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FINAL MARINE GEOTECHNICAL SITE CHARACTERIZATION

SAN FRANCISCO-OAKLAND BAY BRIDGE EAST SPAN SEISMIC SAFETY PROJECT

VOLUME 2D - APPENDICES
(Borings 98-28 through 98-32)

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

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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

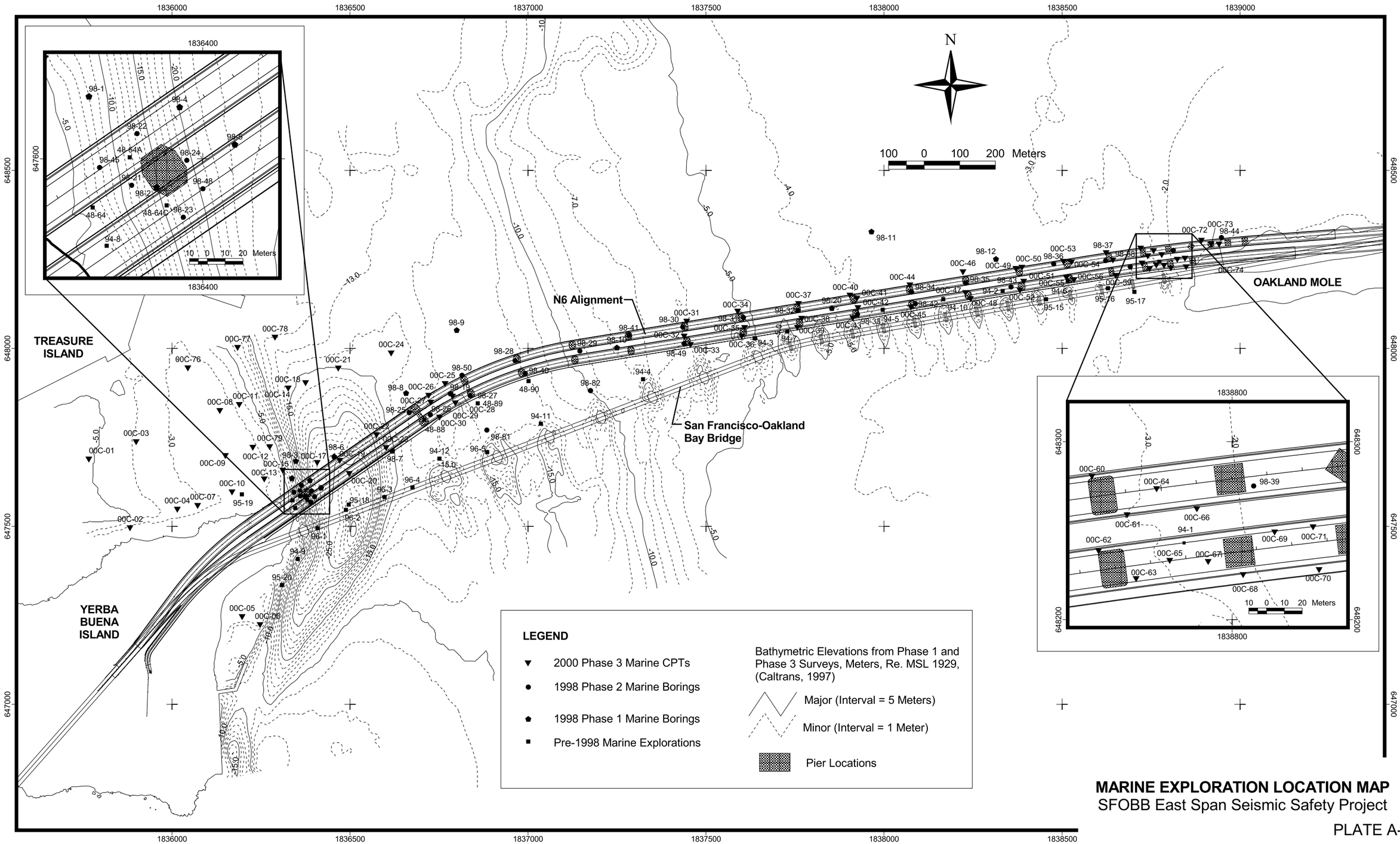
The results of the 77 marine CPT soundings are presented in Volume 2H of this report. The CPT logs provide graphical plots versus depth showing:

- 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)

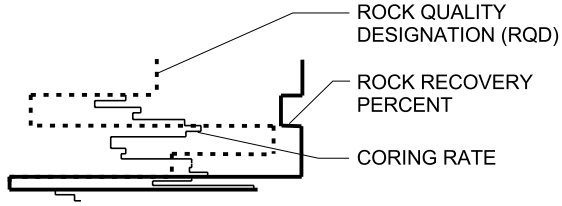
SAMPLERS

- 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

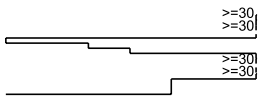
ROCK QUALITY AND CORING RATE



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

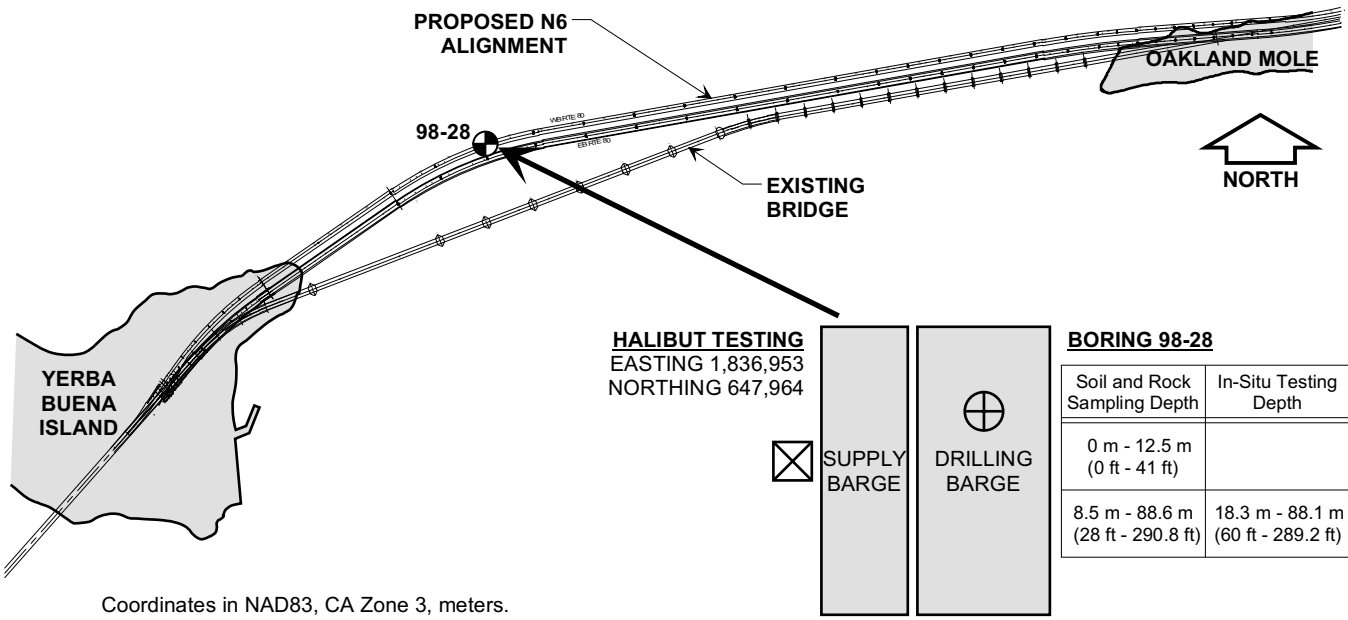
BORING 98-28

Date	Time From	Time To	Description of Activity
August 29, 1998	2000	2400	Travel from CS Marine yard, Mare Island to SFOBB location 98-28.
August 30, 1998	0000	0200	Travel from CS Marine yard, Mare Island to SFOBB location 98-28.
	0200	0400	Position vessel. Set 4 anchors and 2 spuds.
	0400	0545	Rig up for drilling. Lower drill pipe to mudline.
	0545	0615	Measure water depth of 11.6m (38 ft) using bottom sensor. Current tide level is approximately +0.2m (0.6 ft) MSL. Corresponding mudline elevation is -11.4m (-37.4 ft) MSL.
	0615	1340	Drill and sample from mudline to 12.5m (41 ft).
	1340	1540	Pull drill pipe to deck. Reposition barge. Drill from mudline to 6.4m (21 ft). Drill and sample from 6.4m (21 ft) to 8.8m (29 ft). Pull drill pipe to deck.
	1540	2400	Reposition barge. Set casing.
August 31, 1998	0000	0830	Set casing.
	0830	1015	CPT pipe test at 1.5m (5 ft) in casing.
	1015	1150	CPT tool stuck in thruster. Retrieve CPT tool.
	1150	1230	Pull drill pipe to deck. Remove piston from thruster.
	1230	1500	Drill to 7.6m (25 ft). Attempt to restore plumb in casing. Pull casing to deck.
	1500	1915	Reposition barge. Set casing. Lower drill pipe to mudline and drill to 8.5m (28 ft).
	1915	2400	Drill and sample from 8.5m (28 ft) to 15.2m (50 ft).
September 1, 1998	0000	0100	Drill and sample from 15.2m (50 ft) to 17.4m (57 ft).
	0100	0200	Remote vane reaction blade damaged during tests at 18.3m (60 ft) and 18.9m (62 ft). Replace reaction blade.
	****	****	
	0200	0800	Halibut Vane testing from 2.4m (8 ft) to 8.5m (28 ft).
	****	****	
	0200	1230	Drill, sample, and remote vane testing from 18.3m (60 ft) to 39.6m (130 ft).
	1230	1340	New piston arrives from Houston. Pull drill pipe to deck and install new piston in thruster.
	1340	1450	Lower drill pipe and perform CPT pipe test.
	1450	1630	Lower drill pipe to 39.6m (130 ft).
	1630	2400	Drill, sample, and CPT testing from 39.6m (130 ft) to 62.5m (205 ft).
September 2, 1998	0000	1330	Drill, sample, and CPT testing from 62.5m (205 ft) to 88.6m (290.8 ft).
	1330	1440	Pull drill pipe to deck.
	1440	1700	P- and S-wave velocity logging from 82.8m (271.7 ft) to 7.9m (26 ft).

SUMMARY OF FIELD OPERATIONS
Boring 98-28
SFOBB East Span Seismic Safety Project

Date	Time From	Time To	Description of Activity
	1700	1840	Pull casing to 1.8m (6 ft).
	1840	1925	P- and S-wave velocity logging from 10.7m (35 ft) to 2.0m (6.6 ft).
	1925	2200	Lower stinger below deck. Lower N-rod.
	2200	2400	Mix and circulate cement.
September 3, 1998	0000	0600	Grout hole 98-28. Pull casing to deck.
	0600	0730	Pull 2 spuds, 4 anchors, and move barge to location 98-29.

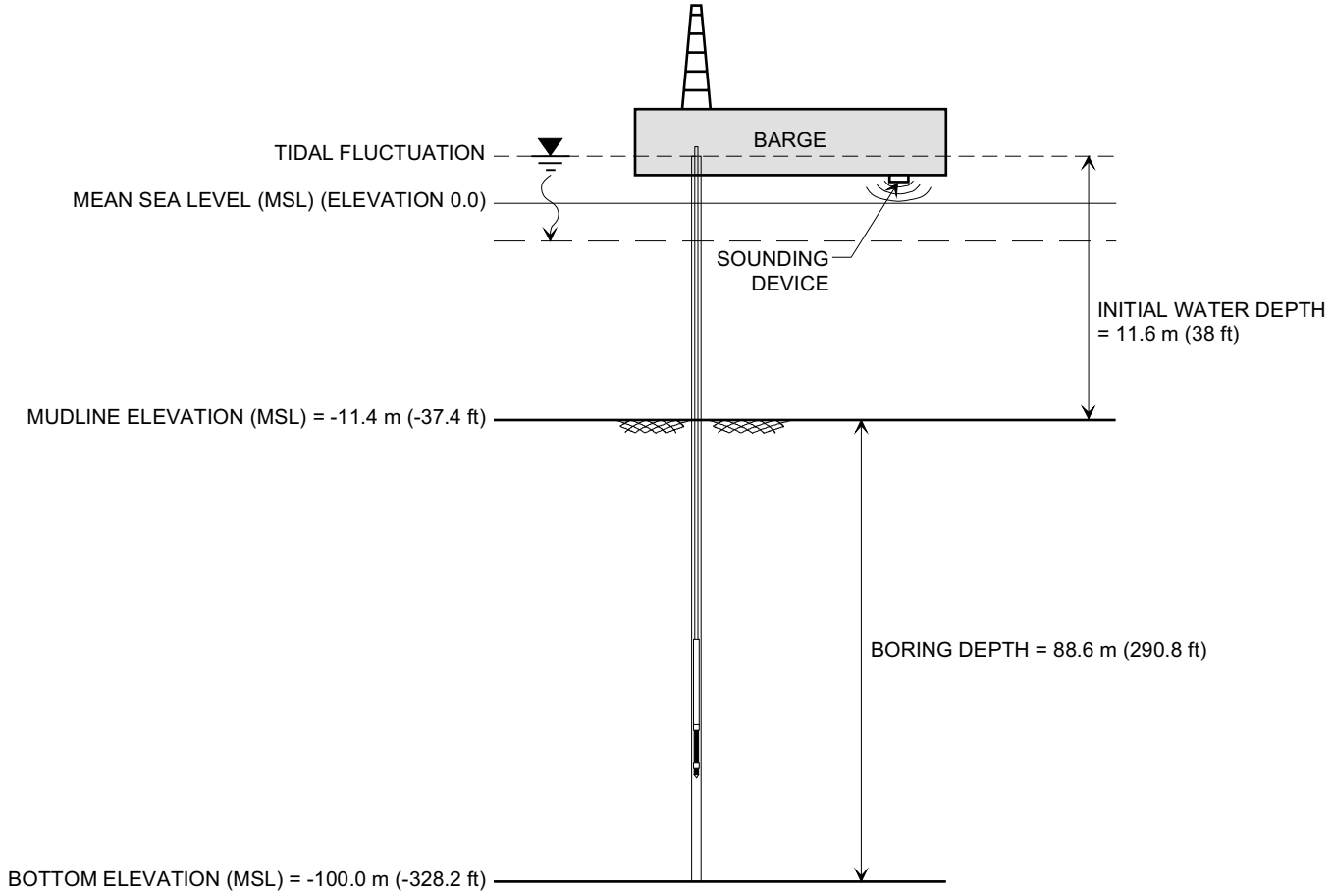
SUMMARY OF FIELD OPERATIONS
Boring 98-28
SFOBB East Span Seismic Safety Project



BORING 98-28

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 12.5 m (0 ft - 41 ft)		E = 1,836,974 N = 647,972
8.5 m - 88.6 m (28 ft - 290.8 ft)	18.3 m - 88.1 m (60 ft - 289.2 ft)	E = 1,836,963 N = 647,965

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-28
SFOBB East Span Seismic Safety Project

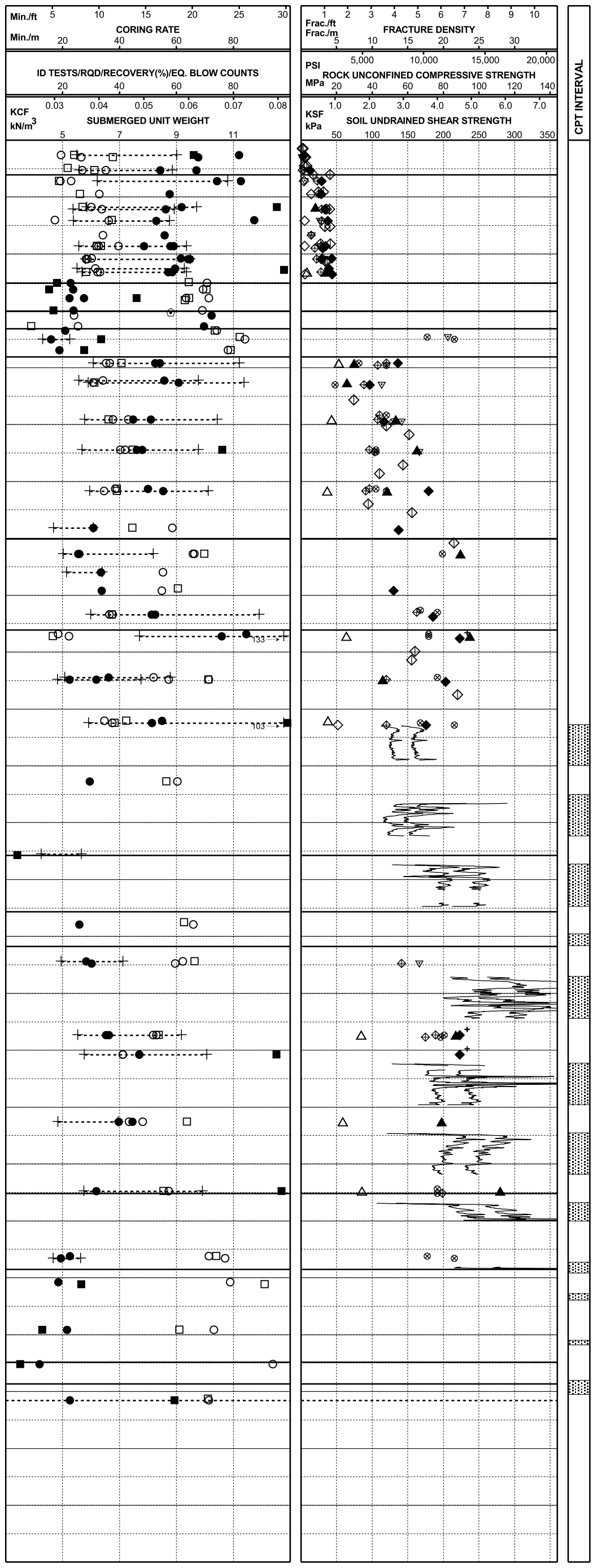
PROJECT NO:	98-42-0054	**START DATE:**	08/30/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-28 (Skyway Frame 1)	**COMPLETION DATE:**	09/03/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836963 N647965
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -11.4m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Fat CLAY (CH), very soft, olive gray (2.4m)	I
Fat CLAY (CH), firm, olive gray -with shell fragments to 4.9m -with silt pockets at 3.7m -with organic pockets at 5.5m -with gas blisters below 5.5m -with shell fragments below 8.2m (10.1m) See Plate 98-28.6 for detailed stratigraphy	II
Silty Fine SAND (SM), dense, gray -intermixed clay and sand, at 11.3m (12.0m)	III
Fat CLAY (CH), firm, olive gray (13.3m)	IV
Silty Fine SAND (SP), dense, greenish gray (15.2m)	V
Fat CLAY (CH), very stiff, gray -greenish gray and with slickensides, to 15.8m -with silt pockets, silty sand pockets and shell fragments, 19.2m to 24.7m -with many shell fragments at 19.2m -greenish gray with many sand pockets and seams, and a few shells, at 27.1m (28.0m)	VI
Fat CLAY (CH), very stiff to hard, greenish gray -with silt seams at 30.2m (34.4m)	VII
Fat CLAY (CH), very stiff to hard, gray -with many large organic pockets and partings at 34.7m -lean clay, 36.6m to 37.8m -vertical organic partings, organic pockets, and desiccated pockets, at 37.8m -with a few silt pockets and partings, at 40.8m -intermixed fine sand and clay, 43.6m to 46.6m -silty sand, below 49.8m (50.3m)	VIII
Fat CLAY (CH), hard, gray -silt with clay seams, 52.7m to 53.6m (54.3m)	IX
Silty Fine SAND (SM), very dense, gray -with a fat clay layer at 55.2m (56.7m)	X
Fat CLAY (CH), hard, gray -lean clay with a few sand and silt pockets, at 57.9m -with organic pockets and a few silt pockets, below 62.5m -with a sand layer, 65.1m to 65.4m -with sand layers, at 65.8m and 66.3m -with silt pockets and partings, at 68.9m -with organic pockets and organic stains, at 73.8m (74.1m)	XI
Lean CLAY (CL), hard, greenish gray to gray -sand layer, 76.2m to 77.4m -intermixed silt and clay layer, 78.6m to 78.9m -sand layer, 78.9m to 79.2m (79.4m)	XII
Silty Fine SAND (SM), very dense, greenish gray to gray -with clay pockets (86.0m)	XIII
Fine GRAVEL with sand (GP), very dense, black to gray (87.5m)	XIV
Sandy SILT (ML),very dense, greenish gray to gray	XV

TOTAL DEPTH: 88.6m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-28

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

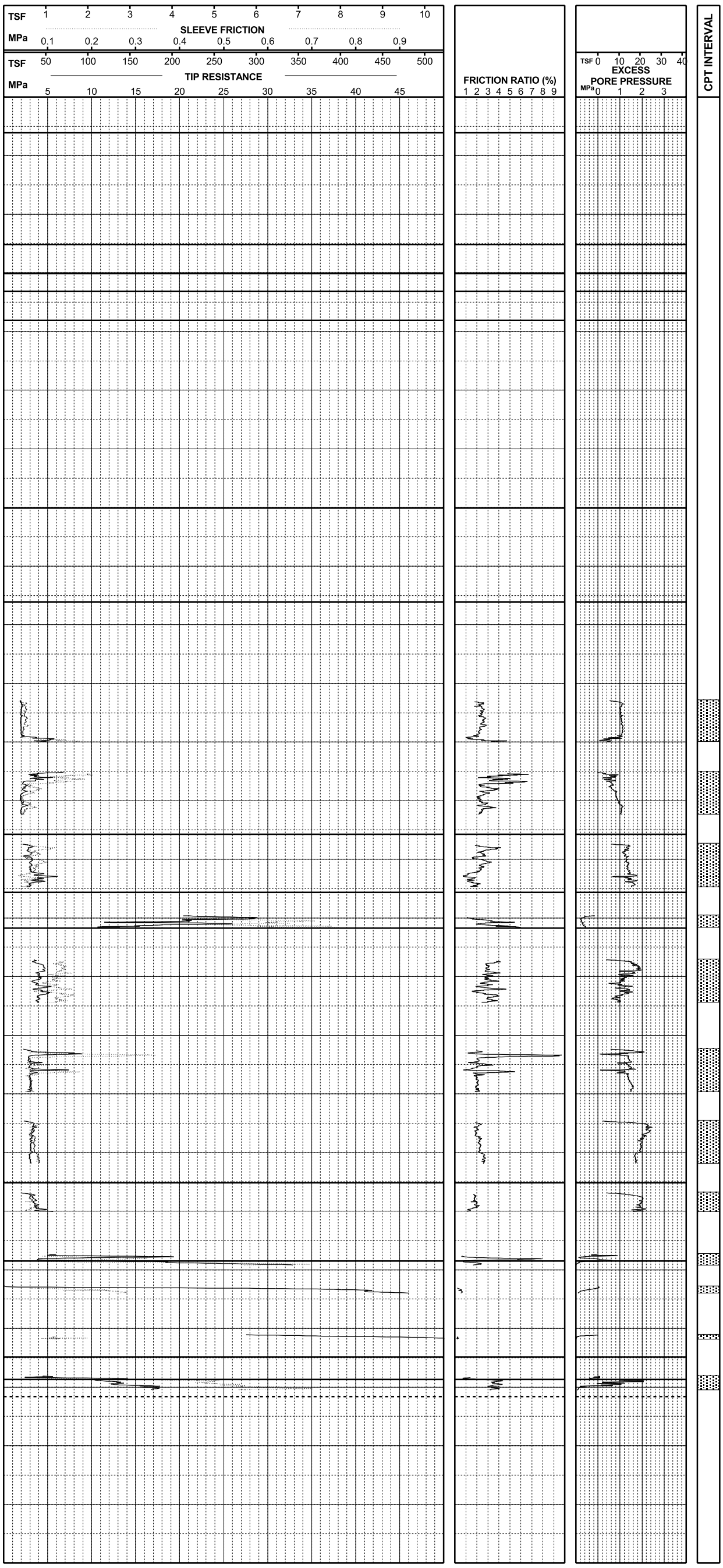
FUGRO

PROJECT NO:	98-42-0054	**START DATE:**	08/30/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-28 (Skyway Frame 1)	**COMPLETION DATE:**	09/03/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836963 N647965
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -11.4m (MSL)

Elevation, m.	Depth, m.	Blow Count	Material Description	Stratum No.
-12		NR, WOH, WOH	Fat CLAY (CH), very soft, olive gray -with shells and shell fragments -with silty sand pockets at 0.9m (2.4m)	I
-16	4	WOH, WOH, PUSH, PUSH, PUSH, PUSH, PUSH, PUSH, SAVE	Fat CLAY (CH), firm, olive gray -with shell fragments to 4.9m -with silt pockets at 3.7m -with organic pockets at 5.5m -with gas blisters below 5.5m -with shell fragments below 8.2m (10.1m)	II
-20	8	PUSH, 30/30cm, PUSH, PUSH, 13/30cm, 30/30cm	Silty Fine SAND (SM), dense, gray -intermixed clay and sand, at 11.3m (12.0m)	III
-24	12	58, PUSH, 30/30cm, PUSH	Fat CLAY (CH), firm, olive gray (13.3m)	IV
			Silty Fine SAND (SP), dense, greenish gray (15.2m)	V
-28	16	30/40cm, 30/60cm, PUSH	Fat CLAY (CH), very stiff, gray -greenish gray and with slickensides, to 15.8m -with silt pockets, silty sand pockets and shell fragments, 19.2m to 24.7m -with many shell fragments at 19.2m	VI
-32	20	PUSH, PUSH	See Plate 98-28.6 for detailed stratigraphy	
-36	24	PUSH, PUSH	-greenish gray with many sand pockets and seams, and a few shells, at 27.1m (28.0m)	
-40	28	30/20cm, SAVE, 30/30cm	Fat CLAY (CH), very stiff to hard, greenish gray -with silt seams at 30.2m (34.4m)	VII
-44	32	PUSH, PUSH, PUSH, PUSH, PUSH, PUSH, SAVE	Fat CLAY (CH), very stiff to hard, gray -with many large organic pockets and partings at 34.7m -lean clay, 36.6m to 37.8m -vertical organic partings, organic pockets, and desiccated pockets, at 37.8m -with a few silt pockets and partings, at 40.8m -intermixed fine sand and clay, 43.6m to 46.6m -silty sand, below 49.8m (50.3m)	VIII
-48	36			
-52	40			
-56	44			
-60	48			
-64	52		Fat CLAY (CH), hard, gray -silt with clay seams, 52.7m to 53.6m (54.3m)	IX
-68	56	PUSH, 30/40cm	Silty Fine SAND (SM), very dense, gray -with a fat clay layer at 55.2m (56.7m)	X
-72	60	PUSH, SAVE, PUSH, PUSH, PUSH, PUSH, PUSH	Fat CLAY (CH), hard, gray -lean clay with a few sand and silt pockets, at 57.9m -with organic pockets and a few silt pockets, below 62.5m -with a sand layer, 65.1m to 65.4m -with sand layers, at 65.8m and 66.3m -with silt pockets and partings, at 68.9m -with organic pockets and organic stains, at 73.8m (74.1m)	XI
-76	64			
-80	68			
-84	72			
-88	76	30/40cm	Lean CLAY (CL), hard, greenish gray to gray -sand layer, 76.2m to 77.4m -intermixed silt and clay layer, 78.6m to 78.9m -sand layer, 78.9m to 79.2m (79.4m)	XII
-92	80	30/40cm, 30/15cm	Silty Fine SAND (SM), very dense, greenish gray to gray -with clay pockets (86.0m)	XIII
-96	84	30/15cm	Fine GRAVEL with sand (GP), very dense, black to gray (87.5m)	XIV
-100	88	30/25cm	Sandy SILT (ML),very dense, greenish gray to gray	XV
-104	92		TOTAL DEPTH: 88.6m BACKFILLED WITH: Cement Grout	
-108	96			



LOG OF BORING AND TEST RESULTS

BORING 98-28

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

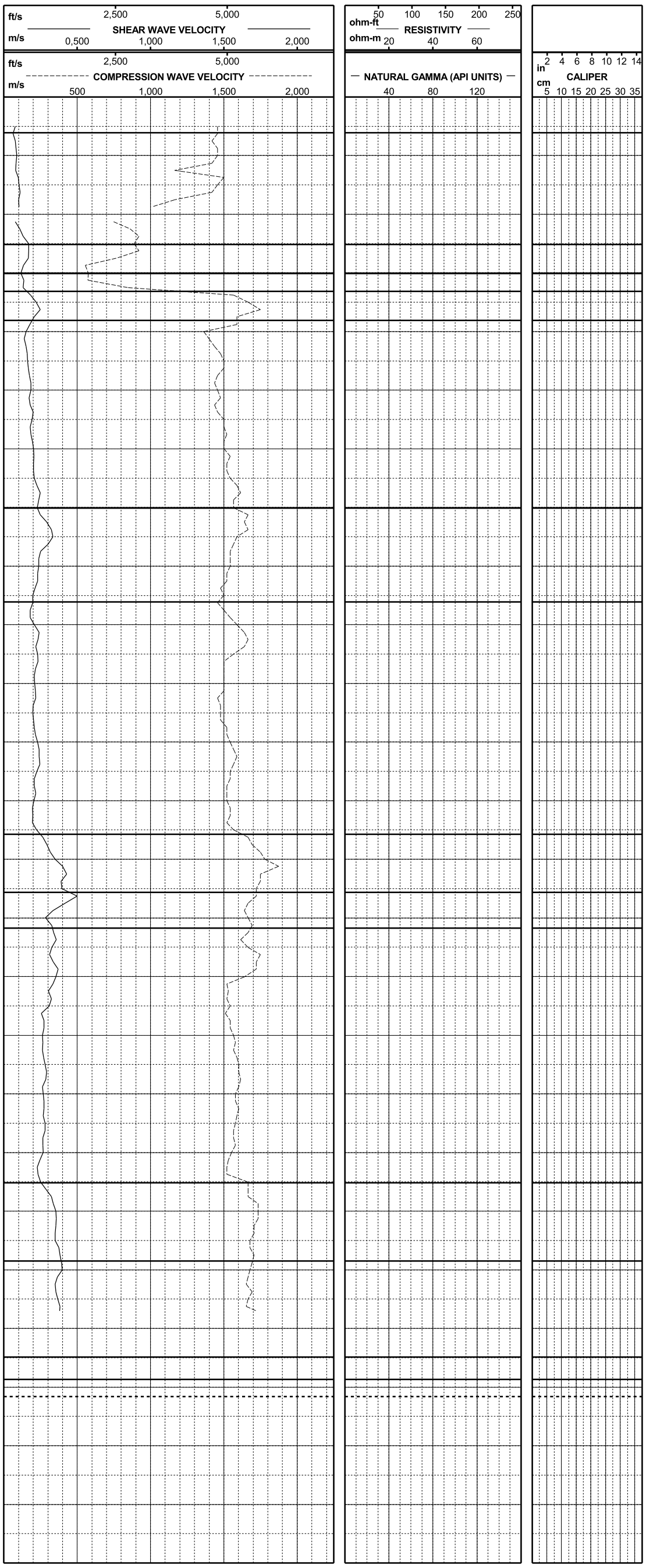
PLATE 98-28.4

PROJECT NO:	98-42-0054	**START DATE:**	08/30/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-28 (Skyway Frame 1)	**COMPLETION DATE:**	09/03/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836963 N647965
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -11.4m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-12		NR, WOH, WOH	Fat CLAY (CH), very soft, olive gray (2.4m)	I
-16	4	WOH, WOH, PUSH, PUSH, PUSH, PUSH, PUSH	Fat CLAY (CH), firm, olive gray See Plate 98-28.6 for detailed stratigraphy (10.1m)	II
-20	8	SAVE, PUSH, 30/30cm, PUSH, PUSH, 13/30cm	Silty Fine SAND (SM), dense, gray -intermixed clay and sand, at 11.3m (12.0m)	III
-24	12	30/30cm, 58, PUSH	Fat CLAY (CH), firm, olive gray (13.3m)	IV
		30/30cm, PUSH	Silty Fine SAND (SP), dense, greenish gray (15.2m)	V
-28	16	30/40cm, 30/60cm, PUSH	Fat CLAY (CH), very stiff, gray -greenish gray and with slickensides, to 15.8m -with silt pockets, silty sand pockets and shell fragments, 19.2m to 24.7m -with many shell fragments at 19.2m	VI
-32	20	PUSH		
-36	24	PUSH, PUSH	-greenish gray with many sand pockets and seams, and a few shells, at 27.1m (28.0m)	
-40	28	30/20cm, SAVE, 30/30cm	Fat CLAY (CH), very stiff to hard, greenish gray -with silt seams at 30.2m (34.4m)	VII
-44	32	PUSH, PUSH, PUSH	Fat CLAY (CH), very stiff to hard, gray -with many large organic pockets and partings at 34.7m -lean clay, 36.6m to 37.8m -vertical organic partings, organic pockets, and desiccated pockets, at 37.8m	VIII
-48	36	PUSH		
-52	40	PUSH	-with a few silt pockets and partings, at 40.8m	
-56	44	PUSH	-intermixed fine sand and clay, 43.6m to 46.6m	
-60	48	SAVE	-silty sand, below 49.8m (50.3m)	
-64	52		Fat CLAY (CH), hard, gray -silt with clay seams, 52.7m to 53.6m (54.3m)	IX
-68	56	PUSH	Silty Fine SAND (SM), very dense, gray (56.7m)	X
-72	60	30/40cm, PUSH	Fat CLAY (CH), hard, gray -lean clay with a few sand and silt pockets, at 57.9m -with organic pockets and a few silt pockets, below 62.5m	XI
-76	64	SAVE	-with a sand layer, 65.1m to 65.4m -with sand layers, at 65.8m and 66.3m	
-80	68	PUSH	-with silt pockets and partings, at 68.9m	
-84	72	PUSH	-with organic pockets and organic stains, at 73.8m (74.1m)	
-88	76	30/40cm	Lean CLAY (CL), hard, greenish gray to gray -sand layer, 76.2m to 77.4m -intermixed silt and clay layer, 78.6m to 78.9m -sand layer, 78.9m to 79.2m (79.4m)	XII
-92	80	30/40cm, 30/15cm	Silty Fine SAND (SM), very dense, greenish gray to gray -with clay pockets (86.0m)	XIII
-96	84	30/15cm	Fine GRAVEL with sand (GP), very dense, black to gray (87.5m)	XIV
-100	88	30/25cm	Sandy SILT (ML),very dense, greenish gray to gray	XV
-104	92		TOTAL DEPTH: 88.6m BACKFILLED WITH: Cement Grout	
-108	96			



LOG OF BORING AND TEST RESULTS

BORING 98-28

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

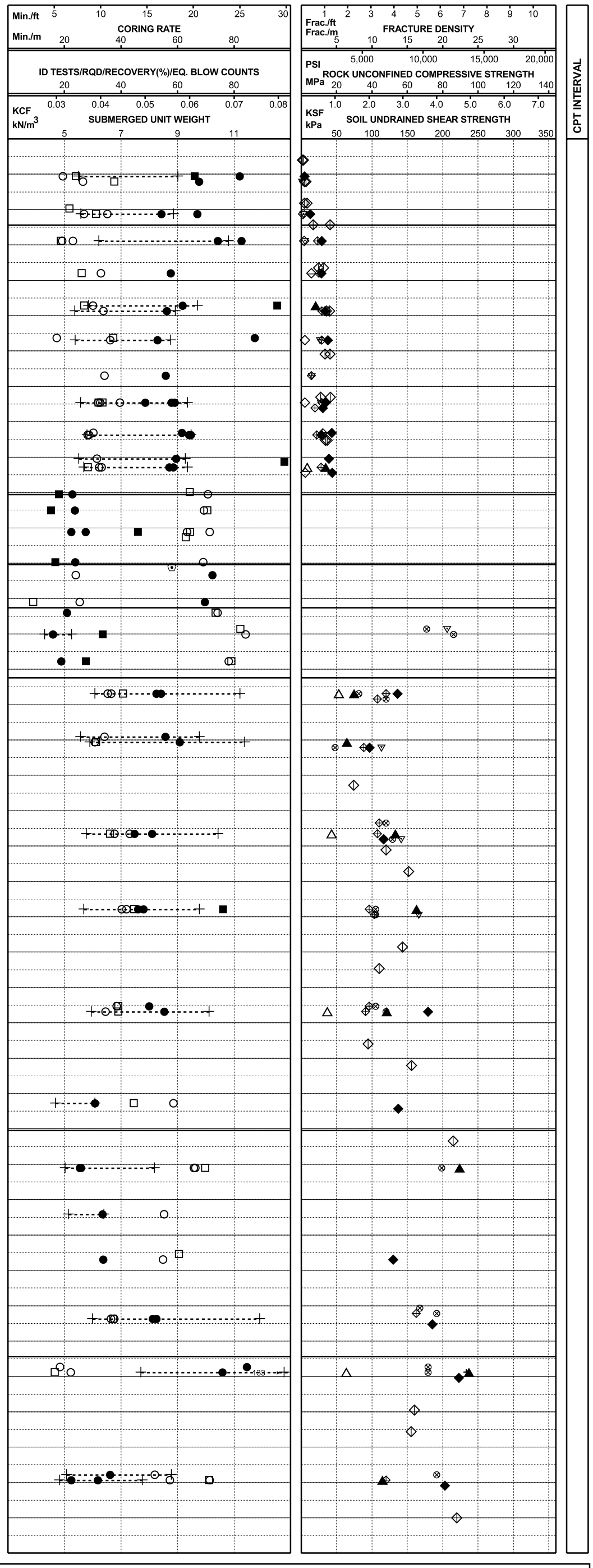
PLATE 98-28.5

PROJECT NO:	98-42-0054	**START DATE:**	08/30/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-28 (Skyway Frame 1)	**COMPLETION DATE:**	09/03/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836963 N647965
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -11.4m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Fat CLAY (CH), very soft, olive gray -with shells and shell fragments -with silty sand pockets at 0.9m (2.4m)	I
Fat CLAY (CH), firm, olive gray -with shell fragments to 4.9m -with silt pockets at 3.7m -with organic pockets at 5.5m -with gas blisters below 5.5m -with shell fragments below 8.2m (10.1m)	II
Silty Fine SAND (SM), dense, gray -with clay pockets to 10.4m -intermixed clay and sand, at 11.3m -with a few clay pockets and partings, at 11.9m (12.0m)	III
Fat CLAY (CH), firm, olive gray -with many large organic pockets, partings and seams, to 13.1m -with a silty sand layer, below 13.1m (13.3m)	IV
Silty Fine SAND (SP), dense, greenish gray -with clay seams and layers -sandy lean clay to 13.9m (15.2m)	V
Fat CLAY (CH), very stiff, gray -greenish gray and with slickensides, to 15.8m -with silt pockets, silty sand pockets and shell fragments, 19.2m to 24.7m -with many shell fragments at 19.2m -greenish gray with many sand pockets and seams, and a few shells, at 27.1m (28.0m)	VI
Fat CLAY (CH), very stiff to hard, greenish gray -with silt seams at 30.2m (34.4m)	VII
Fat CLAY (CH), very stiff to hard, gray -with many large organic pockets and partings at 34.7m -lean clay, 36.6m to 37.8m -vertical organic partings, organic pockets, and desiccated pockets, at 37.8m	VIII



LOG OF BORING AND TEST RESULTS

BORING 98-28

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

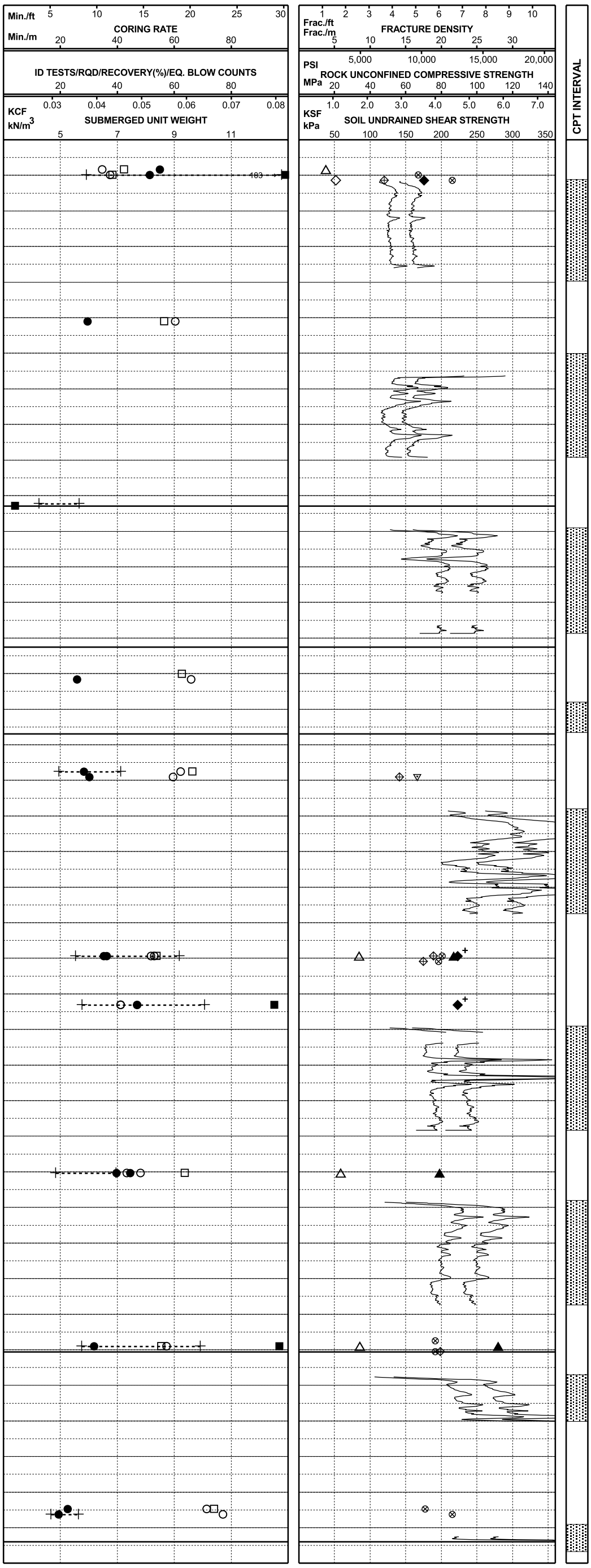
PLATE 98-28.6a

PROJECT NO:	98-42-0054	**START DATE:**	08/30/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-28 (Skyway Frame 1)	**COMPLETION DATE:**	09/03/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836963 N647965
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -11.4m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
				Fat CLAY (CH), very stiff to hard, gray	
-52	41		PUSH	-with a few silt pockets and partings, at 40.8m	
-53	42				
-54	43				
-55	44			-intermixed fine sand and clay, 43.6m to 46.6m	
-56	45		PUSH		VIII
-57	46				
-58	47				
-59	48				
-60	49				
-61	50		SAVE	-silty sand, below 49.8m (50.3m)	
-62	51			Fat CLAY (CH), hard, gray	
-63	52				IX
-64	53			-silt with clay seams, 52.7m to 53.6m	
-65	54			(54.3m)	
-66	55		PUSH	Silty Fine SAND (SM), very dense, gray -with clay partings at 54.9m -with a fat clay layer at 55.2m	X
-67	56			-with clay seams at 56.2m (56.7m)	
-68	57			Fat CLAY (CH), hard, gray	
-69	58		30/40cm	-lean clay with a few sand and silt pockets, at 57.9m	
-70	59				
-71	60				
-72	61				
-73	62				
-74	63		PUSH	-with organic pockets and a few silt pockets, below 62.5m	
-75	64		SAVE		
-76	65			-with a sand layer, 65.1m to 65.4m	XI
-77	66			-with sand layers, at 65.8m and 66.3m	
-78	67				
-79	68				
-80	69		PUSH	-with silt pockets and partings, at 68.9m	
-81	70				
-82	71				
-83	72				
-84	73				
-85	74		PUSH	-with organic pockets and organic stains, at 73.8m (74.1m)	
-86	75			Lean CLAY (CL), hard, greenish gray to gray	
-87	76			-sand layer, 76.2m to 77.4m	
-88	77				XII
-89	78				
-90	79		30/40cm	-intermixed silt and clay layer, 78.6m to 78.9m -sand layer, 78.9m to 79.2m (79.4m)	
-91				Silty Fine SAND (SM), very dense, greenish gray to gray -with clay pockets	XIII



LOG OF BORING AND TEST RESULTS

BORING 98-28

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

PLATE 98-28.6b

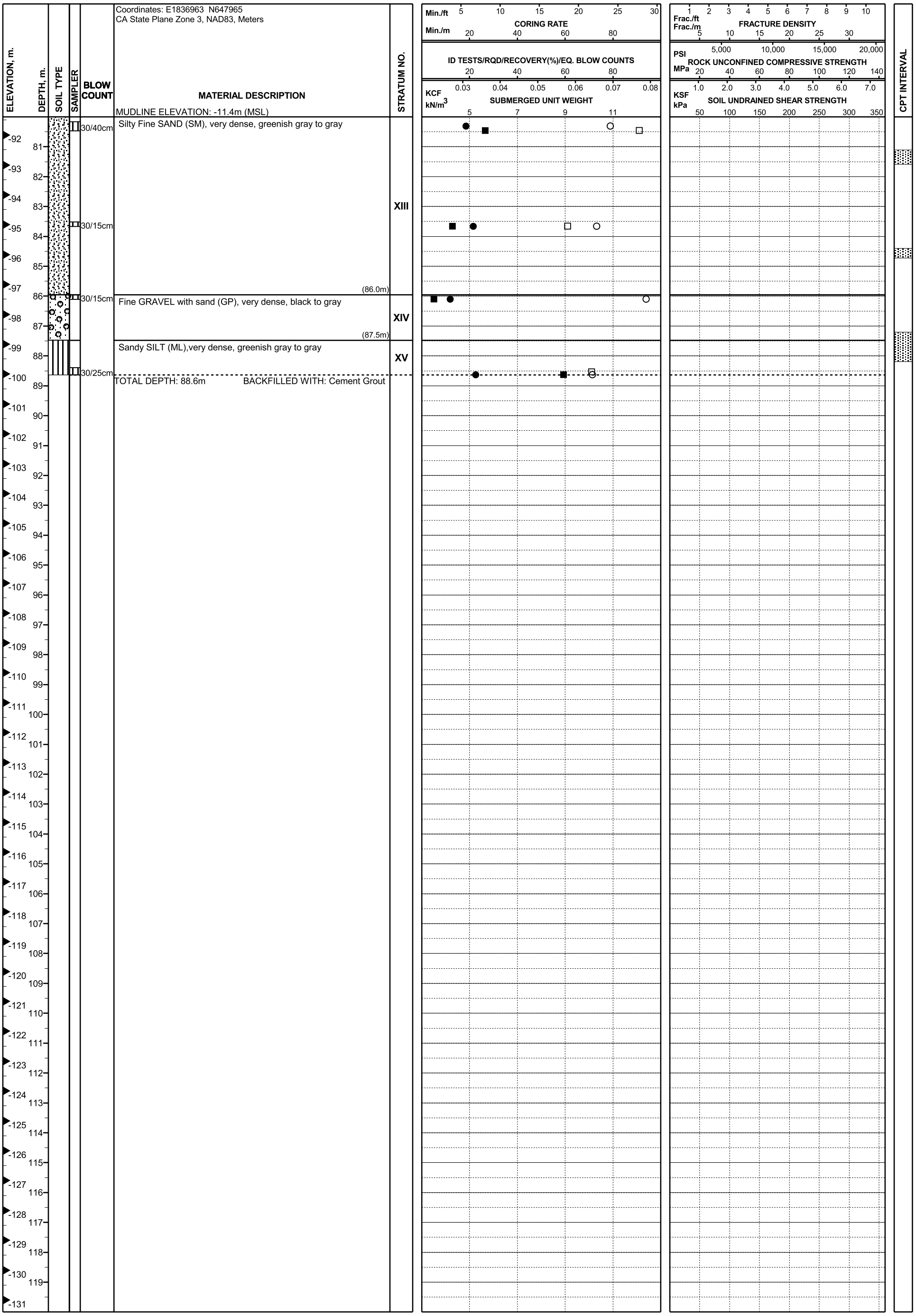
PROJECT NO:	98-42-0054	**START DATE:**	08/30/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-28 (Skyway Frame 1)	**COMPLETION DATE:**	09/03/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836963 N647965
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -11.4m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Silty Fine SAND (SM), very dense, greenish gray to gray (86.0m)	XIII
Fine GRAVEL with sand (GP), very dense, black to gray (87.5m)	XIV
Sandy SILT (ML),very dense, greenish gray to gray	XV

TOTAL DEPTH: 88.6m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-28

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

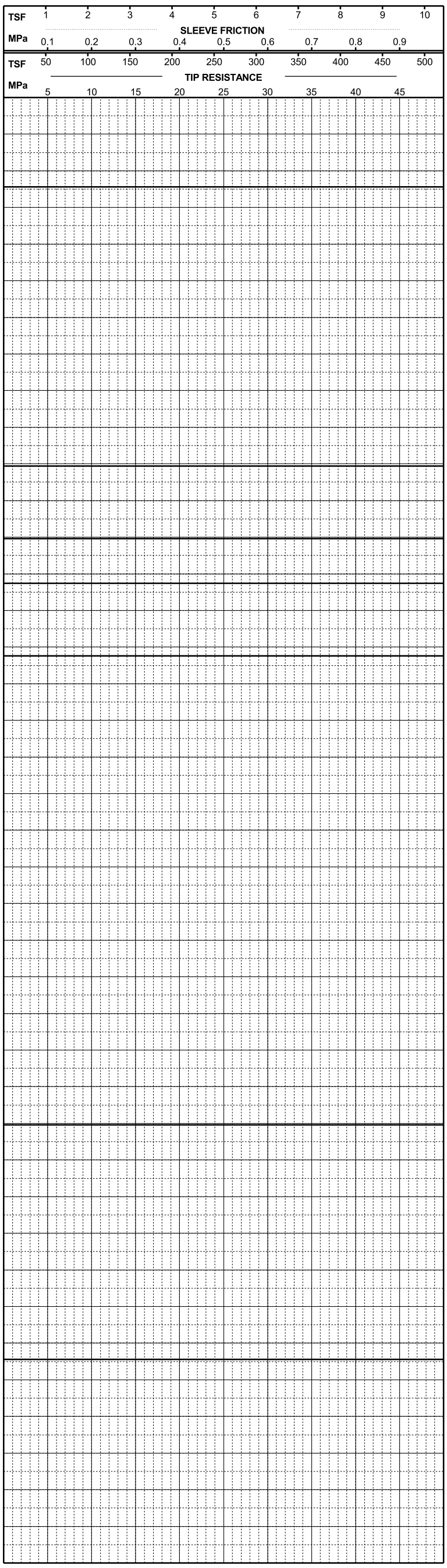
PLATE 98-28.6c

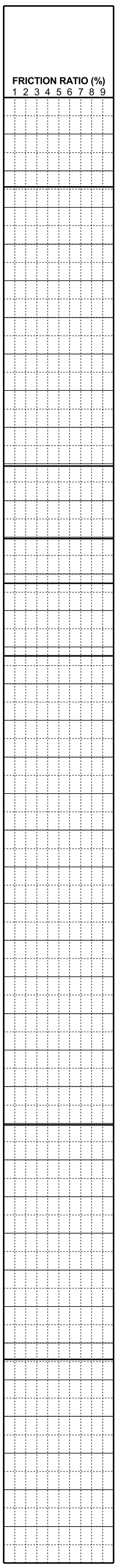
PROJECT NO:	98-42-0054	**START DATE:**	08/30/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-28 (Skyway Frame 1)	**COMPLETION DATE:**	09/03/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

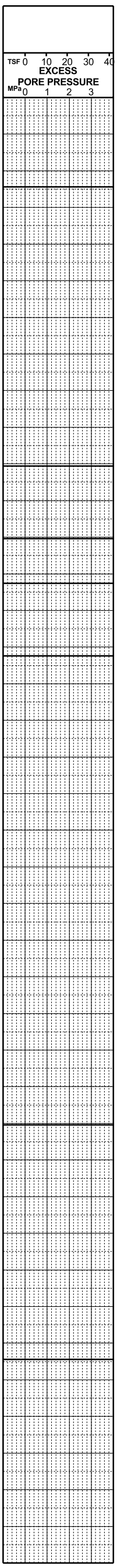
Coordinates: E1836963 N647965
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -11.4m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-12	1		NR	Fat CLAY (CH), very soft, olive gray -with shells and shell fragments	I
			WOH	-with silty sand pockets at 0.9m	
-13	2		WOH	(2.4m)	
-14	3		WOH	Fat CLAY (CH), firm, olive gray -with shell fragments to 4.9m	II
-15	4		WOH	-with silt pockets at 3.7m	
-16	5		PUSH		
-17	6		PUSH	-with organic pockets at 5.5m -with gas blisters below 5.5m	
-18	7		PUSH		
-19	8		PUSH PUSH		
-20	9		PUSH PUSH	-with shell fragments below 8.2m	
-21	10		SAVE PUSH PUSH 30/30cm	(10.1m)	
-22	11		PUSH PUSH 13/30cm	Silty Fine SAND (SM), dense, gray -with clay pockets to 10.4m -intermixed clay and sand, at 11.3m	III
-23	12		30/30cm 58	-with a few clay pockets and partings, at 11.9m (12.0m)	
-24	13		PUSH	Fat CLAY (CH), firm, olive gray -with many large organic pockets, partings and seams, to 13.1m -with a silty sand layer, below 13.1m (13.3m)	IV
-25	14		30/30cm	Silty Fine SAND (SP), dense, greenish gray -with clay seams and layers	V
-26	15		PUSH	-sandy lean clay to 13.9m (15.2m)	
-27	16		30/40cm	Fat CLAY (CH), very stiff, gray -greenish gray and with slickensides, to 15.8m	VI
-28	17		30/60cm		
-29	18				
-30	19			-with silt pockets, silty sand pockets and shell fragments, 19.2m to 24.7m	
-31	20		PUSH	-with many shell fragments at 19.2m	
-32	21				
-33	22		PUSH		
-34	23				
-35	24				
-36	25		PUSH		
-37	26				
-38	27		PUSH	-greenish gray with many sand pockets and seams, and a few shells, at 27.1m (28.0m)	
-39	28			Fat CLAY (CH), very stiff to hard, greenish gray	VII
-40	29		30/20cm		
-41	30		SAVE	-with silt seams at 30.2m	
-42	31				
-43	32		30/30cm		
-44	33		PUSH		
-45	34			(34.4m)	
-46	35		PUSH	Fat CLAY (CH), very stiff to hard, gray -with many large organic pockets and partings at 34.7m	VIII
-47	36				
-48	37			-lean clay, 36.6m to 37.8m	
-49	38		PUSH	-vertical organic partings, organic pockets, and desiccated pockets, at 37.8m	
-50	39				
-51					







CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-28

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

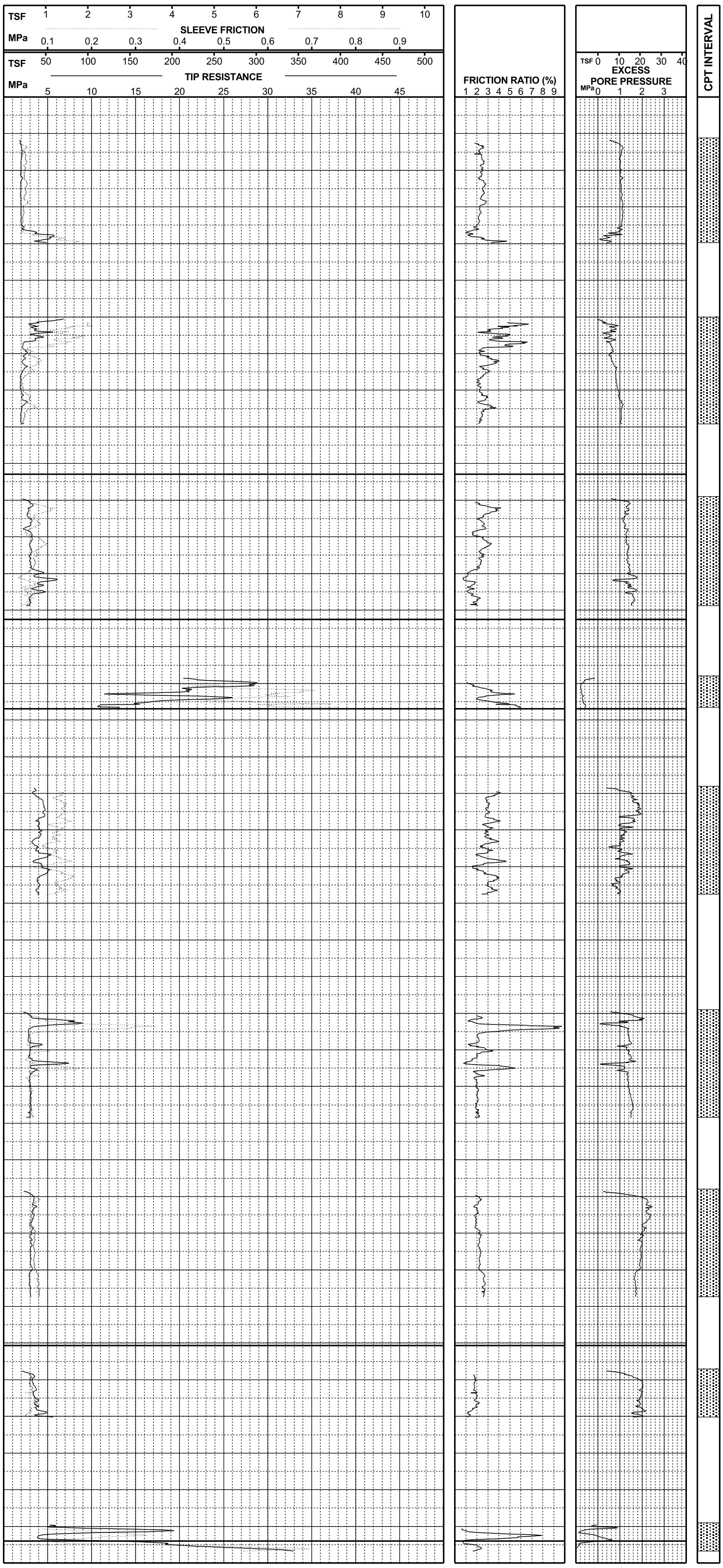
PLATE 98-28.7a

PROJECT NO:	98-42-0054	**START DATE:**	08/30/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-28 (Skyway Frame 1)	**COMPLETION DATE:**	09/03/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836963 N647965
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -11.4m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-52	41		PUSH	Fat CLAY (CH), very stiff to hard, gray -with a few silt pockets and partings, at 40.8m	VIII
-53	42				
-54	43			-intermixed fine sand and clay, 43.6m to 46.6m	
-55	44				
-56	45		PUSH		
-57	46				
-58	47				
-59	48				
-60	49				
-61	50		SAVE	-silty sand, below 49.8m (50.3m)	
-62	51			Fat CLAY (CH), hard, gray	IX
-63	52				
-64	53			-silt with clay seams, 52.7m to 53.6m	
-65	54			(54.3m)	
-66	55		PUSH	Silty Fine SAND (SM), very dense, gray -with clay partings at 54.9m -with a fat clay layer at 55.2m	X
-67	56			-with clay seams at 56.2m (56.7m)	
-68	57			Fat CLAY (CH), hard, gray	
-69	58		30/40cm	-lean clay with a few sand and silt pockets, at 57.9m	
-70	59				
-71	60				
-72	61				
-73	62			-with organic pockets and a few silt pockets, below 62.5m	
-74	63		PUSH		
-75	64		SAVE		
-76	65			-with a sand layer, 65.1m to 65.4m	XI
-77	66			-with sand layers, at 65.8m and 66.3m	
-78	67				
-79	68				
-80	69		PUSH	-with silt pockets and partings, at 68.9m	
-81	70				
-82	71				
-83	72				
-84	73				
-85	74		PUSH	-with organic pockets and organic stains, at 73.8m (74.1m)	
-86	75			Lean CLAY (CL), hard, greenish gray to gray	XII
-87	76			-sand layer, 76.2m to 77.4m	
-88	77				
-89	78				
-90	79		30/40cm	-intermixed silt and clay layer, 78.6m to 78.9m -sand layer, 78.9m to 79.2m (79.4m)	
-91				Silty Fine SAND (SM), very dense, greenish gray to gray	XIII



LOG OF BORING AND TEST RESULTS

BORING 98-28

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

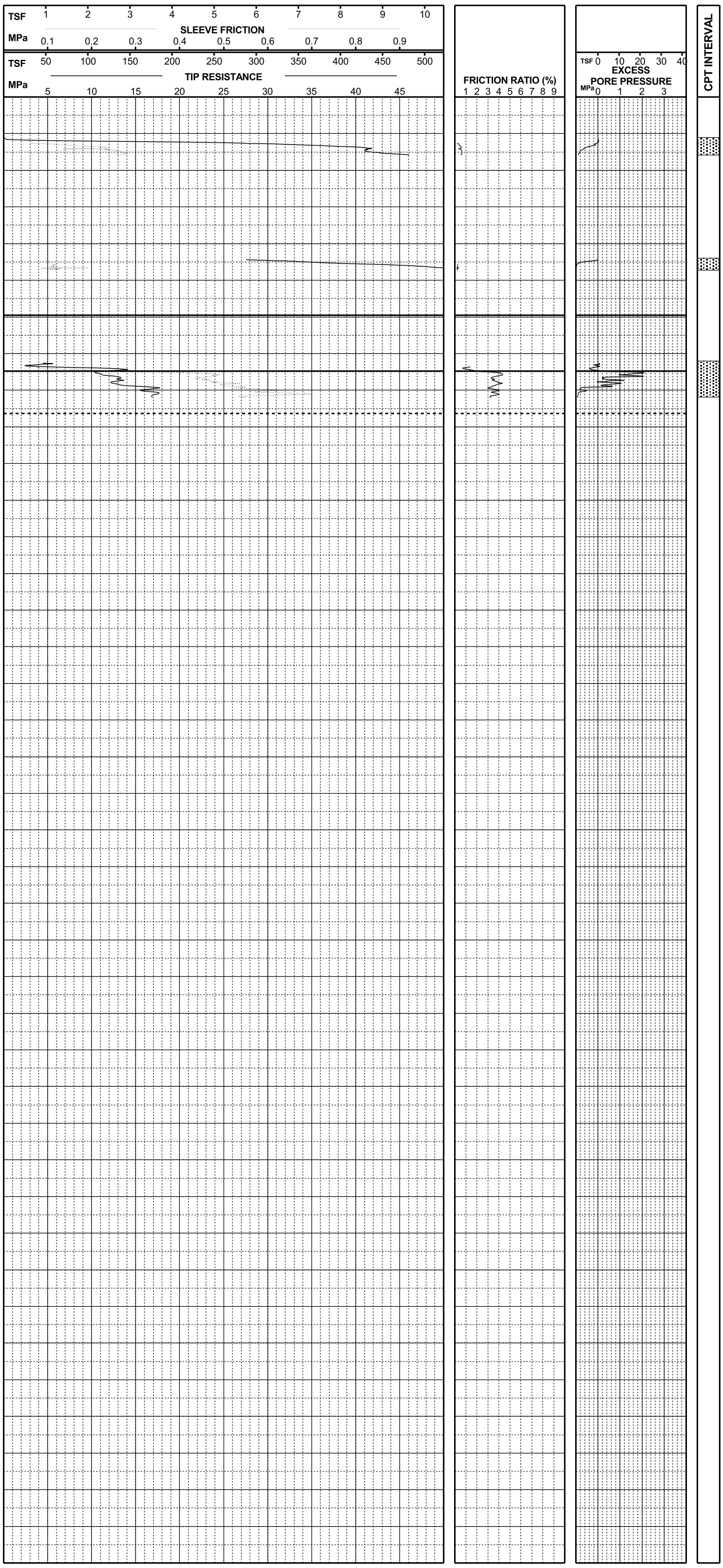
PLATE 98-28.7b

PROJECT NO:	98-42-0054	**START DATE:**	08/30/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-28 (Skyway Frame 1)	**COMPLETION DATE:**	09/03/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836963 N647965
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -11.4m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-92	81			30/40cm	Silty Fine SAND (SM), very dense, greenish gray to gray -with clay pockets	XIII
-93	82					
-94	83					
-95	84			30/15cm		
-96	85					
-97	86			30/15cm	(86.0m) Fine GRAVEL with sand (GP), very dense, black to gray	XIV
-98	87				(87.5m)	
-99	88				Sandy SILT (ML),very dense, greenish gray to gray	XV
-100	89			30/25cm	TOTAL DEPTH: 88.6m BACKFILLED WITH: Cement Grout	
-101	90					
-102	91					
-103	92					
-104	93					
-105	94					
-106	95					
-107	96					
-108	97					
-109	98					
-110	99					
-111	100					
-112	101					
-113	102					
-114	103					
-115	104					
-116	105					
-117	106					
-118	107					
-119	108					
-120	109					
-121	110					
-122	111					
-123	112					
-124	113					
-125	114					
-126	115					
-127	116					
-128	117					
-129	118					
-130	119					
-131						



LOG OF BORING AND TEST RESULTS

BORING 98-28

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

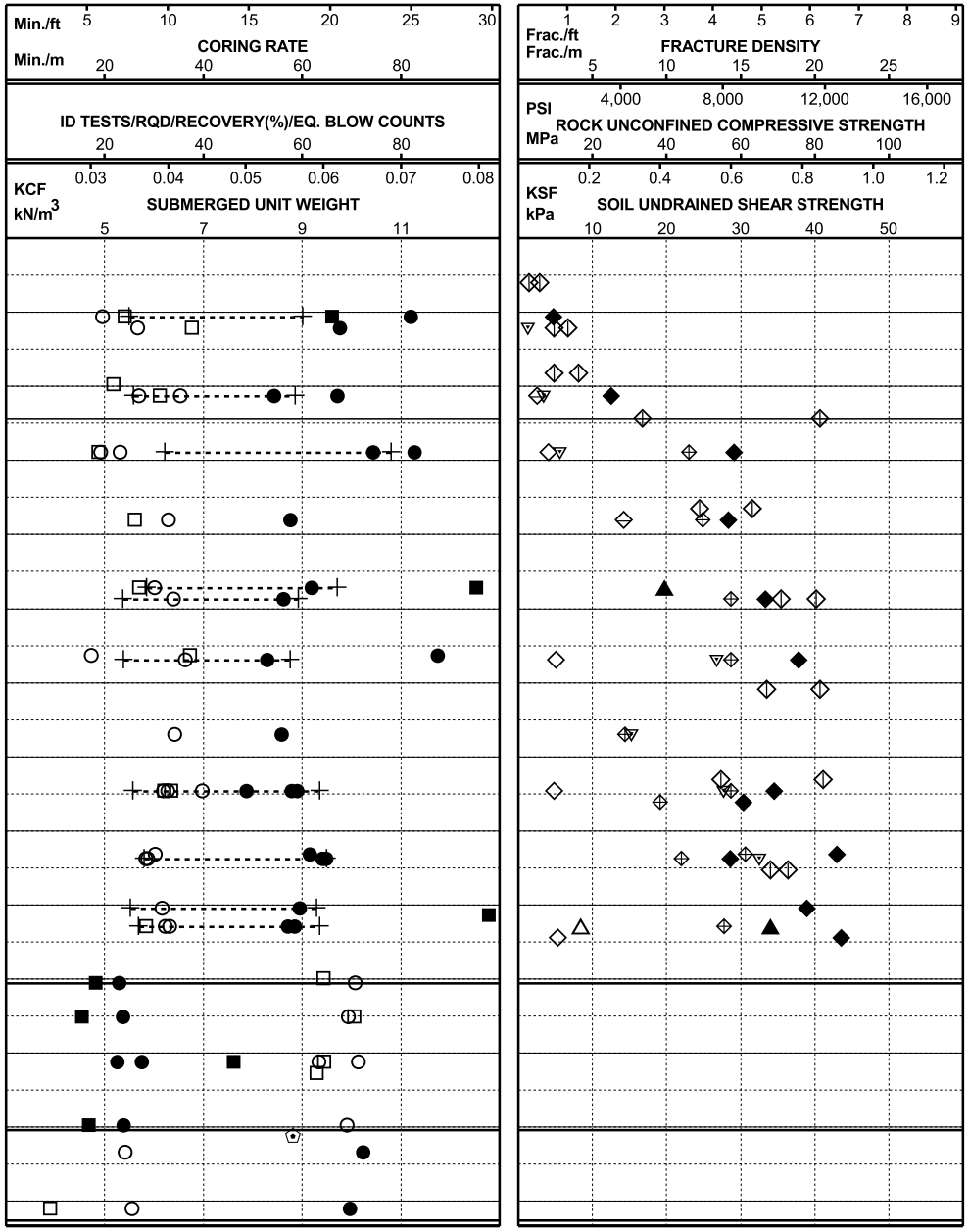
PLATE 98-28.7c

PROJECT NO:	98-42-0054	**START DATE:**	08/30/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-28 (Skyway Frame 1)	**COMPLETION DATE:**	09/03/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836963 N647965
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -11.4m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		NR	Fat CLAY (CH), very soft, olive gray -with shells and shell fragments	I
-12	1	WOH	-with silty sand pockets at 0.9m	
-13	2	WOH	(2.4m)	
-14	3	WOH	Fat CLAY (CH), firm, olive gray -with shell fragments to 4.9m	II
-15	4	WOH	-with silt pockets at 3.7m	
-16	5	PUSH		
-17	6	PUSH	-with organic pockets at 5.5m -with gas blisters below 5.5m	
-18	7	PUSH		
-19	8	PUSH PUSH PUSH PUSH	-with shell fragments below 8.2m	
-20	9	SAVE PUSH PUSH		
-21	10	30/30cm	(10.1m)	
-22	11	PUSH 13/30cm PUSH	Silty Fine SAND (SM), dense, gray -with clay pockets to 10.4m -intermixed clay and sand, at 11.3m	III
-23	12	30/30cm 58	-with a few clay pockets and partings, at 11.9m (12.0m)	
-24	13	PUSH	Fat CLAY (CH), firm, olive gray -with many large organic pockets, partings and seams, to 13.1m -with a silty sand layer, below 13.1m (13.3m)	IV



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-28

SFOBB East Span Seismic Safety Project

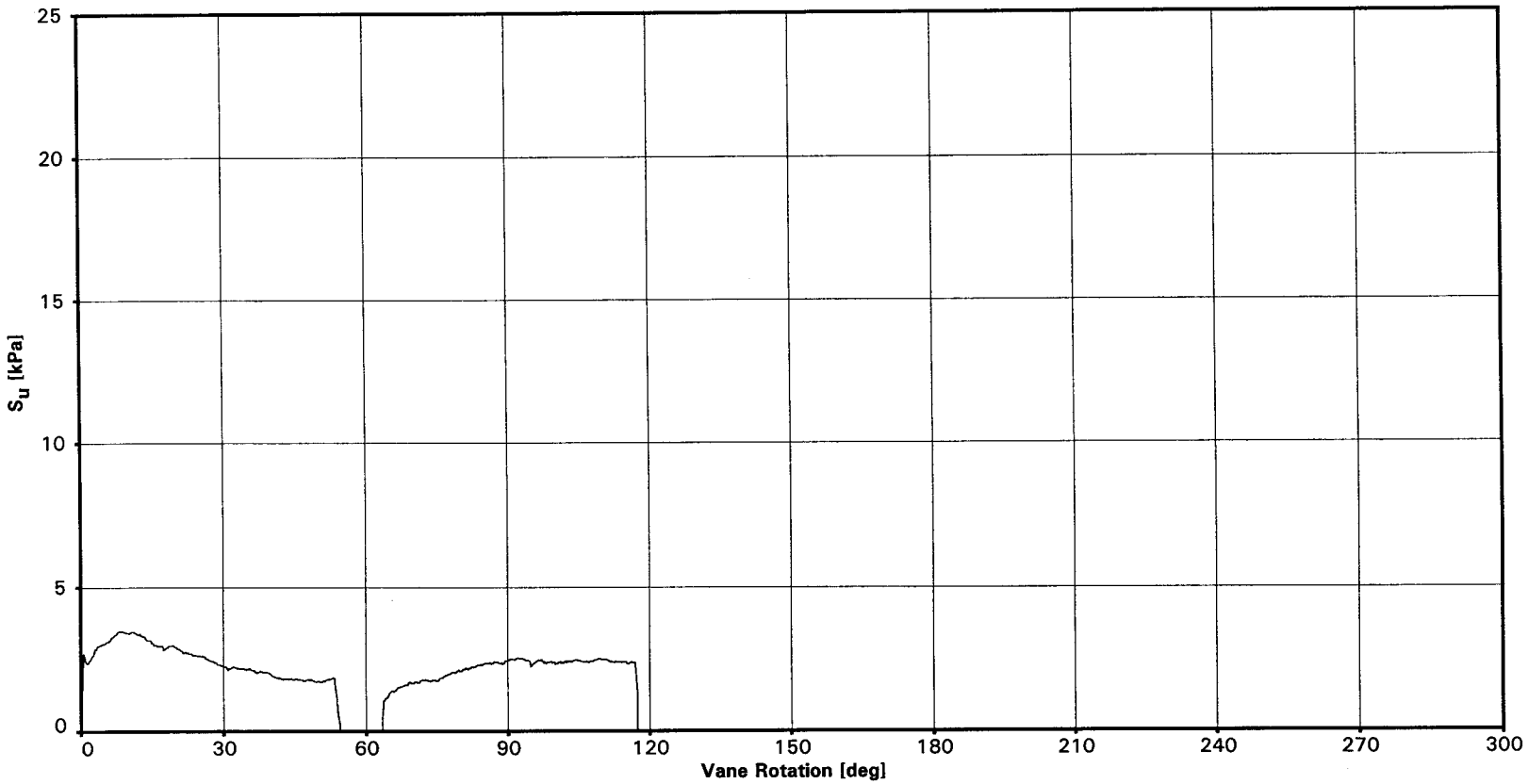
Report Date: 04/30/99

PLATE 98-28.8

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 (HALIBUT) TEST RESULTS
Test Depth: 0.6m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

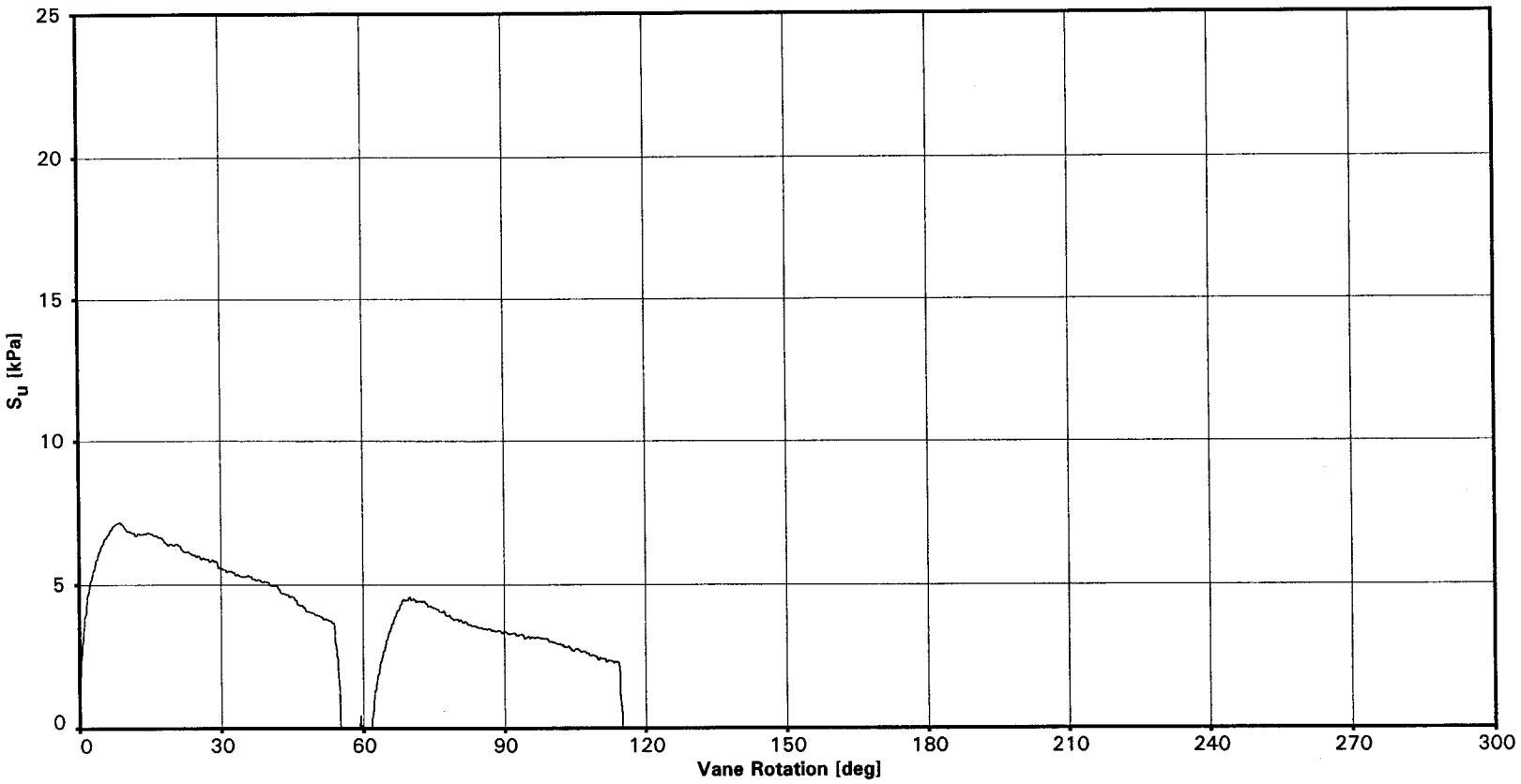
FUGRO

PLATE 98-28.9a

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 (HALIBUT) TEST RESULTS
Test Depth: 1.2m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

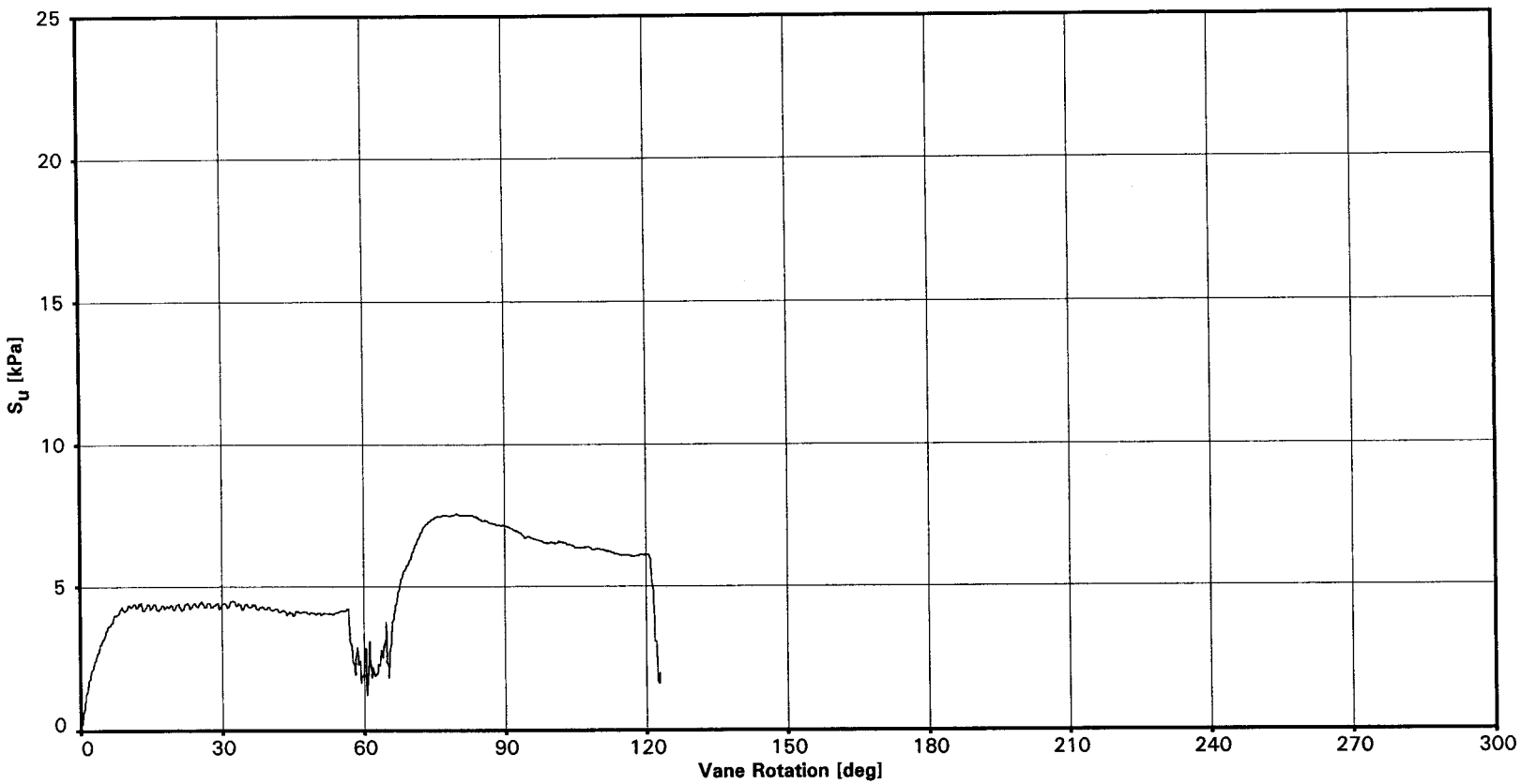
FUGRO

PLATE 98-28.9b

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 (HALIBUT) TEST RESULTS
Test Depth: 1.8m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

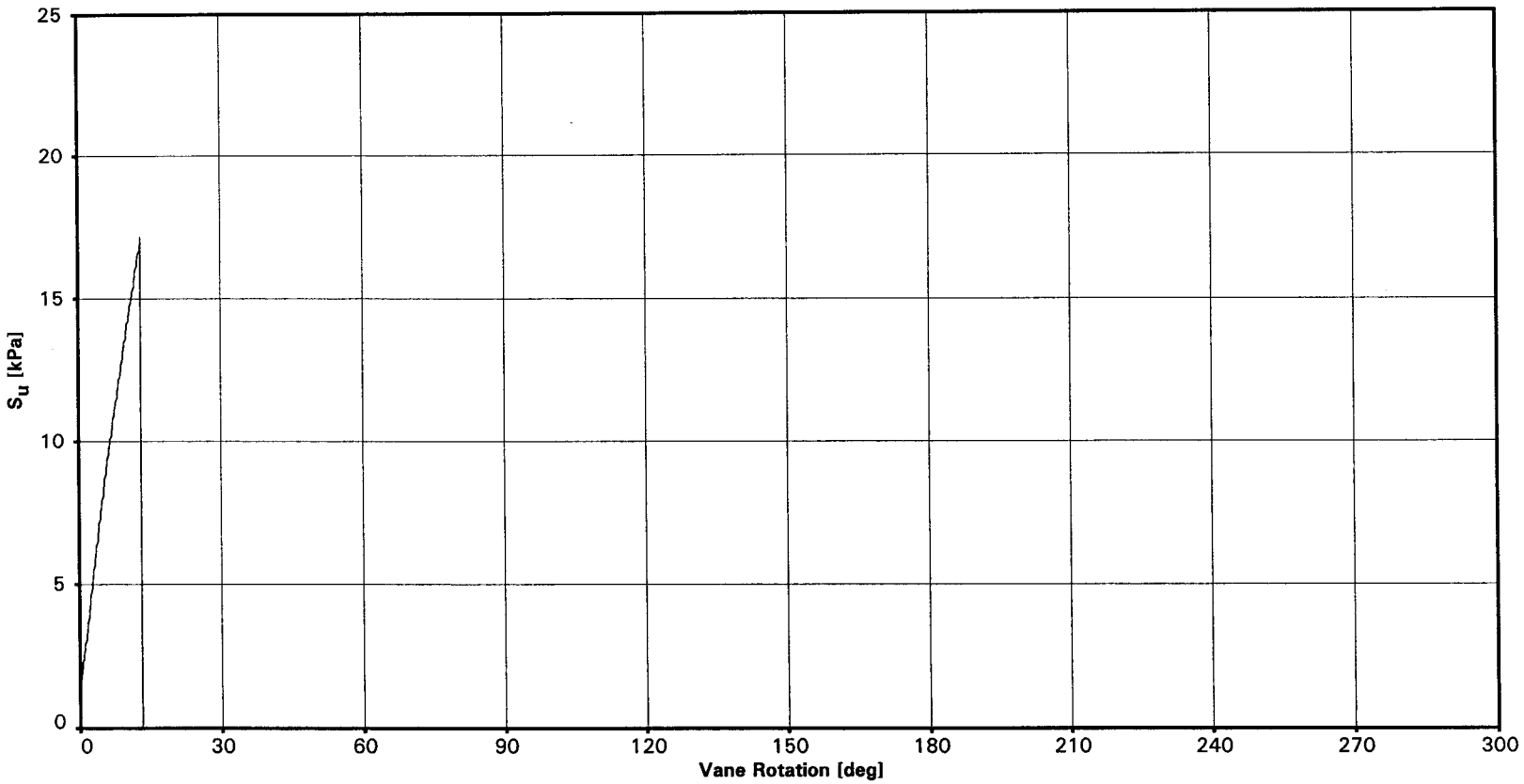
FUGRO

PLATE 98-28.9c

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 (HALIBUT) TEST RESULTS
Test Depth: 2.4m (1st Attempt)
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

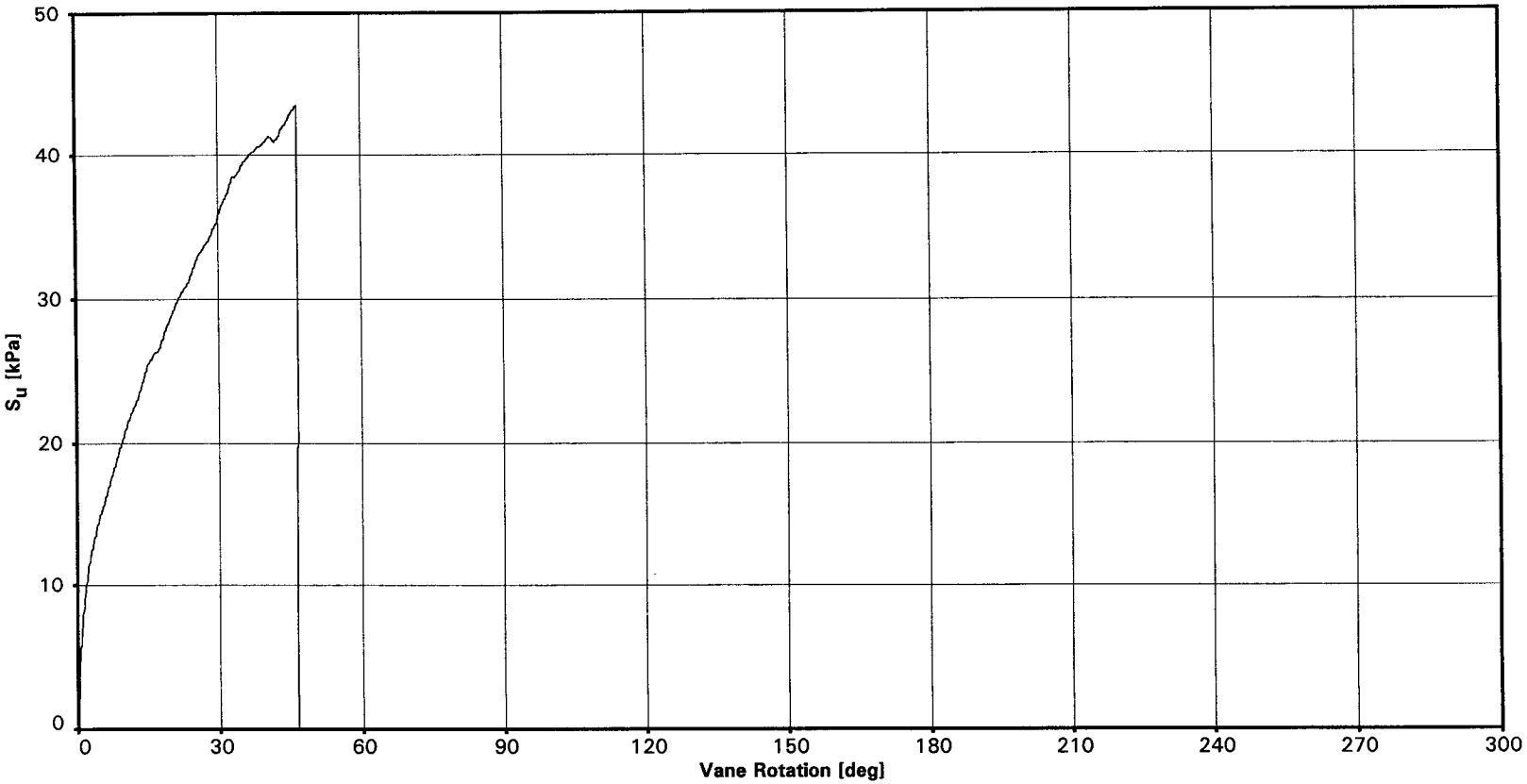
FUGRO

PLATE 98-28.9d

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: 2.4m (2nd Attempt)
Boring 98-28
SFOBB East Span Seismic Safety Project

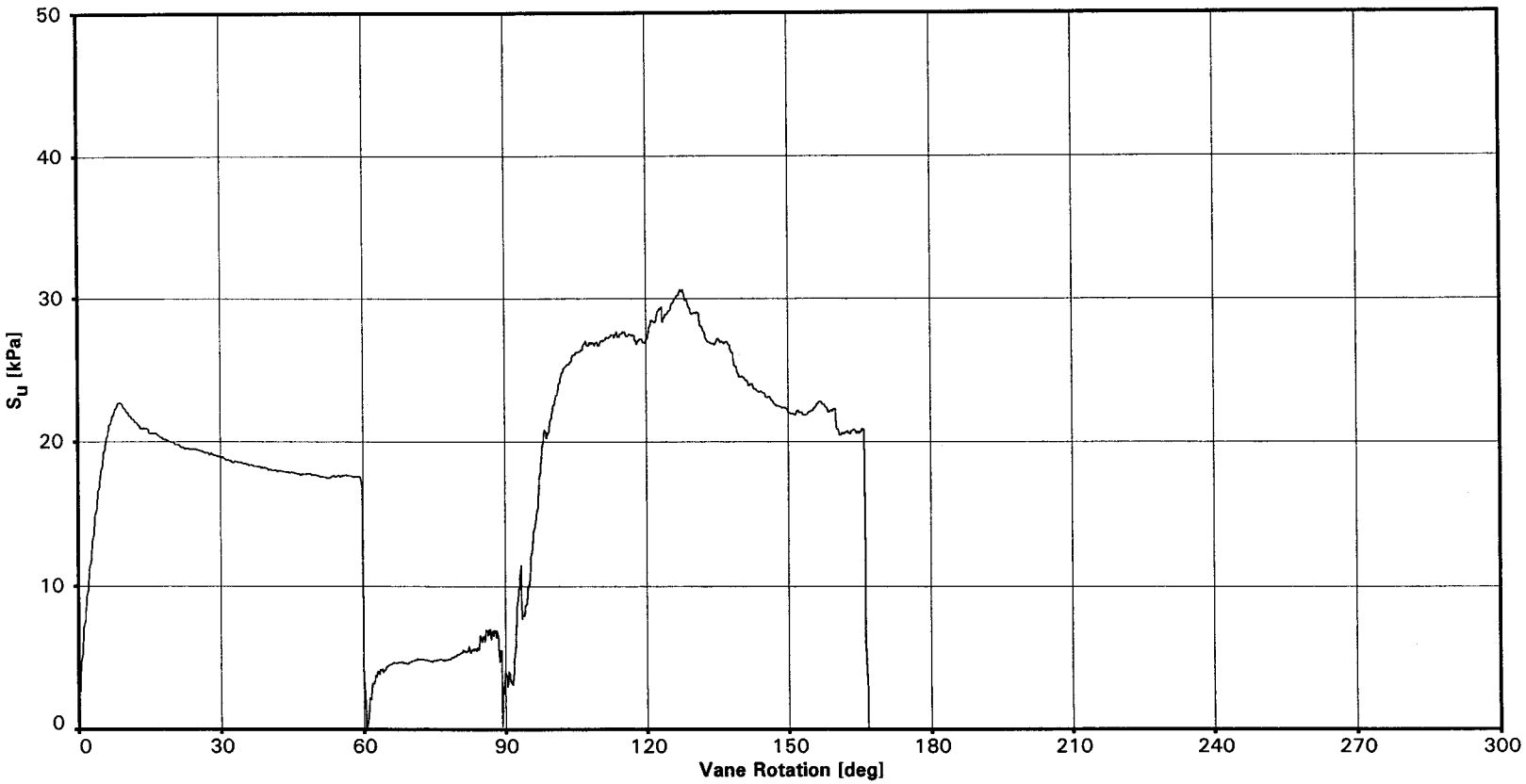
Earth Mechanics

FUGRO

PLATE 98-28.9e

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)

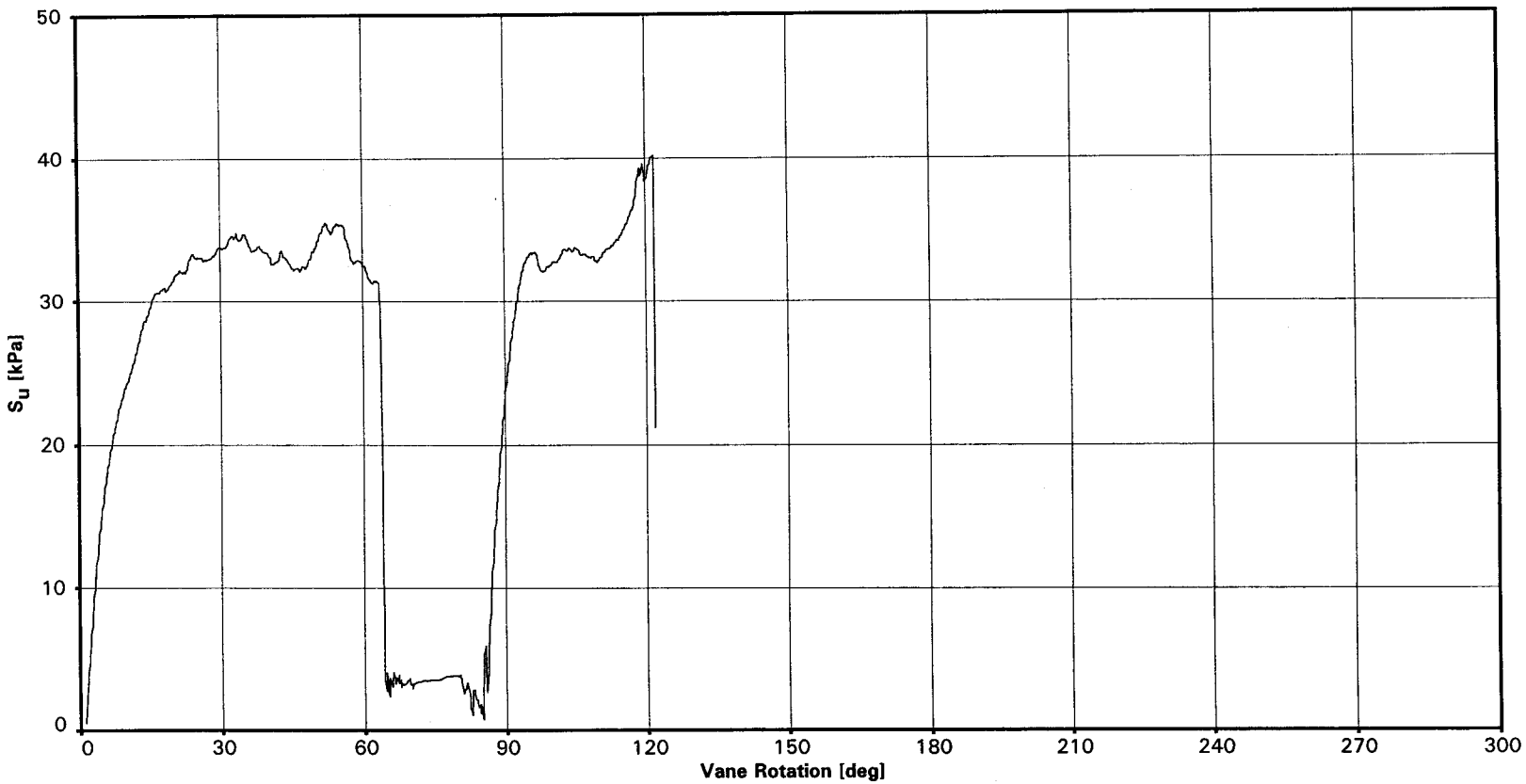


REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.7m
Boring 98-28
SFOBB East Span Seismic Safety Project

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: 4.9m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

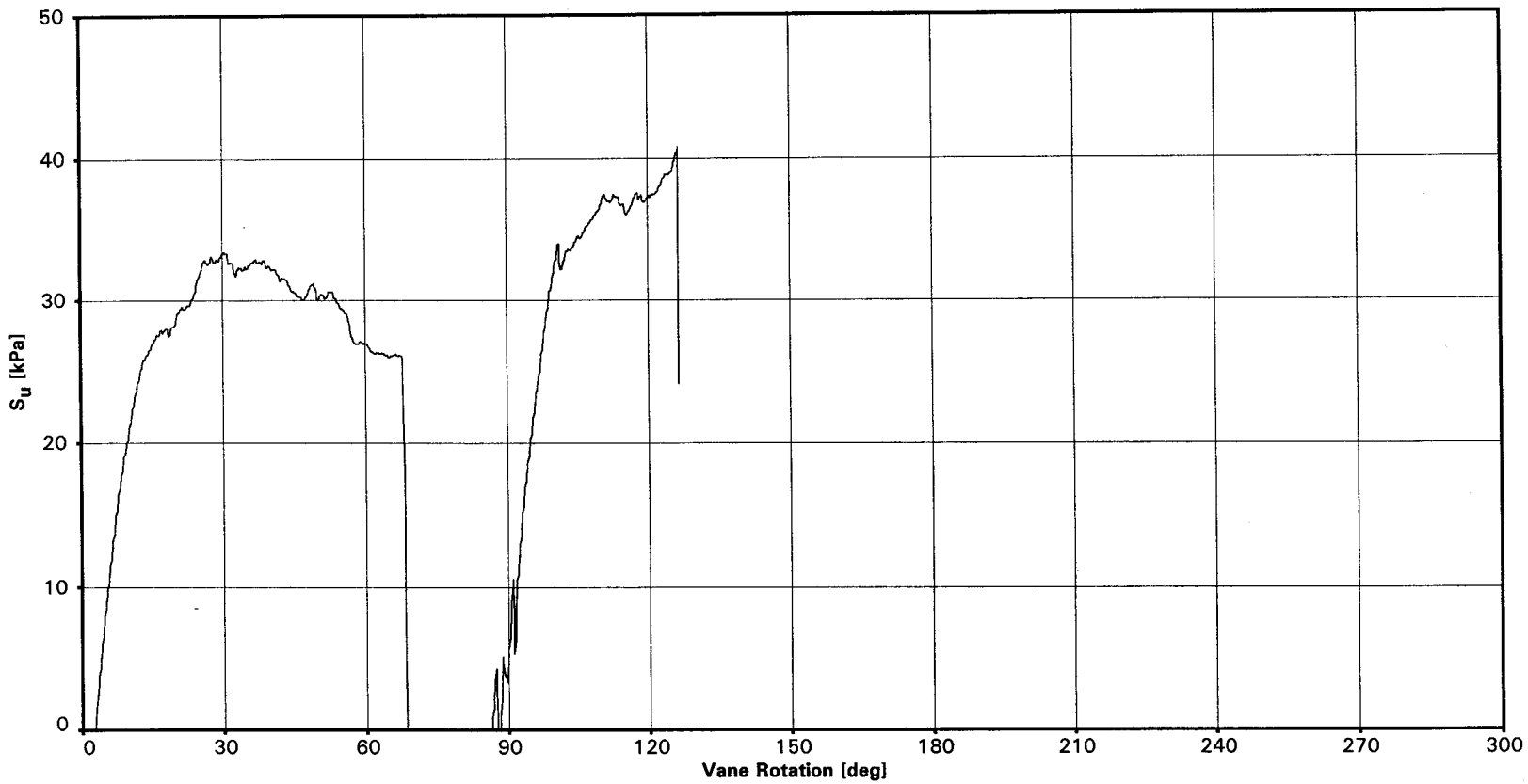
FUGRO

PLATE 98-28.9g

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: 6.1m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

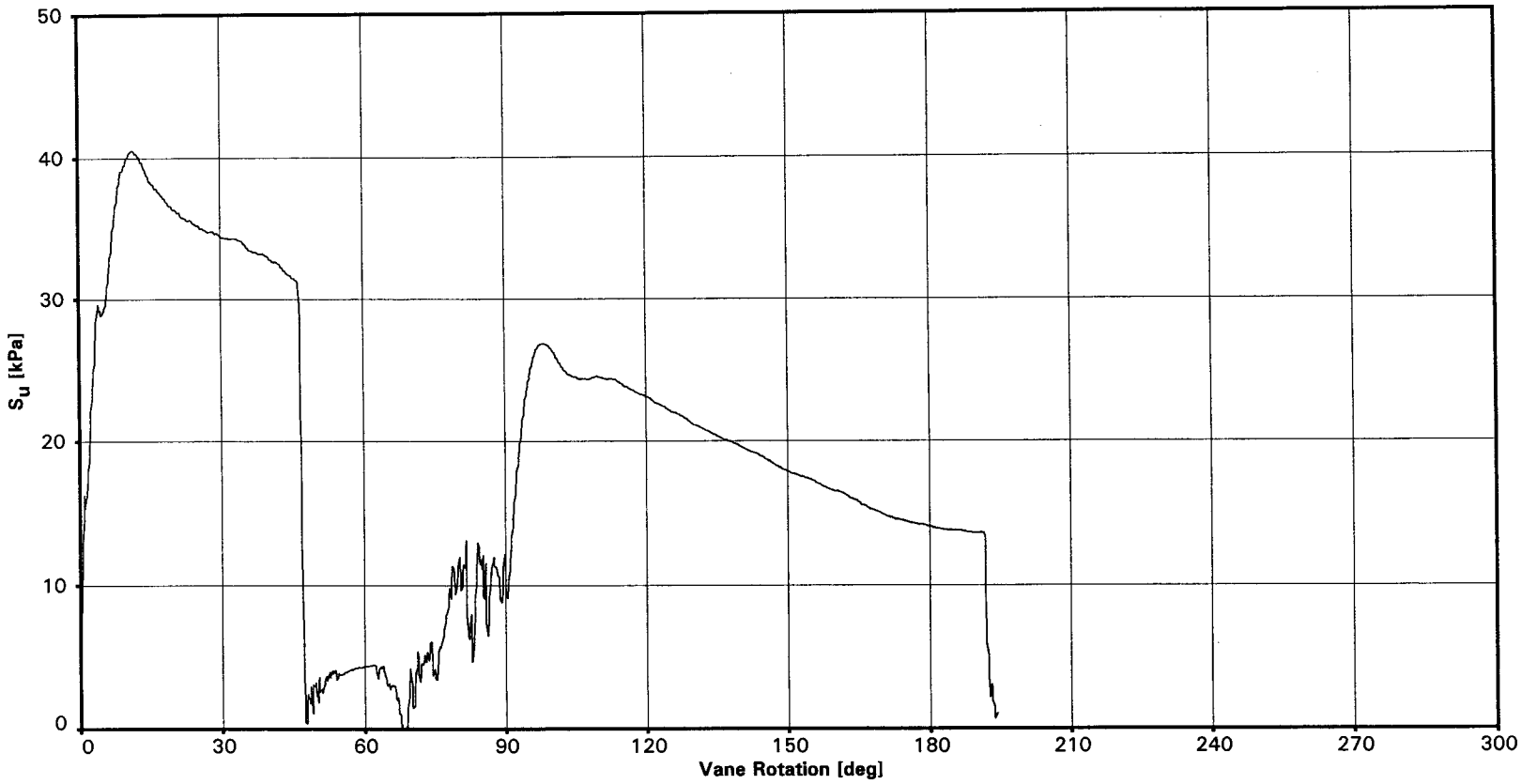
FUGRO

PLATE 98-28.9h

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: 7.3m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

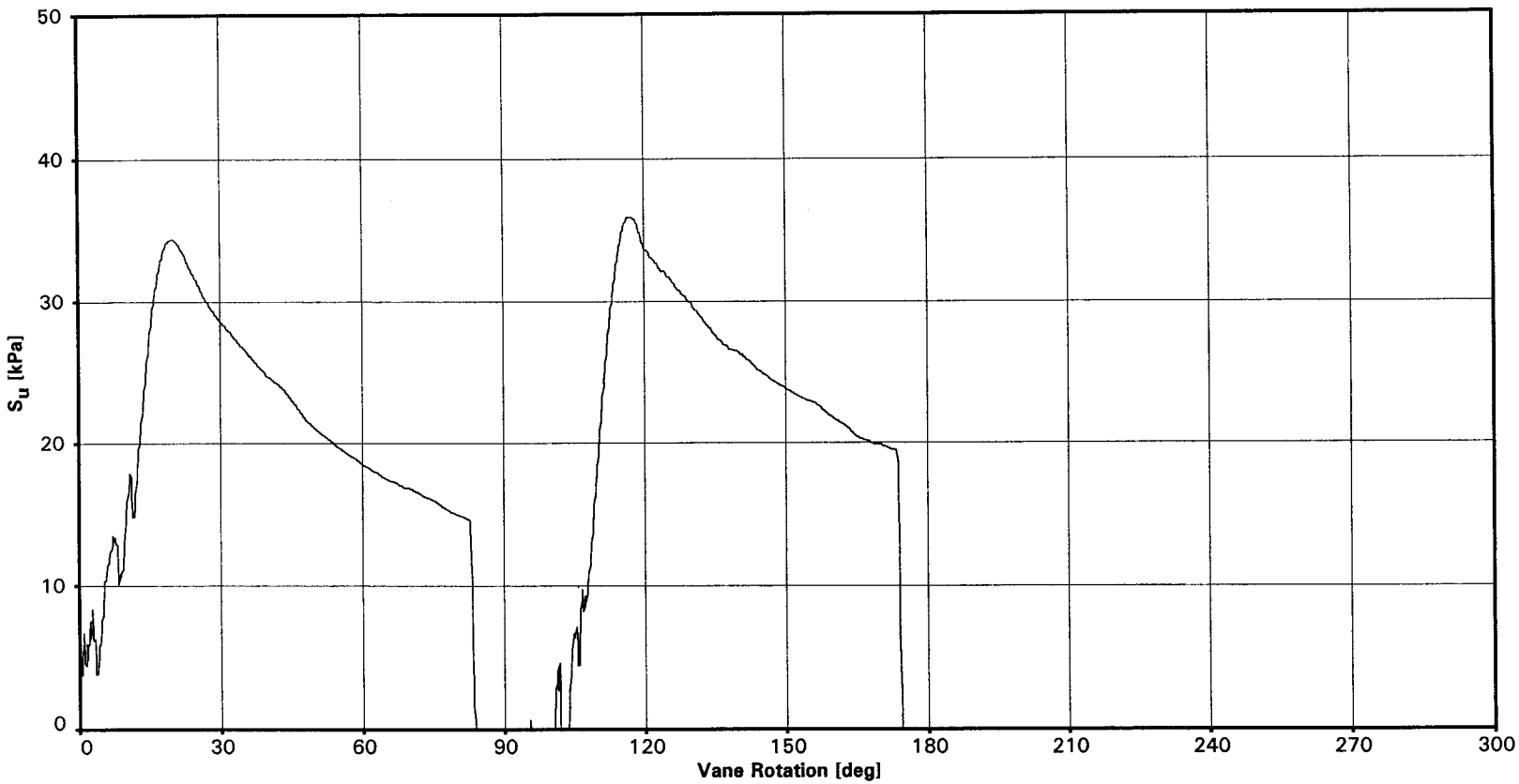
FUGRO

PLATE 98-28.9i

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: 8.5m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

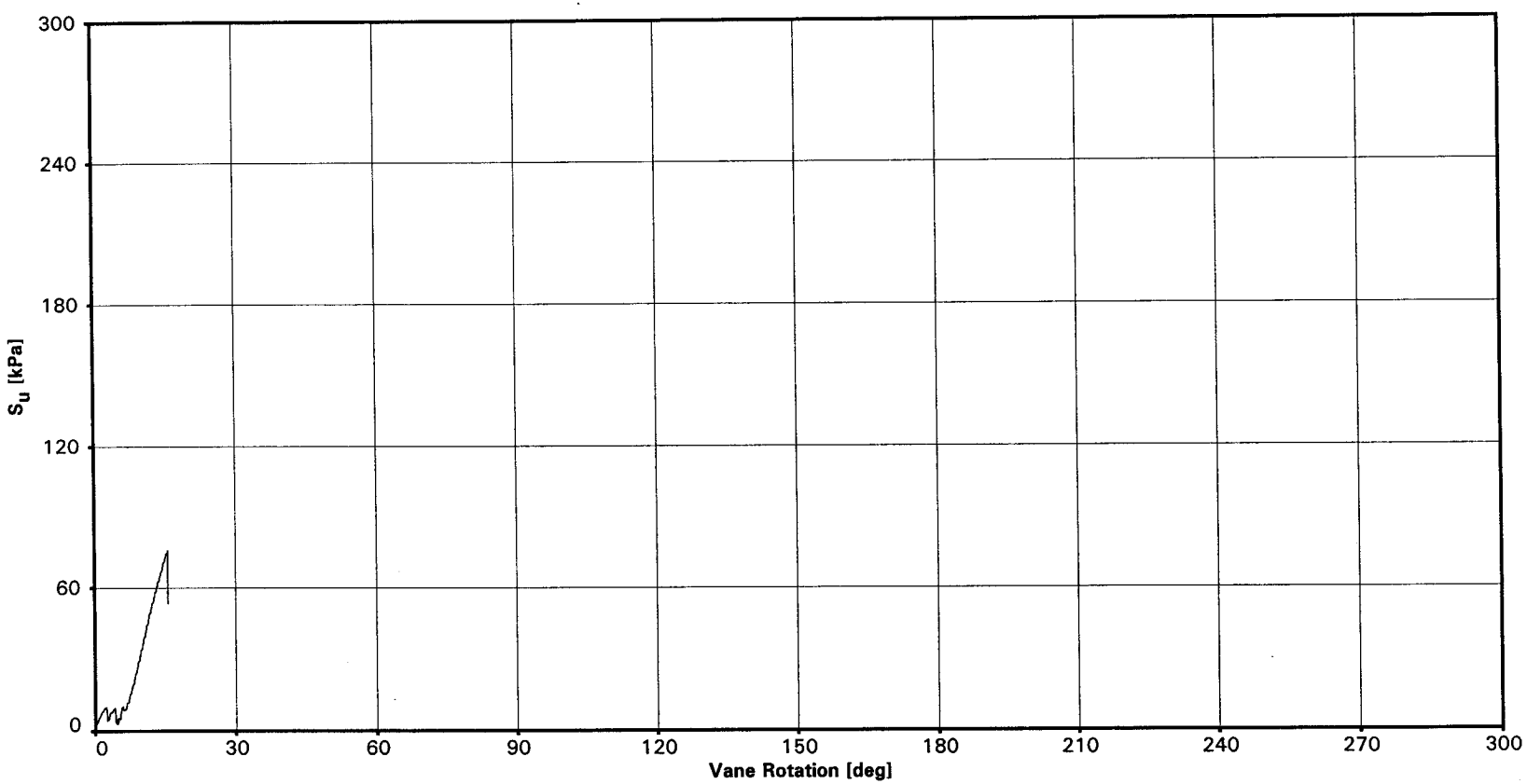
FUGRO

PLATE 98-28.9j

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 (DOWNHOLE) TEST RESULTS
Test Depth: 18.3m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

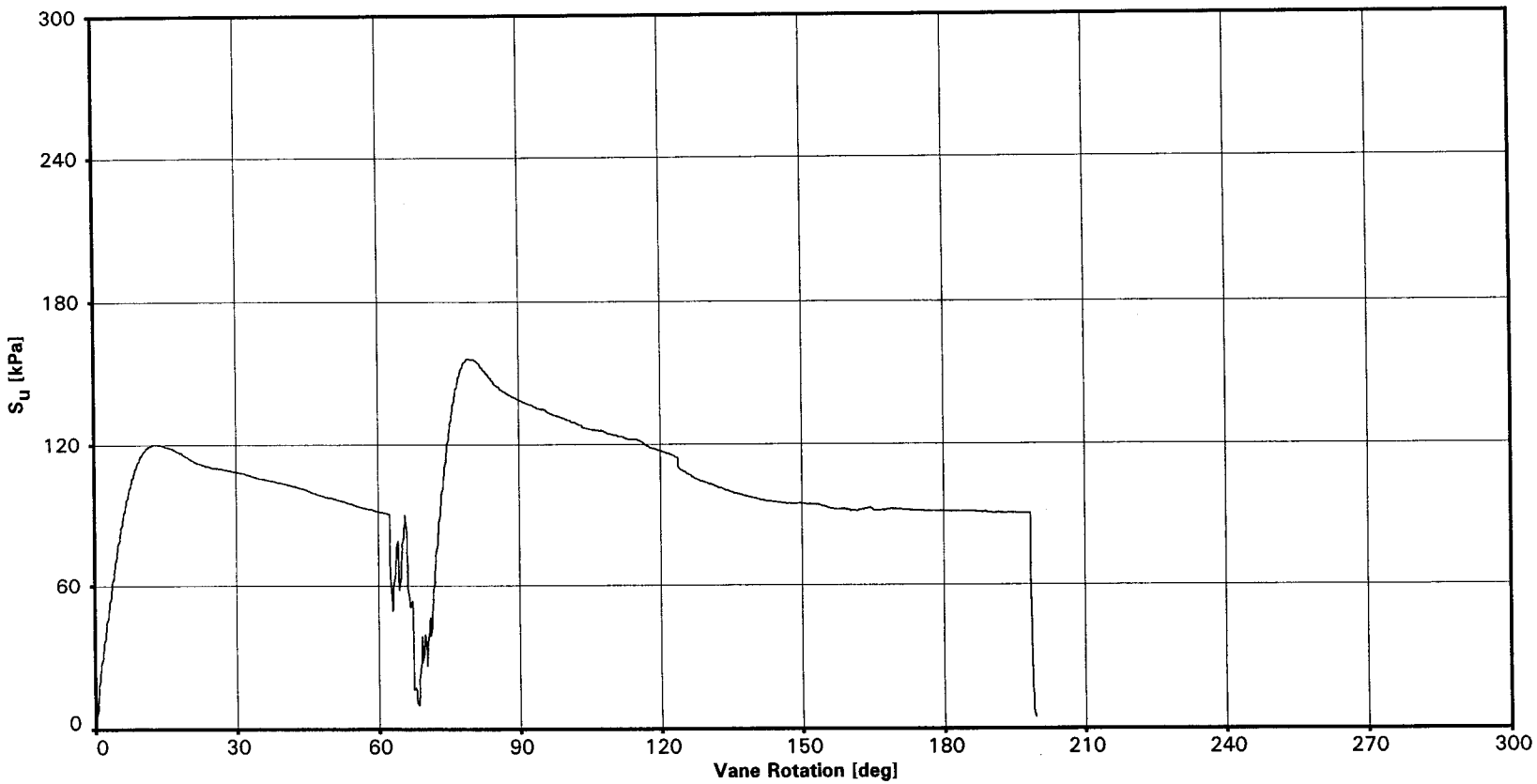
FUGRO

PLATE 98-28.9k

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: 20.1m and 20.7m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

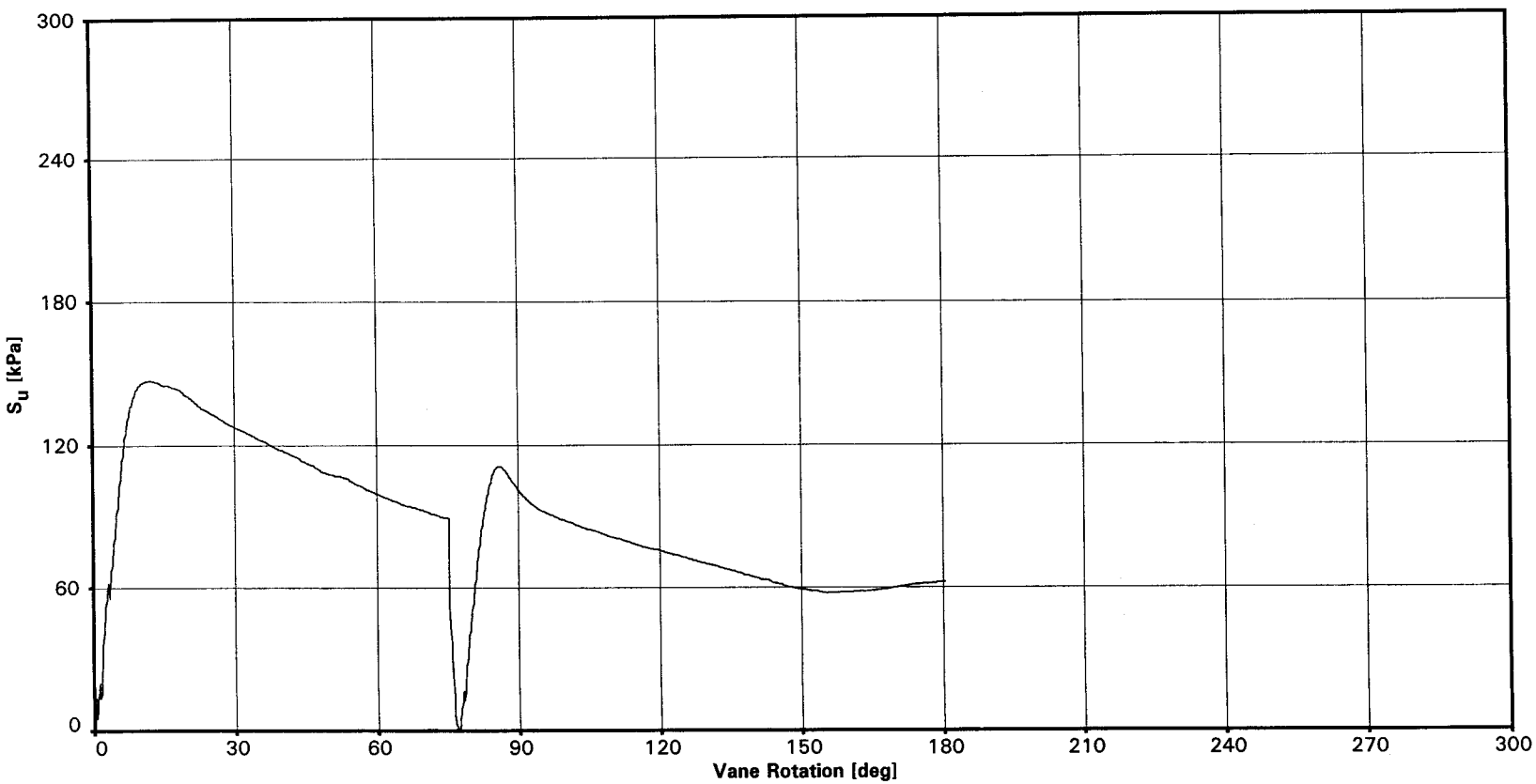
FUGRO

PLATE 98-28.9I

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: 22.9m and 23.5m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

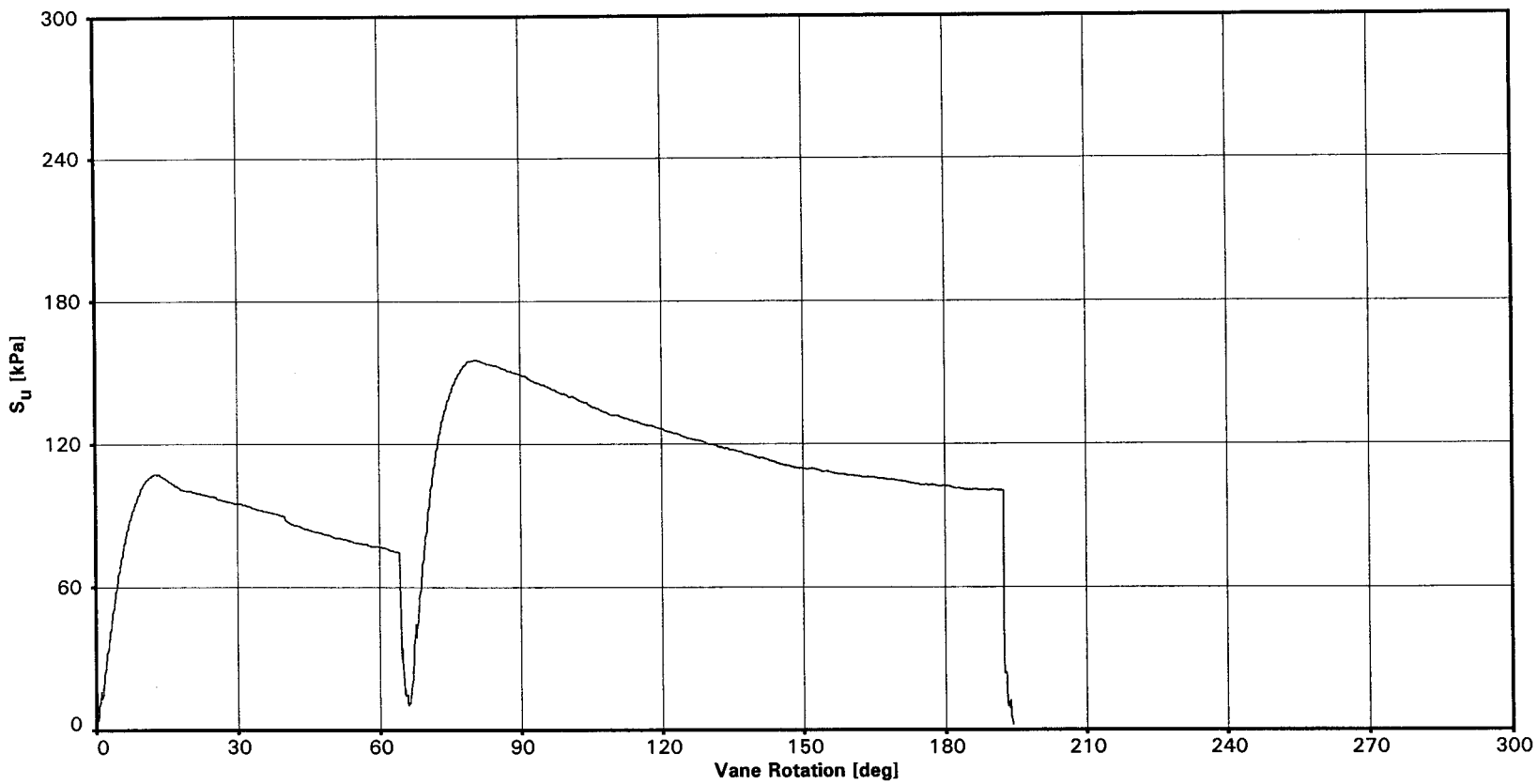
FUGRO

PLATE 98-28.9m

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: 25.6m and 26.2m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

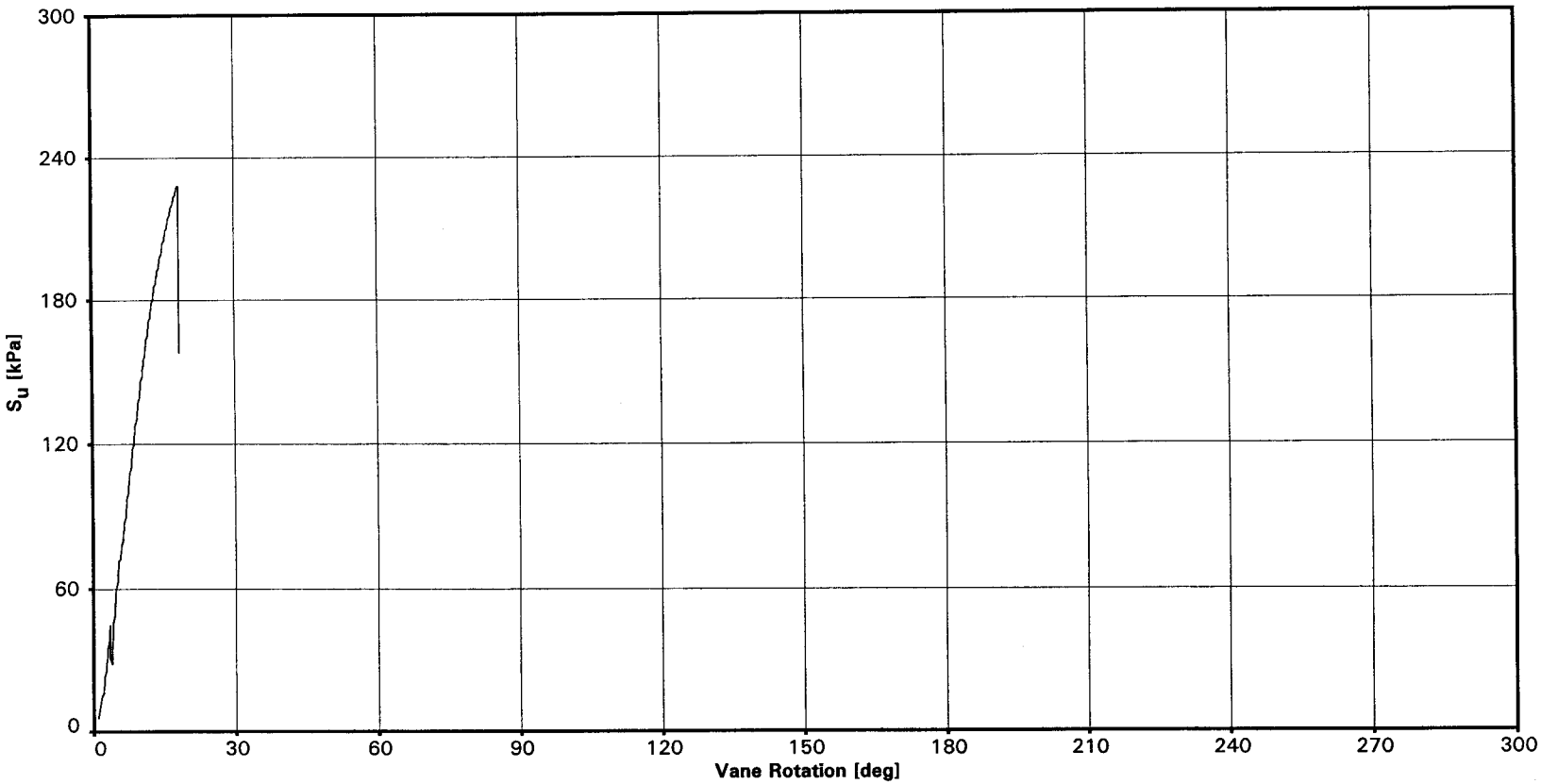
FUGRO

PLATE 98-28.9n

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: 28.3m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

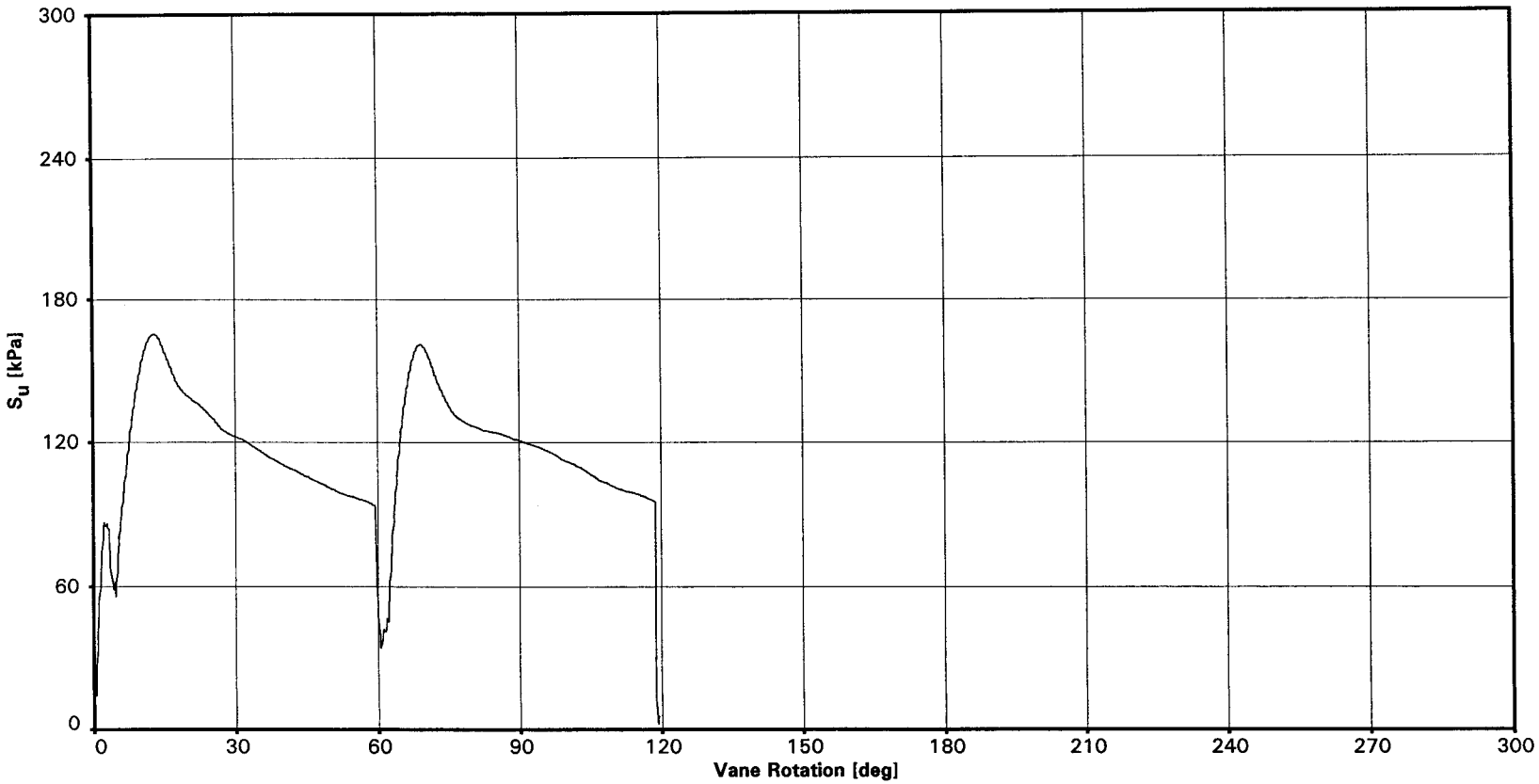
FUGRO

PLATE 98-28.9o

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: 36.0m and 36.6m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

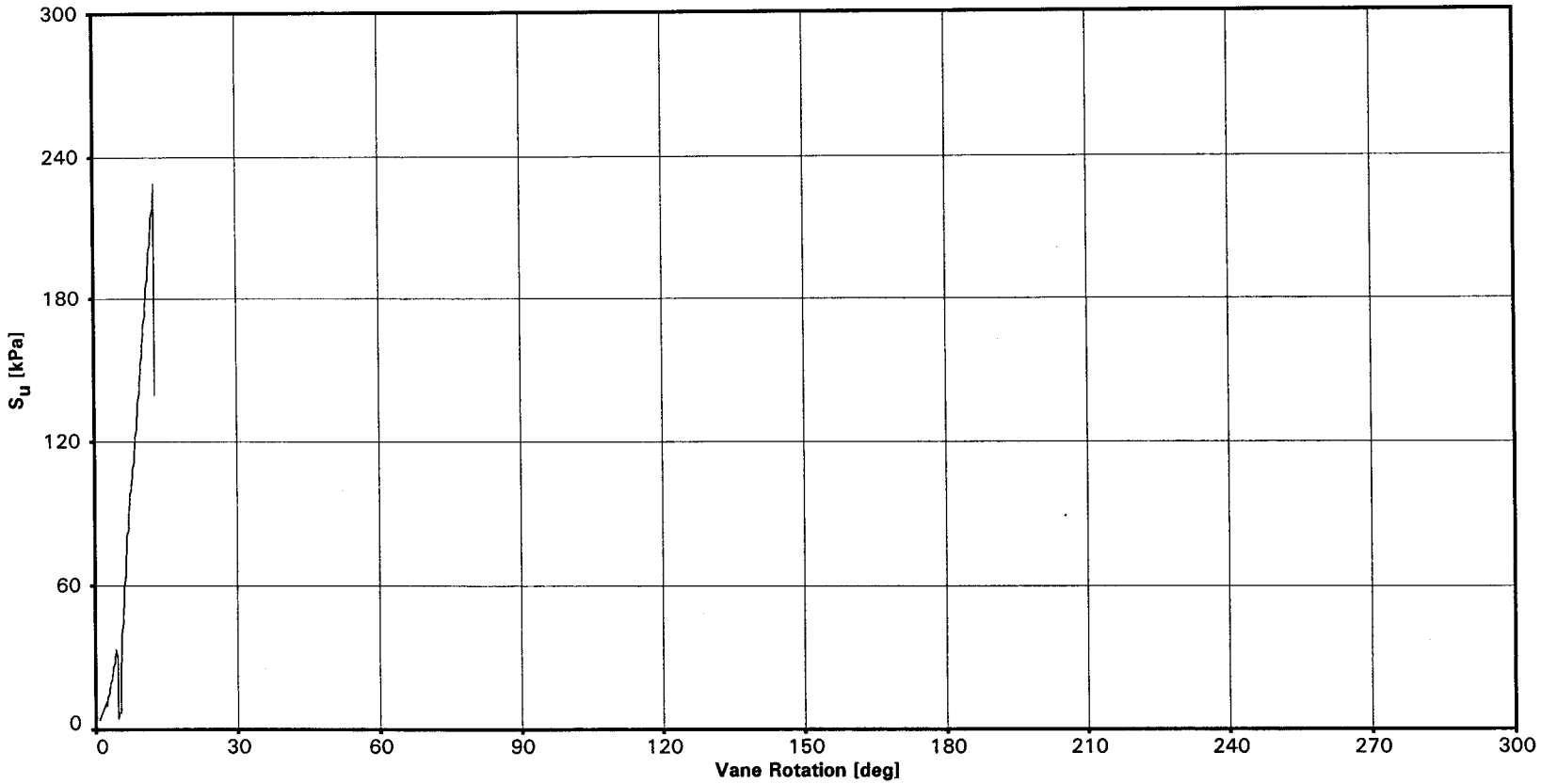
FUGRO

PLATE 98-28.9p

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: 39.0m
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-28.9q

98-28		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)			
0.6	500													2.9												
0.6	501													1.4												
1.1	1	82	60	25	1.62	5.4	66				4.7													H		
1.2	2	68				6.8				1.3																
1.2	502													6.7												
1.2	503													4.8												
1.8	504													4.8												
1.8	505													8.1												
2.0	3					5.2																				
2.1	4	67				6.1				3.4	12.5		2.5													
2.1	4	54	59	26	0.86																					
2.4	506													16.8												
2.4	507													40.7												
2.9	5	83	78	32	1.10	4.9		23.0			29.1	4.1														
2.9	5	74								5.6																

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 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-28		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)			
3.7	508													24.4												
3.7	509													31.6												
3.8	6	58				5.6		24.9			28.3		14.2													
4.7	7	62	67	29	0.86	5.7	95								19.6		0.6							H		
4.9	8	56	59	24	0.91			28.7			33.4															
4.9	510													35.4												
4.9	511													40.2												
5.6	9	87				6.7																				
5.7	10	53	58	24	0.86			28.7		26.8	37.8	5.1														
6.1	512													33.5												
6.1	513													40.7												
6.7	11	56						14.4		15.3																
7.3	514													41.2												
7.3	515													27.3												
7.5	12	59				6.3		28.7			34.5															

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MC = Moisture Content
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-28		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)			
7.5	12	58	64	26	0.84					27.8		4.8														
7.5	300	49				6.2																				
7.6	301							19.2			30.4															
8.3	302	62						30.6			43.0															
8.4	13	64	65	28	0.97			22.0		32.6	28.6															
8.4	13	65																								
8.5	516													34.0												
8.5	517													36.4												
9.1	303	59	63	25	0.91						38.9													C,K	2.74	
9.1	304						98																	H		
9.3	14	58				5.8		27.8							33.9	8.4	1.5									
9.3	14	57	64	27	0.82																					
9.4	15										43.6	5.4														
10.0	306					9.4																				
10.1	307	23					18																			

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Additional Tests
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-28		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)			
10.5	18	24				10.0	15											9.6	35							
11.1	19	27					46																			
11.1	308	22				9.4																				
11.3	20					9.3																				
12.0	21	24					17																			
12.3	310	72																								9
13.1	22	70				3.9																				
13.4	24	21				10.3																				
13.9	25					11.2			177.2	206.8																
14.0	26	16	23	13	0.30		33		215.5															H		
14.8	27	19				10.9	27											19.2	35							
15.7	29	52	82	31	0.42	7.1		119.7	81.4		136.1				74.2	52.7	0.7									
15.7	29	54																								
15.8	30							107.7	119.7																	
16.9	31	56	68	26	0.71																			C		

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-28		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)			
17.1	32	61	84	29	0.58	6.1									64.1		0.7									
17.2	33							88.6	47.9	114.0	96.5															
18.3	400													74.2												
19.4	34							110.1	119.7																	
19.7	36	45	75	28	0.36	6.6		107.7							132.5	42.5	1.0									
19.7	36	51																								
19.8	37							117.3	129.3	141.7	116.3															
20.1	401													119.7												
20.7	402													151.8												
21.8	39	48				7.5	76	95.8	105.3						162.6		0.8							H		
21.8	39	46	68	27	0.47																					
21.9	40							102.9	105.3	166.6																
22.9	403													143.2												
23.5	404													110.1												
24.5	43	50				6.9		95.8	105.3																	

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-28		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	44	55	71	30	0.61	6.9		91.0	119.7		179.5				120.2	36.8	1.9									
25.6	405													94.3												
26.2	406													156.1												
27.3	46	31	31	17	0.99	7.4																				
27.4	47										137.4															
28.3	407													215.0												
29.1	48	25				10.0			198.6						223.6		0.8									
29.1	48	26	52	20	0.17																					
30.4	49	33	34	21	0.95																					
31.5	51					9.0																				
31.7	52	34									129.9															
33.1	53								167.6																	
33.2	54							162.8	191.5																	
33.4	55	51				6.7																				
33.4	55	53	89	30	0.38																					

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-28		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)			
33.5	56										185.6															
34.7	57	85							179.6																	
34.9	58	76	133	47	0.33	4.6			179.6						236.7	63.4	0.9									17
35.1	59										222.8															
36.0	408													159.9												
36.6	409													155.6												
37.8	60	36	58	21	0.41				191.5															C		
37.9	61	32				10.1		119.7							114.3		0.8									
37.9	61	22	48	18	0.14																					
38.1	62										203.0															
39.0	410													219.8												
40.8	63	55				7.2										37.7										
41.0	64	51	103	29	0.30	6.8	99		167.6															H		
41.1	65							119.7	215.5		175.8	51.6														
45.1	66	30				8.6																				

Identification Tests
MC = Moisture Content
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-28		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)			
50.2	69		27	13																						
50.3	70						4																			
55.0	71					9.3																				
55.2	72	26																								
57.8	73	28	41	20	0.39	9.6																				
57.9	74	30						141.2		166.6																
62.9	76	35				8.4		189.1	201.1		222.8				217.0	84.2	0.5									
62.9	76	36	62	25	0.30																					
63.1	77							174.8	196.3																	
64.3	78	47	71	28	0.45		95				222.8													C,H	2.74	
69.0	80	40				9.4									197.0	58.5	1.0									
69.0	80	44	40	18	1.23																					
73.8	82								191.5																	
73.9	83	32	69	28	0.10	8.5	97								279.4	85.2	0.7							H		
74.1	84							198.7	191.5																	

Identification Tests
MC = Moisture Content
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-28
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-28		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)			
78.5	85	22				10.4			177.2																	
78.6	86	19	26	17	0.27				215.5																	
80.3	87	18																								
80.5	88					12.1	27											95.8	34							
83.7	89	21				9.1	13																			
86.1	90	12					5																			
88.5	91					10.1																				
88.6	92	22					59																	H		

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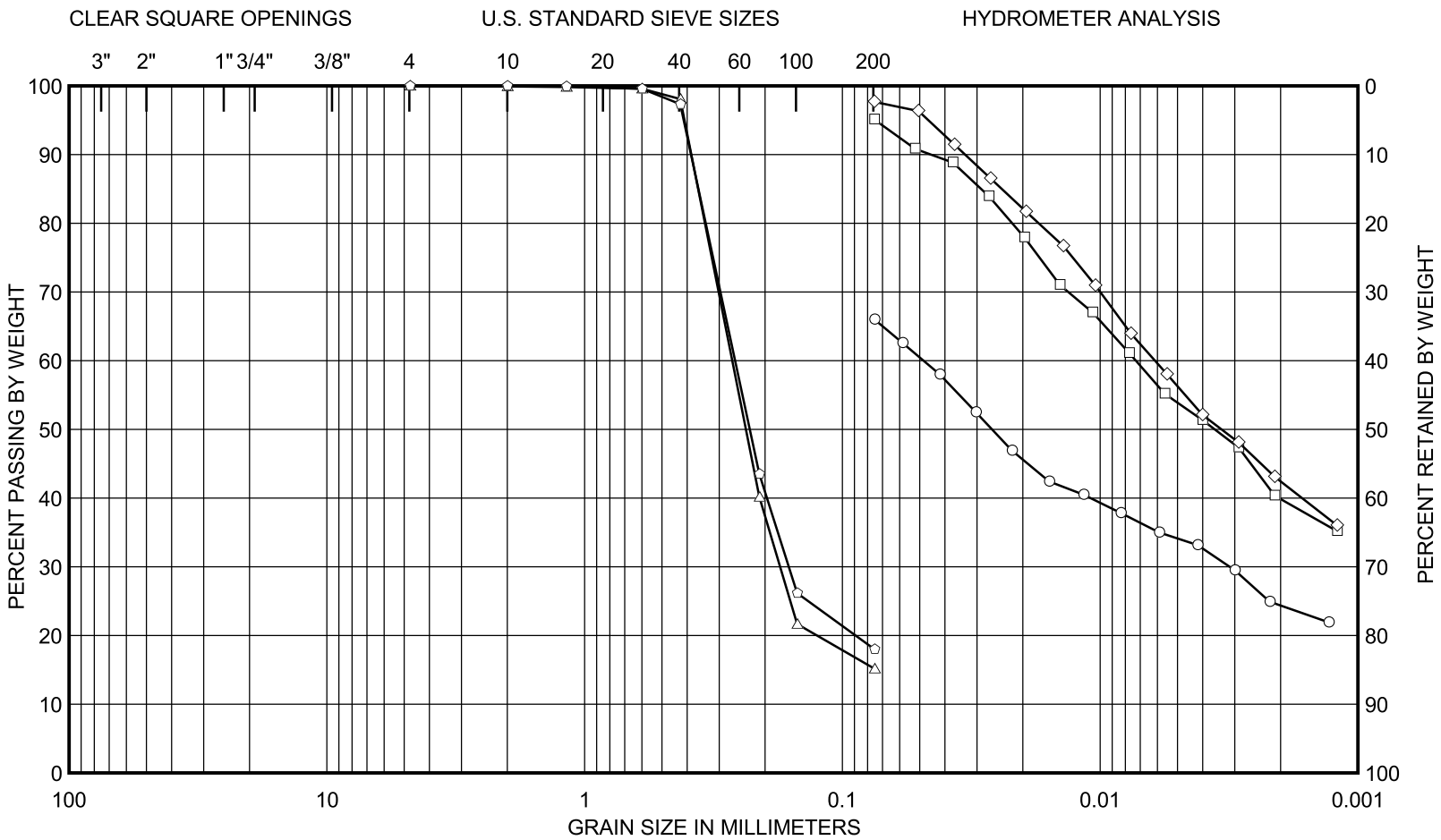
SUMMARY OF LABORATORY TEST RESULTS
Boring 98-28
SFOBB East Span Seismic Safety Project

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)
1	1.1	○——○	FAT CLAY (CH) with silty sand pockets			0.026
7	4.7	□——□	FAT CLAY (CH)			0.0040
18	10.5	△——△	SILTY FINE SAND (SM)			0.24
304	9.1	◇——◇	FAT CLAY (CH)			0.0030
307	10.1	⬠——⬠	SILTY FINE SAND (SM)			0.23

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-28

SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-28.11a

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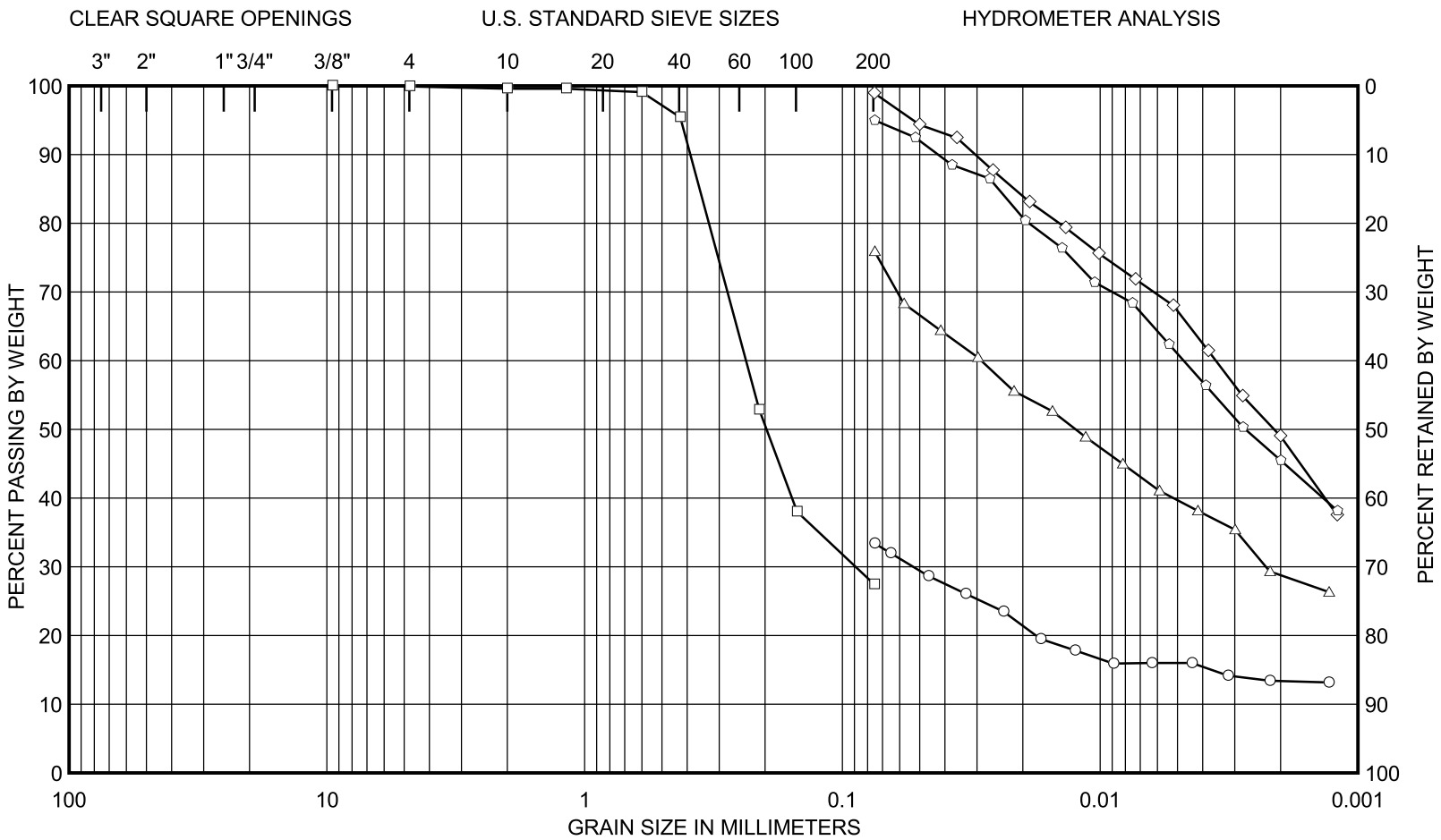

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
26	14.0	○——○	SAND (SP) with clay seams			
27	14.8	□——□	SILTY FINE SAND (SM)			0.20
39	21.8	△——△	FAT CLAY (CH)			0.012
64	41.0	◇——◇	FAT CLAY (CH)			0.0020
78	64.3	⬠——⬠	FAT CLAY (CH)			0.0030

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-28

SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-28.11b

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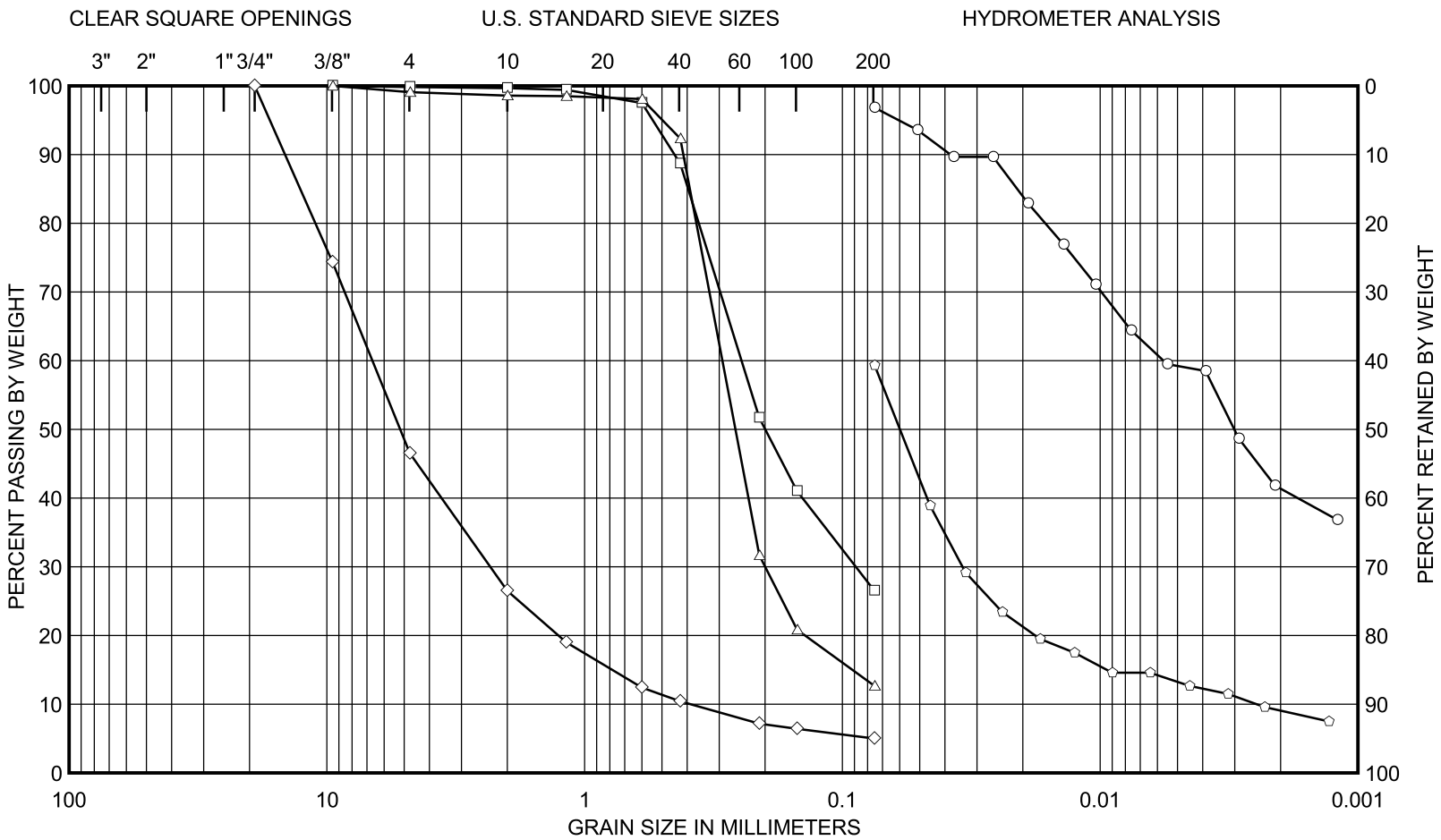

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
83	73.9	○——○	FAT CLAY (CH)			0.0030
88	80.5	□——□	SILTY FINE SAND (SM) with a trace of medium sand			0.20
89	83.7	△——△	SILTY FINE SAND (SM) with a trace of medium sand			0.26
90	86.1	◇——◇	FINE GRAVEL (GW) with coarse, medium and a trace of fine sand	2.1	17.1	5.2
92	88.6	⬠——⬠	SANDY SILT (ML)			0.052

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-28

SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-28.11c

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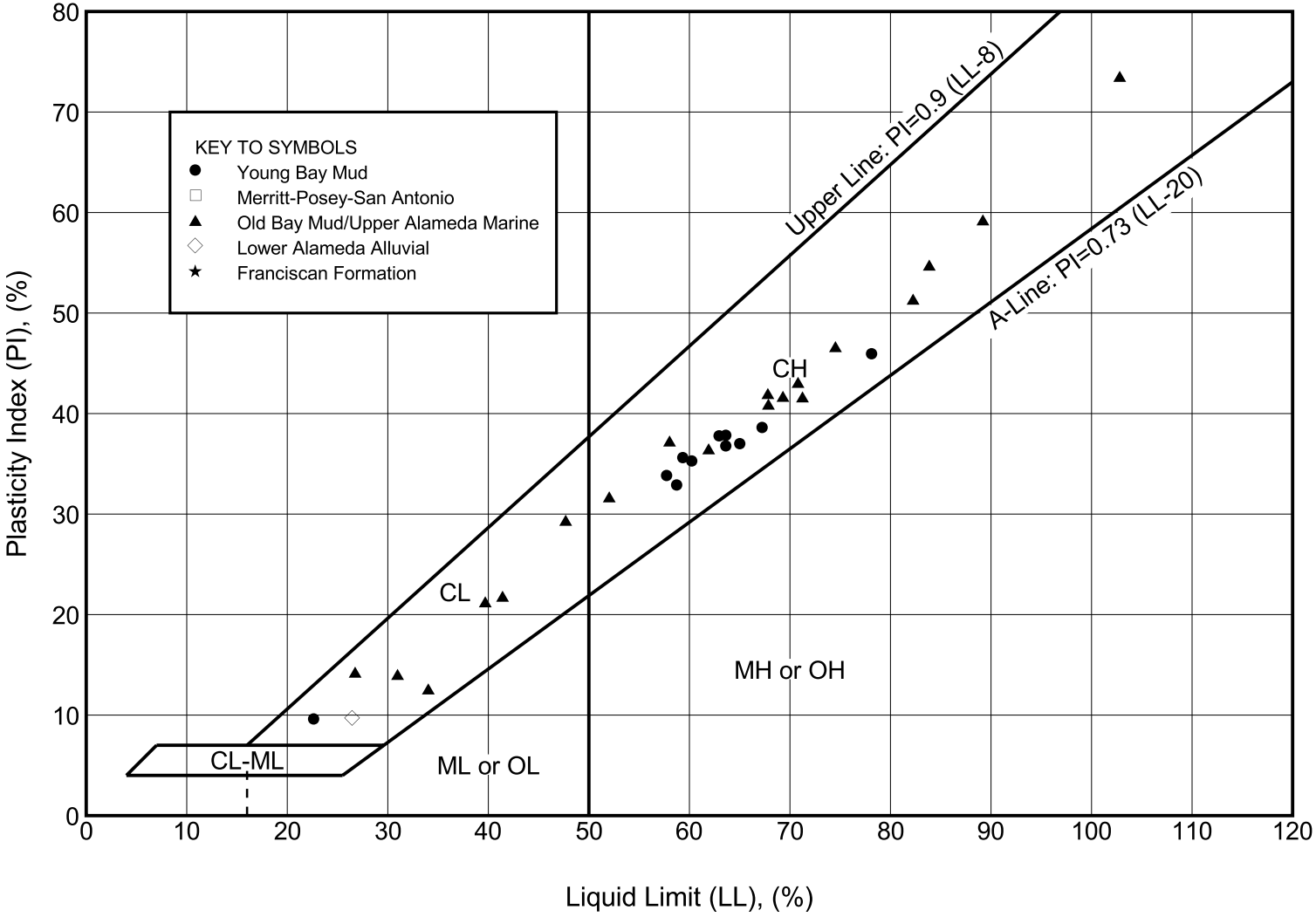

PLASTICITY CHART
Boring 98-28
SFOBB East Span Seismic Safety Project

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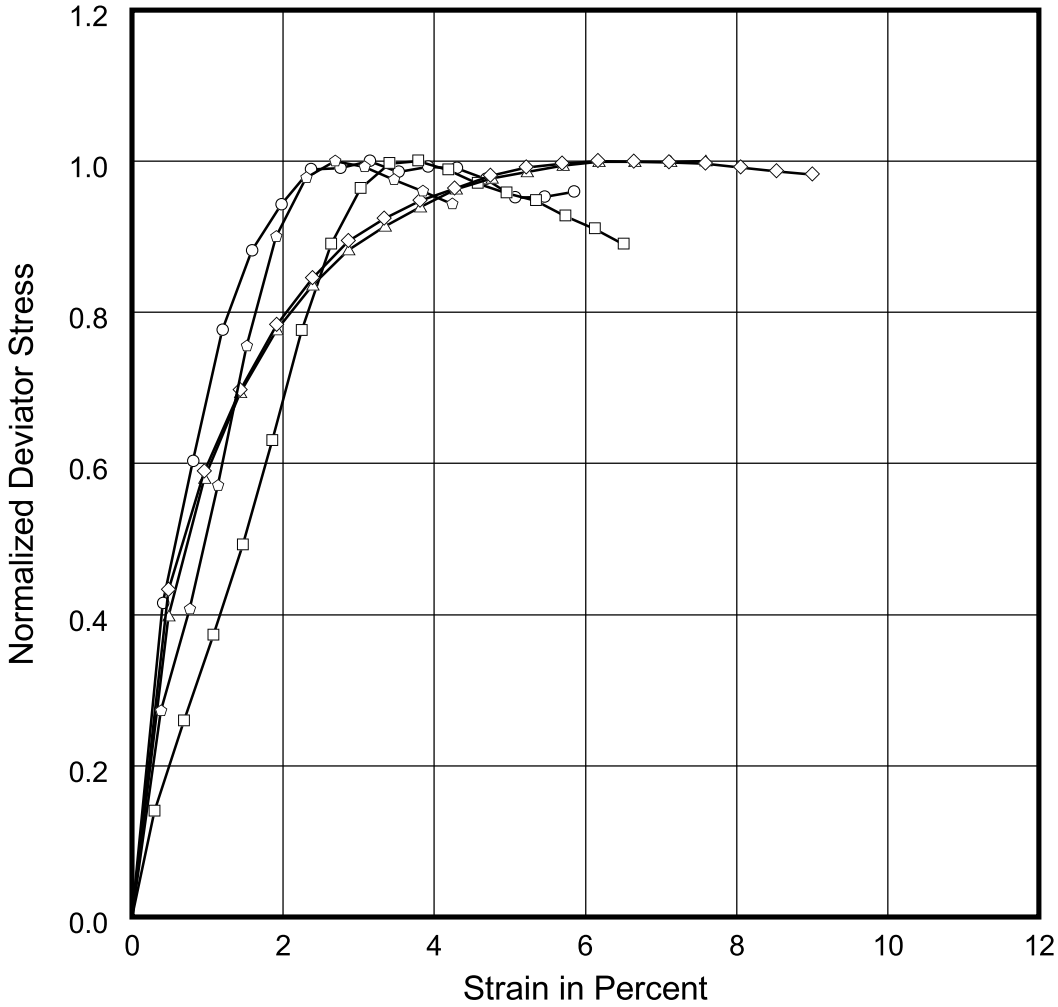
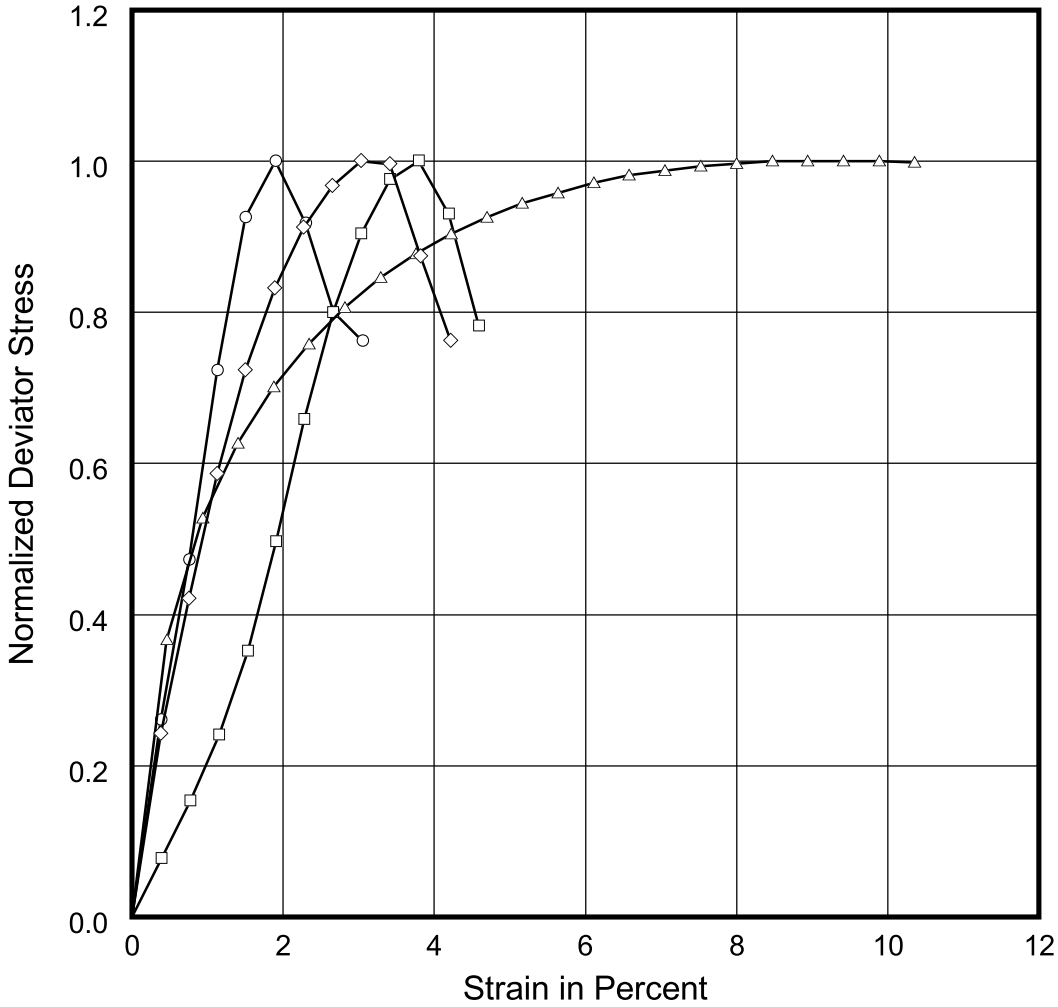


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	7	4.7	UU	103	39	0.6
	14	9.3	UU	207	68	1.5
	29	15.7	UU	379	148	0.7
	32	17.1	UU	379	128	0.7
	36	19.7	UU	448	265	1.0

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-28
SFOBB East Span Seismic Safety Project

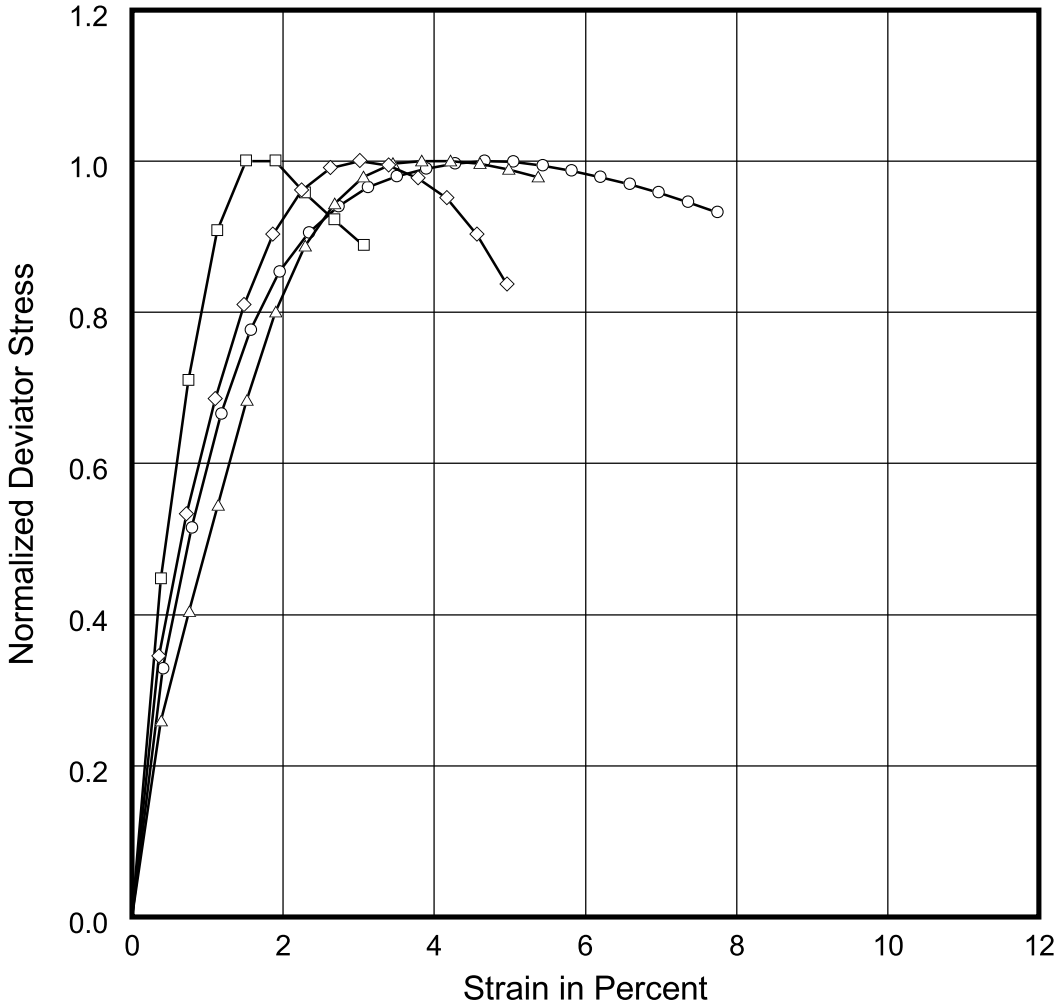


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	39	21.8	UU	483	325	0.8
□——□	44	24.7	UU	552	240	1.9
△——△	48	29.1	UU	655	447	0.8
◇——◇	58	34.9	UU	793	473	0.9

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-28
SFOBB East Span Seismic Safety Project

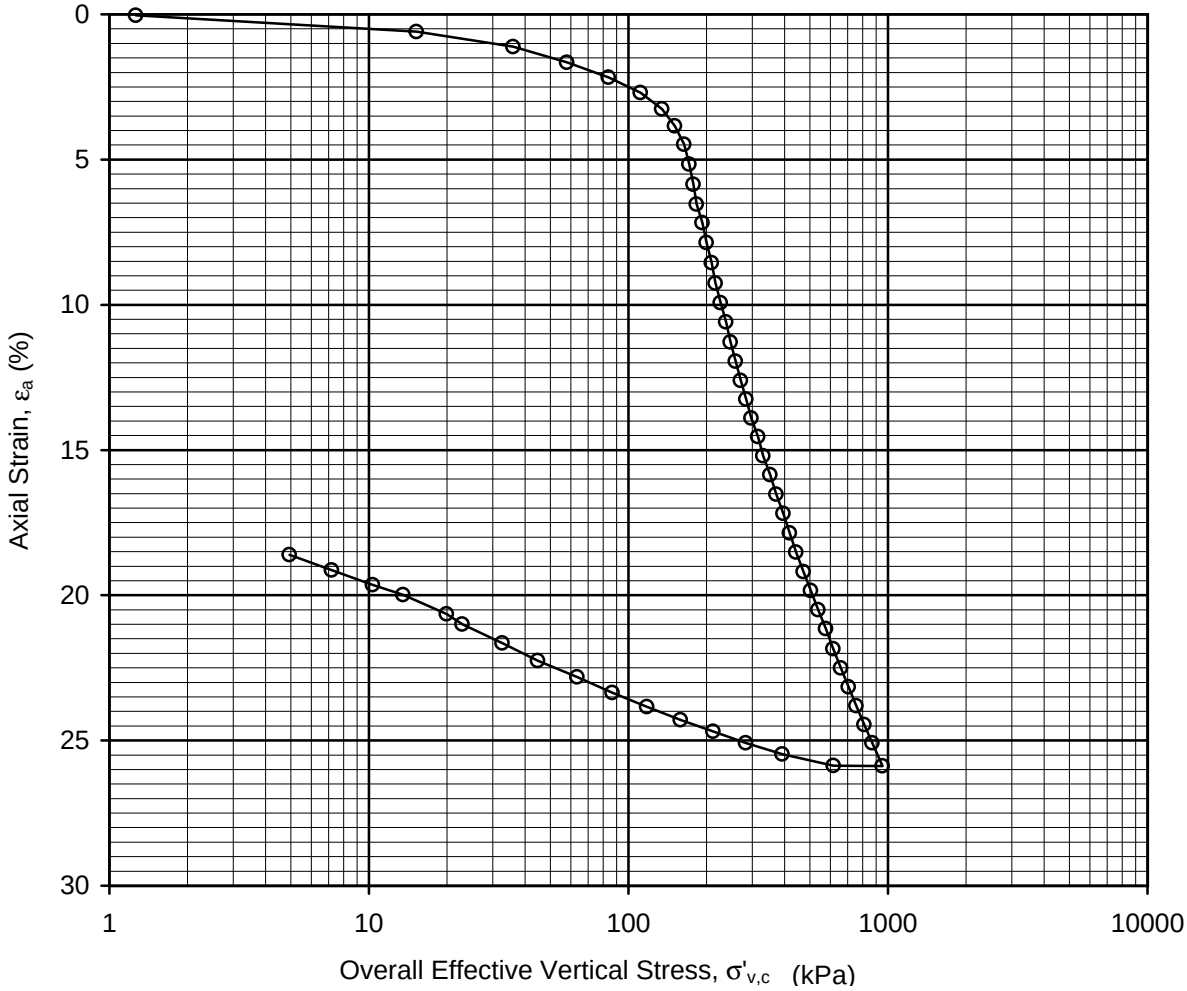


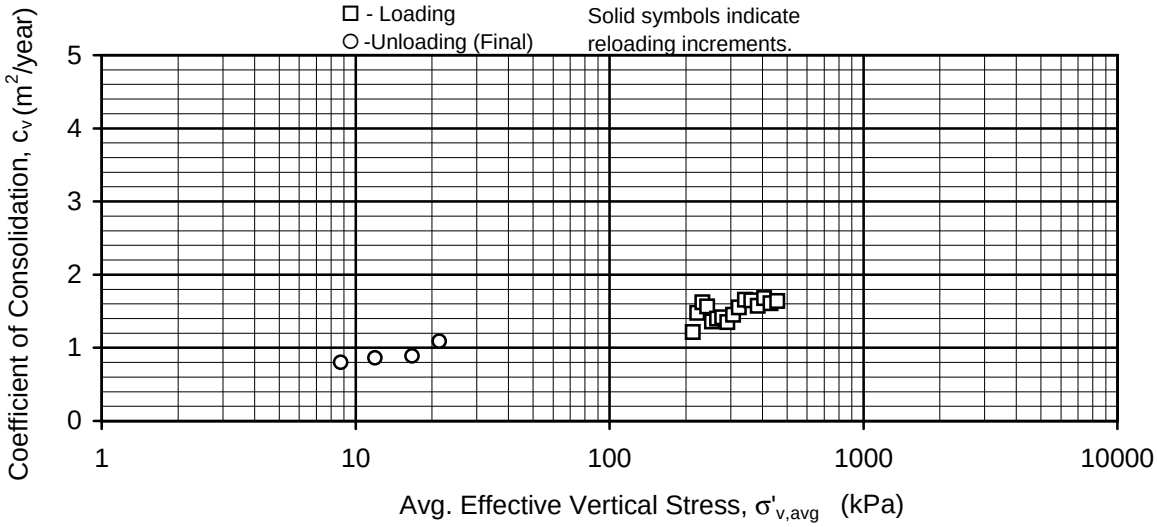
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	61	37.9	UU	862	229	0.8
□——□	76	62.9	UU	1413	434	0.5
△——△	80	69.0	UU	1551	394	1.0
◇——◇	83	73.9	UU	1655	559	0.7

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-28
SFOBB East Span Seismic Safety Project

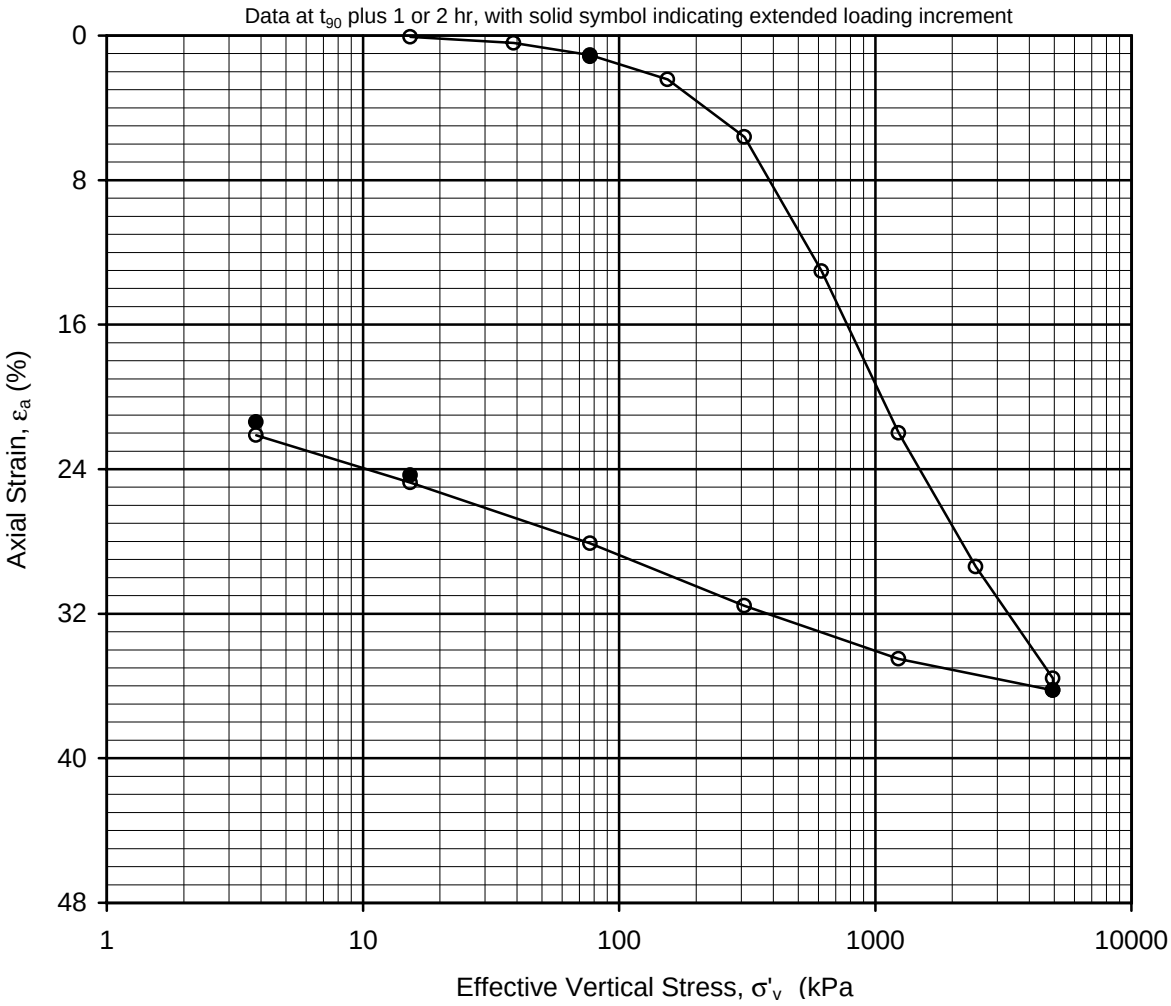


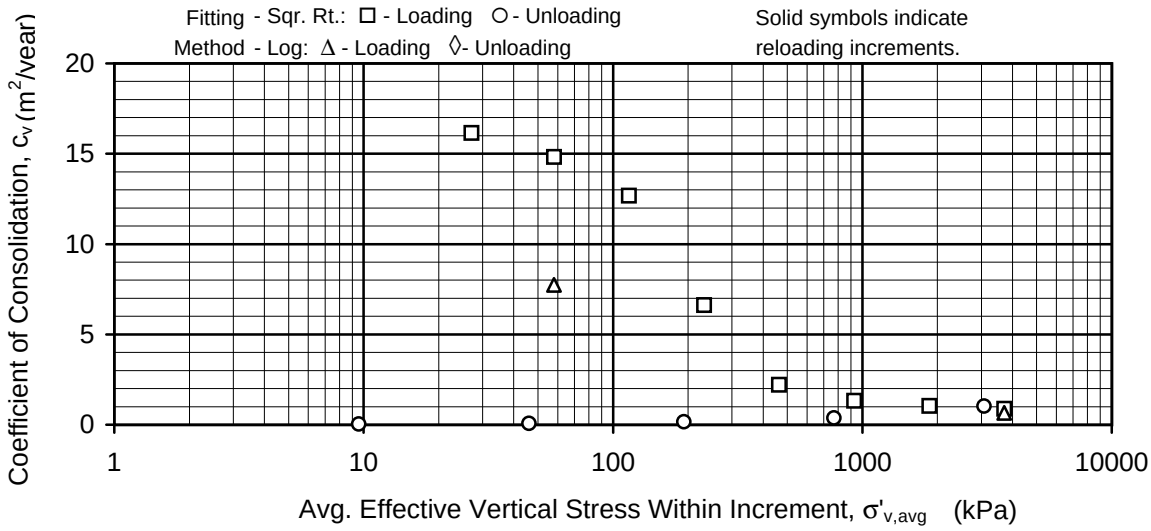


CRS CONSOLIDATION TEST RESULTS

Sample No. 303 - Depth: 9.1m
Boring 98-28
SFOBB East Span Seismic Safety Project

PLATE 98-28.14a

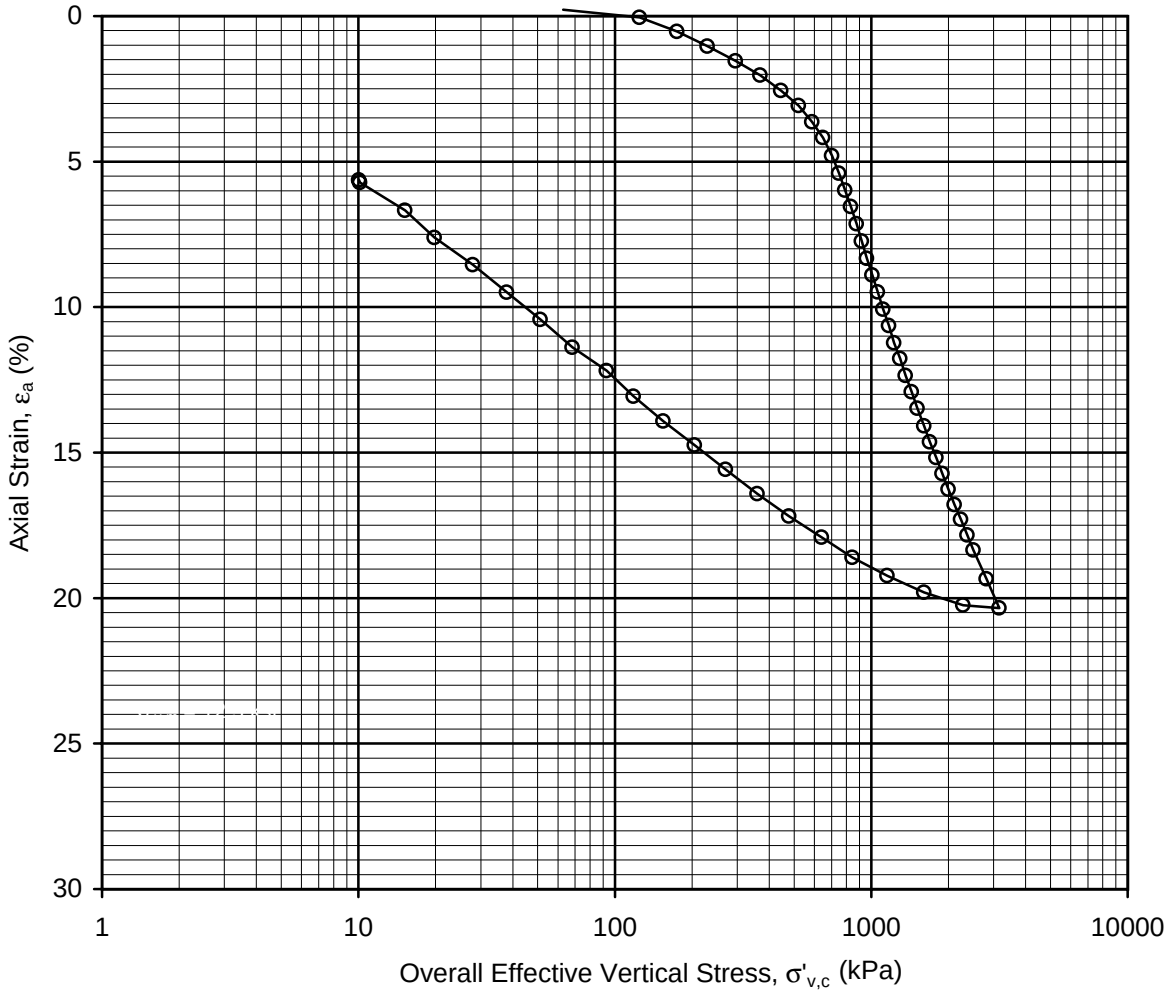


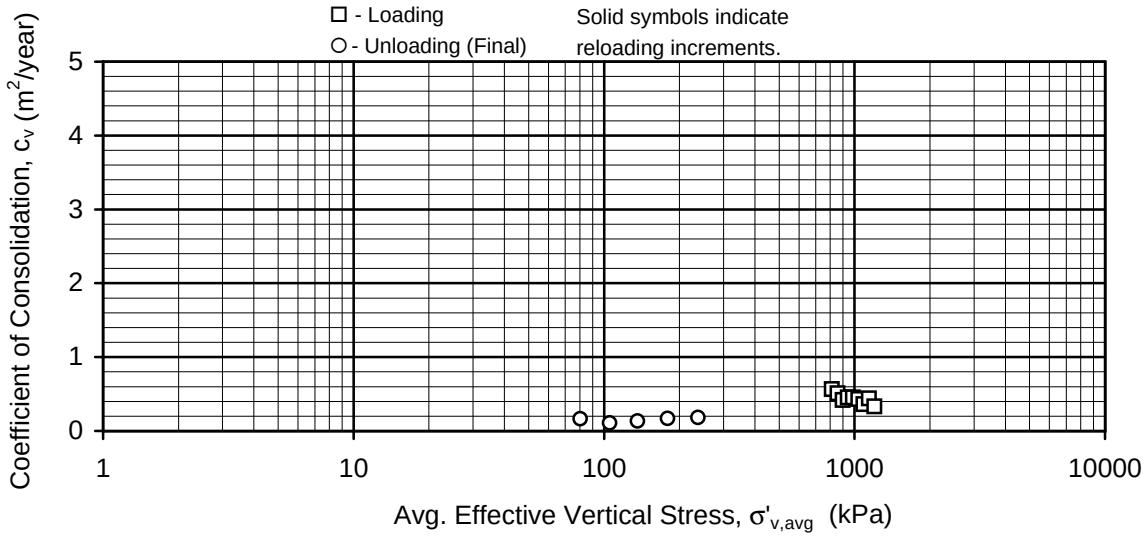


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 31 - Depth: 16.9m
Boring 98-28
SFOBB East Span Seismic Safety Project

PLATE 98-28.14b

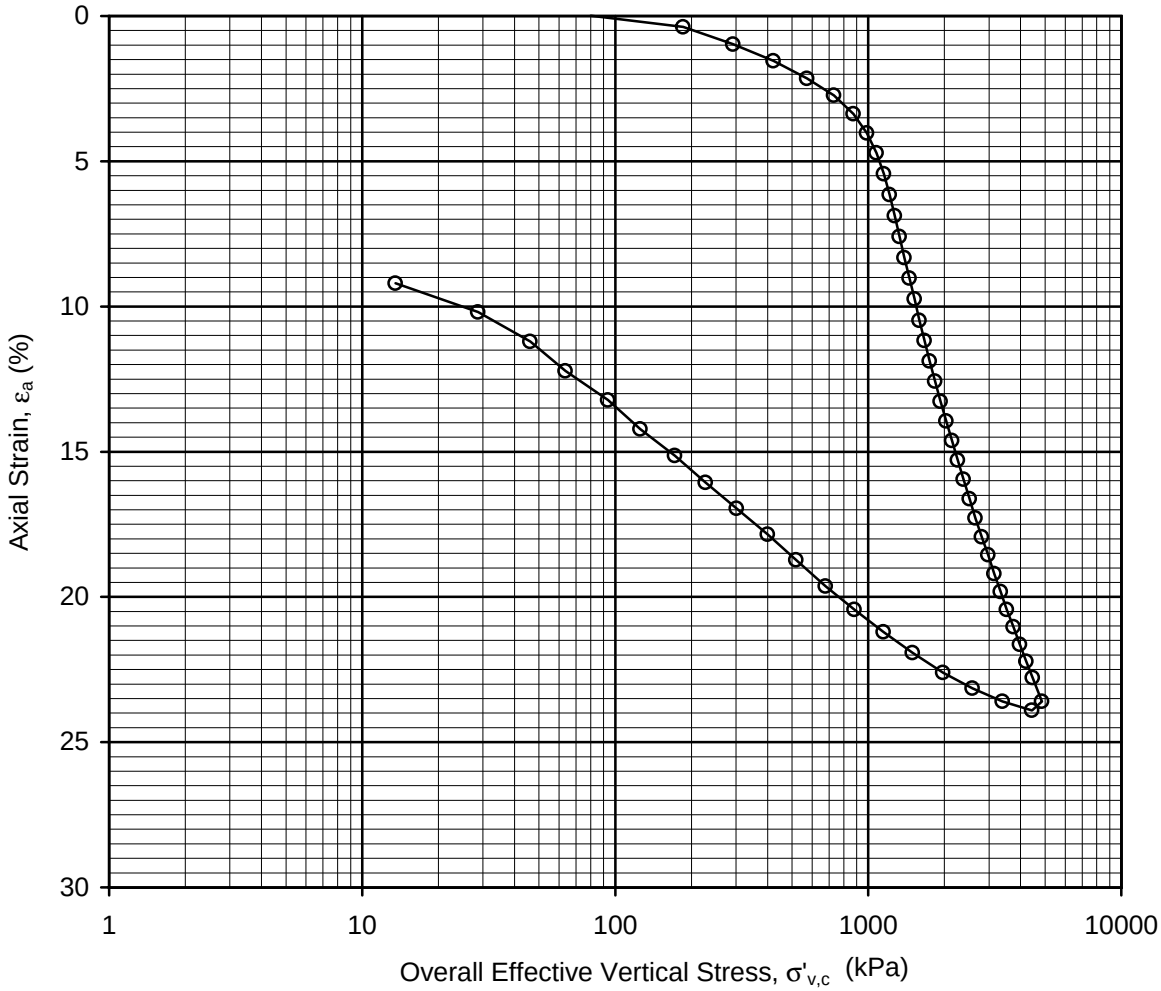




CRS CONSOLIDATION TEST RESULTS

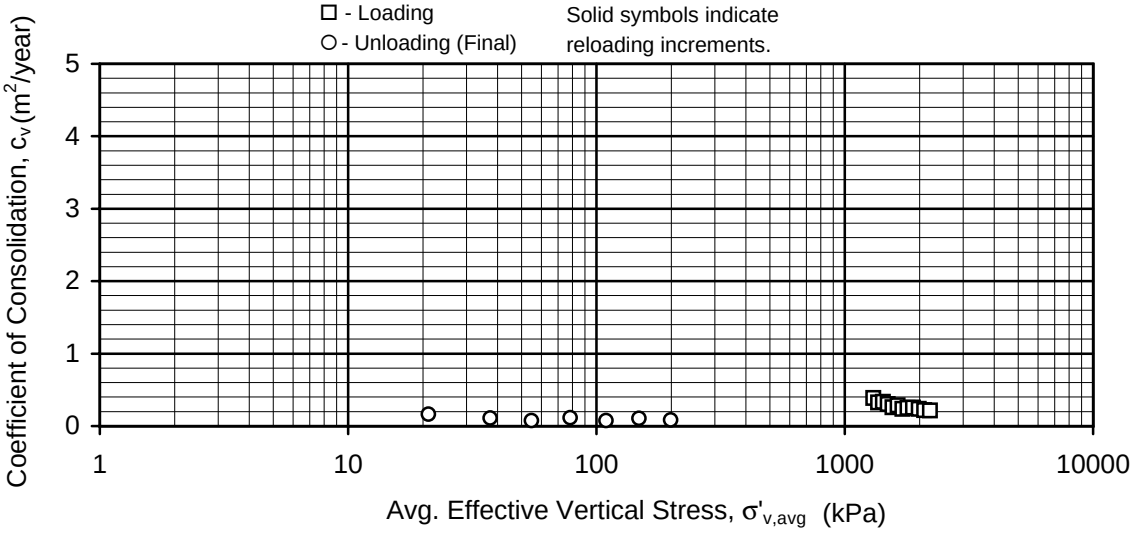
Sample No. 60 - Depth: 37.8m
Boring 98-28
SFOBB East Span Seismic Safety Project

PLATE 98-28.14c



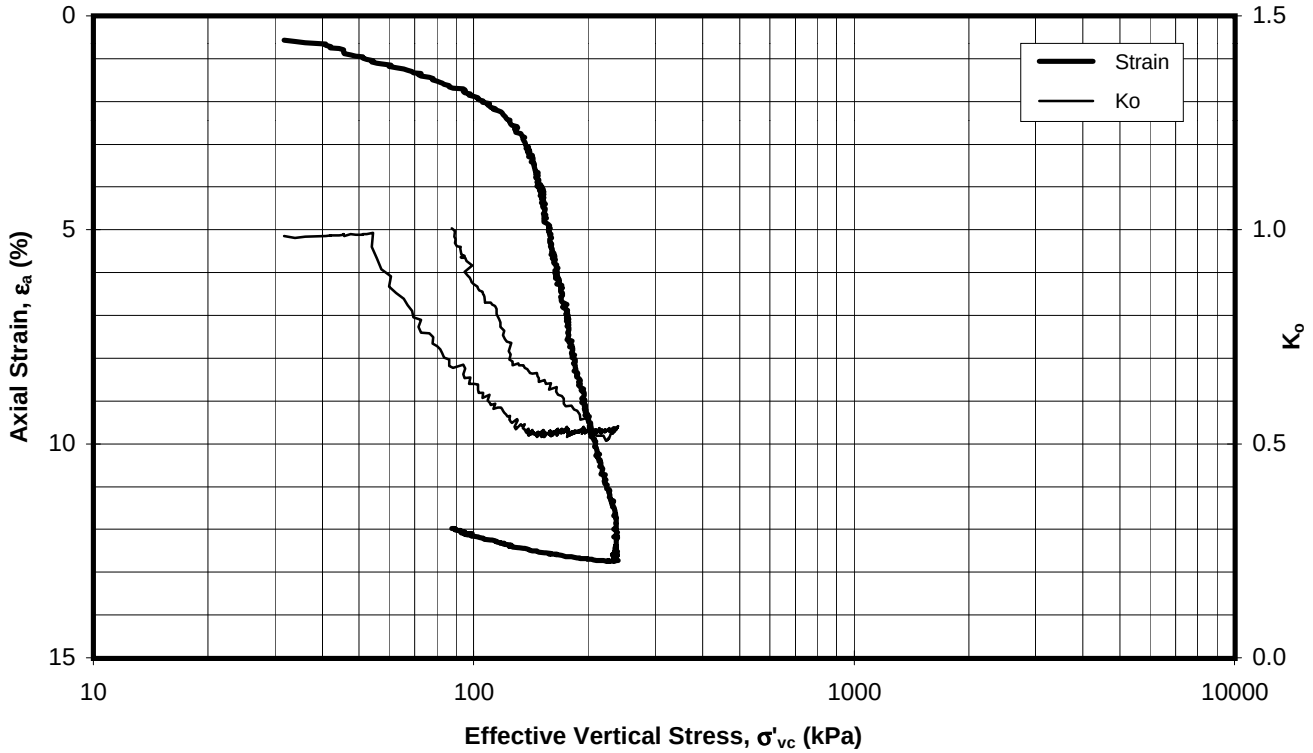
□ - Loading
○ - Unloading (Final)

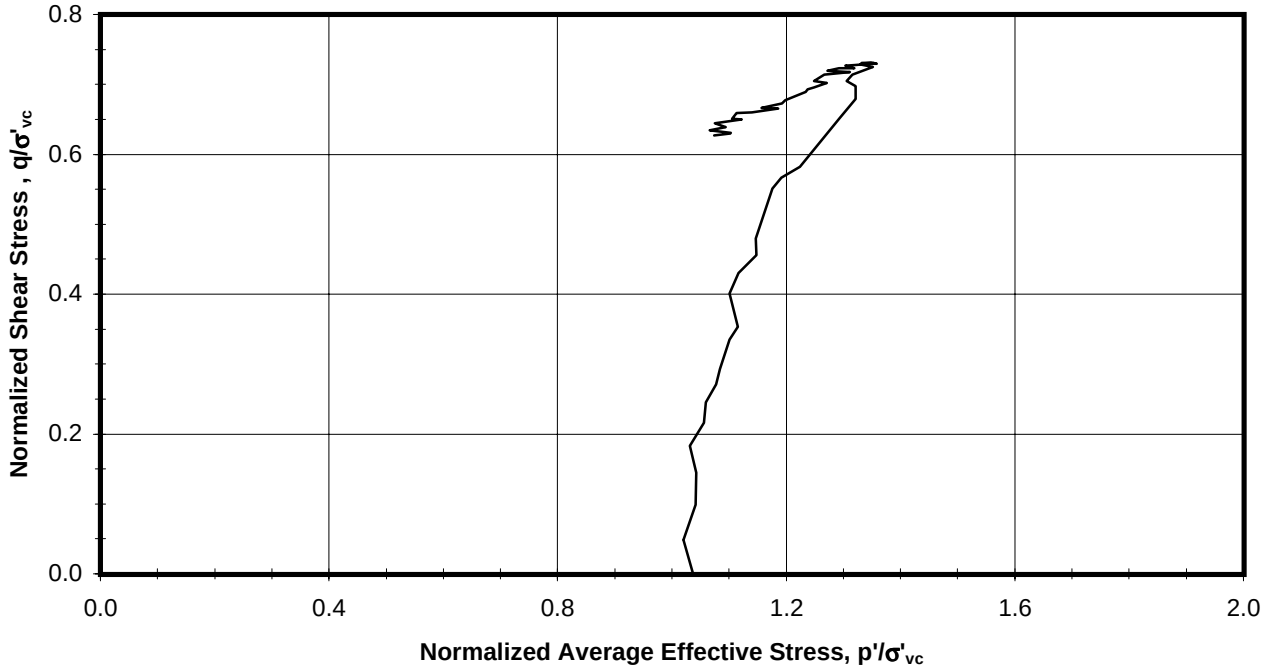
Solid symbols indicate reloading increments.



CRS CONSOLIDATION TEST RESULTS

Sample No. 78 - Depth: 64.3m
Boring 98-28
SFOBB East Span Seismic Safety Project





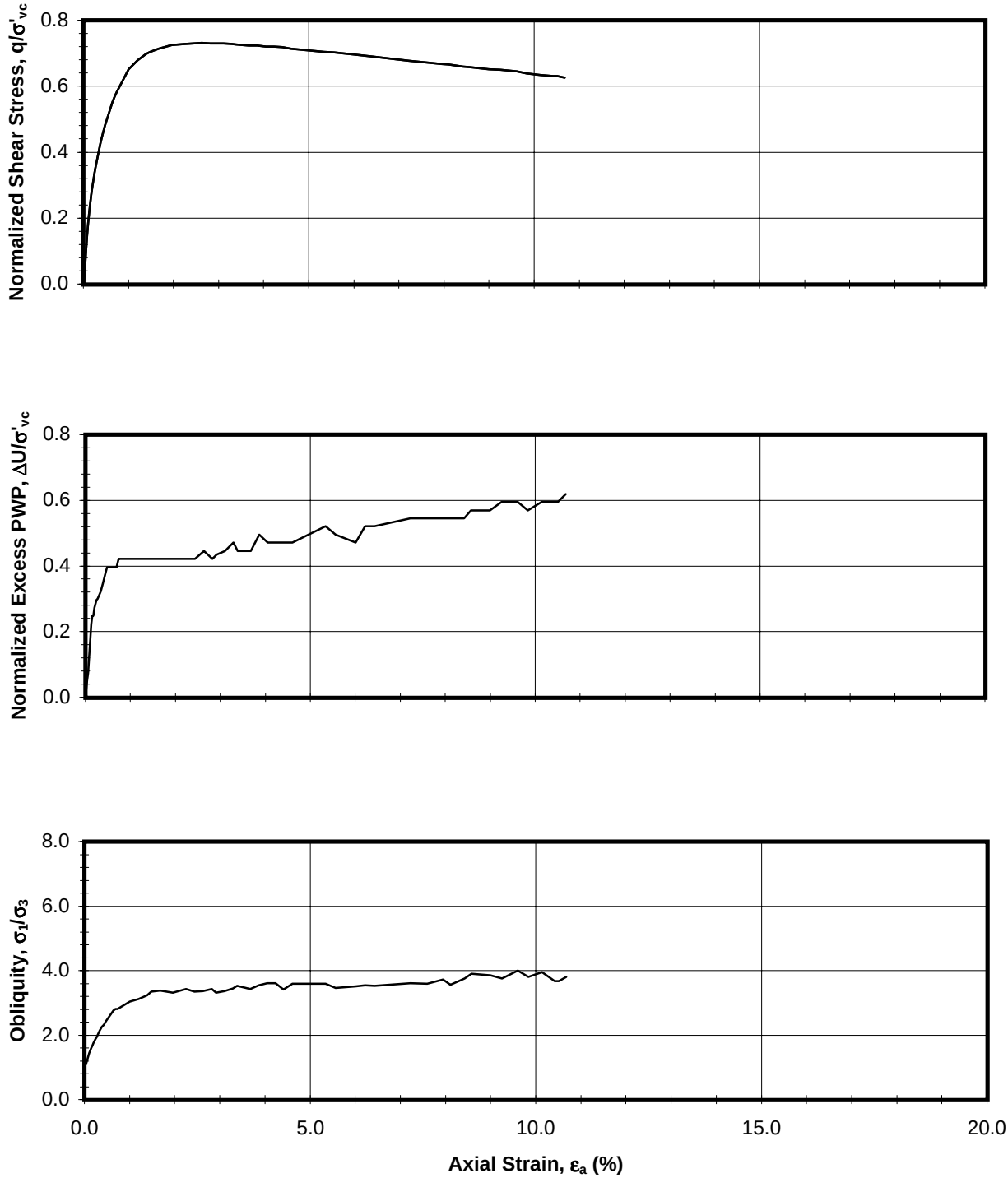
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 303 - Depth: 9.1m

Boring 98-28

SFOBB East Span Seismic Safety Project

PLATE 98-28.15.1

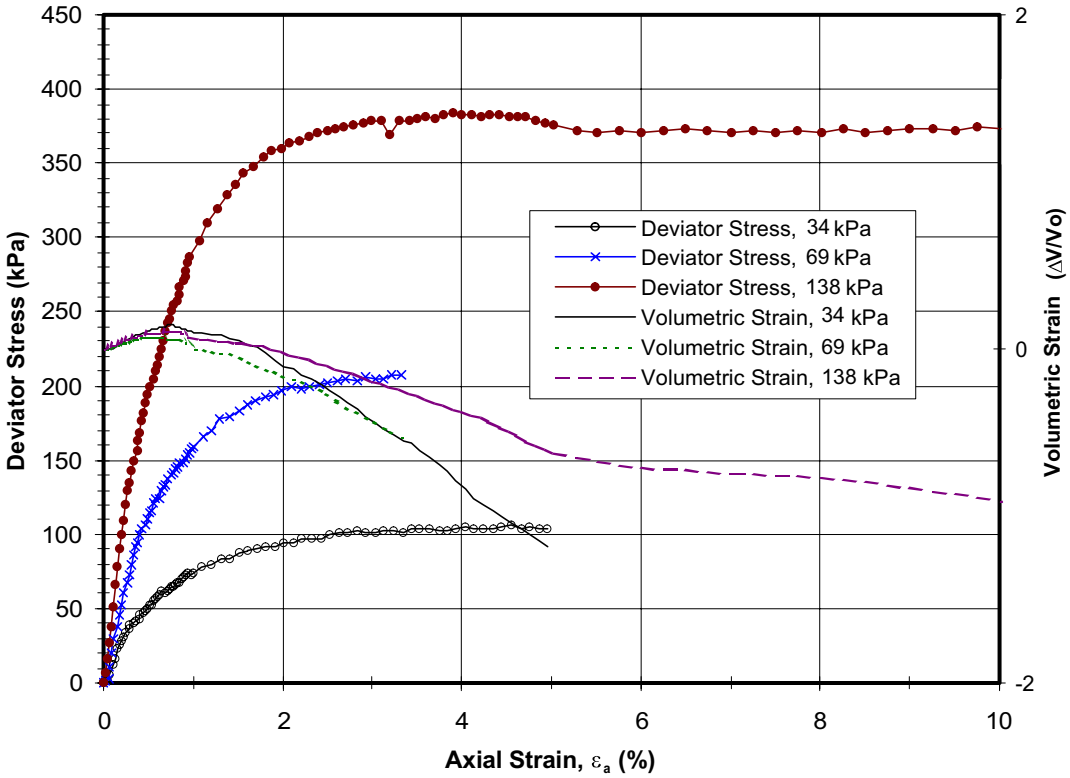


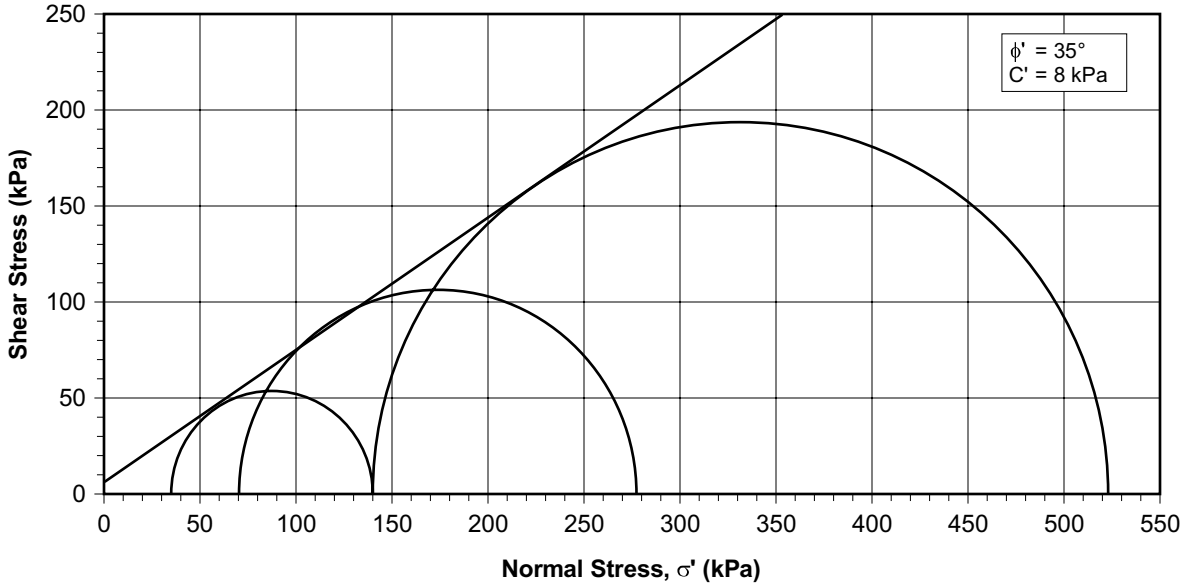
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 303 - Depth: 9.1m

Boring 98-28

SFOBB East Span Seismic Safety Project





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 18 - Depth: 10.5m

Boring 98-28

SFOBB East Span Seismic Safety Project

PLATE 98-28.16a

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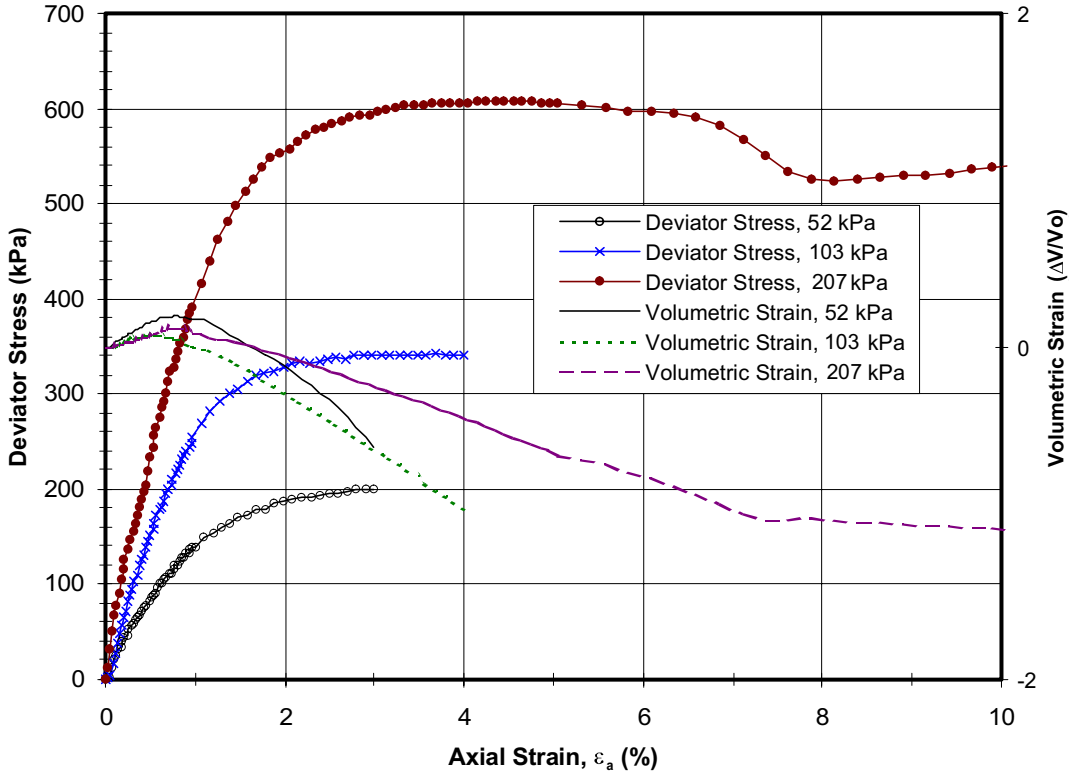

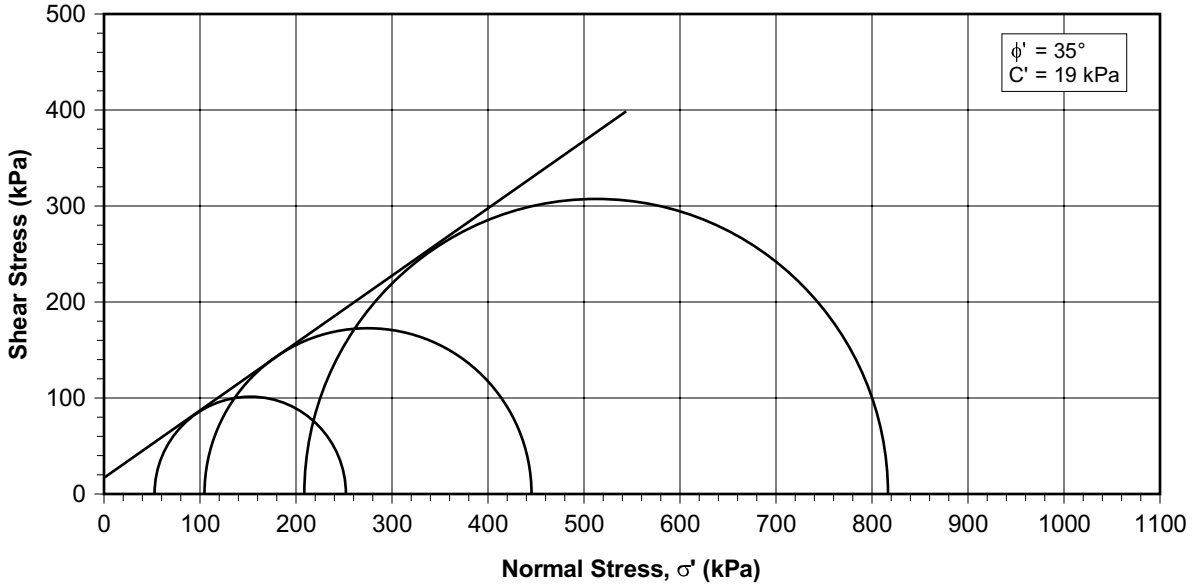

ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 27 - Depth: 14.8m

Boring 98-28

SFOBB East Span Seismic Safety Project

PLATE 98-28.16b

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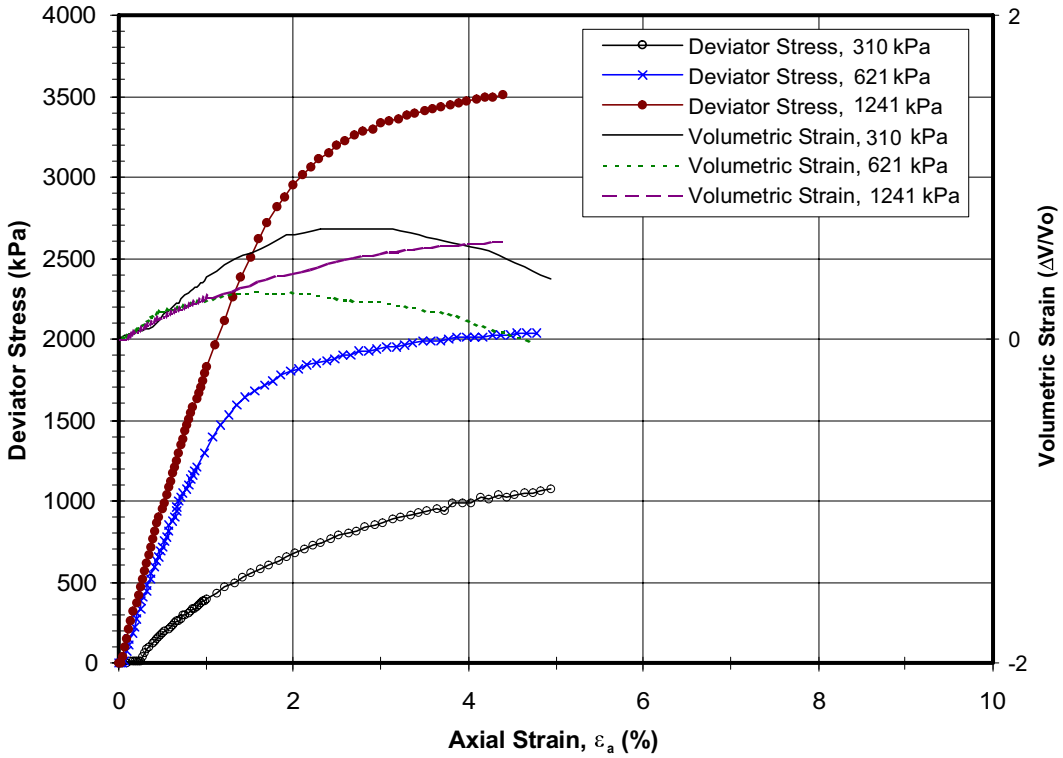

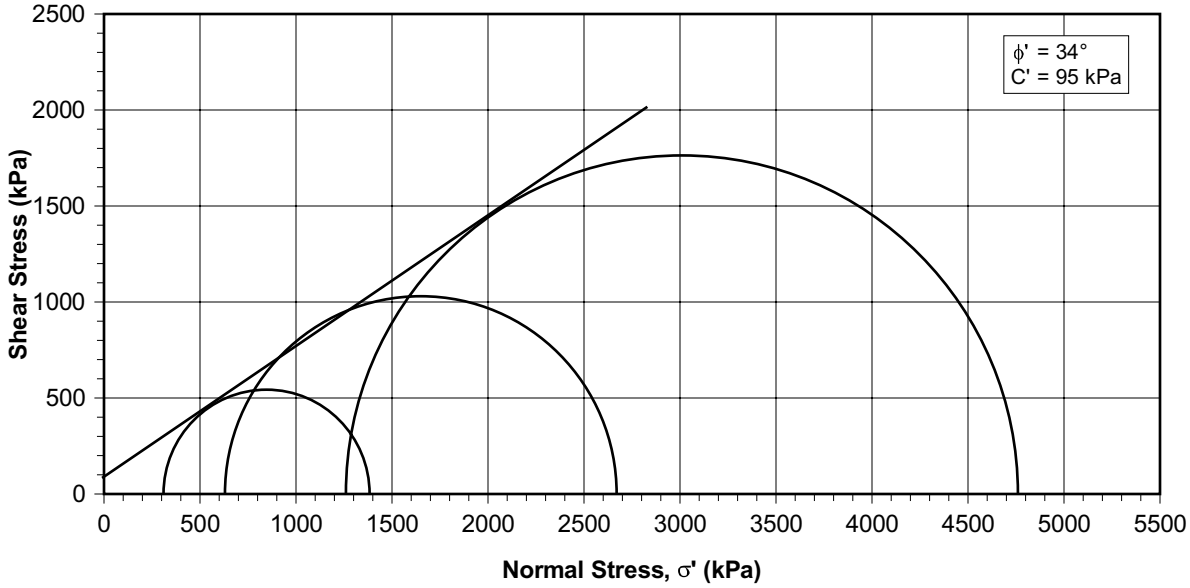

ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 88 - Depth: 80.5m

Boring 98-28

SFOBB East Span Seismic Safety Project

PLATE 98-28.16c

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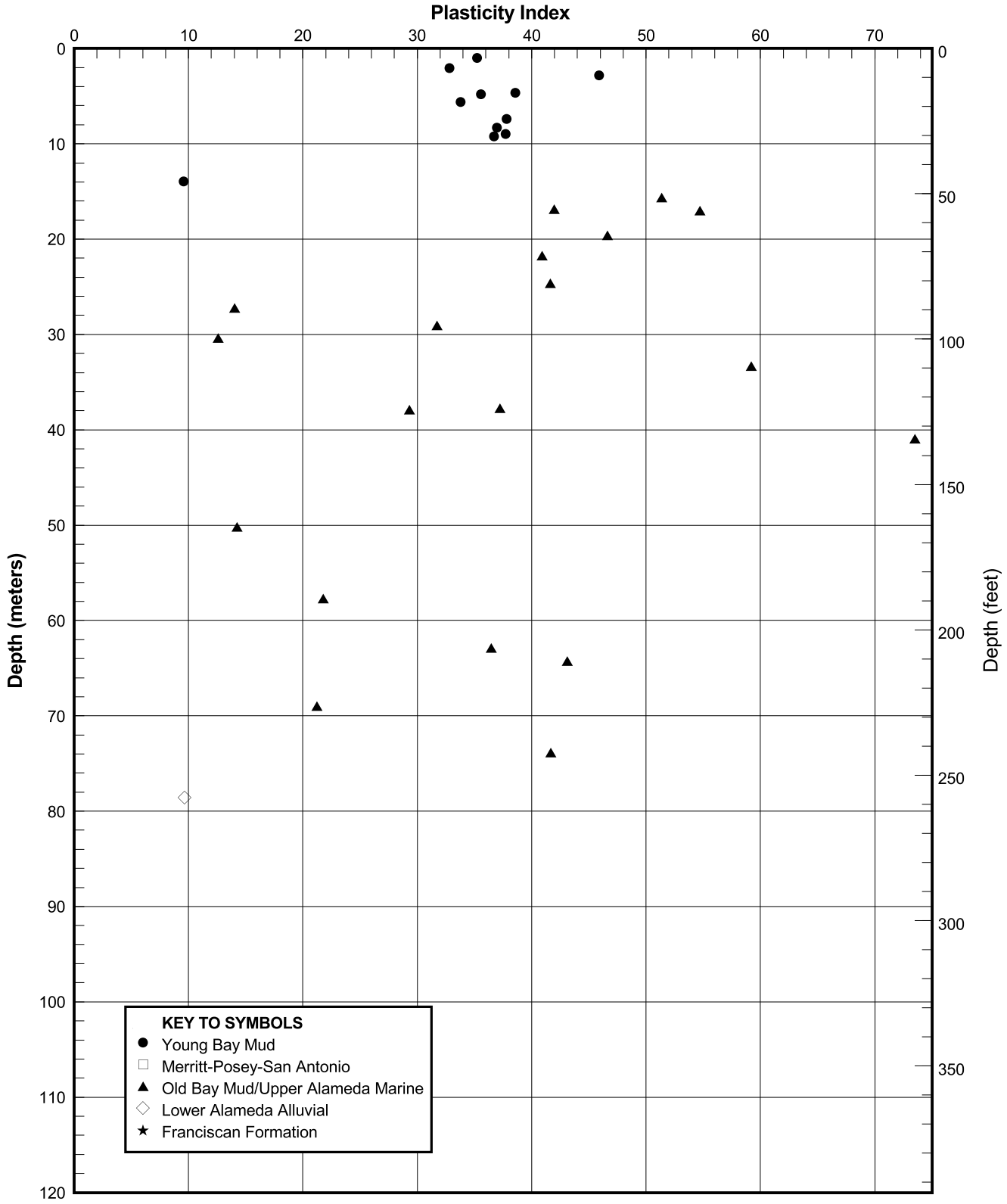
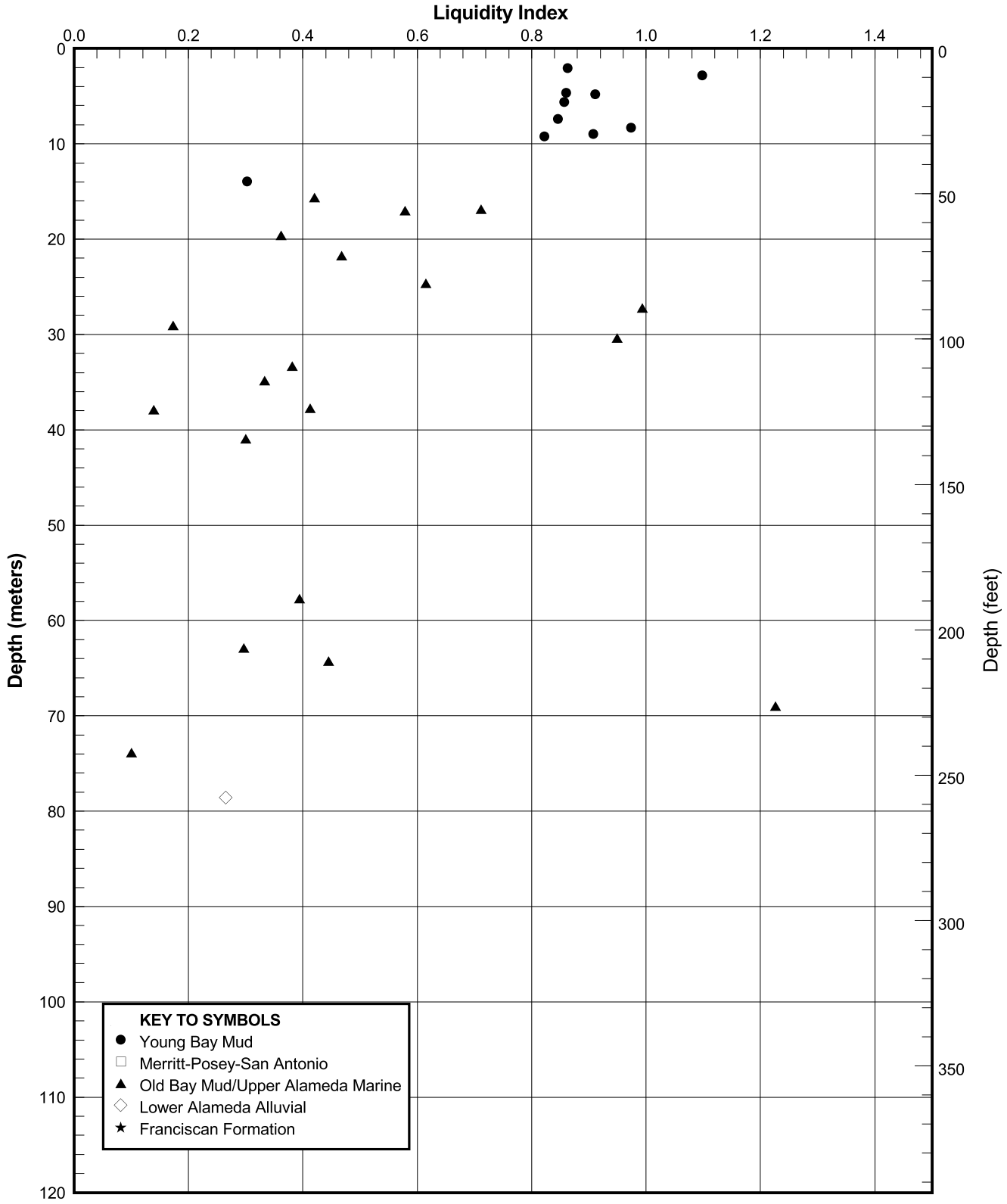


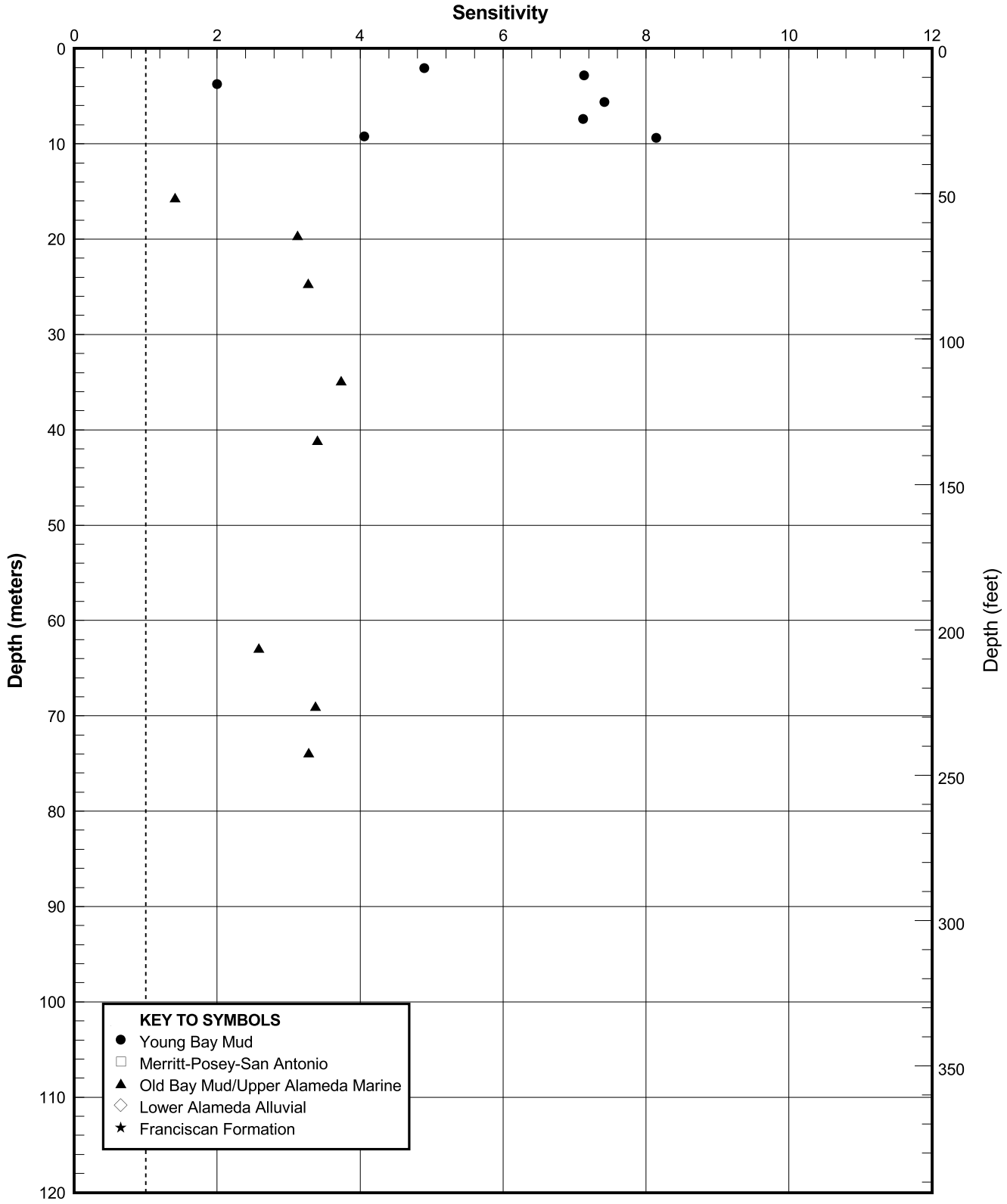
PLASTICITY INDEX PROFILE
Boring 98-28
SFOBB East Span Seismic Safety Project

PLATE 98-28.17



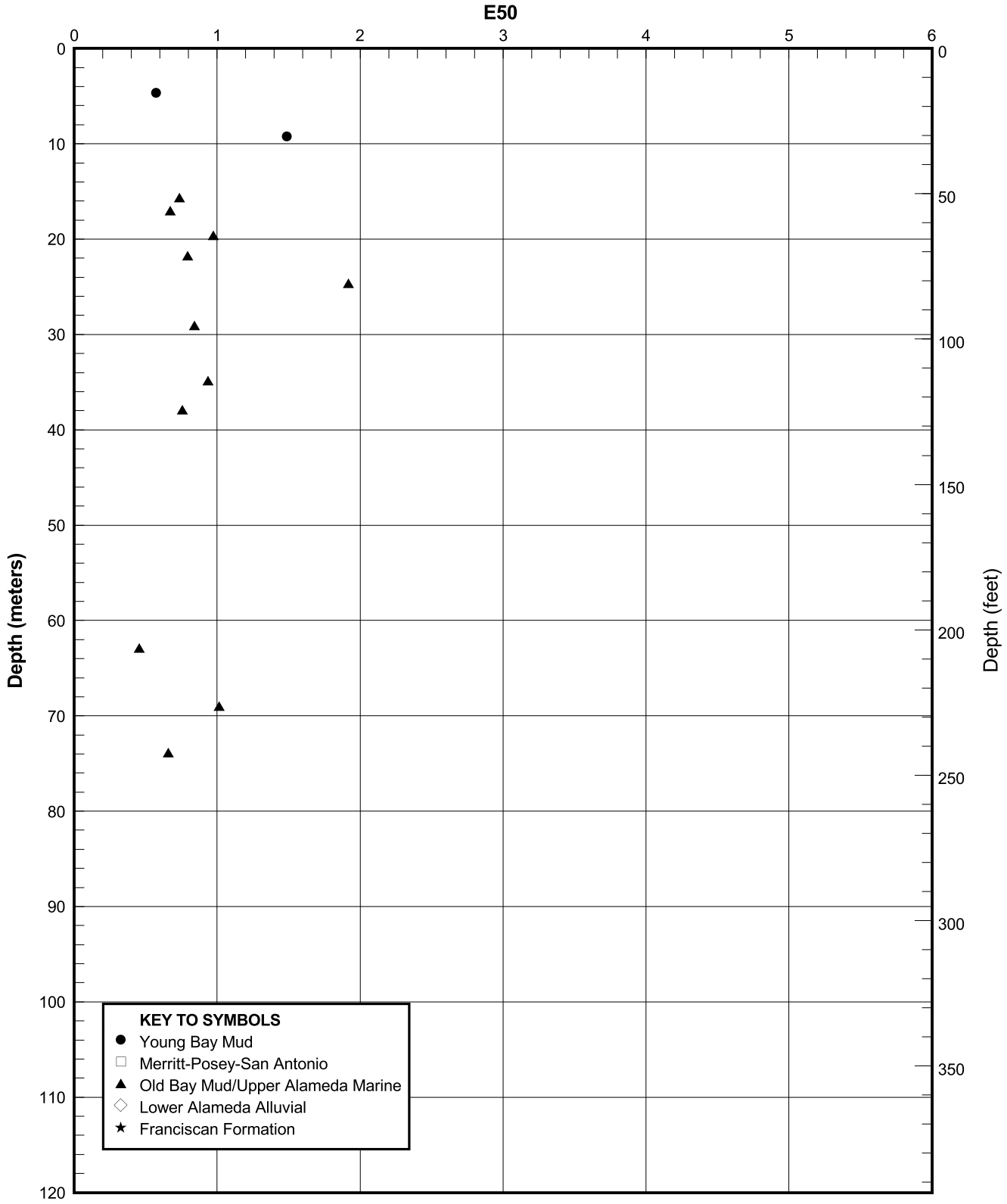
LIQUIDITY INDEX PROFILE
Boring 98-28
SFOBB East Span Seismic Safety Project

PLATE 98-28.18



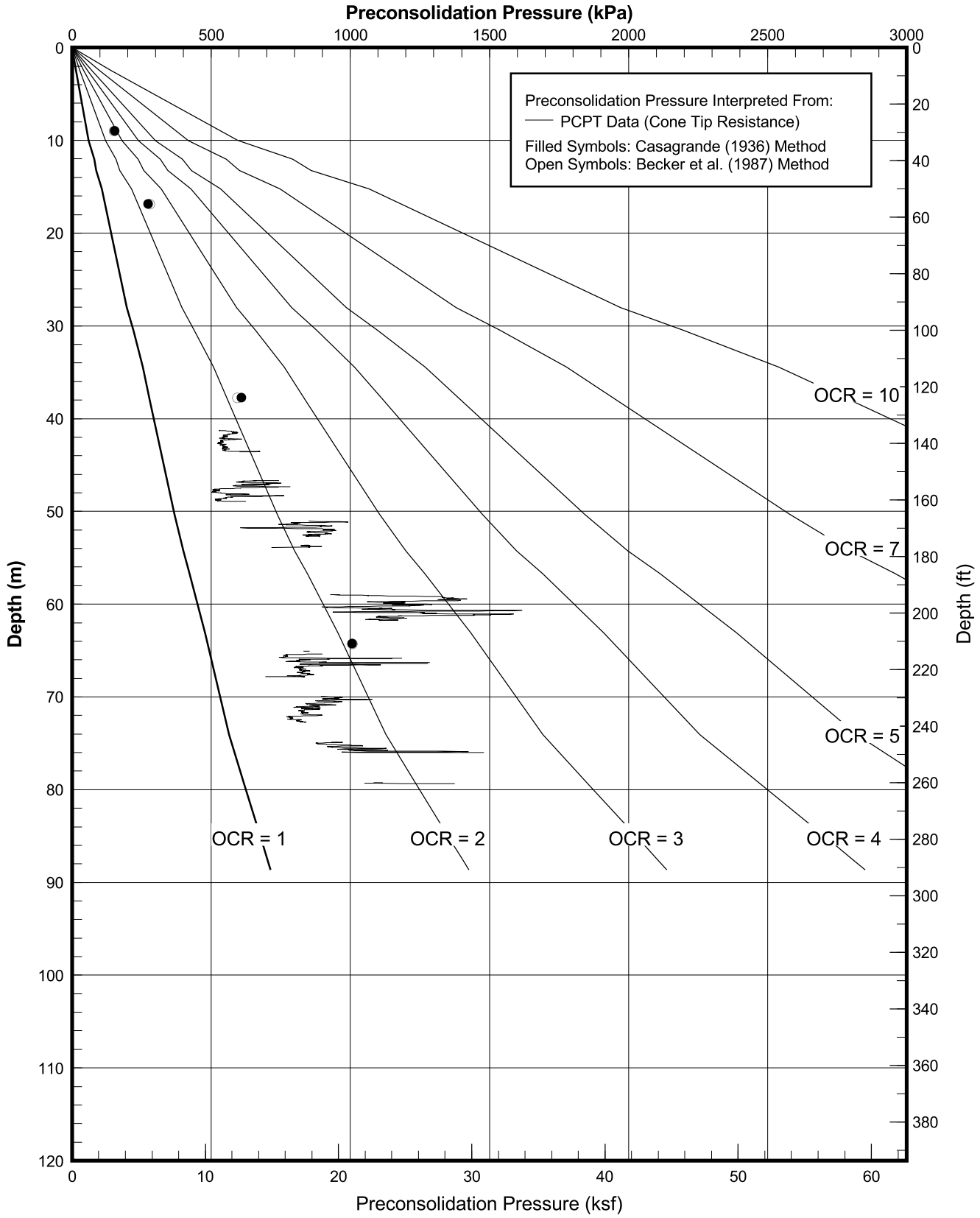
SENSITIVITY PROFILE
Boring 98-28
SFOBB East Span Seismic Safety Project

PLATE 98-28.19



E50 PROFILE
Boring 98-28
SFOBB East Span Seismic Safety Project

PLATE 98-28.20

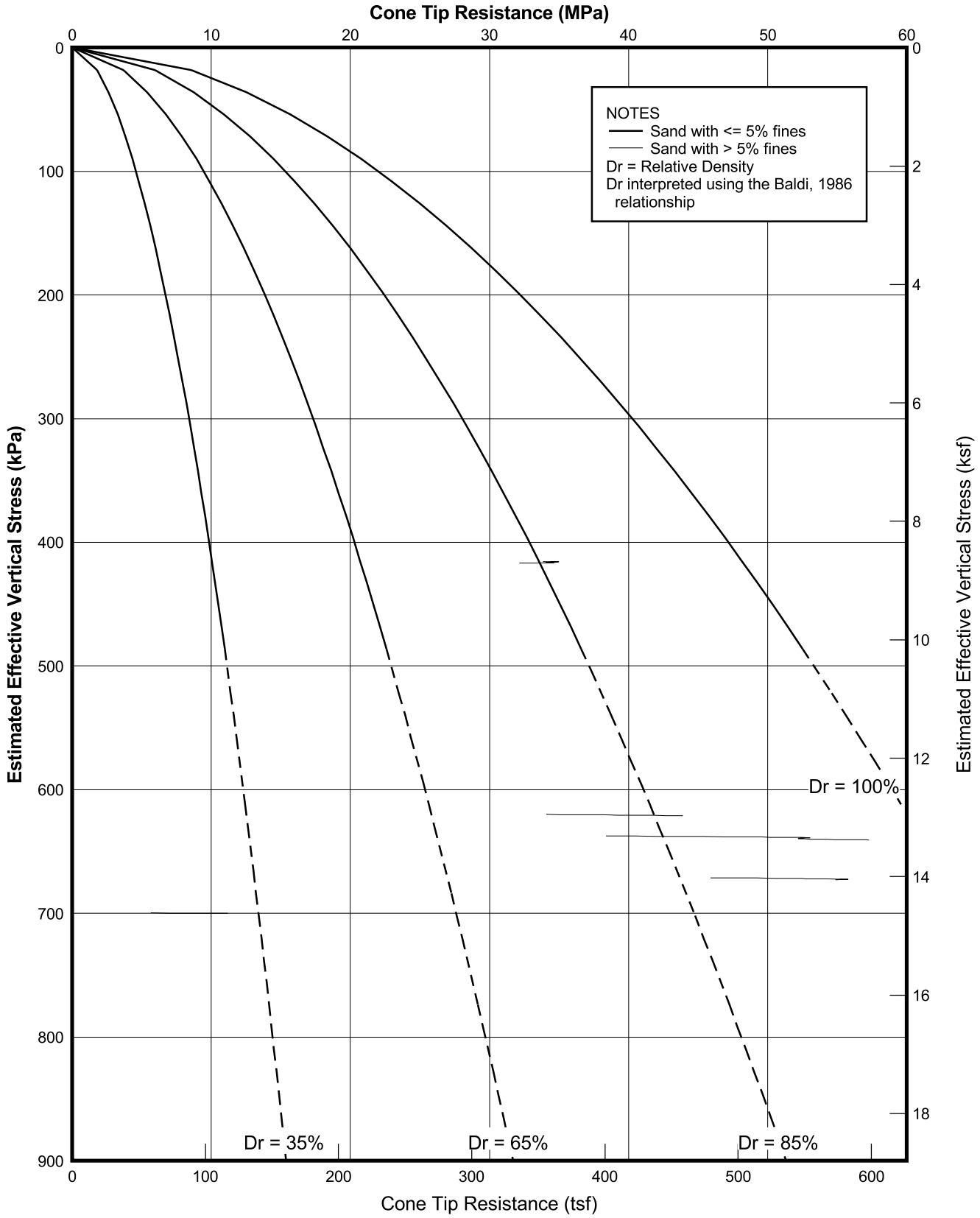


PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-28

SFOBB East Span Seismic Safety Project

PLATE 98-28.21



RELATIVE DENSITY INTERPRETED FROM CPT DATA

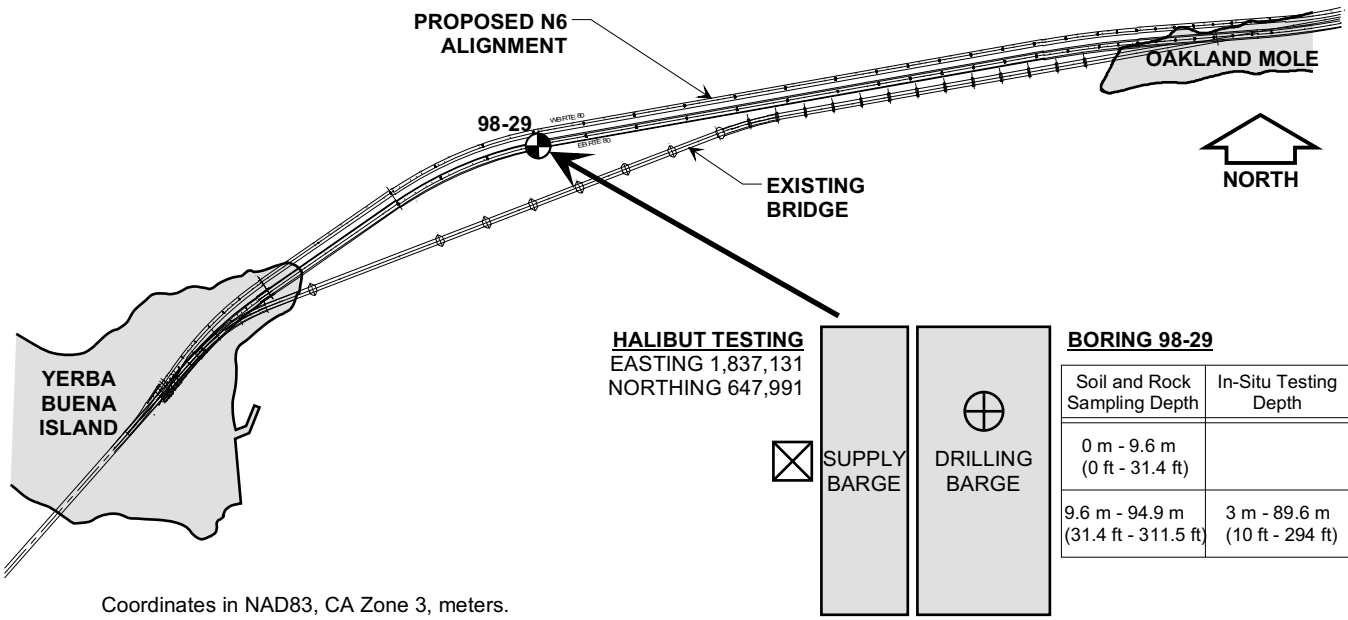
Boring 98-28

SFOBB East Span Seismic Safety Project

BORING 98-29

Date	Time From	Time To	Description of Activity
September 3, 1998	0600	0730	Move barge to location 98-29. Set 4 anchors and 2 spuds.
	0730	0900	Rig up for drilling. Lower drill pipe to mudline.
	0900	0930	Measure water depth of 10.0m (32.8 ft) using bottom sensor. Current tide level is approximately +0.2m (+0.8 ft) MSL. Calculate mudline elevation of -9.8m (-32 ft) MSL.
	0930	1230	Drill and sample from mudline to 9.6m (31.4 ft).
	****	****	
	1000	1215	Rig up Halibut vane equipment. Halibut Vane shear test at 0.6m (2 ft).
	****	****	
	1230	1315	Pull drill pipe to deck.
	1315	1330	Reposition barge.
	1330	2000	Service piston. Lower stinger to 2.1m (7 ft).
	2000	2035	Perform CPT pipe test.
	2035	2115	Drill to 3.1m (10 ft).
	2115	2230	CPT testing from 3.1m (10 ft) to 9.8m (32 ft). No data. Pull pipe to deck.
	2230	2400	Reconfigure casing.
September 4, 1998	0000	0445	Set casing.
	0445	0815	Drive stinger to 7.9m (26 ft).
	0815	1100	Mix drilling mud and shorten connection to mud recirculation system.
	1100	1345	Lower drill pipe to mudline and drill to 7.0m (23 ft).
	1345	2200	Drill sample and CPT testing from 7.0m (23 ft) to 36.9m (121 ft).
	2200	2330	Change CPT metering cylinder and cone.
	2330	2400	Drill and sample from 36.9m (121 ft) to 37.5m (123 ft).
September 5, 1998	0000	0200	Perform CPT test at 37.5m (123 ft). No data. Perform CPT pipe test.
	0200	1200	Drill, sample, and CPT testing from 37.5m (123 ft) to 70.1m (230 ft).
	1200	1615	Drill, sample, and CPT testing from 70.1m (230 ft) to 80.5m (264 ft).
	1615	2010	No pore pressure data. Change cone. Perform pipe test.
	2010	2400	Drill sample and CPT testing from 80.5m (264 ft) to 91.4m (300 ft).
September 6, 1998	0000	0230	Drill to 94.2m (309 ft). Perform maintenance on mud pump.
	0230	0330	Drill and sample from 94.2m (309 ft) to 94.9m (311.5 ft).
	0330	0530	Pull drill pipe to deck.
	0530	0750	P- and S-wave velocity logging from 88.0m (288.7 ft) to 7.0m (23 ft).
	0750	1130	Lower N-rod. Mix and circulate cement. Grout hole 98-29. Pull N-rod to deck.
	1130	1510	Pull casing to deck.
	1510	1730	Pull 2 spuds, 4 anchors, and move barge to location 98-30.

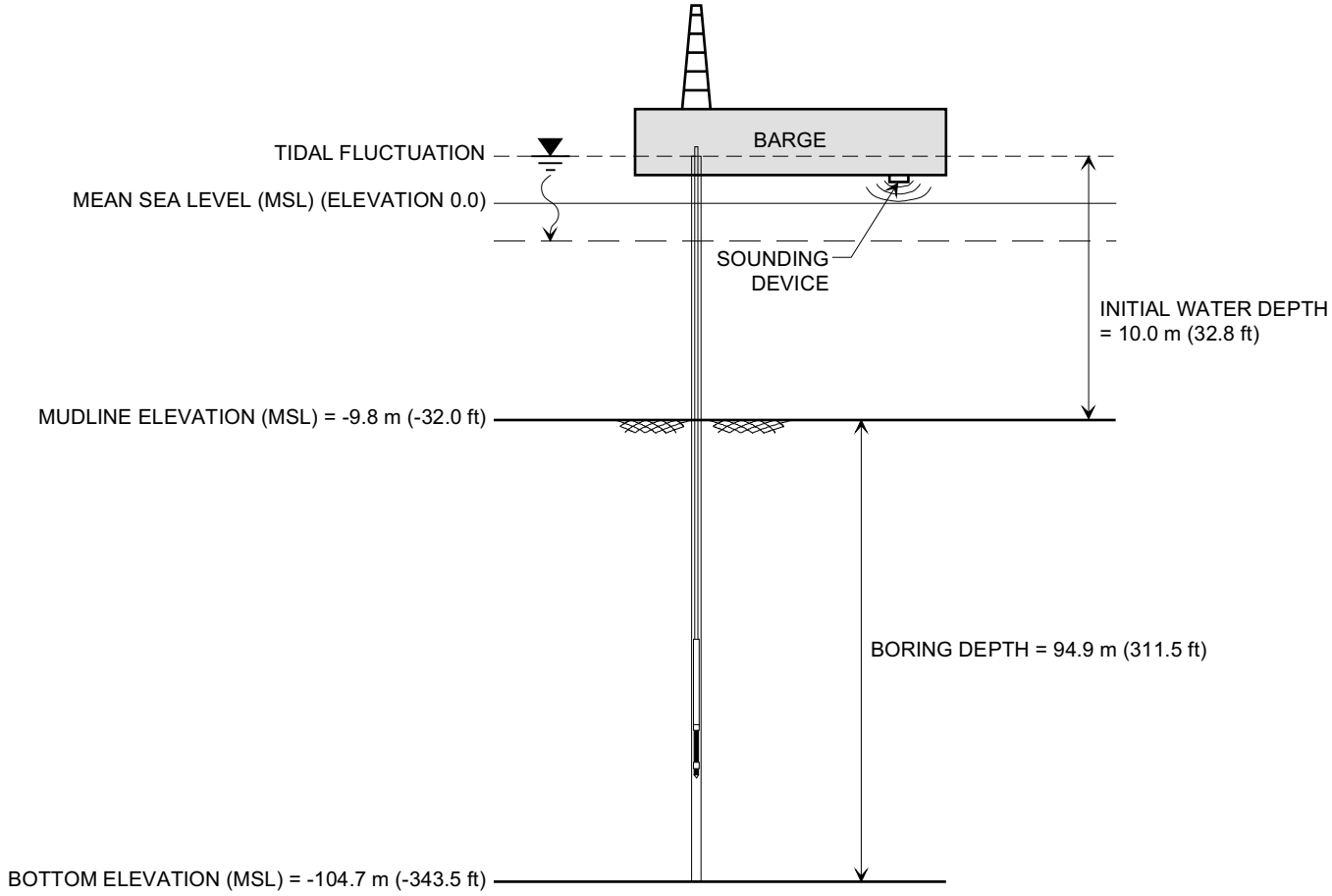
SUMMARY OF FIELD OPERATIONS
Boring 98-29
SFOBB East Span Seismic Safety Project



BORING 98-29

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 9.6 m (0 ft - 31.4 ft)		E = 1,837,133 N = 647,992
9.6 m - 94.9 m (31.4 ft - 311.5 ft)	3 m - 89.6 m (10 ft - 294 ft)	E = 1,837,145 N = 647,992

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-29
SFOBB East Span Seismic Safety Project

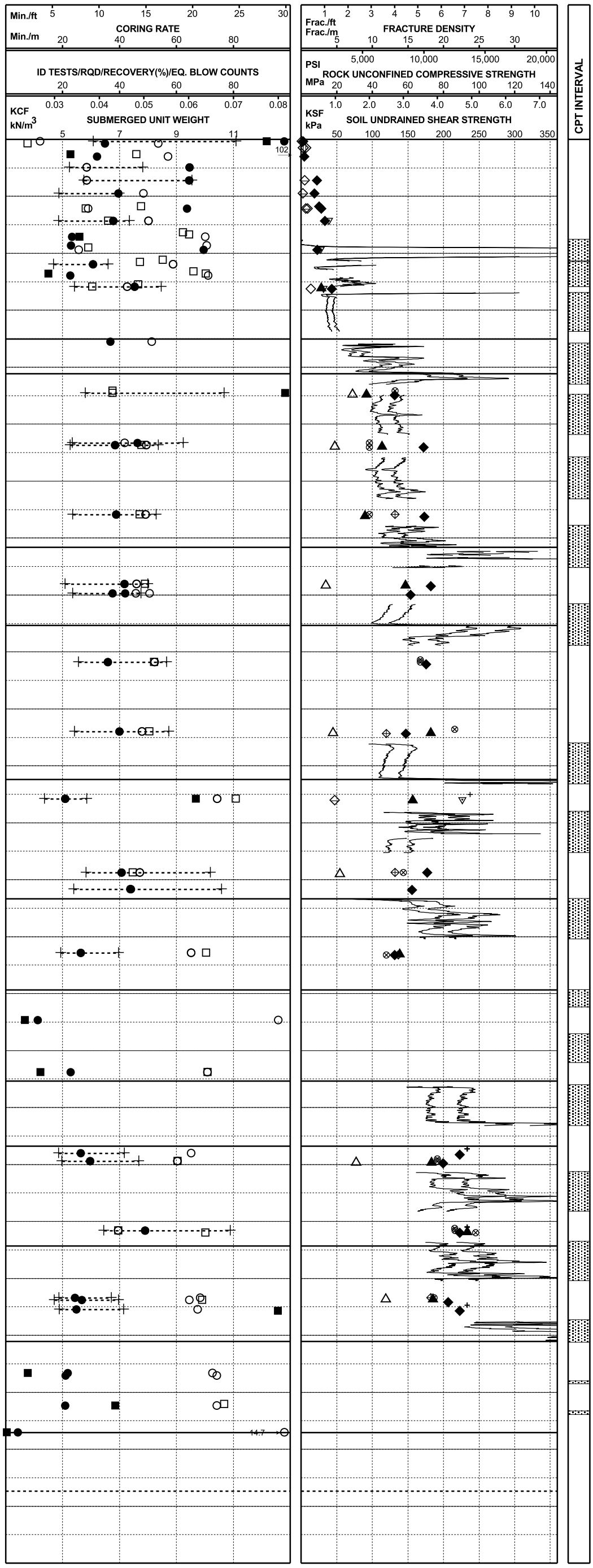
PROJECT NO:	98-42-0054	**START DATE:**	09/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-29 (Skyway - Frame 1)	**COMPLETION DATE:**	09/06/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837145 N647992
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -9.8m (MSL)

Stratum	Material Description	Blow Count / Sampler
I	Fat CLAY (CH), soft to firm, dark gray -with shells and shell fragments -very soft, dark gray clay, to 0.9m -with many sand seams and pockets to 0.6m See Plate 98-29.6 for detailed stratigraphy -intermixed clay and sand, 6.4m to 7.0m -sand layer, 7.6m to 8.2m -sand layer, 8.5m to 8.8m -silty sand layer with clay pockets, 9.1m to 9.7m -sand layer at 10.1m (14.0m)	WOH, WOH, WOH, WOH, WOH, WOH, WOH, 17/45cm, 18/60cm, 30/55cm, 30/45cm, PUSH
II	Fat CLAY (CH), stiff to very stiff, olive gray to gray -intermixed sand and clay with organic pockets, to 14.6m (16.5m)	SAVE
III	Fat CLAY (CH), very stiff, gray -with a silt layer at 16.8m -greenish gray, and with a few silt pockets, slickensides and gas blisters, at 17.7m -with a few shell fragments and silt pockets, at 21.3m -greenish gray with silty sand pockets, a few shell fragments, and mica flakes, at 26.2m (28.7m)	PUSH, PUSH, PUSH
IV	Fat CLAY (CH), very stiff, gray -silt with clay layers to 29.9m -with sandy silt pockets and partings, and shell fragments, 30.8m to 32.0m (34.1m)	PUSH, SAVE
V	Fat CLAY (CH), very stiff to hard, gray -greenish gray with silt pockets and partings, at 36.6m -with a few silt pockets at 41.1m -with organic stains and organic pockets, below 41.1m (45.0m)	PUSH, PUSH
VI	Fat CLAY (CH), very stiff, gray -very stiff to hard sandy lean clay with many silt seams, to 48.8m -with a sand layer at 45.1m with silty sand pockets and seams, at 46.3m -sand layer, 48.8m to 49.1m (53.3m)	30/40cm, PUSH, SAVE
VII	Lean CLAY (CL), very stiff to hard, greenish gray -with a few silt pockets and partings, gas blisters, and organic stains, at 57.2m (59.7m)	30/40cm
VIII	Fine to Coarse SAND with silt (SW-SM), dense, gray -with gravel at 61.7m -silty fine sand below 64.2m -with clay pockets, partings and seams, at 65.2m (66.1m)	30/15cm, 30/30cm
IX	Lean CLAY (CL), very stiff to hard, olive gray -with a sand layer at 69.2m (70.7m)	NR, SAVE, PUSH
X	Lean CLAY (CL), hard, olive gray -with silt partings and pockets, to 71.9m -with silty sand pockets and partings, at 71.6m -with wood fragments and organic pockets, at 76.5m (77.7m)	PUSH
XI	Lean CLAY (CL), hard, gray -with silt pockets and a few shell fragments, at 81.4m -interlayered sand and clay, below 82.9m (84.4m)	PUSH, SAVE
XII	Fine to Medium SAND with silt (SP-SM), dense to very dense, gray -with a clay layer at 86.7m -with a lean clay layer at 88.8m (90.8m)	30/30cm, 30/25cm, 30/5cm
XIII	Fine GRAVEL (GP), very dense, dark gray -sand layer, 91.4m to 92.4m dense to very dense, fine to coarse sand, at 94.8m	50/5cm

TOTAL DEPTH: 94.9m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-29

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

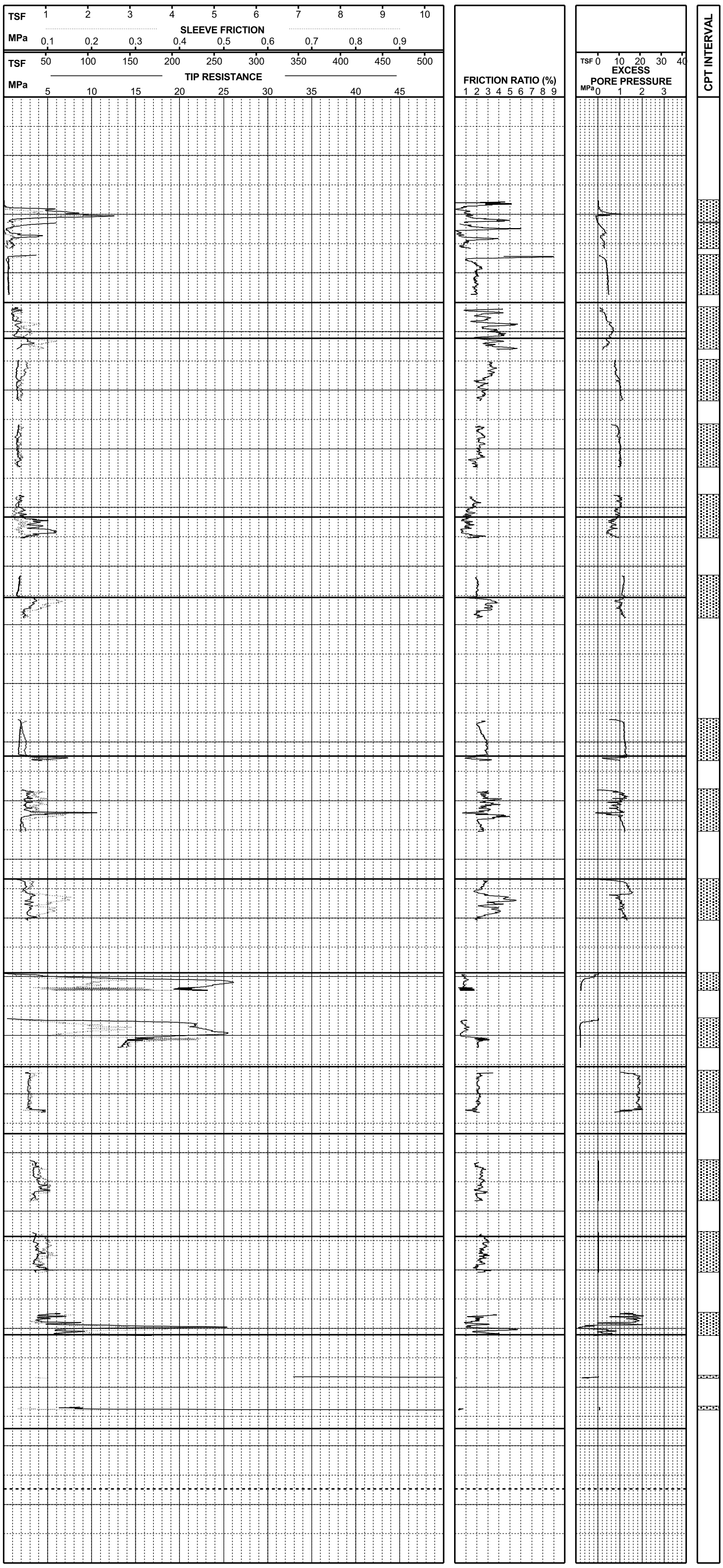
PROJECT NO:	98-42-0054	**START DATE:**	09/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-29 (Skyway - Frame 1)	**COMPLETION DATE:**	09/06/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837145 N647992
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -9.8m (MSL)

Elevation, m.	Depth, m.	Blow Count / Sampler	Material Description	Stratum No.
		WOH, WOH, WOH, WOH, WOH, WOH, WOH, 17/45cm, 18/60cm, 30/55cm, 30/45cm, PUSH	Fat CLAY (CH), soft to firm, dark gray -with shells and shell fragments -very soft, dark gray clay, to 0.9m -very loose, olive gray, silty fine sand layer, with many clay pockets, 0.9m to 1.2m -intermixed clay and sand, 6.4m to 7.0m -sand layer, 7.6m to 8.2m -sand layer, 8.5m to 8.8m -silty sand layer with clay pockets, 9.1m to 9.7m See Plate 98-29.6 for detailed stratigraphy (14.0m)	I
		SAVE	Fat CLAY (CH), stiff to very stiff, olive gray to gray (16.5m)	II
		PUSH, PUSH, PUSH	Fat CLAY (CH), very stiff, gray -with a silt layer at 16.8m -greenish gray, and with a few silt pockets, slickensides and gas blisters, at 17.7m -with a few shell fragments and silt pockets, at 21.3m -greenish gray with silty sand pockets, a few shell fragments, and mica flakes, at 26.2m (28.7m)	III
		PUSH, SAVE	Fat CLAY (CH), very stiff, gray -silt with clay layers to 29.9m -with sandy silt pockets and partings, and shell fragments, 30.8m to 32.0m (34.1m)	IV
		PUSH, PUSH, PUSH	Fat CLAY (CH), very stiff to hard, gray -greenish gray with silt pockets and partings, at 36.6m -with a few silt pockets at 41.1m -with organic stains and organic pockets, below 41.1m (45.0m)	V
		30/40cm, PUSH, SAVE	Fat CLAY (CH), very stiff, gray -very stiff to hard sandy lean clay with many silt seams, to 48.8m -with a sand layer at 45.1m with silty sand pockets and seams, at 46.3m -sand layer, 48.8m to 49.1m (53.3m)	VI
		30/40cm	Lean CLAY (CL), very stiff to hard, greenish gray -with a few silt pockets and partings, gas blisters, and organic stains, at 57.2m (59.7m)	VII
		30/15cm, 30/30cm	Fine to Coarse SAND with silt (SW-SM), dense, gray -with gravel at 61.7m -silty fine sand below 64.2m -with clay pockets, partings and seams, at 65.2m (66.1m)	VIII
		NR, SAVE, PUSH	Lean CLAY (CL), very stiff to hard, olive gray -with a sand layer at 69.2m (70.7m)	IX
		PUSH	Lean CLAY (CL), hard, olive gray -with silt partings and pockets, to 71.9m -with silty sand pockets and partings, at 71.6m -with wood fragments and organic pockets, at 76.5m (77.7m)	X
		PUSH, SAVE	Lean CLAY (CL), hard, gray -with silt pockets and a few shell fragments, at 81.4m -interlayered sand and clay, below 82.9m (84.4m)	XI
		30/30cm, 30/25cm	Fine to Medium SAND with silt (SP-SM), dense to very dense, gray -with a clay layer at 86.7m -with a lean clay layer at 88.8m (90.8m)	XII
		30/5cm, 50/5cm	Fine GRAVEL (GP), very dense, dark gray -sand layer, 91.4m to 92.4m -dense to very dense, fine to coarse sand, at 94.8m	XIII

TOTAL DEPTH: 94.9m
BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-29

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

PLATE 98-29.4

PROJECT NO:	98-42-0054	**START DATE:**	09/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-29 (Skyway - Frame 1)	**COMPLETION DATE:**	09/06/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

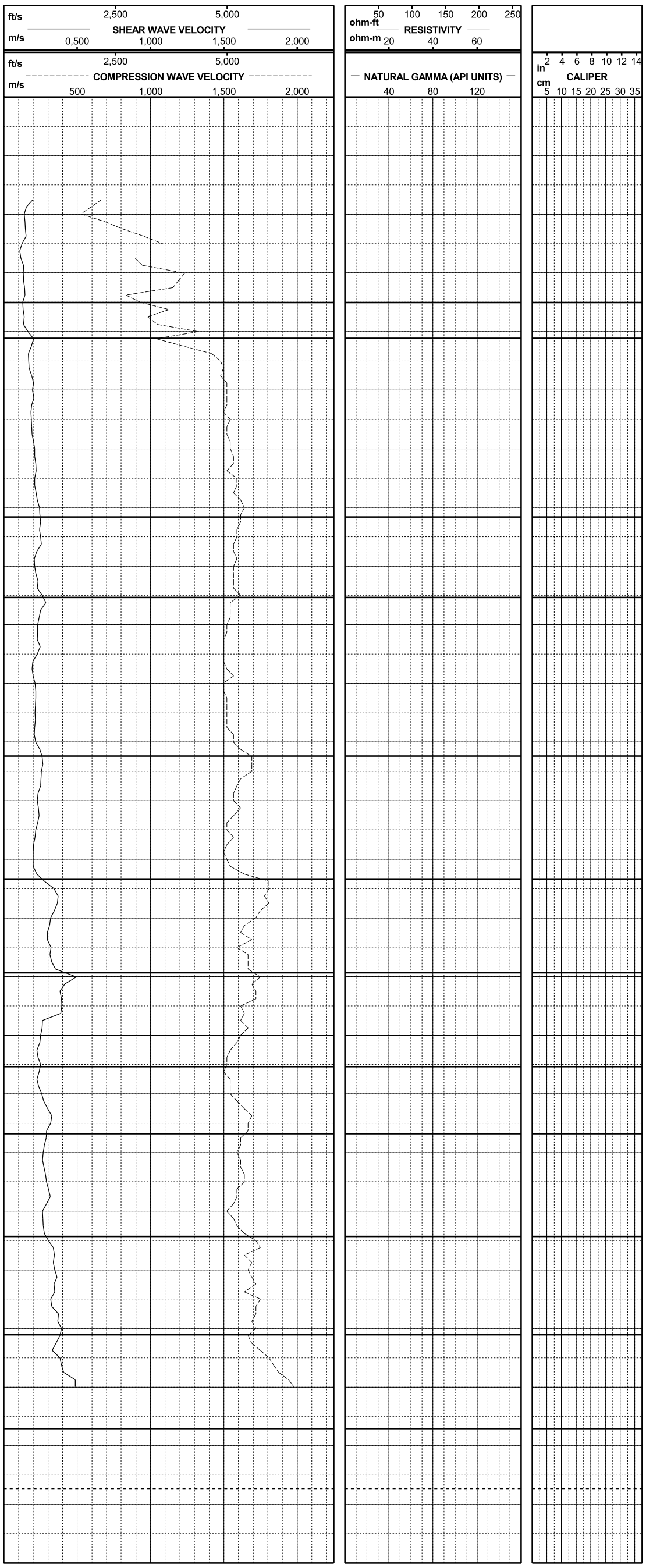
Coordinates: E1837145 N647992
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -9.8m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH, WOH, WOH, WOH, WOH, WOH, WOH, 17/45cm, 18/60cm, 30/55cm, 30/45cm, PUSH	Fat CLAY (CH), soft to firm, dark gray -very loose, olive gray, silty fine sand layer, with many clay pockets, 0.9m to 1.2m See Plate 98-29.6 for detailed stratigraphy -intermixed clay and sand, 6.4m to 7.0m -sand layer, 7.6m to 8.2m -sand layer, 8.5m to 8.8m -silty sand layer with clay pockets, 9.1m to 9.7m (14.0m)	I
		SAVE	Fat CLAY (CH), stiff to very stiff, olive gray to gray (16.5m)	II
		PUSH, PUSH, PUSH	Fat CLAY (CH), very stiff, gray -with a silt layer at 16.8m -greenish gray, and with a few silt pockets, slickensides and gas blisters, at 17.7m -with a few shell fragments and silt pockets, at 21.3m -greenish gray with silty sand pockets, a few shell fragments, and mica flakes, at 26.2m (28.7m)	III
		PUSH, SAVE	Fat CLAY (CH), very stiff, gray -silt with clay layers to 29.9m -with sandy silt pockets and partings, and shell fragments, 30.8m to 32.0m (34.1m)	IV
		PUSH, PUSH	Fat CLAY (CH), very stiff to hard, gray -greenish gray with silt pockets and partings, at 36.6m -with a few silt pockets at 41.1m -with organic stains and organic pockets, below 41.1m (45.0m)	V
		30/40cm, PUSH, SAVE	Fat CLAY (CH), very stiff, gray -very stiff to hard sandy lean clay with many silt seams, to 48.8m -with a sand layer at 45.1m with silty sand pockets and seams, at 46.3m -sand layer, 48.8m to 49.1m (53.3m)	VI
		30/40cm	Lean CLAY (CL), very stiff to hard, greenish gray -with a few silt pockets and partings, gas blisters, and organic stains, at 57.2m (59.7m)	VII
		30/15cm, 30/30cm	Fine to Coarse SAND with silt (SW-SM), dense, gray -with gravel at 61.7m -silty fine sand below 64.2m -with clay pockets, partings and seams, at 65.2m (66.1m)	VIII
			Lean CLAY (CL), very stiff to hard, olive gray -with a sand layer at 69.2m (70.7m)	IX
		NR, SAVE, PUSH, PUSH	Lean CLAY (CL), hard, olive gray -with silt partings and pockets, to 71.9m -with silty sand pockets and partings, at 71.6m -with wood fragments and organic pockets, at 76.5m (77.7m)	X
		PUSH, SAVE	Lean CLAY (CL), hard, gray -with silt pockets and a few shell fragments, at 81.4m -interlayered sand and clay, below 82.9m (84.4m)	XI
		30/30cm, 30/25cm, 30/5cm	Fine to Medium SAND with silt (SP-SM), dense to very dense, gray -with a clay layer at 86.7m -with a lean clay layer at 88.8m (90.8m)	XII
		50/5cm	Fine GRAVEL (GP), very dense, dark gray -sand layer, 91.4m to 92.4m -dense to very dense, fine to coarse sand, at 94.8m	XIII

TOTAL DEPTH: 94.9m

BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-29

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

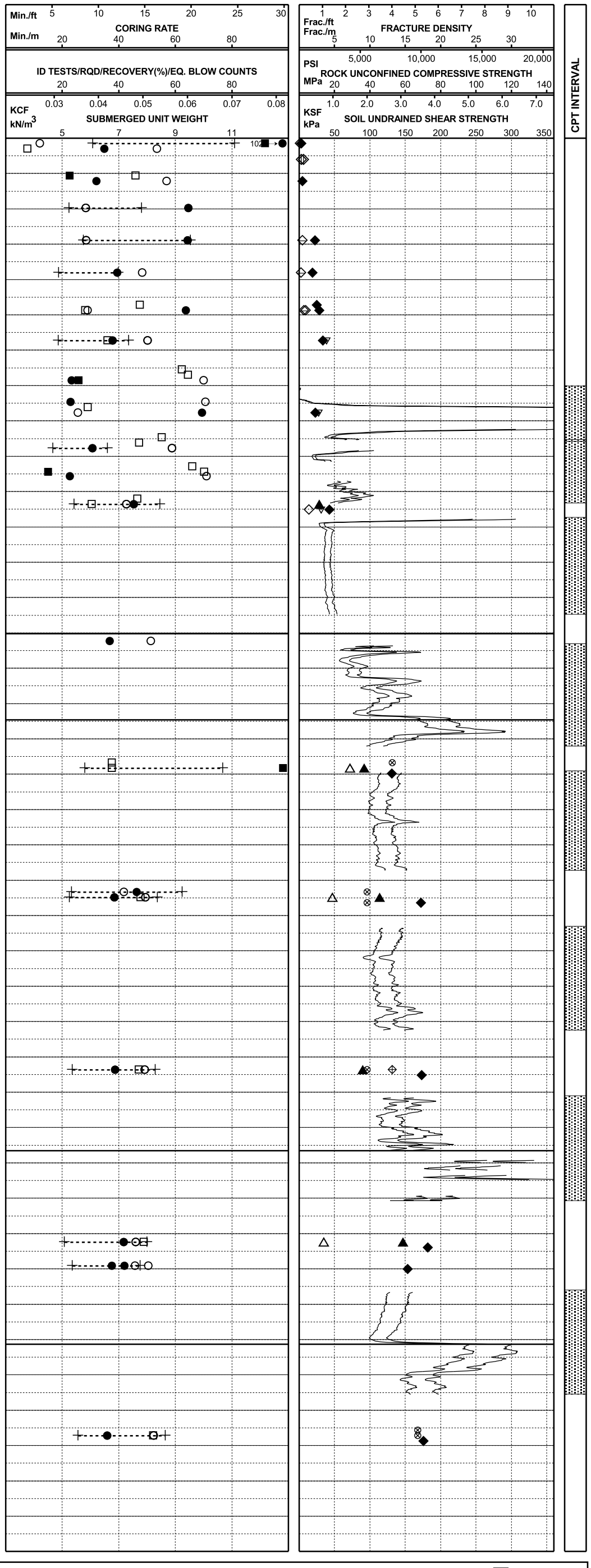
PLATE 98-29.5

PROJECT NO:	98-42-0054	**START DATE:**	09/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-29 (Skyway - Frame 1)	**COMPLETION DATE:**	09/06/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837145 N647992
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -9.8m (MSL)

Stratum	Material Description	Blow Count
I	Fat CLAY (CH), soft to firm, dark gray	WOH
	-with shells and shell fragments	
	-very soft, dark gray clay, to 0.9m	
	-with many sand seams and pockets to 0.6m	WOH
	-very loose, olive gray, silty fine sand layer, with many clay pockets, 0.9m to 1.2m	WOH
		WOH
	-with many shell fragments below 3.7m	WOH
	-with sand pockets, 3.7m to 4.7m	
		WOH
	-with sandy silt pockets at 5.5m	WOH
	-intermixed clay and sand, 6.4m to 7.0m	17/45cm
	-with sand seams at 7.3m	18/60cm
	-with gas blisters below 7.5m	
	-sand layer, 7.6m to 8.2m	
	-sand layer, 8.5m to 8.8m	30/55cm
	-silty sand layer with clay pockets, 9.1m to 9.7m	30/45cm
	-sand layer at 10.1m	PUSH
	-with very few silt pockets and gas blisters, below 10.2m (14.0m)	
II	Fat CLAY (CH), stiff to very stiff, olive gray to gray	SAVE
	-intermixed sand and clay with organic pockets, to 14.6m	
	-with silt seams, at 15.4m and 15.7m (16.5m)	
III	Fat CLAY (CH), very stiff, gray	
	-with a silt layer at 16.8m	
	-greenish gray, and with a few silt pockets, slickensides and gas blisters, at 17.7m	PUSH
	-with a few shell fragments and silt pockets, at 21.3m	PUSH
	-greenish gray with silty sand pockets, a few shell fragments, and mica flakes, at 26.2m (28.7m)	PUSH
IV	Fat CLAY (CH), very stiff, gray	
	-silt with clay layers to 29.9m	
	-with sandy silt pockets and partings, and shell fragments, 30.8m to 32.0m (34.1m)	PUSH SAVE
V	Fat CLAY (CH), very stiff to hard, gray	
	-greenish gray with silt pockets and partings, at 36.6m	PUSH



LOG OF BORING AND TEST RESULTS

BORING 98-29

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

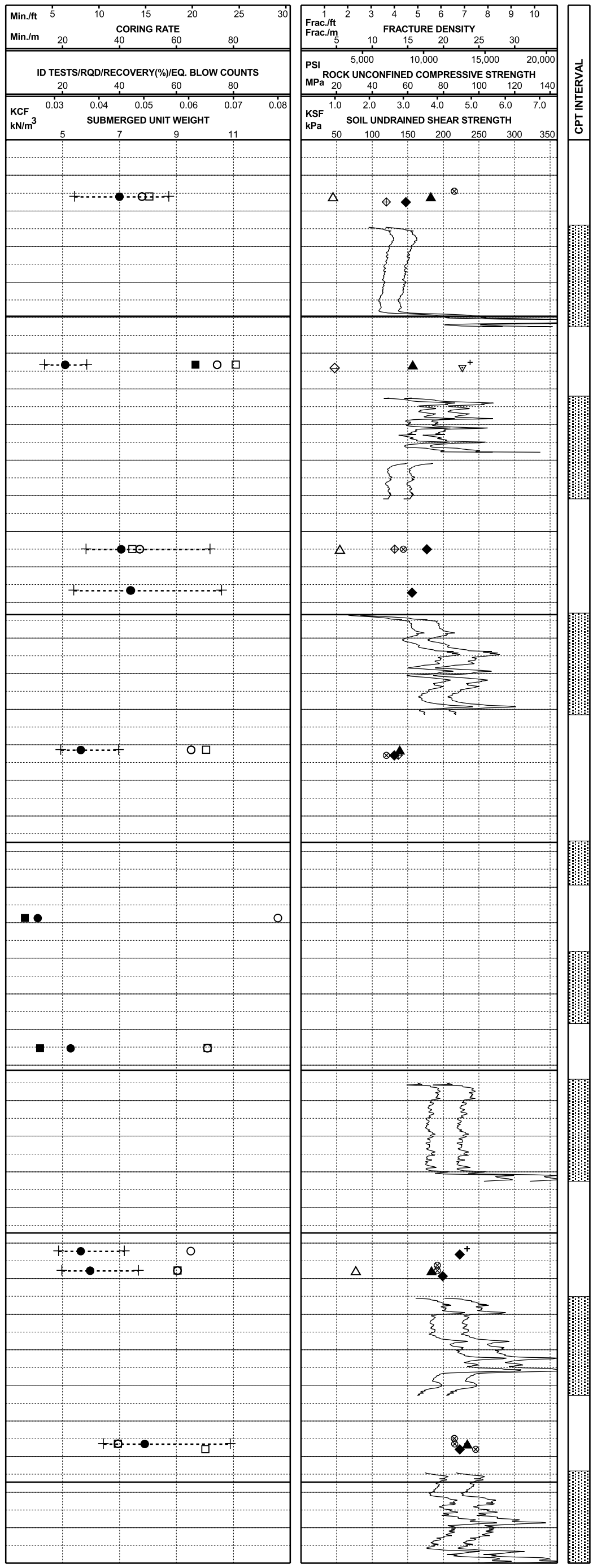
PLATE 98-29.6a

PROJECT NO:	98-42-0054	**START DATE:**	09/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-29 (Skyway - Frame 1)	**COMPLETION DATE:**	09/06/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837145 N647992
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -9.8m (MSL)

Stratum No.	Material Description	Sampler / Blow Count
V	Fat CLAY (CH), very stiff to hard, gray -with a few silt pockets at 41.1m -with organic stains and organic pockets, below 41.1m (45.0m)	PUSH
VI	Fat CLAY (CH), very stiff, gray -very stiff to hard sandy lean clay with many silt seams, to 48.8m -with a sand layer at 45.1m with silty sand pockets and seams, at 46.3m -sand layer, 48.8m to 49.1m (53.3m)	30/40cm; PUSH; SAVE
VII	Lean CLAY (CL), very stiff to hard, greenish gray -with a few silt pockets and partings, gas blisters, and organic stains, at 57.2m (59.7m)	30/40cm
VIII	Fine to Coarse SAND with silt (SW-SM), dense, gray -with gravel at 61.7m -silty fine sand below 64.2m -with clay pockets, partings and seams, at 65.2m (66.1m)	30/15cm; 30/30cm
IX	Lean CLAY (CL), very stiff to hard, olive gray -with a sand layer at 69.2m (70.7m)	NR
X	Lean CLAY (CL), hard, olive gray -with silt partings and pockets, to 71.9m -with silty sand pockets and partings, at 71.6m -with wood fragments and organic pockets, at 76.5m (77.7m)	SAVE; PUSH; PUSH
XI	Lean CLAY (CL), hard, gray	



LOG OF BORING AND TEST RESULTS

BORING 98-29

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

PLATE 98-29.6b

PROJECT NO:	98-42-0054	**START DATE:**	09/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-29 (Skyway - Frame 1)	**COMPLETION DATE:**	09/06/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837145 N647992
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -9.8m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-90					Lean CLAY (CL), hard, gray	
	81					
-91				PUSH	-with silt pockets and a few shell fragments, at 81.4m	
	82			SAVE		XI
-92						
	83				-interlayered sand and clay, below 82.9m	
-93						
	84				(84.4m)	
-94						
	85				Fine to Medium SAND with silt (SP-SM), dense to very dense, gray	
-95						
	86					
-96				30/30cm	-with a clay layer at 86.7m	
	87					
-97						XII
	88					
-98				30/25cm	-with a lean clay layer at 88.8m	
	89					
-99						
	90				(90.8m)	
-100						
	91			30/5cm	Fine GRAVEL (GP), very dense, dark gray -sand layer, 91.4m to 92.4m	
-101						
	92					
-102						
	93					XIII
-103						
	94					
-104					dense to very dense, fine to coarse sand, at 94.8m	
	95			50/5cm	TOTAL DEPTH: 94.9m BACKFILLED WITH: Cement Grout	
-105						
	96					
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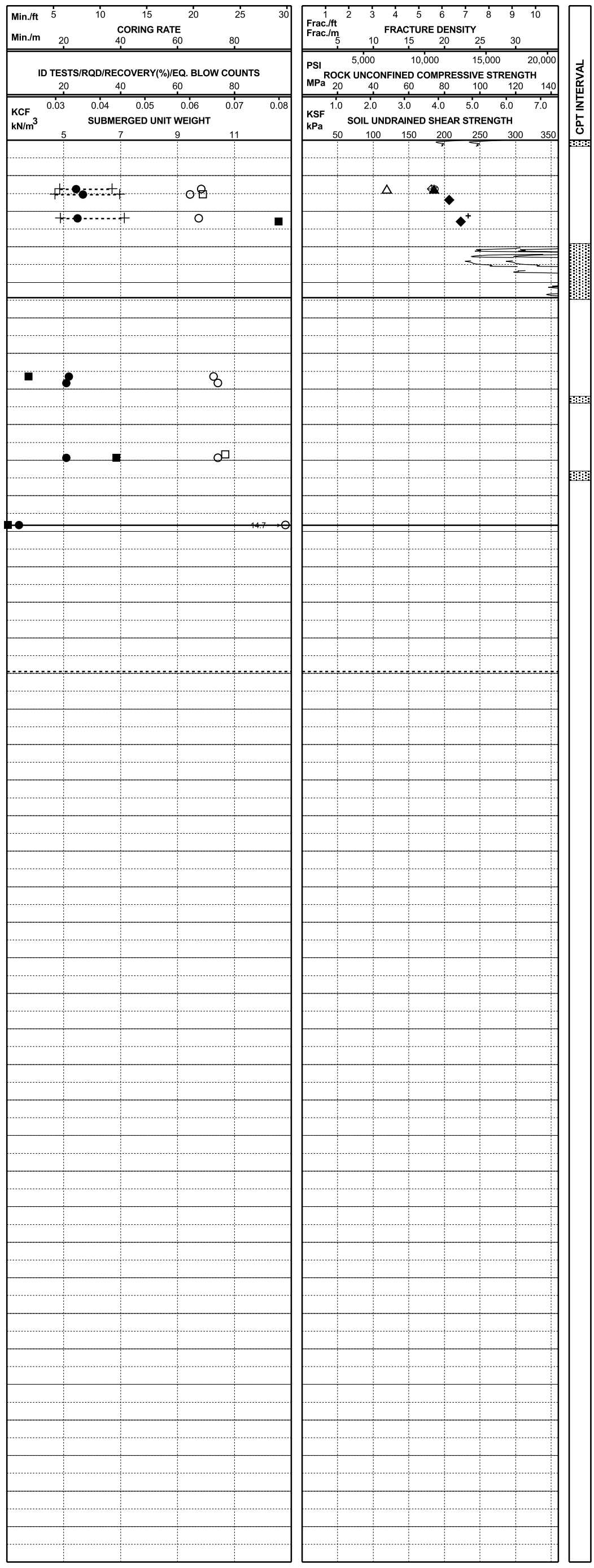


LOG OF BORING AND TEST RESULTS

BORING 98-29

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

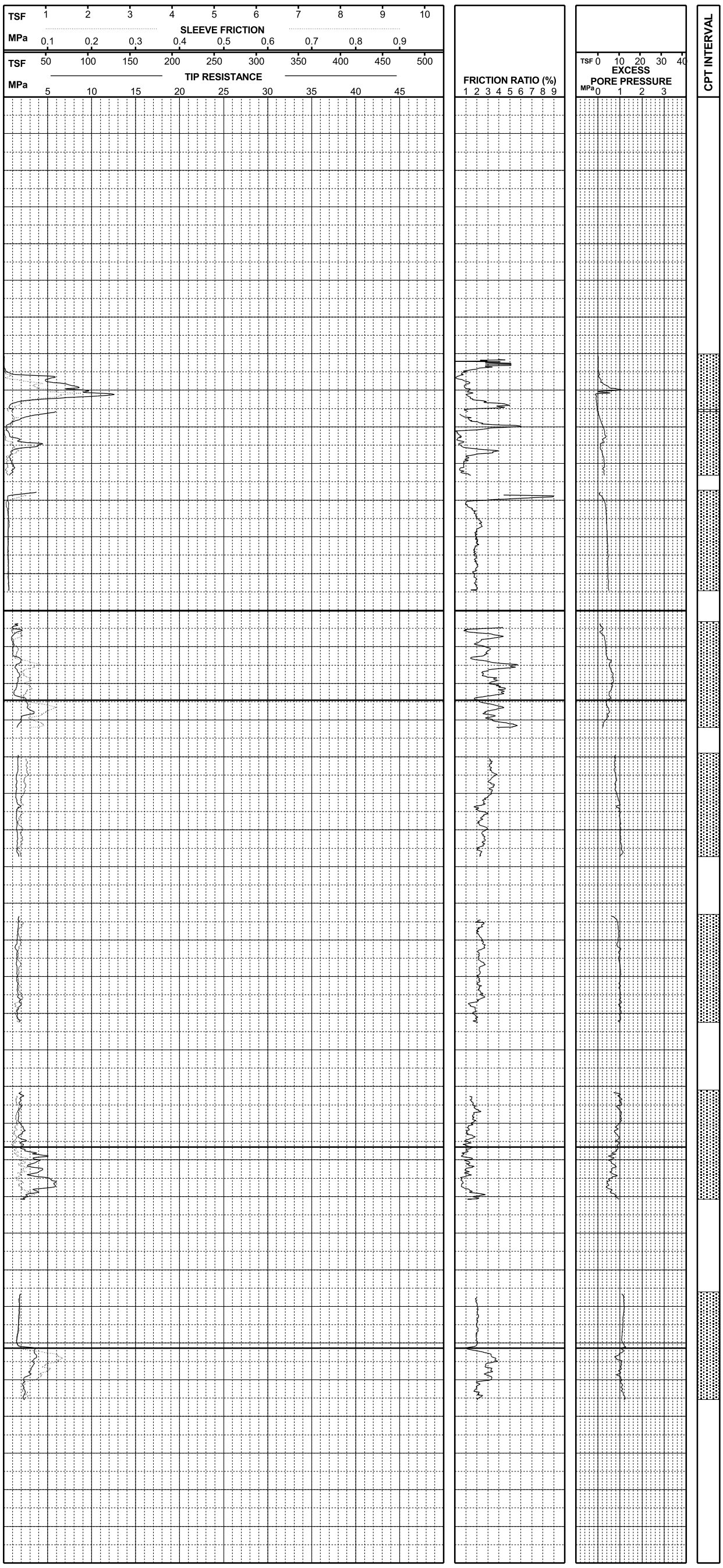
PLATE 98-29.6c

PROJECT NO:	98-42-0054	**START DATE:**	09/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-29 (Skyway - Frame 1)	**COMPLETION DATE:**	09/06/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837145 N647992
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -9.8m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-10				WOH	Fat CLAY (CH), soft to firm, dark gray -with shells and shell fragments	I
-11	1			WOH	-very soft, dark gray clay, to 0.9m -with many sand seams and pockets to 0.6m	
-12	2			WOH	-very loose, olive gray, silty fine sand layer, with many clay pockets, 0.9m to 1.2m	
-13	3			WOH		
-14	4			WOH	-with many shell fragments below 3.7m -with sand pockets, 3.7m to 4.7m	
-15	5			WOH		
-16	6			WOH	-with sandy silt pockets at 5.5m	
-17	7			17/45cm	-intermixed clay and sand, 6.4m to 7.0m	
-18	8			18/60cm	-with sand seams at 7.3m -with gas blisters below 7.5m -sand layer, 7.6m to 8.2m	
-19	9			30/55cm	-sand layer, 8.5m to 8.8m -silty sand layer with clay pockets, 9.1m to 9.7m	
-20	10			30/45cm	-sand layer at 10.1m -with very few silt pockets and gas blisters, below 10.2m	
-21	11			PUSH		
-22	12					
-23	13					
-24	14			SAVE	(14.0m)	
-25	15				Fat CLAY (CH), stiff to very stiff, olive gray to gray -intermixed sand and clay with organic pockets, to 14.6m -with silt seams, at 15.4m and 15.7m	II
-26	16				(16.5m)	
-27	17				Fat CLAY (CH), very stiff, gray -with a silt layer at 16.8m -greenish gray, and with a few silt pockets, slickensides and gas blisters, at 17.7m	III
-28	18			PUSH		
-29	19					
-30	20					
-31	21			PUSH	-with a few shell fragments and silt pockets, at 21.3m	
-32	22					
-33	23					
-34	24					
-35	25					
-36	26			PUSH	-greenish gray with silty sand pockets, a few shell fragments, and mica flakes, at 26.2m	
-37	27					
-38	28				(28.7m)	
-39	29				Fat CLAY (CH), very stiff, gray -silt with clay layers to 29.9m	IV
-40	30					
-41	31			PUSH	-with sandy silt pockets and partings, and shell fragments, 30.8m to 32.0m	
-42	32			SAVE		
-43	33					
-44	34				(34.1m)	
-45	35				Fat CLAY (CH), very stiff to hard, gray	V
-46	36					
-47	37			PUSH	-greenish gray with silt pockets and partings, at 36.6m	
-48	38					
-49	39					



LOG OF BORING AND TEST RESULTS

BORING 98-29

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

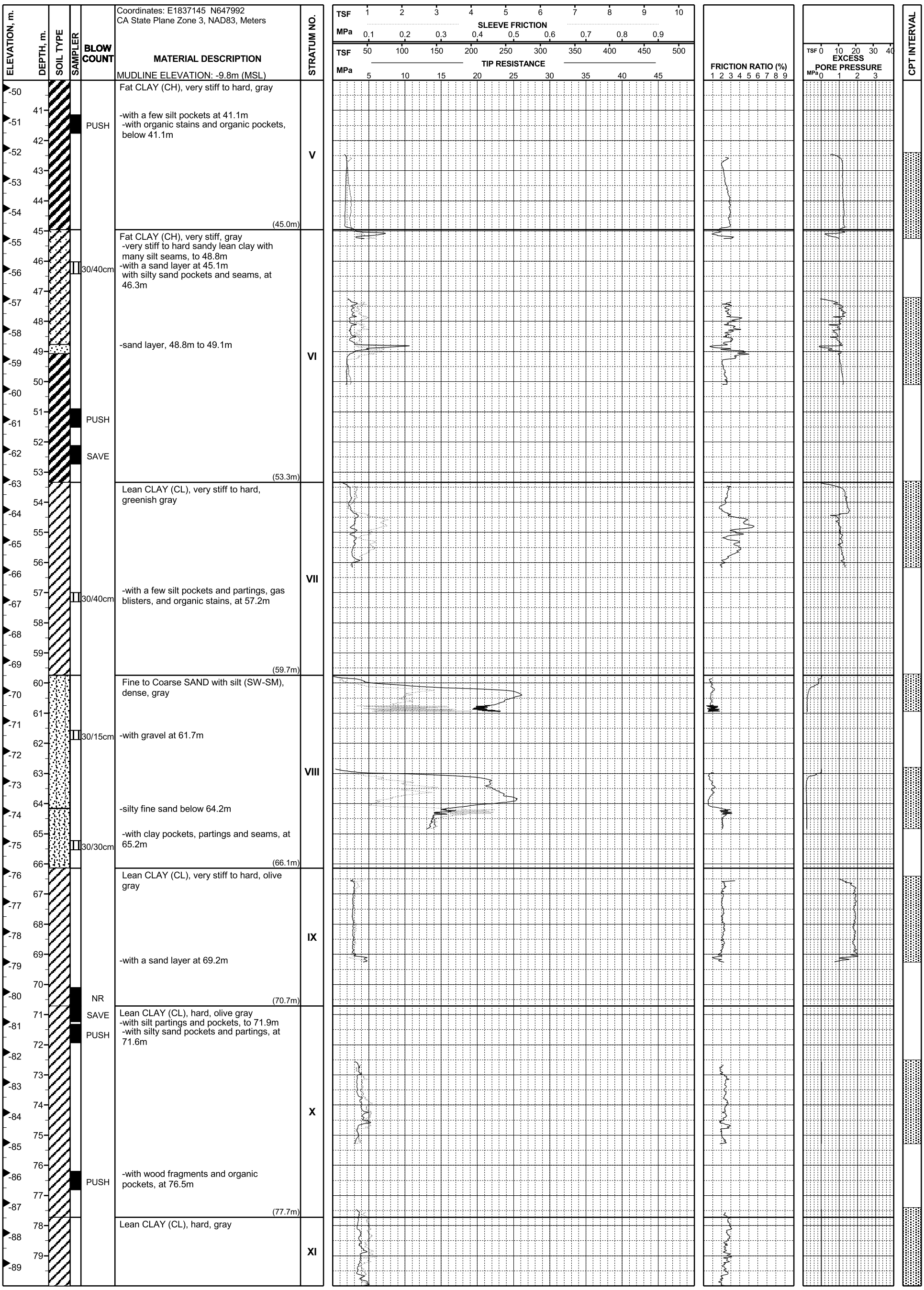
PLATE 98-29.7a

PROJECT NO:	98-42-0054	**START DATE:**	09/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-29 (Skyway - Frame 1)	**COMPLETION DATE:**	09/06/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837145 N647992
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -9.8m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Fat CLAY (CH), very stiff to hard, gray -with a few silt pockets at 41.1m -with organic stains and organic pockets, below 41.1m (45.0m)	V
Fat CLAY (CH), very stiff, gray -very stiff to hard sandy lean clay with many silt seams, to 48.8m -with a sand layer at 45.1m with silty sand pockets and seams, at 46.3m -sand layer, 48.8m to 49.1m (53.3m)	VI
Lean CLAY (CL), very stiff to hard, greenish gray -with a few silt pockets and partings, gas blisters, and organic stains, at 57.2m (59.7m)	VII
Fine to Coarse SAND with silt (SW-SM), dense, gray -with gravel at 61.7m -silty fine sand below 64.2m -with clay pockets, partings and seams, at 65.2m (66.1m)	VIII
Lean CLAY (CL), very stiff to hard, olive gray -with a sand layer at 69.2m (70.7m)	IX
Lean CLAY (CL), hard, olive gray -with silt partings and pockets, to 71.9m -with silty sand pockets and partings, at 71.6m -with wood fragments and organic pockets, at 76.5m (77.7m)	X
Lean CLAY (CL), hard, gray	XI



LOG OF BORING AND TEST RESULTS

BORING 98-29

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

PLATE 98-29.7b

PROJECT NO:	98-42-0054	**START DATE:**	09/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-29 (Skyway - Frame 1)	**COMPLETION DATE:**	09/06/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837145 N647992
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -9.8m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-90					Lean CLAY (CL), hard, gray	
	81				-with silt pockets and a few shell fragments, at 81.4m	
-91				PUSH		
	82			SAVE		XI
-92						
	83				-interlayered sand and clay, below 82.9m	
-93						
	84				(84.4m)	
-94						
	85				Fine to Medium SAND with silt (SP-SM), dense to very dense, gray	
-95						
	86					
-96						
	87			30/30cm	-with a clay layer at 86.7m	
-97						XII
	88					
-98						
	89			30/25cm	-with a lean clay layer at 88.8m	
-99						
	90				(90.8m)	
-100						
	91			30/5cm	Fine GRAVEL (GP), very dense, dark gray -sand layer, 91.4m to 92.4m	
-101						
	92					
-102						
	93					XIII
-103						
	94					
-104					-dense to very dense, fine to coarse sand, at 94.8m	
	95			50/5cm		
-105					TOTAL DEPTH: 94.9m	
	96				BACKFILLED WITH: Cement Grout	
-106						
	97					
-107						
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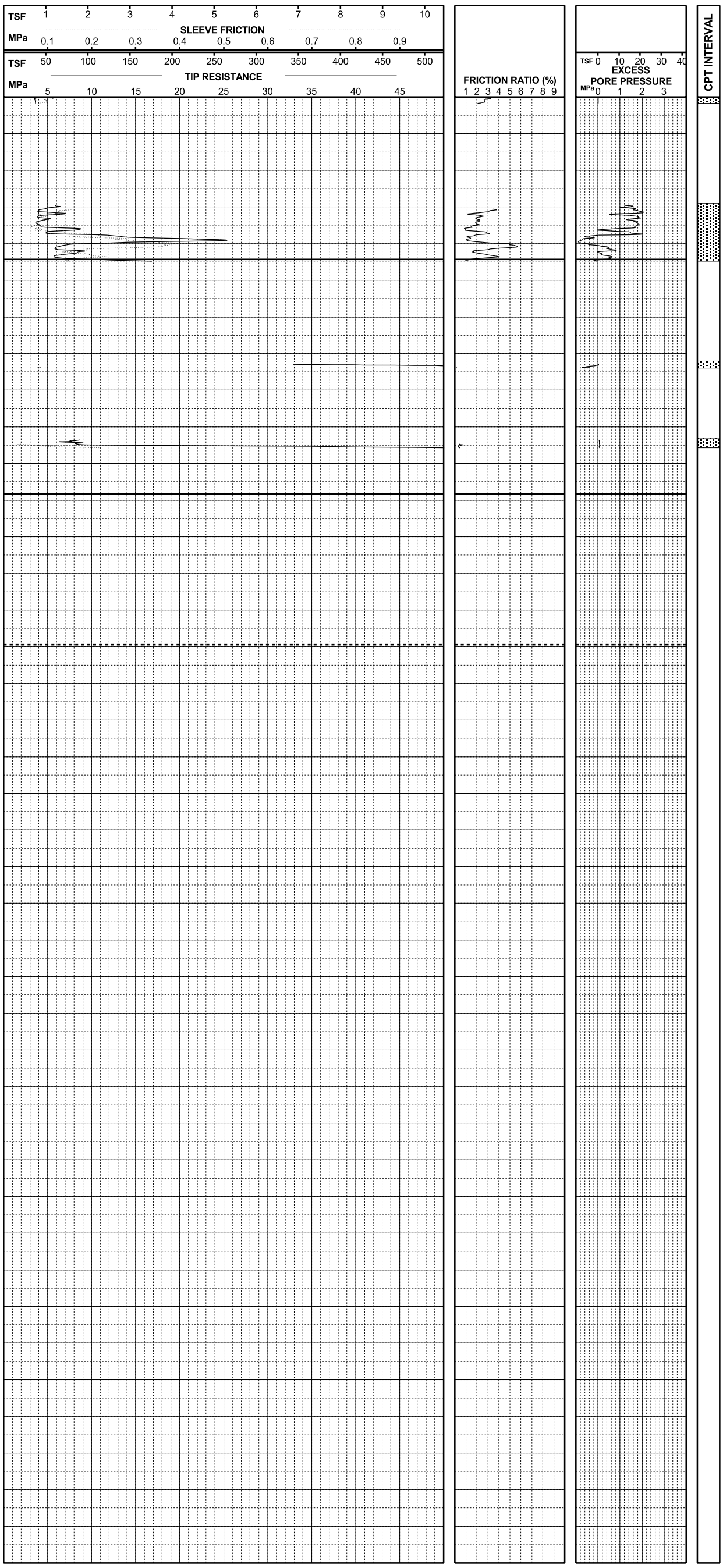
	119					
-129						



LOG OF BORING AND TEST RESULTS

BORING 98-29

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

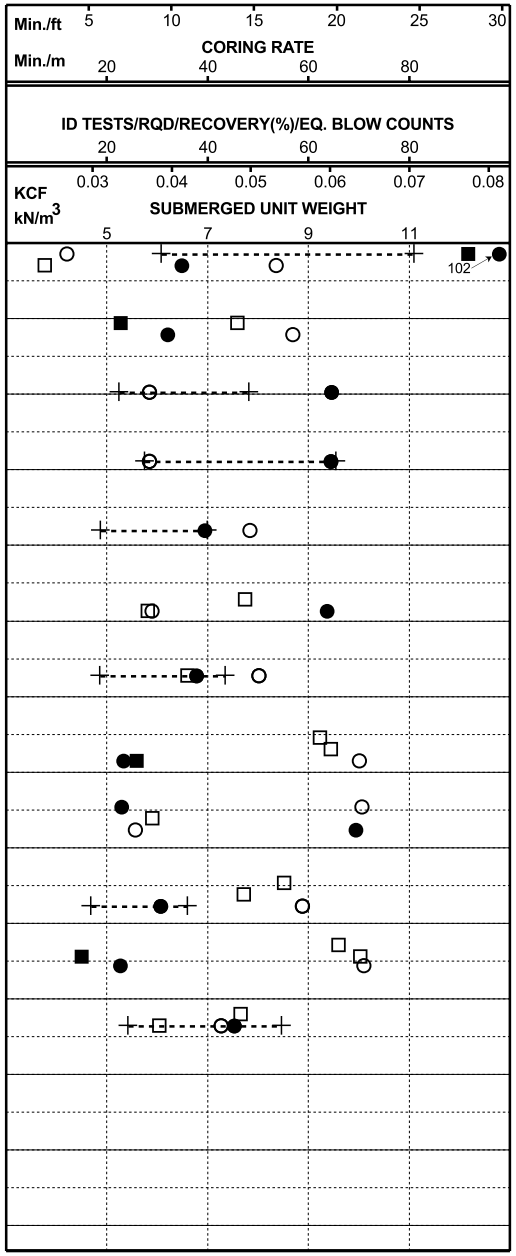
PLATE 98-29.7c

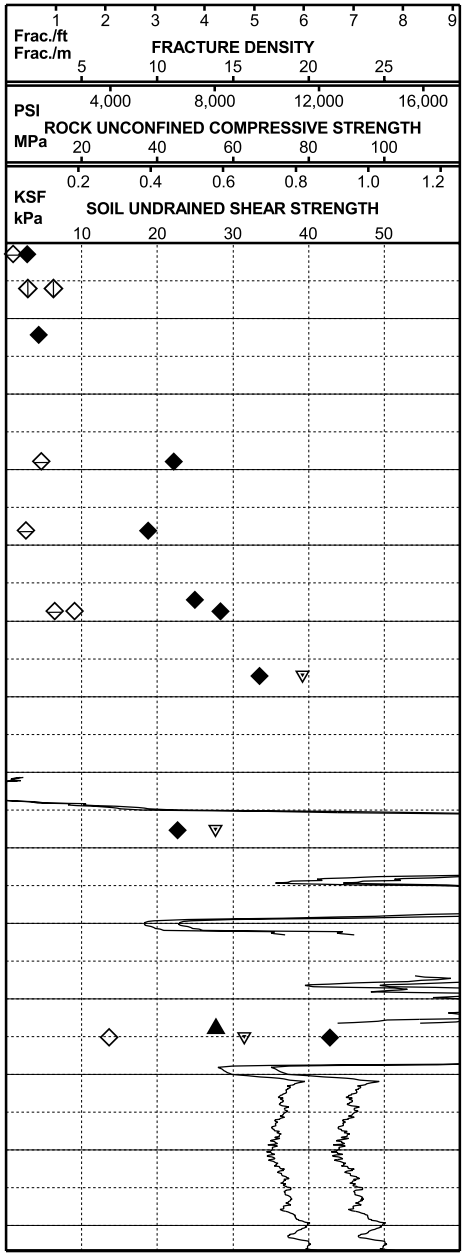
PROJECT NO:	98-42-0054	**START DATE:**	09/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-29 (Skyway - Frame 1)	**COMPLETION DATE:**	09/06/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837145 N647992
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -9.8m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-10		WOH	Fat CLAY (CH), soft to firm, dark gray -with shells and shell fragments -very soft, dark gray clay, to 0.9m -with many sand seams and pockets to 0.6m	I
-11	1	WOH	-very loose, olive gray, silty fine sand layer, with many clay pockets, 0.9m to 1.2m	
-12	2	WOH		
-13	3	WOH		
-14	4	WOH	-with many shell fragments below 3.7m -with sand pockets, 3.7m to 4.7m	
-15	5	WOH		
-16	6	WOH	-with sandy silt pockets at 5.5m	
-17	7	17/45cm	-intermixed clay and sand, 6.4m to 7.0m	
-18	8	18/60cm	-with sand seams at 7.3m -with gas blisters below 7.5m -sand layer, 7.6m to 8.2m	
-19	9	30/55cm	-sand layer, 8.5m to 8.8m	
-20	10	30/45cm	-silty sand layer with clay pockets, 9.1m to 9.7m	
-21	11	PUSH	-sand layer at 10.1m -with very few silt pockets and gas blisters, below 10.2m	
-22	12			
-23	13			





CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-29

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

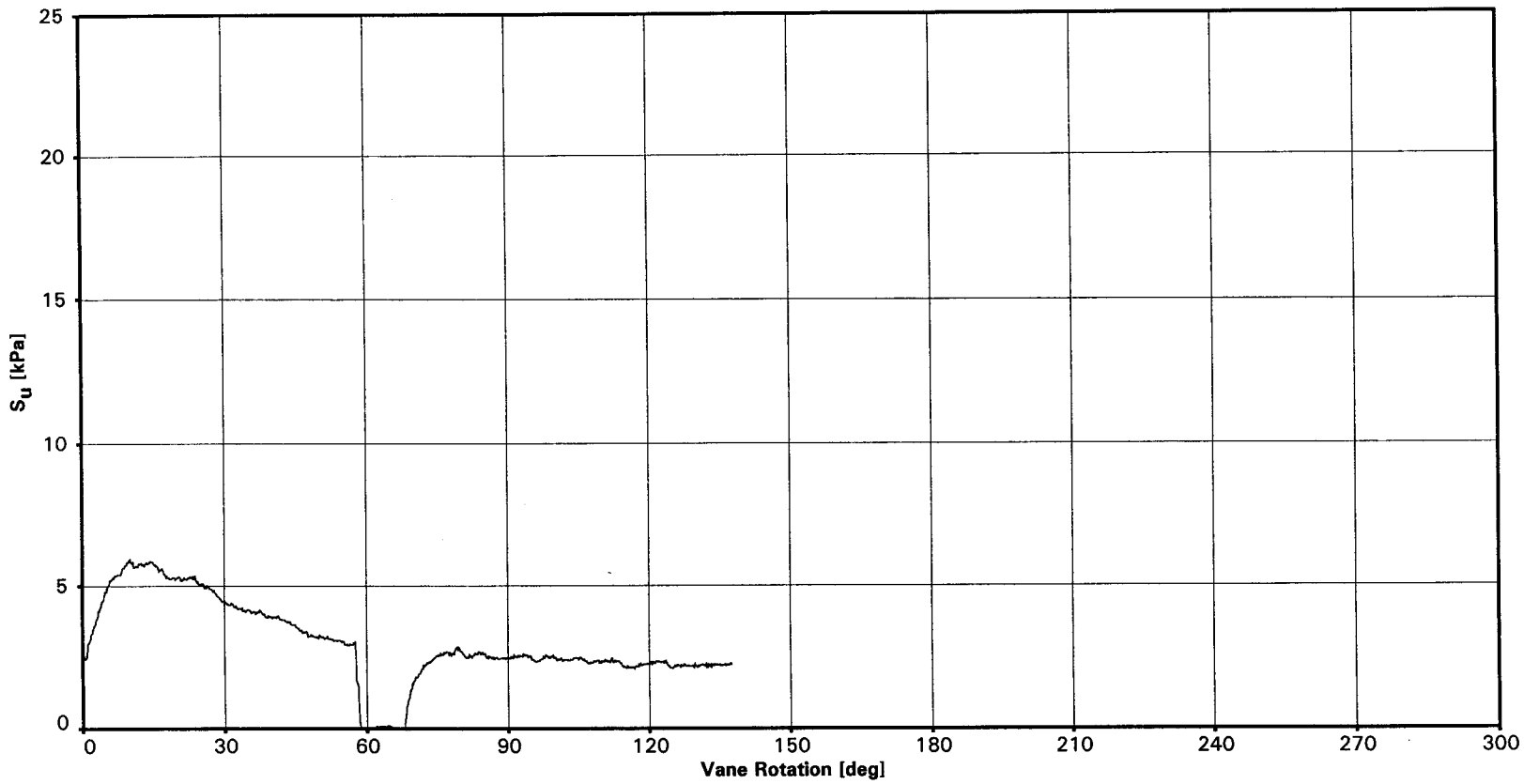
FUGRO

PLATE 98-29.8

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 98-29
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-29.9

98-29		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	102	81	31	1.41		92				2.8		0.9											H		
0.3	2	35				3.8																				
0.6	401													2.9												
0.6	501													6.2												
1.1	3					7.6	23																			
1.2	4	32									4.4															
2.0	5	65	48	22	1.63																					
2.9	6	64	66	28	0.97						22.2		4.6													
3.8	7	39	40	19	0.98						18.8		2.6													
4.7	8					7.7					25.0															
4.9	9	64				5.8					28.3	9.0	6.4													
5.7	10	38	44	19	0.77	6.6				39.3	33.5															
6.6	11					9.2																				
6.7	12					9.4																				
6.9	13	23					26																	H		

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 98-29
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-29		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)			
7.5	14	23																								
7.6	15					5.9																				
7.8	16	69								27.8	22.6															
8.5	17					8.5																				
8.6	18					7.7																				
8.8	19	31	36	17	0.72																					
9.3	20					9.6																				
9.4	21					10.0	15											0.0	35							
9.6	22	23																								
10.2	23					7.6																				
10.4	24	45	55	24	0.69	6.0									27.7		2.8									
10.5	25									31.6	42.8	13.6														
14.2	27	37																								
17.7	28					6.7			131.7																	
17.8	29		77	28		6.7	98								91.4	71.7	0.6							H		

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-29
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-29		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)			
18.0	30										131.2															
21.3	31	46	63	23	0.58				95.8															C		
21.5	32	38	54	23	0.51	7.8									113.0	46.9	0.6									
21.6	33								95.8		172.0															
26.4	35	39	53	24	0.51	7.7		131.7	95.8						89.2		3.0									
26.5	36										173.3															
31.2	38	42	50	21	0.71	7.9									146.3	34.5	1.7									
31.4	39										181.9															
31.9	40	42																								
31.9	40	37	48	24	0.57																			C,K	2.73	
32.0	41										153.5															
36.6	42								167.6																	
36.7	43	36	57	26	0.33	8.2			167.6																	
36.9	44										175.8															
41.5	45								215.5																	

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K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-29
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-29		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)			
41.6	46	40	57	24	0.47	8.0									181.7	44.6	0.7									
41.8	47							119.7			147.3															
46.3	48	21	29	14	0.48	11.1	67								156.3		5.0							H		
46.4	49									227.0			47.0													
51.5	50	41	72	28	0.28	7.4		131.7	143.6		177.0					54.3										
52.7	51	44	76	24	0.38																			C	2.76	
52.7	52										155.9															
57.2	53	26	40	19	0.33	10.0									138.0		3.1									
57.3	54							136.5	119.7		131.2															
61.9	55	11					7																		2.74	
65.5	56	23				10.1	12																			
71.2	57	26	42	19	0.33																			C		
71.3	58										222.8															
71.6	59								191.5																	
71.8	60	30	47	20	0.36	9.0			191.5						182.9	76.8	1.3									

Identification Tests
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-29
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-29		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)			
71.9	61										199.3															
76.5	62								215.5																	
76.7	63	49	79	35	0.32	6.9			216.1						233.1		0.8									
76.8	64					10.0			245.3		222.8															11
81.4	65	24	37	19	0.30			181.9	186.9						184.7	118.7	0.7									
81.5	66	27	40	17	0.42	9.9																				
81.7	67										206.7															
82.2	68	25	42	19	0.26																			C,K		
82.3	69						95				222.8															
86.7	70	22					8																			
86.8	71	21																								
88.8	72					10.7																				
88.9	73	21					38																			
90.8	74	4					< 1																			

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
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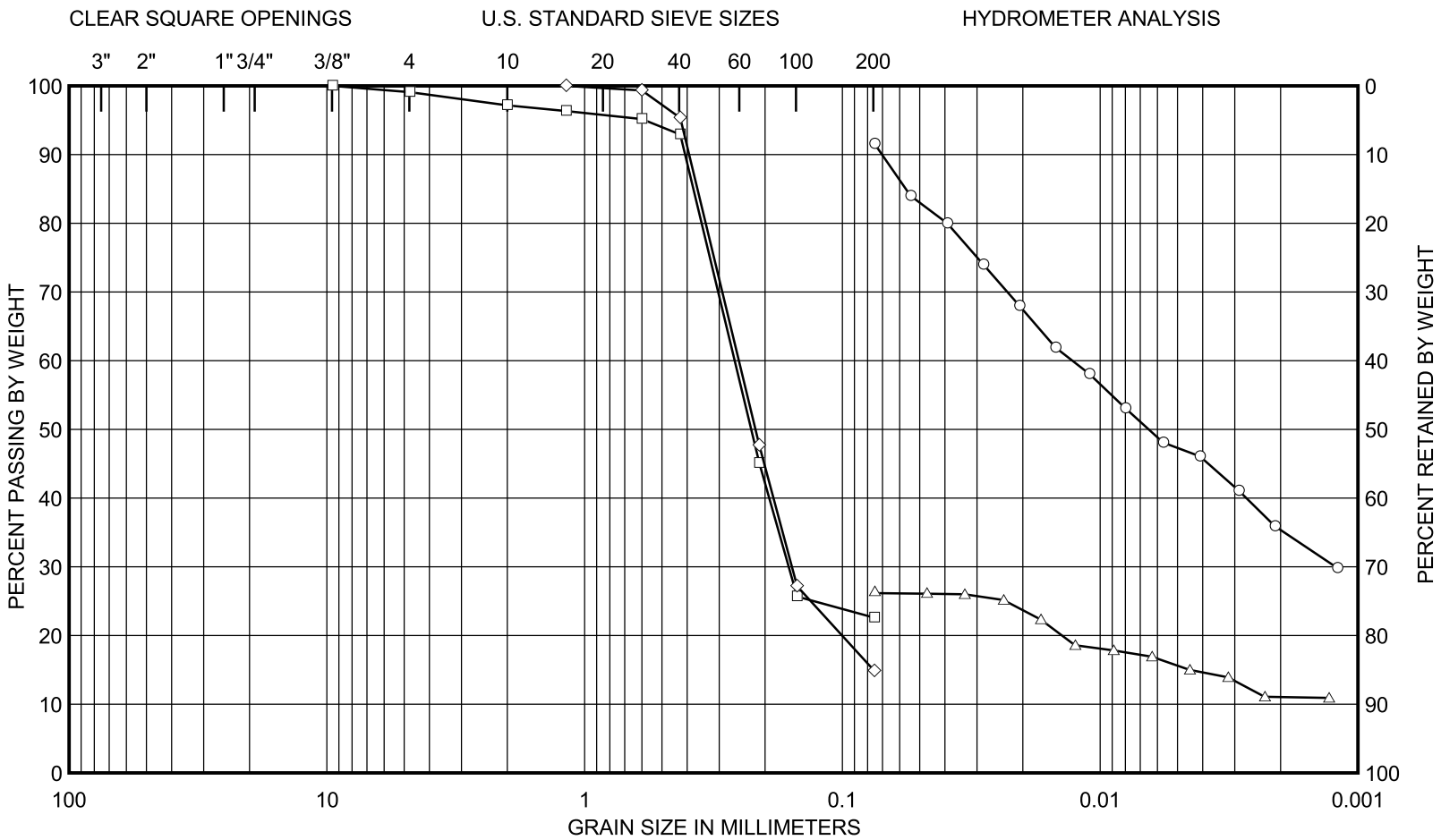
SUMMARY OF LABORATORY TEST RESULTS
Boring 98-29
SFOBB East Span Seismic Safety Project

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)
1	0.2	○——○	FAT CLAY (CH)			0.0060
3	1.1	□——□	SILTY FINE SAND (SM) with a trace of medium sand			0.23
13	6.9	△——△	Intermixed SAND and CLAY			
21	9.4	◇——◇	SILTY FINE SAND (SM)			0.22

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-29
SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-29.11a

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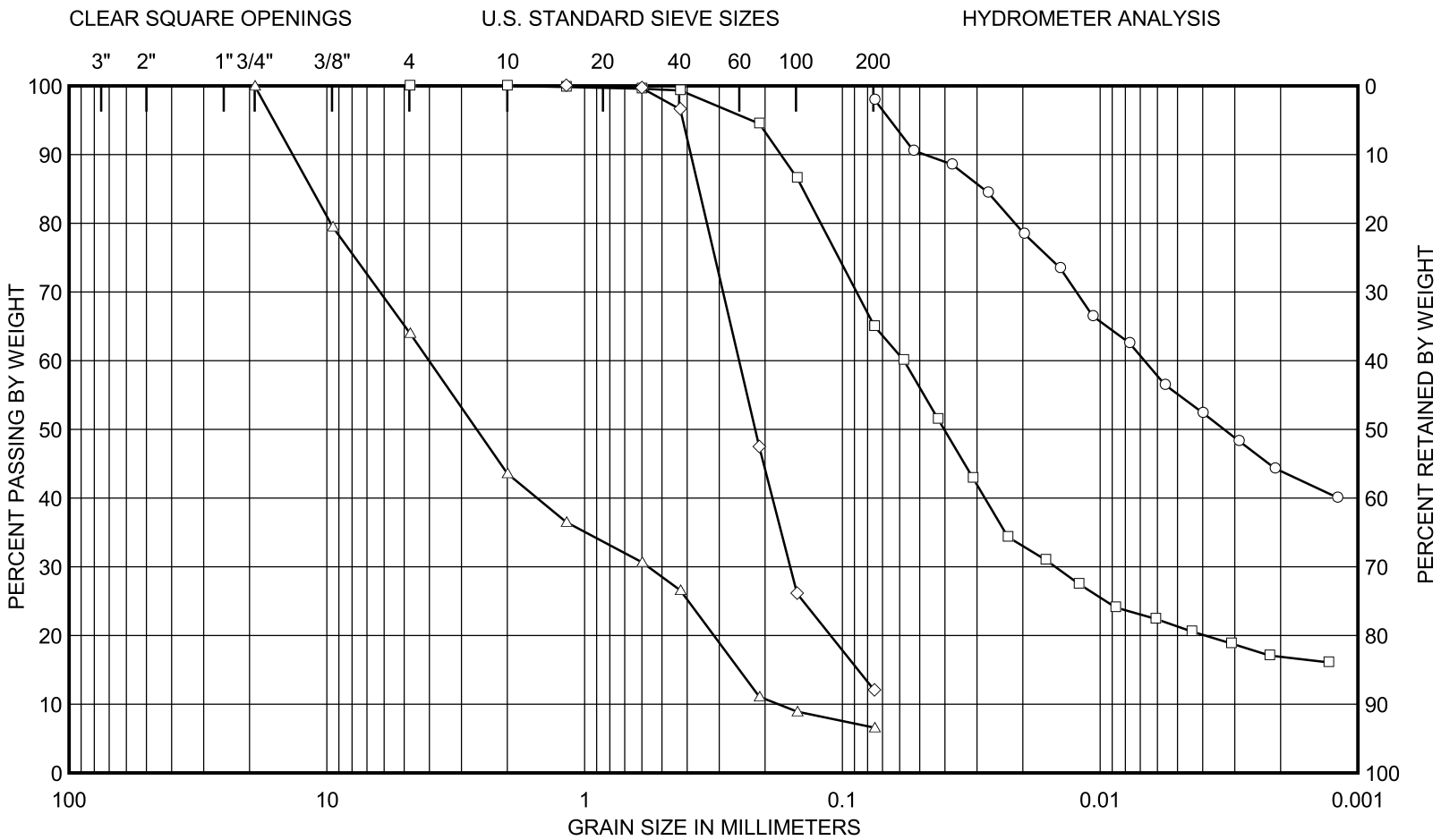

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
29	17.8	○——○	FAT CLAY (CH)			0.0030
48	46.3	□——□	SANDY LEAN CLAY (CL)			0.040
55	61.9	△——△	FINE TO COARSE SAND (SP-SM) with silt and fine gravel	0.4	22.6	2.6
56	65.5	◇——◇	SILTY FINE SAND (SM)			0.22

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-29
SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-29.11b

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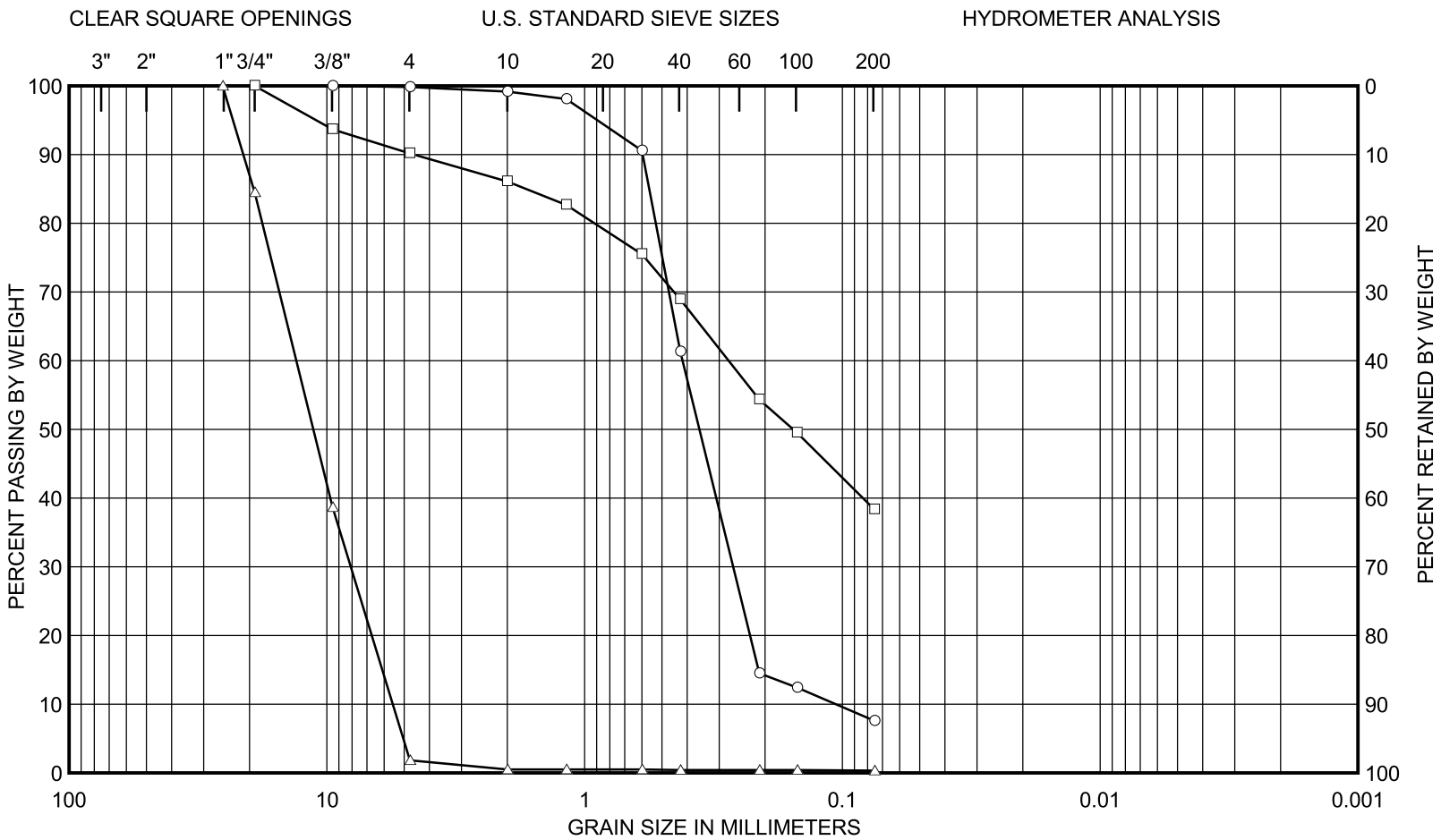

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
70	86.7	○——○	FINE TO MEDIUM SAND (SP-SM) with silt	1.6	3.9	0.36
73	88.9	□——□	SILTY FINE SAND (SM) with medium sand, a trace of coarse sand and clay layers			0.16
74	90.8	△——△	FINE GRAVEL (GP) with a trace of coarse gravel	0.9	2.4	11.3

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-29
SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-29.11c

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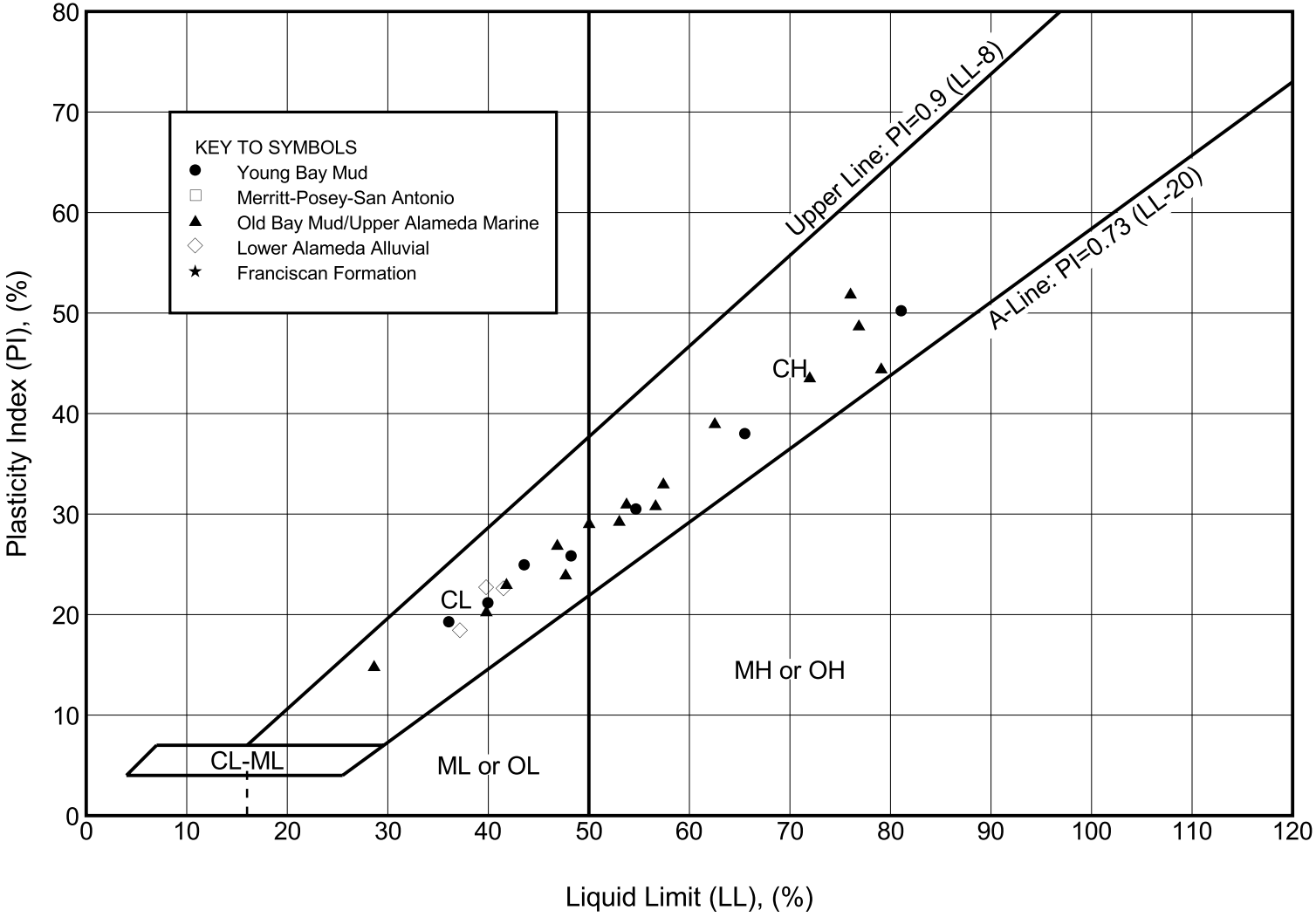

PLASTICITY CHART
Boring 98-29
SFOBB East Span Seismic Safety Project

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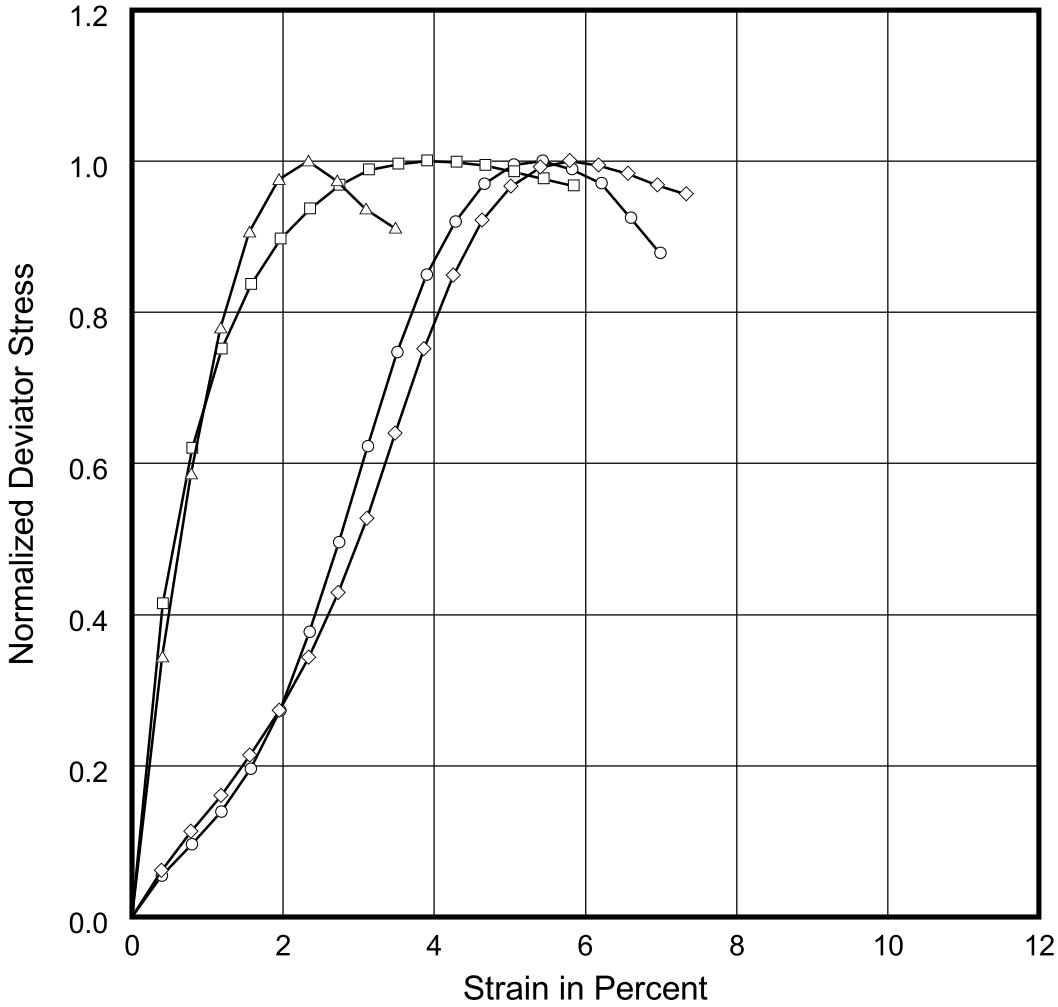
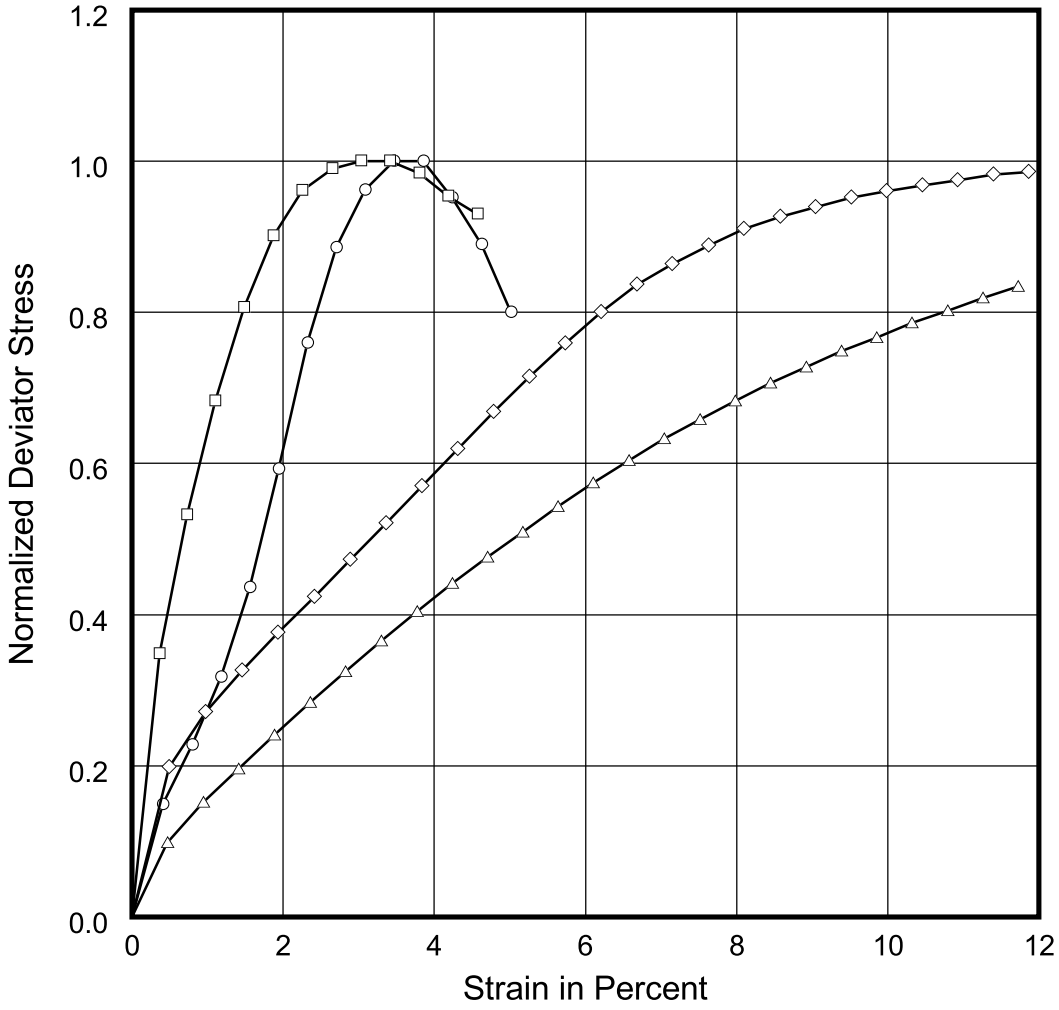


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	24	10.4	UU	241	55	2.8
□——□	29	17.8	UU	827	183	0.6
△——△	32	21.5	UU	827	226	0.6
◇——◇	35	26.4	UU	827	179	3.0

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-29
SFOBB East Span Seismic Safety Project

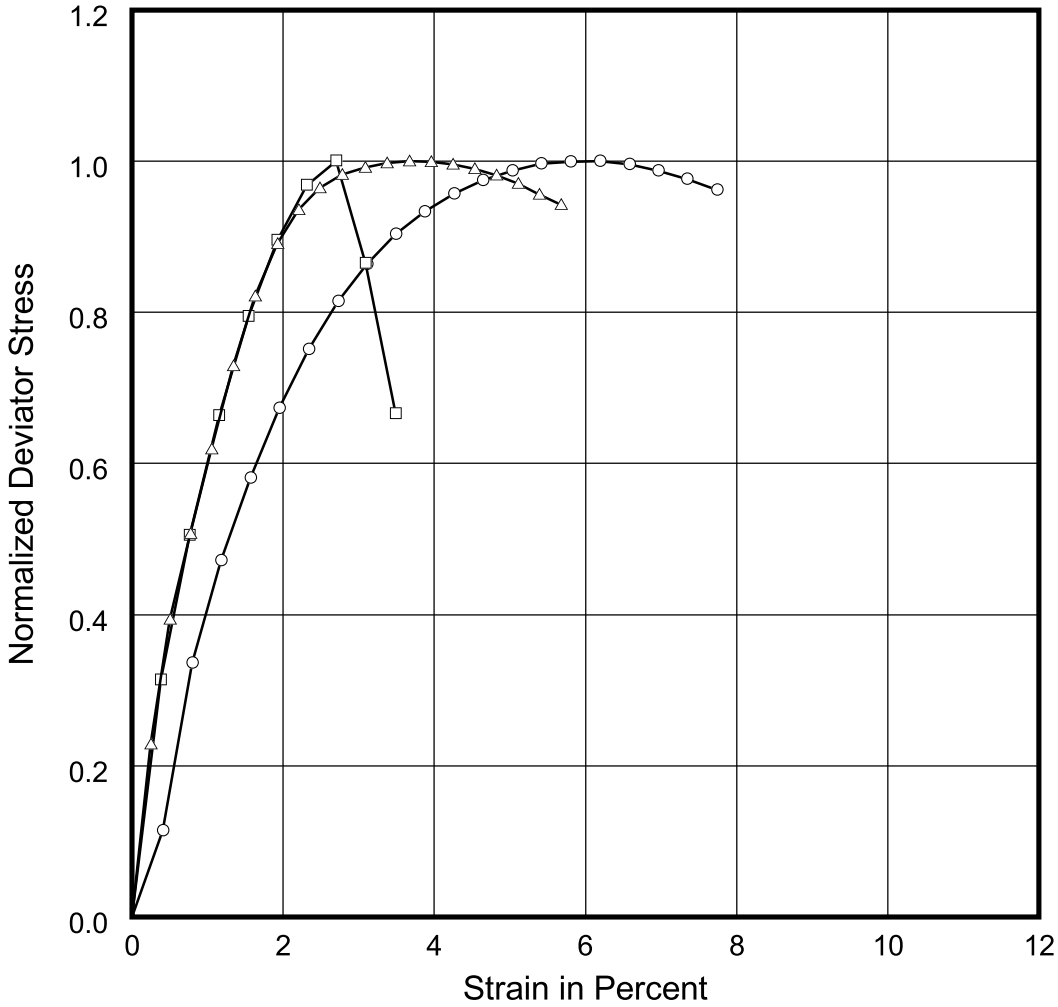


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	38	31.2	UU	827	293	1.7
□—□	46	41.6	UU	931	363	0.7
△—△	48	46.3	UU	1034	313	5.0
◇—◇	53	57.2	UU	1310	276	3.1

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-29
SFOBB East Span Seismic Safety Project

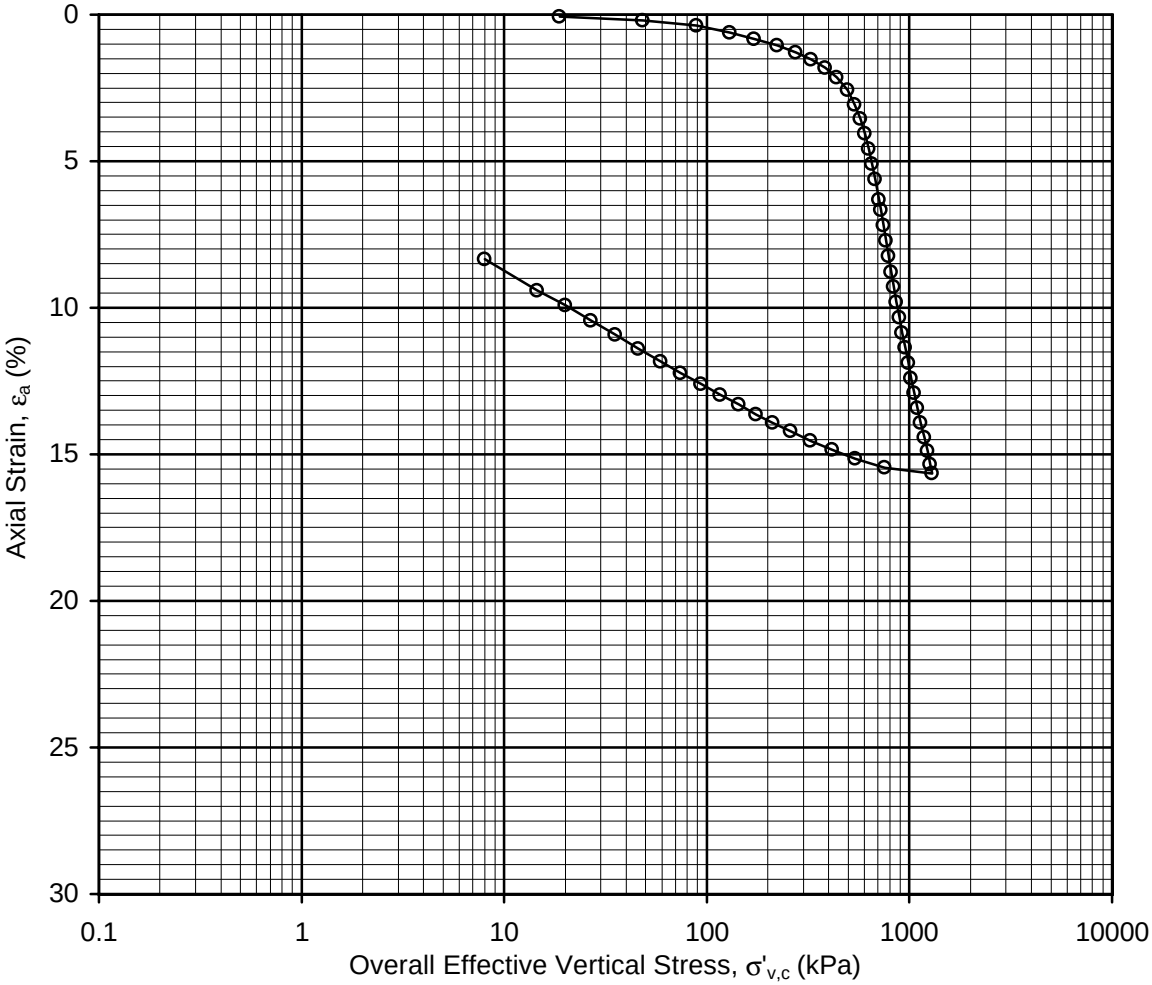


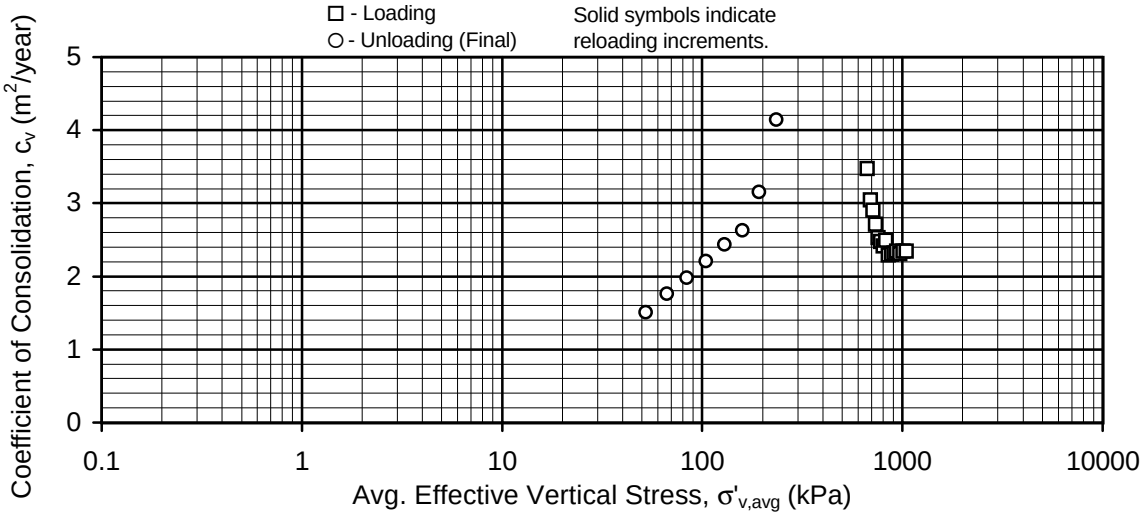
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	60	71.8	UU	1620	366	1.3
□——□	63	76.7	UU	1724	466	0.8
△——△	65	81.4	UU	1724	369	0.7

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

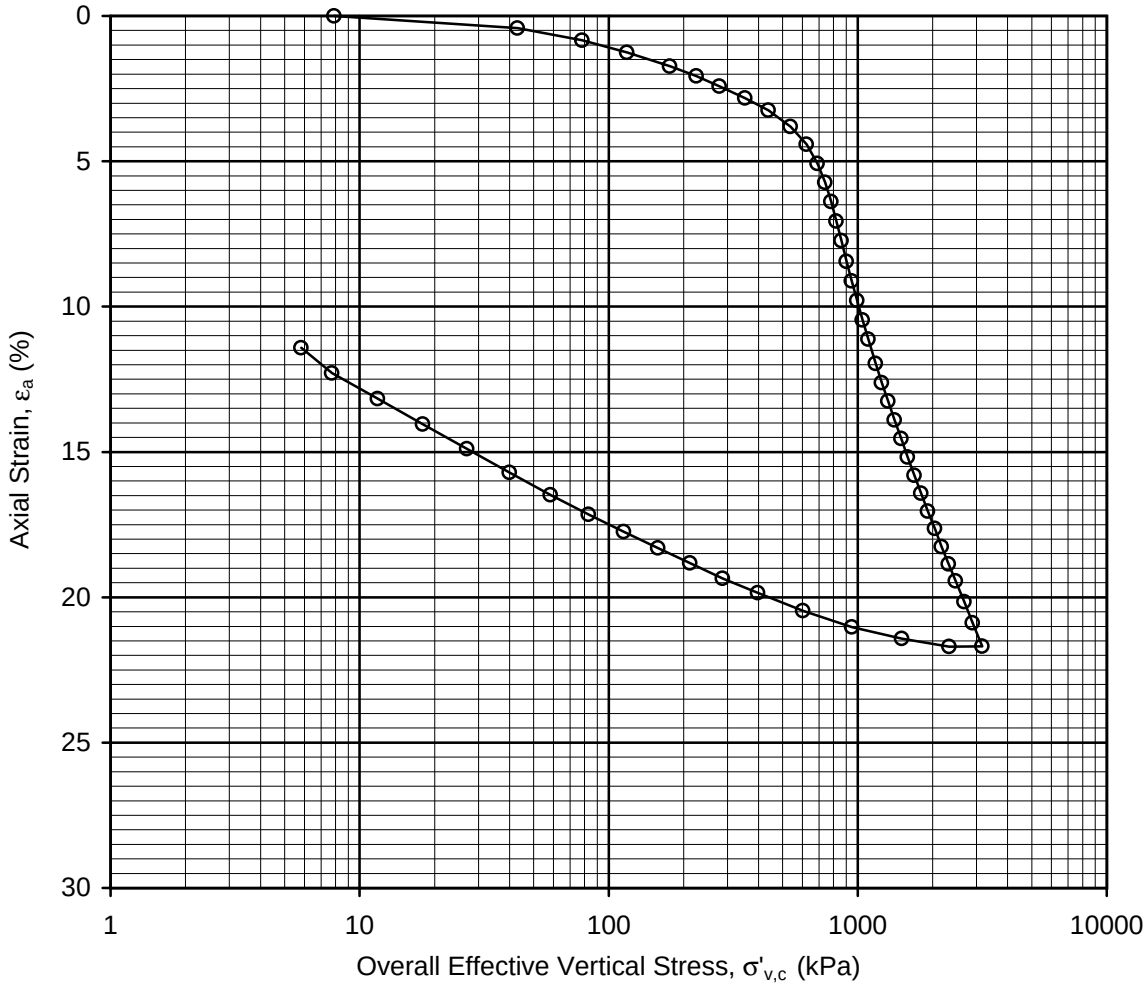
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-29
SFOBB East Span Seismic Safety Project

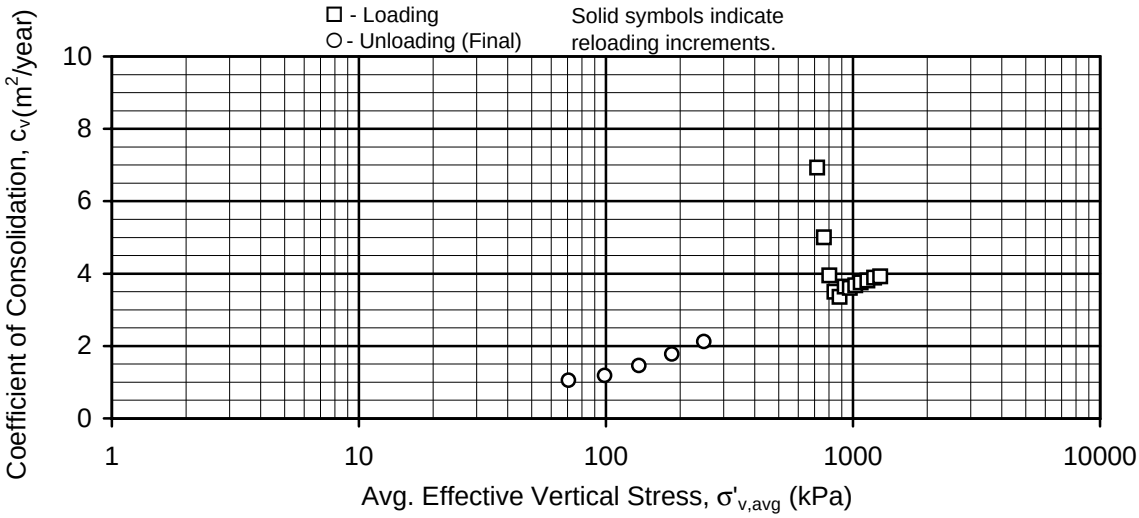




CRS CONSOLIDATION TEST RESULTS

Sample No. 31 - Depth: 21.3m
Boring 98-29
SFOBB East Span Seismic Safety Project

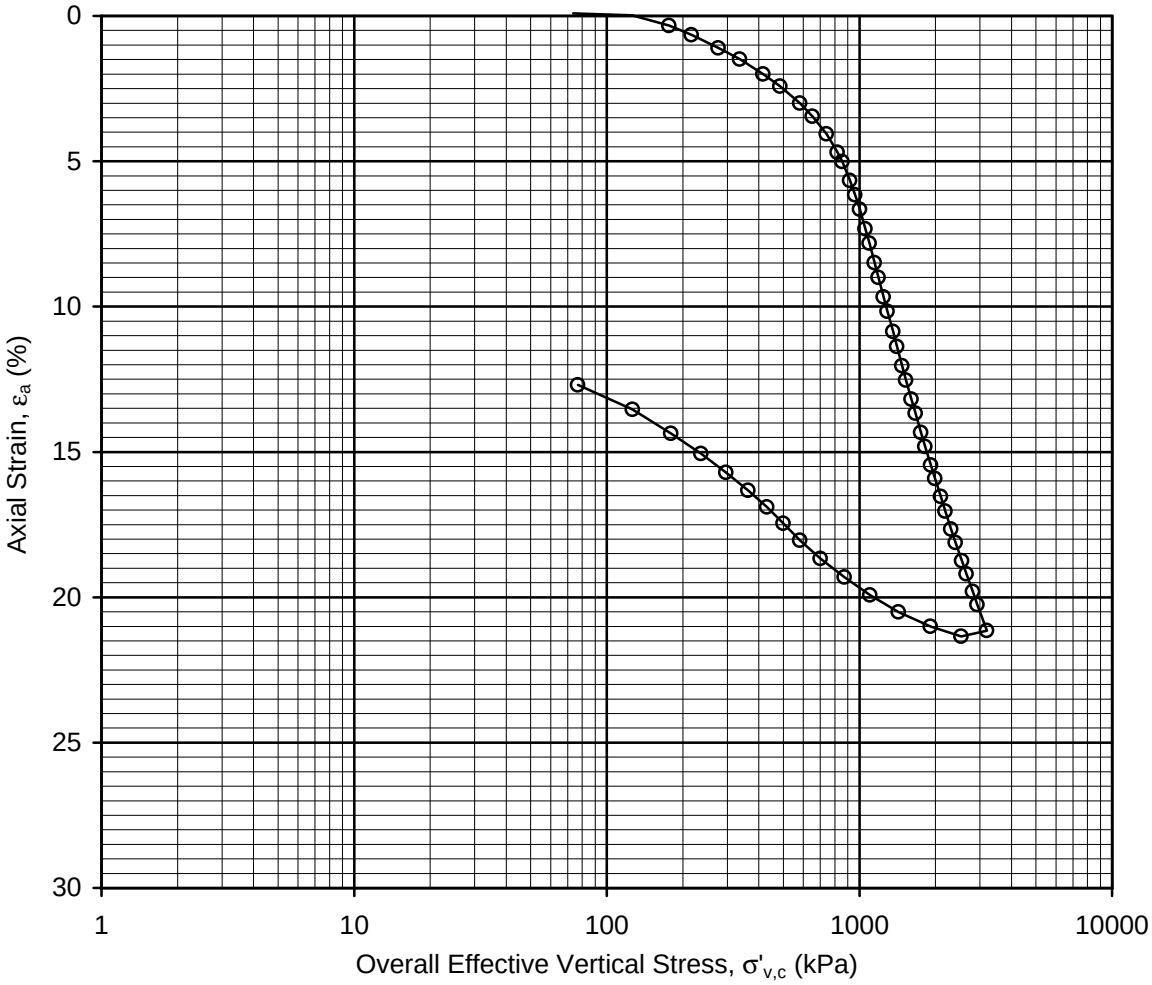


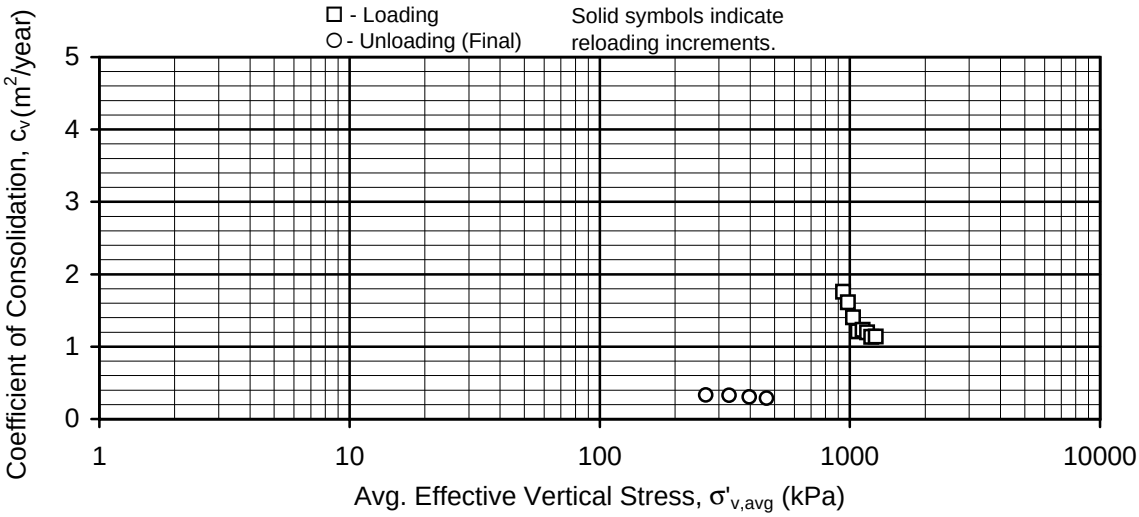


CRS CONSOLIDATION TEST RESULTS

Sample No. 40 - Depth: 31.9m
Boring 98-29
SFOBB East Span Seismic Safety Project

PLATE 98-29.14b

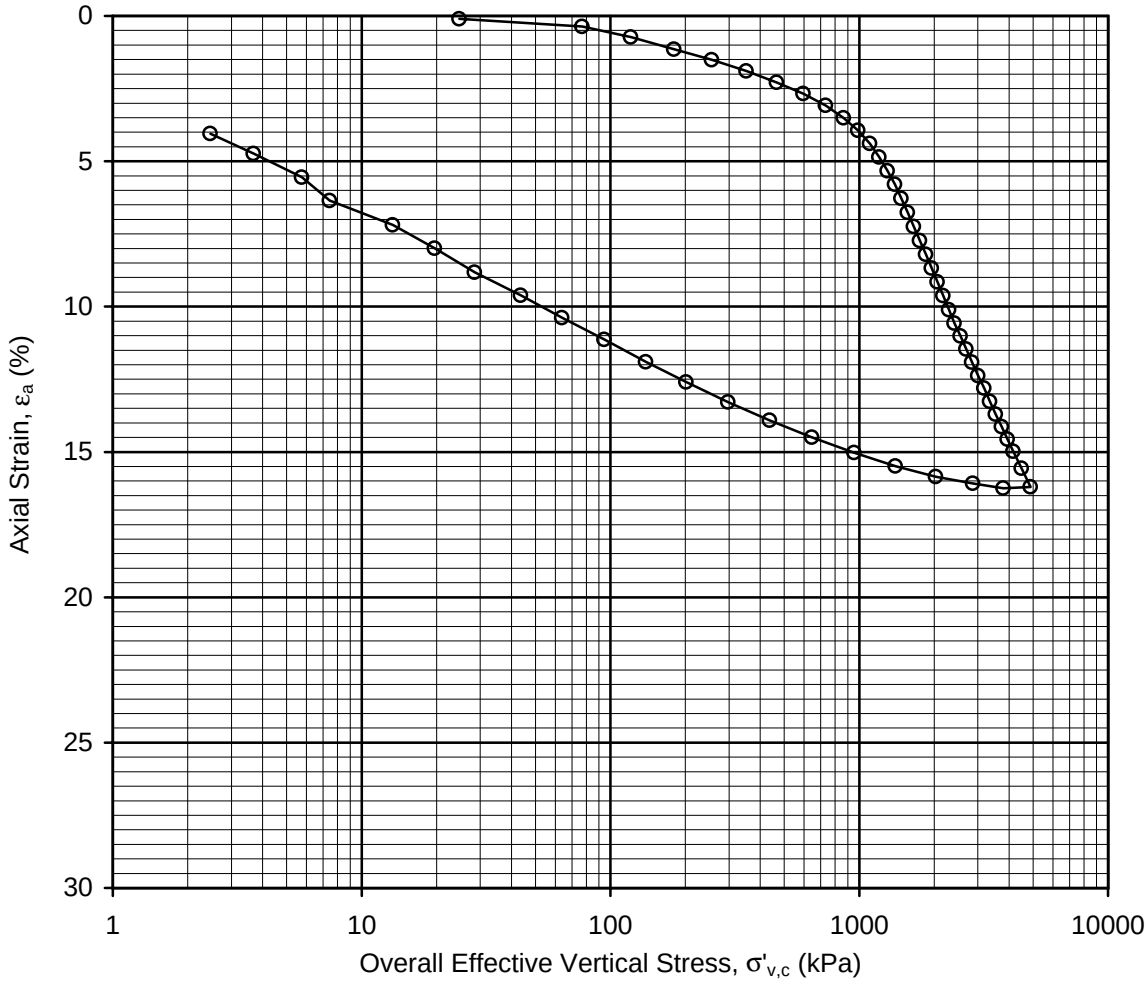


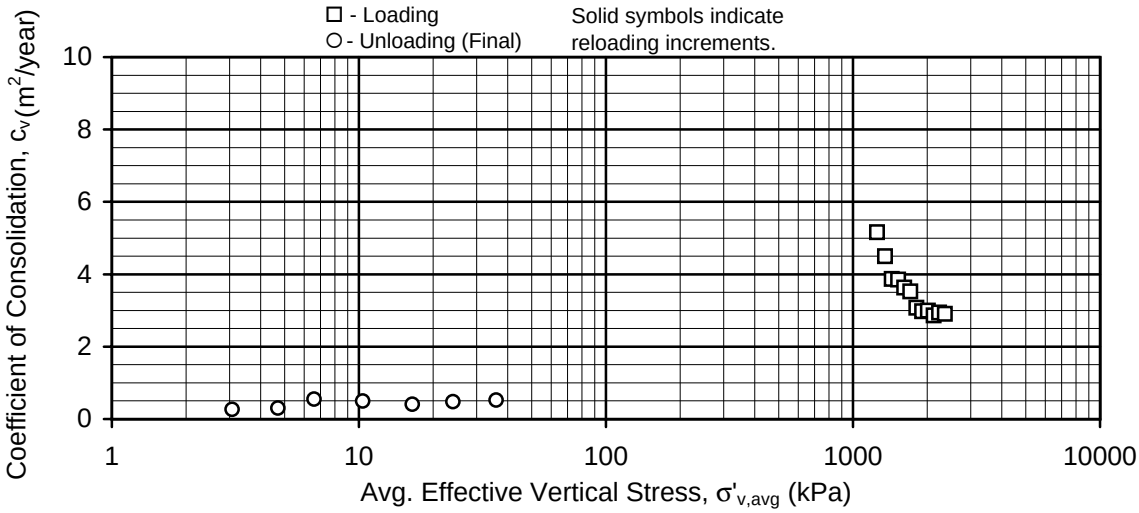


CRS CONSOLIDATION TEST RESULTS

Sample No. 51 - Depth: 52.7m
Boring 98-29
SFOBB East Span Seismic Safety Project

PLATE 98-29.14c

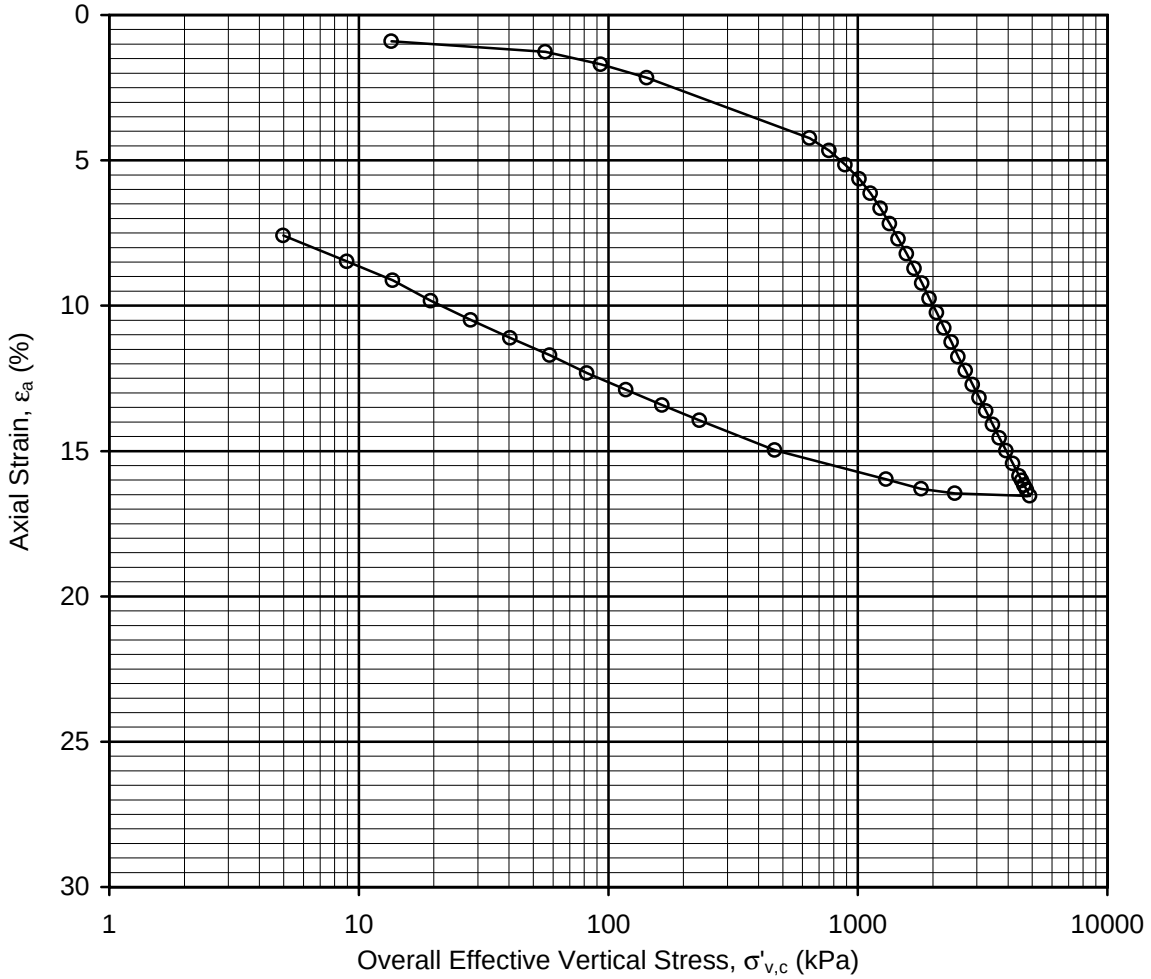


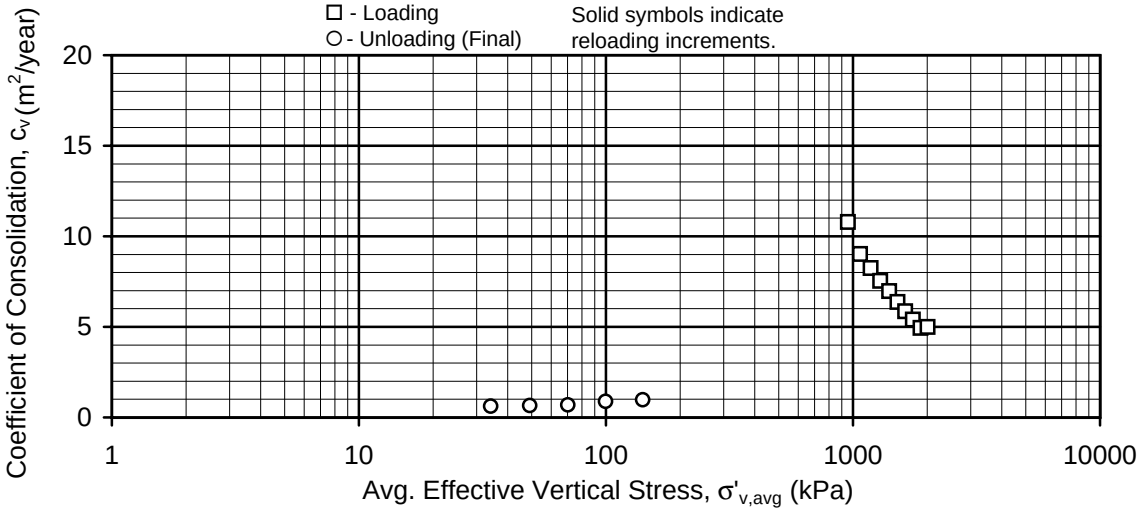


CRS CONSOLIDATION TEST RESULTS

Sample No. 57 - Depth: 71.2m
Boring 98-29
SFOBB East Span Seismic Safety Project

PLATE 98-29.14d

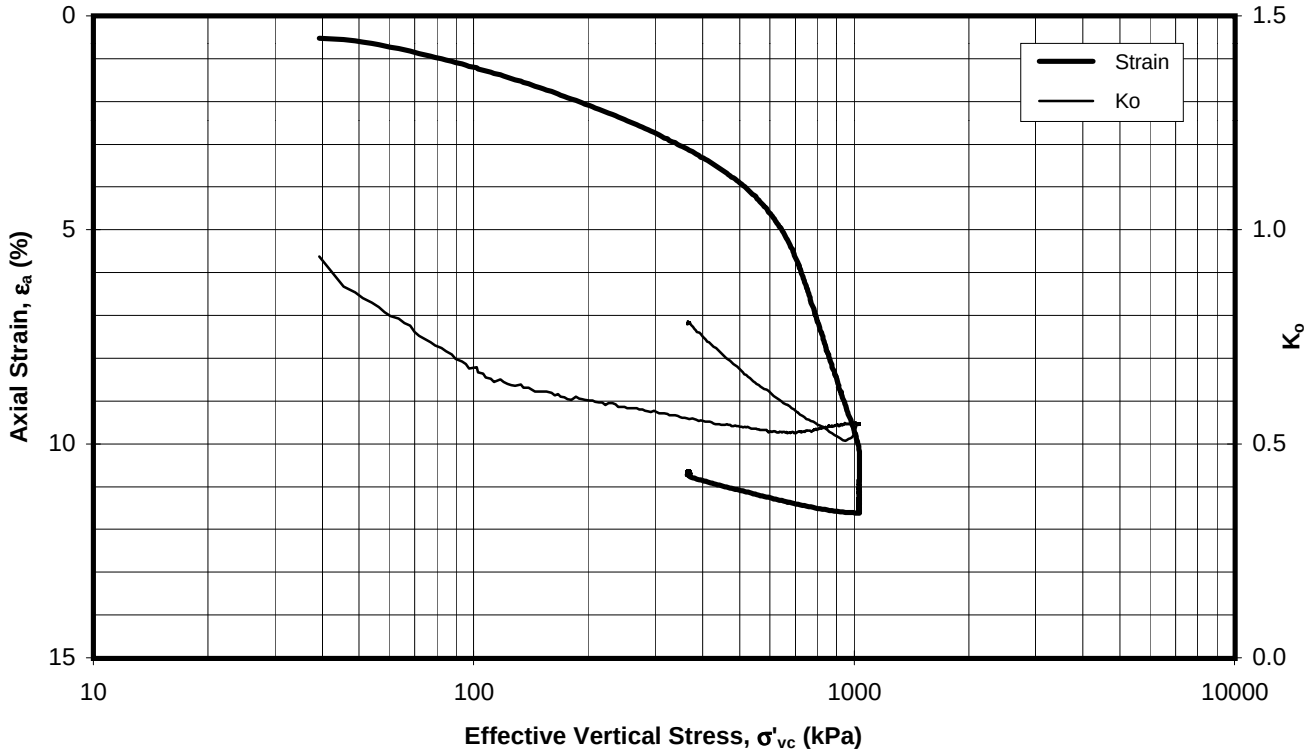


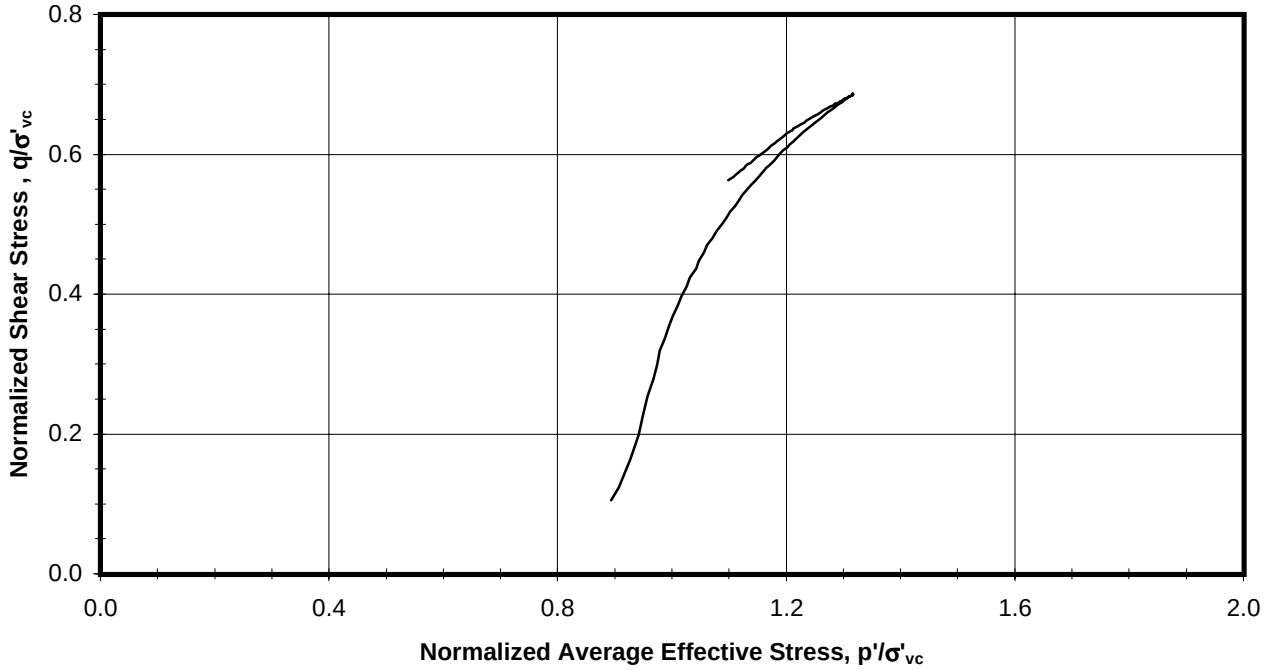


CRS CONSOLIDATION TEST RESULTS

Sample No. 68 - Depth: 82.2m
Boring 98-29
SFOBB East Span Seismic Safety Project

PLATE 98-29.14e





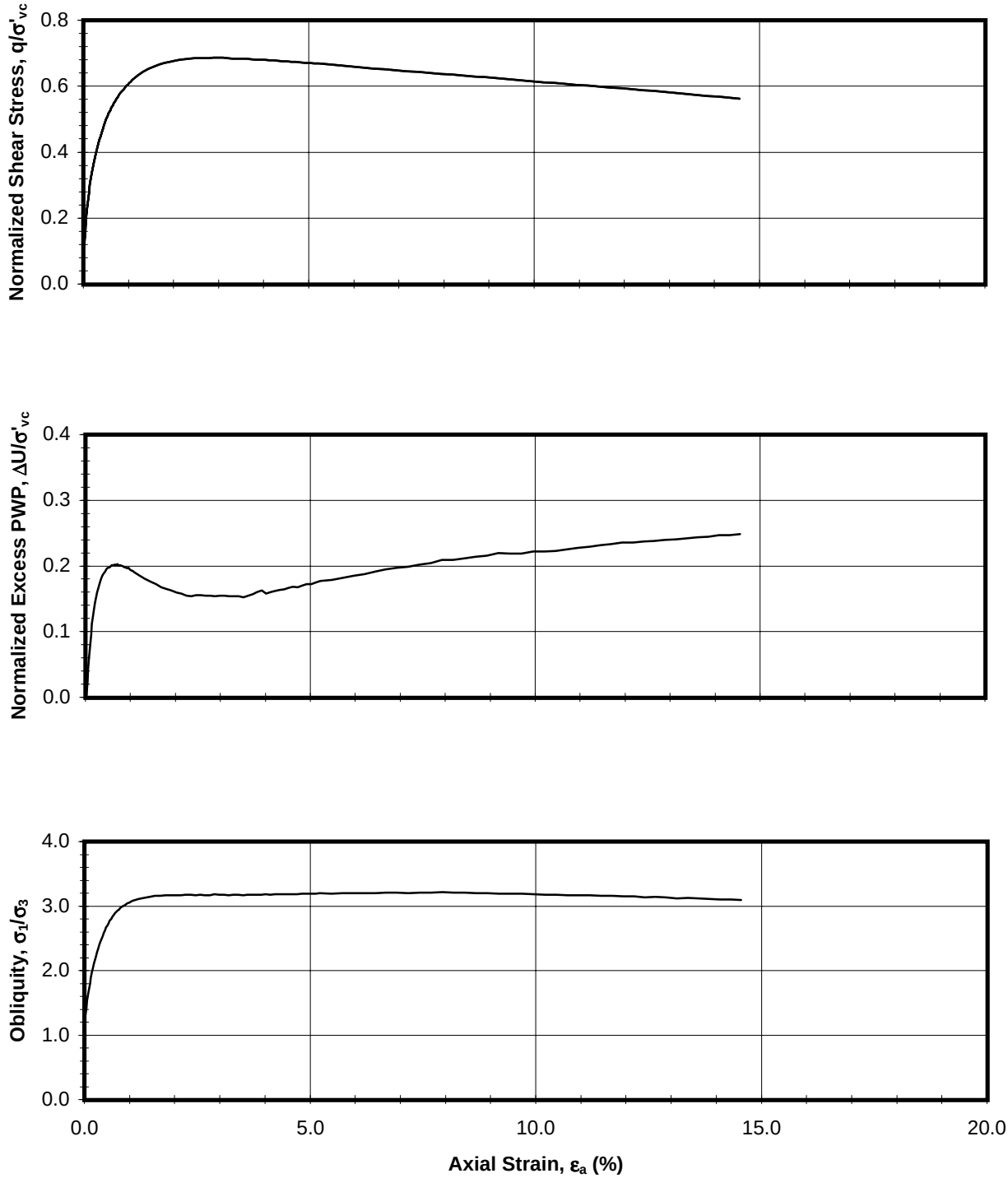
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 40 - Depth: 31.9m

Boring 98-29

SFOBB East Span Seismic Safety Project

PLATE 98-29.15a.1

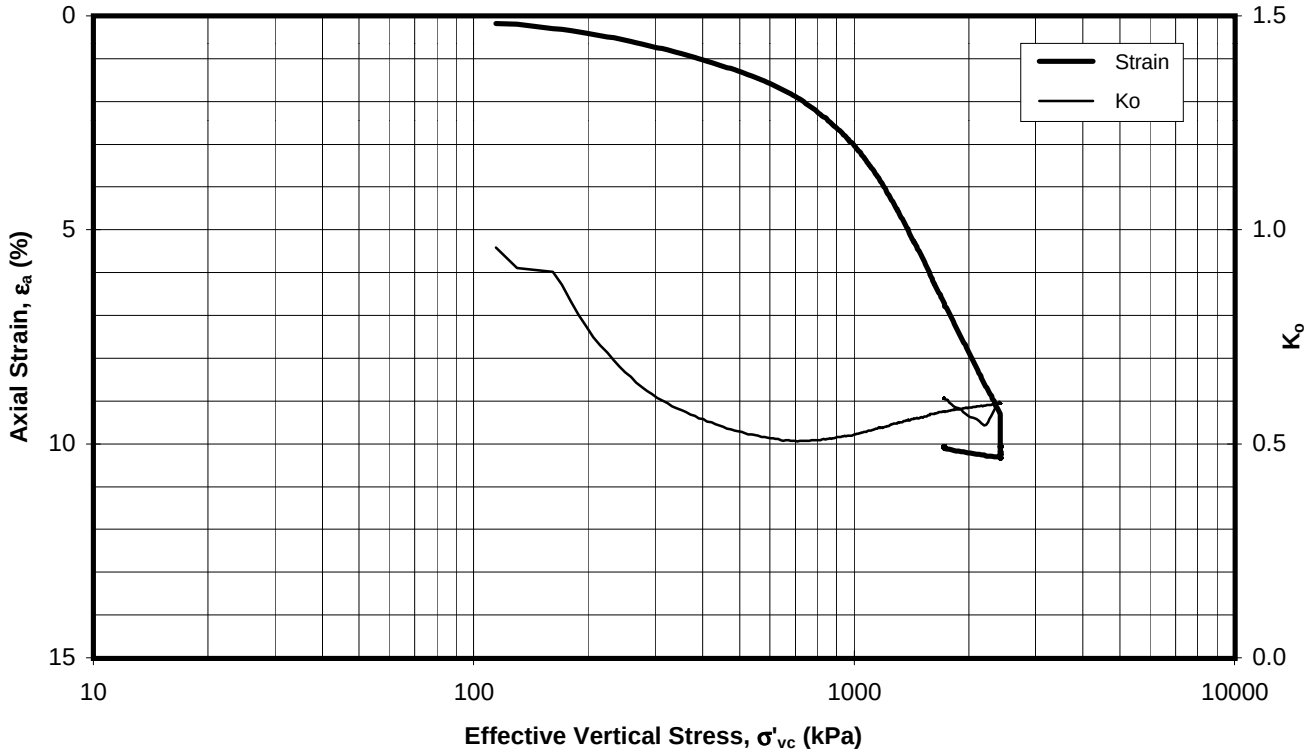


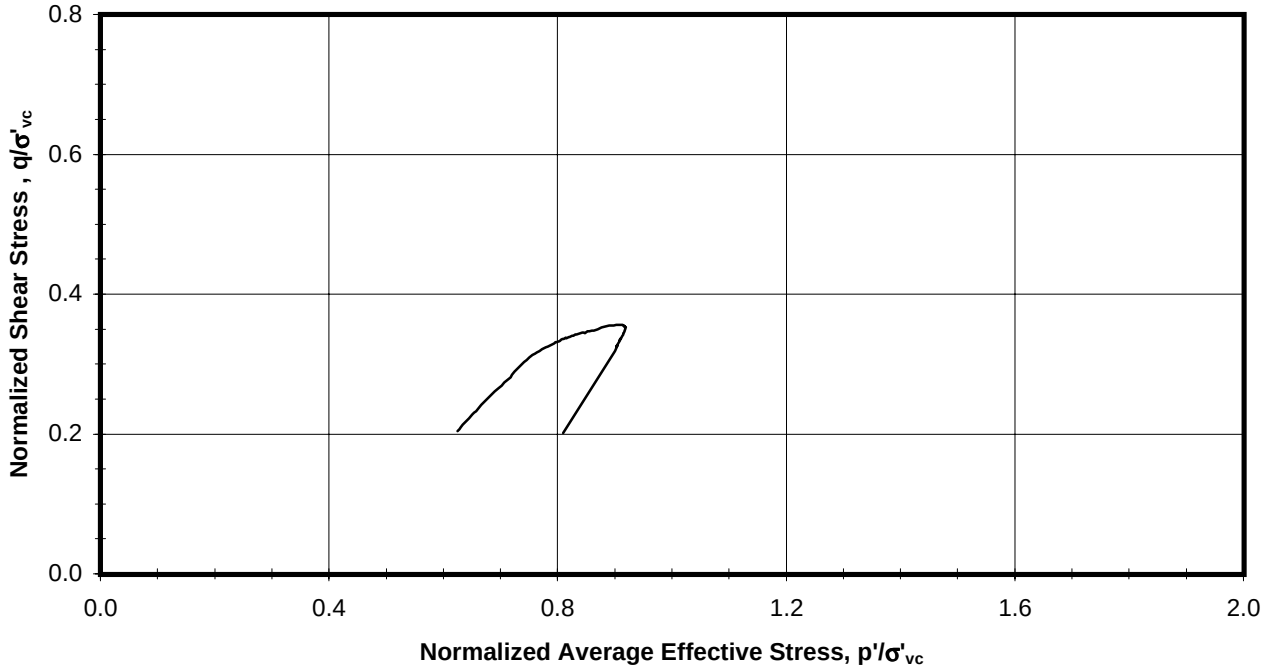
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 40 - Depth: 31.9m

Boring 98-29

SFOBB East Span Seismic Safety Project





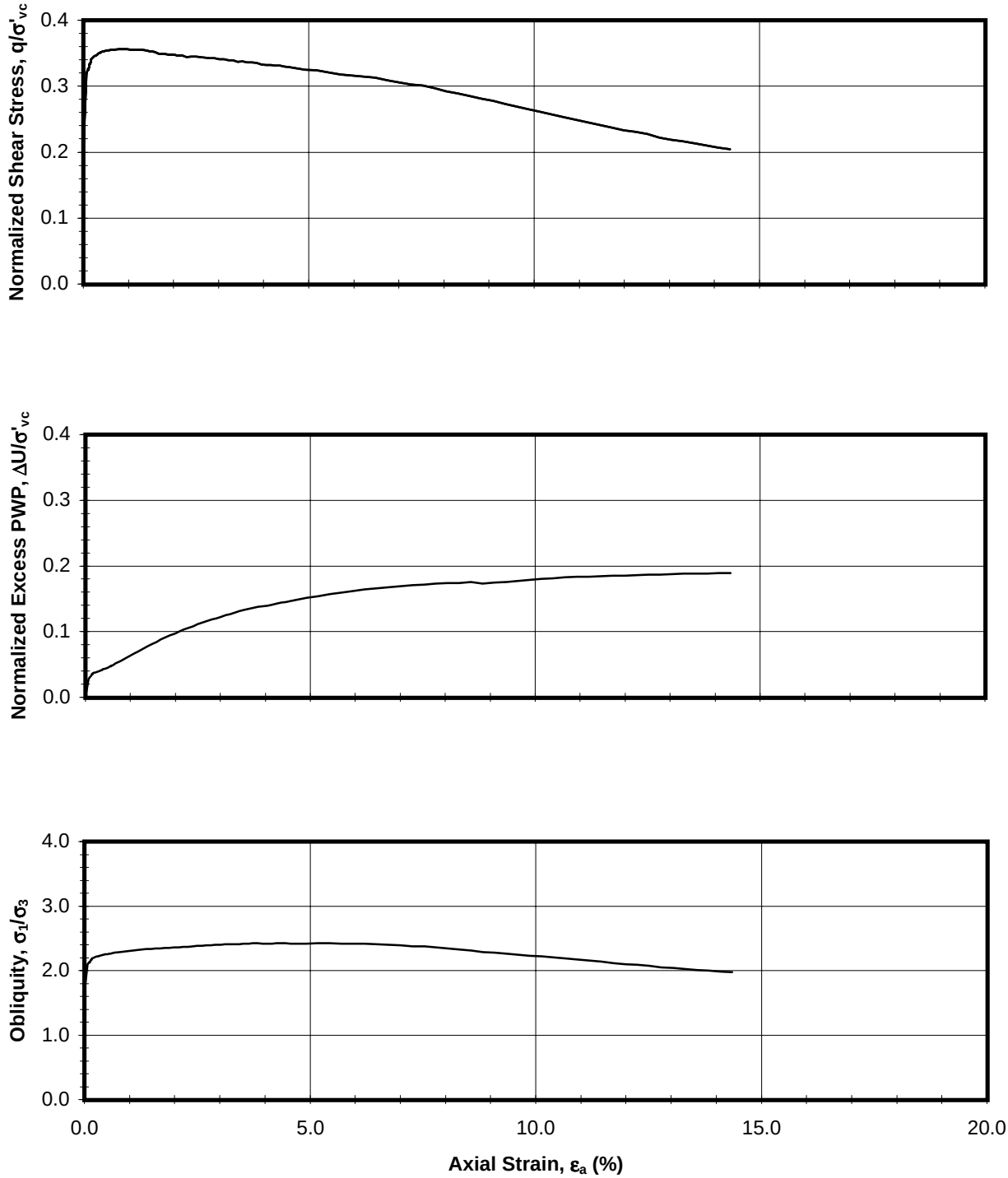
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 68 - Depth: 82.1m

Boring 98-29

SFOBB East Span Seismic Safety Project

PLATE 98-29.15b.1



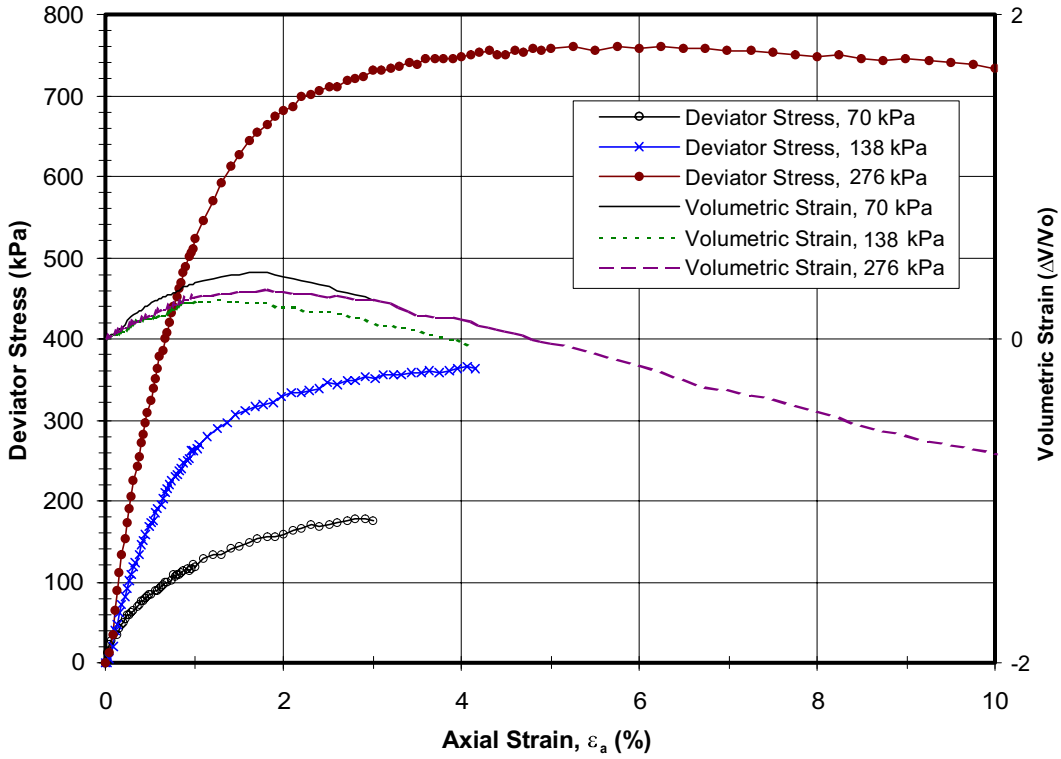
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

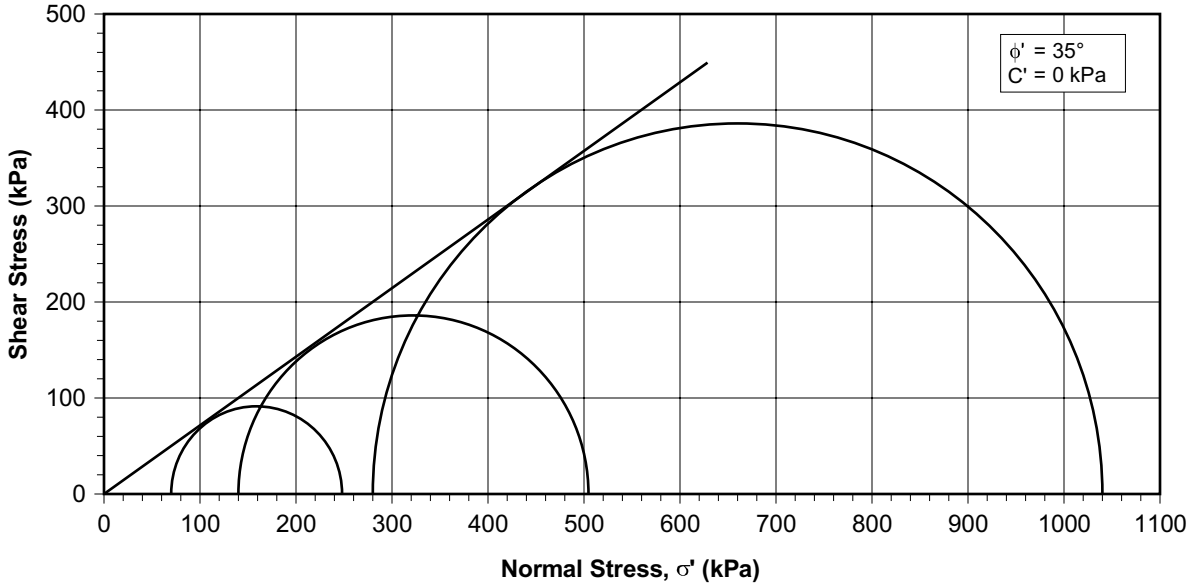
Sample No. 68 - Depth: 82.1m

Boring 98-29

SFOBB East Span Seismic Safety Project

PLATE 98-29.15b.2





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 21 - Depth: 9.5m

Boring 98-29

SFOBB East Span Seismic Safety Project

PLATE 98-29.16

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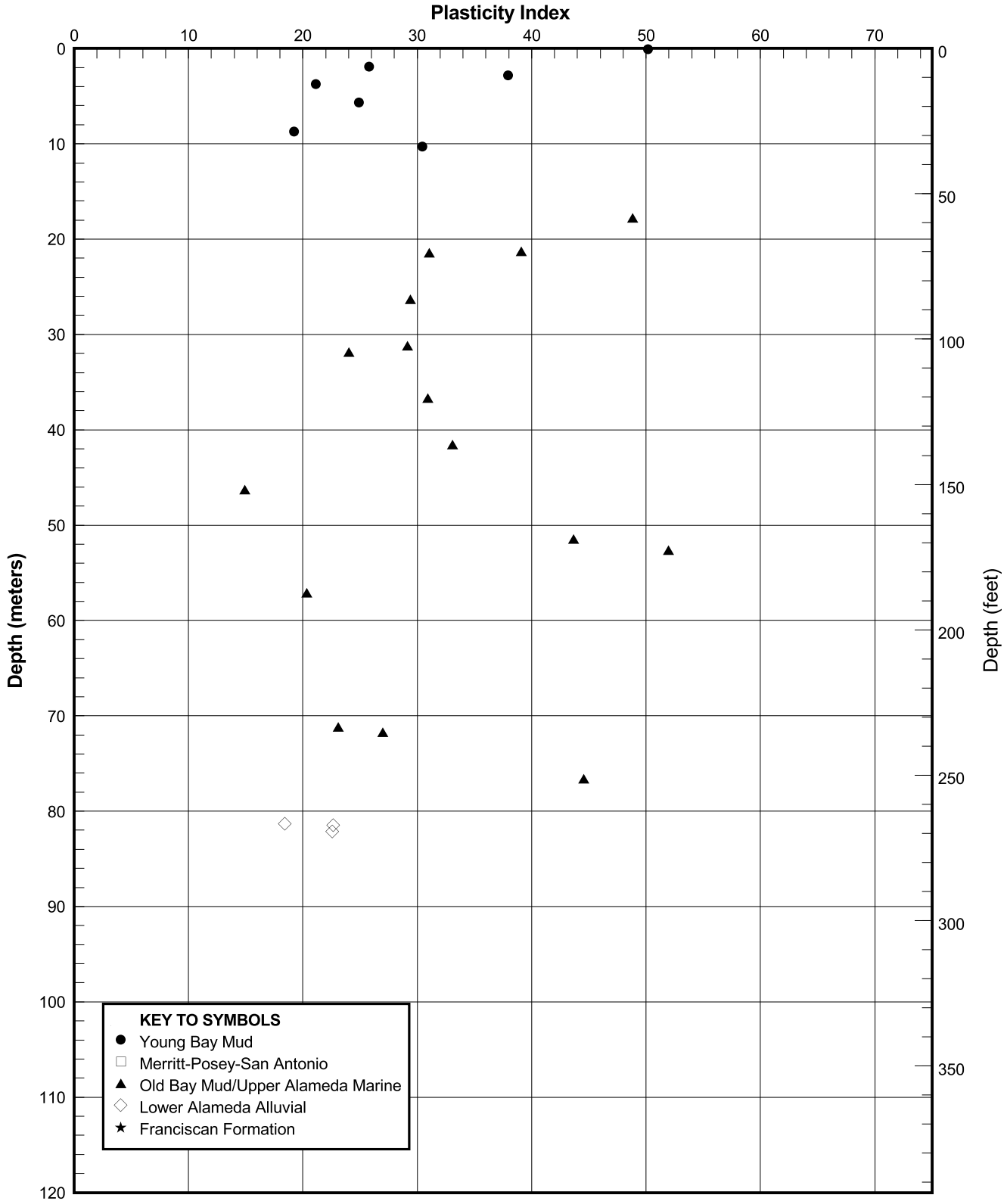
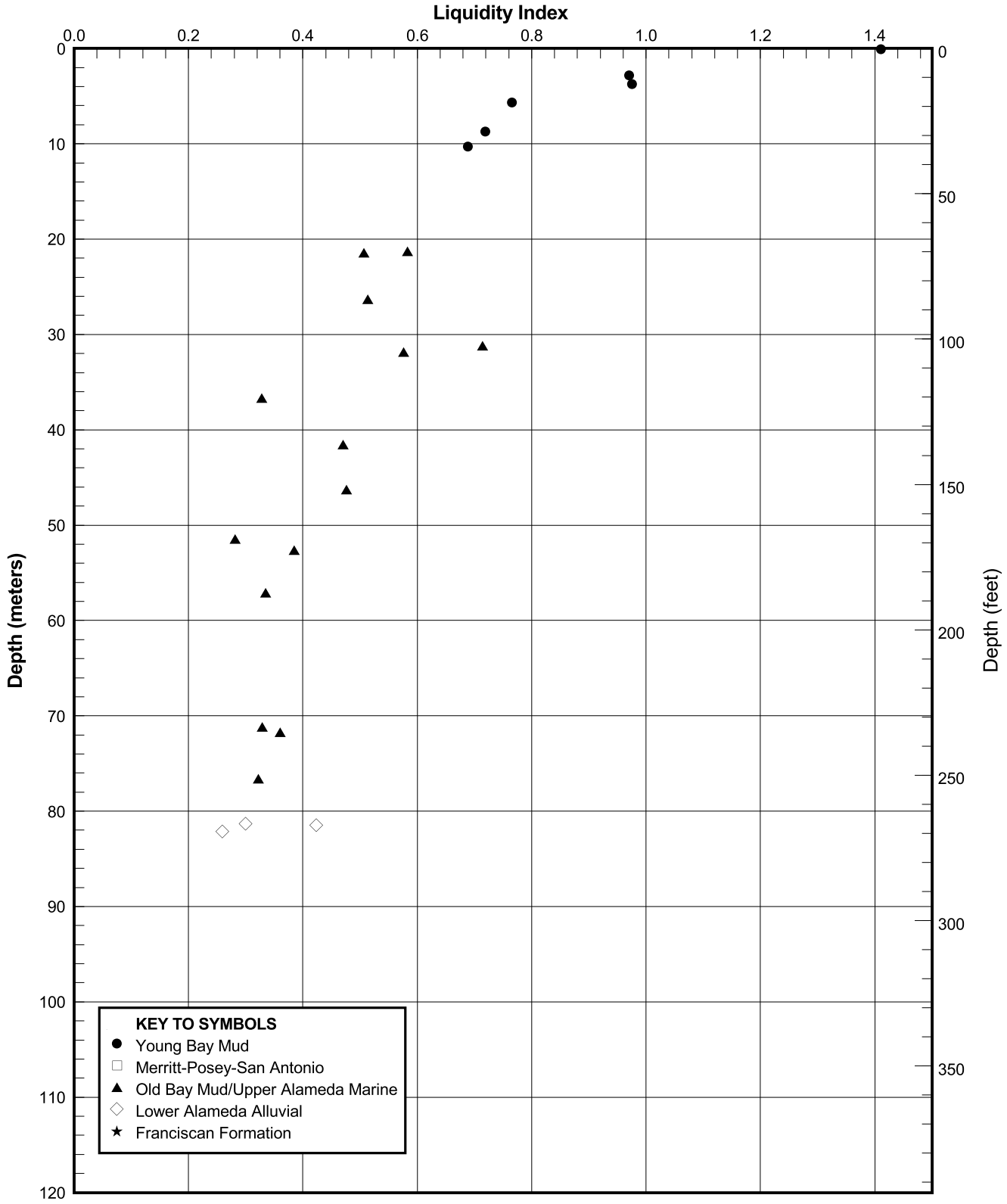


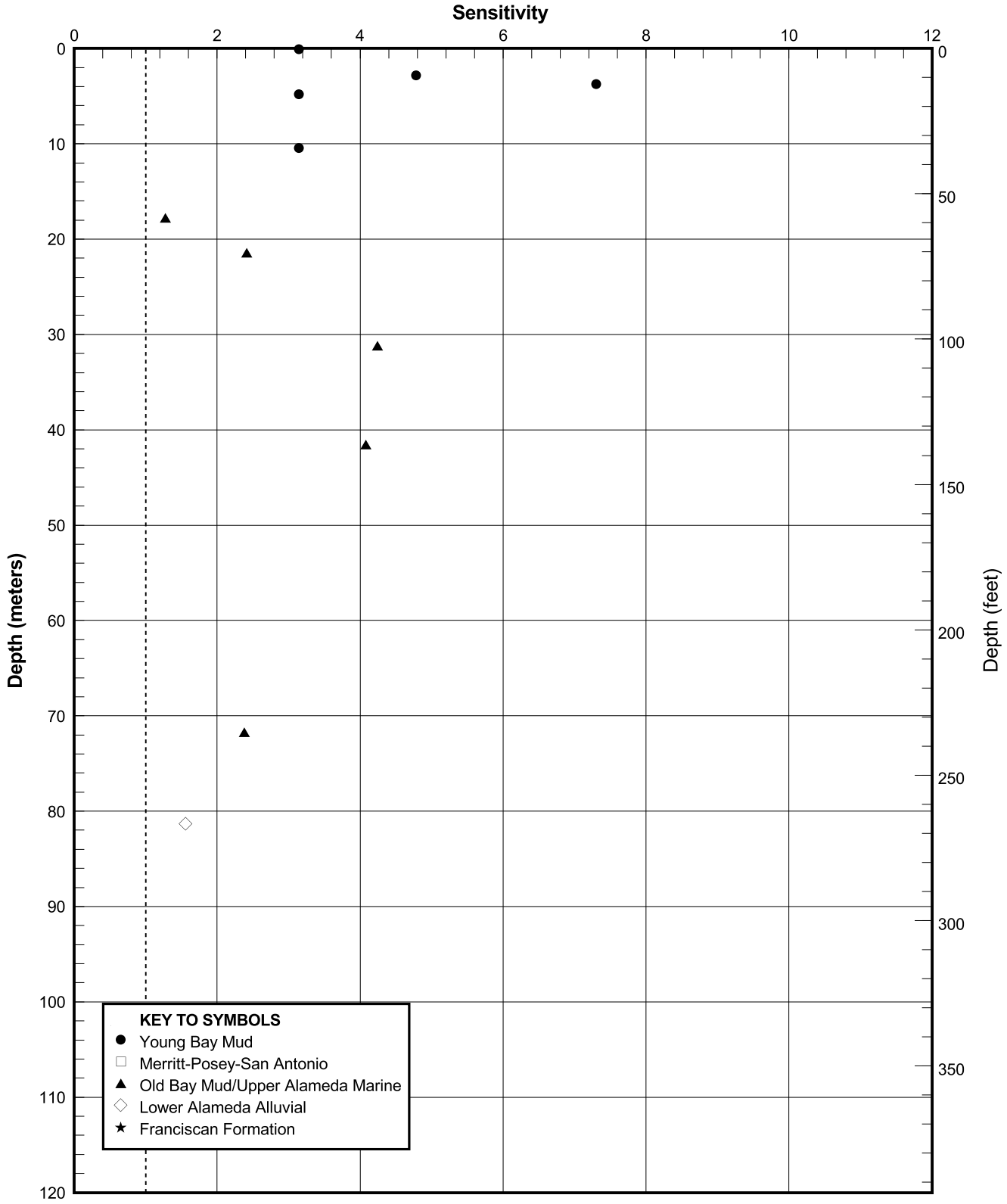
PLASTICITY INDEX PROFILE
Boring 98-29
SFOBB East Span Seismic Safety Project

PLATE 98-29.17



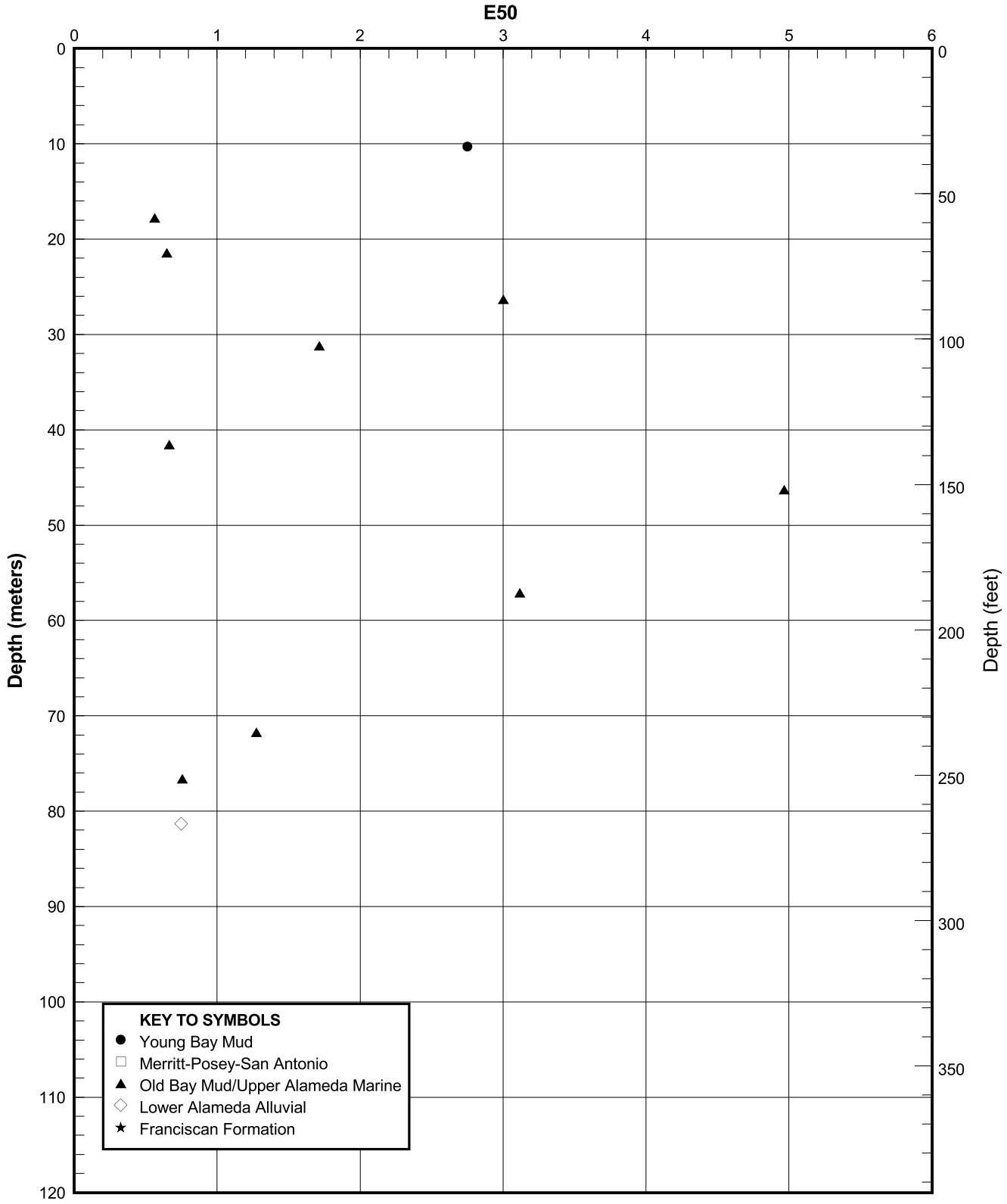
LIQUIDITY INDEX PROFILE
Boring 98-29
SFOBB East Span Seismic Safety Project

PLATE 98-29.18



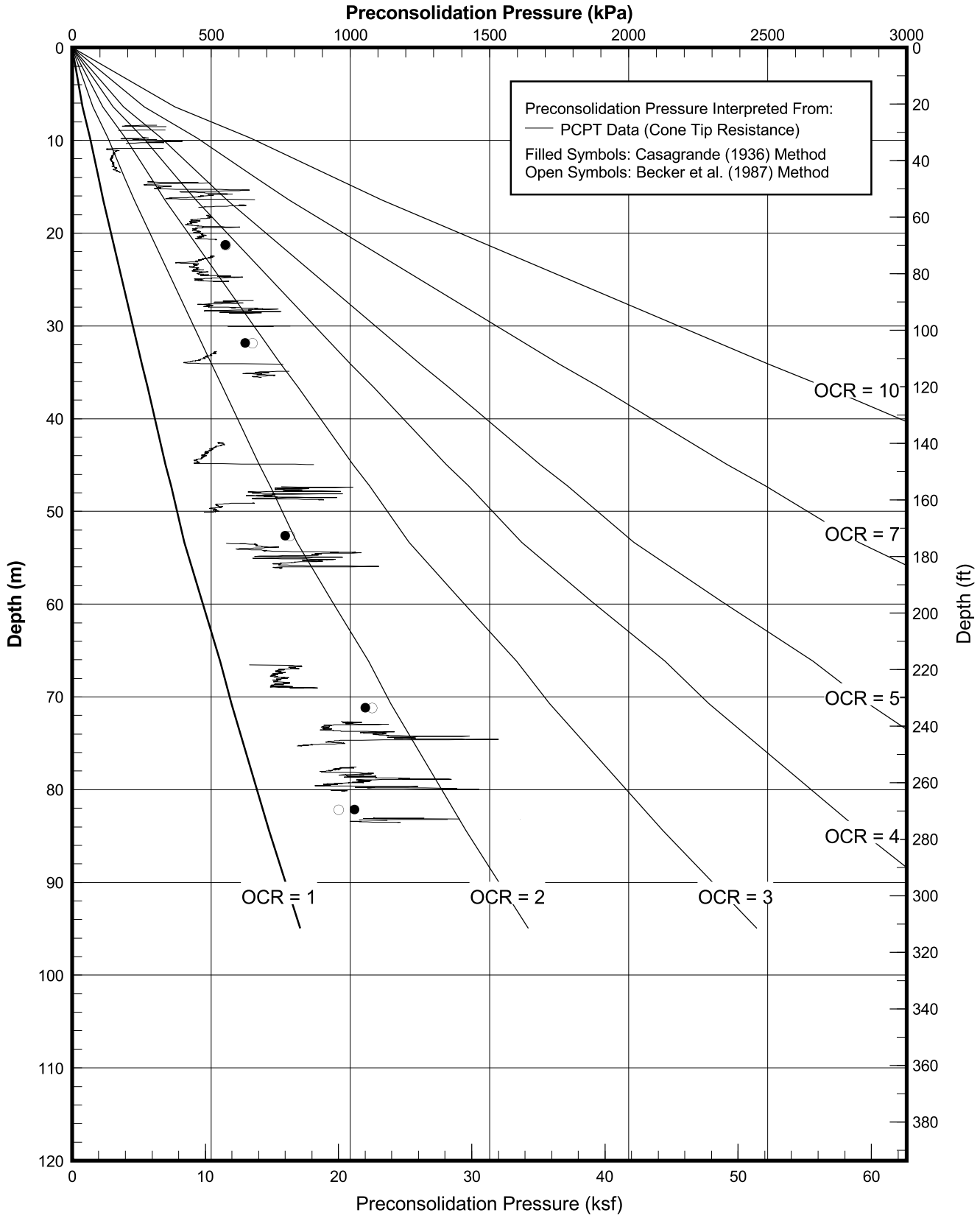
SENSITIVITY PROFILE
Boring 98-29
SFOBB East Span Seismic Safety Project

PLATE 98-29.19



E50 PROFILE
Boring 98-29
SFOBB East Span Seismic Safety Project

PLATE 98-29.20

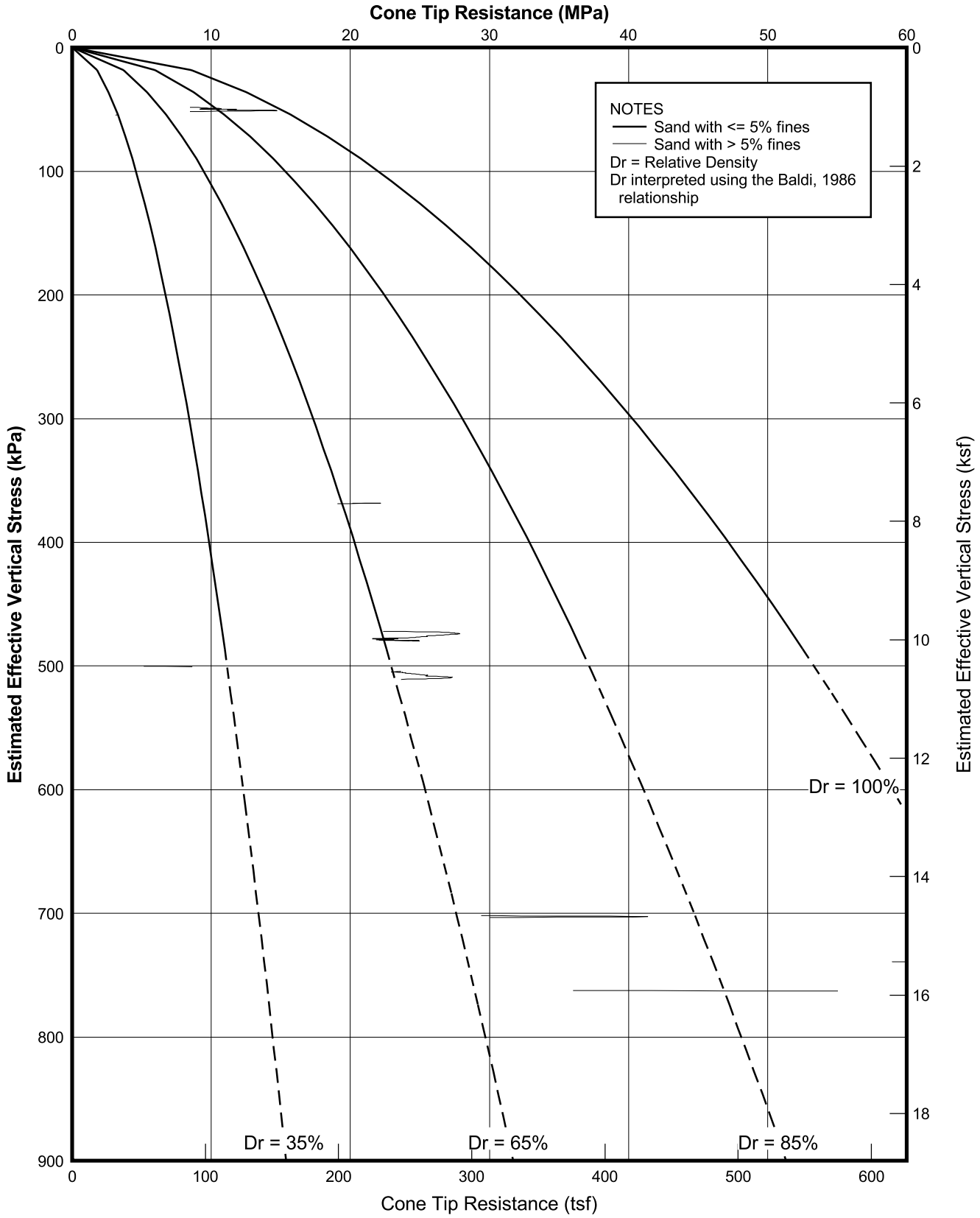


PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-29

SFOBB East Span Seismic Safety Project

PLATE 98-29.21



RELATIVE DENSITY INTERPRETED FROM CPT DATA

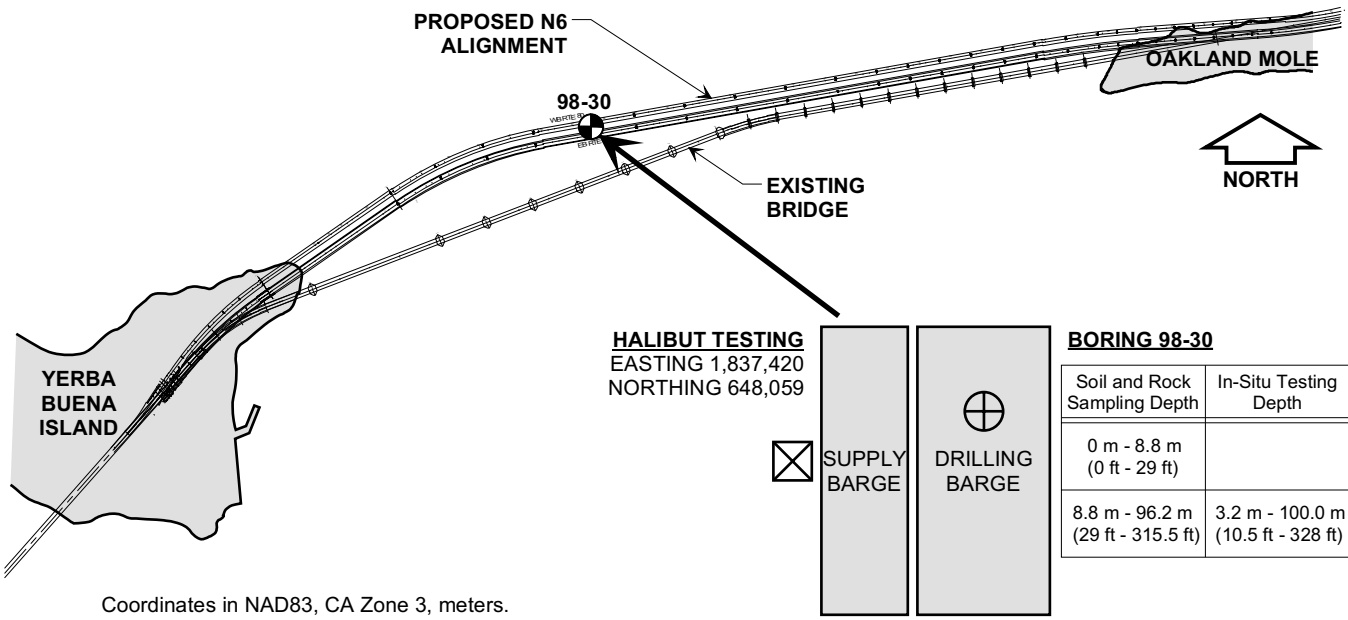
Boring 98-29

SFOBB East Span Seismic Safety Project

BORING 98-30

Date	Time From	Time To	Description of Activity
September 6, 1998	1510	1730	Move barge to location 98-30. Set 4 anchors and 2 spuds.
	1730	2000	Rig up for drilling.
	2000	2040	Lower drill pipe to mudline. Measure water depth of 5.8m (19.0 ft) using bottom sensor. Current tide level is approximately +0.2m (+0.5 ft) MSL. Calculate mudline elevation of –5.6m (-18.5 ft) MSL.
	****	****	
	2145	2400	Rig up Halibut vane equipment. Perform Halibut vane shear testing from 0.6m (2 ft) to 2.4m (8 ft).
	****	****	
	2040	2400	Drill and sample from mudline to 8.8m (29 ft).
September 7, 1998	0000	0330	Pull drill pipe to deck. Reposition barge. Assemble casing.
	0330	0430	Service piston. Lower drill pipe to mudline.
	0430	0530	Rig up for drilling, sampling, and in situ testing.
	0530	0720	Drill from mudline to 3m (10 ft). Perform CPT testing from 3m (10 ft) to 10m (33 ft).
	0720	1000	Pull drill pipe to deck. Set casing.
	1000	1500	Drive stinger to 7.9m (26 ft).
	1500	2400	Drill from mudline to 9m (30 ft). Drill, sample, and CPT testing from 9m (30 ft) to 35m (115 ft).
September 8, 1998	0000	0600	Drill, sample, and CPT testing from 35m (115 ft) to 48.8m (160 ft).
	0600	1615	Drill, sample, and CPT testing from 48.8m (160 ft) to 76.5m (251 ft).
	1615	1710	Rig repair. Perform maintenance on main hoist clutch.
	1710	2400	Drill, sample, and CPT testing from 76.5m (251 ft) to 93.3m (306 ft).
September 9, 1998	0000	0330	Drill, sample, and CPT testing from 93.3m (306 ft) to 100.0m (328 ft).
	0330	0420	Pull drill pipe to deck.
	0420	0730	P- and S- wave velocity logging from 93.5m (306.8 ft) to 8.0m (26.2 ft).
	0730	1120	Lower N-rod. Mix and circulate cement. Grout hole 98-30. Pull N-rod to deck.
	1120	1430	Pull casing to deck.
	1430	1550	Pull 2 spuds, 4 anchors, and move barge to location 98-31.

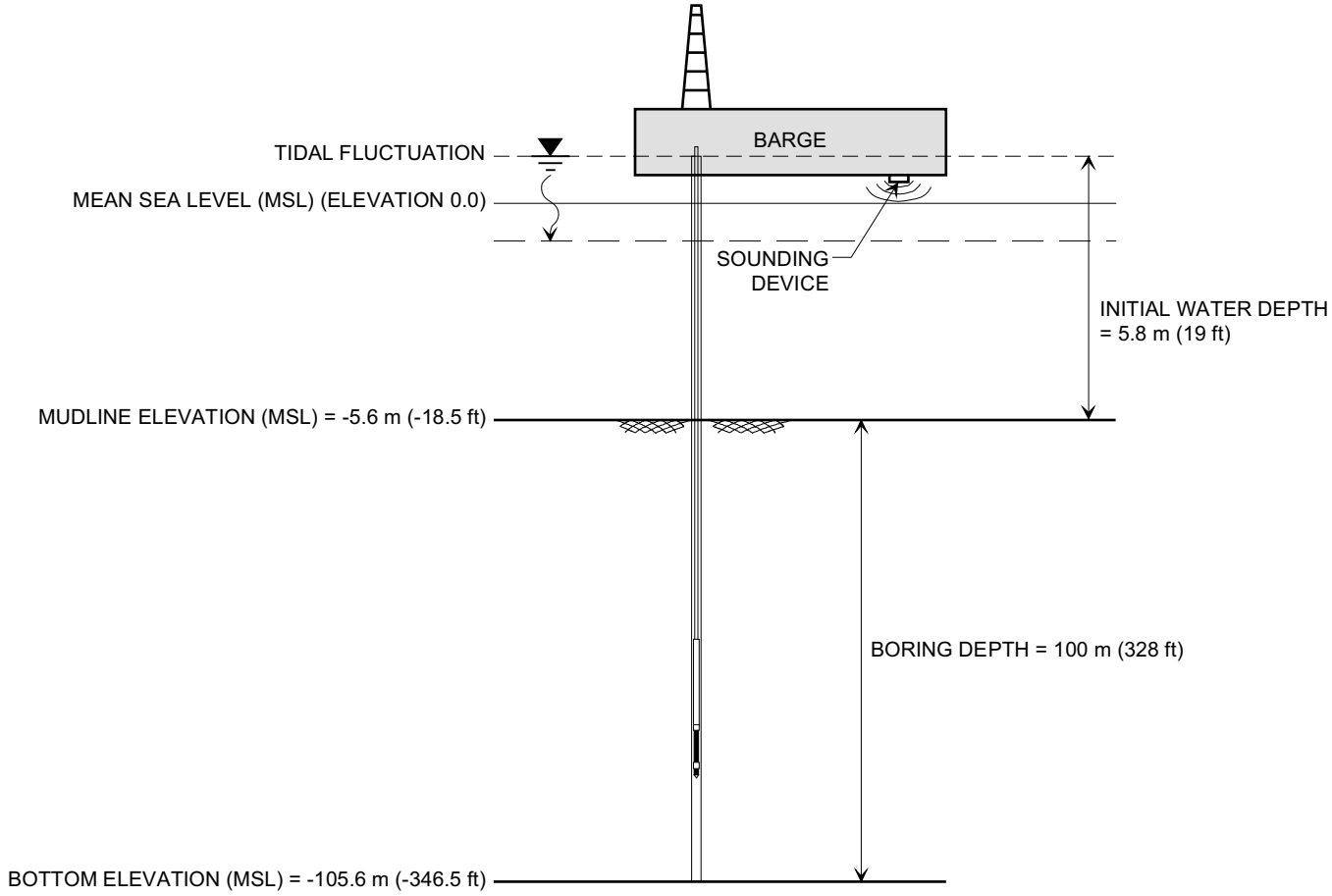
SUMMARY OF FIELD OPERATIONS
Boring 98-30
SFOBB East Span Seismic Safety Project



BORING 98-30

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 8.8 m (0 ft - 29 ft)		E = 1,837,442 N = 648,064
8.8 m - 96.2 m (29 ft - 315.5 ft)	3.2 m - 100.0 m (10.5 ft - 328 ft)	E = 1,837,434 N = 648,060

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-30
SFOBB East Span Seismic Safety Project

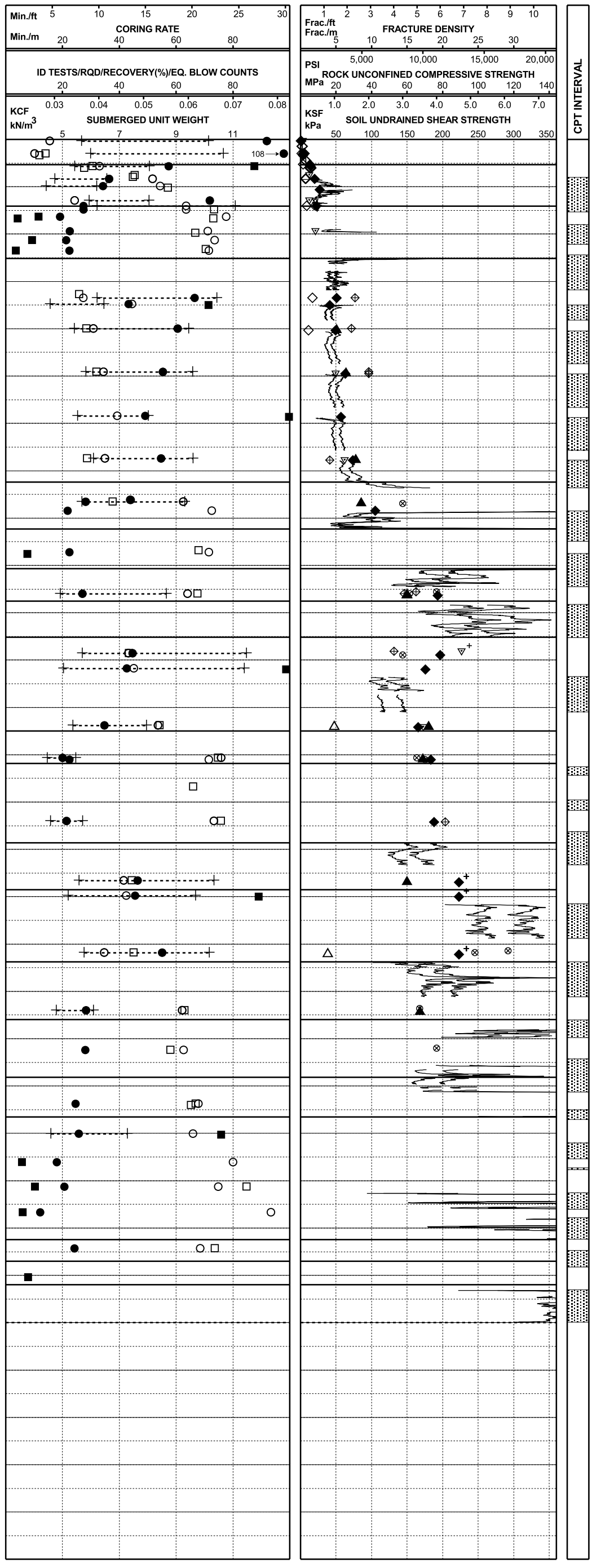
PROJECT NO:	98-42-0054	**START DATE:**	09/06/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-30 (Skyway Frame 2)	**COMPLETION DATE:**	09/09/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837434 N648060
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.6m (MSL)

Stratum No.	Material Description	Depth (m)
I	Fat CLAY (CH), very soft, olive gray	(2.1m)
II	Fat CLAY (CH), soft, olive gray -loose sand layer, 4.1m to 4.3m	(5.6m)
III	Fine SAND (SP), very dense, gray -with a clay layer, at 7.7m	(10.1m)
IV	Fat CLAY (CH), firm to stiff, olive gray -with shell fragments -sand layer, 10.5m to 11.1m See Plate 98-30.6 for detailed stratigraphy	(29.0m)
V	Fat CLAY (CH), stiff to very stiff, greenish gray -desiccated and with organic pockets -organic clay to 30.6m	(32.9m)
VI	Fine SAND with silt (SP-SM), very dense, olive gray -with medium sand -with shell fragments and fine gravel, at 34.7m	(36.3m)
VII	Fat CLAY (CH), very stiff to hard, greenish gray -with calcareous nodules at 38.4m	(39.0m)
VIII	Fat CLAY (CH), hard, greenish gray -with sand partings, and seams, 39.6m to 42.1m	(42.1m)
IX	Fat CLAY (CH), very stiff to hard, greenish gray -with slickensides, at 43.3m -with a silt layer at 46.8m -with a few silt pockets, at 49.4m	(50.0m)
X	Sandy Lean CLAY (CL), very stiff, greenish gray -with silty sand pockets and a few roots, below 51.5m	(52.7m)
XI	Fine SAND (SP), dense to very dense, greenish gray -clay layer, 55.2m to 55.8m -sandy clay layer, 57.0m to 58.2m	(59.4m)
XII	Fat CLAY (CH), hard, greenish gray	(63.4m)
XIII	Fat CLAY (CH), hard, greenish gray -with silt pockets and partings -with sandy silt pockets and partings, at 68.6m	(69.5m)
XIV	Lean CLAY (CL), hard, greenish gray -with a silt seam, at 70.9m -with organic pockets, silt pockets and partings, at 73.5m	(74.4m)
XV	Interlayered Silty Fine SAND (SM), dense, and Fat CLAY (CH), hard, dark greenish gray	(79.2m)
XVI	Lean CLAY (CL), hard, greenish gray -with silt seams, 79.9m to 80.5m -silty sand with clay layers, below 81.4m	(82.6m)
XVII	Fine to Medium SAND (SP-SM) with silt, very dense, gray -greenish gray, lean clay with sand, 83.4m to 84.4m -with a trace of coarse sand, below 86.3m -with gravel below 88.4m -with clay seams and layers, below 89.0m -fine to coarse gravel with silt and sand, at 90.5m	(93.0m)
XVIII	Sandy SILT (ML), hard, brownish yellow	(94.8m)
XIX	Medium SAND (SP-SM) with silt, very dense, dark brown	(96.8m)
XX	Lean CLAY (CL), hard, brown -with silt layers, at 97.5m and 98.1m	

TOTAL DEPTH: 100.0m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-30

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

PLATE 98-30.3

PROJECT NO:	98-42-0054	**START DATE:**	09/06/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-30 (Skyway Frame 2)	**COMPLETION DATE:**	09/09/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

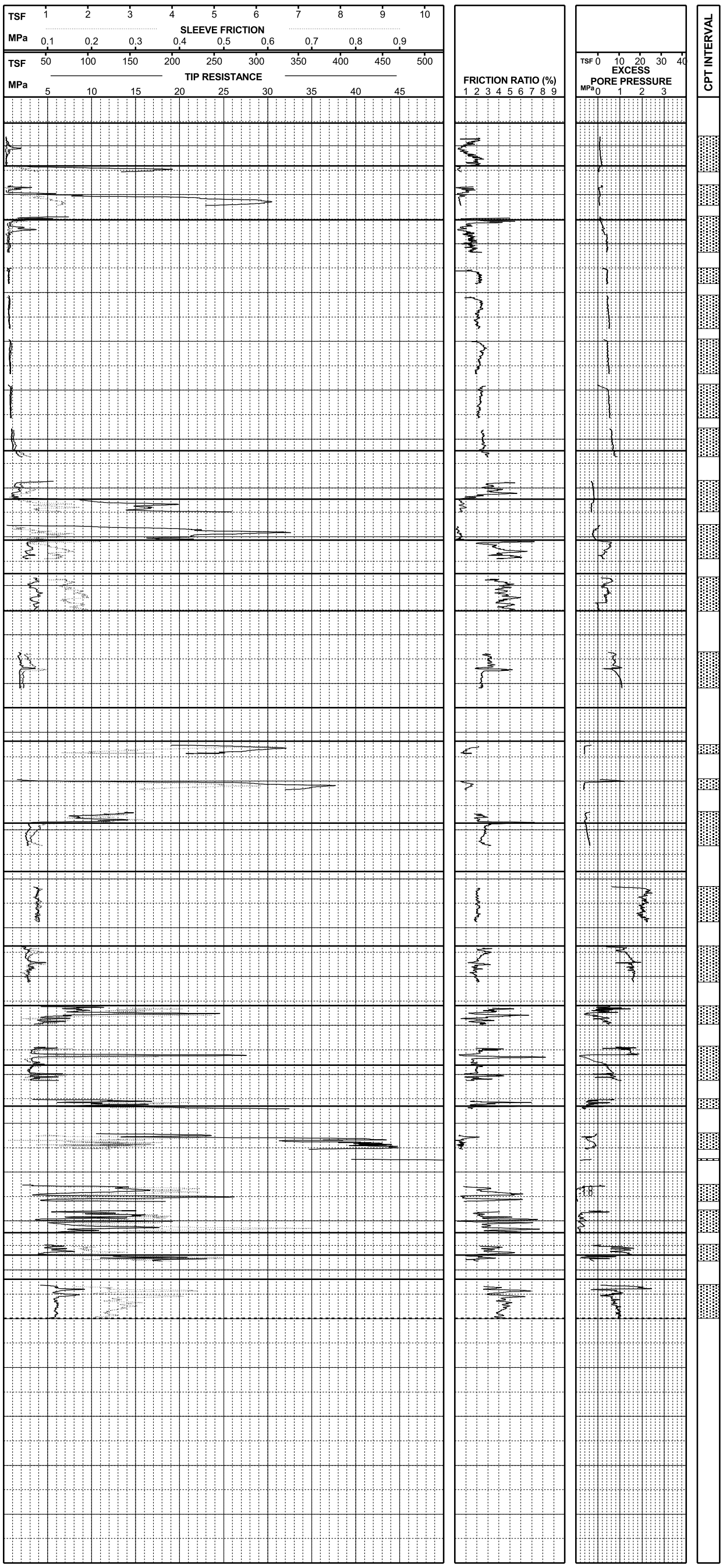
Coordinates: E1837434 N648060
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.6m (MSL)

Stratum No.	Material Description	Blow Count / Sampler
I	Fat CLAY (CH), very soft, olive gray (2.1m)	WOH, WOH, WOH, WOH
II	Fat CLAY (CH), soft, olive gray -loose sand layer, 4.1m to 4.3m (5.6m)	15/60cm, 9/60cm
III	Fine SAND (SP), very dense, gray -with medium sand (10.1m)	30/45cm, 30/30cm, 30/60cm, 30/30cm, 30/25cm
IV	Fat CLAY (CH), firm to stiff, olive gray -with shell fragments -sand layer, 10.5m to 11.1m -with many shells, at 13.1m -with many silt and sand pockets, at 13.7m -with silt pockets and gas blisters, at 15.8m See Plate 98-30.6 for detailed stratigraphy -with gas blisters, at 26.8m (29.0m)	PUSH, SAVE, PUSH, PUSH, SAVE, PUSH
V	Fat CLAY (CH), stiff to very stiff, greenish gray -desiccated and with organic pockets (32.9m)	PUSH, SAVE
VI	Fine SAND with silt (SP-SM), very dense, olive gray -with medium sand (36.3m)	30/60cm
VII	Fat CLAY (CH), very stiff to hard, greenish gray (39.0m)	PUSH
VIII	Fat CLAY (CH), hard, greenish gray -with sand partings, and seams, 39.6m to 42.1m (42.1m)	
IX	Fat CLAY (CH), very stiff to hard, greenish gray -with slickensides, at 43.3m -with a silt layer at 46.8m -with a few silt pockets, at 49.4m (50.0m)	PUSH, SAVE, PUSH
X	Sandy Lean CLAY (CL), very stiff, greenish gray (52.7m)	PUSH
XI	Fine SAND (SP), dense to very dense, greenish gray -clay layer, 55.2m to 55.8m -sandy clay layer, 57.0m to 58.2m (59.4m)	30/15cm, 51/40cm
XII	Fat CLAY (CH), hard, greenish gray (63.4m)	PUSH, SAVE
XIII	Fat CLAY (CH), hard, greenish gray -with silt pockets and partings -with sandy silt pockets and partings, at 68.6m (69.5m)	PUSH
XIV	Lean CLAY (CL), hard, greenish gray -with a silt seam, at 70.9m -with organic pockets, silt pockets and partings, at 73.5m (74.4m)	PUSH
XV	Interlayered Silty Fine SAND (SM), dense, and Fat CLAY (CH), hard, dark greenish gray (79.2m)	PUSH
XVI	Lean CLAY (CL), hard, greenish gray -with silt seams, 79.9m to 80.5m (82.6m)	30/25cm
XVII	Fine to Medium SAND (SP-SM) with silt, very dense, gray -greenish gray, lean clay with sand, 83.4m to 84.4m -with a trace of coarse sand, below 86.3m -with gravel below 88.4m -with clay seams and layers, below 89.0m -fine to coarse gravel with silt and sand, at 90.5m (93.0m)	SAVE, 30/20cm, 30/20cm, 30/15cm
XVIII	Sandy SILT (ML), hard, brownish yellow (94.8m)	PUSH
XIX	Medium SAND (SP-SM) with silt, very dense, dark brown (96.8m)	30/15cm
XX	Lean CLAY (CL), hard, brown -with silt layers, at 97.5m and 98.1m	

TOTAL DEPTH: 100.0m

BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-30

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

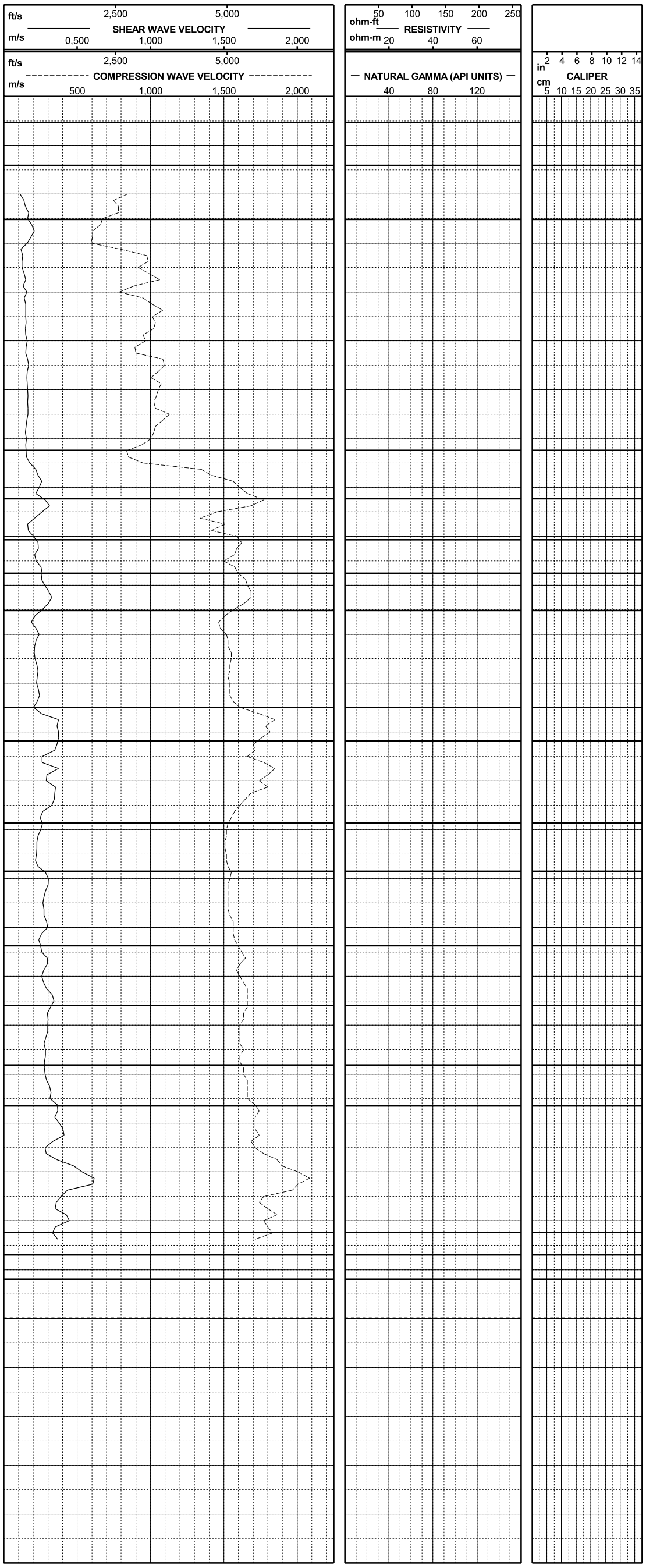
PLATE 98-30.4

PROJECT NO:	98-42-0054	**START DATE:**	09/06/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-30 (Skyway Frame 2)	**COMPLETION DATE:**	09/09/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837434 N648060
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.6m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH, WOH	Fat CLAY (CH), very soft, olive gray (2.1m)	I
-8		WOH, WOH	Fat CLAY (CH), soft, olive gray	II
	4	15/60cm, 9/60cm	-clay with fine sand, 4.3m to 5.0m (5.6m)	
-12		30/45cm, 30/30cm	Fine SAND (SP), very dense, gray	III
	8	30/60cm, 30/30cm, 30/25cm	(10.1m)	
-16			Fat CLAY (CH), firm to stiff, olive gray	IV
	12		-sand layer, 10.5m to 11.1m	
		PUSH	-with many shells, at 13.1m	
-20		SAVE	-with many silt and sand pockets, at 13.7m	
	16	PUSH	-with silt pockets and gas blisters, at 15.8m	
-24			See Plate 98-30.6 for detailed stratigraphy	
	20	PUSH		
-28				
	24	SAVE		
-32				
	28	PUSH	-with gas blisters, at 26.8m (29.0m)	
-36		PUSH, SAVE	Fat CLAY (CH), stiff to very stiff, greenish gray -desiccated and with organic pockets -organic clay to 30.6m (32.9m)	V
	32			
-40		30/60cm	Fine SAND with silt (SP-SM), very dense, olive gray -with medium sand -with shell fragments and fine gravel, at 34.7m (36.3m)	VI
	36			
-44		PUSH	Fat CLAY (CH), very stiff to hard, greenish gray -with calcareous nodules at 38.4m (39.0m)	VII
	40		Fat CLAY (CH), hard, greenish gray -with sand partings, and seams, 39.6m to 42.1m (42.1m)	VIII
-48		PUSH, SAVE	Fat CLAY (CH), very stiff to hard, greenish gray -with slickensides, at 43.3m	IX
	44			
-52			-with a silt layer at 46.8m	
	48	PUSH	-with a few silt pockets, at 49.4m (50.0m)	
-56		PUSH	Sandy Lean CLAY (CL), very stiff, greenish gray -with silty sand pockets and a few roots, below 51.5m (52.7m)	X
	52			
-60		30/15cm	Fine SAND (SP), dense to very dense, greenish gray -clay layer, 55.2m to 55.8m	XI
	56			
-64		51/40cm	-sandy clay layer, 57.0m to 58.2m (59.4m)	
	60		Fat CLAY (CH), hard, greenish gray (63.4m)	XII
-68		PUSH, SAVE		
	64		Fat CLAY (CH), hard, greenish gray -with silt pockets and partings	XIII
-72				
	68	PUSH	-with sandy silt pockets and partings, at 68.6m (69.5m)	
-76			Lean CLAY (CL), hard, greenish gray	XIV
	72	PUSH	(74.4m)	
-80			Interlayered Silty Fine SAND (SM), dense, and Fat CLAY (CH), hard, dark greenish gray	XV
	76	PUSH	(79.2m)	
-84			Lean CLAY (CL), hard, greenish gray -with silt seams, 79.9m to 80.5m -silty sand with clay layers, below 81.4m (82.6m)	XVI
	80	30/25cm		
-88			Fine to Medium SAND (SP-SM) with silt, very dense, gray -greenish gray, lean clay with sand, 83.4m to 84.4m -with a trace of coarse sand, below 86.3m	XVII
	84	SAVE		
-92		30/20cm		
	88	30/20cm	-with gravel below 88.4m -with clay seams and layers, below 89.0m	
-96		30/15cm	-fine to coarse gravel with silt and sand, at 90.5m (93.0m)	
	92			
-100		PUSH	Sandy SILT (ML), hard, brownish yellow (94.8m)	XVIII
	96	30/15cm	Medium SAND (SP-SM) with silt, very dense, dark brown (96.8m)	XIX
-104			Lean CLAY (CL), hard, brown -with silt layers, at 97.5m and 98.1m	XX
	100		TOTAL DEPTH: 100.0m	
-108			BACKFILLED WITH: Cement Grout	
	104			
-112				
	108			
-116				
	112			
-120				
	116			
-124				



LOG OF BORING AND TEST RESULTS

BORING 98-30

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

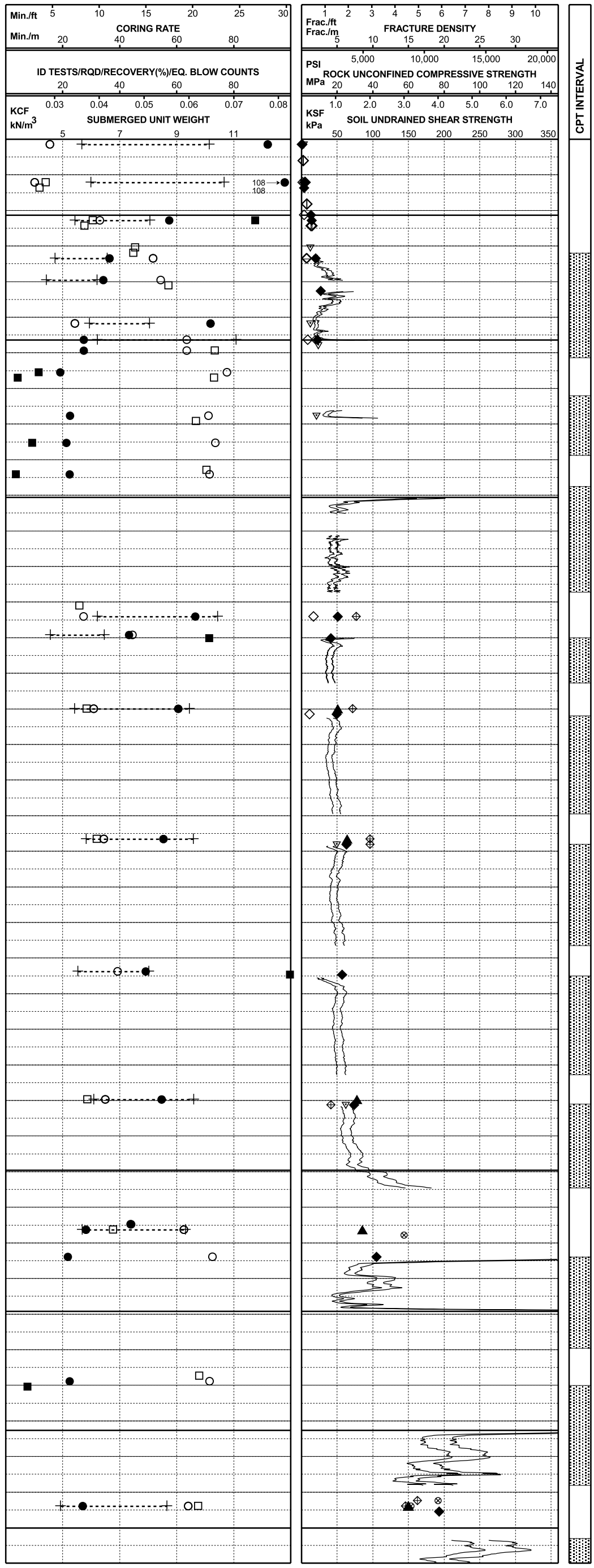
PLATE 98-30.5

PROJECT NO:	98-42-0054	**START DATE:**	09/06/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-30 (Skyway Frame 2)	**COMPLETION DATE:**	09/09/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837434 N648060
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.6m (MSL)

Stratum No.	Material Description	Blow Count / Sampler
I	Fat CLAY (CH), very soft, olive gray -with root fibers, at 0.6m -with a few silt pockets and light brown streaks, at 1.2m -with many shells and shell fragments, below 1.5m (2.1m)	WOH, WOH, WOH
II	Fat CLAY (CH), soft, olive gray -with silt pockets and partings, at 2.1m -with many large sand pockets and sand partings, below 2.7m -loose sand layer, 4.1m to 4.3m -clay with fine sand, 4.3m to 5.0m (5.6m)	WOH, 15/60cm, 9/60cm
III	Fine SAND (SP), very dense, gray -with medium sand -with shell fragments, 5.9m to 6.7m -with clay pockets and seams, 7.3m to 7.8m -with a clay layer, at 7.7m -with silt and shells, at 8.5m (10.1m)	30/45cm, 30/30cm, 30/60cm, 30/30cm, 30/25cm
IV	Fat CLAY (CH), firm to stiff, olive gray -with shell fragments -sand layer, 10.5m to 11.1m -with many shells, at 13.1m -with many silt and sand pockets, at 13.7m -with silt pockets and gas blisters, at 15.8m -with gas blisters, at 26.8m (29.0m)	PUSH, SAVE, PUSH, PUSH, SAVE, PUSH
V	Fat CLAY (CL), stiff to very stiff, greenish gray -desiccated and with organic pockets -organic clay, to 30.6m (32.9m)	PUSH, SAVE
VI	Fine SAND with silt (SP-SM), very dense, olive gray -with medium sand -with shell fragments and fine gravel, at 34.7m (36.3m)	30/60cm
VII	Fat CLAY (CH), very stiff to hard, greenish gray -with calcareous nodules at 38.4m (39.0m)	PUSH
VIII	Fat CLAY (CH), hard, greenish gray -with sand partings, and seams, 39.6m to 42.1m	



LOG OF BORING AND TEST RESULTS

BORING 98-30

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

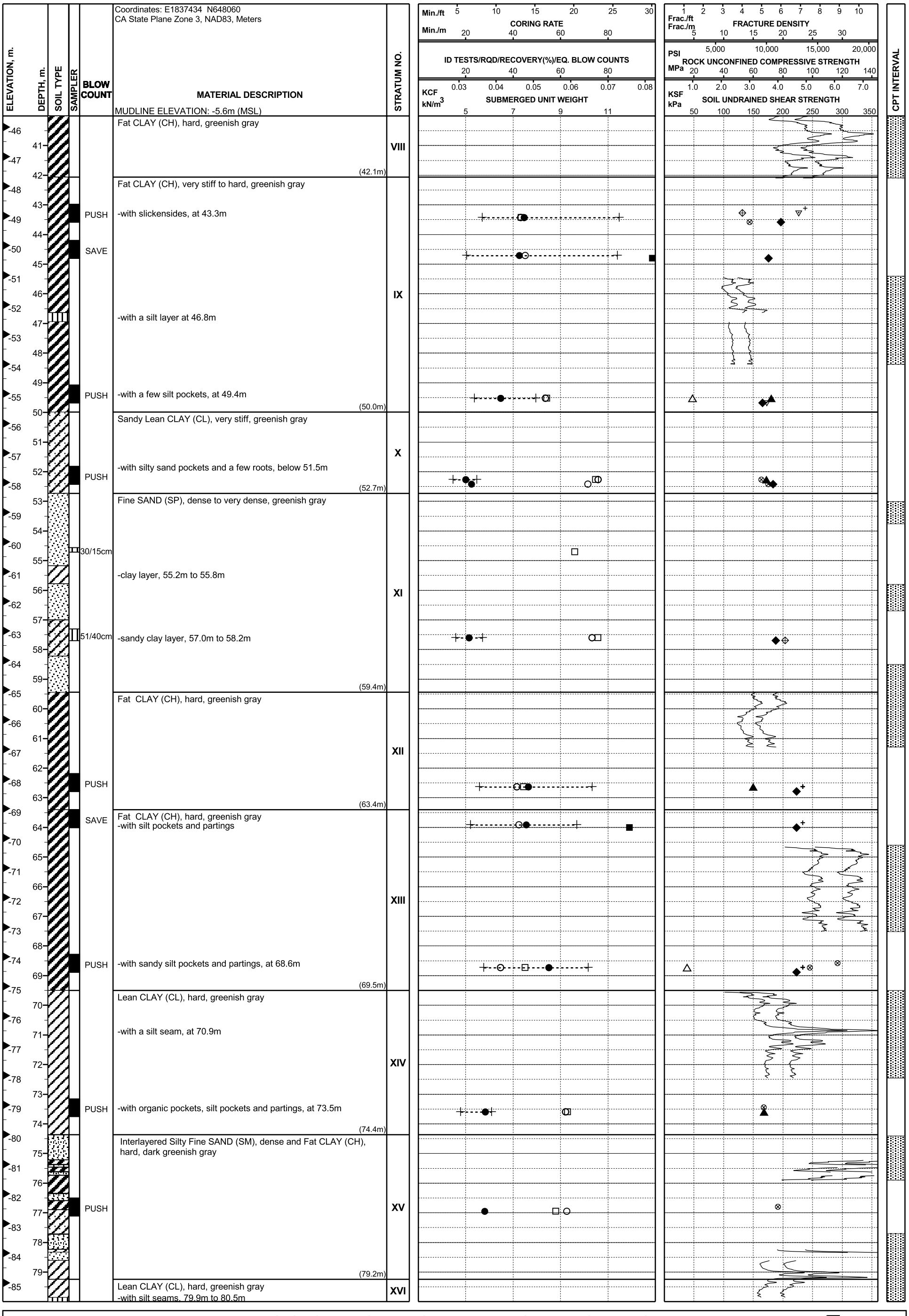
PLATE 98-30.6a

PROJECT NO:	98-42-0054	**START DATE:**	09/06/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-30 (Skyway Frame 2)	**COMPLETION DATE:**	09/09/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837434 N648060
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.6m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Fat CLAY (CH), hard, greenish gray (42.1m)	VIII
Fat CLAY (CH), very stiff to hard, greenish gray -with slickensides, at 43.3m -with a silt layer at 46.8m -with a few silt pockets, at 49.4m (50.0m)	IX
Sandy Lean CLAY (CL), very stiff, greenish gray -with silty sand pockets and a few roots, below 51.5m (52.7m)	X
Fine SAND (SP), dense to very dense, greenish gray -clay layer, 55.2m to 55.8m -sandy clay layer, 57.0m to 58.2m (59.4m)	XI
Fat CLAY (CH), hard, greenish gray (63.4m)	XII
Fat CLAY (CH), hard, greenish gray -with silt pockets and partings -with sandy silt pockets and partings, at 68.6m (69.5m)	XIII
Lean CLAY (CL), hard, greenish gray -with a silt seam, at 70.9m -with organic pockets, silt pockets and partings, at 73.5m (74.4m)	XIV
Interlayered Silty Fine SAND (SM), dense and Fat CLAY (CH), hard, dark greenish gray (79.2m)	XV
Lean CLAY (CL), hard, greenish gray -with silt seams, 79.9m to 80.5m	XVI



LOG OF BORING AND TEST RESULTS

BORING 98-30

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

PLATE 98-30.6b

PROJECT NO:	98-42-0054	**START DATE:**	09/06/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-30 (Skyway Frame 2)	**COMPLETION DATE:**	09/09/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

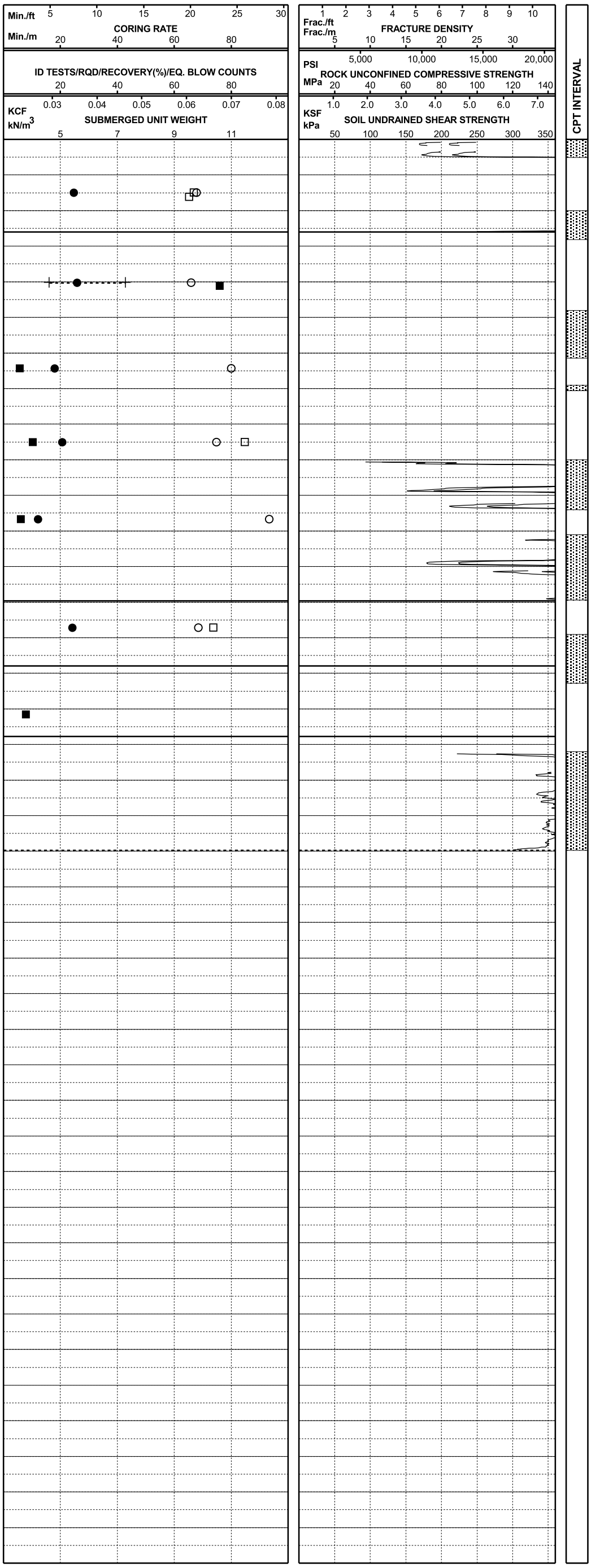
Coordinates: E1837434 N648060
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.6m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Lean CLAY (CL), hard, greenish gray -silty sand with clay layers, below 81.4m (82.6m)	XVI
Fine to Medium SAND (SP-SM) with silt, very dense, gray -greenish gray, lean clay with sand, 83.4m to 84.4m -with a trace of coarse sand, below 86.3m -with gravel below 88.4m -with clay seams and layers, below 89.0m -fine to coarse gravel with silt and sand, at 90.5m (93.0m)	XVII
Sandy SILT (ML), hard, brownish yellow -with clay pockets and seams (94.8m)	XVIII
Medium SAND (SP-SM) with silt, very dense, dark brown -with clay seams (96.8m)	XIX
Lean CLAY (CL), hard, brown -with silt layers, at 97.5m and 98.1m	XX

TOTAL DEPTH: 100.0m BACKFILLED WITH: Cement Grout

SAMPLER: 30/25cm; SAVE; 30/20cm; 30/20cm; 30/15cm; PUSH; 30/15cm



LOG OF BORING AND TEST RESULTS

BORING 98-30

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

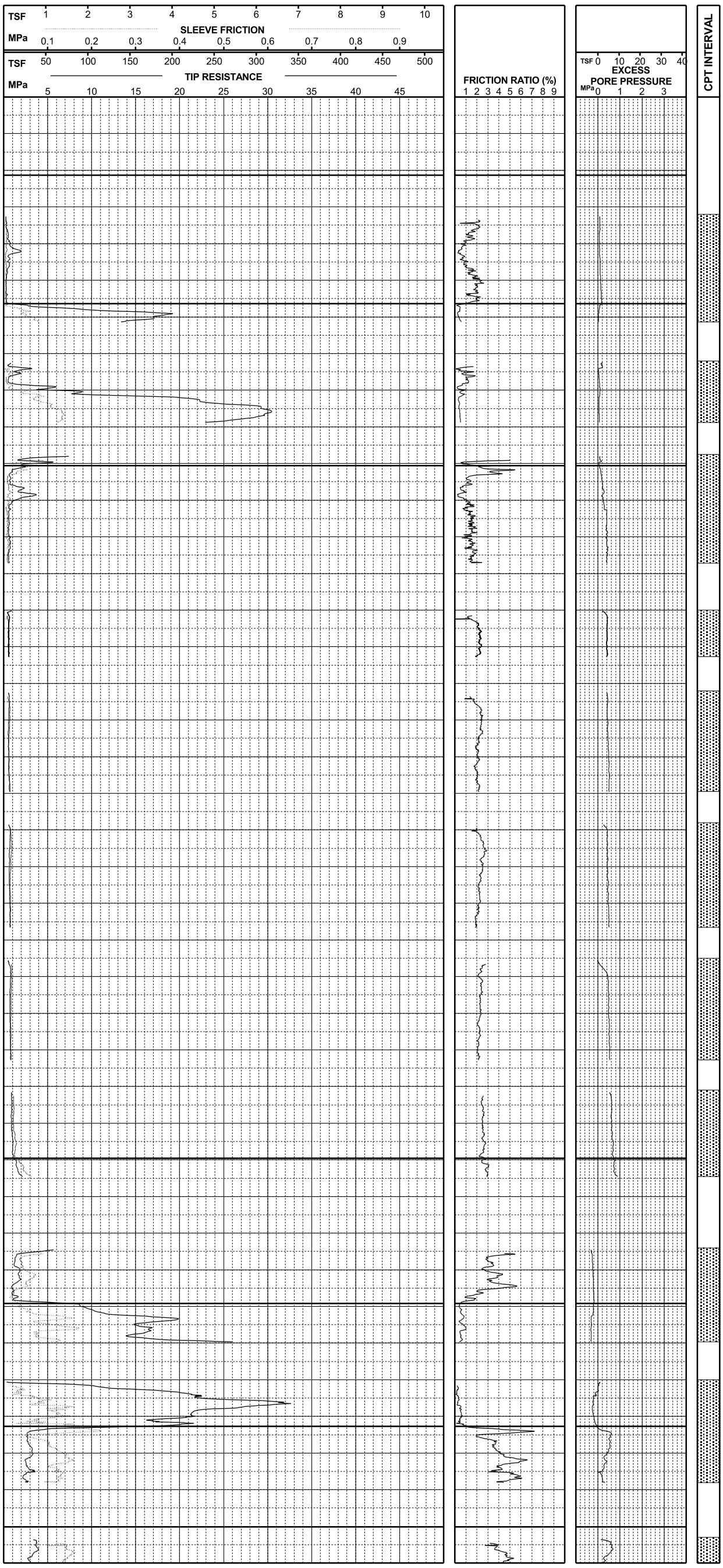
PLATE 98-30.6c

PROJECT NO:	98-42-0054	**START DATE:**	09/06/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-30 (Skyway Frame 2)	**COMPLETION DATE:**	09/09/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837434 N648060
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.6m (MSL)

STRATUM NO.	MATERIAL DESCRIPTION	BLOW COUNT
I	Fat CLAY (CH), very soft, olive gray -with root fibers, at 0.6m -with a few silt pockets and light brown streaks, at 1.2m -with many shells and shell fragments, below 1.5m (2.1m)	WOH WOH WOH
II	Fat CLAY (CH), soft, olive gray -with silt pockets and partings, at 2.1m -with many large sand pockets and sand partings, below 2.7m -loose sand layer, 4.1m to 4.3m -clay with fine sand, 4.3m to 5.0m (5.6m)	WOH WOH 15/60cm 9/60cm
III	Fine SAND (SP), very dense, gray -with medium sand -with shell fragments, 5.9m to 6.7m -with clay pockets and seams, 7.3m to 7.8m -with a clay layer, at 7.7m -with silt and shells, at 8.5m (10.1m)	30/45cm 30/30cm 30/60cm 30/30cm 30/25cm
IV	Fat CLAY (CH), firm to stiff, olive gray -with shell fragments -sand layer, 10.5m to 11.1m -with many shells, at 13.1m -with many silt and sand pockets, at 13.7m -with silt pockets and gas blisters, at 15.8m -with gas blisters, at 26.8m (29.0m)	PUSH SAVE PUSH PUSH SAVE PUSH
V	Fat CLAY (CL), stiff to very stiff, greenish gray -desiccated and with organic pockets -organic clay, to 30.6m (32.9m)	PUSH SAVE
VI	Fine SAND with silt (SP-SM), very dense, olive gray -with medium sand -with shell fragments and fine gravel, at 34.7m (36.3m)	30/60cm
VII	Fat CLAY (CH), very stiff to hard, greenish gray -with calcareous nodules at 38.4m (39.0m)	PUSH
VIII	Fat CLAY (CH), hard, greenish gray -with sand partings, and seams, 39.6m to 42.1m	



LOG OF BORING AND TEST RESULTS

BORING 98-30

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

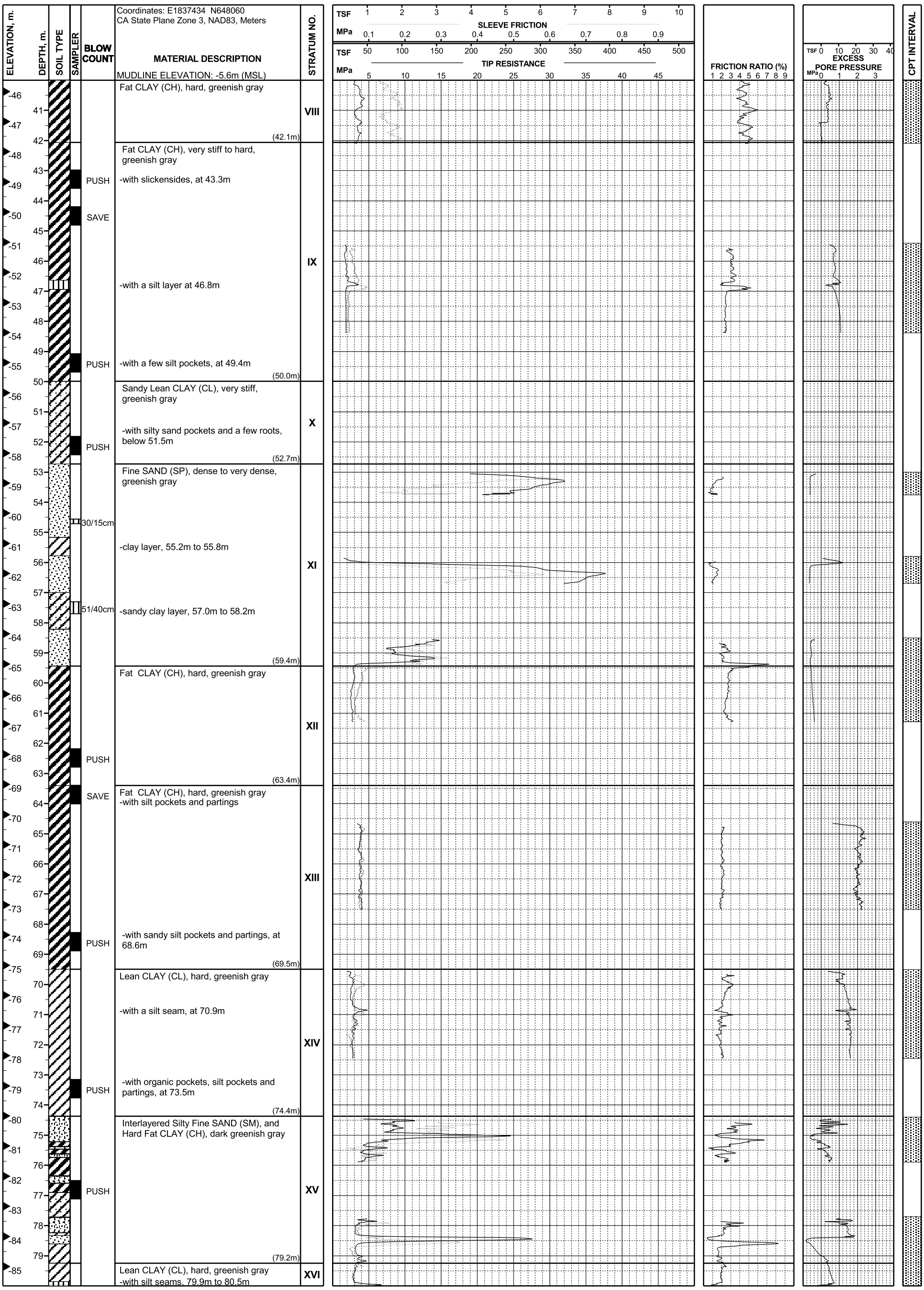
PLATE 98-30.7a

PROJECT NO:	98-42-0054	**START DATE:**	09/06/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-30 (Skyway Frame 2)	**COMPLETION DATE:**	09/09/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837434 N648060
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.6m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Fat CLAY (CH), hard, greenish gray (42.1m)	VIII
Fat CLAY (CH), very stiff to hard, greenish gray -with slickensides, at 43.3m -with a silt layer at 46.8m -with a few silt pockets, at 49.4m (50.0m)	IX
Sandy Lean CLAY (CL), very stiff, greenish gray -with silty sand pockets and a few roots, below 51.5m (52.7m)	X
Fine SAND (SP), dense to very dense, greenish gray -clay layer, 55.2m to 55.8m -sandy clay layer, 57.0m to 58.2m (59.4m)	XI
Fat CLAY (CH), hard, greenish gray (63.4m)	XII
Fat CLAY (CH), hard, greenish gray -with silt pockets and partings -with sandy silt pockets and partings, at 68.6m (69.5m)	XIII
Lean CLAY (CL), hard, greenish gray -with a silt seam, at 70.9m -with organic pockets, silt pockets and partings, at 73.5m (74.4m)	XIV
Interlayered Silty Fine SAND (SM), and Hard Fat CLAY (CH), dark greenish gray (79.2m)	XV
Lean CLAY (CL), hard, greenish gray -with silt seams, 79.9m to 80.5m	XVI



LOG OF BORING AND TEST RESULTS

BORING 98-30

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

PLATE 98-30.7b

PROJECT NO:	98-42-0054	**START DATE:**	09/06/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-30 (Skyway Frame 2)	**COMPLETION DATE:**	09/09/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837434 N648060
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.6m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-86	81			Lean CLAY (CL), hard, greenish gray	XVI
-87	82		30/25cm	-silty sand with clay layers, below 81.4m (82.6m)	
-88	83			Fine to Medium SAND (SP-SM) with silt, very dense, gray	XVII
-89	84		SAVE	-greenish gray, lean clay with sand, 83.4m to 84.4m	
-90	85				
-91	86		30/20cm	-with a trace of coarse sand, below 86.3m	
-92	87				
-93	88		30/20cm	-with gravel below 88.4m	
-94	89			-with clay seams and layers, below 89.0m	
-95	90		30/15cm	-fine to coarse gravel with silt and sand, at 90.5m (93.0m)	
-96	91				
-97	92				
-98	93		PUSH	Sandy SILT (ML), hard, brownish yellow -with clay pockets and seams (94.8m)	XVIII
-99	94				
-100	95			Medium SAND (SP-SM) with silt, very dense, dark brown -with clay seams (96.8m)	XIX
-101	96		30/15cm		
-102	97			Lean CLAY (CL), hard, brown -with silt layers, at 97.5m and 98.1m	XX
-103	98				
-104	99				
-105	100			TOTAL DEPTH: 100.0m	
-106	101			BACKFILLED WITH: Cement Grout	
-107	102				
-108	103				
-109	104				
-110	105				
-111	106				
-112	107				
-113	108				
-114	109				
-115	110				
-116	111				
-117	112				
-118	113				
-119	114				
-120	115				
-121	116				
-122	117				
-123	118				
-124	119				
-125					

LOG OF BORING AND TEST RESULTS

BORING 98-30

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

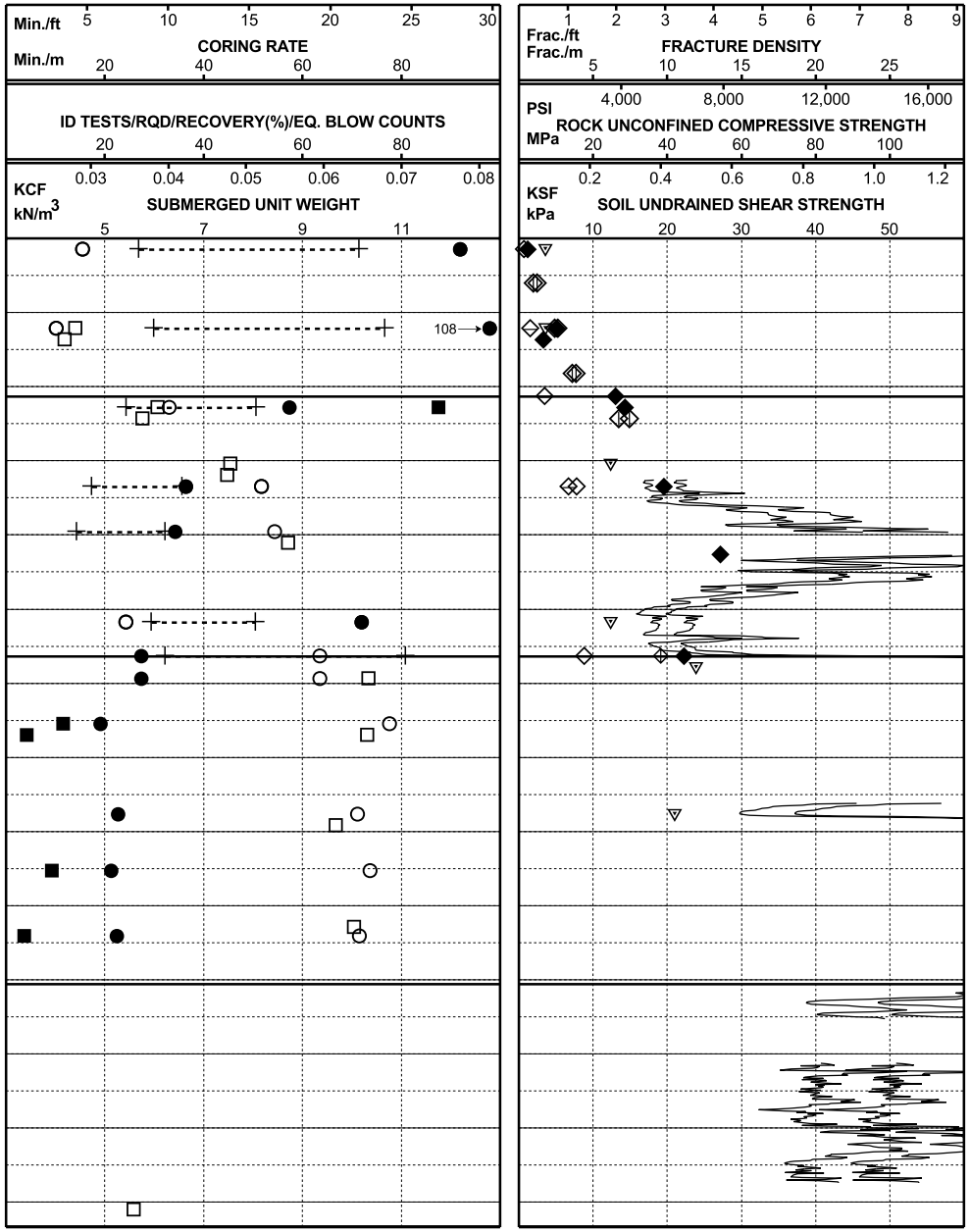
PLATE 98-30.7c

PROJECT NO:	98-42-0054	**START DATE:**	09/06/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-30 (Skyway Frame 2)	**COMPLETION DATE:**	09/09/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837434 N648060
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.6m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-6		WOH	Fat CLAY (CH), very soft, olive gray -with root fibers, at 0.6m	I
-7	1	WOH	-with a few silt pockets and light brown streaks, at 1.2m	
	2	WOH	-with many shells and shell fragments, below 1.5m (2.1m)	
-8		WOH	Fat CLAY (CH), soft, olive gray -with silt pockets and partings, at 2.1m -with many large sand pockets and sand partings, below 2.7m	II
-9	3			
-10	4	15/60cm	-loose sand layer, 4.1m to 4.3m -clay with fine sand, 4.3m to 5.0m	
-11	5	9/60cm	(5.6m)	
-12	6	30/45cm 30/30cm	Fine SAND (SP), very dense, gray -with medium sand -with shell fragments, 5.9m to 6.7m	III
-13	7	30/60cm	-with clay pockets and seams, 7.3m to 7.8m -with a clay layer, at 7.7m	
-14	8	30/30cm	-with silt and shells, at 8.5m	
-15	9	30/25cm	(10.1m)	
-16	10		Fat CLAY (CH), firm to stiff, olive gray -with shell fragments -sand layer, 10.5m to 11.1m	IV
-17	11			
-18	12			
	13	PUSH	-with many shells, at 13.1m	



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-30

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

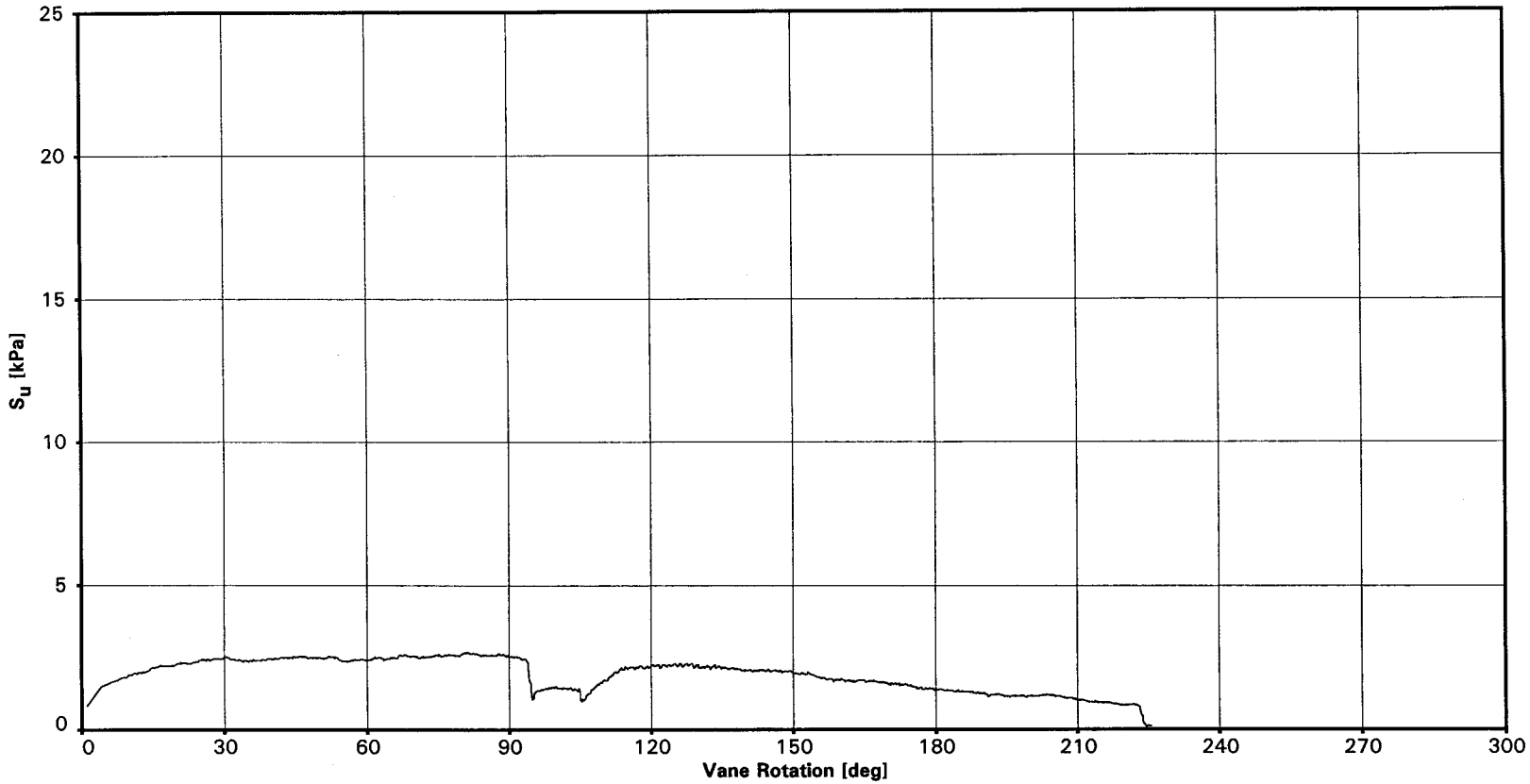
FUGRO

PLATE 98-30.8

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 98-30
SFOBB East Span Seismic Safety Project

Earth Mechanics

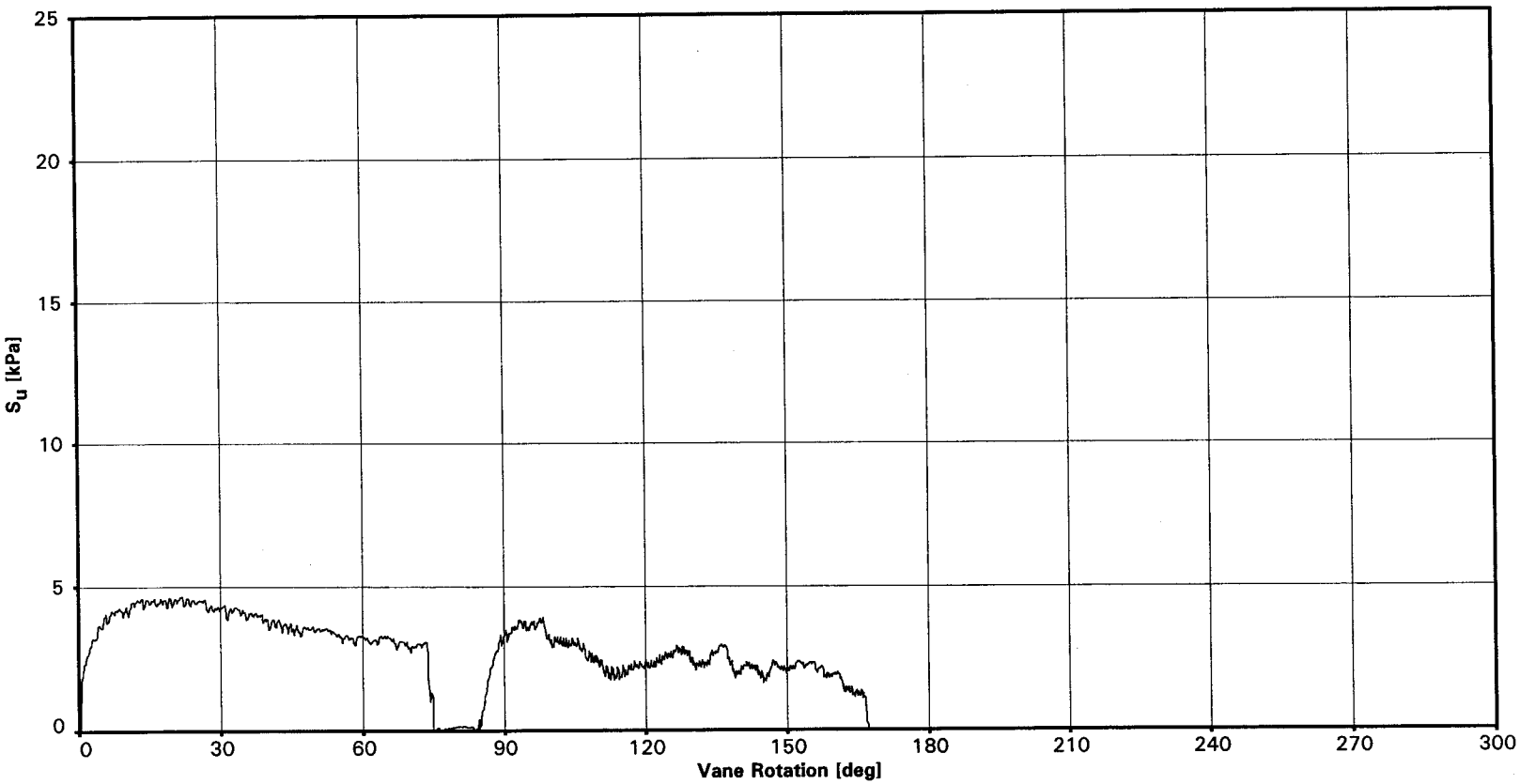
FUGRO

PLATE 98-30.9a

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 98-30
SFOBB East Span Seismic Safety Project

Earth Mechanics

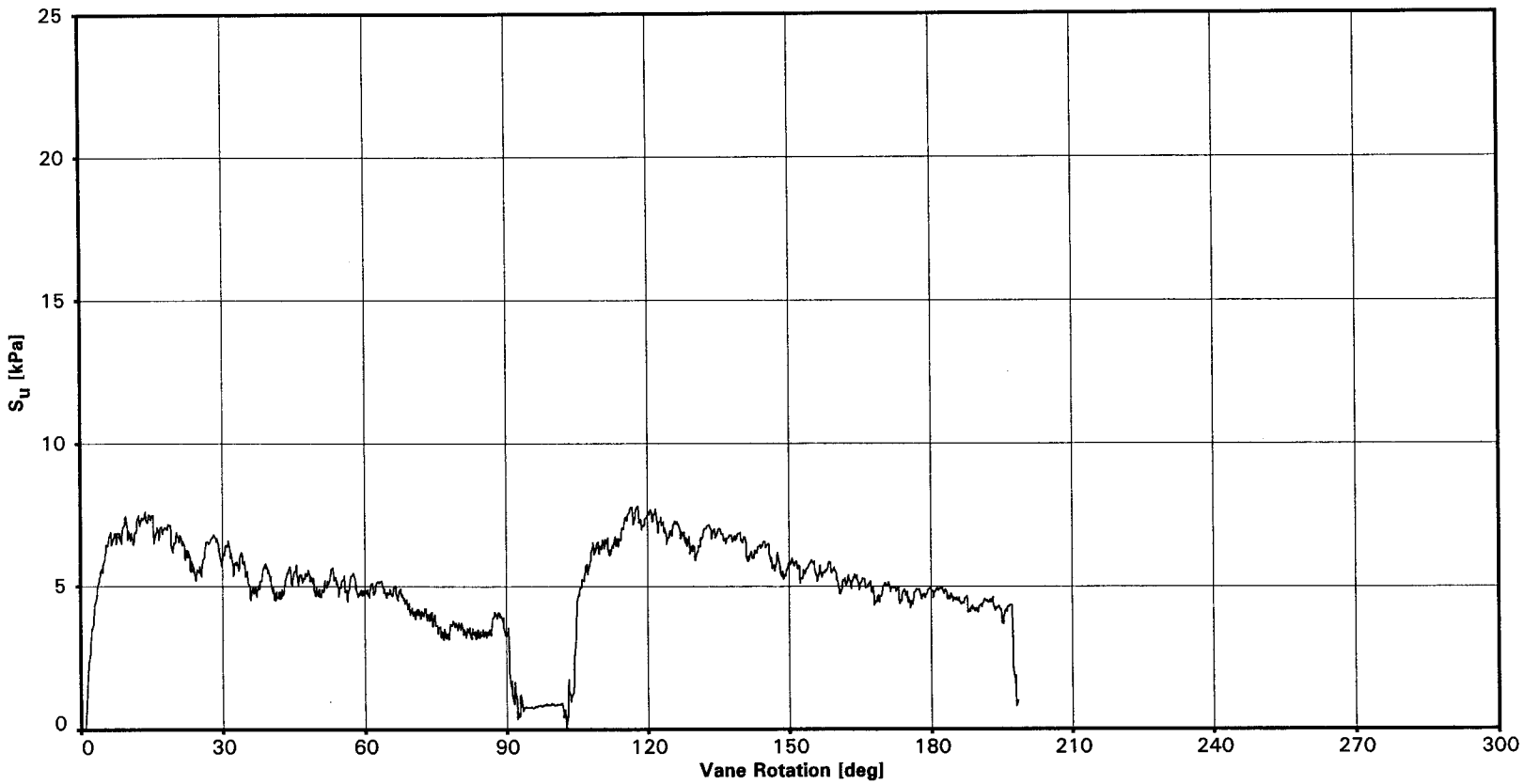
FUGRO

PLATE 98-30.9b

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 98-30
SFOBB East Span Seismic Safety Project

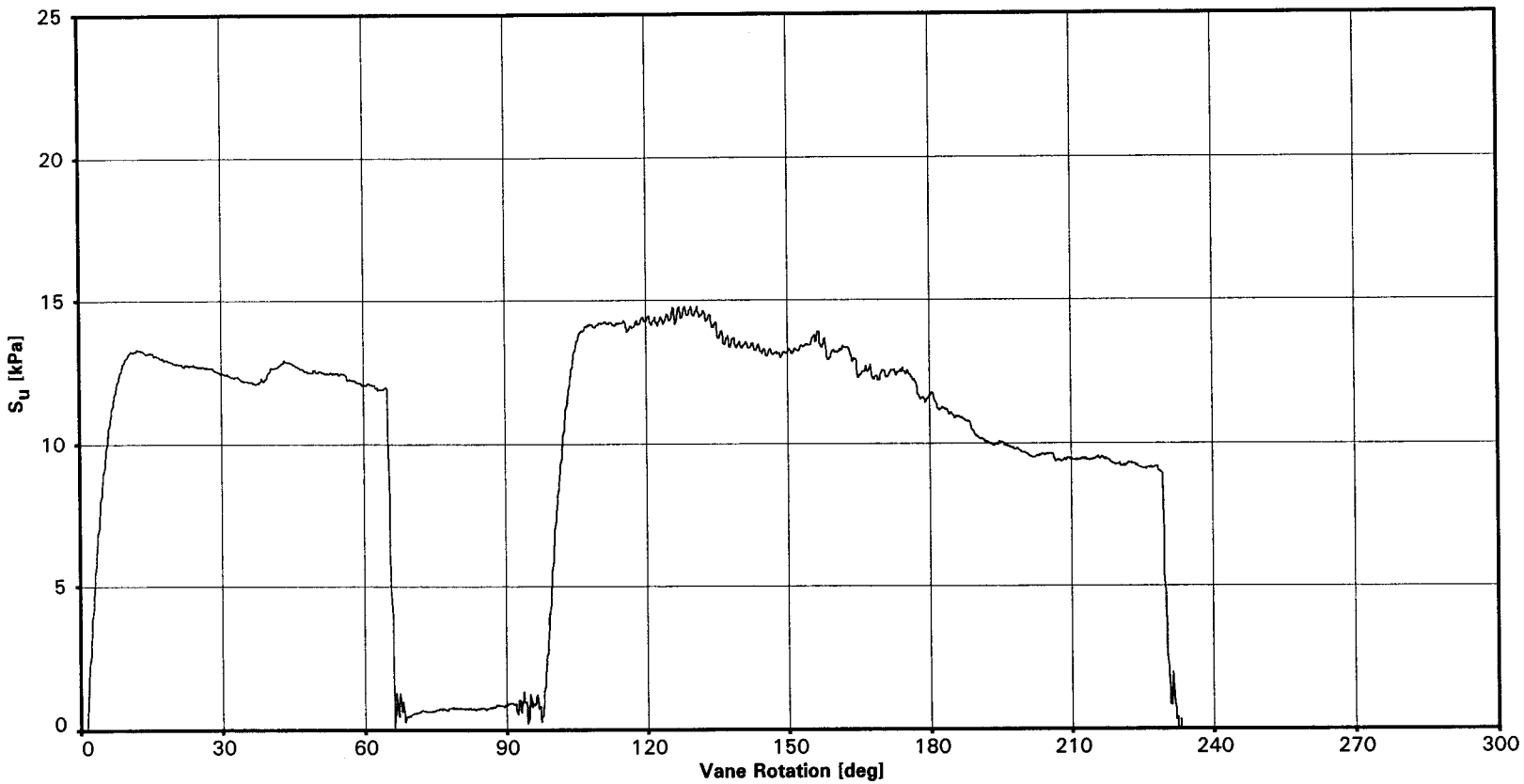
Earth Mechanics

FUGRO

PLATE 98-30.9c

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 2.4m
Boring 98-30
SFOBB East Span Seismic Safety Project

98-30		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	92	72	27	1.45					3.6	1.1		0.6													
0.6	500													2.4												
0.6	501													1.9												
1.2	3	108	77	30	1.67	4.4				3.6	5.1		1.5													
1.2	502													5.3												
1.2	503													4.8												
1.4	4					4.2					3.3															
1.8	504													7.7												
1.8	505													7.2												
2.1	5										13.0		3.4													
2.3	6	57	51	24	1.25	6.1	87				14.3													H		
2.4	7					5.8																				
2.4	506													13.4												
2.4	507													14.8												
3.0	8					7.5				12.4																

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

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

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-30
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-30		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)			
3.2	9					7.5																				
3.4	10	36	36	17	1.04						19.6	7.8	6.7													
4.0	11	34	32	14	1.11																					
4.1	12					8.7																				
4.3	13										27.1															
5.2	15	72	51	29	2.00					12.4																
5.6	16	27	81	32				19.2			22.3	8.8														
5.8	17									23.9																
5.9	18	27				10.3																				
6.6	19	19					11																			
6.7	20					10.3	4											81.4	44							
7.8	22	23								21.1																
7.9	23					9.7																				
8.5	24	21					9																			
9.3	25					10.0																				

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

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

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-30
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-30		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)			
9.4	26	22					4																			
13.1	27					5.6																				
13.4	29	66	74	32	0.81			76.6			50.7	16.8														
13.9	30	43	35	16	1.45																			C,K	2.74	
14.0	31						71				41.4													H		
16.0	33	61	65	24	0.90	5.8		71.8							50.2		1.2									
16.2	34										49.4	11.1														
19.7	36	55	66	28	0.72	6.2		95.8							63.3		0.9									
19.8	37							95.8		49.8	62.7															
23.4	38	49	50	25	0.95																			C,K	2.72	
23.5	39						100				56.9													H		
27.0	41	55	66	31	0.68	5.9									77.2		1.0									
27.1	42							41.2		62.2	73.8															
30.5	43	44																								
30.6	44	28	63	27	0.03	6.8									84.8		0.9									5

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
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-30
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-30		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)			
30.8	45								143.6																	
31.4	47	22									105.2															
34.7	48					9.8																				
34.9	49	22																								
35.1	50						7																			
38.3	51							162.8	191.5																	
38.4	52	27	57	19	0.20	9.7		146.0	153.2						148.8	150.0	0.8									
38.6	53										193.1															
43.3	54							131.7		227.0+																
43.4	55	45	85	27	0.30	7.3																				
43.6	56								143.6		196.8															
44.7	57	43	84	20	0.35																			C	2.77	
44.8	58						99				175.8													H		
49.5	60	35	50	24	0.42	8.4									180.1	47.2	0.7									
49.7	61									173.3	165.9															

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MC = Moisture Content
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-30
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-30		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)			
52.3	63	20	25	15	0.52	10.5			163.6						171.9		1.6									
52.4	64	22							175.2		183.2															
54.7	65					9.6																				
57.6	67	21	27	16	0.48	10.6																				
57.7	68							203.5			188.1															
62.6	70	46	73	26	0.43	7.4									149.3		1.3									
62.8	71										222.8+															
63.9	72	46	67	22	0.52																			C	2.74	
64.0	73						89				222.8+													H		
68.6	74								292.1																	
68.7	75	55	72	28	0.62	7.5			245.3							37.9										
68.9	76										222.8+															
73.5	77								167.6																	
73.6	78	28	31	18	0.79	9.3									167.8		0.8									
76.8	80								191.5																	

Identification Tests
MC = Moisture Content
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-30
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-30		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)			
77.0	81	28				8.8																				
81.5	83	25				9.7																				
81.6	84					9.5																				
84.0	85	26	43	16	0.36																			C	2.72	
84.1	86						76																	H		
86.4	87	18					6																			
88.5	88	21				11.5	10																			
90.7	89	12					6																			
93.7	90	24				10.4																				
96.2	92						8																			

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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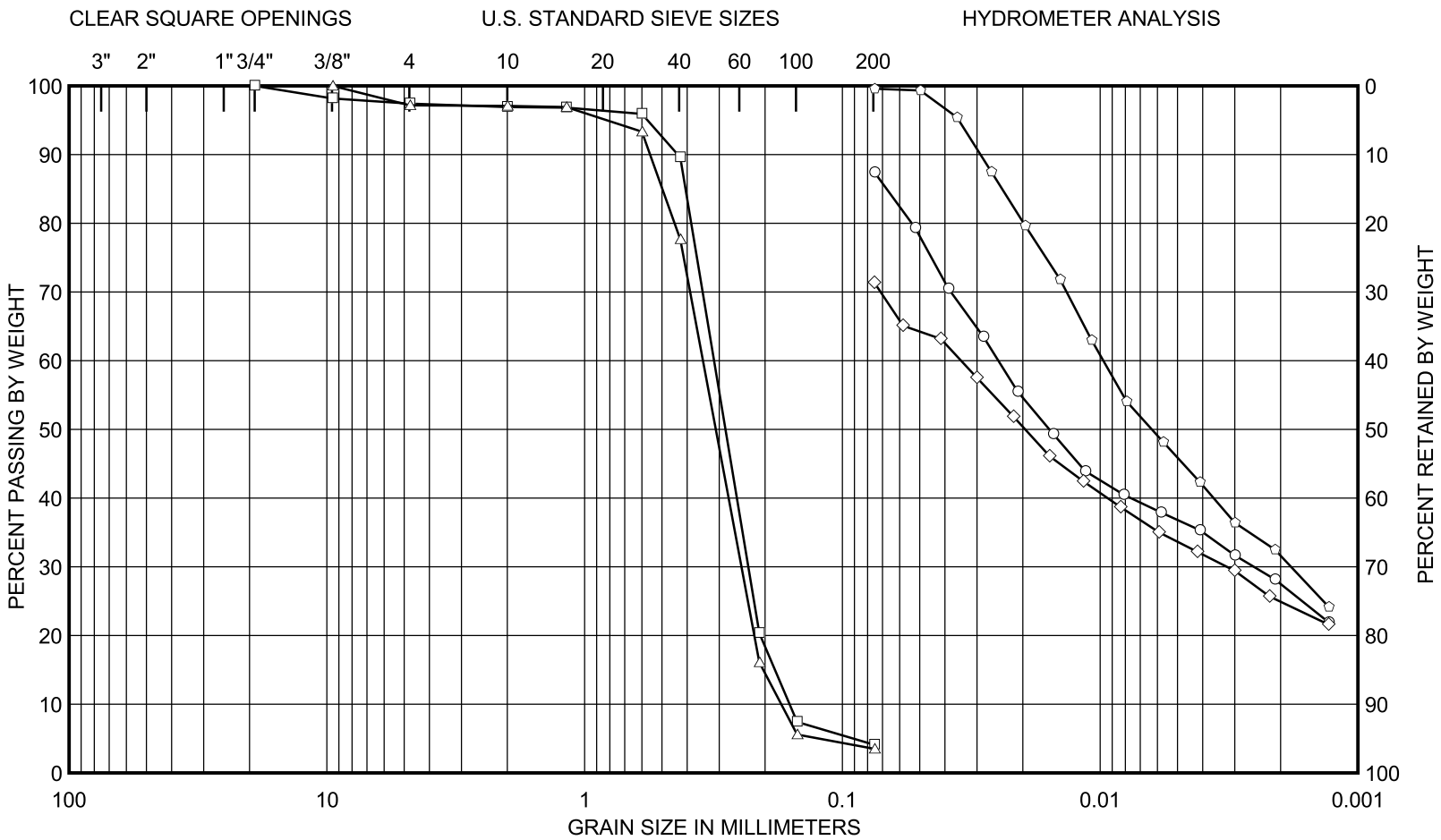
SUMMARY OF LABORATORY TEST RESULTS
Boring 98-30
SFOBB East Span Seismic Safety Project

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)
6	2.3	○——○	FAT CLAY (CH)			0.016
20	6.7	□——□	FINE SAND (SP) with a trace of medium sand	1.1	2.0	0.28
26	9.4	△——△	FINE SAND (SP) with medium sand	1.0	2.0	0.31
31	14.0	◇——◇	LEAN CLAY (CL) with many silt and sand pockets			0.020
39	23.5	⬠——⬠	FAT CLAY (CH)			0.0063

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-30

SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-30.11a

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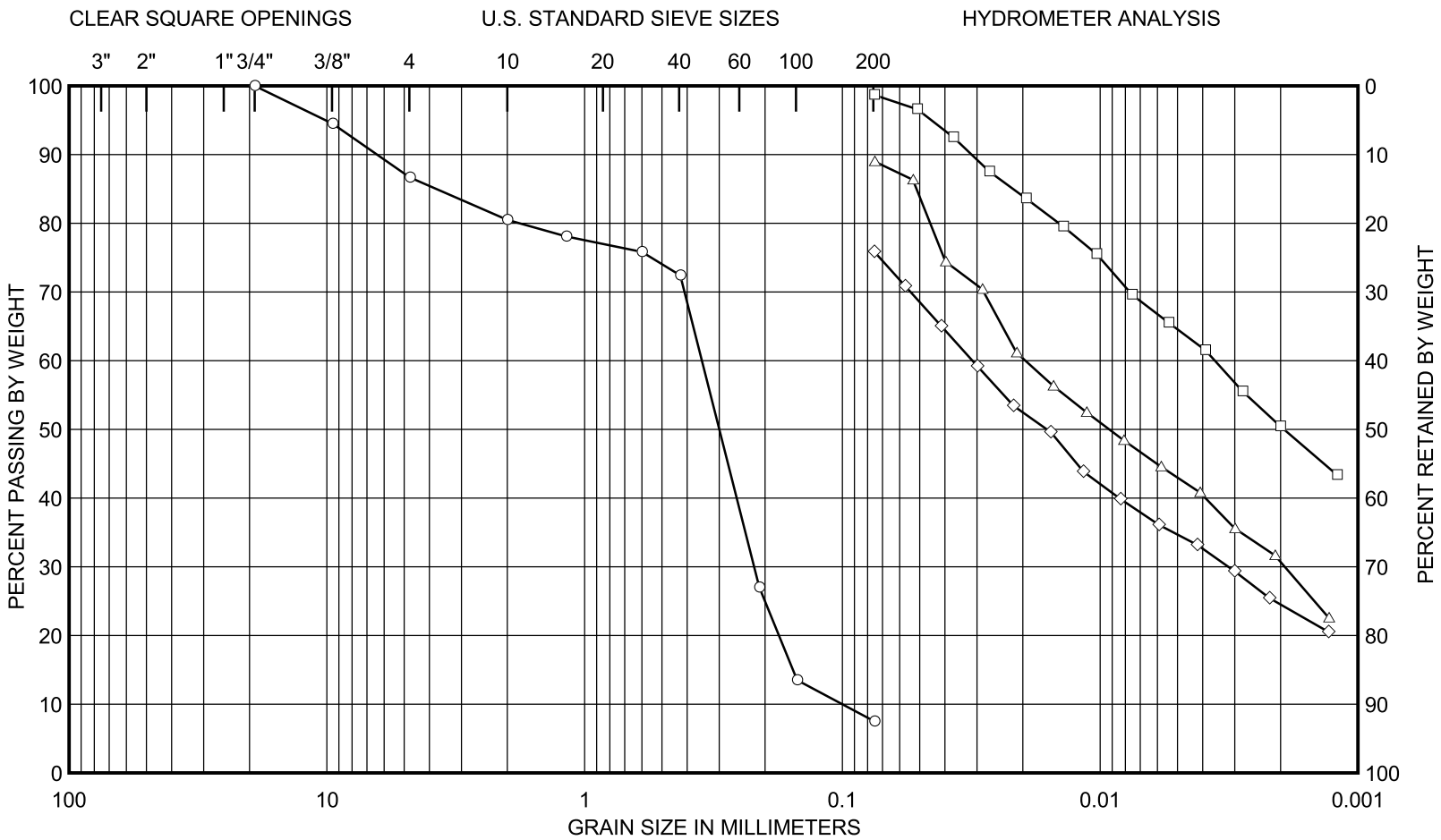

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
50	35.1	○——○	FINE SAND (SP-SM) with silt, a trace of medium and coarse sand and fine gravel	1.4	3.5	0.30
58	44.8	□——□	FAT CLAY (CH)			0.0019
73	64.0	△——△	FAT CLAY (CH)			0.0092
86	84.1	◇——◇	LEAN CLAY (CL) with sand			0.016

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-30
SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-30.11b

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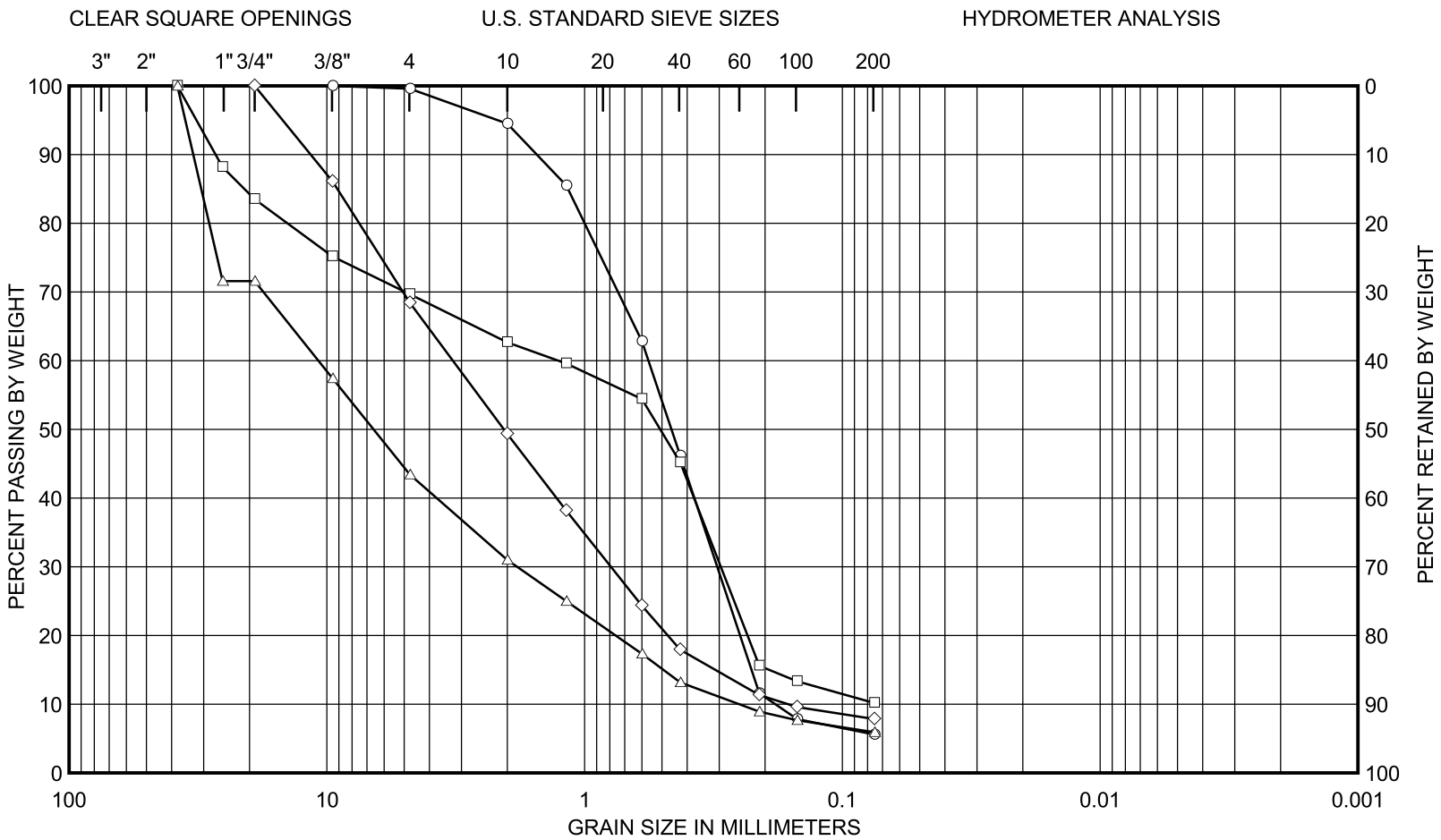

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
87	86.4	○——○	FINE TO MEDIUM SAND (SP-SM) with silt and a trace of coarse sand	0.9	3.1	0.46
88	88.5	□——□	FINE SAND (SP-SM) with silt, gravel, medium sand and a trace of coarse sand			0.51
89	90.7	△——△	FINE TO COARSE GRAVEL (GW-GM) with silt and sand	1.2	43.0	6.6
92	96.2	◇——◇	MEDIUM SAND (SW-SM) with silt, coarse sand and a trace of fine sand	1.2	20.0	2.1

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-30
SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-30.11c

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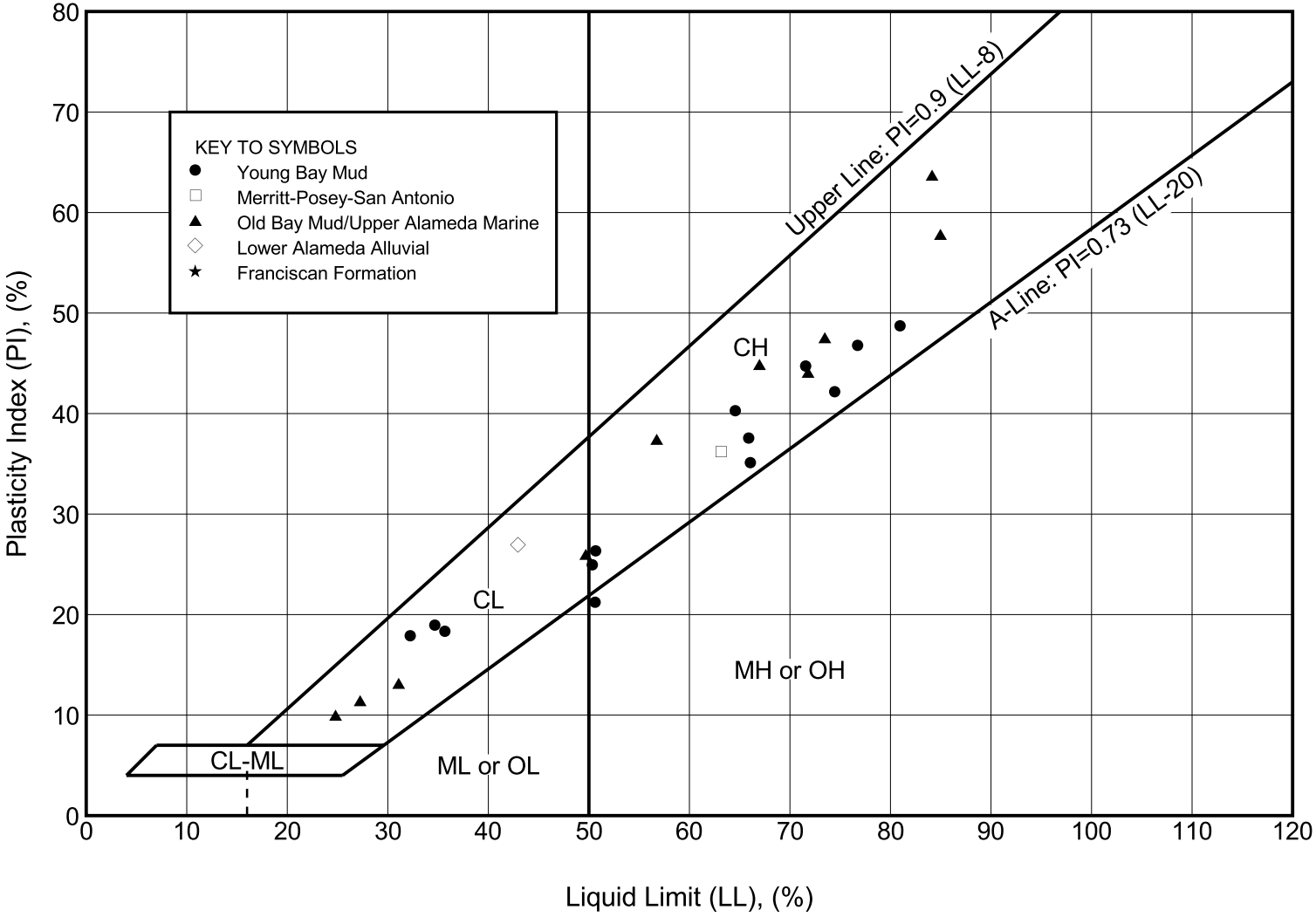

PLASTICITY CHART
Boring 98-30
SFOBB East Span Seismic Safety Project

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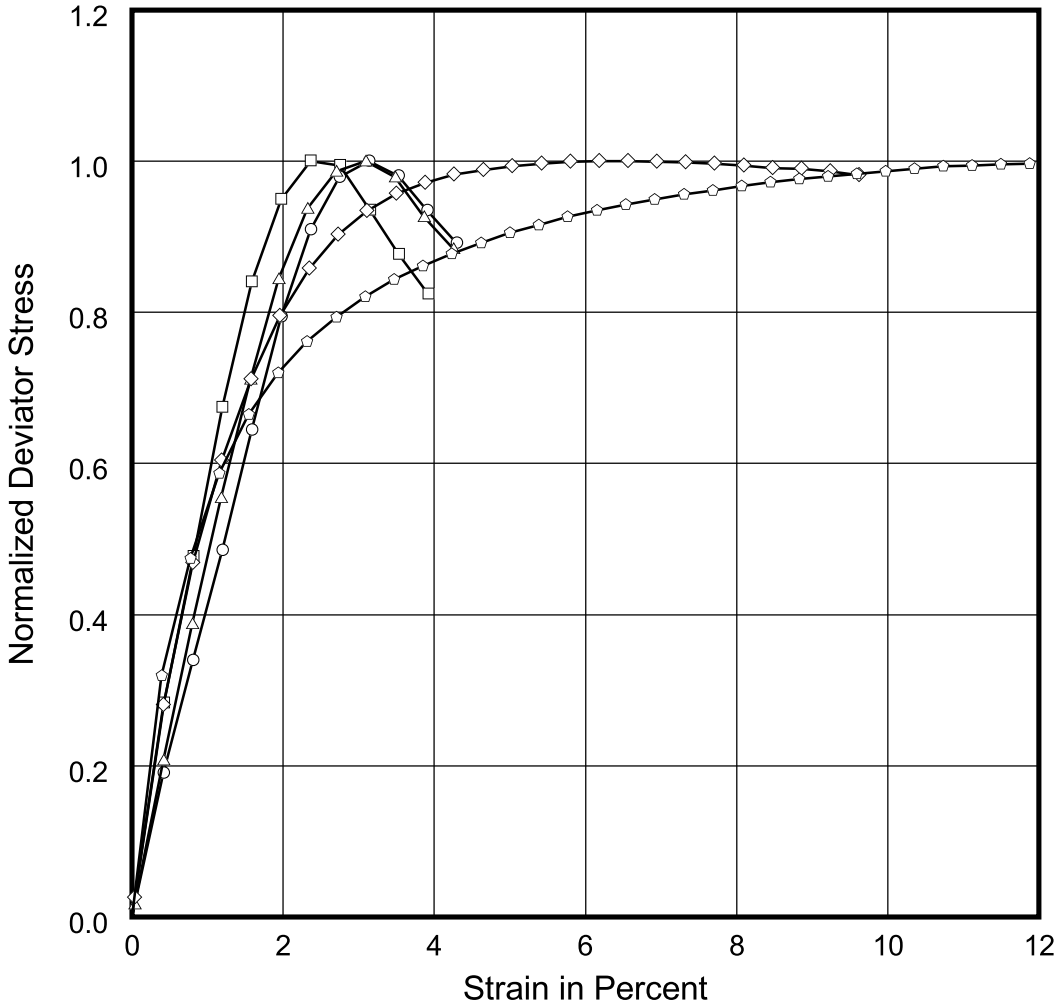
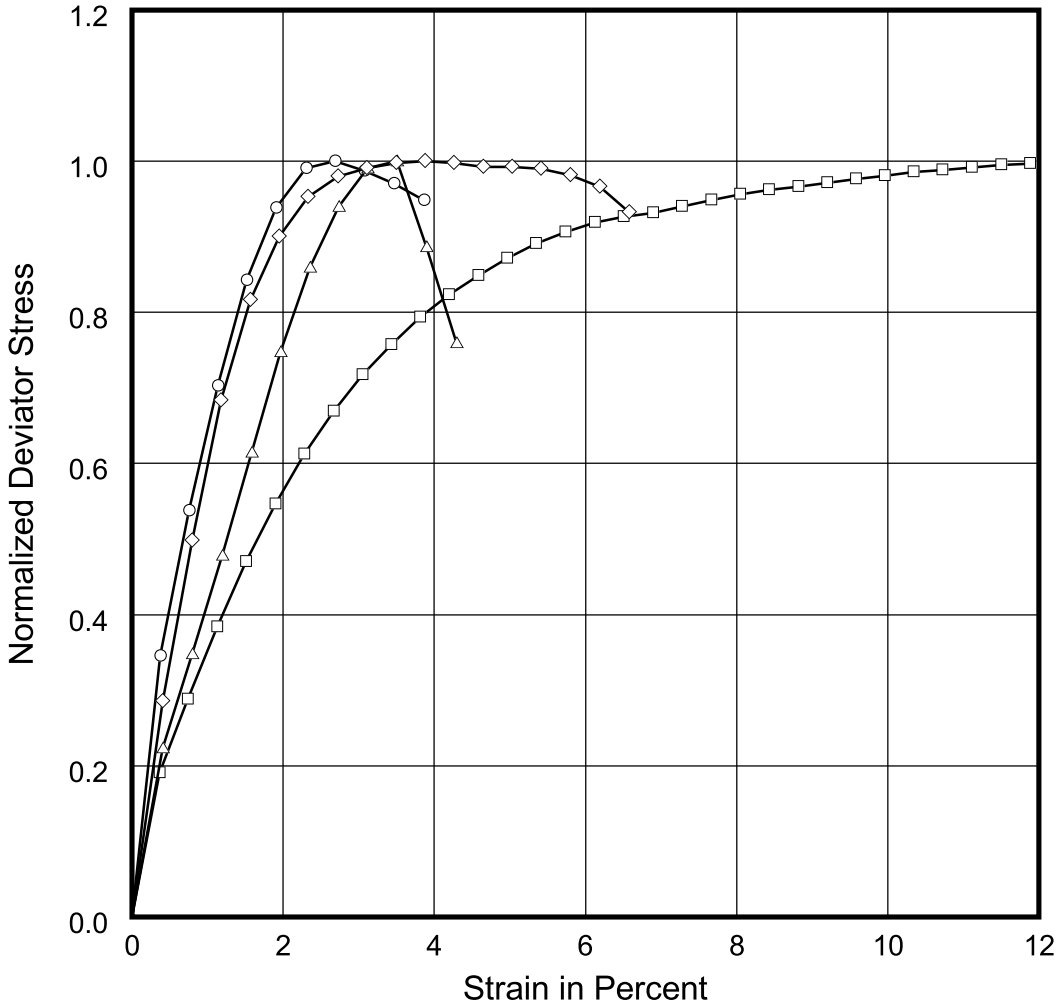


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	33	16.0	UU	345	100	1.2
□—□	36	19.7	UU	448	127	0.9
△—△	41	27.0	UU	621	154	1.0
◇—◇	44	30.6	UU	689	170	0.9
⬠—⬠	52	38.4	UU	862	298	0.8

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-30
SFOBB East Span Seismic Safety Project

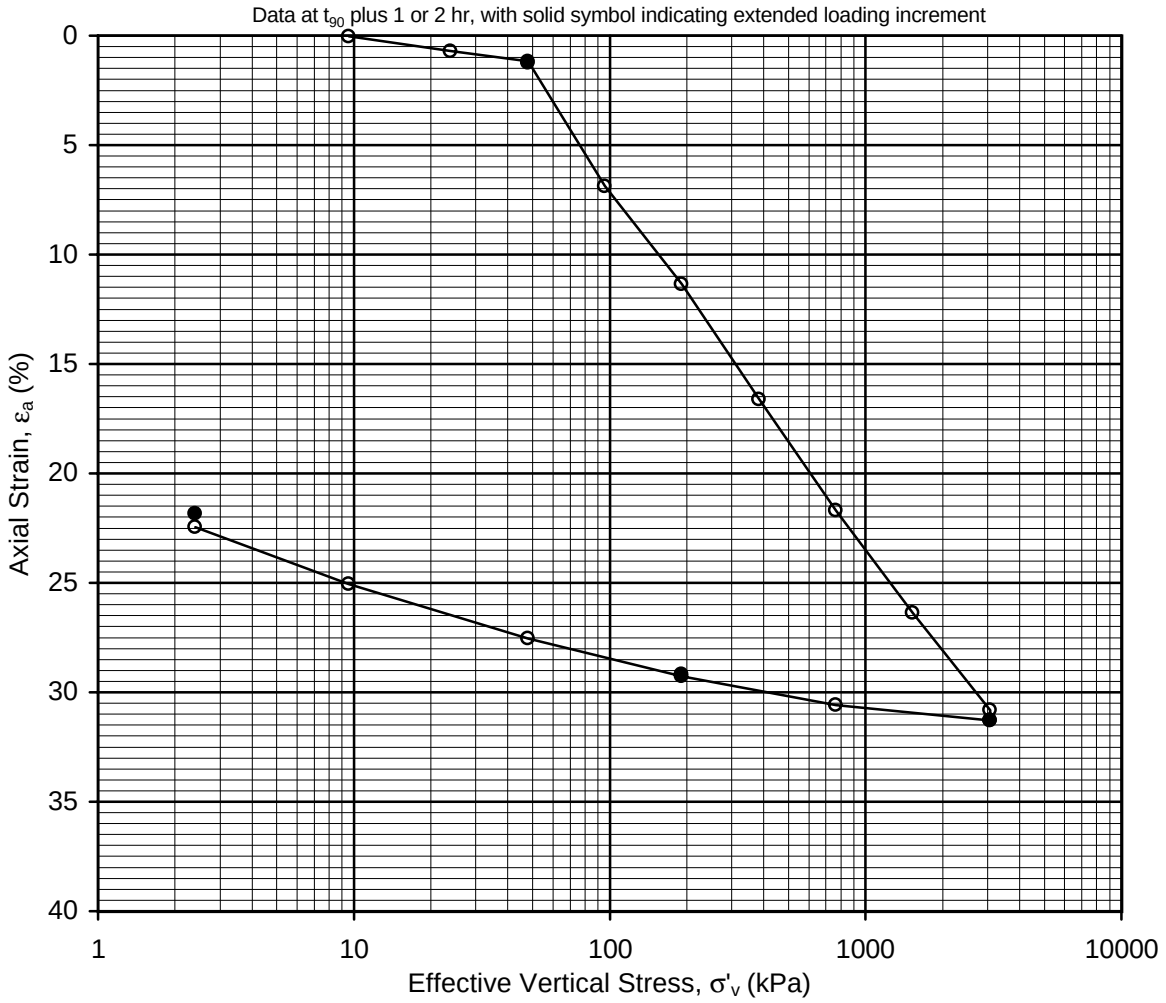


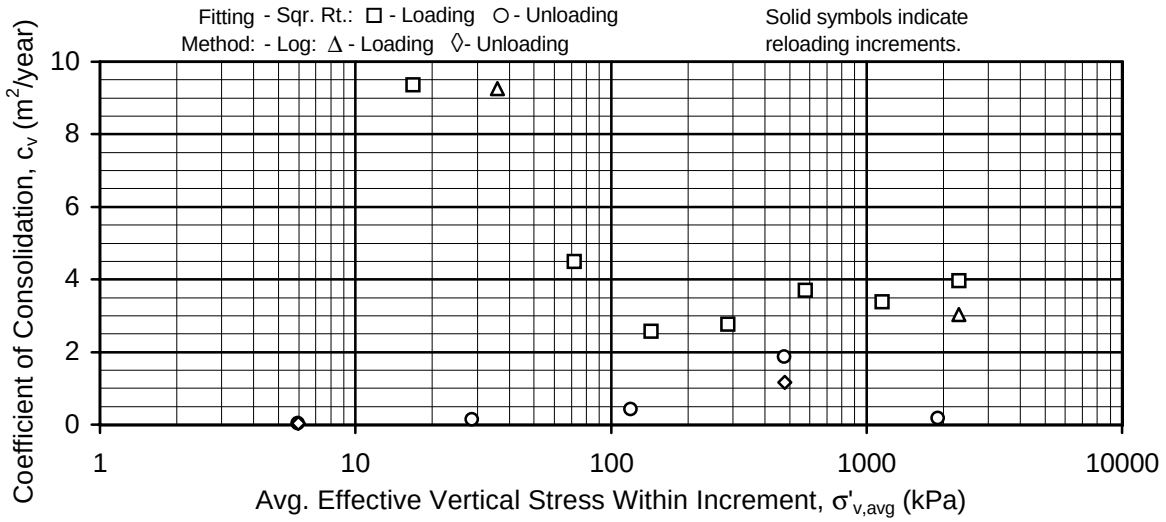
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	60	49.5	UU	1103	360	0.7
□—□	63	52.3	UU	1172	344	1.6
△—△	70	62.6	UU	1413	299	1.3
◇—◇	78	73.6	UU	1655	336	0.8

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-30
SFOBB East Span Seismic Safety Project

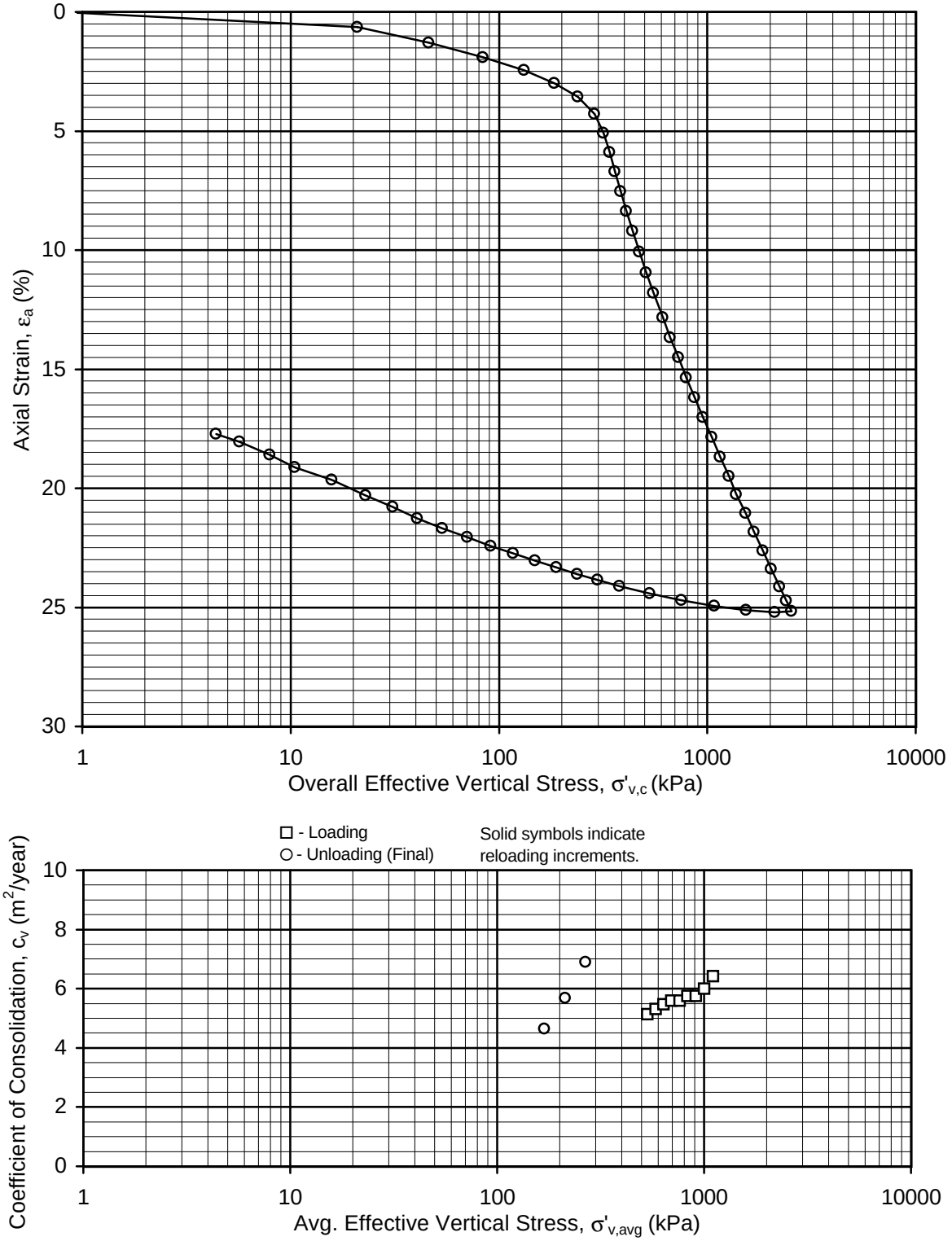




INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 30 - Depth: 13.9m
Boring 98-30
SFOBB East Span Seismic Safety Project

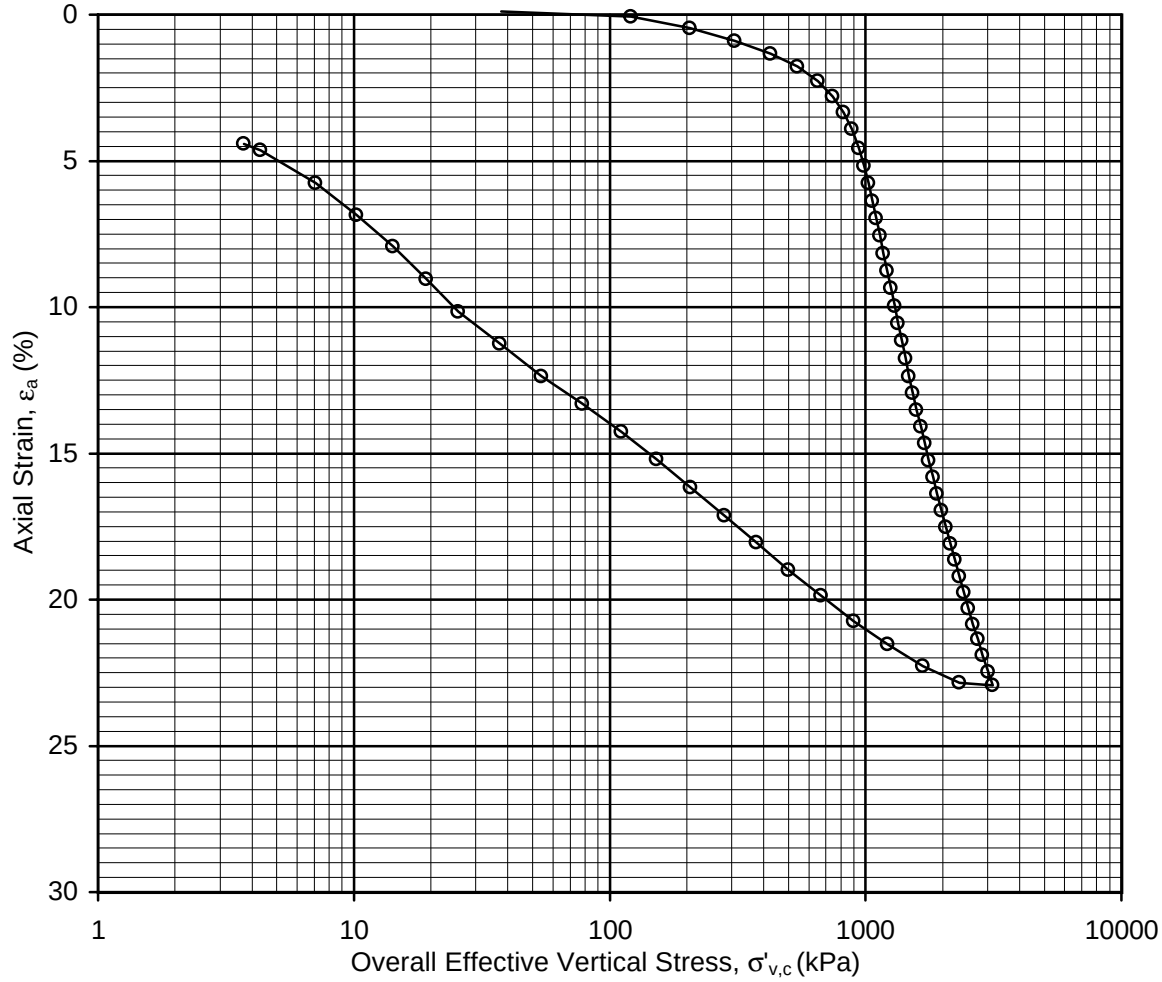
PLATE 98-30.14a

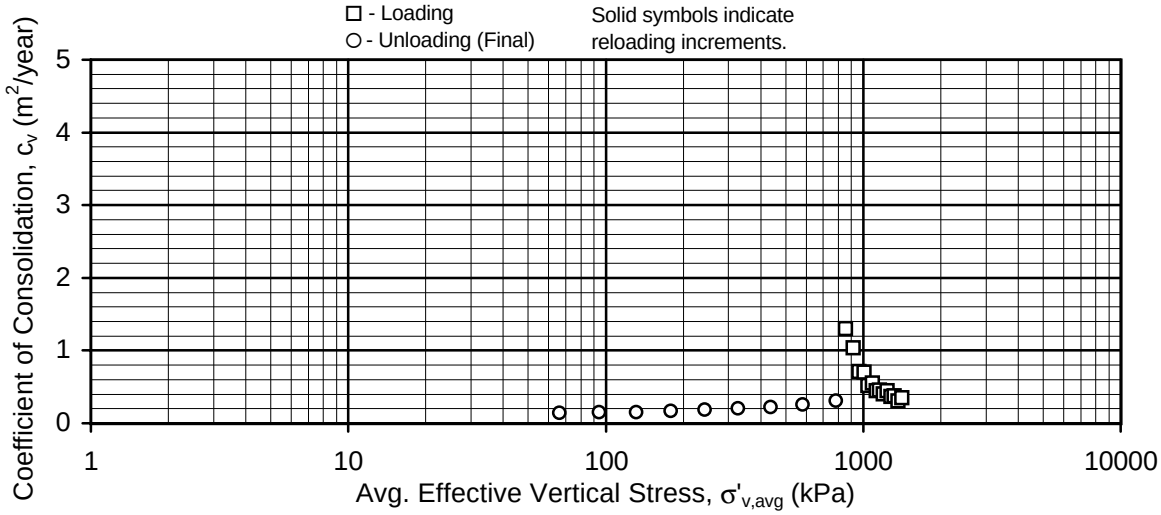


CRS CONSOLIDATION TEST RESULTS

Sample No. 38 - Depth: 23.4m
Boring 98-30
SFOBB East Span Seismic Safety Project

PLATE 98-30.14b

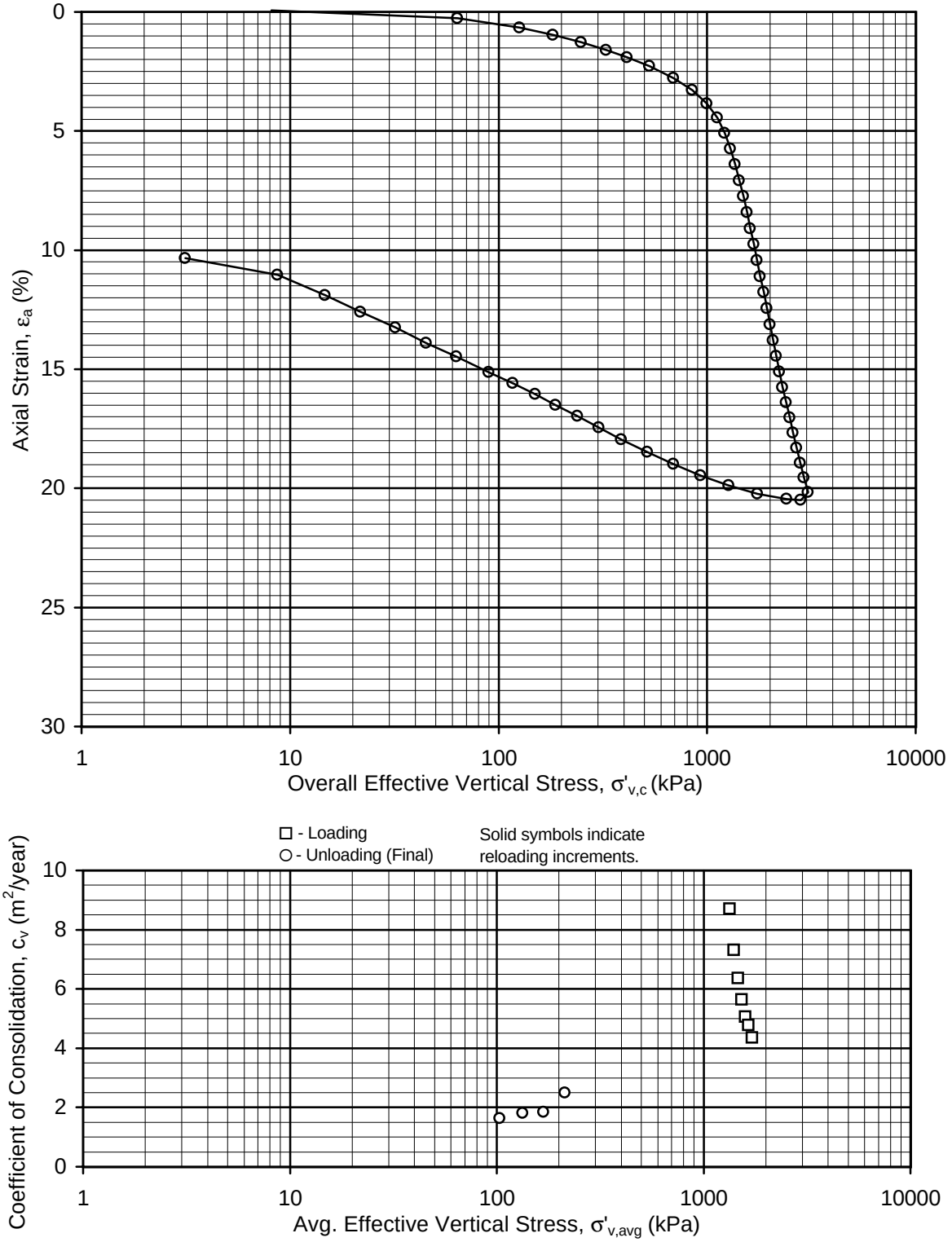




CRS CONSOLIDATION TEST RESULTS

Sample No. 57 - Depth: 44.7m
Boring 98-30
SFOBB East Span Seismic Safety Project

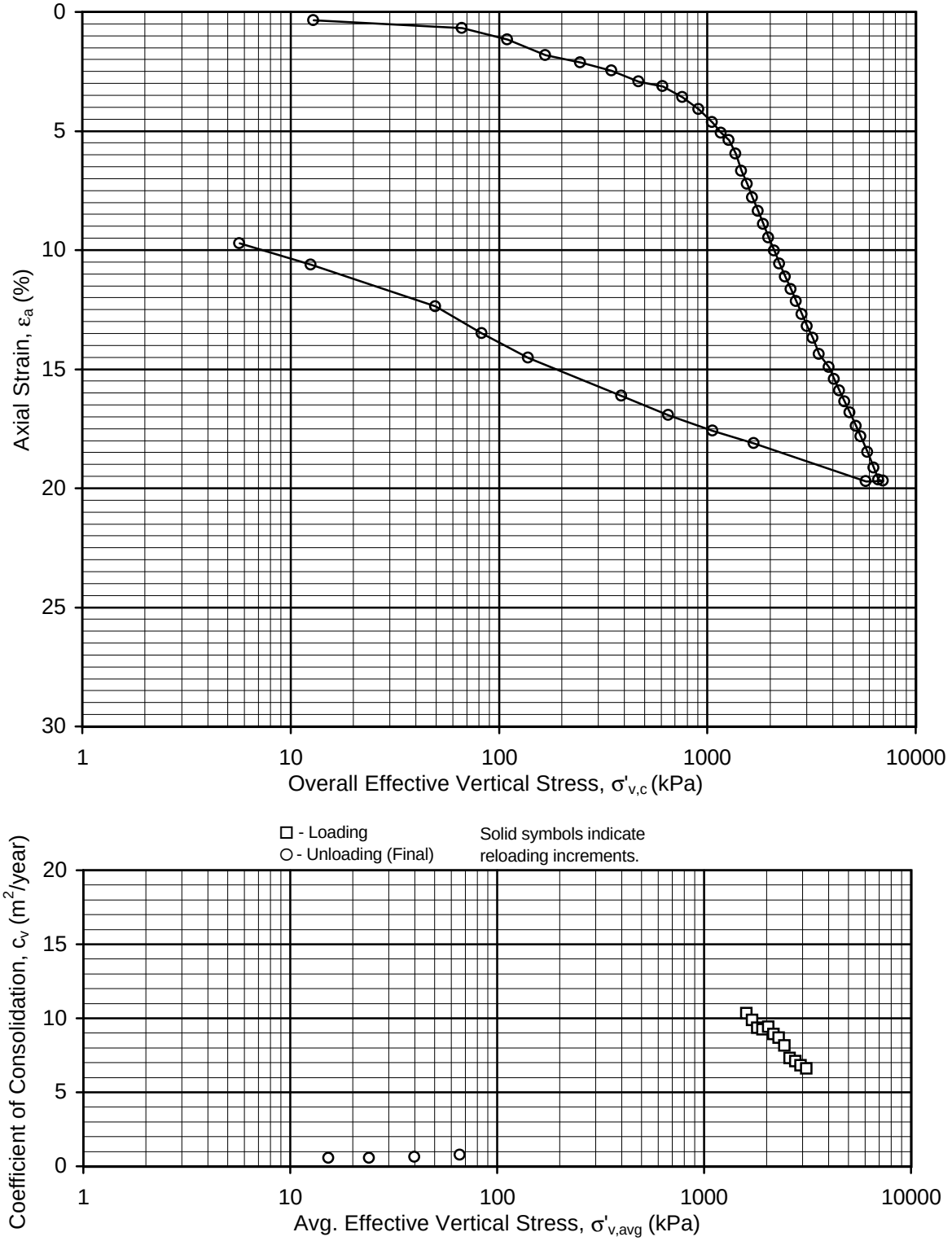
PLATE 98-30.14c



CRS CONSOLIDATION TEST RESULTS

Sample No. 72 - Depth: 63.9m
Boring 98-30
SFOBB East Span Seismic Safety Project

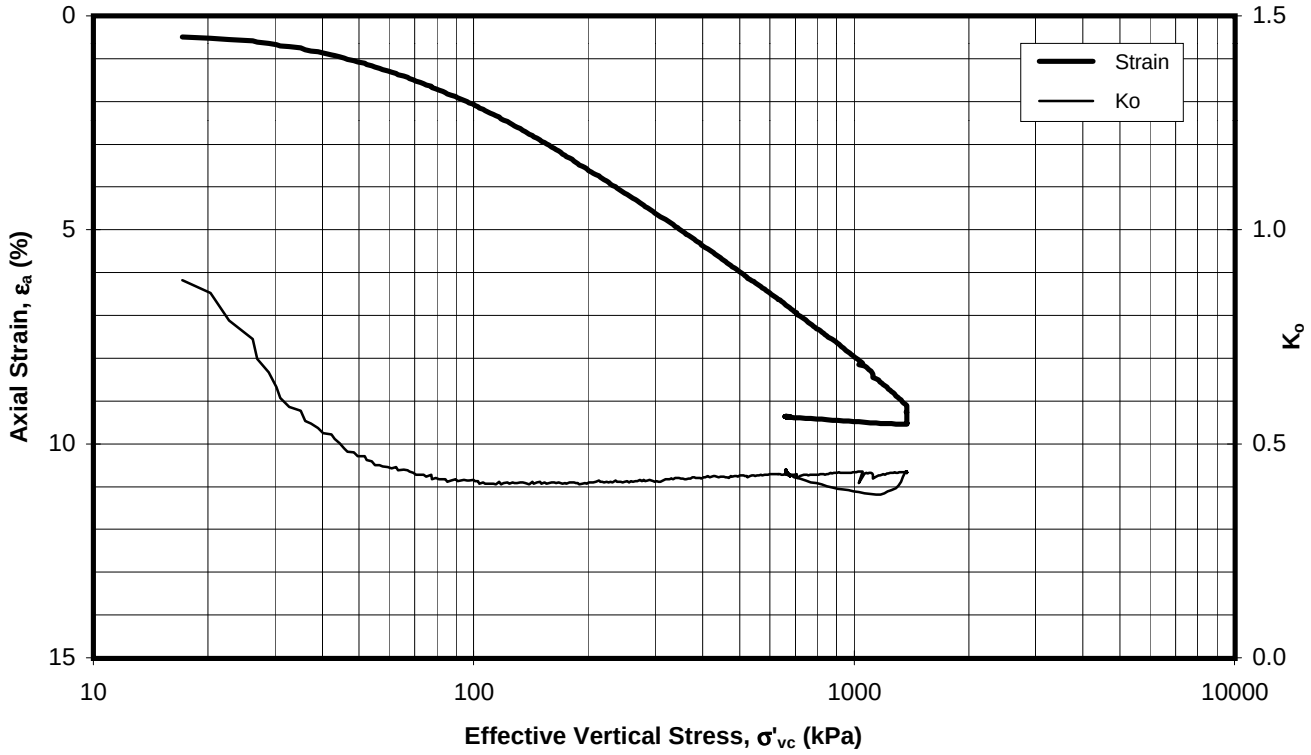
PLATE 98-30.14d

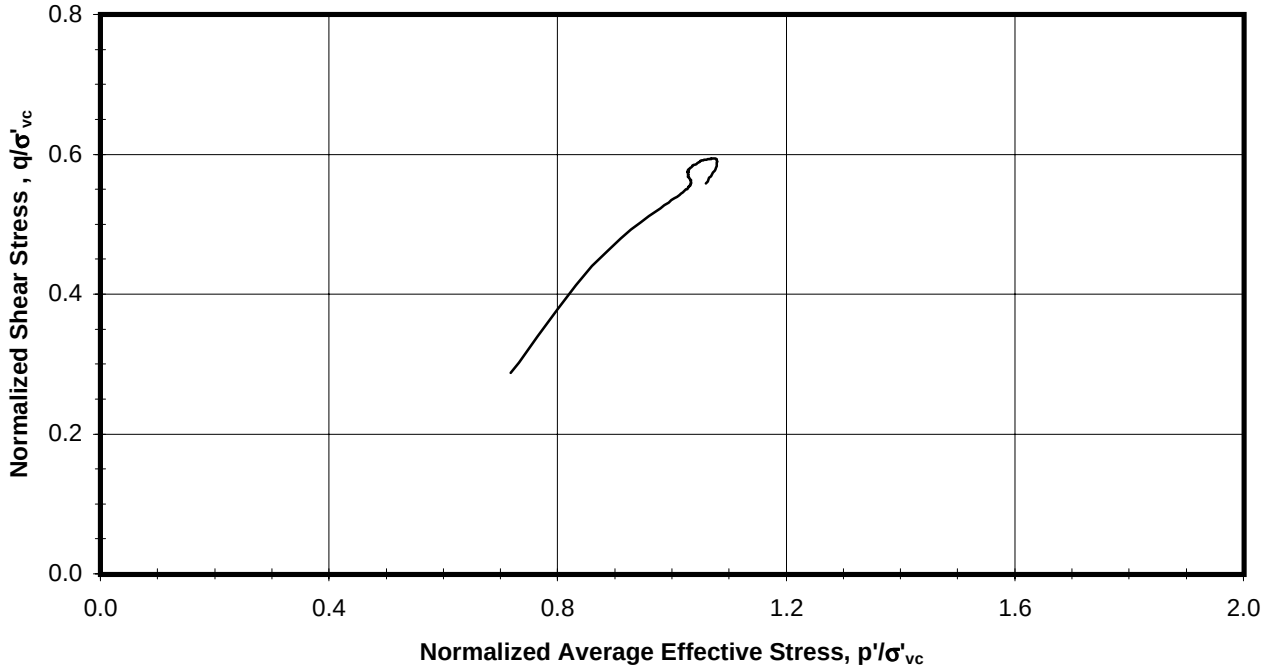


CRS CONSOLIDATION TEST RESULTS

Sample No. 85 - Depth: 84.1m
Boring 98-30
SFOBB East Span Seismic Safety Project

PLATE 98-30.14e





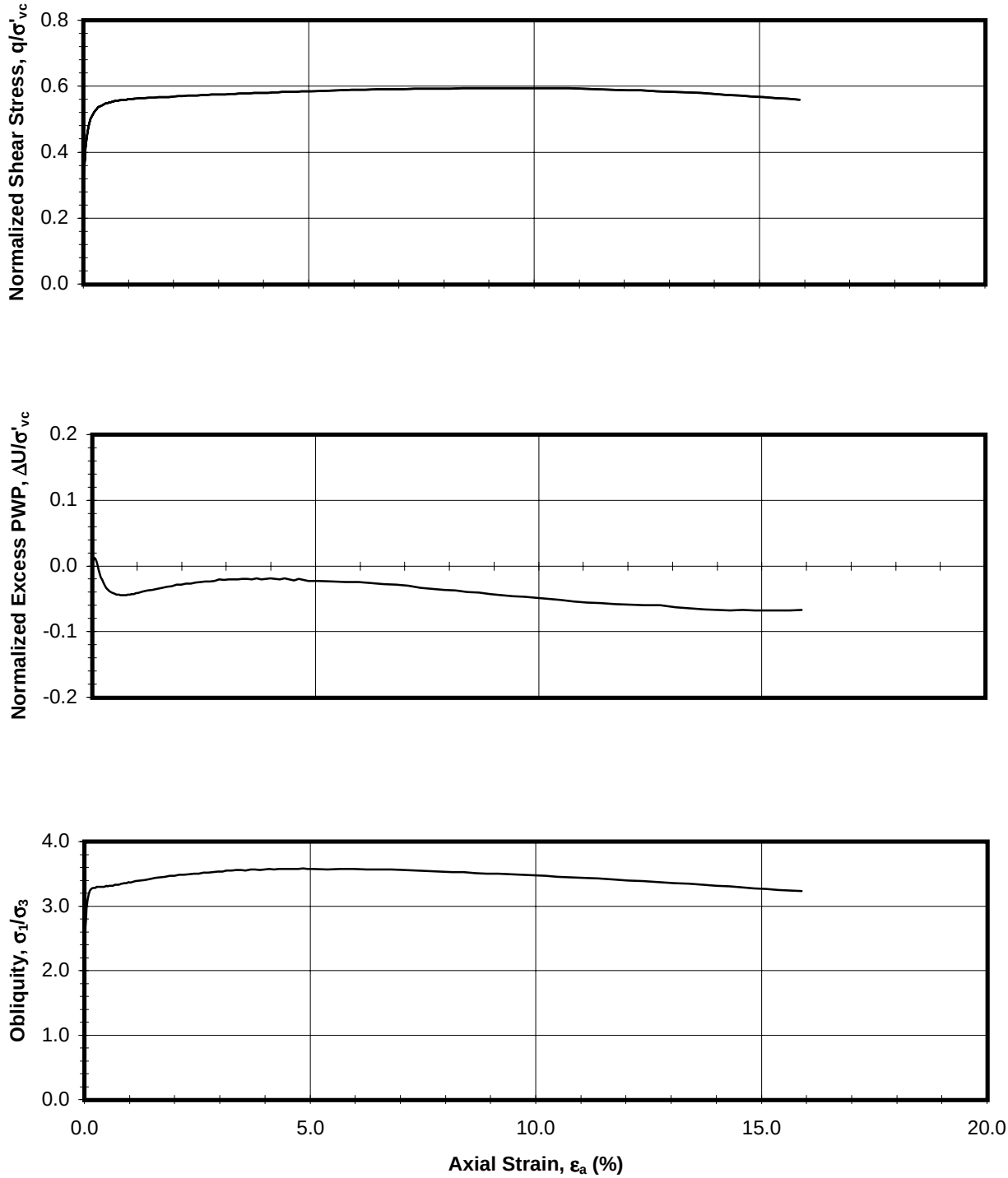
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 30 - Depth: 13.8m

Boring 98-30

SFOBB East Span Seismic Safety Project

PLATE 98-30.15a.1

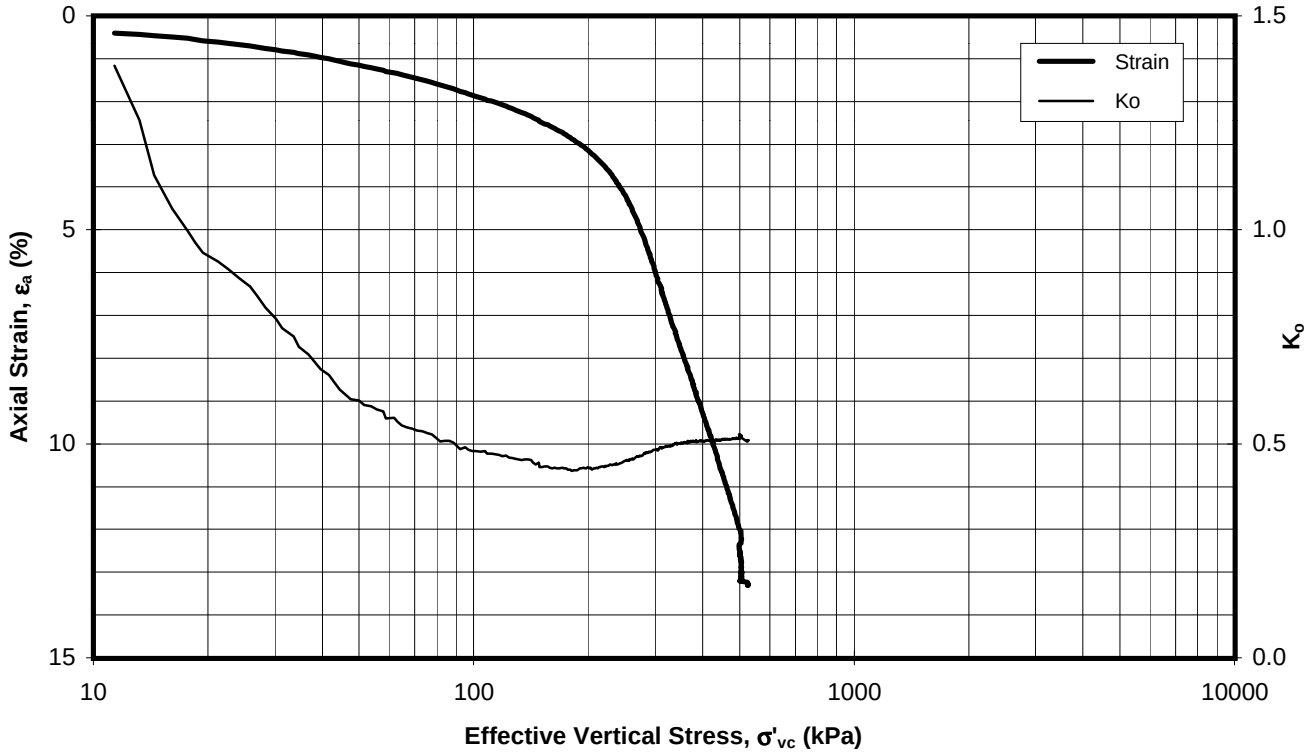


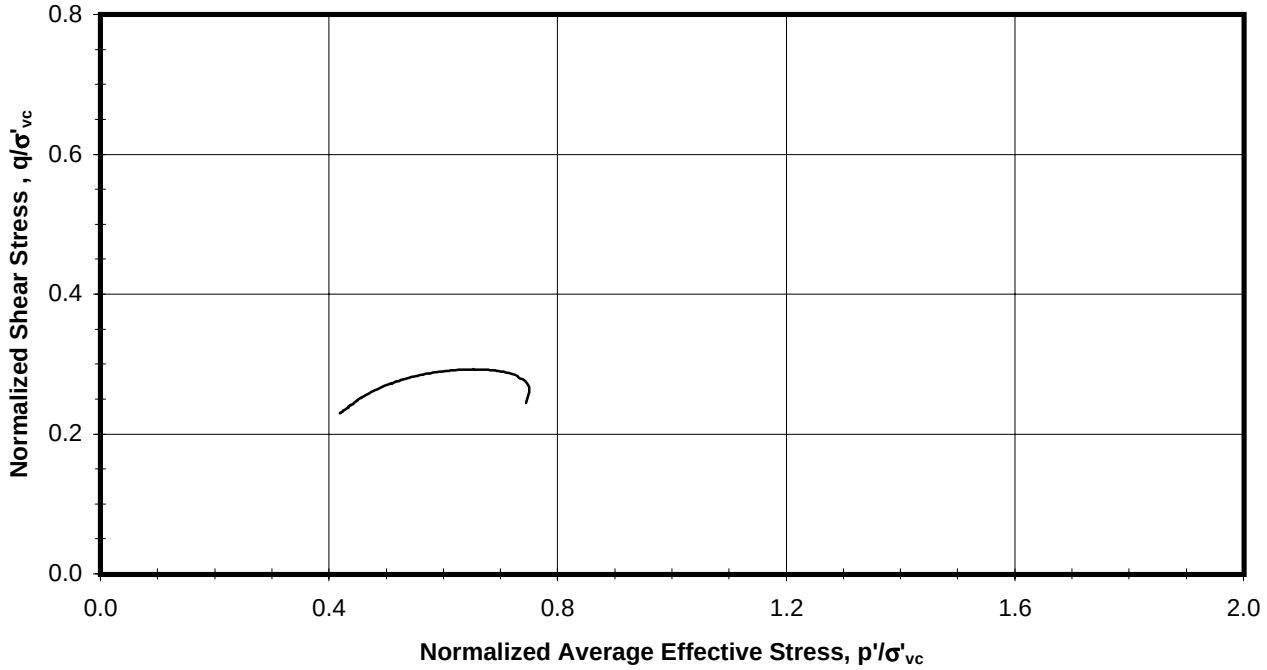
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 30 - Depth: 13.8m

Boring 98-30

SFOBB East Span Seismic Safety Project





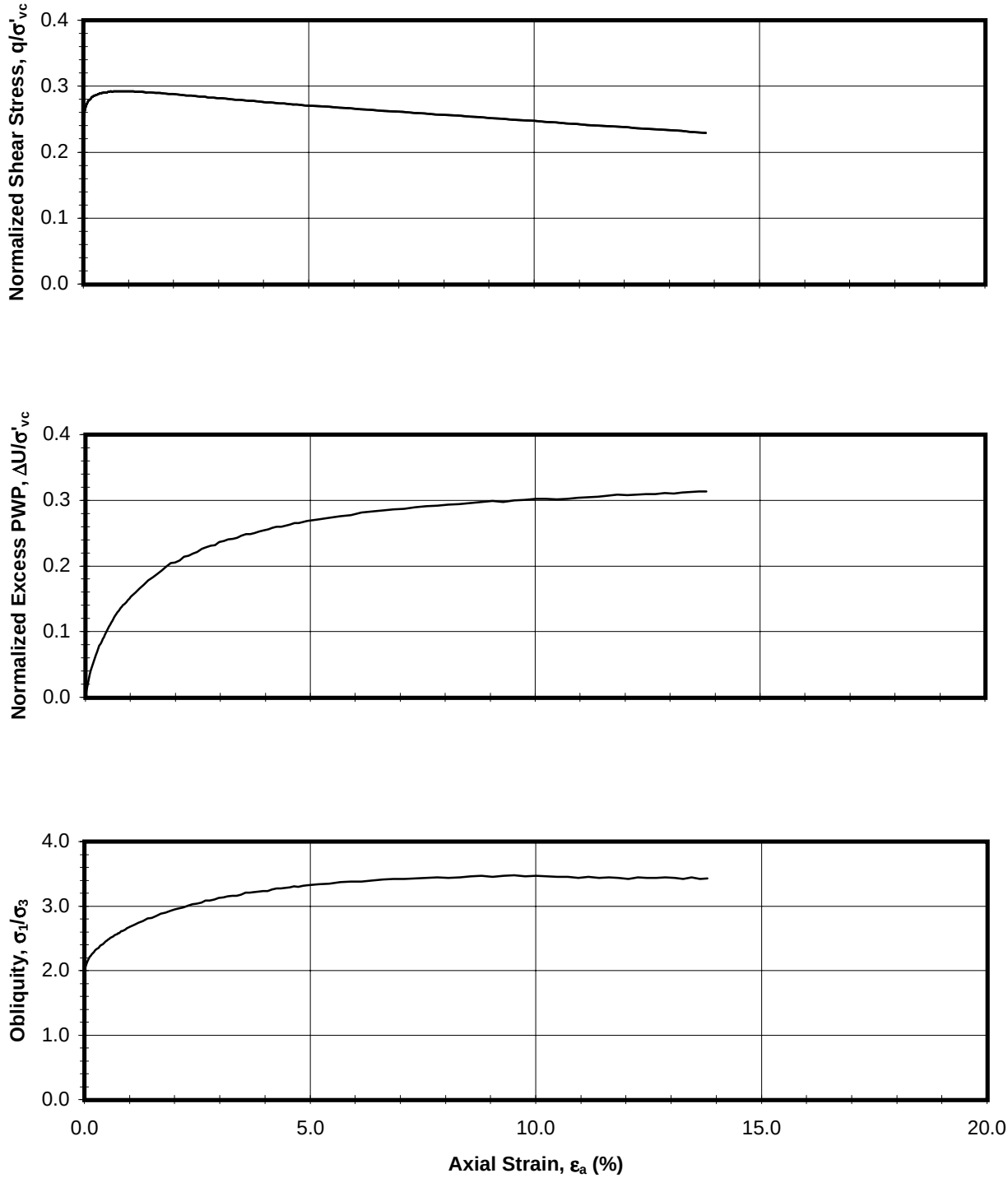
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 38 - Depth: 23.4m

Boring 98-30

SFOBB East Span Seismic Safety Project

PLATE 98-30.15b.1

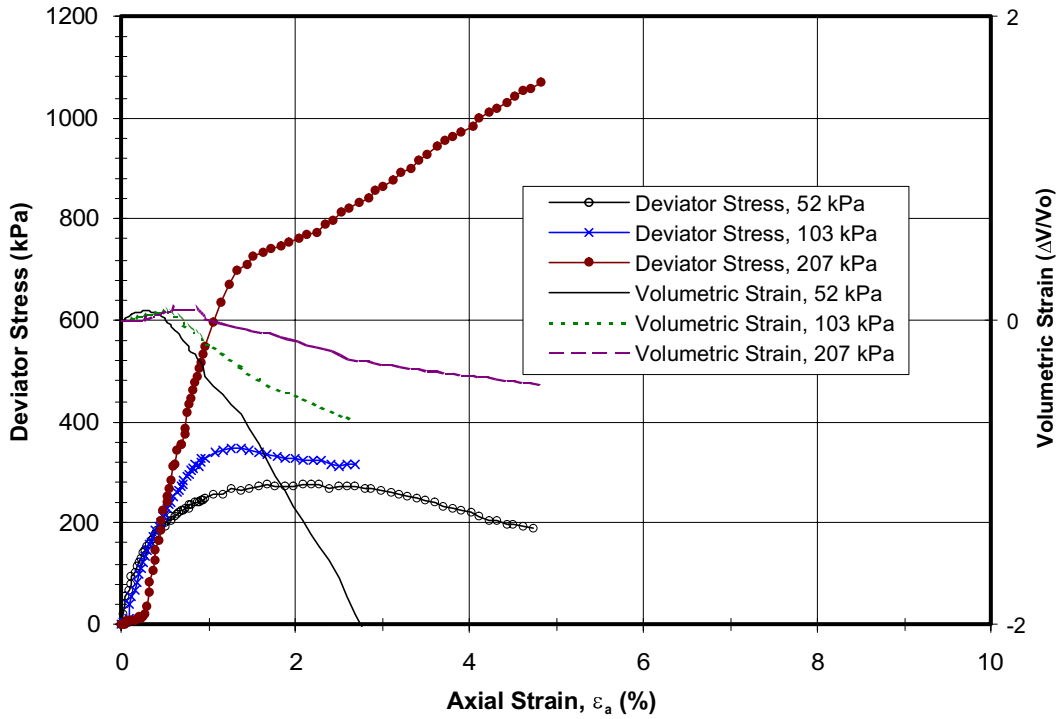


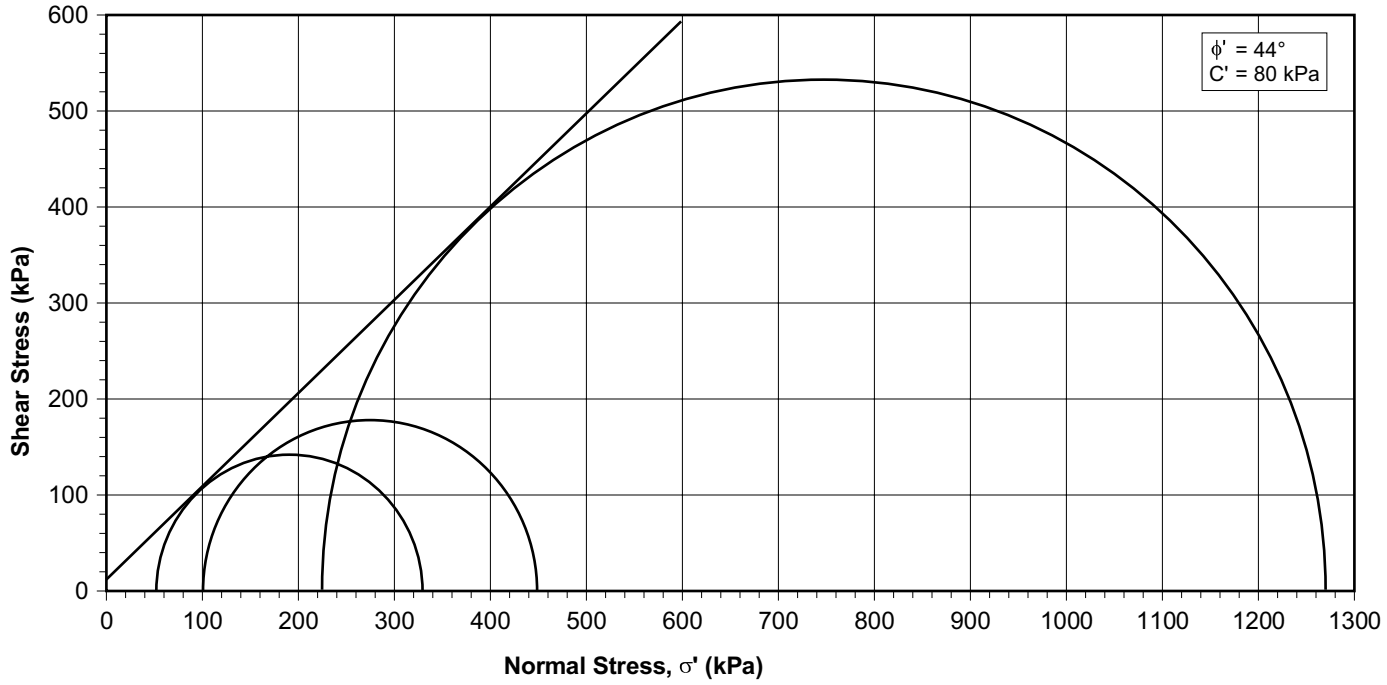
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 38 - Depth: 23.4m

Boring 98-30

SFOBB East Span Seismic Safety Project





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 20 - Depth: 6.7m

Boring 98-30

SFOBB East Span Seismic Safety Project

PLATE 98-30.16

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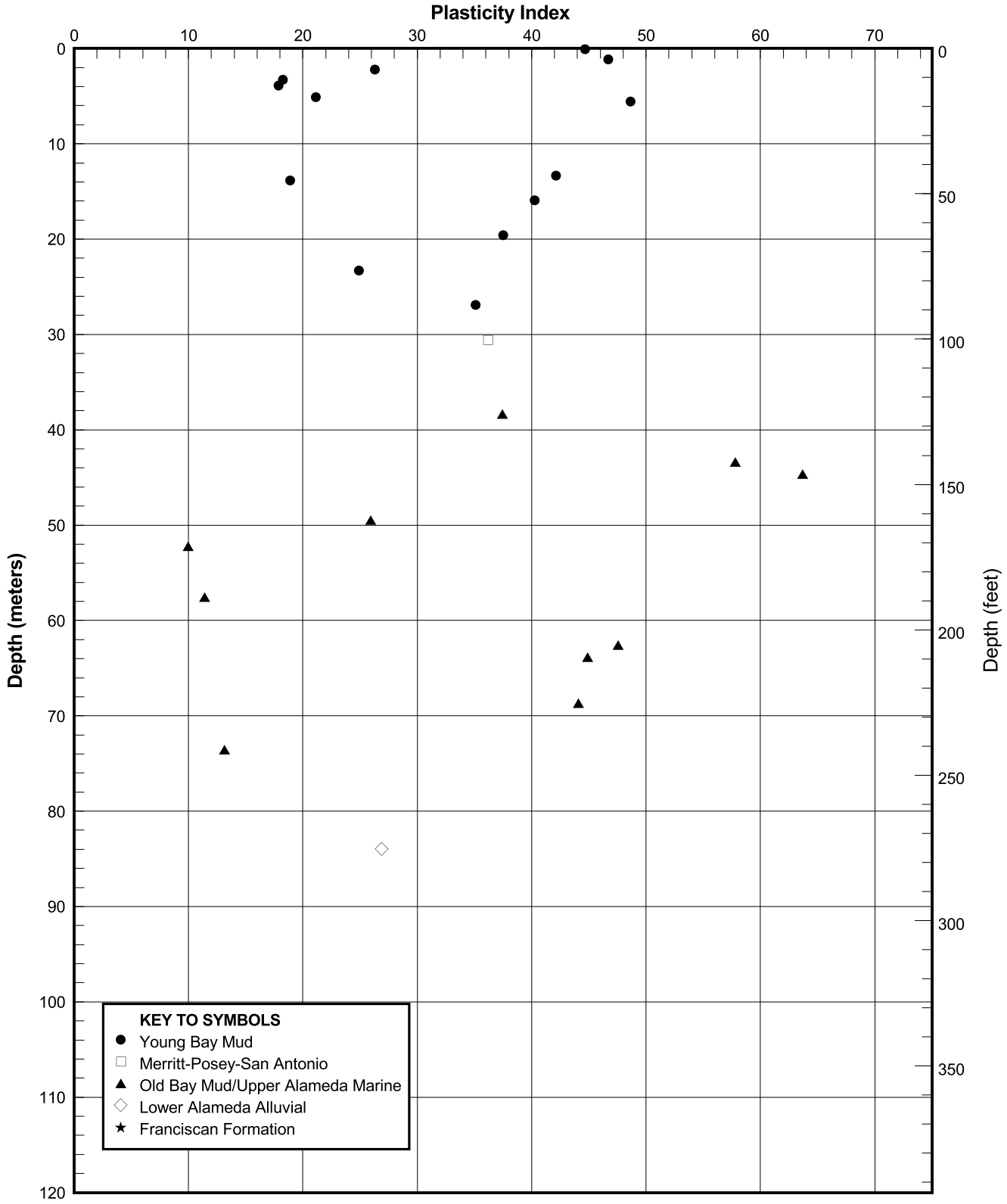
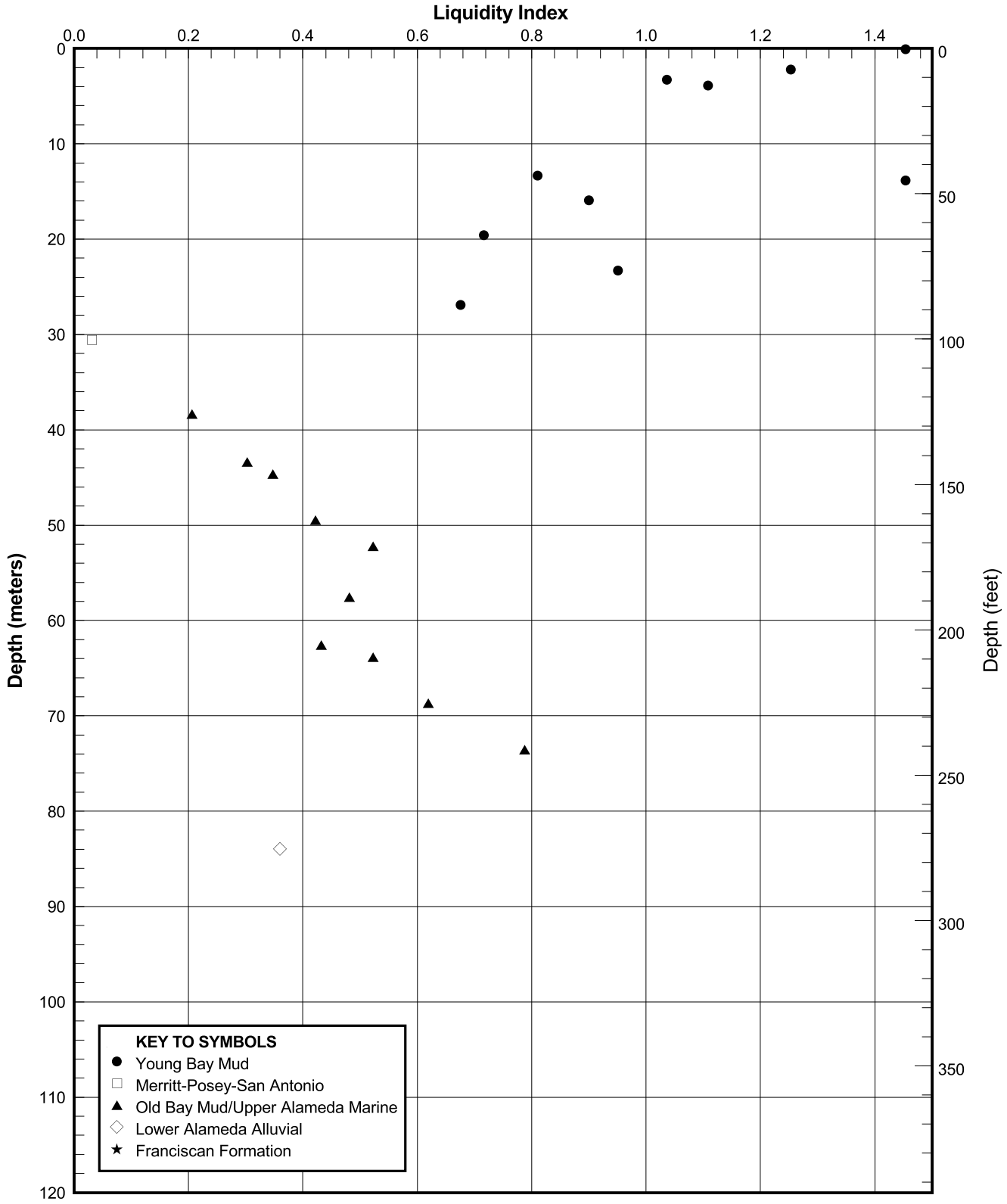
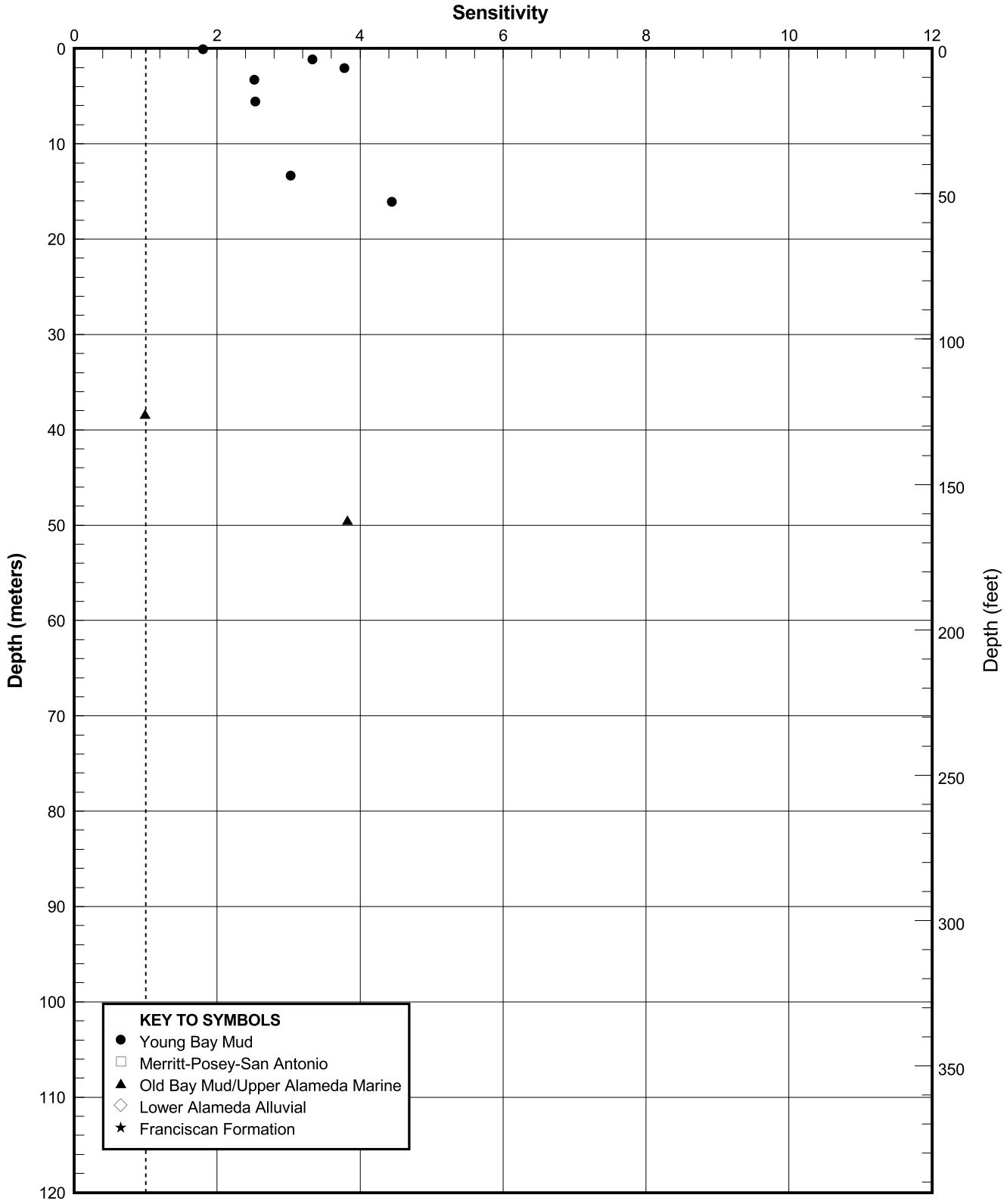


PLASTICITY INDEX PROFILE
Boring 98-30
SFOBB East Span Seismic Safety Project

PLATE 98-30.17

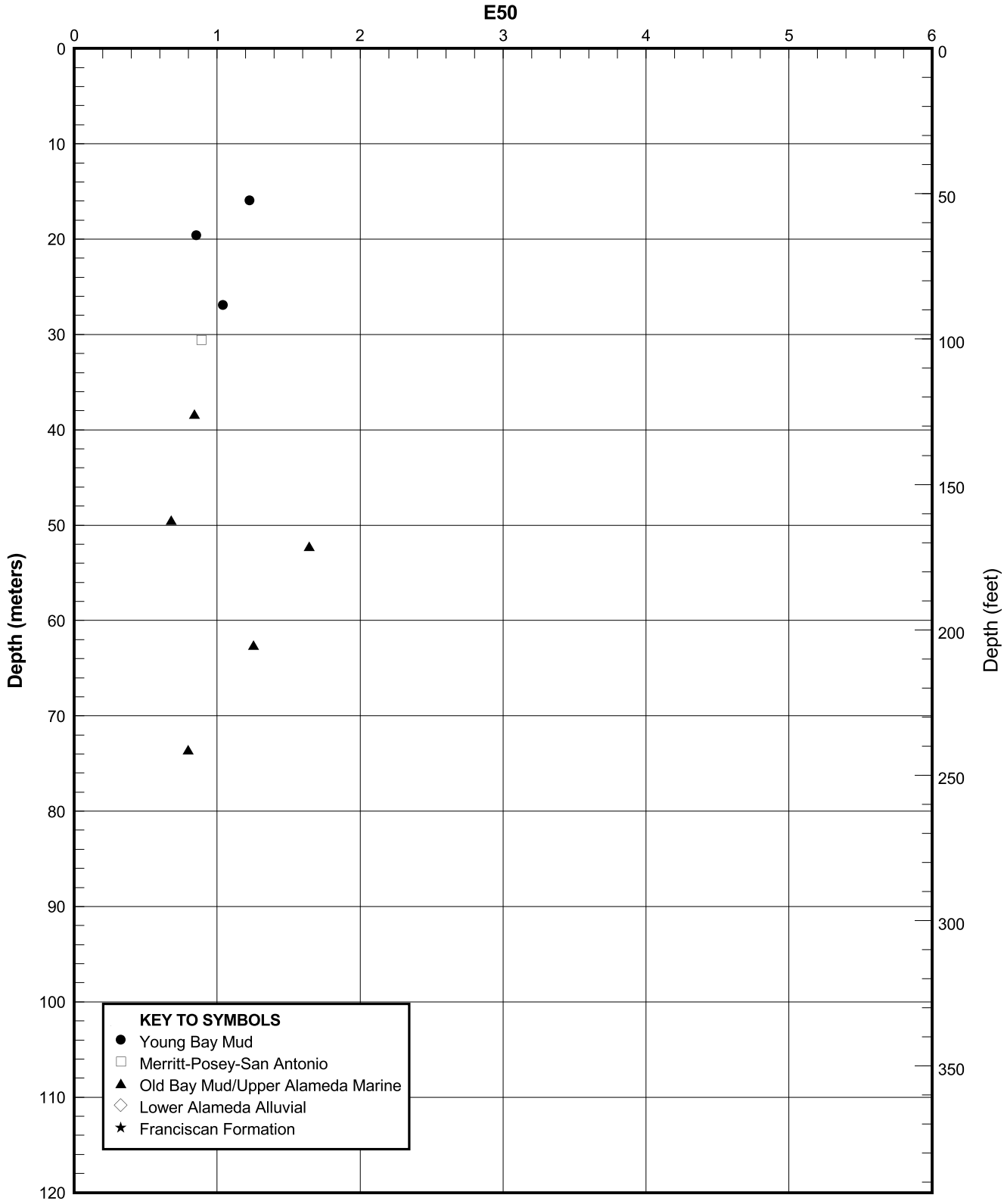


LIQUIDITY INDEX PROFILE
Boring 98-30
SFOBB East Span Seismic Safety Project



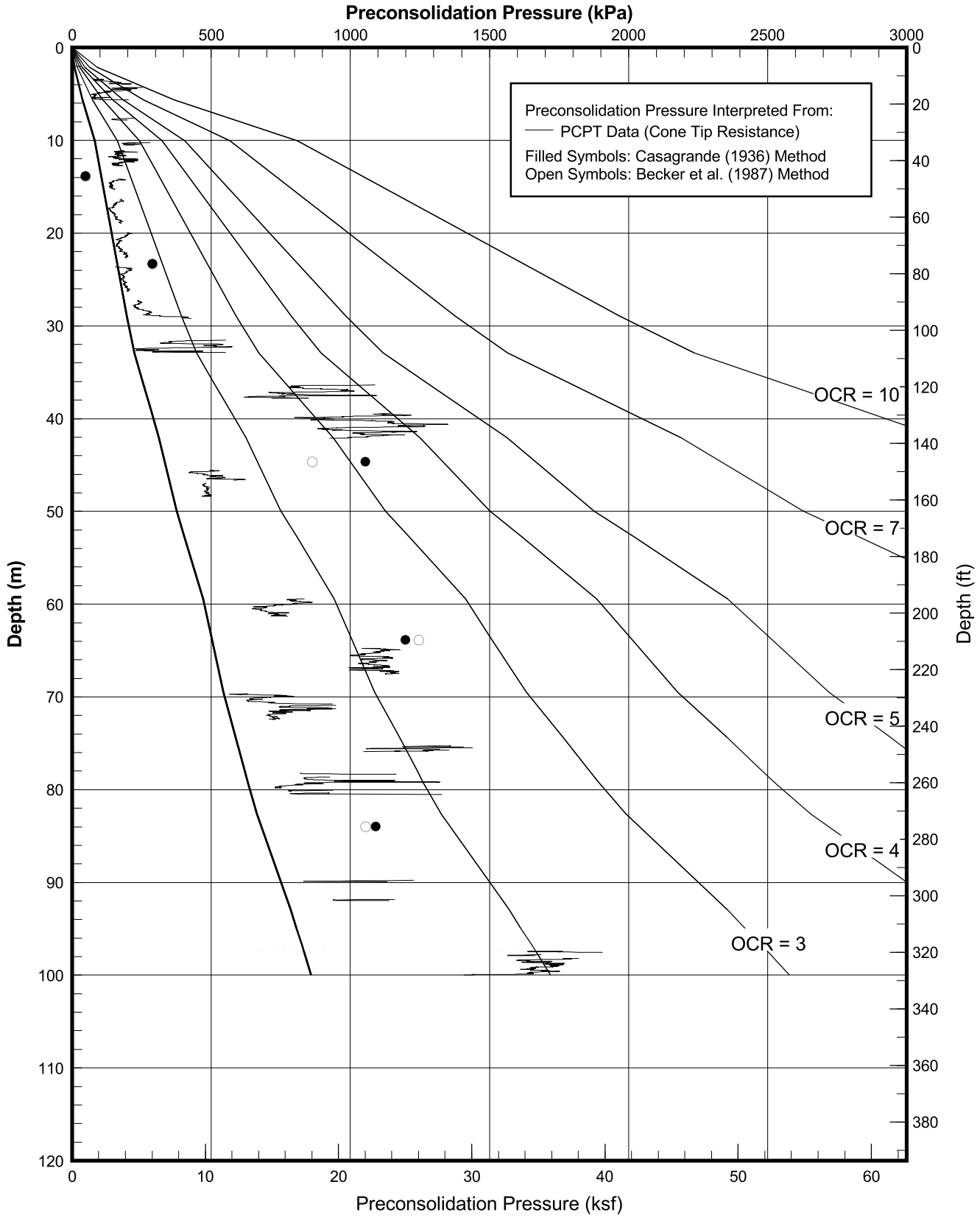
SENSITIVITY PROFILE
Boring 98-30
SFOBB East Span Seismic Safety Project

PLATE 98-30.19



E50 PROFILE
Boring 98-30
SFOBB East Span Seismic Safety Project

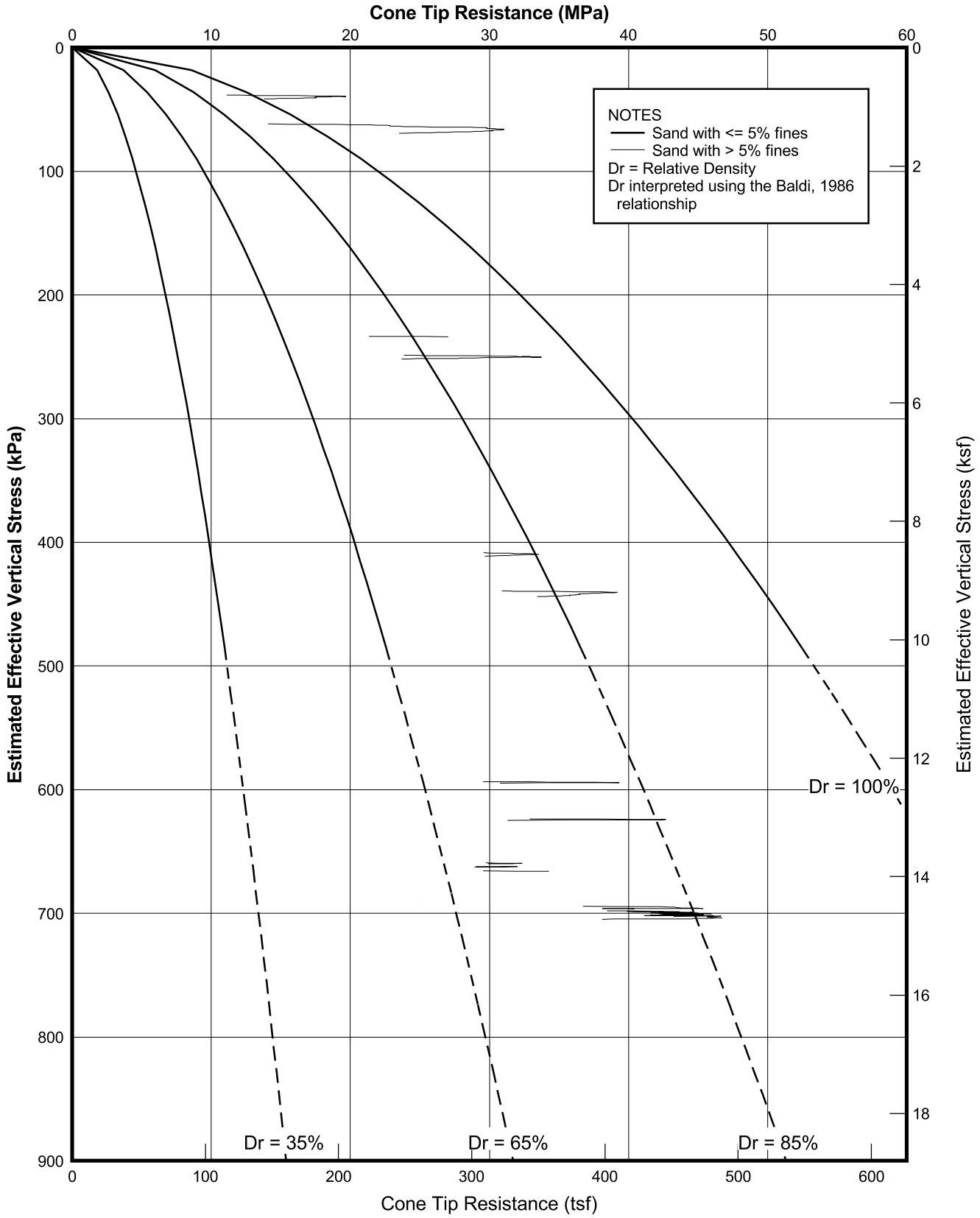
PLATE 98-30.20



PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-30

SFOBB East Span Seismic Safety Project



RELATIVE DENSITY INTERPRETED FROM CPT DATA

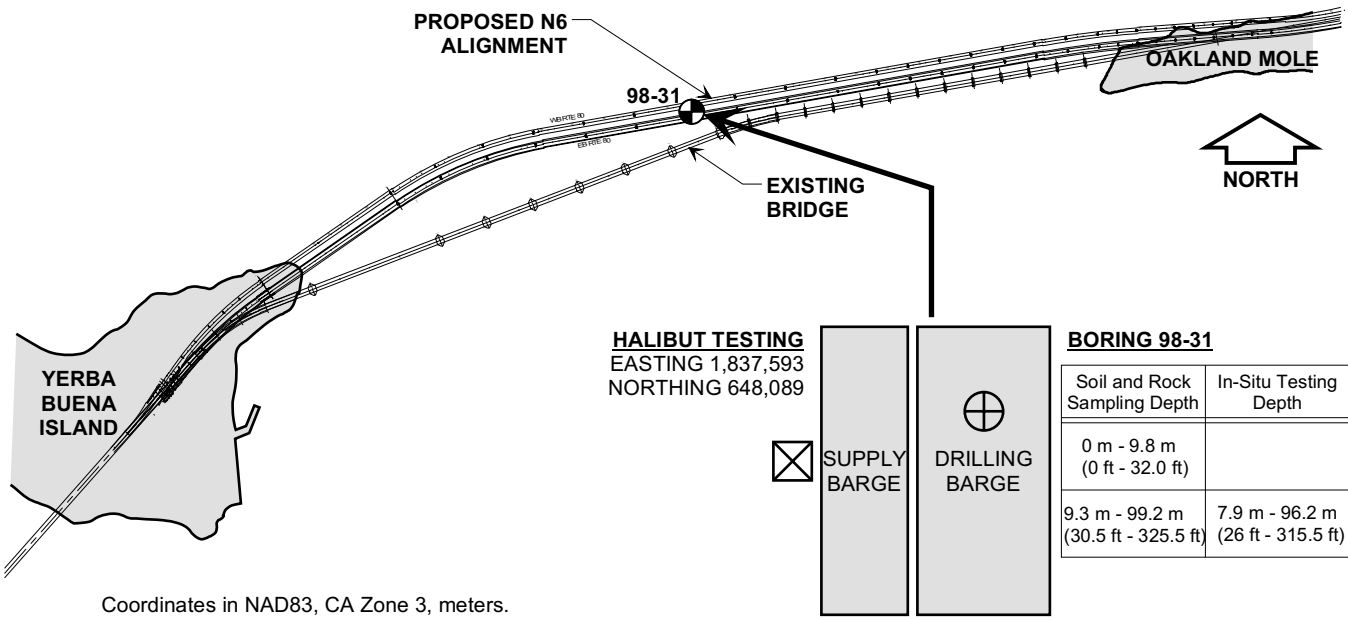
Boring 98-30

SFOBB East Span Seismic Safety Project

BORING 98-31

Date	Time From	Time To	Description of Activity
September 9, 1998	1430	1550	Move barge to location 98-31. Set 4 anchors and 2 spuds.
	1550	1630	Rig up for drilling.
	1630	1645	Lower drill pipe to mudline and measure water depth of 6.0m (19.8 ft) using bottom sensor. Current tide level is approximately 0.8m (2.5 ft) MSL. Calculate mudline elevation of –5.3m (-17.3 ft) MSL.
	1645	2035	Drill and sample from mudline to 9.8m (32 ft). Pull drill pipe to deck.
	****	****	
	1755	1830	Repair mud pump switch case.
	****	****	
	2035	2110	Reposition barge.
	2110	2400	Set casing. Rig up Halibut vane equipment. Perform Halibut vane shear testing from 0.6m (2 ft) to 3.7m (12 ft).
September 10, 1998	0000	0350	Halibut vane shear testing from 3.6m (12 ft) to 5.5m (18 ft).
	****	****	
	0000	0300	Drive stinger to 7.9m (26 ft).
	0300	0350	Lower drill pipe to mudline and drill to 7.9m (26 ft).
	0350	2400	Drill, sample, and CPT and remote vane testing from 7.9m (26 ft) to 57.0m (187 ft).
September 11, 1998	0000	1800	Drill, sample, and CPT testing from 57.0m (187 ft) to 99.2m (325.5 ft).
	1800	1930	Pull drill pipe to deck.
	1930	2100	Wait on suspension logger.
	2100	2400	P- and S-wave velocity logging from 90.5m (296.9 ft) to 9.0m (29.5 ft).
September 12, 1998	0000	0100	Lower N-rod.
	0100	0300	Repair cement pump.
	0300	0500	Mix and circulate cement by hand.
	0500	0530	Grout hole 98-31.
	0530	0830	Pull N-rod and casing to deck.
	0830	1000	Pull 2 spuds, 4 anchors, and move barge to location 98-32.

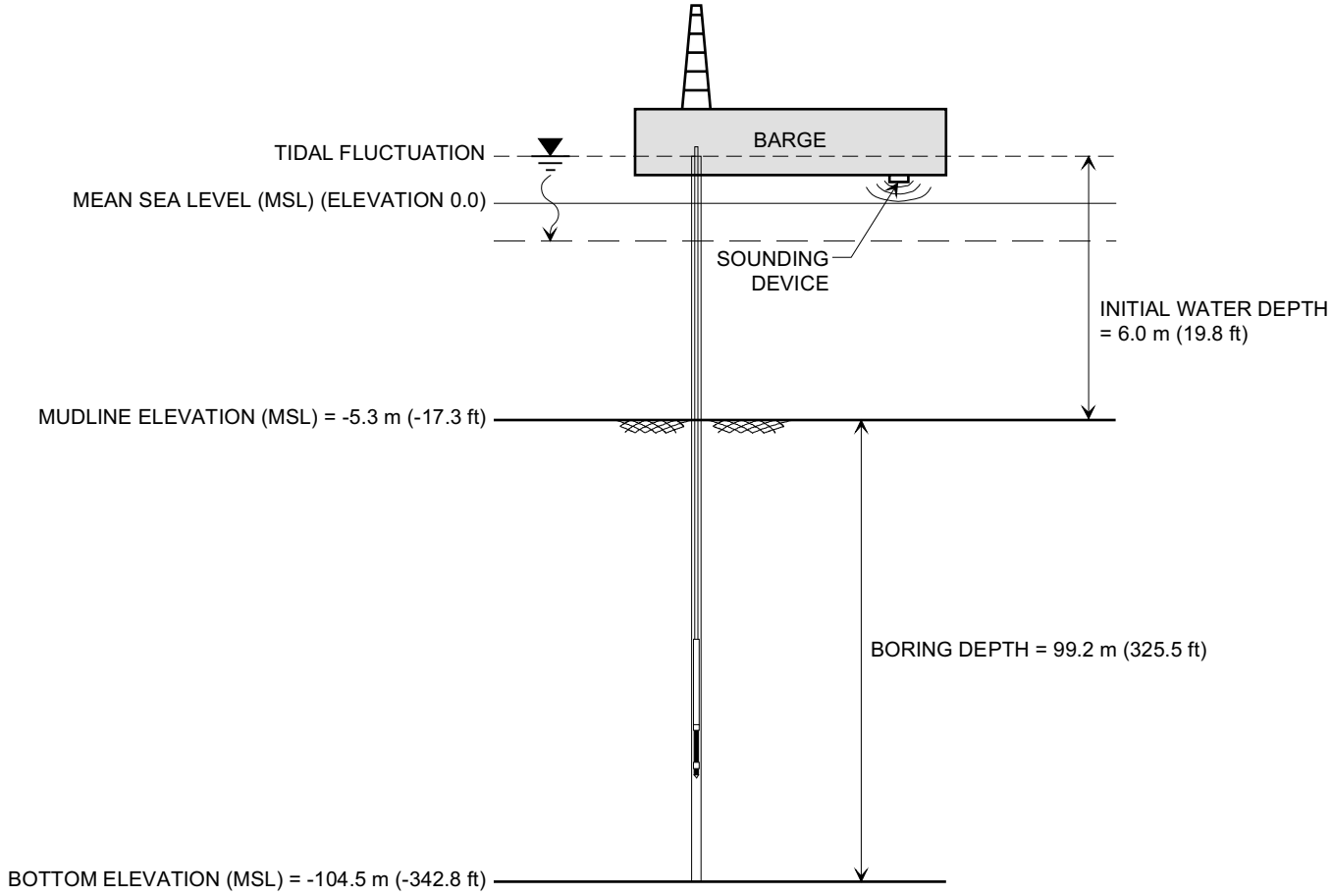
SUMMARY OF FIELD OPERATIONS
Boring 98-31
SFOBB East Span Seismic Safety Project



BORING 98-31

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 9.8 m (0 ft - 32.0 ft)		E = 1,837,608 N = 648,090
9.3 m - 99.2 m (30.5 ft - 325.5 ft)	7.9 m - 96.2 m (26 ft - 315.5 ft)	E = 1,837,605 N = 648,086

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-31
SFOBB East Span Seismic Safety Project

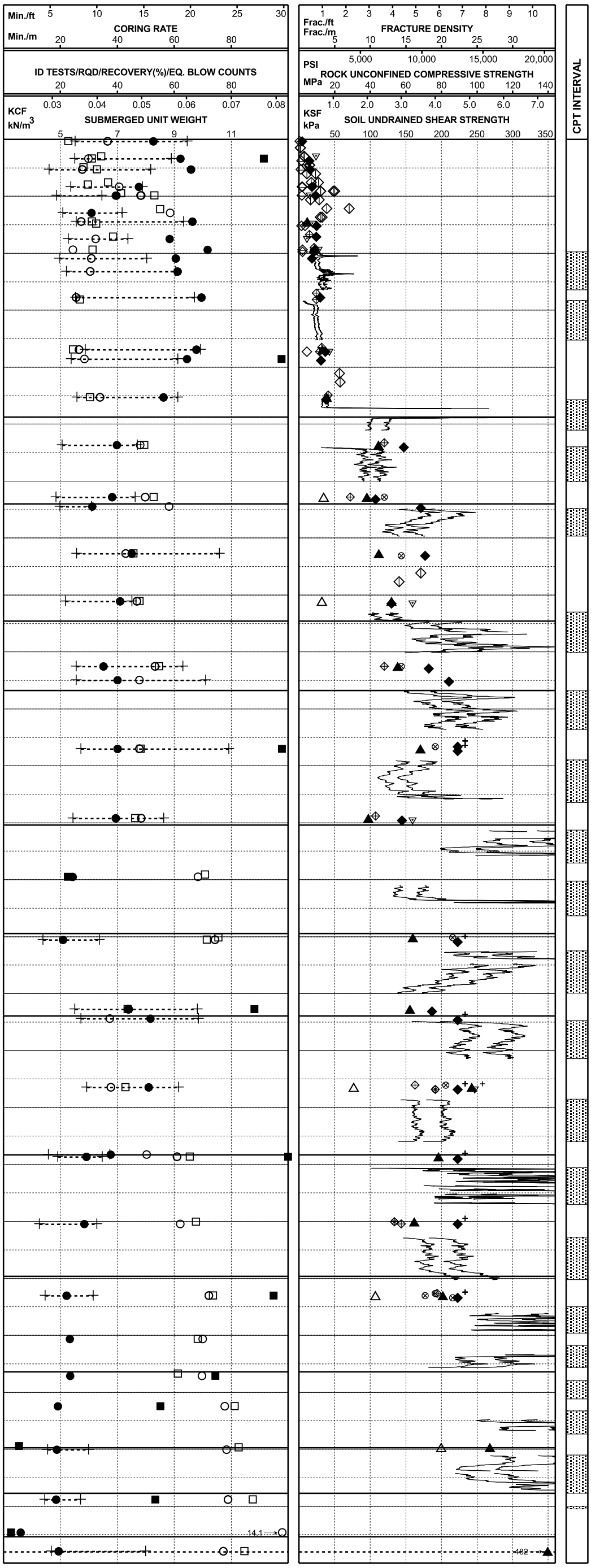
PROJECT NO:	98-42-0054	**START DATE:**	09/09/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-31 (Skyway Frame 2)	**COMPLETION DATE:**	09/12/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837605 N648086
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.3m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), soft to firm, olive gray	I
		WOH	-with silt pockets, shells and shell fragments	
		WOH	-very soft clay to 0.6m	
-8		WOH		
	4	WOH	-with sand pockets at 3.7m	
		8/60cm		
		30/60cm	-sand layer, 6.1m to 6.4m	
-12		9/60cm		
	8	9/60cm		
		PUSH	-with a sand layer at 8.2m	
		PUSH	-with organic pockets, 9.1m to 11.3m	
			-with sand pockets at 9.4m	
-16		PUSH	-platy, 11.0m to 18.3m	
	12			
-20		PUSH	-blocky and with gas blisters, at 14.6m	
		SAVE		
	16			
		PUSH	-with gas blisters at 18.0m	
-24			-dense sand, 18.9m to 19.5m (19.5m)	
	20		Fat CLAY (CH), very stiff to stiff, olive gray to gray	II
		PUSH	-with silt and sand pockets	
-28				
	24		-with a few shell fragments and mica, at 24.7m (25.6m)	
		PUSH		
		SAVE		
-32			Fat CLAY (CH), hard to very stiff, greenish gray	III
	28		-slightly micaceous sandy lean clay to 27.7m	
		PUSH	-desiccated, with organic pockets and gas blisters, at 29.3m	
-36				
	32	PUSH	-gray, with shell fragments and many silt pockets and partings, at 32.3m (33.8m)	
-40			Fat CLAY (CH), very stiff to hard, gray	IV
	36		-with a silt layer, 34.6m to 34.7m	
		PUSH	-with silt partings, organic pockets and gas blisters, at 37.2m	
		SAVE	(38.7m)	
-44			Fat CLAY (CH), very stiff to hard, gray	V
	40		-with organic pockets	
-48		PUSH	-with a few gas blisters, slickensides and wood fragments, at 42.7m	
	44			
-52			-sand layer, 46.3m to 46.6m	
	48	PUSH	-with silt pockets at 47.5m (48.2m)	
-56			Interlayered Fat CLAY (CH), hard to very stiff, and Silty SAND (SM), dense	VI
	52	PUSH	-greenish gray silty sand, with clay pockets, seams and layers, 50.3m to 52.4m	
			-with medium to coarse sand, gravel, and shell fragments, at 51.5m	
-60			(55.8m)	
	56	PUSH	Lean to Fat CLAY (CL/CH), hard to very stiff, gray	VII
			-hard greenish gray lean clay to 59.4m	
-64			-with silt pockets, a few organic pockets, and a few shell fragments, at 56.1m	
	60		-with a sand layer at 57.6m	
		PUSH	-with silt partings and pockets, at 61.0m (61.6m)	
		SAVE		
-68			Fat CLAY (CH), hard, gray	VIII
	64			
		PUSH	-with greenish gray bands and silt pockets, partings and seams, at 66.4m	
-72				
	68		(71.3m)	
-76		PUSH	Lean CLAY (CL), hard, gray	IX
	72		-interlayered with silt and sand, with organic pockets, to 76.2m	
-80				
	76	30/30cm	-with desiccated clay seams at 76.2m	
-84			See Plate 98-31.6 for detailed stratigraphy	
	80		(79.9m)	
		PUSH	Lean CLAY (CL), hard, greenish gray	X
		SAVE	-with silt pockets and a few calcareous nodules, at 81.1m	
-88			-gray silty fine sand layer, 81.7m to 82.4m	
	84		-with sand layers, 83.1m to 83.8m	
		30/35cm	-with a few shell fragments at 84.4m	
			-dense sand with clay seams, 84.7m to 85.3m	
-92		30/30cm	(86.6m)	
	88		Silty Fine SAND (SM), dense, gray	XI
		30/30cm	-silt with sand and with clay seams and layers, 86.9m to 87.5m	
			-with a clay layer at 88.2m	
-96			-clay layer, 89.9m to 90.2m	
			-clay layer, 90.4m to 90.7m	
	92	30/30cm	-sand with silt, below 90.7m (91.9m)	
			Lean CLAY (CL), hard, greenish gray	XII
			-with organic pockets at 92.0m	
-100			-with a silt layer at 93.6m	
			(95.1m)	
	96	30/25cm	GRAVEL with sand (GP), very dense, gray, subangular	XIII
			-olive brown sandy lean clay with gravel, 95.4m to 96.0m	
		30/35cm	(98.1m)	
-104		30/15cm	Fat CLAY (CH), hard, dark yellowish brown mottled with gray	XIV

TOTAL DEPTH: 99.2m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-31

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

PLATE 98-31.3

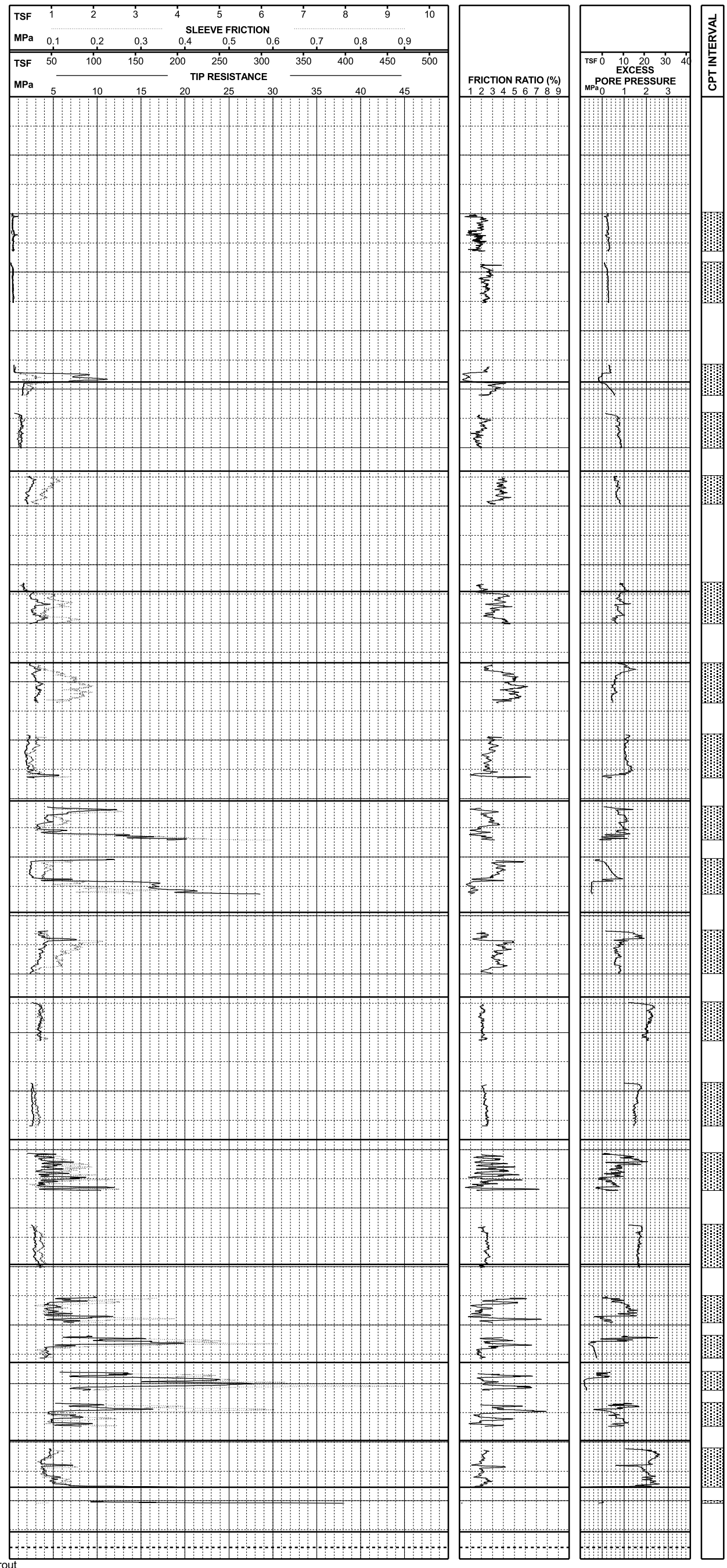
PROJECT NO:	98-42-0054	**START DATE:**	09/09/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-31 (Skyway Frame 2)	**COMPLETION DATE:**	09/12/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837605 N648086
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.3m (MSL)

Elevation, m.	Depth, m.	Blow Count	Material Description	Stratum No.
		WOH	Fat CLAY (CH), soft to firm, olive gray	I
		WOH	-with silt pockets, shells and shell fragments	
		WOH	-very soft clay to 0.6m	
-8	4	WOH	-with sand pockets at 3.7m	
		8/60cm		
		30/60cm	-sand layer, 6.1m to 6.4m	
-12		9/60cm		
	8	9/60cm		
		PUSH	-with a sand layer at 8.2m	
		PUSH	-with organic pockets, 9.1m to 11.3m	
			-with sand pockets at 9.4m	
-16		PUSH	-platy, 11.0m to 18.3m	
	12		See Plate 98-31.6 for detailed stratigraphy	
-20		PUSH SAVE	-blocky and with gas blisters, at 14.6m	
	16			
		PUSH	-with gas blisters at 18.0m	
-24			-dense sand, 18.9m to 19.5m (19.5m)	
	20		Fat CLAY (CH), very stiff to stiff, olive gray to gray	II
		PUSH	-with silt and sand pockets	
-28	24		-with a few shell fragments and mica, at 24.7m (25.6m)	
		PUSH SAVE		
-32	28		Fat CLAY (CH), hard to very stiff, greenish gray	III
			-slightly micaceous sandy lean clay to 27.7m	
		PUSH	-desiccated, with organic pockets and gas blisters, at 29.3m	
-36	32	PUSH	-gray, with shell fragments and many silt pockets and partings, at 32.3m (33.8m)	
-40	36		Fat CLAY (CH), very stiff to hard, gray	IV
			-with a silt layer, 34.6m to 34.7m	
		PUSH SAVE	-with silt partings, organic pockets and gas blisters, at 37.2m (38.7m)	
-44	40		Fat CLAY (CH), very stiff to hard, gray	V
			-with organic pockets	
-48	44	PUSH	-with a few gas blisters, slickensides and wood fragments, at 42.7m	
-52	48	PUSH	-sand layer, 46.3m to 46.6m -with silt pockets at 47.5m (48.2m)	
-56	52	PUSH	Interlayered Fat CLAY (CH), hard to very stiff, and Silty SAND (SM), dense	VI
			-greenish gray silty sand, with clay pockets, seams and layers, 50.3m to 52.4m	
-60			-with medium to coarse sand, gravel, and shell fragments, at 51.5m (55.8m)	
	56	PUSH	Lean to Fat CLAY (CL/CH), hard to very stiff, gray	VII
-64	60		-hard greenish gray lean clay to 59.4m -with silt pockets, a few organic pockets, and a few shell fragments, at 56.1m -with a sand layer at 57.6m (61.6m)	
		PUSH SAVE		
-68	64		Fat CLAY (CH), hard, gray	VIII
		PUSH	-with greenish gray bands and silt pockets, partings and seams, at 66.4m (71.3m)	
-72	68			
-76		PUSH		
	72		Lean CLAY (CL), hard, gray	IX
			-interlayered with silt and sand, with organic pockets, to 76.2m	
-80	76	30/30cm	-with desiccated clay seams at 76.2m (79.9m)	
-84	80		Lean CLAY (CL), hard, greenish gray	X
		PUSH SAVE	-with silt pockets and a few calcareous nodules, at 81.1m	
-88	84	30/35cm	-gray silty fine sand layer, 81.7m to 82.4m -with sand layers, 83.1m to 83.8m -with a few shell fragments at 84.4m -dense sand with clay seams, 84.7m to 85.3m (86.6m)	
-92		30/30cm	Silty Fine SAND (SM), dense, gray	XI
	88	30/30cm	-silt with sand and with clay seams and layers, 86.9m to 87.5m -clay layer, 89.9m to 90.2m -clay layer, 90.4m to 90.7m -sand with silt, below 90.7m (91.9m)	
-96	92	30/30cm	Lean CLAY (CL), hard, greenish gray	XII
			-with organic pockets at 92.0m -with a silt layer at 93.6m (95.1m)	
-100	96	30/25cm	GRAVEL with sand (GP), very dense, gray, subangular (98.1m)	XIII
		30/35cm		
-104		30/15cm	Fat CLAY (CH), hard, dark yellowish brown mottled with gray	XIV

TOTAL DEPTH: 99.2m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-31

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

PLATE 98-31.4

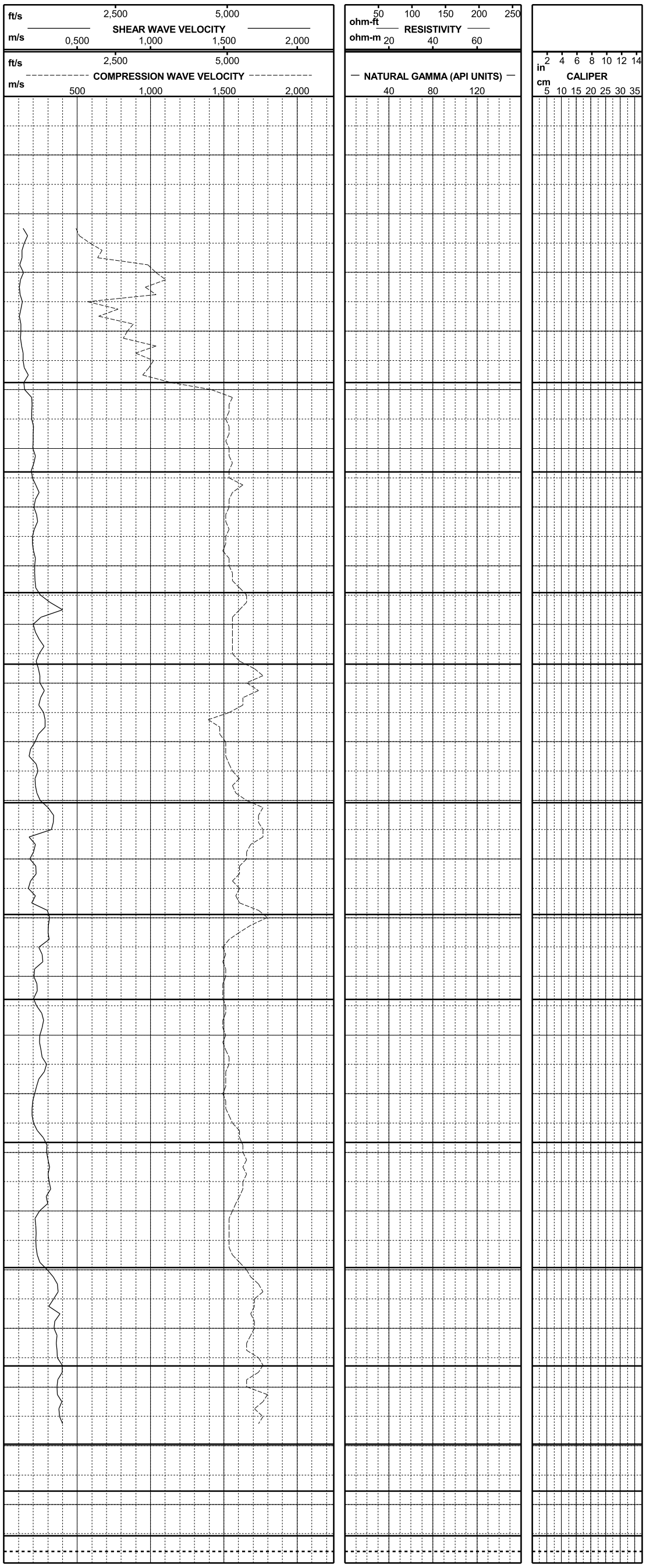
PROJECT NO:	98-42-0054	**START DATE:**	09/09/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-31 (Skyway Frame 2)	**COMPLETION DATE:**	09/12/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837605 N648086
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.3m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), soft to firm, olive gray	I
		WOH	-with silt and sand pockets, shells and shell fragments	
		WOH	-very soft clay to 0.6m	
-8		WOH		
	4	WOH	-with sand pockets at 3.7m	
		8/60cm		
		30/60cm	-sand layer, 6.1m to 6.4m	
-12		9/60cm		
	8	9/60cm		
		PUSH	-with a sand layer at 8.2m	
		PUSH	-with organic pockets, 9.1m to 11.3m	
			-with sand pockets at 9.4m	
-16		PUSH	-platy, 11.0m to 18.3m	
	12			
-20		PUSH SAVE	-blocky and with gas blisters, at 14.6m	
	16			
		PUSH	-with gas blisters at 18.0m	
-24			-dense sand, 18.9m to 19.5m (19.5m)	
	20		Fat CLAY (CH), very stiff to stiff, olive gray to gray	II
		PUSH	-with silt and sand pockets	
-28				
	24			
		PUSH SAVE	-with a few shell fragments and mica, at 24.7m (25.6m)	
-32			Fat CLAY (CH), hard to very stiff, greenish gray	III
	28		-slightly micaceous sandy lean clay to 27.7m	
		PUSH	-desiccated, with organic pockets and gas blisters, at 29.3m	
-36				
	32	PUSH	-gray, with shell fragments and many silt pockets and partings, at 32.3m (33.8m)	
-40			Fat CLAY (CH), very stiff to hard, gray	IV
	36		-with a silt layer, 34.6m to 34.7m	
		PUSH SAVE	-with silt partings, organic pockets and gas blisters, at 37.2m (38.7m)	
-44			Fat CLAY (CH), very stiff to hard, gray	V
	40		-with organic pockets	
-48		PUSH	-with a few gas blisters, slickensides and wood fragments, at 42.7m	
	44			
-52			-sand layer, 46.3m to 46.6m	
	48	PUSH	-with silt pockets at 47.5m (48.2m)	
-56			Interlayered Fat CLAY (CH), hard to very stiff, and Silty SAND (SM), dense	VI
	52	PUSH	-greenish gray silty sand, with clay pockets, seams and layers, 50.3m to 52.4m	
			-with medium to coarse sand, gravel, and shell fragments, at 51.5m	
-60			(55.8m)	
	56	PUSH	Lean to Fat CLAY (CL/CH), hard to very stiff, gray	VII
			-hard greenish gray lean clay to 59.4m	
-64			-with silt pockets, a few organic pockets, and a few shell fragments, at 56.1m	
	60		-with a sand layer at 57.6m	
		PUSH SAVE	-with silt partings and pockets, at 61.0m (61.6m)	
-68			Fat CLAY (CH), hard, gray	VIII
	64			
		PUSH	-with greenish gray bands and silt pockets, partings and seams, at 66.4m	
-72			See Plate 98-31.6 for detailed stratigraphy	
	68			
-76		PUSH	(71.3m)	
	72		Lean CLAY (CL), hard, gray	IX
			-interlayered with silt and sand, with organic pockets, to 76.2m	
-80				
	76	30/30cm	-with desiccated clay seams at 76.2m	
-84			(79.9m)	
	80		Lean CLAY (CL), hard, greenish gray	X
		PUSH SAVE	-with silt pockets and a few calcareous nodules, at 81.1m	
			-gray silty fine sand layer, 81.7m to 82.4m	
-88			-with sand layers, 83.1m to 83.8m	
	84	30/35cm	-with a few shell fragments at 84.4m	
			-dense sand with clay seams, 84.7m to 85.3m	
-92		30/30cm	(86.6m)	
	88		Silty Fine SAND (SM), dense, gray	XI
		30/30cm	-silt with sand and with clay seams and layers, 86.9m to 87.5m	
-96			-clay layer, 89.9m to 90.2m	
			-clay layer, 90.4m to 90.7m	
	92	30/30cm	-sand with silt, below 90.7m (91.9m)	
			Lean CLAY (CL), hard, greenish gray	XII
			-with organic pockets at 92.0m	
-100			-with a silt layer at 93.6m (95.1m)	
	96	30/25cm	GRAVEL with sand (GP), very dense, gray, subangular	XIII
			-olive brown sandy lean clay with gravel, 95.4m to 96.0m (98.1m)	
		30/35cm		
-104		30/15cm	Fat CLAY (CH), hard, dark yellowish brown mottled with gray	XIV

TOTAL DEPTH: 99.2m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-31

SFOBB East Span Seismic Safety Project

Report Date: 05/07/99

FUGRO

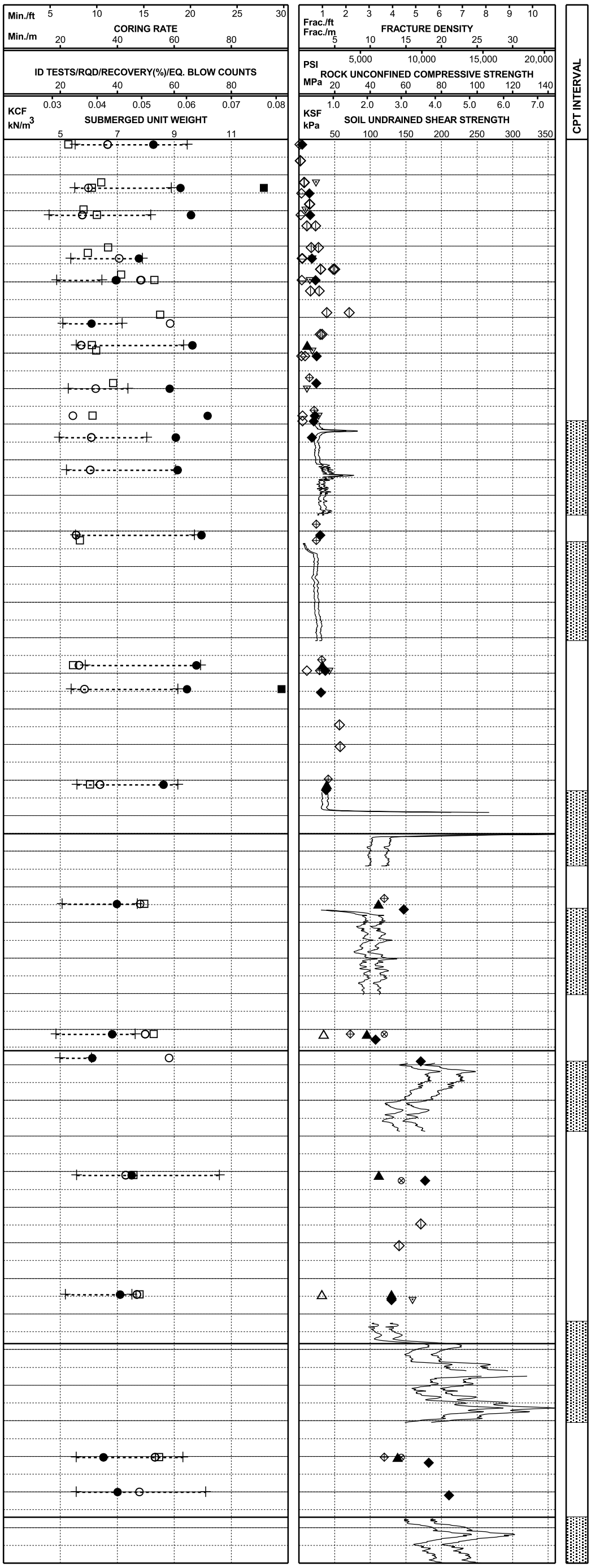
PLATE 98-31.5

PROJECT NO:	98-42-0054	**START DATE:**	09/09/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-31 (Skyway Frame 2)	**COMPLETION DATE:**	09/12/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837605 N648086
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.3m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), soft to firm, olive gray	I
			-with silt pockets, shells and shell fragments	
-6	1		-very soft clay to 0.6m	
		WOH		
-7	2	WOH		
-8	3	WOH		
-9	4	WOH	-with sand pockets at 3.7m	
-10	5	8/60cm		
-11	6	30/60cm	-sand layer, 6.1m to 6.4m	
-12	7	9/60cm		
-13	8	9/60cm		
		PUSH	-with a sand layer at 8.2m	
-14	9	PUSH	-with organic pockets, 9.1m to 11.3m	
			-with sand pockets at 9.4m	
-15	10			
-16	11	PUSH	-platy, 11.0m to 18.3m	
-17	12			
-18	13			
-19	14			
-20	15	PUSH	-blocky and with gas blisters, at 14.6m	
		SAVE		
-21	16			
-22	17			
-23	18	PUSH	-with gas blisters at 18.0m	
-24	19		-dense sand, 18.9m to 19.5m	
			(19.5m)	
-25	20		Fat CLAY (CH), very stiff to stiff, olive gray to gray	II
			-with silt and sand pockets	
-26	21	PUSH		
-27	22			
-28	23			
-29	24			
-30	25	PUSH	-with a few shell fragments and mica, at 24.7m	
			(25.6m)	
-31	26	SAVE	Fat CLAY (CH), hard to very stiff, greenish gray	III
			-slightly micaceous sandy lean clay to 27.7m	
-32	27			
-33	28			
-34	29	PUSH	-desiccated, with organic pockets and gas blisters, at 29.3m	
-35	30			
-36	31			
-37	32	PUSH	-gray, with shell fragments and many silt pockets and partings, at 32.3m	
-38	33			
			(33.8m)	
-39	34		Fat CLAY (CH), very stiff to hard, gray	IV
			-with a silt layer, 34.6m to 34.7m	
-40	35			
-41	36			
-42	37	PUSH	-with silt partings, organic pockets and gas blisters, at 37.2m	
-43	38	SAVE		
			(38.7m)	
-44	39		Fat CLAY (CH), very stiff to hard, gray	V
			-with organic pockets	
-45				



LOG OF BORING AND TEST RESULTS

BORING 98-31

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

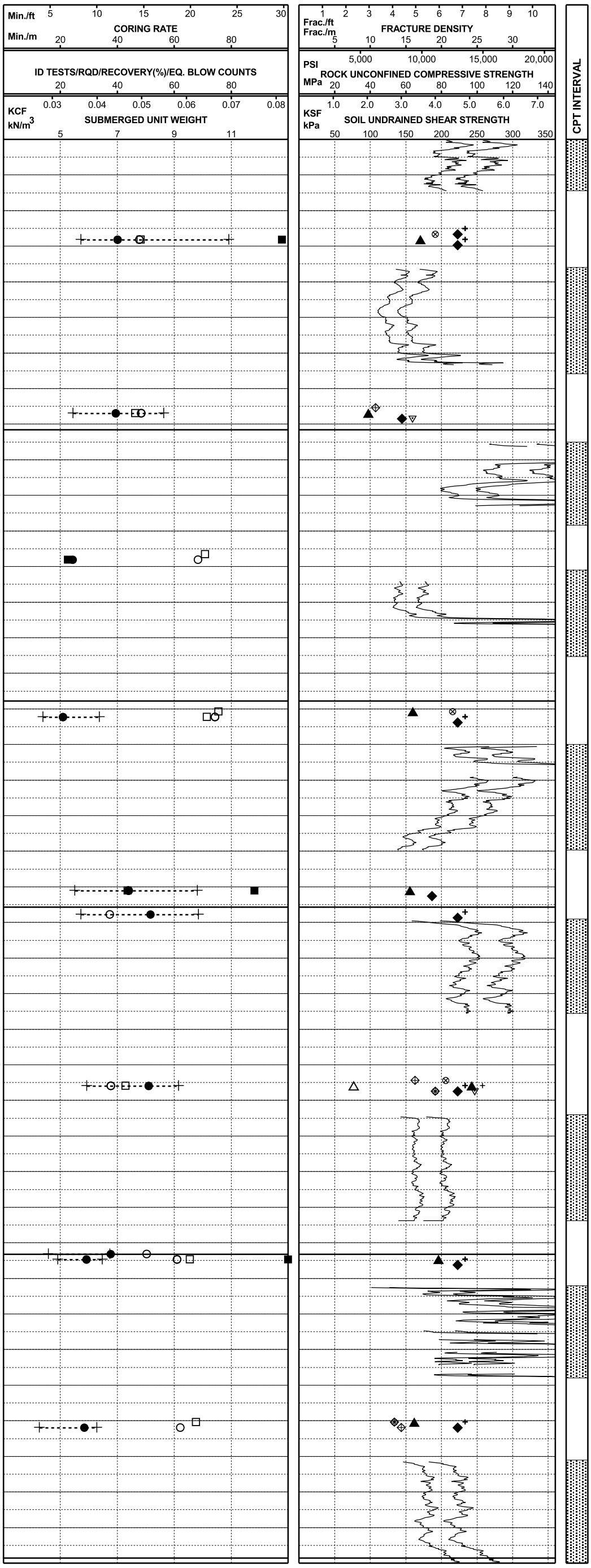
PLATE 98-31.6a

PROJECT NO:	98-42-0054	**START DATE:**	09/09/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-31 (Skyway Frame 2)	**COMPLETION DATE:**	09/12/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837605 N648086
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.3m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-46	41			Fat CLAY (CH), very stiff to hard, gray	V
-47	42				
-48	43		PUSH	-with a few gas blisters, slickensides and wood fragments, at 42.7m	
-49	44				
-50	45				
-51	46				
				-sand layer, 46.3m to 46.6m	
-52	47				
-53	48		PUSH	-with silt pockets at 47.5m (48.2m)	
-54	49			-Interlayered Fat CLAY (CH), hard to very stiff, and Silty SAND (SM), dense	VI
-55	50			-greenish gray silty sand, with clay pockets, seams and layers, 50.3m to 52.4m	
-56	51				
-57	52		PUSH	-with medium to coarse sand, gravel, and shell fragments, at 51.5m	
-58	53				
-59	54				
-60	55				
-61	56		PUSH	Lean to Fat CLAY (CL/CH), hard to very stiff, gray (55.8m)	VII
-62	57			-hard greenish gray lean clay to 59.4m	
				-with silt pockets, a few organic pockets, and a few shell fragments, at 56.1m	
-63	58			-with a sand layer at 57.6m	
-64	59				
-65	60				
-66	61		PUSH	-with silt partings and pockets, at 61.0m (61.6m)	
			SAVE		
-67	62			Fat CLAY (CH), hard, gray	VIII
-68	63				
-69	64				
-70	65				
-71	66		PUSH	-with greenish gray bands and silt pockets, partings and seams, at 66.4m	
-72	67				
-73	68				
-74	69				
-75	70				
-76	71			(71.3m)	
-77	72		PUSH	Lean CLAY (CL), hard, gray -interlayered with silt and sand, with organic pockets, to 76.2m	IX
-78	73				
-79	74				
-80	75				
-81	76		30/30cm	-with desiccated clay seams at 76.2m	
-82	77				
-83	78				
-84	79				
-85				Lean CLAY (CL), hard, greenish gray (79.9m)	X



LOG OF BORING AND TEST RESULTS

BORING 98-31

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

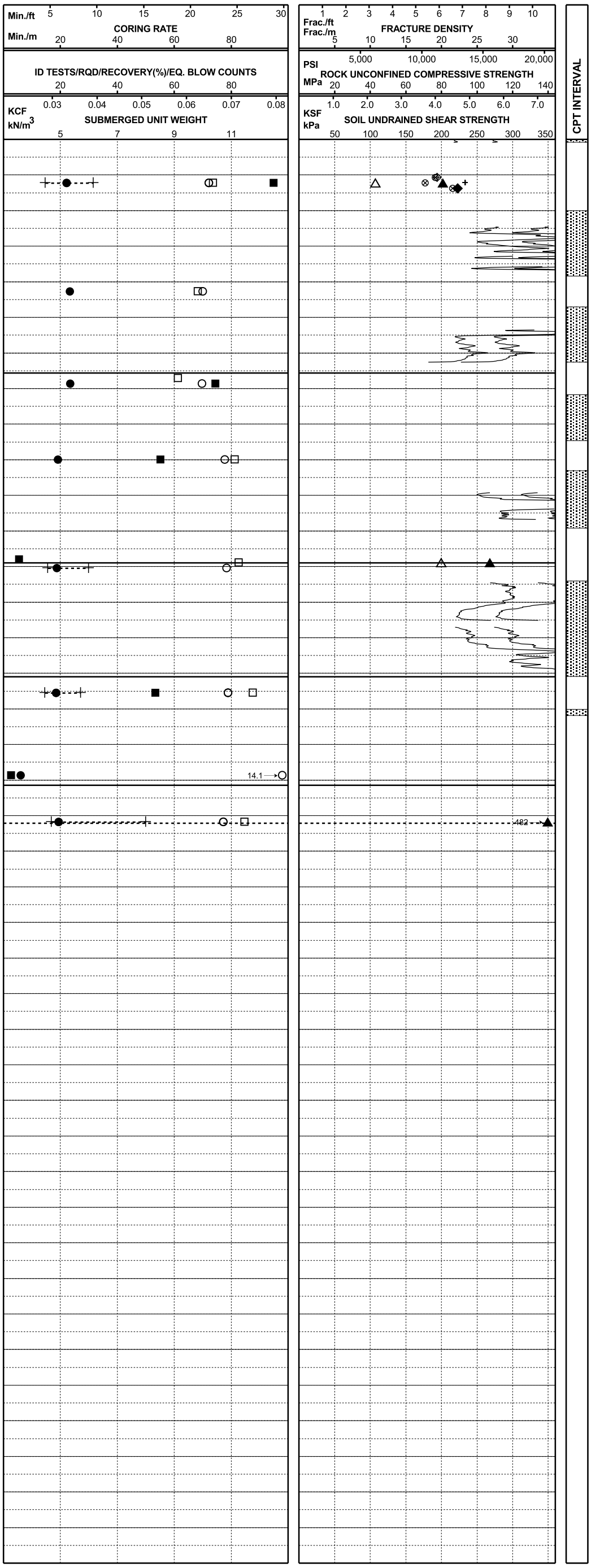
PLATE 98-31.6b

PROJECT NO:	98-42-0054	**START DATE:**	09/09/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-31 (Skyway Frame 2)	**COMPLETION DATE:**	09/12/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837605 N648086
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.3m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
				Lean CLAY (CL), hard, greenish gray	X
-86	81		PUSH	-with silt pockets and a few calcareous nodules, at 81.1m	
-87	82		SAVE	-gray silty fine sand layer, 81.7m to 82.4m	
-88	83			-with sand layers, 83.1m to 83.8m	
-89	84		30/35cm	-with a few shell fragments at 84.4m -dense sand with clay seams, 84.7m to 85.3m	
-90	85				
-91	86			(86.6m)	
-92	87		30/30cm	Silty Fine SAND (SM), dense, gray -silt with sand and with clay seams and layers, 86.9m to 87.5m	XI
-93	88			-with a clay layer at 88.2m	
-94	89		30/30cm	-with many clay pockets at 88.7m	
-95	90			-with silt layers, 89.6m to 90.8m -clay layer, 89.9m to 90.2m	
-96	91			-clay layer, 90.4m to 90.7m -sand with silt, below 90.7m -with a clay layer at 90.8m	
-97	92		30/30cm	(91.9m)	
-98	93			Lean CLAY (CL), hard, greenish gray -with organic pockets at 92.0m	XII
-99	94			-with a silt layer at 93.6m	
-100	95			(95.1m)	
-101	96		30/25cm	GRAVEL with sand (GP), very dense, gray, subangular -olive brown sandy lean clay with gravel, 95.4m to 96.0m	XIII
-102	97				
-103	98		30/35cm	(98.1m)	
-104	99		30/15cm	Fat CLAY (CH), hard, dark yellowish brown mottled with gray -with many gravel and silt pockets	XIV
-105	100			TOTAL DEPTH: 99.2m BACKFILLED WITH: Cement Grout	
-106	101				
-107	102				
-108	103				
-109	104				
-110	105				
-111	106				
-112	107				
-113	108				
-114	109				
-115	110				
-116	111				
-117	112				
-118	113				
-119	114				
-120	115				
-121	116				
-122	117				
-123	118				
-124	119				
-125					



LOG OF BORING AND TEST RESULTS

BORING 98-31

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

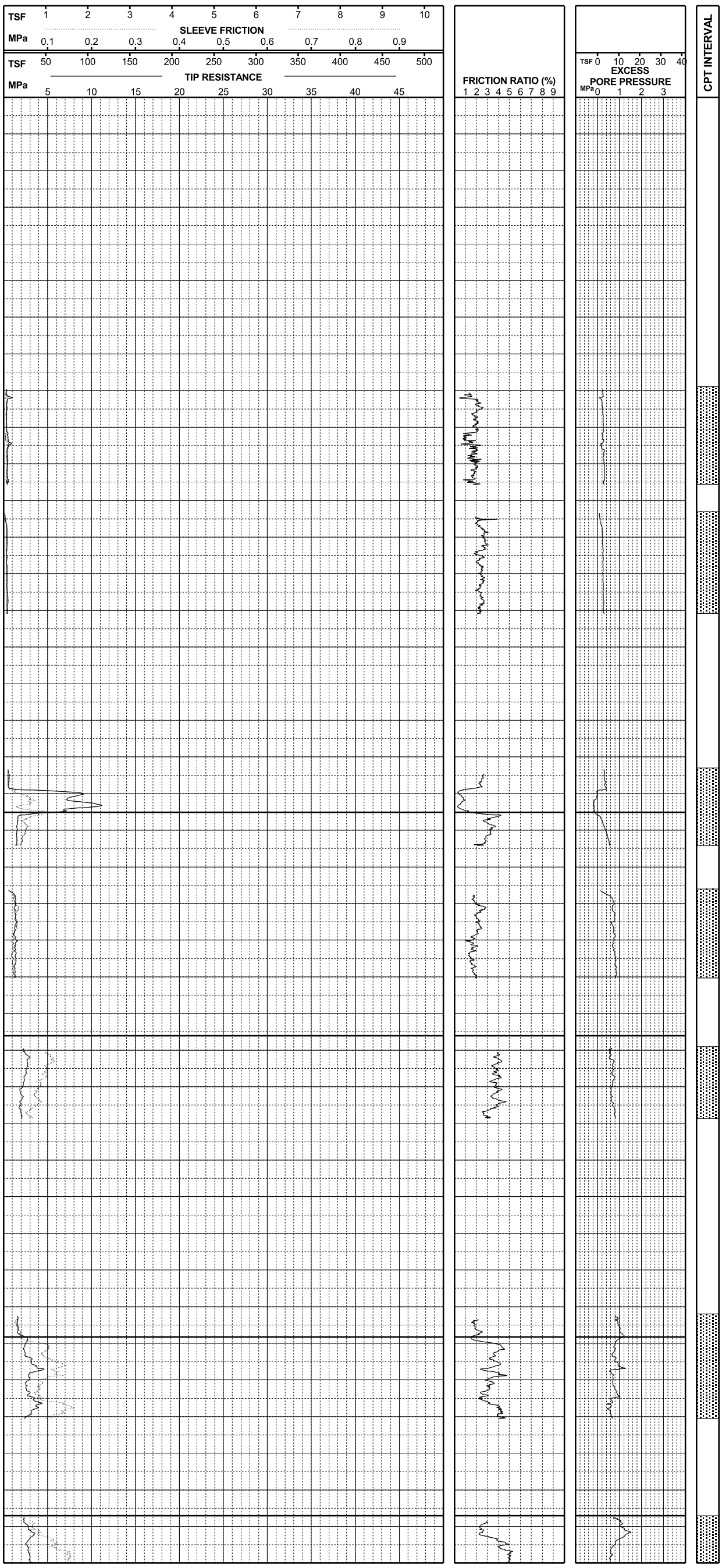
PLATE 98-31.6c

PROJECT NO:	98-42-0054	**START DATE:**	09/09/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-31 (Skyway Frame 2)	**COMPLETION DATE:**	09/12/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837605 N648086
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.3m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), soft to firm, olive gray -with silt pockets, shells and shell fragments	I
-6	1	WOH	-very soft clay to 0.6m	
-7	2	WOH		
-8	3	WOH		
-9	4	WOH	-with sand pockets at 3.7m	
-10	5	8/60cm		
-11	6	30/60cm	-sand layer, 6.1m to 6.4m	
-12	7	9/60cm		
-13	8	9/60cm		
		PUSH	-with a sand layer at 8.2m	
-14	9	PUSH	-with organic pockets, 9.1m to 11.3m -with sand pockets at 9.4m	
-15	10			
-16	11	PUSH	-platy, 11.0m to 18.3m	
-17	12			
-18	13			
-19	14			
-20	15	PUSH SAVE	-blocky and with gas blisters, at 14.6m	
-21	16			
-22	17			
-23	18	PUSH	-with gas blisters at 18.0m	
-24	19		-dense sand, 18.9m to 19.5m (19.5m)	
-25	20		Fat CLAY (CH), very stiff to stiff, olive gray to gray -with silt and sand pockets	II
-26	21	PUSH		
-27	22			
-28	23			
-29	24			
-30	25	PUSH SAVE	-with a few shell fragments and mica, at 24.7m (25.6m)	
-31	26		Fat CLAY (CH), hard to very stiff, greenish gray -slightly micaceous sandy lean clay to 27.7m	III
-32	27			
-33	28			
-34	29	PUSH	-desiccated, with organic pockets and gas blisters, at 29.3m	
-35	30			
-36	31			
-37	32	PUSH	-gray, with shell fragments and many silt pockets and partings, at 32.3m (33.8m)	
-38	33			
-39	34		Fat CLAY (CH), very stiff to hard, gray	IV
-40	35		-with a silt layer, 34.6m to 34.7m	
-41	36			
-42	37	PUSH	-with silt partings, organic pockets and gas blisters, at 37.2m	
-43	38	SAVE	(38.7m)	
-44	39		Fat CLAY (CH), very stiff to hard, gray -with organic pockets	V
-45				



LOG OF BORING AND TEST RESULTS

BORING 98-31

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

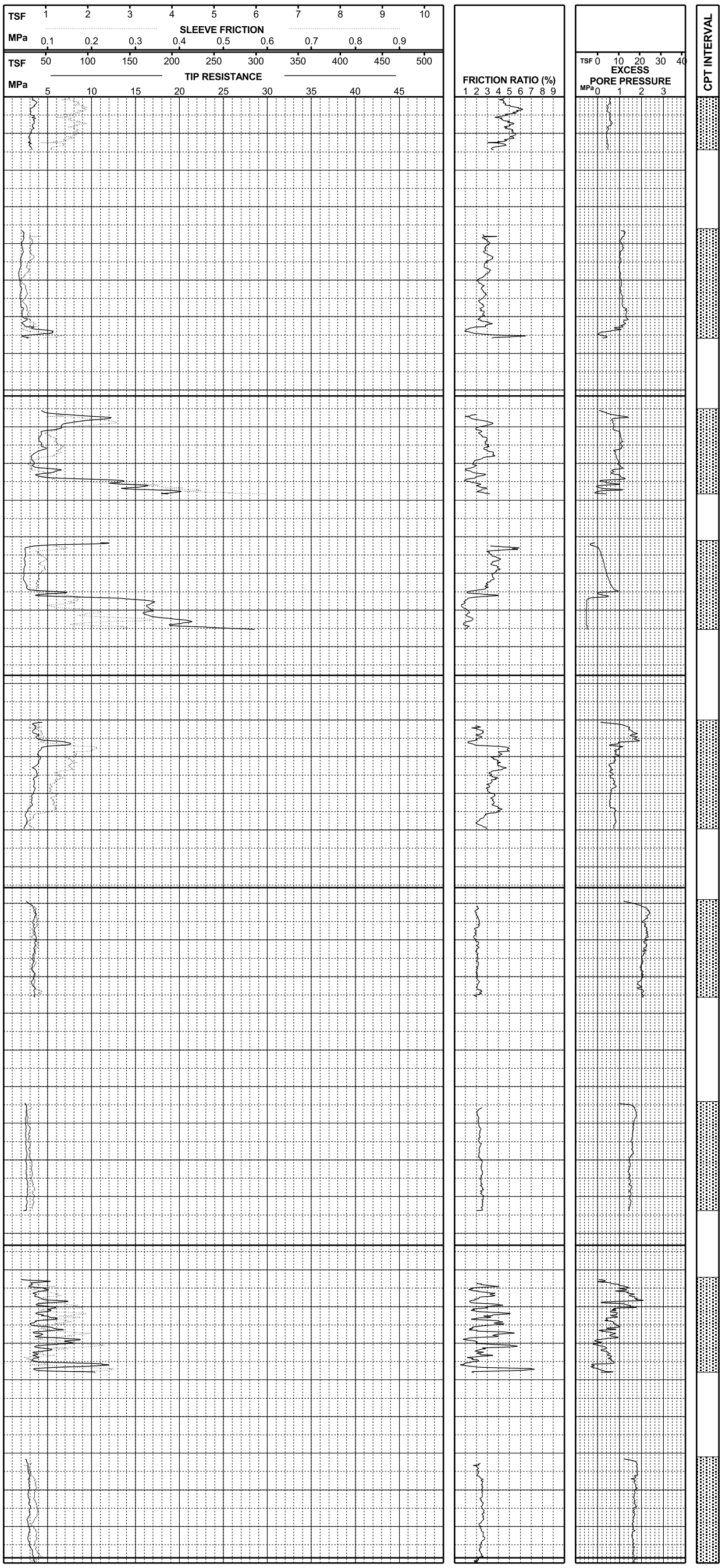
PLATE 98-31.7a

PROJECT NO:	98-42-0054	**START DATE:**	09/09/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-31 (Skyway Frame 2)	**COMPLETION DATE:**	09/12/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837605 N648086
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.3m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
				Fat CLAY (CH), very stiff to hard, gray	V
-46	41				
-47	42				
-48	43		PUSH	-with a few gas blisters, slickensides and wood fragments, at 42.7m	
-49	44				
-50	45				
-51	46			-sand layer, 46.3m to 46.6m	
-52	47				
-53	48		PUSH	-with silt pockets at 47.5m (48.2m)	
-54	49			Interlayered hard to very stiff Fat CLAY (CH) and Dense Silty SAND (SM)	VI
-55	50			-greenish gray silty sand, with clay pockets, seams and layers, 50.3m to 52.4m	
-56	51				
-57	52		PUSH	-with medium to coarse sand, gravel, and shell fragments, at 51.5m	
-58	53				
-59	54				
-60	55			(55.8m)	
-61	56		PUSH	Lean to Fat CLAY (CL/CH), hard to very stiff, gray	VII
-62	57			-hard greenish gray lean clay to 59.4m	
-63	58			-with silt pockets, a few organic pockets, and a few shell fragments, at 56.1m	
-64	59			-with a sand layer at 57.6m	
-65	60				
-66	61		PUSH	-with silt partings and pockets, at 61.0m (61.6m)	
-67	62		SAVE	Fat CLAY (CH), hard, gray	VIII
-68	63				
-69	64				
-70	65				
-71	66		PUSH	-with greenish gray bands and silt pockets, partings and seams, at 66.4m	
-72	67				
-73	68				
-74	69				
-75	70				
-76	71			(71.3m)	
-77	72		PUSH	Lean CLAY (CL), hard, gray	IX
-78	73			-interlayered with silt and sand, with organic pockets, to 76.2m	
-79	74				
-80	75				
-81	76	30/30cm		-with desiccated clay seams at 76.2m	
-82	77				
-83	78				
-84	79				
-85				(79.9m)	



LOG OF BORING AND TEST RESULTS

BORING 98-31

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

PLATE 98-31.7b

PROJECT NO:	98-42-0054	**START DATE:**	09/09/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-31 (Skyway Frame 2)	**COMPLETION DATE:**	09/12/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837605 N648086
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.3m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
				Lean CLAY (CL), hard, greenish gray	
-86	81		PUSH	-with silt pockets and a few calcareous nodules, at 81.1m	
-87	82		SAVE	-gray silty fine sand layer, 81.7m to 82.4m	
-88	83			-with sand layers, 83.1m to 83.8m	X
-89	84		30/35cm	-with a few shell fragments at 84.4m	
-90	85			-dense sand with clay seams, 84.7m to 85.3m	
-91	86			(86.6m)	
-92	87		30/30cm	Silty Fine SAND (SM), dense, gray -silt with sand and with clay seams and layers, 86.9m to 87.5m	
-93	88			-with a clay layer at 88.2m	
-94	89		30/30cm	-with many clay pockets at 88.7m	XI
-95	90			-with silt layers, 89.6m to 90.8m -clay layer, 89.9m to 90.2m	
-96	91			-clay layer, 90.4m to 90.7m -sand with silt, below 90.7m -with a clay layer at 90.8m	
-97	92		30/30cm	(91.9m)	
-98	93			Lean CLAY (CL), hard, greenish gray -with organic pockets at 92.0m	
-99	94			-with a silt layer at 93.6m	XII
-100	95			(95.1m)	
-101	96		30/25cm	GRAVEL with sand (GP), very dense, gray, subangular -olive brown sandy lean clay with gravel, 95.4m to 96.0m	XIII
-102	97				
-103	98		30/35cm	(98.1m)	
-104	99		30/15cm	Fat CLAY (CH), hard, dark yellowish brown mottled with gray -with many gravel and silt pockets	XIV
-105	100			TOTAL DEPTH: 99.2m BACKFILLED WITH: Cement Grout	
-106	101				
-107	102				
-108	103				
-109	104				
-110	105				
-111	106				
-112	107				
-113	108				
-114	109				
-115	110				
-116	111				
-117	112				
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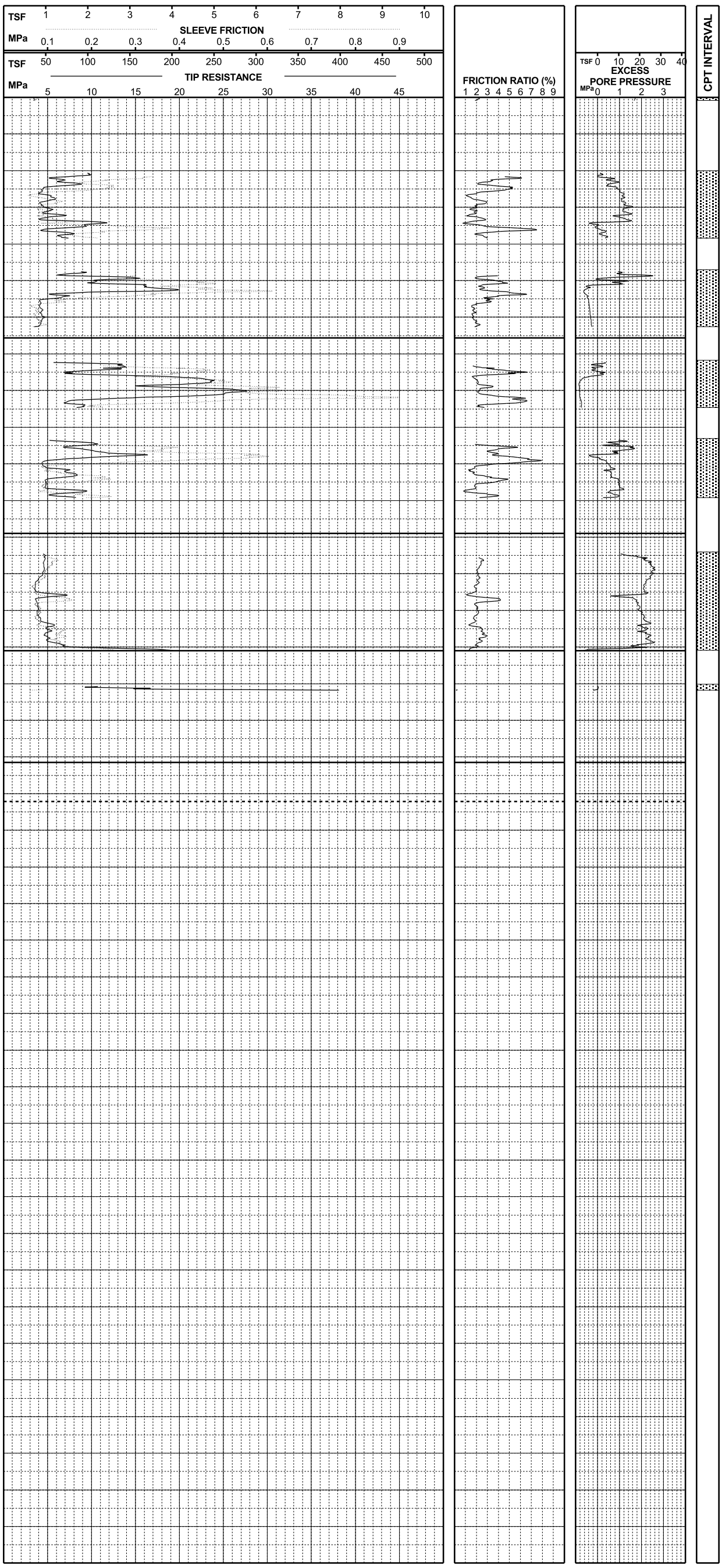
-125					



LOG OF BORING AND TEST RESULTS

BORING 98-31

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

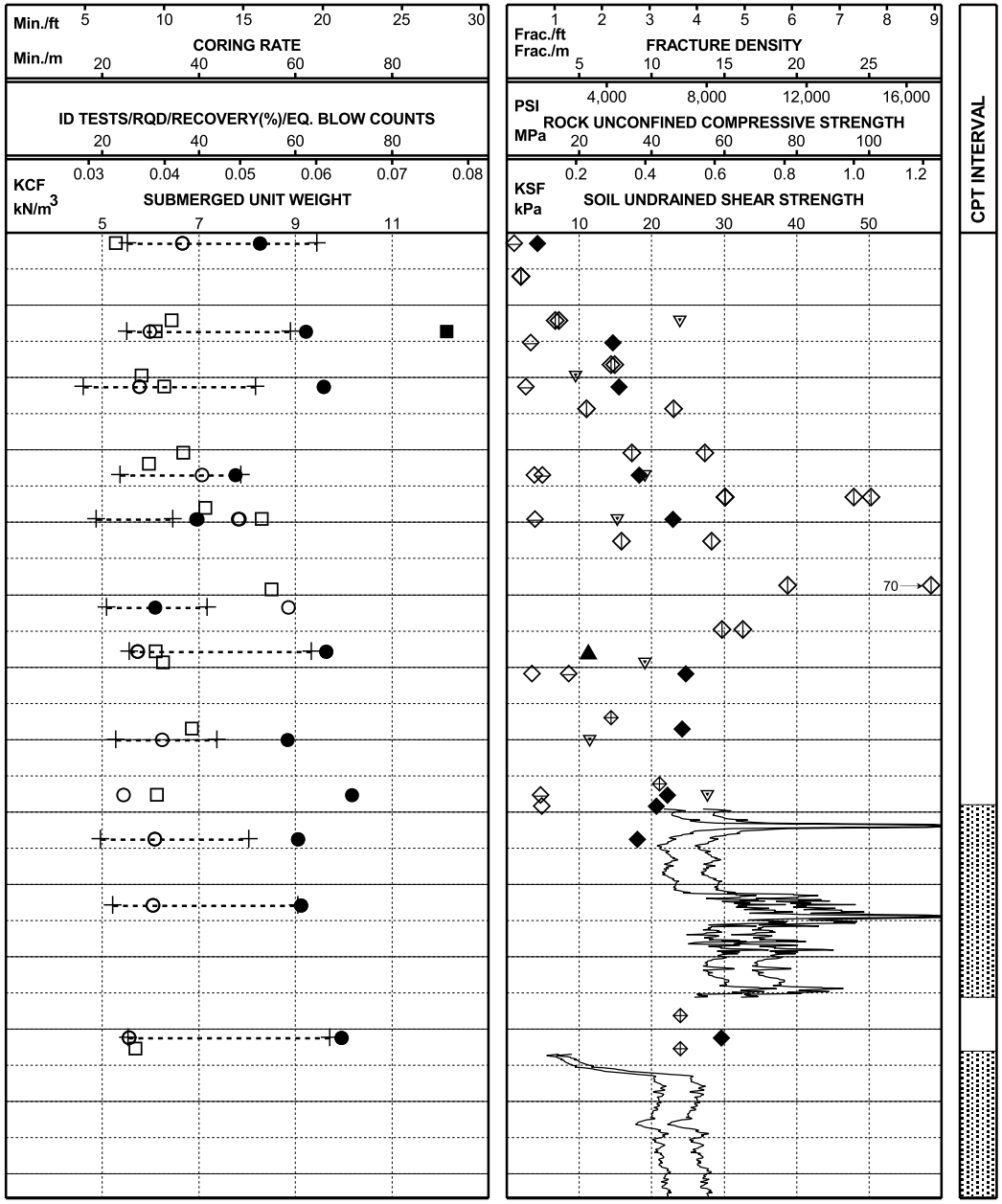
PLATE 98-31.7c

PROJECT NO:	98-42-0054	**START DATE:**	09/09/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-31 (Skyway Frame 2)	**COMPLETION DATE:**	09/12/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837605 N648086
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -5.3m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), soft to firm, olive gray -with silt pockets, shells and shell fragments -very soft clay to 0.6m	I
-6	1	WOH		
-7	2	WOH		
-8	3	WOH		
-9	4	WOH	-with sand pockets at 3.7m	
-10	5	8/60cm		
-11	6	30/60cm	-sand layer, 6.1m to 6.4m	
-12	7	9/60cm		
-13	8	9/60cm		
		PUSH	-with a sand layer at 8.2m	
-14	9	PUSH	-with organic pockets, 9.1m to 11.3m -with sand pockets at 9.4m	
-15	10			
-16	11	PUSH	-platy, 11.0m to 18.3m	
-17	12			
-18	13			



LOG OF BORING AND TEST RESULTS

BORING 98-31

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

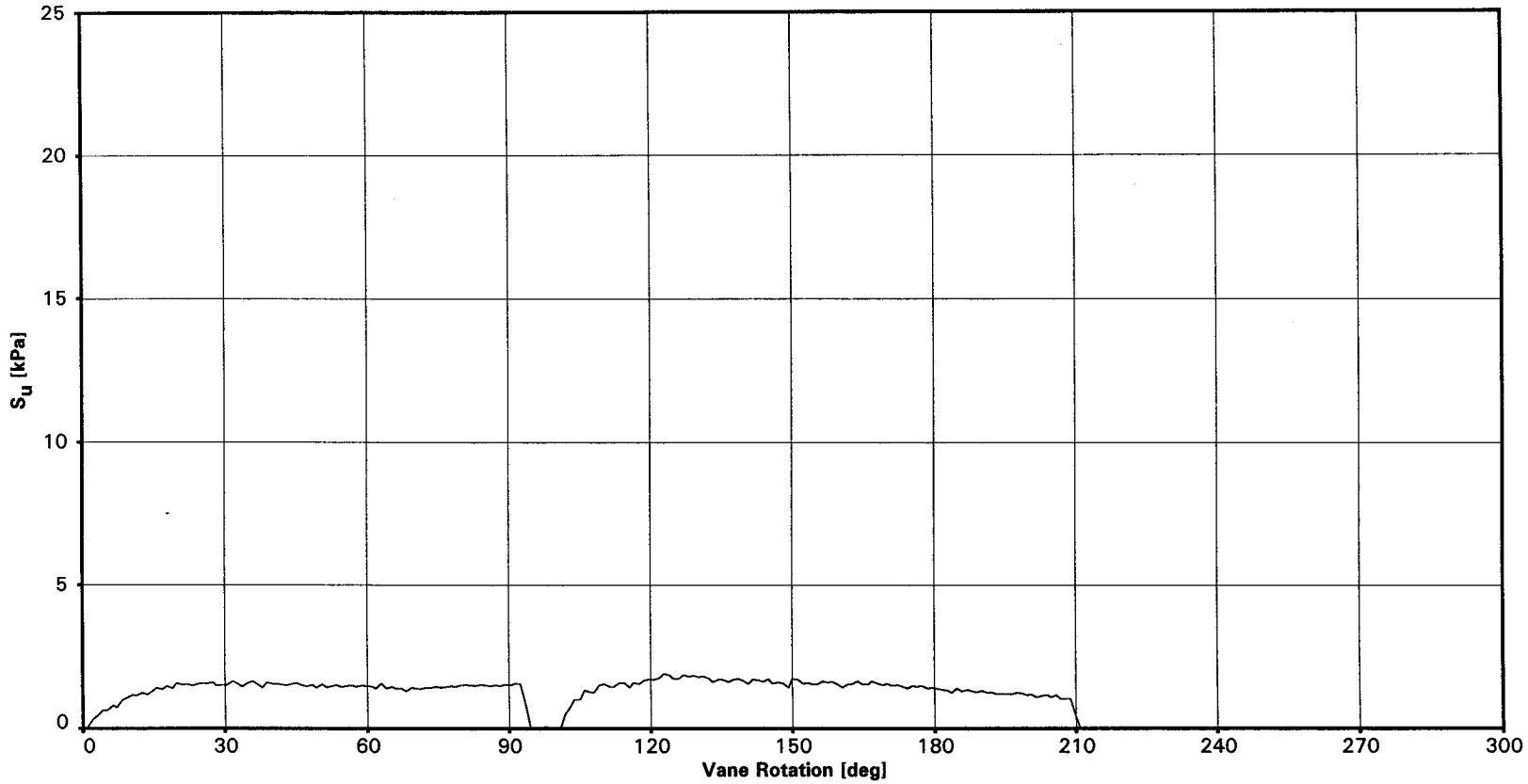
FUGRO

PLATE 98-31.8

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 98-31
SFOBB East Span Seismic Safety Project

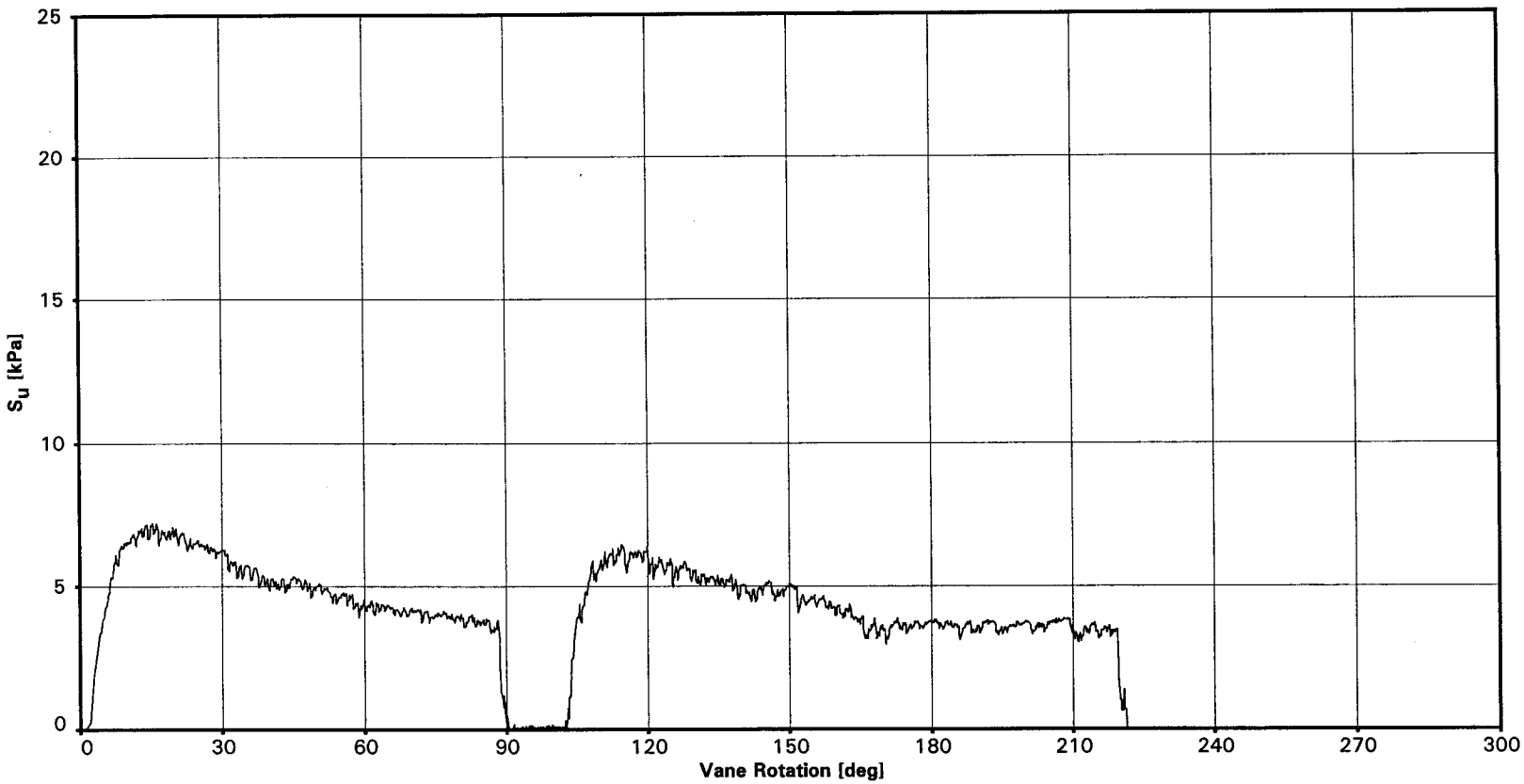
Earth Mechanics

FUGRO

PLATE 98-31.9a

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.2m
Boring 98-31
SFOBB East Span Seismic Safety Project

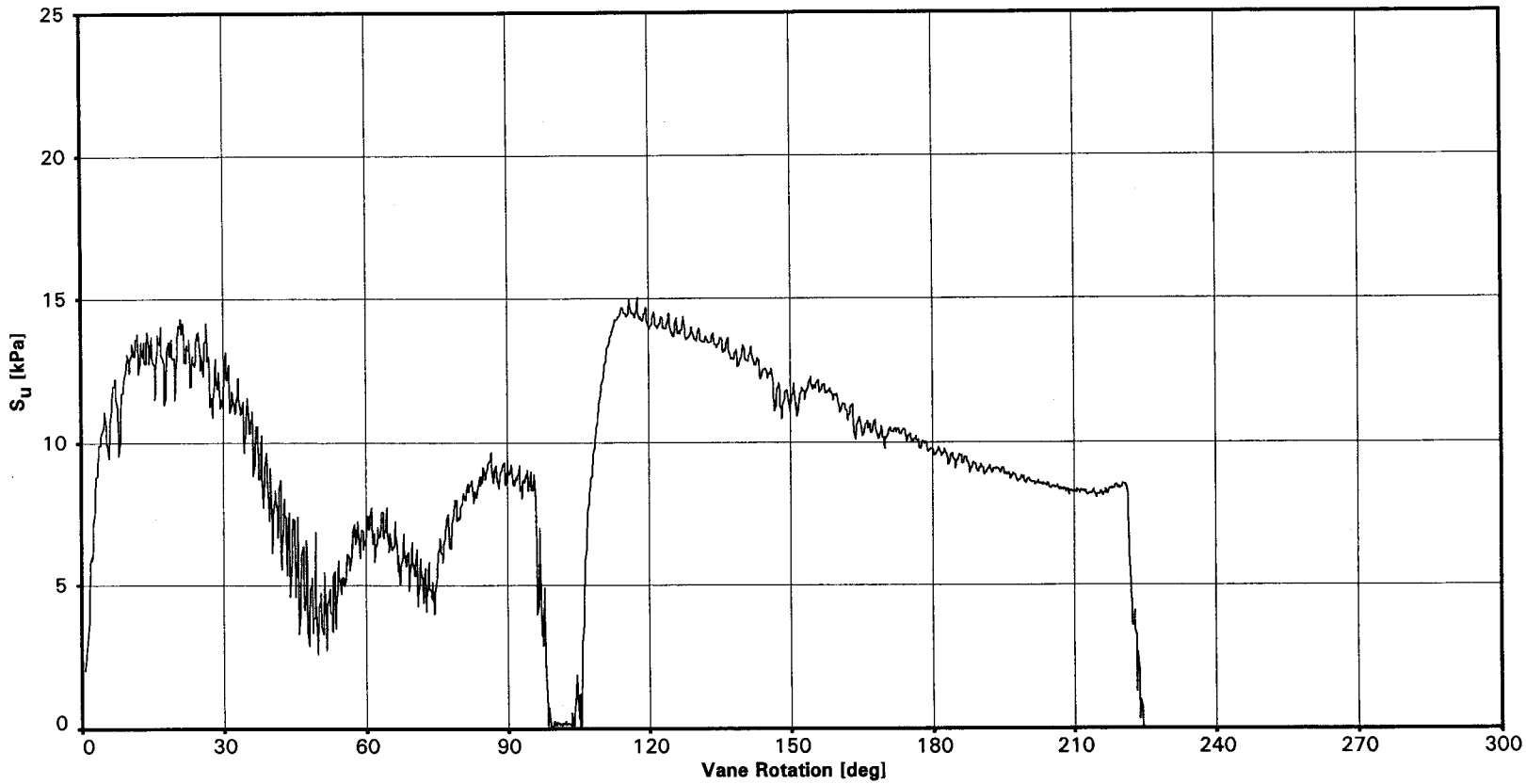
Earth Mechanics

FUGRO

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 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

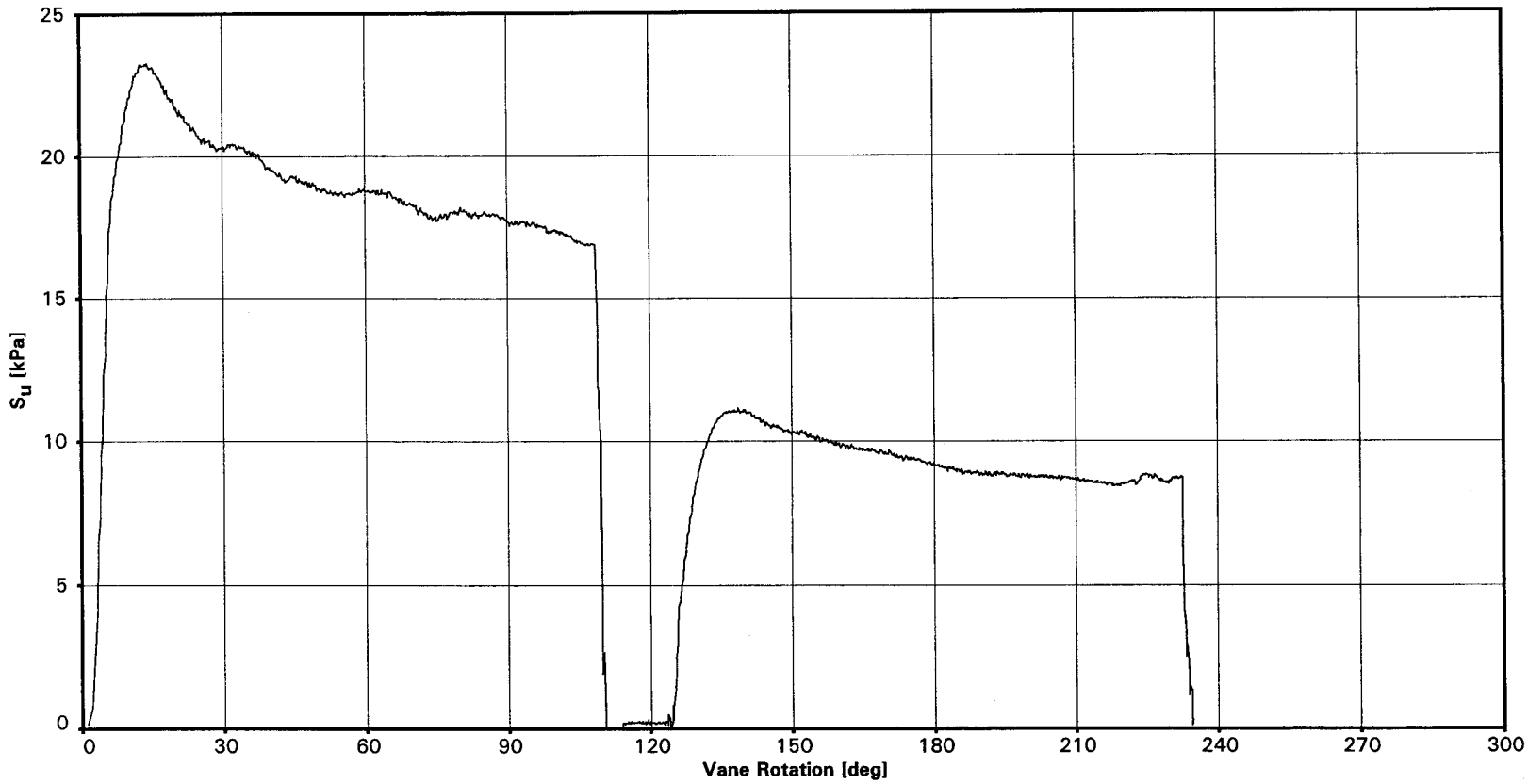
FUGRO

PLATE 98-31.9c

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: 1.8m
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

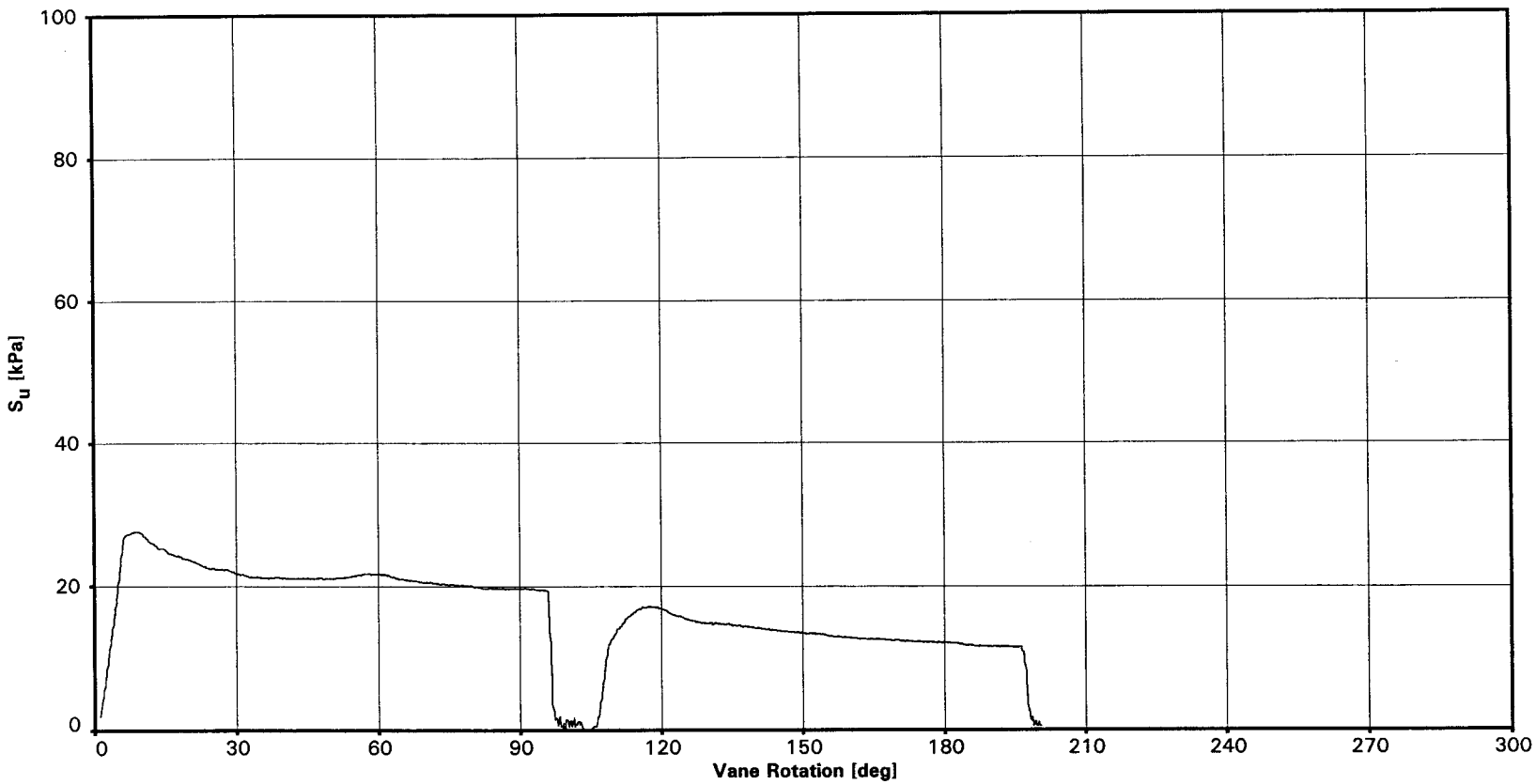
FUGRO

PLATE 98-31.9d

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 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

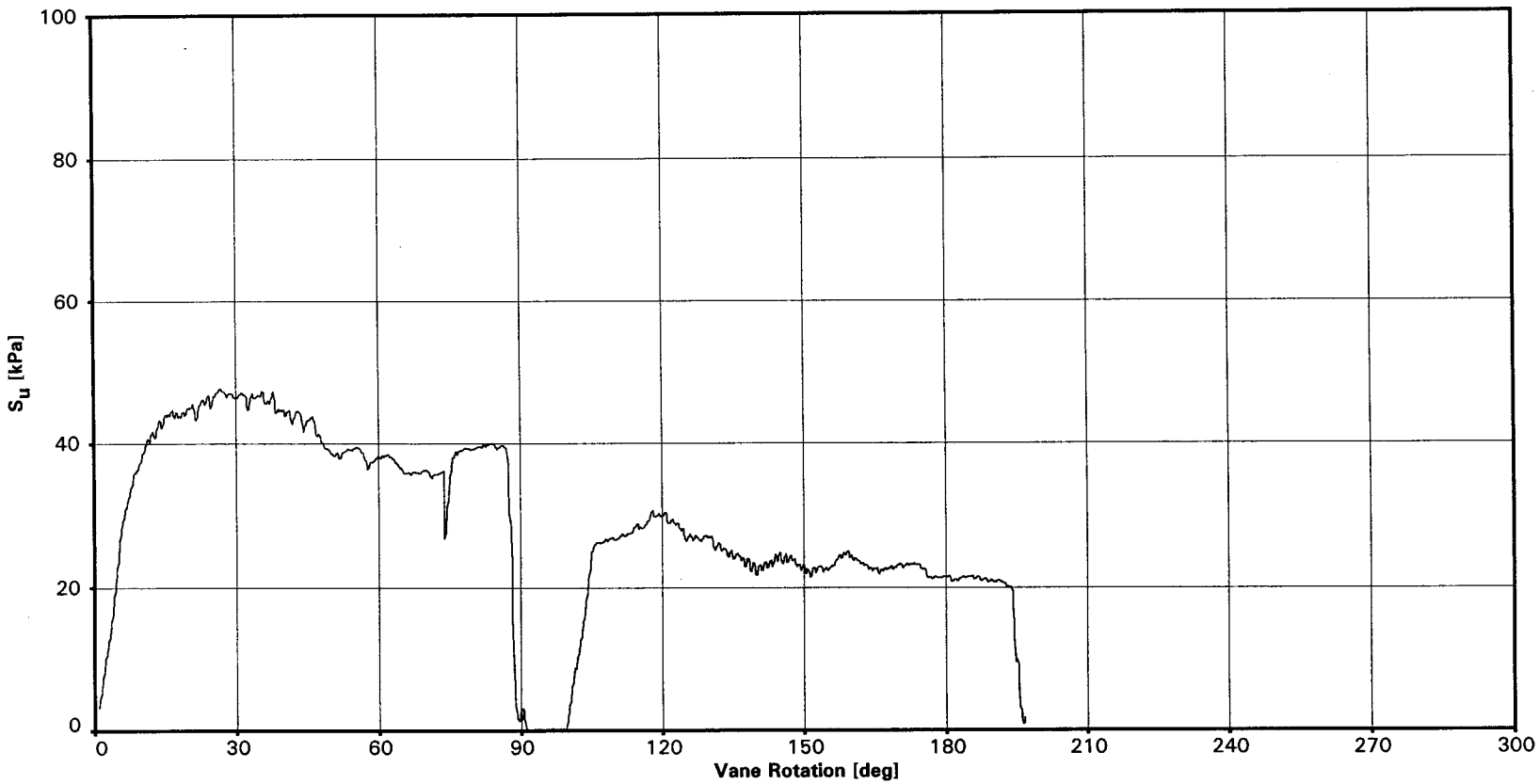
FUGRO

PLATE 98-31.9e

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 (1st attempt)
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

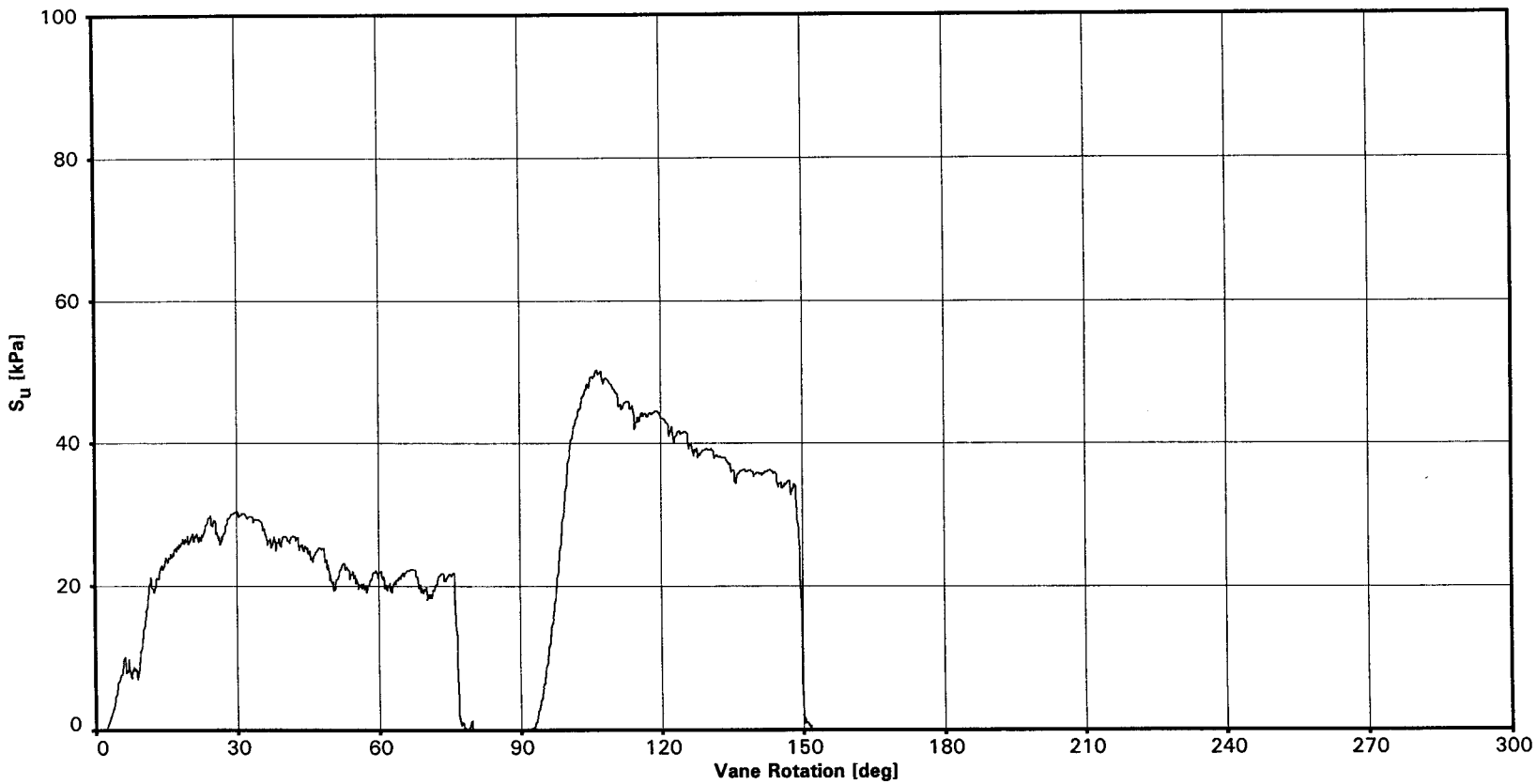
FUGRO

PLATE 98-31.9f

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: 3.7m (2nd attempt)
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

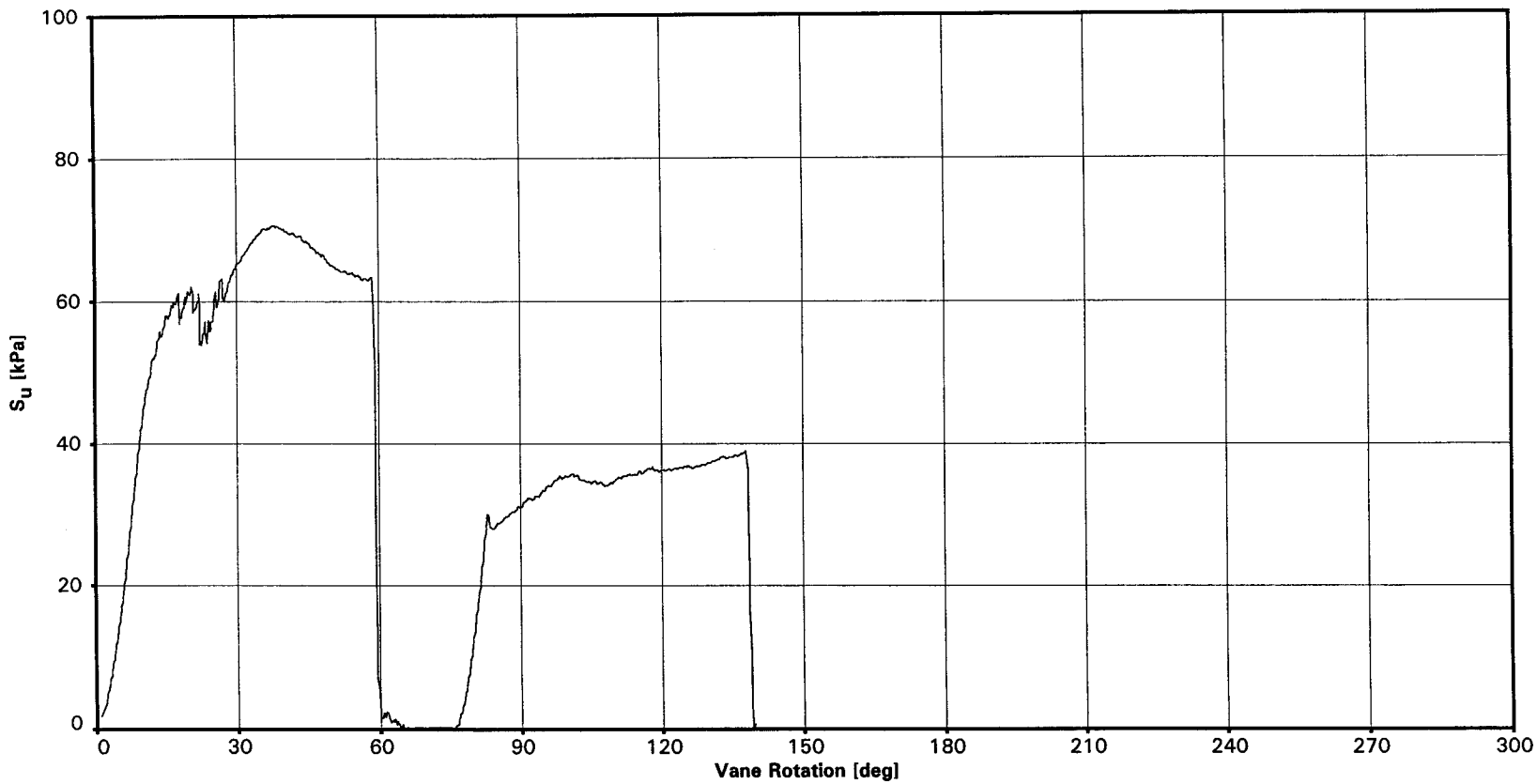
FUGRO

PLATE 98-31.9g

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: 4.9m
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

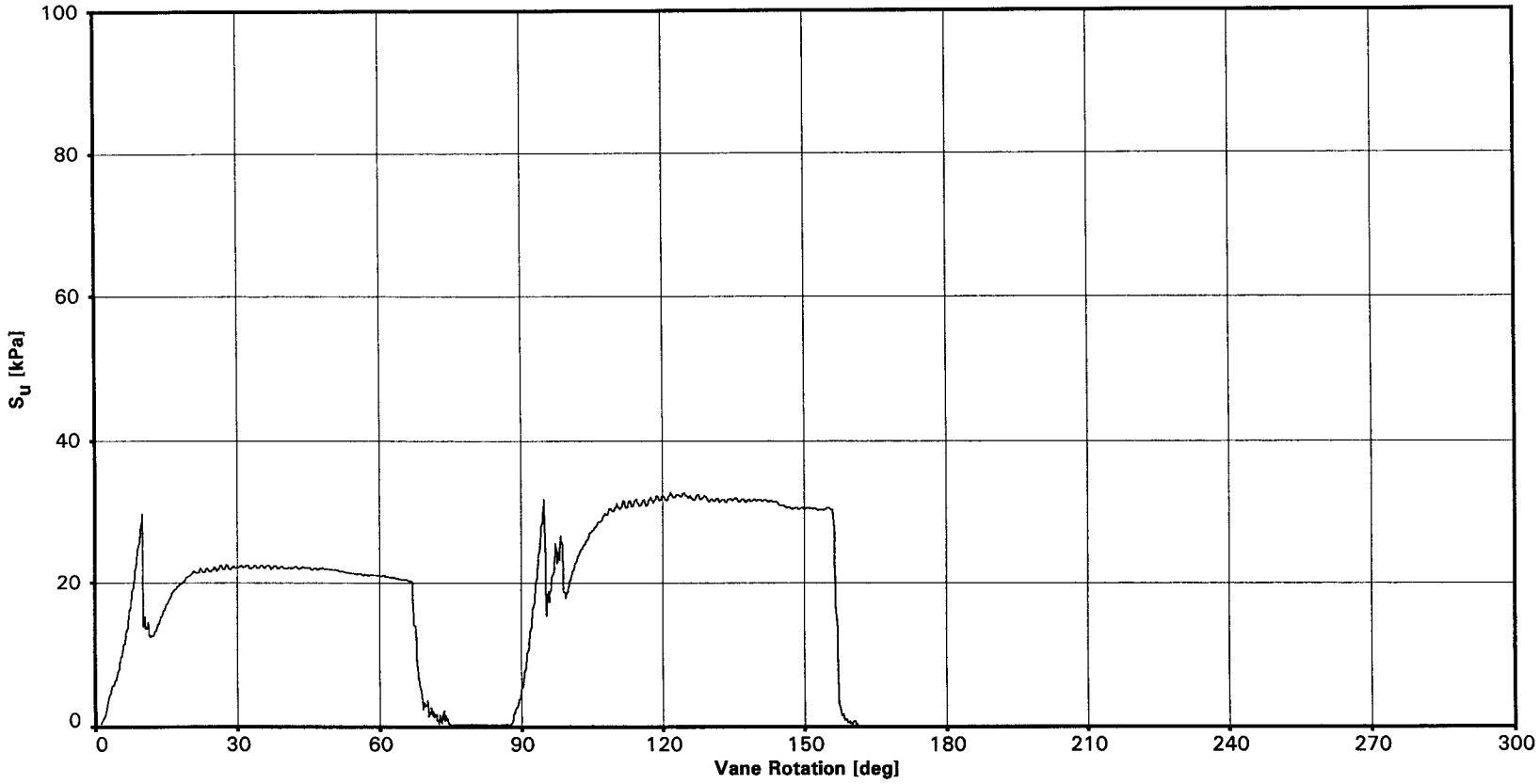
FUGRO

PLATE 98-31.9h

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: 5.5m
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

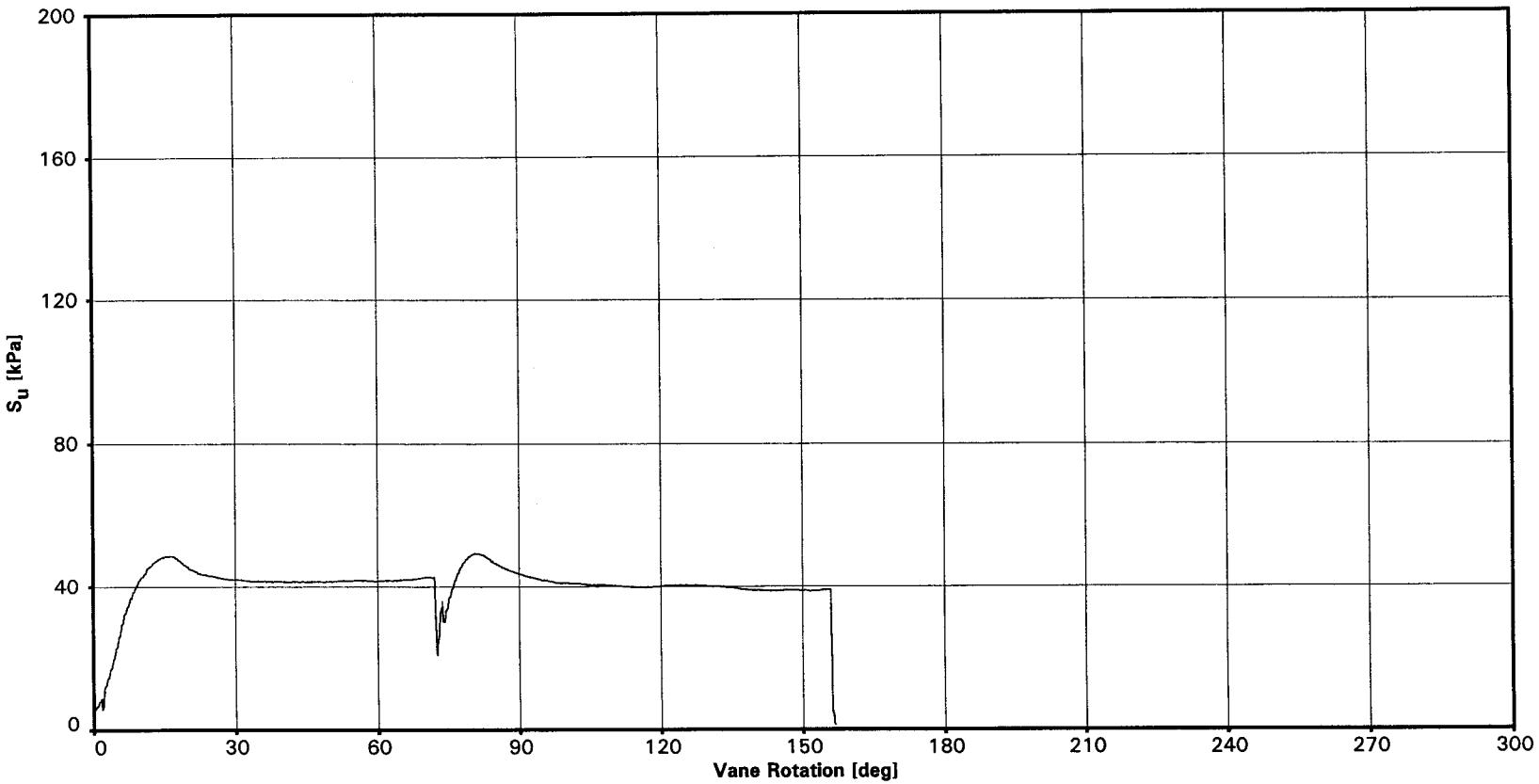
FUGRO

PLATE 98-31.9i

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 (DOWNHOLE) TEST RESULTS
Test Depths: 16.5m and 17.1m
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

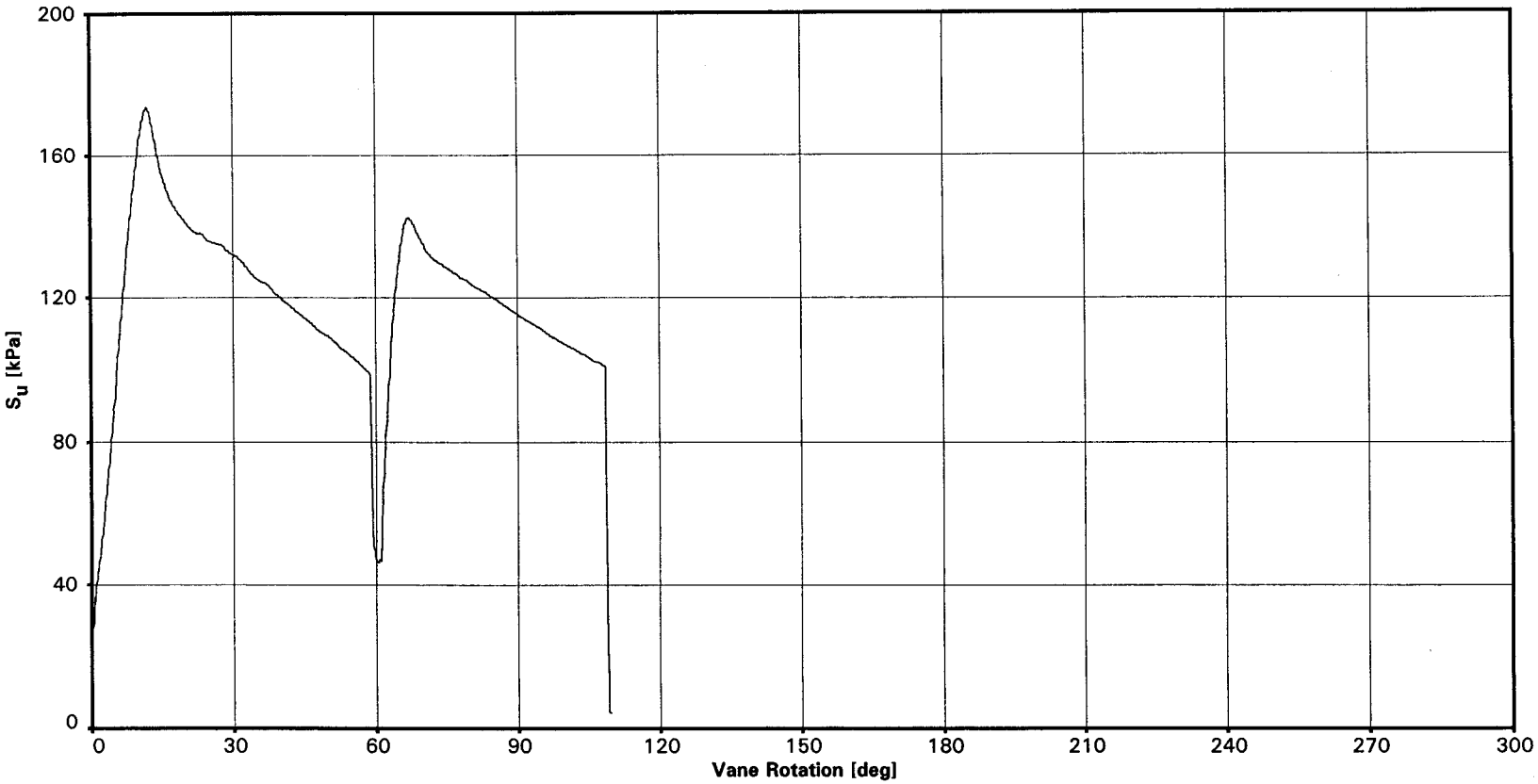
FUGRO

PLATE 98-31.9j

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: 30.5m and 31.1m
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-31.9k

98-31		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	53	65	25	0.69	5.3					4.2		1.0												
0.6	501													1.9											
0.6	502													1.9											
1.2	2					6.4				23.9															
1.2	503													7.2											
1.2	504													6.7											
1.4	3	62	59	25	1.09	6.1	91																	H	
1.5	4										14.7		3.3												
1.8	505													14.4											
1.8	506													14.8											
2.0	5					5.8				9.6															
2.1	6	66	52	16	1.39	6.3					15.5		2.6												
2.4	507													23.0											
2.4	508													11.0											
3.0	7					6.7																			

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 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-31		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													27.3											
3.0	510													17.2											
3.2	8					6.0																			
3.4	9	48	49	24	0.95					19.2	18.3	3.8	4.9												
3.7	511													47.9											
3.7	512													30.2											
3.7	513													30.2											
3.7	514													50.3											
3.8	10					7.1																			
4.0	11	40				8.3				15.3	22.9		3.9												
4.0	11	39	35	19	1.30																				
4.3	515													15.8											
4.3	516													28.2											
4.9	517													70.4											
4.9	518													38.8											

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-31		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)		
4.9	12					8.5																			
5.2	13	31	42	21	0.47																				
5.5	519													29.7											
5.5	520													32.6											
5.8	14	66	63	26	1.08	6.1									11.2		0.4								
5.9	15					6.2				19.2															
6.1	16										24.7	3.4	8.5												
6.7	17							14.4																	
6.9	18					6.9					24.2														
7.0	19	58	44	23	1.69					11.5															
7.6	20							21.1																	
7.8	21	72				6.1				27.8	22.2		4.6												
7.9	22										20.6	4.8													
8.4	23	60	50	20	1.33						18.1														
9.3	24	61	61	22	1.01																				

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-31		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)		
10.8	25							23.9																	
11.1	26	70	67	25	1.06						29.6														
11.3	27					5.7		23.9																	
14.6	28							31.6																	
14.8	29	68	69	29	0.96	5.4						10.8			32.0		0.3								
14.9	30							28.7		43.1	37.1														
15.5	31	64	61	24	1.08		98																	C,H	2.750
15.5	32										30.7														
16.5	400													56.5											
17.1	401													57.5											
18.0	33							41.2																	
18.1	34	56	61	26	0.85	6.0									38.4		0.6								
18.3	35									39.3	38.2														
21.3	36							119.7																	
21.5	37	40	47	21	0.72	7.9									111.1		0.5								

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-31		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)		
21.6	38										147.3														
25.1	40	38	46	19	0.71	8.3		71.8	119.7						94.8	34.3	0.9								
25.3	41										107.7														
25.8	42	31	31	20	1.01																			C	2.718
25.9	43										170.8														
29.1	44	45	76	26	0.38	7.6									111.8		0.6								
29.3	300								143.6		177.0														
30.5	402													170.9											
31.1	521													140.3											
32.5	46	41	45	22	0.82	7.8									129.2	32.0	0.9								
32.6	47									159.9	129.9														
37.0	48	35	63	26	0.25	8.5		119.7	143.6						138.1		0.5								
37.2	49										181.9														
38.0	50	40	71	26	0.32																			C	2.766
38.1	51										210.4														

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-31		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)		
42.7	52								191.5		222.8														
42.8	53	40	79	27	0.25	7.8	98								170.1		0.9							H	
43.0	54										222.8														
47.5	55							107.7																	
47.7	56	39	56	24	0.47	7.6									96.9		0.6								
47.9	57									159.9	144.8														
51.7	58					10.1																			
51.8	59	24					23																		
56.1	60					10.5			215.5						159.3		0.8								
56.2	61	21	34	14	0.35	10.1																			
56.4	62										222.8														
61.1	64	44	68	25	0.44	7.3	88								155.4		0.5							H	
61.3	65										186.9														
61.8	66	52	69	27	0.59																			C	2.745
61.9	67										222.8														

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

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H = Hydrometer
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-31		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)		
66.4	68							162.8	205.9																
66.6	69	51	62	29	0.67	7.3									242.3	76.8	2.3								
66.8	70							191.5	191.5	247.1	222.8														
71.3	71	38	37	16	1.01																			C	2.689
71.5	72	29	35	19	0.63	9.5	100								195.2		0.9							H	
71.6	73										222.8														
76.0	74					9.7		134.1	134.1						161.5		3.3								
76.2	75	28	33	13	0.77			143.6			222.8														
81.1	76							193.9	191.5																
81.2	77	22	32	15	0.43	10.3	95		177.2						201.2	107.2	0.7							H	
81.4	78								215.5		222.8														
81.9	79																							K	
84.3	80	23				9.8																			
86.7	82					9.1																			
86.9	83	23					74																	H	

Identification Tests
MC = Moisture Content
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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
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-31
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-31		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)		
89.0	84	19				11.1	55																		
91.8	87						5																		
91.9	85					11.3									267.4	199.3	4.8								
92.0	86	19	30	16	0.22																				
95.6	88	18	27	15	0.31	11.8	53																		
97.9	89	6					3																		
99.2	90	19	50	17	0.07	11.4									482.4		1.9								

Identification Tests
MC = Moisture Content
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Identification Tests
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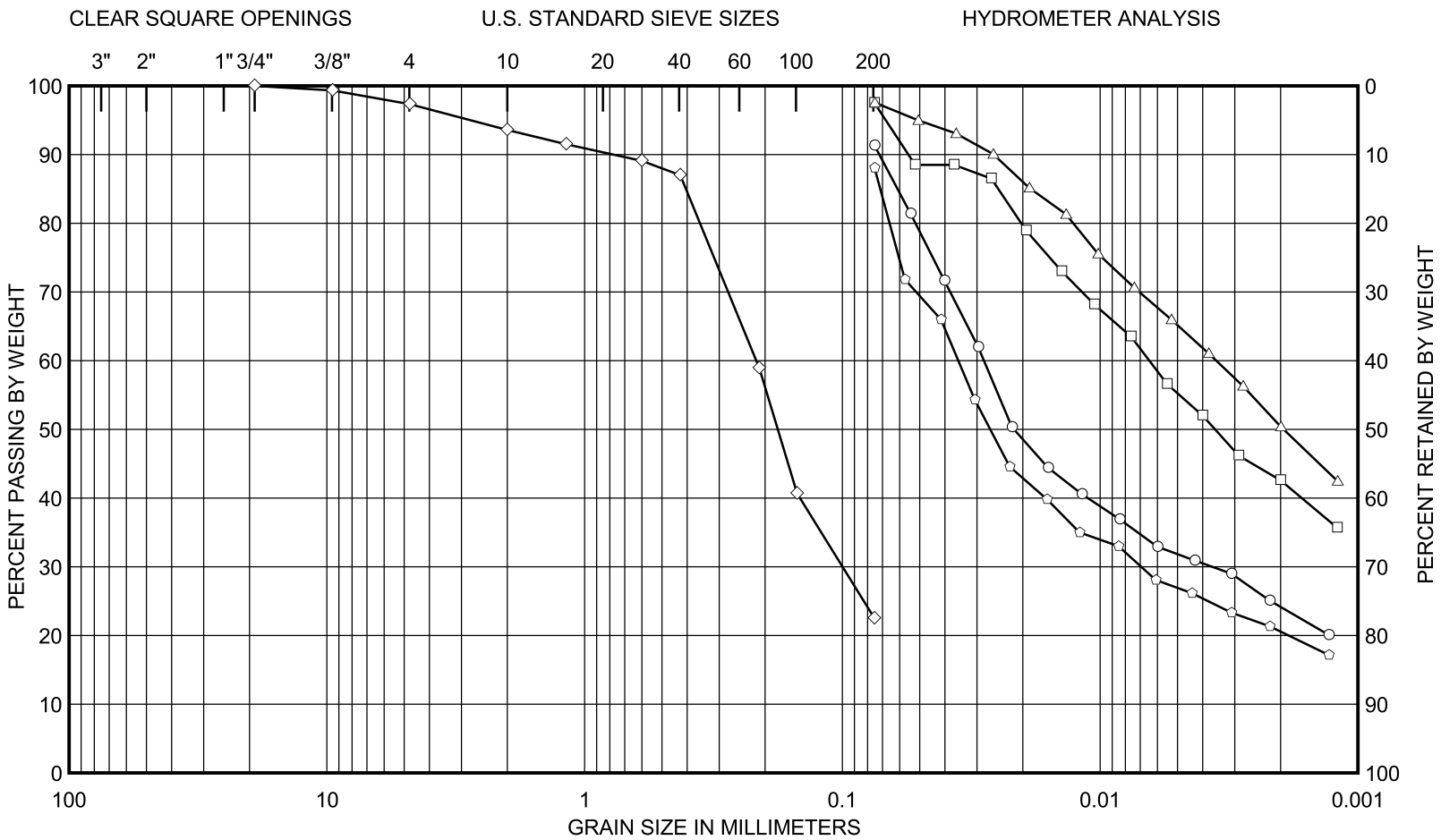
SUMMARY OF LABORATORY TEST RESULTS
Boring 98-31
SFOBB East Span Seismic Safety Project

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 silt pockets, shells and shell fragments			0.022
31	15.5	□——□	FAT CLAY (CH) with silt pockets, shells and shell fragments			0.0036
53	42.8	△——△	FAT CLAY (CH) with wood fragments and organic pockets			0.0019
59	51.8	◇——◇	SILTY FINE SAND (SM) with shell fragments and a trace of medium and coarse sand			0.18
64	61.1	⬠——⬠	FAT CLAY (CH) with silt partings and pockets			0.027

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-31

SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-31.11a

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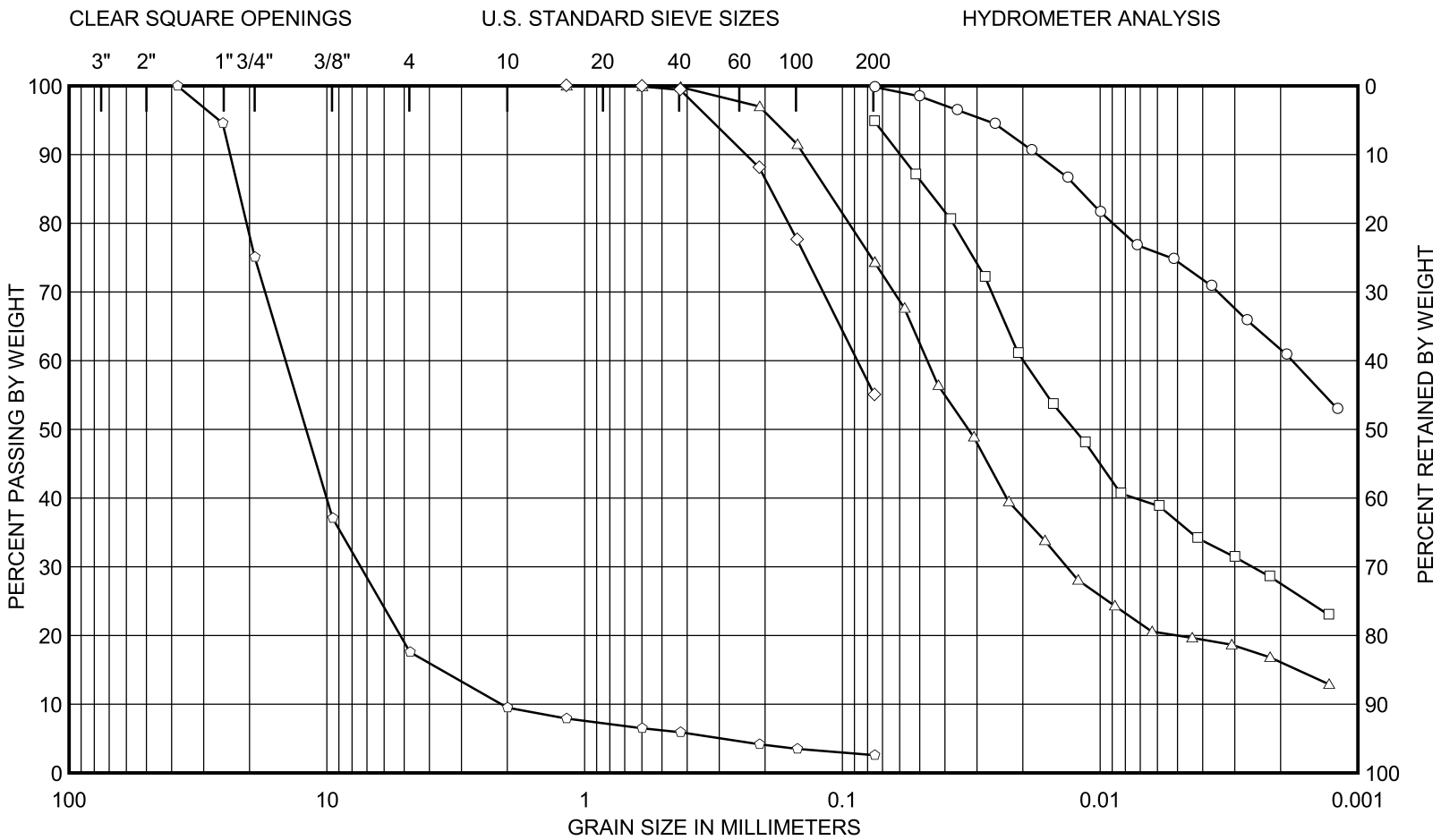

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
72	71.5	○——○	LEAN CLAY (CL)			0.0030
77	81.2	□——□	LEAN CLAY (CL) with silt pockets and a few calcareous nodules			0.013
83	86.9	△——△	SILT (ML) with sand and with clay seams and layers			0.033
84	89.0	◇——◇	SANDY SILT (ML)			
89	97.9	⬠——⬠	FINE GRAVEL (GP) with sand and a trace of coarse gravel	1.8	6.9	12.1

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-31

SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-31.11b

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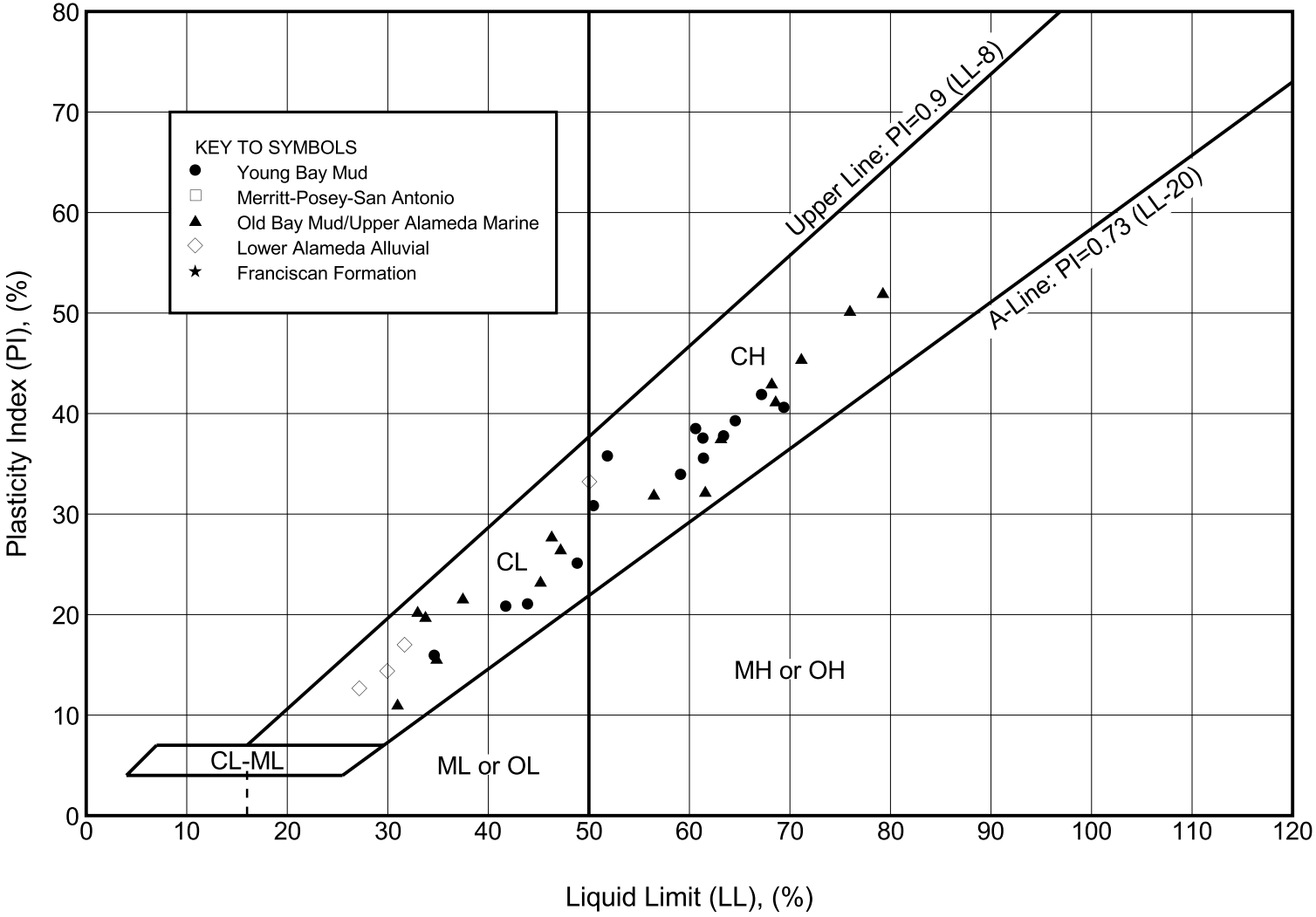

PLASTICITY CHART
Boring 98-31
SFOBB East Span Seismic Safety Project

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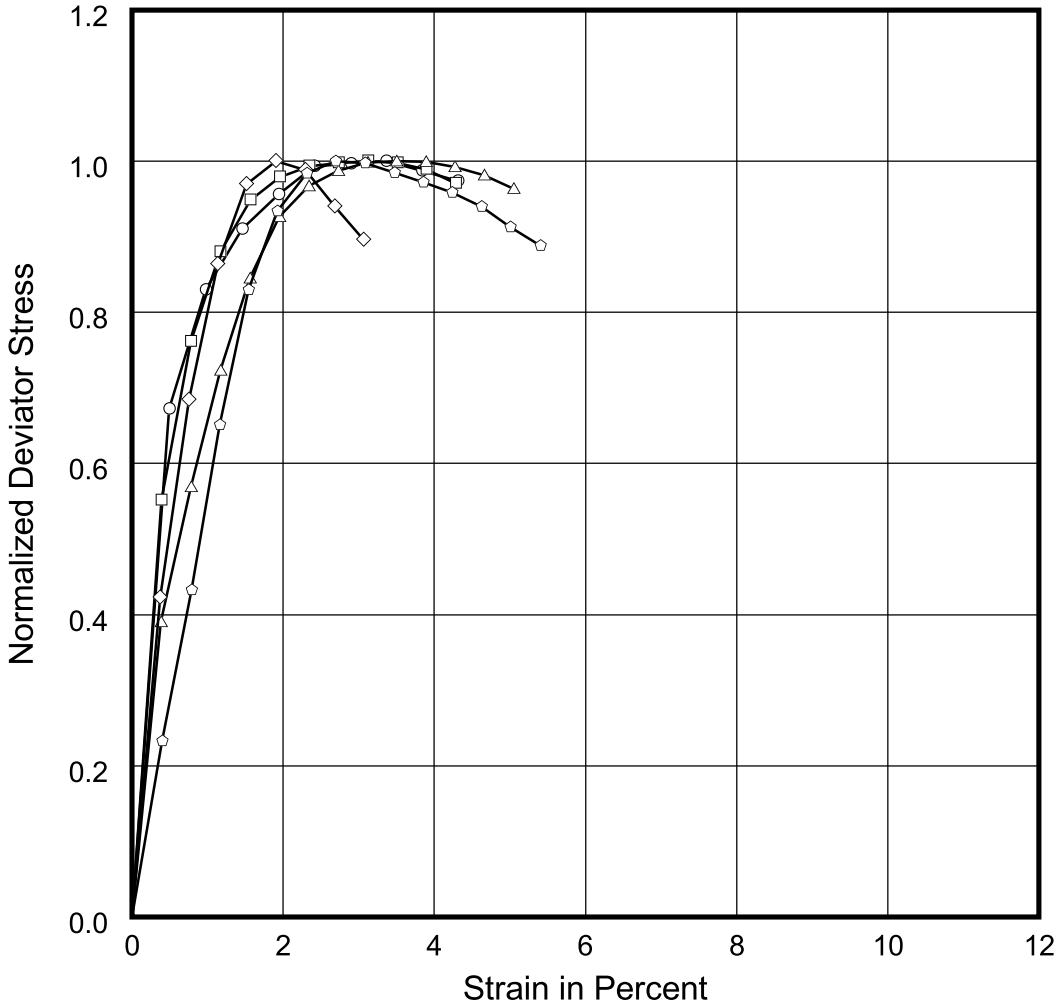
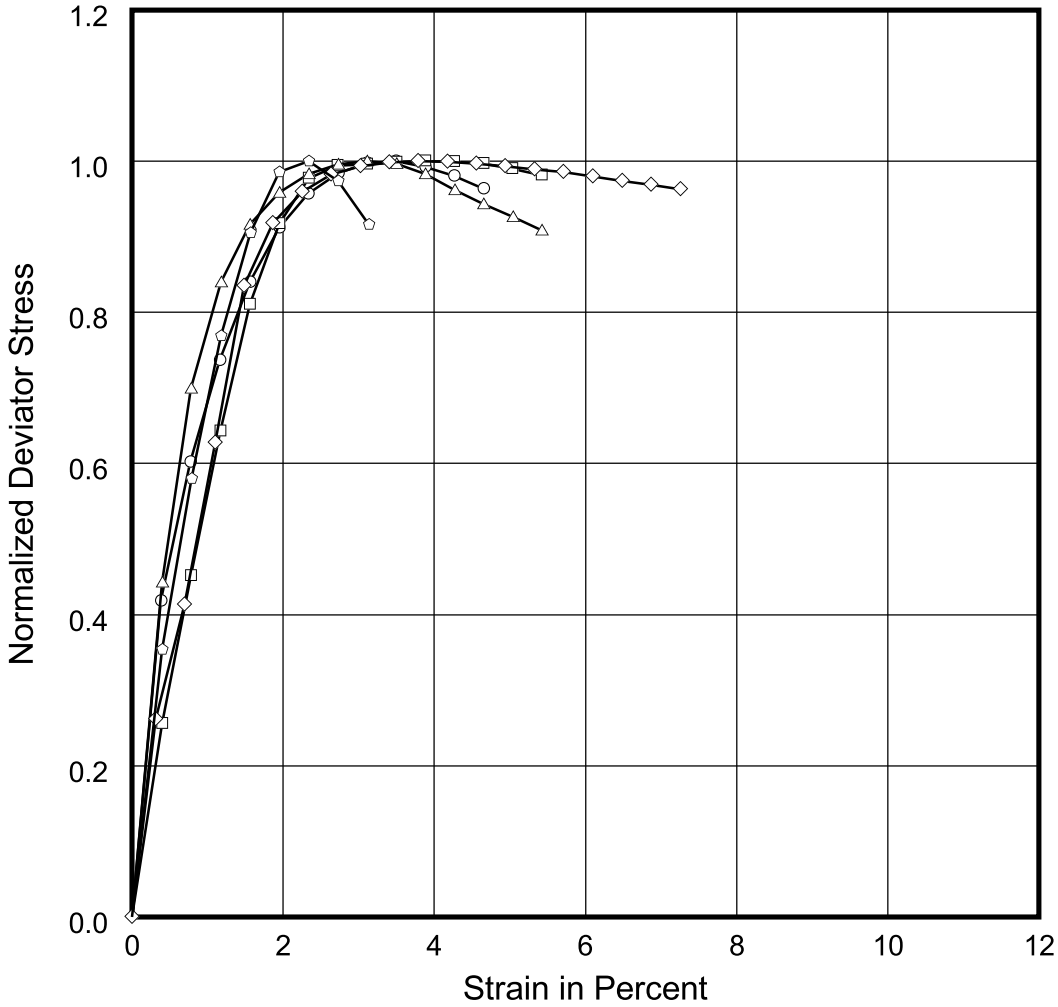


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	14	5.8	UU	138	22	0.4
	29	14.8	UU	345	64	0.3
	34	18.1	UU	414	77	0.6
	37	21.5	UU	827	222	0.5
	40	25.1	UU	552	190	0.9

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-31
SFOBB East Span Seismic Safety Project

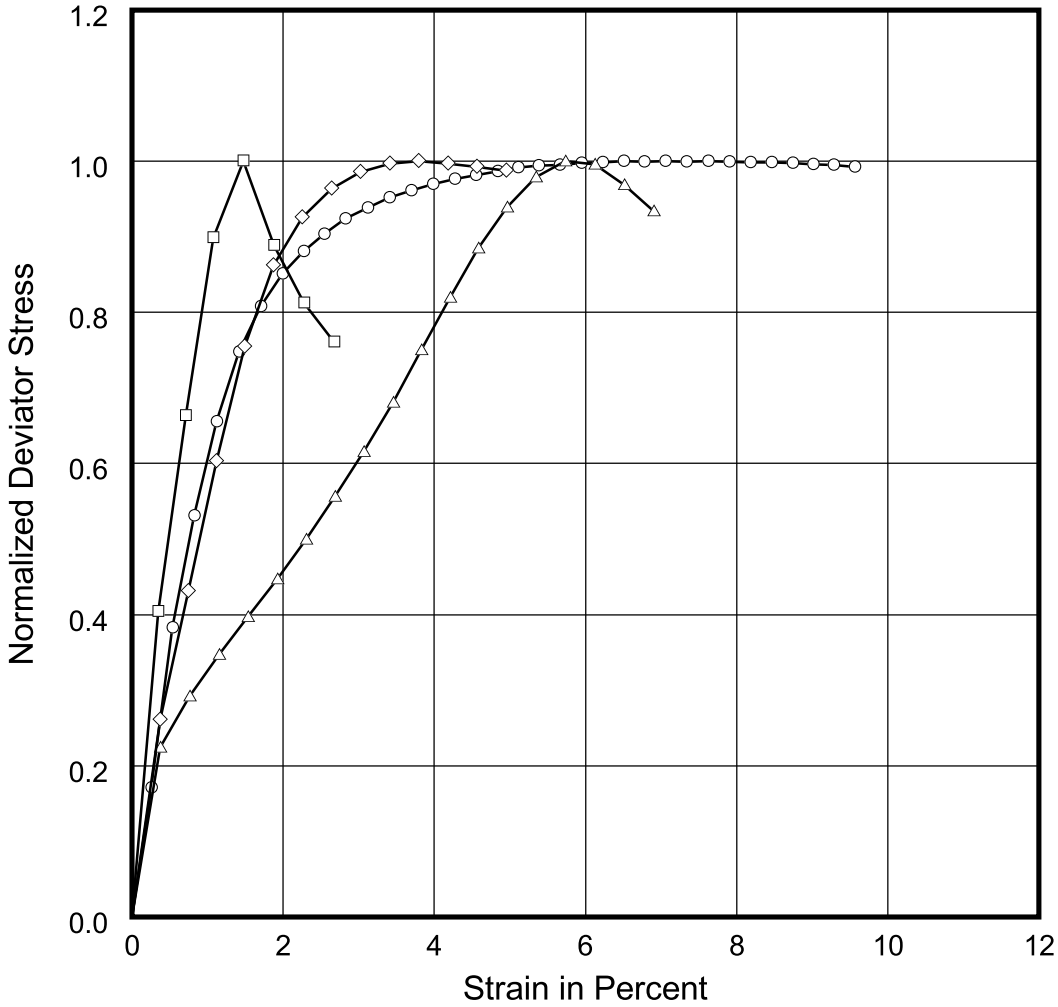


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	44	29.1	UU	655	224	0.6
	46	32.5	UU	724	258	0.9
	48	37.0	UU	827	276	0.5
	53	42.8	UU	965	340	0.9
	56	47.7	UU	1069	194	0.6

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-31
SFOBB East Span Seismic Safety Project

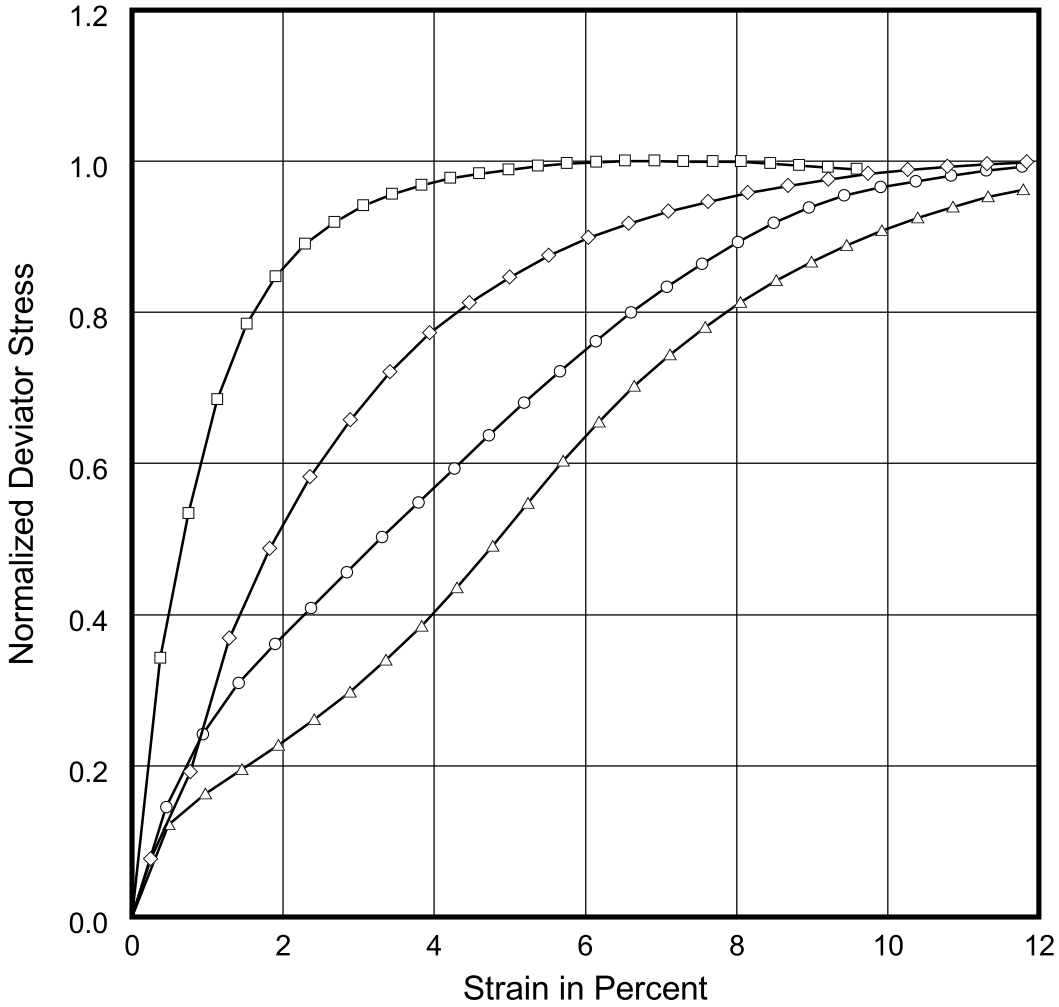


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	60	56.1	UU	1241	319	0.8
□——□	64	61.1	UU	1379	311	0.5
△——△	69	66.6	UU	1517	485	2.3
◇——◇	72	71.5	UU	1586	390	0.9

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-31
SFOBB East Span Seismic Safety Project

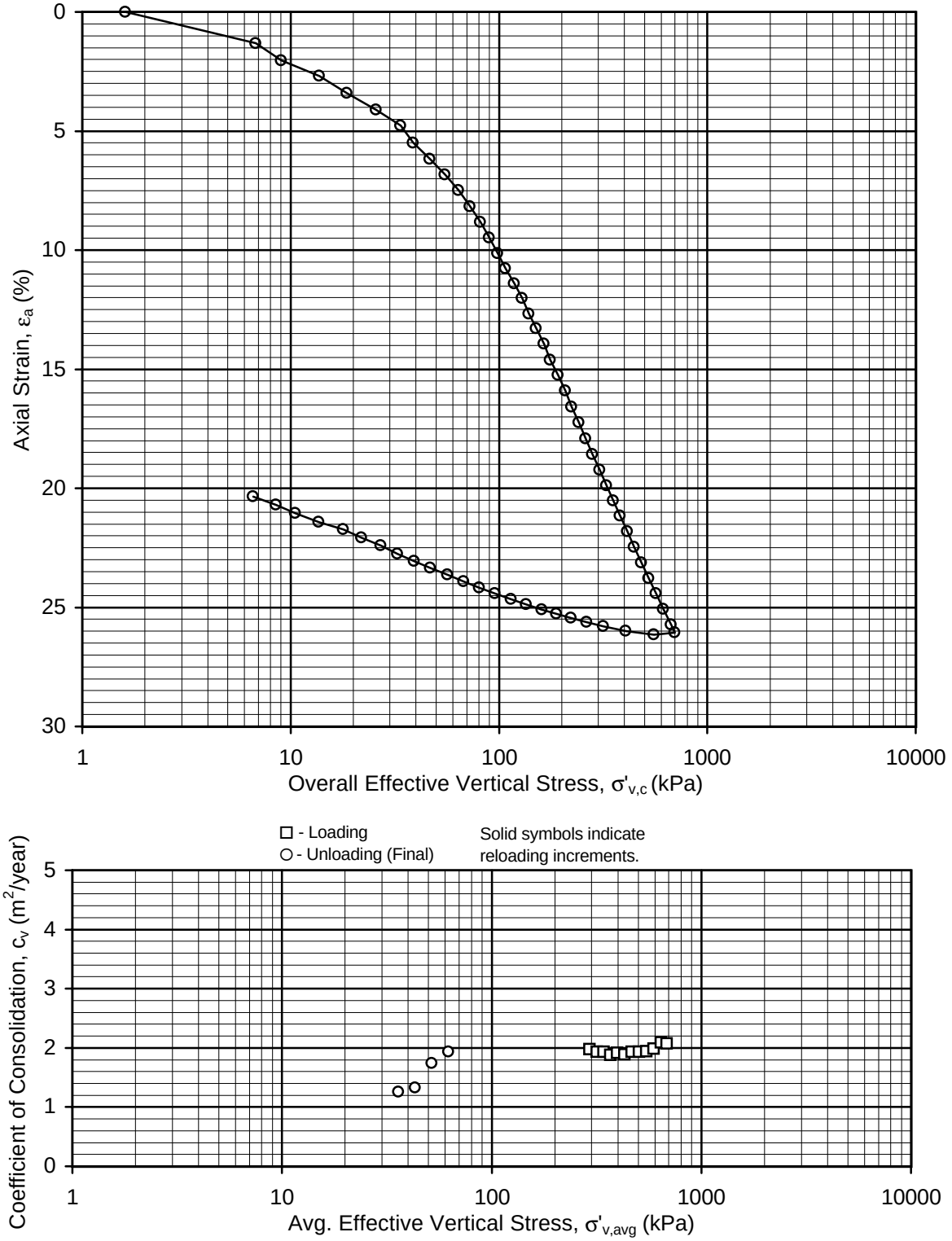


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	74	76.0	UU	1724	323	3.3
□—□	77	81.2	UU	1862	402	0.7
△—△	85	91.9	UU	2068	535	4.8
◇—◇	90	99.2	UU	2241	965	1.9

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

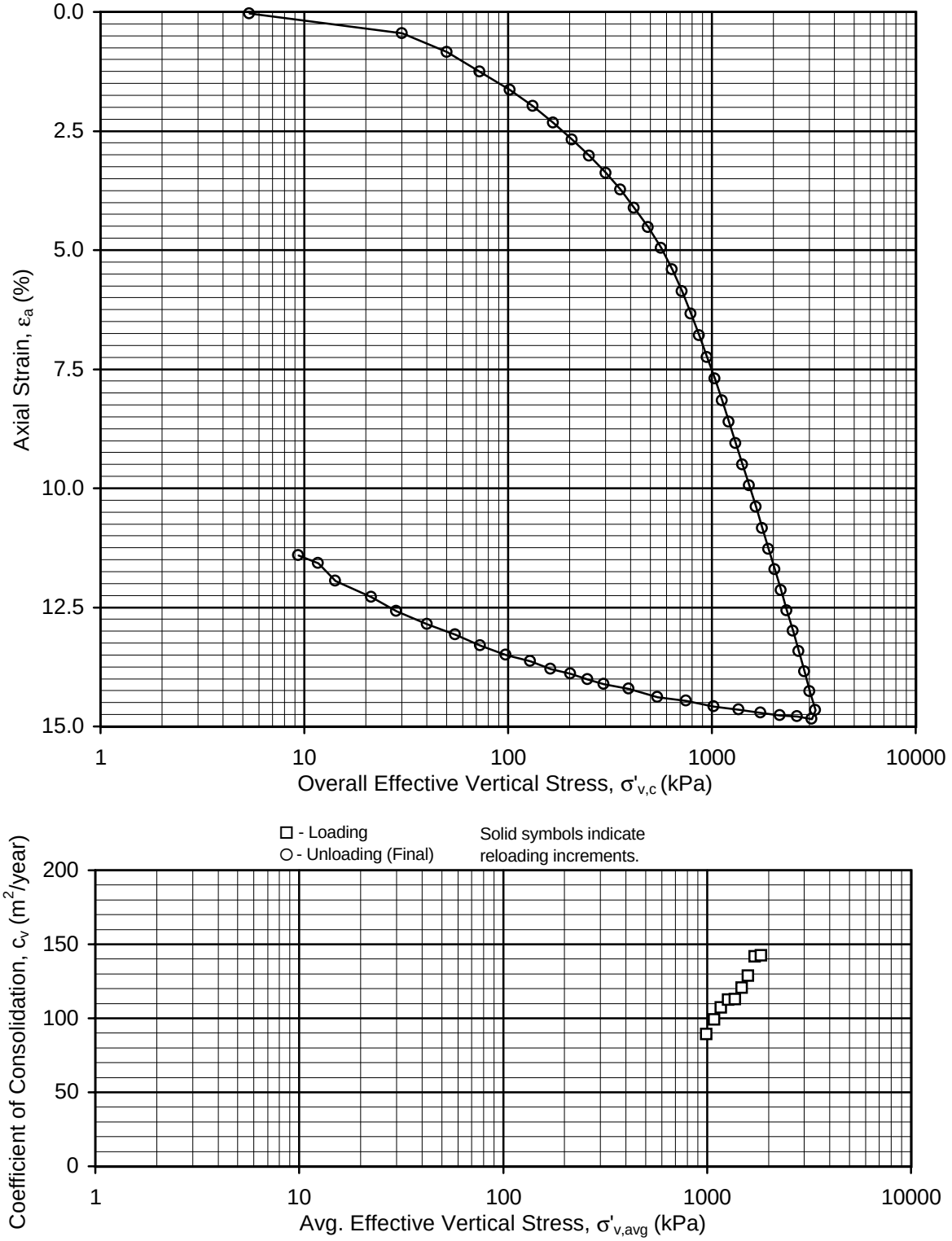
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-31
SFOBB East Span Seismic Safety Project



CRS CONSOLIDATION TEST RESULTS

Sample No. 31 - Depth: 15.5m
Boring 98-31
SFOBB East Span Seismic Safety Project

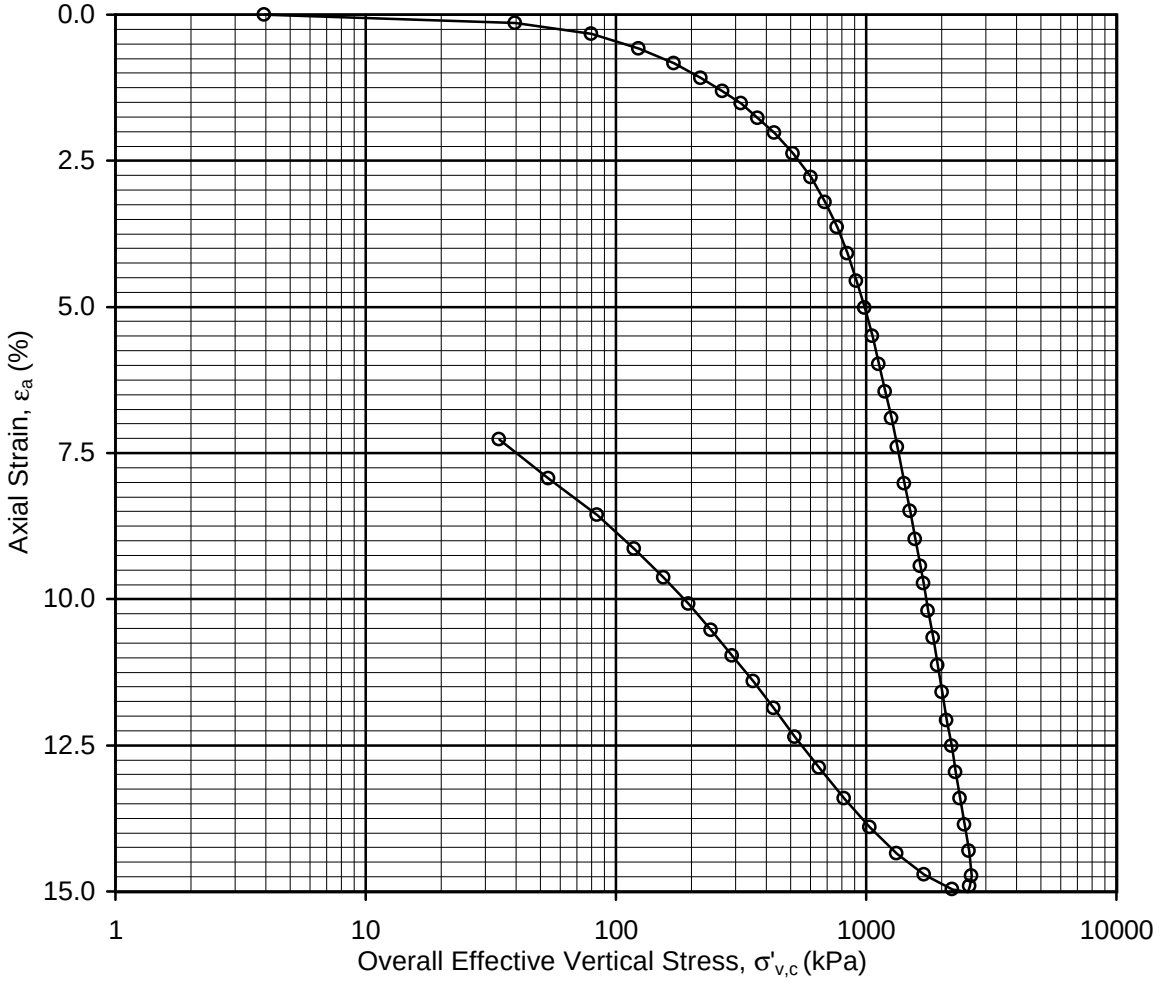
PLATE 98-31.14a

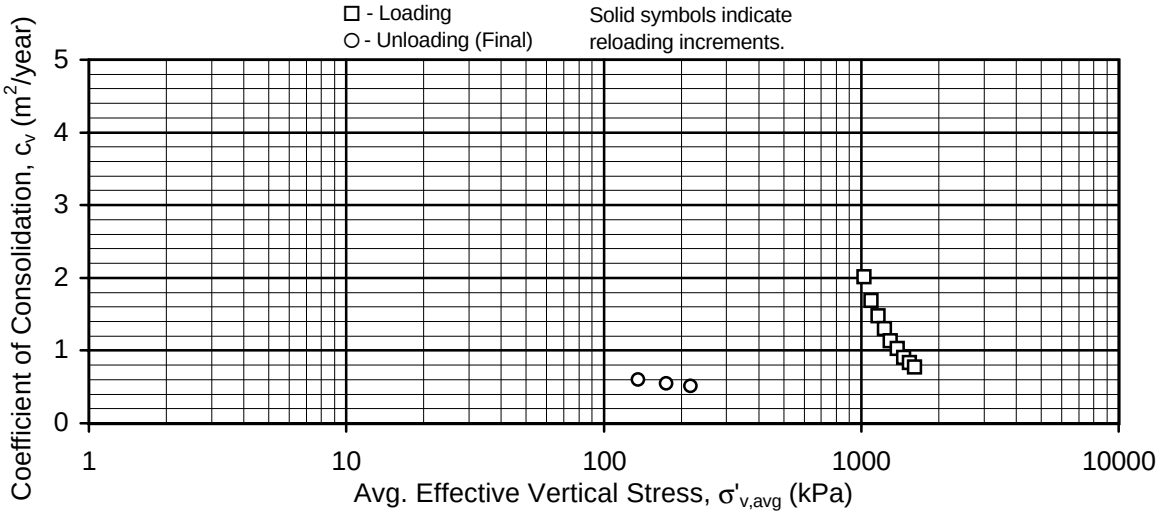


CRS CONSOLIDATION TEST RESULTS

Sample No. 42 - Depth: 25.8m
Boring 98-31
SFOBB East Span Seismic Safety Project

PLATE 98-31.14b

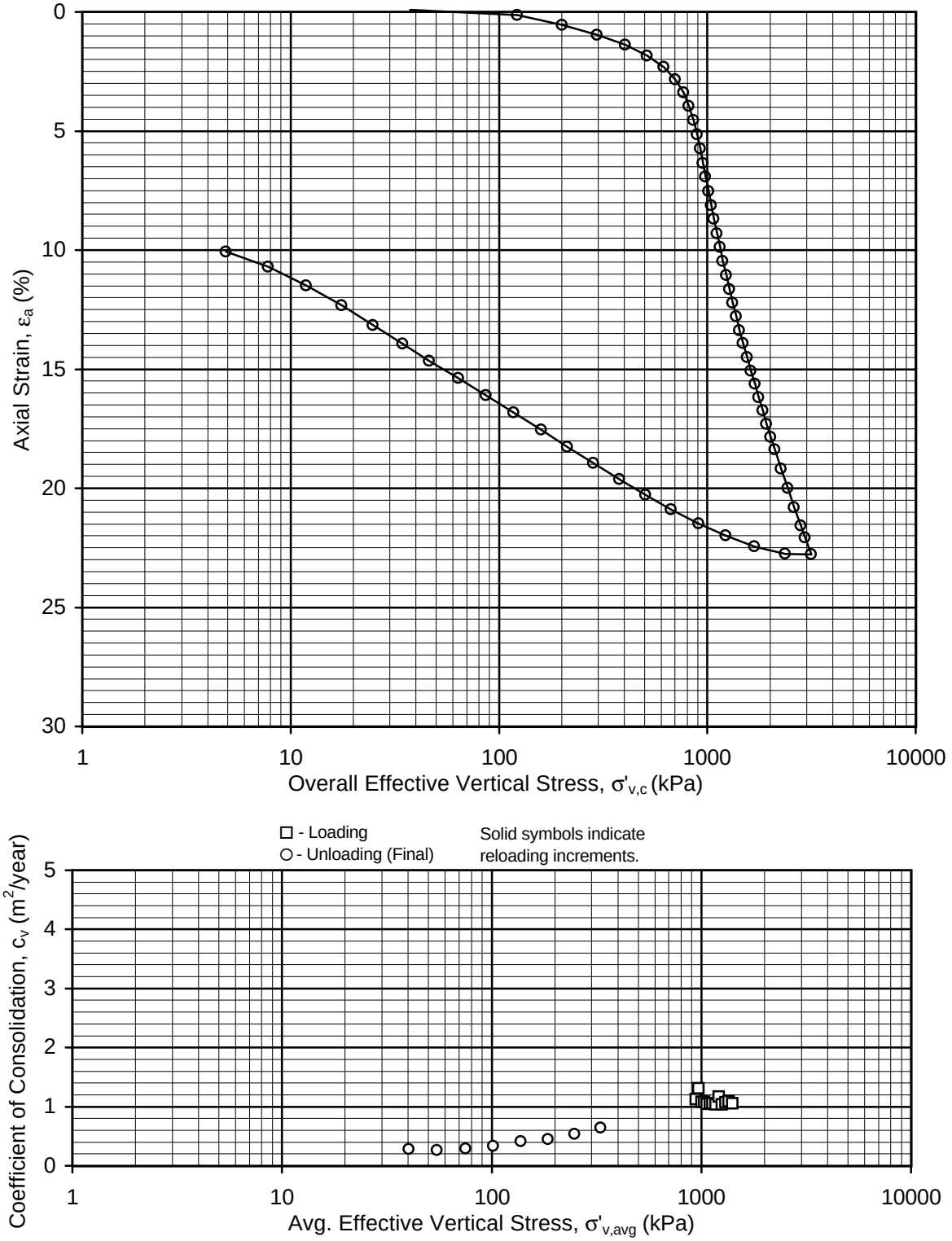




CRS CONSOLIDATION TEST RESULTS

Sample No. 50 - Depth: 38.0m
Boring 98-31
SFOBB East Span Seismic Safety Project

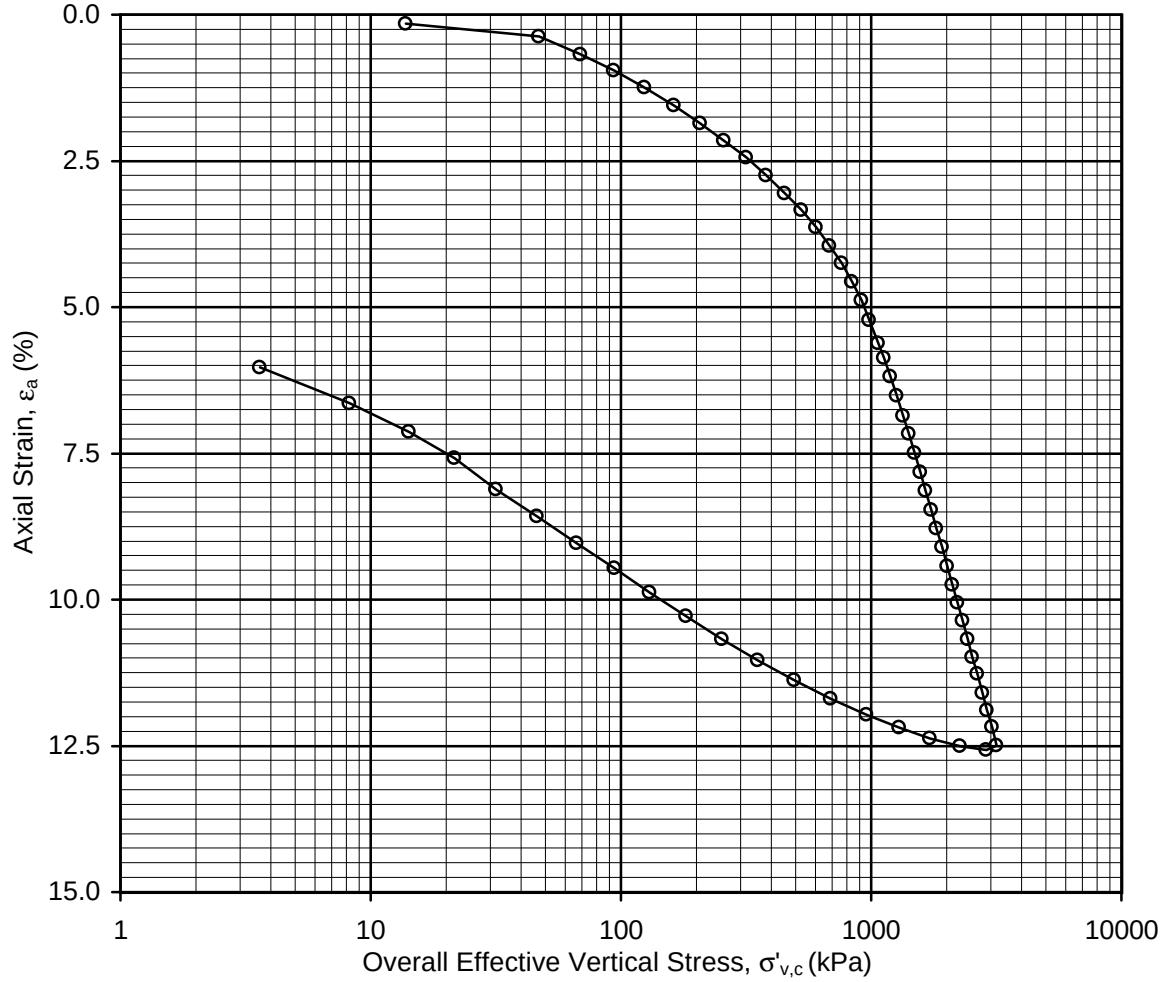
PLATE 98-31.14c

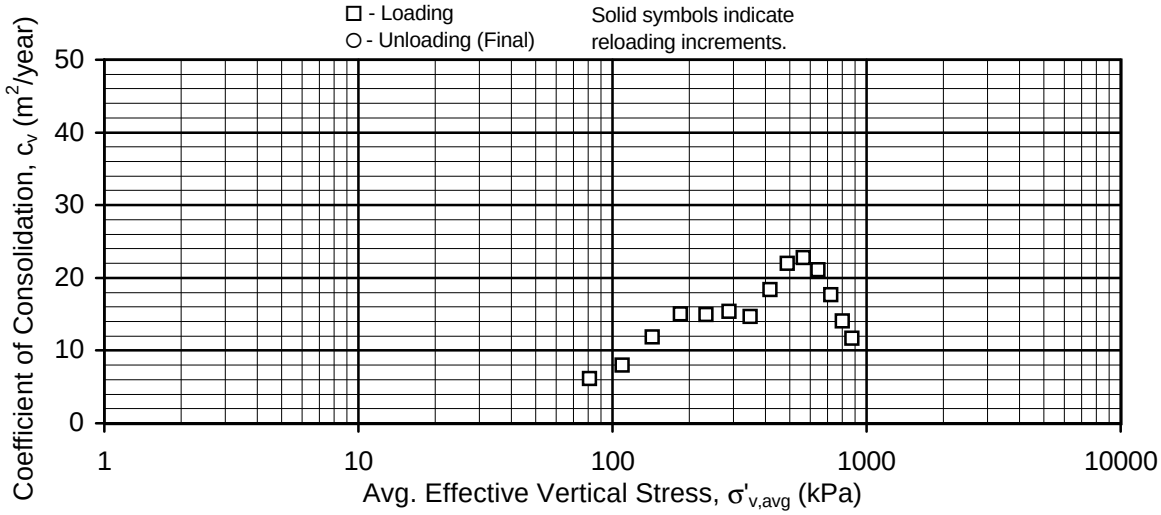


CRS CONSOLIDATION TEST RESULTS

Sample No. 66 - Depth: 61.8m
Boring 98-31
SFOBB East Span Seismic Safety Project

PLATE 98-31.14d

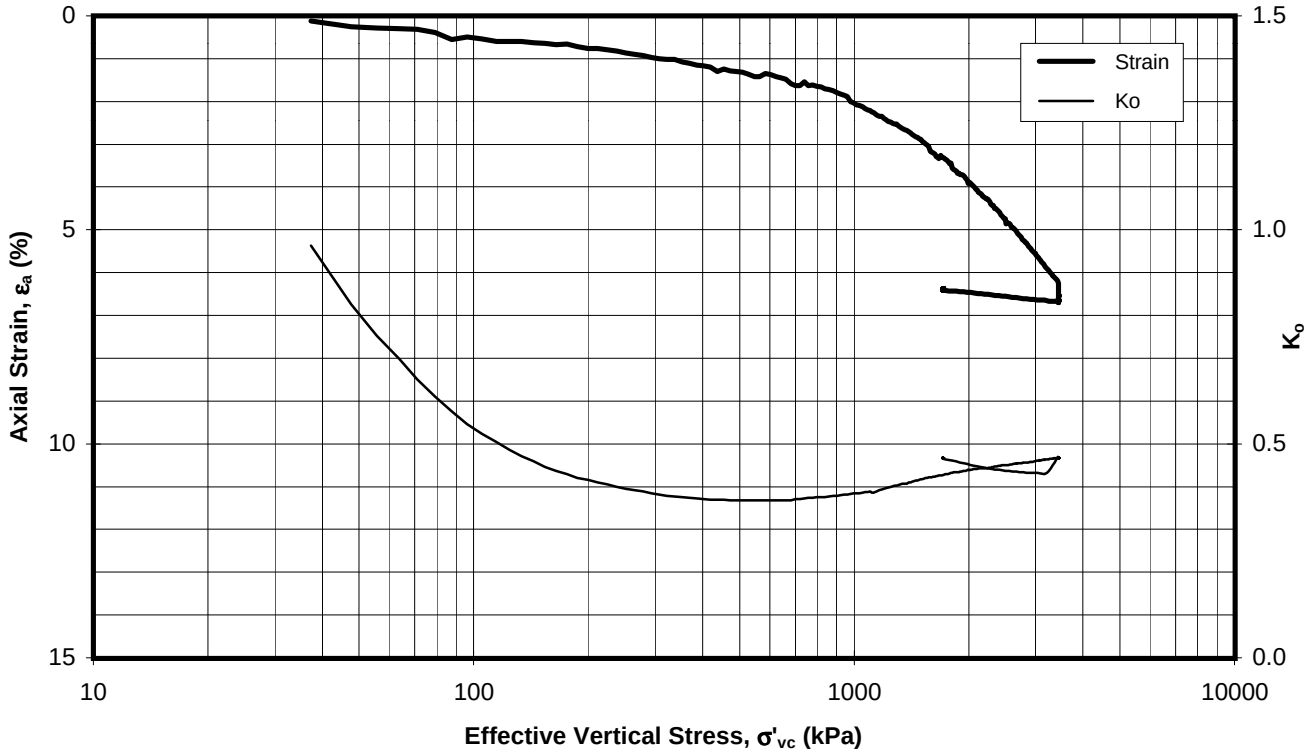


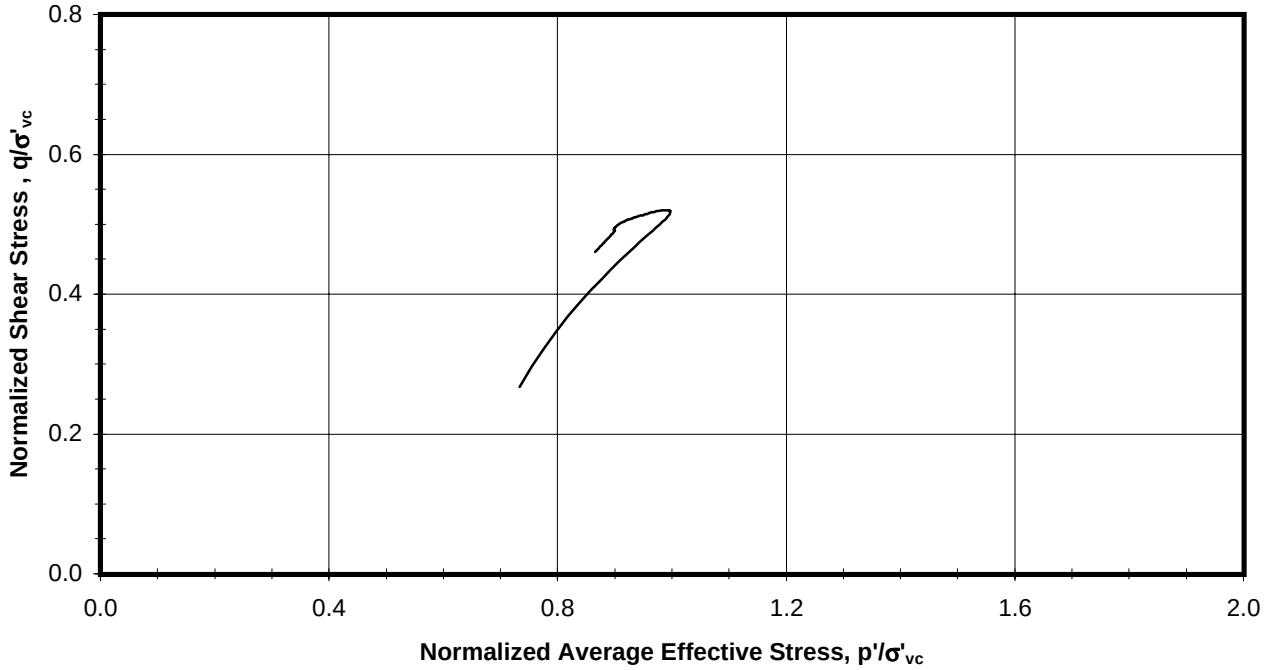


CRS CONSOLIDATION TEST RESULTS

Sample No. 71 - Depth: 71.3m
Boring 98-31
SFOBB East Span Seismic Safety Project

PLATE 98-31.14e





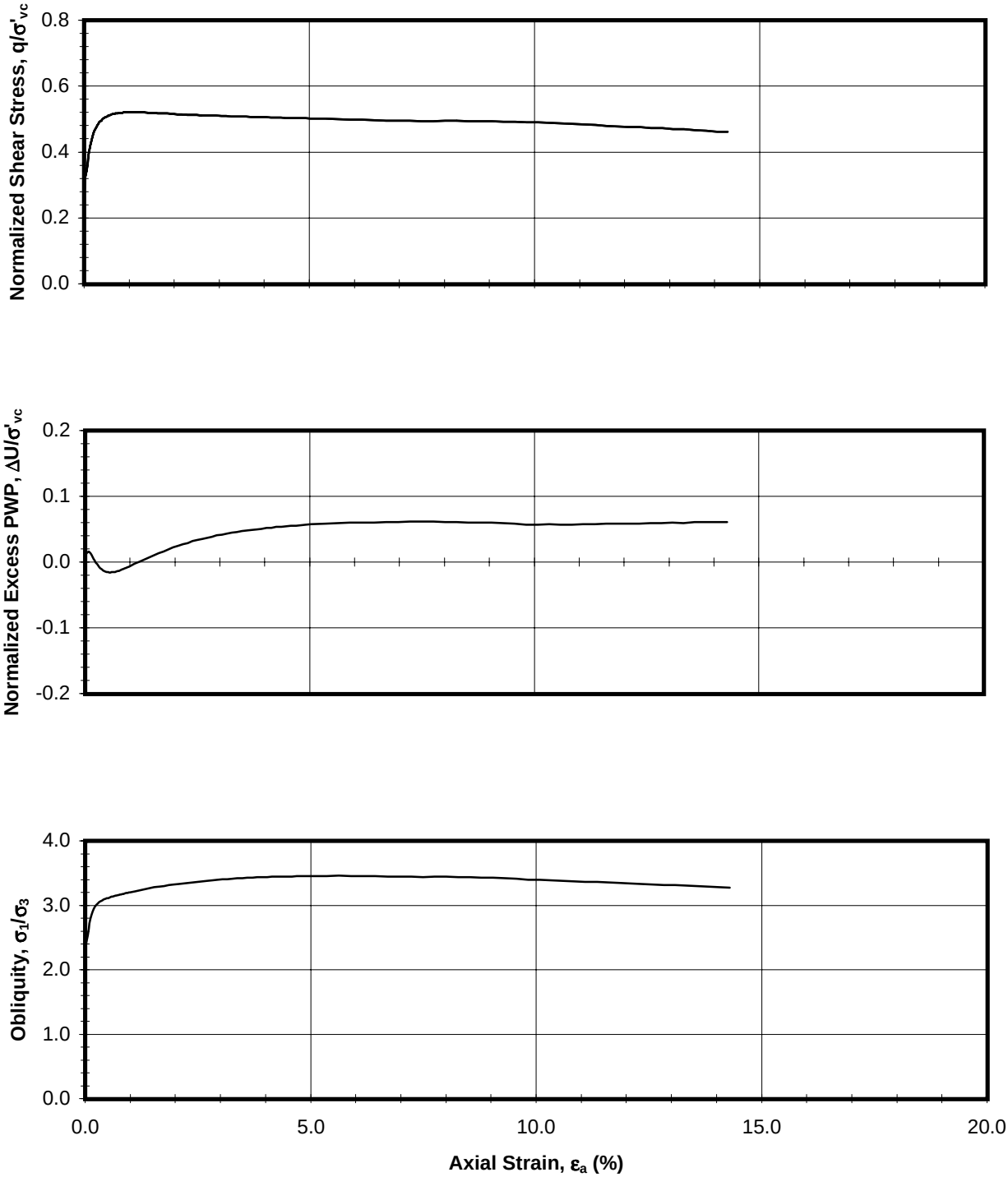
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 79 - Depth: 81.9m

Boring 98-31

SFOBB East Span Seismic Safety Project

PLATE 98-31.15.1



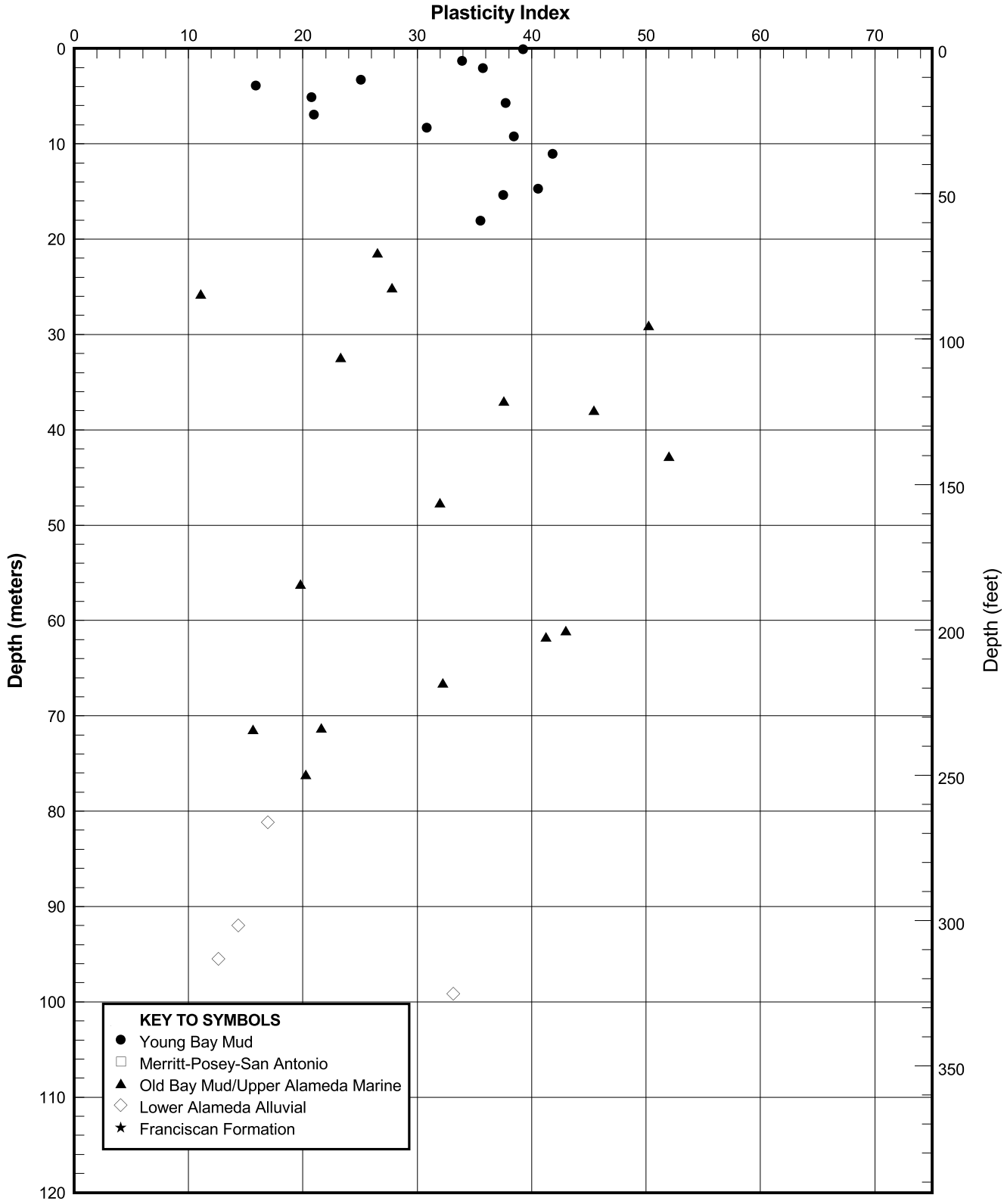
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 79 - Depth: 81.9m

Boring 98-31

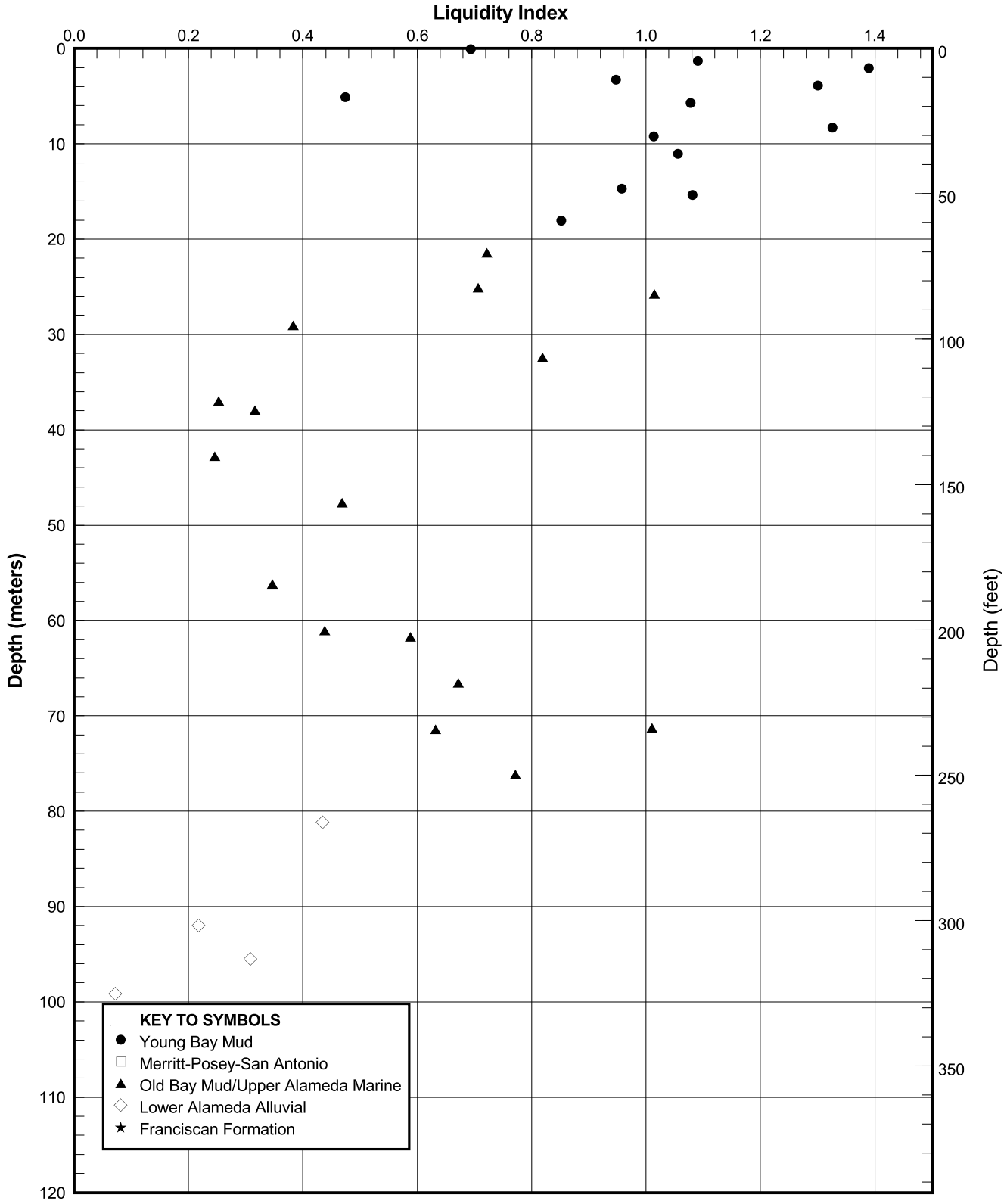
SFOBB East Span Seismic Safety Project

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



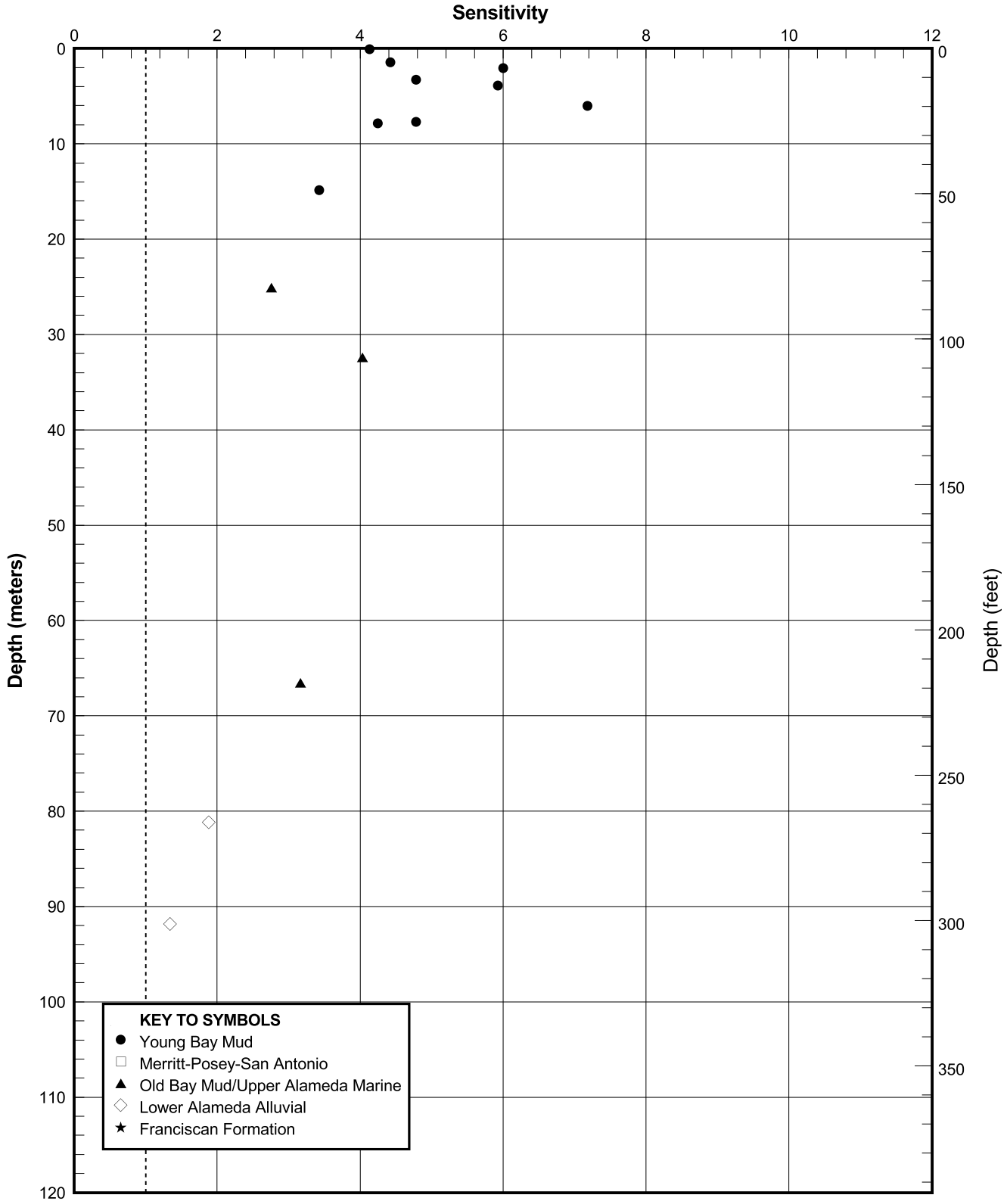
PLASTICITY INDEX PROFILE
Boring 98-31
SFOBB East Span Seismic Safety Project

PLATE 98-31.17



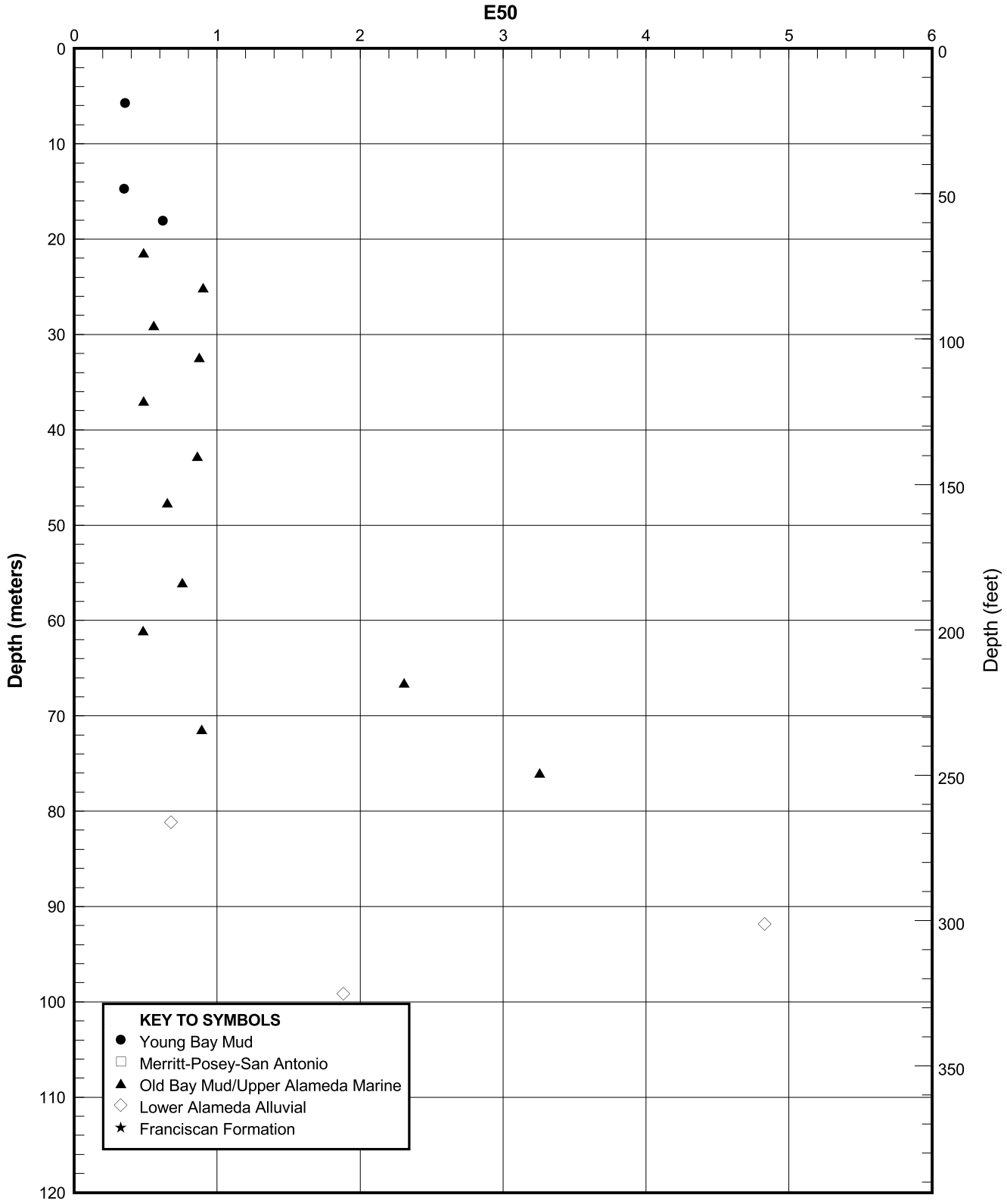
LIQUIDITY INDEX PROFILE
Boring 98-31
SFOBB East Span Seismic Safety Project

PLATE 98-31.18



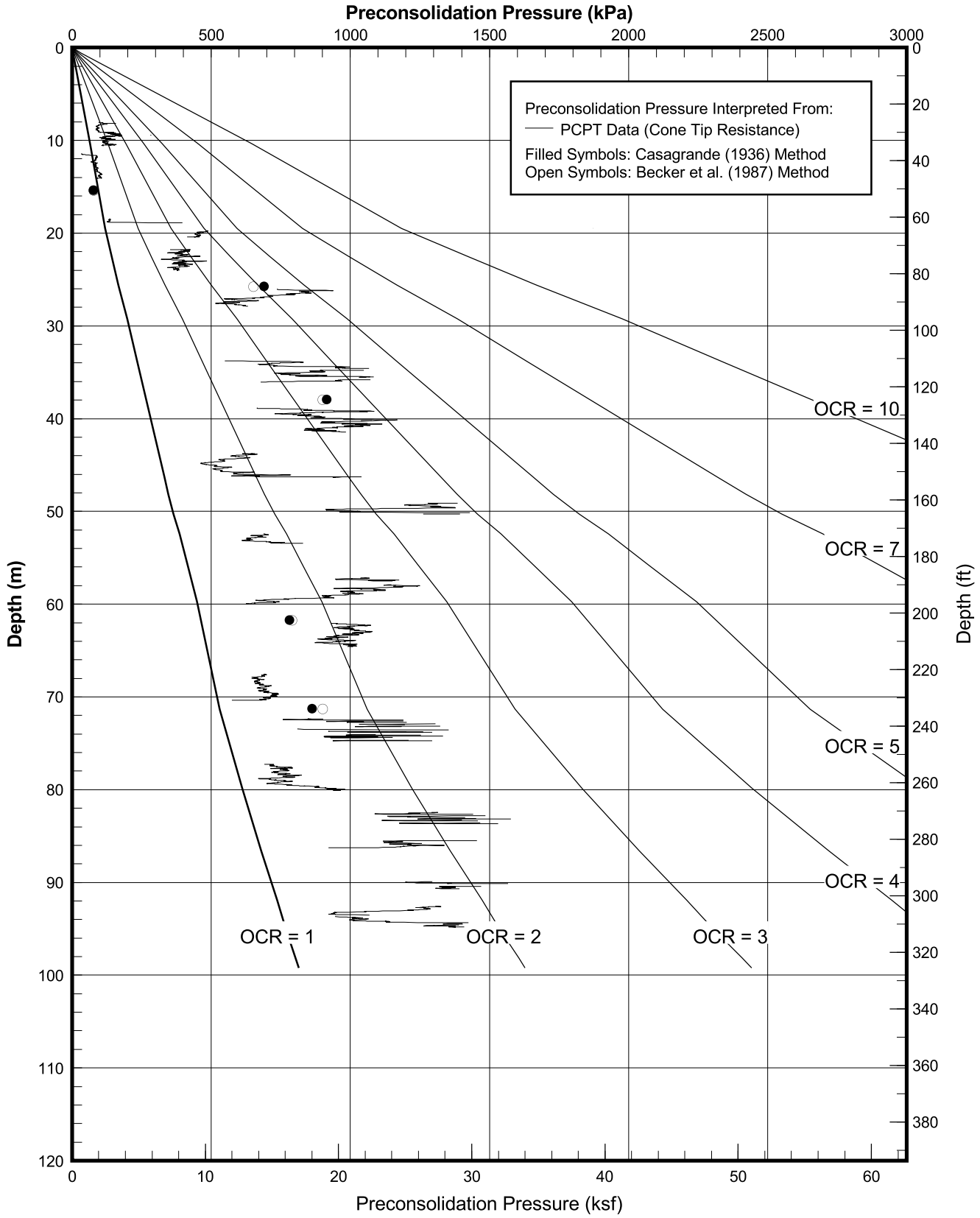
SENSITIVITY PROFILE
Boring 98-31
SFOBB East Span Seismic Safety Project

PLATE 98-31.19



E50 PROFILE
Boring 98-31
SFOBB East Span Seismic Safety Project

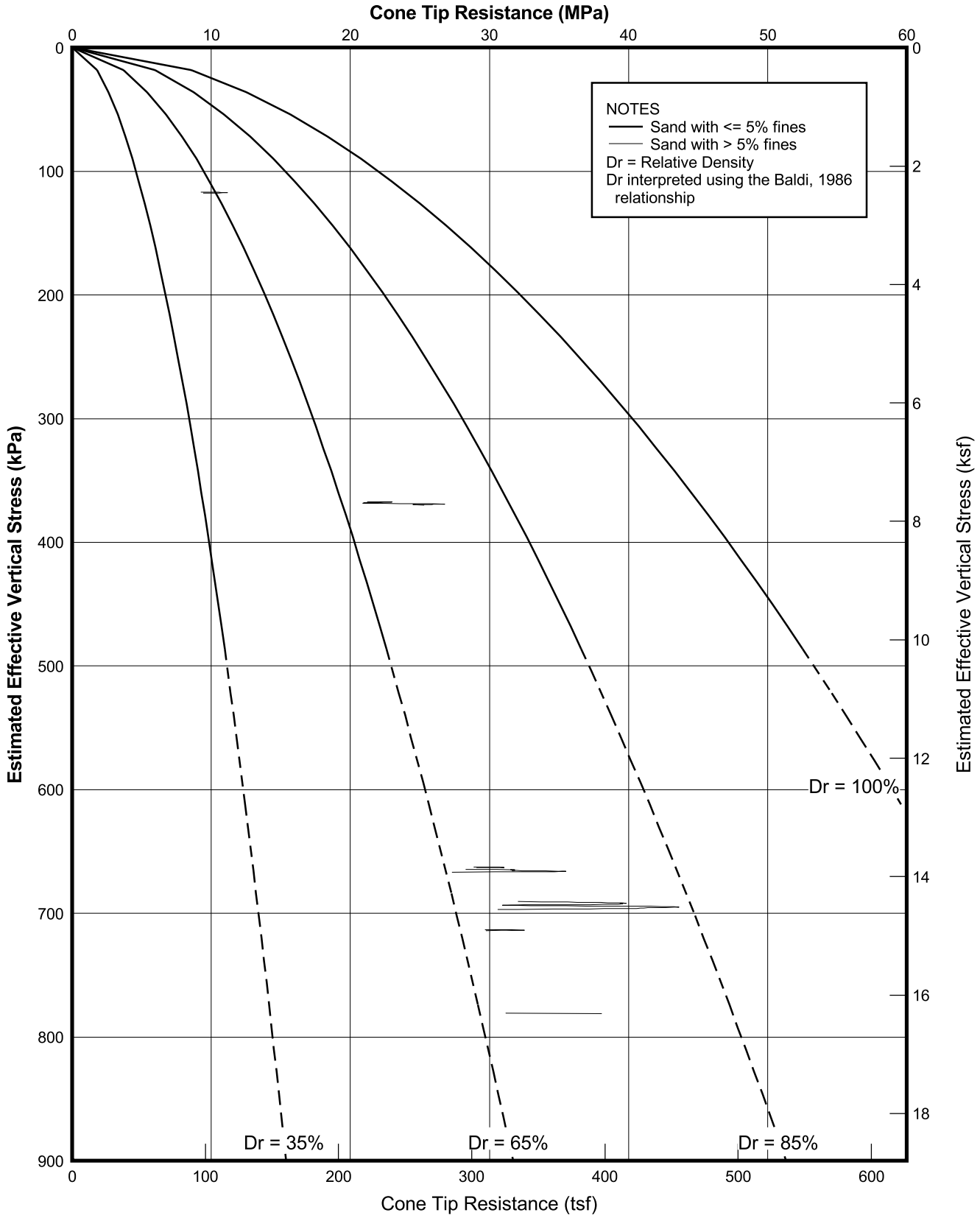
PLATE 98-31.20



PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-31

SFOBB East Span Seismic Safety Project



RELATIVE DENSITY INTERPRETED FROM CPT DATA

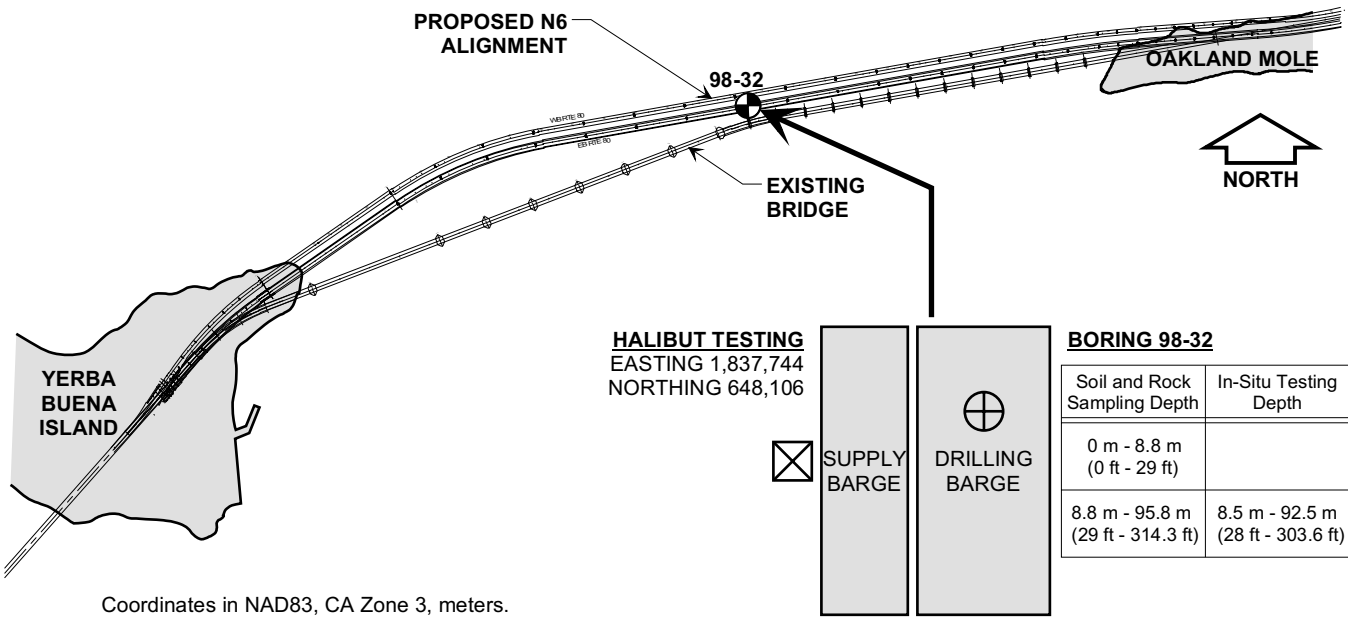
Boring 98-31

SFOBB East Span Seismic Safety Project

BORING 98-32

Date	Time From	Time To	Description of Activity
September 12, 1998	0830	1000	Move barge to location 98-32. Set 4 anchors and 2 spuds.
	1000	1115	Rig up for drilling.
	1115	1145	Lower drill pipe to mudline and measure water depth of 3.8m (12.5 ft) using bottom sensor. Current tide level is approximately -0.2m (-0.5 ft) MSL. Calculate mudline elevation of –4.0m (-13.0 ft) MSL.
	1145	1445	Drill and sample from mudline to 8.8m (29 ft). Pull drill pipe to deck.
	1445	1500	Reposition barge.
	1500	2045	Set casing. Drive stinger to 8.5m (28 ft).
	****	****	
	1600	2015	Rig up Halibut vane equipment. Perform Halibut vane shear tests from 0.6m (2 ft) to 3.7m (12 ft).
	****	****	
	2045	2400	Lower drill pipe to mudline and drill to 8.5m (28 ft).
September 13, 1998	0000	1200	Drill, sample, CPT, and remote vane testing from 11.6m (38 ft) to 46.3m (152 ft).
	1200	2400	Drill, sample, and CPT testing from 46.3m (152 ft) to 80.0m (262 ft).
September 14, 1998	0000	1045	Drill, sample, and CPT testing from 80m (262 ft) to 95.8m (314.3 ft).
	1045	1130	Pull drill pipe to deck.
	1130	1200	Wait on suspension logger.
	1200	1500	P- and S-wave velocity logging from 90.5m (296.9 ft) to 9.5m (31.2 ft). Mix and circulate cement grout.
	1500	1900	Lower N-rod. Grout hole 98-32. Pull N-rod to deck.
	1900	2100	Pull casing to deck.
	2100	2300	Break cable on cathead. Repair cable.
	2300	2400	Pull casing to deck.
September 15, 1998	0000	0245	Pull 2 spuds, 4 anchors, and move barge to location 98-33.

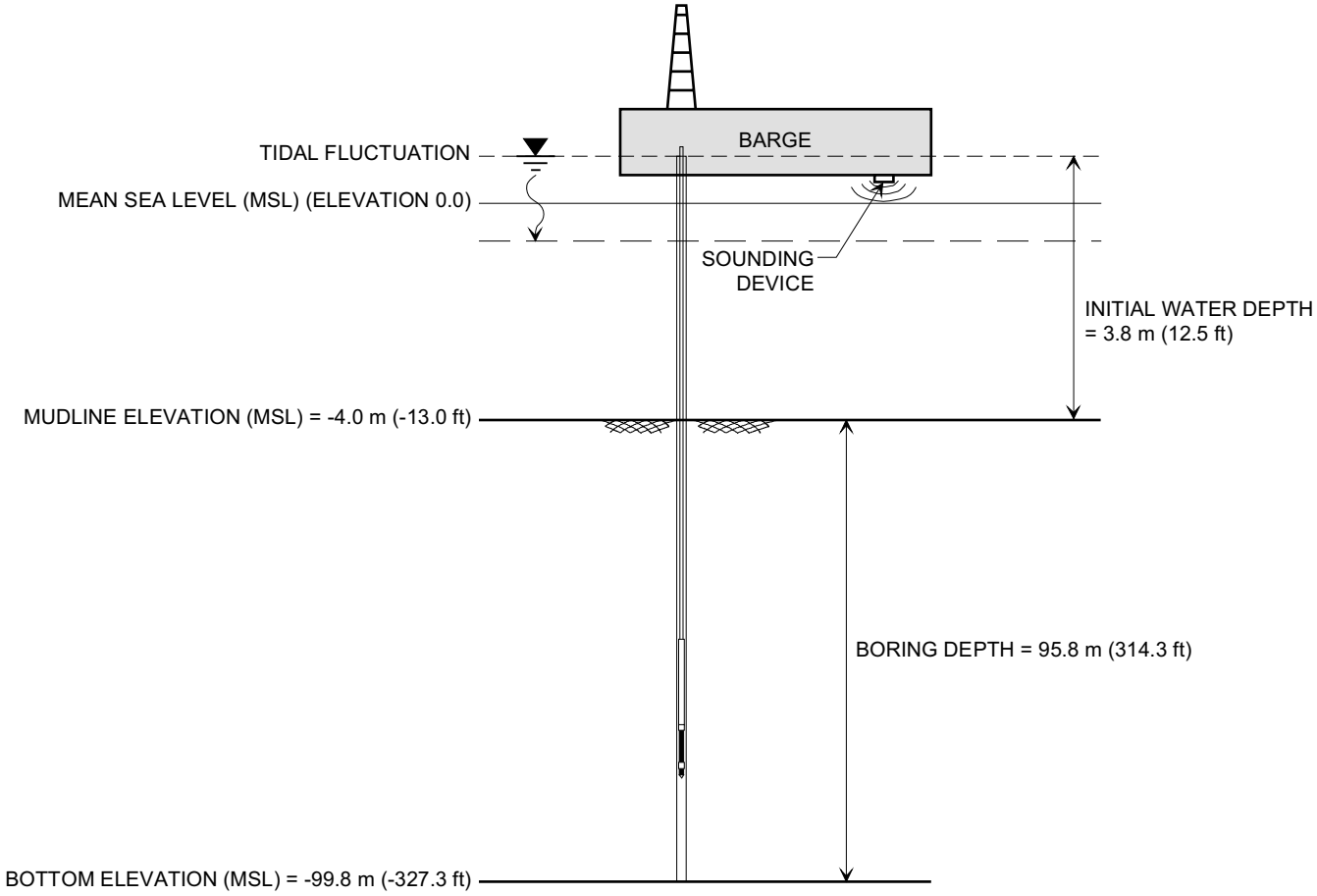
SUMMARY OF FIELD OPERATIONS
Boring 98-32
SFOBB East Span Seismic Safety Project



BORING 98-32

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 8.8 m (0 ft - 29 ft)		E = 1,837,763 N = 648,105
8.8 m - 95.8 m (29 ft - 314.3 ft)	8.5 m - 92.5 m (28 ft - 303.6 ft)	E = 1,837,758 N = 648,106

Coordinates in NAD83, CA Zone 3, meters.



9842\0054loc.dsf(0,32)

DEPTH AND LOCATION REFERENCE MAP
Boring 98-32
SFOBB East Span Seismic Safety Project

PLATE 98-32.2

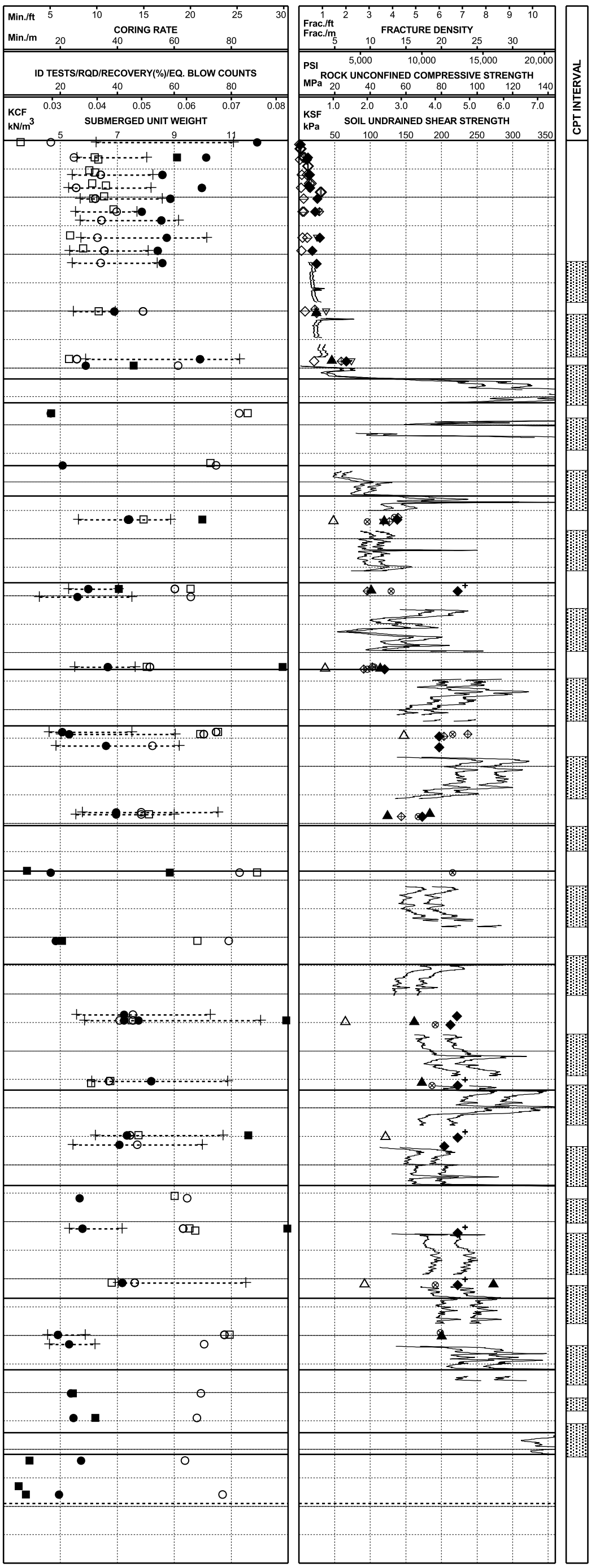
PROJECT NO:	98-42-0054	**START DATE:**	09/12/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-32 (Skyway - Frame 2)	**COMPLETION DATE:**	09/15/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837758 N648106
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -4.0m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4		WOH	Fat CLAY (CH), soft, olive gray	I
		WOH	-very soft, with black streaks, to 0.6m	
		WOH	-with shell fragments to 8.8m	
		WOH	-with silt pockets, 1.8m to 8.8m	
-8	4	WOH	-with gas blisters, 2.7m to 7.0m	
		PUSH	-with an H2S odor, 3.7m to 5.2m	
		PUSH	-with many shells at 4.0m	
			-with sand pockets and wood fragments, at 4.9m	
		PUSH	-with many shells at 5.5m	
-12	8	PUSH	-with sand pockets at 6.7m	
		SAVE		
			See Plate 98-32.6 for detailed stratigraphy	
-16	12	PUSH	-sand layer, 12.2m to 12.5m	
			-sand layer, 13.9m to 14.3m	
-20	16	PUSH	-medium dense silty fine sand, with clay pockets and organic pockets, 15.5m to 15.8m (16.8m)	
			Lean CLAY (CL), hard -silt layer, 17.5m to 17.8m (18.4m)	II
-24	20	PUSH	Silty Fine SAND (SM), very dense, gray -clay layer, 19.7m to 20.0m -clay layer, 20.4m to 20.7m -with clay layers at 21.2m and 21.6m (22.9m)	III
-28	24	PUSH	Fat CLAY (CH), stiff, greenish gray (25.0m)	IV
-32	28	PUSH	Fat CLAY (CH), very stiff, greenish gray -with a sand layer at 25.5m -with silt pockets at 26.5m -with a sand seam at 29.0m (31.1m)	V
-36	32	PUSH SAVE	Fat CLAY (CH), very stiff, greenish gray -clayey sand, with sand pockets, calcareous nodules and a few shell fragments, at 31.4m	VI
-40	36	PUSH	-with silt pockets below 36.6m (37.2m)	
-44	40		Fat CLAY (CH), hard to very stiff, greenish gray -silt layer, 40.4m to 40.7m (41.1m)	VII
-48	44	PUSH SAVE	Fat CLAY (CH), hard to very stiff, greenish gray -with a few calcareous nodules at 41.8m	VIII
-52	48	PUSH	-with silt pockets at 47.2m (48.2m)	
			Fine SAND with silt (SP-SM), dense to very dense, gray (51.4m)	IX
-56	52	30/30cm	Fat CLAY (CH), hard to very stiff, gray -with a sandy lean clay layer at 51.5m -silty fine sand layer, 54.9m to 55.2m	X
-60	56	PUSH	-silty fine to medium sand with trace coarse sand and gravel, below 56.1m (57.9m)	
-64	60	SAVE PUSH	Fat CLAY (CH), very stiff, olive gray -with gas blisters, shell fragments and a few wood fragments, at 61.9m	XI
-68	64	PUSH	-platy and expansive, with dessicated pockets and silt pockets and partings, at 66.1m (66.8m)	
-72	68	PUSH SAVE	Fat CLAY (CH), hard, dark gray -with organic pockets and wood fragments, at 69.8m -with many large organic pockets at 70.4m (73.5m)	XII
-76	72	PUSH	Lean CLAY (CL), hard, gray -with a sand layer at 73.5m -with organic pockets and many silt pockets, partings, and seams, at 74.1m	XIII
-80	76	PUSH	-silty sand layer, 74.2m to 75.3m -with lean clay layers at 74.7m and 75.1m -sandy silt, with clay seams and layers, 75.3m to 76.2m -with silt pockets and seams, at 76.5m	
-84	80	PUSH	-fat clay, with many organic pockets, at 80.2m (81.4m)	
-88	84	PUSH SAVE	Lean CLAY (CL), hard, gray -with silt and sand pockets and seams, 83.8m to 84.4m -with a sand layer at 84.1m (86.4m)	XIV
-92	88	30/30cm 30/45cm	Silty Fine SAND (SM), very dense, gray -with clay pockets and seams -clay layer, 86.9m to 87.2m -sandy clay at 88.8m -clay layer, 89.0m to 89.3m (90.8m)	XV
-96	92		Lean CLAY (CL), hard, gray (92.4m)	XVI
-100	96	30/15cm 30/15cm 30/15cm 30/10cm	Fine to Medium SAND (SW-SM) with silt and gravel, very dense, gray -with coarse sand and many clay seams at 92.7m -with a few clay pockets at 94.5m -fine gravel with fine to coarse sand and silt, at 95.7m	XVII

TOTAL DEPTH: 95.8m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-32

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

PLATE 98-32.3

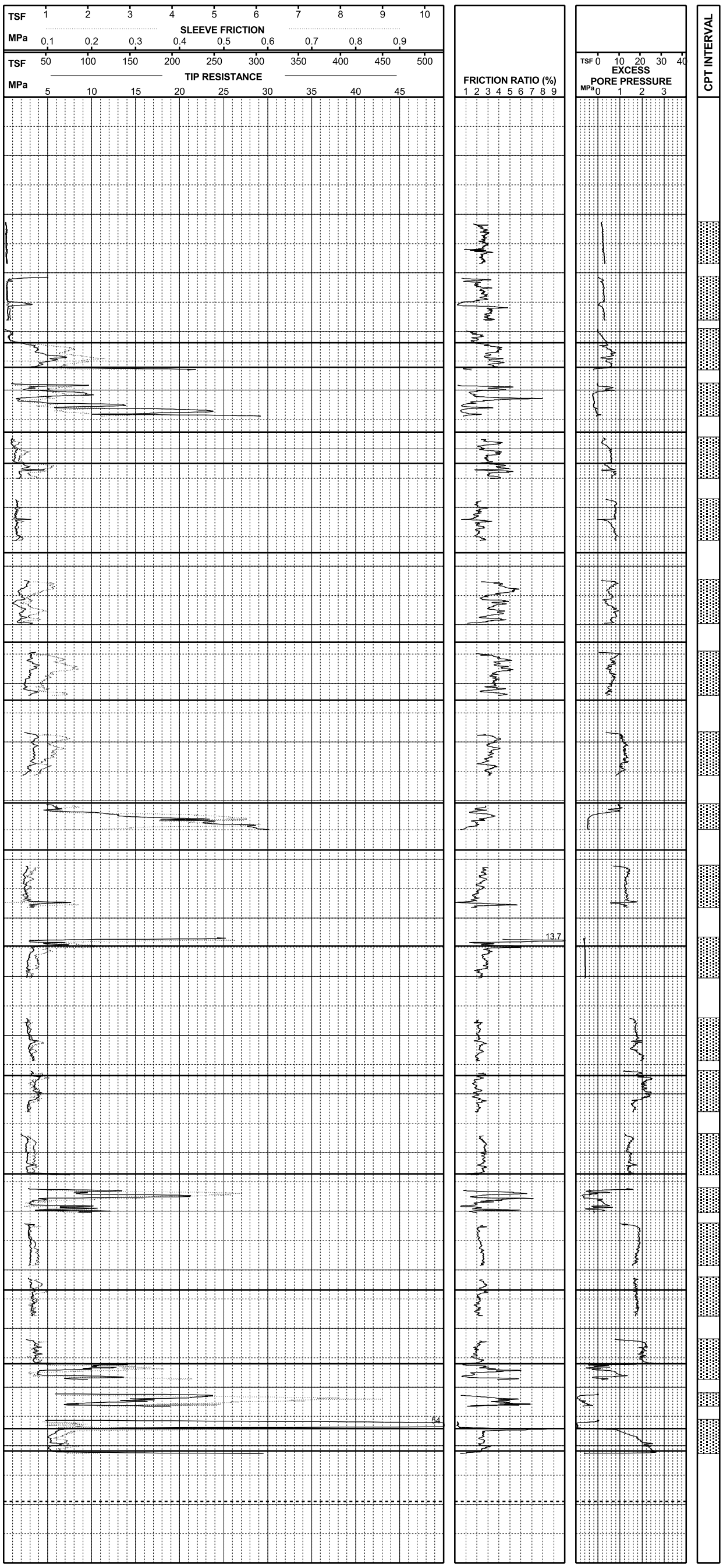
PROJECT NO:	98-42-0054	**START DATE:**	09/12/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-32 (Skyway - Frame 2)	**COMPLETION DATE:**	09/15/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837758 N648106
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -4.0m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4		WOH	Fat CLAY (CH), soft, olive gray	I
		WOH	-very soft, with black streaks, to 0.6m	
		WOH	-with shell fragments to 8.8m	
		WOH	-with silt pockets, 1.8m to 8.8m	
-8	4	WOH	-with gas blisters, 2.7m to 7.0m	
		PUSH	-with an H2S odor, 3.7m to 5.2m	
		PUSH	-with many shells at 4.0m	
		PUSH	-with many shells at 5.5m	
		PUSH	-with sand pockets at 6.7m	
-12	8	SAVE	See Plate 98-32.6 for detailed stratigraphy	
-16	12	PUSH	-sand layer, 12.2m to 12.5m	
			-sand layer, 13.9m to 14.3m	
-20	16	PUSH	-medium dense silty fine sand, with clay pockets and organic pockets, 15.5m to 15.8m (16.8m)	
			Lean CLAY (CL), hard -silt layer, 17.5m to 17.8m (18.4m)	II
-24	20	PUSH	Silty Fine SAND (SM), very dense, gray -clay layer, 19.7m to 20.0m -clay layer, 20.4m to 20.7m (22.9m)	III
-28	24	PUSH	Fat CLAY (CH), stiff, greenish gray (25.0m)	IV
-32	28	PUSH	Fat CLAY (CH), very stiff, greenish gray -with a sand layer at 25.5m -with silt pockets at 26.5m -with a sand seam at 29.0m (31.1m)	V
-36	32	PUSH SAVE	Fat CLAY (CH), very stiff, greenish gray -clayey sand, with sand pockets, calcareous nodules and a few shell fragments, at 31.4m	VI
-40	36	PUSH	-with silt pockets below 36.6m (37.2m)	
-44	40		Fat CLAY (CH), hard to very stiff, greenish gray -silt layer, 40.4m to 40.7m (41.1m)	VII
-48	44	PUSH SAVE	Fat CLAY (CH), hard to very stiff, greenish gray -with a few calcareous nodules at 41.8m	VIII
-52	48	PUSH	-with silt pockets at 47.2m (48.2m)	
			Fine SAND with silt (SP-SM), dense to very dense, gray (51.4m)	IX
-56	52	30/30cm	Fat CLAY (CH), hard to very stiff, gray -with a sandy lean clay layer at 51.5m -silty fine sand layer, 54.9m to 55.2m	X
-60	56	PUSH	-silty fine to medium sand with trace coarse sand and gravel, below 56.1m (57.9m)	
-64	60	SAVE PUSH	Fat CLAY (CH), very stiff, olive gray -with gas blisters, shell fragments and a few wood fragments, at 61.9m	XI
-68	64	PUSH	-platy and expansive, with dessicated pockets and silt pockets and partings, at 66.1m (66.8m)	
-72	68	PUSH SAVE	Fat CLAY (CH), hard, dark gray -with organic pockets and wood fragments, at 69.8m -with many large organic pockets at 70.4m	XII
-76	72		(73.5m)	
-80	76	PUSH	Lean CLAY (CL), hard, gray -with a sand layer at 73.5m -with organic pockets and many silt pockets, partings, and seams, at 74.1m -silty sand layer, 74.2m to 75.3m -with lean clay layers at 74.7m and 75.1m -sandy silt, with clay seams and layers, 75.3m to 76.2m -with silt pockets and seams, at 76.5m (81.4m)	XIII
-84	80	PUSH		
-88	84	PUSH SAVE	Lean CLAY (CL), hard, gray -with silt and sand pockets and seams, 83.8m to 84.4m -with a sand layer at 84.1m (86.4m)	XIV
-92	88	30/30cm 30/45cm	Silty Fine SAND (SM), very dense, gray -with clay pockets and seams -clay layer, 86.9m to 87.2m -sandy clay at 88.8m -clay layer, 89.0m to 89.3m (90.8m)	XV
-96	92		Lean CLAY (CL), hard, gray (92.4m)	XVI
-100	96	30/15cm 30/15cm 30/15cm 30/10cm	Fine to Medium SAND (SW-SM) with silt and gravel, very dense, gray	XVII

TOTAL DEPTH: 95.8m
BACKFILLED WITH: Cement Grout



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-32

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

PLATE 98-32.4

PROJECT NO:	98-42-0054	**START DATE:**	09/12/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-32 (Skyway - Frame 2)	**COMPLETION DATE:**	09/15/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

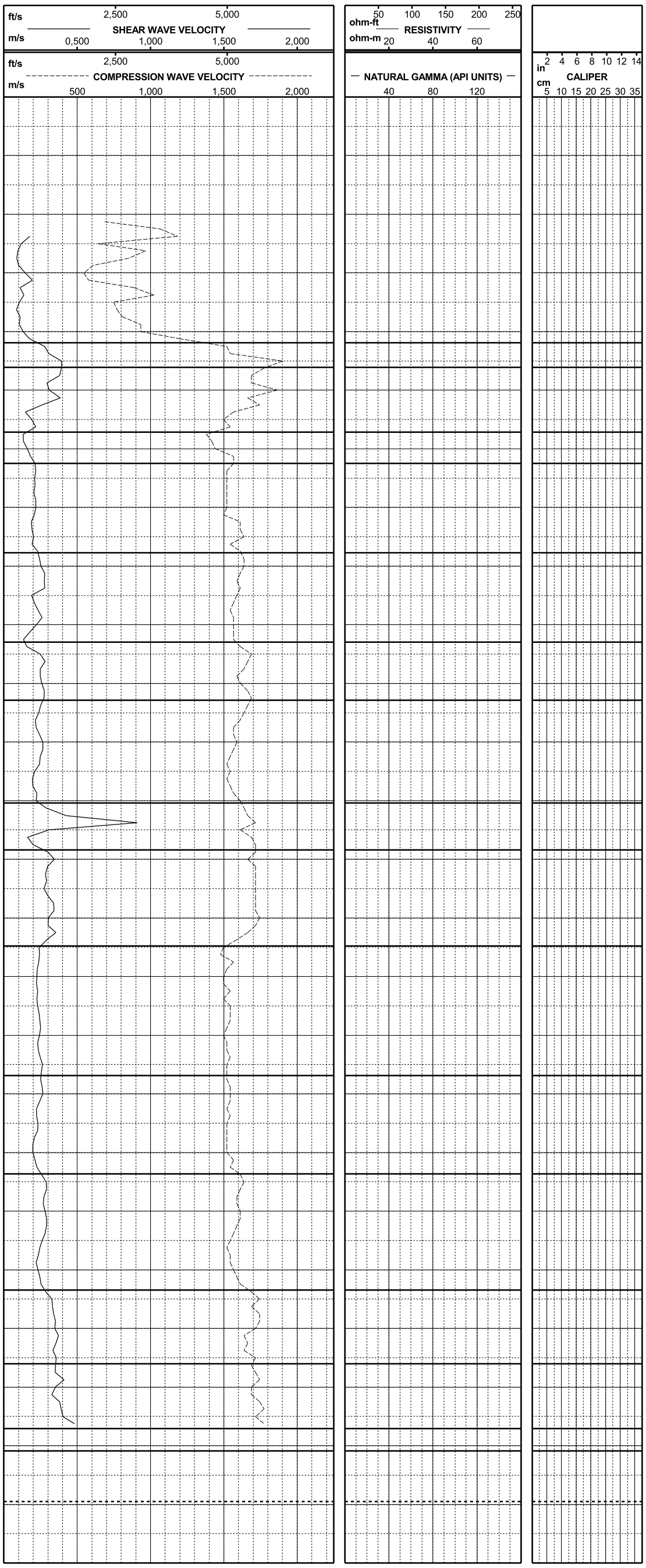
Coordinates: E1837758 N648106
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -4.0m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4		WOH	Fat CLAY (CH), soft, olive gray	I
		WOH		
		WOH		
		WOH		
-8	4	WOH		
		PUSH		
		PUSH	See Plate 98-32.6 for detailed stratigraphy	
		PUSH		
		PUSH		
-12	8	SAVE		
-16	12	PUSH	-sand layer, 12.2m to 12.5m	
			-sand layer, 13.9m to 14.3m	
-20	16	PUSH	-medium dense silty fine sand, with clay pockets and organic pockets, 15.5m to 15.8m (16.8m)	
			Lean CLAY (CL), hard (18.4m)	II
-24	20	PUSH	Silty Fine SAND (SM), very dense, gray -clay layer, 19.7m to 20.0m -clay layer, 20.4m to 20.7m (22.9m)	III
-28	24	PUSH	Fat CLAY (CH), stiff, greenish gray (25.0m)	IV
-32	28	PUSH	Fat CLAY (CH), very stiff, greenish gray -with a sand layer at 25.5m -with silt pockets at 26.5m -with a sand seam at 29.0m (31.1m)	V
-36	32	PUSH SAVE	Fat CLAY (CH), very stiff, greenish gray -clayey sand, with sand pockets, calcareous nodules and a few shell fragments, at 31.4m	VI
-40	36	PUSH	-with silt pockets below 36.6m (37.2m)	
-44	40		Fat CLAY (CH), hard to very stiff, greenish gray -silt layer, 40.4m to 40.7m (41.1m)	VII
-48	44	PUSH SAVE	Fat CLAY (CH), hard to very stiff, greenish gray -with a few calcareous nodules at 41.8m	VIII
-52	48	PUSH	-with silt pockets at 47.2m (48.2m)	
			Fine SAND with silt (SP-SM), dense to very dense, gray (51.4m)	IX
-56	52	30/30cm	Fat CLAY (CH), hard to very stiff, gray -with a sandy lean clay layer at 51.5m -silty fine sand layer, 54.9m to 55.2m	X
-60	56	PUSH	-silty fine to medium sand with trace coarse sand and gravel, below 56.1m (57.9m)	
-64	60		Fat CLAY (CH), very stiff, olive gray	XI
		SAVE PUSH	-with gas blisters, shell fragments and a few wood fragments, at 61.9m	
-68	64	PUSH	-platy and expansive, with dessicated pockets and silt pockets and partings, at 66.1m (66.8m)	
-72	68		Fat CLAY (CH), hard, dark gray	XII
		PUSH SAVE	-with organic pockets and wood fragments, at 69.8m -with many large organic pockets at 70.4m	
-76	72		(73.5m)	
		PUSH	Lean CLAY (CL), hard, gray -with a sand layer at 73.5m	XIII
-80	76	PUSH	-with organic pockets and many silt pockets, partings, and seams, at 74.1m -silty sand layer, 74.2m to 75.3m -with lean clay layers at 74.7m and 75.1m -sandy silt, with clay seams and layers, 75.3m to 76.2m -with silt pockets and seams, at 76.5m	
-84	80	PUSH	-fat clay, with many organic pockets, at 80.2m (81.4m)	
-88	84	PUSH SAVE	Lean CLAY (CL), hard, gray -with silt and sand pockets and seams, 83.8m to 84.4m -with a sand layer at 84.1m (86.4m)	XIV
-92	88	30/30cm	Silty Fine SAND (SM), very dense, gray -with clay pockets and seams -clay layer, 86.9m to 87.2m -sandy clay at 88.8m	XV
		30/45cm	-clay layer, 89.0m to 89.3m (90.8m)	
-96	92		Lean CLAY (CL), hard, gray (92.4m)	XVI
		30/15cm	Fine to Medium SAND (SW-SM) with silt and gravel, very dense, gray	XVII
		30/15cm	-with coarse sand and many clay seams at 92.7m	
		30/15cm	-with a few clay pockets at 94.5m	
-100	96	30/10cm	-fine gravel with fine to coarse sand and silt, at 95.7m	

TOTAL DEPTH: 95.8m

BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-32

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

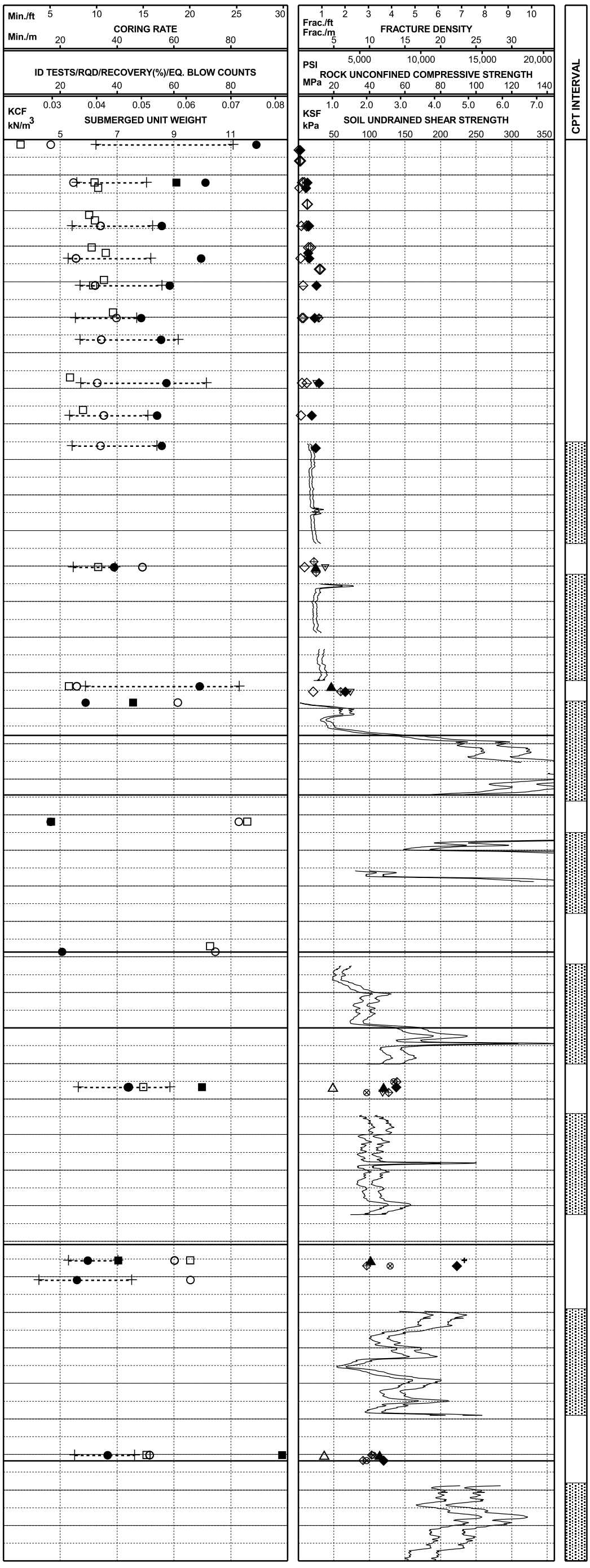
PLATE 98-32.5

PROJECT NO:	98-42-0054	**START DATE:**	09/12/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-32 (Skyway - Frame 2)	**COMPLETION DATE:**	09/15/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837758 N648106
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -4.0m (MSL)

Depth, m.	Blow Count	Material Description	Stratum No.
0	WOH	Fat CLAY (CH), soft, olive gray -very soft, with black streaks, to 0.6m -with shell fragments to 8.8m	I
1	WOH		
2	WOH	-with silt pockets, 1.8m to 8.8m	
3	WOH	-with gas blisters, 2.7m to 7.0m	
4	WOH	-with an H2S odor, 3.7m to 5.2m -with many shells at 4.0m	
5	PUSH	-with sand pockets and wood fragments, at 4.9m	
	PUSH	-with many shells at 5.5m	
6			
7	PUSH	-with sand pockets at 6.7m	
	PUSH		
8	SAVE		
9			
10			
11			
12	PUSH	-gray below 11.6m -with silty sand pockets and seams, a few shell fragments, and a few organic pockets, at 11.9m -sand layer, 12.2m to 12.5m	
13			
14		-sand layer, 13.9m to 14.3m	
15	PUSH	-stiff, with sand and organic pockets, below 15.2m -medium dense silty fine sand, with clay pockets and organic pockets, 15.5m to 15.8m	
16		(16.8m)	
17		Lean CLAY (CL), hard -silt layer, 17.5m to 17.8m	II
18		(18.4m)	
19	PUSH	Silty Fine SAND (SM), very dense, gray -greenish gray, with clayey sand pockets, at 19.2m	III
20		-clay layer, 19.7m to 20.0m -clay layer, 20.4m to 20.7m	
21		-with clay layers at 21.2m and 21.6m	
22	PUSH	-with desiccated clay pockets at 22.9m (22.9m)	
23		Fat CLAY (CH), stiff, greenish gray	IV
24		(25.0m)	
25		Fat CLAY (CH), very stiff, greenish gray -with a sand layer at 25.5m	V
26	PUSH	-with silt pockets at 26.5m	
27			
28			
29		-with a sand seam at 29.0m	
30			
31		(31.1m)	
32	PUSH SAVE	Fat CLAY (CH), very stiff, greenish gray -clayey sand, with sand pockets, calcareous nodules and a few shell fragments, at 31.4m	VI
33			
34			
35			
36		-with silt pockets below 36.6m	
37	PUSH	(37.2m)	
38		Fat CLAY (CH), hard to very stiff, greenish gray	VII
39			



LOG OF BORING AND TEST RESULTS

BORING 98-32

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

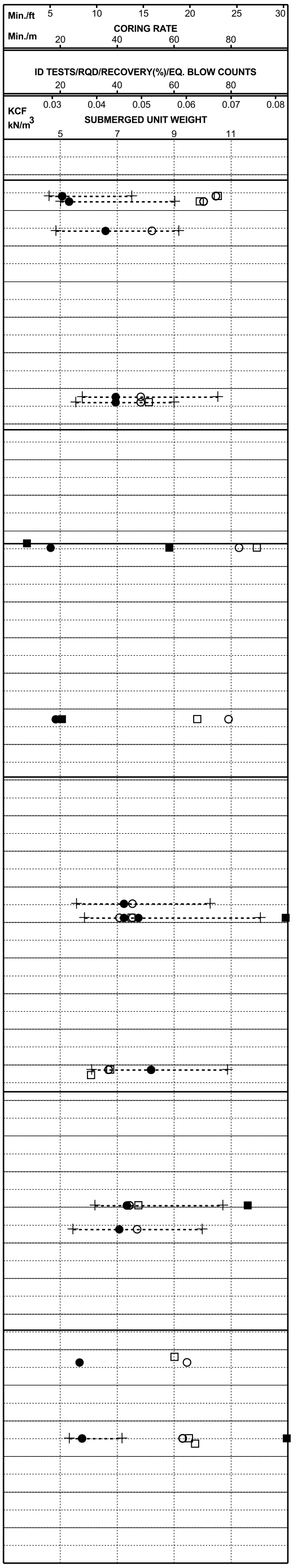
PLATE 98-32.6a

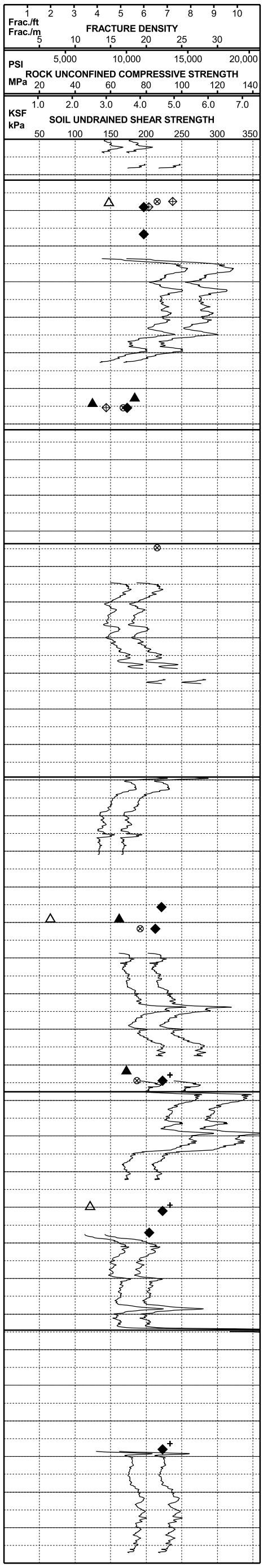
PROJECT NO:	98-42-0054	**START DATE:**	09/12/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-32 (Skyway - Frame 2)	**COMPLETION DATE:**	09/15/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837758 N648106
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -4.0m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-44				Fat CLAY (CH), hard to very stiff, greenish gray -silt layer, 40.4m to 40.7m (41.1m)	VII
-45	41				
-46	42		PUSH SAVE	Fat CLAY (CH), hard to very stiff, greenish gray -with a few calcareous nodules at 41.8m	VIII
-47	43				
-48	44				
-49	45				
-50	46				
-51	47		PUSH	-with silt pockets at 47.2m (48.2m)	
-52	48			Fine SAND with silt (SP-SM), dense to very dense, gray (51.4m)	IX
-53	49				
-54	50				
-55	51		30/30cm	Fat CLAY (CH), hard to very stiff, gray -with a sandy lean clay layer at 51.5m	X
-56	52				
-57	53				
-58	54				
-59	55			-silty fine sand layer, 54.9m to 55.2m	
-60	56		PUSH	-silty fine to medium sand with trace coarse sand and gravel, below 56.1m (57.9m)	
-61	57				
-62	58			Fat CLAY (CH), very stiff, olive gray	XI
-63	59				
-64	60				
-65	61		SAVE		
-66	62		PUSH	-with gas blisters, shell fragments and a few wood fragments, at 61.9m	
-67	63				
-68	64				
-69	65				
-70	66		PUSH	-platy and expansive, with dessicated pockets and silt pockets and partings, at 66.1m (66.8m)	
-71	67			Fat CLAY (CH), hard, dark gray	XII
-72	68				
-73	69				
-74	70		PUSH SAVE	-with organic pockets and wood fragments, at 69.8m -with many large organic pockets at 70.4m	
-75	71				
-76	72				
-77	73			(73.5m)	
-78	74		PUSH	Lean CLAY (CL), hard, gray -with a sand layer at 73.5m -with organic pockets and many silt pockets, partings, and seams, at 74.1m -silty sand layer, 74.2m to 75.3m -with lean clay layers at 74.7m and 75.1m -sandy silt, with clay seams and layers, 75.3m to 76.2m	XIII
-79	75				
-80	76				
-81	77		PUSH	-with silt pockets and seams, at 76.5m	
-82	78				
-83	79		PUSH		





CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-32

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

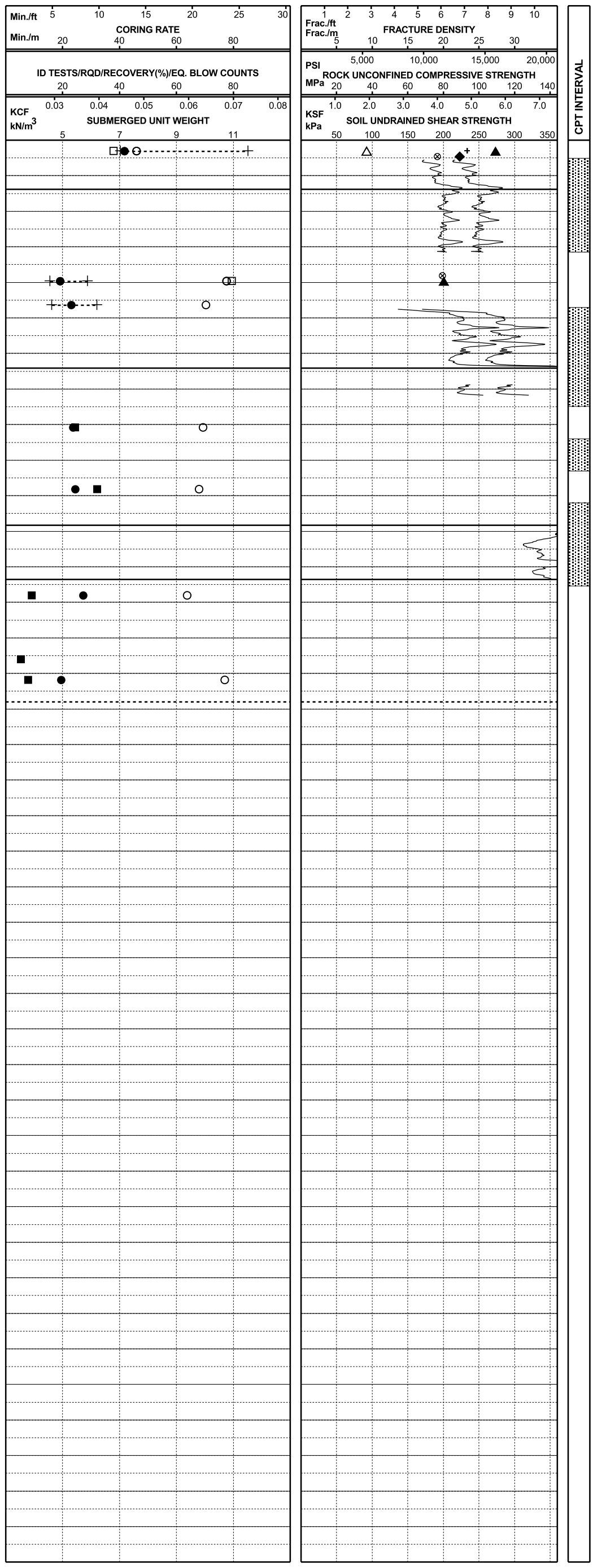
PLATE 98-32.6b

PROJECT NO:	98-42-0054	**START DATE:**	09/12/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-32 (Skyway - Frame 2)	**COMPLETION DATE:**	09/15/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837758 N648106
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -4.0m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-84			PUSH	Lean CLAY (CL), hard, gray -fat clay, with many organic pockets, at 80.2m (81.4m)	XIII
-85	81				
-86	82			Lean CLAY (CL), hard, gray	XIV
-87	83				
-88	84		PUSH SAVE	-with silt and sand pockets and seams, 83.8m to 84.4m -with a sand layer at 84.1m	
-89	85				
-90	86			(86.4m)	
-91	87			Silty Fine SAND (SM), very dense, gray -with clay pockets and seams -clay layer, 86.9m to 87.2m	XV
-92	88		30/30cm		
-93	89			-sandy clay at 88.8m -clay layer, 89.0m to 89.3m	
-94	90		30/45cm	(90.8m)	
-95	91			Lean CLAY (CL), hard, gray	XVI
-96	92			(92.4m)	
-97	93		30/15cm	Fine to Medium SAND (SW-SM) with silt and gravel, very dense, gray -with coarse sand and many clay seams at 92.7m	XVII
-98	94				
-99	95		30/15cm 30/15cm	-with a few clay pockets at 94.5m	
-100	96		30/10cm	-fine gravel with fine to coarse sand and silt, at 95.7m TOTAL DEPTH: 95.8m BACKFILLED WITH: Cement Grout	
-101	97				
-102	98				
-103	99				
-104	100				
-105	101				
-106	102				
-107	103				
-108	104				
-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 98-32

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

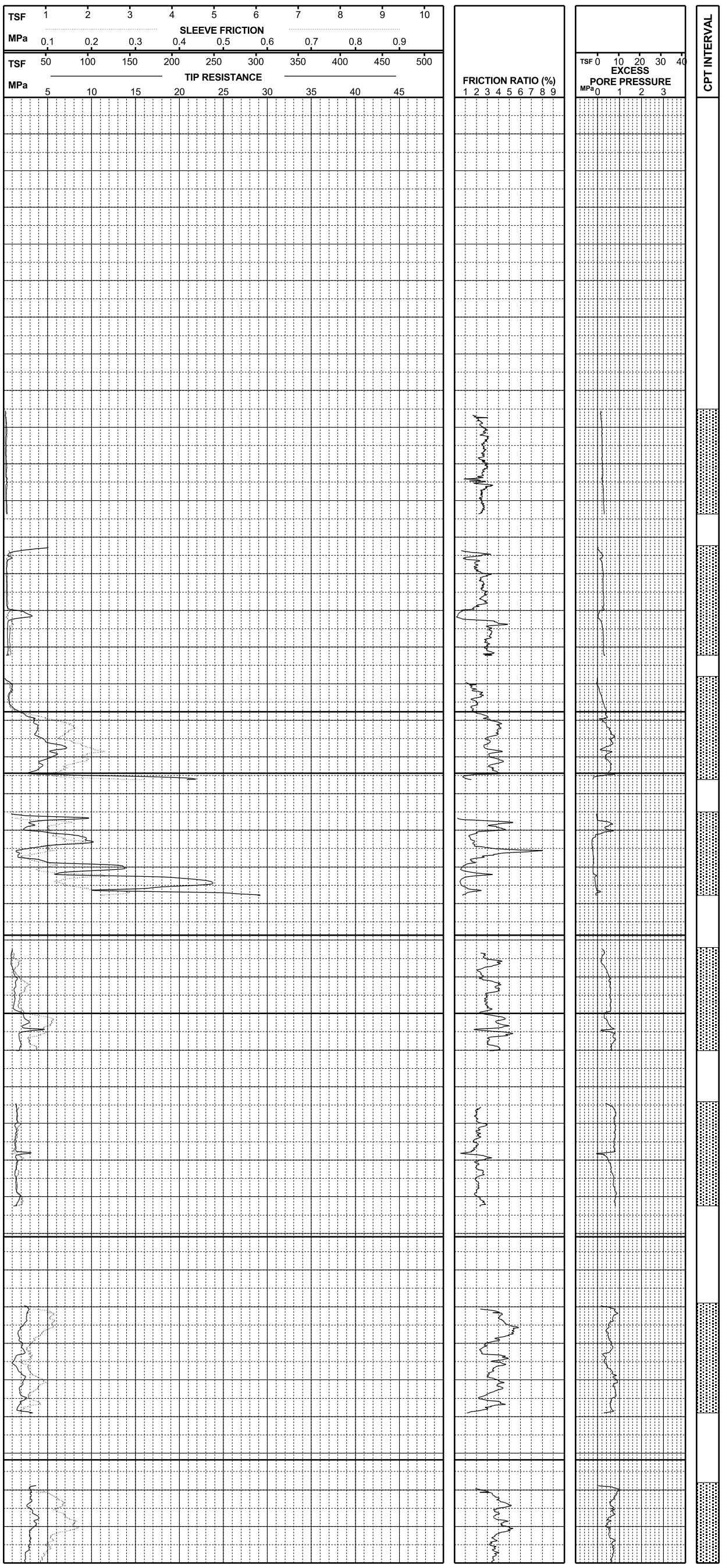
PLATE 98-32.6c

PROJECT NO:	98-42-0054	**START DATE:**	09/12/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-32 (Skyway - Frame 2)	**COMPLETION DATE:**	09/15/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837758 N648106
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -4.0m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4		WOH	Fat CLAY (CH), soft, olive gray -very soft, with black streaks, to 0.6m -with shell fragments to 8.8m	I
-5	1	WOH		
-6	2	WOH	-with silt pockets, 1.8m to 8.8m	
-7	3	WOH	-with gas blisters, 2.7m to 7.0m	
-8	4	WOH	-with an H2S odor, 3.7m to 5.2m -with many shells at 4.0m	
-9	5	PUSH	-with sand pockets and wood fragments, at 4.9m	
-10	6	PUSH	-with many shells at 5.5m	
-11	7	PUSH	-with sand pockets at 6.7m	
-12	8	PUSH		
-13	9	SAVE		
-14	10			
-15	11			
-16	12	PUSH	-gray below 11.6m -with silty sand pockets and seams, a few shell fragments, and a few organic pockets, at 11.9m	
-17	13		-sand layer, 12.2m to 12.5m	
-18	14		-sand layer, 13.9m to 14.3m	
-19	15	PUSH	-stiff, with sand and organic pockets, below 15.2m	
-20	16		-medium dense silty fine sand, with clay pockets and organic pockets, 15.5m to 15.8m (16.8m)	
-21	17		Lean CLAY (CL), hard -silt layer, 17.5m to 17.8m	II
-22	18		(18.4m)	
-23	19	PUSH	Silty Fine SAND (SM), very dense, gray -greenish gray, with clayey sand pockets, at 19.2m	III
-24	20		-clay layer, 19.7m to 20.0m -clay layer, 20.4m to 20.7m	
-25	21		-with clay layers at 21.2m and 21.6m	
-26	22	PUSH	-with desiccated clay pockets at 22.9m (22.9m)	
-27	23		Fat CLAY (CH), stiff, greenish gray	IV
-28	24		(25.0m)	
-29	25		Fat CLAY (CH), very stiff, greenish gray -with a sand layer at 25.5m	V
-30	26	PUSH	-with silt pockets at 26.5m	
-31	27			
-32	28			
-33	29		-with a sand seam at 29.0m	
-34	30			
-35	31	PUSH	(31.1m) Fat CLAY (CH), very stiff, greenish gray -clayey sand, with sand pockets, calcareous nodules and a few shell fragments, at 31.4m	VI
-36	32	SAVE		
-37	33			
-38	34			
-39	35			
-40	36		-with silt pockets below 36.6m	
-41	37	PUSH	(37.2m)	
-42	38		Fat CLAY (CH), hard to very stiff, greenish gray	VII
-43	39			



LOG OF BORING AND TEST RESULTS

BORING 98-32

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

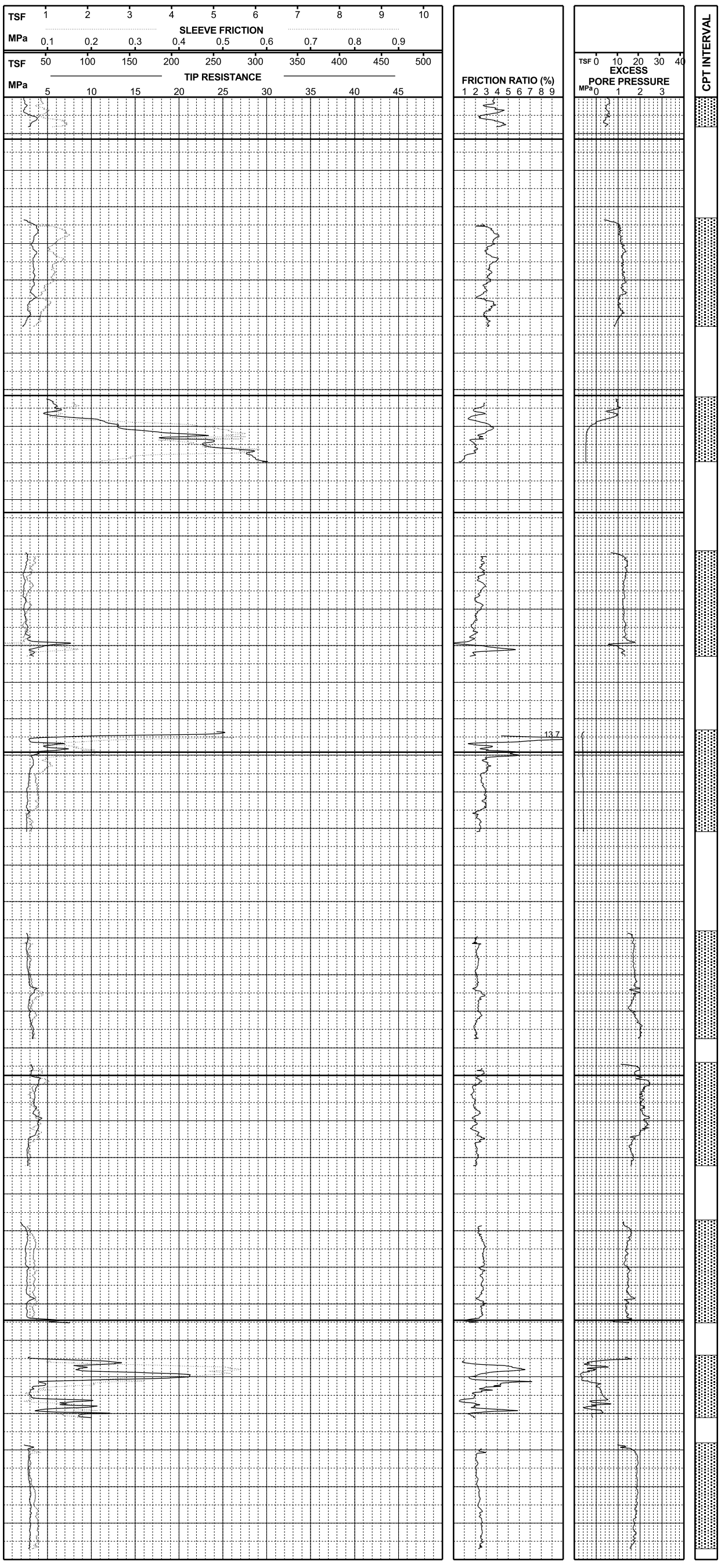
PLATE 98-32.7a

PROJECT NO:	98-42-0054	**START DATE:**	09/12/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-32 (Skyway - Frame 2)	**COMPLETION DATE:**	09/15/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837758 N648106
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -4.0m (MSL)

Elevation, m.	Depth, m.	Blow Count / Sampler	Material Description	Stratum No.
-44	41		Fat CLAY (CH), hard to very stiff, greenish gray -silt layer, 40.4m to 40.7m (41.1m)	VII
-45	42	PUSH	Fat CLAY (CH), hard to very stiff, greenish gray -with a few calcareous nodules at 41.8m	VIII
-46	43	SAVE		
-47	44			
-48	45			
-49	46			
-50	47	PUSH	-with silt pockets at 47.2m (48.2m)	
-51	48		Fine SAND with silt (SP-SM), dense to very dense, gray (51.4m)	IX
-52	49			
-53	50			
-54	51	30/30cm	Fat CLAY (CH), hard to very stiff, gray -with a sandy lean clay layer at 51.5m	X
-55	52			
-56	53			
-57	54			
-58	55		-silty fine sand layer, 54.9m to 55.2m	
-59	56	PUSH	-silty fine to medium sand with trace coarse sand and gravel, below 56.1m (57.9m)	
-60	57			
-61	58		Fat CLAY (CH), very stiff, olive gray	XI
-62	59			
-63	60			
-64	61	SAVE	-with gas blisters, shell fragments and a few wood fragments, at 61.9m	
-65	62	PUSH		
-66	63			
-67	64			
-68	65			
-69	66	PUSH	-platy and expansive, with dessicated pockets and silt pockets and partings, at 66.1m (66.8m)	
-70	67		Fat CLAY (CH), hard, dark gray	XII
-71	68			
-72	69			
-73	70	PUSH	-with organic pockets and wood fragments, at 69.8m	
-74	71	SAVE	-with many large organic pockets at 70.4m	
-75	72			
-76	73			
-77	74		(73.5m)	
-78	75	PUSH	Lean CLAY (CL), hard, gray -with a sand layer at 73.5m -with organic pockets and many silt pockets, partings, and seams, at 74.1m -silty sand layer, 74.2m to 75.3m -with lean clay layers at 74.7m and 75.1m -sandy silt, with clay seams and layers, 75.3m to 76.2m	XIII
-79	76			
-80	77	PUSH	-with silt pockets and seams, at 76.5m	
-81	78			
-82	79			
-83		PUSH		



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-32

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

PLATE 98-32.7b

PROJECT NO:	98-42-0054	**START DATE:**	09/12/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-32 (Skyway - Frame 2)	**COMPLETION DATE:**	09/15/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837758 N648106
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -4.0m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-84			PUSH	Lean CLAY (CL), hard, gray -fat clay, with many organic pockets, at 80.2m (81.4m)	XIII
-85	81				
-86	82			Lean CLAY (CL), hard, gray	
-87	83				
-88	84		PUSH SAVE	-with silt and sand pockets and seams, 83.8m to 84.4m -with a sand layer at 84.1m	XIV
-89	85				
-90	86			(86.4m)	
-91	87			Silty Fine SAND (SM), very dense, gray -with clay pockets and seams -clay layer, 86.9m to 87.2m	
-92	88		30/30cm		
-93	89			-sandy clay at 88.8m -clay layer, 89.0m to 89.3m	XV
-94	90		30/45cm	(90.8m)	
-95	91			Lean CLAY (CL), hard, gray	XVI
-96	92			(92.4m)	
-97	93		30/15cm	Fine to Medium SAND (SW-SM) with silt and gravel, very dense, gray -with coarse sand and many clay seams at 92.7m	
-98	94				XVII
			30/15cm	-with a few clay pockets at 94.5m	
-99	95		30/15cm	-fine gravel with fine to coarse sand and silt, at 95.7m	
			30/10cm		
-100	96			TOTAL DEPTH: 95.8m	
				BACKFILLED WITH: Cement Grout	
-101	97				
-102	98				
-103	99				
-104	100				
-105	101				
-106	102				
-107	103				
-108	104				
-109	105				
-110	106				
-111	107				
-112	108				
-113	109				
-114	110				
-115	111				
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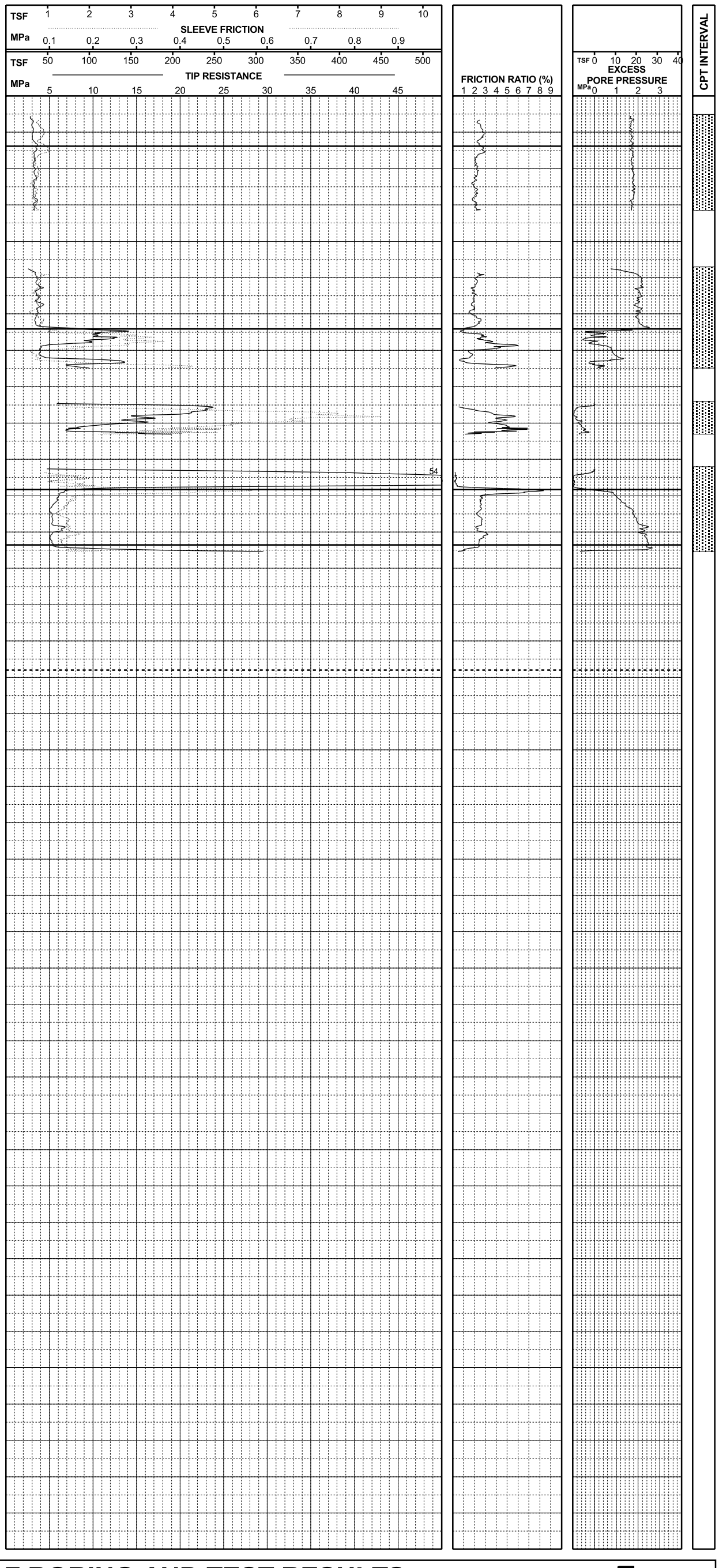
-117	113				
-118	114				
-119	115				
-120	116				
-121	117				
-122	118				
-123	119				



LOG OF BORING AND TEST RESULTS

BORING 98-32

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

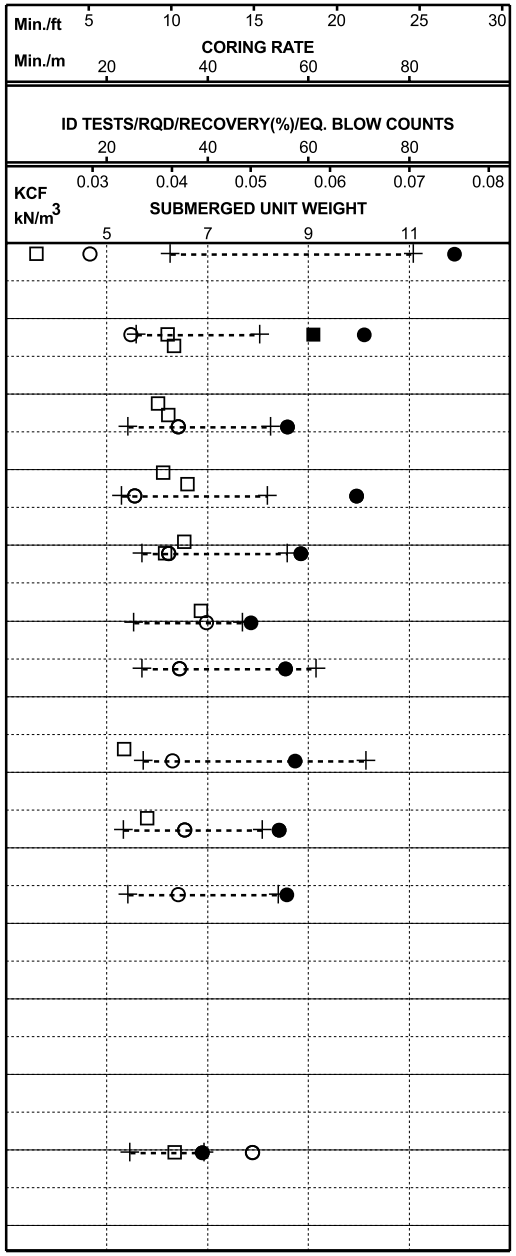
PLATE 98-32.7c

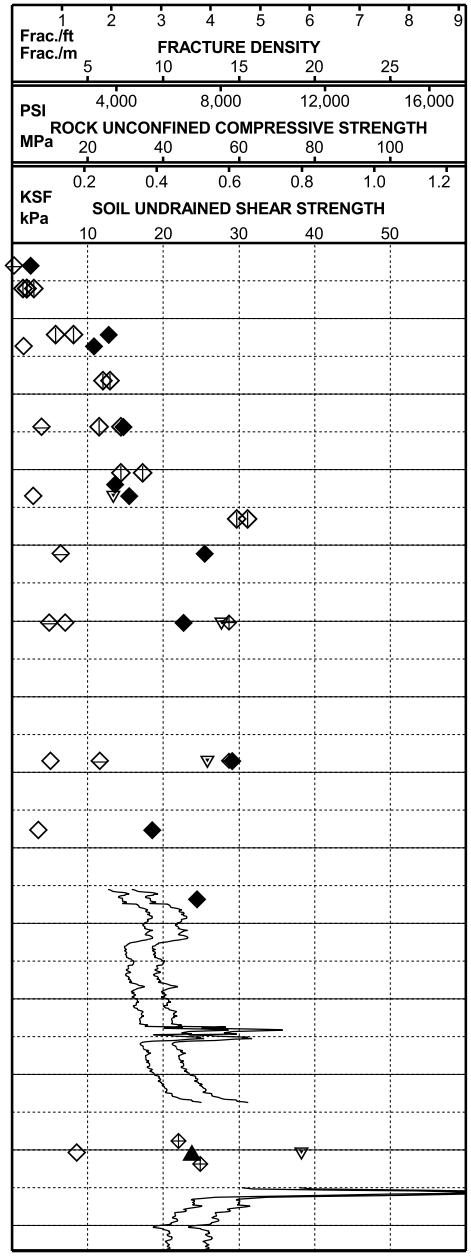
PROJECT NO:	98-42-0054	**START DATE:**	09/12/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-32 (Skyway - Frame 2)	**COMPLETION DATE:**	09/15/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1837758 N648106
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -4.0m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-4				WOH	Fat CLAY (CH), soft, olive gray -very soft, with black streaks, to 0.6m -with shell fragments to 8.8m	I
-5	1			WOH		
-6	2			WOH	-with silt pockets, 1.8m to 8.8m	
-7	3			WOH	-with gas blisters, 2.7m to 7.0m	
-8	4			WOH	-with an H2S odor, 3.7m to 5.2m -with many shells at 4.0m	
-9	5			PUSH	-with sand pockets and wood fragments, at 4.9m	
-10	6			PUSH	-with many shells at 5.5m	
-11	7			PUSH	-with sand pockets at 6.7m	
-12	8			PUSH		
-13	9			SAVE		
-14	10					
-15	11					
-16	12			PUSH	-gray below 11.6m -with silty sand pockets and seams, a few shell fragments, and a few organic pockets, at 11.9m -sand layer, 12.2m to 12.5m	
-17	13					





CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-32

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

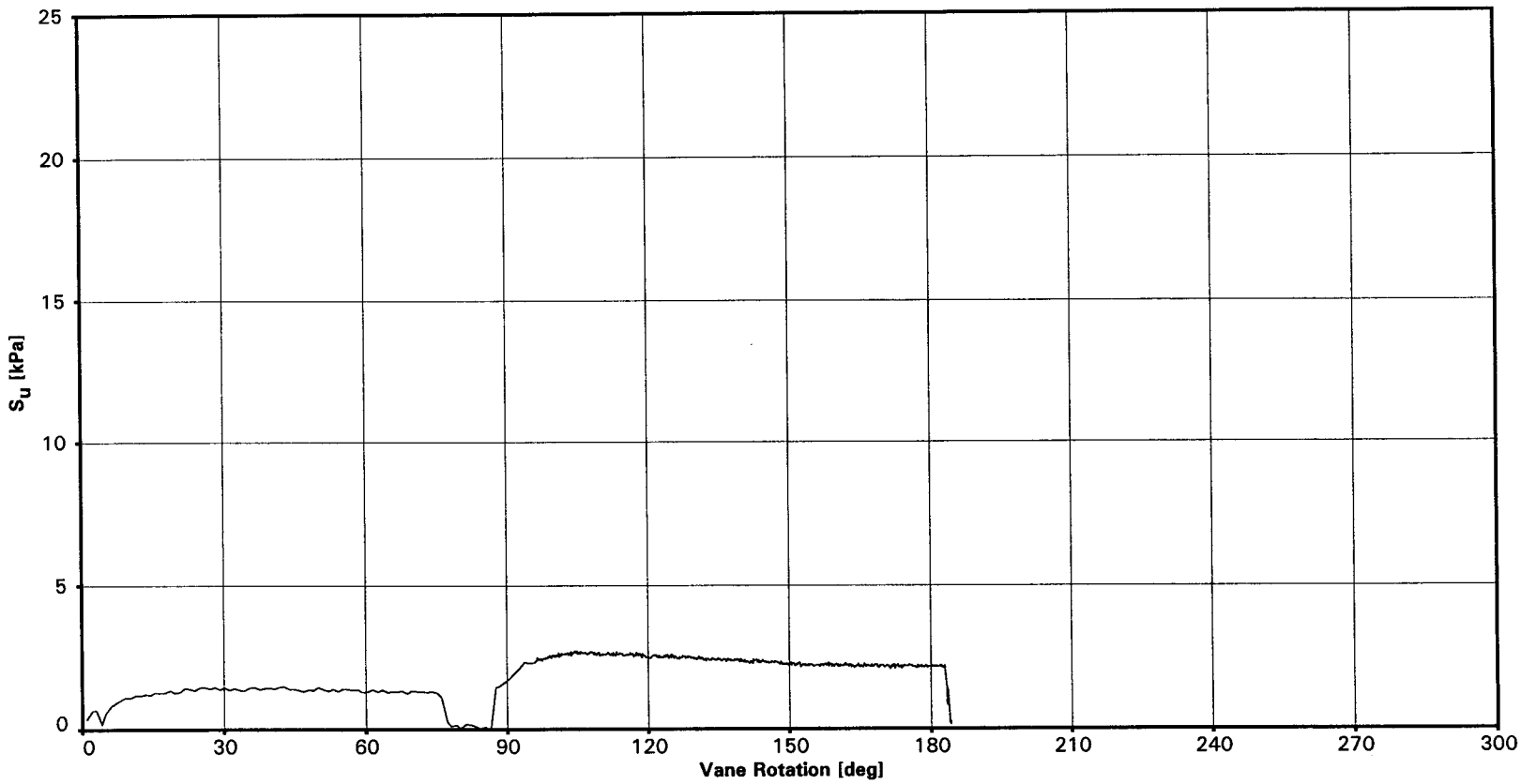
FUGRO

PLATE 98-32.8

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 98-32
SFOBB East Span Seismic Safety Project

Earth Mechanics

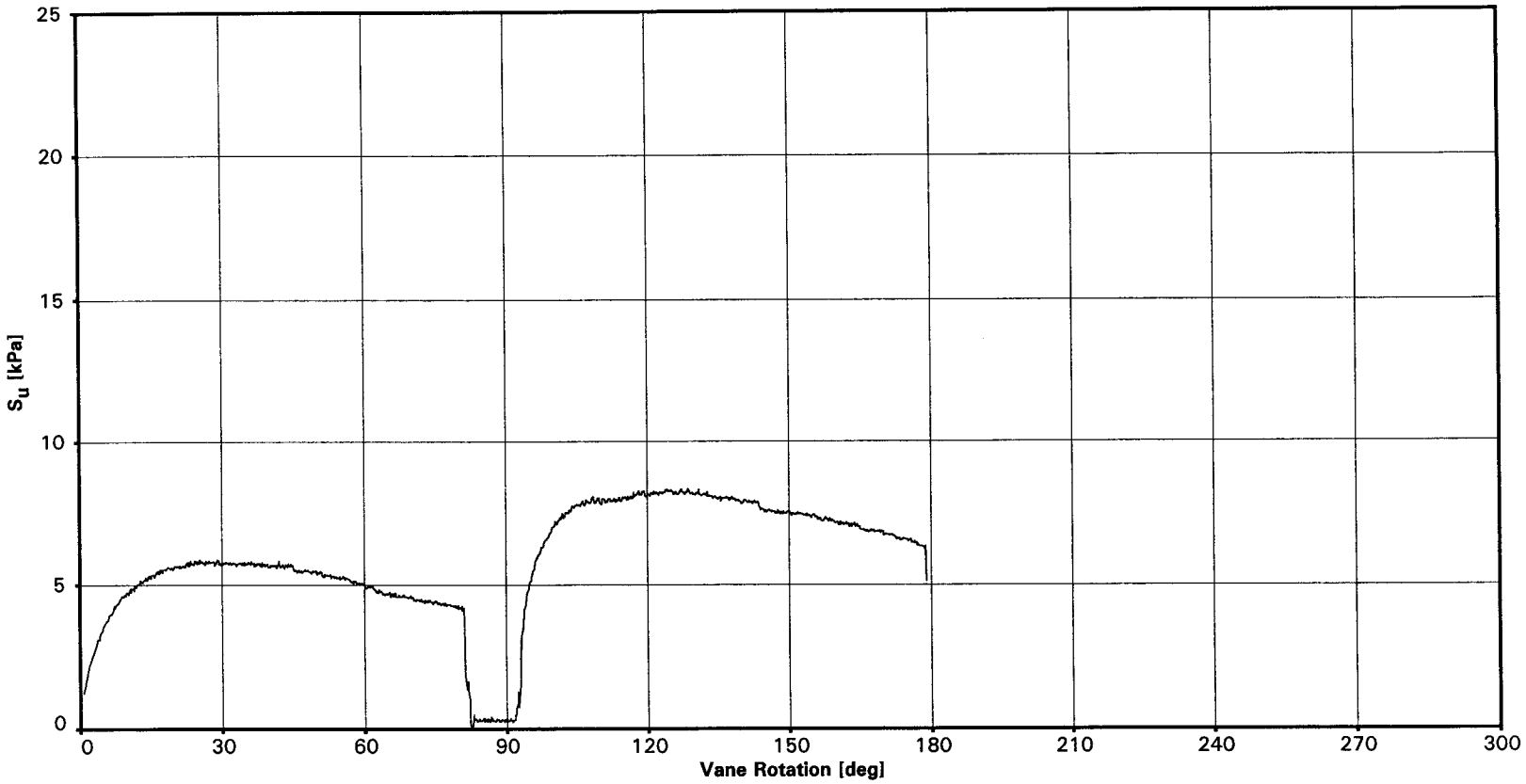
FUGRO

PLATE 98-32.9a

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 98-32
SFOBB East Span Seismic Safety Project

Earth Mechanics

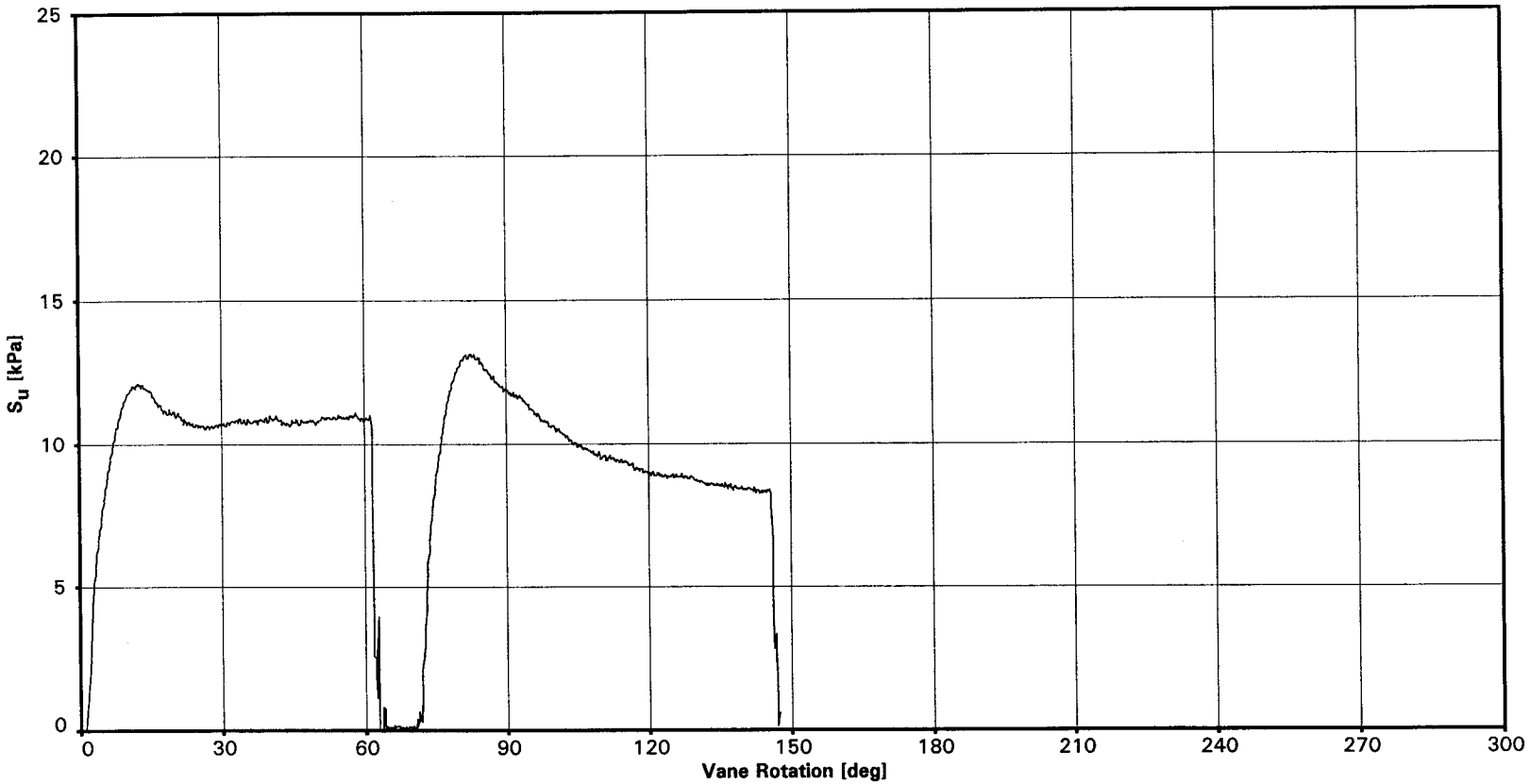
FUGRO

PLATE 98-32.9b

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 98-32
SFOBB East Span Seismic Safety Project

Earth Mechanics

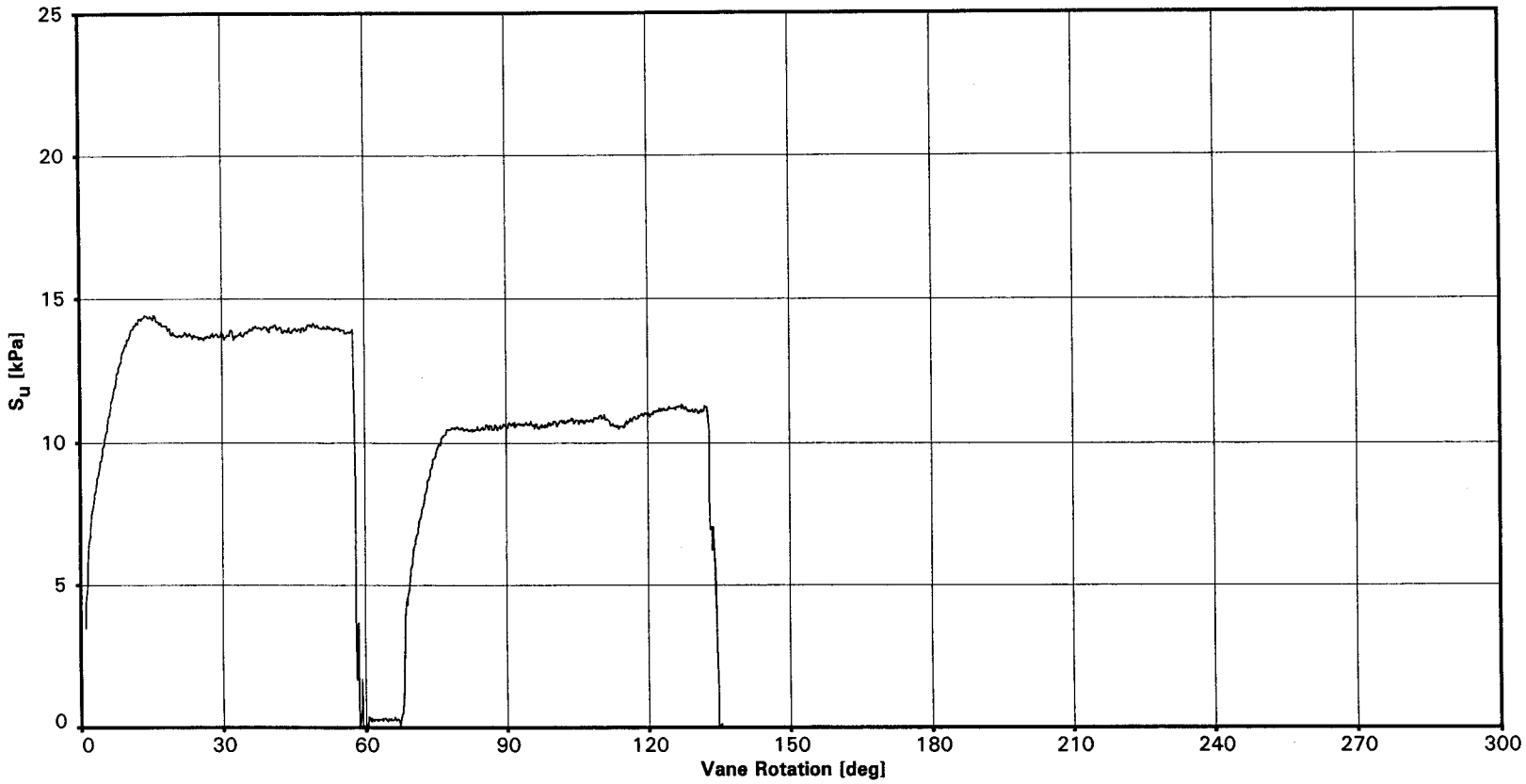
FUGRO

PLATE 98-32.9c

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 98-32
SFOBB East Span Seismic Safety Project

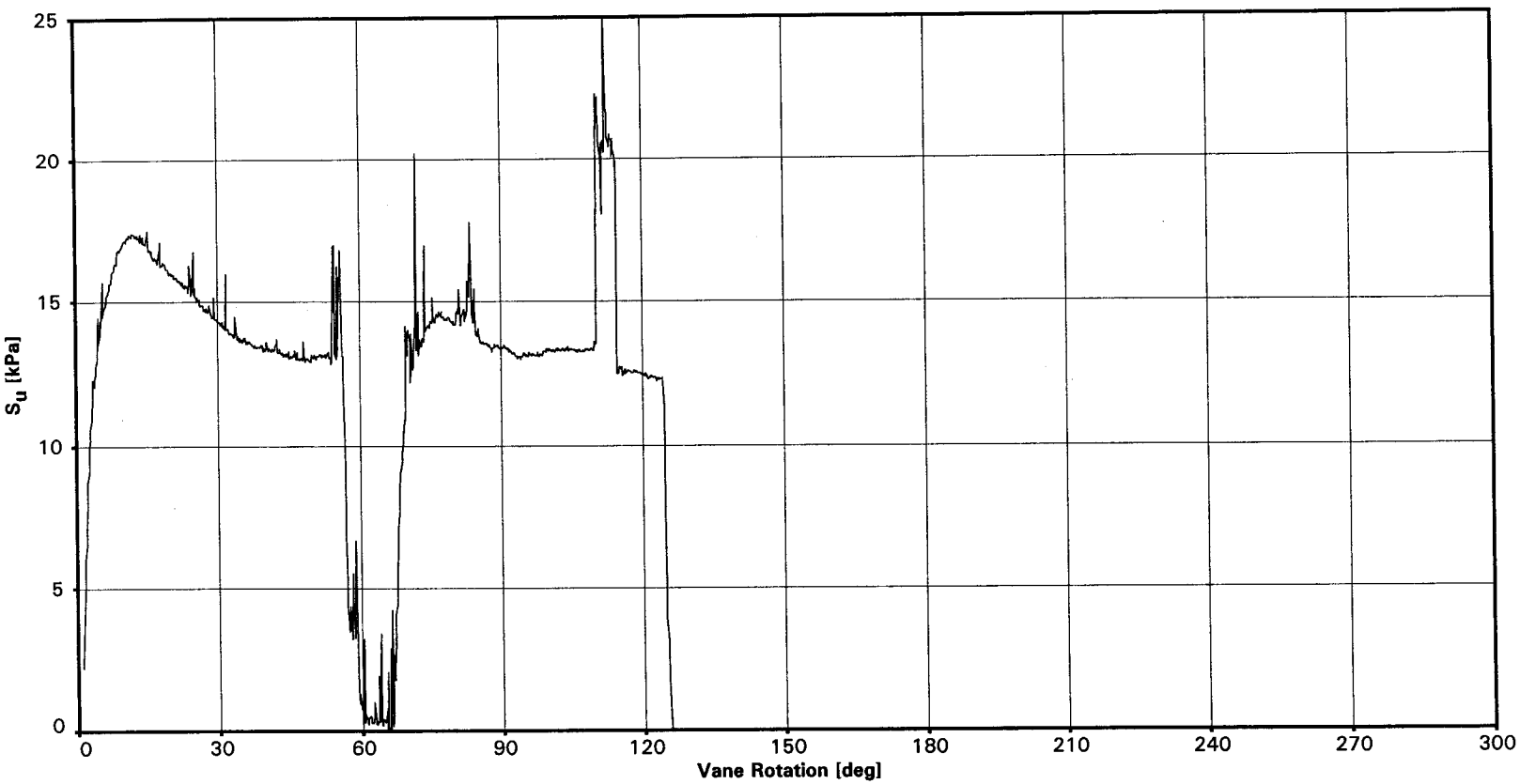
Earth Mechanics

FUGRO

PLATE 98-32.9d

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)

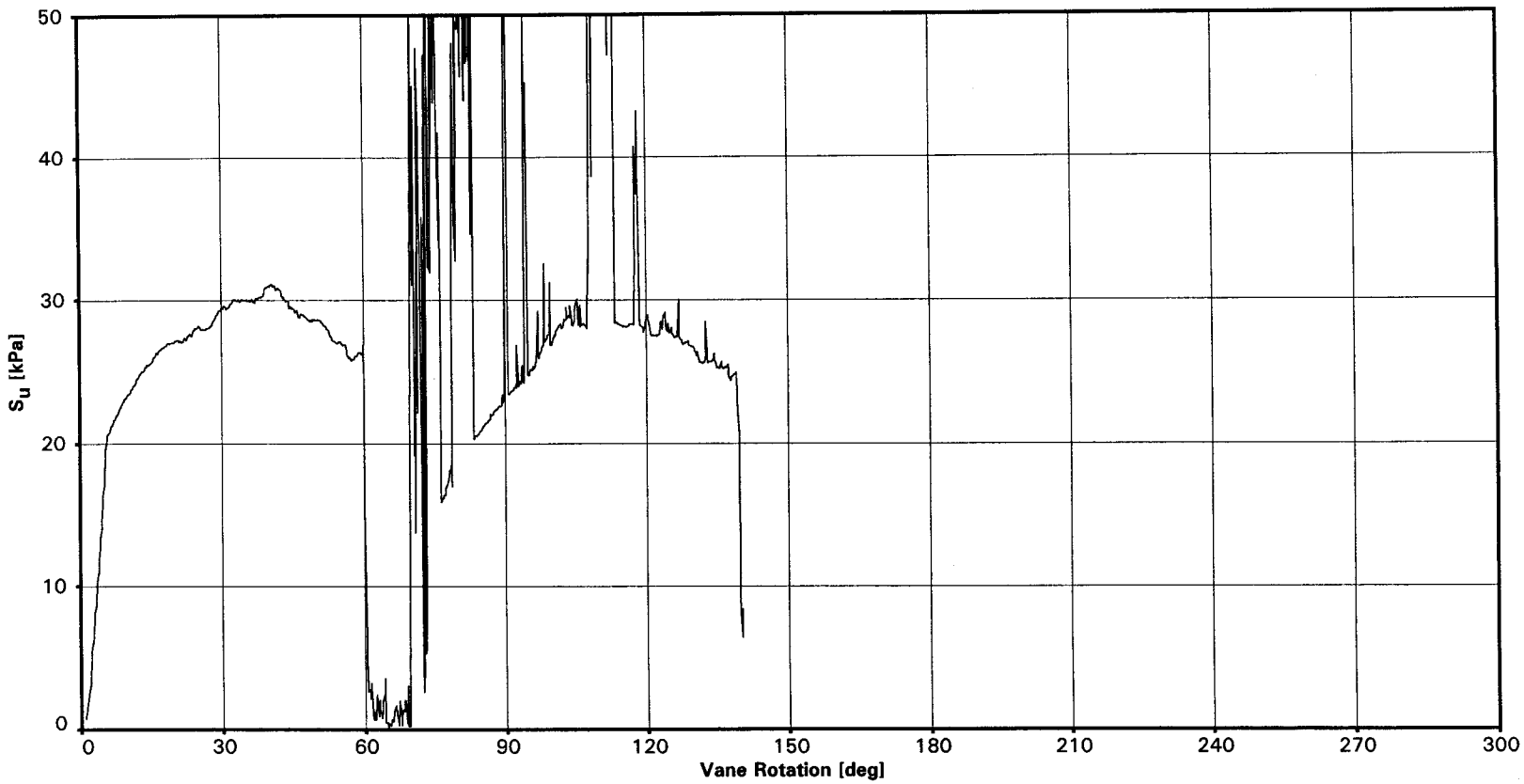


REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.0m
Boring 98-32
SFOBB East Span Seismic Safety Project

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: 3.7m
Boring 98-32
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-32.9f

98-32		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	89	81	33	1.17	3.6																			
0.3	2										2.4		0.2												
0.6	500													1.9											
0.6	501													1.9											
0.6	502													1.4											
0.6	503													2.9											
1.2	3	71	50	26	1.84	6.2	61				12.7													H	
1.2	504													5.7											
1.2	505													8.1											
1.4	4					6.3					10.8	1.5													
1.8	506													12.0											
1.8	507													12.9											
2.1	5					6.0																			
2.3	6					6.2																			
2.4	7	56	53	24	1.11						14.7		3.9												

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 98-32
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-32		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)		
2.4	508													14.4											
2.4	509													11.5											
3.0	8					6.1																			
3.0	510													17.2											
3.0	513													14.4											
3.2	9					6.6					13.6														
3.4	10	70	52	23	1.60					13.4	15.5	2.8													
3.7	511													31.1											
3.7	512													29.7											
4.0	12					6.5																			
4.1	13	58	56	27	1.09	6.1					25.5		6.4												
4.9	15					6.9																			
5.0	16	48	47	25	1.07			28.7		27.8	22.6	7.0	4.9												
5.6	17	55	62	27	0.82																				
6.7	19					5.3																			

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
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phi = Effective Angle of Friction

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-32
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

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

98-32		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)		
6.9	20	57	71	27	0.68			28.7		25.9	29.1	5.1	11.6												
7.6	22					5.8																			
7.8	23	54	51	23	1.11						18.5	3.4													
8.6	24	56	54	24	1.05																			C	2.75
8.7	25										24.5														
11.9	26							22.0																	
12.0	27	39	39	25	0.96	6.3				38.3		8.5			23.7		1.0								
12.2	28							24.9																	
15.4	29	69	83	29	0.74	5.3									45.8		0.8								
15.5	30							59.4		73.7	66.2	21.0													
15.8	31	29					46																		
19.2	32	17				11.6	17																		
22.7	33					10.3																			
22.9	34	21																							
26.5	35							138.9	134.1																

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 98-32
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-32.10c

98-32		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)		
26.7	36	44	59	26	0.54	7.9	70				137.8				119.4	48.1	0.6							H	
26.8	37							126.9	95.8	118.7															
31.5	39	30	40	23	0.38	9.6	40								101.0		4.1							H	
31.7	40							95.8	129.3		222.8														
32.1	41	26	45	13	0.41																			C,K	2.73
37.0	44	37	46	25	0.54	8.0	98	102.9	105.3						113.7	36.3	1.2							H	
37.2	45							91.0	95.8		120.0														
41.6	46	21	45	16	0.16	10.5																			
41.8	47	23	60	20	0.07	9.9		237.0	215.5							147.1									
41.9	48							203.5			196.8														
42.6	49	36	62	19	0.40																			C	2.75
42.7	50										196.8														
47.2	51	39	75	28	0.24										183.4		1.2								
47.4	52	39	60	26	0.40	8.1									123.9		0.5								
47.5	53							143.6	167.6		173.3														

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 98-32
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-32		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)		
51.4	54						8																		
51.5	55	17				11.9	58		215.5															H	
56.3	56	18				9.8	20																		
61.5	57	42	73	26	0.35																			C	
61.6	58										221.5														
61.9	59	42	90	29	0.22	7.5	99								161.4	65.0	0.8								
61.9	59	47																						H	
62.2	61								191.5		212.9														
66.1	62	52	79	31	0.43	6.7									171.8		1.4								
66.3	63					6.1																			
66.4	64								186.9		222.8														
70.0	66	43	77	32	0.25	7.7	86									121.1								H	
70.1	67										222.8														
70.6	68	41	70	25	0.35																			C	
70.7	69										204.2														

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 98-32
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-32		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)		
74.2	71					9.0																			
74.4	72	27																							
76.5	73	28	42	23	0.23	9.5	100																	H	
76.7	74					9.7																			
76.8	75										222.8														
80.3	77	42	85	40	0.03	6.8									272.6	91.7	0.9								
80.5	78								191.5		222.8														
83.8	79								198.6																
84.0	80	19	29	16	0.26	10.9									200.2		2.3								
84.6	82	23	32	16	0.42																			C	
88.1	85	24					24																		
89.8	86	24					32																		
92.8	87	27					9																		
94.6	88						5																		
95.2	89	19					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 98-32
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

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

98-32		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)		
95.8	90						6																		

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

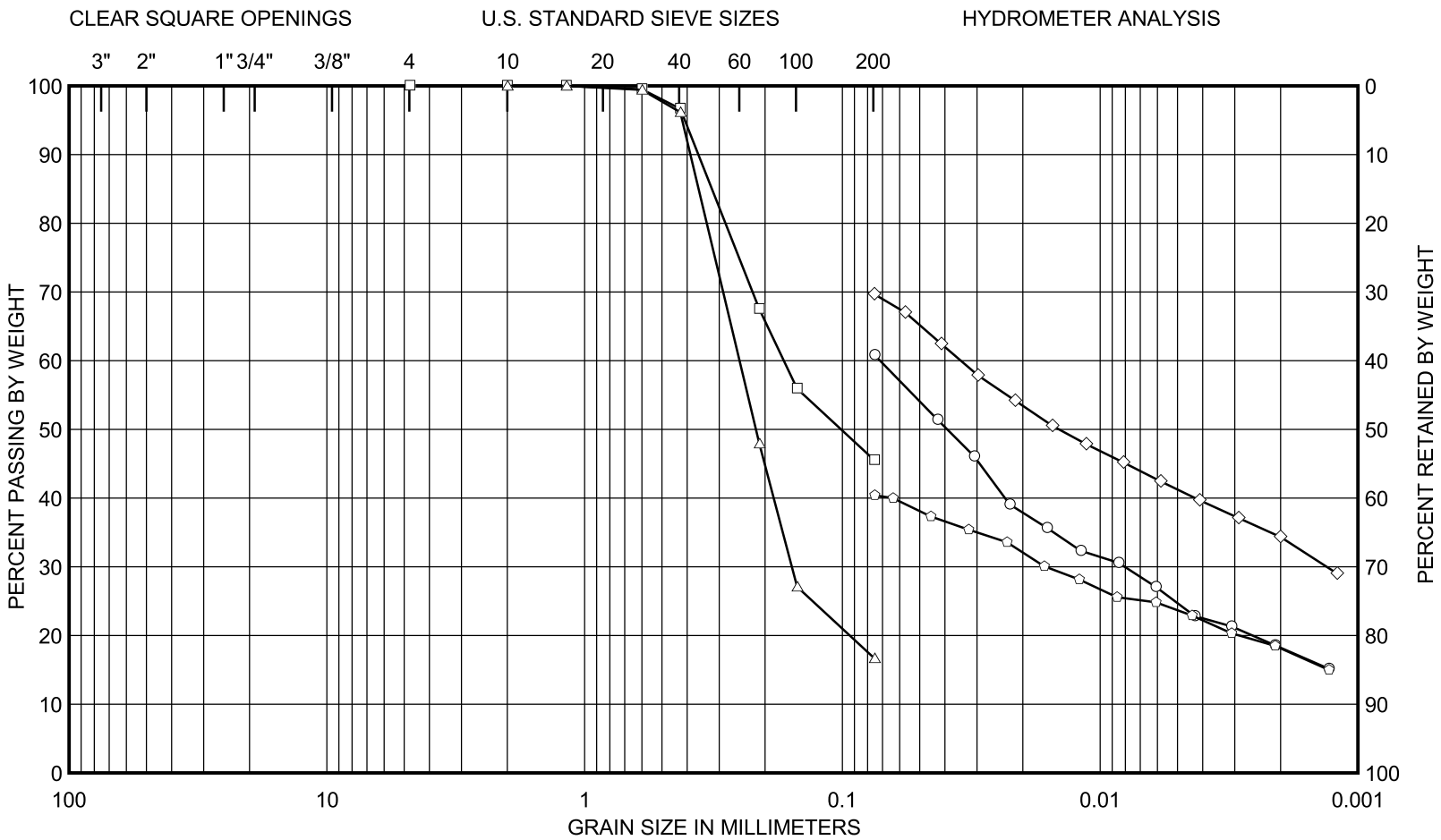
Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-32
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-32.10g



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

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
3	1.2	○——○	FAT CLAY (CH) with shell fragments			0.039
31	15.8	□——□	SILTY FINE SAND (SM) with clay pockets and organic pockets			0.10
32	19.2	△——△	SILTY FINE SAND (SM) with clayey sand pockets			0.22
36	26.7	◇——◇	FAT CLAY (CH) with silt pockets			0.015
39	31.5	⬠——⬠	SANDY LEAN CLAY (CL) with many sand pockets, calcareous nodules and a few shell fragments			

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-32

SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-32.11a

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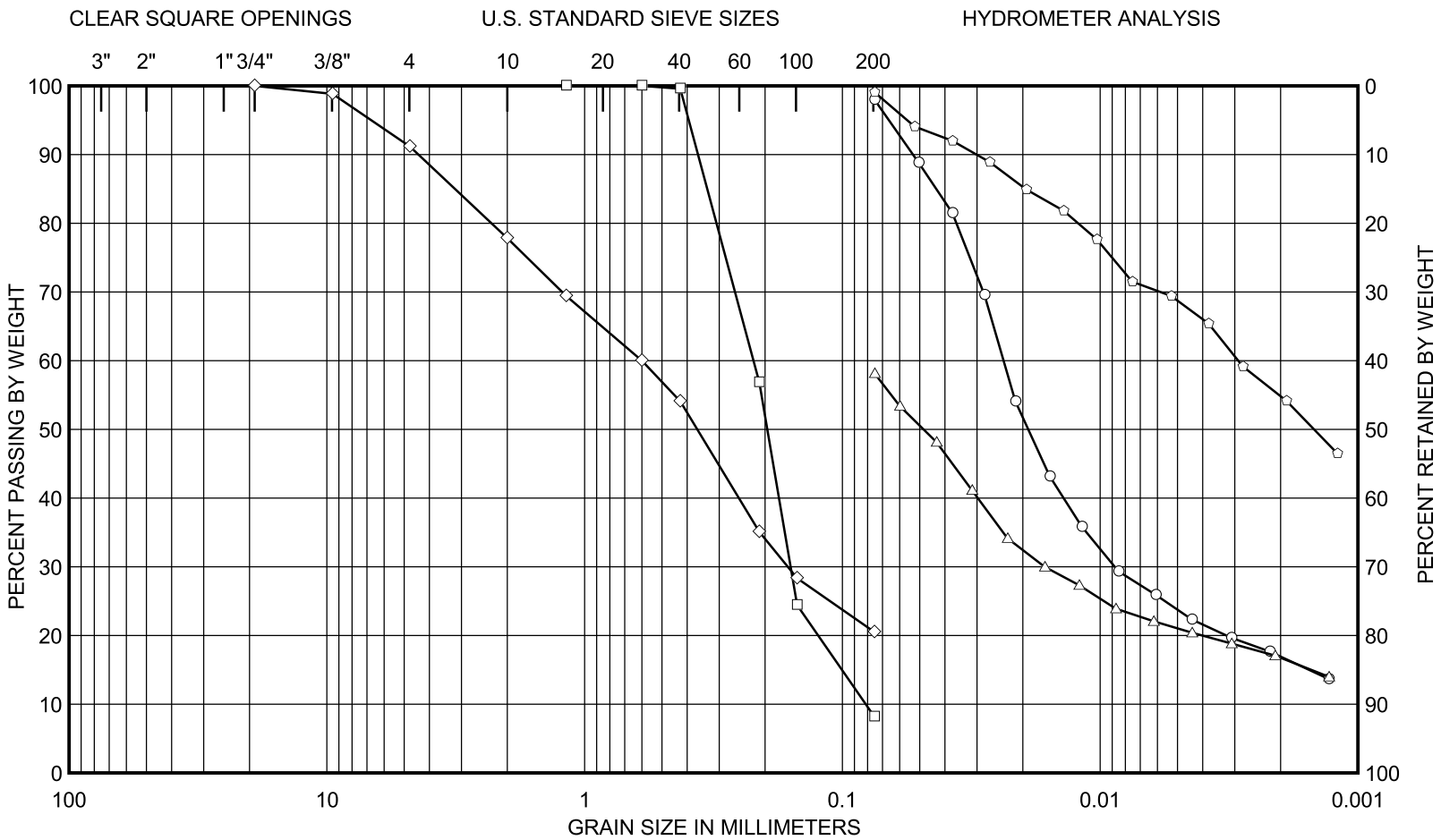

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
44	37.0	○——○	LEAN CLAY (CL) with silt pockets			0.019
54	51.4	□——□	FINE SAND (SP-SM) with silt	1.4	2.7	0.20
55	51.5	△——△	SANDY LEAN CLAY (CL)			0.048
56	56.3	◇——◇	SILTY FINE SAND (SM) with medium sand and a trace of coarse sand and gravel			0.36
59	61.9	⬠——⬠	FAT CLAY (CH) with shell fragments and a few wood fragments			0.0015

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-32

SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-32.11b

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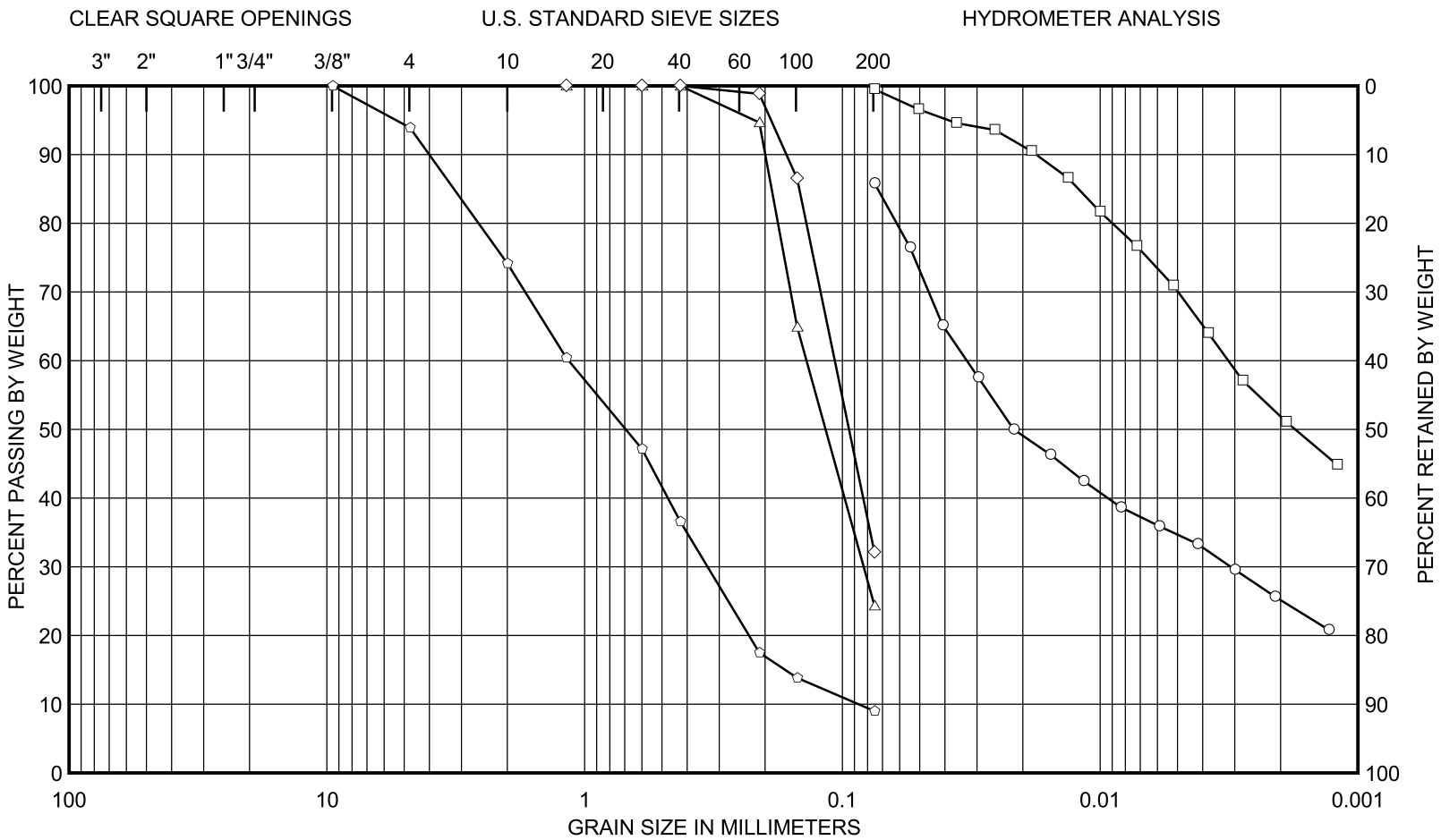


GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
66	70.0	○——○	FAT CLAY (CH) with organic pockets and wood fragments			0.022
73	76.5	□——□	LEAN CLAY (CL) with silt pockets and seams			0.0018
85	88.1	△——△	SILTY FINE SAND (SM)			0.12
86	89.8	◇——◇	SILTY FINE SAND (SM)			0.094
87	92.8	⬠——⬠	FINE TO MEDIUM SAND (SW-SM) with silt, coarse sand and many clay seams	1.1	13.3	0.69

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-32

SFOBB East Span Seismic Safety Project

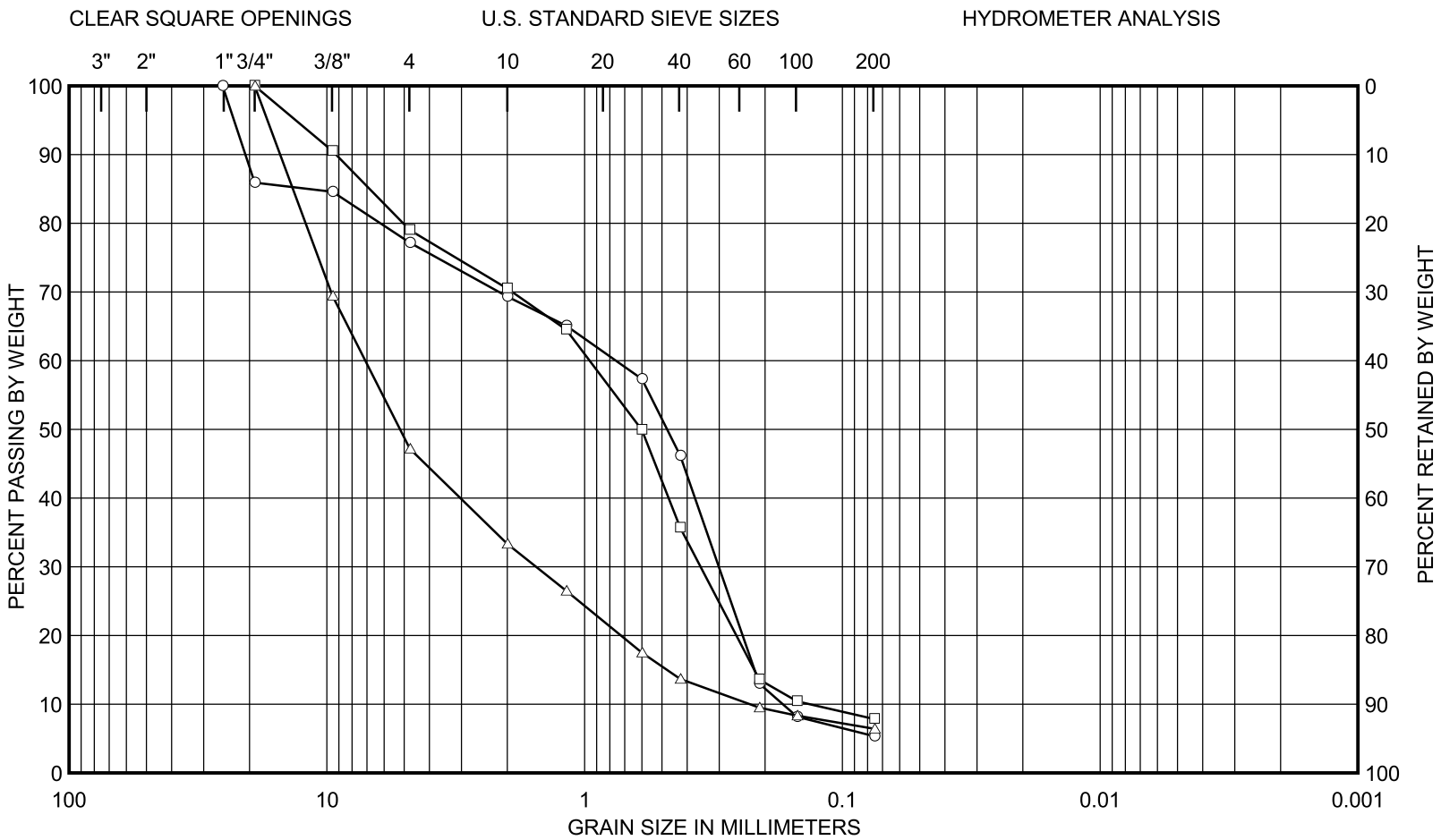
SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-32.11c

i:\caltrans\98-32 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)
88	94.6	○——○	FINE TO MEDIUM SAND (SP-SM) with silt, a few clay pockets and a trace of coarse sand and fine to coarse gravel	0.7	4.5	0.48
89	95.2	□——□	FINE TO MEDIUM SAND (SW-SM) with silt, fine gravel and a trace of coarse sand	1.0	7.1	0.60
90	95.8	△——△	FINE GRAVEL (GW-GM) with silt and fine to coarse sand	1.5	31.1	5.2

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-32
SFOBB East Span Seismic Safety Project

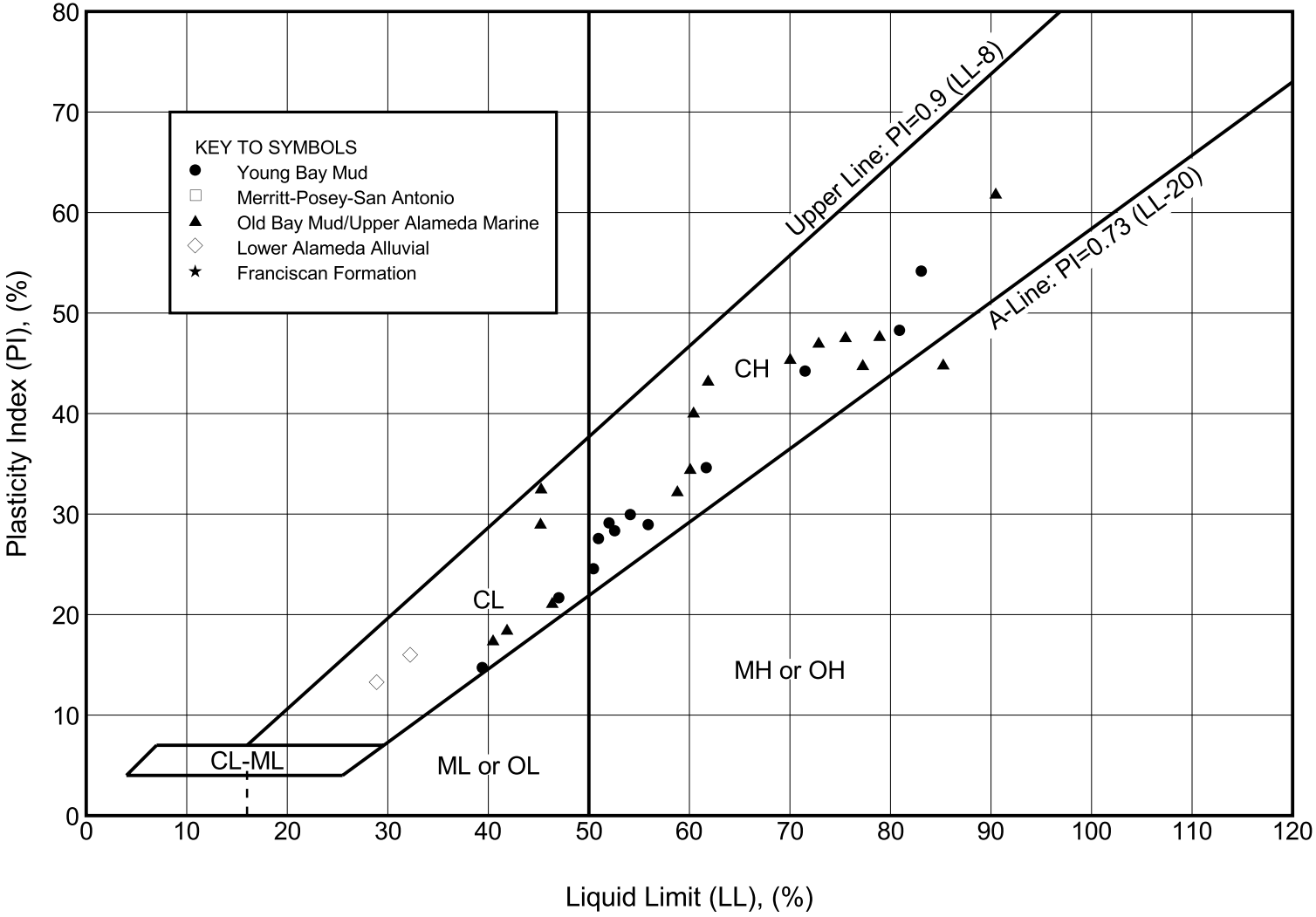
SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-32.11d

i:\caltrans\98-32 04/44/YY



PLASTICITY CHART
Boring 98-32
SFOBB East Span Seismic Safety Project

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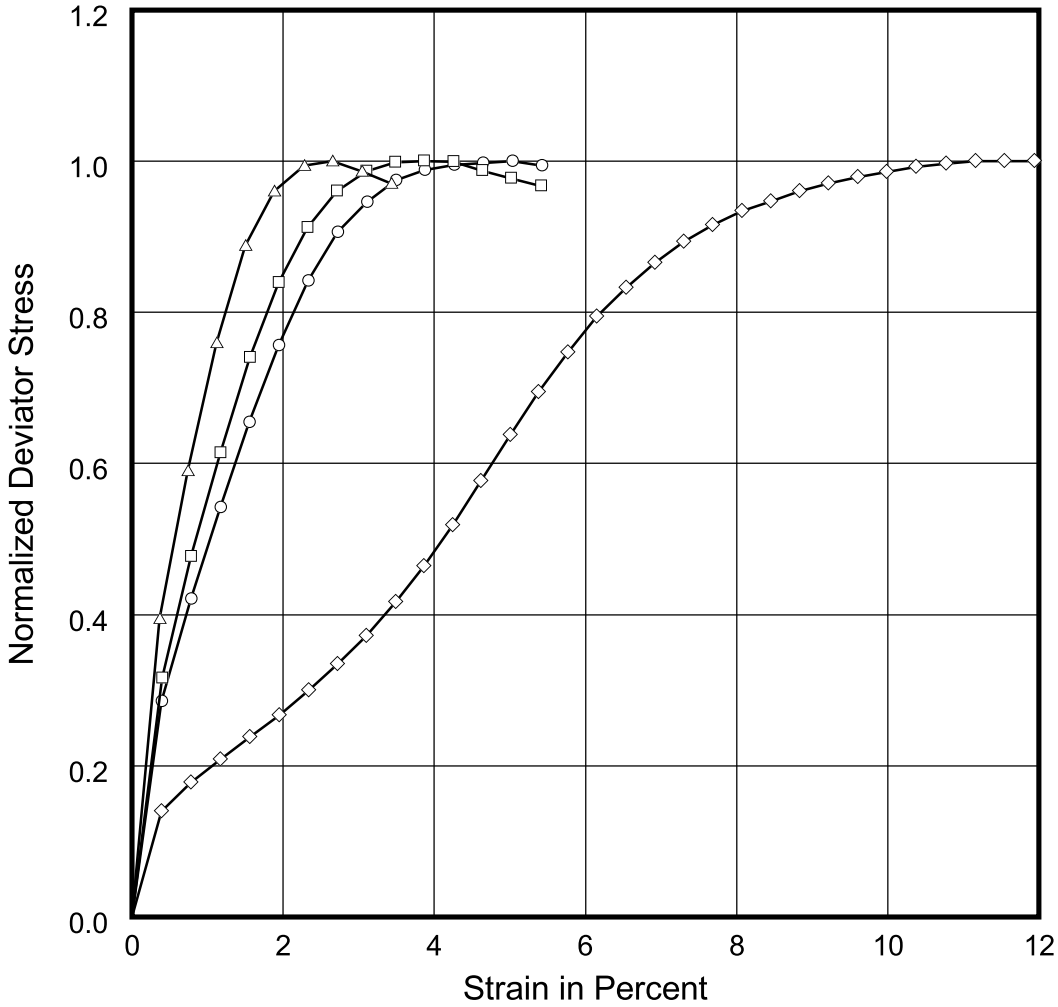
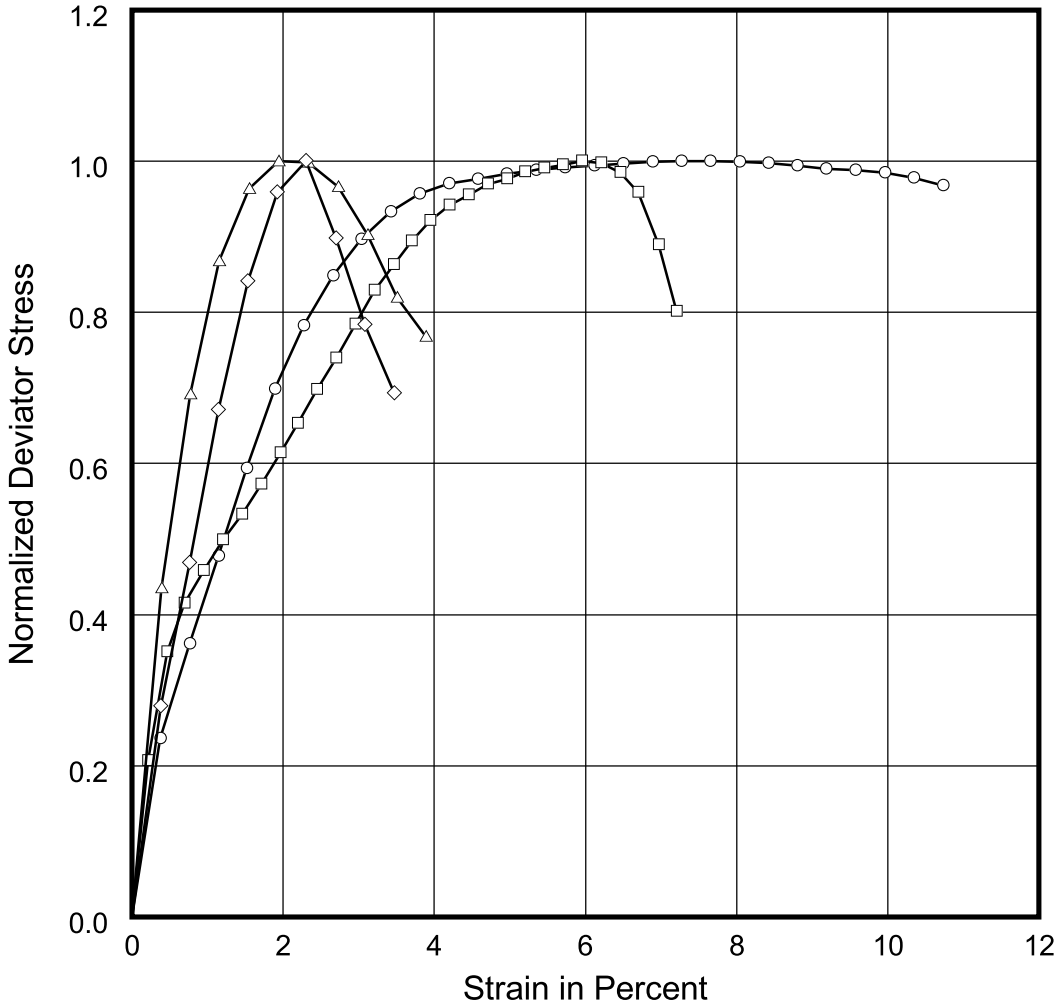


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	27	12.0	UU	276	47	1.0
□——□	29	15.4	UU	345	92	0.8
△——△	36	26.7	UU	827	239	0.6
◇——◇	39	31.5	UU	827	202	4.1

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-32
SFOBB East Span Seismic Safety Project

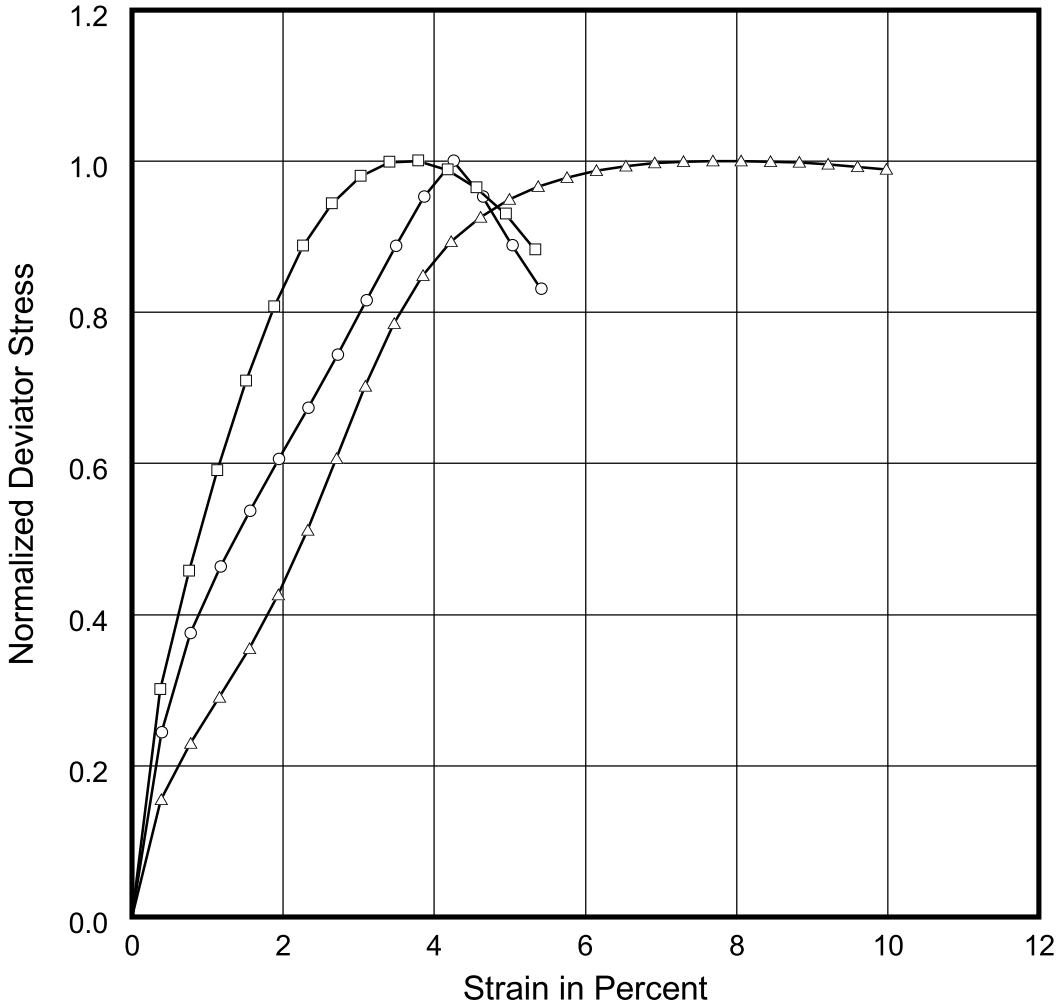


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	44	37.0	UU	827	227	1.2
□—□	51	47.2	UU	827	367	1.2
△—△	52	47.4	UU	1055	248	0.5
◇—◇	59	61.9	UU	1379	323	0.8

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-32
SFOBB East Span Seismic Safety Project

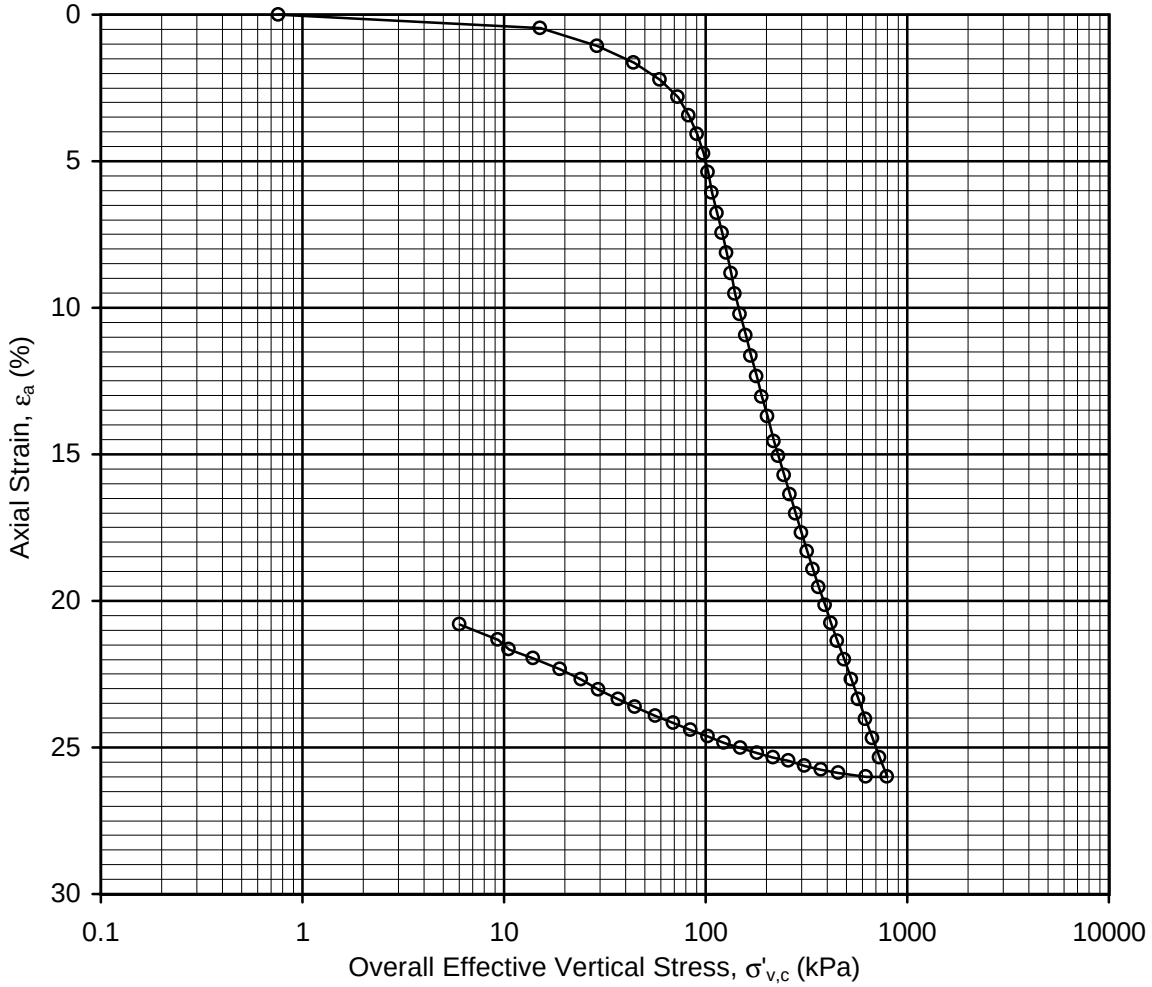


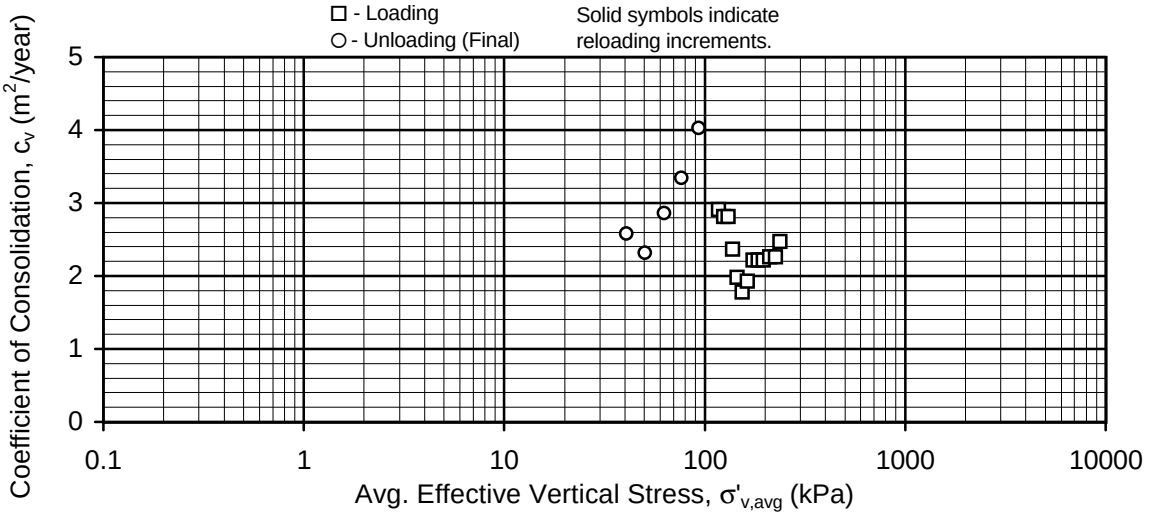
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	62	66.1	UU	1517	344	1.4
□——□	77	80.3	UU	1827	545	0.9
△——△	80	84.0	UU	1896	400	2.3

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-32
SFOBB East Span Seismic Safety Project

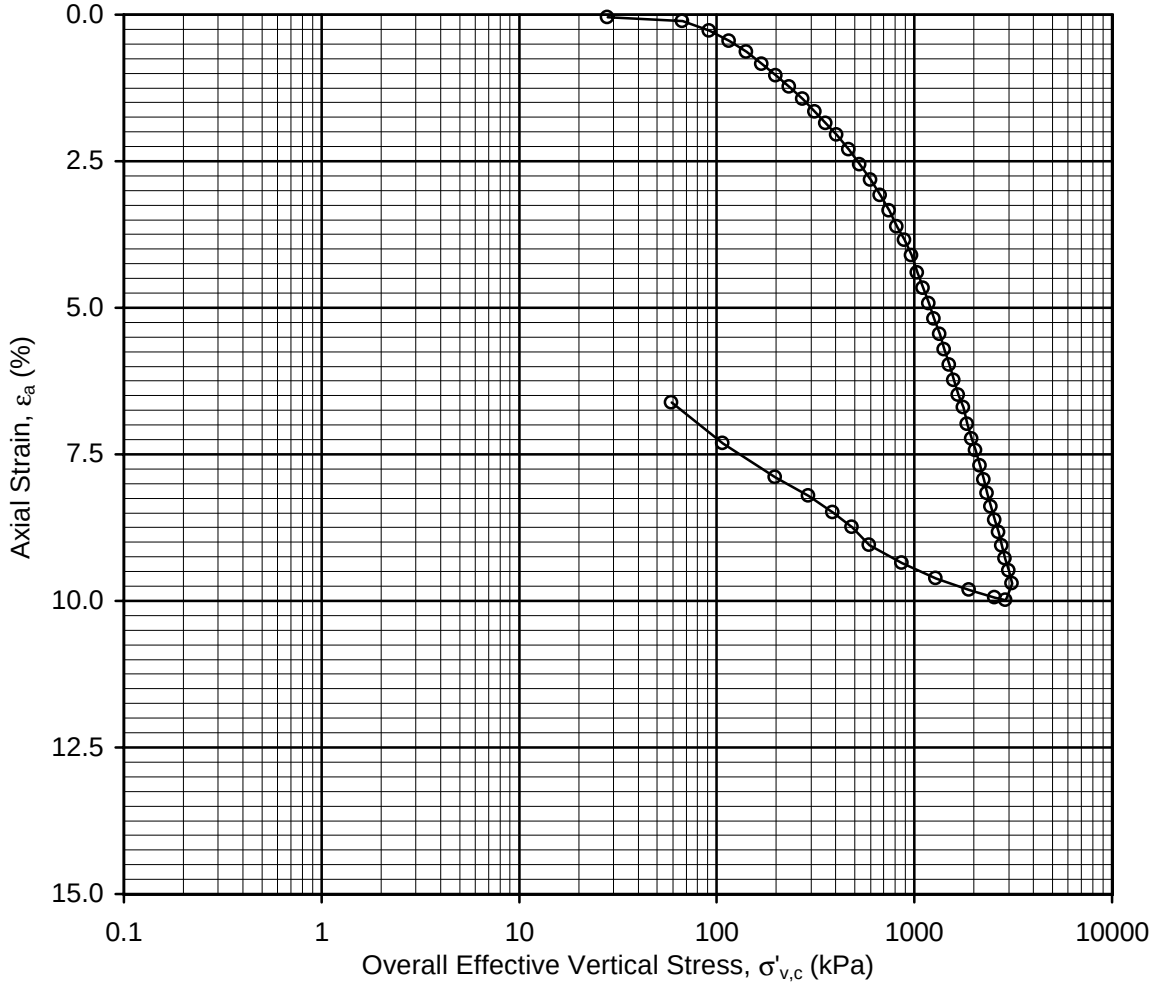


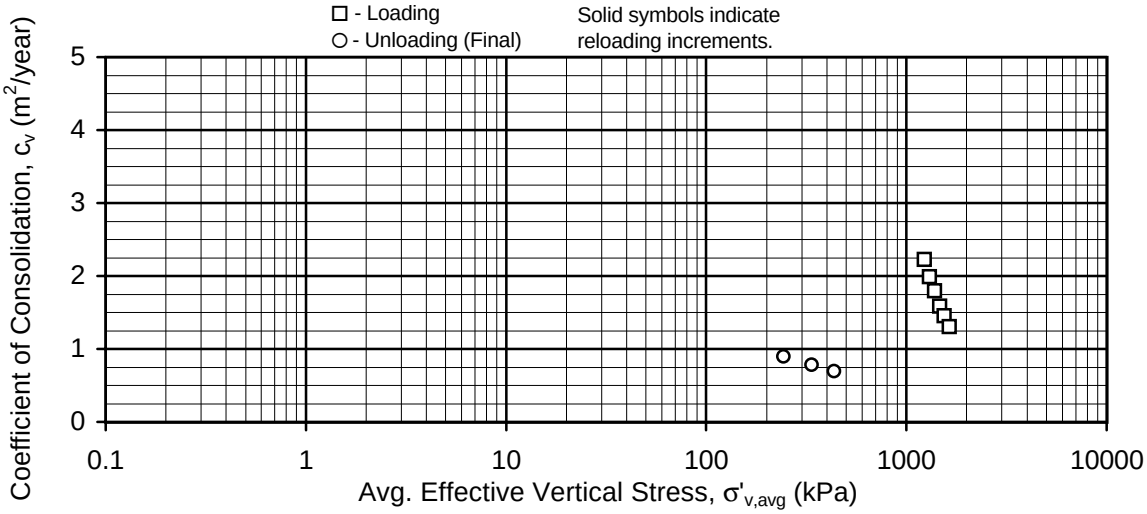


CRS CONSOLIDATION TEST RESULTS

Sample No. 24 - Depth: 8.6m
Boring 98-32
SFOBB East Span Seismic Safety Project

PLATE 98-32.14a

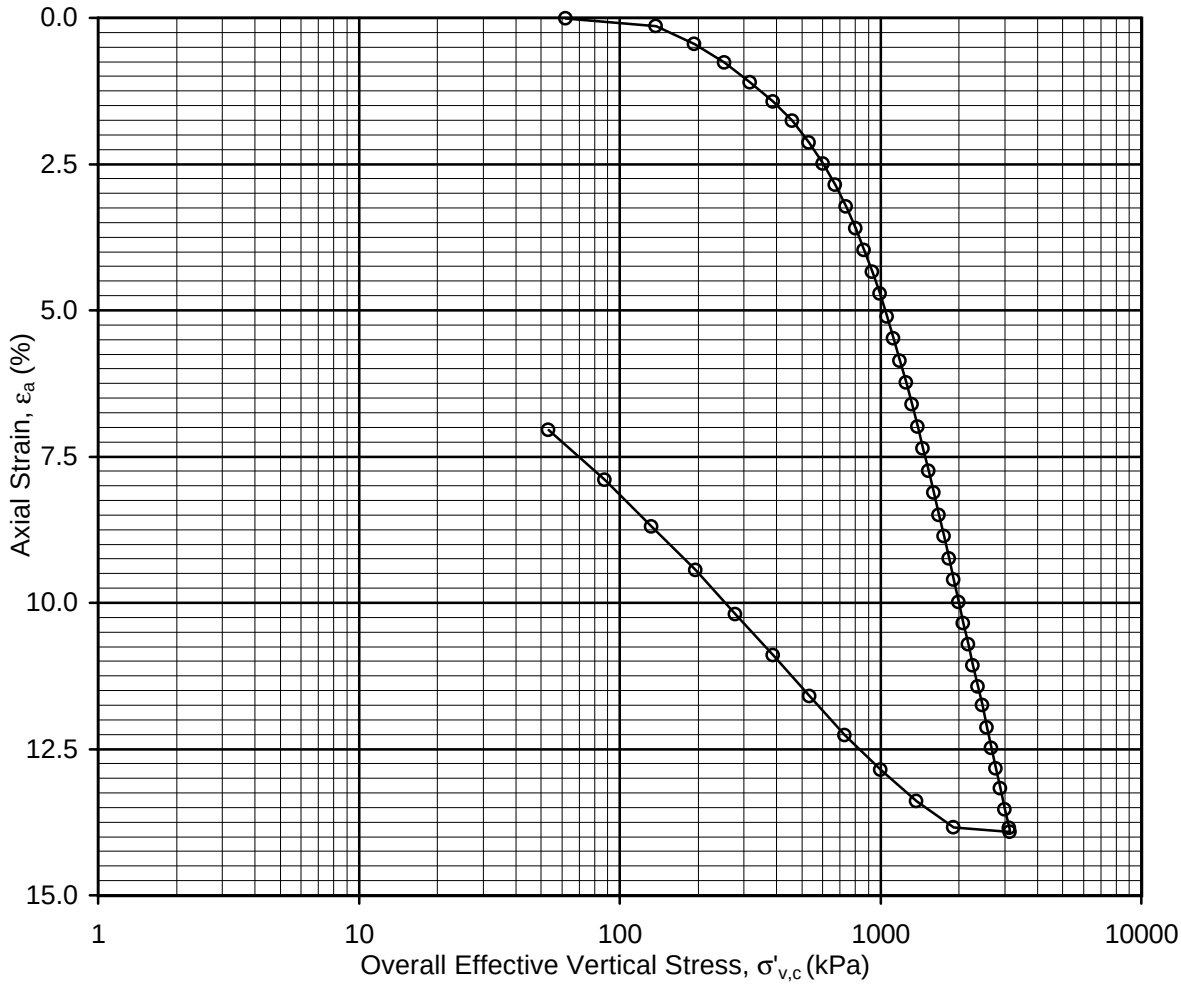


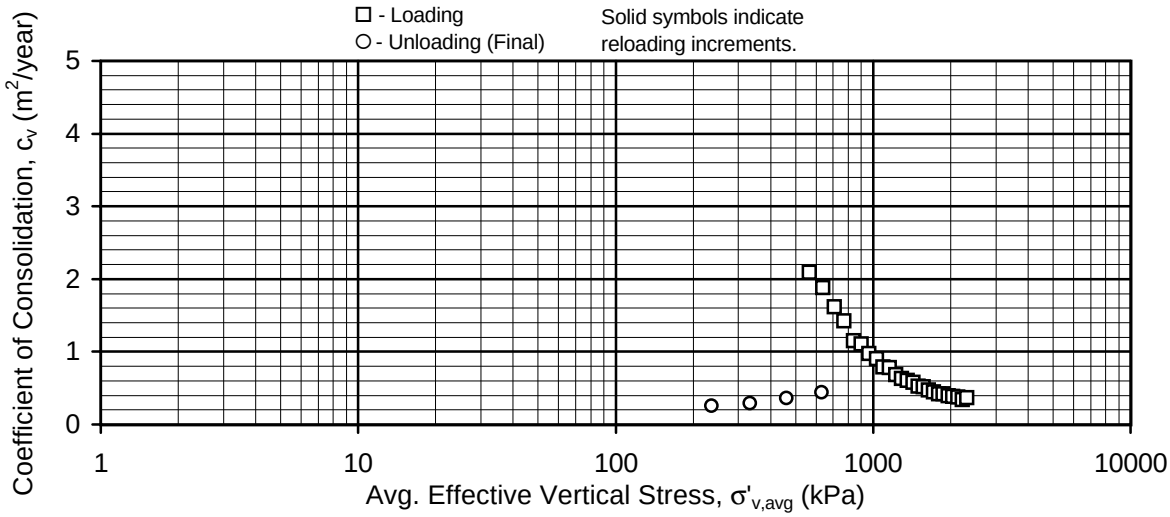


CRS CONSOLIDATION TEST RESULTS

Sample No. 41 - Depth: 32.1m
Boring 98-32
SFOBB East Span Seismic Safety Project

PLATE 98-32.14b

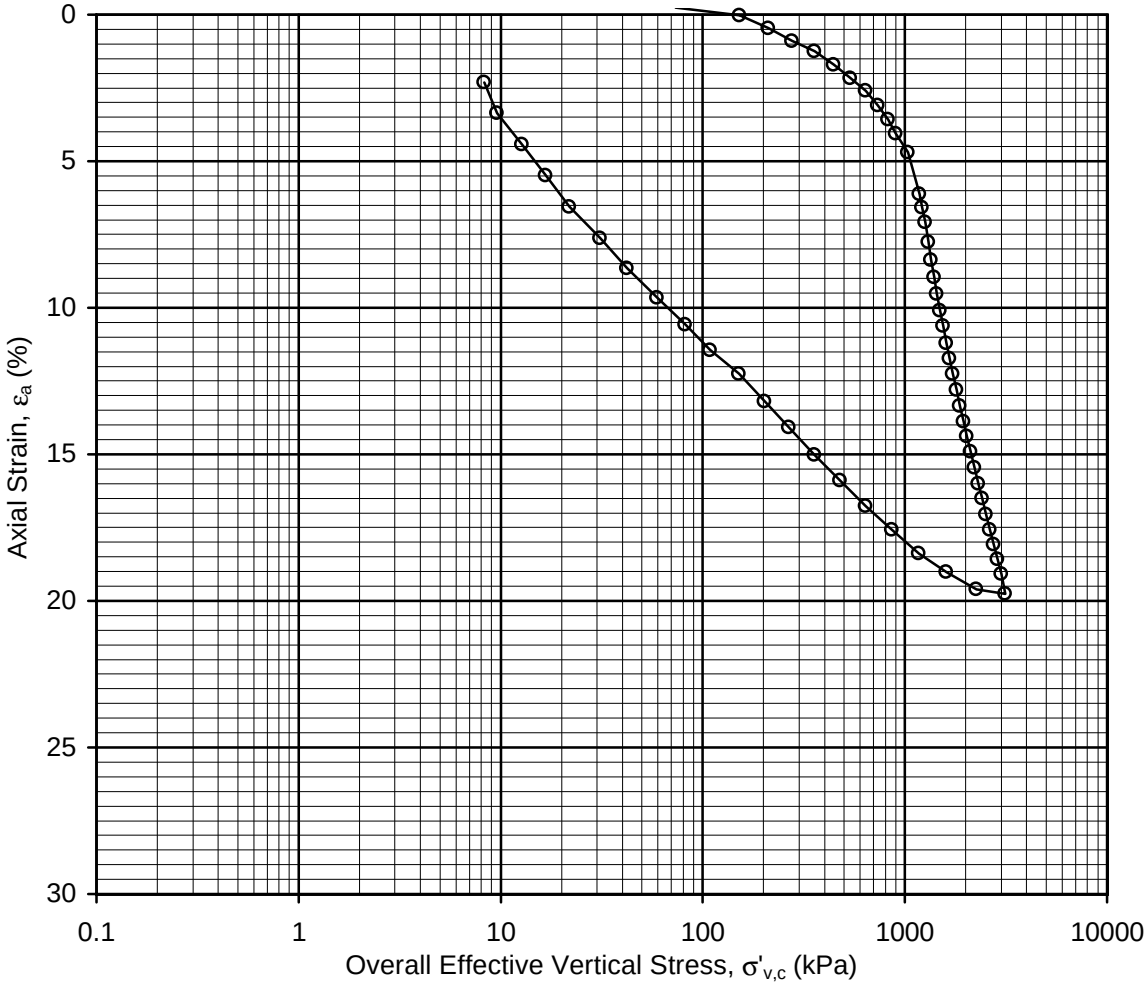


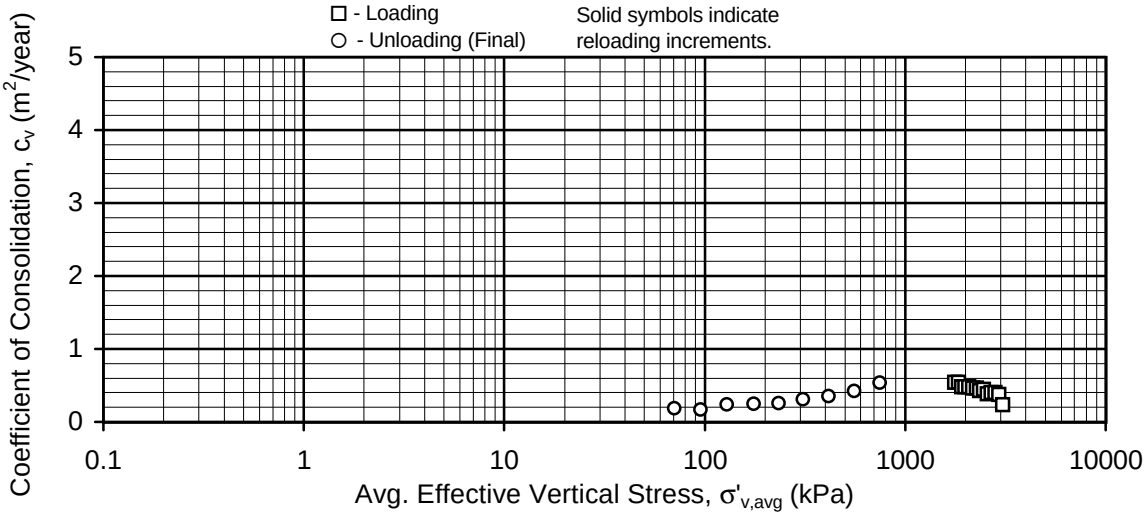


CRS CONSOLIDATION TEST RESULTS

Sample No. 49 - Depth: 42.6m
Boring 98-32
SFOBB East Span Seismic Safety Project

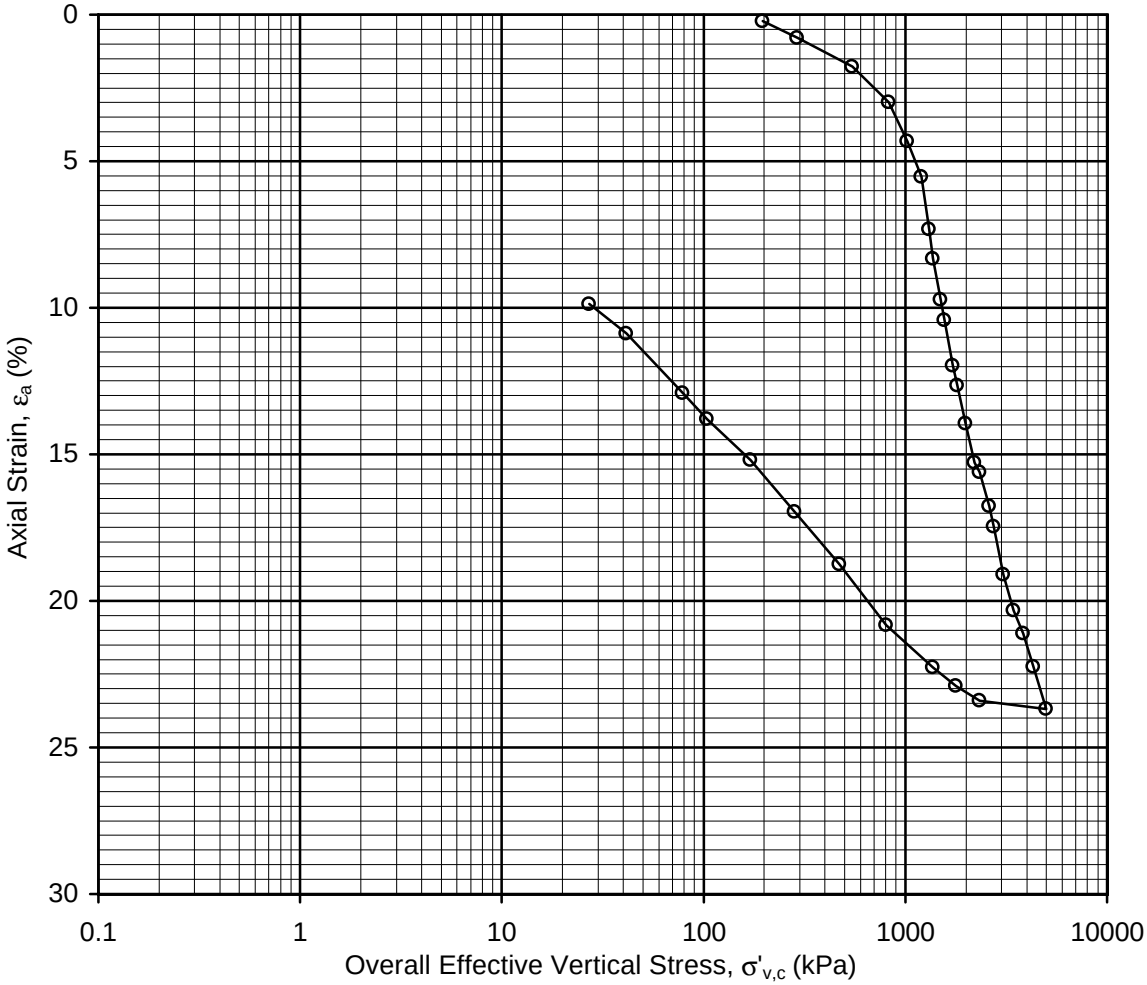
PLATE 98-32.14c

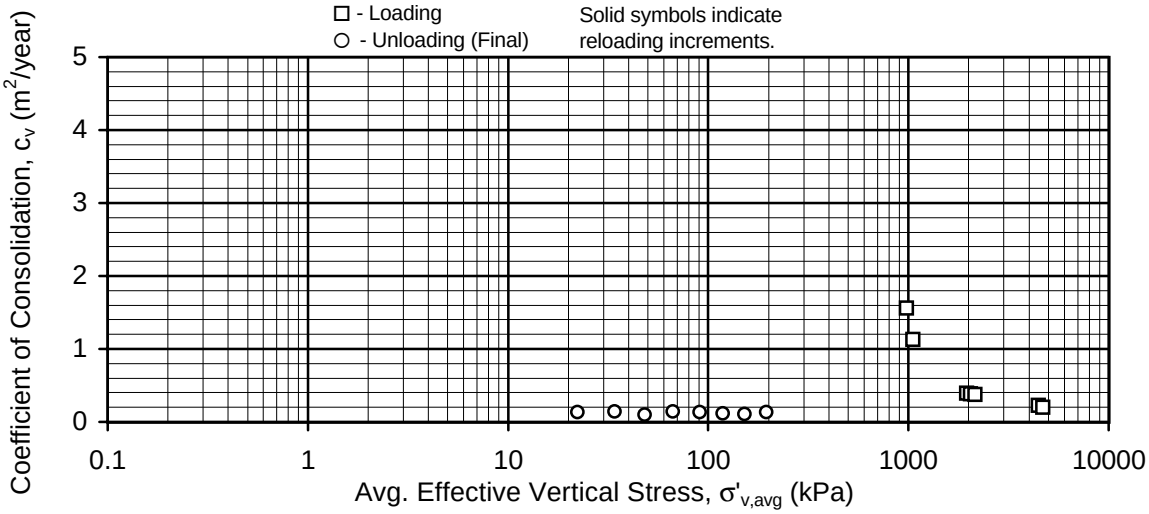




CRS CONSOLIDATION TEST RESULTS

Sample No. 57 - Depth: 61.5m
Boring 98-32
SFOBB East Span Seismic Safety Project

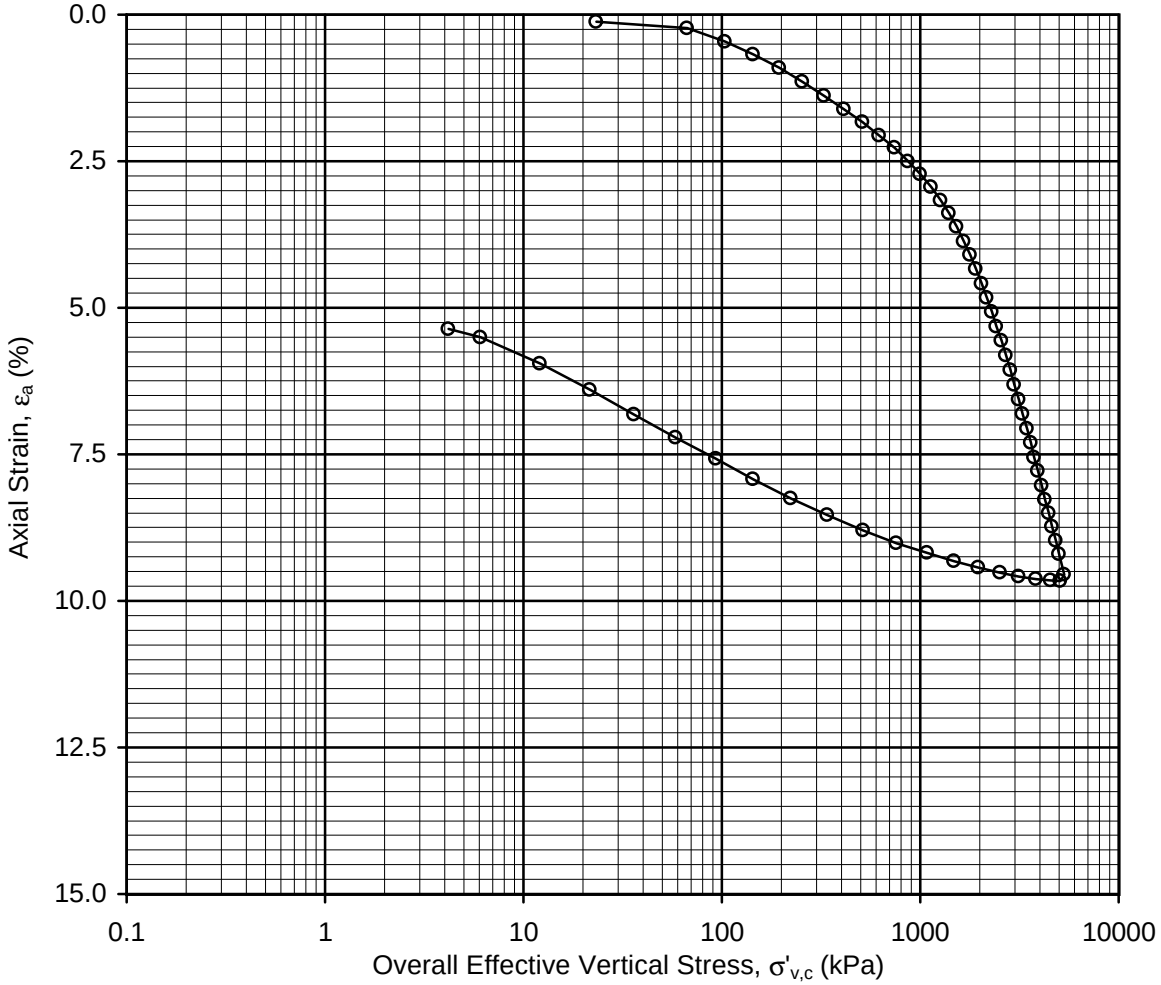


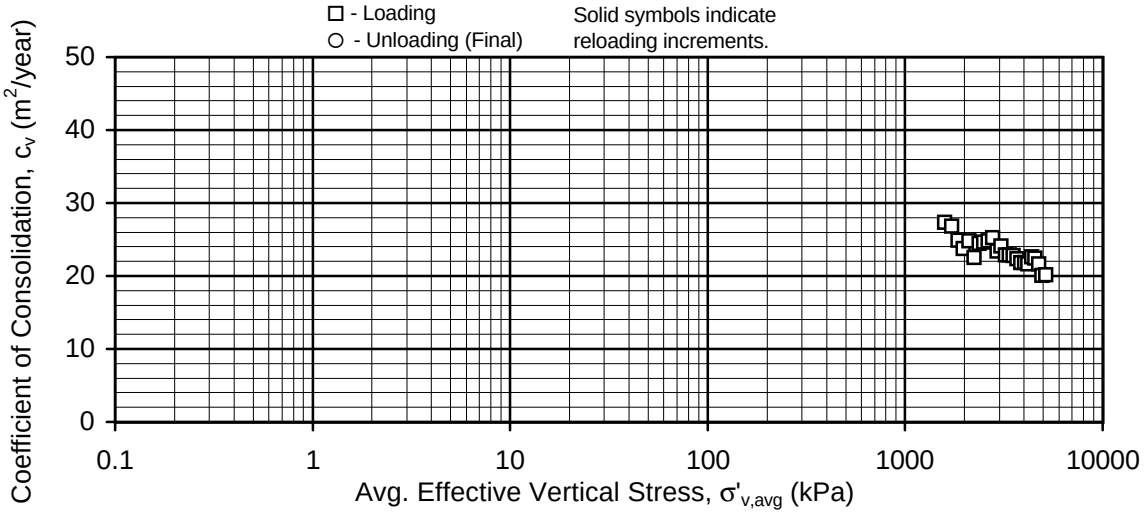


CRS CONSOLIDATION TEST RESULTS

Sample No. 68 - Depth: 70.6m
Boring 98-32
SFOBB East Span Seismic Safety Project

PLATE 98-32.14e

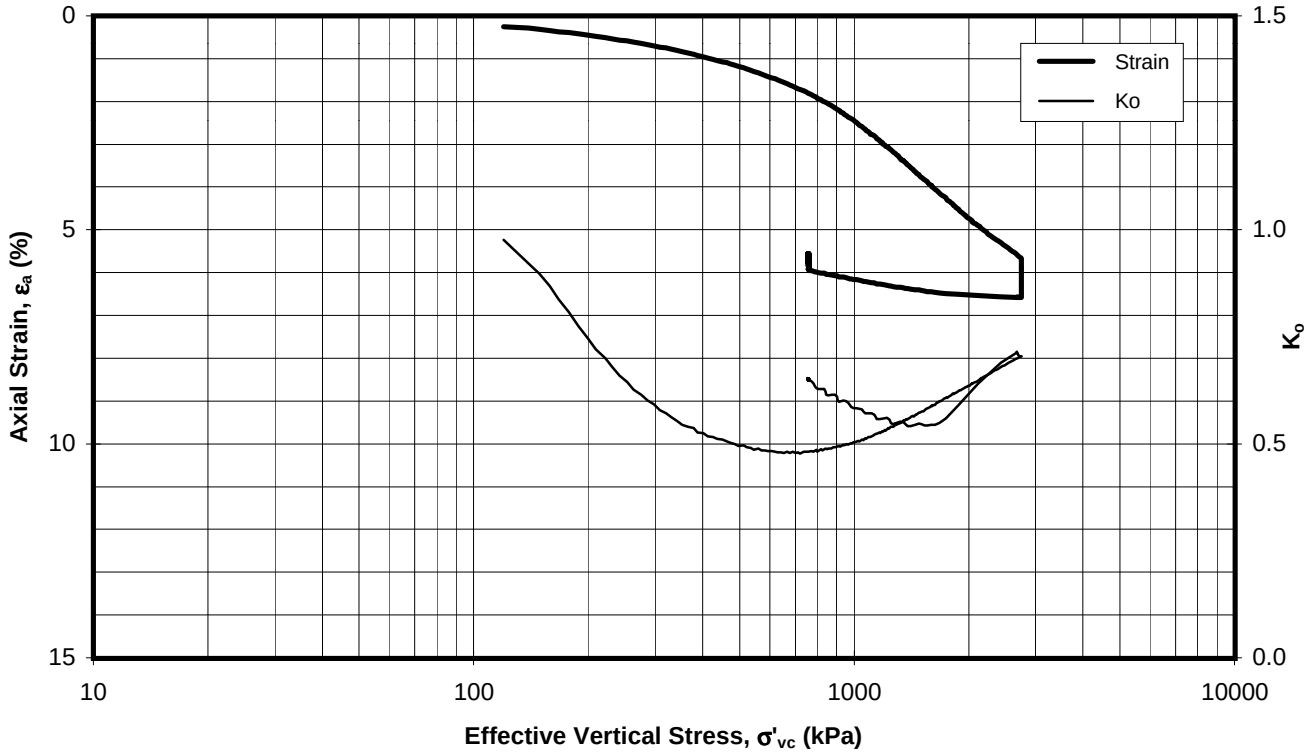


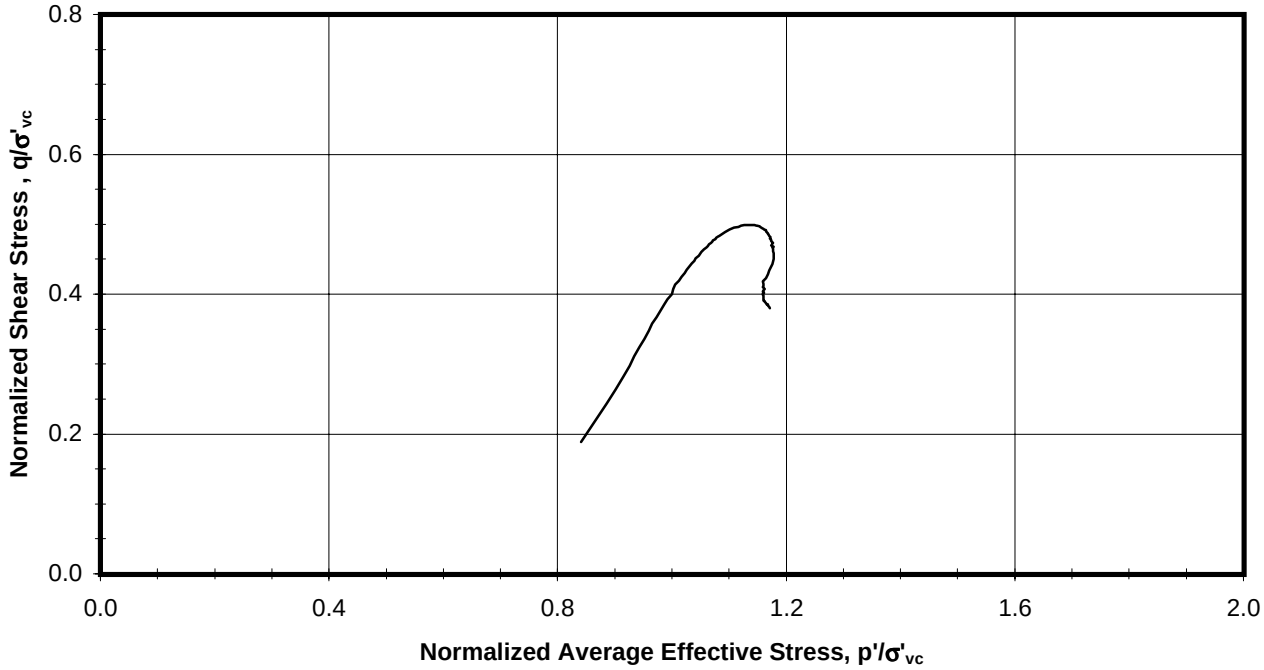


CRS CONSOLIDATION TEST RESULTS

Sample No. 82 - Depth: 84.6m
Boring 98-32
SFOBB East Span Seismic Safety Project

PLATE 98-32.14f





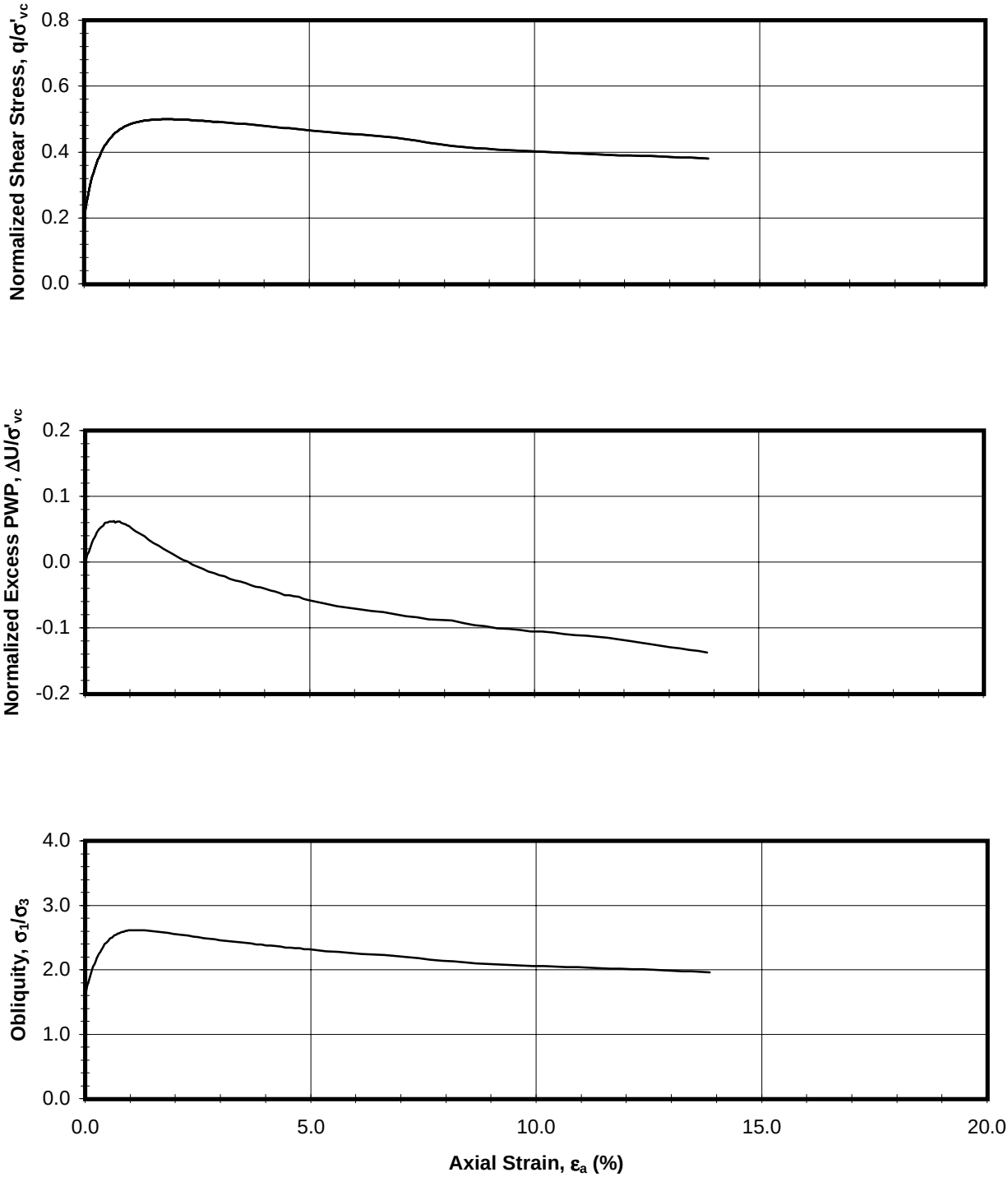
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 41 - Depth: 32.1m

Boring 98-32

SFOBB East Span Seismic Safety Project

PLATE 98-32.15.1



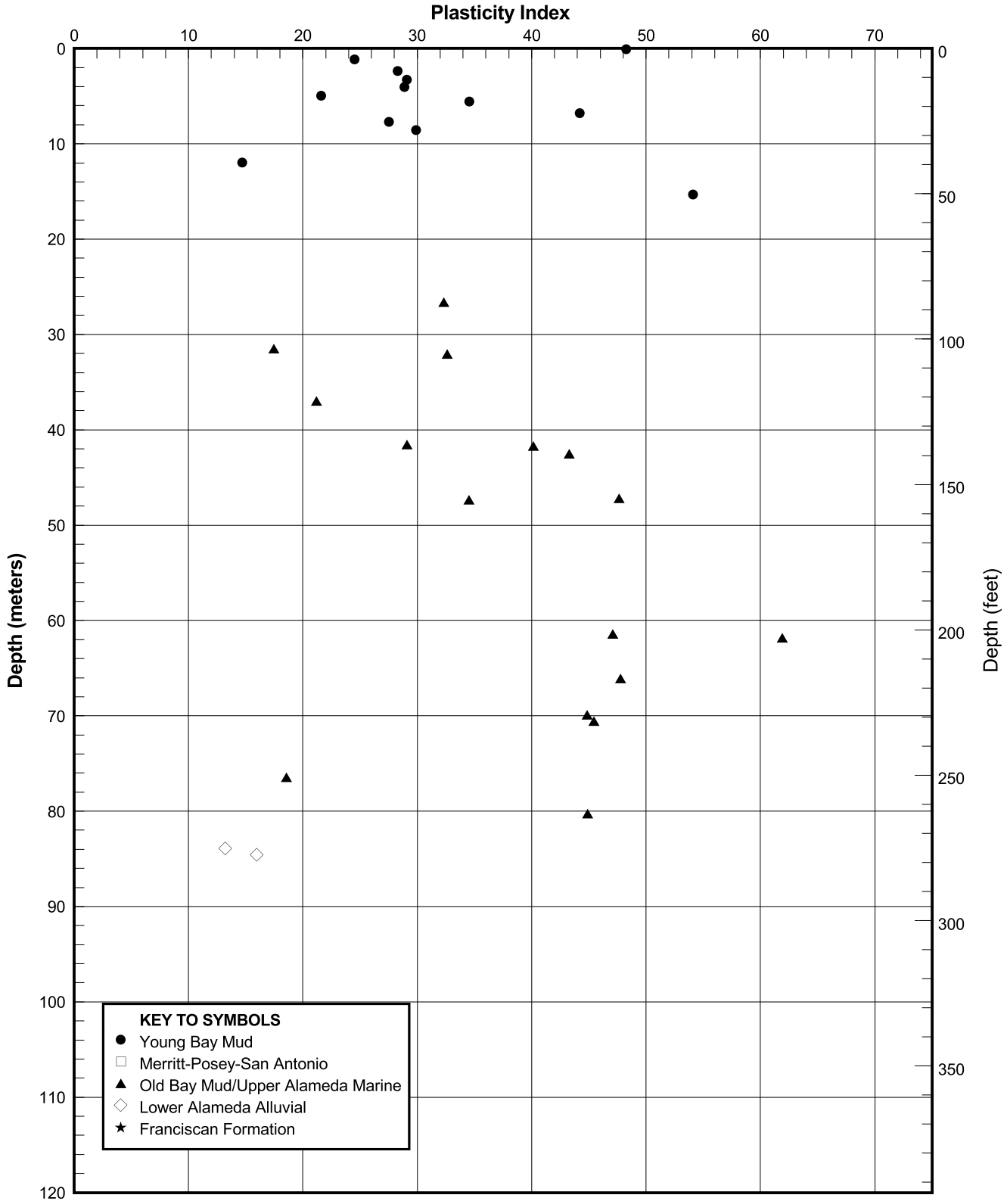
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 41 - Depth: 32.1m

Boring 98-32

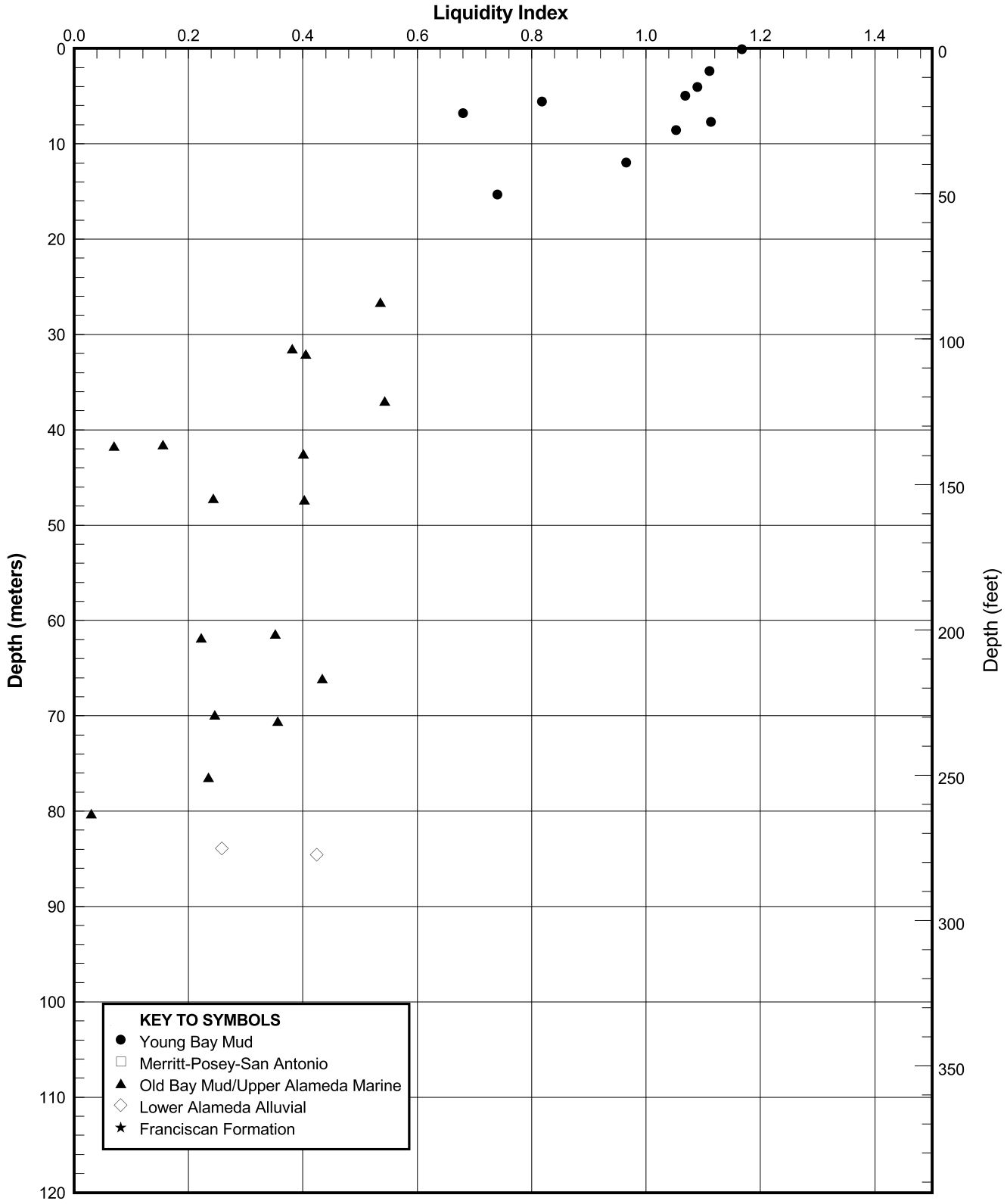
SFOBB East Span Seismic Safety Project

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



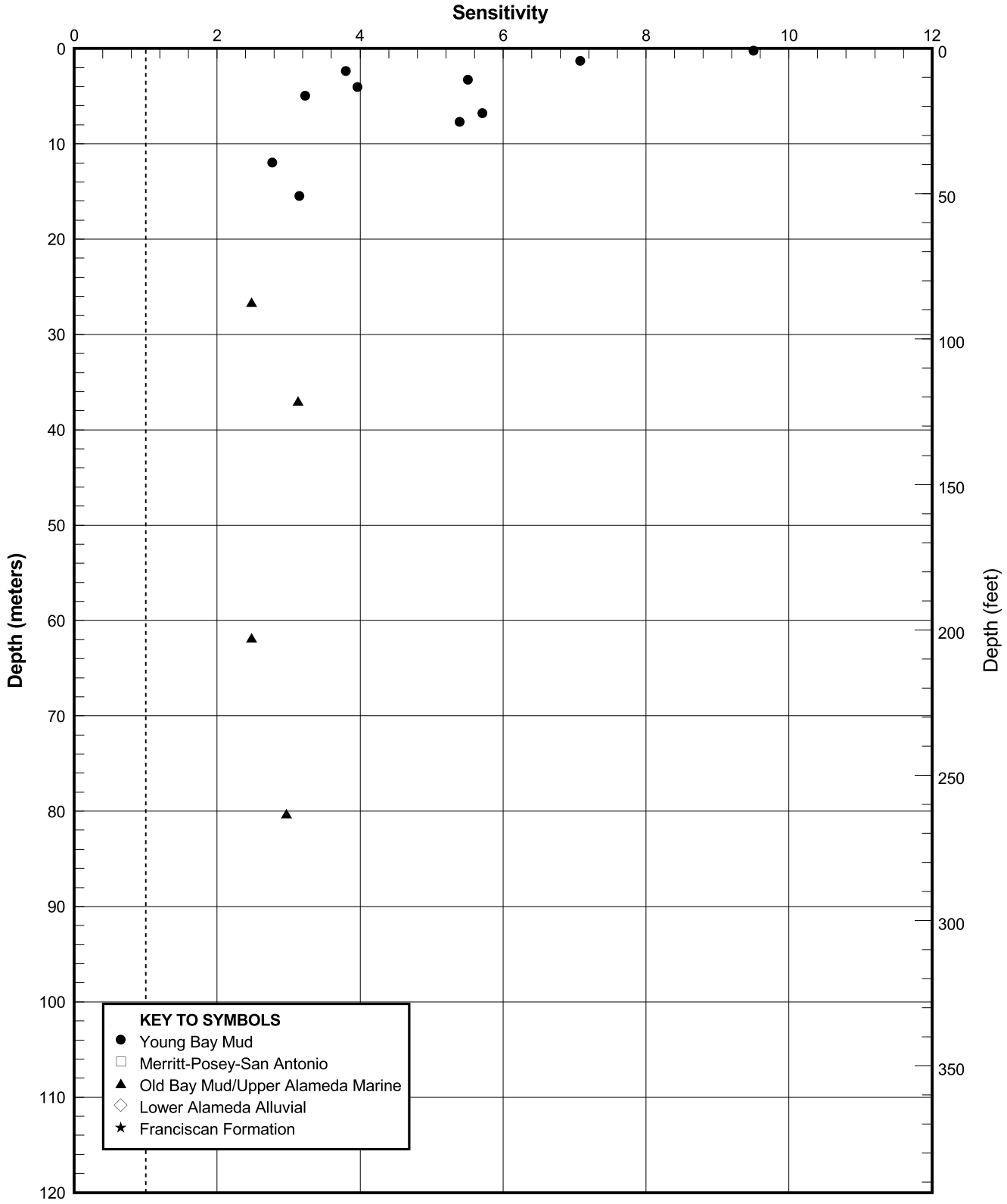
PLASTICITY INDEX PROFILE
Boring 98-32
SFOBB East Span Seismic Safety Project

PLATE 98-32.17



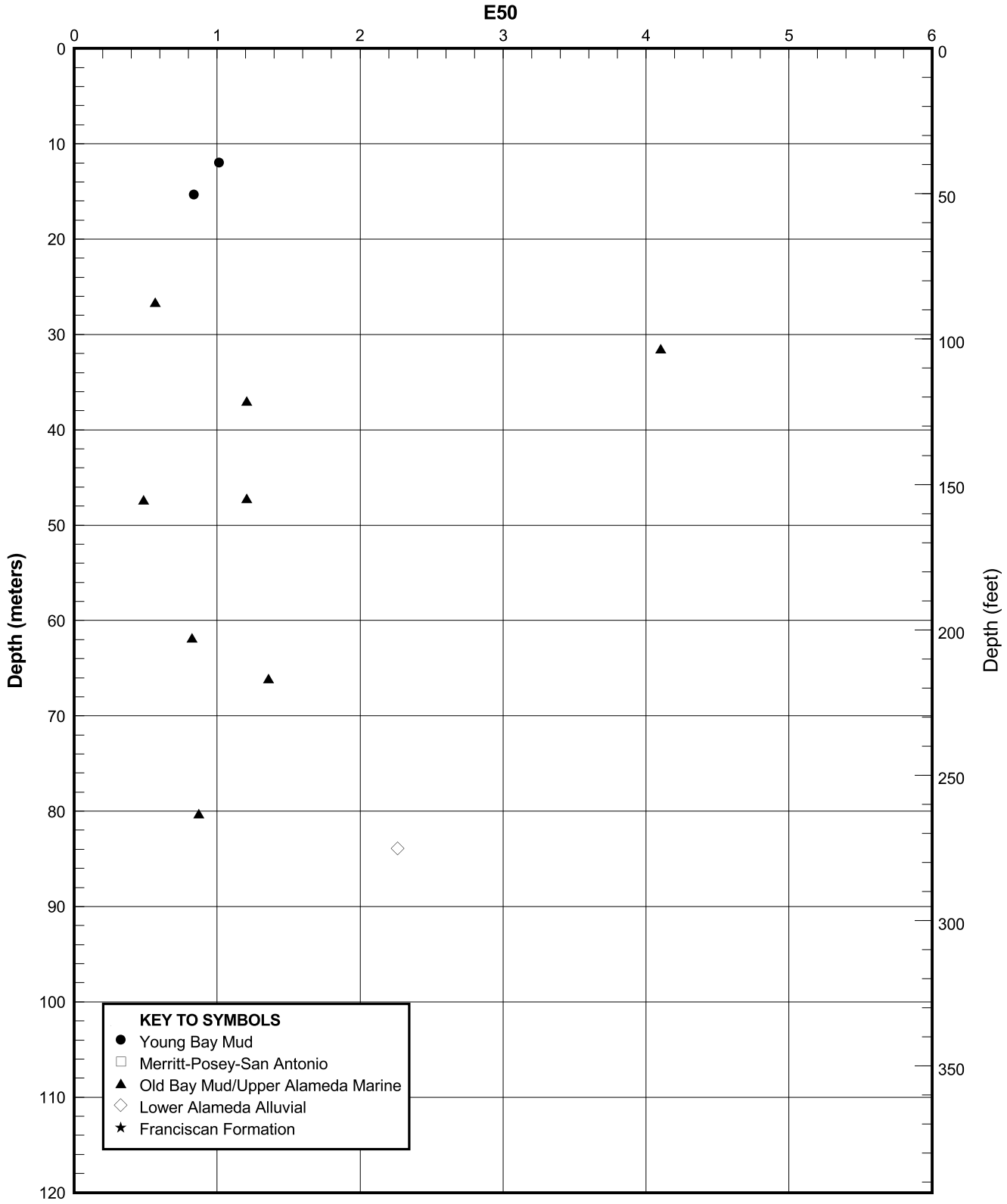
LIQUIDITY INDEX PROFILE
Boring 98-32
SFOBB East Span Seismic Safety Project

PLATE 98-32.18



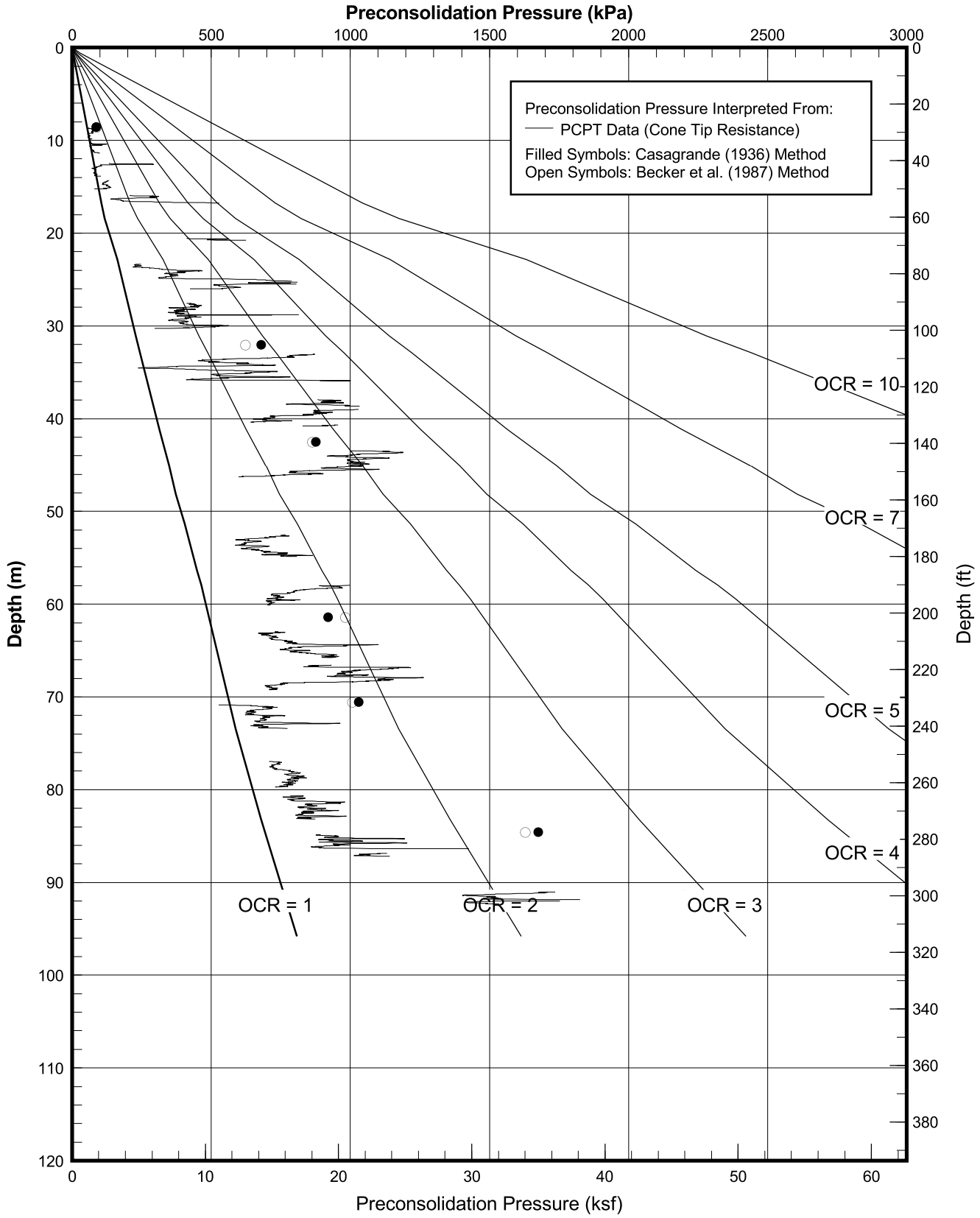
SENSITIVITY PROFILE
Boring 98-32
SFOBB East Span Seismic Safety Project

PLATE 98-32.19



E50 PROFILE
Boring 98-32
SFOBB East Span Seismic Safety Project

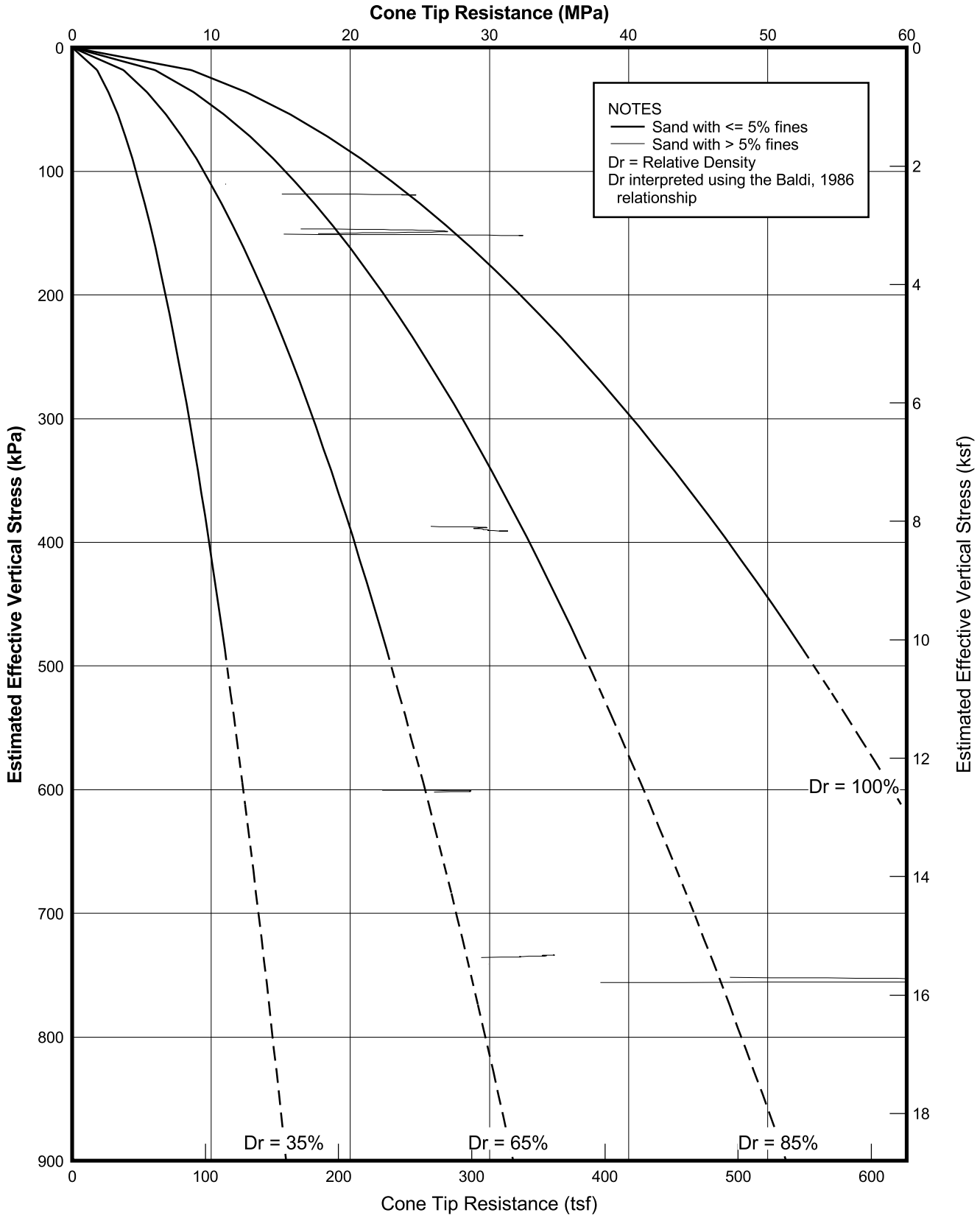
PLATE 98-32.20



PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-32

SFOBB East Span Seismic Safety Project



RELATIVE DENSITY INTERPRETED FROM CPT DATA

Boring 98-32

SFOBB East Span Seismic Safety Project