SSCL-SR-1187
SGR-1

GEOTECHNICAL INVESTIGATION

MAGNET DEVELOPMENT LABORATORY FACILITY

SUPERCONDUCTING SUPER COLLIDER PROJECT

ELLIS COUNTY, TEXAS

FOR

The PB/MK Team

Dallas, Texas

MASON
JOHNSTON
& ASSOCIATES, INC.

geotechnical consultants

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INTRODUCTION

In accordance with Subcontract No. SC-A42-1002 dated August 1990, a Geotechnical Investigation was conducted at the site of the proposed Magnet Development Laboratory Facility for the SSC Project. The site is located on Parcel 141 west of Hoyt Road and north of FM 1446 in Ellis County, Texas as indicated on the Vicinity Map on Plate 1.

The project, as currently planned, consists of a single structure about 160 feet by 450 feet in plan and surface parking. We understand that the structure will be a steel frame structure with tilt-up walls. Columns will be supported on concrete piers founded in the unweathered gray limestone. At the present time the plans indicate that a slab-on-grade floor system is desirable for the facility.

The project, as authorized, provided for the drilling of eight borings. Six additional borings were added after initial information was reviewed. Typical and representative samples of materials penetrated by the borings have been analyzed in the geotechnical laboratory for strength and other pertinent physical properties. The results of the field and laboratory phases of the geotechnical investigation have been evaluated and these studies have concluded in the development of certain recommendations, submitted herewith, believed to be pertinent to the design and construction of the proposed facility.

This report was prepared for the exclusive use of The PB/MK Team for specific application to the design and construction of the Magnet Development Laboratory for the Superconducting Super Collider Project in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

SUBSURFACE EXPLORATION

Subsurface materials present at the building site were explored and sampled by a series of ten (10) Nx-size core borings ranging in depth from 25 to 32.5 feet and four (4) soil borings with depths typically 5 feet or less. The locations of the borings are shown on Plate 2. Boring locations were determined by Mason-Johnston personnel prior to drilling by measuring from existing property corners using a "Rolatape" measuring wheel. Coordinates and elevations of the

boring locations were determined by The PB/MK Team and provided to Mason-Johnston for this report. All of the core borings were drilled by the wash-rotary technique. The sampling procedure incorporated within this investigation provided for the lifting of undisturbed samples of the cohesive soils present at the site utilizing a thin-walled, seamless, Shelby-tube sampler forced into the soil by means of a rapid thrust from two balanced hydraulic rams on the drilling rig.

Near-continuous cores of the underlying primary sediments were obtained by means of a bottom-discharge, double-tube, Nx-size coring tool fitted with an appropriate cutting bit.

All samples were visually classified by an Engineering Geologist in the field. Soil samples were classified in accordance with the Unified System of Soil Classification (Casagrande) as illustrated on the attached "Key to Classification as Used on Logs". Primary geologic materials present at the site have been identified and described in accordance with standard geologic nomenclature. Rock Quality Designation (RQD) was measured and recorded for all core runs. The value obtained by this method is derived by measuring the total length of all core greater than 4 inches and dividing by the total run length. RQD provides an estimate of the variation of rock mass properties.

Upon completion of sampling, all core borings were bailed. No

groundwater was observed in any of the borings at the site. All borings were grouted to the surface prior to leaving the site.

All soil samples were field-extracted, wrapped in polyethylene film to preserve the in-situ moisture content and associated changes in physical properties, identified as to boring number and depth, placed in appropriate containers and transported to the laboratory for further tests and evaluation.

All available samples of primary geologic materials encountered during this investigative program were wrapped in polyethylene film , preserved in appropriate containers and transported to the laboratory for further study.

LABORATORY DETERMINATIONS

In order to assist in visual classification of soil samples as well as to provide soil indices for use in the evaluation of the character and behavior of soil materials present at the site, a series of Atterberg Limit Determinations (both raw soil and with various percentages of lime admix), Moisture Contents, and Unit Dry Weight Determinations were conducted on typical, representative materials extracted from the borings. These test data are summarized on Plate 3.

Tests to guide estimates of soil corrosivity to steel and concrete were performed on selected samples of near surface

soils. Results of sulfate, pH, and resistivity tests are presented on Plate 4.

Strength properties were investigated in the laboratory by means of Unconfined Compression and Modulus of Deformation testing. These determinations were conducted by the application of an axial load to a cylindrical core sample, with no lateral support, until failure occurred within the sample. Results of Unconfined Compression Tests on soil are summarized on Plate 5 and are presented graphically as Stress-Strain plots on Plates 6 through 10. The results of similar tests on rock are summarized numerically on Plate 11 and are presented graphically on Plates 12 through 38.

The expansive characteristics of the near surface cohesive soils present at the subject facility are being investigated by Absorption Pressure and Swell Tests. These tests will be presented in a supplemental report.

Optimum Moisture/Density determinations and California Bearing Ratio (CBR) determinations are presently underway and will be presented in a supplemental report.

SURFACE CONDITIONS

The site consists of gently rolling open prairie land ranging in elevation from approximately 750 to slightly greater than 760. Currently the site is drained by a slight topographic

depression; sloping gently southward across the mid-portion of the proposed structure.

SITE GEOLOGY

Based on data developed by this study, it is anticipated that the thickness of overburden material present may range from approximately 0.5 to 5.0 feet. The thicker soil section is anticipated to occur within the north and west portions of the Site, with somewhat thinner soil cover being present within the east central portions of the Site. Those natural soil materials present are residual in nature, having been derived by differential weathering of the underlying Austin Chalk. For the most part, those natural soil materials range from clay to sandy clay.

Immediately underlying the residual soil materials, the chalky limestone strata identified as the Austin Chalk Limestone Formation of Cretaceous Age are present. Typically, in its unweathered state, the Austin Chalk Limestone Formation is a dense, well-indurated, fossiliferous, chalky limestone. Lithologically, the Austin Chalk Limestone is commonly a sequence of alternating layers of chalky limestone and shaly limestone with a few occasional layers of calcareous shale and occasional very thin bentonitic clay seams.

Throughout the Site vicinity, the uppermost layers of the Austin Chalk Limestone Formation, ranging in thickness from a

few feet to as much as 17 feet, may be tan in color, having experienced differential weathering in the form of leaching. Commonly associated with this weathered layer of the Austin Chalk Limestone Formation are numerous thin clay seams and iron-stained fractures. There is also associated with the unweathered Austin Chalk Limestone a considerable number of fractures. Some of the fractures are open and some have been healed by secondary mineralization in the form of calcite deposition. The uppermost layers of the Austin Chalk Formation within the study area are expected to vary slightly in elevation due to prior erosional processes.

Structures

Throughout Ellis County, Texas, the Austin Chalk Limestone Formation contains a considerable number of minor faults and/or joints. Small gravity (normal) faults, as well as some reverse faults, are known to exist within the primary formation. These features are often zones of weakness and their full extent and location can be adequately identified and defined only by a comprehensive geotechnical study. For the most part, these faults are relatively minor insofar as the vertical displacement is generally less than 10 feet. The tectonic environment which generated the faults is ancient in age and the faults are no longer considered to be active. However, these faults, or shear planes, must be considered as zones of potential weakness; accordingly, consideration of these zones must be given during project design evaluations.

Groundwater

No free groundwater was encountered during this investigative program. However, during periods of high rainfall, some free groundwater may be anticipated within the uppermost layers of the weathered to severely weathered limestone strata present at the site.

Weathering

The Austin Chalk Limestone typically weathers into a moderately to highly plastic black to brown clay. The weathering profile, from the ground surface down, typically grades from a residual black to brown clay, to a residual brown to black clay, with chalky limestone particles, to a tan clay with increasing chalky limestone particles and thin tan chalk beds, to a firm to moderately hard white to tan chalky limestone, and finally into a light gray chalky limestone. The depth of weathering is a function of jointing and fracturing (or faulting), the thickness of cover, the argillaceous content of the Austin Chalk Limestone, and the variability of moisture content and groundwater percolation.

Corrosion

Historical data do not indicate corrosion problems associated with the Austin Chalk Limestone. Laboratory tests on overburden soils at this site have been performed to provide guidance on corrosivity of these soils.

Solutioning

Historical data available to this office indicate that major solution cavities or channels are not present within the Austin Chalk Formation. The lack of apparent solutioning may be due in part to a high percentage of insolubles and in part to an the pH of water in the formation.

Along a low percentage of fault planes, minor cavitation has been noted in construction excavation projects. This minor cavitation is due to the lack of complete secondary mineralization and not due to solutioning.

SUBSURFACE CONDITIONS

The specific type, depth, and character of materials penetrated by each of the borings may be seen in detail on the attached "Logs of Borings". In general, from the ground surface down, materials present at the site consist of a relatively thin layer of varying thicknesses of silty clay with weathered limestone fragments increasing with depth, all underlain by the primary geologic strata identified as the Austin Chalk Limestone Formation of Cretaceous Age.

The overburden soils present at the proposed site are, for the most part, residual in nature, having been derived from differential weathering of the Austin Chalk Limestone Formation during previous geologic time. The resulting soil cover is generally thin, typically less than five feet, with an

anomalous thickness of 13.6 feet in Boring No. MDL-6. Examination of the detailed descriptions on "Logs of Borings" presented herein illustrates the slight irregularity of the overburden materials.

Immediately underlying the overburden materials, each of the core borings drilled at the site encountered and terminated within the chalky limestone formation identified herein as the Austin Chalk Limestone Formation of Cretaceous Age. Core boring depths ranged from about 25 feet to 32.5 feet below existing grade. Typically, and in its unweathered state, the Austin Chalk Limestone is a dense, well-indurated, fossiliferous, earthy limestone which may be considered as an ideal founding medium for structural loads. Lithologically the unweathered Austin Chalk is a sequence of alternating layers of chalk and argillaceous chalk. Historical data on file in this office indicate that the thickness of the Austin Chalk Limestone in the vicinity of the subject site is in excess of 100 feet and that the limestone formation is directly underlain by the clayey shale strata of the Eagle Ford Shale Formation of Cretaceous Age.

Throughout the project area, the uppermost layers of the Austin Chalk Limestone, ranging in thickness from approximately 6 to 17 feet, are tan in color, having experienced differential weathering in the form of leaching. Commonly associated with this weathered or leached layer, of the Austin Chalk are

numerous thin clay seams and numerous iron-stained fractures and/or joints.

Faulting is known to have occurred throughout the project area. A number of faults with displacements in excess of 25 feet have been mapped around the immediate vicinity during previous exploration activities for the SSC project; however, we are unaware of any major faults mapped within the project area. There were two (2) fractures and/or faults encountered during this investigation. While displacements could not be determined these faults and/or fractures are considered relatively minor and the tectonic environment which generated such faulting is ancient in age and the faults are no longer considered active. However, these fault planes or shear planes must be considered as zones of potential weakness; accordingly, consideration was made for these zones in subsequent foundation analyses.

Typically, in the project area, groundwater is perched on top of the unweathered gray Austin Chalk Limestone and is recharged by percolation of surface waters. While no free groundwater was encountered during these exploration activities at the site, perched groundwater should be expected at depths 2 to 5 feet or more above the unweathered Austin Chalk Strata during periods of weather wetter than the August 1990 exploration conducted for this project.

FOUNDATION DESIGN CONSIDERATIONS

The Austin Chalk Limestone Formation is present at the site in an appreciable thickness (100 feet or more). Strength and settlement characteristics of the Austin Chalk are such that these materials may be considered as an ideal founding medium. We recommend that structural loads for the proposed facility be transferred to the gray, unweathered Austin Chalk Limestone Formation by means of straight-walled, auger-excavated, cast-in-place, concrete foundation shafts designed to act in end-bearing stress transfer or a combination of side-shear stress transfer and end-bearing stress transfer or by means of spread or strip footings proportioned to act only in end-bearing stress transfer. We recommend that the straight drilled shaft type of foundation be used for this facility. The Austin Chalk Limestone formation in this area is not conducive to solution cavities or caverns; therefore probe holes at foundation locations will not be required.

The Unconfined Compressive Strength Tests conducted on representative geologic materials encountered at the site indicate that the Austin Chalk Limestone will react elastically within the range of anticipated column loads. Thus, equations based on the Theory of Elasticity have been utilized in determining the allowable unit loading intensities for both end-bearing stress transfer and side-shear stress transfer. Utilizing an average of the Unconfined Compressive Strength data obtained during the laboratory testing program; a safety

factor of 5 and neglecting overburden pressures, the following unit allowable bearing pressures have been determined:

End-Bearing Stress Transfer = 36.4 tsf
Side-Shear Stress Transfer, Compression = 11.6 tsf
Side-Shear Stress Transfer, Tension = 5.8 tsf

These values are for portions of a straight walled, cast-in-place, concrete foundation shaft in intimate contact with the gray, firm, unweathered limestone materials extending a minimum depth of two feet below the upper level of the designated bearing strata.

In the event spread-footings or continuous strip-footings are utilized for foundation support for the proposed facility, side-shear stress transfer values are not applicable, and the footings should be proportioned using the end bearing stress transfer value above.

The allowable unit loading values given above for side-shear stress transfer are based on individual isolated foundation units, separated in plan by a clear distance of at least two shaft diameters. In the event this clear spacing cannot be maintained, this office should be contacted so that additional studies can be performed and reduced design values developed to compensate for stress overlap between adjacent footings.

Considering the magnitude of column loads expected for this facility, we anticipate that straight shaft foundations will be designed for end bearing stress transfer only. If loads require side shear stress transfer, the shaft length to diameter ratio will need to be reviewed to determine if any reduction in side-shear stress transfer is required.

Lateral loads on straight shafts must be considered in the overall straight shaft foundation design. The table presented on Plate 39 summarizes the results of lateral load analyses on 42-inch and 48-inch diameter piers at the site considering two cases of subsurface conditions and using representative column loads from preliminary analyses. Case A assumes that no select fill is present within the depth of the foundation and that the unweathered limestone is at the maximum elevation determined by the site investigation. Case B assumes that select fill is present to a depth of 14 feet and that the unweathered limestone is at the minimum elevation encountered in the boreholes. Loading conditions considered include the "Control" loading condition from the CRSS column reaction dated 15 August 1990 and the maximum moment condition from that list of loads. Plots of pier deflection, moment and shear are presented on Plates 40 through 47.

Based on data developed during this investigation, it was determined that structural elements constructed as set forth previously will experience settlement measured in small

fractions of an inch. This settlement will occur rapidly, during construction as load is applied.

CONSTRUCTION PROCEDURES

Each shaft installation should be vertical (within acceptable tolerances), placed in proper plan location and cleaned prior to concrete placement. Reinforcing steel cages should be prefabricated in a rigid manner to allow expedient placement of both steel and concrete into the excavation. It is essential that the placement of both steel and concrete be completed as soon as practical after completion of the excavation to take advantage of the rebound properties of the bearing stratum. In all cases, no portion of the stratum being counted on to provide structural support should be exposed to atmospheric conditions for more than eight (8) hours prior to the placement of the concrete.

We do not expect that temporary casing will be needed to control groundwater seepage or caving. However, seepage sometimes does occur through the weathered limestone and we recommend that casing be available as a contingency for such a condition. The casing should be installed a sufficient distance into the bearing stratum to insure a water tight seal; normally a distance of 1 to 2 feet is adequate for this purpose. After the satisfactory installation of any temporary casing, the required shaft penetration may be excavated by machine auger within the casing in a conventional manner. If

the groundwater level is above the base of any temporary casing being utilized, extreme care should be maintained at all times to insure that the head of the plastic concrete is higher than the static groundwater level outside the casing. In actual practice, it is desirable that the head of the plastic concrete be appreciably above the static groundwater level prior to breaking of the seal between the temporary casing and the bearing stratum. Once the seal is broken, the temporary casing may be slowly removed in a vertical direction only (no rotation permitted) while additional concrete is elevated to the top of the casing and placed through a tremie in order to connect with the existing concrete contained within the lower portion of the shaft.

Further, any foundation greater than 15 feet deep should receive concrete through a tremie in order that the segregation of aggregate can be restricted as much as possible.

In order to verify compliance with specifications and to verify the acceptability of the bearing stratum, a qualified and experienced geotechnical observer from this office should be present for the duration of all foundation installations.

FLOOR SYSTEMS

As may be noted from a review of the Absorption-Pressure and Swell tests currently in progress, it is apparent that appreciable volumetric changes and pressures can be generated

as a result of only moderate soil moisture variations. Thus, these soils must be considered as expansive soils and sensitive to variation in soil moisture content.

Because of the swell potential exhibited by the ongoing laboratory tests, we strongly recommend that all existing soil in the building areas be removed and select fill used to achieve desired grade. The structural slab can then be formed and poured directly on the select fill.

EARTHWORK

Recommendations for earthwork in building areas are as follows:

1. Excavate and waste all soil and debris present in the building areas and at least five feet outside the building line.

2. Scarify weathered limestone to a depth of approximately six (6) inches, add moisture (if required), mix and recompact to a density of 92 to 98 percent of the maximum density obtained by the Standard Proctor Compaction Test (ASTM D-698). The moisture content of the compacted materials should be maintained between optimum and plus four percent of the optimum value (determined from ASTM D-698) until covered by fills.

3. Place select fill soils in loose lifts not exceeding nine (9) inches and compact to the moisture/density values specified in No. 2 above.

4. Select fill materials should be inorganic and predominantly granular, having a Liquid Limit less than 35 and a Plasticity Index between 4 and 12. Alternatively, crushed rock meeting the requirements of ASTM C-33 may be used as select fill.

BELOW GRADE WALLS

Lateral pressures for design of pit and vault walls will depend on excavation techniques as well as the type of backfill utilized against the walls. Typical design values recommended for backfill with a wall drainage system in place are given below.

Backfill Type	Lateral Pressure (Equivalent Fluid, pcf)
1. Concrete Sand (ASTM C-33)	45
2. Pit Run Sand (Liquid Limit of 35 or less; Plasticity Index between 6 and 12)	55
3. Crushed Stone	60
4. Existing On-Site Materials	65 or higher

A lateral pressure of 20 pounds per square foot (constant) may

be assumed for single form walls in the gray, unweathered limestone. Wall drainage is typically accomplished by means of a synthetic drainage medium, with filter fabric on the rock side and a suitable bond breaker on the wall. If drainage is not provided behind the walls, hydrostatic pressure must be included in determination of lateral pressures.

Wall backfill material should generally be placed in lifts not exceeding nine inches in loose thickness and compacted at a water content at or above the optimum value (-1% to +3%) to a uniform density of 90 to 95 percent of the maximum density obtained from Standard Proctor Compaction Procedures, (ASTM-698). Certain exceptions to this requirement are typically permitted where concrete sand and/or crushed stone are utilized for backfill. These details are best handled during the construction phase.

PAVING AND DRAINAGE

To enhance pavement performance, it is recommended that clay soils exposed at grade be stabilized with hydrated lime for use as subbase. A minimum treatment depth of six (6) inches should be contemplated. Subject to modification during construction, a hydrated lime content of six (6) percent by dry soil weight (approximately 6 pounds of lime per cubic foot of soil treated) would be expected to effectively stabilize the subgrade soil. Where limestone is encountered at grade, lime stabilization is not required nor recommended. However, the limestone should be

scarified and recompacted to at least 95 percent of maximum density in the same manner as select fill, as discussed in the previous paragraphs.

Soils treated with hydrated lime for use as subbase should be compacted to a minimum value of 95 percent of the maximum density as defined by Texas Highway Department Test Method TEX-113E and at a moisture content at least two (2) percentage points above Optimum Moisture content. This requirement is important in minimizing post construction movement and in assuring complete hydration of the lime treated soils.

If the lime stabilization is utilized, pavement grades should be established in anticipation of some vertical movement associated with expansion or contraction of the near surface clay soils. It is important to establish good surface drainage to provide for rapid removal of surface water away from the building and paved areas.

Other roadwork recommendations are as follows:

1. Excavate and waste organic topsoil present in the pavement areas.

2. Scarify soils exposed in fill areas and transitional areas (cut to fill and fill to cut) to a depth of approximately six (6) inches, add moisture (if

required), mix and recompact to a density of at least 95 percent of the maximum density obtained by the Standard Proctor Compaction Test (ASTM D-698). The moisture content of the compacted soils should be maintained between optimum and plus four percent of the optimum value (determined from ASTM D-698) until covered by fills or the subbase.

3. Place fill soils in loose lifts not exceeding nine (9) inches and compact to the moisture/density values specified in No. 2 above.

4. If limestone is present at grade, the limestone should be scarified and recompacted in the same manner as select fill, as discussed in the previous paragraphs.

For temporary roads, we recommend that lime stabilization, as discussed above, be increased to a treatment depth of eight (8) inches. A geotextile such as Mirafi 600 x or 700 x should be placed on top of the lime-stabilized subgrade; crushed rock meeting criteria set forth above should be placed on top of the geotextile. We recommend that this crushed rock base be at least 12 inches in thickness and compacted to 95% maximum density as determined by ASTM D-698.

SUMMARY

The following summarizes our conclusions and recommendations:

1. Major structural loads may be transferred to the hard, gray, unweathered limestone of the Austin Chalk Limestone Formation utilizing straight shaft concrete piers in accordance with criteria delineated in prior paragraphs.

2. Using the anticipated maximum column loads and criteria developed in this investigation, foundation settlements are expected to be small fractions of an inch for structural elements founded in the hard, gray unweathered limestone. Settlement will occur as elastic deformation and should be essentially complete at the end of the construction phase.

3. Due to the potentially damaging swell pressures of near surface soils at the site, it is recommended that all soils under the building footprint be removed and replaced with select fill to desired grade. Recommendations for placement of select fill and compaction of fill and lime stabilized material for parking areas are listed in prior paragraphs.

4. We recommend that a qualified geotechnical observer from this office be retained to provide continuous soil engineering services during foundation and earthwork phases of this project. This is to observe compliance with the design concepts, specifications or

recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

It is recommended that the soil and foundation engineer be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

In the event that any changes in the nature, design or location of the building are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

The analysis and recommendations submitted in this report are based in part upon the data obtained from 14 borings. The nature and extent of variations between the borings may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

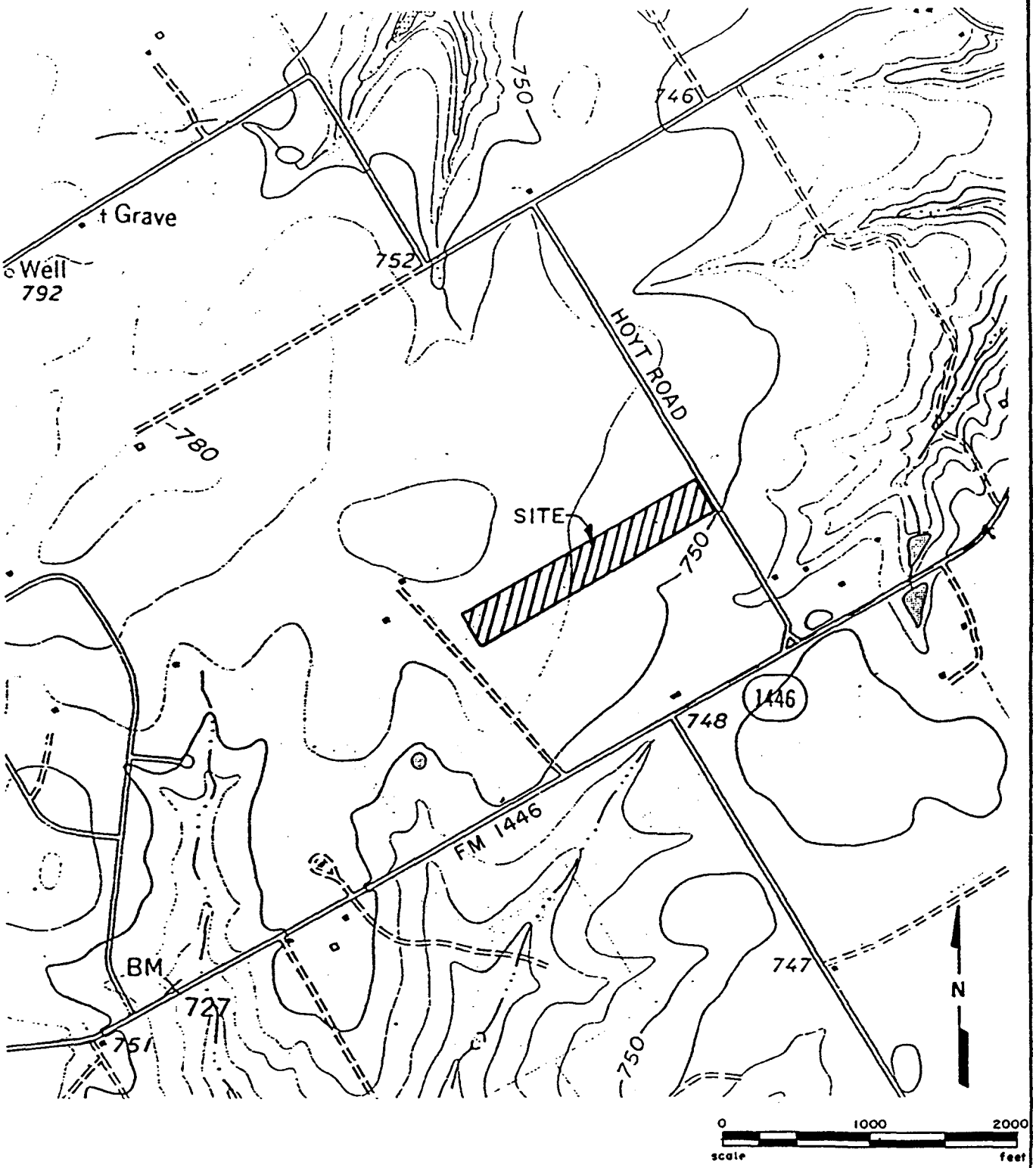
We appreciate the opportunity to work with you on this phase of the project. Please do not hesitate to call if we can be of further assistance.

Respectfully submitted,

John W. Johnston, P.E.

Aubrey D. Henley, R.G.
Mason-Johnston & Associates, Inc.

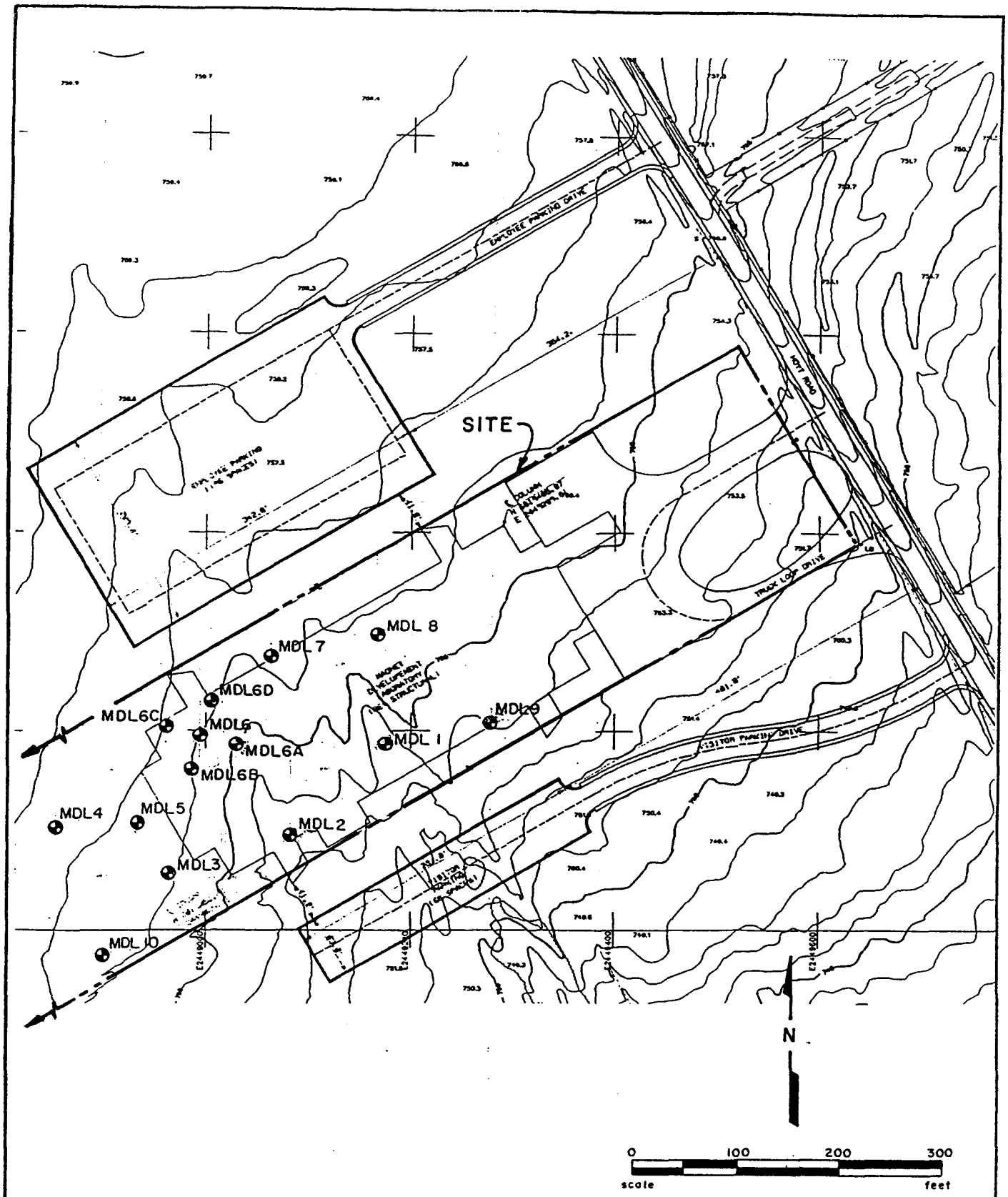
ADH/JWJ:lf
10 September 1990
MJA No. 5730/90



MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS · ENGINEERS
DALLAS, TEXAS

VICINITY MAP
MAGNET DEVELOPMENT LABORATORY
SSC PROJECT
ELLIS COUNTY, TEXAS

MJA NO 5730	DATE 9/90	PLATE 1



MASON-JOHNSTON & ASSOCIATES, INC.
GEOLOGISTS - ENGINEERS
DALLAS, TEXAS

LOCATION OF BORINGS
MAGNET DEVELOPMENT LABORATORY
SSC PROJECT
ELLIS COUNTY, TEXAS

MJA NO 5730	DATE 9/90	PLATE 2

MAGNET DEVLOPMENT LABORATORY FACILITY
SUPERCONDUCTING SUPER COLLIDER PROJECT
ELLIS COUNTY, TEXAS

SUMMARY OF CLASSIFICATION TESTS

BORING NUMBER	DEPTH (Ft.)	LL (%)	PI	MC (%)	DUW (pcf)	UNIFIED SOIL CLASSIFICATION
MDL-3	1.5-3.0			29.5		
MDL-3	3.0-4.0			19.8	106.8	
MDL-4	1.5-3.0			31.7	89.2	
MDL-4	3.0-4.5			20.3		
MDL-5	1.5-3.0	75	39			CH
MDL-5	3.0-4.5			22.3		
MDL-5	4.5-5.0	54	28			CH
MDL-6	1.5-3.0	71	38	23.0		CH
MDL-6	3.0-4.5			26.3		
MDL-6	4.5-6.0			20.1	109.4	
MDL-6	6.0-7.5	53	33			CH
MDL-6	7.5-9.0			22.7	101.3	
MDL-6	9.0-10.0			24.5	99.4	
MDL-6A	0.0-1.5			20.9		
MDL-6A	1.5-2.2			27.0		
MDL-6B	0.0-1.5			27.8		
MDL-6B	1.5-3.0			30.6		
MDL-6B	3.0-4.5			32.5		
MDL-6B	4.5-4.9			16.3		
MDL-6C	0.0-1.5			22.1		
MDL-6C	1.5-3.0			30.2		
MDL-6C	3.0-3.5			34.5		
MDL-6D	0.0-1.5			22.8		
MDL-6D	1.5-3.0			30.8		
MDL-6D	4.5-5.3			21.4		
MDL-10	0.0-1.5			25.1		
MDL-10	1.5-3.0			29.0		

SUMMARY OF LIME SERIES TEST

SAMPLE	LL (%)	PI	LIME (%)
LARGE VOLUME	61	22	RAW
	51	7	4
	53	6	6

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SUMMARY OF TESTS FOR CORROSION POTENTIAL

BORING NUMBER	DEPTH (Ft.)	RESTIVITY ohm-cm	SULFATE mg/kg	pH
MDL-6B	1.5	27960	52	6.7
MDL-6B	4.5	27960	41	7.5

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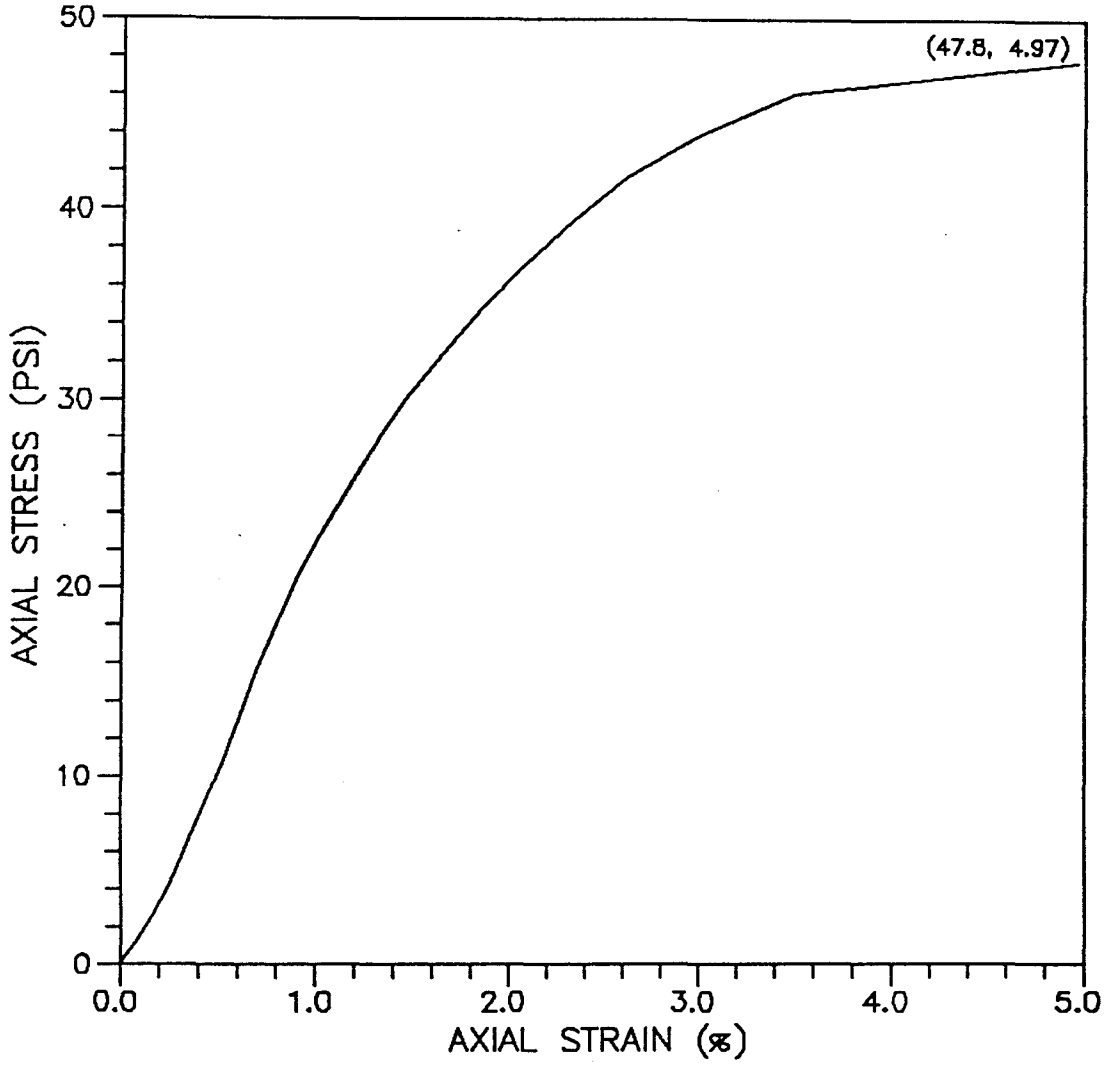
ELLIS COUNTY, TEXAS

SUMMARY OF STRENGTH TESTS ON SOIL

BORING NUMBER	DEPTH (Ft.)	Q_u (psi)	FAILURE STRAIN (%)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	DESCRIPTION
MDL-3	3.0	47.8	5.0	19.8	106.8	CLAY, v. stiff, tan
MDL-4	1.5	48.9	7.3	31.7	89.2	CLAY, v. stiff, dk. brown
MDL-6	4.5	80.3	6.5	20.1	109.4	CLAY, hard, tan
MDL-6	7.5	25.6	6.0	22.7	101.3	CLAY, stiff, tan
MDL-6	9.0	16.8	6.1	24.5	99.4	CLAY, stiff, tan

GEOLOGISTS ENGINEERS
MASON-JOHNSTON & ASSOCIATES, INC. DALLAS, TEXAS

BORING NO.: MDL-3
DEPTH (FT): 3.0-4.0
CLAY, v. stiff, tan

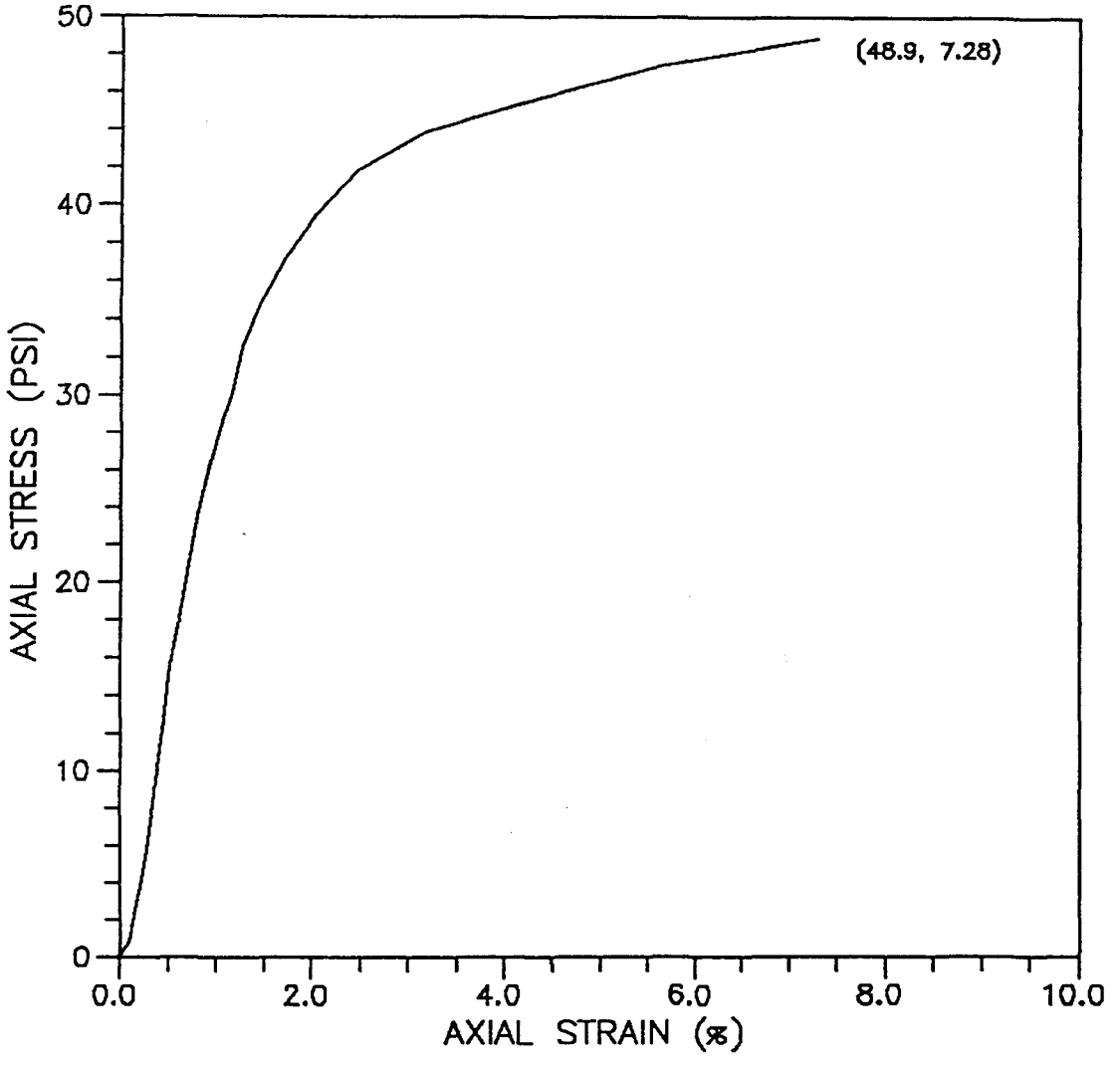


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2166)

MOISTURE CONTENT (%): 19.8
DRY UNIT WEIGHT (PCF): 106.8

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 6

BORING NO.: MDL-4
DEPTH (FT): 1.5-3.0
CLAY, v. stiff, dk. brown

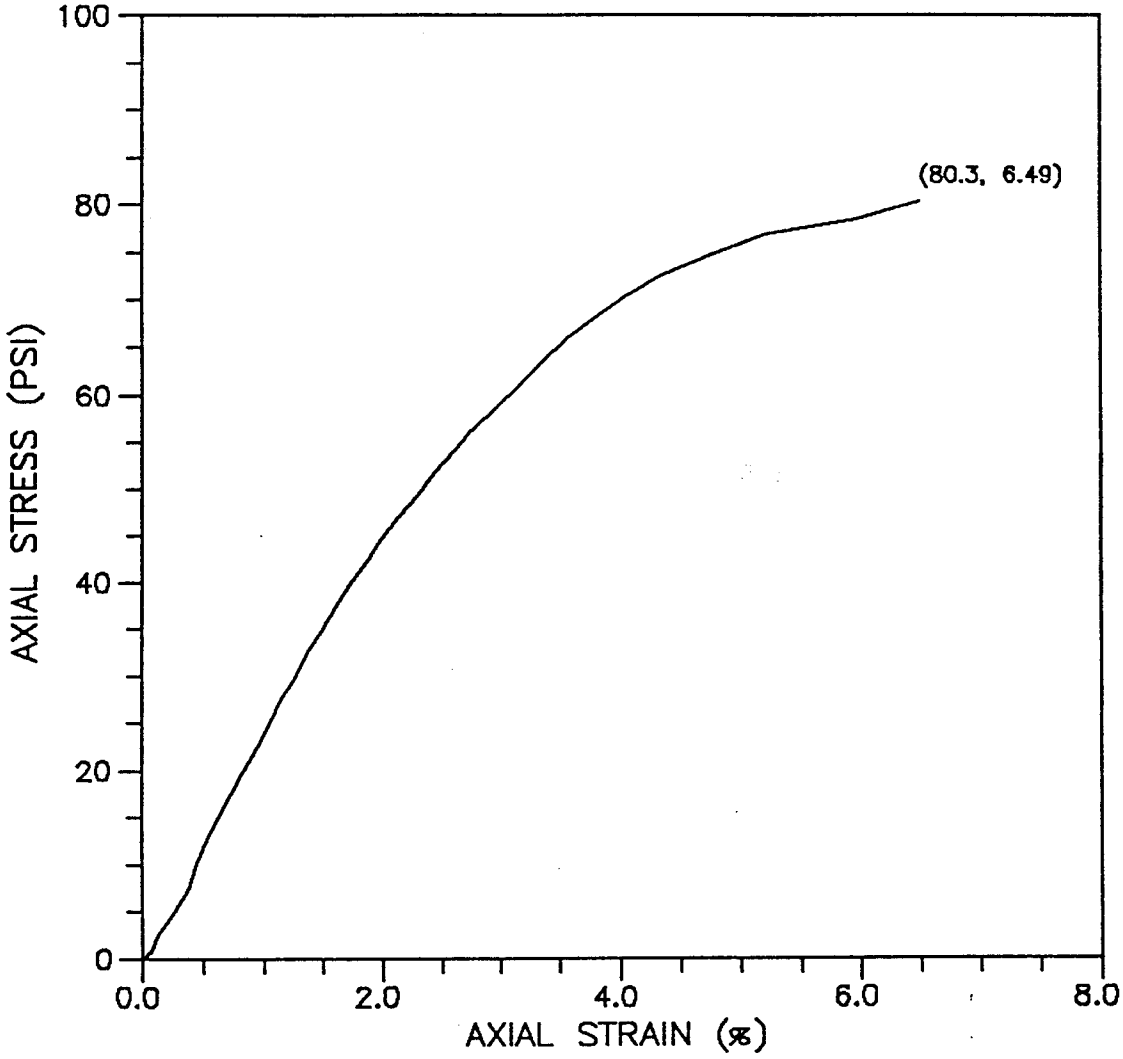


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2166)

MOISTURE CONTENT (%): 31.7
DRY UNIT WEIGHT (PCF): 89.2

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 7

BORING NO.: MDL-6
DEPTH (FT): 4.5-6.0
CLAY, hard, tan

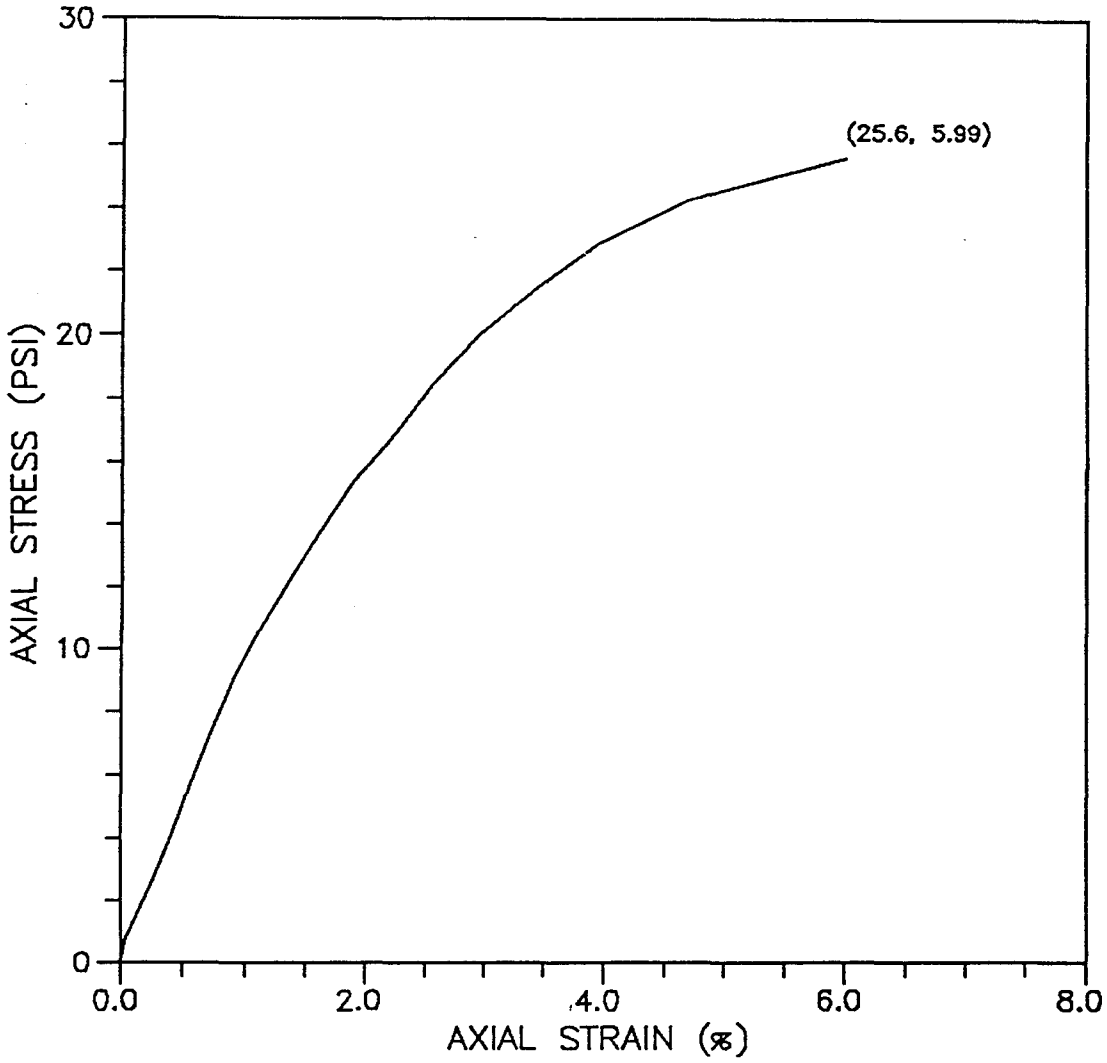


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2166)

MOISTURE CONTENT (%): 20.1
DRY UNIT WEIGHT (PCF): 109.4

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 8

BORING NO.: MDL-6
DEPTH (FT): 7.5-9.0
CLAY, stiff, tan

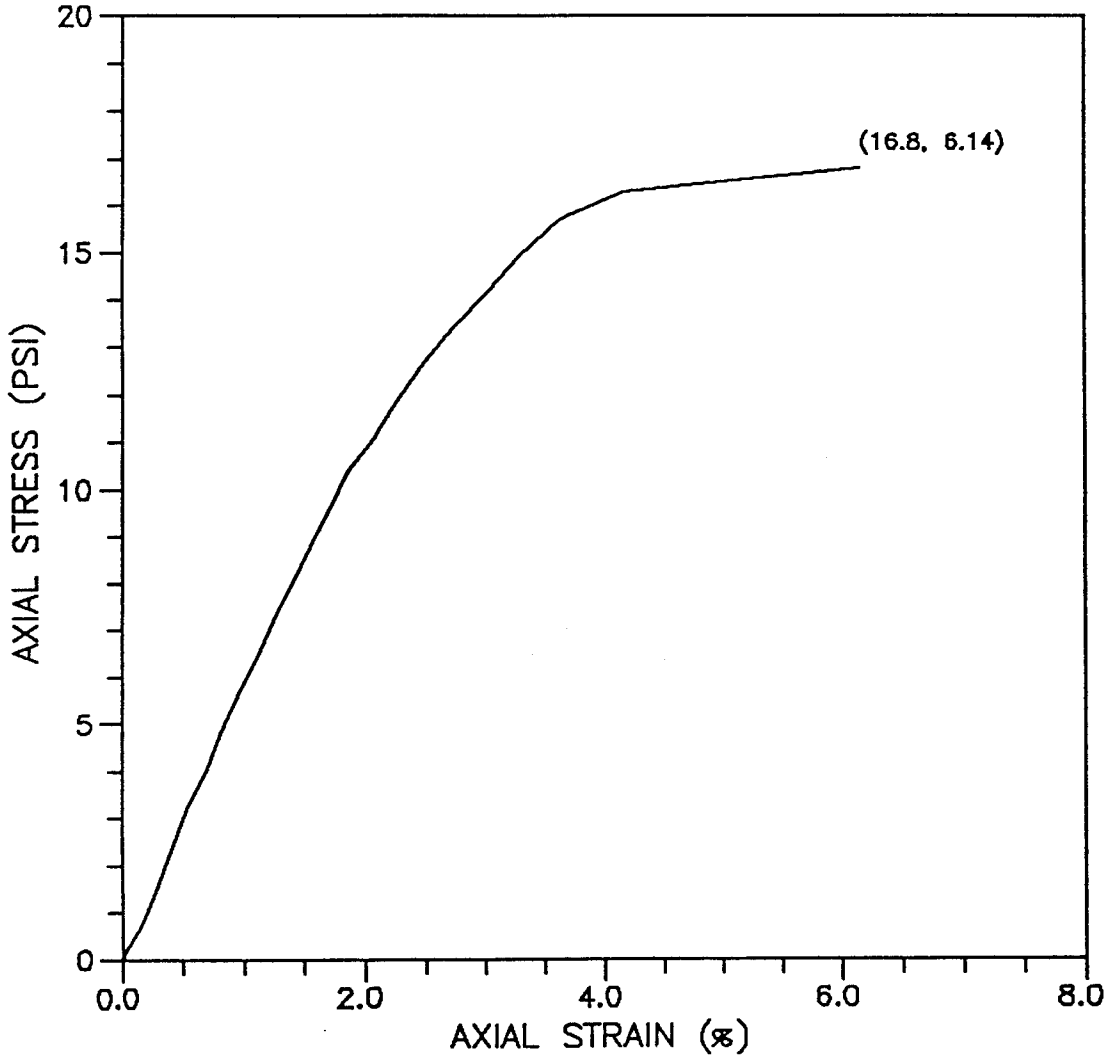


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2166)

MOISTURE CONTENT (%): 22.7
DRY UNIT WEIGHT (PCF): 101.3

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES, INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 9

BORING NO.: MDL-6
DEPTH (FT): 9.0-10.0
CLAY, stiff, tan



TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2166)

MOISTURE CONTENT (%): 24.5
DRY UNIT WEIGHT (PCF): 99.4

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 10

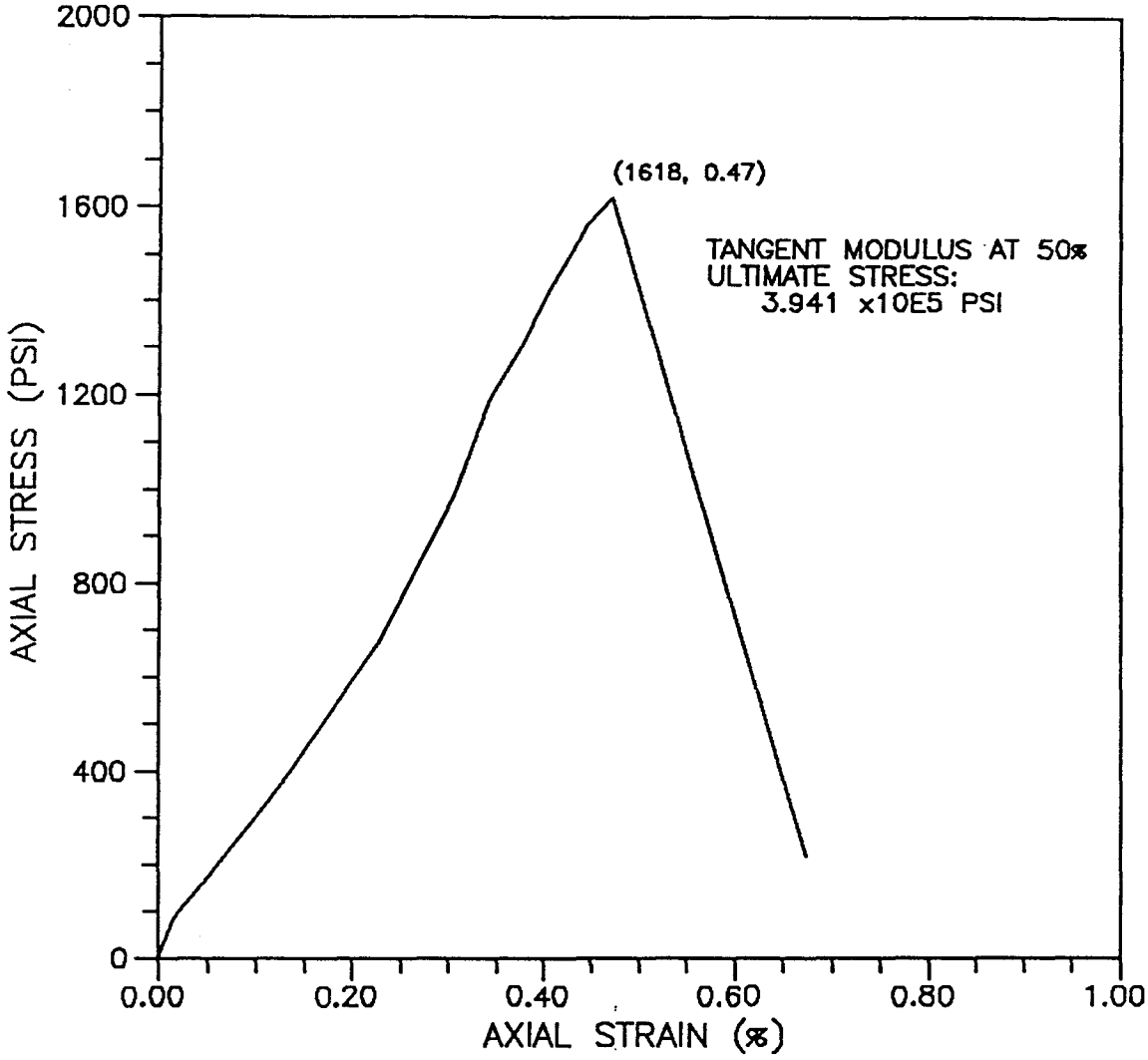
MAGNET DEVELOPMENT LABORATORY FACILITY
SUPERCONDUCTING SUPER COLLIDER PROJECT
ELLIS COUNTY, TEXAS

SUMMARY OF STRENGTH TESTS ON ROCK

BORING NUMBER	DEPTH (Ft.)	Q_u (psi)	TANGENT MODULUS (ksi)	FAILURE STRAIN (%)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	DESCRIPTION
MDL-1	1.5	1618	394.1	0.47	13.8	119.5	LIMESTONE, wea., mod. hard, tan
MDL-1	9.3	363	70.8	0.69	14.9	121.2	LIMESTONE, wea., mod. arg., firm, tan
MDL-1	12.2	1245	162.8	0.99	13.1	121.9	LIMESTONE, mod. arg., mod. hd., dk. gray
MDL-1	16.9	1756	439.6	0.56	13.4	122.6	LIMESTONE, mod. hd. to hard, lt. gray
MDL-2	12.8	1193	363.6	0.37	15.5	116.6	LIMESTONE, wea., mod. hard, tan
MDL-2	14.9	2018	355.6	0.75	13.6	121.2	LIMESTONE, mod. to v. arg., hd., dk. gray
MDL-2	18.4	1600	163.6	1.02	12.2	125.6	LIMESTONE, hard, gray
MDL-3	15.5	1663	473.7	0.49	17.8	112.5	LIMESTONE, wea., mod. hard, tan
MDL-3	19.5	1757	142.3	1.38	11.9	124.7	LIMESTONE, mod. to v. arg., hd., dk. gray
MDL-3	25.5	2330	458.7	0.75	12.9	123.5	LIMESTONE, hard, gray
MDL-4	15.0	1445	703.3	0.38	16.9	114.6	LIMESTONE, wea., stiff to mod. hd., tan
MDL-4	20.1	1884	714.3	0.42	15.2	118.2	LIMESTONE, hard, gray
MDL-4	23.2	1486	641.3	0.38	14.4	118.2	LIMESTONE, hard, gray
MDL-5	21.5	1759	144.4	1.35	12.3	123.9	LIMESTONE, mod. arg., mod. hd., dk. gray
MDL-5	25.6	2126	200.8	1.12	11.8	126.2	LIMESTONE, mod. arg., mod. hd., dk. gray
MDL-6	20.3	1204	194.2	0.61	12.7	125.9	LIMESTONE, sli. arg., mod. hd., gray
MDL-6	26.3	1835	177.8	1.10	12.3	124.3	LIMESTONE, mod. arg., mod. hd., dk. gray
MDL-7	13.9	1637	169.0	1.18	13.4	121.1	LIMESTONE, mod. arg., mod. hd., dk. gray
MDL-7	20.8	1482	135.6	1.28	13.3	120.3	LIMESTONE, mod. arg., mod. hd., dk. gray
MDL-8	3.3	1502	549.6	0.51	15.4	115.9	LIMESTONE, wea., mod. hard, tan
MDL-8	8.2	798	233.9	0.39	19.5	110.4	LIMESTONE, wea., mod. hard, tan
MDL-8	12.6	1194	291.3	0.59	16.2	117.0	LIMESTONE, mod. hard, gray
MDL-8	15.4	1082	366.4	0.37	16.3	115.5	LIMESTONE, mod. hard, gray
MDL-9	10.9	1260	510.6	0.40	16.1	115.2	LIMESTONE, mod. hard, gray
MDL-9	18.3	1180	159.6	0.85	14.1	120.6	LIMESTONE, mod. hard, gray
MDL-10	25.4	1709	281.7	0.53	15.9	117.0	LIMESTONE, hard, gray
MDL-10	32.1	1682	322.6	0.78	16.4	115.1	LIMESTONE, hard, gray

GEOLOGISTS ENGINEERS
MASON-JOHNSTON & ASSOCIATES, INC. DALLAS, TEXAS

BORING NO.: MDL-1
DEPTH (FT): 1.5-1.9
AUSTIN CHALK LIMESTONE, WEATHERED

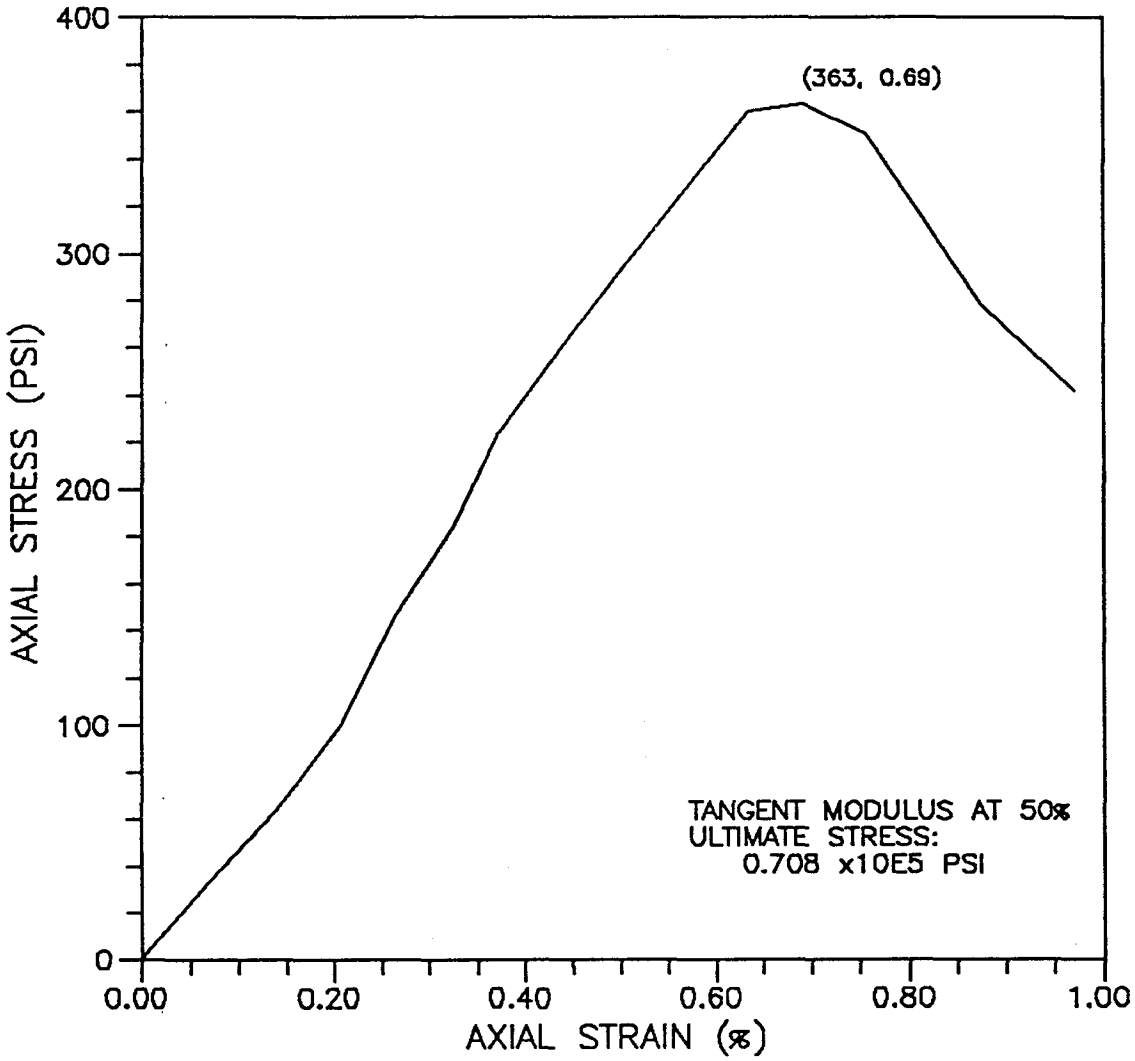


TEST TYPE: UNCONFINED COMPRESSION TEST (ASTM 2938)

MOISTURE CONTENT (%): 13.8
DRY UNIT WEIGHT (PCF): 119.5

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 12

BORING NO.: MDL-1
DEPTH (FT): 9.3-9.6
AUSTIN CHALK LIMESTONE, WEATHERED

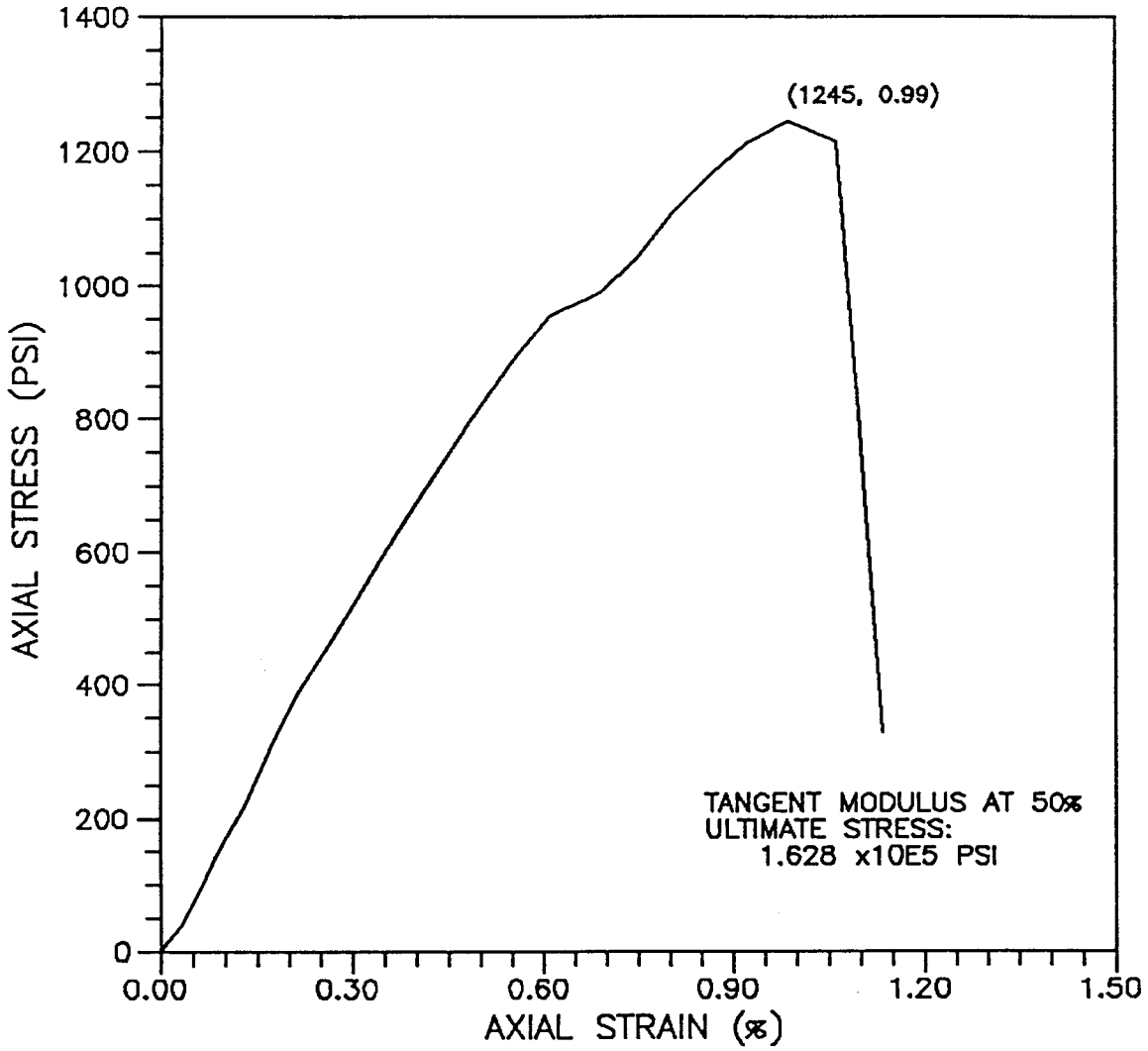


TEST TYPE: UNCONFINED COMPRESSION TEST (ASTM 2938)

MOISTURE CONTENT (%): 14.9
DRY UNIT WEIGHT (PCF): 121.2

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES, INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 13

BORING NO.: MDL-1
DEPTH (FT): 12.2-12.6
AUSTIN CHALK LIMESTONE

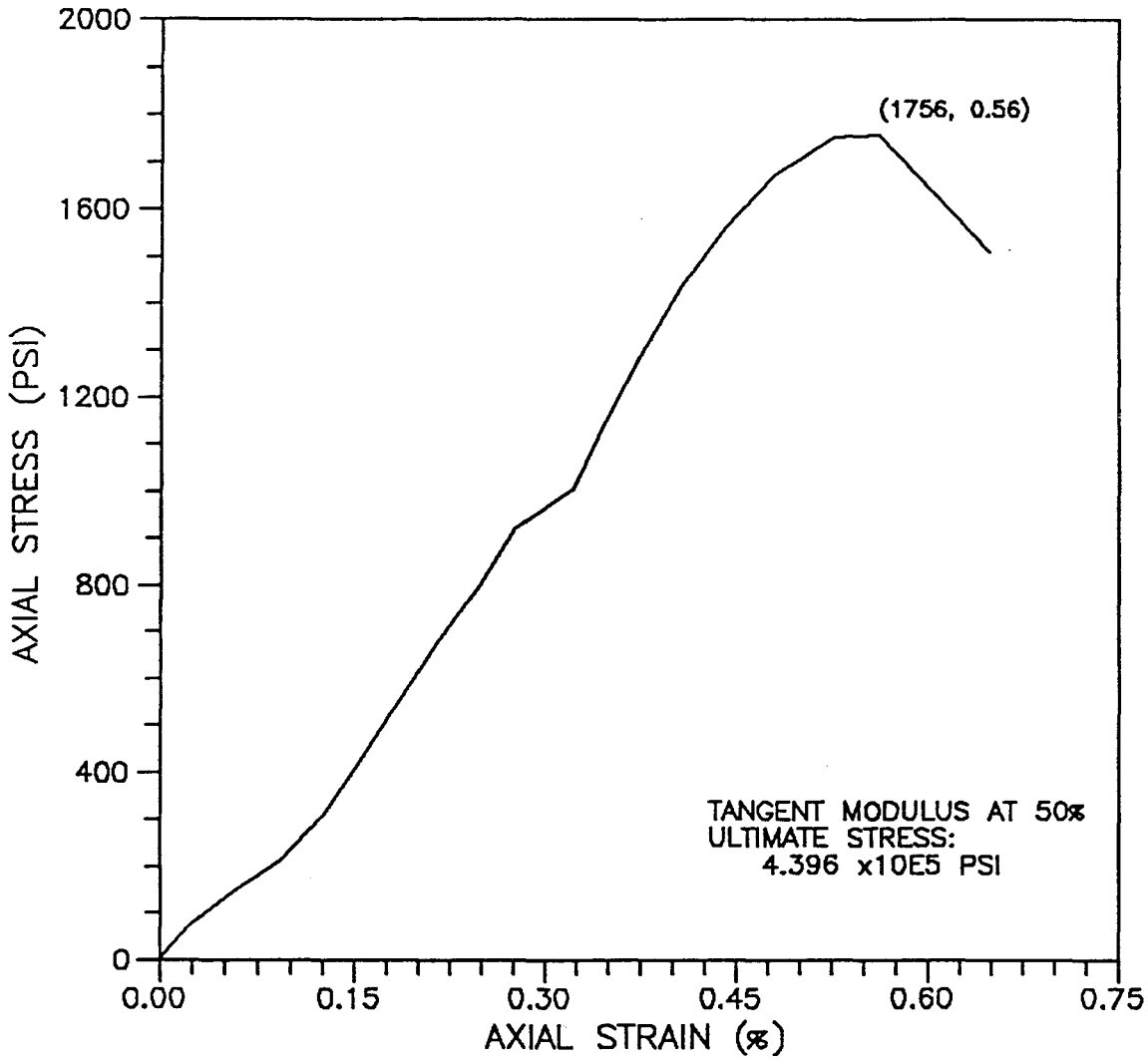


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 13.1
DRY UNIT WEIGHT (PCF): 121.9

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 14

BORING NO.: MDL-1
DEPTH (FT): 16.9-17.3
AUSTIN CHALK LIMESTONE

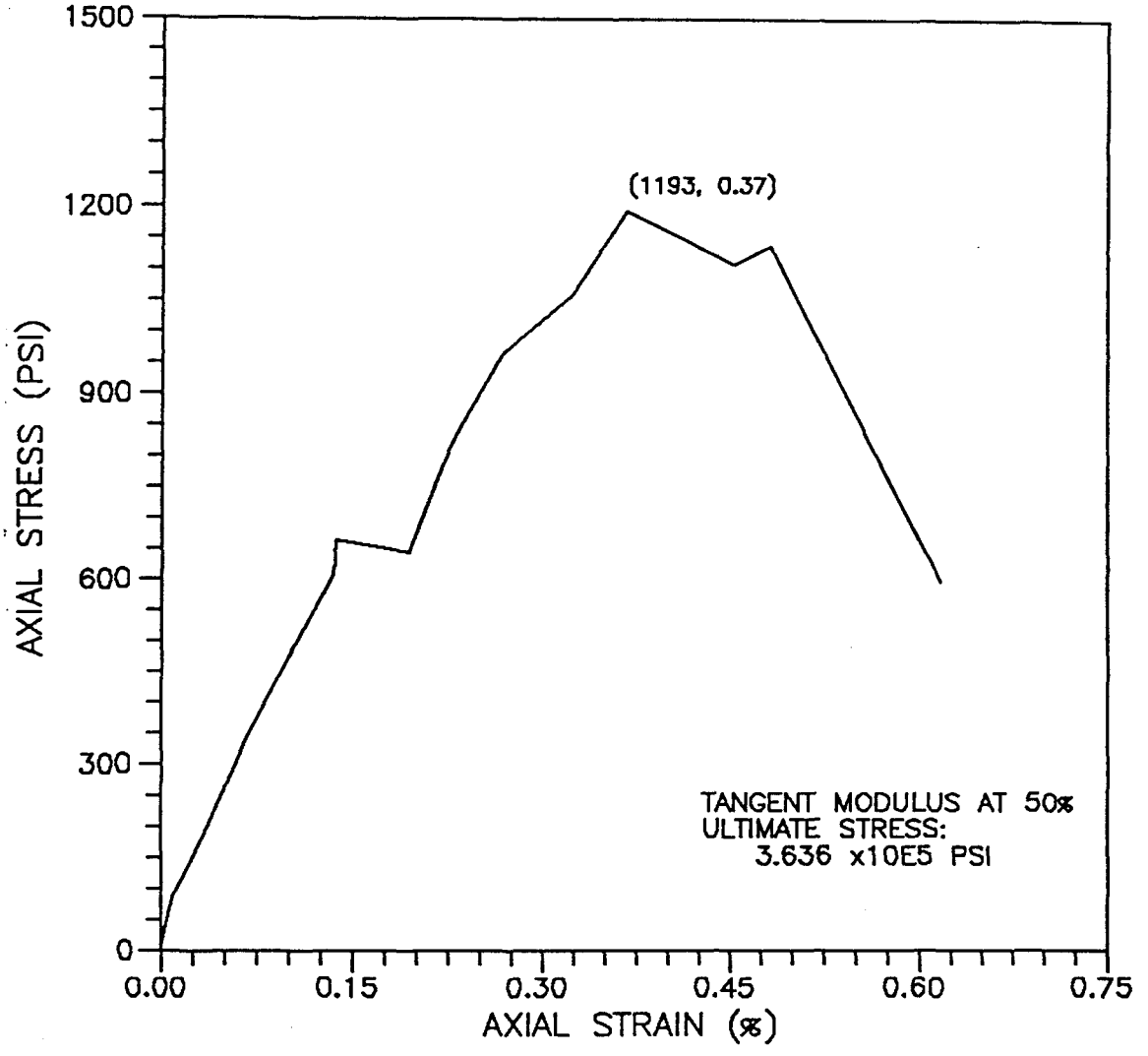


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 13.4
DRY UNIT WEIGHT (PCF): 122.6

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 15

BORING NO.: MDL-2
DEPTH (FT): 12.8-13.2
AUSTIN CHALK LIMESTONE, WEATHERED

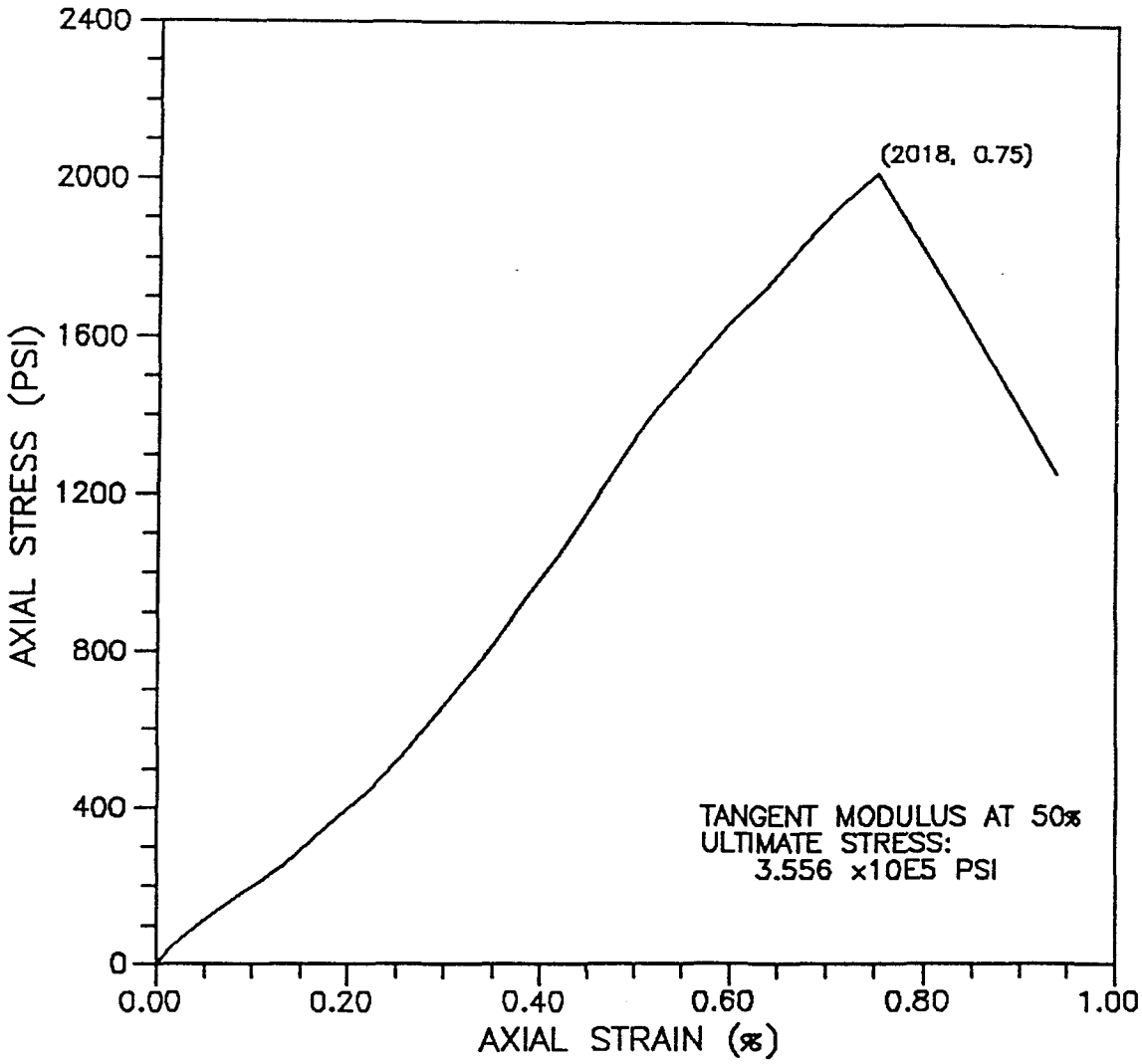


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 15.5
DRY UNIT WEIGHT (PCF): 116.6

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 16

BORING NO.: MDL-2
DEPTH (FT): 14.9-15.3
AUSTIN CHALK LIMESTONE

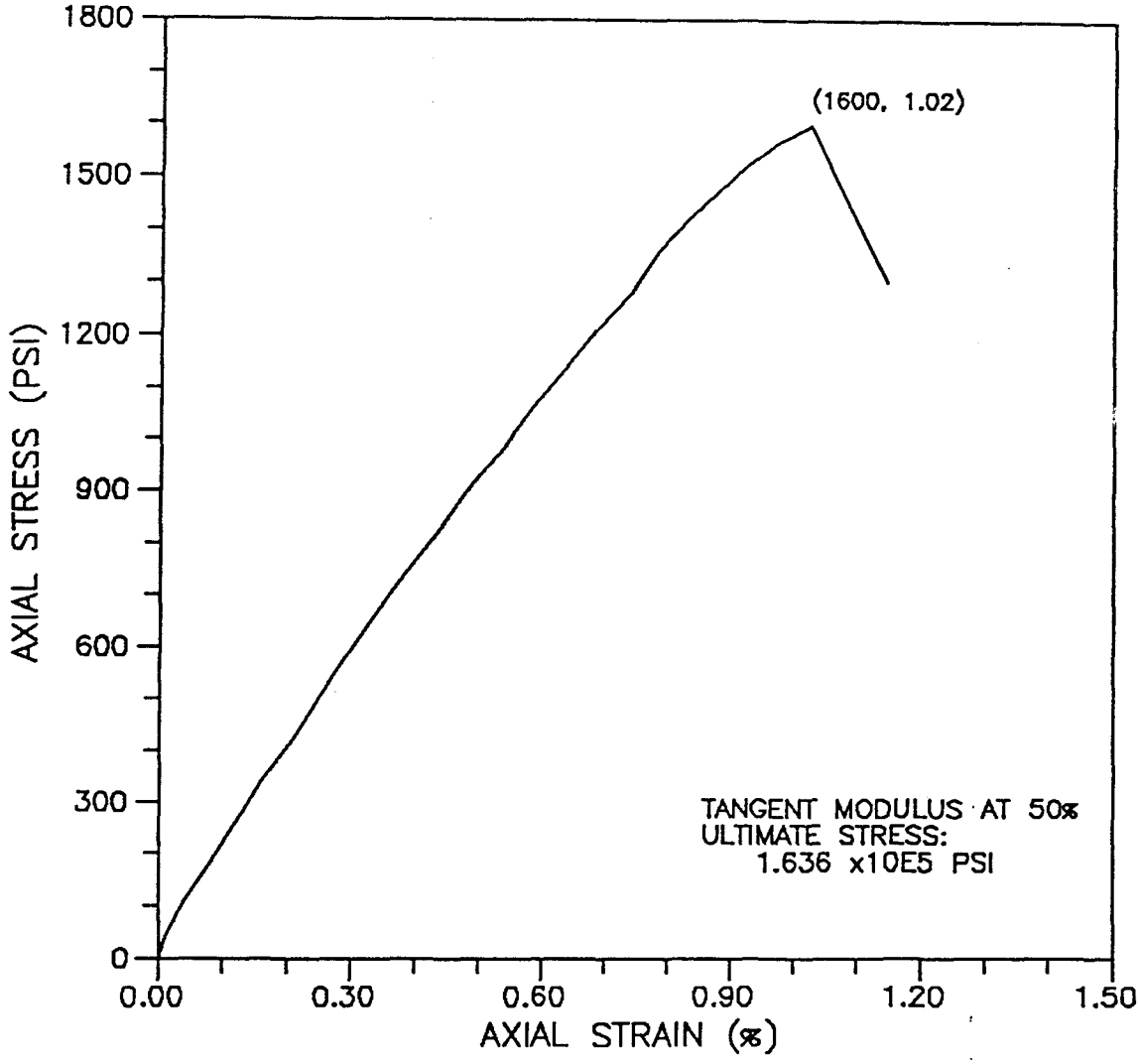


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 13.6
DRY UNIT WEIGHT (PCF): 121.2

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 17

BORING NO.: MDL-2
DEPTH (FT): 18.4-18.8
AUSTIN CHALK LIMESTONE

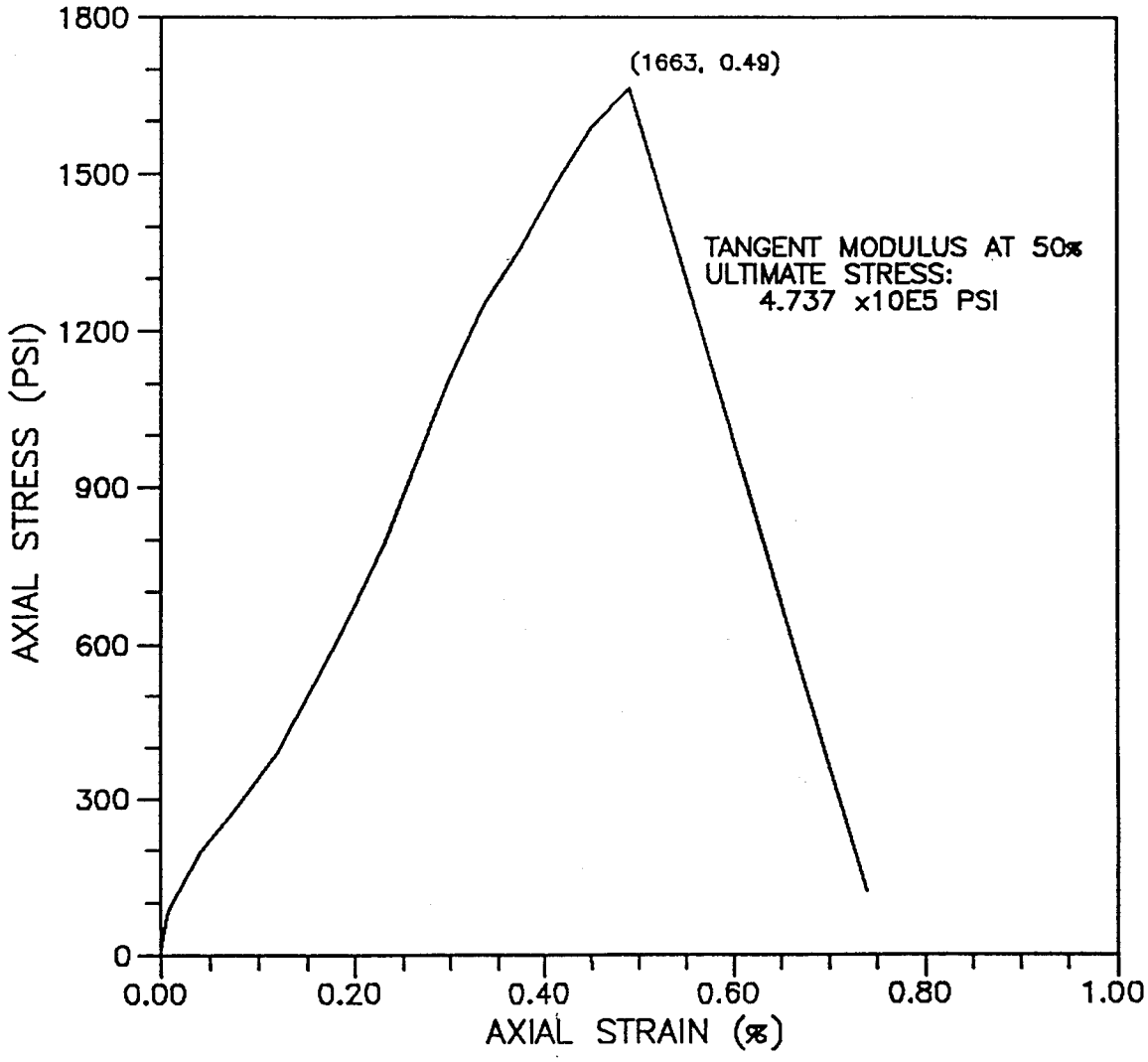


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 12.2
DRY UNIT WEIGHT (PCF): 125.6

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 18

BORING NO.: MDL-3
DEPTH (FT): 15.5-15.9
AUSTIN CHALK LIMESTONE,
WEATHERED

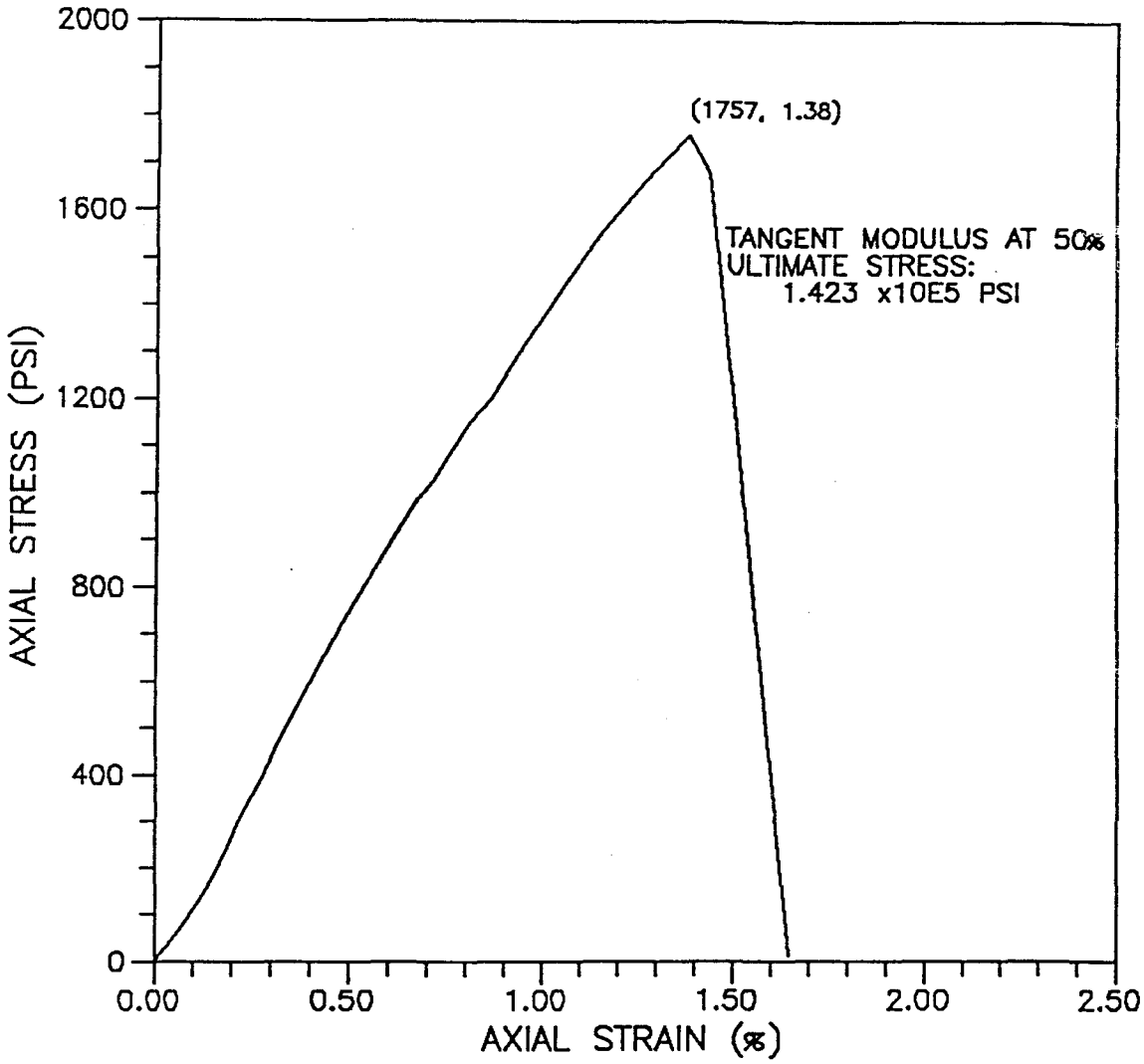


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 17.8
DRY UNIT WEIGHT (PCF): 112.5

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 19

BORING NO.: MDL-3
DEPTH (FT): 19.5-19.9
AUSTIN CHALK LIMESTONE

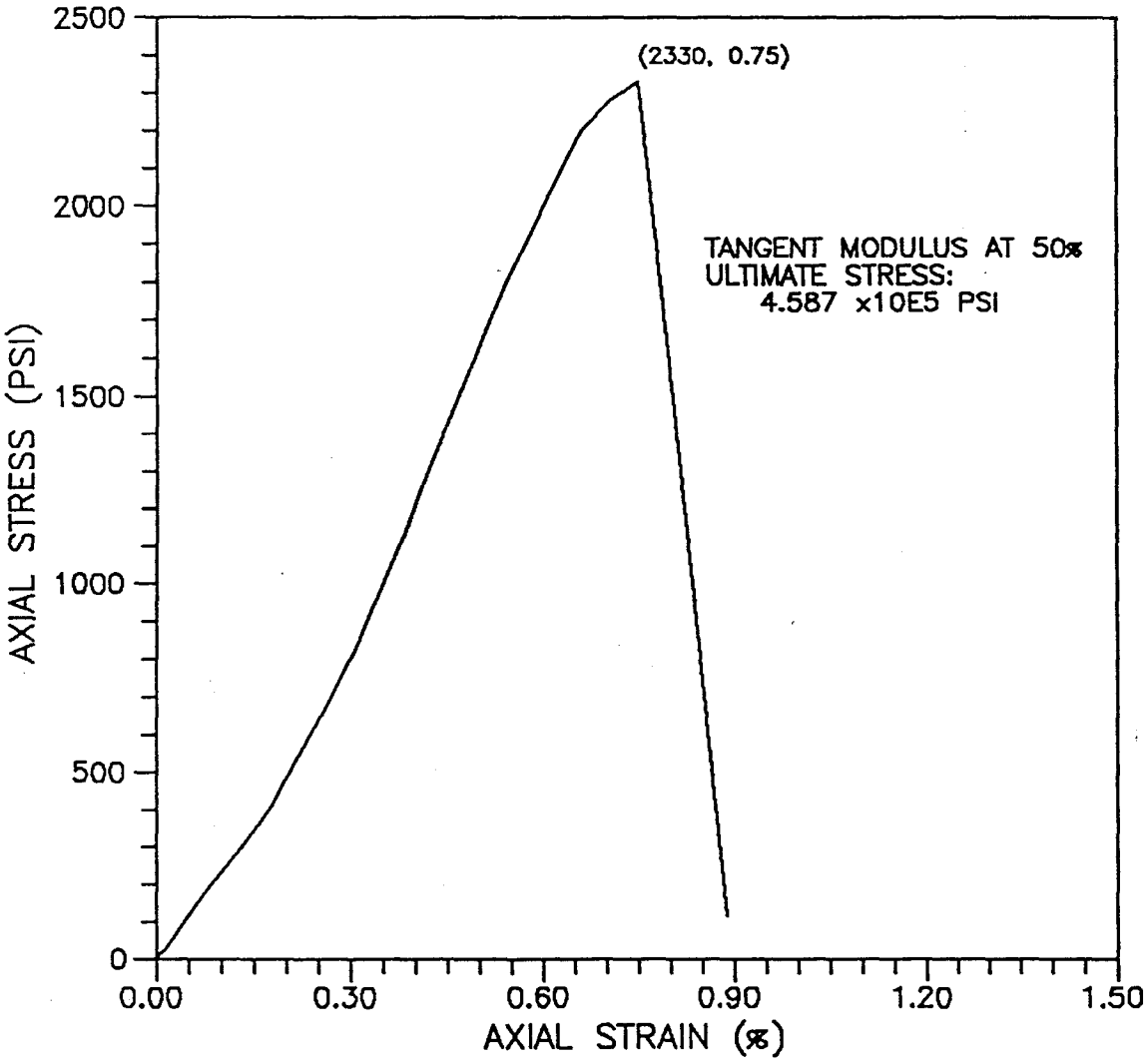


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 11.9
DRY UNIT WEIGHT (PCF): 124.7

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES, INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 20

BORING NO.: MDL-3
DEPTH (FT): 25.5-25.9
AUSTIN CHALK LIMESTONE

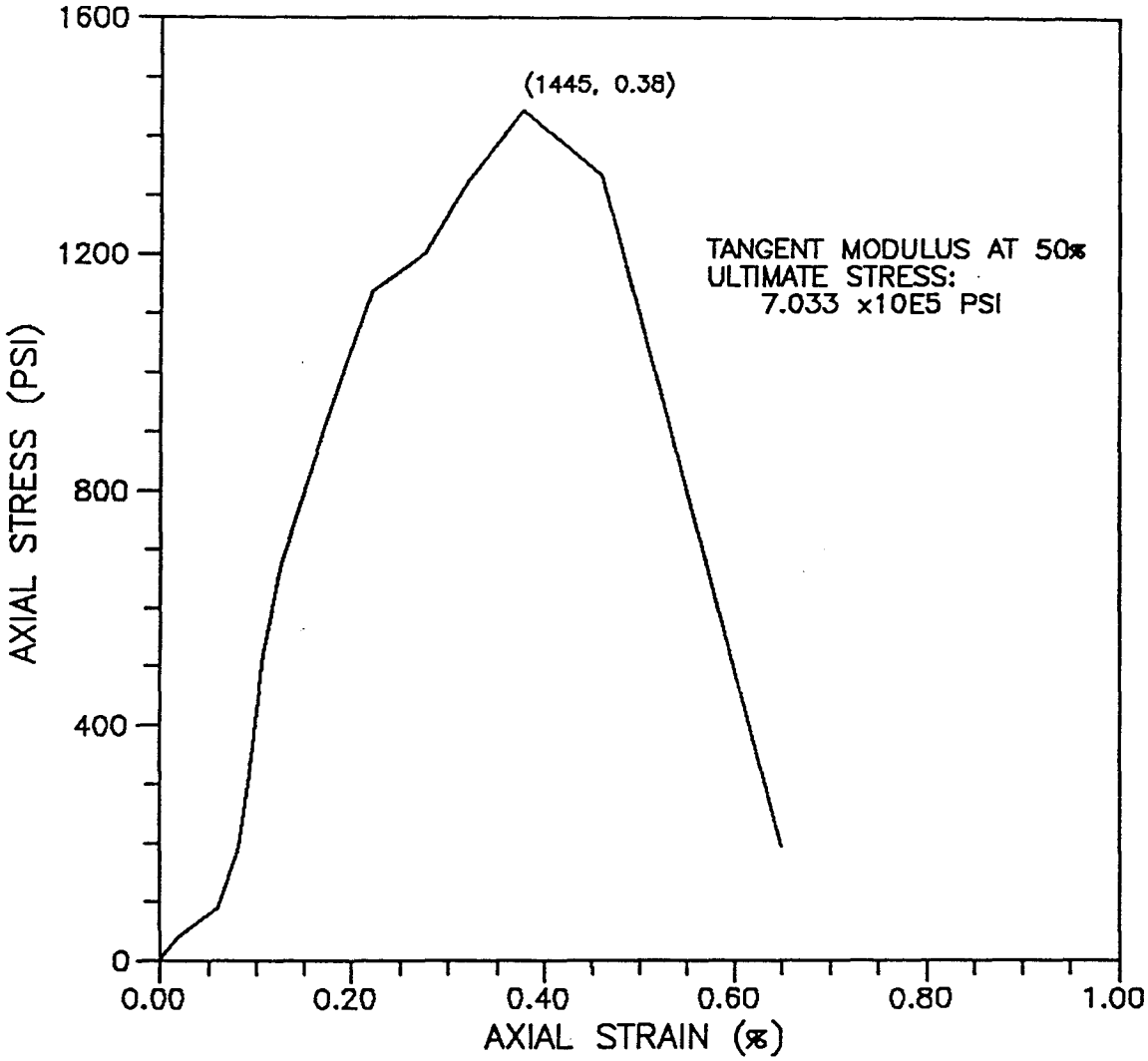


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 12.9
DRY UNIT WEIGHT (PCF): 123.5

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 21

BORING NO.: MDL-4
DEPTH (FT): 15.0-15.4
AUSTIN CHALK LIMESTONE, WEATHERED

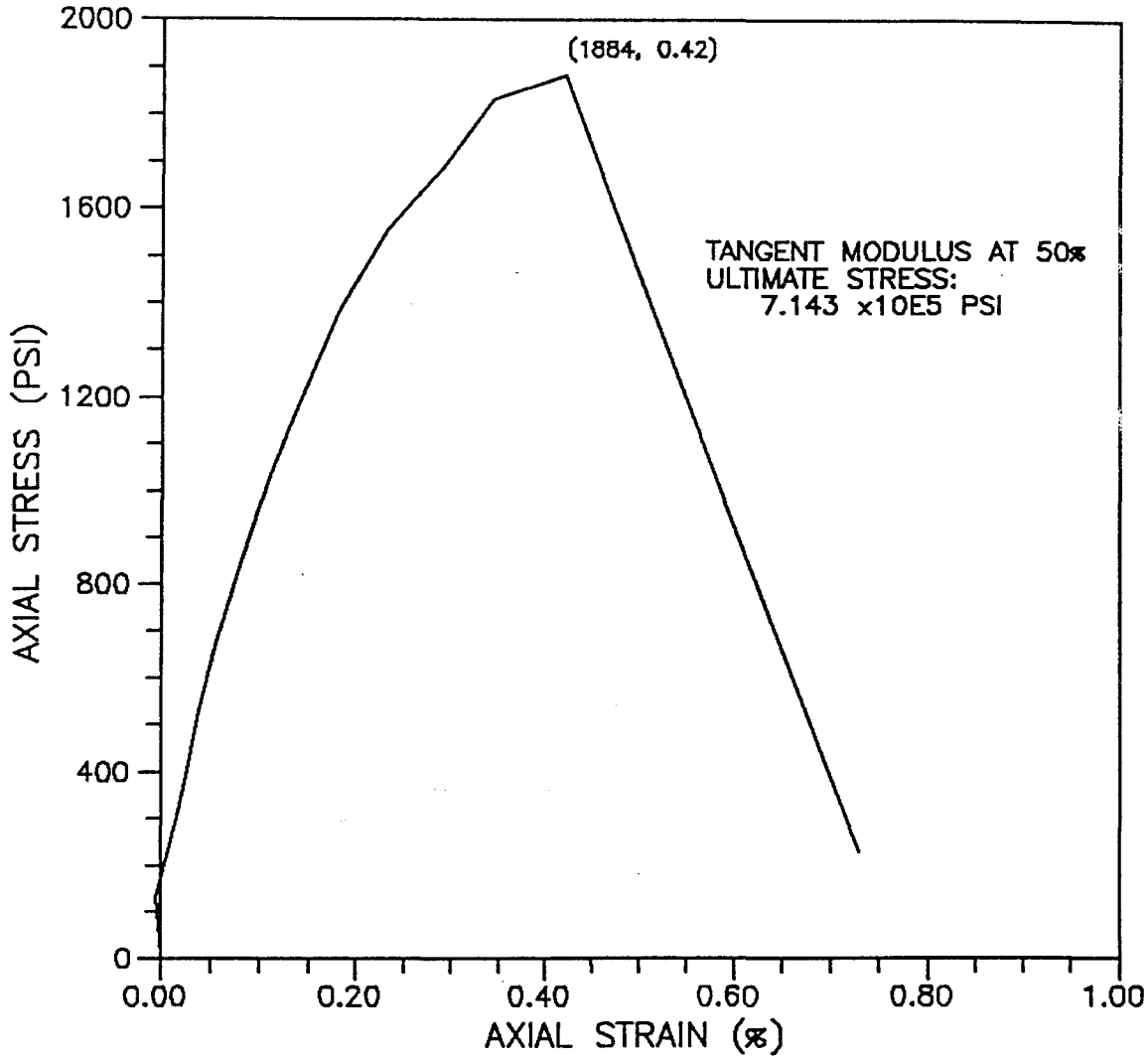


TEST TYPE: UNCONFINED COMPRESSION TEST (ASTM 2938)

MOISTURE CONTENT (%): 16.9
DRY UNIT WEIGHT (PCF): 114.6

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 22

BORING NO.: MDL-4
DEPTH (FT): 20.1-20.5
AUSTIN CHALK LIMESTONE

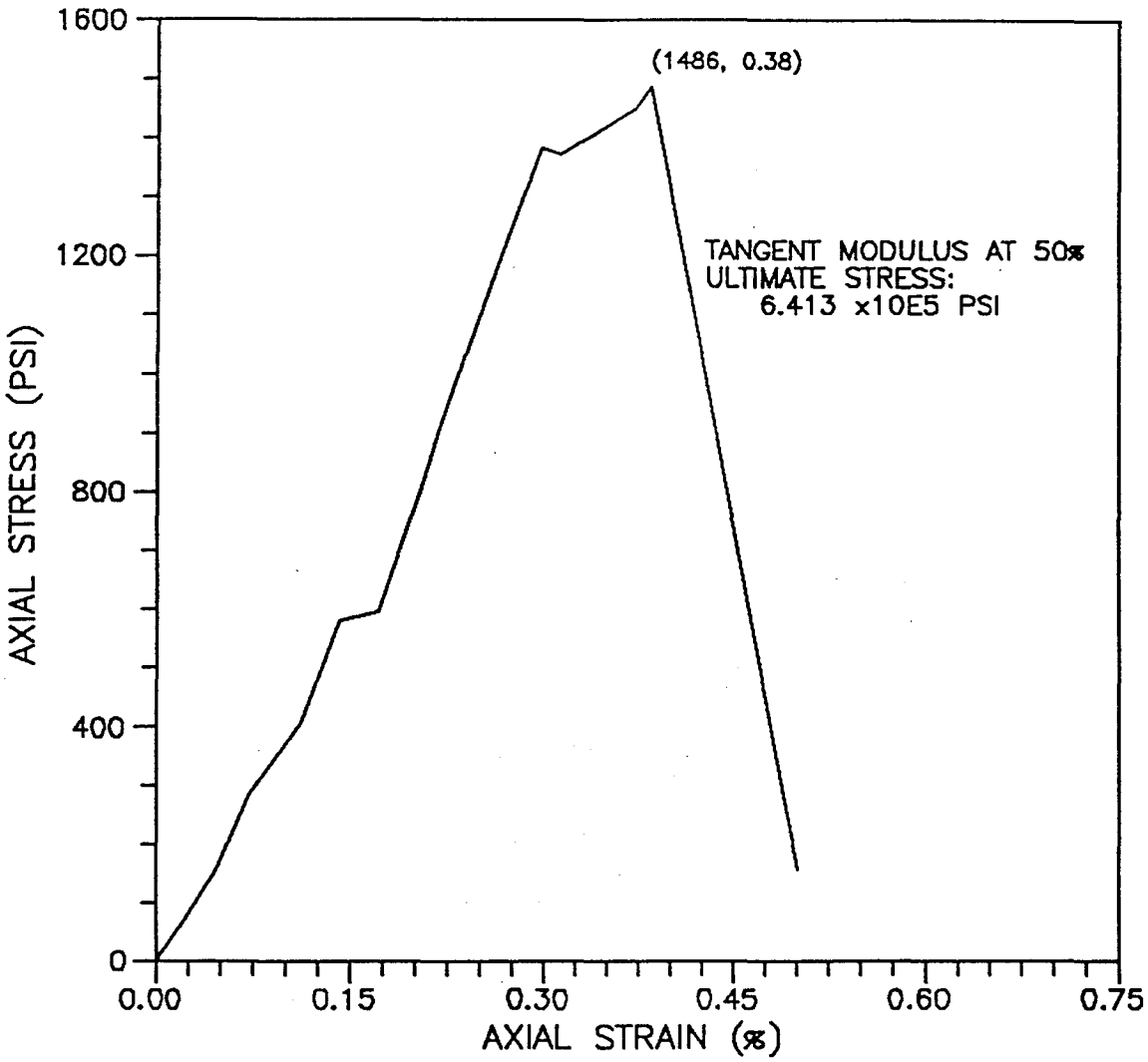


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 15.2
DRY UNIT WEIGHT (PCF): 118.2

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 23

BORING NO.: MDL-4
DEPTH (FT): 23.2-23.6
AUSTIN CHALK LIMESTONE

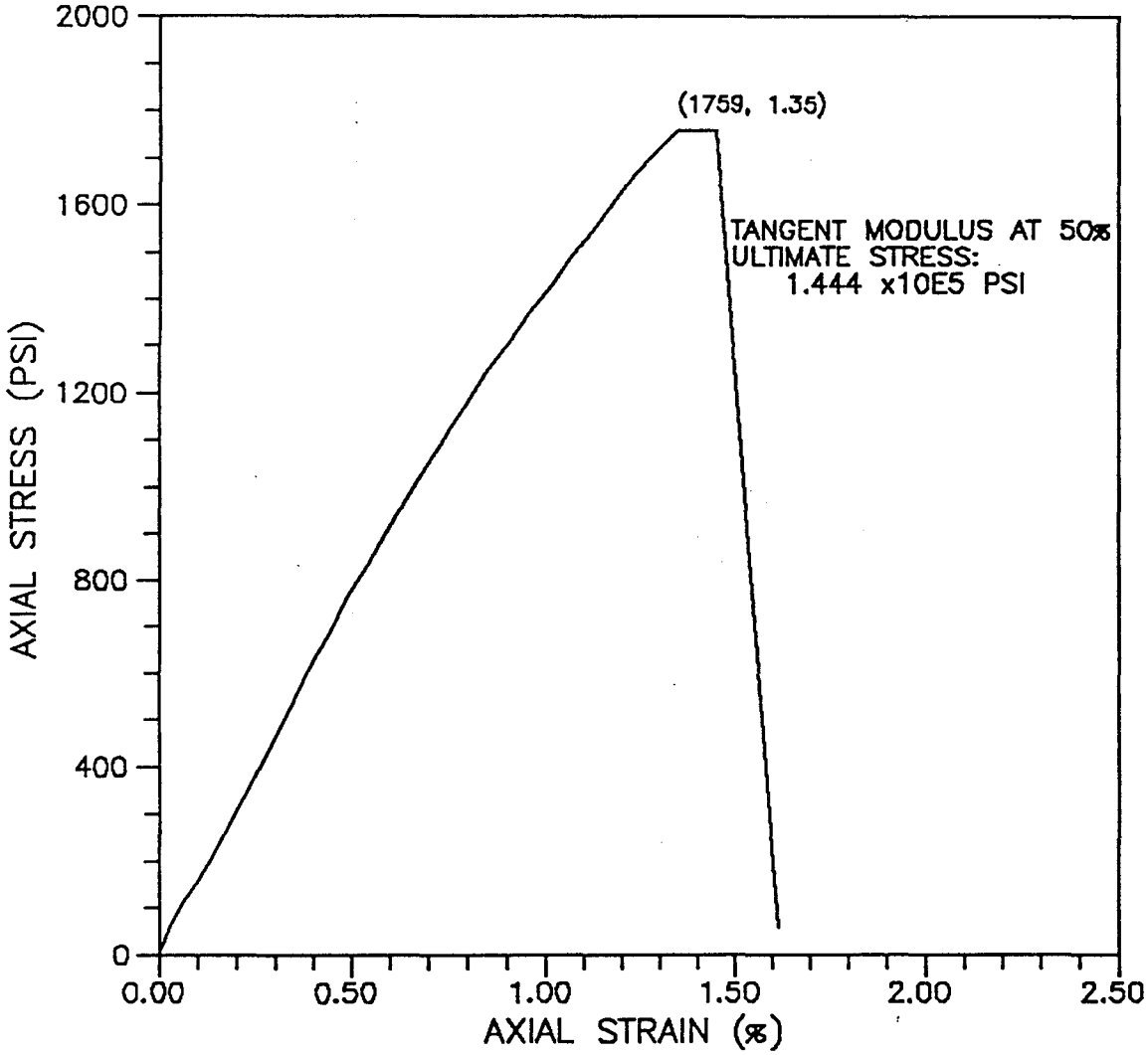


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 14.4
DRY UNIT WEIGHT (PCF): 118.2

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 24

BORING NO.: MDL-5
DEPTH (FT): 21.5-21.9
AUSTIN CHALK LIMESTONE

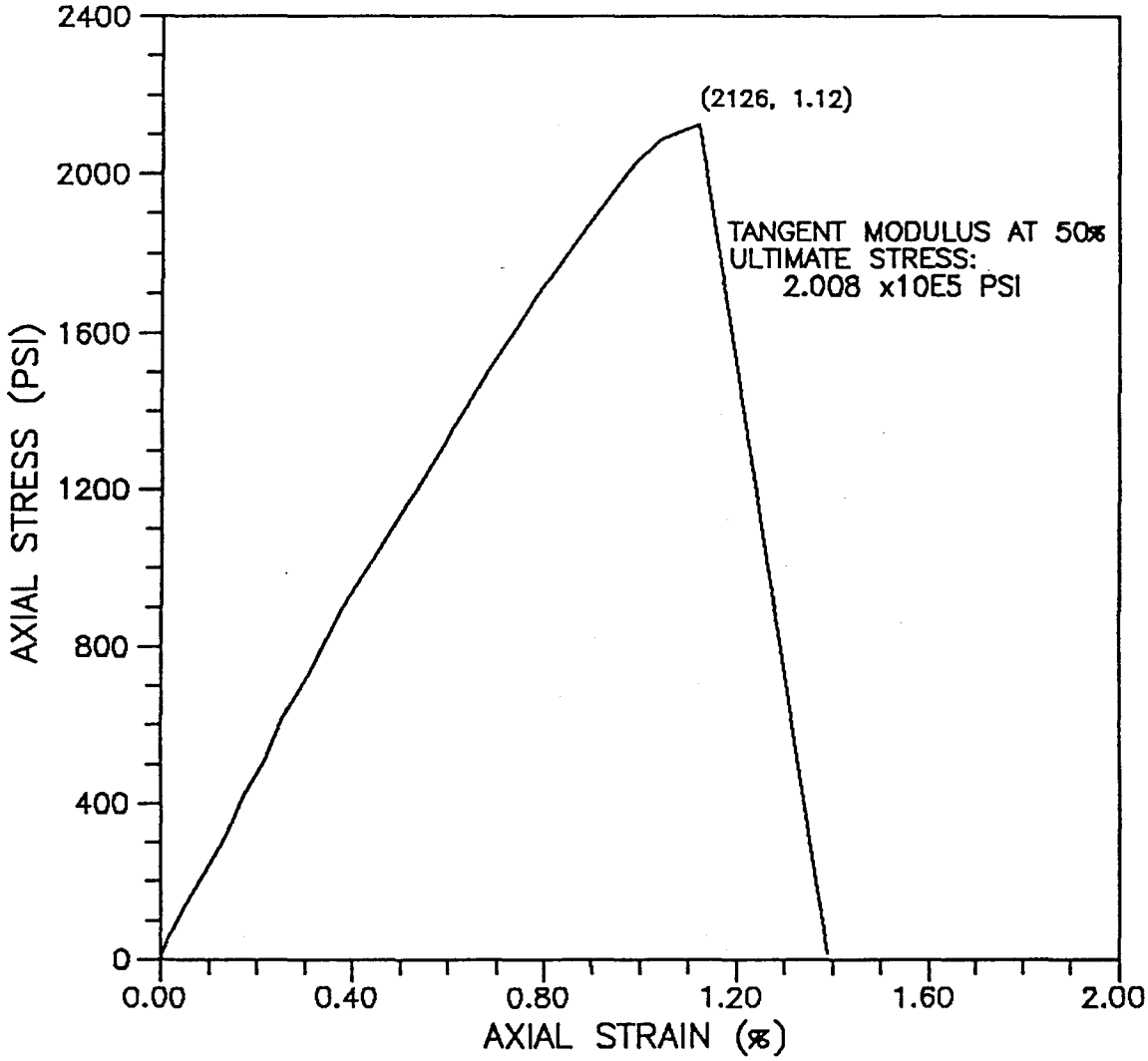


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 12.3
DRY UNIT WEIGHT (PCF): 123.9

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 25

BORING NO.: MDL-5
DEPTH (FT): 25.6-26.0
AUSTIN CHALK LIMESTONE

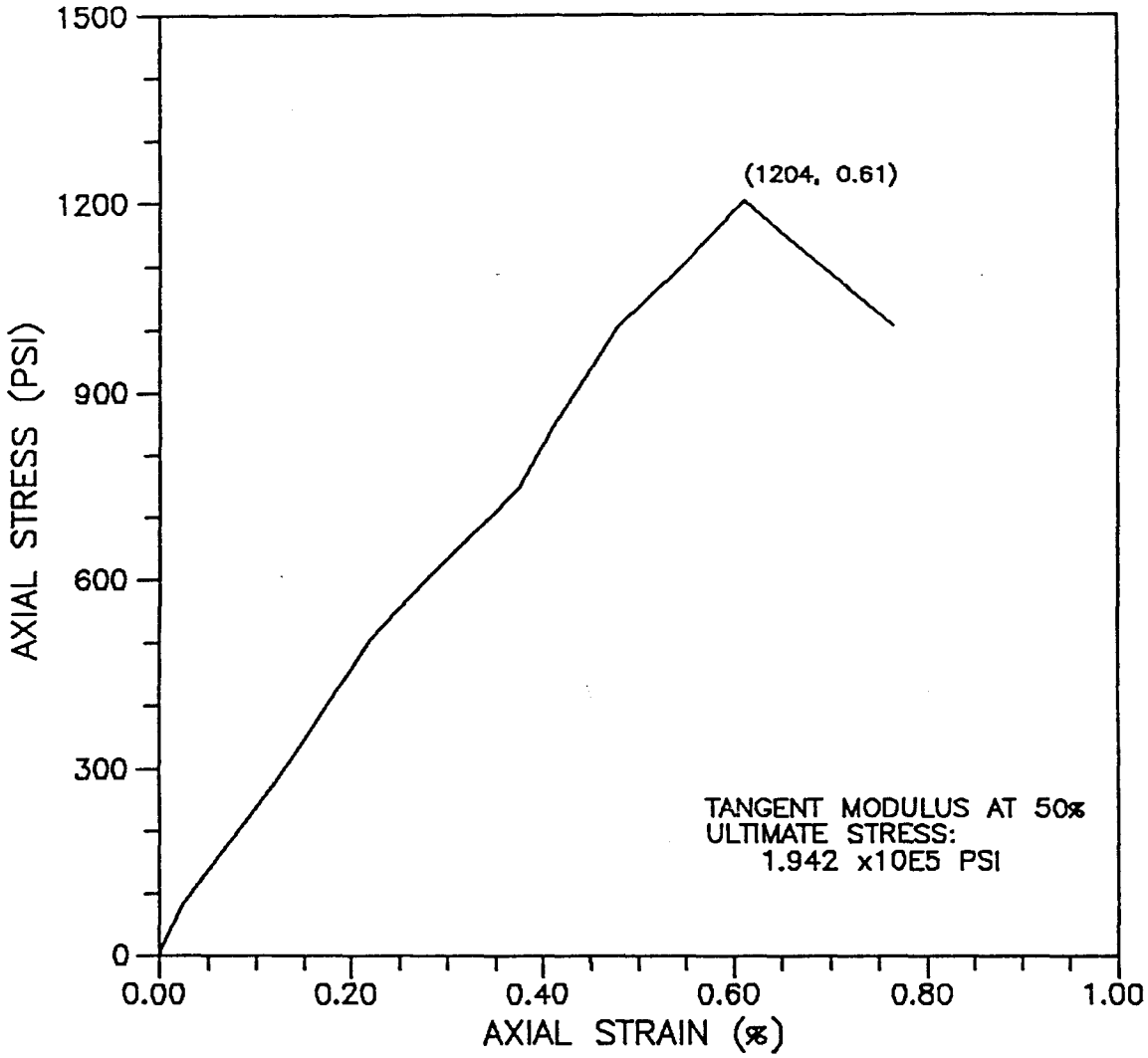


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 11.8
DRY UNIT WEIGHT (PCF): 126.2

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 26

BORING NO.: MDL-6
DEPTH (FT): 20.3-20.6
AUSTIN CHALK LIMESTONE

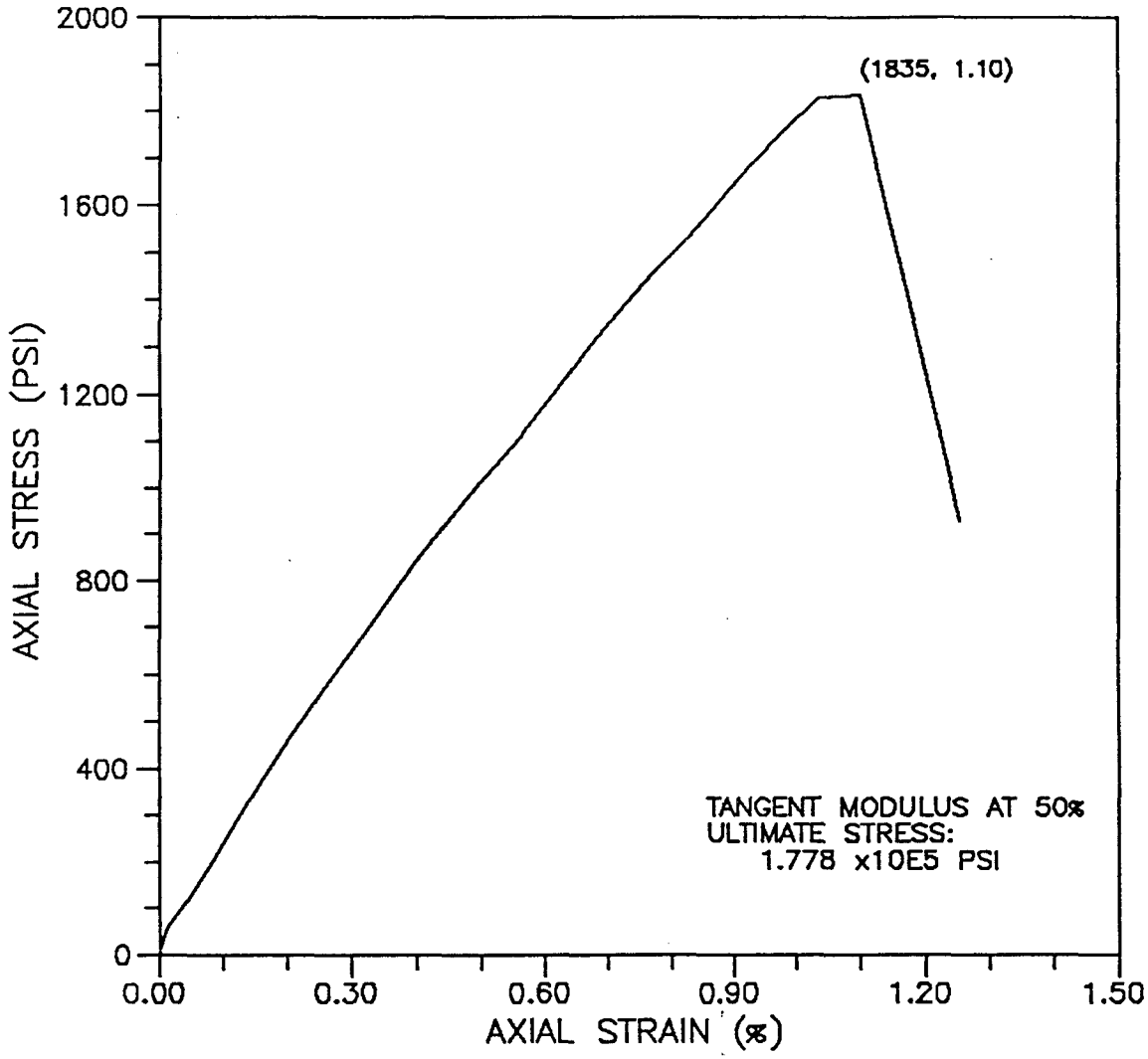


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 12.7
DRY UNIT WEIGHT (PCF): 125.9

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 27

BORING NO.: MDL-6
DEPTH (FT): 26.3-26.7
AUSTIN CHALK LIMESTONE

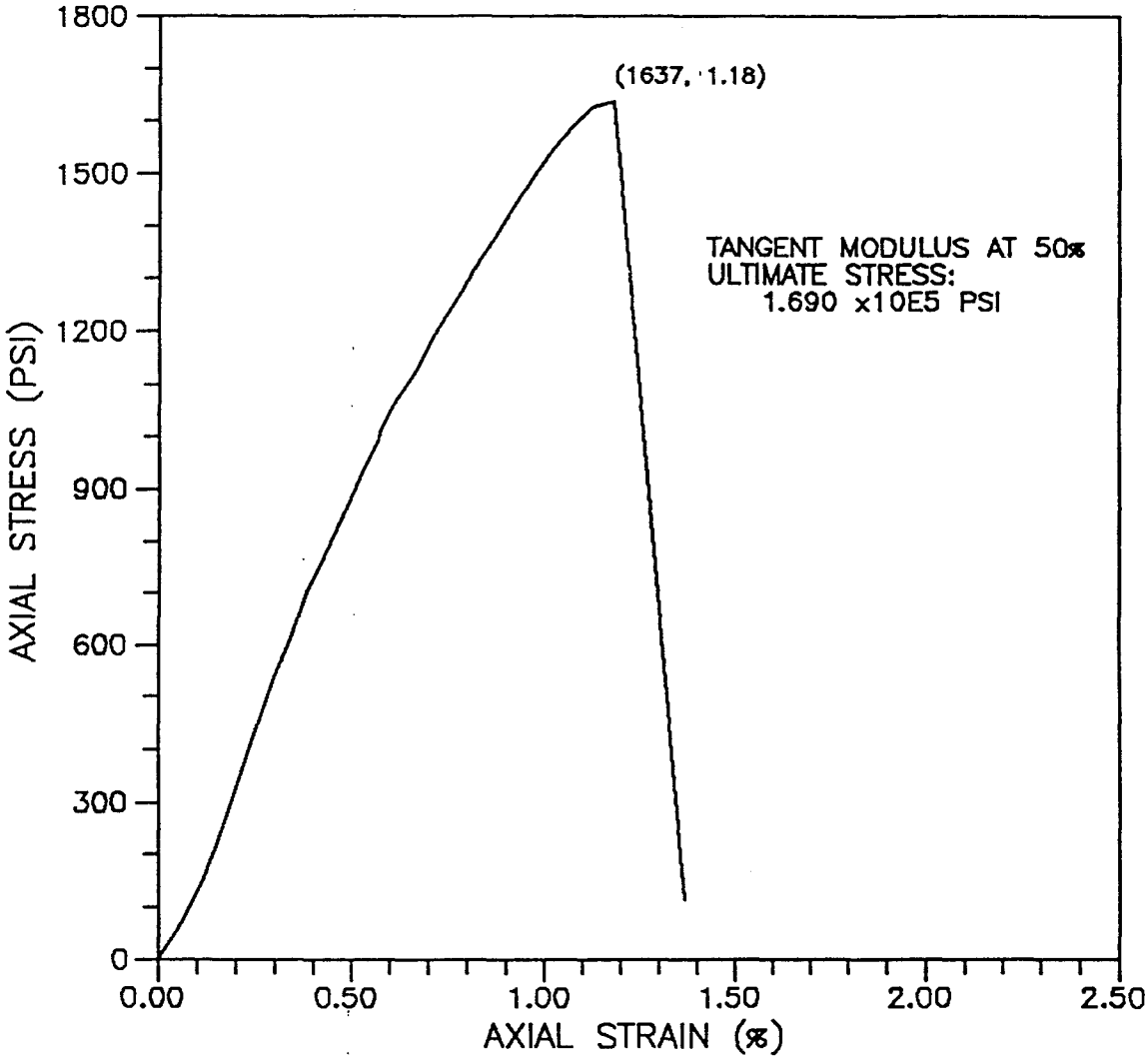


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 12.3
DRY UNIT WEIGHT (PCF): 124.3

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 28

BORING NO.: MDL-7
DEPTH (FT): 13.9-14.3
AUSTIN CHALK LIMESTONE

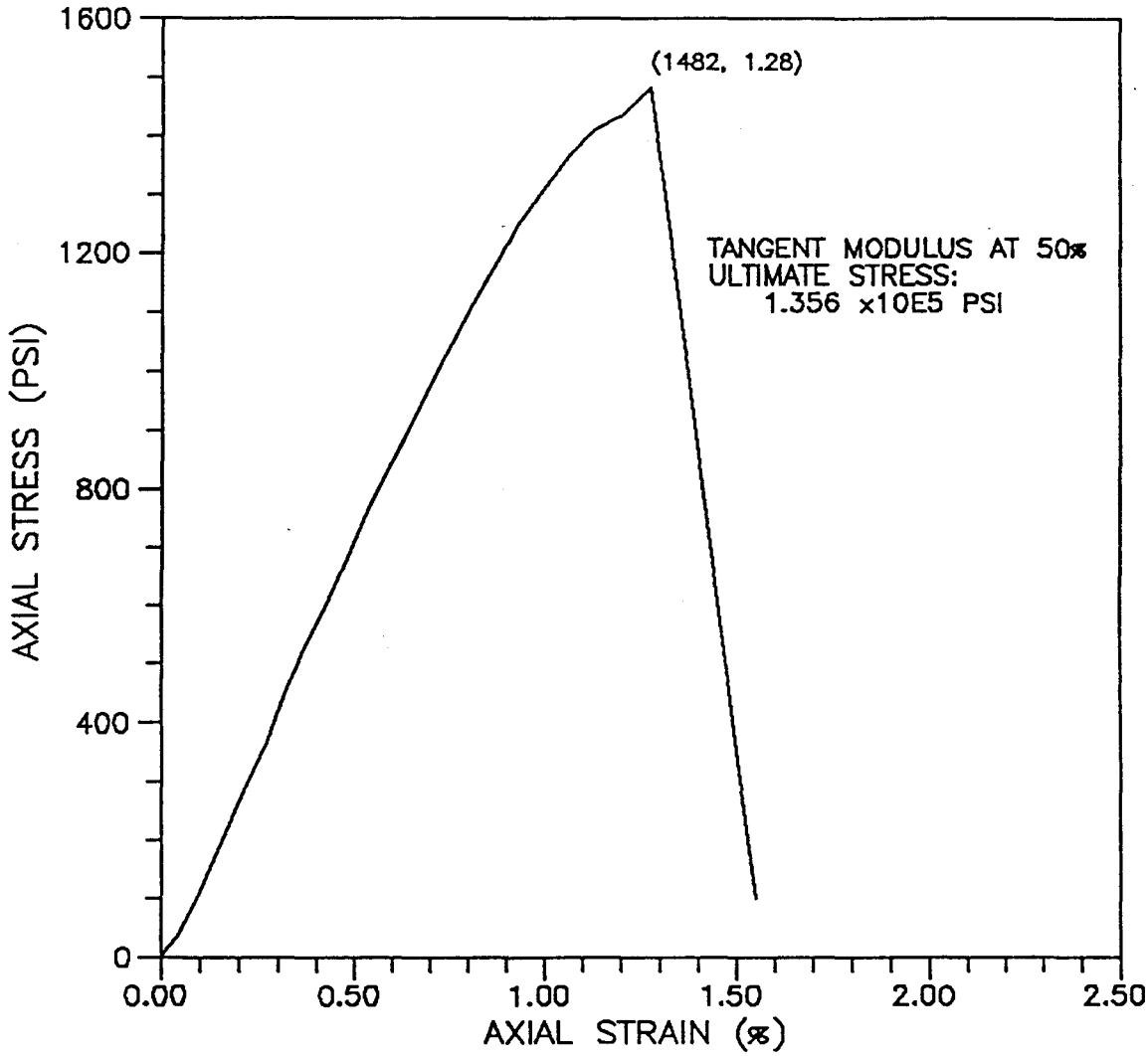


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 13.4
DRY UNIT WEIGHT (PCF): 121.1

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 29

BORING NO.: MDL-7
DEPTH (FT): 20.8-21.2
AUSTIN CHALK LIMESTONE

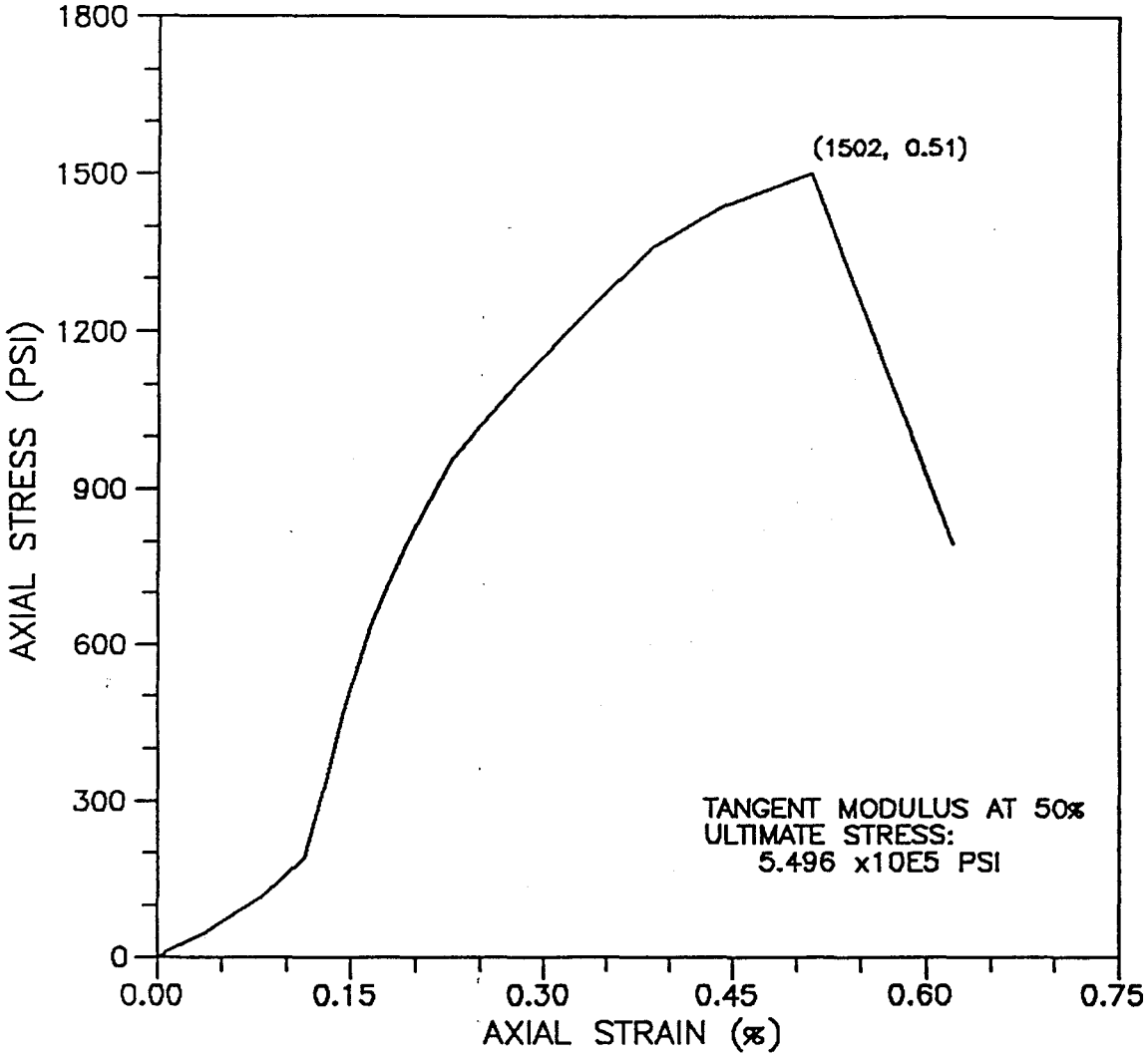


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 13.3
DRY UNIT WEIGHT (PCF): 120.3

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 30

BORING NO.: MDL-8
DEPTH (FT): 3.3-3.7
AUSTIN CHALK LIMESTONE, WEATHERED

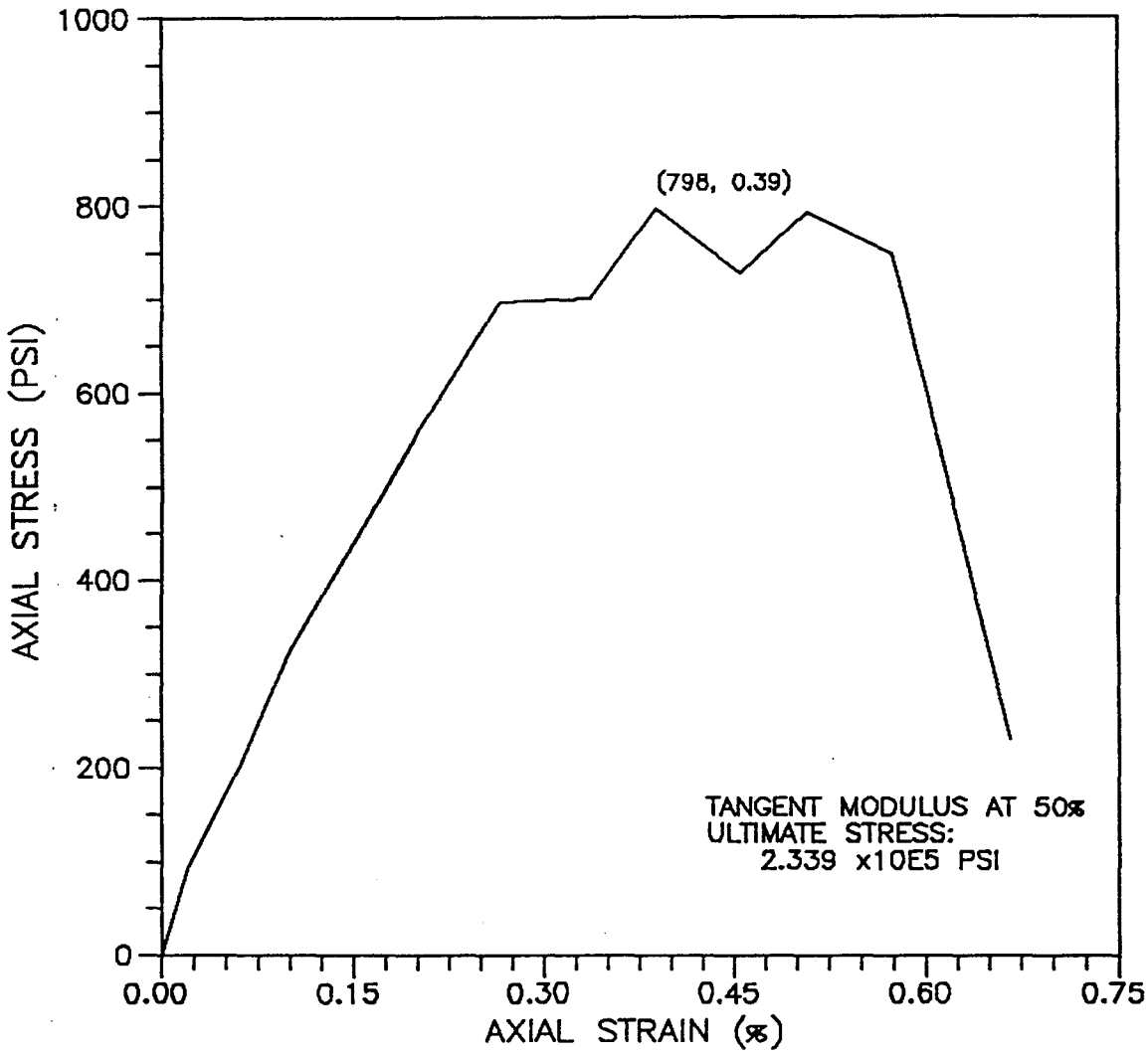


TEST TYPE: UNCONFINED COMPRESSION TEST (ASTM 2938)

MOISTURE CONTENT (%): 15.4
DRY UNIT WEIGHT (PCF): 115.9

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 31

BORING NO.: MDL-8
DEPTH (FT): 8.2-8.6
AUSTIN CHALK LIMESTONE, WEATHERED

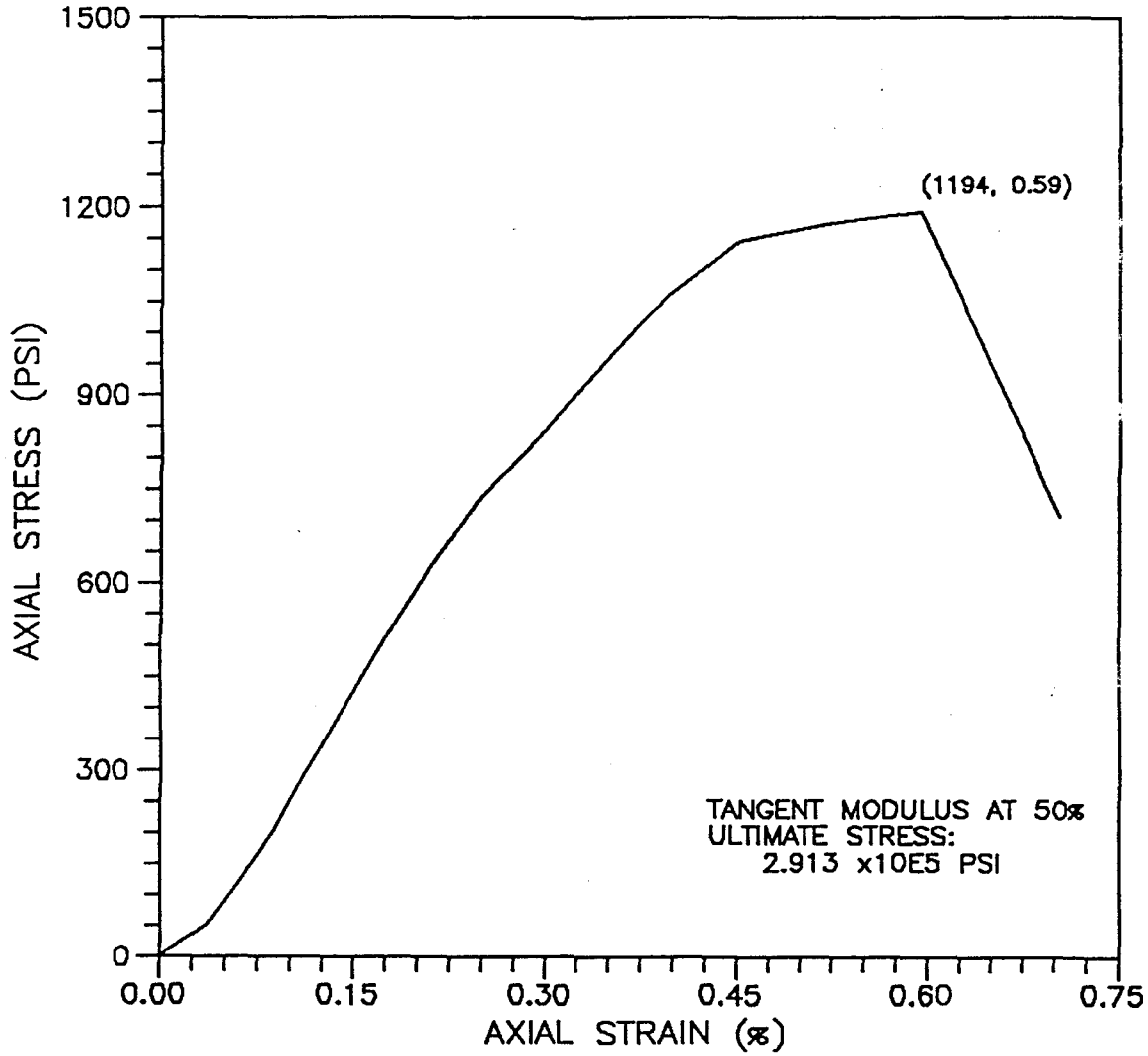


TEST TYPE: UNCONFINED COMPRESSION TEST (ASTM 2938)

MOISTURE CONTENT (%): 19.5
DRY UNIT WEIGHT (PCF): 110.4

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 32

BORING NO.: MDL-8
DEPTH (FT): 12.6-13.0
AUSTIN CHALK LIMESTONE

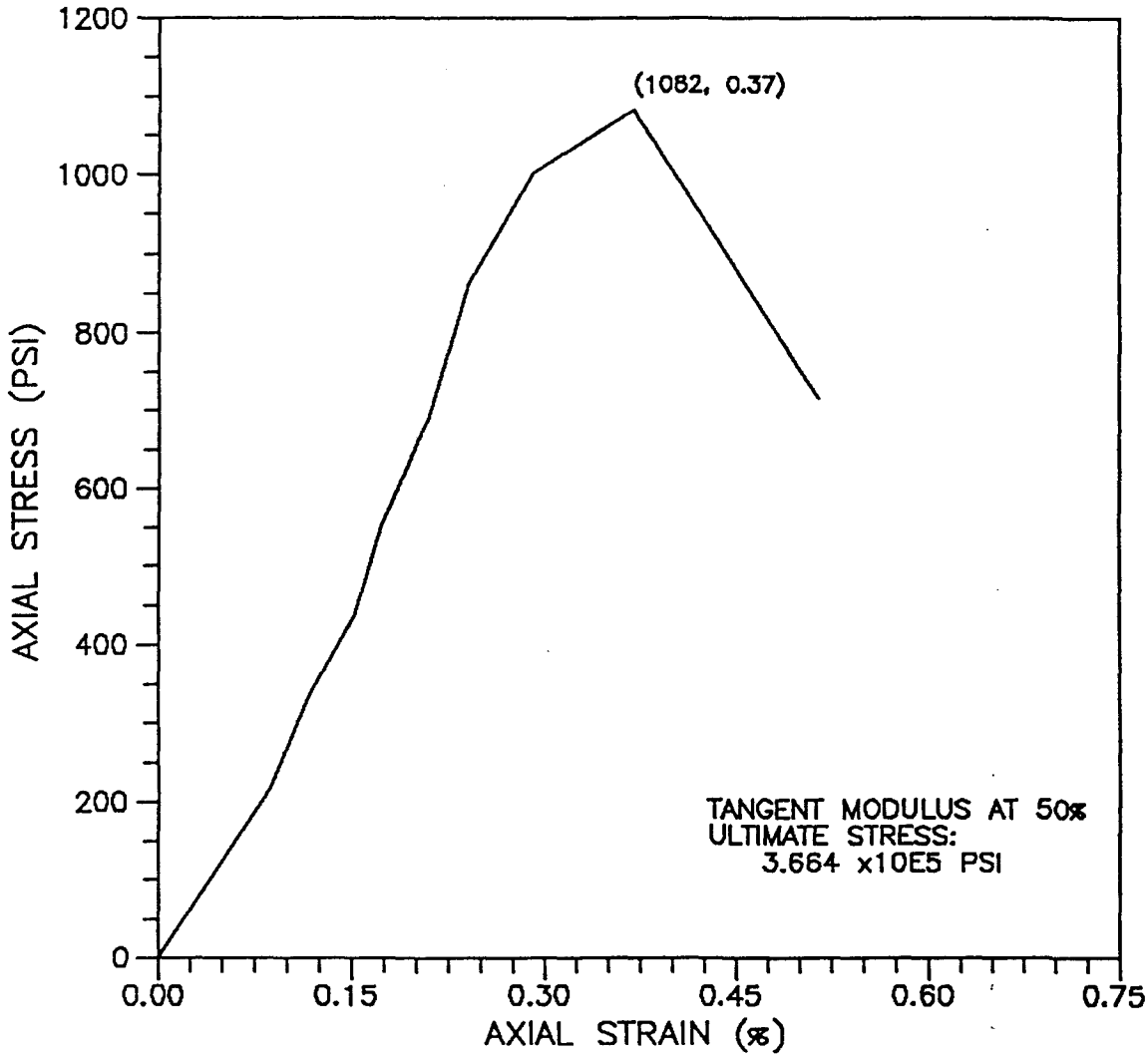


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 16.2
DRY UNIT WEIGHT (PCF): 117.0

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 33

BORING NO.: MDL-8
DEPTH (FT): 15.4-15.8
AUSTIN CHALK LIMESTONE

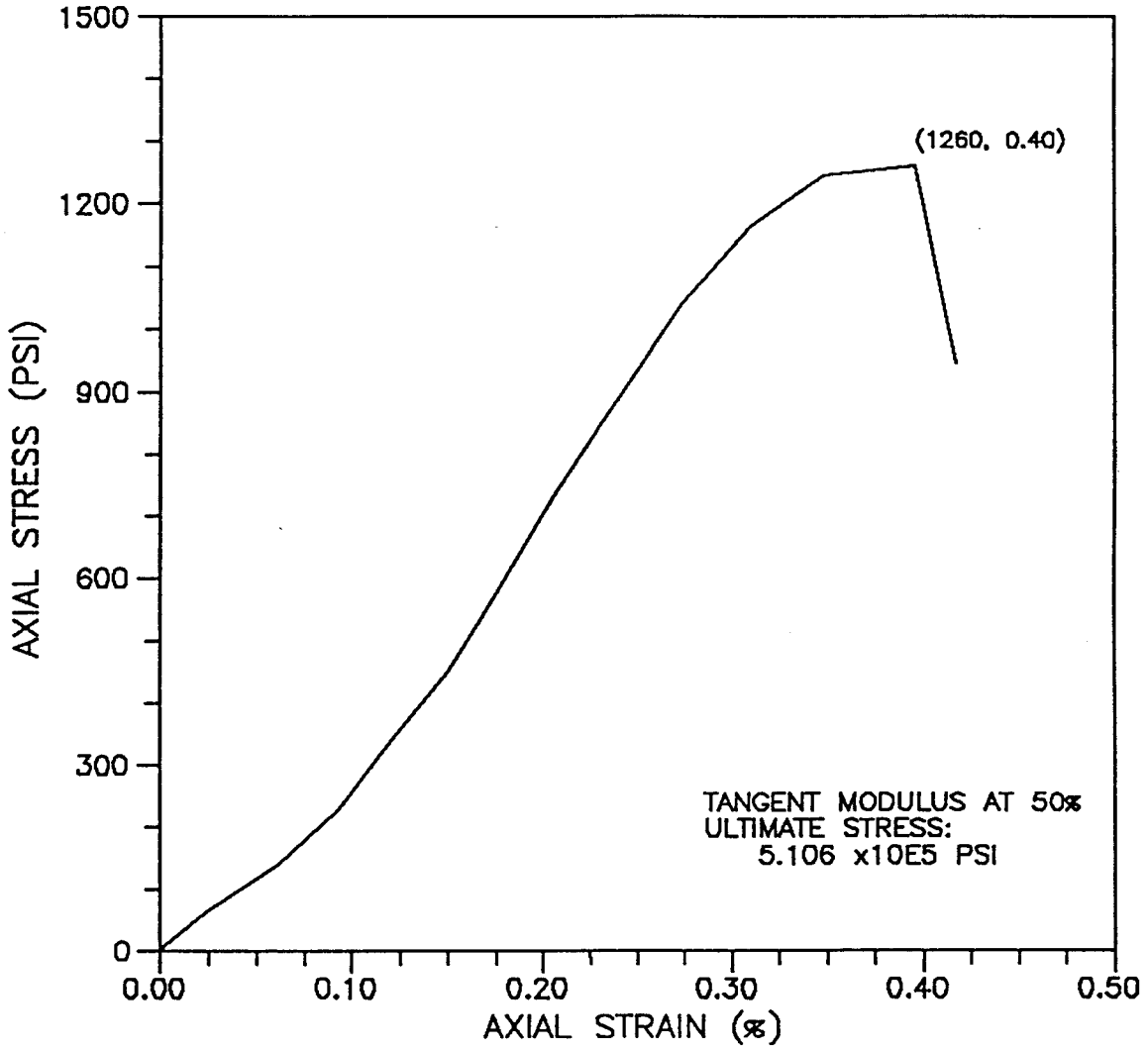


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 16.3
DRY UNIT WEIGHT (PCF): 115.5

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 34

BORING NO.: MDL-9
DEPTH (FT): 10.9-11.3
AUSTIN CHALK LIMESTONE

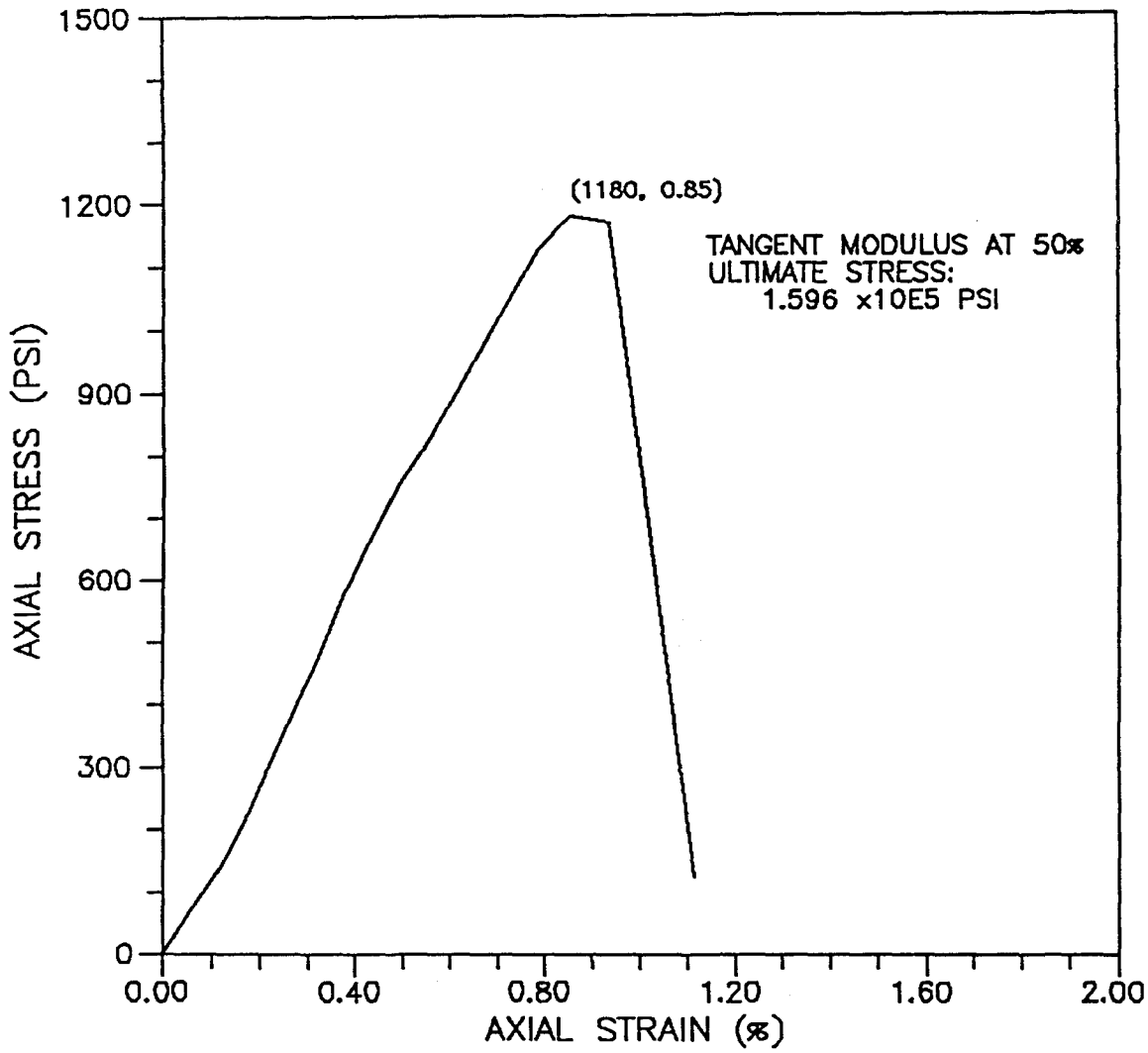


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 16.1
DRY UNIT WEIGHT (PCF): 115.2

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 35

BORING NO.: MDL-9
DEPTH (FT): 18.3-18.7
AUSTIN CHALK LIMESTONE

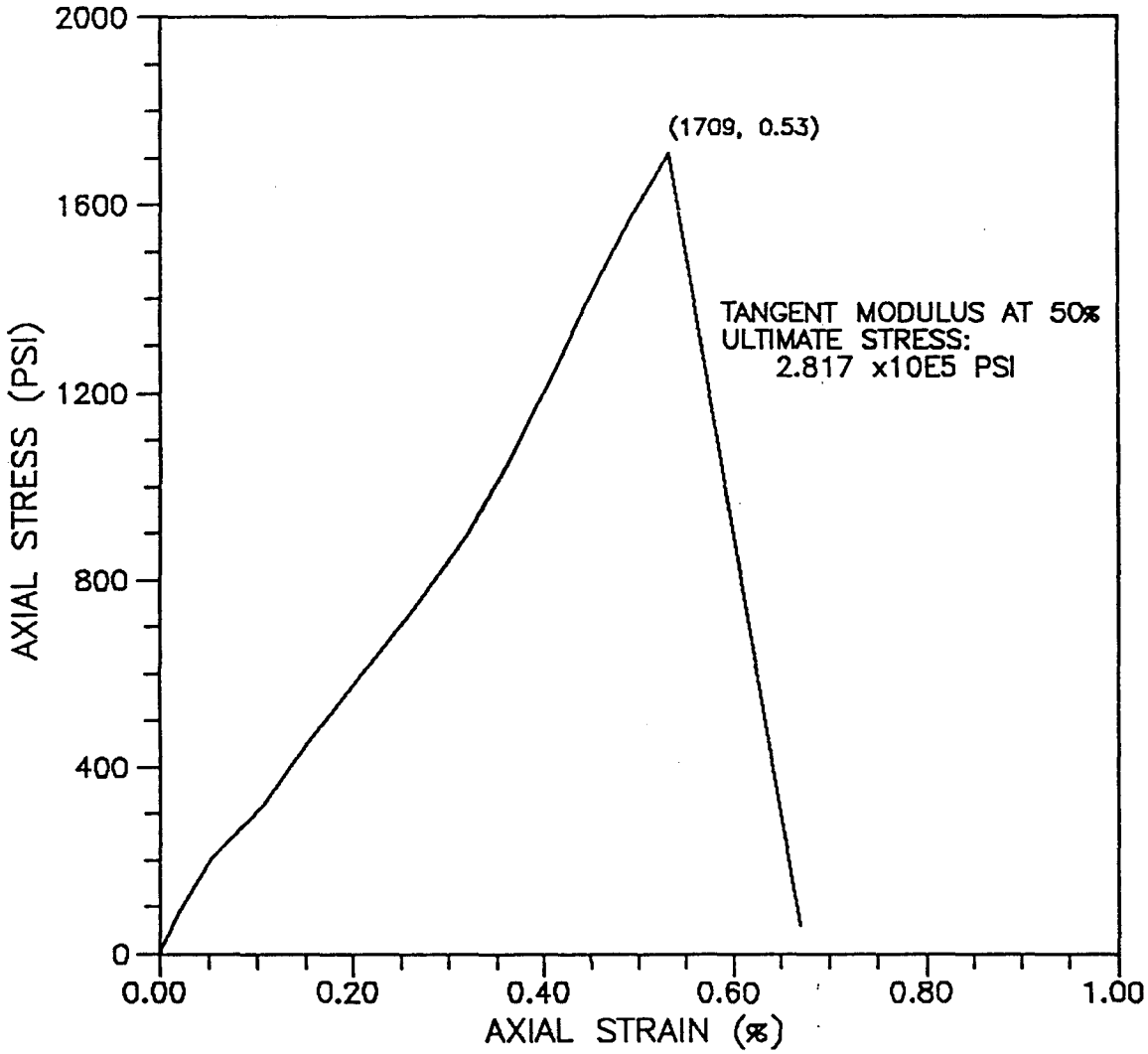


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 14.1
DRY UNIT WEIGHT (PCF): 120.6

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 36

BORING NO.: MDL-10
DEPTH (FT): 25.4-25.8
AUSTIN CHALK LIMESTONE

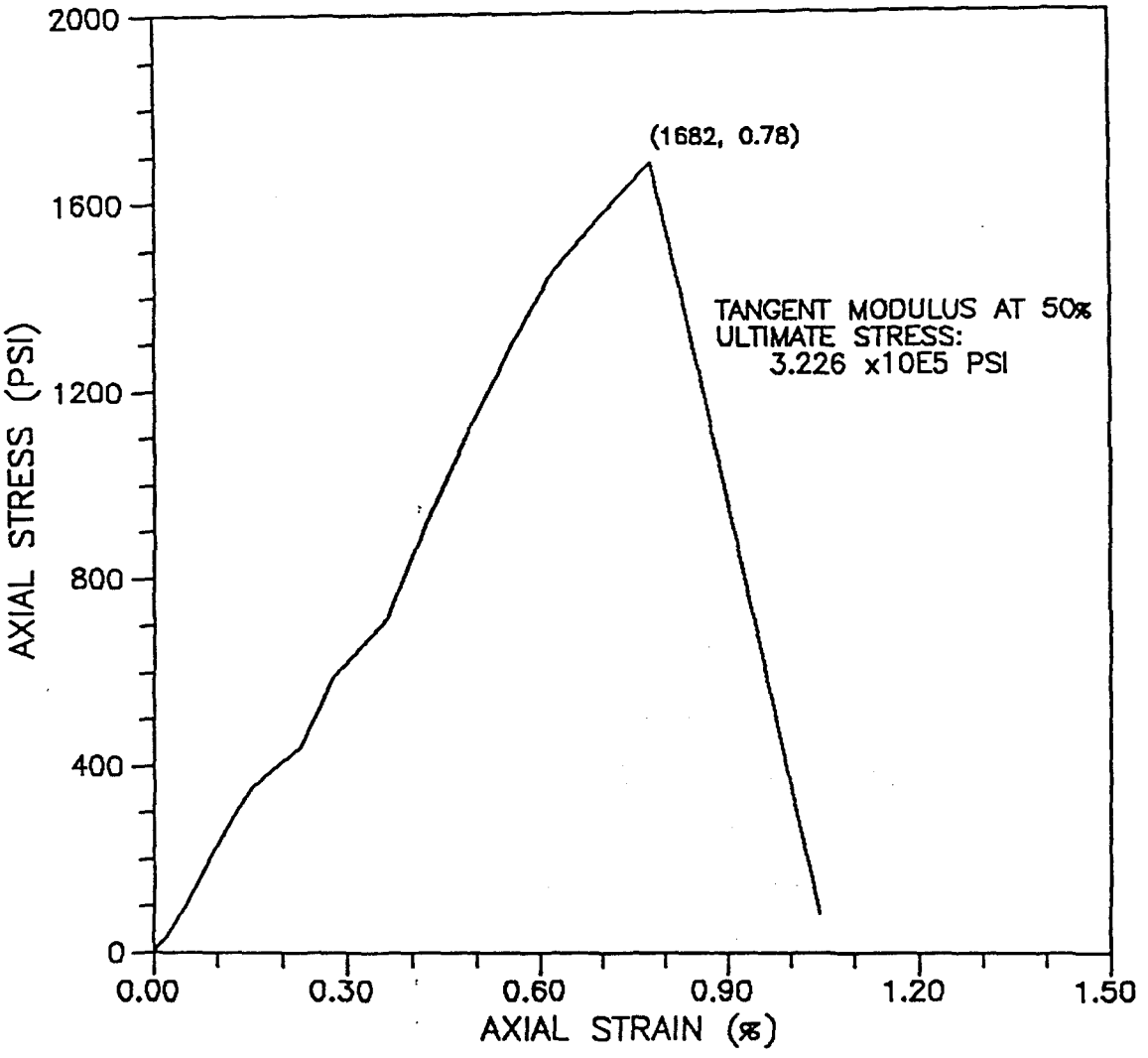


TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 15.9
DRY UNIT WEIGHT (PCF): 117.0

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 37

BORING NO.: MDL-10
DEPTH (FT): 32.1-32.5
AUSTIN CHALK LIMESTONE



TEST TYPE: UNCONFINED COMPRESSION TEST
(ASTM 2938)

MOISTURE CONTENT (%): 16.4
DRY UNIT WEIGHT (PCF): 115.1

MAGNET DEVELOPMENT FACILITY	
STRESS-STRAIN PLOT	
MASON-JOHNSTON & ASSOCIATES,INC. GEOLOGISTS-ENGINEERS	
JOB NO.: 5730	PLATE 38

RESULTS OF PIER LATERAL LOAD ANALYSES

	Pier Head Lateral Definition, In.	
	42-in. Diameter	48-in. Diameter
Case A Soil Conditions		
Controlling Load Condition (Lat. Load = 5.11 Kips; Moment = 169.06 ft-k)		
Working Load	0.05	0.04
Ultimate Load	0.17	0.13
Maximum Moment Condition (Lat. Load = 10.77 Kips; Moment = 178.86 ft-k)		
Working Load	0.06	0.05
Ultimate Load	0.23	0.17
Case B Soil Conditions		
Controlling Load Condition (Lat. Load = 5.11 Kips ; Moment = 169.06 ft-k)		
Working Load	0.19	0.14
Ultimate Load	0.57	0.41
Maximum Moment Condition (Lat. Load = 10.77 Kips ; Moment = 178.86 ft-k)		
Working Load	0.26	0.19
Ultimate Load	0.82	0.59

NOTES:

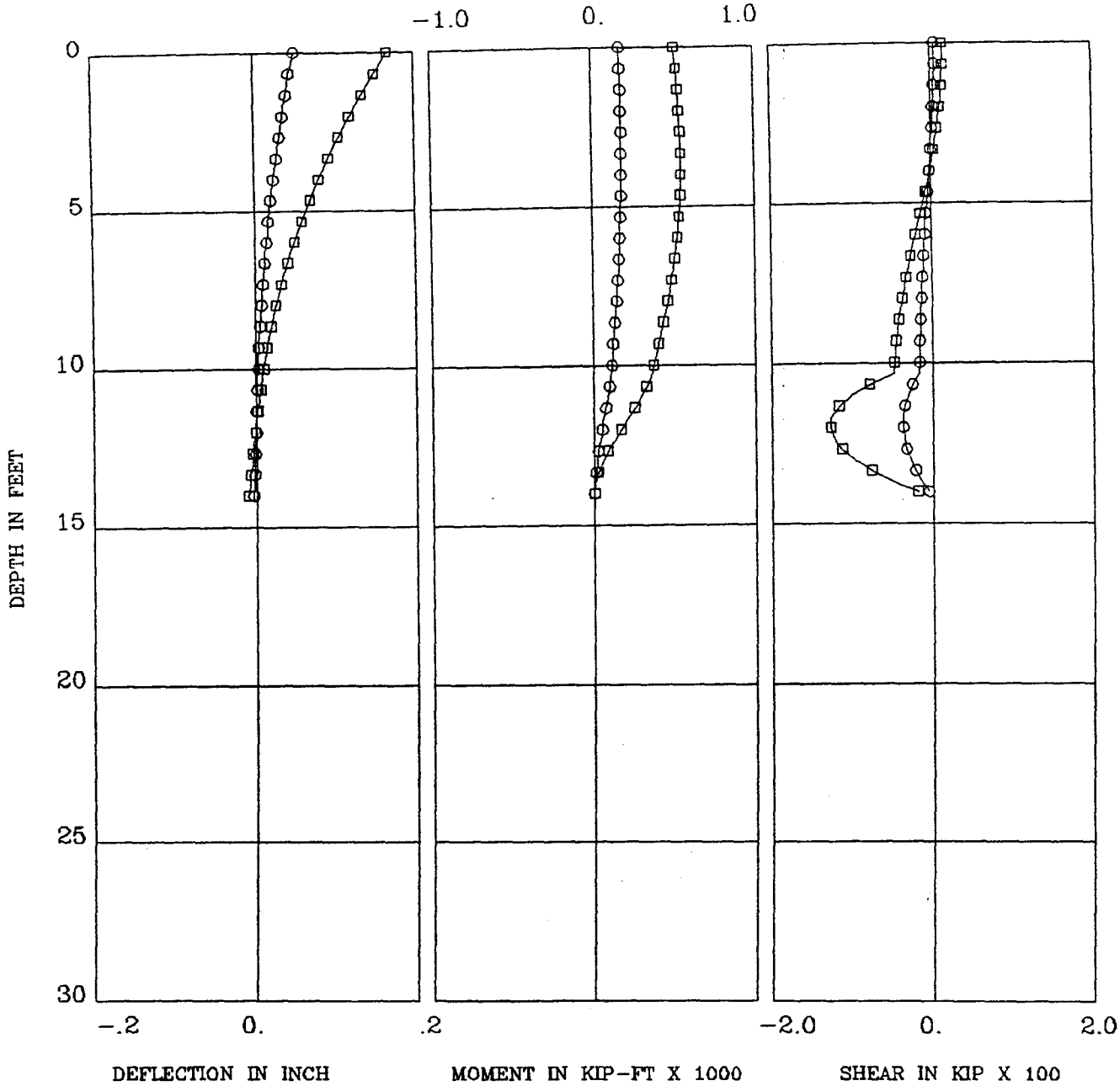
1. Assumes pier extends 4 feet into unweathered limestone.

2. Ultimate Load = Working Load x 3.

3. Case A Soil Conditions
   0' - 10' Weathered Limestone
   10'- 14' Unweathered Limestone

   Case B Soil Conditions
   0' - 14' Select Fill
   14'- 20' Weathered Limestone
   20'- 24' Unweathered Limestone

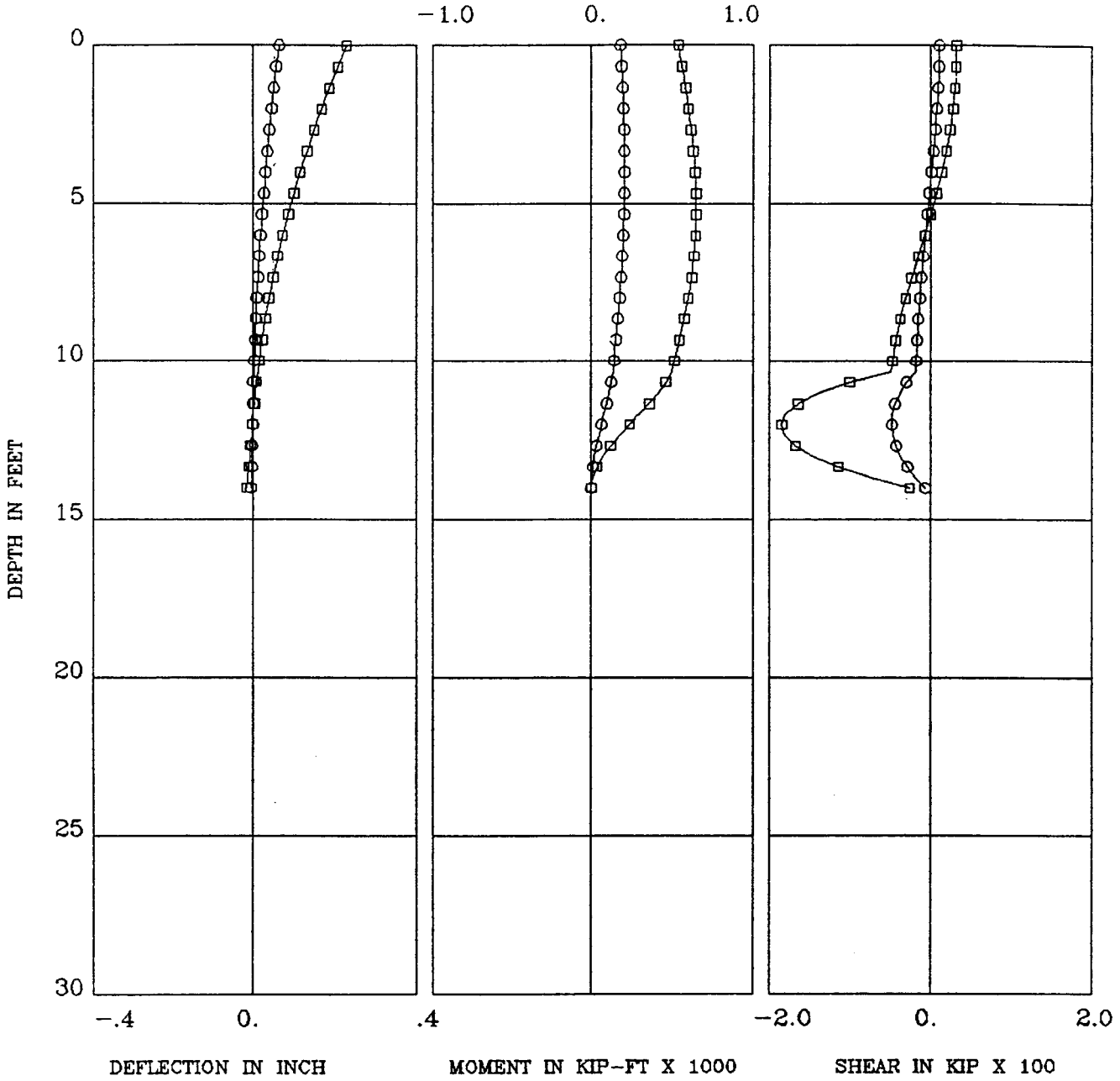
4. Load Conditions are preliminary loads provided by CRSS.



CASE	SYMBOL	DESCRIPTION
1	○	MDL - WORKING LOAD - CASE A SOILS - 42-IN. PIER
2	□	MDL - ULTIMATE LOAD - CASE A SOIL - 42-IN. PIER

CONTROL LOAD CONDITION
LATERAL LOAD = 5.11 KIPS
MOMENT = 169.06 FT-KIPS

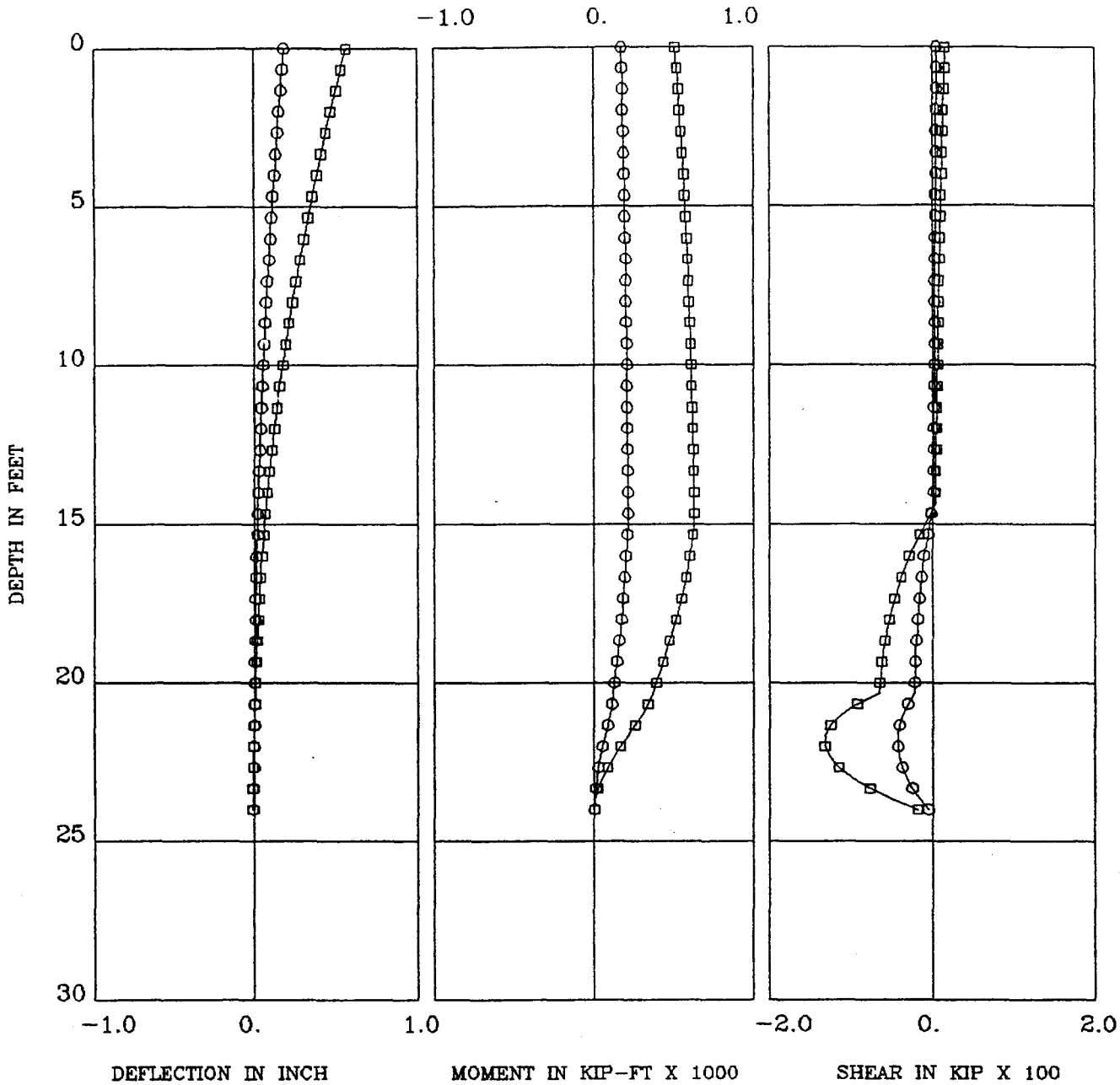
5730	MAGNET DEVELOPMENT LABORATORY - SSC PROJECT
Mason - Johnston, & Associates, Inc.	DEFLECTION, MOMENT, AND SHEAR VS DEPTH



CASE	SYMBOL	DESCRIPTION
1	○	MDL - WORKING LOAD - CASE A SOILS - 42-IN. PIER
2	□	MDL - ULTIMATE LOAD - CASE A SOIL - 42-IN. PIER

MAXIMUM MOMENT CONDITION
LATERAL LOAD = 10.77 KIPS
MOMENT = 178.86 FT-KIPS

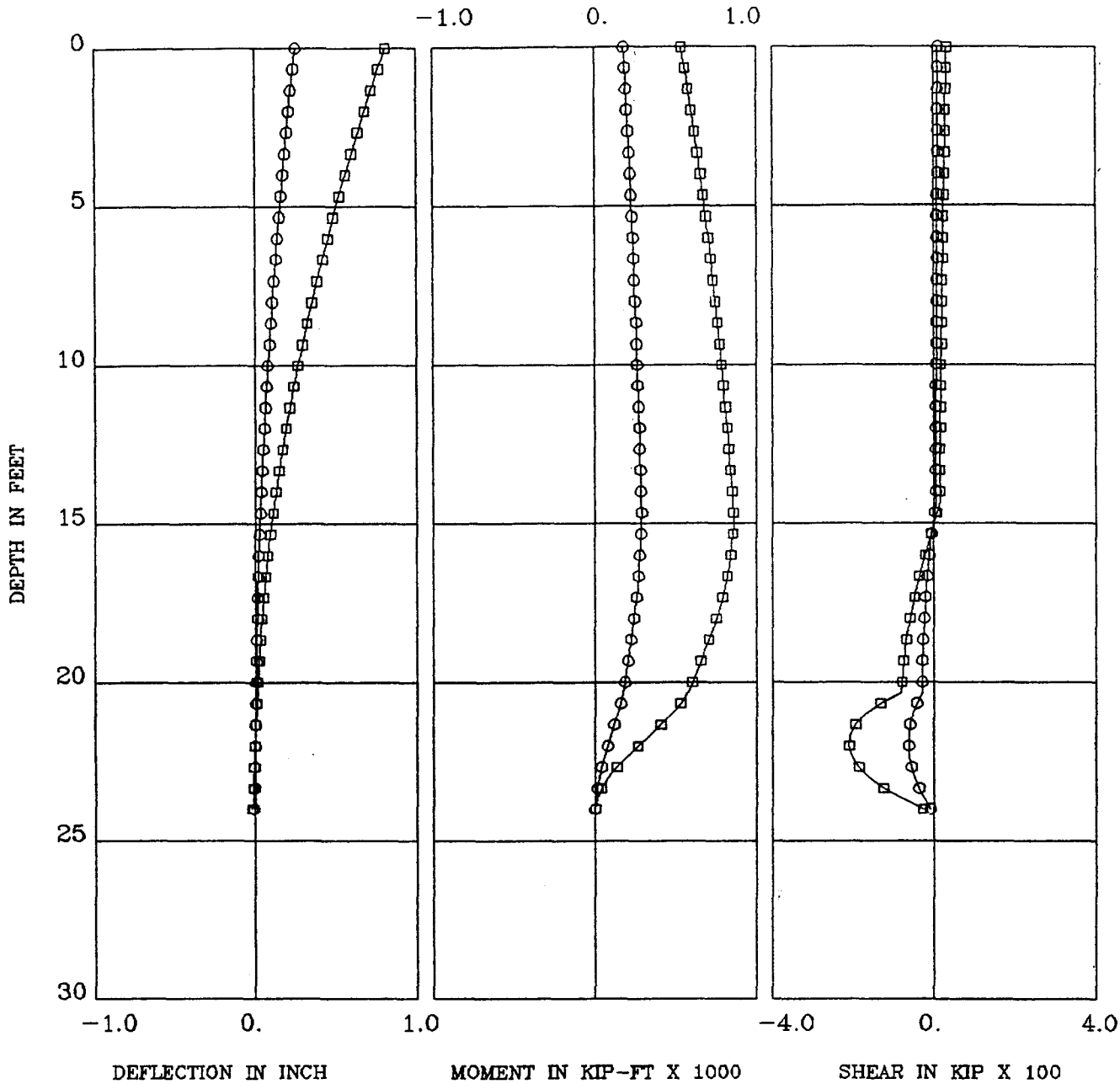
5730	MAGNET DEVELOPMENT LABORATORY - SSC PROJECT
Mason-Johnston, & Associates, Inc.	DEFLECTION, MOMENT, AND SHEAR VS DEPTH



CASE	SYMBOL	DESCRIPTION
1	○	MDL - WORKING LOAD - CASE B SOILS - 42-IN. PIER
2	□	MDL - ULTIMATE LOAD - CASE B SOIL - 42-IN. PIER

CONTROL LOAD CONDITION
LATERAL LOAD = 5.11 KIPS
MOMENT = 169.06 FT-KIPS

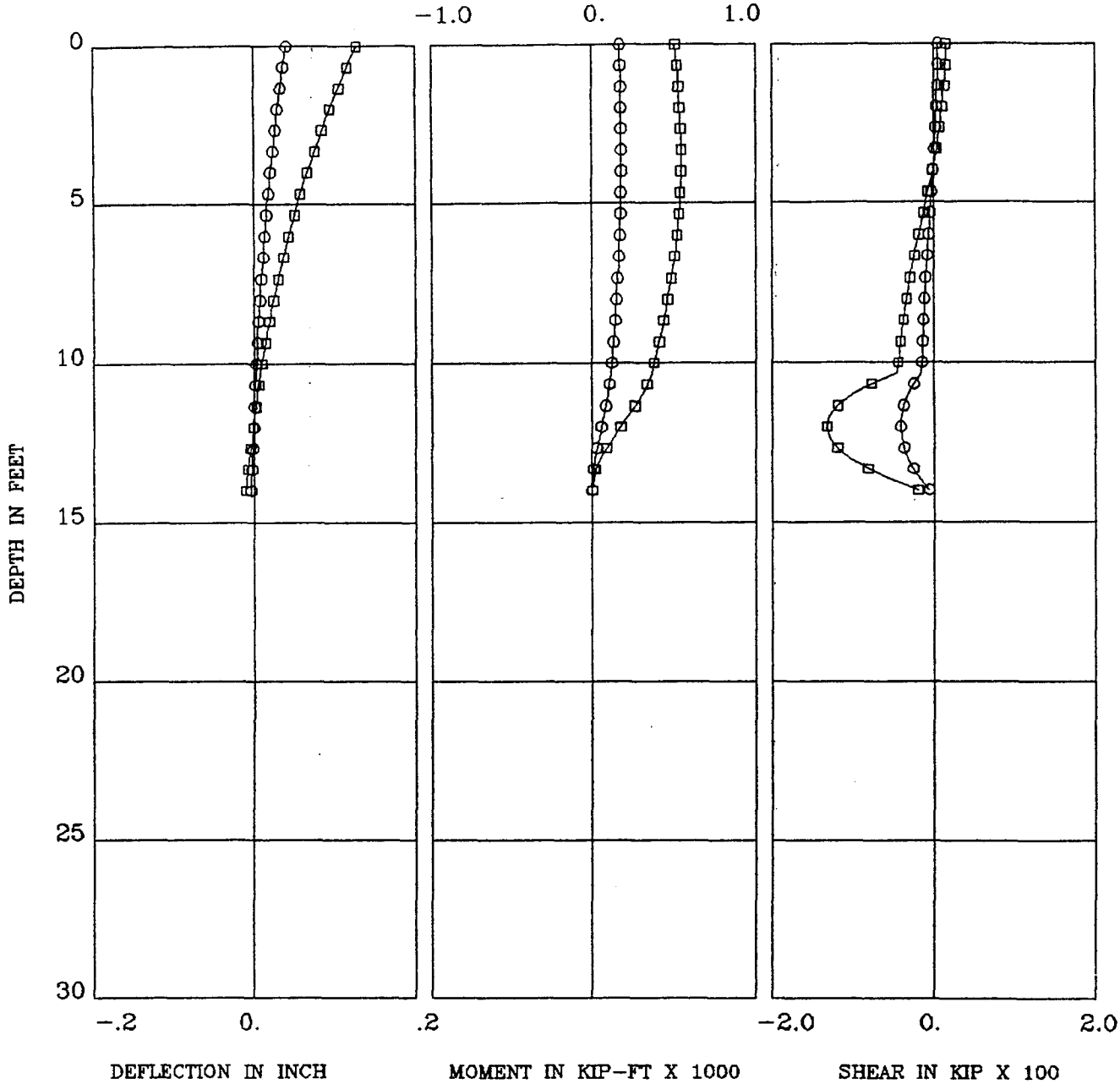
5730	MAGNET DEVELOPMENT LABORATORY - SSC PROJECT
Mason-Johnston, & Associates, Inc.	DEFLECTION, MOMENT, AND SHEAR VS DEPTH



CASE	SYMBOL	DESCRIPTION
1	○	MDL - WORKING LOAD - CASE B SOILS - 42-IN. PIER
2	□	MDL - ULTIMATE LOAD - CASE B SOIL - 42-IN. PIER

MAXIMUM MOMENT CONDITION
LATERAL LOAD = 10.77 KIPS
MOMENT = 178.86 FT-KIPS

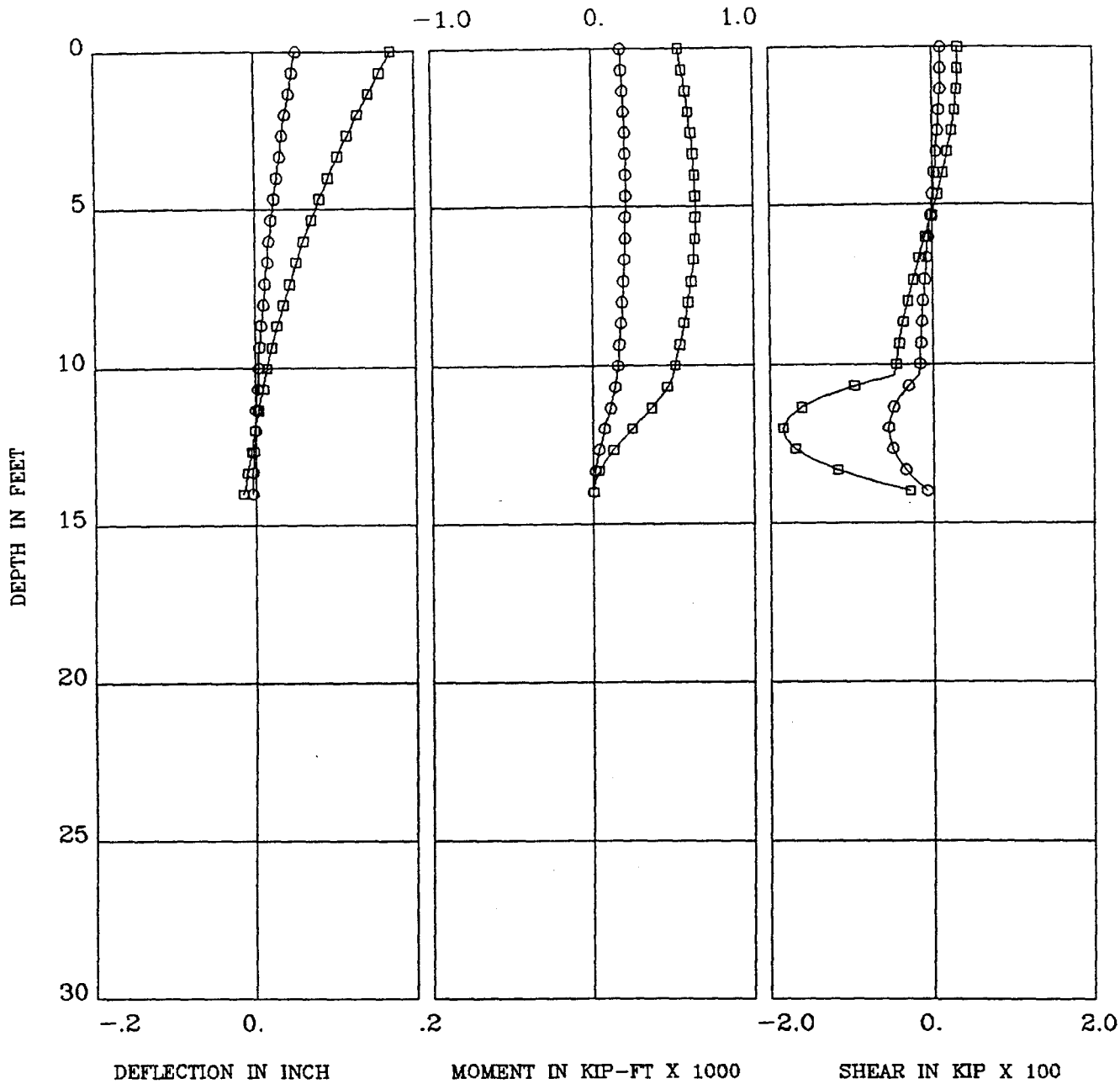
5730	MAGNET DEVELOPMENT LABORATORY - SSC PROJECT
Mason - Johnston, & Associates, Inc.	DEFLECTION, MOMENT, AND SHEAR VS DEPTH



CASE	SYMBOL	DESCRIPTION
1	○	MDL - WORKING LOAD - CASE A SOILS - 48-IN. PIER
2	□	MDL - ULTIMATE LOAD - CASE A SOILS - 48-IN. PIER

CONTROL LOAD CONDITION
LATERAL LOAD = 5.11 KIPS
MOMENT = 169.06 FT-KIPS

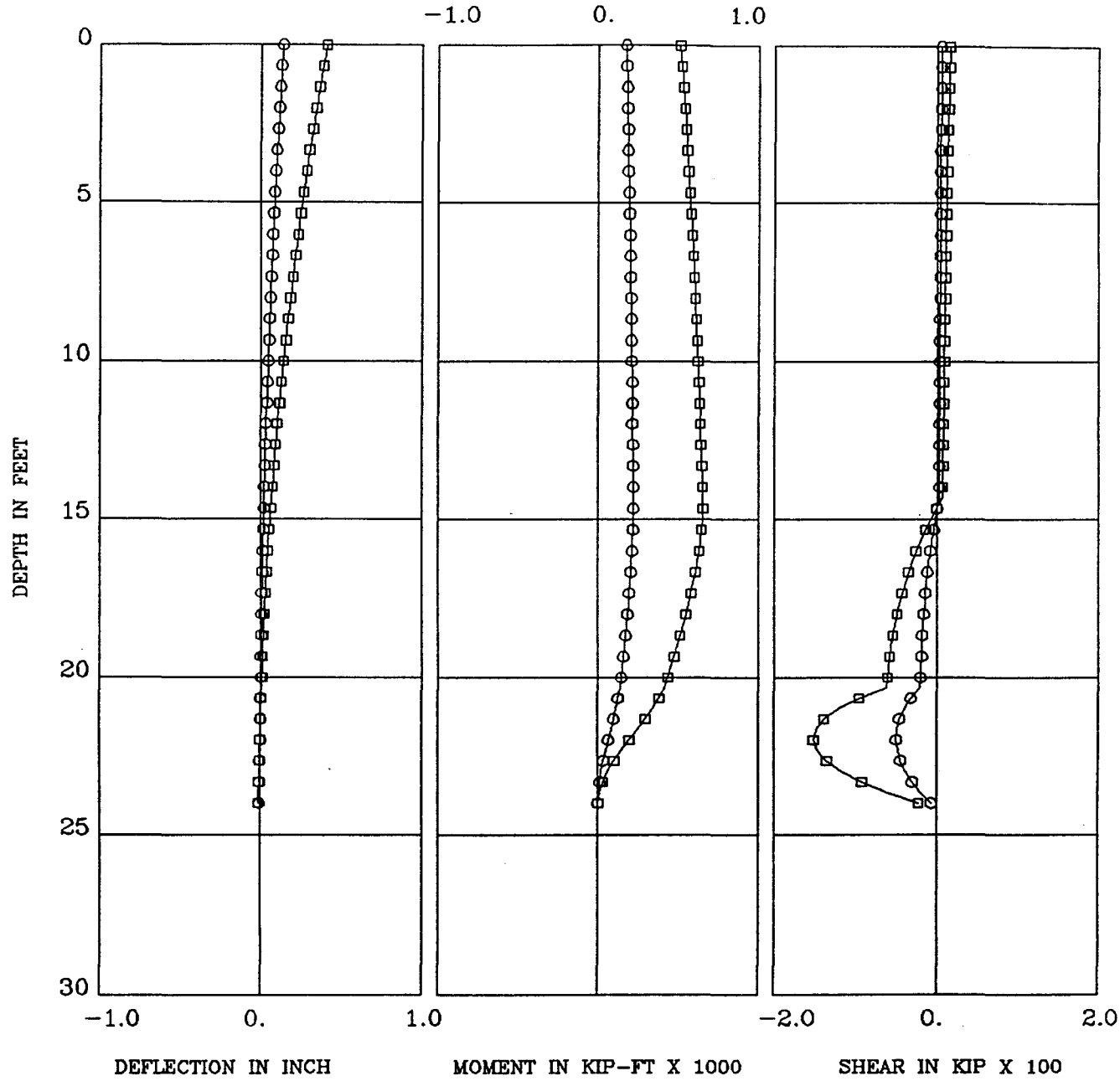
5730	MAGNET DEVELOPMENT LABORATORY - SSC PROJECT
Mason - Johnston, & Associates, Inc.	DEFLECTION, MOMENT, AND SHEAR VS DEPTH



CASE	SYMBOL	DESCRIPTION
1	○	MDL - WORKING LOAD - CASE A SOILS - 48-IN. PIER
2	□	MDL - ULTIMATE LOAD - CASE A SOILS - 48-IN. PIER

MAXIMUM MOMENT CONDITION
LATERAL LOAD = 10.77 KIPS
MOMENT = 178.86 FT - KIPS

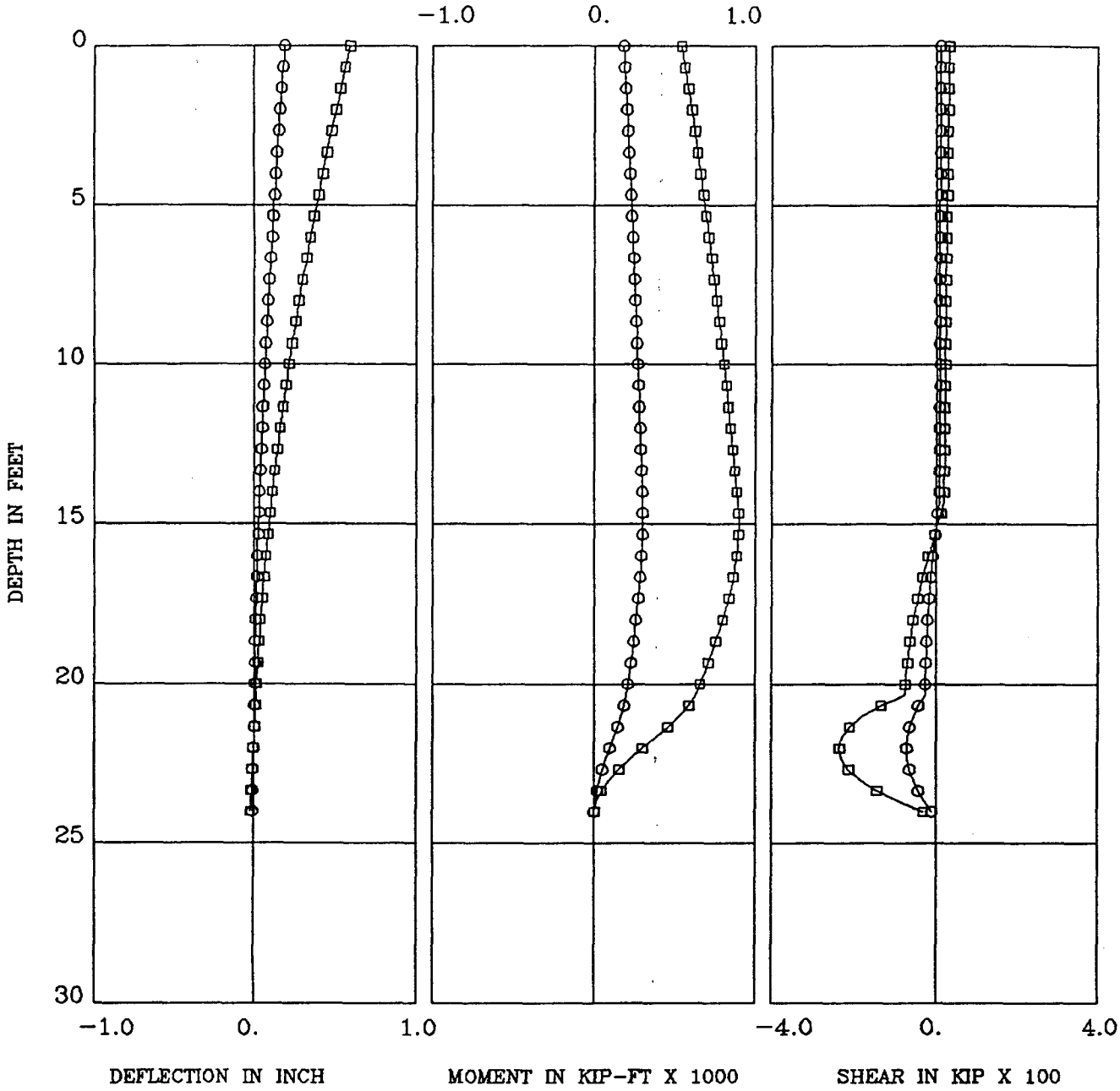
5730	MAGNET DEVELOPMENT LABORATORY - SSC PROJECT
Mason - Johnston, & Associates, Inc.	DEFLECTION, MOMENT, AND SHEAR VS DEPTH



CASE	SYMBOL	DESCRIPTION
1	○	MDL - WORKING LOAD - CASE B SOILS - 48-IN. PIER
2	□	MDL - ULTIMATE LOAD - CASE B SOILS - 48-IN. PIER

CONTROL LOAD CONDITION
LATERAL LOAD = 5.11 KIPS
MOMENT = 169.06 FT-KIPS

5730	MAGNET DEVELOPMENT LABORATORY - SSC PROJECT
Mason - Johnston, & Associates, Inc.	DEFLECTION, MOMENT, AND SHEAR VS DEPTH



CASE	SYMBOL	DESCRIPTION
1	○	MDL - WORKING LOAD - CASE B SOILS - 48-IN. PIER
2	□	MDL - ULTIMATE LOAD - CASE B SOILS - 48-IN. PIER

MAXIMUM MOMENT CONDITION
LATERAL LOAD = 10.77 KIPS
MOMENT = 178.86 FT-KIPS

5730	MAGNET DEVELOPMENT LABORATORY - SSC PROJECT
Mason - Johnston, & Associates, Inc.	DEFLECTION, MOMENT, AND SHEAR VS DEPTH

CLASSIFICATION SYMBOLS
(Soil)

	Asphalt
	Fill
GW	Gravel or Sandy Gravel well-graded
GP	Gravel or Sandy Gravel poorly-graded
GM	Silty Gravel or Silty Sandy Gravel
GC	Clayey Gravel or Clayey Sandy Gravel
SW	Sand or Gravelly Sand well-graded
SP	Sand or Gravelly Sand poorly-graded
SM	Silty Sand or Silty Gravelly Sand
SC	Clayey Sandy or Clayey Gravelly Sand
ML	Silts, Sandy Silts, Gravelly Silts, or Diatomaceous Soils
CL	Lean Clays, Sandy Clays, or Gravelly Clays
OL	Organic Silts or Lean Organic Clays
MH	Micaceous Clays or Diatomaceous Soil
CH	Fat Clays
OH	Fat Organic Clays

CLASSIFICATION SYMBOLS
(Rock)

Ls.	Limestone
Sh.	Shale
	Marl
Ss.	Sandstone
Sltst.	Siltstone
	Weathered Zone

ABBREVIATIONS

abnt.	abundant
ang.	angular
aren.	arenaceous
arg.	argillaceous
bdd.	bedded
bdg.	bedding
bent.	bentonite
bldr.	boulder
calc.	calcareous
carb.	carbonaceous
cmt.	cemented
clst.	claystone
cbl.	cobble
cgl.	conglomerate
fossil.	fossiliferous
frac.	fracture
gyp.	gypsiferous
incl.	inclusion
intbdd.	interbedded
jnt.	joint
lam.	laminated
nod.	nodule
occ.	occasional
part.	particle
phos.	phosphatic
py.	pyritized
Rec.	Recovery
rnd.	rounded
RQD	Rock Quality Designation
sat.	saturated
sept.	septarian
slk.	slickensided
sil.	siliceous
wea.	weathered
sli.	slightly
mod.	moderately
v.	very
sev.	severely
lt.	light
med.	medium
dk.	dark
BT	Brazil Tensile Test
dia.	diameter
DUW	Dry Unit Weight
El.	Elevation
LL	Liquid Limit
MC	Moisture Content
ME	Modulus of Deformation
min.	minutes
Pen.	Penetrometer
PI	Plasticity Index
Qu	Unconfined Compression Test
T.D.	Total Depth

CONSISTENCIES AND HARDNESS DESCRIPTIONS

FOR SANDS, GRAVELS, & SANDY SILTS

Consistency	Relative Density %	Standard Penetration Resistance N
Very loose	Less than 15	Less than 4
Loose	15–35	4–10
Medium	35–65	10–30
Dense	65–85	30–50
Very Dense	85–100	Greater than 50

FOR CLAYS & SANDY CLAYS
(COHESIVE SOILS)

Consistency	UNCONFINED COMPRESSION tsf	Standard Penetration Resistance N
Very Soft	Less than 0.25	Less than 2
Soft	0.25–0.5	2–4
Medium	0.5–1.0	4–8
Stiff	1.0–2.0	8–16
Very Stiff	2.0–4.0	16–32
Hard	Greater than 4.0	Greater than 32

RELATIVE HARDNESS MODIFIERS
(RELATED TO FRESH SAMPLE)

Hardness	Rule of Thumb Test
Soft	Permits denting by moderate finger pressure.
Firm	Resists denting by fingers but can be penetrated by pencil point to medium to shallow depth. (No. 2 pencil)
Mod. Hard	Very shallow penetration of pencil point, can be scratched by knife and in some instances cut with knife.
Hard	No pencil penetration, can be scratched with knife, can be broken by light to moderate hammer blows.
Very Hard	Cannot be scratched by knife, can be broken by repeated heavy hammer blows.

MASON-JOHNSTON & ASSOCIATES, INC
GEOLOGISTS - ENGINEERS
DALLAS, TEXAS

LEGEND, LITHOLOGY, SOIL CONSISTENCY, & RELATIVE ROCK HARDNESS

MJA NO. 5730	DATE 9/90

LOG OF BORING

BORING NO: MDL-1 PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

LOCATION: N 6819170.3748 E 2449184.3050

CLIENT: The PB/MK Team

GROUND EL: See PLATE 2

TASK NO.: 5730

DATE: 08/20/90 TYPE: NX-Core CASED TO: 1.0 CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

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
		U1	0.0	0.4					4.5+	CLAY, slightly silty, with weathered limestone fragments 0.4' hard, dark brown
5		C1	1.5	10.0	100	32				LIMESTONE, moderately weathered, firm to moderately hard closely spaced joints - some with iron staining, tan 2.6 - 2.75 mod. arg., firm 3.35 - 3.65 mod. arg., firm 4.25 - 4.5 mod. arg., firm 8.0 - 9.7 mod. -v.arg., firm 10.7'
10		C2	10.0	20.0	98	98				LIMESTONE, fresh, mod. hard to hard, lt. gray, with gray, argillaceous interbeds 10.7 - 11.0 mod. arg., dk. gray 12.4 - 13.3 mod. arg., dk. gray 16.0 - 17.0 mod. arg., dk. gray 19.2 - 20.5 mod. arg., dk. gray
15										
20		C3	20.0	25.6	100	100				22.3 - 24.4 mod. arg., dk. gray
25										
30										TOTAL DEPTH OF BORING: 25.6 Ft. NOTE: (1) Boring started : 10:45 a.m. (2) Boring completed: 12.50 p.m. (3) Boring grouted : 08/21/90
35										
40										

DRILLING GEOLOGIST Scott E. Lesikar

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-2 PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

LOCATION: N 6819100.0462 E 2449080.3138

CLIENT: The PB/MK Team

GROUND EL: See PLATE 2

TASK NO.: 5730

DATE: 08/21/90 TYPE: NX-Core CASED TO: 1.0 CONTRACTOR: Mason-Johnston & Associates

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

WATER INFORMATION: No free water observed during drilling.

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
		U1	0.0	1.3				4.5+	CLAY, slightly silty, with weathered limestone fragments 1.3 hard, dk. brown
		C1	2.0	4.0	90	20			LIMESTONE, moderately to severely weathered, firm to mod hard, occasional clay interbeds, closely spaced joints - some with iron staining, tan
5		C2	4.0	9.0	41	35			3.1 - 3.2 55° fracture, slk., rough
10		C3	9.0	12.0	100	100			10.3 - 10.4 40° fracture slk., sli. rough 10.9 - 11.8 mod. to v. arg., v. stiff - firm
15		C4	12.0	22.0	97	91			14.8 LIMESTONE, fresh, mod. hard to hard, lt. gray, with dk. gray arg. interbeds
20									21.45 - 22.0 mod. arg., dk. gray
25		C5	22.0	27.0	100	100			23.8 - 24.75 mod. to v. arg., dk. gray
30									TOTAL DEPTH OF BORING: 27.0 Ft. NOTE: (1) Boring started 8:10 a.m. (2) Boring completed: 9:00 a.m. (3) Boring grouted upon completion.
35									
40									

DRILLING GEOLOGIST Mark G. Thomas

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-3 PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

CLIENT: The PB/MK Team

TASK NO.: 5730

LOCATION: N 6819038.6514
E 2448974.1318

GROUND EL.: See PLATE 2

DATE: 08/21/90 TYPE: NX-Core CASED TO: 4.0 CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

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
		U1	0.0	1.5				4.0	CLAY, slightly silty, with weathered limestone fragments very stiff, dk. brown
		U2	1.5	3.0				3.75	3.0
		U3	3.0	4.0				3.5	CLAY, slightly silty, with weathered limestone fragments very stiff, tan
5		C1	4.5	9.5	60	44			4.0 LIMESTONE, moderately to severely weathered, moderately hard, occasional clay interbeds, closely spaced joints - some with iron staining, tan
10		C2	9.5	19.5	67	36			
15									19.3
20		C3	19.5	29.5	100	100			LIMESTONE, fresh, mod. hard to hard, lt. gray, with dk. gray, arg. interbeds 19.3 - 20.6 mod. to very arg., dk. gray 21.15 - 24.2 mod. to very arg., dk. gray 26.1 - 27.1 mod. to very arg., dk. gray 28.1 Inoceramus fossil
25									
30									TOTAL DEPTH OF BORING: 29.5 Ft. NOTE: (1) Boring started : 9:30 a.m. (2) Boring completed: 10:20 a.m. (3) Boring grouted upon completion.
35									
40									

DRILLING GEOLOGIST Mark G. Thomas

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-4 PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

CLIENT: The PB/MK Team

TASK NO.: 5730

LOCATION: N 6819090.4174
E 2448848.9451

GROUND EL: See PLATE 2

DATE: 08/21/90 TYPE: NX-Core CASED TO: 4.0 CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

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
		U1	0.0	1.5					3.75	CLAY, slightly silty, with weathered limestone fragments very stiff, dk. brown
		U2	1.5	3.0					3.5	3.0
		U3	3.0	4.5					3.5	CLAY, slightly silty, with weathered limestone fragments very stiff, tan
5		C1	4.5	9.5	15	8				4.0 LIMESTONE, mod. to severely weathered, occasional clay interbeds, closely spaced joints - some with iron staining, tan
10		C2	9.5	19.5	80	33				
15										18.3
20		C3	19.5	27.5	100	100				LIMESTONE, fresh, moderately hard to hard, lt. gray, with dk. gray, argillaceous interbeds. 18.3 - 19.65 sli. to v. arg., dk. gray 20.9 - 21.85 mod. arg., dk. gray
25										24.55 - 25.4 mod. arg., dk. gray
30										TOTAL DEPTH OF BORING: 27.5 Ft.
35										NOTE: (1) Boring started : 10.40 a.m. (2) Boring completed: 11:15 a.m. (3) Boring grouted upon completion.
40										

DRILLING GEOLOGIST Mark G. Thomas

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-5 PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

CLIENT: The PB/MK Team

TASK NO.: 5730

LOCATION: N 6819098.3960 E 2448930.9825

GROUND EL: See PLATE 2

DATE: 08/21/90 TYPE: NX-Core CASED TO: 4.0 CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT ROD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
		U1	0.0	1.5				3.75	CLAY, slightly silty, with weathered limestone fragments very stiff to hard, dk. brown
		U2	1.5	3.0				4.5	
		U3	3.0	4.5				4.5	4.0
5		U4	4.5	5.0				4.5+	CLAY, slightly silty, with weathered limestone fragments hard, tan 5.0
		C1	6.0	10.5	60	17			LIMESTONE, mod. weathered, firm to mod. hard, closely spaced joints - some with iron staining
10									
15		C2	10.5	20.0	79	32			17.6 - 18.0 mod. arg., firm 18.9
20		C3	20.0	29.0	100	100			LIMESTONE, fresh, mod. hard to hard, lt. gray, with dk. gray argillaceous interbeds 19.4 - 20.0 mod. to v. arg., dk. gray 21.0 - 22.2 mod. arg., dk .gray 25.1 - 26.0 mod. arg., dk. gray 28.5 - 29.0 mod. arg., dk. gray
25									
30									TOTAL DEPTH OF BORING: 29.0 Ft. NOTE: (1) Boring started. : 10:45 a.m. (2) Boring completed: 12:00 p.m. (3) Boring grouted upon completion.
35									
40									

DRILLING GEOLOGIST Scott E. Lesikar

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-6 PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

CLIENT: The PB/MK Team

TASK NO.: 5730

LOCATION: N 6819182.8191
E 2448991.2457

GROUND EL: See PLATE 2

DATE: 08/21/90 TYPE: NX-Core CASED TO: 14.0 CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

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
		U1	0.0	1.5				4.5+	CLAY, slightly silty, with occasional weathered limestone fragments, hard, dk. brown
		U2	1.5	3.0				4.5+	
		U3	3.0	4.5				4.5+	4.1
5		U4	4.5	6.0				4.5	CLAY, slightly silty, with weathered limestone fragments very stiff, tan
		U5	6.0	7.5				3.0	
		U6	7.5	9.0				2.75	
10		U7	9.0	10.0				2.5	
									13.6
15		C1	14.0	20.0	47	0			LIMESTONE, mod. weathered, firm to mod. hard, close to v. closely spaced joints - some with iron staining, tan
									19.8
20		C2	20.0	30.0	90	90			LIMESTONE, fresh, mod. hard to hard, lt. gray, with dk. gray, argillaceous interbeds 19.8 - 20.5 sli. arg., med. gray 22.6 - 23.5 sli. arg., med. gray 26.2 - 27.3 mod. arg., dk. gray
25									
30									TOTAL DEPTH OF BORING: 30.0 Ft. NOTE: (1) Boring started : 9:30 a.m. (2) Boring completed: 10:30 a.m. (3) Boring grouted upon completion
35									
40									

DRILLING GEOLOGIST Scott E. Lesikar

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-6APG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

LOCATION: N 6819174.6643
E 2449023.3321

CLIENT: The PB/MK Team

GROUND EL: See PLATE 2

TASK NO.: 5730

DATE: 08/22/90 TYPE: Shelby Tube CASED TO: - CONTRACTOR: Mason-Johnston & Associates

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
		U1	0.0	1.5					4.5	CLAY, slightly silty, with weathered limestone fragments, dk. brown
		U2	1.5	2.2					4.5	LIMESTONE, weathered, tan @ 2.2
5										TOTAL DEPTH OF BORING: 2.2 Ft.
10										NOTE: (1) Boring started : 10:10 a.m. (2) Boring completed: 10:15 a.m. (3) Boring grouted upon completion
15										
20										
25										
30										
35										
40										

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

DRILLING GEOLOGIST Scott E. Lesikar

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-6B PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

LOCATION: N 6819144.6826
E 2448981.8689

CLIENT: The PB/MK Team

GROUND EL: See PLATE 2.

TASK NO.: 5730

DATE: 08/22/90 TYPE: Shelby Tube CASED TO: - CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

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
		U1	0.0	1.5				4.0	CLAY, slightly silty, with weathered limestone fragments v. stiff to hard, dk. brown
		U2	1.5	3.0				4.5	
		U3	3.0	4.5				4.5	4.2
5		U4	4.5	5.0				4.5+	CLAY, sli. silty, with wea l.s. fragments, hard, tan LIMESTONE, wea., tan @ 4.9
10									TOTAL DEPTH OF BORING: 4.9 Ft.
15									NOTE: (1) Boring started : 10:20 a.m. (2) Boring completed: 10:25 a.m. (3) Boring grouted upon completion
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25									
30									
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40									

DRILLING GEOLOGIST Scott E. Lesikar

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-6C PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

LOCATION: N 6819188.1272 E 2448954.8006

CLIENT: The PB/MK Team

GROUND EL: See PLATE 2

TASK NO.: 5730

DATE: 08/22/90 TYPE: Shelby Tube CASED TO: - CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND	WATER INFORMATION
S= SPLIT SPOON T= 2" THIN WALL TUBE U= 3" THIN WALL TUBE C= NX ROCK CORE	No free water observed during drilling.

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
		U1	0.0	1.5				3.75	CLAY, slightly silty, with weathered limestone fragments v. stiff, dk. brown.
		U2	1.5	3.0				3.25	
		U3	3.0	3.5				3.0	-LIMESTONE, wea., tan @ 3.5
5									TOTAL DEPTH OF BORING: 3.5 Ft.
									NOTE: (1) Boring started : 10:30 a.m. (2) Boring completed: 10:35 a.m. (3) Boring grouted upon completion
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15									
20									
25									
30									
35									
40									

DRILLING GEOLOGIST Scott E. Lesikar

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-6D PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

LOCATION: N 6819217.7833
E 2448997.6000

CLIENT: The PB/MK Team

GROUND EL: See PLATE 2

TASK NO.: 5730

DATE: 08/22/90 TYPE: Shelby Tube CASED TO: - CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

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
		U1	0.0	1.5					4.5	CLAY, slightly silty, with weathered limestone fragments very stiff to hard, dk. brown
		U2	1.5	3.0					3.75	
		U3	3.0	4.5					4.5	4.0 CLAY, sli.silty, w/wea. limestone fragments, hard, tan
5		U4	4.5	5.3					4.5	-LIMESTONE, wea., tan @ 5.3
10										TOTAL DEPTH OF BORING: 5.3 Ft.
15										NOTE: (1) Boring started : 10:40 a.m. (2) Boring completed: 10:45 a.m. (3) Boring grouted upon completion
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25										
30										
35										
40										

DRILLING GEOLOGIST Scott E. Lesikar

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-7 PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

CLIENT: The PB/MK Team

TASK NO.: 5730

LOCATION: N 6819265.2866
E 2449059.7068

GROUND EL: See PLATE 2

DATE: 08/21/90 TYPE: NX-Core CASED TO: 1.0 CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

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
		U1	0.0	0.5				4.5+	CLAY, slightly silty, with weathered limestone fragments hard, dk. brown 0.5
		C1	2.0	7.0	86	38			LIMESTONE, mod. weathered, firm to mod. hard, closely spaced joints - some with iron staining, tan
5									
		C2	7.0	12.0	100	48			10.1 - 11.0 mod. arg., firm 12.6
10									
		C3	12.0	20.0	100	100			LIMESTONE, fresh, mod. hard to hard, lt. gray, with dk. gray, argillaceous interbeds 13.6 - 14.8 mod. arg., dk. gray 17.7 - 18.6 sli. arg., med. gray
15									
20		C4	20.0	25.0	96	96			20.7 - 21.7 mod. arg., dk. gray 24.3 - 24.8 mod. to v. arg., dk. gray
25									TOTAL DEPTH OF BORING: 25.0 Ft. NOTE: (1) Boring started : 8:00 a.m. (2) Boring completed: 9:30 a.m. (3) Boring grouted upon completion
30									
35									
40									

DRILLING GEOLOGIST Scott E. Lesikar

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-8 PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

LOCATION: N 6819287.9412 E 2449165.3167

CLIENT: The PB/MK Team

GROUND EL: See PLATE 2

TASK NO.: 5730

DATE: 08/20/90 TYPE: NX-Core CASED TO: 1.0 CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

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
		U1						4.5+	CLAY, slightly silty, with weathered limestone fragments, 0.5 hard, dk. brown.
5		C1	1.5	6.5	100	42			LIMESTONE, mod. weathered, firm to mod. hard, closely spaced joints - some with iron staining, tan 4.1 - 4.6 mod. arg., firm
10		C2	6.5	11.5	88	30			9.5 - 10.0 mod. arg., firm 11.5
15		C3	11.5	20.0	100	100			LIMESTONE, fresh, mod. hard to hard, lt. gray, with dk. gray argillaceous interbeds. 17.0 - 18.0 mod. arg., dk. gray
20		C4	20.0	25.0	76	76			20.0 - 21.4 mod. arg., dk. gray
25									TOTAL DEPTH OF BORING: 25.0 Ft.
30									NOTE: (1) Boring started : 1:10 p.m. (2) Boring completed: 2:30 p.m. (3) Boring grouted 08/21/90
35									
40									

DRILLING GEOLOGIST Scott E. Lesikar

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-9 PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

LOCATION: N 6819195.5252
E 2449260.4384

CLIENT: The PB/MK Team

GROUND EL: See PLATE 2

TASK NO.: 5730

DATE: 08/22/90 TYPE: NX-Core CASED TO: 1.0 CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

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
		U1						4.5+	CLAY, slightly silty, with weathered limestone fragments 0.5 hard, dk. brown
		C1	2.0	7.0	96	54			LIMESTONE, mod. to severely weathered, firm to mod. hard closely spaced joints - some with iron staining, tan
5									
		C2	7.0	12.0	76	64			8.3 - 8.9 mod. arg., firm 10.15 LIMESTONE, fresh, mod. hard to hard, lt. gray, with dk. gray argillaceous interbeds.
10									
		C3	12.0	20.0	99	99			11.6 - 12.3 mod. arg., dk. gray 15.6 - 16.1 mod. arg., dk. gray 18.7 - 19.6 mod. arg., dk. gray
15									
20									TOTAL DEPTH OF BORING: 20.0 Ft. NOTE: (1) Boring started : 9:00 a.m. (2) Boring completed: 10:00 a.m. (3) Boring grouted upon completion
25									
30									
35									
40									

DRILLING GEOLOGIST Scott E. Lesikar

CHECKED BY W.D. Flanigan

LOG OF BORING

BORING NO: MDL-10 PG 1 OF 1

PROJECT: SSC Magnet Development Laboratory - Ellis County, Texas

LOCATION: N 6818991.1545 E 2448922.2848

CLIENT: The PB/MK Team

GROUND EL: See PLATE 2

TASK NO.: 5730

DATE: 08/22/90 TYPE: NX-Core CASED TO: 3.0 CONTRACTOR: Mason-Johnston & Associates

SAMPLE LEGEND

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

WATER INFORMATION

No free water observed during drilling.

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
		U1						4.5+	CLAY, slightly silty, with weathered limestone fragments, hard, dk. brown (1.7)
		U2						4.5+	3.0 CLAY, sli. silty, w/wea l.s.frags,hard,tan
5		C1	4.0	9.0	36	28			LIMESTONE, mod. to severely weathered, firm to mod. hard, occasional clay interbeds, closely spaced joints - some with iron staining, tan
10		C2	9.0	11.5	74	54			
15		C3	11.5	17.0	83	75			
20		C4	17.0	22.5	95	91			20.0 LIMESTONE, fresh, mod. hard to hard, lt. gray, with dk. gray argillaceous interbeds. 20.45 - 21.5 mod. to v. arg., dk. gray
25		C5	22.5	25.0	100	100			22.25 - 23.65 mod. arg., dk. gray
30		C6	25.0	32.5	100	100			26.4 - 27.35 mod. arg., dk. gray; 29.45 - 30.3 mod. to v. arg., dk. gray
35									TOTAL DEPTH OF BORING: 32.5 Ft.
40									NOTE: (1) Boring started : 9:20 a.m. (2) Boring completed : 10:35 a.m. (3) Boring grouted upon completion

DRILLING GEOLOGIST Scott E. Lesikar

CHECKED BY W.D. Flanigan