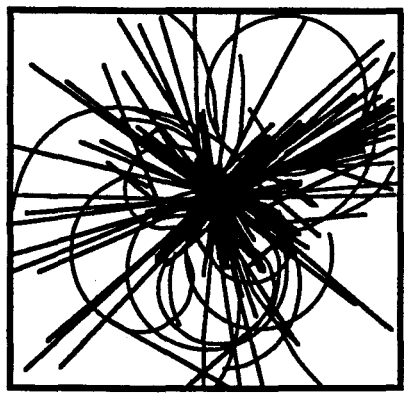
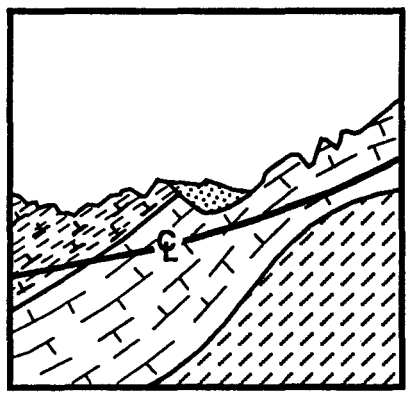
SSCL-SR-1104

SSCL-SR-1104
Project No. 87-888-0017
Report No. SSC-GR-45
July 1990
GR-45

Data Report for Corehole BE 4





Prepared by: The Earth Technology Corporation
Long Beach, California

Prepared for: RTK a joint venture
Oakland, California

FOREWORD

The goal of the geotechnical studies at the Texas Superconducting Super Collider (SSC) site is to allow the geologist and engineer to build their level of knowledge and confidence about the geologic structures and geotechnical properties of the site materials to the point at which there remains only a realistically small risk of encountering geotechnical conditions during construction that would significantly increase construction costs or delay construction schedules. To do this, a characterization program has been designed to meet the following objectives:

- To confirm the site's suitability and optimize the ring location (the "footprint") and hall positions on the ring
- To provide data for a preliminary structural design
- To provide a rational framework within which construction contracts and schedules can be formulated
- To maximize the use of the site-specific data already gathered by the proposer.

The geotechnical program to meet these objectives has been divided into the following three phases of study:

- Footprint location data
- Structure-specific data
- Global data

This is one in a series of data reports prepared for the global data phase of geotechnical characterization at the SSC site. Data collection for this study phase focused on drillhole-based geological, geohydrological, geophysical, and geotechnical tests in the near vicinity of the E and F access shaft sites. The global data set has three key attributes: (1) uniform geographic distribution over the site footprint, (2) complete coverage of all of the strata through which the SSC tunnels and shafts will pass, and (3) consistency of the data from sampling site to sampling site throughout the SSC site. In combination with data from the other phases, these data will allow conceptual designs of construction methods. Each data report includes the results of both field and laboratory tests for specific drilling and sampling site(s).

DATA REPORT

Site Designator: BE 4

Objective: Drill a corehole at the proposed shaft location and determine geotechnical conditions through in-situ hydrological testing and laboratory geomechanical testing. The corehole extended at least 35 feet below tunnel depth.

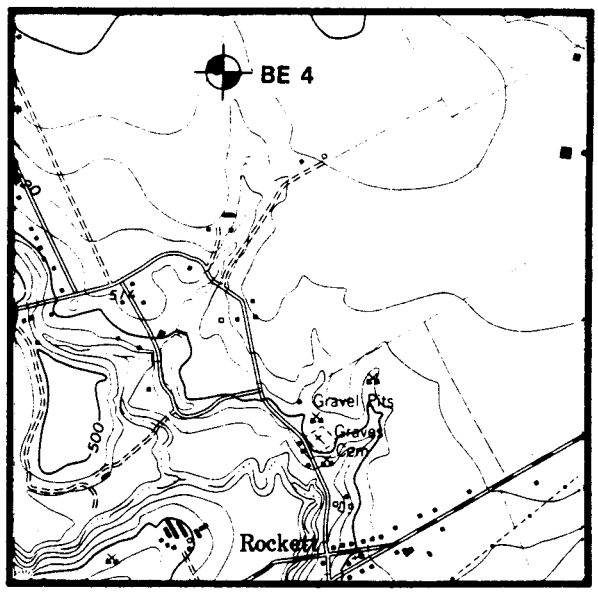
Location:

North 297,829 feet

East 2,225,784 feet

Surface Elevation 549.8 feet

BE 4 is located on the north-northeastern section of the proposed tunnel alignment, approximately one mile north northwest of Rockett, Texas.



SCALE 1:24,000

0 1000 2000 3000 4000 Feet

CONTOUR INTERVAL 10 FEET

Scope and Schedule:

Coring (full depth)	January 25 to 27, 1990
Wire-line Logging	January 27, 1990
Hydrologic Testing	January 30, 1990
Laboratory Testing	February 5 to March 9, 1990
Well Construction	January 31 to February 6, 1990

Conditions Encountered: (see lithologic log, Appendix A)

Total Hole Depth:	287.0 feet
Soil:	0.0 to 30.0 feet
Weathered Austin Chalk:	30.0 to 43.3 feet
Fresh Austin Chalk:	43.3 to 287.0 feet (bottom of hole)
Static Water Level:	Water level in the well probably has not reached static condition. It was last measured at 410.3 feet above MSL (139.5 feet below ground surface) on June 25, 1990, 139 days after the well had been air-lifted to approximately 287.8 feet above MSL.

Geophysical Logging: (see wire-line logs, Appendix B)

Spontaneous Potential (SP)
Normal Resistivity (short and long)
Guard Resistivity
Point Resistance
Natural Gamma
Short and Long Gamma
Compensated Density (caliper)
Sonic Velocity (full wave)

(Note: Normal resistivity logs exhibit erroneous data due to a short circuit in the tool; short located and repaired on January 28, 1990.)

Hydrologic Test Results Summary: (see also Appendix C)

Vertical Depth (ft)	Packer Pressure (psi)	Gauge Pressure (psi)	Formation/ Lithology	Hydraulic Conductivity (cm/sec)
64.0-84.0	150	15	Austin Chalk (fractured)	$<5.1 \times 10^{-8}$
242.0-262.0	190	15	Austin Chalk	$<5.3 \times 10^{-8}$

Laboratory Geomechanical Test Results Summary: (see also Appendix D)

Vertical Depth (ft)	Formation/ Lithology	Moisture Content (%)	Dry Density (pcf)	*Compressive Strength (psi)	Tangent Young's Modulus E_{50} (psi x 10^5)	Brazil Tensile Strength (psi)
50	Austin Chalk	10	129	2175	2.09	
70	Austin Chalk	9	131	2917	6.48	
102-103	Austin Chalk	10-11	127	3316	6.28	310-325
132	Austin Chalk	8	136	1289	2.46	
171	Austin Chalk	7-8	137	2146	1.96	
178	Austin Chalk	7-8	137	1873	1.99	
220	Austin Chalk	8	138			382
229	Bentonite	24				
229-232	Austin Chalk	8-12	125-136	1517-3548 (100)	3.39 (200)-5.82 (100)	
254-255	Austin Chalk	8-9	134			168
264	Austin Chalk	8	138	1493	2.75	
282	Austin Chalk	10	132	3386	7.83	

* UU triaxial test indicated by confining pressure in parentheses.

Hole Status: A monitoring well was installed in the boring on February 6, 1990 (see Appendix E).

APPENDIX A

LITHOLOGIC LOG

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BE-4 PG 1 OF 8

LOCATION: N 297,829 feet
E 2,225,784 feet

GROUND EL: 549.8 feet

DATE: 1-25/1-27-90 TYPE: NX Core CASED TO: 30' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND

S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

Begin using rotary wash from 0-30.0'. Begin coring with air rotary from 30.0'-140.0'. Encountered water at 121.0'. Begin using water rotary at 140.0'.

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
									CLAY, silty, trace of roots and organic debris, dark brown (3.0)
5									CLAY, silty, jointed, tan and brown (8.0)
10, 15, 20, 25, 30									CLAY, silty, embedded limestone fragments, tan to light brown (30.0)
35, 40		C-1	30.0	40.0	79	10			LIMESTONE (Austin Chalk) severely weathered, moderately fractured, tan
			40.0						

DRILLING GEOLOGIST Mike Granger ASSISTANT Kevin Jones CHECKED BY Clem Bommarito

Shawn Wood
(3-7-90)

LOG OF BORING

BORING NO: BE 4 PG 2 OF 8

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

LOCATION: N. 297,829 feet E. 2,225,784 feet

GROUND EL: 549.8 feet

DATE: 1-25/1-27-90 TYPE: NX Core CASED TO: 30' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See P. 1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
		C2	40.0	50.0	100 / 99	30 / 99			LIMESTONE (Austin Chalk) severely weathered, moderately fractured, tan, occasional fossil partings (43.3); LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.2' thick moderately, argillaceous limestone interbeds. Also shale layers 0.2' thick, fossil partings, and medium angle calcite filled fractures. -fossil partings at 43.5' and 61.2'
45, 50		C-3	50.0	60.0	100	100			
55, 60		C-4	60.0	70.0	100	100			-shale layer, soft, dark gray, gradational contact at 62.5' to sharp contact at 62.7' -moderately argillaceous layer, medium gray, gradational contacts at 65.3'-65.6' -fossil parting at 68.7'
65, 70		C-5	70.0	80.0	100	98			-60° rough, open, calcite filled (½"), fracture at 74.3' -fossil parting at 79.5'
75, 80			80.0						

DRILLING GEOLOGIST Mike Granger ASSISTANT Kevin Jones CHECKED BY Clem Bommarito

Shawn Wood (3-7-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BE 4 PG 3 OF 8

LOCATION: N. 297,829 feet, E. 2,225,784 feet

GROUND EL: 549.8 feet

DATE: 1-25/1-27-90 TYPE: NX Core CASED TO: 30' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See p. 1 of 8

DEPTH IN FEET	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
85	C-6	80.0	90.0	100	100			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.2' to 2' thick slightly, moderately argillaceous to shaly limestone interbeds 1' to 4' apart. Also fossil partings and traces of pyrite. -slightly argillaceous layer, medium gray, gradational contacts at 85.1'-85.7' -fossil partings at 80.3', 81.2', and 82.9' -fossil partings at 88.0', 88.6', and 89.1'
90	C-7	90.0	100.0	100	100			-moderately argillaceous layer, medium gray, gradational contacts at 90.6'-91.3' -moderately argillaceous layer, medium gray, sharp contacts at 94.1'-94.2' -shaly limestone layer, dark gray, gradational contacts at 97.8'-98.1'
95								
100	C-8	100.0	110.0	100	100			-½" pryite nodule at 101.4' -moderately argillaceous layer, medium gray, sharp contact at 105.0' to gradational contact at 105.5' -slightly argillaceous layer, medium gray, gradational contacts at 109.4'-109.8'
105								
110	C-9	110.0	120.0	98	98			-slightly argillaceous layer, medium gray, sharp contact at 114.0' to gradational contact at 114.2' -slightly argillaceous layer, medium gray, gradational contacts at 117.8'-118.2' -moderately argillaceous layer, medium gray, gradational contacts at 119.0'-119.2'
115								
120		120.0						

DRILLING GEOLOGIST Mike Granger ASSISTANT Kevin Jones CHECKED BY Clem Bommarito

Shawn Wood
(3-7-90)

LOG OF BORING

PROJECT: Superconducting Supercollider
CLIENT: The Earth Technology Corporation
TASK NO.: 17

BORING NO: BE 4 PG 4 OF 8
LOCATION: N. 297,829 feet E. 2,225,784 feet
GROUND EL: 549.8 feet

DATE: 1-25/1-27-90 TYPE: NX Core CASED TO: 30' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See p. 1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
		C-10	120.0	130.0	100	100			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.2' to 7' thick moderately argillaceous limestone interbeds 1' to 6' apart. Also fossil partings. -fossil partings at 120.5', 121.9' and 122.3' -moderately argillaceous layer, medium gray, gradational contact at 122.6' to sharp contact at 123.8' -moderately argillaceous layer, medium gray, gradational contacts at 126.0'-126.2' -moderately argillaceous layer, medium gray, gradational contact at 127.4' to sharp contact at 127.8' -fossil partings at 129.3' and 131.3'
125									
130		C-11	130.0	140.0	100	100			-moderately argillaceous layer, medium gray, gradational contact at 136.7' to sharp contact at 137.1' -fossil partings at 138.4' and 139.7'
135									
140		C-12	140.0	150.0	100	88			-moderately fossiliferous limestone layer, gradational contacts at 140.0'-147.0' -fossil partings at 140.1', 140.7', 141.0', 142.0', 142.4', 142.7', 143.5', 143.8', 149.2' and 149.6'
145									
150		C-13	150.0	160.0	100	100			-moderately argillaceous layer, medium gray, gradational contact at 153.2' to sharp contact at 153.7' -fossil partings at 152.8', 154.8' and 159.4'
155									
160			160.0						

DRILLING GEOLOGIST Mike Granger ASSISTANT Kevin Jones CHECKED BY Clem Bommarito

Shawn Wood

(3-7-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BE 4 PG 5 OF 8

LOCATION: N. 297,829 feet, E. 2,225,784 feet

GROUND EL: 549.8 feet

DATE: 1-25/1-27-90 TYPE: NX Core CASED TO: 30' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See p. 1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
165		C-14	160.0	166.0	75	75			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 1' to 2' thick moderately argillaceous to shaly limestone interbeds 1' to 3' apart. Also fossiliferous layers 1' thick, fossil partings. -fossil partings at 160.5', 162.5', and 163.3' -fossil parting at 167.2'
170 175		C-15	166.0	176.0	100	98			-moderately argillaceous layer, medium gray, sharp contact at 167.6' to gradational contact at 169.7' -fossil partings at 170.1', 170.3', 171.9' and 174.3' -fossil partings at 176.5', 177.0', 177.3', 181.4', 181.8' and 182.6'
180 185		C-16	176.0	186.0	100	97			-shaly limestone layer, dark gray, gradational contact at 182.8' to sharp contact at 183.0' -fossil partings at 184.1', 185.2', 186.5' and 186.7' -moderately argillaceous layer, medium gray, sharp contact at 186.1' to gradational contact at 187.0'
190 195		C-17	186.0	196.0	100	98			-shaly limestone layer, dark gray, sharp contact at 189.0' to gradational contact at 190.6' -fossil partings at 189.2', 191.6'. 192.5', 193.1' and 193.8' -highly fossiliferous layer, gradational contacts at 192.9'-194.0'
200		C-18	196.0		98	98			-fossil parting at 197.5' -moderately argillaceous layer, medium gray, gradational contacts at 199.5'-200.4'

DRILLING GEOLOGIST Mike Granger ASSISTANT Kevin Jones CHECKED BY Clem Bommarito

Shawn Wood

(3-7-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BE 4 PG 6 OF 8

LOCATION: N. 297,829 feet
E. 2,225,784 feet

GROUND EL: 549.8 feet

DATE: 1-25/1-27-90 TYPE: NX Core CASED TO: 30' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND:
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION: See p.1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
-205		C-18		206.0	98	98			LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.5' to 5' thick slightly, moderately argillaceous to shaly limestone interbeds 1' to 3' apart. Also fossil partings and bentonite seams. -moderately argillaceous layer, medium gray with abundant fossils, gradational contacts at 201.5'-202.2' -shaly limestone layer, medium gray with interbedded bentonite seams, sharp contacts at 203.4'-204.0' -fossil partings at 204.0', 205.4', 206.8' and 207.5'
-210		C-19	206.0	216.0	100	100			-moderately argillaceous layer, medium gray, gradational contacts at 208.4'-209.2' -moderately argillaceous layer, medium gray, gradational contacts at 212.4'-212.9' -slightly argillaceous layer, medium gray, gradational contacts at 216.0'-217.0' -fossil parting at 219.5'
-220		C-20	216.0	226.0	100	100			-moderately argillaceous layer, medium gray, gradational contacts at 220.6'-225.0'
-230		C-21	226.0	236.0	91	90			-moderately argillaceous layer, medium gray, gradational contacts at 226.0'-227.6' -shaly limestone layer, medium gray, gradational contacts at 227.6'-229.1' with interbedded bentonite seams at 227.6', 228.1' and 229.0' -¼" pyrite nodule at 228.1' -moderately argillaceous layer, medium gray, gradational contacts at 231.7'-234.4'
-240		C-22	236.0		100	100			-moderately argillaceous layer, medium gray, gradational contacts 237.1'-238.3' -moderately argillaceous layer, medium gray, gradational contact at 239.3'-241.5'

DRILLING GEOLOGIST Mike Granger ASSISTANT Kevin Jones CHECKED BY Clem Bommarito

Shawn Wood
(3-7-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BE 4 PG 7 OF 8

LOCATION: N. 297,829 feet E. 2,225,784 feet

GROUND EL: 549.8 feet

DATE: 1-25/1-27-90 TYPE: NX Core CASED TO: 30' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION: See p.1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
245				246.0					LIMESTONE (Austin Chalk), moderately to medium hard, fresh, light gray to dark gray with 0.3' to 1' thick slightly, moderately argillaceous to shaly limestone interbeds 2' to 12' apart. Also fossil partings and low angle fractures. -moderately argillaceous layer, medium gray, gradational contacts at 242.2'-242.7' -moderately argillaceous layer, medium gray, gradational contacts at 245.4'-246.1' -moderately argillaceous layer, medium gray, gradational contacts at 250.0'-250.8'
250		C-23	246.0	256.0	100	100			-fossil parting at 248.8'
255									
260		C-24	256.0	266.0	100	100			-slightly argillaceous layer, medium gray, gradational contacts at 262.0'-262.8' -¼" pyrite nodules at 264.2' and 264.4'
265									-moderately argillaceous layer, medium gray, gradational contacts at 267.2'-268.0'
270		C-25	266.0	276.0	100	100			-15° smooth, open, slickensided fracture at 269.8'
275									-½" pyrite nodule at 273.9' -shaly limestone layer, medium gray, gradational contacts at 275.6'-275.9' -¼" pyrite nodule at 275.9'
280		C-26	276.0	282.0	100	100			-moderately argillaceous layer, medium gray, gradational contacts at 277.7'-278.5'

DRILLING GEOLOGIST MIke Granger ASSISTANT Kevin Jones CHECKED BY Clem Bommarito

Shawn Wood
(3-7-90)

LOG OF BORING

PROJECT: Superconducting Supercollider

CLIENT: The Earth Technology Corporation

TASK NO.: 17

BORING NO: BE 4 PG 8 OF 8

LOCATION: N. 297,829 feet
E. 2,225,784 feet

GROUND EL: 549.8 feet

DATE: 1-25/1-27-90 TYPE: NX core CASED TO: 30' CONTRACTOR: SwL (89-192)

SAMPLE LEGEND:
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION: See p. 1 of 8

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
			282.0						
285		C-27		287.0	100	100			LIMESTONE (Austin chalk) medium to moderately hard, fresh, light gray.
290									Bottom of Exploration at 287.0 feet Monitor well installed upon completion
295									
300									
305									
310									
315									
320									

DRILLING GEOLOGIST Mike Granger ASSISTANT Kevin Jones CHECKED BY Clem Bommarito

Shawn Wood
(3-7-90)

APPENDIX B

WIRE-LINE LOGS

WIRE-LINE LOGGING PARAMETERS

Hole No. BE 4 **Log Measured From:** Ground Level

Drilling Parameters

Depth 287.0 feet

Bit Diameter 4.75 inches

Logging Parameters	Electrical Log	Gamma Log	Sonic Log
Date	January 27, 1990	January 27, 1990	January 27, 1990
Bottom Log Interval	284.0 feet	284.0 feet	278.9 feet
Top Log Interval	surface	surface	surface
Type of Fluid in Hole	drilling mud	drilling mud	drilling mud
Time Since Circulation Stop	30 minutes	30 minutes	30 minutes
Probe Type/S.N.	ALP-4979	XAP-4383	CLP-4877A
Module Type/S.N.	ALM-4979	XAM-4383	CLM-4877A
Logging Speed	40 feet/min.	20 feet/min.	20 feet/min.
Sample Interval	0.5 foot	0.5 foot	0.5 foot

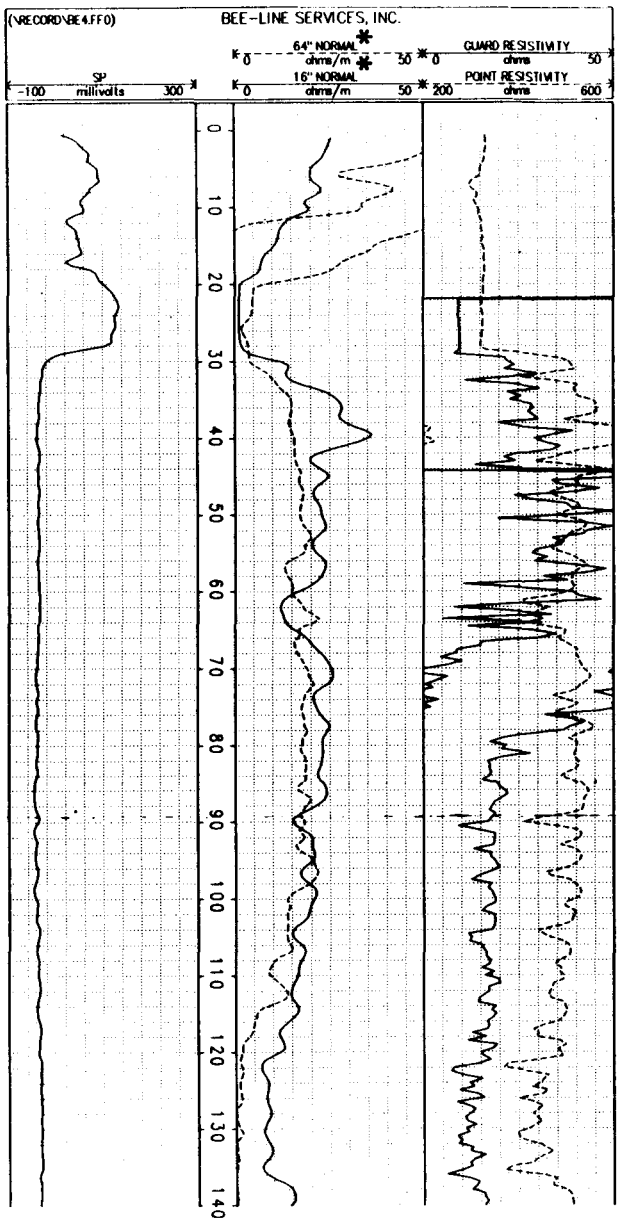
Note: Normal resistivity logs exhibit erroneous data due to a short circuit in the tool.

Logged by: BEE-LINE SERVICES, INC.
P. O. Box 2096
Corsicana, TX 75151

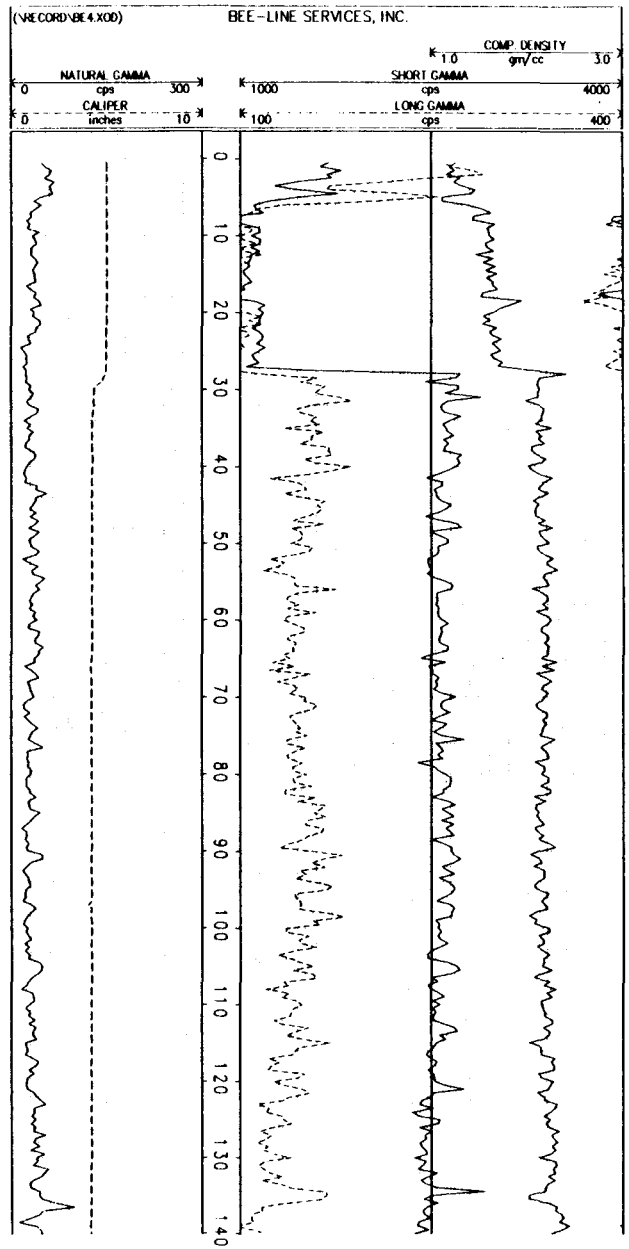
BE 4 Wire-line logs run January 27, 1990. Surface elevation 549.8 feet.

*Note: Normal resistivity logs exhibit erroneous data due to a short in the tool.

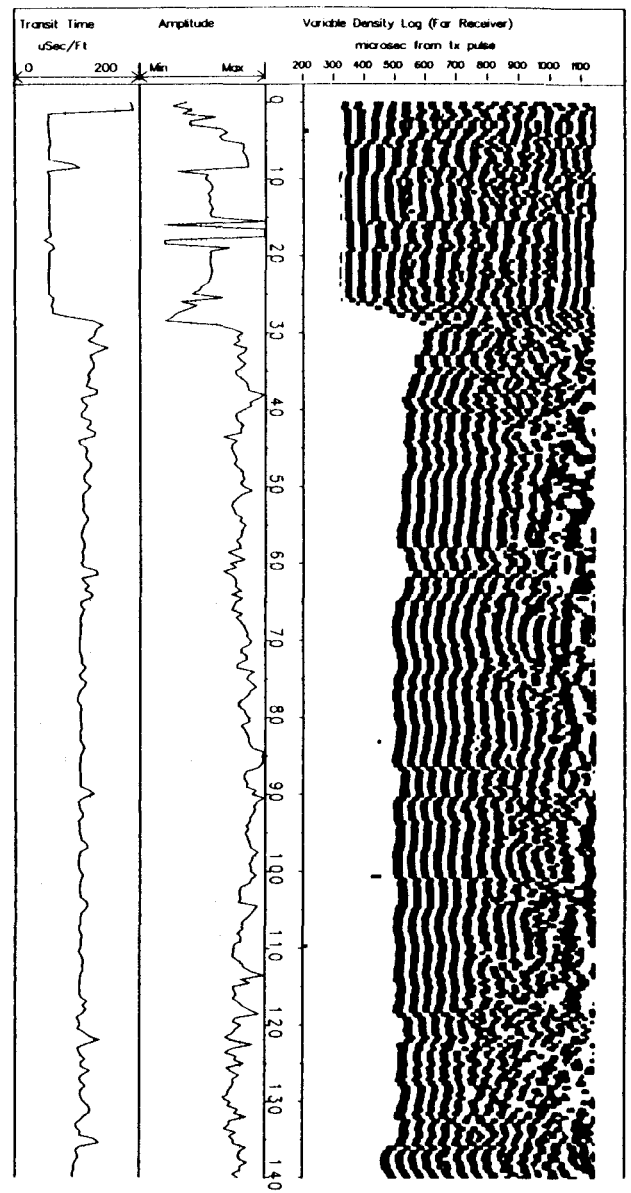
ELECTRICAL LOG



GAMMA LOG

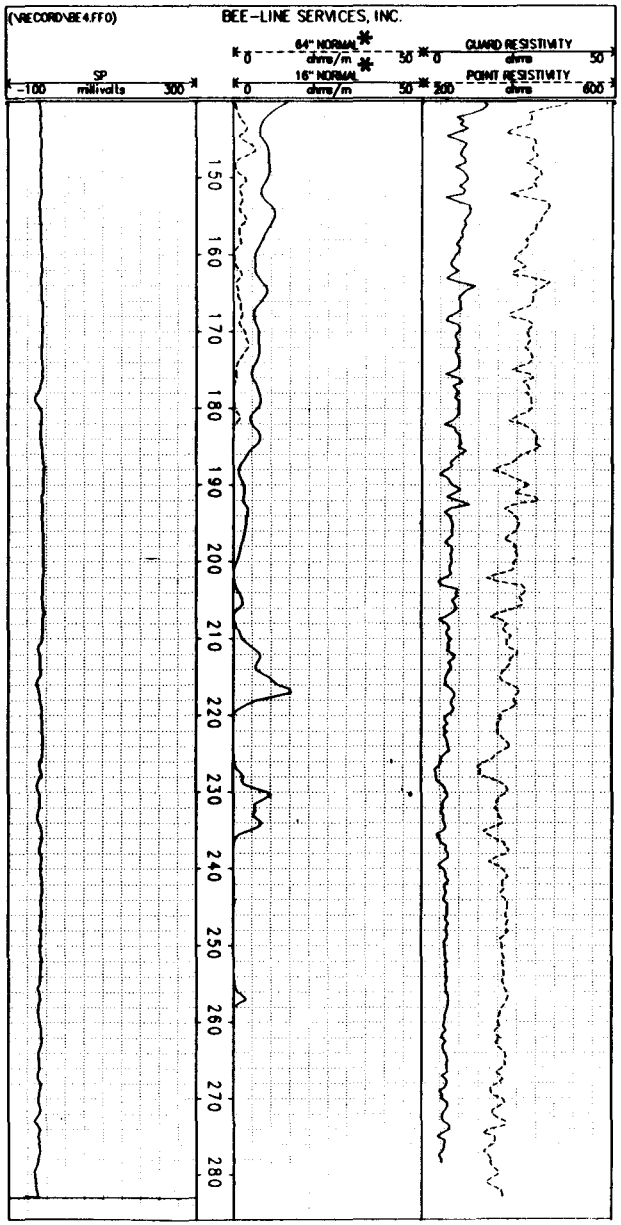


SONIC LOG

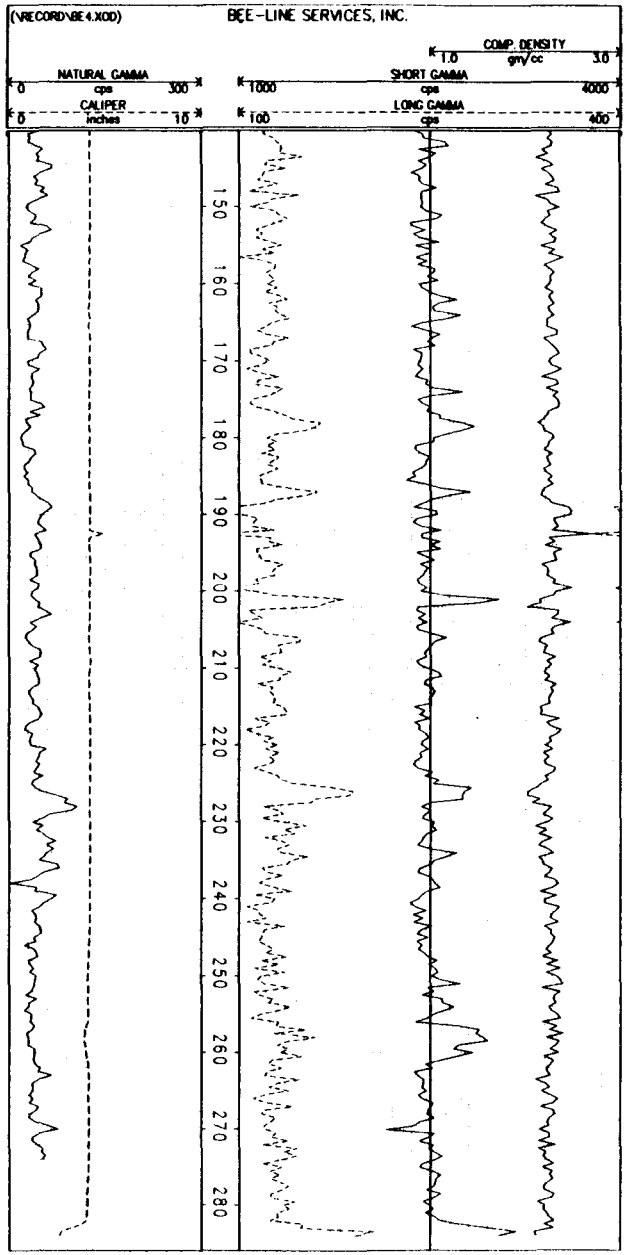


BE 4 Wire-line logs run January 27, 1990 (Continued). Surface elevation 549.8 feet.

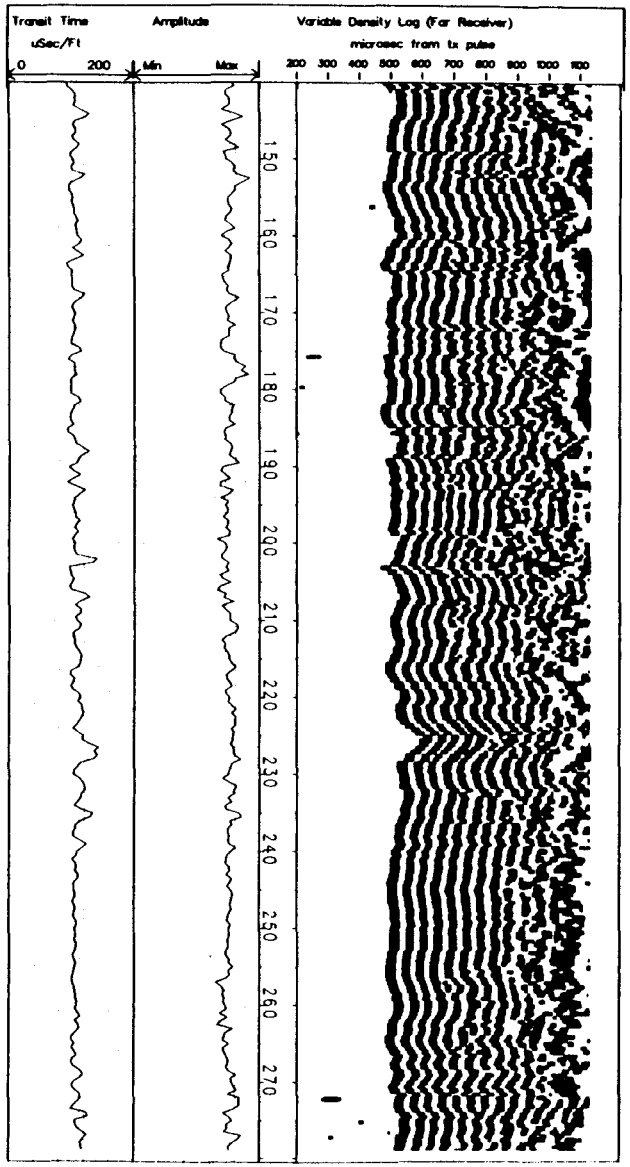
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



SONIC LOG CONTINUED



APPENDIX C

HYDROLOGIC TEST RESULTS

APPENDIX C

The objectives of the hydrologic (packer) tests were to provide estimates of the hydraulic conductivity within the Taylor Marl, Austin Chalk, and Eagle Ford Shale formations in unfractured zones, fractured or other suspected water-bearing zones, at the formation contacts, and at the tunnel elevation. Intervals within boreholes were selected for packer testing based on visual inspections of rock cores and the results of borehole geophysical testing. Sections of a borehole that exhibited increased frequency of fractures or bedding plane parting were commonly packer tested.

Standard procedures used to conduct these tests included lowering a pair of pneumatically operated rubber packers (in straddle-packer configuration) separated by a known length of perforated pipe into the drill hole to a predetermined depth. The packer interval was approximately 20 feet. The packers were then inflated to a precalculated pressure to seal against the rock side walls and water was pumped into the test interval at a selected pressure while the flow rate was measured with a cumulative flow meter. To improve the accuracy of measurements at low flow water was often pumped from a large container (e.g., a drum or section of casing) and the volume removed was recorded. In addition to monitoring the water pressure and flow rate at appropriate intervals, the height of the water pressure gauge above ground surface, as well as the diameter and length of water pipe used, were recorded. The tests were continued until five consecutive readings indicated a stabilization of the flow rate but for a minimum of at least 10 minutes. Standard forms were used for data records and the hydraulic conductivity was calculated using standard Bureau of Reclamation procedures.

STRADDLE PACKER TEST RESULTS

Test Depth (feet)	Packer Pressure (psi)	Gauge Pressure (psi)	Formation/ Lithology	Hydraulic Conductivity (cm/sec)	Estimated Depth to Static Water Level* (feet)
64.0-84.0	150	15	Austin Chalk (fractured)	$<5.1 \times 10^{-8}$	10.0
242.0-262.0	190	15	Austin Chalk	$<5.3 \times 10^{-8}$	10.0

At boring BE 4 two test intervals were selected based on a review of the lithologic and wire-line logs. The upper test interval was selected to provide hydrologic data for fractured Austin Chalk. The lower interval straddled an area of unfractured Austin Chalk at one potential tunnel elevation. Hydrologic (packer) testing followed the general procedures outlined above. Packer and gauge pressures used during the testing along with the calculated hydraulic conductivities are listed in the table above. Flow volumes were measured using a calibrated container.

* The hydraulic conductivity values presented are based on an estimated static water level 10.0 feet below the ground surface. When last measured, the water level was 139.5 feet below ground surface. Hydraulic conductivity values calculated from the test data would be lower for a static water level below the estimated value.

APPENDIX D

LABORATORY RESULTS

GEOMECHANICAL TEST RESULTS – BORING BE 4

GENERAL LITHOLOGY	BORING DEPTH feet	MOISTURE CONTENT percent	DRY DENSITY pcf	SPECIFIC GRAVITY	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	FRACTION FINER THAN # 200 SIEVE percent	CARBONATE CONTENT	SAMPLE DIMENSION RATIO L/D	SAMPLE FAILURE MODE/ DEGREES *	UNCONFINED COMPRESSIVE STRENGTH psi	TRIAXIAL COMPRESSION CONFINING PRESSURE σ_3 psi	TRIAXIAL COMPRESSION DEVIATOR STRESS $\sigma_1-\sigma_3$ psi	FAILURE STRAIN percent	TANGENT YOUNG'S MODULUS E50 (psi)x10E5	TANGENT YOUNG'S MODULUS UNLOAD/ RELOAD (psi)x10E5	TANGENT YOUNG'S MODULUS σ_3 psi	POISSON'S RATIO	BRAZIL TENSILE STRENGTH psi	2ND CYCLE SLAKE DURABILITY INDEX percent	MODIFIED TABER ABRASION INDEX	SWELL PRESSURE INDEX psi	COMMENTS
AUSTIN CHALK	50.2	10.1																					
AUSTIN CHALK	50.3	10.2	128.7						2.4	B-1/30	2175			1.11	2.09		0						
AUSTIN CHALK	70.0	9.2																					Note 1
AUSTIN CHALK	70.2	8.9	131.2						2.3	D	2917			0.55	6.48		0						
AUSTIN CHALK	102.0	10.1																					
AUSTIN CHALK	102.1	11.3	127.0	2.71					2.3	B-1/30	3316			0.70	6.28		0						
AUSTIN CHALK	102.6	10.9							0.3										325				
AUSTIN CHALK	102.7																				0.391		
AUSTIN CHALK	103.1	10.3							0.5										310				
AUSTIN CHALK	132.0	8.0																					
AUSTIN CHALK	132.2	8.5	136.3						2.3	D	1289			0.60	2.46		0						
AUSTIN CHALK	171.2	7.5																					
AUSTIN CHALK	171.3	8.0	136.9						2.3	B-1/30	2146			1.17	1.96		0						
AUSTIN CHALK	177.6	7.0																					
AUSTIN CHALK	177.8	7.6	137.1						2.3	D	1873			1.10	1.99		0						
AUSTIN CHALK	219.6	8.0	137.8																				
AUSTIN CHALK	219.7	8.1							0.5										382				
BENTONITE	228.9	23.8			211	136	96.9																
AUSTIN CHALK	229.1	11.9	125.2																				
AUSTIN CHALK	231.1	8.7	133.2	2.65					2.3			100	3548	0.92	4.08	7.04	100						Notes 2 and 3
AUSTIN CHALK	231.1														5.82	8.60		0.12					Note 4
AUSTIN CHALK	231.5	8.5	136.1						2.3	D		200	2514	0.94	2.84	4.27	200						Note 3
AUSTIN CHALK	231.5														3.39	5.33		0.12(1)					Notes 4 and 5
AUSTIN CHALK	231.9	10.4	130.0																				
AUSTIN CHALK	232.2	10.0	130.6						2.3	D	1517			0.73	2.50		0						
AUSTIN CHALK	254.0																				0.490		
AUSTIN CHALK	254.9	8.0	133.8																				
AUSTIN CHALK	255.1	8.6							0.5										168				
AUSTIN CHALK	264.2	8.1	138.0						2.4	D	1493			0.52	2.75		0						
AUSTIN CHALK	282.1	9.7	132.5						2.4	D	3386			0.51	7.83		0						
PROCEDURE		ASTM-D2216		ASTM-D854	ASTM-D4318		ASTM-D1140				ASTM-D2938	ASTM-D2664			ASTM-D3148			ASTM-D3148	ASTM-D3967	ISRM	ISRM	ISRM	

BE4PRT22.WK1
REVISION: 2.1
DATE: 07/13/90

* EXPLANATION OF SAMPLE FAILURE MODE AS FOLLOWS.

Symbol	Failure Type
A	No discernible failure plane
(B)	Well defined shear plane @ "X" angle (deg) to vertical or to long axis of core
B-1	Shear plane
B-2	Bedding plane shear
B-3	Shear plane along pre-existing fracture, shear zone, etc.
B-4	Combination
C	Barreling/Bulging
D	Longitudinal (axial) splitting
E	Conical
F	No information

NOTES:

1) All moduli calculated from axial strains using a dial micrometer except where noted. Axial gage length is the sample length.

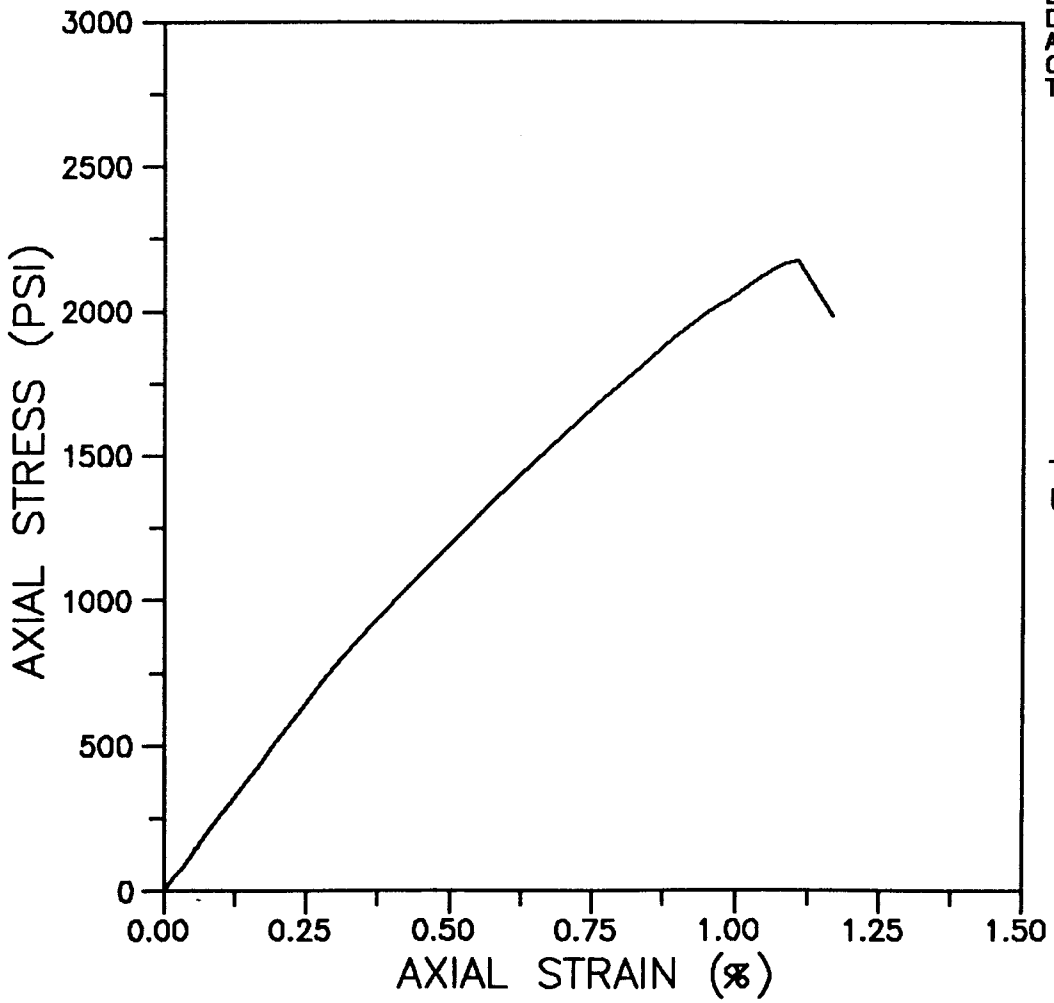
2) Load frame capacity exceeded. Sample not taken to failure. Modulus taken at 50% of maximum stress.

3) Triaxial compression test is cyclic with one unload/reload cycle.

4) Modulus and Poisson's ratio calculated from axial and lateral strains measured using LVDTs. Axial gage length is 2.8 inches.

5) For Poisson's ratio values: the value within parenthesis indicates the number of LVDTs recording lateral strains. Otherwise all 3 LVDTs recorded strains.

BORING NO: BE4
DEPTH (FT): 50.3
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 10.2
DRY UNIT WEIGHT (PCF): 128.7
DEG. OF SATURATION (%): 88.8
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.09 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

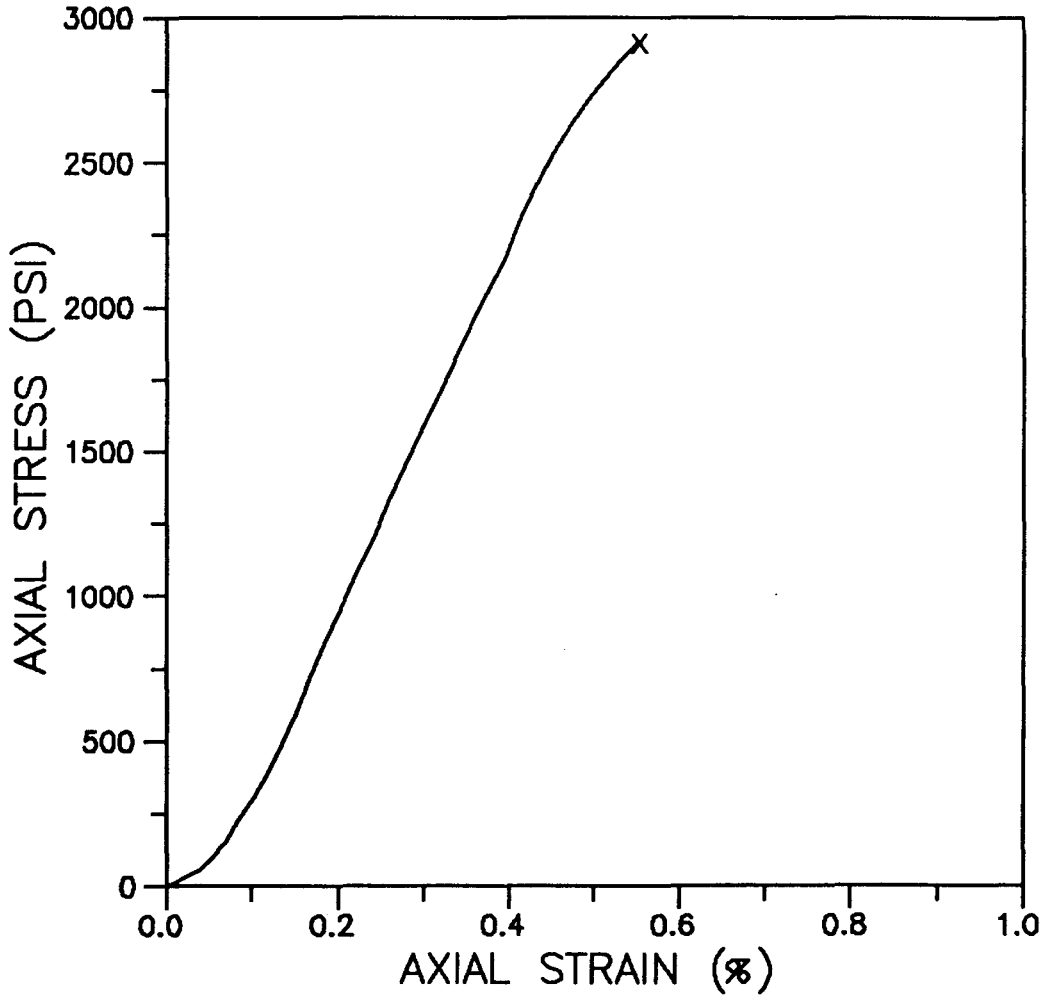
STRESS–STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89–192

FIGURE

BORING NO: BE4
DEPTH (FT): 70.2
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 8.9
DRY UNIT WEIGHT (PCF): 131.2
DEG. OF SATURATION (%): 84.6
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
6.48 x 10E5 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

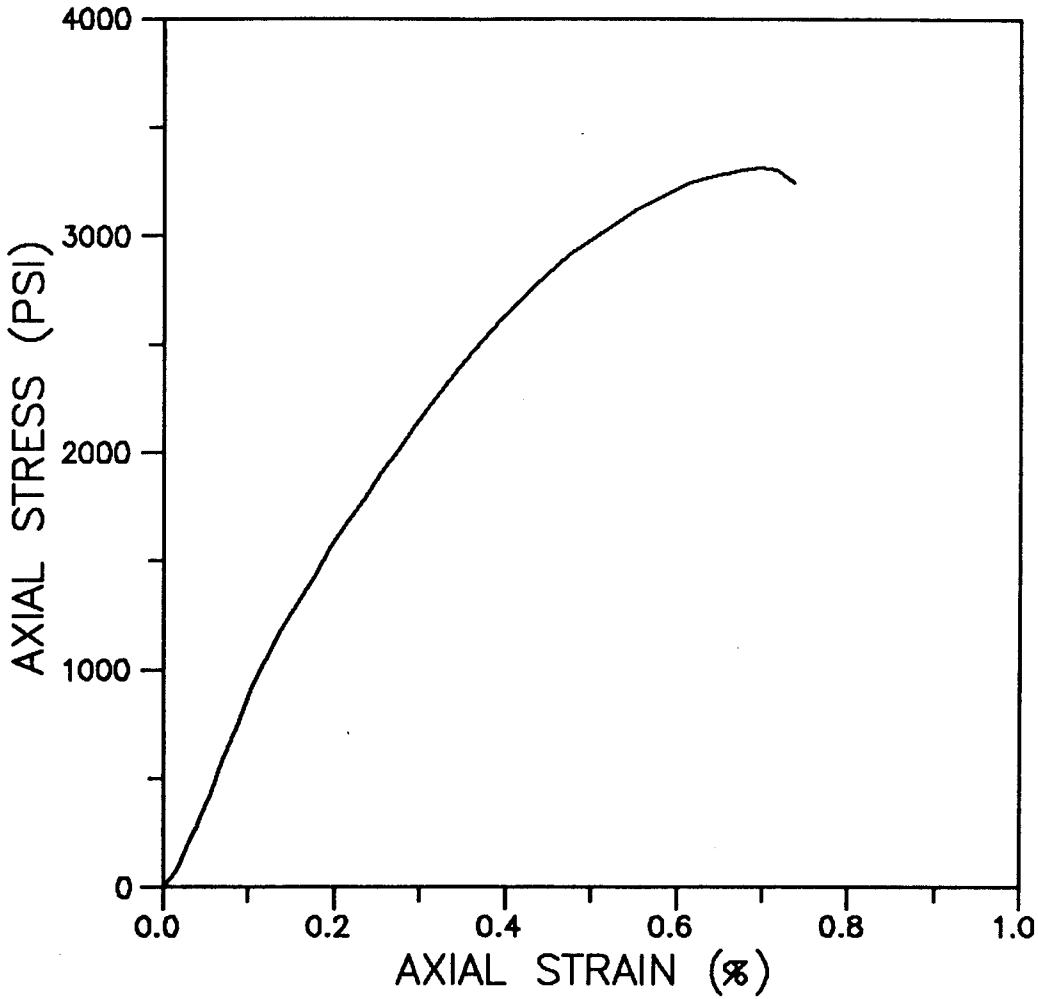
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BE4
DEPTH (FT): 102.1
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 11.3
DRY UNIT WEIGHT (PCF): 127.0
DEG. OF SATURATION (%): 92.9
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
6.28 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

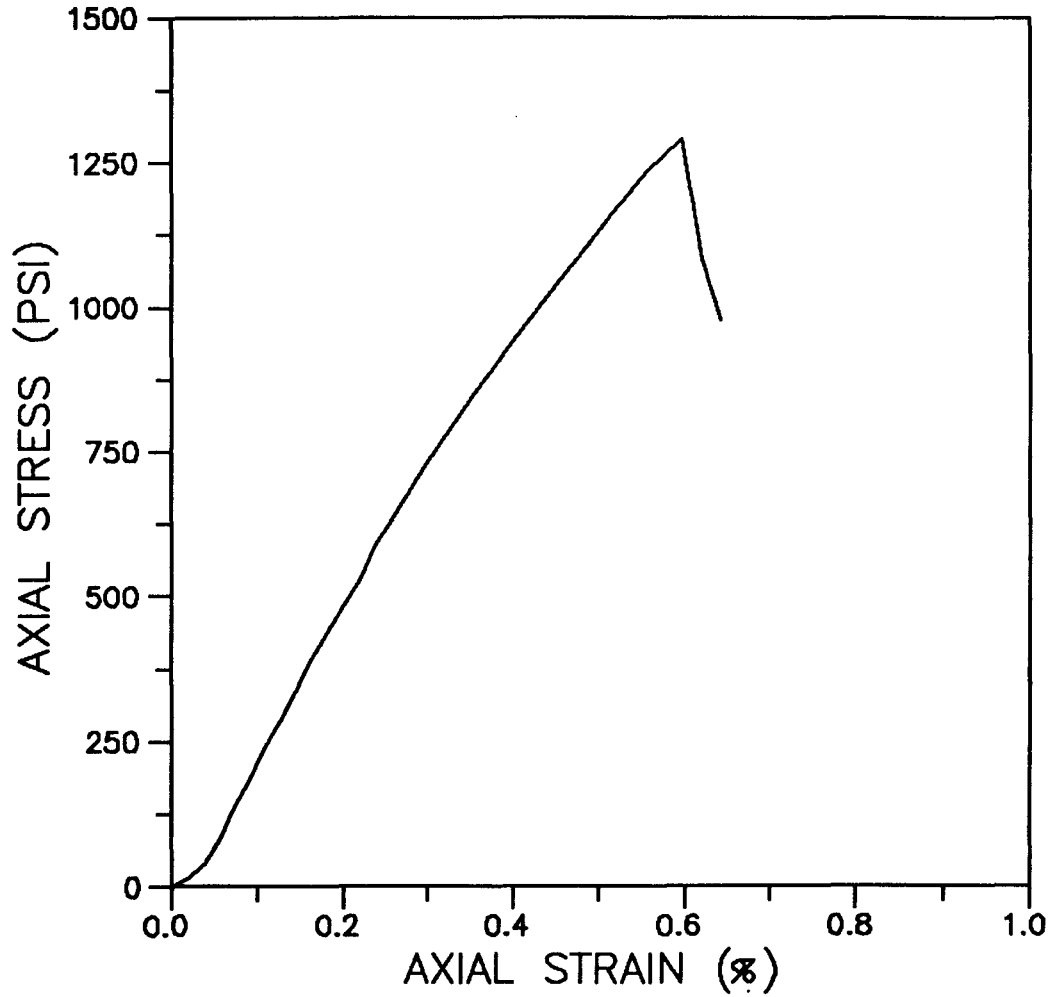
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BE4
DEPTH (FT): 132.2
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 8.5
DRY UNIT WEIGHT (PCF): 136.3
DEG. OF SATURATION (%): 96.6
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.46 x 10E5 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

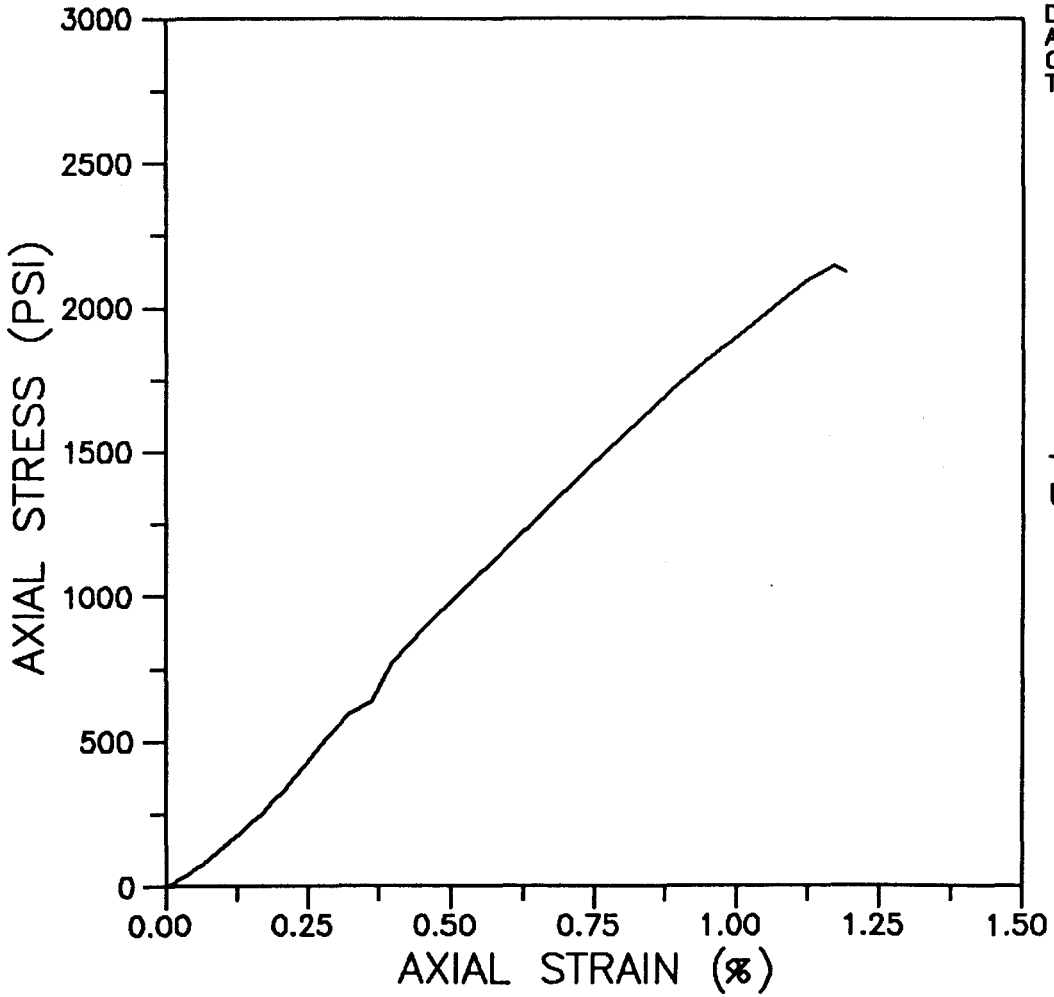
STRESS–STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89–192

FIGURE

BORING NO: BE4
DEPTH (FT): 171.3
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 8.0
DRY UNIT WEIGHT (PCF): 136.9
DEG. OF SATURATION (%): 93.6
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
1.96 x 10E5 PSI

FAILURE MODE:
SHEAR PLANE AT 30 DEG

TEXAS SSC SITE

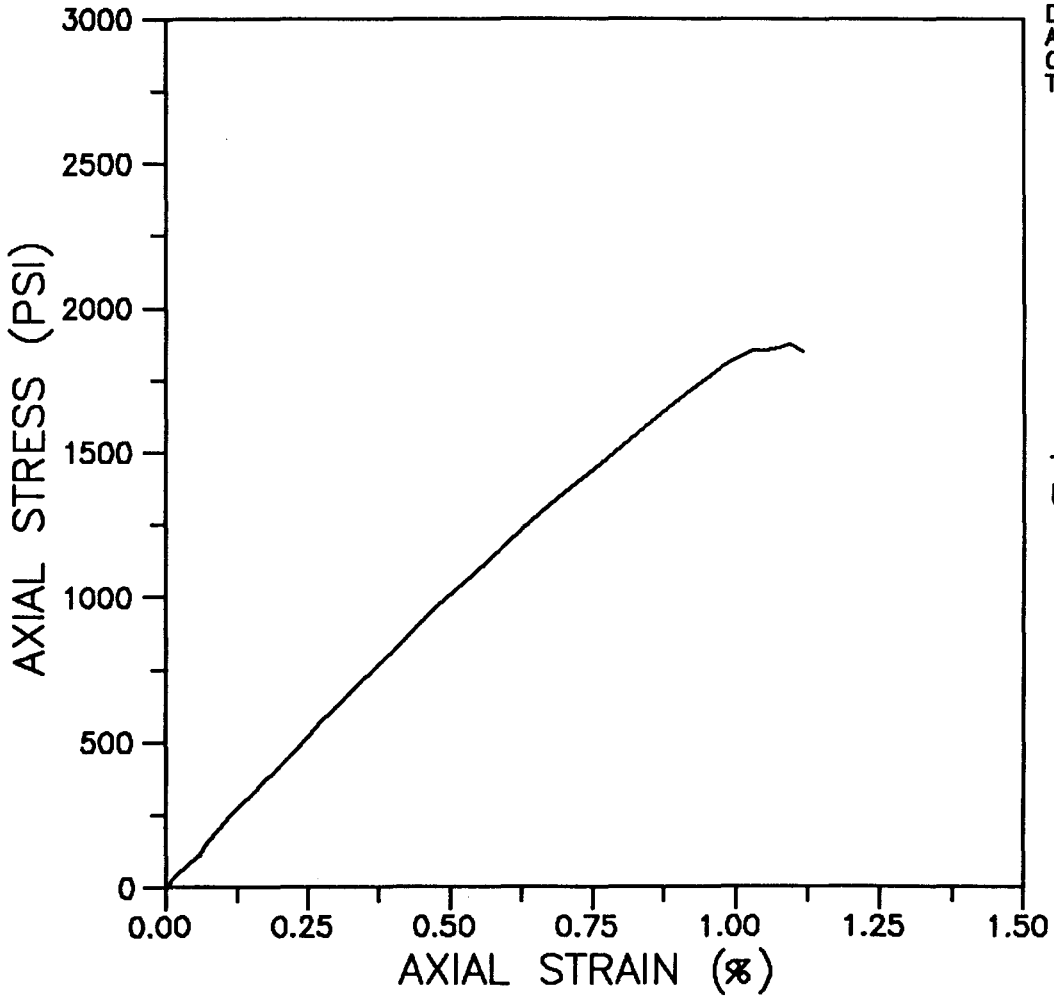
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BE4
DEPTH (FT): 177.8
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 7.6
DRY UNIT WEIGHT (PCF): 137.1
DEG. OF SATURATION (%): 89.7
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
1.99 x 10E5 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

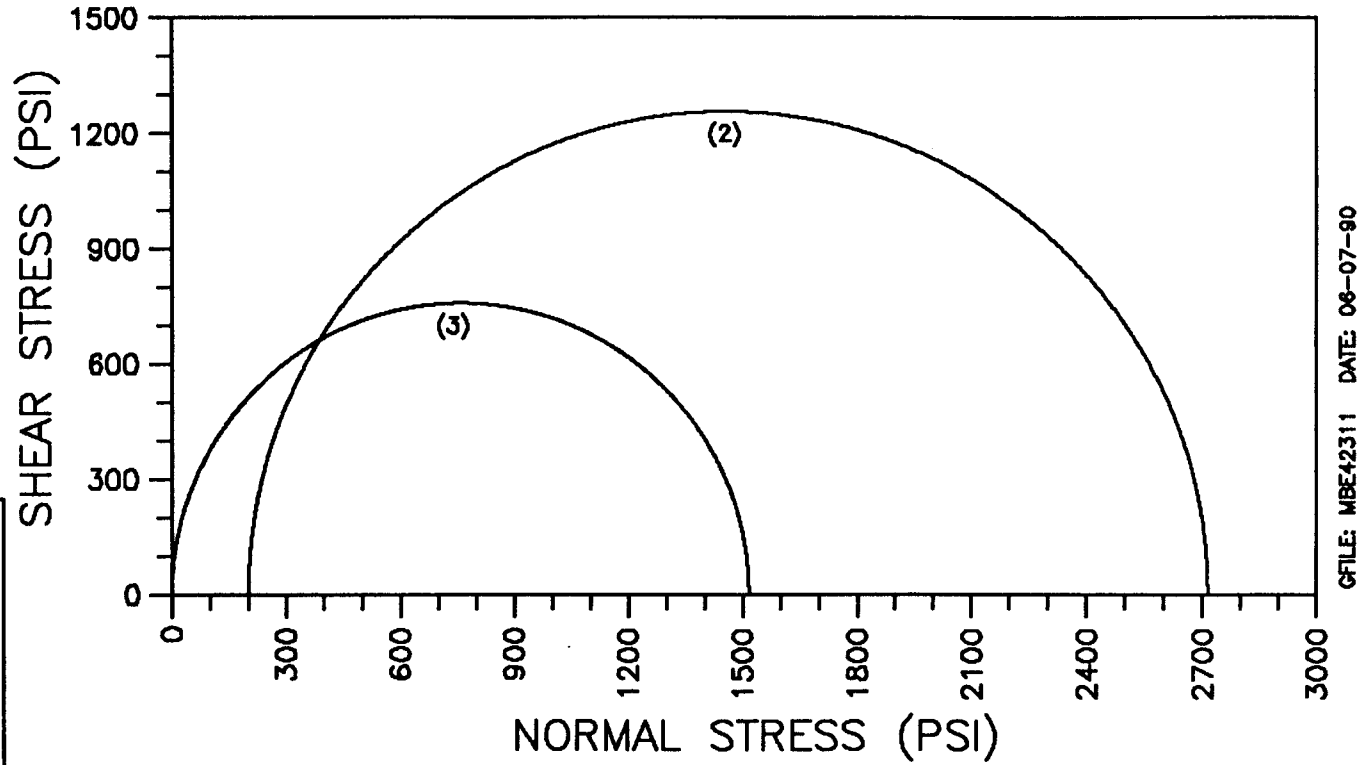
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO.: BE4
DEPTH RANGE (FT): 231.1-232.6
AUSTIN CHALK LIMESTONE



GFILE: MBE42311 DATE: 06-07-90

SEE STRESS-STRAIN PLOTS FOR INDIVIDUAL SAMPLE DATA

INCLINATION (DEG): VERTICAL
TEST TYPE: UNCONFINED COMPRESSION (ASTM D2938)
TRIAXIAL COMPRESSION (ASTM D2664)

(1) DEPTH (FT): 231.1(THIS SAMPLE DID NOT FAIL-DELETED FROM MOHR CIRCLE PLOT)
(2) DEPTH (FT): 231.5
(3) DEPTH (FT): 232.2

TEXAS SSC SITE

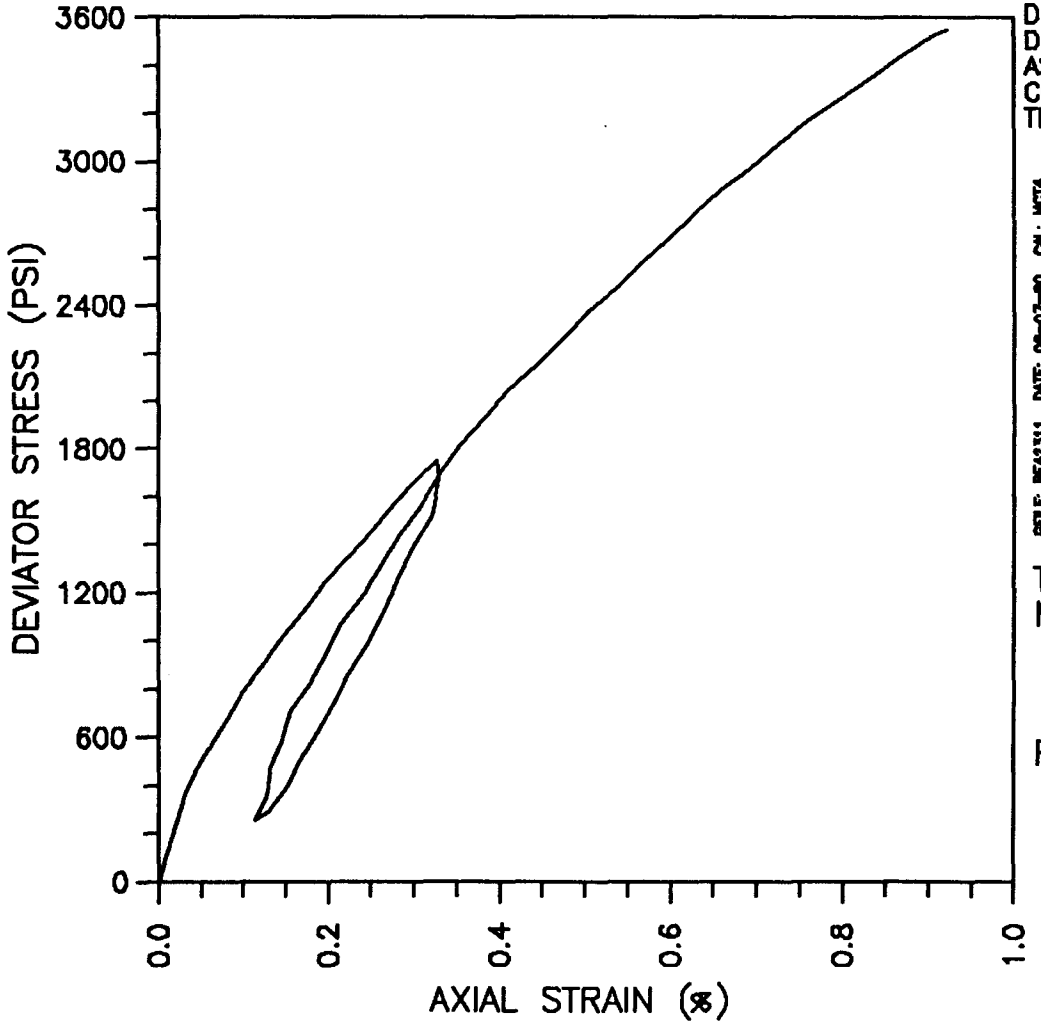
MOHR CIRCLE PLOT

MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.17

FIGURE

BORING NO.: BE4
DEPTH (FT): 231.1
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 8.7
DRY UNIT WEIGHT (PCF): 133.2
DEG. OF SATURATION (%): 88.5
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 100
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

FILE: BE42311 DATE: 08-07-90 CAL: MGT4

TANGENT MODULUS AT 50%
MAXIMUM STRESS:
4.082 x10E5 PSI

FAILURE MODE:
LOADED TO 3548 PSI
W/O FAILURE

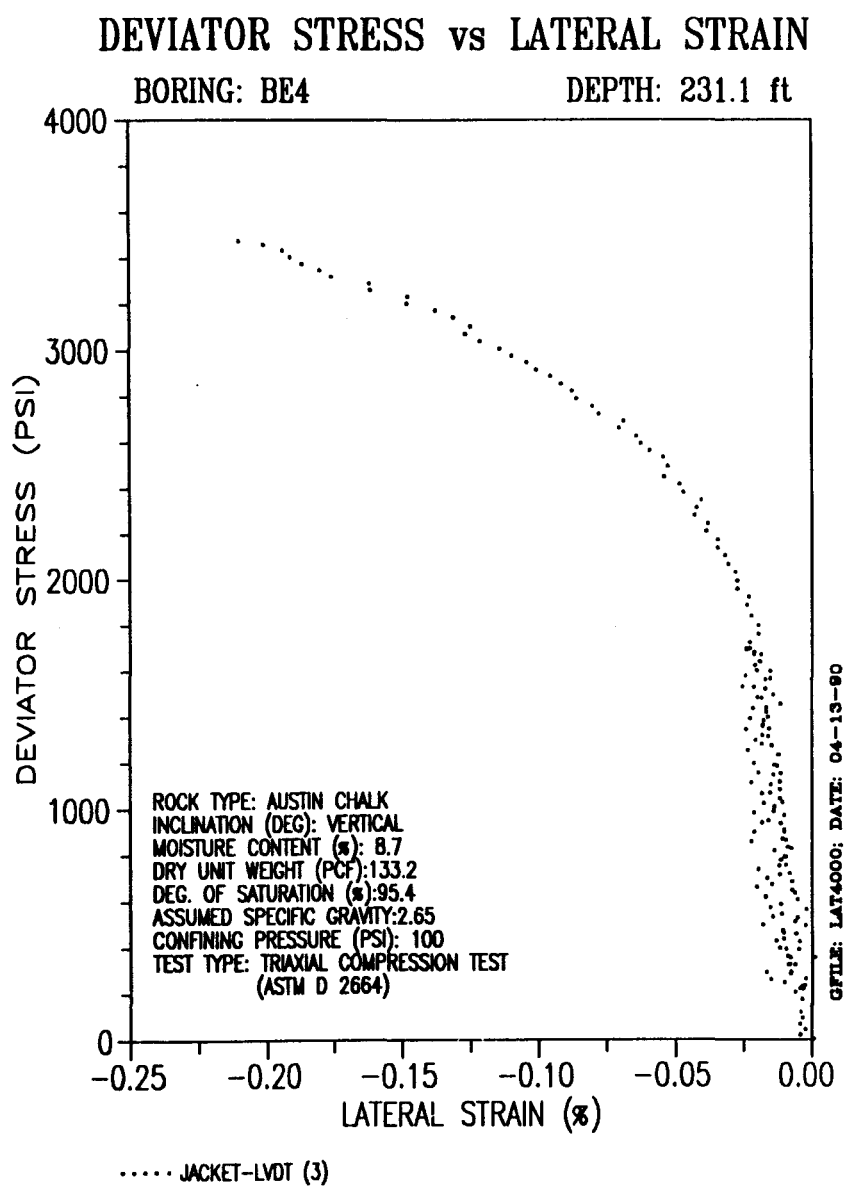
TEXAS SSC SITE

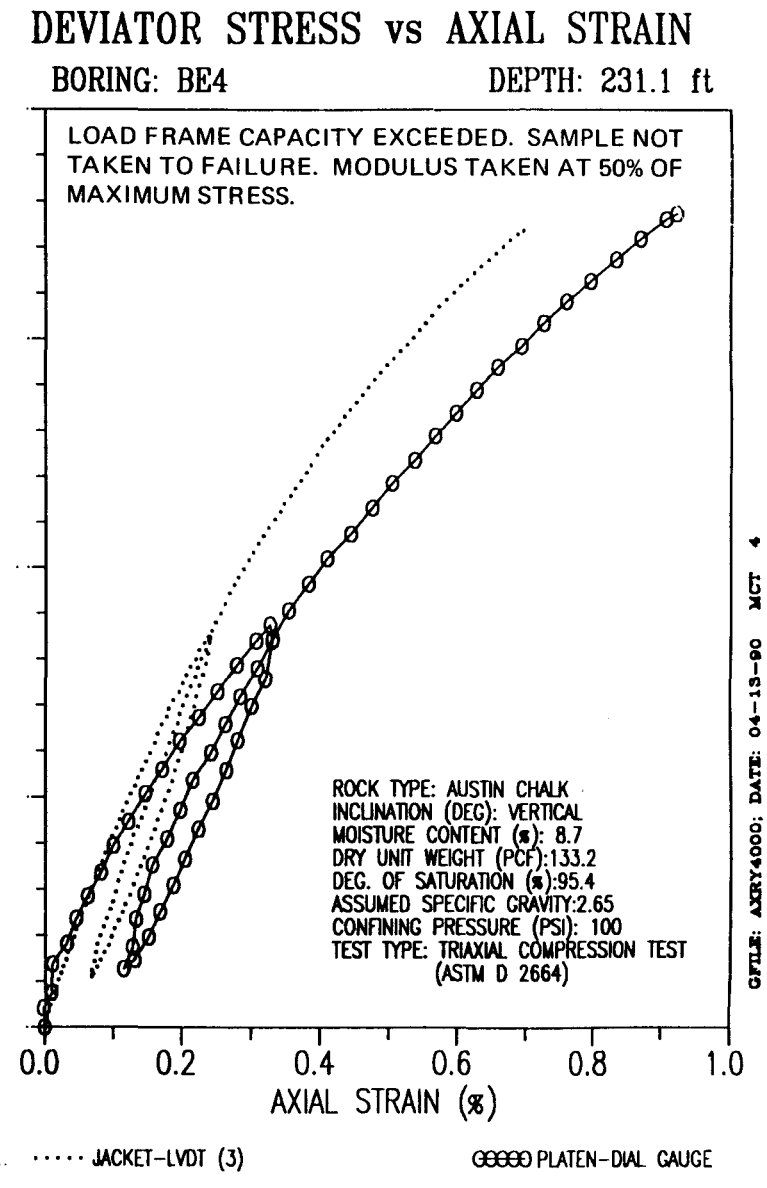
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

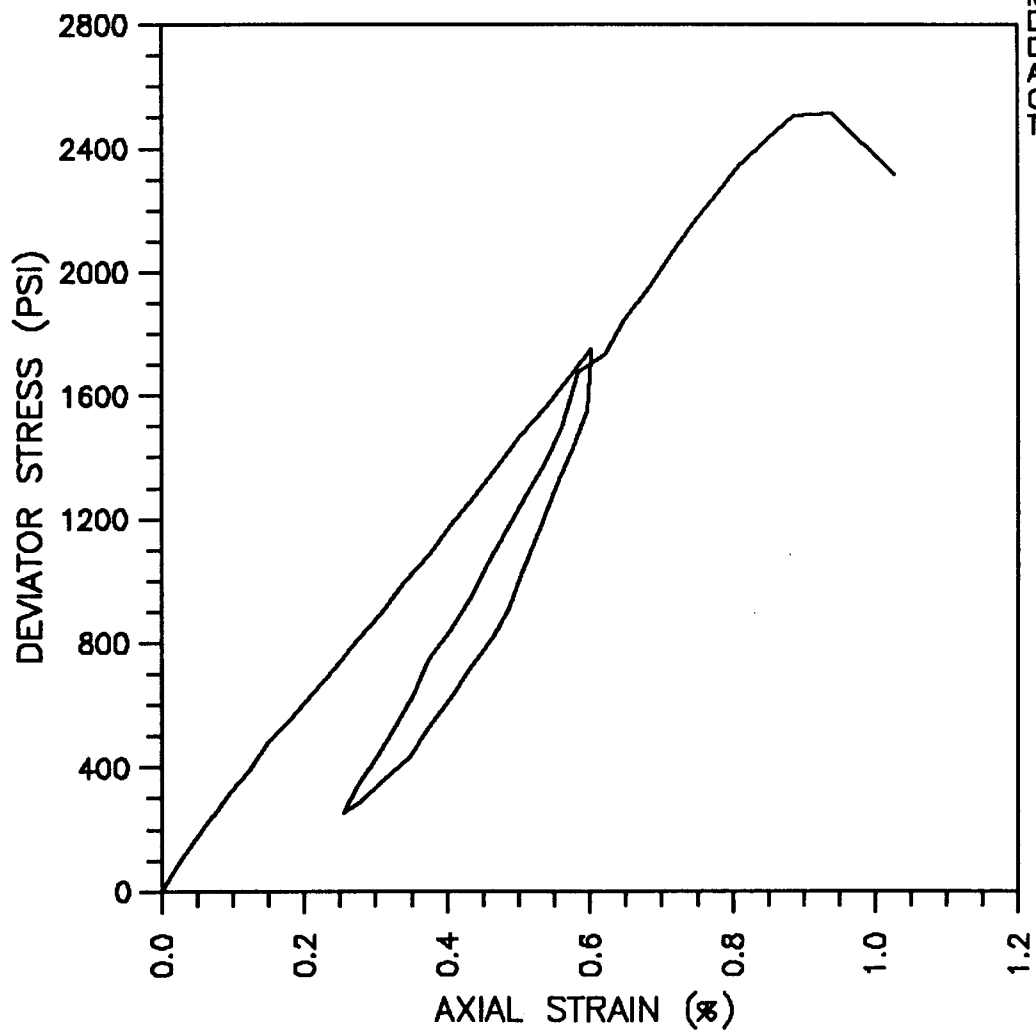
JOB NO.: 5530.17

FIGURE


DEVIATOR STRESS vs LATERAL STRAIN
BORING: BE4
DEPTH: 231.1 ft
DEVIATOR STRESS (PSI)
4000
3000
2000
1000
0
-0.25
-0.20
-0.15
-0.10
-0.05
0.00
LATERAL STRAIN (%)
ROCK TYPE: AUSTIN CHALK
INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 8.7
DRY UNIT WEIGHT (PCF):133.2
DEG. OF SATURATION (%):95.4
ASSUMED SPECIFIC GRAVITY:2.65
CONFINING PRESSURE (PSI): 100
TEST TYPE: TRIAXIAL COMPRESSION TEST
(ASTM D 2664)
GFILE: LAT4000; DATE: 04-13-90
JACKET-LVDT (3)


DEVIATOR STRESS vs AXIAL STRAIN
BORING: BE4
DEPTH: 231.1 ft
LOAD FRAME CAPACITY EXCEEDED. SAMPLE NOT TAKEN TO FAILURE. MODULUS TAKEN AT 50% OF MAXIMUM STRESS.
0.0
0.2
0.4
0.6
0.8
1.0
AXIAL STRAIN (%)
ROCK TYPE: AUSTIN CHALK
INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 8.7
DRY UNIT WEIGHT (PCF):133.2
DEG. OF SATURATION (%):95.4
ASSUMED SPECIFIC GRAVITY:2.65
CONFINING PRESSURE (PSI): 100
TEST TYPE: TRIAXIAL COMPRESSION TEST
(ASTM D 2664)
GFILE: AXRY4000; DATE: 04-13-90 MCT 4
JACKET-LVDT (3)
PLATEN-DIAL GAUGE

BORING NO.: BE4
DEPTH (FT): 231.5
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 8.5
DRY UNIT WEIGHT (PCF): 136.1
DEG. OF SATURATION (%): 96.4
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION
(ASTM D 2664)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.837 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

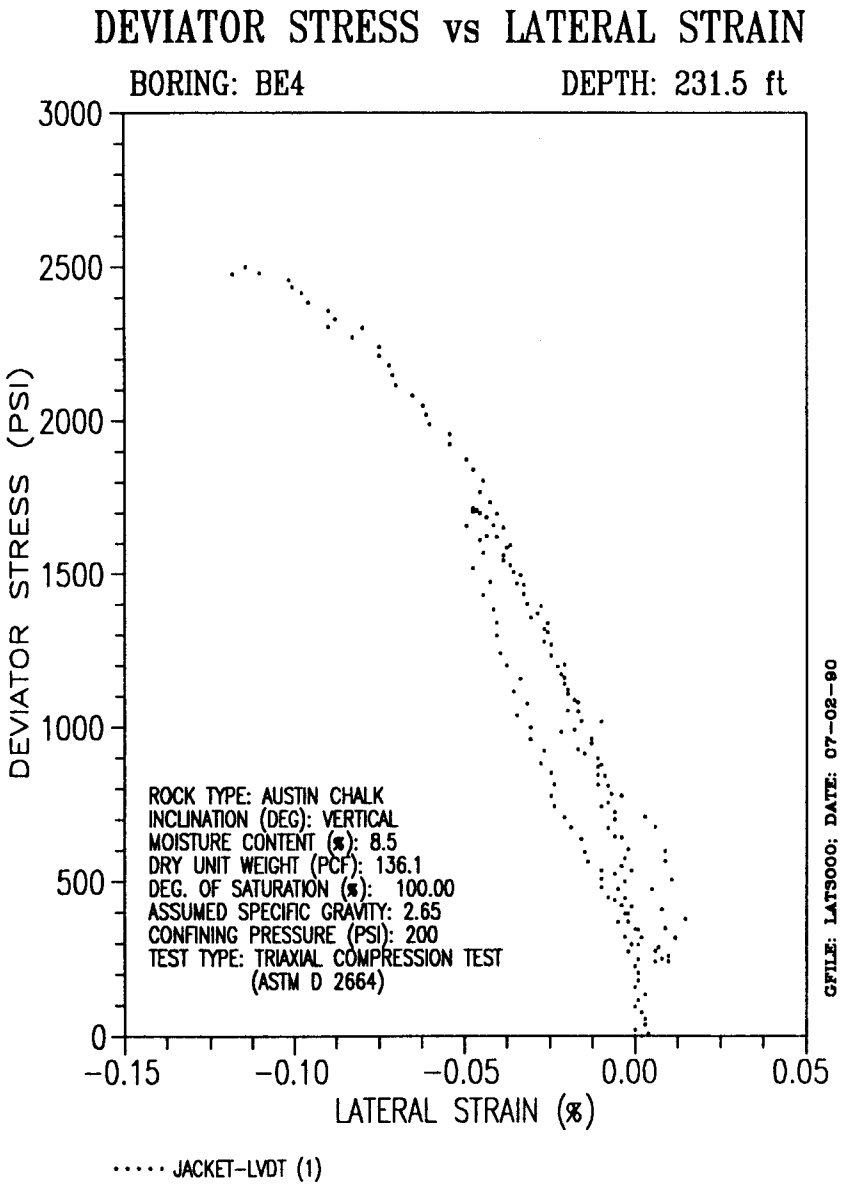
TEXAS SSC SITE

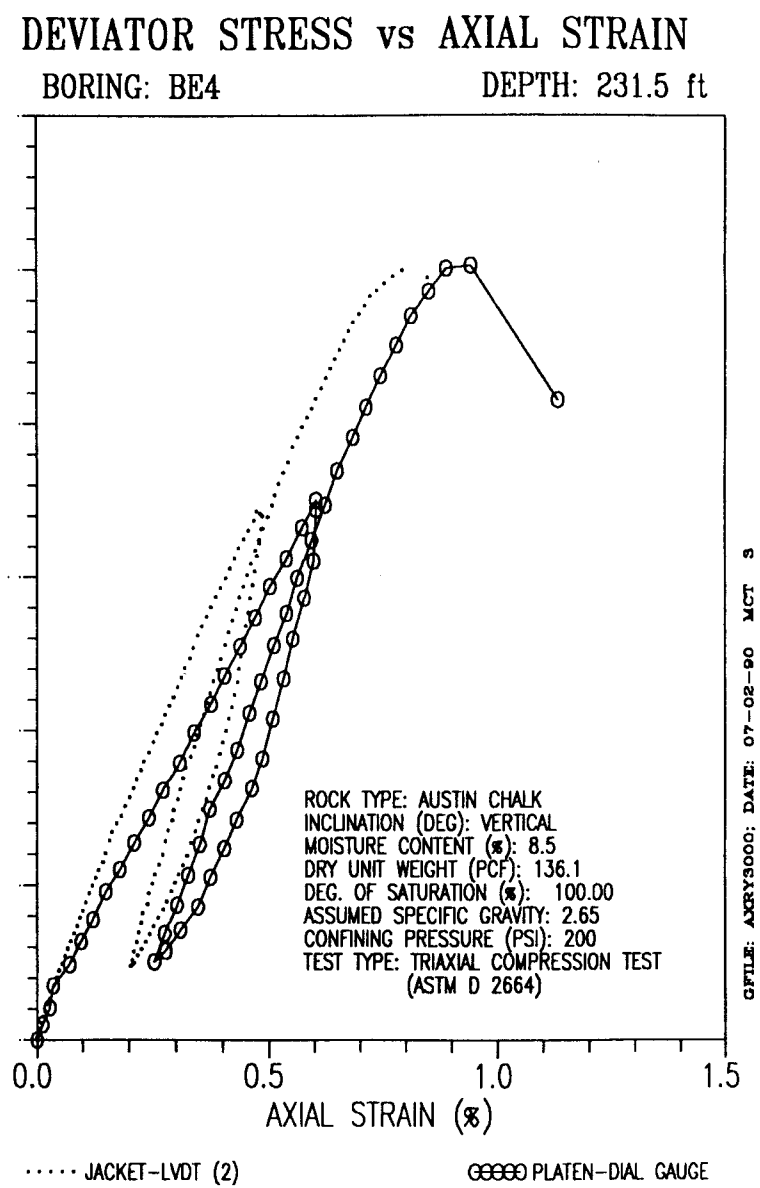
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

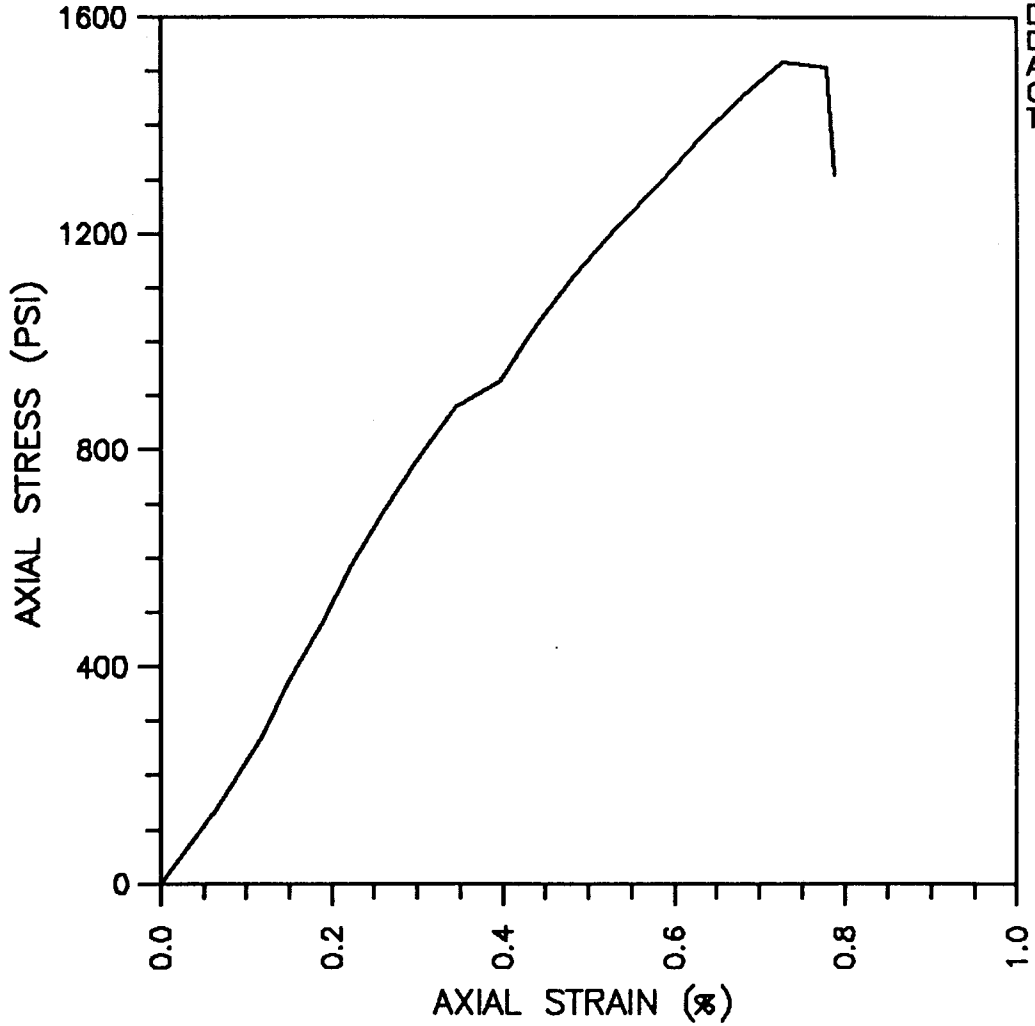
JOB NO.: 5530.17

FIGURE


DEVIATOR STRESS vs LATERAL STRAIN
BORING: BE4
DEPTH: 231.5 ft
DEVIATOR STRESS (PSI)
3000
2500
2000
1500
1000
500
0
-0.15
-0.10
-0.05
0.00
0.05
LATERAL STRAIN (%)
ROCK TYPE: AUSTIN CHALK
INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 8.5
DRY UNIT WEIGHT (PCF): 136.1
DEG. OF SATURATION (%): 100.00
ASSUMED SPECIFIC GRAVITY: 2.65
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION TEST
(ASTM D 2664)
GFILE: LAT3000; DATE: 07-02-90
JACKET-LVDT (1)


DEVIATOR STRESS vs AXIAL STRAIN
BORING: BE4
DEPTH: 231.5 ft
0.0
0.5
1.0
1.5
AXIAL STRAIN (%)
ROCK TYPE: AUSTIN CHALK
INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 8.5
DRY UNIT WEIGHT (PCF): 136.1
DEG. OF SATURATION (%): 100.00
ASSUMED SPECIFIC GRAVITY: 2.65
CONFINING PRESSURE (PSI): 200
TEST TYPE: TRIAXIAL COMPRESSION TEST
(ASTM D 2664)
GFILE: AXRY3000; DATE: 07-02-90 MCT S
JACKET-LVDT (2)
PLATEN-DIAL GAUGE

BORING NO.: BE4
DEPTH (FT): 232.2
AUSTIN CHALK LIMESTONE



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 10.0
DRY UNIT WEIGHT (PCF): 130.6
DEG. OF SATURATION (%): 93.3
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE: UNCONFINED COMPRESSION
(ASTM D 2938)

DFILE: BE42322 DATE: 08-07-90 CAL: MCT4

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.500 x10E5 PSI

FAILURE MODE:
AXIAL SPLITTING

TEXAS SSC SITE

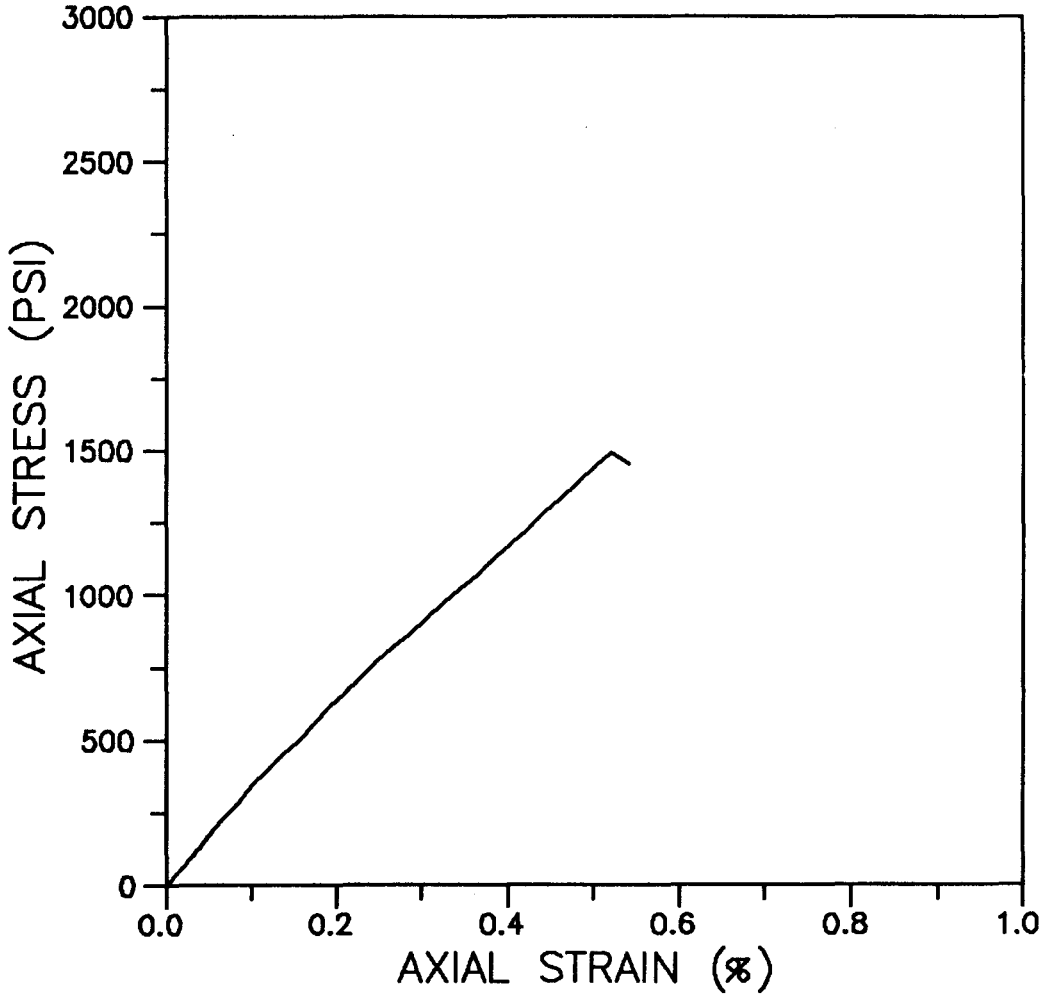
STRESS-STRAIN PLOT

MASON-JOHNSTON & ASSOCIATES,INC.
GEOLOGISTS-ENGINEERS

JOB NO.: 5530.17

FIGURE

BORING NO: BE4
DEPTH (FT): 264.2
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 8.1
DRY UNIT WEIGHT (PCF): 138.0
DEG. OF SATURATION (%): 99.0
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
2.75 x 10E5 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

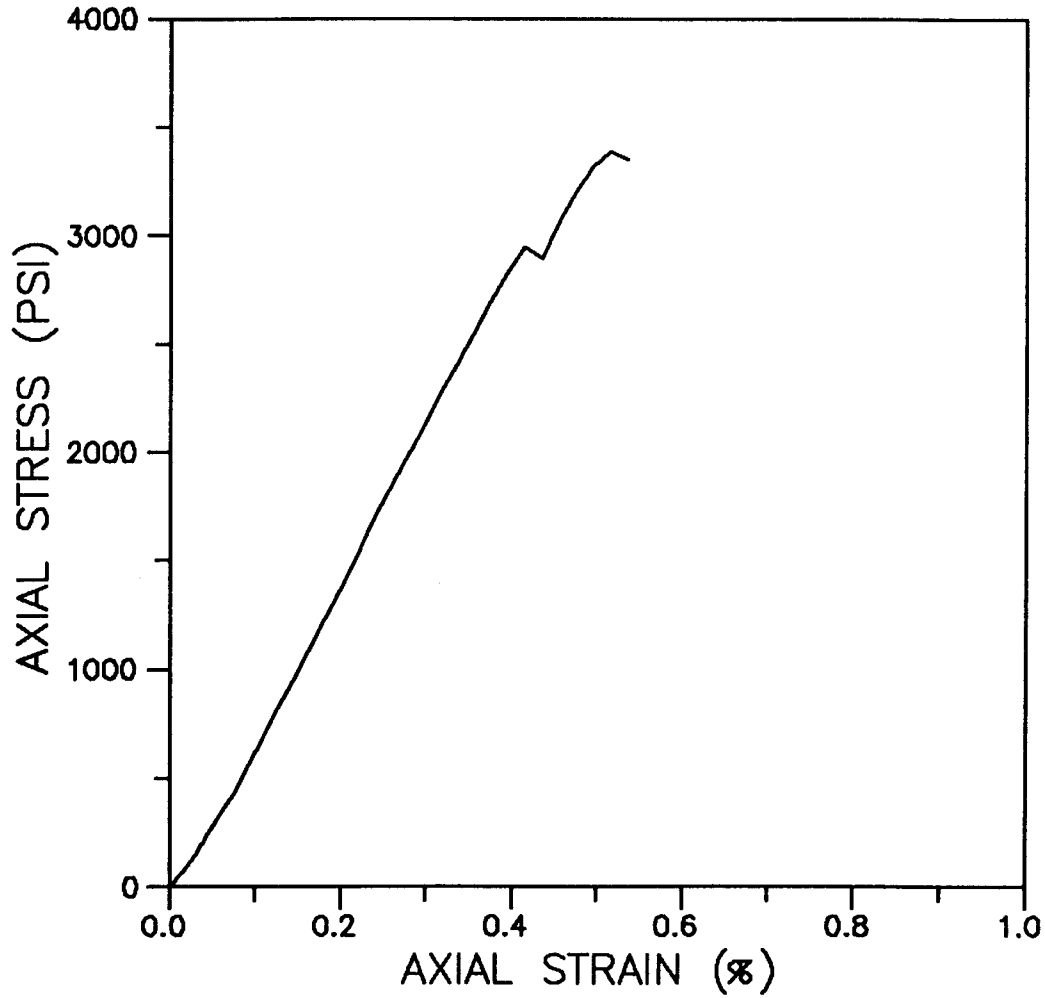
STRESS-STRAIN PLOT

SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89-192

FIGURE

BORING NO: BE4
DEPTH (FT): 282.1
AUSTIN CHALK



INCLINATION (DEG): VERTICAL
MOISTURE CONTENT (%): 9.7
DRY UNIT WEIGHT (PCF): 132.5
DEG. OF SATURATION (%): 96.4
ASSUMED SPECIFIC GRAVITY: 2.7
CONFINING PRESSURE (PSI): 0
TEST TYPE:UNCONFINED COMPRESSION
(ASTM D 2938)

TANGENT MODULUS AT 50%
ULTIMATE STRESS:
7.83 x 10E5 PSI

FAILURE MODE:
LONGITUDINAL (AXIAL)
SPLITTING

TEXAS SSC SITE

STRESS–STRAIN PLOT

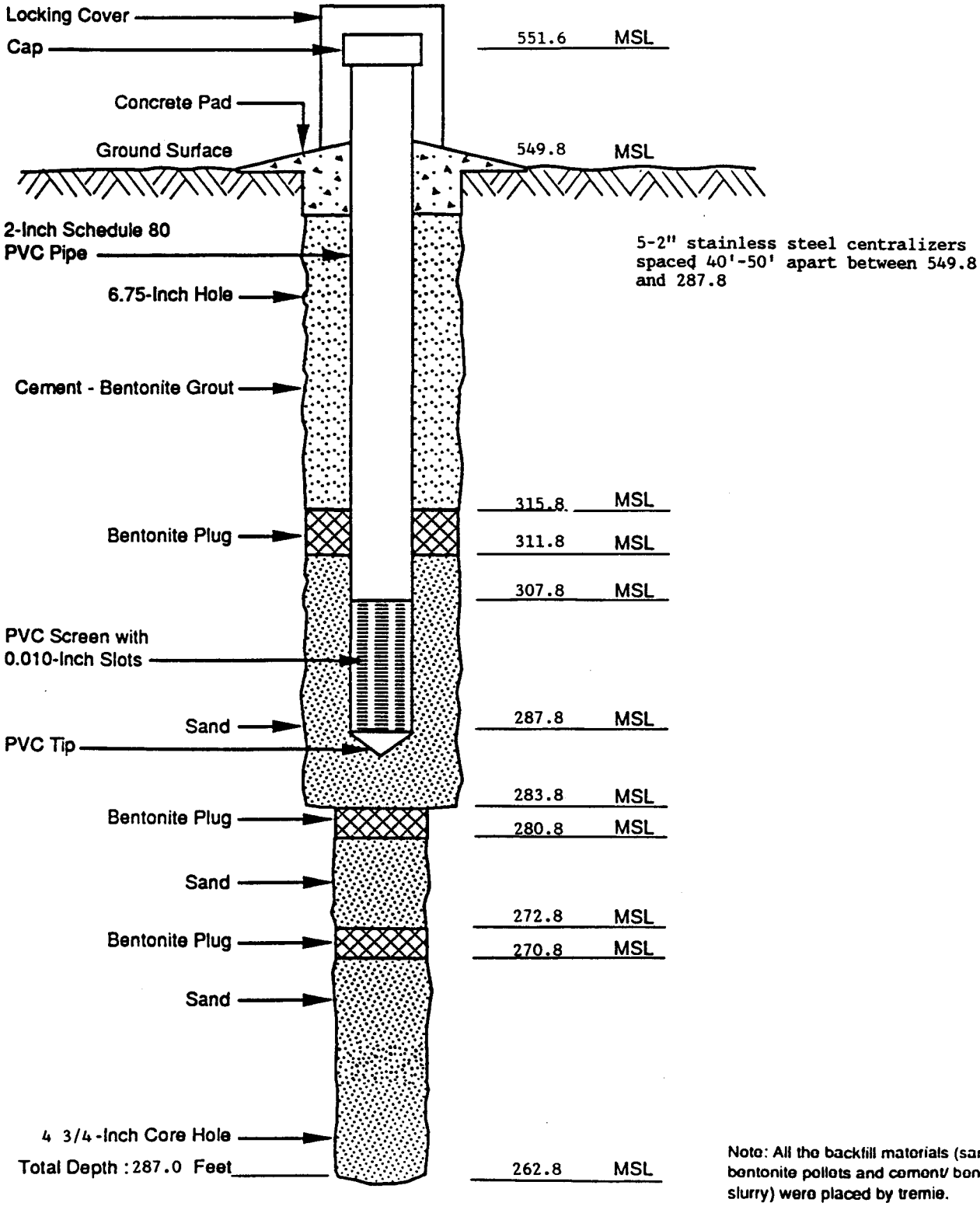
SOUTHWESTERN LABORATORIES
DALLAS, TEXAS

JOB NO.: 89–192

FIGURE

APPENDIX E

WELL AS-BUILT DIAGRAM



Note: All the backfill materials (sand, bentonite pellets and cement/ bentonite slurry) were placed by tremie.

NOT TO SCALE

Boring: BE 4
Location: N 297,829
E 2,225,784
Date(s) Installed: 1-25-90
Well Construction Supervising Geologist: Mike Granger
Approved By: Shawn Wood
Date: 5-14-90

"As Built"
Well Construction Diagram
Observation Well
No.
BE 4

5/90

Figure