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FINAL MARINE GEOTECHNICAL SITE CHARACTERIZATION

SAN FRANCISCO-OAKLAND BAY BRIDGE EAST SPAN SEISMIC SAFETY PROJECT

VOLUME 2C - APPENDICES
(Borings 98-21 through 98-27)

Prepared for

CALIFORNIA DEPARTMENT OF TRANSPORTATION

March 2001

Earth Mechanics

Fugro - Earth Mechanics
A JOINT VENTURE

7700 Edgewater Drive, Suite 848
Oakland, California 94621
Tel: (510) 633-5100
Fax: (510) 633-5101

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

REGISTERED PROFESSIONAL ENGINEER
ROGER W. A. HOWARD JR.
No. C61002
Exp. 12/31/04
CIVIL
STATE OF CALIFORNIA

Roger Howard, Jr., P.E.
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
M. JACOB CHACKO
NO. 58850
Exp. 06/30/03
CIVIL
STATE OF CALIFORNIA

Jacob Chacko, P.E.
Project Engineer

REGISTERED GEOLOGIST
CRAIG D. PRENTICE
EG NO. 1602
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Craig D. Prentice, R.G., C.E.G.
Senior Engineering Geologist

REGISTERED PROFESSIONAL ENGINEER
T.W. McNeilan
No. 0583
Exp. 12/31/03
Geotechnical
STATE OF CALIFORNIA

Thomas W. McNeilan, C.E., G.E.
Vice President

Attachment

Copies submitted: Mr. Mark Willian, Caltrans
Mr. Saba Mohan, Caltrans
Mr. Robert Price, Caltrans
Dr. Brian Maroney, Caltrans
Ms. Sharon Naramore, Caltrans
Mr. Gerry Houlahan, TY Lin/M&N
Mr. Sajid Abbas, TY Lin/M&N
Mr. Al Ely, TY Lin/M&N

SAN FRANCISCO-OAKLAND BAY BRIDGE
EAST SPAN SEISMIC SAFETY PROJECT

CALTRANS CONTRACT 59A0053

FINAL MARINE GEOTECHNICAL SITE CHARACTERIZATION

VOLUME 2C - APPENDICES
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MARCH 2001

Prepared For:

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5900 Folsom Boulevard
Sacramento, California 95819-0128

Prepared By:

FUGRO-EARTH MECHANICS
A Joint Venture
7700 Edgewater Drive, Suite 848
Oakland, California 94621

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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

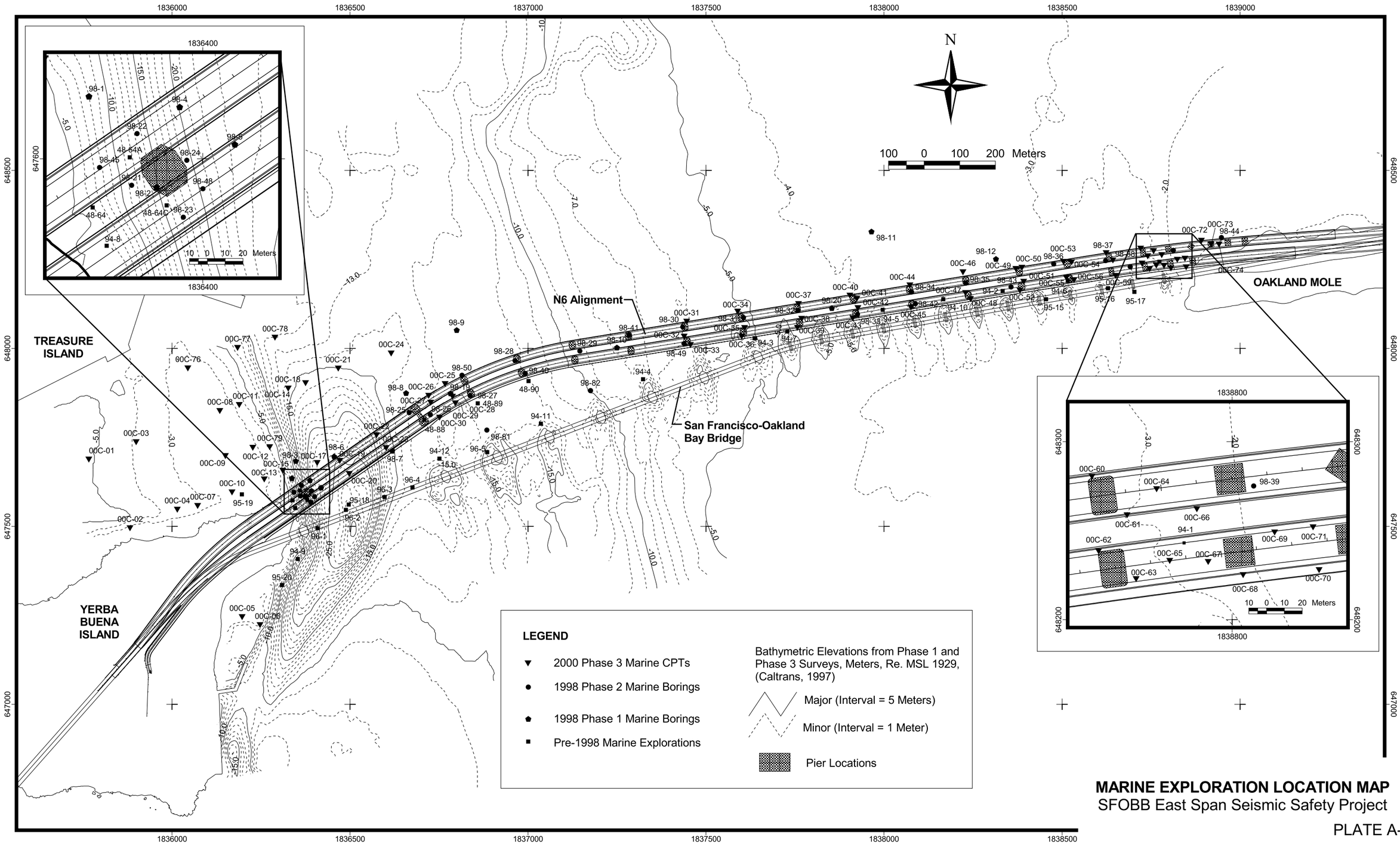
The results of the 77 marine CPT soundings are presented in Volume 2H of this report. The CPT logs provide graphical plots versus depth showing:

- 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)

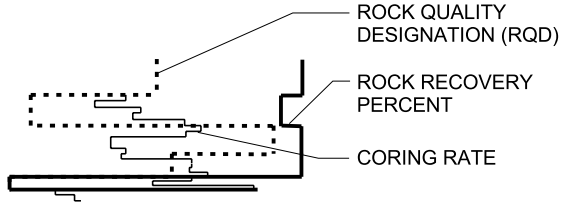
SAMPLERS

- 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

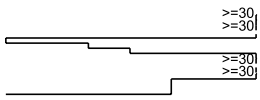
ROCK QUALITY AND CORING RATE



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.

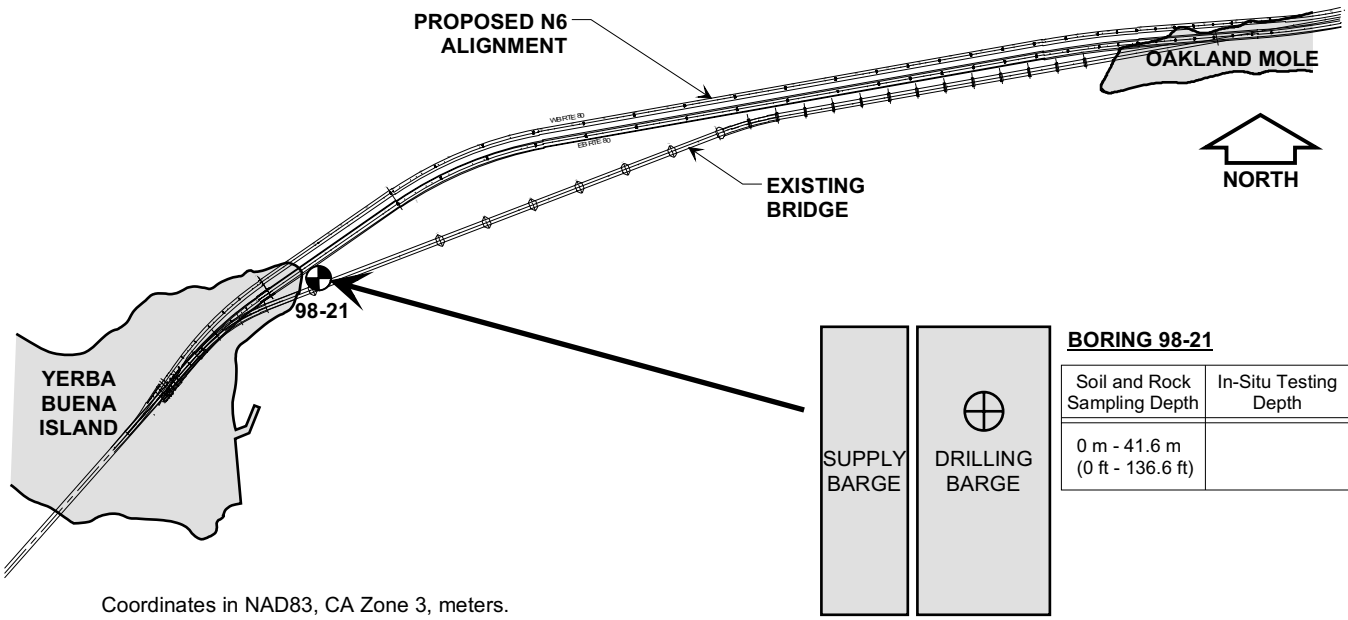
KEY TO TERMS AND SYMBOLS USED ON LOGS

SFOBB East Span Seismic Safety Project

BORING 98-21

Date	Time From	Time To	Description of Activity
October 18, 1998	0515	0730	Move barge to location 98-21. Set 4 anchors and 2 spuds.
	0730	0915	Reconfigure slip joint for shallow water.
	0915	1000	Rig up for drilling. Lower drill pipe to mudline.
	1000	1010	Measure water depth of 10.9m (35.7 ft) using bottom sensor. Current tide level is approximately +0.6m (1.9 ft) MSL. Calculate mudline elevation of -10.3m (-33.8 ft).
	1010	1200	Drill and sample from mudline to 4.4m (14.4 ft). Pull drill pipe to deck.
	1200	1500	Set casing. Lower drill pipe to mudline. Drill to 4.6m (15 ft).
	1500	1800	Set drill pipe at 4.6m (15 ft). Lower core pipe to 4.6m (15 ft).
	1800	2400	Rock coring from 4.6m (15 ft) to 11.6m (37.9 ft).
October 19, 1998	0000	2400	Rock coring from 11.6m (37.9 ft) to 36m (118 ft).
October 20, 1998	0000	0500	Rock coring from 36m (118 ft) to 41.6m (136.6 ft).
	0500	0600	Pull core pipe to deck and rig up for Suspension Logging.
	0600	0700	P- and S-wave velocity logging and caliper logging from 41.6m (136.6 ft) to 4.6m (15 ft).
	0700	0900	Acoustic televiewer logging from 41.6m (136.6 ft) to 4.6m (15 ft).
	0900	1015	Lower N-rod. Mix and circulate cement. Grout hole 98-21. Pull N-rod to deck.
	1015	1045	Pull drill pipe to deck.
	1045	1130	Pull casing to deck.
	1130	1400	Pull 4 anchors and 2 spuds and move barge to location 98-25.

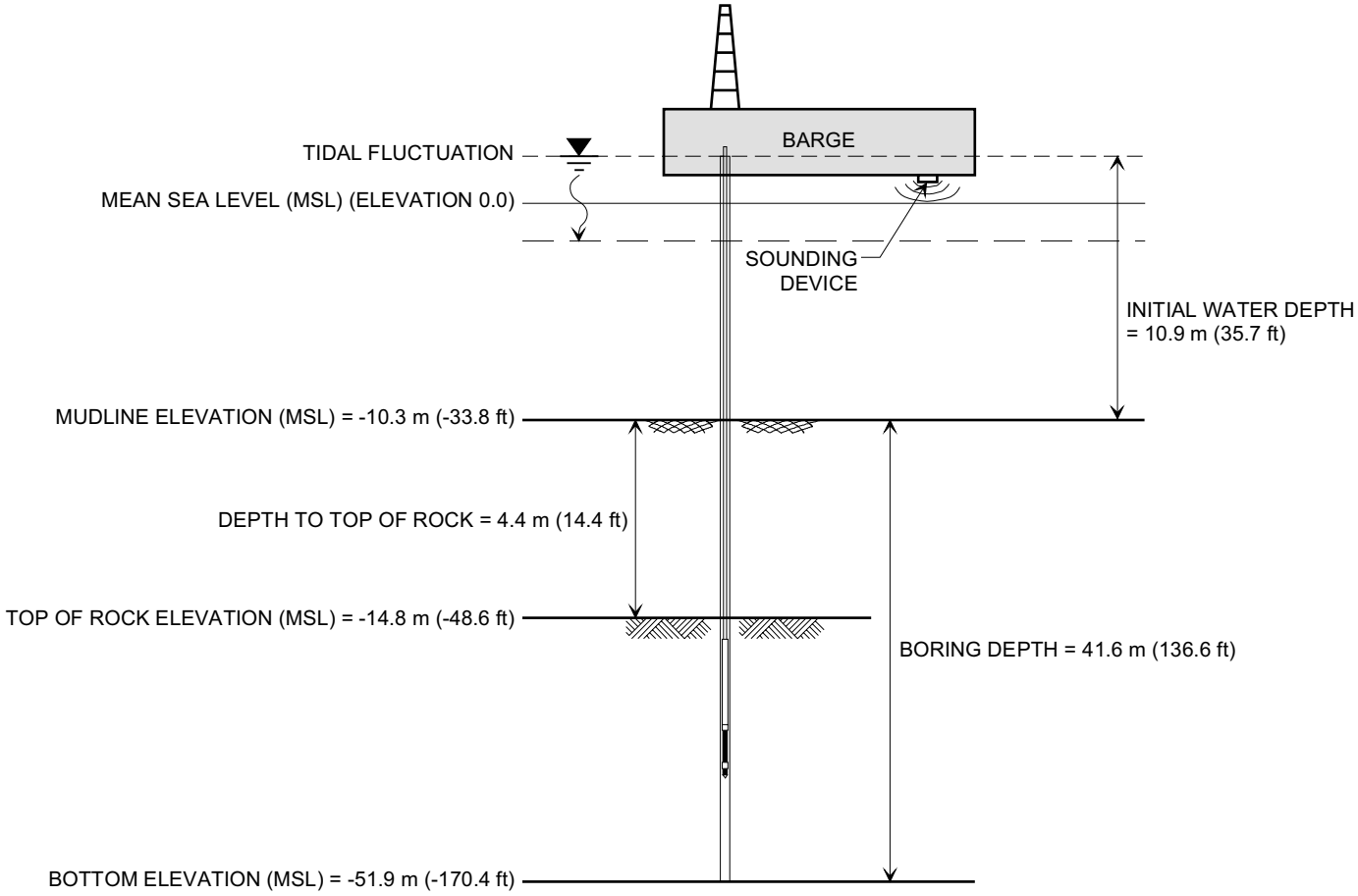
SUMMARY OF FIELD OPERATIONS
Boring 98-21
SFOBB East Span Seismic Safety Project



BORING 98-21

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 41.6 m (0 ft - 136.6 ft)		E = 1,836,360 N = 647,585

Coordinates in NAD83, CA Zone 3, meters.



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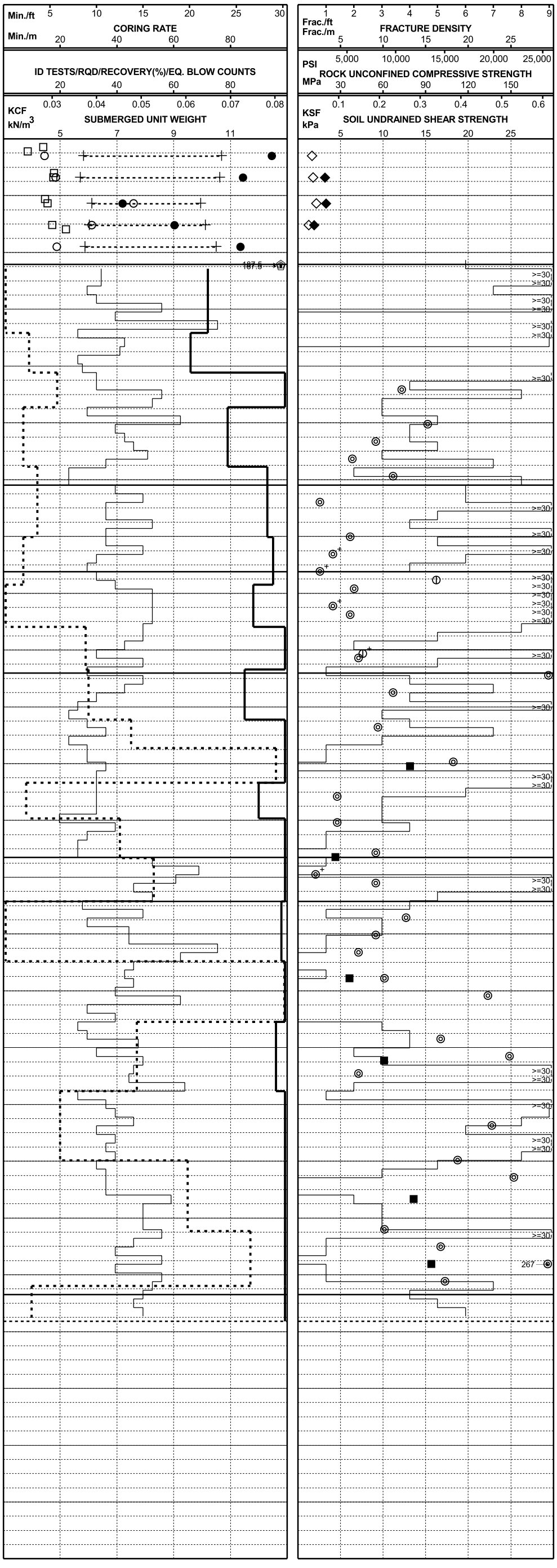
DEPTH AND LOCATION REFERENCE MAP
Boring 98-21
SFOBB East Span Seismic Safety Project

PROJECT NO:	98-42-0054	**START DATE:**	10/18/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-21 (Main Span - Pylon)	**COMPLETION DATE:**	10/20/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836360 N647585
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -10.3m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH, WOH, WOH, WOH, WOH, 50/5cm	FAT CLAY (CH), dark olive gray to dark gray, very soft See Plate 98-21.6 for detailed stratigraphy -subangular, moderate yellowish brown, sandstone gravel, below 4.3m (4.4m)	I
-12, -14	2, 4	50/5cm, 72-0, 66-9, 100-19, 79-7	SANDSTONE (Graywacke) (Rx) with interbedded SILTSTONE (Rx), [10:1], moderate to dark yellowish brown, intensely to moderately weathered, moderately soft, poorly indurated, fine to coarse grained, moderately fractured -claystone interbed, slightly weathered, 9.4m to 9.8m -slightly weathered, moderately to intensely fractured sandstone, below 9.8m (12.2m)	II
-16, -18, -20	6, 8, 10	93-12, 95-7	SANDSTONE (Graywacke) (Rx), interbedded with SILTSTONE (Rx), [5:1], olive gray, slightly weathered, hard, intensely fractured to very intensely fractured (15.2m)	III
-22, -24	12, 14	88-0, 100-29	SILTSTONE (Rx), dark gray, fresh, hard, thinly bedded, very intensely to intensely fractured with clean, smooth to slightly rough fracture surfaces -very intensely sheared with interbedded sandstone, 17.1m to 17.5m (18.8m)	IV
-26, -28, -30	16, 18, 20	85-30, 100-45, 100-96, 90-8, 100-41	SANDSTONE (Graywacke) (Rx) with interbedded SILTSTONE (Rx), [10:1], moderate to dark yellowish brown, intensely to moderately weathered, moderately soft, poorly indurated, fine to coarse grained, moderately fractured -siltstone interbed, dipping 30 degrees, 19.2m to 19.6m -90mm thick siltstone interbed, very intensely fractured, 22.7m to 23.1m -siltstone interbed, slightly fractured, bedding dipping 35 degrees, 23.9m to 24.1m -siltstone interbed, dipping at 35 degrees, 24.2m to 24.8m (25.3m)	V
-32, -34	22, 24	100-53	Interbedded SANDSTONE (Graywacke) (Rx) and SILTSTONE (Rx) (26.9m)	VI
-36, -38, -40	26, 28, 30	98-0, 100-99, 96-47, 100-20, 100-65, 100-87	SANDSTONE (Graywacke) (Rx), medium dark gray, fresh, hard, moderately indurated, fine to coarse grained, thickly bedded, intensely to moderately fractured with slightly rough, clean to very thinly coated surfaces -sandstone with interbedded siltstone, 31.9m to 38.6m (40.7m)	VII
-42, -44, -46, -48, -50	32, 34, 36, 38, 40	100-10	SILTSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) [3:1] -sandstone below 41.5m	VIII
-52, -54, -56, -58, -60	42, 44, 46, 48		TOTAL DEPTH: 41.6m BACKFILLED WITH: Cement Grout	



LOG OF BORING AND TEST RESULTS

BORING 98-21

SFOBB East Span Seismic Safety Project

Report Date: 05/06/99

FUGRO

NO SINGLE-PAGE BORING LOGS WITH CPT DATA FOR THIS BORING

PROJECT NO:	98-42-0054	**START DATE:**	10/18/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-21 (Main Span - Pylon)	**COMPLETION DATE:**	10/20/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

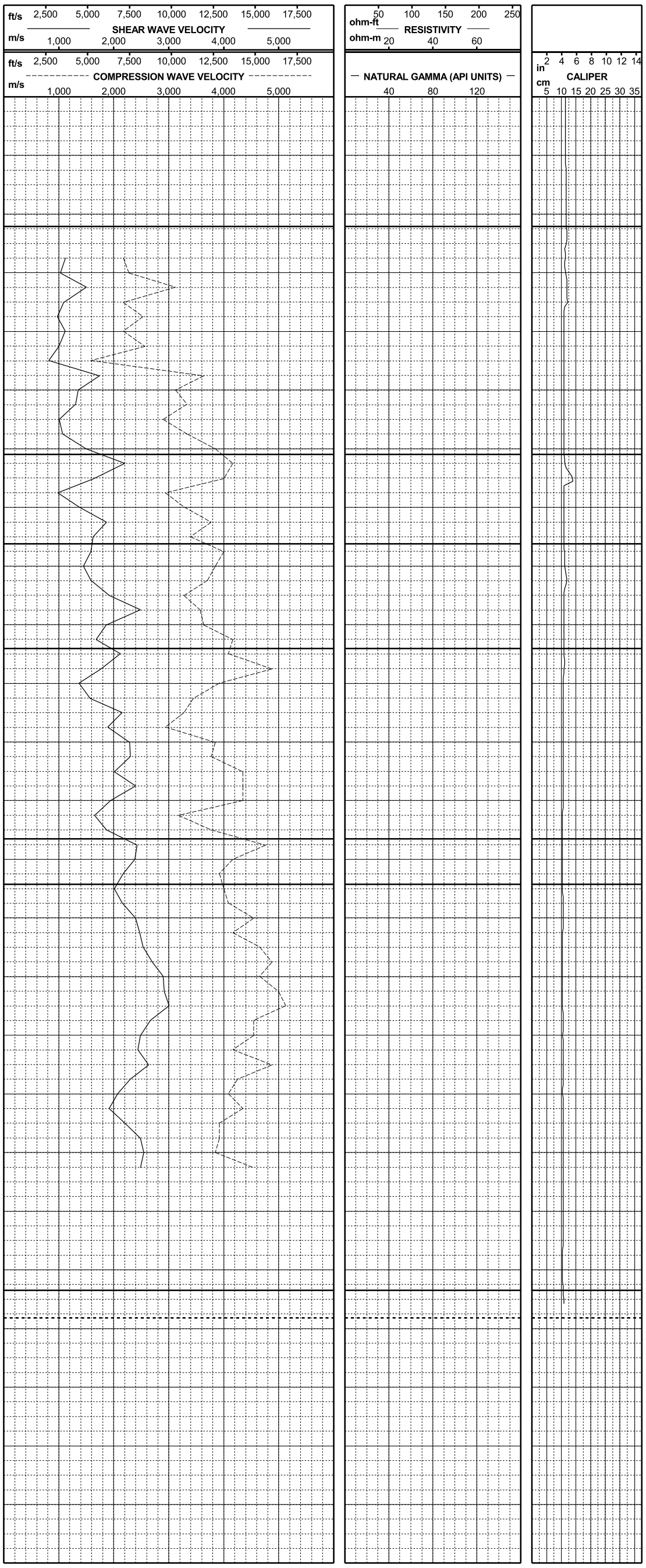
Coordinates: E1836360 N647585
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -10.3m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH, WOH, WOH, WOH, WOH	FAT CLAY (CH), dark olive gray to dark gray, very soft See Plate 98-21.6 for detailed stratigraphy -subangular, moderate yellowish brown, sandstone gravel, below 4.3m (4.4m)	I
		50/5cm, 72-0, 66-9, 100-19, 79-7	SANDSTONE (Graywacke) (Rx) with interbedded SILTSTONE (Rx), [10:1], moderate to dark yellowish brown, intensely to moderately weathered, moderately soft, poorly indurated, fine to coarse grained, moderately fractured -claystone interbed, slightly weathered, 9.4m to 9.8m -slightly weathered, moderately to intensely fractured sandstone, below 9.8m (12.2m)	II
		93-12, 95-7	SANDSTONE (Graywacke) (Rx), interbedded with SILTSTONE (Rx), [5:1], olive gray, slightly weathered, hard, intensely fractured to very intensely fractured (15.2m)	III
		88-0, 100-29	SILTSTONE (Rx), dark gray, fresh, hard, thinly bedded, very intensely to intensely fractured with clean, smooth to slightly rough fracture surfaces -very intensely sheared with interbedded sandstone, 17.1m to 17.5m (18.8m)	IV
		85-30, 100-45, 100-96, 90-8, 100-41	SANDSTONE (Graywacke) (Rx) with interbedded SILTSTONE (Rx), [10:1], moderate to dark yellowish brown, intensely to moderately weathered, moderately soft, poorly indurated, fine to coarse grained, moderately fractured -siltstone interbed, dipping 30 degrees, 19.2m to 19.6m -90mm thick siltstone interbed, very intensely fractured, 22.7m to 23.1m -siltstone interbed, slightly fractured, bedding dipping 35 degrees, 23.9m to 24.1m -siltstone interbed, dipping at 35 degrees, 24.2m to 24.8m (25.3m)	V
		100-53	Interbedded SANDSTONE (Graywacke) (Rx) and SILTSTONE (Rx) (26.9m)	VI
		98-0, 100-99, 96-47, 100-20, 100-65, 100-87	SANDSTONE (Graywacke) (Rx), medium dark gray, fresh, hard, moderately indurated, fine to coarse grained, thickly bedded, intensely to moderately fractured with slightly rough, clean to very thinly coated surfaces -sandstone with interbedded siltstone, 31.9m to 38.6m (40.7m)	VII
		100-10	SILTSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) [3:1] -sandstone below 41.5m	VIII

TOTAL DEPTH: 41.6m

BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-21

SFOBB East Span Seismic Safety Project

Report Date: 05/06/99

FUGRO

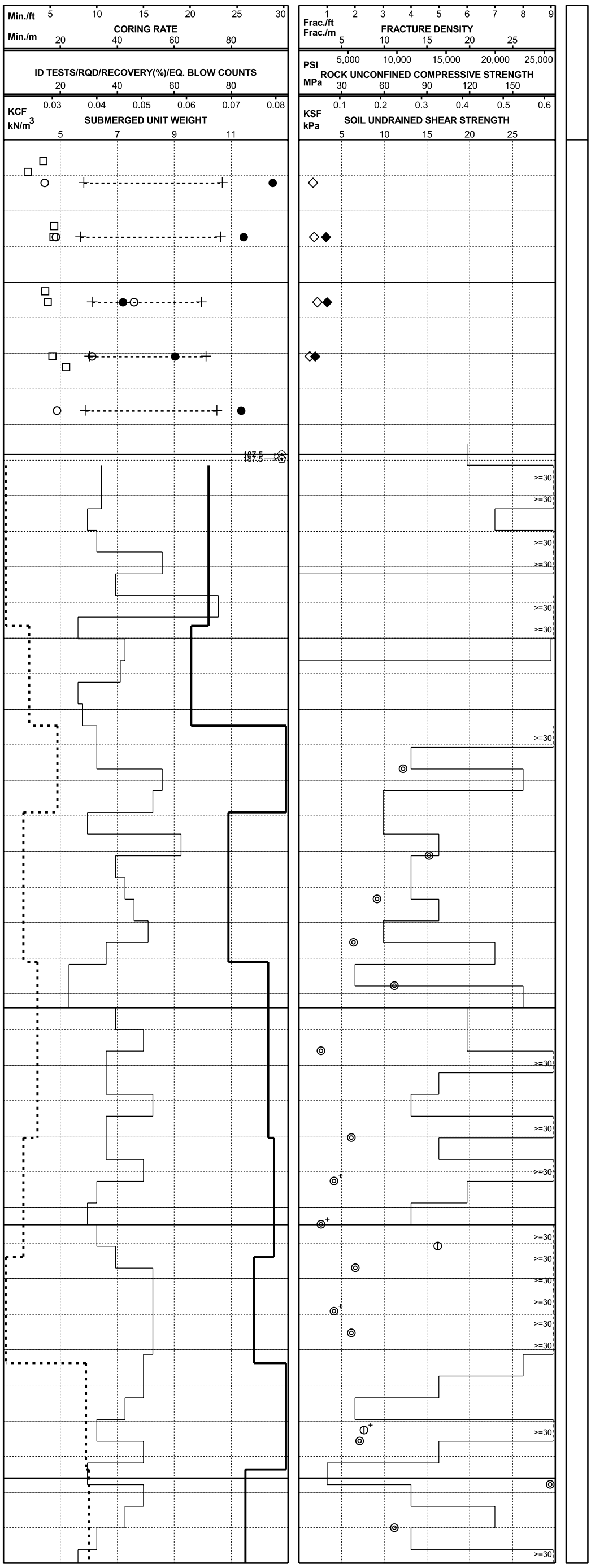
PLATE 98-21.5

PROJECT NO:	98-42-0054	**START DATE:**	10/18/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-21 (Main Span - Pylon)	**COMPLETION DATE:**	10/20/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836360 N647585
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -10.3m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	FAT CLAY (CH), dark olive gray to dark gray, very soft	I
-11	1	WOH		
-12	2	WOH	-with sand pockets and a few shell fragments, at 2.1m	
-13	3	WOH	-with an H2S odor at 3.0m	
-14	4	WOH		
		50/5cm 50/5cm	-subangular, moderate yellowish brown, sandstone gravel, below 4.3m (4.4m)	
-15	5	72-0	SANDSTONE (Graywacke) (Rx) with interbedded SILTSTONE (Rx), [10:1] -sandstone: moderate to dark yellowish brown, intensely to moderately weathered, moderately soft, poorly indurated, fine to coarse grained, locally with subrounded, elongate, fine to medium gravel sequences, moderately fractured -siltstone: medium dark gray, intensely to moderately weathered, thinly to moderately bedded, intensely fractured -fractures: slightly rough, moderately to closely spaced, with very thin iron oxide and calcite/quartz fillings	II
-16	6		-60mm thick, intensely sheared, siltstone interbed, at 4.9m -fractures in sandstone, dipping 10 to 25 degrees, at 5.1m -30mm thick, intensely sheared zone at 5.3m	
-17	7	66-9	-bedding dipping 30 degrees at 5.5m -60mm thick siltstone bed, dipping 35 degrees, at 5.6m -subrounded to subangular siltstone gravel, at 5.9m -intensely fractured, 6.1m to 6.2m -moderately weathered, subrounded to rounded coarse sandstone/conglomerate bed, at 6.8m	
-18	8		-intensely fractured, claystone interbed, with medium grained sandstone lenses, and subrounded pebbles, 7.1m to 7.4m -open fracture with striations and voids from pebbles, at 7.3m -very thin (< 1mm) clay filled fracture dipping 50 degrees, at 7.4m	
-19	9	100-19	-numerous, very thin (< 1mm) clay filled fractures, dipping 45 to 80 degrees, at 8.1m -siltstone interbed, smooth fractures with iron oxide staining and minor clay infilling, dipping 30 to 50 degrees, at 8.4m -slightly weathered sandstone, medium dark gray, with 10mm to 25mm weathering rinds along discontinuities, at 8.7m -claystone interbed, moderate dark gray, slightly weathered, 9.4m to 9.8m	
-20	10		-moderately indurated, intensely fractured with closely spaced, very thin, smooth clean surfaces, below 9.4m -olive gray sandstone, slightly weathered, well indurated, fine grained, thickly bedded, dipping 25 degrees, moderately to intensely fractured, with slightly to moderately rough surfaces coated with iron oxide, below 9.8m	
-21	11	79-7	-fractures dipping 30 and 50 to 60 degrees, at 10.2m -fractures dipping 75 and 80 degrees, at 10.5m	
-22	12		-medium to coarse grained sandstone, very intensely to intensely fractured, 11.7m to 11.9m (12.2m)	
-23	13	93-12	SANDSTONE (Graywacke) (Rx), interbedded with SILTSTONE (Rx), [5:1] -sandstone: olive gray, slightly weathered, hard, well indurated, fine grained, intensely fractured to very intensely fractured -siltstone: slightly weathered, dark gray, moderately hard to hard, thinly bedded, moderately fractured. -very intensely fractured, 13.2m to 13.3m	III
-24	14		-bedding dipping 20 degrees at 13.7m -very intensely fractured, 14.0m to 14.3m -bedding dipping 20 degrees at 14.3m	
-25	15	95-7	-very intensely fractured, 14.6m to 15.0m -moderately fractured with healed, very thin (<1mm) quartz/calcite filled fractures, dipping 60 to 80 degrees, at 15.0m (15.2m)	
-26	16		SILTSTONE (Rx), dark gray, fresh, hard -well indurated, thinly bedded, very intensely to intensely fractured with clean, smooth to slightly rough fracture surfaces -moderately fractured 40 to 70 degrees, at 15.8m	IV
-27	17	88-0	-intensely to very intensely fractured with 5mm to 10mm wide calcite/quartz filled fractures, 16.6m to 17.0m -very intensely sheared with very thin (1mm) calcite/quartz infilling and interbedded sandstone, 17.1m to 17.5m -fractures with 25mm to 50mm spacing, dipping 30 to 40 degrees, with smooth, clean surfaces, 17.5m to 18.1m	
-28	18	100-29	-sandstone, medium dark gray, fresh, hard, well indurated, fine grained, normally graded, moderately bedded, moderately fractured, 18.0m to 18.5m -fractures in sandstone: slightly rough to rough, surfaces stained with iron oxide (18.8m)	
-29	19	85-30	SANDSTONE (Graywacke) (Rx) with interbedded SILTSTONE (Rx), [10:1] -sandstone interbed dipping 40 degrees, fractures dipping 30 to 40 degrees, at 19.0m -siltstone interbed, dipping 30 degrees, 19.2m to 19.6m -very intensely to intensely fractured with clean, smooth to slightly rough surfaces, at 19.6m	V
-30				



LOG OF BORING AND TEST RESULTS

BORING 98-21

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

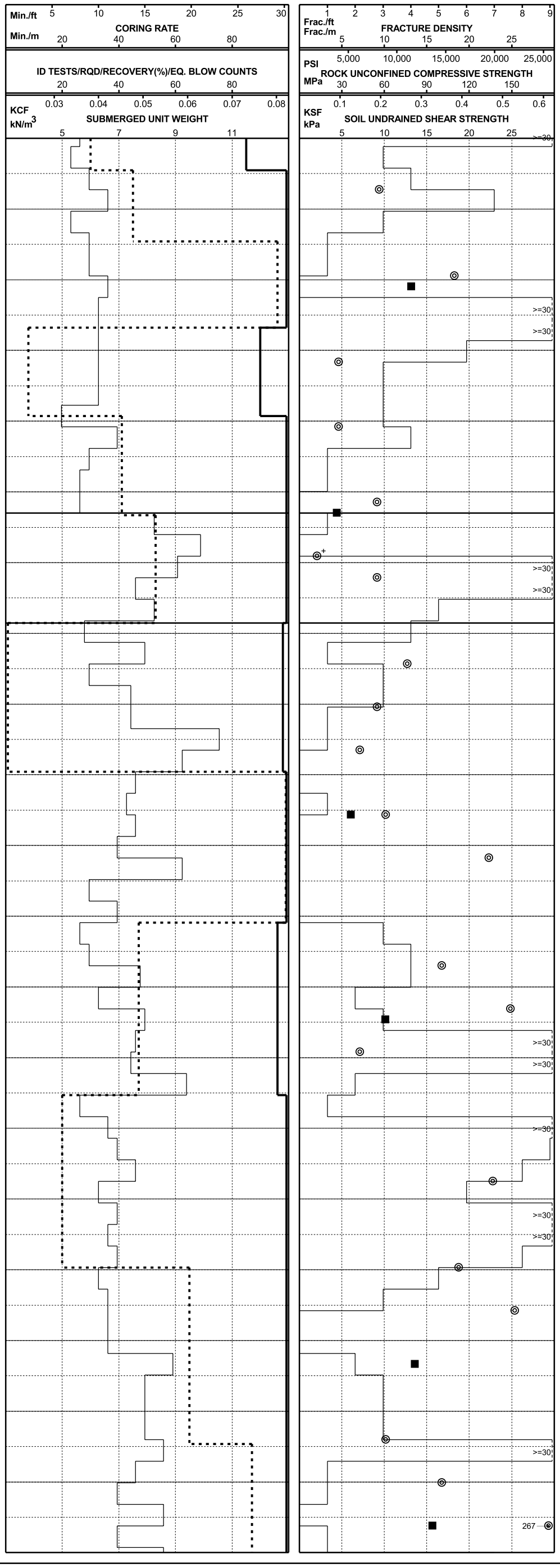
PLATE 98-21.6a

PROJECT NO:	98-42-0054	**START DATE:**	10/18/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-21 (Main Span - Pylon)	**COMPLETION DATE:**	10/20/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836360 N647585
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -10.3m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		85-30	SANDSTONE (Graywacke) (Rx) with interbedded SILTSTONE (Rx), [10:1]	V
-31	21	100-45	-moderately fractured, siltstone interbed, with bedding dipping 30 to 40 degrees, at 20.7m	
-32	22	100-96	-well indurated, fine to medium grained, thickly to very thickly bedded, slightly fractured with moderately rough surfaces and quartz/calcite infilling, at 21.7m	
-33	23	90-8	-90mm thick siltstone interbed, very intensely fractured, 22.7m to 23.1m -siltstone inclusions, and moderately fractured with dips of 60 to 80 degrees, at 23.2m	
-34	24	100-41	-siltstone interbed, slightly fractured, bedding dipping 35 degrees, 23.9m to 24.1m -siltstone interbed, 24.2m to 24.8m	
-35	25		-bedding dipping 35 degrees, at 24.8m (25.3m)	
-36	26	100-53	Interbedded SANDSTONE (Graywacke) (Rx) and SILTSTONE (Rx) -sandstone: medium dark gray, fresh, hard, well indurated, fine to medium grained, thickly to very thickly bedded, slightly fractured with moderately rough surfaces -siltstone: dark gray, hard, moderately indurated, very thinly bedded, smooth, clean surfaces -moderately fractured with slightly rough, very thin surfaces with calcite/quartz filling, at 25.3m	VI
-37	27		-with soft sediment deformation, at 25.6m -bedding dipping 20 degrees, at 25.7m -90mm thick, very intensely fractured zone, at 26.5m -90mm thick, very intensely fractured zone, at 26.8m (26.9m)	
-38	28	98-0	SANDSTONE (Graywacke) (Rx), medium dark gray, fresh, hard -moderately indurated, fine to coarse grained, thickly bedded, intensely to moderately fractured with slightly rough, clean to very thinly coated surfaces -4mm to 6mm thick calcite/quartz healed fractures dipping 30 to 40 degrees, at 27.0m	VII
-39	29		-very intensely to intensely fractured zone with clean to very thinly calcite/quartz coated slightly rough surfaces, 27.1m to 27.3m -30mm thick, very intensely fractured zone, at 27.4m -intensely fractured zone, with slightly rough, calcite/quartz coated surfaces, dipping 55 to 60 degrees, 28.1m to 28.5m -60mm thick, siltstone interbed, at 29.3m	
-40	30	100-99	-numerous, very thin calcite/quartz healed fractures, dipping 20 to 35 degrees, at 29.4m -medium to coarse grained sandstone, 29.6m to 29.7m -bedding dipping 35 degrees, at 29.7m	
-41	31		-60mm thick, siltstone interbed, at 30.6m	
-42	32		-moderately fractured with moderately spaced, slightly rough, calcite/quartz coated surfaces dipping 25 to 55 degrees, at 31.6m -numerous, closely spaced, very thin, calcite/quartz healed fractures, at 31.8m -sandstone with interbedded siltstone, 31.9m to 38.6m	
-43	33	96-47	-50mm thick, laminated to very thinly bedded, siltstone interbed, dipping 30 degrees, at 31.9m -90mm thick, laminated to very thinly bedded, siltstone interbed, dipping 30 degrees, at 32.1m -60mm thick, very intensely fractured zone, with moderately rough, calcite/quartz filled fractures, at 33.0m -very intensely fractured zone with moderately rough, calcite/quartz filled fractures, 33.3m to 33.5m	
-44	34		-very intensely fractured zone with numerous, closely spaced, healed, 8mm thick, calcite filled fractures, 33.9m to 34.2m	
-45	35	100-20	-siltstone clasts up to 10mm in diameter, at 34.5m	
-46	36		-10mm thick, very intensely fractured zone, at 36.2m	
-47	37	100-65	-very thickly bedded to massive and moderately to slightly fractured, at 36.9m	
-48	38			
-49	39		-dark gray, hard, intensely to very intensely fractured, siltstone interbed with numerous, healed, 3mm thick, calcite filled fractures, 38.7m to 39.0m	
-50		100-87	-siltstone inclusions up to 10mm in diameter, at 39.3m	



LOG OF BORING AND TEST RESULTS

BORING 98-21

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

PLATE 98-21.6b

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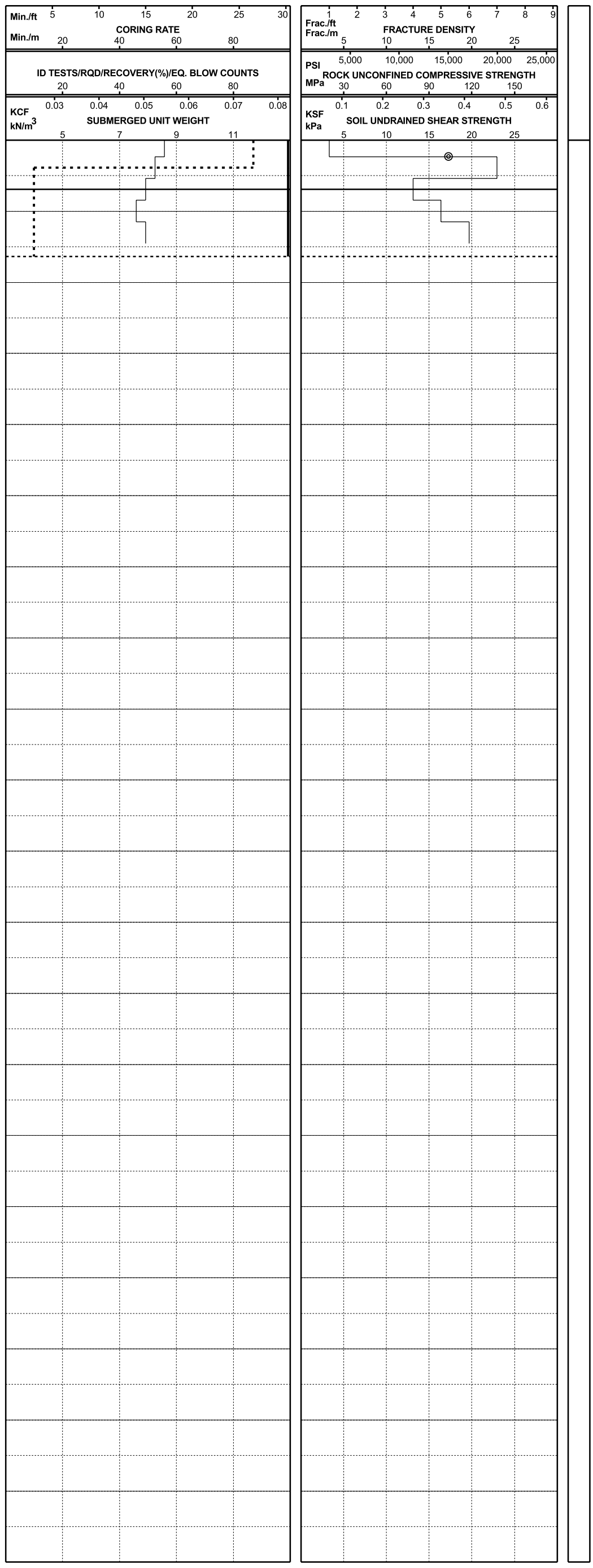
PROJECT NO:	98-42-0054	**START DATE:**	10/18/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-21 (Main Span - Pylon)	**COMPLETION DATE:**	10/20/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836360 N647585
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -10.3m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
				100-87	SANDSTONE (Graywacke) (Rx), medium dark gray, fresh, hard (40.7m)	VII
-51	41			100-10	SILTSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) [3:1] -dark gray, hard, well indurated, thinly to moderately bedded, intensely fractured, with clean, smooth to slightly rough bedding/fracture plane surfaces -sandstone below 41.5m	VIII
-52	42				TOTAL DEPTH: 41.6m BACKFILLED WITH: Cement Grout	
-53	43					
-54	44					
-55	45					
-56	46					
-57	47					
-58	48					
-59	49					
-60	50					
-61	51					
-62	52					
-63	53					
-64	54					
-65	55					
-66	56					
-67	57					
-68	58					
-69	59					
-70						



LOG OF BORING AND TEST RESULTS

BORING 98-21

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

PLATE 98-21.6c

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NO MULTI-PAGE BORING LOGS WITH CPT DATA FOR THIS BORING

**NO LOG OF NEAR-SURFACE MATERIALS
FOR THIS BORING**

NO HALIBUT OR DOWNHOLE VANE TESTS PERFORMED FOR THIS BORING

98-21		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
0.2	1																									
0.3	2					4.4																				
0.5	3					3.9																				
0.6	4	94	77	28	1.36							1.7														
1.2	5					4.8																				
1.4	6	84	76	27	1.16	4.8					3.2	1.8														
2.1	8					4.5																				
2.3	9	42	70	31	0.28	4.6					3.3	2.2														
3.0	11	60	71	30	0.73	4.7					1.9	1.3														
3.2	12					5.2																				
3.8	13	83	75	29	1.18																					
8.8																									72.9	
10.1																									91.1	
10.7																									54.7	
11.3																									38.0	

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
c = Effective Cohesion
phi = Effective Angle of Friction

Compaction Tests
Max DD = Max. Dry Unit Wt.
OMC = Optimum Moisture Content

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 98-21
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-21		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
11.9																									66.8	
12.8																									15.2	
13.7	20														6.7	24	13.9	24								
14.0																									36.4	
14.6																									24.3	
15.2																									15.2	
15.5																									97.2	
15.8																									39.5	
16.5																									24.3	
16.8																									36.4	
18.1																									45.6	
18.3																									42.5	
18.9																									176.2	
19.5																									66.8	
20.7																									56.2	

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

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

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

Compaction Tests
Max DD = Max. Dry Unit Wt.
OMC = Optimum Moisture Content

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 98-21
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-21		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
21.9																									109.3	
22.1																					78.8	47.9	26.3	0.27		
23.2																									27.3	
24.1																									27.3	
25.1																									54.7	
25.3																					26.1	28.8	26.5	0.35		
25.9																									12.1	
26.2																									54.7	
27.4																									75.9	
28.0																									54.7	
28.7																									42.5	
29.6																					36.1	44.2	26.4	0.29	60.7	
29.9	31														42.1	33	24.9	32								
30.2																									133.6	
31.7																									100.2	

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

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

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

Compaction Tests
Max DD = Max. Dry Unit Wt.
OMC = Optimum Moisture Content

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 98-21
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-21		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
32.3																									148.8	
32.5																					60.4	50.0	26.3	0.22		
32.9																									42.5	
34.7																									136.5	
36.0																									112.4	
36.6																									151.9	
37.3																					81.3	44.7	26.5	0.32		
37.6	34														48.8	37	29.2	38								
38.4																									60.7	
39.0																									100.2	
39.6																					93.6	53.8	26.5	0.32	267.3	
40.2																									103.3	
40.5	36														53.6	29	20.1	25								
41.3	36														7.7	27	28.2	24								

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
c = Effective Cohesion
phi = Effective Angle of Friction

Compaction Tests
Max DD = Max. Dry Unit Wt.
OMC = Optimum Moisture Content

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

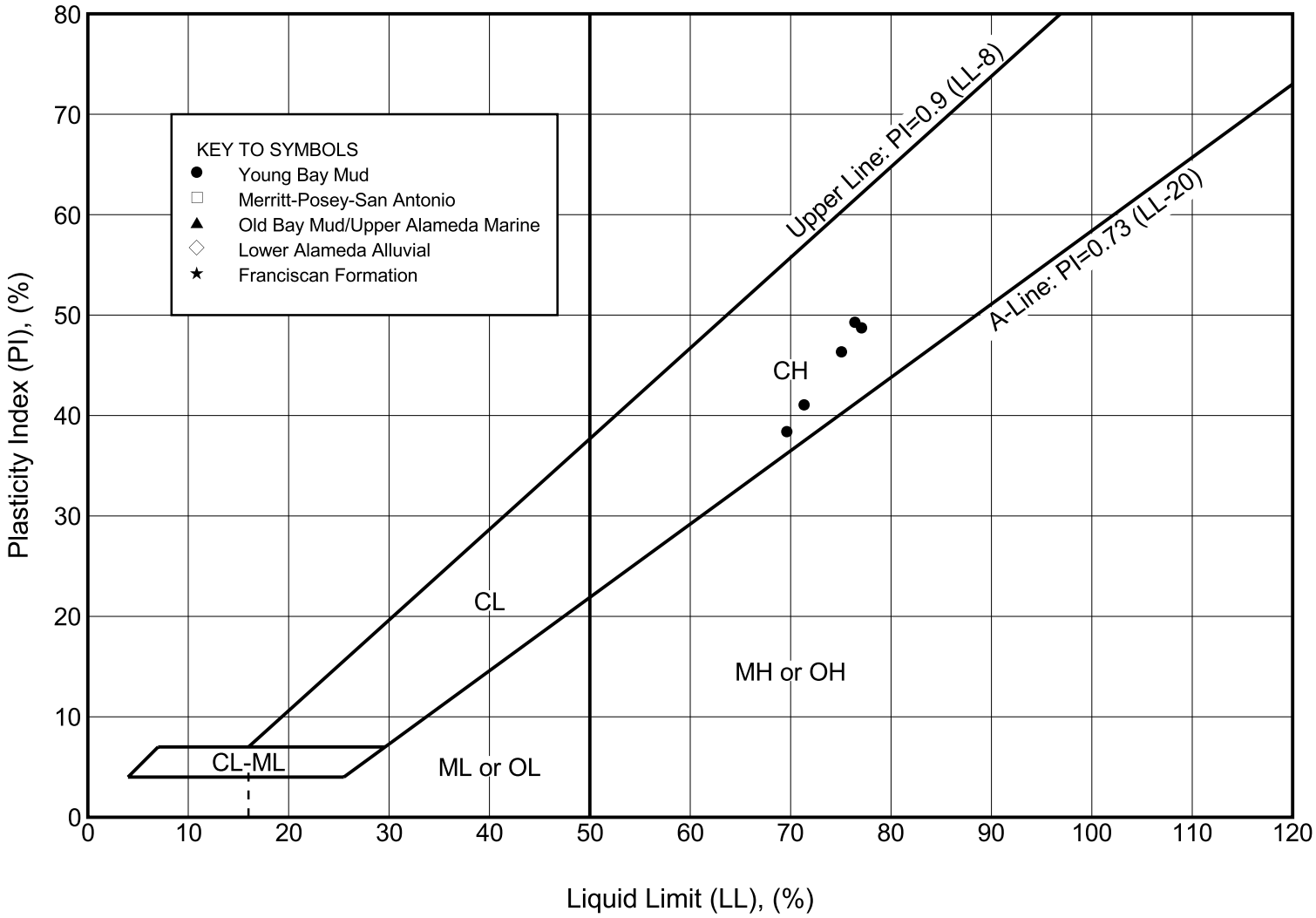
Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-21
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

**NO GRAIN SIZE DISTRIBUTION CURVES
FOR THIS BORING**



PLASTICITY CHART
Boring 98-21
SFOBB East Span Seismic Safety Project

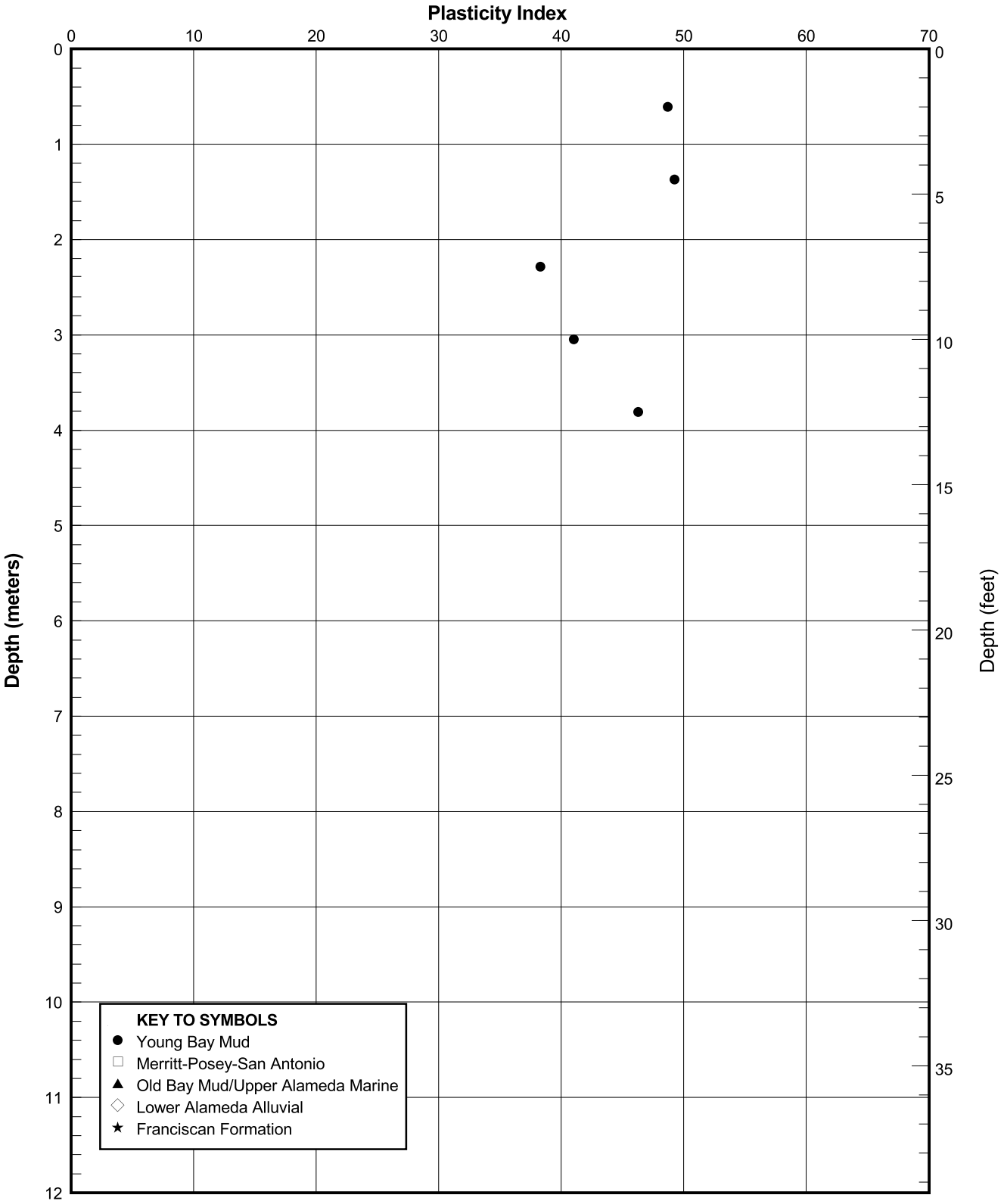
Earth Mechanics
FUGRO

NO STRESS-STRAIN CURVES FOR THIS BORING

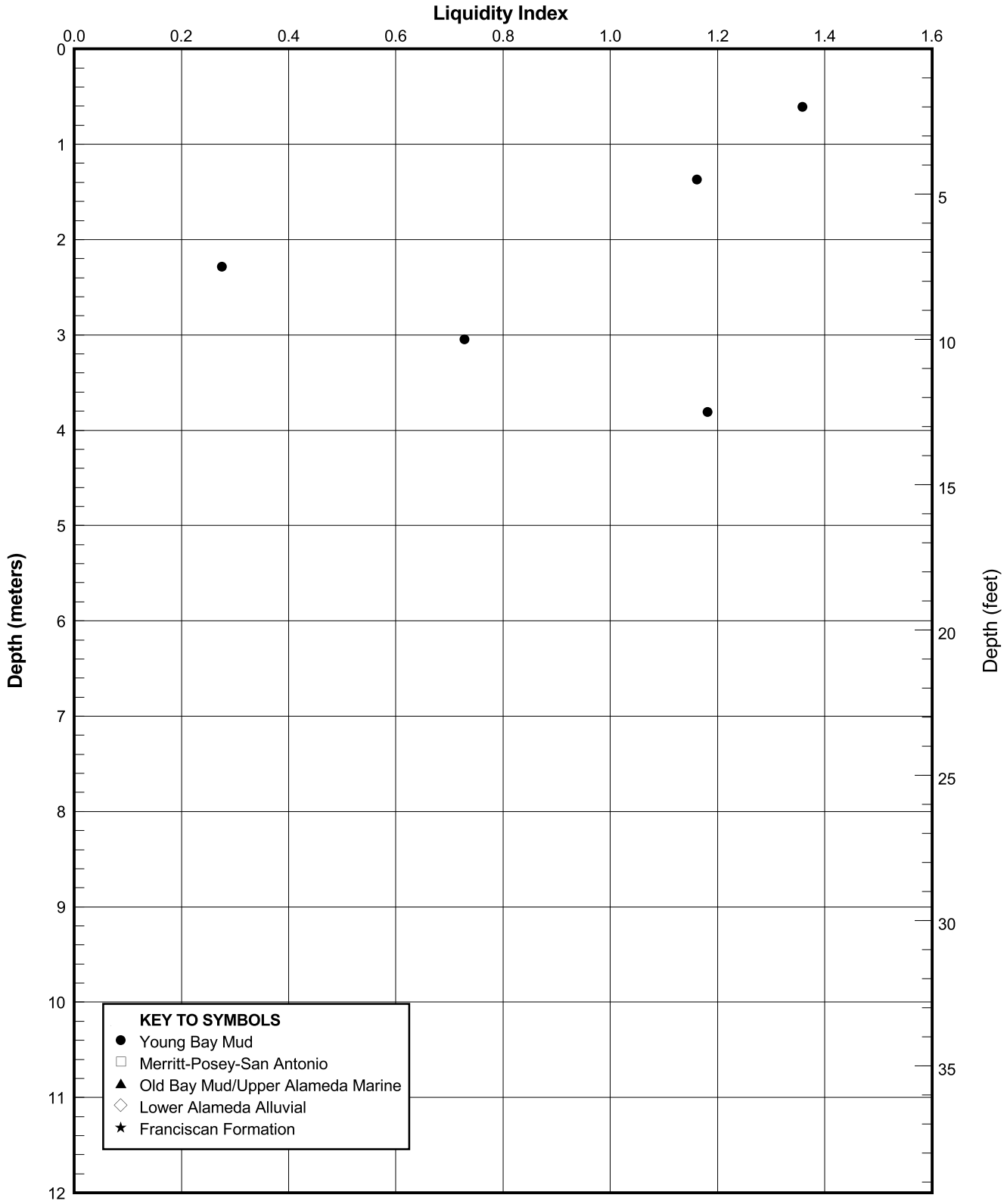
NO CRS OR INCREMENTAL CONSOLIDATION TESTS PERFORMED FOR THIS BORING

NO K_O CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TESTS PERFORMED FOR THIS BORING

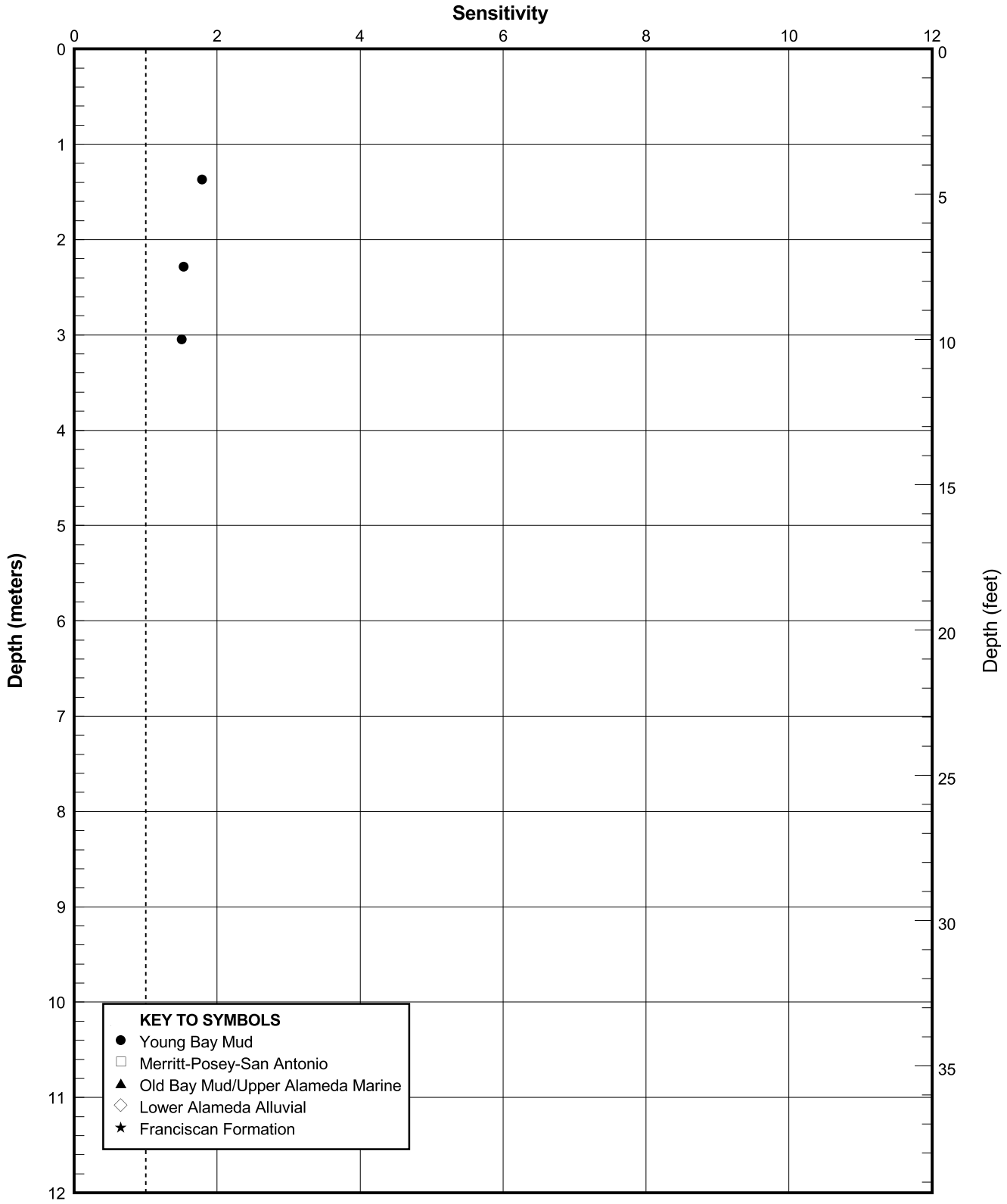
NO ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TESTS PERFORMED FOR THIS BORING



PLASTICITY INDEX PROFILE
Boring 98-21
SFOBB East Span Seismic Safety Project



LIQUIDITY INDEX PROFILE
Boring 98-21
SFOBB East Span Seismic Safety Project



SENSITIVITY PROFILE
Boring 98-21
SFOBB East Span Seismic Safety Project

NO E50 PROFILE FOR THIS BORING

NO PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA FOR THIS BORING

NO RELATIVE DENSITY INTERPRETED FROM CPT DATA FOR THIS BORING

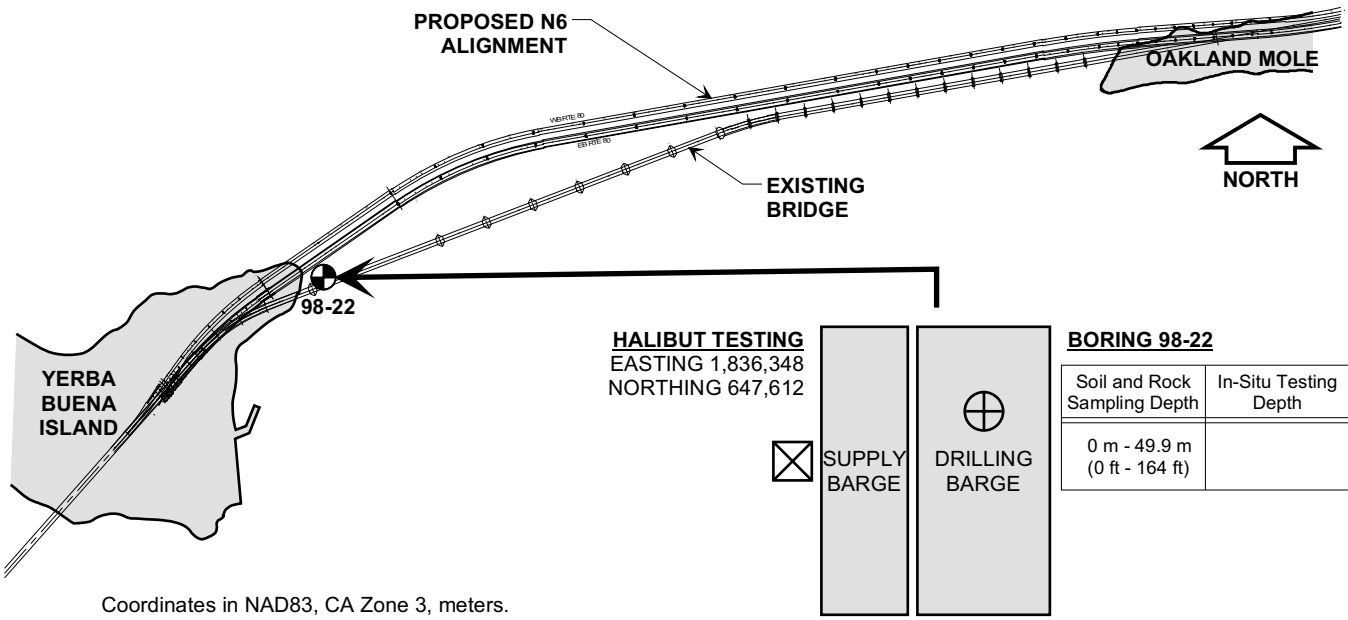
BORING 98-22

Date	Time From	Time To	Description of Activity
October 11, 1998	0300	0400	Position barge at location 98-22.
	0400	0520	Rig up for drilling. Lower drill pipe to mudline.
	0520	0530	Measure water depth of 13.1m (43 ft) using bottom sensor. Current tide level is approximately +0.6m (+2 ft) MSL. Calculate mudline elevation of –12.5m (-41 ft) MSL.
	0530	0900	Drill and sample from mudline to 6.7m (22 ft).
	0900	1445	Pull pipe to deck and set casing.
	****	****	
	1220	1500	Rig up for Halibut testing.
	****	****	
	1445	1545	Lower drill pipe to mudline.
	****	****	
	1500	1530	Halibut testing at 0.6m (2 ft).
	****	****	
	1545	1700	Rig repair, change kelly packing.
	****	****	
	1530	1630	Halibut basket sinks below mudline. No data. Remove 300 pounds of weight from Halibut basket.
	1630	1915	Halibut vane shear testing from 0.6m (2 ft) to 3m (10 ft).
	****	****	
	1700	1815	Drill from mudline to 7.6m (25 ft).
	1815	2030	Set drill pipe at 7.6m (25 ft). Lower core pipe to 7.1m (23.3 ft). Coring from 7.1m (23.3 ft) to 8.6m (28.3 ft). Pull core pipe to deck.
	2030	2215	Advance drill pipe to 9.1m (30 ft).
	2215	2400	Set drill pipe at 9.1m (30 ft). Lower core pipe to 8.8m (28.7 ft). Rock coring from 8.8m (28.7 ft) to 10.4m (34 ft).
October 12, 1998	0000	2400	Rock coring from 10.4m (34 ft) to 32.9m (108 ft).
October 13, 1998	0000	1700	Rock coring from 32.9m (108 ft) to 50m (164 ft).
	1700	1800	Pull core pipe to 12.9m (42.3 ft).
	1800	1900	P- and S-wave velocity logging from 50m (164 ft) to 16.5m (54 ft).
	1900	1930	Caliper logging from 50m (164 ft) to 12.9m (42.3 ft).
	1930	2030	Acoustic televiewer logging from 50m (164 ft) to 12.9m (42.3 ft).
	2030	2100	Pull core pipe to deck.
	2100	2115	Acoustic televiewer logging from 24.4m (80 ft) to 9.1m (30 ft).
	2115	2130	Caliper logging from 50m (164 ft) to 9.1m (30 ft).

SUMMARY OF FIELD OPERATIONS
Boring 98-22
SFOBB East Span Seismic Safety Project

Date	Time From	Time To	Description of Activity
	2130	2215	P- and S-wave velocity logging from 16.5m (54 ft) to 9.1m (30 ft).
	2215	2330	Lower N-rod. Mix and circulate cement. Grout hole 98-22. Pull N-rod to deck.
	2330	2400	Pull drill pipe to deck.
October 14, 1998	0000	0145	Pull casing to deck.
	0145	0330	Pull two anchors and move barge to location 98-23.

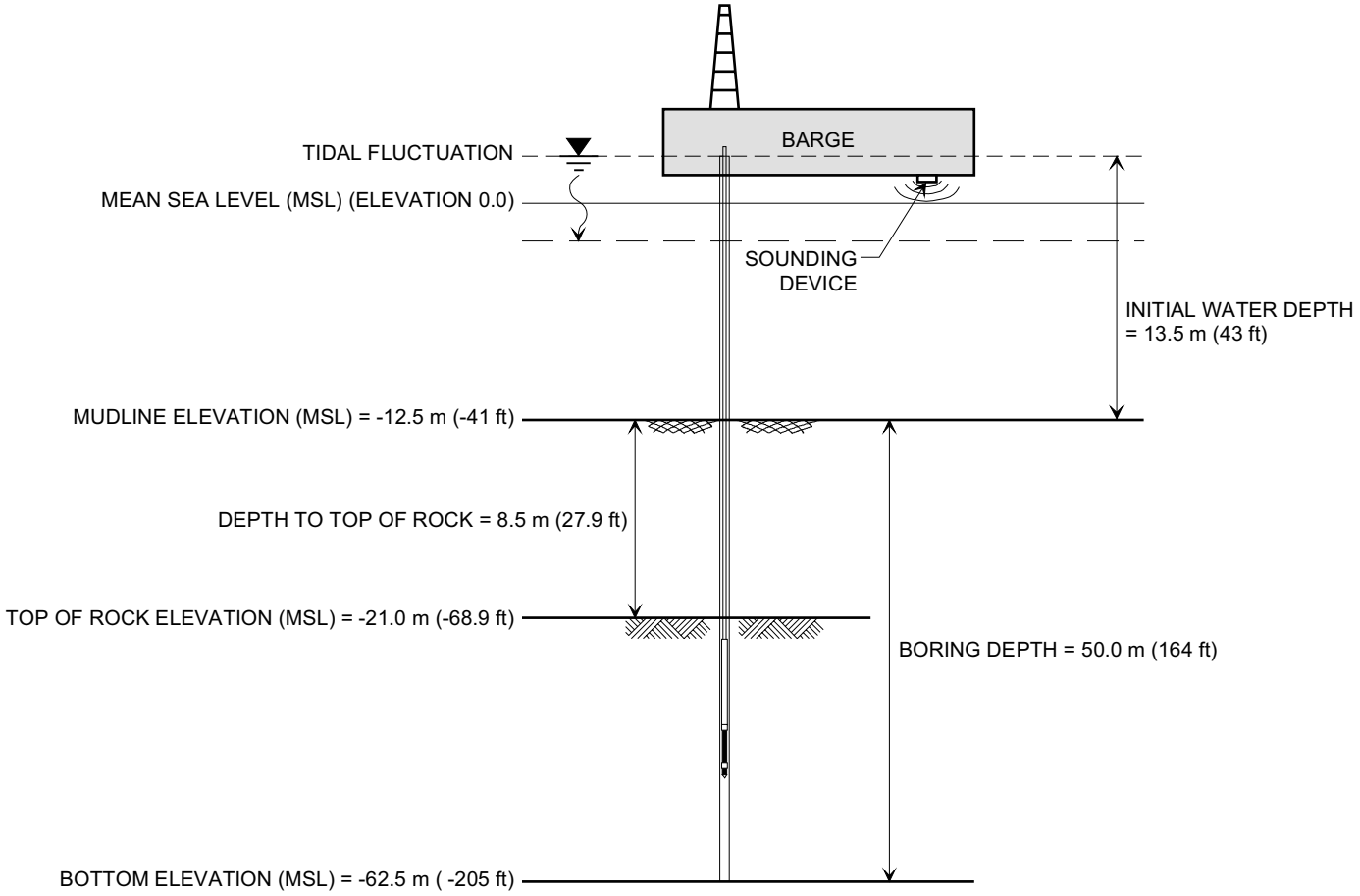
SUMMARY OF FIELD OPERATIONS
Boring 98-22
SFOBB East Span Seismic Safety Project



BORING 98-22

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 49.9 m (0 ft - 164 ft)		E = 1,836,363 N = 647,614

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-22
SFOBB East Span Seismic Safety Project

PLATE 98-22.2

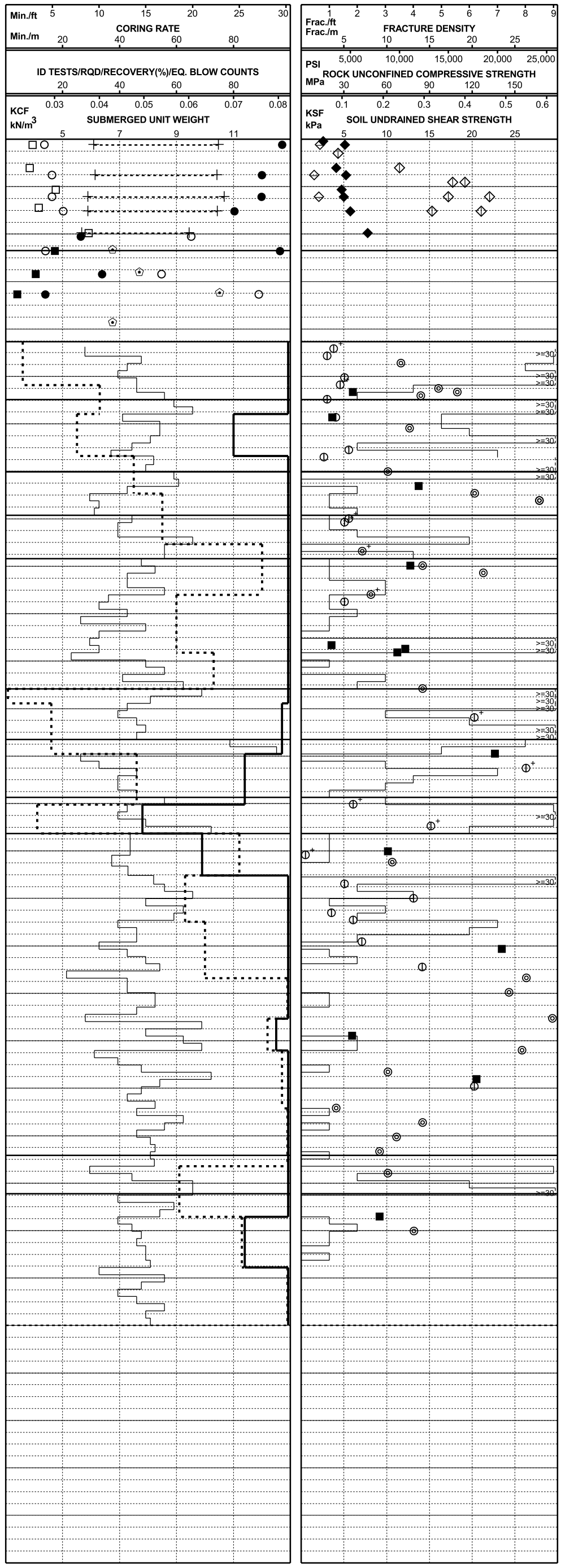
PROJECT NO:	98-42-0054	**START DATE:**	10/11/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-22 (Main Span - Pylon)	**COMPLETION DATE:**	10/14/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836363 N647614
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.5m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Fat CLAY (CH), olive gray to gray, very soft to soft See Plate 98-22.6 for detailed stratigraphy (4.7m)	I
ROCK FRAGMENTS with sand and fat clay, light brown (8.5m)	II
SANDSTONE (Graywacke) (Rx), light yellowish brown, intensely weathered, moderately soft to moderately hard, intensely fractured (11.0m)	III
SILTSTONE (Rx) with interbedded SANDSTONE (Rx) [4:1], moderately weathered -sandstone, 12.8m to 13.7m (14.0m)	IV
SANDSTONE (Graywacke) (Rx), medium dark gray, slightly weathered to fresh, hard, thickly bedded, slightly fractured (15.8m)	V
SILTSTONE (Rx) with interbedded CLAYSTONE (Rx) and SANDSTONE (Graywacke) (Rx) [2:1:1], slightly weathered to fresh (17.7m) -light gray sandstone bed, dipping 35 degrees, 16.8m to 17.1m	VI
SANDSTONE (Graywacke) (Rx) with minor thinly interbedded SILTSTONE (Rx) [10:1] (23.2m)	VII
SILTSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) [2:1], fresh (25.3m)	VIII
SANDSTONE (Graywacke) (Rx) fresh -siltstone, dark gray, hard, very thinly to thinly bedded, moderately to intensely fractured, 26.7m to 27.0m (27.7m)	IX
CLAYSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) [2:1] (29.3m)	X
SANDSTONE (Graywacke) (Rx) with minor thinly interbedded SILTSTONE (Rx) [10:1] -interbedded sandstone and siltstone, 31.1m to 31.5m -siltstone, 33.8m to 34.0m -interbedded sandstone and siltstone, 34.6m to 35.2m -interbedded sandstone and siltstone, 36.1m to 36.4m -siltstone, 37.8m to 38.1m -dark gray siltstone, 39.3m to 39.6m -dark gray siltstone 40.7m to 40.8m -undulating siltstone bed dipping 30 degrees, at 41.1m (42.8m)	XI
SANDSTONE (Graywacke) (Rx) interbedded with SILTSTONE (Rx) [2:1] (44.4m)	XII
SANDSTONE (Graywacke) (Rx) with minor thinly bedded SILTSTONE (Rx) [10:1] -siltstone dipping 32 degrees, 45.7m to 46.0m	XIII

TOTAL DEPTH: 50.0m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-22

SFOBB East Span Seismic Safety Project

Report Date: 05/10/99

PLATE 98-22.3

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NO SINGLE-PAGE BORING LOGS WITH CPT DATA FOR THIS BORING

PROJECT NO:	98-42-0054	**START DATE:**	10/11/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-22 (Main Span - Pylon)	**COMPLETION DATE:**	10/14/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

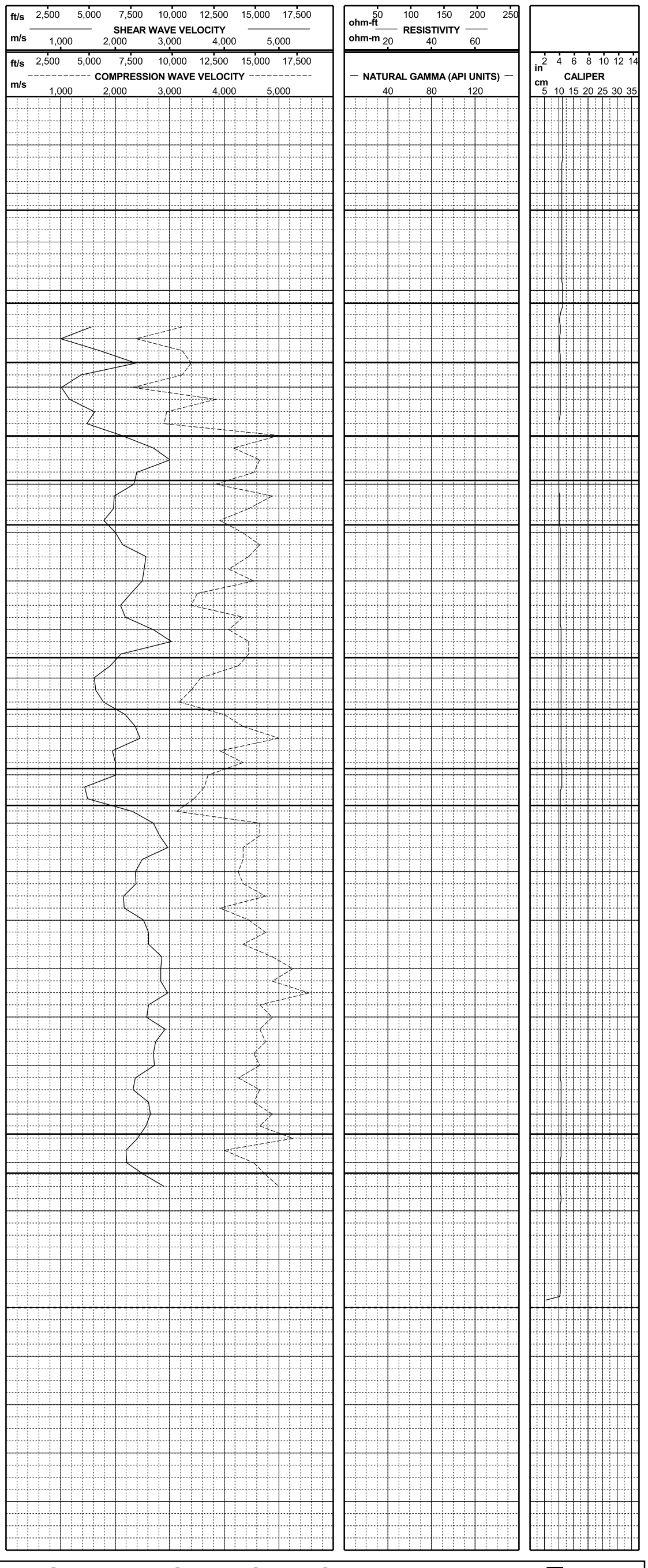
Coordinates: E1836363 N647614
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.5m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH, WOH, WOH, WOH, WOH	Fat CLAY (CH), olive gray to gray, very soft to soft See Plate 98-22.6 for detailed stratigraphy (4.7m)	I
		30/15cm, 50/20cm, 50/15cm, 30/15cm	ROCK FRAGMENTS with sand and fat clay, light brown (8.5m)	II
		100-6	SANDSTONE (Graywacke) (Rx), light yellowish brown, intensely weathered, moderately soft to moderately hard, intensely fractured (11.0m)	III
		100-33, 80-25	SILTSTONE (Rx) with interbedded SANDSTONE (Rx) [4:1], moderately weathered -sandstone, 12.8m to 13.7m (14.0m)	IV
		100-45	SANDSTONE (Graywacke) (Rx), medium dark gray, slightly weathered to fresh, hard, thickly bedded, slightly fractured (15.8m)	V
		100-55	SILTSTONE (Rx) with interbedded CLAYSTONE (Rx) and SANDSTONE (Graywacke) (Rx) [2:1:1], slightly weathered to fresh (17.7m)	VI
		100-90, 100-60, 100-73	-light gray sandstone bed, dipping 35 degrees, 16.8m to 17.1m SANDSTONE (Graywacke) (Rx) with minor thinly interbedded SILTSTONE (Rx) [10:1] (23.2m)	VII
		100-0, 97-16	SILTSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) [2:1], fresh (25.3m)	VIII
		84-46	SANDSTONE (Graywacke) (Rx) fresh -siltstone, dark gray, hard, very thinly to thinly bedded, moderately to intensely fractured, 26.7m to 27.0m (27.7m)	IX
		48-11	CLAYSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) [2:1] (29.3m)	X
		69-82, 100-63, 100-70, 100-99, 95-92, 100-97, 100-99	SANDSTONE (Graywacke) (Rx) with minor thinly interbedded SILTSTONE (Rx) [10:1] -interbedded sandstone and siltstone, 31.1m to 31.5m -siltstone, 33.8m to 34.0m -interbedded sandstone and siltstone, 34.6m to 35.2m -interbedded sandstone and siltstone, 36.1m to 36.4m -siltstone, 37.8m to 38.1m -dark gray siltstone, 39.3m to 39.6m -dark gray siltstone 40.7m to 40.8m -undulating siltstone bed dipping 30 degrees, at 41.1m (42.8m)	XI
		100-61	SANDSTONE (Graywacke) (Rx) interbedded with SILTSTONE (Rx) [2:1] (44.4m)	XII
		84-83, 100-99	SANDSTONE (Graywacke) (Rx) with minor thinly bedded SILTSTONE (Rx) [10:1] -siltstone dipping 32 degrees, 45.7m to 46.0m	XIII

TOTAL DEPTH: 50.0m

BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-22

SFOBB East Span Seismic Safety Project

Report Date: 05/10/99

PLATE 98-22.5

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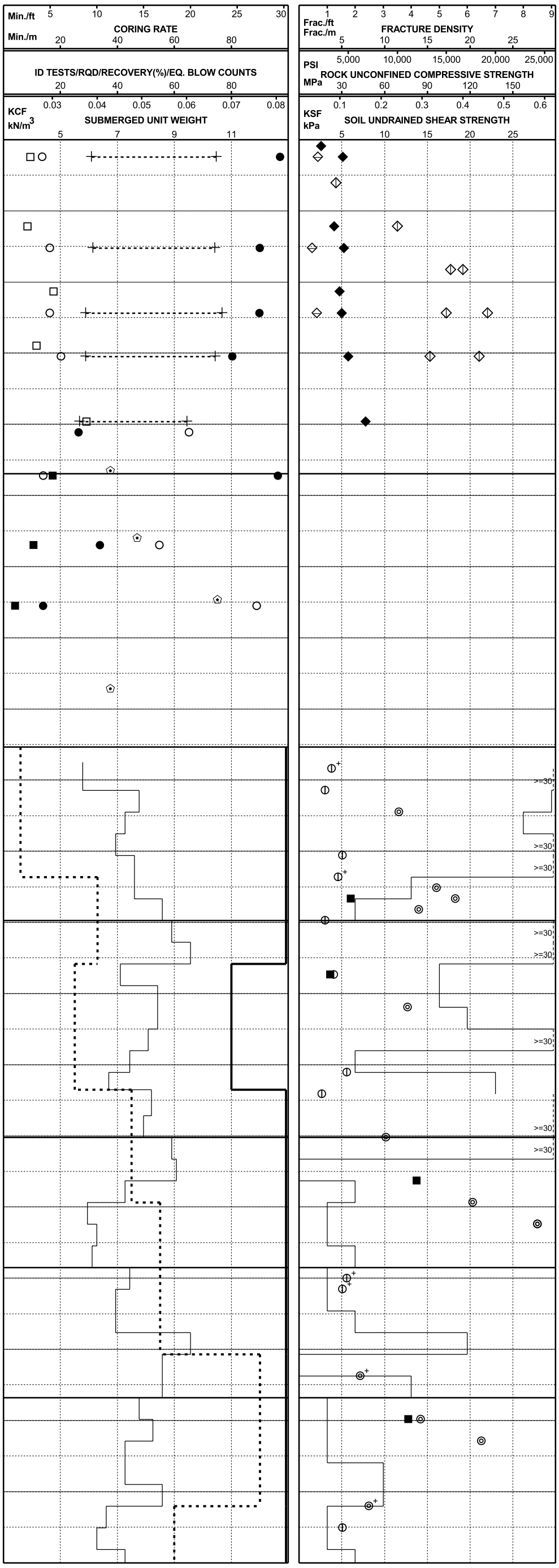
PROJECT NO:	98-42-0054	**START DATE:**	10/11/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-22 (Main Span - Pylon)	**COMPLETION DATE:**	10/14/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836363 N647614
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.5m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), olive gray to gray, very soft to soft -with worm holes, roots, and black streaks, at 0.3m	I
-13	1	WOH	-with a few shell fragments at 1.2m	
-14	2	WOH	-with silt pockets at 2.1m -with black streaks at 2.2m	
-15	3	WOH		
-16	4	WOH	-with a silty sand layer at 4.1m	
-17		30/15cm	(4.7m)	
-18	5	50/20cm	ROCK FRAGMENTS with sand and fat clay, light brown -subangular gravel to cobble size sandstone rock fragments, origin uncertain, possibly intensely weathered rock	II
-19	6	50/15cm	-gravel and cobbles with clay, below 6.4m	
-20	7	30/15cm		
-21	8		(8.5m)	
-22	9	100-6	SANDSTONE (Graywacke) (Rx), light yellowish brown, intensely weathered, moderately soft to moderately hard, intensely fractured -fractures: slightly to moderately rough, dipping 20 to 40, and 70 degrees, dark brown staining on surfaces, minor light brown, very thin, clay infilling	III
-23	10			
	11	100-33	(11.0m)	
-24	12		SILTSTONE (Rx) with interbedded SANDSTONE (Rx) [4:1], moderately weathered -siltstone to sandy siltstone: dark gray, moderately hard, thinly bedded, moderately to intensely fractured -sandstone: medium gray with thinly interbedded siltstone, intensely fractured -fractures: dipping 20 to 30 degrees (along bedding), moderately rough, with thin, iron oxide staining	IV
-25		80-25	-sandstone, 12.8m to 13.7m	
-26	13			
	14		(14.0m)	
-27	15	100-45	SANDSTONE (Graywacke) (Rx), medium dark gray, slightly weathered to fresh, hard, thickly bedded, slightly fractured -fractures: dipping 20 to 30 degrees, slightly rough, with thin dark yellowish orange, iron oxide staining	V
-28			(15.8m)	
-29	16	100-55	SILTSTONE (Rx) with interbedded CLAYSTONE (Rx) and SANDSTONE (Graywacke) (Rx) [2:1:1], slightly weathered to fresh -siltstone and claystone: dark gray, moderately hard, intensely fractured, thinly to very thinly bedded -sandstone: medium dark gray, hard, slightly fractured, thinly bedded -light gray sandstone bed, dipping 35 degrees, 16.8m to 17.1m	VI
-30	17		(17.7m)	
-31	18	100-90	SANDSTONE (Graywacke) (Rx) with minor thinly interbedded SILTSTONE (Rx) [10:1] -sandstone: medium gray, fresh, hard, thinly to thickly bedded, slightly to moderately fractured -siltstone: medium dark gray, fresh, moderately hard to hard, intensely fractured -fractures: dipping 30 to 40 degrees (along bedding), 10 to 20 degrees, slightly to moderately rough, thin to very thin calcite/quartz filling	VII
-32	19	100-60	-25mm thick, siltstone interbed at 19.5m	



LOG OF BORING AND TEST RESULTS

BORING 98-22

SFOBB East Span Seismic Safety Project

Report Date: 05/10/99

PLATE 98-22.6a

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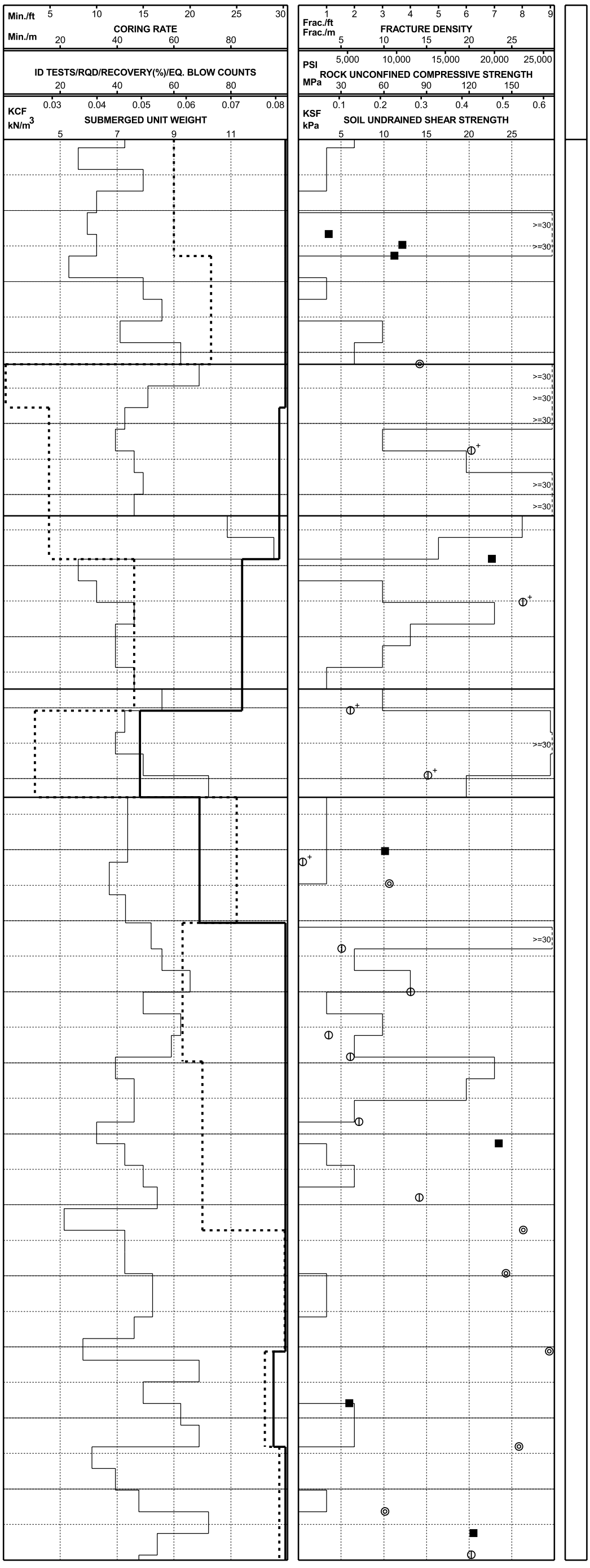
PROJECT NO:	98-42-0054	**START DATE:**	10/11/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-22 (Main Span - Pylon)	**COMPLETION DATE:**	10/14/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836363 N647614
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.5m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-33	21	100-60	SANDSTONE (Graywacke) (Rx) with minor thinly interbedded SILTSTONE (Rx) [10:1] -50mm thick, siltstone interbed, dipping 40 degrees, at 21.3m	VII
-34	22			
-35	23	100-73	(23.2m)	
-36	24	100-0	SILTSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) [2:1], fresh -siltstone: medium dark gray, moderately hard to hard, intensely fractured -sandstone: medium gray, hard, thickly bedded, slightly to moderately rough fractures -fractures: dipping 10 to 20 degrees, with slightly to moderately rough surfaces, thin to very thin calcite/quartz filling -bedding dipping 30 to 40 degrees, at 24.1m	VIII
-37	25	97-16	(25.3m)	
-38	26		SANDSTONE (Graywacke) (Rx) fresh -sandstone: medium dark gray, hard, fine grained, moderately fractured, thickly bedded	IX
-39	27	84-46	-siltstone, dark gray, hard, very thinly to thinly bedded, moderately to intensely fractured, 26.7m to 27.0m	
-40			(27.7m)	
-41	28	48-11	CLAYSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) [2:1] -claystone: dark gray to black, fresh, hard, thinly bedded, slightly to intensely fractured, with smooth, polished, bedding plane surfaces, dipping 30 to 35 degrees -sandstone: medium dark gray, hard, fine grained, moderately fractured, with soft sediment deformation	X
	29		(29.3m)	
-42	30	69-82	SANDSTONE (Graywacke) (Rx) with minor thinly interbedded SILTSTONE (Rx) [10:1] -sandstone: medium gray, fresh, hard to very hard, thickly bedded to massive, slightly to very slightly fractured -siltstone: medium dark gray, fresh, hard, slightly to intensely fractured, with smooth, polished bedding plane surfaces, dipping 20 degrees -fractures: dipping 10 to 30 degrees, slightly to moderately rough, generally 0.3m spacing, with thin, discontinuous calcite/quartz filling	XI
-43	31		-interbedded sandstone and siltstone, 31.1m to 31.5m	
-44	32	100-63		
-45	33		-intensely fractured zone, 32.9m to 33.5m	
-46	34	100-70	-siltstone, 33.8m to 34.0m	
-47	35		-interbedded sandstone and siltstone, 34.6m to 35.2m -very hard, moderately fractured, with few very thin, closed, healed, calcite/quartz filled fractures, dipping 60 to 80 degrees, below 35.4m	
-48	36	100-99	-interbedded sandstone and siltstone, 36.1m to 36.4m	
-49	37			
-50	38	95-92	-siltstone, 37.8m to 38.1m	
-51	39	100-97	-dark gray siltstone, 39.3m to 39.6m	
-52				



LOG OF BORING AND TEST RESULTS

BORING 98-22

SFOBB East Span Seismic Safety Project

Report Date: 05/10/99

PLATE 98-22.6b

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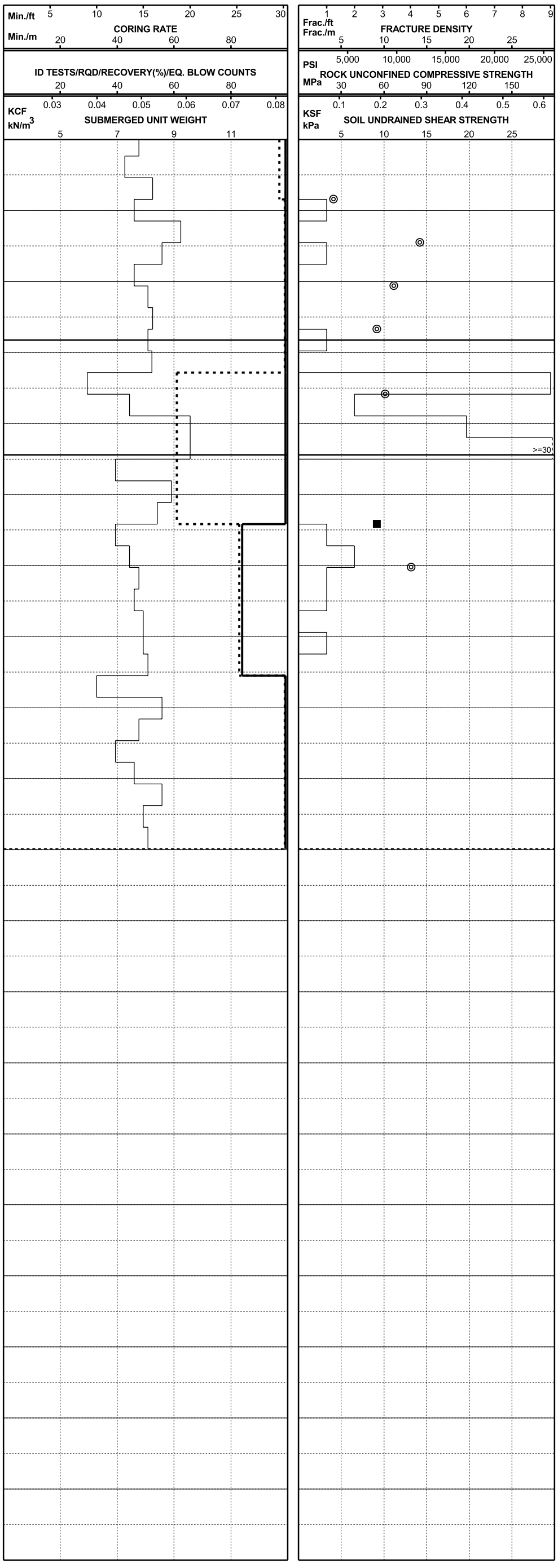
PROJECT NO:	98-42-0054	**START DATE:**	10/11/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-22 (Main Span - Pylon)	**COMPLETION DATE:**	10/14/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836363 N647614
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.5m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-53	41	100-97	SANDSTONE (Graywacke) (Rx) with minor thinly interbedded SILTSTONE (Rx) [10:1] -dark gray siltstone 40.7m to 40.8m -undulating siltstone bed dipping 30 degrees, at 41.1m	XI
-54	42	100-99		
-55			(42.8m)	
-56	43		SANDSTONE (Graywacke) (Rx) interbedded with SILTSTONE (Rx) [2:1] -sandstone: medium dark gray, hard, fresh, very slightly fractured, with soft sediment deformation -siltstone: dark gray, hard, very thinly to thinly bedded, moderately to intensely fractured -horizontal siltstone bedding, at 43.6m -bedding in coarse-grained sandstone, dipping 25 degrees, at 43.9m	XII
	44	100-61	(44.4m)	
-57	45		SANDSTONE (Graywacke) (Rx) with minor thinly bedded SILTSTONE (Rx) [10:1] -intensely fractured zone, 44.4m to 44.5m -sandstone: moderate dark gray, fresh, hard, medium to coarse grained, very thickly bedded, slightly fractured -siltstone: dark gray, hard, indurated, moderately to intensely fractured, laminated to very thinly bedded -siltstone dipping 32 degrees, 45.7m to 46.0m	XIII
-58	46			
-59		84-83		
-60	47			
-61	48		-lenticular, elongate, imbricate siltstone clasts, at 47.9m -bedding dipping 30 degrees, at 48.0m	
-62	49	100-99	-bedding dipping 35 degrees, at 45.9m	
	50		TOTAL DEPTH: 50.0m BACKFILLED WITH: Cement Grout	
-63	51			
-64	52			
-65	53			
-66	54			
-67	55			
-68	56			
-69	57			
-70	58			
-71	59			
-72				



LOG OF BORING AND TEST RESULTS

BORING 98-22

SFOBB East Span Seismic Safety Project

Report Date: 05/10/99

FUGRO

PLATE 98-22.6c

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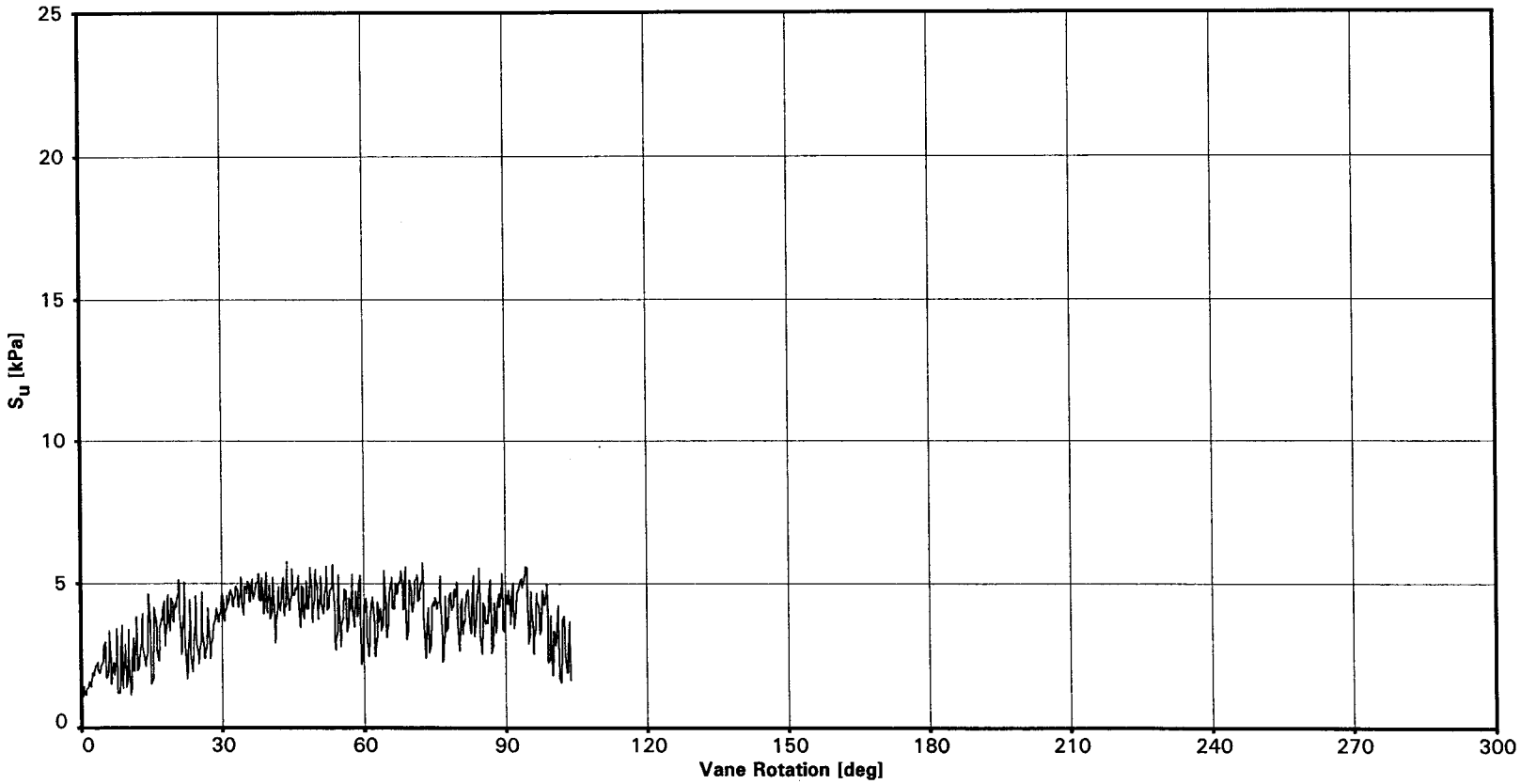
NO MULTI-PAGE BORING LOGS WITH CPT DATA FOR THIS BORING

**NO LOG OF NEAR-SURFACE MATERIALS
FOR THIS BORING**

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 98-22
SFOBB East Span Seismic Safety Project

Earth Mechanics

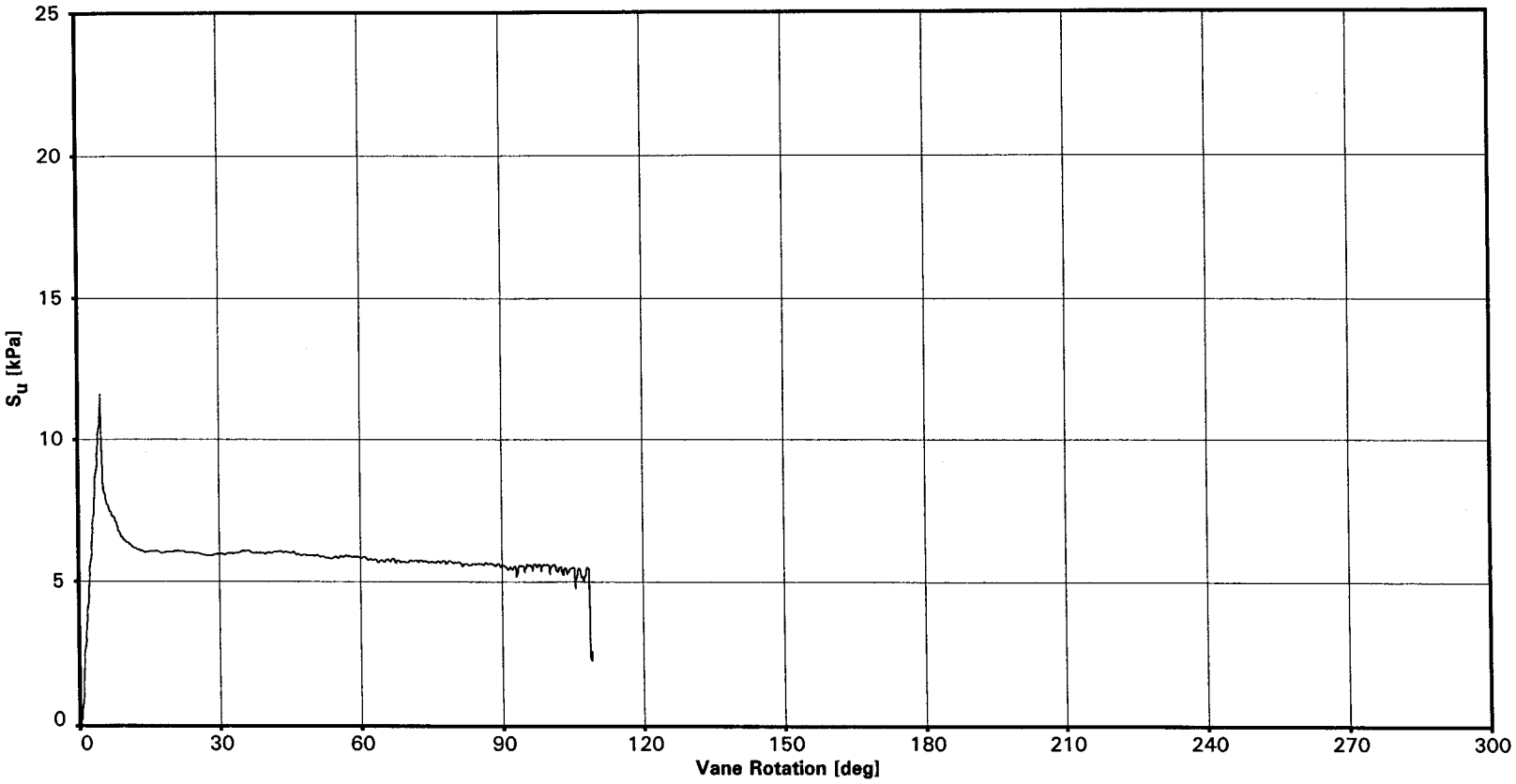
FUGRO

PLATE 98-22.9a

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 98-22
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-22.9b

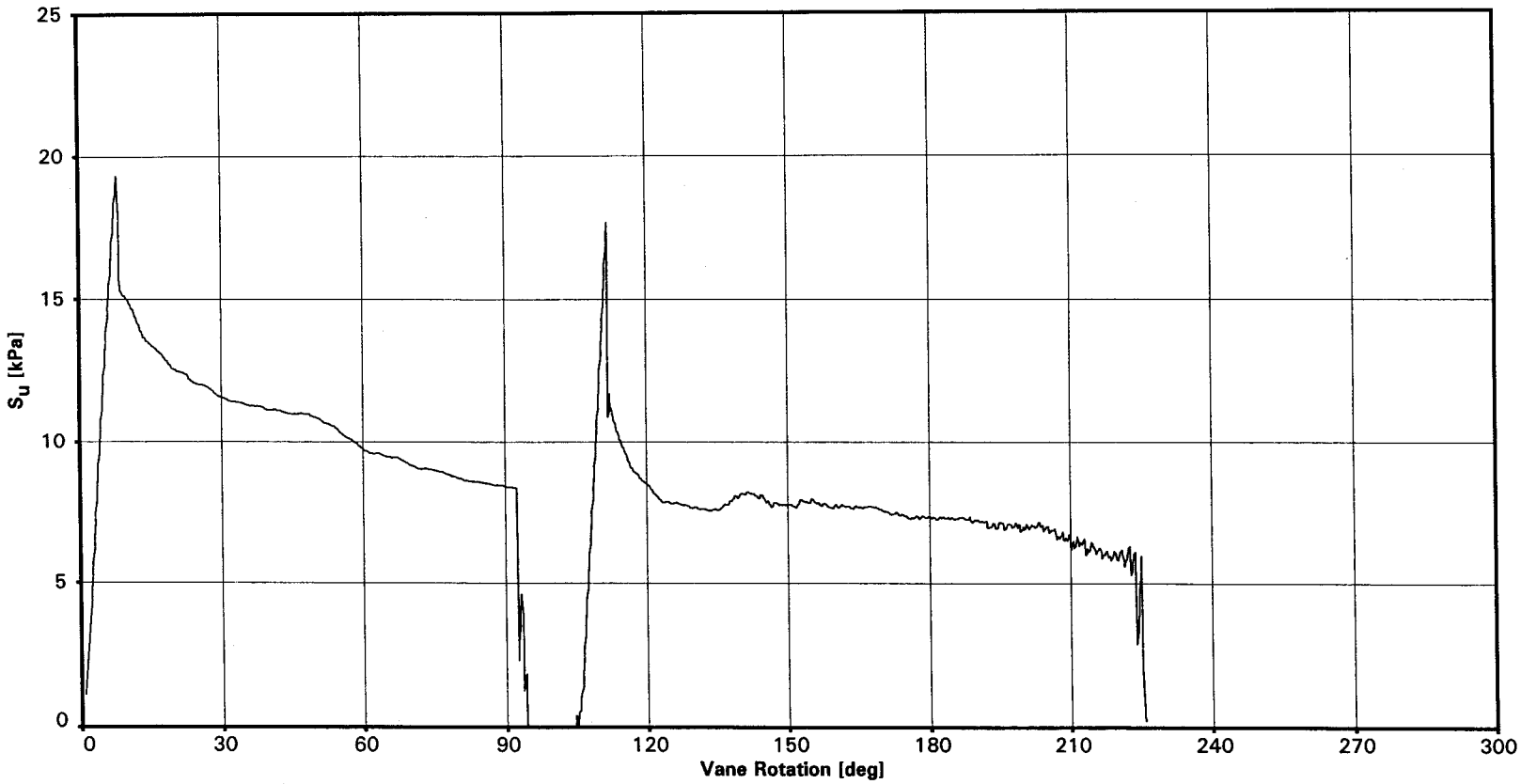
SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

Vane Size used: Dolphin Large

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 1.8m
Boring 98-22
SFOBB East Span Seismic Safety Project

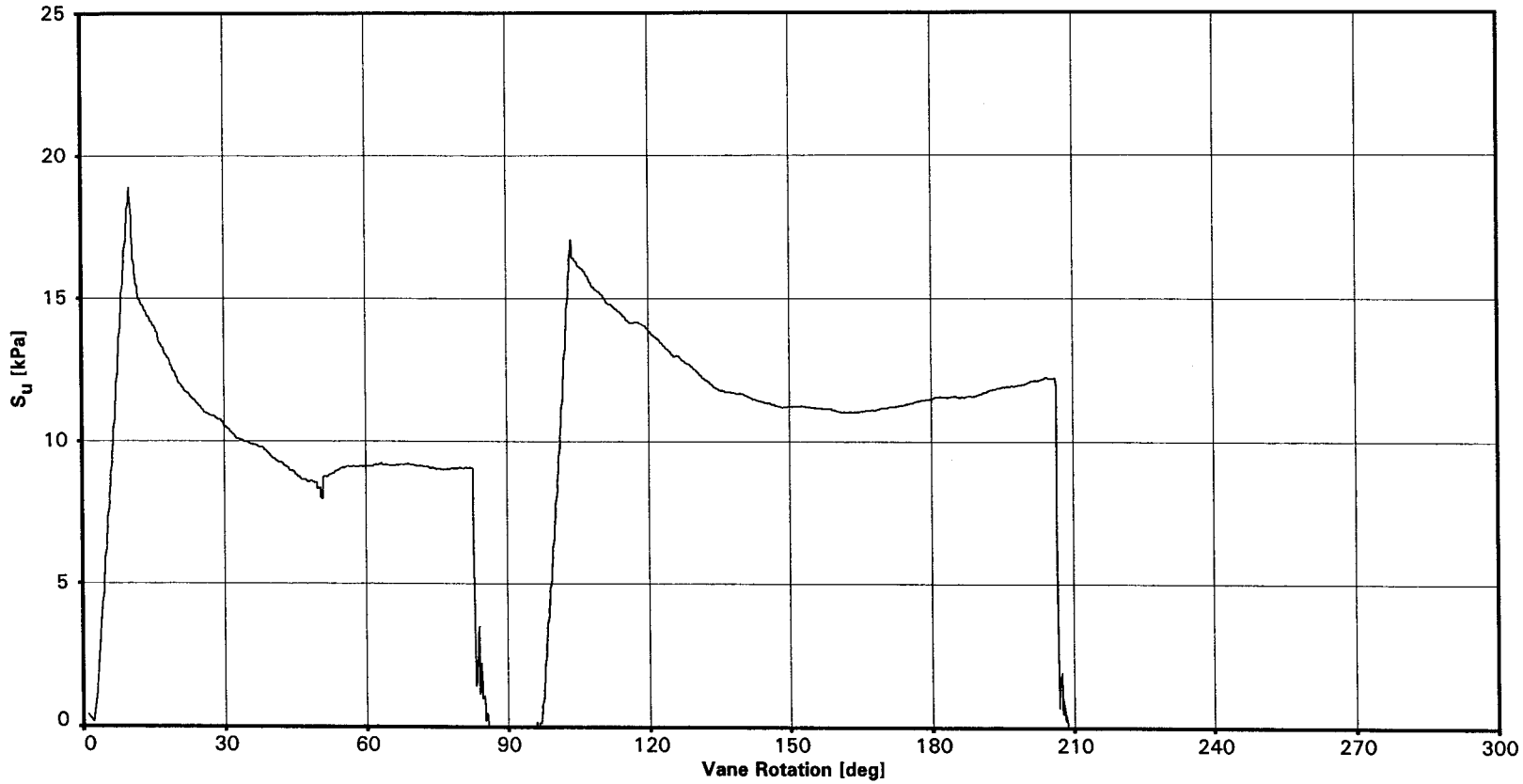
PLATE 98-22.9c

Earth Mechanics

FUGRO

Vane Size used: Dolphin Large

(30 Degrees Corresponds to 8.3% Shear Strain)

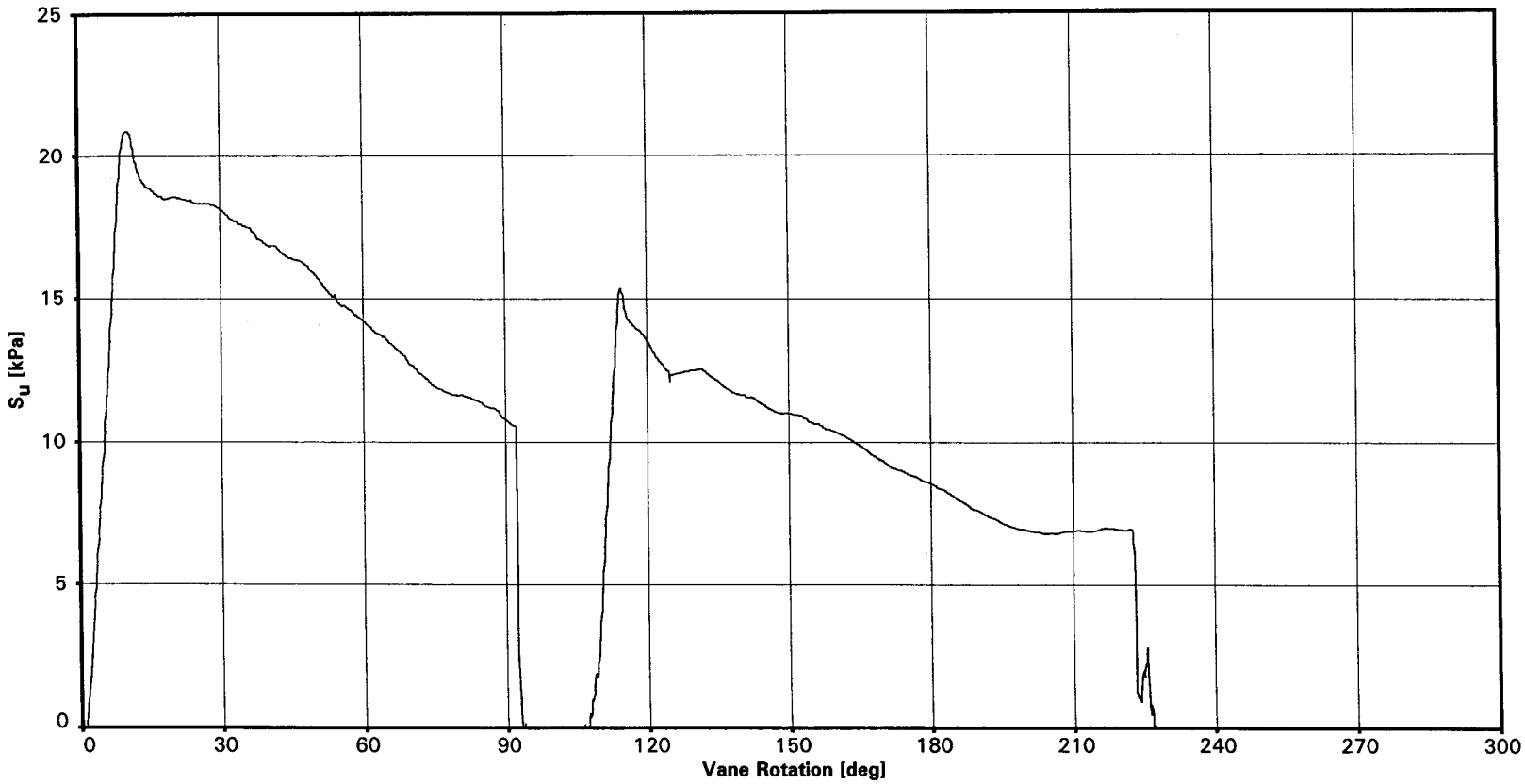


REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 2.4m
Boring 98-22
SFOBB East Span Seismic Safety Project

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: 3.0m
Boring 98-22
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-22.9e

98-22		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
0.1	1										2.5															
0.2	2	97	75	31	1.51	3.9					5.1		2.2													
0.6	401													4.3												
1.2	3					3.8					4.1															
1.2	402													11.5												
1.5	4	90	74	32	1.37						5.2		1.5													
1.8	403													19.2												
1.8	404													17.7												
2.1	5					4.8					4.7															
2.4	6	90	77	29	1.27						5.0		2.1													
2.4	405													22.0												
2.4	406													17.2												
2.9	7					4.2																				
3.0	8	80	74	29	1.13						5.7															
3.0	407													21.1												

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
c = Effective Cohesion
phi = Effective Angle of Friction

Compaction Tests
Max DD = Max. Dry Unit Wt.
OMC = Optimum Moisture Content

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 98-22
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-22		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
3.0	408													15.3												
4.0	9		64	27		5.9					7.8															
4.1	10	26																								
4.7	11	96					17																			
5.7	12	34					10																			
6.6	13	14					4																			
8.8																									22.8	
9.1																									18.2	
9.4																									69.9	
10.1																									30.4	
10.4																									27.3	
10.5																									96.2	
10.7																					36.0	19.2	25.8	0.31	109.3	
10.8																									83.8	
11.0																									18.2	

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-22
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-22		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
11.7																					21.5	15.4	25.5	0.20	24.3	
12.2																									75.9	
13.1																									33.4	
13.4																									16.0	
14.0																									60.7	
14.6																					82.3	52.3	26.4	0.25		
14.9																									121.5	
15.2																									167.1	
15.2																									167.1	
15.5	19														84.3	39	13.9	30								
16.0																									33.4	
16.2																									30.4	
16.8	19														26.3	37	34.0	27								
17.4																									42.5	
18.0																					76.4	33.8	26.4	0.34	85.0	

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-22
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-22		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
18.3																									127.6	
19.2																									48.6	
19.5																									30.4	
21.3																					20.9	37.1	26.3	0.25		
21.5																					72.7	53.0	26.3	0.21		
21.6																					67.2	46.0	26.4	0.22		
23.2																									85.0	
24.4																									121.5	
25.9																					135.9	57.4	26.6	0.29		
26.2	25														53.6	36	31.1	30								
26.5																									157.9	
27.9	25														1.4	20	23.9	23								
28.0																									36.4	
29.0																									91.1	
30.0																					60.7	39.6	26.5	0.31		

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-22
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-22		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
30.2																									3.0	
30.5																									63.8	
31.4																									30.4	
32.0																									79.0	
32.6																									21.3	
32.9																									36.4	
33.8																									42.5	
34.1																					140.8	69.0	26.5	0.38		
34.9																									85.0	
35.4																									157.9	
36.0																									145.8	
37.1																									176.2	
37.8																					35.4	24.3	26.3	0.31		
38.4																									154.9	
39.3																									60.7	

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Identification Tests
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Fines = % Passing No. 200 Sieve

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

Compaction Tests
Max DD = Max. Dry Unit Wt.
OMC = Optimum Moisture Content

Additional Tests
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C = Consolidation Test
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Additional Tests
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-22
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-22		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
39.6																					122.8	46.0	26.4	0.27		
39.9																									121.5	
40.8																									24.3	
41.5																									85.0	
42.1																									66.8	
42.7																									54.7	
43.6																									60.7	
45.4																					54.9	63.8	26.5	0.30		
46.0																									79.0	

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
c = Effective Cohesion
phi = Effective Angle of Friction

Compaction Tests
Max DD = Max. Dry Unit Wt.
OMC = Optimum Moisture Content

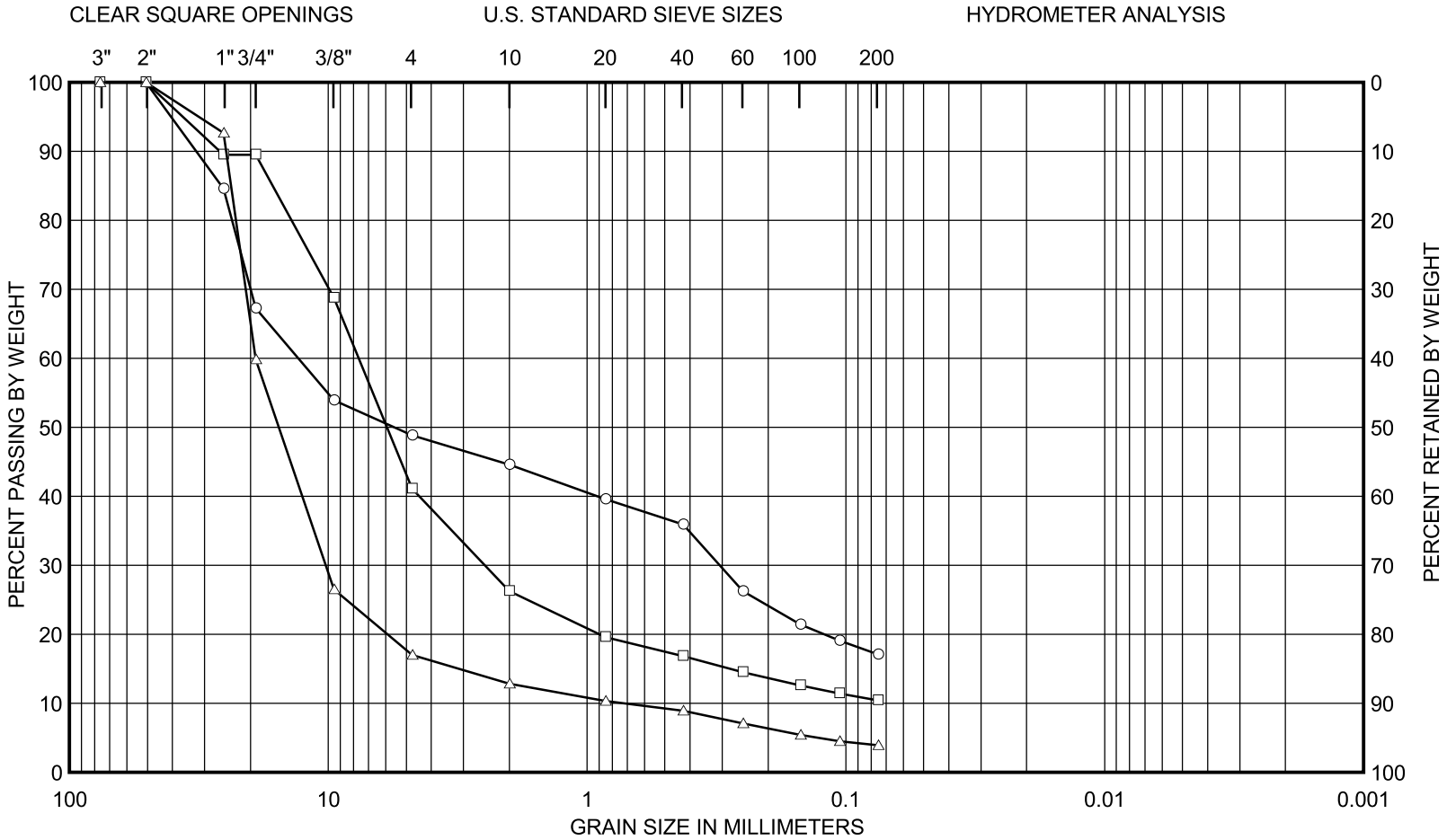
Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-22
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)
11	4.7	○——○	Clayey Coarse to Fine GRAVEL (GC) with sand			5.6
12	5.7	□——□	Fine GRAVEL (GW-GC) with sand, and a trace of coarse gravel			5.9
13	6.6	△——△	Fine GRAVEL (GP) with a trace of coarse gravel	7.5	26.0	15.5

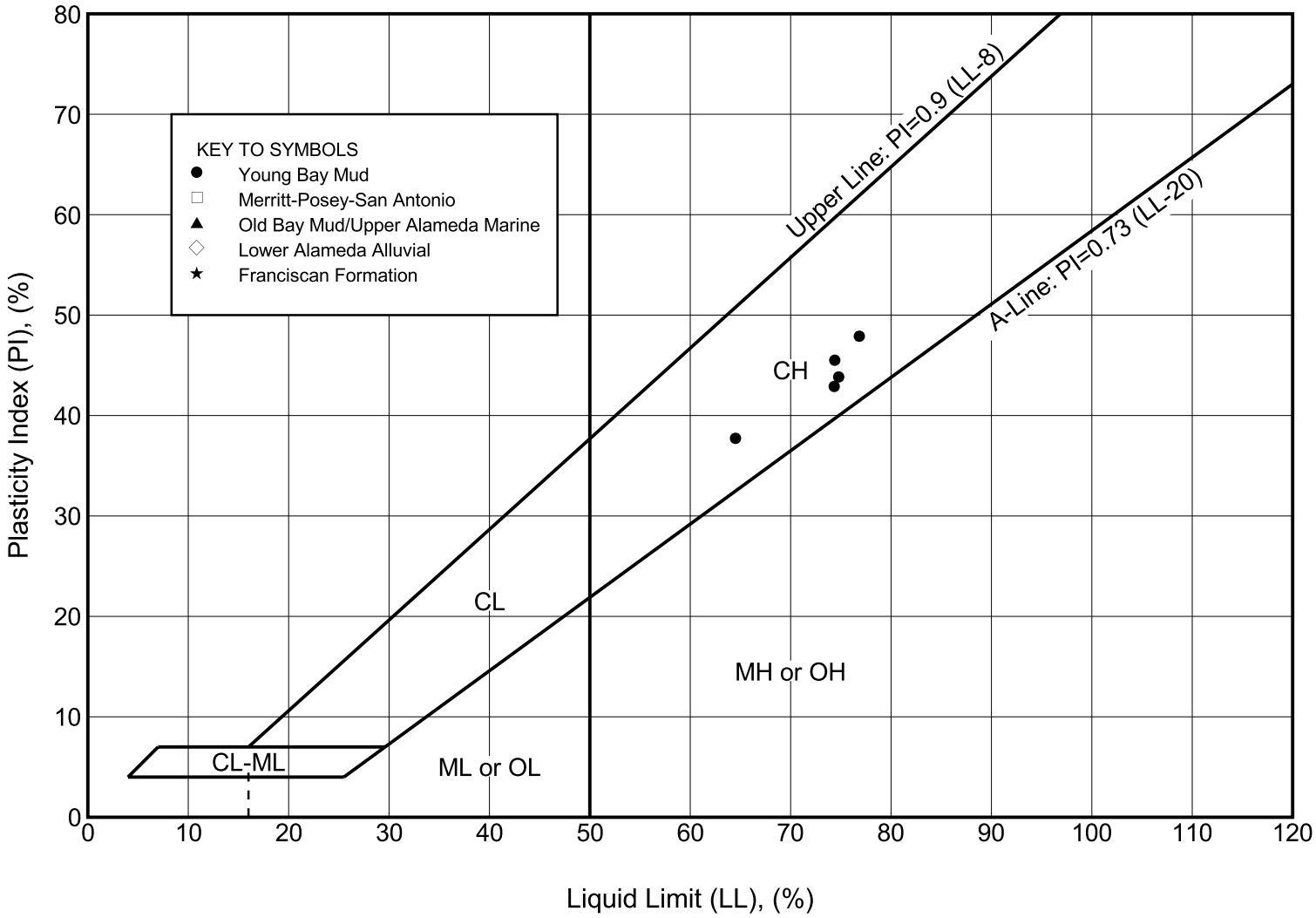
GRAIN SIZE DISTRIBUTION CURVES
Boring 98-22
SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-22.11



PLASTICITY CHART
Boring 98-22
SFOBB East Span Seismic Safety Project

Earth Mechanics

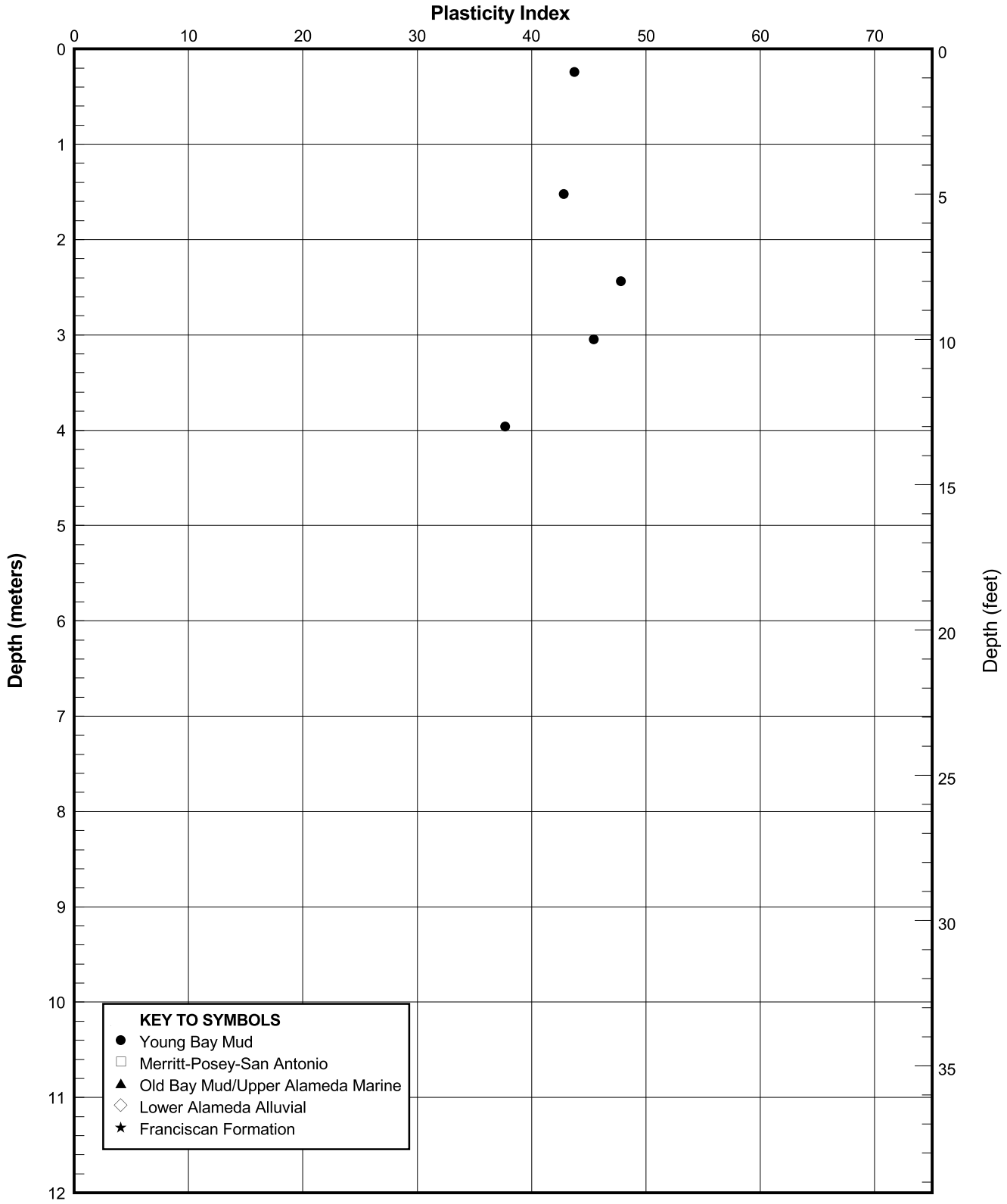
FUGRO

NO STRESS-STRAIN CURVES FOR THIS BORING

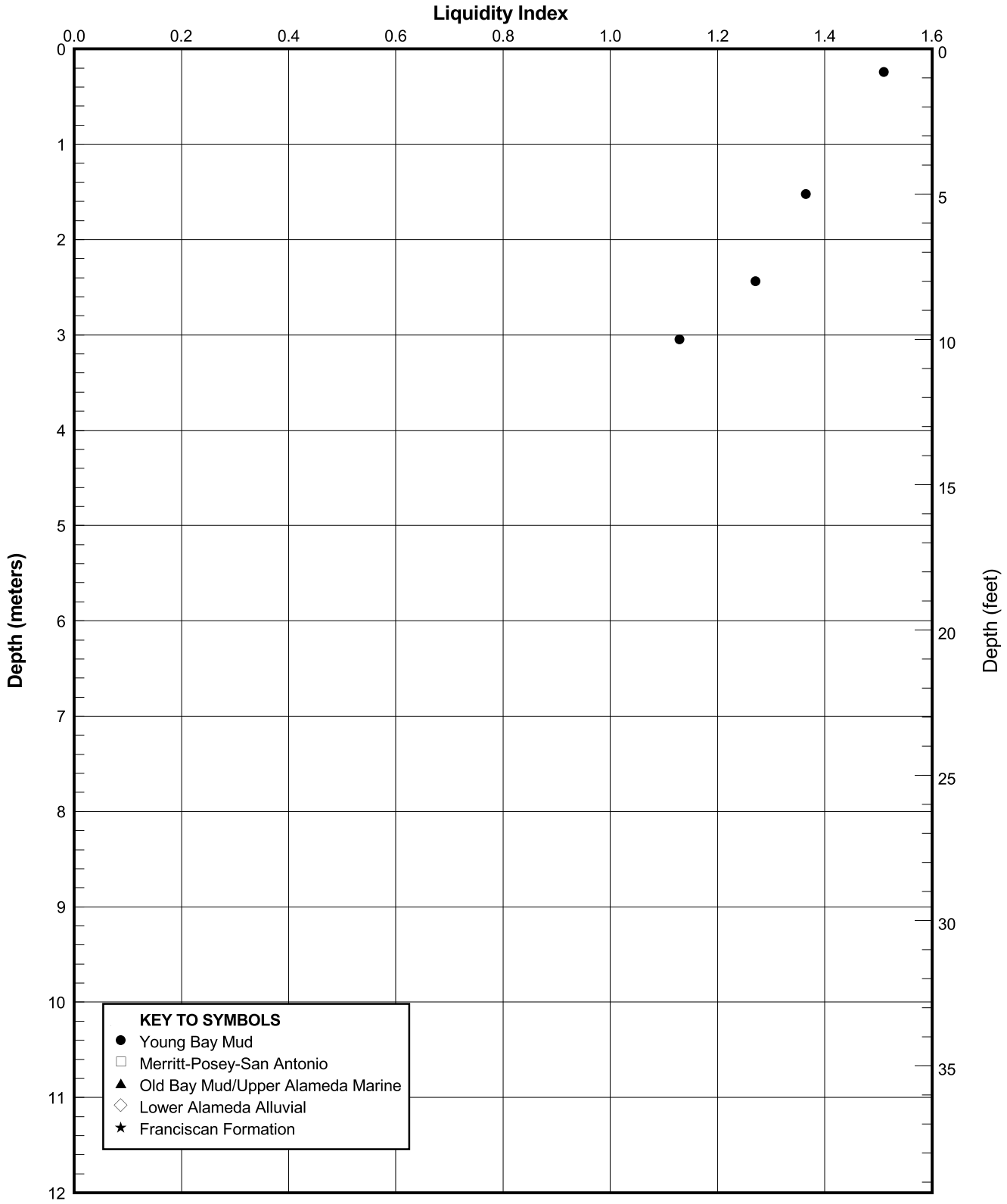
NO CRS OR INCREMENTAL CONSOLIDATION TESTS PERFORMED FOR THIS BORING

NO K_O CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TESTS PERFORMED FOR THIS BORING

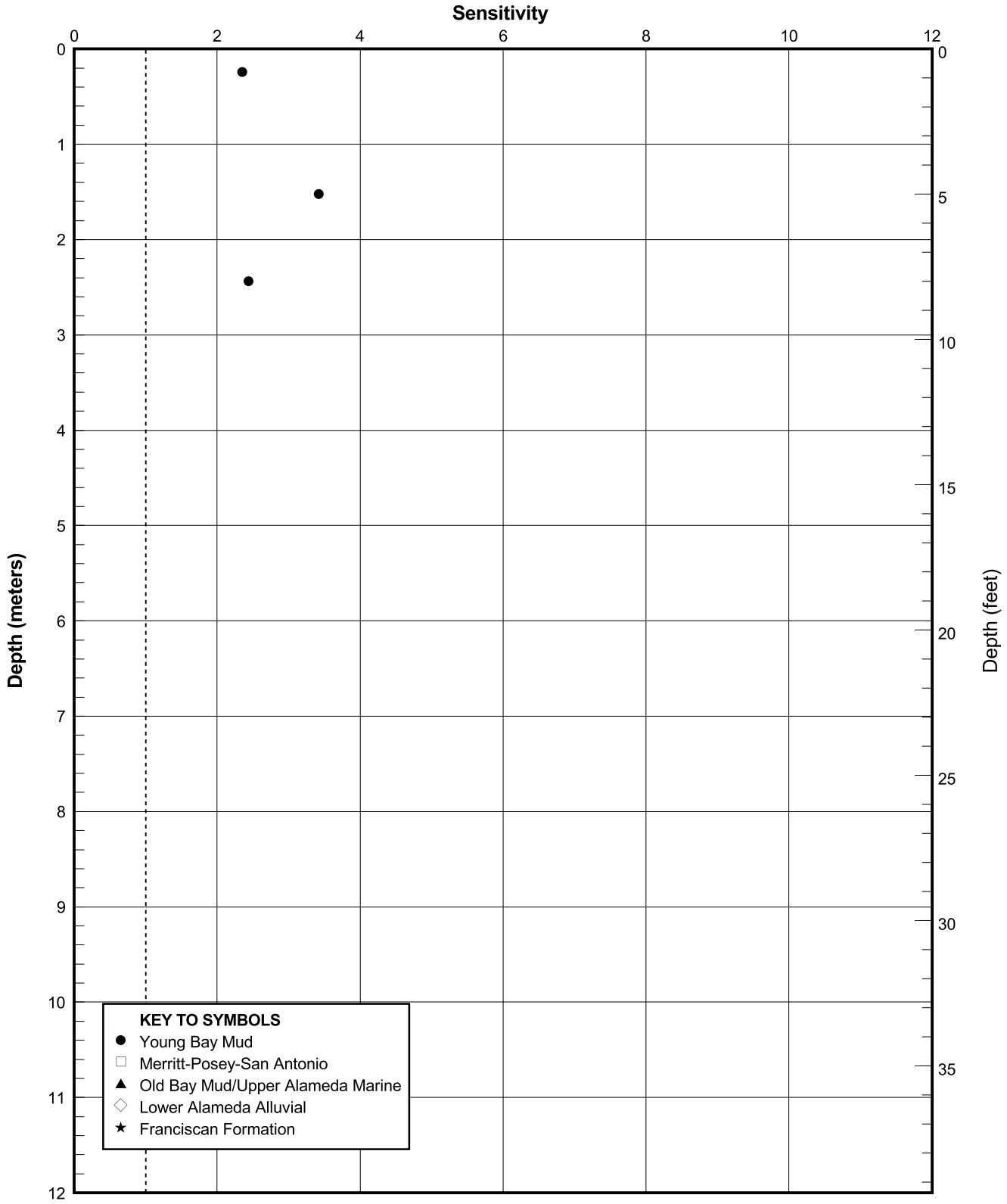
NO ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TESTS PERFORMED FOR THIS BORING



PLASTICITY INDEX PROFILE
Boring 98-22
SFOBB East Span Seismic Safety Project



LIQUIDITY INDEX PROFILE
Boring 98-22
SFOBB East Span Seismic Safety Project



SENSITIVITY PROFILE
Boring 98-22
SFOBB East Span Seismic Safety Project

NO E50 PROFILE FOR THIS BORING

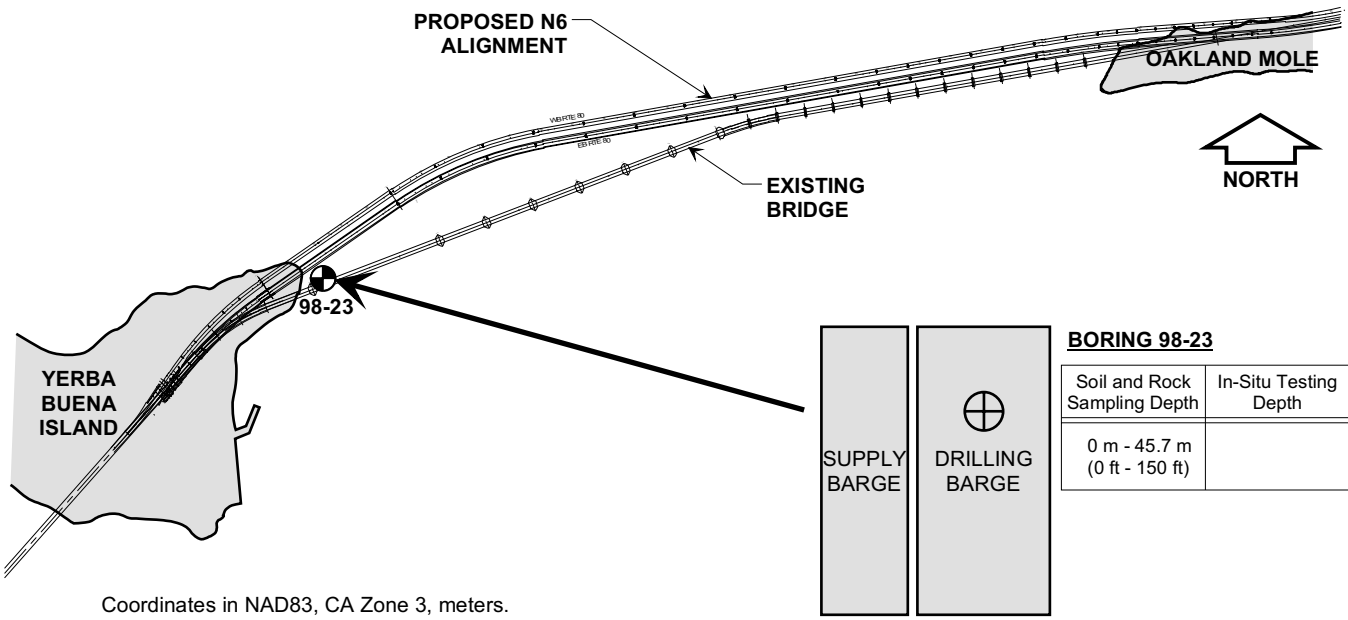
NO PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA FOR THIS BORING

NO RELATIVE DENSITY INTERPRETED FROM CPT DATA FOR THIS BORING

BORING 98-23

Date	Time From	Time To	Description of Activity
October 14, 1998	0145	0330	Move barge to location 98-23. Set 2 anchors.
	0330	0425	Rig up for drilling. Lower drill pipe to mudline.
	0425	0430	Measure water depth of 16.4m (53.7 ft) using bottom sensor. Current tide level is approximately -0.6m (-1.8 ft) MSL. Calculate mudline elevation of -16.9m (-55.4 ft) MSL.
	0430	0530	Drill and sample from mudline to 1.5m (5 ft). Refusal to drilling at 2.4m (8 ft) due to large cobbles.
	0530	1200	Pull drill pipe to deck and set casing. Drive stinger to 1.5m (5 ft).
	1200	1330	Lower drill pipe to mudline. Drill to 1.5m (5 ft).
	1330	1400	Lower core pipe to 1.0m (3.3 ft).
	1400	1800	Core from 1.0m (3.3 ft) to 4.9m (16 ft).
	1800	2000	Pull core pipe to deck and advance drill pipe to 3.6m (11.8 ft).
	2000	2130	Lower core pipe and advance core pipe to 4.9m (16 ft) with center bit.
	2130	2400	Rock coring from 4.9m (16 ft) to 6.7m (22 ft).
October 15, 1998	0000	0320	Rock coring from 6.7m (16 ft) to 32m (104.9 ft).
October 16, 1998	0000	1100	Rock coring from 32m (104.9 ft) to 45.7m (150 ft).
	1100	1130	Pull core pipe to deck.
	1130	1300	P- and S- wave velocity logging from 45.4m (149 ft) to 5.2m (17 ft).
	1300	1400	Caliper logging from 45.4m (149 ft) to 5.2m (17 ft).
	1400	1500	Acoustic televiewer logging from 45.4m (149 ft) to 5.2m (17 ft).
	1500	1530	Repeat acoustic televiewer logging with different gains.
	1530	1730	Lower N-rod. Mix and circulate cement. Grout hole 98-23. Pull N-rod to deck.
	1730	2000	Pull drill pipe and casing to deck.
	2000	2130	Pull 4 anchors and move barge to location 98-48.

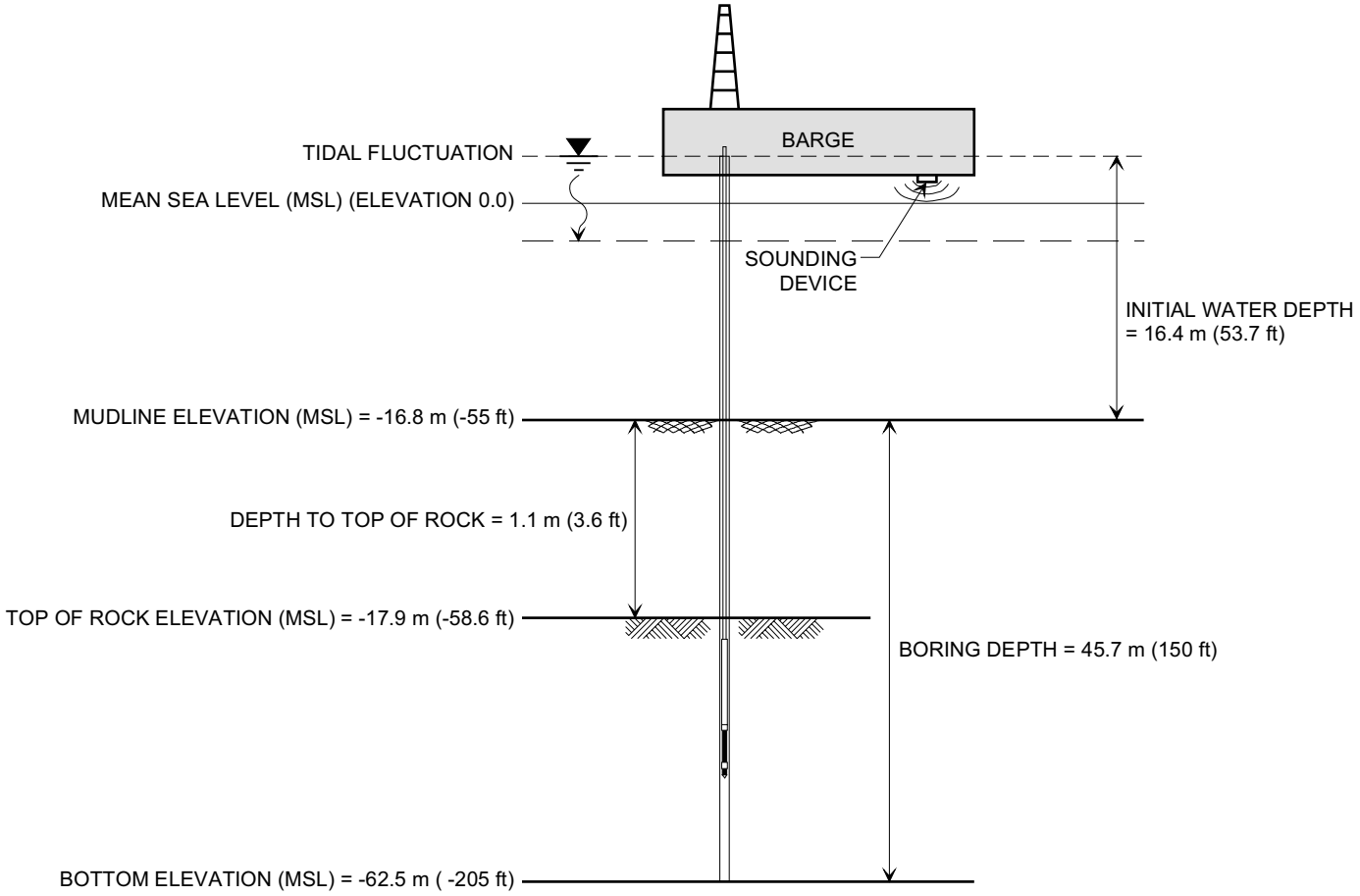
SUMMARY OF FIELD OPERATIONS
Boring 98-23
SFOBB East Span Seismic Safety Project



BORING 98-23

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 45.7 m (0 ft - 150 ft)		E = 1,836,389 N = 647,567

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-23
SFOBB East Span Seismic Safety Project

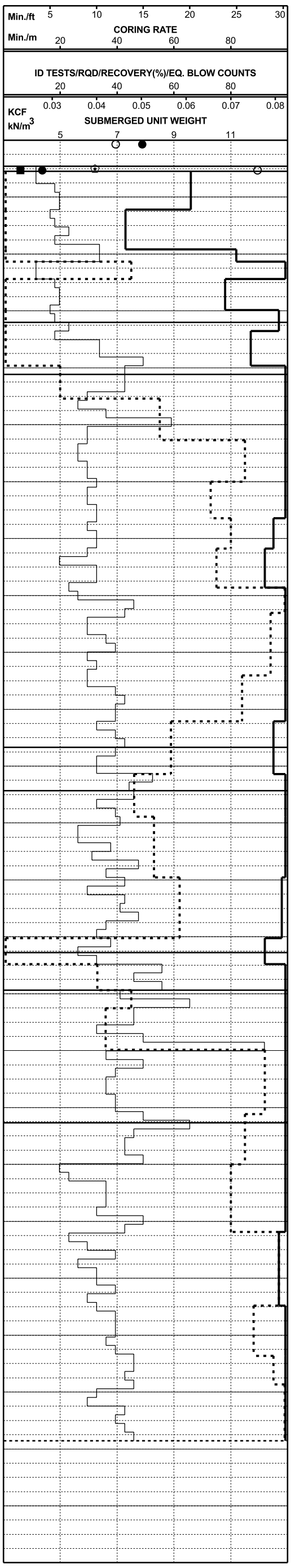
PLATE 98-23.2

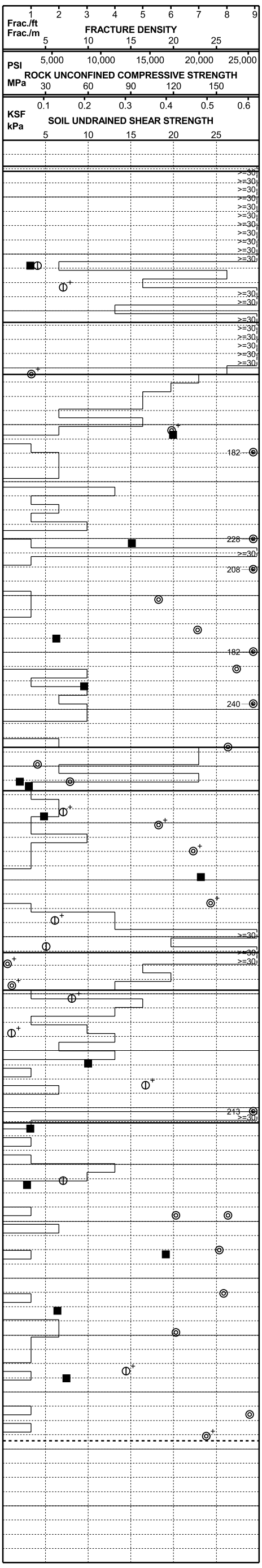
PROJECT NO:	98-42-0054	**START DATE:**	10/14/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-23 (Main Span - Pylon)	**COMPLETION DATE:**	10/16/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836389 N647567
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -16.8m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), gray, very soft (0.9m)	I
-18	2	30/20cm	Fine GRAVEL (GP-GM) with silt, clay, sand, and coarse gravel, gray to olive gray (1.1m)	II
		66-0	SANDSTONE (Graywacke) (Rx), olive gray, moderately to intensely weathered, moderately hard	III
-20	4	43-0		
		82-0		
		100-45	See Plate 98-23.6 for detailed stratigraphy	
-22	6	78-0	(6.4m)	
		97-0	SILTSTONE (Rx) dark greenish gray, moderately to intensely weathered, moderately soft to moderately hard, poorly indurated, very thinly bedded, bedding dips 30 degrees, intensely fractured (8.2m)	IV
-24	8	87-0		
		100-20	SANDSTONE (Graywacke) (Rx) with interbedded SILTSTONE (Rx) [10:1] -slightly to moderately rough fractures, slightly undulating, with very thin, dark yellowish brown iron oxide staining along 30, 60, and 80 degree fractures, and few healed fractures, below 9.1m	V
-26	10	100-55		
-28	12	100-85		
		100-73		
-30	14	95-80	-fine grained gravel (pebbly sandstone) interbed at 13.5m	
-32		92-75		
	16	100-99	-siltstone, 16.1m to 16.5m	
-34	18	100-94	-60mm thick, intensely fractured, claystone interbed, at 17.4m -siltstone with bedding dipping 25 degrees, 17.5m to 17.7m -fresh, hard, thinly bedded claystone, with bedding dipping 20 degrees, 18.7m to 18.8m -thinly bedded siltstone, dipping 20 degrees, 18.8m to 19.2m -iron oxide staining on steeply dipping (>60 degree) fractures, at 19.2m	
-36	20	100-84	(21.3m)	
-38	22	95-59	SANDSTONE (Graywacke) (Rx) interbedded with SILTSTONE (Rx) [1:1] (22.9m)	VI
-40	24	100-46	SANDSTONE (Graywacke) (Rx), moderate dark gray, fresh, hard -interbedded siltstone and sandstone, 23.2m to 23.4m -siltstone, dipping 20 degrees, pyrite mineralization along fracture plane, 23.8m to 24.0m -numerous vertical and near vertical healed, very thin (1mm), calcite/quartz filled fractures, 24.0m to 25.6m	VII
-42	26	100-53		
-44	28	98-62	-dark gray, fresh, moderately hard claystone, 27.6m to 27.8m (28.6m)	
-46	30	92-0	CLAYSTONE (Rx), dark gray, fresh (29.9m)	VIII
		100-33		
-48	32	100-45	SANDSTONE (Graywacke) (Rx) with interbedded CLAYSTONE (Rx) [2:1]	IX
		100-36		
-50	34	100-92	-claystone, intensely fractured, 33.4m to 33.7m -claystone with bedding dipping 20 degrees, below 34.2m (34.5m)	
-52	36	100-85	SANDSTONE (Graywacke) (Rx), medium dark gray, fresh, hard to very hard	X
-54	38	100-80		
-56	40	97-97		
-58	42	100-88		
-60	44	100-95		
-62	46	100-99	TOTAL DEPTH: 45.7m BACKFILLED WITH: Cement Grout	
-64	48			
-66				





LOG OF BORING AND TEST RESULTS

BORING 98-23

SFOBB East Span Seismic Safety Project

Report Date: 05/06/99

FUGRO

PLATE 98-23.3

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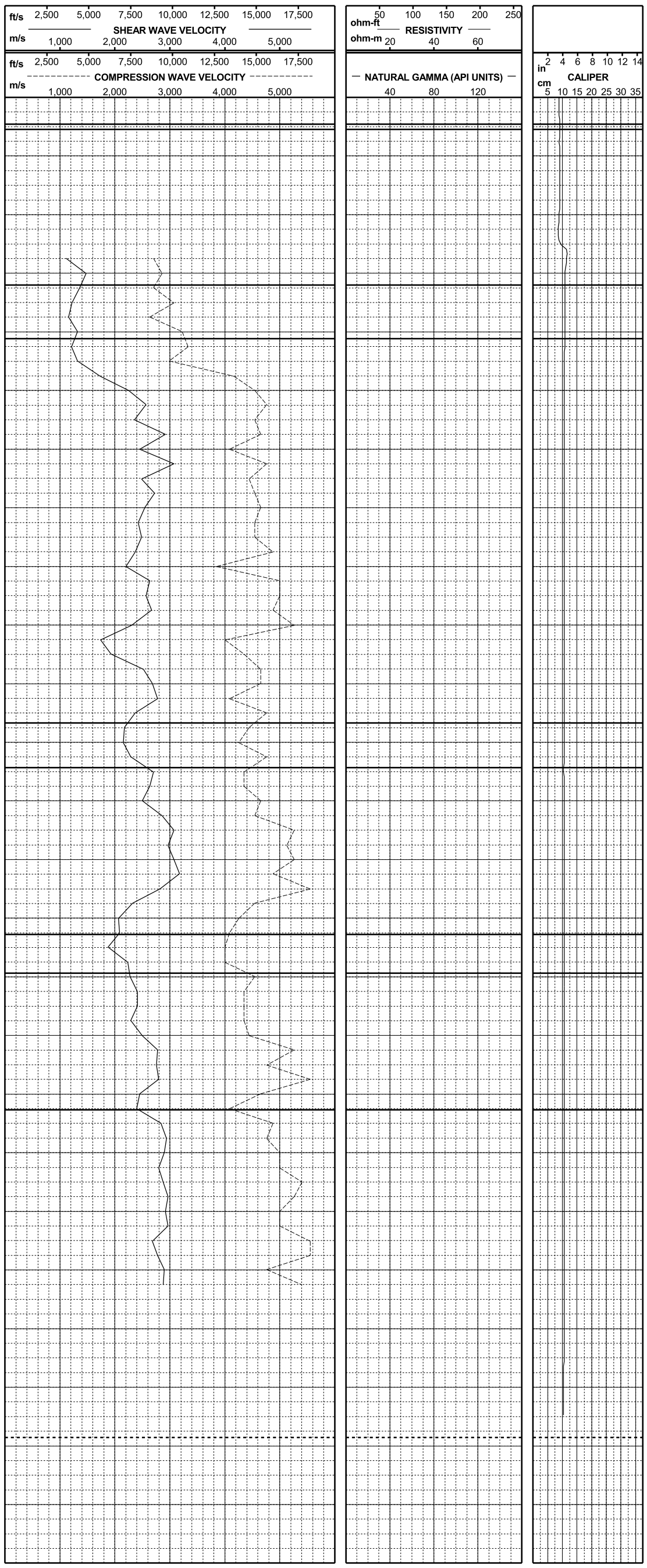
NO SINGLE-PAGE BORING LOGS WITH CPT DATA FOR THIS BORING

PROJECT NO:	98-42-0054	**START DATE:**	10/14/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-23 (Main Span - Pylon)	**COMPLETION DATE:**	10/16/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836389 N647567
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -16.8m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), gray, very soft (0.9m)	I
-18		30/20cm	Fine GRAVEL (GP-GM) with silt, clay, sand, and coarse gravel, gray to olive gray (1.1m)	II
	2	66-0	SANDSTONE (Graywacke) (Rx), olive gray, moderately to intensely weathered, moderately hard	III
-20		43-0		
	4	82-0	See Plate 98-23.6 for detailed stratigraphy	
		100-45		
-22		78-0		
	6	97-0	(6.4m)	
-24		87-0	SILTSTONE (Rx) dark greenish gray, moderately to intensely weathered, moderately soft to moderately hard, poorly indurated, very thinly bedded, bedding dips 30 degrees, intensely fractured (8.2m)	IV
	8	100-20	SANDSTONE (Graywacke) (Rx) with interbedded SILTSTONE (Rx) [10:1]	V
-26			-slightly to moderately rough fractures, slightly	
	10	100-55	undulating, with very thin, dark yellowish brown iron oxide staining along 30, 60, and 80 degree fractures, and few healed fractures, below 9.1m	
-28		100-85		
	12			
		100-73		
-30			-fine grained gravel (pebbly sandstone) interbed at 13.5m	
	14	95-80		
-32		92-75		
	16	100-99	-siltstone, 16.1m to 16.5m	
-34			-60mm thick, intensely fractured, claystone interbed, at 17.4m	
	18	100-94	-siltstone with bedding dipping 25 degrees, 17.5m to 17.7m	
-36			-fresh, hard, thinly bedded claystone, with bedding dipping 20 degrees, 18.7m to 18.8m	
	20	100-84	-thinly bedded siltstone, dipping 20 degrees, 18.8m to 19.2m	
			-iron oxide staining on steeply dipping (>60 degree) fractures, at 19.2m (21.3m)	
-38		95-59	SANDSTONE (Graywacke) (Rx) interbedded with SILTSTONE (Rx) [1:1] (22.9m)	VI
	22	100-46	SANDSTONE (Graywacke) (Rx), moderate dark gray, fresh, hard	VII
-40			-interbedded siltstone and sandstone, 23.2m to 23.4m	
	24	100-53	-siltstone, dipping 20 degrees, pyrite mineralization along fracture plane, 23.8m to 24.0m	
-42			-numerous vertical and near vertical healed, very thin (1mm), calcite/quartz filled fractures, 24.0m to 25.6m	
	26			
-44		98-62	-dark gray, fresh, moderately hard claystone, 27.6m to 27.8m	
	28		(28.6m)	
		92-0	CLAYSTONE (Rx), dark gray, fresh	VIII
-46		100-33	(29.9m)	
	30	100-45	SANDSTONE (Graywacke) (Rx) with interbedded CLAYSTONE (Rx) [2:1]	IX
-48		100-36		
	32			
-50		100-92	-claystone, intensely fractured, 33.4m to 33.7m	
	34		-claystone with bedding dipping 20 degrees, below 34.2m (34.5m)	
-52		100-85	SANDSTONE (Graywacke) (Rx), medium dark gray, fresh, hard to very hard	X
	36			
-54		100-80		
	38			
-56		97-97		
	40			
-58		100-88		
	42			
-60		100-95		
	44			
		100-99		
-62				
	46		TOTAL DEPTH: 45.7m	
			BACKFILLED WITH: Cement Grout	
-64				
	48			
-66				



LOG OF BORING AND TEST RESULTS

BORING 98-23

SFOBB East Span Seismic Safety Project

Report Date: 05/06/99

PLATE 98-23.5

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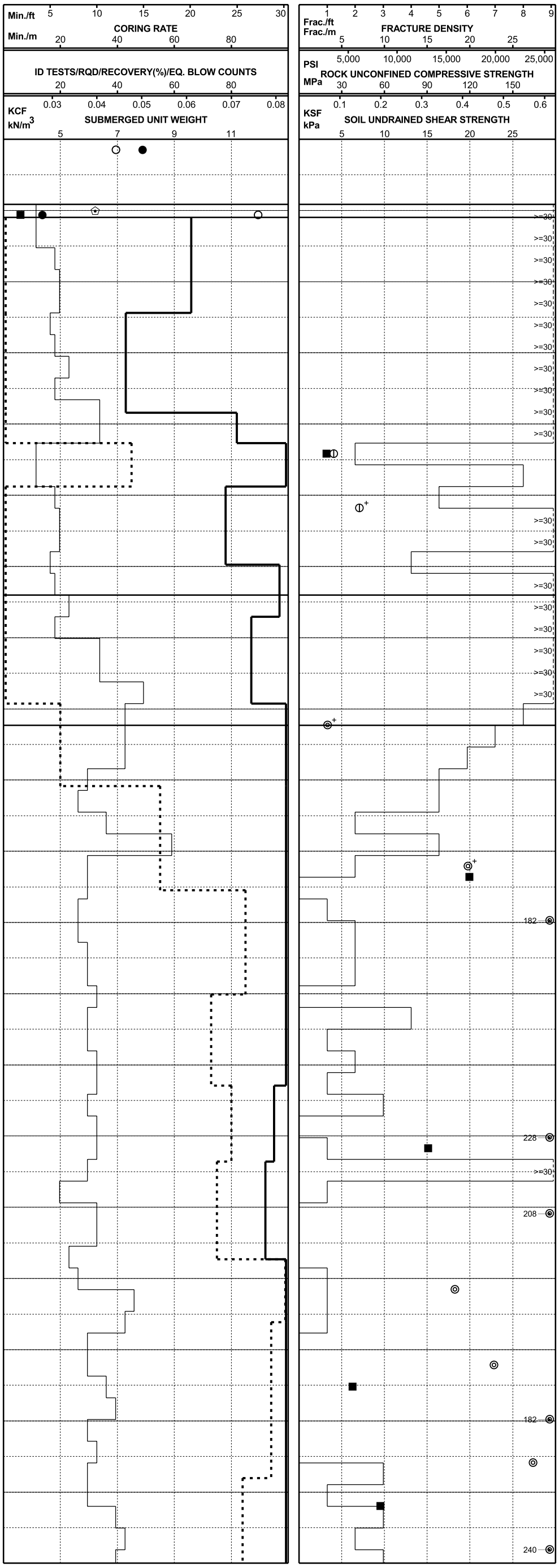
PROJECT NO:	98-42-0054	**START DATE:**	10/14/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-23 (Main Span - Pylon)	**COMPLETION DATE:**	10/16/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836389 N647567
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -16.8m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-17		WOH	Fat CLAY (CH), gray, very soft -with sand at 0.2m (0.9m)	I
-18	1	30/20cm	Fine GRAVEL (GP-GM) with silt, clay, sand, and coarse gravel, gray to olive gray -with a few shell fragments, and hard, subrounded, sandstone gravel (1.1m)	II
-19	2	66-0	SANDSTONE (Graywacke) (Rx), olive gray, moderately to intensely weathered, moderately hard -poorly indurated, fine to medium grained, thickly bedded, moderately to intensely fractured -fractures: dipping 20 to 50 degrees, with minor calcite/quartz filling, and iron oxide staining along discontinuity planes	III
-20	3	43-0		
-21	4	82-0	-moderately weathered, with 1mm thick, clay infilling, at 4.4m	
-22	5	100-45	-10mm to 50mm thick, silty to sandy clay fracture infilling, at 4.7m	
-23	6	78-0		
-24	7	97-0	SILTSTONE (Rx) dark greenish gray, moderately to intensely weathered, moderately soft to moderately hard, poorly indurated, very thinly bedded, bedding dips 30 degrees, intensely fractured -claystone, 6.4m to 6.7m -slightly rough, iron oxide stained fractures, dipping 30 to 60 degrees, at 6.4m -laminated to thinly bedded at 7.3m (6.4m)	IV
-25	8	87-0		
-26	9	100-20	SANDSTONE (Graywacke) (Rx) with interbedded SILTSTONE (Rx) [10:1] -sandstone: moderate yellowish brown, moderately weathered, moderately hard, poorly indurated, fine to medium grained, thinly to thickly bedded, bedding dipping 30 degrees, intensely fractured -siltstone: dark gray, bedding dipping 20 degrees, intensely to very intensely fractured -fractures: slightly rough, thin calcite/quartz and iron oxide coated fractures, scattered healed fractures, dipping 20 to 30 and 60 to 80 degrees -medium dark gray, slightly weathered, moderately to slightly fractured with very thin fracture infilling, below 8.4m - with 10mm weathering rinds along fractures, 9.1m to 10.5m -siltstone, 9.1m to 9.4m -slightly to moderately rough fractures, slightly undulating, with very thin, dark yellowish brown iron oxide staining along 30, 60, and 80 degree fractures, and few healed fractures, below 9.1m -siltstone, 9.8m to 10.1m -60mm thick, claystone interbed, with bedding dipping 20 degrees, at 10.9m (8.2m)	V
-27	10	100-55		
-28	11	100-85		
-29	12	100-73	-fresh below 12.3m -thinly laminated siltstone, 12.6m to 12.8m	
-30	13		-very intensely fractured, at 13.0m -siltstone, 13.3m to 13.5m -fine grained gravel (pebbly sandstone) interbed at 13.5m	
-31	14	95-80	-siltstone, 14.5m to 15.0m	
-32	15	92-75	-iron oxide staining on discontinuity surfaces at 15.7m	
-33	16	100-99	-normally graded sequence, at 16.0m -siltstone, 16.1m to 16.5m	
-34	17	100-94	-60mm thick, intensely fractured, claystone interbed, at 17.4m -siltstone with bedding dipping 25 degrees, 17.5m to 17.7m -two, healed, very thin, calcite/quartz infilled fractures, at 17.6m	
-35	18		-fresh, hard, thinly bedded claystone, with bedding dipping 20 degrees, 18.7m to 18.8m -moderately fractured with smooth to slightly rough surfaces, dipping 40 to 60 degrees, below 18.7m	
-36	19	100-84	-thinly bedded siltstone, dipping 20 degrees, 18.8m to 19.2m -well indurated, thickly bedded, with thin calcite/quartz infilled fractures, below 18.9m -iron oxide staining on steeply dipping (>60 degree) fractures, at 19.2m -healed fractures, dipping 55 to 75 degrees, with 4mm thick calcite/quartz filling, at 19.2m	



LOG OF BORING AND TEST RESULTS

BORING 98-23

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

PLATE 98-23.6a

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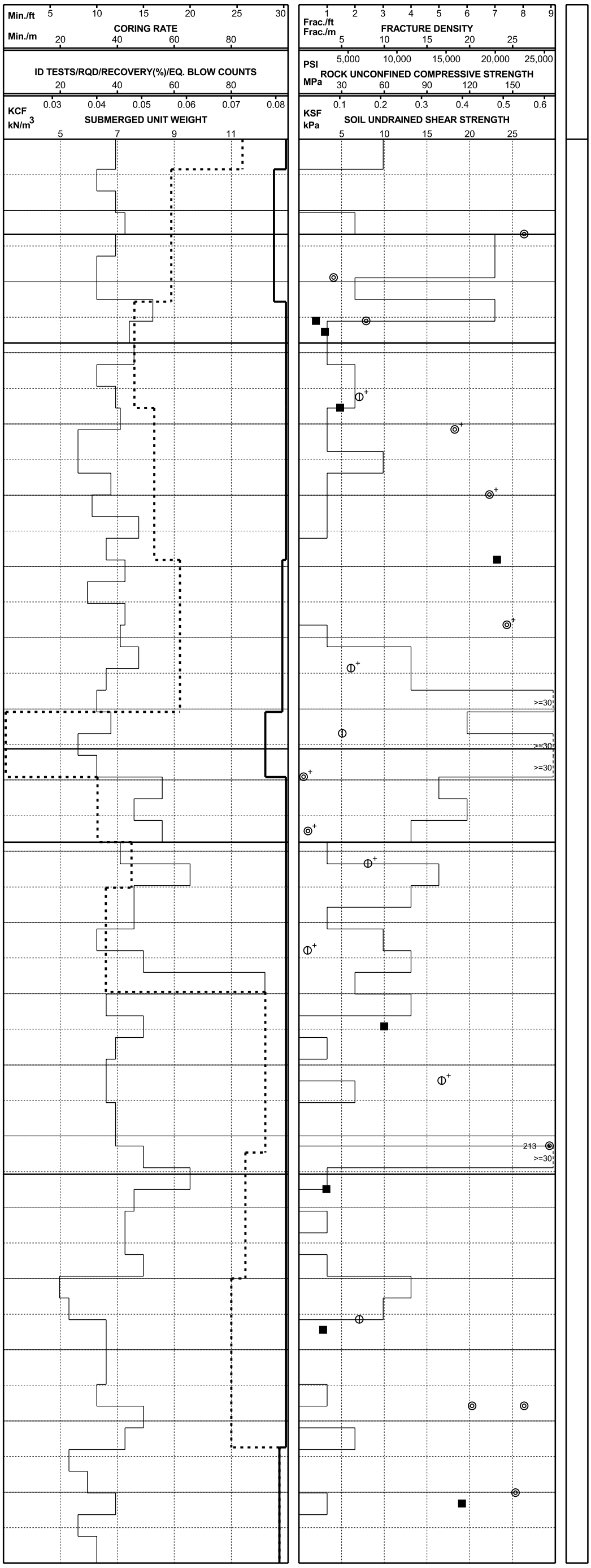
PROJECT NO:	98-42-0054	**START DATE:**	10/14/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-23 (Main Span - Pylon)	**COMPLETION DATE:**	10/16/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836389 N647567
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -16.8m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-37	21	100-84	SANDSTONE (Graywacke) (Rx) with interbedded SILTSTONE (Rx) [10:1] (21.3m)	V
-38	22	95-59	SANDSTONE (Graywacke) (Rx) interbedded with SILTSTONE (Rx) [1:1] -sandstone: medium dark gray, fresh, hard, moderately indurated, fine to medium grained -siltstone: dark gray, fresh, hard, laminated to very thinly bedded -50mm thick, intensely fractured zone, at 21.5m -bedding dipping 35 degrees at 21.8m -vertical, healed, fault with approximately 8mm of displacement, at 21.8m (22.9m)	VI
-39	23	100-46	-bedding dipping 30 degrees, at 22.2m -bedding dipping 20 degrees at 22.4m -bedding dipping 35 degrees, at 22.6m	
-40	24		SANDSTONE (Graywacke) (Rx), moderate dark gray, fresh, hard -moderately indurated, fine to medium grained, thickly bedded, slightly fractured with slightly rough, very thin calcite/quartz filling, dipping 30 to 80 degrees -15mm thick, calcite/quartz filling, bedding dipping 35 degrees, at 23.0m -interbedded siltstone and sandstone, 23.2m to 23.4m -siltstone, dipping 20 degrees, pyrite mineralization along fracture plane, 23.8m to 24.0m	
-41	25	100-53	-numerous vertical and near vertical healed, very thin (1mm), calcite/quartz filled fractures, 24.0m to 25.6m -slightly rough fractures, dipping 35 to 60 degrees, with thin calcite/quartz filling, and pyrite mineralization, at 24.1m -fractures dipping 60 degrees, at 24.5m -numerous closely spaced, very thin, healed fractures, dipping 40 to 70 degrees, with less than 1mm of calcite/quartz filling, 25.3m to 27.1m	VII
-42	26		-numerous, slightly rough, calcite/quartz filled fractures, dipping 40 to 60 degrees, 27.3m to 27.9m	
-43	27	98-62	-closely spaced, healed, very thin calcite/quartz filled fractures, dipping 70 degrees, 27.7m to 27.9m	
-44	28		-dark gray, fresh, moderately hard claystone, 27.6m to 27.8m -very thinly bedded to laminated, bedding dipping at 25 degrees, intensely fractured, with smooth to slightly rough fracture planes, at 28.0m	
-45		92-0	-bedding dipping at 20 degrees, most fractures dipping 10 to 20 degrees and 50 to 60 degrees, most fractures coated with very thin calcite/quartz, at 28.5m (28.6m)	
-46	29	100-33	CLAYSTONE (Rx), dark gray, fresh -very thinly bedded to laminated, bedding dipping 25 degrees, intensely fractured with smooth to slightly rough fracture planes, very thin calcite/quartz infilling -bedding dipping 20 degrees and a slickensided fracture surface, at 29.1m (29.9m)	VIII
-47	30	100-45	SANDSTONE (Graywacke) (Rx) with interbedded CLAYSTONE (Rx) [2:1] -sandstone: medium dark gray, fresh, hard, moderately indurated, fine to medium grained with scattered coarse grains, thinly bedded, slightly fractured -claystone: dark gray, fresh, moderately hard, moderately indurated, thinly bedded to laminated, moderately fractured with smooth, clean fractures dipping 20 to 40 degrees	
-48	31	100-36	-soft sediment deformation and numerous healed fractures with up to 2mm calcite/quartz infilling, at 29.9m -claystone with bedding dipping 20 degrees, 30.2m to 30.3m -soft sediment deformation at 30.5m -numerous healed, calcite/quartz filled fractures, dipping 65 degrees to vertical, at 30.7m	
-49	32		-fine grained conglomerate (pebbly sandstone) interbed, at 30.8m -claystone with bedding dipping 30 degrees, 31.3m to 32.2m	IX
-50	33	100-92	-claystone, intensely fractured, 33.4m to 33.7m	
-51	34		-claystone with bedding dipping 20 degrees, below 34.2m (34.5m)	
-52	35	100-85	SANDSTONE (Graywacke) (Rx), medium dark gray, fresh, hard to very hard -moderately fractured with 60 degree to vertical fractures, at 35.2m -60mm thick, siltstone interbed, with bedding dipping 20 degrees, at 35.2m	
-53	36		-very slightly fractured at 36.0m -minor pyrite mineralization on fracture surface, at 36.4m	
-54	37	100-80		X
-55	38		-2mm to 10mm thick zone of light gray clay, with 10mm thick disks of sandstone, oriented nearly horizontal, 37.7m to 37.8m -slightly rough fractures, dipping 20 degrees, with discontinuous calcite/quartz filling, at 38.4m	
-56	39	97-97	-slightly rough fractures, dipping 70 degrees, with calcite/quartz filling, at 39.1m	



LOG OF BORING AND TEST RESULTS

BORING 98-23

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

PLATE 98-23.6b

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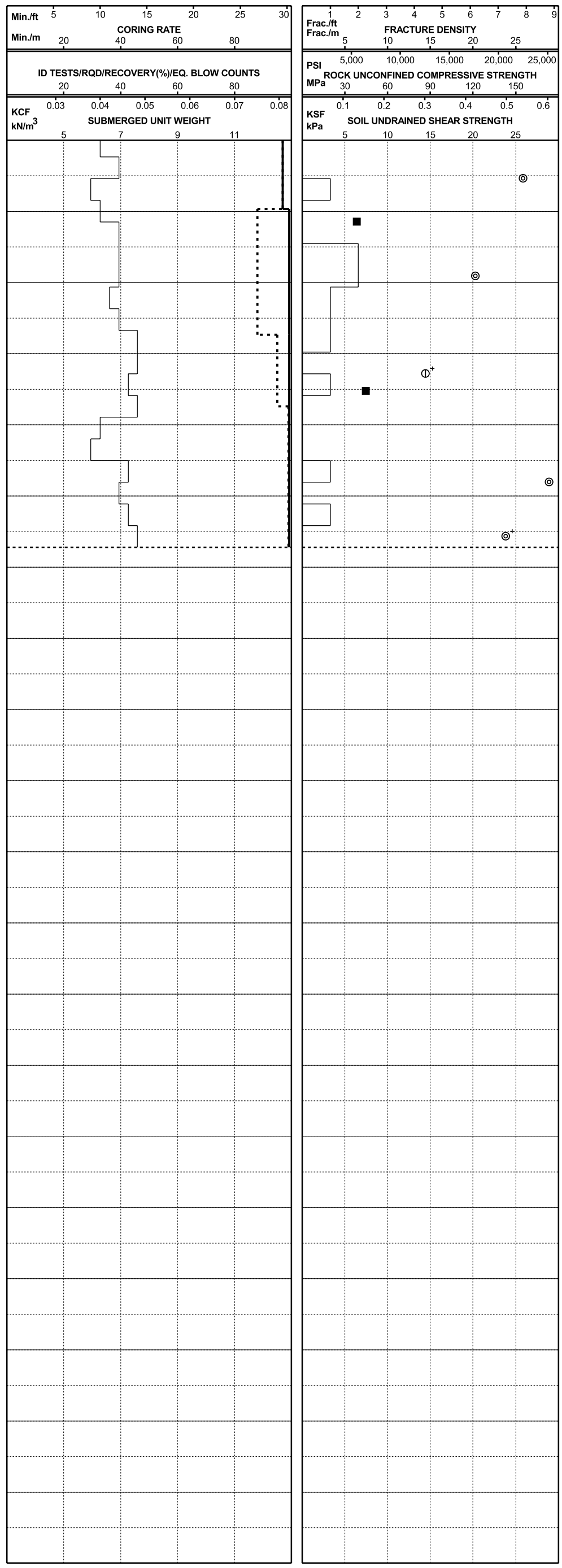
PROJECT NO:	98-42-0054	**START DATE:**	10/14/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-23 (Main Span - Pylon)	**COMPLETION DATE:**	10/16/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836389 N647567
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -16.8m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-57					SANDSTONE (Graywacke) (Rx), medium dark gray, fresh, hard to very hard	
				97-97	-moderately fractured, with slightly rough, calcite/quartz filled fractures, generally dipping 20 degrees, at 40.7m	
-58	41					
				100-88	-numerous healed, 1mm thick, calcite/quartz filled fractures, dipping about 70 degrees, at 41.8m	
-59	42					
-60	43			100-95		X
-61	44					
				100-99		
-62	45				-60mm thick, claystone interbed, with bedding dipping 20 degrees, at 45.3m	
					TOTAL DEPTH: 45.7m BACKFILLED WITH: Cement Grout	
-63	46					
-64	47					
-65	48					
-66	49					
-67	50					
-68	51					
-69	52					
-70	53					
-71	54					
-72	55					
-73	56					
-74	57					
-75	58					
-76	59					



LOG OF BORING AND TEST RESULTS

BORING 98-23

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

PLATE 98-23.6c

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NO MULTI-PAGE BORING LOGS WITH CPT DATA FOR THIS BORING

**NO LOG OF NEAR-SURFACE MATERIALS
FOR THIS BORING**

NO HALIBUT OR DOWNHOLE VANE TESTS PERFORMED FOR THIS BORING

98-23		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
0.2	1	49																								
1.1	2	14					6																			
4.4																					19.0	12.2	25.4	0.30	24.3	
5.2																									42.5	
5.3	7														23.9	33	34.0	29								
5.4	7														60.3	42	47.9	27								
8.2																									19.7	
10.2																									118.5	
10.4																					119.5	62.7	26.5	0.21		
11.0																									182.2	
14.0																									227.8	
14.2																					90.4	80.2	26.7	0.26		
15.1																									208.5	
16.2																									109.3	
17.2																									136.7	

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
c = Effective Cohesion
phi = Effective Angle of Friction

Compaction Tests
Max DD = Max. Dry Unit Wt.
OMC = Optimum Moisture Content

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 98-23
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-23		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
17.5																					37.2	35.9	26.5	0.36		
17.7	17														15.3	30	30.2	28								
18.0																									182.2	
18.6																									164.0	
19.2																					56.9	39.6	26.4	0.33		
19.8																									240.4	
21.3																									157.9	
21.9																									24.0	
22.6																					11.6	23.3	26.3	0.19	47.1	
22.7																					17.9	14.8	26.3	0.33		
23.6																									42.5	
23.8																					28.8	34.5	26.4	0.19		
24.1																									109.3	
25.0																									133.6	
25.9																					138.9	57.4	26.6	0.24		

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-23
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-23		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
26.8																									145.8	
27.4																									36.4	
28.3																									30.4	
29.0																									3.0	
29.4	24														182.4	35	37.8	29								
29.7																									6.1	
30.2																									48.6	
31.4																									6.1	
31.5	26														35.9	32	19.2	29								
31.9	26														85.7	27	96.7	21								
32.5																					59.8	65.0	26.5	0.36		
33.2																									100.2	
34.1																									212.6	
34.7																					19.2	19.9	26.4	0.14		
36.6																									42.5	

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-23
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-23		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
36.7																					16.6	37.8	26.6	0.21		
37.8																									121.5	
37.8																									157.9	
39.0																									151.9	
39.0	30														87.6	31	47.9	24								
39.2																					114.3	57.4	26.7	0.25		
40.5																									154.9	
41.1																					38.0	47.9	26.7	0.22		
41.9																									121.5	
43.3																									86.6	
43.5																					44.5	37.1	26.5	0.24		
44.8																									173.1	
45.6																									142.8	

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Fines = % Passing No. 200 Sieve

Strength Tests
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Compaction Tests
Max DD = Max. Dry Unit Wt.
OMC = Optimum Moisture Content

Additional Tests
H = Hydrometer
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Additional Tests
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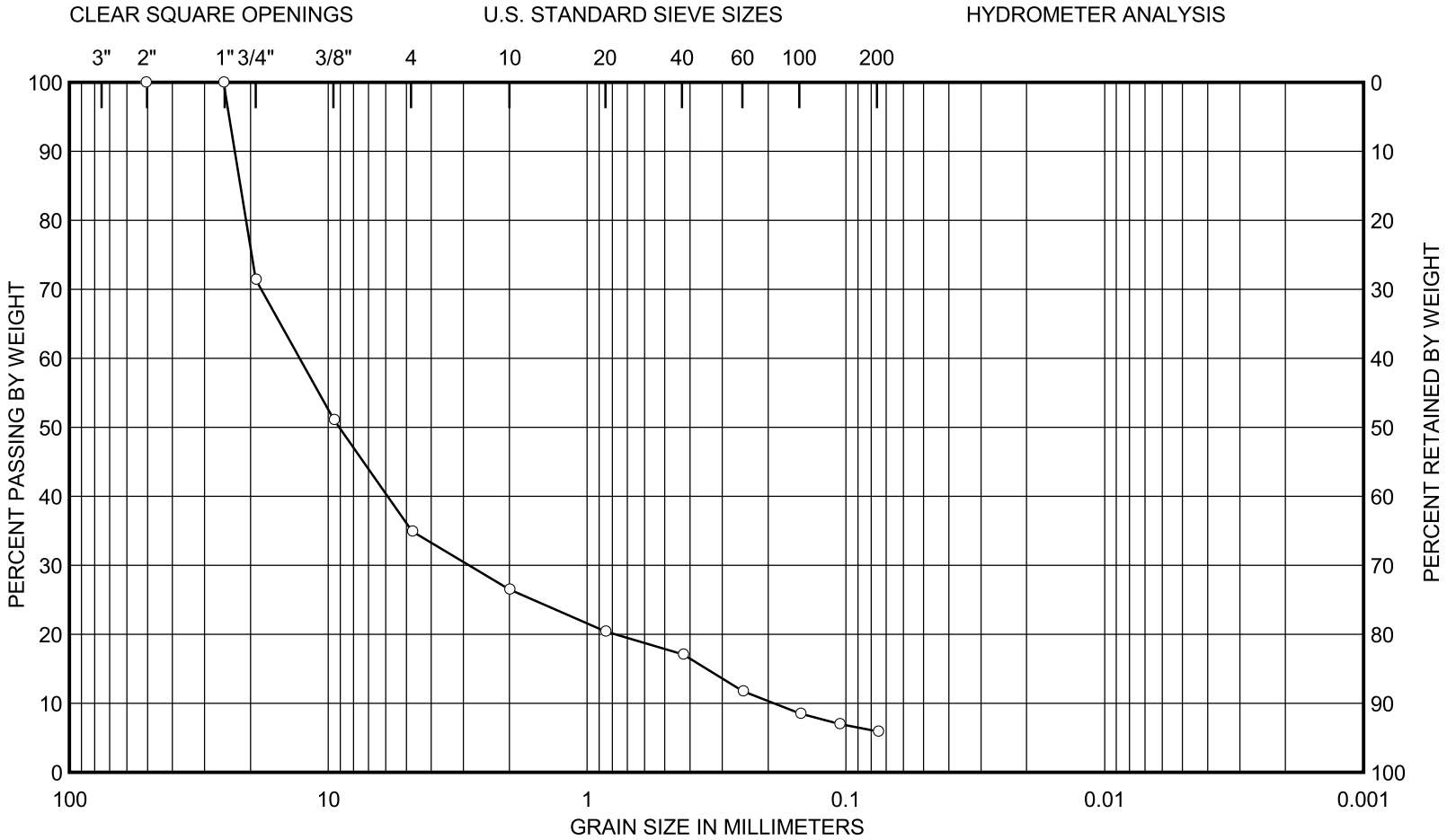
SUMMARY OF LABORATORY TEST RESULTS
Boring 98-23
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO



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

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50
2	1.1	○——○	Fine GRAVEL (GP-GM) with silt, sand, and coarse gravel	3.34	67.73	9.09

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-23
SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-23.11

NO PLASTICITY CHART FOR THIS BORING

NO STRESS-STRAIN CURVES FOR THIS BORING

NO CRS OR INCREMENTAL CONSOLIDATION TESTS PERFORMED FOR THIS BORING

NO K_O CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TESTS PERFORMED FOR THIS BORING

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

NO PLASTICITY INDEX PROFILE FOR THIS BORING

NO LIQUIDITY INDEX PROFILE FOR THIS BORING

NO SENSITIVITY PROFILE FOR THIS BORING

NO E50 PROFILE FOR THIS BORING

NO PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA FOR THIS BORING

NO RELATIVE DENSITY INTERPRETED FROM CPT DATA FOR THIS BORING

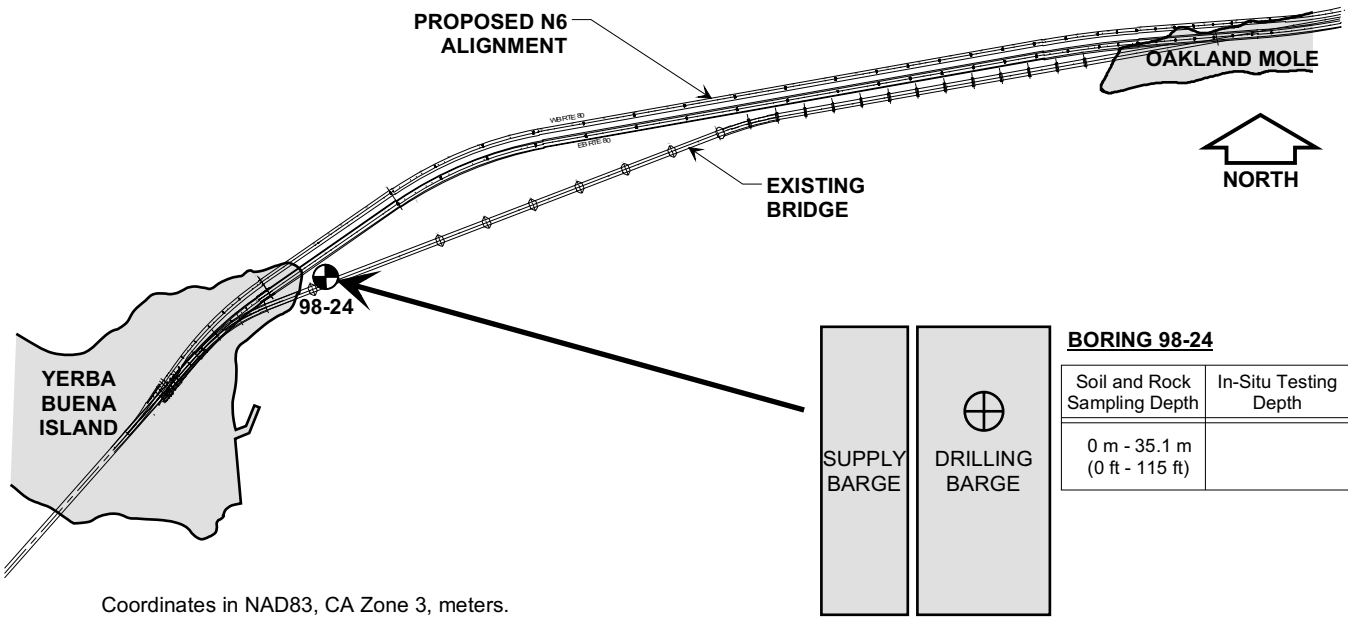
BORING 98-24

Date	Time From	Time To	Description of Activity
October 7, 1998	1045	1435	Move barge to location 98-24. Set 4 anchors.
	1435	1630	Rig up for drilling. Lower drill pipe to mudline.
	1630	1645	Measure water depth of 19.6m (64.2 ft) using bottom sensor. Current tide level is approximately +0.1m (+0.2 ft) MSL. Calculate mudline elevation of -19.5m (-64 ft) MSL.
	1645	2030	Drill and sample from mudline to 1.2m (4 ft). Encounter refusal to drilling due to cobbles and boulders.
	2030	2100	Winch barge over 1.5m (5 ft). Refusal to drilling at 0.9m (3 ft). Pull drill pipe to deck.
	2100	2400	Set casing.
October 8, 1998	0000	0400	Set casing and lower drill pipe to mudline.
	0400	0730	Clean core pipe thread and check split barrels and adapters. Lower core pipe to 0.9m (3 ft).
	0730	1130	Core from 0.9m (3 ft) to 4.9m (16 ft).
	1130	1200	Mix and circulate drilling mud.
	1200	1400	Core from 4.9m (16 ft) to 6.7m (22 ft). Hole caved in while adding joint of core pipe.
	1400	1500	Core to 4.9m (16 ft) and recover gravel.
	1500	1600	Pull core pipe to deck.
	1600	2045	Advance drill pipe to 7.3m (24 ft).
	2045	2145	Advance core pipe through drill pipe with center bit.
	2145	2210	Rig repair. Perform maintenance on master clutch.
	2210	2315	Advance core pipe to 7.6m (25 ft).
	2315	2400	Rock coring from 7.6m (25 ft) to 9.1m (30 ft).
October 9, 1998	0000	0930	Rock coring from 9.1m (30 ft) to 19.2m (63 ft). Core pipe stuck in the hole.
	0930	1200	Attempt to retrieve core pipe. Pull drill pipe to mudline.
	1200	1430	Pump seawater and partially free core pipe. Mix and circulate drilling mud.
	1430	1630	Pump mud to remove coarse cuttings. Free core pipe and pull to deck.
	1630	1830	Advance drill pipe to 8.5m (28 ft).
	1830	2400	Advance core pipe with center bit from 0.9m (3 ft) to 13.7m (45 ft).
October 10, 1998	0000	0140	Advance core pipe with center bit from 13.7m (45 ft) to 19.2m (63 ft).
	0140	1730	Rock coring from 19.2m (63 ft) to 35.1m (115 ft).
	1730	1800	Pull core pipe to 12.2m (40 ft).
	1800	2000	P- and S-wave velocity logging from 35.1m (115 ft) to 12.2m (40 ft).

SUMMARY OF FIELD OPERATIONS
Boring 98-24
SFOBB East Span Seismic Safety Project

Date	Time From	Time To	Description of Activity
	2000	2100	Caliper and acoustic televiewer logging from 35.1m (115 ft) to 12.2m (40 ft).
	2100	2125	Pull core pipe to deck.
	2125	2230	Acoustic televiewer logging from 12.2m (40 ft) to 8.5m (28 ft), and caliper logging from 35.1m (115 ft) to 8.5m (28 ft).
	2230	2300	P- and S-wave velocity logging from 15.2m (50 ft) to 8.5m (28 ft).
	2300	2400	Lower N-rod. Mix and circulate cement. Grout hole 98-24.
October 11, 1998	0000	0300	Pull N-rod, drill pipe, and casing to deck.
	0300	0400	Reposition barge at location 98-22.

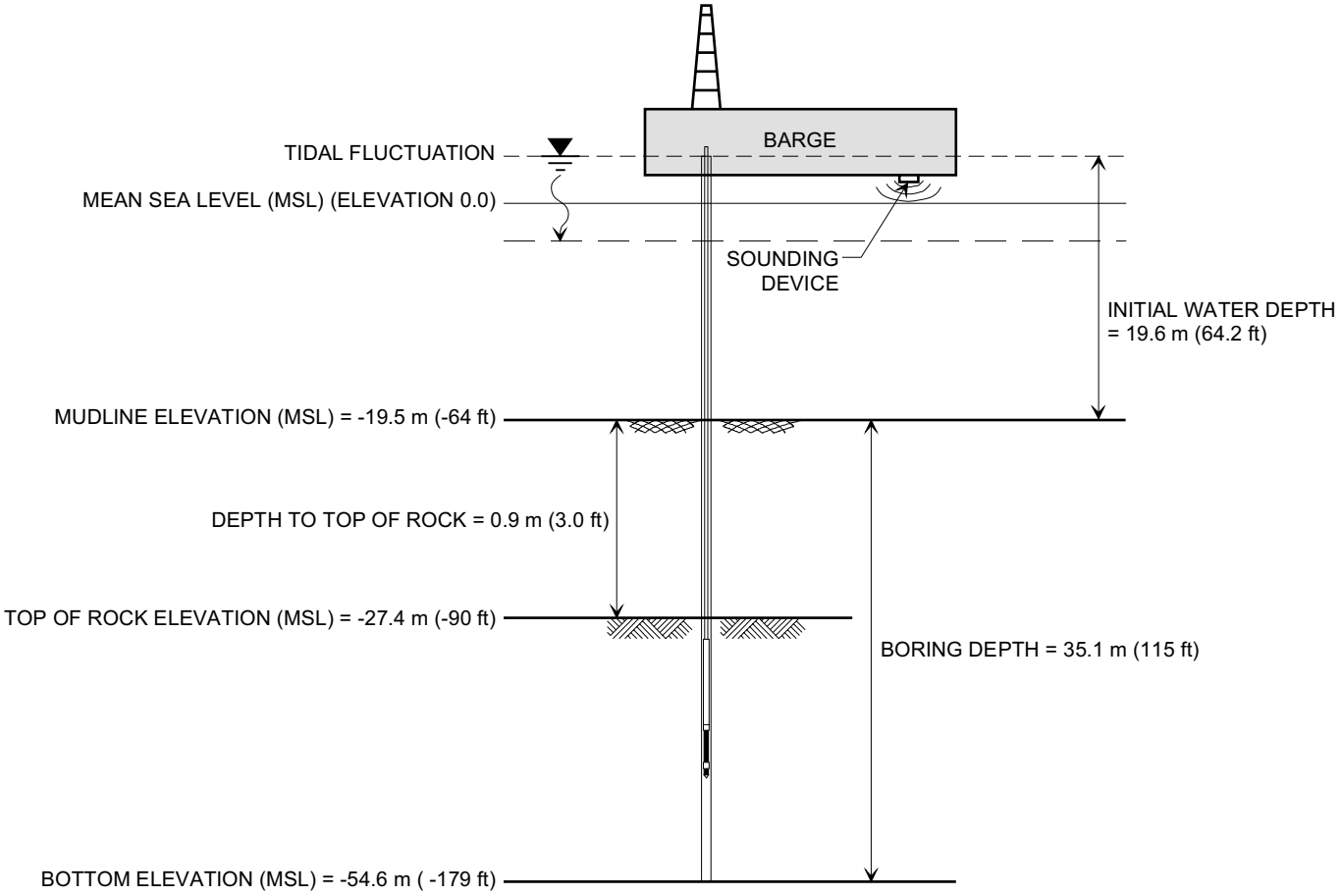
SUMMARY OF FIELD OPERATIONS
Boring 98-24
SFOBB East Span Seismic Safety Project



BORING 98-24

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 35.1 m (0 ft - 115 ft)		E = 1,836,391 N = 647,599

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-24
SFOBB East Span Seismic Safety Project

PROJECT NO:	98-42-0054	**START DATE:**	10/07/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-24 (Main Span - Pylon)	**COMPLETION DATE:**	10/11/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

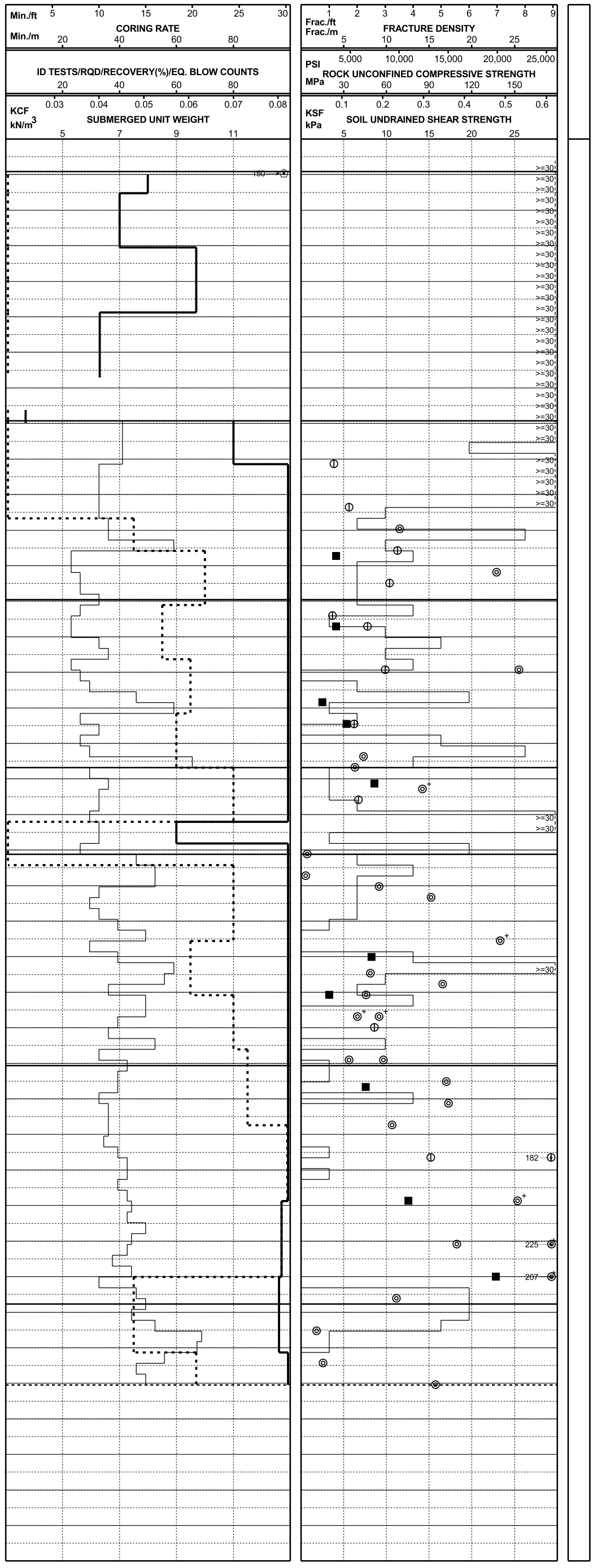
Coordinates: E1836391 N647599
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -19.5m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Sandy CLAY (CH), dark olive gray, very soft, with shell fragments and gravel to 0.1m (0.9m)	I
SANDSTONE (Graywacke) (Rx), dark greenish gray to light brown (7.9m)	II
SANDSTONE (Graywacke) (Rx), yellowish brown, moderately weathered, moderately soft, intensely fractured, thinly to thickly bedded (13.0m)	III
SANDSTONE (Graywacke) (Rx) with thinly interbedded SILTSTONE (Rx) [10:1], slightly weathered -sandstone: medium gray, hard, moderately fractured, slightly rough with thin yellowish orange iron oxide staining, fractures dipping 20, 30, 40 and 60 degrees -siltstone, 14.3m to 14.5m -siltstone, 15.8m to 16.2m -siltstone, dark gray, moderately hard, thinly bedded, intensely fractured, bedding dipping 20 degrees, below 17.4m (17.7m)	IV
SANDSTONE (Graywacke) (Rx), medium gray, fresh, hard, slightly fractured (20.1m)	V
SANDSTONE (Graywacke) (Rx) with thinly interbedded SILTSTONE (Rx) and CLAYSTONE (Rx) [1:1:0.5], fresh -sandstone: medium gray, hard, slightly fractured, with numerous, healed, closed, 1mm to 3mm thick, quartz/calcite filled fractures, dipping 60 to 80 degrees -interbedded siltstone and claystone, 23.3m to 24.7m -sandstone, 24.7m to 25.6m (26.1m)	VI
SANDSTONE (Graywacke) (Rx), medium gray, fresh, hard, slightly fractured (32.8m)	VII
SILTSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) and CLAYSTONE (Rx) [1.5:1:0.5], fresh -sandstone interbed, 33.4m to 34.0m -claystone interbed, 34.0m to 34.4m -sandstone below 34.4m	VIII

TOTAL DEPTH: 35.1m BACKFILLED WITH: Cement Grout

See Plate 98-24.6 for detailed stratigraphy



LOG OF BORING AND TEST RESULTS

BORING 98-24

SFOBB East Span Seismic Safety Project

Report Date: 05/07/99

PLATE 98-24.3

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NO SINGLE-PAGE BORING LOGS WITH CPT DATA FOR THIS BORING

PROJECT NO:	98-42-0054	**START DATE:**	10/07/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-24 (Main Span - Pylon)	**COMPLETION DATE:**	10/11/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836391 N647599
CA State Plane Zone 3, NAD83, Meters

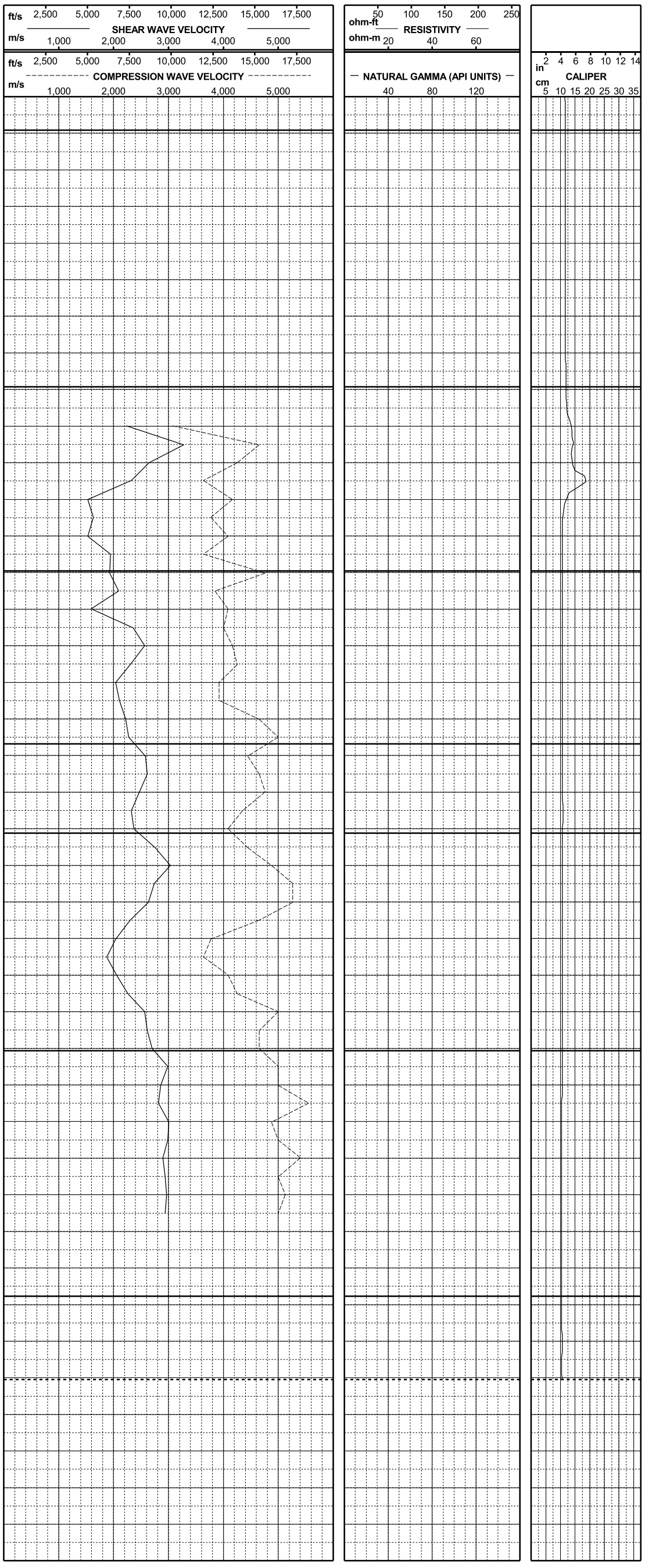
MUDLINE ELEVATION: -19.5m (MSL)

Blow Count	Material Description	Stratum No.
WOH	Sandy CLAY (CH), dark olive gray, very soft, with shell fragments and gravel to 0.1m (0.9m)	I
60/10cm, 50-0, 40-0, 67-0, 67-0, 33-0, 7-0	SANDSTONE (Graywacke) (Rx), dark greenish gray to light brown (7.9m)	II
80-0, 100-0, 100-45, 100-70	SANDSTONE (Graywacke) (Rx), yellowish brown, moderately weathered, moderately soft, intensely fractured, thinly to thickly bedded (13.0m)	III
100-55, 100-65, 100-60	SANDSTONE (Graywacke) (Rx) with thinly interbedded SILTSTONE (Rx) [10:1], slightly weathered -sandstone: medium gray, hard, moderately fractured, slightly rough with thin yellowish orange iron oxide staining, fractures dipping 20, 30, 40 and 60 degrees -siltstone, 14.3m to 14.5m -siltstone, 15.8m to 16.2m -siltstone, dark gray, moderately hard, thinly bedded, intensely fractured, bedding dipping 20 degrees, below 17.4m (17.7m)	IV
100-80, 60-0	SANDSTONE (Graywacke) (Rx), medium gray, fresh, hard, slightly fractured (20.1m)	V
100-0, 100-80, 100-65, 100-80	SANDSTONE (Graywacke) (Rx) with thinly interbedded SILTSTONE (Rx) and CLAYSTONE (Rx) [1:1:0.5], fresh -sandstone: medium gray, hard, slightly fractured, with numerous, healed, closed, 1mm to 3mm thick, quartz/calcite filled fractures, dipping 60 to 80 degrees -interbedded siltstone and claystone, 23.3m to 24.7m -sandstone, 24.7m to 25.6m (26.1m)	VI
100-85, 100-99, 97-97	SANDSTONE (Graywacke) (Rx), medium gray, fresh, hard, slightly fractured (32.8m)	VII
96-45, 100-67	SILTSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) and CLAYSTONE (Rx) [1.5:1:0.5], fresh -sandstone interbed, 33.4m to 34.0m -claystone interbed, 34.0m to 34.4m -sandstone below 34.4m	VIII

See Plate 98-24.6 for detailed stratigraphy

TOTAL DEPTH: 35.1m

BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-24

SFOBB East Span Seismic Safety Project

Report Date: 05/07/99

PLATE 98-24.5

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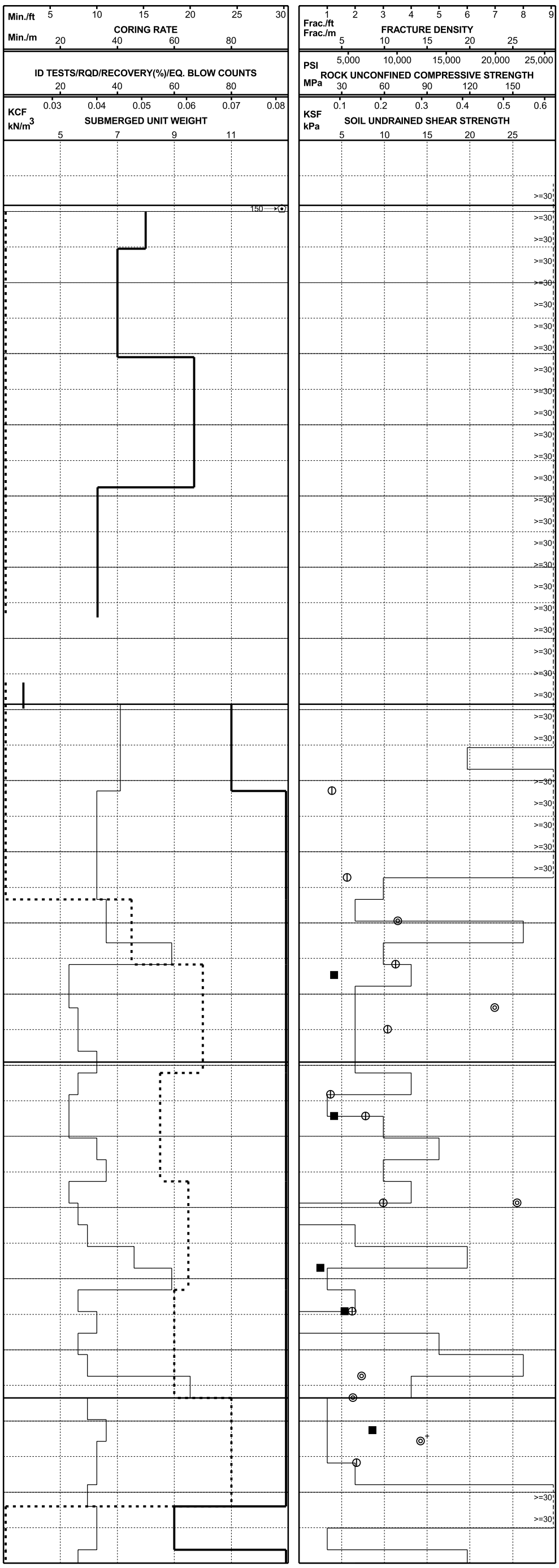
PROJECT NO:	98-42-0054	**START DATE:**	10/07/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-24 (Main Span - Pylon)	**COMPLETION DATE:**	10/11/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836391 N647599
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -19.5m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
				WOH	Sandy CLAY (CH), dark olive gray, very soft, with shell fragments and gravel to 0.1m (0.9m)	I
-20	1			60/10cm	SANDSTONE (Graywacke) (Rx), dark greenish gray to light brown -intensely weathered, intensely fractured, gravel to cobble size, sandstone/rock fragments	II
-21				50-0		
-22	2			40-0		
-23	3			67-0		
-24	4			67-0		
-25	5			33-0		
-26	6					
-27	7			7-0	(7.9m)	
-28	8			80-0	SANDSTONE (Graywacke) (Rx), yellowish brown, moderately weathered, moderately soft, intensely fractured, thinly to thickly bedded -bedding dipping 20 to 30 degrees, slightly rough fractures, clean with thin clay filling	III
-29	9					
-30	10			100-0	-grading to slightly weathered, moderately hard to hard, intensely to moderately weathered for 25mm on each side of fractures, at 10.7m	
-31	11			100-45	-iron oxide staining on fracture surfaces, only minor weathering of rock adjacent to fractures, at 11.6m	
-32	12			100-70	(13.0m)	
-33	13				SANDSTONE (Graywacke) (Rx) with thinly interbedded SILTSTONE (Rx) [10:1], slightly weathered -sandstone: medium gray, hard, moderately fractured, slightly rough with thin yellowish orange iron oxide staining, fractures dipping 20, 30, 40 and 60 degrees	IV
-34	14			100-55	-siltstone: dark gray, moderately hard, thinly bedded, intensely fractured, bedding dipping 20 degrees, with smooth bedding-plane surfaces -siltstone to 13.1m -siltstone, 14.3m to 14.5m -slightly to moderately rough fracture surfaces with thin yellowish orange iron oxide staining, at 14.6m	
-35	15			100-65	-0.15m to 0.3m wide zones, with numerous healed, 1mm to 5mm thick, quartz/calcite filled fractures, dipping 60 degrees to near vertical, at 14.9m -medium gray, fresh, hard, at 15.2m	
-36	16				-siltstone, 15.8m to 16.2m -bedding dipping 25 degrees, at 16.5m	
-37	17			100-60	-50mm thick, intensely fractured claystone interbed, with smooth, polished bedding-plane surfaces, and well developed slickensides parallel to 30 degree bedding dip, at 16.8m -zone of 1mm thick quartz/calcite, healed fractures, dipping 60 to 70 degrees, 17.1m to 17.6m -siltstone, dark gray, moderately hard, thinly bedded, intensely fractured, bedding dipping 20 degrees, below 17.4m (17.7m)	
-38	18			100-80	SANDSTONE (Graywacke) (Rx), medium gray, fresh, hard, slightly fractured -fractures: slightly rough, dipping 45 and 70 degrees, with thin, discontinuous quartz/calcite filling, 0.3m spacing between fractures	V
-39	19			60-0		
				100-0		



LOG OF BORING AND TEST RESULTS

BORING 98-24

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

PLATE 98-24.6a

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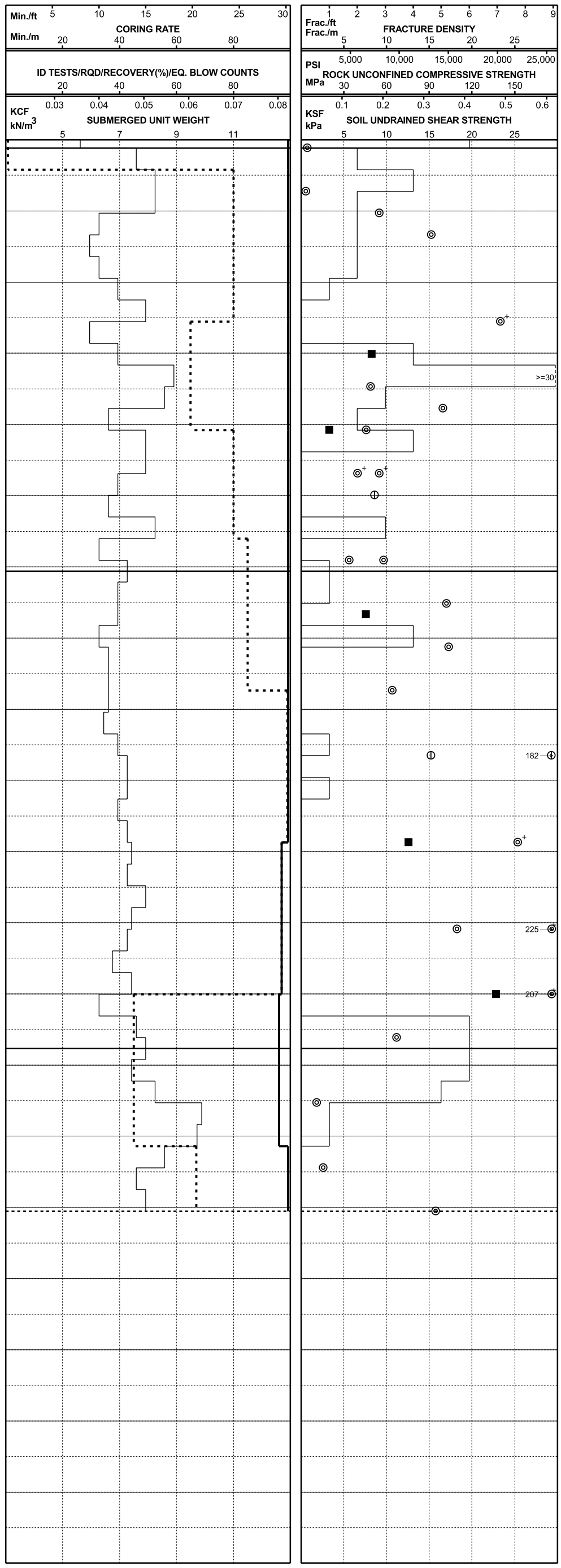
PROJECT NO:	98-42-0054	**START DATE:**	10/07/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-24 (Main Span - Pylon)	**COMPLETION DATE:**	10/11/98	**DRILLING METHOD:**	Rotary Sample/Diamond Core Boring

Coordinates: E1836391 N647599
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -19.5m (MSL)

BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
100-0	SANDSTONE (Graywacke) (Rx), medium gray, fresh, hard, slightly fractured (20.1m)	V
100-80 100-65 100-80	SANDSTONE (Graywacke) (Rx) with thinly interbedded SILTSTONE (Rx) and CLAYSTONE (Rx) [1:1:0.5], fresh -sandstone: medium gray, hard, slightly fractured, with numerous, healed, closed, 1mm to 3mm thick, quartz/calcite filled fractures, dipping 60 to 80 degrees -siltstone: dark gray, moderately hard, thinly bedded, intensely fractured, smooth bedding-plane surfaces, with some pyrite, dipping 20 degrees -claystone: dark gray to black, moderately hard, very thinly bedded, very intensely fractured, with thin calcite striations parallel to 20 degree bedding-plane surfaces -fractures: slightly rough fractures, dipping 30, 50, 60 and 70 degrees, 50mm to 0.3m spacing, with thin discontinuous quartz/calcite filling -interbedded siltstone and claystone, 23.3m to 24.7m -sandstone, 20.9m to 21.6m -with healed, 1mm to 5mm thick, calcite/quartz filled fractures, dipping 60, 70, and 80 degrees, in 0.3m thick zones, with numerous fractures per zone, at 23.5m -sandstone, 24.7m to 25.6m (26.1m)	VI
100-85 100-99 97-97	SANDSTONE (Graywacke) (Rx), medium gray, fresh, hard, slightly fractured -fractures: primarily 1mm thick, healed, dipping 60 degrees to near vertical, spacing typically 0.15m to 0.3m -with a few shallow (10 to 30 degree), fractures, slightly rough fracture surface, with discontinuous, very thin to 5mm thick calcite/quartz filling, spacing typically 0.3m to 1.0m, below 26.2m (32.8m)	VII
96-45 100-67	SILTSTONE (Rx) with interbedded SANDSTONE (Graywacke) (Rx) and CLAYSTONE (Rx) [1.5:1:0.5], fresh -siltstone: dark gray, moderately hard, thinly bedded, intensely fractured, smooth bedding-plane surfaces, with some pyrite mineralization, dipping 20 degrees -sandstone: medium gray, hard, slightly fractured, thinly to thickly bedded, with numerous, healed, 1mm thick, quartz/calcite filled fractures, dipping at 60 degrees -sandstone interbed, 33.4m to 34.0m -claystone interbed, 34.0m to 34.4m -sandstone below 34.4m	VIII

TOTAL DEPTH: 35.1m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-24

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

PLATE 98-24.6b

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NO MULTI-PAGE BORING LOGS WITH CPT DATA FOR THIS BORING

**NO LOG OF NEAR-SURFACE MATERIALS
FOR THIS BORING**

NO HALIBUT OR DOWNHOLE VANE TESTS PERFORMED FOR THIS BORING

98-24		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
9.1																									23.1	
10.4																									33.8	
11.0																									69.2	
11.6																									67.9	
11.7																					24.3	38.3	26.4	0.31		
12.2																									137.1	
12.5																									62.3	
13.4																									22.1	
13.7																					24.3	34.5	26.3	0.37	46.7	
14.9																									59.2	
14.9																									152.9	
15.8																					14.6	14.3	26.0	0.31		
16.5																					31.8	27.0	26.5	0.36	37.4	
17.4																									43.6	
17.7																									37.7	

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
c = Effective Cohesion
phi = Effective Angle of Friction

Compaction Tests
Max DD = Max. Dry Unit Wt.
OMC = Optimum Moisture Content

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 98-24
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-24		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
18.1																					51.4	55.6	26.6	0.32		
18.3																									85.0	
18.6																									40.5	
20.1																									4.1	
20.7																									3.0	
21.0																									54.7	
21.3																									91.1	
22.6																									139.7	
23.0																					49.2	42.1	26.5	0.37		
23.5																									48.6	
23.8																									99.2	
24.1																					19.5	28.3	26.4	0.35	45.5	
24.1	21														2.9	24	23.5	23								
24.4	21														9.1	24	15.3	24								
24.7																									39.5	

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Identification Tests
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Fines = % Passing No. 200 Sieve

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-24
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-24		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
24.7																									54.7	
25.0																									51.6	
25.9																									33.4	
25.9																									57.7	
26.5																									101.7	
26.7																					45.2	65.0	26.6	0.31		
27.1																									103.3	
27.7																									63.8	
28.7																									91.1	
28.7																									182.2	
29.9																					75.2	66.3	26.7	0.30	151.9	
31.1																									224.8	
31.1																									109.3	
32.0																					136.8	69.0	26.7	0.35	206.5	
32.6																									66.8	

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Fines = % Passing No. 200 Sieve

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-24
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-24		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	DIRECT SHEAR TESTS				COMPACTION TESTS		ROCK TESTS					ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	Max DD (kN/m3)	OMC (%)	Unconf. Comp. (MPa)	Youngs Modulus (GPa)	TUW (kN/m3)	Poisson Ratio	Point Load Test (MPa)	
33.5																									10.6	
34.4																									15.2	
35.1																									94.2	

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
c = Effective Cohesion
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Compaction Tests
Max DD = Max. Dry Unit Wt.
OMC = Optimum Moisture Content

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 98-24
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

**NO GRAIN SIZE DISTRIBUTION CURVES
FOR THIS BORING**

NO PLASTICITY CHART FOR THIS BORING

NO STRESS-STRAIN CURVES FOR THIS BORING

NO CRS OR INCREMENTAL CONSOLIDATION TESTS PERFORMED FOR THIS BORING

NO K_O CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TESTS PERFORMED FOR THIS BORING

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

NO PLASTICITY INDEX PROFILE FOR THIS BORING

NO LIQUIDITY INDEX PROFILE FOR THIS BORING

NO SENSITIVITY PROFILE FOR THIS BORING

NO E50 PROFILE FOR THIS BORING

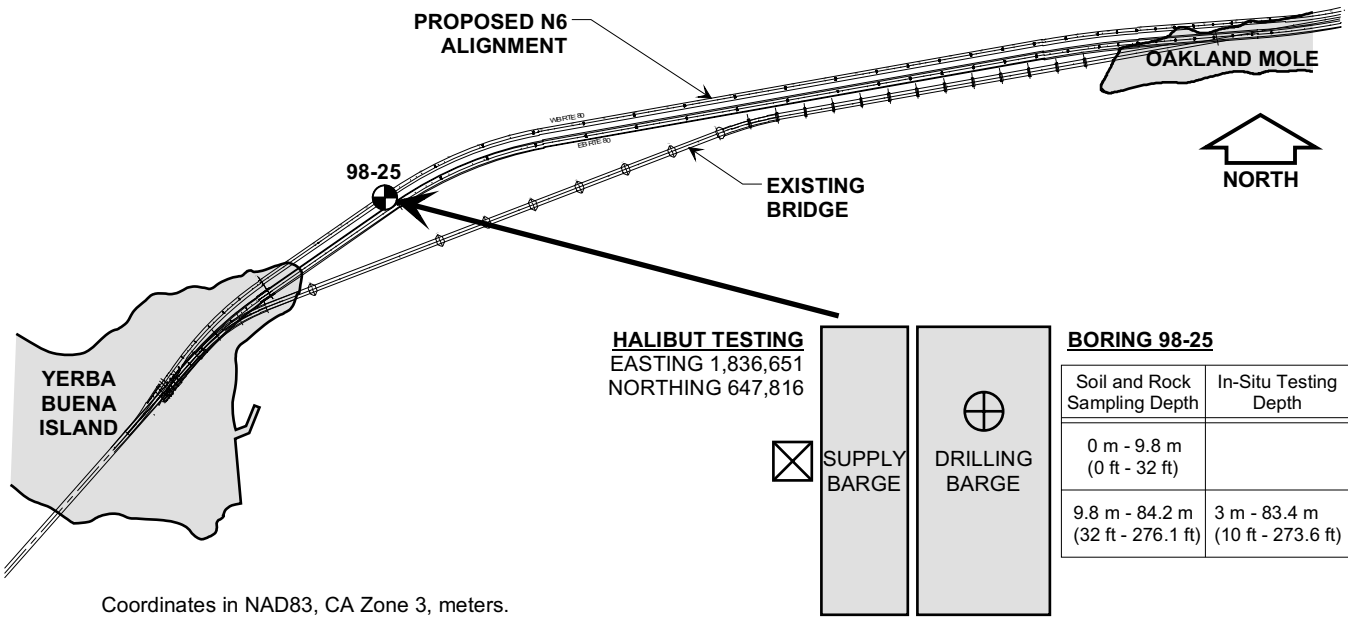
NO PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA FOR THIS BORING

NO RELATIVE DENSITY INTERPRETED FROM CPT DATA FOR THIS BORING

BORING 98-25

Date	Time From	Time To	Description of Activity
October 20, 1998	1100	1330	Move barge to location 98-25. Set 4 anchors and 2 spuds.
	1330	1445	Position barge at location 98-25.
	1445	1515	Rig up for drilling. Lower drill pipe to mudline.
	1515	1520	Measure water depth of 13.0m (42.6 ft) using bottom sensor. Current tide level is approximately 0.23m (0.76 ft) MSL. Calculate mudline elevation of -12.7m (-41.8 ft) MSL.
	1520	1720	Drill and sample from mudline to 9.8m (32 ft).
	1720	2400	Pull drill pipe to deck, reposition barge, set casing.
October 21, 1998	0000	0245	Set casing. Drive stinger to 8.5m (28 ft).
	0245	0400	Lower drill pipe to mudline.
	0400	2400	Diagnose and perform repair on CPT tool, casing, and piston.
October 22, 1998	0000	0345	Perform CPT deck test and pipe test.
	0345	2400	Drill, sample, and CPT testing from mudline to 63.4m (208 ft).
October 23, 1998	0000	0130	Restore plumb in casing string.
	0130	0900	Drill, sample, and CPT testing from 63.4m (208 ft) to 83.4m (273.5 ft).
	0900	1100	Drill and sample from 83.4m (273.5 ft) to 84.2m (276.1 ft). Mix mud.
	1100	1200	Pull drill pipe to deck. Hole caved in to 78.6m (258 ft).
	1200	1615	P- and S-wave velocity logging from 78.7m (258.2 ft) to 8.5m (28 ft). Rig up Halibut vane equipment. Halibut testing from 0.6m (2 ft) to 1.2m (4 ft).
	1615	1715	Pull stinger to 1.5m (5 ft). P- and S-wave velocity logging from 8.5m (28 ft) to 2.5m (8.2 ft).
	1715	1900	Lower N-rod.
	1900	2045	Mix and circulate cement. Grout hole 98-25.
	2045	2145	Pull N-rod to deck.
	2145	2220	Pull casing to deck.
	2220	2400	Pull 2 spuds, 4 anchors, and move barge to location 98-26.

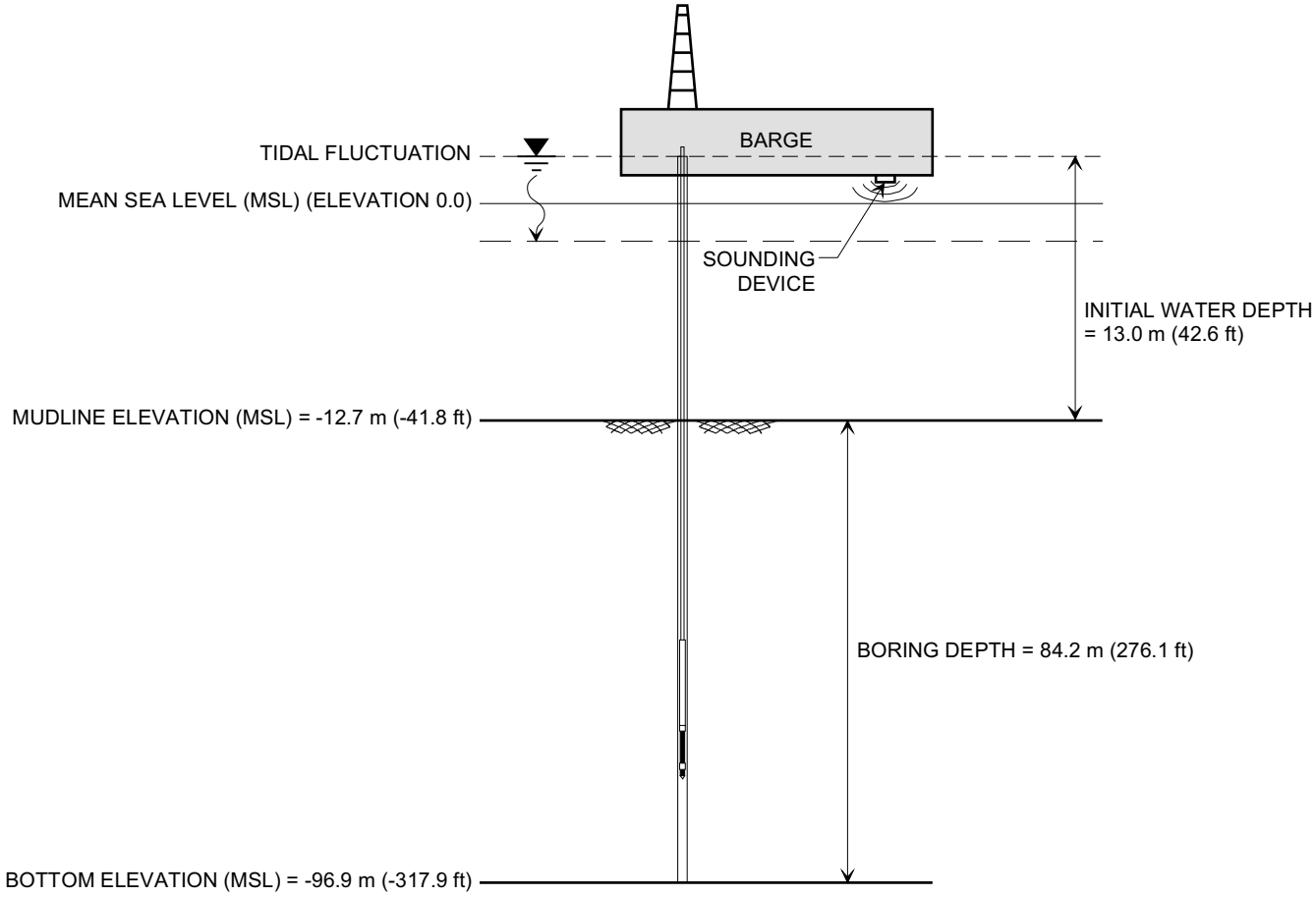
SUMMARY OF FIELD OPERATIONS
Boring 98-25
SFOBB East Span Seismic Safety Project



BORING 98-25

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 9.8 m (0 ft - 32 ft)		E = 1,836,668 N = 647,818
9.8 m - 84.2 m (32 ft - 276.1 ft)	3 m - 83.4 m (10 ft - 273.6 ft)	E = 1,836,666 N = 647,819

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-25
SFOBB East Span Seismic Safety Project

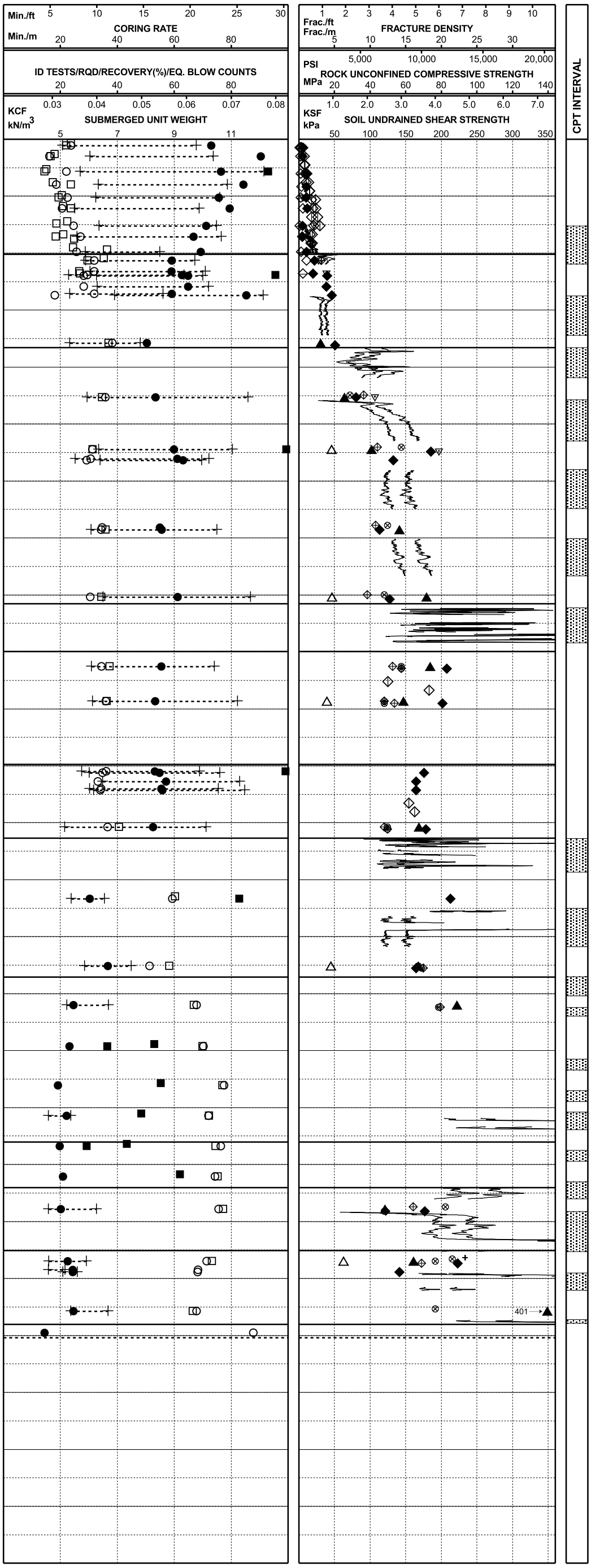
PROJECT NO:	98-42-0054	**START DATE:**	10/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-25 (Main Span-East Pier)	**COMPLETION DATE:**	10/23/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836666 N647819
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

Elevation, m.	Depth, m.	Blow Count	Material Description	Stratum No.
		WOH, WOH, WOH, WOH, WOH, WOH, WOH, WOH, WOH, WOH, WOH, WOH, SAVE, SAVE, SAVE, PUSH	Fat CLAY (CH), very soft to soft, olive gray -with shell fragments -dark gray with olive gray streaks and many sandy silt pockets, at 0.3m -with organic stains at 0.9m -with many silt pockets at 2.1m -with silt pockets below 2.7m -with silt seams at 3.0m -with mica at 4.7m -with sand pockets below 6.4m (8.1m) Fat CLAY (CH), firm, gray -with shell fragments -with silt pockets and many sand pockets, at 9.1m -platy, 9.1m to 11.0m -with organic pockets at 11.0m -with organic pockets, at 14.3m -intermixed sand and clay, below 14.3m (14.6m)	I II
-16, -20, -24, -28	4, 8, 12, 16	26/30cm, PUSH, SAVE, PUSH	Fat CLAY (CH), stiff to very stiff, greenish gray -with silt partings and gas blisters, 21.3m to 27.4m -with silt pockets, silt seams and shell fragments, at 27.1m -with silty sand pockets, shell fragments and slickensides, at 32.0m (32.6m)	III
-32, -36, -40, -44	20, 24, 28, 32			
-48	36		Fat CLAY (CH), very stiff, greenish gray -with dense, silty fine sand layers (36.0m)	IV
-52	40	PUSH, PUSH	Fat CLAY (CH), very stiff, greenish gray -with silt pockets, silty sand seams and shell fragments, at 36.9m -with silty sand pockets and seams, and shell fragments, at 39.5m -interlayered dense, silty fine sand and very stiff clay, 40.2m to 42.7m (43.9m)	V
-56, -60	44, 48	SAVE, SAVE, SAVE, PUSH	Fat CLAY (CH), very stiff, greenish gray -with organic pockets, and silt pockets and partings, at 48.2m (49.1m)	VI
-64, -68	52, 56	PUSH, PUSH	Lean CLAY (CL), very stiff, greenish gray -interlayered, lean clay, silty sand and sandy silt to 55.5m -with sand seams, 49.4m to 51.2m -clay with many silt pockets, partings and seams, at 53.0m -with silty sand partings, organic pockets, a few shells, and shell fragments, at 57.9m (58.8m)	VII
-72, -76, -80	60, 64, 68	PUSH, 30/30cm, 30/30cm, 30/30cm	Silty Fine SAND (SM), very dense, gray -lean clay layer with fine to medium sand and wood pockets, 60.4m to 61.0m -with a clay layer at 61.4m -with fat clay pockets at 63.6m -with medium sand and clay pockets at, 66.1m -sandy silt at 66.3m -with a clay layer at 67.7m -interlayered sand and clay, 68.3m to 70.1m -lean clay layer with fine sand pockets, at 68.6m (70.4m)	VIII
-84	72	30/30cm, 30/25cm	Silty Fine SAND (SM), very dense, dark gray -with clay layers at 71.3m, 71.6m, and 71.8m -sandy silt below 72.5m (73.6m)	IX
-88	76	PUSH	Lean CLAY (CL), hard, dark greenish gray -with organic pockets and calcareous nodules, at 75.0m -sandy silt below 77.4m (78.0m)	X
-92	80	PUSH, SAVE, PUSH	Lean CLAY (CL), hard, greenish gray -with many silt pockets at 78.6m -with sand pockets, at 79.2m -silty sand layer, 79.9m to 80.6m (83.2m)	XI
-96	84	50/5cm, 50/5cm, 50/5cm	SANDSTONE (Graywacke) (Rx), soft, intensely weathered, intensely fractured to decomposed	XII
-100, -104, -108, -112	88, 92, 96			

TOTAL DEPTH: 84.2m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-25

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

PLATE 98-25.3

PROJECT NO:	98-42-0054	**START DATE:**	10/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-25 (Main Span-East Pier)	**COMPLETION DATE:**	10/23/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

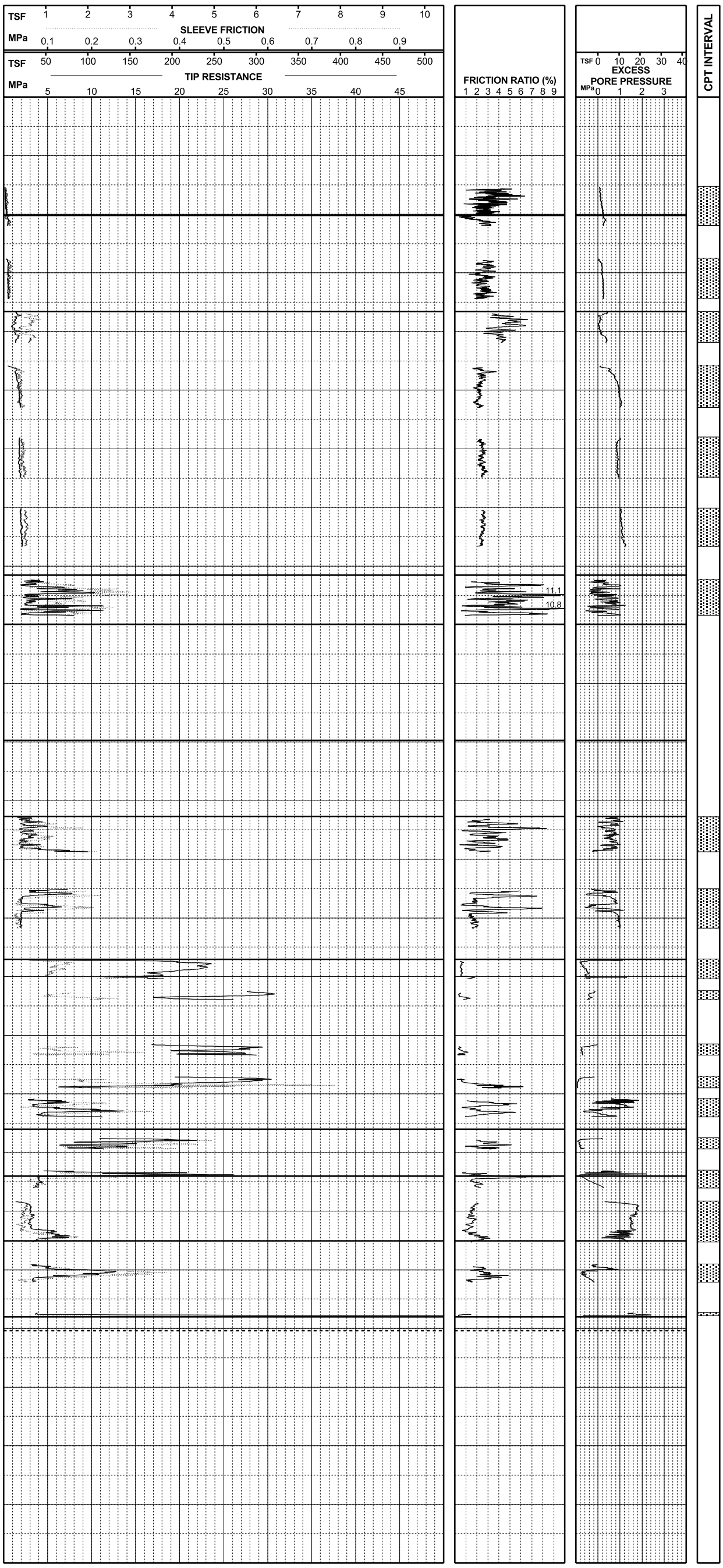
Coordinates: E1836666 N647819
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH, WOH, WOH, WOH, WOH, WOH, WOH, WOH, WOH, WOH, WOH, WOH, SAVE, SAVE, SAVE, PUSH	Fat CLAY (CH), very soft to soft, olive gray -with shell fragments -dark gray with olive gray streaks and many sandy silt pockets, at 0.3m -with organic stains at 0.9m -with many silt pockets at 2.1m -with silt pockets below 2.7m -with silt seams at 3.0m -with mica at 4.7m -with sand pockets below 6.4m (8.1m) Fat CLAY (CH), firm, gray -with shell fragments -with silt pockets and many sand pockets, at 9.1m -platy, 9.1m to 11.0m -with organic pockets at 11.0m -with organic pockets, at 14.3m (14.6m) -intermixed sand and clay, below 14.3m	I II
		26/30cm, PUSH, SAVE, PUSH, PUSH, PUSH	Fat CLAY (CH), stiff to very stiff, greenish gray -with silt partings and gas blisters, 21.3m to 27.4m -with silt pockets, silt seams and shell fragments, at 27.1m -with silty sand pockets, shell fragments and slickensides, at 32.0m (32.6m)	III
			Fat CLAY (CH), very stiff, greenish gray -with dense, silty fine sand layers (36.0m)	IV
		PUSH, PUSH	Fat CLAY (CH), very stiff, greenish gray -with silt pockets, silty sand seams and shell fragments, at 36.9m -with silty sand pockets and seams, and shell fragments, at 39.5m -interlayered dense, silty fine sand and very stiff clay, 40.2m to 42.7m (43.9m)	V
		SAVE, SAVE, SAVE, PUSH	Fat CLAY (CH), very stiff, greenish gray -with organic pockets, and silt pockets and partings, at 48.2m (49.1m)	VI
		PUSH, PUSH, PUSH	Lean CLAY (CL), very stiff, greenish gray -interlayered, lean clay, silty sand and sandy silt to 55.5m -with sand seams, 49.4m to 51.2m -clay with many silt pockets, partings and seams, at 53.0m -with silty sand partings, organic pockets, a few shells, and shell fragments, at 57.9m (58.8m)	VII
		PUSH, 30/30cm, 30/30cm, 30/30cm, 30/30cm, 30/30cm, 30/25cm	Silty Fine SAND (SM), very dense, gray -lean clay layer with fine to medium sand and wood pockets, 60.4m to 61.0m -with a clay layer at 61.4m -with fat clay pockets at 63.6m -with medium sand and clay pockets at, 66.1m -sandy silt at 66.3m -with a clay layer at 67.7m -interlayered sand and clay, 68.3m to 70.1m (70.4m)	VIII
			Silty Fine SAND (SM), very dense, dark gray -sandy silt below 72.5m (73.6m)	IX
		PUSH	Lean CLAY (CL), hard, dark greenish gray -with organic pockets and calcareous nodules, at 75.0m -sandy silt below 77.4m (78.0m)	X
		PUSH, SAVE, PUSH	Lean CLAY (CL), hard, greenish gray -with many silt pockets at 78.6m -with sand pockets, at 79.2m -silty sand layer, 79.9m to 80.6m (83.2m)	XI
		50/5cm, 50/5cm, 50/5cm	SANDSTONE (Graywacke) (Rx), soft, intensely weathered, intensely fractured to decomposed	XII

TOTAL DEPTH: 84.2m

BACKFILLED WITH: Cement Grout



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-25

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

PLATE 98-25.4

PROJECT NO:	98-42-0054	**START DATE:**	10/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-25 (Main Span-East Pier)	**COMPLETION DATE:**	10/23/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

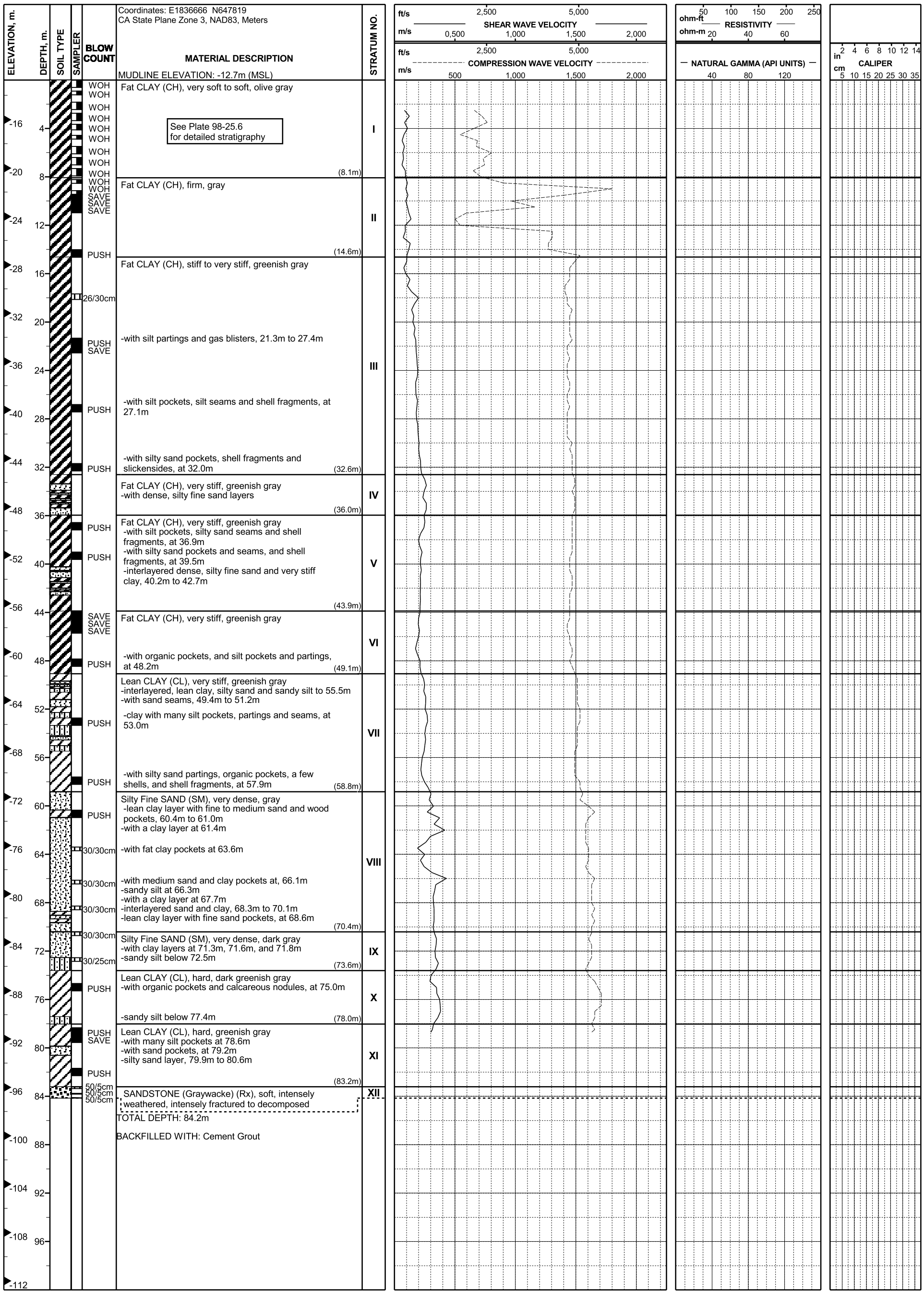
Coordinates: E1836666 N647819
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Fat CLAY (CH), very soft to soft, olive gray See Plate 98-25.6 for detailed stratigraphy (8.1m)	I
Fat CLAY (CH), firm, gray (14.6m)	II
Fat CLAY (CH), stiff to very stiff, greenish gray -with silt partings and gas blisters, 21.3m to 27.4m -with silt pockets, silt seams and shell fragments, at 27.1m -with silty sand pockets, shell fragments and slickensides, at 32.0m (32.6m)	III
Fat CLAY (CH), very stiff, greenish gray -with dense, silty fine sand layers (36.0m)	IV
Fat CLAY (CH), very stiff, greenish gray -with silt pockets, silty sand seams and shell fragments, at 36.9m -with silty sand pockets and seams, and shell fragments, at 39.5m -interlayered dense, silty fine sand and very stiff clay, 40.2m to 42.7m (43.9m)	V
Fat CLAY (CH), very stiff, greenish gray -with organic pockets, and silt pockets and partings, at 48.2m (49.1m)	VI
Lean CLAY (CL), very stiff, greenish gray -interlayered, lean clay, silty sand and sandy silt to 55.5m -with sand seams, 49.4m to 51.2m -clay with many silt pockets, partings and seams, at 53.0m -with silty sand partings, organic pockets, a few shells, and shell fragments, at 57.9m (58.8m)	VII
Silty Fine SAND (SM), very dense, gray -lean clay layer with fine to medium sand and wood pockets, 60.4m to 61.0m -with a clay layer at 61.4m -with fat clay pockets at 63.6m -with medium sand and clay pockets at, 66.1m -sandy silt at 66.3m -with a clay layer at 67.7m -interlayered sand and clay, 68.3m to 70.1m -lean clay layer with fine sand pockets, at 68.6m (70.4m)	VIII
Silty Fine SAND (SM), very dense, dark gray -with clay layers at 71.3m, 71.6m, and 71.8m -sandy silt below 72.5m (73.6m)	IX
Lean CLAY (CL), hard, dark greenish gray -with organic pockets and calcareous nodules, at 75.0m -sandy silt below 77.4m (78.0m)	X
Lean CLAY (CL), hard, greenish gray -with many silt pockets at 78.6m -with sand pockets, at 79.2m -silty sand layer, 79.9m to 80.6m (83.2m)	XI
SANDSTONE (Graywacke) (Rx), soft, intensely weathered, intensely fractured to decomposed	XII

TOTAL DEPTH: 84.2m

BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-25

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

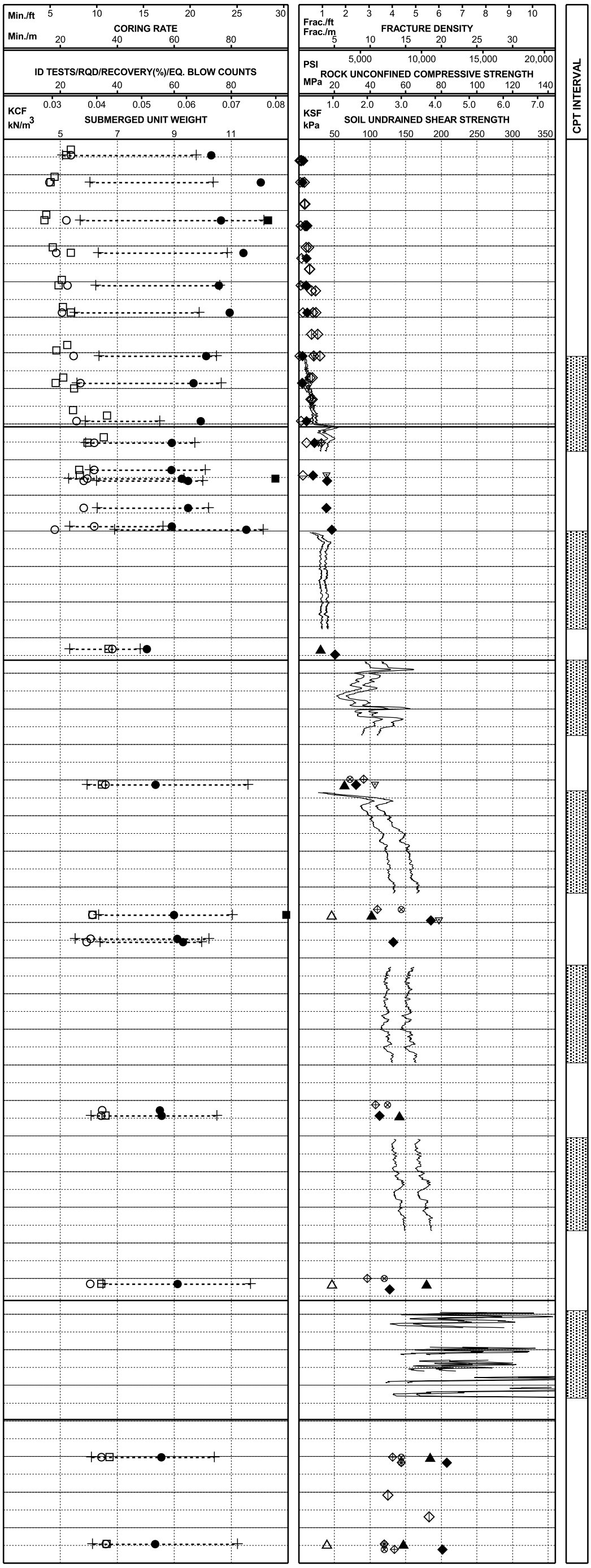
PLATE 98-25.5

PROJECT NO:	98-42-0054	**START DATE:**	10/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-25 (Main Span-East Pier)	**COMPLETION DATE:**	10/23/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836666 N647819
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-13		WOH	Fat CLAY (CH), very soft to soft, olive gray	I
			-with shell fragments	
	1	WOH	-dark gray with olive gray streaks and many sandy silt pockets, at 0.3m	
-14			-with organic stains at 0.9m	
	2	WOH	-with many silt pockets at 2.1m	
-15			-with silt pockets below 2.7m	
	3	WOH	-with silt seams at 3.0m	
-16				
	4	WOH		
-17				
	5	WOH	-with mica at 4.7m	
-18				
	6	WOH		
-19			-with sand pockets below 6.4m	
	7	WOH		
-20				
	8	WOH	(8.1m)	
-21		WOH	Fat CLAY (CH), firm, gray	II
			-with shell fragments	
	9		-with silt pockets and many sand pockets, at 9.1m	
-22		WOH SAVE	-platy, 9.1m to 11.0m	
	10	SAVE		
-23				
	11	SAVE	-with organic pockets at 11.0m	
-24				
	12			
-25				
	13			
-26				
	14			
-27		PUSH	-with organic pockets, at 14.3m	
			-intermixed sand and clay, below 14.3m (14.6m)	
-28	15		Fat CLAY (CH), stiff to very stiff, greenish gray	III
	16			
-29				
	17			
-30				
	18	26/30cm		
-31				
	19			
-32				
	20			
-33				
	21			
-34		PUSH	-with silt partings and gas blisters, 21.3m to 27.4m	
	22	SAVE		
-35				
	23			
-36				
	24			
-37				
	25			
-38				
	26			
-39				
	27	PUSH	-with silt pockets, silt seams and shell fragments, at 27.1m	
-40				
	28			
-41				
	29			
-42				
	30			
-43				
	31			
-44				
	32	PUSH	-with silty sand pockets, shell fragments and slickensides, at 32.0m	
-45			(32.6m)	
-46	33		Fat CLAY (CH), very stiff, greenish gray	IV
			-with dense, silty fine sand layers	
-47	34			
	35			
-48				
	36		(36.0m)	
-49			Fat CLAY (CH), very stiff, greenish gray	V
	37	PUSH	-with silt pockets, silty sand seams and shell fragments, at 36.9m	
-50				
	38			
-51				
	39			
-52		PUSH	-with silty sand pockets and seams, and shell fragments, at 39.5m	



LOG OF BORING AND TEST RESULTS

BORING 98-25

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

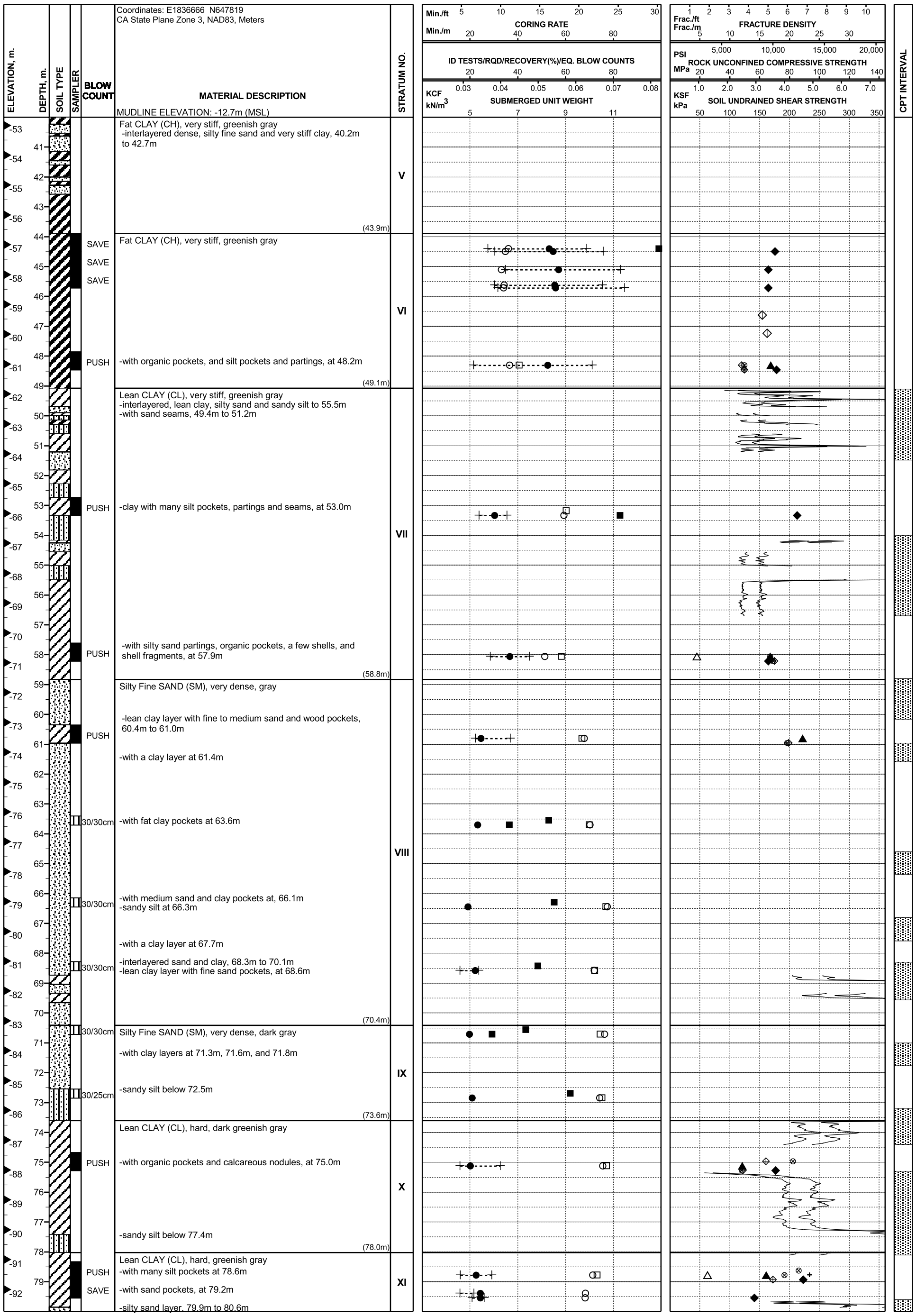
PLATE 98-25.6a

PROJECT NO:	98-42-0054	**START DATE:**	10/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-25 (Main Span-East Pier)	**COMPLETION DATE:**	10/23/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836666 N647819
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

STRATUM NO.	MATERIAL DESCRIPTION	BLOW COUNT
V	Fat CLAY (CH), very stiff, greenish gray -interlayered dense, silty fine sand and very stiff clay, 40.2m to 42.7m (43.9m)	
VI	Fat CLAY (CH), very stiff, greenish gray	SAVE SAVE SAVE
	-with organic pockets, and silt pockets and partings, at 48.2m (49.1m)	PUSH
VII	Lean CLAY (CL), very stiff, greenish gray -interlayered, lean clay, silty sand and sandy silt to 55.5m -with sand seams, 49.4m to 51.2m	
	-clay with many silt pockets, partings and seams, at 53.0m	PUSH
	-with silty sand partings, organic pockets, a few shells, and shell fragments, at 57.9m (58.8m)	PUSH
VIII	Silty Fine SAND (SM), very dense, gray	
	-lean clay layer with fine to medium sand and wood pockets, 60.4m to 61.0m	PUSH
	-with a clay layer at 61.4m	
	-with fat clay pockets at 63.6m	30/30cm
	-with medium sand and clay pockets at, 66.1m -sandy silt at 66.3m	30/30cm
	-with a clay layer at 67.7m	
	-interlayered sand and clay, 68.3m to 70.1m -lean clay layer with fine sand pockets, at 68.6m (70.4m)	30/30cm
IX	Silty Fine SAND (SM), very dense, dark gray	30/30cm
	-with clay layers at 71.3m, 71.6m, and 71.8m	
	-sandy silt below 72.5m (73.6m)	30/25cm
X	Lean CLAY (CL), hard, dark greenish gray	
	-with organic pockets and calcareous nodules, at 75.0m	PUSH
	-sandy silt below 77.4m (78.0m)	
XI	Lean CLAY (CL), hard, greenish gray -with many silt pockets at 78.6m	PUSH
	-with sand pockets, at 79.2m	SAVE
	-silty sand layer, 79.9m to 80.6m	



LOG OF BORING AND TEST RESULTS

BORING 98-25

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

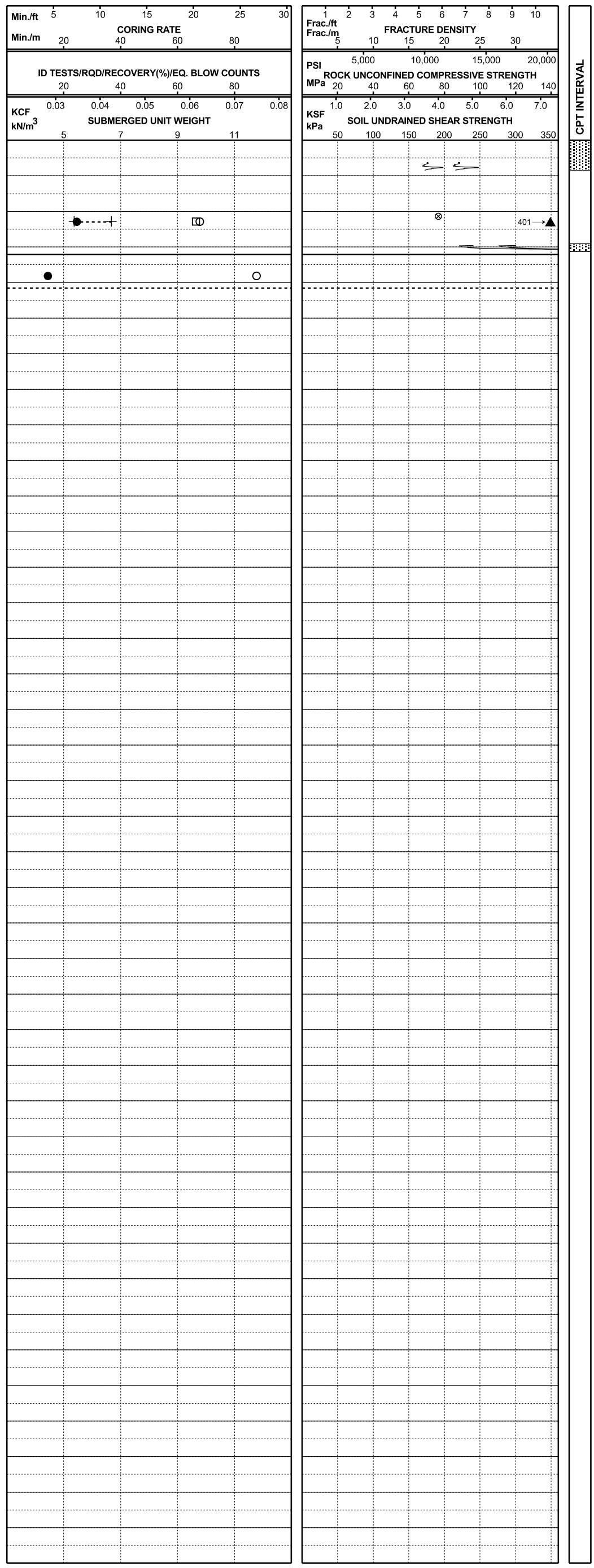
PLATE 98-25.6b

PROJECT NO:	98-42-0054	**START DATE:**	10/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-25 (Main Span-East Pier)	**COMPLETION DATE:**	10/23/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836666 N647819
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-93	81				Lean CLAY (CL), hard, greenish gray	XI
-94	82			PUSH		
-95	83				(83.2m)	
-96	84			50/5cm 50/5cm 50/5cm	SANDSTONE (Graywacke) (Rx), soft, intensely weathered, intensely fractured to decomposed	XII
-97					TOTAL DEPTH: 84.2m BACKFILLED WITH: Cement Grout	
-98	85					
-99	86					
-100	87					
-101	88					
-102	89					
-103	90					
-104	91					
-105	92					
-106	93					
-107	94					
-108	95					
-109	96					
-110	97					
-111	98					
-112	99					
-113	100					
-114	101					
-115	102					
-116	103					
-117	104					
-118	105					
-119	106					
-120	107					
-121	108					
-122	109					
-123	110					
-124	111					
-125	112					
-126	113					
-127	114					
-128	115					
-129	116					
-130	117					
-131	118					
-132	119					



LOG OF BORING AND TEST RESULTS

BORING 98-25

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

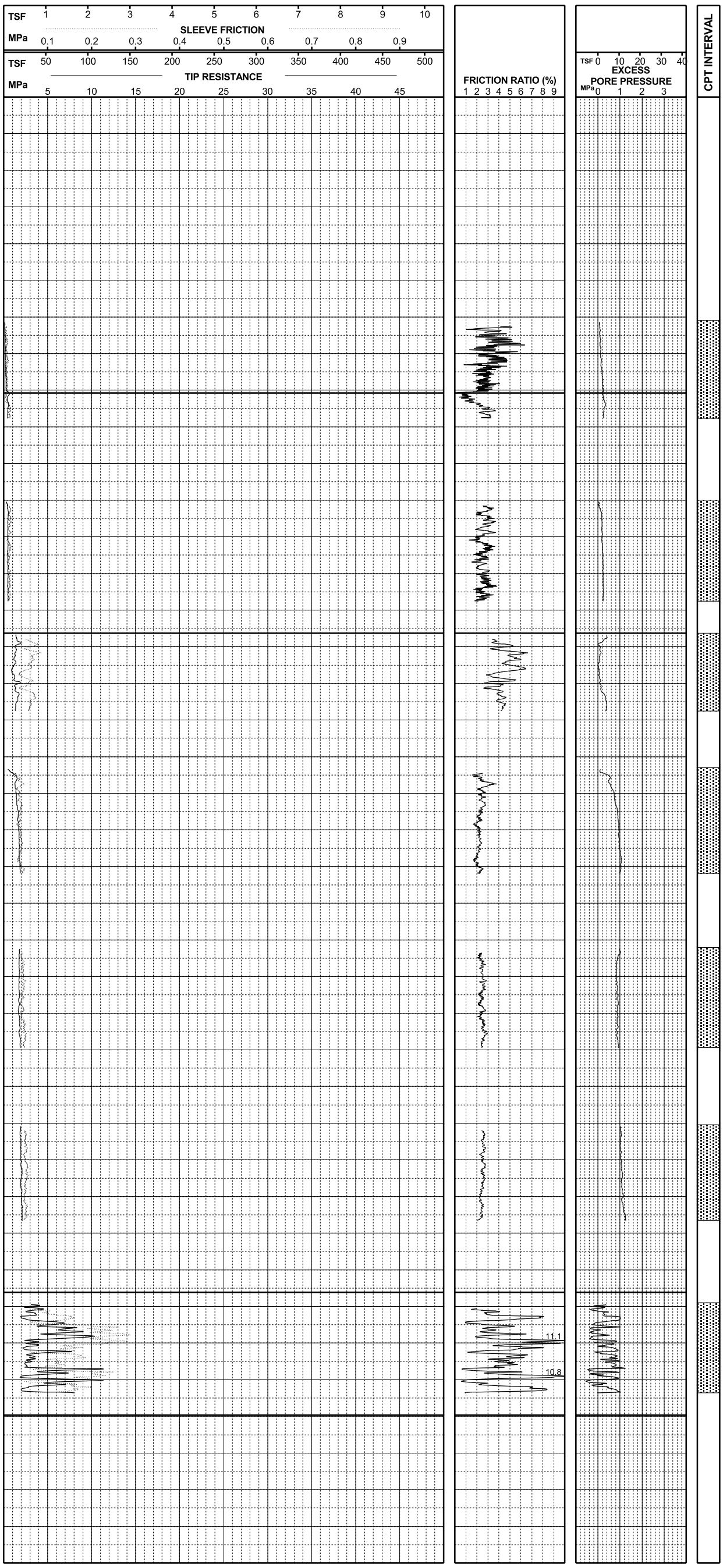
PLATE 98-25.6c

PROJECT NO:	98-42-0054	**START DATE:**	10/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-25 (Main Span-East Pier)	**COMPLETION DATE:**	10/23/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836666 N647819
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-13				WOH	Fat CLAY (CH), very soft to soft, olive gray -with shell fragments	I
	1			WOH	-dark gray with olive gray streaks and many sandy silt pockets, at 0.3m	
-14					-with organic stains at 0.9m	
	2			WOH	-with many silt pockets at 2.1m	
-15					-with silt pockets below 2.7m	
	3			WOH	-with silt seams at 3.0m	
-16						
	4			WOH		
-17						
	5			WOH	-with mica at 4.7m	
-18						
	6			WOH		
-19					-with sand pockets below 6.4m	
	7			WOH		
-20						
	8			WOH	(8.1m)	
-21				WOH	Fat CLAY (CH), firm, gray -with shell fragments	II
	9				-with silt pockets and many sand pockets, at 9.1m	
-22				WOH SAVE	-platy, 9.1m to 11.0m	
	10			SAVE		
-23						
	11			SAVE	-with organic pockets at 11.0m	
-24						
	12					
-25						
	13					
-26						
	14				-with organic pockets, at 14.3m	
-27				PUSH	-intermixed sand and clay, below 14.3m (14.6m)	
	15				Fat CLAY (CH), stiff to very stiff, greenish gray	III
-28						
	16					
-29						
	17					
-30						
	18			26/30cm		
-31						
	19					
-32						
	20					
-33						
	21				-with silt partings and gas blisters, 21.3m to 27.4m	
-34				PUSH		
	22					
-35				SAVE		
	23					
-36						
	24					
-37						
	25					
-38						
	26					
-39						
	27			PUSH	-with silt pockets, silt seams and shell fragments, at 27.1m	
-40						
	28					
-41						
	29					
-42						
	30					
-43						
	31					
-44						
	32			PUSH	-with silty sand pockets, shell fragments and slickensides, at 32.0m	
-45					(32.6m)	
	33				Fat CLAY (CH), very stiff, greenish gray -with dense, silty fine sand layers	IV
-46						
	34					
-47						
	35					
-48						
	36				(36.0m)	
-49					Fat CLAY (CH), very stiff, greenish gray	V
	37			PUSH	-with silt pockets, silty sand seams and shell fragments, at 36.9m	
-50						
	38					
-51						
	39					
-52				PUSH	-with silty sand pockets and seams, and shell fragments, at 39.5m	



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-25

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

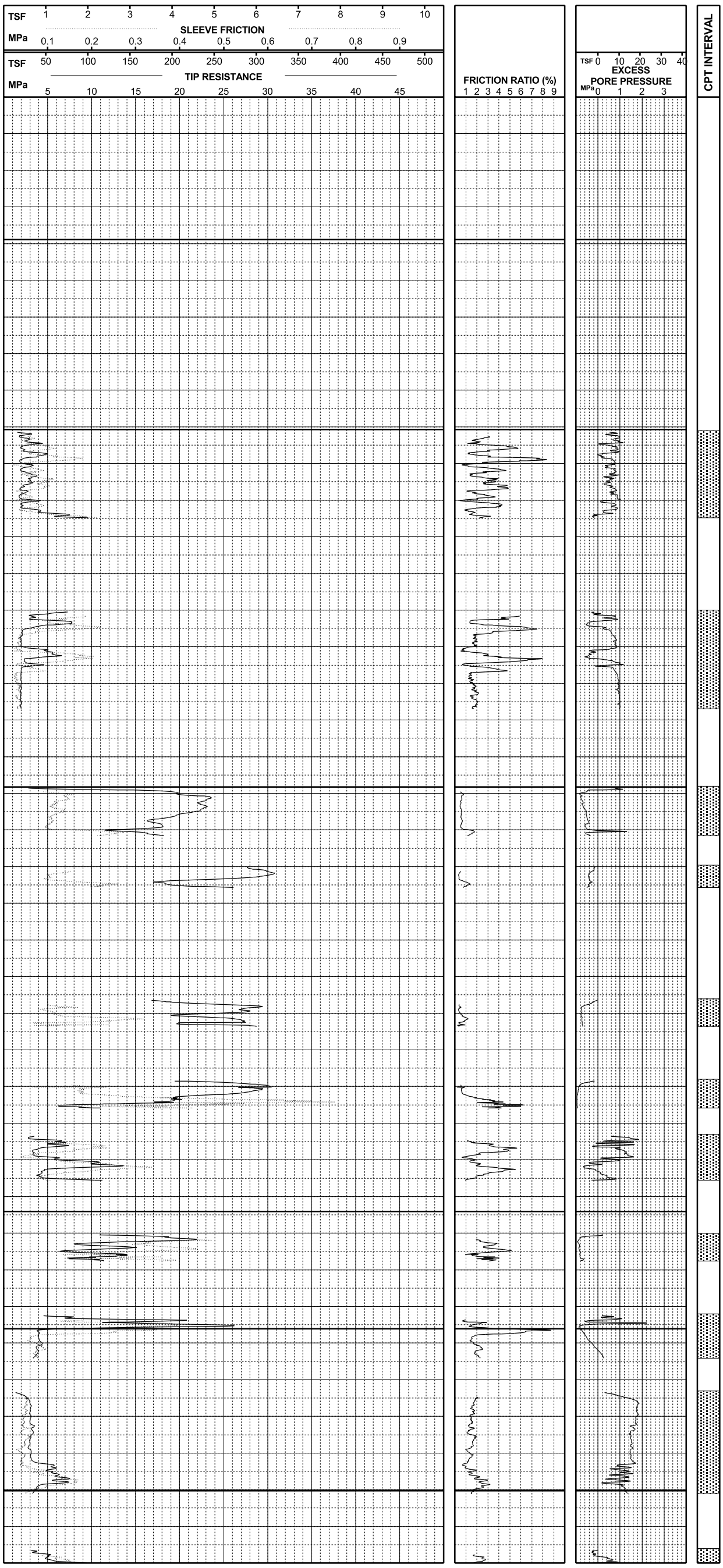
PLATE 98-25.7a

PROJECT NO:	98-42-0054	**START DATE:**	10/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-25 (Main Span-East Pier)	**COMPLETION DATE:**	10/23/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836666 N647819
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-53	41			Fat CLAY (CH), very stiff, greenish gray -interlayered dense, silty fine sand and very stiff clay, 40.2m to 42.7m	V
-54	42				
-55	43				
-56				(43.9m)	
-57	44		SAVE	Fat CLAY (CH), very stiff, greenish gray	VI
-58	45		SAVE		
-59	46		SAVE		
-60	47				
-61	48		PUSH	-with organic pockets, and silt pockets and partings, at 48.2m	
				(49.1m)	
-62	49			Lean CLAY (CL), very stiff, greenish gray -interlayered, lean clay, silty sand and sandy silt to 55.5m -with sand seams, 49.4m to 51.2m	VII
-63	50				
-64	51				
-65	52				
-66	53		PUSH	-clay with many silt pockets, partings and seams, at 53.0m	
-67	54				
-68	55				
-69	56				
-70	57				
-71	58		PUSH	-with silty sand partings, organic pockets, a few shells, and shell fragments, at 57.9m	
				(58.8m)	
-72	59			Silty Fine SAND (SM), very dense, gray	VIII
-73	60		PUSH	-lean clay layer with fine to medium sand and wood pockets, 60.4m to 61.0m	
-74	61			-with a clay layer at 61.4m	
-75	62				
-76	63		30/30cm	-with fat clay pockets at 63.6m	
-77	64				
-78	65				
-79	66		30/30cm	-with medium sand and clay pockets at, 66.1m -sandy silt at 66.3m	
-80	67			-with a clay layer at 67.7m	
-81	68		30/30cm	-interlayered sand and clay, 68.3m to 70.1m -lean clay layer with fine sand pockets, at 68.6m	
-82	69				
-83	70		30/30cm		
				(70.4m)	
-84	71			Silty Fine SAND (SM), very dense, dark gray -with clay layers at 71.3m, 71.6m, and 71.8m	IX
-85	72				
-86	73		30/25cm	-sandy silt below 72.5m	
				(73.6m)	
-87	74			Lean CLAY (CL), hard, dark greenish gray	X
-88	75		PUSH	-with organic pockets and calcareous nodules, at 75.0m	
-89	76				
-90	77			-sandy silt below 77.4m	
				(78.0m)	
-91	78			Lean CLAY (CL), hard, greenish gray	XI
-92	79		PUSH SAVE	-with many silt pockets at 78.6m -with sand pockets, at 79.2m -silty sand layer, 79.9m to 80.6m	



LOG OF BORING AND TEST RESULTS

BORING 98-25

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

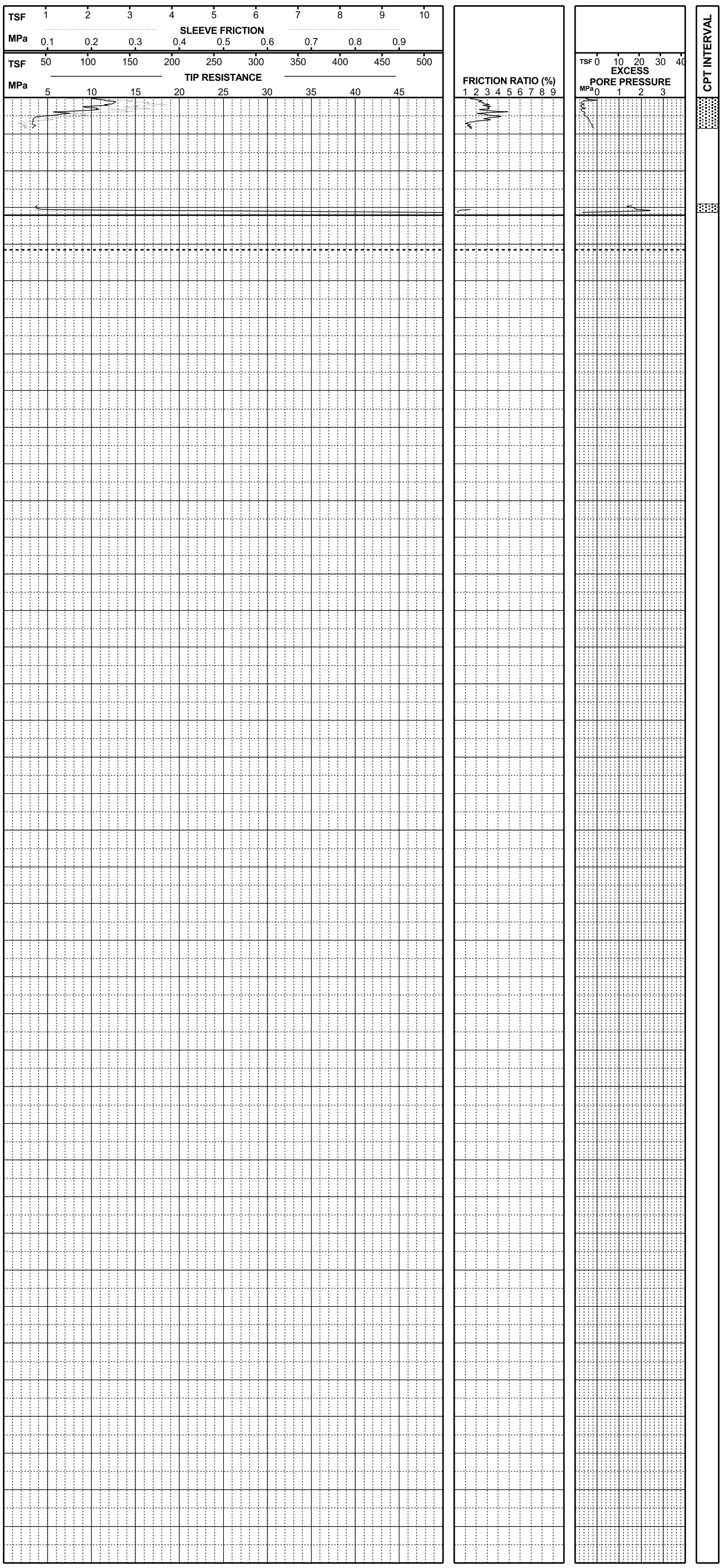
PLATE 98-25.7b

PROJECT NO:	98-42-0054	**START DATE:**	10/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-25 (Main Span-East Pier)	**COMPLETION DATE:**	10/23/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836666 N647819
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-93	81				Lean CLAY (CL), hard, greenish gray	XI
-94	82			PUSH		
-95	83				(83.2m)	
-96	84			50/5cm 50/5cm 50/5cm	SANDSTONE (Graywacke) (Rx), soft, intensely weathered, intensely fractured to decomposed	XII
-97	85				TOTAL DEPTH: 84.2m	
-98	86				BACKFILLED WITH: Cement Grout	
-99	87					
-100	88					
-101	89					
-102	90					
-103	91					
-104	92					
-105	93					
-106	94					
-107	95					
-108	96					
-109	97					
-110	98					
-111	99					
-112	100					
-113	101					
-114	102					
-115	103					
-116	104					
-117	105					
-118	106					
-119	107					
-120	108					
-121	109					
-122	110					
-123	111					
-124	112					
-125	113					
-126	114					
-127	115					
-128	116					
-129	117					
-130	118					
-131	119					
-132						



LOG OF BORING AND TEST RESULTS

BORING 98-25

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

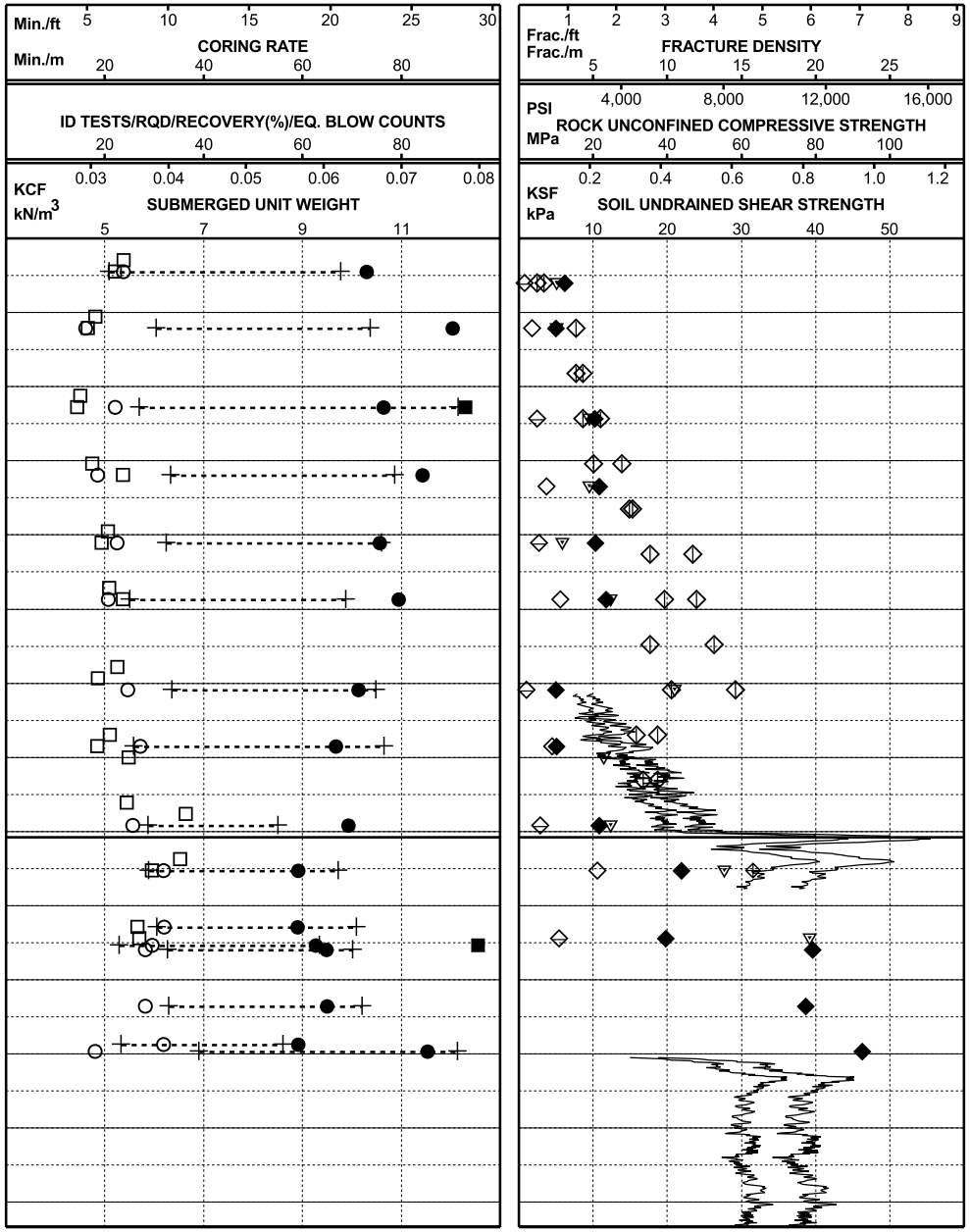
PLATE 98-25.7c

PROJECT NO:	98-42-0054	**START DATE:**	10/20/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-25 (Main Span-East Pier)	**COMPLETION DATE:**	10/23/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836666 N647819
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-13		WOH	Fat CLAY (CH), very soft to soft, olive gray	I
			-with shell fragments	
			-dark gray with olive gray streaks and many sandy silt pockets, at 0.3m	
-14	1	WOH	-with organic stains at 0.9m	
-15	2	WOH	-with many silt pockets at 2.1m	
			-with silt pockets below 2.7m	
-16	3	WOH	-with silt seams at 3.0m	
-17	4	WOH		
-18	5	WOH	-with mica at 4.7m	
-19	6	WOH		
			-with sand pockets below 6.4m	
-20	7	WOH		
	8	WOH	(8.1m)	
-21		WOH	Fat CLAY (CH), firm, gray	II
			-with shell fragments	
			-with silt pockets and many sand pockets, at 9.1m	
-22	9	WOH	-platy, 9.1m to 11.0m	
		SAVE		
-23	10	SAVE		
		SAVE		
-24	11		-with organic pockets at 11.0m	
-25	12			
-26	13			



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-25

SFOBB East Span Seismic Safety Project

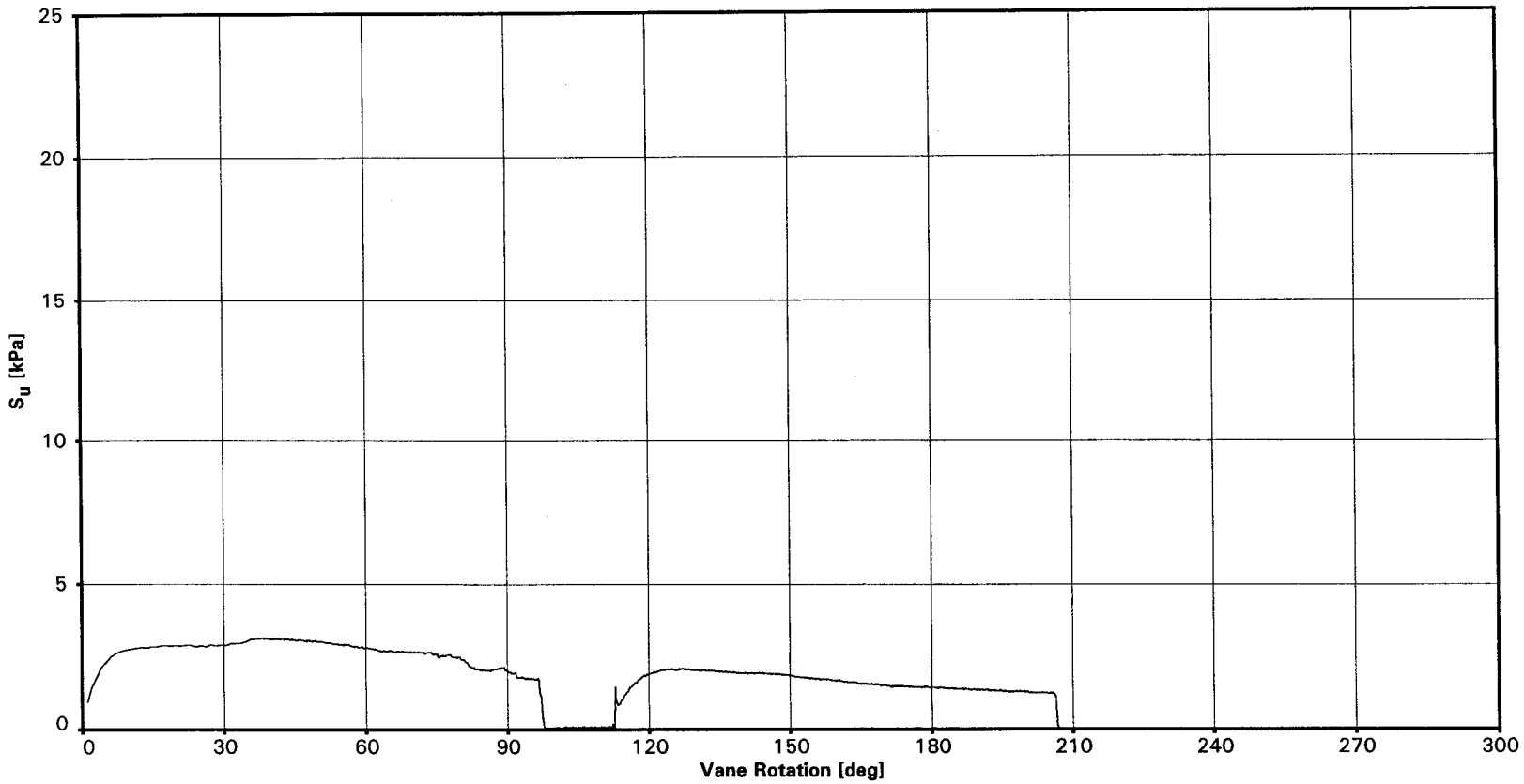
Report Date: 04/30/99

PLATE 98-25.8

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 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

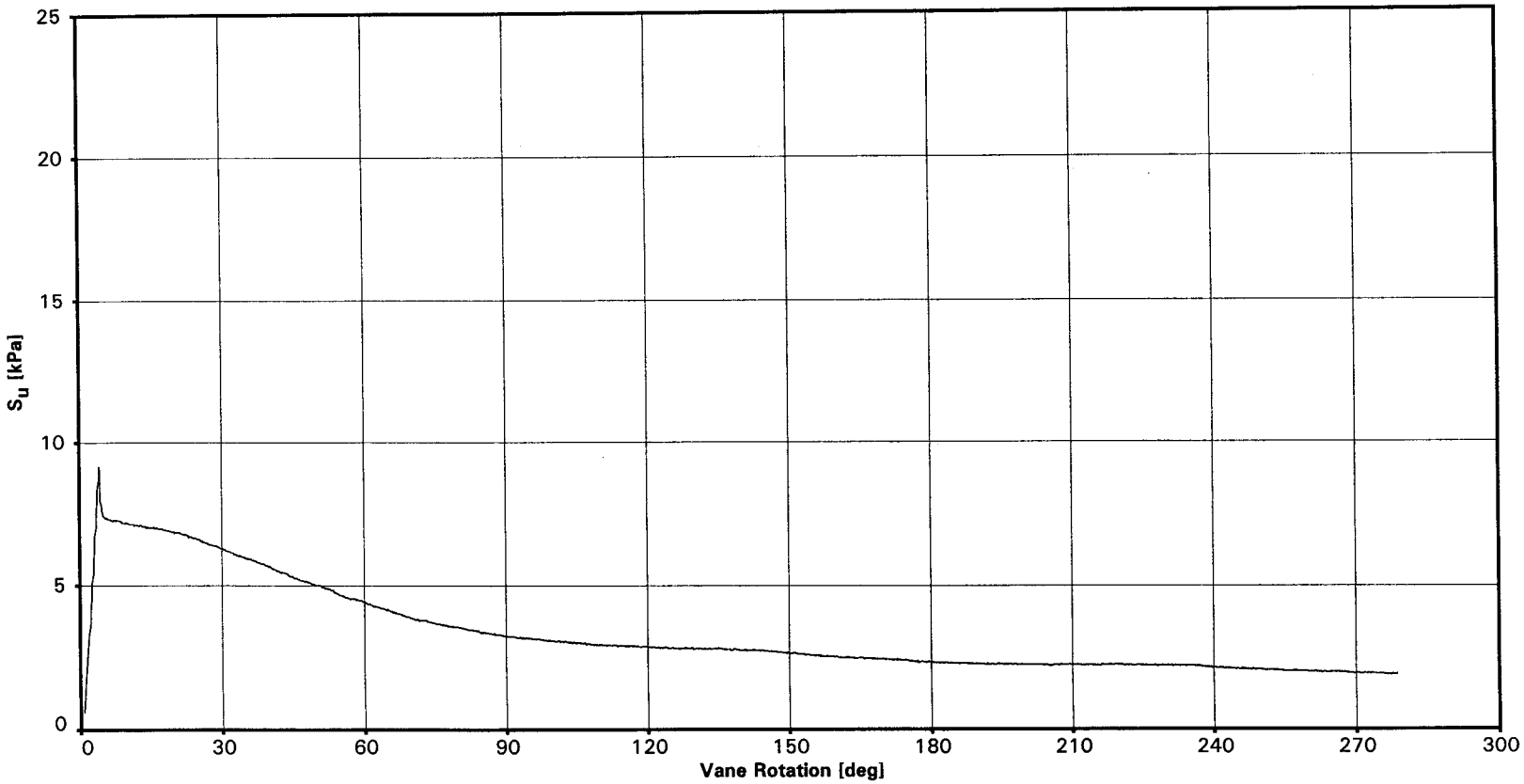
FUGRO

PLATE 98-25.9a

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 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

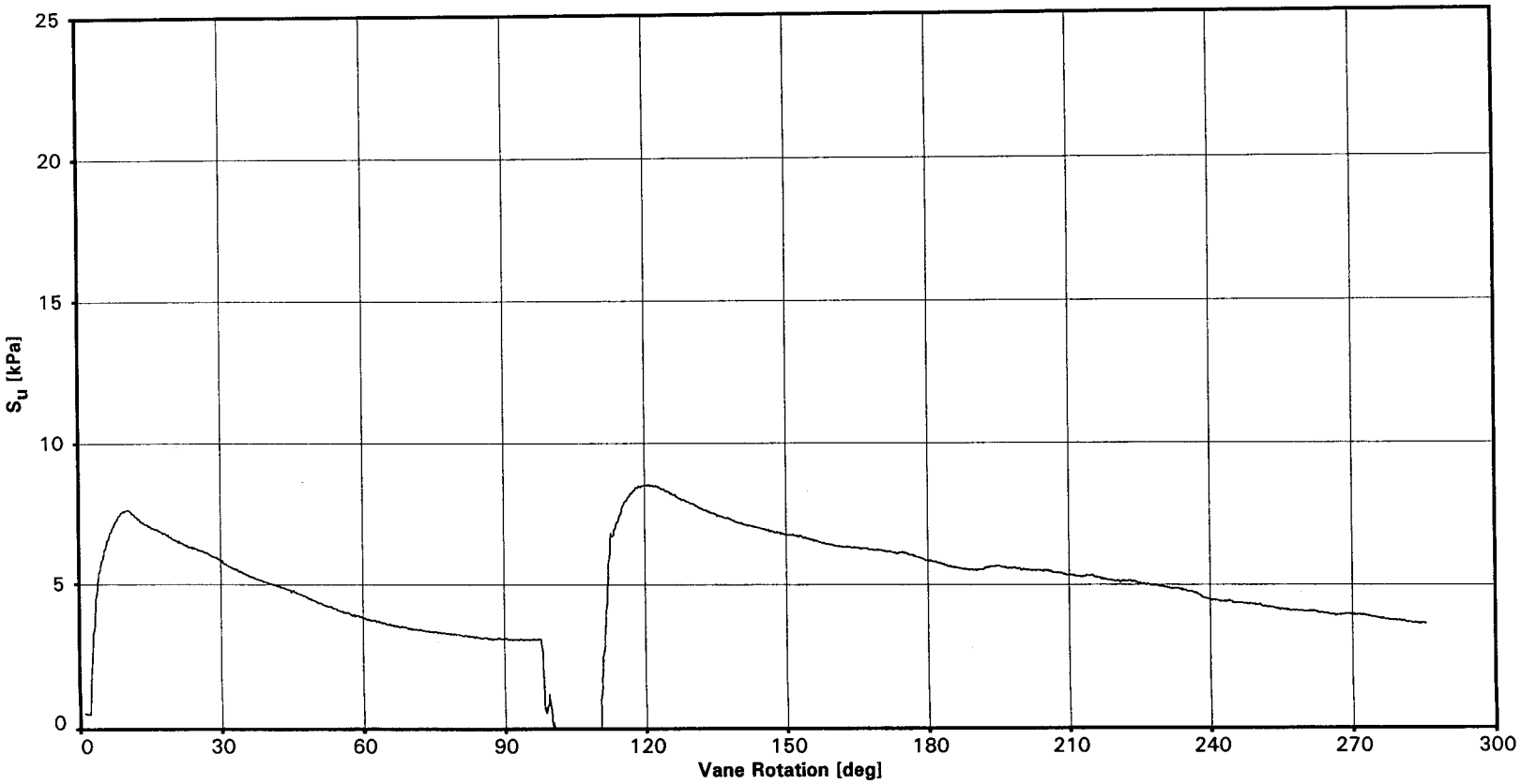
FUGRO

PLATE 98-25.9b

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 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

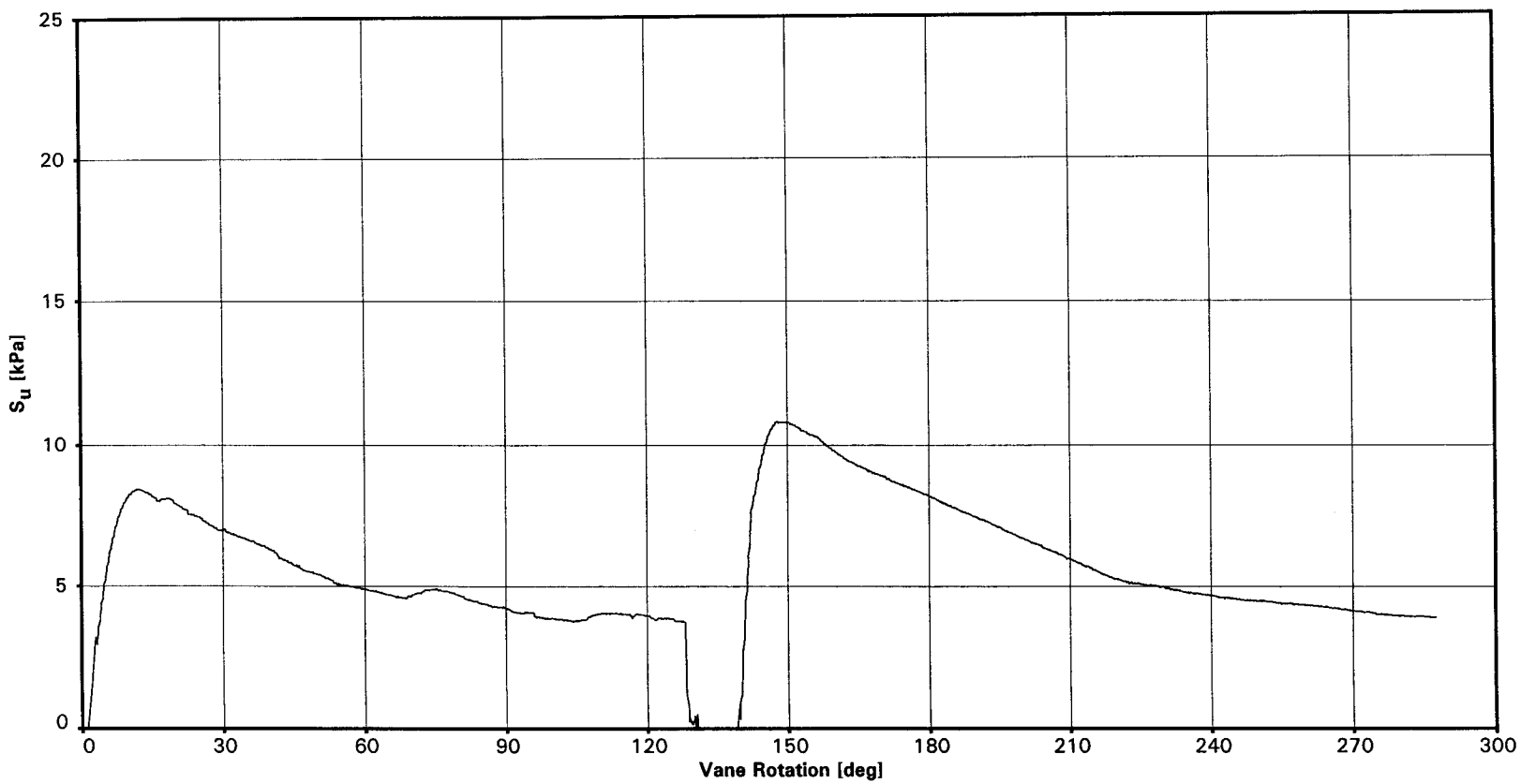
FUGRO

PLATE 98-25.9c

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
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

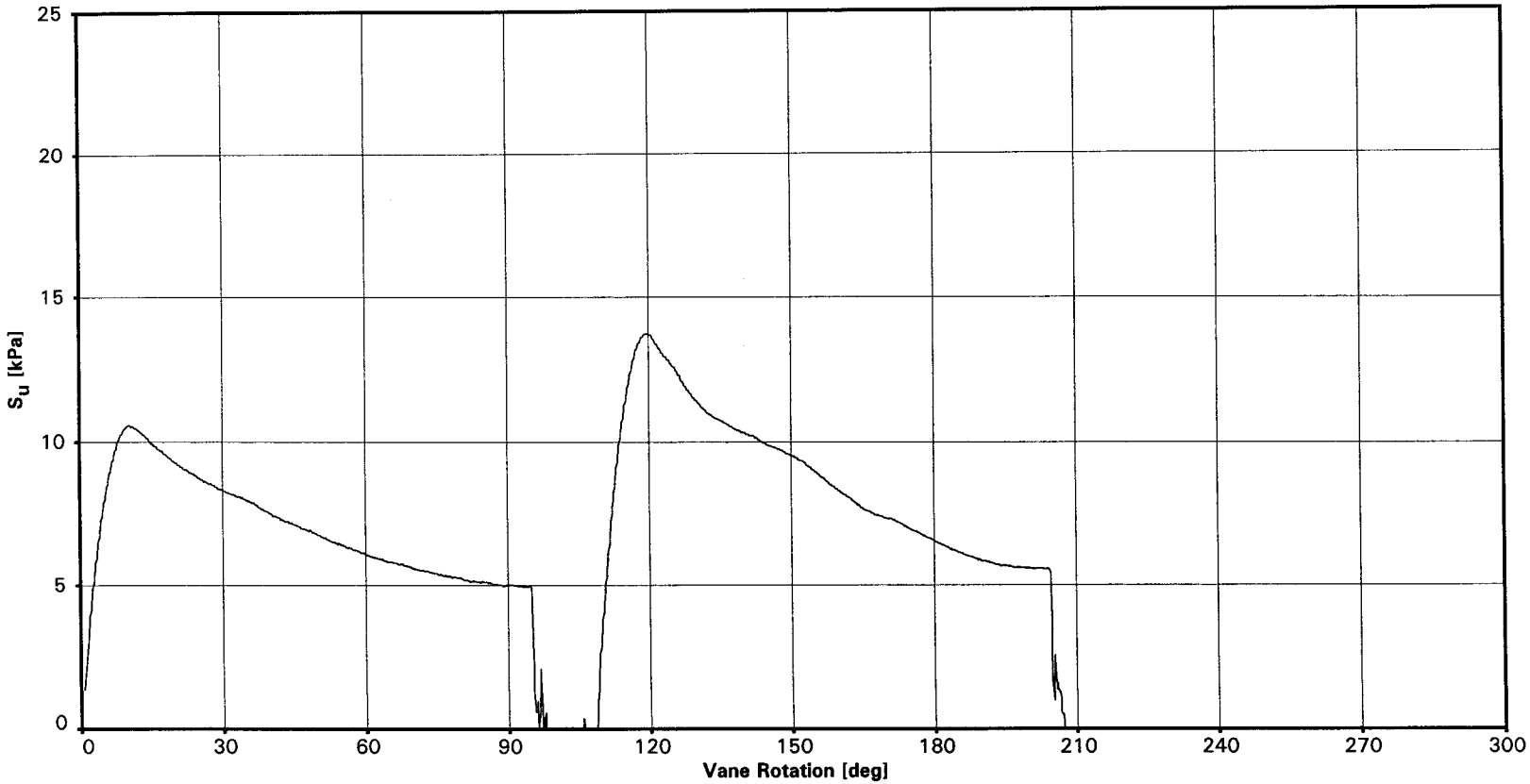
FUGRO

PLATE 98-25.9d

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

Vane Size used: Dolphin Large

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.0m
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

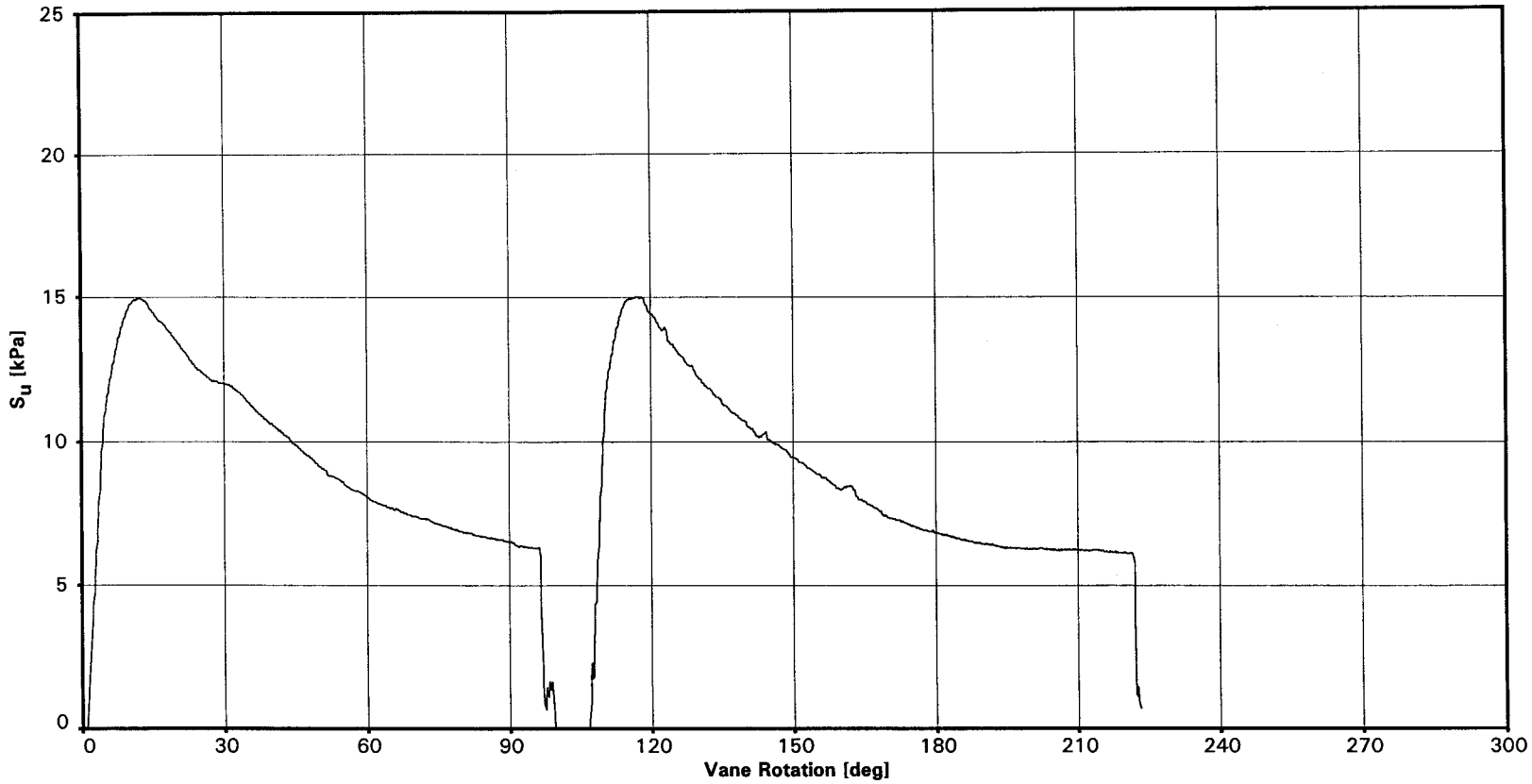
FUGRO

PLATE 98-25.9e

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

Vane Size used: Dolphin Large

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.7m
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

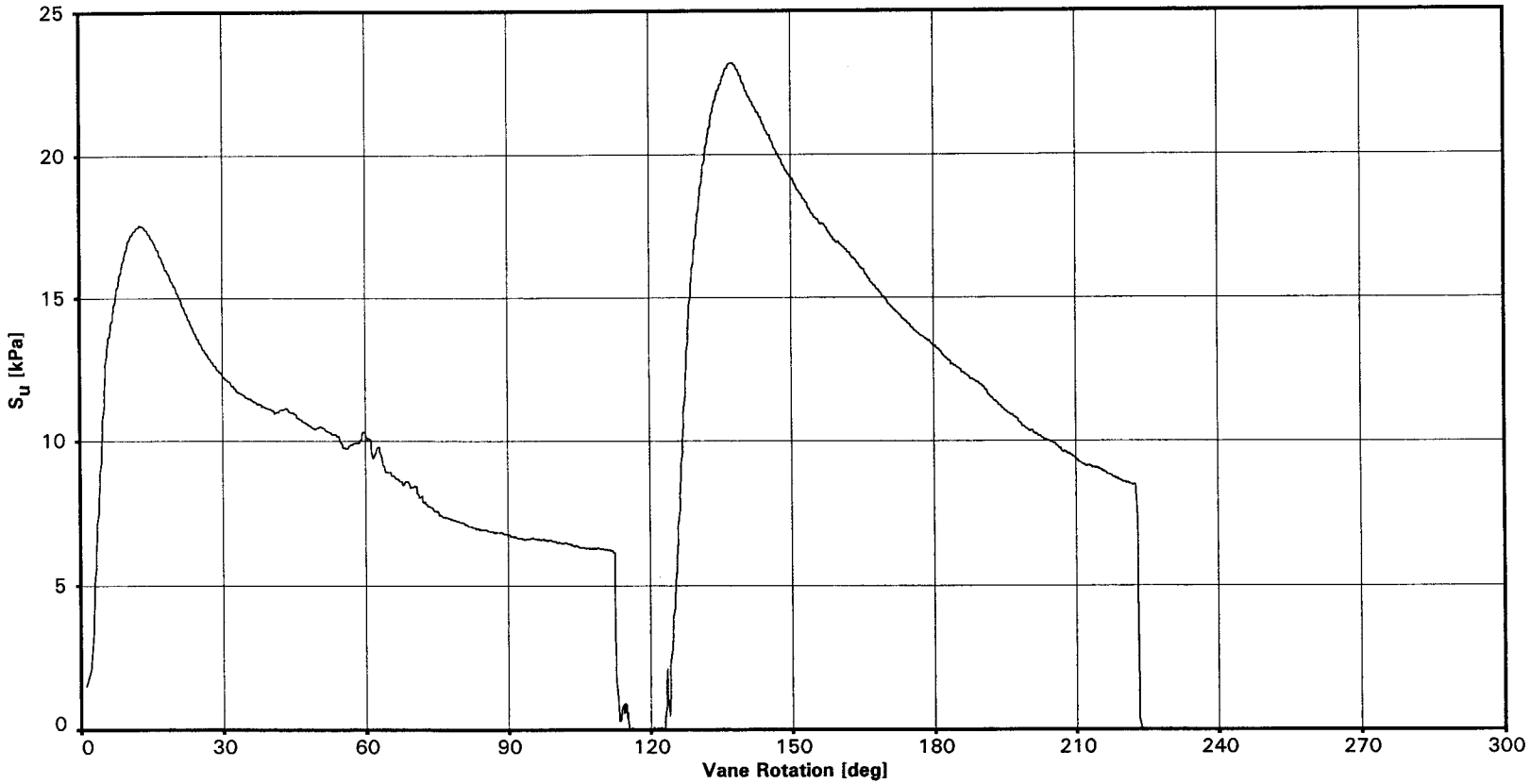
FUGRO

PLATE 98-25.9f

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: 4.3m
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

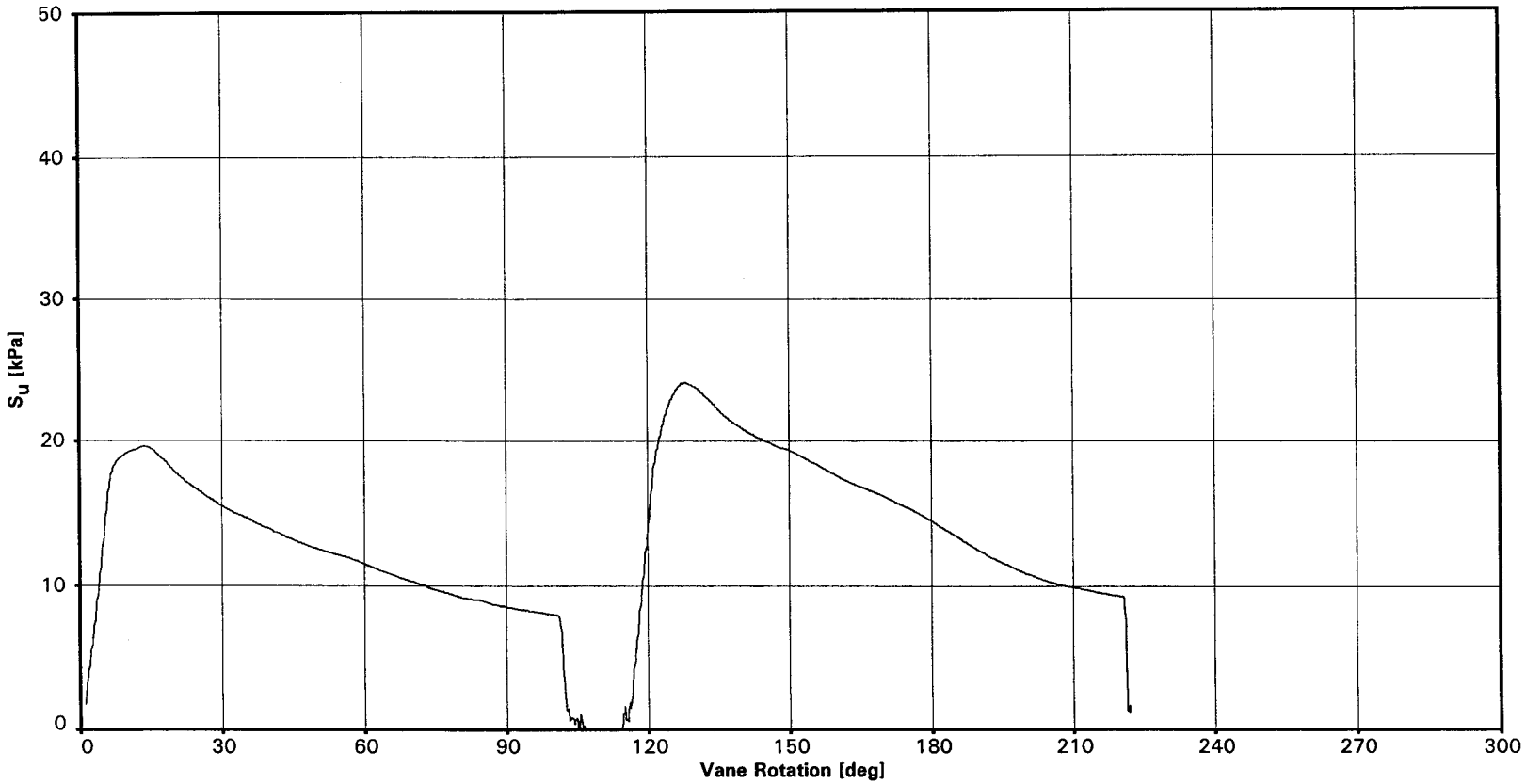
FUGRO

PLATE 98-25.9g

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: 4.9m
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

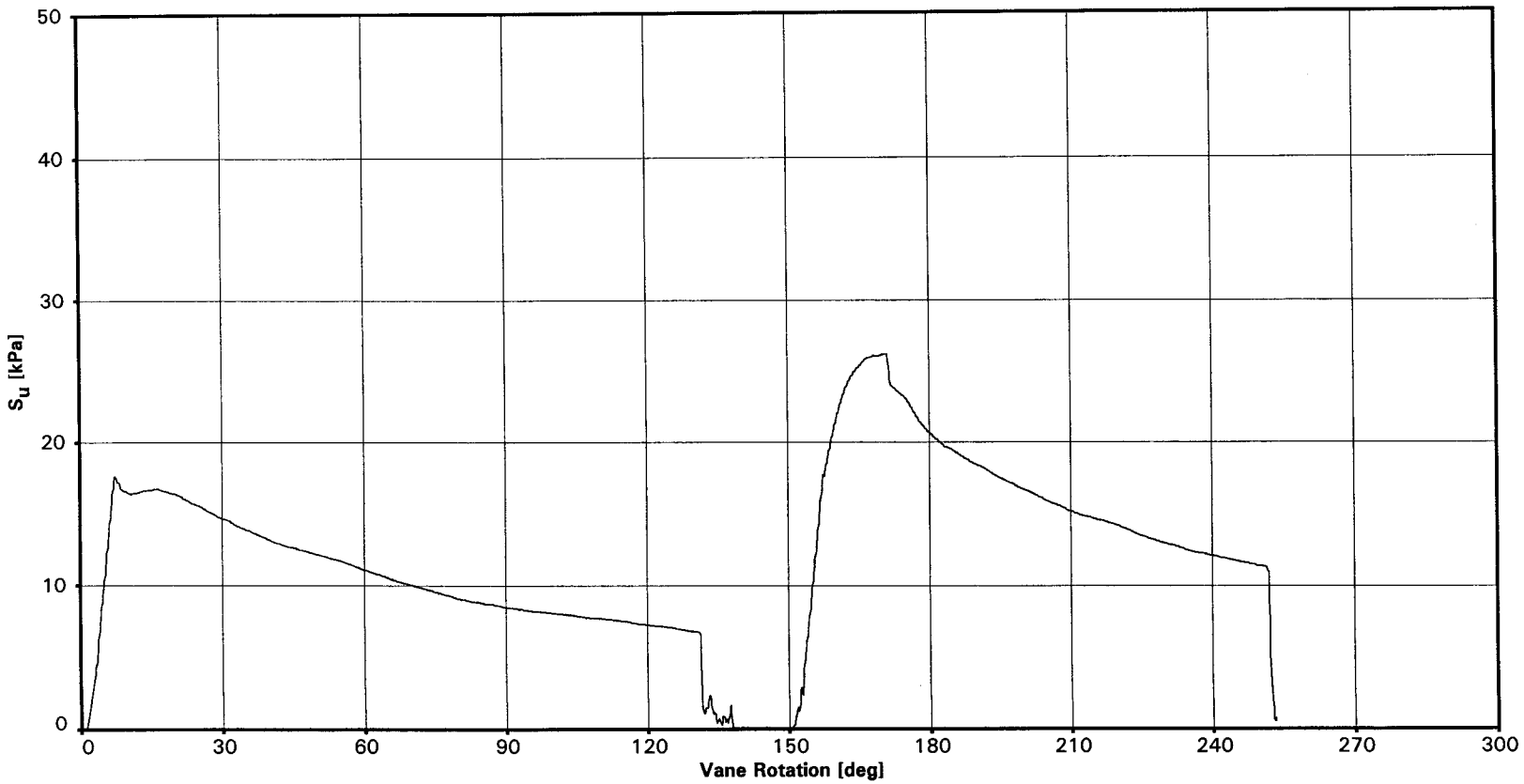
FUGRO

PLATE 98-25.9h

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: 5.5m
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

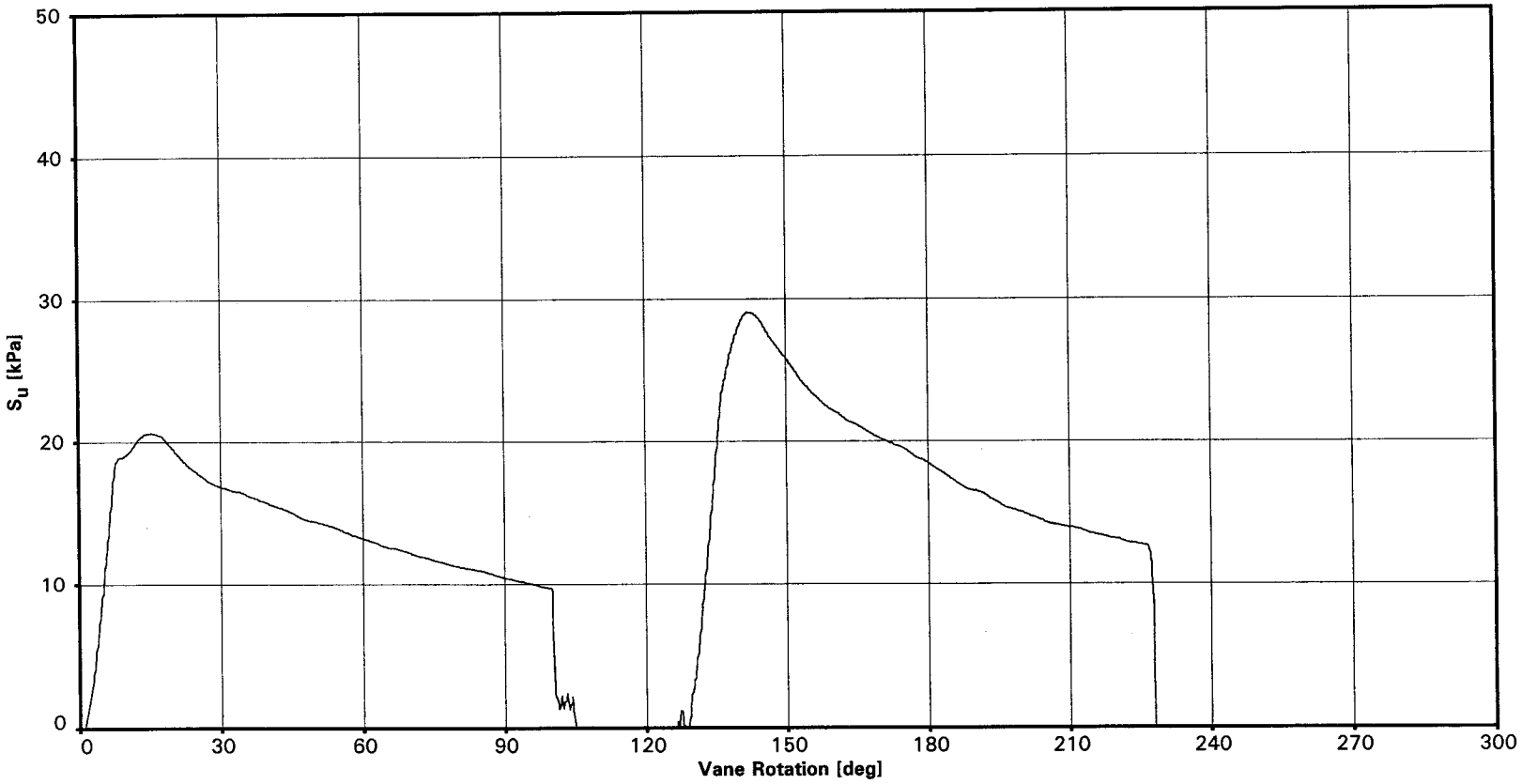
FUGRO

PLATE 98-25.9i

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: 6.1m
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

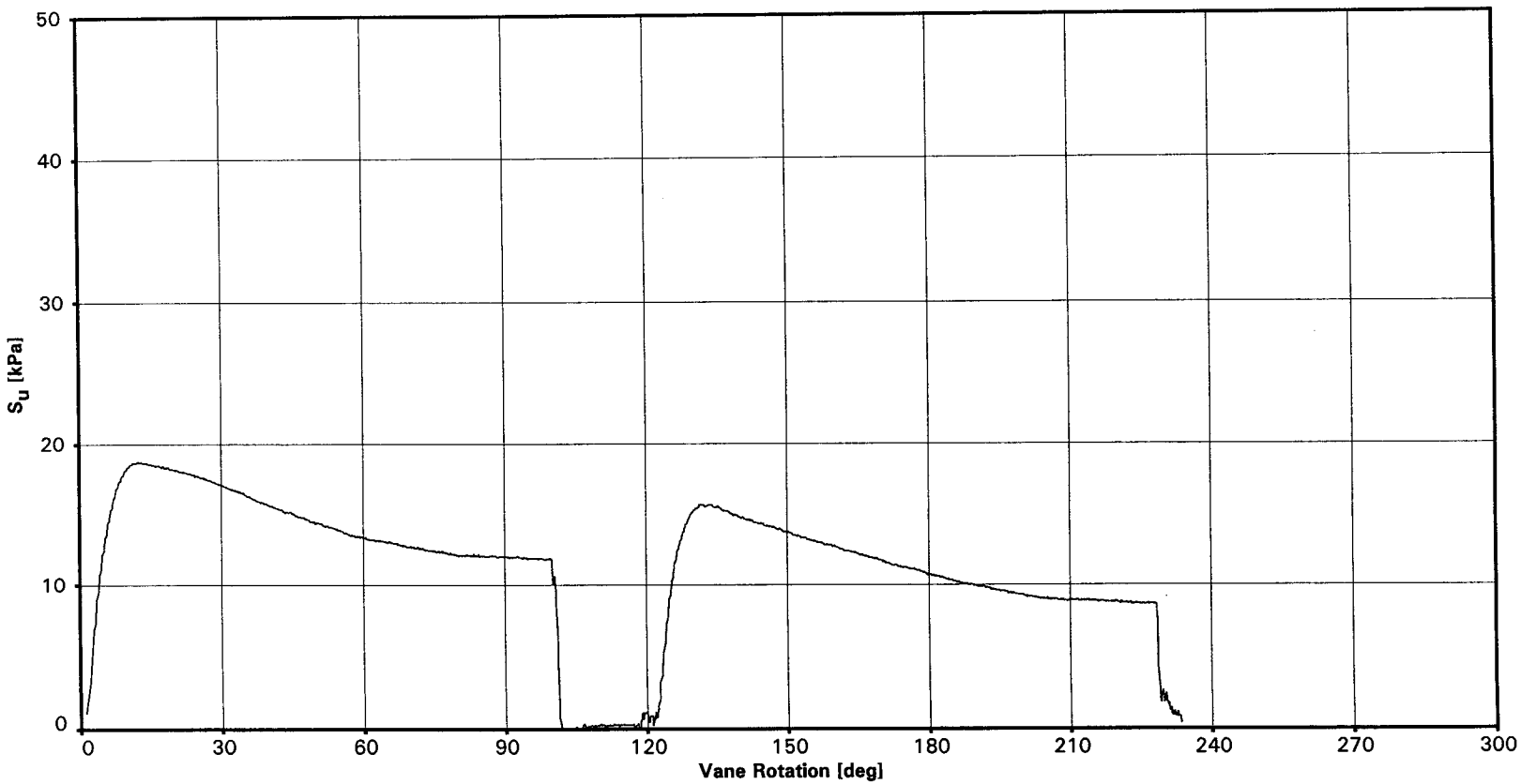
FUGRO

PLATE 98-25.9j

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 (HALIBUT) TEST RESULTS
Test Depth: 6.7m
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

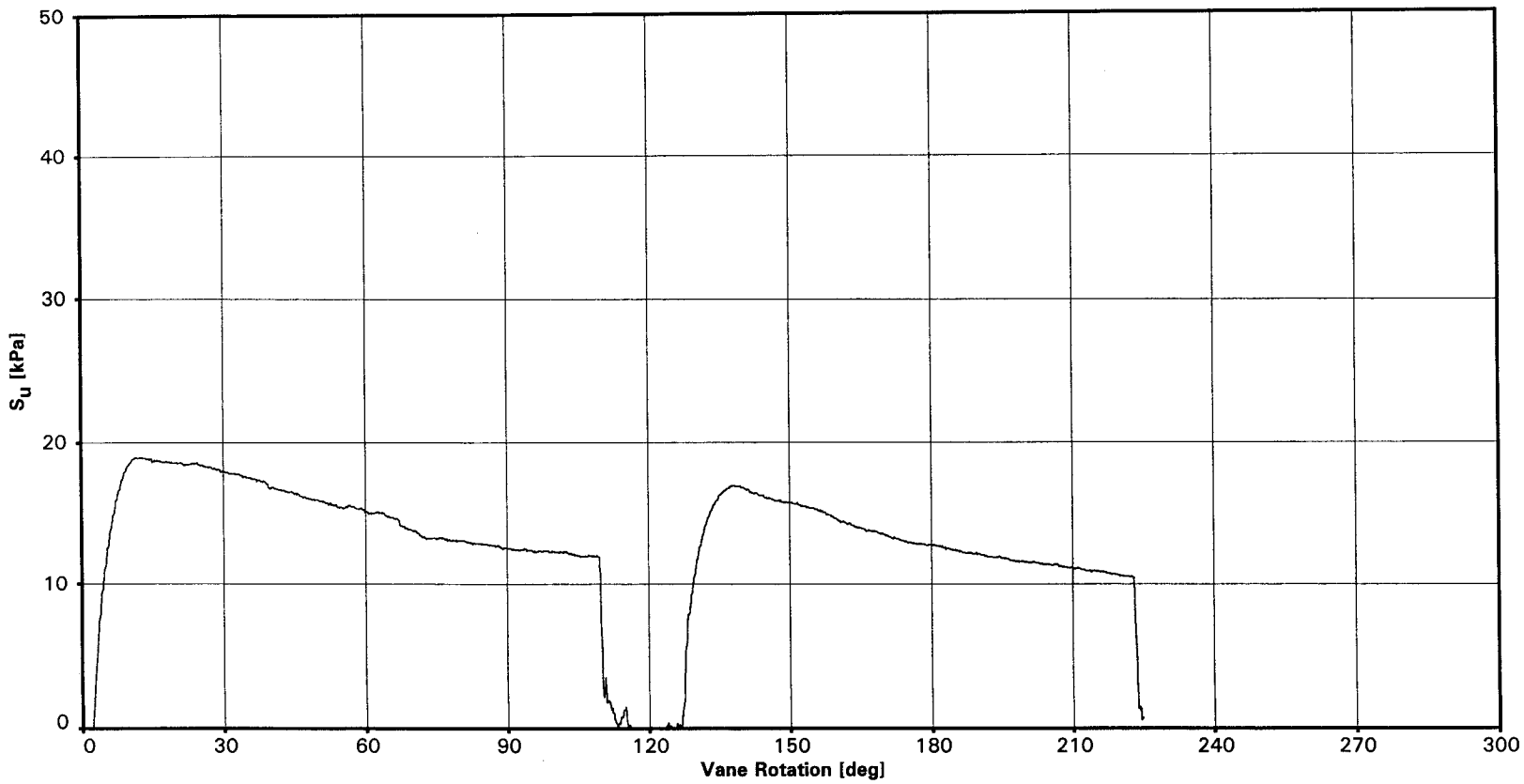
FUGRO

PLATE 98-25.9k

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 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

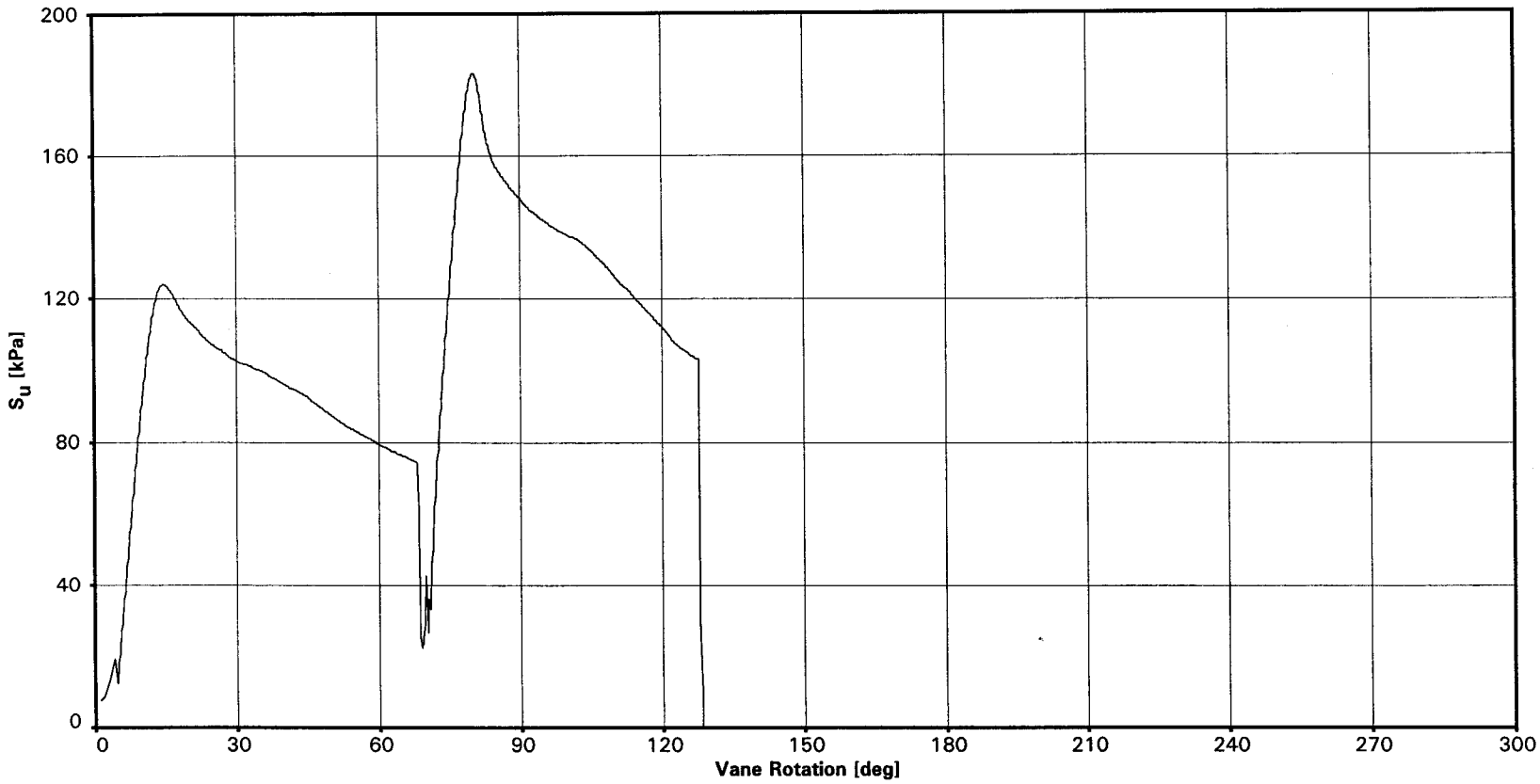
FUGRO

PLATE 98-25.9l

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: 38.1m and 38.7m
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

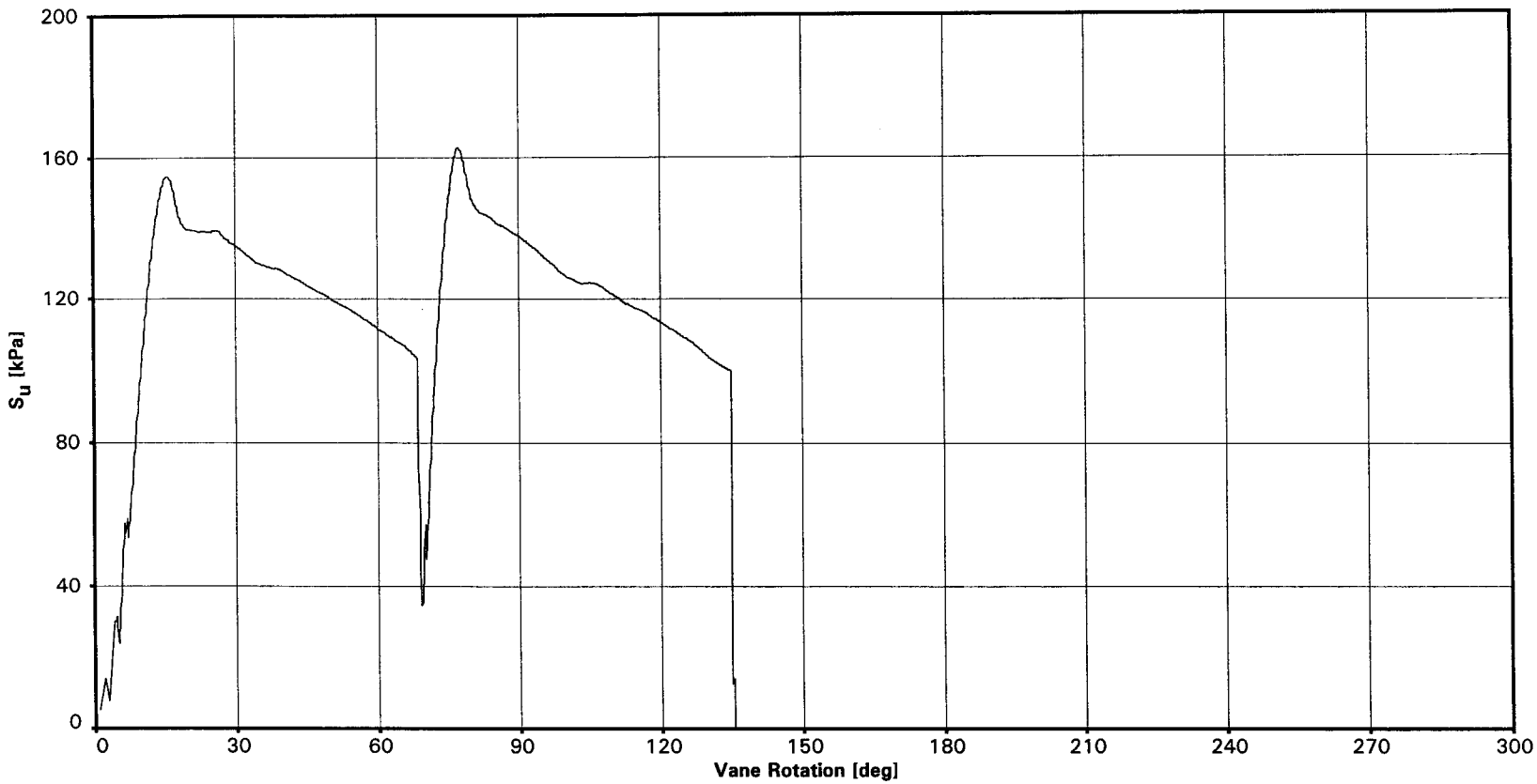
FUGRO

PLATE 98-25.9m

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: 46.6m and 47.2m
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-25.9n

98-25		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
0.3	1					5.4																		
0.5	2	73	68	21	1.11	5.2																		
0.6	3									5.2	6.1		0.8											
0.6	401													3.4										
0.6	416													2.4										
1.1	4					4.8																		
1.2	5	90	74	31	1.38	4.6				5.2	5.0	1.8												
1.2	402													7.7										
1.8	403													7.7										
1.8	413													8.6										
2.1	6					4.5																		
2.3	7	76	92	27	0.76	4.4	93																	H
2.4	8									9.6	10.2		2.4											
2.4	404													8.6										
2.4	414													11.0										

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

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

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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-25		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
3.0	9					4.7																		
3.0	405													10.1										
3.0	415													13.9										
3.2	10	84	79	33	1.12	5.4																		
3.4	11									9.6	10.8	3.7												
3.7	406													15.3										
3.7	417													14.8										
4.0	12					5.1																		
4.1	13	76	76	33	0.99	4.9				5.9	10.3		2.7											
4.3	407													17.7										
4.3	418													23.5										
4.7	14					5.1																		
4.9	15	79	69	25	1.24	5.4				12.4	11.7	5.6												
4.9	408													19.6										
4.9	419													23.9										

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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phi = Effective Angle of Friction

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Additional Tests
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-25		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
5.5	409													26.3										
5.5	420													17.7										
5.8	16					5.2																		
5.9	17					4.9																		
6.1	18	71	75	34	0.91					21.1	5.0		1.0											
6.1	410													20.6										
6.1	421													29.2										
6.7	19					5.1																		
6.7	411													18.7										
6.7	422													15.8										
6.9	20	67	77	26	0.80	4.8					5.1	4.5												
7.0	21					5.5				11.5														
7.3	412													18.7										
7.3	423													16.8										
7.6	22					5.4																		

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

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

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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-25		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
7.8	23					6.6																		
7.9	24	69	55	29	1.54					12.4	10.8		2.8											
8.4	25					6.5																		
8.5	26	59	67	29	0.78	5.9		31.6		27.8	21.9	10.6												
9.3	27	59	71	31	0.70	5.7																		
9.4	28					5.7				39.3	19.8		5.4											
9.5	29	63	64	23	0.98		95																	C,H
9.6	30	65	70	33	0.86						39.6													
10.3	31																							K
10.4	32	65	72	33	0.81						38.7													
10.9	33	59	56	23	1.09																			C
11.0	34	85	91	39	0.88						46.3													
14.3	35	50	48	23	1.09	6.7									30.0		2.4							
14.5	36										50.7													
18.0	38							91.0	71.8															

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 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-25		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
18.1	39	53	86	29	0.42	6.5				107.3	80.1				63.6		0.7							
21.6	40							110.1	143.6															
21.8	41	60	81	34	0.56	6.1	99								101.5	45.7	0.4							H
21.9	42									197.3	185.6													
22.5	43	61	72	25	0.76																			C,K
22.6	44	63	70	34	0.81						132.4													
27.1	45							107.7	124.5															
27.3	46	55																						
27.4	47	56	75	31	0.56	6.6					113.1				140.6		1.3							
32.0	48							95.8	119.7															
32.2	49	61	87	35	0.50	6.4									179.1	46.1	0.9							
32.3	50										127.3													
37.0	52	55	74	31	0.56	6.7		131.7	143.6						183.8		2.0							
37.2	53							143.6	143.6		207.9													
38.1	500													125.0										

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

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

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

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

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-25		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
38.7	501													182.9										
39.5	55	53	82	31	0.43	6.6		119.7	119.7						146.1	39.3	2.5							
39.6	56							134.1	119.7		201.7													
44.4	57	53	69	28	0.61		99																	C,H
44.5	58	55	76	30	0.53						175.8													
45.1	60	57	83	35	0.46						164.6													
45.6	61	55	76	30	0.55																			C
45.7	62	56	85	32	0.45						164.6													
46.6	502													154.7										
47.2	503													162.8										
48.3	64	52	71	22	0.62	7.1		119.7	124.5						168.0		0.9							
48.5	65							124.5	124.5		178.2													
53.2	67					9.0																		
53.3	68	30	36	24	0.55		83				212.9													
58.1	70	37	45	29	0.49	8.8			167.6						167.1	44.5	0.7							

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 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-25		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
58.2	71							174.8	172.4		164.6													
60.8	73	25	37	22	0.15	9.7									221.6		1.5							
61.0	74							198.7	196.3															
63.6	75						53																	
63.7	76	23				10.0	36											9.6	31					
66.3	77						55																	
66.4	78	19				10.7																		
68.4	79						48																	
68.6	80	22	24	16	0.79	10.2																		
70.6	81						43																	
70.7	82	20				10.4	29											62.2	34					
72.7	83						62																	H
72.8	84	21				10.5																		
75.0	85							160.4	205.9															
75.1	86	20	33	16	0.26	10.7									120.3		1.8							

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
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Additional Tests
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K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-25		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
75.3	87							122.1	119.7		177.0													
78.6	88								215.5															
78.8	89	22	29	16	0.49	10.3			191.5						160.7	62.4	1.2							
78.9	90							172.4			222.8													
79.4	91	24	22	16	1.43																			C,K
79.6	92	24	26	21	0.65						141.1													
82.1	94								191.5															
82.3	95	25	37	24	0.06	9.6									400.5		1.2							
83.8	96	14																						

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

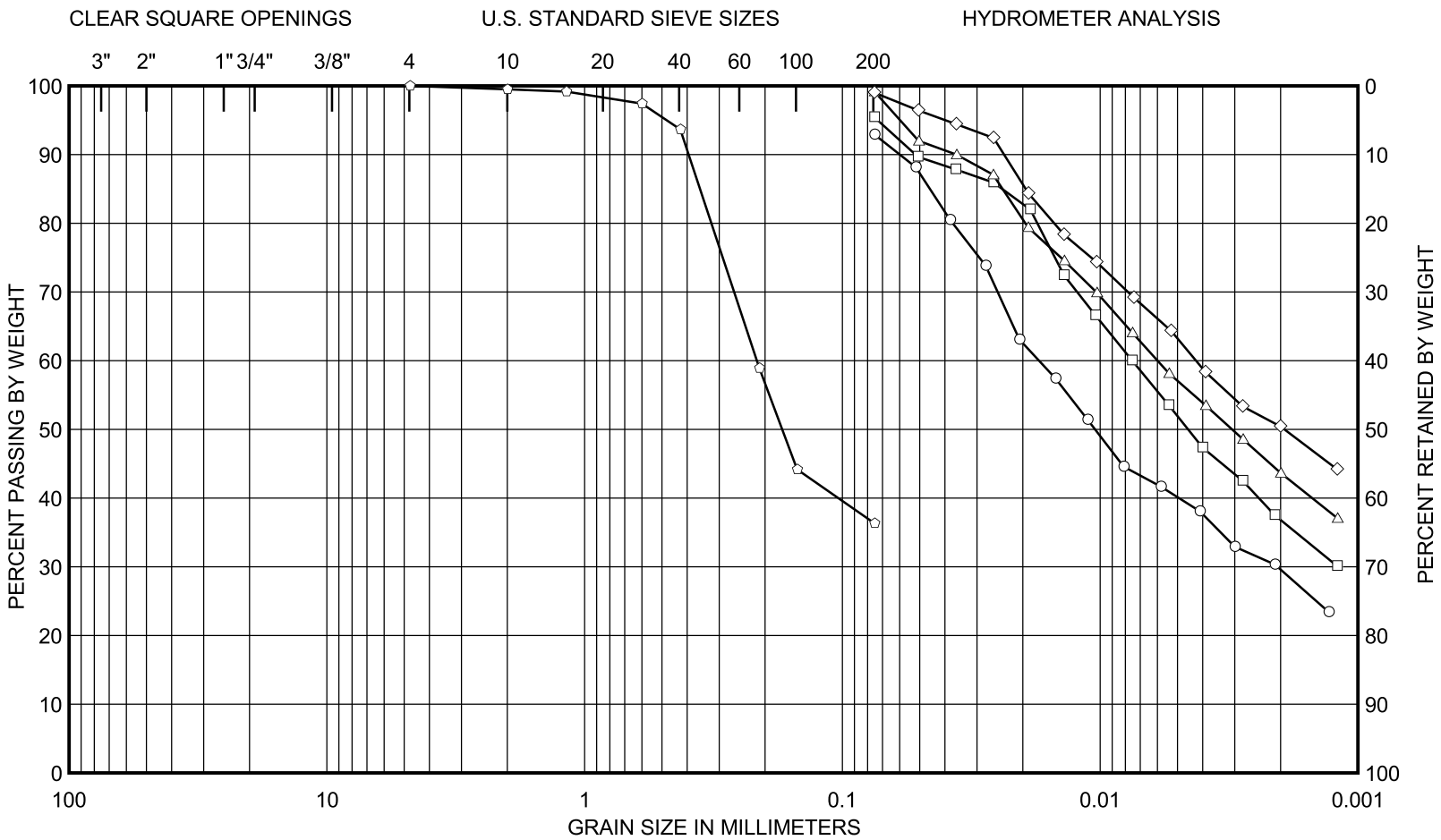
Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-25
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO



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

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
7	2.3	○——○	FAT CLAY (CH) with silt pockets			0.011
29	9.5	□——□	FAT CLAY (CH)			0.0046
41	21.8	△——△	FAT CLAY (CH)			0.0031
57	44.4	◇——◇	FAT CLAY (CH)			0.0019
76	63.7	⬠——⬠	SILTY FINE SAND (SM) with a trace of medium sand			0.17

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-25

SFOBB East Span Seismic Safety Project

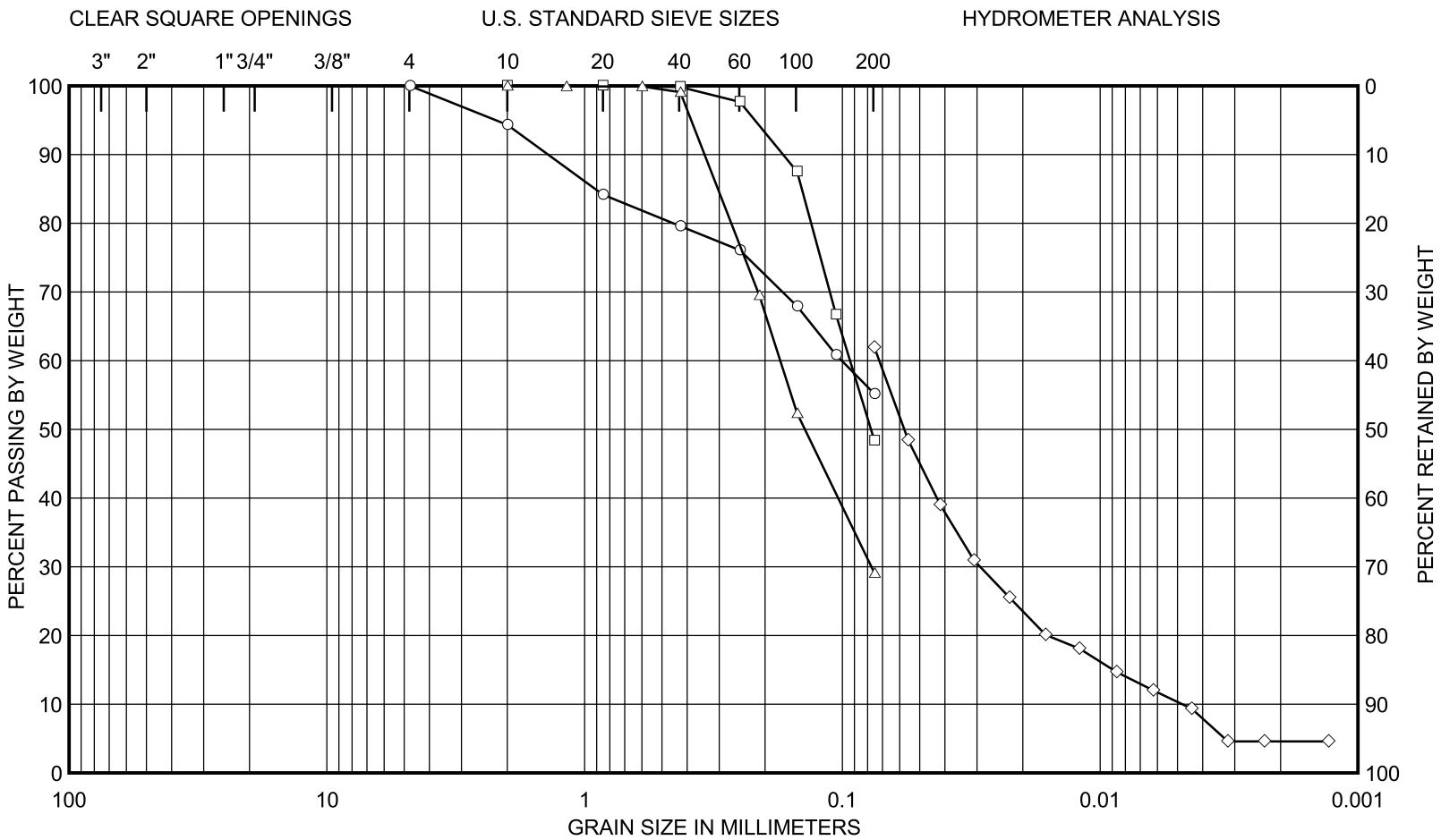
SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

PLATE 98-25.11a

i:\caltrans\98-25 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)
77	66.3	○——○	SANDY SILT (ML) with a trace of medium and coarse sand			
79	68.4	□——□	SILTY FINE SAND (SM)			0.077
82	70.7	△——△	SILTY FINE SAND (SM)			0.14
83	72.7	◇——◇	SANDY SILT (ML)			0.057

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-25
SFOBB East Span Seismic Safety Project

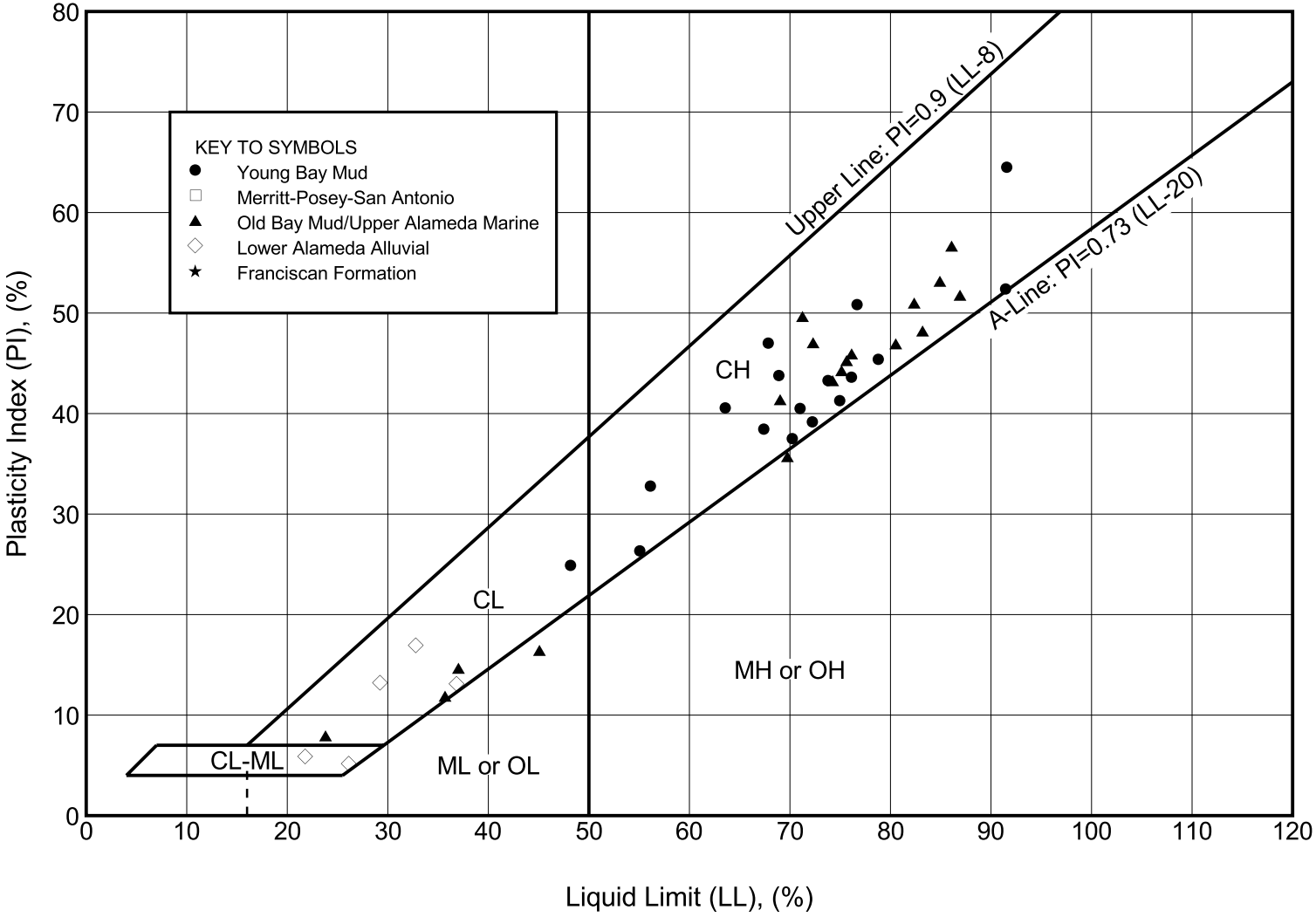
SFOBB Task Order No. 5
Project No. 98-42-0054

Earth Mechanics

FUGRO

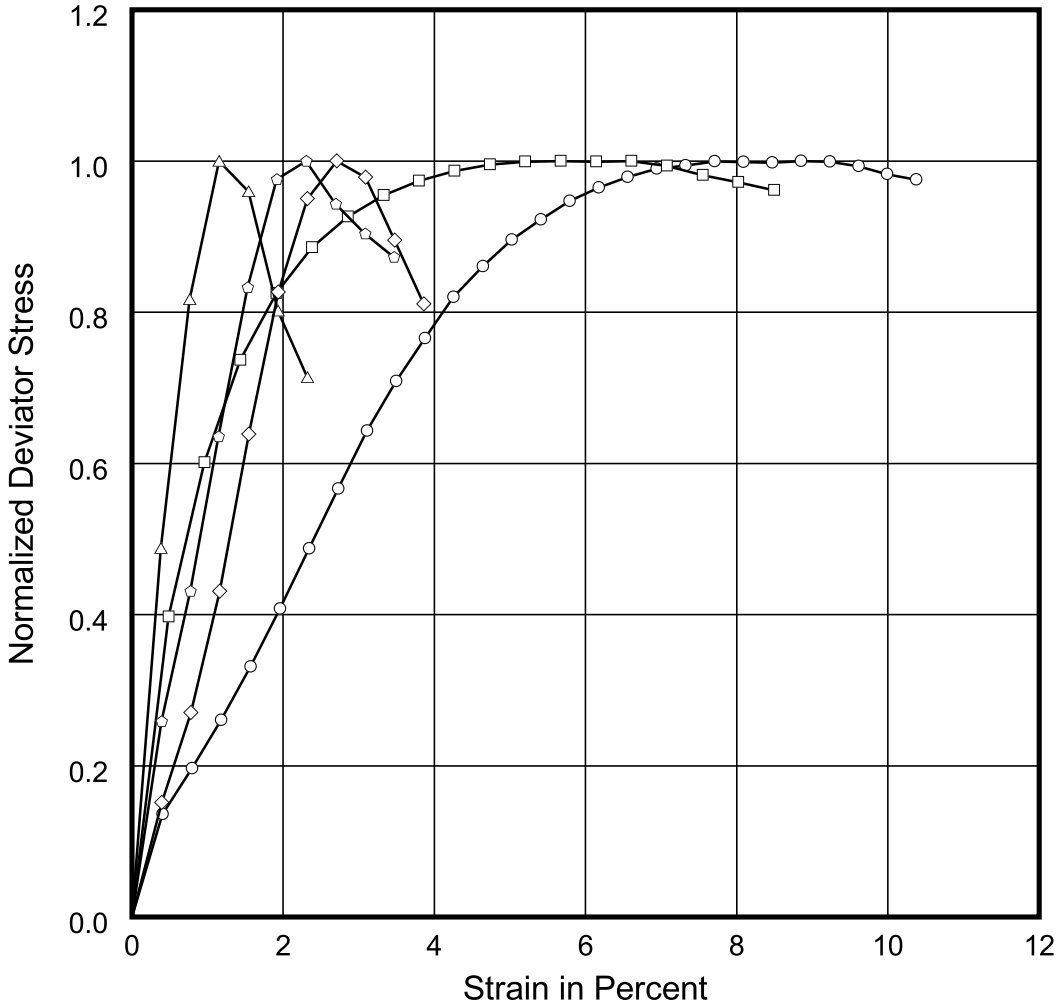
PLATE 98-25.11b

i:\caltrans\98-25 04/55/YY



PLASTICITY CHART
Boring 98-25
SFOBB East Span Seismic Safety Project

i:\caltrans\ 04/22/YY

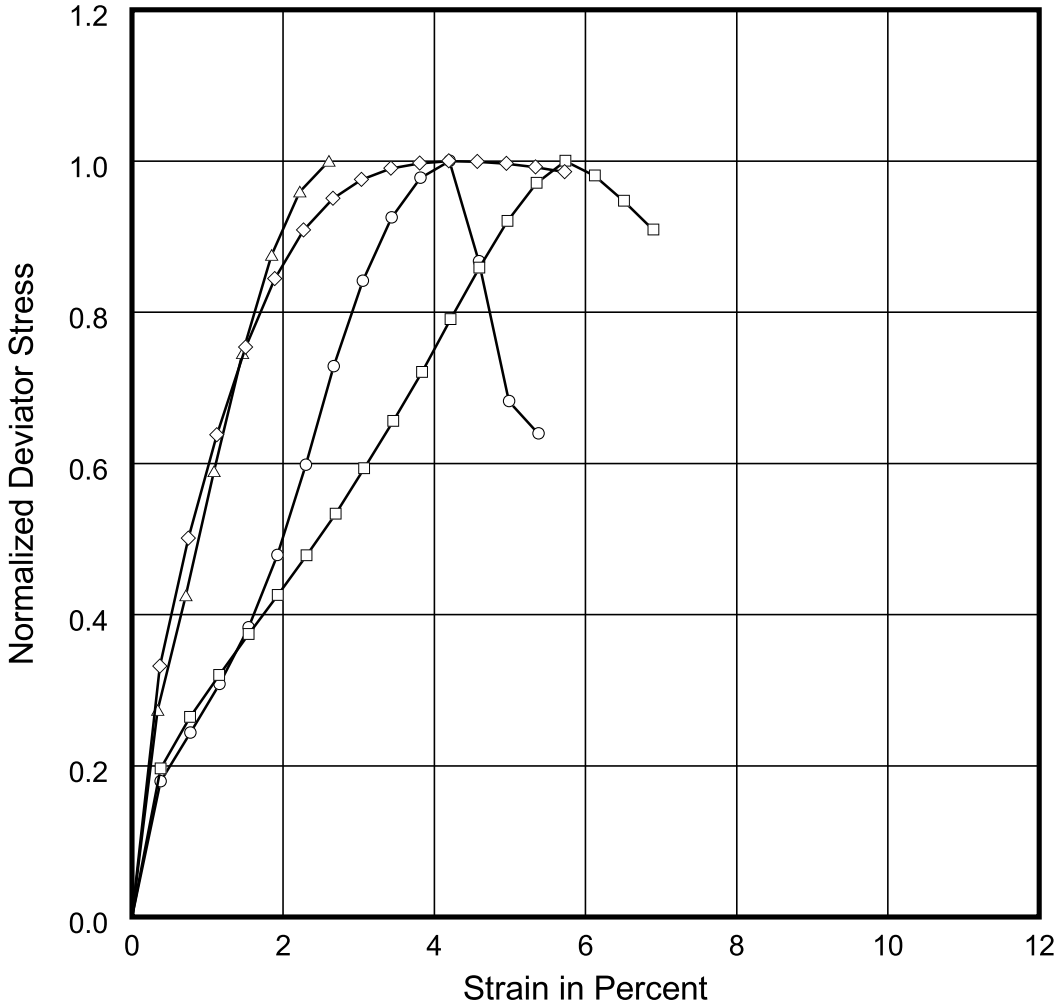


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	35	14.3	UU	241	60	2.4
	39	18.1	UU	758	127	0.7
	41	21.8	UU	827	203	0.4
	47	27.4	UU	827	281	1.3
	49	32.2	UU	1069	358	0.9

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-25
SFOBB East Span Seismic Safety Project

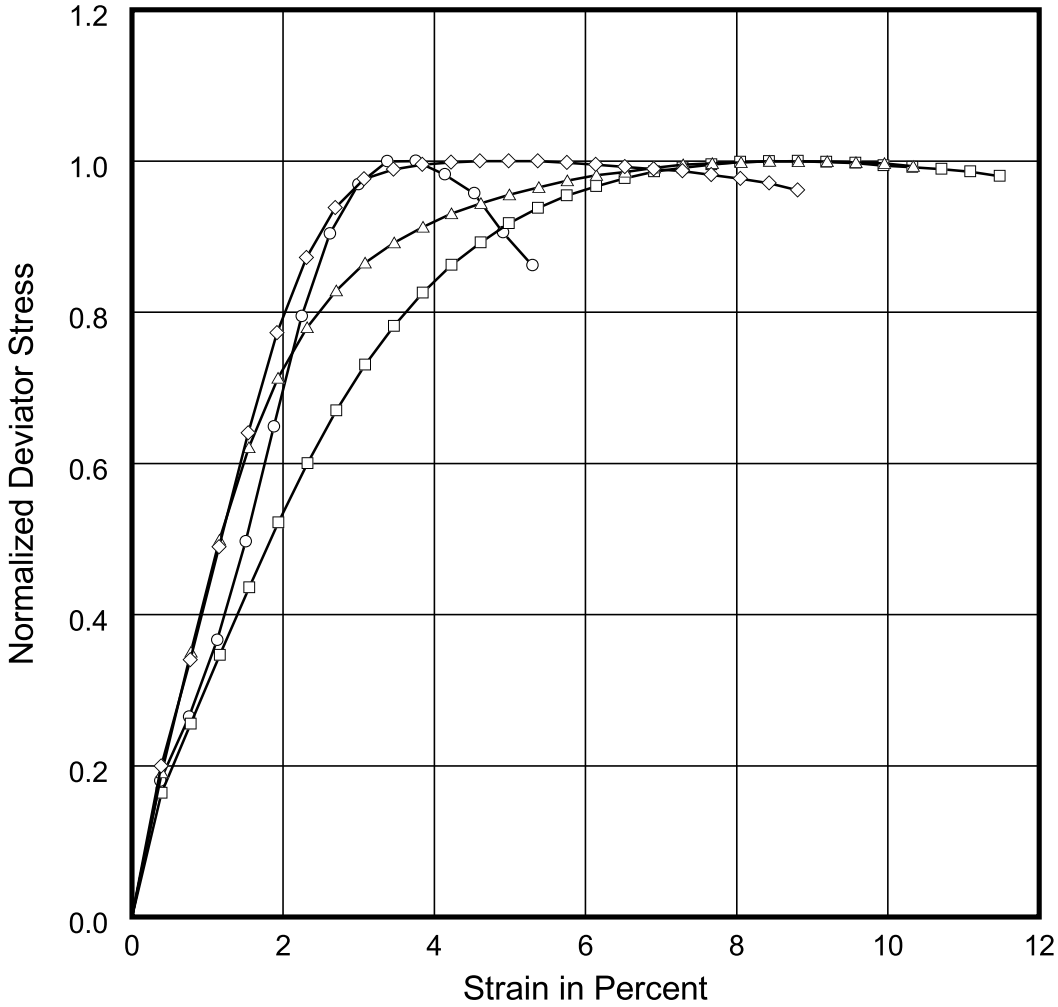


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	52	37.0	UU	1103	367	2.0
□—□	55	39.5	UU	1241	292	2.5
△—△	64	48.3	UU	1448	336	0.9
◇—◇	70	58.1	UU	1655	334	0.7

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-25
SFOBB East Span Seismic Safety Project

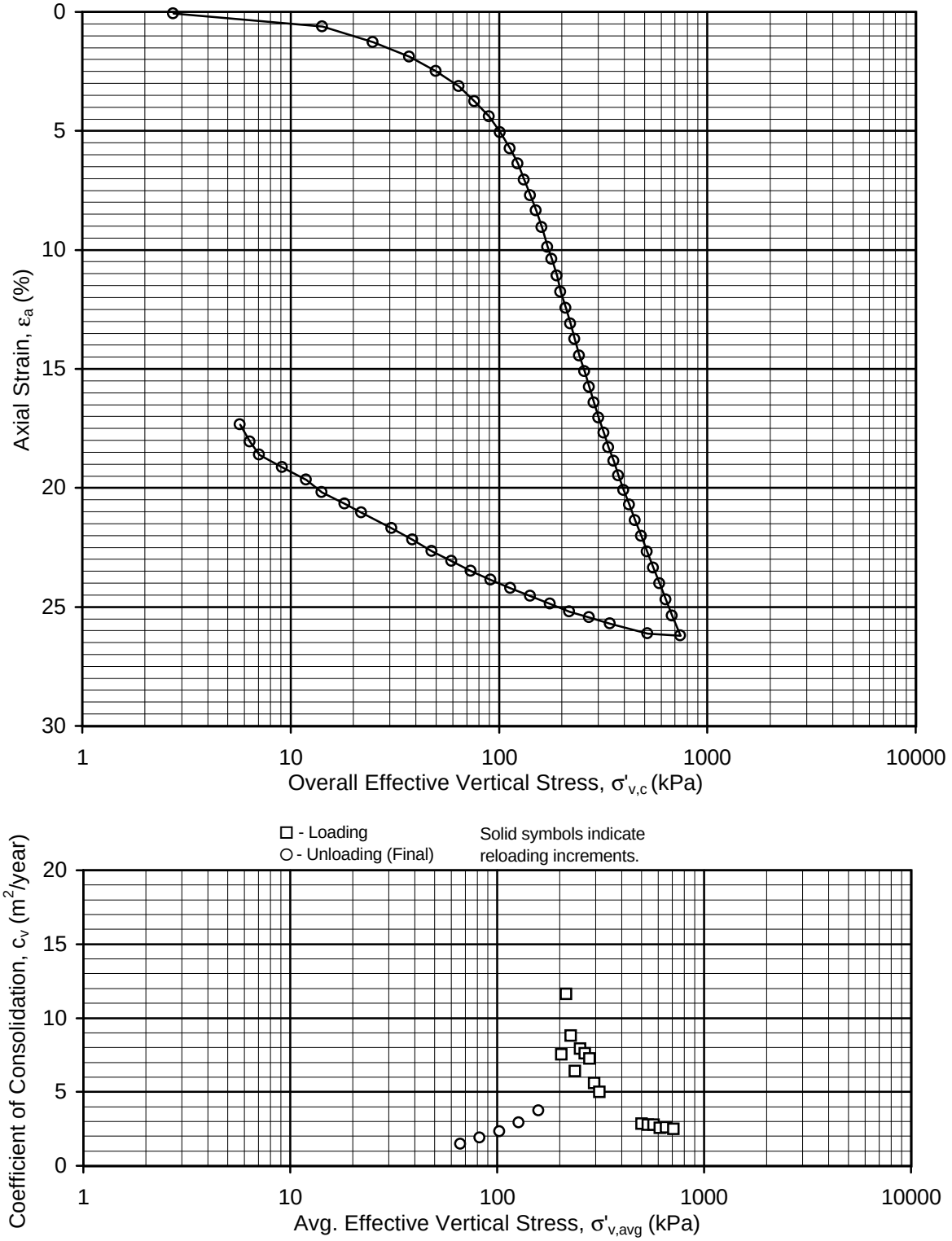


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○——○	73	60.8	UU	1724	443	1.5
□——□	86	75.1	UU	2034	241	1.8
△——△	89	78.8	UU	2137	321	1.2
◇——◇	95	82.3	UU	2206	801	1.2

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

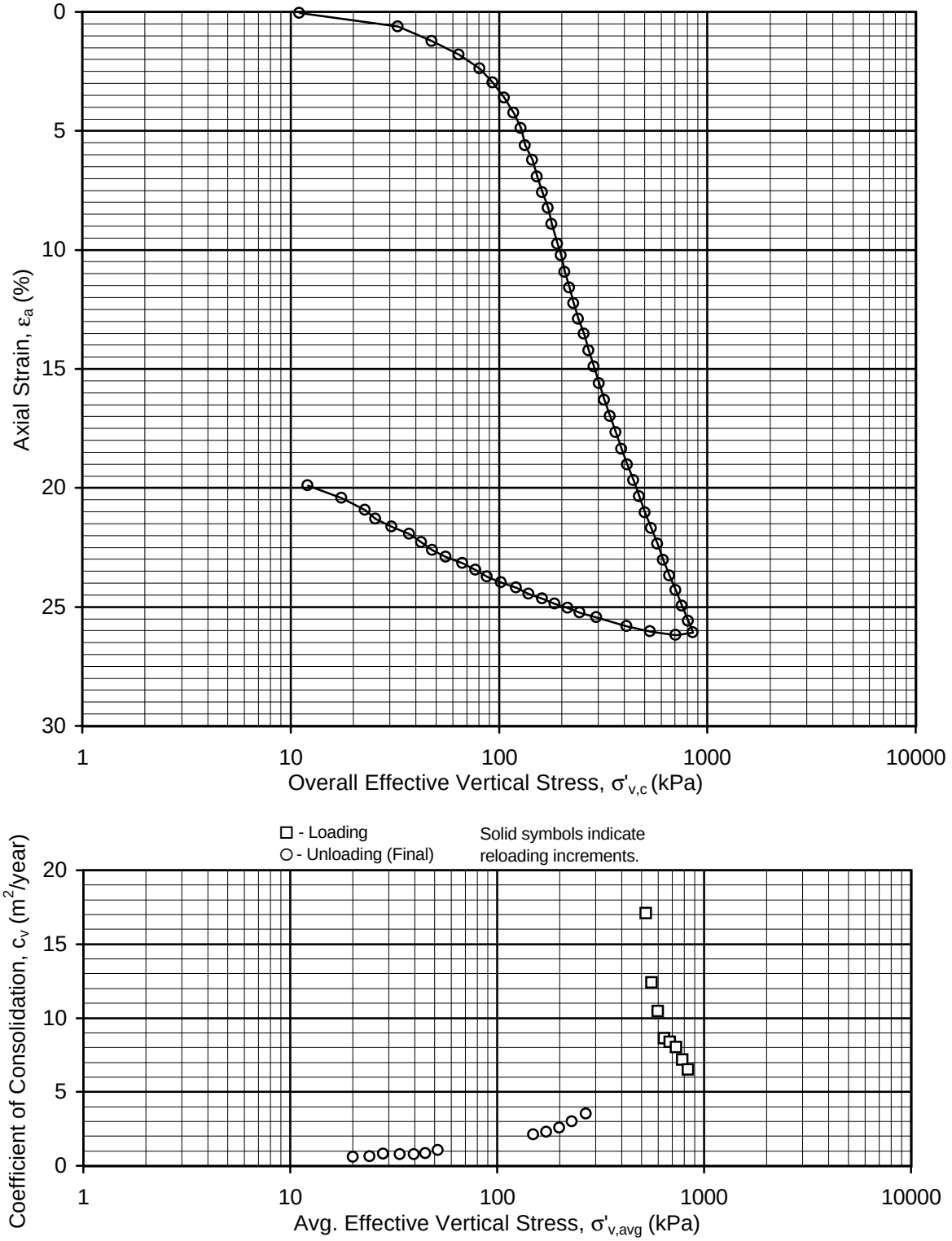
Unconsolidated-Undrained Triaxial Compression Test
Boring 98-25
SFOBB East Span Seismic Safety Project



CRS CONSOLIDATION TEST RESULTS

Sample No. 29A - Depth: 9.5m
Boring 98-25
SFOBB East Span Seismic Safety Project

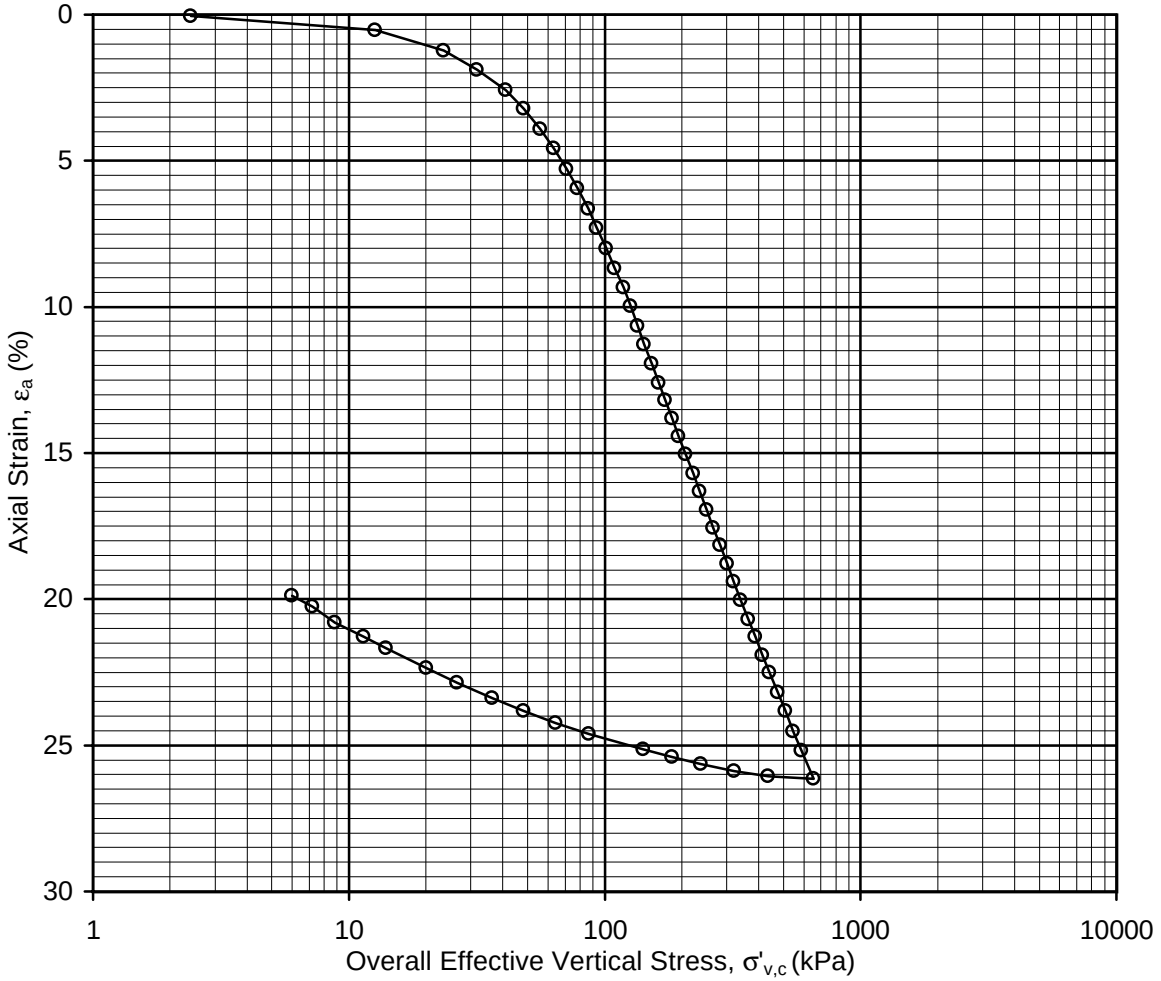
PLATE 98-25.14a

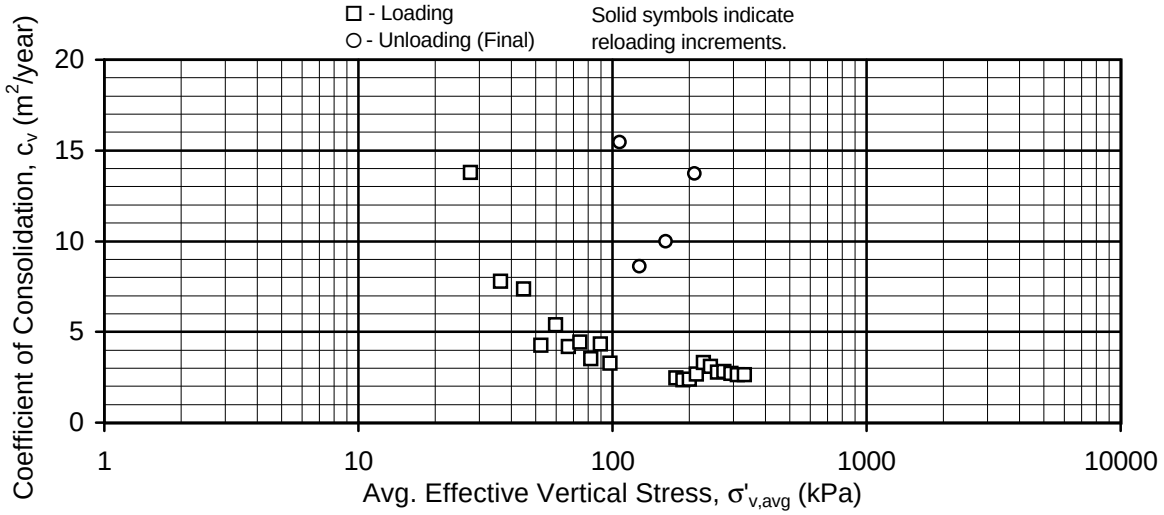


CRS CONSOLIDATION TEST RESULTS

Sample No. 29B (45° Loading) - Depth: 9.5m
Boring 98-25
SFOBB East Span Seismic Safety Project

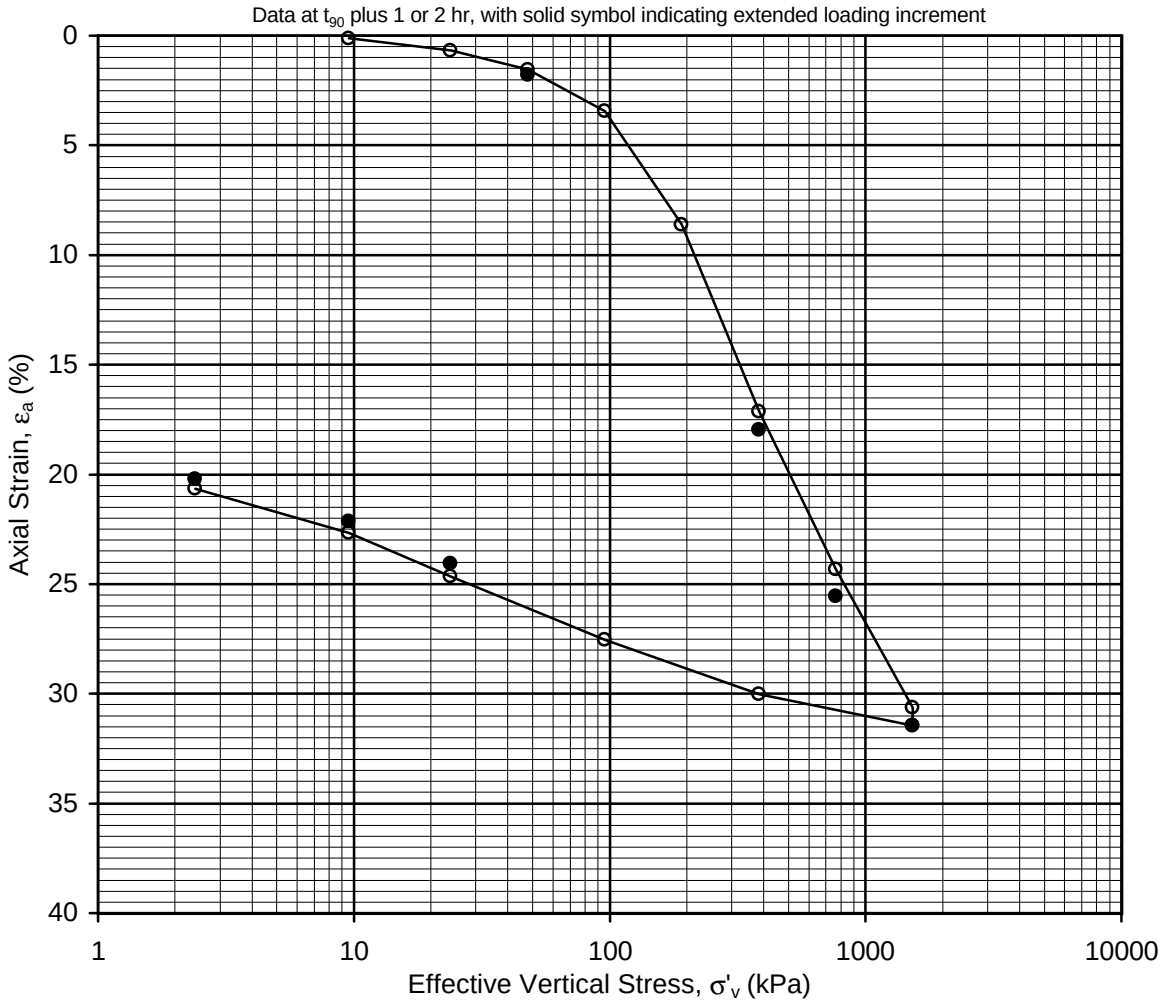
PLATE 98-25.14b

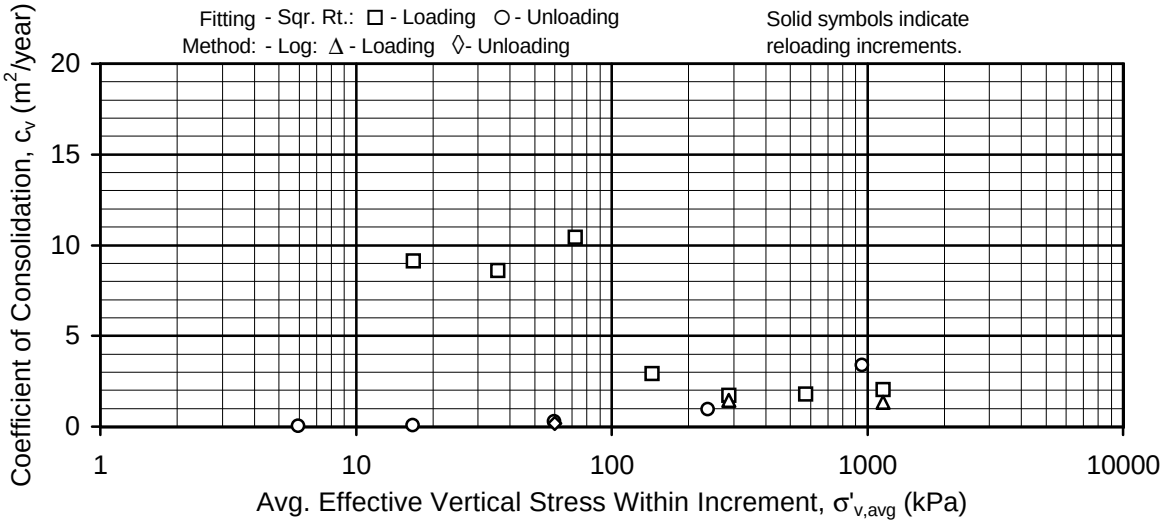




CRS CONSOLIDATION TEST RESULTS

Sample No. 29C (Horizontal Loading) - Depth: 9.5m
Boring 98-25
SFOBB East Span Seismic Safety Project

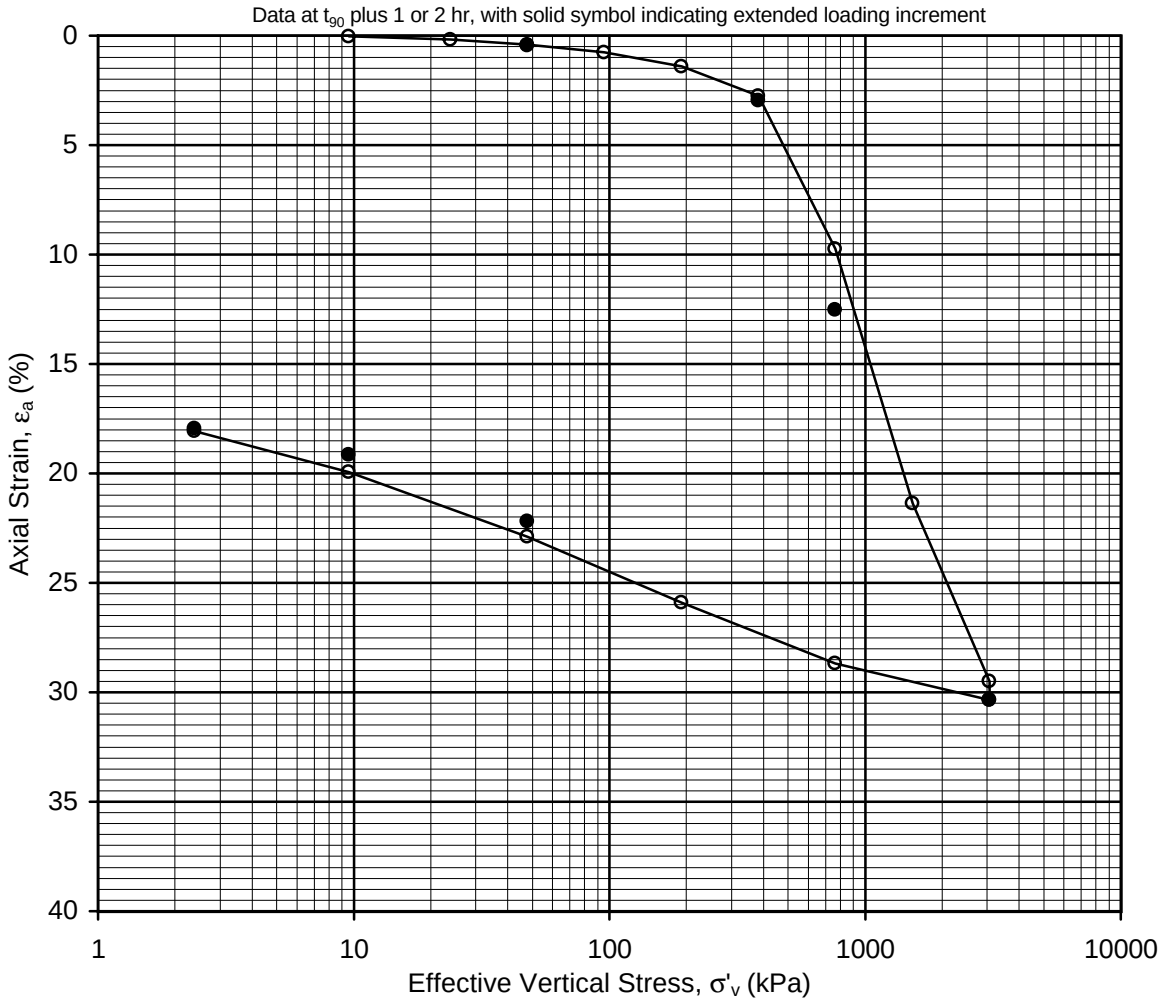


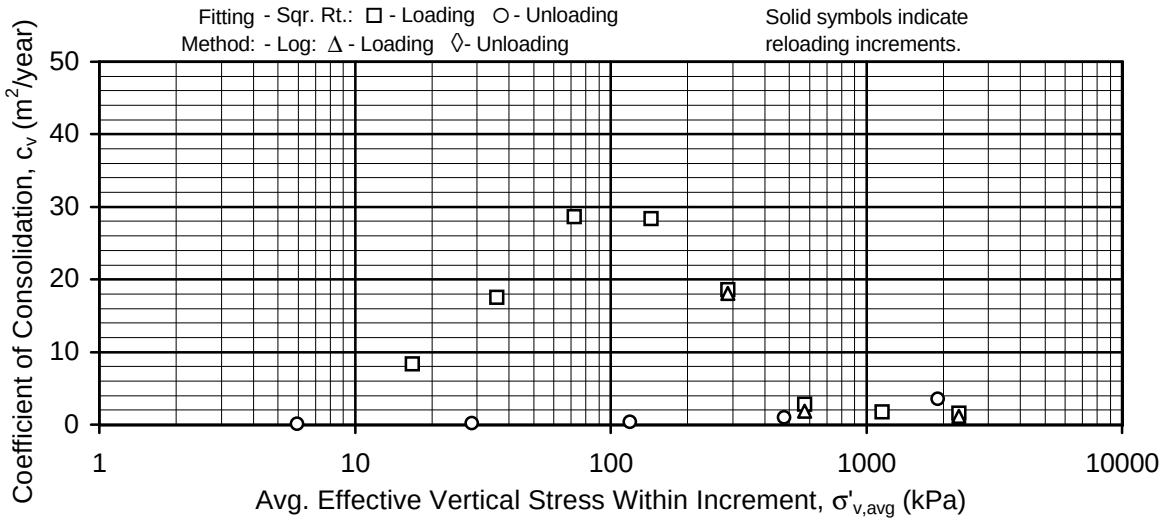


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 33 - Depth: 10.9m
Boring 98-25
SFOBB East Span Seismic Safety Project

PLATE 98-25.14d

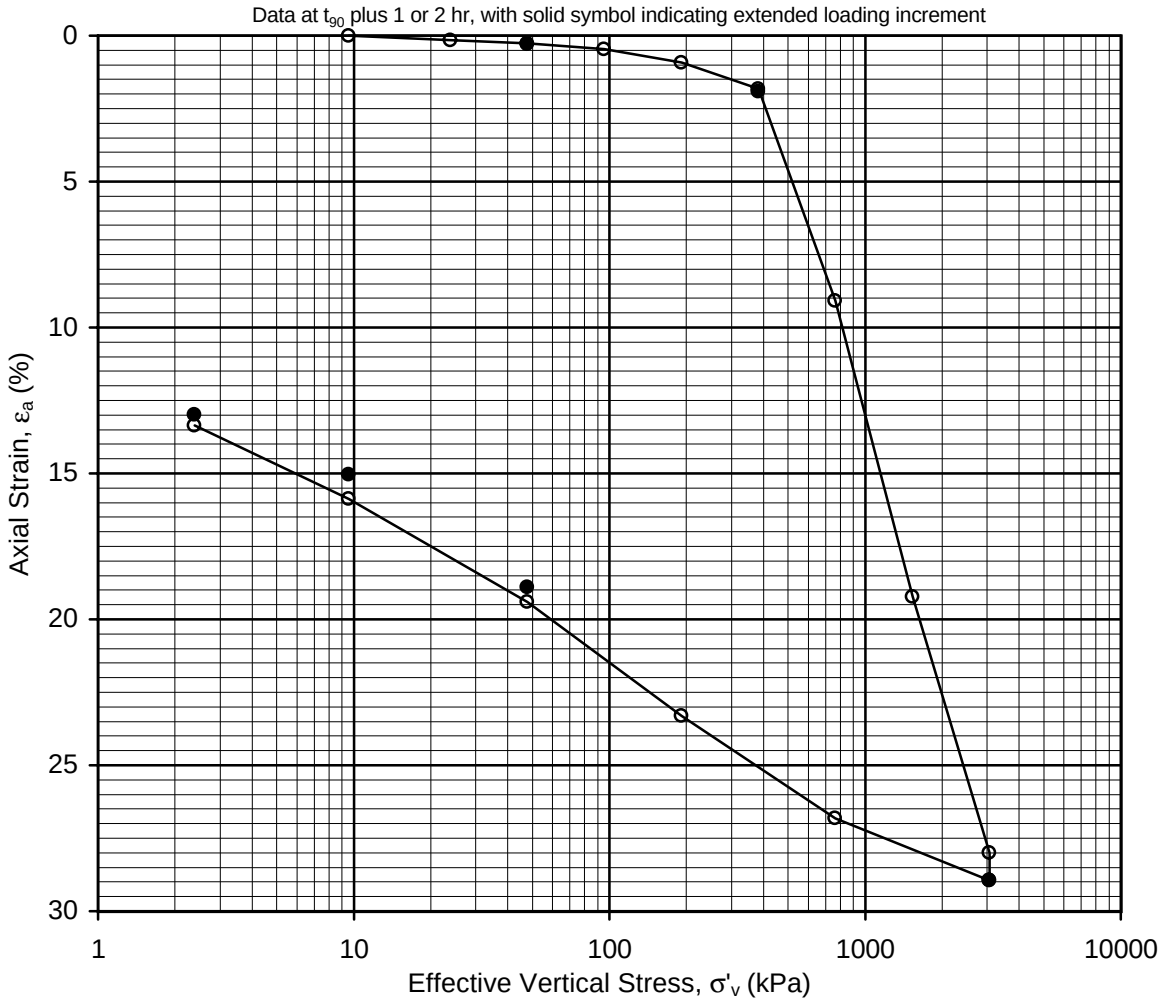


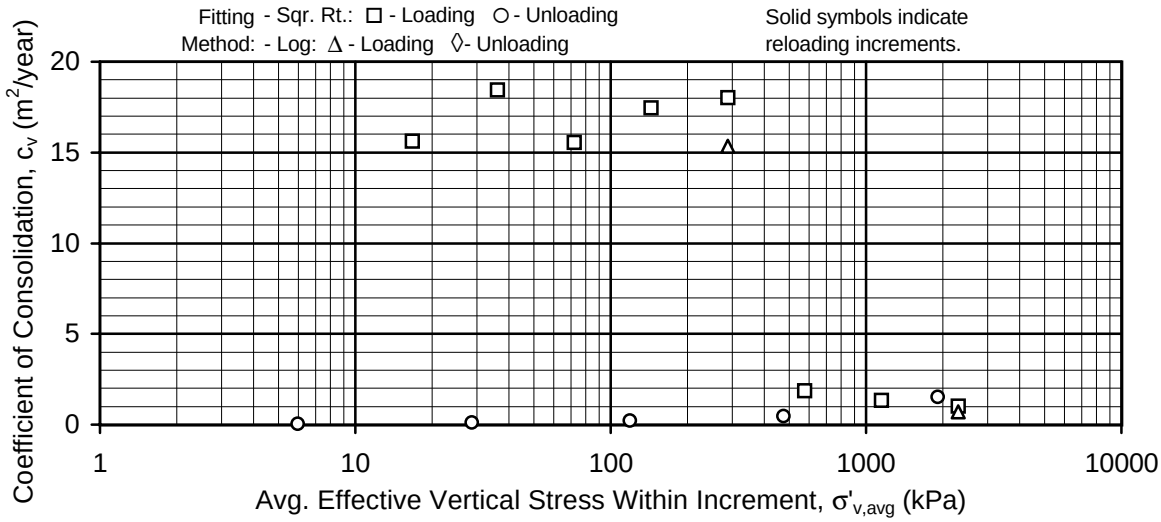


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 43 - Depth: 22.5m
Boring 98-25
SFOBB East Span Seismic Safety Project

PLATE 98-25.14e

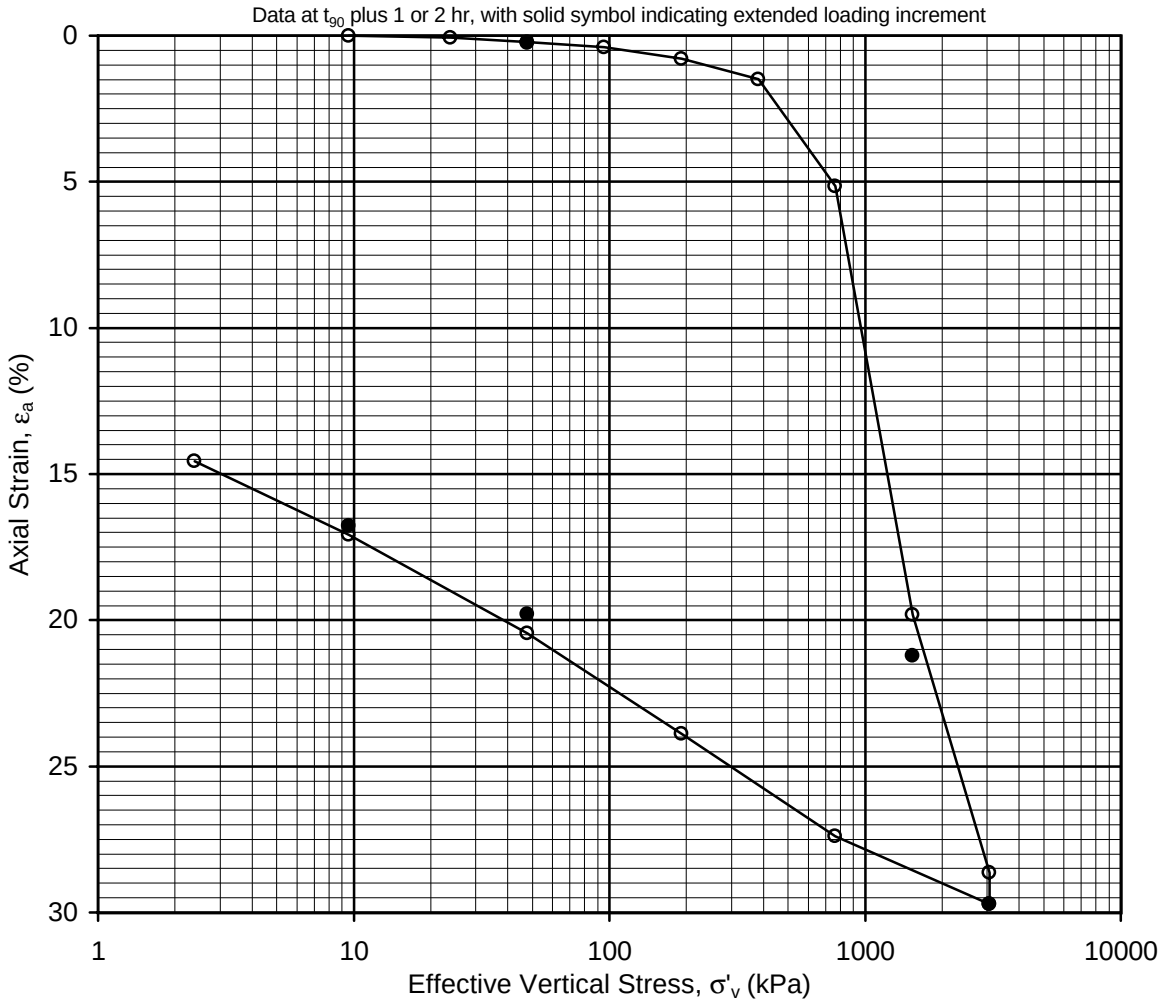


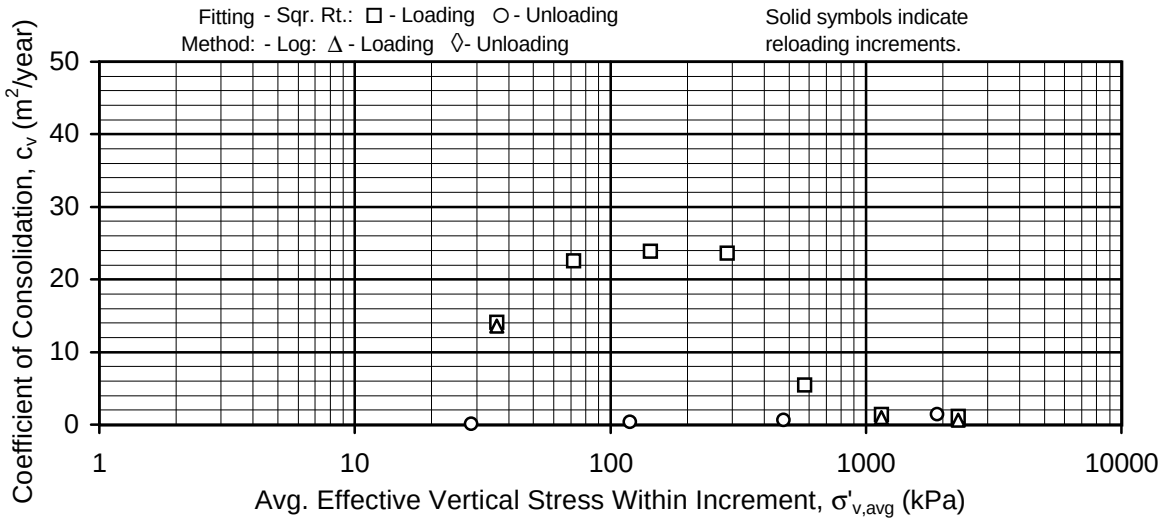


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 57A - Depth: 44.4m
Boring 98-25
SFOBB East Span Seismic Safety Project

PLATE 98-25.14f

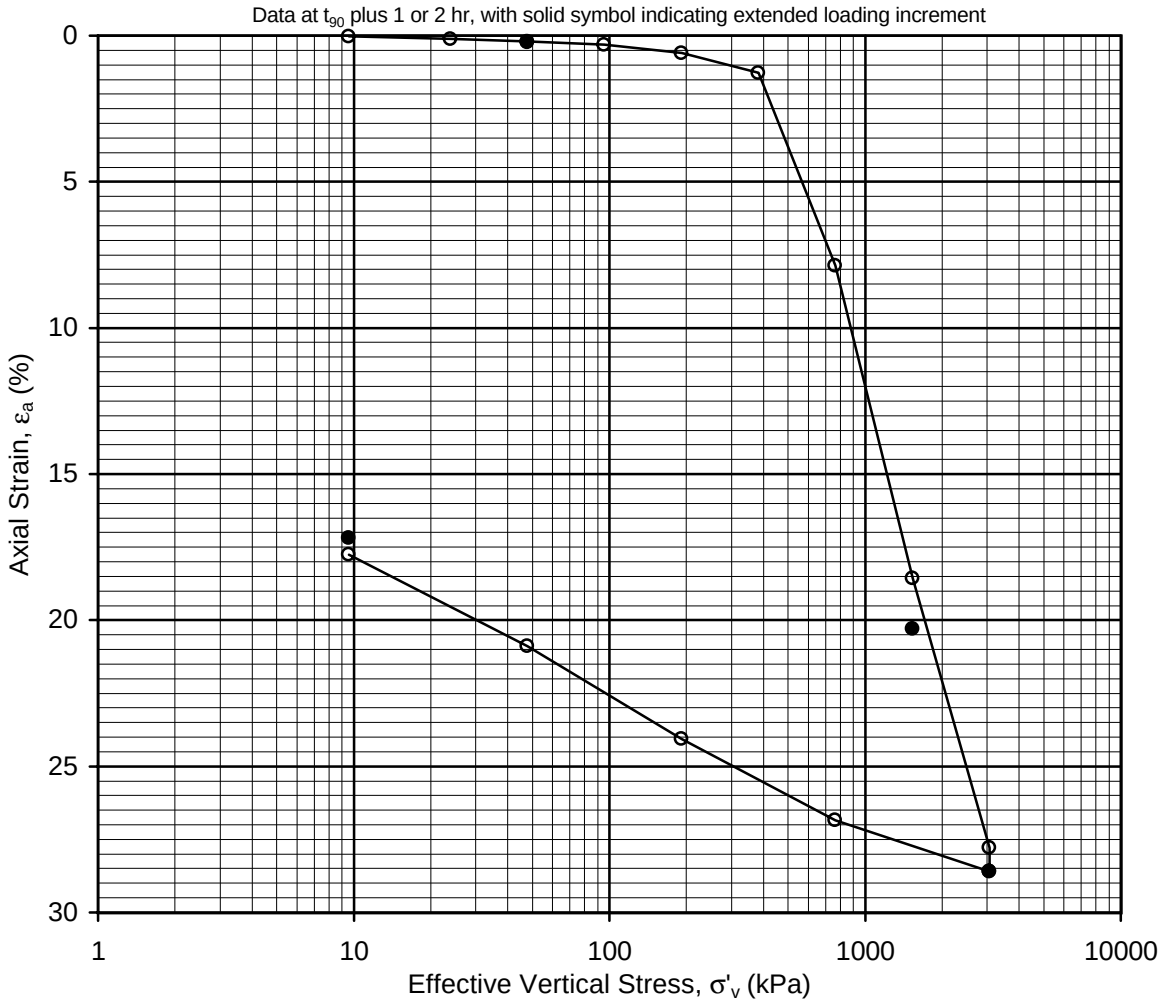


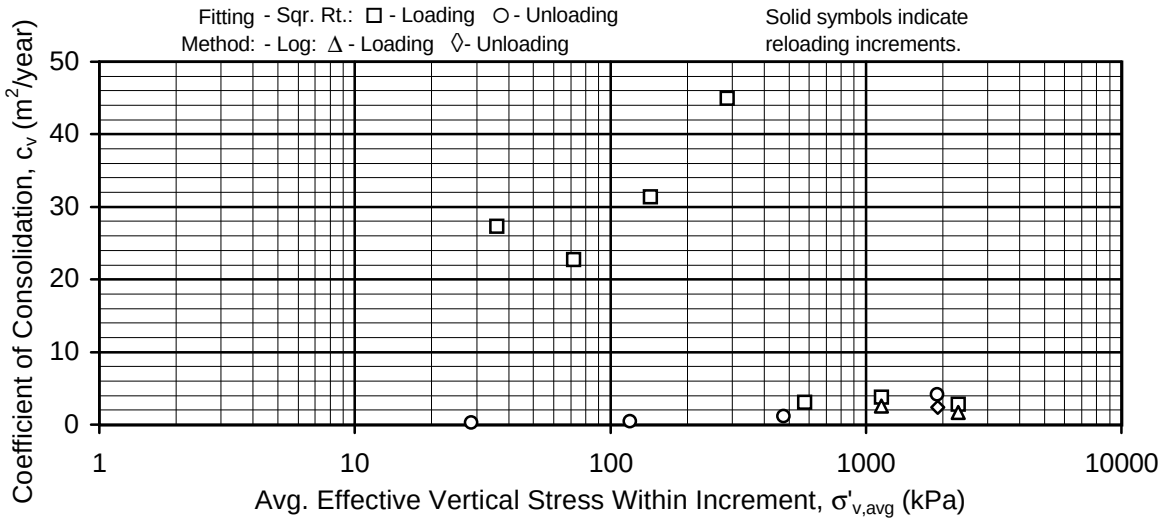


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 57B (45° Loading) - Depth: 44.4m
Boring 98-25
SFOBB East Span Seismic Safety Project

PLATE 98-25.14g

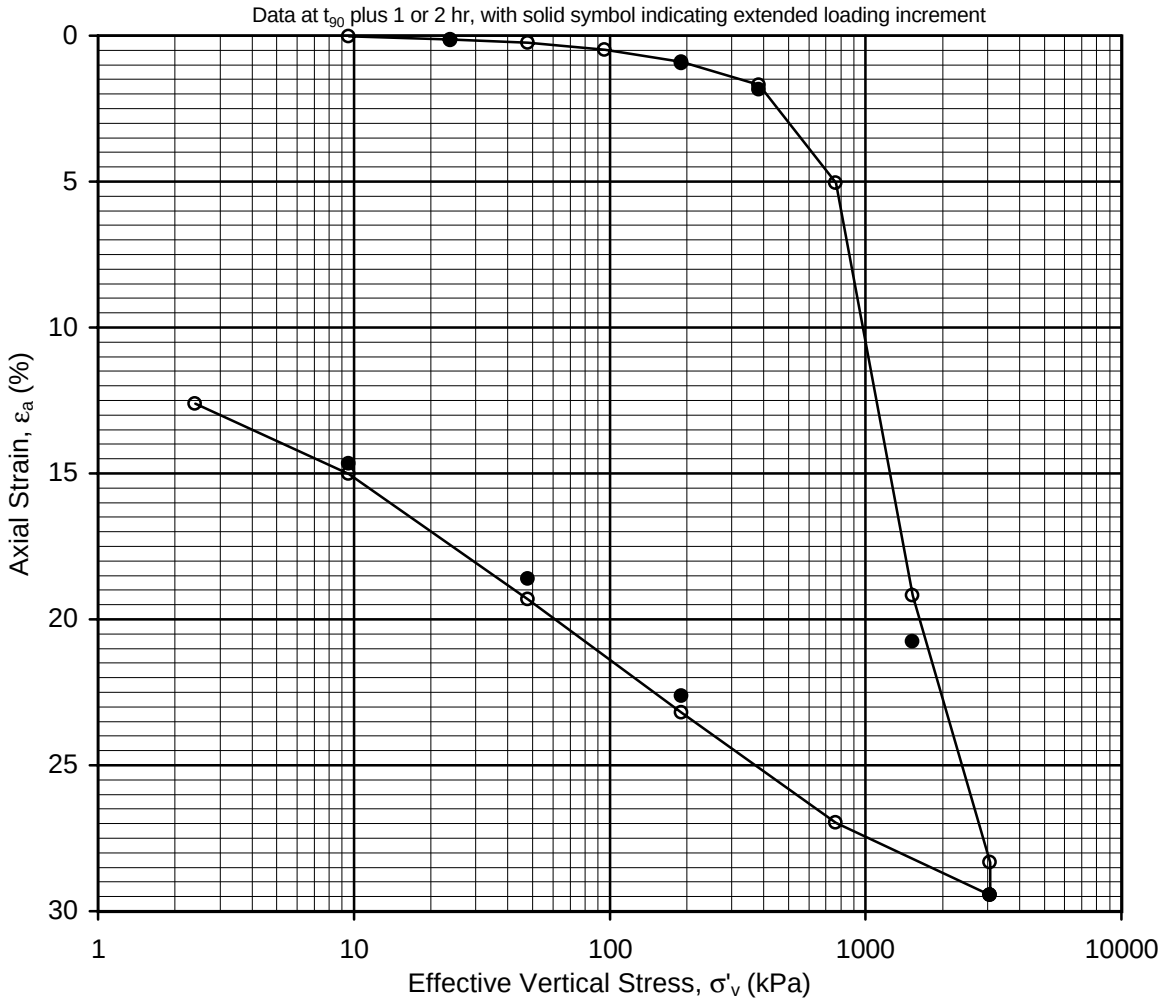


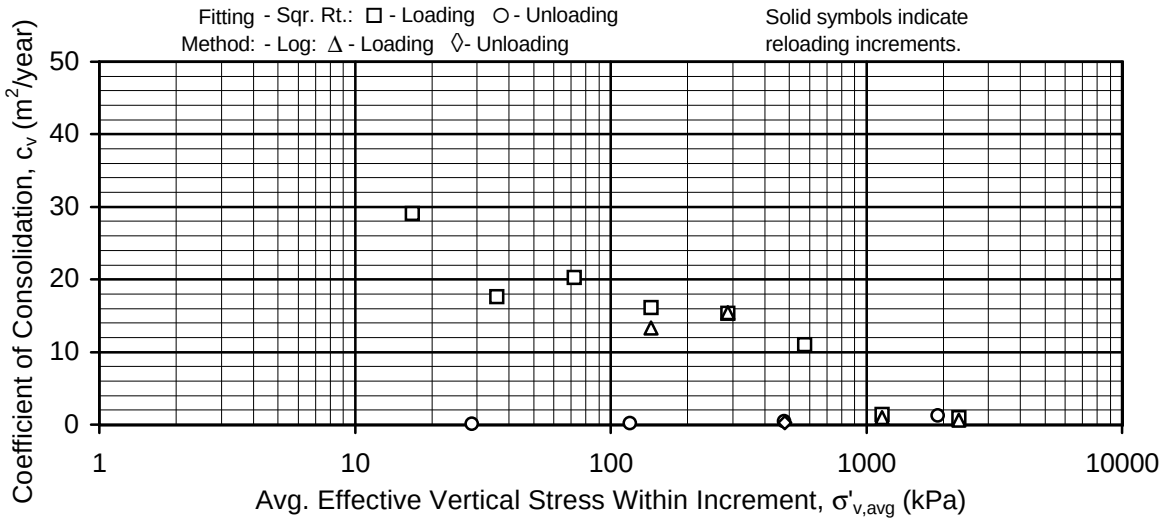


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 57C (Horizontal Loading) - Depth: 44.4m
Boring 98-25
SFOBB East Span Seismic Safety Project

PLATE 98-25.14h

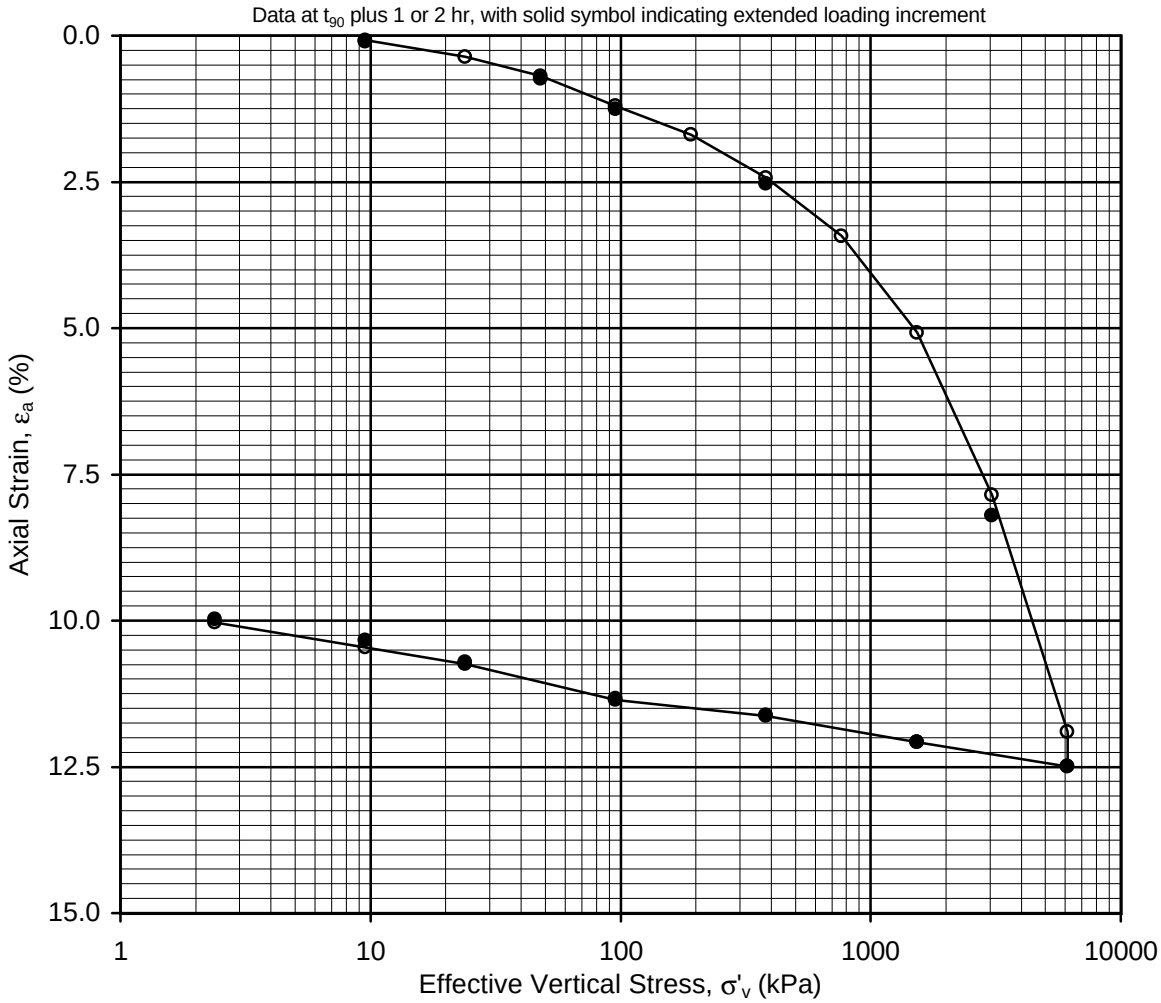


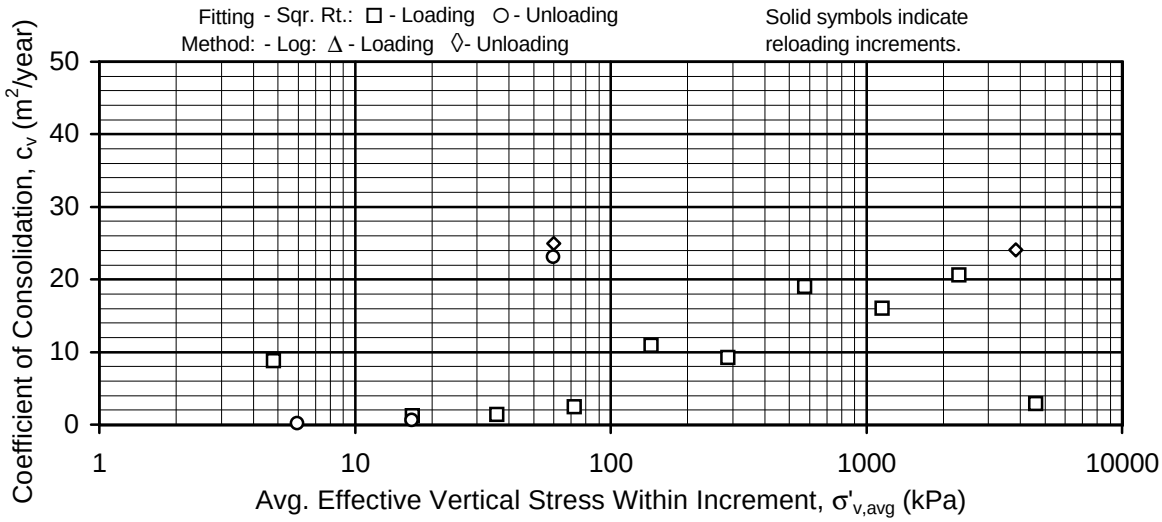


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 61 - Depth: 45.6m
Boring 98-25
SFOBB East Span Seismic Safety Project

PLATE 98-25.14i

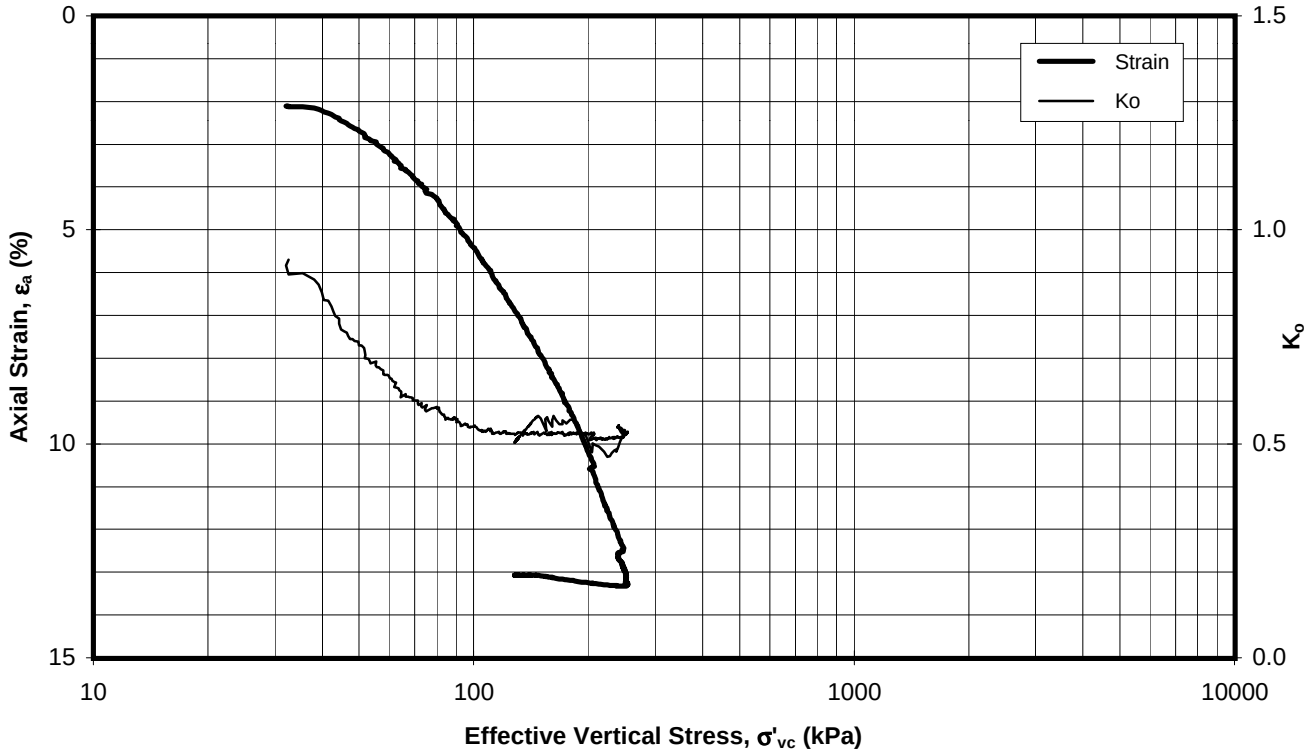


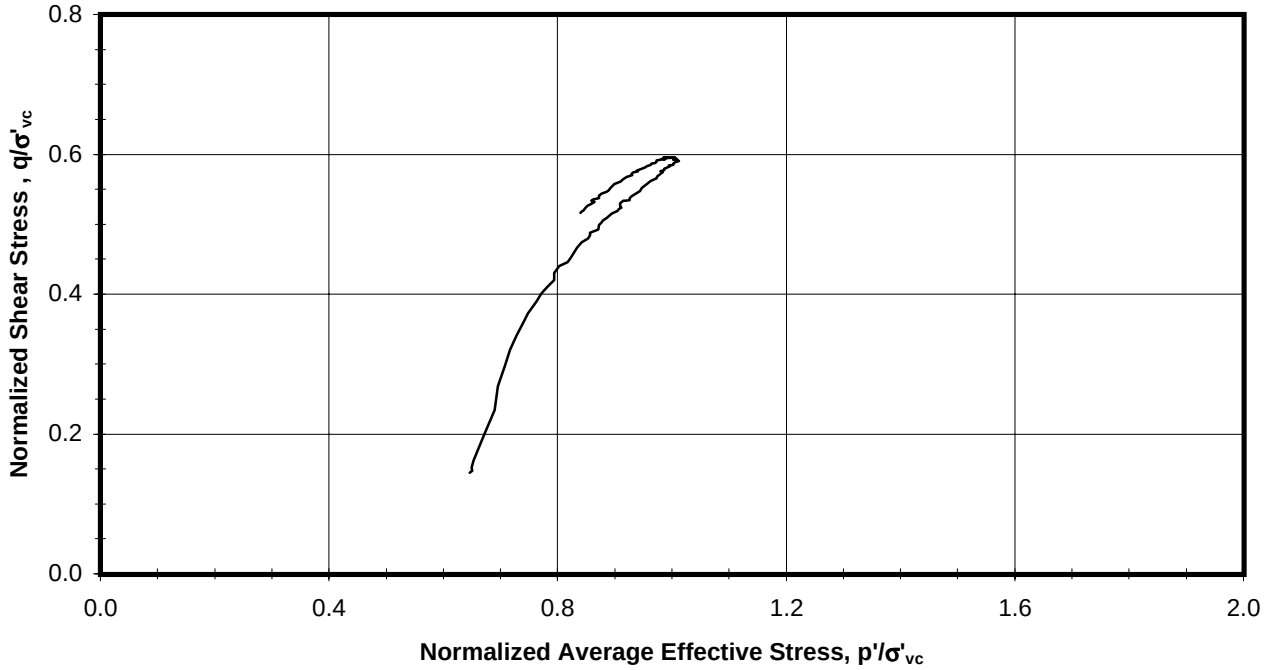


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 91 - Depth: 79.4m
Boring 98-25
SFOBB East Span Seismic Safety Project

PLATE 98-25.14j





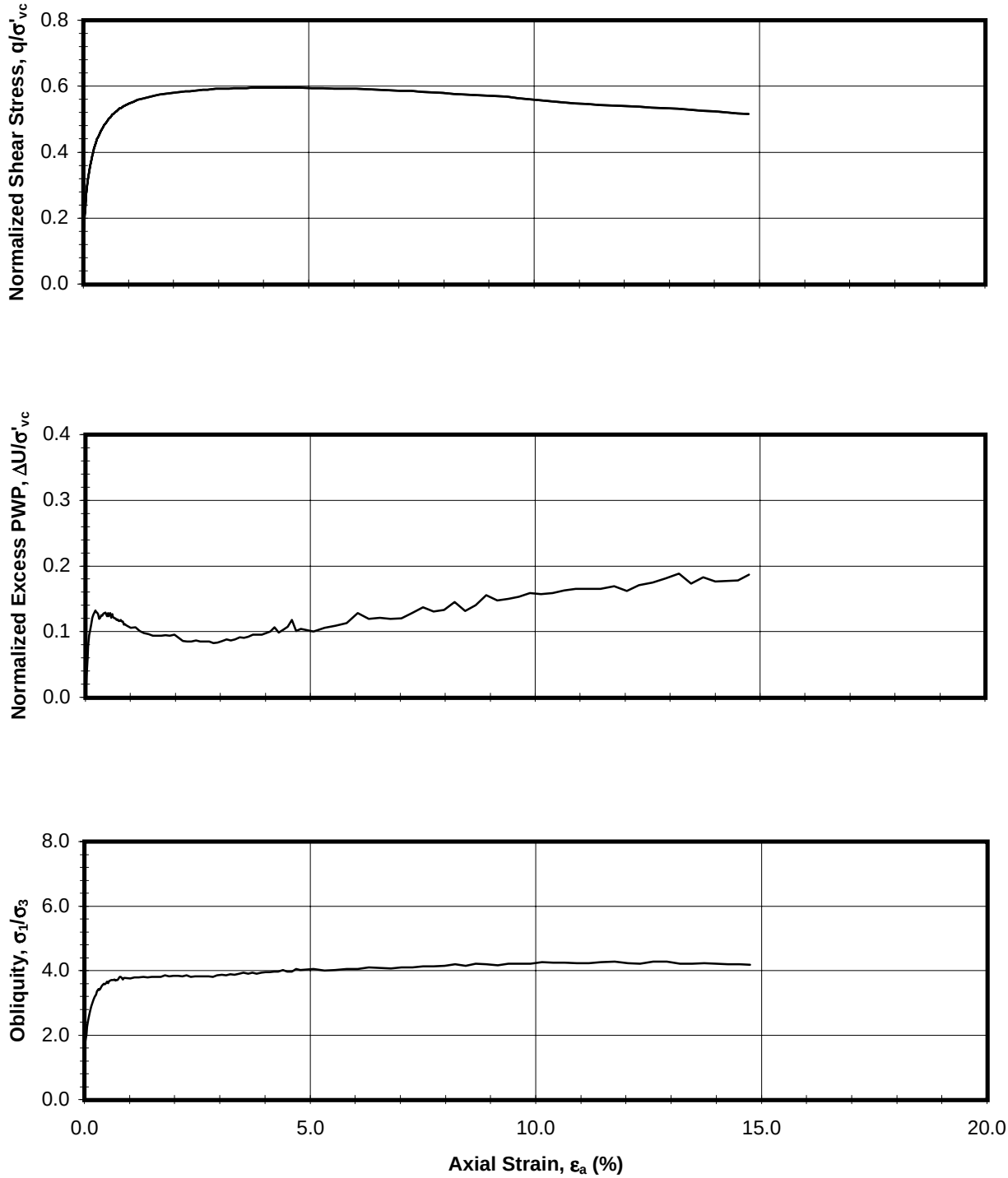
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 31a - Depth: 10.3m

Boring 98-25

SFOBB East Span Seismic Safety Project

PLATE 98-25.15a.1



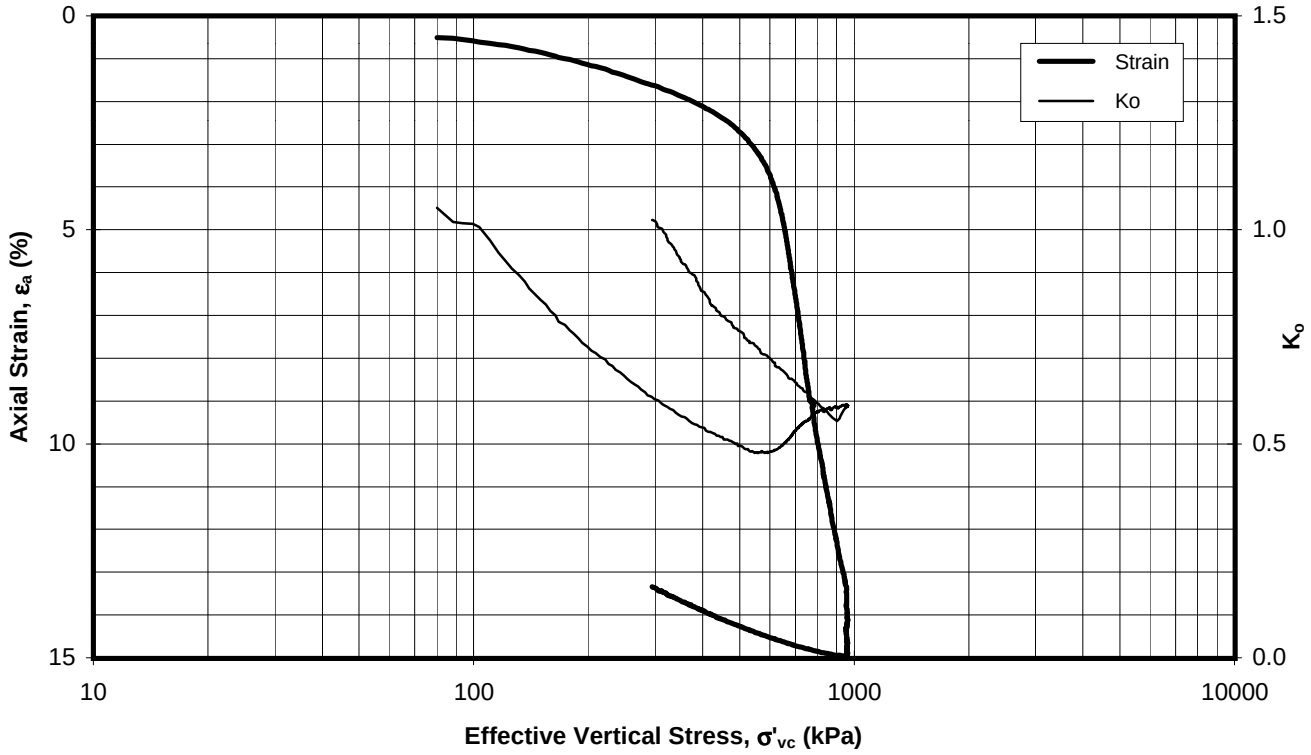
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

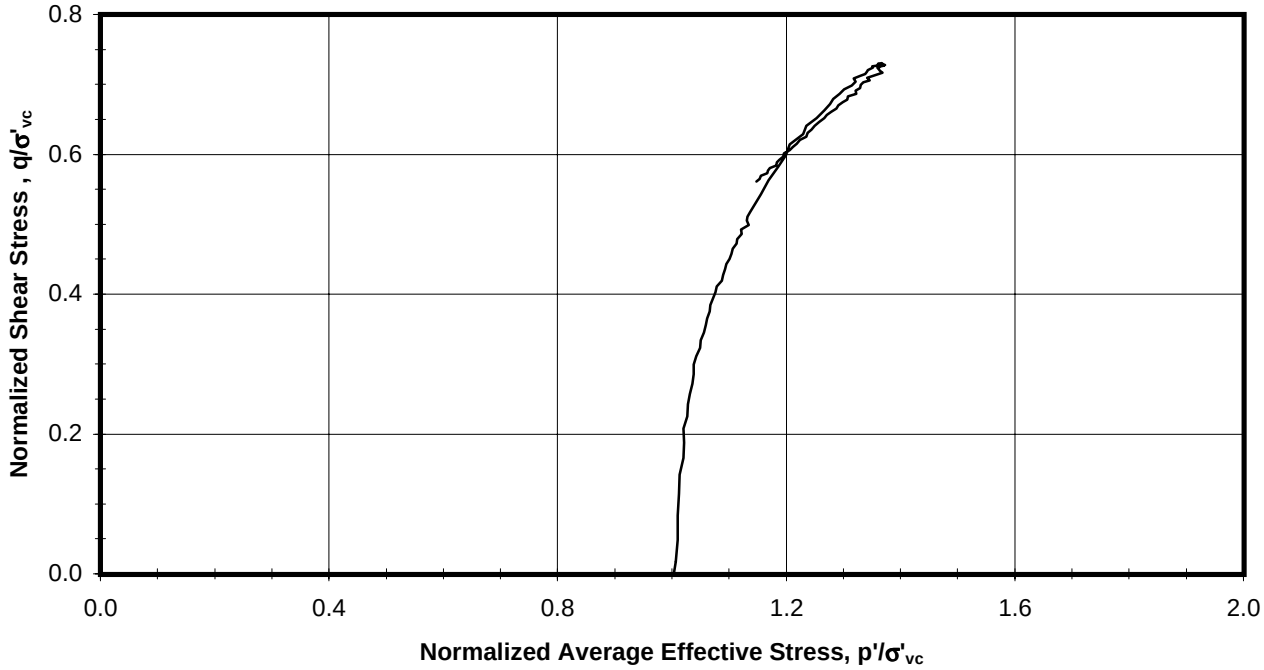
Sample No. 31a - Depth: 10.3m

Boring 98-25

SFOBB East Span Seismic Safety Project

PLATE 98-25.15a.2





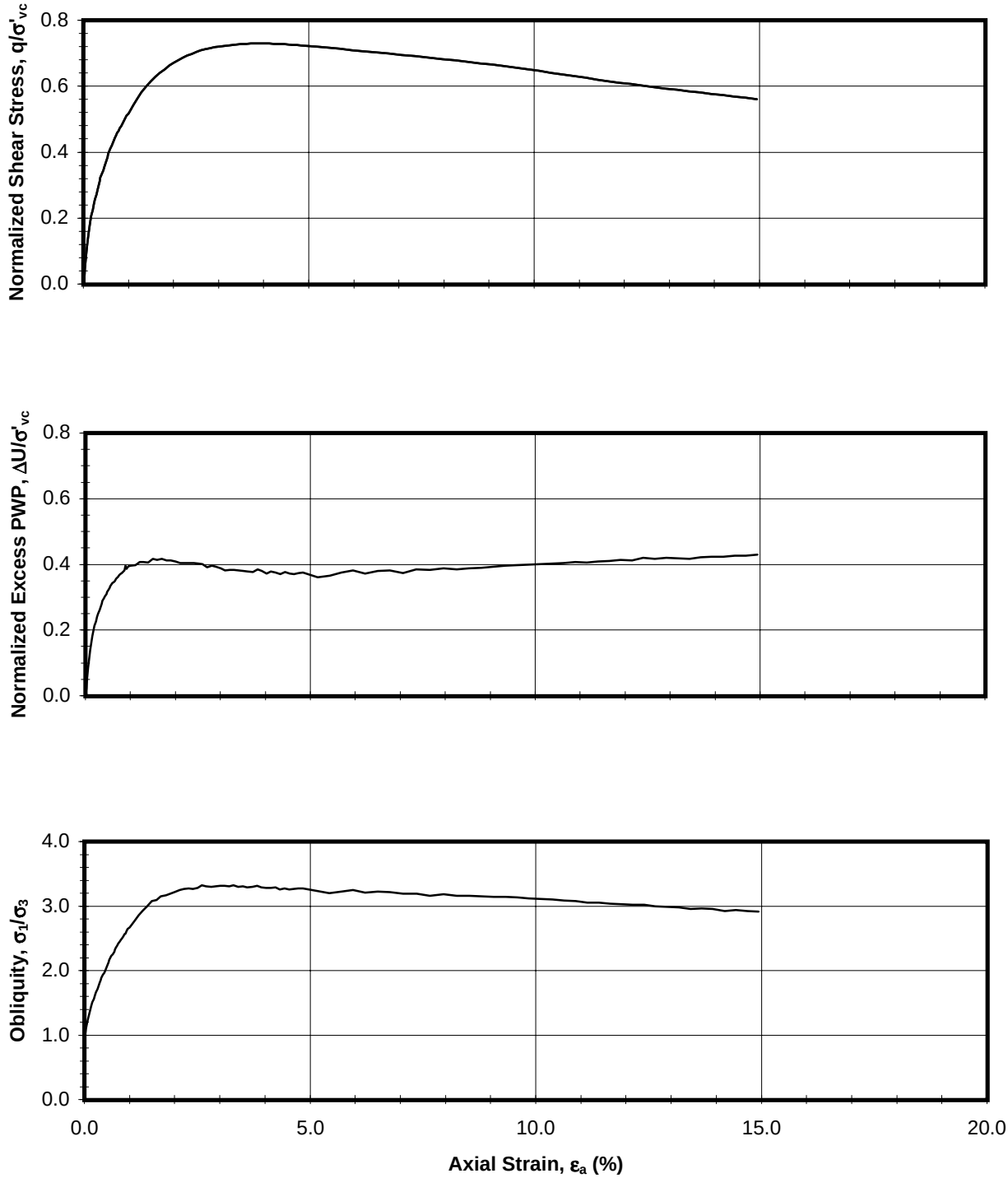
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 43 - Depth: 22.4m

Boring 98-25

SFOBB East Span Seismic Safety Project

PLATE 98-25.15b.1

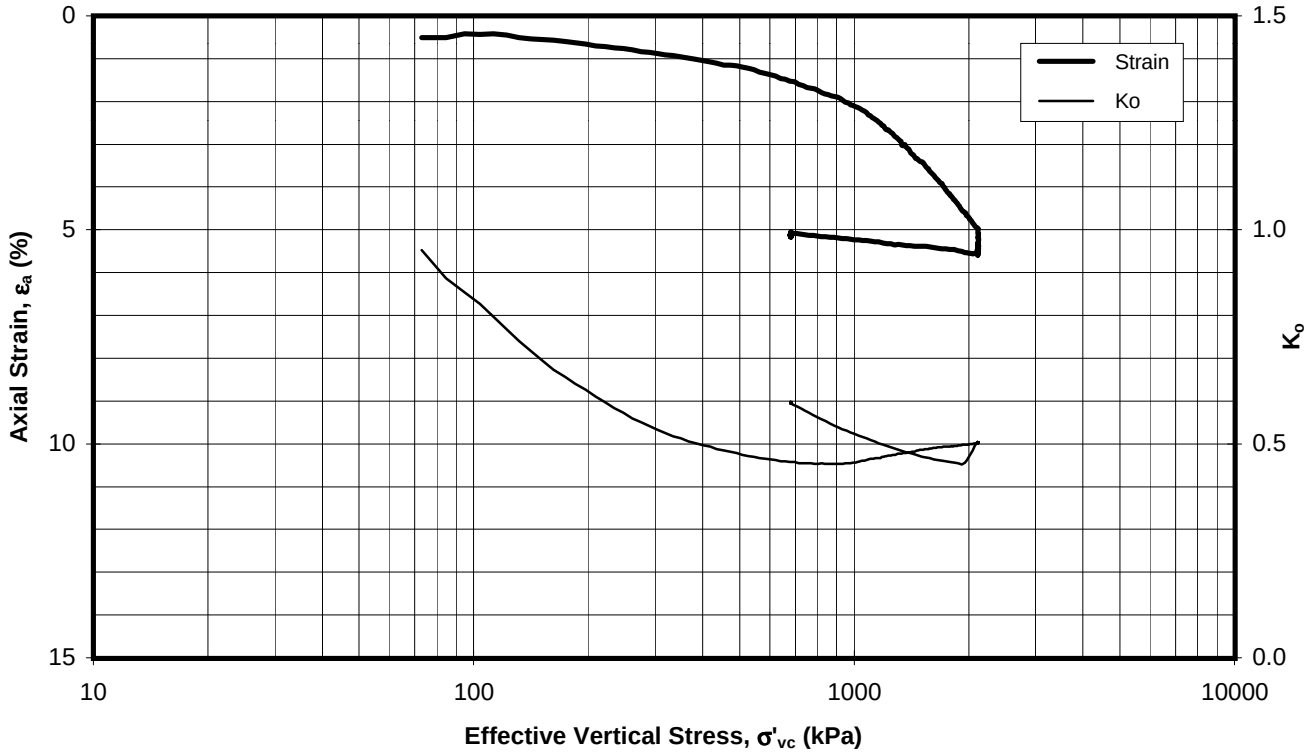


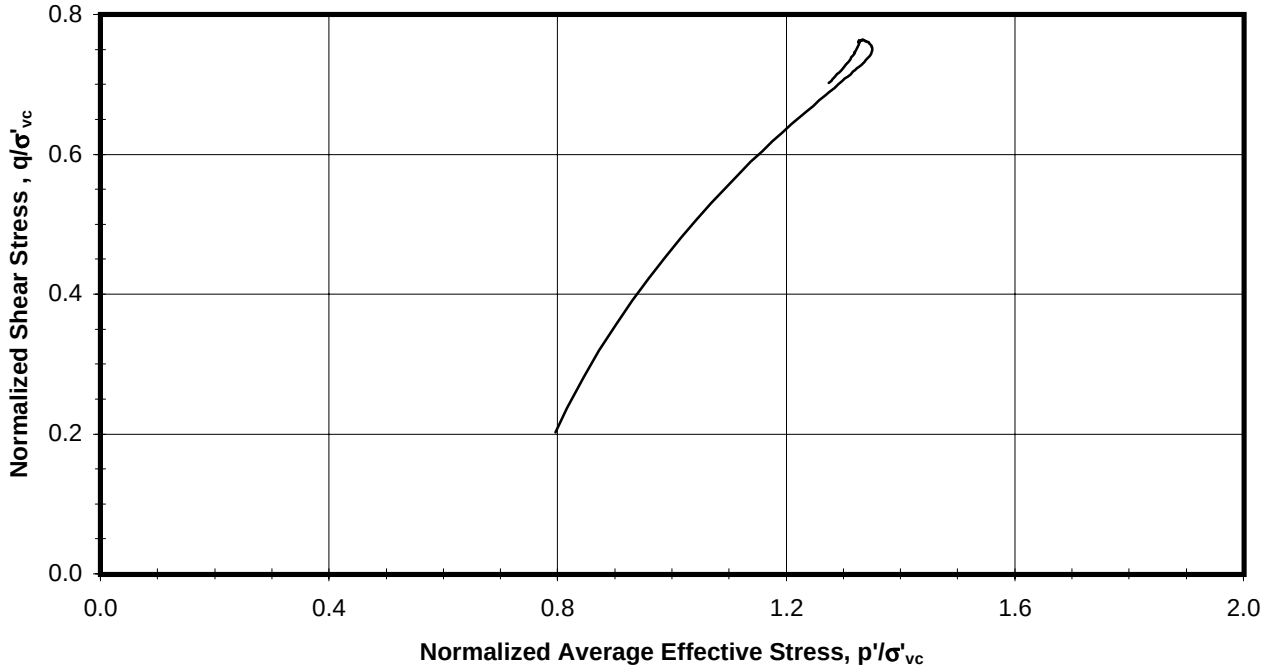
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 43 - Depth: 22.4m

Boring 98-25

SFOBB East Span Seismic Safety Project





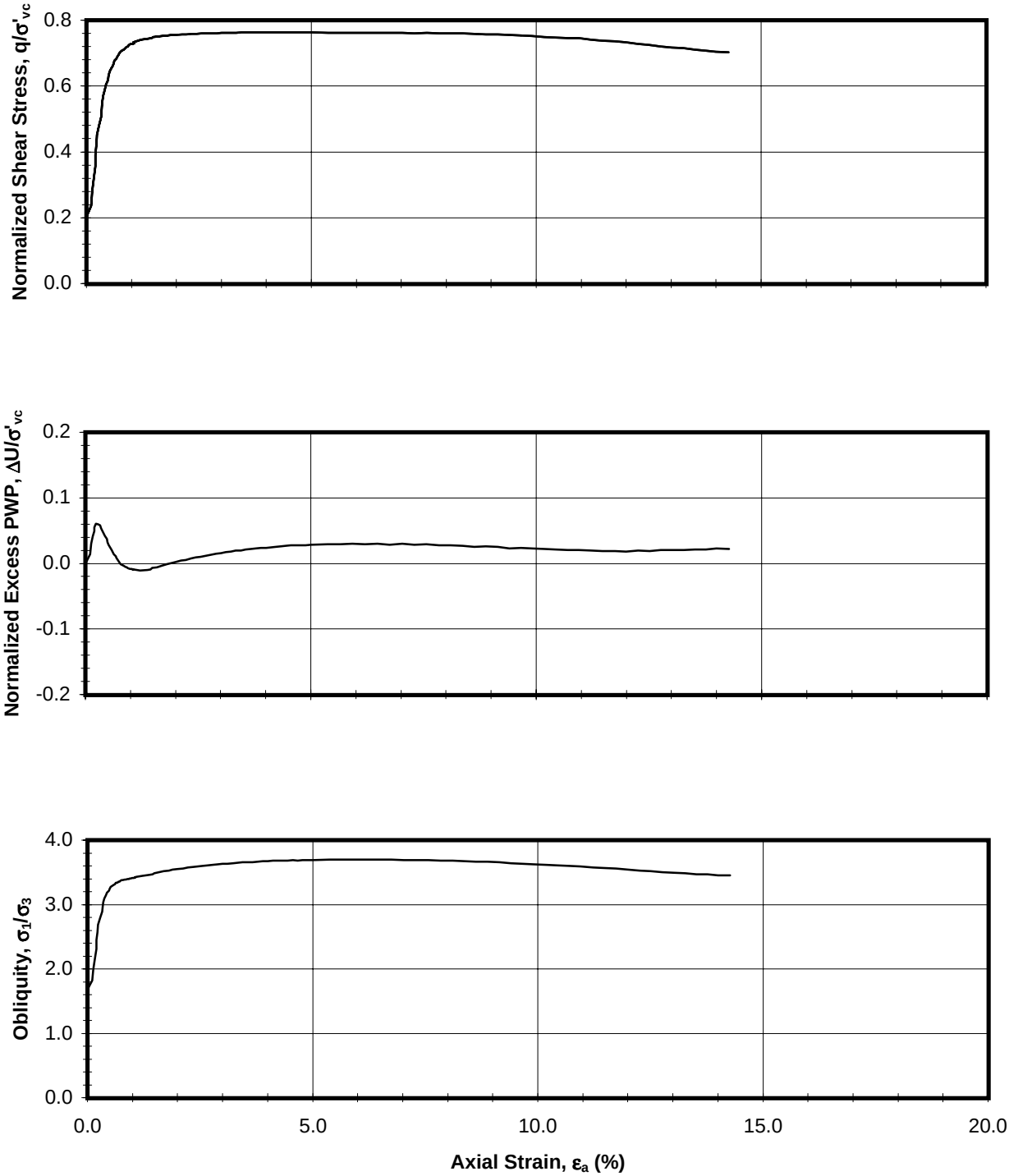
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 91 - Depth: 79.5m

Boring 98-25

SFOBB East Span Seismic Safety Project

PLATE 98-25.15c.1

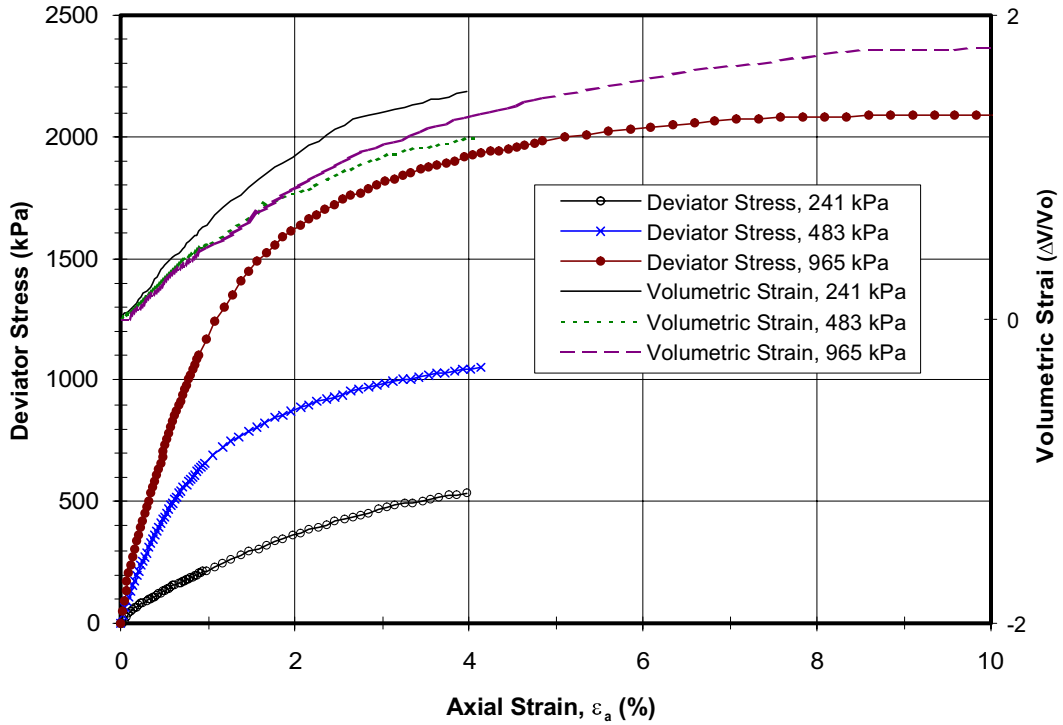


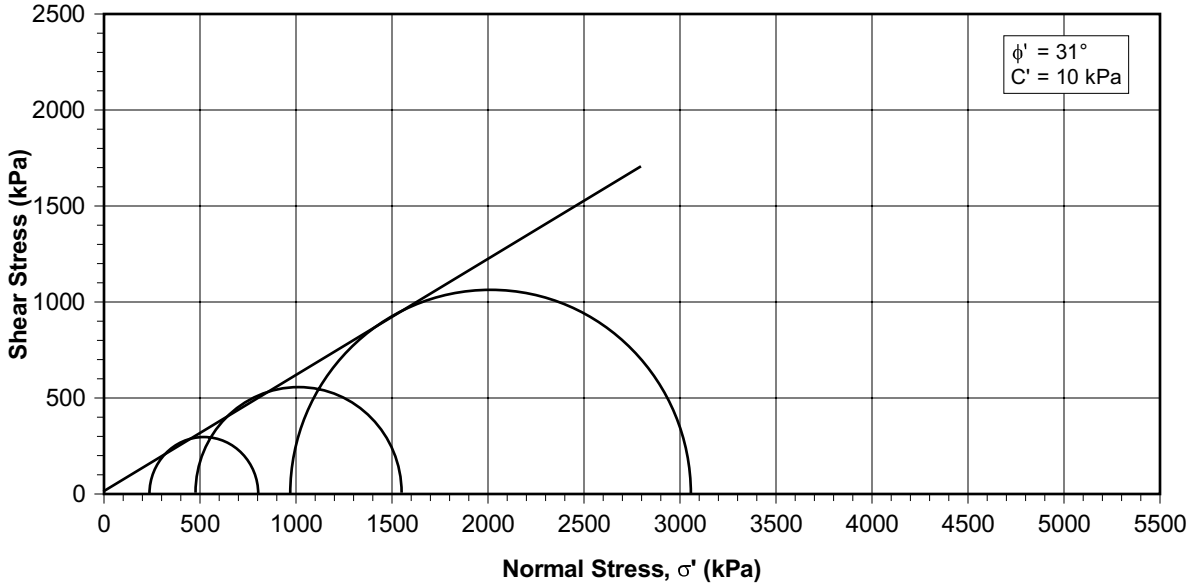
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 91 - Depth: 79.5m

Boring 98-25

SFOBB East Span Seismic Safety Project





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 76 - Depth: 63.7m

Boring 98-25

SFOBB East Span Seismic Safety Project

PLATE 98-25.16a

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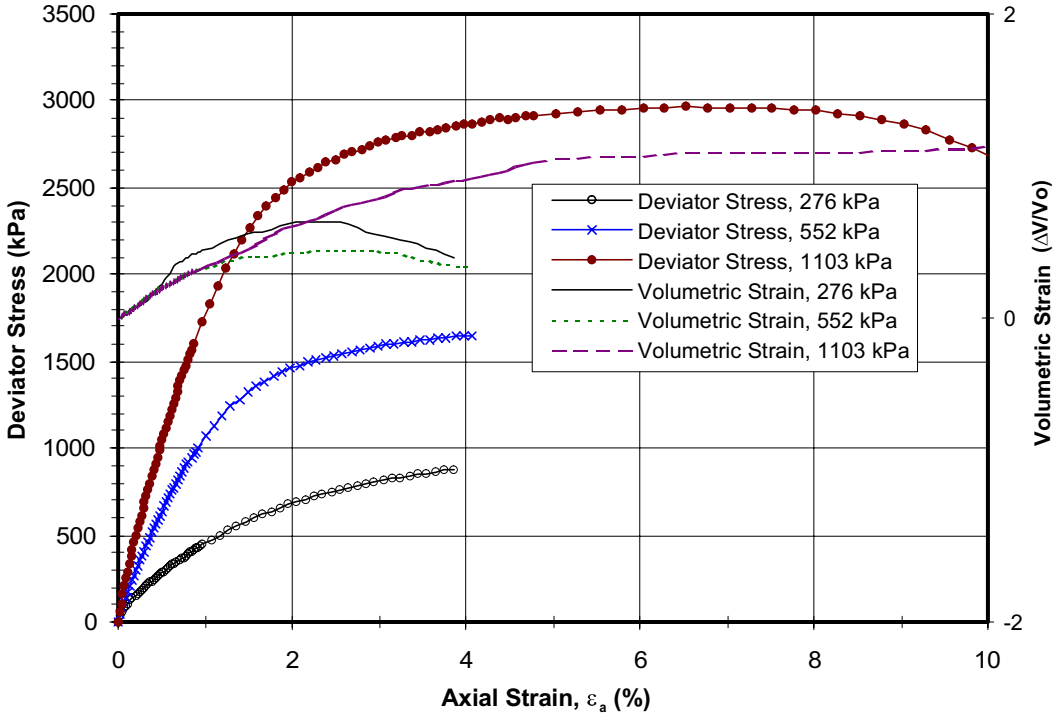

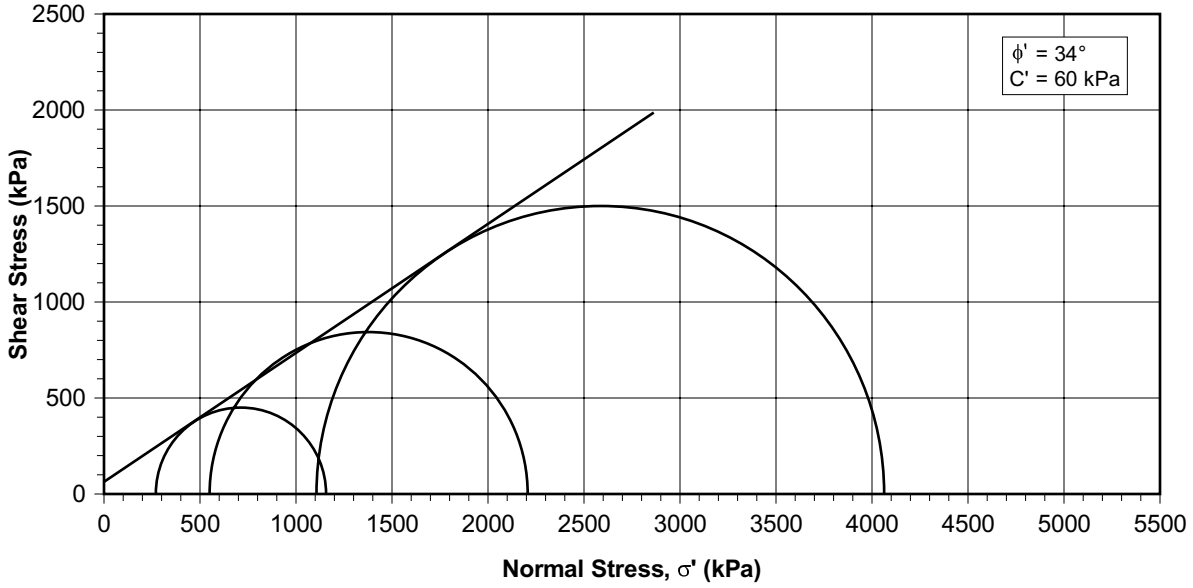

ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 82 - Depth: 70.7m

Boring 98-25

SFOBB East Span Seismic Safety Project

PLATE 98-25.16b

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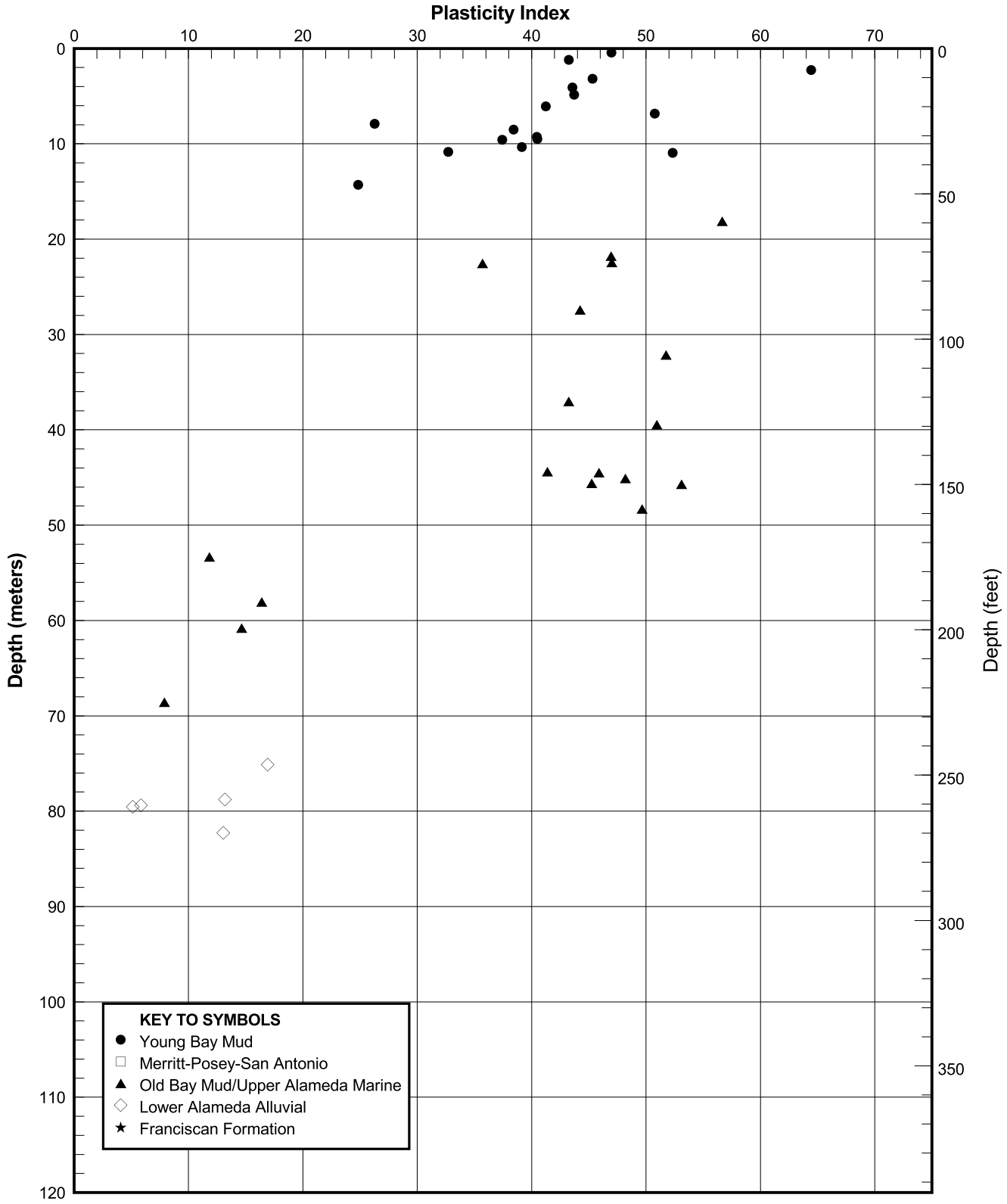
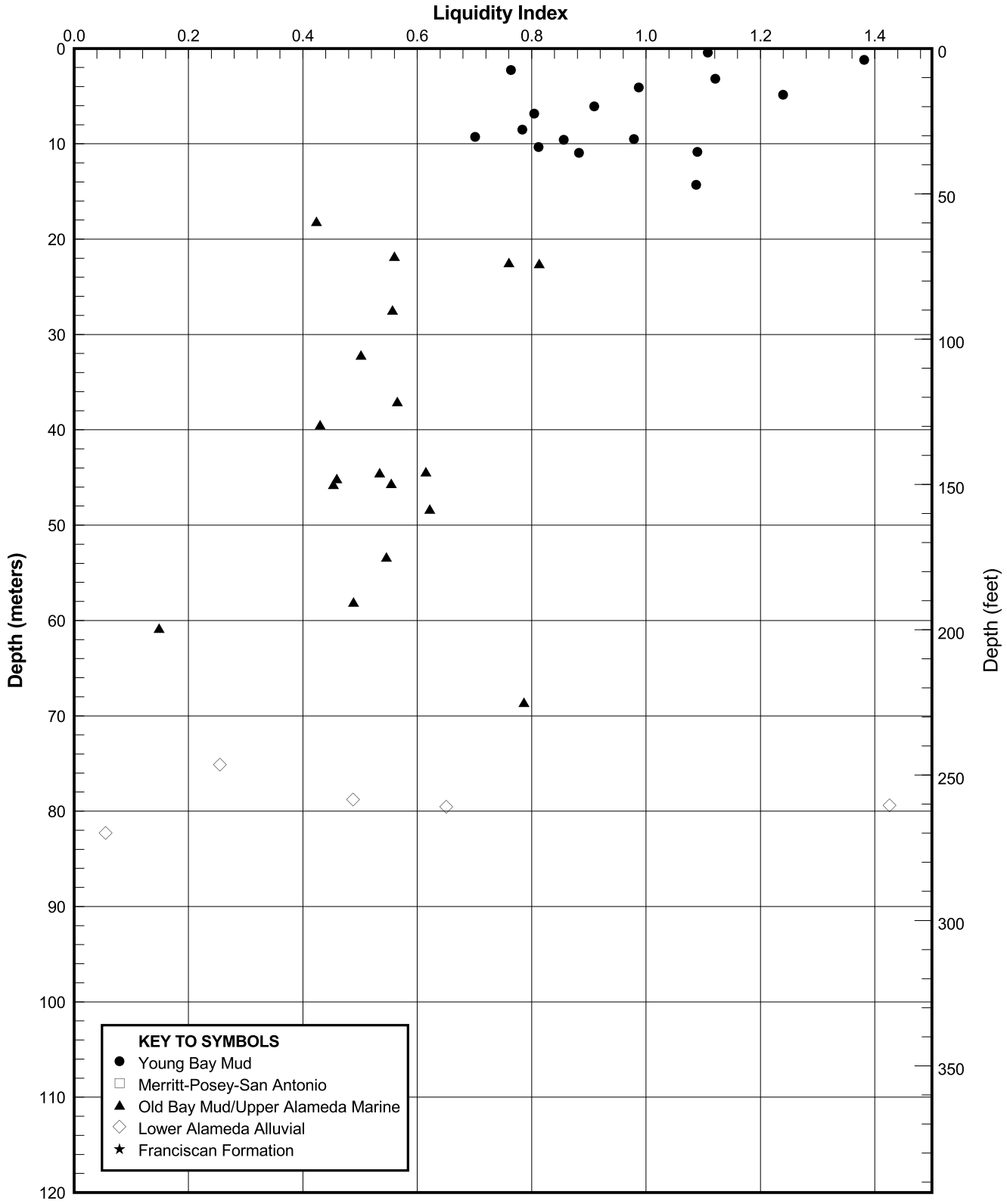


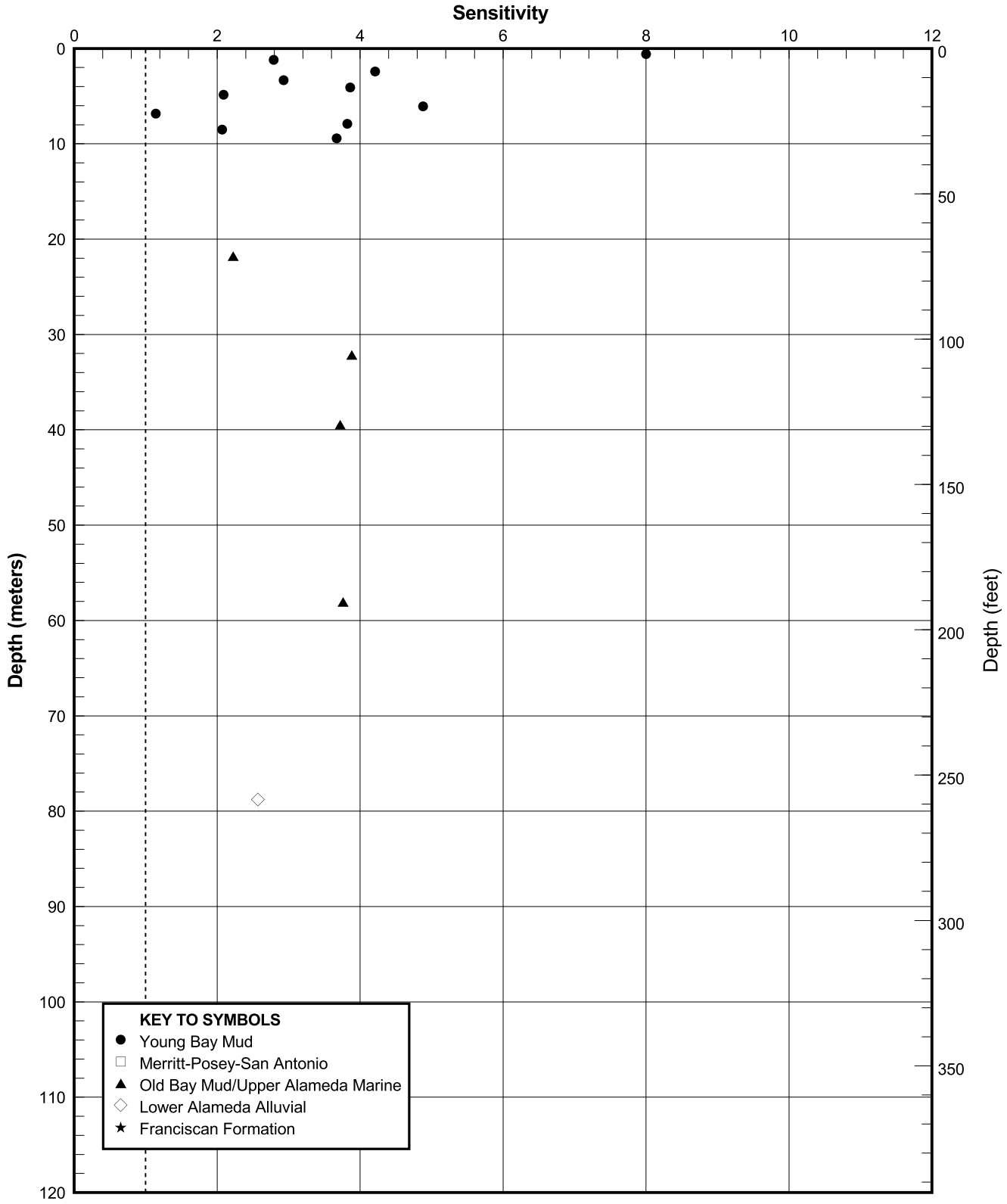
PLASTICITY INDEX PROFILE
Boring 98-25
SFOBB East Span Seismic Safety Project

PLATE 98-25.17



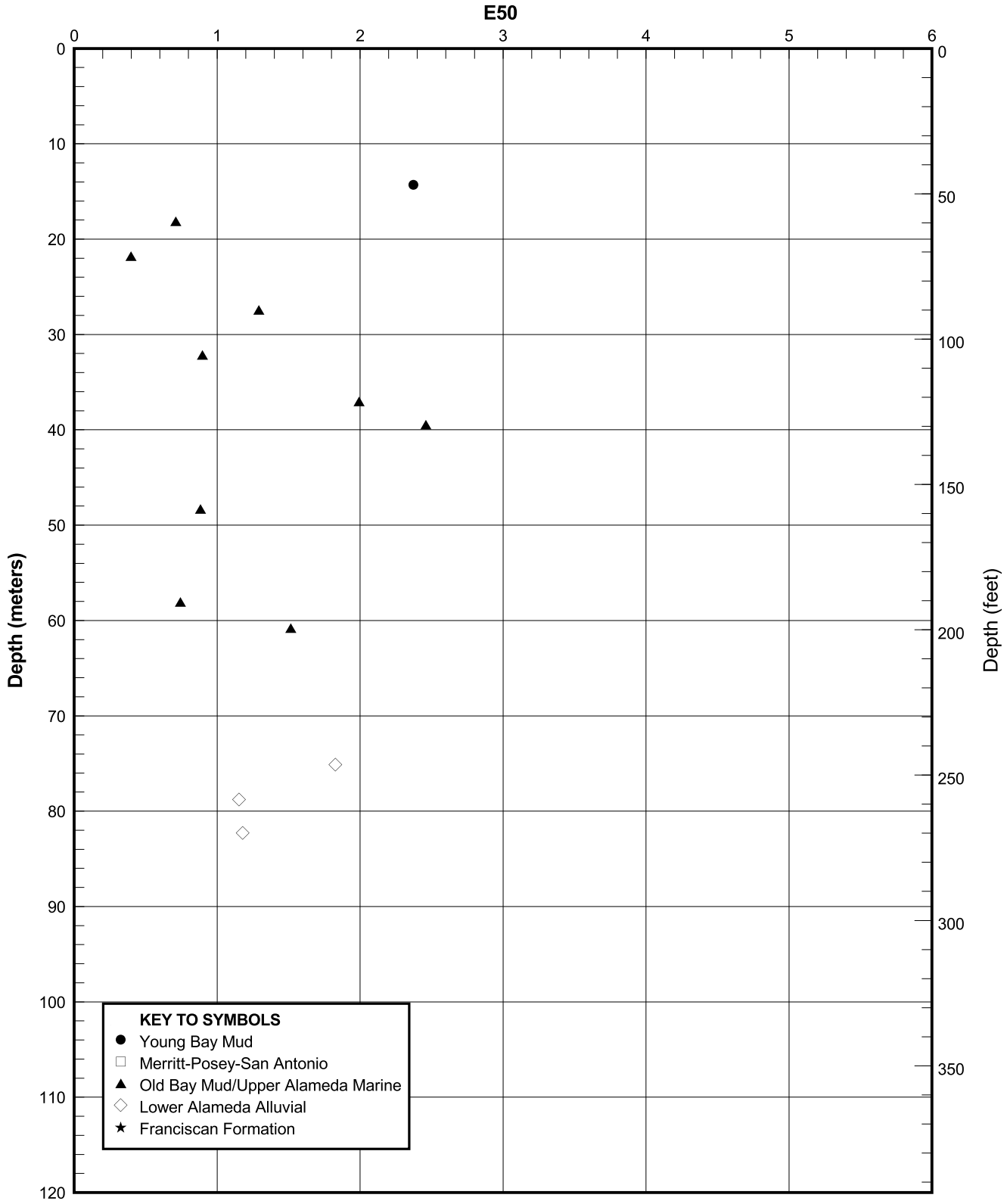
LIQUIDITY INDEX PROFILE
Boring 98-25
SFOBB East Span Seismic Safety Project

PLATE 98-25.18



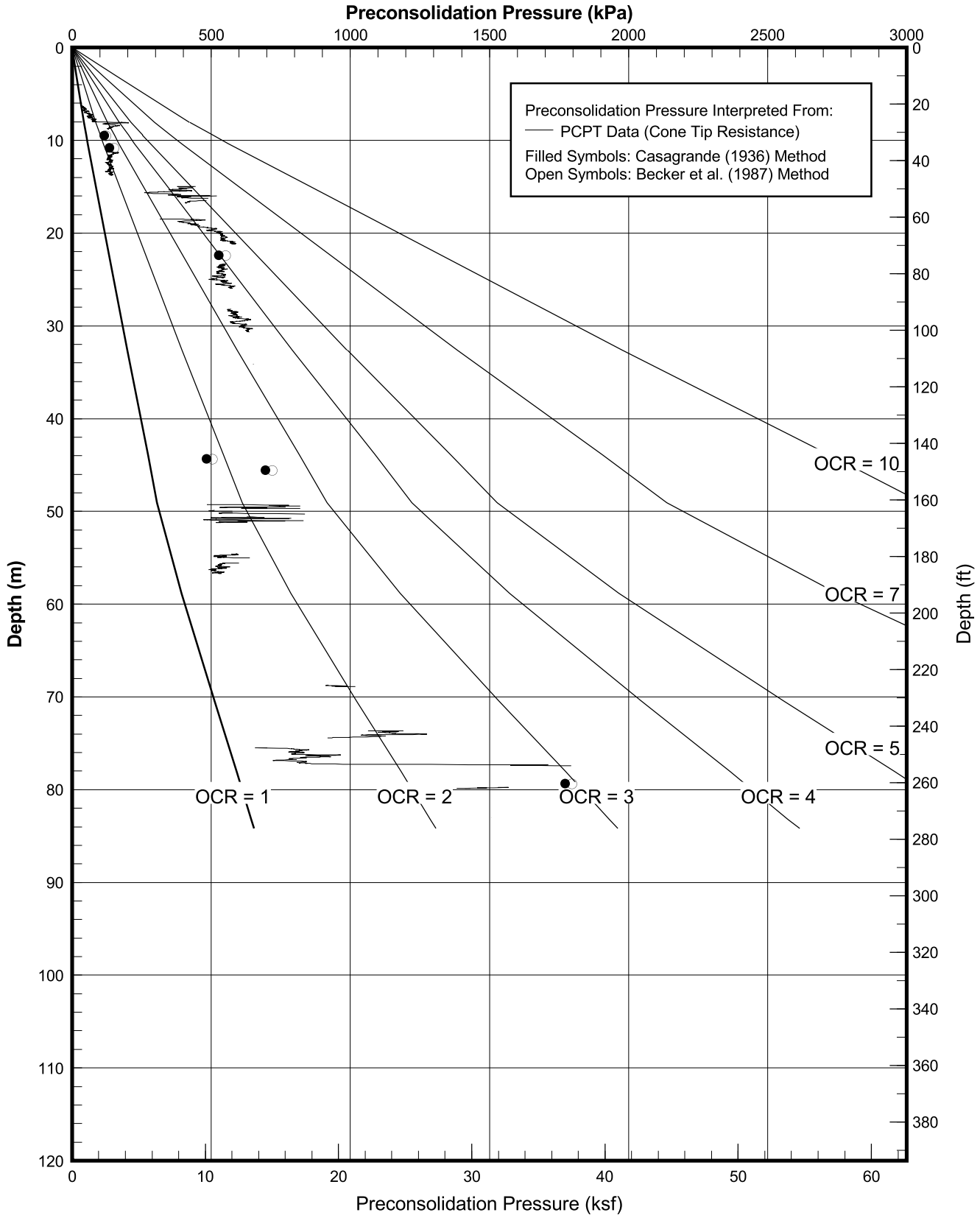
SENSITIVITY PROFILE
Boring 98-25
SFOBB East Span Seismic Safety Project

PLATE 98-25.19



E50 PROFILE
Boring 98-25
SFOBB East Span Seismic Safety Project

PLATE 98-25.20

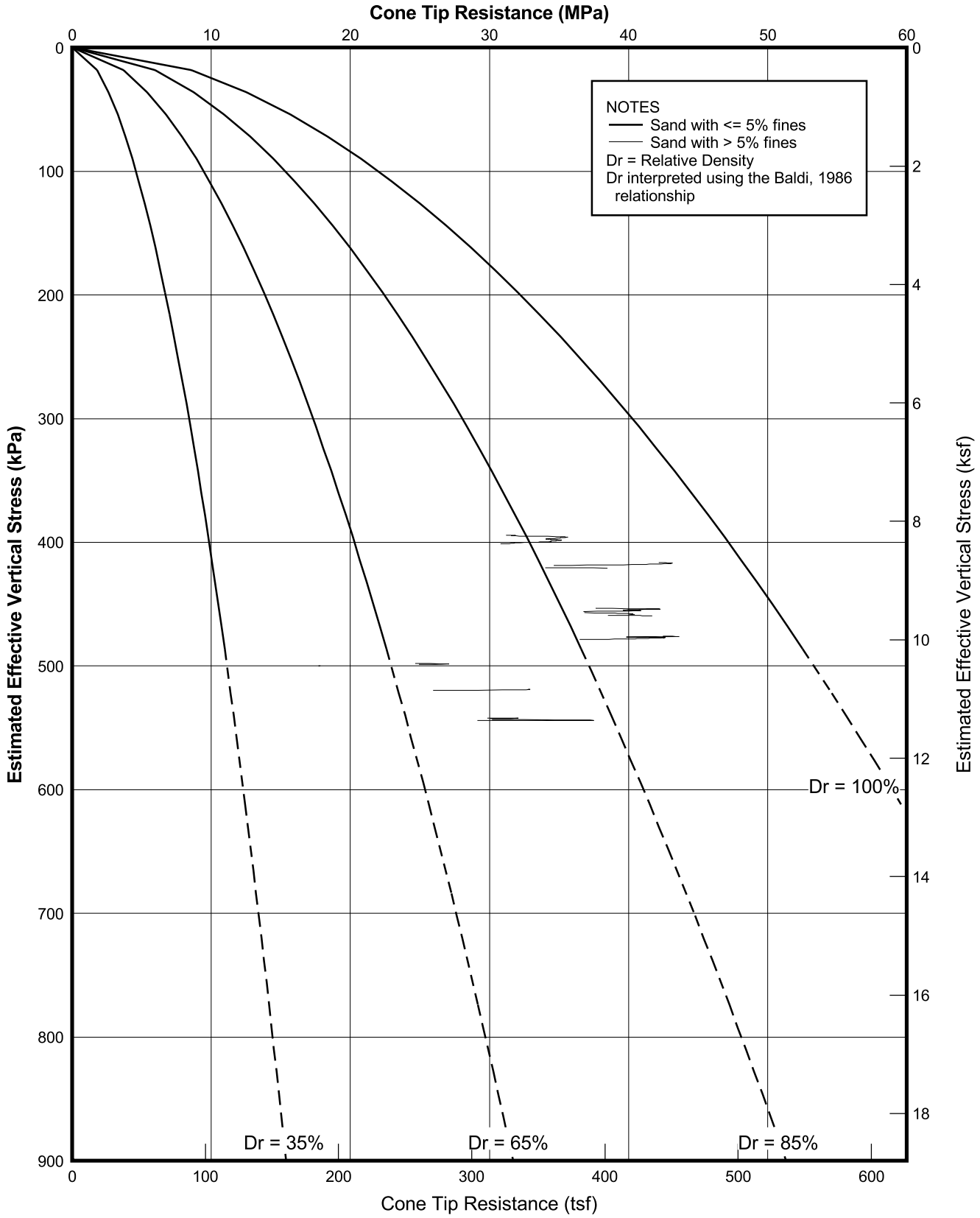


PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-25

SFOBB East Span Seismic Safety Project

PLATE 98-25.21



RELATIVE DENSITY INTERPRETED FROM CPT DATA

Boring 98-25

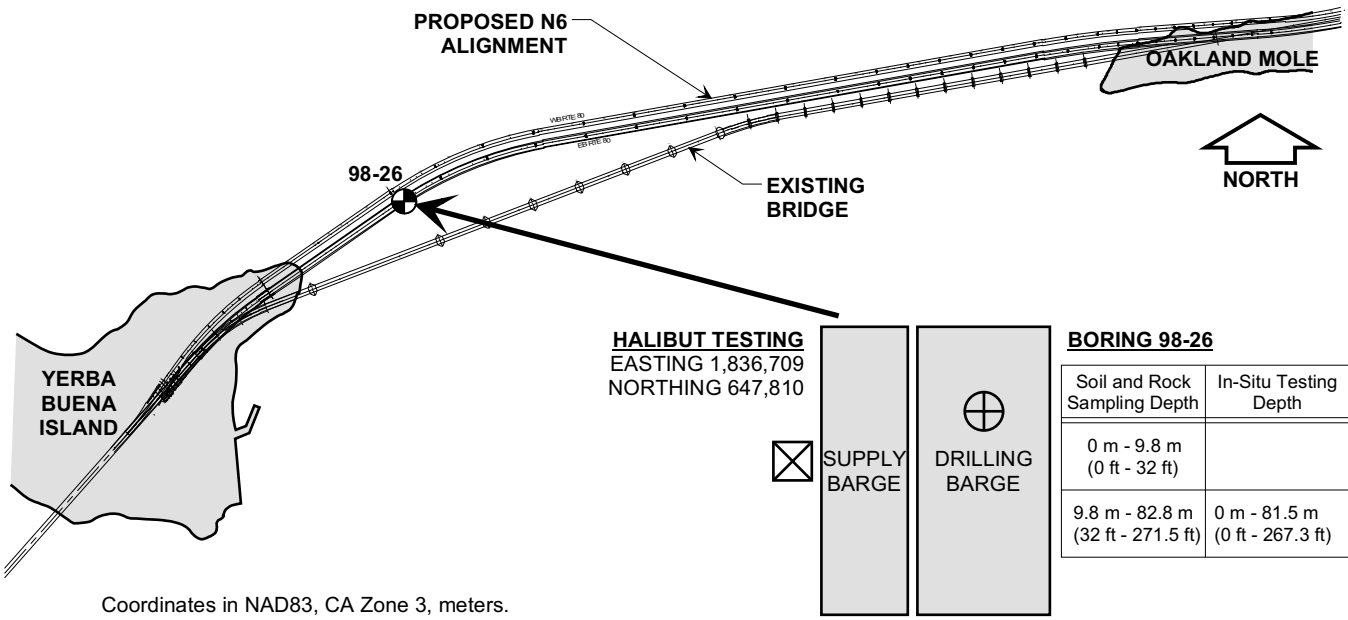
SFOBB East Span Seismic Safety Project

PLATE 98-25.22

BORING 98-26

Date	Time From	Time To	Description of Activity
October 23, 1998	2220	2400	Move barge to location 98-26. Set 4 anchors and 2 spuds.
October 24, 1998	0000	0100	Rig up for drilling. Lower drill pipe to mudline.
	0100	0115	Measure water depth of 12.8m (42 ft) using bottom sensor. Current tide level is approximately 0.1m (0.4 ft) MSL. Calculate mudline elevation of -12.7m (–41.6 ft) MSL.
	0115	0245	Drill and sample from mudline to 9.8m (32 ft).
	0245	0345	Pull drill pipe to deck, reposition barge, and set casing.
	****	****	
	0200	1000	Rig up Halibut vane equipment. Halibut testing from 0.6m (2 ft) to 4.3m (14 ft).
	****	****	
	0345	0700	Set casing. Drive stinger to 8.5m (28 ft).
	0700	0845	Rig up for CPT testing. Perform CPT deck test. Lower drill pipe to mudline.
	0845	1000	Perform CPT pipe test.
	1000	1145	Drill, sample, and CPT testing from mudline to 12.8m (42 ft).
	1145	1300	Diagnose and perform repair on CPT tool, casing, and piston.
	1300	2400	Drill, sample, and CPT testing from 12.8m (42 ft) to 54.6m (179 ft).
October 25, 1998	0000	0200	Drill, sample, and CPT testing from 54.6m (179 ft) to 60.6m (199 ft).
	****	0200	Daylight savings time change. Set clock back 1 hour.
	0100	1015	Drill, sample, and CPT testing from 60.6m (199 ft) to 82.8m (271.5 ft).
	1015	1100	Pull drill pipe to deck.
	1100	1330	P- and S-wave velocity logging from 77.4m (253.9 ft) to 8.5m (27.9 ft).
	1330	1650	Mix and circulate cement grout. Lower N-rod. Grout hole 98-26.
	1650	1845	Pull N-rod to deck. Pull casing to deck.
	1845	2140	Pull 2 spuds, 4 anchors, and move barge to location 98-40.

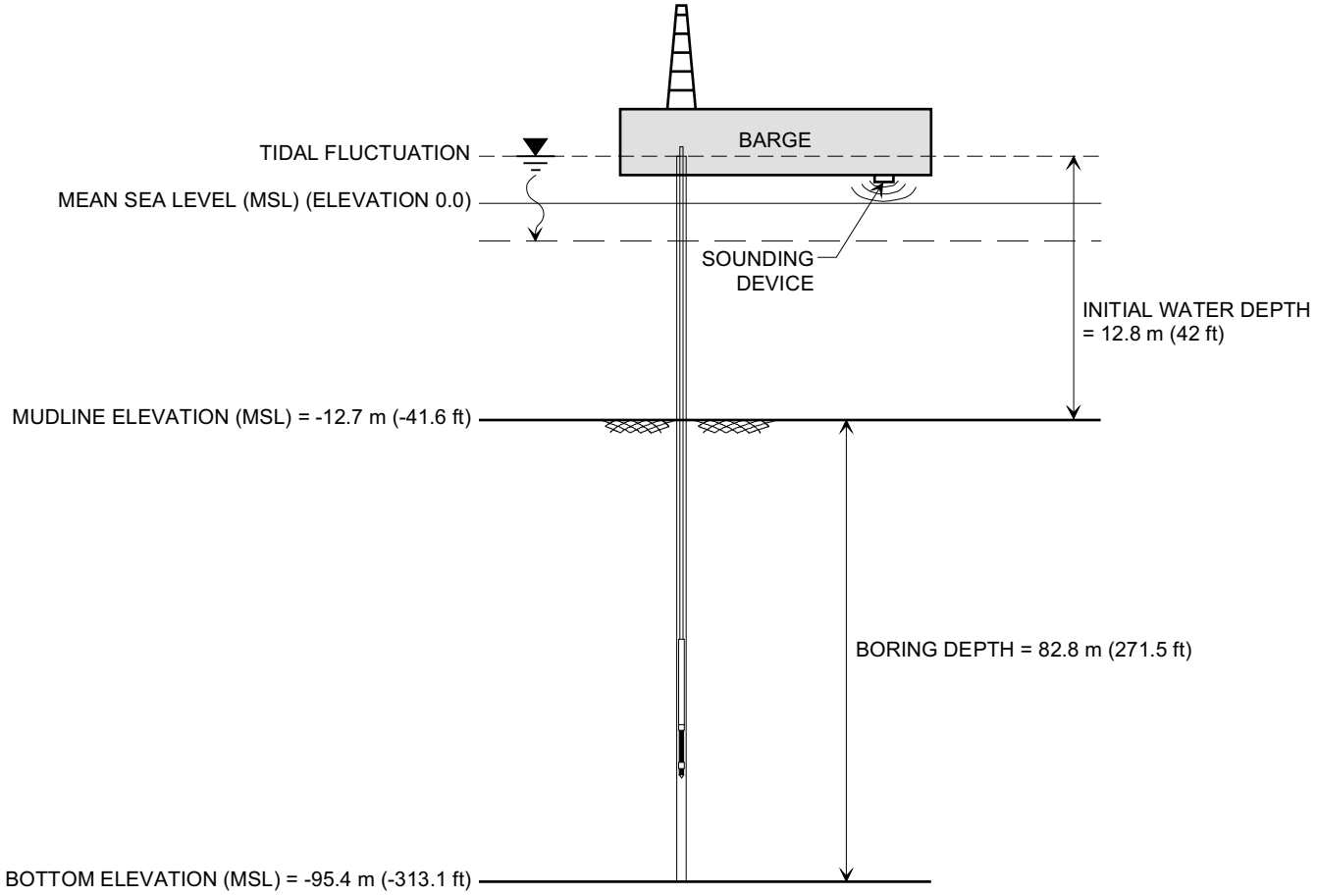
SUMMARY OF FIELD OPERATIONS
Boring 98-26
SFOBB East Span Seismic Safety Project



BORING 98-26

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 9.8 m (0 ft - 32 ft)		E = 1,836,716 N = 647,819
9.8 m - 82.8 m (32 ft - 271.5 ft)	0 m - 81.5 m (0 ft - 267.3 ft)	E = 1,836,725 N = 647,813

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-26
SFOBB East Span Seismic Safety Project

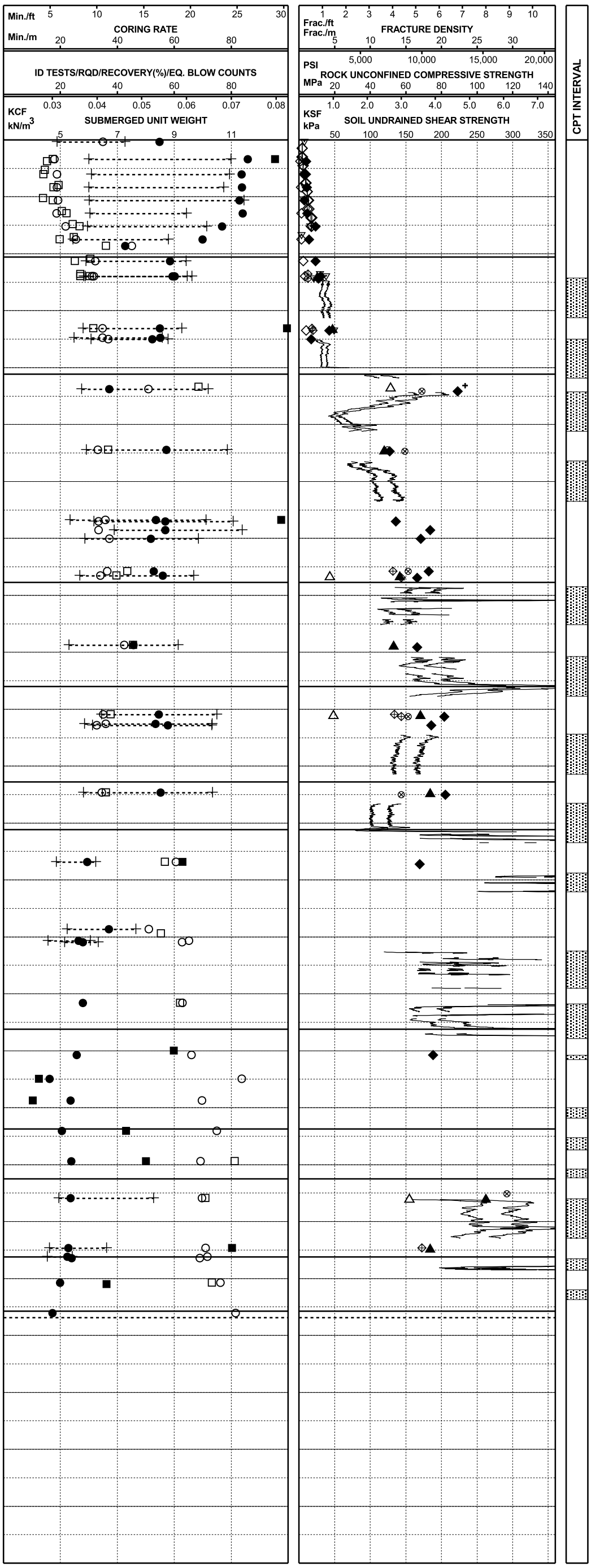
PROJECT NO:	98-42-0054	**START DATE:**	10/23/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-26 (Main Span-East Pier)	**COMPLETION DATE:**	10/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836725 N647813
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), very soft to soft, olive gray	I
		WOH	-with silt pockets	
		WOH	-dark gray and with sand pockets, organic pockets, shells, and shell fragments, at 0.2m	
		WOH	-with mica at 2.1m	
-16	4	WOH	-with silt partings, 2.7m to 6.1m	
		WOH	-with shell fragments, below 4.6m	
		WOH	-with fine sand pockets, partings and seams, below 5.5m	
		WOH		
-20	8	WOH	(8.2m)	
		WOH	Fat CLAY (CH), firm, dark olive gray	II
		WOH	-platy and, with silt pockets, gas blisters and shell fragments	
-24	12			
		PUSH SAVE		
-28	16		-silty sand, below 16.0m (16.5m)	
		PUSH	Fat CLAY (CH), very stiff to hard, greenish gray	III
			-with slickensides at 17.4m	
-32	20			
		PUSH		
-36	24			
		SAVE	-with calcareous nodules, shell fragments and mica, at 26.5m	
		SAVE		
-40	28	SAVE	-with a few shell fragments, at 27.7m	
		PUSH	-with many shells and shell fragments, silt pockets and silt partings, at 30.5m (31.1m)	
-44	32		Fat CLAY (CH), very stiff, greenish gray	IV
			-interlayered fat clay, silty fine sand and sandy silt, to 33.7m	
-48	36	PUSH	-with many silty sand pockets, at 35.4m	
			-sand layer, 37.2m to 37.5m (38.4m)	
-52	40		Fat CLAY (CH), very stiff, greenish gray	V
		PUSH SAVE	-with silt pockets and few shell fragments, at 40.2m	
-56	44		(45.1m)	
		PUSH	Fat CLAY (CH), very stiff, greenish gray	VI
			-with a few organic pockets, a few silt pockets, and a few shell fragments, at 45.7m (48.5m)	
-60	48			
			Lean CLAY (CL), very stiff to hard, greenish gray	VII
			-interlayered clay, silty sand and sandy silt to 50.3m	
		PUSH	-interlayered lean clay and silty fine sand at 50.6m	
-64	52		-sand with clay layers, 51.5m to 52.7m	
			-with many sand partings and seams, and organic pockets, 55.2m to 55.8m	
-68	56	PUSH SAVE	-dense sandy silt with sand and clay seams and layers, 57.2m to 59.6m	
-72	60	PUSH	-laminated clay and silty sand with laminations dipping 15 degrees, at 60.4m	
			-sand at 61.3m (62.5m)	
-76	64	PUSH	-Silty Fine SAND (SM), very dense, dark gray	VIII
			-silty fine sand with clay pockets, to 64.2m	
			-with a clay layer, 62.8m to 62.9m	
			-very stiff, dark greenish gray lean clay layer, at 64.2m	
		30/15cm	-silty coarse sand with gravel and fine to medium sand, at 65.8m	
-80	68	30/15cm	-fine to medium sand with silt at 67.4m (69.5m)	
		30/15cm	Silty Fine SAND (SM), very dense, greenish gray	IX
			-with fine subrounded gravel, and organic pockets, at 69.6m	
-84	72	30/15cm	-with a clay layer at 70.7m	
			-with silt seams at 71.6m (73.0m)	
		PUSH	Lean CLAY (CL), hard, greenish gray	X
			-with organic pockets, calcareous nodules and slickensides, at 74.1m	
-88	76			
		PUSH SAVE	-with many silt pockets at 77.4m	
			-sandy clay below 78.3m (78.5m)	
-92	80		Silty SAND (SM), very dense, greenish gray	XI
		30/25cm	-lean clay layer, 79.1m to 79.4m	
			-with a few clay pockets, at 80.2m	
			-with a clay layer, at 80.9m (82.3m)	
		30/15cm		XII
		30/15cm	SANDSTONE (Rx) interbedded with SILTSTONE (Rx), dark gray, moderately to highly weathered, moderately soft	
-96	84			
-100	88			
-104	92			
-108	96			
-112				

TOTAL DEPTH: 82.8m BACKFILLED WITH: Cement Grout



LOG OF BORING AND TEST RESULTS

BORING 98-26

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

PLATE 98-26.3

PROJECT NO:	98-42-0054	**START DATE:**	10/23/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-26 (Main Span-East Pier)	**COMPLETION DATE:**	10/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

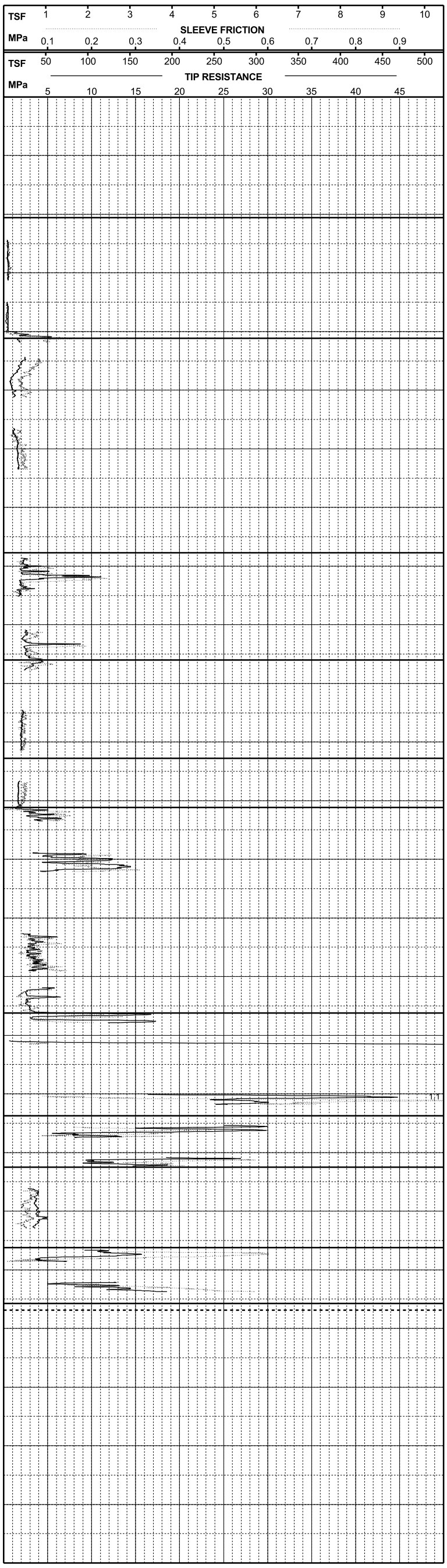
Coordinates: E1836725 N647813
CA State Plane Zone 3, NAD83, Meters

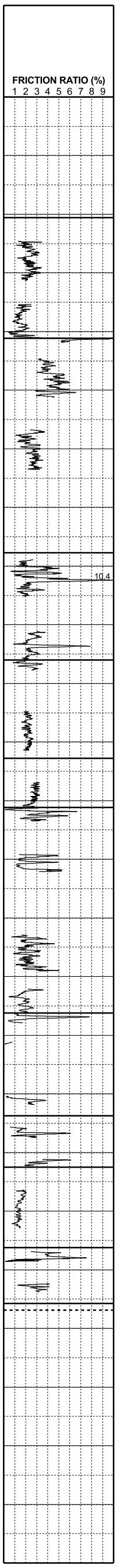
MUDLINE ELEVATION: -12.7m (MSL)

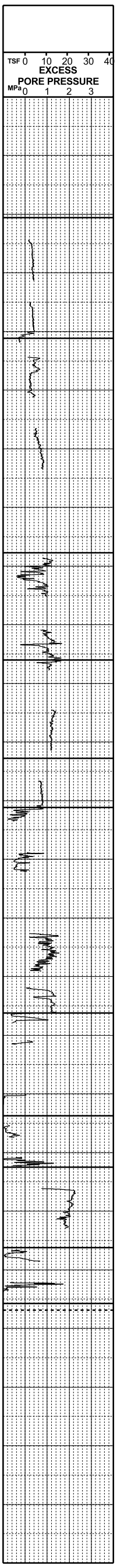
ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH WOH WOH WOH WOH WOH WOH WOH WOH WOH	Fat CLAY (CH), very soft to soft, olive gray -with silt pockets -dark gray and with sand pockets, organic pockets, shells, and shell fragments, at 0.2m -with mica at 2.1m -with silt partings, 2.7m to 6.1m -with shell fragments, below 4.6m -with fine sand pockets, partings and seams, below 5.5m (8.2m)	I
		WOH WOH PUSH SAVE	Fat CLAY (CH), firm, dark olive gray -platy and, with silt pockets, gas blisters and shell fragments See Plate 98-26.6 for detailed stratigraphy -silty sand, below 16.0m (16.5m)	II
		PUSH PUSH SAVE SAVE SAVE PUSH	Fat CLAY (CH), very stiff to hard, greenish gray -with slickensides at 17.4m -with calcareous nodules, shell fragments and mica, at 26.5m -with a few shell fragments, at 27.7m -with many shells and shell fragments, silt pockets and silt partings, at 30.5m (31.1m)	III
		PUSH PUSH	Fat CLAY (CH), very stiff, greenish gray -interlayered fat clay, silty fine sand and sandy silt, to 33.7m -with many silty sand pockets, at 35.4m -sand layer, 37.2m to 37.5m (38.4m)	IV
		PUSH SAVE	Fat CLAY (CH), very stiff, greenish gray -with silt pockets and few shell fragments, at 40.2m (45.1m)	V
		PUSH	Fat CLAY (CH), very stiff, greenish gray -with a few organic pockets, a few silt pockets, and a few shell fragments, at 45.7m (48.5m)	VI
		PUSH PUSH SAVE PUSH	Lean CLAY (CL), very stiff to hard, greenish gray -interlayered clay, silty sand and sandy silt to 50.3m -interlayered lean clay and silty fine sand at 50.6m -sand with clay layers, 51.5m to 52.7m -with many sand partings and seams, and organic pockets, 55.2m to 55.8m -dense sandy silt with sand and clay seams and layers, 57.2m to 59.6m -laminated clay and silty sand with laminations dipping 15 degrees, at 60.4m -sand at 61.3m (62.5m)	VII
		PUSH 30/15cm 30/15cm 30/15cm 30/15cm	-Silty Fine SAND (SM), very dense, dark gray -silty fine sand with clay pockets, to 64.2m -with a clay layer, 62.8m to 62.9m -very stiff, dark greenish gray lean clay layer, at 64.2m -silty coarse sand with gravel and fine to medium sand, at 65.8m (69.5m)	VIII
			Silty Fine SAND (SM), very dense, greenish gray -with fine subrounded gravel, and organic pockets, at 69.6m (73.0m)	IX
		PUSH PUSH SAVE	Lean CLAY (CL), hard, greenish gray -with organic pockets, calcareous nodules and slickensides, at 74.1m -with many silt pockets at 77.4m -sandy clay below 78.3m (78.5m)	X
		30/25cm 30/15cm 30/15cm	Silty SAND (SM), very dense, greenish gray -lean clay layer, 79.1m to 79.4m -with a clay layer, at 80.9m (82.3m)	XI
			SANDSTONE (Rx) interbedded with SILTSTONE (Rx), dark gray, moderately to highly weathered, moderately soft	XII

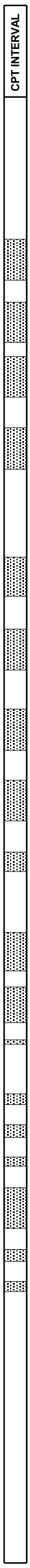
TOTAL DEPTH: 82.8m

BACKFILLED WITH: Cement Grout









LOG OF BORING AND TEST RESULTS

BORING 98-26

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

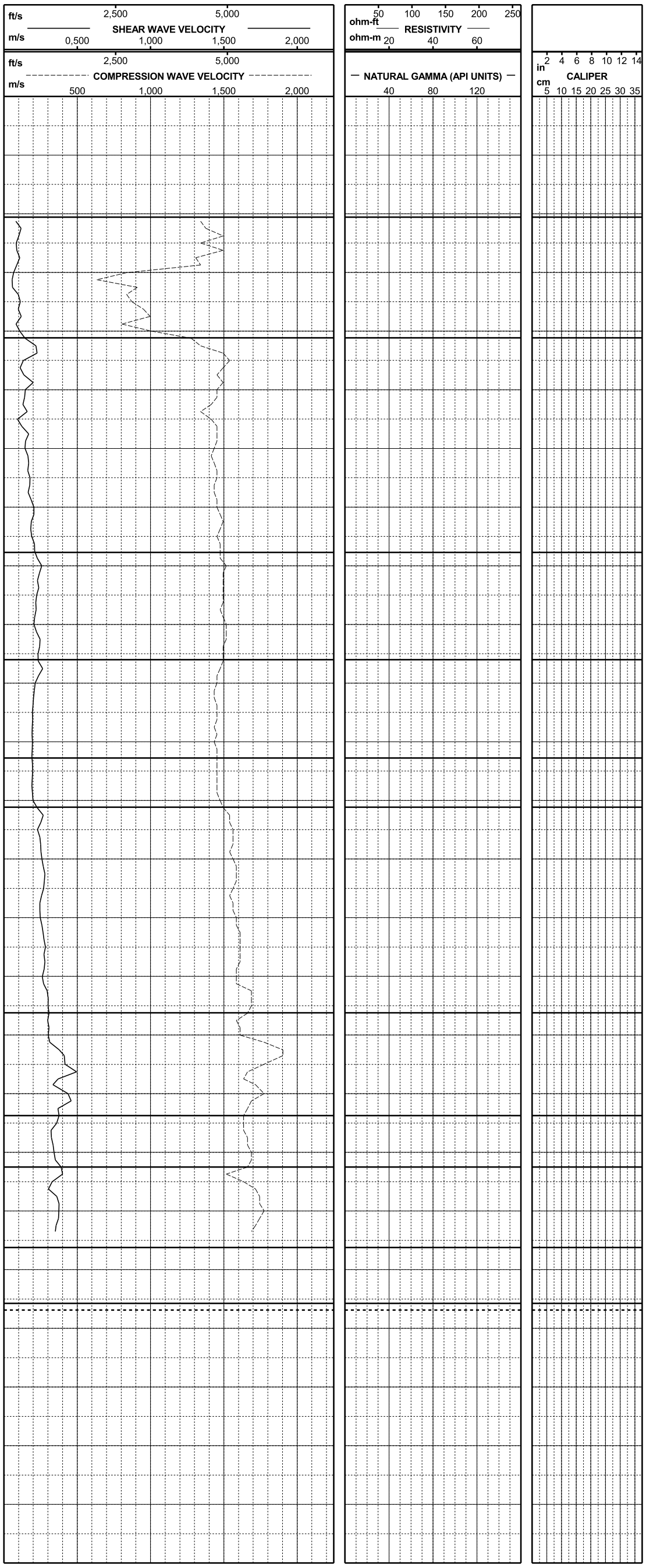
PLATE 98-26.4

PROJECT NO:	98-42-0054	**START DATE:**	10/23/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-26 (Main Span-East Pier)	**COMPLETION DATE:**	10/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836725 N647813
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH	Fat CLAY (CH), very soft to soft, olive gray	I
		WOH	-with silt pockets	
		WOH	-dark gray and with sand pockets, organic pockets, shells, and shell fragments, at 0.2m	
-16	4	WOH	-with mica at 2.1m	
		WOH	-with silt partings, 2.7m to 6.1m	
		WOH	-with shell fragments, below 4.6m	
		WOH	-with fine sand pockets, partings and seams, below 5.5m	
-20	8	WOH	(8.2m)	
		WOH	Fat CLAY (CH), firm, dark olive gray	II
		WOH	-platy and, with silt pockets, gas blisters and shell fragments	
-24	12		See Plate 98-26.6 for detailed stratigraphy	
		PUSH SAVE		
-28	16		-silty sand, below 16.0m (16.5m)	
		PUSH	Fat CLAY (CH), very stiff to hard, greenish gray	III
			-with slickensides at 17.4m	
-32	20			
		PUSH		
-36	24			
		SAVE	-with calcareous nodules, shell fragments and mica, at 26.5m	
-40	28	SAVE	-with a few shell fragments, at 27.7m	
		SAVE		
		PUSH	-with many shells and shell fragments, silt pockets and silt partings, at 30.5m (31.1m)	
-44	32		Fat CLAY (CH), very stiff, greenish gray	IV
			-interlayered fat clay, silty fine sand and sandy silt, to 33.7m	
-48	36	PUSH	-with many silty sand pockets, at 35.4m	
			-sand layer, 37.2m to 37.5m (38.4m)	
-52	40		Fat CLAY (CH), very stiff, greenish gray	V
		PUSH SAVE	-with silt pockets and few shell fragments, at 40.2m	
-56	44		(45.1m)	
		PUSH	Fat CLAY (CH), very stiff, greenish gray	VI
			-with a few organic pockets, a few silt pockets, and a few shell fragments, at 45.7m (48.5m)	
-60	48			
			Lean CLAY (CL), very stiff to hard, greenish gray	VII
		PUSH	-interlayered clay, silty sand and sandy silt to 50.3m	
			-interlayered lean clay and silty fine sand at 50.6m	
-64	52		-sand with clay layers, 51.5m to 52.7m	
			-with many sand partings and seams, and organic pockets, 55.2m to 55.8m	
-68	56	PUSH SAVE	-dense sandy silt with sand and clay seams and layers, 57.2m to 59.6m	
-72	60	PUSH	-laminated clay and silty sand with laminations dipping 15 degrees, at 60.4m	
			-sand at 61.3m (62.5m)	
-76	64	PUSH	-Silty Fine SAND (SM), very dense, dark gray	VIII
			-silty fine sand with clay pockets, to 64.2m	
			-with a clay layer, 62.8m to 62.9m	
			-very stiff, dark greenish gray lean clay layer, at 64.2m	
		30/15cm	-silty coarse sand with gravel and fine to medium sand, at 65.8m	
-80	68	30/15cm	-fine to medium sand with silt at 67.4m	
			(69.5m)	
		30/15cm	Silty Fine SAND (SM), very dense, greenish gray	IX
			-with fine subrounded gravel, and organic pockets, at 69.6m	
-84	72	30/15cm	-with a clay layer at 70.7m (73.0m)	
		PUSH	Lean CLAY (CL), hard, greenish gray	X
			-with organic pockets, calcareous nodules and slickensides, at 74.1m	
-88	76		-with many silt pockets at 77.4m	
		PUSH SAVE	-sandy clay below 78.3m (78.5m)	
-92	80	30/25cm	Silty SAND (SM), very dense, greenish gray	XI
			-lean clay layer, 79.1m to 79.4m	
			-with a few clay pockets, at 80.2m	
		30/15cm	-with a clay layer, at 80.9m (82.3m)	
		30/15cm	SANDSTONE (Rx) interbedded with SILTSTONE (Rx), dark gray, moderately to highly weathered, moderately soft	XII
-96	84			
			TOTAL DEPTH: 82.8m	
			BACKFILLED WITH: Cement Grout	
-100	88			
-104	92			
-108	96			
-112				



LOG OF BORING AND TEST RESULTS

BORING 98-26

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

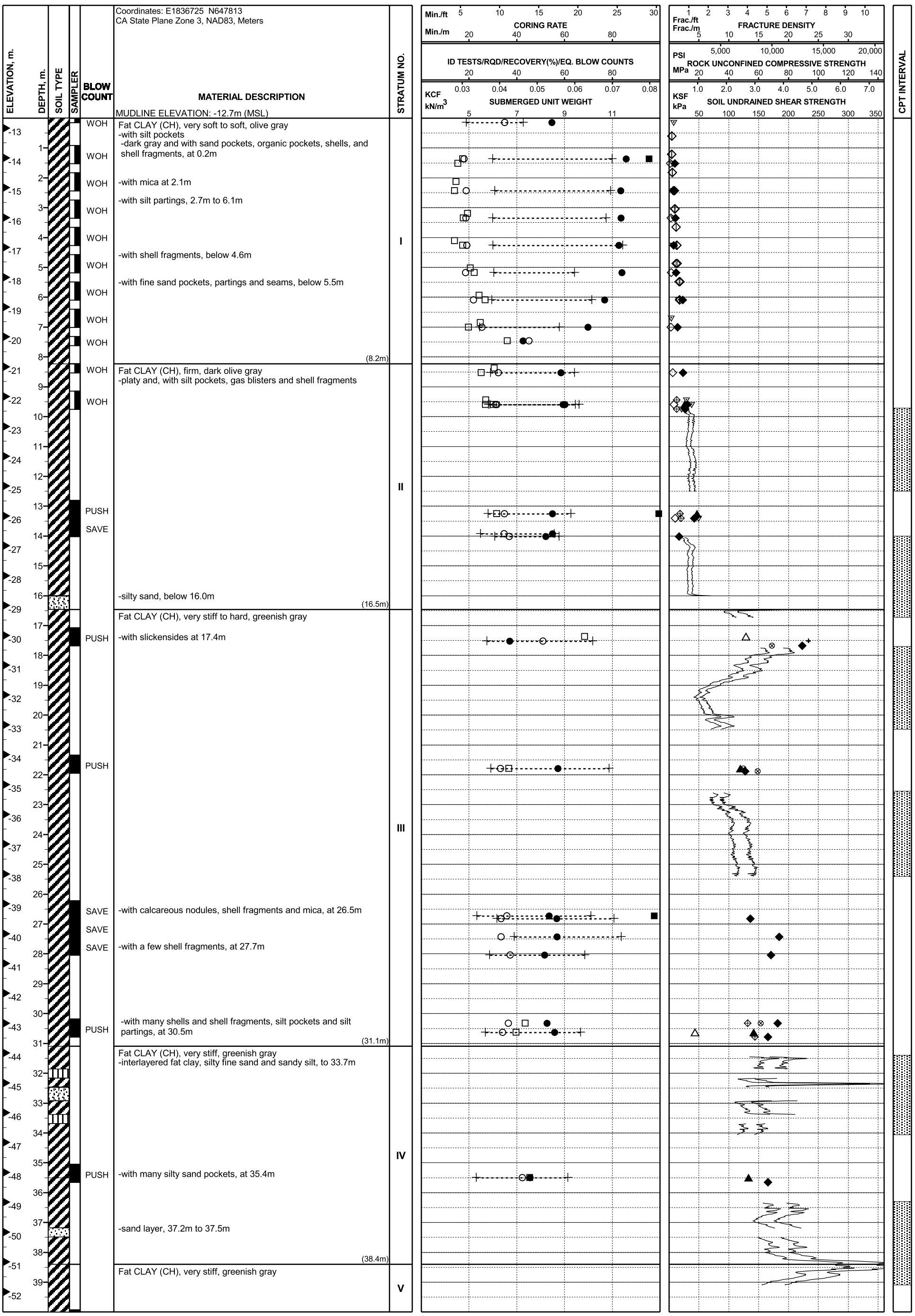
PLATE 98-26.5

PROJECT NO:	98-42-0054	**START DATE:**	10/23/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-26 (Main Span-East Pier)	**COMPLETION DATE:**	10/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836725 N647813
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

STRATUM NO.	MATERIAL DESCRIPTION
I	Fat CLAY (CH), very soft to soft, olive gray -with silt pockets -dark gray and with sand pockets, organic pockets, shells, and shell fragments, at 0.2m -with mica at 2.1m -with silt partings, 2.7m to 6.1m -with shell fragments, below 4.6m -with fine sand pockets, partings and seams, below 5.5m (8.2m)
II	Fat CLAY (CH), firm, dark olive gray -platy and, with silt pockets, gas blisters and shell fragments -silty sand, below 16.0m (16.5m)
III	Fat CLAY (CH), very stiff to hard, greenish gray -with slickensides at 17.4m -with calcareous nodules, shell fragments and mica, at 26.5m -with a few shell fragments, at 27.7m -with many shells and shell fragments, silt pockets and silt partings, at 30.5m (31.1m)
IV	Fat CLAY (CH), very stiff, greenish gray -interlayered fat clay, silty fine sand and sandy silt, to 33.7m -with many silty sand pockets, at 35.4m -sand layer, 37.2m to 37.5m (38.4m)
V	Fat CLAY (CH), very stiff, greenish gray



LOG OF BORING AND TEST RESULTS

BORING 98-26

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

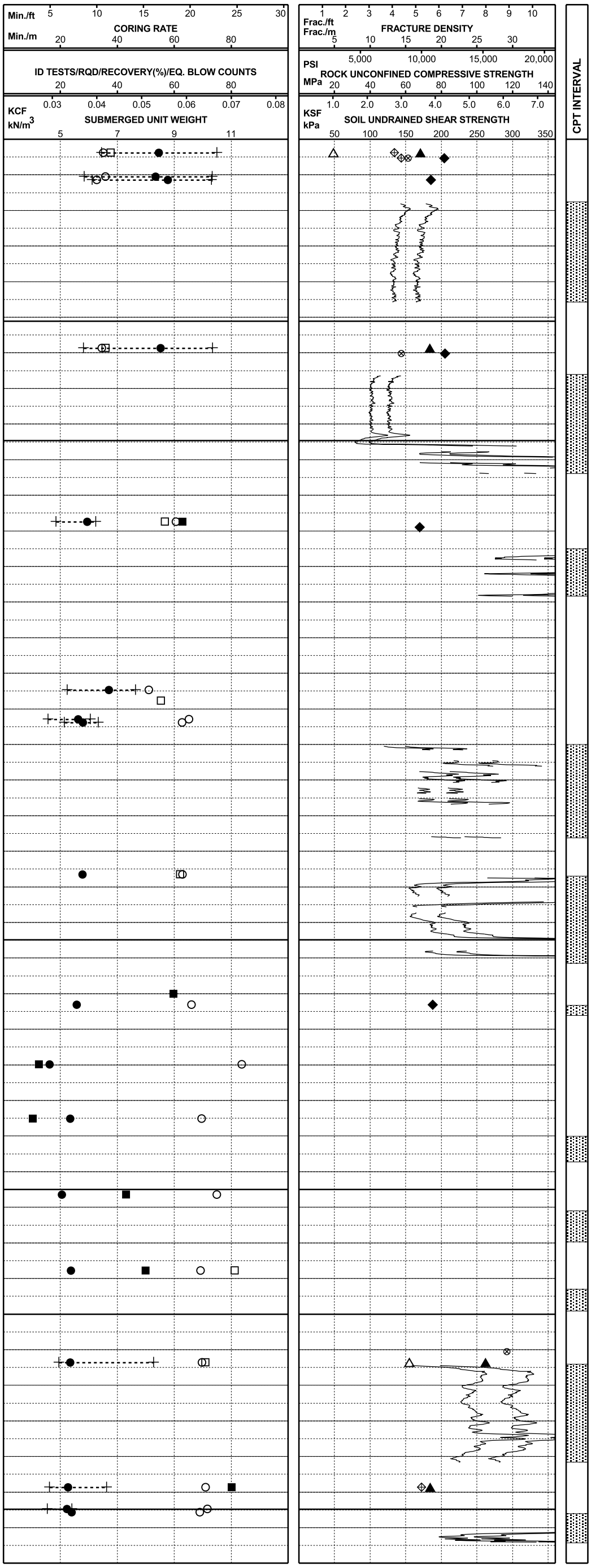
PLATE 98-26.6a

PROJECT NO:	98-42-0054	**START DATE:**	10/23/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-26 (Main Span-East Pier)	**COMPLETION DATE:**	10/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836725 N647813
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m. / DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-53 / 41	PUSH SAVE	Fat CLAY (CH), very stiff, greenish gray -with silt pockets and few shell fragments, at 40.2m	V
-54 / 42, -55 / 43, -56 / 44, -57 / 45		(45.1m)	
-58 / 46	PUSH	Fat CLAY (CH), very stiff, greenish gray -with a few organic pockets, a few silt pockets, and a few shell fragments, at 45.7m	VI
-59 / 47, -60 / 48		(48.5m)	
-61 / 49		Lean CLAY (CL), very stiff to hard, greenish gray -interlayered clay, silty sand and sandy silt to 50.3m	VII
-62 / 50			
-63 / 51	PUSH	-interlayered lean clay and silty fine sand at 50.6m	
-64 / 52		-sand with clay layers, 51.5m to 52.7m	
-65 / 53, -66 / 54			
-67 / 55		-with many sand partings and seams, and organic pockets, 55.2m to 55.8m	
-68 / 56	PUSH SAVE		
-69 / 57		-dense sandy silt with sand and clay seams and layers, 57.2m to 59.6m	
-70 / 58, -71 / 59, -72 / 60			
-73 / 61	PUSH	-laminated clay and silty sand with laminations dipping 15 degrees, at 60.4m	
-74 / 62		-sand at 61.3m	
-75 / 63		(62.5m)	
-76 / 64		-Silty Fine SAND (SM), very dense, dark gray -silty fine sand with clay pockets, to 64.2m -with a clay layer, 62.8m to 62.9m	VIII
-77 / 65	PUSH	-very stiff, dark greenish gray lean clay layer, at 64.2m	
-78 / 66	30/15cm	-silty coarse sand with gravel and fine to medium sand, at 65.8m	
-79 / 67			
-80 / 68	30/15cm	-fine to medium sand with silt at 67.4m	
-81 / 69		(69.5m)	
-82 / 70	30/15cm	Silty Fine SAND (SM), very dense, greenish gray -with fine subrounded gravel, and organic pockets, at 69.6m	IX
-83 / 71		-with a clay layer at 70.7m	
-84 / 72	30/15cm	-with silt seams at 71.6m	
-85 / 73		(73.0m)	
-86 / 74	PUSH	Lean CLAY (CL), hard, greenish gray -with organic pockets, calcareous nodules and slickensides, at 74.1m	X
-87 / 75, -88 / 76, -89 / 77			
-90 / 78	PUSH SAVE	-with many silt pockets at 77.4m -sandy clay below 78.3m	
-91 / 79		(78.5m)	
-92		Silty SAND (SM), very dense, greenish gray -lean clay layer, 79.1m to 79.4m	XI



LOG OF BORING AND TEST RESULTS

BORING 98-26

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

PLATE 98-26.6b

PROJECT NO:	98-42-0054	**START DATE:**	10/23/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-26 (Main Span-East Pier)	**COMPLETION DATE:**	10/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836725 N647813
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-93	81			30/25cm	Silty SAND (SM), very dense, greenish gray -with a few clay pockets, at 80.2m -with a clay layer, at 80.9m	XI
-94	82				(82.3m)	
-95	83			30/15cm 30/15cm	SANDSTONE (Rx) interbedded with SILTSTONE (Rx), dark gray, moderately to highly weathered, moderately soft	XII
-96	84				TOTAL DEPTH: 82.8m BACKFILLED WITH: Cement Grout	
-97	85					
-98	86					
-99	87					
-100	88					
-101	89					
-102	90					
-103	91					
-104	92					
-105	93					
-106	94					
-107	95					
-108	96					
-109	97					
-110	98					
-111	99					
-112	100					
-113	101					
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-122	110					
-123	111					
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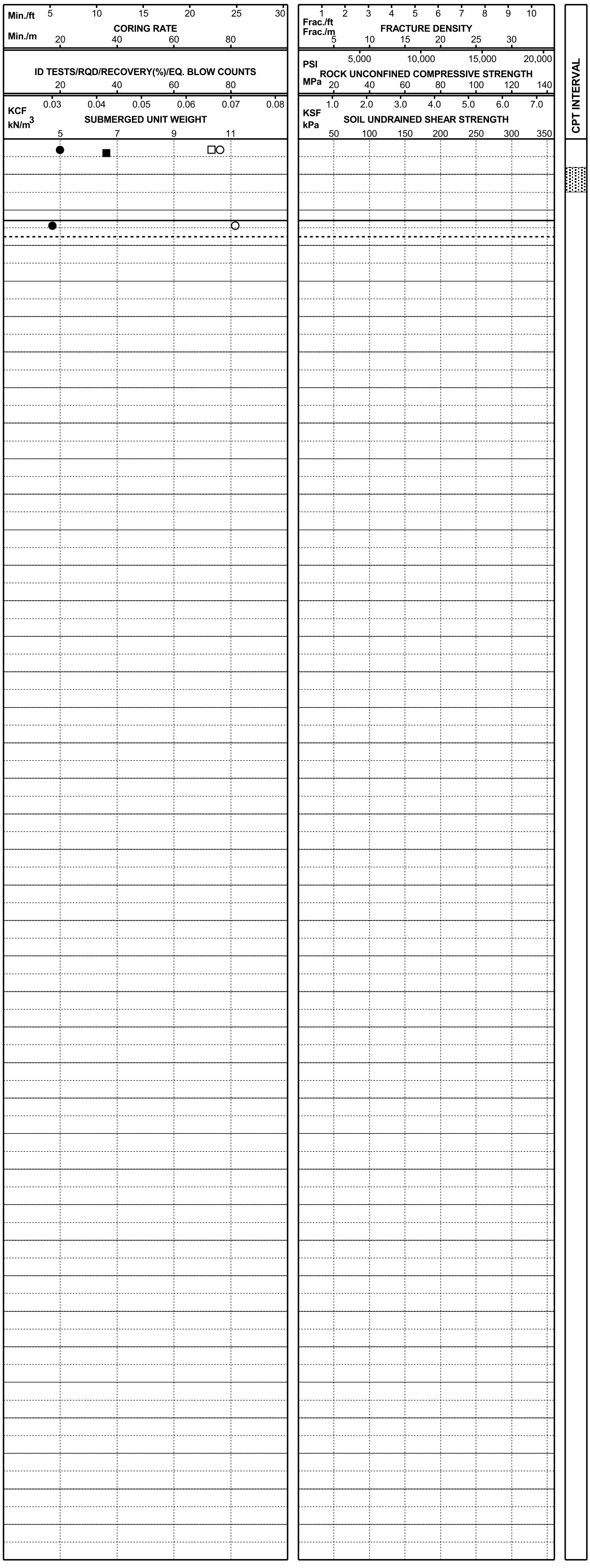
-128	116					
-129	117					
-130	118					
-131	119					
-132						



LOG OF BORING AND TEST RESULTS

BORING 98-26

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

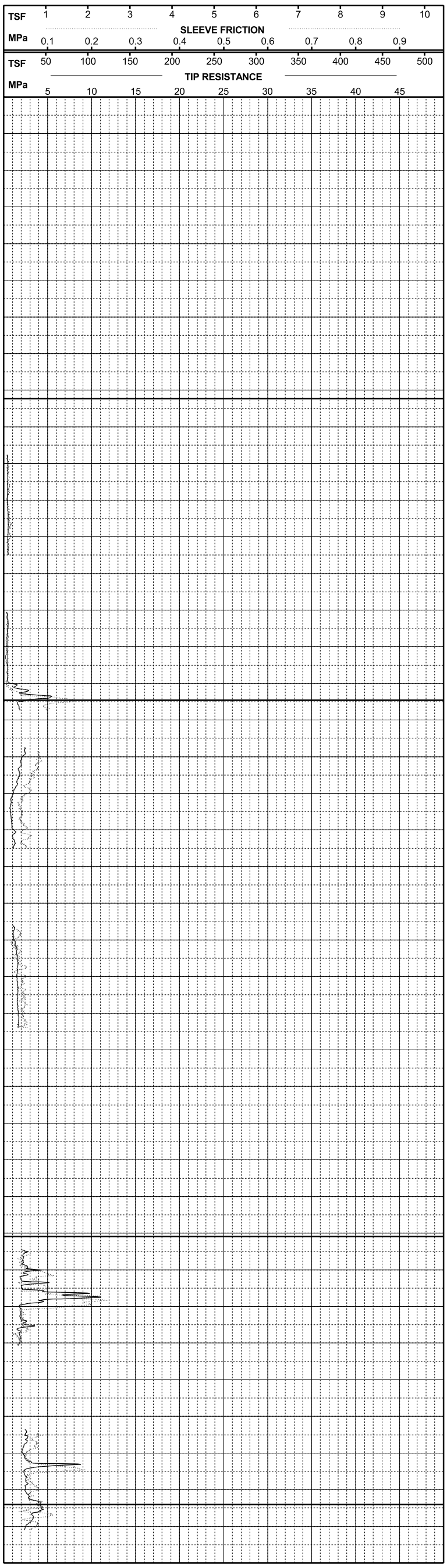
PLATE 98-26.6c

PROJECT NO:	98-42-0054	**START DATE:**	10/23/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-26 (Main Span-East Pier)	**COMPLETION DATE:**	10/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836725 N647813
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-13		WOH	Fat CLAY (CH), very soft to soft, olive gray	I
			-with silt pockets	
	1		-dark gray and with sand pockets, organic pockets, shells, and shell fragments, at 0.2m	
-14		WOH		
	2		-with mica at 2.1m	
-15		WOH		
			-with silt partings, 2.7m to 6.1m	
	3			
-16		WOH		
	4			
-17		WOH		
			-with shell fragments, below 4.6m	
	5			
-18		WOH	-with fine sand pockets, partings and seams, below 5.5m	
	6			
-19		WOH		
	7			
-20		WOH		
			(8.2m)	
-21	8	WOH	Fat CLAY (CH), firm, dark olive gray	II
			-platy and, with silt pockets, gas blisters and shell fragments	
-22	9	WOH		
	10			
-23				
	11			
-24				
	12			
-25				
	13	PUSH		
-26		SAVE		
	14			
-27				
	15			
-28				
	16		-silty sand, below 16.0m	
			(16.5m)	
-29	17		Fat CLAY (CH), very stiff to hard, greenish gray	III
-30		PUSH	-with slickensides at 17.4m	
	18			
-31				
	19			
-32				
	20			
-33				
	21			
-34		PUSH		
	22			
-35				
	23			
-36				
	24			
-37				
	25			
-38				
	26			
-39		SAVE	-with calcareous nodules, shell fragments and mica, at 26.5m	
	27	SAVE		
-40		SAVE	-with a few shell fragments, at 27.7m	
	28			
-41				
	29			
-42				
	30			
-43		PUSH	-with many shells and shell fragments, silt pockets and silt partings, at 30.5m	
			(31.1m)	
	31		Fat CLAY (CH), very stiff, greenish gray	IV
-44			-interlayered fat clay, silty fine sand and sandy silt, to 33.7m	
	32			
-45				
	33			
-46				
	34			
-47				
	35			
-48		PUSH	-with many silty sand pockets, at 35.4m	
	36			
-49				
	37			
-50			-sand layer, 37.2m to 37.5m	
	38			
			(38.4m)	
-51	39		Fat CLAY (CH), very stiff, greenish gray	V
-52		PUSH		



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-26

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

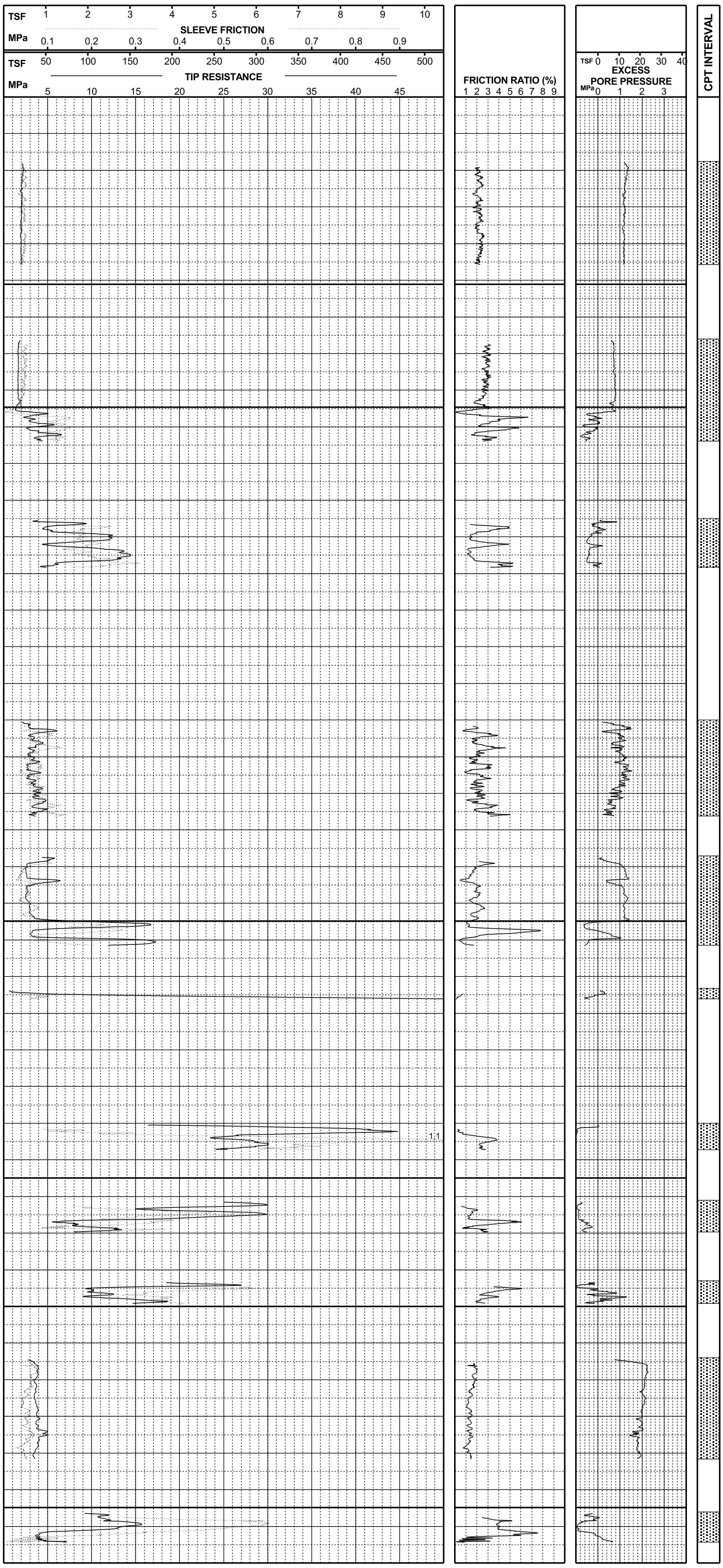
PLATE 98-26.7a

PROJECT NO:	98-42-0054	**START DATE:**	10/23/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-26 (Main Span-East Pier)	**COMPLETION DATE:**	10/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836725 N647813
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-53	41	PUSH SAVE	Fat CLAY (CH), very stiff, greenish gray -with silt pockets and few shell fragments, at 40.2m	V
-54, -55, -56, -57	42, 43, 44, 45		(45.1m)	
-58, -59, -60, -61	46, 47, 48	PUSH	Fat CLAY (CH), very stiff, greenish gray -with a few organic pockets, a few silt pockets, and a few shell fragments, at 45.7m	VI
			(48.5m)	
-61, -62, -63	49, 50	PUSH	Lean CLAY (CL), very stiff to hard, greenish gray -interlayered clay, silty sand and sandy silt to 50.3m -interlayered lean clay and silty fine sand at 50.6m	VII
-64, -65, -66, -67	51, 52, 53, 54		-sand with clay layers, 51.5m to 52.7m	
-68, -69	55, 56	PUSH SAVE	-with many sand partings and seams, and organic pockets, 55.2m to 55.8m	
-70, -71, -72	57, 58, 59		-dense sandy silt with sand and clay seams and layers, 57.2m to 59.6m	
-73, -74, -75	60, 61, 62	PUSH	-laminated clay and silty sand with laminations dipping 15 degrees, at 60.4m -sand at 61.3m	
			(62.5m)	
-76, -77, -78, -79	63, 64, 65, 66	PUSH 30/15cm	-Silty Fine SAND (SM), very dense, dark gray -silty fine sand with clay pockets, to 64.2m -with a clay layer, 62.8m to 62.9m -very stiff, dark greenish gray lean clay layer, at 64.2m -silty coarse sand with gravel and fine to medium sand, at 65.8m	VIII
-80, -81, -82	67, 68, 69	30/15cm	-fine to medium sand with silt at 67.4m	
			(69.5m)	
-83, -84, -85	70, 71, 72	30/15cm 30/15cm	Silty Fine SAND (SM), very dense, greenish gray -with fine subrounded gravel, and organic pockets, at 69.6m -with a clay layer at 70.7m -with silt seams at 71.6m	IX
			(73.0m)	
-86, -87, -88, -89, -90, -91	73, 74, 75, 76, 77, 78	PUSH PUSH SAVE	Lean CLAY (CL), hard, greenish gray -with organic pockets, calcareous nodules and slickensides, at 74.1m -with many silt pockets at 77.4m -sandy clay below 78.3m	X
			(78.5m)	
-92	79		Silty SAND (SM), very dense, greenish gray -lean clay layer, 79.1m to 79.4m	XI



LOG OF BORING AND TEST RESULTS

BORING 98-26

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

PLATE 98-26.7b

PROJECT NO:	98-42-0054	**START DATE:**	10/23/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-26 (Main Span-East Pier)	**COMPLETION DATE:**	10/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836725 N647813
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-93	81			30/25cm	Silty SAND (SM), very dense, greenish gray -with a few clay pockets, at 80.2m -with a clay layer, at 80.9m	XI
-94	82				(82.3m)	
-95	83			30/15cm 30/15cm	SANDSTONE (Rx) interbedded with SILTSTONE (Rx), dark gray, moderately to highly weathered, moderately soft	XII
-96	84				TOTAL DEPTH: 82.8m BACKFILLED WITH: Cement Grout	
-97	85					
-98	86					
-99	87					
-100	88					
-101	89					
-102	90					
-103	91					
-104	92					
-105	93					
-106	94					
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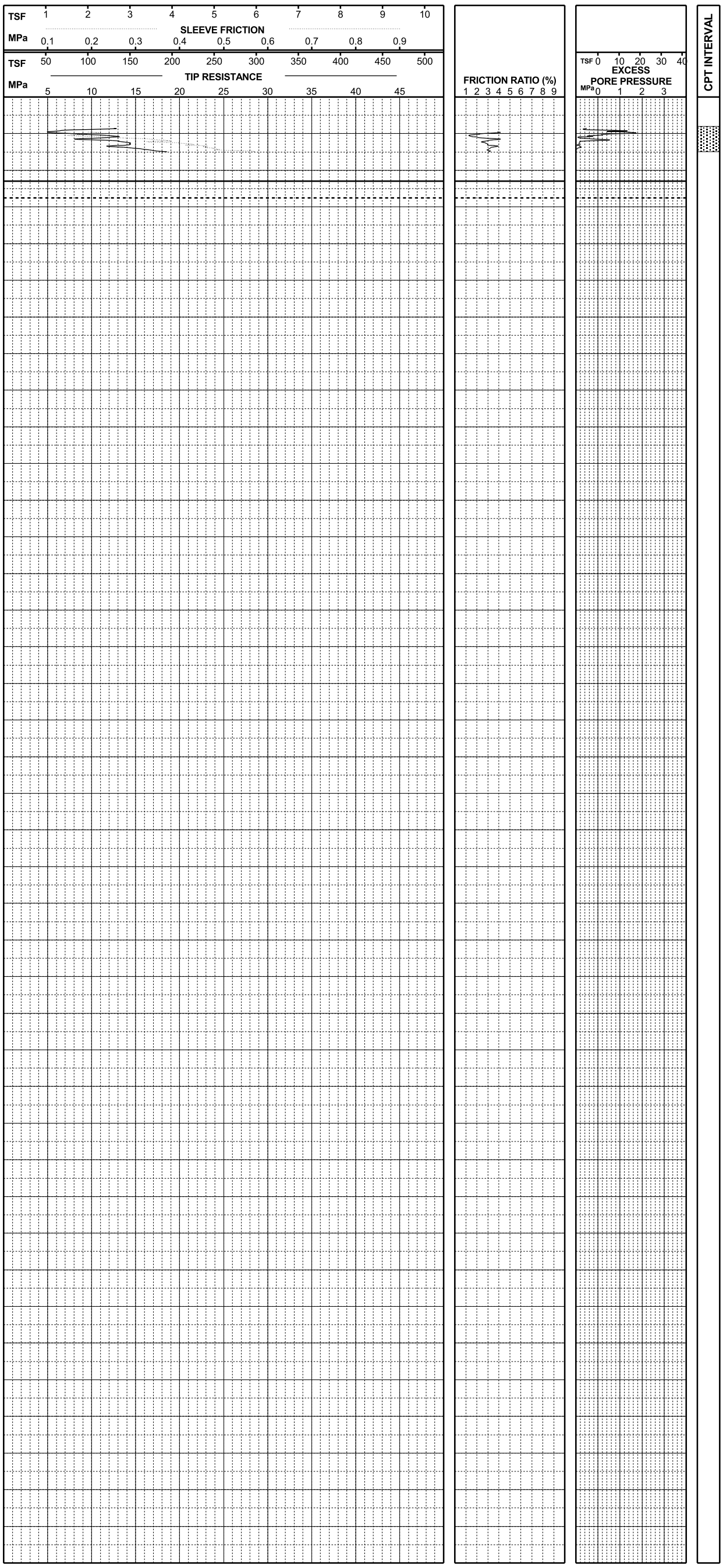


LOG OF BORING AND TEST RESULTS

BORING 98-26

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

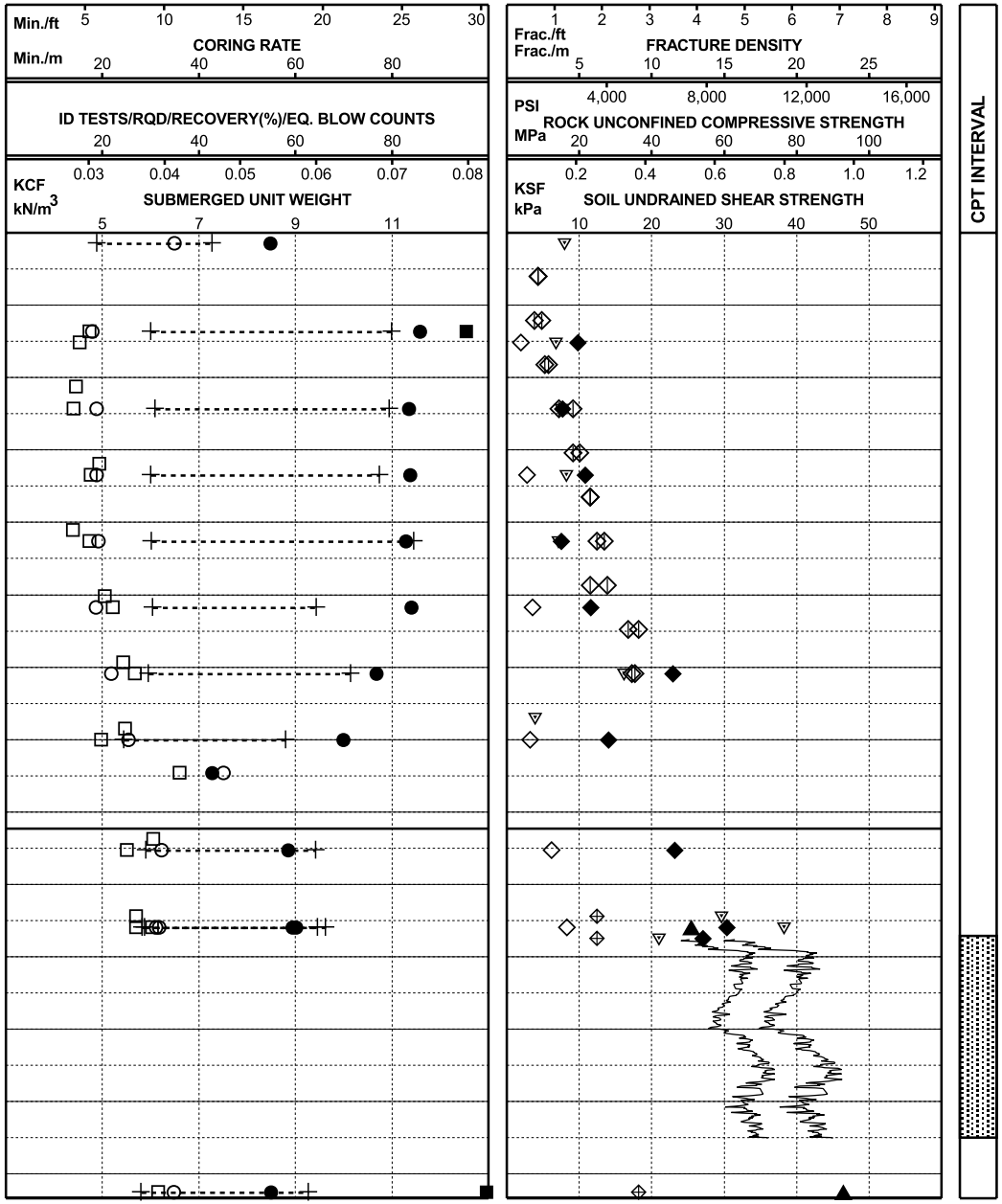
PLATE 98-26.7c

PROJECT NO:	98-42-0054	**START DATE:**	10/23/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-26 (Main Span-East Pier)	**COMPLETION DATE:**	10/25/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836725 N647813
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.7m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-13		WOH	Fat CLAY (CH), very soft to soft, olive gray -with silt pockets -dark gray and with sand pockets, organic pockets, shells, and shell fragments, at 0.2m	I
-14	1	WOH		
-15	2	WOH	-with mica at 2.1m -with silt partings, 2.7m to 6.1m	
-16	3	WOH		
-17	4	WOH	-with shell fragments, below 4.6m	
-18	5	WOH	-with fine sand pockets, partings and seams, below 5.5m	
-19	6	WOH		
-20	7	WOH		
-21	8	WOH	(8.2m) Fat CLAY (CH), firm, dark olive gray -platy and, with silt pockets, gas blisters and shell fragments	II
-22	9	WOH		
-23	10			
-24	11			
-25	12			
	13	PUSH		



CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-26

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

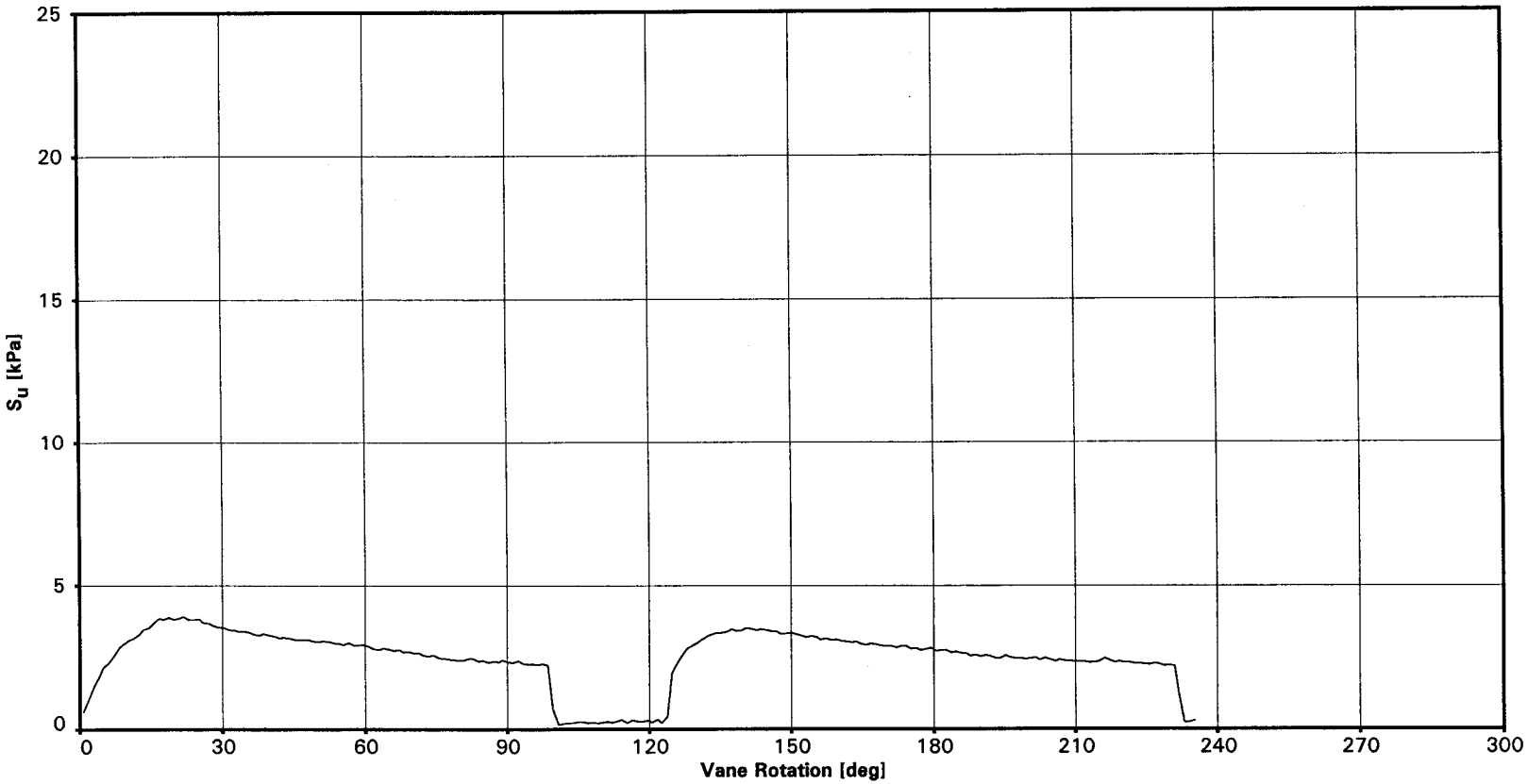
FUGRO

PLATE 98-26.8

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 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

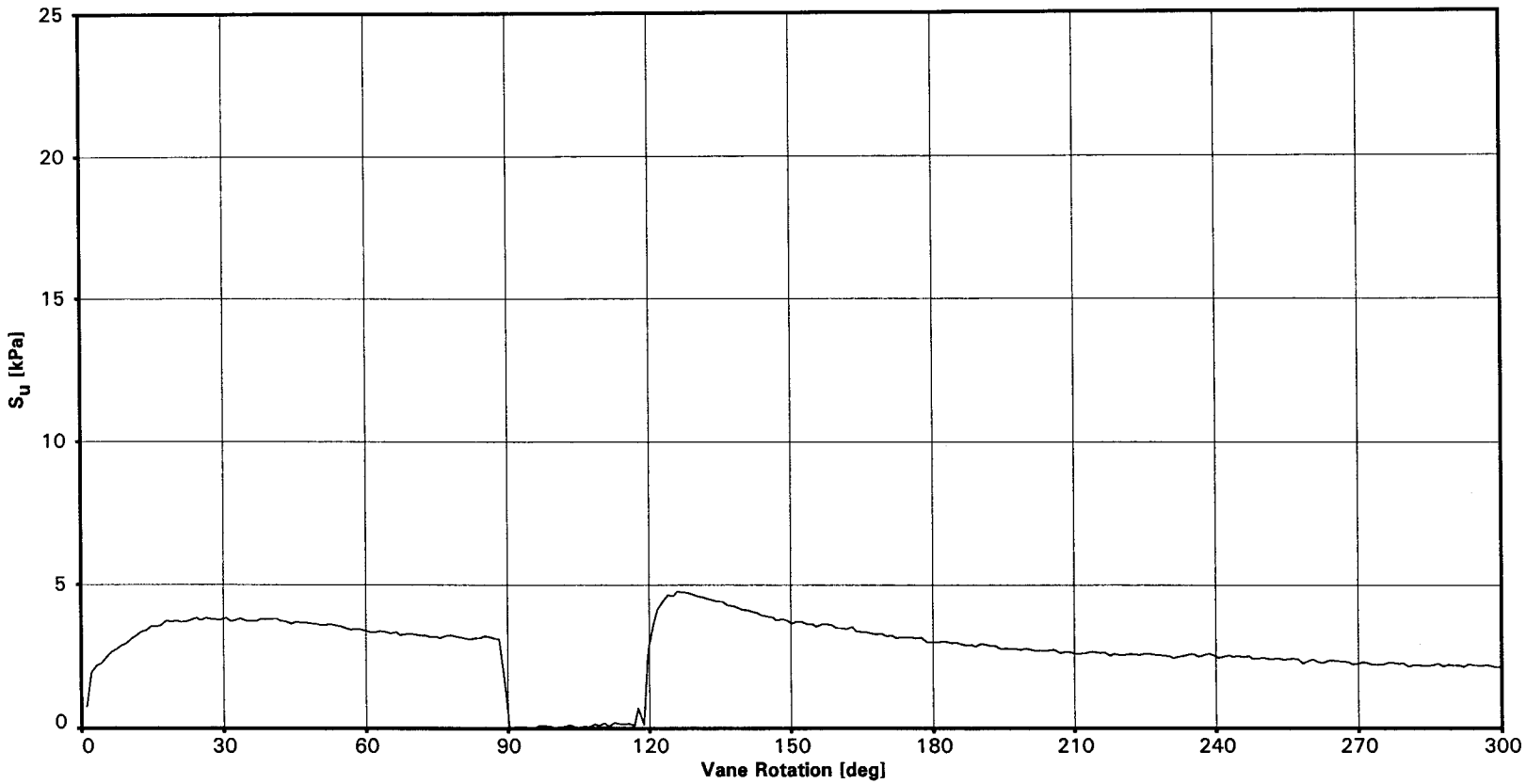
FUGRO

PLATE 98-26.9a

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 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

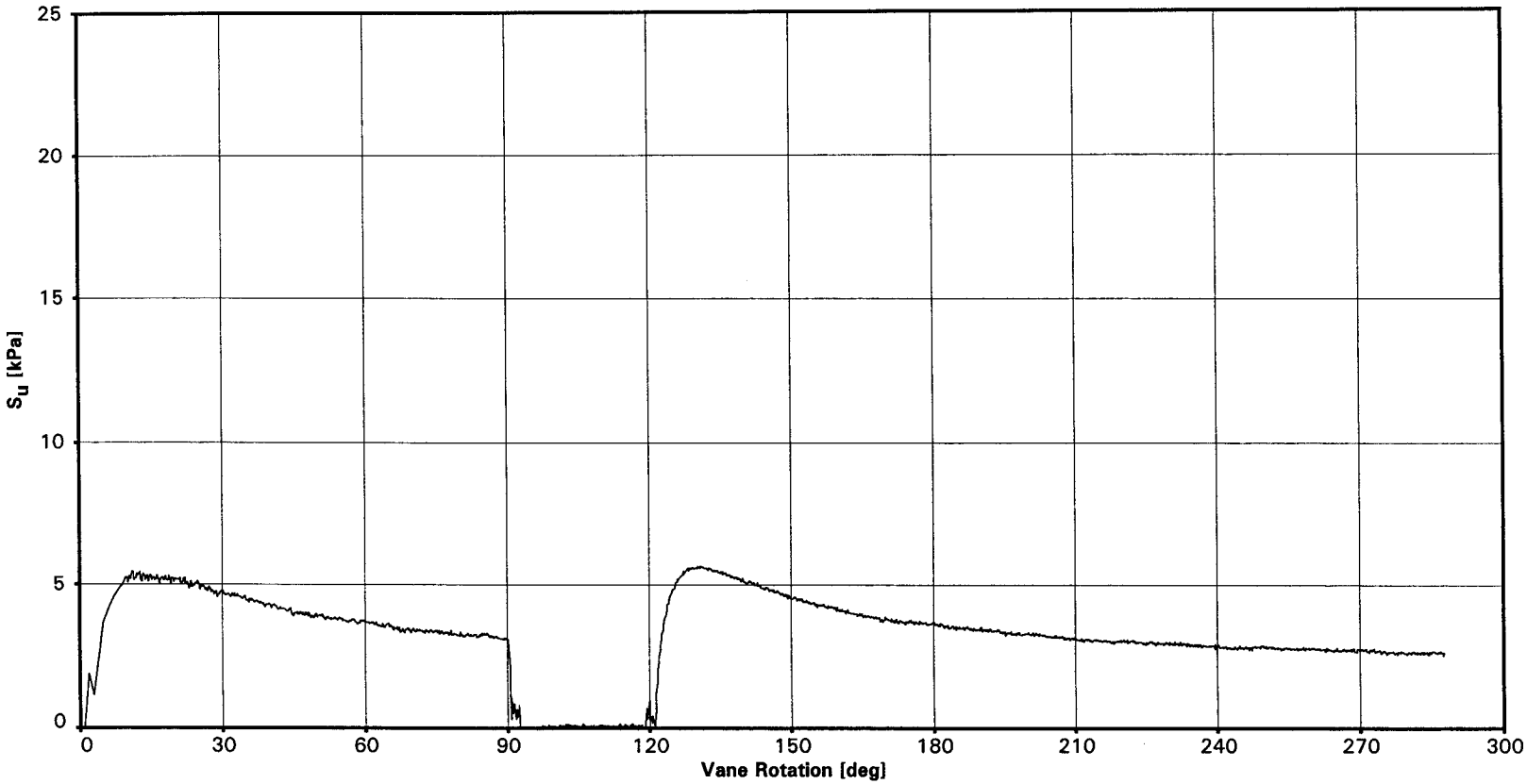
FUGRO

PLATE 98-26.9b

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 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

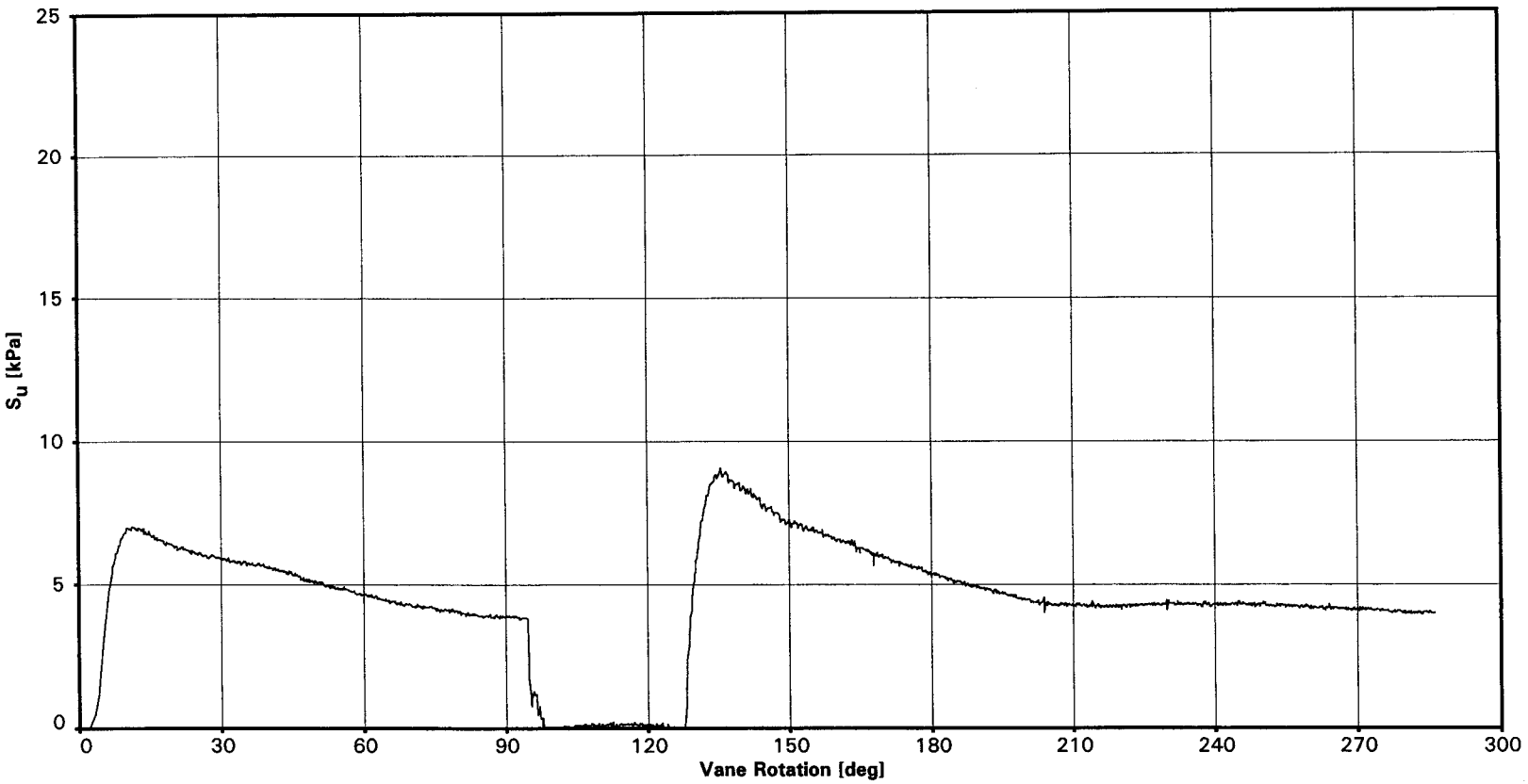
FUGRO

PLATE 98-26.9c

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 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

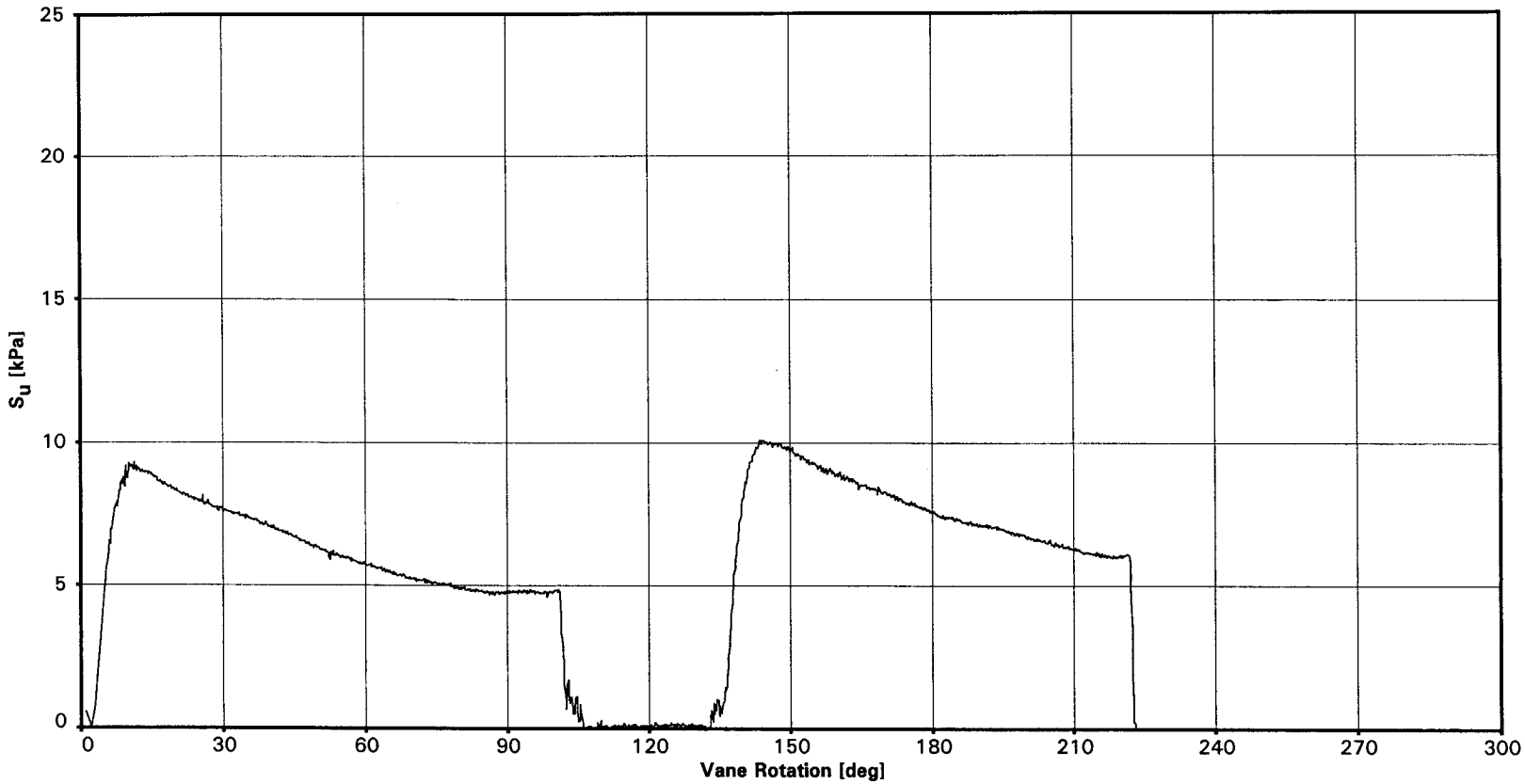
FUGRO

PLATE 98-26.9d

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 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

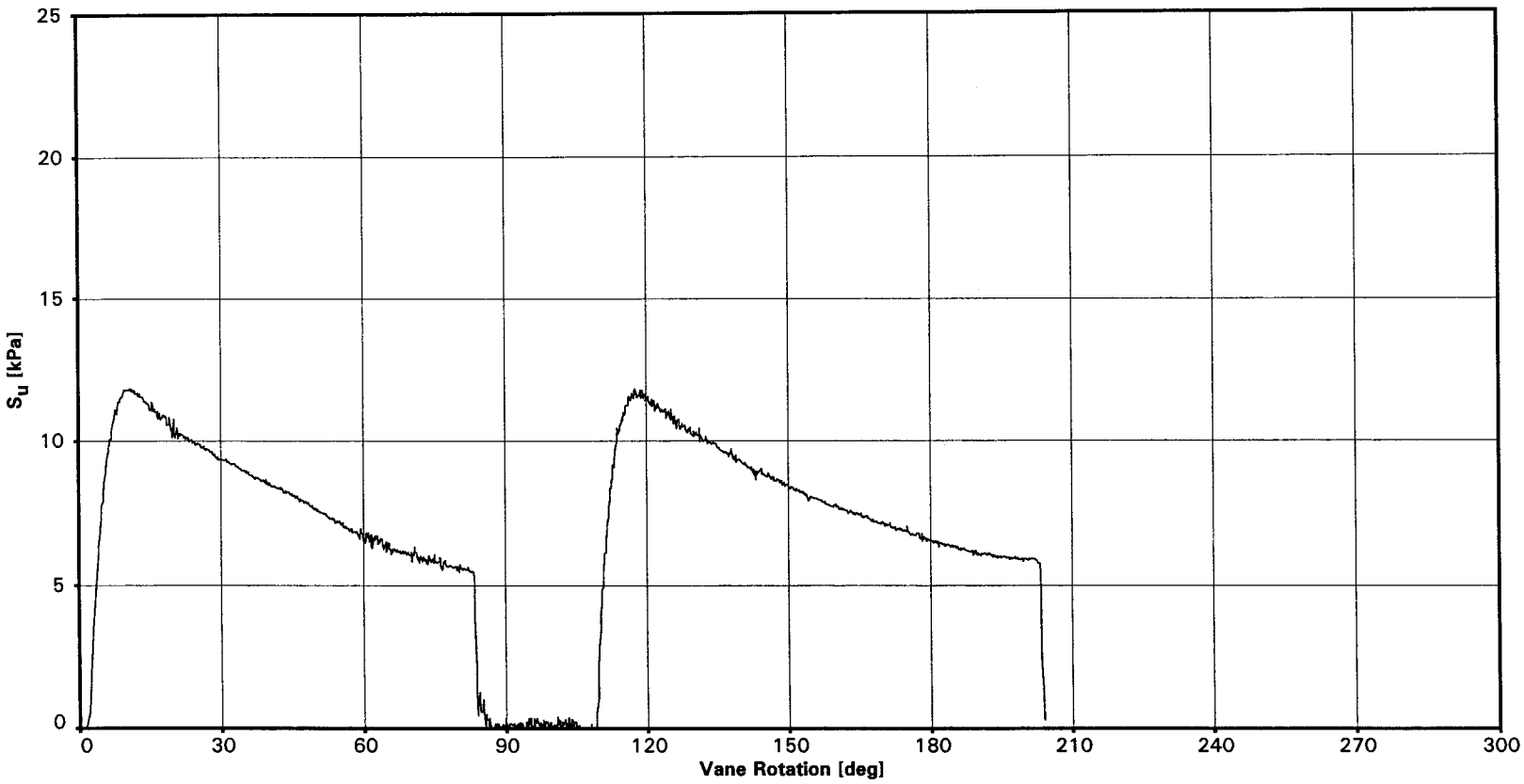
FUGRO

PLATE 98-26.9e

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

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.7m
Boring 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

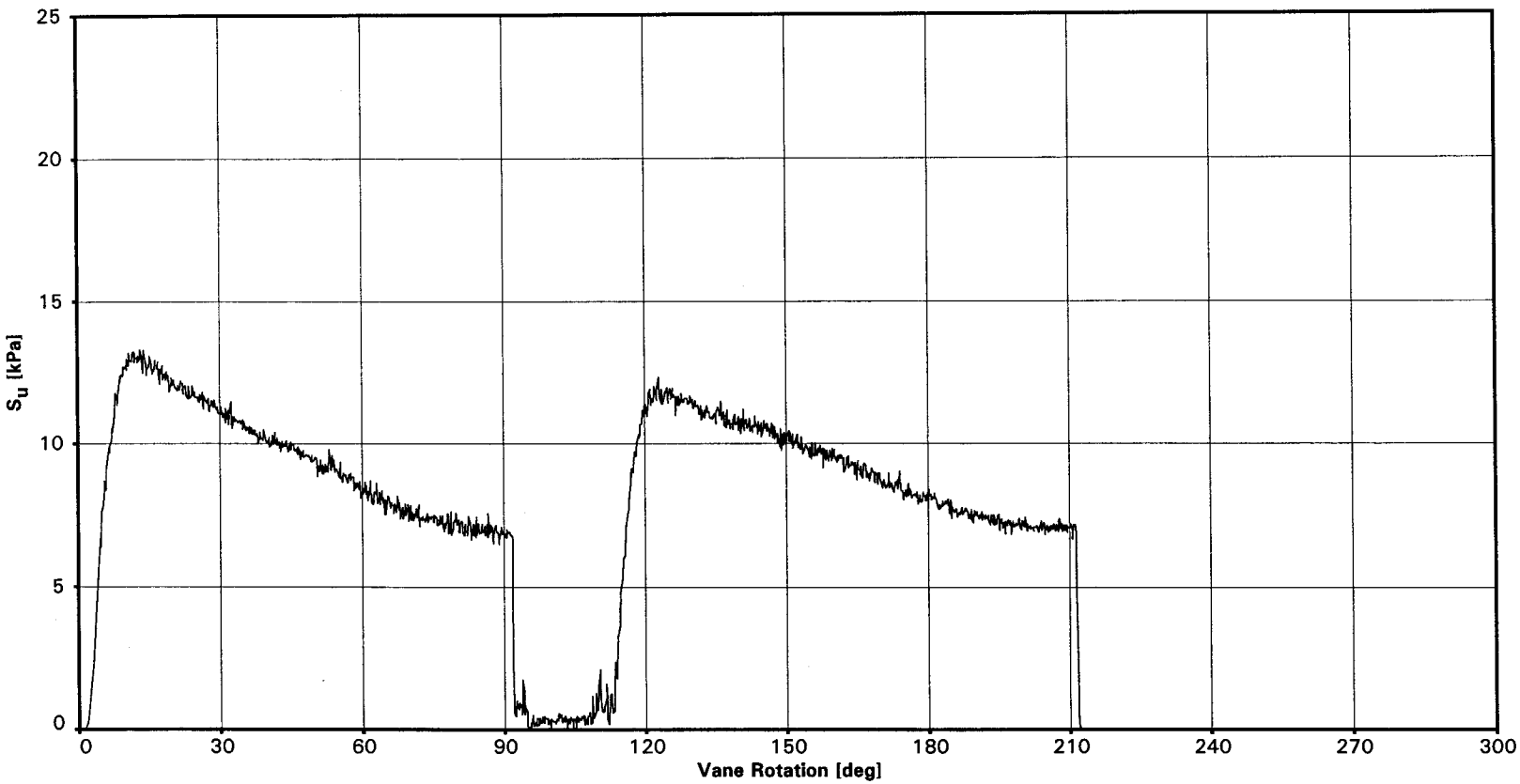
FUGRO

PLATE 98-26.9f

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

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 4.3m
Boring 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

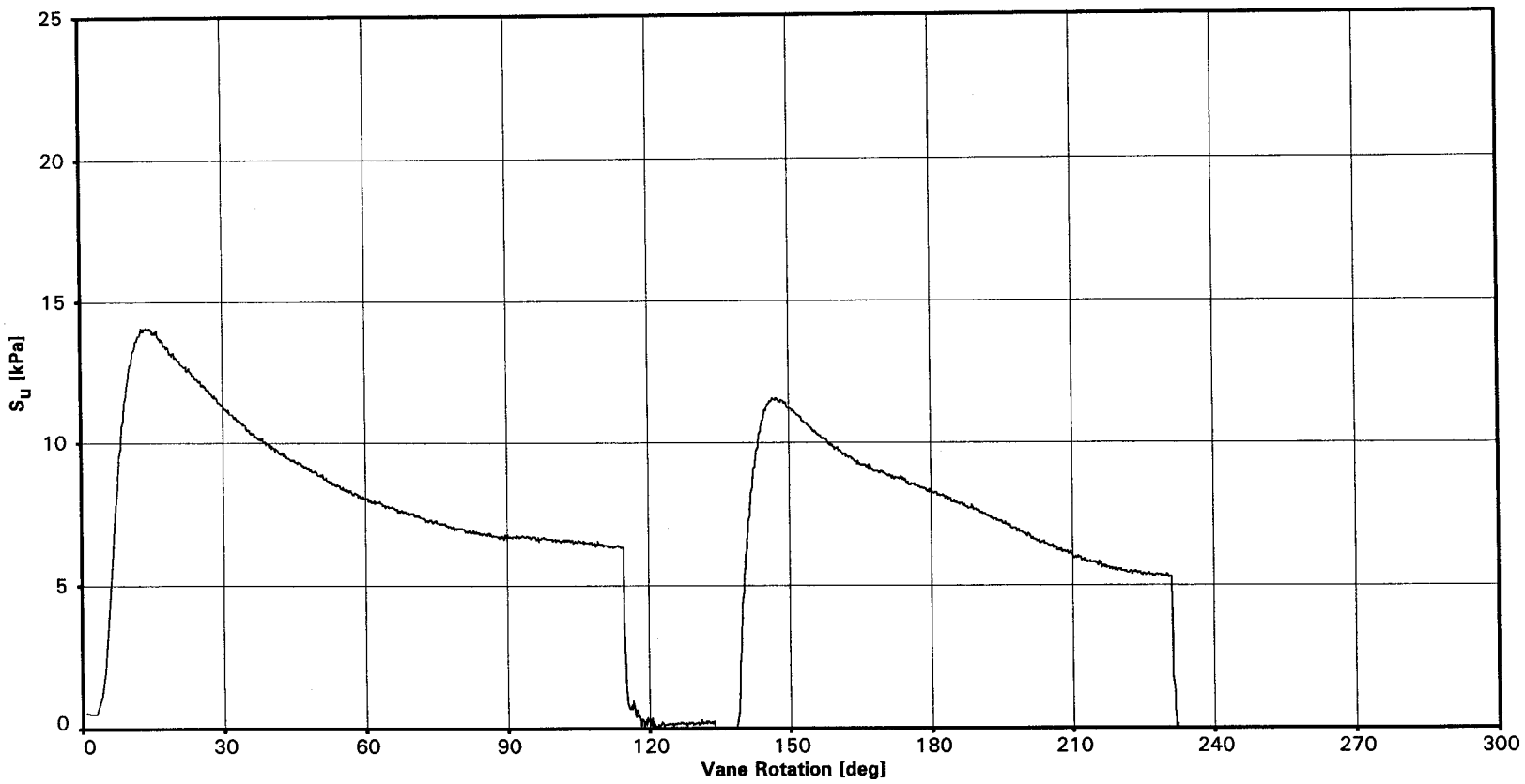
PLATE 98-26.9g

Earth Mechanics

FUGRO

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)

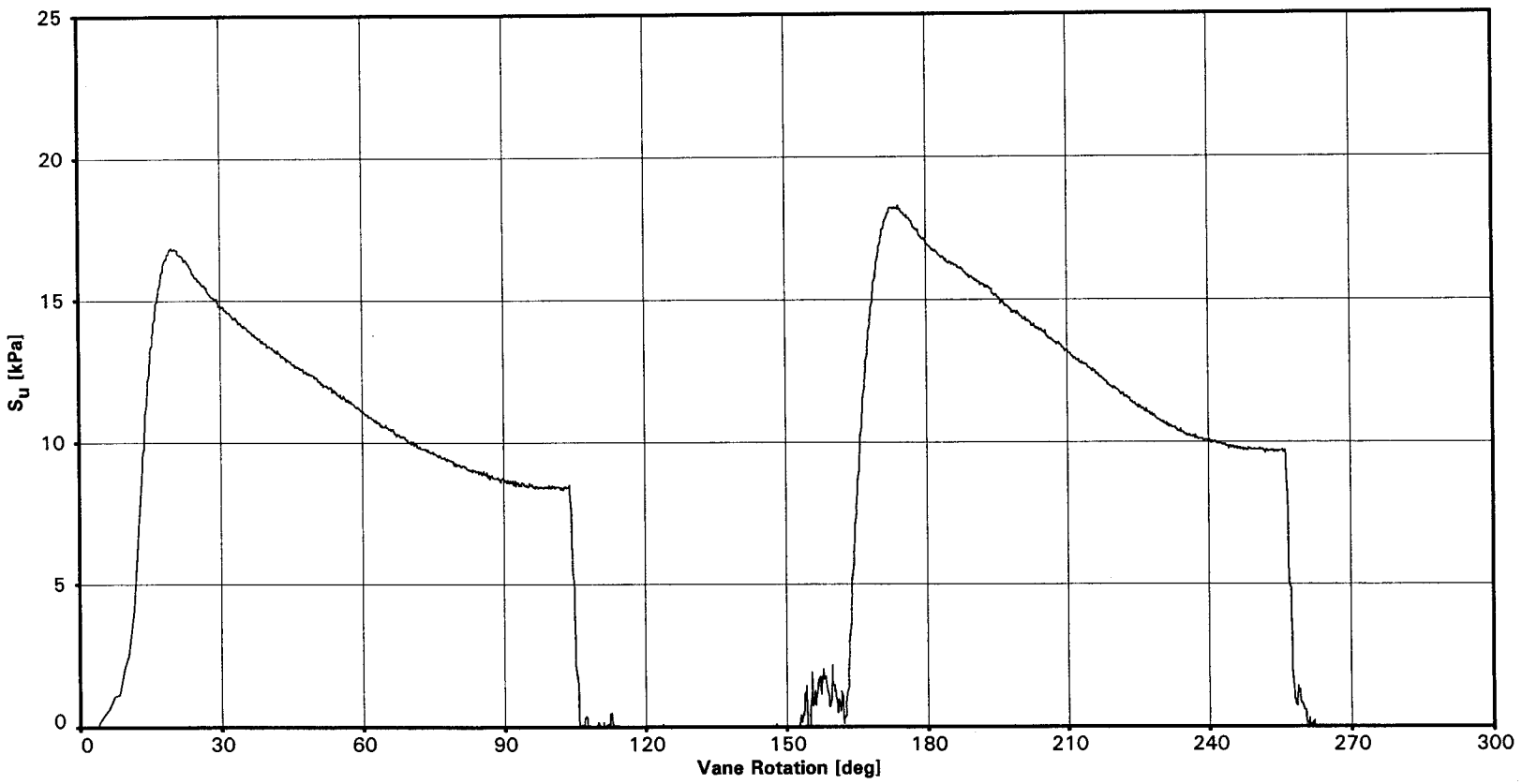


REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 4.9m
Boring 98-26
SFOBB East Span Seismic Safety Project

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: 5.5m
Boring 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

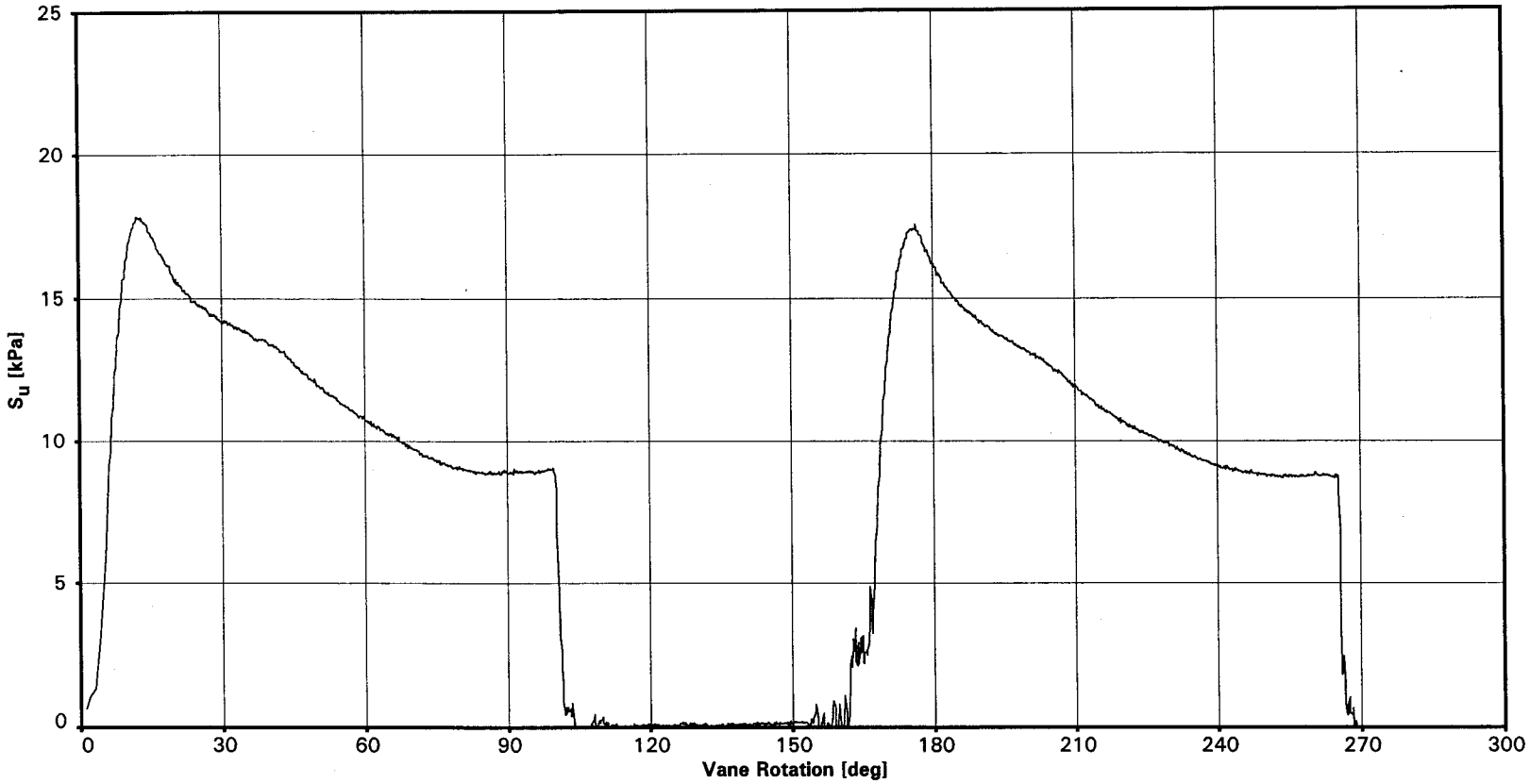
FUGRO

PLATE 98-26.9i

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: 6.1m
Boring 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-26.9j

98-26		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
0.2	1	55	43	19	1.50					8.0														
0.6	401													4.3										
0.6	411													4.3										
1.2	402													4.8										
1.2	412													3.8										
1.4	3	86	80	30	1.12	4.7	95																	H
1.5	4					4.5				6.8	9.8	1.9												
1.8	403													5.7										
1.8	413													5.3										
2.1	5					4.5																		
2.4	7	84	79	31	1.08	4.4				7.6	7.7													
2.4	404													7.2										
2.4	414													9.1										
3.0	405													9.1										
3.0	415													10.1										

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 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-26		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
3.2	9					4.9																		
3.4	10	84	78	30	1.13	4.8				8.2	10.8	2.8												
3.7	406													11.5										
3.7	416													11.5										
4.1	12					4.4																		
4.3	13	83	85	30	0.97	4.7				7.2	7.5													
4.3	407													13.4										
4.3	417													12.4										
4.9	408													13.9										
4.9	418													11.5										
5.0	15					5.0																		
5.2	16	84	64	30	1.58	5.2					11.6	3.6												
5.5	409													16.8										
5.5	419													18.2										
5.9	18					5.4																		

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-26		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
6.1	19	77	72	30	1.12	5.7				16.3	22.9													
6.1	410													17.2										
6.1	420													17.7										
6.7	20									3.9														
6.9	21					5.5																		
7.0	22	70	58	24	1.35	5.0					14.0	3.2												
7.5	23	43				6.6																		
8.4	25					6.1																		
8.5	26	58	64	29	0.83	5.5					23.2	6.1												
9.4	27					5.7				29.7														
9.4	29							12.4																
9.6	28	59	65	28	0.85	6.0				38.3	30.4	8.2												
9.6	30	60	66	29	0.83	5.7									25.3		1.5							
9.8	31							12.4		21.1	27.1													
13.3	33	55	63	28	0.77	6.2	99	18.2							46.3		0.7							H

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-26		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
13.4	34							19.6		49.8	42.3	10.0												
13.9	35	55	56	25	0.97																			C,K
14.0	36	52	58	31	0.79						16.9													
17.4	37					9.8										128.4								
17.5	38	37	72	28	0.21																			C
17.7	39								172.4		222.8													
21.8	41	57	79	29	0.56	6.7			124.5						119.0		0.6							
21.9	42								148.4		127.5													
26.7	43	53	71	23	0.63		97																	C,H
26.8	44	57	81	32	0.51						136.1													
27.4	46	57	84	39	0.40						184.4													
28.0	48	52	69	29	0.57						170.8													
30.3	49	53				7.3		131.7	153.2		181.9													
30.6	51	56	67	27	0.72	7.0									141.0	43.0	1.8							
30.8	52							143.6			165.9													

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-26		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
35.5	53	46	61	23	0.59	7.5									132.4		1.5							
35.7	54										165.9													
40.4	56	55	75	35	0.49	6.8		134.1							170.0	48.0	0.9							
40.5	57							143.6	153.2		204.2													
41.1	58	53	73	29	0.55																			C
41.1	59	58	73	31	0.63						185.6													
45.9	61	55	74	28	0.59	6.6									183.6		0.9							
46.0	62								143.6		205.5													
50.7	64	29	33	19	0.77	8.7	63																	
50.9	65										169.5													
55.5	66	37	47	22	0.60																			
55.8	68					8.5																		
56.3	69	26	31	16	0.70																			C,K
56.4	70	28	33	22	0.53																			
60.7	73	28				9.2																		

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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-26
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-26		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)	
64.0	74						60											9.6	29					
64.3	76	26									188.1													
66.0	77	16					12																	
67.5	78	23					10																	
69.6	79	20					43																	
71.8	80	24				11.1	50																	
74.1	81								292.1															
74.4	83	23	53	20	0.12	10.1									261.8	154.9	0.7							
77.9	85	23	36	16	0.32		80	172.4							183.7		1.5							H
78.5	86	22	24	15	0.78																			C
78.6	87	24																						
80.3	88	20				10.3																		
80.4	89						36																	H
82.4	90	17																						

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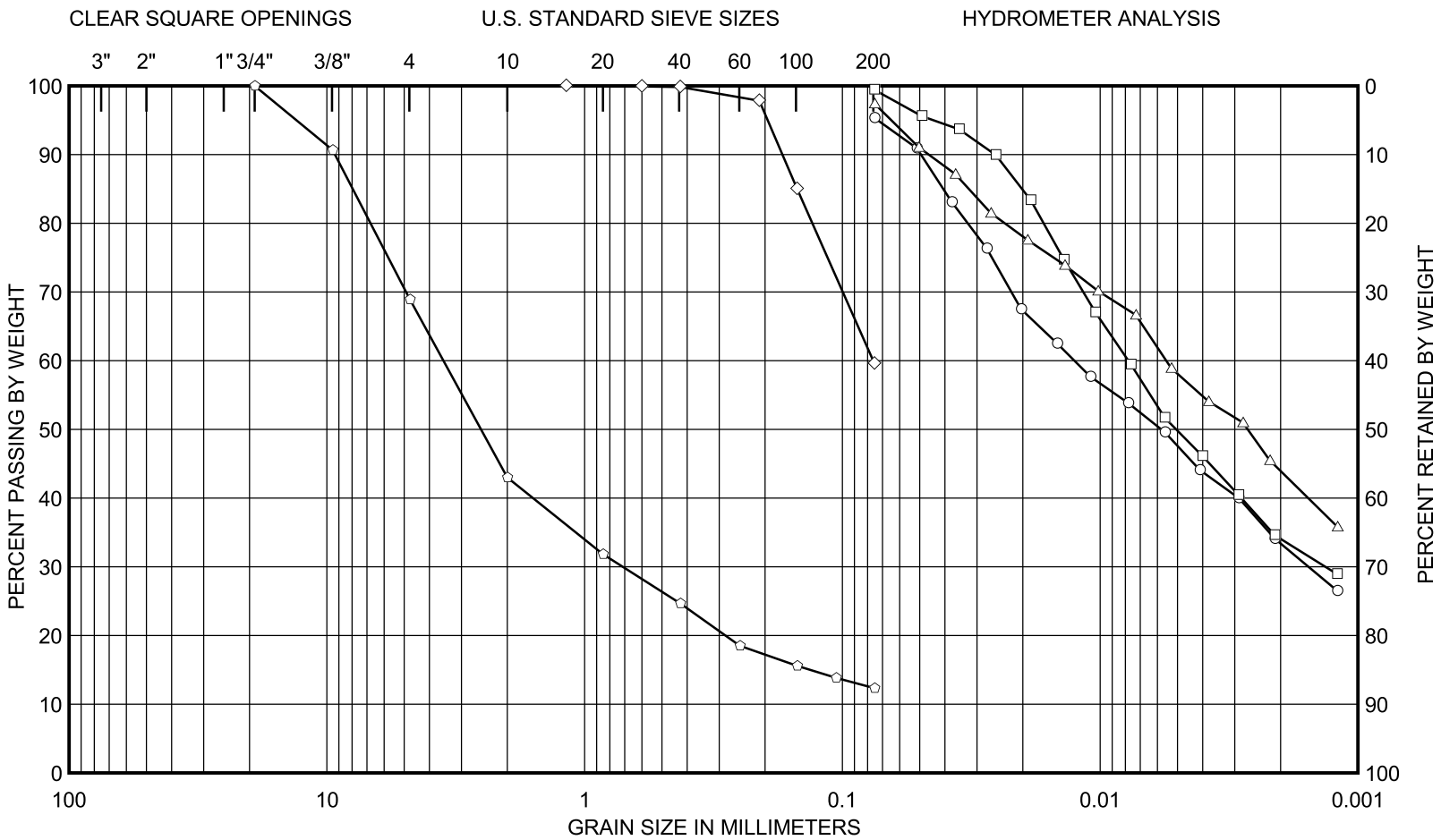
SUMMARY OF LABORATORY TEST RESULTS
Boring 98-26
SFOBB East Span Seismic Safety Project

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)			0.0058
33	13.3	□——□	FAT CLAY (CH)			0.0051
43	26.7	△——△	FAT CLAY (CH)			0.0027
74	64.0	◇——◇	SANDY SILT (ML)			
77	66.0	⬠——⬠	SILTY COARSE SAND (SM) with fine gravel and medium to fine sand			2.5

GRAIN SIZE DISTRIBUTION CURVES

Boring 98-26

SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-26.11a

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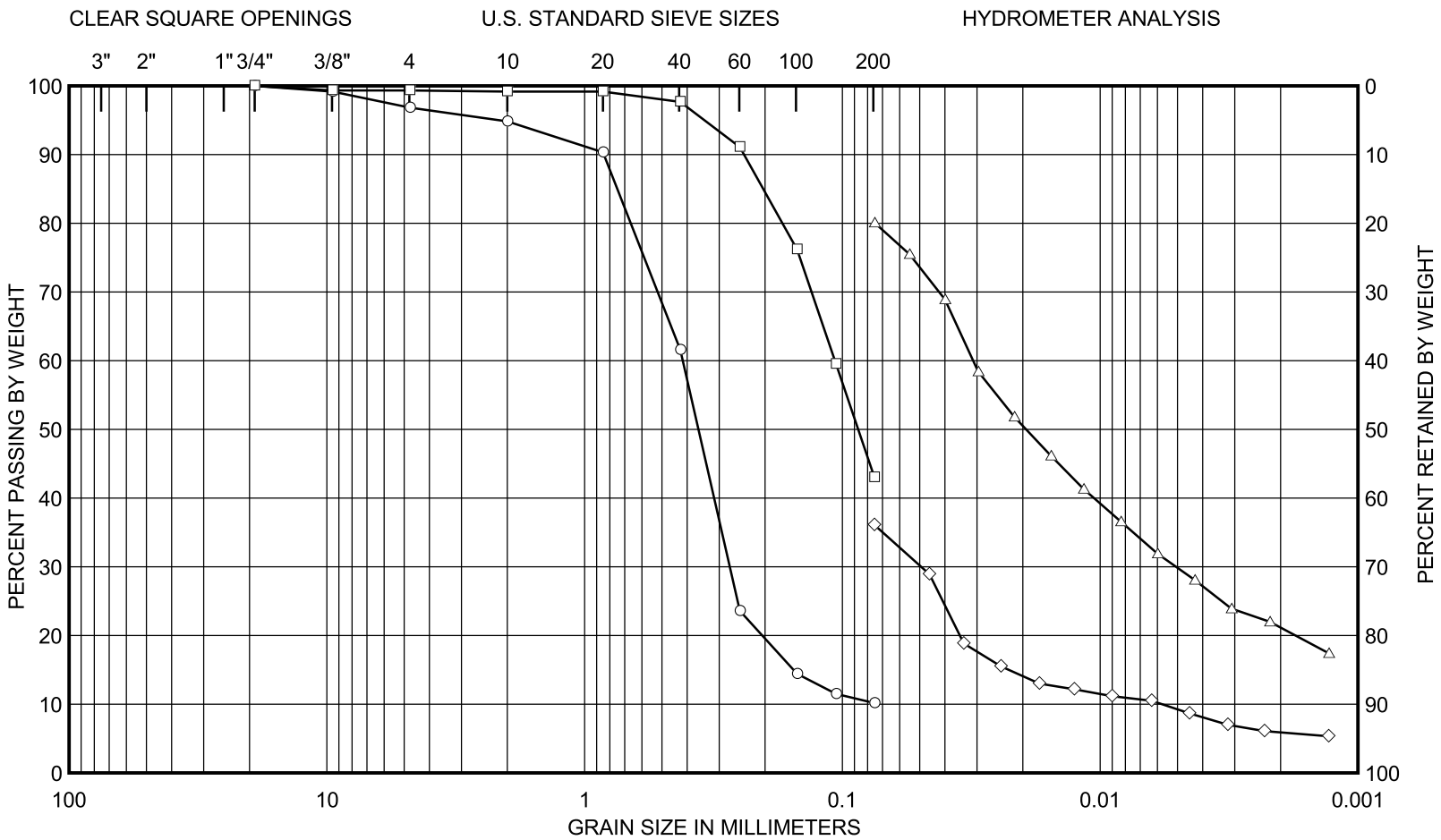

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
78	67.5	○——○	FINE TO MEDIUM SAND (SP-SM) with silt			0.36
79	69.6	□——□	SILTY FINE SAND (SM)			0.087
85	77.9	△——△	LEAN CLAY (CL) with sand			0.019
89	80.4	◇——◇	SILTY FINE SAND (SM)			

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-26
SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-26.11b

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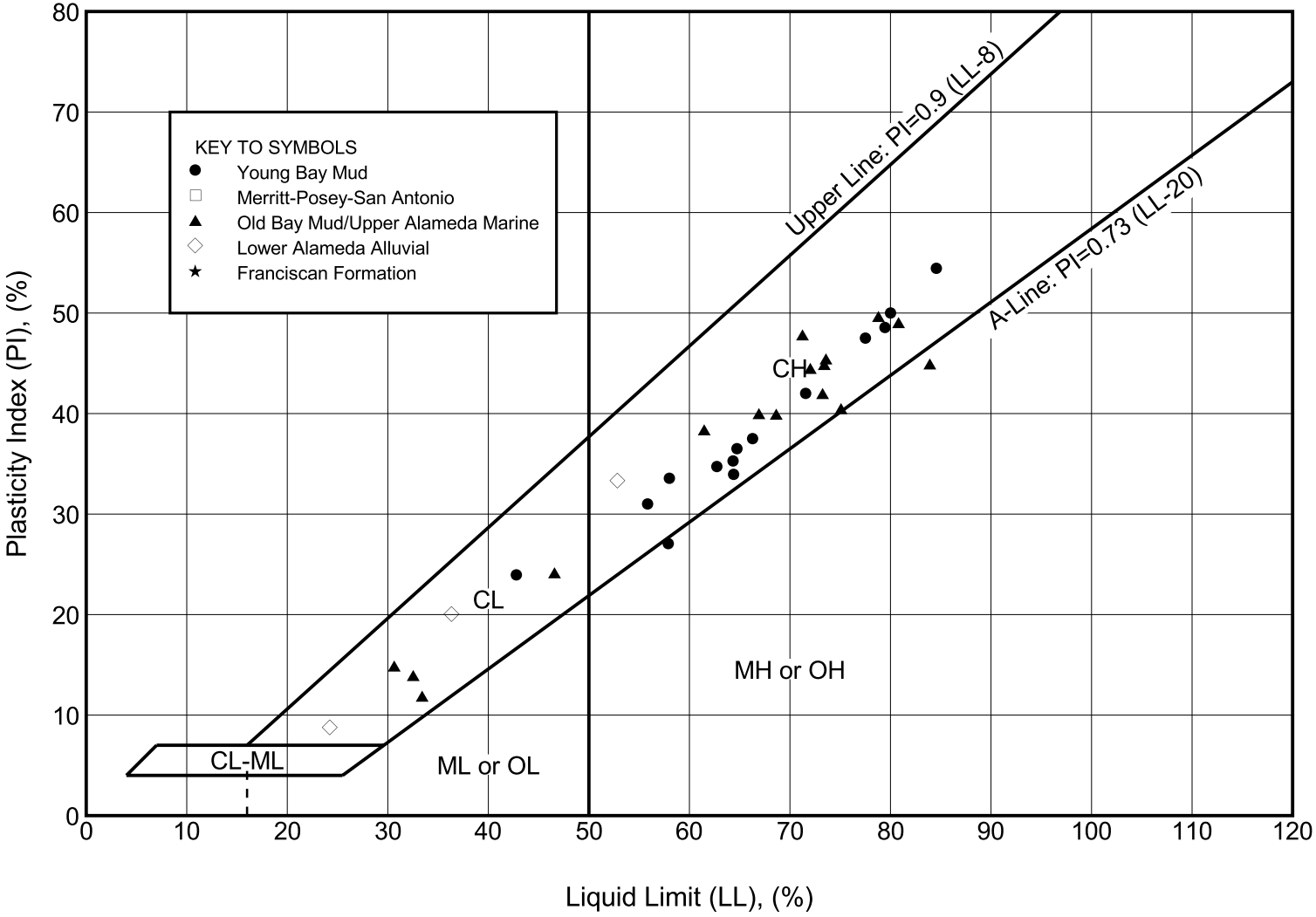

PLASTICITY CHART
Boring 98-26
SFOBB East Span Seismic Safety Project

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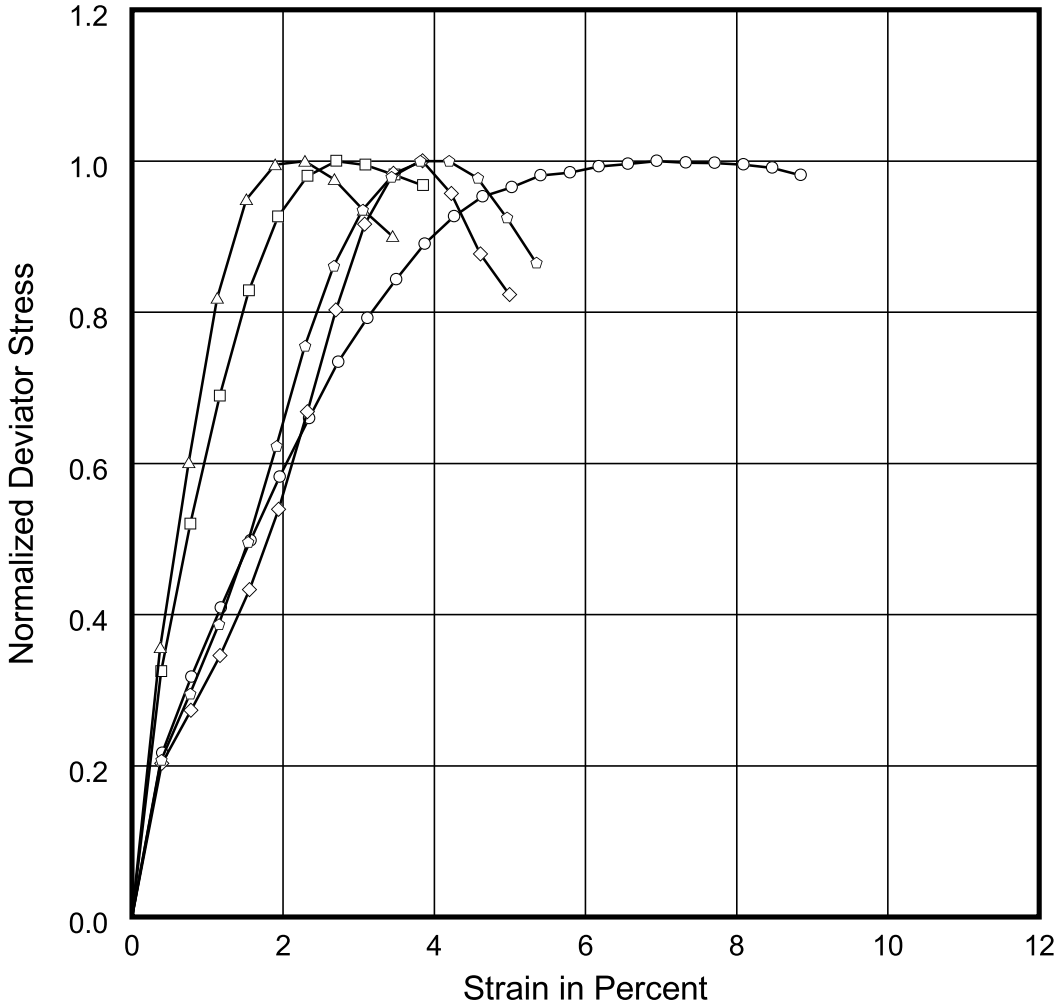
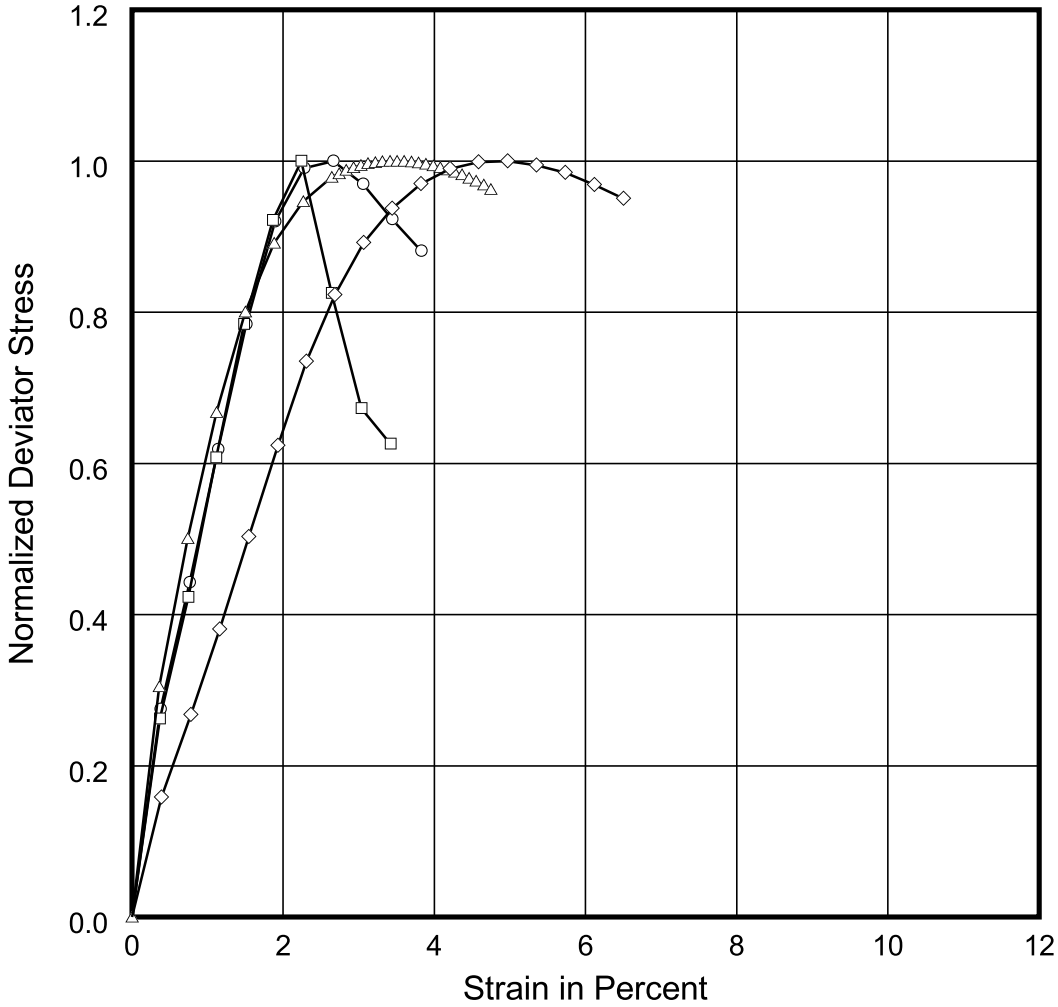


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	30	9.6	UU	221	51	1.5
	33	13.3	UU	310	93	0.7
	41	21.8	UU	827	238	0.6
	51	30.6	UU	1034	282	1.8
	53	35.5	UU	1138	265	1.5

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-26
SFOBB East Span Seismic Safety Project

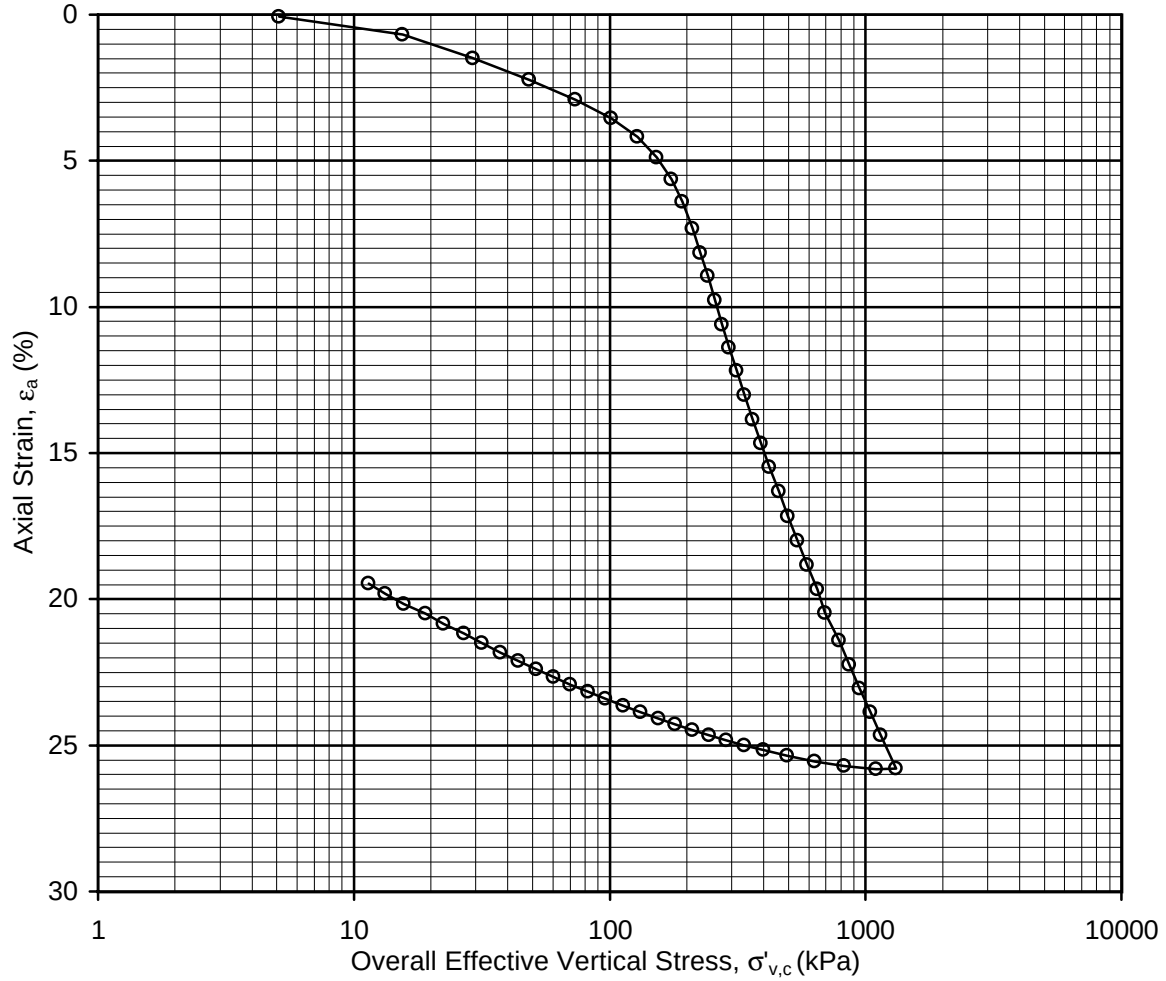


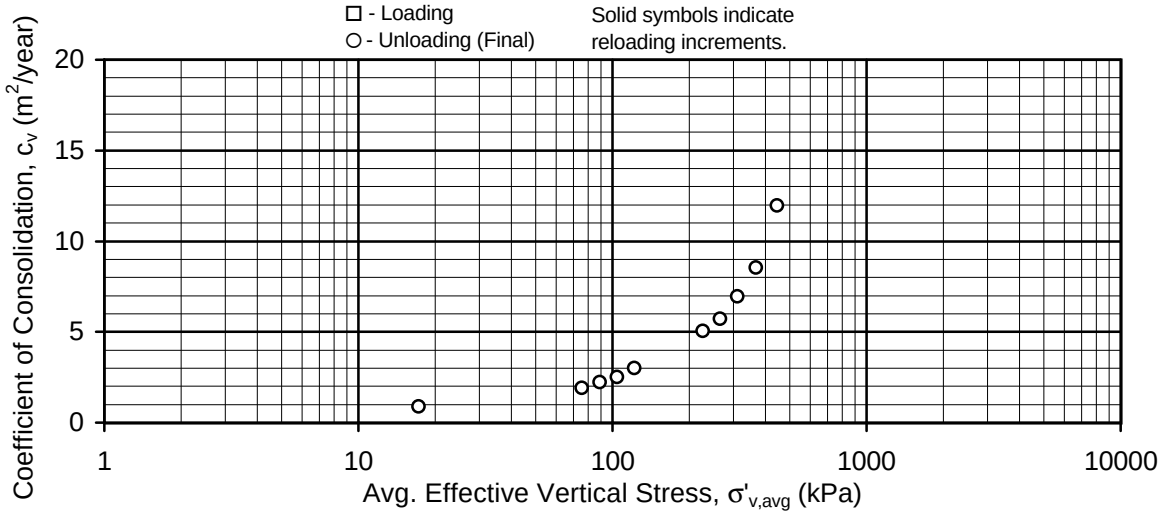
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	56	40.4	UU	1241	340	0.9
□—□	61	45.9	UU	1379	367	0.9
△—△	83	74.4	UU	2034	524	0.7
◇—◇	85	77.9	UU	2103	367	1.5

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-26
SFOBB East Span Seismic Safety Project

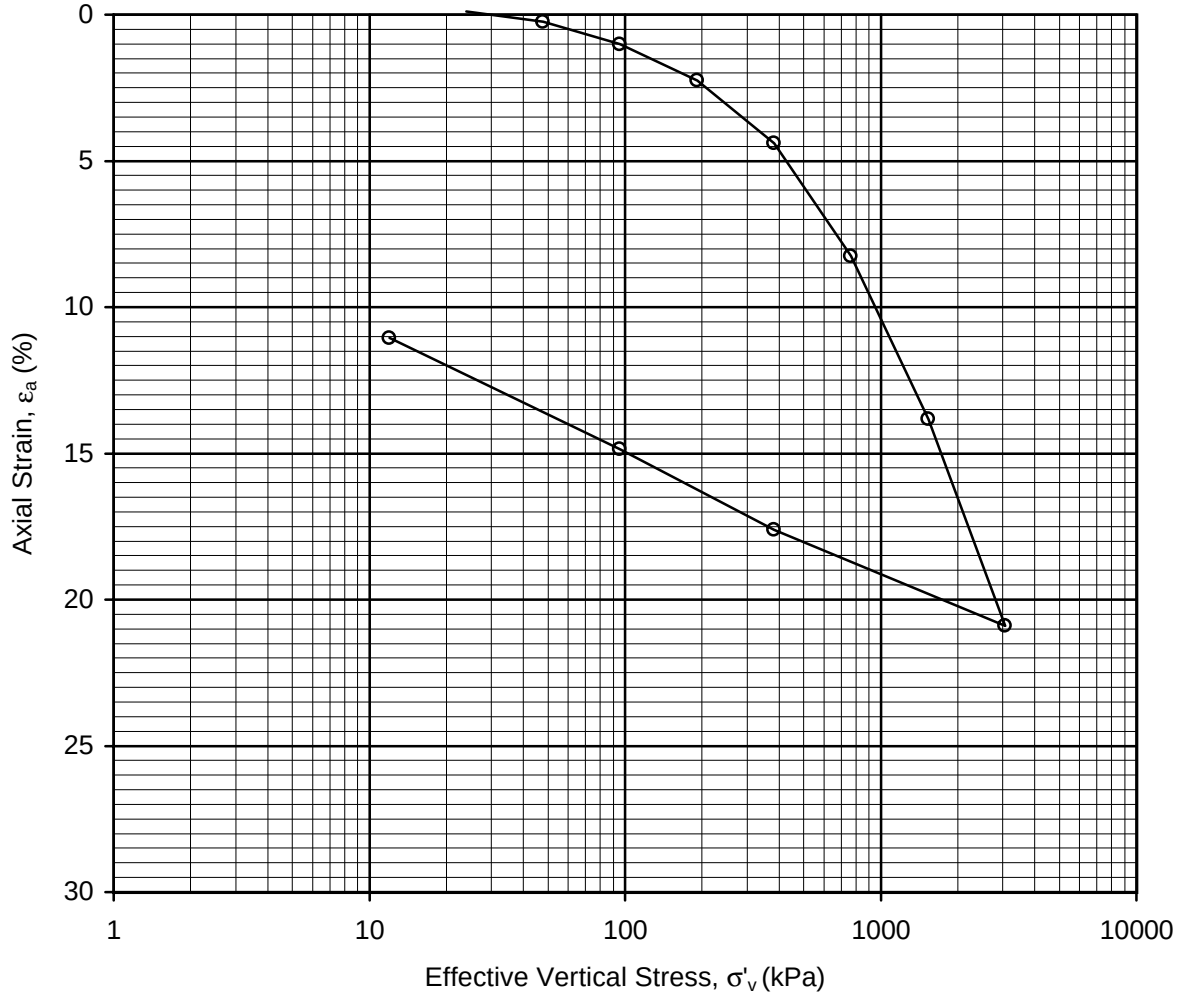


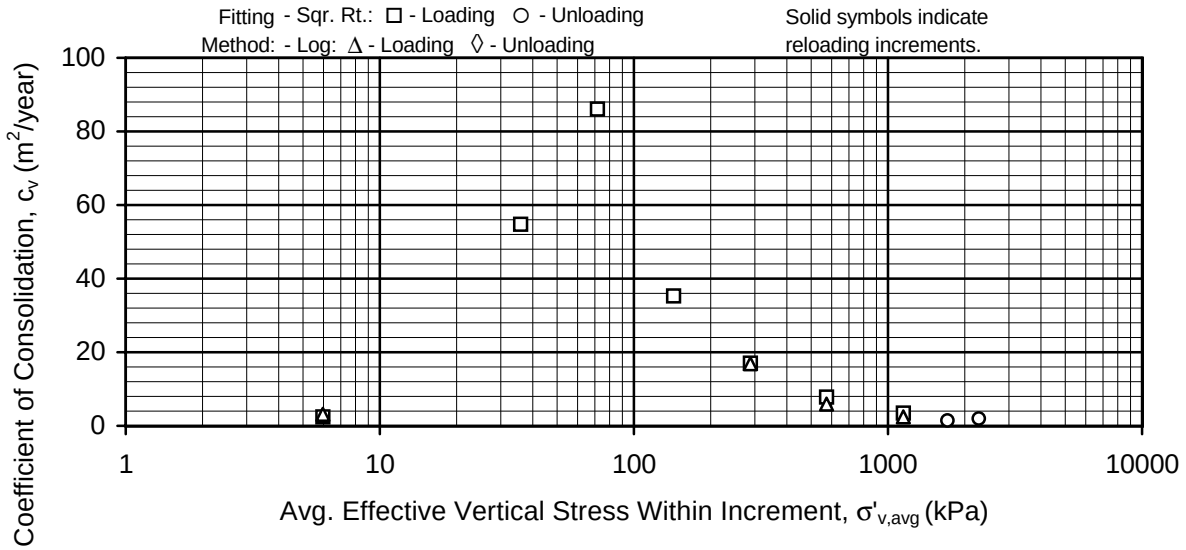


CRS CONSOLIDATION TEST RESULTS

Sample No. 35 - Depth: 13.9m
Boring 98-26
SFOBB East Span Seismic Safety Project

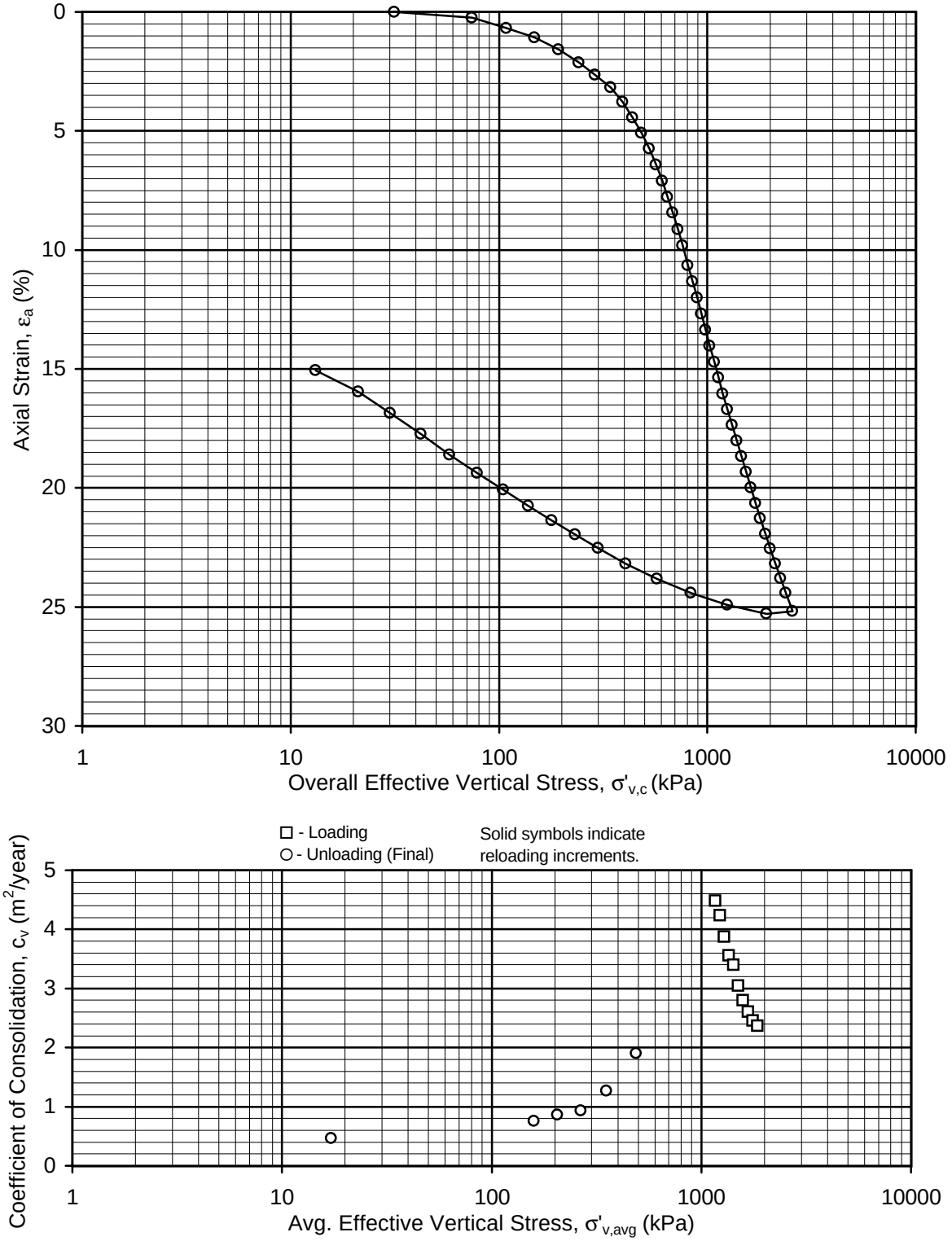
PLATE 98-26.14a





INCREMENTAL CONSOLIDATION TEST RESULTS

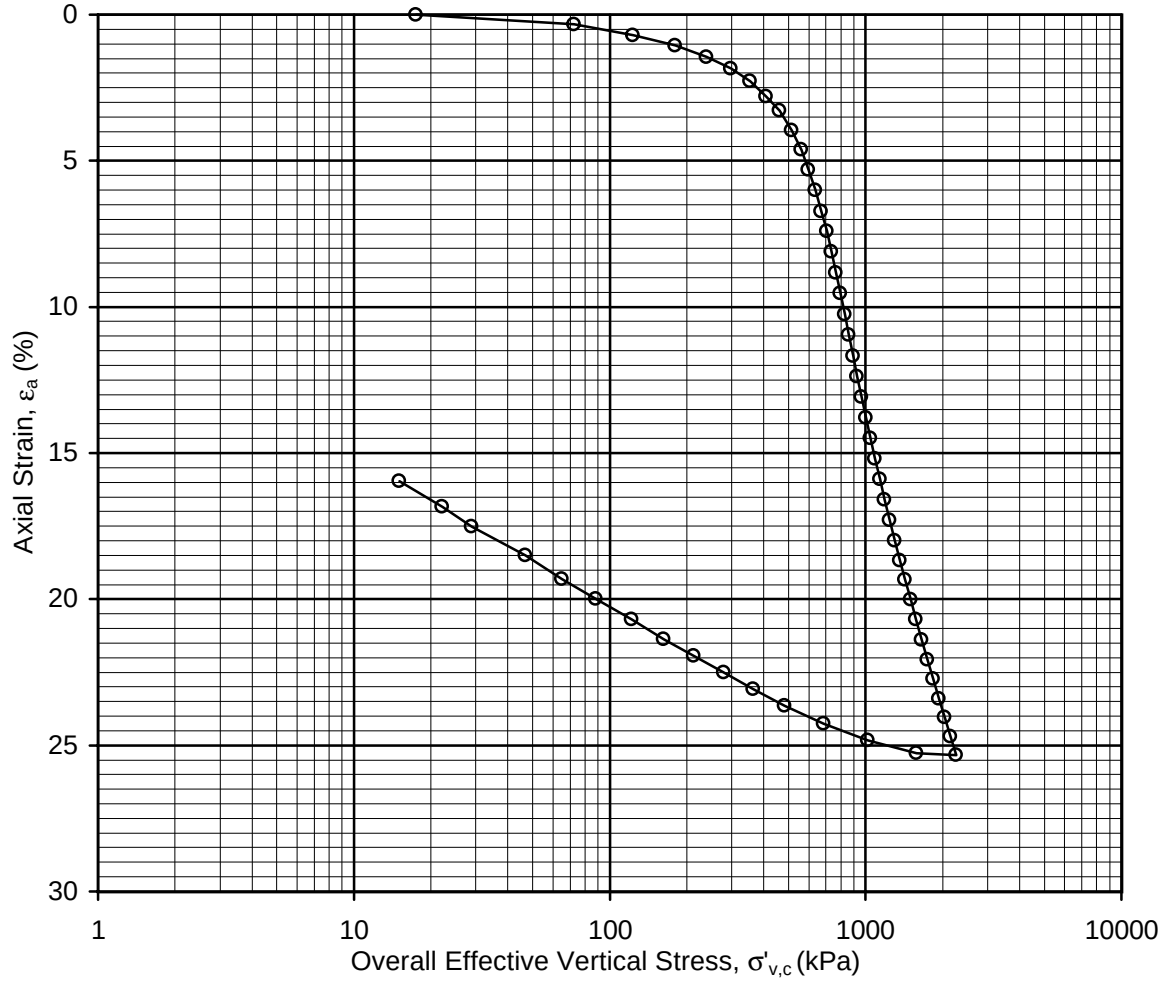
Sample No. 38 - Depth: 17.5m
Boring 98-26
SFOBB East Span Seismic Safety Project

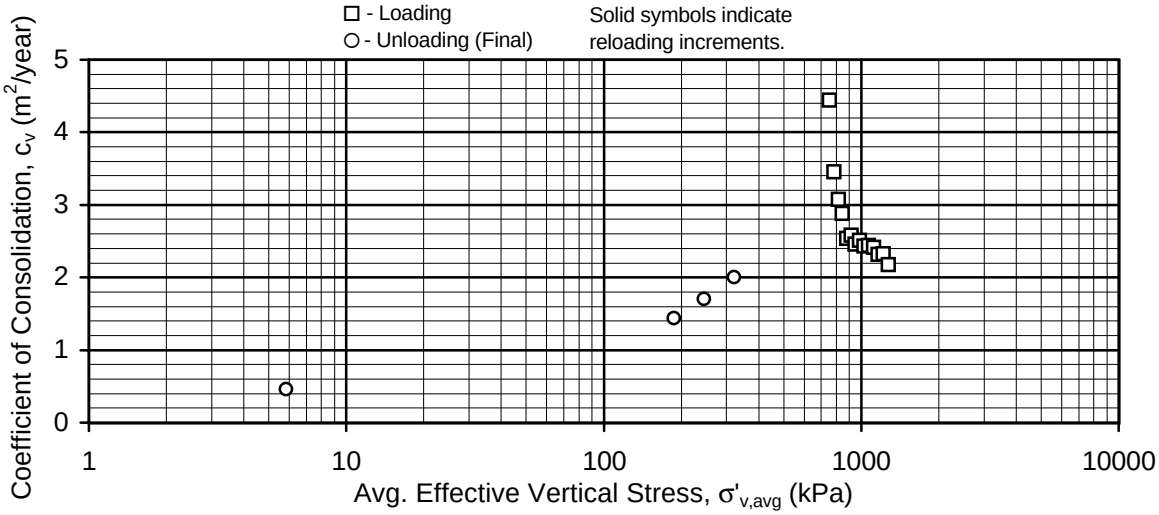


CRS CONSOLIDATION TEST RESULTS

Sample No. 43A - Depth: 26.7m
Boring 98-26
SFOBB East Span Seismic Safety Project

PLATE 98-26.14c

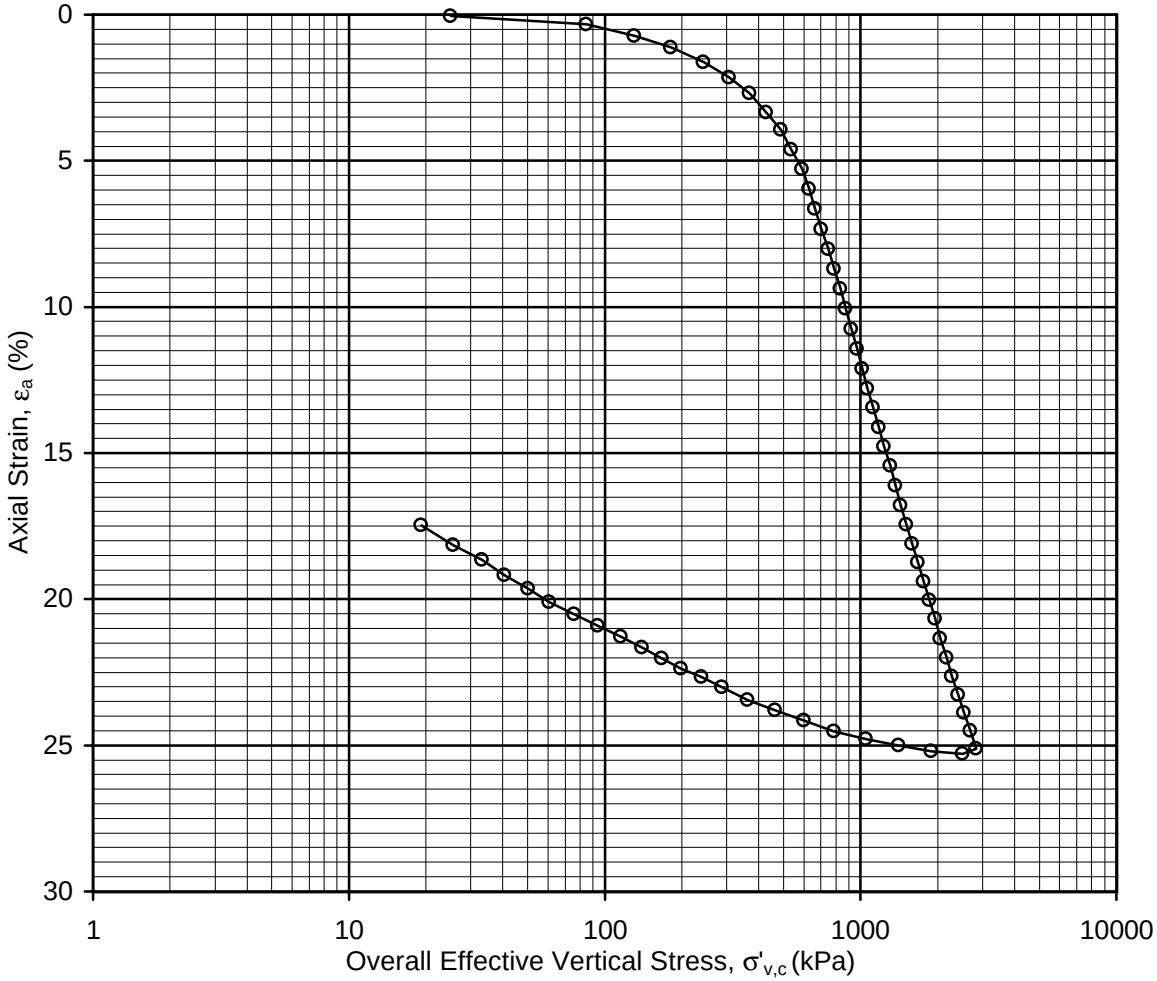


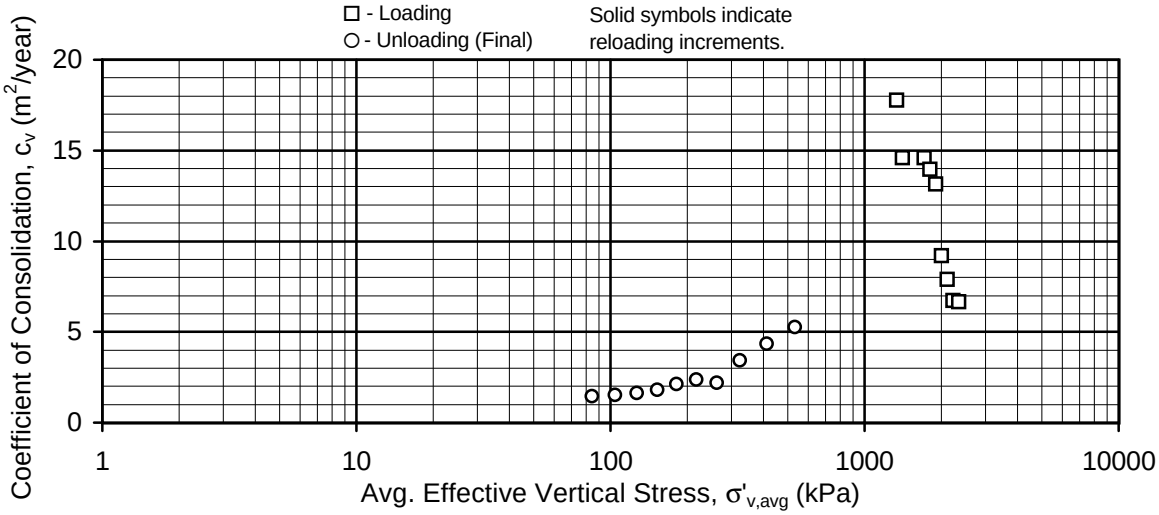


CRS CONSOLIDATION TEST RESULTS

Sample No. 43B (45° Loading) - Depth: 26.7m
Boring 98-26
SFOBB East Span Seismic Safety Project

PLATE 98-26.14d

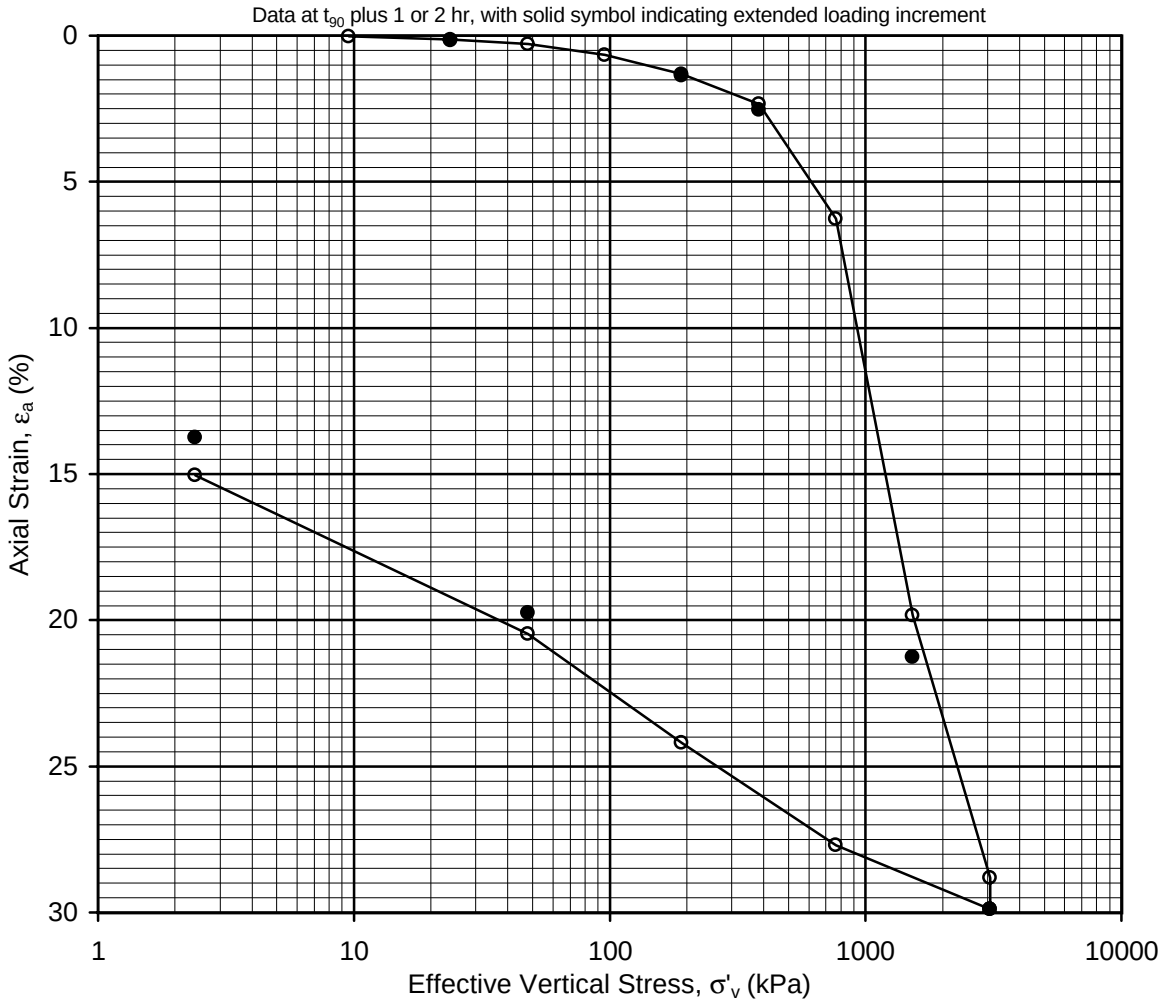


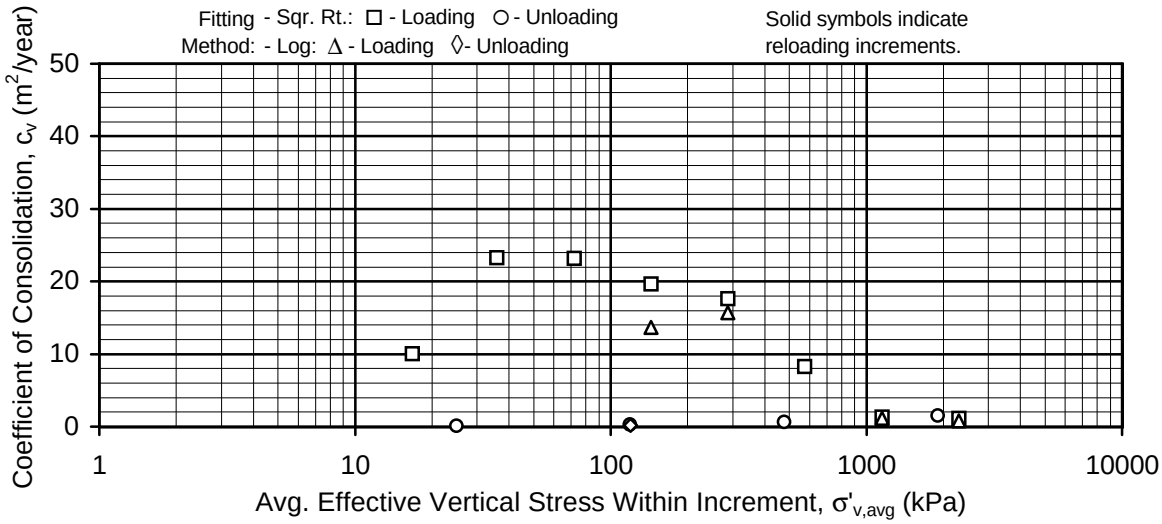


CRS CONSOLIDATION TEST RESULTS

Sample No. 43C (Horizontal Loading) - Depth: 26.7m
Boring 98-26
SFOBB East Span Seismic Safety Project

PLATE 98-26.14e

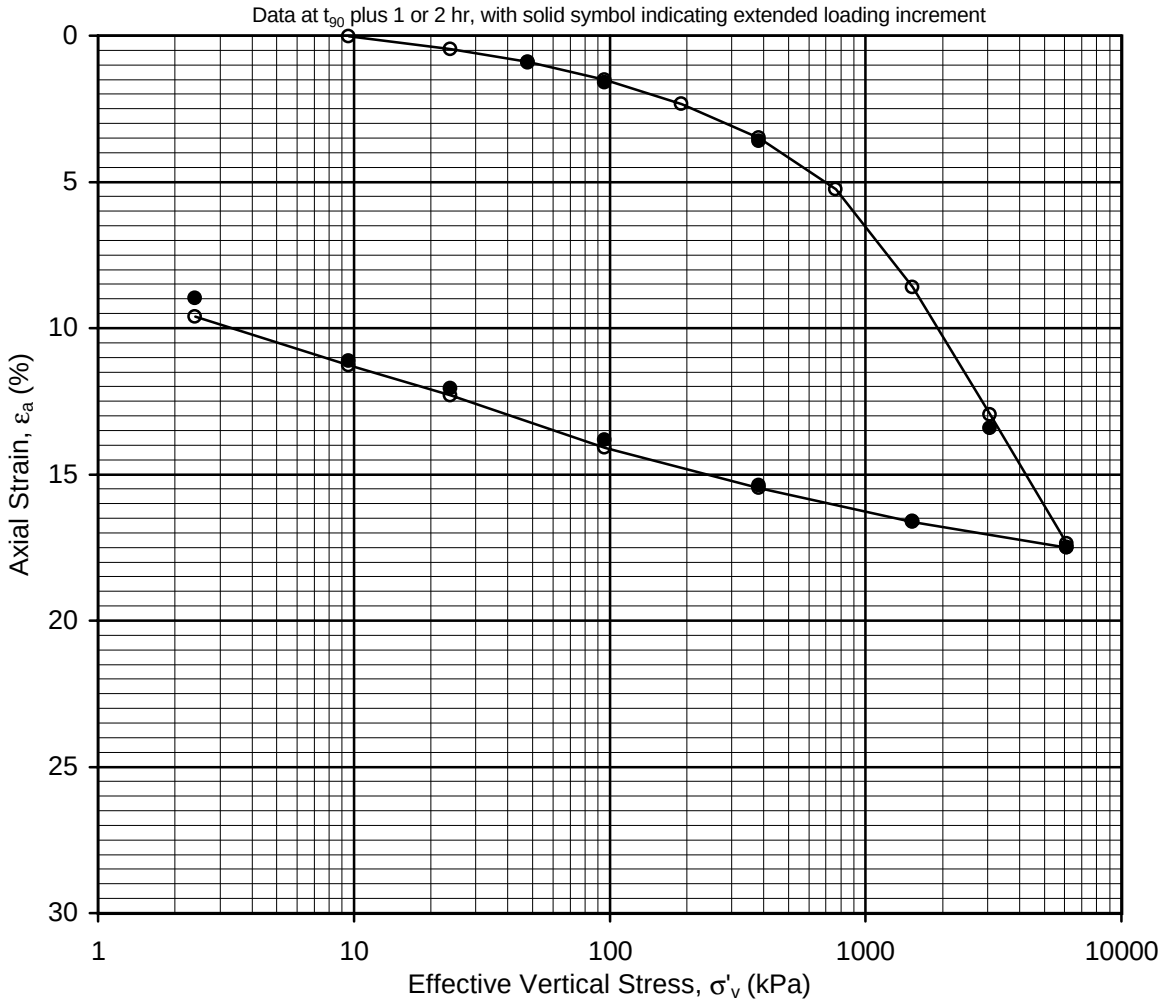


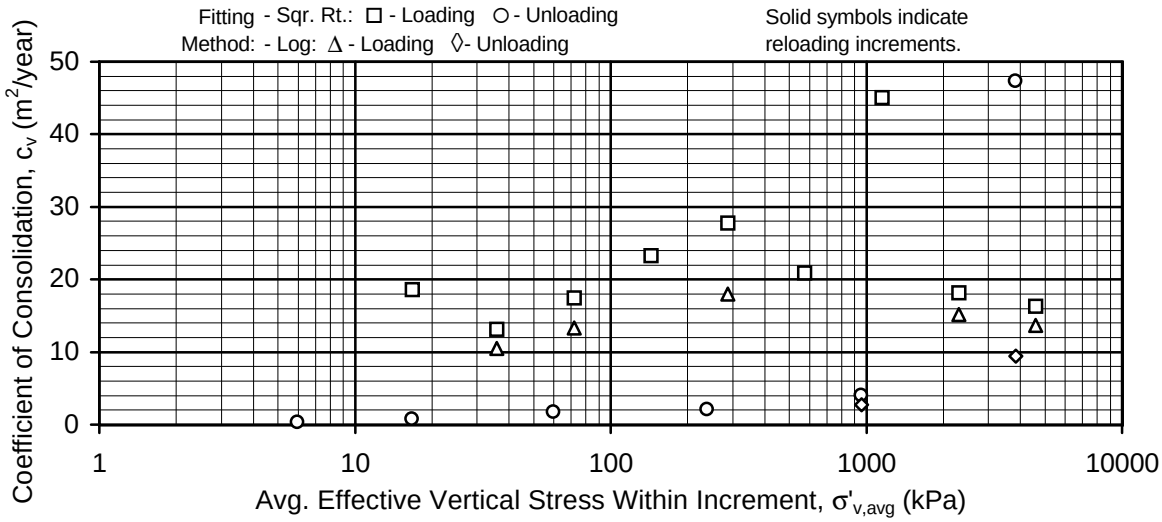


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 58 - Depth: 41.1m
Boring 98-26
SFOBB East Span Seismic Safety Project

PLATE 98-26.14f

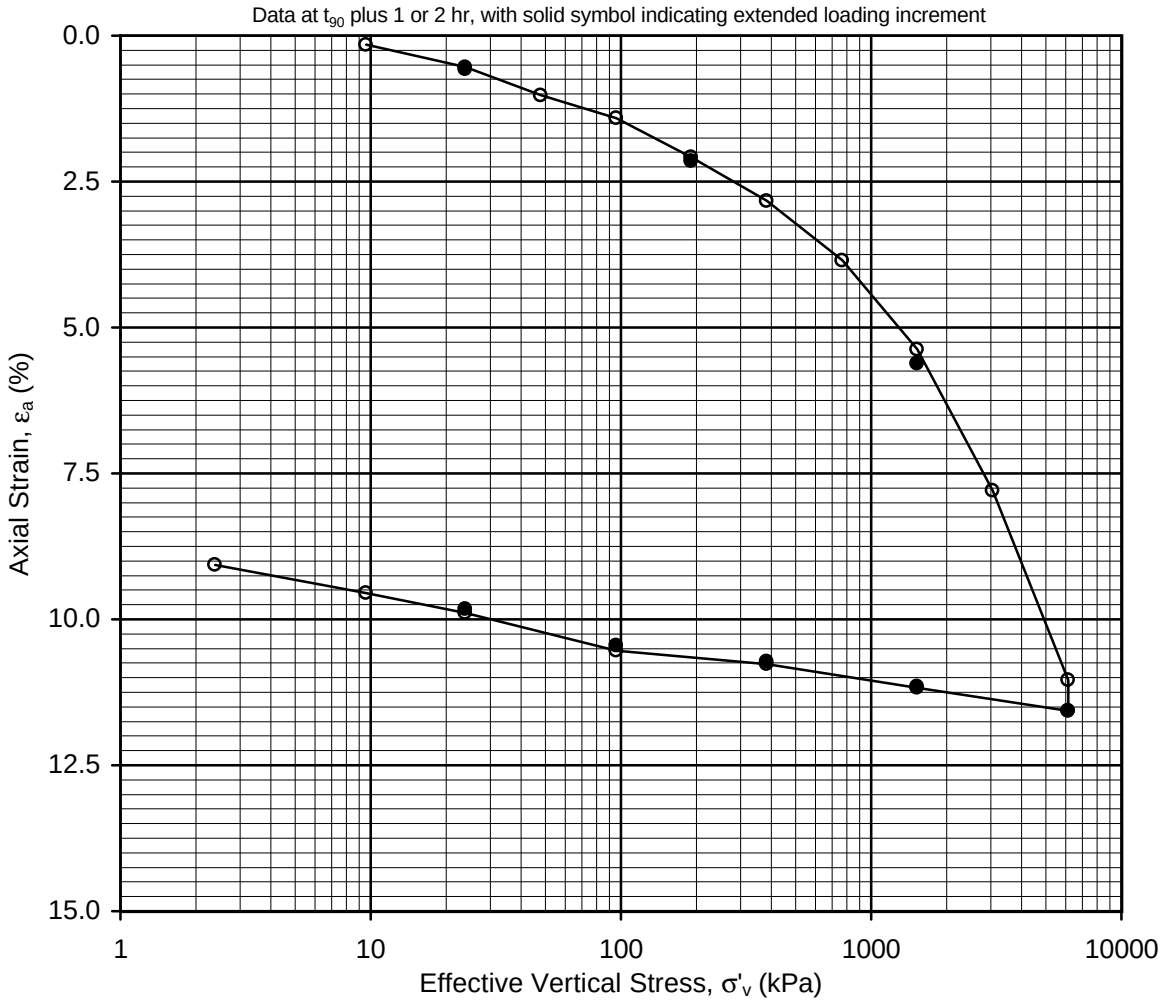


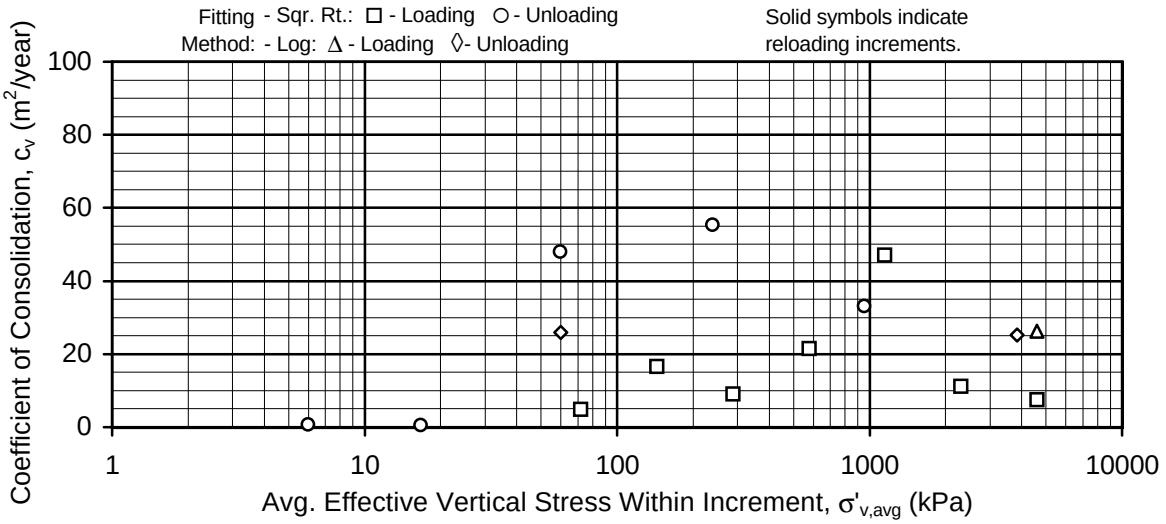


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No.69 - Depth: 56.3m
Boring 98-26
SFOBB East Span Seismic Safety Project

PLATE 98-26.14g

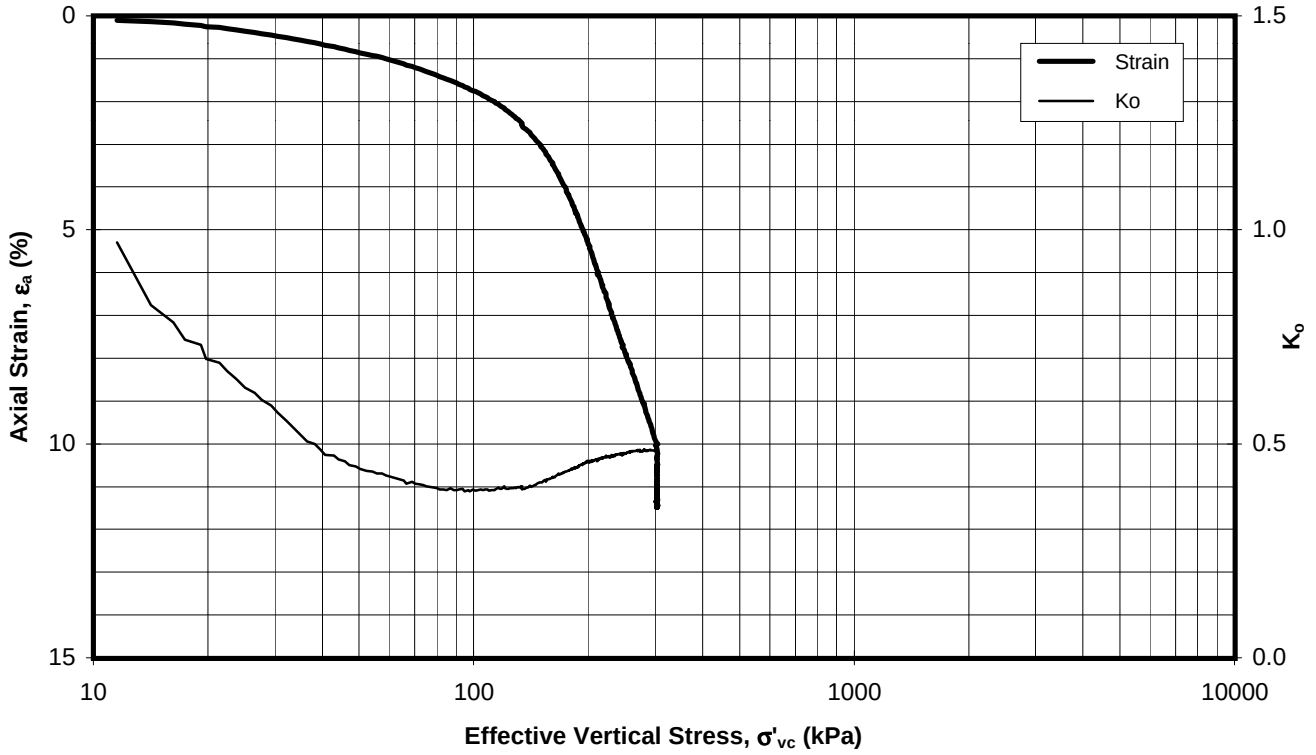


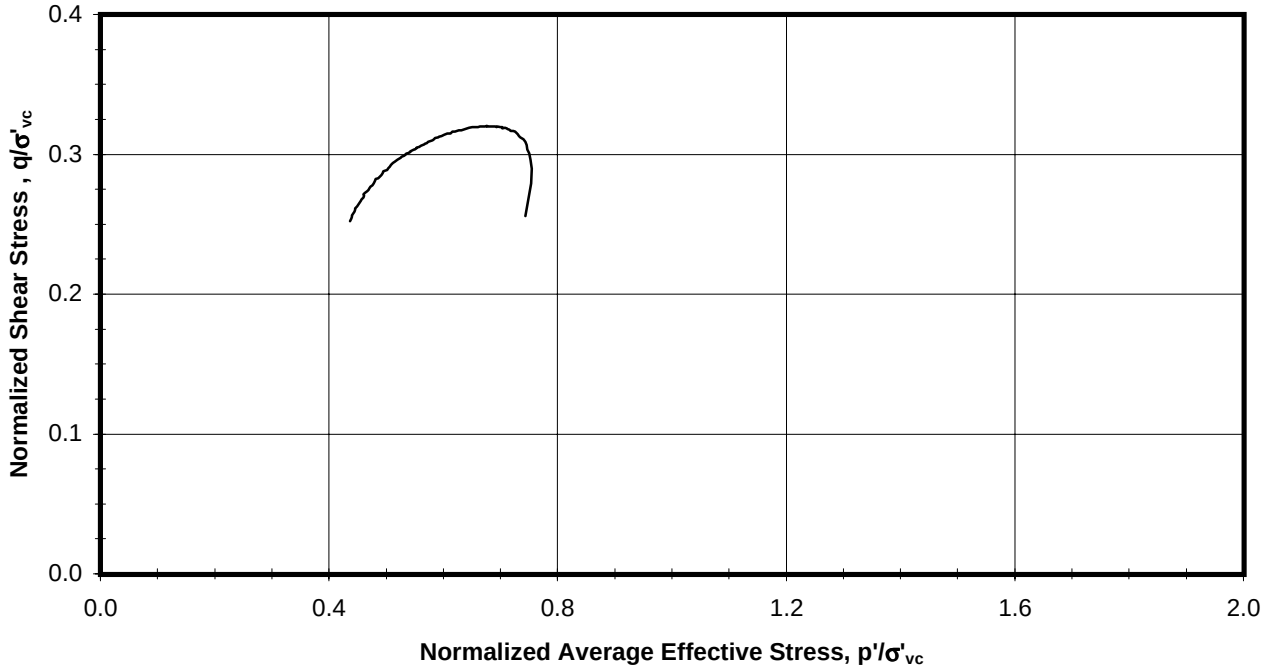


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 86 - Depth: 78.5m
Boring 98-26
SFOBB East Span Seismic Safety Project

PLATE 98-26.14h





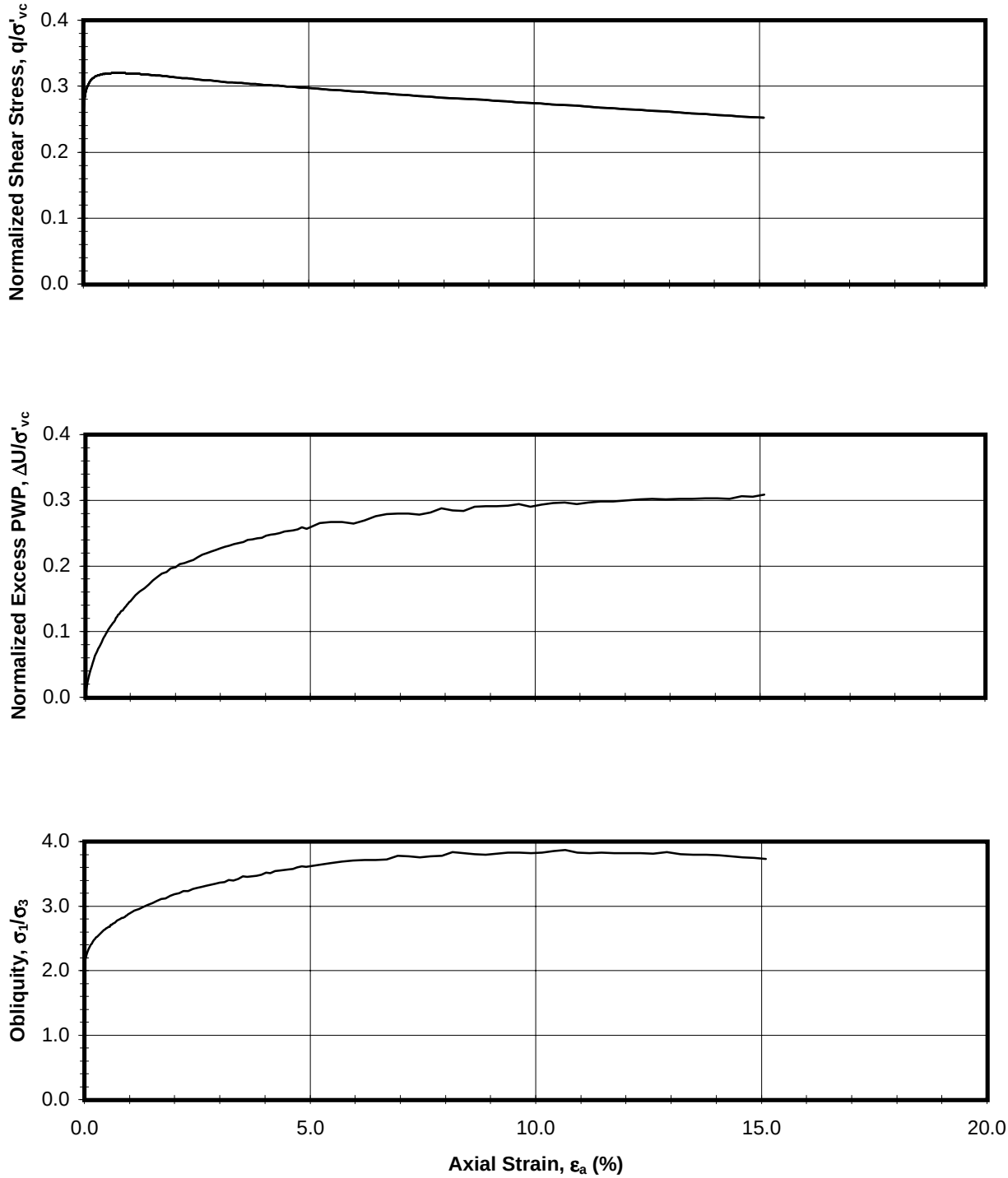
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 35 - Depth: 13.9m

Boring 98-26

SFOBB East Span Seismic Safety Project

PLATE 98-26.15a.1

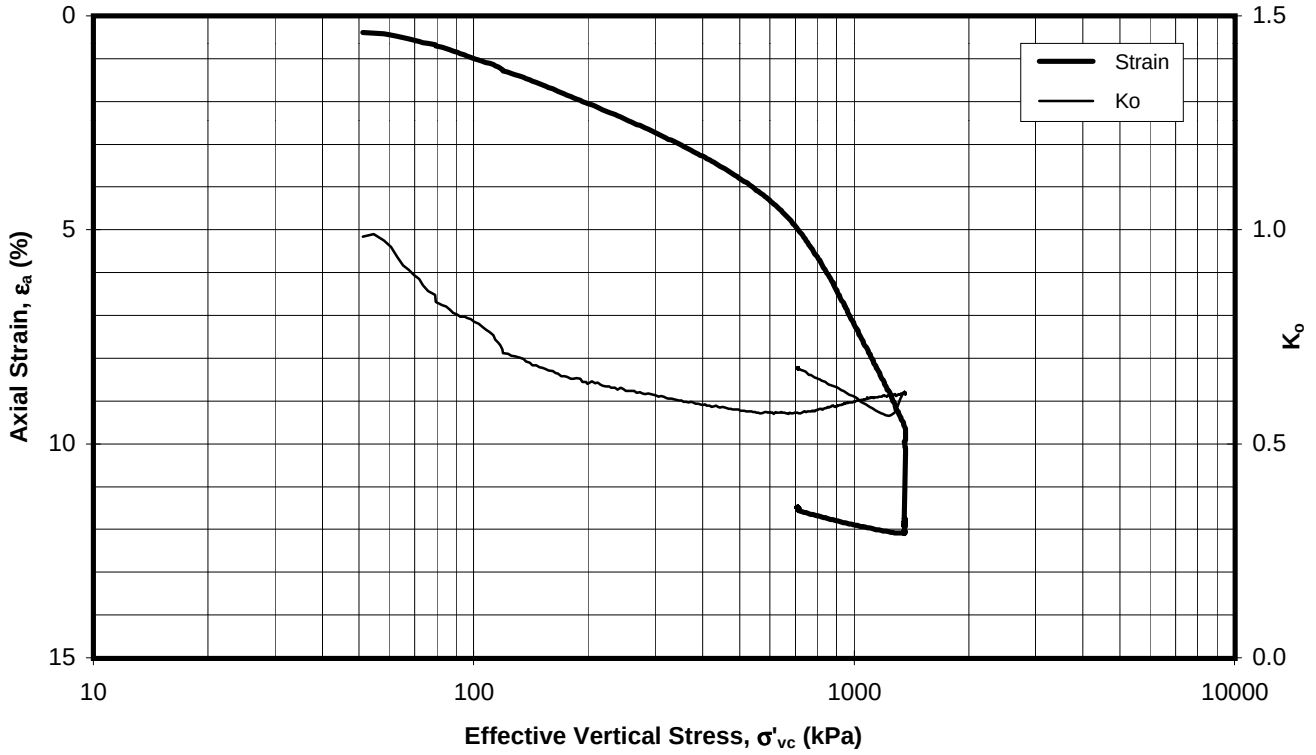


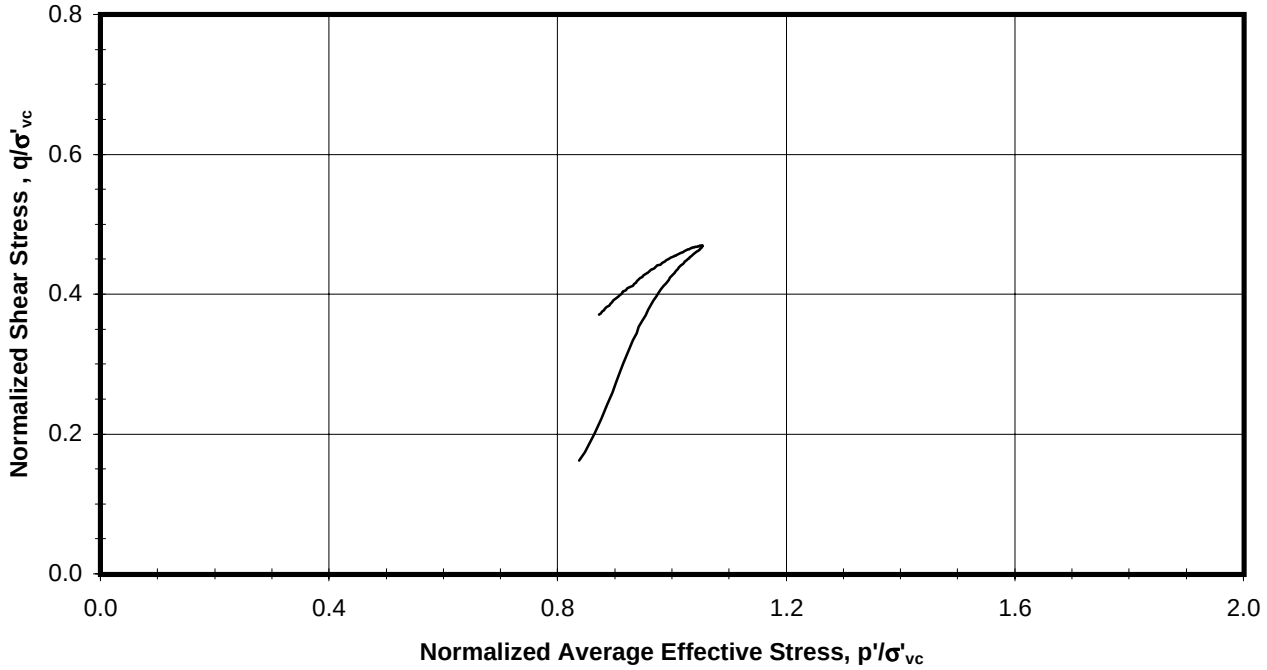
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 35 - Depth: 13.9m

Boring 98-26

SFOBB East Span Seismic Safety Project





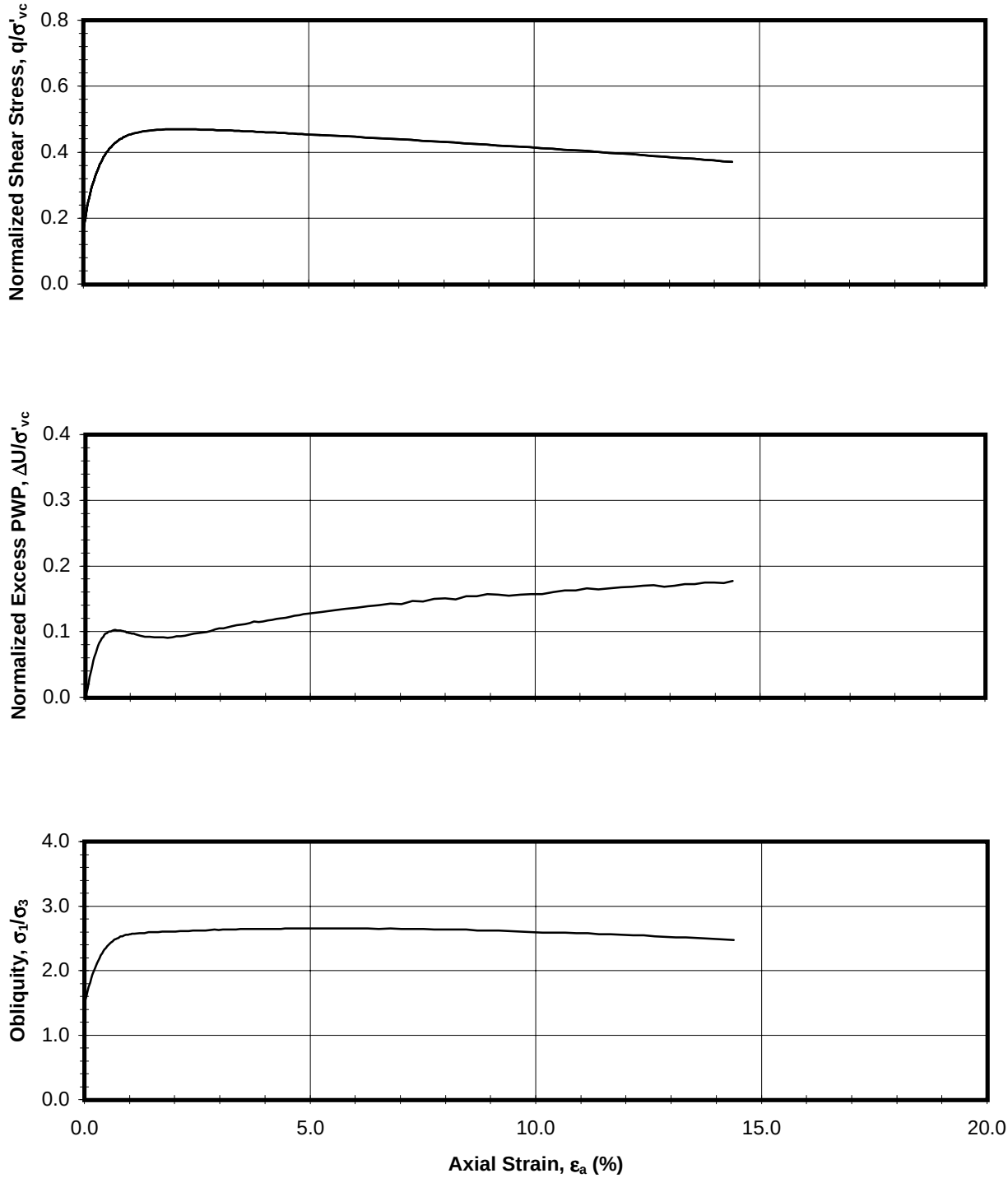
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 69 - Depth: 56.3m

Boring 98-26

SFOBB East Span Seismic Safety Project

PLATE 98-26.15b.1



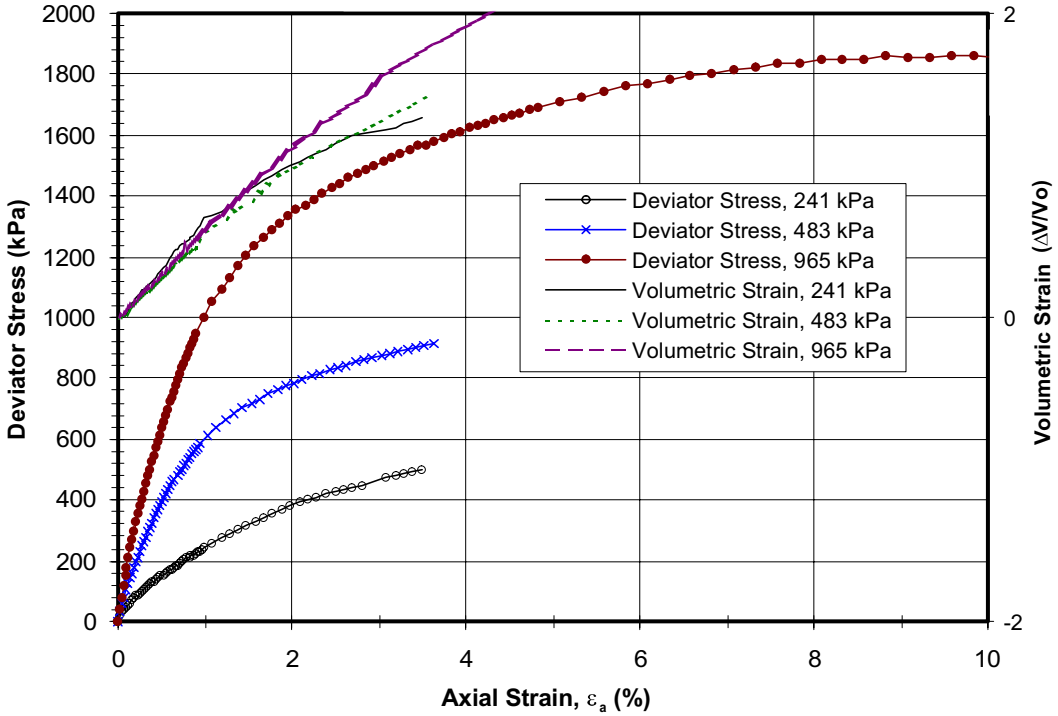
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

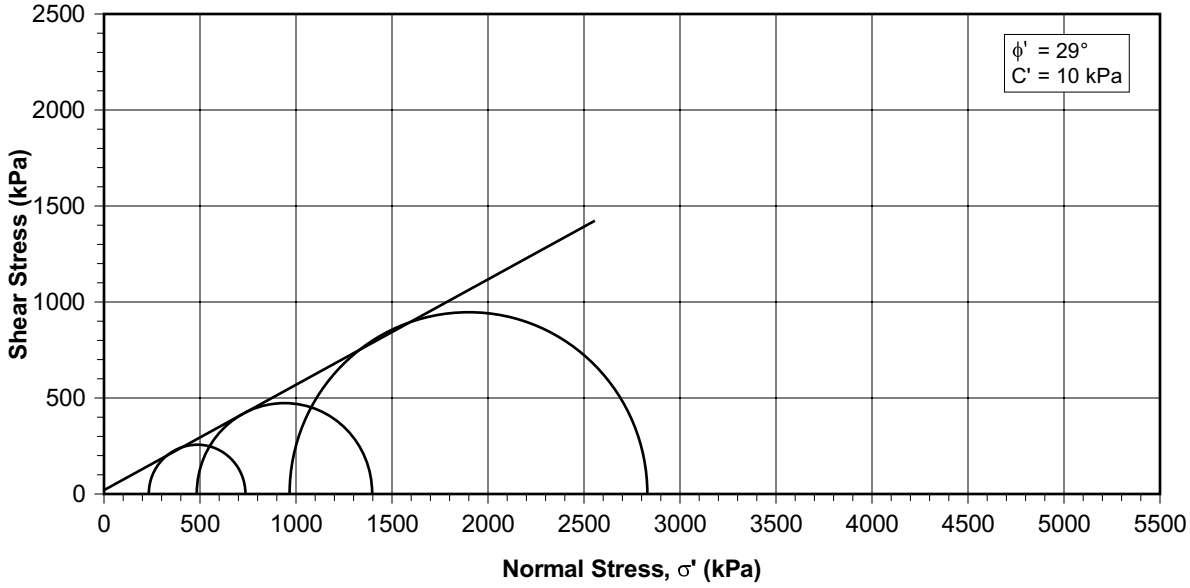
Sample No. 69 - Depth: 56.3m

Boring 98-26

SFOBB East Span Seismic Safety Project

PLATE 98-26.15b.2





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 74 - Depth: 64.0m

Boring 98-26

SFOBB East Span Seismic Safety Project

PLATE 98-26.16

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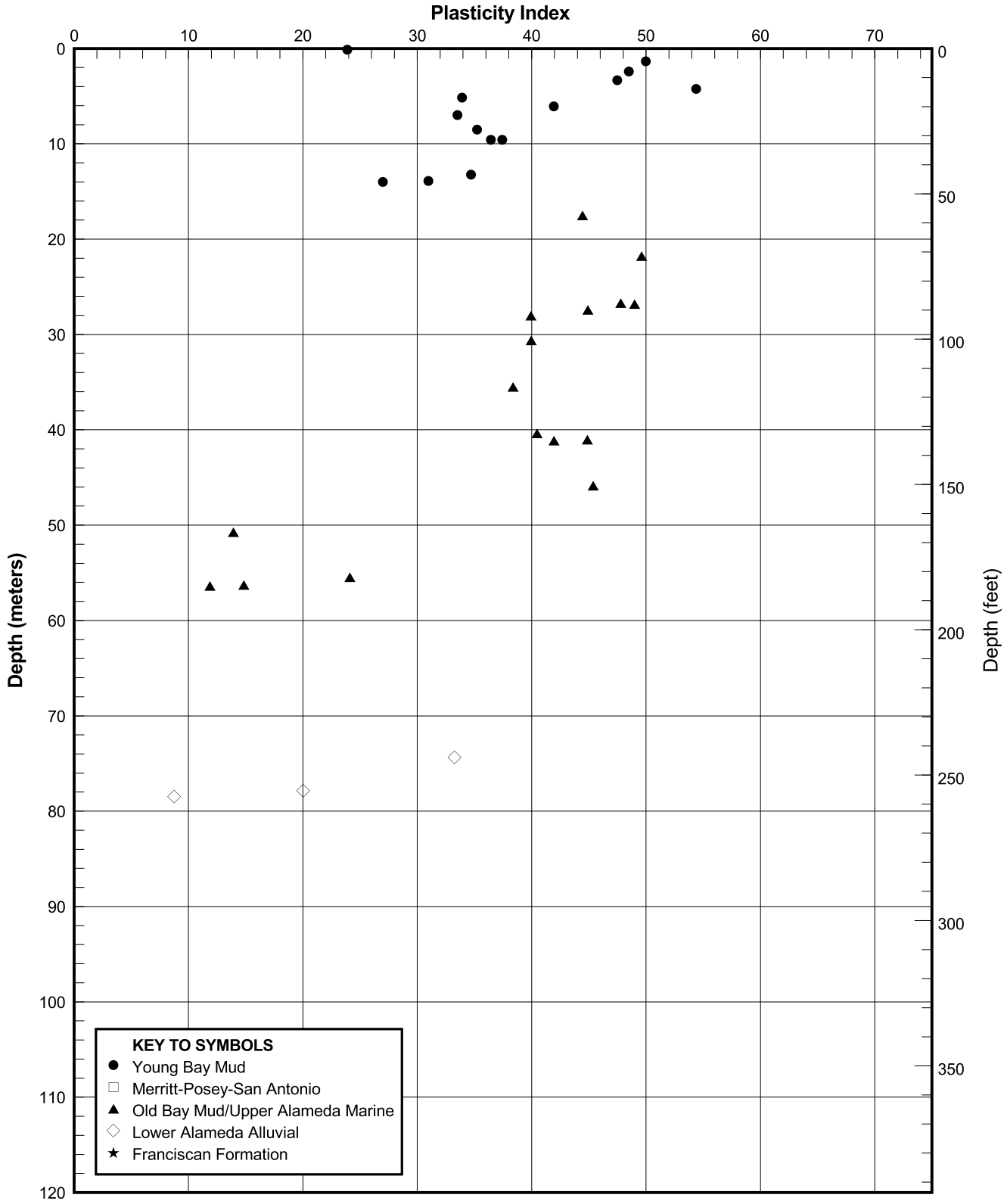
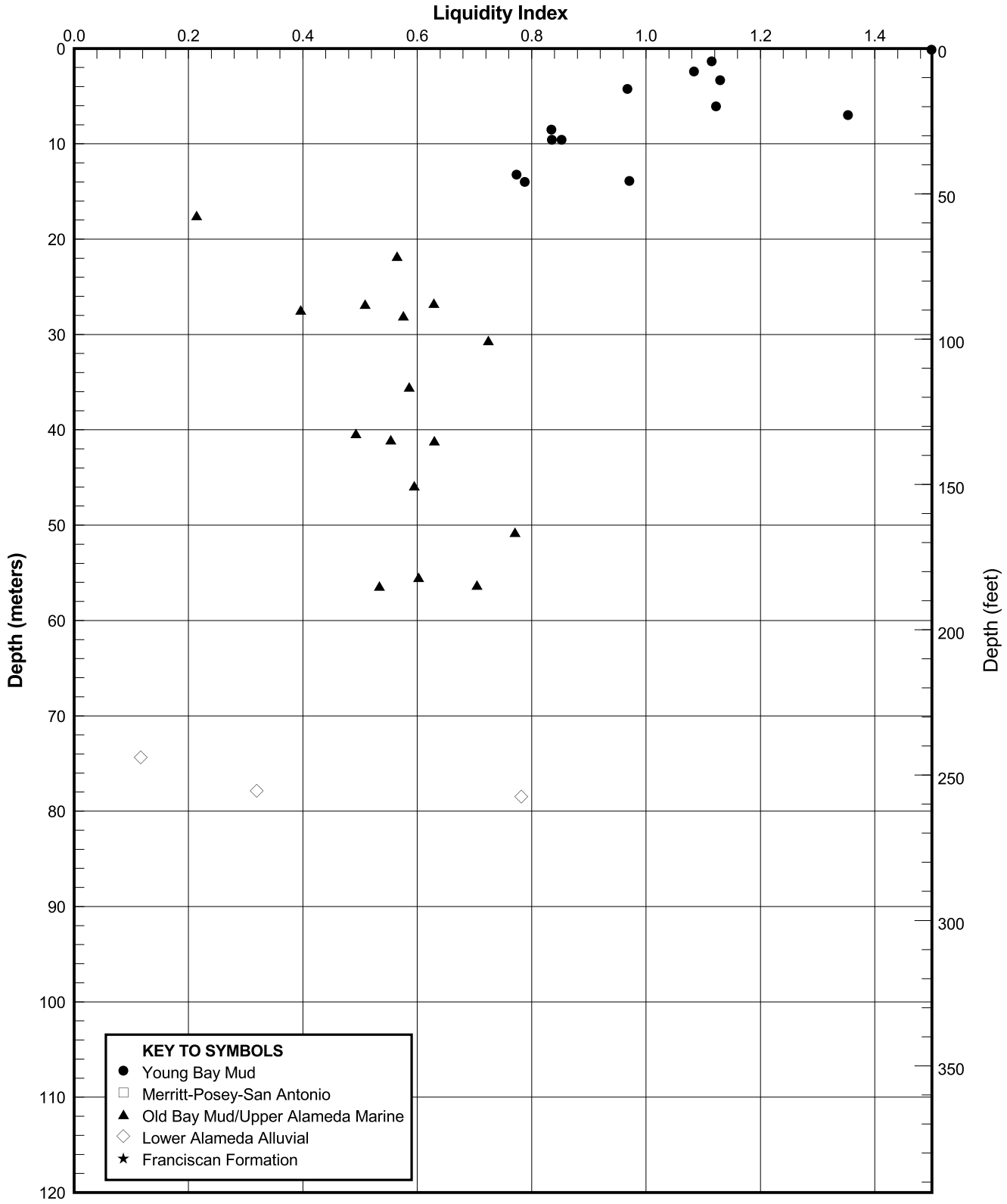
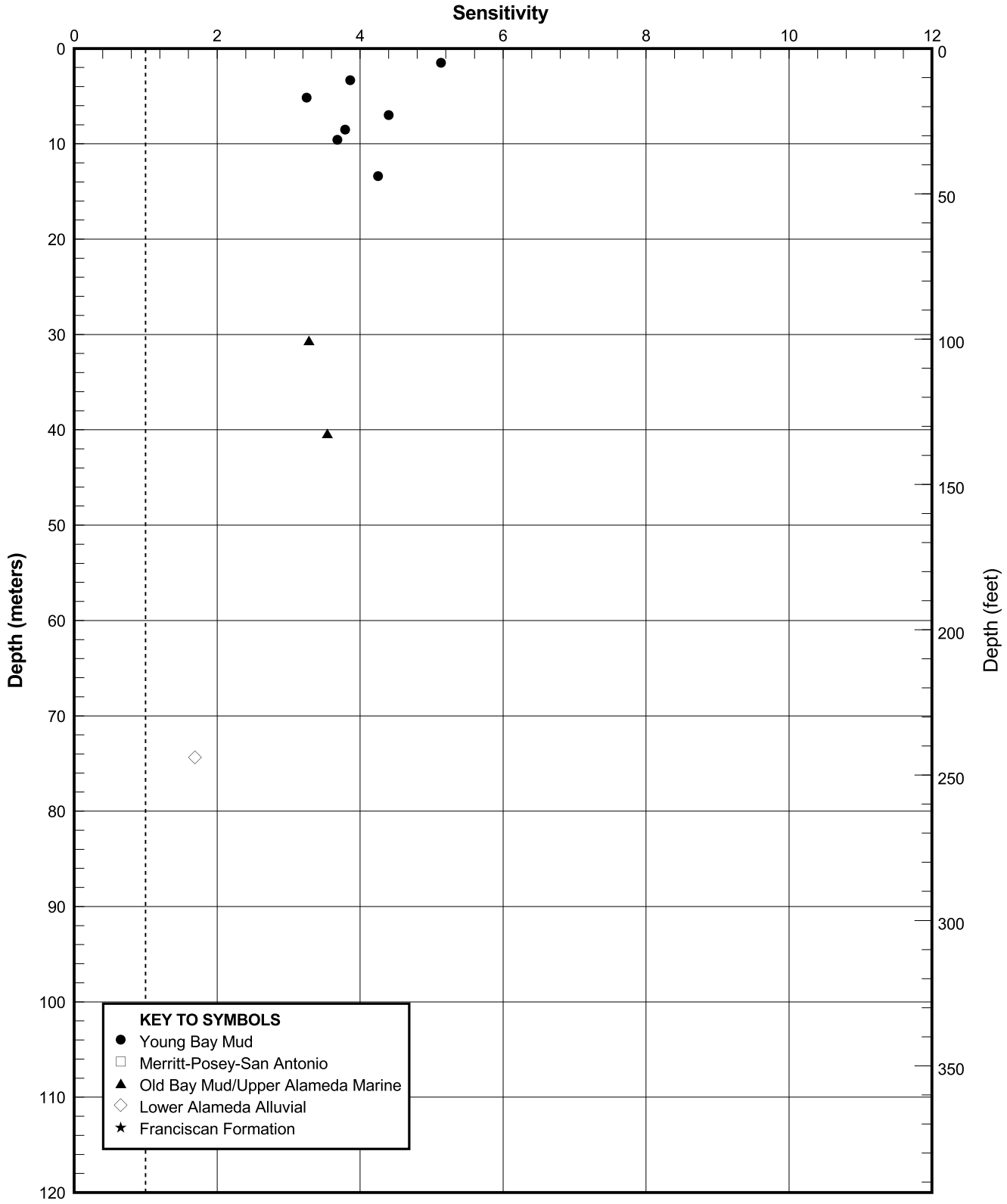


PLASTICITY INDEX PROFILE
Boring 98-26
SFOBB East Span Seismic Safety Project



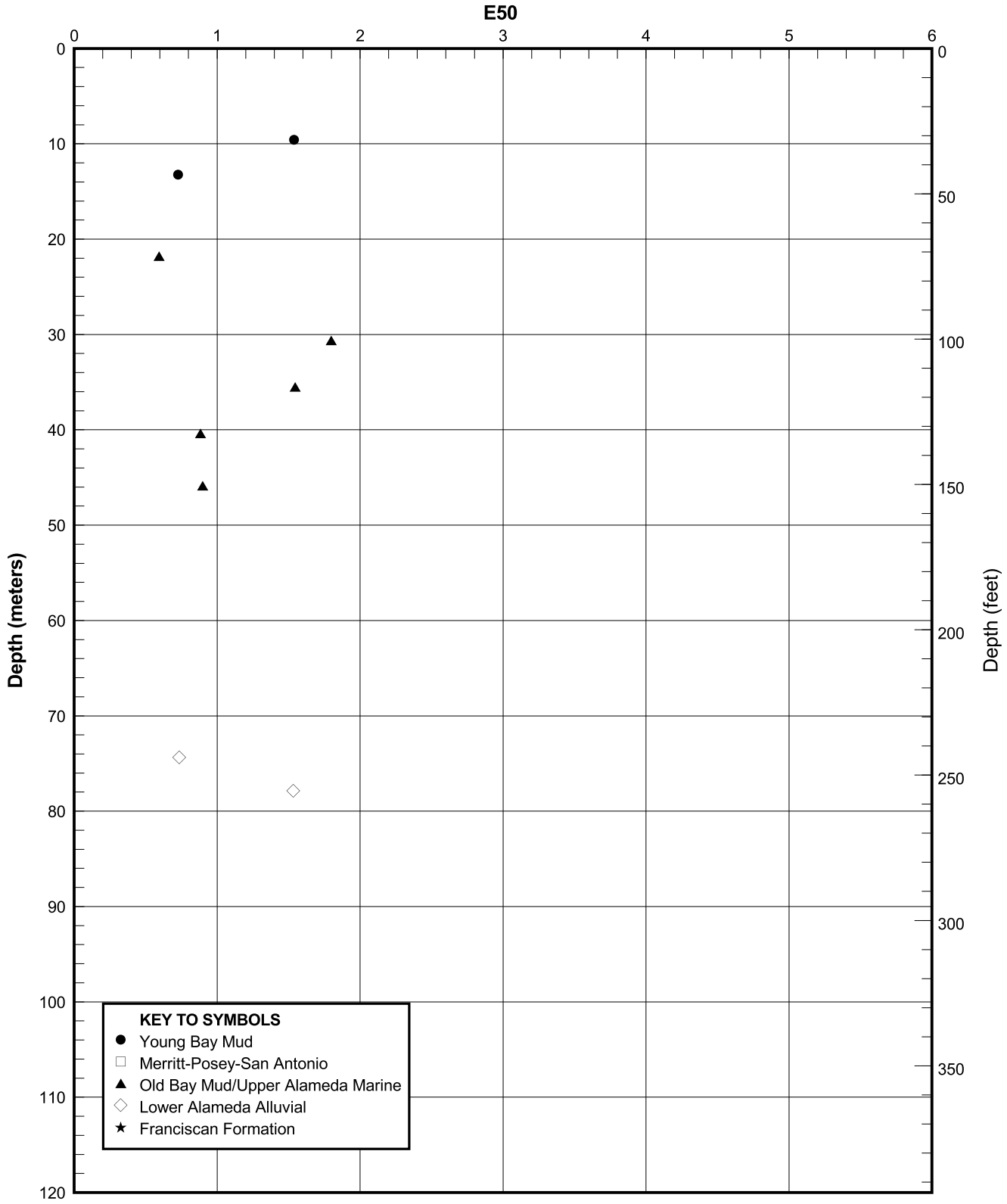
LIQUIDITY INDEX PROFILE
Boring 98-26
SFOBB East Span Seismic Safety Project

PLATE 98-26.18

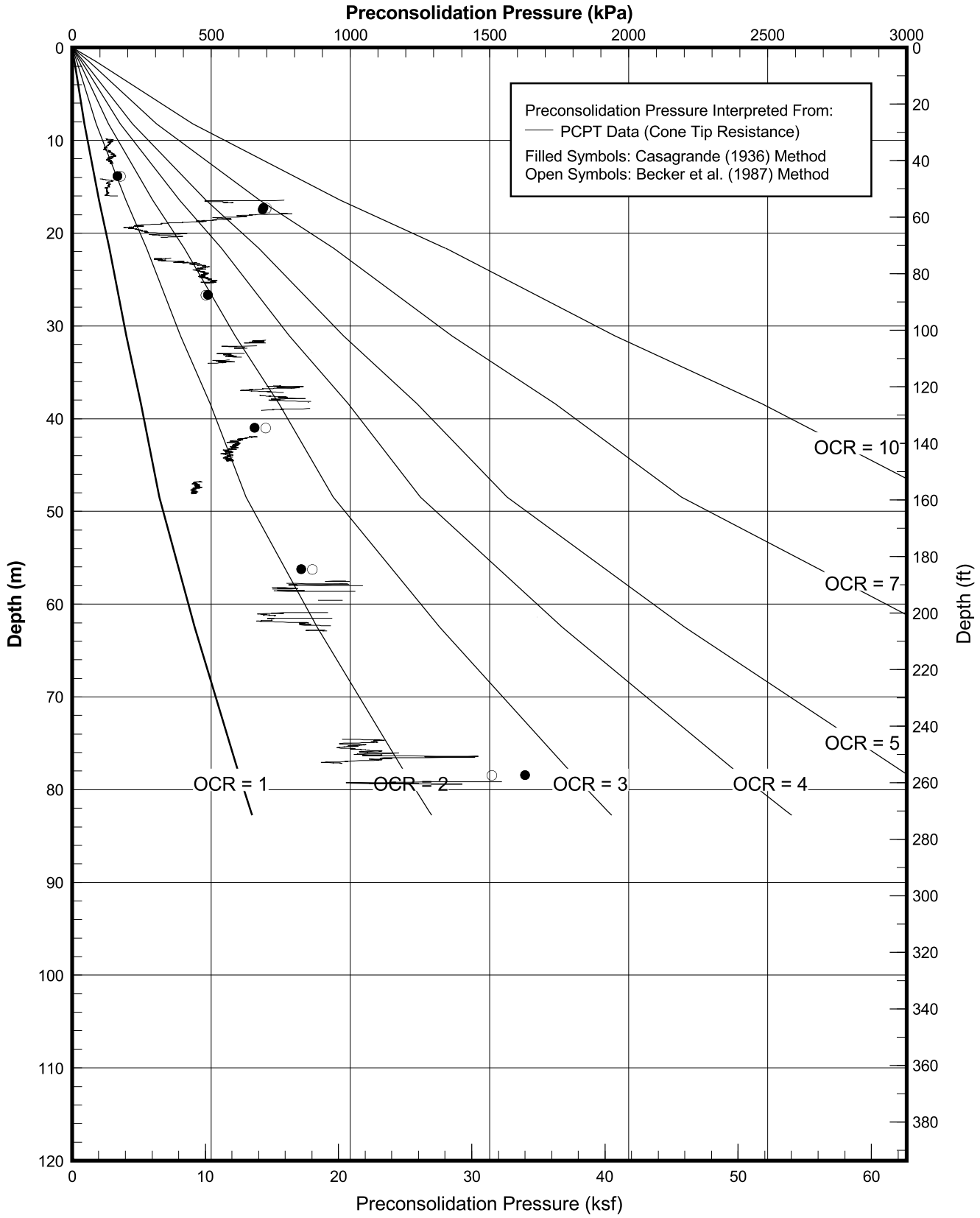


SENSITIVITY PROFILE
Boring 98-26
SFOBB East Span Seismic Safety Project

PLATE 98-26.19



E50 PROFILE
Boring 98-26
SFOBB East Span Seismic Safety Project

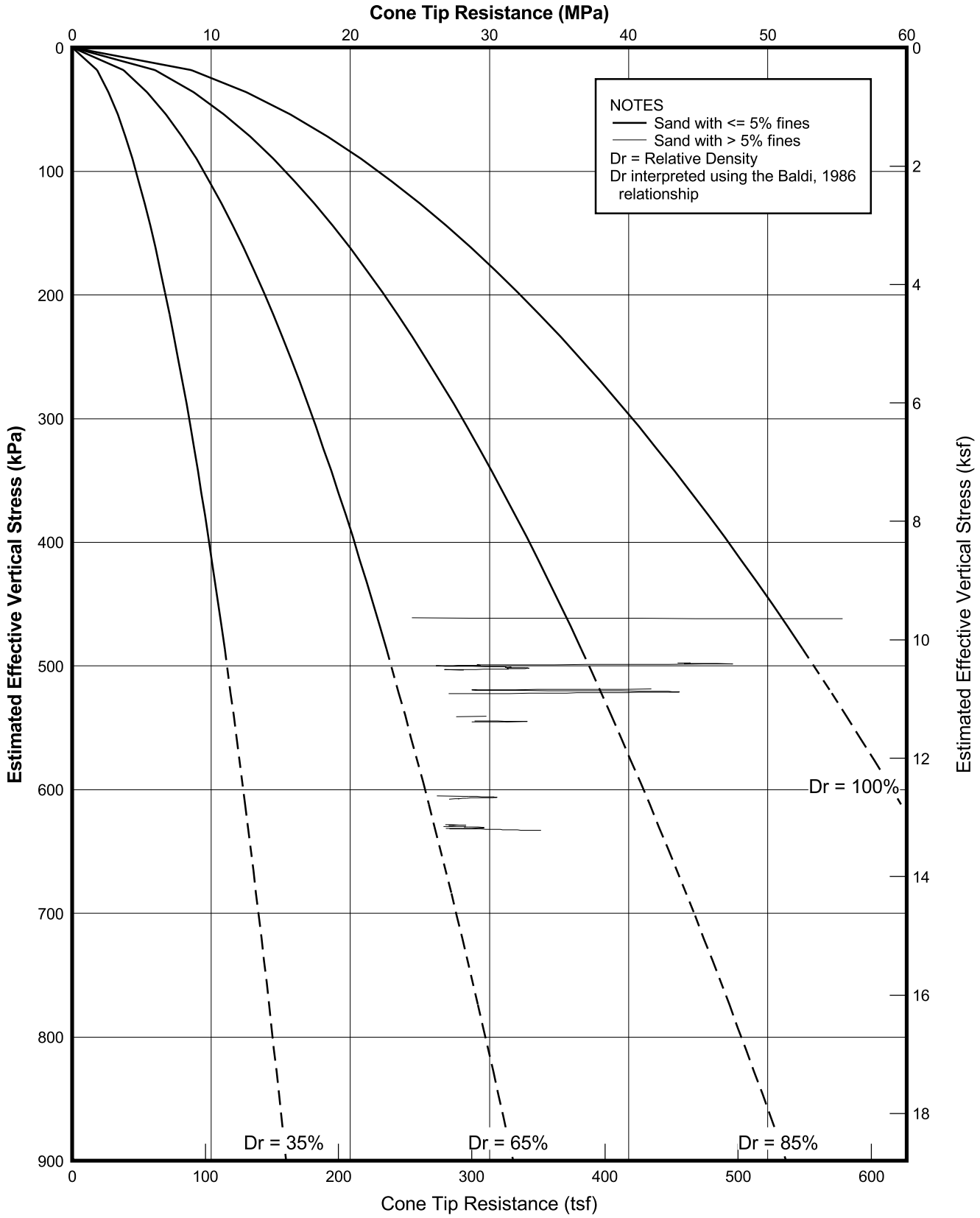


PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-26

SFOBB East Span Seismic Safety Project

PLATE 98-26.21



RELATIVE DENSITY INTERPRETED FROM CPT DATA

Boring 98-26

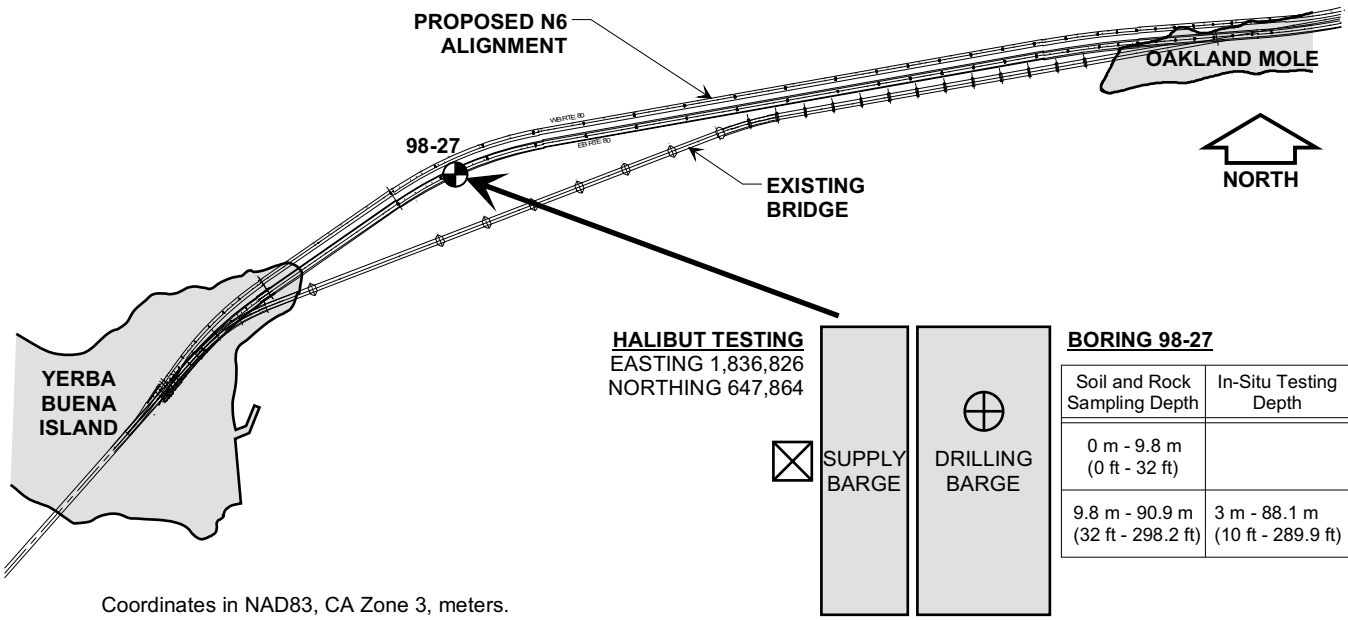
SFOBB East Span Seismic Safety Project

PLATE 98-26.22

BORING 98-27

Date	Time From	Time To	Description of Activity
October 3, 1998	0730	1200	Move barge to location 98-27 and set 4 anchors.
	1200	1300	Position barge at hole 98-27 and set 2 spuds.
	1300	1410	Rig up for drilling and Halibut testing. Lower drill pipe to mudline.
	1410	1420	Measure water depth of 12.7m (41.7 ft) using bottom sensor. Current tide level is approximately +0.1m (+0.3 ft) MSL. Calculate mudline elevation of –12.6m (-41.5 ft) MSL.
	1420	1600	Drill and sample from mudline to 9.8m (32 ft). Perform maintenance on mud pump.
	****	****	
	1430	1700	Halibut vane shear testing from 0.6m (2 ft) to 4.3m (14 ft).
	****	****	
	1600	2400	Pull drill pipe to deck. Reposition barge. Set casing.
October 4, 1998	0000	0200	Set casing.
	0200	2400	Sheared weld between ring gear and drive shaft. Remove gear and send broken flange to machine shop. Perform maintenance on rig.
October 5, 1998	0000	1800	Reassemble drive shaft.
	1800	2210	Set casing.
	2210	2400	Winch barge to restore plumb in casing string.
October 6, 1998	0000	1200	Drill, sample, CPT and remote vane shear testing from 3.0m (10 ft) to 52.1m (171 ft).
	1200	2400	Drill, sample and CPT testing from 52.1m (171 ft) to 89.3m (293 ft).
October 7, 1998	0000	0200	Drill and sample from 89.3m (293 ft) to 90.9m (298.2 ft).
	0200	0300	Pull drill pipe to deck.
	0300	0500	Perform P- and S-wave velocity logging from 86.2m (282.8 ft) to 7.5m (24.6 ft).
	0500	0900	Lower N-rod. Mix and circulate cement. Grout hole 98-27. Pull N-rod to deck.
	0900	1045	Pull casing to deck.
	1045	1435	Pull 2 spuds, 4 anchors, and move barge to location 98-24.

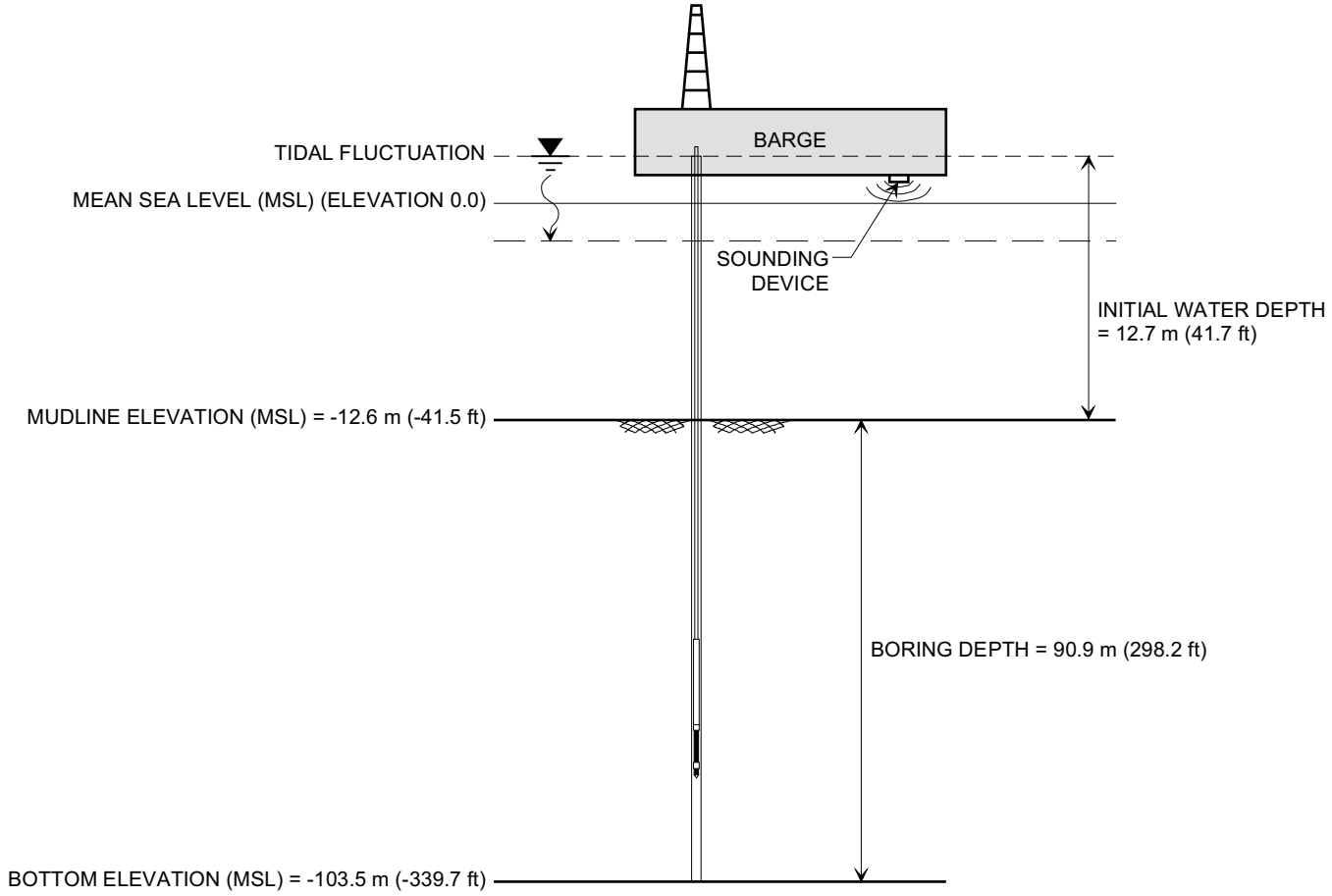
SUMMARY OF FIELD OPERATIONS
Boring 98-27
SFOBB East Span Seismic Safety Project



BORING 98-27

Soil and Rock Sampling Depth	In-Situ Testing Depth	Coordinates
0 m - 9.8 m (0 ft - 32 ft)		E = 1,836,849 N = 647,867
9.8 m - 90.9 m (32 ft - 298.2 ft)	3 m - 88.1 m (10 ft - 289.9 ft)	E = 1,836,837 N = 647,867

Coordinates in NAD83, CA Zone 3, meters.



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DEPTH AND LOCATION REFERENCE MAP
Boring 98-27
SFOBB East Span Seismic Safety Project

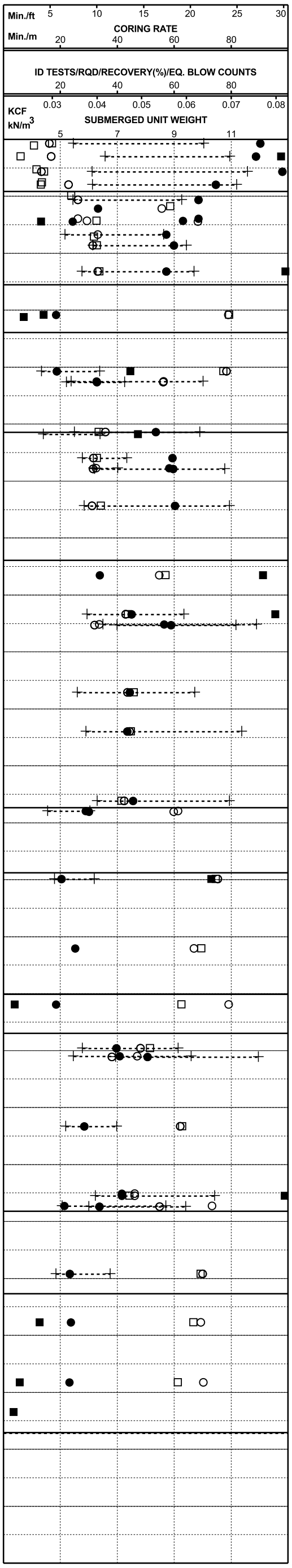
PROJECT NO:	98-42-0054	**START DATE:**	10/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-27 (Skyway Frame 1)	**COMPLETION DATE:**	10/7/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

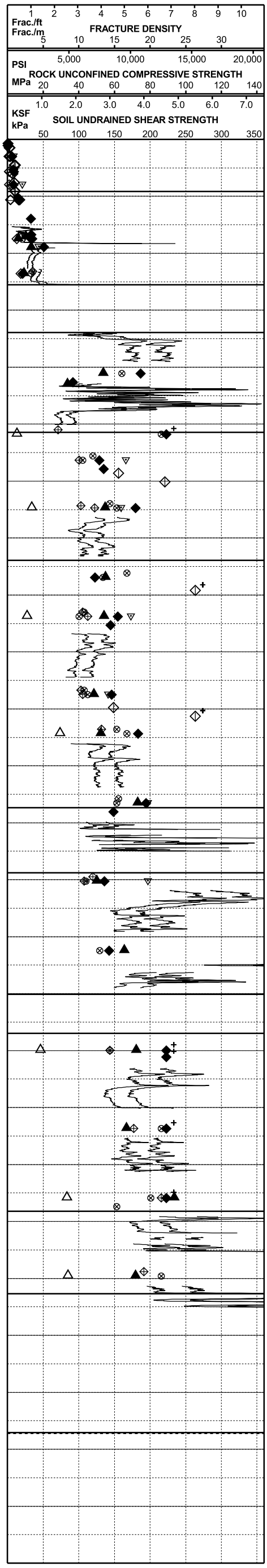
Coordinates: E1836837 N647867
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.6m (MSL)

Stratum No.	Material Description	Depth, m.	Blow Count
I	Fat CLAY (CH), very soft , gray to dark gray -with shell fragments to 7.0m -with a few silt pockets, 0.9m to 2.4m -with sand pockets below 2.7m (3.7m)	4	WOH, WOH, WOH, WOH, WOH, WOH
II	Fat CLAY (CH), soft to firm, gray -silty fine to medium sand, with clay pockets and seams, and shells, 4.6m to 5.2m -silty sand layer with clay seams, 5.6m to 6.1m -sand, 7.3m to 7.6m See Plate 98-27.6 for detailed stratigraphy (10.2m)	8	30/30cm, 17/60cm, PUSH, NR, PUSH
III	Silty Fine Sand (SM), dense to very dense, greenish gray (13.6m)	12	30/25cm
IV	Lean CLAY (CL), very stiff to hard, greenish gray -interlayered sand and clay below 15.8m -with a few organic matter pockets at 16.2m (20.6m)	16	PUSH, SAVE
V	Fat CLAY (CH), very stiff, olive gray -greenish gray to 23.2m -with many sand pockets and partings, and with many organic pockets, to 20.6m -sandy clay with black stains, at 20.7m -with a few shell fragments below 21.9m -sand below 29.3m (29.6m)	20	PUSH
		24	PUSH, SAVE, PUSH
		28	
VI	Fat CLAY (CH), very stiff, gray -greenish gray lean clay with many silt pockets, to 31.7m -with many organic pockets at 34.1m -greenish gray with many silt pockets, at 41.5m -with a silt layer at 43.6m -with silt pockets at 46.3m (46.9m)	32	PUSH, PUSH, SAVE
		36	
		40	PUSH, PUSH
		44	
		48	PUSH, PUSH
VII	Interlayered CLAY (CL), very stiff, and SAND (SP), dense, gray (51.5m)		
VIII	Lean CLAY (CH), hard, gray -with many sandy silt pockets and with organic pockets, at 52.1m -greenish gray, with many silt pockets, partings, and seams, and with gas blisters, at 56.7m -sand with clay layers, 57.6m to 58.5m (60.0m)	52	PUSH
		56	PUSH
IX	Fine SAND (SP) with gravel, dense to very dense, gray -with medium to coarse sand (62.8m)	60	PUSH
X	Fat CLAY (CH), very stiff to hard, gray -with light brown desiccated seams (inclined at 30 degrees), and with sand partings and silt pockets, at 63.7m -with many organic pockets at 64.3m -with a silt layer at 66.4m -with silt partings and seams, 68.9m to 72.5m -with organic matter pockets, below 68.9m -with wood fragments at 73.8m (75.3m)	64	PUSH, SAVE
		68	PUSH
		72	PUSH, SAVE
XI	Lean CLAY (CL), hard, dark greenish gray -silt, 76.8m to 77.1m -silt, 77.3m to 77.6m -with a sand layer at 78.0m -dark greenish gray at 79.6m (81.1m)	76	
		80	PUSH
XII	SAND (SP), dense to very dense, gray -silty fine sand to 82.9m -clay layer, 81.4m to 81.7m -clay layer, 81.8m to 82.1m -medium to coarse sand with gravel, at 85.6m -fine sand with silt at 87.2m -fine to coarse gravel with medium sand and a trace of coarse sand, at 89.3m (90.8m)	84	30/25cm, 30/15cm, 30/25cm, 30/10cm, 30/5cm
		88	
XIII	CLAYSTONE (RX), dark gray, intensely weathered	92	

TOTAL DEPTH: 90.9m BACKFILLED WITH: Cement Grout





CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-27

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

FUGRO

PROJECT NO:	98-42-0054	**START DATE:**	10/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-27 (Skyway Frame 1)	**COMPLETION DATE:**	10/7/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836837 N647867
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.6m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH, WOH, WOH, WOH, WOH, WOH, 30/30cm, 17/60cm, PUSH, NR, PUSH	Fat CLAY (CH), very soft , gray to dark gray (3.7m)	I
-16, -20	4, 8		Fat CLAY (CH), soft to firm, gray -silty fine to medium sand, with clay pockets and seams, and shells, 4.6m to 5.2m -silty sand layer with clay seams, 5.6m to 6.1m -sand, 7.3m to 7.6m (10.2m)	II
-24	12	30/25cm	Silty Fine Sand (SM), dense to very dense, greenish gray (13.6m)	III
-28, -32	16, 20	PUSH, SAVE, PUSH	Lean CLAY (CL), very stiff to hard, greenish gray -interlayered sand and clay below 15.8m -with a few organic matter pockets at 16.2m See Plate 98-27.6 for detailed stratigraphy (20.6m)	IV
-36, -40	24, 28	PUSH, SAVE, PUSH, PUSH	Fat CLAY (CH), very stiff, olive gray -greenish gray to 23.2m -with many sand pockets and partings, and with many organic pockets, to 20.6m -sandy clay with black stains, at 20.7m -with a few shell fragments below 21.9m -sand below 29.3m (29.6m)	V
-44, -48, -52, -56	32, 36, 40, 44	PUSH, SAVE, PUSH, PUSH, PUSH, PUSH	Fat CLAY (CH), very stiff, gray -greenish gray lean clay with many silt pockets, to 31.7m -with many organic pockets at 34.1m -greenish gray with many silt pockets, at 41.5m -with a silt layer at 43.6m -with silt pockets at 46.3m (46.9m)	VI
-60	48		Interlayered CLAY (CL), very stiff, and SAND (SP), dense, gray (51.5m)	VII
-64, -68, -72	52, 56, 60	PUSH, PUSH, PUSH	Lean CLAY (CH), hard, gray -with many sandy silt pockets and with organic pockets, at 52.1m -greenish gray, with many silt pockets, partings, and seams, and with gas blisters, at 56.7m -sand with clay layers, 57.6m to 58.5m (60.0m) Fine SAND (SP) with gravel, dense to very dense, gray -with medium to coarse sand (62.8m)	VIII IX
-76, -80, -84	64, 68, 72	PUSH SAVE, PUSH, PUSH SAVE	Fat CLAY (CH), very stiff to hard, gray -with light brown desiccated seams (inclined at 30 degrees), and with sand partings and silt pockets, at 63.7m -with many organic pockets at 64.3m -with a silt layer at 66.4m -with silt partings and seams, 68.9m to 72.5m -with organic matter pockets, below 68.9m -with wood fragments at 73.8m (75.3m)	X
-88, -92	76, 80	PUSH	Lean CLAY (CL), hard, dark greenish gray -silt, 76.8m to 77.1m -silt, 77.3m to 77.6m -with a sand layer at 78.0m -dark greenish gray at 79.6m (81.1m)	XI
-96, -100	84, 88	30/25cm, 30/15cm, 30/25cm, 30/10cm, 30/5cm	SAND (SP), dense to very dense, gray -silty fine sand to 82.9m -clay layer, 81.4m to 81.7m -clay layer, 81.8m to 82.1m -medium to coarse sand with gravel, at 85.6m -fine sand with silt at 87.2m -fine to coarse gravel with medium sand and a trace of coarse sand, at 89.3m (90.8m)	XII XIII
-104, -108, -112	92, 96		CLAYSTONE (RX), dark gray, intensely weathered TOTAL DEPTH: 90.9m BACKFILLED WITH: Cement Grout	

LOG OF BORING AND TEST RESULTS

BORING 98-27

SFOBB East Span Seismic Safety Project

Report Date: 05/03/99

FUGRO

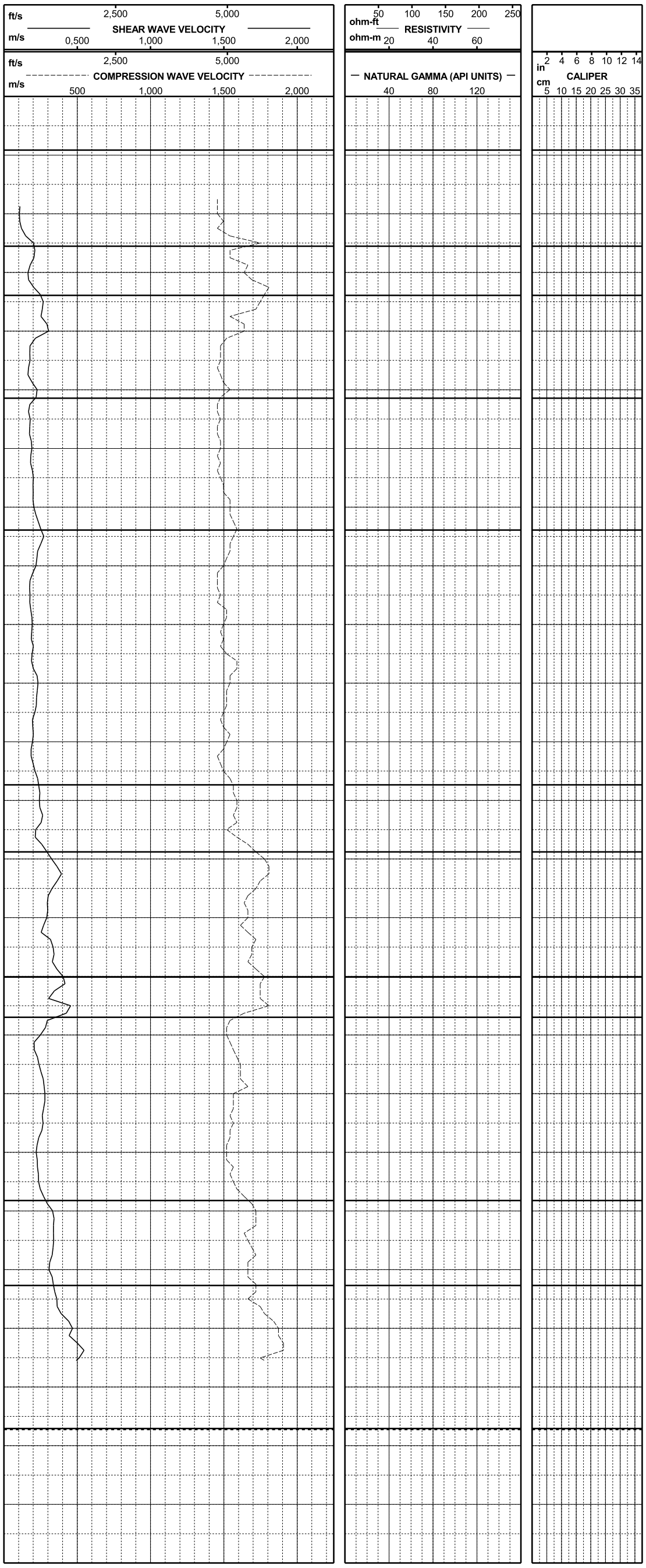
PLATE 98-27.4

PROJECT NO:	98-42-0054	**START DATE:**	10/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-27 (Skyway Frame 1)	**COMPLETION DATE:**	10/7/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836837 N647867
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.6m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
		WOH, WOH, WOH, WOH, WOH, WOH	Fat CLAY (CH), very soft , gray to dark gray (3.7m)	I
-16	4	30/30cm, 17/60cm, PUSH	Fat CLAY (CH), soft to firm, gray -silty fine to medium sand, with clay pockets and seams, and shells, 4.6m to 5.2m -silty sand layer with clay seams, 5.6m to 6.1m -sand, 7.3m to 7.6m -with mica at 7.6m (10.2m)	II
-20	8	NR, PUSH		
-24	12	30/25cm	Silty Fine Sand (SM), dense to very dense, greenish gray (13.6m)	III
-28	16	PUSH, SAVE	Lean CLAY (CL), very stiff to hard, greenish gray See Plate 98-27.6 for detailed stratigraphy (20.6m)	IV
-32	20	PUSH		
-36	24	PUSH, SAVE, PUSH	Fat CLAY (CH), very stiff, olive gray -sand below 29.3m (29.6m)	V
-40	28			
-44	32	PUSH, PUSH, SAVE	Fat CLAY (CH), very stiff, gray -with many organic pockets at 34.1m	VI
-48	36			
-52	40	PUSH, PUSH	-greenish gray with many silt pockets, at 41.5m	
-56	44	PUSH, PUSH	-with a silt layer at 43.6m -with silt pockets at 46.3m (46.9m)	
-60	48		Interlayered CLAY (CL), very stiff, and SAND (SP), dense, gray (51.5m)	VII
-64	52	PUSH	Lean CLAY (CH), hard, gray -with many sandy silt pockets and with organic pockets, at 52.1m	VIII
-68	56	PUSH	-greenish gray, with many silt pockets, partings, and seams, and with gas blisters, at 56.7m -sand with clay layers, 57.6m to 58.5m (60.0m)	
-72	60	PUSH	Fine SAND (SP) with gravel, dense to very dense, gray -with medium to coarse sand (62.8m)	IX
-76	64	PUSH, SAVE	Fat CLAY (CH), very stiff to hard, gray -with light brown desiccated seams (inclined at 30 degrees), and with sand partings and silt pockets, at 63.7m -with many organic pockets at 64.3m -with a silt layer at 66.4m	X
-80	68	PUSH	-with silt partings and seams, 68.9m to 72.5m -with organic matter pockets, below 68.9m	
-84	72	PUSH, SAVE	-with wood fragments at 73.8m (75.3m)	
-88	76		Lean CLAY (CL), hard, dark greenish gray -silt, 76.8m to 77.1m -silt, 77.3m to 77.6m -with a sand layer at 78.0m	XI
-92	80	PUSH	-dark greenish gray at 79.6m (81.1m)	
-96	84	30/25cm, 30/15cm, 30/25cm, 30/10cm, 30/5cm	SAND (SP), dense to very dense, gray -silty fine sand to 82.9m -clay layer, 81.4m to 81.7m -clay layer, 81.8m to 82.1m -medium to coarse sand with gravel, at 85.6m -fine sand with silt at 87.2m -fine to coarse gravel with medium sand and a trace of coarse sand, at 89.3m (90.8m)	XII
-100	88			
-104	92		CLAYSTONE (RX), dark gray, intensely weathered	XIII
-108	96		TOTAL DEPTH: 90.9m BACKFILLED WITH: Cement Grout	
-112				



LOG OF BORING AND TEST RESULTS

BORING 98-27

SFOBB East Span Seismic Safety Project

Report Date: 05/05/99

FUGRO

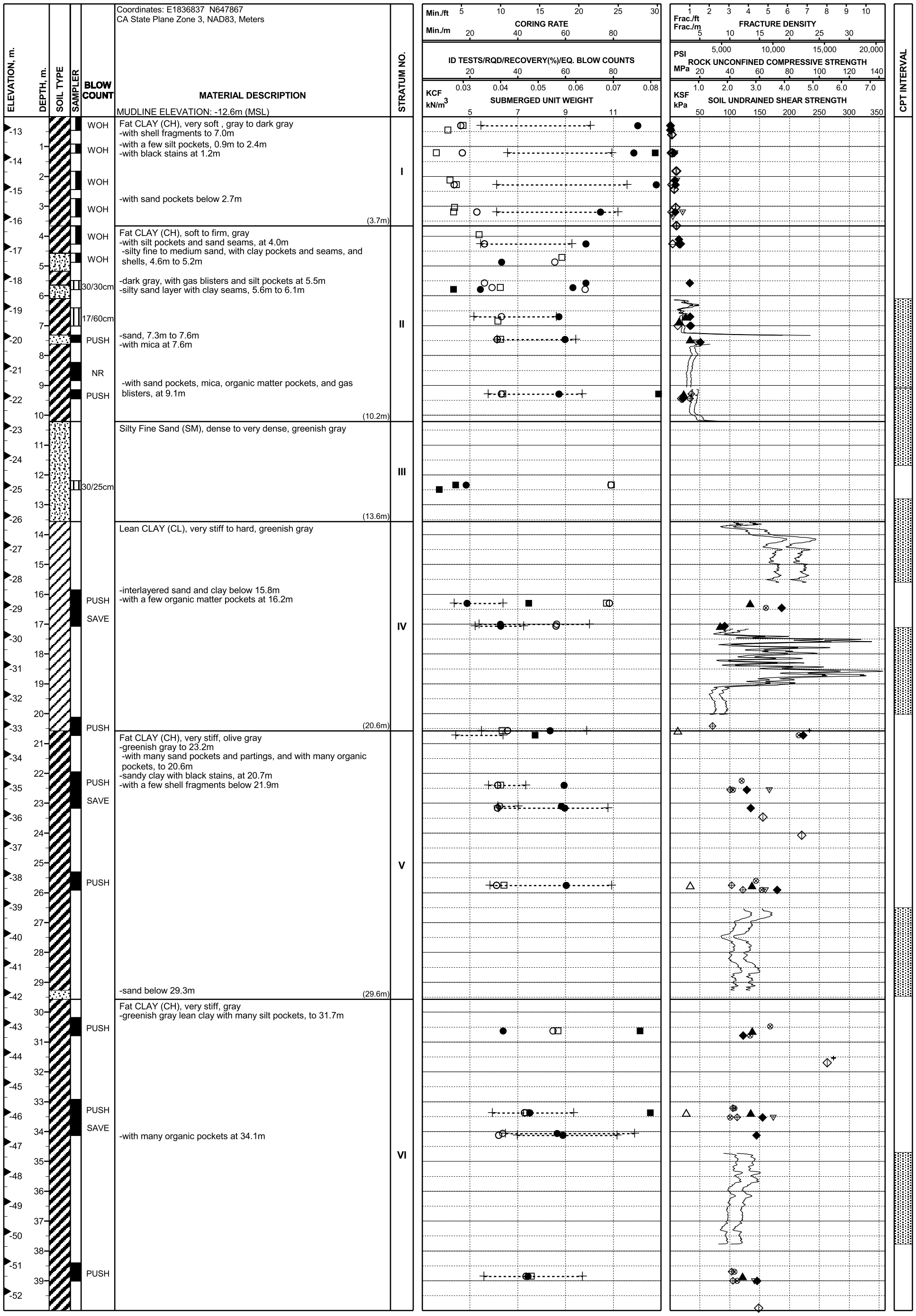
PLATE 98-27.5

PROJECT NO:	98-42-0054	**START DATE:**	10/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-27 (Skyway Frame 1)	**COMPLETION DATE:**	10/7/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836837 N647867
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.6m (MSL)

MATERIAL DESCRIPTION	STRATUM NO.
Fat CLAY (CH), very soft , gray to dark gray -with shell fragments to 7.0m -with a few silt pockets, 0.9m to 2.4m -with black stains at 1.2m -with sand pockets below 2.7m (3.7m)	I
Fat CLAY (CH), soft to firm, gray -with silt pockets and sand seams, at 4.0m -silty fine to medium sand, with clay pockets and seams, and shells, 4.6m to 5.2m -dark gray, with gas blisters and silt pockets at 5.5m -silty sand layer with clay seams, 5.6m to 6.1m -sand, 7.3m to 7.6m -with mica at 7.6m -with sand pockets, mica, organic matter pockets, and gas blisters, at 9.1m (10.2m)	II
Silty Fine Sand (SM), dense to very dense, greenish gray (13.6m)	III
Lean CLAY (CL), very stiff to hard, greenish gray -interlayered sand and clay below 15.8m -with a few organic matter pockets at 16.2m (20.6m)	IV
Fat CLAY (CH), very stiff, olive gray -greenish gray to 23.2m -with many sand pockets and partings, and with many organic pockets, to 20.6m -sandy clay with black stains, at 20.7m -with a few shell fragments below 21.9m -sand below 29.3m (29.6m)	V
Fat CLAY (CH), very stiff, gray -greenish gray lean clay with many silt pockets, to 31.7m -with many organic pockets at 34.1m	VI



LOG OF BORING AND TEST RESULTS

BORING 98-27

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

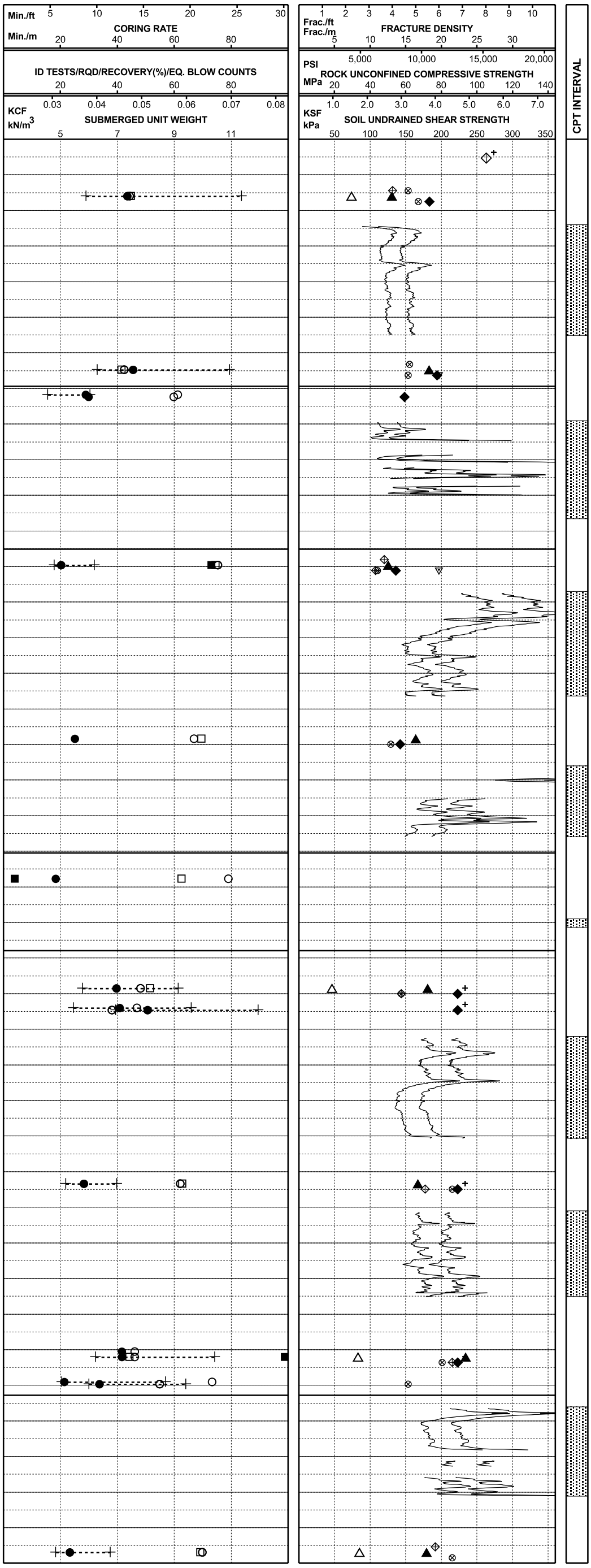
PLATE 98-27.6a

PROJECT NO:	98-42-0054	**START DATE:**	10/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-27 (Skyway Frame 1)	**COMPLETION DATE:**	10/7/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836837 N647867
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.6m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
				Fat CLAY (CH), very stiff, gray	VI
-54	41–42		PUSH	-greenish gray with many silt pockets, at 41.5m	
-56	43–44			-with a silt layer at 43.6m	
-59	45–46		PUSH	-with silt pockets at 46.3m (46.9m)	
			PUSH	Interlayered CLAY (CL) and SAND (SP), very stiff to dense, gray	VII
				(51.5m)	
			PUSH	Lean CLAY (CH), hard, gray -with many sandy silt pockets and with organic pockets, at 52.1m	VIII
-69	56–57		PUSH	-greenish gray, with many silt pockets, partings, and seams, and with gas blisters, at 56.7m	
-70	57–58			-sand with clay layers, 57.6m to 58.5m	
				(60.0m)	
-73	60–61		PUSH	Fine SAND (SP) with gravel, dense to very dense, gray -with medium to coarse sand	IX
				(62.8m)	
				Fat CLAY (CH), very stiff to hard, gray	X
-76	63–64		PUSH	-with light brown desiccated seams (inclined at 30 degrees), and with sand partings and silt pockets, at 63.7m	
-77	64–65		SAVE	-with many organic pockets at 64.3m	
-79	66–67			-with a silt layer at 66.4m	
-82	69–70		PUSH	-with silt partings and seams, 68.9m to 72.5m -with organic matter pockets, below 68.9m	
-86	73–74		PUSH	-with wood fragments at 73.8m	
-87	74–75		SAVE		
				(75.3m)	
				Lean CLAY (CL), hard, dark greenish gray	XI
-89	76–77			-silt, 76.8m to 77.1m	
-90	77–78			-silt, 77.3m to 77.6m -with a sand layer at 78.0m	
-92	79		PUSH	-dark greenish gray at 79.6m	



LOG OF BORING AND TEST RESULTS

BORING 98-27

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

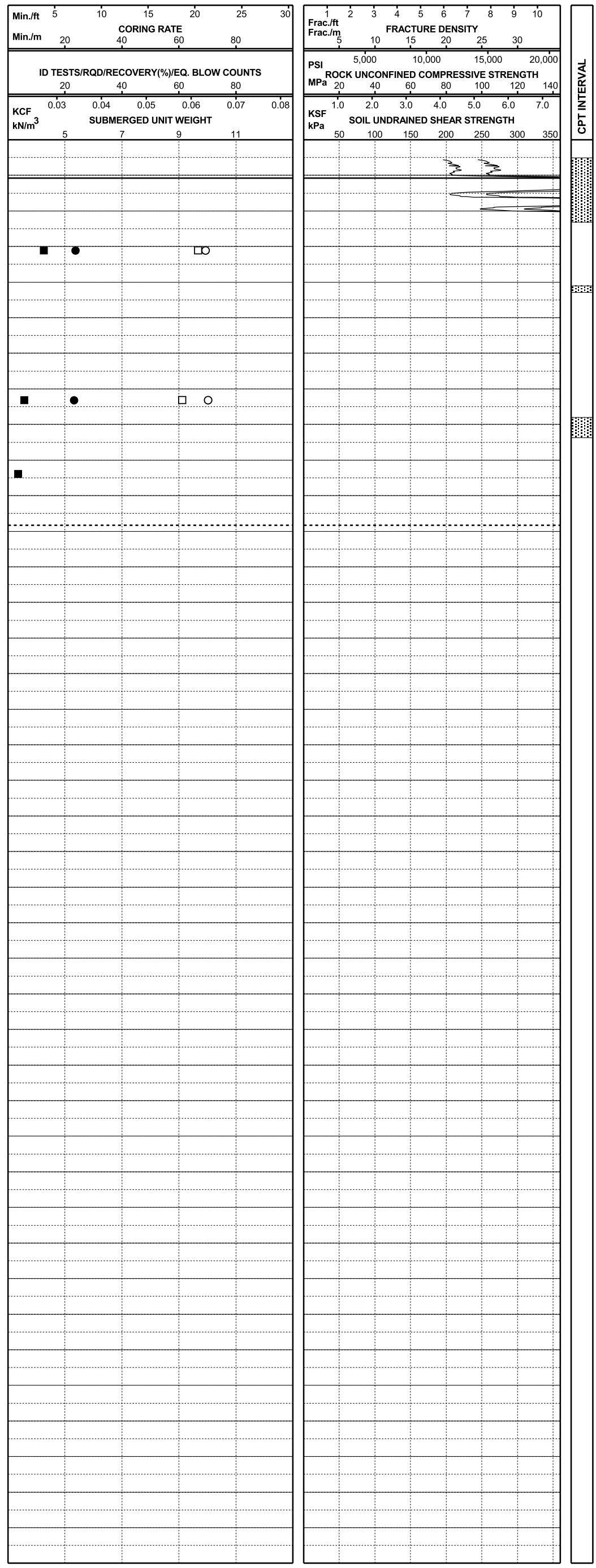
PLATE 98-27.6b

PROJECT NO:	98-42-0054	**START DATE:**	10/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-27 (Skyway Frame 1)	**COMPLETION DATE:**	10/7/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836837 N647867
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.6m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-93	81				Lean CLAY (CL), hard, dark greenish gray (81.1m)	XI
-94	82				SAND (SP), dense to very dense, gray -silty fine sand to 82.9m -clay layer, 81.4m to 81.7m -clay layer, 81.8m to 82.1m	XII
-95						
-96	83			30/25cm		
-97	84					
-98	85					
-99	86			30/15cm	-medium to coarse sand with gravel, at 85.6m	
-100	87			30/25cm	-fine sand with silt at 87.2m	
-101	88					
-102	89			30/10cm	-fine to coarse gravel with medium sand and a trace of coarse sand, at 89.3m	
-103	90					
-104	91			30/5cm	TOTAL DEPTH: 90.9m BACKFILLED WITH: Cement Grout	
-105	92					
-106	93					
-107	94					
-108	95					
-109	96					
-110	97					
-111	98					
-112	99					
-113	100					
-114	101					
-115	102					
-116	103					
-117	104					
-118	105					
-119	106					
-120	107					
-121	108					
-122	109					
-123	110					
-124	111					
-125	112					
-126	113					
-127	114					
-128	115					
-129	116					
-130	117					
-131	118					
-132	119					



LOG OF BORING AND TEST RESULTS

BORING 98-27

SFOBB East Span Seismic Safety Project

Report Date: 04/27/99

FUGRO

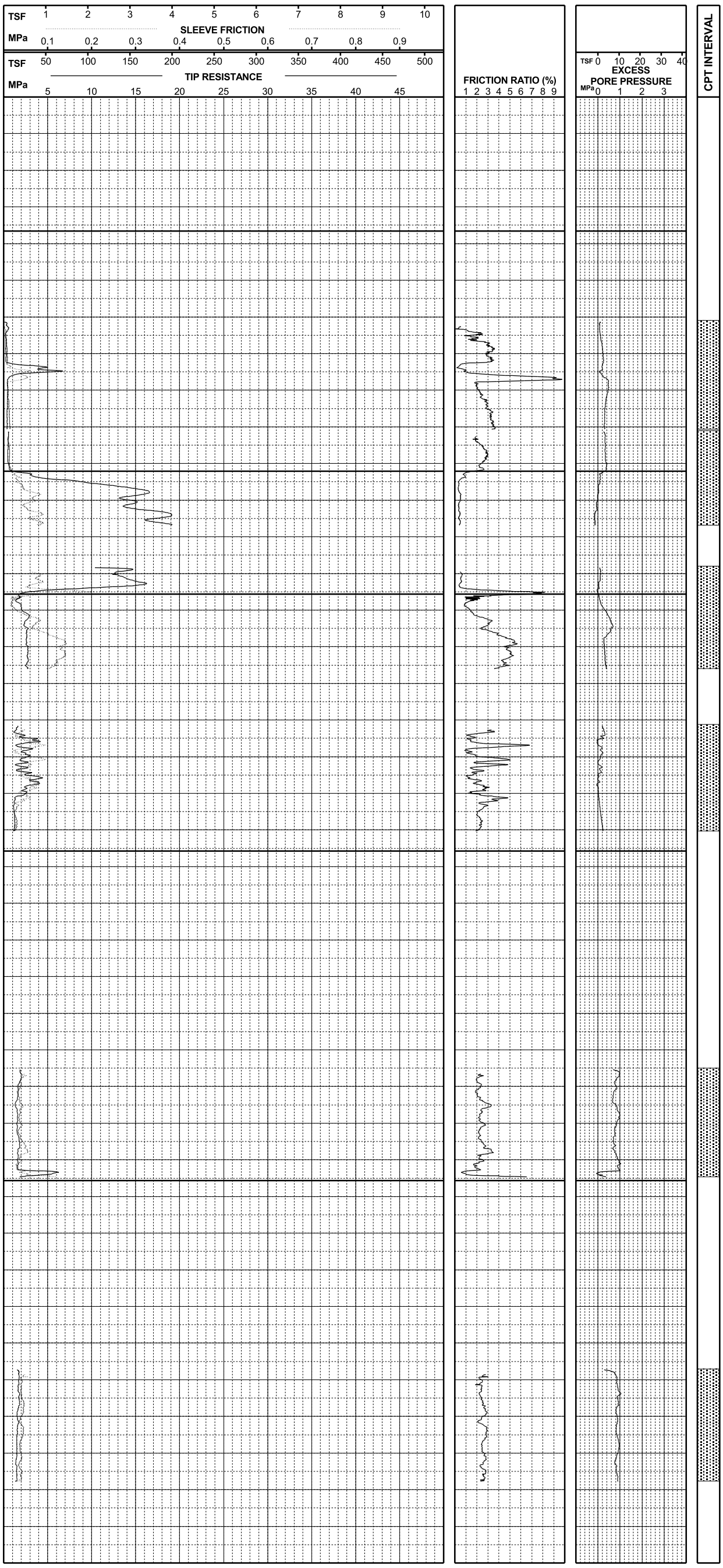
PLATE 98-27.6c

PROJECT NO:	98-42-0054	**START DATE:**	10/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-27 (Skyway Frame 1)	**COMPLETION DATE:**	10/7/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836837 N647867
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.6m (MSL)

ELEVATION, m.	DEPTH, m.	SOIL TYPE	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-13				WOH	Fat CLAY (CH), very soft , gray to dark gray	I
	1			WOH	-with shell fragments to 7.0m -with a few silt pockets, 0.9m to 2.4m	
-14					-with black stains at 1.2m	
	2			WOH		
-15					-with sand pockets below 2.7m	
	3			WOH		
-16					(3.7m)	
	4			WOH	Fat CLAY (CH), soft to firm, gray -with silt pockets and sand seams, at 4.0m	II
-17					-silty fine to medium sand, with clay pockets and seams, and shells, 4.6m to 5.2m	
	5			WOH		
-18				30/30cm	-dark gray, with gas blisters and silt pockets at 5.5m	
	6				-silty sand layer with clay seams, 5.6m to 6.1m	
-19				17/60cm		
	7					
-20				PUSH	-sand, 7.3m to 7.6m -with mica at 7.6m	
	8					
-21				NR		
	9				-with sand pockets, mica, organic matter pockets, and gas blisters, at 9.1m	
-22				PUSH		
	10				(10.2m)	
-23					Silty Fine Sand (SM), dense to very dense, greenish gray	III
	11					
-24						
	12			30/25cm		
-25						
-26	13				(13.6m)	
	14				Lean CLAY (CL), very stiff to hard, greenish gray	IV
-27						
	15					
-28						
	16			PUSH	-interlayered sand and clay below 15.8m -with a few organic matter pockets at 16.2m	
-29				SAVE		
	17					
-30						
	18					
-31						
	19					
-32						
	20				(20.6m)	
-33				PUSH	Fat CLAY (CH), very stiff, olive gray	V
	21				-greenish gray to 23.2m -with many sand pockets and partings, and with many organic pockets, to 20.6m	
-34						
	22			PUSH	-sandy clay with black stains, at 20.7m -with a few shell fragments below 21.9m	
-35				SAVE		
	23					
-36						
	24					
-37						
	25					
-38				PUSH		
	26					
-39						
	27					
-40						
	28					
-41						
	29				-sand below 29.3m (29.6m)	
-42						
	30				Fat CLAY (CH), very stiff, gray -greenish gray lean clay with many silt pockets, to 31.7m	VI
-43				PUSH		
	31					
-44						
	32					
-45						
	33			PUSH		
-46				SAVE		
	34				-with many organic pockets at 34.1m	
-47						
	35					
-48						
	36					
-49						
	37					
-50						
	38					
-51				PUSH		
	39					
-52						



LOG OF BORING AND TEST RESULTS

BORING 98-27

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

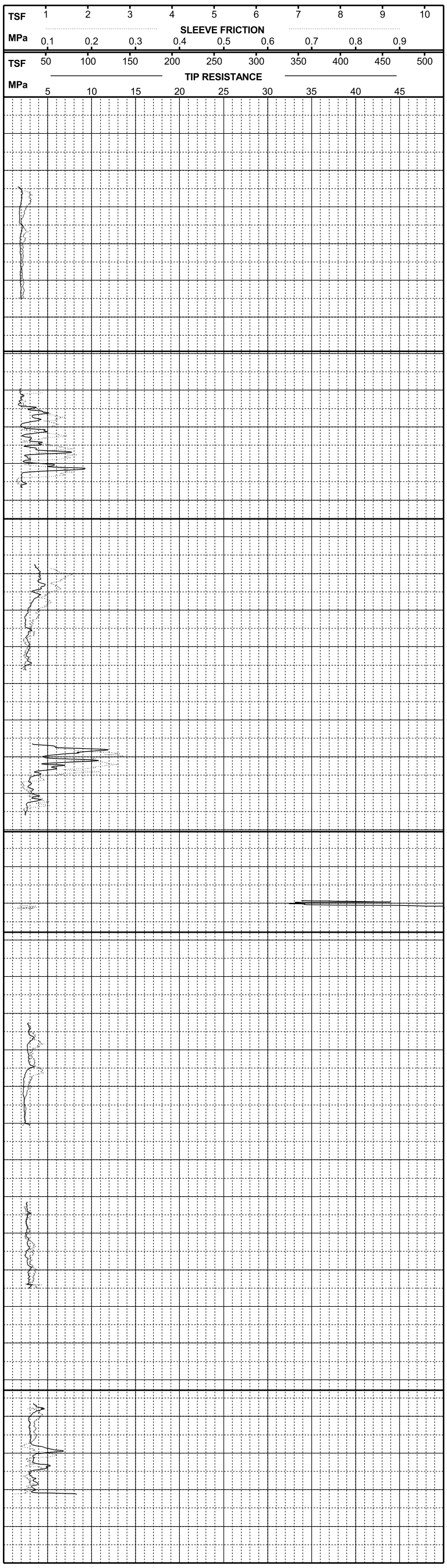
PLATE 98-27.7a

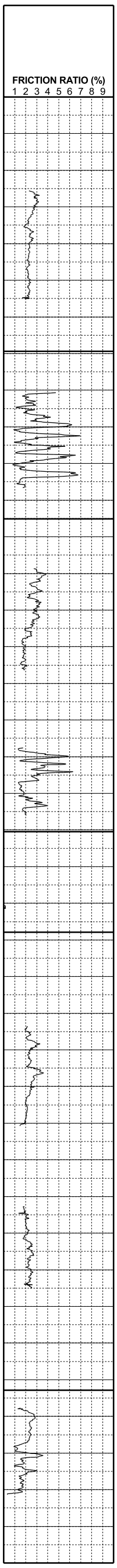
PROJECT NO:	98-42-0054	**START DATE:**	10/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-27 (Skyway Frame 1)	**COMPLETION DATE:**	10/7/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

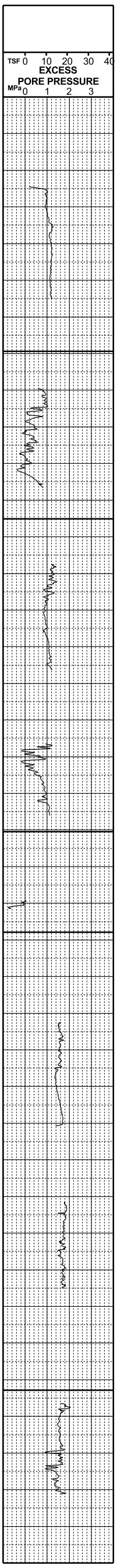
Coordinates: E1836837 N647867
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.6m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-53	41			Fat CLAY (CH), very stiff, gray	VI
-54	42		PUSH	-greenish gray with many silt pockets, at 41.5m	
-55	43				
-56	44			-with a silt layer at 43.6m	
-57	45				
-58	46				
-59	47		PUSH	-with silt pockets at 46.3m (46.9m)	
-60	48		PUSH	Interlayered CLAY (CL) and SAND (SP), very stiff to dense, gray	VII
-61	49				
-62	50				
-63	51			(51.5m)	
-64	52		PUSH	Lean CLAY (CH), hard, gray -with many sandy silt pockets and with organic pockets, at 52.1m	VIII
-65	53				
-66	54				
-67	55				
-68	56				
-69	57		PUSH	-greenish gray, with many silt pockets, partings, and seams, and with gas blisters, at 56.7m	
-70	58			-sand with clay layers, 57.6m to 58.5m	
-71	59				
-72	60			(60.0m)	
-73	61		PUSH	Fine SAND (SP) with gravel, dense to very dense, gray -with medium to coarse sand	IX
-74	62				
-75	63			(62.8m)	
-76	64		PUSH SAVE	Fat CLAY (CH), very stiff to hard, gray -with light brown desiccated seams (inclined at 30 degrees), and with sand partings and silt pockets, at 63.7m -with many organic pockets at 64.3m	X
-77	65				
-78	66			-with a silt layer at 66.4m	
-79	67				
-80	68				
-81	69		PUSH	-with silt partings and seams, 68.9m to 72.5m -with organic matter pockets, below 68.9m	
-82	70				
-83	71				
-84	72				
-85	73				
-86	74		PUSH SAVE	-with wood fragments at 73.8m	
-87	75			(75.3m)	
-88	76			Lean CLAY (CL), hard, dark greenish gray	XI
-89	77			-silt, 76.8m to 77.1m -silt, 77.3m to 77.6m	
-90	78			-with a sand layer at 78.0m	
-91	79				
-92			PUSH	-dark greenish gray at 79.6m	







CPT INTERVAL

LOG OF BORING AND TEST RESULTS

BORING 98-27

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

PLATE 98-27.7b

PROJECT NO:	98-42-0054	**START DATE:**	10/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-27 (Skyway Frame 1)	**COMPLETION DATE:**	10/7/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836837 N647867
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.6m (MSL)

ELEVATION, m.	DEPTH, m.	SAMPLER	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-93	81			Lean CLAY (CL), hard, dark greenish gray (81.1m)	XI
-94, -95	82			SAND (SP), dense to very dense, gray -silty fine sand to 82.9m -clay layer, 81.4m to 81.7m -clay layer, 81.8m to 82.1m	XII
-96	83		30/25cm		
-97	84				
-98	85		30/15cm	-medium to coarse sand with gravel, at 85.6m	
-99	86				
-100	87		30/25cm	-fine sand with silt at 87.2m	
-101	88				
-102	89		30/10cm	-fine to coarse gravel with medium sand and a trace of coarse sand, at 89.3m	
-103	90			(90.8m)	
-104	91		30/5cm	CLAYSTONE (RX), dark gray, intensely weathered	
-105	92			TOTAL DEPTH: 90.9m	
-106	93			BACKFILLED WITH: Cement Grout	
-107	94				
-108	95				
-109	96				
-110	97				
-111	98				
-112	99				
-113	100				
-114	101				
-115	102				
-116	103				
-117	104				
-118	105				
-119	106				
-120	107				
-121	108				
-122	109				
-123	110				
-124	111				
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-126	113				
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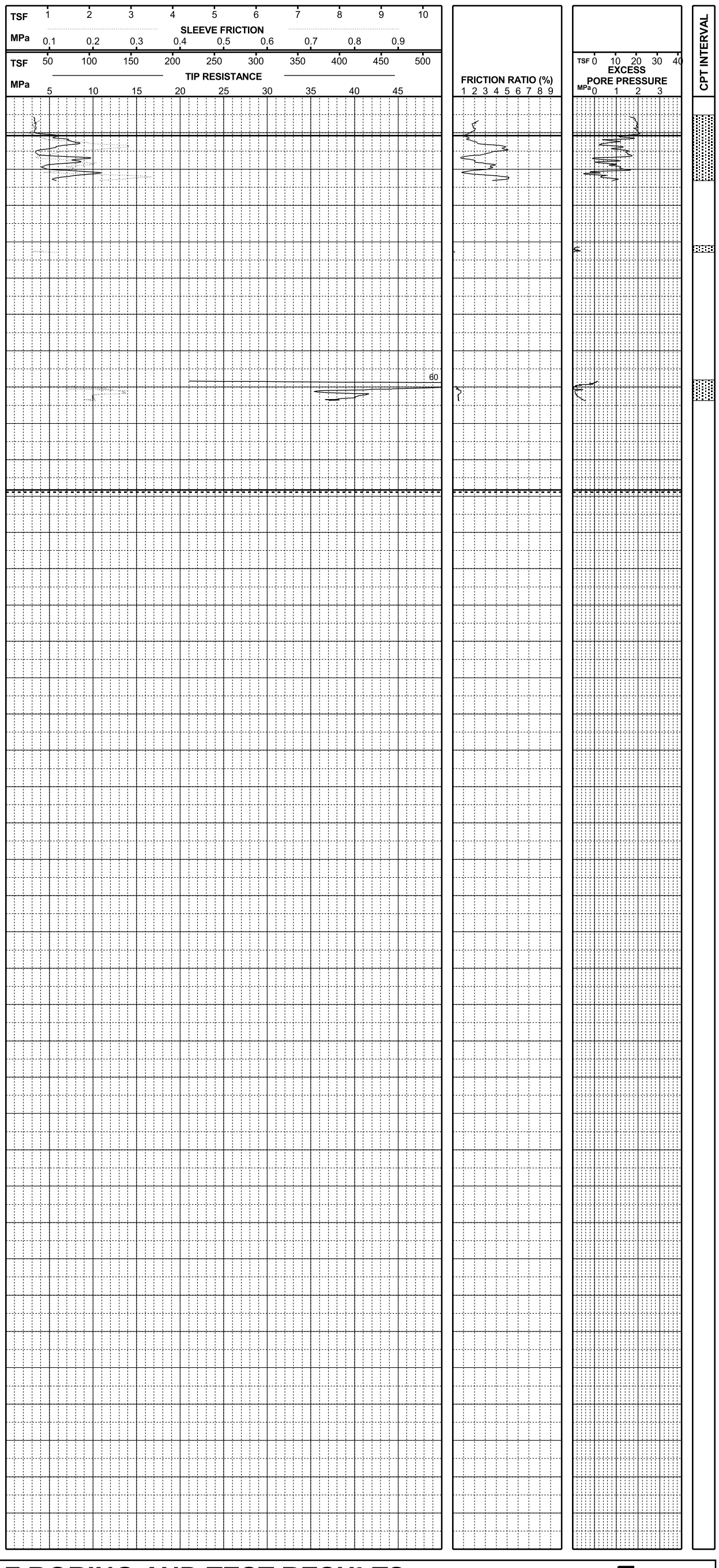
-128	115				
-129	116				
-130	117				
-131	118				
-132	119				



LOG OF BORING AND TEST RESULTS

BORING 98-27

SFOBB East Span Seismic Safety Project

Report Date: 04/28/99

FUGRO

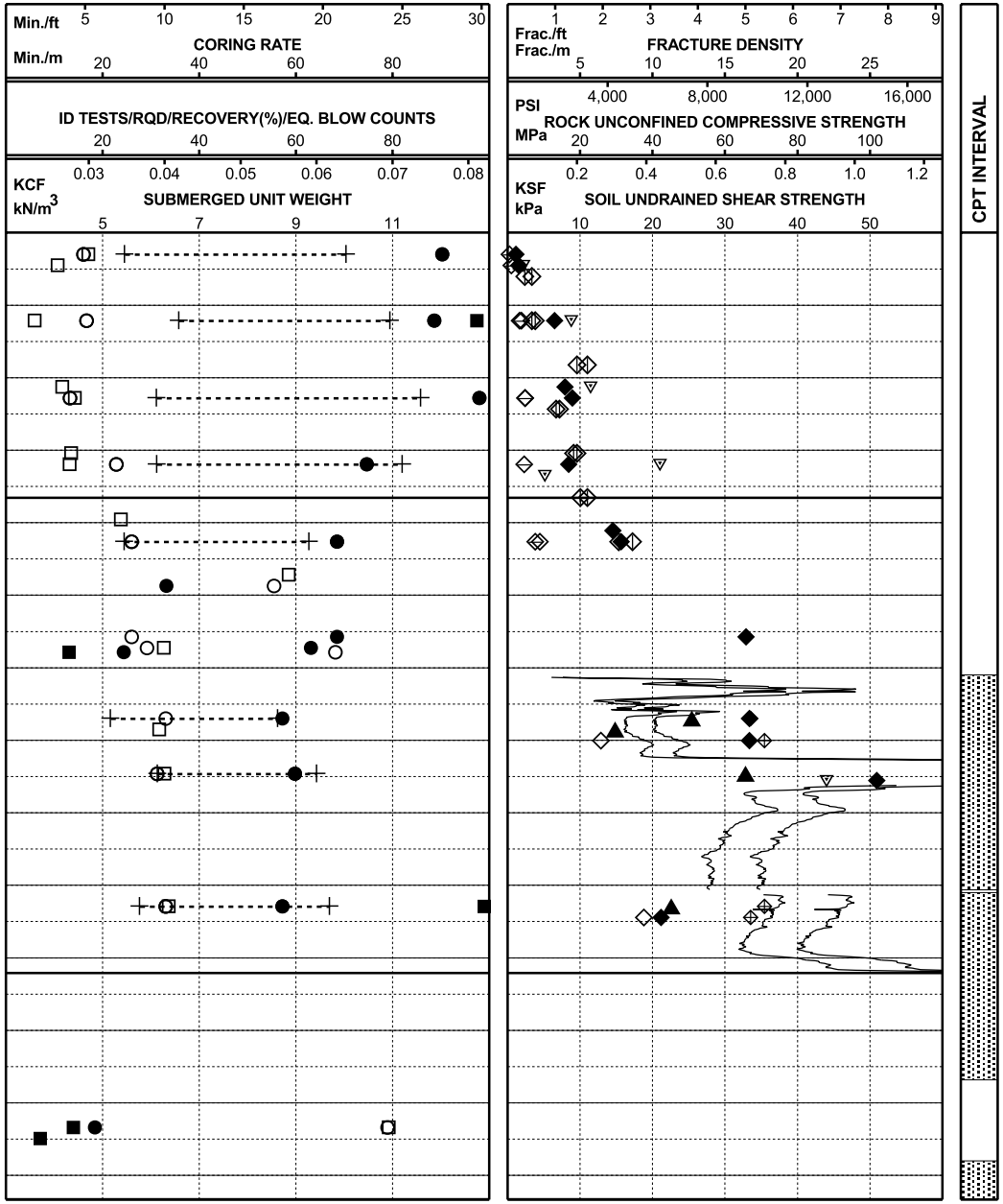
PLATE 98-27.7c

PROJECT NO:	98-42-0054	**START DATE:**	10/03/98	**DRILLER:**	Fugro-McClelland Marine Geosciences
BORING:	98-27 (Skyway Frame 1)	**COMPLETION DATE:**	10/7/98	**DRILLING METHOD:**	Rotary Sample Boring (Wet)

Coordinates: E1836837 N647867
CA State Plane Zone 3, NAD83, Meters

MUDLINE ELEVATION: -12.6m (MSL)

ELEVATION, m.	DEPTH, m.	BLOW COUNT	MATERIAL DESCRIPTION	STRATUM NO.
-13		WOH	Fat CLAY (CH), very soft , gray to dark gray -with shell fragments to 7.0m	I
-14	1	WOH	-with a few silt pockets, 0.9m to 2.4m -with black stains at 1.2m	
-15	2	WOH		
-16	3	WOH	-with sand pockets below 2.7m (3.7m)	
-17	4	WOH	Fat CLAY (CH), soft to firm, gray -with silt pockets and sand seams, at 4.0m -silty fine to medium sand, with clay pockets and seams, and shells, 4.6m to 5.2m	II
-18	5	WOH		
-19	6	30/30cm	-dark gray, with gas blisters and silt pockets at 5.5m -silty sand layer with clay seams, 5.6m to 6.1m	
-20	7	17/60cm		
-21	8	PUSH	-sand, 7.3m to 7.6m -with mica at 7.6m	
-22	9	NR		
	10	PUSH	-with sand pockets, mica, organic matter pockets, and gas blisters, at 9.1m (10.2m)	
-23	11		Silty Fine Sand (SM), dense to very dense, greenish gray	III
-24	12			
-25	13	30/25cm		



LOG OF BORING AND TEST RESULTS

BORING 98-27

SFOBB East Span Seismic Safety Project

Report Date: 04/30/99

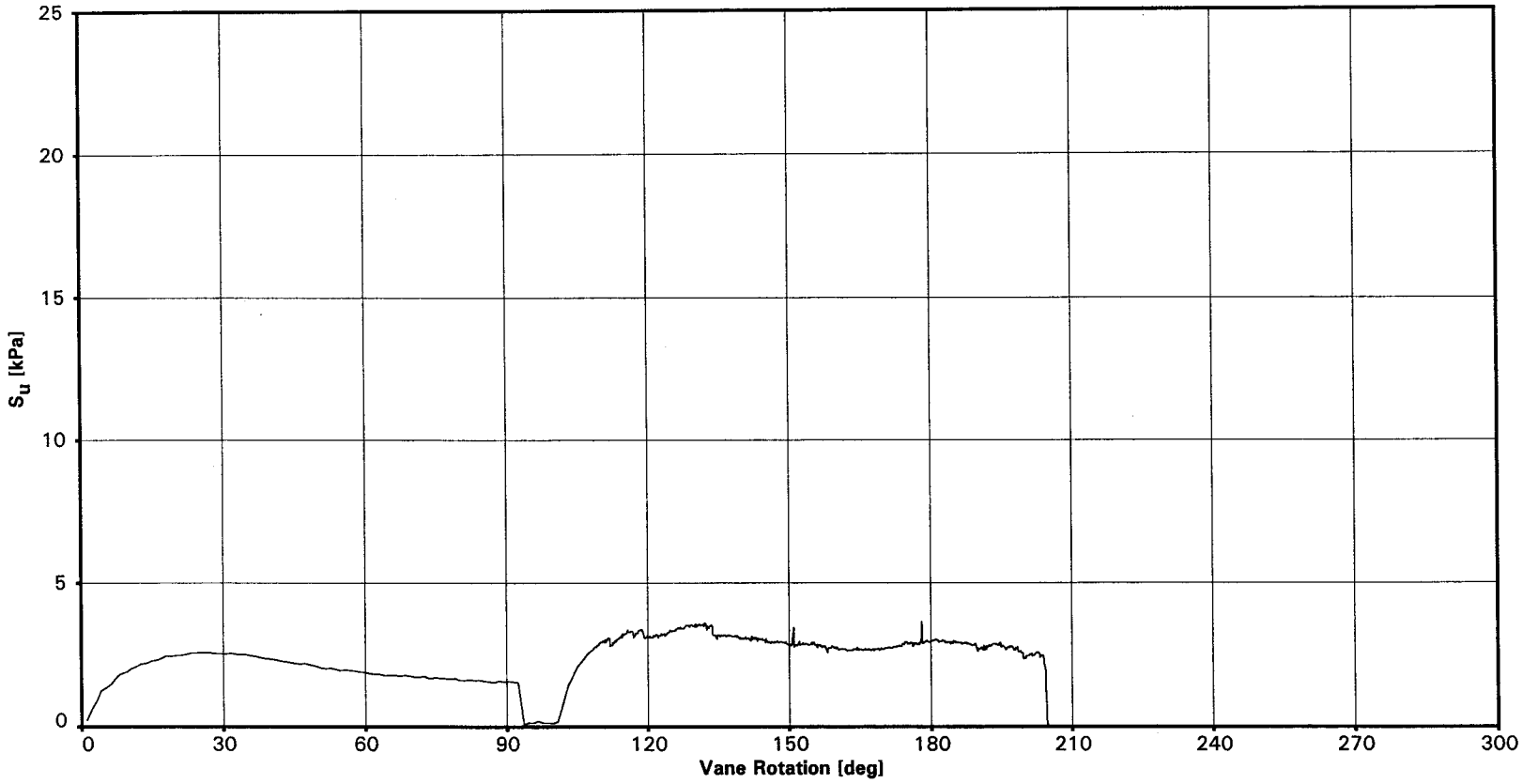
FUGRO

PLATE 98-27.8

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 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

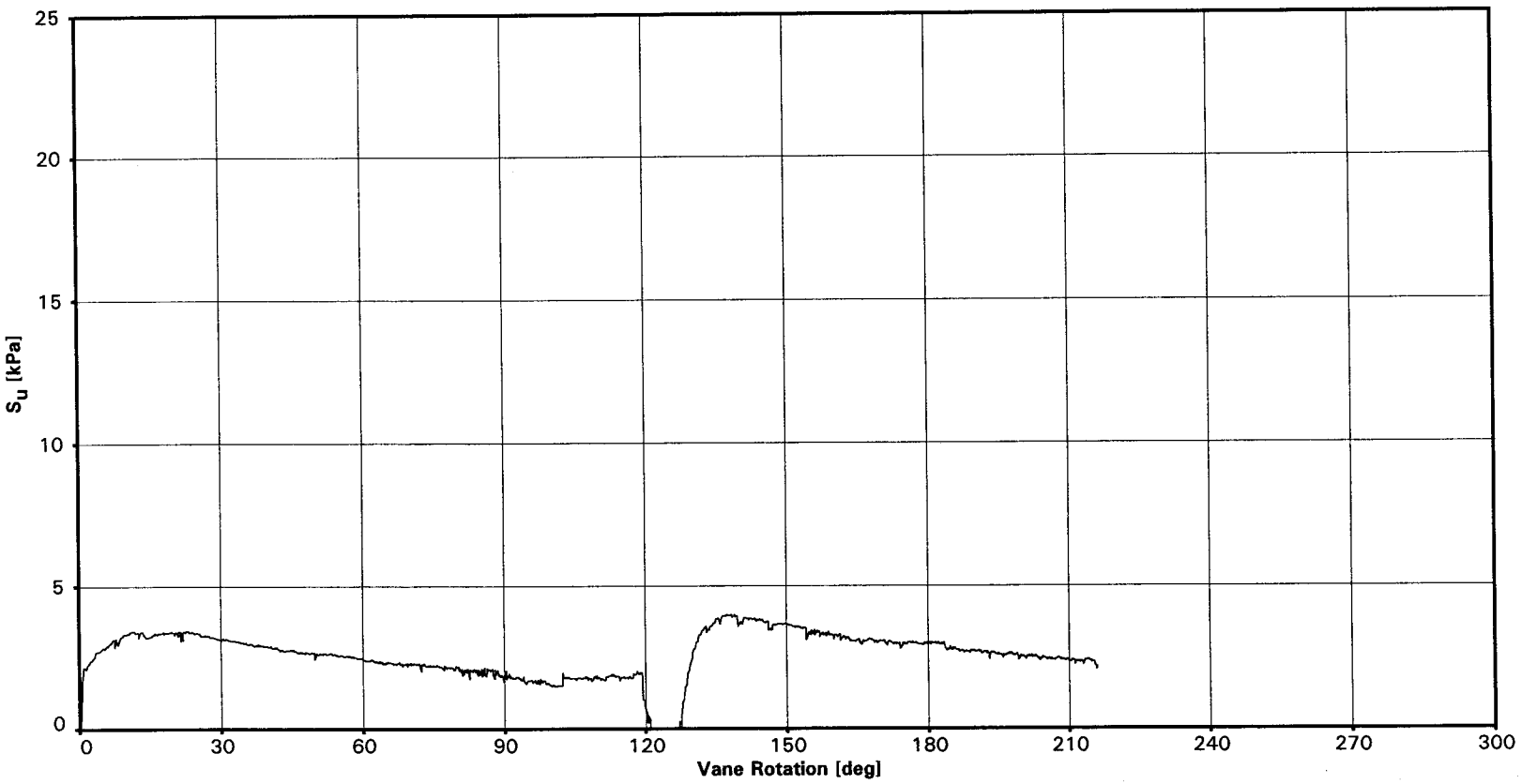
FUGRO

PLATE 98-27.9a

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 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

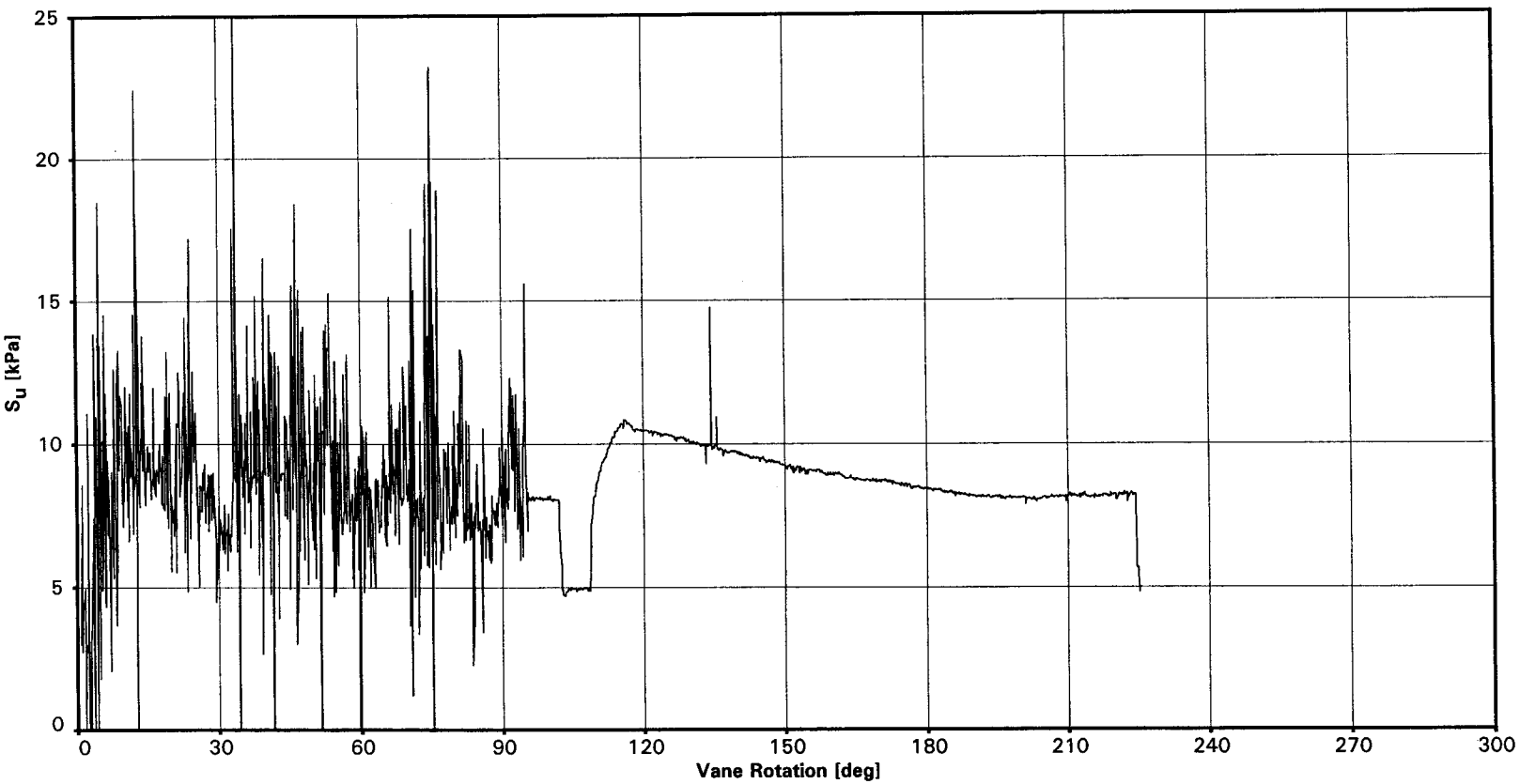
FUGRO

PLATE 98-27.9b

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 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

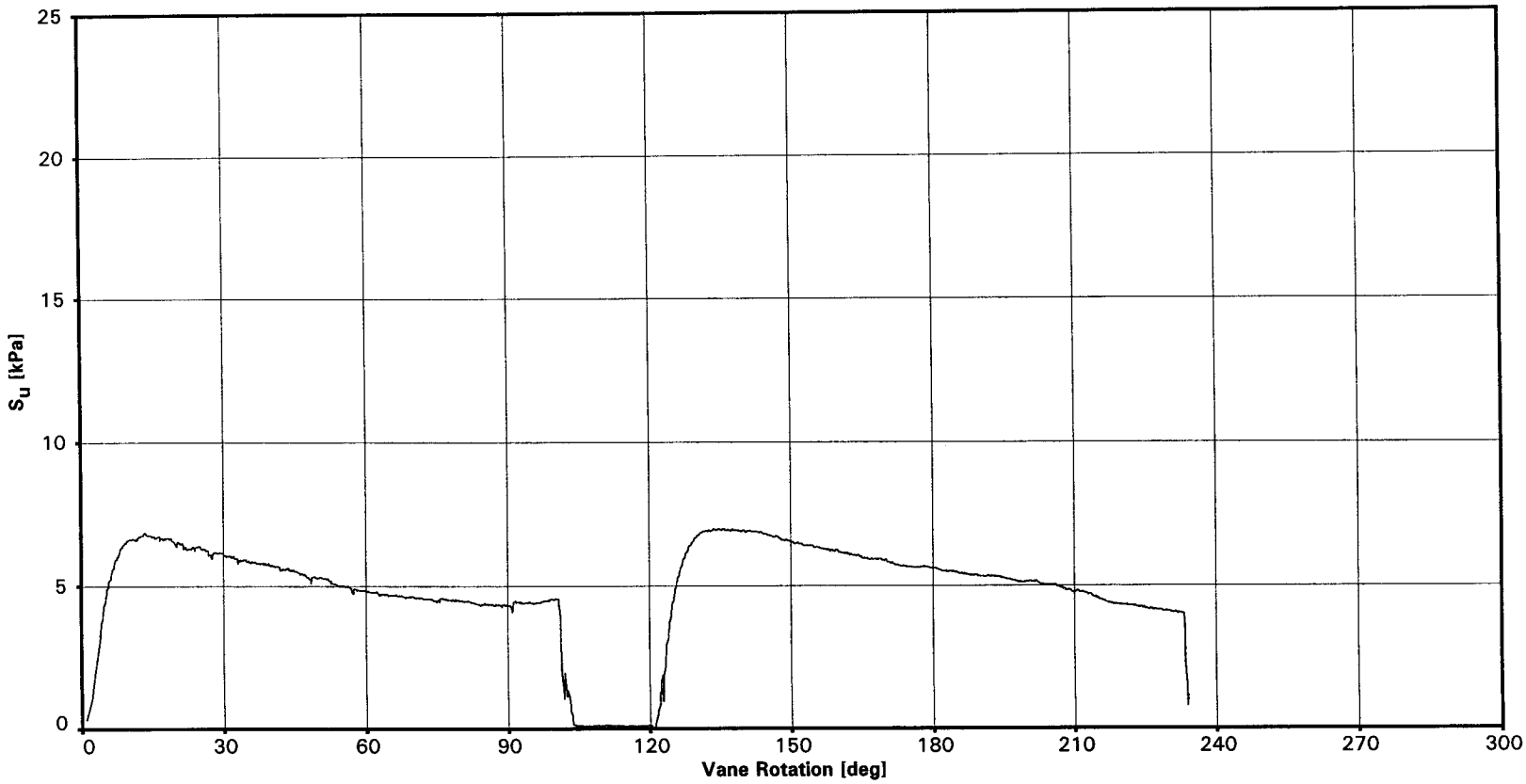
FUGRO

PLATE 98-27.9c

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 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

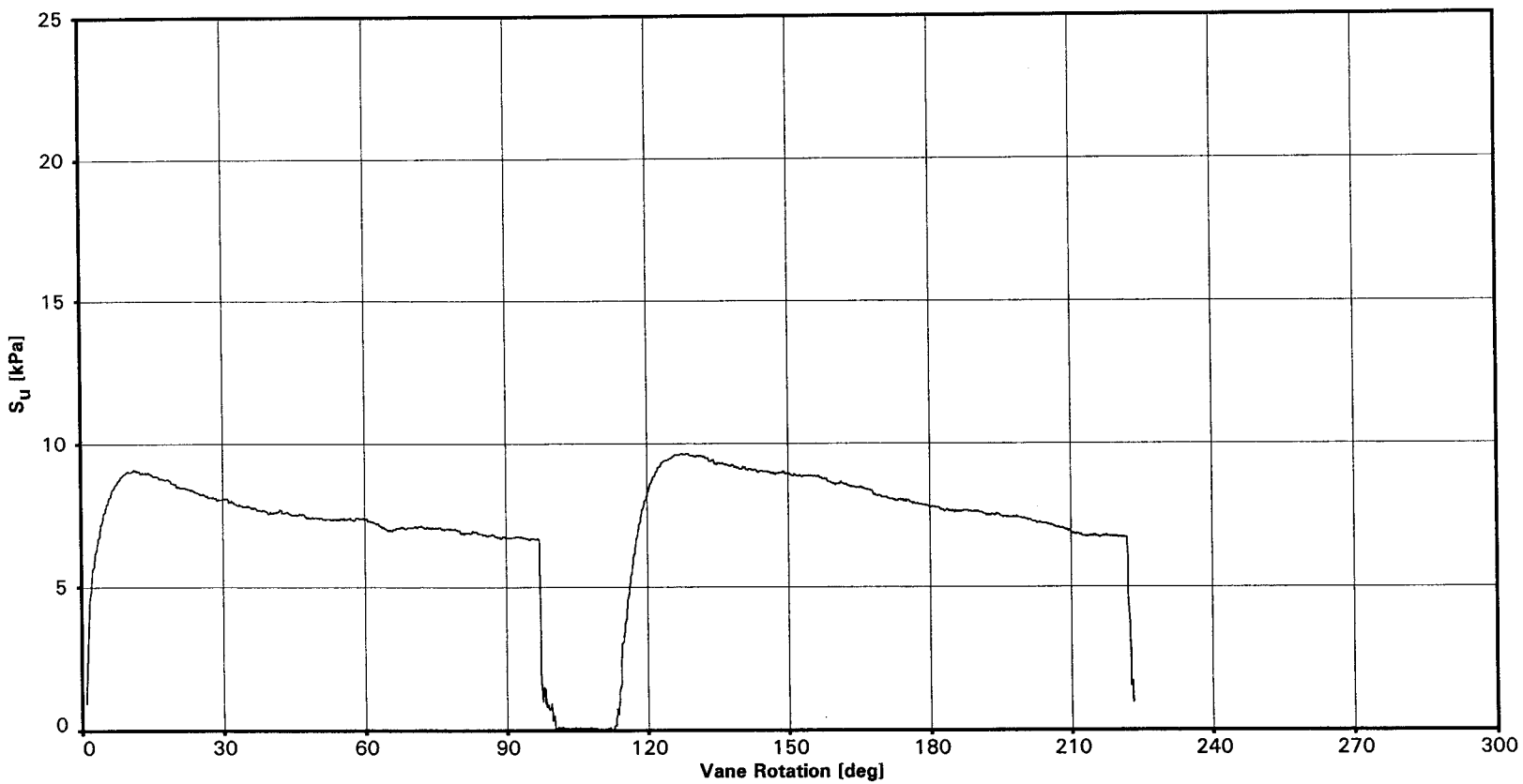
FUGRO

PLATE 98-27.9d

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 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

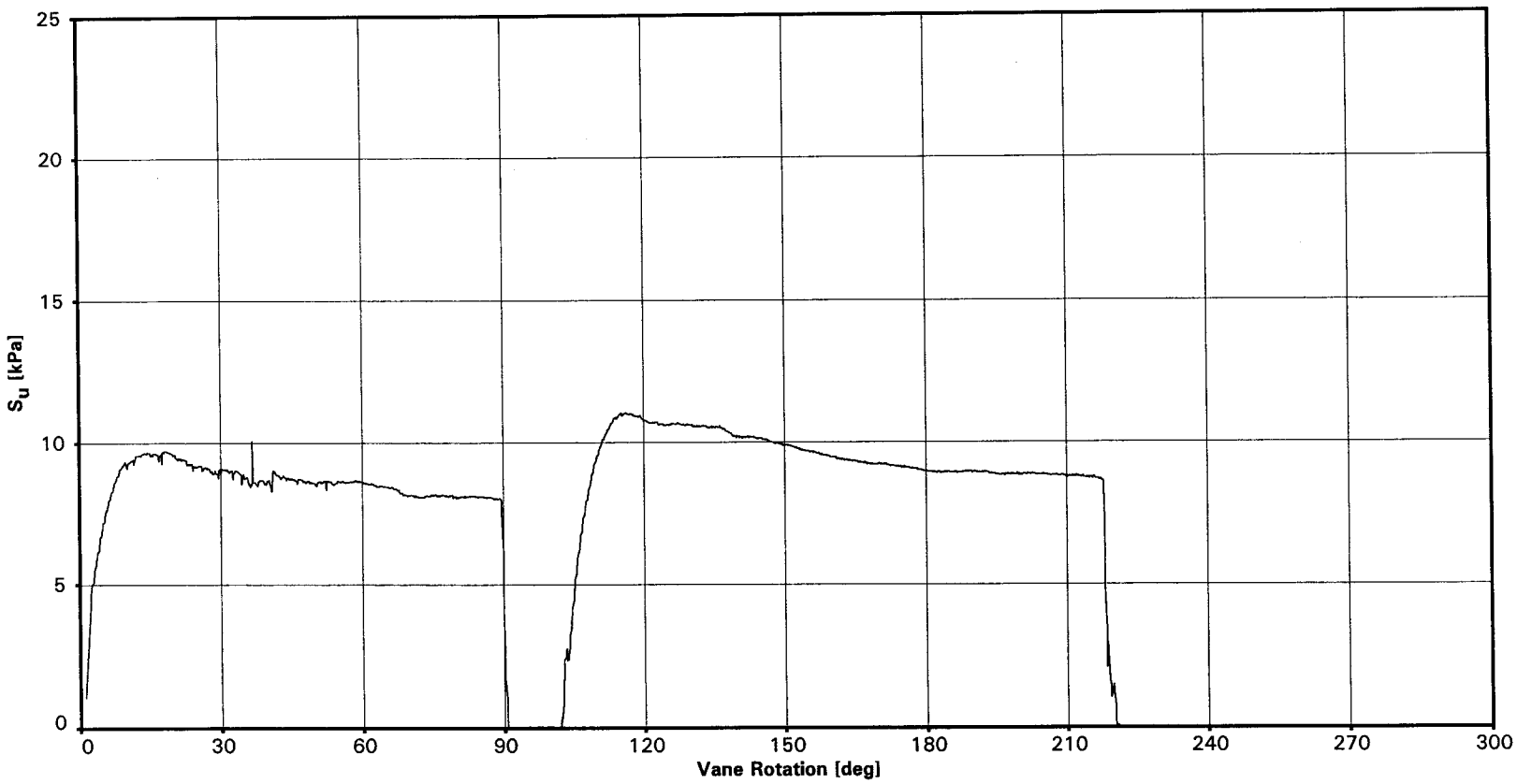
FUGRO

PLATE 98-27.9e

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

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 3.7m
Boring 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

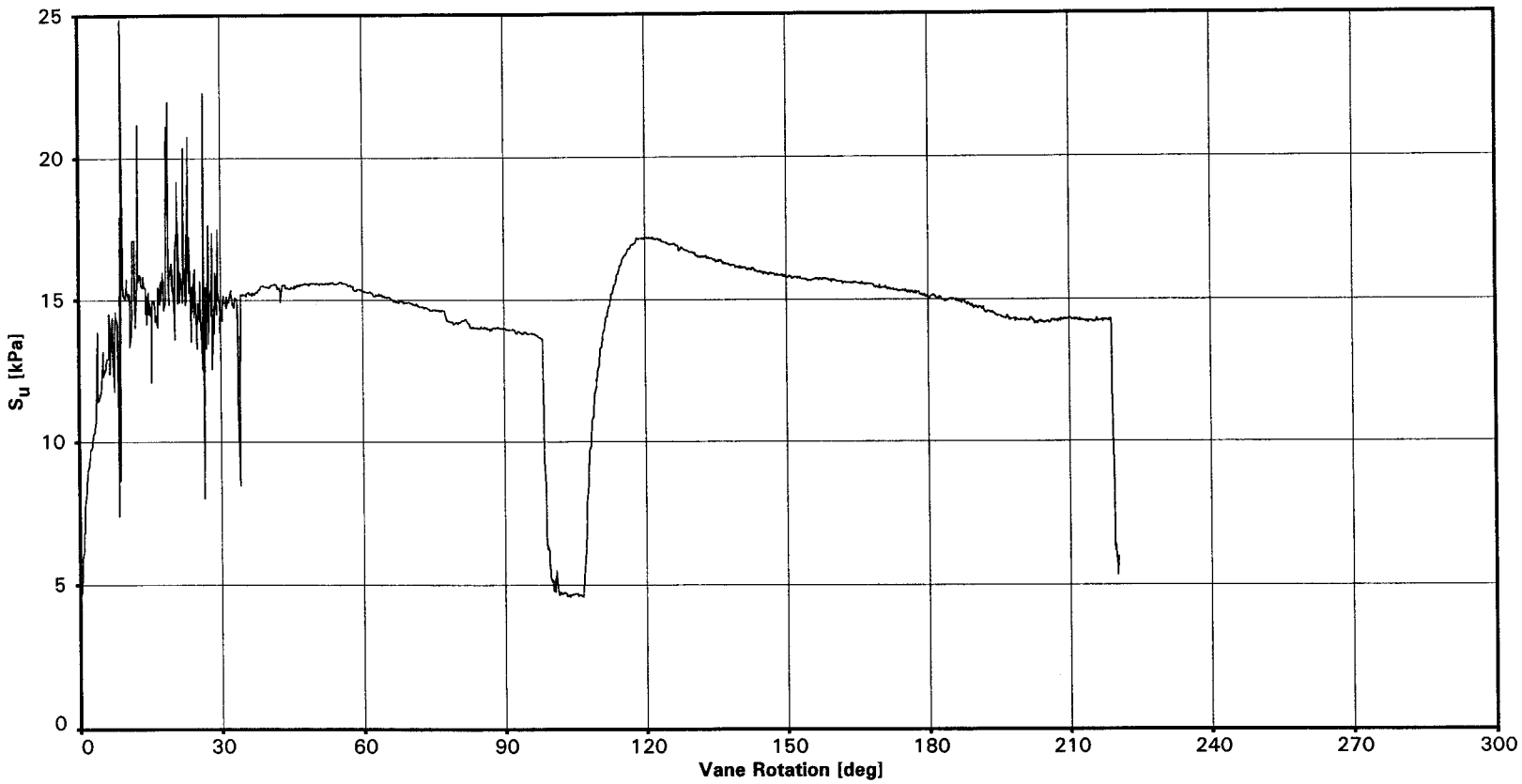
FUGRO

PLATE 98-27.9f

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

Vane Size used: Dolphin Medium

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (HALIBUT) TEST RESULTS
Test Depth: 4.3m
Boring 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

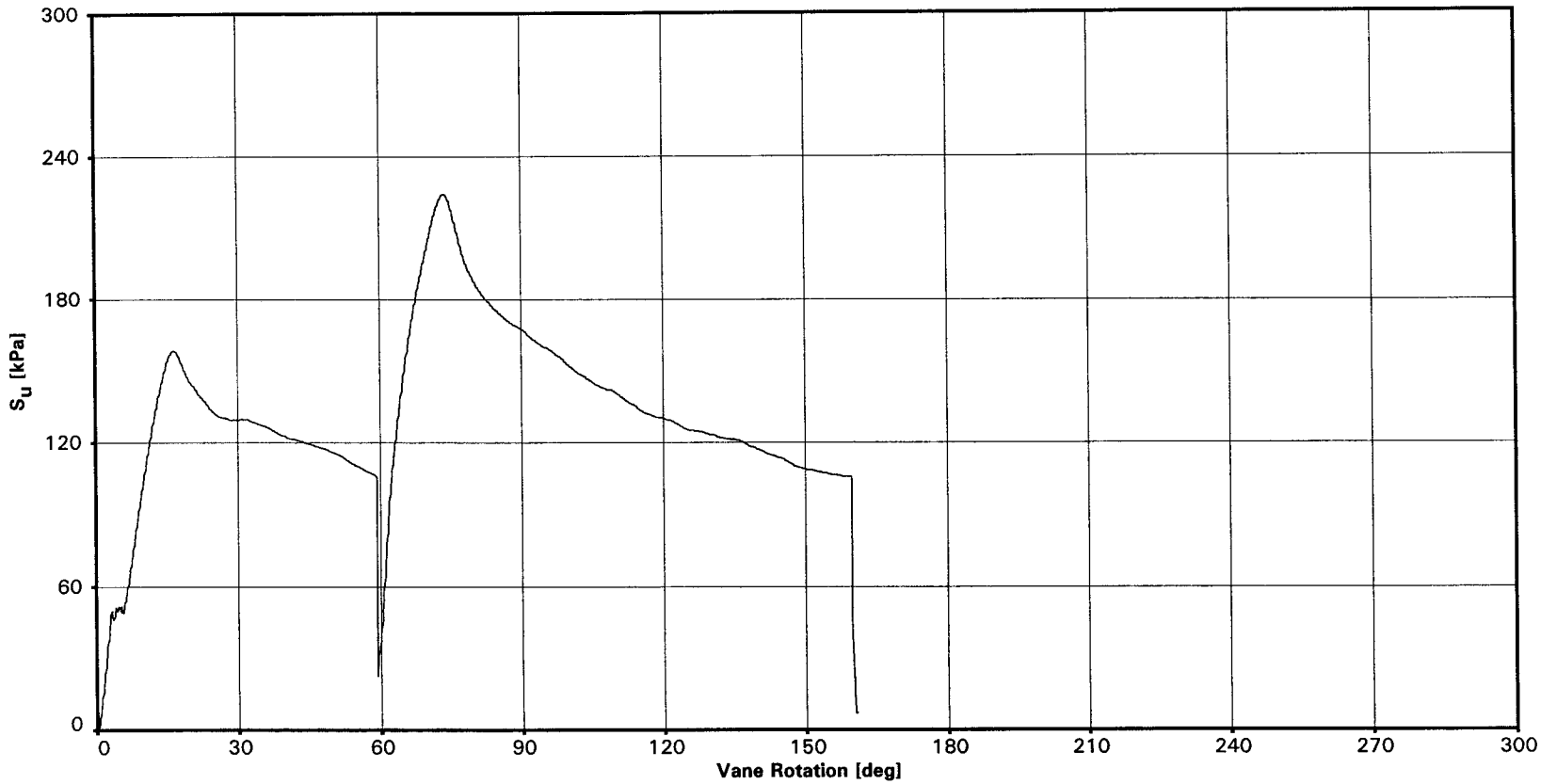
FUGRO

PLATE 98-27.9g

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

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)



REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 23.5m and 24.1m
Boring 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

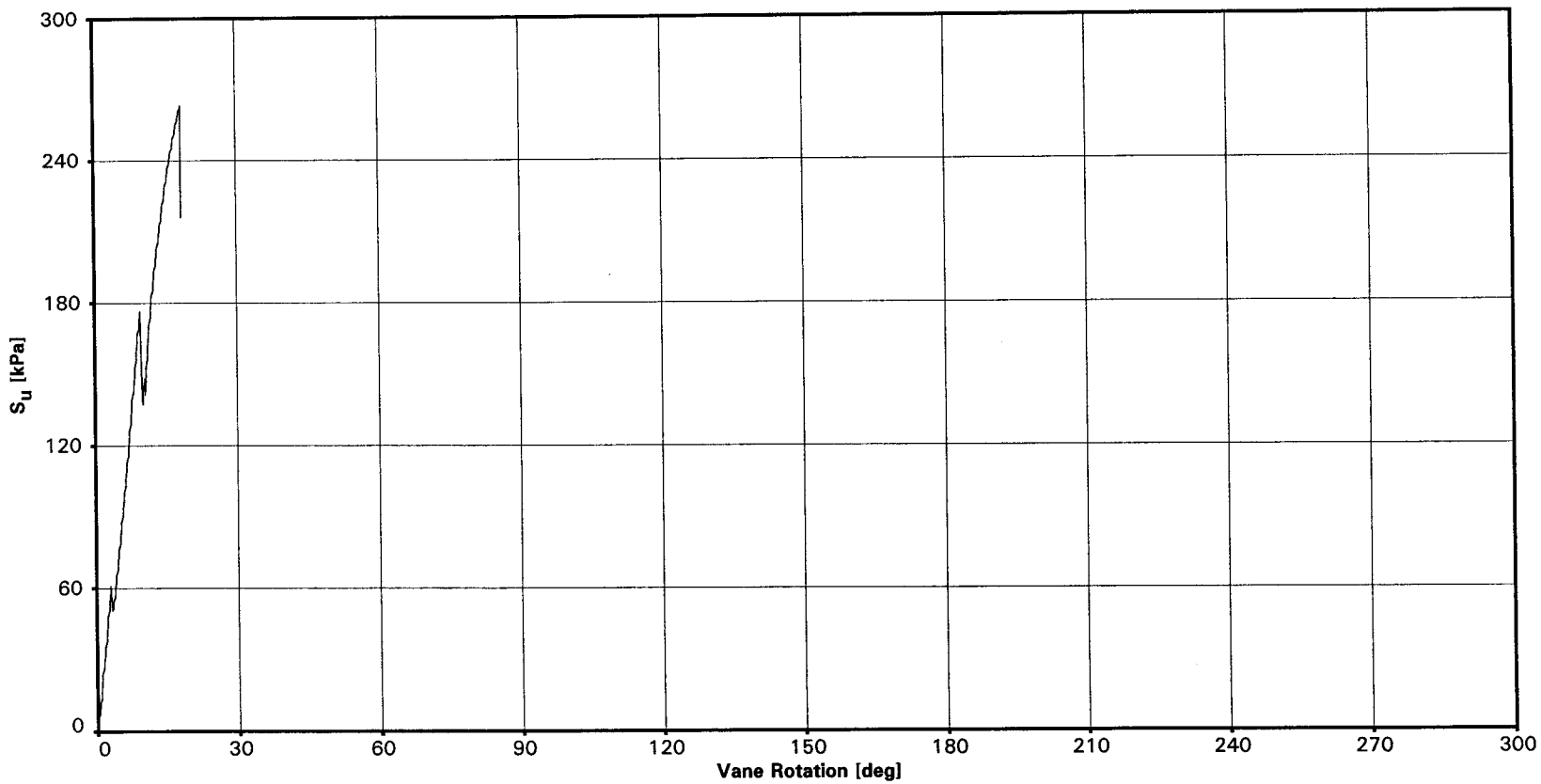
PLATE 98-27.9h

Earth Mechanics

FUGRO

Vane Size used: Dolphin Small

(30 Degrees Corresponds to 8.3% Shear Strain)

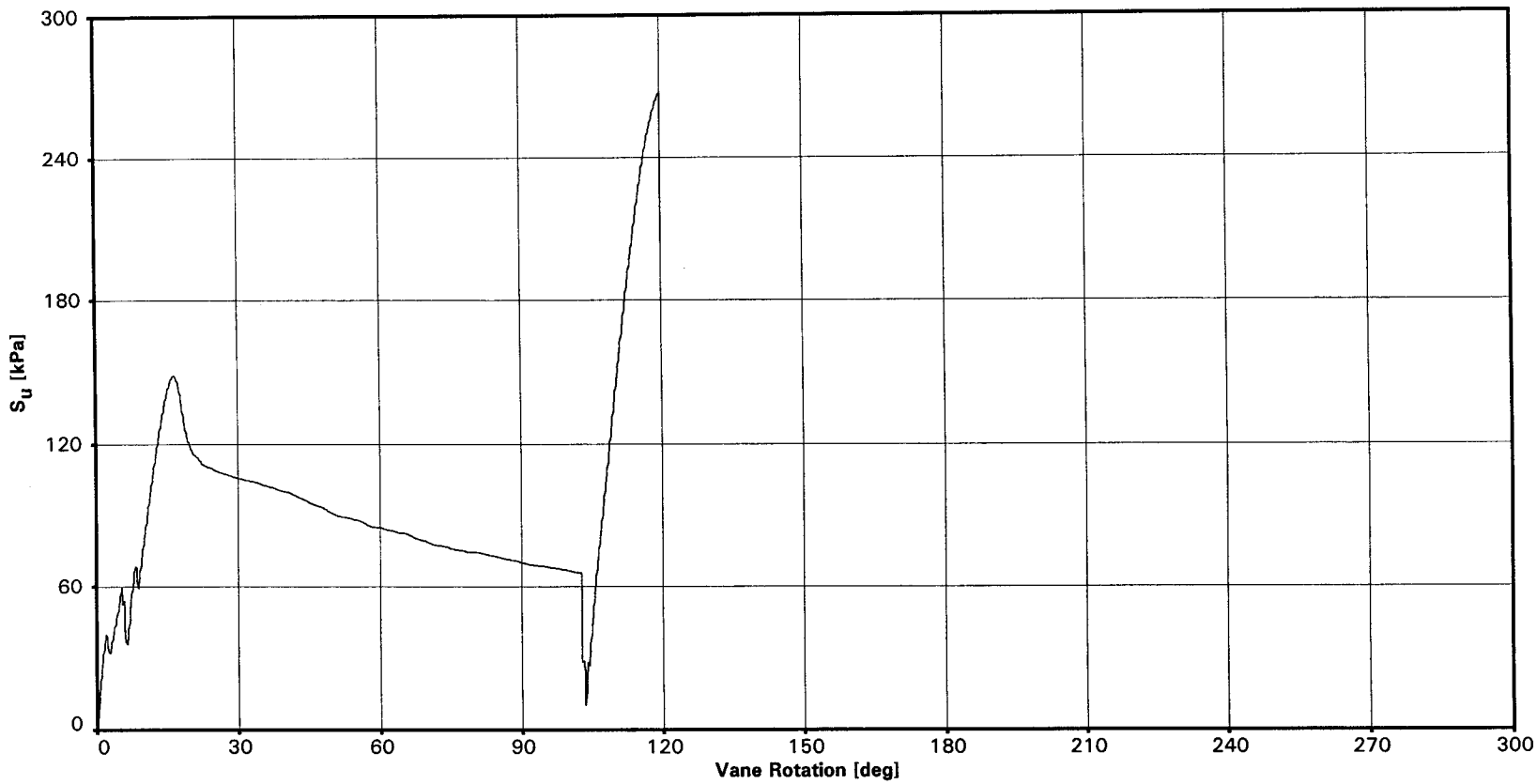


REMOTE VANE (DOWNHOLE) TEST RESULTS
Test Depths: 31.7m and 32.3m
Boring 98-27
SFOBB East Span Seismic Safety Project

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: 39.9m and 40.5m
Boring 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

PLATE 98-27.9j

98-27		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	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																								
0.3	2	90	70	25	1.43	4.7					1.1		0.2												
0.5	3					4.1				2.2	1.5		0.5												
0.6	500													2.4											
0.6	501													3.4											
1.2	4	89	80	36	1.21	3.6	97			8.8	6.5	1.7	1.9											H	
1.2	502													3.4											
1.2	503													3.8											
1.8	406													9.6											
1.8	504													11.0											
2.1	5					4.2				11.5	7.9														
2.3	6	98	86	31	1.22	4.4					8.9	2.4	2.4												
2.4	505													6.7											
2.4	506													7.2											
3.0	8					4.3																			

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 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-27		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)		
3.0	507													9.1											
3.0	508													9.6											
3.2	9	75	82	31	0.85	4.3				21.1	8.4		2.3												
3.4	10									5.2															
3.7	509													10.1											
3.7	510													11.0											
4.0	11					5.4																			
4.1	12										14.6														
4.3	13	68	63	25	1.15						15.7	4.5	3.8												
4.3	511													15.3											
4.3	512													17.2											
4.7	14					8.8																			
4.9	15	33																							
5.6	16	68									32.9														
5.7	17	63				6.3																			

Identification Tests
MC = Moisture Content
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SUMMARY OF LABORATORY TEST RESULTS
Boring 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-27		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	ORGANIC CONTENT (%)
DEPTH (m)	Sample No.	MC (%)	LL (%)	PL (%)	LI	SUW (kN/m3)	Fines (%)	Torvane (kPa)	Pocket Pen. (kPa)	Fall Cone (kPa)	Undist. (kPa)	Remold. (kPa)	Resid. (kPa)		Undist. (kPa)	Remold. (kPa)	e50 (%)	c (kPa)	phi (deg)	Peak c (kPa)	Peak phi (deg)	Post Peak c (kPa)	Post Peak phi (deg)		
5.8	18	24					13																		
6.7	19	57	56	22	1.02			33.5			33.4				25.4		1.5								
6.9	20					6.2									14.8		1.1								
7.0	21							35.4			33.4	12.9													
7.5	22	60	64	31	0.86	6.3									32.8		0.5								
7.6	23									44.0	50.9														
9.3	24	57	67	28	0.75	6.4	99	35.4							22.6		1.7							H	
9.4	25							33.5			21.2	18.8													
12.3	26	18				10.9	14											19.2	39						
12.5	27						7																		
16.3	29	19	34	14	0.25	10.7	44								133.8		2.1							H	
16.5	30								160.4		186.9														
17.0	31	33	70	24	0.19																			C	
17.1	32	33	43	22	0.52						91.6				83.5		0.5								
20.4	33							70.9																	

Identification Tests
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K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-27		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	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)		
20.6	34	54	69	25	0.65	6.3										12.8									
20.7	35		34	14			47		215.5		222.8														
22.3	36								119.7																
22.4	37	59	43	28	2.02	6.3																			
22.6	38							100.5	105.3	166.6	128.7														
23.1	39	58	40	32	3.11																			C	
23.2	40	60	78	32	0.60						134.9														
23.5	401													155.6											
24.1	402													220.7											
25.6	41								143.6																
25.8	42	60	79	28	0.62	6.4		102.9							136.5	33.7	1.7								
25.9	43							122.1	153.2	159.9	179.5														
30.5	44								167.6																
30.6	45	34				8.7	91								137.0		0.8							H	
30.8	46								134.1		122.5														

Identification Tests
MC = Moisture Content
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Identification Tests
SUW = Submerged Unit Weight
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Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
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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 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-27		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	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)		
31.7	403													263.3											
33.2	47							105.3	107.7																
33.4	48	45	64	29	0.46	7.4	95								134.9	27.1	0.9							H	
33.5	49							112.5	100.5	173.3	154.7														
34.1	50	56	89	35	0.40																			C,K	
34.1	51	59	82	40	0.45						144.8														
38.7	52							102.9	107.7																
38.9	53	44	67	26	0.44	7.6									120.8		0.9								
39.0	54							105.3	112.5	141.7	146.0														
39.9	404													148.4											
40.5	405													263.3											
41.5	55							131.7	153.2																
41.6	56	43	84	29	0.26	7.5									130.2	73.7	0.3								
41.8	57								167.6		183.2														
46.3	58								155.6																

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

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

Strength Tests
UU = Unconsolidated Undrained
e50 = Strain at 50% Failure Stress
c = Effective Cohesion
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 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-27		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	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)		
46.5	59	45	80	33	0.27	7.1									182.3		1.0								
46.6	60								153.2	197.3	194.3														
47.2	61	29	31	16	0.89																			C	
47.2	62	30									148.5														
51.8	63							119.7																	
52.0	64	20	32	18	0.16	10.4	73								124.8		1.7							H	
52.1	65							107.7	110.1	197.3	136.1														
56.8	67	25				9.9									163.5		1.1								
57.0	68								129.3		142.3														
60.8	69	18				9.2	4																		
63.9	71	40	62	28	0.35	8.1									180.1	46.2	2.0								
64.0	72							143.6	143.6		222.8														
64.4	73	41	66	25	0.39																			C	
64.5	74	51	90	40	0.22						222.8														
69.3	76	28	40	22	0.35	9.3									166.5		2.1								

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
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CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-27
SFOBB East Span Seismic Safety Project

Earth Mechanics

FUGRO

98-27		IDENTIFICATION TESTS						STRENGTH ESTIMATE			MINIATURE VANE TESTS			REMOTE VANE (kPa)	UU TRIAXIAL			MULTI-STAGE TRIAXIAL		DIRECT SHEAR TESTS				ADDITIONAL TESTS	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)		
69.5	77							177.2	215.5		222.8														
74.1	78	42																							
74.2	79	42	74	32	0.22	7.4	99								233.7	83.0	0.7							H	6
74.4	80							215.5	201.1		222.8														
74.9	81	21	57	21	0.02																			C	
75.0	82	34	64	30	0.11				153.2																
79.6	83							191.5																	
79.7	84	23	38	18	0.25	9.9									179.0	84.7	0.8								
79.9	85								215.5																
83.1	86	24				9.7	13																		
87.3	88	23				9.1	6																		
89.4	89						3																		
91.0	90	63																							

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

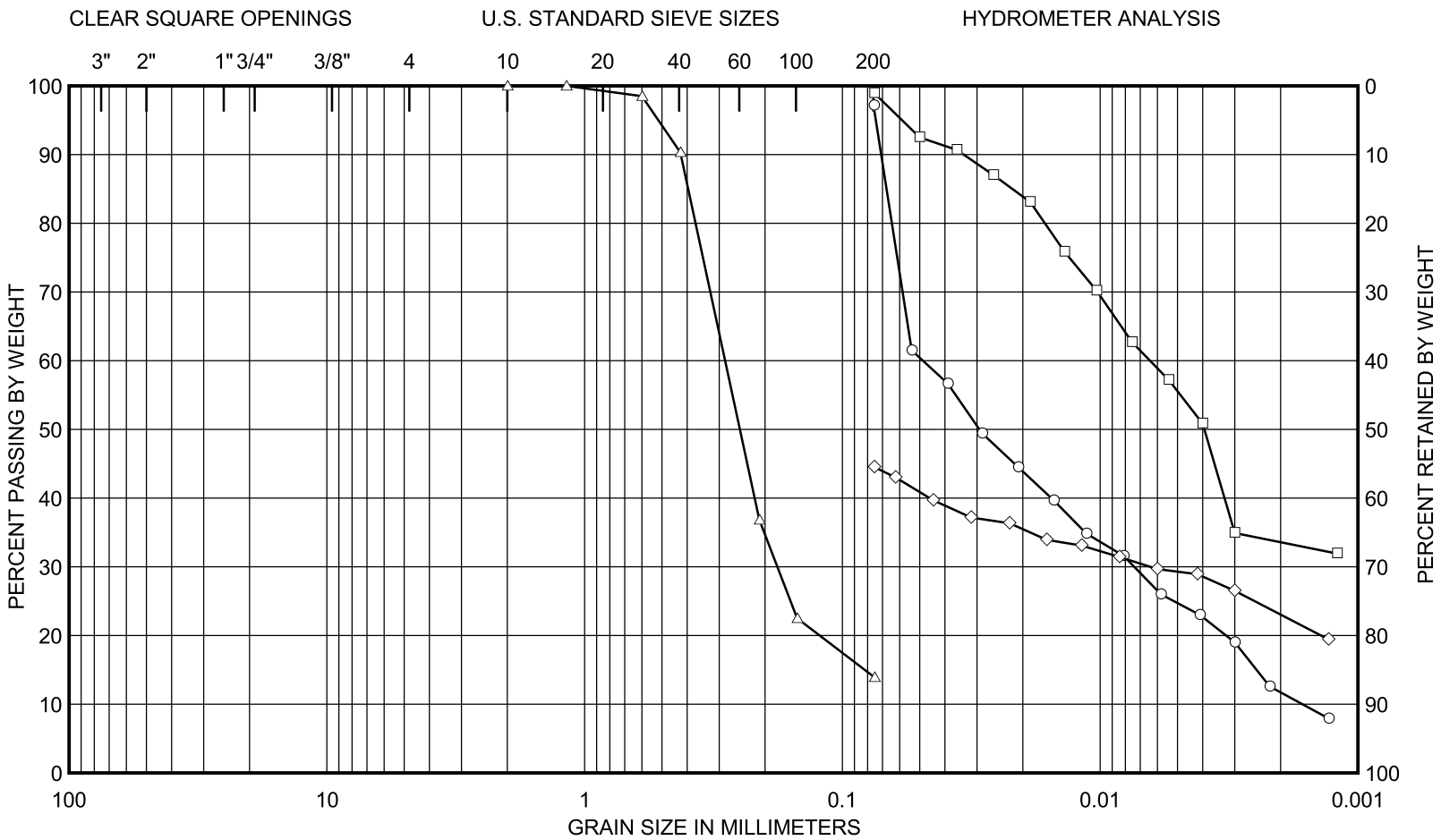
Additional Tests
H = Hydrometer
C = Consolidation Test
RC = Resonant Column
CS = Cyclic Simple Shear

Additional Tests
K = Ko Consolidated Triaxial Test

SUMMARY OF LABORATORY TEST RESULTS
Boring 98-27
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)
4	1.2	○——○	FAT CLAY (CH)			0.029
24	9.3	□——□	FAT CLAY (CH)			0.0039
26	12.3	△——△	SILTY FINE SAND (SM) with a trace of medium sand			0.25
29	16.3	◇——◇	SANDY LEAN CLAY (CL)			

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-27
SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-27.11a

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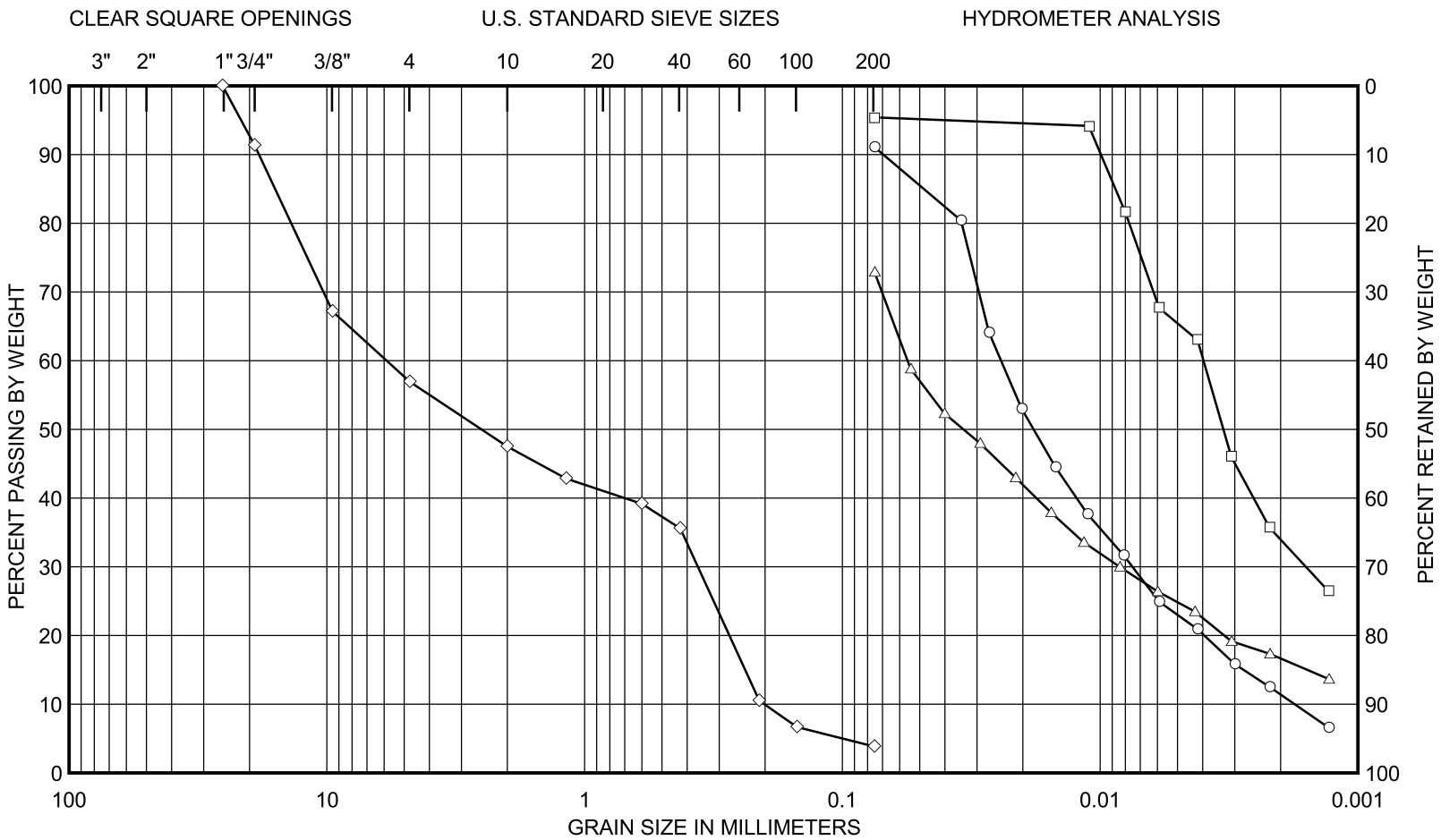

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
45	30.6	○——○	FAT CLAY (CH)			0.018
48	33.4	□——□	FAT CLAY (CH)			0.0033
64	52.0	△——△	LEAN CLAY (CL) with sand			0.034
69	60.8	◇——◇	FINE SAND (SP) with fine gravel and medium to coarse sand	0.1	29.2	2.5

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-27
SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-27.11b

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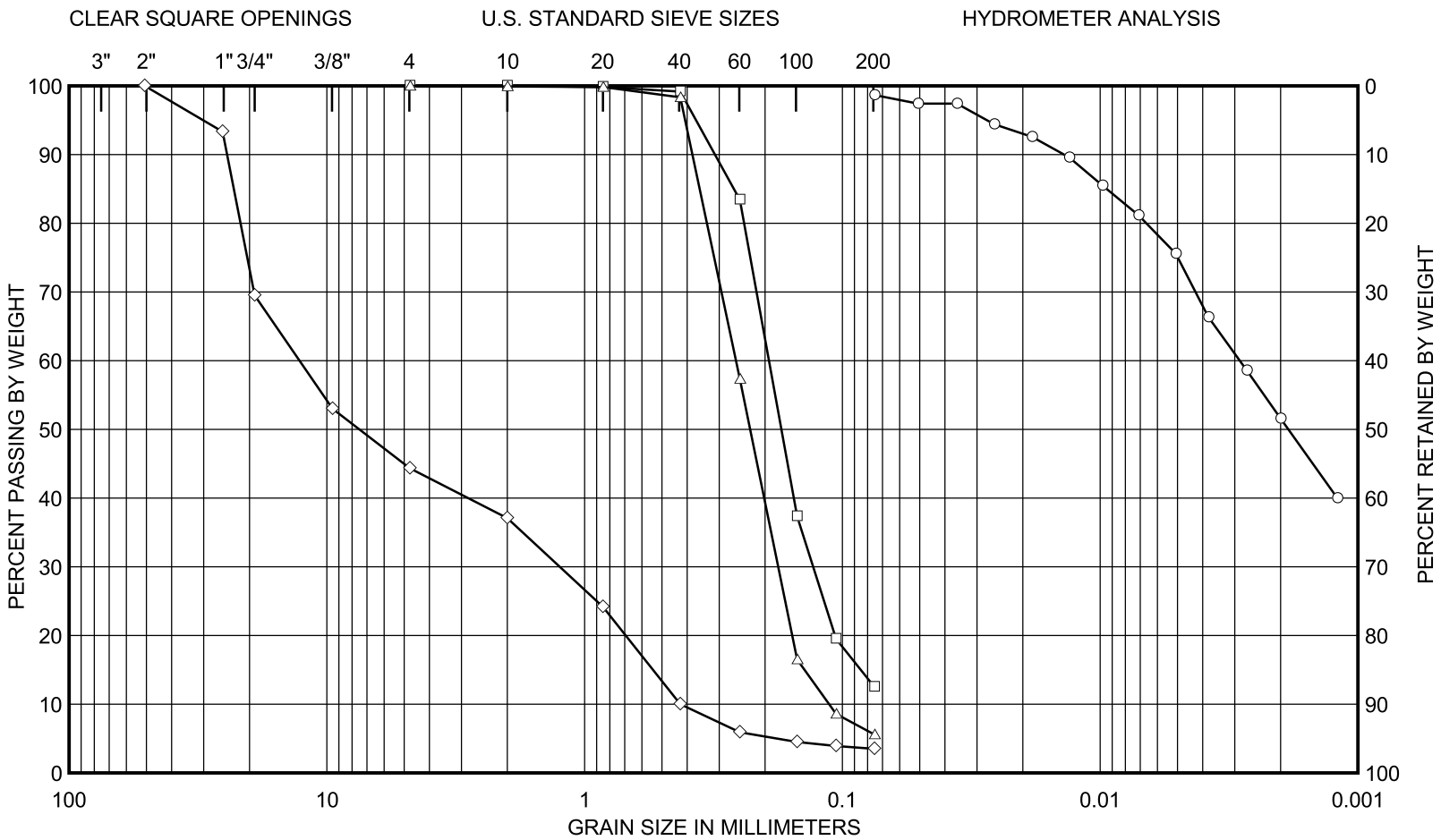

GRAVEL		SAND			SILT (nonplastic)
COARSE	FINE	COARSE	MEDIUM	FINE	to CLAY (plastic)

SAMPLE NO.	DEPTH (m)	CURVE	CLASSIFICATION	Cc	Cu	D50 (mm)
79	74.2	○——○	FAT CLAY (CH)			0.0019
86	83.1	□——□	SILTY FINE SAND (SM)			0.17
88	87.3	△——△	FINE SAND (SP-SM) with silt	1.1	2.3	0.23
89	89.4	◇——◇	FINE TO COARSE GRAVEL (GP) with medium sand and a trace of fine and coarse sand	0.3	30.1	7.5

GRAIN SIZE DISTRIBUTION CURVES
Boring 98-27
SFOBB East Span Seismic Safety Project

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

Earth Mechanics

FUGRO

PLATE 98-27.11c

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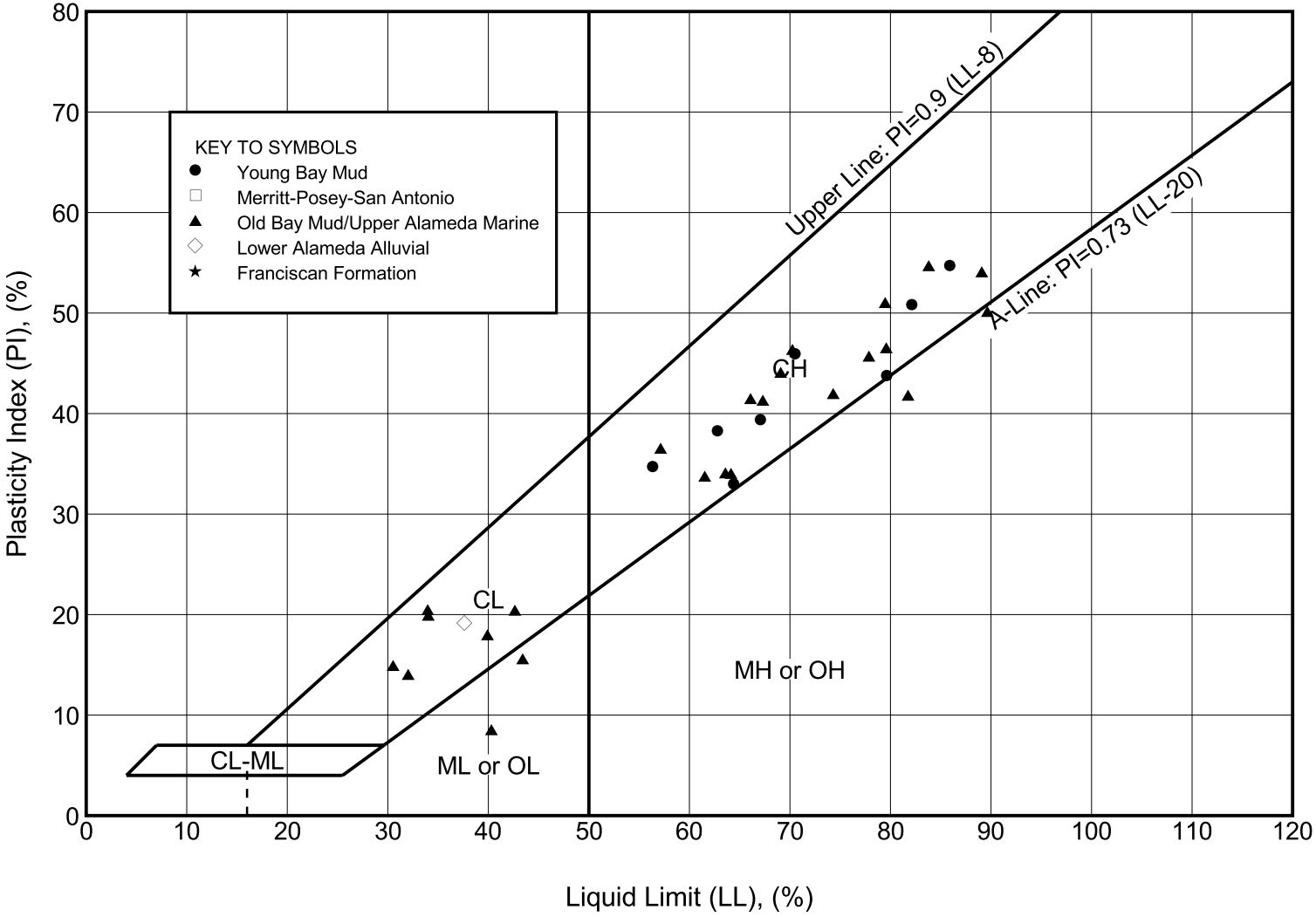

PLASTICITY CHART
Boring 98-27
SFOBB East Span Seismic Safety Project

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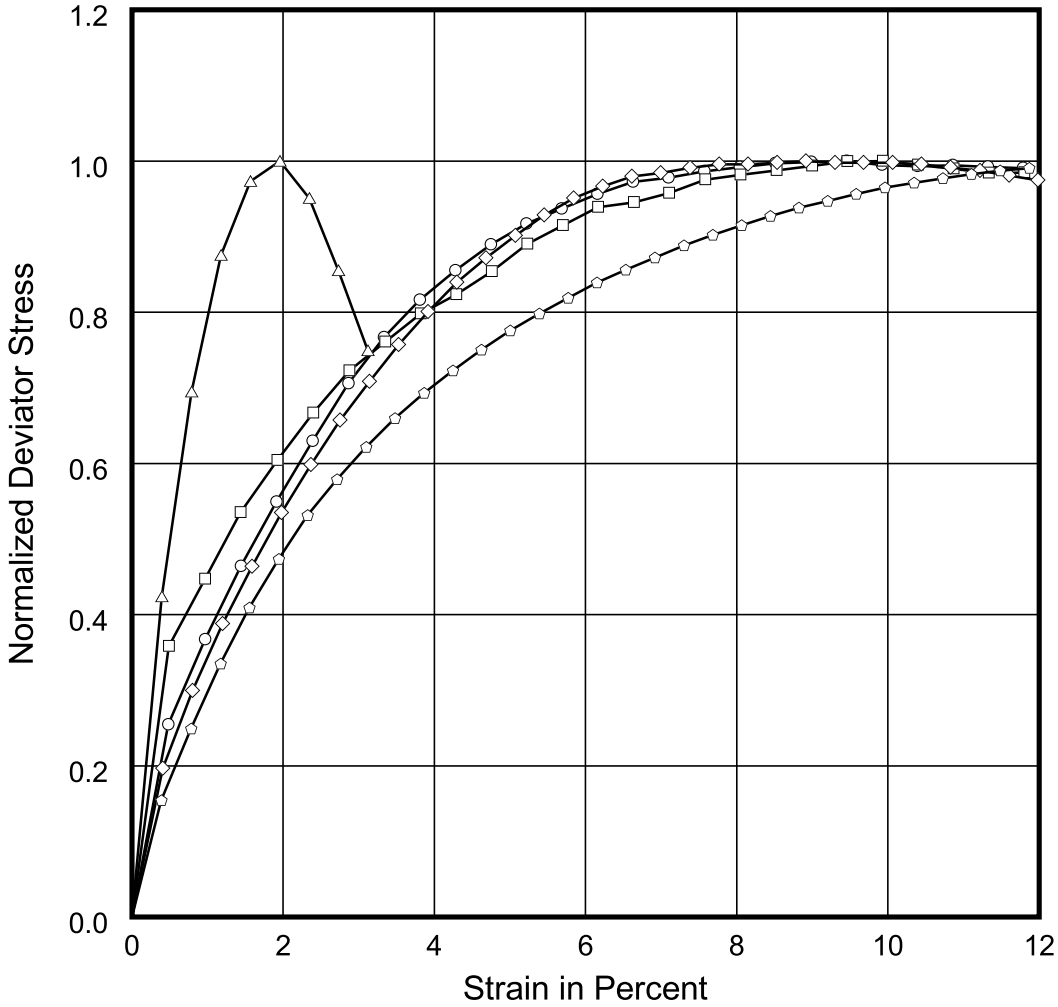
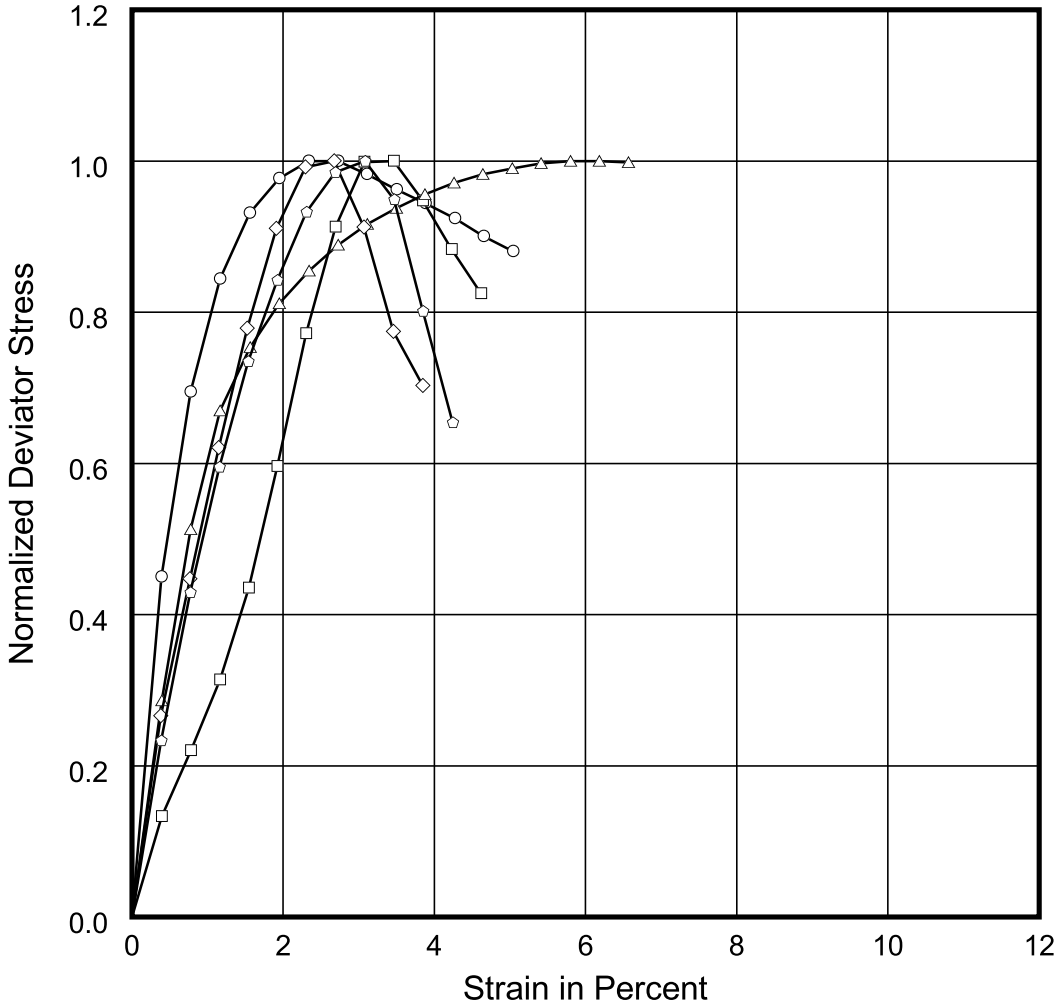


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	19	6.7	UU	138	51	1.5
	20	6.9	UU	172	30	1.1
	22	7.5	UU	172	66	0.5
	24	9.3	UU	207	45	1.7
	29	16.3	UU	689	268	2.1

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-27
SFOBB East Span Seismic Safety Project

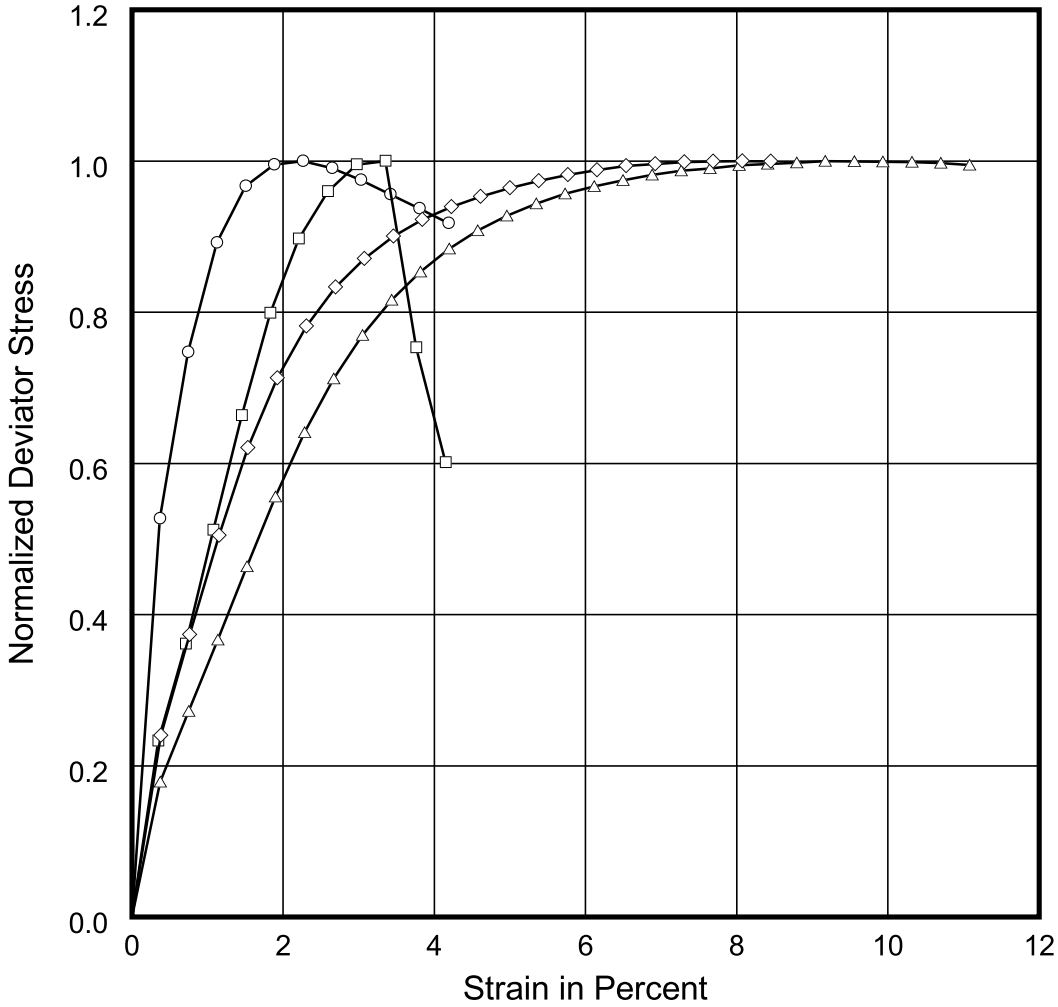


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
	32	17.1	UU	827	167	0.5
	42	25.8	UU	931	273	1.7
	45	30.6	UU	1034	274	0.8
	48	33.4	UU	1103	270	0.9
	53	38.9	UU	1241	242	0.9

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-27
SFOBB East Span Seismic Safety Project

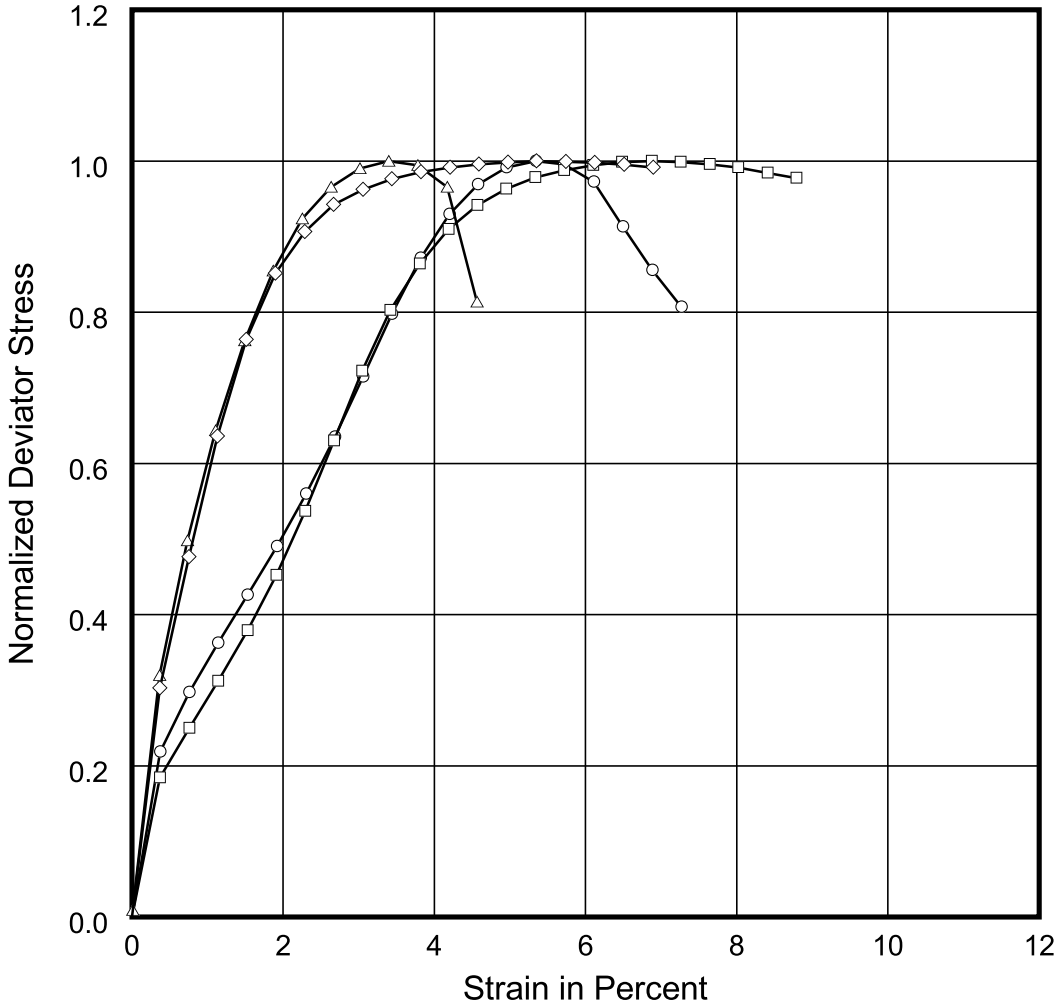


Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	56	41.6	UU	1275	260	0.3
□—□	59	46.5	UU	1379	365	1.0
△—△	64	52.0	UU	1517	250	1.7
◇—◇	67	56.8	UU	1620	327	1.1

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-27
SFOBB East Span Seismic Safety Project

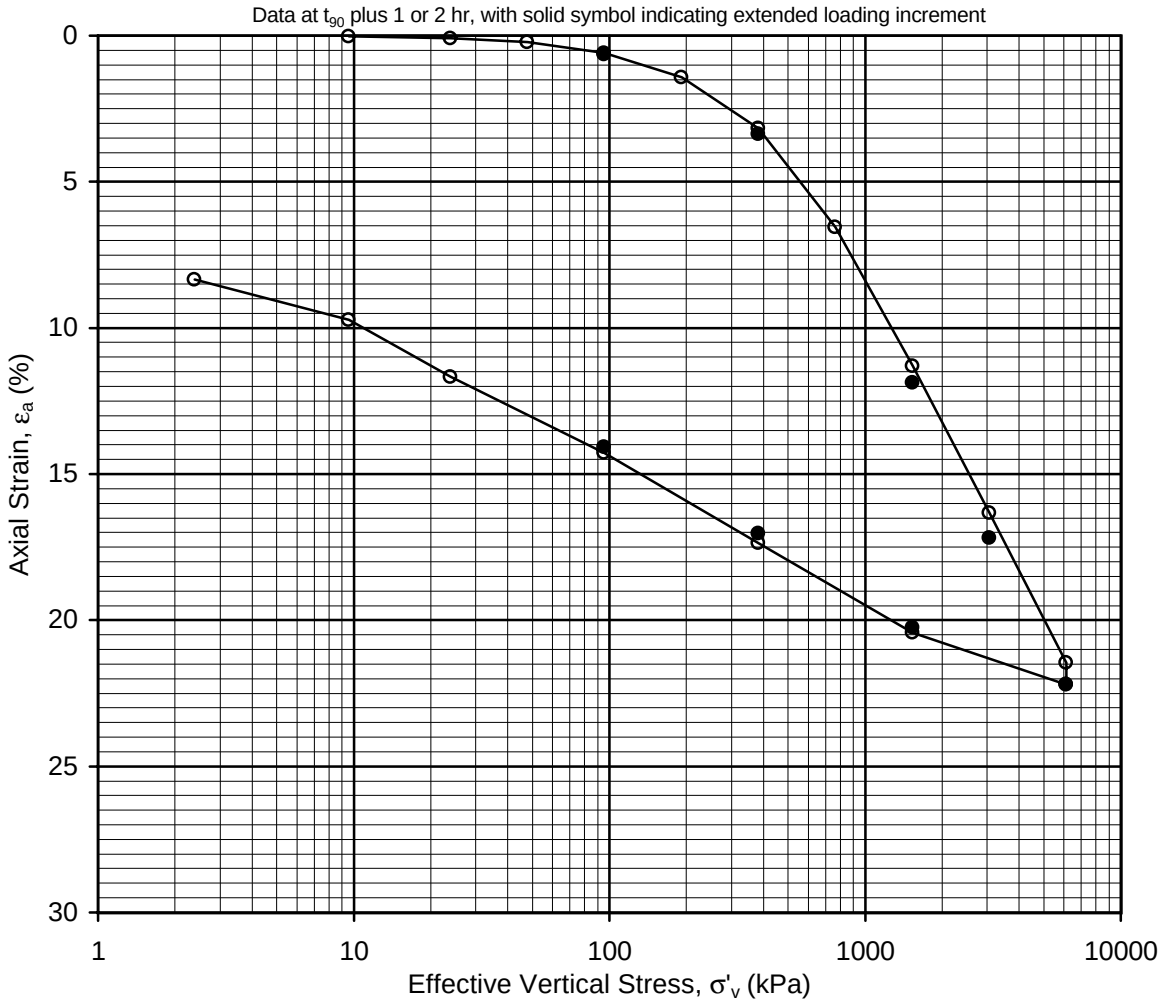


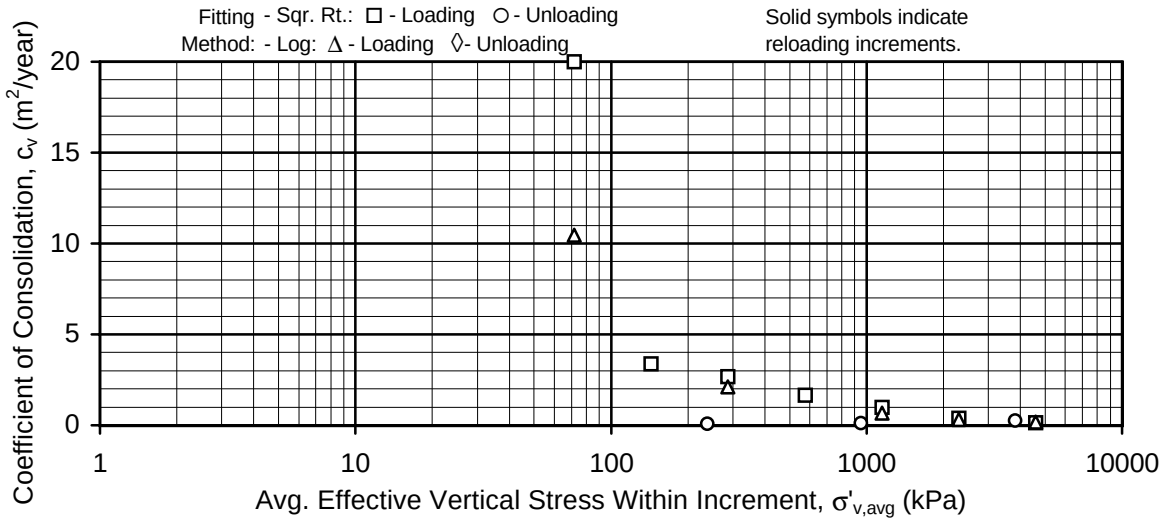
Curve	Sample No.	Depth (m)	Test Type	Confining Pressure (kPa)	Maximum Deviator Stress (kPa)	e50 (%)
○—○	71	63.9	UU	1793	360	2.0
□—□	76	69.3	UU	1930	333	2.1
△—△	79	74.2	UU	2034	467	0.7
◇—◇	84	79.7	UU	2137	358	0.8

Deviator stress normalized with respect to maximum deviator stress.

STRESS-STRAIN CURVES

Unconsolidated-Undrained Triaxial Compression Test
Boring 98-27
SFOBB East Span Seismic Safety Project

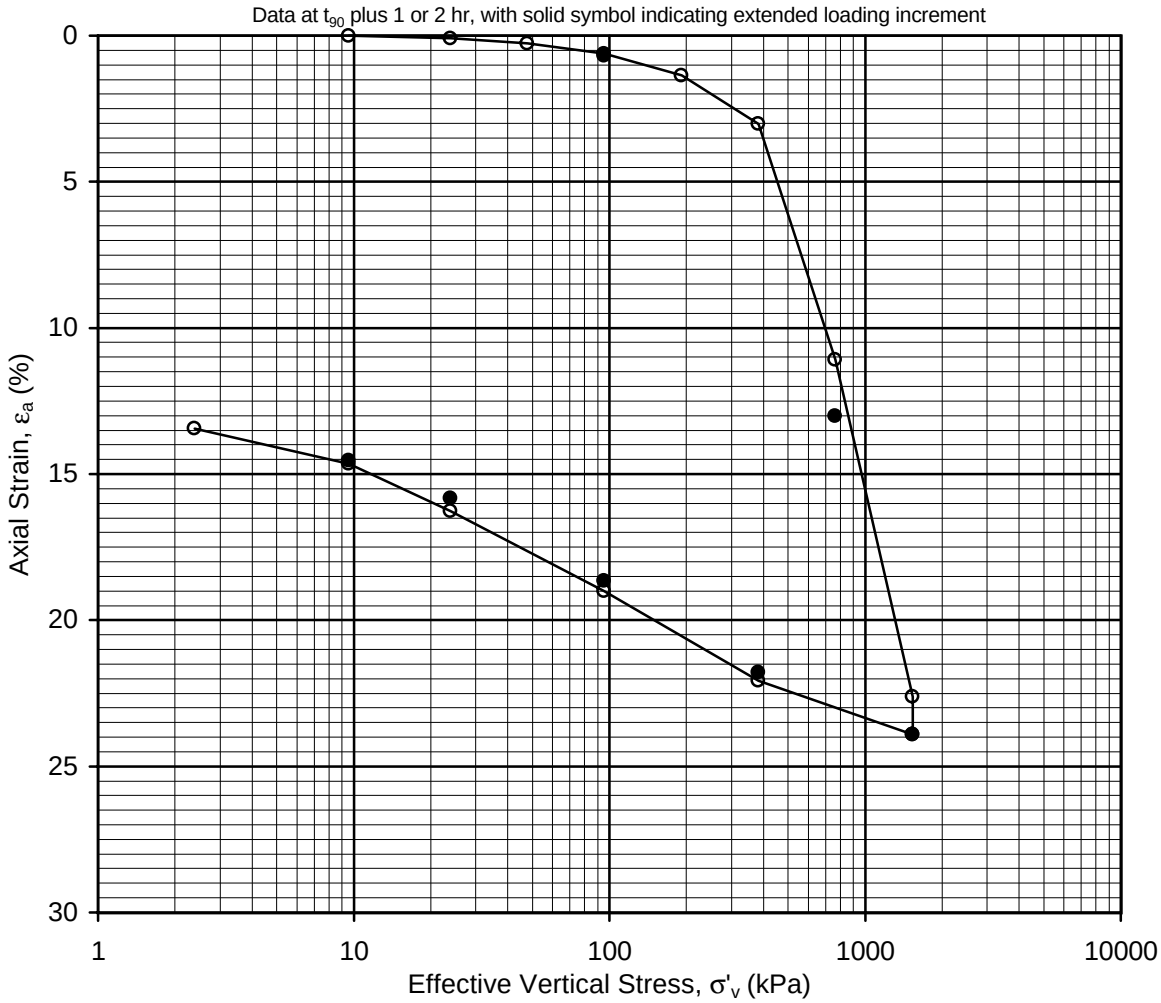


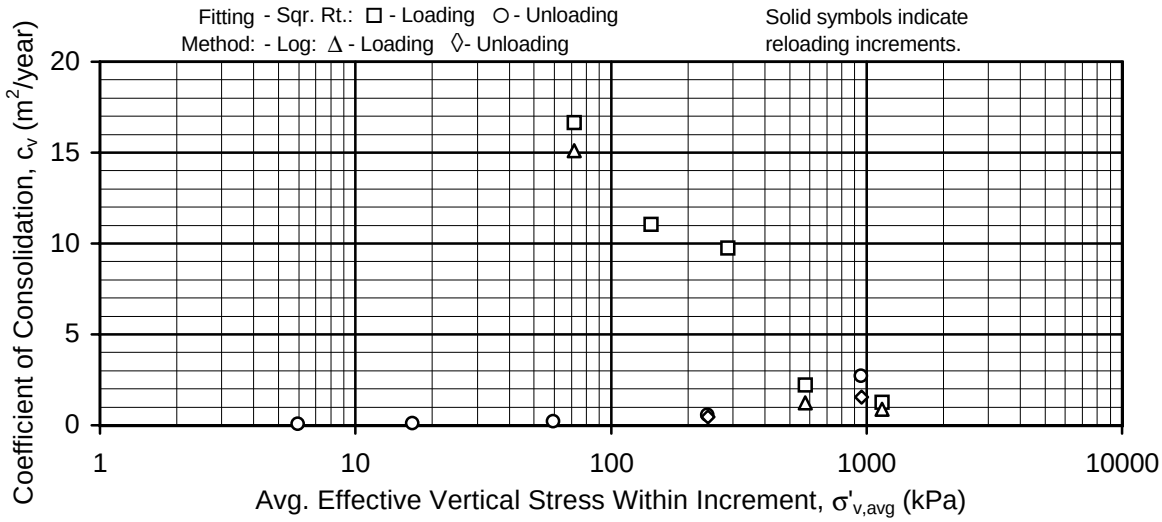


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 31 - Depth: 17.0m
Boring 98-27
SFOBB East Span Seismic Safety Project

PLATE 98-27.14a

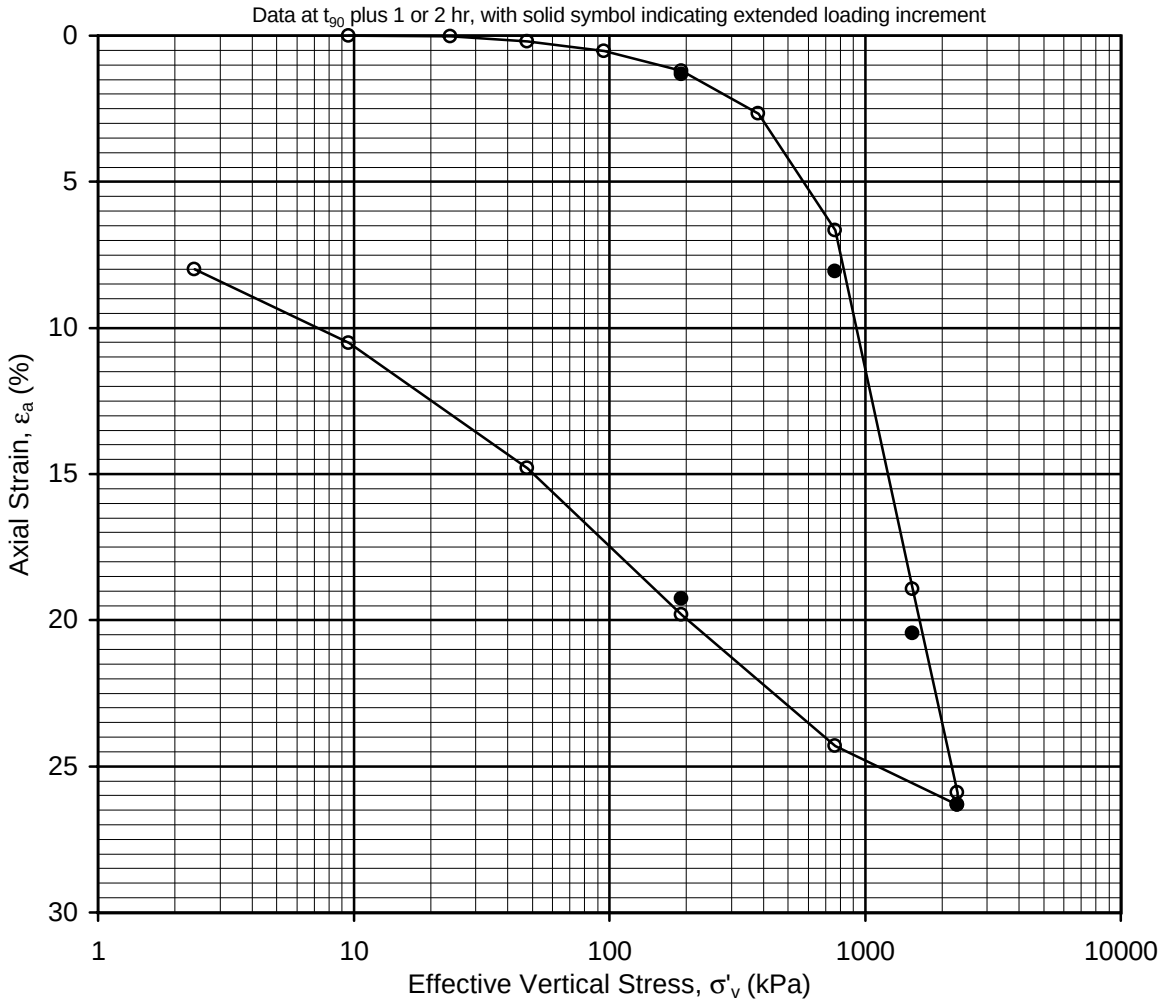


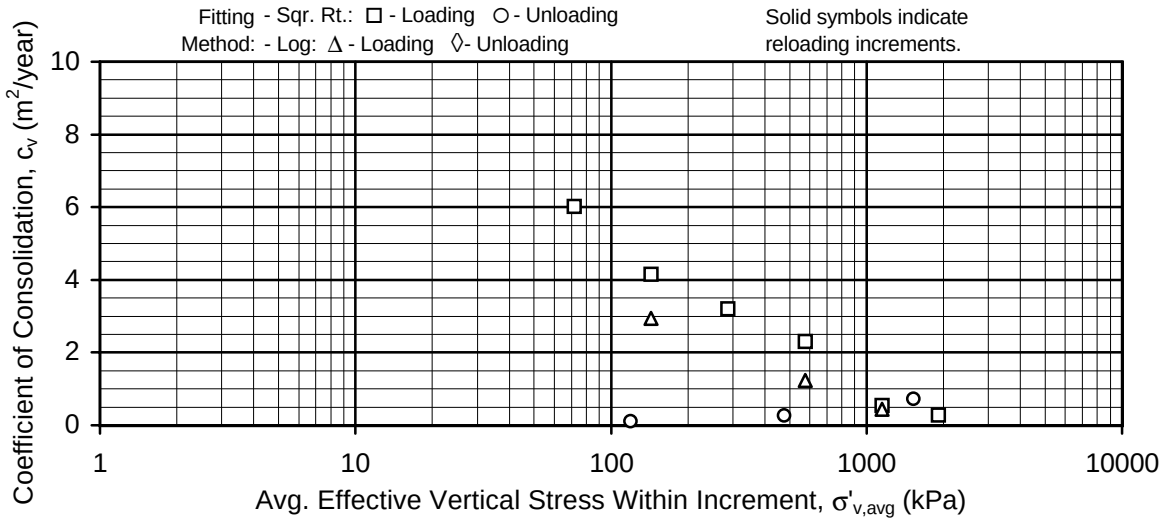


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 39 - Depth: 23.1m
Boring 98-27
SFOBB East Span Seismic Safety Project

PLATE 98-27.14b

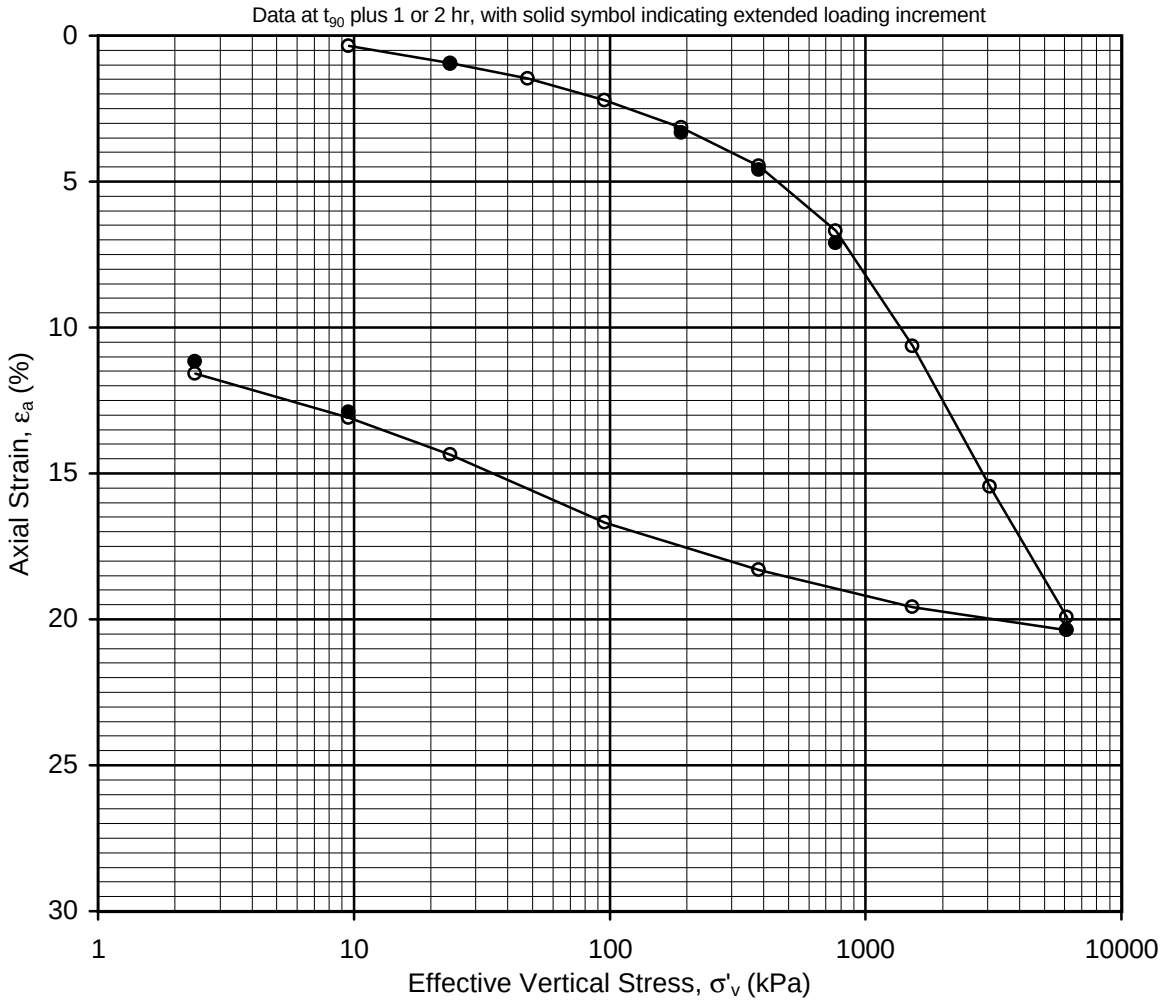


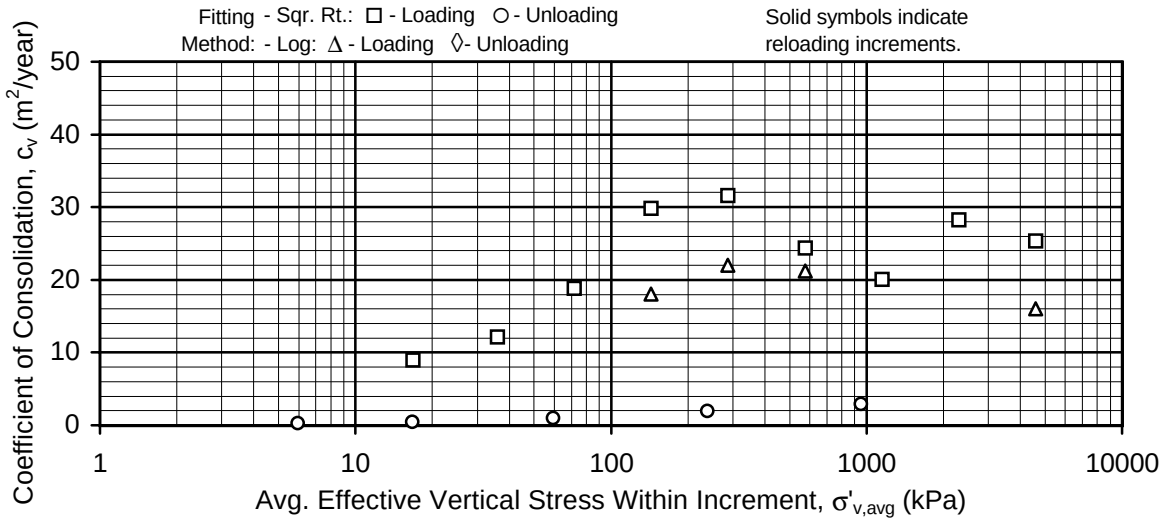


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 50 - Depth: 34.1m
Boring 98-27
SFOBB East Span Seismic Safety Project

PLATE 98-27.14c

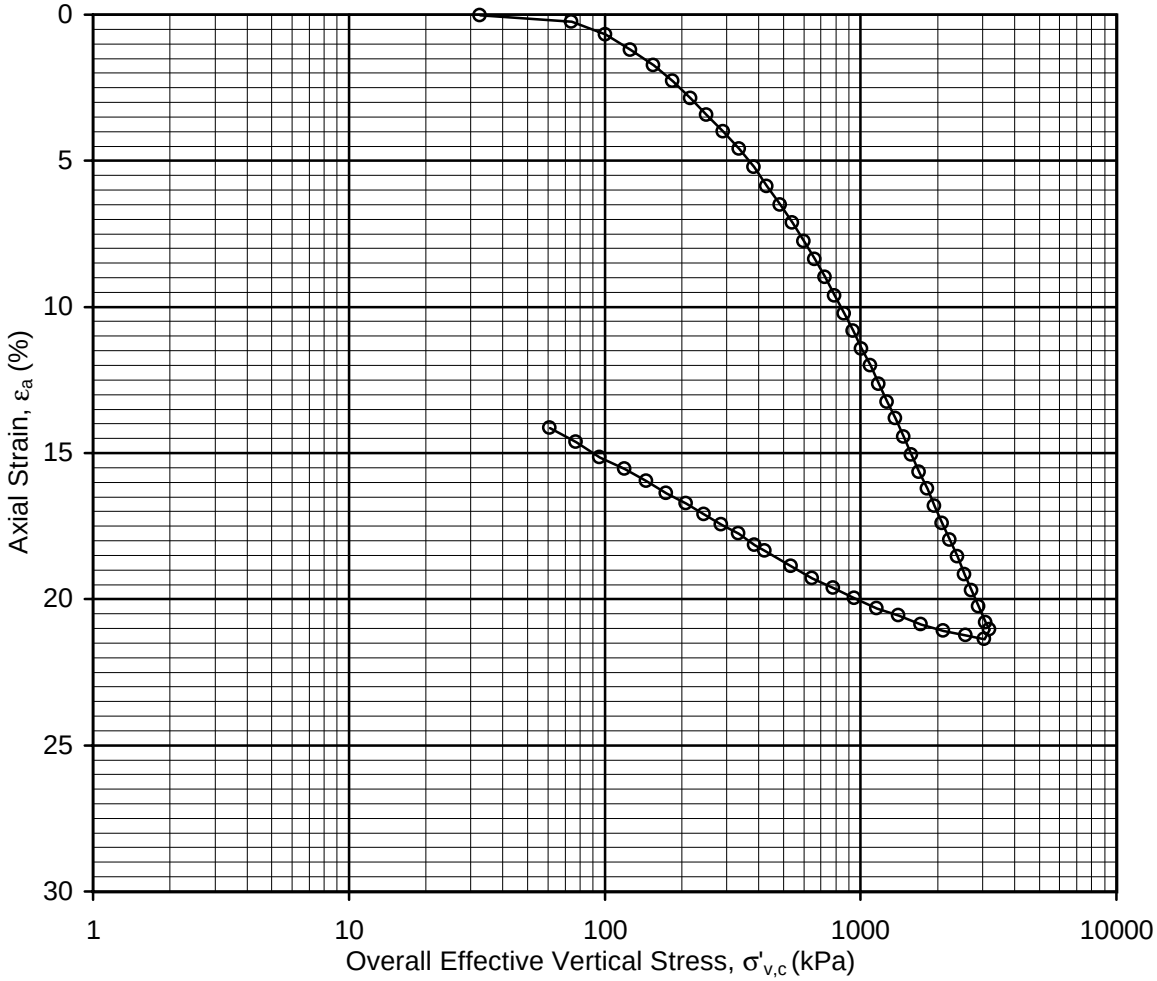


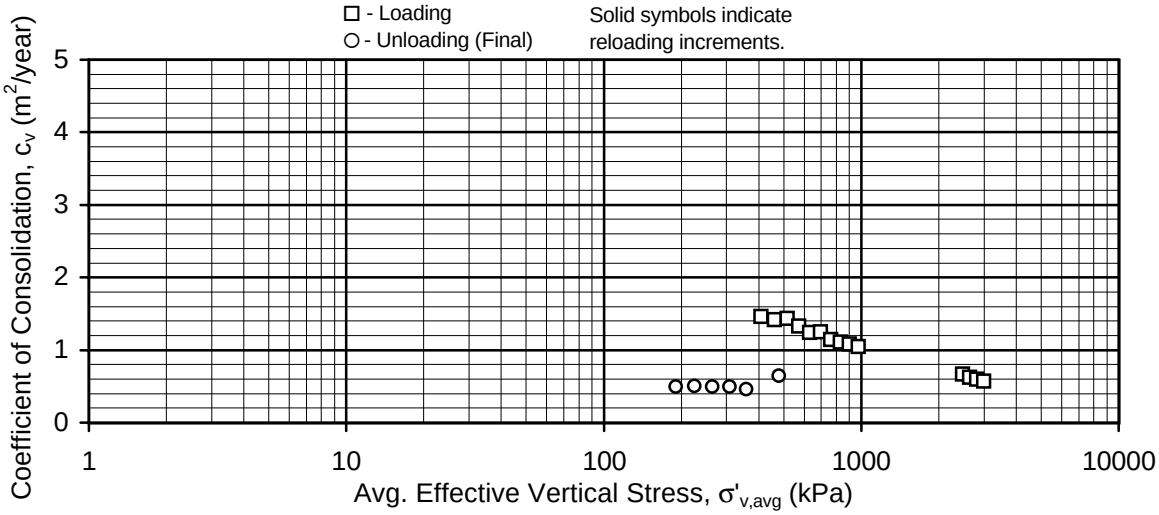


INCREMENTAL CONSOLIDATION TEST RESULTS

Sample No. 61 - Depth: 47.2m
Boring 98-27
SFOBB East Span Seismic Safety Project

PLATE 98-27.14d

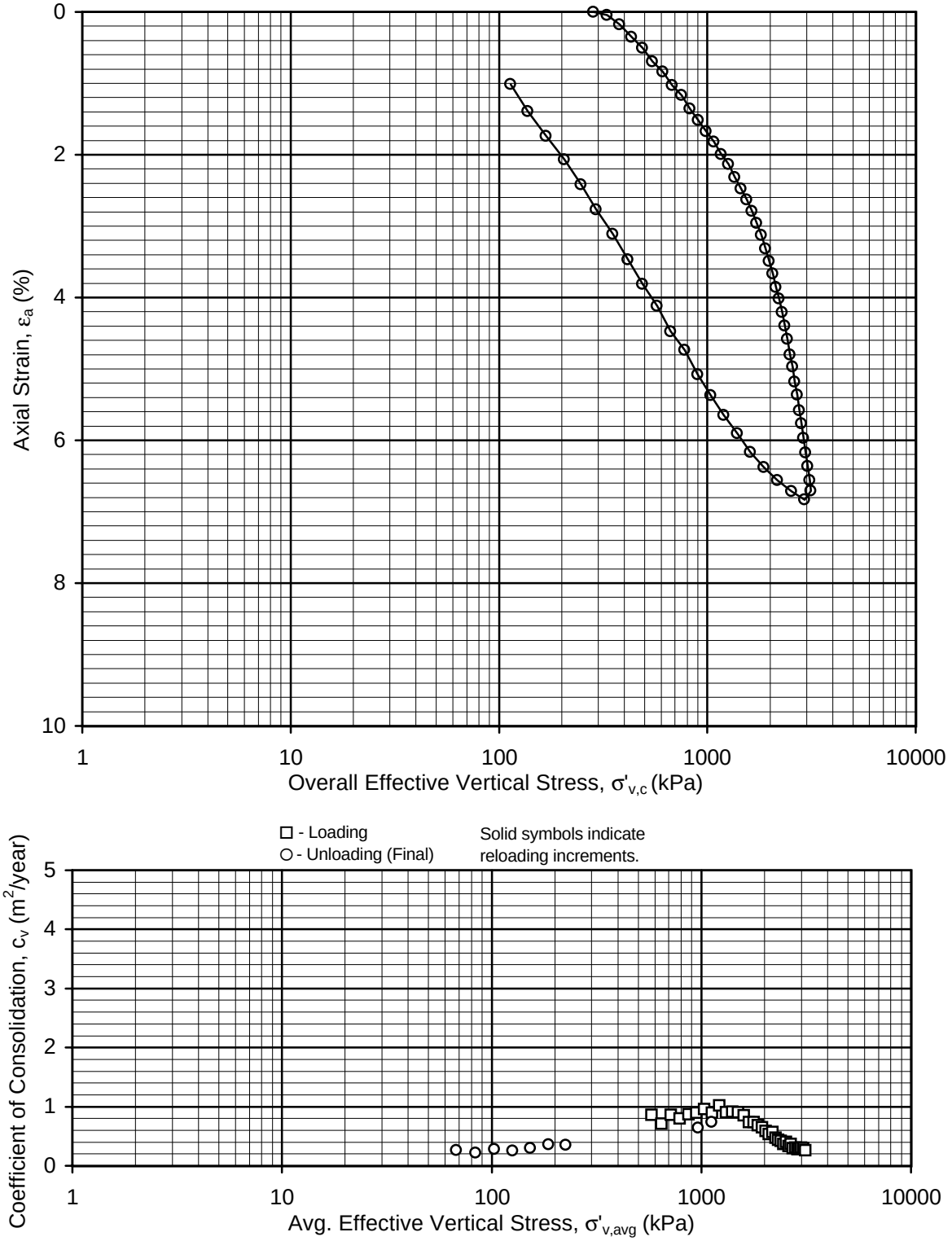




CRS CONSOLIDATION TEST RESULTS

Sample No. 73 - Depth: 64.4m
Boring 98-27
SFOBB East Span Seismic Safety Project

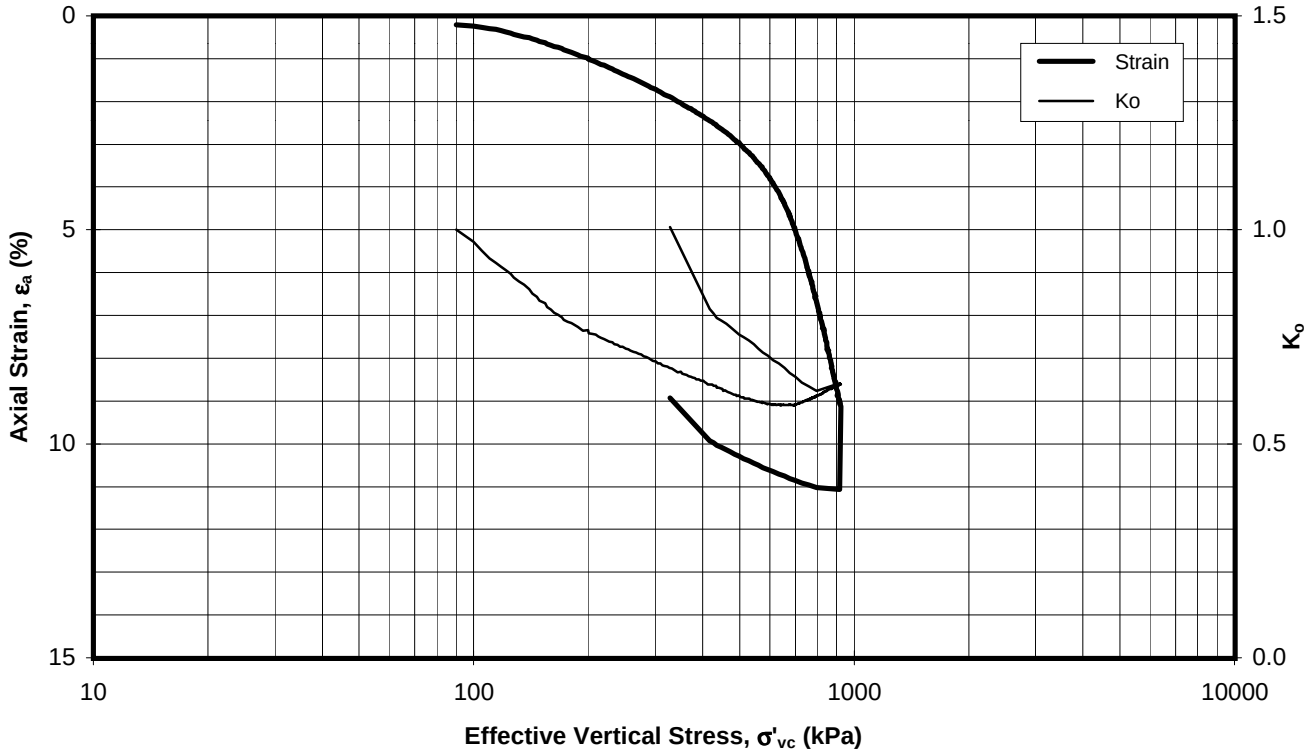
PLATE 98-27.14e

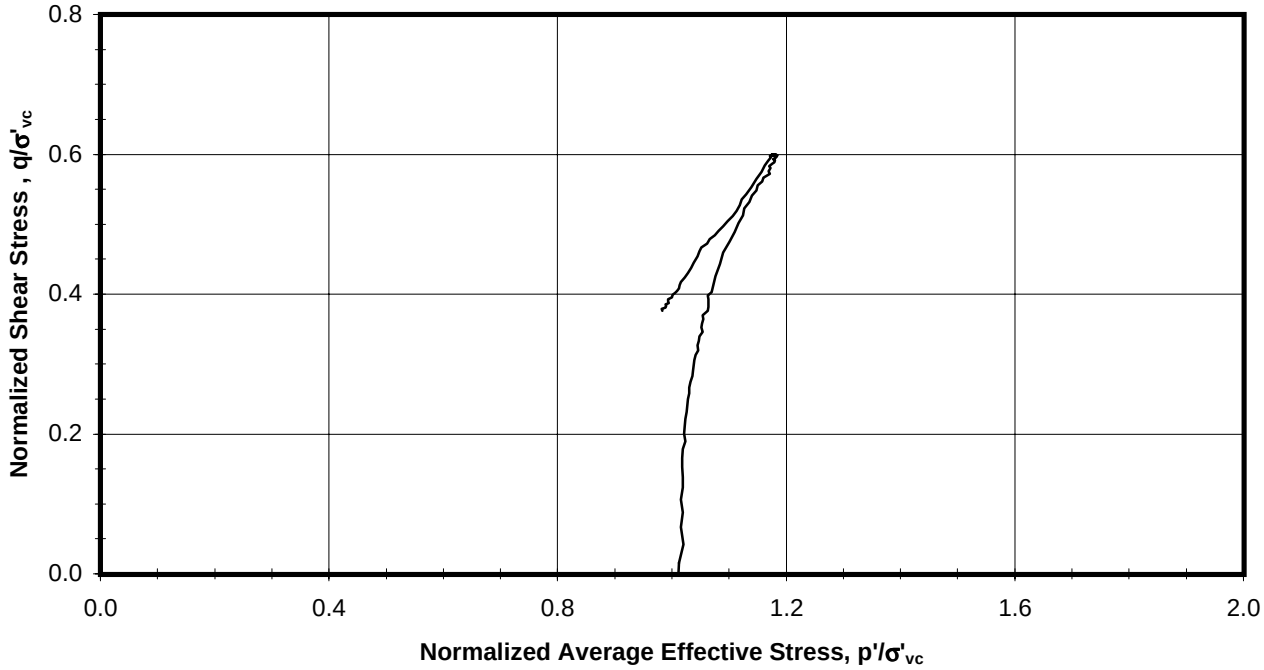


CRS CONSOLIDATION TEST RESULTS

Sample No. 81 - Depth: 74.9m
Boring 98-27
SFOBB East Span Seismic Safety Project

PLATE 98-27.14f





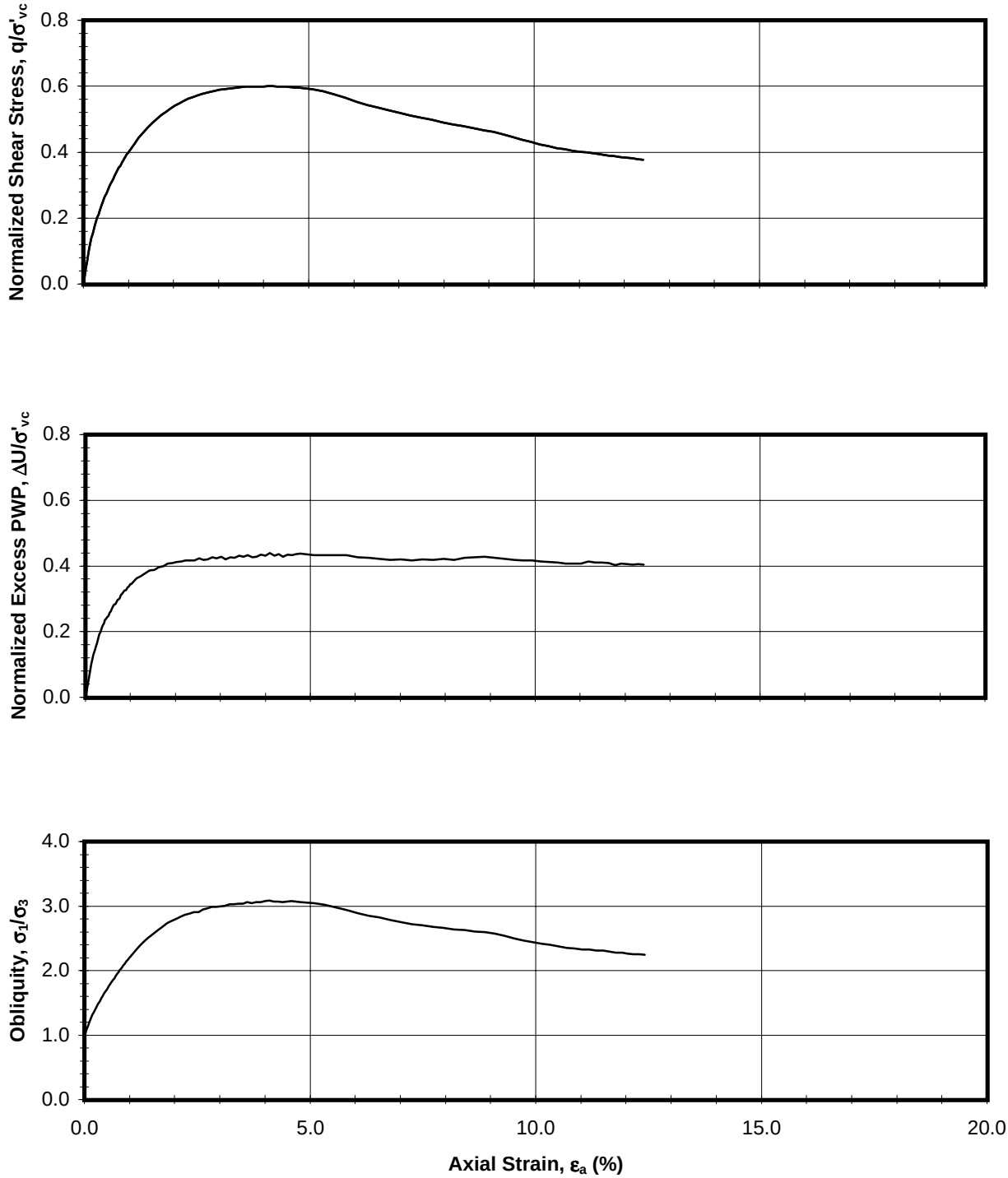
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 50 - Depth: 34.0m

Boring 98-27

SFOBB East Span Seismic Safety Project

PLATE 98-27.15.1

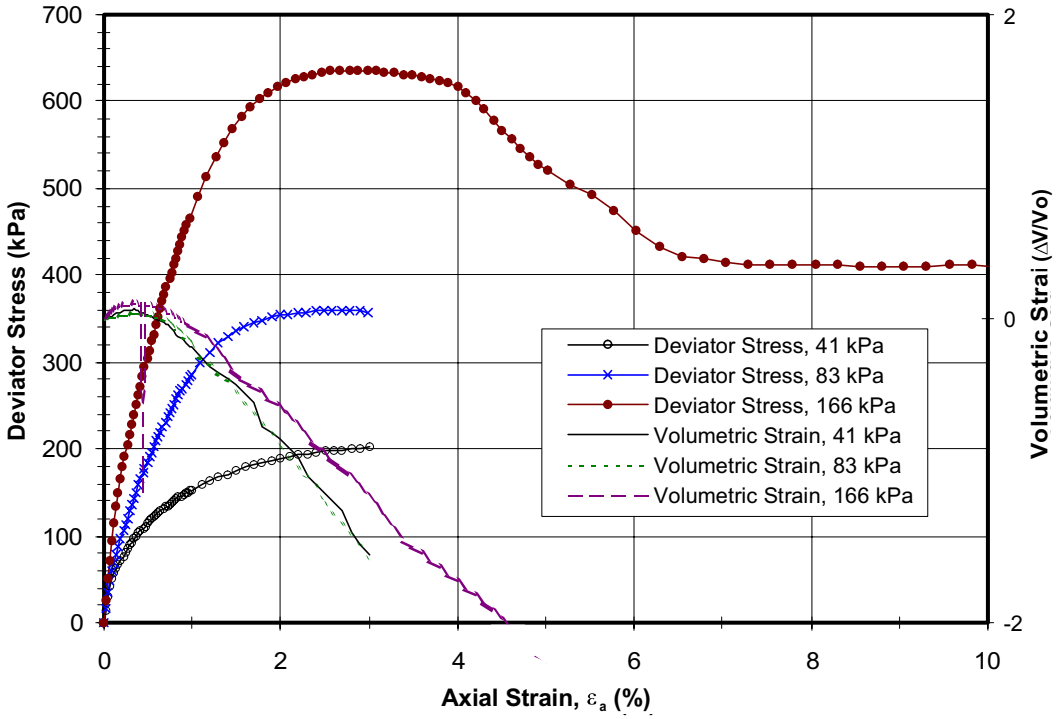


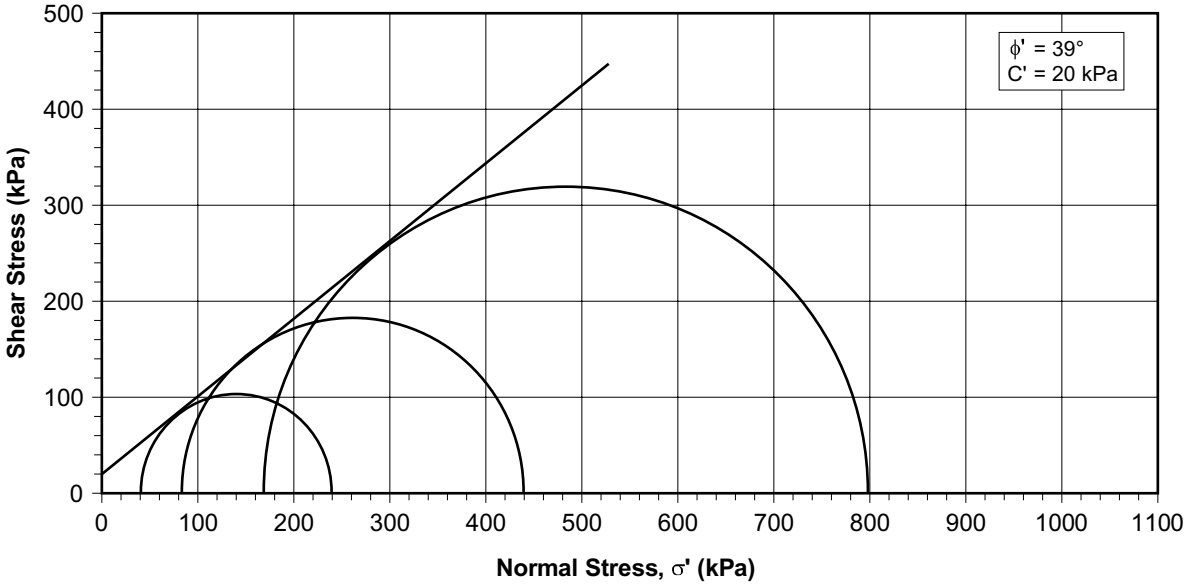
Ko CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

Sample No. 50 - Depth: 34.0m

Boring 98-27

SFOBB East Span Seismic Safety Project





ISOTROPICALLY CONSOLIDATED-DRAINED TRIAXIAL COMPRESSION TEST

Sample 26 - Depth: 12.3m

Boring 98-27

SFOBB East Span Seismic Safety Project

PLATE 98-27.16

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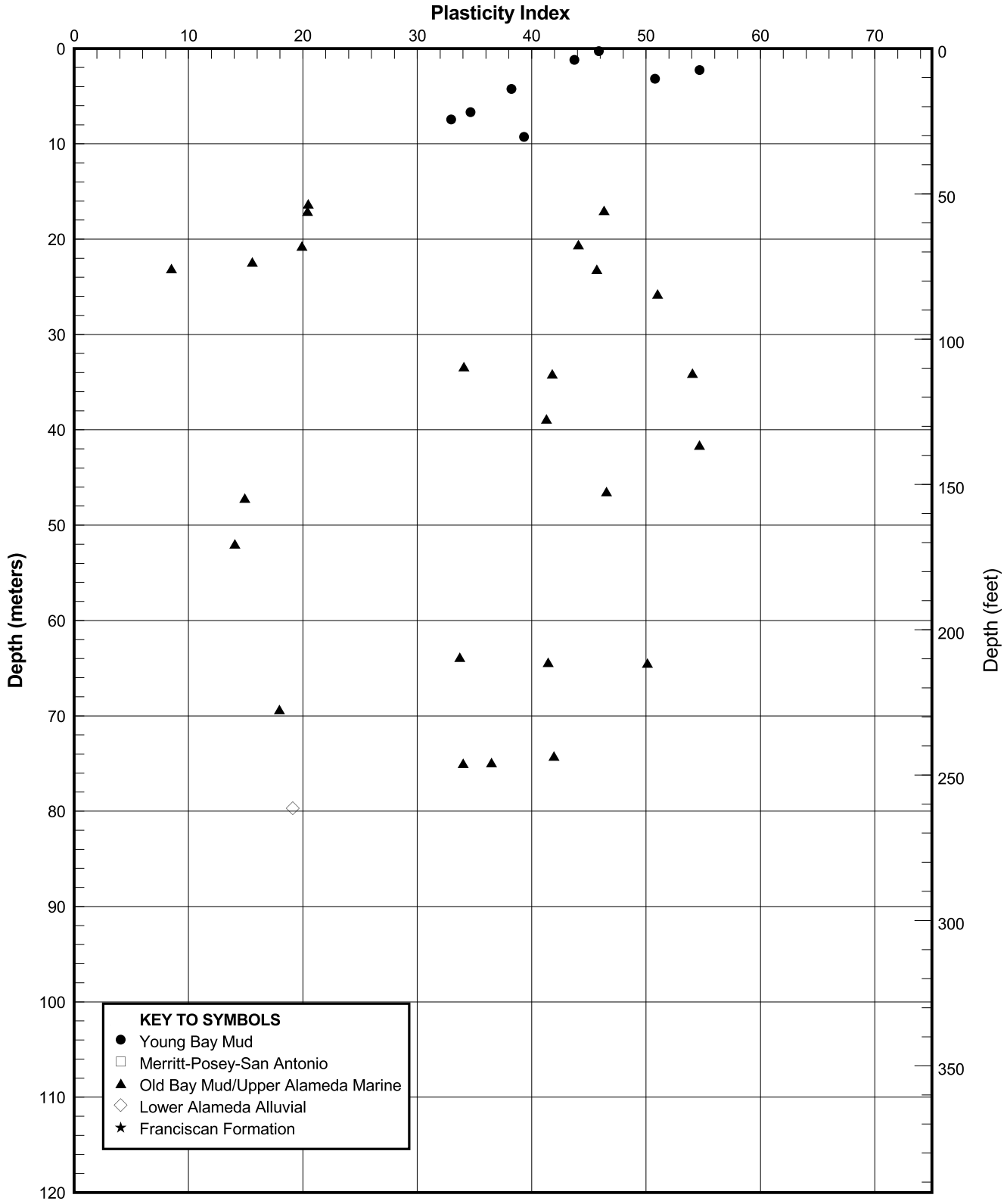
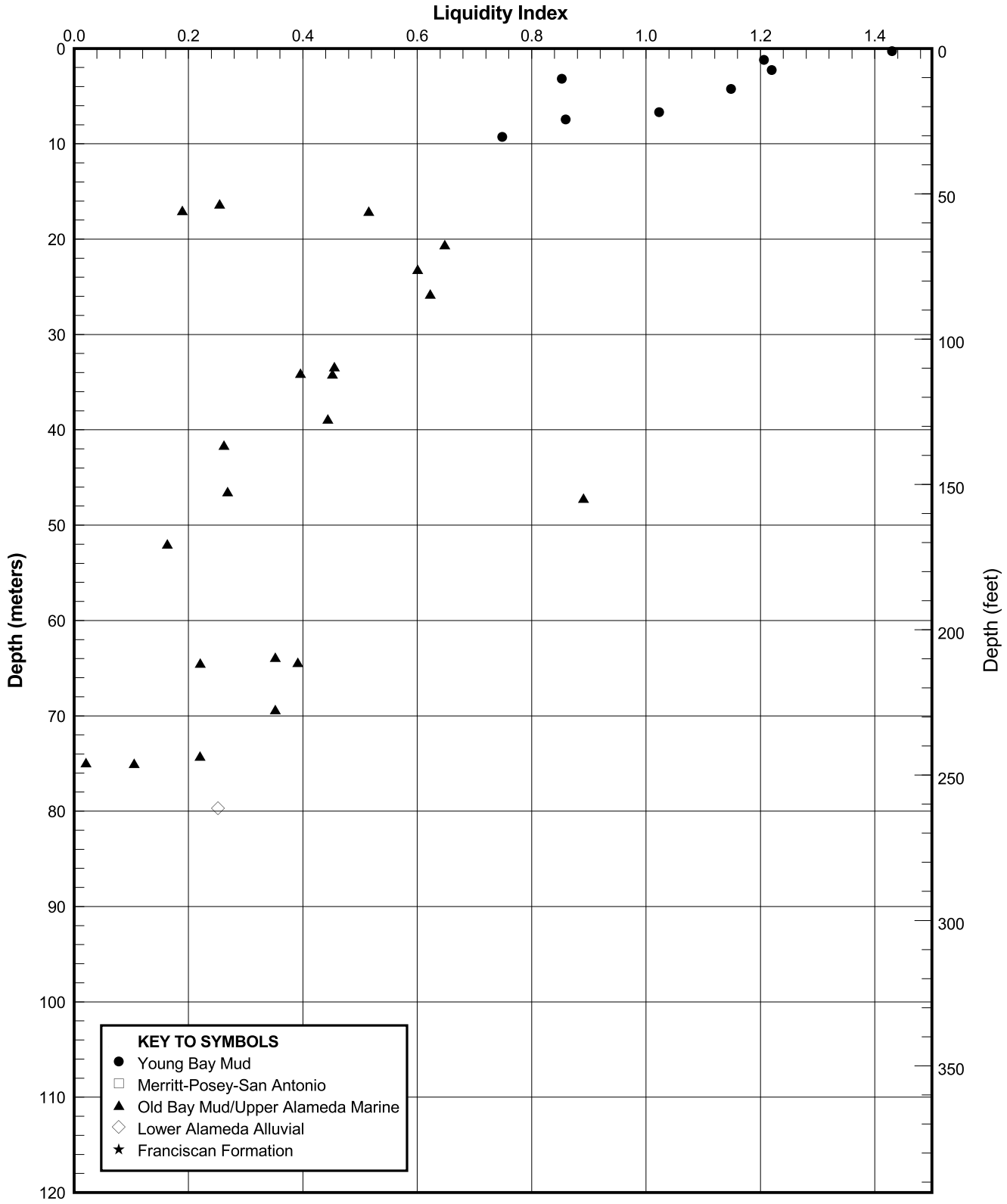
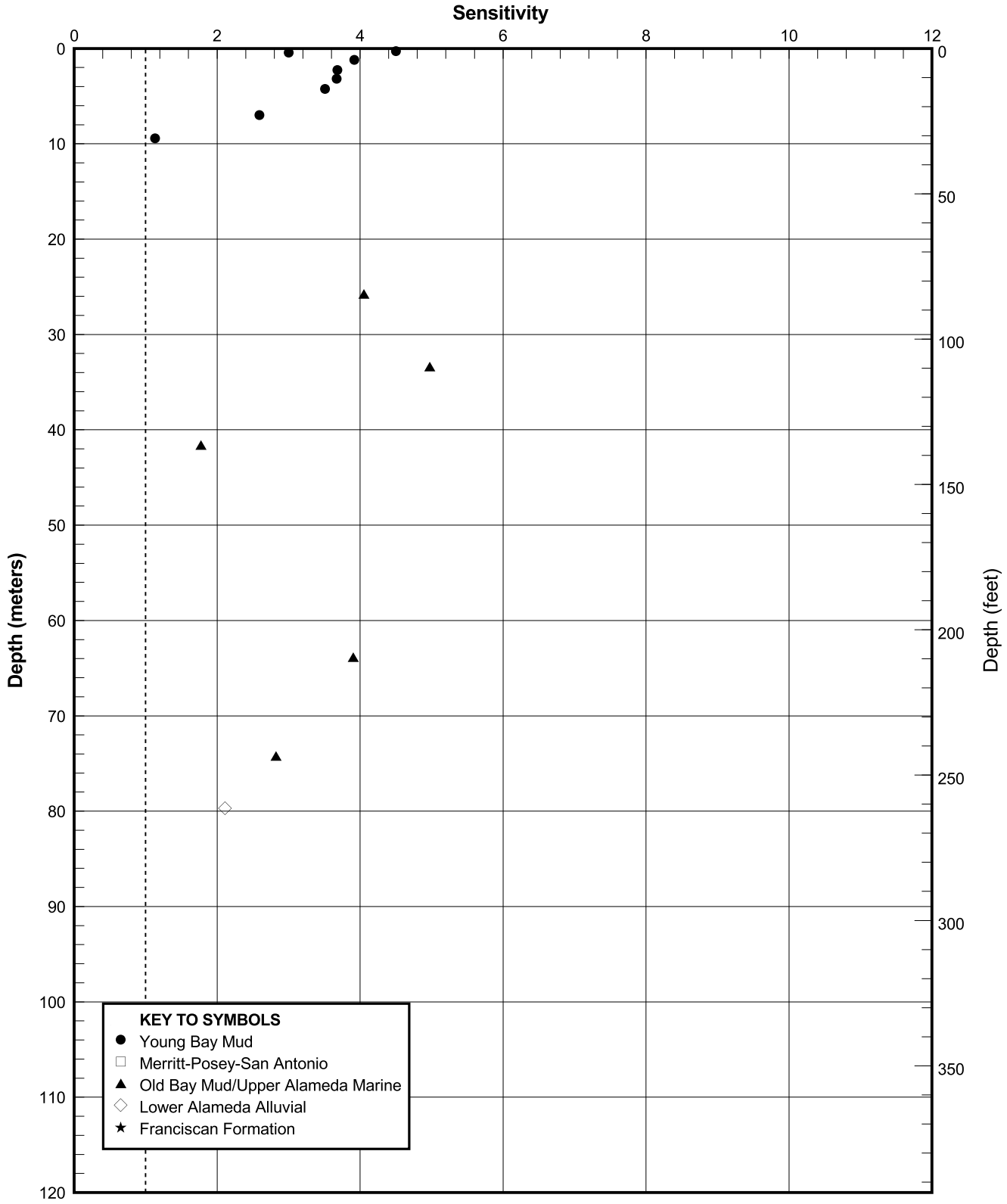


PLASTICITY INDEX PROFILE
Boring 98-27
SFOBB East Span Seismic Safety Project

PLATE 98-27.17

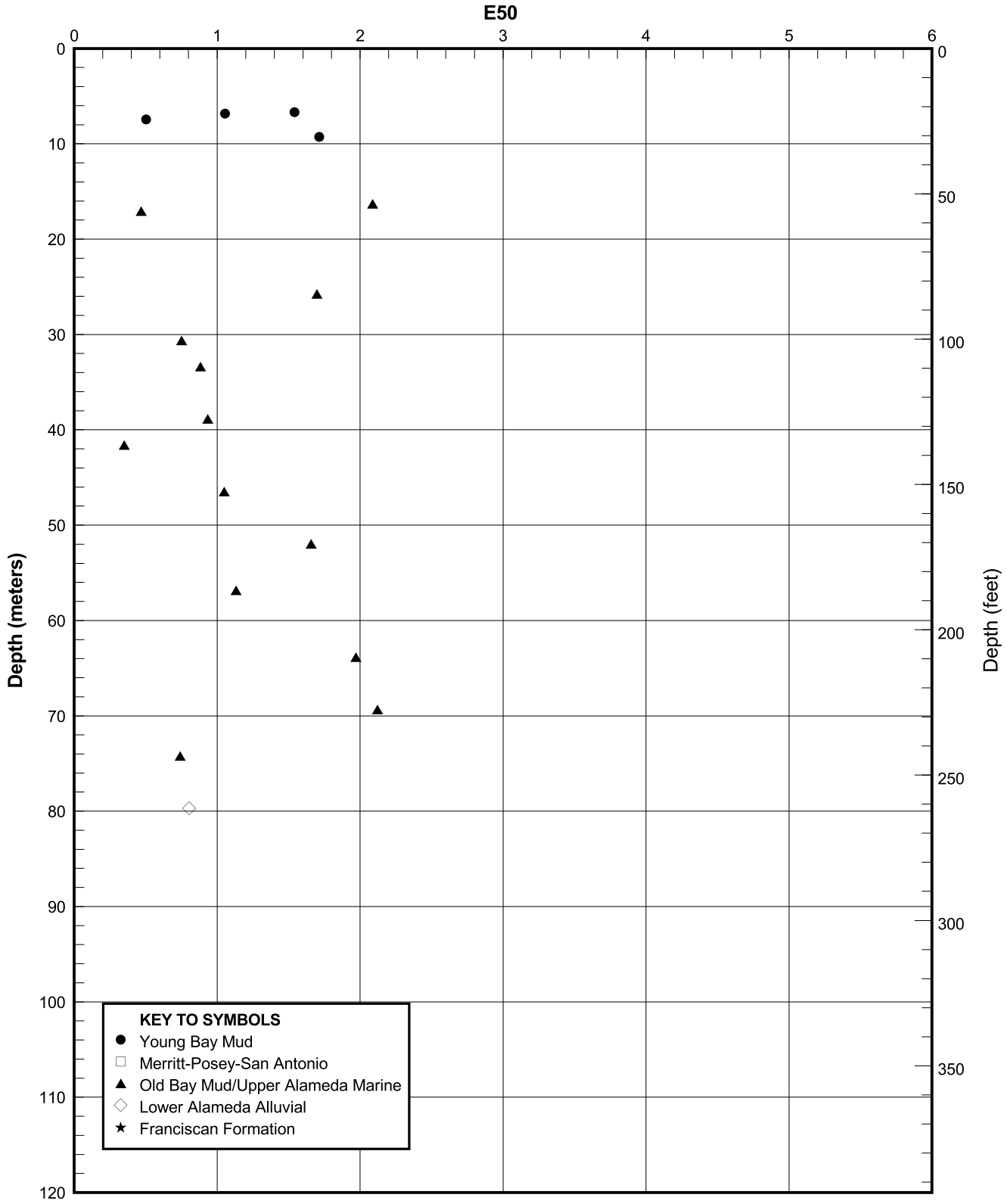


LIQUIDITY INDEX PROFILE
Boring 98-27
SFOBB East Span Seismic Safety Project



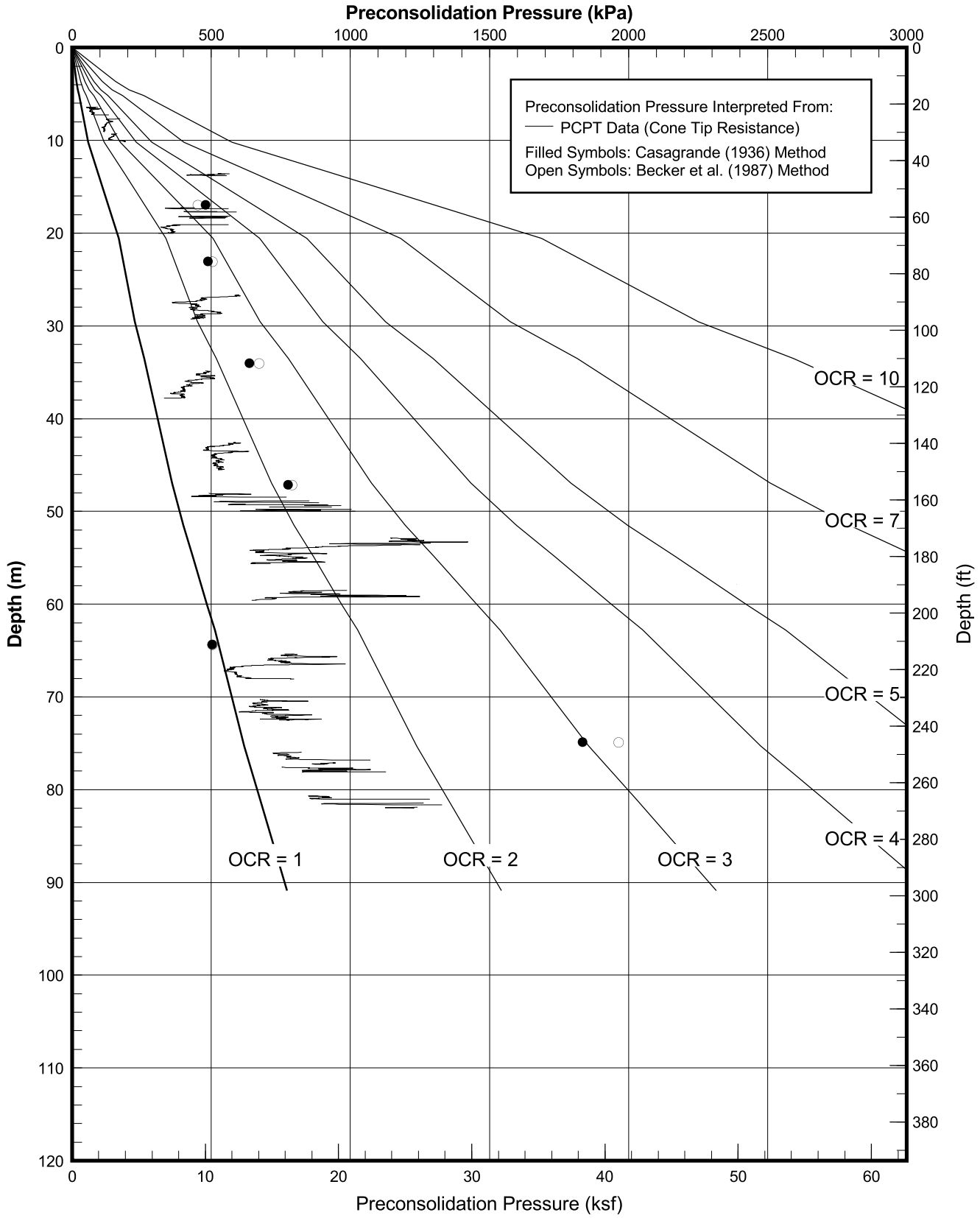
SENSITIVITY PROFILE
Boring 98-27
SFOBB East Span Seismic Safety Project

PLATE 98-27.19



E50 PROFILE
Boring 98-27
SFOBB East Span Seismic Safety Project

PLATE 98-27.20

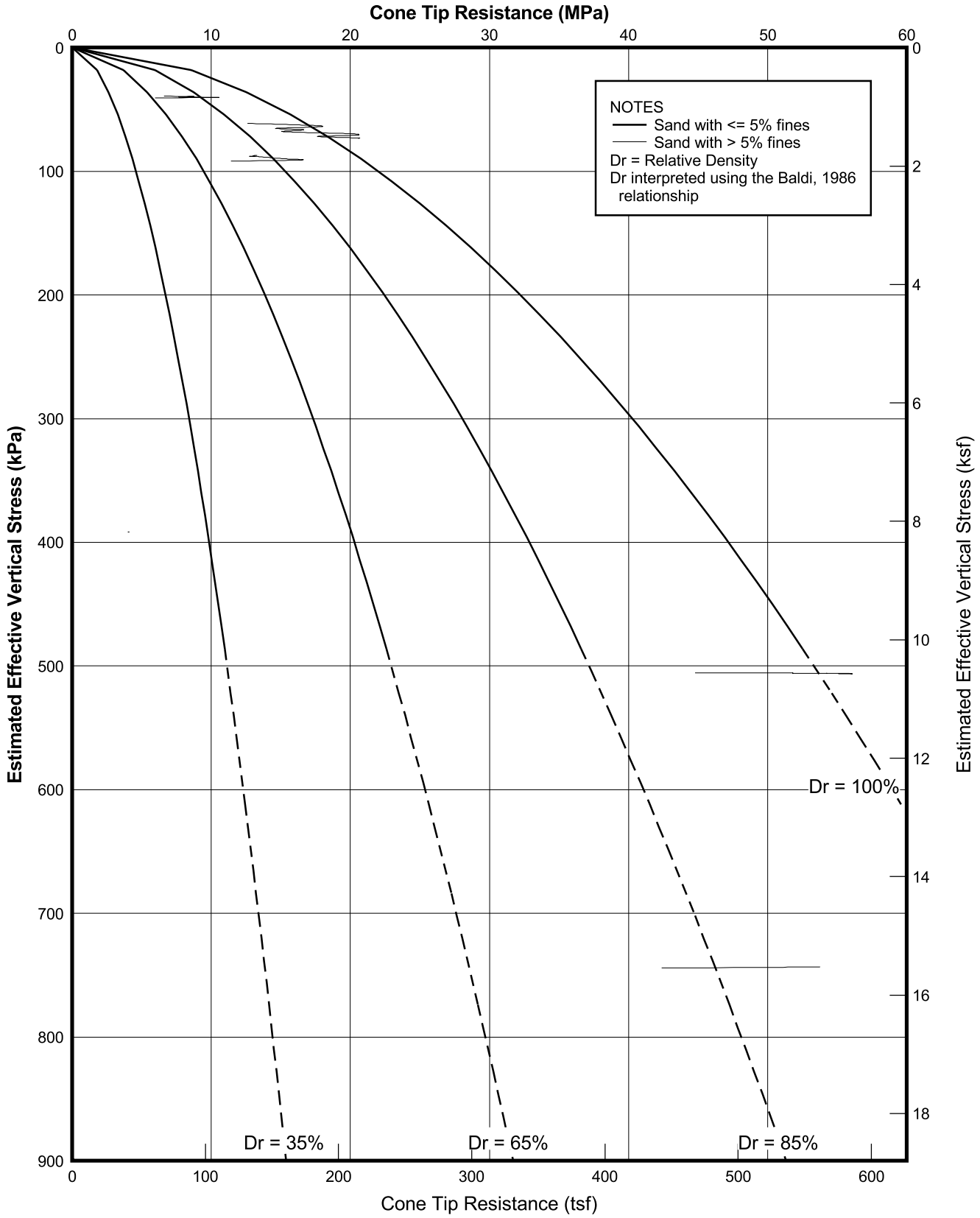


PRECONSOLIDATION PRESSURE INTERPRETED FROM CPT DATA

Boring 98-27

SFOBB East Span Seismic Safety Project

PLATE 98-27.21



RELATIVE DENSITY INTERPRETED FROM CPT DATA

Boring 98-27

SFOBB East Span Seismic Safety Project

PLATE 98-27.22