-36
SFOBB East Span Seismic Safety Project

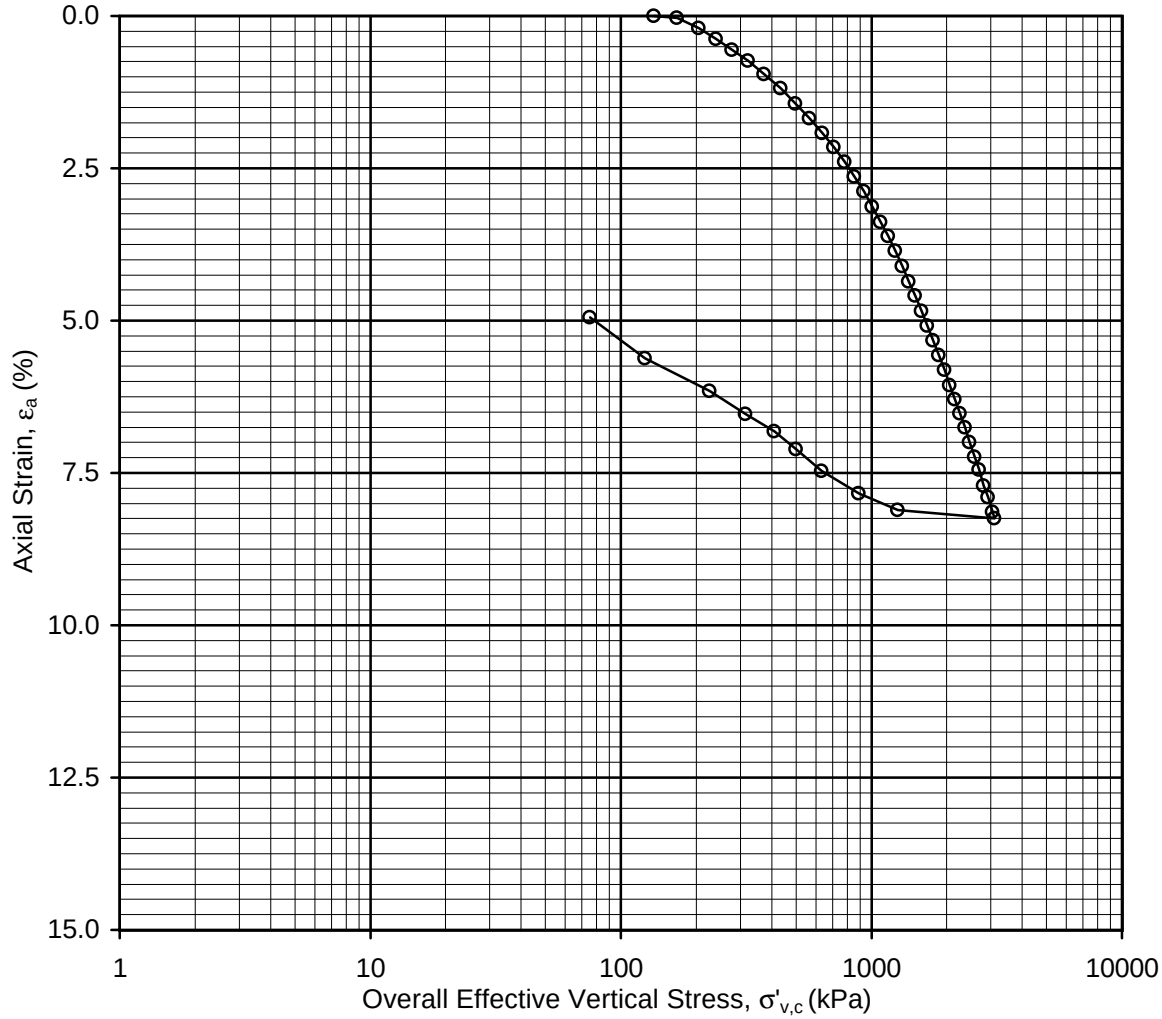


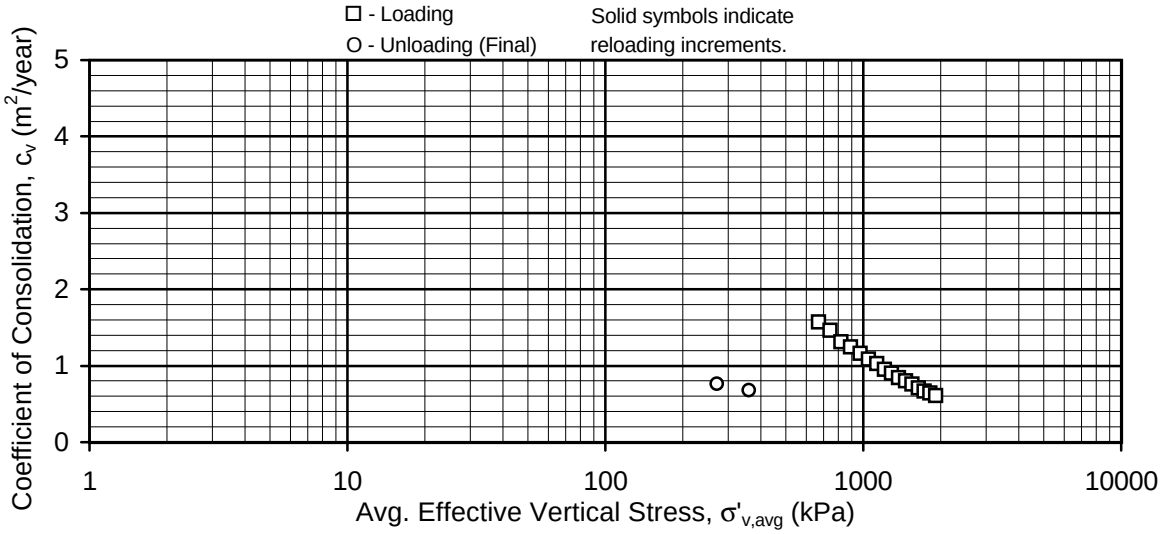


CRS CONSOLIDATION TEST RESULTS

Sample No. 37 - Depth: 22.8m
Boring 98-36
SFOBB East Span Seismic Safety Project

PLATE 98-36.14b

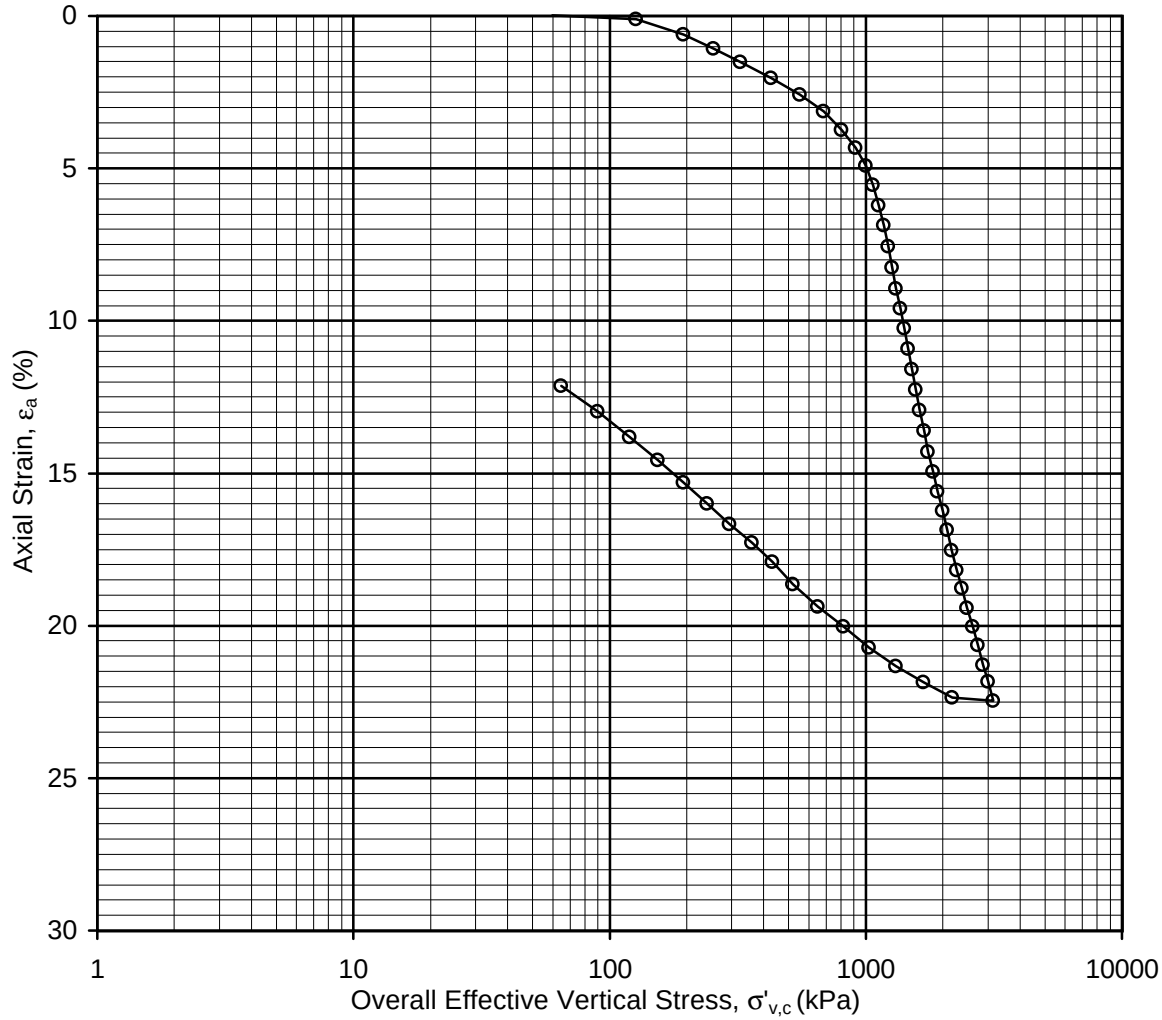


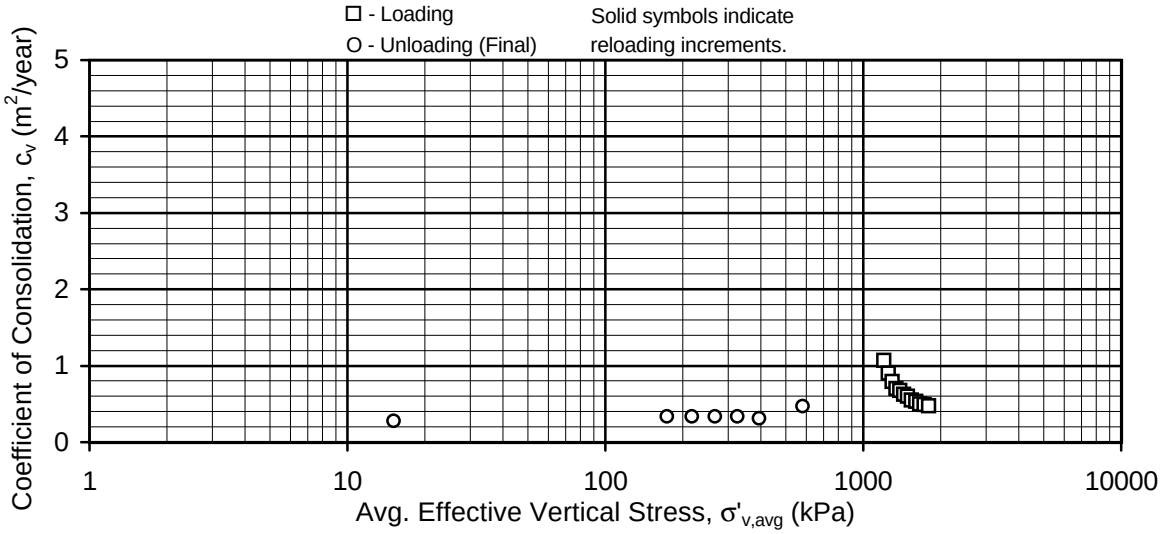


CRS CONSOLIDATION TEST RESULTS

Sample No. 52 - Depth: 39.5m
Boring 98-36
SFOBB East Span Seismic Safety Project

PLATE 98-36.14c

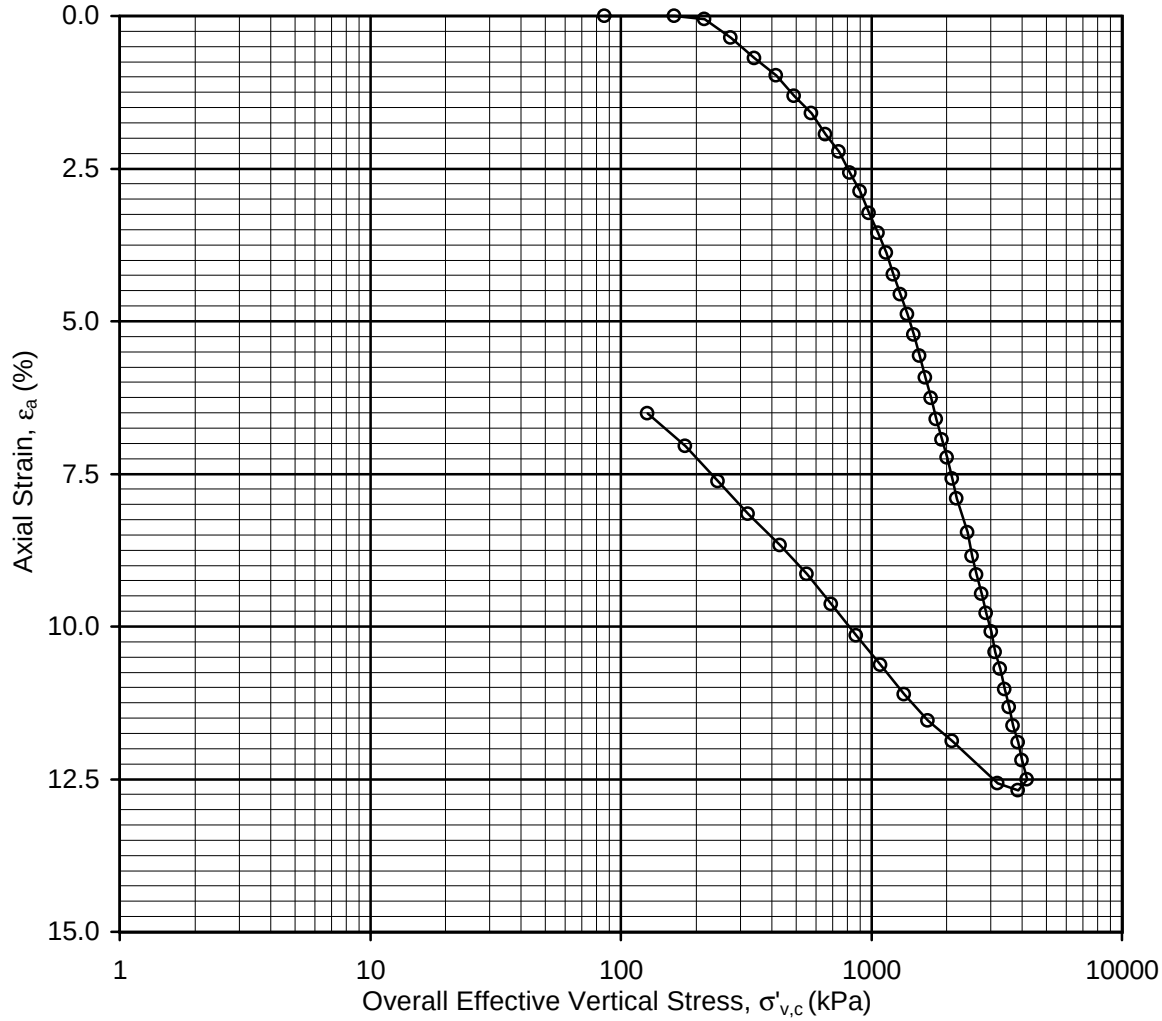


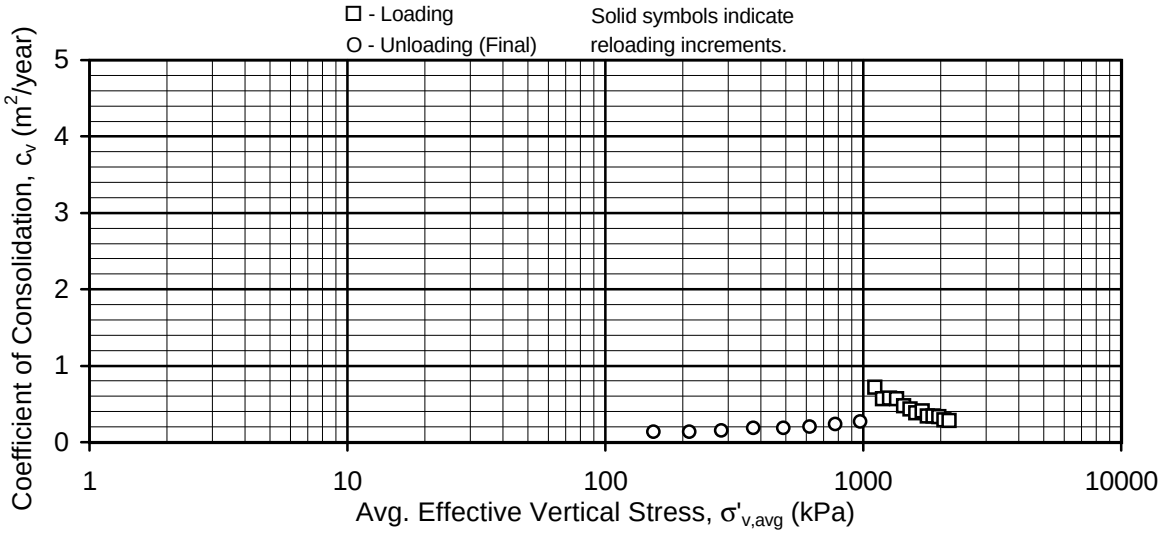


CRS CONSOLIDATION TEST RESULTS

Sample No. 63 - Depth: 52.6m
Boring 98-36
SFOBB East Span Seismic Safety Project

PLATE 98-36.14d

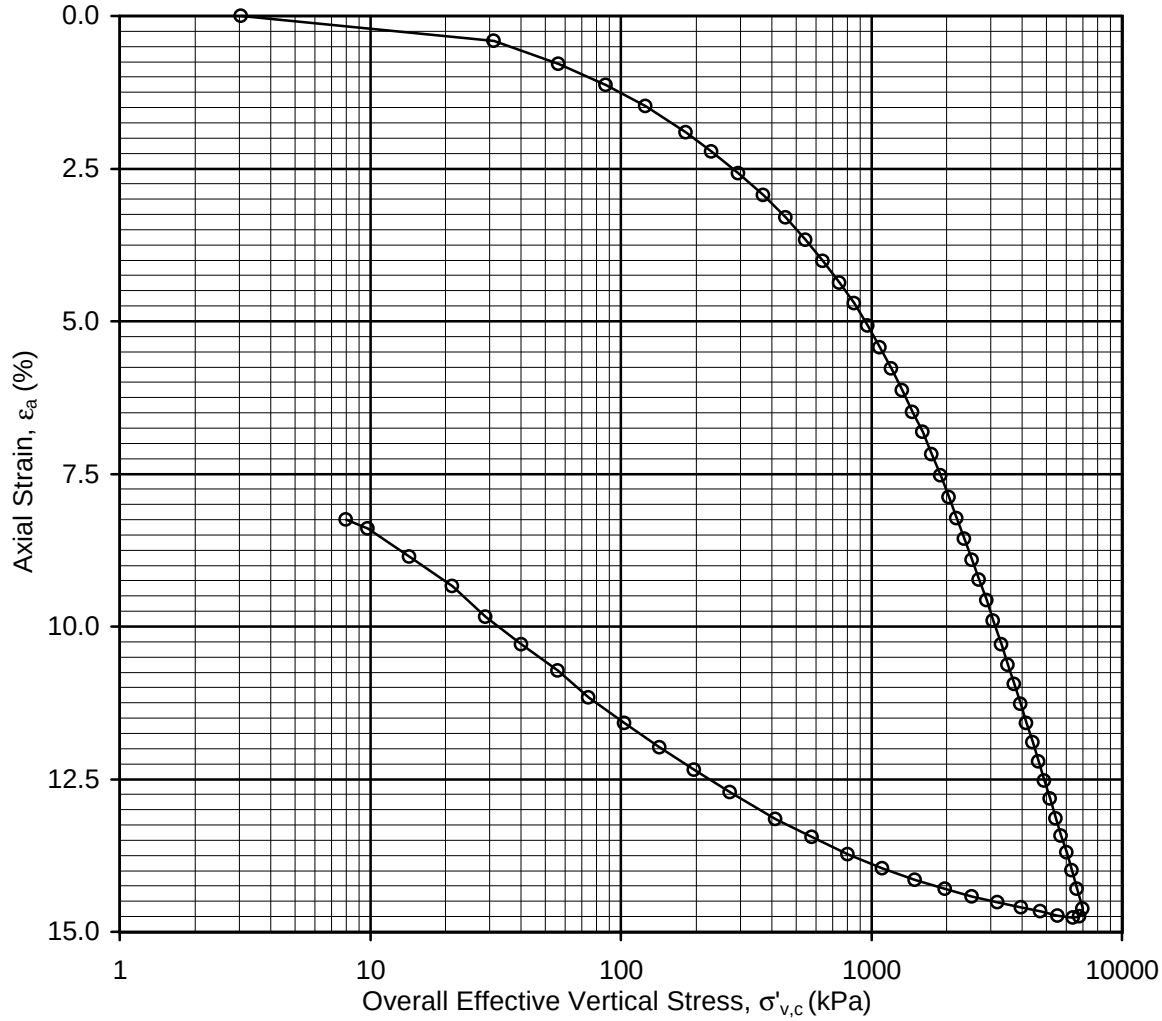


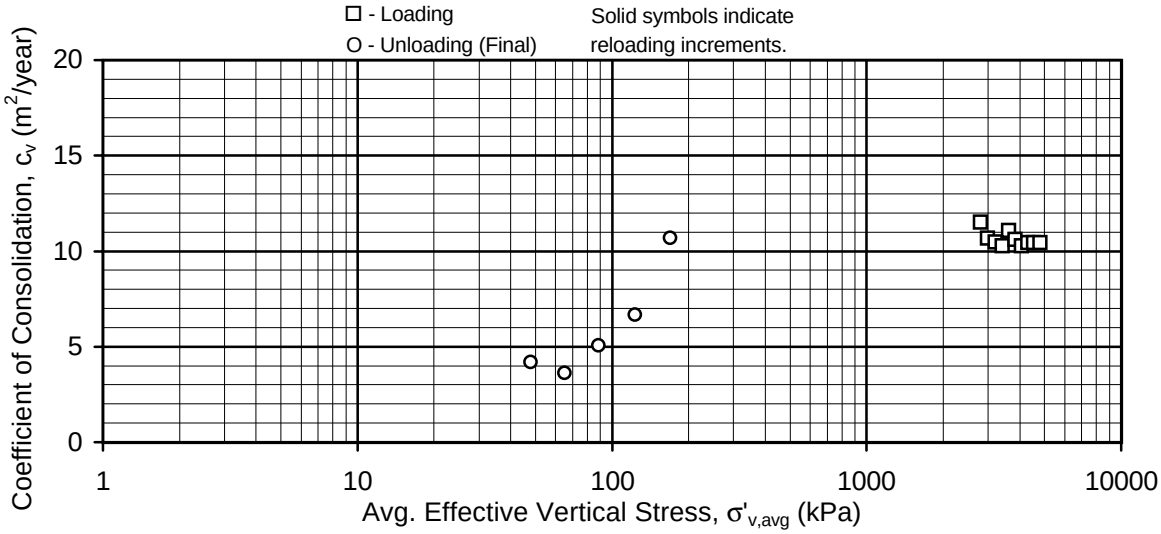


CRS CONSOLIDATION TEST RESULTS

Sample No. 74 - Depth: 67.9m
Boring 98-36
SFOBB East Span Seismic Safety Project

PLATE 98-36.14e

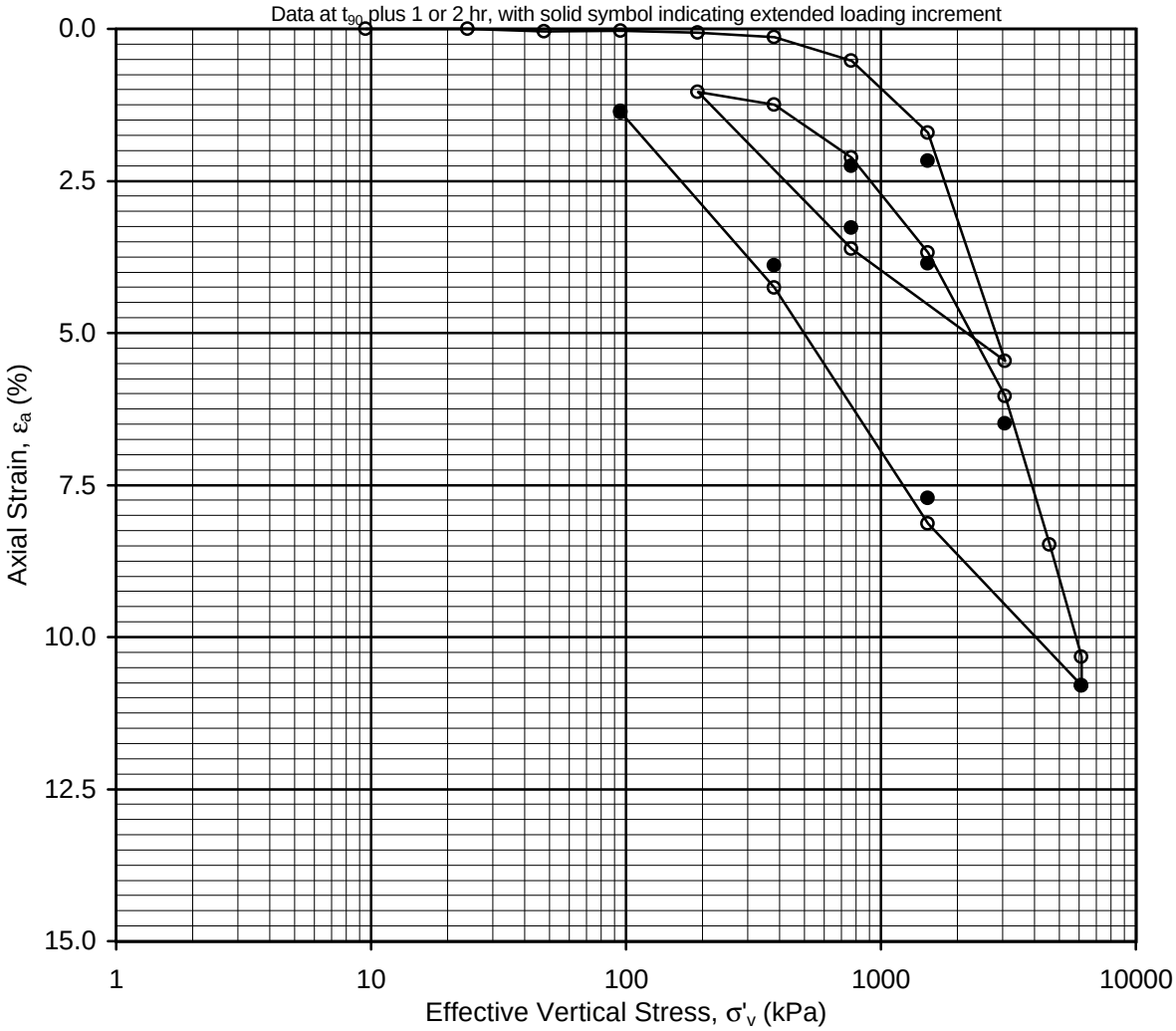


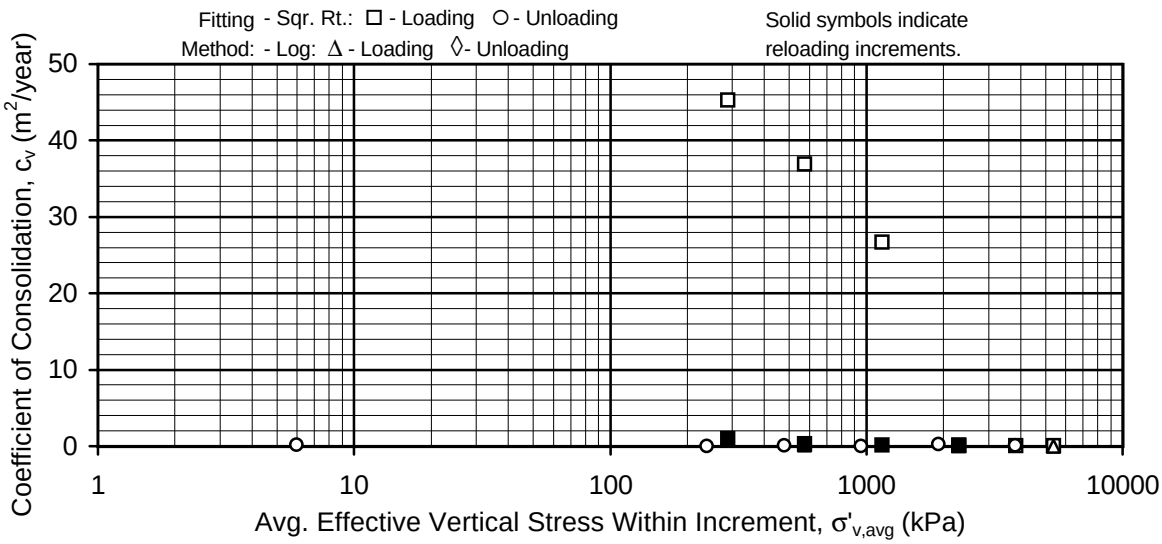


CRS CONSOLIDATION TEST RESULTS

Sample No. 85 - Depth: 83.1m
Boring 98-36
SFOBB East Span Seismic Safety Project

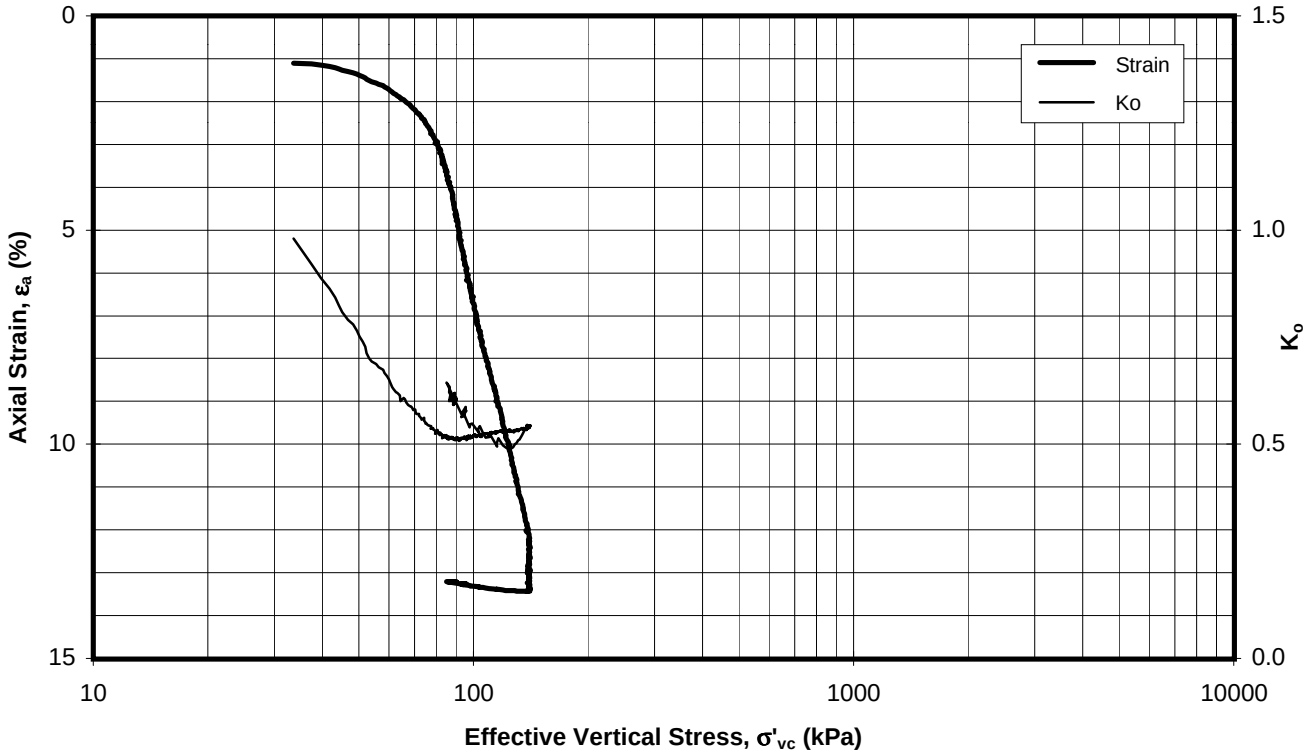
PLATE 98-36.14f

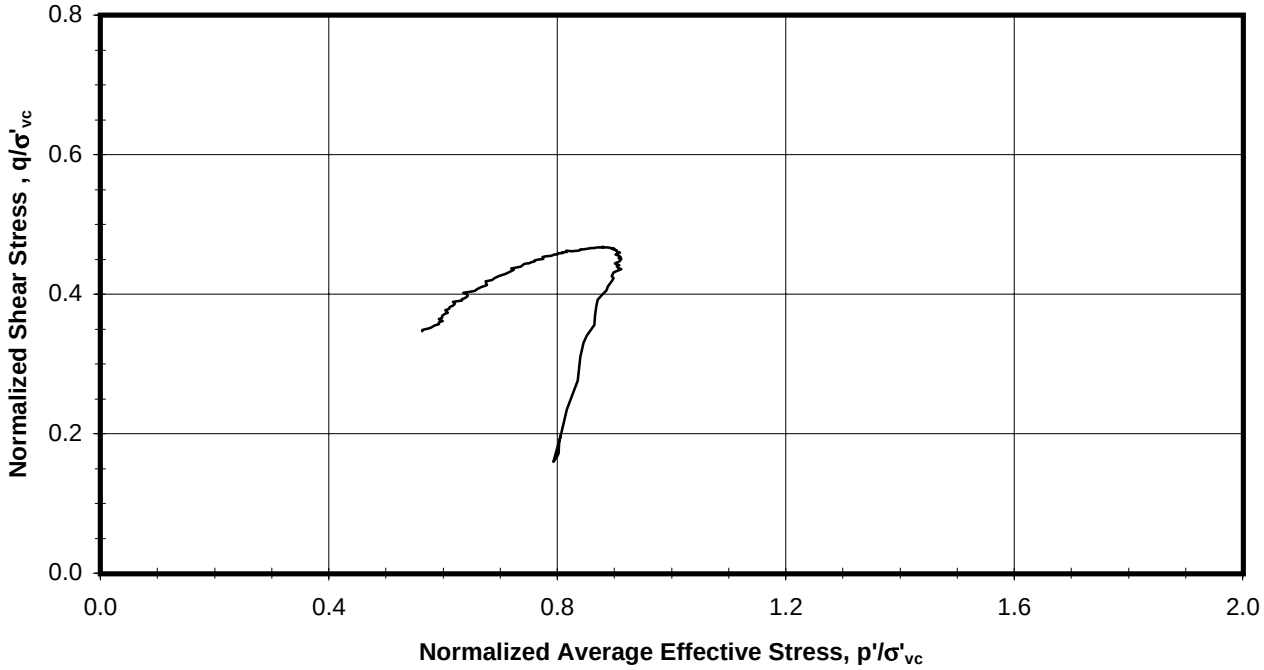




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 96 - Depth: 101.5m
Boring 98-36
SFOBB East Span Seismic Safety Project





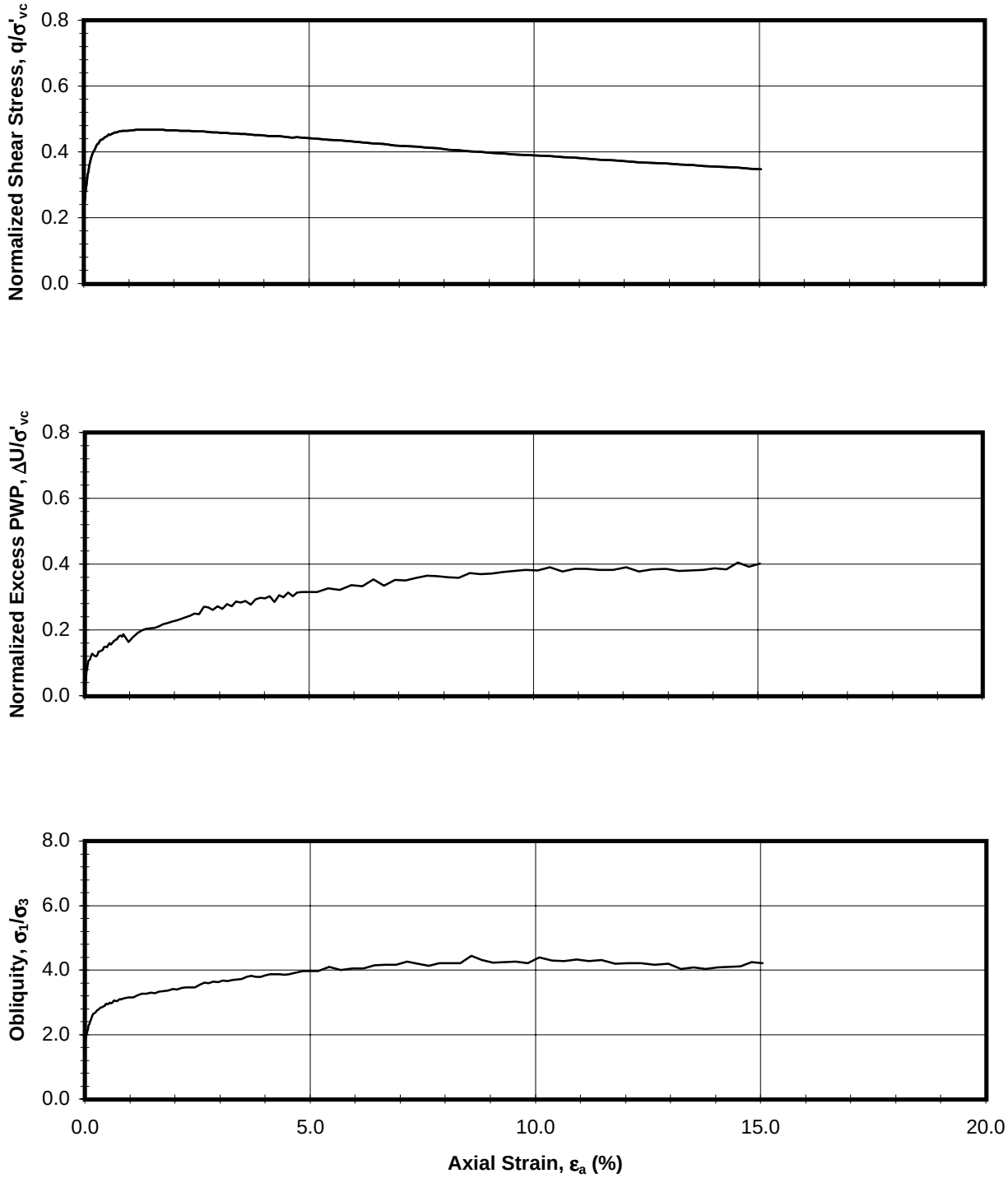
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 21 - Depth: 8.6m

Boring 98-36

SFOBB East Span Seismic Safety Project

PLATE 98-36.15.1



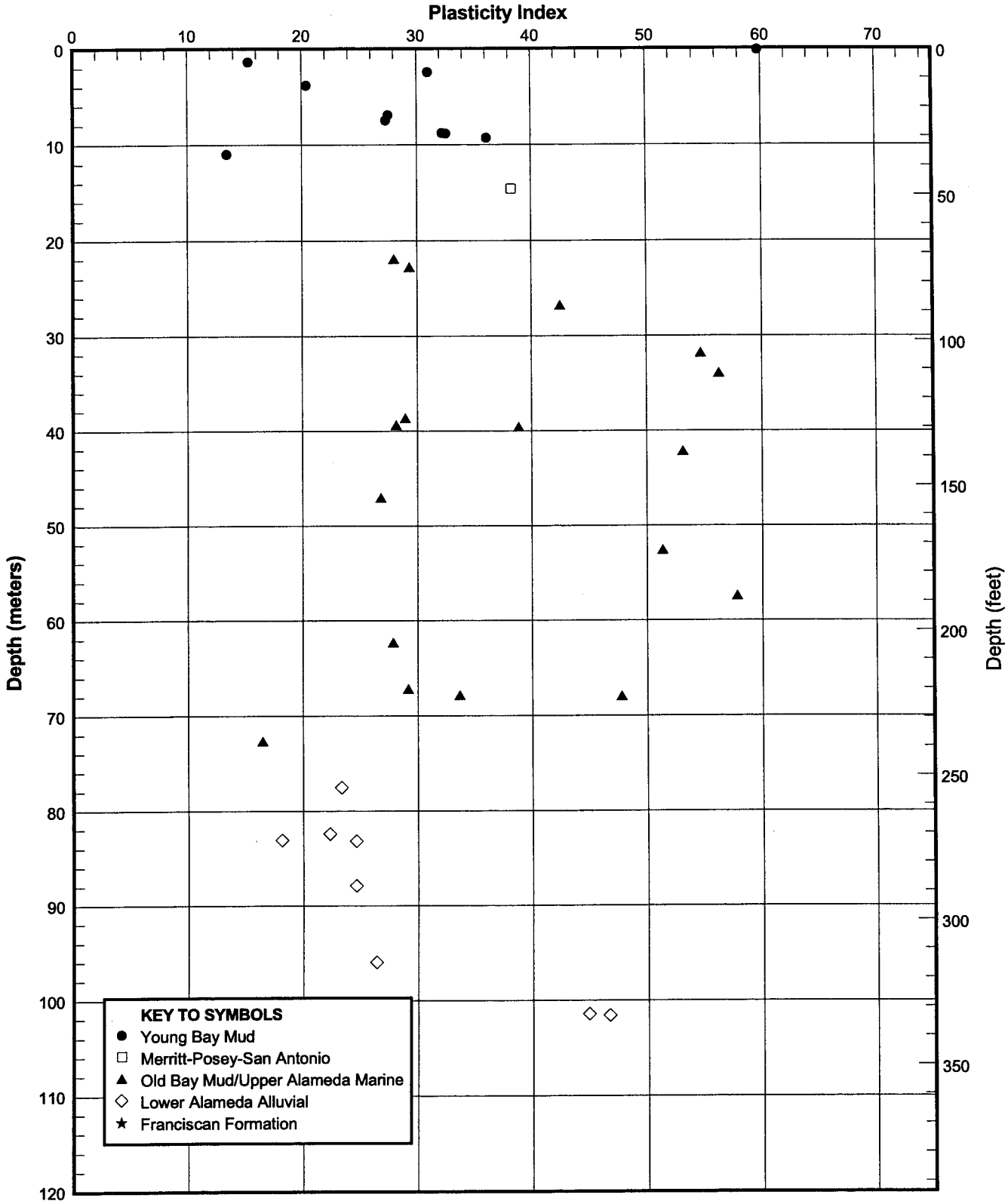
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 21 - Depth: 8.6m

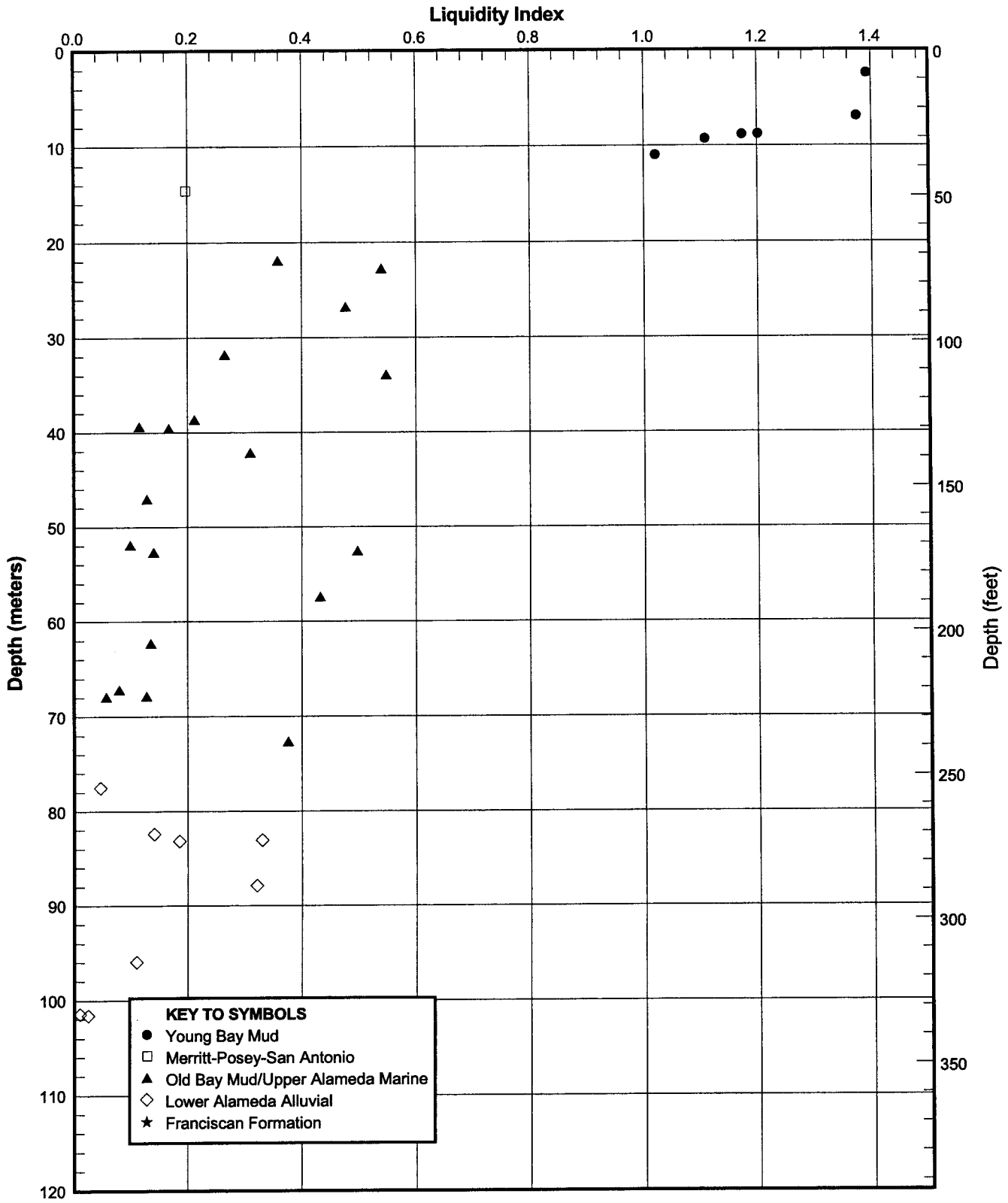
Boring 98-36

SFOBB East Span Seismic Safety Project

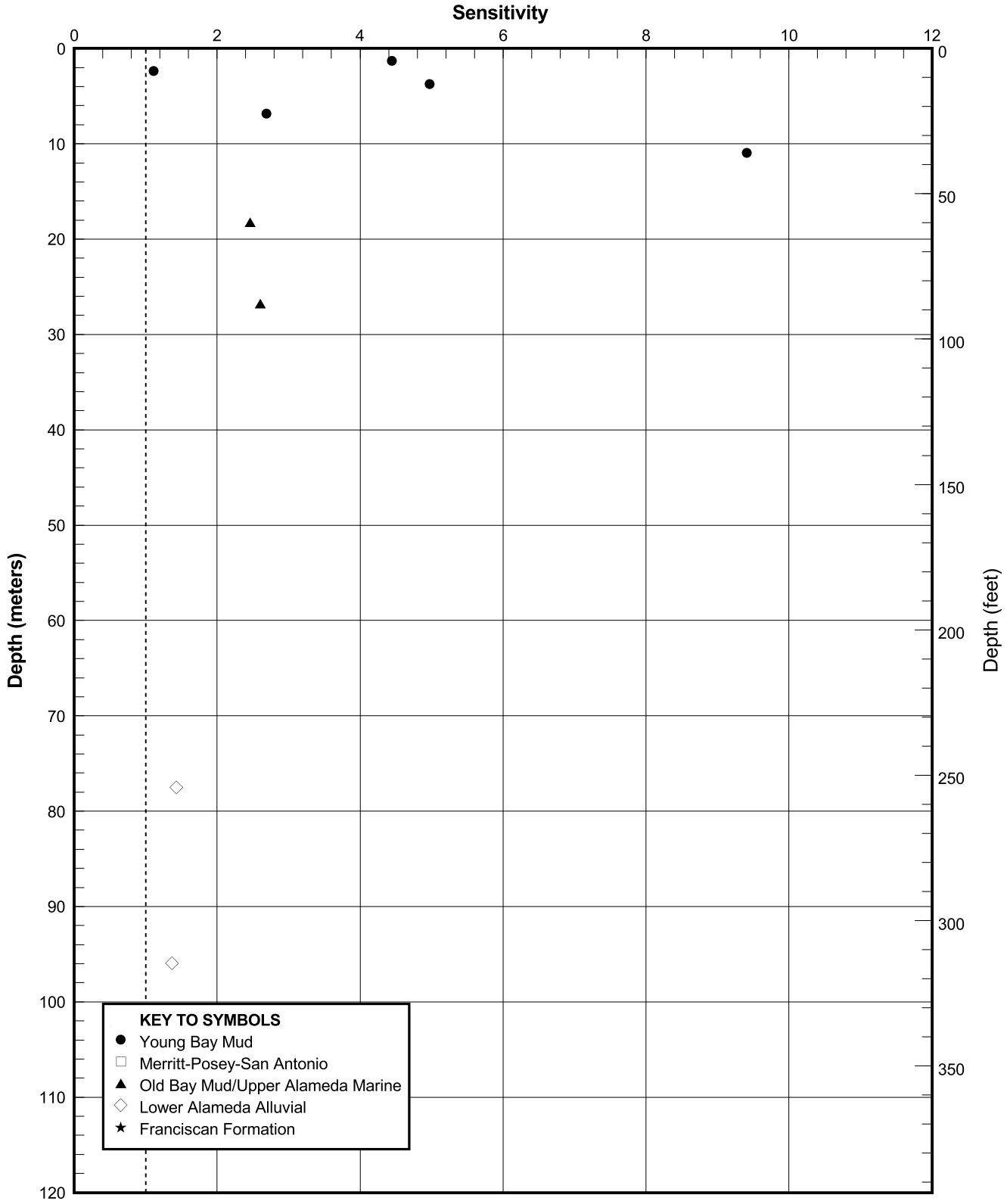
NO ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TESTS PERFORMED FOR THIS BORING



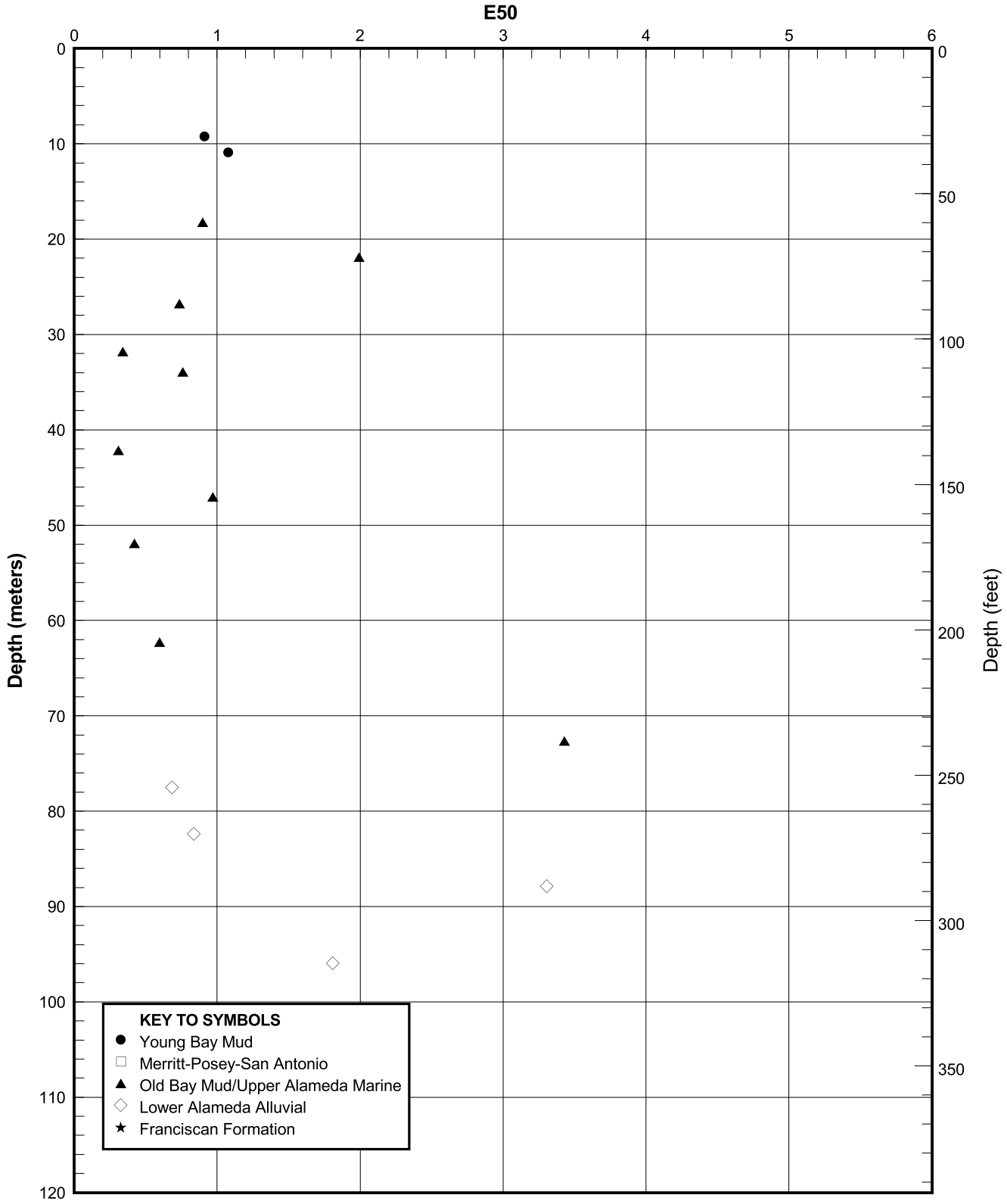
PLASTICITY INDEX PROFILE
Boring 98-36
SFOBB East Span Seismic Safety Project



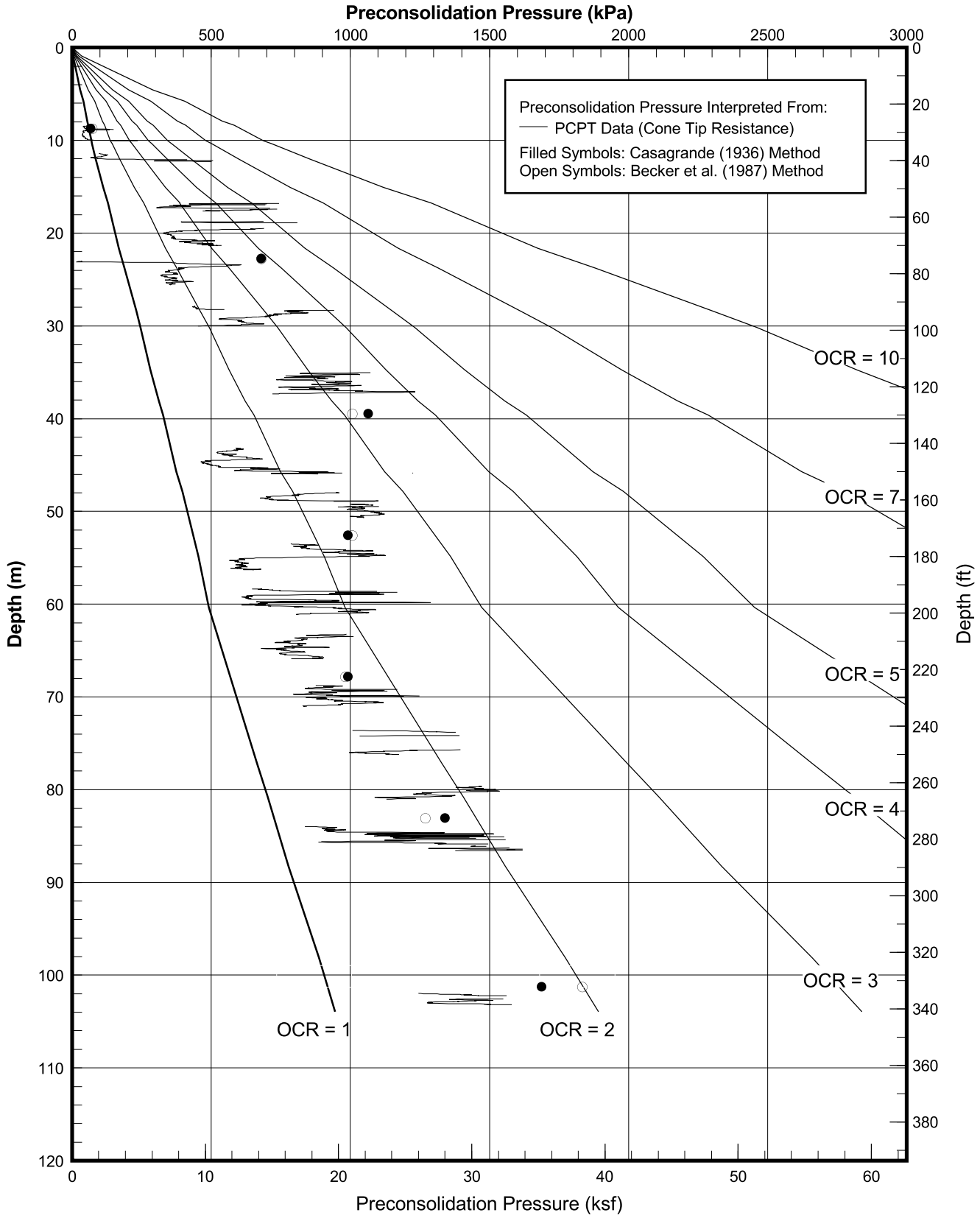
LIQUIDITY INDEX PROFILE
Boring 98-36
SFOBB East Span Seismic Safety Project



SENSITIVITY PROFILE
Boring 98-36
SFOBB East Span Seismic Safety Project



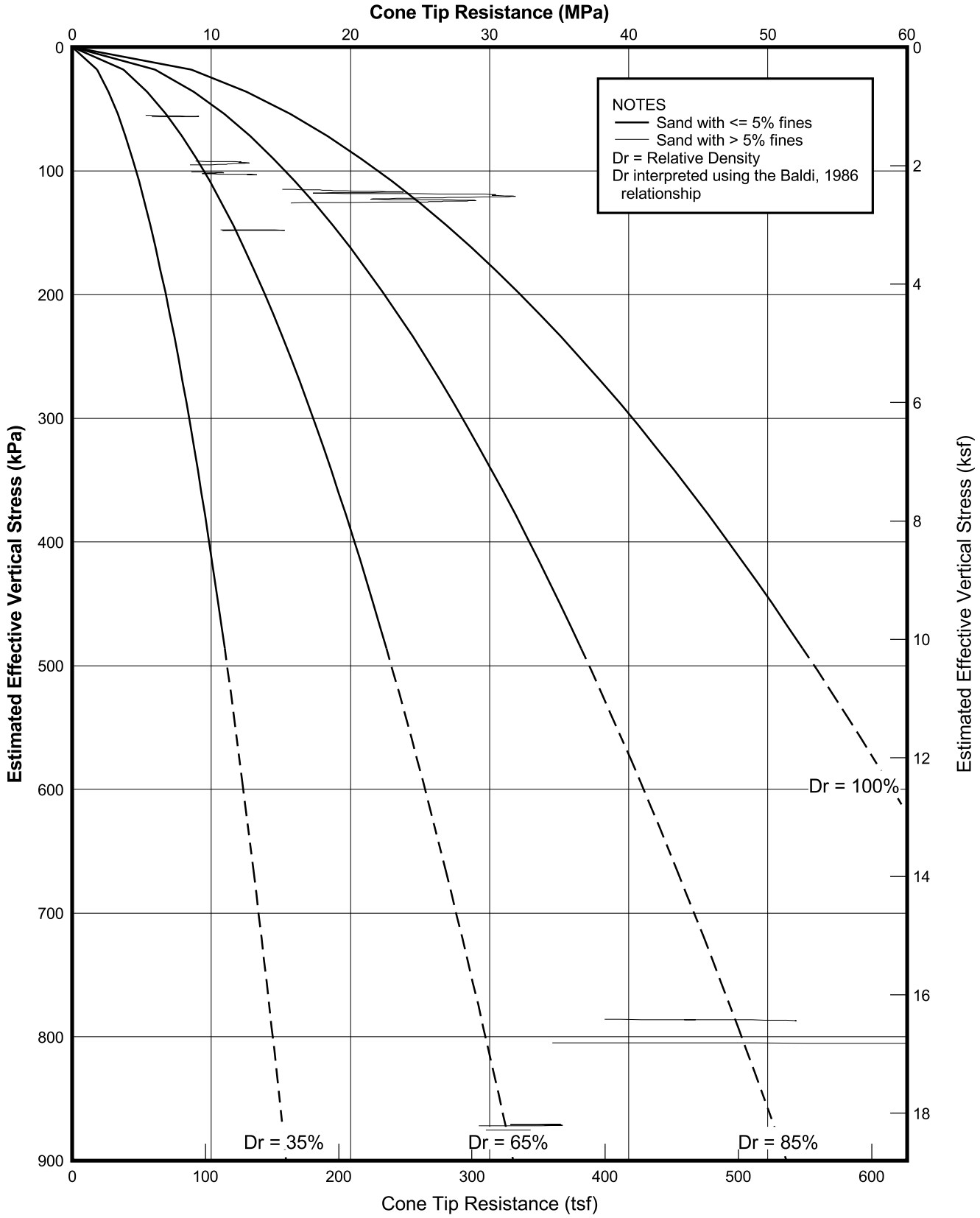
E50 PROFILE
Boring 98-36
SFOBB East Span Seismic Safety Project



PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-36

SFOBB East Span Seismic Safety Project



RELATIVE DENSITY INTERPRETED FROM CPT DATA

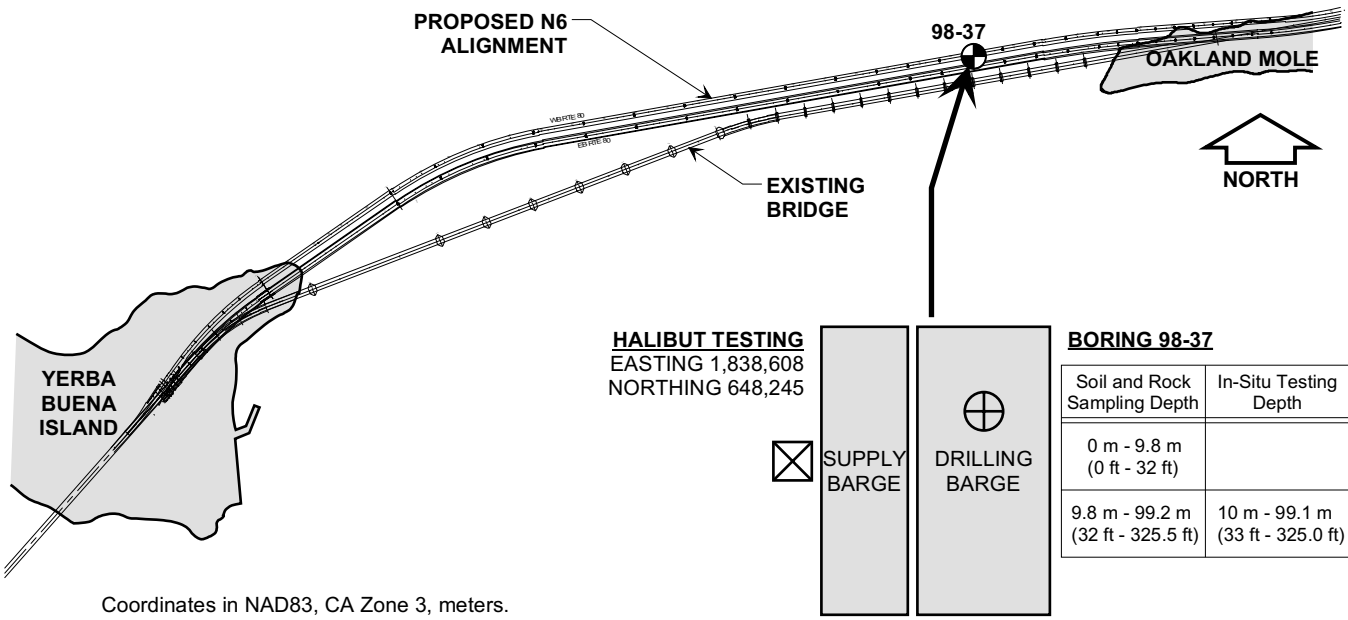
Boring 98-36

SFOBB East Span Seismic Safety Project

BORING 98-37

Date	Time From	Time To	Description of Activity
September 26, 1998	0000	0600	Travel from CS Marine yard at Mare Island to location 98-37.
	0600	1200	Set 4 anchors and 2 spuds.
	1200	1500	Rig up for drilling and Halibut testing.
	1500	1515	Lower drill pipe to mudline.
	1515	1530	Measure water depth of 4.1m (13.6 ft) using bottom sensor. Current tide level is approximately -0.7m (-2.4 ft) MSL. Calculate mudline elevation of –3.4m (-11.2 ft) MSL.
	1530	1800	Drill and sample from mudline to 9.8m (32 ft). Halibut vane shear testing from 0.6m (2 ft) to 1.8m (6 ft).
	1800	1930	Pull drill pipe to deck. Rig up for drilling. Halibut vane shear testing at 2.4m (8 ft) and 3.0m (10 ft).
	1930	1940	Reposition barge.
	1940	2400	Set casing.
September 27, 1998	0000	0200	Drive stinger to 8.4m (27.5 ft).
	0200	0230	Service thruster. Lower drill pipe to mudline.
	0230	0300	Perform CPT pipe test.
	0300	0730	Drill, sample, and remote vane shear and CPT testing from the mudline to 20.7m (68 ft).
	0730	0830	Broken release overshot cable. Pull drill pipe to deck to retrieve CPT tool. Lower drill pipe to 20.7m (68 ft).
	0830	2400	Drill, sample, and CPT testing from 20.7m (68 ft) to 79.9m (262 ft).
September 28, 1998	0000	0700	Drill, sample, and CPT testing from 79.9m (262 ft) to 99.2m (325.5 ft).
	0700	0815	Pull drill pipe to deck.
	0815	1030	P- and S-wave velocity logging from 93.5m (306.8 ft) to 8.5m (27.9 ft).
	1030	1115	Rig maintenance.
	1115	1200	Lower N-rod.
	1200	1340	Mix and circulate cement.
	1340	1600	Grout hole 98-37. Pull N-rod to deck.
	1600	1800	Pull casing to deck.
	1800	1945	Pull 2 spuds, 4 anchors, and move barge to location 98-38.

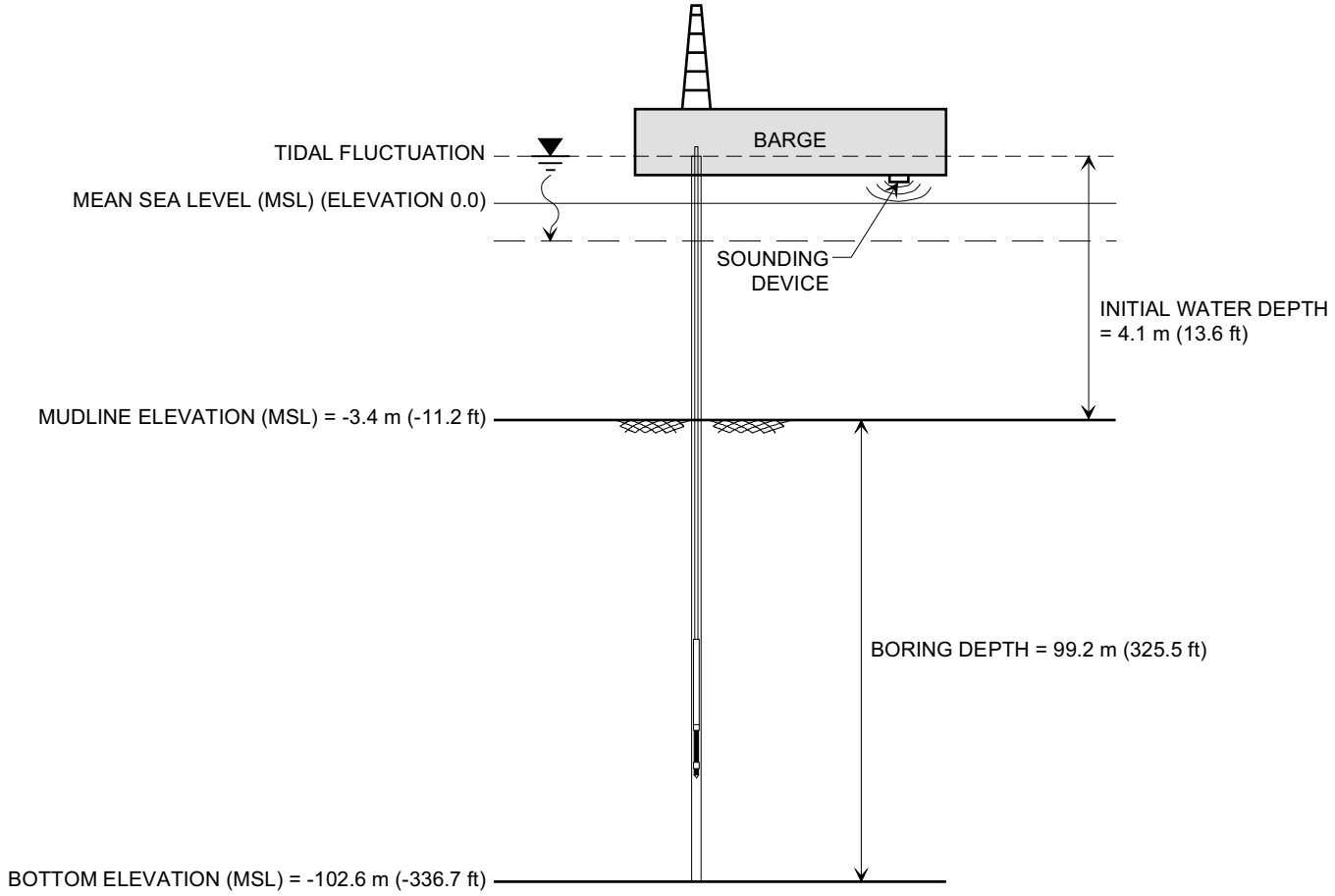
SUMMARY OF FIELD OPERATIONS
Boring 98-37
SFOBB East Span Seismic Safety Project



BORING 98-37

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 9.8 m (0 ft - 32 ft)		E = 1,838,625 N = 648,250
9.8 m - 99.2 m (32 ft - 325.5 ft)	10 m - 99.1 m (33 ft - 325.0 ft)	E = 1,838,622 N = 648,246

Coordinates in NAD83, CA Zone 3, meters.



9842\0054loc.dsf(0,37)

DEPTH AND LOCATION REFERENCE MAP
Boring 98-37
SFOBB East Span Seismic Safety Project

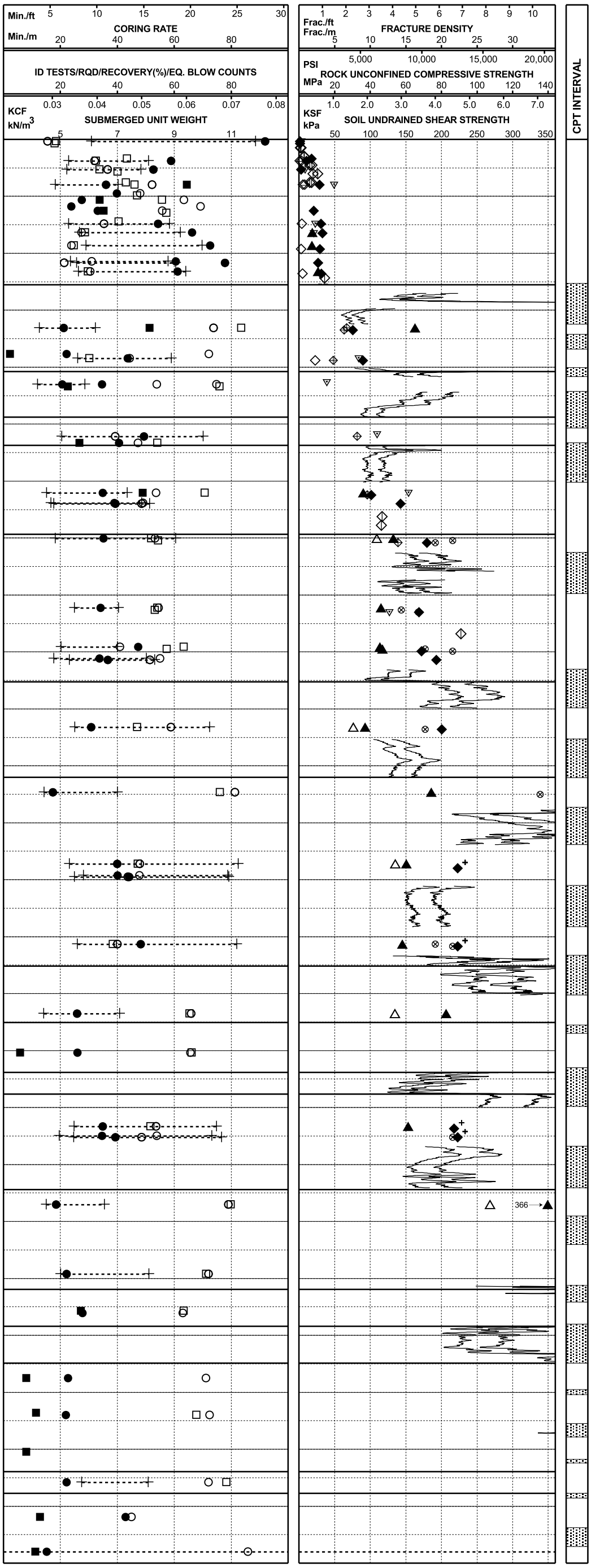
PROJECT NO:	98-42-0054	**START DATE:**	9/26/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-37 (Skyway - Frame 4)	**COMPLETION DATE:**	9/28/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838622 N648246
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

Stratum	Material Description	Blow Count
I	Fat CLAY (CH), very soft to firm, olive gray -with shells and shell fragments to 6.1m -with sand pockets to 3.8m -with black streaks at 0.3m -with silt pockets at 1.8m -fine sand, with clay pockets and seams, 4.0m to 4.7m -intermixed sand and clay, 4.7m to 5.0m -with sand pockets, 5.0m to 6.1m -with a few shell fragments below 6.4m -with a few silt pockets at 6.7m -with a few silt pockets at 9.4m (10.2m)	WOH, WOH, WOH, WOH, WOH, 11/60cm, 6/45cm, PUSH, PUSH, SAVE, PUSH
II	Interlayered Fine SAND (SP), dense to very dense, gray, and Fat CLAY (CH), very stiff to stiff, olive gray -very stiff clay, 10.8m to 11.4m -stiff clay, with silty sand pockets and a few calcareous pockets, 11.9m to 13.4m -with a clay layer at 14.0m -stiff clay with organic pockets, below 15.1m (16.3m)	PUSH, PUSH
III	Fat CLAY (CH), very stiff, olive gray -silty fine sand layer, with many clay pockets and a few organic pockets, at 17.2m (19.5m)	30/35cm
IV	Silty Fine SAND (SM), dense, gray -with clay layers at 19.8m and 20.3m (21.5m)	PUSH
V	Fat CLAY (CH), very stiff, gray to olive gray -with a silt layer at 21.8m -with many sand and silt pockets at 24.7m -with a few shell fragments at 25.6m (27.7m)	PUSH, SAVE
VI	Fat CLAY (CH), hard to very stiff, greenish gray -with silt seams and layers -blocky, slickensided and with calcareous nodules, at 28.0m -with a silty sand layer, 30.3m to 30.9m -olive gray to gray lean clay at 32.9m See Plate 98-37.6 for detailed stratigraphy (38.1m)	PUSH, PUSH, SAVE
VII	Fat CLAY (CH), hard to very stiff, yellowish brown -with yellowish red stains and slickensides, at 41.1m (44.8m)	PUSH
VIII	Fat CLAY (CH), hard, gray -with slickensides -lean to 48.8m -greenish gray to 51.8m -with many calcareous nodules and trace gravel, at 45.7m -with many silt partings at 50.6m -with gray stains at 51.5m -with a few shell fragments at 56.4m (58.1m)	PUSH, PUSH, SAVE, PUSH
IX	Lean CLAY (CL), hard, greenish gray -with large silty sand pockets, partings and seams, at 61.3m (62.0m)	PUSH
X	Fine SAND with silt (SP-SM), very dense, olive gray -with clay layers at 62.3m and 62.6m (65.5m)	30/15cm
XI	Lean CLAY (CL), very stiff to hard, greenish gray (67.1m)	
XII	Fat CLAY (CH), hard, greenish gray -with slickensides, gray stains, and a few calcareous nodules, at 69.2m (73.8m)	PUSH, SAVE
XIII	Lean CLAY (CL), hard, greenish gray -sandy clay, with large sand pockets, at 74.7m -interlayered clay and silt, 75.6m to 76.8m -brown fat clay, with ferrous stains and silt seams, at 79.6m (80.8m)	PUSH, PUSH
XIV	Silty fine SAND (SM), dense to very dense, yellowish gray to olive gray -clay layer with sand seams, 80.9m to 81.2m (83.4m)	PUSH
XV	Lean CLAY (CL), hard (86.0m)	
XVI	Fine SAND with silt and medium sand (SP-SM), dense to very dense, gray -hard clay layer, 90.5m to 91.1m -fine to coarse sand, with silt and fine gravel, below 92.0m (93.6m)	PUSH, 30/30cm, 30/15cm
XVII	Fat CLAY (CH), hard, yellowish gray -with gravel and large, fine to coarse sand pockets (95.1m)	30/20cm
XVIII	Fine to Coarse SAND with clay and fine gravel (SP-SC), very dense, yellowish brown to olive gray -with red stains at 96.0m	30/15cm, 30/15cm

TOTAL DEPTH: 99.2m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-37

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

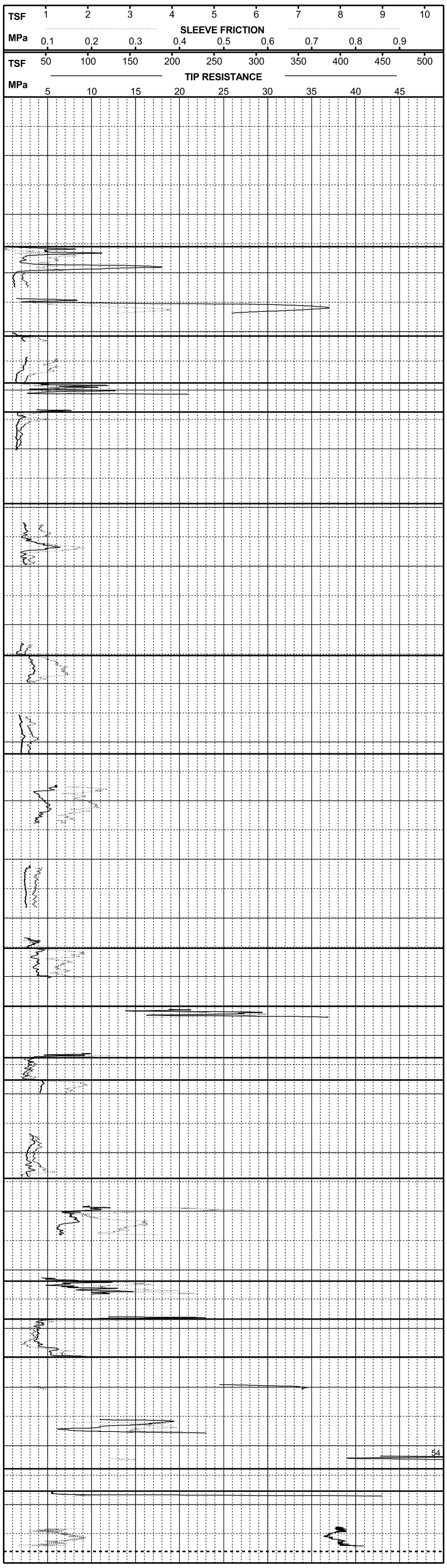
PLATE 98-37.3

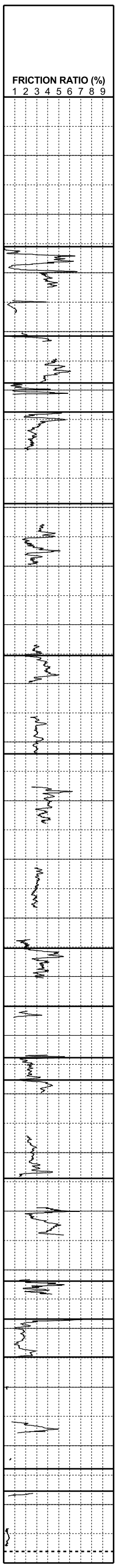
PROJECT NO:	98-42-0054	**START DATE:**	9/26/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-37 (Skyway - Frame 4)	**COMPLETION DATE:**	9/28/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

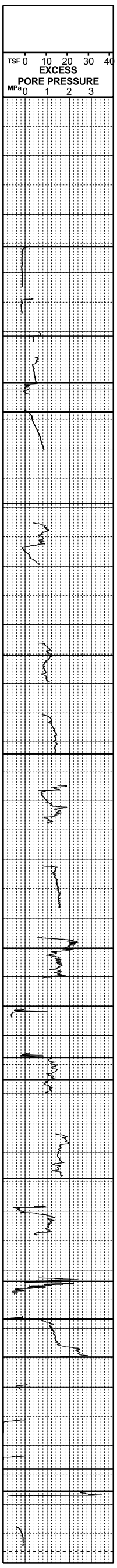
Coordinates: E1838622 N648246
CA State Plane Zone 3, NAD83, Meters

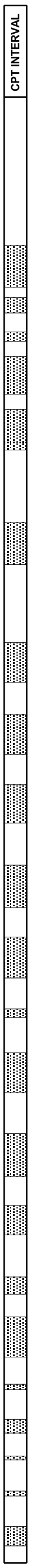
MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4		WOH, WOH, WOH, WOH, WOH	Fat CLAY (CH), very soft to firm, olive gray	I
-8	4	11/60cm, 6/45cm	-fine sand, with clay pockets and seams, 4.0m to 4.7m -intermixed sand and clay, 4.7m to 5.0m	
-12	8	PUSH, PUSH, SAVE, PUSH	See Plate 98-37.6 for detailed stratigraphy (10.2m)	
-16	12	PUSH, PUSH	Interlayered Fine SAND (SP), dense to very dense, gray, and Fat CLAY (CH), very stiff to stiff, olive gray (16.3m)	II
-20	16	30/35cm	Fat CLAY (CH), very stiff, olive gray (19.5m)	III
-24	20	PUSH	Silty Fine SAND (SM), dense, gray (21.5m)	IV
-28	24	PUSH, SAVE	Fat CLAY (CH), very stiff, gray to olive gray -with a silt layer at 21.8m -with many sand and silt pockets at 24.7m -with a few shell fragments at 25.6m (27.7m)	V
-32	28	PUSH	Fat CLAY (CH), hard to very stiff, greenish gray -with silt seams and layers -blocky, slickensided and with calcareous nodules, at 28.0m	
-36	32	PUSH	-with a silty sand layer, 30.3m to 30.9m -olive gray to gray lean clay at 32.9m	VI
-40	36	PUSH, SAVE	(38.1m)	
-44	40	PUSH	Fat CLAY (CH), hard to very stiff, yellowish brown -with yellowish red stains and slickensides, at 41.1m (44.8m)	VII
-48	44	PUSH	Fat CLAY (CH), hard, gray -with slickensides -lean to 48.8m -greenish gray to 51.8m	
-52	48		-with many calcareous nodules and trace gravel, at 45.7m	
-56	52	PUSH, SAVE	-with many silt partings at 50.6m -with gray stains at 51.5m	VIII
-60	56	PUSH	-with a few shell fragments at 56.4m (58.1m)	
-64	60	PUSH	Lean CLAY (CL), hard, greenish gray -with large silty sand pockets, partings and seams, at 61.3m (62.0m)	IX
-68	64	30/15cm	Fine SAND with silt (SP-SM), very dense, olive gray -with clay layers at 62.3m and 62.6m (65.5m)	X
			Lean CLAY (CL), very stiff to hard, greenish gray (67.1m)	XI
-72	68	PUSH, SAVE	Fat CLAY (CH), hard, greenish gray -with slickensides, gray stains, and a few calcareous nodules, at 69.2m (73.8m)	XII
-76	72			
-80	76	PUSH	Lean CLAY (CL), hard, greenish gray -sandy clay, with large sand pockets, at 74.7m -interlayered clay and silt, 75.6m to 76.8m	XIII
-84	80	PUSH	-brown fat clay, with ferrous stains and silt seams, at 79.6m (80.8m)	
-88	84	PUSH	Silty fine SAND (SM), dense to very dense, yellowish gray to olive gray (83.4m)	XIV
-92	88	PUSH, 30/30cm	Lean CLAY (CL), hard (86.0m)	XV
-96	92	30/15cm	Fine SAND with silt and medium sand (SP-SM), dense to very dense, gray -hard clay layer, 90.5m to 91.1m -fine to coarse sand, with silt and fine gravel, below 92.0m (93.6m)	XVI
		30/20cm	Fat CLAY (CH), hard, yellowish gray (95.1m)	XVII
-100	96	30/15cm, 30/15cm	Fine to Coarse SAND with clay and fine gravel (SP-SC), very dense, yellowish brown to olive gray TOTAL DEPTH: 99.2m BACKFILLED WITH: Cement Grout	XVIII









LOG OF BORING AND TEST RESULTS

BORING 98-37

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

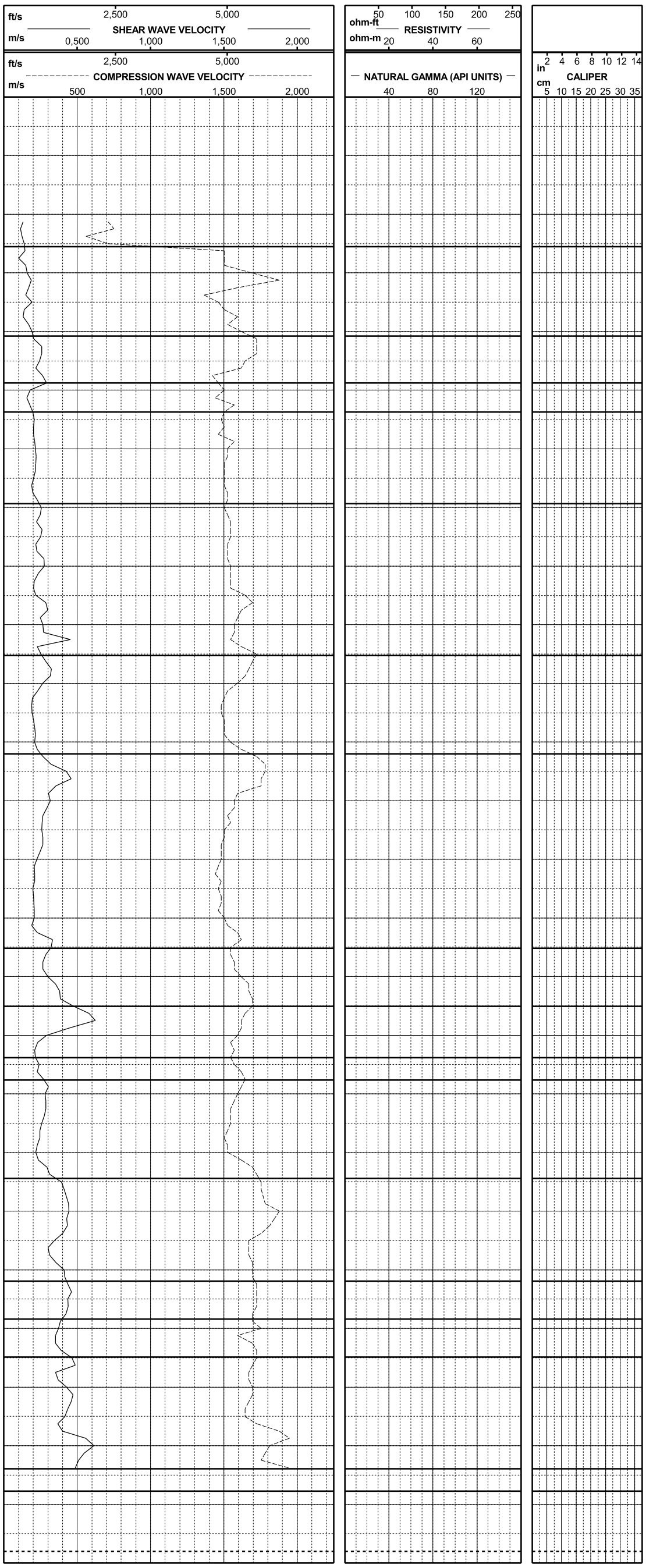
PLATE 98-37.4

PROJECT NO:	98-42-0054	**START DATE:**	9/26/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-37 (Skyway - Frame 4)	**COMPLETION DATE:**	9/28/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838622 N648246
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4				WOH	Fat CLAY (CH), very soft to firm, olive gray	I
				WOH		
				WOH		
				WOH		
	4			WOH	-fine sand, with clay pockets and seams, 4.0m to 4.7m	
-8				11/60cm	-intermixed sand and clay, 4.7m to 5.0m	
				6/45cm		
				PUSH	See Plate 98-37.6 for detailed stratigraphy	
				PUSH		
	8			SAVE		
-12				PUSH	(10.2m)	
					Interlayered Fine SAND (SP), dense to very dense, gray, and Fat CLAY (CH), very stiff to stiff, olive gray	II
	12				-very stiff clay, 10.8m to 11.4m	
-16				PUSH	-stiff clay, with silty sand pockets and a few calcareous pockets, 11.9m to 13.4m	
				PUSH	-stiff clay with organic pockets, below 15.1m (16.3m)	
	16				Fat CLAY (CH), very stiff, olive gray	III
-20				30/35cm	(19.5m)	
	20				Silty Fine SAND (SM), dense, gray	IV
-24				PUSH	(21.5m)	
					Fat CLAY (CH), very stiff, gray to olive gray	V
	24				-with a silt layer at 21.8m	
-28				PUSH SAVE	-with many sand and silt pockets at 24.7m	
					-with a few shell fragments at 25.6m (27.7m)	
	28			PUSH	Fat CLAY (CH), hard to very stiff, greenish gray	VI
-32					-with silt seams and layers	
					-blocky, slickensided and with calcareous nodules, at 28.0m	
	32				-with a silty sand layer, 30.3m to 30.9m	
-36				PUSH	-olive gray to gray lean clay at 32.9m	
	36			PUSH SAVE		
-40					(38.1m)	
					Fat CLAY (CH), hard to very stiff, yellowish brown	VII
	40					
-44				PUSH	-with yellowish red stains and slickensides, at 41.1m	
	44				(44.8m)	
-48				PUSH	Fat CLAY (CH), hard, gray	VIII
					-with slickensides	
					-lean to 48.8m	
	48				-greenish gray to 51.8m	
-52					-with many calcareous nodules and trace gravel, at 45.7m	
				PUSH SAVE	-with many silt partings at 50.6m	
					-with gray stains at 51.5m	
	52					
-56						
	56			PUSH	-with a few shell fragments at 56.4m	
-60					(58.1m)	
					Lean CLAY (CL), hard, greenish gray	IX
	60				-with large silty sand pockets, partings and seams, at 61.3m	
-64				PUSH	(62.0m)	
	64			30/15cm	Fine SAND with silt (SP-SM), very dense, olive gray	X
					-with clay layers at 62.3m and 62.6m	
-68					(65.5m)	
					Lean CLAY (CL), very stiff to hard, greenish gray (67.1m)	XI
	68				Fat CLAY (CH), hard, greenish gray	XII
-72				PUSH SAVE	-with slickensides, gray stains, and a few calcareous nodules, at 69.2m	
	72					
-76					(73.8m)	
				PUSH	Lean CLAY (CL), hard, greenish gray	XIII
					-sandy clay, with large sand pockets, at 74.7m	
	76				-interlayered clay and silt, 75.6m to 76.8m	
-80						
				PUSH	-brown fat clay, with ferrous stains and silt seams, at 79.6m	
	80				(80.8m)	
-84				PUSH	Silty fine SAND (SM), dense to very dense, yellowish gray to olive gray	XIV
					-clay layer with sand seams, 80.9m to 81.2m (83.4m)	
	84				Lean CLAY (CL), hard	XV
-88					(86.0m)	
				PUSH	Fine SAND with silt and medium sand (SP-SM), dense to very dense, gray	XVI
	88					
-92				30/30cm	-hard clay layer, 90.5m to 91.1m	
	92			30/15cm		
-96					(93.6m)	
				30/20cm	Fat CLAY (CH), hard, yellowish gray (95.1m)	XVII
	96				Fine to Coarse SAND with clay and fine gravel (SP-SC), very dense, yellowish brown to olive gray	XVIII
-100				30/15cm	-with red stains at 96.0m	
				30/15cm	TOTAL DEPTH: 99.2m	
					BACKFILLED WITH: Cement Grout	



LOG OF BORING AND TEST RESULTS

BORING 98-37

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

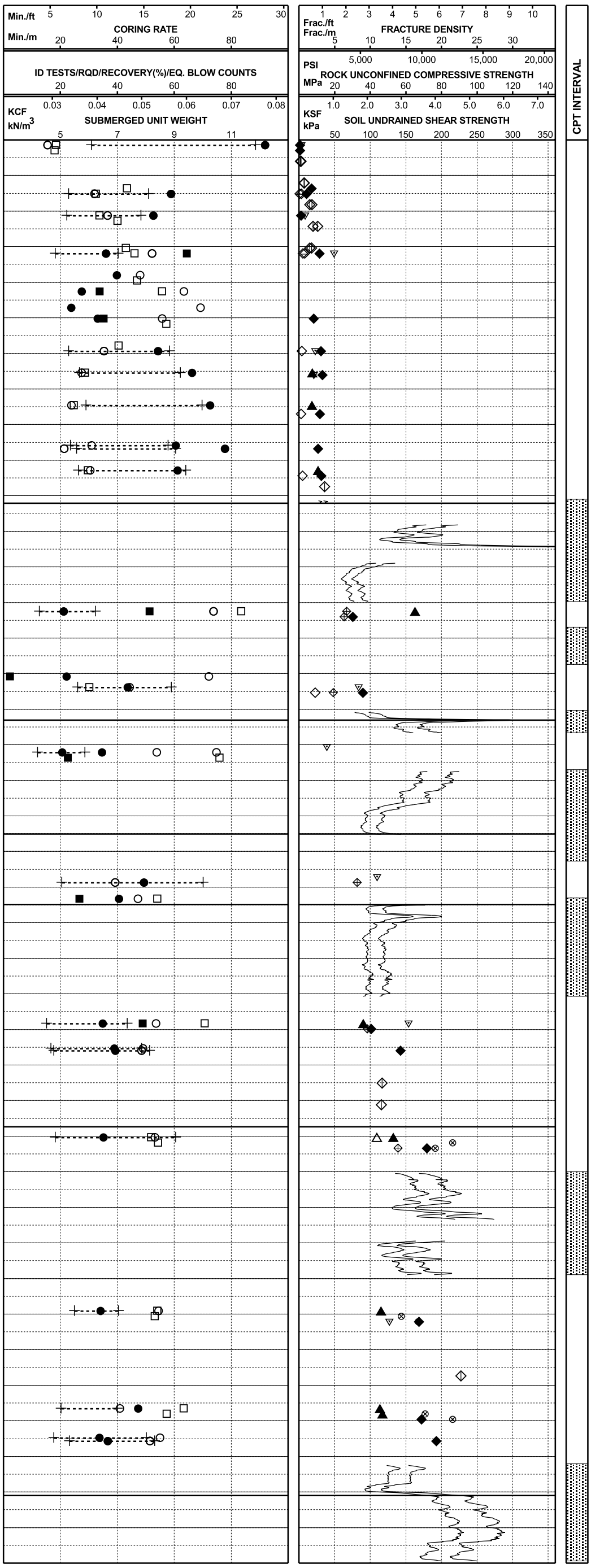
PLATE 98-37.5

PROJECT NO:	98-42-0054	**START DATE:**	9/26/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-37 (Skyway - Frame 4)	**COMPLETION DATE:**	9/28/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838622 N648246
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

Stratum No.	Material Description	Blow Count
I	Fat CLAY (CH), very soft to firm, olive gray -with shells and shell fragments to 6.1m -with sand pockets to 3.8m -with black streaks at 0.3m	WOH, WOH
	-with silt pockets at 1.8m	WOH, WOH
	-fine sand, with clay pockets and seams, 4.0m to 4.7m	WOH
	-intermixed sand and clay, 4.7m to 5.0m -with sand pockets, 5.0m to 6.1m	11/60cm, 6/45cm
	-with a few shell fragments below 6.4m -with a few silt pockets at 6.7m	PUSH, PUSH, SAVE, PUSH
	-with a few silt pockets at 9.4m (10.2m)	
II	Interlayered Fine SAND (SP), dense to very dense, gray, and Fat CLAY (CH), very stiff to stiff, olive gray -very stiff clay, 10.8m to 11.4m -stiff clay, with silty sand pockets and a few calcareous pockets, 11.9m to 13.4m	PUSH
	-with a clay layer at 14.0m -stiff clay with organic pockets, below 15.1m (16.3m)	PUSH
III	Fat CLAY (CH), very stiff, olive gray -silty fine sand layer, with many clay pockets and a few organic pockets, at 17.2m (19.5m)	30/35cm
IV	Silty Fine SAND (SM), dense, gray -with clay pockets, partings, and seams -with clay layers at 19.8m and 20.3m -with a stiff greenish gray clay layer at 20.9m (21.5m)	PUSH
V	Fat CLAY (CH), very stiff, gray to olive gray -with a silt layer at 21.8m -with many sand and silt pockets at 24.7m -with a few shell fragments at 25.6m (27.7m)	PUSH, SAVE
VI	Fat CLAY (CH), hard to very stiff, greenish gray -with silt seams and layers -blocky, slickensided and with calcareous nodules, at 28.0m -with a silty sand layer, 30.3m to 30.9m -olive gray to gray lean clay at 32.9m (38.1m)	PUSH, PUSH, PUSH, SAVE
VII	Fat CLAY (CH), hard to very stiff, yellowish brown	



LOG OF BORING AND TEST RESULTS

BORING 98-37

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

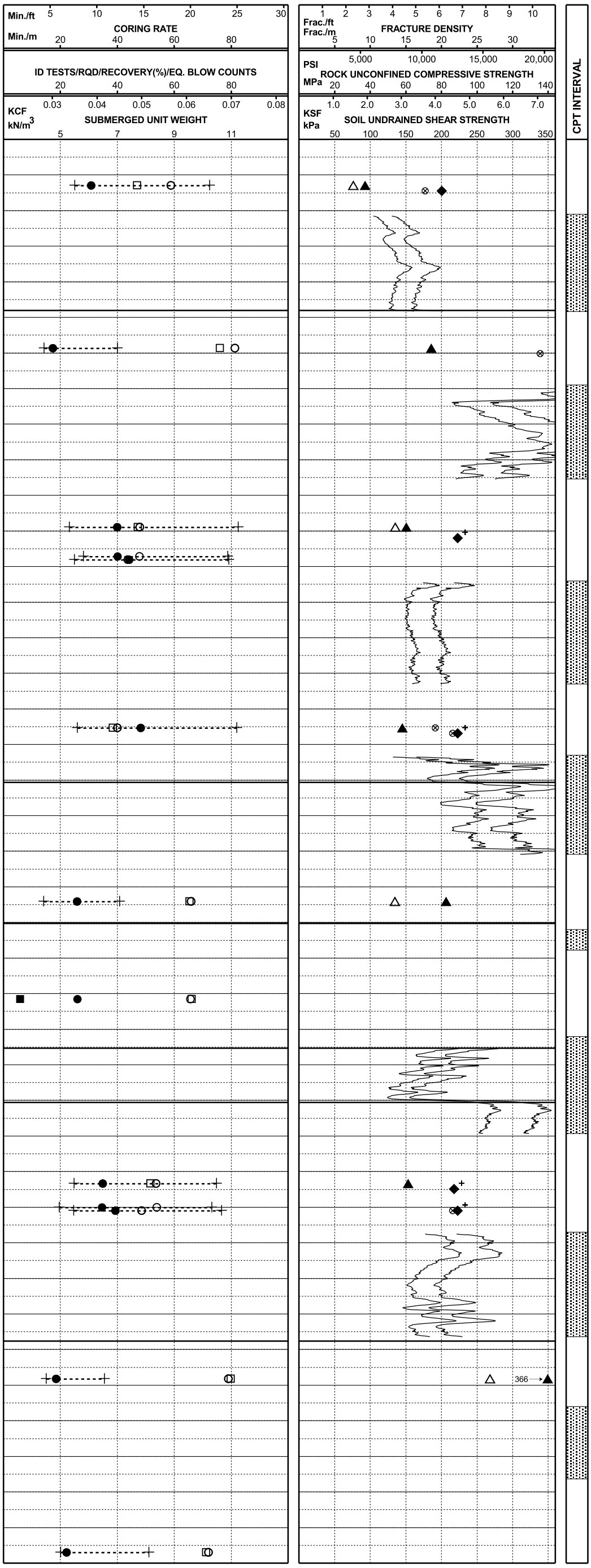
PLATE 98-37.6a

PROJECT NO:	98-42-0054	**START DATE:**	9/26/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-37 (Skyway - Frame 4)	**COMPLETION DATE:**	9/28/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838622 N648246
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-44	41		PUSH	Fat CLAY (CH), hard to very stiff, yellowish brown -with yellowish red stains and slickensides, at 41.1m (44.8m)	VII
-49	46		PUSH	Fat CLAY (CH), hard, gray -with slickensides -lean to 48.8m -greenish gray to 51.8m -with many calcareous nodules and trace gravel, at 45.7m	
-54	51		PUSH	-with many silt partings at 50.6m	VIII
-55	52		SAVE	-with gray stains at 51.5m	
-60	57		PUSH	-with a few shell fragments at 56.4m (58.1m)	
-62	59			Lean CLAY (CL), hard, greenish gray	IX
-64	61		PUSH	-with large silty sand pockets, partings and seams, at 61.3m (62.0m)	
-67	64		30/15cm	Fine SAND with silt (SP-SM), very dense, olive gray -with clay layers at 62.3m and 62.6m (65.5m)	X
-69	66			Lean CLAY (CL), very stiff to hard, greenish gray (67.1m)	XI
-72	69		PUSH	Fat CLAY (CH), hard, greenish gray -with slickensides, gray stains, and a few calcareous nodules, at 69.2m	XII
-73	70		SAVE		
-77	74			Lean CLAY (CL), hard, greenish gray	XIII
-78	75		PUSH	-sandy clay, with large sand pockets, at 74.7m	
-79	76			-interlayered clay and silt, 75.6m to 76.8m	
-83	79		PUSH	-brown fat clay, with ferrous stains and silt seams, at 79.6m	



LOG OF BORING AND TEST RESULTS

BORING 98-37

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

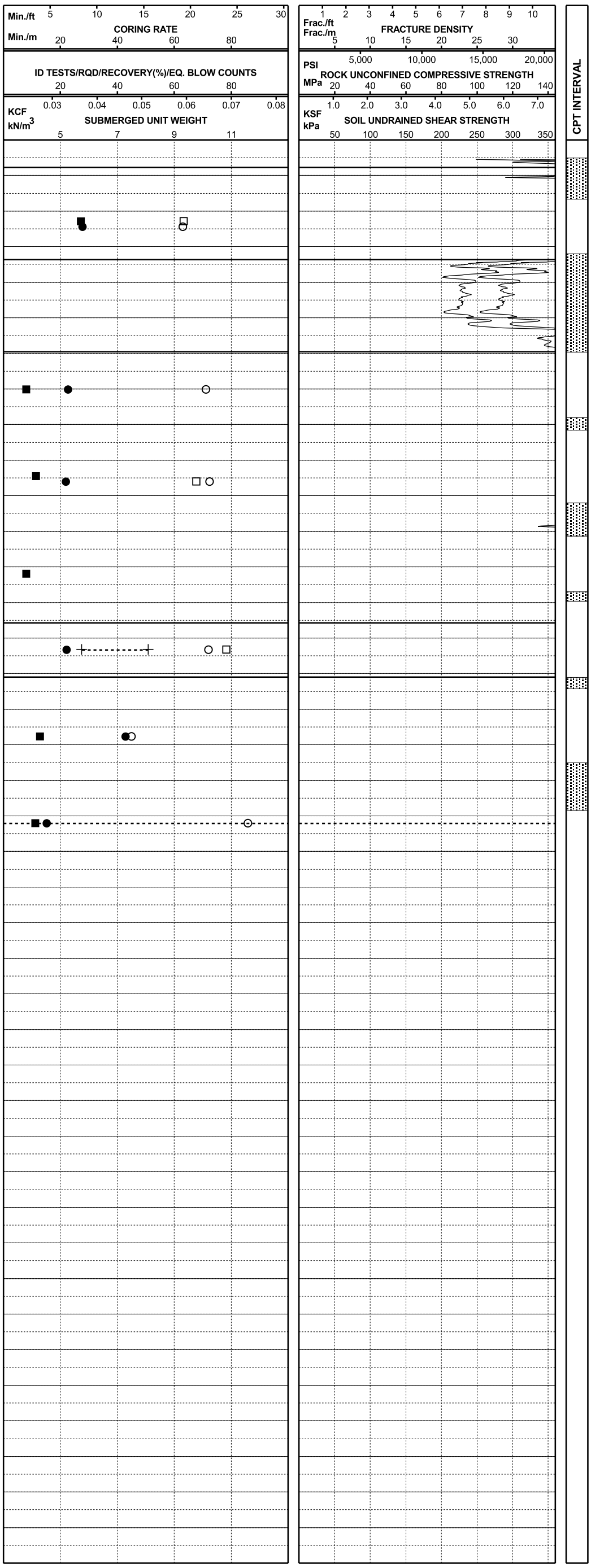
PLATE 98-37.6b

PROJECT NO:	98-42-0054	**START DATE:**	9/26/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-37 (Skyway - Frame 4)	**COMPLETION DATE:**	9/28/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838622 N648246
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-84	81			Lean CLAY (CL), hard, greenish gray (80.8m)	XIII
-85	82		PUSH	Silty fine SAND (SM), dense to very dense, yellowish gray to olive gray -with clay pockets and seams -clay layer with sand seams, 80.9m to 81.2m (83.4m)	XIV
-86	83				
-87	84			Lean CLAY (CL), hard (86.0m)	XV
-88	85				
-89	86			Fine SAND with silt and medium sand (SP-SM), dense to very dense, gray	
-90	87		PUSH		
-91	88				
-92	89		30/30cm		XVI
-93	90				
-94	91			-hard clay layer, 90.5m to 91.1m	
-95	92		30/15cm	-fine to coarse sand, with silt and fine gravel, below 92.0m (93.6m)	
-96	93				
-97	94		30/20cm	Fat CLAY (CH), hard, yellowish gray -with gravel and large fine to coarse sand pockets (95.1m)	XVII
-98	95				
-99	96			Fine to Coarse SAND with clay and fine gravel (SP-SC), very dense, yellowish brown to olive gray -with red stains at 96.0m	
-100	97		30/15cm		XVIII
-101	98				
-102	99		30/15cm	TOTAL DEPTH: 99.2m BACKFILLED WITH: Cement Grout	
-103	100				
-104	101				
-105	102				
-106	103				
-107	104				
-108	105				
-109	106				
-110	107				
-111	108				
-112	109				
-113	110				
-114	111				
-115	112				
-116	113				
-117	114				
-118	115				
-119	116				
-120	117				
-121	118				
-122	119				
-123					



LOG OF BORING AND TEST RESULTS

BORING 98-37

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

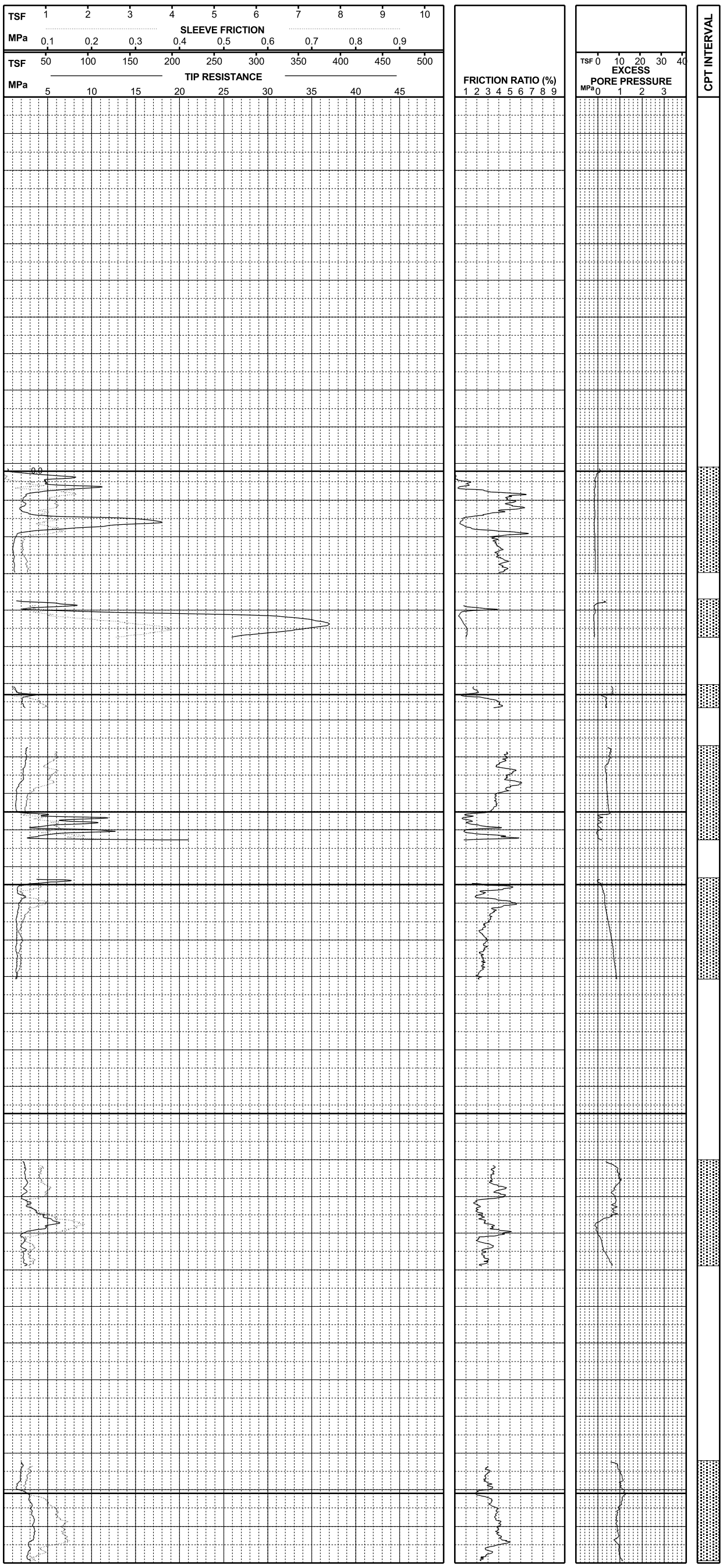
PLATE 98-37.6c

PROJECT NO:	98-42-0054	**START DATE:**	9/26/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-37 (Skyway - Frame 4)	**COMPLETION DATE:**	9/28/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838622 N648246
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

Stratum	Material Description	Blow Count / Sampler
I	Fat CLAY (CH), very soft to firm, olive gray -with shells and shell fragments to 6.1m -with sand pockets to 3.8m -with black streaks at 0.3m -with silt pockets at 1.8m -fine sand, with clay pockets and seams, 4.0m to 4.7m -intermixed sand and clay, 4.7m to 5.0m -with sand pockets, 5.0m to 6.1m -with a few shell fragments below 6.4m -with a few silt pockets at 6.7m -with a few silt pockets at 9.4m (10.2m)	WOH, WOH, WOH, WOH, WOH, WOH, 11/60cm, 6/45cm, PUSH, PUSH, SAVE, PUSH
II	Interlayered Fine SAND (SP), dense to very dense, gray, and Fat CLAY (CH), very stiff to stiff, olive gray -very stiff clay, 10.8m to 11.4m -stiff clay, with silty sand pockets and a few calcareous pockets, 11.9m to 13.4m -with a clay layer at 14.0m -stiff clay with organic pockets, below 15.1m (16.3m)	PUSH, PUSH
III	Fat CLAY (CH), very stiff, olive gray -silty fine sand layer, with many clay pockets and a few organic pockets, at 17.2m (19.5m)	30/35cm
IV	Silty Fine SAND (SM), dense, gray -with clay pockets, partings, and seams -with clay layers at 19.8m and 20.3m -with a stiff greenish gray clay layer at 20.9m (21.5m)	PUSH
V	Fat CLAY (CH), very stiff, gray to olive gray -with a silt layer at 21.8m -with many sand and silt pockets at 24.7m -with a few shell fragments at 25.6m (27.7m)	PUSH, SAVE
VI	Fat CLAY (CH), hard to very stiff, greenish gray -with silt seams and layers -blocky, slickensided and with calcareous nodules, at 28.0m -with a silty sand layer, 30.3m to 30.9m -olive gray to gray lean clay at 32.9m (38.1m)	PUSH, PUSH, PUSH, SAVE
VII	Fat CLAY (CH), hard to very stiff, yellowish brown	



LOG OF BORING AND TEST RESULTS

BORING 98-37

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

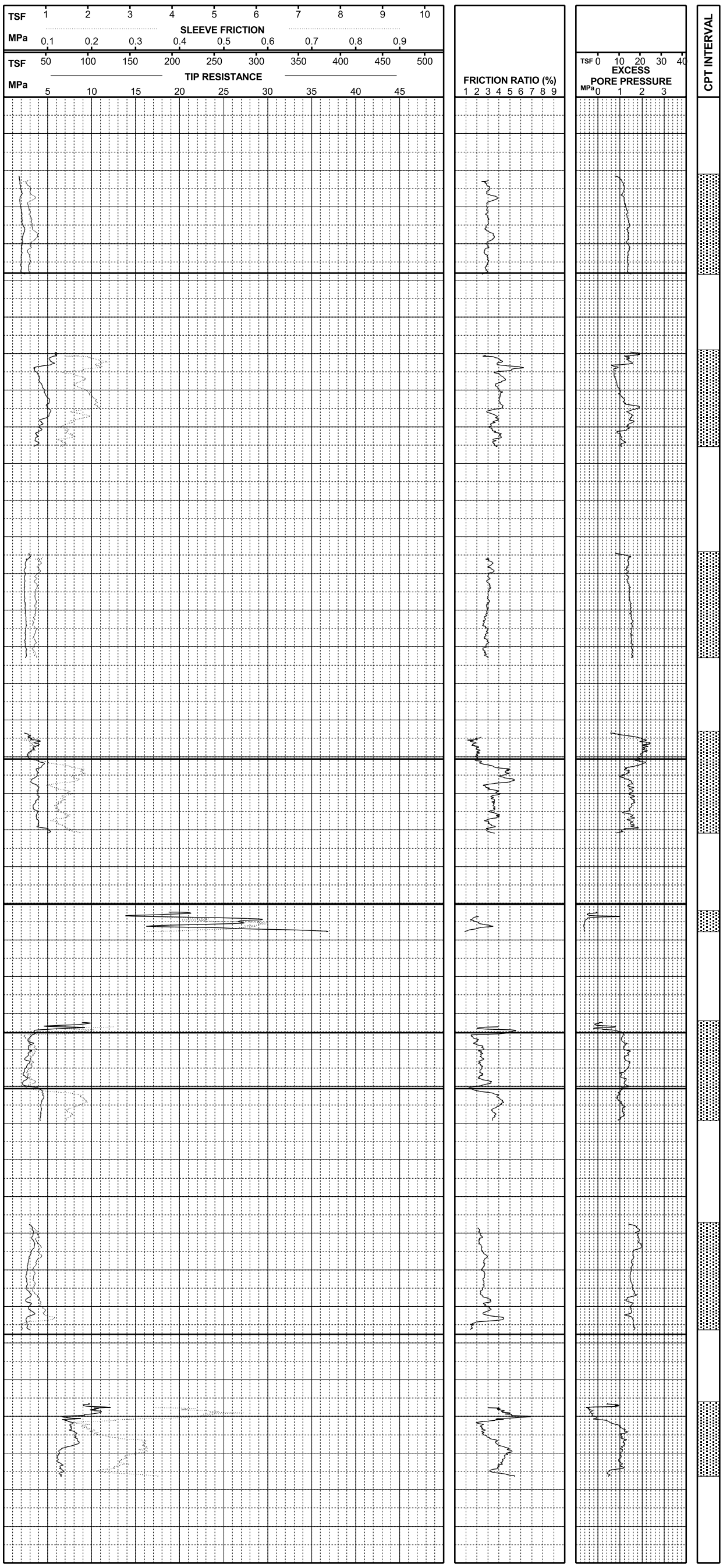
PLATE 98-37.7a

PROJECT NO:	98-42-0054	**START DATE:**	9/26/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-37 (Skyway - Frame 4)	**COMPLETION DATE:**	9/28/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838622 N648246
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-44	41		PUSH	Fat CLAY (CH), hard to very stiff, yellowish brown -with yellowish red stains and slickensides, at 41.1m (44.8m)	VII
-45, -46, -47, -48	42, 43, 44				
-49	45, 46		PUSH	Fat CLAY (CH), hard, gray -with slickensides -lean to 48.8m -greenish gray to 51.8m -with many calcareous nodules and trace gravel, at 45.7m	
-50, -51, -52	47, 48, 49				
-53, -54	50, 51		PUSH SAVE	-with many silt partings at 50.6m -with gray stains at 51.5m	VIII
-55, -56, -57, -58	52, 53, 54, 55				
-59, -60	56, 57		PUSH	-with a few shell fragments at 56.4m (58.1m)	
-61, -62	58, 59			Lean CLAY (CL), hard, greenish gray	IX
-63, -64	60, 61		PUSH	-with large silty sand pockets, partings and seams, at 61.3m (62.0m)	
-65, -66	62, 63			Fine SAND with silt (SP-SM), very dense, olive gray -with clay layers at 62.3m and 62.6m	X
-67	64	30/15cm			
-68, -69	65, 66			(65.5m) Lean CLAY (CL), very stiff to hard, greenish gray (67.1m)	XI
-70, -71	67, 68			Fat CLAY (CH), hard, greenish gray	XII
-72, -73	69, 70		PUSH SAVE	-with slickensides, gray stains, and a few calcareous nodules, at 69.2m	
-74, -75, -76	71, 72, 73			(73.8m)	
-77, -78	74, 75		PUSH	Lean CLAY (CL), hard, greenish gray -sandy clay, with large sand pockets, at 74.7m	XIII
-79, -80, -81	76, 77, 78			-interlayered clay and silt, 75.6m to 76.8m	
-82, -83	79		PUSH	-brown fat clay, with ferrous stains and silt seams, at 79.6m	



LOG OF BORING AND TEST RESULTS

BORING 98-37

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

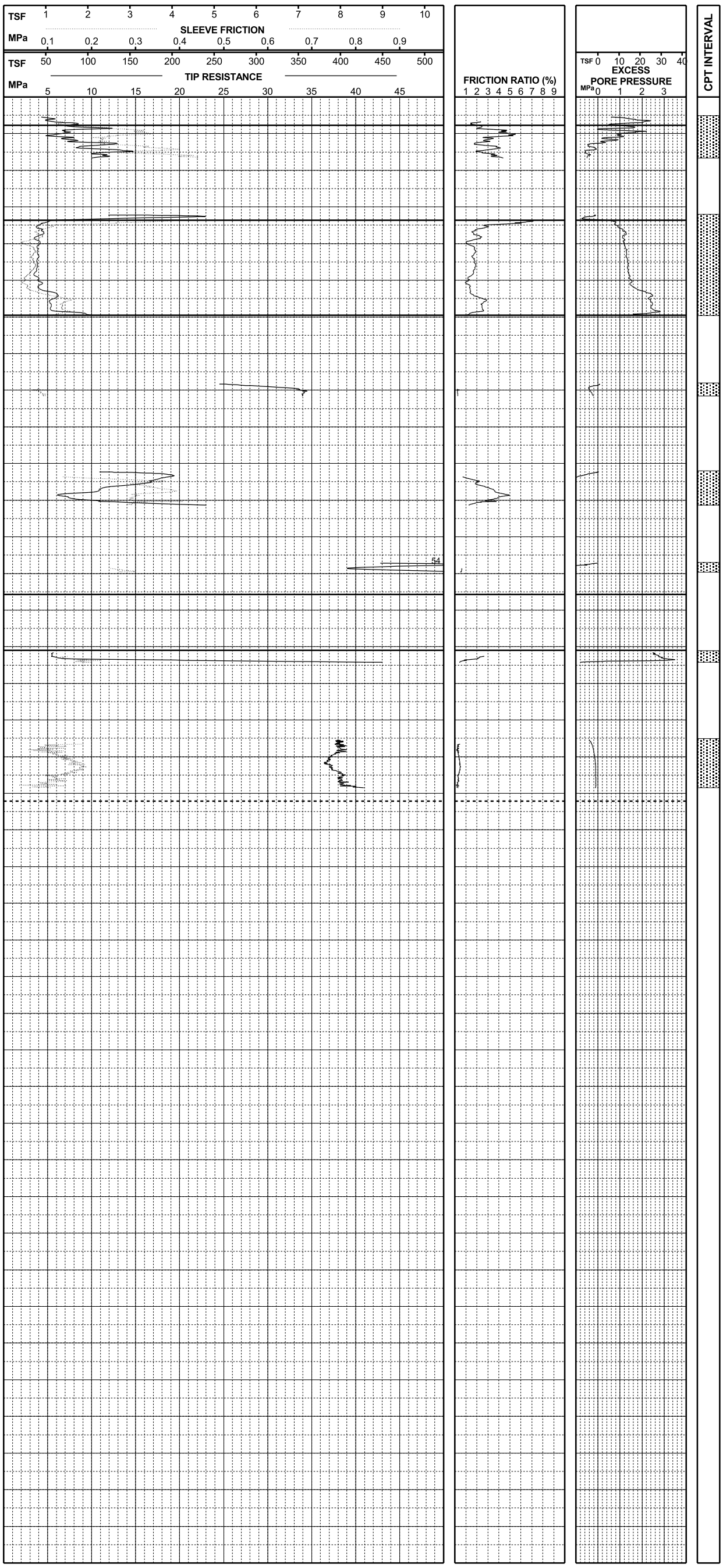
PLATE 98-37.7b

PROJECT NO:	98-42-0054	**START DATE:**	9/26/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-37 (Skyway - Frame 4)	**COMPLETION DATE:**	9/28/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838622 N648246
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
				Lean CLAY (CL), hard, greenish gray (80.8m)	XIII
			PUSH	Silty fine SAND (SM), dense to very dense, yellowish gray to olive gray -with clay pockets and seams -clay layer with sand seams, 80.9m to 81.2m (83.4m)	XIV
				Lean CLAY (CL), hard (86.0m)	XV
			PUSH	Fine SAND with silt and medium sand (SP-SM), dense to very dense, gray	XVI
			30/30cm	-hard clay layer, 90.5m to 91.1m	
			30/15cm	-fine to coarse sand, with silt and fine gravel, below 92.0m (93.6m)	
			30/20cm	Fat CLAY (CH), hard, yellowish gray -with gravel and large fine to coarse sand pockets (95.1m)	XVII
			30/15cm	Fine to Coarse SAND with clay and fine gravel (SP-SC), very dense, yellowish brown to olive gray -with red stains at 96.0m	XVIII
			30/15cm	TOTAL DEPTH: 99.2m BACKFILLED WITH: Cement Grout	



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-37

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

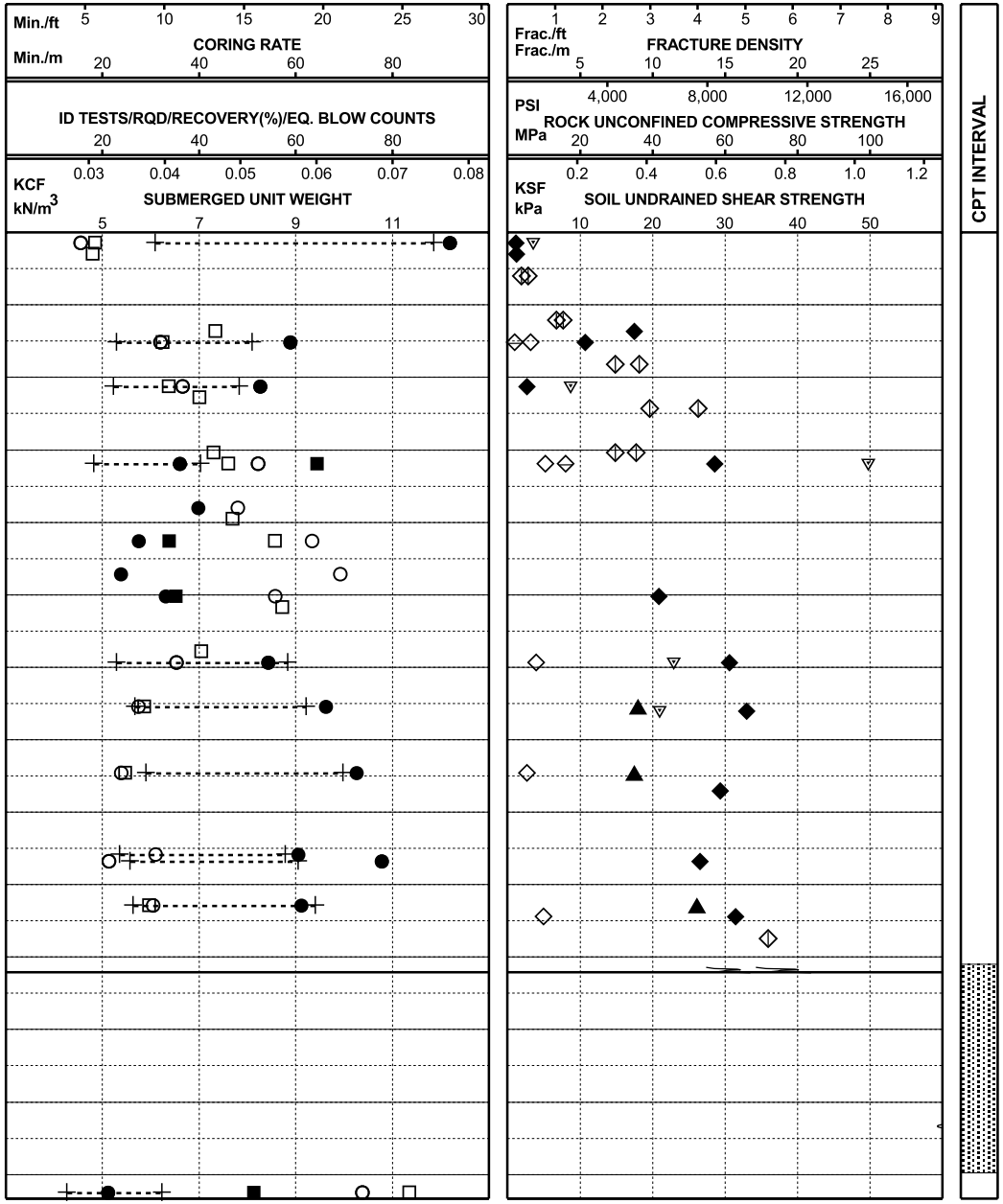
PLATE 98-37.7c

PROJECT NO:	98-42-0054	**START DATE:**	9/26/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-37 (Skyway - Frame 4)	**COMPLETION DATE:**	9/28/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838622 N648246
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), very soft to firm, olive gray	I
-4			-with shells and shell fragments to 6.1m	
	1		-with sand pockets to 3.8m	
		WOH	-with black streaks at 0.3m	
-5				
	2	WOH	-with silt pockets at 1.8m	
-6				
	3	WOH		
-7				
	4	WOH	-fine sand, with clay pockets and seams, 4.0m to 4.7m	
-8			-intermixed sand and clay, 4.7m to 5.0m	
	5	11/60cm	-with sand pockets, 5.0m to 6.1m	
-9				
	6	6/45cm		
-10		PUSH	-with a few shell fragments below 6.4m -with a few silt pockets at 6.7m	
	7			
-11		PUSH		
	8			
-12		SAVE		
	9			
-13		PUSH	-with a few silt pockets at 9.4m	
	10		(10.2m)	
-14			Interlayered Fine SAND (SP), dense to very dense, gray, and Fat CLAY (CH), very stiff to stiff, olive gray	II
	11		-very stiff clay, 10.8m to 11.4m	
-15			-stiff clay, with silty sand pockets and a few calcareous pockets, 11.9m to 13.4m	
	12			
-16				
	13	PUSH		



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-37

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

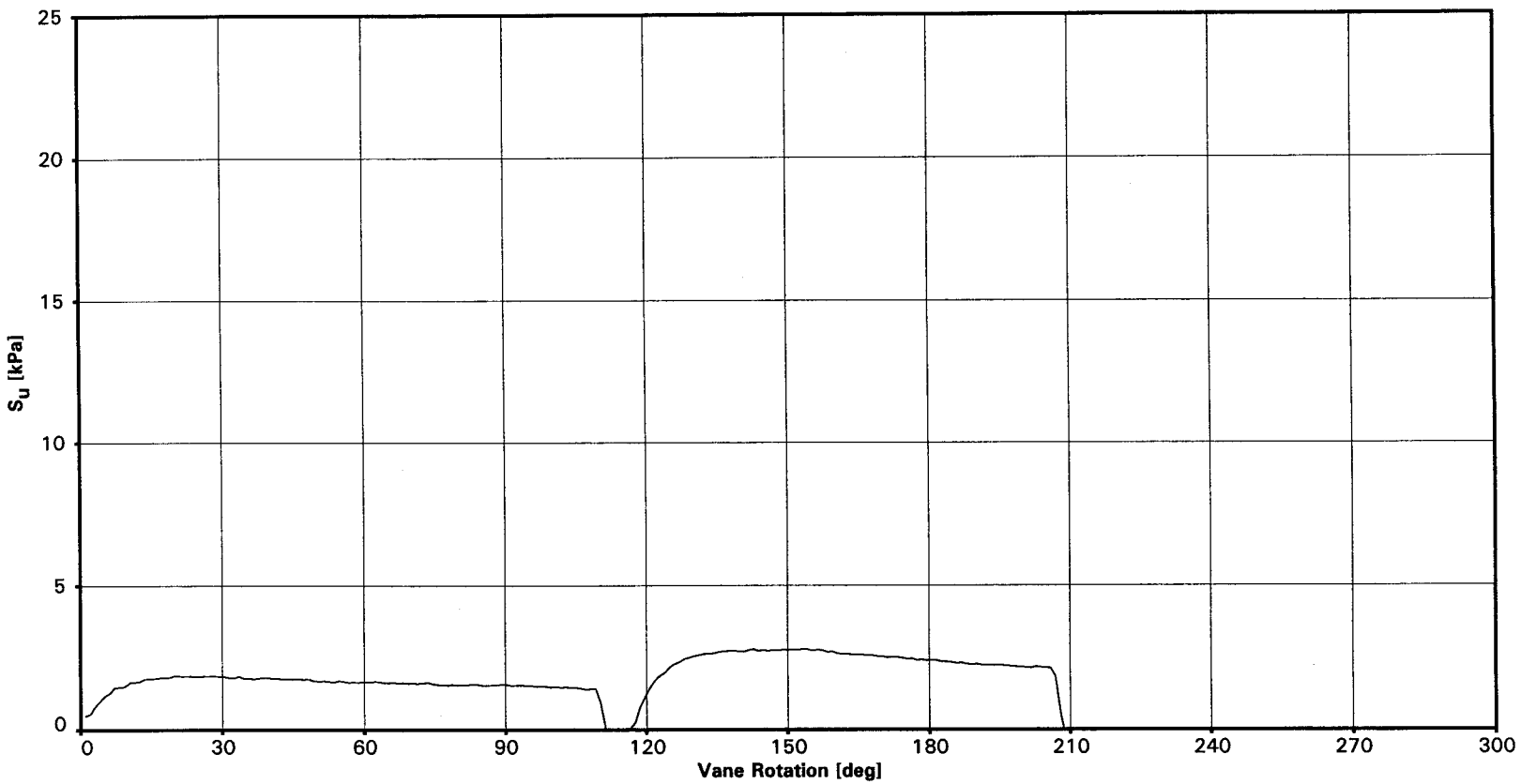
FUGRO

PLATE 98-37.8

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 0.6m
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

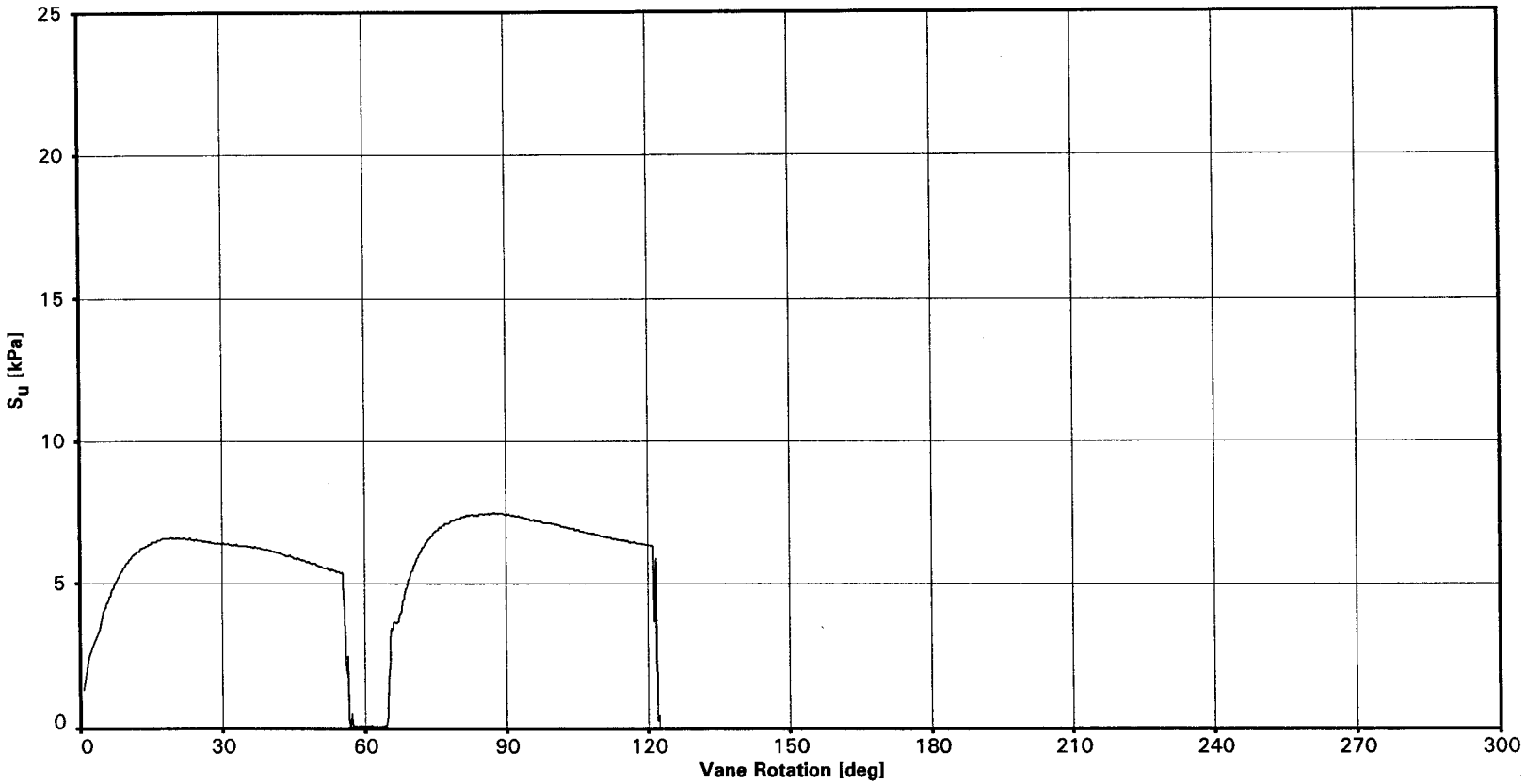
FUGRO

PLATE 98-37.9a

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.2m
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

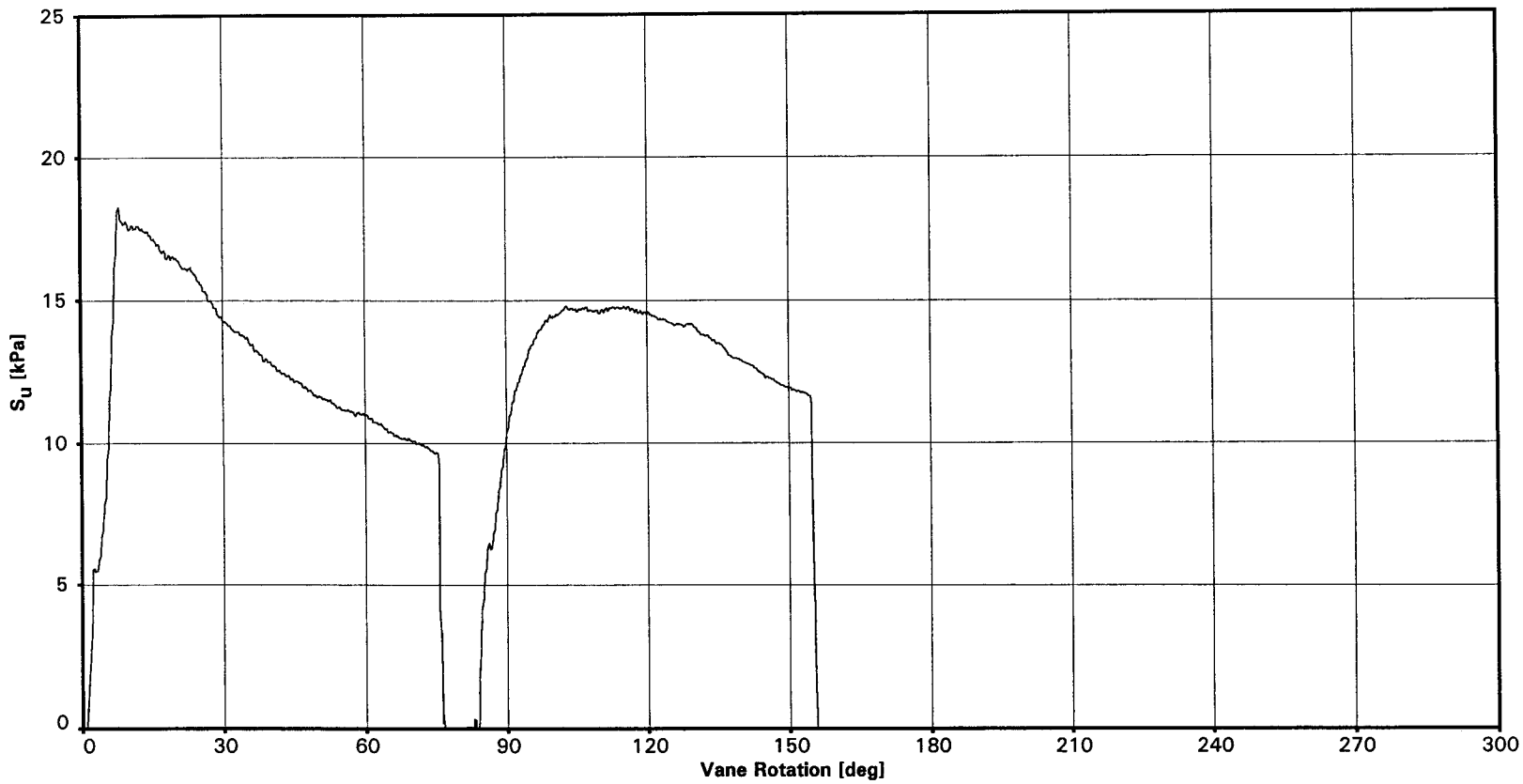
FUGRO

PLATE 98-37.9b

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.8m
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

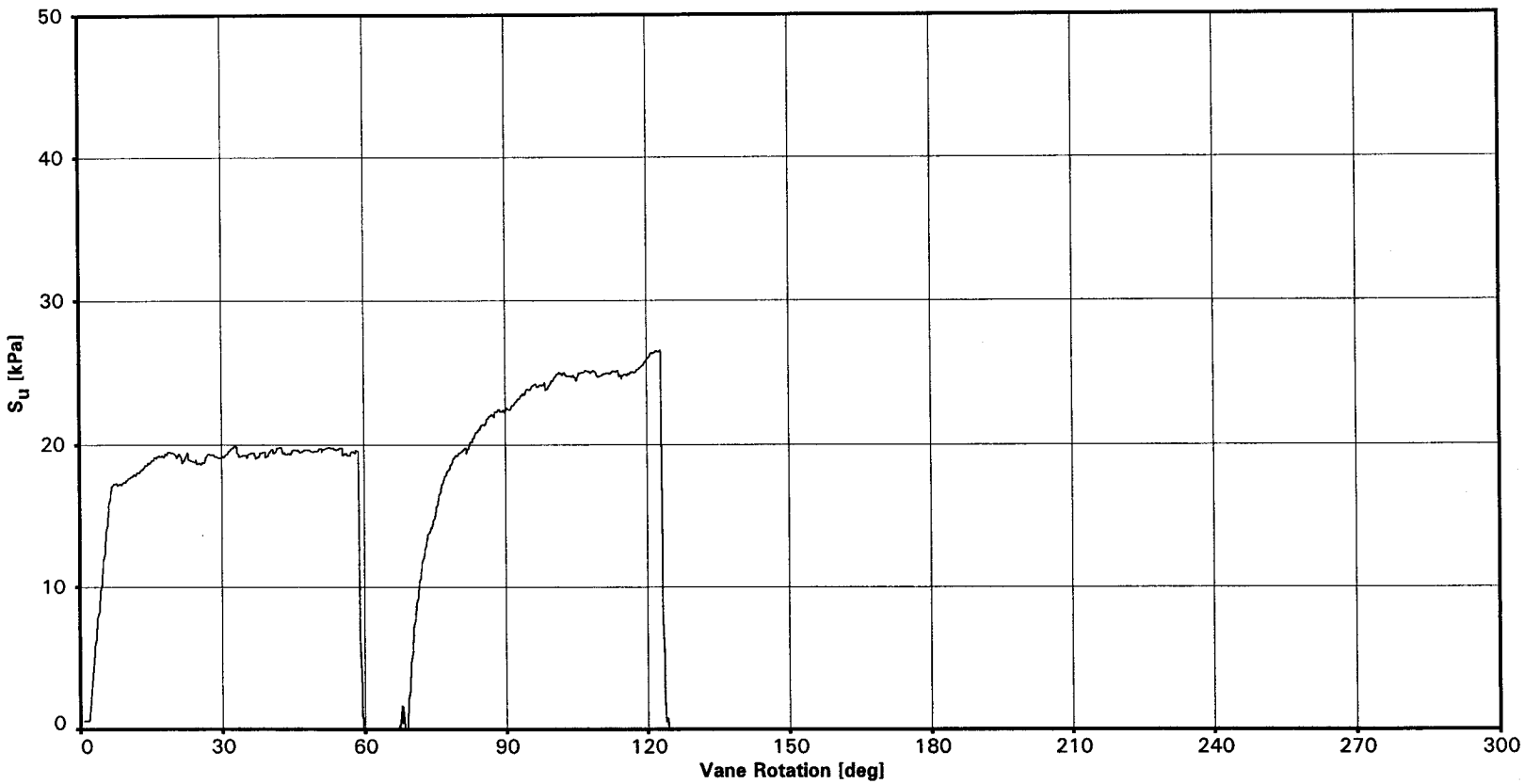
FUGRO

PLATE 98-37.9c

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 2.4m
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

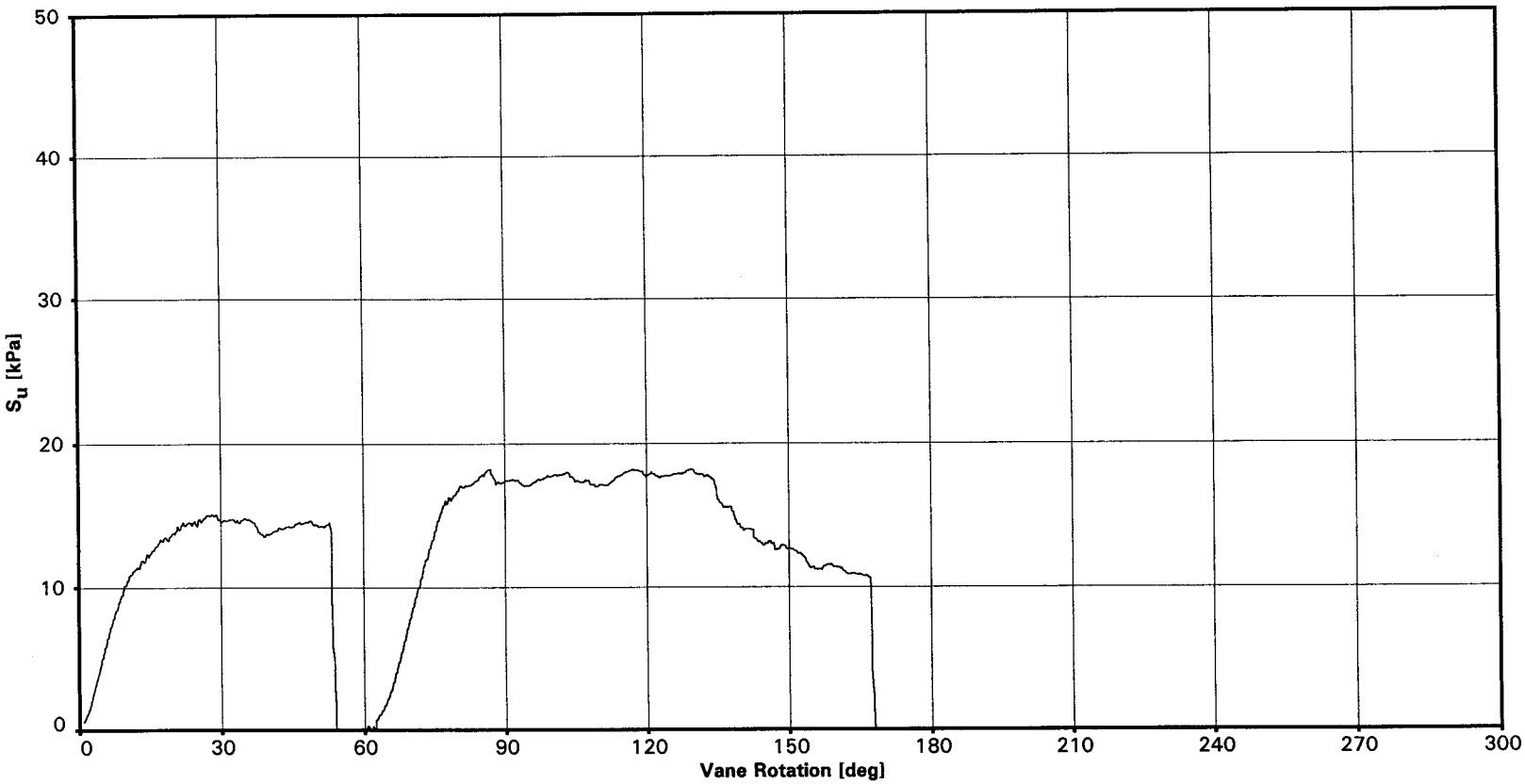
FUGRO

PLATE 98-37.9d

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.0m
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

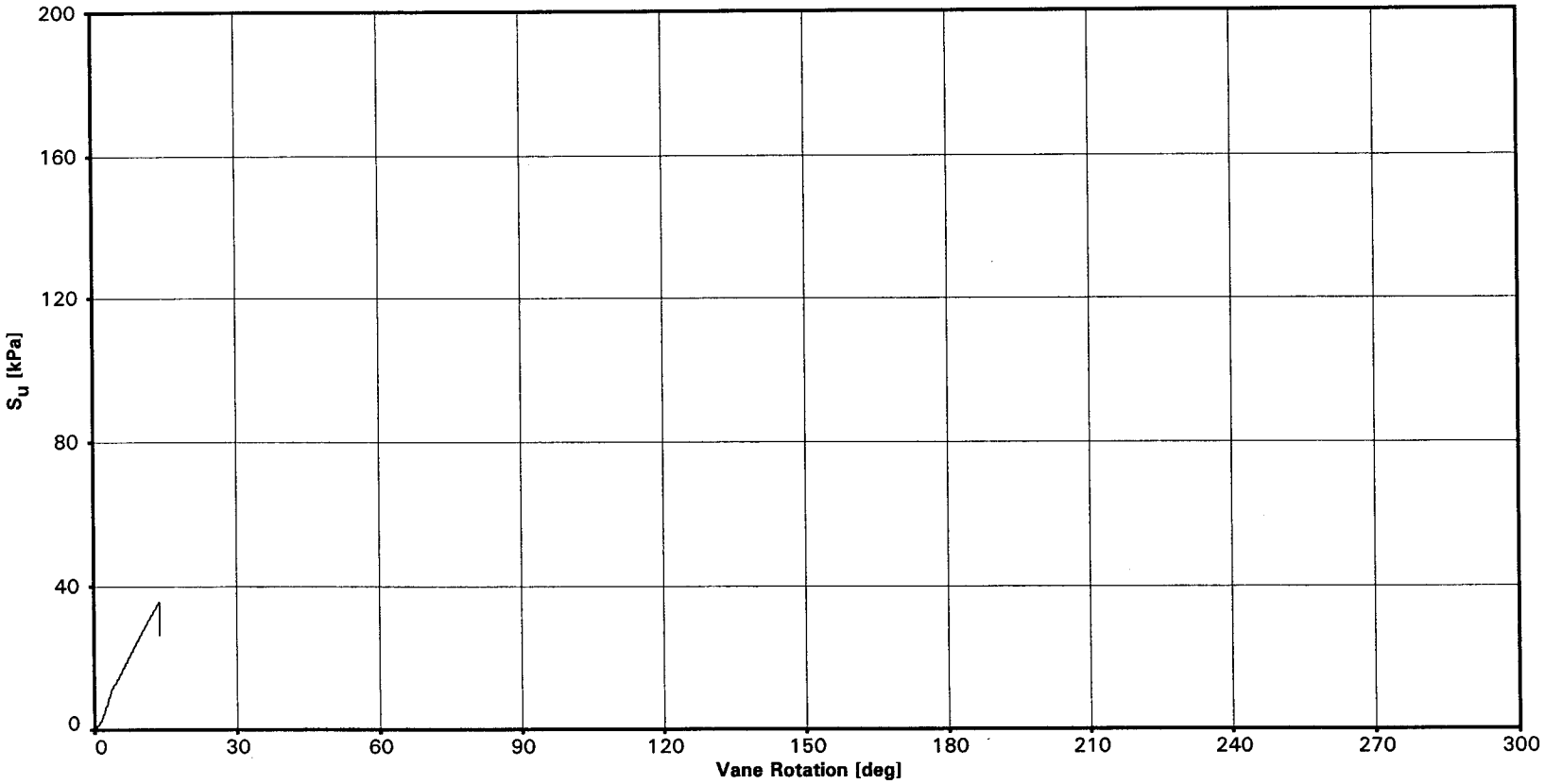
FUGRO

PLATE 98-37.9e

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Large

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 9.8m
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

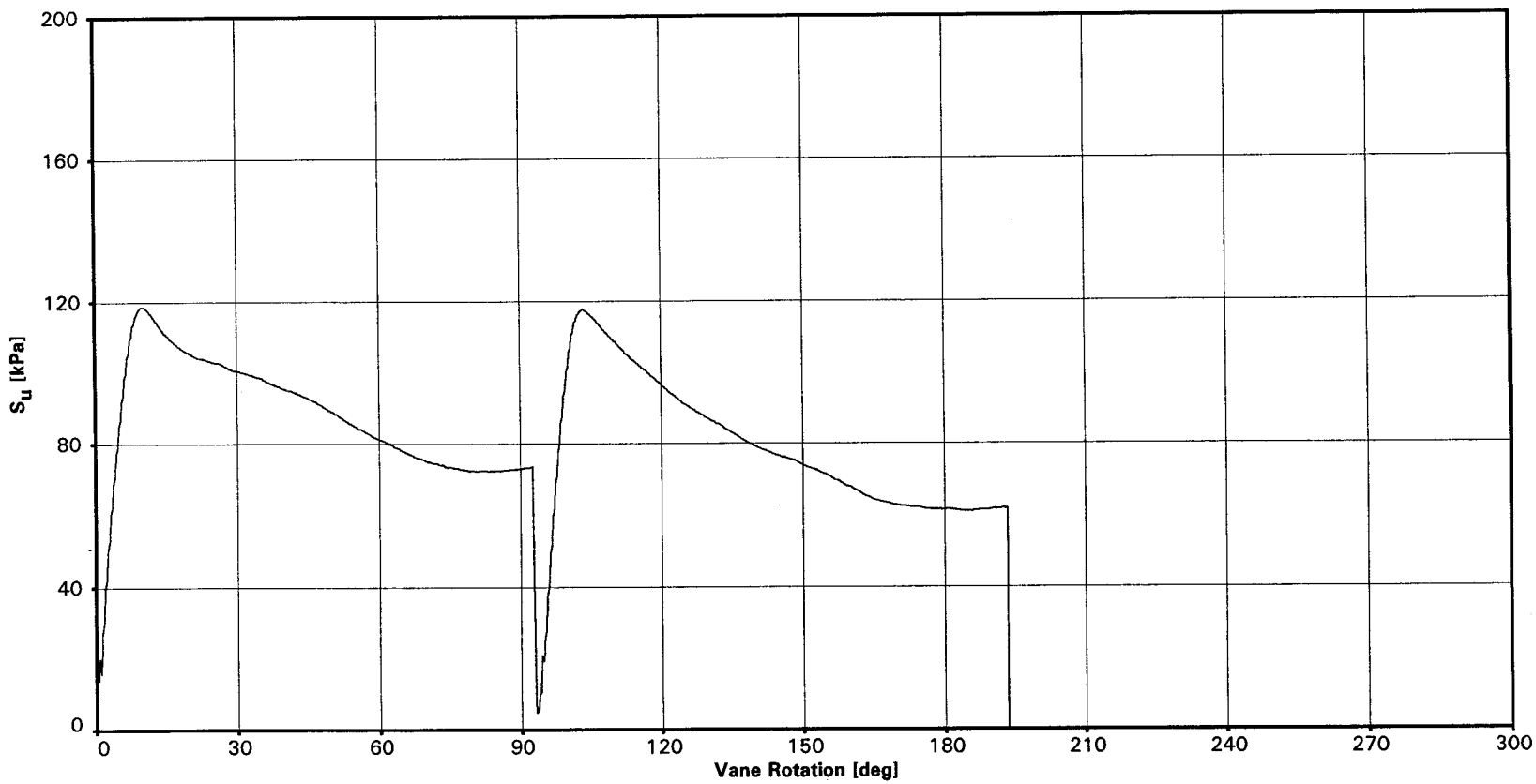
FUGRO

PLATE 98-37.9f

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 26.5m and 27.1m
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

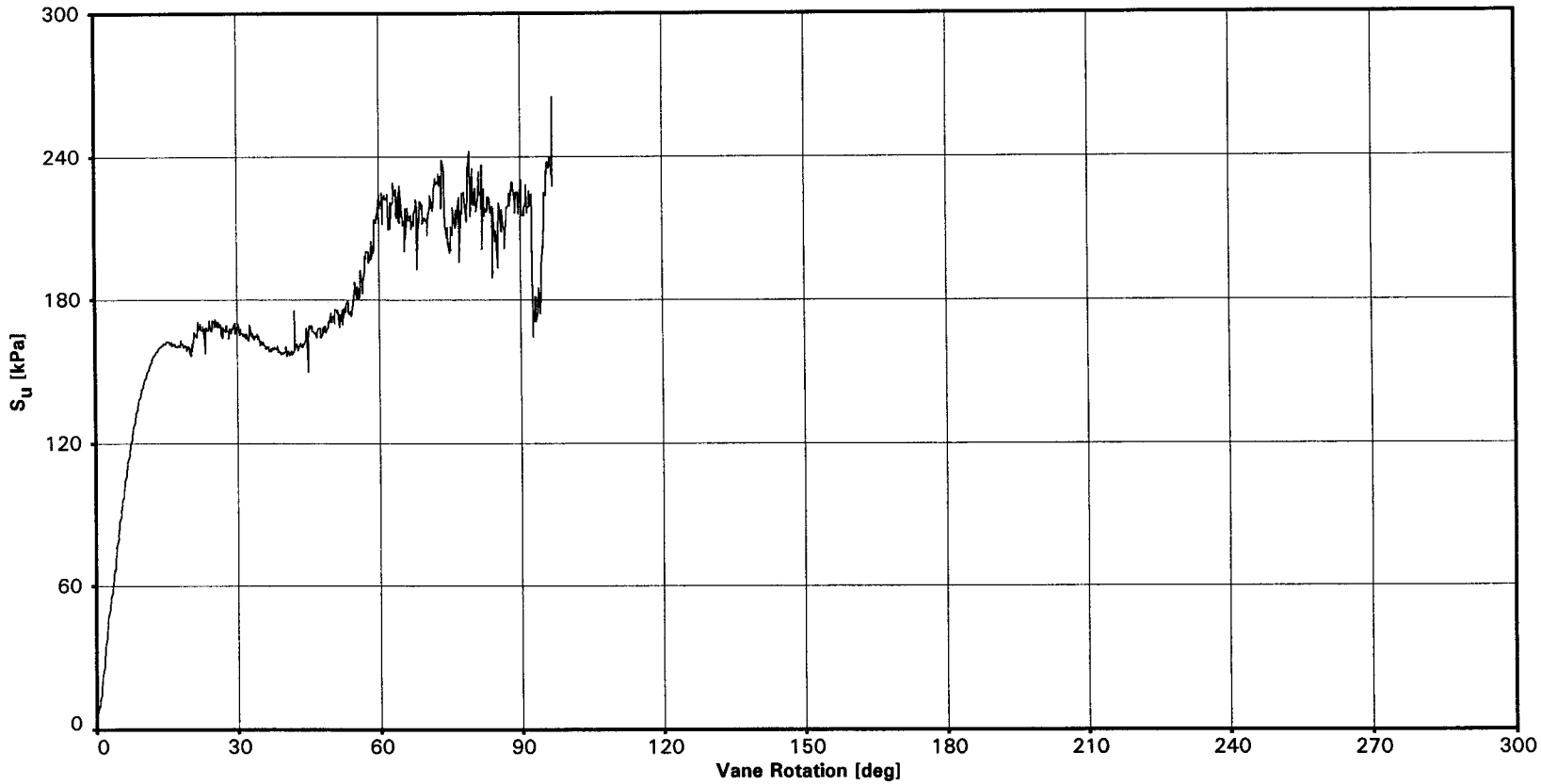
FUGRO

PLATE 98-37.9g

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depth: 34.7m
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-37.9h

98-37		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
0.2	1	92	89	31	1.06	4.8				3.6	1.1													
0.3	2					4.8					1.3													
0.6	500													1.9										
0.6	501													2.9										
1.2	502													6.7										
1.2	503													7.7										
1.4	5					7.3					17.5													
1.5	6	59	51	23	1.28	6.2					10.7	3.2	1.0											
1.8	504													18.2										
1.8	505													14.8										
2.1	8	53	48	22	1.16	6.4				8.8	2.7													
2.3	9					7.0																		
2.4	506													19.6										
2.4	507													26.3										
3.0	11					7.3																		

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-37		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
3.0	508													14.8										
3.0	509													17.7										
3.2	12	36	40	18	0.80	7.6	64			49.8	28.6	5.2	8.0											H
3.8	300	40																						
4.0	13					7.7																		
4.3	15	27				8.6	34																	
4.7	16	24																						
5.0	17	33					35				20.9													
5.2	18					8.7																		
5.8	20					7.0																		
5.9	21	54	58	23	0.88					23.0	30.6	4.0												
6.6	22	66	62	27	1.11	5.9									17.9		0.5							
6.6	23									21.1	33.0													
7.5	24	73	70	29	1.07	5.5									17.4		0.8							
7.7	26										29.4	2.7												

Identification Tests
MC = Moisture Content
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PL = Plastic Limit
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Identification Tests
SUW = Submerged Unit Weight
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-37		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
8.6	27	60	58	24	1.07																			C,K
8.7	28	78	61	26	1.50						26.5													
9.3	29	61	64	26	0.92	6.0									26.0		1.5							
9.4	30										31.4	5.0												
9.8	400													35.9										
13.3	31	21	32	13	0.43	11.3	51	67.0							162.2		1.2							H
13.4	32							63.2			75.7													
15.1	33	22					2																	
15.4	34	44	59	26	0.53	6.0																		
15.4	35									84.3														
15.5	35							47.9			89.5	22.6												
17.1	36									39.3														
17.2	36	35																						
17.2	36	21	29	12	0.51																			
17.4	37					10.6	23																	

Identification Tests
MC = Moisture Content
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Identification Tests
SUW = Submerged Unit Weight
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Additional Tests
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-37		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
20.7	38									110.1														
20.9	38	49	70	21	0.58			81.4																
21.3	39	40				8.4	26																	
24.8	41	35	44	15	0.69	10.1	49								89.8		2.6							H
24.8	42									154.2														
25.0	42							95.8			101.2													
25.5	43	39	49	17	0.69																			C
25.6	44	39	51	18	0.64						142.3													
26.5	401													116.8										
27.1	402													115.9										
28.0	45	35	61	18	0.40	8.2									132.1	108.8	0.3							
28.2	46					8.4			215.5															
28.3	47							138.9	191.5		179.5													
32.9	48	34	41	25	0.58	8.4									114.4		0.9							
33.1	49					8.3			143.6															

Identification Tests
MC = Moisture Content
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Identification Tests
SUW = Submerged Unit Weight
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Strength Tests
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Additional Tests
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C = Consolidation Test
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CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-37		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
33.2	50								167.6	127.4	168.3													
34.7	403													227.4										
35.7	51	47	40	20	1.36	9.3									112.9		0.7							
35.8	52					8.7			177.2						116.5		1.0							
36.0	53								215.5		172.0													
36.5	54	34	50	18	0.49																			C
36.6	55	37	53	23	0.45						193.1													
41.3	57	31	73	25	0.12	7.7									92.3	75.9	0.4							
41.5	58								177.2		200.5													
45.9	59	17	40	14	0.11	10.6									185.1		0.9							
46.0	60								338.8															
50.9	61	40	83	23	0.28	7.7									150.1	134.8	0.9							
51.2	63										222.8													
51.7	64	40	79	28	0.23																			C
51.8	65	44	79	25	0.35																			

Identification Tests
MC = Moisture Content
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PL = Plastic Limit
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Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-37		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
56.5	67	48	82	26	0.40	6.8			191.5						144.7		0.5							
56.7	68								215.5		222.8													
61.4	70	26	41	14	0.43	9.5									206.2	134.6	0.9							
64.2	72	26				9.6	6																	
69.3	74	35	75	25	0.20	8.2									152.8		0.5							
69.5	75										217.9													
70.0	76	35	73	20	0.28																			C
70.1	77	39	77	25	0.28				215.5		222.8													
74.8	79	18	36	15	0.16	11.0									366.1	268.2	1.3							
79.7	82	22	51	20	0.06	10.1																		
82.3	84					9.3	27											81.4	29					
82.4	85	28																						
87.0	86	23					8																	
89.5	87						11											148.4	32					
89.6	88	22				9.8																		

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-37		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
92.2	89						8																	
94.3	90	22	51	28		10.8																		
96.8	91	43					13																	
99.2	92	15					11																	

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

Identification Tests
SUW = Submerged 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

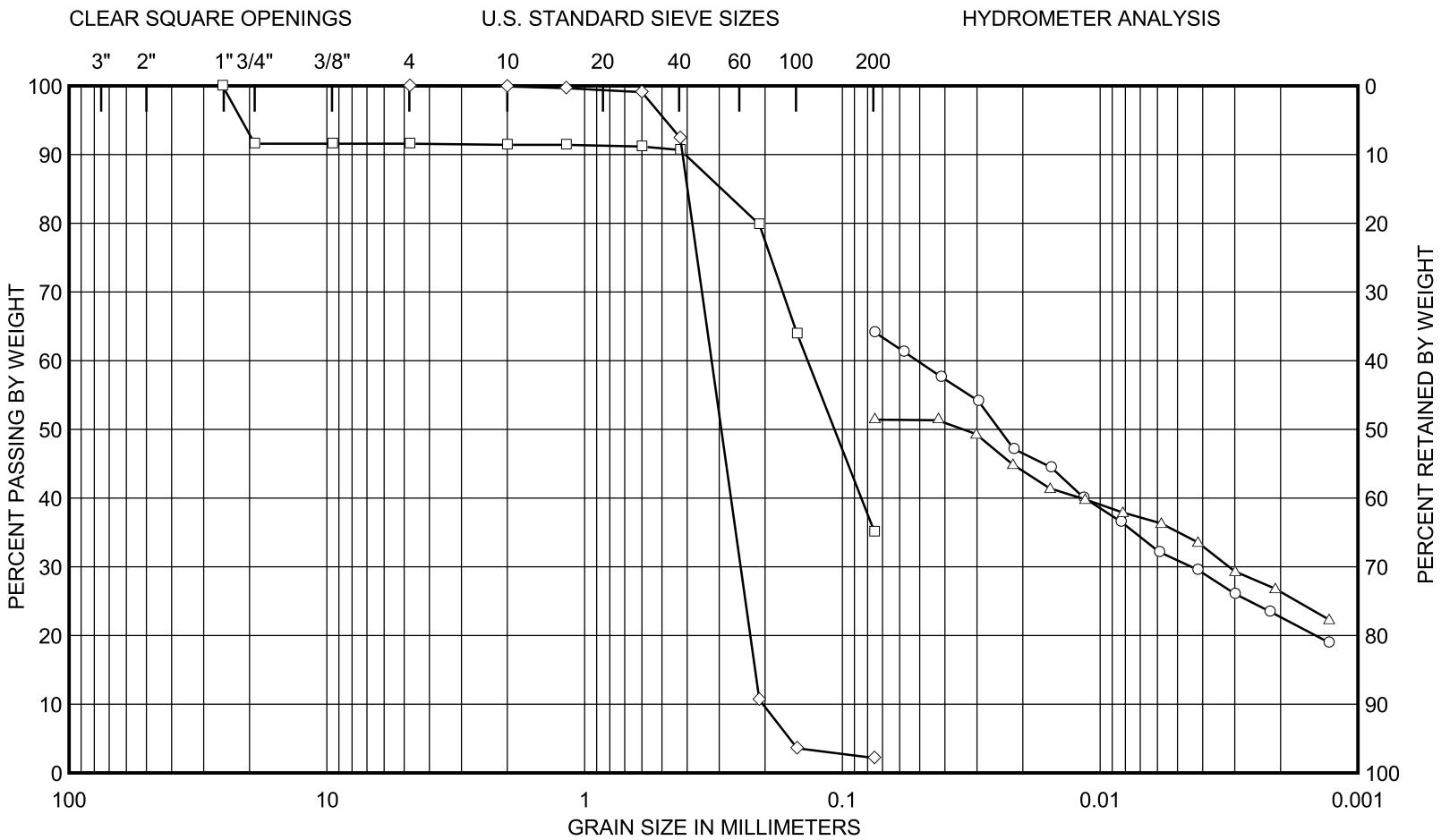
Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-37
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO



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

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
12	3.2	○——○	FAT CLAY (CH) with sand pockets and shell fragments			0.025
17	5.0	□——□	INTERMIXED SAND AND CLAY (SP/CH) with shells and shell fragments			0.11
31	13.3	△——△	SANDY FAT CLAY (CH) with silty sand pockets			0.033
33	15.1	◇——◇	FINE SAND (SP) with a few clay pockets and a trace of medium sand	0.9	1.6	0.29

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-37
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-37.11a

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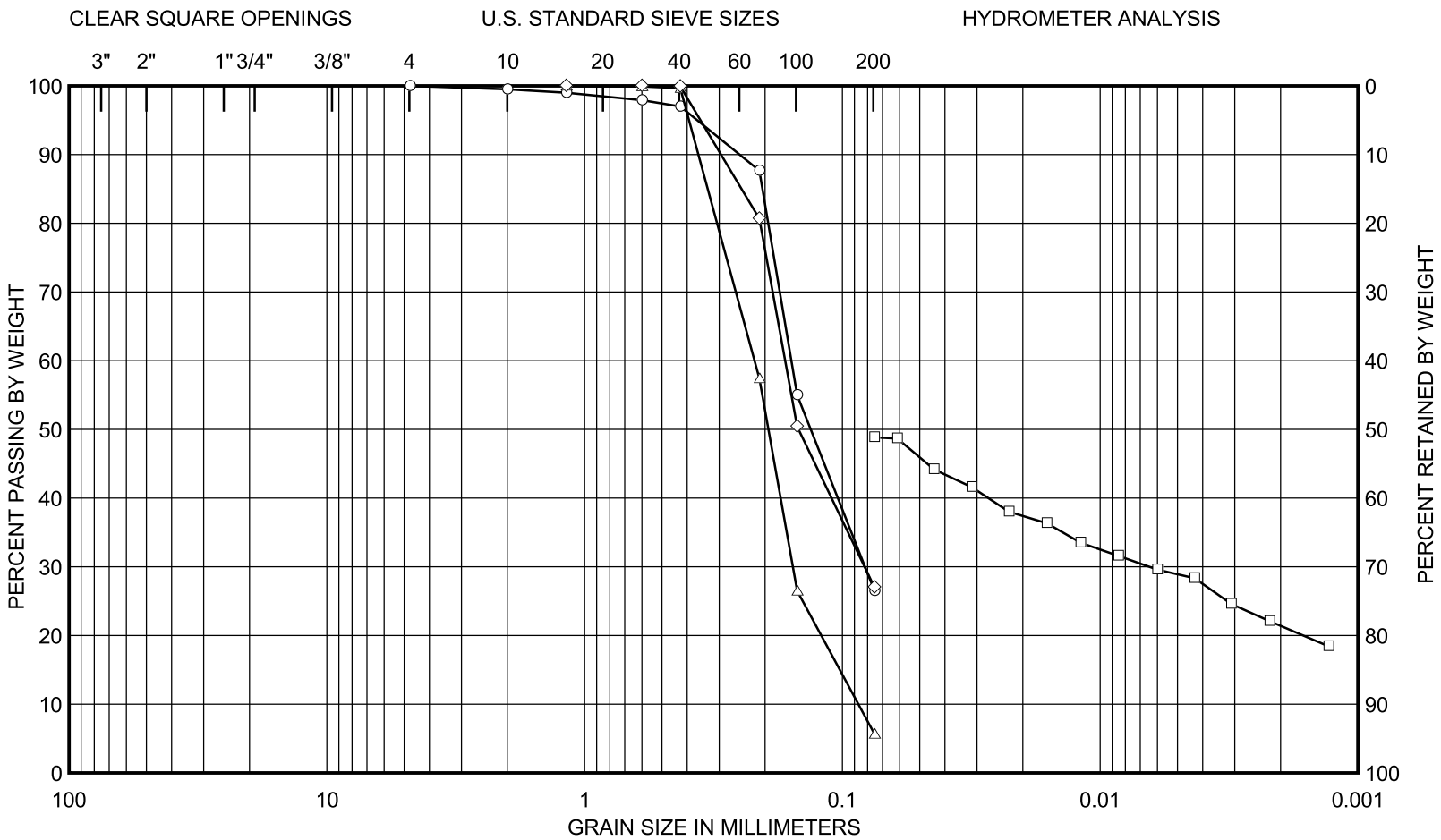

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
39	21.3	○——○	SILTY FINE SAND (SM) with clay pockets, partings and seams			0.13
41	24.8	□——□	FAT CLAY (CH) with many sand and silt pockets			
72	64.2	△——△	FINE SAND (SP-SM) with silt	1.3	2.5	0.19
84	82.3	◇——◇	SILTY FINE SAND (SM) with clay pockets and seams			0.15

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-37
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-37.11b

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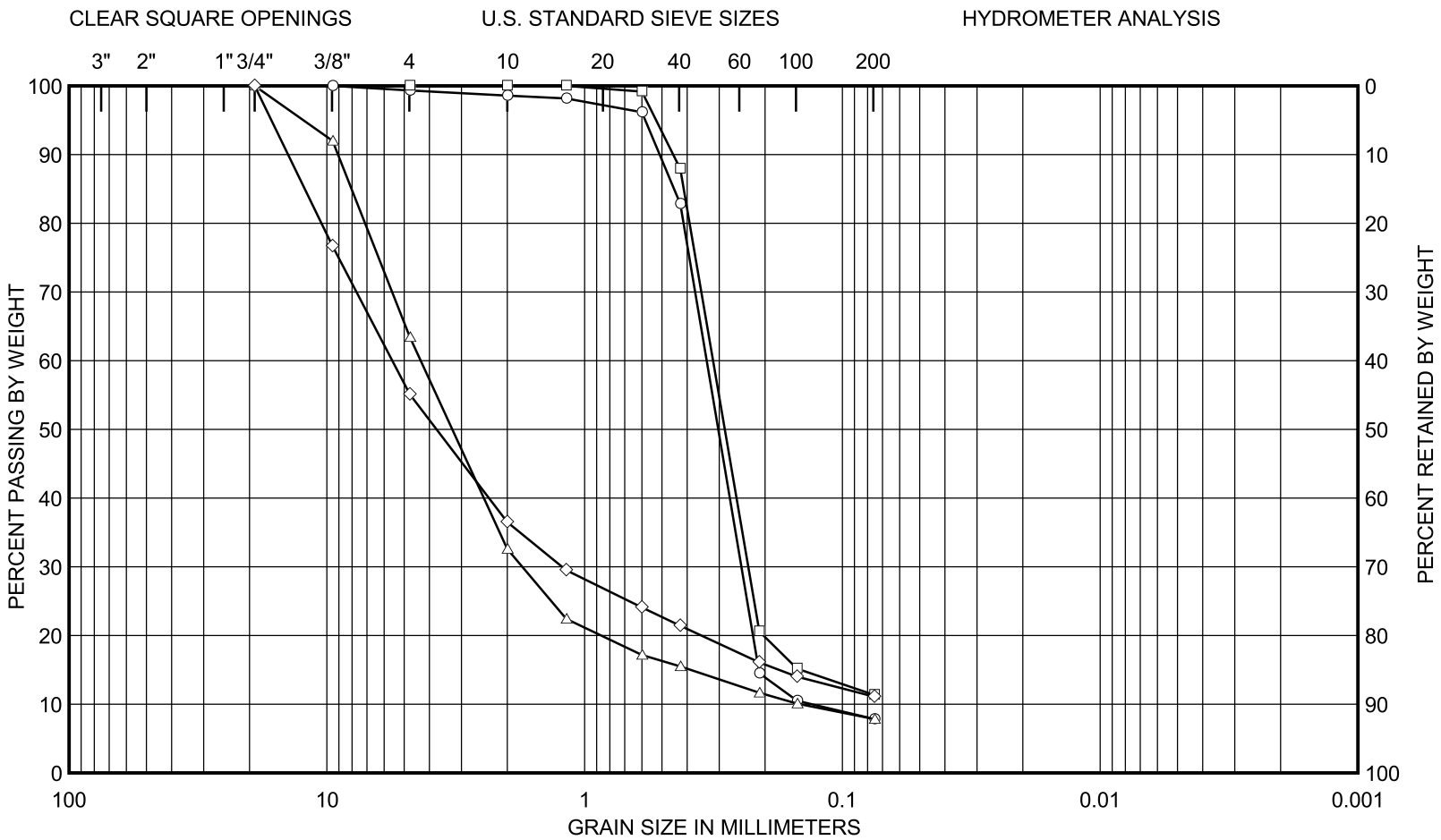

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
86	87.0	○——○	FINE SAND (SP-SM) with silt and medium sand	1.4	2.5	0.30
87	89.5	□——□	FINE SAND (SP-SM) with silt and a trace of medium sand			0.29
89	92.2	△——△	FINE TO COARSE SAND (SP-SM) with silt and fine gravel	4.9	29.7	3.3
92	99.2	◇——◇	FINE TO COARSE SAND (SP-SC) with clay and fine gravel			3.7

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-37
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-37.11c

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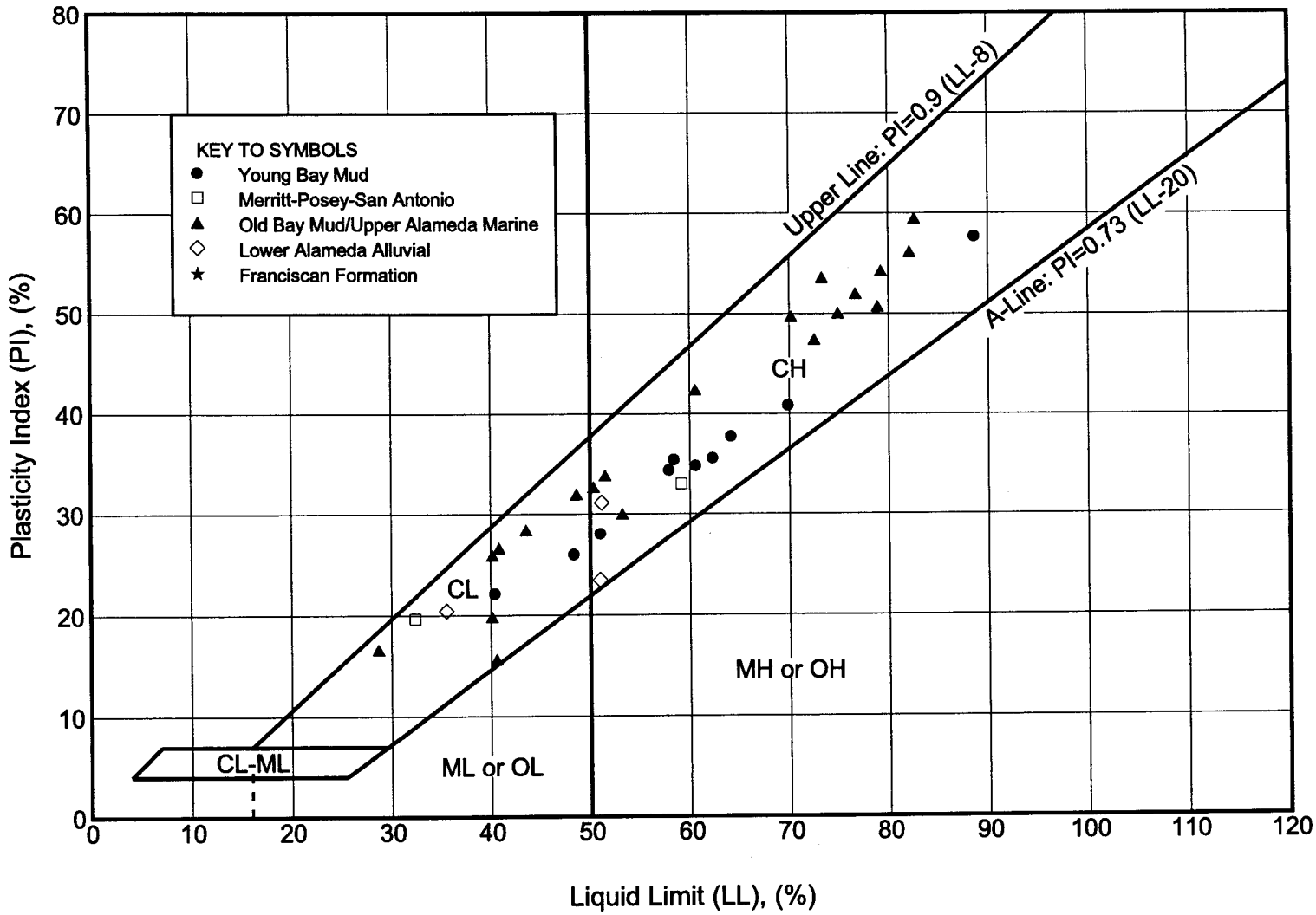
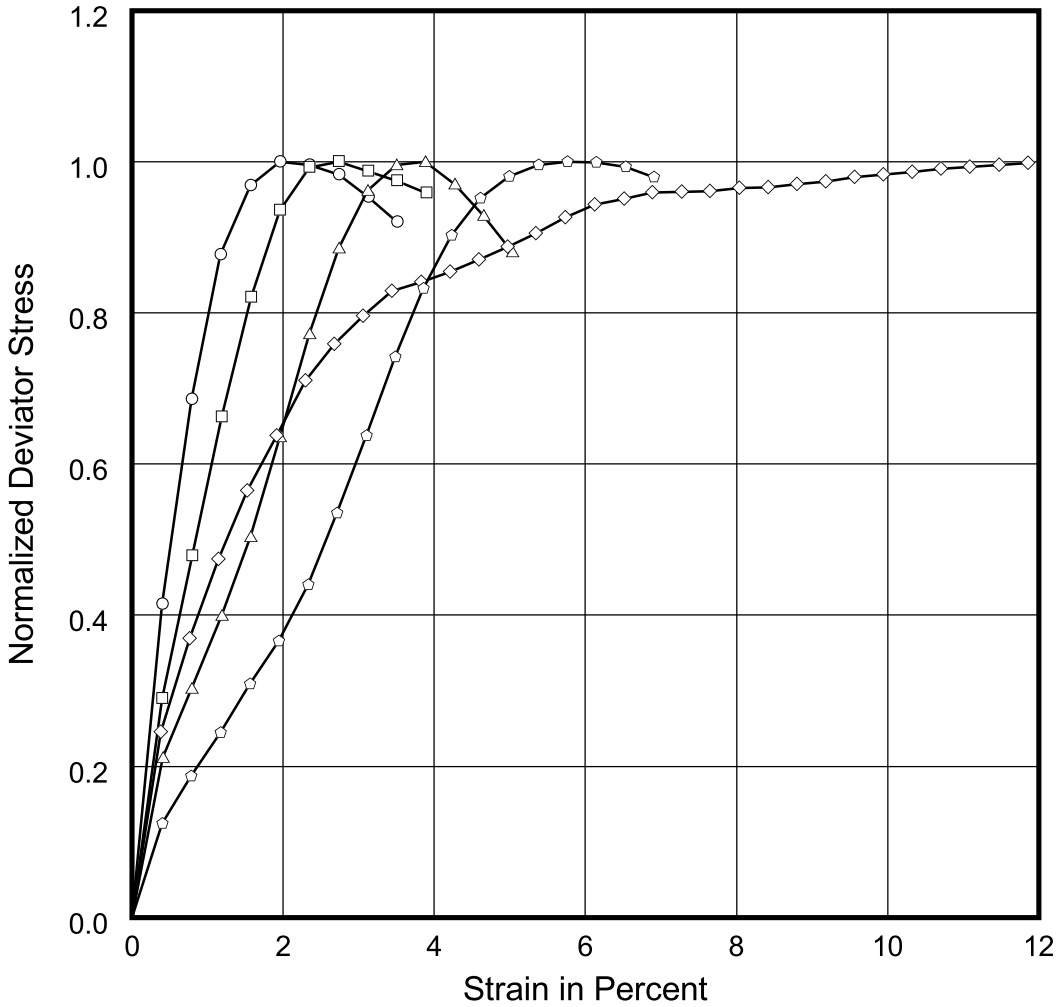


PLASTICITY CHART
Boring 98-37
SFOBB East Span Seismic Safety Project

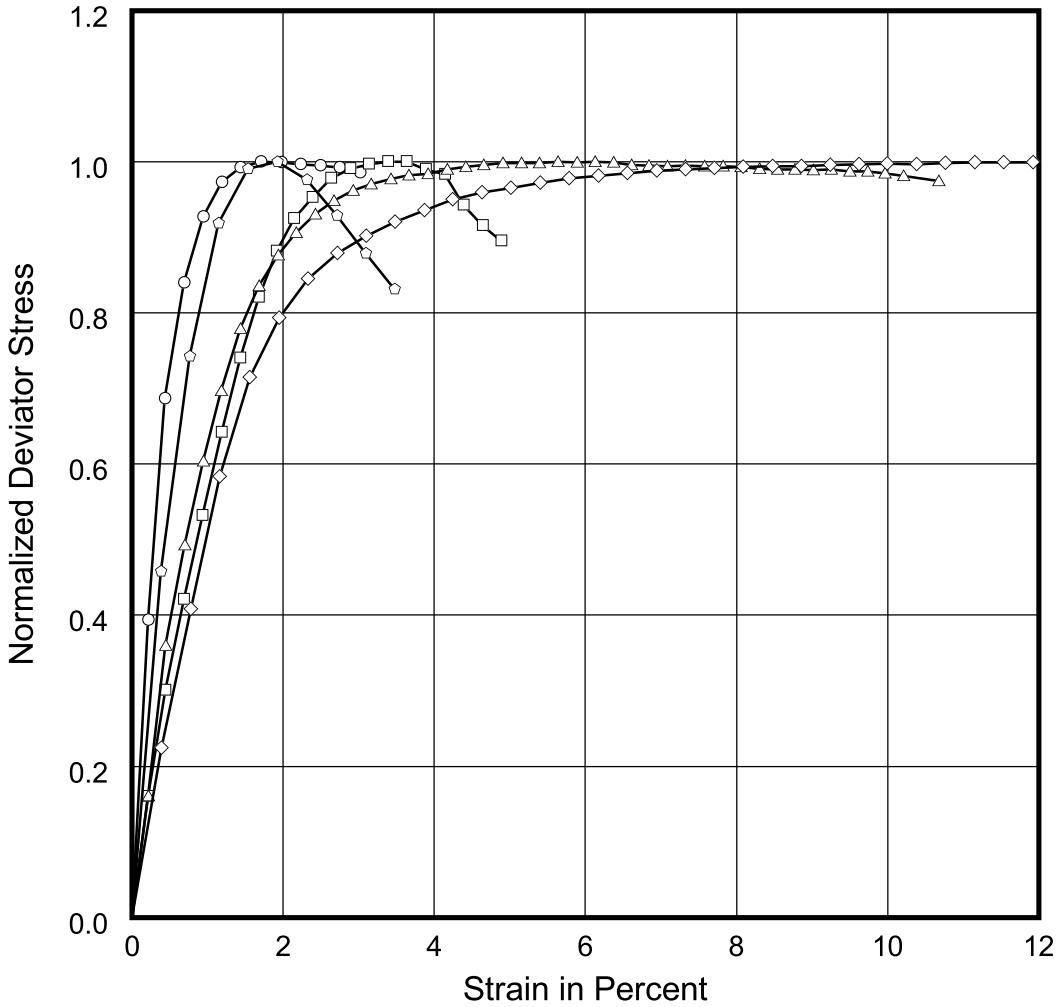


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	22	6.6	UU	172	36	0.5
	24	7.5	UU	172	35	0.8
	29	9.3	UU	207	52	1.5
	31	13.3	UU	827	324	1.2
	41	24.8	UU	827	180	2.6

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-37
SFOBB East Span Seismic Safety Project

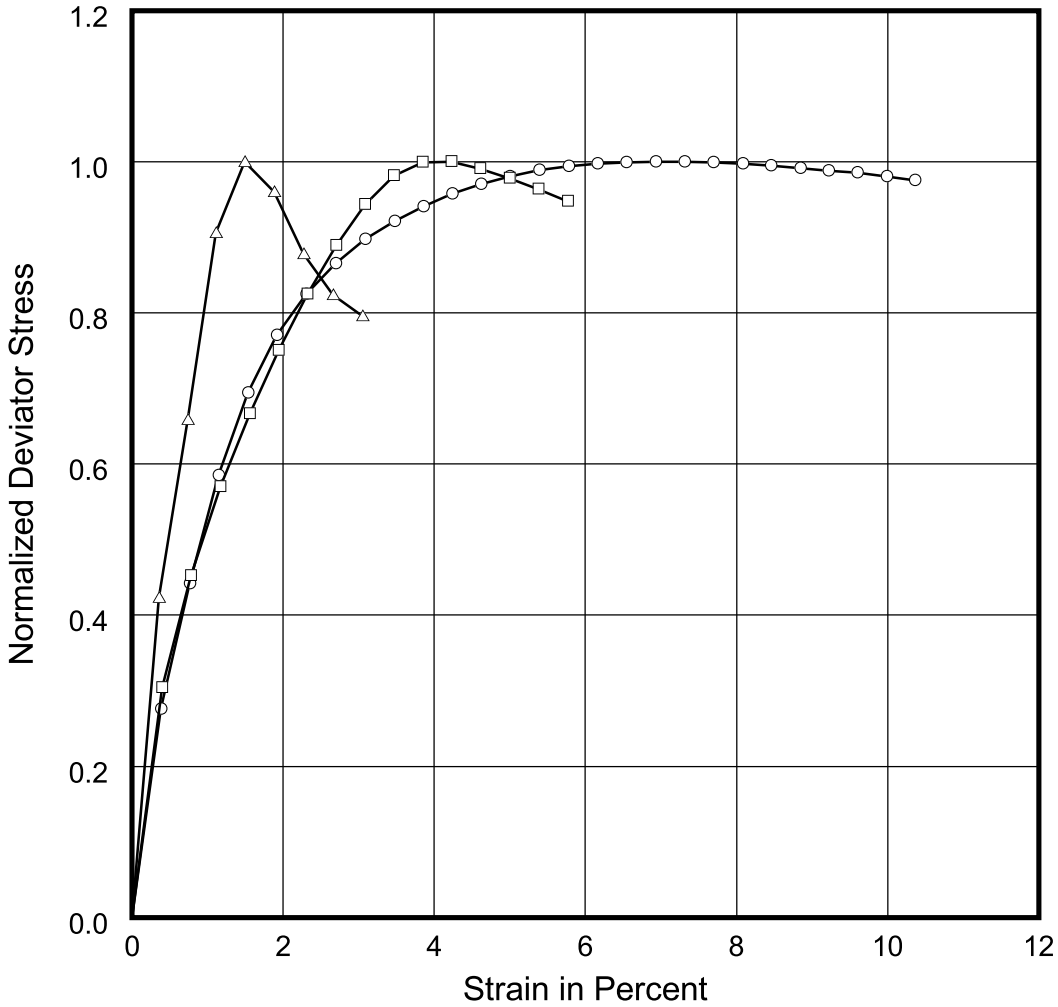


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	45	28.0	UU	965	264	0.3
	48	32.9	UU	1103	229	0.9
	51	35.7	UU	1172	226	0.7
	52	35.8	UU	1138	233	1.0
	57	41.3	UU	1275	185	0.4

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-37
SFOBB East Span Seismic Safety Project

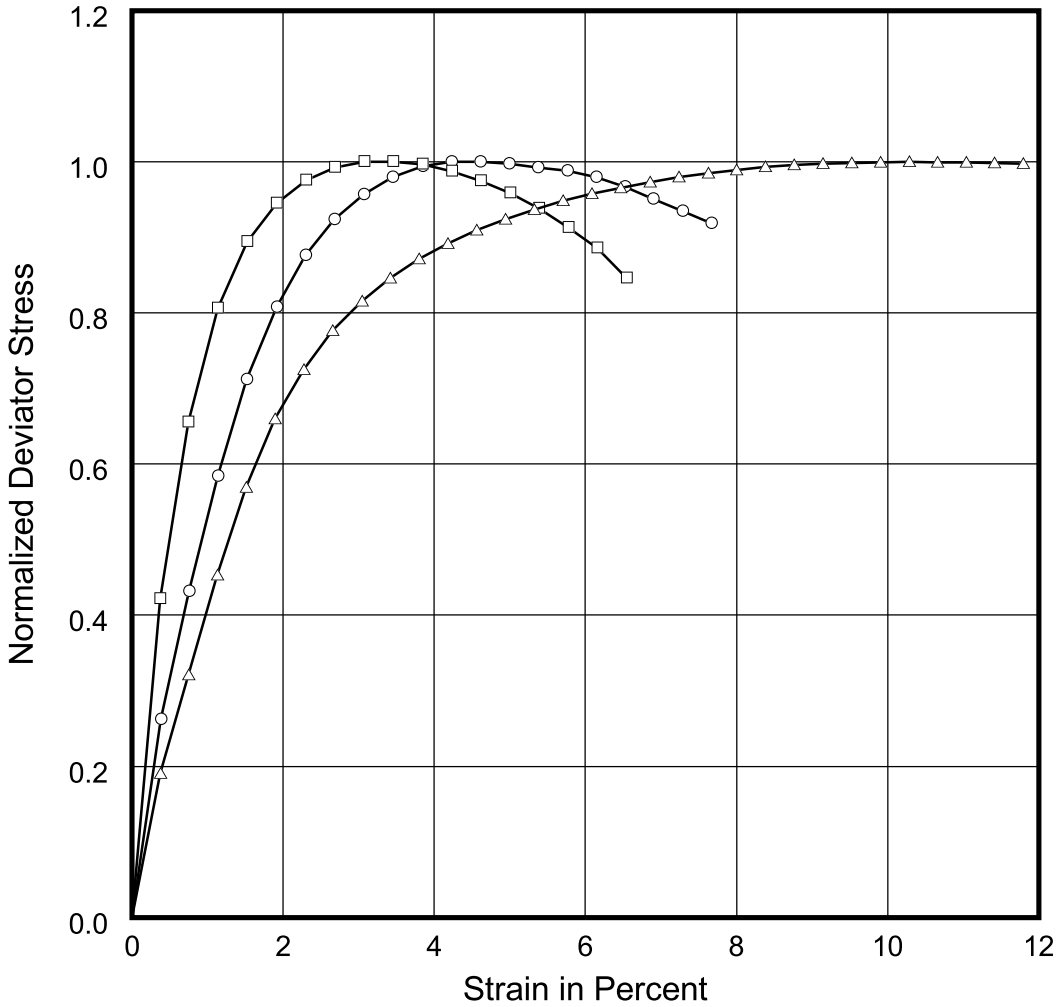


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
⊙——○	59	45.9	UU	1379	370	0.9
⊡——□	61	50.9	UU	1517	300	0.9
△——△	67	56.5	UU	1620	289	0.5

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-37
SFOBB East Span Seismic Safety Project

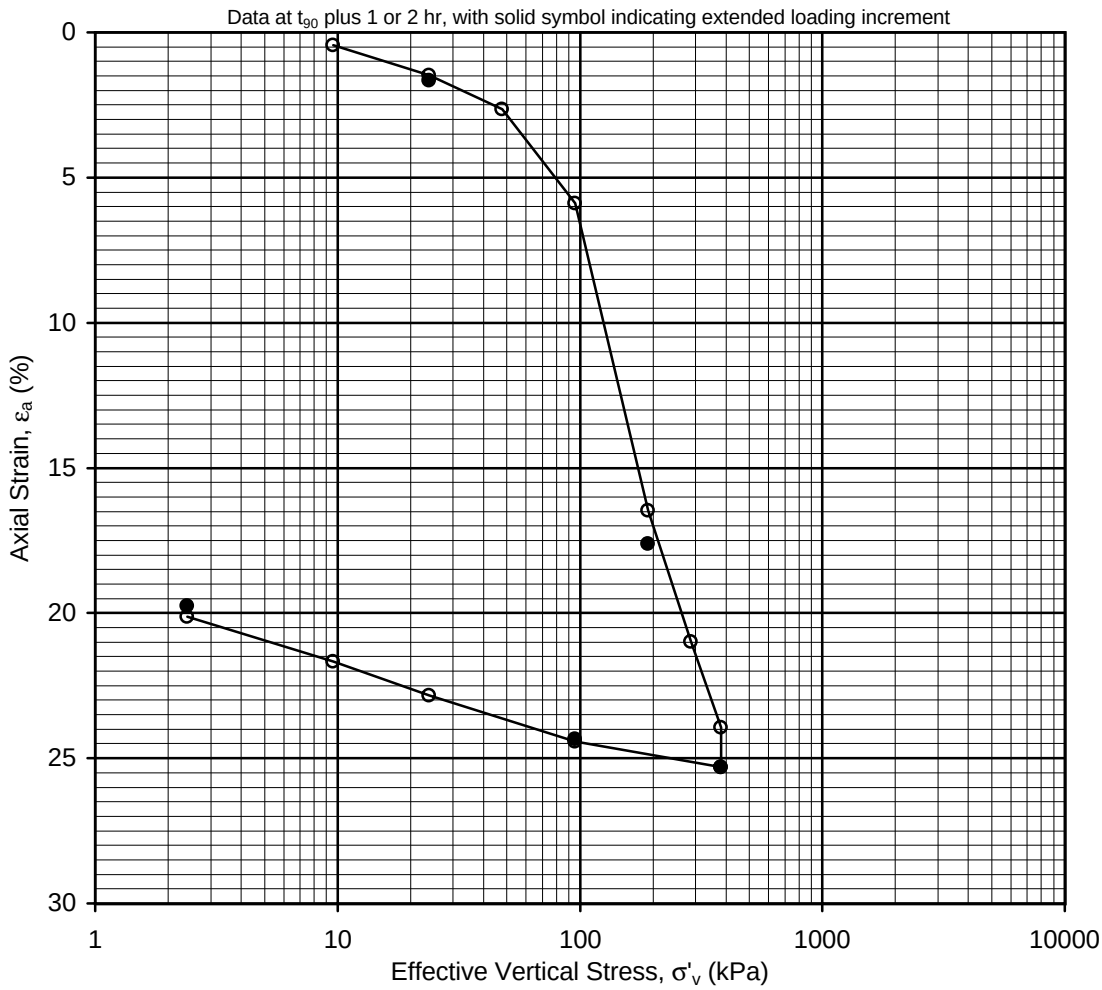


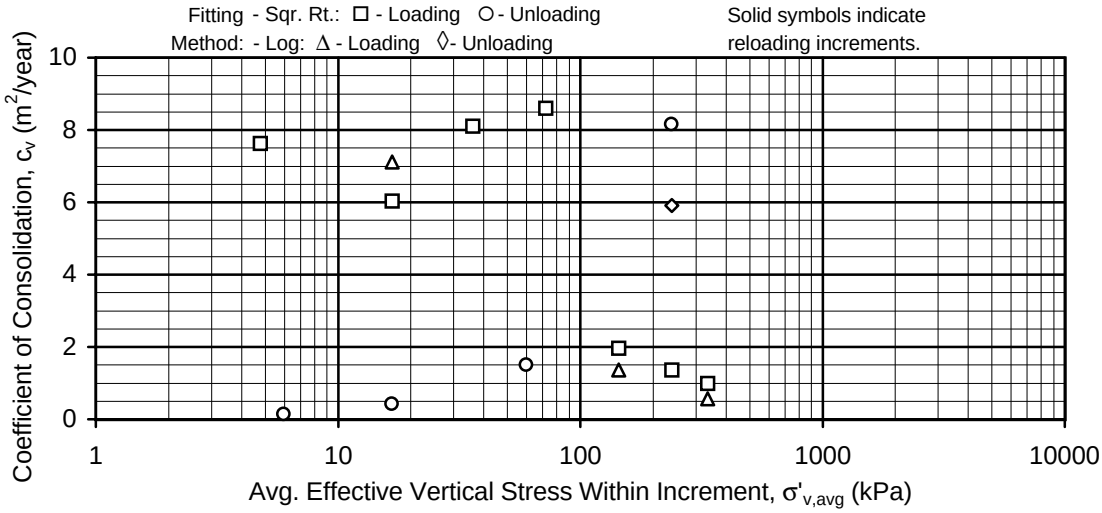
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
⊙——○	70	61.4	UU	1724	412	0.9
⊡——□	74	69.3	UU	2068	306	0.5
△——△	79	74.8	UU	2068	732	1.3

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

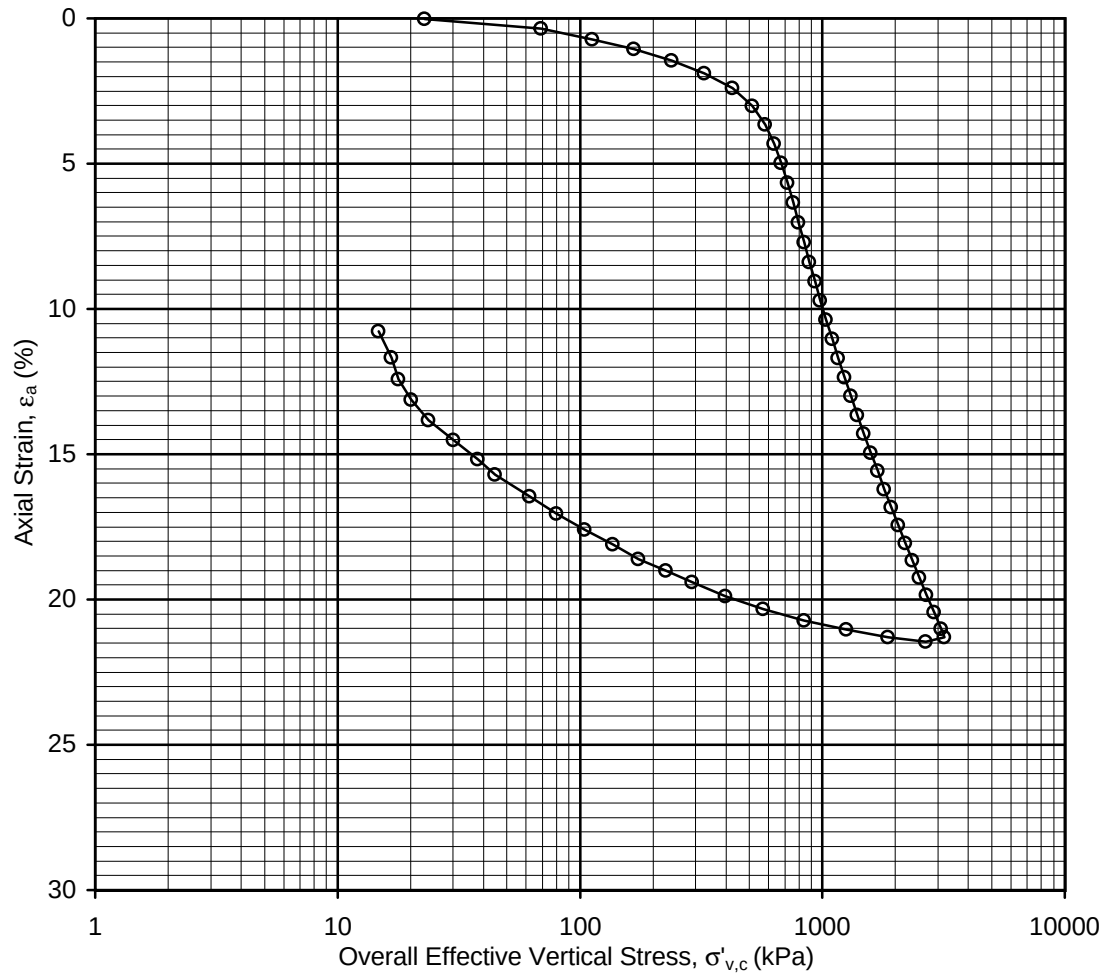
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-37
SFOBB East Span Seismic Safety Project

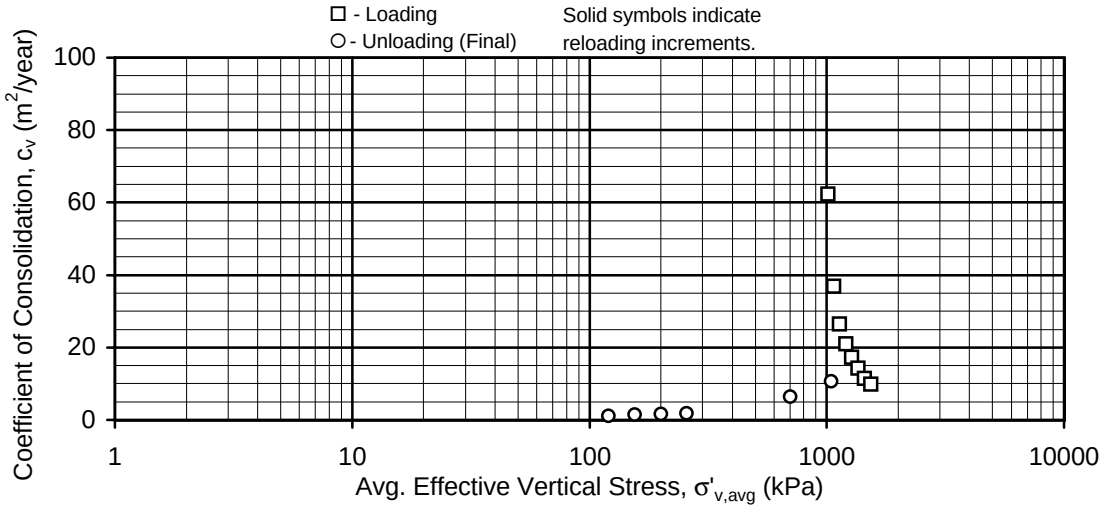




INCREMENTAL CONSOLIDATION TEST RESULTS

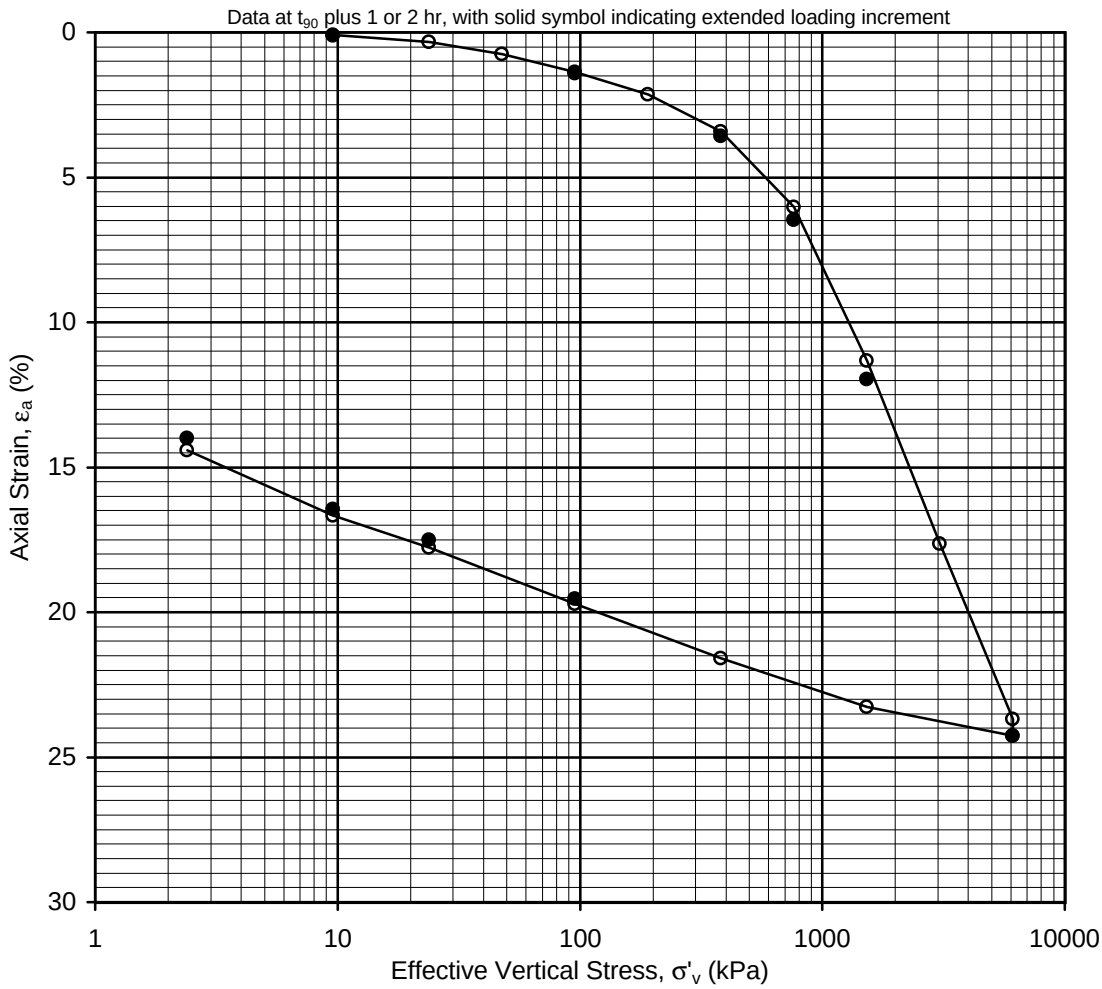
Sample No. 27 - Depth: 8.6m
Boring 98-37
SFOBB East Span Seismic Safety Project

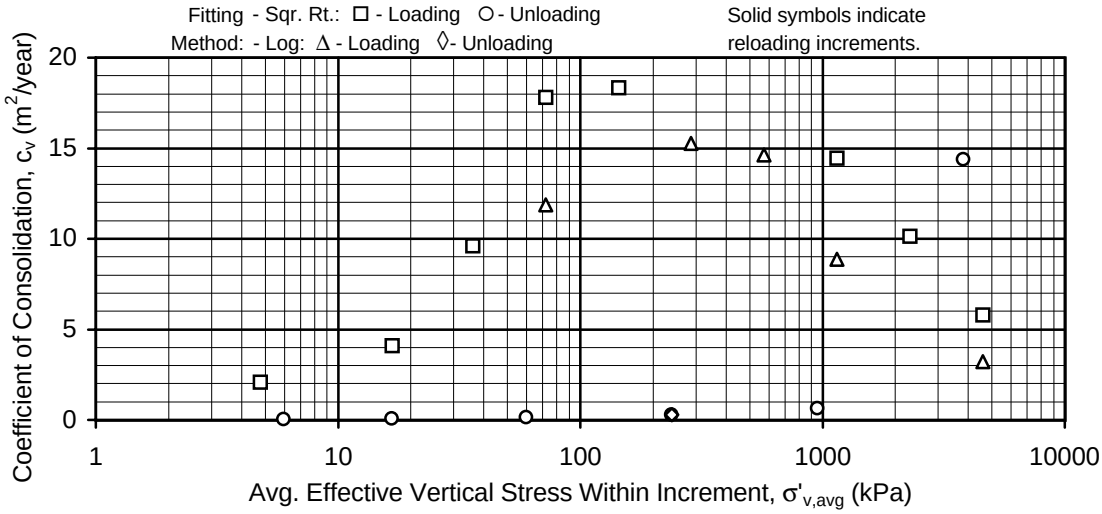




CRS CONSOLIDATION TEST RESULTS

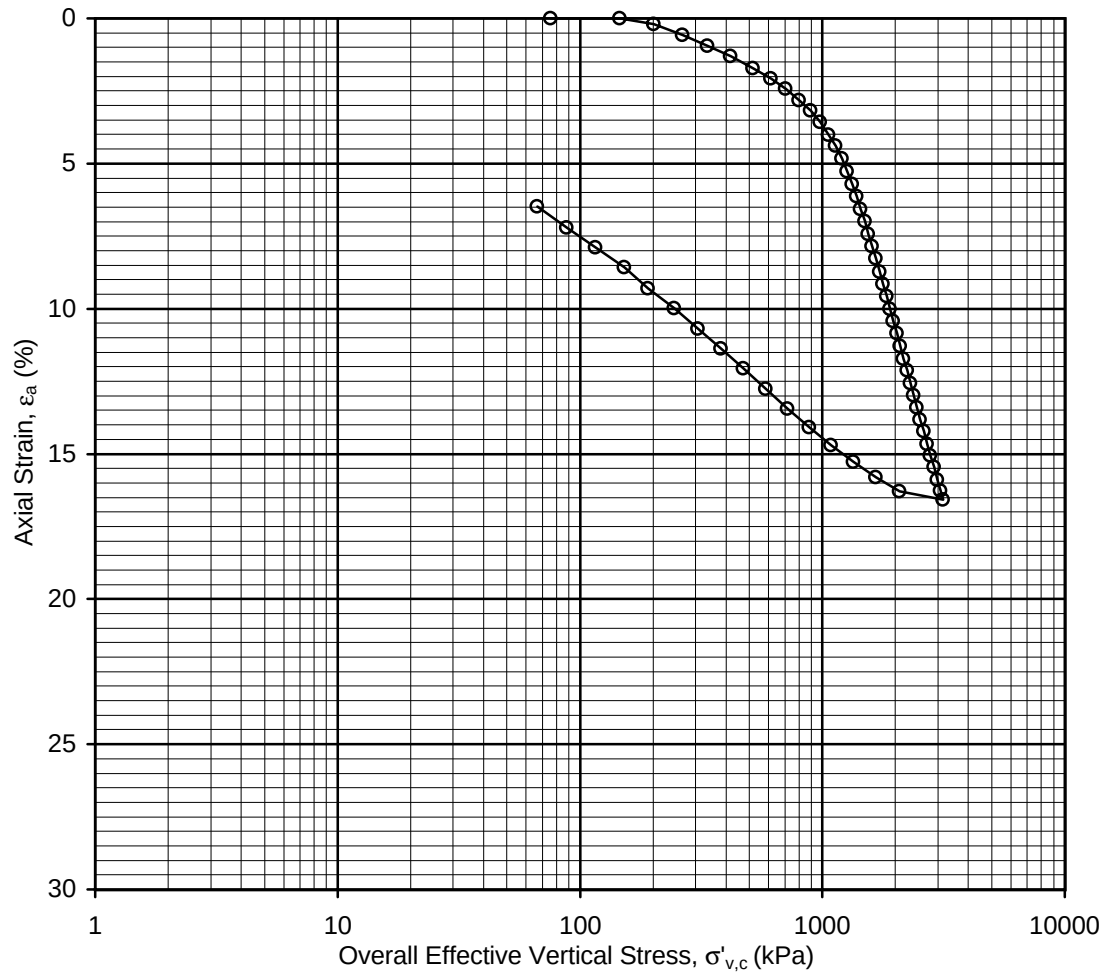
Sample No. 43 - Depth: 25.5m
Boring 98-37
SFOBB East Span Seismic Safety Project

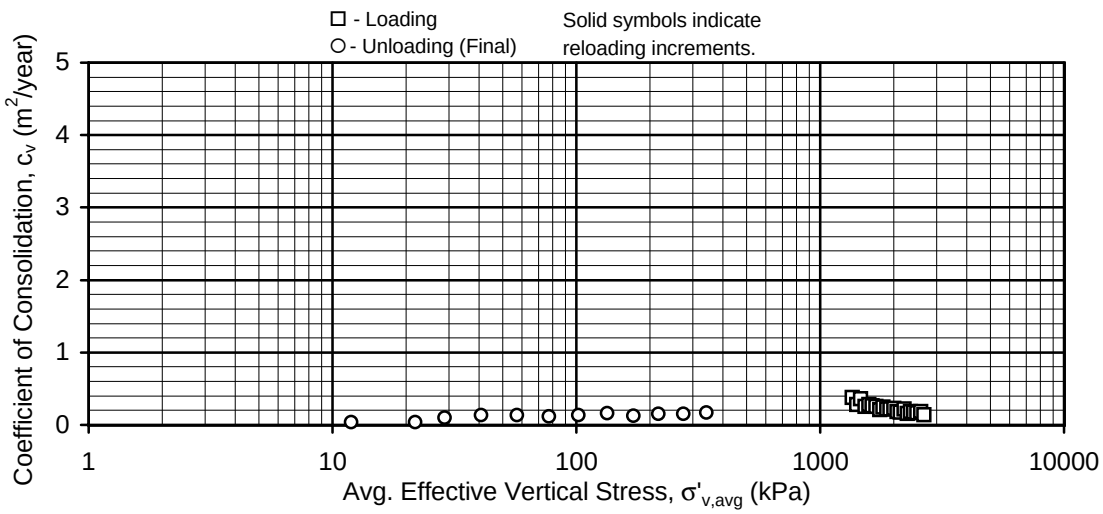




INCREMENTAL CONSOLIDATION TEST RESULTS

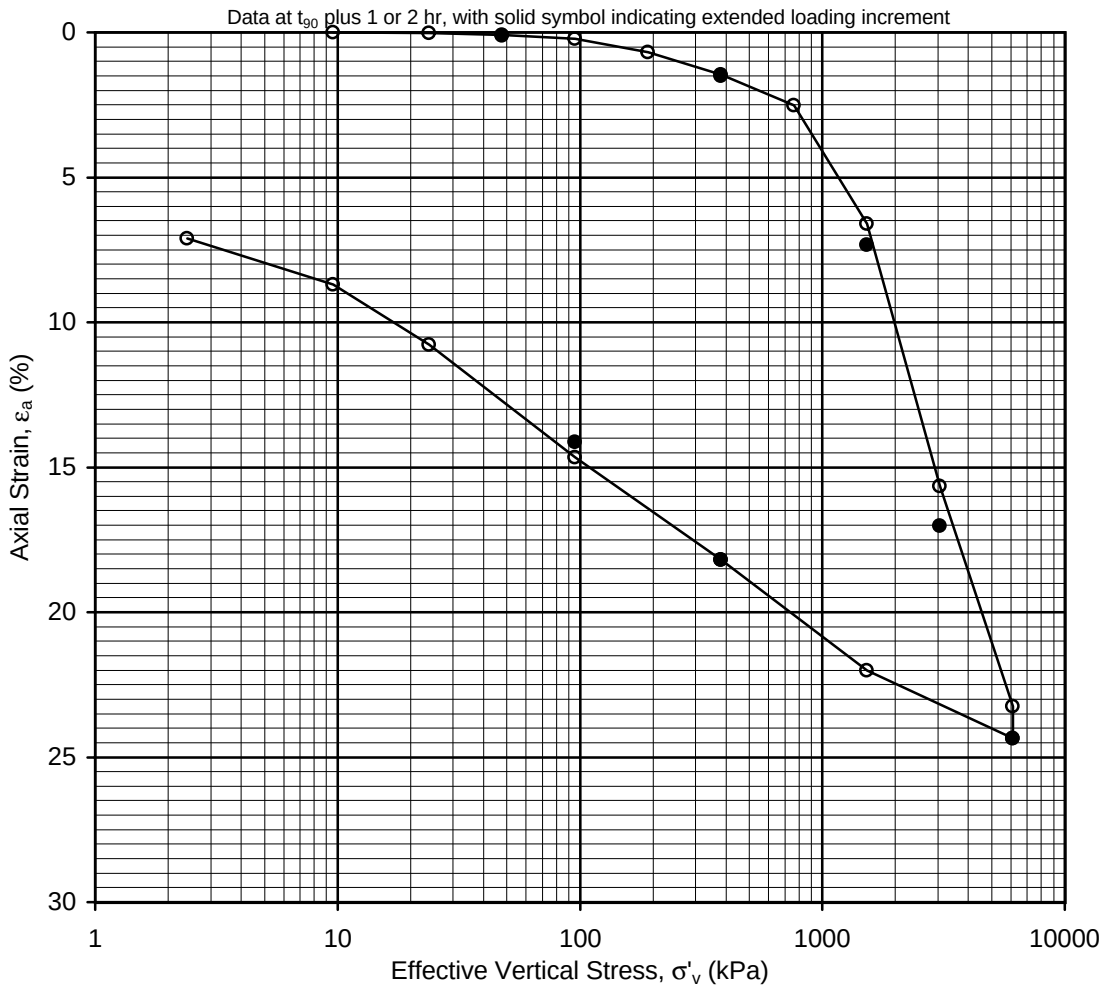
Sample No. 54 - Depth: 36.5m
Boring 98-37
SFOBB East Span Seismic Safety Project

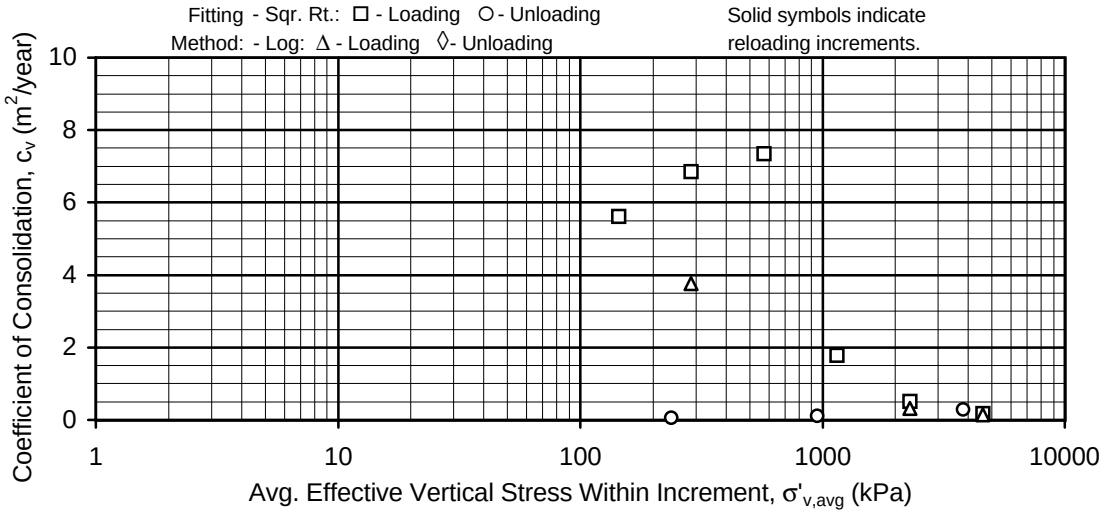




CRS CONSOLIDATION TEST RESULTS

Sample No. 64 - Depth: 51.2m
Boring 98-37
SFOBB East Span Seismic Safety Project

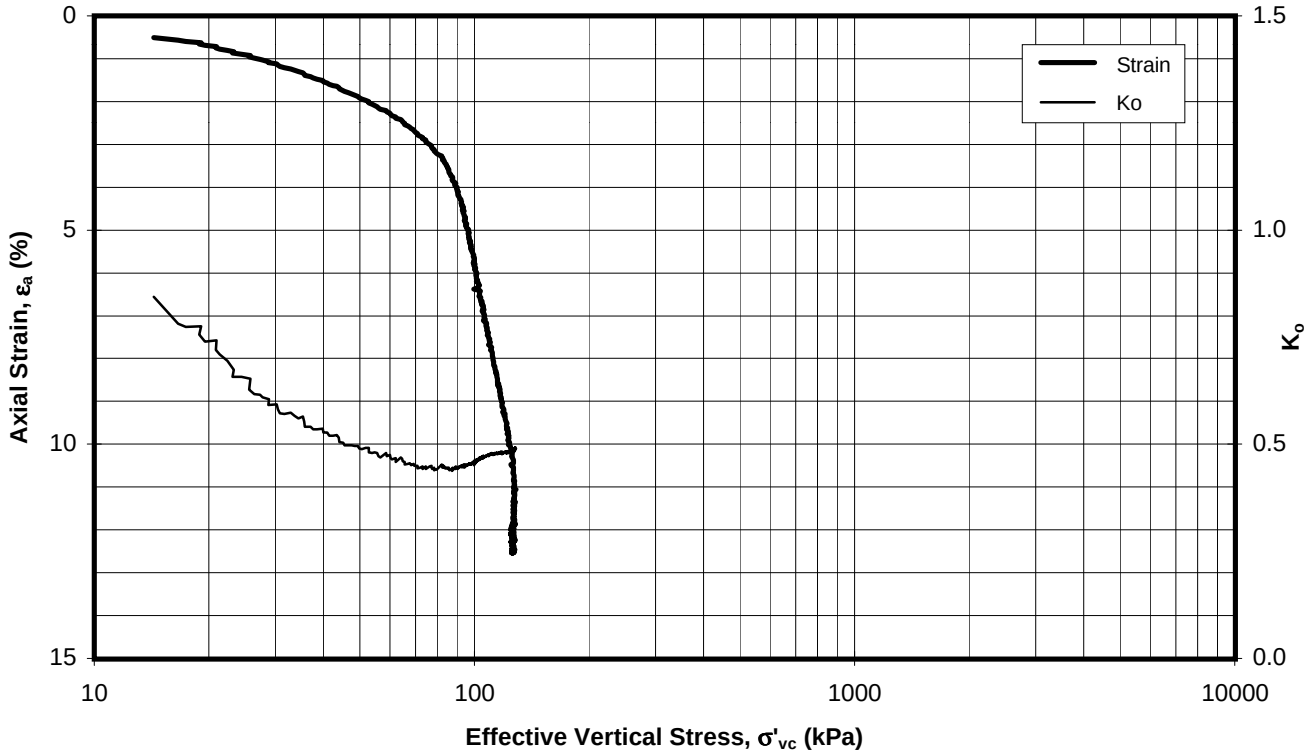


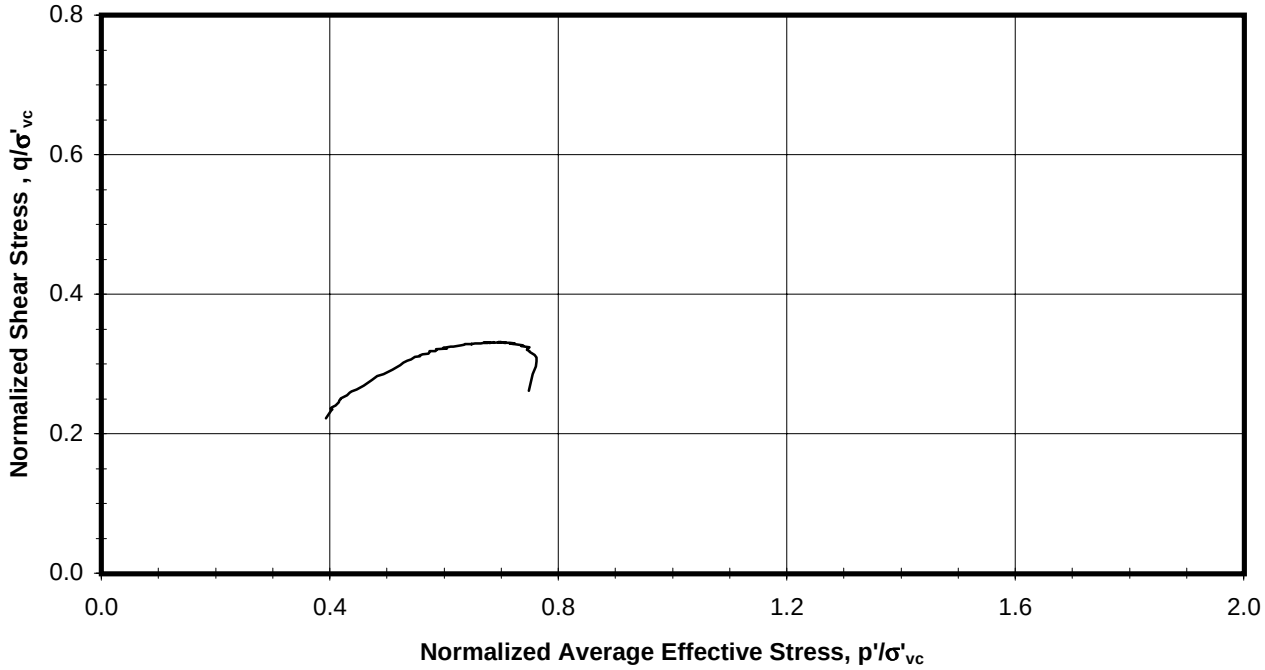


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No.76 - Depth: 70.0m
Boring 98-37
SFOBB East Span Seismic Safety Project

PLATE 98-37.14e





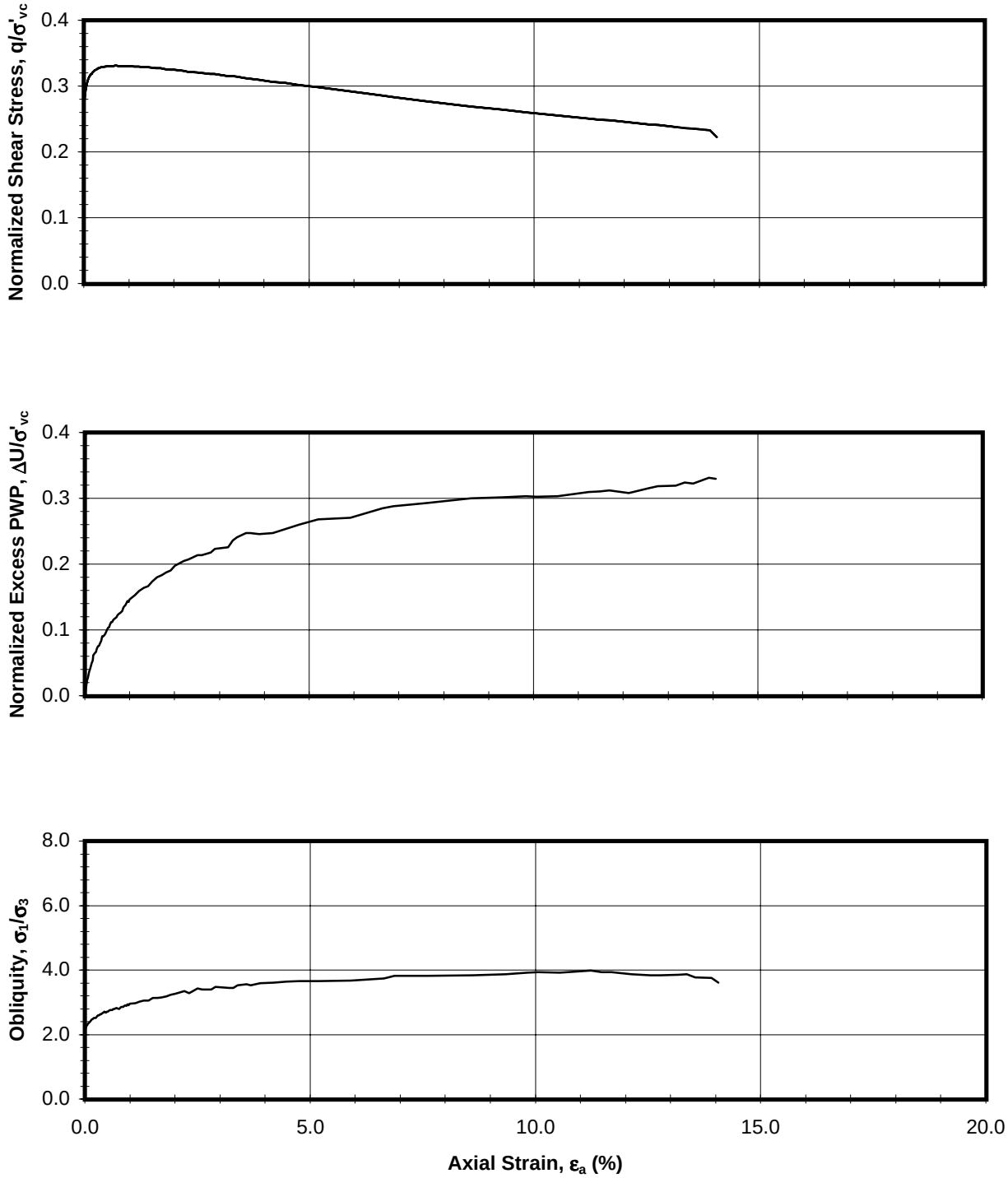
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 27 - Depth: 8.5m

Boring 98-37

SFOBB East Span Seismic Safety Project

PLATE 98-37.15.1

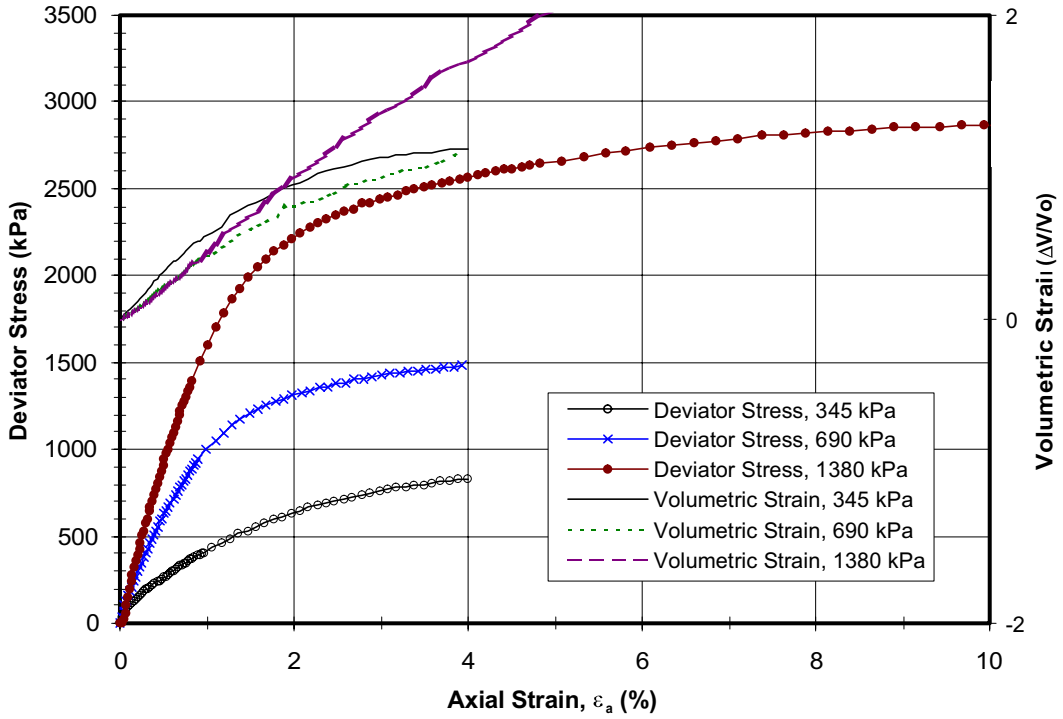


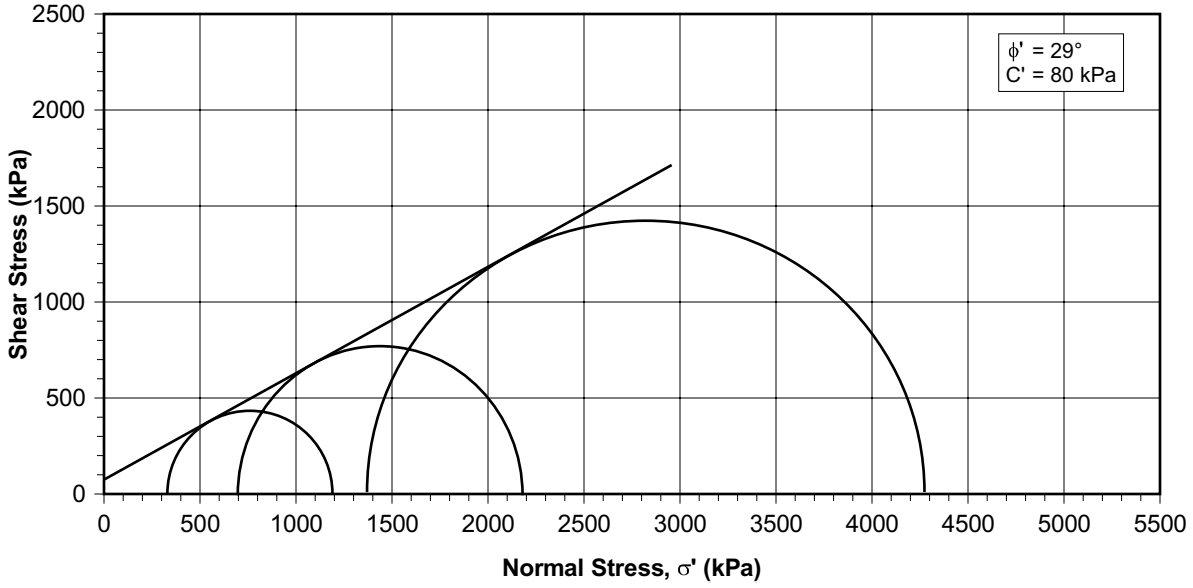
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 27 - Depth: 8.5m

Boring 98-37

SFOBB East Span Seismic Safety Project





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 84 - Depth: 82.3m

Boring 98-37

SFOBB East Span Seismic Safety Project

PLATE 98-37.16a

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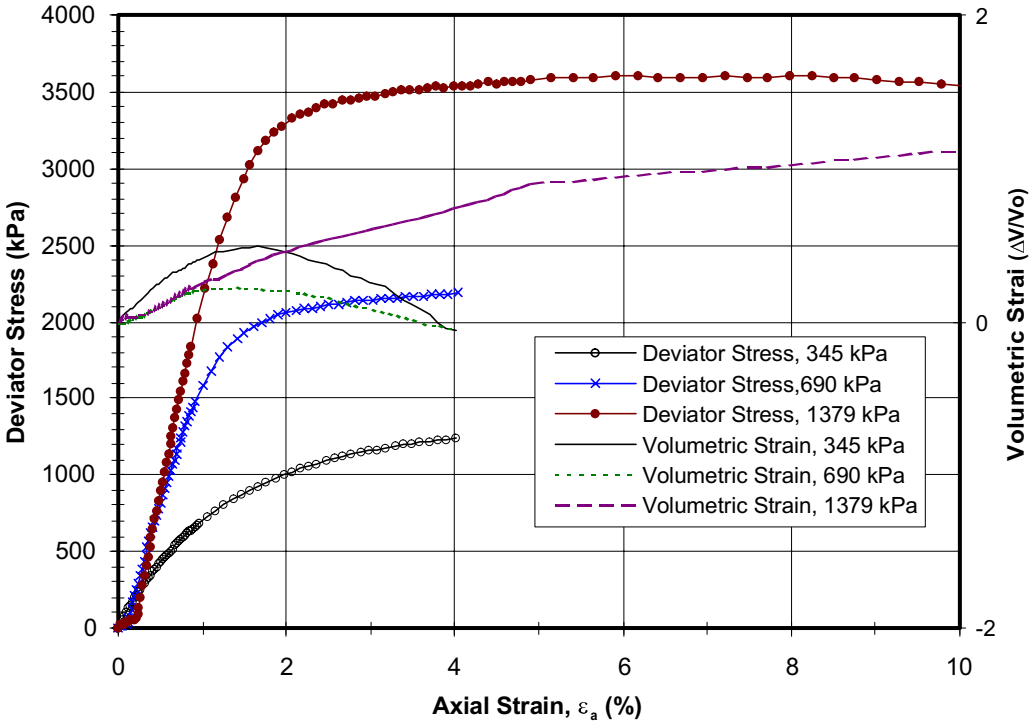

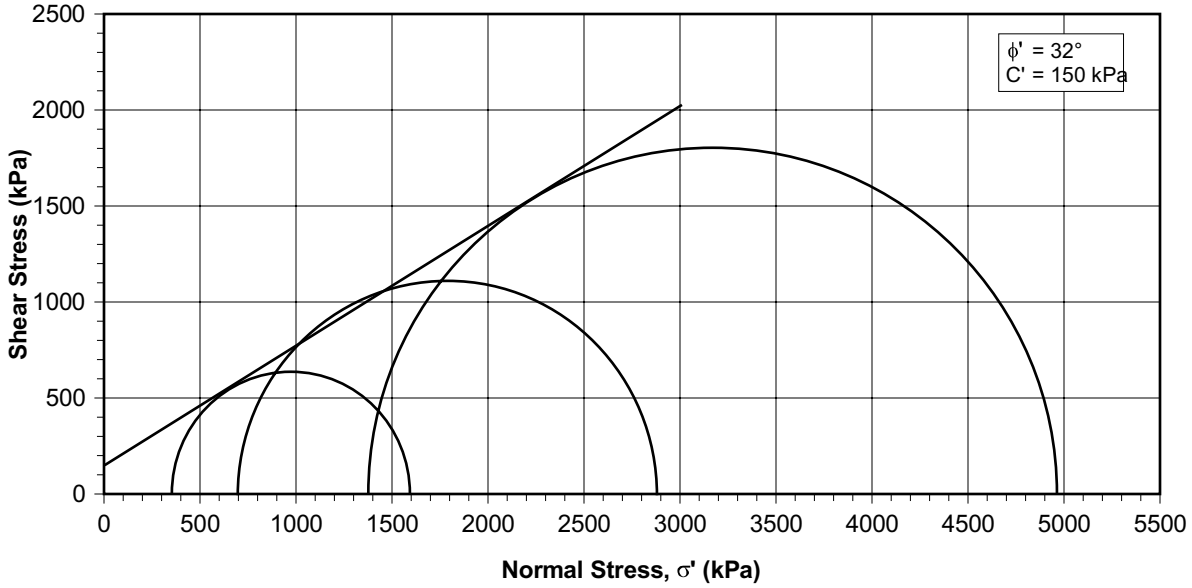

ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 87 - Depth: 89.5m

Boring 98-37

SFOBB East Span Seismic Safety Project

PLATE 98-37.16b

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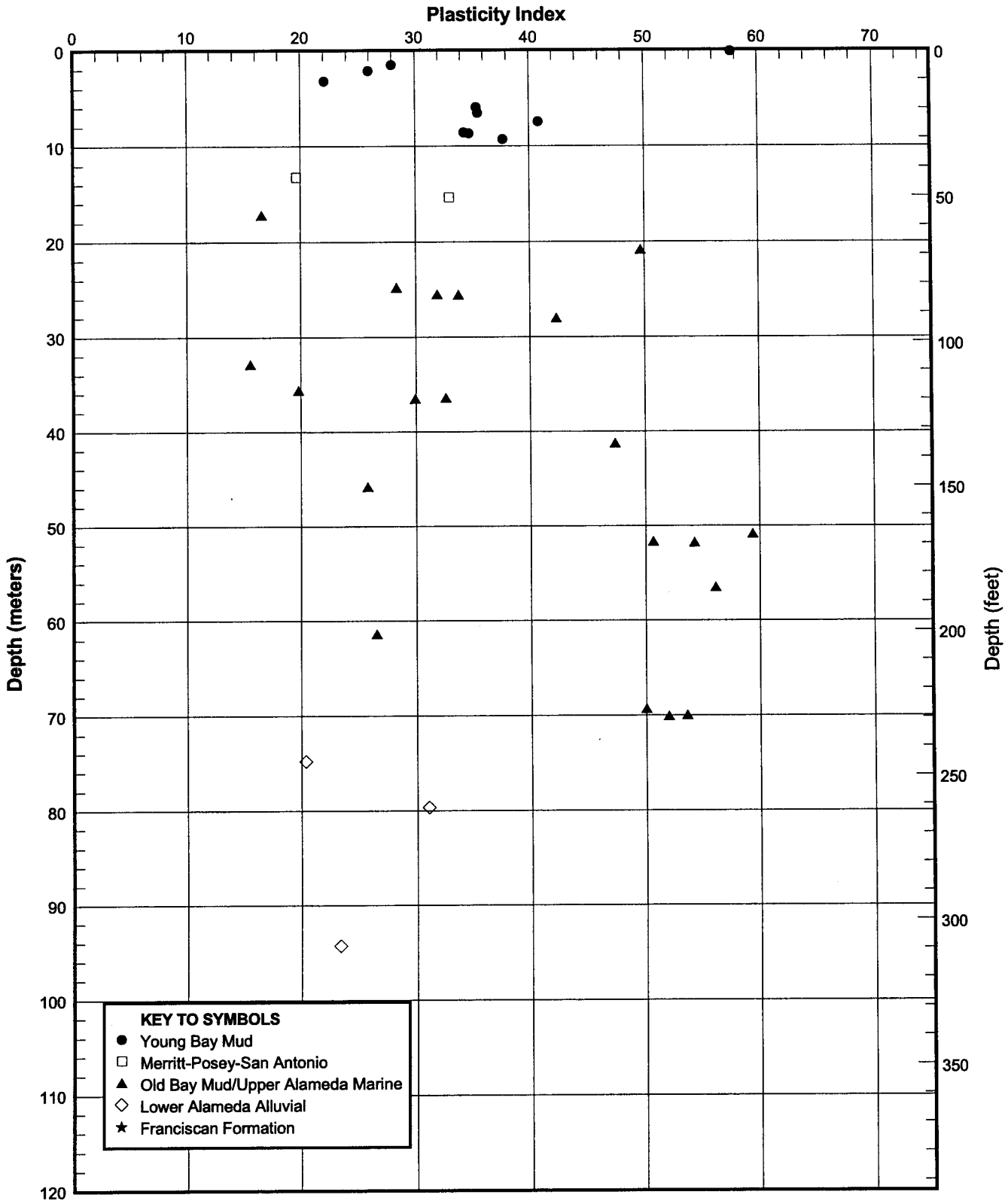
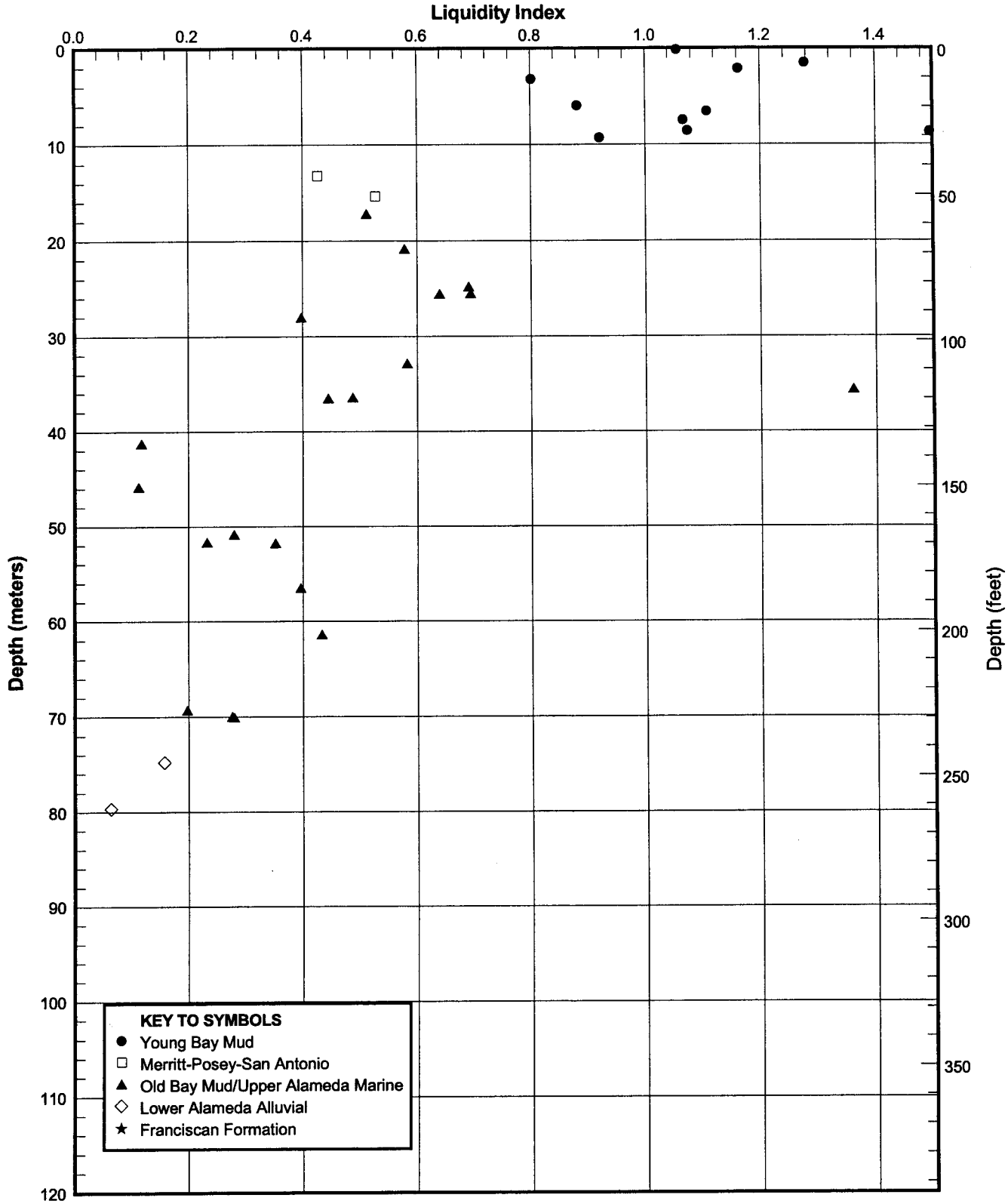
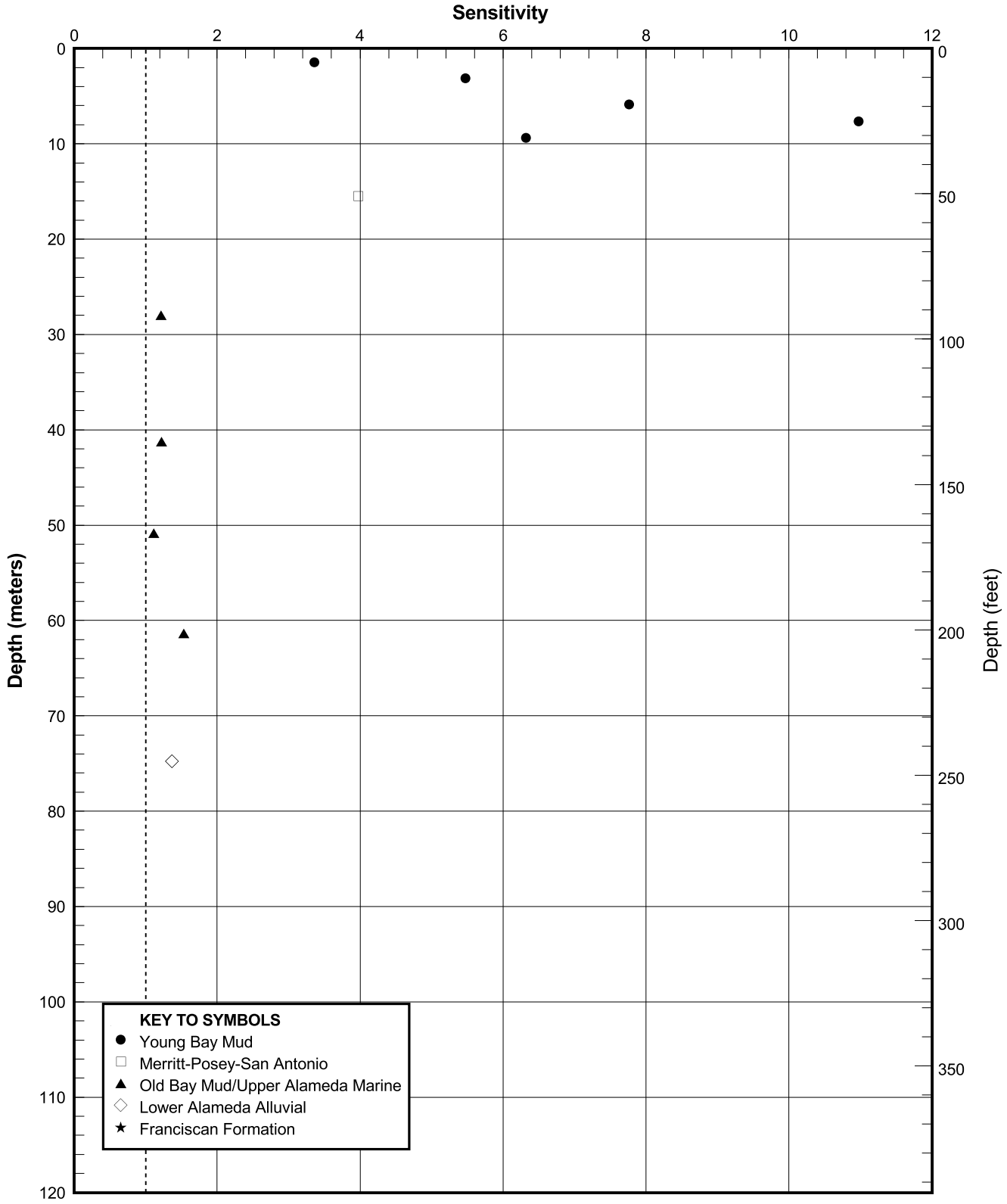


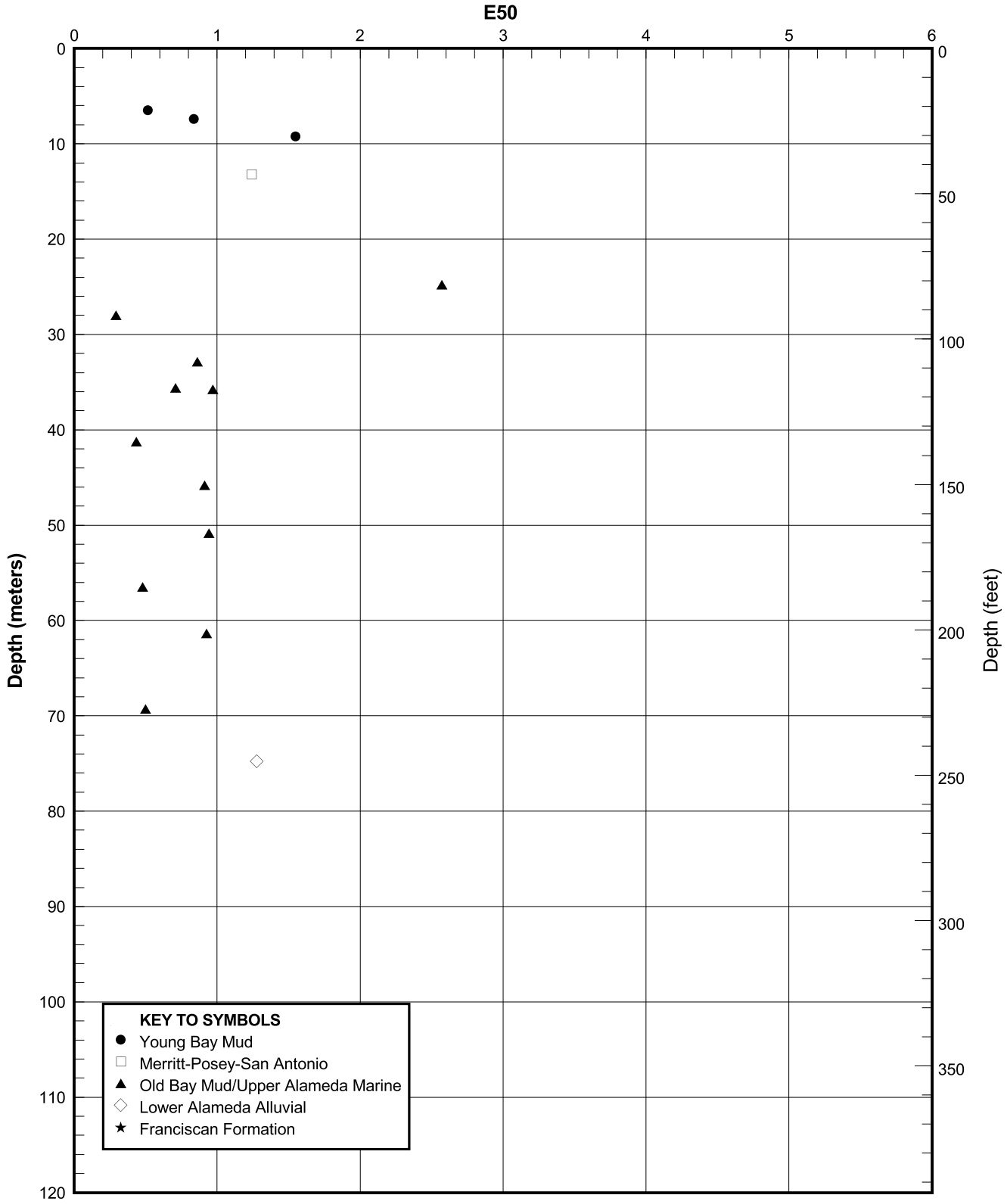
PLASTICITY INDEX PROFILE
Boring 98-37
SFOBB East Span Seismic Safety Project



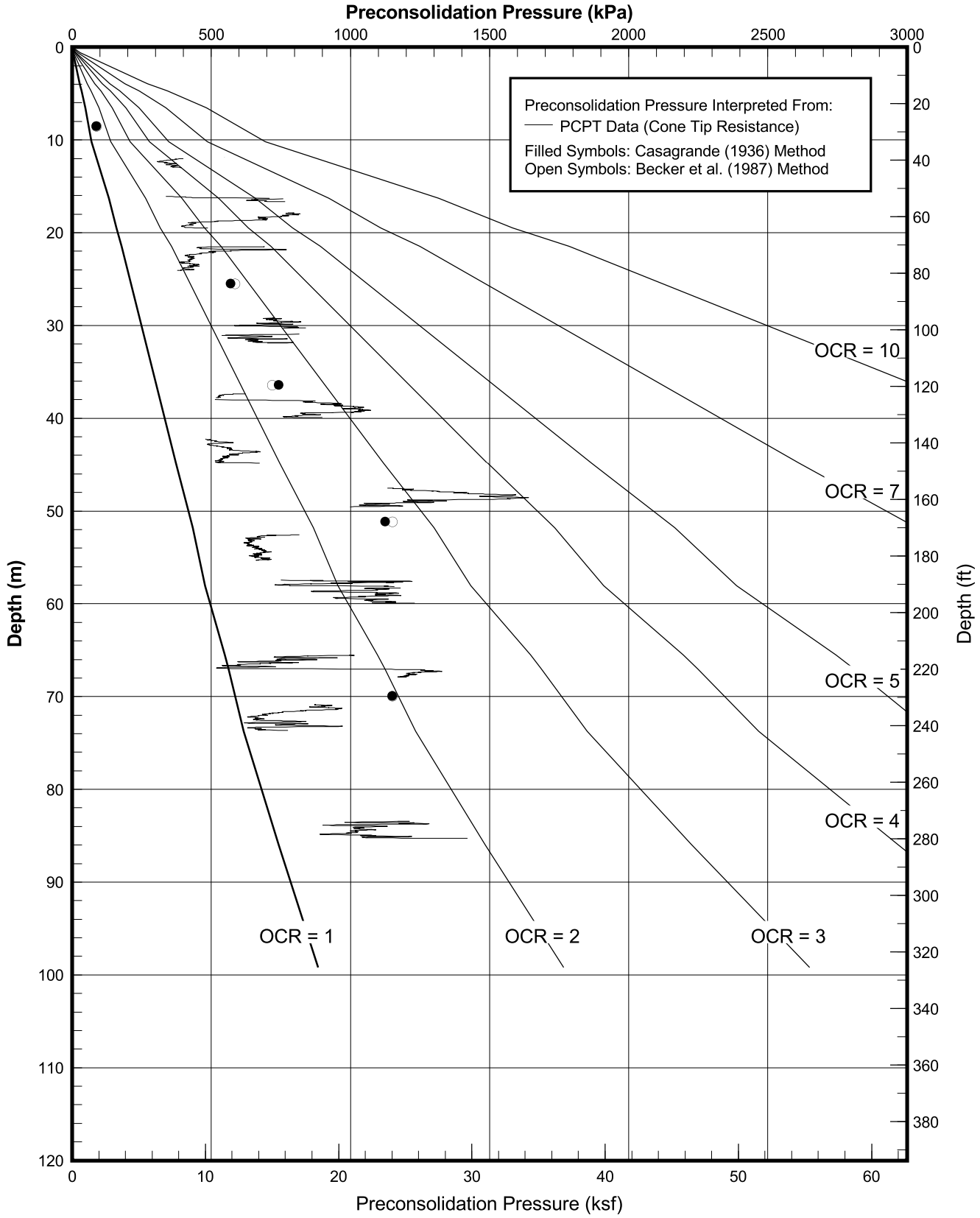
LIQUIDITY INDEX PROFILE
Boring 98-37
SFOBB East Span Seismic Safety Project



SENSITIVITY PROFILE
Boring 98-37
SFOBB East Span Seismic Safety Project



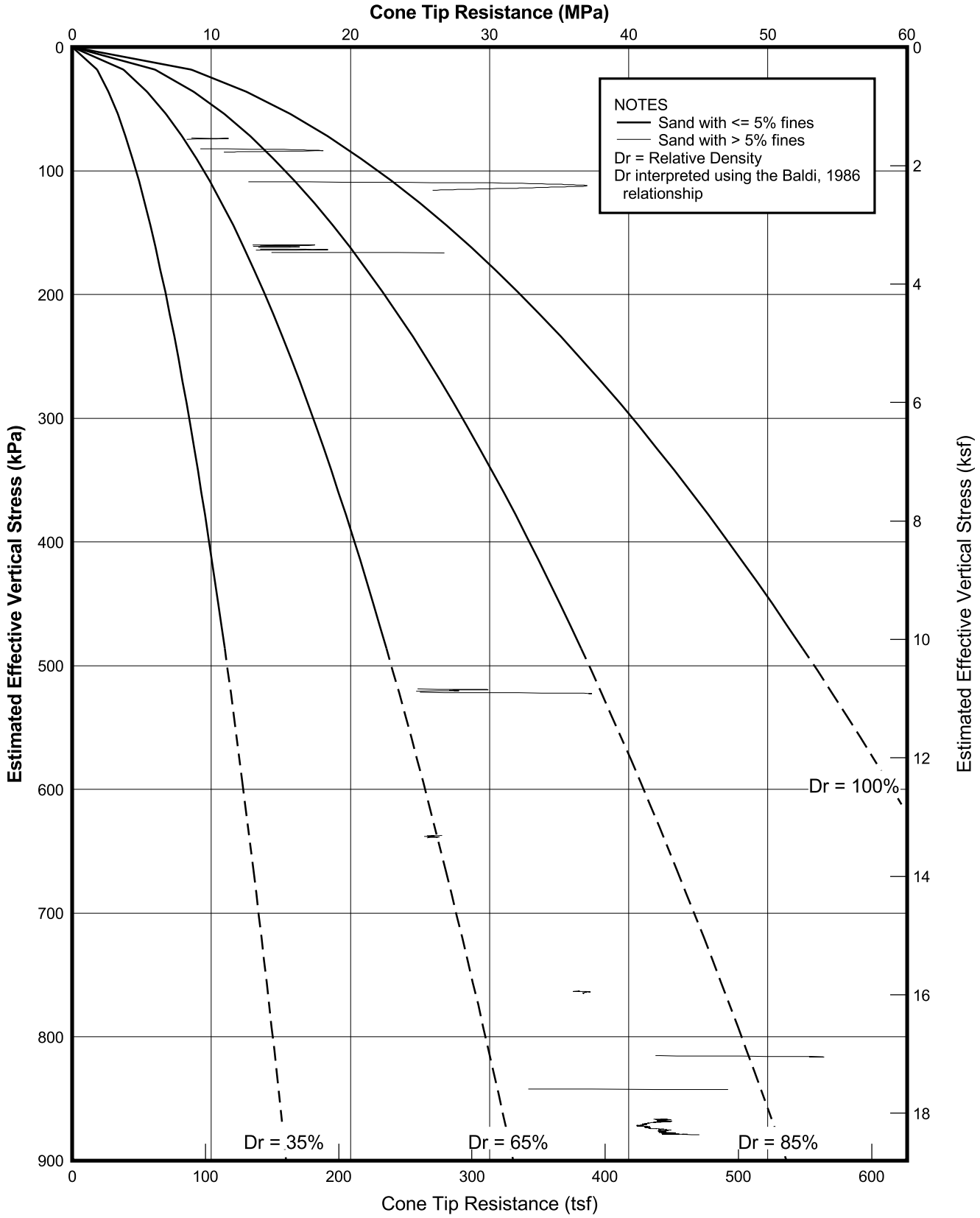
E50 PROFILE
Boring 98-37
SFOBB East Span Seismic Safety Project



PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-37

SFOBB East Span Seismic Safety Project



RELATIVE DENSITY INTERPRETED FROM CPT DATA

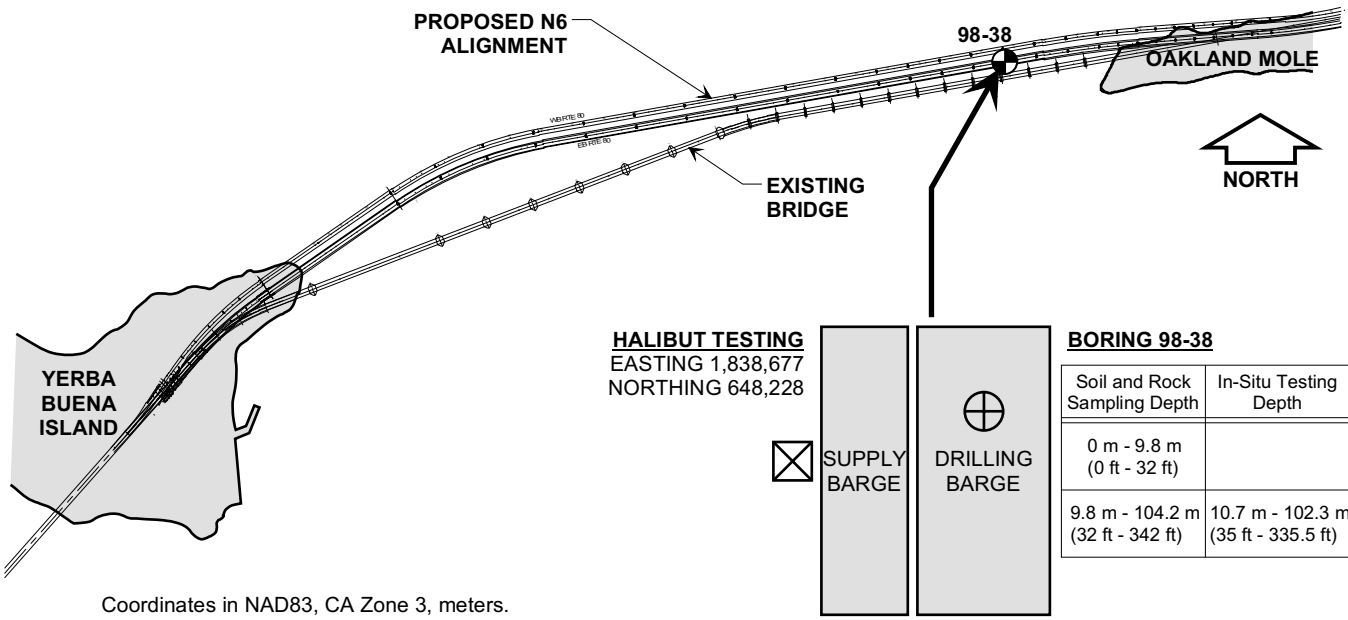
Boring 98-37

SFOBB East Span Seismic Safety Project

BORING 98-38

Date	Time From	Time To	Description of Activity
September 28, 1998	1800	1945	Move barge to location 98-38. Set 4 anchors and 2 spuds.
	1945	2030	Rig up for drilling and Halibut testing.
	2030	2045	Lower drill pipe to mudline.
	2045	2100	Measure water depth of 3.5m (11.5 ft) using bottom sensor. Current tide level is approximately 0.1m (0.4 ft) MSL. Calculate mudline elevation of -3.4m (-11.1 ft) MSL.
	2100	2400	Drill and sample from mudline to 9.8m (32 ft). Halibut vane shear testing from 0.6m (2 ft) to 2.4m (8 ft).
September 29, 1998	0000	0030	Pull drill pipe to deck. Rig up for drilling.
	0030	0415	Set casing. Drive stinger to 8.8m (29 ft).
	0415	0445	Perform CPT pipe test at 3m (10 ft).
	0445	0645	Drill, sample, CPT testing and remote vane shear testing from mudline to 14.3m (47 ft).
	0645	0800	No flow during CPT test. Swap CPT and remote vane RMUs.
	0800	1030	Drill, sample, CPT testing and remove vane shear testing from 14.3m (47 ft) to 25m (82 ft).
	1030	1200	RMU flooded in CPT. Replace with RMU from remote vane.
	1200	2400	Drill, sample, and CPT testing from 25m (82 ft) to 64.6m (212 ft).
September 30, 1998	0000	1130	Drill, sample, and CPT testing from 64.6m (212 ft) to 104.2m (342 ft).
	1130	1215	Pull drill pipe to deck.
	1215	1600	P- and S-wave velocity logging from 99.0m (324.8 ft) to 9.0m (29.5 ft).
	1600	1915	Lower N-rod. Mix and circulate cement. Grout hole 98-38. Pull N-rod to deck.
	1915	2100	Pull casing to deck.
	2100	2200	Pull 2 spuds, 4 anchors, and move barge to location 98-39.

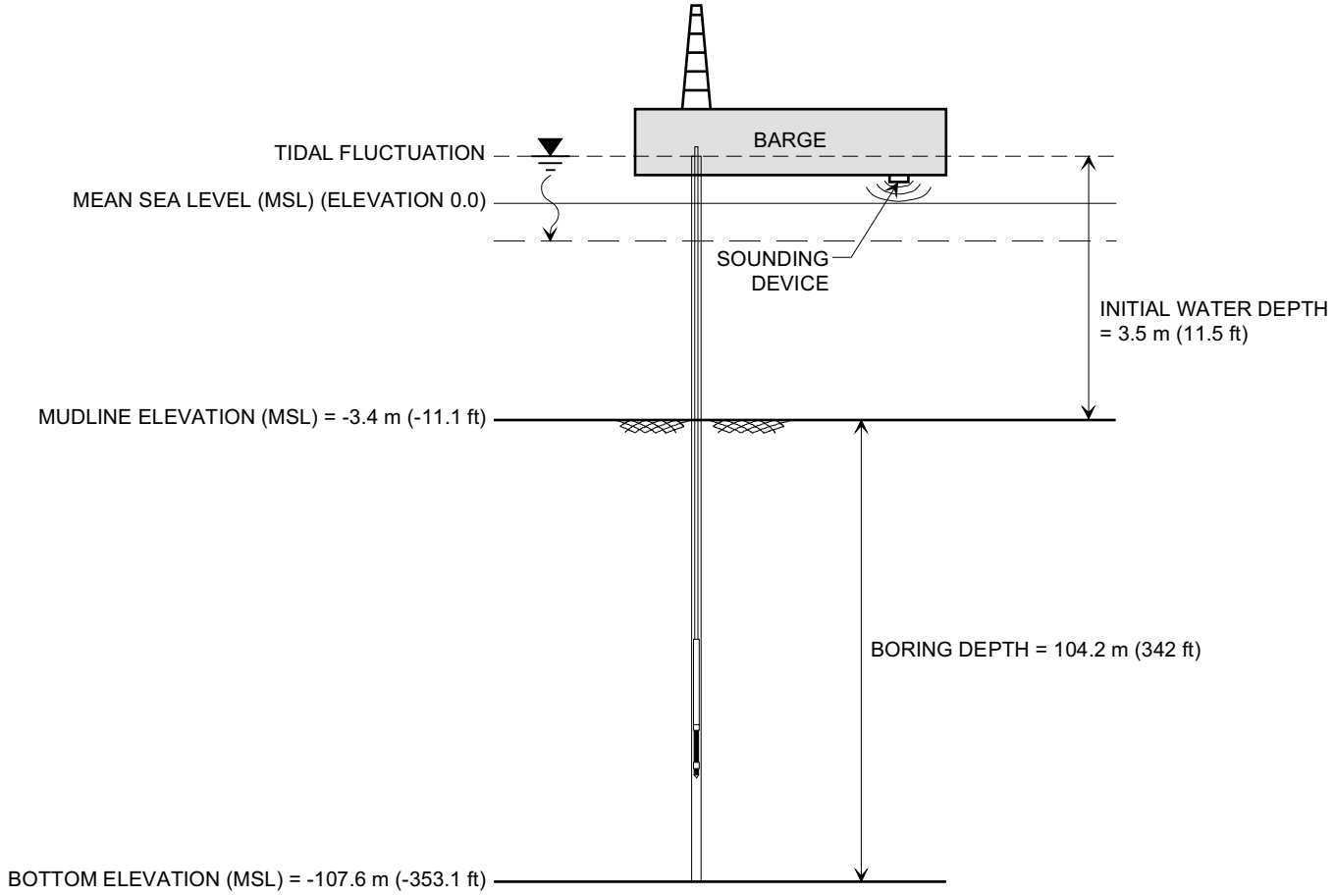
SUMMARY OF FIELD OPERATIONS
Boring 98-38
SFOBB East Span Seismic Safety Project



BORING 98-38

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 9.8 m (0 ft - 32 ft)		E = 1,838,690 N = 648,233
9.8 m - 104.2 m (32 ft - 342 ft)	10.7 m - 102.3 m (35 ft - 335.5 ft)	E = 1,838,691 N = 648,229

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-38
SFOBB East Span Seismic Safety Project

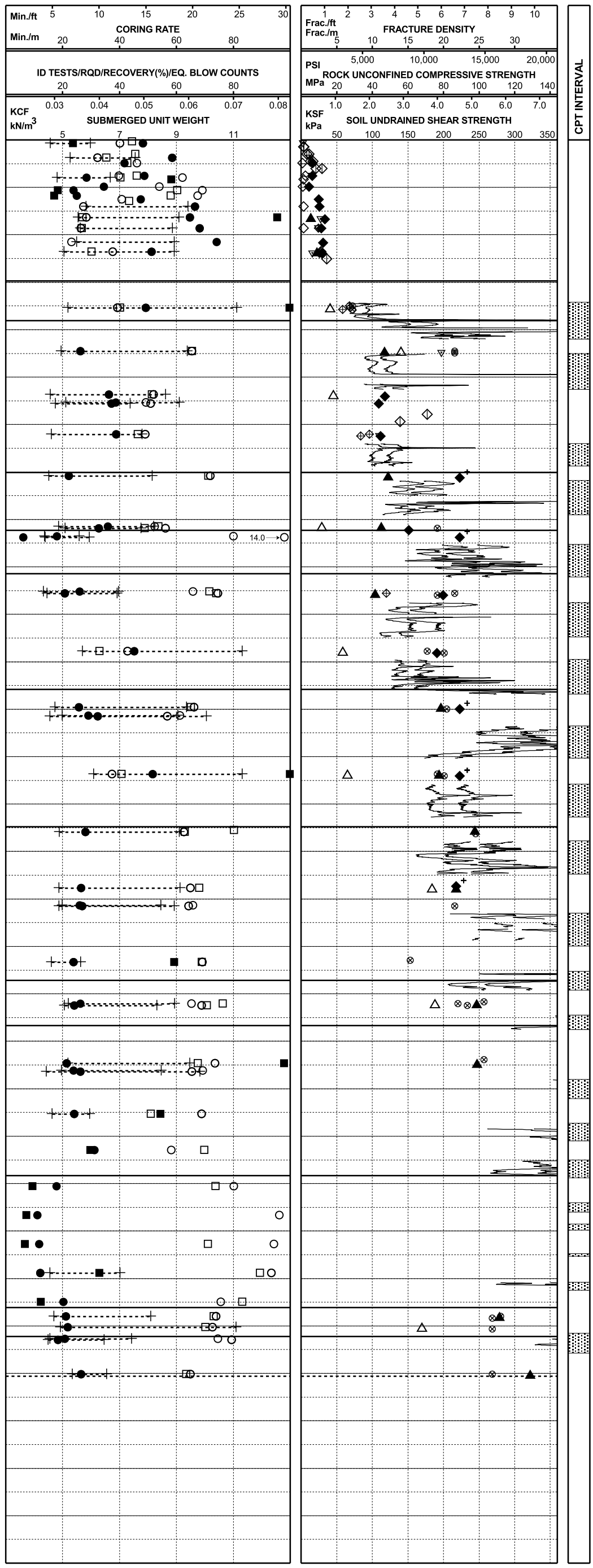
PROJECT NO:	98-42-0054	**START DATE:**	09/28/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-38 (Skyway - Frame 4)	**COMPLETION DATE:**	09/30/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838691 N648229
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

Stratum	Material Description	Blow Count / Sampler
I	Fat CLAY (CH), very soft to firm, olive gray to gray -dark gray to 1.2m -with large sand pockets to 1.5m -with shells and shell fragments to 2.0m -with sand pockets, 2.7m to 4.0m -with sand seams at 3.0m -with shells , 3.7m to 4.3m -gray to olive gray silty fine sand with clay pockets, 4.0m to 4.7m -with gas blisters, 4.7m to 7.5m -with inclined fissures and voids at 4.9m -with a few silt pockets, 5.5m to 6.7m -with a few shells at 9.4m (11.9m)	WOH, WOH, WOH, WOH, 9/60cm, 4/60cm, PUSH, PUSH, PUSH, SAVE, PUSH
II	Fat CLAY (CH), stiff to very stiff, greenish gray -with a few silt pockets at 14.0m -with a sand layer at 15.1m (15.2m)	PUSH
III	Fat CLAY (CH), very stiff, greenish gray -sand layer, 15.8m to 15.8m -slickensided at 17.7m -sand with clay seams and layers, 19.8m to 20.6m -with many sandy silt pockets below 21.0m -with organic matter pockets at 21.3m -with a sand layer at 25.9m (28.0m)	PUSH, PUSH, SAVE, PUSH, PUSH
IV	Fat CLAY (CH), very stiff, gray -with silt seams and layers -greenish gray at 28.3m -sand layer, 30.0m to 30.5m -with sandy silt pockets and seams at 32.6m (32.9m)	PUSH, PUSH, SAVE
V	Lean CLAY (CL), hard, gray (36.6m)	
VI	Fat CLAY (CH), very stiff to hard, olive gray -with yellowish brown stains -greenish gray lean clay to 41.5m -desiccated and with silt pockets, at 38.1m -sand layer, 39.9m to 40.2m (46.3m)	PUSH, PUSH
VII	Fat CLAY (CH), hard, greenish gray -slickensided -desiccated to 51.5m -with a few silt pockets at 53.3m (57.9m)	PUSH, SAVE, PUSH
VIII	Fat CLAY (CH), hard, greenish gray -with silt seams -slickensided to 63.2m -with calcareous nodules at 58.2m -mottled with yellowish red at 63.1m -interlayered clay and silt, 65.2m to 67.7m -sandy lean clay, 68.6m to 70.1m -sand layer, 70.1m to 70.3m (70.9m)	PUSH, PUSH, SAVE, PUSH
IX	Fat CLAY (CH), very stiff to hard, olive gray -slickensided at 72.5m -sand layer below 73.9m (74.7m)	PUSH
X	Fat CLAY (CH), hard, brown -friable to 78.6m -interlayered clay and silt, 79.4m to 82.3m -sandy lean clay, 81.7m to 82.9m -sand layer, 82.9m to 83.4m -lean clay below 83.4m -silty fine sand layer, 84.9m to 85.2m (87.3m)	PUSH, SAVE, PUSH, PUSH
XI	Fine to Medium SAND with silt (SP-SM), dense to very dense, gray -with a clay layer at 90.2m -with coarse sand and fine gravel, 90.5m to 93.1m See Plate 98-38.6 for detailed stratigraphy -very stiff, brown clayey sand with gravel, 95.4m to 96.3m -clay layer, 96.3m to 96.6m (98.5m)	30/15cm, 30/15cm, 30/15cm, 50/15cm, 50/10cm
XII	Fat CLAY (CH), hard, olive gray (100.9m)	PUSH, PUSH, SAVE
XIII	Lean CLAY (CL), hard, olive brown -silt layer, 101.2m to 101.5m -with a silt layer at 101.8m and 102.1m	PUSH

TOTAL DEPTH: 104.2m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-38

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

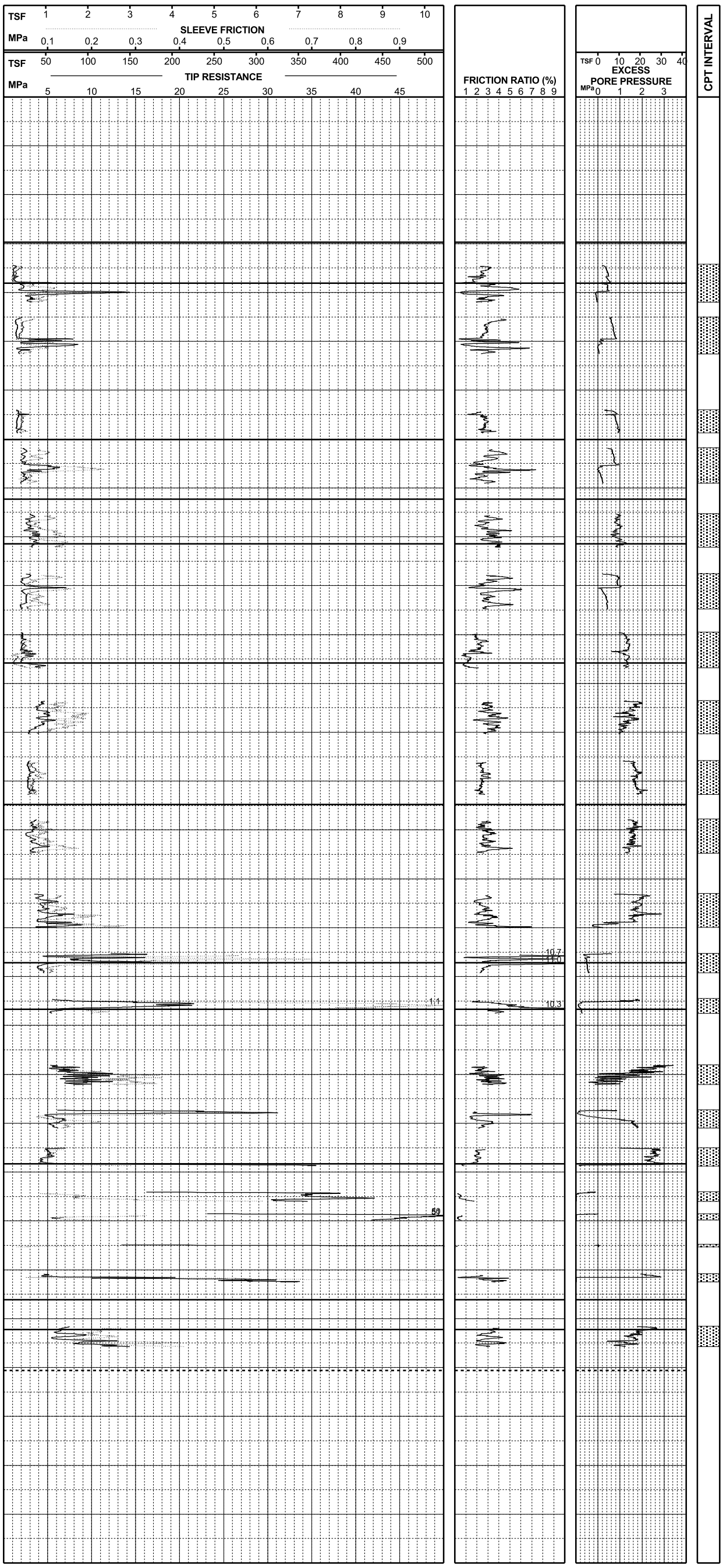
PROJECT NO:	98-42-0054	**START DATE:**	09/28/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-38 (Skyway - Frame 4)	**COMPLETION DATE:**	09/30/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838691 N648229
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

Stratum No.	Material Description	Blow Count / Sampler
I	Fat CLAY (CH), very soft to firm, olive gray to gray -gray to olive gray silty fine sand with clay pockets, 4.0m to 4.7m See Plate 98-38.6 for detailed stratigraphy (11.9m)	WOH, WOH, WOH, WOH, 9/60cm, 4/60cm, PUSH, PUSH, PUSH, SAVE, PUSH
II	Fat CLAY (CH), stiff to very stiff, greenish gray (15.2m)	PUSH
III	Fat CLAY (CH), very stiff, greenish gray -sand layer, 15.8m to 15.8m -slickensided at 17.7m -sand with clay seams and layers, 19.8m to 20.6m -with many sandy silt pockets below 21.0m -with organic matter pockets at 21.3m -with a sand layer at 25.9m (28.0m)	PUSH, PUSH, SAVE, PUSH
IV	Fat CLAY (CH), very stiff, gray -with silt seams and layers -greenish gray at 28.3m -sand layer, 30.0m to 30.5m (32.9m)	PUSH, PUSH, SAVE
V	Lean CLAY (CL), hard, gray (36.6m)	
VI	Fat CLAY (CH), very stiff to hard, olive gray -with yellowish brown stains -greenish gray lean clay to 41.5m -desiccated and with silt pockets, at 38.1m -sand layer, 39.9m to 40.2m (46.3m)	PUSH, PUSH
VII	Fat CLAY (CH), hard, greenish gray -slickensided -desiccated to 51.5m -with a few silt pockets at 53.3m (57.9m)	PUSH, SAVE, PUSH
VIII	Fat CLAY (CH), hard, greenish gray -with silt seams -slickensided to 63.2m -with calcareous nodules at 58.2m -mottled with yellowish red at 63.1m -interlayered clay and silt, 65.2m to 67.7m -sandy lean clay, 68.6m to 70.1m -sand layer, 70.1m to 70.3m -sand with clay seams below 70.4m (70.9m)	PUSH, PUSH, SAVE, PUSH
IX	Fat CLAY (CH), very stiff to hard, olive gray -sand layer below 73.9m (74.7m)	PUSH
X	Fat CLAY (CH), hard, brown -friable to 78.6m -interlayered clay and silt, 79.4m to 82.3m -sandy lean clay, 81.7m to 82.9m -sand layer, 82.9m to 83.4m -lean clay below 83.4m -silty fine sand layer, 84.9m to 85.2m (87.3m)	PUSH, SAVE, PUSH, PUSH
XI	Fine to Medium SAND with silt (SP-SM), dense to very dense, gray -with a clay layer at 90.2m -with coarse sand and fine gravel, 90.5m to 93.1m -very stiff, brown clayey sand with gravel, 95.4m to 96.3m -clay layer, 96.3m to 96.6m -with a clay layer at 97.5m (98.5m)	30/15cm, 30/15cm, 30/15cm, 50/15cm, 50/10cm
XII	Fat CLAY (CH), hard, olive gray (100.9m)	PUSH, PUSH, SAVE
XIII	Lean CLAY (CL), hard, olive brown -silt layer, 101.2m to 101.5m -with a silt layer at 101.8m and 102.1m	PUSH

TOTAL DEPTH: 104.2m
BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-38

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

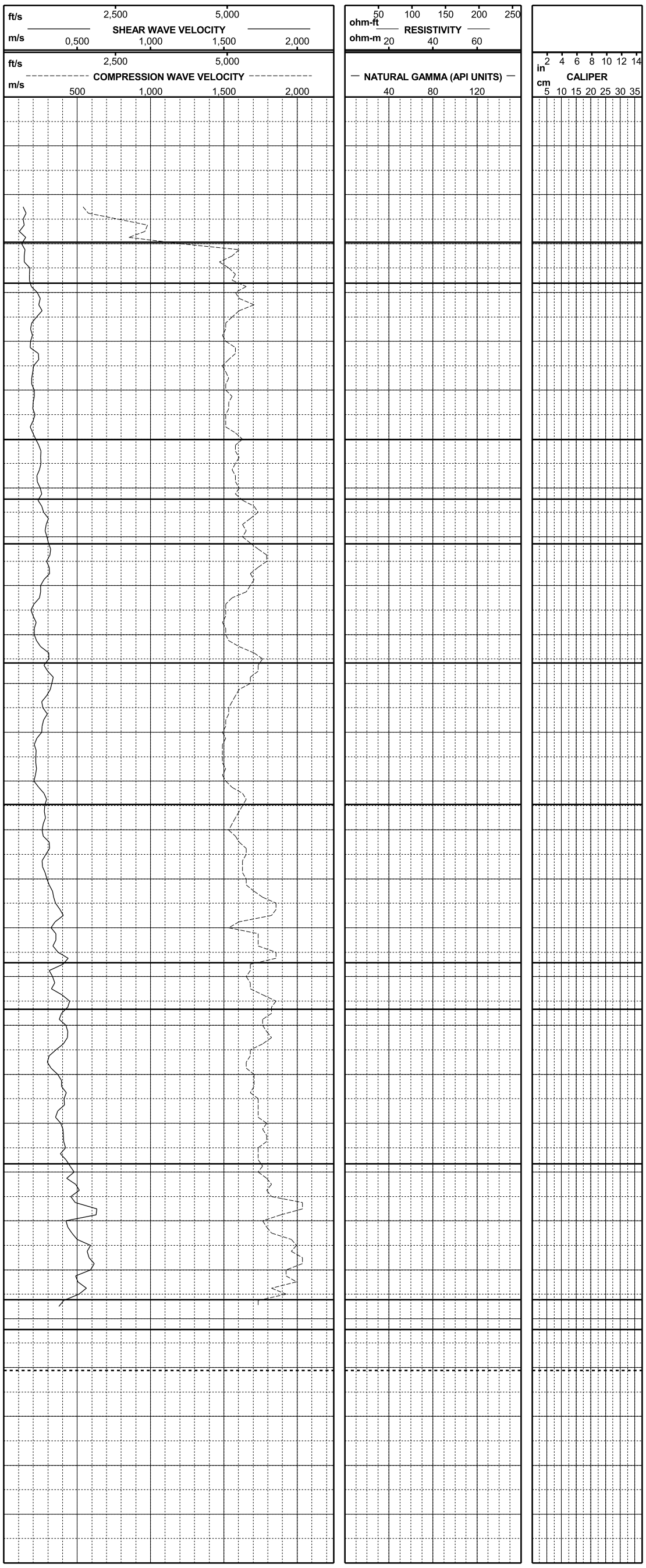
PLATE 98-38.4

PROJECT NO:	98-42-0054	**START DATE:**	09/28/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-38 (Skyway - Frame 4)	**COMPLETION DATE:**	09/30/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838691 N648229
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4			WOH	Fat CLAY (CH), very soft to firm, olive gray to gray	I
			WOH		
			WOH		
			WOH	-gray to olive gray silty fine sand with clay pockets, 4.0m to 4.7m	
-8	4		9/60cm		
			4/60cm	-with gas blisters, 4.7m to 7.5m	
			PUSH		
			PUSH		
	8		PUSH	See Plate 98-38.6 for detailed stratigraphy	
-12			SAVE		
			PUSH	(11.9m)	
-16	12		PUSH	Fat CLAY (CH), stiff to very stiff, greenish gray (15.2m)	II
-20	16		PUSH	Fat CLAY (CH), very stiff, greenish gray -sand layer, 15.8m to 15.8m -slickensided at 17.7m	III
-24	20		PUSH SAVE	-sand with clay seams and layers, 19.8m to 20.6m -with many sandy silt pockets below 21.0m -with organic matter pockets at 21.3m	
-28	24		PUSH	-with a sand layer at 25.9m (28.0m)	
-32	28		PUSH	Fat CLAY (CH), very stiff, gray -with silt seams and layers -greenish gray at 28.3m -sand layer, 30.0m to 30.5m	IV
-36	32		PUSH SAVE	(32.9m)	
				Lean CLAY (CL), hard, gray (36.6m)	V
-40	36		PUSH	Fat CLAY (CH), very stiff to hard, olive gray -with yellowish brown stains -greenish gray lean clay to 41.5m -desiccated and with silt pockets, at 38.1m -sand layer, 39.9m to 40.2m	VI
-44	40				
-48	44		PUSH	(46.3m)	
-52	48		PUSH SAVE	Fat CLAY (CH), hard, greenish gray -slickensided -desiccated to 51.5m	VII
-56	52		PUSH	-with a few silt pockets at 53.3m	
-60	56			(57.9m)	
-64	60		PUSH	Fat CLAY (CH), hard, greenish gray -with silt seams -slickensided to 63.2m -with calcareous nodules at 58.2m	VIII
-68	64		PUSH SAVE	-mottled with yellowish red at 63.1m -interlayered clay and silt, 65.2m to 67.7m	
-72	68		PUSH	-sandy lean clay, 68.6m to 70.1m -sand layer, 70.1m to 70.3m (70.9m)	
-76	72		PUSH	Fat CLAY (CH), very stiff to hard, olive gray -slickensided at 72.5m -with a few desiccated nodules at 73.0m. -sand layer below 73.9m (74.7m)	IX
-80	76		PUSH SAVE	Fat CLAY (CH), hard, brown -friable to 78.6m	X
-84	80		PUSH	-interlayered clay and silt, 79.4m to 82.3m -sandy lean clay, 81.7m to 82.9m	
-88	84		PUSH	-sand layer, 82.9m to 83.4m -lean clay below 83.4m -silty fine sand layer, 84.9m to 85.2m (87.3m)	
-92	88		30/15cm	Fine to Medium SAND with silt (SP-SM), dense to very dense, gray	XI
			30/15cm	-with a clay layer at 90.2m -with coarse sand and fine gravel, 90.5m to 93.1m	
-96	92		30/15cm		
-100	96		50/15cm	-very stiff, brown clayey sand with gravel, 95.4m to 96.3m -clay layer, 96.3m to 96.6m	
			50/10cm	-with a clay layer at 97.5m (98.5m)	
-104	100		PUSH PUSH SAVE	Fat CLAY (CH), hard, olive gray (100.9m)	XII
				Lean CLAY (CL), hard, olive brown -silt layer, 101.2m to 101.5m -with a silt layer at 101.8m and 102.1m	XIII
-108	104		PUSH	TOTAL DEPTH: 104.2m BACKFILLED WITH: Cement Grout	
-112	108				
-116	112				
-120	116				



LOG OF BORING AND TEST RESULTS

BORING 98-38

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

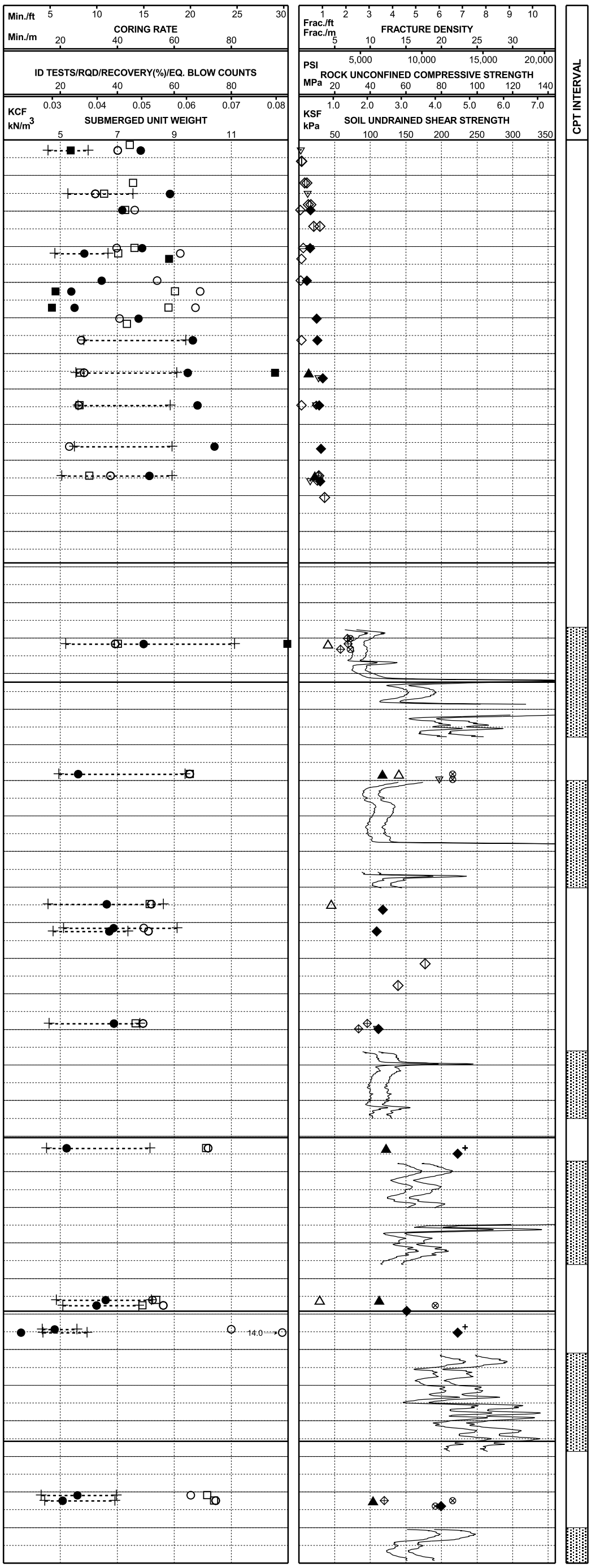
PLATE 98-38.5

PROJECT NO:	98-42-0054	**START DATE:**	09/28/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-38 (Skyway - Frame 4)	**COMPLETION DATE:**	09/30/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838691 N648229
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

Elevation, m.	Depth, m.	Blow Count	Material Description	Stratum No.
		WOH	Fat CLAY (CH), very soft to firm, olive gray to gray	I
-4	1		-dark gray to 1.2m	
			-with large sand pockets to 1.5m	
		WOH	-with shells and shell fragments to 2.0m	
-5	2	WOH		
-6	3		-with sand pockets, 2.7m to 4.0m	
		WOH	-with sand seams at 3.0m	
-7	4	9/60cm	-with shells , 3.7m to 4.3m -gray to olive gray silty fine sand with clay pockets, 4.0m to 4.7m	
-8	5	4/60cm	-with gas blisters, 4.7m to 7.5m -with inclined fissures and voids at 4.9m	
-9	6	PUSH	-with a few silt pockets, 5.5m to 6.7m	
-10	7	PUSH		
-11	8	PUSH		
-12	9	SAVE		
-13	10	PUSH	-with a few shells at 9.4m	
-14	11			
-15	12		(11.9m)	
-16	13		Fat CLAY (CH), stiff to very stiff, greenish gray	II
-17	14	PUSH	-with a few silt pockets at 14.0m	
-18	15		-with a sand layer at 15.1m (15.2m)	
-19	16		Fat CLAY (CH), very stiff, greenish gray -sand layer, 15.8m to 15.8m	III
-20	17			
-21	18	PUSH	-slickensided at 17.7m	
-22	19			
-23	20		-sand with clay seams and layers, 19.8m to 20.6m	
-24	21	PUSH	-with many sandy silt pockets below 21.0m -with organic matter pockets at 21.3m	
-25	22	SAVE		
-26	23			
-27	24			
-28	25	PUSH		
-29	26		-with a sand layer at 25.9m	
-30	27			
-31	28		(28.0m)	
-32	29	PUSH	Fat CLAY (CH), very stiff, gray -with silt seams and layers -greenish gray at 28.3m	IV
-33	30		-sand layer, 30.0m to 30.5m	
-34	31			
-35	32			
-36	33	PUSH	-with sandy silt pockets and seams at 32.6m (32.9m)	
-37	34	SAVE	Lean CLAY (CL), hard, gray	V
-38	35			
-39	36		(36.6m)	
-40	37		Fat CLAY (CH), very stiff to hard, olive gray -with yellowish brown stains -greenish gray lean clay to 41.5m	VI
-41	38	PUSH	-desiccated and with silt pockets, at 38.1m	
-42	39			
-43			-sand layer, 39.9m to 40.2m	



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-38

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

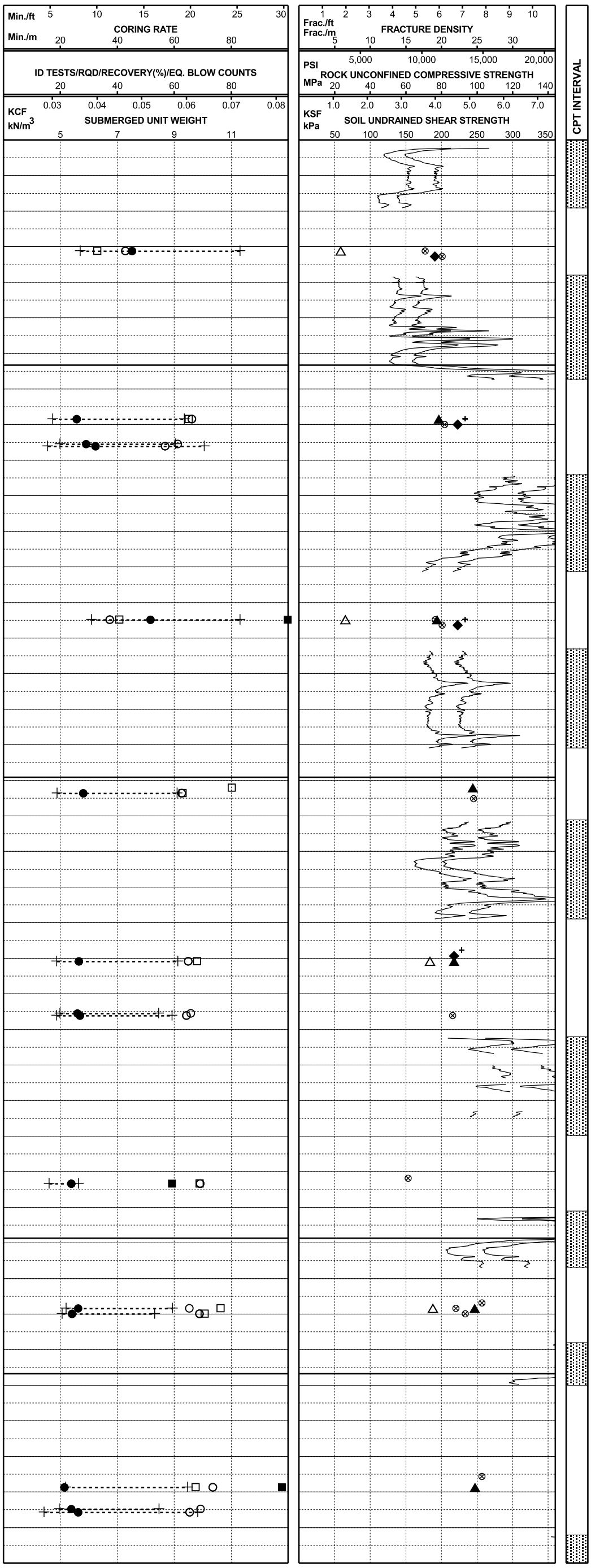
PLATE 98-38.6a

PROJECT NO:	98-42-0054	**START DATE:**	09/28/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-38 (Skyway - Frame 4)	**COMPLETION DATE:**	09/30/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838691 N648229
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

Elevation, m.	Depth, m.	Sampler	Blow Count	Material Description	Stratum No.
-44	41			Fat CLAY (CH), very stiff to hard, olive gray	VI
-45	42				
-46	43		PUSH		
-47	44				
-48	45				
-49	46			(46.3m)	
-50	47			Fat CLAY (CH), hard, greenish gray -slickensided -desiccated to 51.5m	VII
-51	48		PUSH		
-52	49		SAVE		
-53	50				
-54	51				
-55	52				
-56	53		PUSH	-with a few silt pockets at 53.3m	
-57	54				
-58	55				
-59	56				
-60	57				
-61	58		PUSH	(57.9m) Fat CLAY (CH), hard, greenish gray -with silt seams -slickensided to 63.2m -with calcareous nodules at 58.2m	VIII
-62	59				
-63	60				
-64	61				
-65	62				
-66	63		PUSH	-mottled with yellowish red at 63.1m	
-67	64		SAVE		
-68	65			-interlayered clay and silt, 65.2m to 67.7m	
-69	66				
-70	67				
-71	68				
-72	69		PUSH	-sandy lean clay, 68.6m to 70.1m	
-73	70			-sand layer, 70.1m to 70.3m -sand with clay seams below 70.4m	
-74	71			(70.9m) Fat CLAY (CH), very stiff to hard, olive gray	IX
-75	72				
-76	73		PUSH	-slickensided at 72.5m -with a few desiccated nodules at 73.0m.	
-77	74			-sand layer below 73.9m	
-78	75			(74.7m) Fat CLAY (CH), hard, brown -friable to 78.6m	X
-79	76				
-80	77				
-81	78		PUSH		
-82	79		SAVE		
-83				-interlayered clay and silt, 79.4m to 82.3m	



LOG OF BORING AND TEST RESULTS

BORING 98-38

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

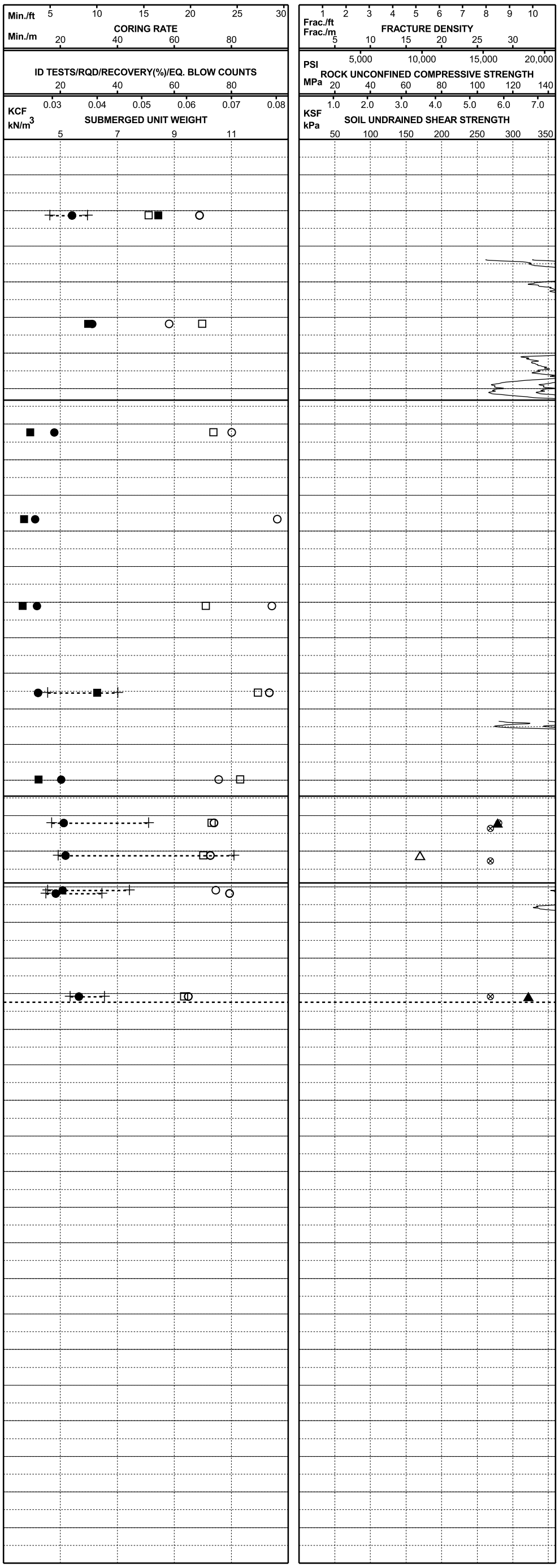
PLATE 98-38.6b

PROJECT NO:	98-42-0054	**START DATE:**	09/28/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-38 (Skyway - Frame 4)	**COMPLETION DATE:**	09/30/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838691 N648229
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-84	81			Fat CLAY (CH), hard, brown	X
-85	82		PUSH	-sandy lean clay, 81.7m to 82.9m	
-86	83			-sand layer, 82.9m to 83.4m -lean clay below 83.4m	
-87	84				
-88	85		PUSH	-silty fine sand layer, 84.9m to 85.2m	
-89	86				
-90	87			(87.3m)	
-91	88		30/15cm	Fine to Medium SAND with silt (SP-SM), dense to very dense, gray	XI
-92	89				
-93	90			-with a clay layer at 90.2m	
-94	91		30/15cm	-with coarse sand and fine gravel, 90.5m to 93.1m	
-95	92				
-96	93		30/15cm		
-97	94				
-98	95				
-99	96		50/15cm	-very stiff, brown clayey sand with gravel, 95.4m to 96.3m	
-100	97			-clay layer, 96.3m to 96.6m	
-101	98		50/10cm	-with a clay layer at 97.5m -reddish brown to gray, silty fine to medium sand with coarse sand and fine gravel, at 98.0m (98.5m)	
-102	99		PUSH	Fat CLAY (CH), hard, olive gray -slickensided, with organic matter pockets, at 98.8m	XII
-103	100		PUSH	-with a few silty sand pockets and partings, and a few organic matter pockets, at 100.0m (100.9m)	
-104	101		SAVE	Lean CLAY (CL), hard, olive brown -silt layer, 101.2m to 101.5m -with a silt layer at 101.8m and 102.1m	XIII
-105	102				
-106	103				
-107	104		PUSH		
-108	105			TOTAL DEPTH: 104.2m BACKFILLED WITH: Cement Grout	
-109	106				
-110	107				
-111	108				
-112	109				
-113	110				
-114	111				
-115	112				
-116	113				
-117	114				
-118	115				
-119	116				
-120	117				
-121	118				
-122	119				
-123					



LOG OF BORING AND TEST RESULTS

BORING 98-38

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

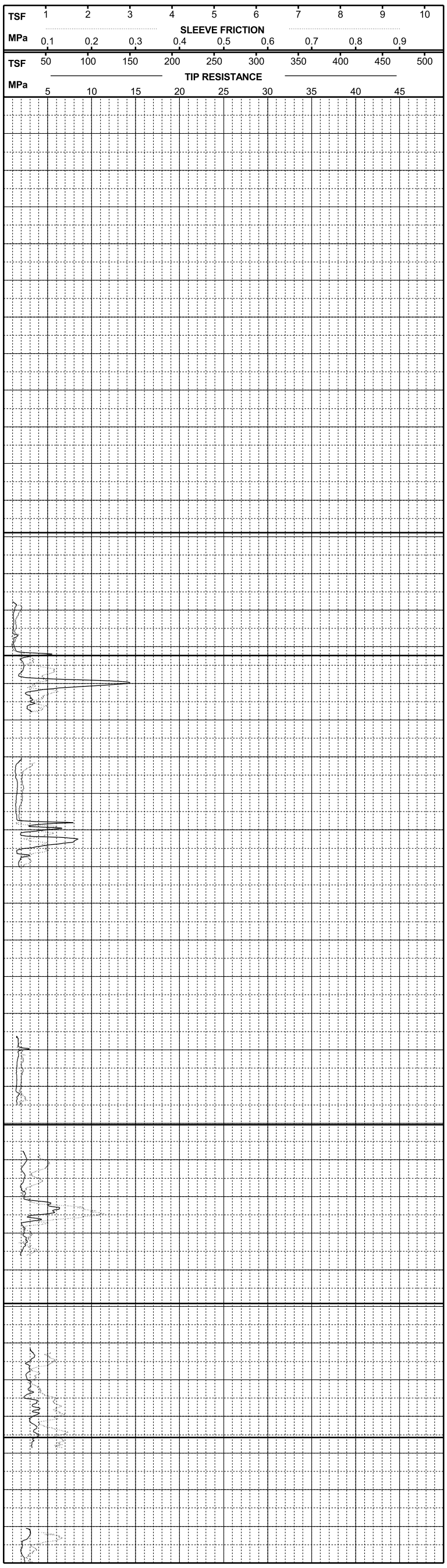
PLATE 98-38.6c

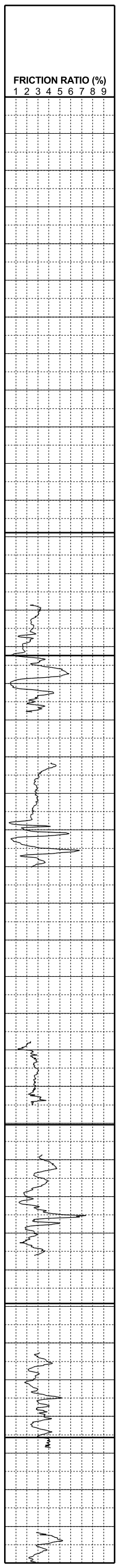
PROJECT NO:	98-42-0054	**START DATE:**	09/28/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-38 (Skyway - Frame 4)	**COMPLETION DATE:**	09/30/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

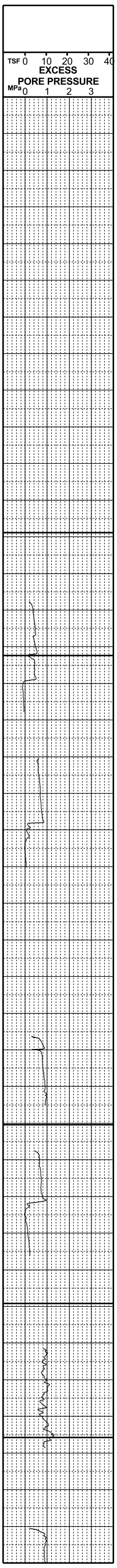
Coordinates: E1838691 N648229
CA State Plane Zone 3, NAD83, Meters

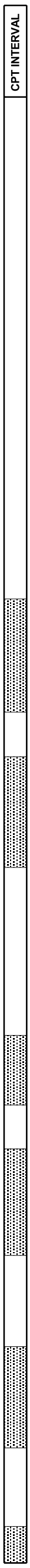
MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), very soft to firm, olive gray to gray	I
-4	1	WOH	-dark gray to 1.2m -with large sand pockets to 1.5m	
-5	2	WOH	-with shells and shell fragments to 2.0m	
-6	3	WOH	-with sand pockets, 2.7m to 4.0m -with sand seams at 3.0m	
-7	4	9/60cm	-with shells , 3.7m to 4.3m -gray to olive gray silty fine sand with clay pockets, 4.0m to 4.7m	
-8	5	4/60cm	-with gas blisters, 4.7m to 7.5m -with inclined fissures and voids at 4.9m	
-9	6	PUSH	-with a few silt pockets, 5.5m to 6.7m	
-10	7	PUSH		
-11	8	PUSH		
-12	9	SAVE		
-13	10	PUSH	-with a few shells at 9.4m	
-14	11			
-15	12		(11.9m)	
-16	13		Fat CLAY (CH), stiff to very stiff, greenish gray	II
-17	14	PUSH	-with a few silt pockets at 14.0m	
-18	15		-with a sand layer at 15.1m (15.2m)	
-19	16		Fat CLAY (CH), very stiff, greenish gray -sand layer, 15.8m to 15.8m	III
-20	17			
-21	18	PUSH	-slickensided at 17.7m	
-22	19			
-23	20		-sand with clay seams and layers, 19.8m to 20.6m	
-24	21	PUSH	-with many sandy silt pockets below 21.0m -with organic matter pockets at 21.3m	
-25	22	SAVE		
-26	23			
-27	24			
-28	25	PUSH		
-29	26		-with a sand layer at 25.9m	
-30	27			
-31	28		(28.0m)	
-32	29	PUSH	Fat CLAY (CH), very stiff, gray -with silt seams and layers -greenish gray at 28.3m	IV
-33	30		-sand layer, 30.0m to 30.5m	
-34	31			
-35	32			
-36	33	PUSH	-with sandy silt pockets and seams at 32.6m (32.9m)	
		SAVE	Lean CLAY (CL), hard, gray	V
-37	34			
-38	35			
-39	36		(36.6m)	
-40	37		Fat CLAY (CH), very stiff to hard, olive gray -with yellowish brown stains -greenish gray lean clay to 41.5m	VI
-41	38	PUSH	-desiccated and with silt pockets, at 38.1m	
-42	39			
-43			-sand layer, 39.9m to 40.2m	









LOG OF BORING AND TEST RESULTS

BORING 98-38

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

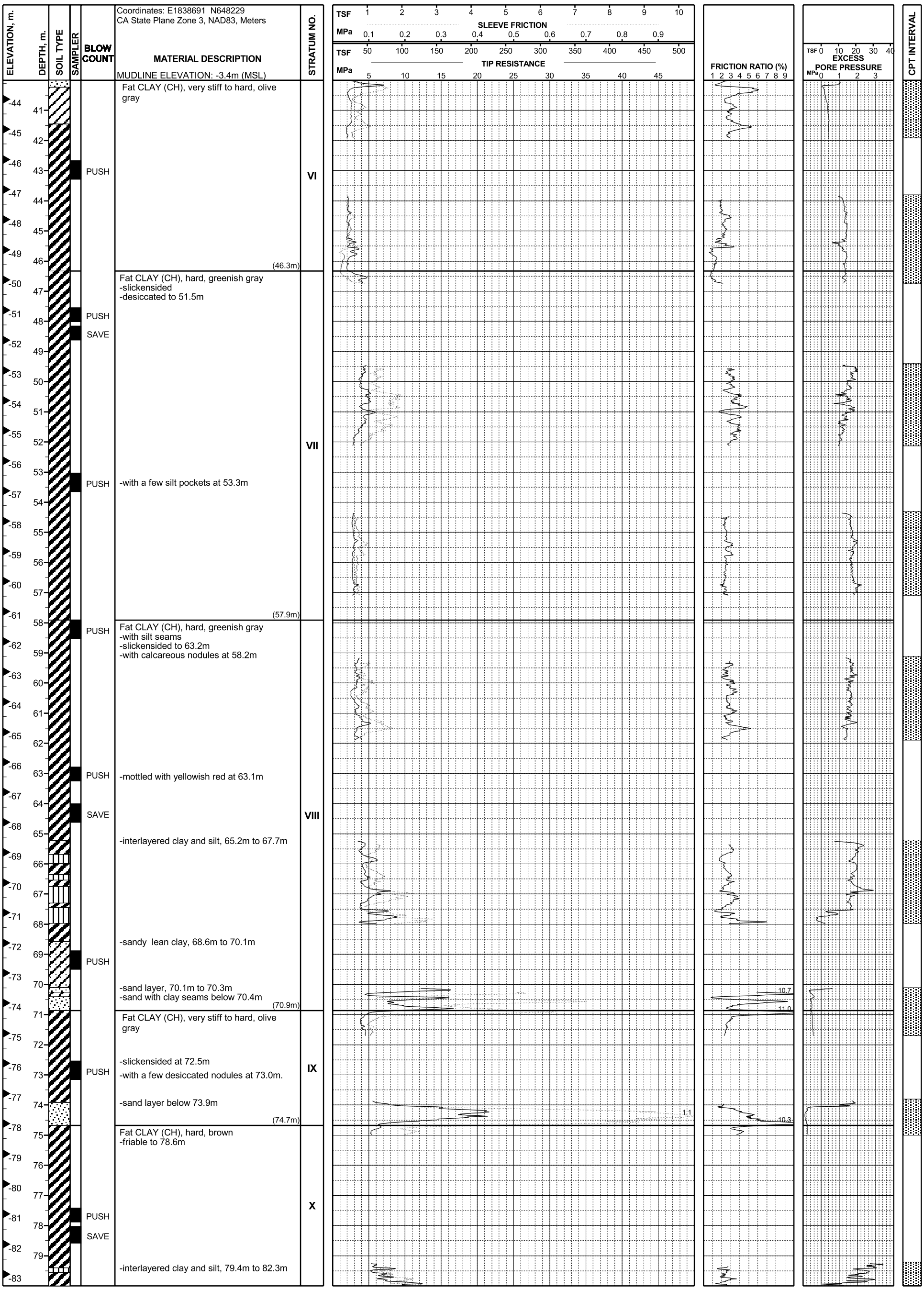
PLATE 98-38.7a

PROJECT NO:	98-42-0054	**START DATE:**	09/28/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-38 (Skyway - Frame 4)	**COMPLETION DATE:**	09/30/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838691 N648229
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Fat CLAY (CH), very stiff to hard, olive gray (46.3m)	VI
Fat CLAY (CH), hard, greenish gray -slickensided -desiccated to 51.5m -with a few silt pockets at 53.3m (57.9m)	VII
Fat CLAY (CH), hard, greenish gray -with silt seams -slickensided to 63.2m -with calcareous nodules at 58.2m -mottled with yellowish red at 63.1m -interlayered clay and silt, 65.2m to 67.7m -sandy lean clay, 68.6m to 70.1m -sand layer, 70.1m to 70.3m -sand with clay seams below 70.4m (70.9m)	VIII
Fat CLAY (CH), very stiff to hard, olive gray -slickensided at 72.5m -with a few desiccated nodules at 73.0m. -sand layer below 73.9m (74.7m)	IX
Fat CLAY (CH), hard, brown -friable to 78.6m -interlayered clay and silt, 79.4m to 82.3m	X



LOG OF BORING AND TEST RESULTS

BORING 98-38

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

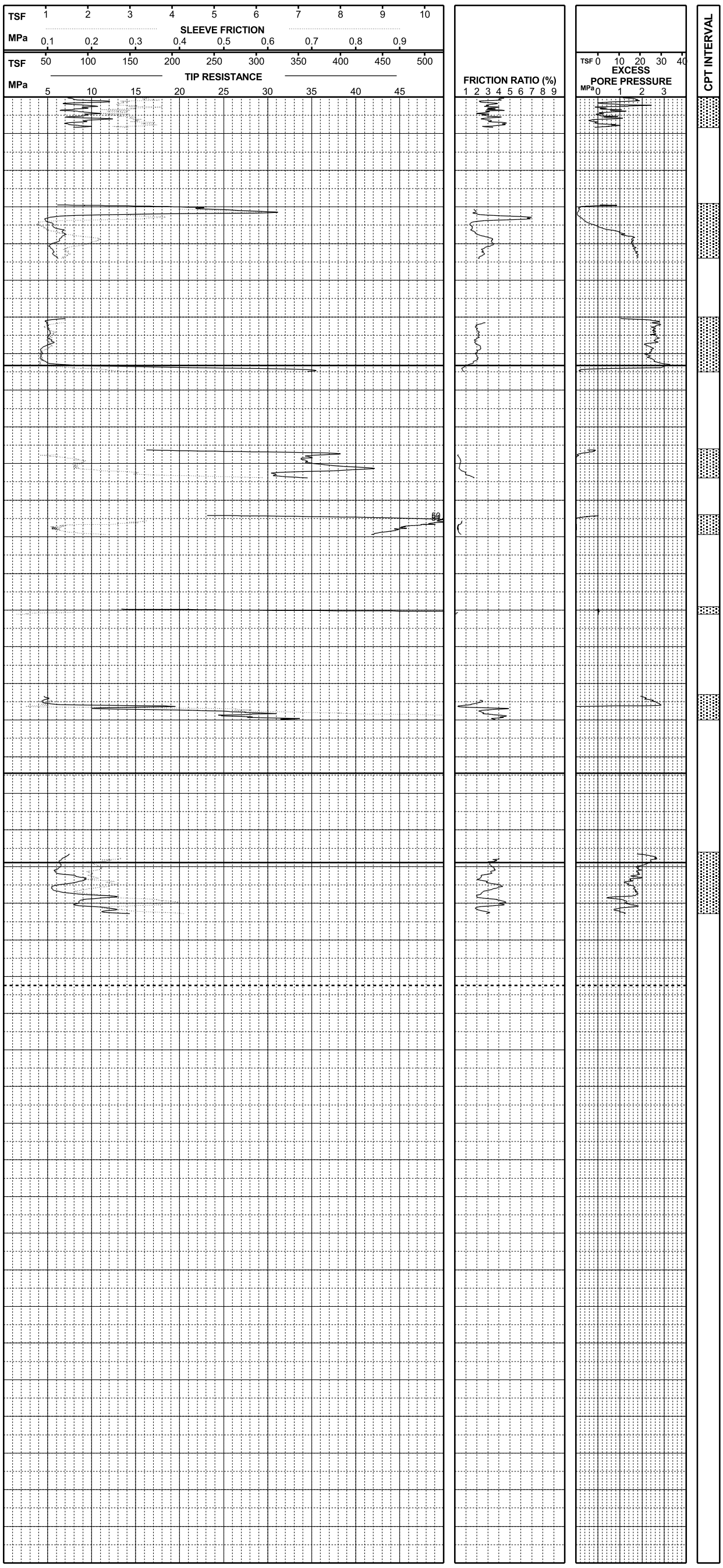
PLATE 98-38.7b

PROJECT NO:	98-42-0054	**START DATE:**	09/28/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-38 (Skyway - Frame 4)	**COMPLETION DATE:**	09/30/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838691 N648229
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-84	81			Fat CLAY (CH), hard, brown	
-85	82		PUSH	-sandy lean clay, 81.7m to 82.9m	
-86	83			-sand layer, 82.9m to 83.4m -lean clay below 83.4m	
-87	84				X
-88	85		PUSH	-silty fine sand layer, 84.9m to 85.2m	
-89	86				
-90	87			(87.3m)	
-91	88		30/15cm	Fine to Medium SAND with silt (SP-SM), dense to very dense, gray	
-92	89				
-93	90			-with a clay layer at 90.2m	
-94	91		30/15cm	-with coarse sand and fine gravel, 90.5m to 93.1m	
-95	92				
-96	93		30/15cm		XI
-97	94				
-98	95			-very stiff, brown clayey sand with gravel, 95.4m to 96.3m	
-99	96		50/15cm		
-100	97			-clay layer, 96.3m to 96.6m	
-101	98		50/10cm	-with a clay layer at 97.5m -reddish brown to gray, silty fine to medium sand with coarse sand and fine gravel, at 98.0m (98.5m)	
-102	99		PUSH	Fat CLAY (CH), hard, olive gray -slickensided, with organic matter pockets, at 98.8m	
-103	100		PUSH	-with a few silty sand pockets and partings, and a few organic matter pockets, at 100.0m	XII
-104	101		SAVE	(100.9m)	
-105	102			Lean CLAY (CL), hard, olive brown -silt layer, 101.2m to 101.5m -with a silt layer at 101.8m and 102.1m	
-106	103				XIII
-107	104		PUSH		
-108	105			TOTAL DEPTH: 104.2m BACKFILLED WITH: Cement Grout	
-109	106				
-110	107				
-111	108				
-112	109				
-113	110				
-114	111				
-115	112				
-116	113				
-117	114				
-118	115				
-119	116				
-120	117				
-121	118				
-122	119				
-123					



LOG OF BORING AND TEST RESULTS

BORING 98-38

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

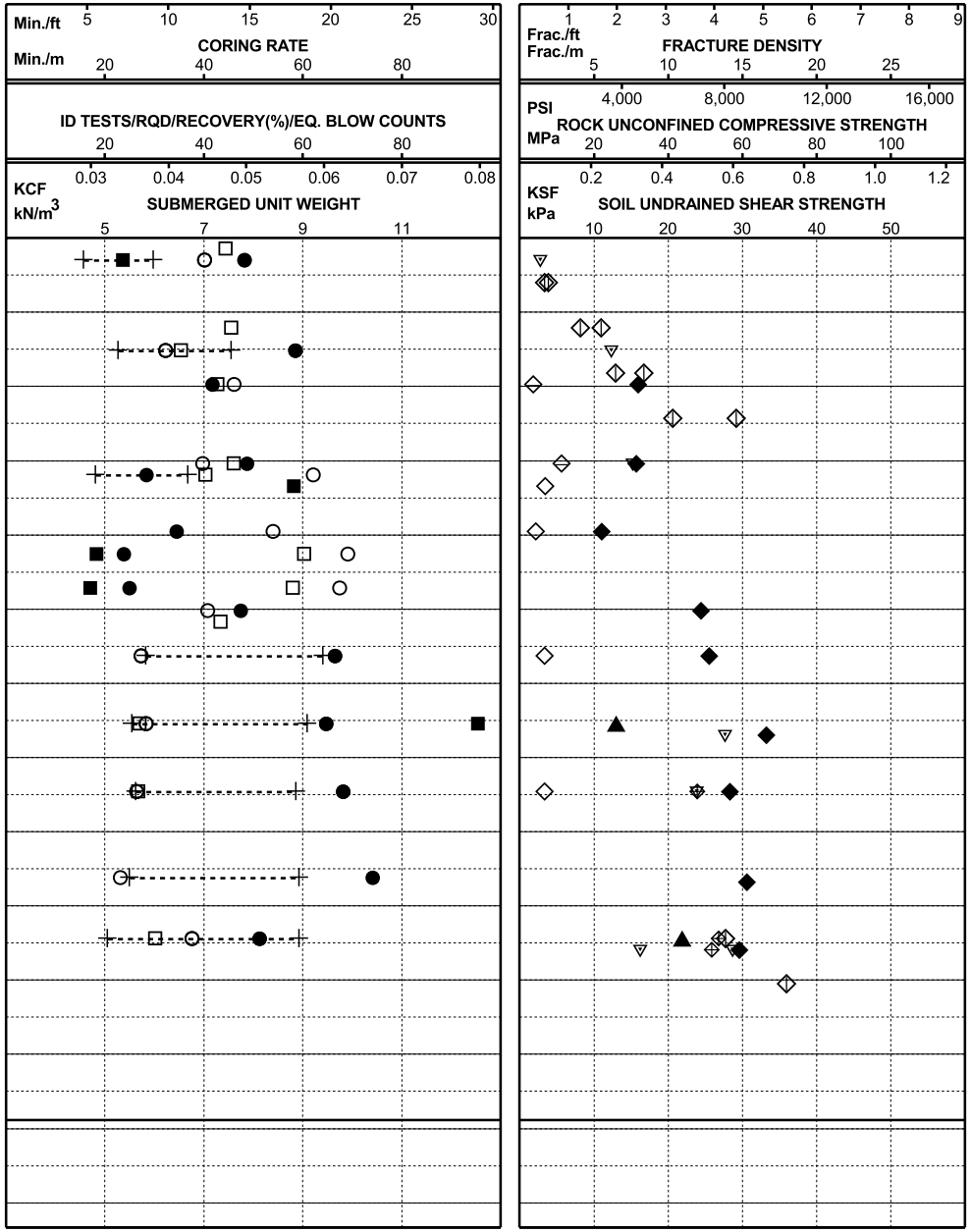
PLATE 98-38.7c

PROJECT NO:	98-42-0054	**START DATE:**	09/28/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-38 (Skyway - Frame 4)	**COMPLETION DATE:**	09/30/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1838691 N648229
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -3.4m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), very soft to firm, olive gray to gray	I
-4	1		-dark gray to 1.2m	
			-with large sand pockets to 1.5m	
			-with shells and shell fragments to 2.0m	
		WOH		
-5	2	WOH		
-6			-with sand pockets, 2.7m to 4.0m	
	3	WOH	-with sand seams at 3.0m	
-7			-with shells , 3.7m to 4.3m	
	4	9/60cm	-gray to olive gray silty fine sand with clay pockets, 4.0m to 4.7m	
-8			-with gas blisters, 4.7m to 7.5m	
	5	4/60cm	-with inclined fissures and voids at 4.9m	
-9		PUSH	-with a few silt pockets, 5.5m to 6.7m	
	6			
-10		PUSH		
	7			
-11		PUSH		
	8			
-12		SAVE		
	9		-with a few shells at 9.4m	
-13		PUSH		
	10			
-14				
	11			
-15			(11.9m)	
	12		Fat CLAY (CH), stiff to very stiff, greenish gray	II
-16				
	13			



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-38

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

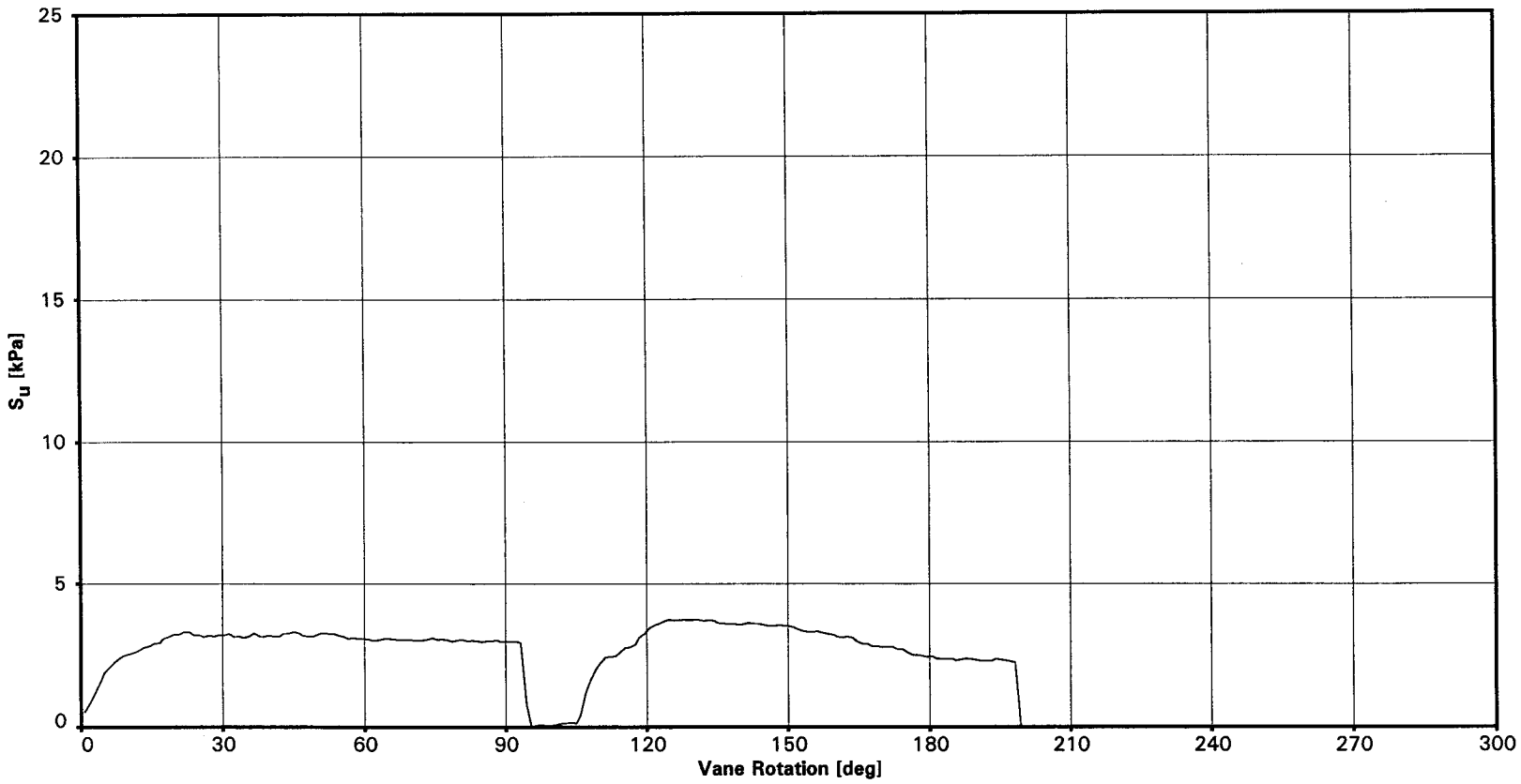
FUGRO

PLATE 98-38.8

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 0.6m
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

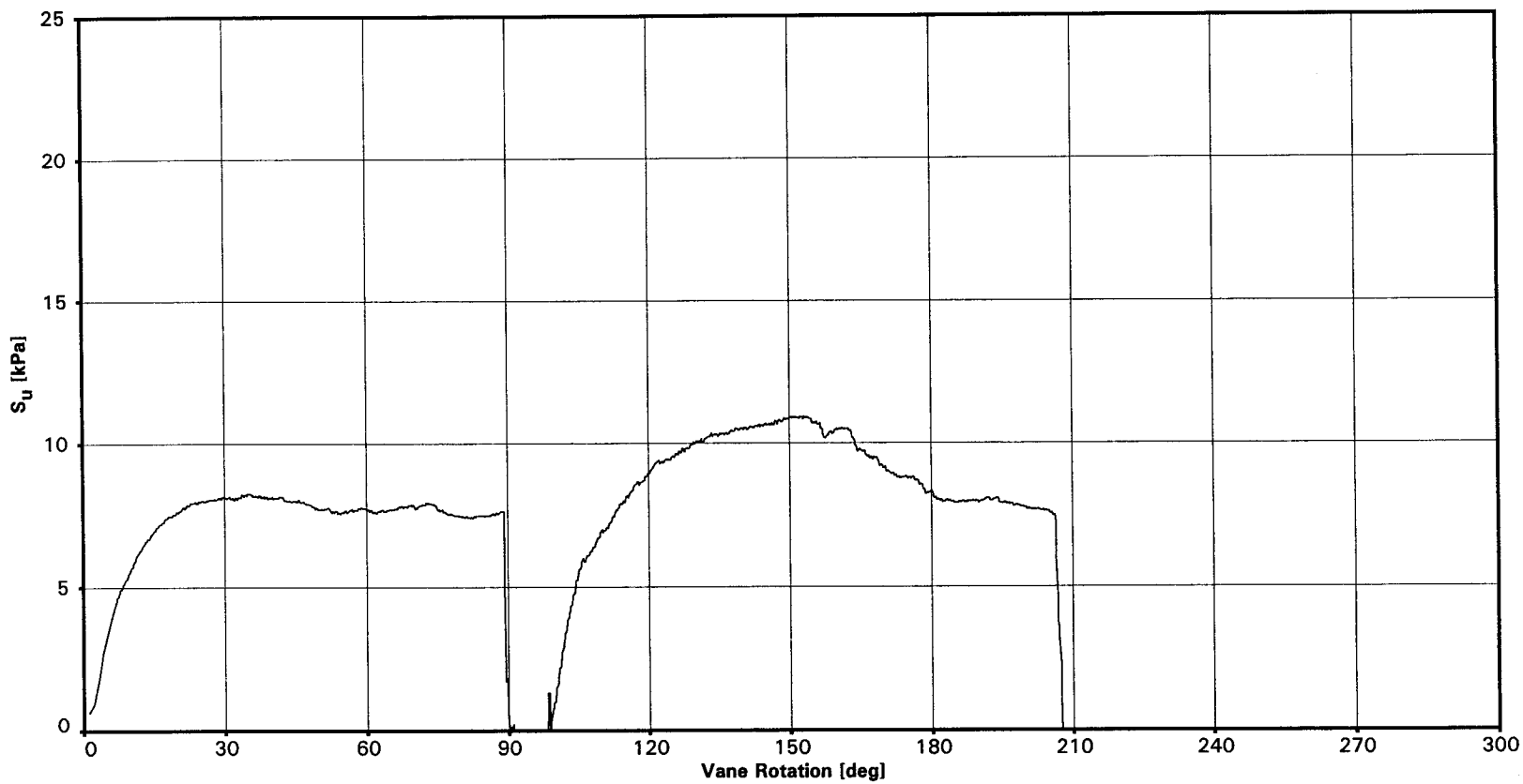
FUGRO

PLATE 98-38.9a

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.2m
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

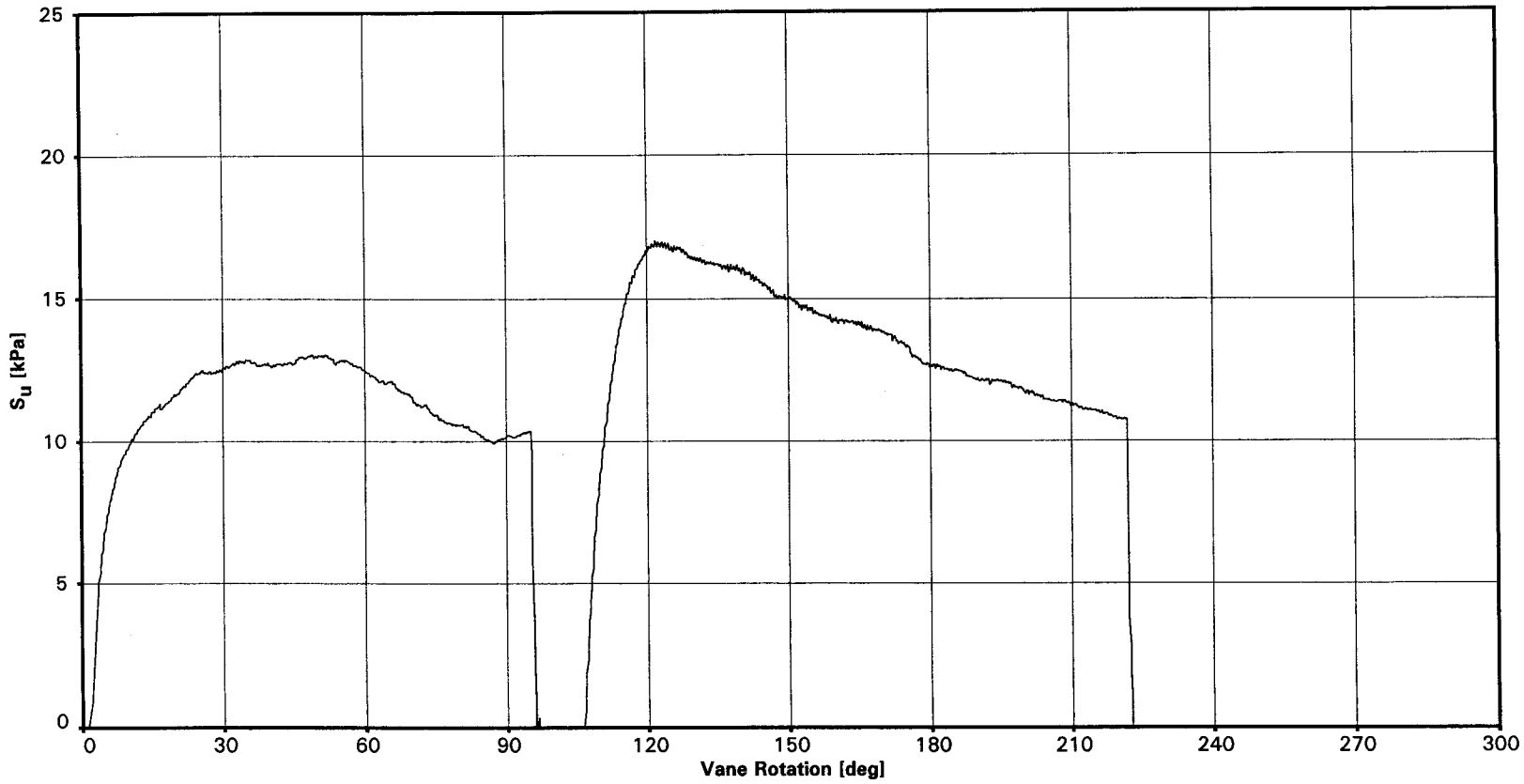
FUGRO

PLATE 98-38.9b

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.8m
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

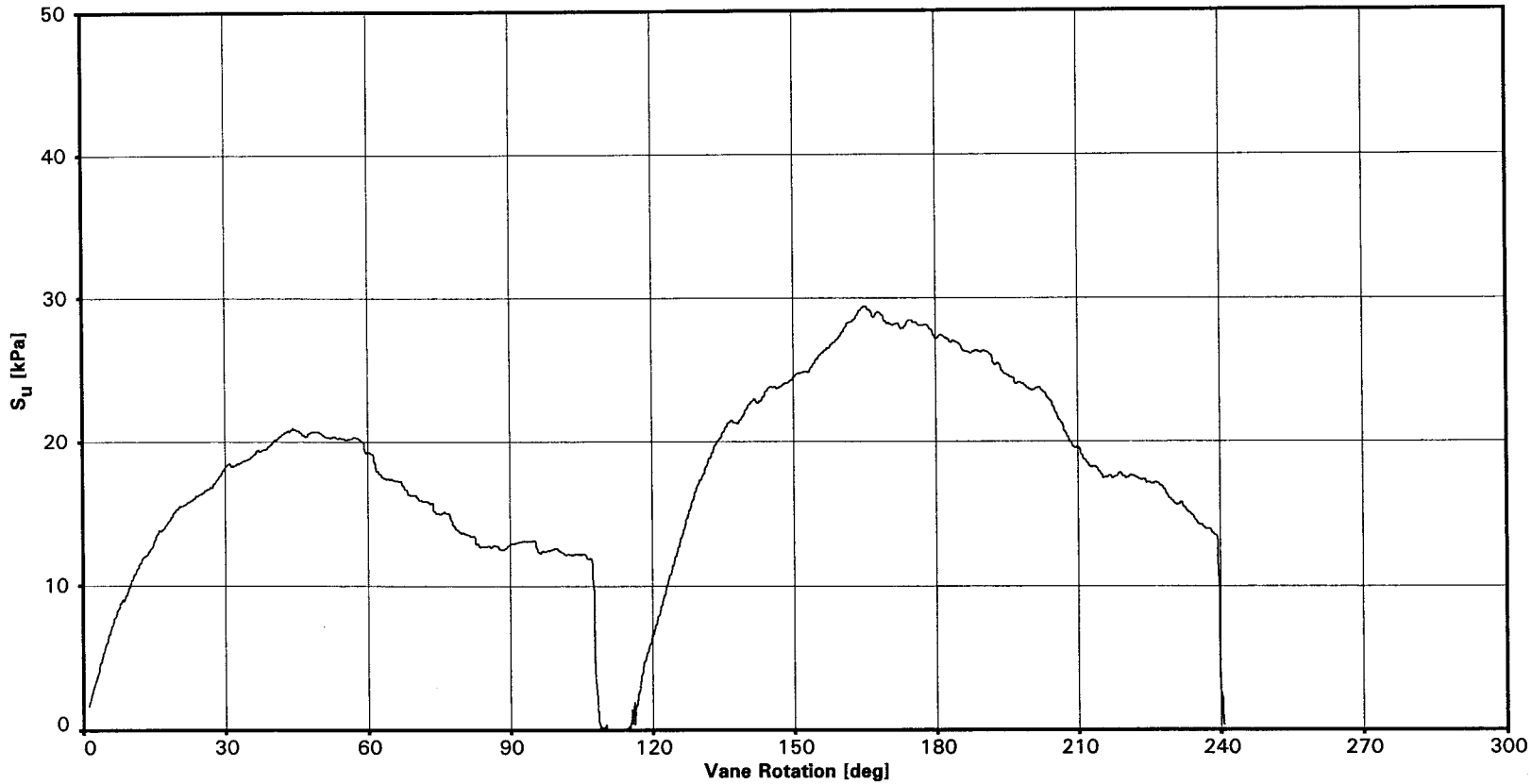
FUGRO

PLATE 98-38.9c

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 2.4m
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

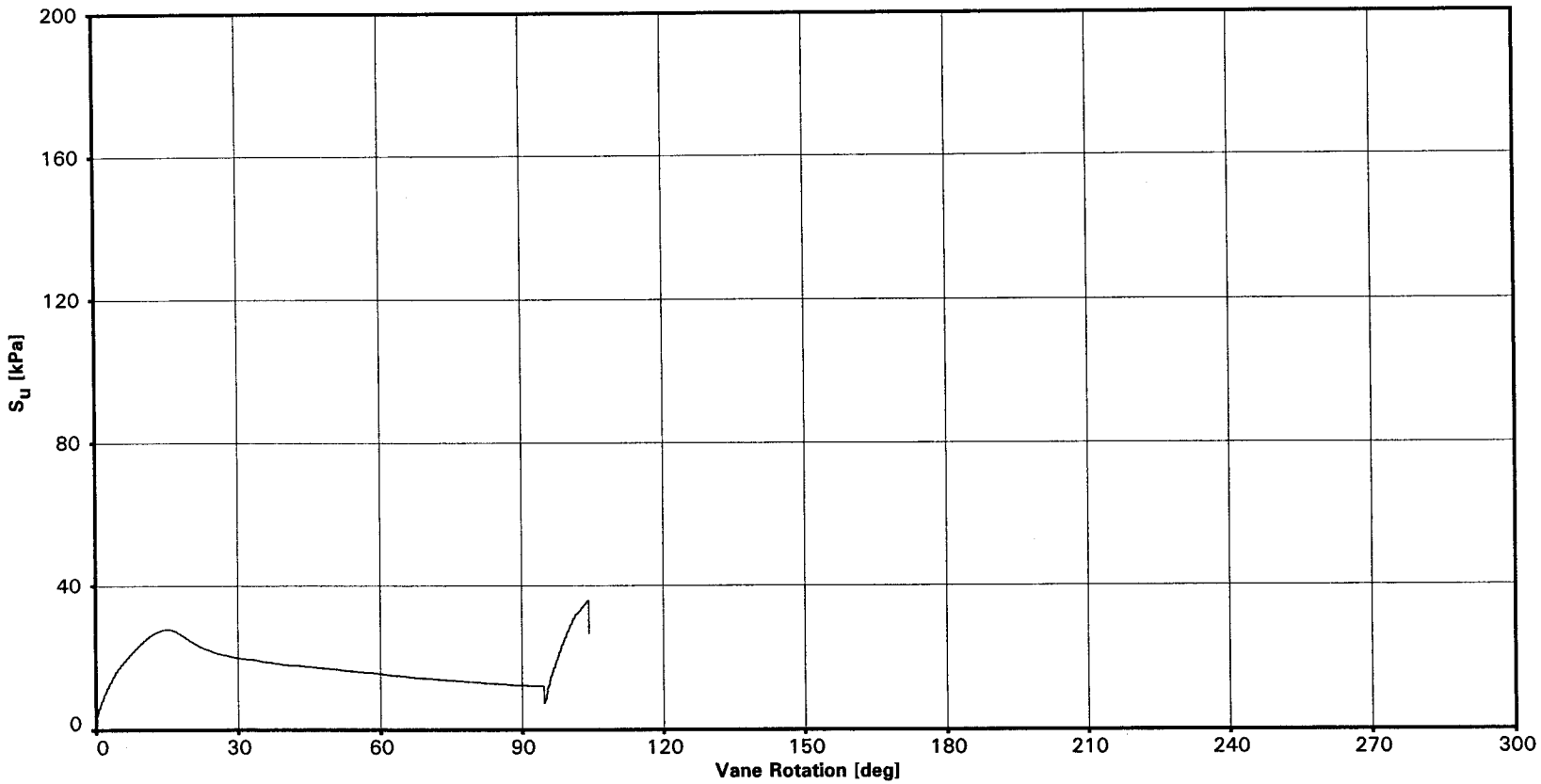
FUGRO

PLATE 98-38.9d

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Large

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 9.4m and 10.1m
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

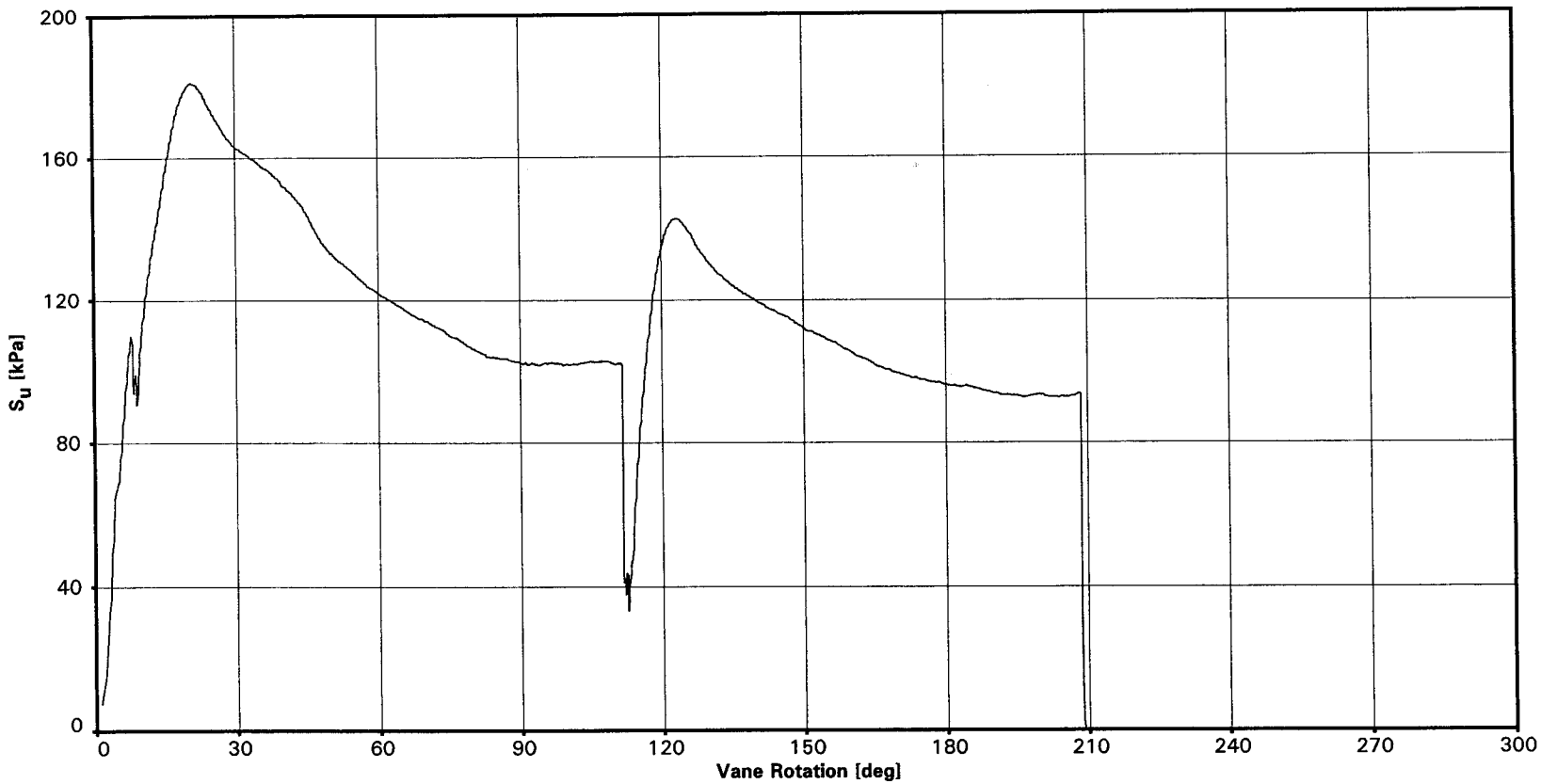
FUGRO

PLATE 98-38.9e

SFOBB Task Order No. 5
Project No. 98-42-0054

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 23.2m and 23.8m
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-38.9f

98-38		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
0.2	1					7.4																		
0.3	2	48	30	16	2.29		24			2.9														
0.6	400													3.4										
0.6	401													3.8										
1.2	3					7.5																		
1.2	402													8.1										
1.2	403													11.0										
1.5	5	58	46	23	1.56	6.5				12.4														
1.8	404													12.9										
1.8	405													16.8										
2.0	6	42				7.3					16.0		1.8											
2.4	406													20.6										
2.4	407													29.2										
3.0	7	49				7.6				15.3	15.7		5.6											
3.2	8	28	37	18	0.55	7.0																		C

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-38		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
3.4	9						58					3.4												
4.0	10	34									11.1	2.2												
4.3	12	24				9.0	18											0.0	34					
4.7	13	25				8.8	17											9.6	33					
5.0	14	47									24.5													
5.2	15					7.3																		C
5.6	16	66	64	28	1.06						25.5	3.3												
6.6	17	65	61	26	1.11	5.7	95								12.9		0.4							H
6.7	18									27.8	33.2													
7.5	19	68	59	26	1.29	5.7		23.9		23.9	28.3	3.3												
8.6	20	74	59	25	1.43																			C
8.7	21										30.6													
9.4	23	51	59	21	0.79	6.0		26.8							21.8		1.1							
9.4	500													27.8										
9.6	24							25.9		16.3	29.6													

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-38		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
9.6	24									28.7														
10.1	501													35.9										
14.0	25							68.0	71.8															
14.2	26	49	81	22	0.46	7.0	100	68.9								40.5								H
14.3	27							58.4	71.8															
17.8	29	26	64	20	0.15	9.5			215.5						116.6	140.2	0.8							
18.0	30								215.5	197.3														
21.5	32	36	56	16	0.51	8.1										45.0								
21.6	33										117.6													
22.2	34	39	61	21	0.44																			C
22.3	35	37	44	18	0.75						108.9													
23.2	502													177.2										
23.8	503													138.9										
24.8	37	39	48	16	0.71	7.6		95.8																
25.0	38							83.8		110.1	111.4													

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C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-38		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
28.3	40	22	52	15	0.19	10.1									121.8		1.1							
28.5	41										222.8													
32.6	42	36	52	19	0.51	8.4									111.9	28.6	1.1							
32.8	43	33	48	21	0.44	7.9			191.5															
32.9	44										151.0													
33.4	45	18	26	14	0.34																			C,K
33.5	46	6	29	14							222.8													
38.1	47	26	40	13	0.47	10.1																		
38.3	48	21	39	15	0.25	10.4		119.7	215.5						103.4		1.2							
38.4	49								191.5		199.3													
43.1	51	45	83	27	0.32	6.3			177.2							58.5								
43.3	52								201.1		190.6													
47.9	54	26	64	17	0.18	9.5									196.1		0.7							
48.0	55								204.4		222.8													
48.6	56	29	61	20	0.22																			C

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-38		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
48.6	57	32	71	16	0.30																			
53.5	59	52	83	31	0.39	7.1	100		191.5						193.4	64.9	0.9							H
53.6	60								201.1		222.8													
58.2	61					11.0									243.5		0.6							
58.4	62	28	61	19	0.21	9.3																		
58.5	63								245.3															
62.9	64										217.9													
63.1	65	26	61	19	0.18	9.8									217.3	183.8	0.7							
64.6	67	26	55	20	0.17																			C,K
64.6	68	27	59	19	0.20				215.5															
69.2	69								153.2															
69.3	70	24	26	16	0.74	9.9	59																	H
72.7	75								257.0															
72.8	72	26	59	22	0.11	10.6			220.2						246.3	187.5	0.5							
73.0	73	24	53	21	0.10	10.1			233.7															

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

Identification Tests
SUW = Submerged 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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-38		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
77.6	76								257.0															
77.9	78	21	65	22		9.7	98								246.8		0.8							H
78.5	79	24	55	20	0.12																			C,K
78.6	80	26	68	14	0.22																			
82.1	82	24	30	16	0.57	8.1	54																	H
85.2	83	31				10.0	30																	
88.2	84	18				10.4	9																	
90.7	85	11					7																	
93.1	86	12				10.1	7																	
95.6	87	12	40	16		11.9	33																	
98.0	88	20				11.3	12																	
99.2	90	21	51	17	0.12	10.3			280.4						278.1		0.5							
99.4	91								268.7															
100.1	93	22	81	19	0.04	10.0										169.4								
100.3	94								268.7															

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

Identification Tests
SUW = Submerged 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

Additional Tests
H = Hydrometer
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Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-38		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (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)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
101.1	95	21	44	16	0.18																			K
101.2	96	18	35	15	0.17																			
104.1	98	26	36	24	0.24	9.3			268.7						321.3		1.7							

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

Identification Tests
SUW = Submerged 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

Additional Tests
H = Hydrometer
C = Consolidation Test
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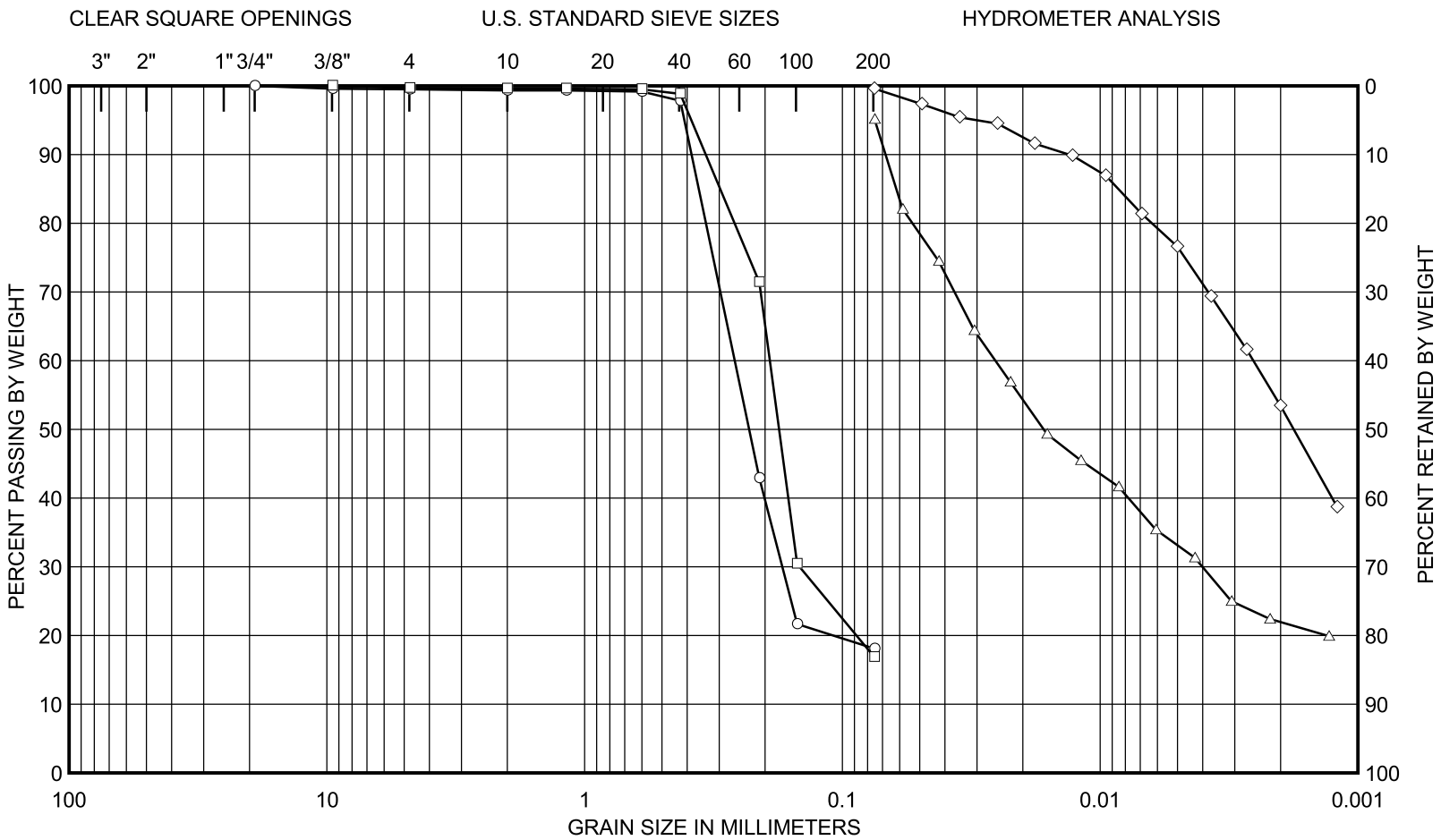
Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO



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

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
12	4.3	○——○	SILTY FINE SAND (SM) with clay pockets			0.23
13	4.7	□——□	SILTY FINE SAND (SM) with clay pockets			0.18
17	6.6	△——△	FAT CLAY (CH) with a few silt pockets			0.017
26	14.2	◇——◇	FAT CLAY (CH)			0.0018

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-38
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-38.11a

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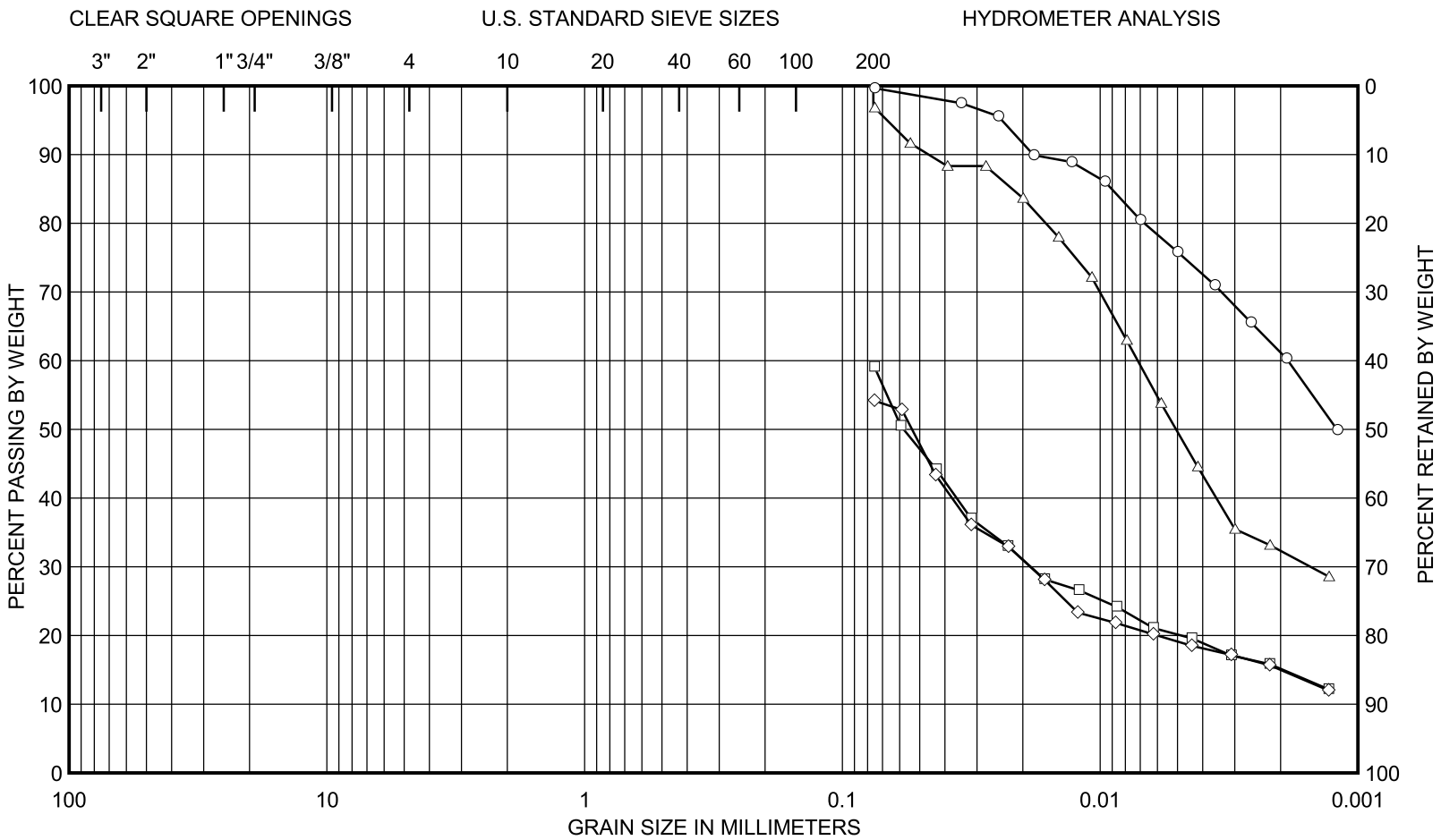

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
59	53.5	○——○	FAT CLAY (CH) with a few silt pockets			0.0012
70	69.3	□——□	SANDY LEAN CLAY (CL)			0.058
78	77.9	△——△	FAT CLAY (CH)			0.0051
82	82.1	◇——◇	SANDY LEAN CLAY (CL)			0.054

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-38
SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-38.11b

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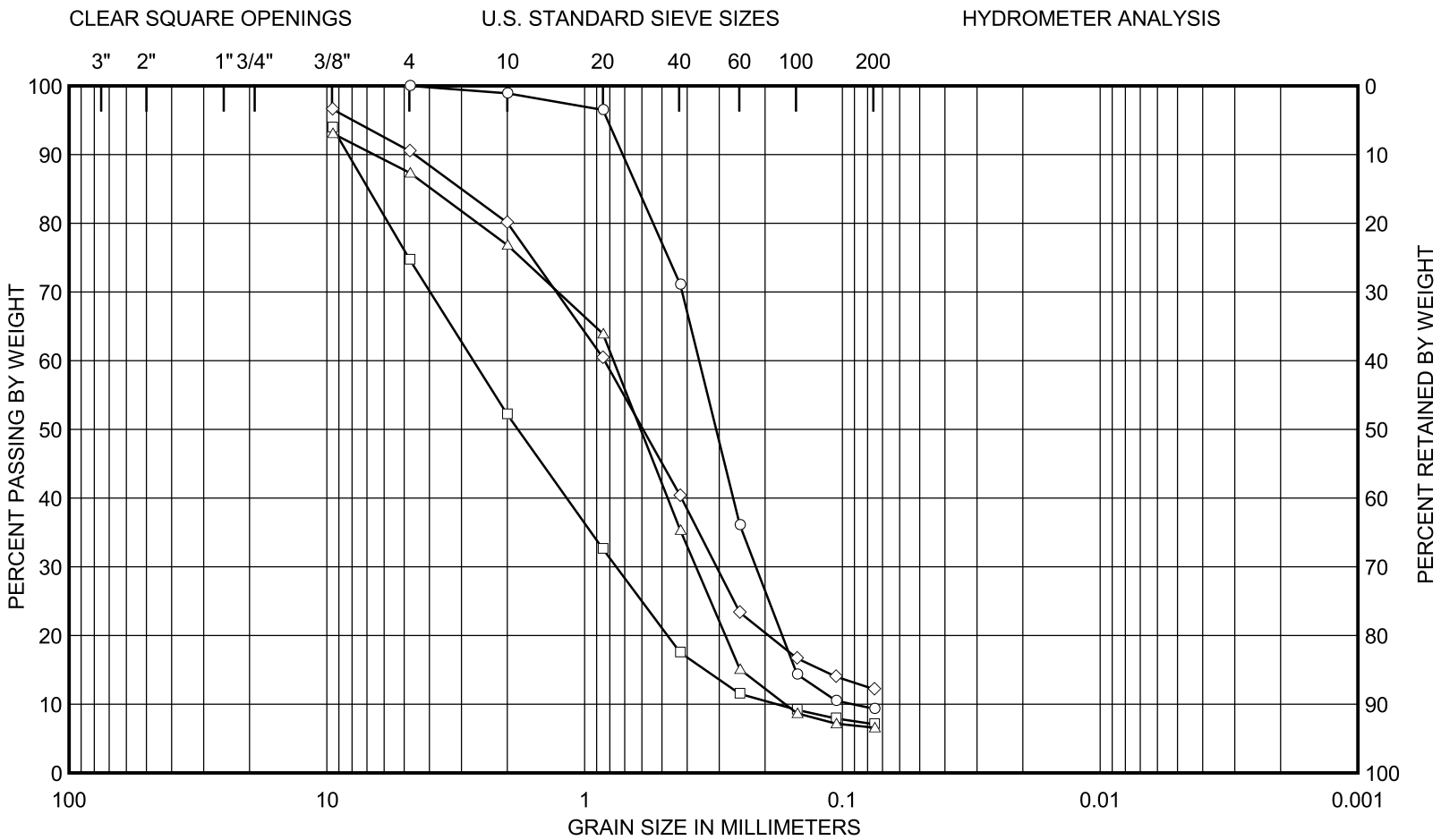

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
84	88.2	○——○	FINE SAND (SP-SM) with silt and medium sand	1.4	3.9	0.31
85	90.7	□——□	FINE TO MEDIUM SAND (SW-SM) with silt, coarse sand and fine gravel	1.2	15.1	1.8
86	93.4	△——△	FINE TO MEDIUM SAND (SW-SM) with silt and a trace of coarse sand and fine gravel	1.1	4.6	0.61
88	98.0	◇——◇	SILTY FINE TO MEDIUM SAND (SM) with a trace of coarse sand and fine gravel			0.59

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-38

SFOBB East Span Seismic Safety Project

SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-38.11c

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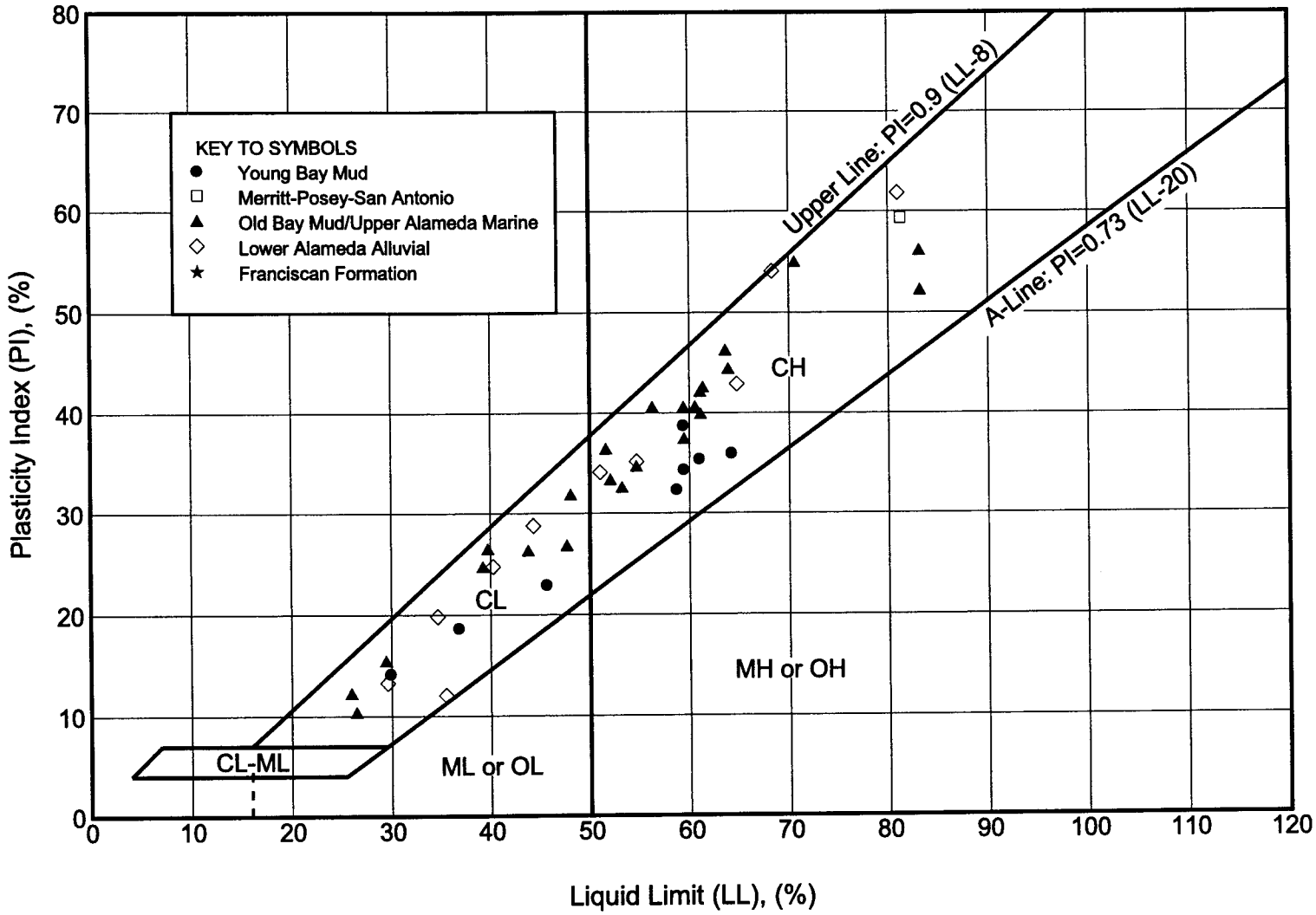
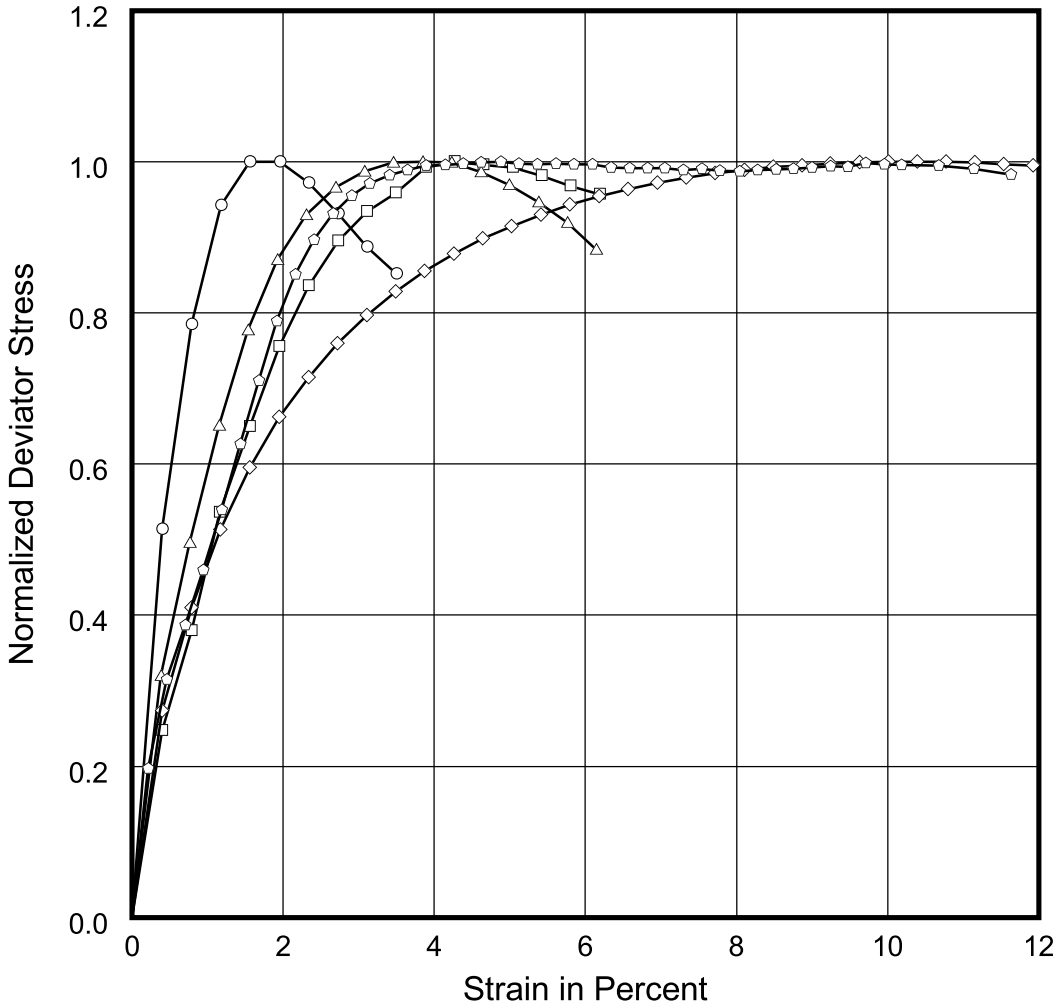


PLASTICITY CHART
Boring 98-38
SFOBB East Span Seismic Safety Project

Earth Mechanics
FUGRO

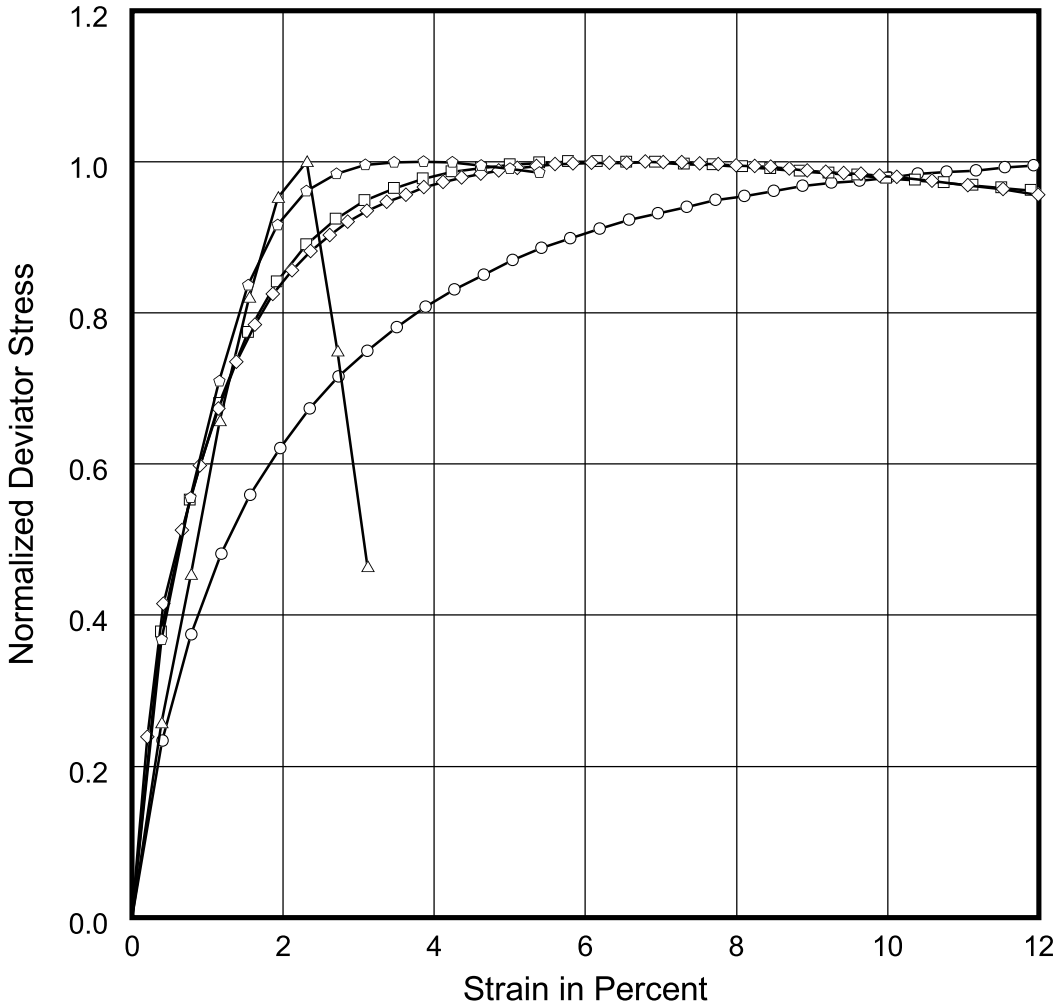


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	17	6.6	UU	138	26	0.4
	23	9.4	UU	207	44	1.1
	29	17.8	UU	827	233	0.8
	40	28.3	UU	1000	243	1.1
	42	32.6	UU	1103	224	1.1

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-38
SFOBB East Span Seismic Safety Project

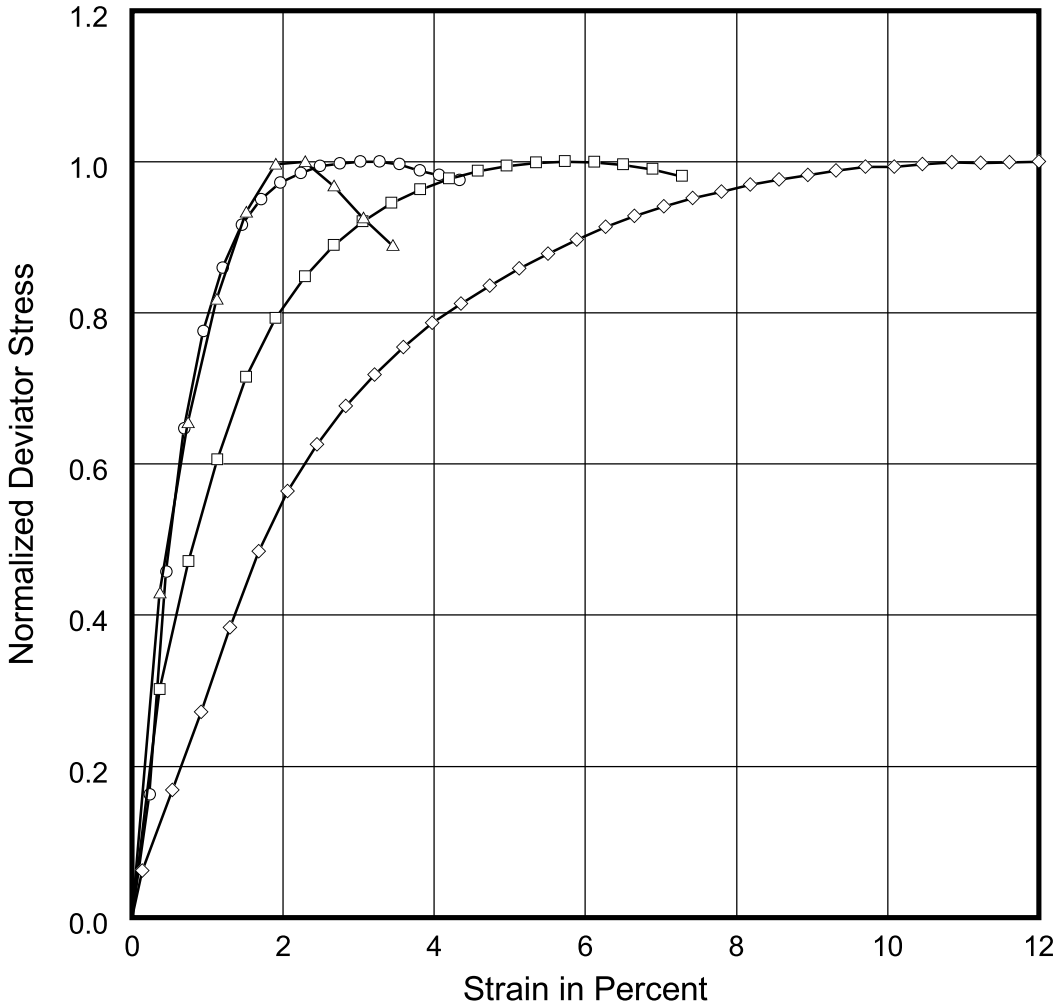


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	48	38.3	UU	1207	207	1.2
	54	47.9	UU	1413	392	0.7
	59	53.5	UU	1551	387	0.9
	61	58.2	UU	1655	487	0.6
	65	63.1	UU	1793	435	0.7

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-38
SFOBB East Span Seismic Safety Project

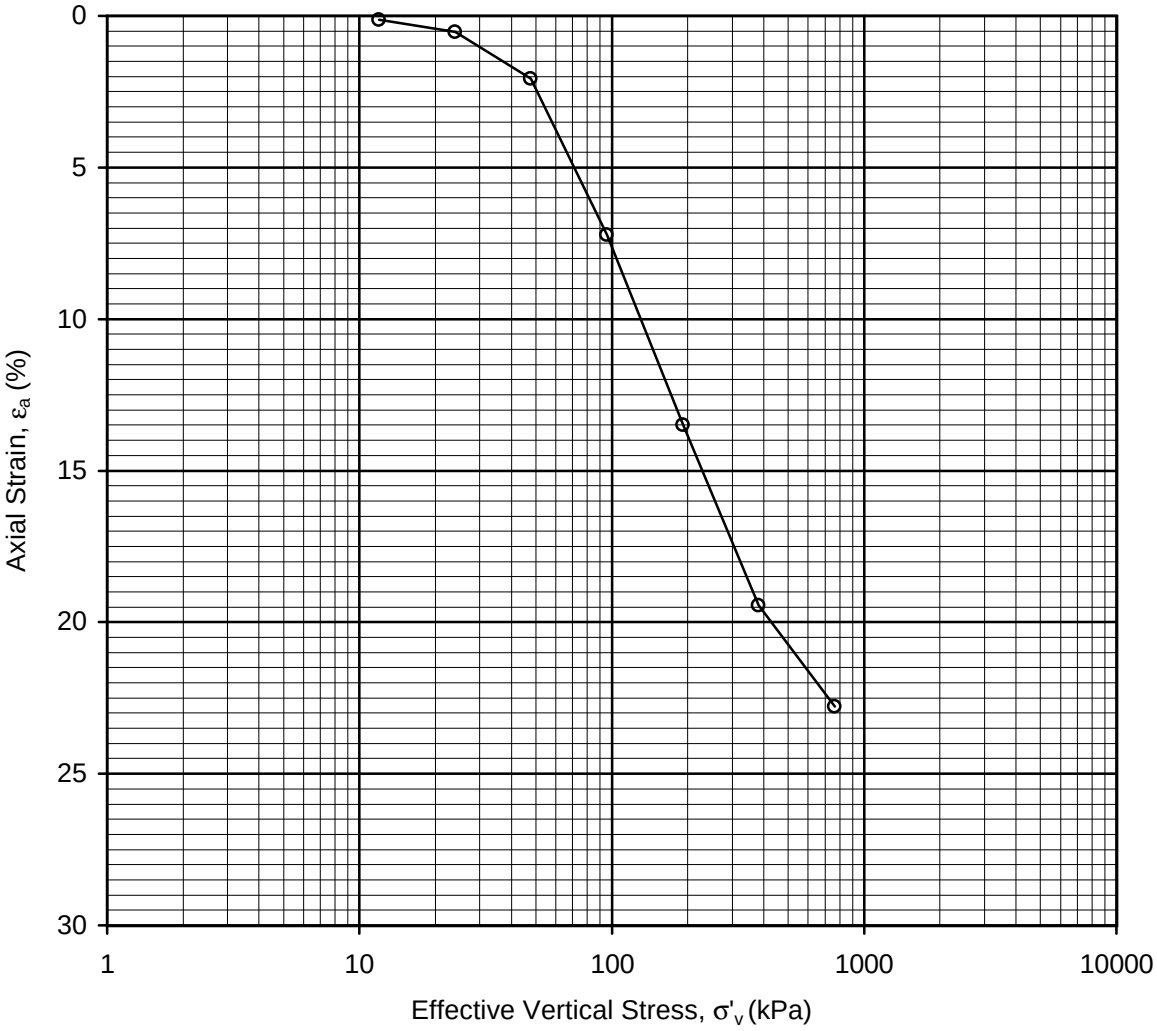


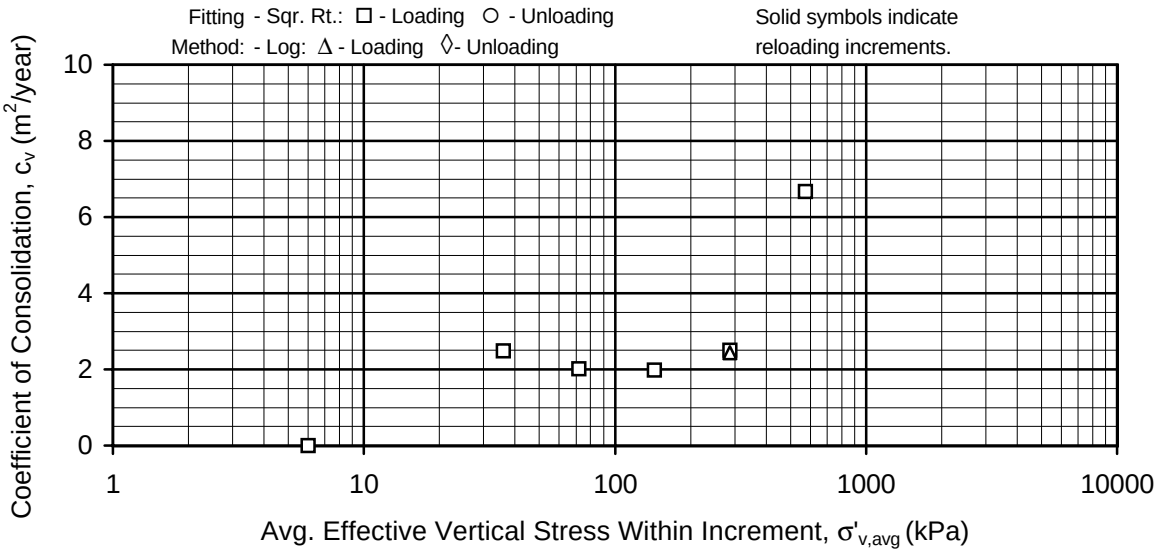
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○	72	72.8	UU	1999	493	0.5
□	78	77.9	UU	2068	494	0.8
△	90	99.2	UU	2482	556	0.5
◇	98	104.1	UU	2482	643	1.7

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-38
SFOBB East Span Seismic Safety Project

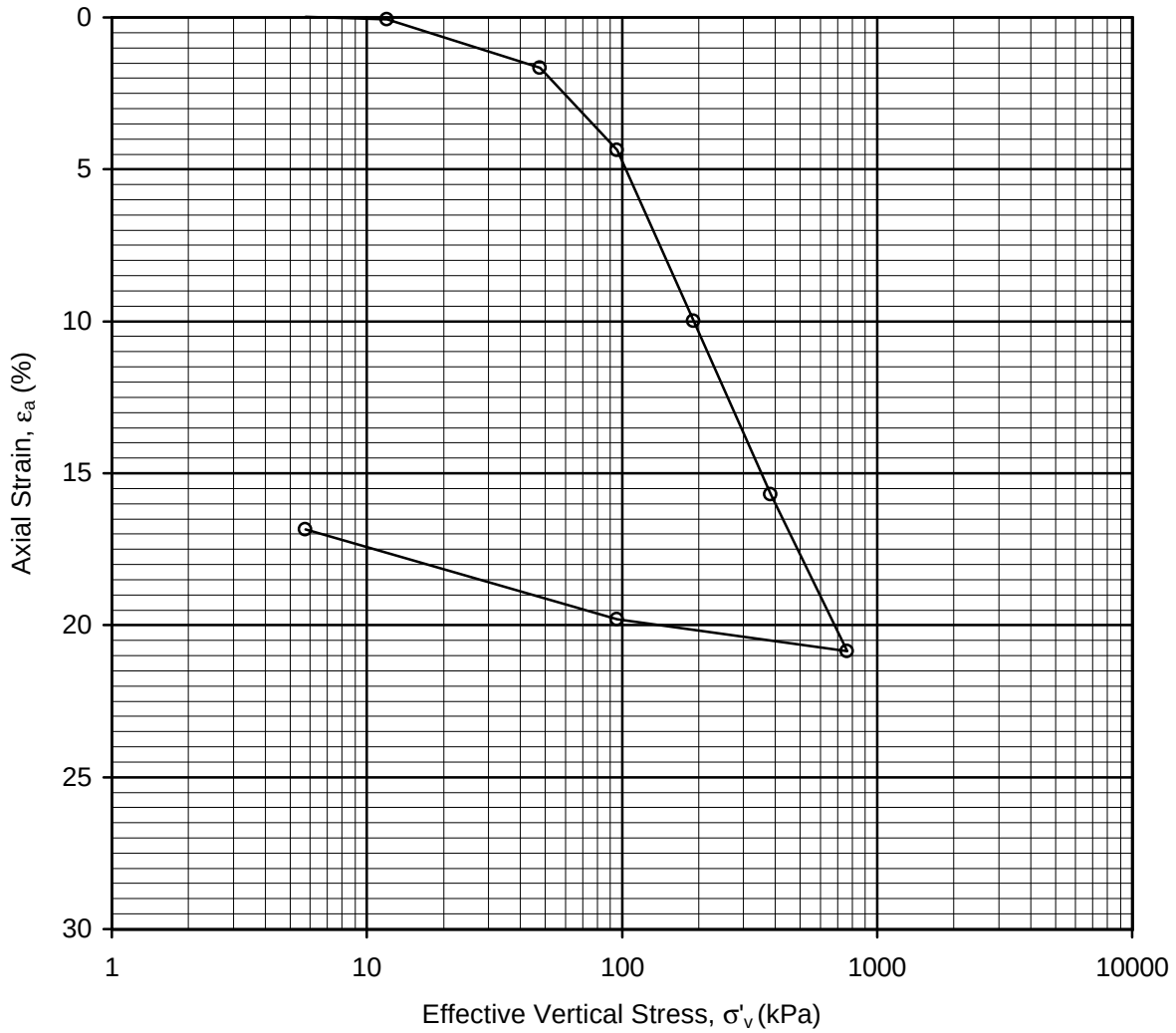




INCREMENTAL CONSOLIDATION TEST RESULTS

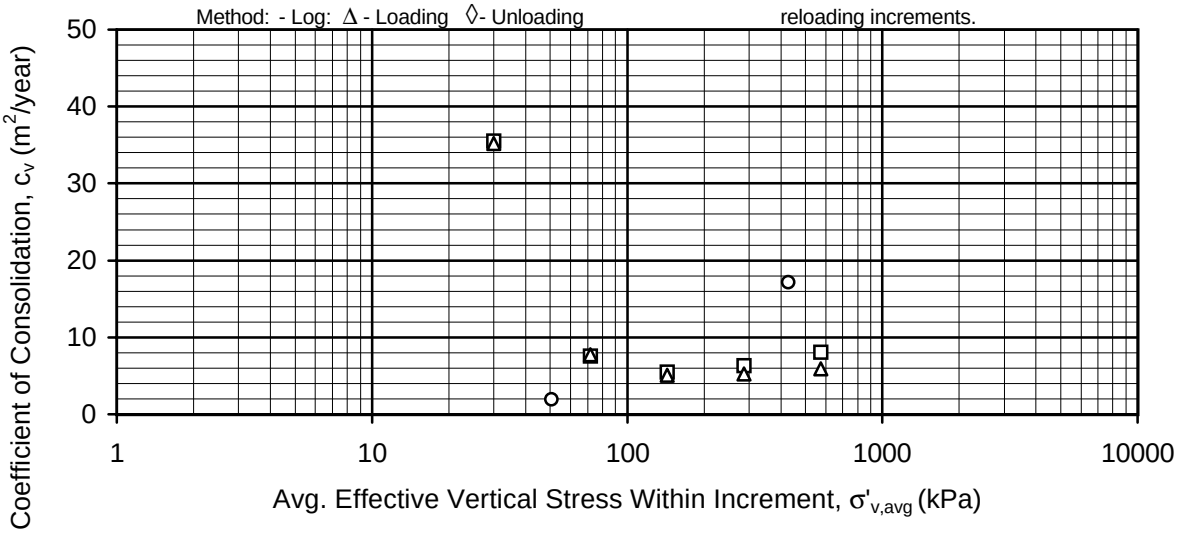
Sample No. 8 - Depth: 3.2m
Boring 98-38
SFOBB East Span Seismic Safety Project

PLATE 98-38.14a



Fitting - Sqr. Rt.: □ - Loading ○ - Unloading
Method: - Log: Δ - Loading ◊- Unloading

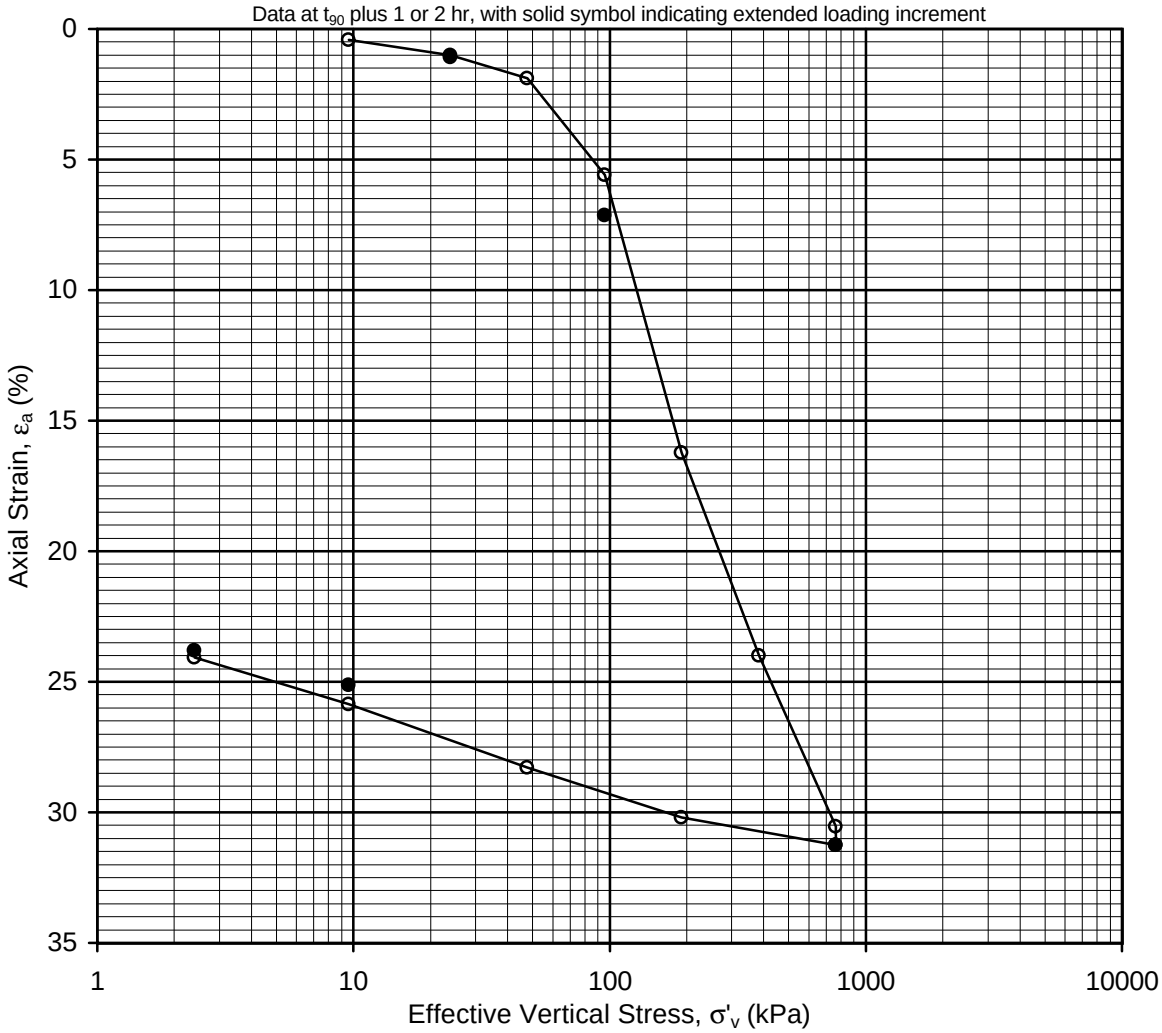
Solid symbols indicate reloading increments.

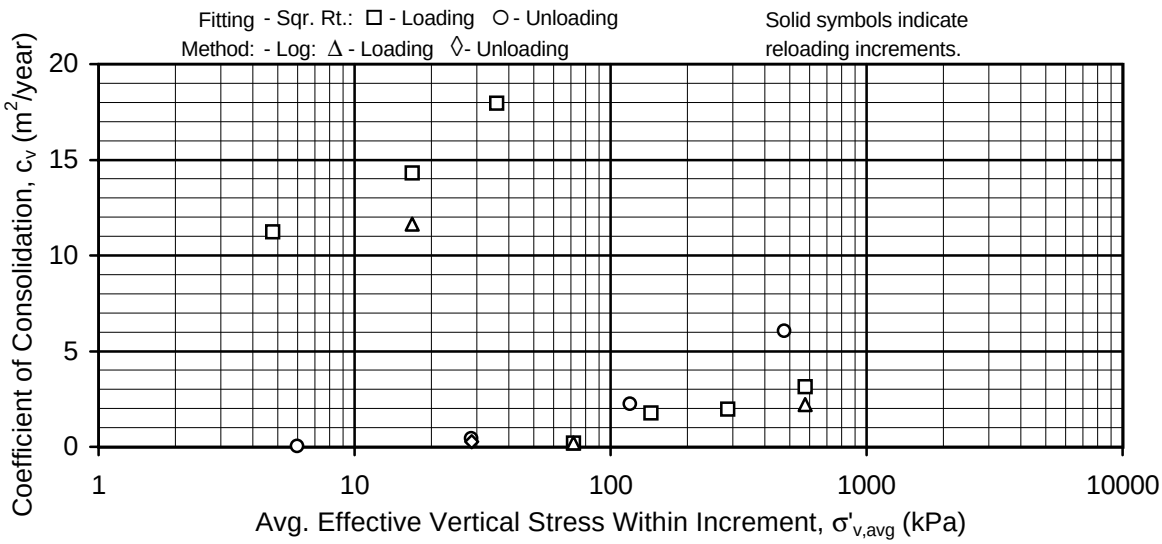


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 15 - Depth: 5.2m
Boring 98-38
SFOBB East Span Seismic Safety Project

PLATE 98-38.14b

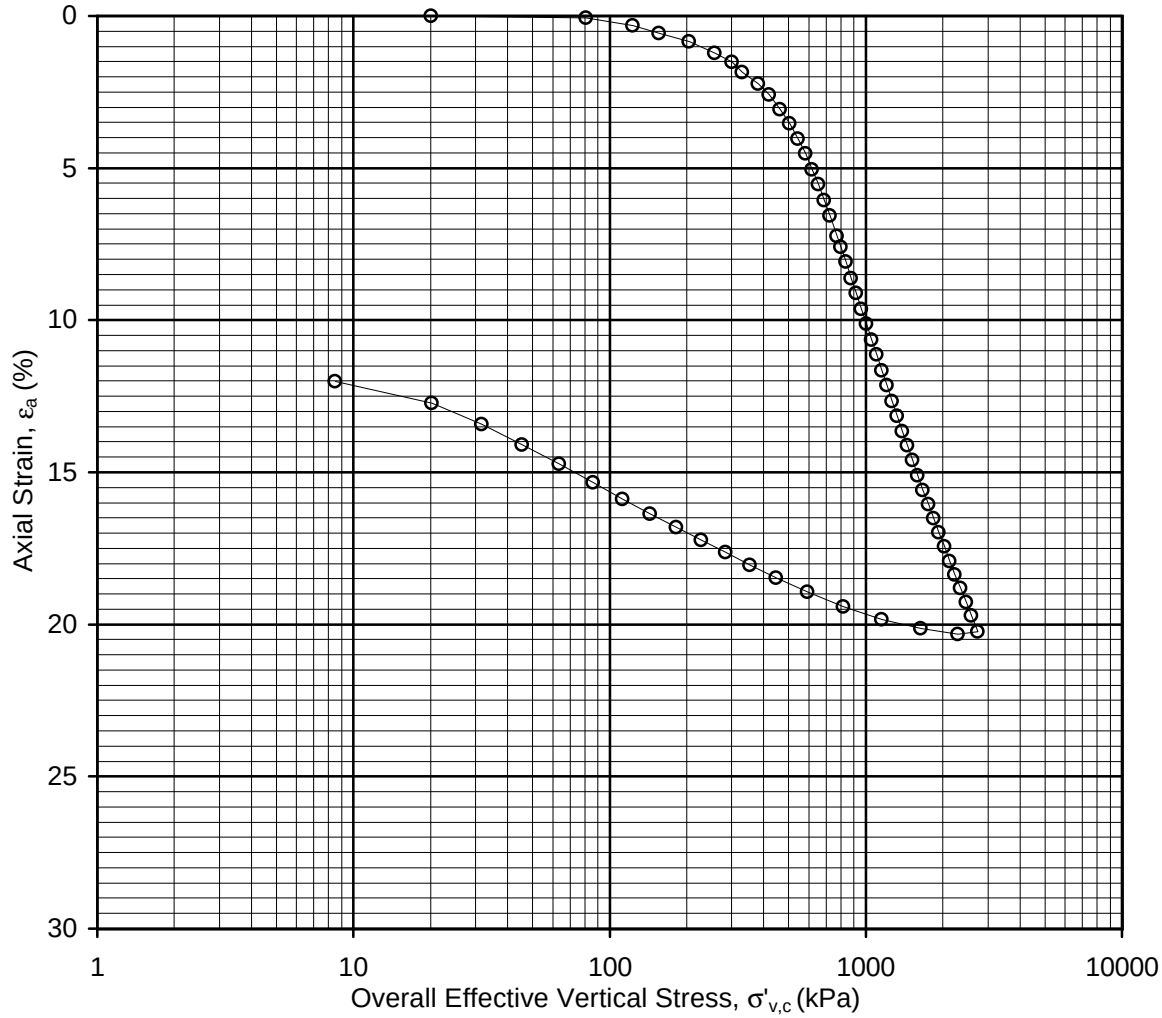


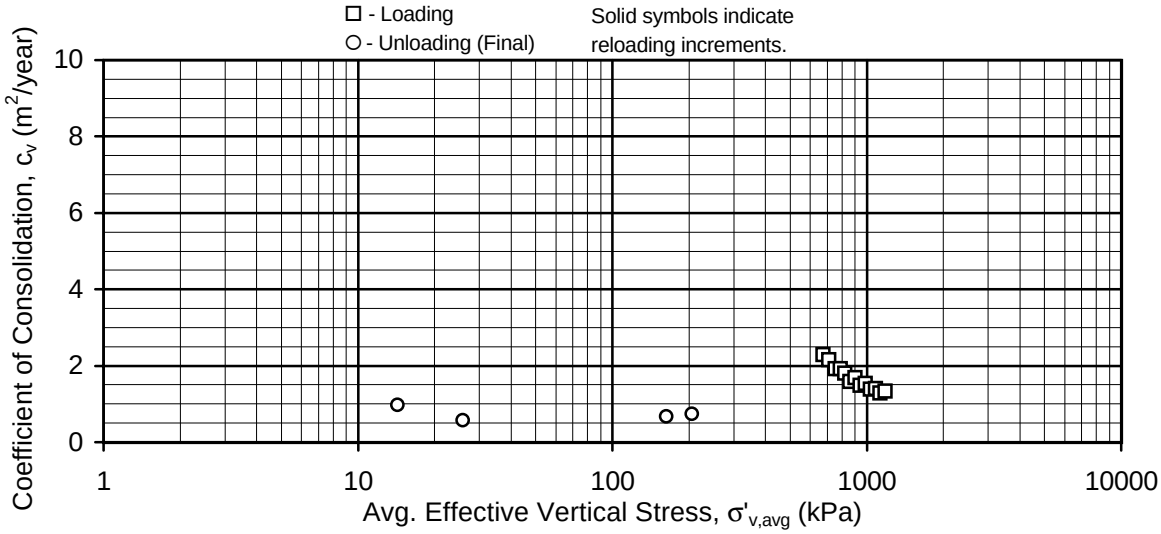


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No.20 - Depth: 8.7m
Boring 98-38
SFOBB East Span Seismic Safety Project

PLATE 98-38.14c

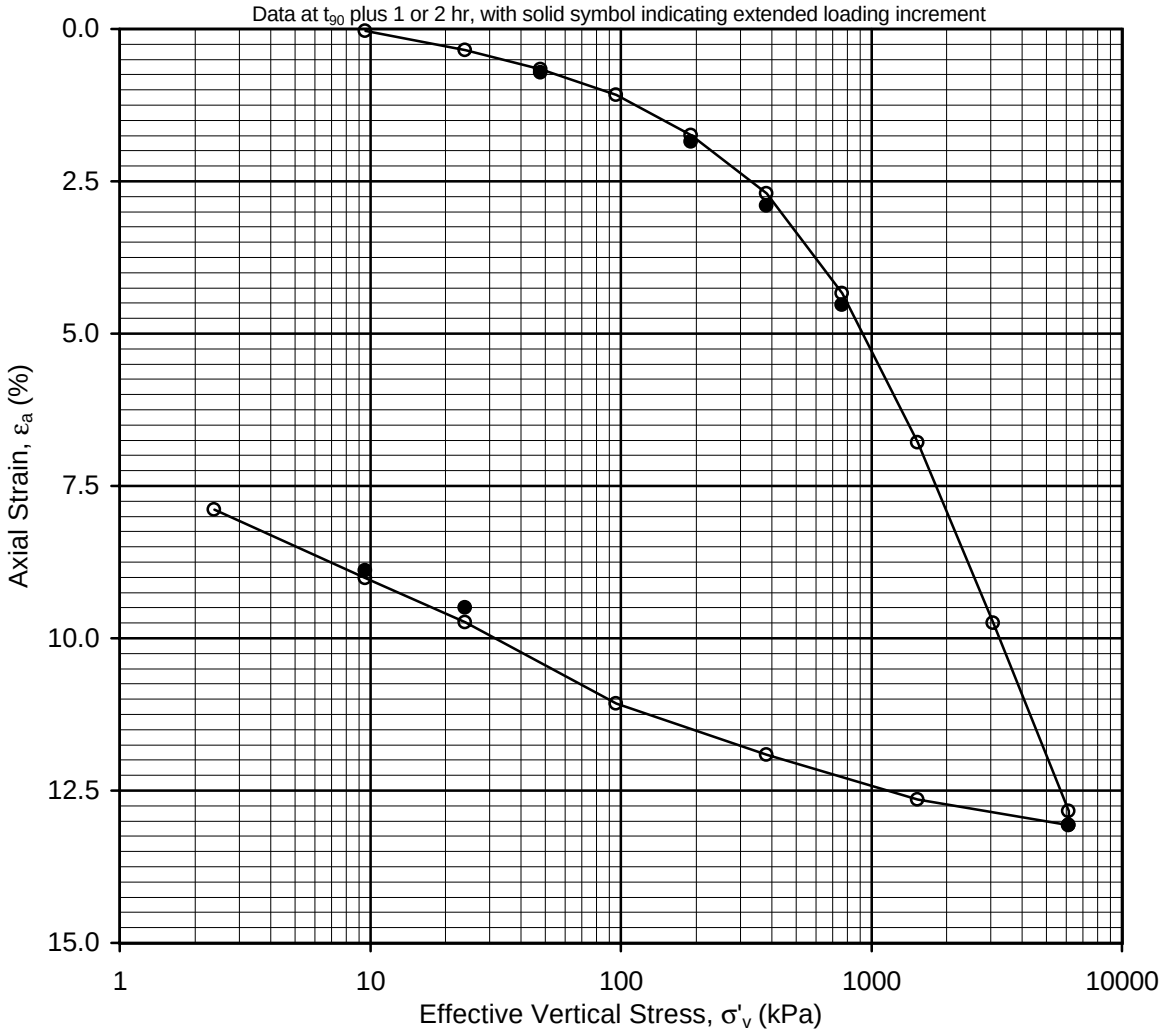


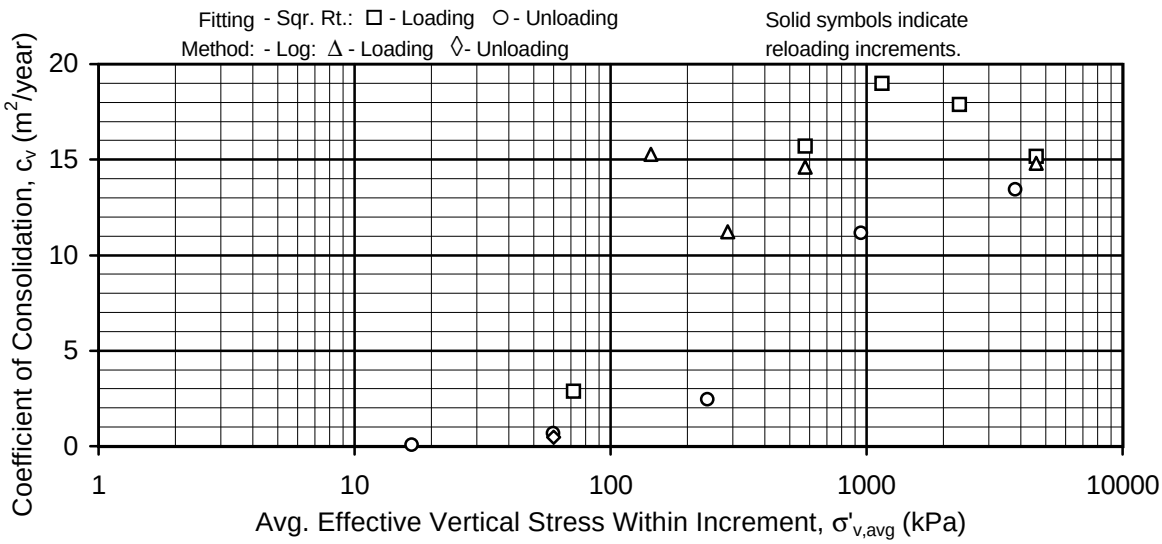


CRS CONSOLIDATION TEST RESULTS

Sample No. 34A - Depth: 22.2m
Boring 98-38
SFOBB East Span Seismic Safety Project

PLATE 98-38.14d

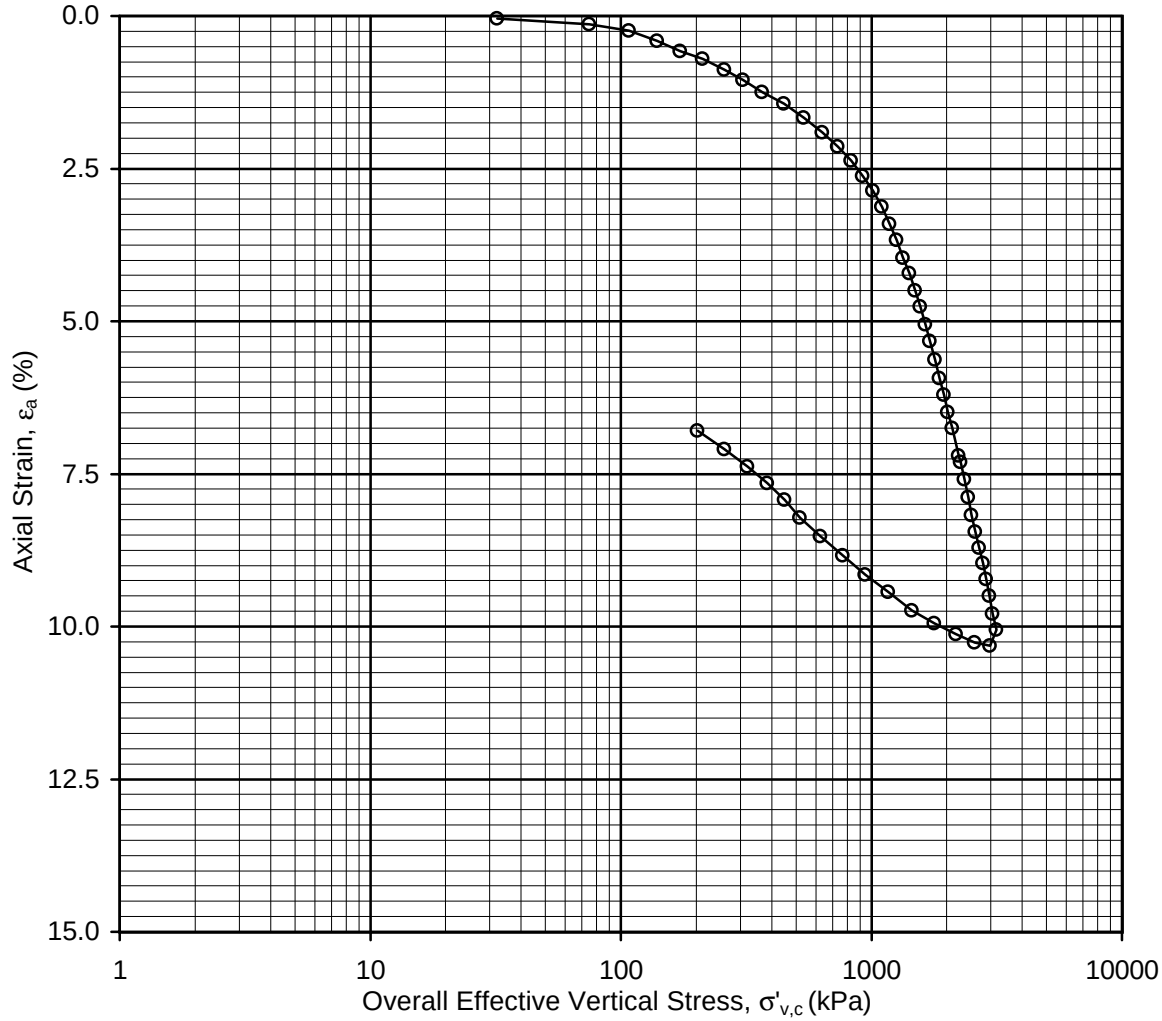


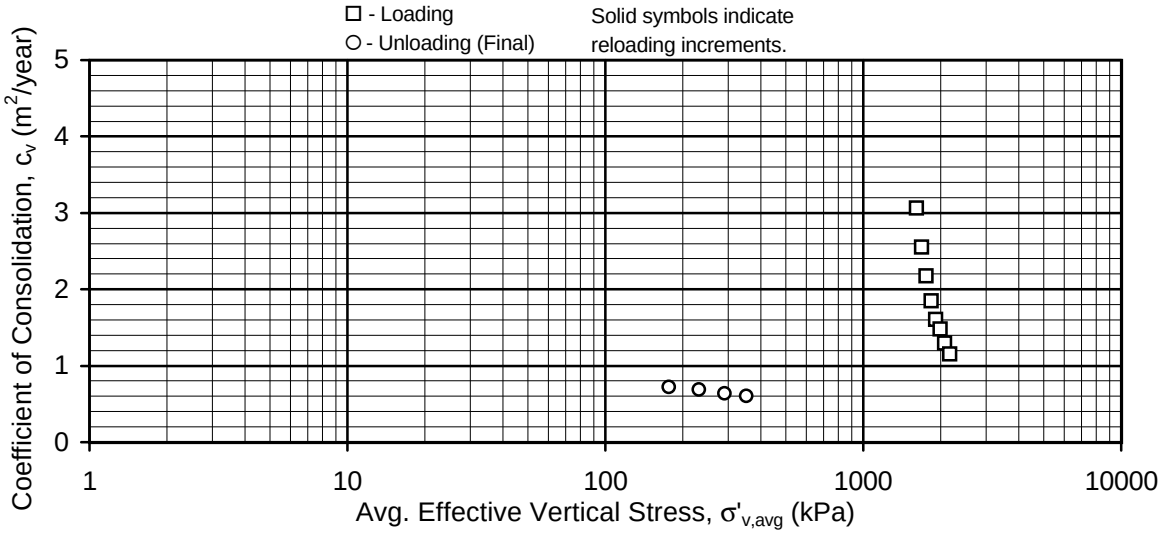


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 45 - Depth: 33.4m
Boring 98-38
SFOBB East Span Seismic Safety Project

PLATE 98-38.14e

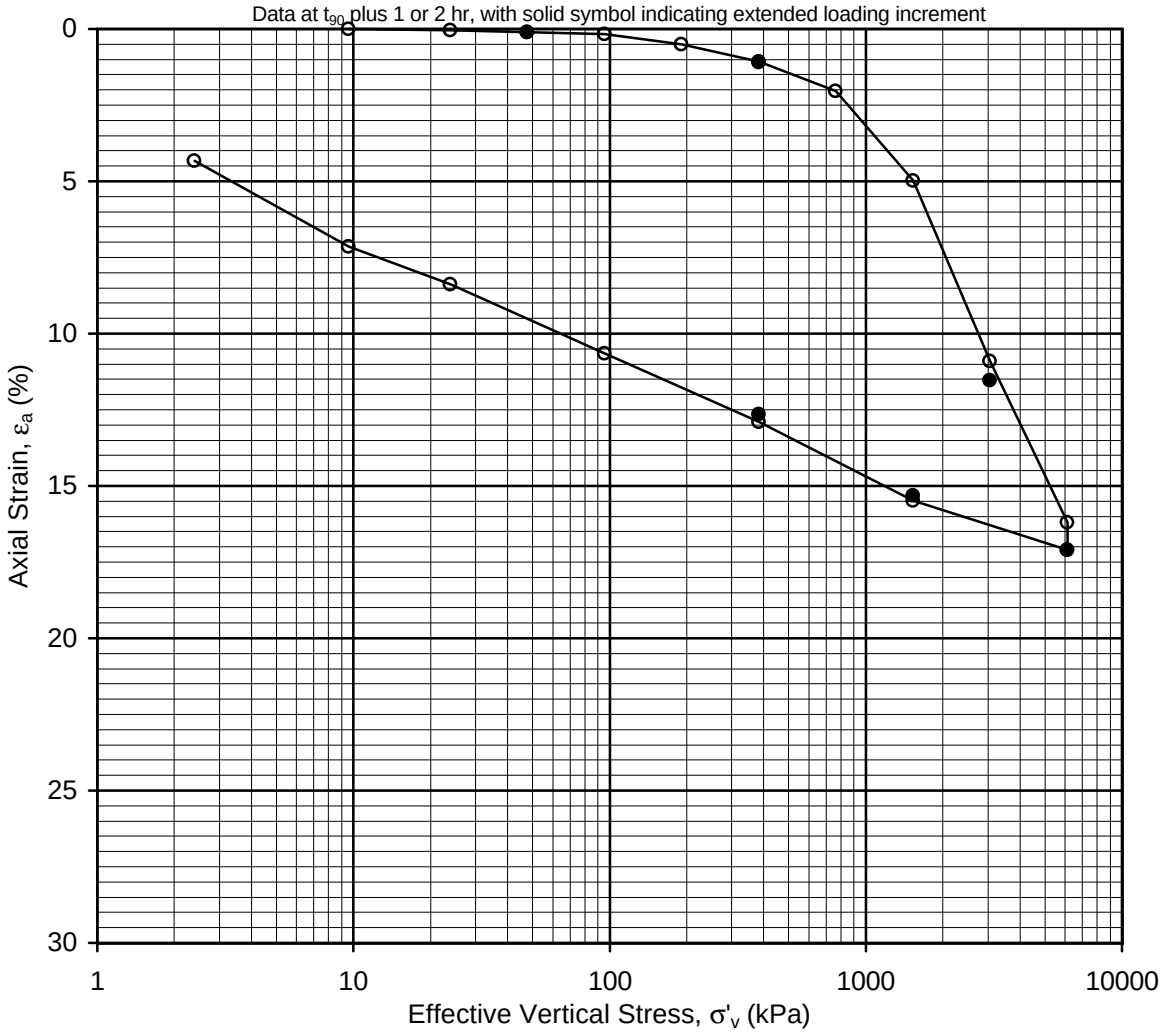


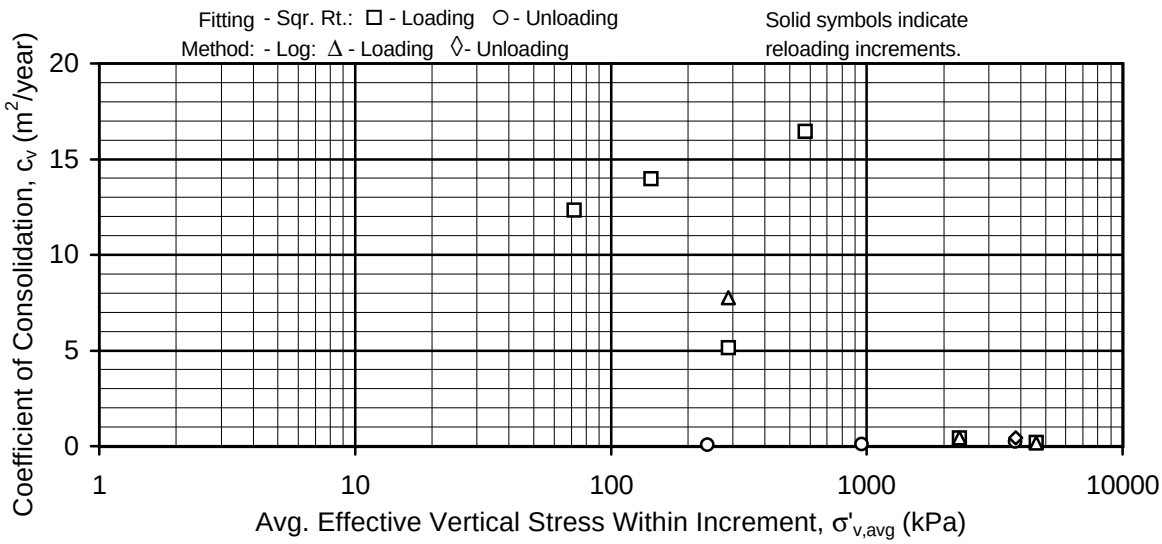


CRS CONSOLIDATION TEST RESULTS

Sample No. 56 - Depth: 48.6m
Boring 98-38
SFOBB East Span Seismic Safety Project

PLATE 98-38.14f

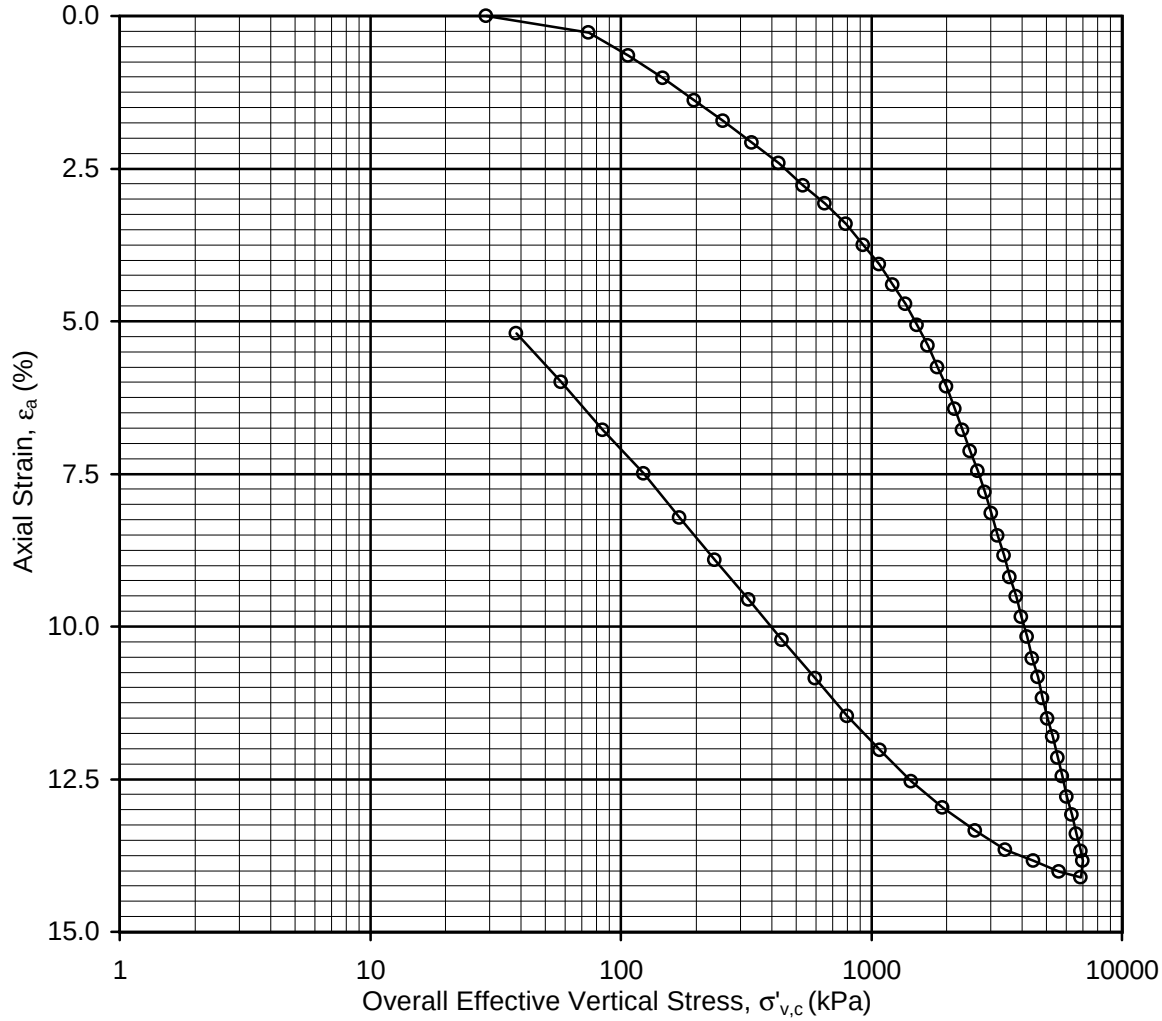


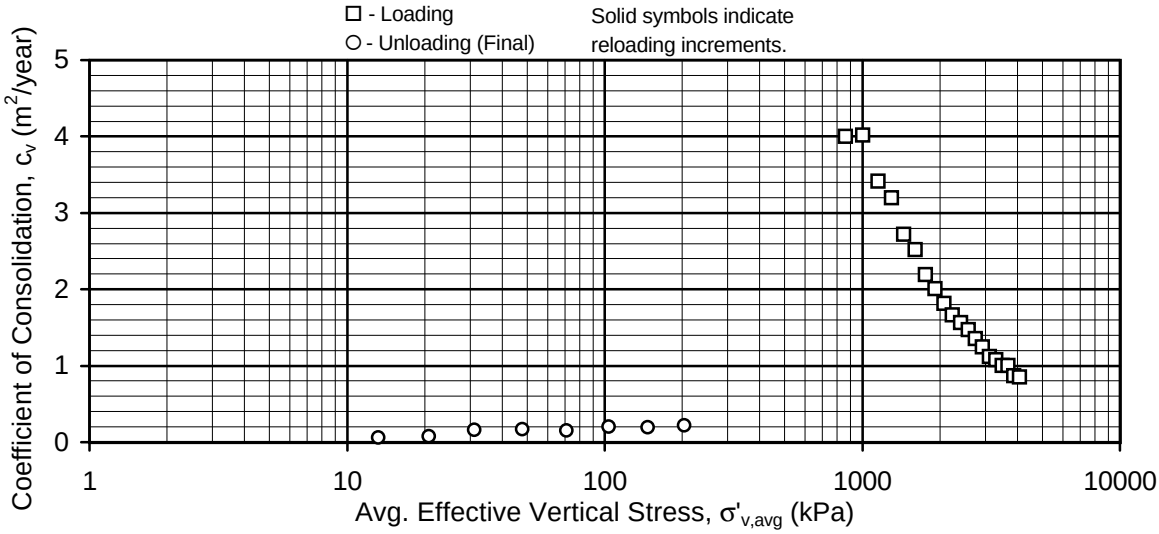


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 67 - Depth: 64.6m
Boring 98-38
SFOBB East Span Seismic Safety Project

PLATE 98-38.14g

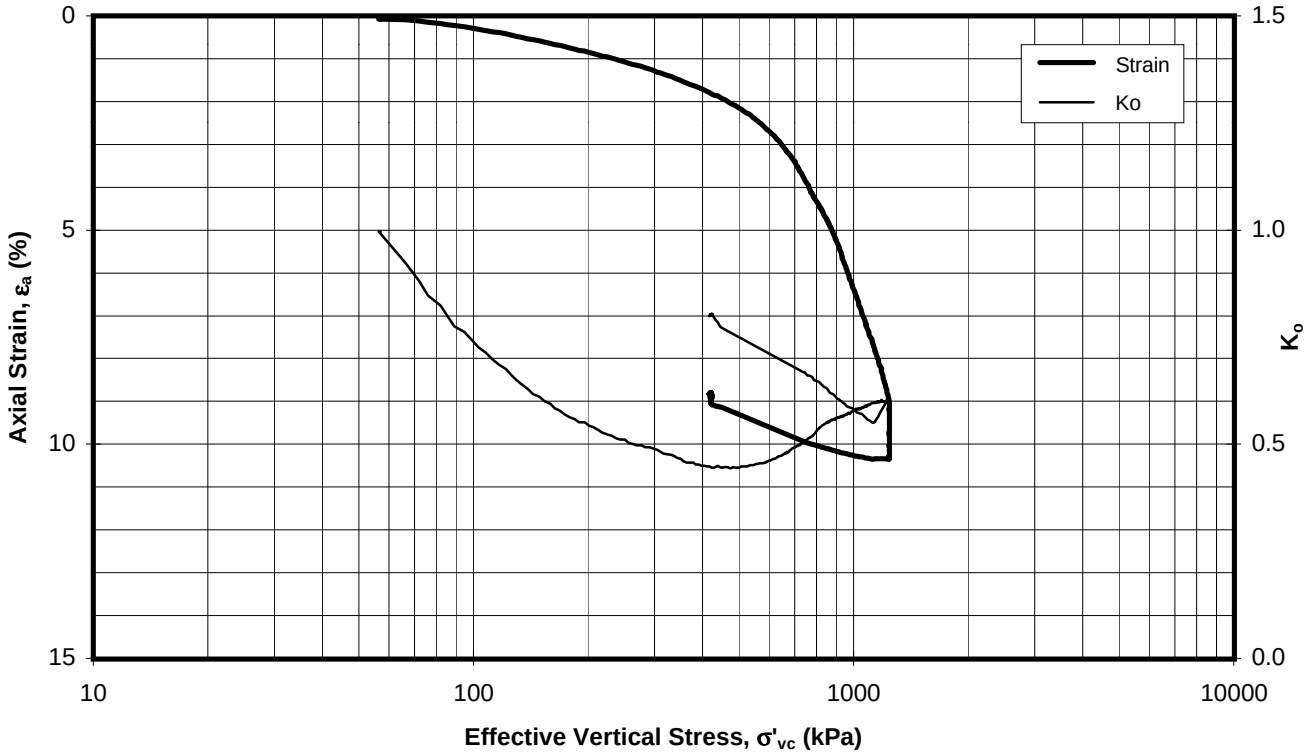


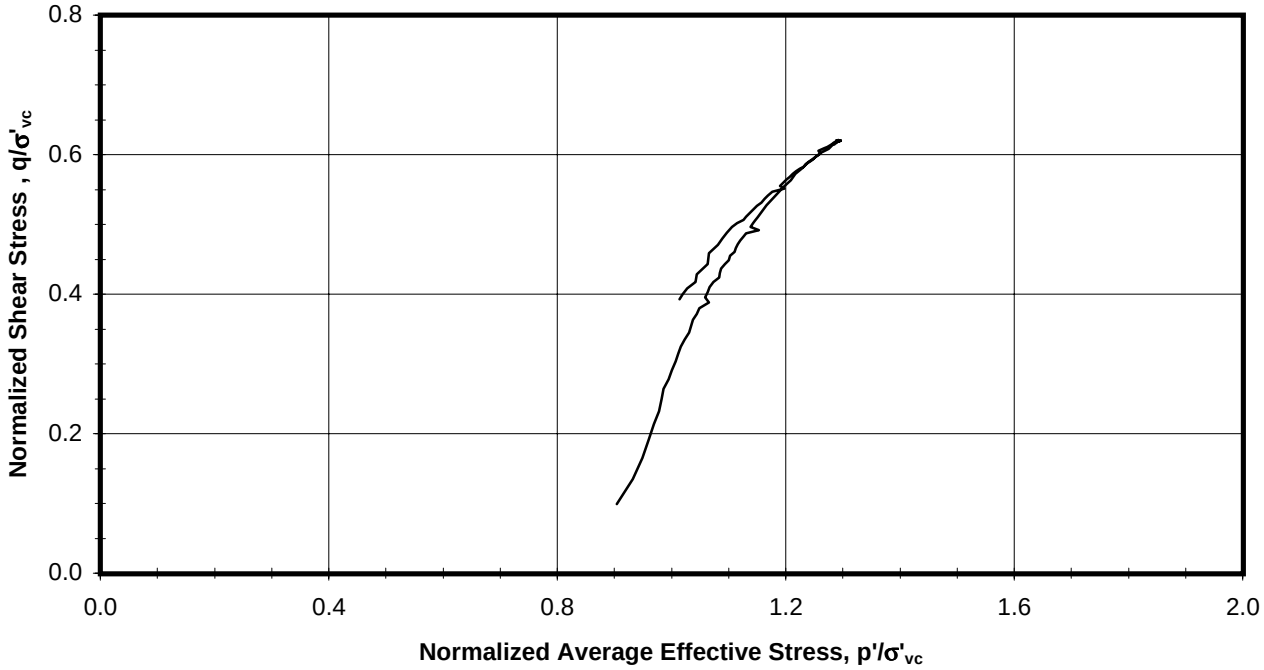


CRS CONSOLIDATION TEST RESULTS

Sample No. 79 - Depth: 78.5m
Boring 98-38
SFOBB East Span Seismic Safety Project

PLATE 98-38.14h





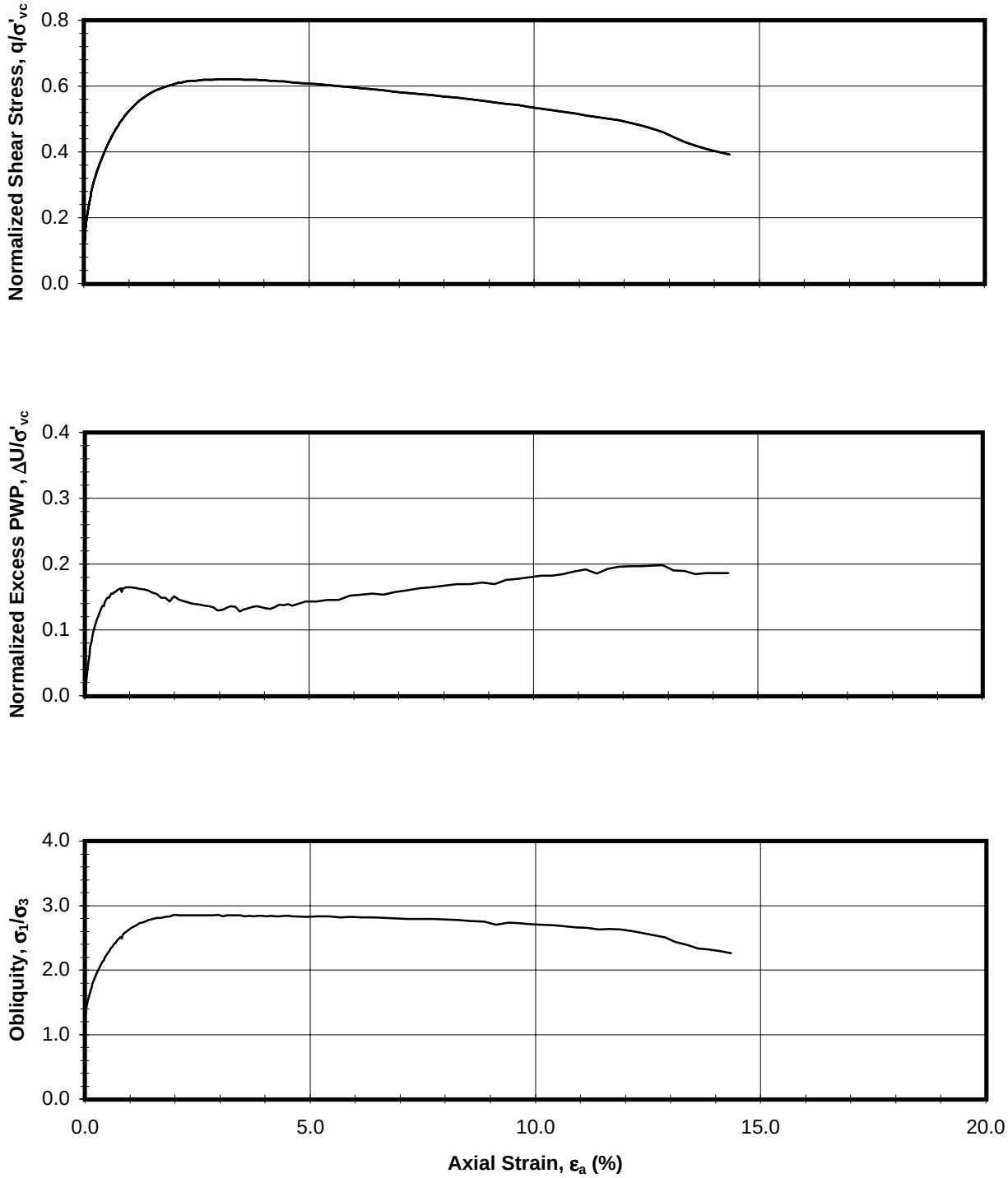
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 45 - Depth: 33.4m

Boring 98-38

SFOBB East Span Seismic Safety Project

PLATE 98-38.15a.1

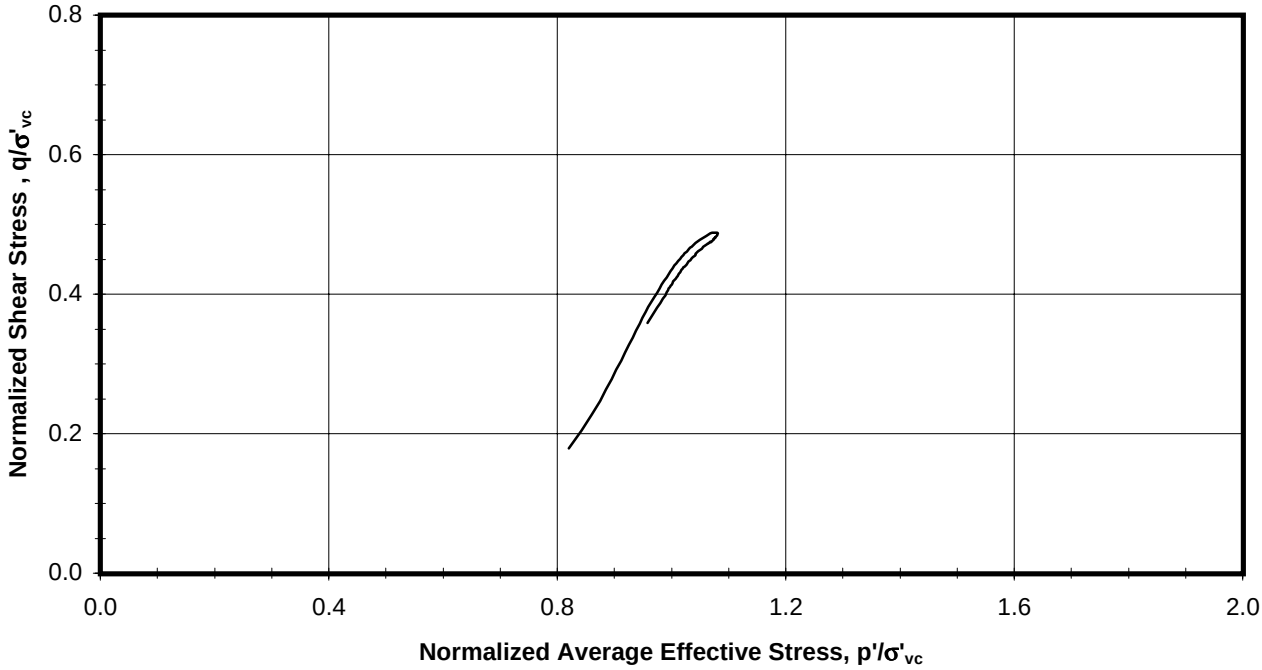


Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 45 - Depth: 33.4m

Boring 98-38

SFOBB East Span Seismic Safety Project



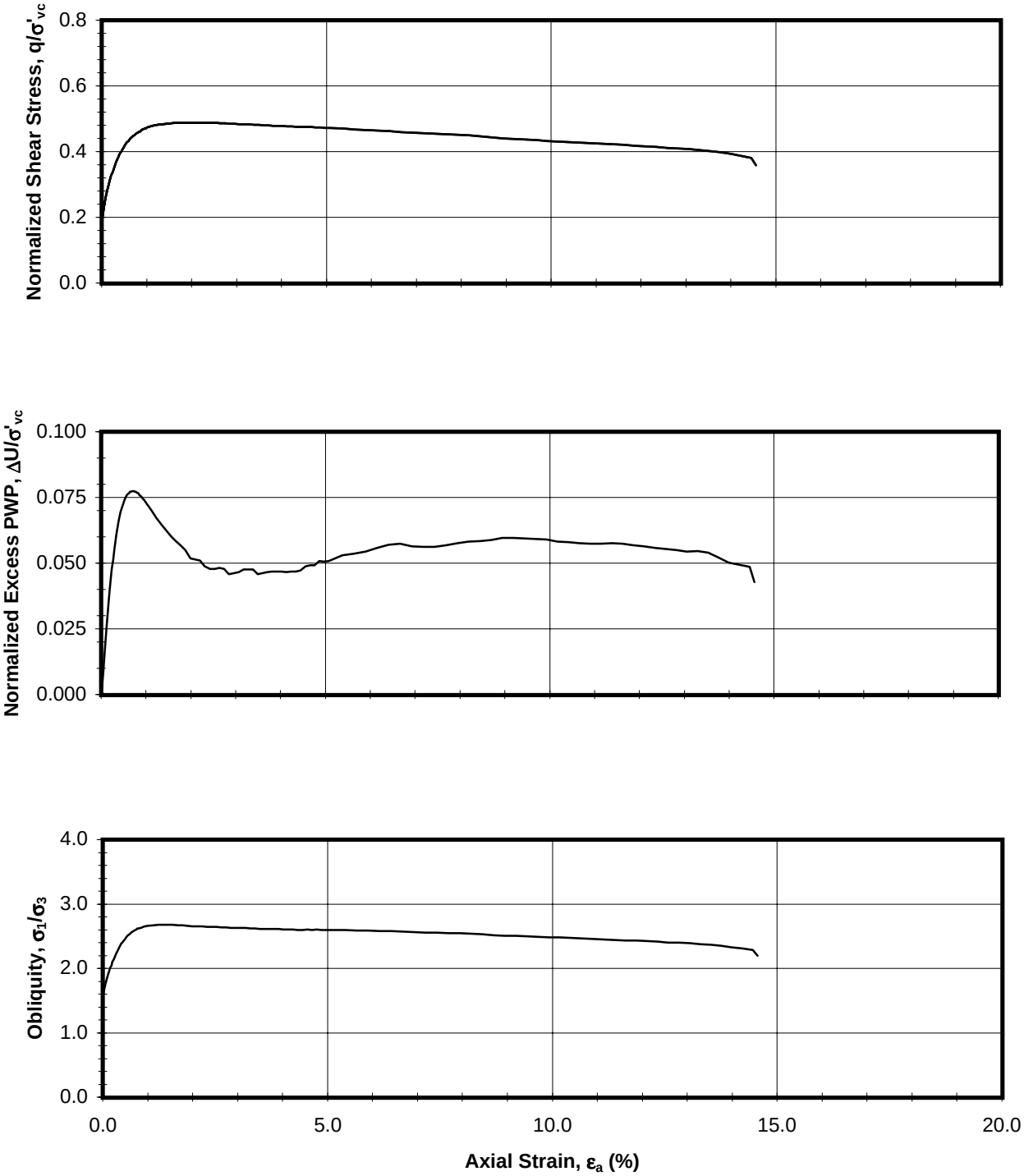
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 67 - Depth: 64.4m

Boring 98-38

SFOBB East Span Seismic Safety Project

PLATE 98-38.15b.1

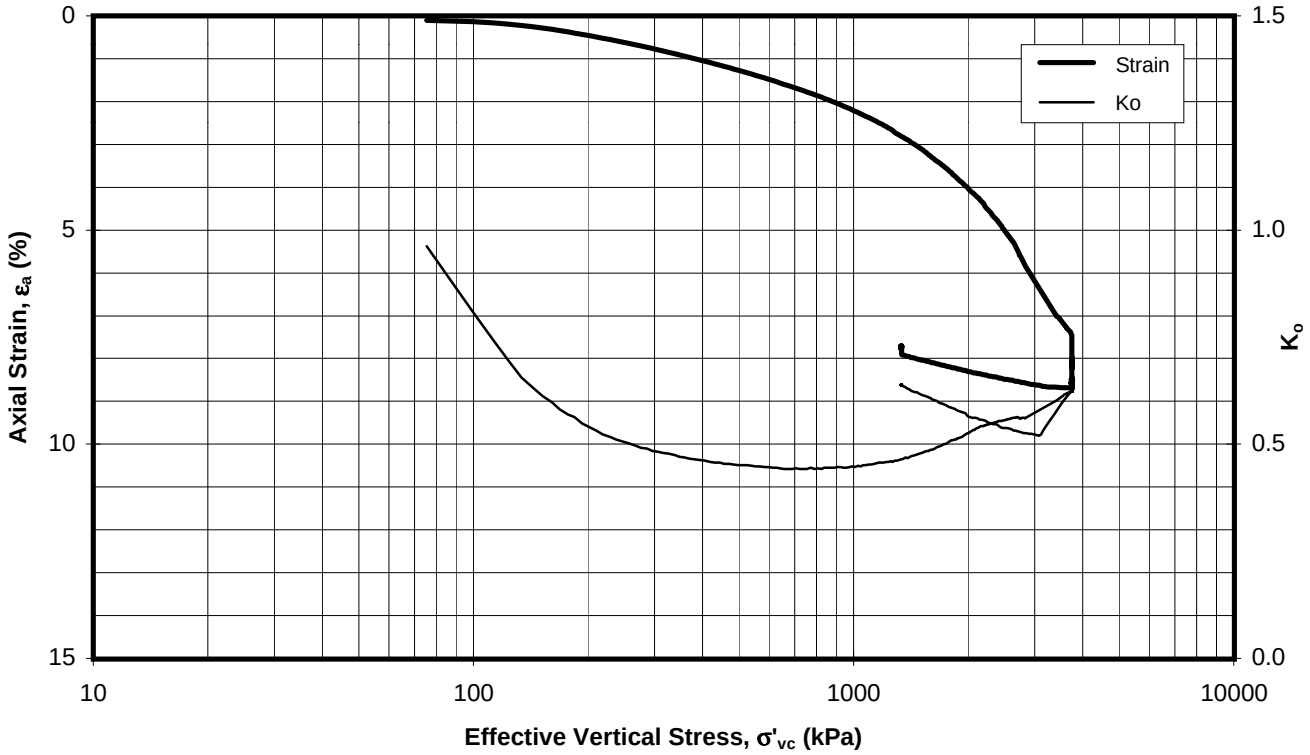


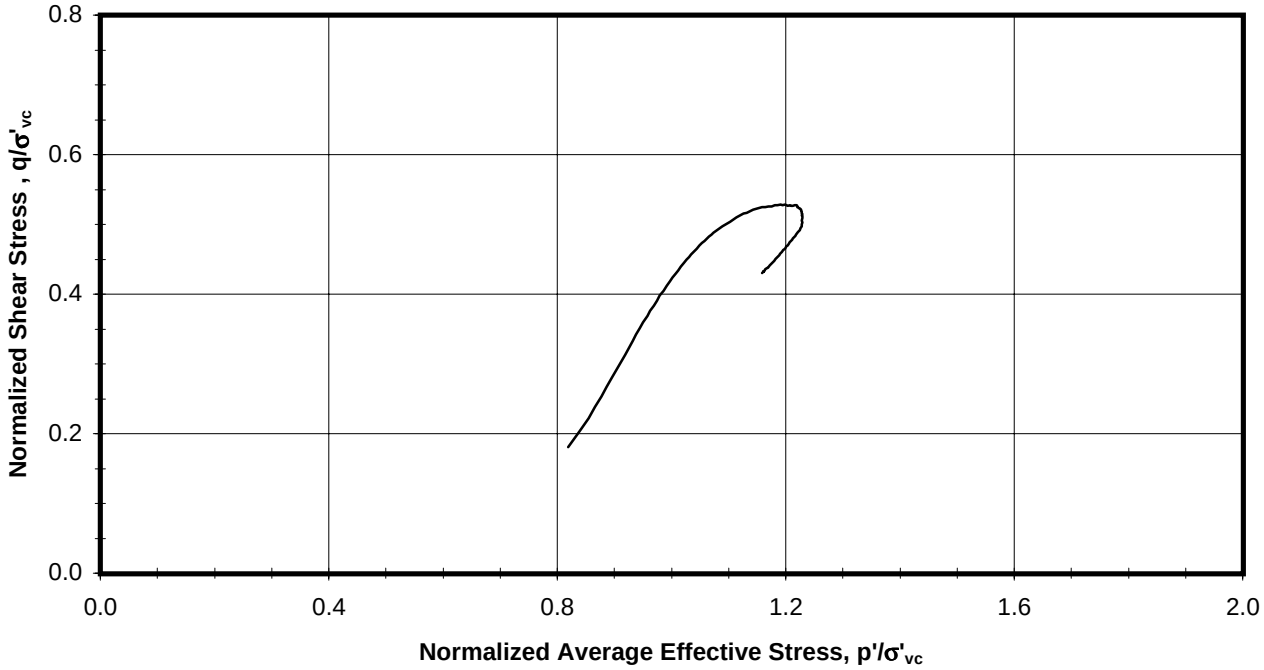
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 67 - Depth: 64.4m

Boring 98-38

SFOBB East Span Seismic Safety Project





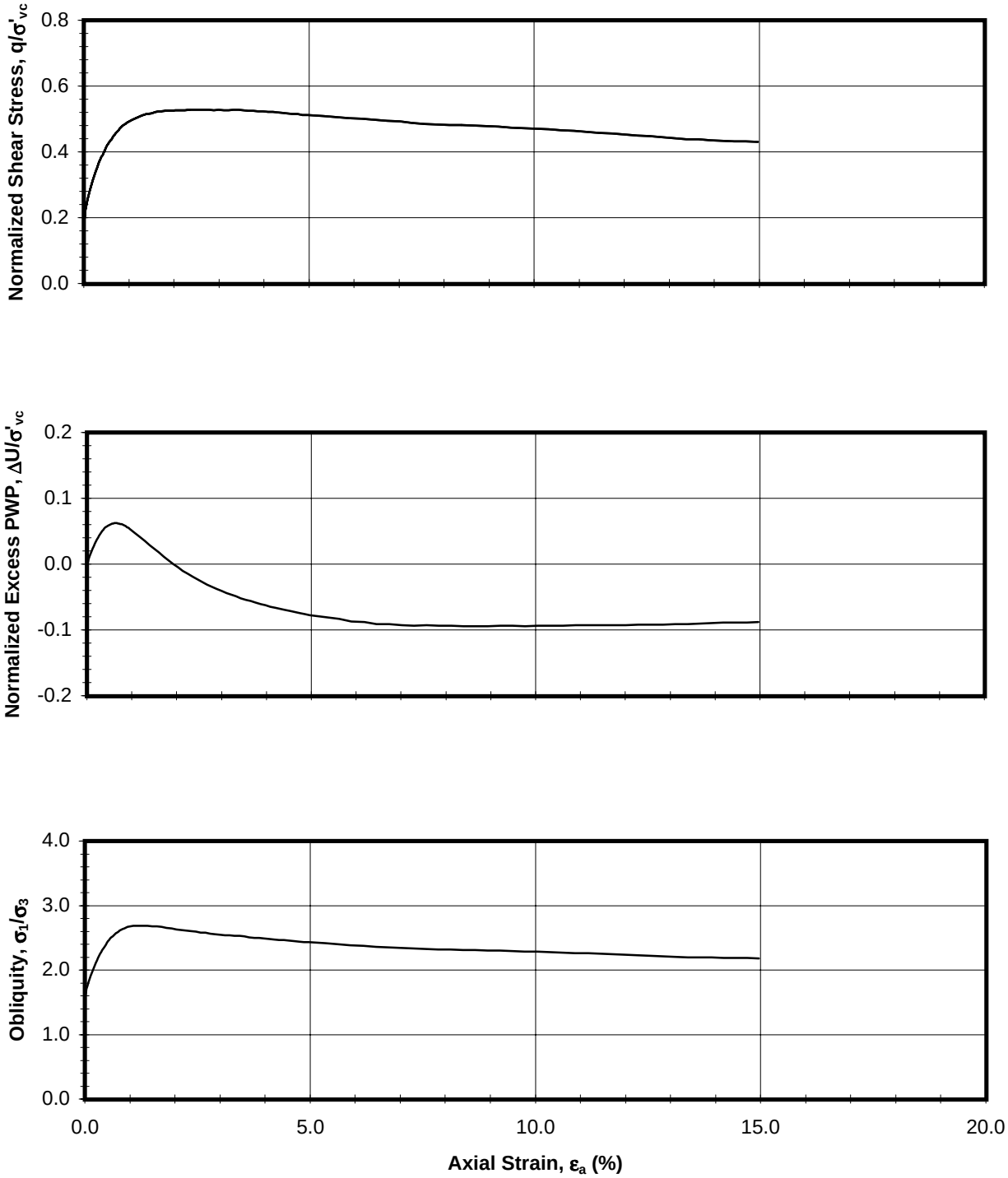
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 79 - Depth: 78.5m

Boring 98-38

SFOBB East Span Seismic Safety Project

PLATE 98-38.15c.1



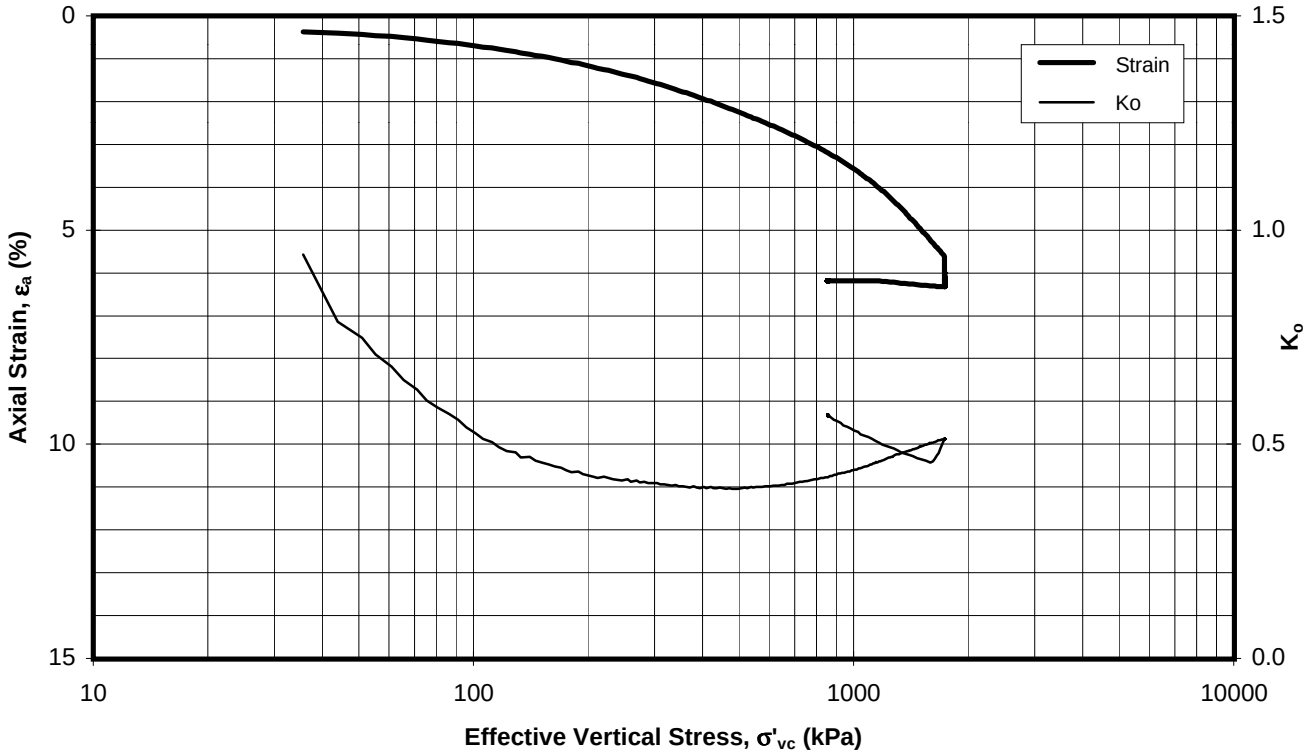
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

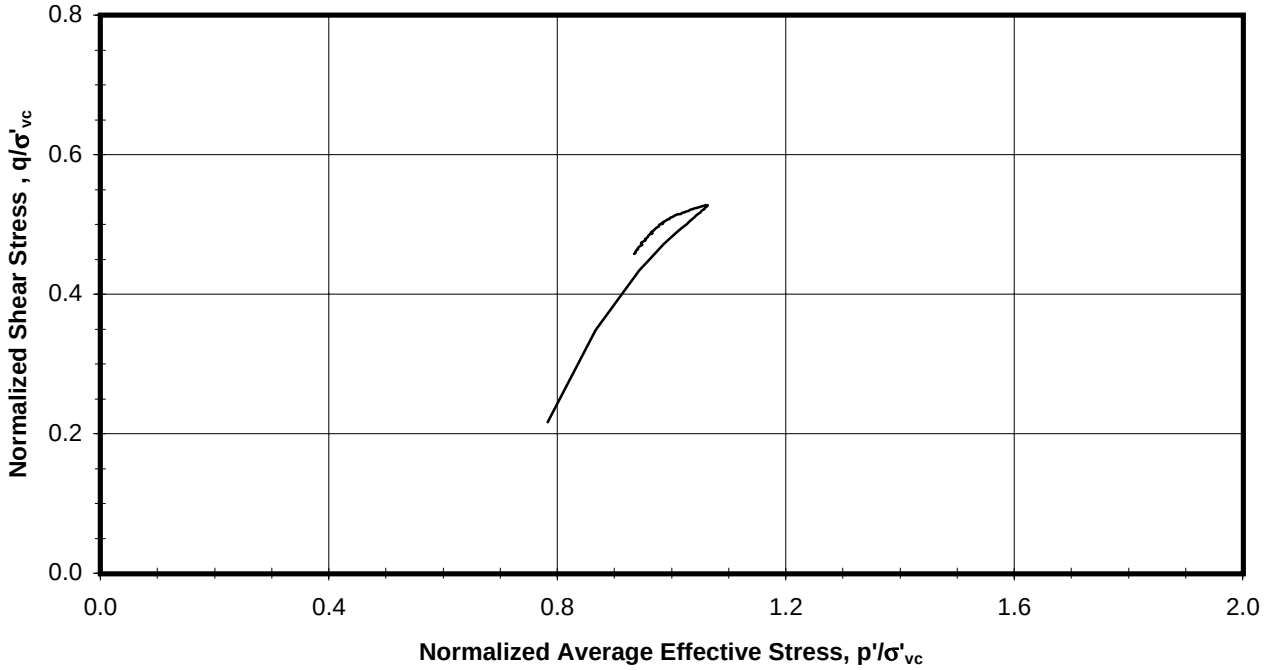
Sample No. 79 - Depth: 78.5m

Boring 98-38

SFOBB East Span Seismic Safety Project

PLATE 98-38.15c.2





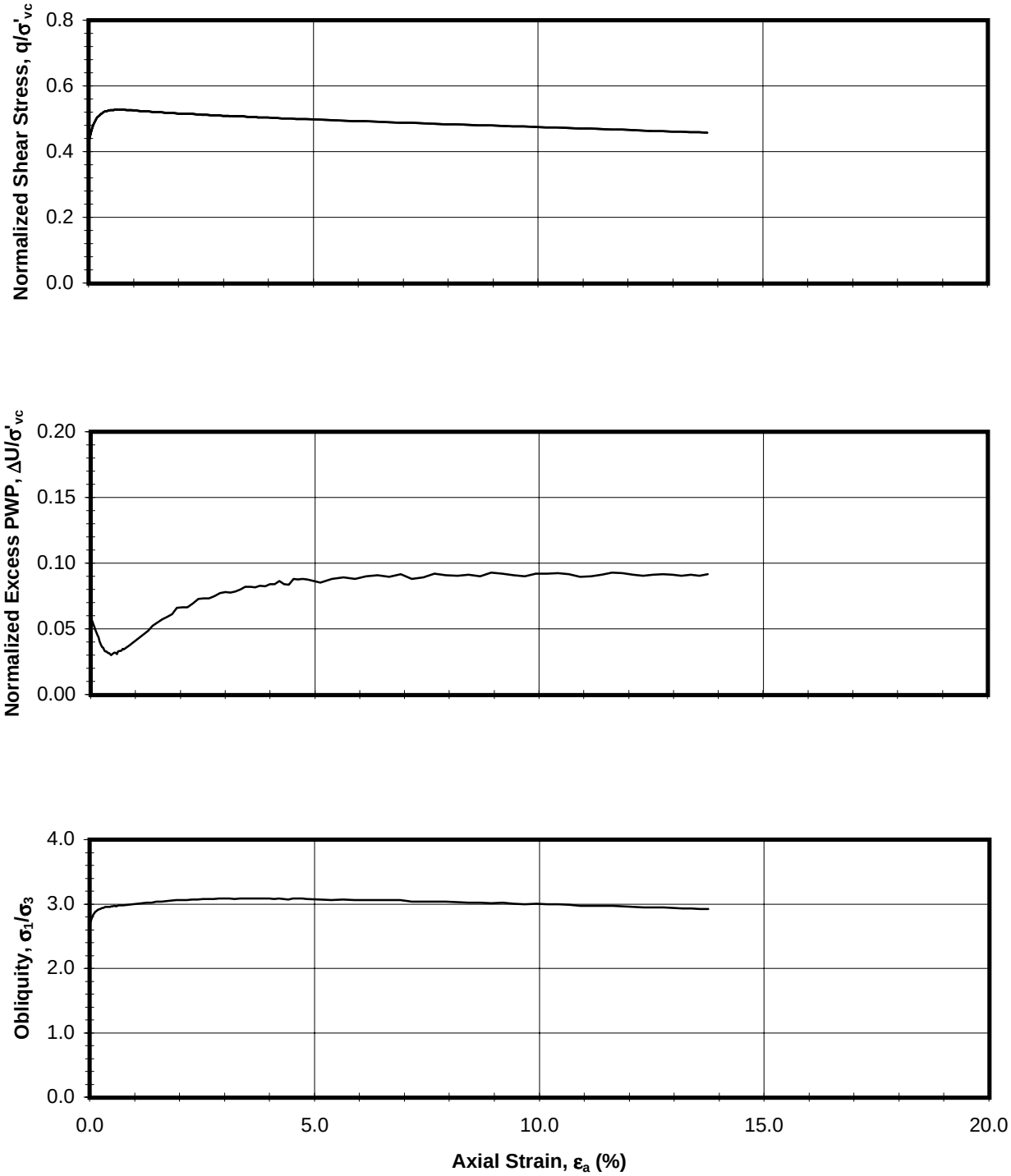
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 95 - Depth: 101.1m

Boring 98-38

SFOBB East Span Seismic Safety Project

PLATE 98-38.15d.1



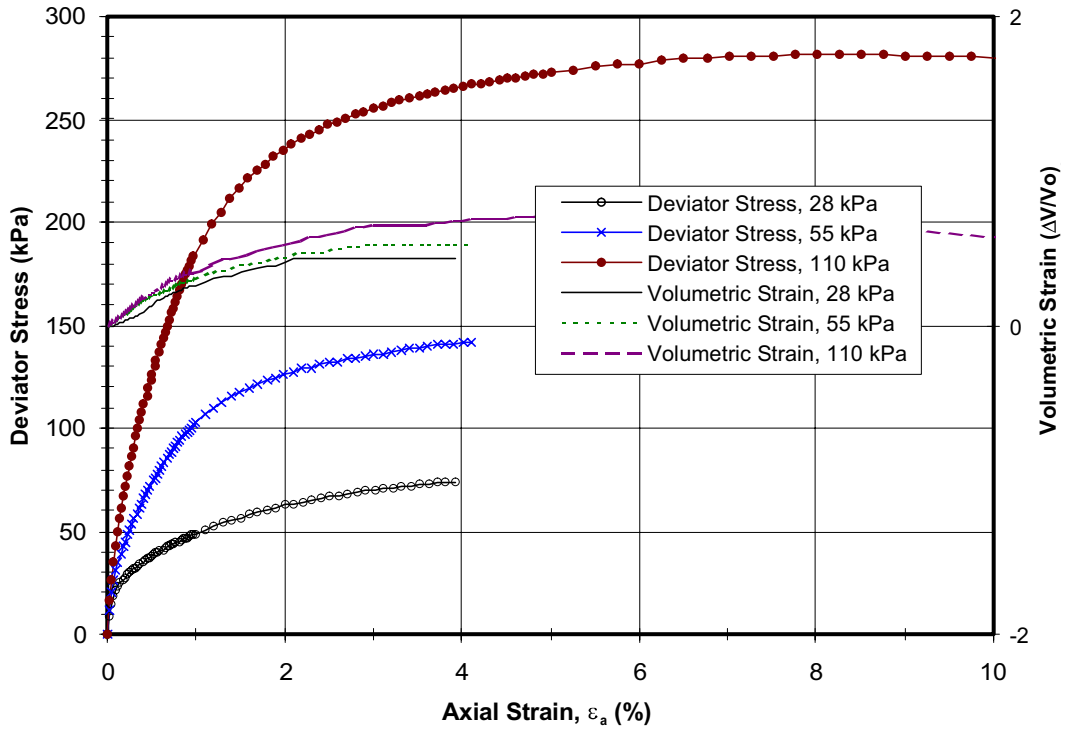
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

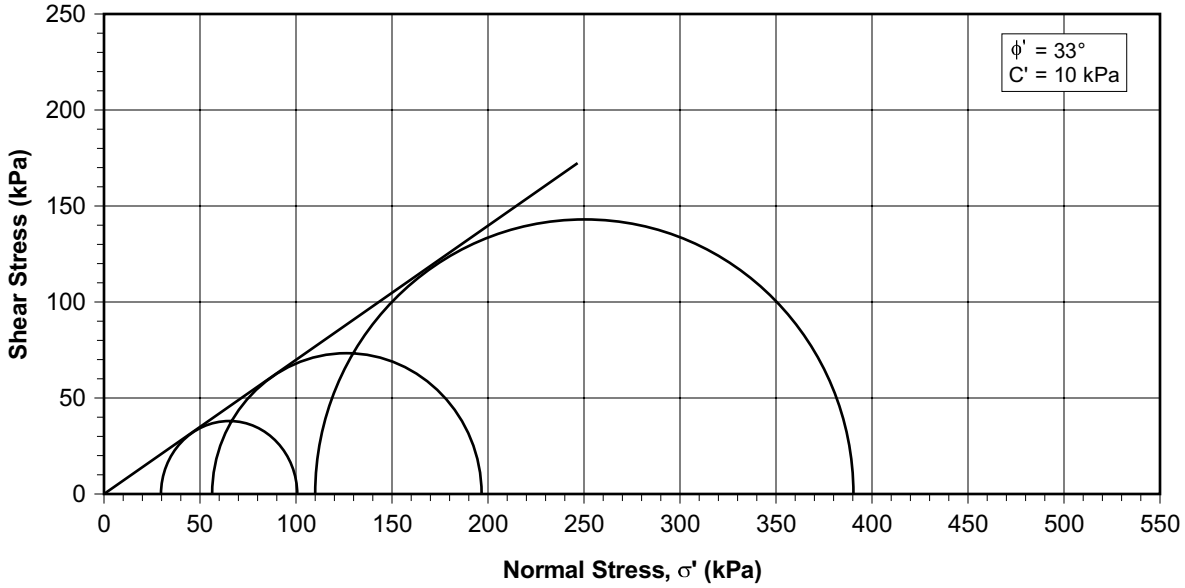
Sample No. 95 - Depth: 101.1m

Boring 98-38

SFOBB East Span Seismic Safety Project

PLATE 98-38.15d.2





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

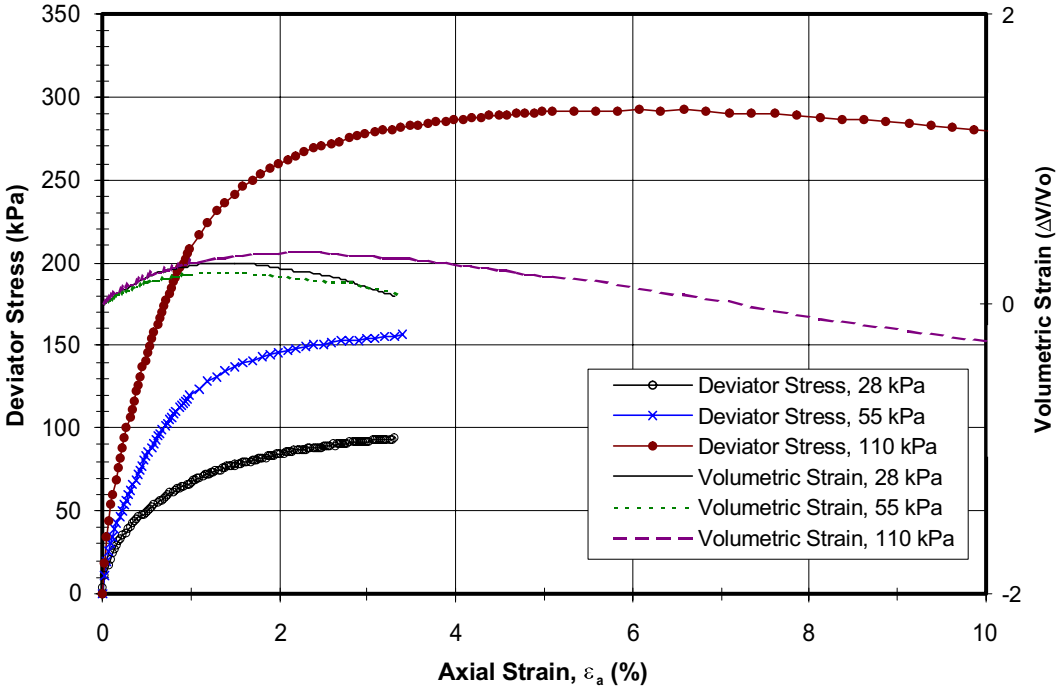
Sample 12 - Depth: 4.3m

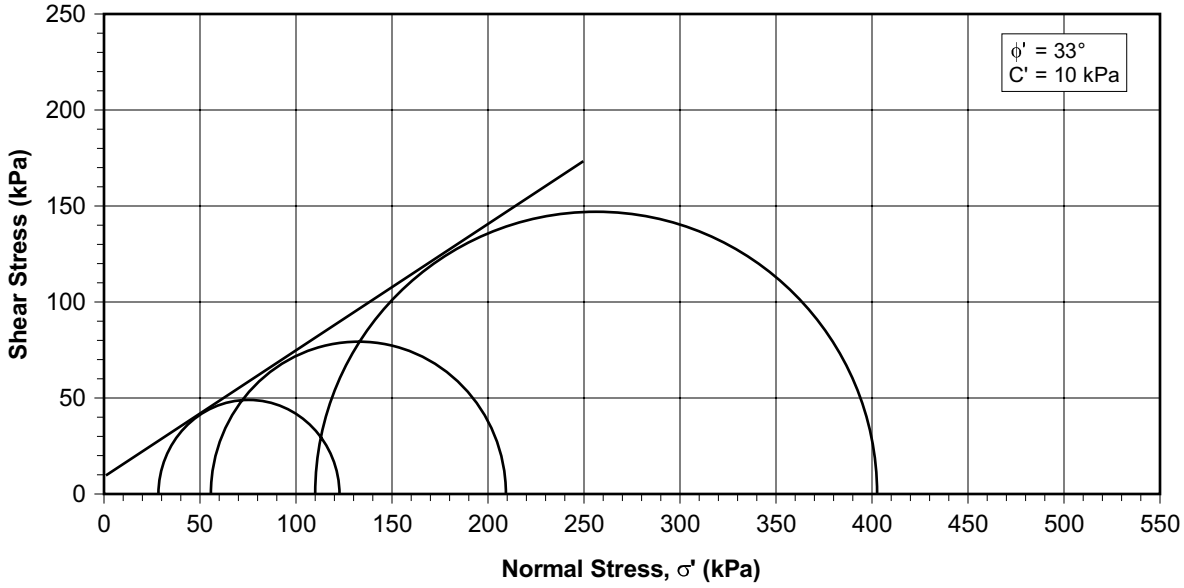
Boring 98-38

SFOBB East Span Seismic Safety Project

PLATE 98-38.16a

9842\0054\38a.dsf(1,2);q\caltrans\excel\phase2\cds\38s13.xls





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

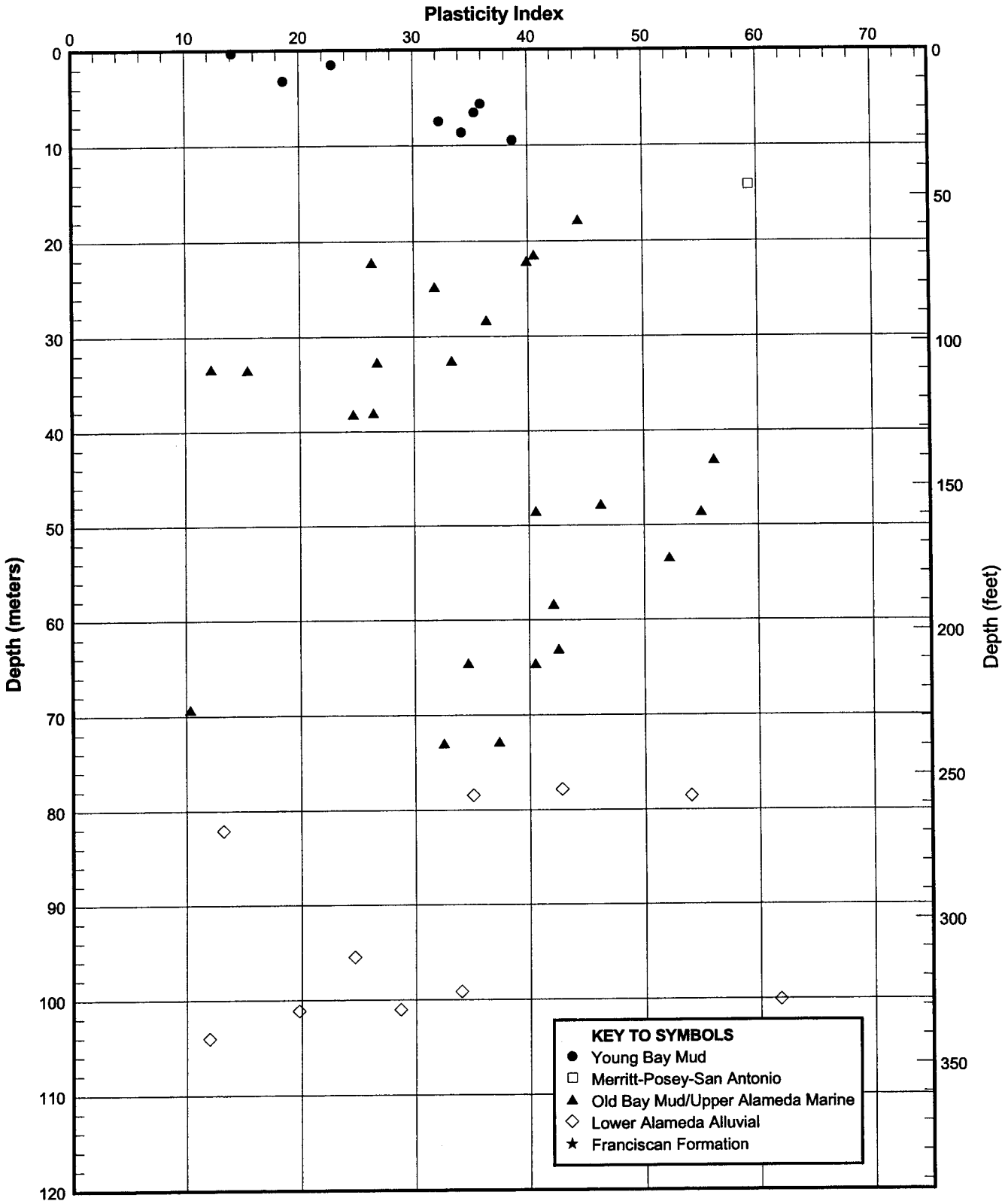
Sample 13 - Depth: 4.7m

Boring 98-38

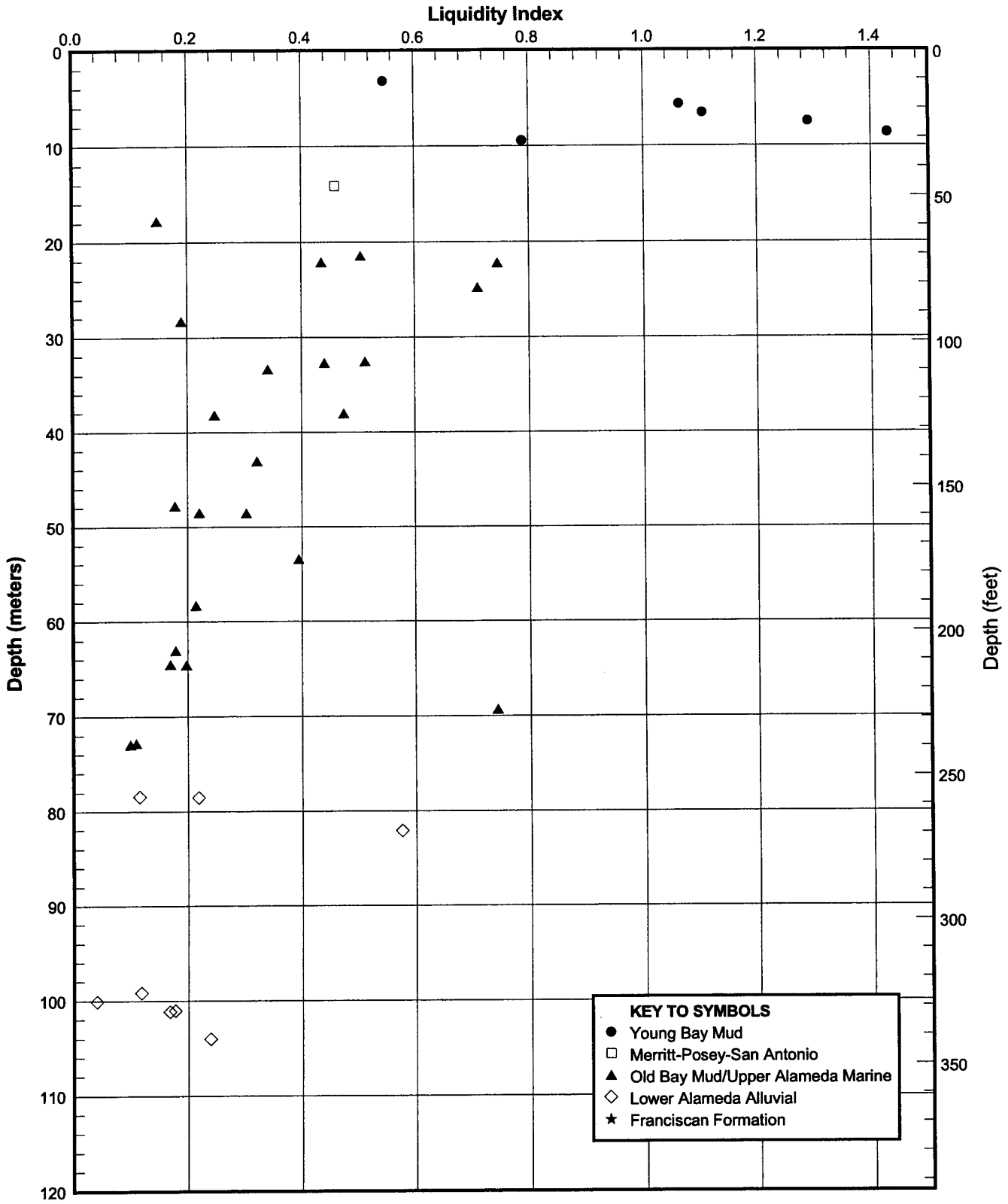
SFOBB East Span Seismic Safety Project

PLATE 98-38.16b

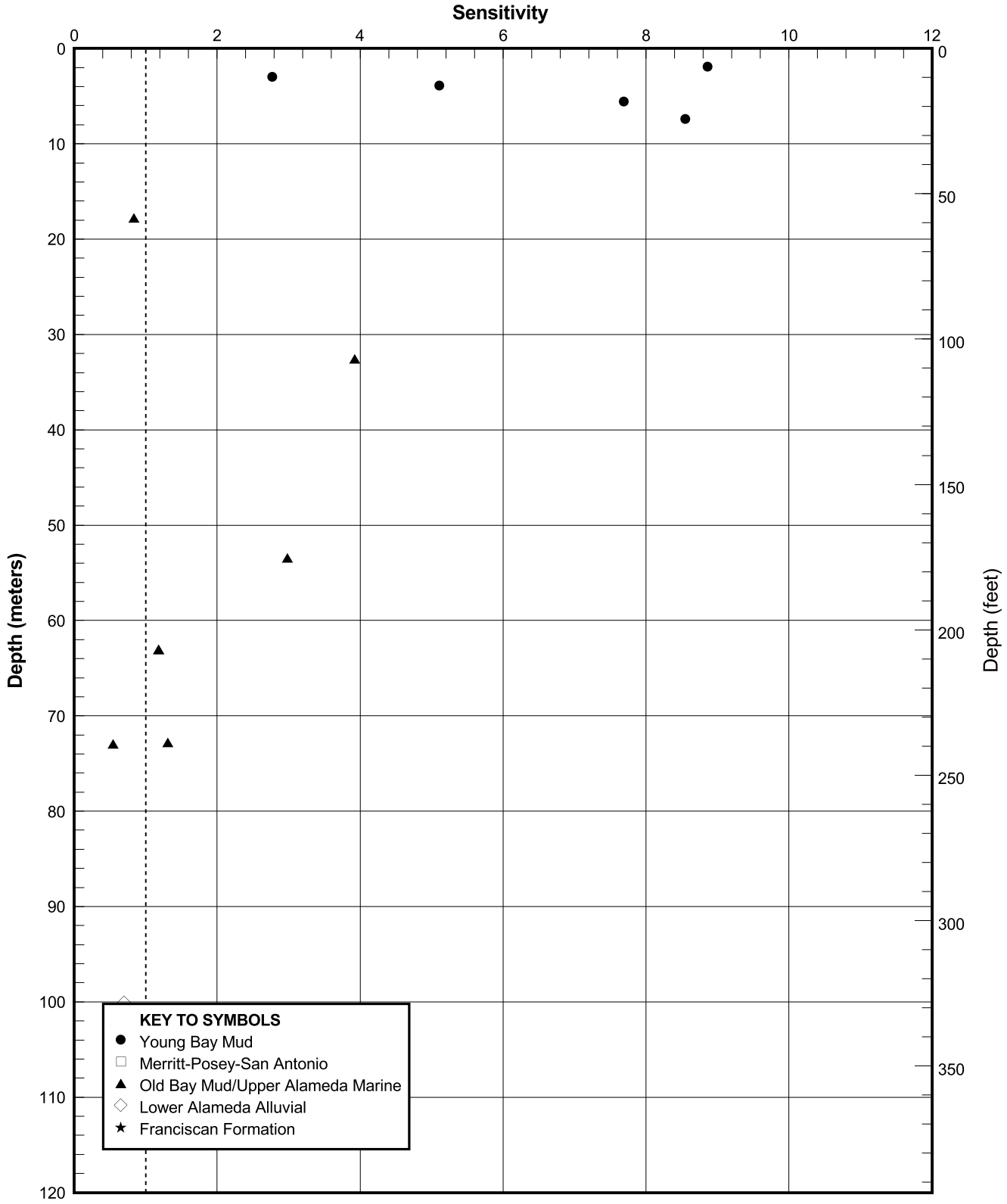
9842\0054\38b.dsf(1,2);q\caltrans\excel\phase2\cds\38s13.xls



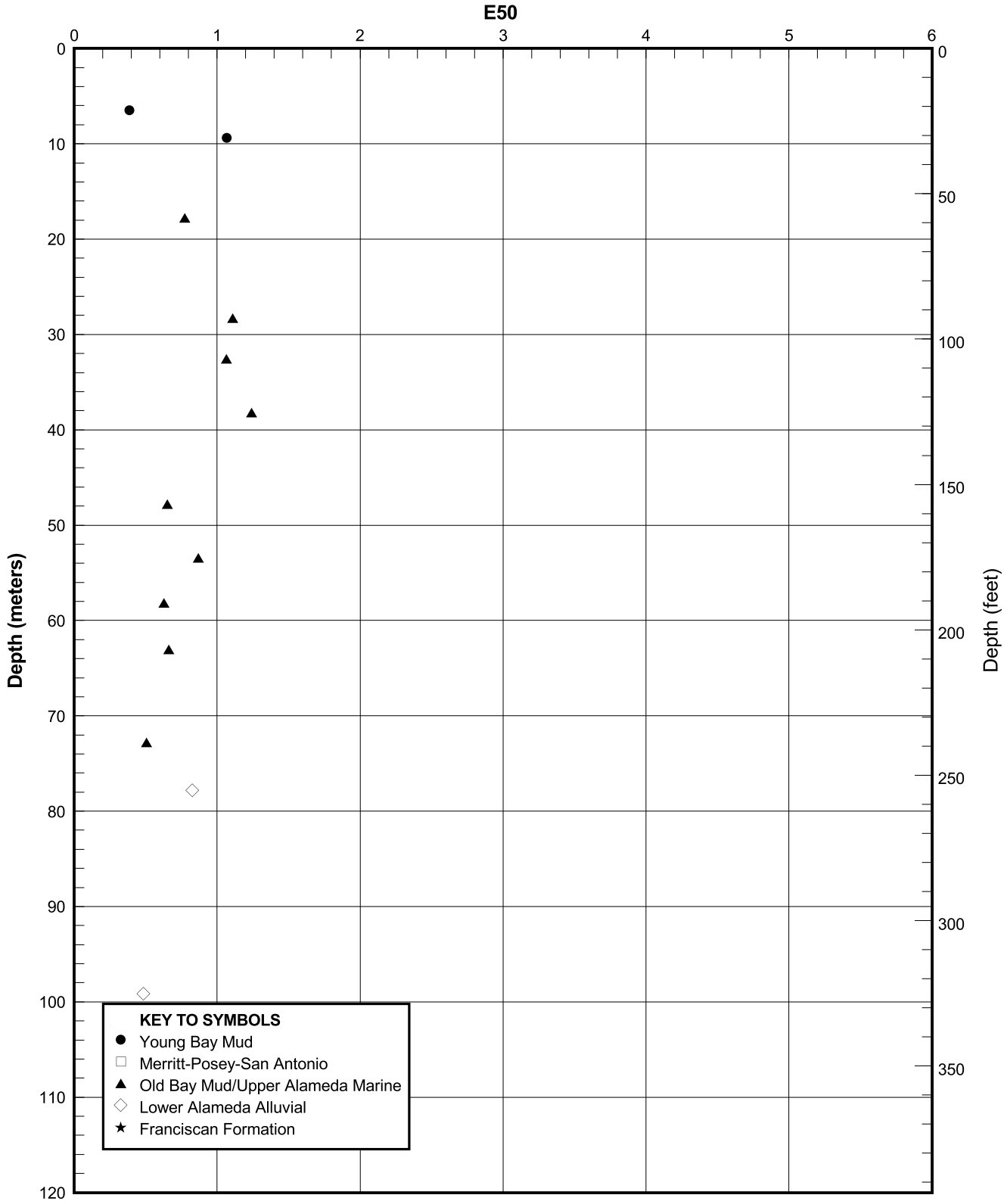
PLASTICITY INDEX PROFILE
Boring 98-38
SFOBB East Span Seismic Safety Project



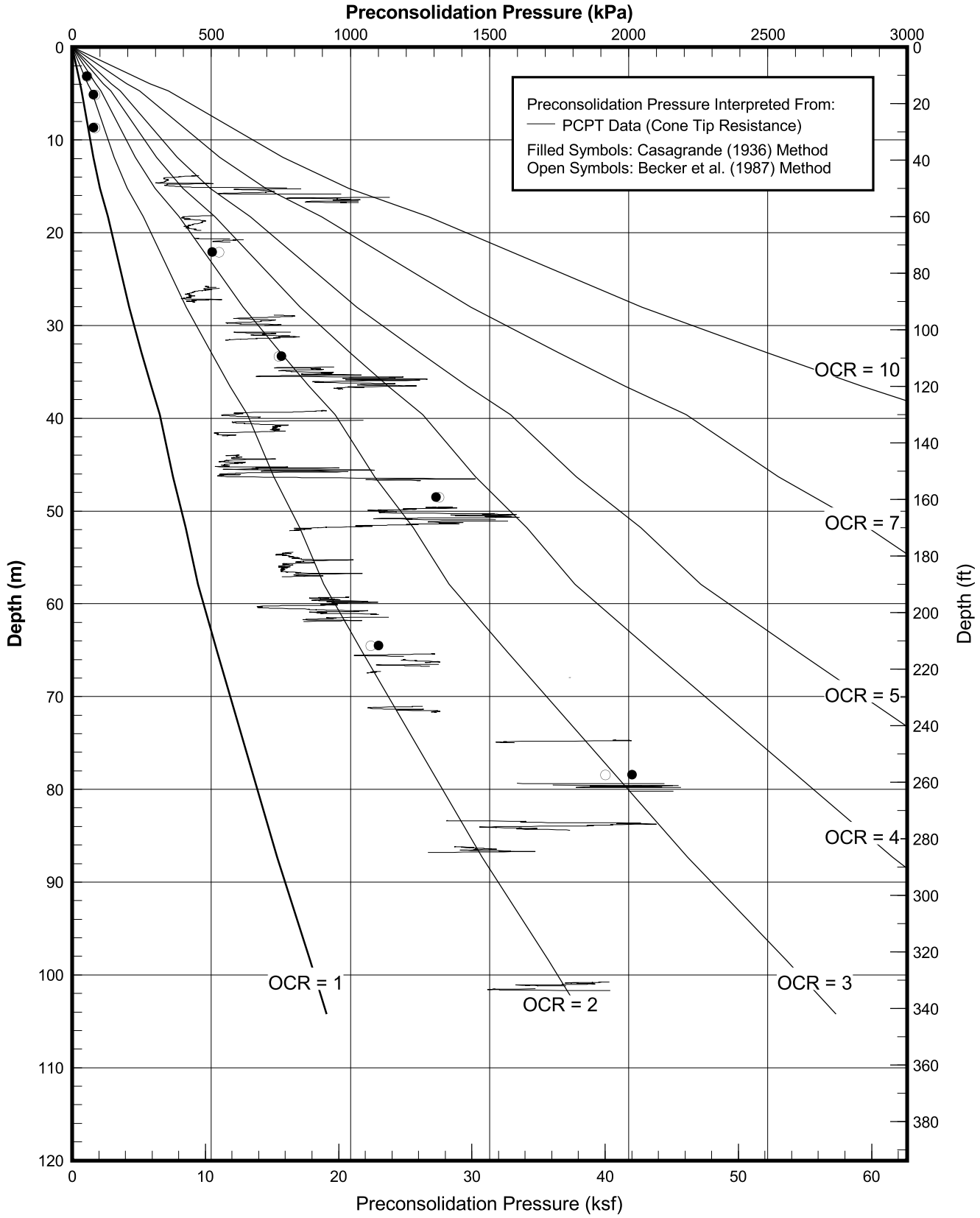
LIQUIDITY INDEX PROFILE
Boring 98-38
SFOBB East Span Seismic Safety Project



SENSITIVITY PROFILE
Boring 98-38
SFOBB East Span Seismic Safety Project



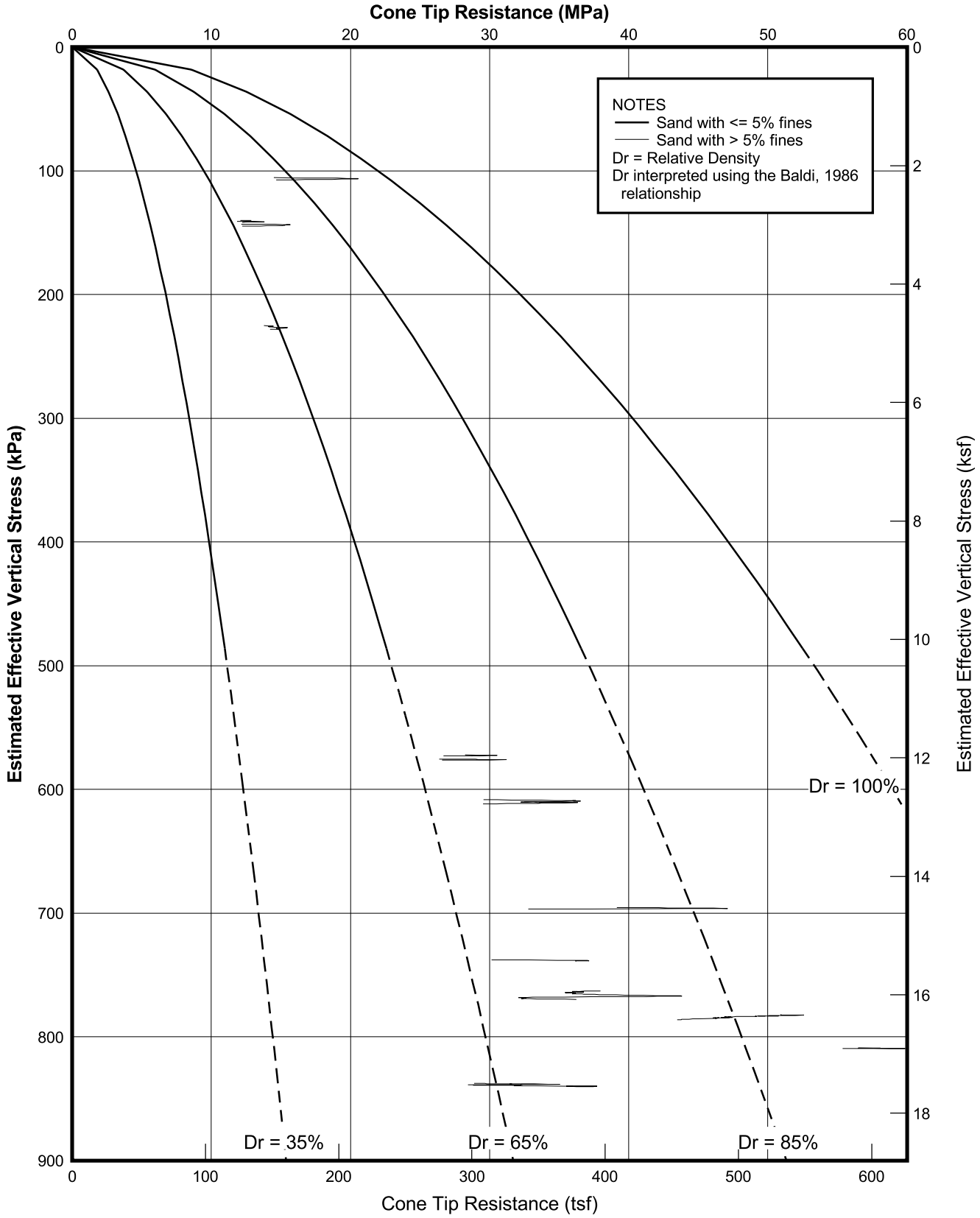
E50 PROFILE
Boring 98-38
SFOBB East Span Seismic Safety Project



PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-38

SFOBB East Span Seismic Safety Project



RELATIVE DENSITY INTERPRETED FROM CPT DATA

Boring 98-38

SFOBB East Span Seismic Safety Project