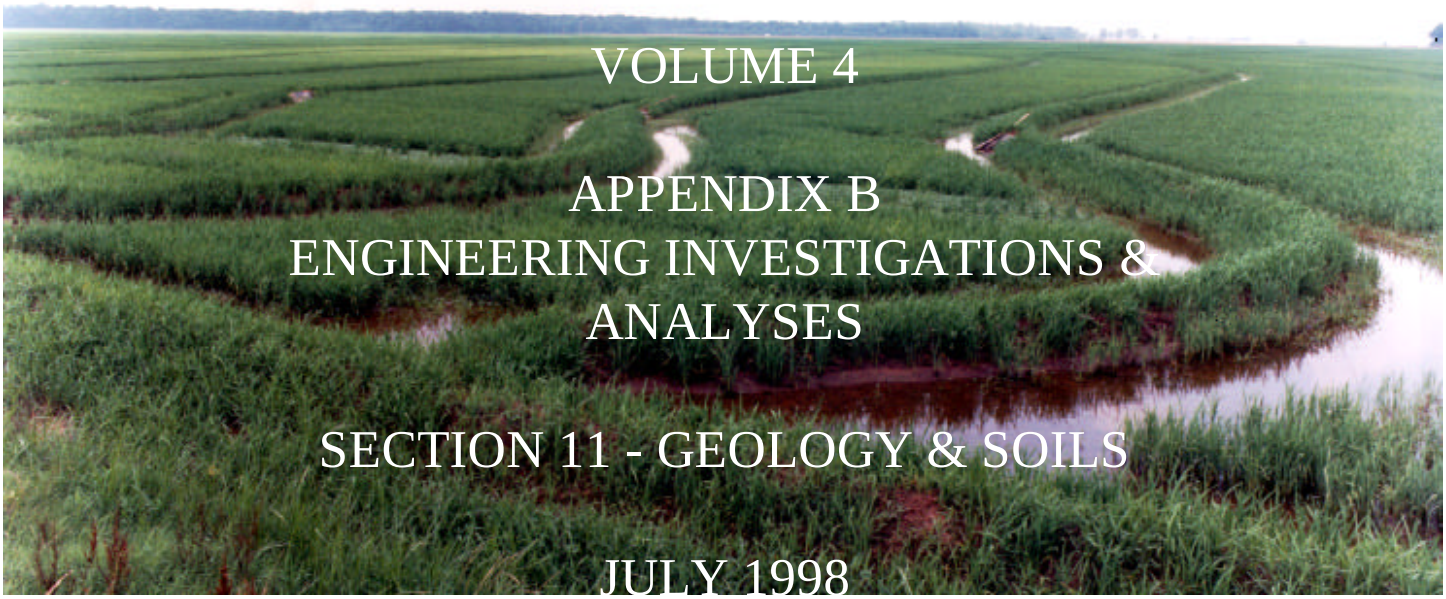
US Army Corps
of Engineers
Memphis District
Mississippi River Comission

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY

GRAND PRAIRIE REGION AND BAYOU METO BASIN, ARKANSAS PROJECT

GRAND PRAIRIE AREA DEMONSTRATION PROJECT

GENERAL REEVALUATION REPORT



VOLUME 4

APPENDIX B
ENGINEERING INVESTIGATIONS & ANALYSES

SECTION 11 - GEOLOGY & SOILS

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Eastern Arkansas Region Comprehensive Study
Grand Prairie Area
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SECTION II - GEOLOGY AND SOILS

2.01 GENERAL

This report is part of the Eastern Arkansas Region Comprehensive Study or more specifically, the Grand Prairie Area Demonstration Project. The project consists of a large water distribution system to provide supplemental agricultural water supply to the depleted areas of the Grand Prairie while preserving the groundwater resource. The project area includes portions of Arkansas, Prairie, Lonoke, and Monroe counties in eastern Arkansas. The general area begins about 25 miles east of Little Rock, Arkansas and extends approximately 50 miles to the south. See Plate II-1 for a general location map. The plan of improvement for the Grand Prairie area consists of a major pumping station and a network of new canals, existing channels, pipelines, and associated channel structures to accomplish interbasin transfer of surface water to the water depleted areas. This report will address the major features of the project: a 1640 cubic feet per second (cfs) main pumping station (Major Pumping Station), a 100 cfs secondary pumping station (Relift Station), four gated check structures located in the main distribution canals, general stability of the canals and levee embankment system and the estimated seepage loss throughout the network of the water distribution system. There are a significant number of other smaller structures or features that will not be addressed in this report due to the magnitude of this project. These features include gated conduit structures, gated and lateral canal turnouts, bridges, inverted box siphons, inverted siphons (natural drainage), inverted pipe siphons (road crossings and natural drainage), wasteways, small horsepower pumps, and weirs on existing streams. More detail on these structures can be found in Section IV - Structural, Mechanical & Electrical. A location map of the project limits, new canal alignment, some pipeline alignment, turnout structures, check structures and pumps are shown on Plate II-6. Both pumping stations and the larger gated check structures are also shown on Plate II-6. Corps of Engineers design criteria and standards were used for the geotechnical design presented in this study.

The major pumping station will be located on the White River just northeast of DeValls Bluff, Arkansas in Prairie County. Water will be provided from the White River to the pumping station by a 2000 foot long inlet channel with a 104 foot bottom width that slopes from El. 137.0 feet NGVD at the White River confluence to an inlet El. of 144.0 feet NGVD at the station. The pumping station consists of six pumps capable of producing a total of 1640 cfs of flow to the distribution canals. Four of the pumps are rated at 360 cfs with two smaller pumps rated at 100 cfs. These pumps will discharge into two 10.5 foot diameter discharge pipes that will supply water to the distribution canals that begin approximately 9000 feet from the station. Other features of the major pumping station include earth reinforced inlet retaining walls, an earthen access road, earthen fill placed in excess of 20 feet around the pumping station for permanent flood protection, an earthen cofferdam for protection during construction and a dewatering system to lower the ground water during construction. A final site plan for the major pumping station is shown on Plate II-7.

The relift pumping station is a smaller 100 cfs lift station that will supply water to the northern most boundary of the project distribution limits. This area consists of the canals and pipelines with

the 3200 series designation north of the 100 cfs pumping station location as shown on Plate II-6. The station will lift the water around 11 feet in elevation utilizing five pumps rated at 20 cfs each. Other features include an inlet structure, five lines of 36 inch diameter concrete inlet pipe, the pumping station structure, fill placed around the station, and a 12 foot wide bottom width outlet channel contained within earthen embankments. The outlet channel bottom elevation is approximately equal to natural ground at the pumping station site. A general site plan of the relift station is shown on Plate II-37 with a section through the station shown on Plate II-38.

There are four major gated check structures located in the main distribution canals. These structures are labeled C3000.01, C4000.01, C5000.01 and C6000.01 as shown on Plate II-6. The first three structures listed above are three gated structures and C6000.01 is a single gated structure. Each gate is approximately 14 feet wide by 13.5 feet in height. A typical gate structure is shown on Plates II-46 and II-47. Overflow weirs are located on each side of the gated structures which will limit the maximum upstream height of the water surface.

2.02 GEOLOGY

a. General Geology. This project consists of two distinctive geological areas located within the project boundaries. The first geological area encompasses the alluvial floodplain of the White River where the major pumping station is located. The other geological area is the Grand Prairie region located in the uplands west of the White River. All of the project features except for the major pumping station are located within the Grand Prairie region. Each of these geological areas is described in detail in the following paragraphs.

b. Geology of the Grand Prairie Region. The Grand Prairie region of Arkansas is in a subdivision of the Coastal Plain province know as the Mississippi Alluvial Plain. Geological maps indicate deposits of Quaternary age are continuous throughout the project limits. The Quaternary deposits are composed of sediments from the Pleistocene and Recent series. No differentiation has been made between the Pleistocene and Recent deposits. Two major zones have been identified within the Quaternary deposits. They are a substratum zone of sand or sand and gravel and an overlying zone of silt and clay. Particle sizes of the substratum sands vary from very fine to coarse size. The substratum sands are also interbedded with thin clay and silt lenses. Within the Grand Prairie region the substratum sands generally vary in thickness from 25 to 140 feet and are underlain by Tertiary deposits. Geological maps indicate the Tertiary deposits to be of the Jackson or Claiborne Group. Review of selected drillers' logs for deep wells indicates the top of the Tertiary deposits within the Grand Prairie region to be composed of a dark-bluish-gray clay. It was also noted from the logs that in many instances a small zone of dense gravel, cobblestones and boulders overlaid the Tertiary clays. Tertiary deposits were generally encountered between Elevation 50 and Elevation 100 feet NGVD.

The surface deposits, which is the upper zone identified within the Quaternary age deposits, are composed of very dense and relatively impervious layers of clays and silts. These deposits are also referrred to as the Loessial Plains. These deposits are generally composed of dark-reddish-brown

clays and various shades of silts. Silt shades of tan, gray, blue, red and brown have been noted. The thickness of the surface deposits ranges from 5 to 60 feet throughout the study area. These deposits are also noted in geological literature for being remarkably continuous and very nearly impervious over much of the Grand Prairie region. See Plates II-2 and II-3 for the geology map and profile of the Grand Prairie region.

c. Geology of the Major Pumping Station. Based on a review of geological maps, the major pumping station site appears to be located predominantly on point bar deposits of the prehistoric Mississippi-Ohio River complex. The general geology adjacent to the location site has some abandoned channel deposits and major crevasse channel deposits (White River) mixed with these point bar deposits. However, the borings taken at the site indicate only point bar deposits around the station location. Material of this type has been recently deposited and is generally loosely consolidated. Within the point bar top stratum, there are two types of deposits: silty and sandy elongate bar deposits or "ridges" which are laid down during high stages on the stream, and silty and clayey deposits in arcuate depressions or "swales" which are laid down during falling river stages. Characteristically, the ridges and swales form an alternating series, the configuration of which conforms to the curvature of the migrating channel and indicates the direction and extent of meandering. Successive occupation of many areas by different streams of different sizes has resulted in complex patterns of ridge-and-swale topography. These deposits tend to be composed of tan to gray clayey silts, silts, and silty sands in ridges, and soft, gray silty and sandy clays in the swales. The high plasticity clays located in the swales tend to have low cohesive strengths. Excluding the larger swales, which occasionally may be over 40 feet thick, the top stratum varies in general from 5 to 25 feet in thickness. The top stratum soil consists of Recent or Pleistocene deposits. The surface deposits are underlain by substratum sands which range from a fine sand through a gravelly sand to a sandy gravel. The thickness of the substratum sands varies but the geological maps show that it is approximately 60 feet in the area of the station. The substratum sands in turn are underlain by the Undifferentiated Tertiary deposits. Borings taken at the site located the Tertiary deposits between 70 and 95 feet from the surface (Elevation 100 to Elevation 76 ft. NGVD). See Plate II-4 for the geological map of the major pumping station site.

2.03 Subsurface Investigation.

a. General. The level of the subsurface investigation performed for this report was selected in an attempt to provide an accurate yet cost efficient characterization of the subsurface. The investigation consisted of obtaining new data to supplement historical data maintained by other agencies. The new data was obtained using both intrusive and non-intrusive methods. The non-intrusive methods consisted of resistivity surveys performed by the Waterways Experiment Station (WES) and airborne electromagnetic surveys performed by an A-E Contract (Aerodat INC.) under the direction of Dr. Richard Lewis, a geophysicist with the Waterways Experiment Station. Dr. Lewis was selected to oversee the contract due to the high degree of specialization required for the surveys. The intrusive method of obtaining subsurface information consisted of using standard drilling equipment, methods and procedures. Five undisturbed borings and 11 general sample borings were taken at the major pumping station site. Another 25 undisturbed borings and 20 general sample

borings were taken throughout the project limits. Most of these borings were taken at a major canal structure and/or canal junction locations. An additional 14 shallow borings (8 to 17 foot depth range) for determining permeability of different soil types or strata were also taken for this project. These holes were drilled at previous boring locations.

b. Non-Intrusive Subsurface Investigation. The airborne electromagnetic (EM) surveys were taken along the centerline and 50 meters to each side of the proposed distribution canals. These surveys were taken with a helicopter approximately 75 to 100 feet above the surface. The purpose of these EM surveys was to define the interface between the upper clay layers and the subsurface aquifers. Conventional ground resistivity surveys to develop parameters for the airborne EM surveys were performed by WES prior to the EM flights. The airborne data was processed using a multi-frequency, multi-layer routine. Three parameters were allowed to vary, the most critical one being the thickness of the upper layer. New boring data along with the resistivity soundings taken by WES were used to refine the data calibration. Results from the EM surveys showed that the subsurface stratification was more complex than originally anticipated.

The general findings indicated the presence of a very hard and dense clay within the upper five to fifteen feet. This clay is commonly referred to by the locals as "hardpan" and it is this stratum's relative impermeability which makes this region conducive to rice crops. The hardpan stratum was generally found to be underlain by dry silts, lean clays or silty sands which varied in depth from ten to thirty feet and were reddish in color. Underlying this stratum was usually a 10 to 20 foot thick stratum of clay which was overlying the aquifer sands. The proposed depth of the canals is generally between 10 and 20 feet. The EM surveys were used in determining when the depth of the distribution canals would penetrate through the upper clay layer into a more pervious strata.

In summary, the EM surveys were consistent with the boring stratifications in most areas. In other areas, the results were not as accurate as anticipated. However, the results did give general ranges of the upper clay thicknesses with varying degrees of accuracy and helped define those areas of the proposed canals that might be more susceptible to seepage losses. This information was used in determining where actual field permeabiltiy tests would be conducted and used to estimate total seepage losses for the distribution system. A VHS tape was also furnished by Aerodat of all the flight lines. This VHS tape was useful in finalizing canal alignments and aiding in environmental issues.

c. Intrusive Subsurface Investigation. The undisturbed borings were advanced and sampled with a 5-inch auger, 5-inch thin wall tubes and split spoon samplers. The general borings were advanced and sampled with a 5-inch auger and split spoon samplers. In general, the borings indicated typical stratification expected after review of the geological maps. The typical stratification of the Grand Prairie region is summarized in paragraph 2.02(b) above. The stratification of the major pumping station site consisted of approximately 20 feet of clay deposits underlain by 40 to 70 feet of substratum sands over the Tertiary deposits. The boring locations are shown on Plates II-7 for the major pumping station site and II-6 for the project. The boring logs are shown on Plates II-8 through II-15. The standard boring legend for the Unified Soil Classification System is presented as Plate II-5.

2.04 Laboratory Testing. Laboratory testing of the boring samples was performed by the Waterways Experiment Station (WES) and the Memphis District laboratories. Unconsolidated-undrained (Q), consolidated-undrained (R), and consolidated-drained (S) shear tests, and permeability (k) and consolidation (C) tests were performed by WES. Classification, natural moisture contents, natural densities, and Atterberg limits were performed on representative samples by both laboratories. Unconfined compression tests and mechanical analyses on coarse-grained samples were performed by the Memphis District Laboratory. Test results for the project are located in Appendix II-A (pages 1 - 318) at the end of this report. The specific strata where WES test were conducted are shown on the boring logs.

2.05 Soils and Foundation Analysis.

a. General. The boring logs along with the corresponding test results were examined to determine appropriate soil stratification and shear strength parameters for the major structures foundation design. Once stratifications and shear strength values were assigned, a variety of foundation analyses were performed as applicable to determine liquefaction potential, channel slope stability, structural excavation slope stability, structural sliding and overturning stability, bearing capacity, settlement, uplift analyses, and dewatering requirements.

b. Design Shear Strengths. (1). Clays. The selection of the design values for the Q and R conditions was based on consistencies indicated by the boring logs, natural densities, moisture contents, Atterberg limits, unconfined compression tests and Q triaxial tests. Design values for the S condition were based on S (direct shear) tests by WES and the Plasticity Index (PI) verses ϕ' relationship developed for LMVD and contained in WES Technical Report No. 31-604, June 1962.

(2). Silts. The design shear strengths for silts were selected conservatively using consistencies indicated by the boring logs, natural moisture contents, past experience with similar soils, and values suggested in DIVR 1110-1-400, Section 5, Part 4 Item 1, dated March 1973. Design values of ϕ=20° , c=300 psf were selected for the Q and R conditions. Design values of ϕ=28°, c=0 psf were chosen for the S case strengths.

(3). Sands. Design values for the coarse grained soils were selected based on past experience with similar soils, suggested values in the above DIVR, and correlations between standard penetration tests (N-values) and the angle of internal friction (ϕ). Cohesive values were taken as zero for all loading conditions.

2.06 Stability Analyses.

a. Slope Stability. Slope stability analyses were performed to determine the required slopes for the canals and embankments of the distribution system, for the cofferdam of the major pumping station, for excavation slopes at both pumping stations and the gated check structures, and for the

inlet and outlet channel slopes at both pumping stations. Slope stability analyses were conducted in accordance with guidelines and criteria presented in DIVR 1110-1-400, Section 5, Part 4, Item 1, dated March 1973, for Type A projects. Long term stability analyses for the canals used Type B criteria or a factor of safety greater than 1.0. All other stability analyses were performed for the following loading cases with respective minimum allowable factors of safety for Type A projects:

Loading Case	Minimum Factor of Safety
After Construction (AC)	1.30
Long- Term (LT)	1.25
Sudden Drawdown (SD)	1.20
Partial Pool (PP)	1.30

Stability analyses for the appropriate loading conditions were performed using the micro computer software package GEOSLOPE which is available through the GEOCOMP Corporation. The program's capability to analyze both circular and non-circular shaped failure surfaces was used in the analysis of all slopes. The analysis of circular failure surfaces was performed using the Modified Bishop Method of Slices. For non-circular failure surfaces or wedge failures, the Janbu Method of Generalized Slices was utilized. There were no manual checks of the minimum factors of safety for the stability analyses since these analyses are routine in nature and the Memphis District has a high degree of confidence in the software program. Confirmation of all results will be performed during final design of the structures. Only the critical factors of safety are presented for each analysis. A legend for the slope stability analyses is presented as Plate II-16.

b. Structural Stability Analyses. (1). Sliding. Sliding stability analyses were performed for the major pumping station structure and inlet retaining walls, relift pumping station and gated check structures in accordance with procedures presented in ETL 1110-2-256 and EM 1110-2-2502. Sliding stability analyses were performed to ensure the stability against sliding at the base of the structure or through any soil layer below the base. Program CSLIDE from the WES library was used to design and analyze the structure. CSLIDE is a computer program for assessing the sliding stability of concrete structures using the Limit Equilibrium Method described in ETL 1110-2-265, "Sliding Stability For Concrete Structures". A minimum allowable factor of safety of 1.50 was used for normal loading conditions and 1.33 for unusual loading conditions. Since the project is located within Seismic Risk Zone 2, stability of each structure was analyzed for earthquake induced loadings. A horizontal acceleration coefficient of 0.10 g was used to determine the lateral earthquake forces acting on the structure. The vertical earthquake acceleration was neglected. Criteria was based on guidance presented in ER 1110-2-1806. The minimum allowable factor of safety for sliding for earthquake loading was 1.10. Due to the preliminary nature of this report, no manual checks are presented.

(2). Overturning Analyses. Overturning stability analyses were performed for the major pumping station structure and inlet retaining walls, relift pumping station and gated check structures. These analyses were conducted to ensure the location of the resultant force occurred within the middle third of the base for the after construction (AC) loading condition (Case I) and the middle half of the base for the sudden drawdown (SD) loading condition (Case II). The method of analysis used for overturning along with the required minimum resultant locations are presented in EM 1110-2-2502. The active soil and water pressures were applied to the structure using at rest earth pressure coefficients for the driving side forces. The resisting side forces varied from zero (ignoring passive resistance) to a maximum force calculated using up to one-half the passive earth pressure coefficient. Overturning analyses were also performed for earthquake loading to determine the resultant location with seismic forces applied. A horizontal acceleration coefficient of 0.10 g was used to determine the lateral earthquake forces. Guidance presented in EM1110-2-2502 requires only that the resultant force be located within the base for earthquake conditions.

(3). Bearing Capacity. Bearing capacity computations were based on principles and methods presented in EM 1110-1-1905. Bearing capacity was determined by Hansen's Equation, which is a modification of the general bearing capacity equation to account for effects of embedment, overburden pressure, foundation shape, and inclination of loading. Earthquake loading using a horizontal acceleration coefficient of 0.10 g was considered a viable case. Analyses included determining a factor of safety by dividing the ultimate bearing capacity of the foundation soil by the soil pressure determined from the net vertical load and the eccentricity loading on each structure. A minimum allowable factor of safety of 3.0 is required for normal loading conditions, 2.0 for unusual loading conditions and foundations of retaining walls founded on sand, and 1.0 for earthquake loading as presented in EM 1110-1-1905 and EM 1110-2-2502. The major pumping station and inlet retaining walls, relift pumping station and some of the gated check structures will be founded on sand. The other gated check structure foundations could vary depending on their final location.

(4). Settlement. Since the major pumping station structure will be founded on sand, settlement was considered negligible and no analyses were performed. However, settlement was a concern for the relift pumping station, gated check structures and for the fill required around both pumping station structures. Settlement analyses were conducted to estimate the magnitude of the settlement. The estimates were based on limited consolidation test data taken for this project, empirical relationships developed for clay strata, and experience from previous projects.

(5). Uplift. Uplift analyses were performed for the major pumping station and gated control structure stilling basin. ETL 1110-2-307, Flotation Stability Criteria for Concrete Hydraulic Structures, was used for the analysis for the major pumping station. The gated control structure was designed utilizing an impervious blanket to prevent excessive uplift in the stilling basin. The line of creep method was used for determining seepage forces under the stilling basin. A factor of safety of 1.20 was used in the design. These analyses are presented on Plates II-25 and II-48. The applicable loading cases for each structure are shown on the plates.

2.07 Canal Stability. A review of the preliminary canal design was performed to determine the critical section required for the water distribution system. This critical section was based on the highest combination of both canal embankment and canal excavation required for water distribution and included freeboard above maximum pool and overexcavation of the canal bottom for additional material needed for construction of the levee embankments in select reaches. It was assumed that additional material would be excavated at the same continuous slope as selected for the combined canal and embankment slope. This review resulted in a critical section with a maximum height of 26 feet and occurred in the 1000 canal reach as shown on Plate II-6. Stability analyses on a 28 foot high embankment (conservative) as shown on Plate II-17 were conducted utilizing the after construction loading case, partial pool loading case and long term stability case. The sudden drawdown condition was not analyzed due to the upper banks consisting either of clay or clayey silt for the borings taken throughout the project limits. The AC analyses with a slope of 1V on 3.0H resulted in a minimum factor of safety of 1.35 utilizing very conservative shear strengths of either ϕ=0, c=700 psf for clay or ϕ=20°, c=300 psf for the silt, or a combination of the two materials. Shear strengths in the water depleted areas of the Grand Prairie region generally ranged in excess of ϕ=0, c=1500 psf for these upper bank clays. Outside of the 1000 and 3000 canal reaches, typical heights required for water distribution ranged between a total of 10 and 20 feet. Typical bottom widths for the canals range from 60 feet maximum on the northern end of the system to as little as 6 feet on the southern end.

Twenty-two direct shear "S" tests were analyzed by WES. These tests were conducted on both insitu samples and recompacted samples (semi-compacted at 15 blow effort) on a range of materials from silts to silty clays to fat clays. The results are plotted on Plate II-18 along with the standard Plasticity Index (PI) verses ϕ' relationship developed for LMVD and contained in WES Technical Report No. 31-604, June 1962. The results of the Grand Prairie test data indicated a ϕ' of slightly lower than the standard curve, although seven of the twenty-two data points plotted above the curve. The Memphis District's plasticity indexes for companion samples were plotted on Plate II-18 instead of the plasticity indexes determined by WES. There was some discrepancy between the Memphis Lab and WES on the plasticity index test results and the Memphis Lab data was used for this study. However, it was decided to use the standard LMVD curve for determining ϕ' and long term factors of safety mainly because of limited test data for this study and because there have been no instances associated with long term (LT) failures observed in the region. Long term factors of safety determined from the borings taken for the project varied from a low of 1.09 (Boring 6-EAU-94 with an average value of ϕ'=20° selected for the embankment) to 1.3. Most LT factors of safety for the borings ranged between 1.15 and 1.3. The recommended geometry for the canal system is listed below. Maintenance considerations dictated landside slopes and minimum crown widths.

<u>MAIN CANALS</u>

SLOPES: 1V:3.0H CANALSIDE
1V:3.5H LANDSIDE FOR HEIGHTS > 10 FEET ABOVE NATURAL GROUND
1V:3.0H LANDSIDE FOR HEIGHTS < 10 FEET ABOVE NATURAL GROUND

CROWN WIDTH: 10 FEET MINIMUM FOR BOTH SIDES OF CANAL

SECONDARY CANALS

SLOPES: 1V:3.0H CANALSIDE
1V:3.5H LANDSIDE FOR HEIGHTS >10 FEET ABOVE NATURAL GROUND
1V:3.0H LANDSIDE FOR HEIGHTS < 10 FEET ABOVE NATURAL GROUND

CROWN WIDTH: 8 FEET MINIMUM FOR BOTH SIDES OF CANAL

2.08 Canal Seepage.

a. General. Initial seepage loss estimates used in sizing the pumping station were made based on an assumed permeability of $k=10^{-4}$ cm/sec for the stratum underlying the distribution canals and a value of $k=10^{-5}$ cm/sec for the natural channels. The results indicated an estimated total seepage loss of approximately 150 cfs for the project which was used in the Hydraulic Model to determine actual cfs required for the major pumping station. Permeability tests on sandy silts and clays by WES indicated the original assumed values may be from one to two orders of magnitude on the conservative side. The permeability test data is shown in Appendix II-A with test locations indicated in the boring logs. A more detailed seepage analysis was performed to verify the permeability assumptions and tests conducted at WES. This analysis was based on both the intrusive and non-intrusive test data and field permeability tests conducted at selected sites. The results of this analysis are presented in the following paragraph and estimated total seepage losses of 32 cfs initially that will decrease to 24 cfs as siltation occurs. Although this estimate is conservative compared to the initially assumed 150 cfs, the high degree of variability in stratification encountered in the subsurface investigation justifies not changing the hydraulic model. Another factor in this decision is that the pumping station will not operate continuously. Based on estimated operating hours for the hydraulic input data from 1940 to 1986, the average cfs allowed for seepage losses was calculated to be 120 cfs.

b. Canal Seepage Analysis. A seepage analysis was performed to determine the amount of seepage loss during operation of the system. The seepage loss was calculated using the method of inversion by Vedernikov as presented in Section 9.3 of Groundwater and Seepage by M. E. Harr published by McGraw-Hill Book Company in 1962. The seepage loss for a trapezoidal channel was calculated using the formula, $q=k(B+AH)$, where:

q	=	Seepage Loss
k	=	Permeability of Soil in Channel Bottom
b	=	BW + 2mH
BW	=	Channel Bottom Width
m	=	Channel Slope (1V on 3H)

H = Head from Projected Water Surface to Channel Grade (See Tables II-1 through II-4)

The permeabilities of insitu soils were estimated using field permeability tests of the type performed by the U. S. Bureau of Reclamation, Designation E-14, using open-end casings. The permeabilities were calculated using the relationship, $k = q/5.5rh$, where:

q = Constant Rate of Flow into the Hole

r = Inside Radius of the Casing

h = Differential Head of Water Used in Maintaining a Steady Rate

Fourteen field tests were performed resulting in the following permeabilities:

Soil Type	Permeability (ft/sec)
Clay	3.28×10^{-9}
Silt	1.64×10^{-7}
Sandy Silt	3.28×10^{-7}
Silty Sand	1.64×10^{-6}
Fine Sand	3.28×10^{-6}

The type of soil in the bottom of each seepage canal was estimated using relevant borings and the geophysical information from electromagnetic surveys provided by AERODAT, Inc. Based on the seepage analysis, approximately 32 cfs of seepage loss will initially occur along the seepage canals. This quantity will gradually decrease to approximately 24 cfs as siltation occurs. Tables II-1 through II-4 located at the end of the text provides a breakdown of the seepage loss by canal and reach.

2.09 Major Pumping Station.

a. Introduction. The major pumping station will consist of a 124-foot by 112-foot concrete structure approximately 90 feet in height with an inlet slab grade of Elevation 144.0 feet NGVD. Three borings (1-EAPSU-94, 2-EAPSU-94 and 3-EAPSU-94) were originally taken in 1994 in the general proximity of the proposed site to determine the most favorable location. A location was established at that time and additional borings 12-EAPST-95 and 13-EAPST-95 were drilled to Tertiary at this site. However, due to economic and design considerations, the major pumping station was moved approximately 300 feet west of the original location. The new site is approximately half

way between borings 1-EAPSU-94 and 12-EAPST-95 as shown on the site plan on Plate II-7. The change in station location occurred during the latter stages of this report and did not allow sufficient time or funds to obtain additional soil data at the new site. Based on existing boring data, the location of Boring 1-EAPSU-94 (near the bluff) is not considered an adequate site for a foundation on grade due to the deep clay strata below the proposed foundation grade. The original site location is suitable for placement of the structure. Additional borings will be taken at the newly proposed site to obtain soil data and to evaluate the overall site feasibility. The analyses for this report assume that the structure is being placed at the original site. Borings 12-EAPST-95, 13-EAPST-95 and 2-EAPSU-94 were combined (see Plate II-26) to form a composite representation of the soil conditions at the structure and were used in the stability analyses of the pumping station structure. The other borings taken for the area were utilized in the design of the cofferdam and excavation, inlet channel, embankments and settlement for the fill placed around the structure.

b. Seismic Risk Study. An analysis of the proposed site of the major pumping station (1640 cfs) was undertaken to determine the annual risk factor ((R_t) for an earthquake to cause liquefaction of the underlying foundation sands. This analysis is shown on Plates II-20 and II-21. The analysis was controlled by the sand layer at Elevation 128.0 feet NGVD (44 feet from the surface) of Boring 2-EAPSU-94. This risk factor was determined to be equal to 0.000823 for existing conditions.

Three alternatives were selected as the most economical methods for improving the foundation conditions at the pumping station site. In the first method (Case I) it was assumed that an additional 12 feet of material below Elevation 136.0 feet NGVD would be excavated and recompacted to a relative density of 80 percent. The improved foundation conditions would result in a reduction of the annual risk factor (R_t) to a value of 0.000361. In the second method (Case II) it was assumed that an additional 12 feet of material below Elevation 136.0 feet NGVD would be excavated and replaced with a select backfill and compacted to a relative density of 80 percent. This modification would result in a further reduction of the annual risk factor (R_t) to a value of 0.000078. The third method (Case III) assumed placement of stone columns through the loose sand layer and eliminated the liquefaction risk.

The cost effectiveness of each of these three methods for densifying the foundation sands was determined by comparing the present worth value of the annual damages eliminated by densifying the foundation sands to the cost of densifying the foundation sands. The damages from liquifaction were estimated by assuming that the structure remained as a unit but sustained excessive settlement severing all outside connections. The total estimated cost required to repair the pumping station assumed dewatering, pressure grouting the foundation, removing and replacing the inlet retainings walls, and repairing the structural, mechanical and electrical damage. This cost was estimated at $5,000,000. The benefit to cost ratio for densifying the sands were determined as follows:

Case I = 0.55 Case II = 0.28 Case III = 0.20

The benefit to cost ratios for each alternative was significantly below 1.0. It would take an additional

$4,000,000 of earthquake damage to raise the B/C ratio to 1.0 for Case I. Therefore, ground modification by densification is not an economic solution to mitigate seismic risk due to liquefaction.

c. Excavation and Cofferdam Stability Analyses. The structural excavation will be protected from flood stages on the White River by an earthen cofferdam. The cofferdam will consist of a semi-compacted embankment with side slopes of 1V on 3H minimum, a minimum crown width of 10 feet and a crown elevation of 190 feet NGVD. This crown elevation is based on the 100-year flood plus an additional 2 feet to provide adequate freeboard and account for settlement. The location of the cofferdam will require a minimum 25 foot berm on the east side of the excavation and a minimum 50 foot berm on the west side. The excavation slopes will begin at natural ground (elevation 172.0 feet NGVD) and extend to elevation 136.0 feet NGVD on a minimum slope of 1V to 2.5H. The additional four feet of excavation (structure bottom at El. 140.0 feet NGVD) will be required to remove a loose sand strata indicated by Boring 12-EAPSU-95. The cofferdam and excavation layout are shown on Plate II-19.

Stability analyses were conducted for the cofferdam, excavation, and the combined cofferdam and excavation together with the above slopes. The results are presented on Plate II-22. The combined analysis controlled with a factor of safety of 1.25 for the west side of the structure (Boring 1-EAPSU-94). The factor of safety was reduced to 1.17 utilizing S strengths for the analysis. However, the lower factor of safety was considered adequate due to the temporary loading for this condition. The east side of the structure was analyzed using a composite boring for Borings 12-EAPST-95, 13-EAPST-95 and 2-EAPSU-94 and a minimum berm width of 25 feet. This analysis resulted in high factors of safety. The excavation limits were extended to include removal of the overburden material beneath the earth reinforced inlet retaining walls to limit settlement and prevent future foundation problems. These analyses assumed that the dewatering system will maintain the ground water below the excavation bottom and side slopes.

d. Dewatering. A dewatering analysis was performed to determine the required number and layout of wells for the dewatering cost estimate. Dewatering requirements were based on procedures and guidelines presented in TM 5-818-5. The dewatering system was designed to lower the water table to elevation 133 feet NGVD which is 3 feet below the bottom of the deepest excavation. It was assumed that the White River would act as a line source at a distance of approximately 1600 feet from the centerline of the excavation. The analyses was performed assuming a headwater elevation of 188 feet NGVD which is the 100-year flood on the White River and assuming artesian flow conditions would prevail. The Tertiary deposits were conservatively assumed to be located at elevation 76 feet NGVD based on Boring 2-EAPSU-94 resulting in an aquifer thickness of 80 feet. A horizontal permeability of 800×10^{-4} cm/sec was selected based on the D_{10} grain size of the foundation sands taken from boring samples in the area. The analysis as presented on Plates II-23 and II-24 indicates that a dewatering system consisting of six 16-inch-diameter fully penetrating deep wells is required. The dewatering well locations are also shown on the excavation/cofferdam plan on Plate II-19. As noted before, the dewatering analysis is presented for cost estimating purposes only since the actual dewatering system will be Contractor designed, installed and operated.

e. Uplift Analysis. The proposed station will be constructed in the White River basin and succeptable to fluctuations in river stages, especially to extreme high and low water periods. An uplift analysis of the major pumping station was performed to determine if the proposed station has sufficient weight to prevent the structure from floating or moving due to uplift pressures associated with high river stages. This analysis assumed only the weight of the concrete in the structure plus additional water loading on the inlet slab for the resisting forces. The uplift forces were based on a 100-year flood event on the White River or elevation 188 feet NGVD. The highest stage recorded on the White River at DeValls Bluff was elevation 187.6 during the 1927 high water. The bottom of the pumping station slab is at elevation 140 feet NGVD resulting in a net uplift head of 48 feet. ETL 1110-2-307 was used for determining the factors of safety against uplift for the applicable loading conditions which include normal operation, unusual operation, and extreme maintenance or the pumping station. The analysis is presented on Plate II-25 and indicates the structure is safe against uplift.

f. Inlet Channel Stability. The inlet channel for the major pumping station consists of a 2000 foot long, 104 foot bottom width channel with an inlet invert Elevation of 144 feet NGVD at the intake slab that slopes down to elevation 137 feet NGVD at the confluence of the White River. Eleven general sample borings were taken along the proposed inlet channel at approximately 200 foot intervals along mid-slope of each side as shown on Plate II-7. The intent of these borings was to delineate any clay plugs or swales along the alignment. The borings are presented on Plate II-9 and indicate a consistent 15 to 25 foot stratum of fine-grained deposits overlying the subsurface sands. Stability analyses were performed utilizing a composite boring taken from the eleven general sample borings and Boring 3-EAPSU-94. See Plate II-26 for the stratification for Composite Boring No 2. The results were factors of safety greater than 2.0 using both Q and S strengths with a slope of 1V on 3.5H for the inlet channel. The flatter slope was chosen from experiences with other projects where the finer sands tend to flow out from the slope, especially if the channel is dredged. Stability analyses were also conducted for the north and south finger levees. The north finger levee was analyzed using Composite Boring No. 1 (Borings 12-EAPST-95, 13-EAPST-95 and 2-EAPSU-94). A minimum factor of safety of 1.77 was calculated from this analysis as shown on Plate II-26. The south finger levee was analyzed using Composite Boring No. 2 and resulted in a factor of safety of 1.29 with a minimum 50 foot berm. A conservative shear strength of $\phi = 0$, and $c = 350$ psf was used in the controlling strata from Elevation 150.0 to 156.0 feet NGVD. Embankment strengths of $\phi = 0$, and $c = 750$ psf were used in all analyses. No excavated material from the inlet channel will be placed within 1000 feet from top bank of the White River because the material could cause blockage of the floodway raising upstream flow lines during high water. A 50 foot berm will be required if excavated material is placed along the channel outside this 1000 foot zone. However, the recommended placement for the excavated material will be in the general fill around the pumping station structure. Riprap will be placed on the inlet channel bottom and side slopes from the pumping station inlet to 10 feet beyond the inlet retaining walls (approximately 80 feet). The riprap will be placed in the dry on filter fabric.

2.10 Major Pumping Station Structure Structural Stability.

a. General. The major pumping station was analyzed for structural stability. The following loading cases were established. Factors of safety for sliding, overturning, and bearing capacity were determined based on these loading conditions. Settlement of the general fill placed around the structure was also evaluated.

Case I	=	Construction case; backfill in place; no hydrostatic forces applied.
Case II	=	Drawdown condition; water in backfill at El. 188 feet NGVD; water in the inlet channel at El. 185 feet NGVD; uplift determined by creep path method.
Case III	=	Partial pool case; water in backfill same as in the inlet channel and varied between El. 153 and El. 188 feet NGVD.
Case IV	=	Earthquake condition. Water in inlet channel same as backfill at El. 172 feet NGVD (one year event) with earthquake forces applied. Horizontal acceleration coefficient of 0.10 was used.

b. Sliding Stability Analyses. Sliding stability analyses were performed for a one-foot section of the 124-foot-wide pumping station structure as shown on Plate II-27. A pervious backfill will be placed behind the structure. Design shear strengths of $\phi = 30°$, c= 0 psf were selected for the backfill material. Passive soil resistance was conservatively ignored. The results of the sliding stability analysis as shown on Plate II-27 indicate sliding stability for the pumping station structure is adequate for all loading cases.

c. Overturning Analyses. Overturning stability analyses were performed for a one-foot section of the major pumping station structure. A lateral at-rest earth pressure coefficient of $K_o = 0.5$ was selected based on the value of $\phi = 30°$ for a horizontal backfill. Results of the overturning analyses as shown on Plates II-28 and II-29 and indicate a resultant force location within the allowed structural base to meet the minimum requirements for all cases analyzed.

d. Bearing Capacity. Using the results of the overturning analyses, bearing capacity analyses were then performed to determine the maximum foundation pressures and the corresponding factors of safety for bearing. Since the pumping station will be founded on sand, the factors of safety against bearing capacity failure were very high for all three cases analyzed. The results are presented on Plate II-30.

e. Settlement. Since the major pumping station structure will be founded on sand, settlement was considered negligible and no analyses were performed. However, approximately 20 feet of fill will be placed around three sides of the structure and will induce settlement in the clay strata below the ground surface and in the semi-compacted fill area itself. Natural ground is approximate Elevation 172 feet NGVD for the major pumping station site and a minimum Elevation of 190 feet NGVD is required for flood protection from the White River. This fill area includes the outlet discharge pipes that deliver the water to the canal distribution system, the electrical substation foundation (150 ft. by 150 ft.) located adjacent to the structure and parking area around the pumping station. Other fill areas include the access road embankment and both the north and south finger levees located along the inlet channel. The finger levees will provide protection at the structure during high water and provide control points for the inlet trash rake system. Additional material from excavation of the inlet channel will most likely be placed around the structure also. The final site plan of the pumping station as presented on Plate II-7 shows the minimum fill area required for operation of the structure. However, this plan does not account for an additional 200,000 cubic yards of excavation required for the inlet channel if the proposed site remains a feasible location.

Settlement analyses were undertaken to estimate settlement of the discharge pipes and the adjacent fill areas. Seven consolidation tests were conducted by WES from the borings taken at the pumping station site. The results of these tests are presented in Appendix II-A. Four of these consolidation tests were on insitu material and three tests were conducted on semi-compacted (15 blow effort) samples representing the embankment fill. Typical compression index (C_c) and recompression index (C_r) values were selected either from the WES tests or from empirical relationships developed for similar material. Boring 1-EAPSU-94 controlled for the settlement estimate of the discharge pipes. The results are presented on Plates II-31 and II-32 and show an estimated settlement of 7.5 inches to 9.5 inches. A settlement analysis using a composite boring for Borings 12-EAPST-95, 13-EAPST-95 and 2-EAPST-95 resulted in an estimated settlement between 4.5 and 6.5 inches. All settlement analyses assumed C_r values in the clay strata instead of C_c values. The recompression index value was used based on the high shear strengths in the clay layers and over consolidation due to the lack of a water table. Additional testing of these clay strata will be required to determine if this assumption is valid.

2.11 Major Pumping Station Inlet Retaining Walls.

a. General. The inlet retaining walls for the major pumping station will consist of stair stepped reinforced earth retaining walls located along each side of the inlet channel. Both the North and South retaining walls will project approximately 80 feet from each corner of the pumping station structure at an angle of 45 degrees with the pumping station and inlet channel. From this point, each wall will turn perpendicular to the inlet channel and tie-in to the crown of the finger levees on each side of the inlet channel. The top of the wall will be approximate Elevation 190 feet NGVD and the inlet channel elevation will vary as the walls continue along the slope. A plan view and layout of the walls are shown on Plates II-7 and II-19. Also, a foundation plan showing the required excavation lines, step footings, wall limits and completed grade lines is presented on Plate II-33. The overburden material under the proposed wall layout will be excavated and replaced with a compacted pervious

backfill to eliminate excessive settlement and provide an adequate foundation. The excavation will be completed with the dewatering system in place and operating as shown on Plate II-19.

Analyses were performed for a one-foot section located adjacent to the pumping station where the tallest section exists. Two additional feet of surcharge was added to the top of the wall resulting in a net wall height of 48 feet (Elevation 192.0 to 144.0 feet NGVD). Passive soil resistance was also ignored resulting in analyses of a 54 foot high earth reinforced retaining wall. The analyses assumed that the reinforced earth wall would act as unit including the reinforcing strips and select backfill. Exterior stability of the wall was performed for the same loading conditions presented in Section 2.09, (1) General, of this report except for Case IV. A year round average inlet channel water surface elevation of 165.0 feet NGVD was used for Case IV. This elevation was based on available gage data for the White River at DeValls Bluff, Arkansas. Several different wall widths were analyzed to determine the optimum wall width that met all the required design criteria. A 40 foot wall width was selected as the optimum width. Interior stability of the wall will be the responsibility of the manufacturer and contractor for the particular wall system selected for final design and construction. Shear strength values of $\phi = 30°$ and c=0 psf were assumed for the backfill and wall foundation for this report. Additional analyses will be required to determine the minimum required widths for typical wall sections of varying heights as the wall traverses up the inlet channel slope.

b. Sliding Stability Analyses. The results of the sliding stability of the reinforced earth inlet channel retaining walls for the various loading cases are presented on Plate II-34. As shown on the plate, Case IV or earthquake induced loading was determined to be the most critical. The results of these analyses indicate that sliding stability for the wall is adequate for all loading cases. These analyses are also considered conservative as the actual shear strength of the sand foundation will be higher than the assumed value of $\phi = 30°$.

c. Overturning Analyses and Bearing Capacity. Overturning stability analyses were performed for a one-foot section of the retaining wall. A lateral at-rest earth pressure coefficient of $K_o = 0.5$ was selected based on the value of $\phi = 30°$ for a horizontal backfill. Results of the overturning analyses as shown on Plate II-35 indicate that the resultant location is within the minimum required base location for each of the loading conditions analyzed. Using the results of the overturning analyses, bearing capacity analyses were performed to determine the maximum foundation pressures and the corresponding factors of safety for bearing. A foundation shear strength of $\phi = 32°$ was used in the analyses to meet the required factors of safety as shown on Plate II-36. The results indicated the wall is safe against bearing capacity failure for all loading cases.

2.12 Relift Station.

a. Introduction. The relift station or 100 cfs pumping station will consist of a concrete structure with dimensions of 31.3 feet by 22 feet at the base and a height of 24.5 feet. A general layout and section of the station are shown on Plates II-37 and II-38. The structure will be placed on a sandy silt layer by excavating to elevation 216.8 ft. NGVD and backfilling with two feet of

compacted pervious material to support the base slab of the structure at elevation 218.8. The inlet channel will consist of a 50 foot wide canal excavated into natural ground with a channel bottom elevation of 220.8 feet NGVD. The flow will be carried horizontally from the inlet canal to the inlet pump bays through a concrete inlet structure and five lines of 36-inch diameter reinforced concrete pipe approximately 75 feet in length. Five pumps at the station will lift the water approximately 11 feet in height to supply the water distribution system above the station. The outlet channel will consist of a 12 foot bottom width canal with earthen embankments along each side to contain the flow since the canal bottom elevation is 231.8 feet NGVD or approximate natural ground. Boring 14-EAU-94 was taken at the pumping station site and was used for all analyses performed for the structure. The loading cases used for the stability analyses of the relift station are defined on Plate II-42. Since the structure is located in the Grand Prairie region, dewatering will not be required since the water table is substantially below the pumping station foundation.

b. Stability Analyses - Excavation, Inlet and Outlet Canals. The excavation lines required for the relift station are shown on Plates II-40 and II-41. The results of the stability analyses for the structural excavation and inlet and outlet canals are presented on Plate II-39. Long term stability and general maintenance considerations were the controlling factors in determining the required slopes. As shown by Boring 14-EAU-94, the upper bank material consists of a dry sandy silt and silty clay material. Using conservative shear strengths resulted in high factors of safety for the after construction and sudden drawdown loading conditions for all stability analyses. The results of the structural excavation and the inlet canal analyses resulted in factors of safety greater than 2.0 except for the long term case which was 1.33 for the excavation and 1.60 for the inlet canal. Since the outlet canal will consist of earthen embankments or levees, no additional analyses were conducted as the stability was addressed and presented on the general stability of the canals as shown on Plate II-17.

c. Settlement. Settlement for the relift station was estimated using both the WES program CSETT and using Boussinesq Coefficients. Settlement will be induced by the earth fill placed around three sides of the relift station. The fill height varies around the structure, with a maximum fill placement of 10 feet above natural ground. No consolidation tests were conducted on the soil samples taken from Boring 14-EAU-94, therefore the use of empirical relationships was required for the analyses. The major compressible layer of soil at the relift station site is a clay stratum from Elevation 168.0 feet NGVD to Elevation 178 feet NGVD. It was assumed based on strength characteristics of the clay stratum that the induced loading would fall on the recompression portions of the consolidation curve. This assumption resulted in an estimated settlement of less than one inch by both methods utilized. This settlement would be in the tolerable limits for the structure. The results of these analyses are presented on Plates II-40 and II-41. However, if the assumption is not valid, then excessive settlement at the station would result from the soil loading. Additional soil data will be obtained at the relift station site and consolidation tests will be conducted to determine the preconsolidation history of the clay layer. Depending on the test results, additional analyses will be performed to insure that an adequate foundation meeting minimum settlement criteria is incorporated into the design of the station.

d. Sliding Stability. Sliding stability analyses were performed for a one-foot section through the center of the relift station and outlet canal. A full view section of the relift station and results of the analyses are shown on Plate II-42. All loading cases were analyzed using either sand or silt under the base of the structure and in the backfill. Sand strengths were analyzed because of the two feet of compacted sand that will be placed under the structure base after excavation for the structure. The sand was conservatively ignored for all silt analyses. An S strength of $\phi' = 28°$ was used for Case V. The results indicate the relift station has an adequate factor of safety against sliding for all loading cases analyzed.

e. Overturning Stability and Bearing Capacity. Overturning stability analyses were performed for a one-foot section of the relift station. A lateral earth pressure coefficient of $K_a = 0.50$ was selected based on a horizontal backfill of $\phi = 30°$. Results of the analyses as shown on Plates II-43 and II-44 indicate that the resultant force is located within the allowable structural base for all loading cases. The results of the overturning analyses were then used to determine the maximum foundation pressures and the corresponding factors of safety for bearing capacity. The structure will be founded on a sandy silt. Both Q and S strengths were utilized in the analyses as presented on Plate II-45. Bearing capacity is adequate for all loading cases.

2.13 Gated Check Structures.

a. Introduction. The canal distribution system has four major gated check structures for controlling pool elevations and passing water downstream. These four structures are labeled C3000.01, C4000.01, C5000.01 and C6000.01 as shown on Plate II-6. Each of the proposed gated check structures has three individual gates except for C6000.01 which is a single gated structure. All gates dimensions are 14 feet in width and 13.5 feet in height. These structures also provide overflow weirs on each side of the structure along the canal slopes. These weirs will limit the maximum upstream pool elevation at each structure. Typical sections of the proposed gated check structures are presented on Plates II-46 and II-47. Normal head differentials of approximately 3 feet will exist between upstream and downstream water pools during normal operation of the system. However, each structure will be required to hold either the upstream or downstream water surface while the other side is dewatered for maintenance purposes. Analyses for sliding, overturning, bearing, settlement and uplift were performed to insure adequate stability of the proposed design. There were no site specific borings at the gated check structures. Analyses were based on information obtained from the nearest available borings which ranged from distances of 1500 feet to 5000 feet from the proposed structure locations. Critical loading along with the critical soil conditions were considered in each analyses. However, site specific borings will be required at each structure to verify soil conditions and completion of the design for plans and specs. Slope stability has already been addressed in this report. Excavation slopes of 1V on 2.5H will be required during construction and a final canal slope of 1V on 3.0H will be required for each structure. Since this report is preliminary and site specific soil conditions were not known, the design of the sheet pile overflow weir was not included in this report.

b. Sliding Stability. Sliding Stability analyses were performed for a one-foot section of the gated check structure as shown on Plate II-48. Clay, silt and sand foundation conditions were all considered in the sliding analyses. The after construction loading case (Case I) was not applicable due to no horizontal loading without water against the gates. The sudden drawdown loading case (Case II) considered full pool upstream of the structure and the downstream pool dewatered at the structure. Normal operating pools upstream and downstream of the structures were used for the earthquake induced loading or Case IV (head differential of three feet). Case V utilized S strengths in the clay and silt analyses as shown on Plate II-48. Conservative Q strengths of $\phi = 0°$, c = 1000 psf were selected along with S strengths of $\phi' = 18°$, c = 0 psf in the sliding stability analyses for a clay foundation which was the controlling foundation condition. The results of the analyses indicate that sliding stability is adequate for all loading cases. The structure is basically symmetrical from upstream to downstream resulting in a centroid very near the center of the structure. Therefore, these analyses would also be representative of reverse loading simulating upstream canal dewatering with a normal pool elevation downstream.

c. Overturning Stability and Bearing Capacity. Overturning stability analyses were performed for a one-foot section of the gated check structure for Cases II and IV. Both cases resulted in resultant locations within the allowable portion of the structure base for each respective loading conditions. The results of the overturning analysis are presented on Plate II-49. The results of the overturning analyses were then used to determine the maximum foundation pressures and the corresponding factors of safety for bearing capacity. Again, all three possible soil foundations were considered in the analyses. The results of the bearing analyses are presented on Plate II-50 and indicate that the bearing capacity is adequate for all loading cases.

d. Settlement. Settlement analyses for the gated check structures were performed to estimate the range of settlement expected at each of the proposed sites. Utilizing available soil information resulted in estimated settlement magnitudes from less than 1 inch to 5 inches for the structures. The analysis for structure C5000.01 is presented on Plate II-51 and indicates excessive settlement for the structure. This settlement is based on C_r values estimated by empirical relationships developed for cohesive soils from Boring 15-EAU-94. Additional foundation design will be required if new boring information at the site indicates similar soil conditions. An undisturbed soil boring will be taken at each structure site. Analyses will be performed to estimate settlement. Based on the results of the soil tests and analyses performed, an adequate foundation will be incorporated into the design to limit excessive settlement for each structure.

e. Uplift Analysis. An uplift analysis for the stilling basin was performed for a one-foot section of the gated check structure. The line of creep method was utilized for determining seepage forces under the stilling basin. The critical loading occurred with a normal water pool upstream of the structure and the downstream pool dewatered to the bottom of the canal. Analyses using different impervious blanket cutoff lengths were performed to determine the minimum blanket length required for a factor of safety against uplift equal to 1.20. A 150 foot blanket resulted in a factor of safety

of 1.23 as presented on Plate II-52. The blanket was also extended 150 feet downstream of the structure to prevent uplift and piping of material if the upstream pool is dewatered for maintenance purposes while holding the normal pool downstream.

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TABLES

Section II - Geology and Soils

TABLE II-1
MAIN CANALS

Canal No.	Sta. No. From	Sta. No. To	Permeability of Canal Bottom ft/sec	Seepage Loss (cfs)	Permeability Assuming Siltation	Seepage Loss (cfs)
1000	76+04	229+732	1.64×10^{-6}	4.72	1.64×10^{-7}	3.10
2000	229+73	333+50	1.64×10^{-6}	2.99	1.64×10^{-7}	2.00
	333+50	400+00	1.64×10^{-7}	0.10	1.64×10^{-7}	0.10
	400+00	674+06	1.64×10^{-7}	0.77	1.64×10^{-7}	0.77
3000	674+06	1100+00	3.28×10^{-7}	2.21	1.64×10^{-7}	2.10
	1100+00	1273+29	1.64×10^{-6}	4.38	1.64×10^{-7}	2.93
4000	1273+29	1462+11	3.28×10^{-7}	0.96	1.64×10^{-7}	0.91
	1462+11	1650+00	1.64×10^{-7}	0.45	1.64×10^{-7}	0.45
	1650+00	1810+19	1.64×10^{-7}	0.38	1.64×10^{-7}	0.38
	1810+19	1863+88	3.28×10^{-9}	0.00	3.28×10^{-9}	0.00
5000	1863+88	2109+00	1.64×10^{-7}	0.55	1.64×10^{-7}	0.55
	2109+00	2243+63	3.28×10^{-7}	0.63	1.64×10^{-7}	0.60
6000	2243+63	2353+00	1.64×10^{-7}	0.23	1.64×10^{-7}	0.23
	2353+00	2451+00	3.28×10^{-9}	0.00	3.28×10^{-9}	0.00
	2451+00	2617+00	1.64×10^{-6}	3.25	1.64×10^{-7}	2.18
	2617+00	3189+81	3.28×10^{-9}	0.02	3.28×10^{-9}	0.02
Totals				21.54		16.32

TABLE II-2
SMALL LATERALS

Canal No.	Sta. No. From	Sta. No. To	Permeability of Canal Bottom ft/sec	Seepage Loss (cfs)	Permeability Assuming Siltation	Seepage Loss (cfs)
Small Laterals	---	---	---	5.00	1.64×10^{-7}	3.62

TABLE II-3
LATERAL CANALS

Canal No.	Sta. No. From	Sta. No. To	Permeability of Canal Bottom ft/sec	Seepage Loss (cfs)	Permeability Assuming Siltation	Seepage Loss (cfs)
1500	0+00	320+05	1.64×10^{-6}	0.34	1.64×10^{-7}	0.23
2200	0+00	288+00	1.64×10^{-6}	0.08	1.64×10^{-7}	0.08
	288+00	523+00	1.64×10^{-7}	0.66	1.64×10^{-7}	0.44
	523+00	671+35	1.64×10^{-7}	0.06	1.64×10^{-7}	0.06
3200	0+00	35+00	3.28×10^{-7}	0.15	1.64×10^{-7}	0.14
	35+00	373+65	3.28×10^{-7}	0.54	1.64×10^{-7}	0.51
3500	0+00	365+00	1.64×10^{-6}	2.42	1.64×10^{-7}	1.62
5200	0+00	27+00	1.64×10^{-6}	0.01	1.64×10^{-7}	0.01
	27+00	336+69	1.64×10^{-6}	0.04	1.64×10^{-7}	0.04
5500	0+00	277+00	3.28×10^{-9}	0.01	3.28×10^{-9}	0.01
	277+00	545+10	3.28×10^{-7}	0.14	1.64×10^{-7}	0.13
	545+10	731+81	3.28×10^{-7}	0.10	1.64×10^{-7}	0.09
6200	0+00	412+00	3.28×10^{-9}	0.01	3.28×10^{-9}	0.01
	412+00	595+00	3.28×10^{-7}	0.60	1.64×10^{-7}	0.57
	595+00	703+00	1.64×10^{-7}	0.15	1.64×10^{-7}	0.15
	703+00	864+50	3.28×10^{-9}	0.00	3.28×10^{-9}	0.00
6600	0+00	445+48	3.28×10^{-9}	0.10	3.28×10^{-9}	0.10
Totals				5.41		4.19

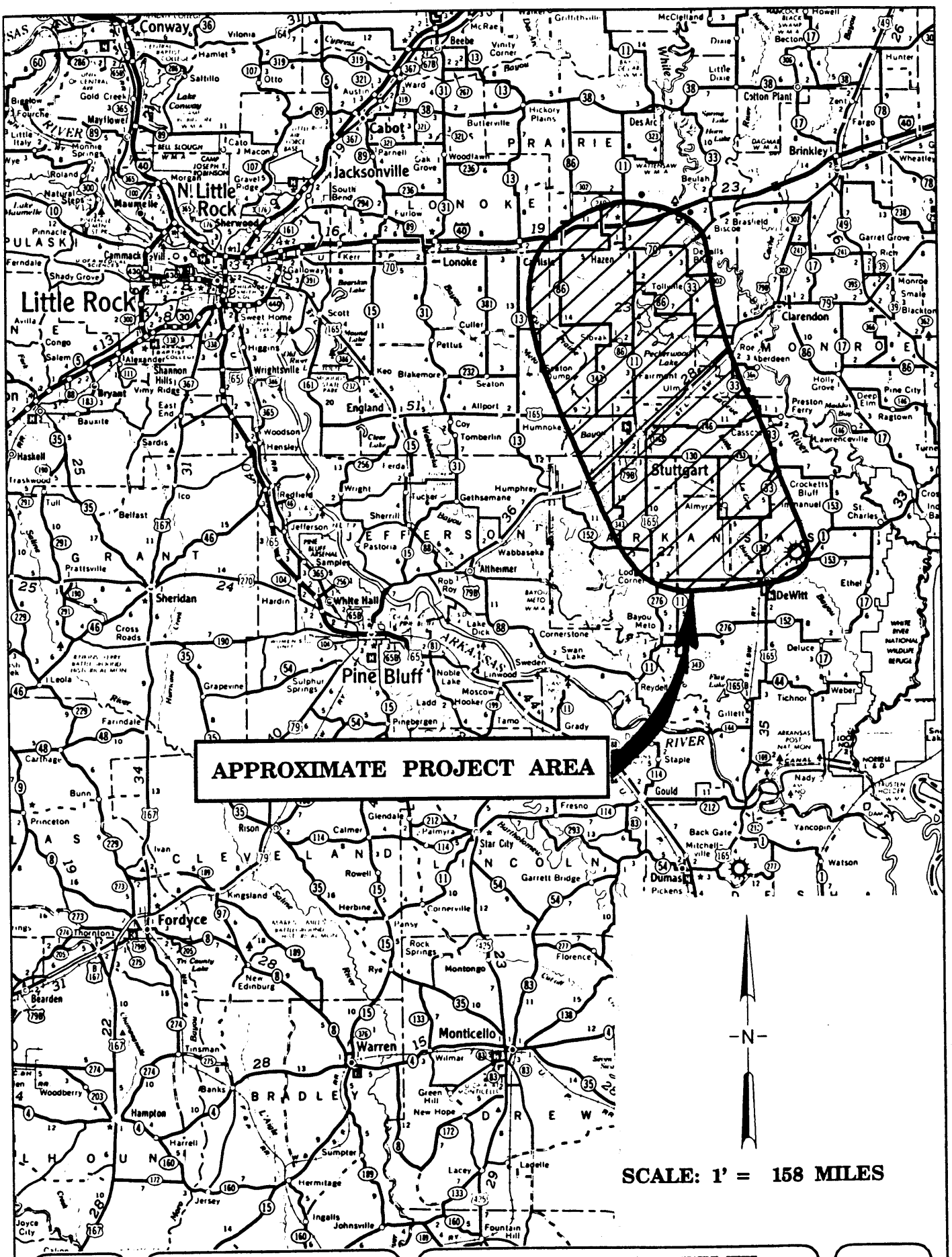
TABLE II-4 GRAND TOTAL FOR PROJECT

Canal No.	Sta. No. From	Sta. No. To	Permeability of Canal Bottom ft/sec	Seepage Loss (cfs)	Permeability Assuming Siltation	Seepage Loss (cfs)
Grand Total				32.0		24.1

Eastern Arkansas Region Comprehensive Study
Grand Prairie Area
Demonstration Project

PLATES

Section II - Geology and Soils



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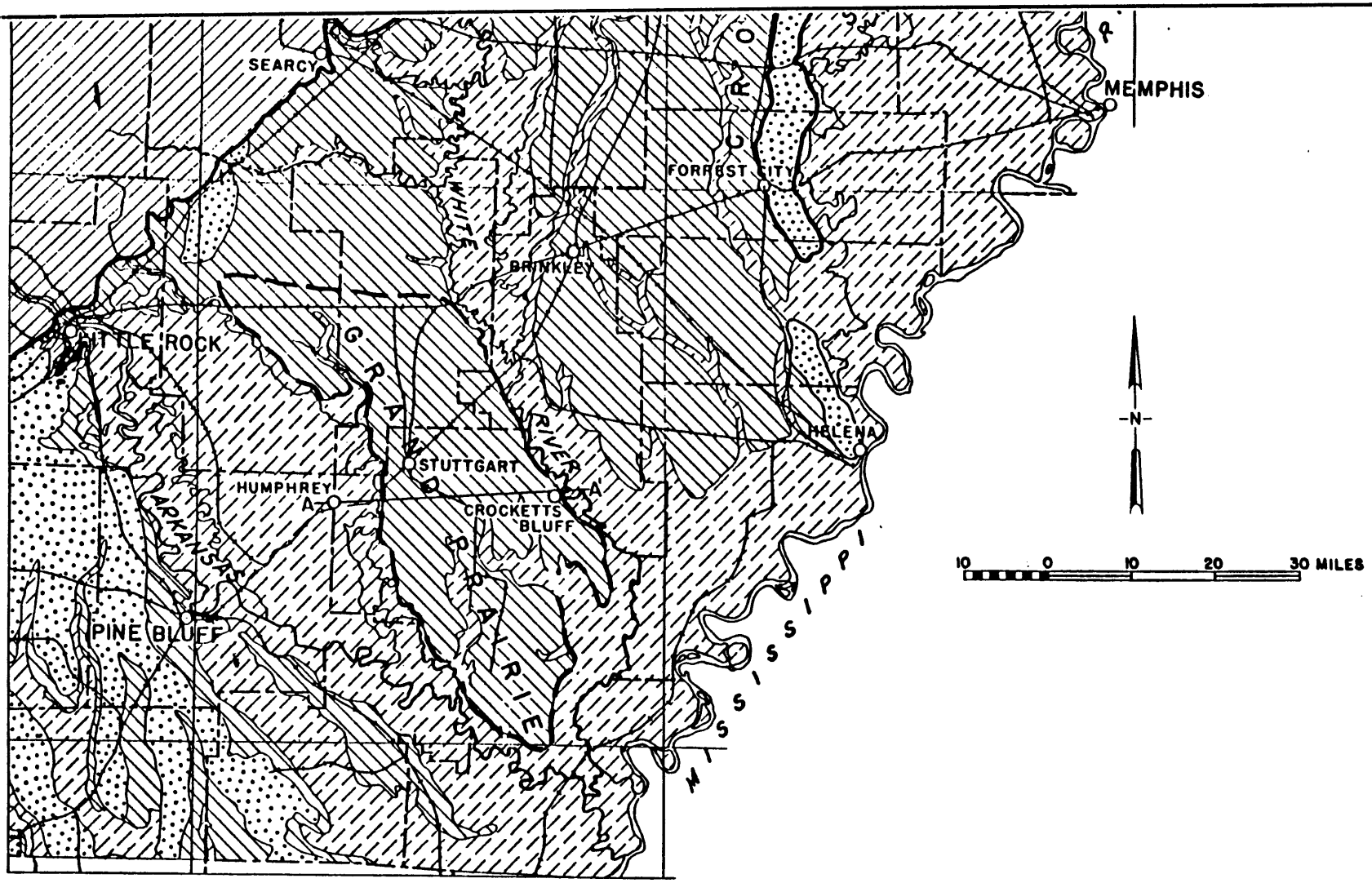
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

PROJECT LOCATION MAP

PLATE
II-1



RECENT ALLUVIUM (possibly including some Pleistocene alluvium; loam, clay sand and gravel)

PLEISTOCENE ALLUVIUM (clay, sand and gravel; principal water-bearing formation) See plate II-3 for profile.

Approximate boundary of the prairie area of the Grand Prairie region

TERTIARY AND UPPER CRETACEOUS FORMATIONS (including so-called Lafayette formation, Jackson, Claiborne, Wilcox and Midway formations, and Nacatoch (?) sand; in places on Crowleys Ridge and near the eastern edge of the Ozark Plateau overlain by Pleistocene loess; includes water-bearing sands)

CARBONIFEROUS, DEVONIAN, SILURIAN AND ORDOVICIAN ROCKS (in places along eastern border of Ozark Plateau overlain by discontinuous patches of Pleistocene loess and so-called Lafayette formation of Tertiary age)

IGNEOUS ROCKS

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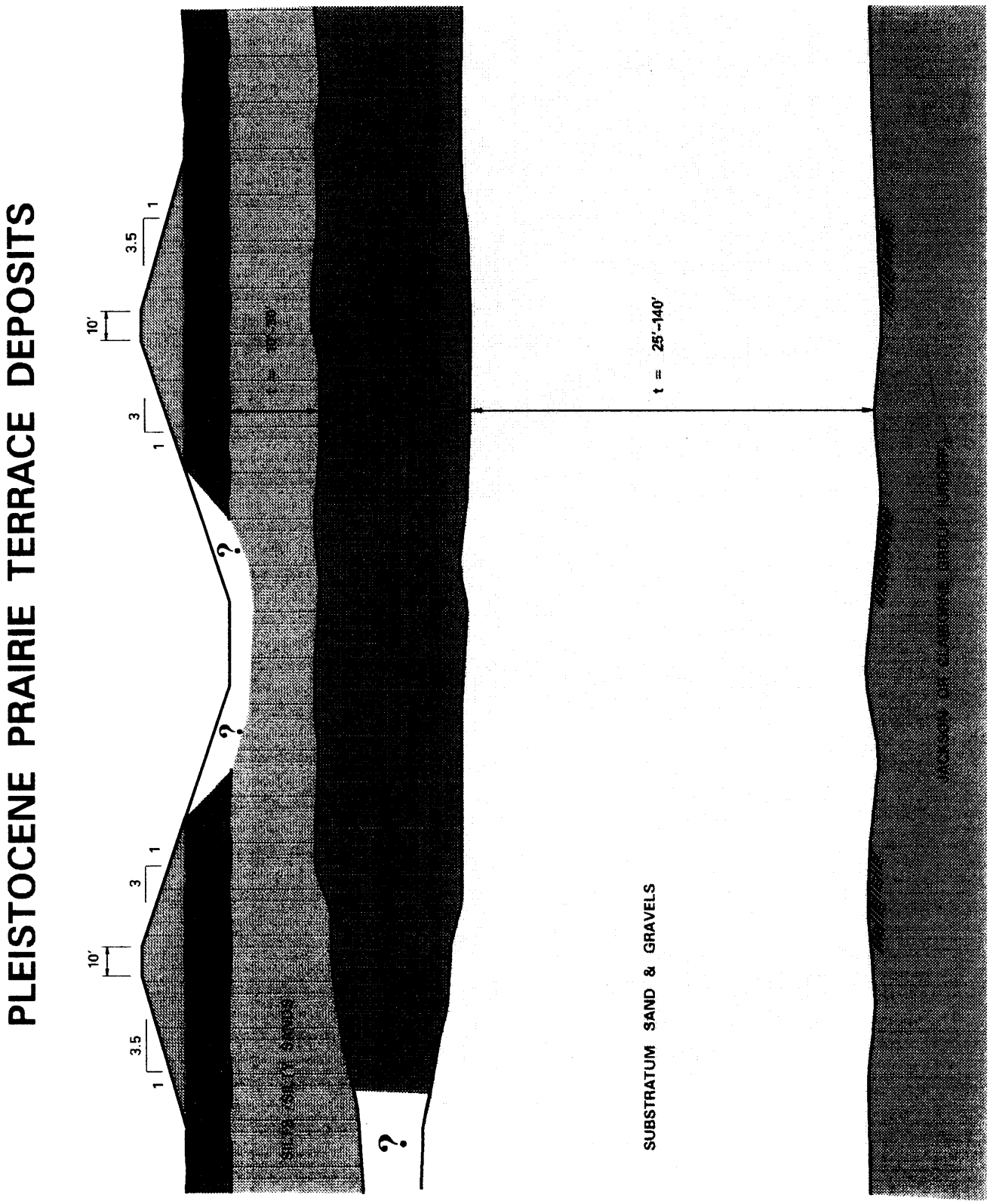
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

GENERAL GEOLOGY MAP

PLATE II-2



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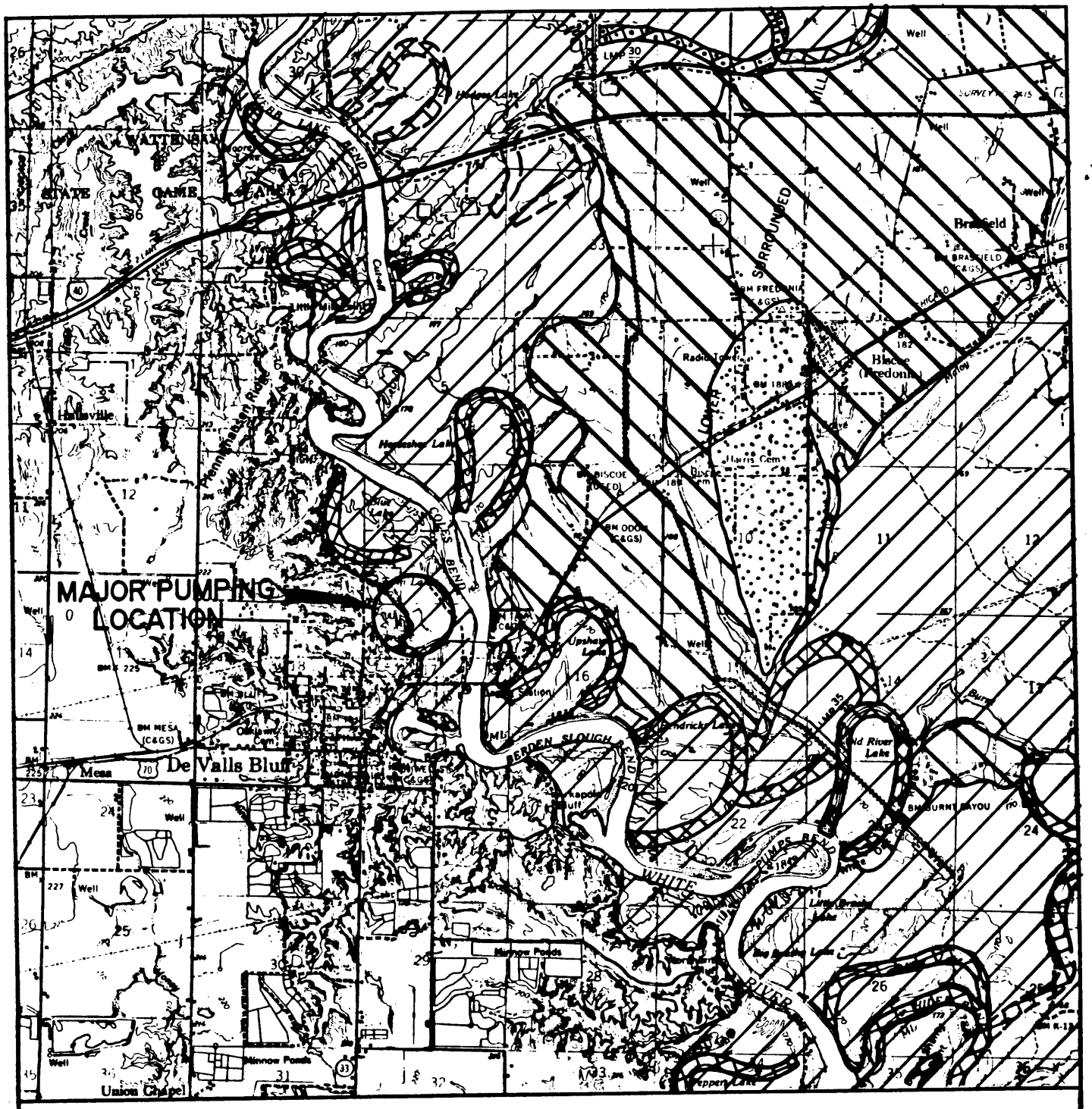
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

GEOLOGICAL PROFILE

PLATE
II-3



POINT BAR

ABANDONED CHANNEL

ABANDONED COURSE

TERRACE VENEERED WITH DUNES

BRAIDED STREAM TERRACES

-N-

SCALE 1:62,500

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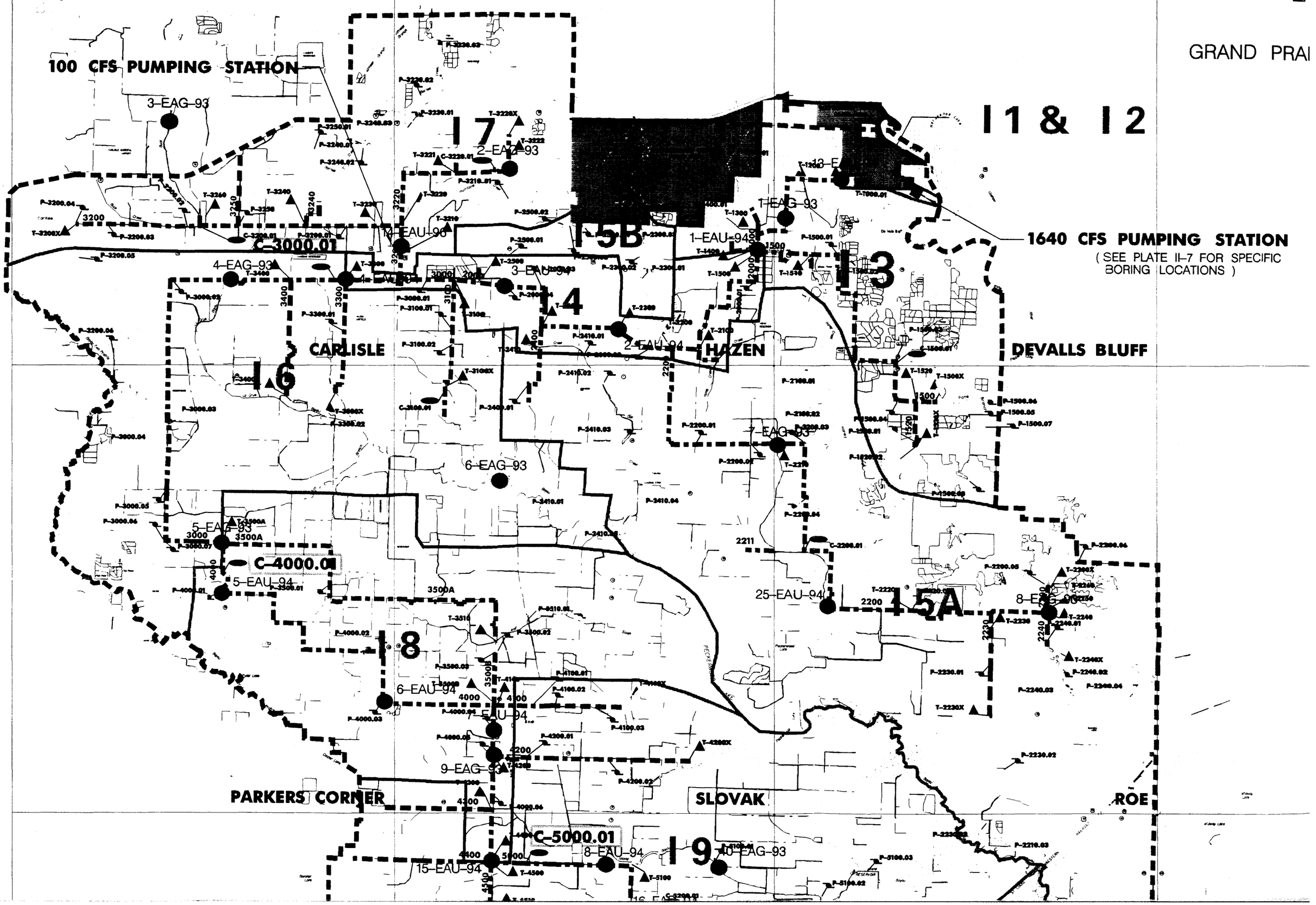
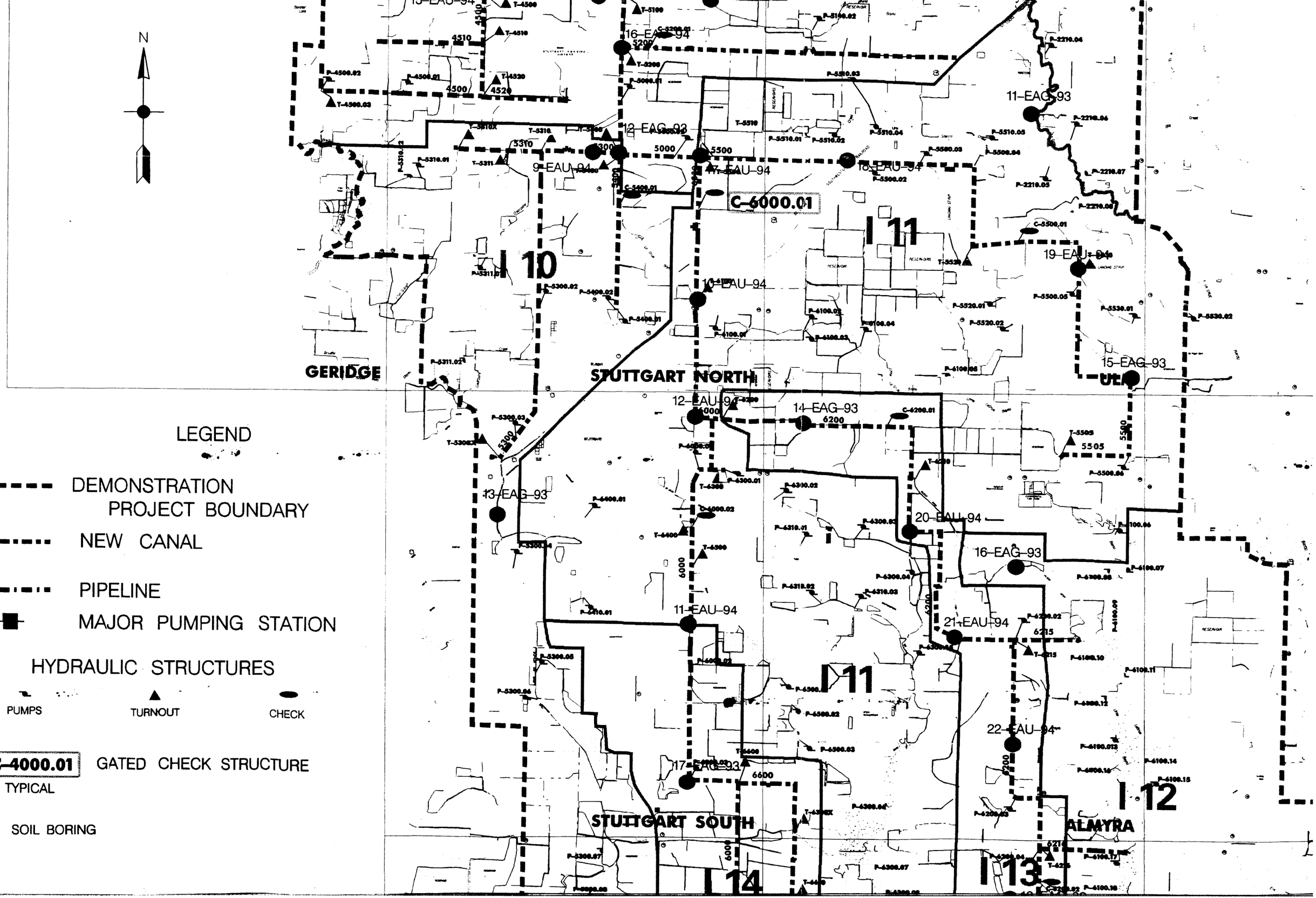
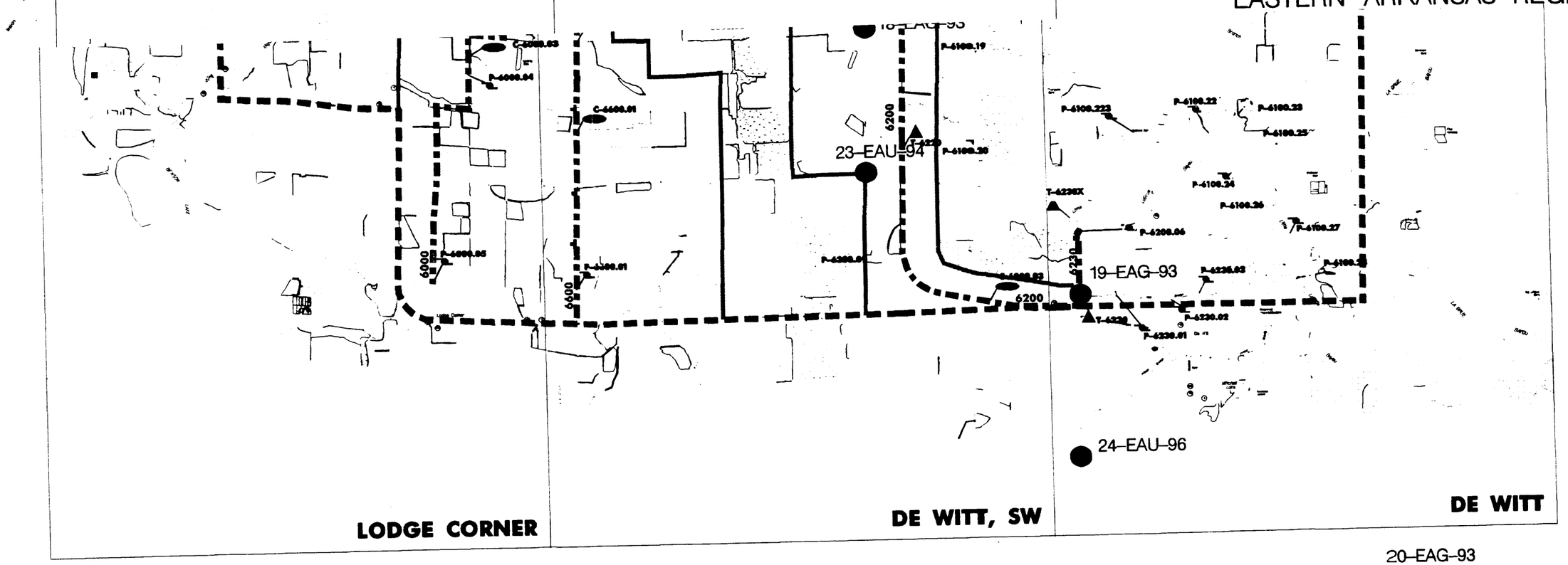
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

MAJOR PUMPING STATION GEOLOGY MAP

PLATE II-4


GRAND PRAI
100 CFS PUMPING STATION
3-EAG-93
I7
2-EAG-93
I1 & I2
1-EAG-93
1640 CFS PUMPING STATION
(SEE PLATE II-7 FOR SPECIFIC BORING LOCATIONS)
I5B
1-EAU-94
C-3000.01
4-EAG-93
3-EAU-94
I4
I3
CARLISLE
2-EAU-94
HAZEN
DEVALLS BLUFF
I6
7-EAG-93
6-EAG-93
5-EAG-93
C-4000.01
5-EAU-94
25-EAU-94
I5A
8-EAG-93
I8
6-EAU-94
EAU-94
9-EAG-93
PARKERS CORNER
SLOVAK
ROE
C-5000.01
8-EAU-94
I9
10-EAG-93
15-EAU-94


N
LEGEND
DEMONSTRATION PROJECT BOUNDARY
NEW CANAL
PIPELINE
MAJOR PUMPING STATION
HYDRAULIC STRUCTURES
PUMPS
TURNOUT
CHECK
C-4000.01
GATED CHECK STRUCTURE
TYPICAL
SOIL BORING
GERIDGE
STUTTGART NORTH
STUTTGART SOUTH
ALMYRA
I 10
I 11
I 12
I 13
I 14
C-6000.01
11-EAG-93
12-EAG-93
13-EAG-93
14-EAG-93
15-EAG-93
16-EAG-93
17-EAG-93
9-EAU-94
10-EAU-94
11-EAU-94
12-EAU-94
16-EAU-94
17-EAU-94
19-EAU-94
20-EAU-94
21-EAU-94
22-EAU-94



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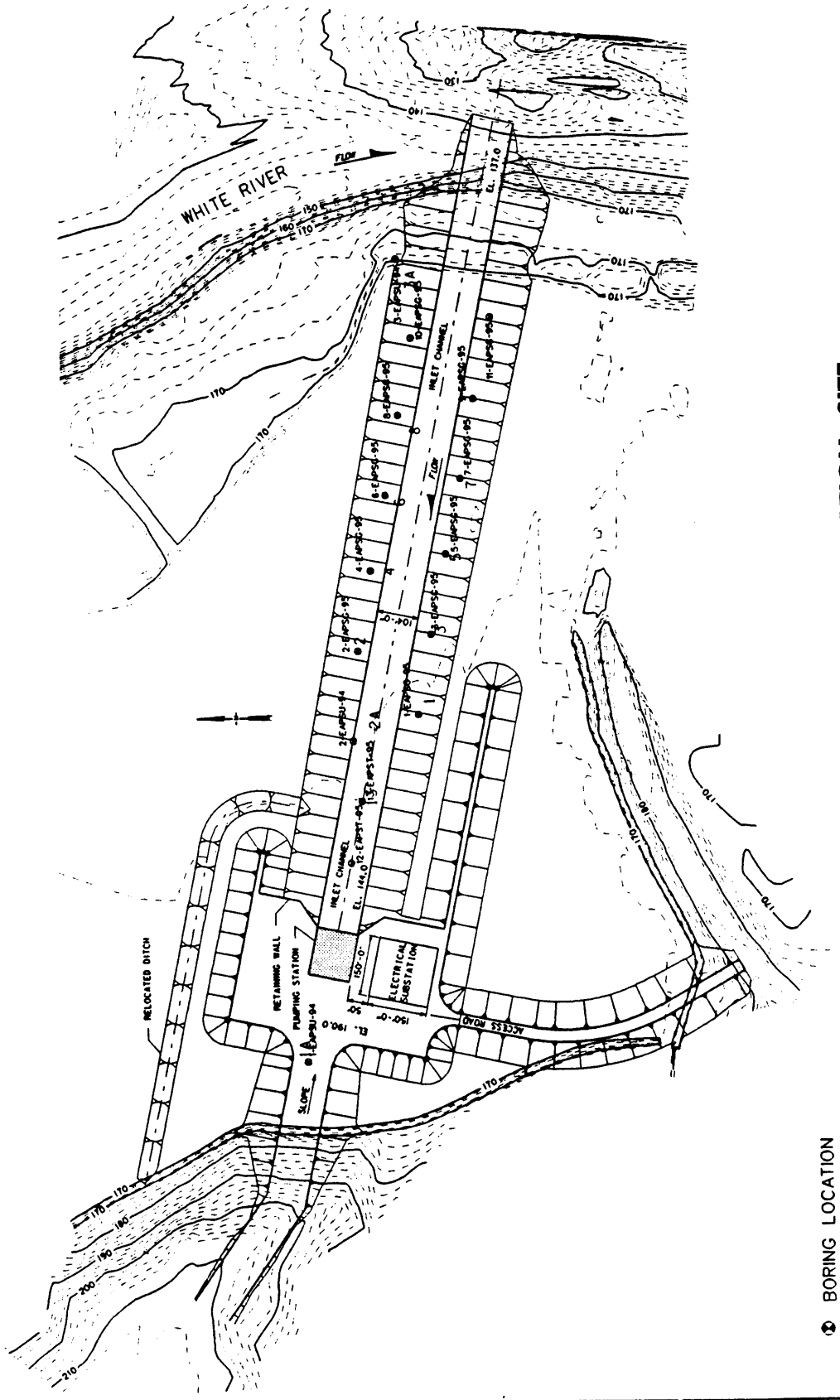
EASTERN ARKANSAS REGIONAL COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

BORING LOCATIONS

PLATE
II-6



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EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

BORING LOCATIONS

PLATE
II-7

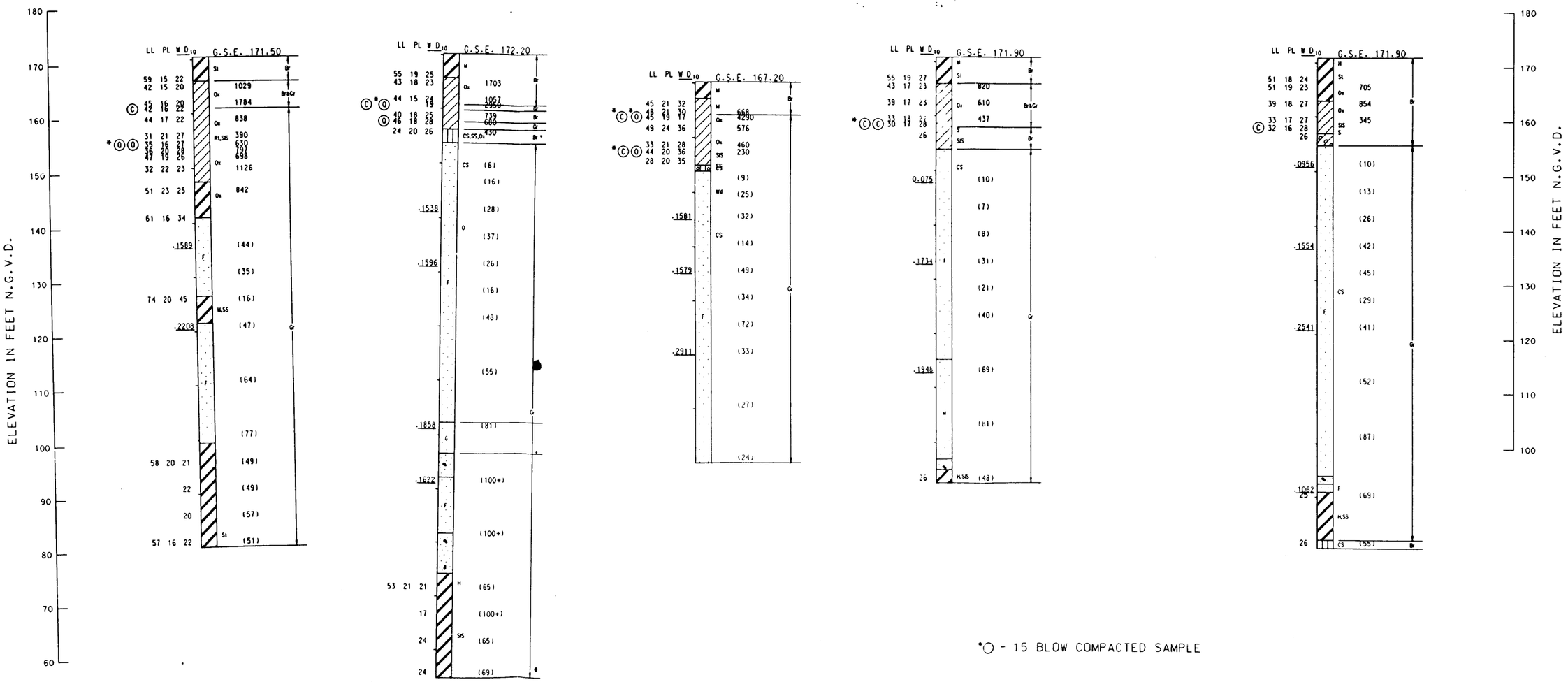
BOR. 1-EAPSU-94
2087976.9 N, 1476622.9 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 167.3
31 OCT 94

BOR. 2-EAPSU-94
2087849.8 N, 1477424.3 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 155.6
27 OCT 94

BOR. 3-EAPSU-94
2087724.9 N, 1478634.3 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 156.7
2 NOV 94

BOR. 12-EAPST-95
2087860.0 N, 1477120 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 171.1
7 JUN 95

BOR. 13-EAPST-95
2087830.0 N, 1477275.0 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 168.1
5 JUN 95



*○ - 15 BLOW COMPACTED SAMPLE

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MEMPHIS, TENNESSEE

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

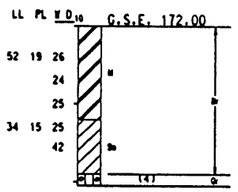
MAJOR PUMPING STATION BORING LOGS

PLATE
II-8

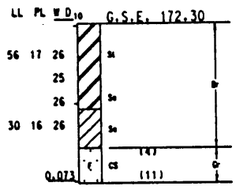
ELEVATION IN FEET N.G.V.D.

180 170 160 150 140

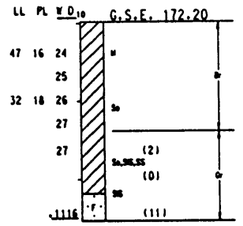
BOR. 1-EAPSG-95
2087685.0 N, 1477490.0 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 168.0
8 JUN 95



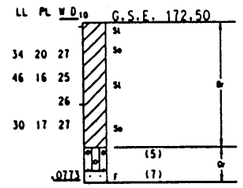
BOR. 2-EAPSG-95
2087835.0 N, 1477650.0 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 168.1
9 JUN 95



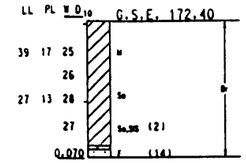
BOR. 3-EAPSG-95
2087650.0 N, 1477690.0 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 168.3
8 JUN 95



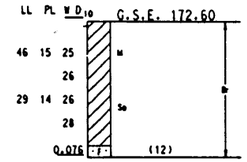
BOR. 4-EAPSG-95
2087800.0 N, 1477850.0 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 168.5
9 JUN 95



BOR. 5-EAPSG-95
2087610.0 N, 1477890.0 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 167.9
8 JUN 95



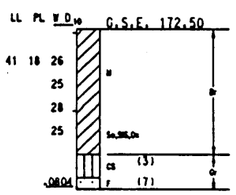
BOR. 6-EAPSG-95
2087760.0 N, 1478040.
BOR. TYPE-AUGER & S
GROUND WATER EL. 168
9 JUN 95



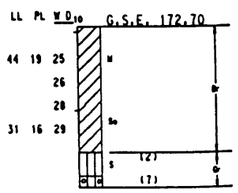
180 170 160 150 140

ELEVATION IN FEET N.G.V.D.

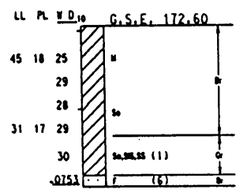
BOR. 7-EAPSG-95
2087570.0 N, 1478080.0 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 168.6
8 JUN 95



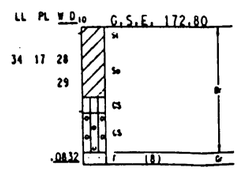
BOR. 8-EAPSG-95
2087725.0 N, 1478240.0 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 169.2
9 JUN 95



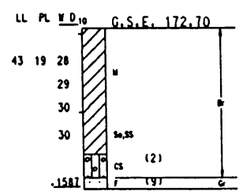
BOR. 9-EAPSG-95
2087535.0 N, 1478280.0 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 169.3
8 JUN 95



BOR. 10-EAPSG-95
2087690.0 N, 1478435.0 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 169.5
9 JUN 95



BOR. 11-EAPSG-95
2087490.0 N, 1478485.0 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 165.7
8 JUN 95



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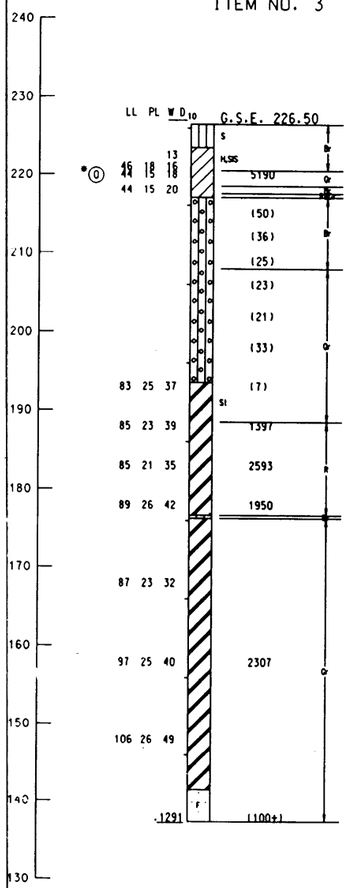
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
MAJOR PUMPING STATION
INLET CHANNEL
BORING LOGS

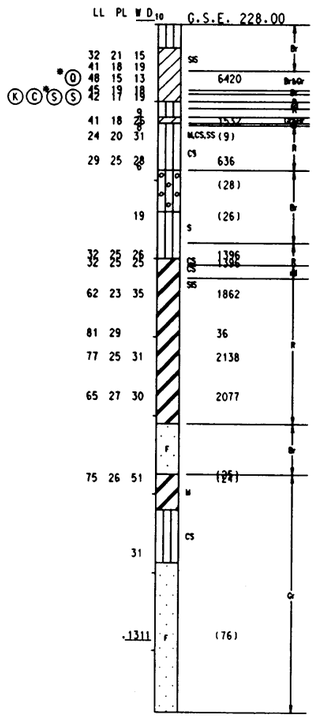
BOR. 1-EAU-94
2082507.7 N, 1460811.4 E
BOR. TYPE-AUGER & SS
25 OCT 94

ITEM NO. 3



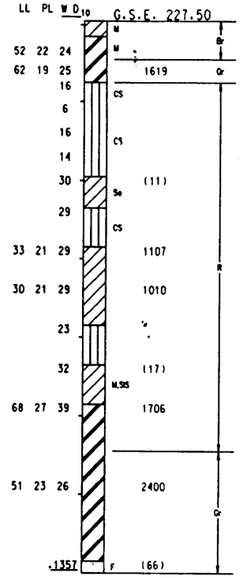
BOR. 2-EAU-94
2074417.2 N, 1447133.4 E
BOR. TYPE-AUGER & SS
19 OCT 94

ITEM NO. 4



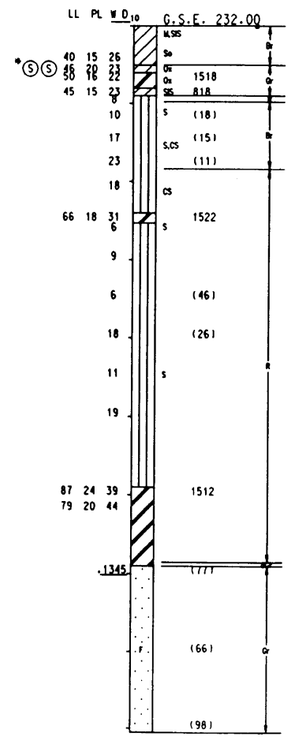
BOR. 3-EAU-94
2078736.9 N, 1435743.5 E
BOR. TYPE-AUGER & SS
30 NOV 94

ITEM NO. 4



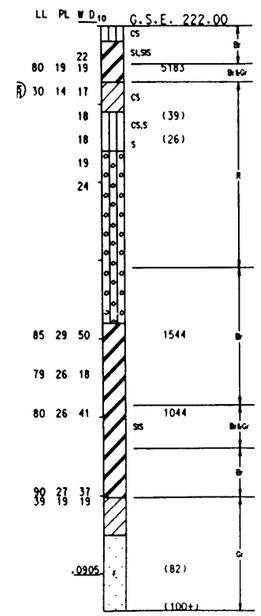
BOR. 4-EAU-94
2079355.9 N, 1420199.2
BOR. TYPE-AUGER & SS
1 DEC 94

ITEM NO. 4



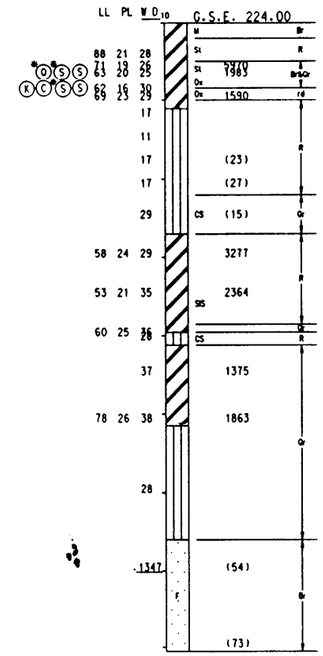
BOR. 5-EAU-94
2047378.1 N, 1408052.0 E
BOR. TYPE-AUGER & SS
4 NOV 94

ITEM NO. 8



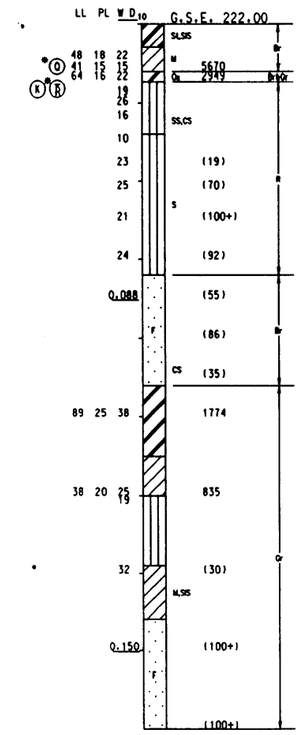
BOR. 6-EAU-94
2036544.1 N, 1424125.4 E
BOR. TYPE-AUGER & SS
14 NOV 94

ITEM NO. 8



BOR. 7-EAU-94
2033673.2 N, 1434846.6
BOR. TYPE-AUGER & SS
8 NOV 94

ITEM NO. 8



O - 15 BLOW COMPACTED SAMPLE
K - COEFFICIENT OF PERMEABILITY TEST

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EASTERN ARKANSAS REGION COMPREHENSIVE S
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

BORING LOGS

BOR. 8-EAU-94
2020163.0 N, 1446092.3
BOR. TYPE-AUGER & SS
18 OCT 94

ITEM NO. 9

BOR. 9-EAU-94
2004238.6 N, 1445676.5 E
BOR. TYPE-AUGER & SS
7 OCT 94

ITEM NO. 10

BOR. 10-EAU-94
1989284.0 N, 1456291.8 E
BOR. TYPE-AUGER & SS
3 DEC 94

ITEM NO. 11

BOR. 11-EAU-94
1956163.1 N, 1455617.2
BOR. TYPE-AUGER & SS
6 DEC 94

ITEM NO. 11

BOR. 12-EAU-94
1977344.2 N, 1456146.6
BOR. TYPE-AUGER & SS
4 OCT 94

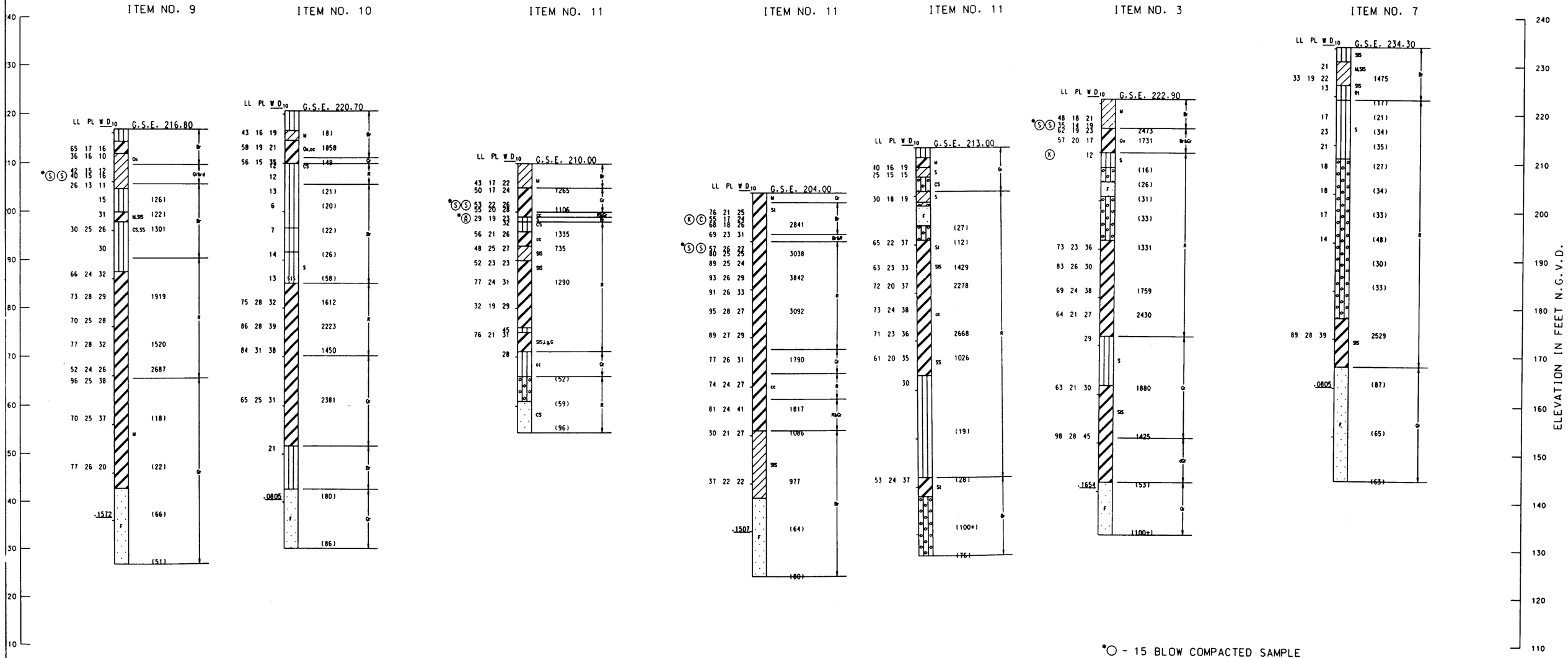
ITEM NO. 11

BOR. 13-EAU-94
2089635.6 N, 1468991.6 E
BOR. TYPE-AUGER & SS
28 NOV 94

ITEM NO. 3

BOR. 14-EAU-94
2082691.5 N, 1425626.1 E
BOR. TYPE-AUGER & SS
18 NOV 94

ITEM NO. 7



*○ - 15 BLOW COMPACTED SAMPLE

Ⓚ - COEFFICIENT OF PERMEABILITY TEST

U. S. ARMY ENGINEER DISTRICT
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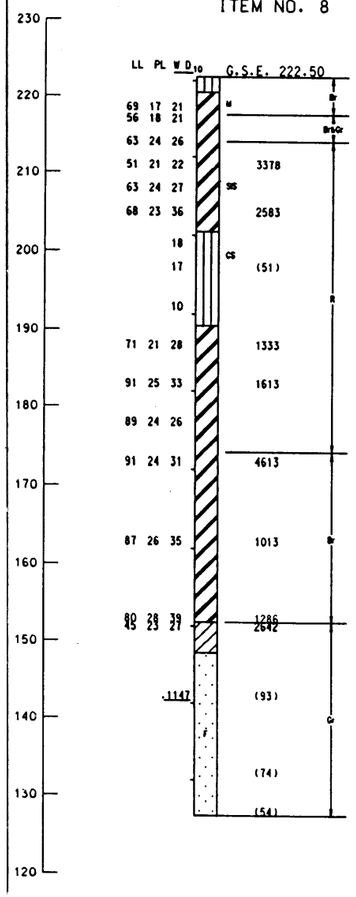
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

BORING LOGS

PLATE
II-11

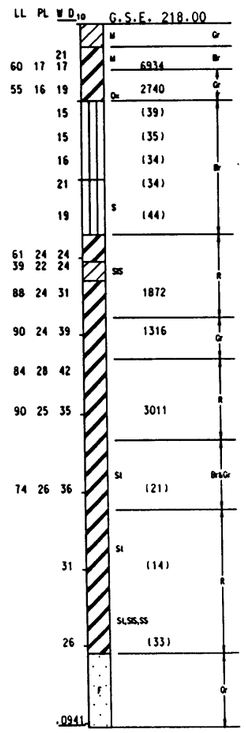
BOR. 15-EAU-94
2020459.2 N, 1434656.8 E
BOR. TYPE-AUGER & SS
10 NOV 94

ITEM NO. 8



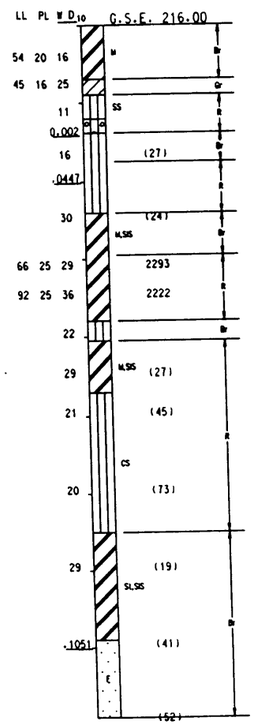
BOR. 16-EAU-94
2014855.6 N, 1448447.8 E
BOR. TYPE-AUGER & SS
14 OCT 94

ITEM NO. 9



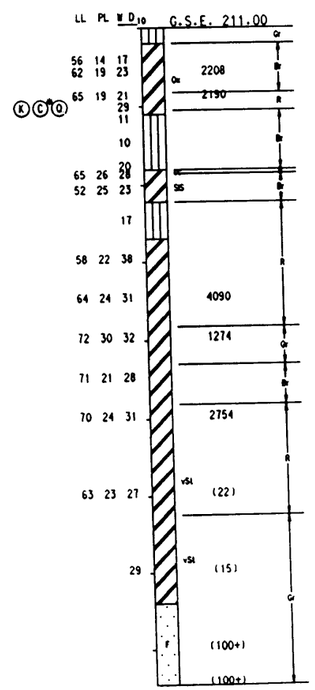
BOR. 17-EAU-94
2004024.1 N, 1456406.9 E
BOR. TYPE-AUGER & SS
5 OCT 94

ITEM NO. 9



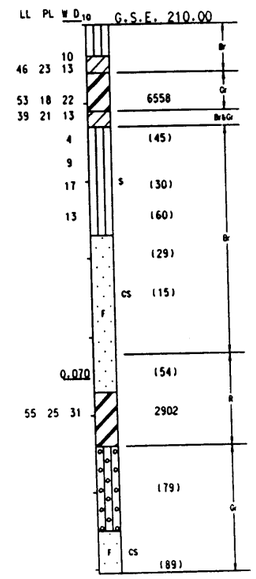
BOR. 18-EAU-94
2003630.7 N, 1470993.9 E
BOR. TYPE-AUGER & SS
13 OCT 94

ITEM NO. 11



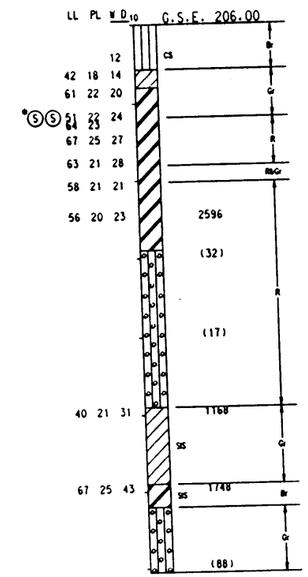
BOR. 19-EAU-94
1992849.5 N, 1493988.9
BOR. TYPE-AUGER & SS
16 NOV 94

ITEM NO. 11



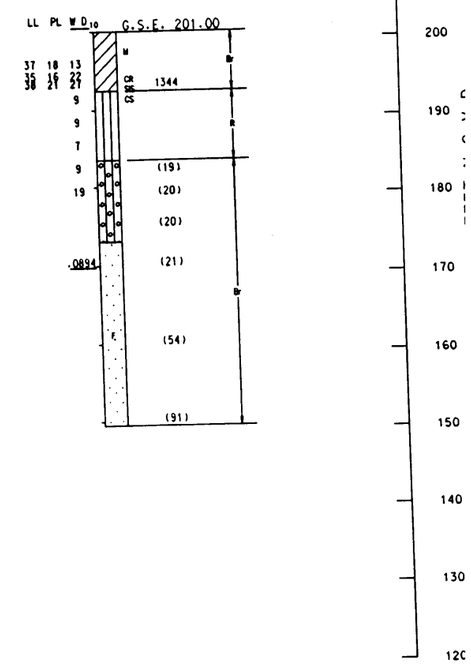
BOR. 20-EAU-94
1965916.8 N, 1477543.3 E
BOR. TYPE-AUGER & SS
7 DEC 94

ITEM NO. 13



BOR. 21-EAU-94
1955124.7 N, 1482099.1 E
BOR. TYPE-AUGER & SS
18 JAN 95

ITEM NO. 13



*○ - 15 BLOW COMPACTED SAMPLE

Ⓚ - COEFFICIENT OF PERMEABILITY TEST

US Army of Engr

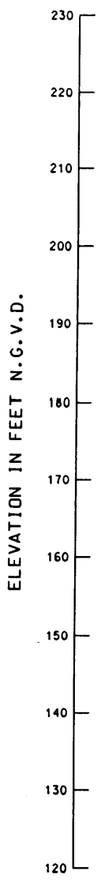
U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

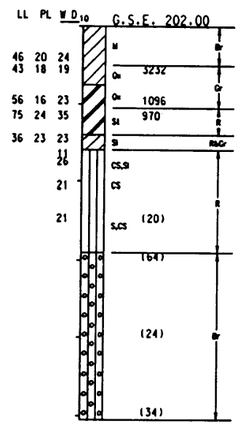
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

BORING LOGS

BOR. 22-EAU-94
1944269.7 N, 1487906.9 E
BOR. TYPE-AUGER & SS
11 JAN 95

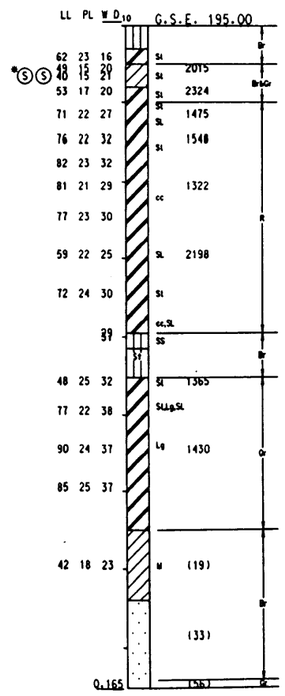
ITEM NO. 13



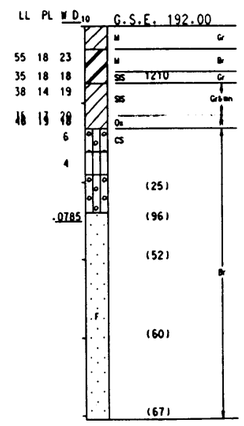


BOR. 23-EAU-94
1917348.1 N, 1487649.1 E
BOR. TYPE-AUGER & SS
21 SEP 94

ITEM NO. 13

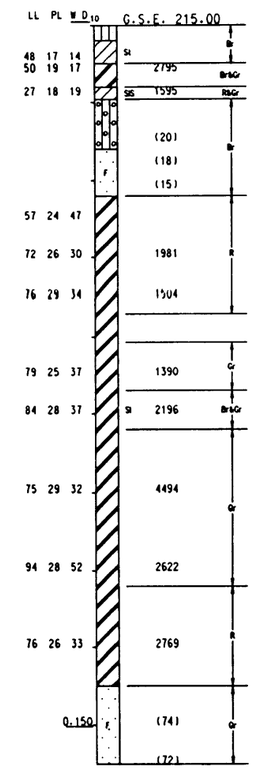


BOR. 24-EAU-94
1895170.9 N, 1503259.1 E
BOR. TYPE-AUGER & SS
GROUND WATER EL. 175.0
12 JAN 95



BOR. 25-EAU-94
2046489.9 N, 1467841.9 E
BOR. TYPE-AUGER & SS
2 NOV 94

ITEM NO. 5A



*○ - 15 BLOW COMPACTED SAMPLE

US Army Corps of Engineers

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MEMPHIS, TENNESSEE

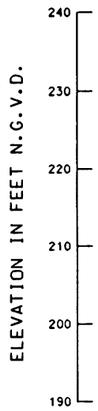
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

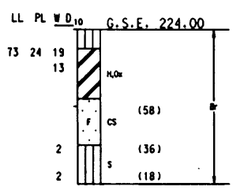
BORING LOGS

PLATE
II-13

BOR. 1-EAG-93
2085736.1 N, 1463539.9 E
BOR. TYPE-AUGER & SS
24 JUN 93

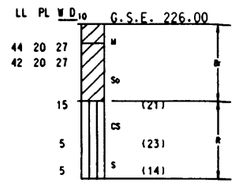
ITEM NO. 3





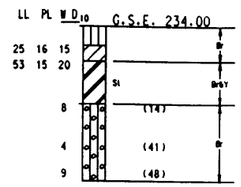
BOR. 2-EAG-93
2090557.7 N, 1436204.7 E
BOR. TYPE-AUGER & SS
21 JUN 93

ITEM NO. 7



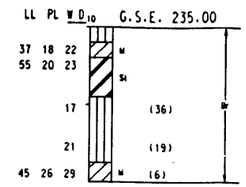
BOR. 3-EAG-93
2095142.4 N, 1402775.6 E
BOR. TYPE-AUGER & SS
22 JUN 93

ITEM NO. 7



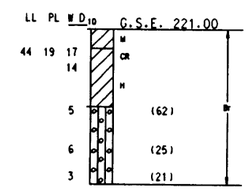
BOR. 4-EAG-93
2079247.5 N, 1408887.3 E
BOR. TYPE-AUGER & SS
22 JUN 93

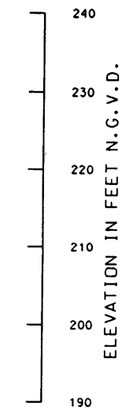
ITEM NO. 6



BOR. 5-EAG-93
2052604.9 N, 1408027.4 E
BOR. TYPE-AUGER & SS
22 JUN 93

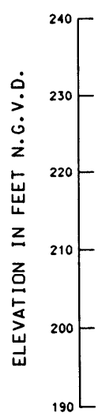
ITEM NO. 8

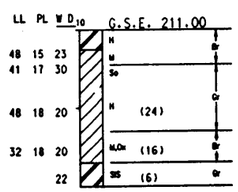




BOR. 6-EAG-93
2059081.3 N, 1435346.6 E
BOR. TYPE-AUGER & SS
22 JUN 93

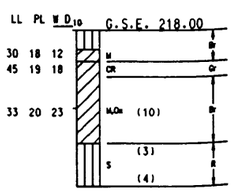
ITEM NO. 6





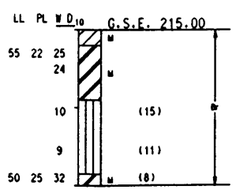
BOR. 7-EAG-93
2062843.5 N, 1462901.3 E
BOR. TYPE-AUGER & SS
24 JUN 93

ITEM NO. 5A



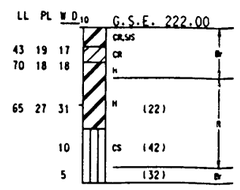
BOR. 8-EAG-93
2045991.2 N, 1489675.4 E
BOR. TYPE-AUGER & SS
10 JUN 93

ITEM NO. 5A



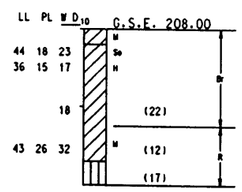
BOR. 9-EAG-93
2031176.2 N, 1434856.5 E
BOR. TYPE-AUGER & SS
23 JUN 93

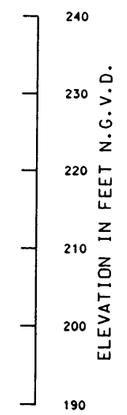
ITEM NO. 8



BOR. 10-EAG-93
2019920.3 N, 1457260.4 E
BOR. TYPE-AUGER & SS
23 JUN 93

ITEM NO. 9





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MEMPHIS, TENNESSEE

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

BORING LOGS

PLATE
II-14

BOR. 11-EAG-93
2008622.7 N, 1489179.9 E
BOR. TYPE-AUGER & SS
10 JUN 93

ITEM NO. 11

BOR. 12-EAG-93
2004199.4 N, 1448277.5 E
BOR. TYPE-AUGER & SS
23 JUN 93

ITEM NO. 9

BOR. 13-EAG-93
1967179.7 N, 1436409.0 E
BOR. TYPE-AUGER & SS
7 JUN 93

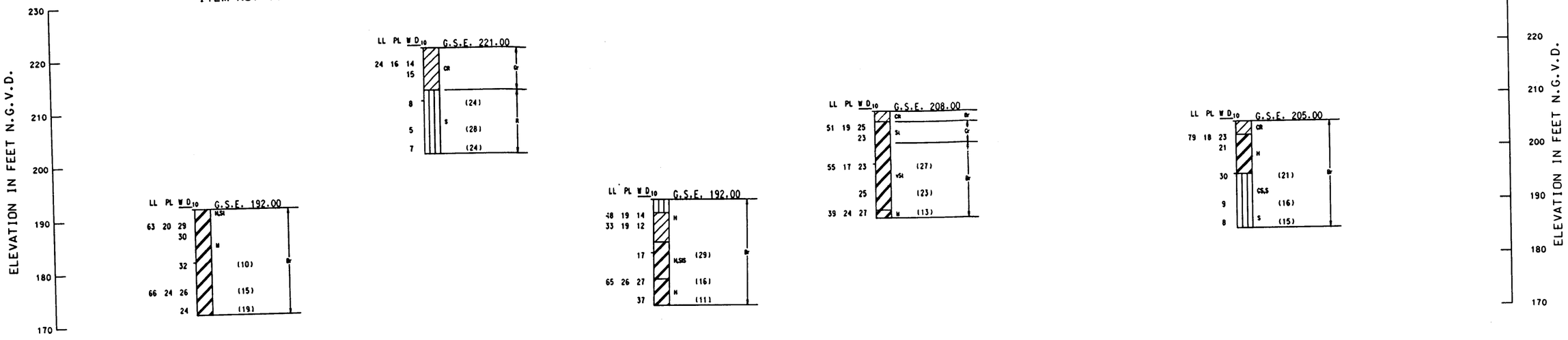
ITEM NO. 10

BOR. 14-EAG-93
1982076.6 N, 1466845.1 E
BOR. TYPE-AUGER & SS
8 JUN 93

ITEM NO. 13

BOR. 15-EAG-93
1981791.2 N, 1499301.4 E
BOR. TYPE-AUGER & SS
9 JUN 93

ITEM NO. 11



BOR. 16-EAG-93
1962376.1 N, 1488088.7 E
BOR. TYPE-AUGER & SS
9 JUN 93

ITEM NO. 12

BOR. 17-EAG-93
1940049.3 N, 1455608.2 E
BOR. TYPE-AUGER & SS
8 JUN 93

ITEM NO. 12

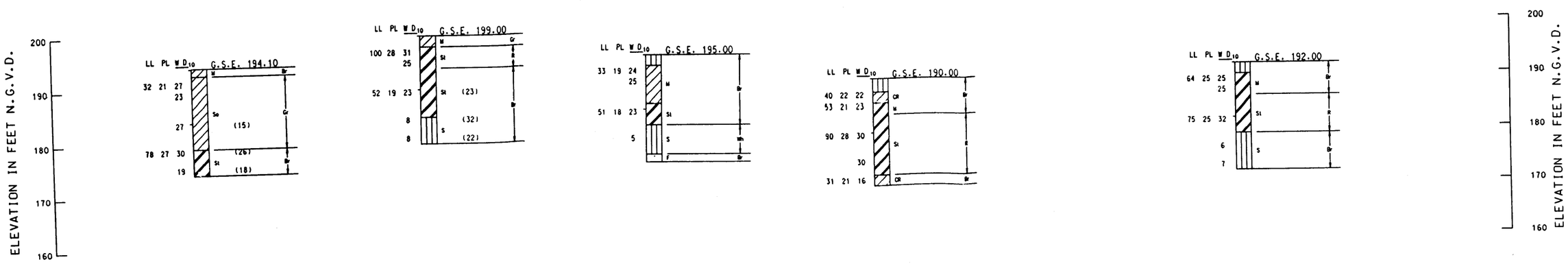
BOR. 18-EAG-93
1928468.4 N, 1487745.3 E
BOR. TYPE-AUGER & SS
9 JUN 93

ITEM NO. 13

BOR. 19-EAG-93
1907686.8 N, 1503458.7 E
BOR. TYPE-AUGER & SS
9 JUN 93

ITEM NO. 13

BOR. 20-EAG-93
1885291.4 N, 1525937.0 E
BOR. TYPE-AUGER & SS
8 JUN 93



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MEMPHIS, TENNESSEE

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

BORING LOGS

PLATE
II-15

LEGEND
FOR
SLOPE STABILITY PRESENTATION

SOIL PROFILE

EL. . . . . Elevation
FT. . . . . Feet
N.G.V.D. . . . . National Geodetic Vertical Datum
L.W.R.P. . . . . Low Water Reference Plane
BOR . . . . . Boring
X_1 . . . . . Neutral Block Left Base Coordinate
X_2 . . . . . Neutral Block Right Base Coordinate
Y . . . . . Neutral Block Base Elevation
▽ . . . . . Water Surface
BD . . . . . Before Drawdown
AD . . . . . After Drawdown
CP . . . . . Critical Partial Pool

SLOPE STABILITY LOADING CASES

AC . . . . . After Construction (End of Construction)
SD . . . . . Sudden Drawdown
PP . . . . . Partial Pool
SS . . . . . Steady Seepage
EQ . . . . . Earthquake
LT . . . . . Long Term

SOIL SHEAR STRENGTHS

C . . . . . Soil Cohesion - PSF
ϕ . . . . . Soil Friction Angle - Degrees
Q . . . . . Unconsolidated-Undrained Shear Strengths
R . . . . . Consolidated-Undrained Shear Strengths
S . . . . . Consolidated-Drained Shear Strengths

SLOPE STABILITY COMPUTER PROGRAMS

Program Name	Contact Office	Program Number	Reference Document
SSAØØ3	WES*	741-F3-RØØØ3	M.P. K-73-2
SSWØ28	WES	741-F3-RØØ28	M.P. K-76-3
CHANELS	Memphis District		M.P. GL-82-1
SSWT28**	WES		M.P. K-76-3
GEOSLOPE***	GEOCOMP CORP.		

*Waterways Experiment Station
**Modified Version of SSWØ28
***Geoslope is a microstation software package available through the GEOCOMP Corporation

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CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
LEGEND FOR SLOPE STABILITY PRESENTATION

PLATE
II-16

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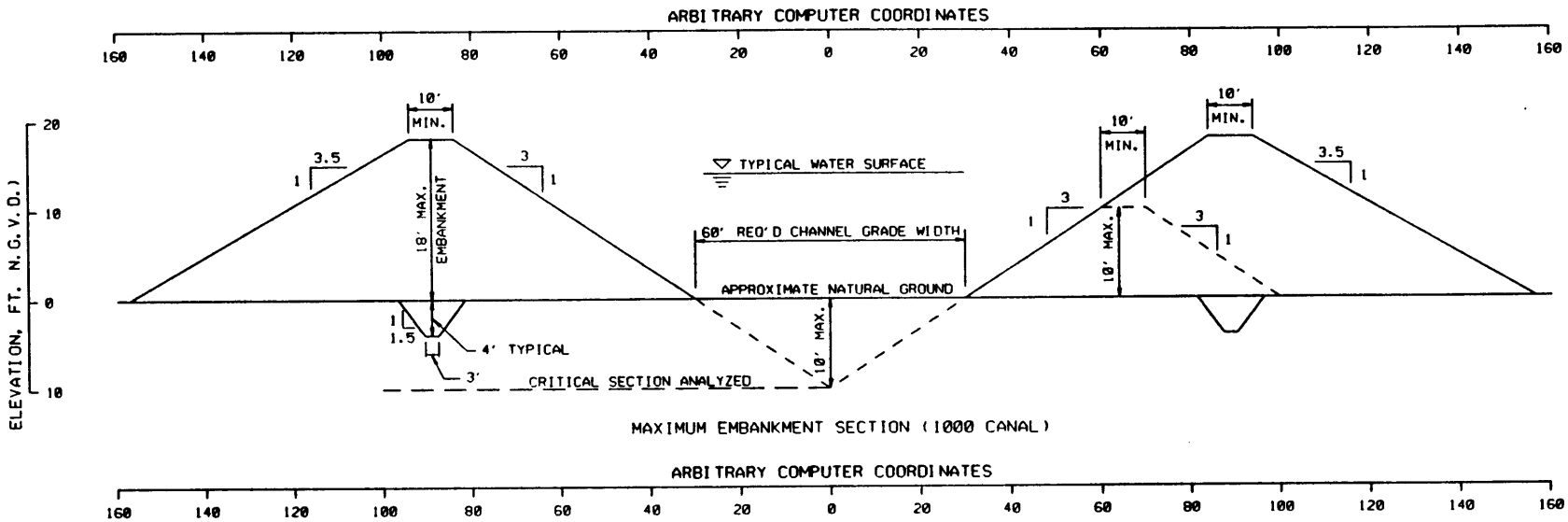
MEMPHIS, TENNESSEE

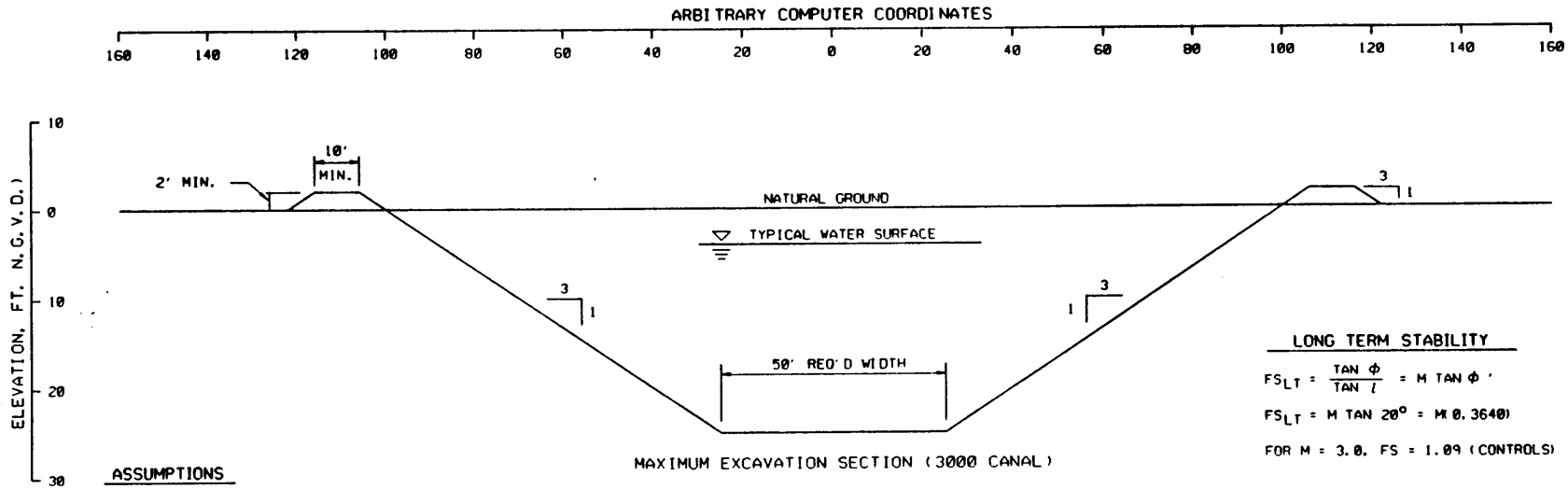
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

GENERAL SLOPE STABILITY

PLATE II-17



MAXIMUM EMBANKMENT SECTION (1000 CANAL)



MAXIMUM EXCAVATION SECTION (3000 CANAL)

LONG TERM STABILITY

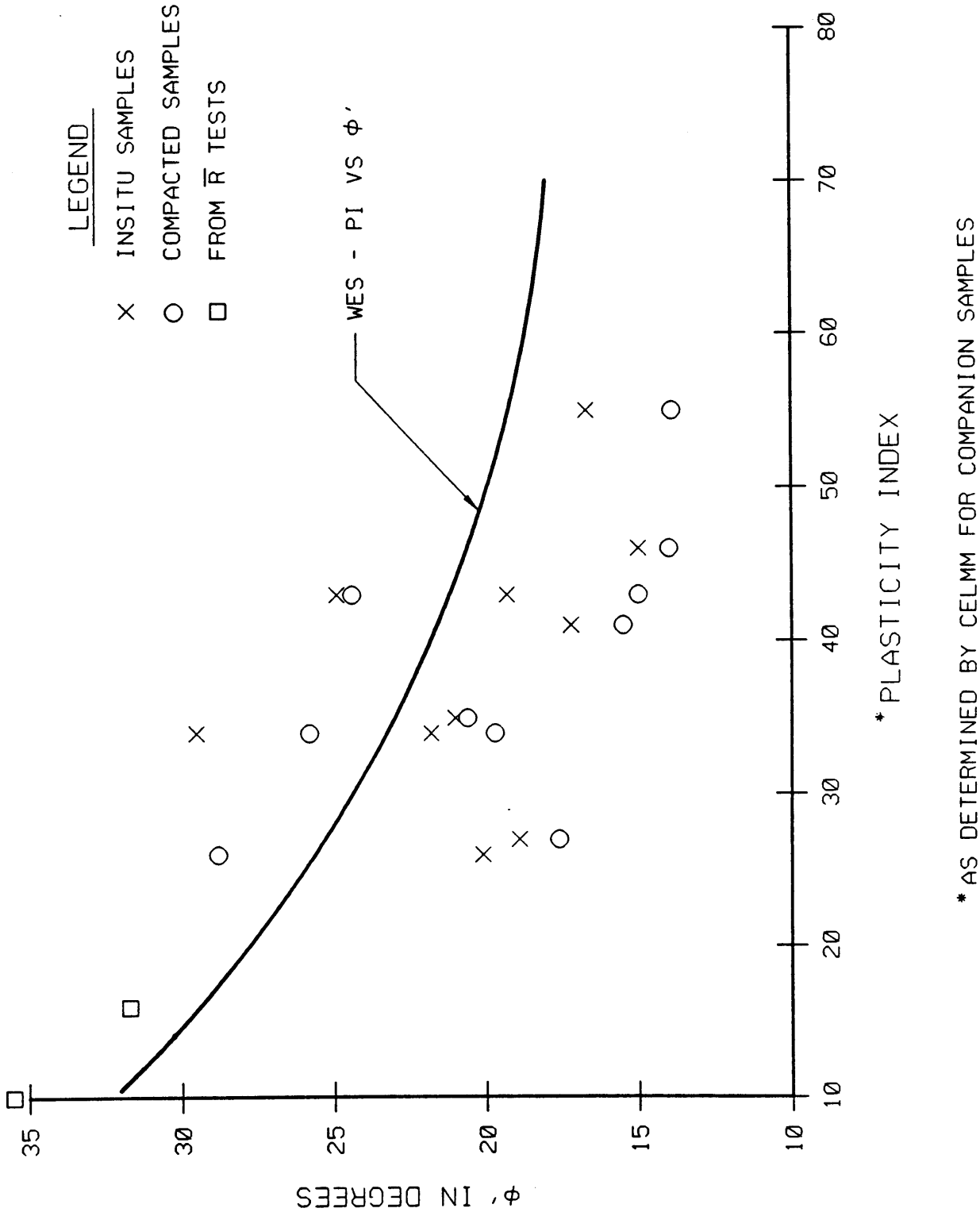
$$FS_{LT} = \frac{\tan \phi}{\tan i} = M \tan \phi'$$

$$FS_{LT} = M \tan 20^\circ = M\,0.3640)$$

FOR M = 3.0, FS = 1.09 (CONTROLS)

ASSUMPTIONS

1. THE MAXIMUM ELEVATION DIFFERENCE BETWEEN THE TOP OF THE EMBANKMENT AND CHANNEL EXCAVATION BOTTOM FOR THE WATER DISTRIBUTION CHANNELS OF EASTERN ARKANSAS WAS 26 FEET.
2. CRITICAL ANALYSES ASSUMING A CHANNEL SLOPE HEIGHT OF 28 FEET, 1V:3H SLOPES, AND BOTH CLAY AND/OR SILT STRENGTHS RESULTED IN A MINIMUM FACTOR OF SAFETY OF 1.35. CONSERVATIVE SHEAR STRENGTHS OF ϕ = 20° AND C = 300 PSF WERE UTILIZED FOR THE SILT AND ϕ = 0° AND C = 700 PSF FOR THE CLAY (CLAY CONTROLLED).
3. LONG TERM STABILITY CONTROLLED FOR THE CHANNEL SLOPE DESIGN. AN AVERAGE 'S' STRENGTH OF ϕ' = 20° WAS USED FOR THE ANALYSES. THIS AVERAGE VALUE WAS BASED ON TESTING OF RANDOM SOIL SAMPLES AND EXISTING SLOPES IN THE PROPOSED PROJECT AREA.
4. FOR EMBANKMENT HEIGHTS LESS THAN 10' ABOVE NATURAL GROUND, SIDE SLOPES OF 1V:3H ARE RECOMMENDED. FOR EMBANKMENT HEIGHTS GREATER THAN 10', A SLOPE OF 1V:3.5H IS RECOMMENDED FOR THE LANDSIDE SLOPE FOR MAINTENANCE CONSIDERATIONS. SECTIONS ARE SHOWN ABOVE.



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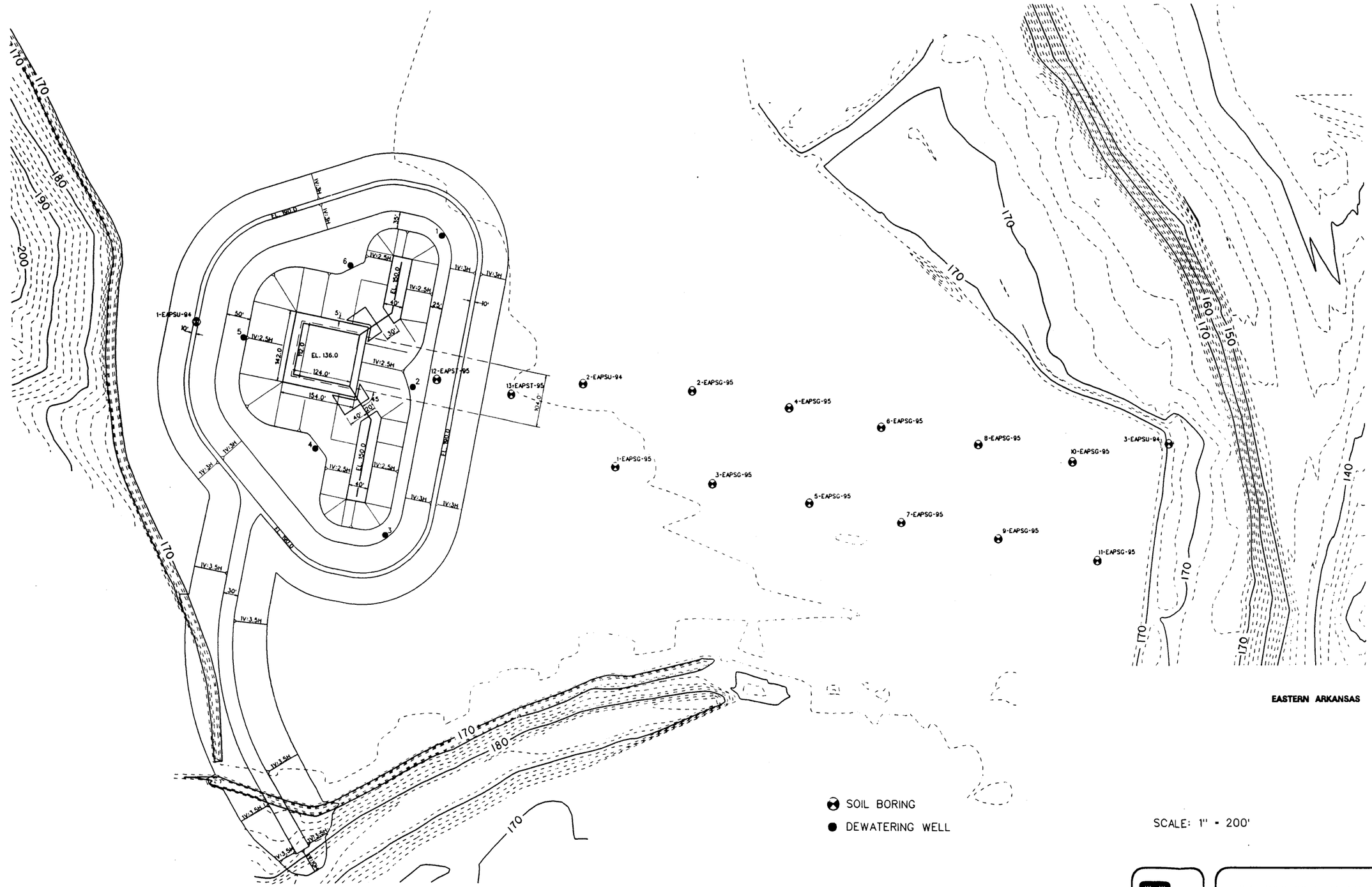
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

PI VS ϕ RELATIONSHIP

PLATE
II-18



EASTERN ARKANSAS

SCALE: 1" = 200'

US Army Corps of Engineers

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MEMPHIS, TENNESSEE

EASTERN ARKANSAS REGION COMPREHE
GRAND PRAIRIE AREA
DEMONSTRATION PROJE

MAJOR PUMPING
COFFERDAM AND EXCAV

RECURRENCE EQUATIONS - CENTRAL UNITED STATES[1]

REGION	SEISMIC AREA "A" (km^2)	a	M_bMAX
WITCHITA-QUACHITA	261,829	2.79	6.3
NEW MADRID "B"	27,506	2.99	6.5
NEW MADRID "A"	22,506	3.90	7.5
OZARK UPLIFT	36,557	3.19	6.7
RESIDUAL	6,185,019	1.83	5.3

[1] BOUNDARIES OF SEISMIC SOURCE ZONES AND COEFFICIENTS FOR MAGNITUDE-RECURRENCE EQUATIONS OBTAINED FROM WES MP S-73-1, 'STATE-OF-ART FOR ASSESSING EARTHQUAKE HAZARDS IN THE UNITED STATES, REPORT 12, CREDIBLE EARTHQUAKES FOR THE CENTRAL UNITED STATES', BY NUTTLI & HERRMANN, 1978.

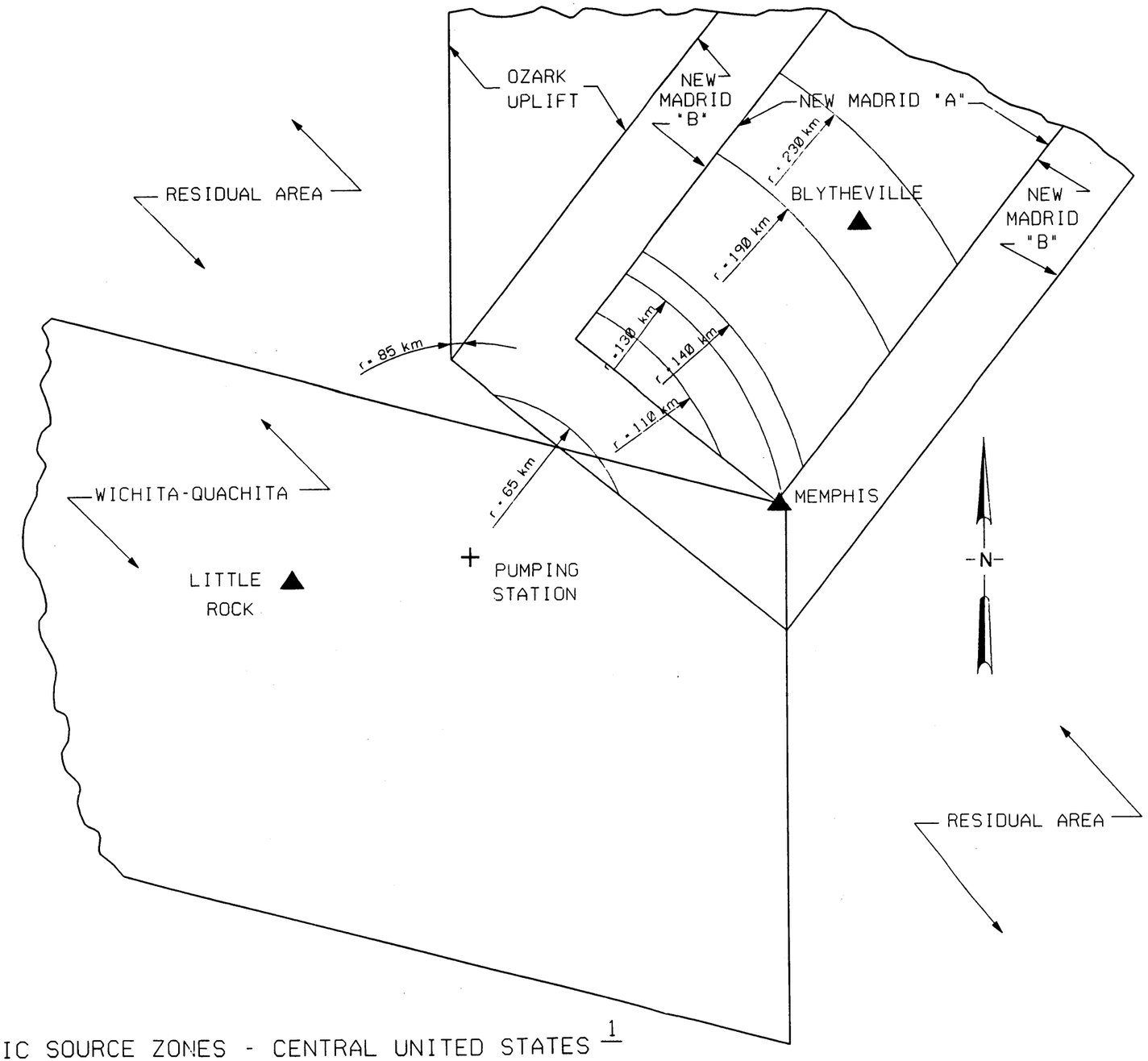
EFERENCES:

(1) NUTTLI, O.W. AND HERRMANN, R.B., "STATE-OF-THE-ART FOR ASSESSING EARTHQUAKE HAZARDS IN THE UNITED STATES, CREDIBLE EARTHQUAKE FOR THE CENTRAL UNITED STATES", MISCELLANEOUS PAPERS S-73-1, REPORT 12, DECEMBER 1978, U.S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION, CE, VICKSBURG, MS.

(2) NUTTLI, O. W. AND HERRMANN, R. B., "GROUND MOTION OF MISSISSIPPI VALLEY EARTHQUAKES", JOURNAL OF TECHNICAL TOPICS IN CIVIL ENGINEERING, ASCE, VOL. 110. NO. 1, MAY, 1984, PP. 54-68.

(3) SEED, H.B. AND IDRISS, I.M., "EVALUATION OF LIQUEFACTION POTENTIAL USING FIELD PERFORMANCE DATA", JOURNAL OF GEOTECHNICAL ENGINEERING, ASCE, VOL. 109, NO. 3, MARCH, 1983, PP. 459-482.

(4) SEED, H.B. AND IDRISS, I.M., "SIMPLIFIED PROCEDURE FOR EVALUATING SOIL LIQUEFACTION POTENTIAL", JOURNAL OF THE SOIL MECHANICS AND FOUNDATIONS DIVISION, ASCE, VOL. 97, NO. SMO, SEPT., 1971, PAGES 1255 AND 1265.



SEISMIC SOURCE ZONES - CENTRAL UNITED STATES[1]

SCALE: 1" = 50 KM

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MEMPHIS, TENNESSEE

EASTERN ARKANSAS REGION COMPREHE
GRAND PRAIRIE AREA
DEMONSTRATION PROJE
SEISMIC ANAL

I. EVALUATE LIQUEFACTION POTENTIAL AT SITE OF PUMPING STATION. ASSUME WATER AT SAND/CLAY INTERFACE: γ_{sat} = 115 PCF, γ_{sub} = 63 PCF.

SEMI-EMPIRICAL PROCEDURE TO EVALUATE LIQUEFACTION POTENTIAL

BORING 2-EAPSU-94

DEPTH	ELEV	SOIL TYPE	N_f	σ_o (ksf)	σ_o' (ksf)	N_1	C_N	N_2	τ/σ_o'	r_d	a/g
(ABOVE 36' TO BE REPLACED BY STRUCTURE)											
38	134	SP	26	4.60	3.23	21	0.81	17	0.18	0.88	0.22
44	128	SP	16	5.35	3.60	16	0.78	13	0.14	0.81	0.18*
48	124	SP	48	5.85	3.85	32	0.76	24	0.26	0.77	0.34
58	114	SP	55	7.10	4.48	35	0.70	25	0.27	0.71	0.37
68	104	SP	81	8.35	5.10	48	0.67	32	0.35	0.62	0.53
78	94	SP	100+	(ASSUMED TO BE NON-LIQUIFIABLE)							
88	84	SP	100+	(ASSUMED TO BE NON-LIQUIFIABLE)							

* CONTROLS (FIRST TO LIQUEFY)

II. UTILIZING THE ATTENUATION RELATIONSHIP CURVES FOR THE MISSISSIPPI VALLEY (SEE FIG. 6, REF. 2) AND THE CHART EVALUATING LIQUEFACTION POTENTIAL FOR DIFFERENT MAGNITUDE (M_b) EARTHQUAKES (SEE FIG. 13, REF. 3) THEN THE MAXIMUM DISTANCE (r) FROM THE EPICENTER TO THE SITE THAT WOULD PRODUCE LIQUEFACTION CAN BE DETERMINED FOR DIFFERENT MAGNITUDES OF EARTHQUAKES. FURTHERMORE, THE TOTAL ANNUAL RISK FACTOR (R_T) FOR AN EARTHQUAKE TO CAUSE LIQUEFACTION OF THE CONTROLLING SAND STRATUM CAN BE DETERMINED AS THE SUM OF THE INDIVIDUAL RISKS FOR ALL SEISMIC ZONES.

CALCULATION OF ANNUAL RISK FACTOR OF LIQUEFACTION

BORING 2-EAPSU-94, STRATUM AT 44' DEPTH, N_2 = 13, σ_o = 5.35, σ_o' = 3.60

EXISTING CONDITIONS

M_b	N_c	I	τ/σ_o'	a/g	r(km)	P_A	P_{AVG}	RISK
WICHITA-QUACHITA SEISMIC ZONE; a = 2.79; M_b(MAX) = 6.3								
5.25	0.009120		0.205	0.262	7	0.001539		
		0.003750					0.002341	0.000009
5.50	0.005370		0.195	0.249	10	0.003142		
		0.002208					0.006661	0.000015
5.75	0.003162		0.185	0.236	18	0.010179		
		0.001300					0.012692	0.000016
6.00	0.001862		0.180	0.230	22	0.015205		
		0.000876					0.055119	0.000048
6.30	0.000986		0.150	0.192	55	0.095033		
								0.000088
NEW MADRID 'B' SEISMIC ZONE; a = 2.99; M_b(MAX) = 6.5								
6.25	0.001738		0.155	0.198	43	(NO RISK TO PUMPING STATION)		
		0.000715					0.005453	0.000004
6.50	0.001023		0.142	0.181	65	0.010907		
								0.000004
NEW MADRID 'A' SEISMIC ZONE; a = 3.90; M_b(MAX) = 7.5								
6.75	0.004898		0.135	0.173	95	(NO RISK TO PUMPING STATION)		
		0.002565					0.083978	0.000215
7.10	0.002333		0.120	0.153	140	0.167955		
		0.001333					0.387230	0.000516
7.50	0.001000		0.110	0.141	230	0.606505		
								0.000731
OZARK UPLIFT SEISMIC ZONE; a = 3.19; M_b(MAX) = 6.7								
6.50	0.001622		0.142	0.181	65	(NO RISK TO PUMPING STATION)		
		0.000560					0.000462	≈ 0.
6.70	0.001062		0.138	0.176	85	0.000923		
								≈ 0.
RESIDUAL EVENTS SEISMIC ZONE; a = 1.83; M_b(MAX) = 5.3								
5.30			0.20	0.256	7	(NO RISK TO PUMPING STATION)		
								≈ 0.

Σ RISKS = 0.000823

III. IF THE CONTROLLING STRATUM AT A DEPTH OF 44 FT WAS DENSIFIED THE RISK OF OF LIQUEFACTION COULD BE REDUCED. ASSUMING DENSIFICATION OF THE EXISTING MATERIALS TO A RELATIVE DENSITY OF 80% WOULD RESULT IN A FIELD N VALUE OF N_f = 33 (SEE FIG. 13, REF. 4) WHICH TRANSLATES TO N_2 = 19. IF THE CONTROLLING STRATUM WAS REPLACED WITH SELECT BACKFILL AT 80% RELATIVE DENSITY VALUES OF N_f = 33 AND N_2 = 26 COULD BE ACHIEVED. THE RISK OF LIQUEFACTION ASSOCIATED WITH EACH N_2 VALUE IS COMPUTED BELOW. AS SHOWN IN PARAGRAPH II APPROXIMATELY 90% OF THE TOTAL RISK IS DERIVED FROM THE NEW MADRID 'A' SEISMIC ZONE. THEREFORE, IN THE FOLLOWING ANALYSES IT IS ASSUMED THAT THE TOTAL RISK APPROXIMATES THE RISK FOR THE NEW MADRID 'A' SEISMIC ZONE.

CALCULATION OF ANNUAL RISK FACTOR OF LIQUEFACTION

BORING 2-EAPSU-94, STRATUM AT 44' DEPTH, σ_o = 5.35, σ'_o = 3.60

IMPROVED CONDITIONS

M_b	N_c	I	τ/σ'_o	a/g	r(km)	P_A	P_{AVG}	RISK
CASE I								
NEW MADRID 'A' SEISMIC ZONE; a = 3.90; M_b (MAX) = 7.5; N_2 = 19								
6.75	0.004898		0.190	0.243	65	(NO RISK TO PUMPING STATION)		
		0.002565					0.019551	0.000050
7.10	0.002333		0.175	0.224	110	0.039101		
		0.001333					0.233494	0.000311
7.50	0.001000		0.160	0.204	190	0.427886		
								0.000361
CASE II								
NEW MADRID 'A' SEISMIC ZONE; a = 3.90; M_b (MAX) = 7.5; N_2 = 26								
7.10	0.002333		0.248	0.317	72	(NO RISK TO PUMPING STATION)		
		0.001333					0.058318	0.000078
7.50	0.001000		0.225	0.288	130	0.116636		
								0.000078

IV. DETERMINE COST EFFECTIVENESS FOR VARIOUS METHODS OF GROUND MODIFICATION TO REDUCE THE RISK OF LIQUEFACTION. ASSUME DAMAGES DUE TO LIQUEFACTION EQUALS $5,000,000. (DAMAGES BASED ON COSTS TO PRESSURE GROUT THE FOUNDATION, MINOR DAMAGE INSIDE STRUCTURE, RECONNECTING PIPES AND UTILITIES AND REPLACING INLET WALLS). EFFECTIVENESS OF VARIOUS METHODS IS MEASURED AS SAVINGS IN ANNUAL DAMAGE ASSOCIATED WITH EACH METHOD. ANNUAL DAMAGES ARE CONVERTED TO PRESENT WORTH BASED ON 100-YEAR LIFE OF STRUCTURE AND AN INTEREST RATE EQUAL TO 7.375%.

CASE I - EXISTING FOUNDATION SANDS DENSIFIED

BENEFITS:

SAVINGS IN ANNUAL DAMAGES = (0.000823 - 0.000361)($5,000,000) = $2,310

PRESENT WORTH (n = 100 YEARS, i = 7.375%, A = 2,310) = $31,300

COSTS:

ASSUME OVEREXCAVATION [120' X 130' + 2(80' X 80')]12' = 12,622 C.Y.

UNIT COST = $4.50 C.Y. ($2.00 EXCAVATE, $2.50 BACKFILL & DENSIFY)

TOTAL COST = (12,622)(4.50) = $56,800

BENEFITS/COST:

B/C = 31,300/56,800 = 0.55

CASE II - FOUNDATION SANDS REPLACED WITH SELECT BACKFILL

BENEFITS:

SAVINGS IN ANNUAL DAMAGES = (0.000823 - 0.000078)($5,000,000) = $3,725

PRESENT WORTH (n = 100 YEARS, i = 7.375%, A = 3,725) = $50,468

COSTS:

ASSUME OVEREXCAVATION [120' X 130' + 2(80' X 80')]12' = 12,622 C.Y.

UNIT COST = $4.50 C.Y. ($2.00 EXCAVATE, $2.50 BACKFILL & DENSIFY)

SELECT BACKFILL = $10.00 C.Y.

TOTAL COST = (12,622)(10 + 4.50) = $183,019

BENEFITS/COST:

B/C = 50,468/183,019 = 0.28

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CASE III - INSITU DENSIFICATION, STONE COLUMNS

BENEFITS:

ASSUME ELIMINATION OF LIQUEFACTION RISK

SAVINGS IN ANNUAL DAMAGES = (0.000823)($5,000,000) = $4,115

PRESENT WORTH (n = 100 YEARS, i = 7.375%, A = 4,115) = $55,752

COSTS:

ASSUME COLUMNS ON 5' CENTERS, 12' DEEP; LINEAL FEET = 14,000 L.F.

MOBILIZATION = $50,000

UNIT COST = $17.50 L.F.

TOTAL COST = 50,000 + (14,000)(17.50) = $295,000

BENEFITS/COST:

B/C = 55,752/295,000 = 0.20

V. IN SUMMARY IT IS NOT COST EFFECTIVE TO PERFORM GROUND MODIFICATIONS FOR THE PURPOSE OF REDUCING OR ELIMINATING THE RISKS OF EARTHQUAKE INDUCED LIQUEFACTION

DEFINITIONS:

$1/N_c$ = RECURRENCE PERIOD IN YEARS.

$\text{LOG } N_c = a - 0.92\, M_b$ (PARA. 50, REF. 1)

a = COEFFICIENT INDICATIVE OF THE NUMBER OF EVENTS PER SEISMIC AREA 'A' UP TO 100,000 km^2

M_b = BODY WAVE MAGNITUDE.

N_f = FIELD RESULTS OF STANDARD PENETRATION TEST (SPT) BLOWS/FT.

N_1 = RESULTS OF SPT CORRECTED FOR PRESENCE OF FINES.

$$N_1 = 15 + \frac{(N - 15)}{2}$$

C_n = CORRECTION FACTOR FOR EFFECTIVE OVERBURDEN PRESSURE (FIG. 4, REF. 3)

N_2 = N_1 CORRECTED FOR EFFECTIVE OVERBURDEN PRESSURE.

$$N_2 = C_c N_1$$

σ_o = TOTAL OVERBURDEN PRESSURE (ksf)

σ_o' = EFFECTIVE OVERBURDEN PRESSURE (ksf)

τ/σ_o' = CYCLIC STRESS RATIO CAUSING LIQUEFACTION AT σ_o' = 1 tsf (FIG. 9, REF. 3)

r_d = STRESS REDUCTION COEFFICIENT (FIG. 4, REF. 4)

a/g = ACCELERATION/GRAVITY AT WHICH LIQUEFACTION WILL OCCUR

$$a/g = \left(\frac{\tau}{\sigma_o'}\right)\left(\frac{\sigma_o'}{\sigma_o}\right)\left(\frac{1}{0.65\, r_d}\right) \quad \text{(EQ. 1, REF. 3)}$$

r = MAXIMUM RADIUS FROM EPICENTER AT WHICH LIQUEFACTION WILL OCCUR

I = INCREMENTAL RECURRENCE $(N_{c(n)} - N_{c(n+1)})$

P_A = AREA OF SEISMIC SOURCE ZONE ENCOMPASSED BY RADIUS "r" DIVIDED BY SEISMIC AREA 'A' FOR 'A' $\leq$ 100,000 km^2

$$P_{AVG} = \frac{(P_{A(n)} + P_{A(n+1)})}{2}$$

RISK = $I \times P_{AVG}$ = INCREMENTAL ANNUAL RISK FACTOR FOR AN EARTHQUAKE OF M_b = X TO CAUSE LIQUEFACTION OF THE CONTROLLING SAND STRATUM.

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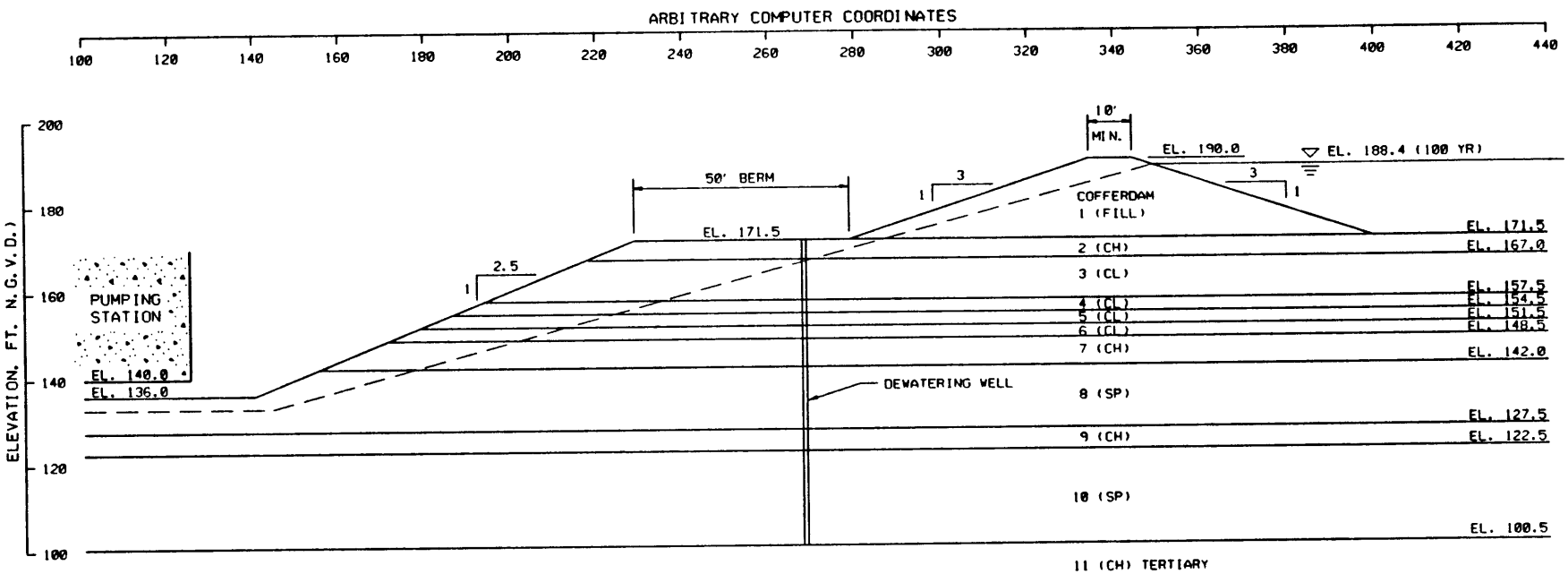
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
MAJOR PUMPING STATION
EXCAVATION AND COFFERDAM
STABILITY ANALYSIS

PLATE
II-22



STRATIFICATION FROM BORING 1-EAPSU-94

SOIL SHEAR STRENGTHS - BORING 1-EAPSU-94

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				φ (°)	C (PSF)	φ (°)	C (PSF)	φ (°)	C (PSF)
1	FILL	190.0-170.0	115	0	750	12	375	23	0
2	CH	171.5-167.0	120	0	850	11	425	22.5	0
3	CL	167.0-157.5	120	0	850	12	425	25	0
4	CL	157.5-154.5	120	0	500	14	250	28+	0
5	CL	154.5-151.5	125	0	800	12	400	25	0
6	CL	151.5-148.5	120	0	1100	14	550	28+	0
7	CH	148.5-142.0	120	0	850	11	425	23	0
8	SP	142.0-127.5	125	30	0	30	0	30	0
9	CH	127.5-122.5	120	0	1000	10	500	19.5	0
10	SP	122.5-100.5	125	33	0	33	0	33	0
11	CH	BELOW 100.5	120	0	2000	10	100	21	0

ASSUMPTIONS

1. ANALYSES ASSUMED THAT THE DEWATERING SYSTEM SHALL BE CAPABLE OF MAINTAINING THE GROUND WATER AT OR BELOW EL. 133.0 FOR THE EXCAVATION.
2. THE PHREATIC PROFILE OUTSIDE OF THE WELLS VARIED FROM EL. 150.0 (NORMAL GROUND WATER) TO EL. 188.0. RECORD FLOOD IS EL. 187.6.
3. BOTH Q AND S STRENGTHS WERE USED IN THE ANALYSES.
4. LOADING FOR ADDITIONAL FILL PLACEMENT WAS CHECKED IN THE ANALYSIS.
5. BOTH CIRCULAR AND WEDGE TYPE METHODS WERE UTILIZED
6. ANALYSES UTILIZING A COMPOSITE BORING FROM BORINGS 12-EAPST-95, 13-EAPST-95 AND 2-EAPSU-94 RESULTED IN ADEQUATE FACTORS OF SAFFETY FOR ALL CASES WITH A 25 FOOT BERM. THE ANALYSIS IS NOT PRESENTED ON THIS PLATE.
7. THE FACTORS OF SAFETY FOR THE ANALYSIS ABOVE ARE AS FOLLOWS:

	Q	S
MIN. FS FOR EXCAVATION	1.64	1.25
MIN. FS FOR COFFERDAM	1.72	1.72
MIN. OVERALL FS*	1.25	1.17 (CONTROLS)

* @ EL. 122.5

LONG TERM STABILITY (EXCAVATION)

$$FS_{LT} = \frac{\tan \phi}{\tan i} = M \tan \phi'$$

$$FS_{LT} = M\left[\frac{4.5 \tan 22.5° + 12.5 \tan 25° + 6 \tan 28° + 6.5 \tan 23° + 6 \tan 30°}{35.5}\right]$$

FS_{LT} @ EL. 136.0 = M (0.4819) FOR M = 2.5, FS = 1.20

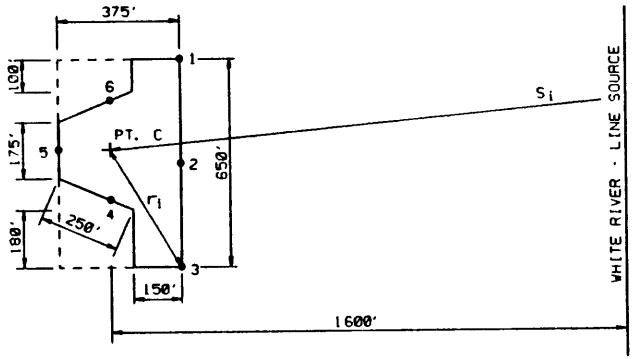
FS_{LT} @ EL. 142.0 = M (0.4624) FOR M = 2.5, FS = 1.16 (CONTROLS)

LONG TERM STABILITY (COFFERDAM)

$$FS_{LT} = \frac{\tan \phi}{\tan i} = M \tan \phi'$$

S STRENGTH OF 23° WAS CONSERVATIVELY SELECTED FOR THE FILL MATERIAL PLACED IN THE COFFERDAM

FS_{LT} = M (TAN 23°) = M (0.4245) FOR M = 3.0, FS = 1.27 (CONTROLS)



STRUCTURE EXCAVATION

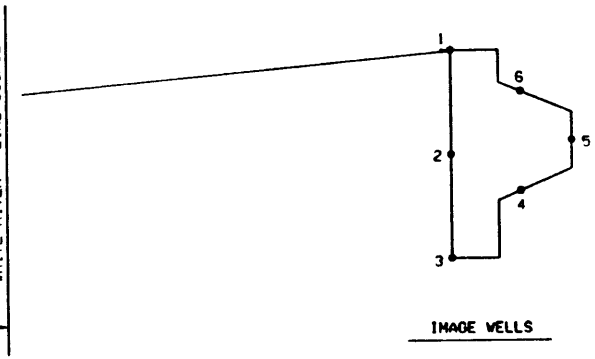


IMAGE WELLS

ASSUMPTIONS

1. TERTIARY ELEVATION WAS CONSERVATIVELY BASED ON BORING 2-EAPU-94 INSTEAD OF BORINGS 12-EAPST-95 AND 13-EAPST-95.
2. THE DEWATERING SYSTEM WILL BE REQUIRED TO LOWER THE WATER TABLE TO EL. 133.0 OR THREE FEET BELOW THE EXCAVATION.
3. HEAD WATER ELEVATION OF 188.0 IS BASED ON THE 100 YEAR WHITE RIVER FLOOD.
4. THE WHITE RIVER CHANNEL IS LOCATED APPROXIMATELY 1600 FEET AWAY AND WILL ACT AS THE LINE SOURCE TO THE EXCAVATION.
5. PERMEABILITY OF AQUIFER, $K_h = 800 \times 10^{-4}$ CM/SEC = 0.158 FT/MIN.
6. DEPTH OF AQUIFER = 80 FT.
7. A SECTION PARALLEL WITH THE INLET CHANNEL IS SHOWN ON PLATE II-24.

DETERMINE EQUIVALENT RADIUS A_E OF WELL SYSTEM
ASSUME BASICALLY SQUARE

$$A_E = (4/\pi)\sqrt{(650/2)(375/2)} = 314.3 \text{ FT} = r_w$$

COMPUTE RADIUS OF INFLUENCE (R):

$D_{10} = 0.17$MM, $K = 800 \times 10^{-4}$ CM/SEC ≈ 0.158 FT/MIN

$$R = C(H - h_c)\sqrt{K}$$

$$R = 3(188 - 133)\sqrt{800} = 4.667 \text{ FT}$$

COMPARE 2L VS R :

$2L = 2(1600) = 3200'$ $R = 4.667$

$\therefore$ SINCE 2L IS LESS THAN R, THE EQUATIONS FOR A LINE SOURCE OF SEEPAGE ARE APPLICABLE.

ESTIMATE TOTAL FLOW USING RADIUS A_E OF AN EQUIVALENT LARGE DIAMETER WELL FOR ARTESIAN FLOW CONDITIONS.

$$Q_T = \frac{2\pi KD(H-h_c)}{\ln(2L/r_w)}$$

$$Q_T = \frac{2\pi(0.158)(80)(112-57)}{\ln(3200/314.3)} = 1881.4 \text{ CFM} = 14{,}073 \text{ GPM}$$

ASSUME 16" DIAMETER FULLY PENTRATING DEEP WELLS WILL BE USED. MAXIMUM FLOW FOR 16" WELLS IS 2400 GPM.

NO. OF WELL = 14,073 GPM/2400 GPM = 5.86 OR 6 WELLS

FLOW PER WELL 1881/6 = 313.5 CFM = Q_w

DETERMING HEAD AT CENTER OF EXCAVATION ASSUMING METHOD OF IMAGE WELLS AND LAYOUT SHOWN.

HEAD AT POINT C

WELL	S_i	r_i	$\ln S_i/r_i$
1	2960	365	2.09
2	2940	220	2.59
3	2970	420	1.96
4	3160	150	3.05
5	3330	170	2.97
6	3160	150	3.05
			15.71

$F'_c = 15.71(313.5) = 4925$

$H-h_c = F'_c/2\pi KD = 4925/[2\pi(0.158)(80)] = 62.0'$

$H-h_c = 62.0$

$h_c = 112 - 62 = 50' < 57'$, O.K.

REFERENCES: 1. TM 5-818-5, "DEWATERING AND GROUNDWATER FOR DEEP EXCAVATIONS"
2. BORINGS 2-EAPSU-94, 12 EAPST-95 AND 13-EAPST-95

NOTE: DEWATERING ANALYSIS AND LAYOUT ARE FOR ESTIMATING PURPOSES ONLY.

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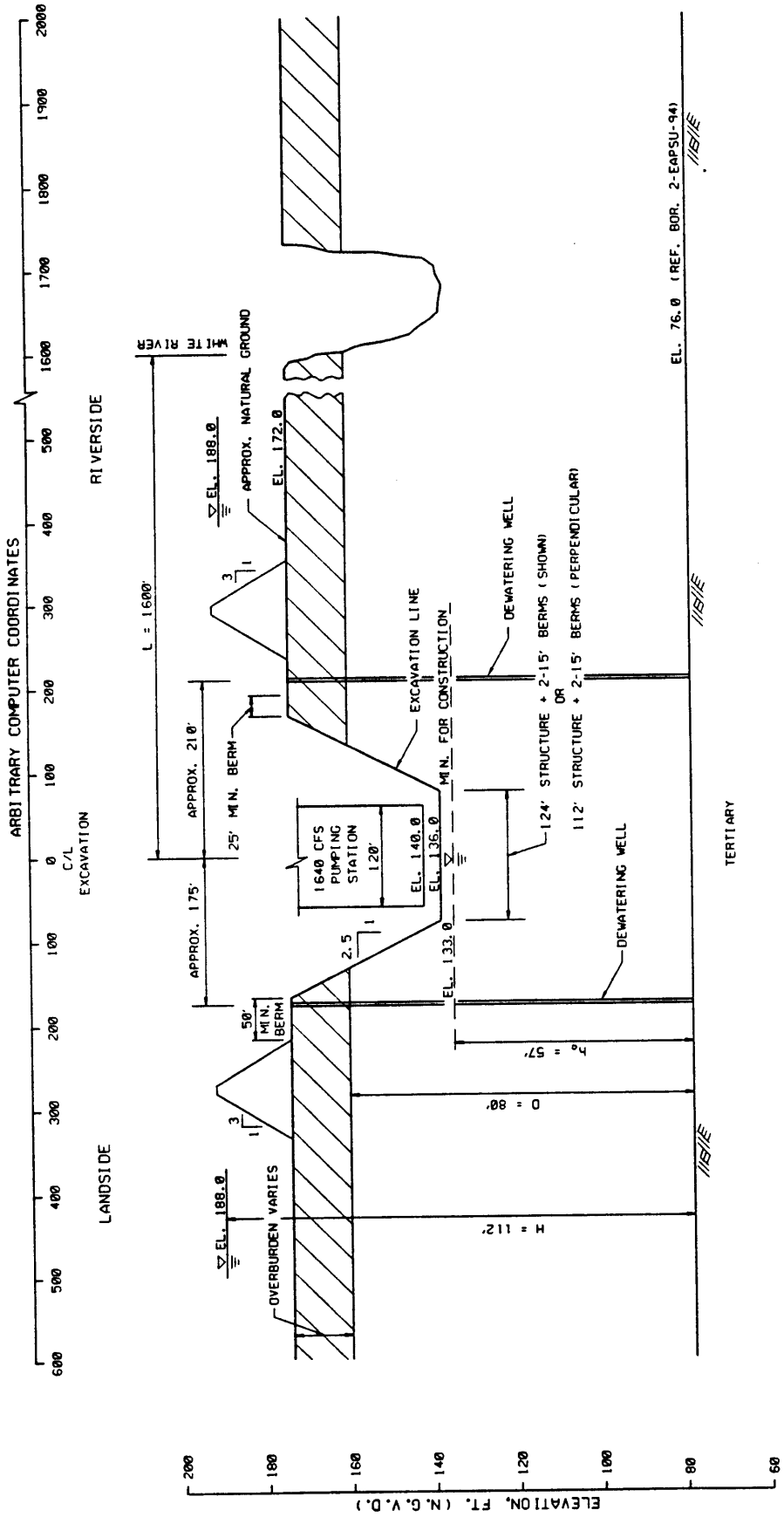
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

MAJOR PUMPING STATION DEWATERING ANALYSIS

PLATE II-23



SECTION SHOWN IS PARALLEL WITH INLET CHANNEL THROUGH CENTER OF THE EXCAVATION AND PUMPING STATION

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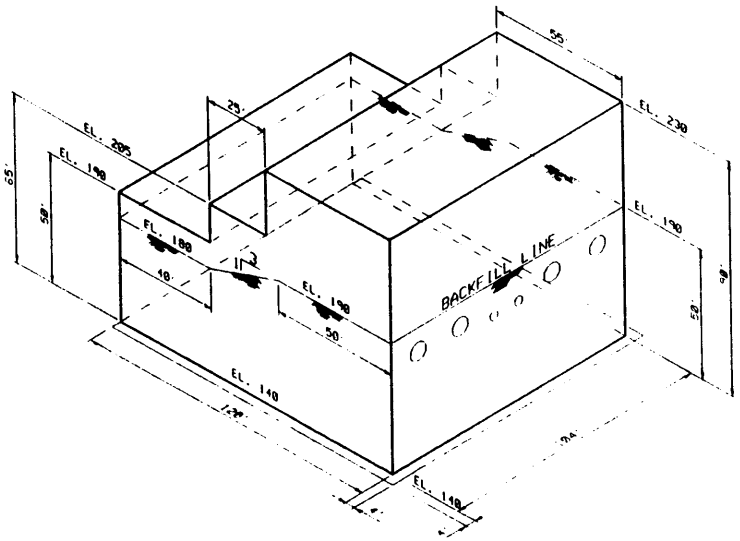
DEMONSTRATION PROJECT

MAJOR PUMPING STATION DEWATERING ANALYSIS

PLATE
II-24



UPLIFT

BASE WIDTH = (120' + 4')(104' + 4' + 4') = 124' X 112' = 13,888 S.F.

PRESSURE AT EL. 140.0 = (188 - 140)(0.0625) = 3.0 KSF

UPLIFT FORCE = 13,888(3.0) = 41,664 KIPS

CRITERIA FROM ETL 1110-2-307 WAS USED IN DETERMINING THE FACTORS OF SAFETY RELATED TO UPLIFT PRESSURES.

$$SF_f = \frac{W_s + W_c + S}{U - W_g} \quad \text{OR} \quad \frac{\text{RESISTING}}{\text{UPLIFT}}$$

W_s - WEIGHT OF STRUCTURE INCLUDING WEIGHTS OF FIXED EQUIPMENT AND SOIL ABOVE THE TOP SURFACE OF THE STRUCTURE. THE MOIST OR SATURATED UNIT WEIGHT WAS USED ABOVE THE GROUNDWATER TABLE AND SUBMERGED UNIT WEIGHT WAS USED BELOW THE GROUNDWATER TABLE.

W_c - WEIGHT OF WATER CONTAINED WITHIN THE STRUCTURE WHICH IS CONTROLLED BY A MECHANICAL OPERATOR.

S - SURCHARGE LOAD (NONE)

U - UPLIFT FORCES ACTING ON THE BASE OF THE STRUCTURE.

W_g - WEIGHT OF SURCHARGE WATER ABOVE TOP SURFACE OF THE STRUCTURE WHICH IS CONTROLLED BY GRAVITY FLOW.

RESISTING UPLIFT

W_s - WEIGHT OF STUCTURE INCLUDING EQUIPMENT, PARTITION BLOCK WALLS, GATES, ETC. = $40,000^k$

SOIL ON EXTERIOR FOOTING (SUBMERGED, EL. 188 TO 144) = (44')(4')(352')(0.0626) = $3,878.0^k$

SOIL ON EXTERIOR FOOTING (SATURATED, EL. 190 TO 188) = (2')(4')(352')(0.120) = 337.9^k

TOTAL $44,215.9^k$

W_c = [(20.5)(15.75)4 + (20.5)(9.3)2](188-144)(0.0624) = 4592.8^k

W_g = [(12.5)(15.75)4 + (12.5)(9.3)2](44)(0.0624) = 2800.5^k

$$SF_f = \frac{44,215.9 + 4592.8}{41,664 - 2800.5} = 1.26$$ O.K. (FS = 1.3 REQUIRED FOR UNUSUAL OPERATION)

A MAXIMUM OF ONE PUMP BAY CAN BE DEWATERED DURING HIGH WATER

W_c = 20.5(15.75)(44)(0.0624) = 886.5^k 4592.8 - 886.5 = 3706.3^k

$$SF_f = \frac{44,215.9 + 3706.3}{41,664 - 2800.5} = 1.23$$ O.K. (FS = 1.1 REQUIRED FOR EXTREME MAINTENANCE)

ASSUME A 10 FOOT LAG FOR A SUDDEN DROP IN THE WHITE RIVER BETWEEN THE GROUND WATER AROUND THE STRUCTURE AND RIVER SURFACE.

W_c = [(20.5)(15.75)4 + (20.5)(9.3)2](178-144)(0.0624) = 3549^k

W_g = [(12.5)(15.75)4 + (12.5)(9.3)2](34)(0.0624) = 2164^k

$$SF_f = \frac{44,215.9 + 3549}{41,664 - 2800.5} = 1.23$$

ALTHOUGH THE FACTOR OF SAFETY IS BELOW THE RECOMMENDED FS = 1.3, THE STRUCTURE IS SAFE AGAINST UPLIFT SINCE FULL UPLIFT WAS USED IN THE ANALYSIS, SUBMERGED UNIT WEIGHTS WERE USED FOR THE SOIL ABOVE THE EXTERIOR FOOTING AND SIDE FRICTION AROUND THE STRUCTURE WAS IGNORED. THIS ALSO WOULD BE A VERY EXTREME UPLIFT LOADING CONDITION.

NORMAL OPERATION OF THE PUMPING STATION (WHITE RIVER AT EL. 168)

$W_s = 44,215.9^k$ $W_g = 1532^k$

$W_c = 2505^k$ U = (168-140)(0.0624)(13,888) = $24,265^k$

$$SF_f = \frac{44,215.9 + 2505}{41,664 - 2800.5} = 1.80$$ O.K. (FS = 1.5 REQUIRED)

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DEMONSTRATION PROJECT

MAJOR PUMPING STATION
UPLIFT ANALYSIS

PLATE
II-25

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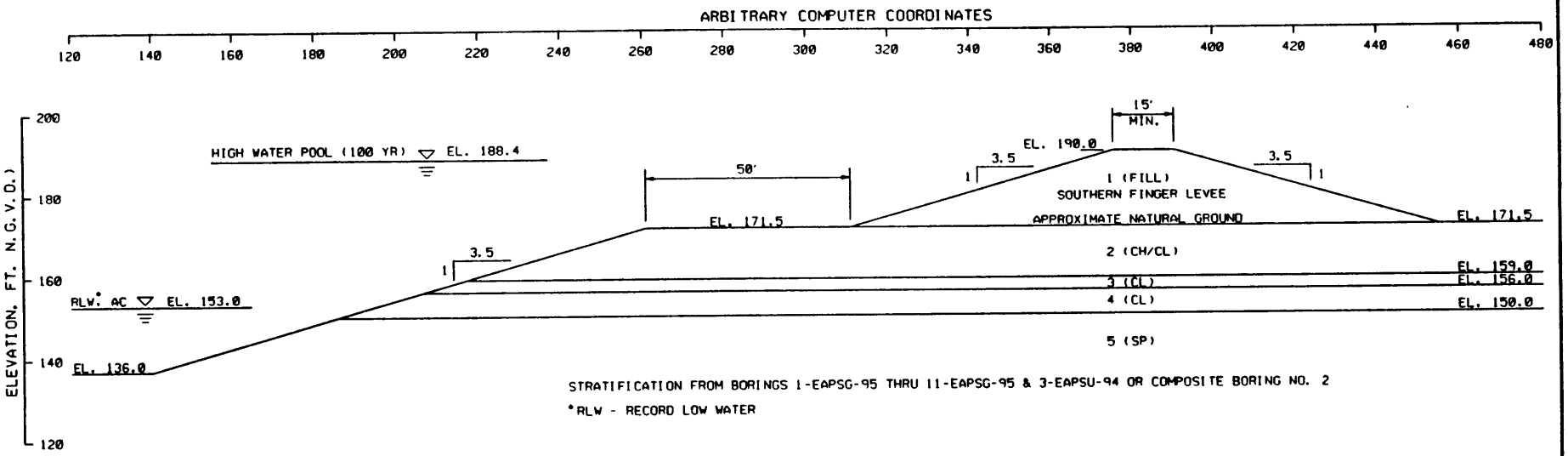
DEMONSTRATION PROJECT
MAJOR PUMPING STATION
INLET CHANNEL
STABILITY ANALYSIS

PLATE
II-26



SOIL SHEAR STRENGTHS
BORINGS 1-EAPSG-95 THRU 11-EAPSG-95 & 3-EAPSU-94 OR COMPOSITE BORING NO. 2

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				Φ (°)	C (PSF)	Φ (°)	C (PSF)	Φ (°)	C (PSF)
1	FILL	190.0-171.5	120	0	750	11	375	23	0
2	CH/CL	171.5-159.0	115	0	700	12	350	24	0
3	CL	159.0-156.0	120	0	600	14	300	28	0
4	CL	156.0-150.0	115	0	350	14	175	28	0
5	SP	BELOW 150.0	125	30	0	30	0	30	0

SOIL SHEAR STRENGTHS
BORINGS 2-EAPSU-94, 12-EAPST-95 & 13-EAPST-95 OR COMPOSITE BORING NO. 1

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				Φ (°)	C (PSF)	Φ (°)	C (PSF)	Φ (°)	C (PSF)
1	FILL	190.0-171.5	115	0	750	11	375	23	0
2	CH/CL	171.5-161.0	115	0	850	11	425	23	0
3	CL	161.0-158.0	120	0	500	13	250	27	0
4	ML	158.0-155.0	120	20	300	14	150	28	0
5	SP	155.0-125.0	125	30	0	15	0	30	0
6	SP	125.0- 87.0	125	34	0	17	0	34	0
7	CH	BELOW 87.0	115	0	2000		1000		0

ASSUMPTIONS

1. THE NORTHERN INLET FINGER LEVEE WHICH EXTENDS 100 FEET FROM THE RETAINING WALL WAS ANALYZED USING A COMPOSITE BORING FROM BORINGS 12-EAPST-95, 13-EAPST-95 & 2-EASPU-94 OR COMPOSITE BORING NO. 1. CONSERVATIVE SHEAR STRENGTHS WERE SELECTED FOR THE COMPOSITE BORING AND BOTH Q AND S STRENGTHS WERE UTILIZED IN THE ANALYSES. THE SEMI COMPACTED FILL WAS PLACED WITHOUT A BERM ON A CONTINUOUS SLOPE OF 1V:3.5H. THE MINIMUM FACTOR OF SAFETY WAS 1.77 USING Q STRENGTHS AND 1.50 USING S STRENGTHS. THE WATER LOADING WAS AT EL. 153.0 FOR AFTER CONSTRUCTION AND WAS VARIED TO HIGH WATER AT EL. 188.0 FOR ALL STABILITY ANALYSES.

2. A COMPOSITE BORING AS SHOWN ABOVE WAS UTILIZED FOR ANALYSIS OF THE SOUTHERN FINGER LEVEE WHICH EXTENDS APPROXIMATELY 600 FEET FROM THE RETAINING WALL. THIS COMPOSITE BORING UTILIZES CONSERVATIVE SHEAR STRENGTHS SELECTED FROM THE ELEVEN GENERAL SAMPLE BORINGS AND UNDISTURBED BORING 3-EAPSU-94 TAKEN ALONG THE PROPOSED INLET CHANNEL. Q AND S STRENGTHS UTILIZING BOTH CIRCULAR AND WEDGE TYPE FAILURES WERE CHECKED. THE AFTER CONSTRUCTION AND PARTIAL POOL ANALYSES WITH VARYING POOL ELEVATION AS SPECIFIED IN ASSUMPTION NO. 1. RESULTED IN A MINIMUM FACTOR OF SAFETY OF 1.29. THE AFTER CONSTRUCTION CASE CONTROLLED USING RECORD LOW WATER AT EL. 153.0, C = 350 PSF AT EL. 150.0 AND A 50 FOOT BERM.

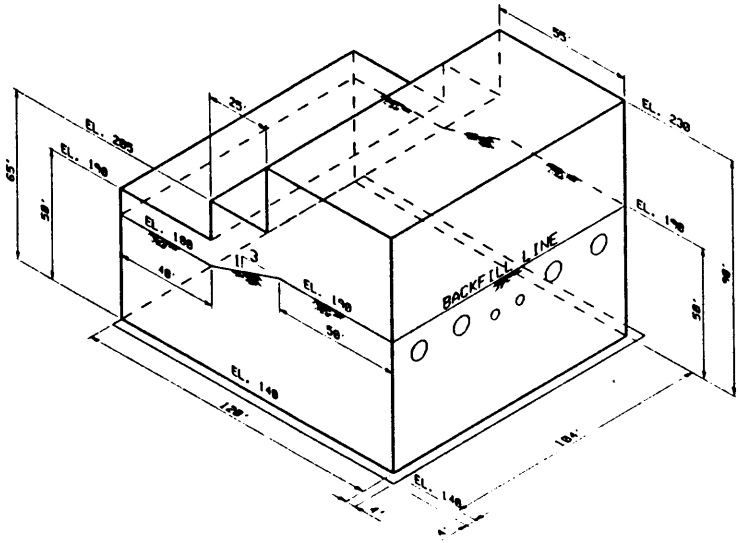
3. THE INLET CHANNEL STABILITY ANALYSES WITHOUT THE FINGER LEVEES (TOP BANK AT EL. 171.5) RESULTED IN FACTORS OF SAFETY GREATER THAN 2.0 FOR ALL CASES.

LONG TERM STABILITY

$$FS_{LT} = \frac{\tan \Phi}{\tan i} = M \tan \Phi$$

$$FS_{LT} = M\left[\frac{18.5 \tan 23^\circ + 12.5 \tan 24^\circ + 9 \tan 28^\circ}{40}\right]$$

$$FS_{LT} = M(0.4551) \quad \text{FOR } M = 3.5,\ FS = 1.59$$



SLIDING ANALYSIS (EL. 140.0)

NOTE: SLIDING ANALYSES WERE COMPUTED FOR EL. 140.0 USING CONSERVATIVE SAND SHEAR STRENGTHS OF ϕ = 30° UNDER THE STRUCTURE BASE.

CASES ANALYZED

CASE I - AFTER CONSTRUCTION CONDITION. NO WATER IN INLET CHANNEL.

CASE II - SUDDEN DRAWDOWN CONDITION. WATER IN BACKFILL AT EL. 188.0. WATER IN INLET CHANNEL AT 183.0.

CASE III - PARTIAL POOL CONDITION. WATER ELEVATION IN THE BACKFILL SAME AS WATER ELEVATION IN INLET CHANNEL. WITH VARYING HORIZONTAL POOL ELEVATIONS. RECORD HIGH, EL. 187.6 (1937), RECORD LOW, EL. 153.3 (1987).

CASE IV - EARTHQUAKE CONDITION. WATER IN BACKFILL AND INLET CHANNEL AT EL. 180.0 .

FACTORS OF SAFETY

FAILURE PLANE	EL. 140.0 SAND, SAND BACKFILL	REQUIRED MIN. F.S.
CASE I	2.34	1.50
CASE II	1.52	1.33
CASE III	1.70	1.50
CASE IV	1.58	1.10

SLIDING ANALYSES WERE COMPUTED USING WES COMPUTER PROGRAM CSLIDE (X0075) THESE ANALYSES WERE COMPUTED ASSUMING A SAND BACKFILL AROUND THE STRUCTURE AND UTILIZED ONLY THE WEIGHT OF CONCRETE IN THE STRUCTURE. NO WEIGHT WAS ADDED FOR PUMPS, PUMP MOTORS, OR LIVE LOAD. PASSIVE SOIL RESISTANCE WAS ALSO IGNORED FOR ALL ANALYSES. THE STRUCTURE IS SAFE AGAINST SLIDING.

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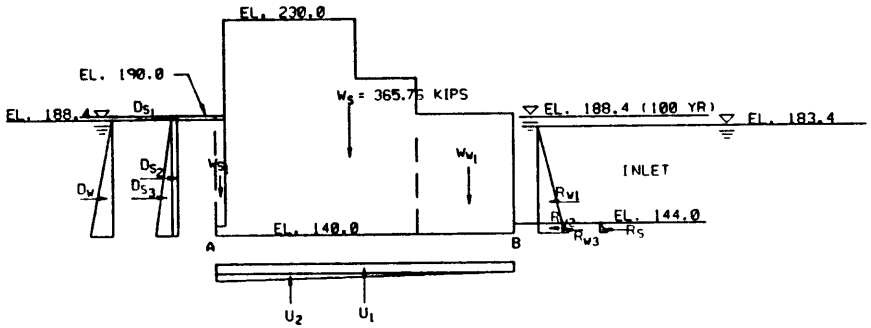
MEMPHIS, TENNESSEE

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
MAJOR PUMPING STATION
OUTLET STRUCTURE
SLIDING ANALYSIS

PLATE
II-27



CASE II LOADING

ITEM	FORCES (KIPS) VERTICAL ↓	VERTICAL ↑	HORIZONTAL →	HORIZONTAL ←	MOMENT ARM (FEET)	MOMENTS (KIP-FEET) OVERTURNING	RESISTING
W_S	365.76				67.80		24.798.53
W_{S_1}	23.00				122.00		2.806.00
W_{W_1}	80.94				18.50		1.497.39
D_{S_1}			0.08		48.93	3.91	
D_{S_2}			4.84		24.20	117.13	
D_{S_3}			36.6		16.13	590.36	
D_W			73.21		16.13	1.180.88	
R_S				0.75	1.30		0.98
R_{W_1}				48.51	13.13		636.94
R_{W_2}				9.85	2.00		19.70
R_{W_3}				0.52	1.30		0.68
U_1		337.28	11.00		62.00	20.911.36	
U_2		13.64	14.67		82.67	1.127.61	
TOTALS	469.70	350.92				23.931.25	29.760.22

OVERTURNING ANALYSIS

CREEP METHOD = 48.4' + 124' + 4' = 176.4'

HEAD @ A = (128/176.4)(5) + 43.4 = 47.03 FT. (2.94 KSF)
HEAD @ B = (4/176.4)(5) + 43.4 = 43.51 FT. (2.72 KSF)

$K_0 = 0.5 = 1 - \sin 30°$; $K_A = \tan^2(45 - 30/2) = 0.33$; $K_P = 1/K_A = 3$;

$D_{S_1} = 0.5(1.6)^2(0.125)(0.5) = 0.08^K$
$D_{S_2} = 0.125(1.6)(48.4)(0.5) = 4.84^K$
$D_{S_3} = 0.5(48.4)^2(0.0625)(0.5) = 36.6^K$
$D_W = 0.5(48.4)^2(0.0625) = 73.21^K$

$R_S = 0.5(4)^2(0.0625)(1.5) = 0.75^K$
$R_{W_1} = 0.5(39.4)^2(0.0625) = 48.51^K$
$R_{W_2} = 39.4(4)(0.0625) = 9.85^K$
$R_{W_3} = 0.5[2.72 - 39.4(0.0625)]4 = 0.52^K$

$U_1 = 2.72(124) = 337.28^K$
$U_2 = 0.5(124)(2.94 - 2.72) = 13.64^K$

W_S = WEIGHT OF STRUCTURE = 38,039.2/104 = 365.76 K/FT. WIDTH

$W_{S_1} = 46(0.125)(4) = 23^K$

$W_{W_1} = 35'H(37'W)(0.0625) = 80.94^K$

CASE II - $\bar{y}$ = RESULTANT LOCATION = $\frac{\Sigma M}{\Sigma V} = \frac{29,760.22 - 23,931.25}{469.70 - 350.92} = 49.07'$ (O.K. RESULTANT LOCATED WITHIN 75% OF BASE)

CASE I - $\bar{y} = \frac{24,798.52 - 1,302.1}{365.76} = 64.24$ (O.K.)

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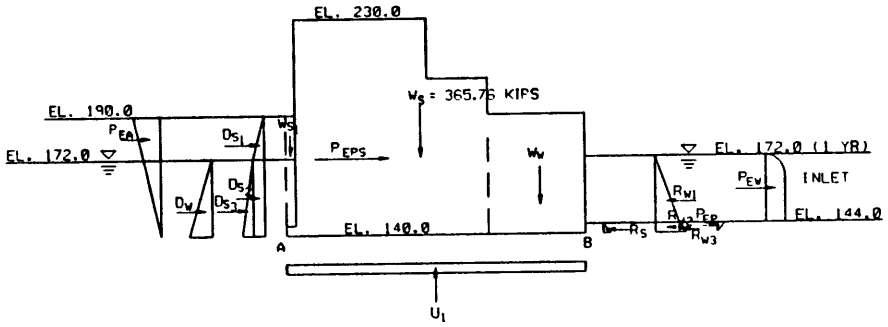
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
MAJOR PUMPING STATION
SUDDEN DRAWDOWN CASE II
OVERTURNING ANALYSIS

PLATE
II-28



CASE IV LOADING

ITEM	FORCES (KIPS) VERTICAL ↓	VERTICAL ↑	HORIZONTAL →	HORIZONTAL ←	MOMENT ARM (FEET)	MOMENTS (KIP-FEET) OVERTURNING	RESISTING
W_S	365.76				67.80		24,798.52
W_{S1}	23.00				122.00		2,806.00
W_W	64.75				18.50		1,197.88
D_{S1}			10.13		38.00	384.94	
D_{S2}			36.00		16.00	576.00	
D_{S3}			16.00		10.67	170.72	
D_W			32.00		10.67	341.44	
R_S				0.75	1.33		1.00
R_{W1}				24.5	13.33		326.59
R_{W2}				7	2.00		14.00
R_{W3}				0.5	1.33		0.67
U_1		248.0			62.00	15,376.00	
P_{EPS}			45.35		22.67	1,028.08	
P_{EA}			9.41		31.30	294.53	
P_{EV}			2.67		15.20	40.58	
P_{EP}			0.83		3.80	3.15	
TOTALS	453.51	248.0				18,215.44	29,144.65

CASE IV - $\bar{y}$ = RESULTANT LOCATION = $\frac{\Sigma M}{\Sigma V} = \frac{29,144.65 - 18,215.44}{453.51 - 248} = 53.2'$ (O.K. RESULTANT LOCATED WITHIN THE BASE)

OVERTURNING ANALYSIS

NORMAL OPERATING WATER ELEVATION (1 YR) = EL. 172.0

$K_O = 0.5$; $K_P = 3.0$; $K_P/2 = 1.5$

$W_S = 38,039.2/104 = 365.76^K$
$W_{S1} = 46(0.125)(4) = 23^K$
$W_W = 28'H(37'W)(0.0625) = 64.75^K$

$D_{S1} = 0.5(18)^2(0.125)(0.5) = 10.13^K$
$D_{S2} = 0.125(18)(32)(0.5) = 36^K$
$D_{S3} = 0.5(32)^2(0.0625)(0.5) = 16^K$
$D_W = 0.5(32)^2(0.0625) = 32^K$

$R_S = 0.5(4)^2(0.0625)(1.5) = 0.75^K$
$R_{W1} = 0.5(28)^2(0.0625) = 24.5^K$
$R_{W2} = 28(4)(0.0625) = 7^K$
$R_{W3} = 0.5(0.0625)(4)^2 = 0.5^K$

$U_1 = 0.0625(32)(124) = 248^K$

APPLY DYNAMIC FORCES

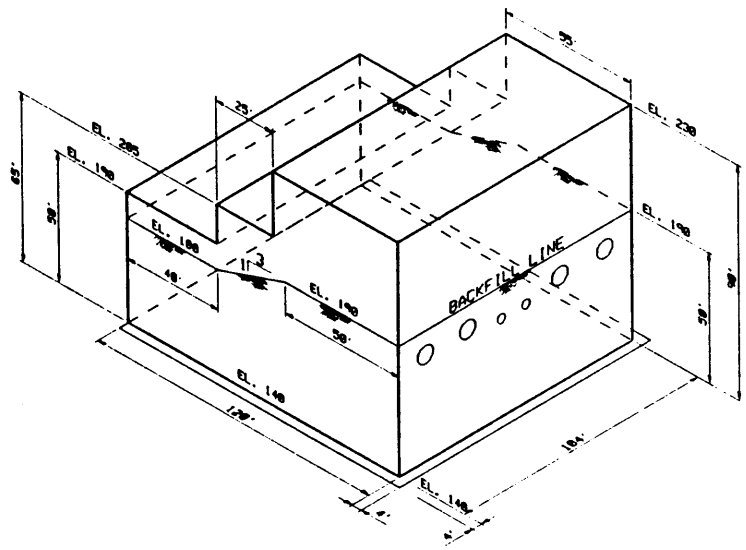
$P_{E\ \text{PUMPING STATION}} = 0.1(W_S + W_W + W_{S1})$
$= 0.10(365.76 + 23 + 64.75) = 45.35^K$

$P_{EA} = 0.10(D_{S1} + D_{S2} + D_{S3} + D_W)$
$= 0.10(10.13 + 36 + 16 + 32) = 9.41$

USE WESTERGAARD'S EQUATION TO DETERMINE P_{EV}
(WATER ABOVE GROUND)

$P_{EV} = 2/3\ C_E K_h h^2 = (2/3)(0.051)(0.1)(28)^2$
$= 2.67^K$

$P_{EP} = 0.1(R_S + R_{W2} + R_{W3}) = 0.1(0.75 + 7 + 0.5)$
$= 0.83^K$



BEARING CAPACITY

THE EXCAVATION WILL EXTEND TO EL. 136.0. FOUR FEET OF COMPACTED PERVIOUS BACKFILL WILL BE PLACED UNDER THE STRUCTURE TO EL. 140.0. THE STRUCTURE WILL THEN BE CONSTRUCTED ON GRADE.

STRUCTURE = B = 124' AND L = 112'; L/6 = 124/6 = 20.67'

$B' = B - 2e$

CASE I (AC) - e = 2.23'* B' = 119.54' V = 365.8
CASE II (SD) - e = 12.93' B' = 98.1' V = 118.8
CASE IV (EO) - e = 8.8' B' = 106.4' V = 205.5
FOR ALL CASES - e < L/6 ∴ FULL FOOTING

*e IS FROM OVERTURNING ANALYSES

$$Q = \frac{V}{BL}\left(1 + \frac{6e}{L}\right)^{**}$$

$$Q = \frac{365.76}{124}\left[1 + \frac{6(2.23)}{124}\right] = 3.27 \text{ K/S.F.} \quad \text{CASE I}$$

$$Q = \frac{118.8}{124}\left[1 + \frac{6(12.93)}{124}\right] = 1.56 \text{ K/S.F.} \quad \text{CASE II}$$

$$Q = \frac{205.51}{124}\left[1 + \frac{6(8.8)}{124}\right] = 2.36 \text{ K/S.F.} \quad \text{CASE IV}$$

$$q_{ult} = cN_c \cancel{S_c d_c I_c g_c b_c}^{\,0} + \bar{q}N_q S_q d_q I_q g_q b_q + 0.5\gamma' B N_\gamma S_\gamma d_\gamma I_\gamma g_\gamma b_\gamma{}^{**}$$

ASSUME $\phi = 30$; $N_c = 30.14$; $N_q = 18.4$; $N_\gamma = 15.1$

$\gamma' = 0.0625$ D = 4' B = 124' L = 112'

$\bar{q} = \gamma' D = 0.0625(4) = 0.25$

$S_q = 1 + (B/L)\tan\phi = 1 + (124/112)\tan 30° = 1.639$
$S_\gamma = 1 - 0.4(B/L) = 1 - 0.4(124/112) = 0.557$

$d_q = 1 + 2\tan\phi(1 - \sin\phi)^2 D/B = 1 + 2\tan 30°(1 - \sin 30°)^2 (4/124) = 1.009$
$d_\gamma = 1.0$

$I_q = g_q = b_q = d_\gamma = I_\gamma = g_\gamma = b_\gamma = 1$

<u>Q CASE = S CASE</u>

CASE I $q_{ult} = 0.25(18.4)(1.639)(1.009)(1) + 0.5(0.0625)(119.5)(15.1)(0.557)(1)$
$= 39$ KSF

CASE II $q_{ult} = 33.6$ KSF

CASE IV $q_{ult} = 35.9$ KSF

CASE I F.S. $= \frac{Q_{ult}}{q_{ult}} = \frac{39}{3.27} = 11.9$

CASE II F.S. $= \frac{33.6}{1.56} = 21.54$

CASE IV F.S. $= \frac{35.9}{2.36} = 15.08$ SAFE, ALL CASES > 3.0

**FROM FOUNDATION ANALYSIS AND DESIGN", BY JOSEPH E. BOWLES, 2ND EDITION, P. 120 & P. 256.

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

MAJOR PUMPING STATION BEARING ANALYSIS

PLATE II-30

ASSUMPTIONS

1. USE STRATIFICATION AND SOIL TEST DATA FROM BORING 1-EASPU-94

2. MINIMUM FILL IS FOUR FEET ON TOP OF 10.5 FT. DIAMETER DISCHARGE PIPES RESULTING IN APPROXIMATELY 20 FT. OF FILL ABOVE NATURAL GROUND. THE SURCHARGE LOAD FROM THE FILL WAS COMPUTED AS

   P = 20 FT (0.120 KCF) = 2.4 KSF

3. THE SIX FEET OF FILL PLACED ON NATURAL GROUND TO SUPPORT THE DISCHARGE PIPES SHALL BE COMPACTED SAND. THEREFORE, NO SETTLEMENT IS PREDICTED IN THIS SIX FEET OF FILL PLACEMENT. THE FILL REQUIRED AROUND THE PUMPING STATION, ELECTRICAL SUBSTATION PAD AND THE ACCESS ROAD EMBANKMENT SHALL BE PLACED TO ELEVATION 190.0 USING SEMI COMPACTED EFFORT. THIS EMBANKMENT SETTLEMENT CAN BE ESTIMATED BASED ON PREVIOUS PROJECTS AND CONSOLIDATION TESTS CONDUCTED ON THREE SAMPLES OF 15 BLOW COMPACTED MATERIAL FROM BORINGS 12-EAPST-94 AND 3-EAPS-94. ANALYSIS RESULTED IN AN ADDITIONAL 1 TO 2 INCHES OF SETTLEMENT.

4. A CONSOLIDATION TEST WAS PERFORMED ON AN UNDISTURBED SAMPLE TAKEN AT A DEPTH OF 9 - 10.2 FEET BELOW THE SURFACE (STRATA NO. 3 PLATE II-32). THE RESULTS OF THE DATA INDICATED A C_c VALUE OF 0.17, C_r VALUE OF 0.06 AND A PRECONSOLIDATION STRESS OF 7.6 KSF. FOR THE REMAINING STRATA, THE VALUES FOR THE COMPRESSION INDEX, C_c, WERE BASED ON THE EMPIRICAL RELATIONSHIP C_c = 0.009(LL-10).

5. THE INCREASE IN VERTICAL STRESS, ΔP, FROM THE SURCHARGE OF THE FILL WAS DETERMINED FROM THE "TABLES OF BOUSSINESQ COEFFICIENTS FOR VERTICAL STRESS INDUCTION", NEW ORLEANS DISTRICT, MARCH 1969.

6. BASED ON A REVIEW OF WATER CONTENTS, ATTERBERG LIMITS, AND THE RELATIVELY HIGH UNDRAINED SHEAR STRENGTHS OF THE CLAY SAMPLES FROM BORING 1-EAPSU-94, IT APPEARS THE CLAY MAY HAVE BEEN PRECONSOLIDATED TO A STRESS GREATER THAN THAT OF THE EXISTING VERTICAL STRESS. IN STRATAS 1,2 AND 3 THE PRECONSOLIDATON STRESS IS GREATER THAN THE VERTICAL STRESS PLUS THE PROPOSED FILL SURCHARGE ($P_o + \Delta P$). IN LAYERS 4 AND 6, THE PRECONSOLIDATION STRESS IS BETWEEN THE PRESENT STRESS AND ANTICIPATED STRESS AFTER FILL PLACEMENT.

$$\sigma'_p = \frac{C_u}{0.11 + 0.0037\ PI}$$ (EQ. 1-2, EM 1110-1-1904)

WHERE σ'_p = PRECONSOLIDATION STRESS, KSF
C_u = UNDRAINED SHEAR STRENGTH, KSF
PI = PLASTICITY INDEX, PERCENT

LAYER NO.	ELEVATION	PI	C_u (KSF)	σ'_p (KSF)	P_o (KSF)	ΔP (KSF)	$P_o + \Delta P$ (KSF)
1	171.5-167.0	27	1.029	4.902	0.270	2.40	2.670
2	167.0-157.5	27	0.838	3.992	1.134	2.40	3.534
3	157.5-148.5	10	0.700 [1]	4.762	2.009	2.39	4.409
4	148.5-142.0	28	0.850	3.980	2.493	2.36	4.853
6	127.5-122.5	45	1.600 [2]	5.160	3.746	2.26	6.006

[1] BASED ON AVERAGE SHEAR STRENGTHS FOR STRATA

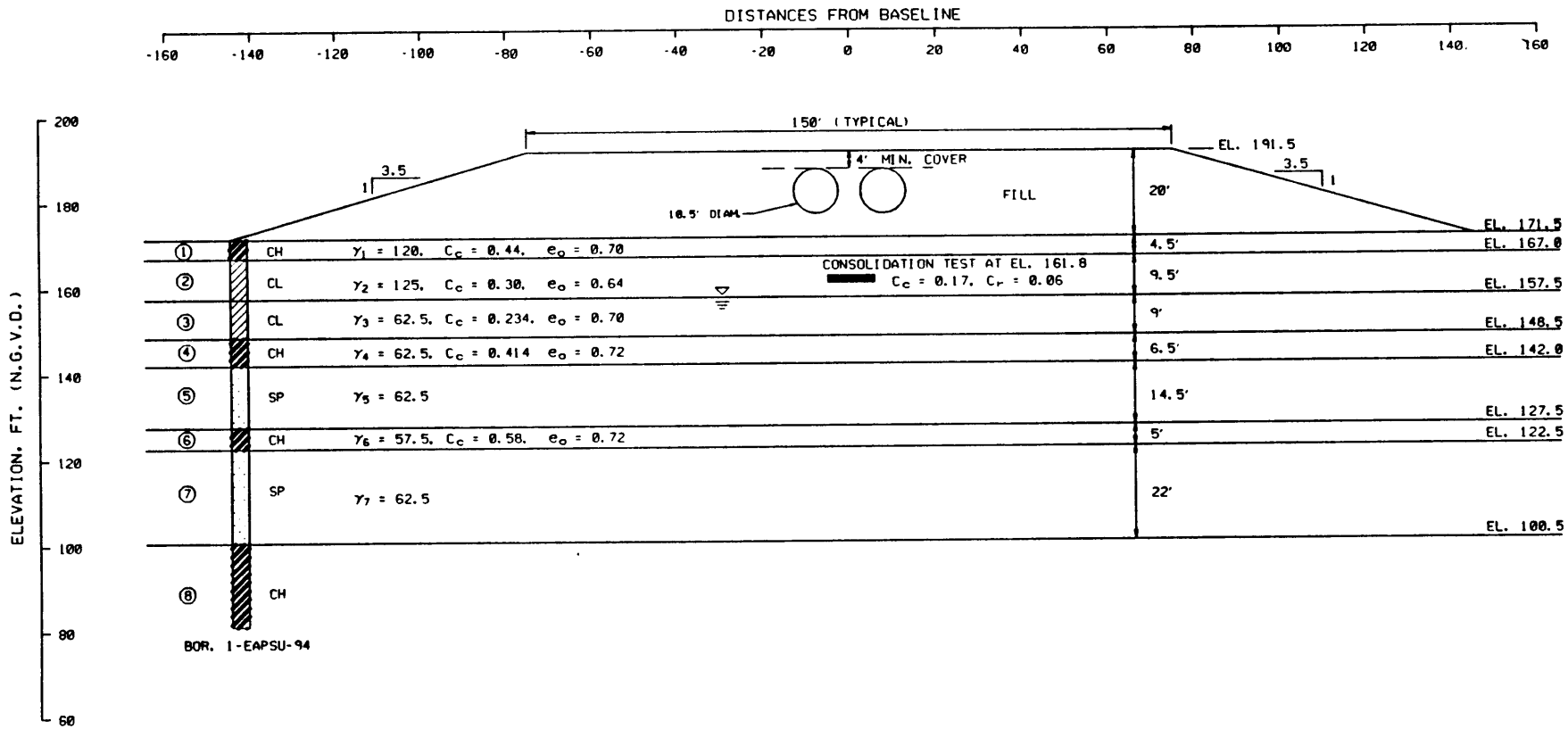
[2] BASED ON ADJUSTED SPT VALUES

7. MOST OF THE STRATA INDICATE THAT THE LOADING FROM THE 20 FEET OF FILL SHOULD FALL ALONG THE RECOMPRESSION PORTIONS OF THE CONSOLIDATION CURVE RATHER THAN THE VIRGIN COMPRESSION PORTION. THEREFORE, C_r VALUES WERE USED TO DETERMINE THE ESTIMATED SETTLEMENT (RECOMPRESSION INDEX). THESE C_r VALUES WERE ESTIMATED AS 15 TO 20 PERCENT OF C_c VALUES BASED ON EXPERIENCE AND NUMEROUS CONSOLIDATION TESTS ON OTHER PROJECTS WITHIN THE MEMPHIS DISTRICT.

   ADDITIONAL TESTING IN STRATA 4 AND 6 WILL BE REQUIRED TO DETERMINE IF THESE ASSUMPTIONS ARE VALID. THE PIPES AND GENERAL FILL WILL BE DESIGNED TO ACCOMMODATE 7.5 INCHES OF SETTLEMENT.

8. A SETTLEMENT ANALYSIS USING COMPOSITE BORING NO. 1 FROM BORINGS 12-EAPST-95, 13-EAPST-95 AND 2-EAPSU-94 RESULTED IN AN ESTIMATED SETTLEMENT FOR THE EMBANKMENT FOUNDATION BETWEEN 4.5 AND 6.5 INCHES OF SETTLEMENT.

9. RESULTS OF THE SETTLEMENT ANALYSIS ARE SHOWN ON PLATE II-32.



LAYER	ELEVATION	DEPTH TO MIDPOINT	H (FT)	C_c	C_r	e_o	$S = \frac{C_r H}{1 + e_o} \text{LOG} \frac{P_o + \Delta P}{P_o}$
1	171.5-167.0	2.25	4.5	0.44	0.08	0.70	0.211
2	167.0-157.5	9.25	9.5	0.17[3]	0.06[3]	0.64	0.167
3	157.5-148.5	18.50	9.0	0.23	0.05	0.70	0.090
4	148.5-142.0	26.25	6.5	0.41	0.08	0.72	0.088
6	127.5-122.5	46.50	5.0	0.58	0.12	0.72	0.072
							0.628 FT = 7.54 INCHES

[3] FROM CONSOLIDATION DATA

∴ NET SETTLEMENT FOR PIPES = 7.5'

∴ NET SETTLEMENT FOR EMBANKMENT AWAY FROM PIPES = 7.5' + 2" = 9.5'

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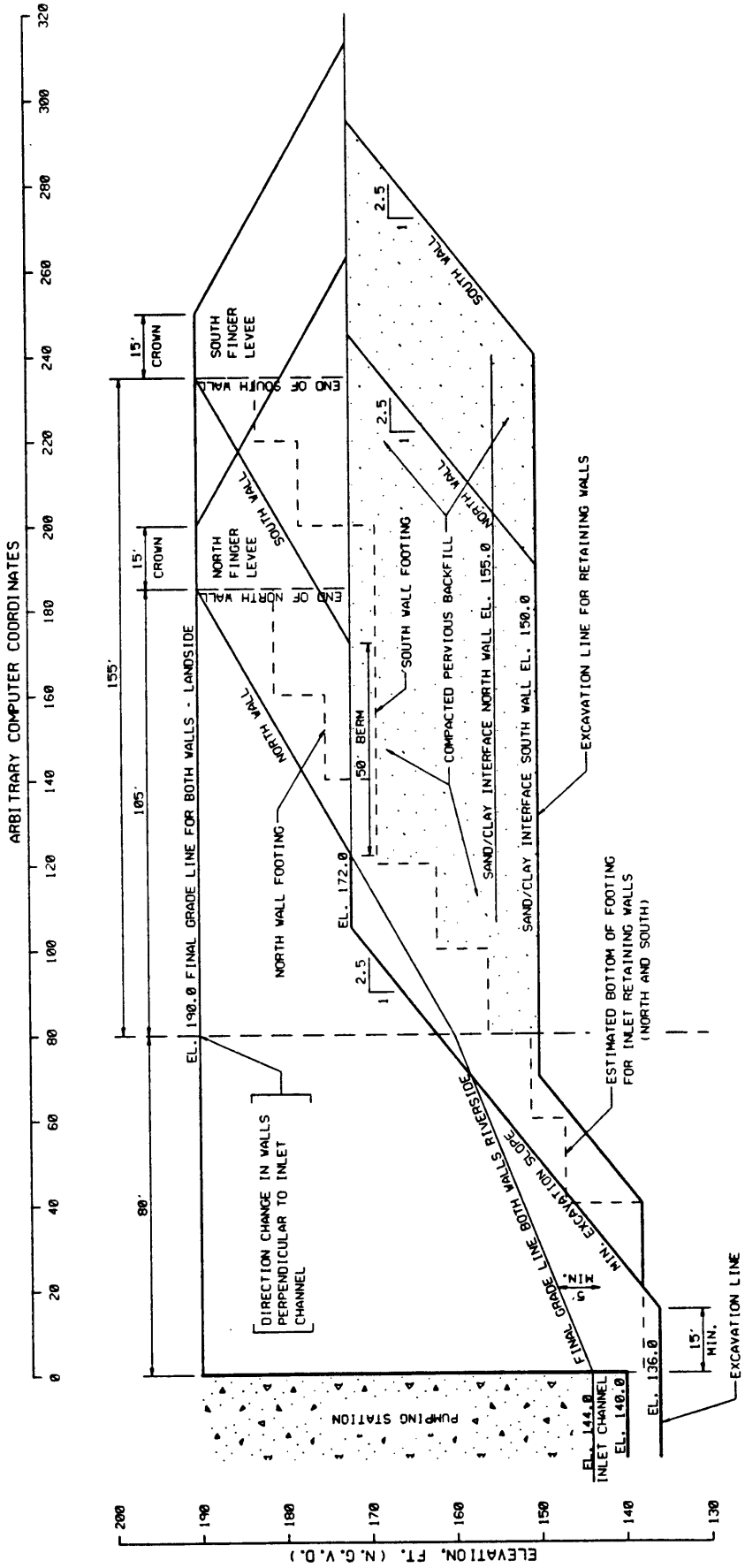
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
MAJOR PUMPING STATION
EARTH EMBANKMENTS
SETTLEMENT ANALYSIS

PLATE
II-32



SKETCH SHOWS BOTH NORTH AND SOUTH RETAINING WALLS EXCAVATION LINES. ESTIMATED BOTTOM OF FOOTING LINES FOR WALLS. WALL LIMITS. AND COMPLETED GRADE LINES

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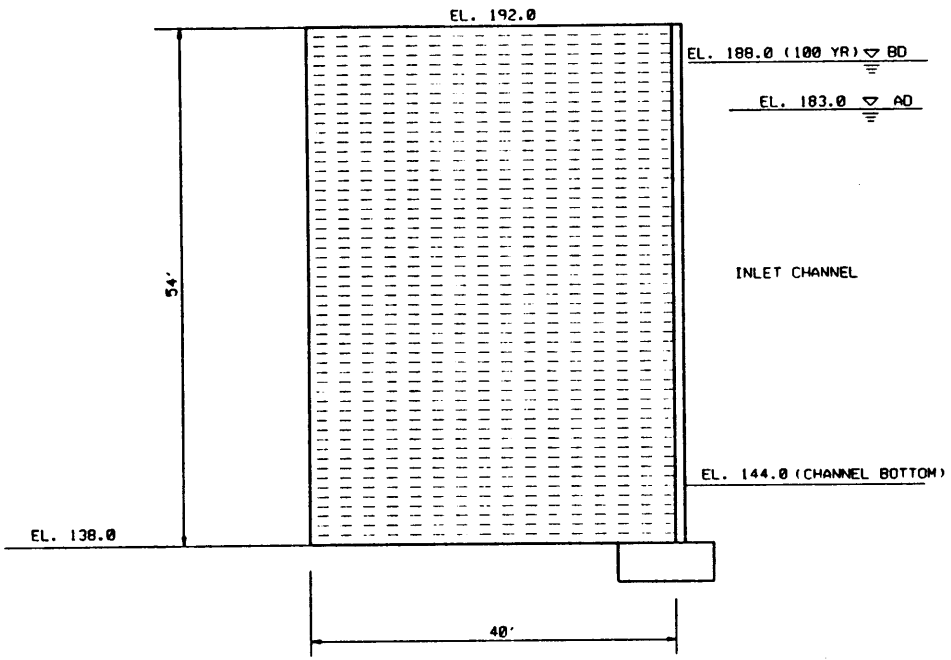
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

MAJOR PUMPING STATION INLET RETAINING WALLS

PLATE
II-33



EARTH REINFORCED RETAINING WALL

SLIDING ANALYSIS (EL. 138.0)

NOTE: SLIDING ANALYSES WERE COMPUTED FOR EL. 138.0 USING CONSERVATIVE SAND SHEAR STRENGTHS OF Φ = 30° UNDER THE EARTH REINFORCED RETAINING WALL.

CASES ANALYZED

CASE I - AFTER CONSTRUCTION CONDITION. NO WATER IN INLET CHANNEL.

CASE II - SUDDEN DRAWDOWN CONDITION. WATER IN BACKFILL AT EL. 188.0. WATER IN INLET CHANNEL AT 183.0.

CASE III - PARTIAL POOL CONDITION. WATER ELEVATION IN THE BACKFILL SAME AS WATER ELEVATION IN INLET CHANNEL, WITH VARYING HORIZONTAL POOL ELEVATIONS. RECORD HIGH, EL. 187.6 (1937), RECORD LOW, EL. 153.3 (1987).

CASE IV - EARTHQUAKE CONDITION. WATER IN BACKFILL AND INLET CHANNEL AT EL. 165.0.

FACTORS OF SAFETY

FAILURE PLANE	EL. 138.0 SAND. SAND BACKFILL	REQUIRED MIN. F.S.
CASE I	1.63	1.50
CASE II	1.42	1.33
CASE III	1.48	1.50
CASE IV	1.09	1.10

SLIDING ANALYSES WERE COMPUTED USING WES COMPUTER PROGRAM CSLIDE (X0075) THESE ANALYSES WERE COMPUTED ASSUMING A SAND BACKFILL BEHIND THE RETAINING WALL . PASSIVE SOIL RESISTANCE WAS ALSO IGNORED FOR ALL ANALYSES. THESE FACTORS OF SAFETY SHOWN ARE FOR A WALL OF 38 FEET WIDTH. THE WALL WAS WIDENED TO 40 FEET DUE TO BEARING ANALYSES, WHICH WILL INCREASE THE FACTORS OF SAFETY. THE STRUCTURE IS SAFE AGAINST SLIDING.

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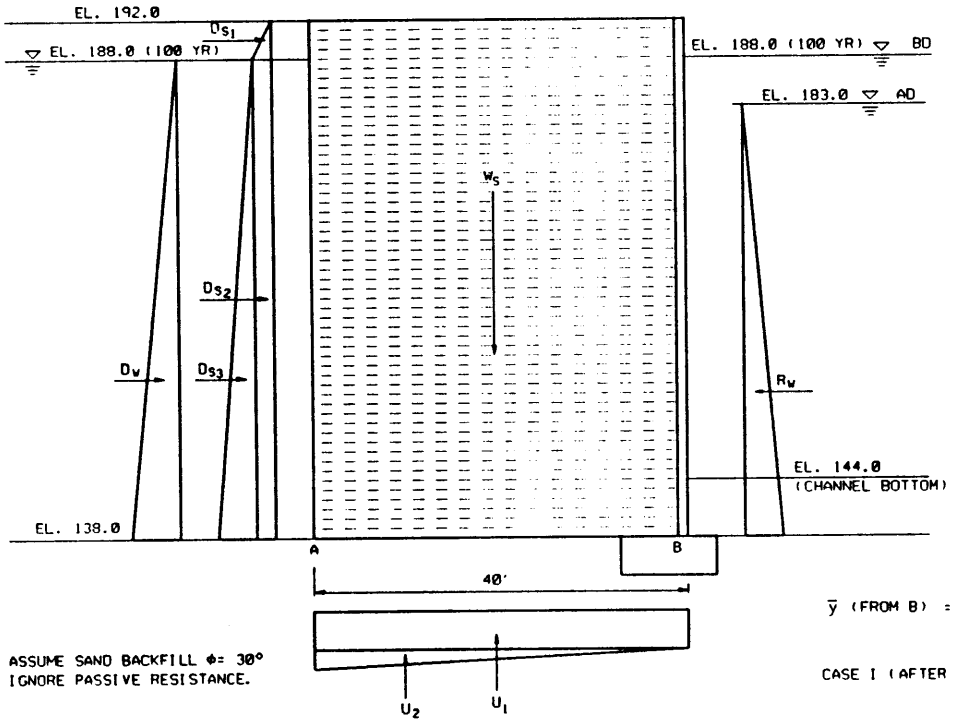
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
MAJOR PUMPING STATION
INLET RETAINING WALL
SLIDING ANALYSIS

PLATE
II-34



ASSUME SAND BACKFILL $\phi = 30°$
IGNORE PASSIVE RESISTANCE.

EARTH REINFORCED RETAINING WALL

ITEM	FORCES (KIPS) VERTICAL ↓	FORCES (KIPS) VERTICAL ↑	FORCES (KIPS) HORIZONTAL →	FORCES (KIPS) HORIZONTAL ←	MOMENT ARM (FEET)	MOMENTS (KIP-FEET) OVERTURNING	MOMENTS (KIP-FEET) RESISTING
W_S	270.0				20.00		5400.0
D_{S_1}			0.50		51.33	25.67	
D_{S_2}			12.50		25.00	312.50	
D_{S_3}			39.06		16.67	651.13	
W_1			78.13		16.67	1302.43	
U_1		113.2			20.00	2264.00	
U_2		2.6			26.67	69.34	
R_W				63.28	15.00		949.2
NOTE: IGNORE PASSIVE SOIL RESISTANCE							
TOTALS	270.0	115.8				4625.06	6349.2

$\bar{y}$ (FROM B) = RESULTANT LOCATION = $\frac{\Sigma M}{\Sigma V} = \frac{6349.2 - 4625.06}{270.0 - 115.8} = 11.18'$ (O.K. RESULTANT LOCATED IN MID HALF OF BASE)

CASE I (AFTER CONSTRUCTION) $\bar{y}$ (FROM B) = $\frac{5400.0 - 1640.34}{270.0} = 13.92'$ (O.K. RESULTANT LOCATED IN MID THIRD)

CASE IV (EARTHQUAKE) $\bar{y}$ (FROM B) = $\frac{5608.42 - 4216.73}{270.0 - 67.5} = 6.87'$ (O.K. RESULTANT LOCATED IN BASE)

OVERTURNING ANALYSIS (CASE II - SD)

$W_S = 40 \times 54 \times 0.125 = 270.0^K$

CREEP PATH = 50' + 40' + 6' = 96'

HEAD @ A = (46/96)(5) + 45 = 47.4 FT (2.96 KSF)
HEAD @ B = (6/96)(5) + 45 = 45.3 FT (2.83 KSF)

$K_a = 1 - \sin\phi = 0.5$

$D_{S_1} = 0.5(4)^2(0.125)(0.5) = 0.5^K$
$D_{S_2} = 0.125(4)(50)(0.5) = 12.5^K$
$D_{S_3} = 0.5(50)^2(0.125 - 0.0625)(0.5) = 39.06^K$
$D_W = 0.5(50)^2(0.0625) = 78.13^K$

$U_1 = 2.83(40) = 113.2^K$
$U_2 = 0.5(2.96 - 2.83)(40) = 2.60^K$
$R_W = 0.5(0.0625)(45)^2 = 63.28^K$

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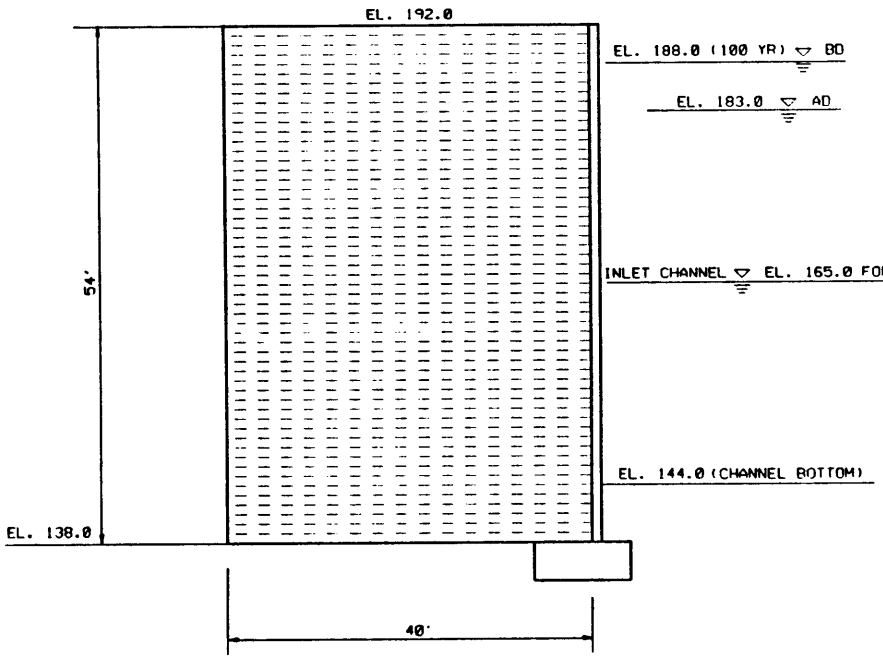
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
MAJOR PUMPING STATION
INLET RETAINING WALL
OVERTURNING ANALYSIS

PLATE
II-35



EARTH REINFORCED RETAINING WALL

DIMENSIONS B = 40' ASSUME L = 1' B/6 = 40/6 = 6.67'

B' = B - 2e

CASE I (AC): *e = 6.08 B' = 27.84' V = 270.0^K

CASE II (SD): e = 8.82' B' = 22.36' V = 154.2^K

CASE IV (EO): e = 13.13' B' = 13.75' V = 202.5^K

*e FROM OVERTURNING ANALYSES

$$q = \frac{V}{B'}$$

CASE I $q = \frac{270.0}{27.84} = 9.70$ K.S.F.

CASE II $q = \frac{154.2}{22.36} = 6.90$ K.S.F.

CASE IV $q = \frac{202.5}{13.75} = 14.73$ K.S.F.

$$q_{ult} = cN_c \cancel{S_c d_c i_c g_c b_c}^{\,0} + \bar{q}N_q S_q d_q i_q g_q b_q + [0.5\gamma B' N_\gamma S_\gamma d_\gamma i_\gamma g_\gamma b_\gamma]\, r_\gamma^{**}$$

** r_γ = REDUCTION FACTOR FOR LARGE FOOTINGS

SAND FOUNDATION $\phi = 32°$; C = 0; $N_c = 35.49$; $N_q = 23.18$; $N_\gamma = 20.79$

CASE I (AFTER CONSTRUCTION)

B = 40' B' = 27.84' B/L = 27.84/40 = 0.696 D/B = 6/40 = 0.150 L = 40'

$\bar{q} = \gamma' D = 0.0625(6) = 0.375$

$S_q = 1 + (B/L)\tan\phi = 1 + (0.696)\tan 32° = 1.435$

$S_\gamma = 1 - 0.4(B/L) = 1 - 0.4(0.696) = 0.722$

$d_q = 1 + 2\tan\phi(1 - \sin\phi)^2 D/B = 1 + 2\tan 32°(1 - \sin 32°)^2(0.15) = 1.041$

$r_\gamma = 1 - 0.25\log_{10}(B/L) = 1 - 0.25\log_{10}(40/6) = 0.794$

$q_{ult} = 0 + 0.375(23.18)(1.435)(1.041)(1) + 0.5(0.0625)(27.84)(20.79)(0.722)(0.794) = 23.35$ KSF

$$F.S. = \frac{Q_{ult}}{q} = \frac{23.35}{9.70} = 2.41 \text{ O.K.} > 2.0$$

FOR $\phi = 30°$; F.S. = 1.83

CASE II (SUDDEN DRAWDOWN)

$q_{ult} = 0 + 0.375(23.18)(1.349)(1.041)(1) + 0.5(0.0625)(22.36)(20.79)(0.776)(0.794) = 21.16$ KSF

$$F.S. = \frac{Q_{ult}}{q} = \frac{21.16}{6.90} = 3.07 \text{ O.K.} > 2.0$$

FOR $\phi = 30$; F.S. = 2.34

CASE II (SUDDEN DRAWDOWN)

$q_{ult} = 0 + 0.375(23.18)(1.215)(1.041)(1) + 0.5(0.0625)(13.75)(20.79)(0.862)(0.794) = 17.11$ KSF

$$F.S. = \frac{Q_{ult}}{q} = \frac{17.11}{14.73} = 1.16 \text{ O.K.} > 1.0 \text{ (CONTROLS)}$$

FOR $\phi = 30$; F.S. = 0.89

CASE IV OR EARTHQUAKE LOADING CONTROLLED THE ANALYSES. A VERY CONSERVATIVE FOUNDATION STRENGTH OF $\phi = 30°$ RESULTED IN FACTORS OF SAFETY BELOW THE MINIMUM REQUIRED FOR RETAINING WALLS ON NON COHESIVE MATERIAL (SAND) AS SHOWN ABOVE. THE SHEAR STRENGTH OF THE SAND WAS RAISED TO A $\phi = 32°$ AND RESULTED IN ADEQUATE FACTORS OF SAFETY FOR BEARING. A $\phi = 32°$ IS CONSERVATIVE BASED ON BORINGS 12-EAPST-95 AND 13-EAPST-95 (CLOSEST BORINGS TO INLET WALLS) WHICH INDICATED STRENGTHS AFTER OVERBURDEN ADJUSTMENT BETWEEN $\phi = 33°$ AND $\phi = 34°$ AT ELEVATION 138.0. THESE ANALYSES ASSUMED MAXIMUM LOAD WHICH WILL OCCUR ADJACENT TO THE PUMPING STATION.

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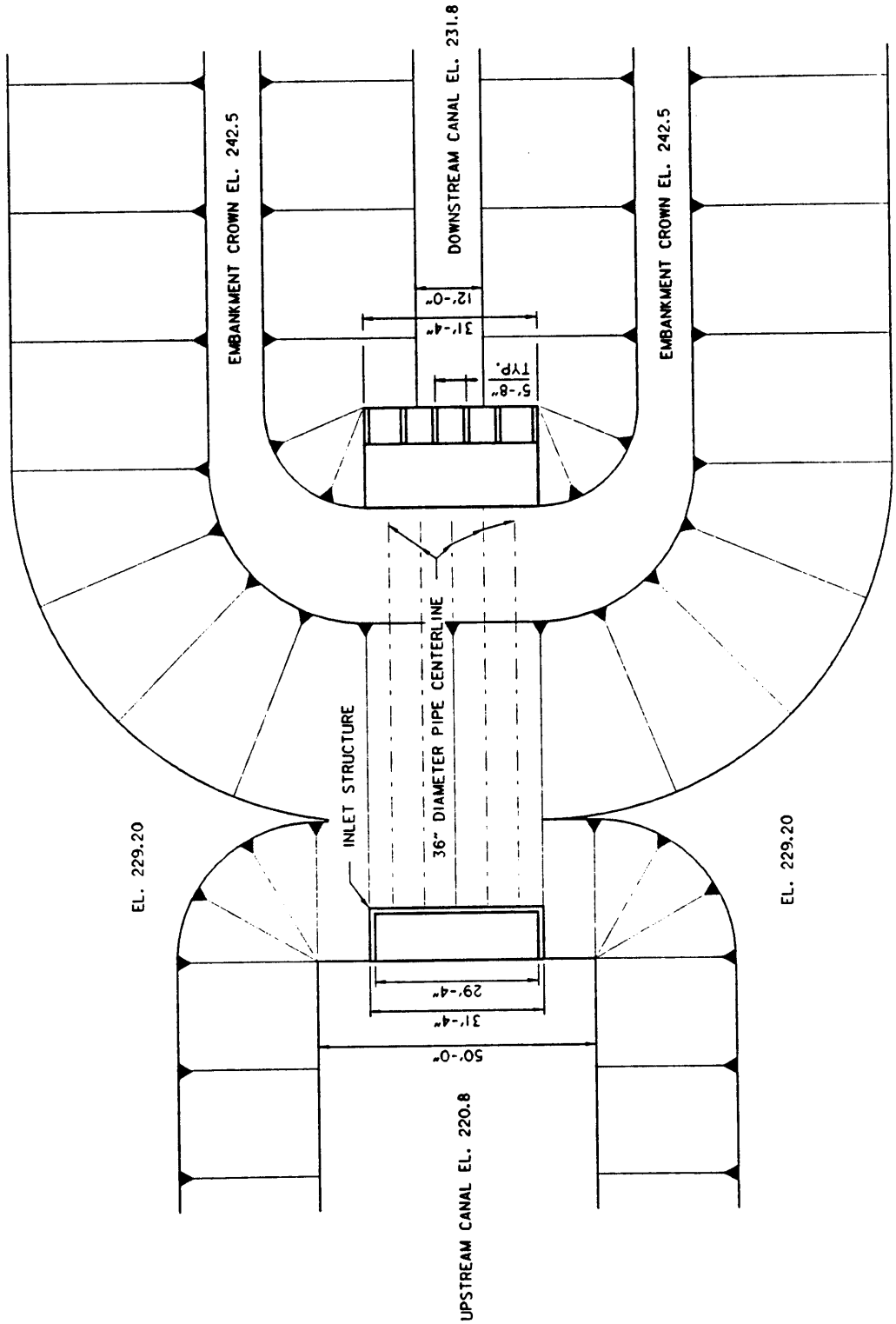
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
MAJOR PUMPING STATION
INLET RETAINING WALL
BEARING ANALYSIS

PLATE
II-36



SITE PLAN
SCALE 1" = 30'-0"

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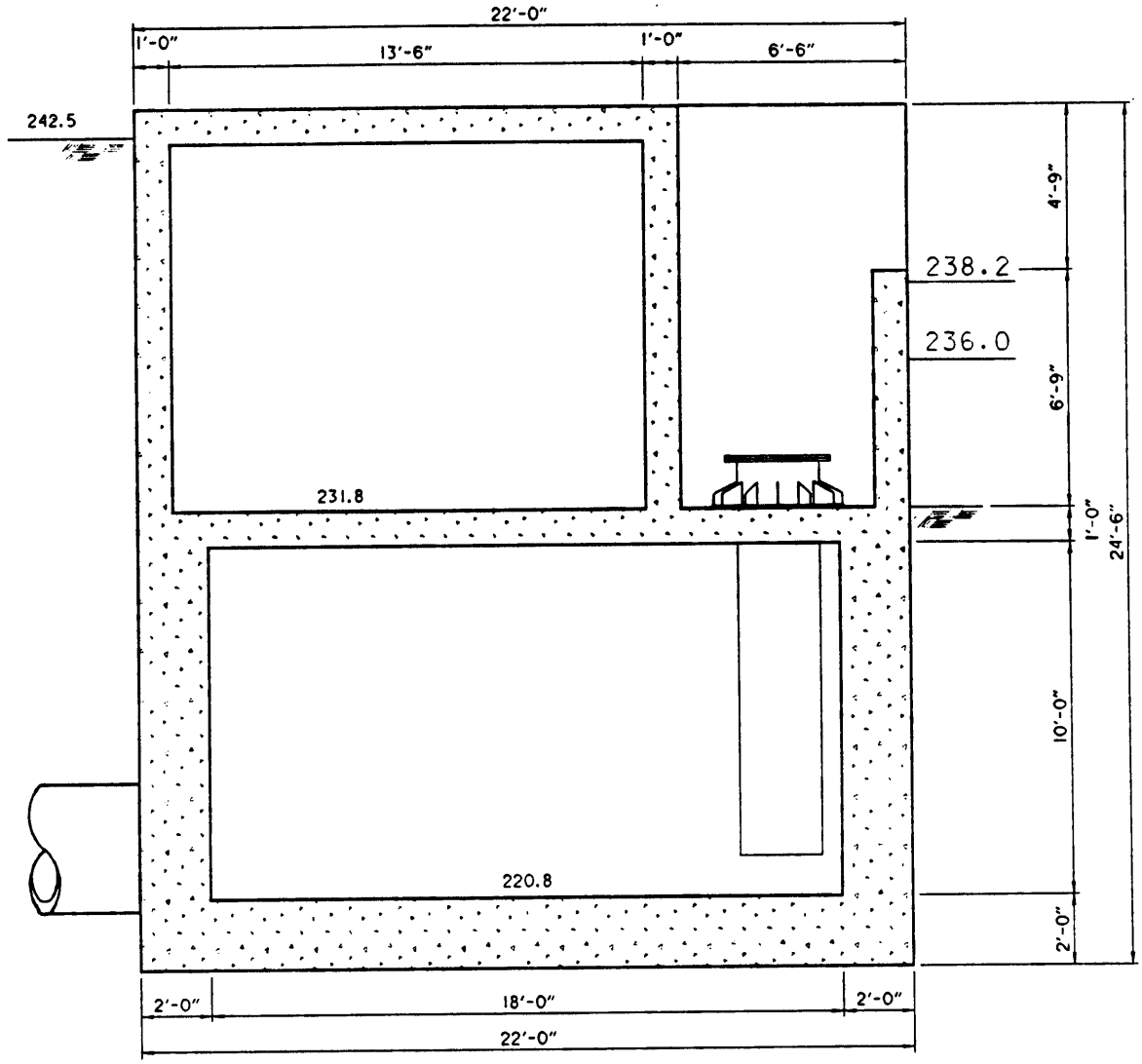
DEMONSTRATION PROJECT

RELIFT STATION SITE PLAN

PLATE
II–37



LONGITUDINAL SECTION

SCALE 3/16" = 1'-0"

Basic Data

Sump Floor	El. 220.8 NGVD
Minumum Water Level in Sump	El. 226.2 NGVD
Maximum Water Level in Sump	El. 228.0 NGVD
Minimum Water Level in Discharge Channel	El. 235.9 NGVD
Maximum Water Level in Discharge Channel	El. 238.2 NGVD
Elevation of Wier	El. 238.2 NGVD
Elevation of Water Flowing Over Wier	El. 241.2 NGVD
Maximum Differential Head on Pump (241.2-226.2)	15 feet
Design Station Flow Rate	100 CFS
Design Pump Flow Rate	20 CFS

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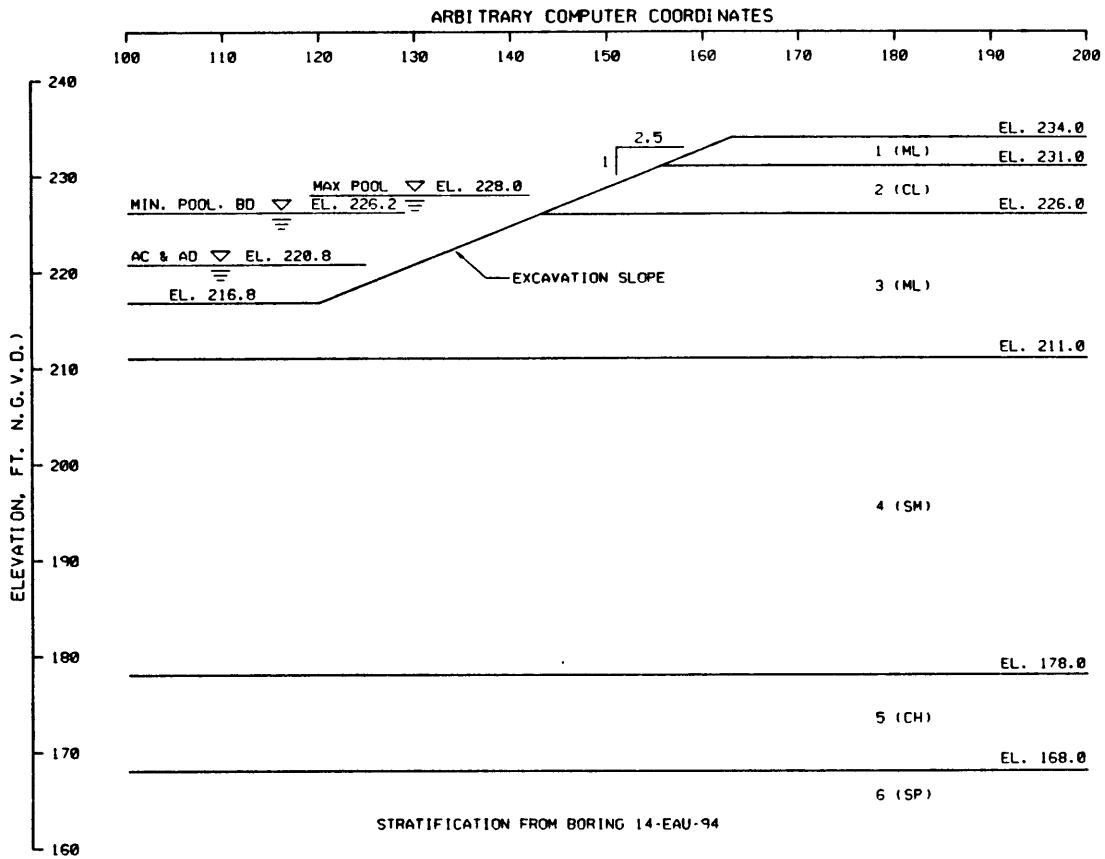
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
RELIFT STATION
LONGITUDINAL SECTION

PLATE
II-38



LONG TERM STABILITY

$FS_{LT} = \frac{\tan \phi}{\tan i} = M \tan \phi'$

$FS_{LT} = M \tan 28°$

$FS_{LT} = M(0.5317)$

EXCAVATION

FOR M = 2.5; FS = 1.33 GOVERNS

INLET CHANNEL

FOR M = 3.0; FS = 1.60

OUTLET CHANNEL

$FS_{LT} = M \tan 23°$

$FS_{LT} = M(0.4245)$

FOR M = 3.0; FS = 1.27

SOIL SHEAR STRENGTHS - BORING 14-EAU-94

SOIL NO.	SOIL TYPE	ELEVATION (N.G.V.D.)	UNIT WT. (PCF)	Q		R		S	
				φ (°)	C (PSF)	φ (°)	C (PSF)	φ (°)	C (PSF)
1	ML	234.3-231.3	120	20	300	20	300	28+	0
2	CL	231.3-226.3	120	0	750+	14	375	28+	0
3	ML	226.3-211.3	120	20	300	20	300	28+	0
4	SM	211.3-178.3	125	30+	0	30	0	30	0
5	CH	178.3-168.3	115	0	1500+	9	750	19	0
6	SP	BELOW 168.3	125	30	0	30	0	30	0

NOTES: STABILITY ANALYSES WERE PERFORMED USING BOTH THE CIRCULAR AND WEDGE METHODS. THE MINIMUM FACTOR OF SAFETY FOR THE EXCAVATION SLOPES WAS GREATER THAN 2.5. DUE TO THE HIGH FACTORS OF SAFETY, THE RESULTS ARE NOT PRESENTED.

THE INLET SLOPES WILL BE FLATTENED TO A 1V:3H WITH A BOTTOM GRADE OF EL. 220.8. THE MAXIMUM POOL IS EL. 228.0. THE SUDDEN DRAWDOWN CONDITION CONTROLLED FROM EL. 226.0 TO EL. 220.8. THE MINIMUM FACTOR OF SAFETY WAS 2.17.

THE OUTLET CHANNEL CONSISTS OF A MAXIMUM POOL OF EL. 238.2 AND A MINIMUM POOL OF EL. 236.0. THE CHANNEL BOTTOM IS EL. 231.8 OR PRACTICALLY NATURAL GROUND. THEREFORE, THE CHANNEL WILL BE RETAINED BY EARTH EMBANKMENTS ON EACH SIDE WITH 1V:3H SIDE SLOPES. THE FACTORS OF SAFETY FOR THE EMBANKMENTS ARE PRESENTED ON THE GENERAL STABILITY PLATE OR PLATE II-17.

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GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
RELIFT STATION
EXCAVATION, INLET & OUTLET CHANNEL
STABILITY ANALYSIS

PLATE
II-39

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EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

RELIFT STATION SETTLEMENT ANALYSIS

PLATE II-40

ASSUMPTIONS

1. WEIGHT OF PUMPING STATION 1.123 KIPS

   WEIGHT OF SOIL EXCAVATED

   15.2' DEPTH X (22' X 31.33') AREA = 10.476 FT^3

   10.476 X 0.120 KCF = 1.257 KIPS

   NET DIFFERENCE 1257 - 1123 = 134 KIPS/ 22 X 31.33 = 0.195 K/SF

   WEIGHT IS NEGLIGIBLE FOR THE PUMPING STATION AS THE STATION WEIGHS LESS THAN THE SOIL DISPLACED. THE ONLY ADDITIONAL LOAD WOULD BE THE EARTH FILL AROUND THREE SIDES OF THE PUMPING STATION.

2. NO CONSOLIDATION TESTS WERE PERFORMED. THE VALUES SELECTED FOR THE COMPRESSION INDEX, C_c, WERE BASED ON PAST EXPERIENCE (CONSOLIDATION DATA FROM PREVIOUS PROJECTS) IN LAYER 2 AND THE EMPERICAL RELATIONSHIP C_c = 0.009 (LL-10) FOR LAYER 4. ALL OTHER LAYERS WERE ASSUMED INCOMPRESSIBLE.

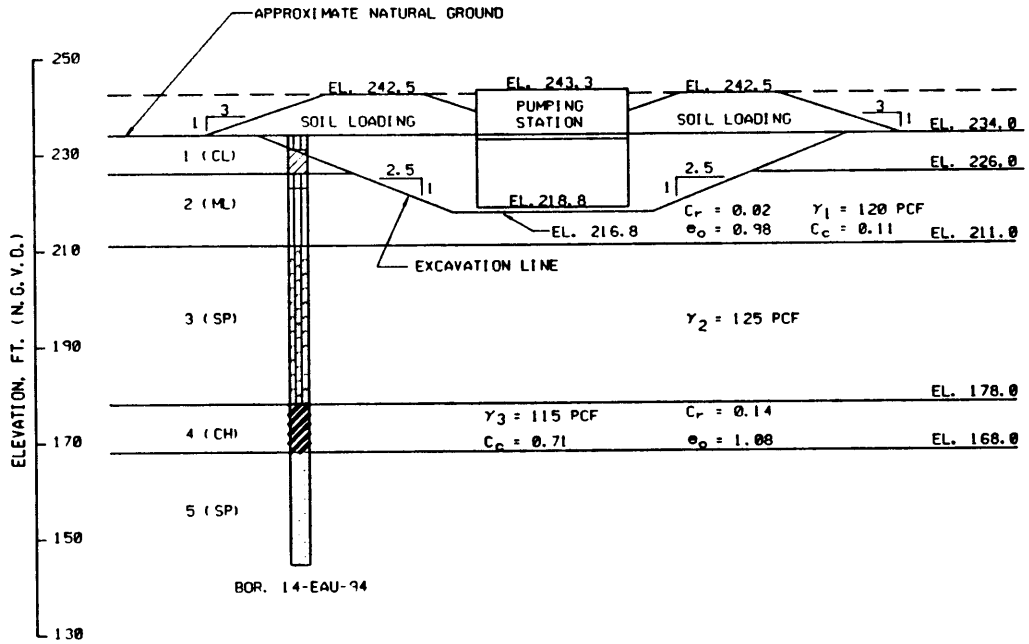
3. THE TOTAL SETTLEMENT WAS ESTIMATED USING CSETT(10019) WES PROGRAM. THE SETTLEMENT WAS ALSO CHECKED BY ASSUMING THE FILL WAS CONTINUOUS ACROSS THE PUMPING STATION AREA USING BOUSSINESQ COEFFICIENTS (CONSERVATIVE ANALYSIS) FOR LOAD DISTRIBUTION. THIS ANALYSIS IS SHOWN ON PLATE II-41.

4. BASED ON THE FACT THAT THE WATER TABLE HAS BEEN DEPLETED (BY PUMPING), ATTERBERG LIMIT VALUES AND THE HIGH UNDRAINED SHEAR STRENGTH OF THE CLAY LAYER, IT APPEARS THAT THE CLAY MAY HAVE BEEN PRECONSOLIDATED TO A STRESS GREATER THAN THAT OF THE EXISTING VERTICAL STRESS PLUS THE SURCHARGE OF THE PROPOSED PUMPING STATION FILL (P_o + ΔP).

5. BOTH OF THESE METHODS OF ESTIMATING SETTLEMENT FOR THE PUMPING STATION RESULTED IN A NET SETTLEMENT OF LESS THAN 1 INCH UNDER THE STRUCTURE IF THE ASSUMPTION THAT THE ADDITIONAL LOADING WOULD FALL ALONG THE RECOMPRESSION PORTIONS OF THE CONSOLIDATION CURVE RATHER THAN THE VIRGIN COMPRESSION PORTION. THIS BEING THE CASE, IT WAS DETERMINED THAT REASONABLE VALUES OF C_r ARE APPROXIMATELY 20% OF C_c. THIS CONCLUSION IS BASED ON THE RESULTS OF NUMEROUS CONSOLIDATION TESTS ON OTHER PROJECTS WITHIN THE MEMPHIS DISTRICT. HOWEVER, IF THIS ASSUMPTION IS NOT TRUE, THEN SETTLEMENT BETWEEN 2.5 AND 4 INCHES WOULD BE EXPECTED IN THE CLAY LAYER.

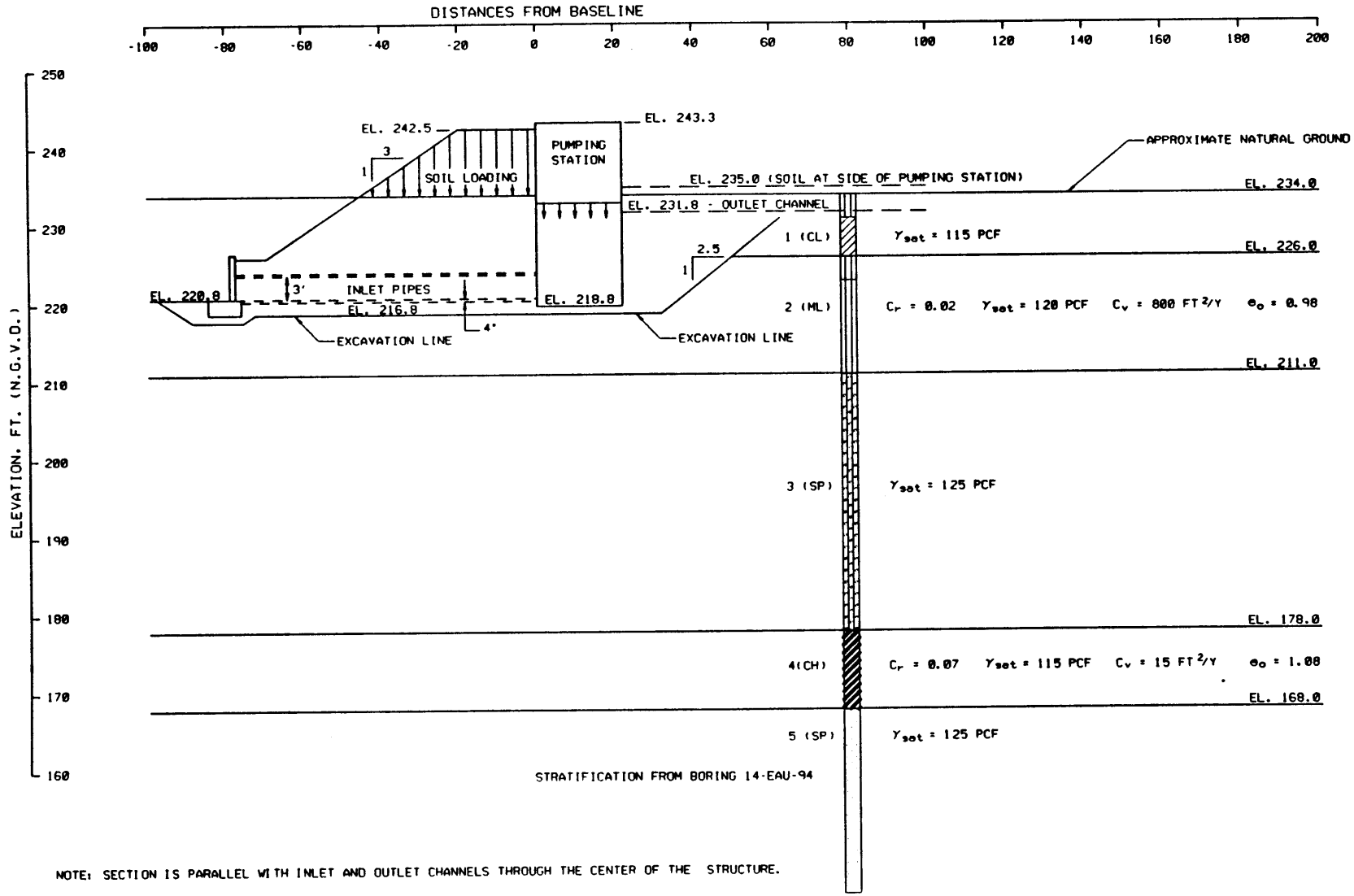
CONCLUSION

ADDITIONAL SOIL DATA WILL BE TAKEN AT THE PUMPING STATION LOCATION. CONSOLIDATION TESTS WILL BE CONDUCTED IN THE SANDY SILT UNDER THE STRUCTURE TO DETERMINE IF THE SILT IS A COLLAPSING SOIL WHEN SUBJECTED TO A FLUCTUATING WATER TABLE. CONSOLIDATION TESTS WILL ALSO BE CONDUCTED ON THE DEEPER CLAY LAYER TO DETERMINE P_o' (PREVIOUS PRESSURE OR MAXIMUM LOADING IN THE FIELD AND C_c AND C_r VALUES). A FINAL ANALYSIS WILL BE CONDUCTED BEFORE PLANS AND SPECS ARE COMPLETED.



SECTION PERPENDICULAR TO INLET & OUTLET CHANNELS THROUGH CENTER OF THE STATION

NOTE: SECTION PARALLEL WITH INLET AND OUTLET CHANNELS IS SHOWN ON PLATE II-41.



NOTE: SECTION IS PARALLEL WITH INLET AND OUTLET CHANNELS THROUGH THE CENTER OF THE STRUCTURE.

LAYER	ELEVATION	DEPTH TO MIDPOINT	P_o (KSF)	ΔP (KSF)	$P_o + \Delta P$ (KSF)	H (FT)	C_c	C_r	e_o	$S = \frac{C_r H}{1 + e_o} \text{LOG} \frac{P_o + \Delta P}{P_o}$
2	218.8-211.0	19.1	2.29	0.999	3.289	7.8	0.11	0.02	0.98	0.012
4	178.0-168.0	61.0	7.46	0.785	8.245	10.0	0.71	0.11	1.08	0.023
										0.035 FT = 0.42 INCH

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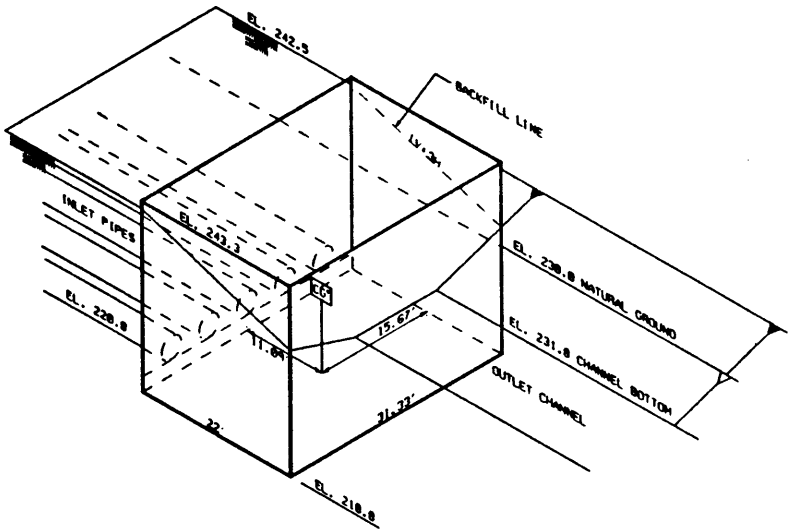
DEMONSTRATION PROJECT

RELIFT STATION SETTLEMENT ANALYSIS

PLATE II-41



SLIDING ANALYSIS (EL. 218.8)

NOTE: SLIDING ANALYSES WERE COMPUTED USING WES COMPUTER PROGRAM CSLIDE (X0075) FOR THE 100 CFS PUMPING STATION. THESE ANALYSES WERE COMPUTED FOR THE STRUCTURE PLACED EITHER ON SAND OR SILT AT ELEVATION 218.8 WITH EITHER SAND OR SILT USED FOR BACKFILL MATERIAL. THESE CONSERVATIVE ANALYSES WERE COMPUTED USING ONLY THE CONCRETE WEIGHT OF THE STRUCTURE (NO WEIGHT WAS ADDED FOR PUMPS, PUMP MOTORS OR WATER IN THE STRUCTURE). THE STRUCTURE IS SAFE AGAINST SLIDING.

CASES ANALYZED

CASE I - AFTER CONSTRUCTION CONDITION. NO WATER ON STRUCTURE

CASE II - SUDDEN DRAWDOWN CONDITION. WATER IN BACKFILL AT EL. 238.2, WATER IN OUTLET CHANNEL AT 231.8.

CASE III - PARTIAL POOL CONDITION. WATER ELEVATION IN THE BACKFILL SAME AS WATER ELEVATION IN OUTLET CHANNEL, WITH VARYING HORIZONTAL POOL ELEVATIONS.

CASE IV - EARTHQUAKE CONDITION. WATER IN BACKFILL AND OUTLET CHANNEL AT EL. 237.0 (NORMAL OPERATING POOL).

CASE V - SUDDEN DRAWDOWN CONDITION. WATER SAME AS CASE II USING S STRENGTHS FOR SILT.

FACTORS OF SAFETY

FAILURE PLANE	EL. 218.8 SILT/SILT BACKFILL	EL. 218.8 SILT/SAND BACKFILL	EL. 218.8 SAND/SAND BACKFILL	REQUIRED MIN. F.S.
CASE I	2.97	2.74	2.68	1.50
CASE II	1.96	1.55	1.36	1.33
CASE III	2.34	2.06	1.70	1.50
CASE IV	1.84	1.38	1.17	1.10
CASE V	1.73	1.33	N/A	1.20

THE ABOVE FACTORS OF SAFETY WERE CALCULATED USING BOTH SILT AND SAND FOR THE BACKFILL AND FOR THE MATERIAL UNDER THE STRUCTURE. A $\phi' = 28^\circ$ WAS CONSERVATIVELY USED IN THE SILT STRATA FOR CASE V.

ALTHOUGH CASE II SHOWS A FACTOR OF SAFETY AT THE MINIMUM REQUIRED, BACKFILL DETAILS (DRAINS, WATERPROOFING AND IMPERVIOUS LAYERS) SHOULD ELIMINATE WATER FROM SATURATING THE BACKFILL ABOVE EL. 227.0 THEREFORE, THIS IS AN EXTREME CASE.

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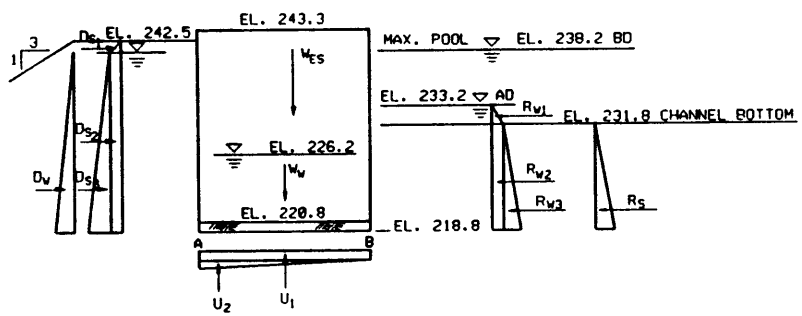
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
RELIFT STATION
SLIDING ANALYSIS

PLATE
II-42



CASE II

ITEM	FORCES (KIPS) VERTICAL ↓	VERTICAL ↑	HORIZONTAL →	HORIZONTAL ←	MOMENT ARM (FEET)	MOMENTS (KIP-FEET) OVERTURNING ↷	RESISTING ↶
STRUCTURE	43.27				10.91		472.08
D_{S_1}			0.58		20.80	12.06	
D_{S_2}			5.21		9.70	50.54	
D_{S_3}			5.88		6.50	38.22	
D_W			11.76		6.50	76.44	
R_S				7.92	4.33		34.29
R_{W_1}				0.06	13.47		0.81
R_{W_2}				1.15	6.50		7.48
R_{W_3}				5.73	4.33		24.81
U_1		21.30			11.00	234.30	
U_2		1.43			14.67	20.98	
TOTALS	43.27	22.73				432.54	539.47

CASE II - $\bar{y}$ (FROM B) = RESULTANT LOCATION = $\frac{\Sigma M}{\Sigma V} = \frac{459.6 - 138.65}{43.27 - 22.73}$ = 5.21' (O.K. RESULTANT LOCATED IN 75% OF BASE)

CASE I - $\bar{y} = \frac{459.6 - 138.65}{35.84}$ = 8.96 (O.K.) ANALYSIS IGNORED PASSIVE RESISTANCE

OVERTURNING ANALYSIS

CREEP METHOD = 19.4' + 22' + 13' = 54.4'

HEAD @ A = 35/54.4(5) + 14.4 = 17.6 FT. (1.1 KSF)
HEAD @ B = 13/54.4(5) + 14.4 = 15.59 FT. (0.97 KSF)

$K_0 = 0.5 = 1 - \sin 30°$; $K_A = \tan^2(45 - 30/2) = 0.33$; $K_P = 1/K_A = 3$;

WEIGHT OF STRUCTURE = 1123/31.33 = 35.84 K/FT. WIDTH
WATER = 5.4(22)0.0625 = $\frac{7.43}{43.27}$ K/FT. WIDTH

$D_{S_1} = 0.5(4.3)^2(0.125)(0.5) = 0.58^K$
$D_{S_2} = 0.125(4.3)(19.4)(0.5) = 5.21^K$
$D_{S_3} = 0.5(19.4)^2(0.0625)(0.5) = 5.88^K$
$D_W = 0.5(19.4)^2(0.0625) = 11.76^K$

$R_S = 0.5(13)^2(0.0625)(1.5) = 7.92$
$R_{W_1} = 0.5(1.41)^2(0.0625) = 0.06^K$
$R_{W_2} = 1.41(13)(0.0625) = 1.15^K$
$R_{W_3} = 0.5(0.88)(13) = 5.73^K$

$U_1 = 22(0.97) = 21.3^K$
$U_2 = 0.5(22)(1.1 - 0.97) = 1.43^K$

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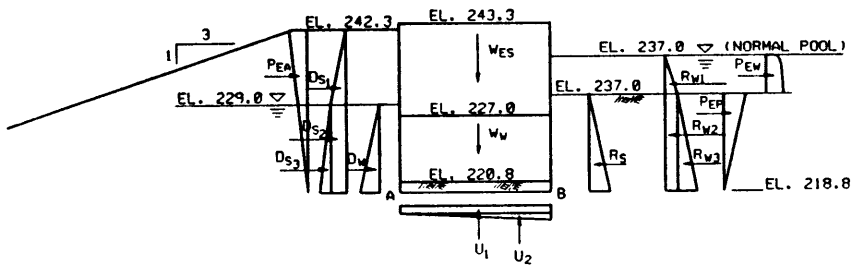
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
RELIFT STATION
SUDDEN DRAWDOWN CASE II
OVERTURNING ANALYSIS

PLATE
II-43



CASE IV

ITEM	FORCES (KIPS) VERTICAL ↓	FORCES (KIPS) VERTICAL ↑	FORCES (KIPS) HORIZONTAL →	FORCES (KIPS) HORIZONTAL ←	MOMENT ARM (FEET)	MOMENTS (KIP-FEET) OVERTURNING	MOMENTS (KIP-FEET) RESISTING
STRUCTURE	44.37				10.91		484.08
D_{S_1}			5.70		14.70	83.79	
D_{S_2}			8.61		5.10	43.91	
D_{S_3}			1.63		3.40	5.54	
D_W			3.25		3.40	11.05	
R_S				7.92	4.33		34.29
R_{W_1}				0.85	14.73		12.52
R_{W_2}				4.23	6.50		27.50
R_{W_3}				6.44	4.33		27.89
U_1		16.50			11.00	181.50	
U_2		2.64			7.33	19.35	
P_{EPS}			4.44		9.15	40.63	
P_{EA}			1.92		15.04	28.88	
P_{EW}			0.09		15.08	1.36	
P_{EP}			1.86		10.51	19.55	
TOTALS	44.37	19.14				435.55	586.27

CASE IV - $\bar{y}$ (FROM B) = RESULTANT LOCATION = $\frac{\Sigma M}{\Sigma V} = \frac{586.27 - 435.55}{44.37 - 19.14} = 5.97'$ (O.K. RESULTANT LOCATED IN BASE OF SLAB)

OVERTURNING ANALYSIS

CREEP METHOD = 13' + 22' + 10.2' = 45.2'

PRESSURE @ A = [(10.2/45.2)(8) + 10.2](0.0625) = 0.75 KSF
PRESSURE @ B = [(32.2/45.2)(8) + 10.2](0.0625) = 0.99 KSF

$K_0 = 0.5$ $K_P = 3.0$ $K_P/2 = 1.5$

WEIGHT OF STRUCTURE = 1123/31.33 = 35.84 K/FT. WIDTH
WATER = 6.2(22)0.0625 = 8.53
44.37 K/FT. WIDTH

$D_{S_1} = 0.5(13.5)^2(0.125)(0.5) = 5.70^K$
$D_{S_2} = 0.125(13.5)(10.2)(0.5) = 8.61^K$
$D_{S_3} = 0.5(10.2)^2(0.0625)(0.5) = 1.63^K$
$D_W = 0.5(10.2)^2(0.0625) = 3.25^K$

$R_S = 0.5(13)^2(0.0625)(1.5) = 7.92$
$R_{W_1} = 0.5(5.2)^2(0.0625) = 0.85^K$
$R_{W_2} = 5.2(13)(0.0625) = 4.23^K$
$R_{W_3} = 0.5(0.99)(13) = 6.44^K$

$U_1 = 22(0.75) = 16.5^K$
$U_2 = 0.5(22)(0.99 - 0.75) = 2.64^K$ K

APPLY DYNAMIC FORCES

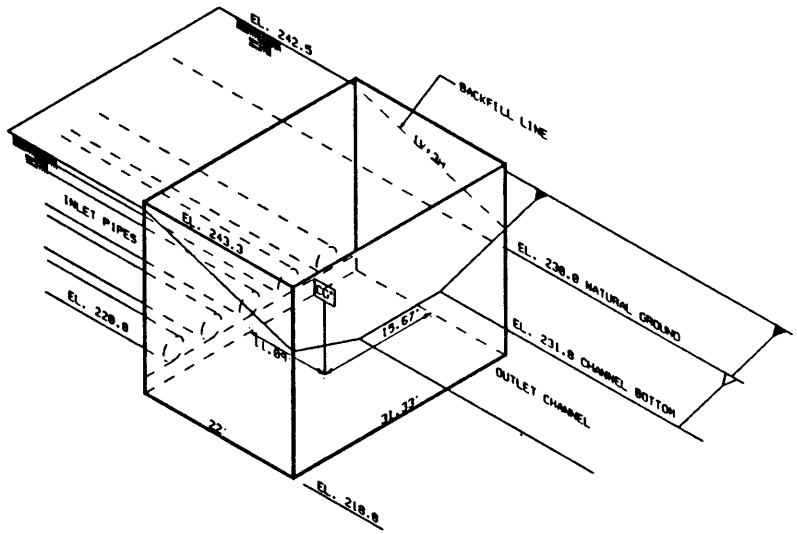
P_E PUMPING STATION $= 0.10(35.84 + 8.53)$ 4.44^K

$P_{EA} = 0.10(D_{S_1} + D_{S_2} + D_{S_3} + D_W)$
$= 0.10(5.70 + 8.61 + 1.63 + 3.25) = 1.92$

USE WESTERGAARD'S EQUATION TO DETERMINE P_{EW}
(WATER ABOVE GROUND)

$P_{EW} = 2/3\ C_E K_h h^2 = (2/3)(0.051)(0.1)(5.2)^2$
$= 0.09^K$

$P_{EP} = 0.1(R_S + R_{W_2} + R_{W_2}) = 0.1(7.92 + 4.23 + 6.44)$
$= 1.86^K$



BEARING CAPACITY

*CG = 1,021,200 LBS (WEIGHT INCLUDES CONCRETE ONLY)

NOTE: ADDED 10% WEIGHT FOR PUMPS, MOTORS, ETC. 1021.2 X 1.1 = 1.123 K

RECTANGULAR AREA = B = 22' AND L = 31.33'

$B' = B - 2e$

CASE I (AC) - $e = 1.95'$ $B' = 18.1'$
CASE II (SD) - $e = 5.79'$ $B' = 10.42'$
CASE IV (EO) - $e = 4.94'$ $B' = 12.12'$
FOR ALL CASES - $L/6 = 31.33/6 = 5.22$

$$L/6 > e', Q = \frac{V}{BL}\left(1 + \frac{6e}{L}\right)^{**}, L/6 > e', Q = \frac{2V}{3B(L/2 - e)}$$

$$Q = \frac{1123}{(31.33)(22)}\left[1 + \frac{6(1.95)}{22}\right] = 2.50 \text{ K/S.F.} \quad \text{CASE I}$$

$$Q = \frac{2(20.54)}{3(11 - 5.79)} = 2.63 \text{ K/S.F.} \quad \text{CASE II}$$

$$Q = \frac{25.23}{22}\left[1 + \frac{6(4.94)}{22}\right] = 2.69 \text{ K/S.F.} \quad \text{CASE IV}$$

$$q_{ult} = cN_c \cancel{S_c d_c i_c} g_c b_c + \bar{q} N_q S_q d_q i_q g_q b_q + 0.5\gamma B N_\gamma S_\gamma d_\gamma i_\gamma g_\gamma b_\gamma \quad (\cancel{S_c d_c} \to 0)$$

$\phi = 28°$ $N_c = 25.8$ $N_q = 14.7$ $N_\gamma = 10.9$
$\phi = 20°$ $N_c = 14.83$ $N_q = 6.4$ $N_\gamma = 2.9$

O_{CASE} $C = 300$ $\phi = 20°$
S_{CASE} $C = 0$ $\phi = 28°$

$\gamma' = 0.0625$ $D = 13'$ $B = 22'$ $L = 31.33'$

$\bar{q} = \gamma' D = 0.0625(13) = 0.81$
$S_c = 1 + N_q B/N_c L = 1 + 18.4(21.8)/30.14(31.33) = 1.425$
$S_q = 1 + (B/L)\tan\phi = 1 + (21.8/31.33)\tan 20° = 1.253$
$S_\gamma = 1 - 0.4(B/L) = 1 - 0.4(21.8/31.33) = 0.722$

$d_c = 1 + 0.4(D/B)$ FOR $D < B$ $1 + 0.4(13/22) = 1.24$
$d_q = 1 + 2\tan\phi(1 - \sin\phi)^2 D/B$, $D < B$ $1 + 2\tan 20°(1 - \sin 20°)^2(13/22) = 1.19$
$d_\gamma = 1.0$

$i_c = g_c = b_c = 1 = i_q = g_q = b_q = d_\gamma = i_\gamma = g_\gamma = b_\gamma$

O CASE

CASE I $q_{ult} = 0.3(14.83)(1.425)(1.24)(1)(1)(1) + 0.81(6.4)(1.253)(1.19)(1)(1)(1) + 0.5(0.0625)(18.1)(2.9)(0.722)(1) = 16.78$ KSF

CASE I F.S. $= \frac{Q_{ult}}{q_{ult}} = \frac{16.78}{2.5} = 6.7$ SAFE > 3.0

CASE II F.S. $= \frac{16.27}{2.63} = 6.2$

CASE IV F.S. $= \frac{16.38}{2.69} = 6.1$ (ALL CASES OK)

$$q_{ult} = cN_c \cancel{S_c d_c i_c} g_c b_c + \bar{q} N_q S_q d_q i_q g_q b_q + 0.5\gamma B N_\gamma S_\gamma d_\gamma i_\gamma g_\gamma b_\gamma \quad (\cancel{S_c d_c} \to 0)$$

S CASE $C = 0$, $\phi = 28°$

CASE I $q_{ult} = 0.81(14.7)(1.253)(1.19)(1) + 0.5(0.0625)(18.1)(10.9)(0.722)(1) = 22.2$ KSF

CASE I F.S. $= \frac{Q_{ult}}{q_{ult}} = \frac{22.2}{2.5} = 8.9$ SAFE > 3.0

CASE II F.S. $= \frac{20.32}{2.63} = 7.7$

CASE IV F.S. $= \frac{20.72}{2.69} = 7.7$ (ALL CASES OK)

***FROM FOUNDATION ANALYSIS AND DESIGN", BY JOSEPH E. BOWLES, 2ND EDITION, P. 120 & P. 256.

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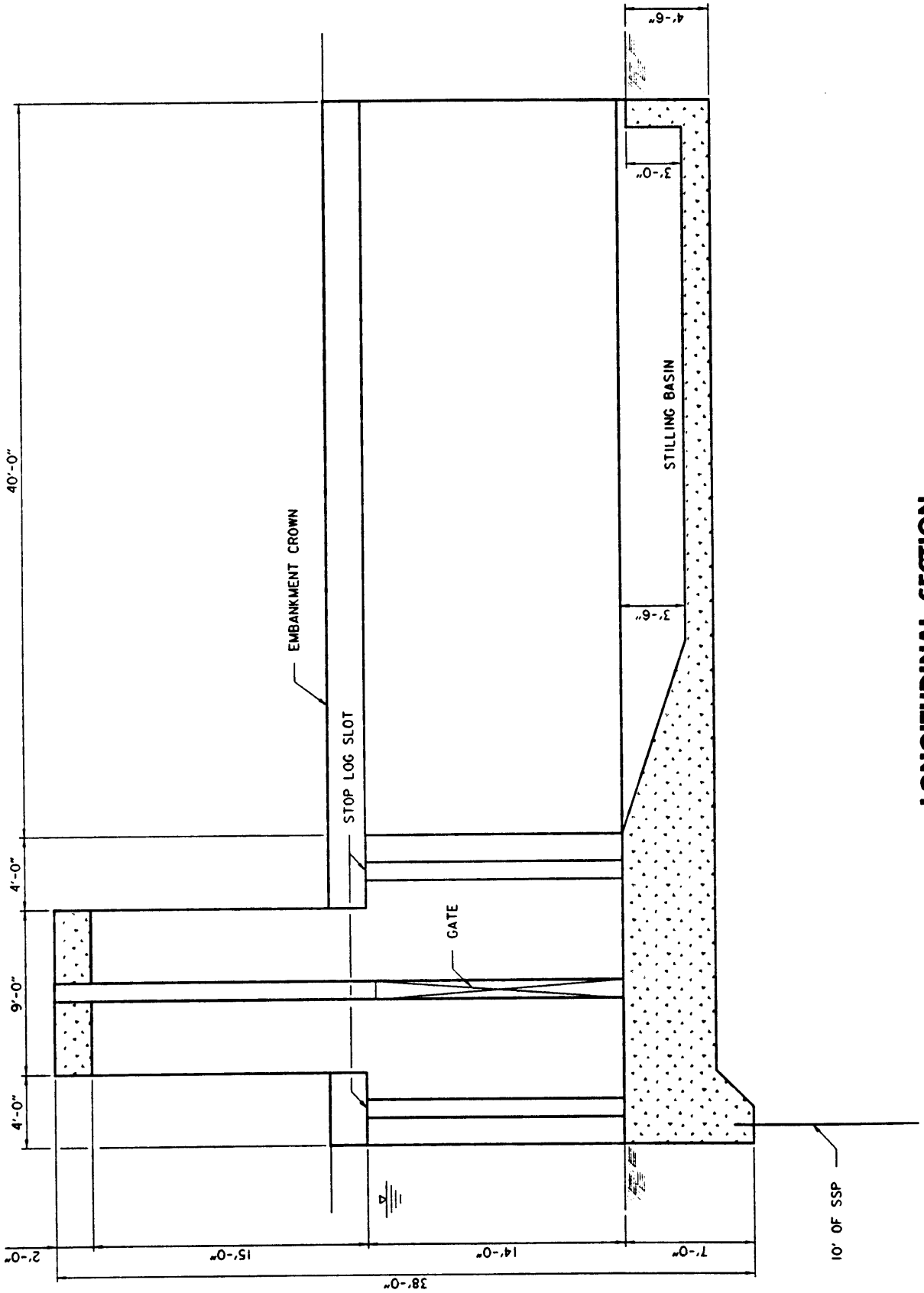
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

RELIFT STATION BEARING ANALYSIS

PLATE II-45



LONGITUDINAL SECTION

SCALE 1/8" = 1'-0"

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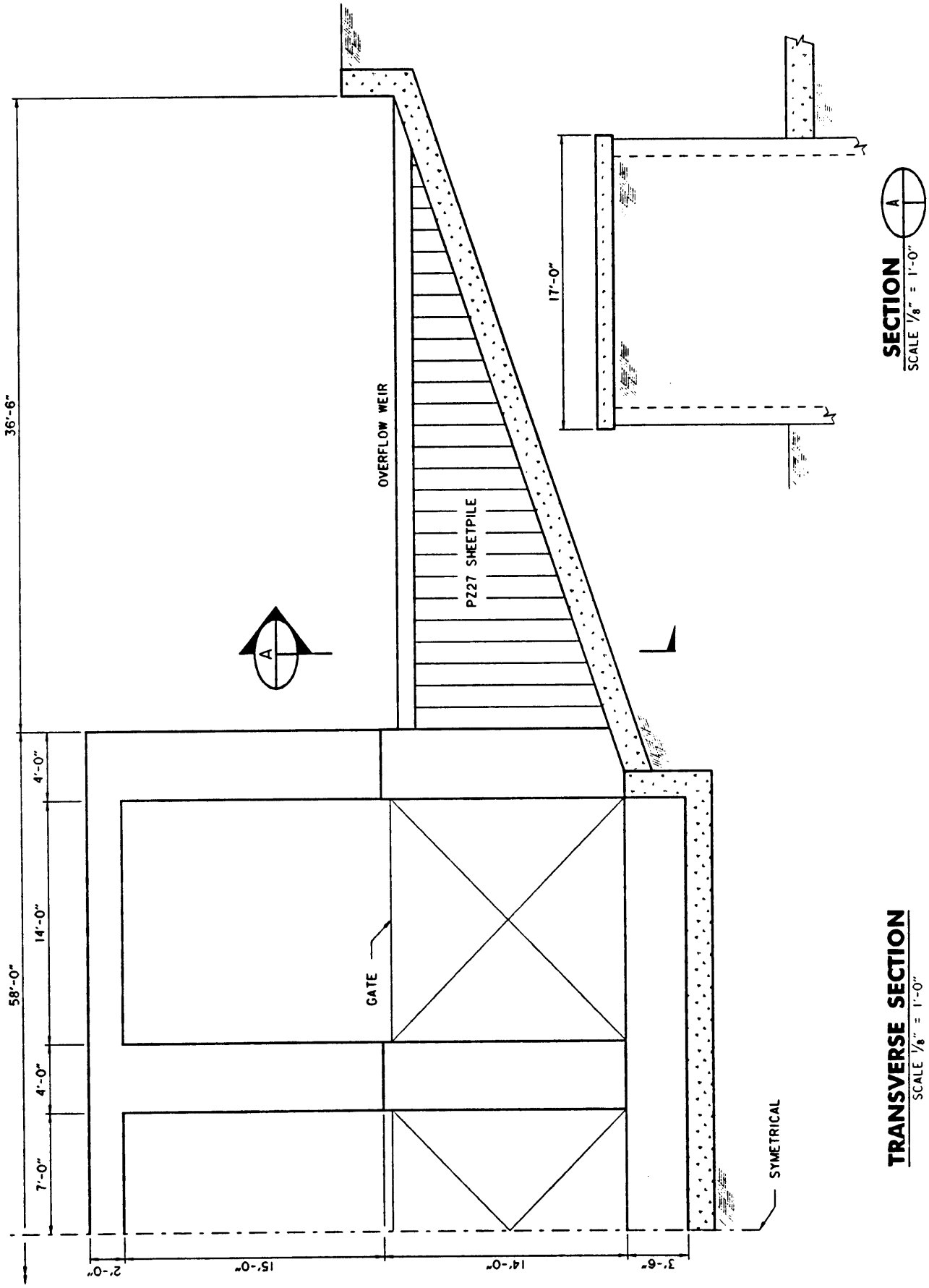
CHECK STRUCTURE

PLATE

II–46



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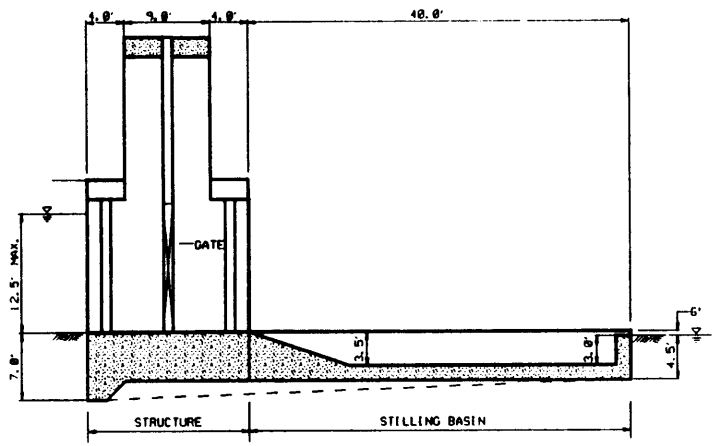
CHECK STRUCTURE

PLATE
II–47



GATED CHECK STRUCTURE

SLIDING ANALYSIS

NOTE: SLIDING ANALYSES WERE COMPUTED FOR THE GATED CHECK STRUCTURES FOR CASES II, IV AND V. THESE WERE THE ONLY CASES RESULTING IN HORIZONTAL LOADING. ALL THREE SOIL CONDITIONS FOR POSSIBLE STRUCTURE PLACEMENT WERE CONSIDERED: CLAY, SILT OR SAND. CONSERVATIVE SHEAR STRENGTHS AS SHOWN BELOW WERE USED:

CLAY $\phi = 0°$, C = 1000 PSF, $\phi' = 18°$

SILT $\phi = 20°$, C = 300 PSF, $\phi' = 28°$

SAND $\phi = 30°$, C = 0

THE SLIDING ANALYSES CONSERVATIVELY ASSUMED ONLY THE WEIGHT OF THE STRUCTURE. PASSIVE RESISTANCE WAS USED FOR THE STILLING BASIN WITH A SHEAR STRENGTH OF $\phi = 30°$.

CASES ANALYZED

CASE I - AFTER CONSTRUCTION CONDITION. NO WATER IN INLET CHANNEL OR OUTLET CHANNEL. N/A (NO LOAD)

CASE II - SUDDEN DRAWDOWN CONDITION. WATER IN THE INLET CHANNEL AT EL. 227.2, (12.5 HEAD). WATER IN OUTLET CHANNEL AT THE CHANNEL BOTTOM.

CASE III - N/A

CASE IV - EARTHQUAKE CONDITION. WATER IN THE INLET CHANNEL AT NORMAL POOL, EL. 227.2. WATER IN OUTLET CHANNEL AT NORMAL POOL. EL. 224.5

CASE V - SAME AS CASE II USING S STRENGTH FOR CLAY AND SILT ANALYSES.

FACTORS OF SAFETY

FAILURE PLANE	CLAY	SILT	SAND
CASE II	1.99	1.58	1.53
CASE IV	2.64	2.17	2.06
CASE V	1.19	1.41	N/A

THE FACTORS OF SAFETY SHOWN FOR CASES II AND IV CONSERVATIVELY ASSUMED A HORIZONTAL BASE OF FIVE FEET THICK WITHOUT THE ADDITIONAL TWO FOOT HEEL AS SHOWN ON THIS PLATE. THE FACTORS OF SAFETY PRESENTED FOR THE EXTREME LOADING OF CASE V ASSUMED THE ACTUAL STRUCTURE AS SHOWN. BOTH SLOPING AND HORIZONTAL SLIDING SURFACES WERE CONSIDERED WITH THE MINIMUM VALUES SHOWN IN THE TABLE.

SLIDING ANALYSES WERE COMPUTED USING WES COMPUTER PROGRAM CSLIDE (X0075) THESE ANALYSES WERE COMPUTED ASSUMING A SAND BACKFILL AROUND THE STRUCTURE AND UTILIZED ONLY THE WEIGHT OF CONCRETE IN THE STRUCTURE. NO WEIGHT WAS ADDED FOR GATES OR LIVE LOAD. THE STRUCTURE IS SAFE AGAINST SLIDING.

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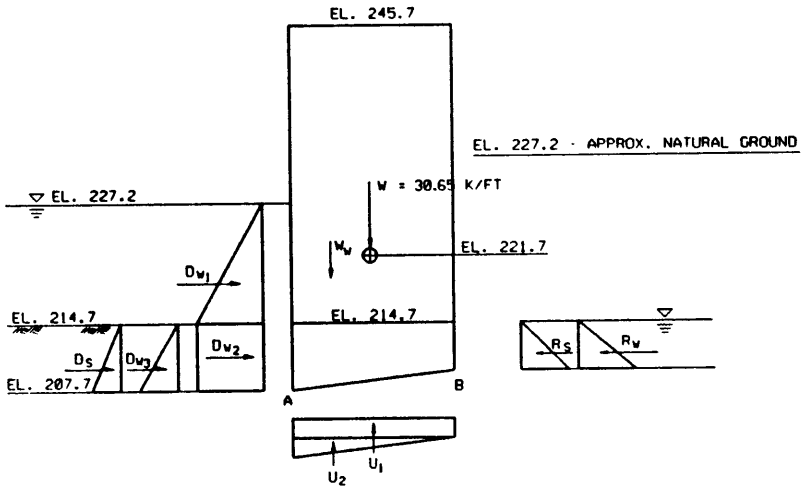
GATED CHECK STRUCTURE
SLIDING ANALYSIS

PLATE
II-48



CASE II
GATED CHECK STRUCTURE

ITEM	FORCES (KIPS) VERTICAL ↓	VERTICAL ↑	HORIZONTAL →	HORIZONTAL ←	MOMENT ARM (FEET)	MOMENTS (KIP-FEET) OVERTURNING ↷	RESISTING ↶
STRUCTURE	30.65				8.70		266.66
WATER	5.85				13.25		77.51
D_{w_1}			4.88		9.17	44.73	
D_{w_2}			5.46		1.50	8.19	
D_{w_3}			1.53		0.33	0.50	
D_s			0.77		0.33	0.25	
R_s				1.17	1.67		11.95
R_w				0.78	1.67		1.30
U_1		7.65			8.50	65.03	
U_2		4.93			11.33	55.86	
TOTALS	36.50	12.58				174.56	347.42

CASE II - $\bar{y}$ (FROM B) = RESULTANT LOCATION = $\frac{\Sigma M}{\Sigma V} = \frac{347.42 - 174.56}{36.5 - 12.58} = 7.23'$ (O.K. RESULTANT LOCATED IN IN MID HALF OF BASE)

CASE I (AFTER CONSTRUCTION) N/A

CASE IV (EARTHQUAKE) $\bar{y}$ (FROM B) = $\frac{96.55}{21.8} = 4.43'$ (O.K. WITHIN BASE OF STRUCTURE)

OVERTURNING ANALYSIS

CREEP METHOD = 7' + 17.2' + 5' = 29.2'

HEAD @ A = (22.2/29.2)(12.5) + 7 = 16.5 FT (1.03 KSF)
HEAD @ B = (5/29.2)(12.5) + 5 = 7.14 FT. (0.45 KSF)

$K_0 = 0.5 = 1 - \sin 30°$; $K_A = \tan^2(45 - 30/2) = 0.33$; $K_P = 1/K_A = 3$;

WEIGHT OF STRUCTURE = 1777.8/58 = 30.65 K/FT. WIDTH
WATER = 7.5(12.5)0.0624 = 5.85 K/FT
36.50 K/FT. WIDTH

$D_{w_1} = 0.5(12.5)^2(0.0624) = 4.88^K$
$D_{w_2} = 0.0624(12.5)(7) = 5.46^K$
$D_{w_3} = 0.5(0.0624)(7)^2 = 1.53^K$
$D_s = 0.5(0.5)(0.125 - 0.0624)(7)^2 = 0.767^K$

$R_s = 0.5(0.125 - 0.0624)(5)^2(1.5) = 1.17^K$
$R_w = 0.5(0.0624)(5)^2 = 0.78^K$

$U_1 = 17(0.45) = 7.65^K$
$U_2 = 0.5(17)(1.03 - 0.45) = 4.93^K$

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GRAND PRAIRIE AREA
DEMONSTRATION PROJECT
GATED STRUCTURE
STEADY SEEPAGE
OVERTURNING ANALYSIS

PLATE
II-49

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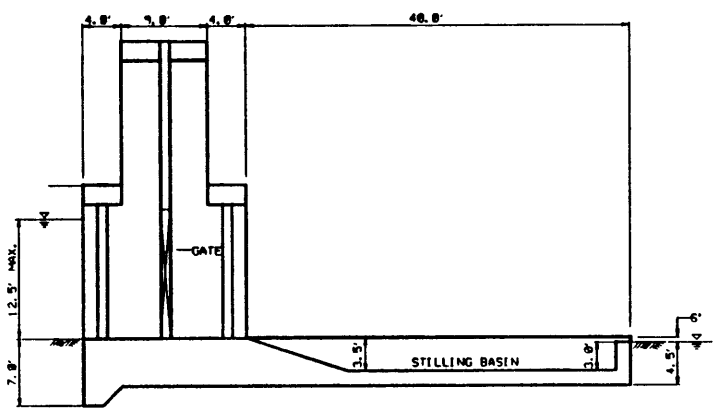
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

GATED CHECK STRUCTURE BEARING ANALYSIS

PLATE II-50



GATED CHECK STRUCTURE

BEARING ANALYSIS

WEIGHT - 1778 KIPS

DIMENSIONS B = 17' L = 58' B/6 = 17/6 = 2.83

B' = B - 2e

CASE I (AC): e*= 0 B' = 17' e < B/6 V = 1778/58 = 30.65^K
CASE II (SD): e = 1.27' B' = 14.46' e < B/6 V = 23.92^K
CASE IV (EO): e = 4.07' B' = 8.86' e > B/6 V = 21.8^K
*e FROM OVERTURNING ANALYSES

FOR e < B/6, $q = \frac{V}{BL}\left(1 + \frac{6e}{B}\right)$ FOR e > B/6, $q = \frac{2V}{3L(B/2 - e)}$

CASE I $q = \frac{30.65}{17}(1) = 1.80$ K/S.F.

CASE II $q = \frac{23.92}{17}\left[1 + \frac{6(1.27)}{17}\right] = 2.04$ K/S.F.

CASE IV $q = \frac{2(21.8)}{3[(17/2) - 4.07]} = 3.28$ K/S.F.

$q_{ult} = cN_c S_c d_c I_c g_c b_c + \bar{q} N_q S_q d_q I_q g_q b_q + 0.5\gamma B N_\gamma S_\gamma d_\gamma I_\gamma g_\gamma b_\gamma$

NOTE: THREE SUBGRADES WERE ANALYZED TO FIND CRITICAL CASE

SILT	ϕ = 20°, C = 300	N_c = 14.83,	N_q = 6.4,	N_γ = 2.9
SAND	ϕ = 30°, C = 0	N_c = 30.14,	N_q = 18.4,	N_γ = 15.1
CLAY	ϕ = 0°, C = 1000	N_c = 5.14,	N_q = 1,	N_γ = 0

B = 17' B'(CASE IV) = 8.86'** γ' = 0.0624 L = 58' D/B = 5/17 = 0.294

**USED CASE IV FOR ALL CASES (CONSERVATIVE) $\bar{q} = \gamma' D$ = 0.0624(5) = 0.312

$S_c = 1 + N_q B/N_c L = 1 + 6.4(8.86)/14.83(58) = 1.07$ SILT; FOR CLAY, S_c = 1.03
$S_q = 1 + (B/L)\tan\phi = 1 + (8.86/58)\tan 20° = 1.06$; FOR ϕ = 30°, S_q = 1.09
$S_\gamma = 1 - 0.4(B/L) = 1 - 0.4(17/58) = 0.88$

$d_c = 1 + 0.4(D/B) = 1 + 0.4(0.294) = 1.12$
$d_q = 1 + 2\tan\phi(1 - \sin\phi)^2 D/B = 1 + 2\tan 20°(1 - \sin 20°)^2(0.294) = 1.093$; FOR ϕ = 30°, d_q = 1.08

FOR SILT

$q_{ult} = 0.3(14.83)(1.066)(1.12) + 0.312(6.4)(1.06)(1.093)$
$+ 0.5(0.0626)(8.86)(2.9)(0.88) = 8.33$ KSF

FOR SAND

$q_{ult} = 0.312(18.4)(1.09)(1.08) + 0.5(0.0626)(8.86)(15.1)(0.88) = 10.44$ KSF

FOR CLAY

$q_{ult} = 1.0(5.14)(1)(1.03)(1.12) + 0.312(1)(1)(1) = 6.24$ KSF

CLAY SUBGRADE RESULTED IN THE MOST CRITICAL ULTIMATE BEARING CAPACITY AND WAS USED FOR DETERMINING FACTORS OF SAFETY. MOST OF THE STRUCTURES WILL BE PLACED ON EITHER A SANDY SILT OR SAND FOUNDATION. ALSO, THE CLAY STRENGTH OF C = 1000 PSF IS VERY CONSERVATIVE.

CASE I F.S. = $\frac{q_{ult}}{q} = \frac{6.24}{1.8} = 3.5$ O.K. > 3.0

CASE II F.S. = $\frac{6.24}{2.04} = 3.1$ OK > 2

CASE IV F.S. = $\frac{6.24}{3.28} = 1.9$ OK > 1

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EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

GATED CHECK STRUCTURE SETTLEMENT ANALYSIS

PLATE II-51

SETTLEMENT ANALYSIS

ASSUMPTIONS

1. WEIGHT OF GATED STRUCTURE = 1.778 KIPS (NO GATES)
   ADD 5% OF STRUCTURE FOR GATES = 90 KIPS
   ADD 12 FEET OF WATER (12)(17 - 4)(58)0.0624 = 565 KIPS

   TOTAL WEIGHT 2.433 KIPS OR 2.468 KSF

   WEIGHT OF SOIL DEPENDS ON DEPTH OF EXCAVATION. FOR 4 MAIN GATED STRUCTURES, THE DEPTH VARIES FROM 13' TO 22'. IT WAS ASSUMED THAT MAXIMUM SETTLEMENT WILL BE COMPUTED AT STRUCTURE C-5000.01 USING BORING 15-EAU-94.

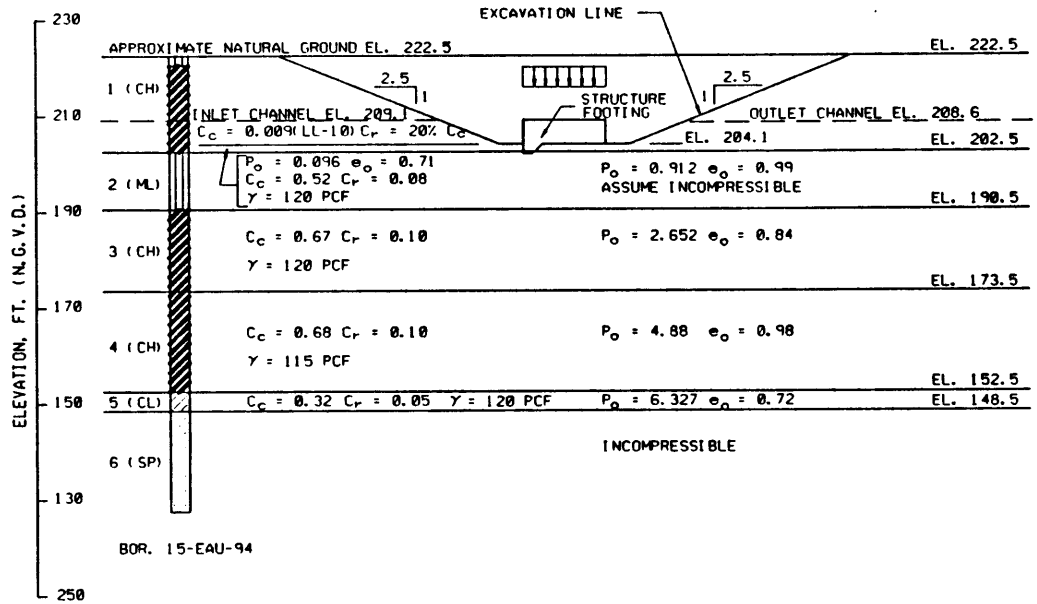
   DEPTH OF EXCAVATION IS 18.4 FEET
   WEIGHT OF SOIL = (18.4 X 17 X 58)0.120 = 2.177 KIPS.

2. SINCE STRUCTURE WEIGHT IS APPROXIMATELY EQUAL TO SOIL EXCAVATED AND THE HIGH STRENGTHS OF THE CLAY STRATA INDICATED SOIL HAS BEEN PRESTRESSED, C_r OR THE RECOMPRESSION INDEX WAS USED FOR DETERMINING SETTLEMENT.

3. NO CONSOLIDATION TESTS WERE PERFORMED FOR BORING 15-EAU-94. THE VALUES SELECTED FOR THE COMPRESSION INDEX, C_c, WERE BASED ON PAST EXPERIENCE AND THE EMPERICAL RELATIONSHIP $C_c = 0.009(LL-10)$. THE RECOMPRESSION INDEX, C_r, WAS TAKEN AS 15% TO 20% OF C_c FOR ESTIMATING SETTLEMENT.

4. THE SANDY SILT LAYER, NO. 2, WAS ASSUMED INCOMPRESSIBLE.

5. BOUSSINESQ COEFFICIENTS WERE USED TO DETERMINE THE VERTICAL STRESS BENEATH THE GATED STRUCTURE FOOTING. FOR A UNIFORMLY LOADED RECTANGLE, THE COEFFICIENTS ARE FOUND ON PG 7.1-168 OF THE DESIGN MANUAL 7.1, "SOIL MECHANICS" OR NAVFAC DM-7.1.

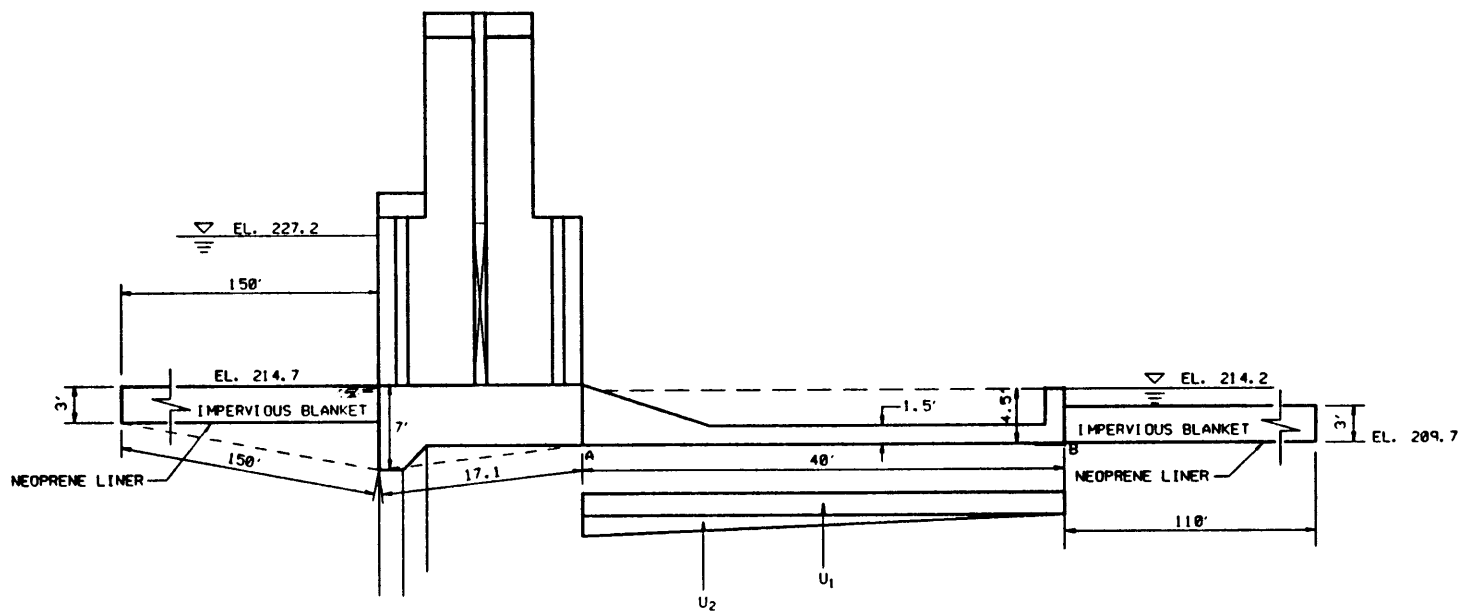


SECTION PARALLEL TO INLET & OUTLET CHANNELS THROUGH CENTER OF THE GATED CHECK STRUCTURE

CONCLUSION

THIS ANALYSIS ASSUMED CONDITIONS THAT WOULD RESULT IN MAXIMUM SETTLEMENT FOR THE GATED STRUCTURES. TYPICAL SETTLEMENT FOR THE OTHER GATED STRUCTURES RANGED FROM 1 INCH TO 3 INCHES. ADDITIONAL BORINGS WILL BE TAKEN AT EACH STRUCTURE TO DETERMINE STRATIFICATION. EACH STUCTURE WILL BE REANALYZED AND APPROPRIATE MEASURES WILL BE INCORPORATED INTO THE FINAL DESIGN TO ASSURE AN ADEQUATE FOUNDATION TO PREVENT EXCESSIVE SETTLEMENT AND MEET DESIGN CRITERIA FOR GENERAL STABILITY.

LAYER	ELEVATION	DEPTH TO MIDPOINT	P_o (KSF)	ΔP (KSF)	$P_o + \Delta P$ (KSF)	H (FT)	C_c	C_r	e_o	$S = \frac{C_r H}{1 + e_o} \text{LOG} \frac{P_o + \Delta P}{P_o}$
1	204.1-202.5	0.8	0.096	2.468	2.564	1.6	0.52	0.08	0.71	0.107
3	190.5-173.5	22.1	2.652	1.777	4.429	17.0	0.67	0.10	0.84	0.206
4	173.5-152.5	41.1	4.880	1.111	5.991	21.0	0.68	0.10	0.98	0.095
5	152.5-148.5	53.6	6.327	0.814	7.141	4.0	0.32	0.05	0.72	0.006
										0.414 FT = 5 INCHES



WEIGHT OF BASIN = $\left[\frac{(5.0 + 1.5)}{2}(10.5) + 1.5(28) + 4.5(1.5)\right](0.150)$

$= [34.125 + 42 + 6.75](0.150) = 12.43$ K/FT

WEIGHT OF WATER = $[3(28) + 0.5(3)(9)](0.0624) = 6.08$ K/FT

PATH = $3 + 150 + 17.1 + 40 + 4.5 = 214.6$

HEAD @ A = $(44.5/214.6)(13) + 4.5 = 7.20$ FT $(0.45$ KSF$)$

HEAD @ B = $(4.5/214.6)(13) + 4.5 = 4.77$ FT. $(0.30$ KSF$)$

$U_1 = 0.3(40) = 12.0^K$

$U_2 = 0.5(40)(0.45 - 0.30) = 3.0^K$

$F.S. = \frac{12.43 + 6.08}{12 + 3} = 1.23$ O.K.

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA
DEMONSTRATION PROJECT

GATED CHECK STRUCTURE UPLIFT OF STILLING BASIN

PLATE
II-52

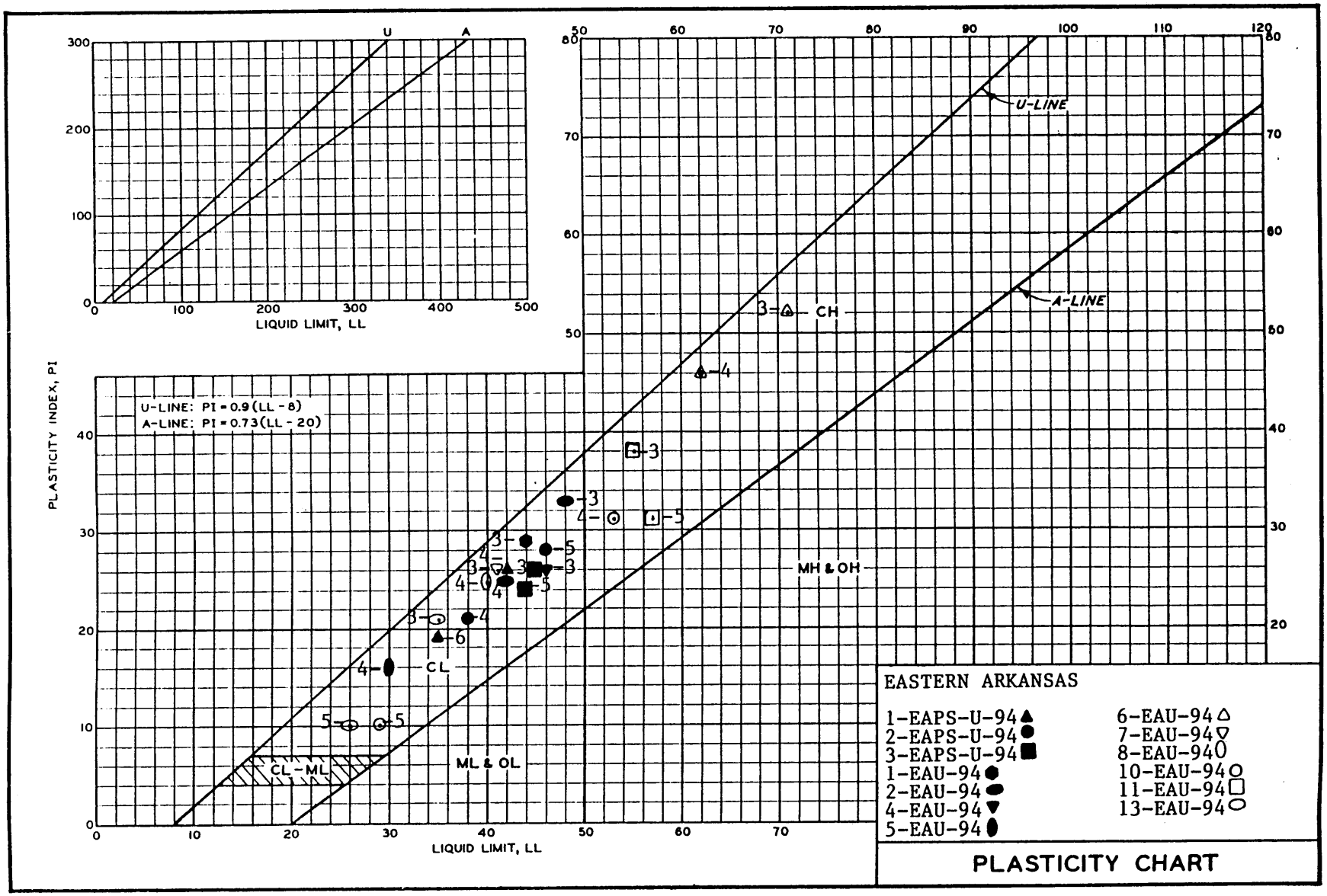
Eastern Arkansas Region Comprehensive Study
Grand Prairie Area
Demonstration Project

APPENDIX II - A

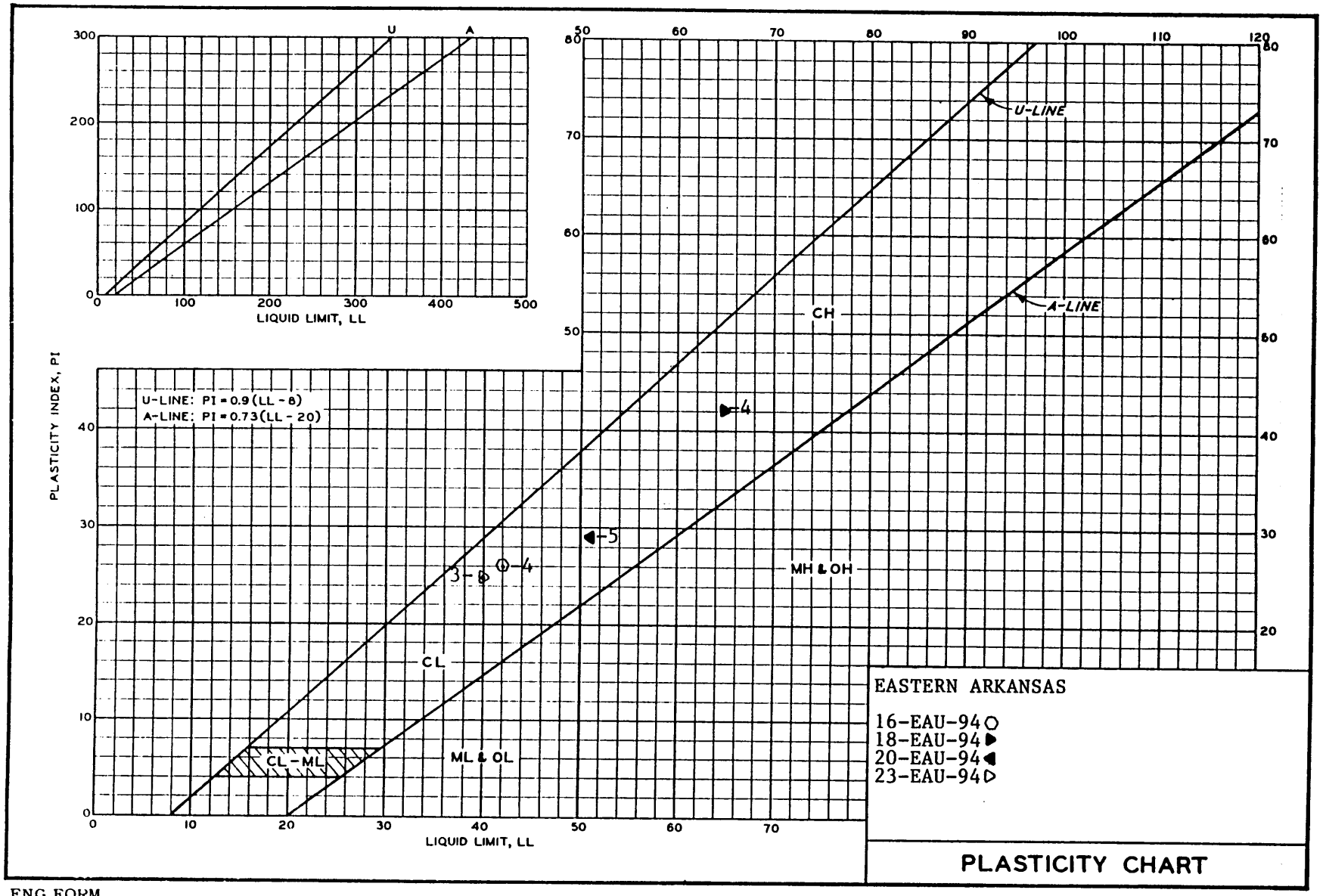
Section II - Geology and Soils - Test Data

Eastern Arkansas Region Comprehensive Study
Grand Prairie Area
Demonstration Project

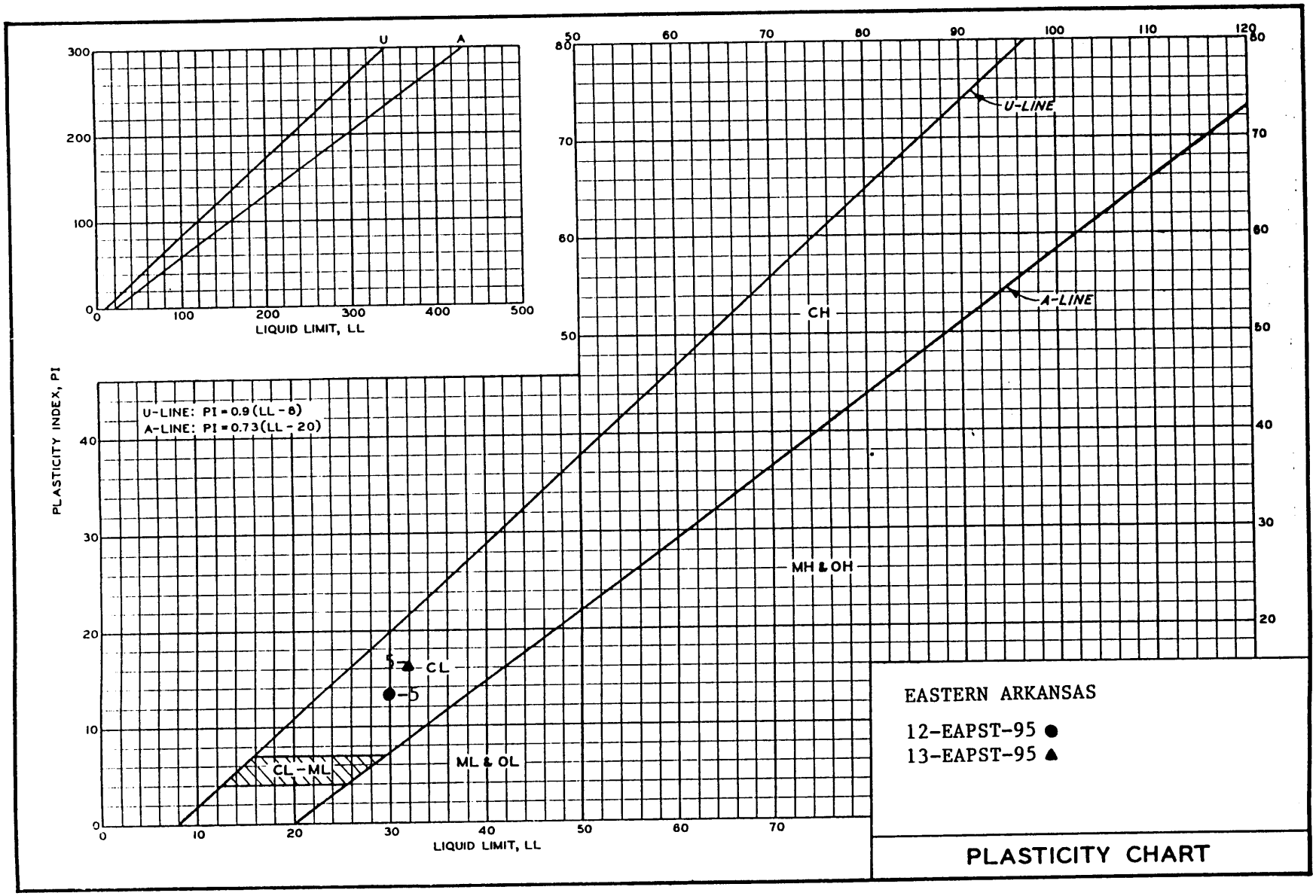
Memphis District Soils Laboratory
UC Test Data
Unconfined Compression Test Data



ENG FORM JUN 70 4334 (EM 1110-2-1906) TRANSLUCENT

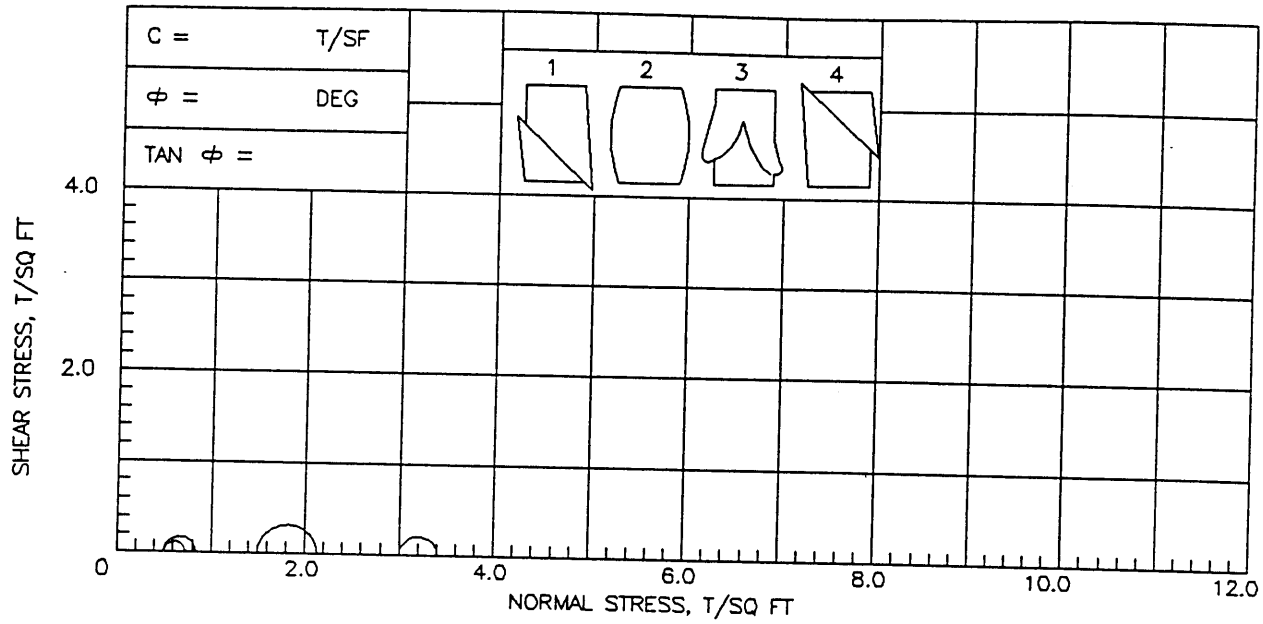


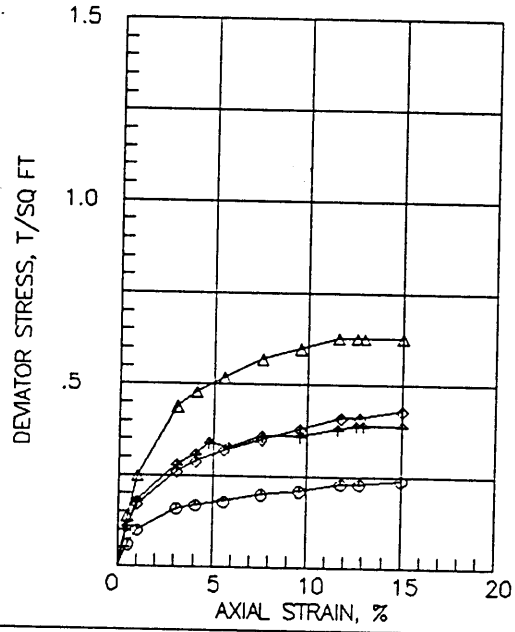
ENG FORM JUN 70 4334 (E M 1110-2-1906) TRANSLUCENT



PLASTICITY CHART

ENG FORM JUN 70 4334 (E M 1110-2-1906) TRANSLUCENT





SPECIMEN NO.		○ 1	△ 2	◇ 3	+ 4
INITIAL	WATER CONTENT, %	31.3	27.1	27.6	28.7
	DRY DENSITY, PCF	90.8	94.8	95.4	96.1
	SATURATION, %	98.8	94.1	97.3	100+
	VOID RATIO	.856	.778	.767	.755
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESSURE, TSF				
CHAMBER PRESSURE, TSF		.50	1.50	3.00	.50
MAX. DEV. STRESS, TSF		.23	.63	.41	.34
TIME TO FAILURE, MIN.		26	26	36	15
STRAIN RATE INCR., %					
INITIAL DIAMETER, IN.		1.36	1.38	1.36	1.37
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; IRON OXIDE PARTICLES

LL 35	PL 16	PI 19	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

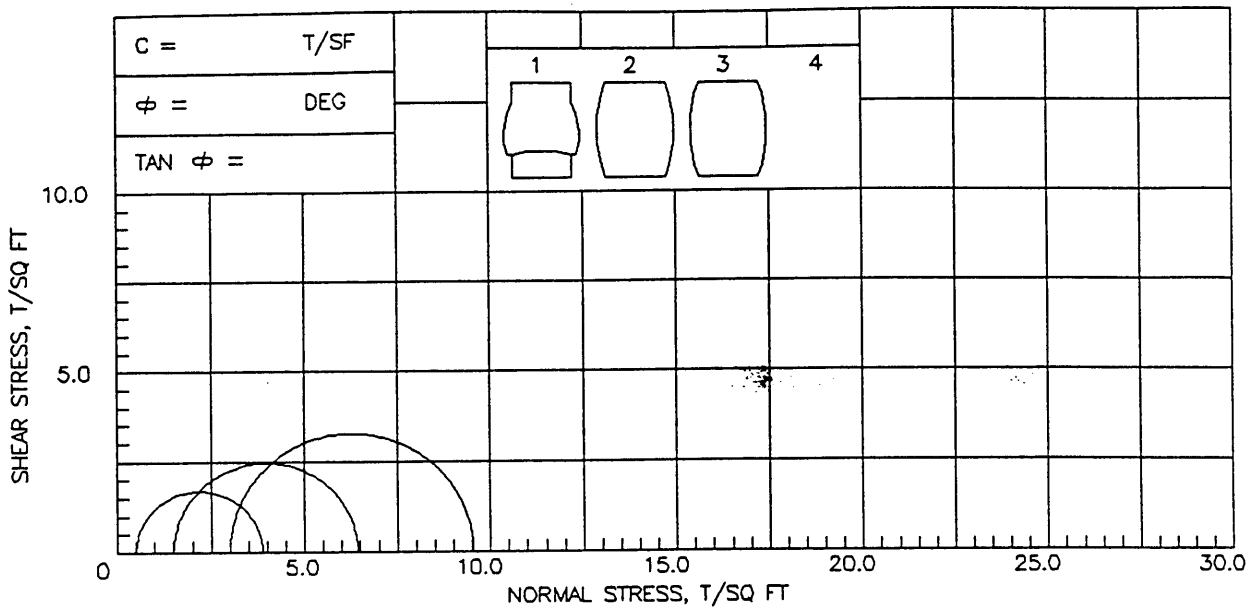
PROJECT EASTERN ARKANSAS

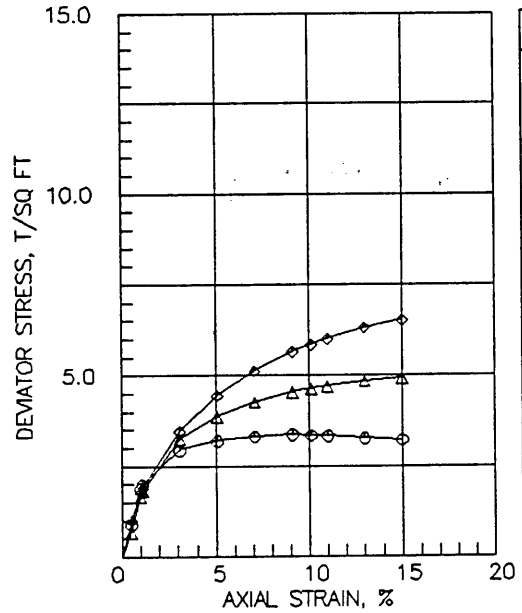
BORING NO. 1-EAPS-U-94 | SAMPLE NO. 6

DEPTH/ELEV 15.5-16.5 | TECH. US

LABORATORY USAE WES - STF/GL | DATE 01 FEB 95

TRIAXIAL COMPRESSION TEST REPORT





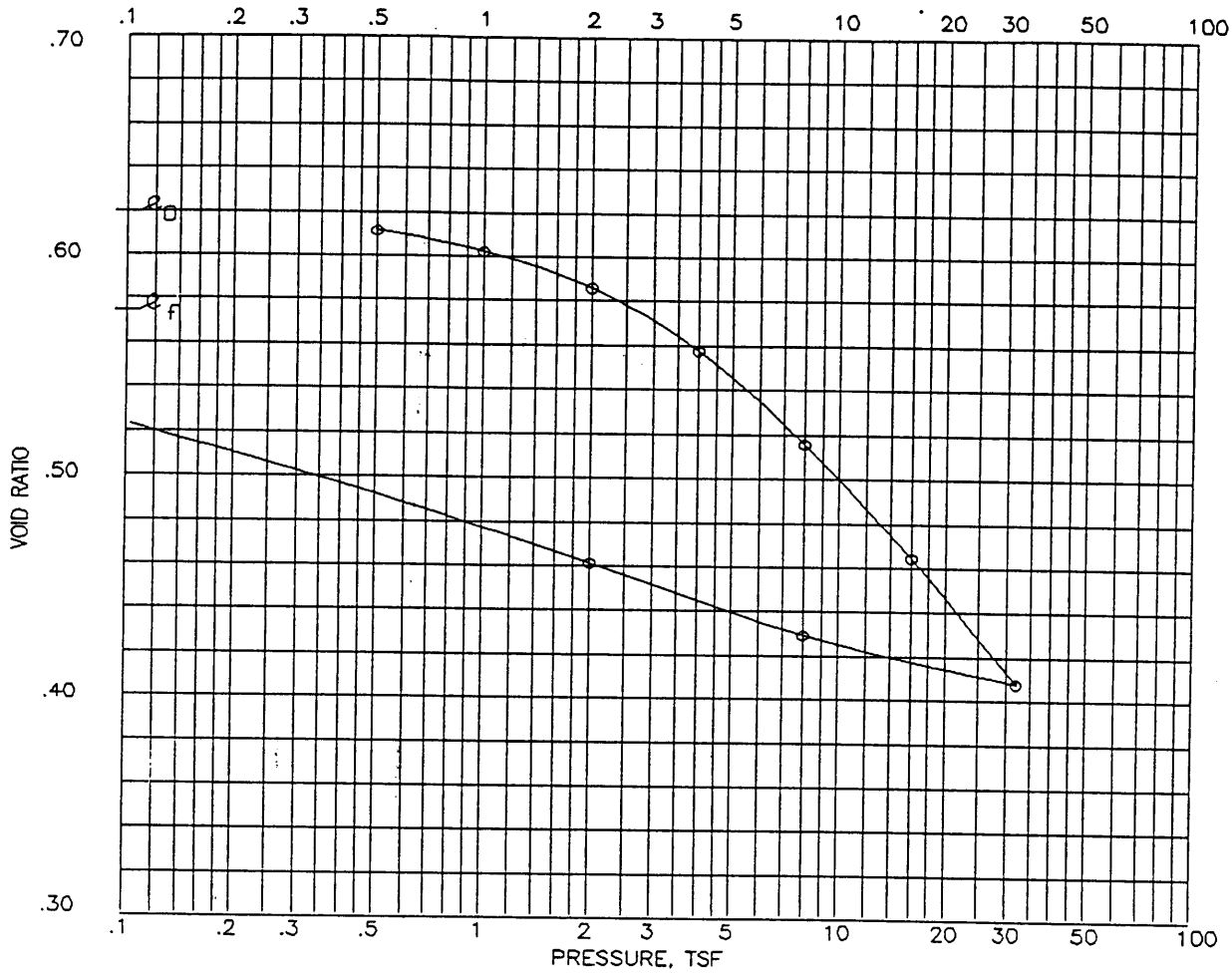
SPECIMEN NO.		○ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	13.6	13.7	13.8	
	DRY DENSITY, PCF	97.8	97.9	99.6	
	SATURATION, %	50.8	51.2	53.9	
	VOID RATIO	.723	.721	.692	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESSURE, TSF				
CHAMBER PRESSURE, TSF		.50	1.50	3.00	
MAX. DEV. STRESS, TSF		3.38	4.93	6.54	
TIME TO FAILURE, MIN.		22	36	36	
STRAIN RATE INCR., %					
INITIAL DIAMETER, IN.		1.38	1.38	1.37	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY

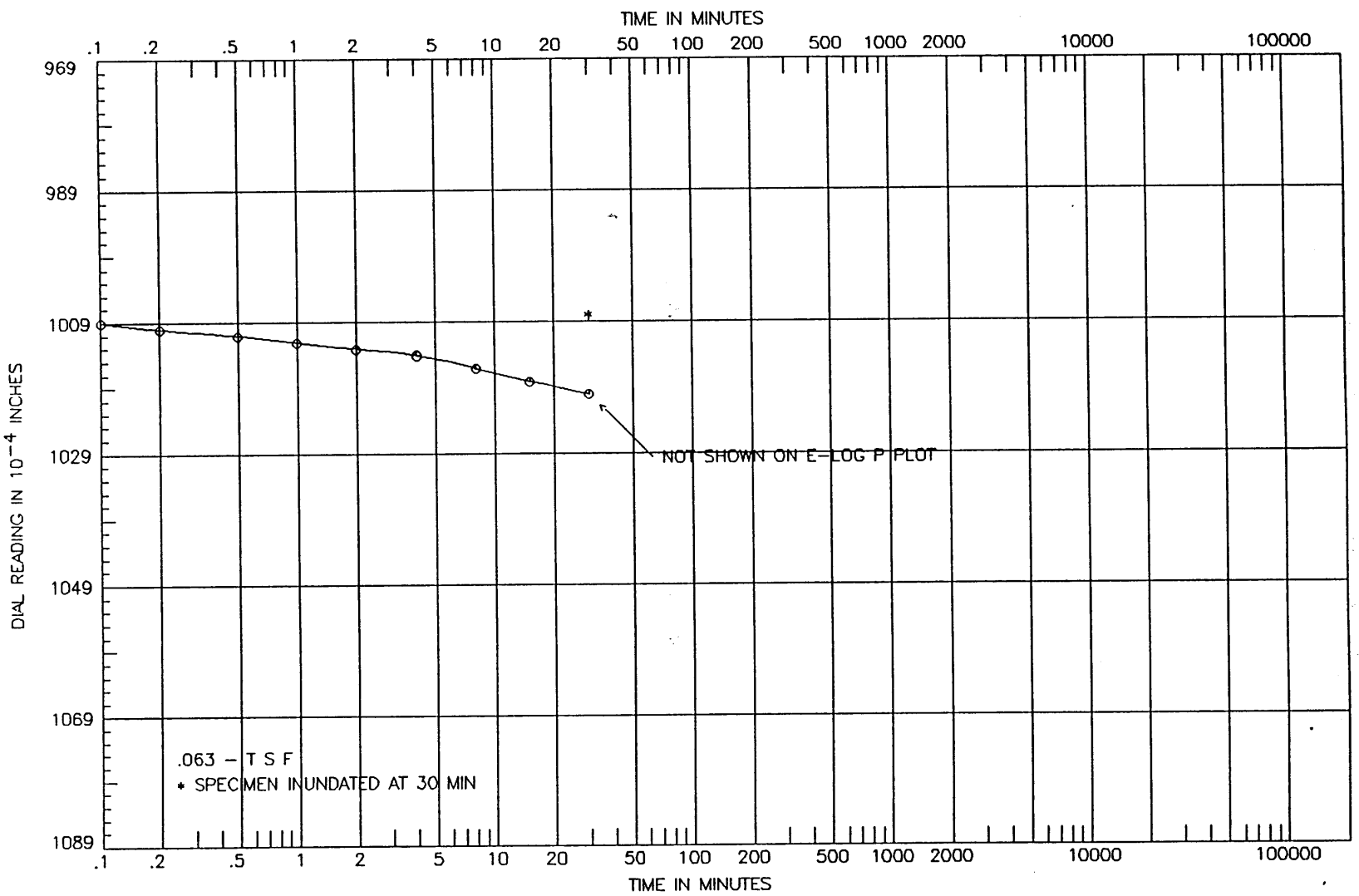
LL	PL	PI	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	Q TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 1-EAPS-U-94	SAMPLE NO. 6
	DEPTH/ELEV 15.5-16.5	TECH. US
	LABORATORY USAE WES - STF/GL	DATE 27 MAR 95
	TRIAXIAL COMPRESSION TEST REPORT	



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	22.0	22.2
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	104.1	107.1
COMPRESSION INDEX		SATURATION, %	95.8	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	.619	.574
DIA. IN 4.44	HT. IN 1.109	BACK PRESSURE, TSF		
CLASSIFICATION	CLAY (CL), REDDISH GRAY			
LL 42	PL 16	PI 26	PROJECT EASTERN ARKANSAS	
GS 2.70 (EST)	D_{10}			
REMARKS:		BORING NO. 1-EAPS-U-94	SAMPLE NO. 4	
		DEPTH/ELEV 9-10.2	TECH. JL	
		LABORATORY USAE WES - STF/GL	DATE 27 FEB 95	
		CONSOLIDATION TEST REPORT		

SHEET 1 OF 12

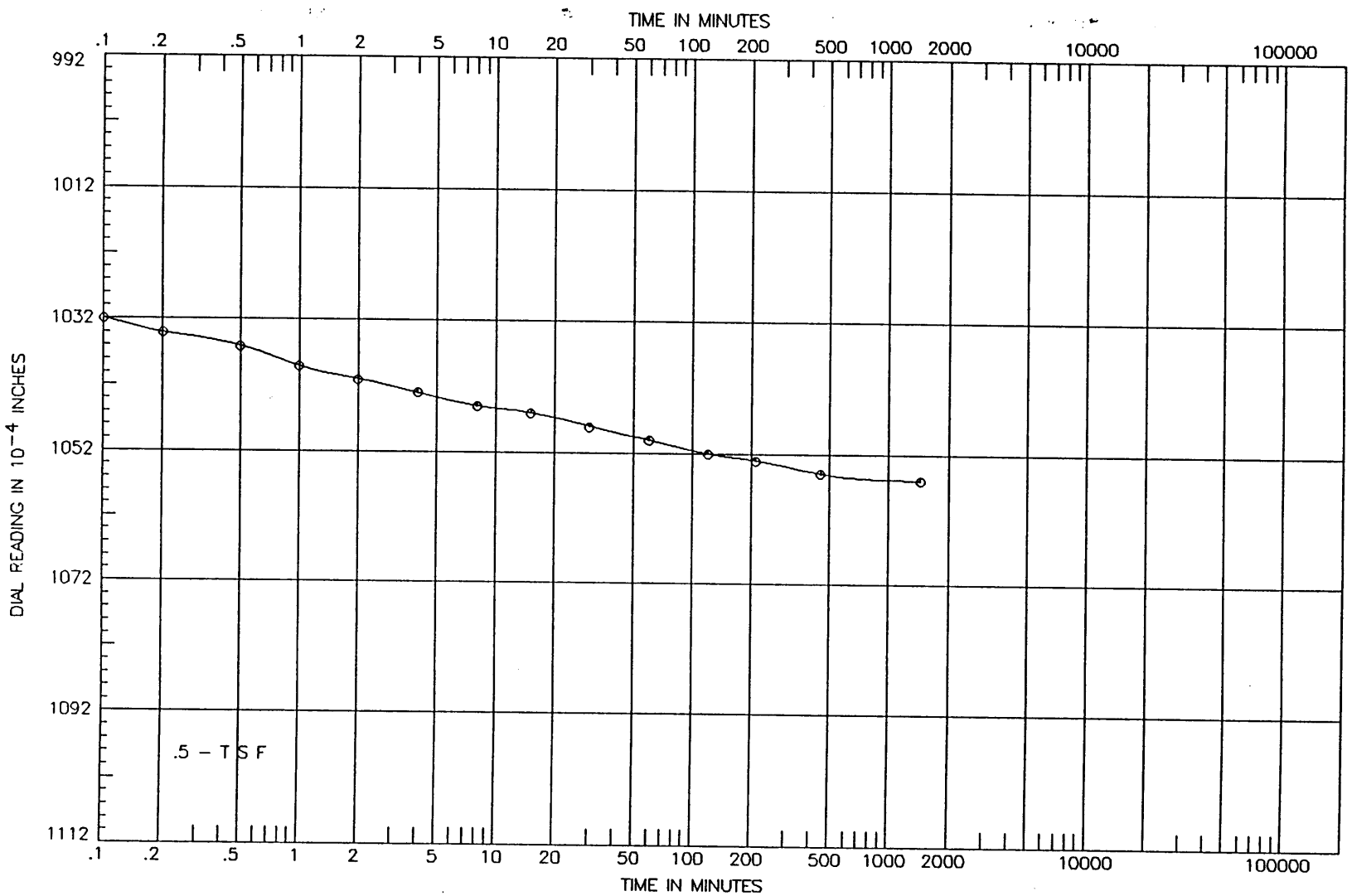


PROJECT EASTERN ARKANSAS	
BORING 1-EAPS-U-94	SAMPLE NO. 4
DEPTH/ELEV 9-10.2	DATE 27 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 2 OF 12

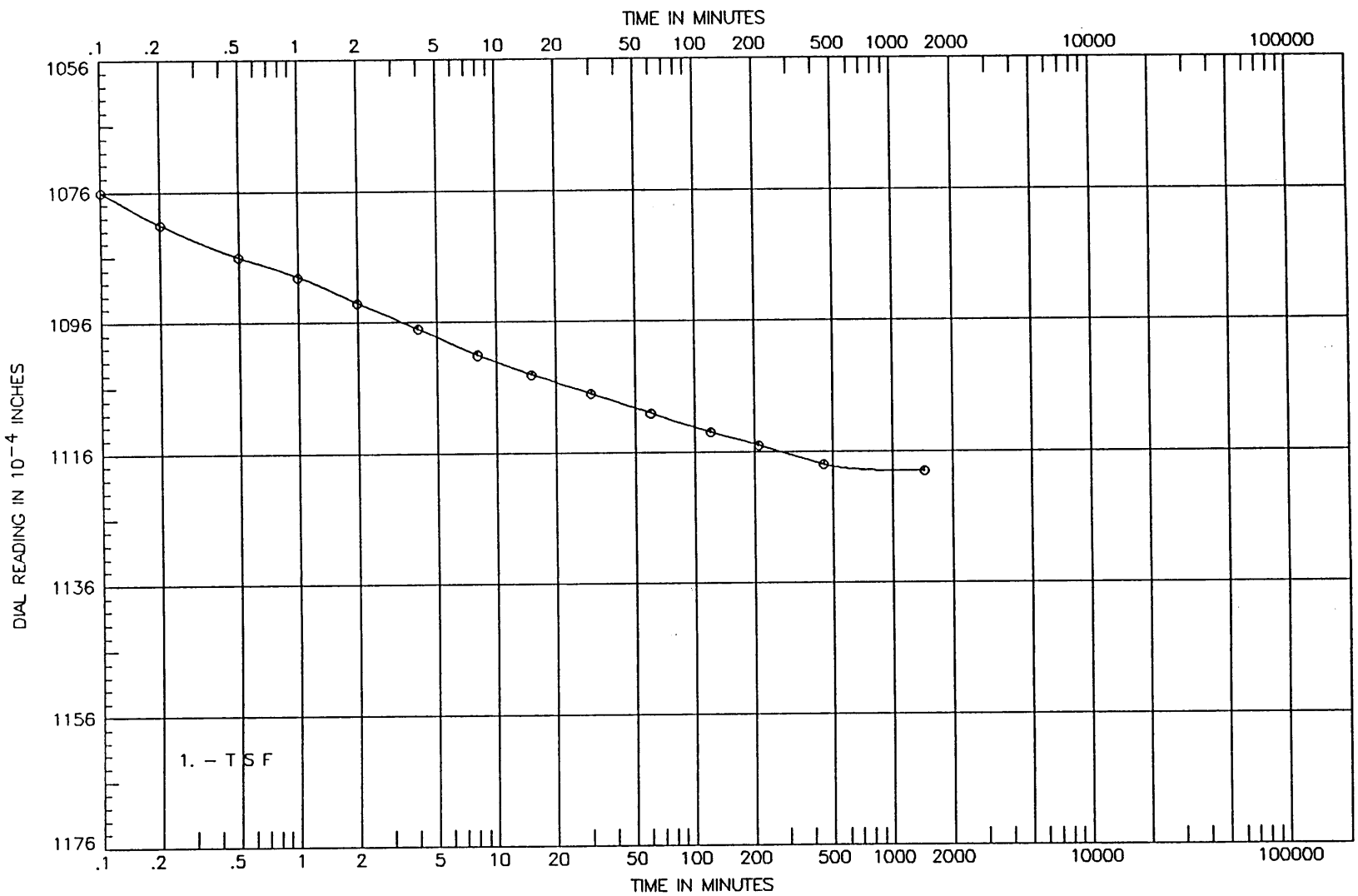


PROJECT	EASTERN ARKANSAS		
BORING	1-EAPS-U-94	SAMPLE NO.	4
DEPTH/ELEV	9-10.2	DATE	27 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 3 OF 12

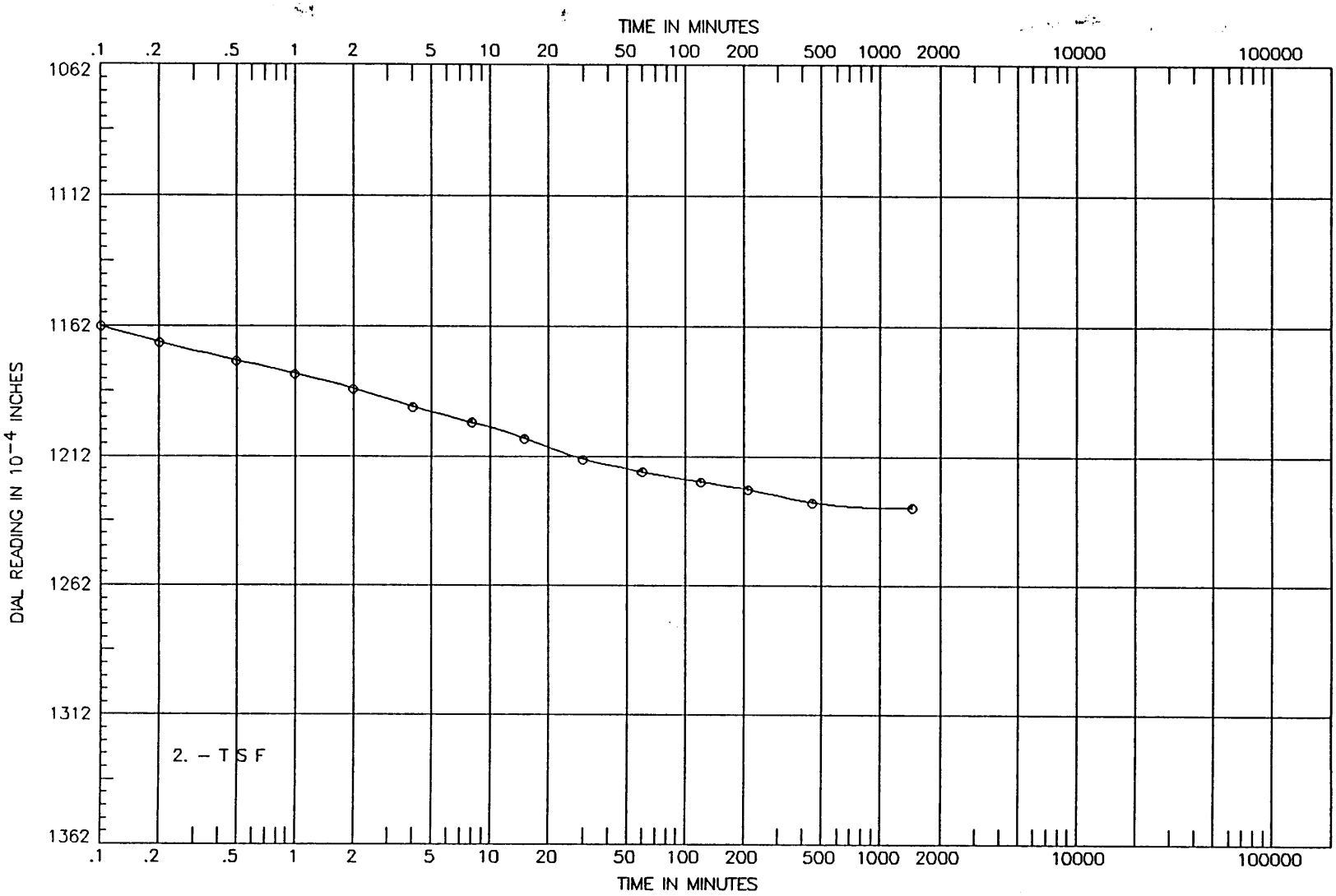


PROJECT	EASTERN ARKANSAS		
BORING	1-EAPS-U-94	SAMPLE NO.	4
DEPTH/ELEV	9-10.2	DATE	27 FEB 95

CONSOLIDATION TEST TIME CURVES

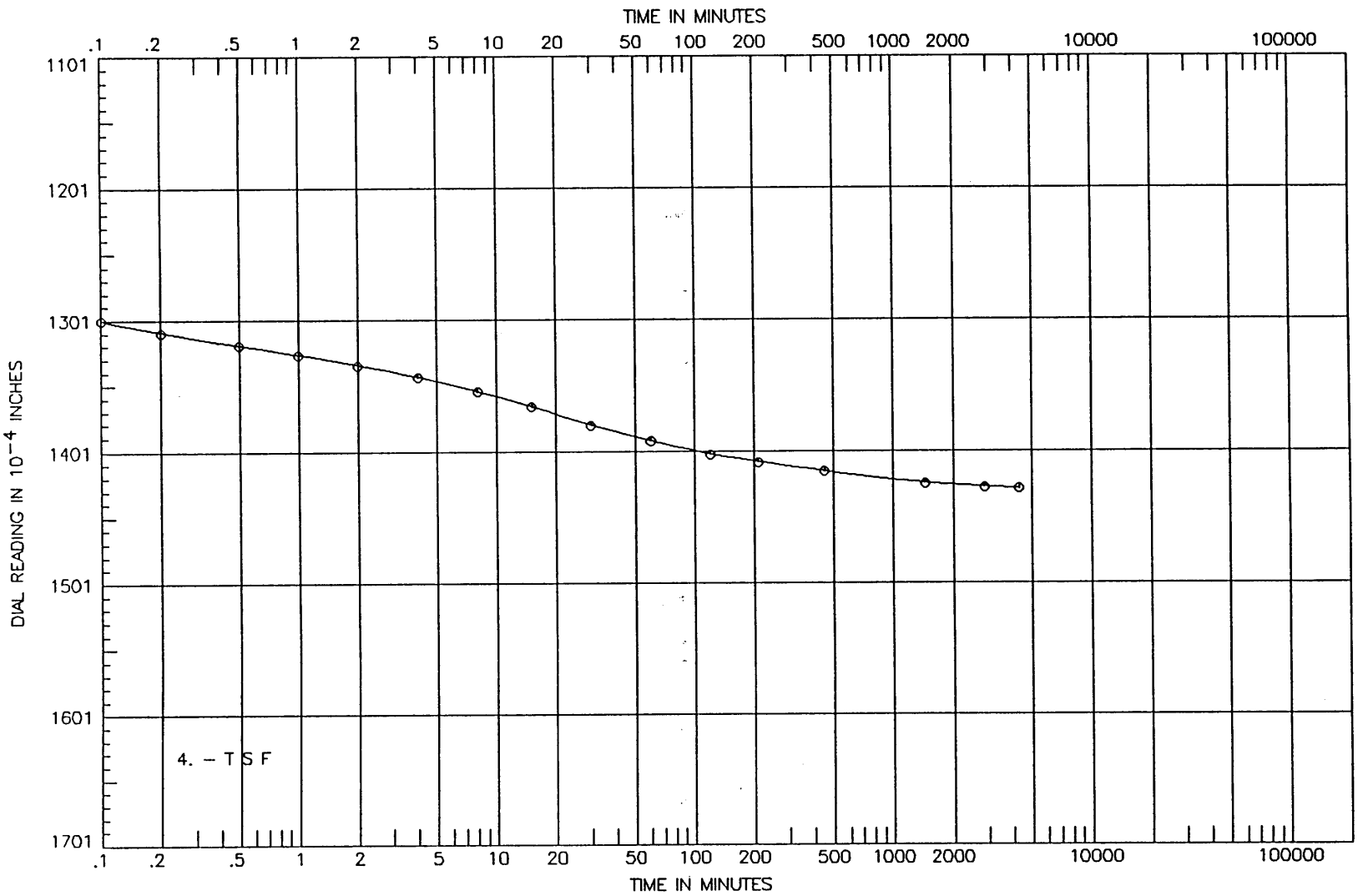
LABORATORY USAE WES - STF/GL

SHEET 4 OF 12



PROJECT EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
		LABORATORY USAE WES – STF/GL
BORING 1–EAPS–U–94	SAMPLE NO. 4	
DEPTH/ELEV 9–10.2	DATE 27 FEB 95	

SHEET 5 OF 12

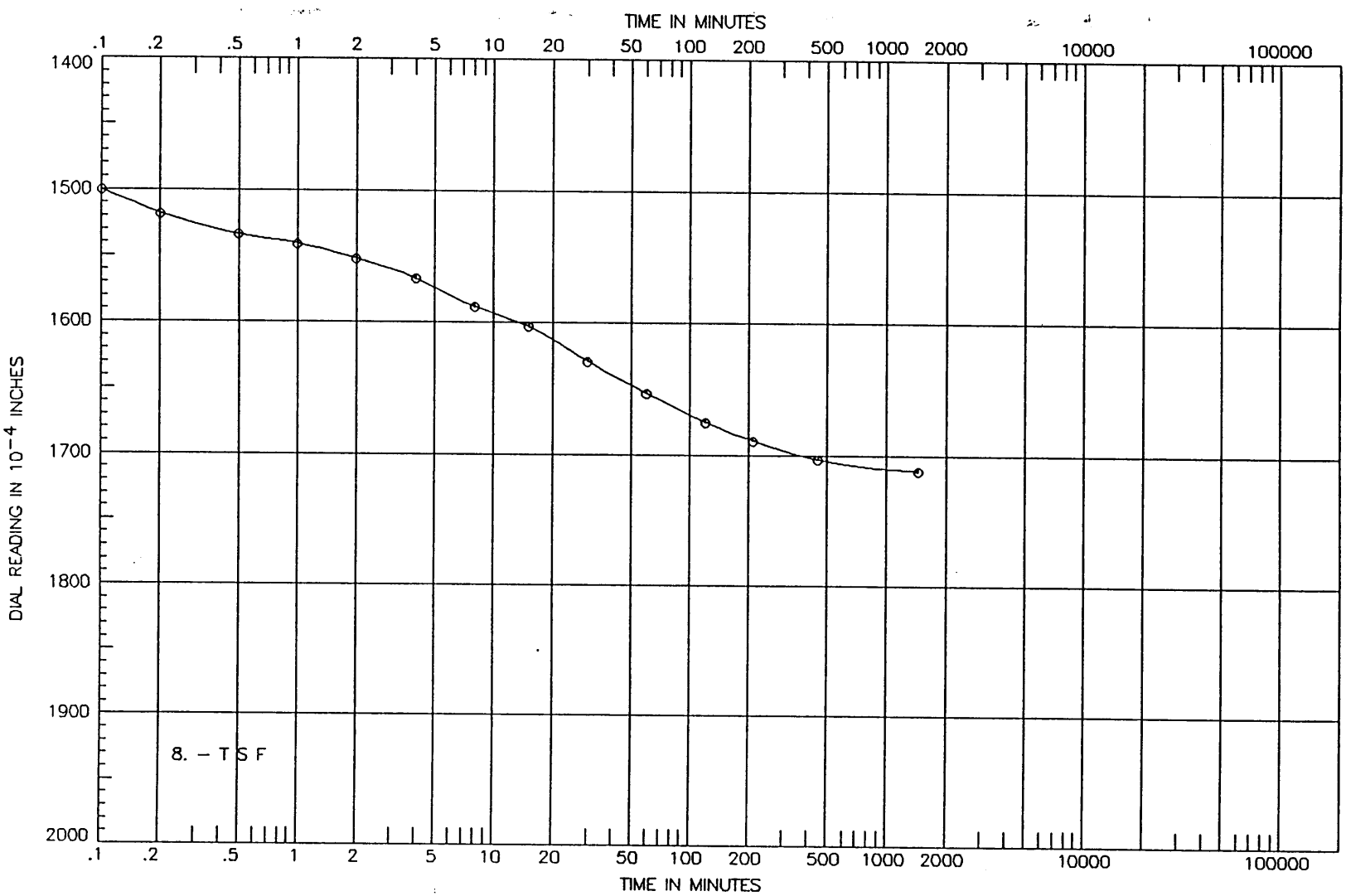


PROJECT EASTERN ARKANSAS	
BORING 1-EAPS-U-94	SAMPLE NO. 4
DEPTH/ELEV 9-10.2	DATE 27 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 6 OF 12

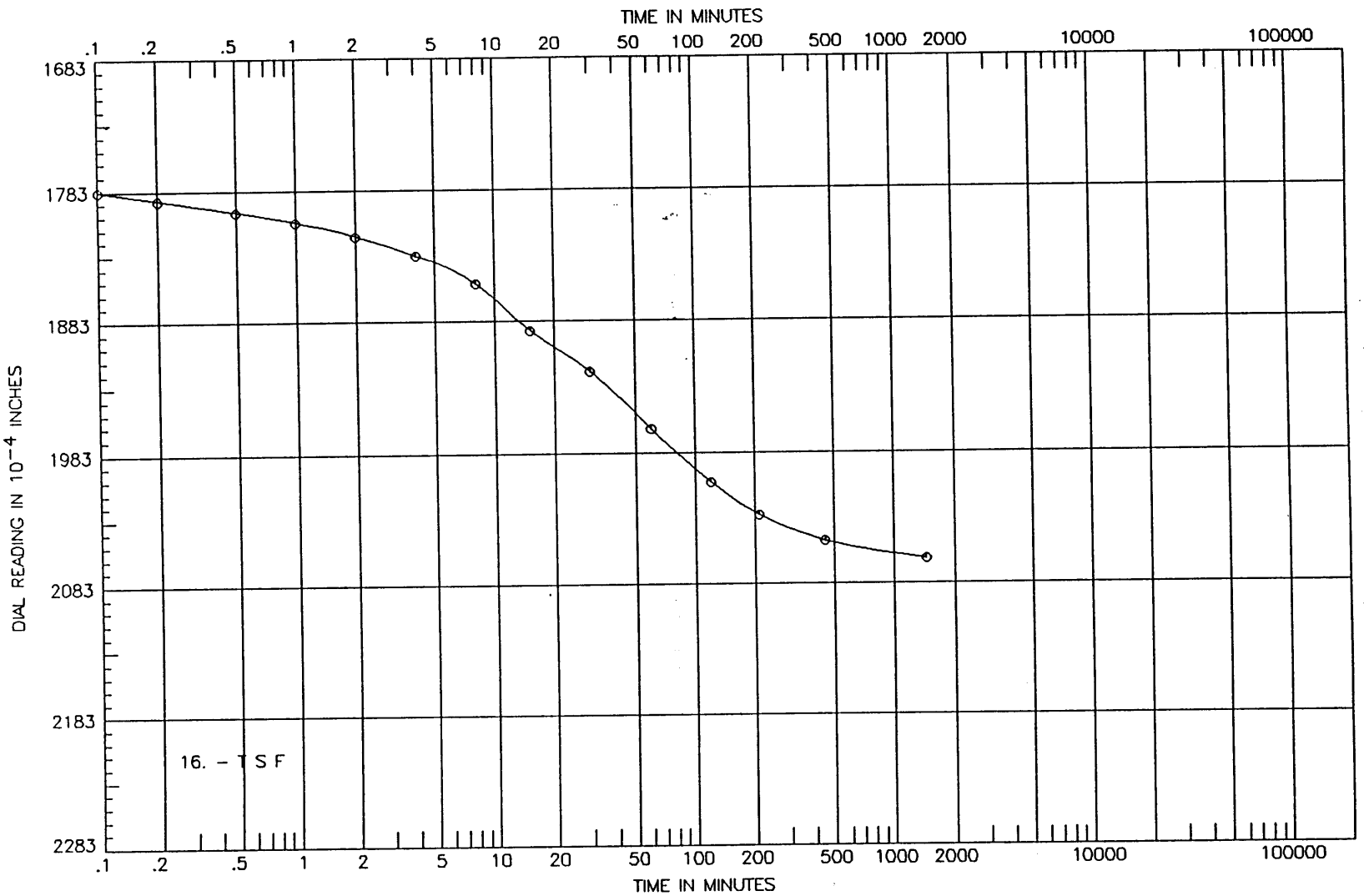


PROJECT	EASTERN ARKANSAS		
BORING	1-EAPS-U-94	SAMPLE NO.	4
DEPTH/ELEV	9-10.2	DATE	27 FEB 95

CONSOLIDATION TEST TIME CURVES

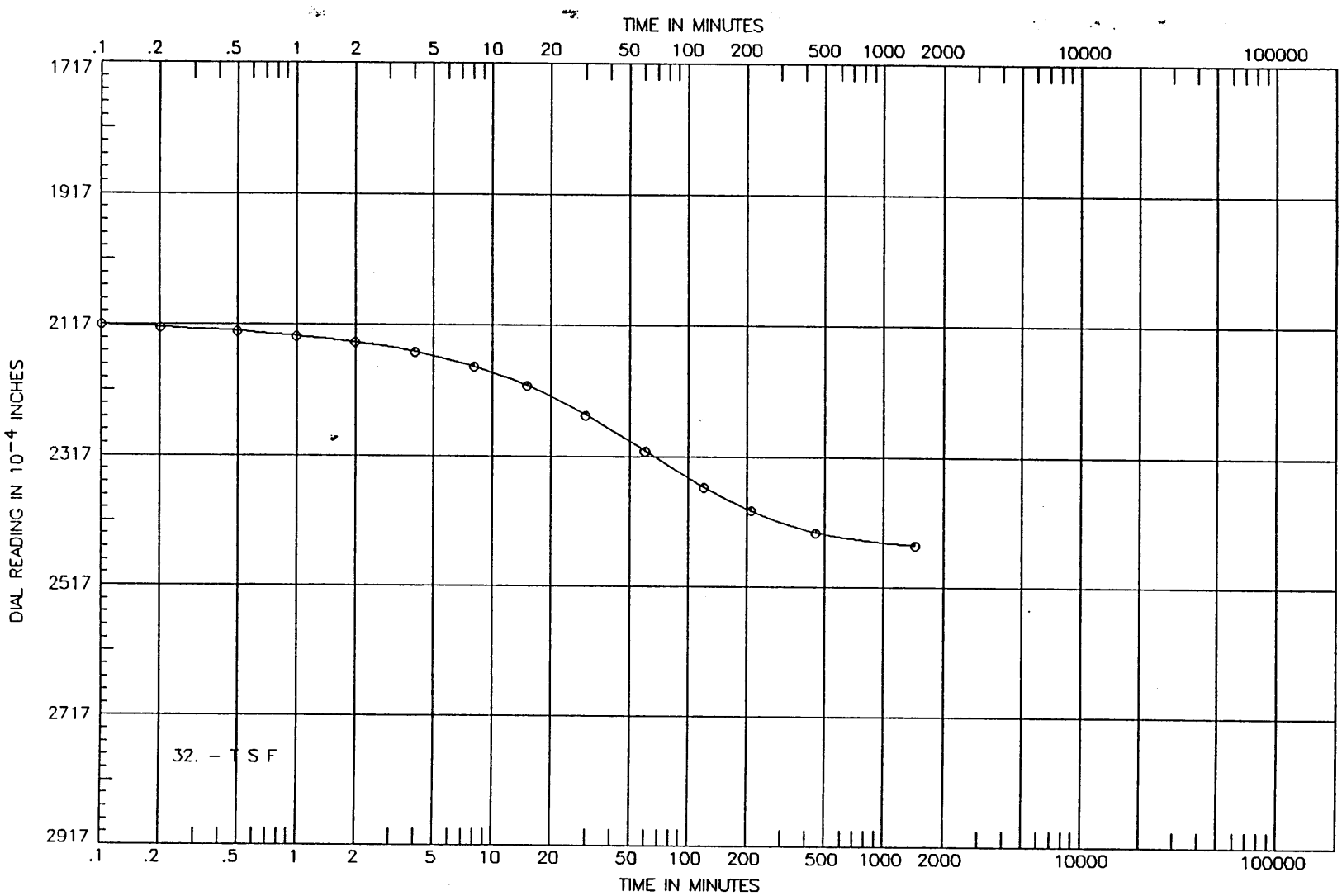
LABORATORY USAE WES - STF/GL

SHEET 7 OF 12



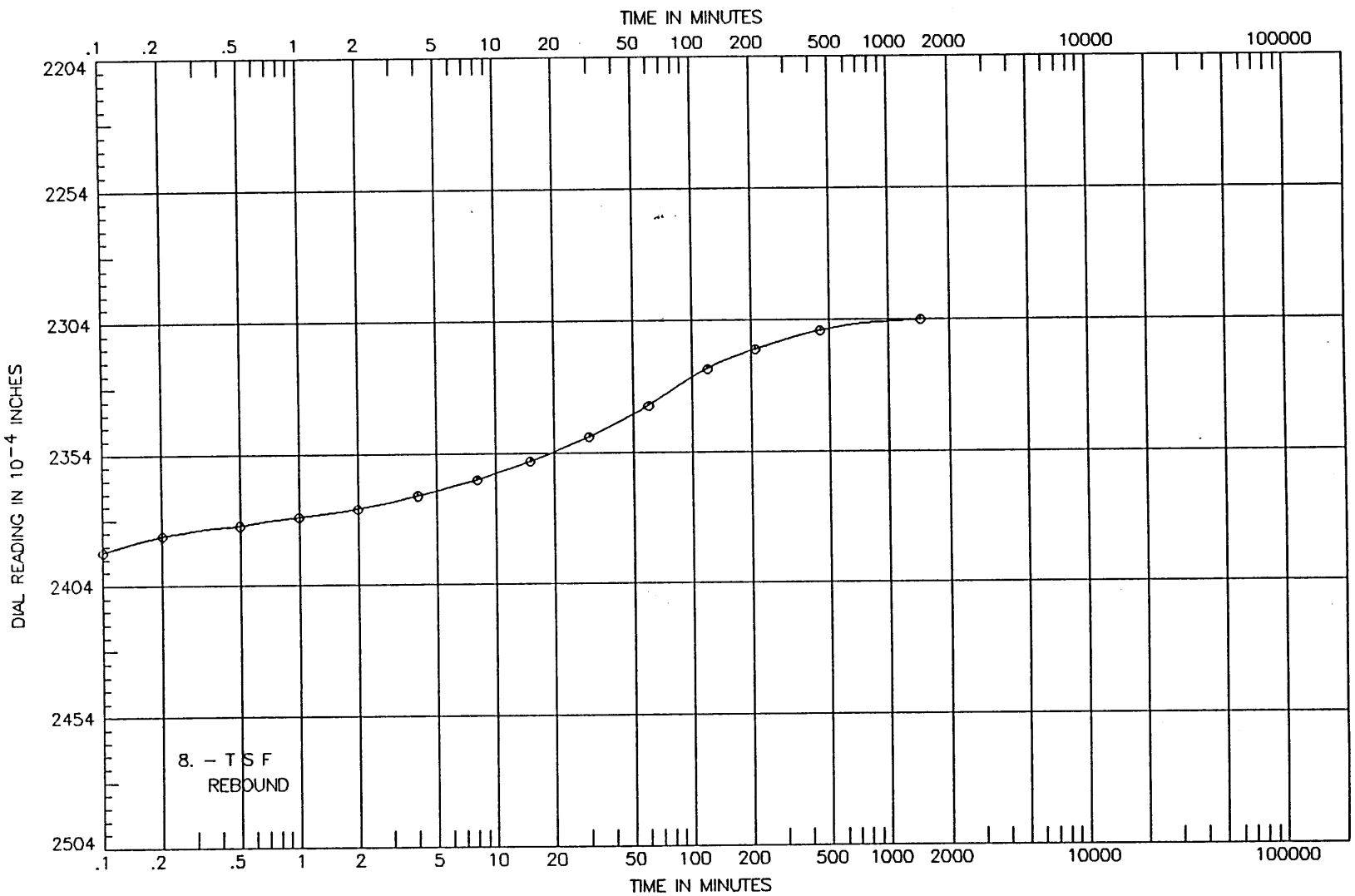
PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING	1-EAPS-U-94	SAMPLE NO. 4	
DEPTH/ELEV	9-10.2	DATE 27 FEB 95	

SHEET 8 OF 12



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING	1-EAPS-U-94	SAMPLE NO. 4	
DEPTH/ELEV	9-10.2	DATE 27 FEB 95	

SHEET 9 OF 12

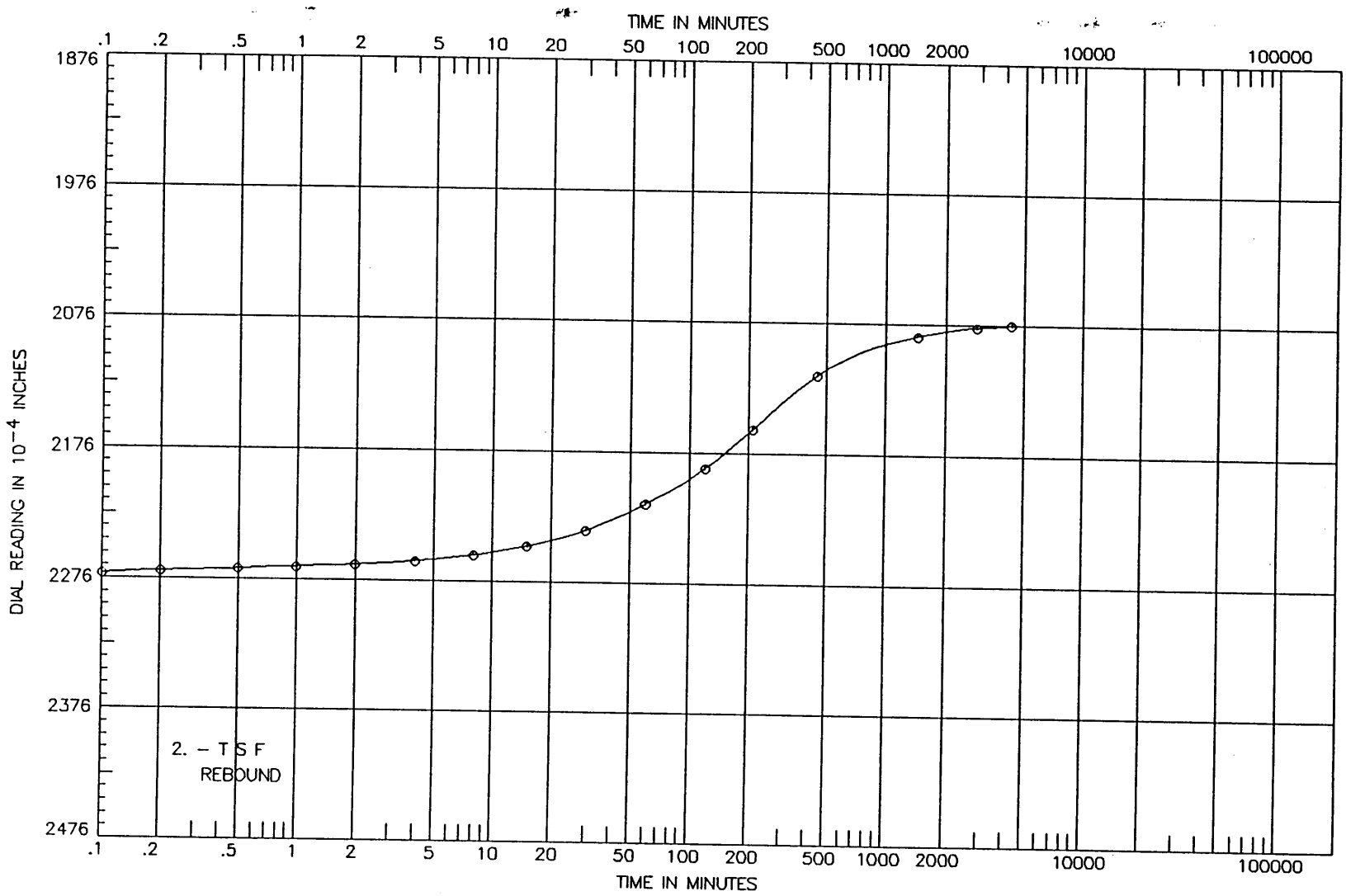


PROJECT EASTERN ARKANSAS	
BORING 1-EAPS-U-94	SAMPLE NO. 4
DEPTH/ELEV 9-10.2	DATE 27 FEB 95

CONSOLIDATION TEST TIME CURVES

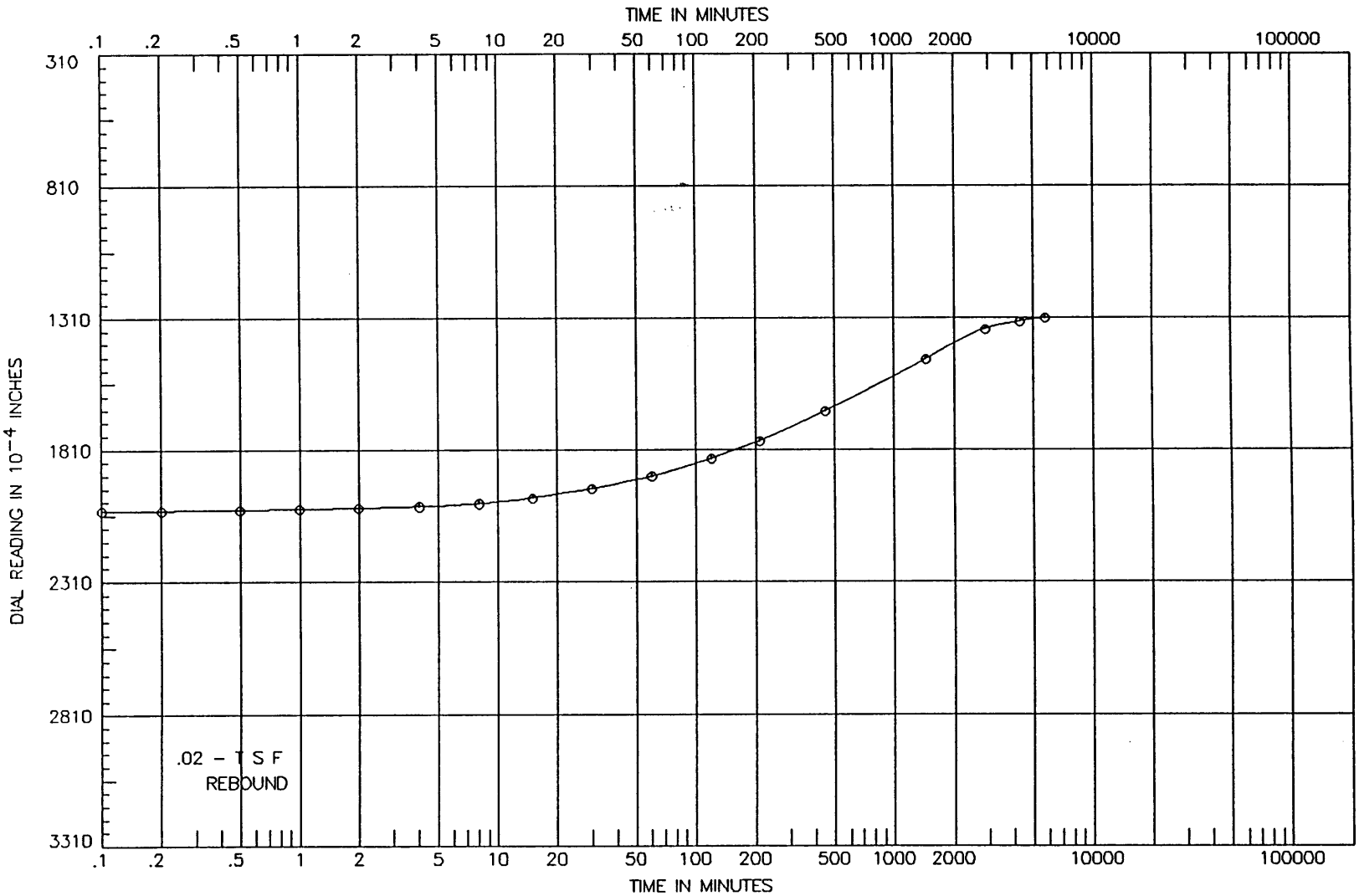
LABORATORY USAE WES – STF/GL

SHEET 10 OF 12



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING	1-EAPS-U-94	SAMPLE NO. 4	
DEPTH/ELEV	9-10.2	DATE 27 FEB 95	

SHEET 11 OF 12

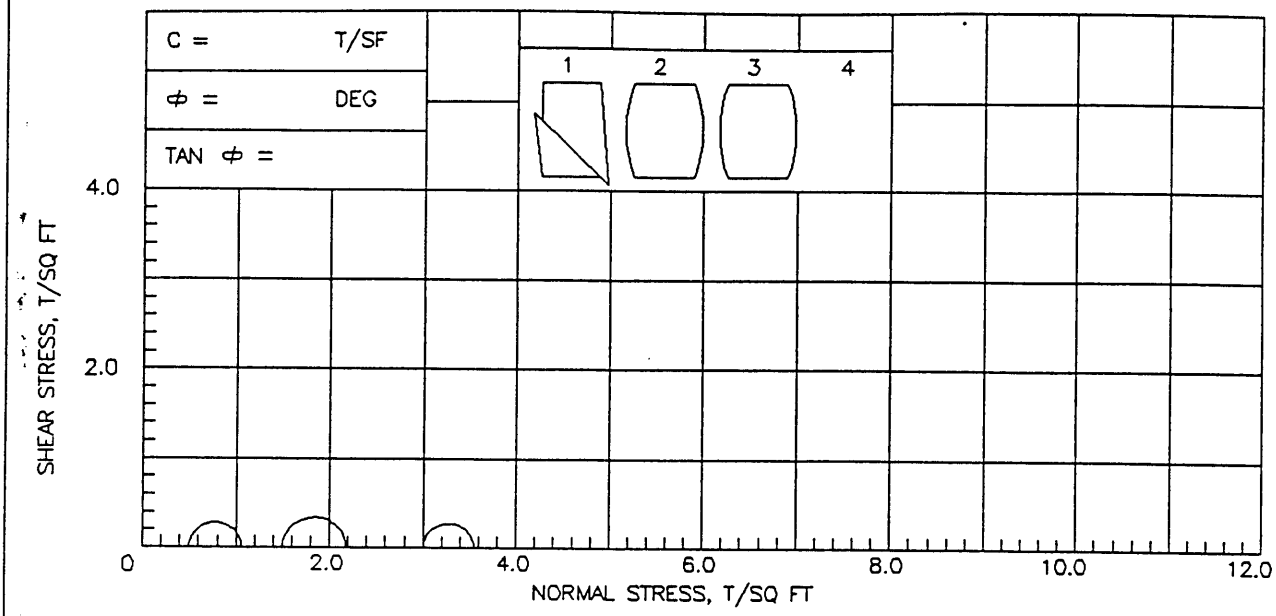


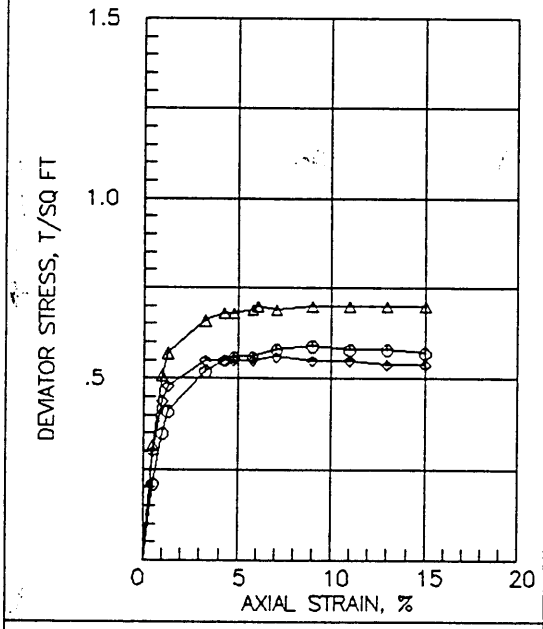
PROJECT EASTERN ARKANSAS	
BORING 1-EAPS-U-94	SAMPLE NO. 4
DEPTH/ELEV 9-10.2	DATE 27 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 12 OF 12





SPECIMEN NO.		○ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	27.3	27.5	28.7	
	DRY DENSITY, PCF	94.2	94.1	92.4	
	SATURATION, %	93.5	93.9	94.0	
	VOID RATIO	.789	.791	.824	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESSURE, TSF				
CHAMBER PRESSURE, TSF		.50	1.50	3.00	
MAX. DEV. STRESS, TSF		.56	.68	.55	
TIME TO FAILURE, MIN.		12	14	11	
STRAIN RATE INCR., %				6	
INITIAL DIAMETER, IN.		1.39	1.39	1.38	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; IRON OXIDE PARTICLES

LL 46	PL 18	PI 28	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

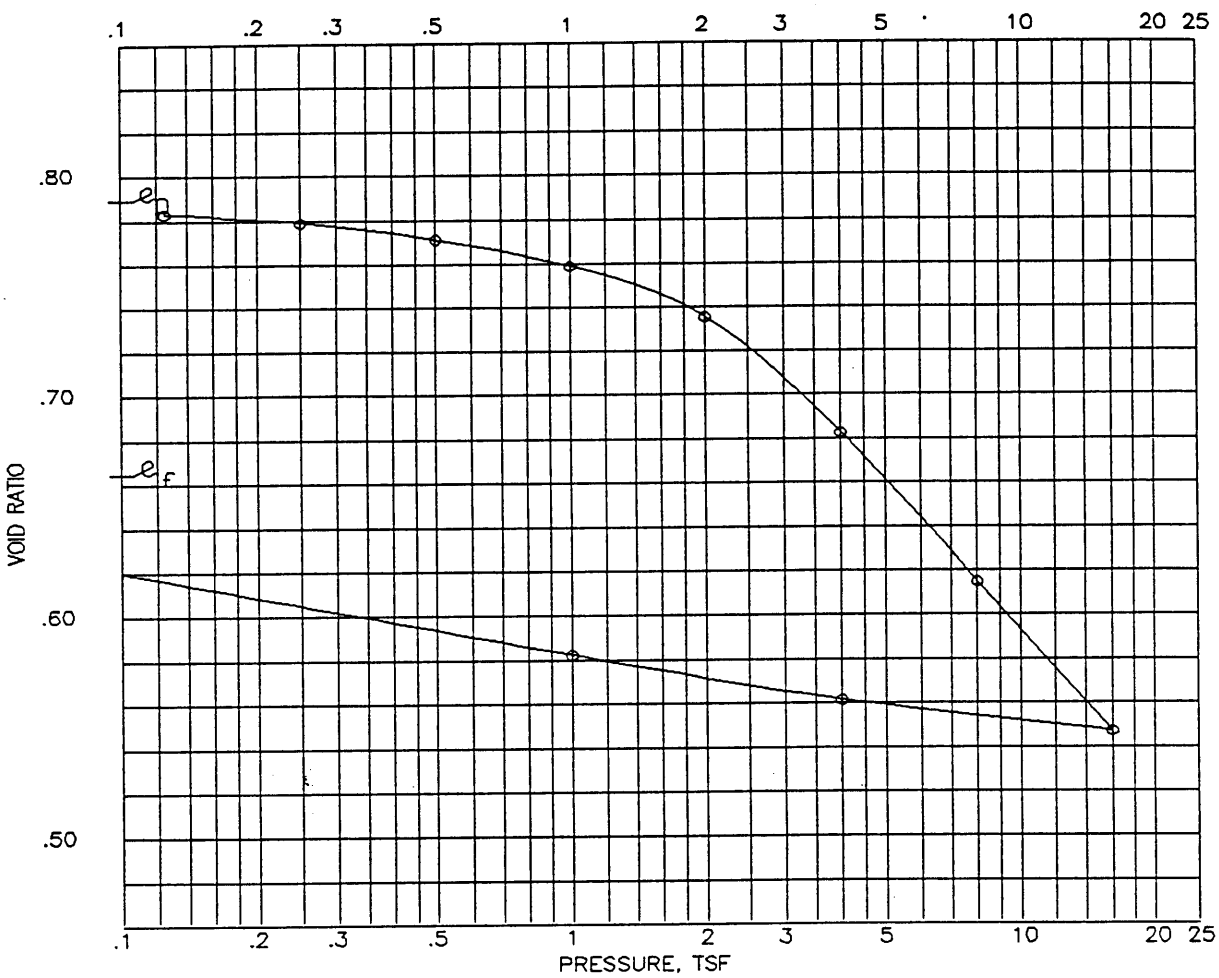
PROJECT EASTERN ARKANSAS

BORING NO. 2-EAPS-U-94 | SAMPLE NO. 5

DEPTH/ELEV 12.2-13.5 | TECH. US

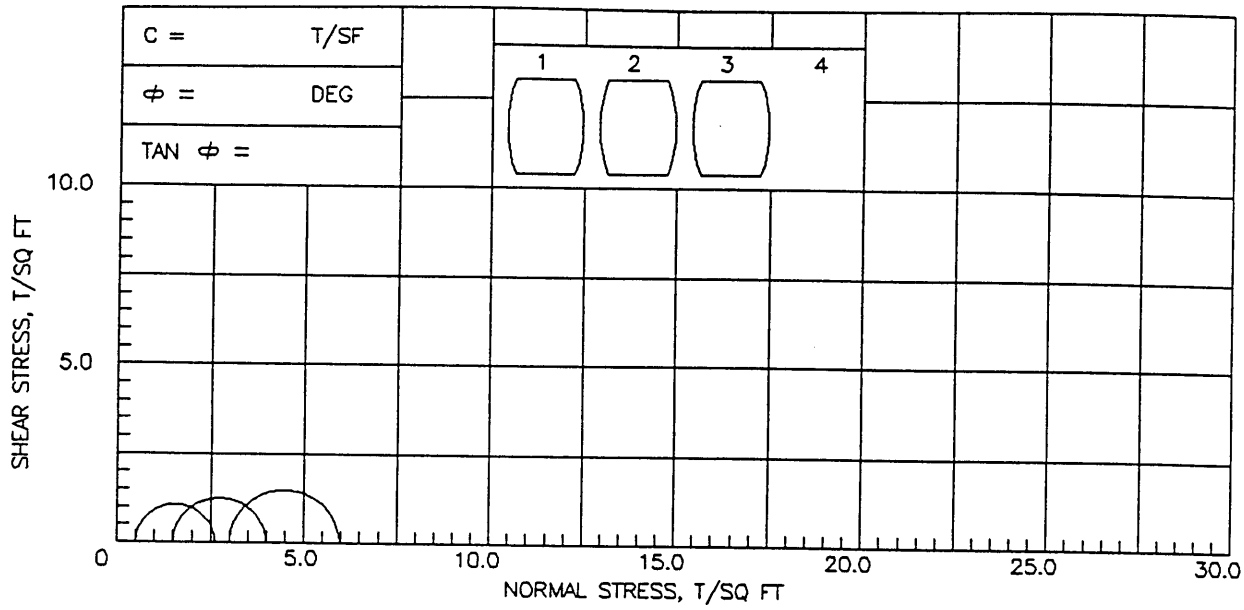
LABORATORY USAE WES - STF/GL | DATE 10 MAR 95

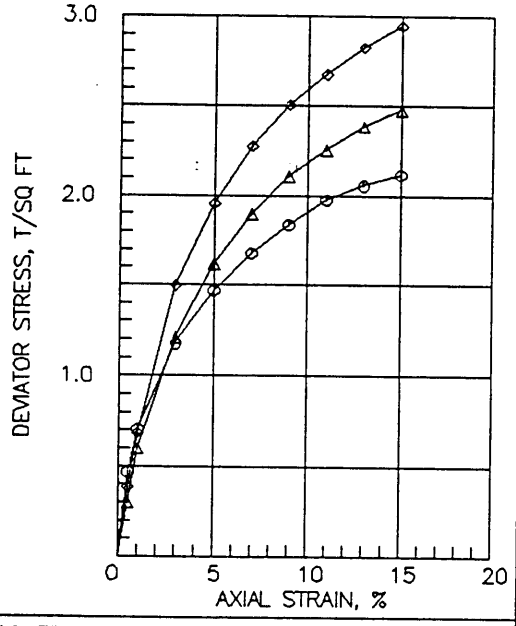
TRIAXIAL COMPRESSION TEST REPORT



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	25.0	23.8
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	94.3	101.3
COMPRESSION INDEX		SATURATION, %	85.5	96.7
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	.788	.664
DIA. IN 4.44	HT. IN 1.122	BACK PRESSURE, TSF		
CLASSIFICATION	CLAY (CL), REDDISH GRAY; IRON OXIDE PARTICLES			
LL 38	PL 17	PI 21	PROJECT EASTERN ARKANSAS	
GS 2.70 (EST)	D_{10}			
REMARKS:		BORING NO. 2-EAPS-U-94	SAMPLE NO. 4	
		DEPTH/ELEV 9-10.0	TECH. JL	
		LABORATORY USAE WES - STF/GL	DATE 27 FEB 95	
		CONSOLIDATION TEST REPORT		

SHEET 1 OF 13





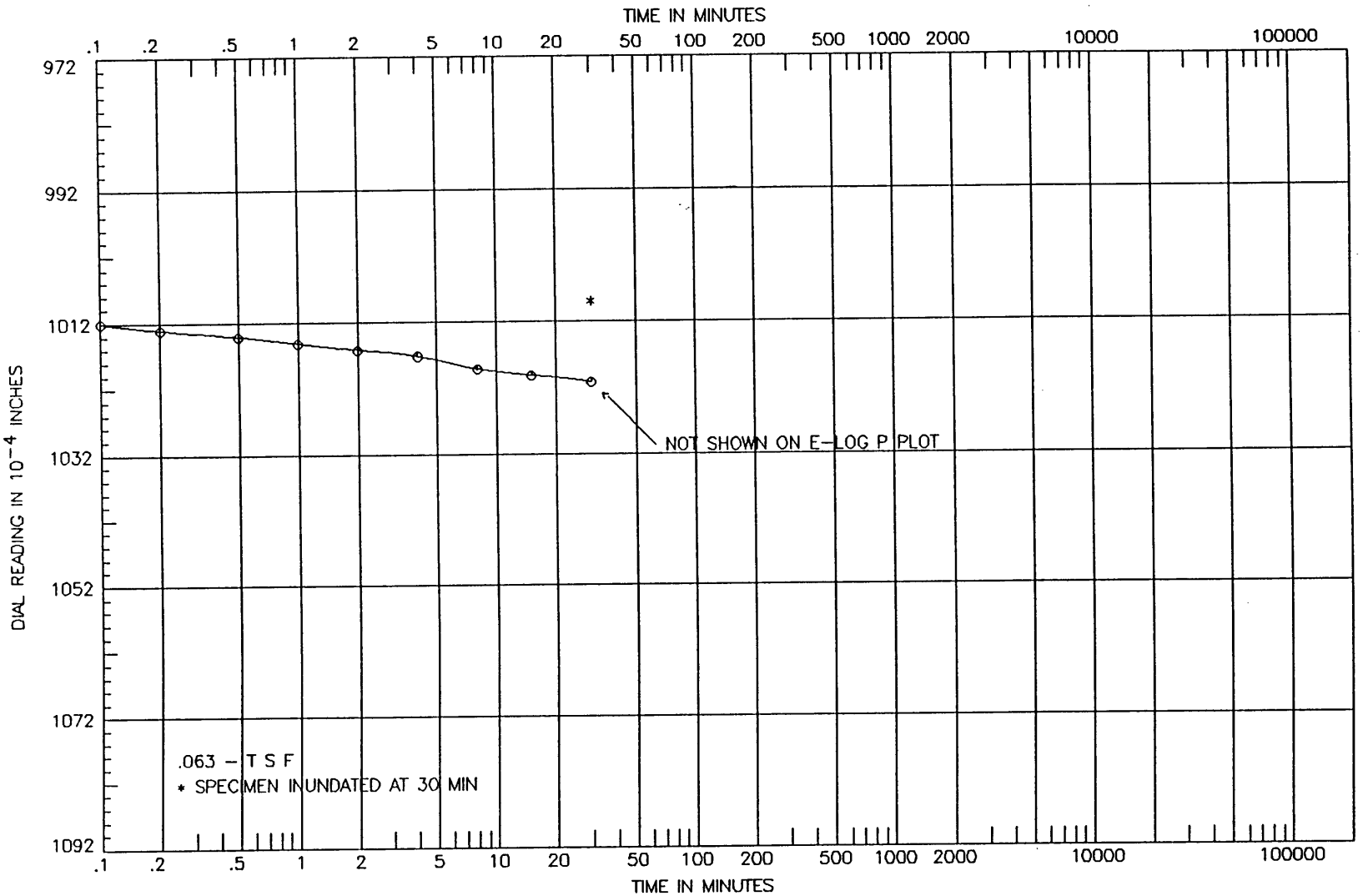
SPECIMEN NO.		○ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	19.0	19.2	19.2	
	DRY DENSITY, PCF	99.1	98.9	100.0	
	SATURATION, %	73.3	73.7	75.5	
	VOID RATIO	.701	.704	.686	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESSURE, TSF				
CHAMBER PRESSURE, TSF		.50	1.50	3.00	
MAX. DEV. STRESS, TSF		2.12	2.48	2.95	
TIME TO FAILURE, MIN.		33	31	31	
STRAIN RATE INCR., %					
INITIAL DIAMETER, IN.		1.37	1.37	1.37	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY

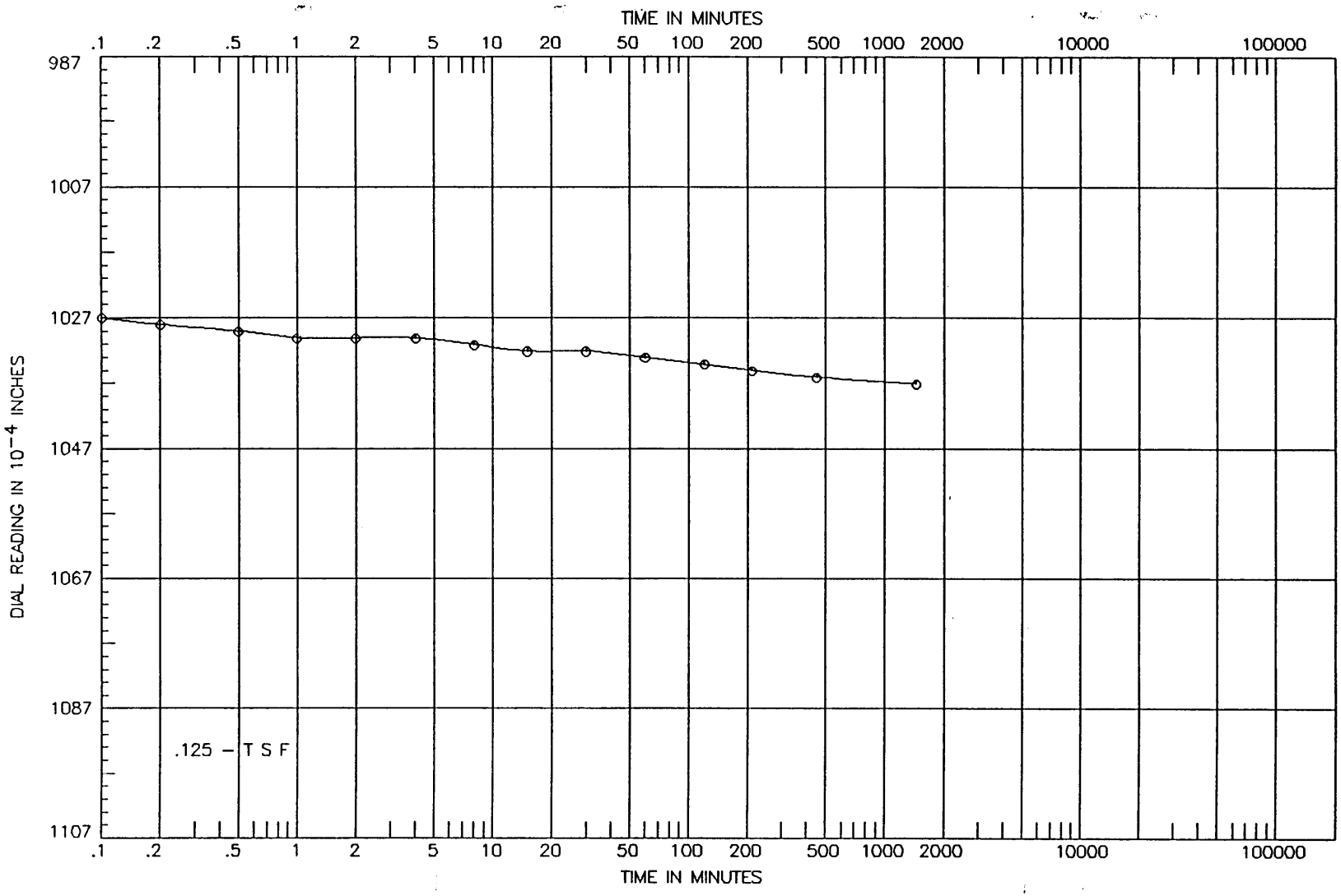
LL	PL	PI	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	Q TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 2-EAPS-U-94	SAMPLE NO. 4
	DEPTH/ELEV 9.0-10.0	TECH. US
	LABORATORY USAE WES - STF/GL	DATE 30 MAR 95
	TRIAXIAL COMPRESSION TEST REPORT	



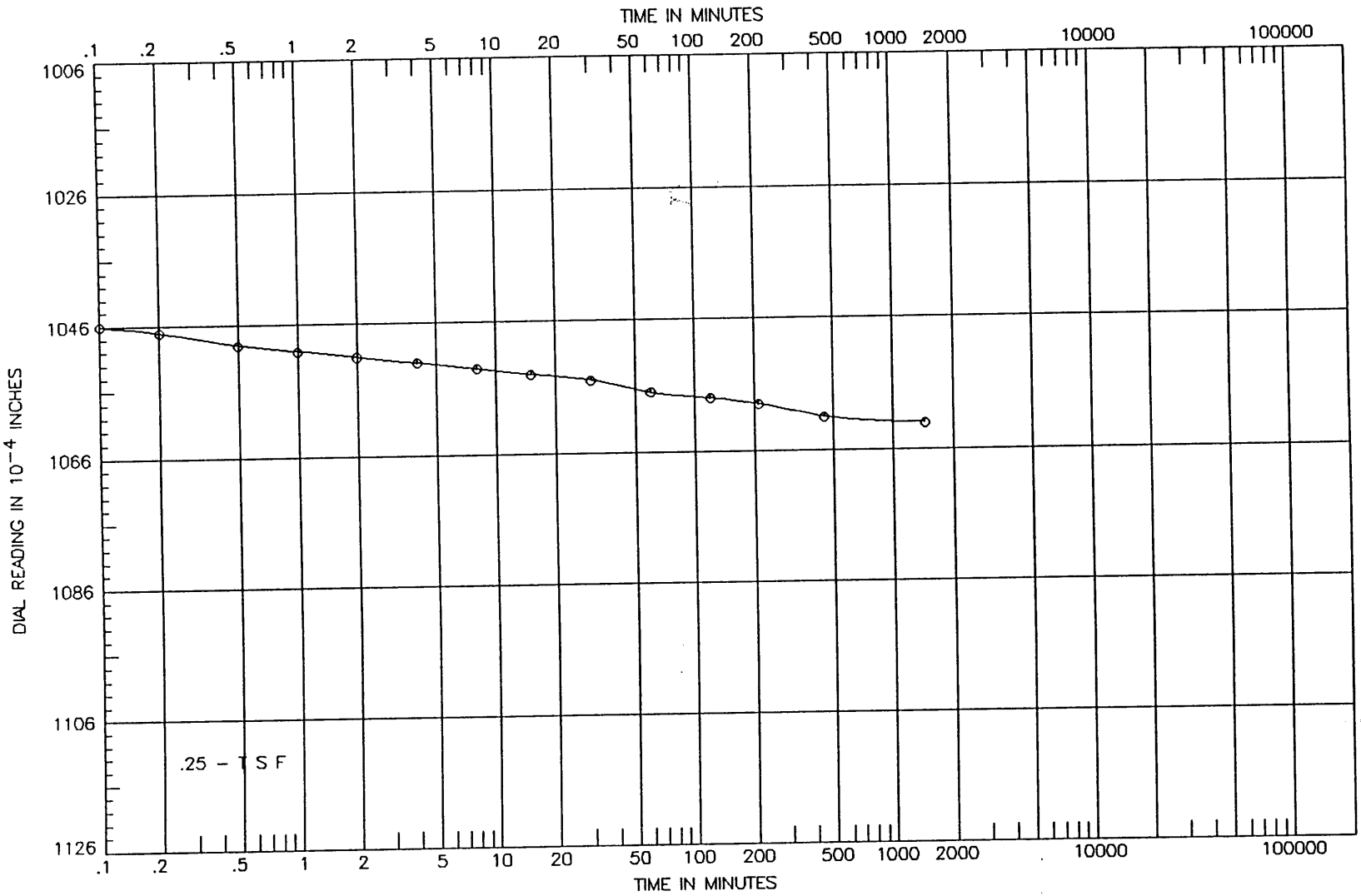
PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES - STF/GL
BORING	2-EAPS-U-94	SAMPLE NO. 4	
DEPTH/ELEV	9-10.0	DATE 27 FEB 95	

SHEET 2 OF 13



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
BORING	2-EAPS-U-94	SAMPLE NO. 4	LABORATORY USAE WES – STF/GL
DEPTH/ELEV	9-10.0	DATE 27 FEB 95	

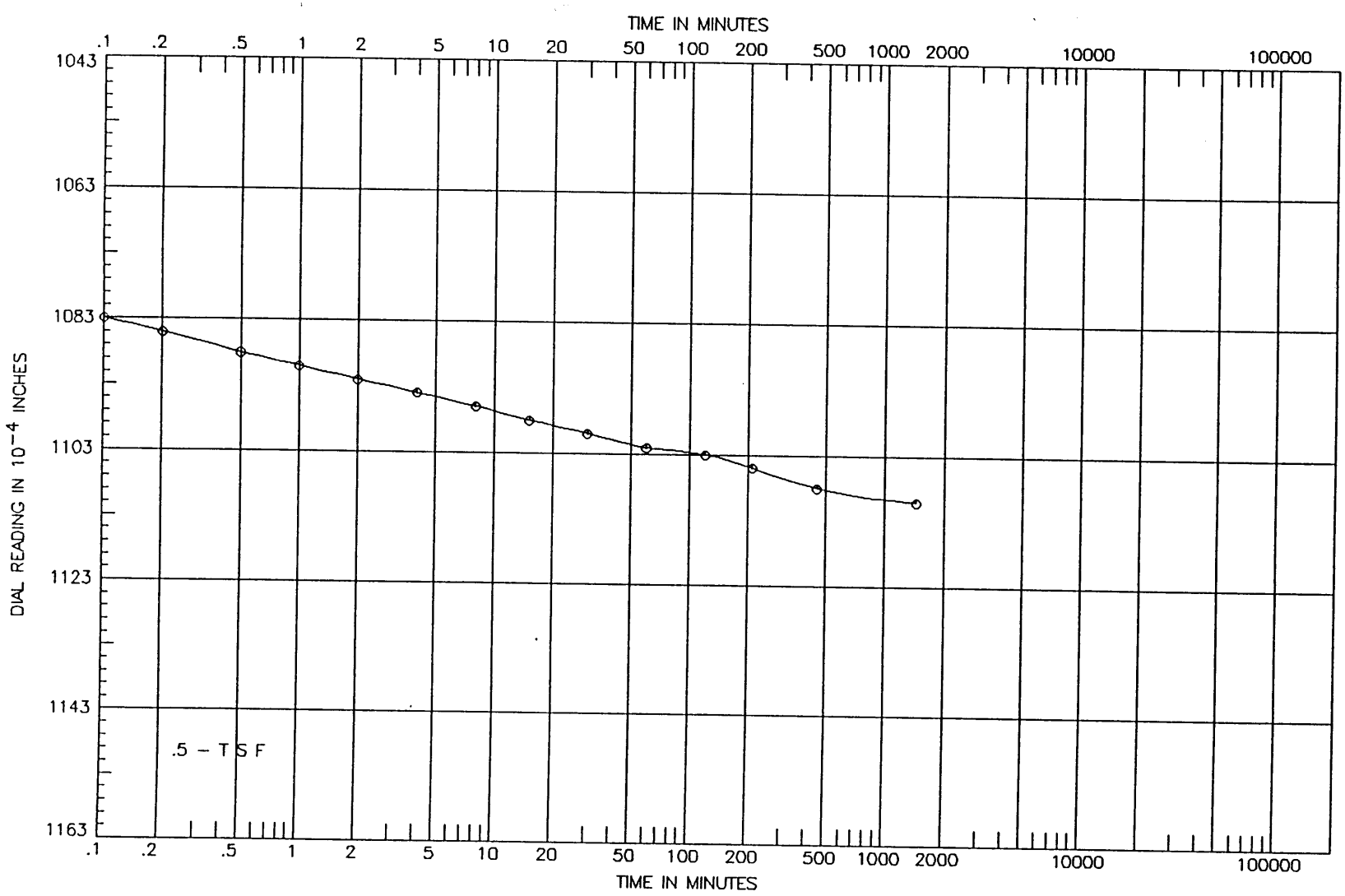
SHEET 3 OF 13



PROJECT	EASTERN ARKANSAS		
BORING	2-EAPS-U-94	SAMPLE NO.	4
DEPTH/ELEV	9-10.0	DATE	27 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

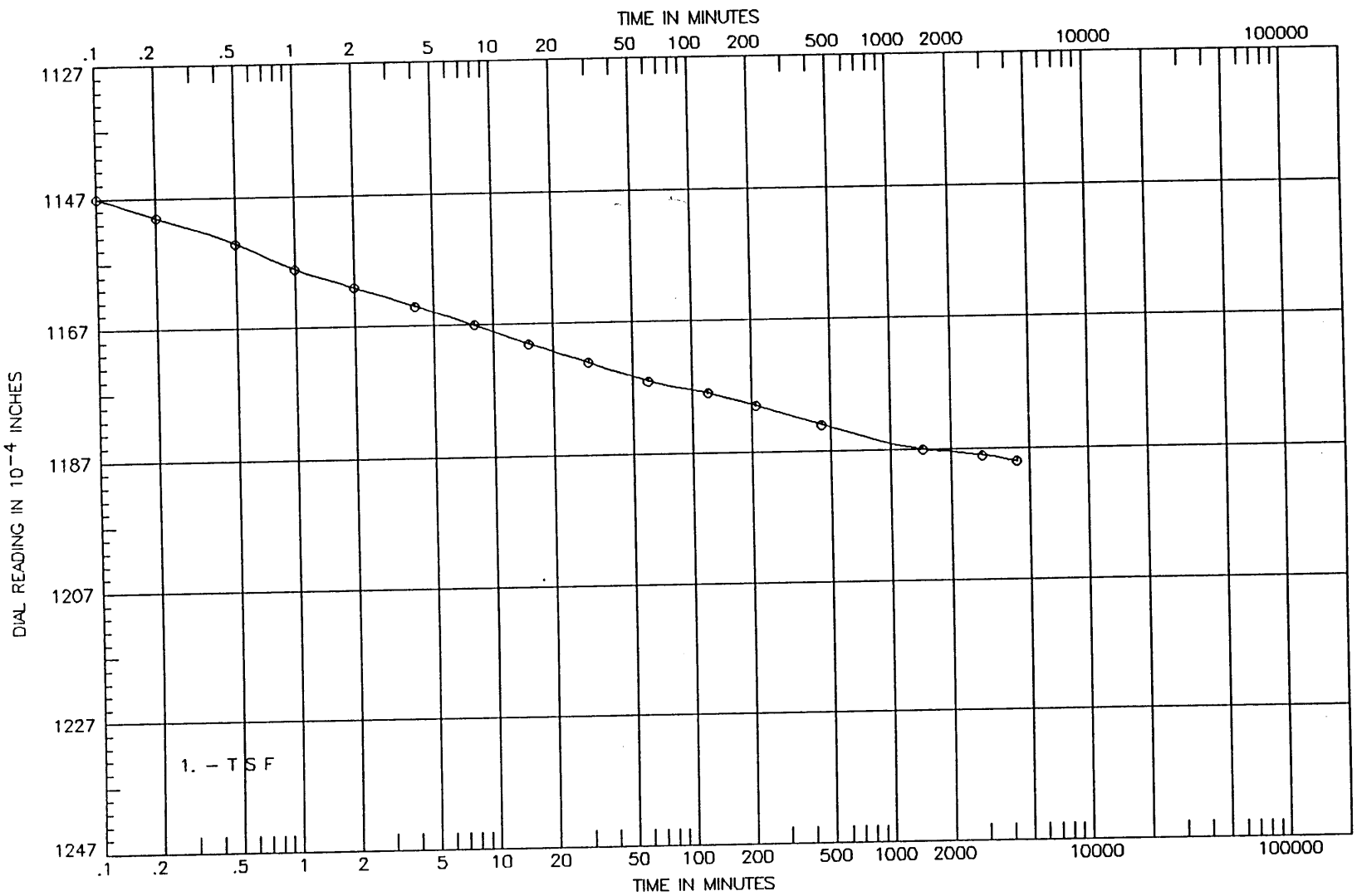


PROJECT	EASTERN ARKANSAS		
BORING	2-EAPS-U-94	SAMPLE NO.	4
DEPTH/ELEV	9-10.0	DATE	27 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

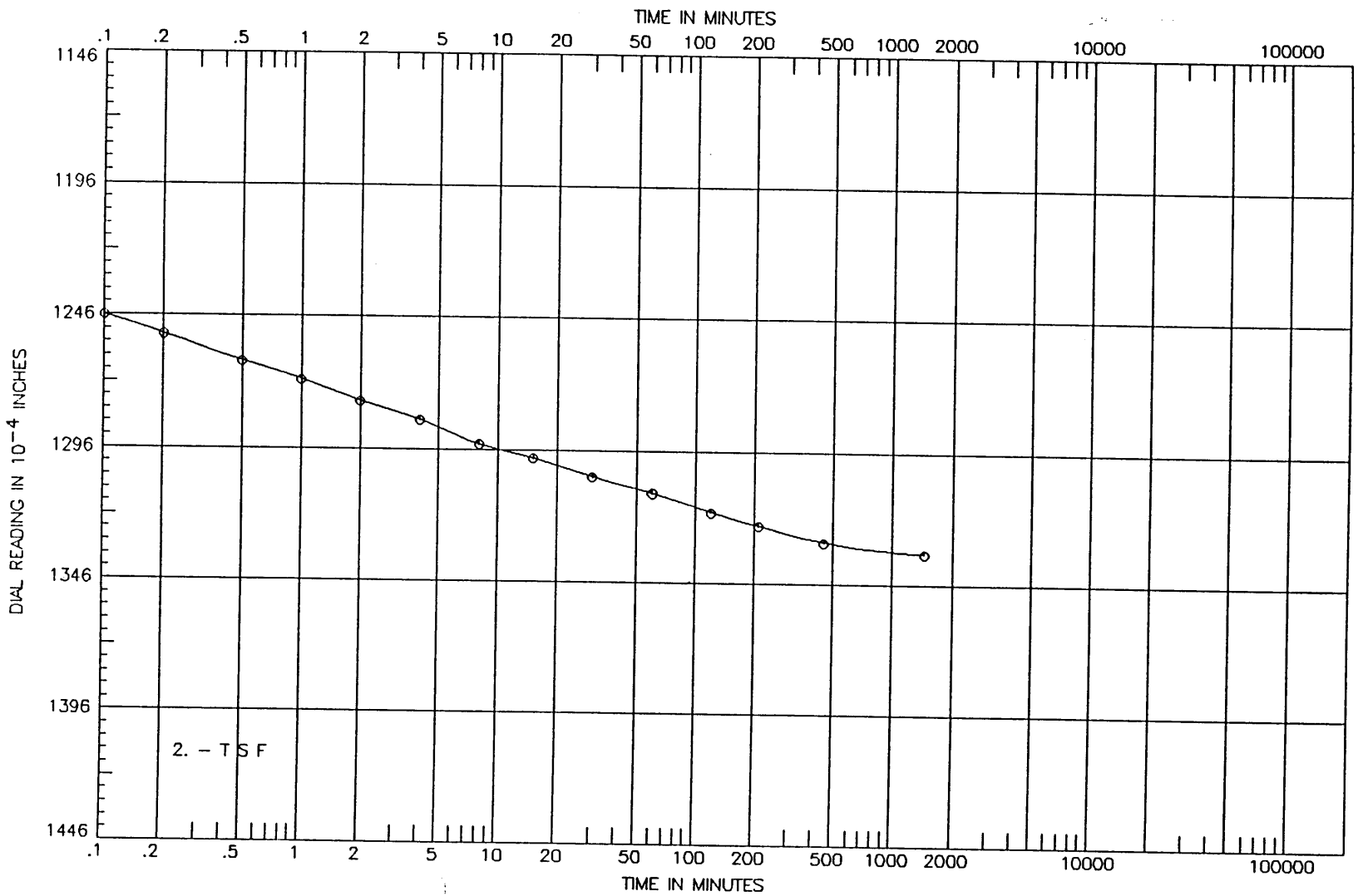
SHEET 5 OF 13



PROJECT	EASTERN ARKANSAS		
BORING	2-EAPS-U-94	SAMPLE NO.	4
DEPTH/ELEV	9-10.0	DATE	27 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

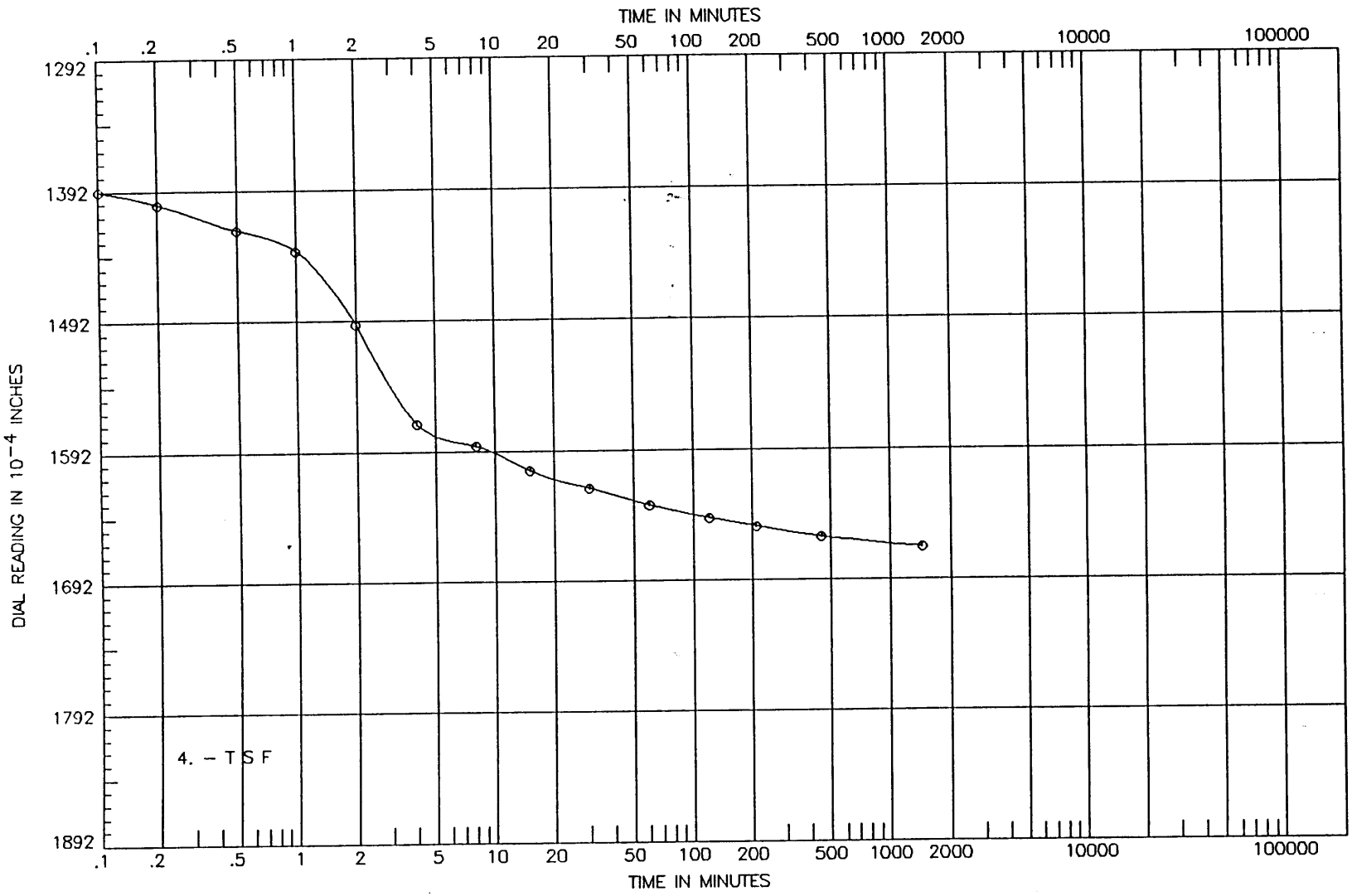


PROJECT	EASTERN ARKANSAS		
BORING	2-EAPS-U-94	SAMPLE NO.	4
DEPTH/ELEV	9-10.0	DATE	27 FEB 95

SHEET 7 OF 13

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

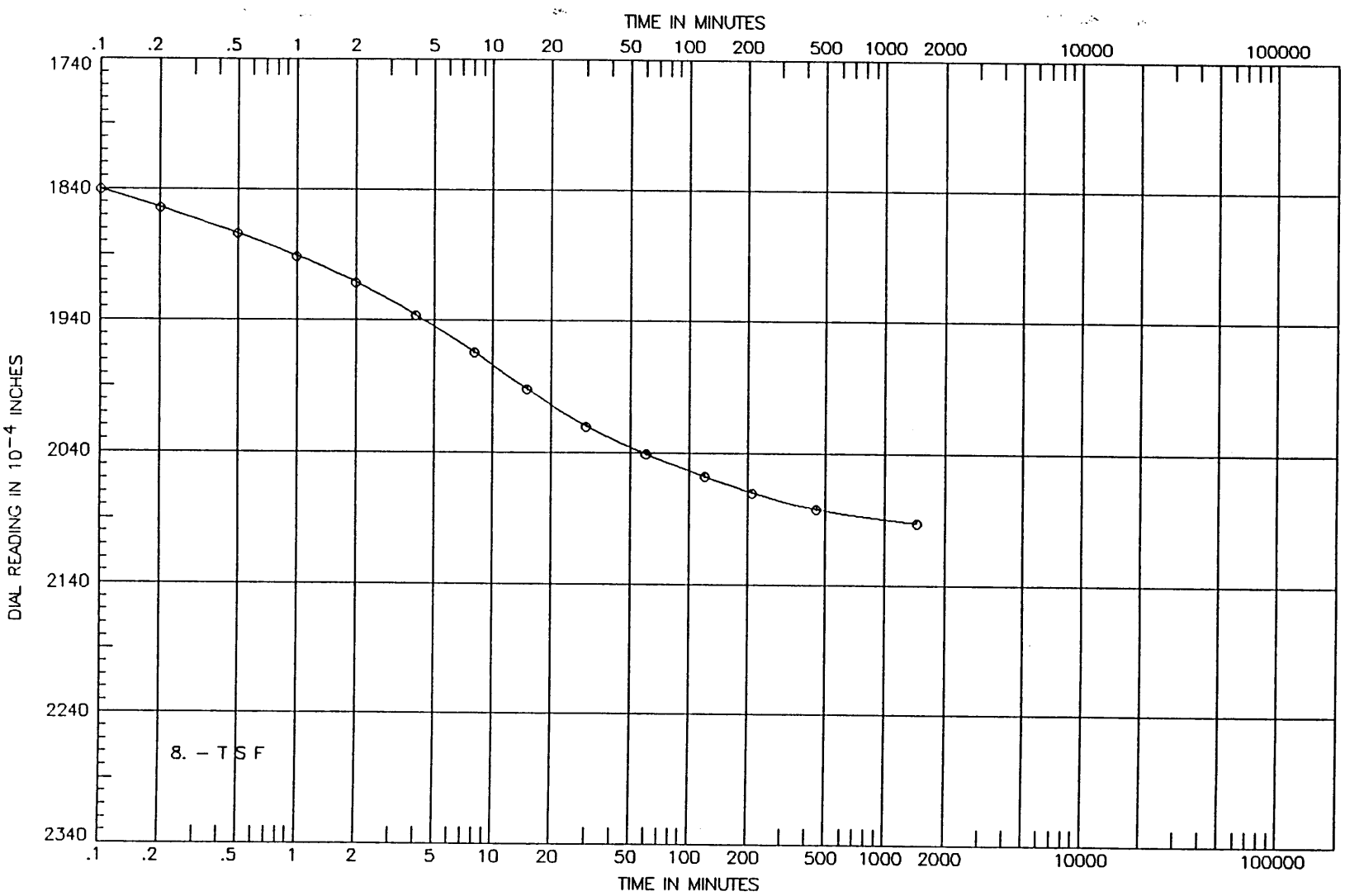


PROJECT EASTERN ARKANSAS	
BORING 2-EAPS-U-94	SAMPLE NO. 4
DEPTH/ELEV 9-10.0	DATE 27 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 8 OF 13

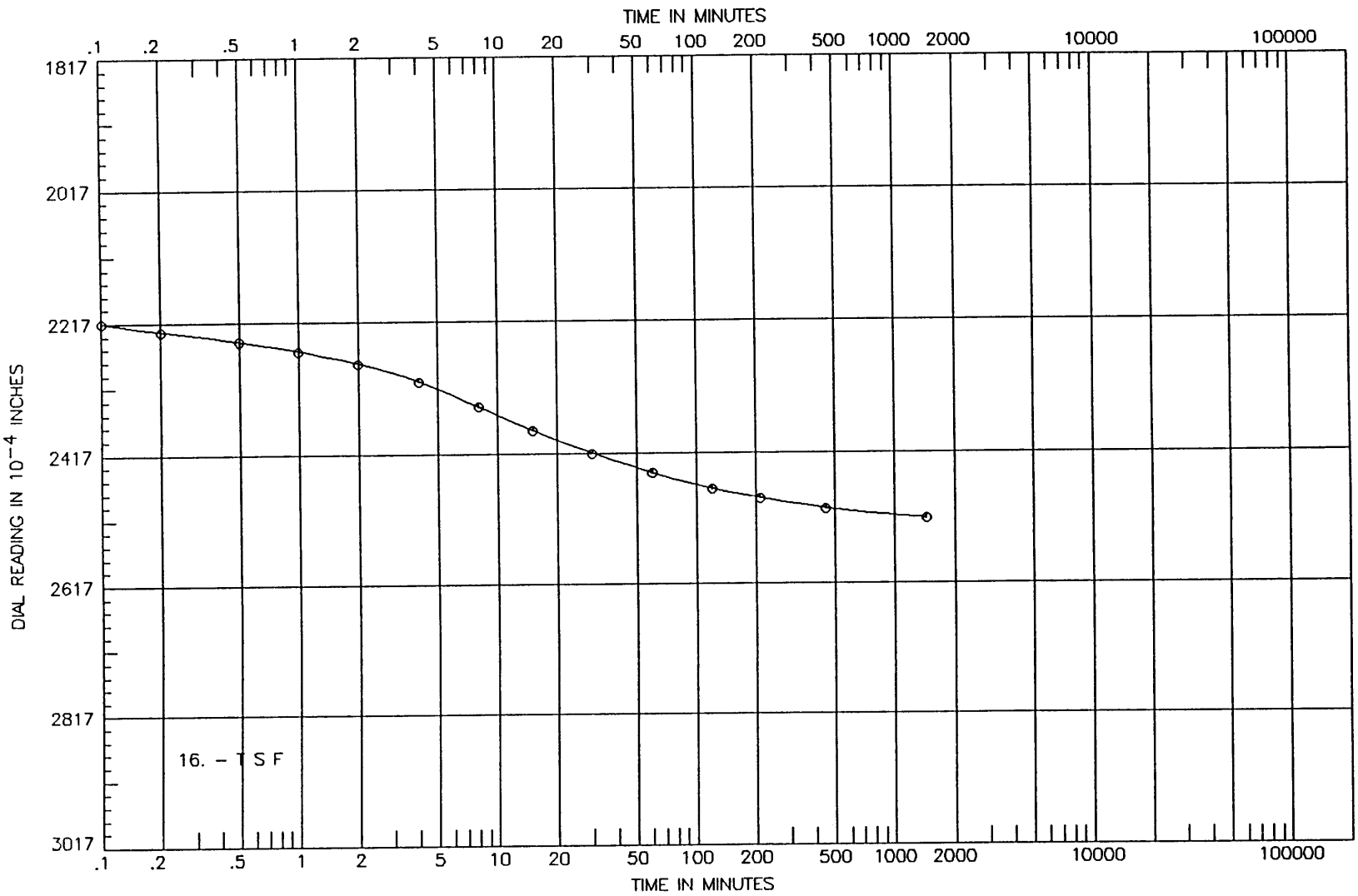


PROJECT	EASTERN ARKANSAS		
BORING	2-EAPS-U-94	SAMPLE NO.	4
DEPTH/ELEV	9-10.0	DATE	27 FEB 95

CONSOLIDATION TEST TIME CURVES

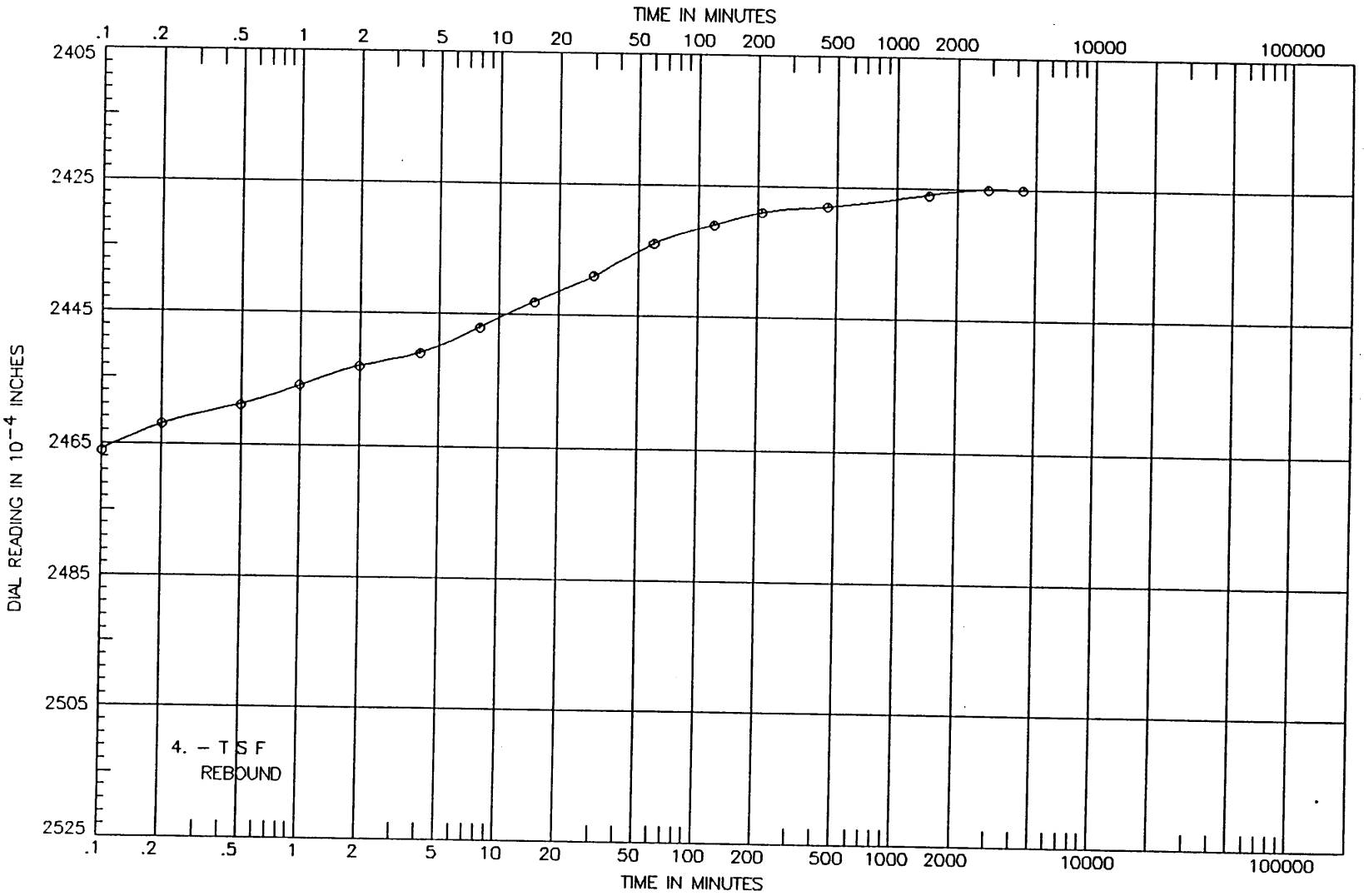
LABORATORY USAE WES - STF/GL

SHEET 9 OF 13



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING	2-EAPS-U-94	SAMPLE NO. 4	
DEPTH/ELEV	9-10.0	DATE 27 FEB 95	

SHEET 10 OF 13

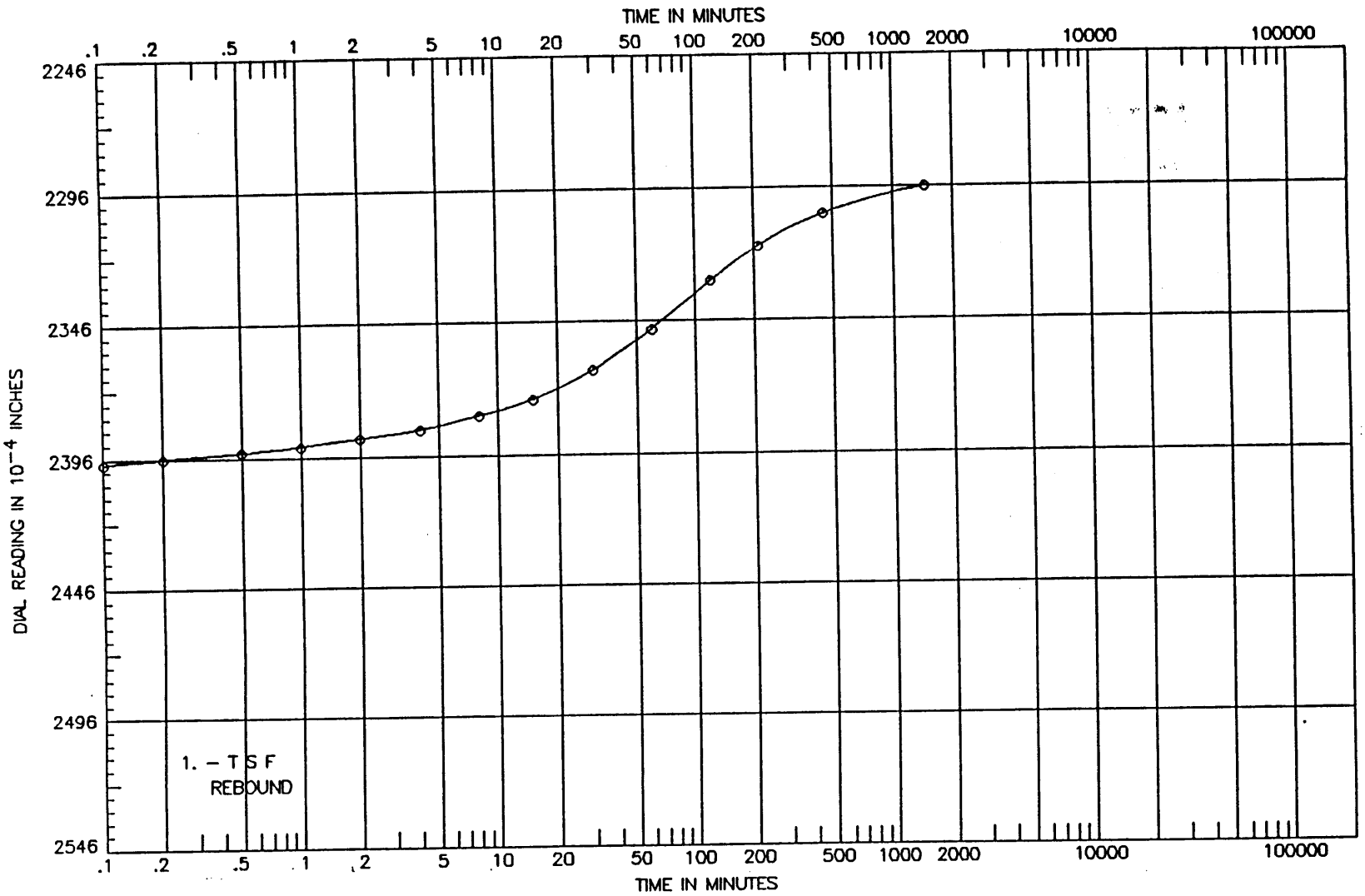


PROJECT	EASTERN ARKANSAS		
BORING	2-EAPS-U-94	SAMPLE NO.	4
DEPTH/ELEV	9-10.0	DATE	27 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

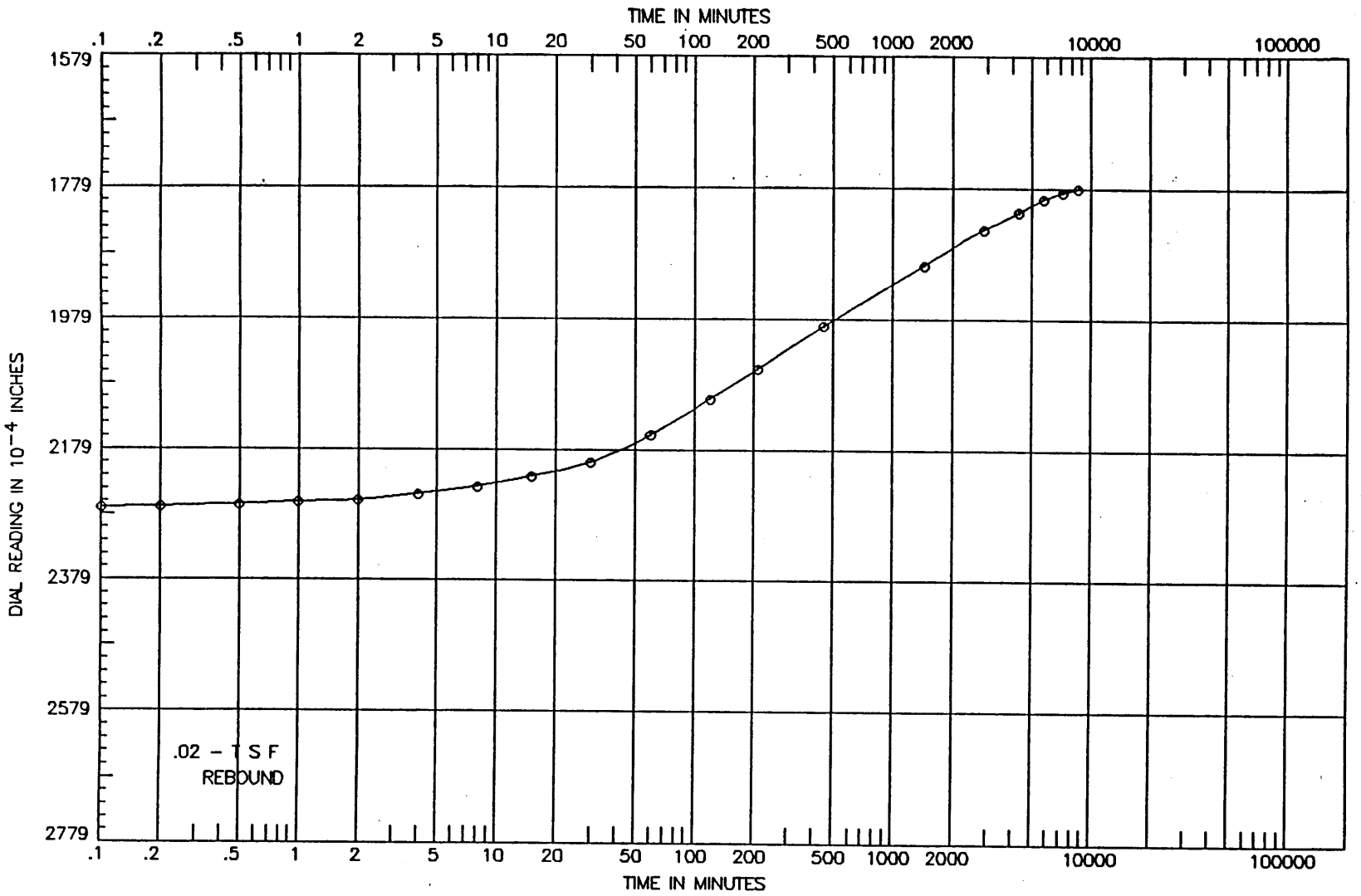
SHEET 11 OF 13



PROJECT	EASTERN ARKANSAS		
BORING	2-EAPS-U-94	SAMPLE NO.	4
DEPTH/ELEV	9-10.0	DATE	27 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

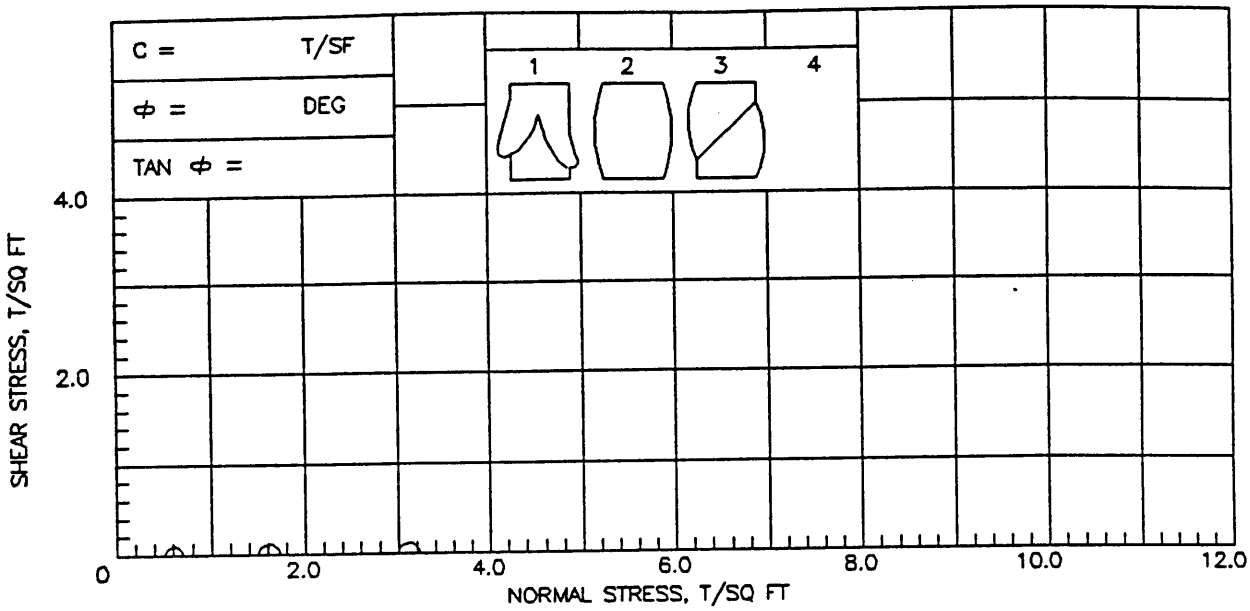


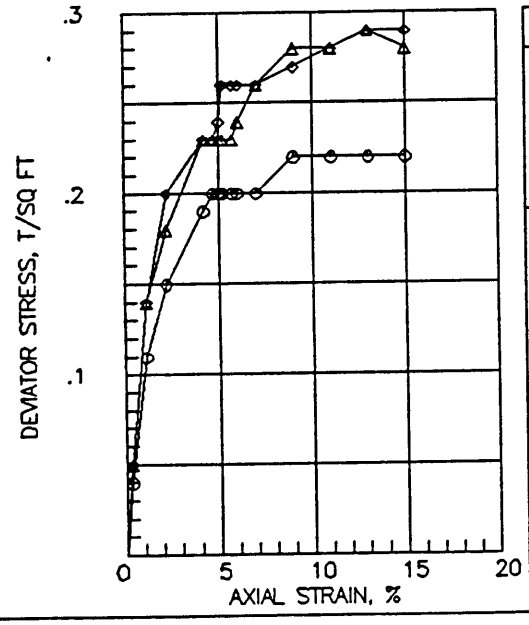
PROJECT	EASTERN ARKANSAS		
BORING	2-EAPS-U-94	SAMPLE NO.	4
DEPTH/ELEV	9-10.0	DATE	27 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 13 OF 13





SPECIMEN NO.		○ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	35.8	35.7	35.5	
	DRY DENSITY, PCF	84.9	86.6	86.8	
	SATURATION, %	98.1	100+	100+	
	VOID RATIO	.984	.946	.942	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESSURE, TSF				
CHAMBER PRESSURE, TSF		.50	1.50	3.00	
MAX. DEV. STRESS, TSF		.20	.23	.23	
TIME TO FAILURE, MIN.		10	20	19	
STRAIN RATE INCR., %			6	5	
INITIAL DIAMETER, IN.		1.36	1.35	1.36	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY

LL 44	PL 20	PI 24	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

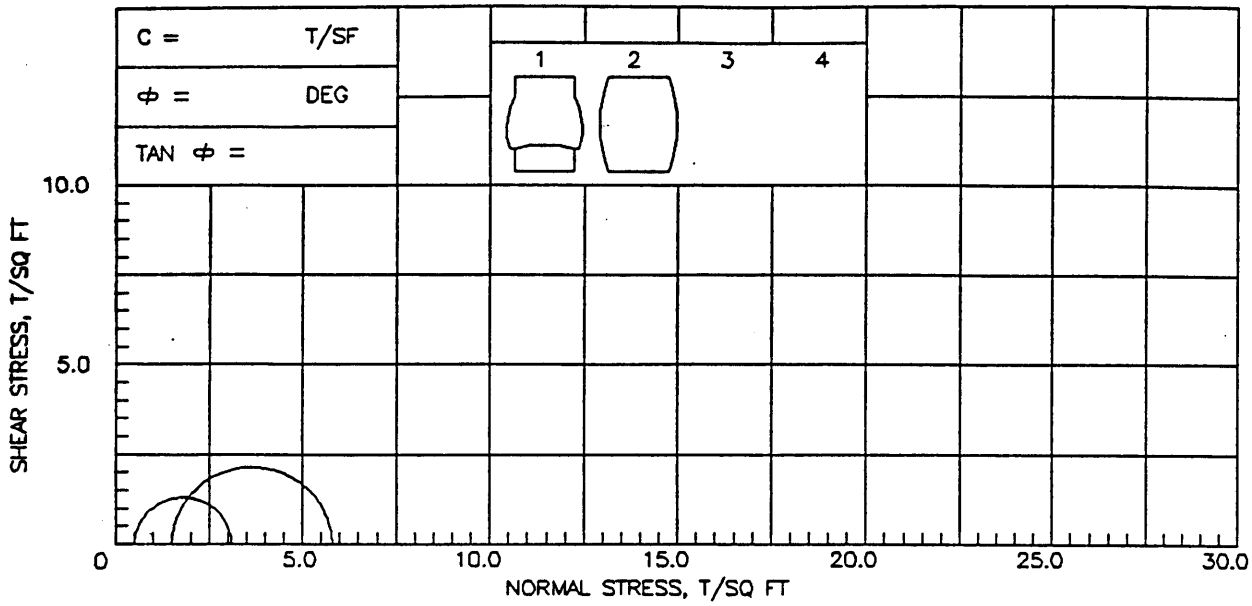
PROJECT EASTERN ARKANSAS

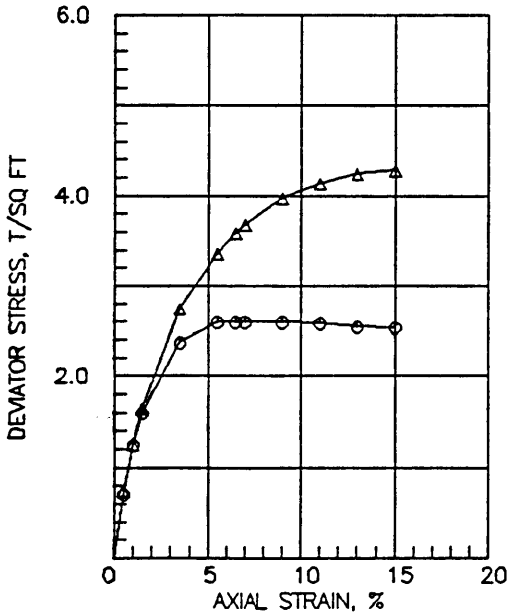
BORING NO. 3-EAPS-U-94 | SAMPLE NO. 5

DEPTH/ELEV 12.3-13.5 | TECH. US

LABORATORY USAE WES - STF/GL | DATE 09 FEB 95

TRIAXIAL COMPRESSION TEST REPORT





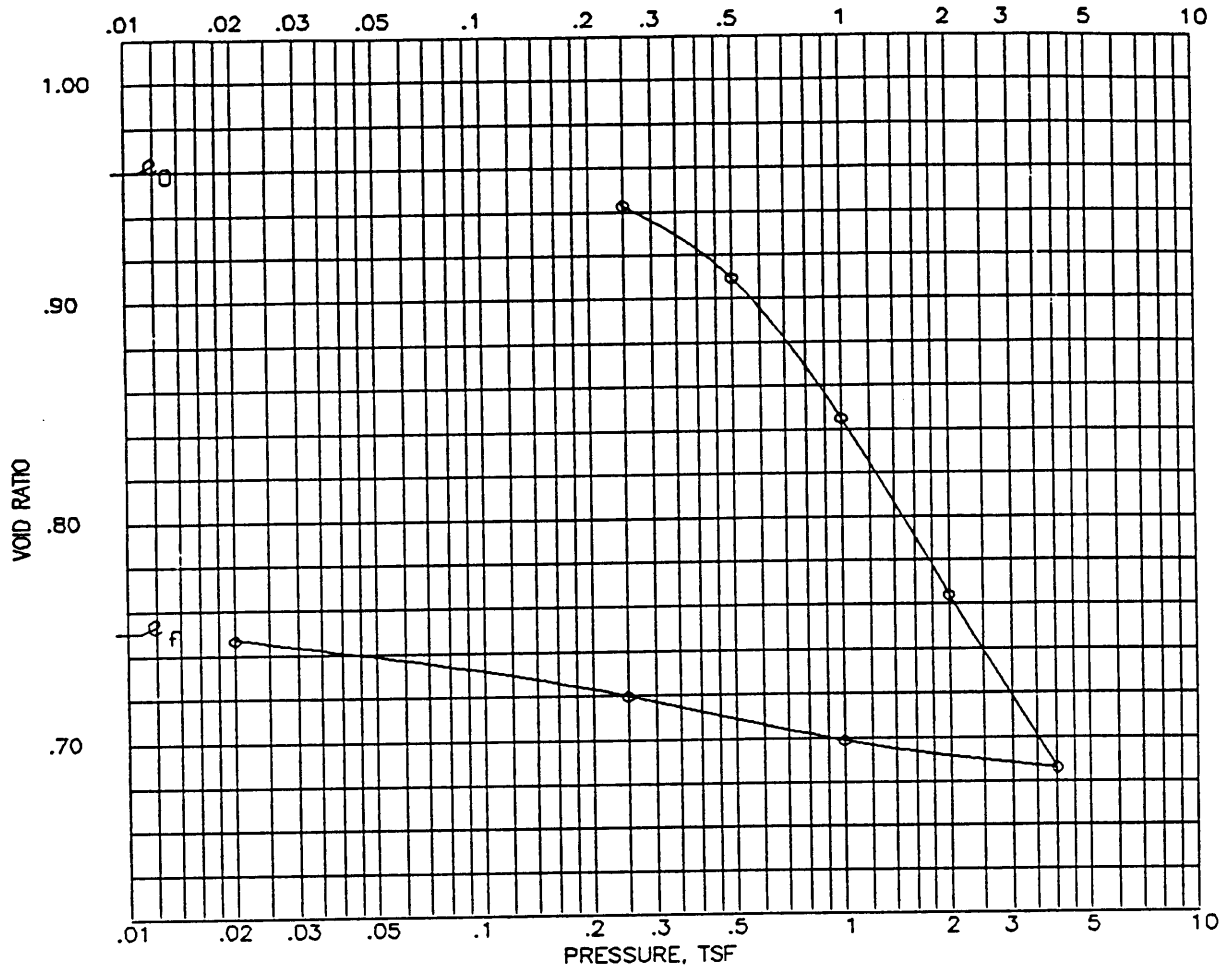
SPECIMEN NO.		o 1	Δ 2	3	4
INITIAL	WATER CONTENT, %	17.3	17.3		
	DRY DENSITY, PCF	84.0	87.0		
	SATURATION, %	46.5	49.8		
	VOID RATIO	1.006	.937		
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESSURE, TSF				
CHAMBER PRESSURE, TSF		.50	1.50		
MAX. DEV. STRESS, TSF		2.60	4.29		
TIME TO FAILURE, MIN.		13	36		
STRAIN RATE INCR., %					
INITIAL DIAMETER, IN.		1.39	1.38		
INITIAL HEIGHT, IN.		3.00	3.00		

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY

LL 45	PL 19	PI 26	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	Q TEST

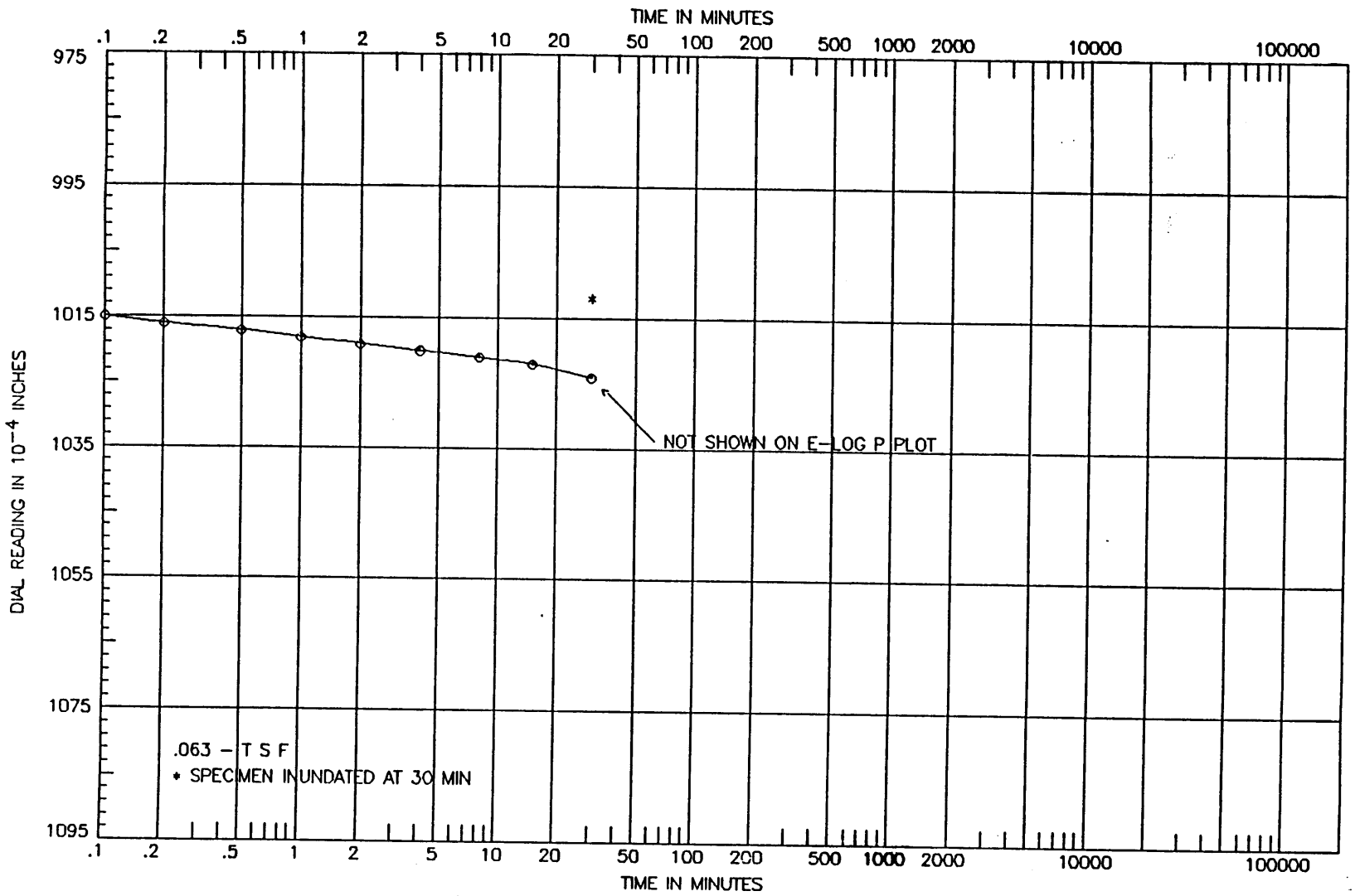
REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT;	BORING NO. 3-EAPS-U-94	SAMPLE NO. 3
INSUFFICIENT MATERIAL	DEPTH/ELEV 6.0-7.5	TECH. US
FOR THIRD SPECIMEN	LABORATORY USAE WES - STF/GL	DATE 27 MAR 95
	TRIAXIAL COMPRESSION TEST REPORT	



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	17.5	25.4
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	86.0	96.3
COMPRESSION INDEX		SATURATION, %	49.2	91.6
TYPE SPECIMEN	COMPACTED	VOID RATIO	.959	.750
DIA. IN 4.44	HT. IN 1.138	BACK PRESSURE, TSF		

CLASSIFICATION	CLAY (CL), BROWN			
LL	PL	PI	PROJECT EASTERN ARKANSAS	
GS 2.70 (EST)	D_{10}			
REMARKS:			BORING NO. 3-EAPS-U-94	SAMPLE NO. 3
SPECIMEN COMPACTED			DEPTH/ELEV 6.0-7.5	TECH. JL
AT 15 BLOW EFFORT			LABORATORY USAE WES - STF/GL	DATE 28 MAR 95
			CONSOLIDATION TEST REPORT	

SHEET 1 OF 10

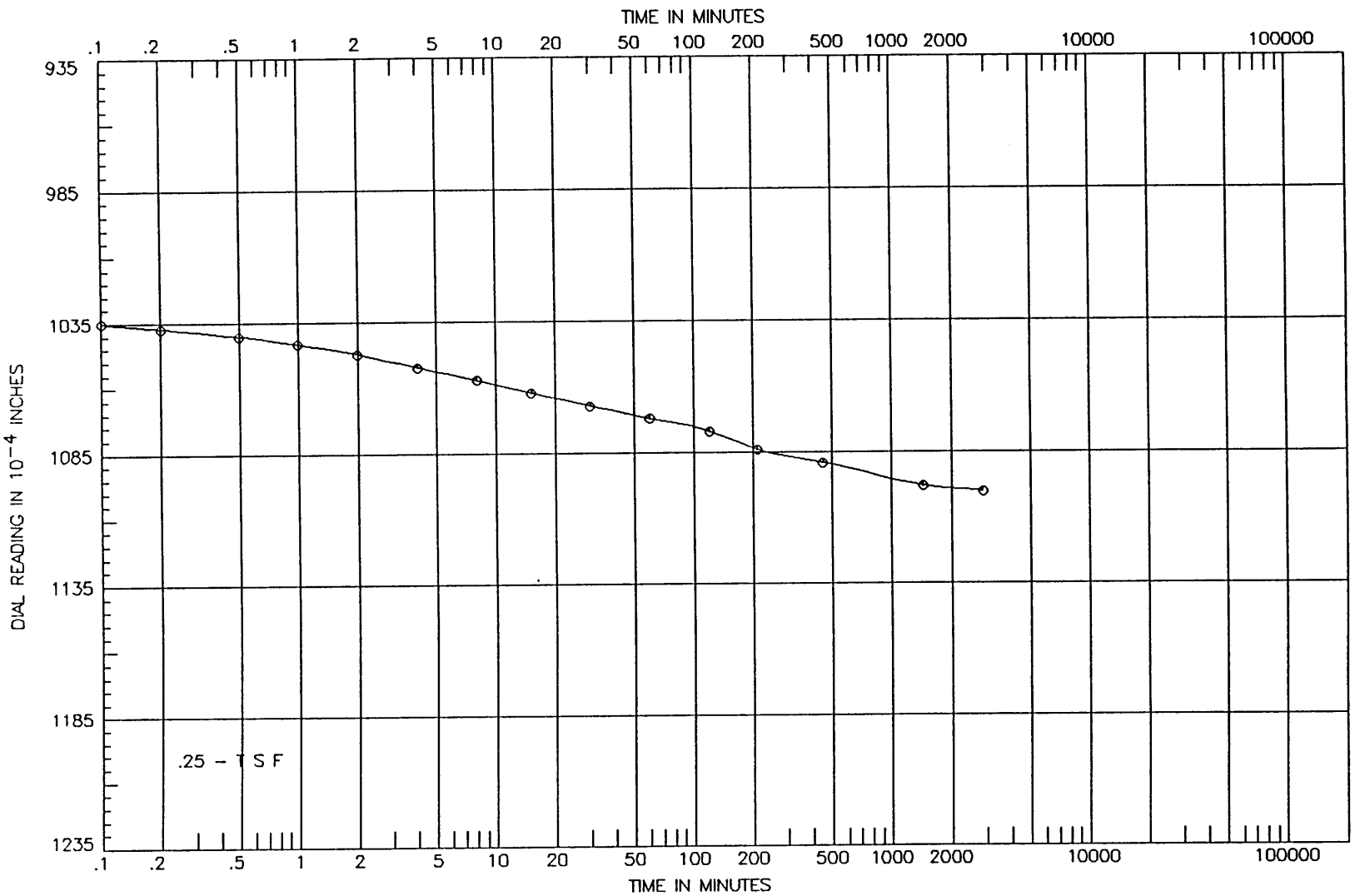


PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	3
DEPTH/ELEV	6.0-7.5	DATE	28 MAR 95

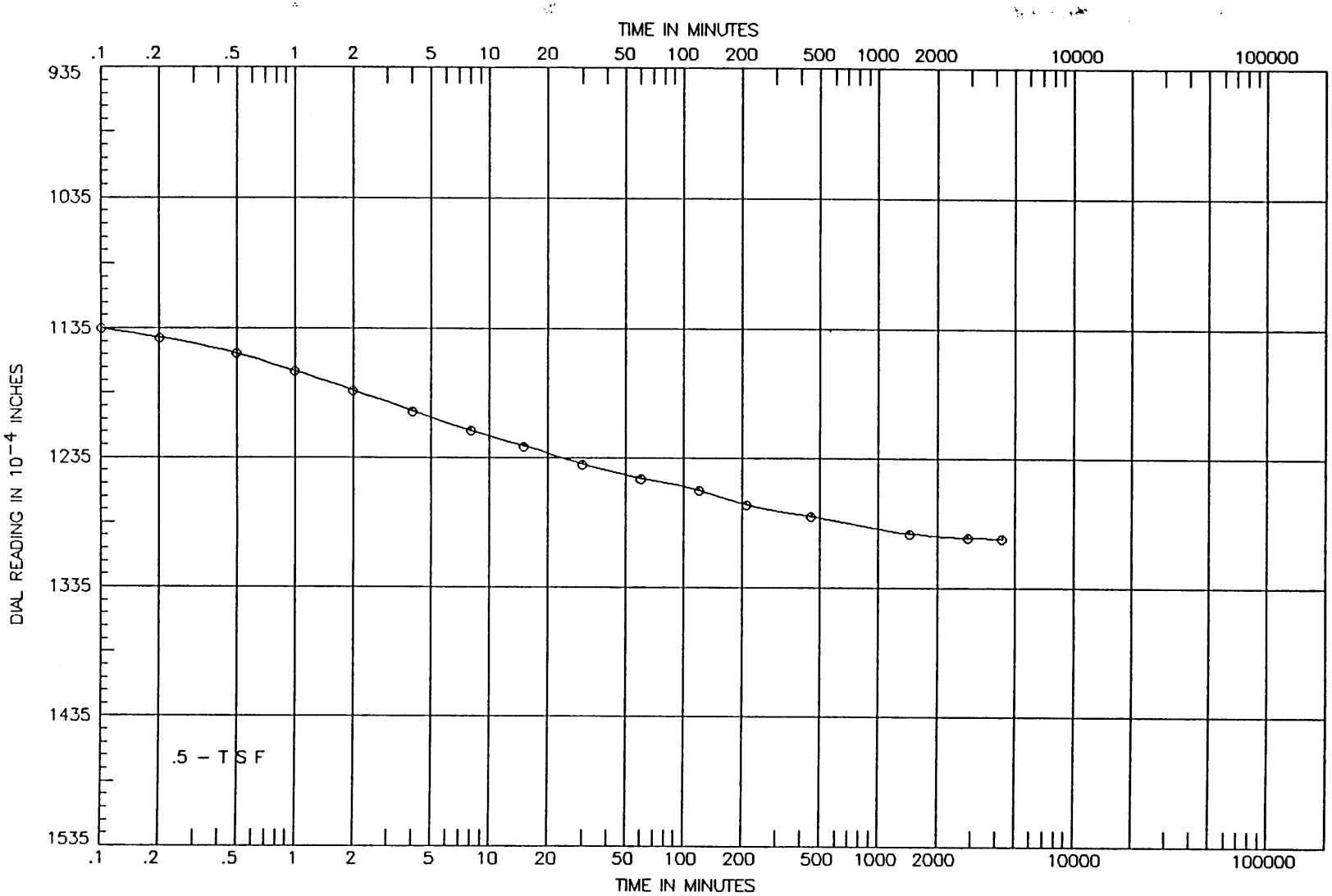
CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 2 OF 10



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES LABORATORY USAE WES – STF/GL
BORING	3-EAPS-U-94	SAMPLE NO. 3	
DEPTH/ELEV	6.0-7.5	DATE 28 MAR 95	

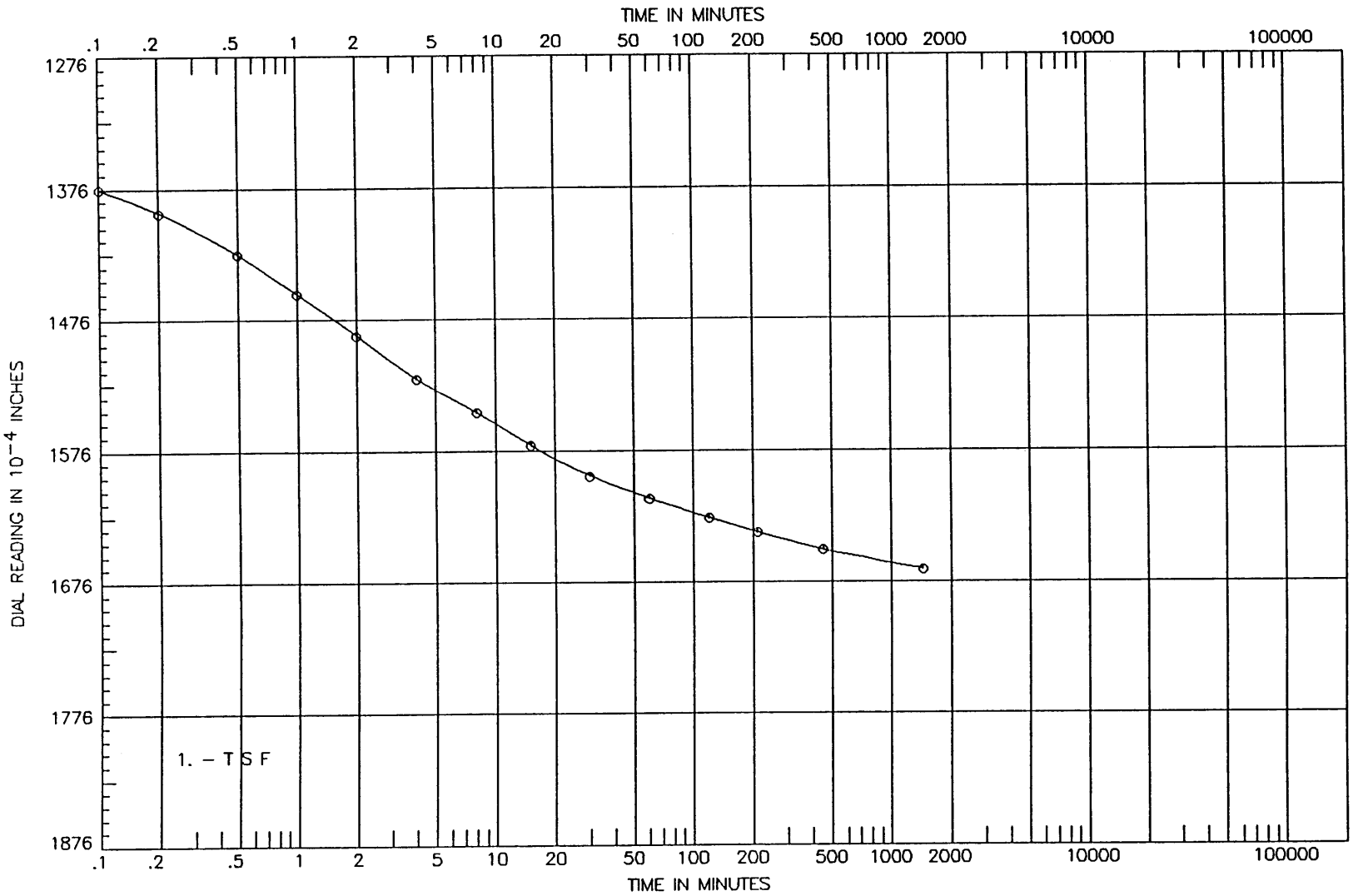


PROJECT EASTERN ARKANSAS	
BORING 3-EAPS-U-94	SAMPLE NO. 3
DEPTH/ELEV 6.0-7.5	DATE 28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 4 OF 10

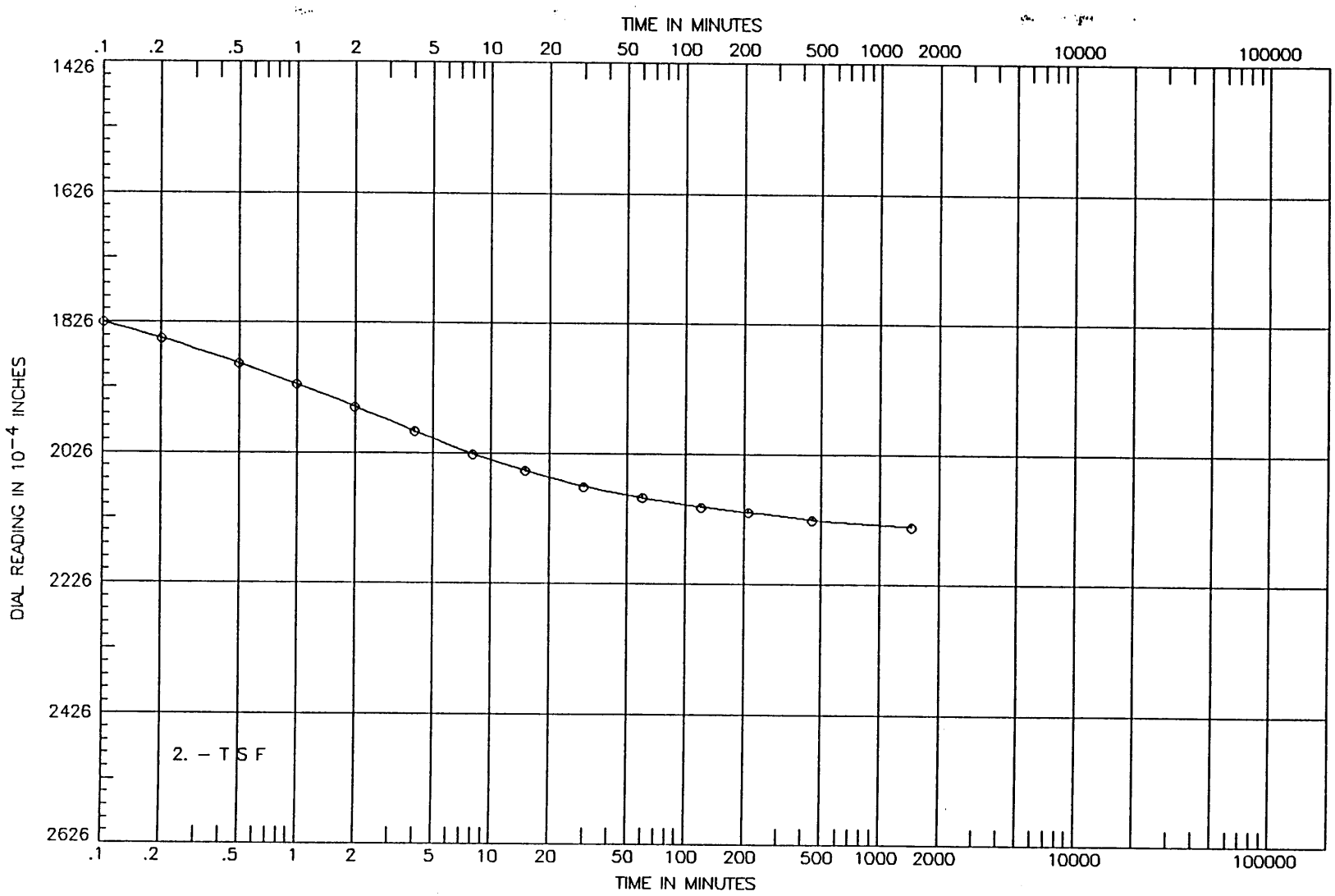


PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	3
DEPTH/ELEV	6.0-7.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 5 OF 10

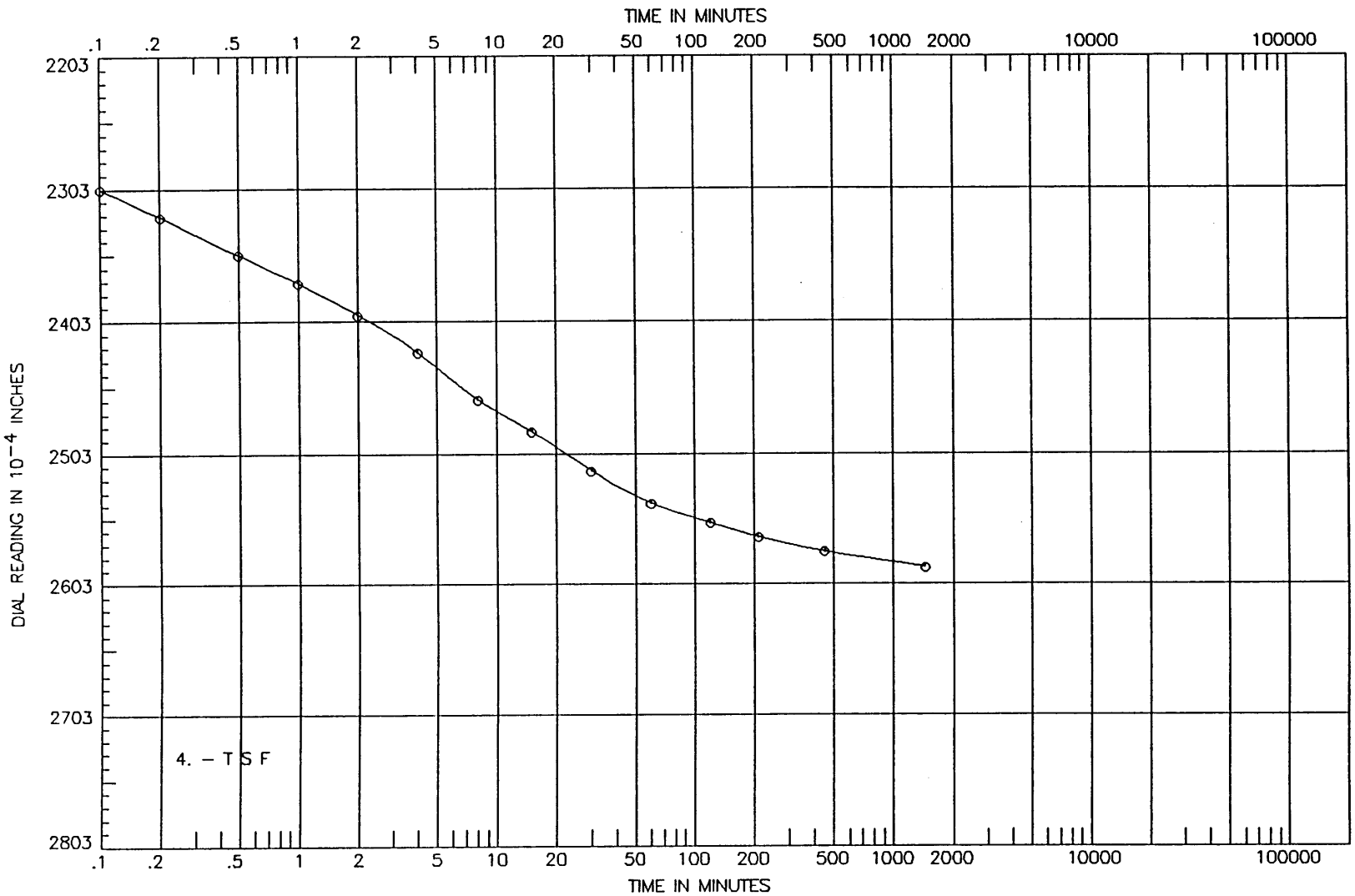


PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	3
DEPTH/ELEV	6.0-7.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 6 OF 10

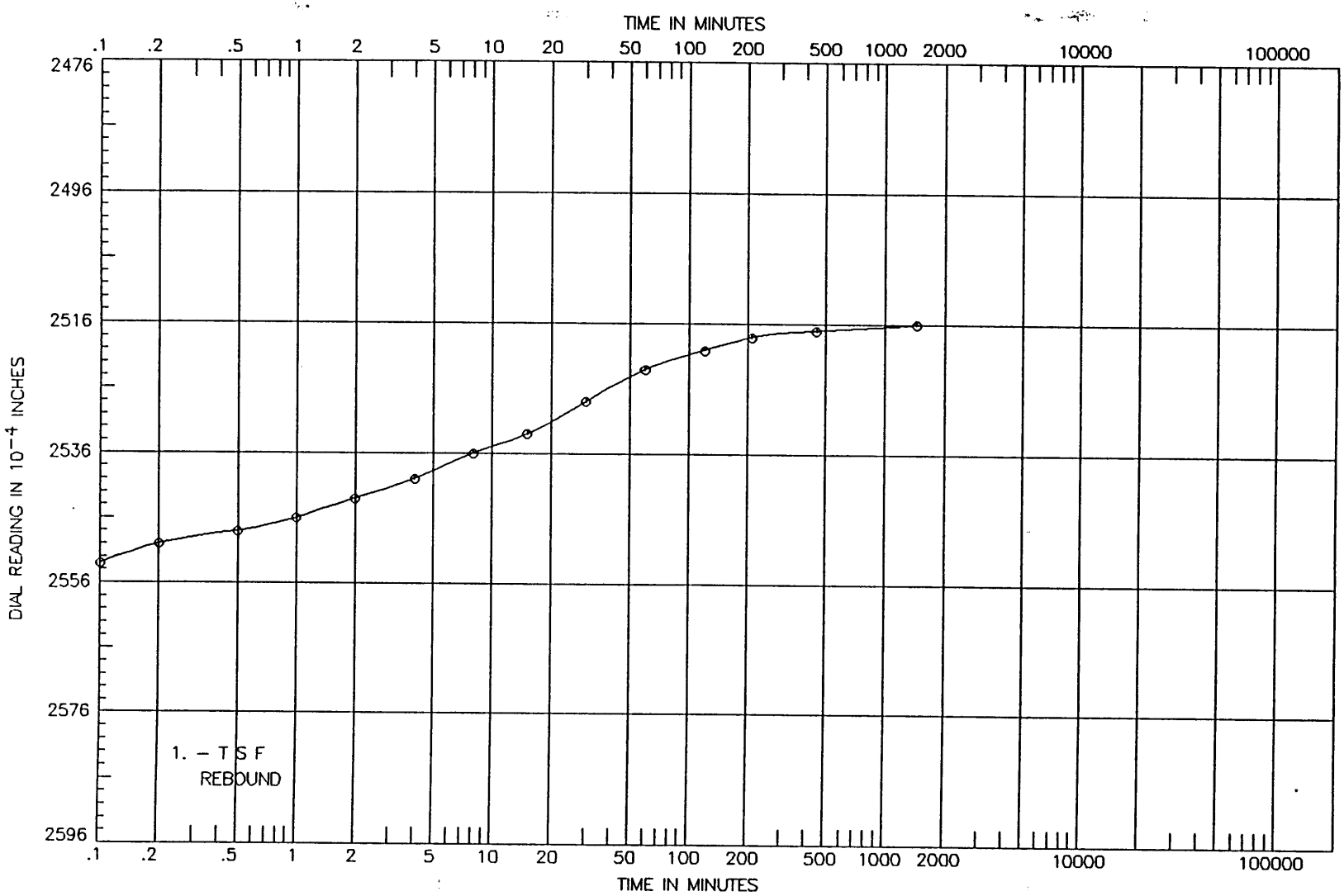


PROJECT EASTERN ARKANSAS	
BORING 3-EAPS-U-94	SAMPLE NO. 3
DEPTH/ELEV 6.0-7.5	DATE 28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 7 OF 10

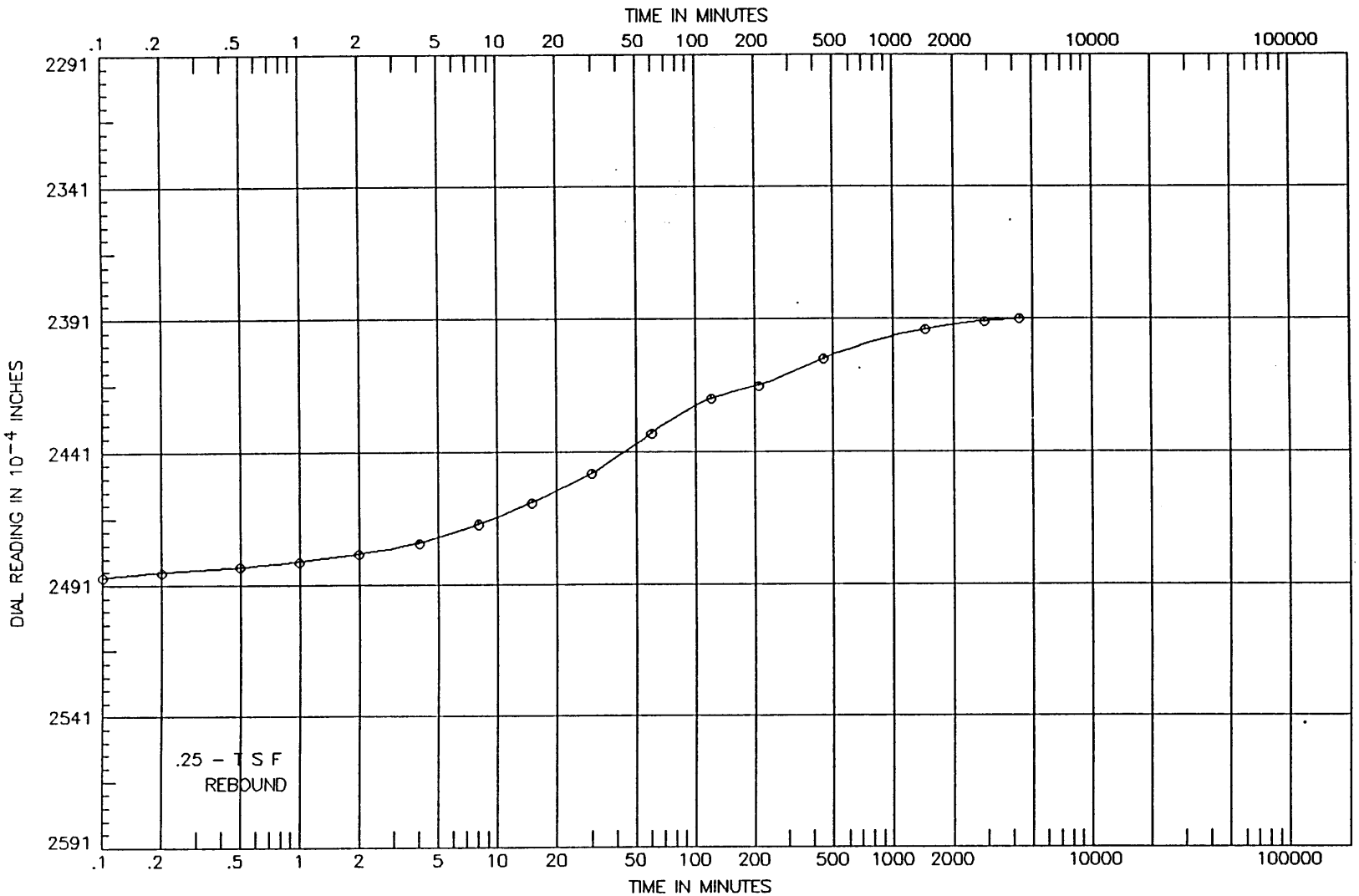


PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	3
DEPTH/ELEV	6.0-7.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 8 OF 10

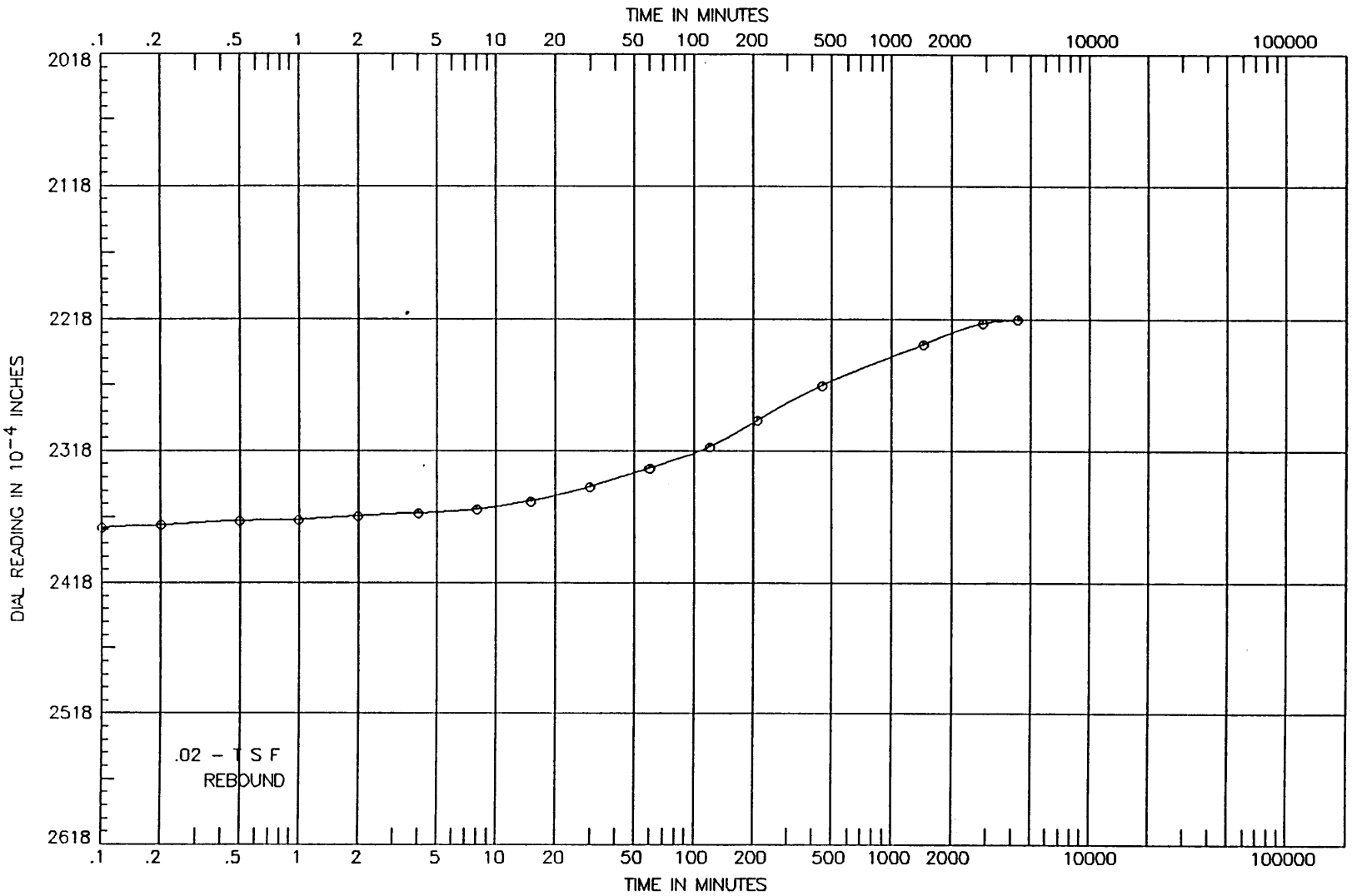


PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	3
DEPTH/ELEV	6.0-7.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 9 OF 10

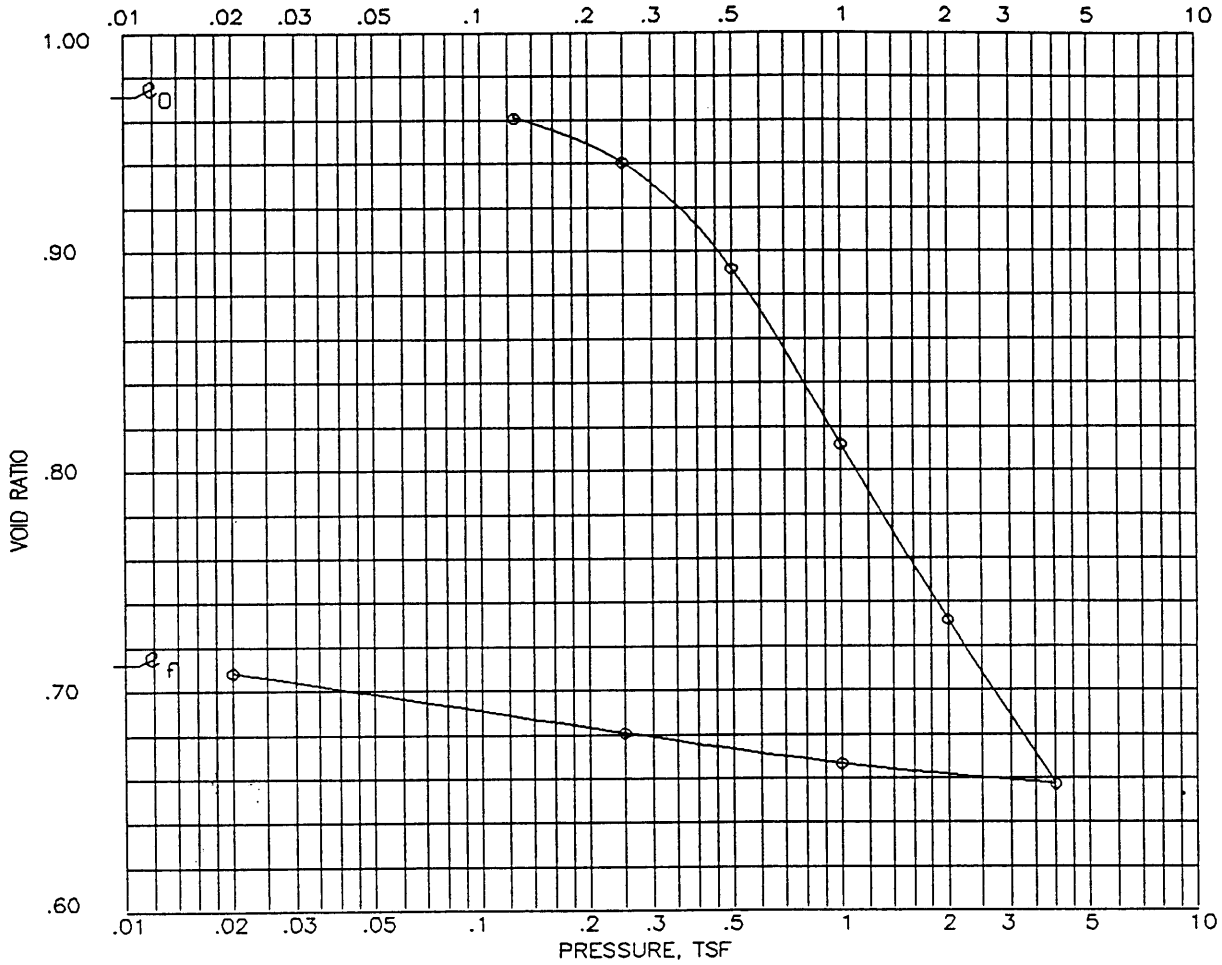


PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	3
DEPTH/ELEV	6.0-7.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

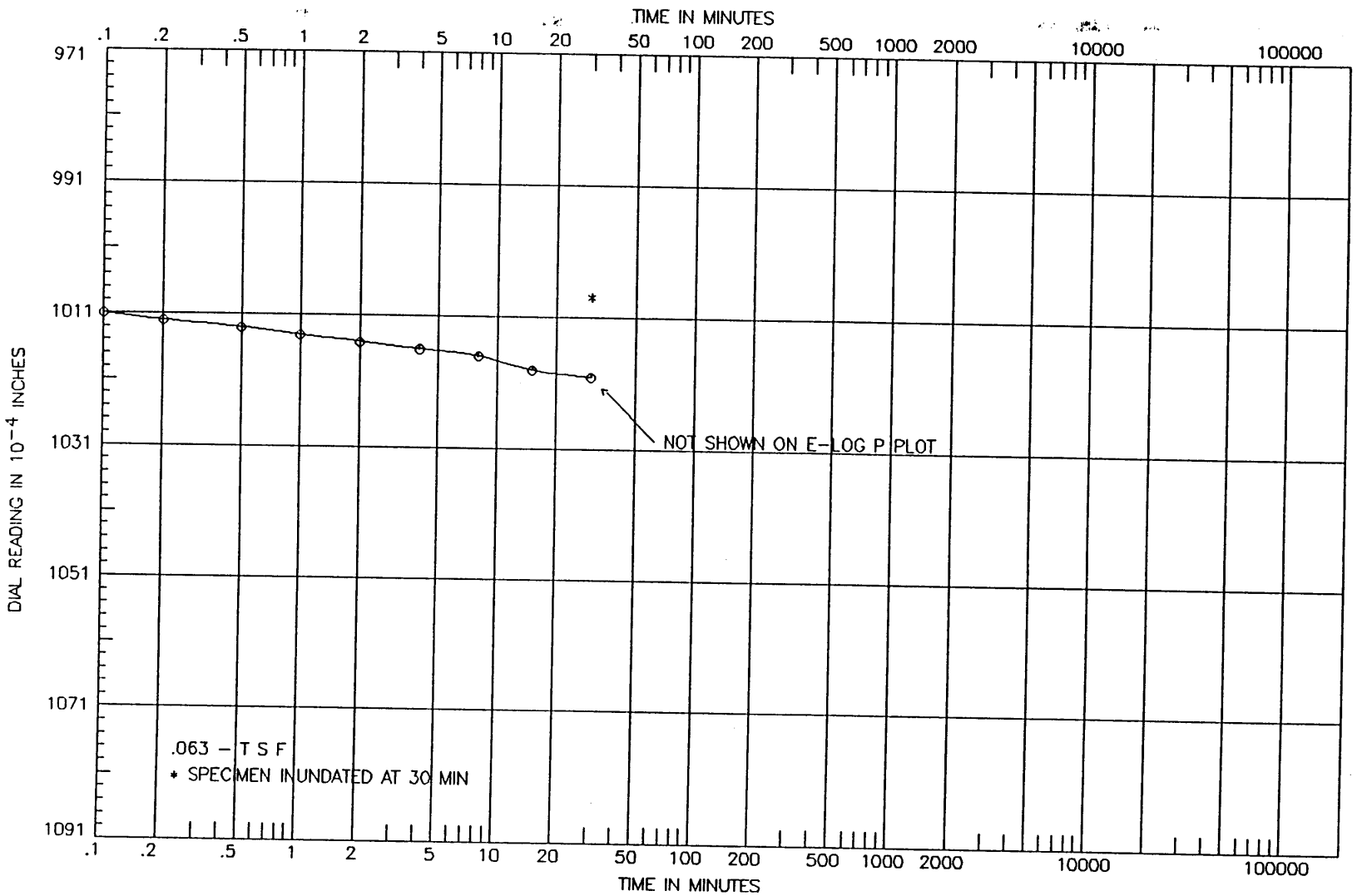
LABORATORY USAE WES – STF/GL

SHEET 10 OF 10



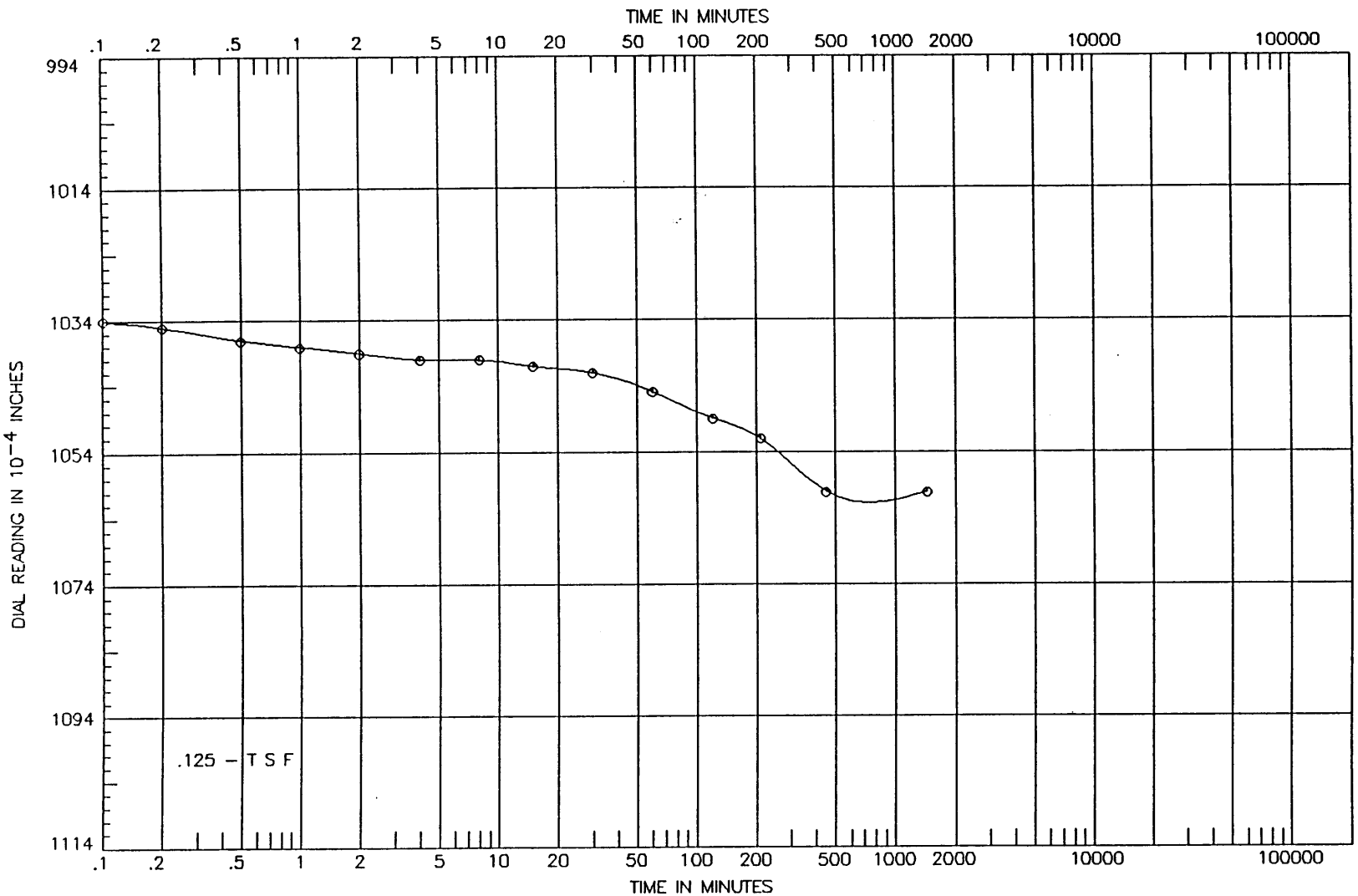
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	14.0	23.8
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	85.5	98.5
COMPRESSION INDEX		SATURATION, %	38.9	90.4
TYPE SPECIMEN	COMPACTED	VOID RATIO	.971	.711
DIA. IN 4.44	HT. IN 1.122	BACK PRESSURE, TSF		
CLASSIFICATION	CLAY (CL), BROWN			
LL / PL / PI		PROJECT	EASTERN ARKANSAS	
GS 2.70 (EST)	D_{10}			
REMARKS:		BORING NO.	3-EAPS-U-94	SAMPLE NO. 5
SPECIMEN COMPACTED		DEPTH/ELEV	12.3-13.5	TECH. JL
AT 15 BLOW EFFORT		LABORATORY	USAE WES - STF/GL	DATE 28 MAR 95
		CONSOLIDATION TEST REPORT		

SHEET 1 OF 11



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES - STF/GL
BORING	3-EAPS-U-94	SAMPLE NO. 5	
DEPTH/ELEV	12.3-13.5	DATE 28 MAR 95	

SHEET 2 OF 11

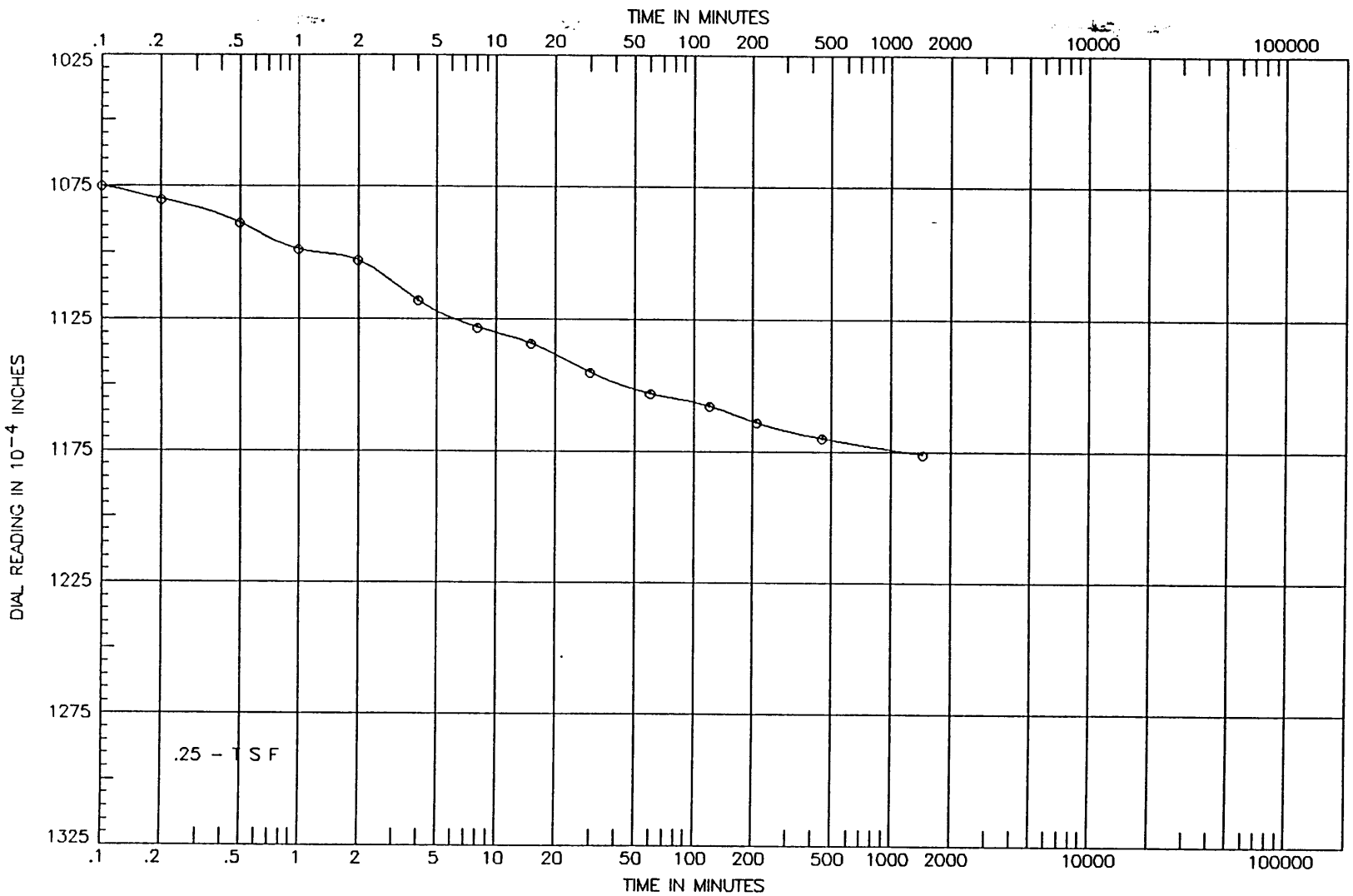


PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	5
DEPTH/ELEV	12.3-13.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

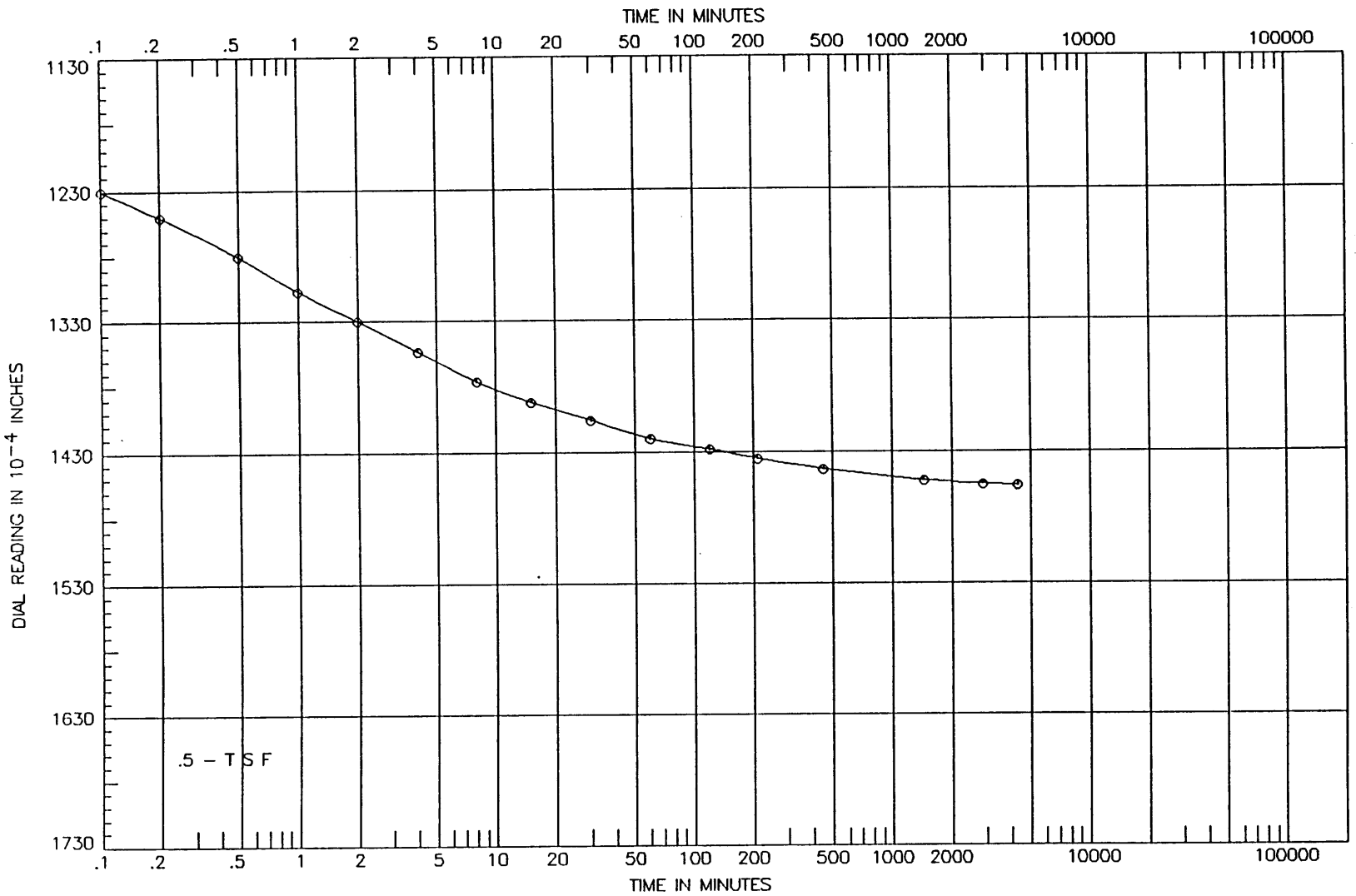
LABORATORY USAE WES – STF/GL

SHEET 3 OF 11



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING	3-EAPS-U-94	SAMPLE NO. 5	
DEPTH/ELEV	12.3-13.5	DATE 28 MAR 95	

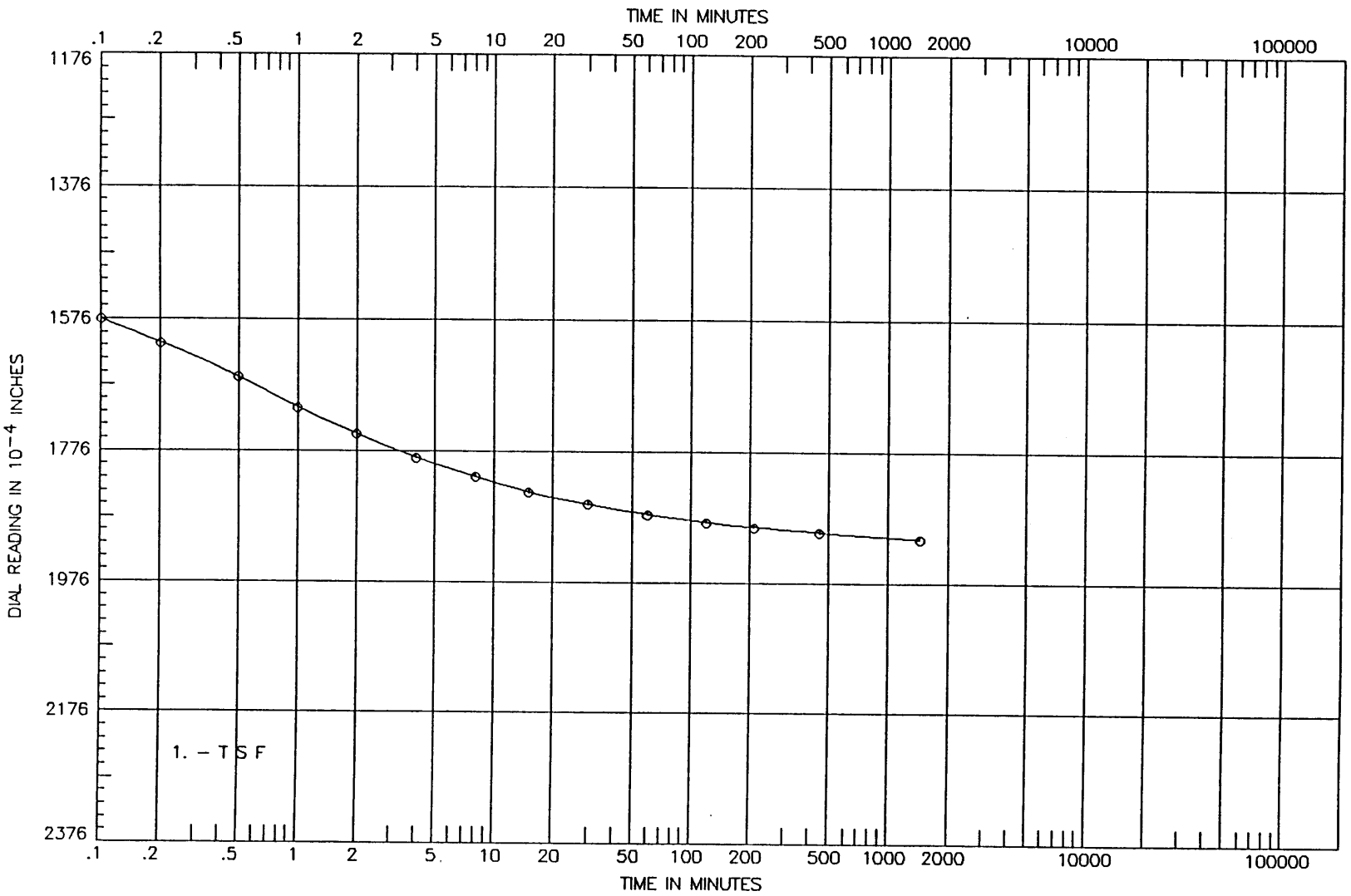
SHEET 4 OF 11



PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	5
DEPTH/ELEV	12.3-13.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

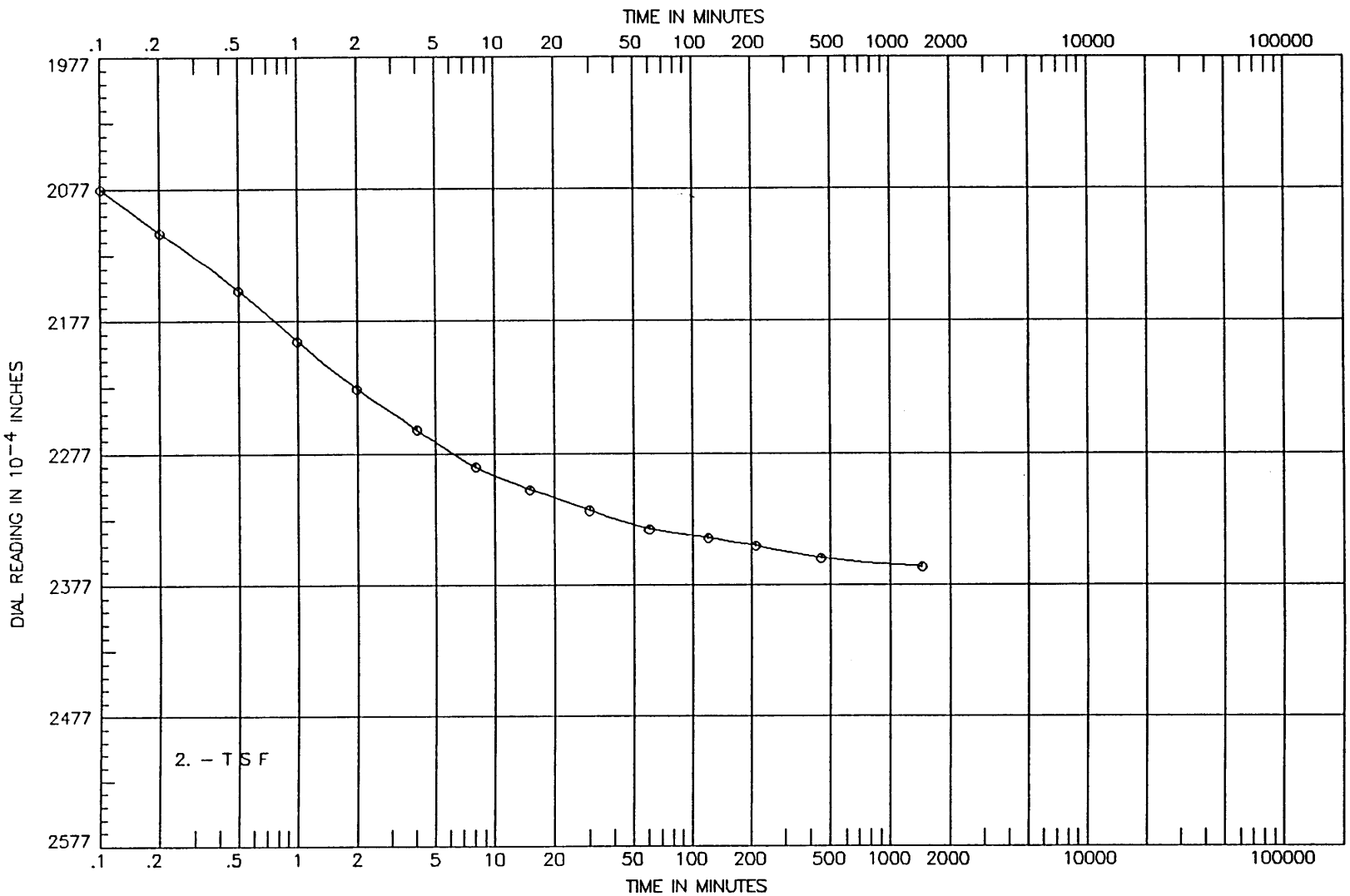


PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	5
DEPTH/ELEV	12.3-13.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 6 OF 11

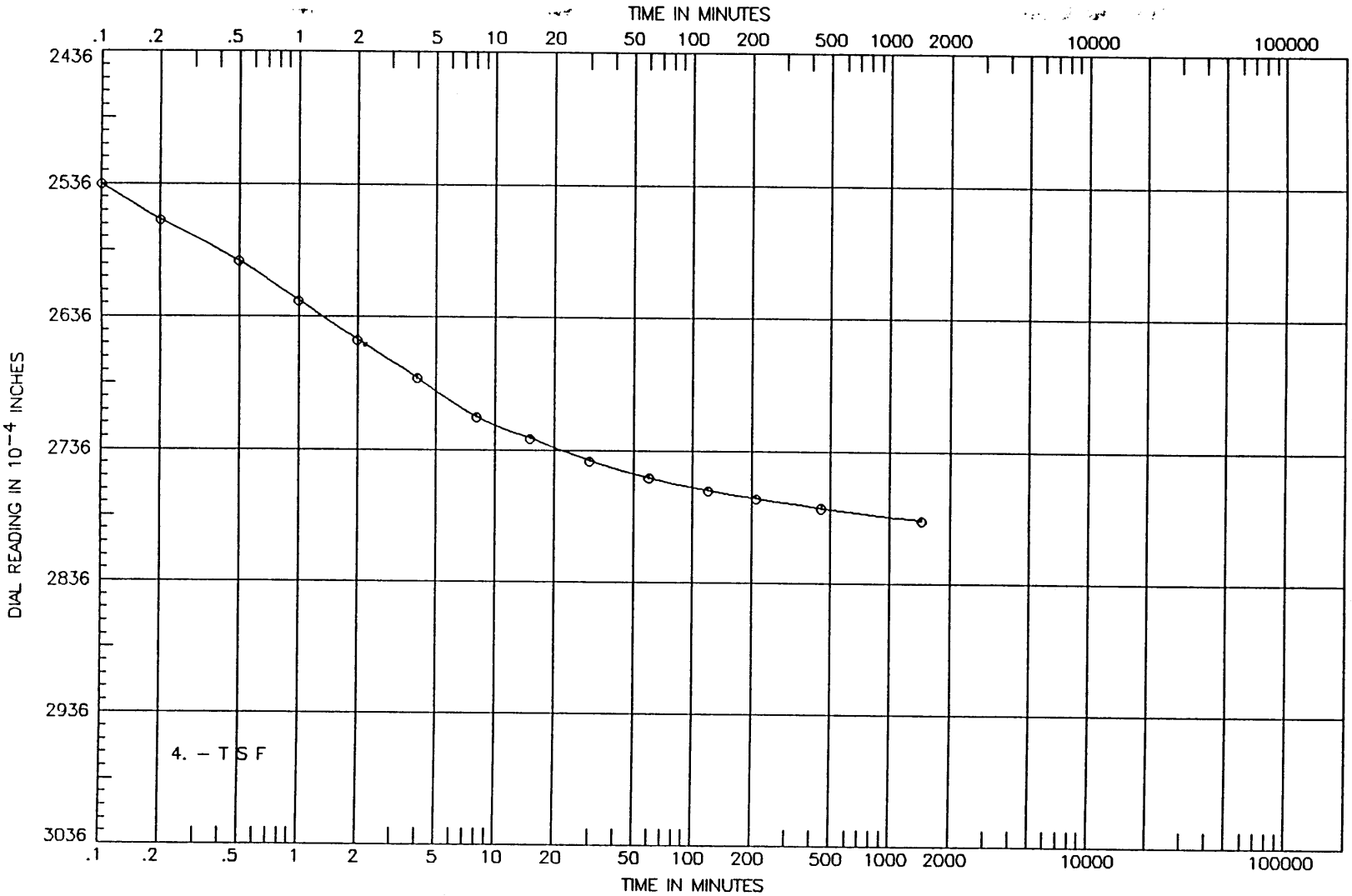


PROJECT EASTERN ARKANSAS	
BORING 3-EAPS-U-94	SAMPLE NO. 5
DEPTH/ELEV 12.3-13.5	DATE 28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 7 OF 11

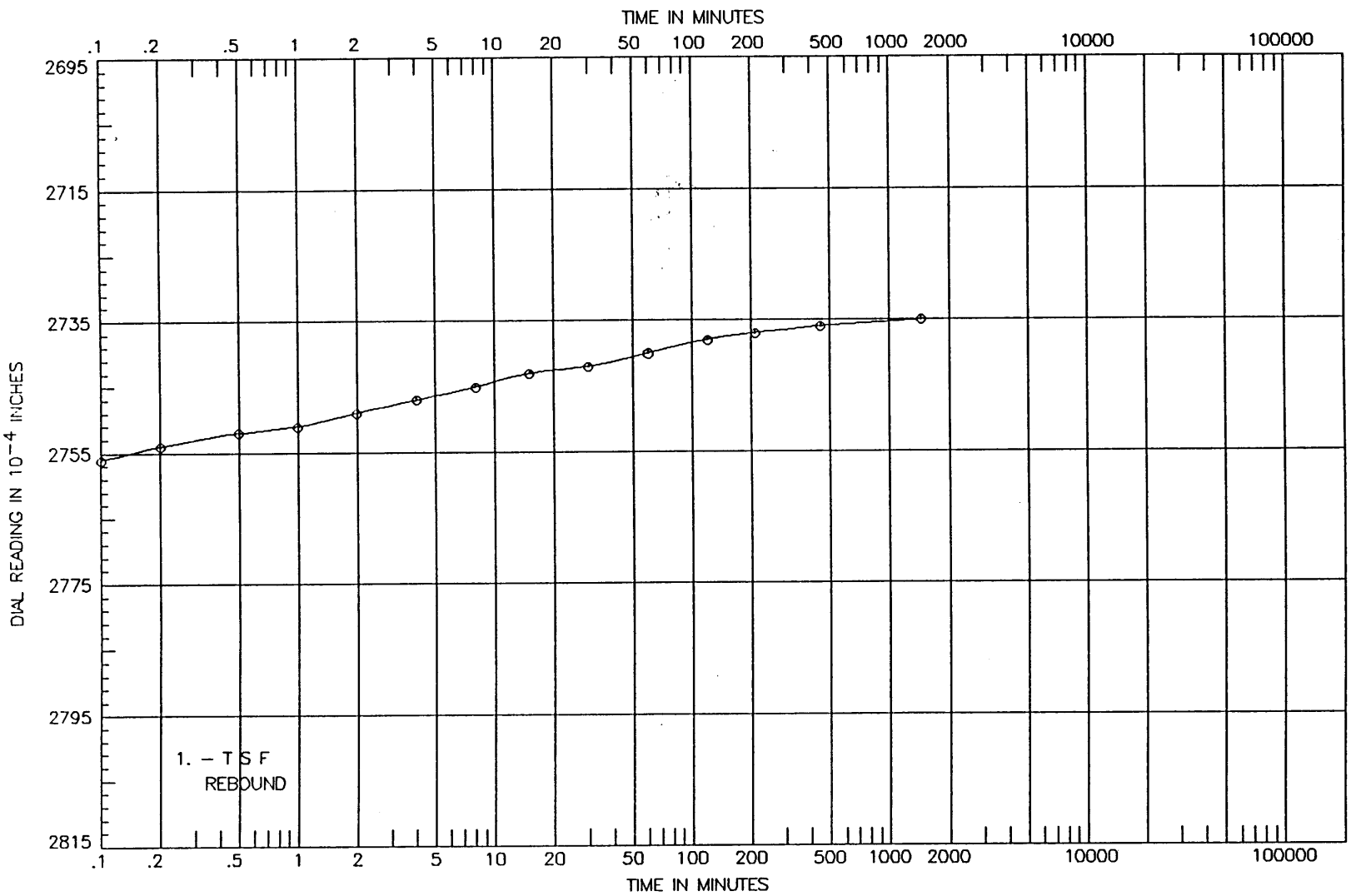


PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	5
DEPTH/ELEV	12.3-13.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 8 OF 11

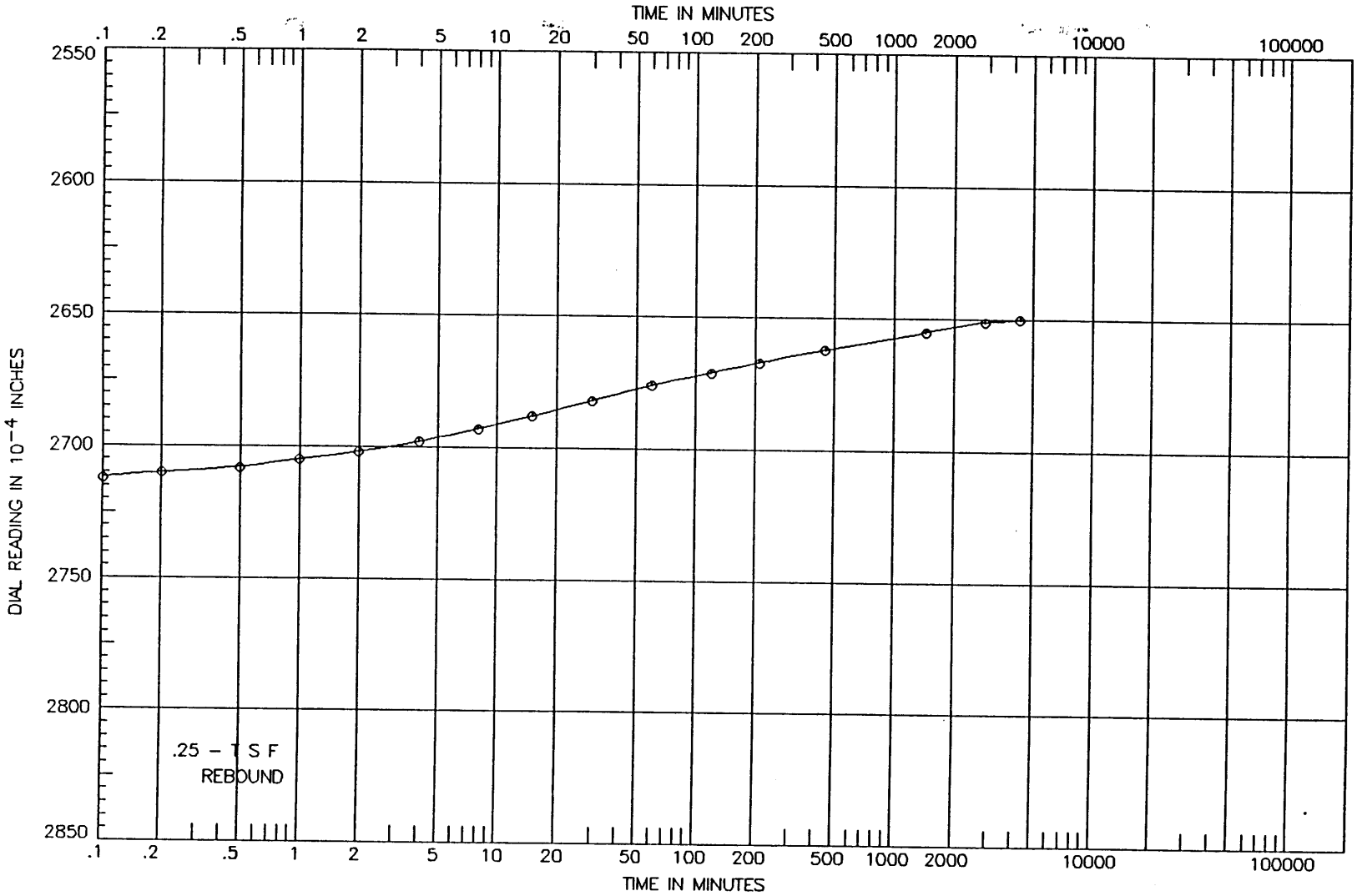


PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	5
DEPTH/ELEV	12.3-13.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 2 OF 11

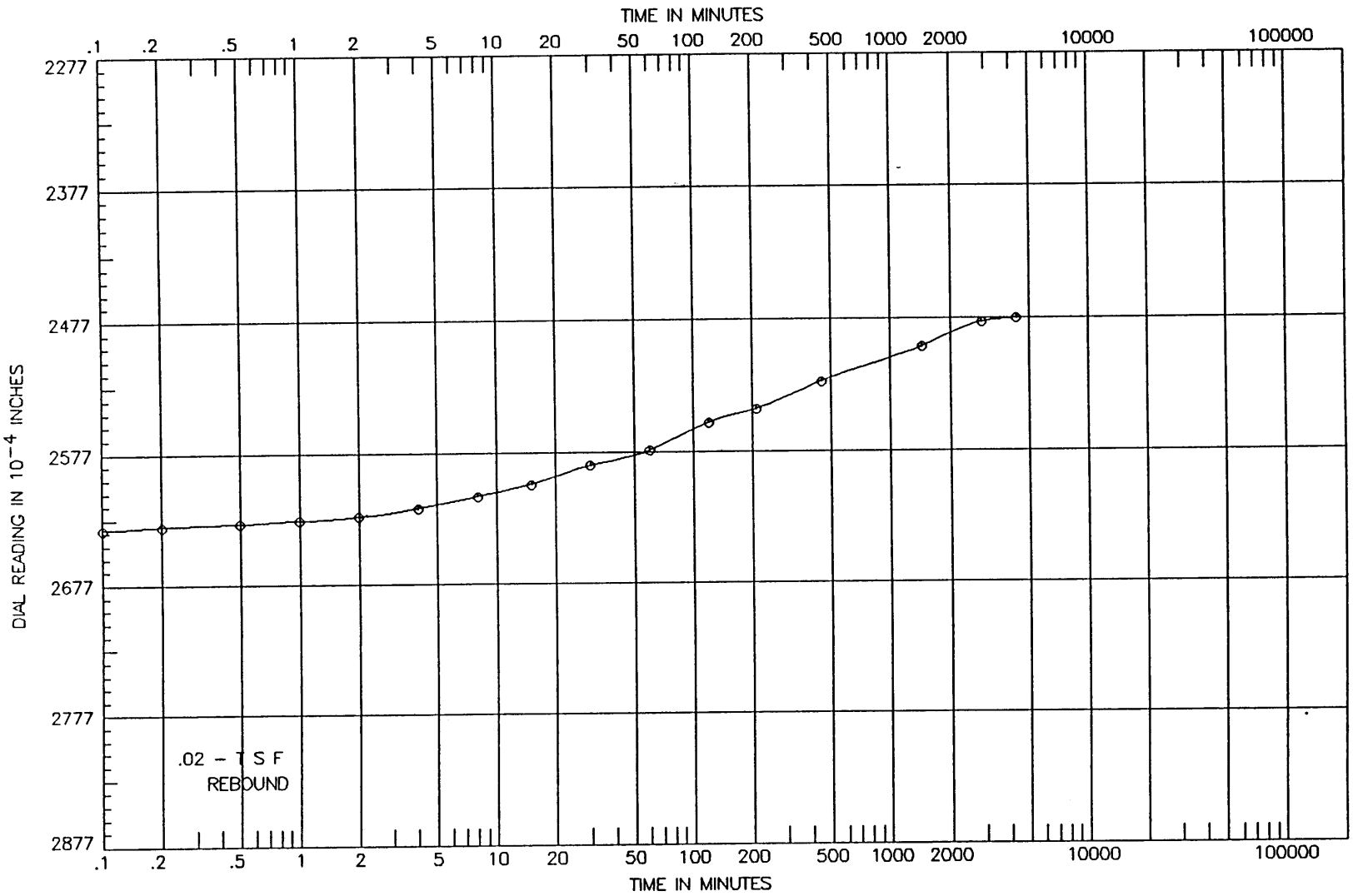


PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	5
DEPTH/ELEV	12.3-13.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

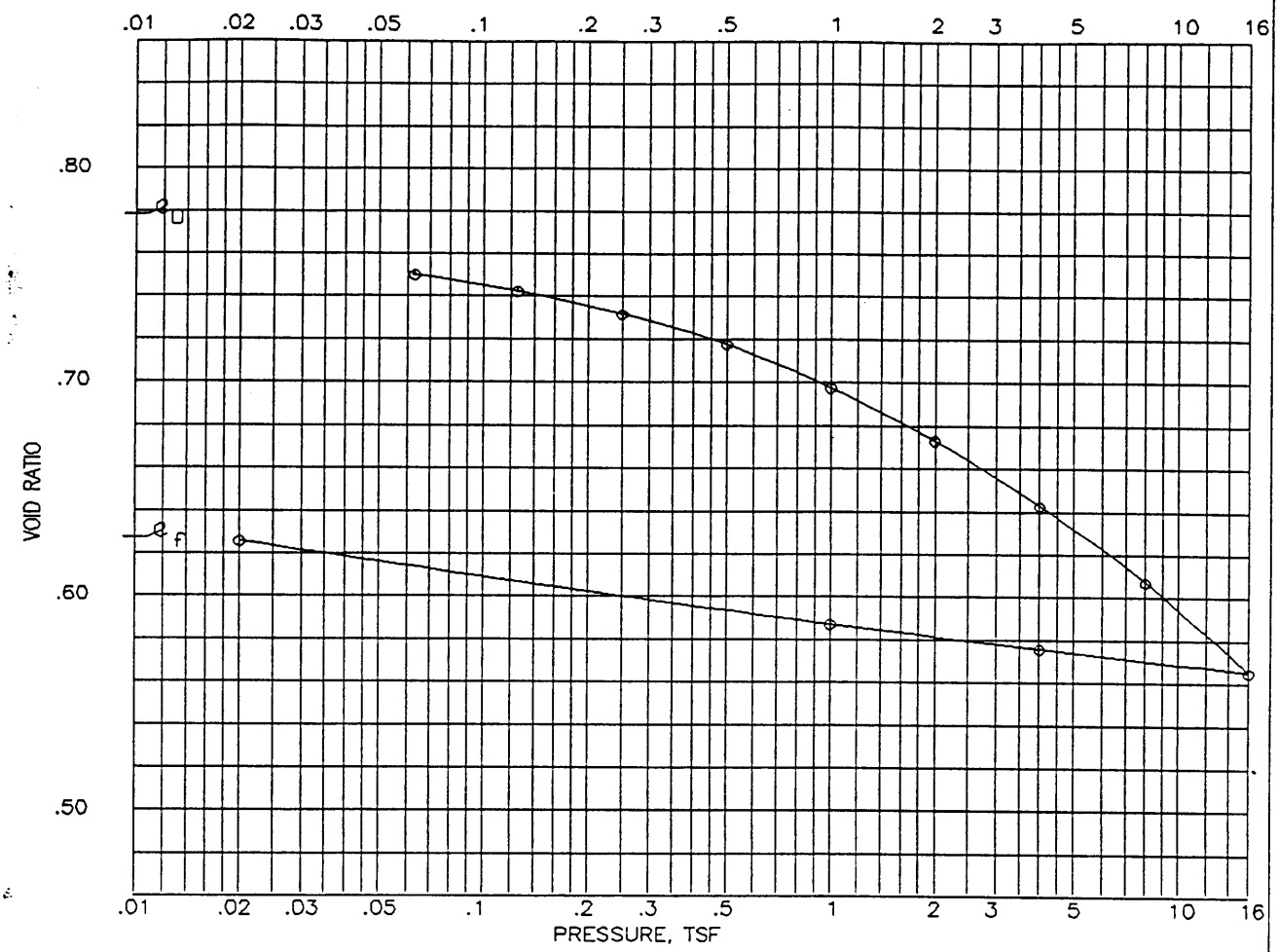
SHEET 10 OF 11



PROJECT	EASTERN ARKANSAS		
BORING	3-EAPS-U-94	SAMPLE NO.	5
DEPTH/ELEV	12.3-13.5	DATE	28 MAR 95

CONSOLIDATION TEST TIME CURVES

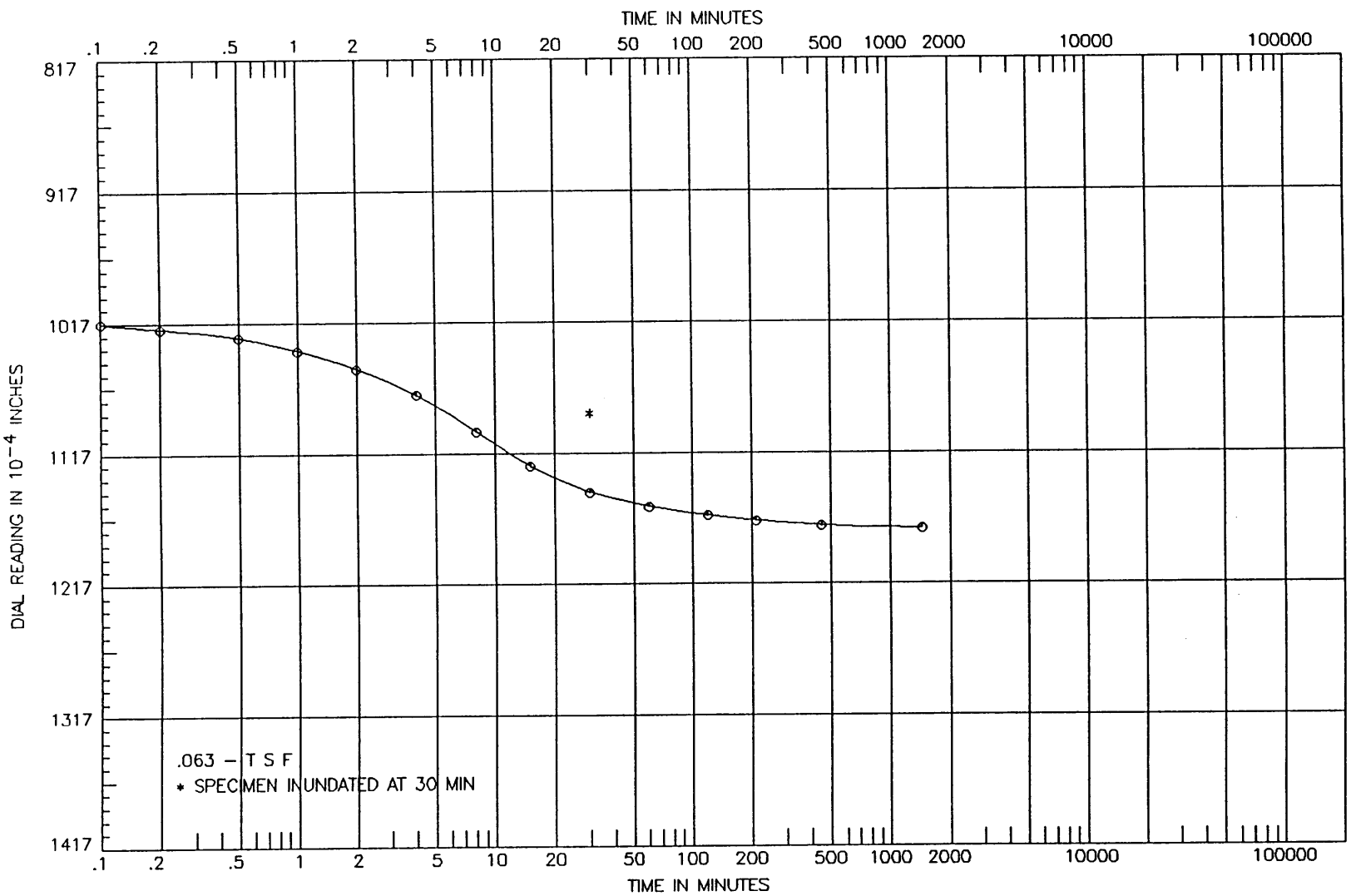
LABORATORY USAE WES - STF/GL



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	28.1	21.1
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	94.5	103.3
COMPRESSION INDEX		SATURATION, %	97.3	90.7
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	.777	.626
DIA. IN 4.44	HT. IN 1.112	BACK PRESSURE, TSF		

CLASSIFICATION	SANDY CLAY (CL), REDDISH BROWN			
LL 30	PL 17	PI 13	PROJECT EASTERN ARKANSAS	
GS 2.69 (EST)	D_{10}			
REMARKS:			BORING NO. 12-EAPST-95	SAMPLE NO. 5
			DEPTH/ELEV 12.0-13.5	TECH. JL
			LABORATORY USAE WES - STF/GL	DATE 20 JUL 95
			CONSOLIDATION TEST REPORT	

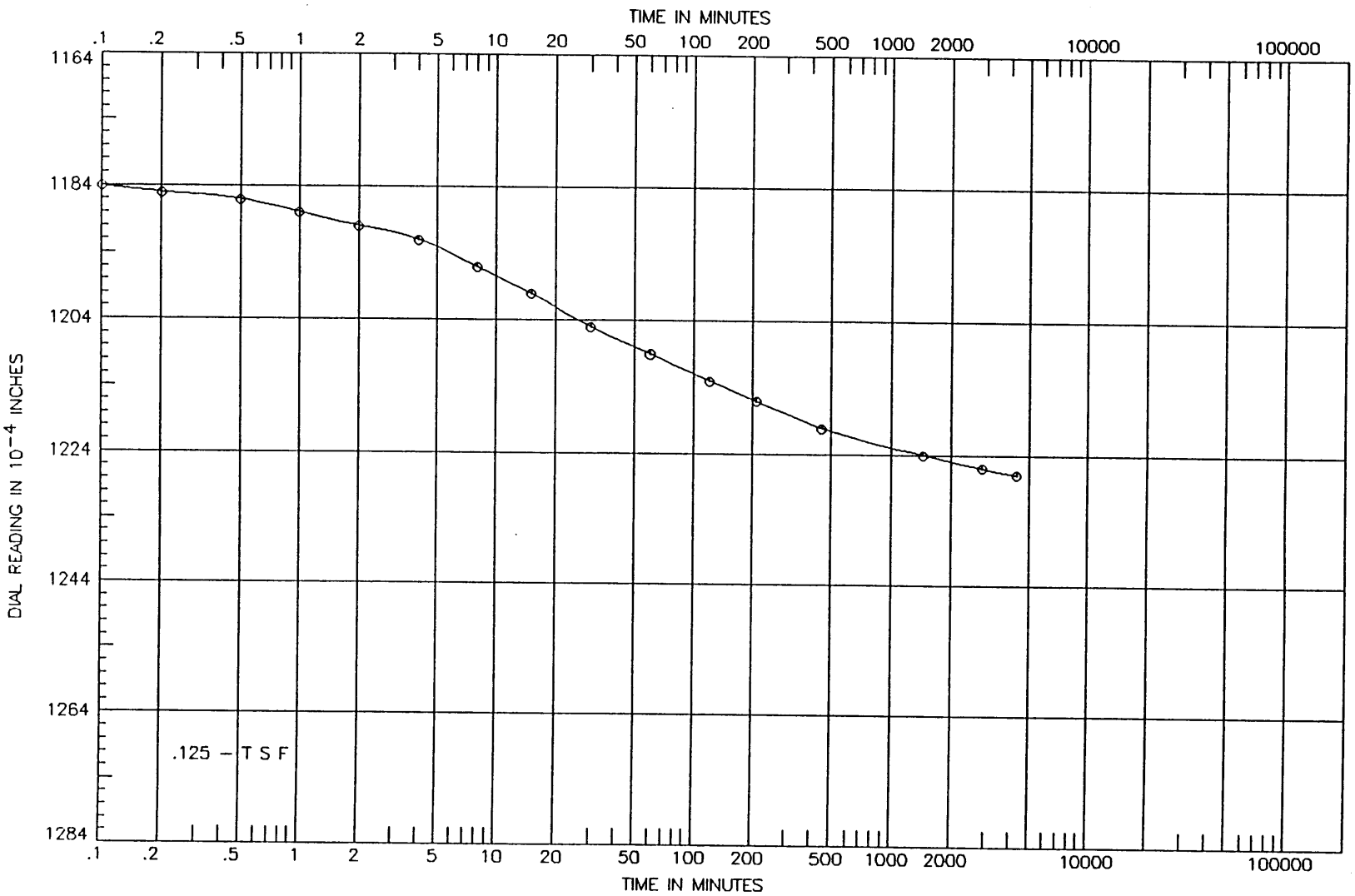
SHEET 1 OF 13



PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	20 JUL 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

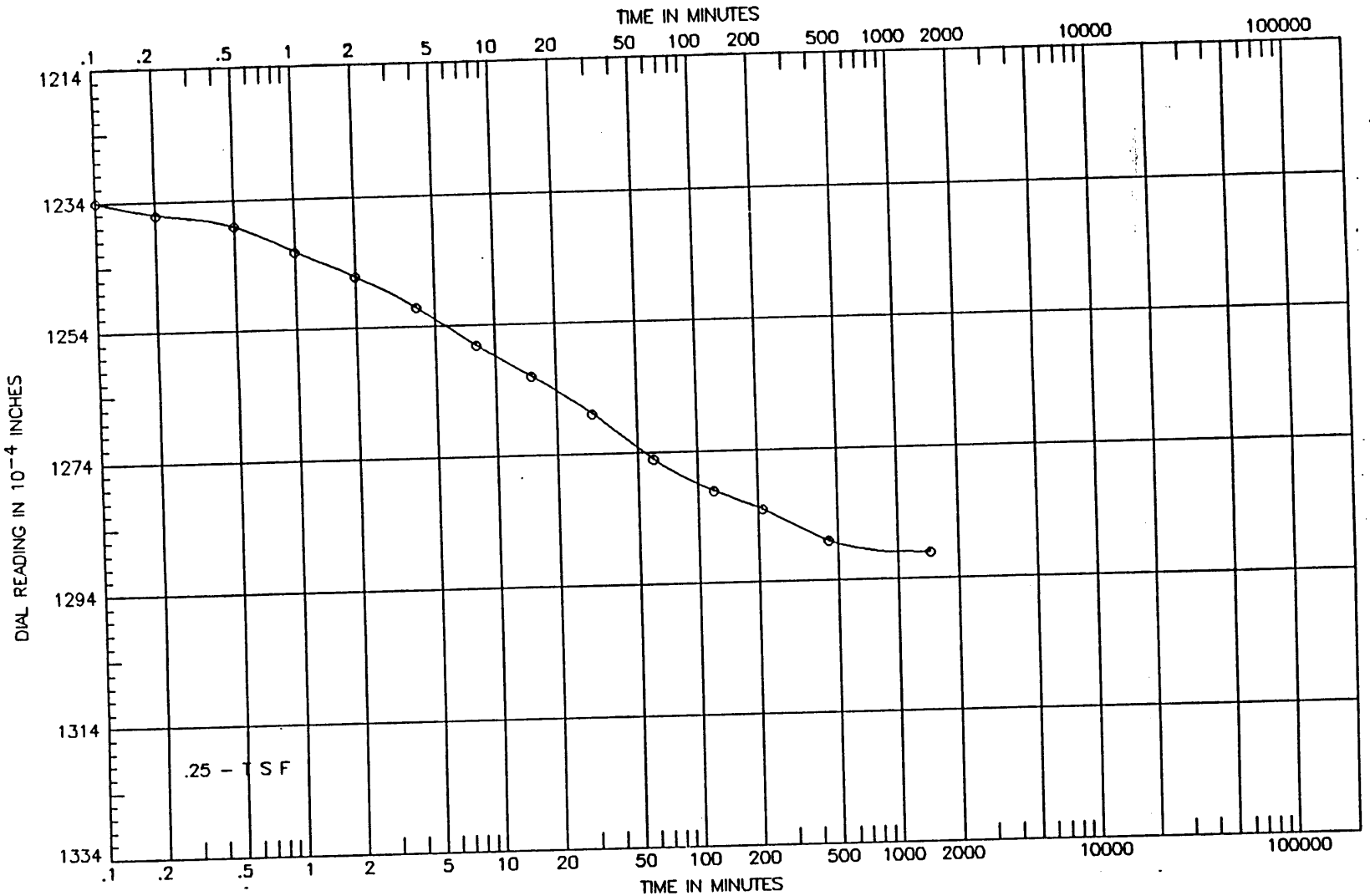


PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	20 JUL 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

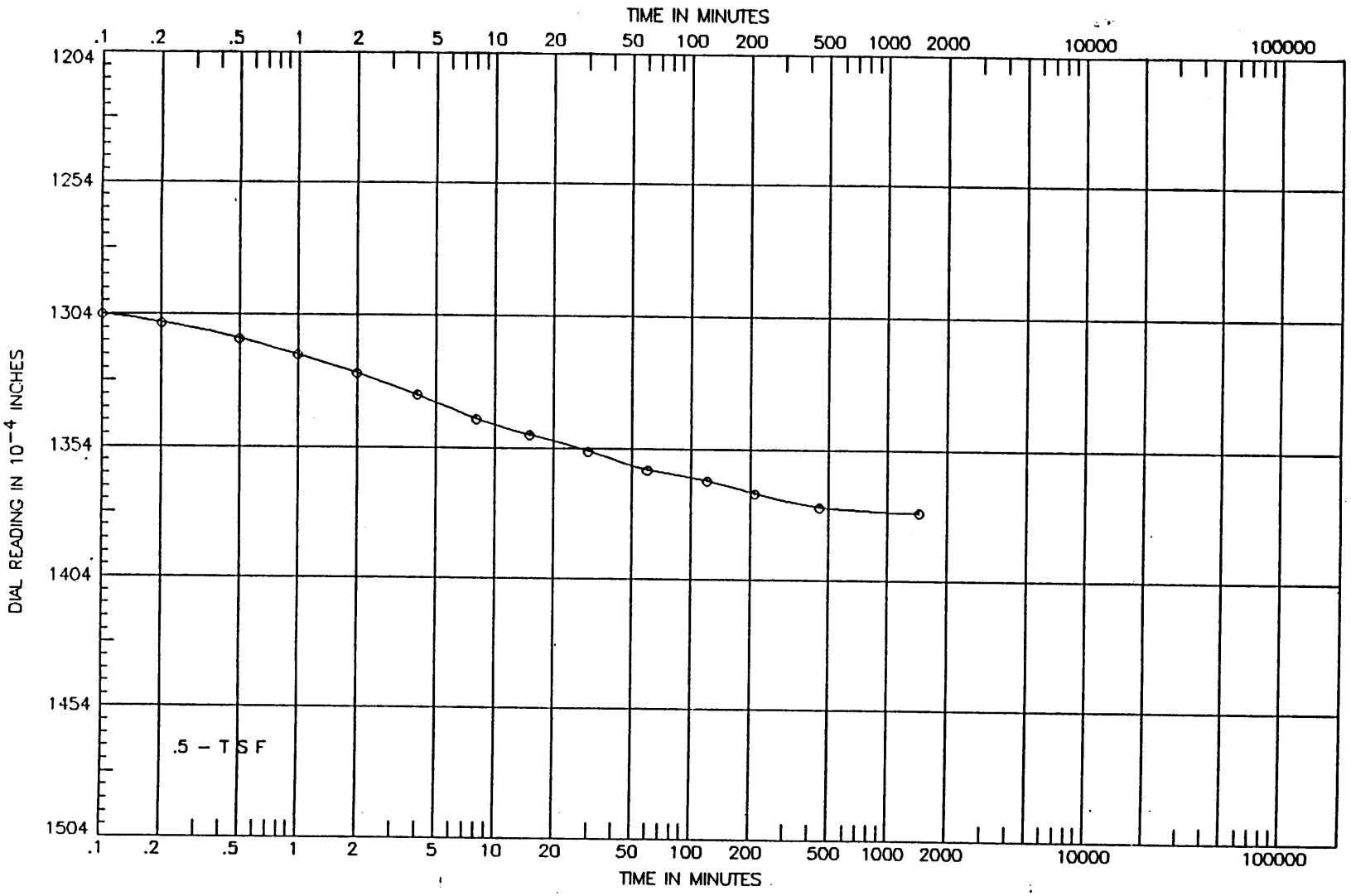
SHEET 3 OF 13



PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	20 JUL 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

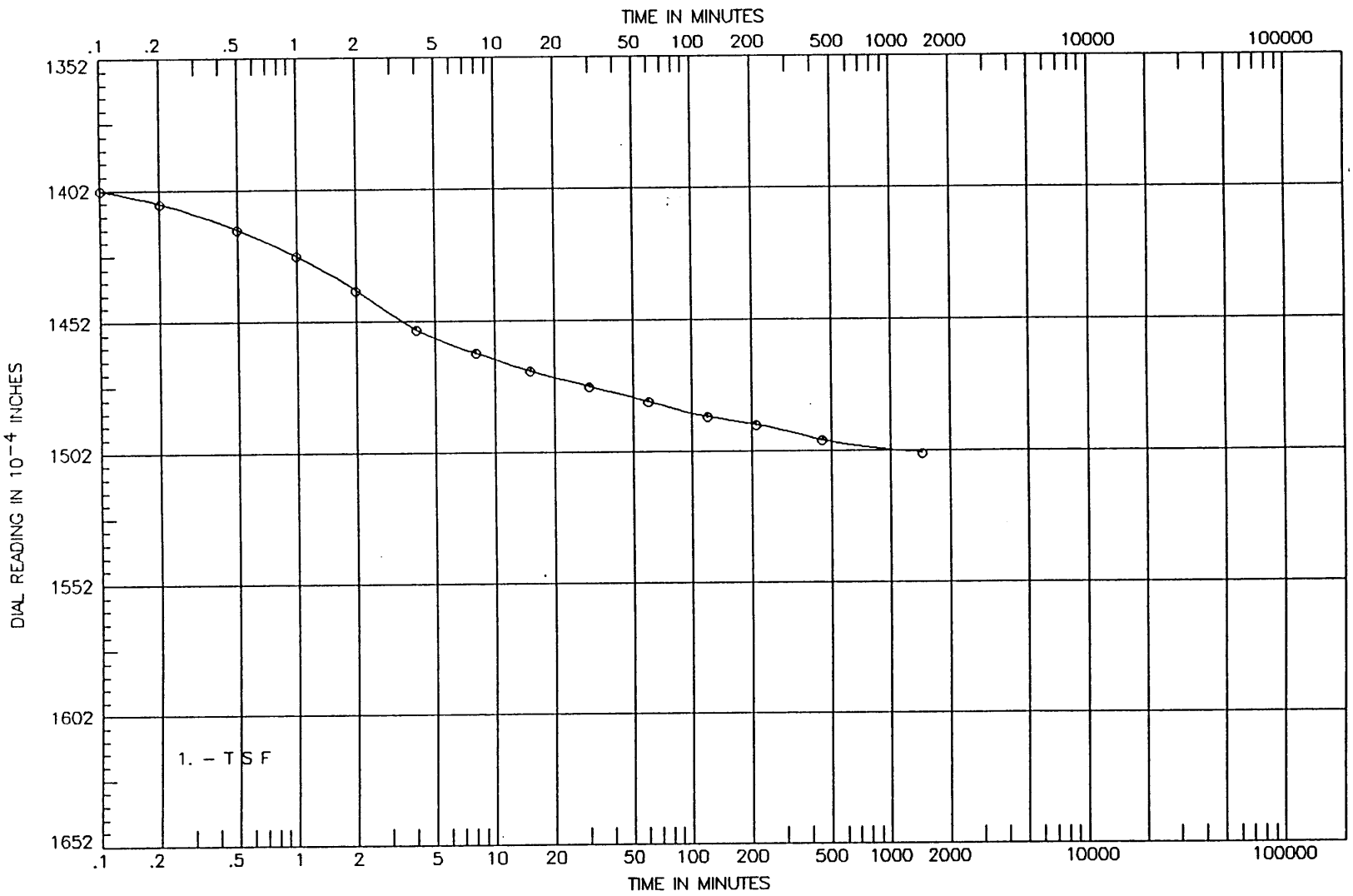


PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	20 JUL 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 5 OF 13

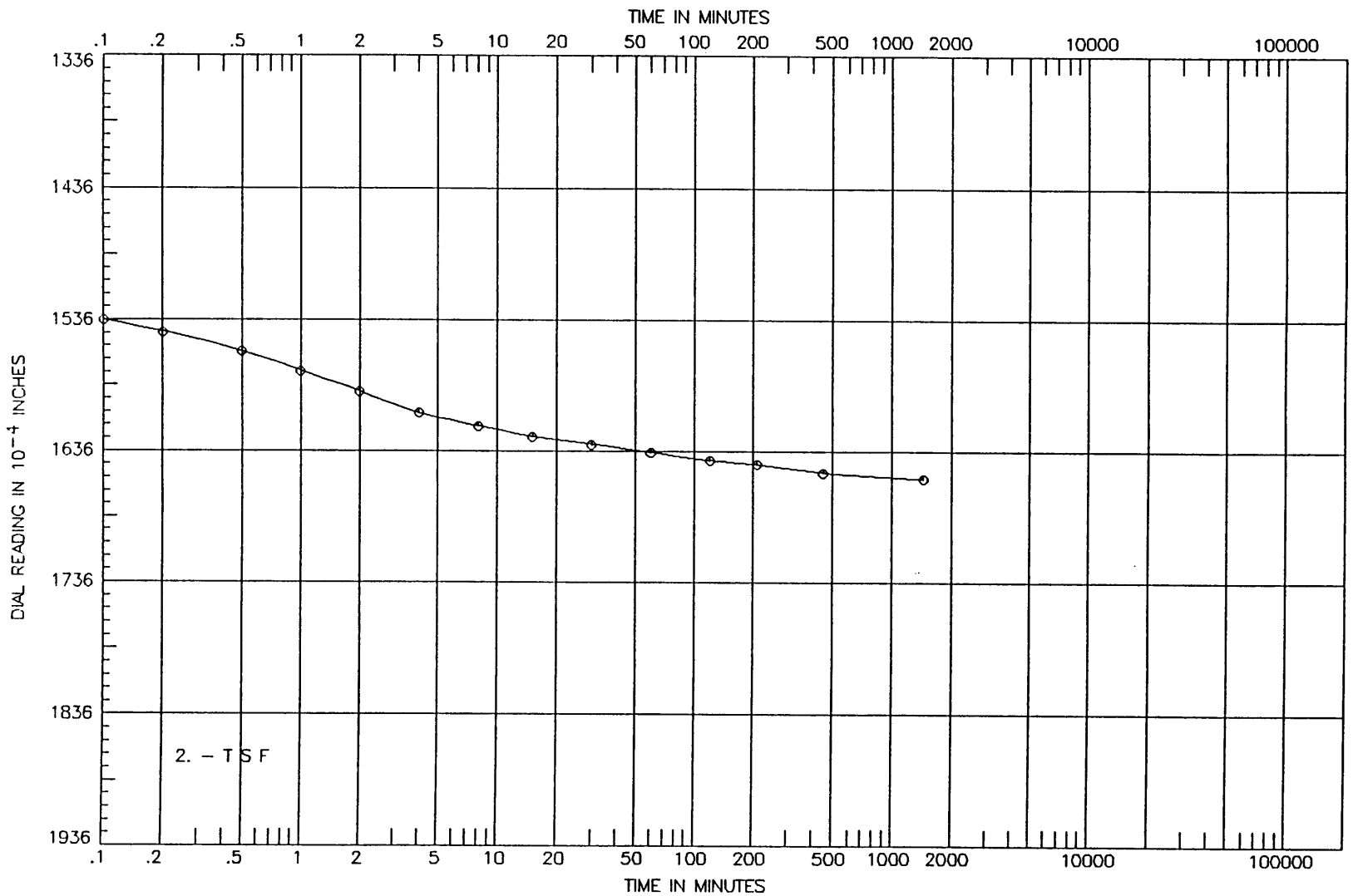


PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	20 JUL 95

CONSOLIDATION TEST TIME CURVES

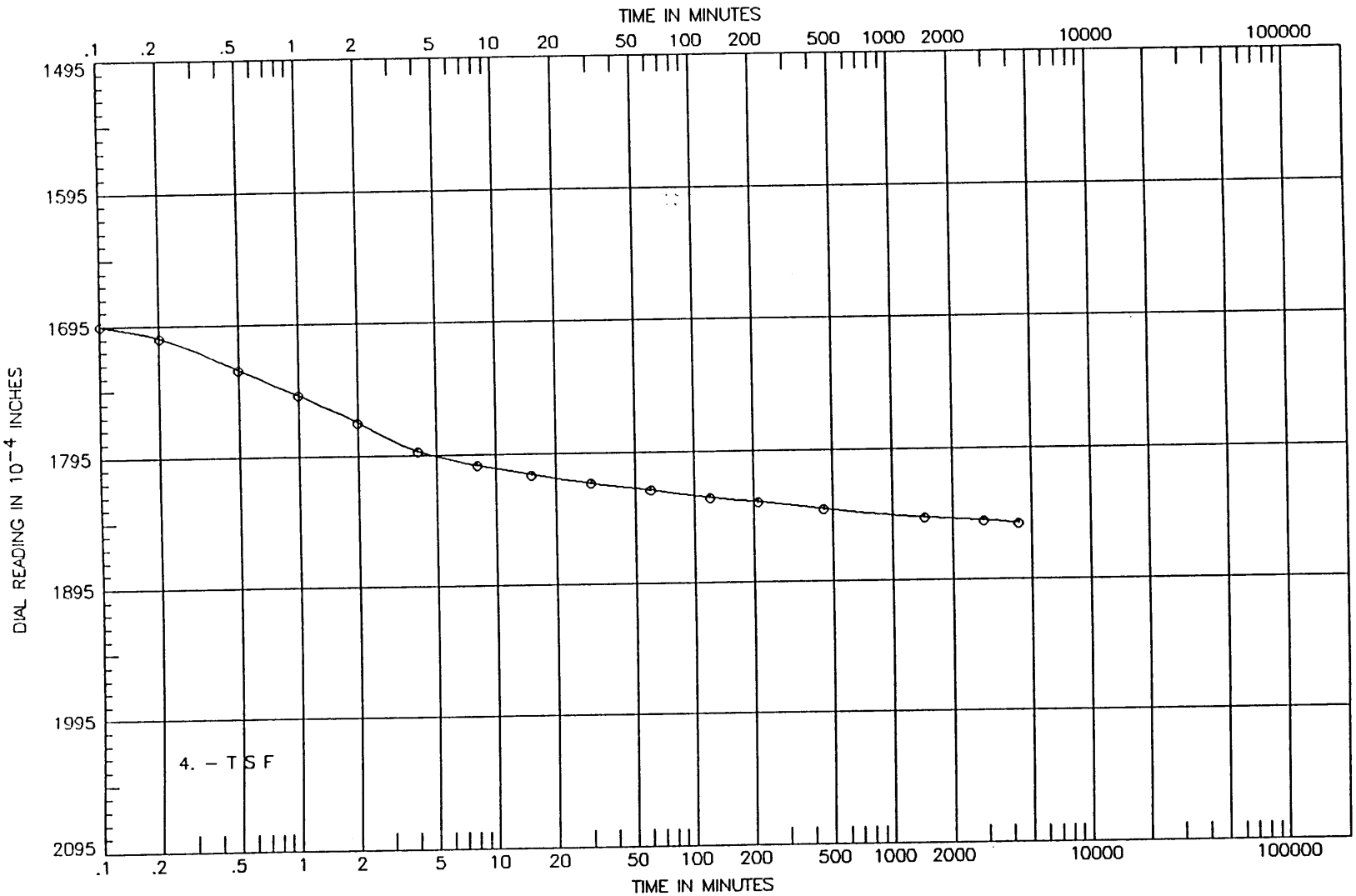
LABORATORY USAE WES - STF/GL

SHEET 6 OF 13



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING	12-EAPST-95	SAMPLE NO. 5	
DEPTH/ELEV	12.0-13.5	DATE 20 JUL 95	

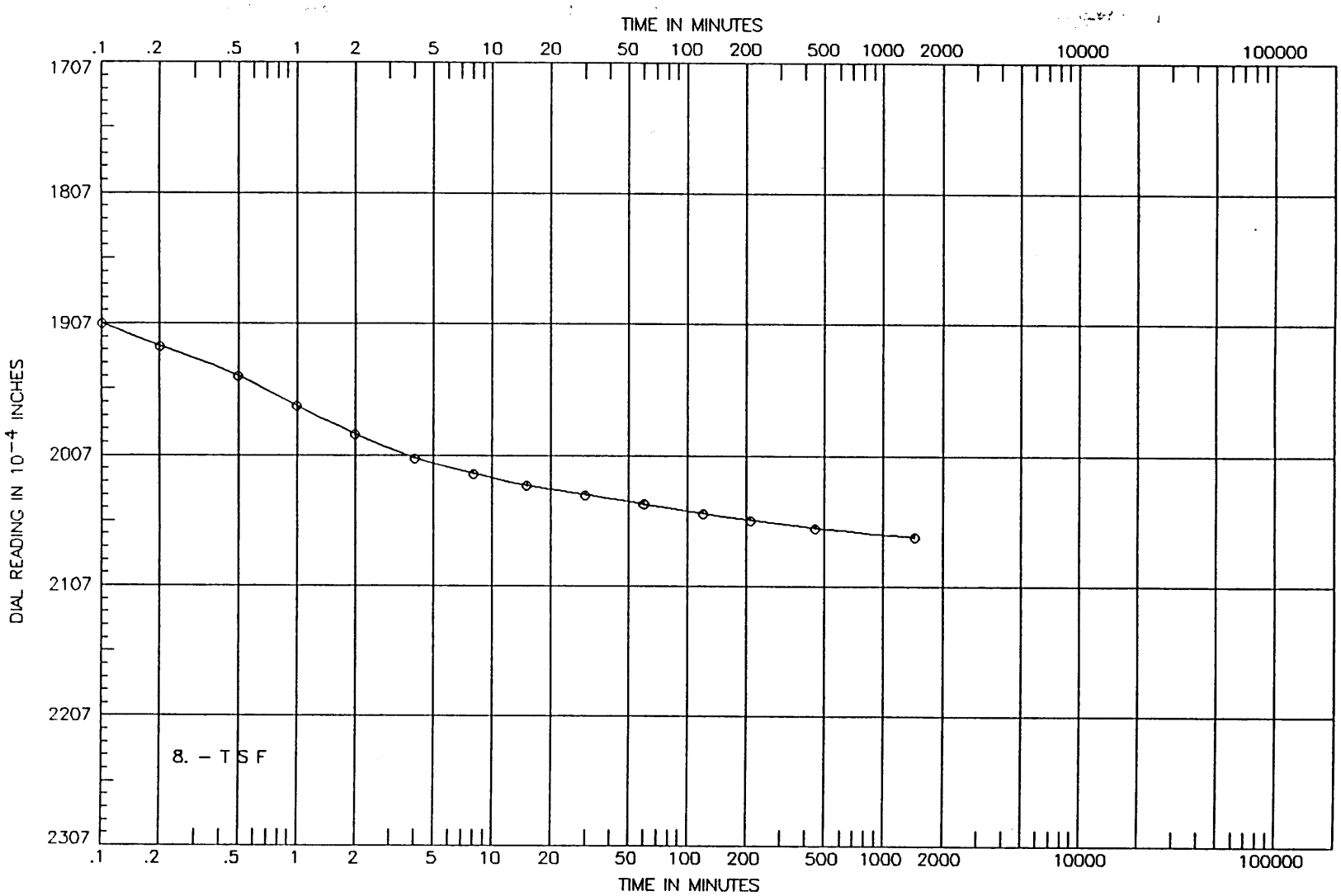
SHEET 7 OF 13



PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	20 JUL 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

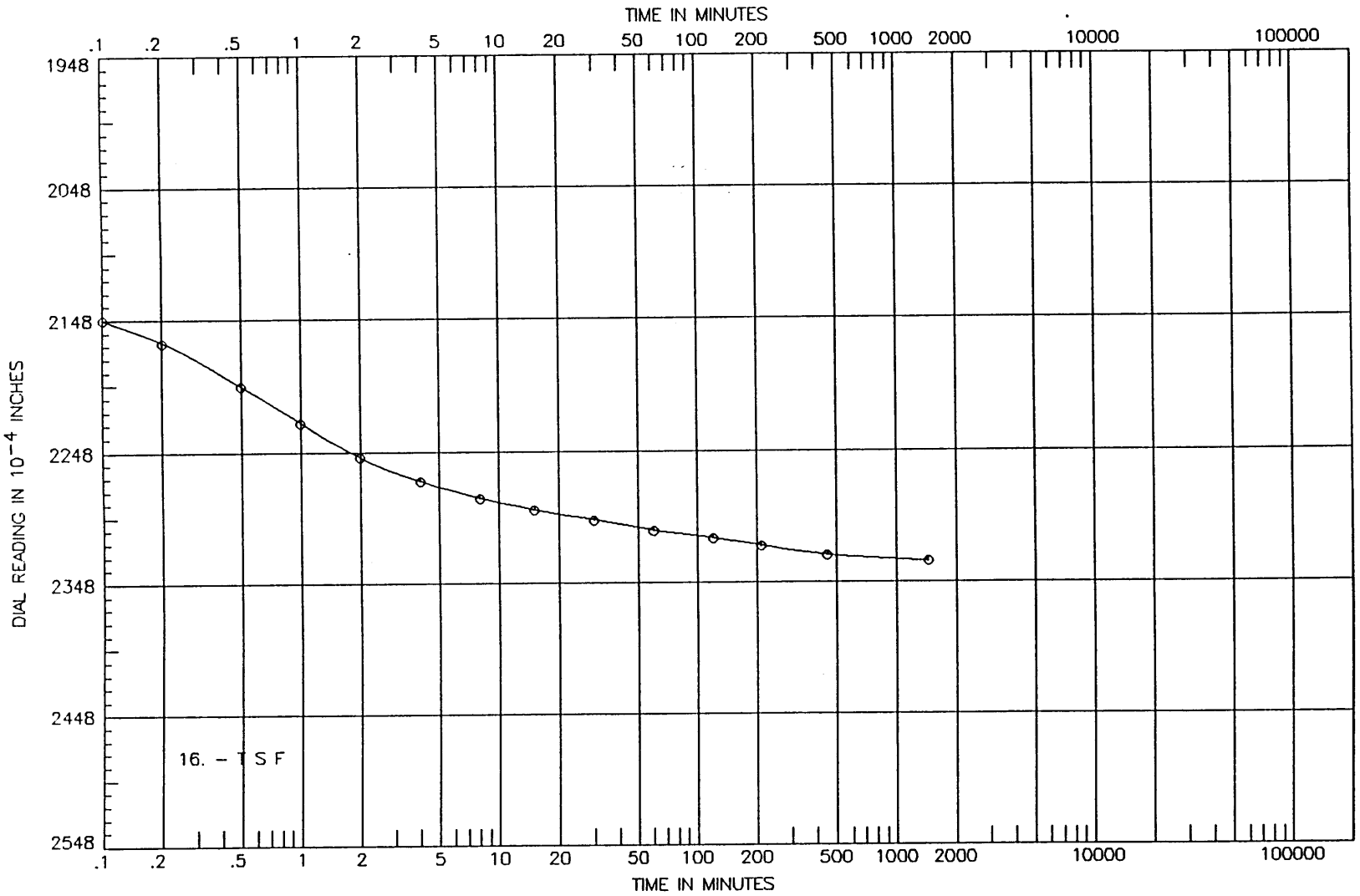


PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	20 JUL 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 9 OF 13

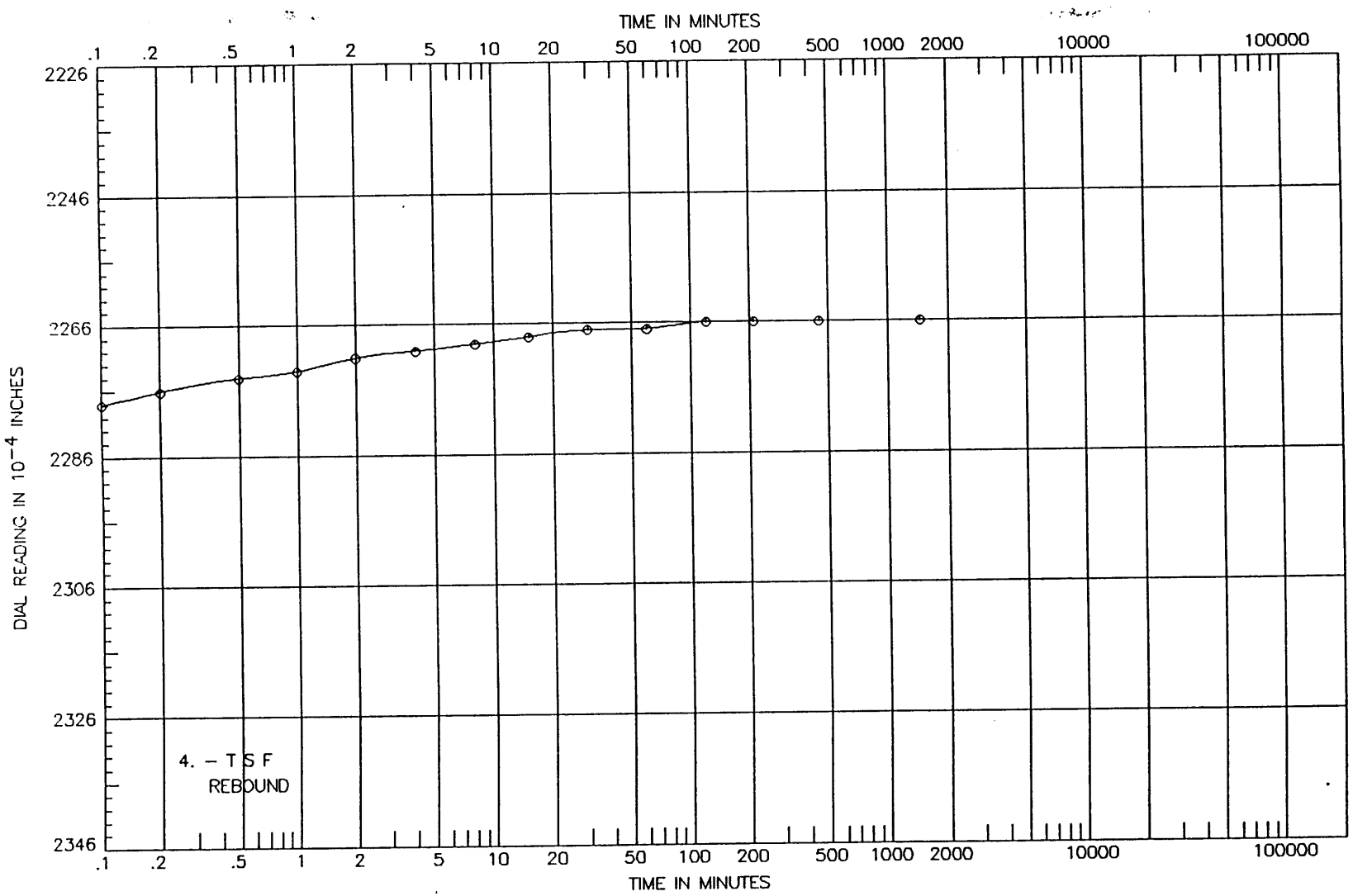


PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	20 JUL 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 10 OF 13

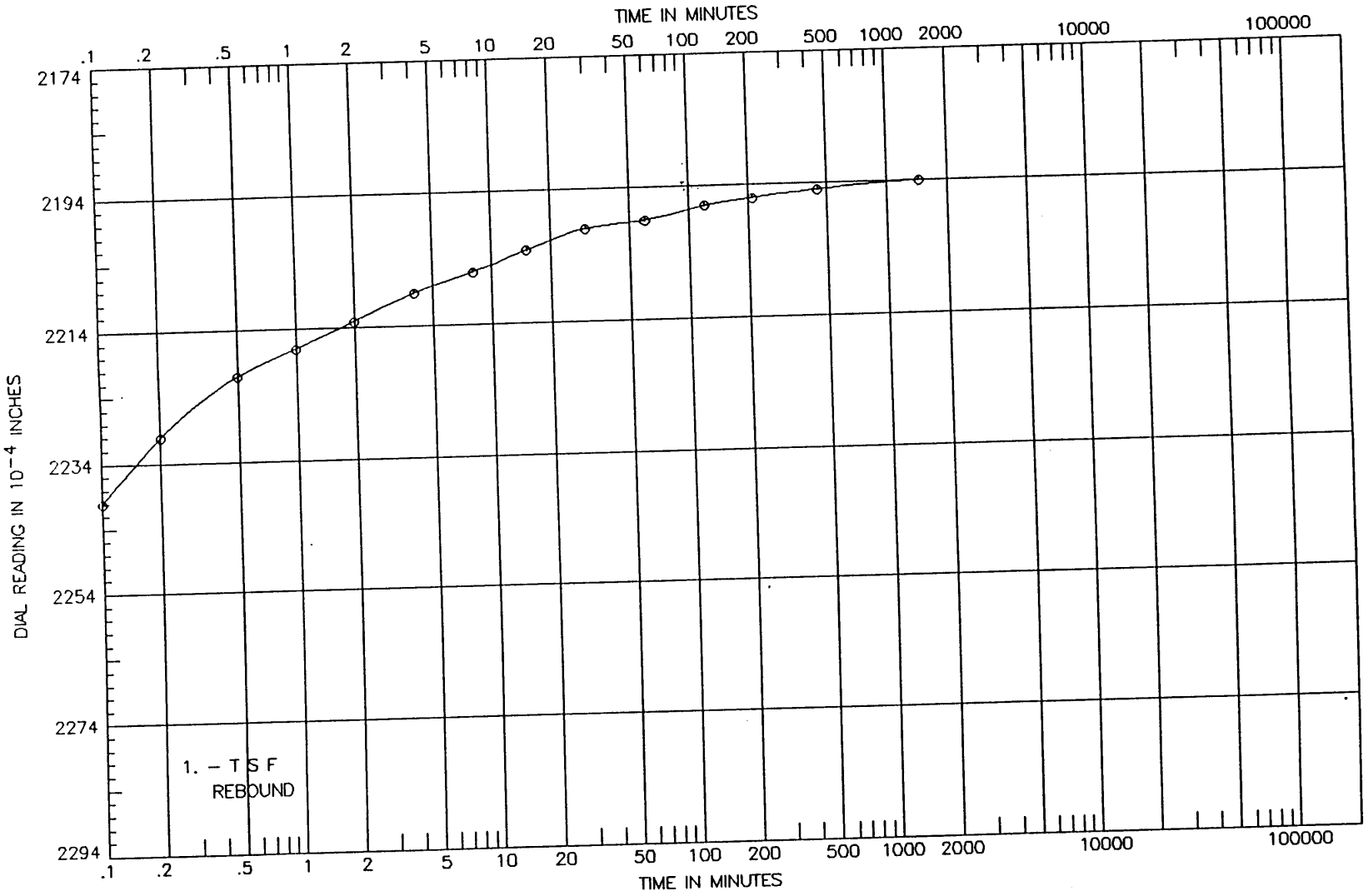


PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	20 JUL 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

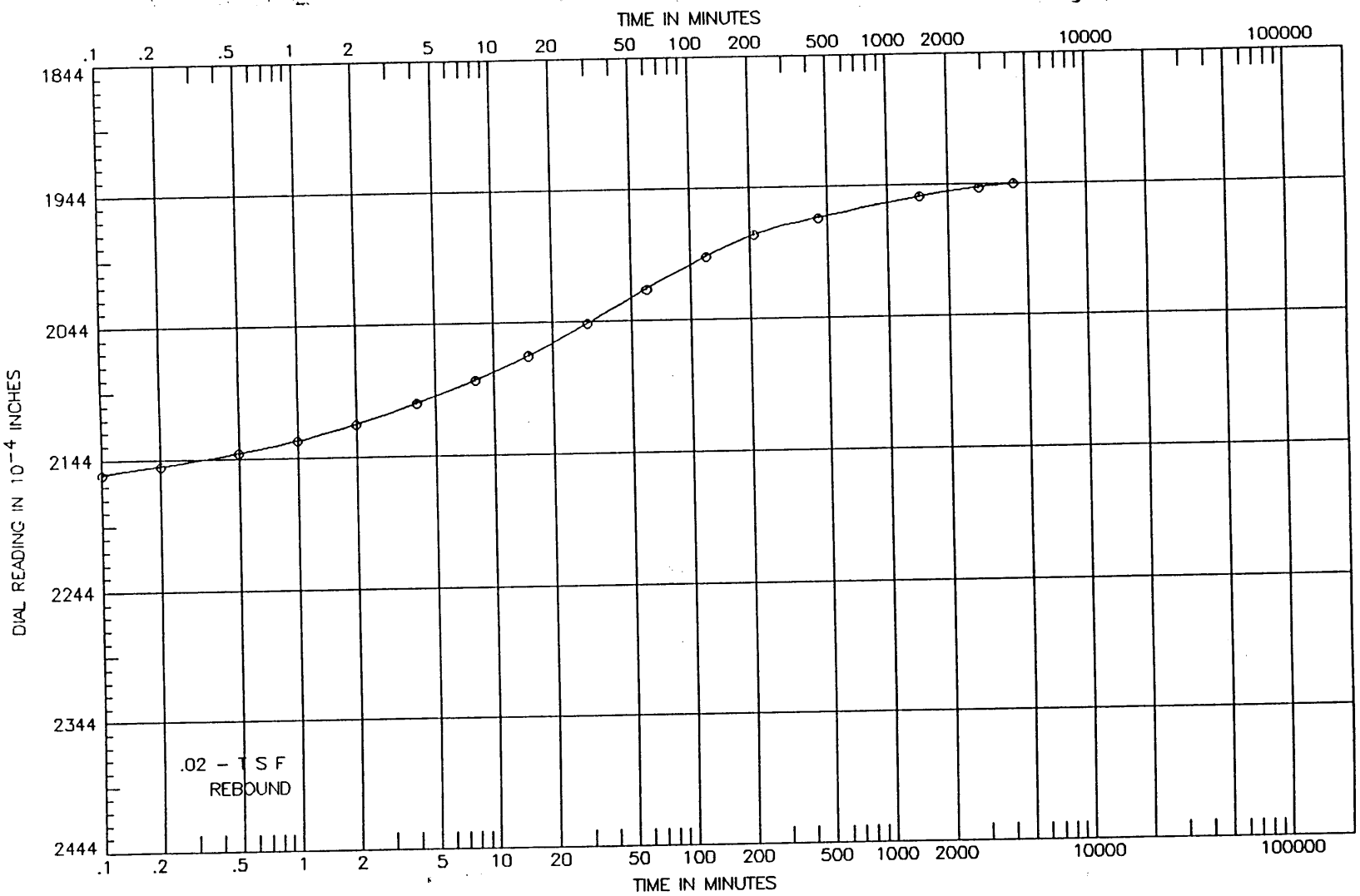
SHEET 11 OF 13



PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	20 JUL 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

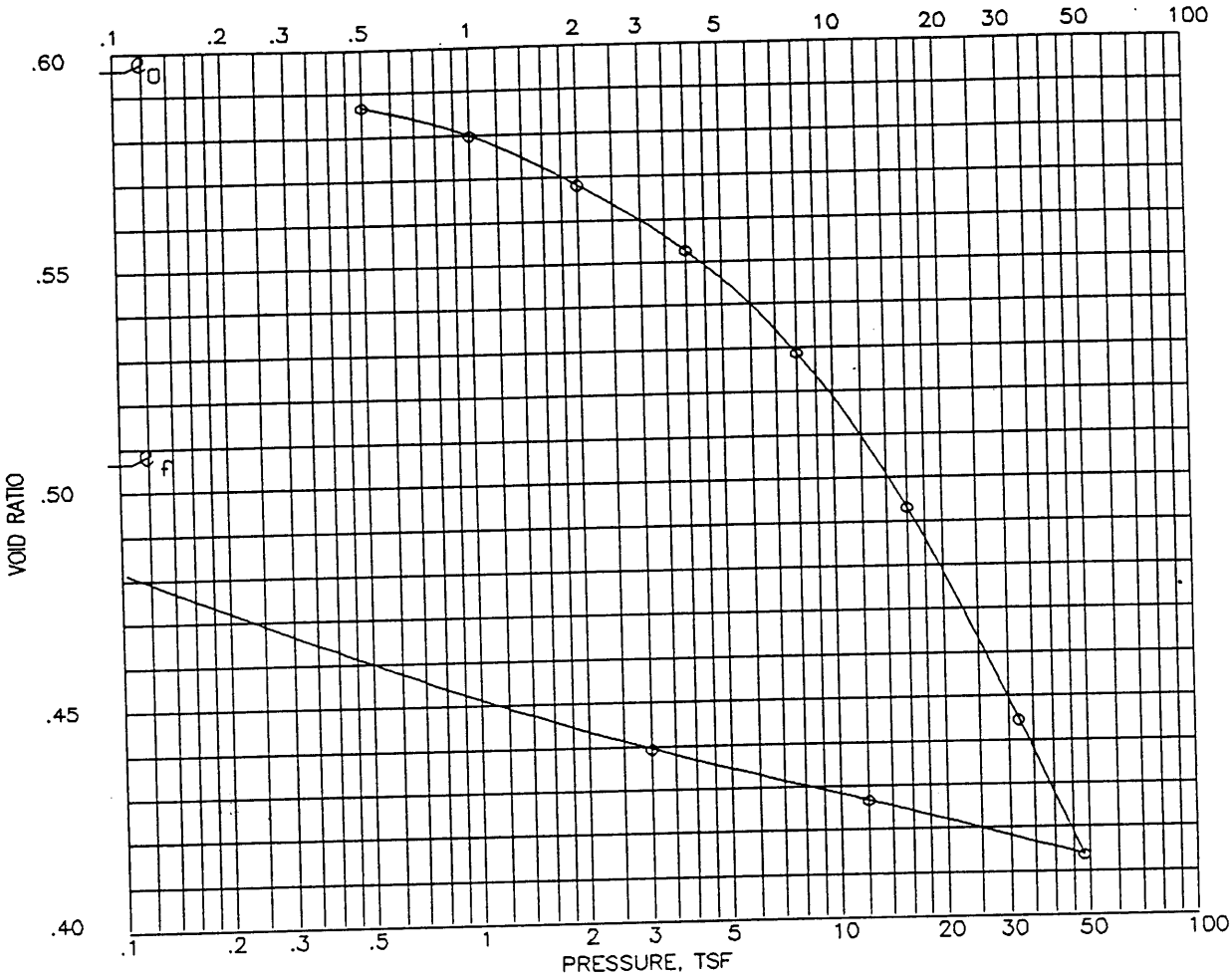


PROJECT EASTERN ARKANSAS	
BORING 12-EAPST-95	SAMPLE NO. 5
DEPTH/ELEV 12.0-13.5	DATE 20 JUL 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

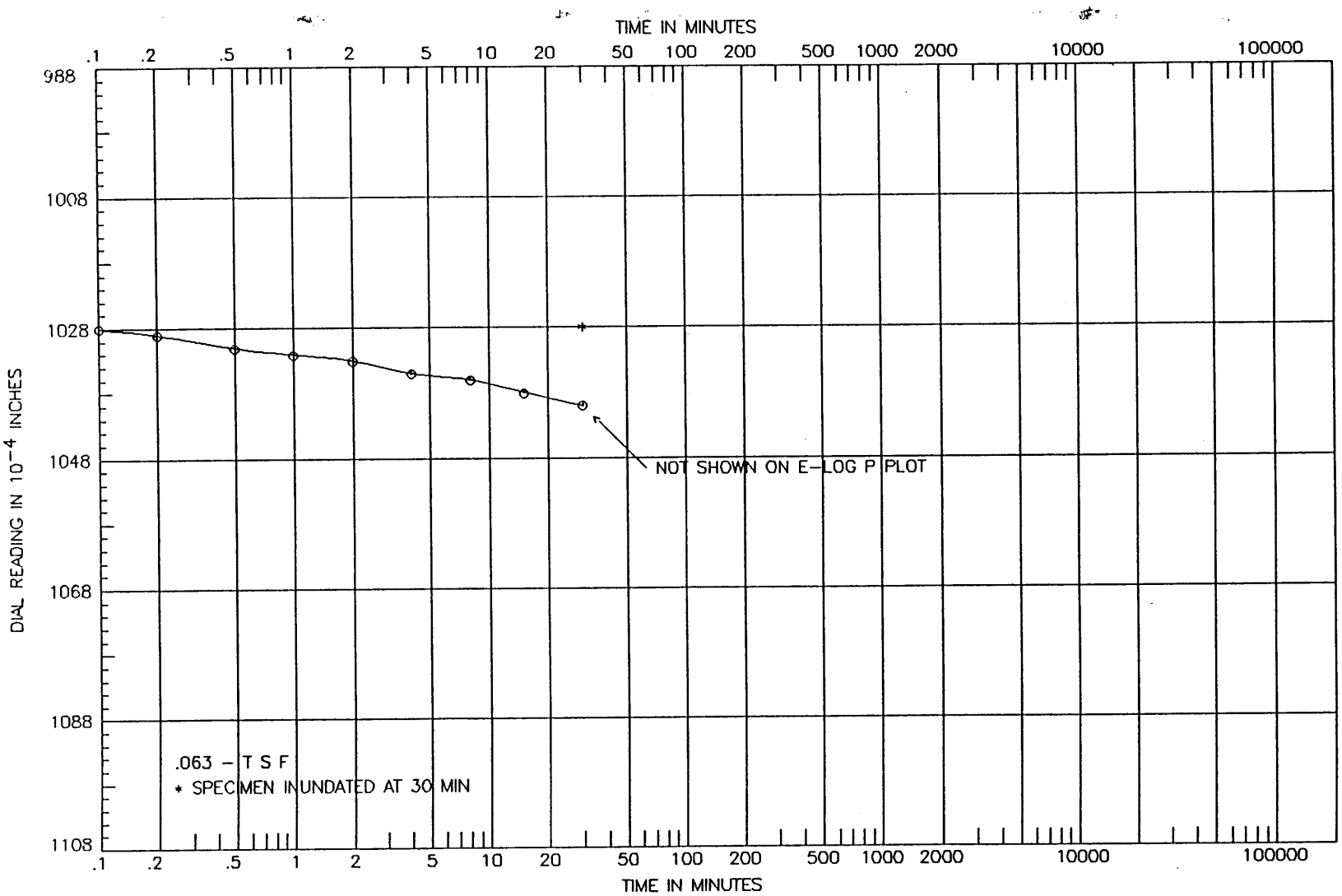
SHEET 13 OF 13



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	13.3	17.1
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	105.2	111.5
COMPRESSION INDEX		SATURATION, %	59.9	91.0
TYPE SPECIMEN	COMPACTED	VOID RATIO	.596	.506
DIA. IN 4.44	HT. IN 1.133	BACK PRESSURE, TSF		

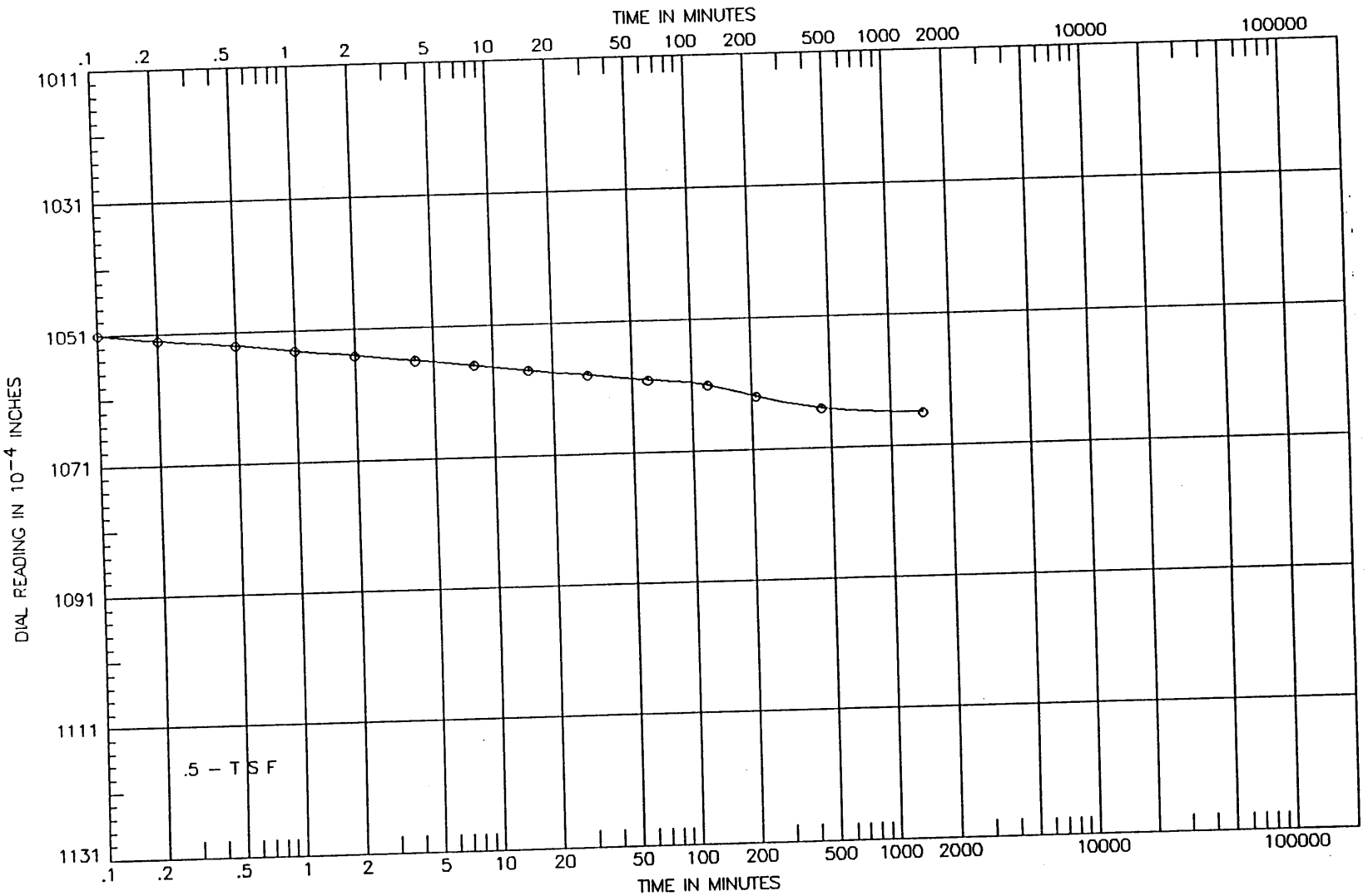
CLASSIFICATION	SANDY CLAY (CL), REDDISH BROWN			
LL 30	PL 17	PI 13	PROJECT EASTERN ARKANSAS	
GS 2.69 (EST)	D_{10}			
REMARKS:			BORING NO. 12-EAPST-95	SAMPLE NO. 5
SPECIMEN COMPACTED			DEPTH/ELEV 12.0-13.5	TECH. JL
AT 15 BLOW EFFORT			LABORATORY USAE WES - STF/GL	DATE 11 SEP 95
			CONSOLIDATION TEST REPORT	

SHEET 1 OF 13



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING	12-EAPST-95	SAMPLE NO. 5	
DEPTH/ELEV	12.0-13.5	DATE 11 SEP 95	

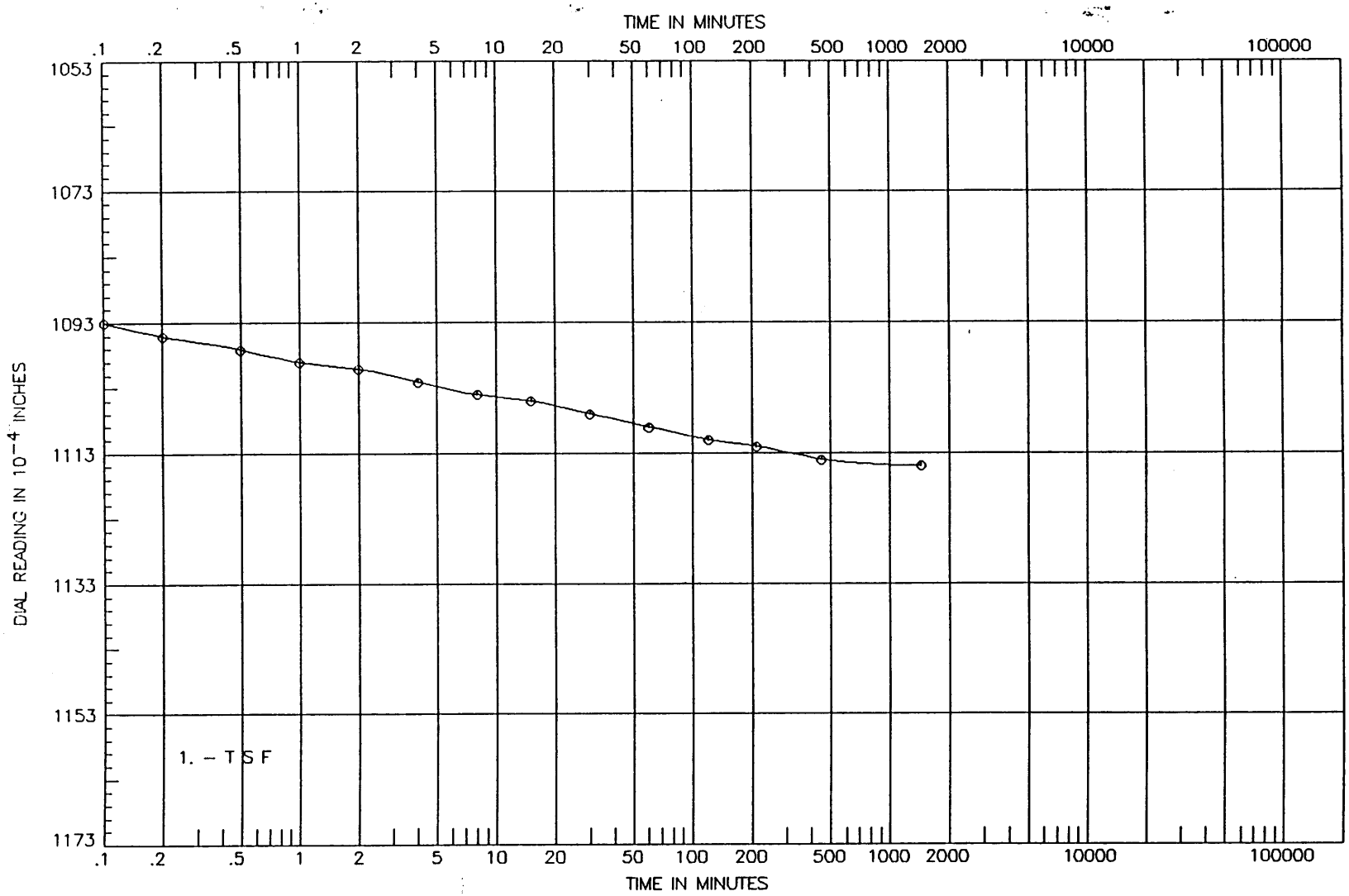
SHEET 2 OF 13



PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	11 SEP 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

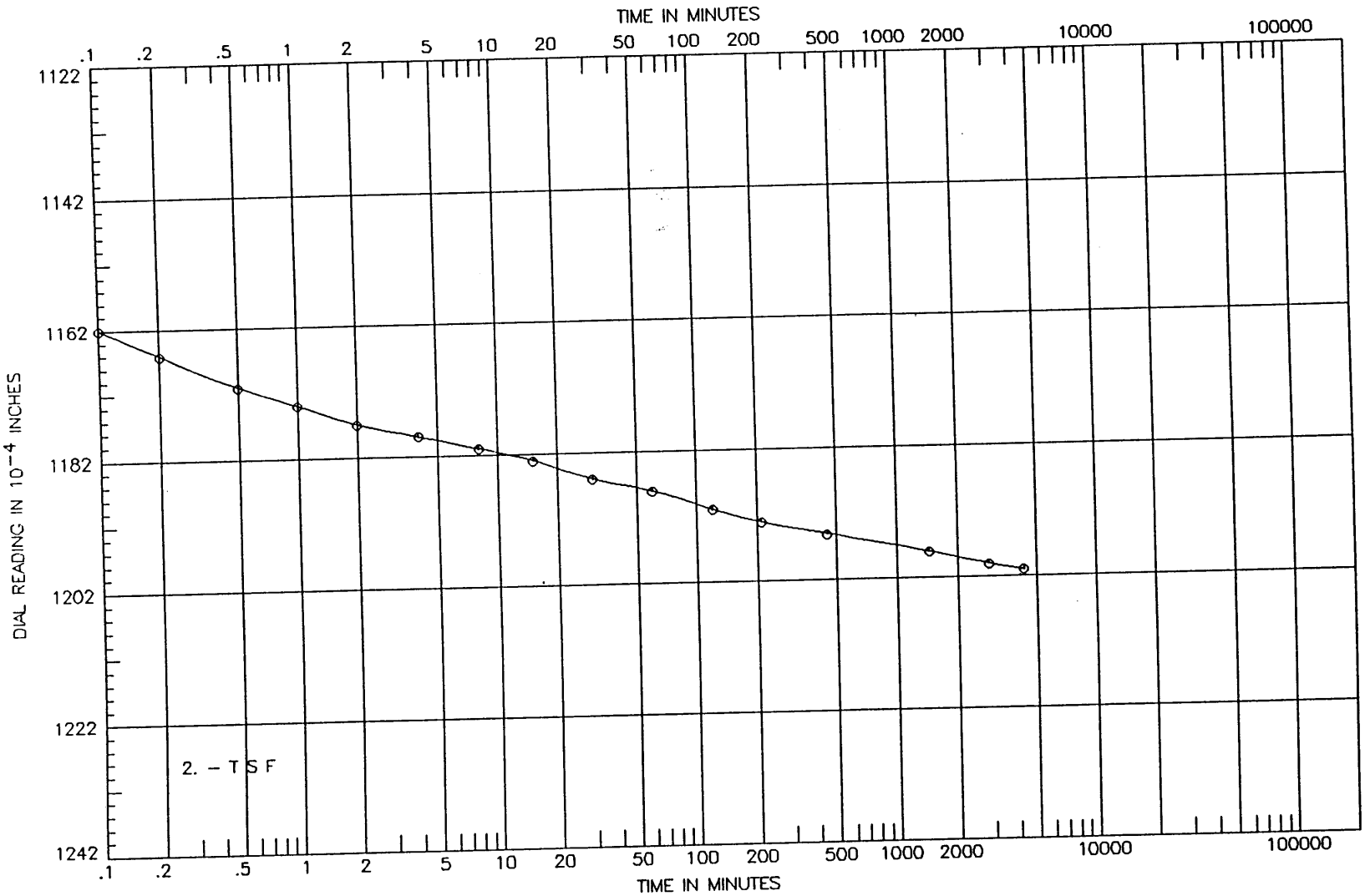


PROJECT EASTERN ARKANSAS	
BORING 12-EAPST-95	SAMPLE NO. 5
DEPTH/ELEV 12.0-13.5	DATE 11 SEP 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 4 OF 13

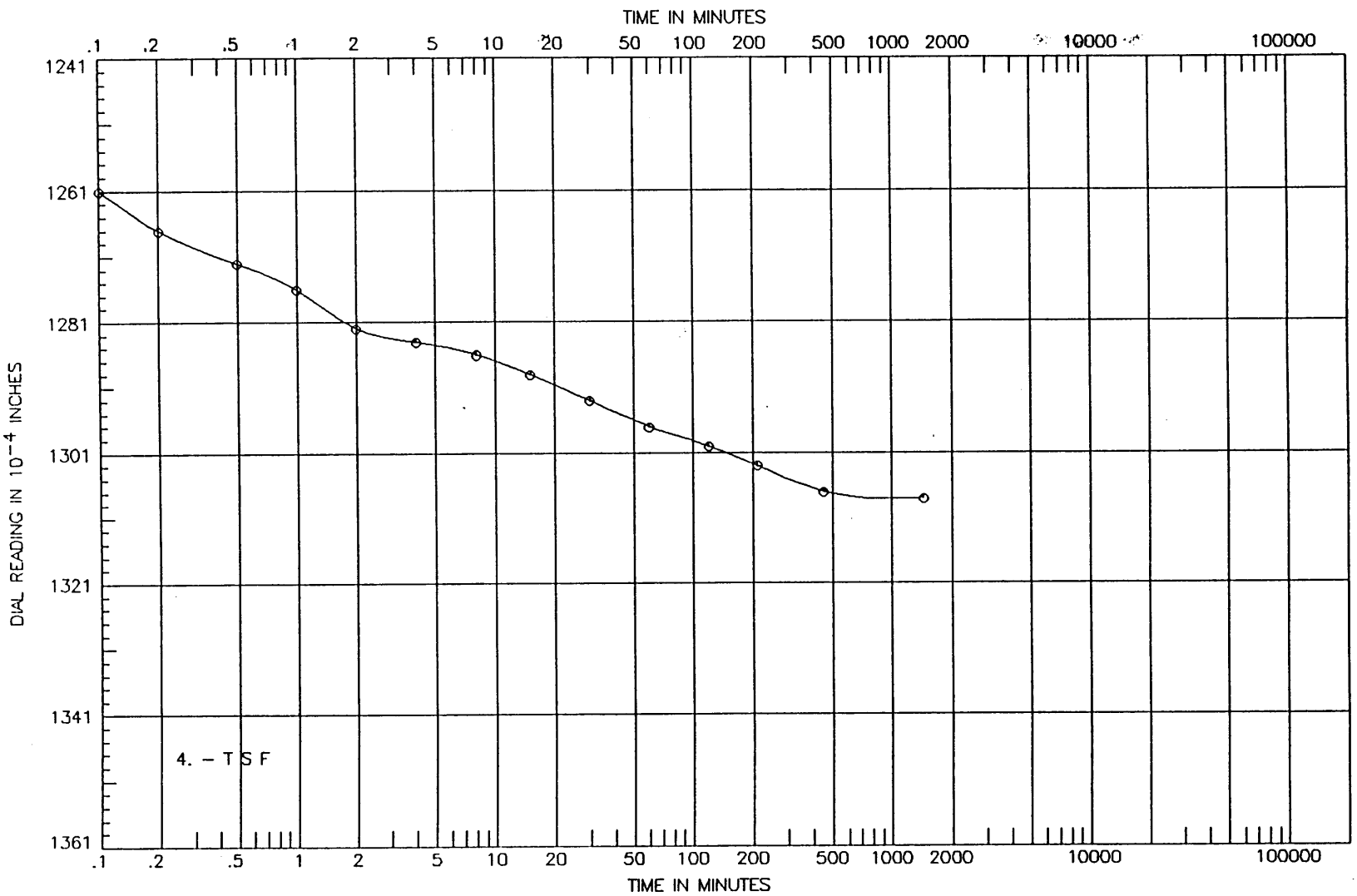


PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	11 SEP 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 5 OF 13

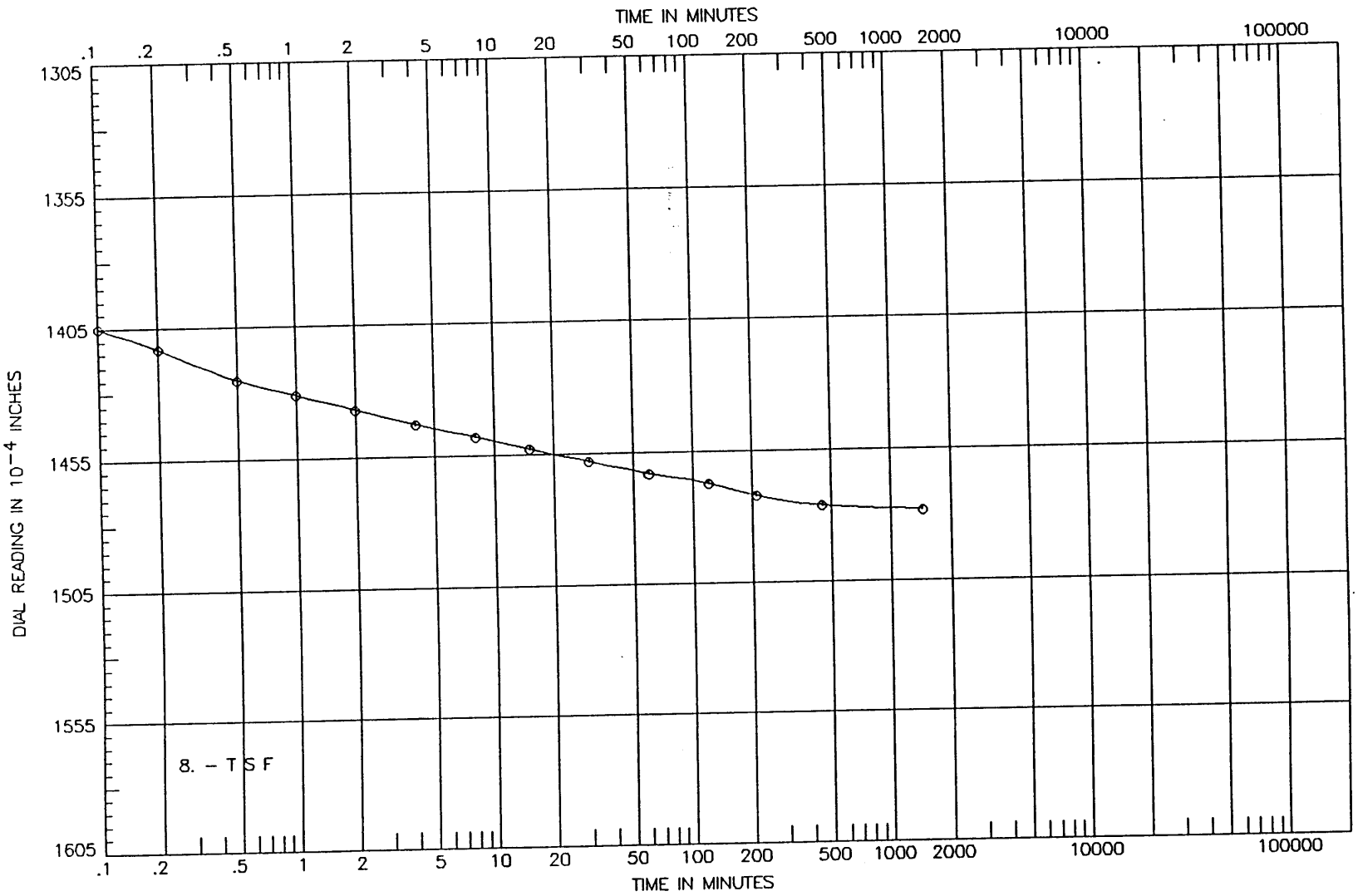


PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	11 SEP 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 6 OF 13

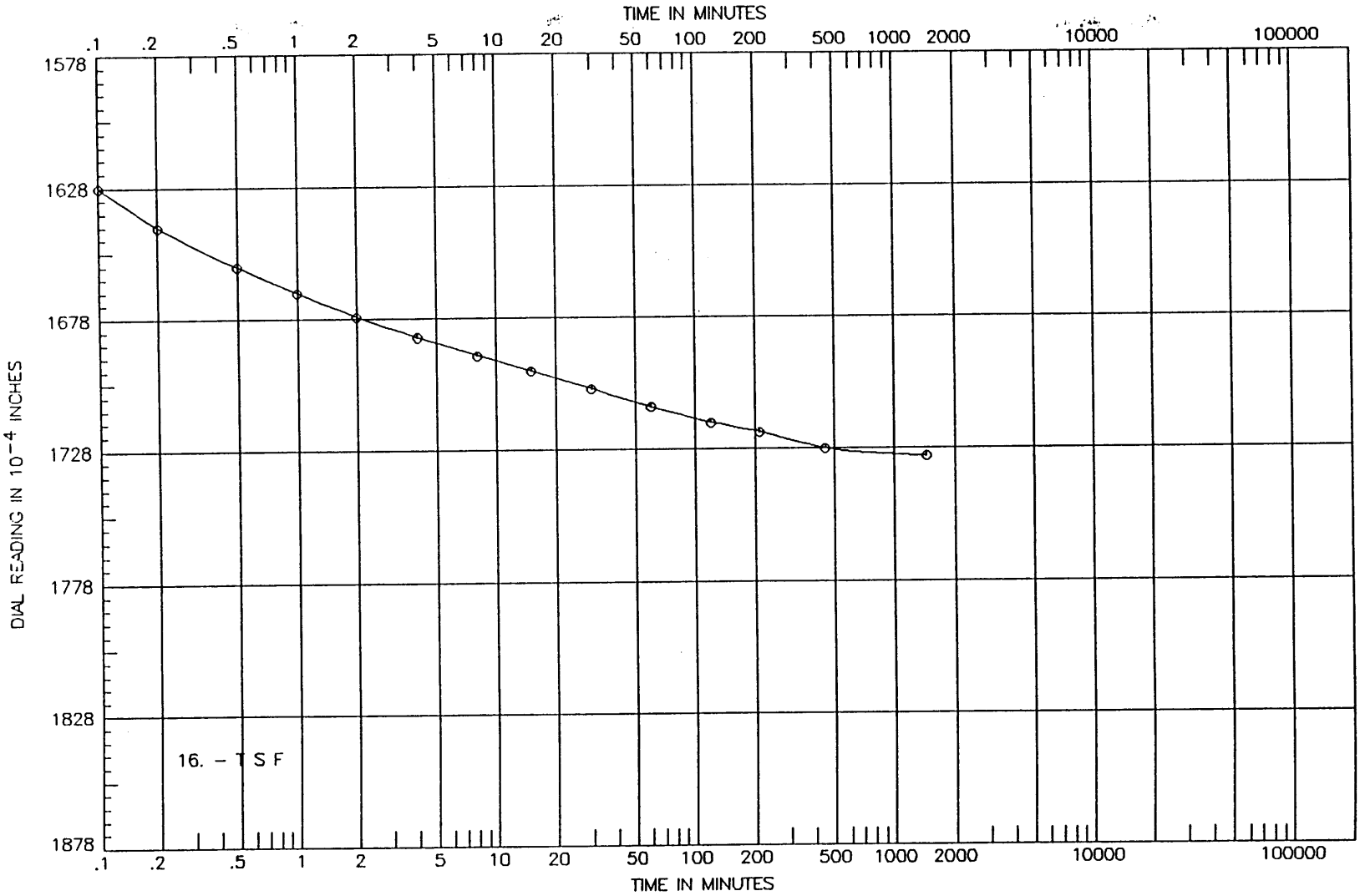


PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	11 SEP 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 7 OF 13

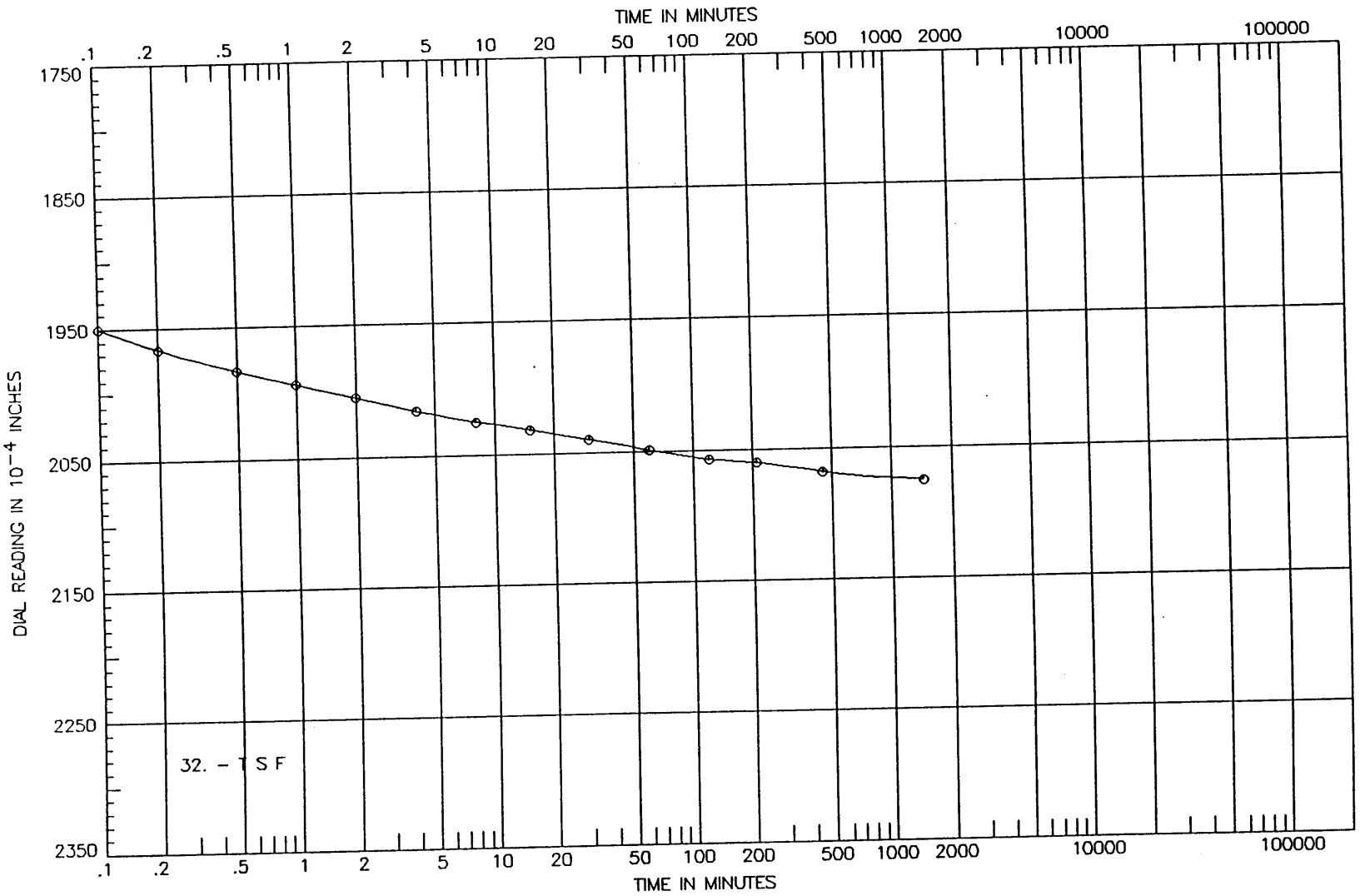


PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	11 SEP 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

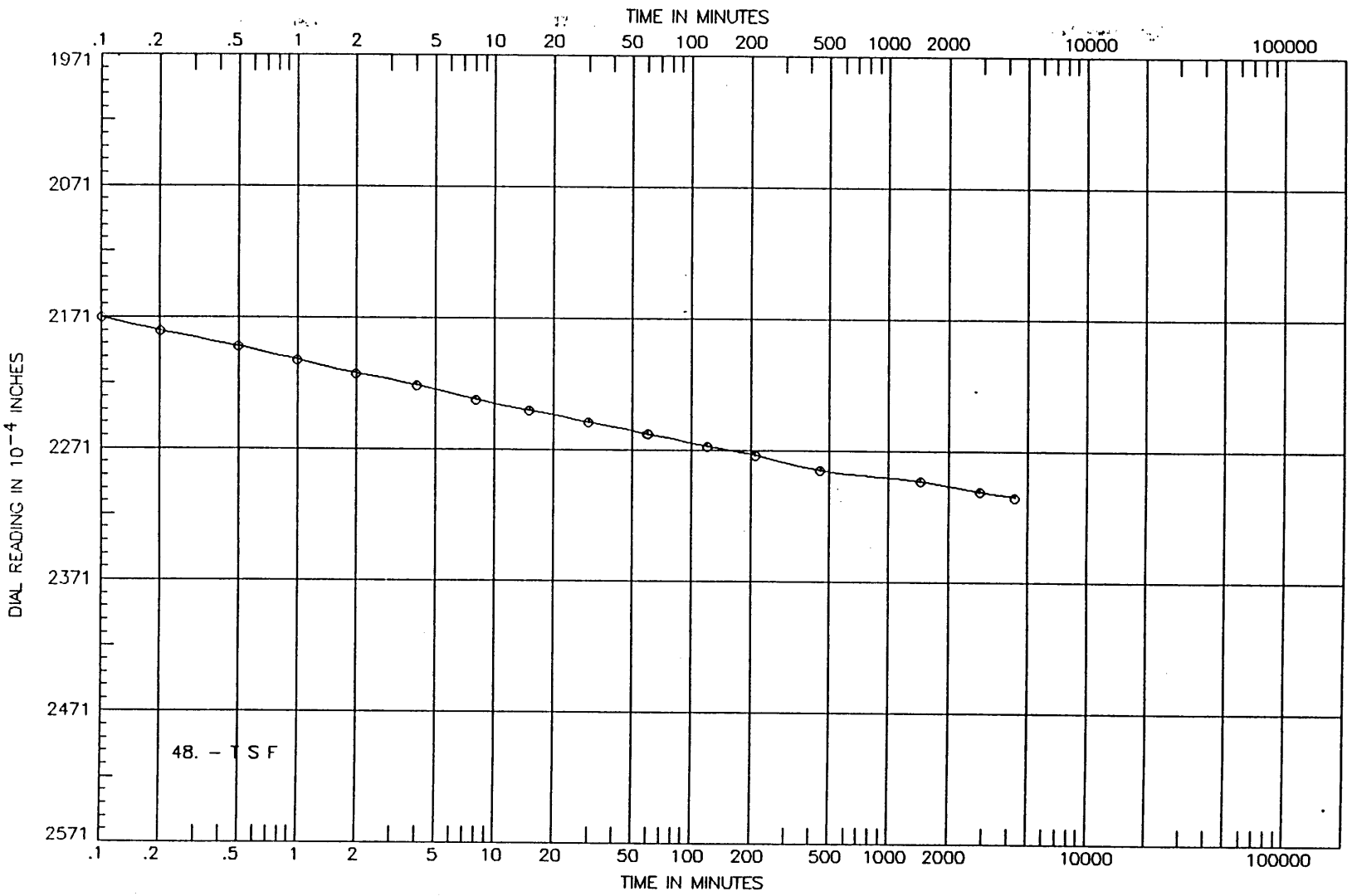
SHEET 8 OF 13



PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	11 SEP 95

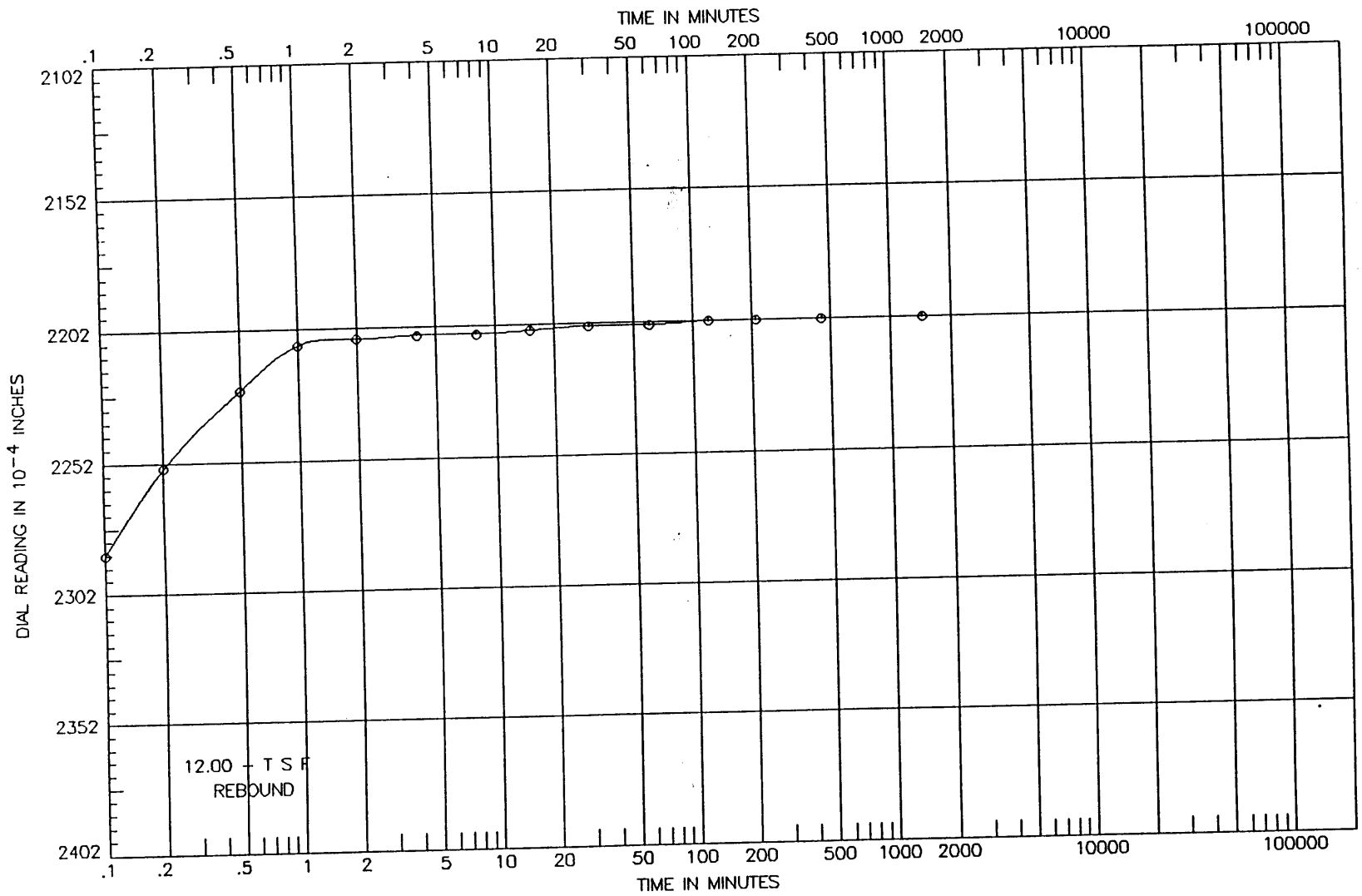
CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING	12-EAPST-95	SAMPLE NO. 5	
DEPTH/ELEV	12.0-13.5	DATE 11 SEP 95	

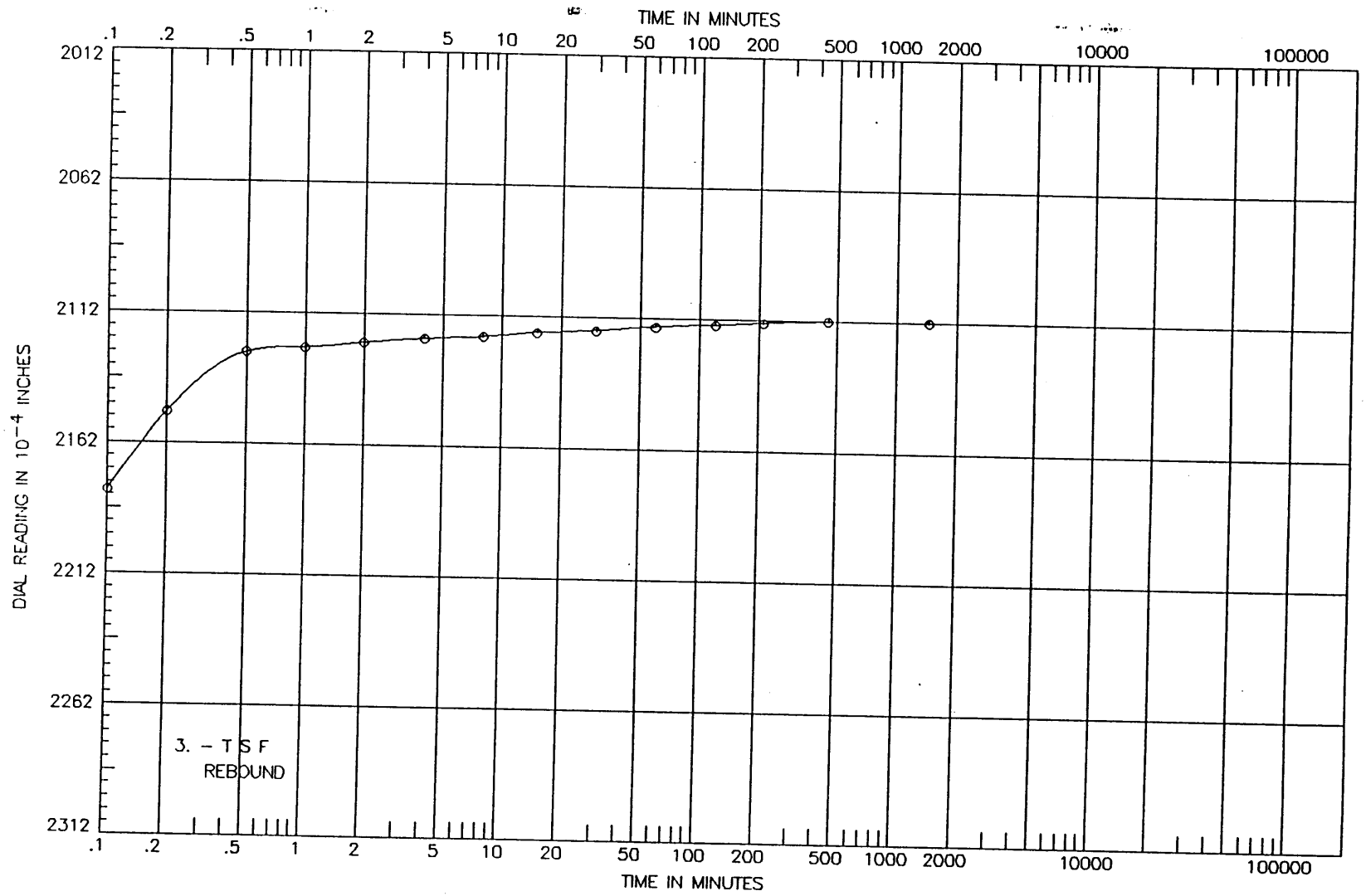
SHEET 10 OF 13



PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	11 SEP 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

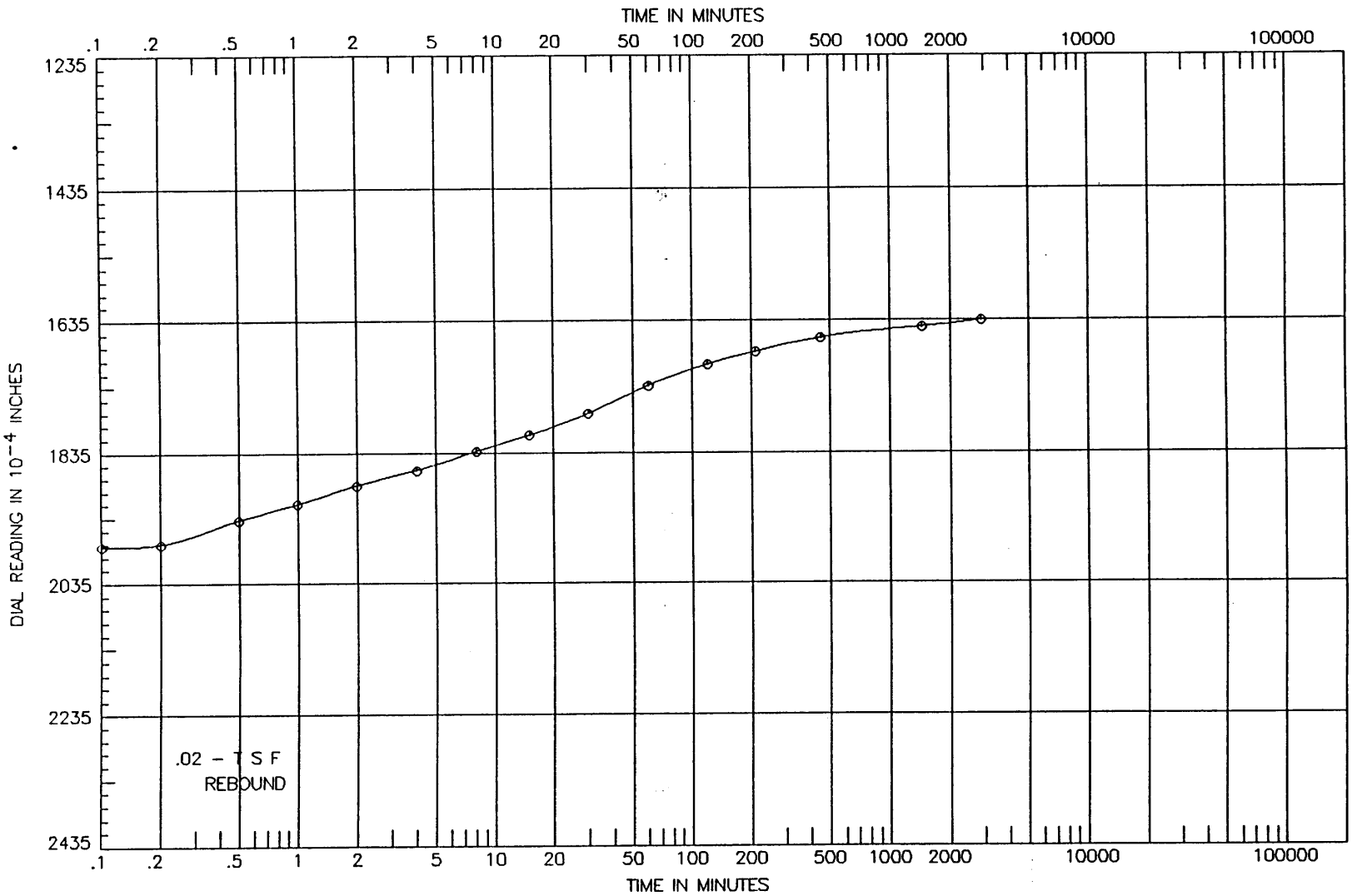


PROJECT EASTERN ARKANSAS	
BORING 12-EAPST-95	SAMPLE NO. 5
DEPTH/ELEV 12.0-13.5	DATE 11 SEP 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 12 OF 13

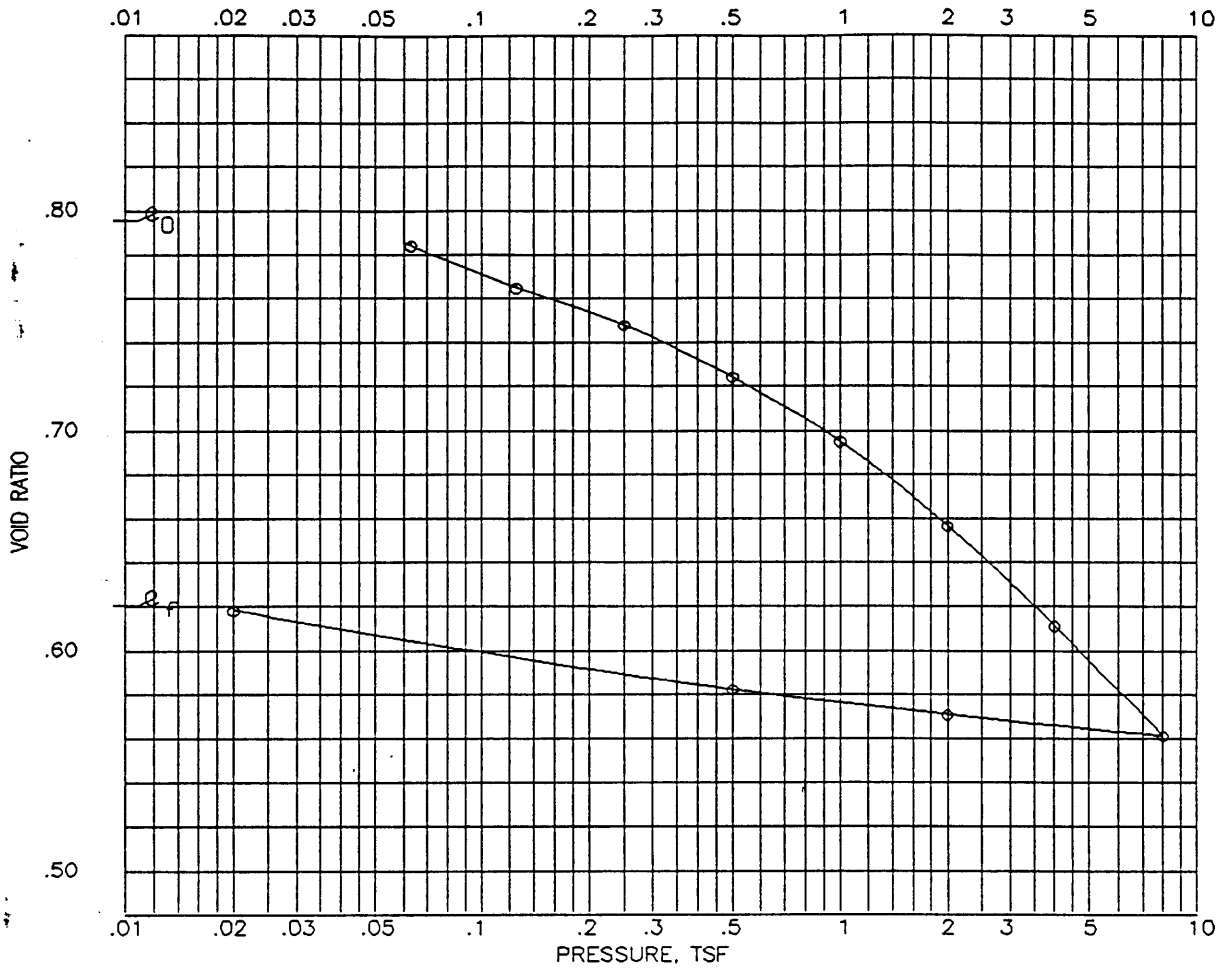


PROJECT	EASTERN ARKANSAS		
BORING	12-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.0-13.5	DATE	11 SEP 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 13 OF 13

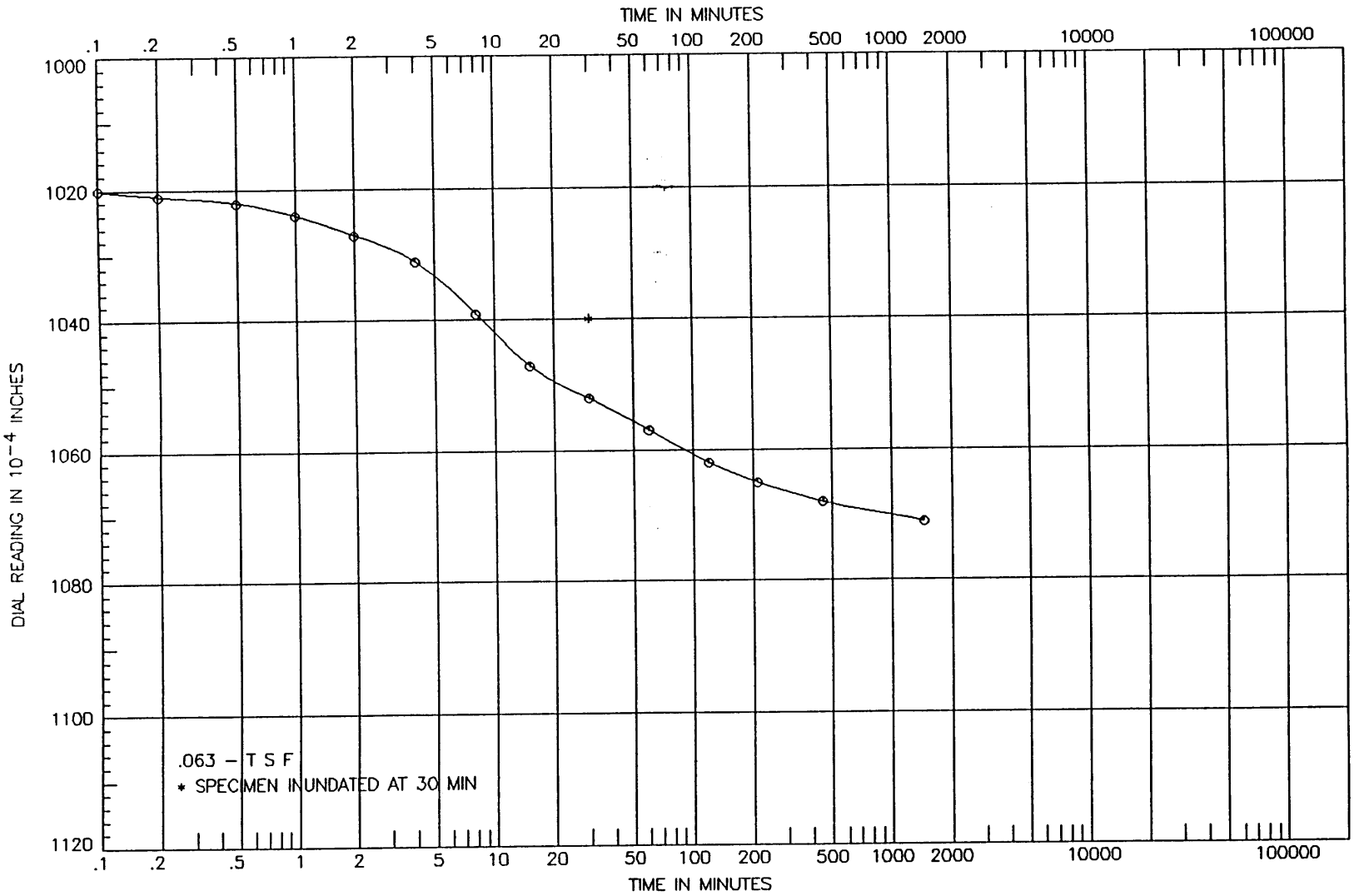


			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	28.1	21.7
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	93.6	103.7
COMPRESSION INDEX		SATURATION, %	95.0	94.0
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	.795	.620
DIA. IN 4.44	HT. IN 1.141	BACK PRESSURE, TSF		

CLASSIFICATION	SANDY CLAY (CL), REDDISH BROWN		
LL 32	PL 16	PI 16	PROJECT EASTERN ARKANSAS
GS 2.69 (EST)	D_{10}		

REMARKS:	BORING NO. 13-EAPST-95	SAMPLE NO. 5
	DEPTH/ELEV 12.5-13.5	TECH. JL
	LABORATORY USAE WES - STF/GL	DATE 01 AUG 95
	CONSOLIDATION TEST REPORT	

SHEET 1 OF 12

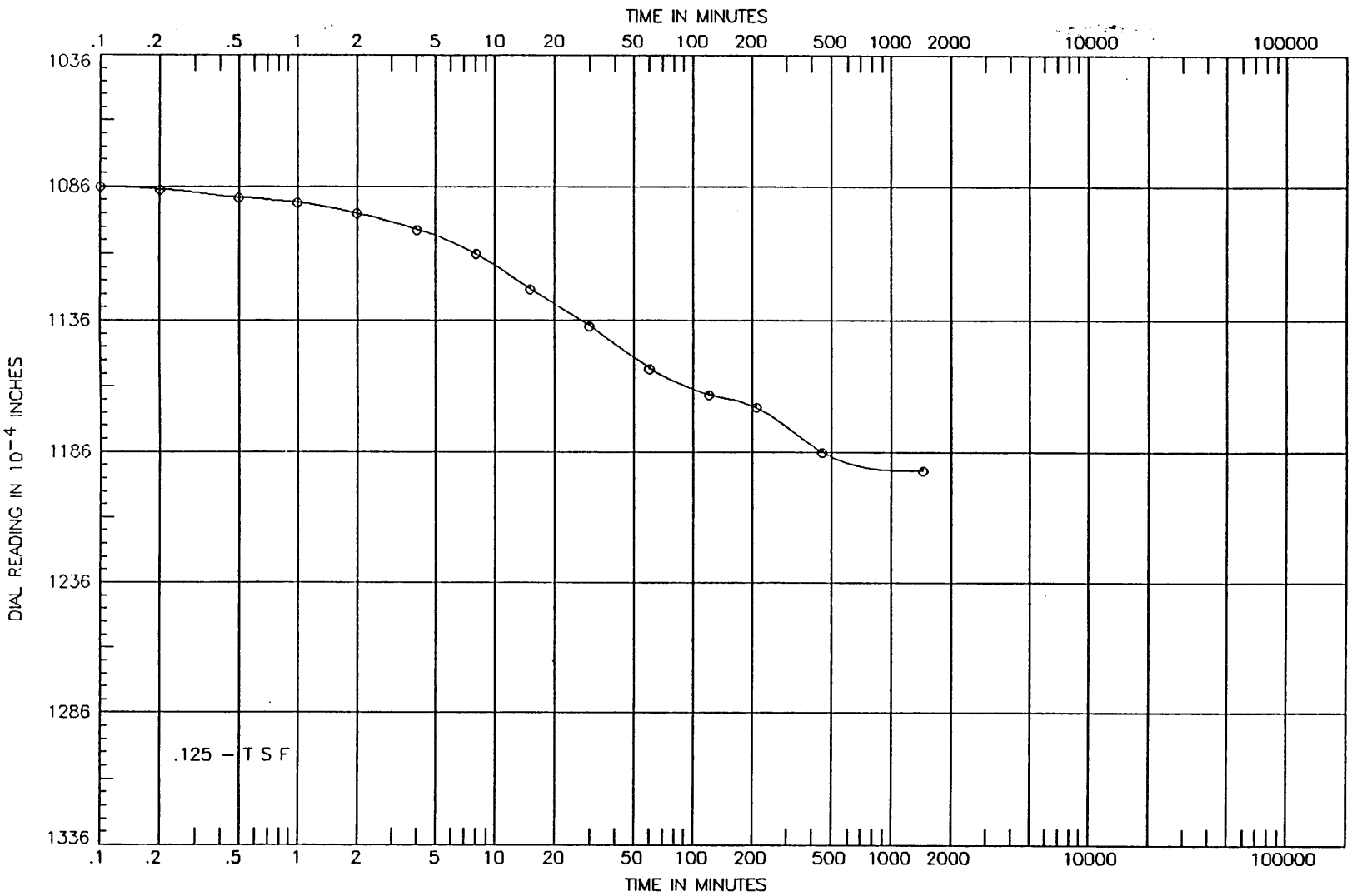


PROJECT	EASTERN ARKANSAS		
BORING	13-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.5--13.5	DATE	01 AUG 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 2 OF 12

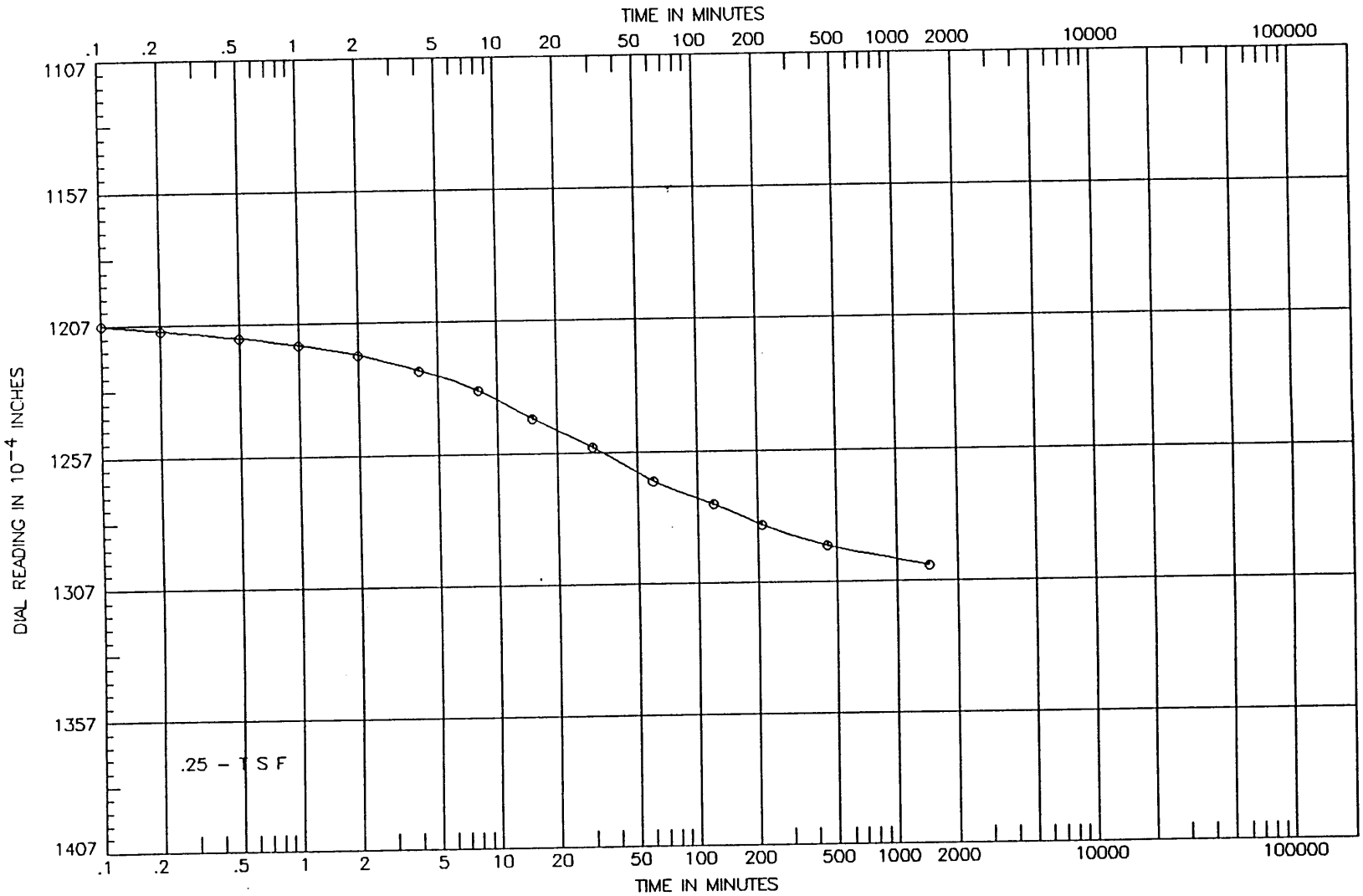


PROJECT EASTERN ARKANSAS	
BORING 13-EAPST-95	SAMPLE NO. 5
DEPTH/ELEV 12.5-13.5	DATE 01 AUG 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

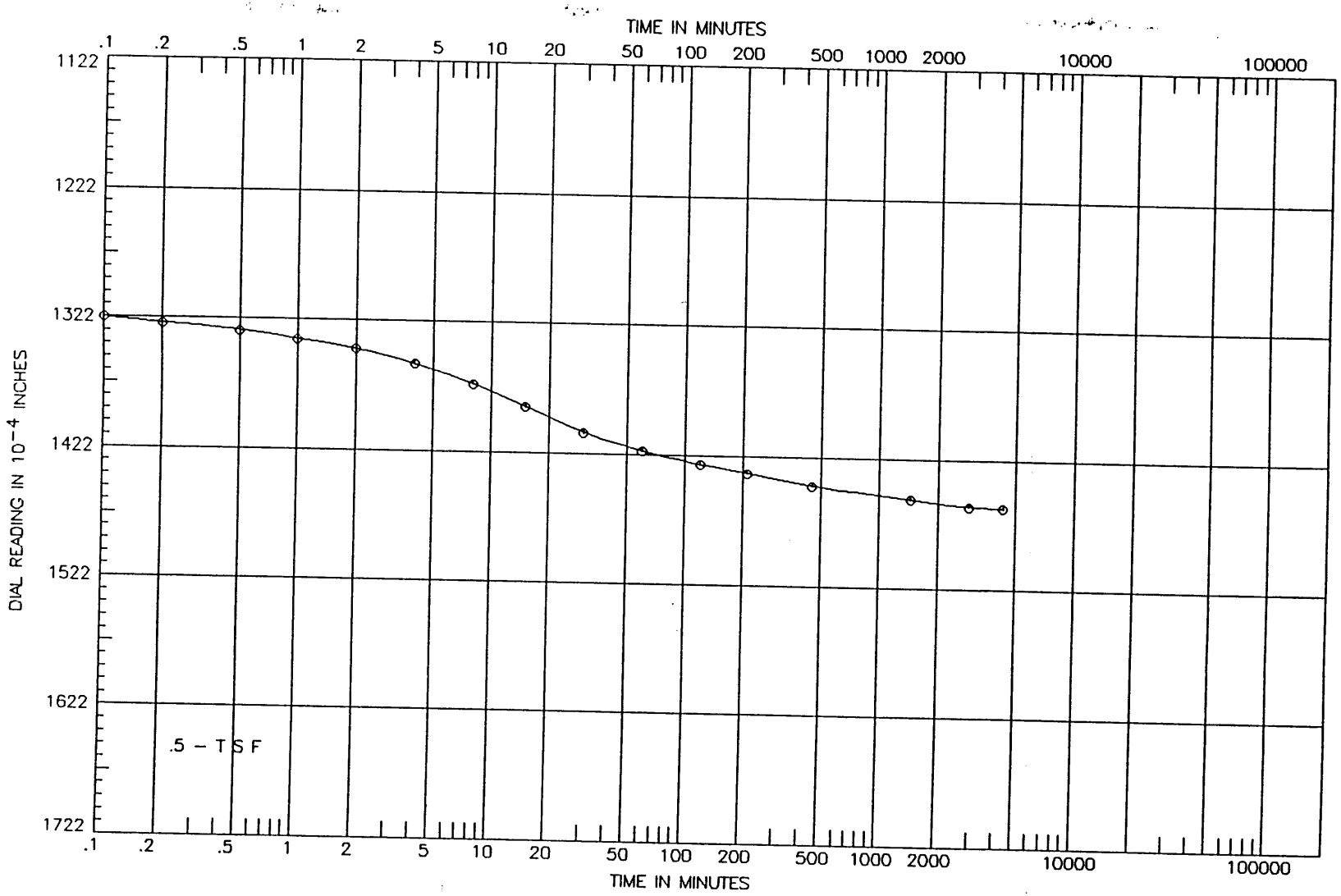
SHEET 3 OF 12



PROJECT	EASTERN ARKANSAS		
BORING	13-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.5-13.5	DATE	01 AUG 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

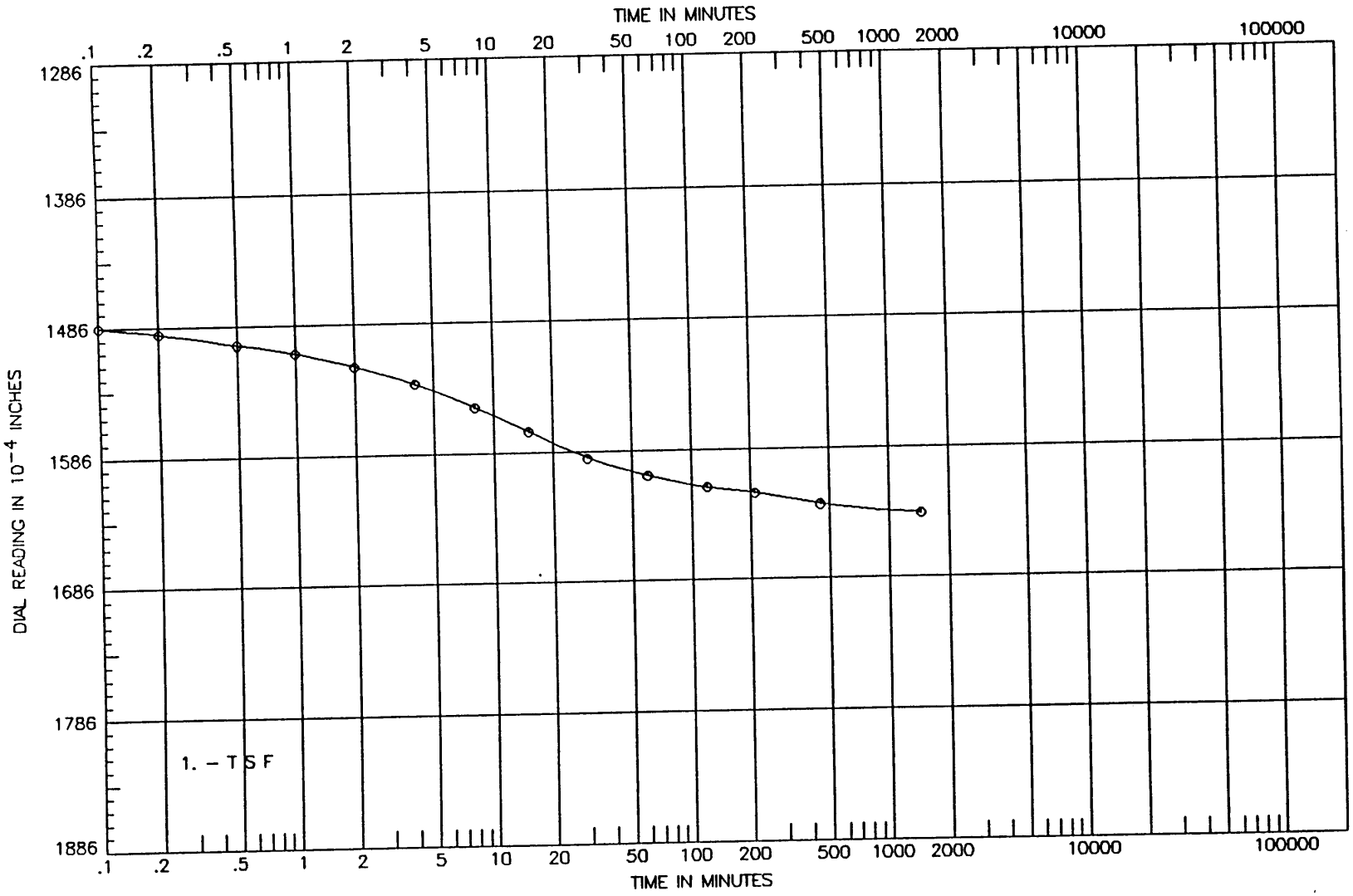


PROJECT	EASTERN ARKANSAS		
BORING	13-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.5-13.5	DATE	01 AUG 95

SHEET 5 OF 12

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

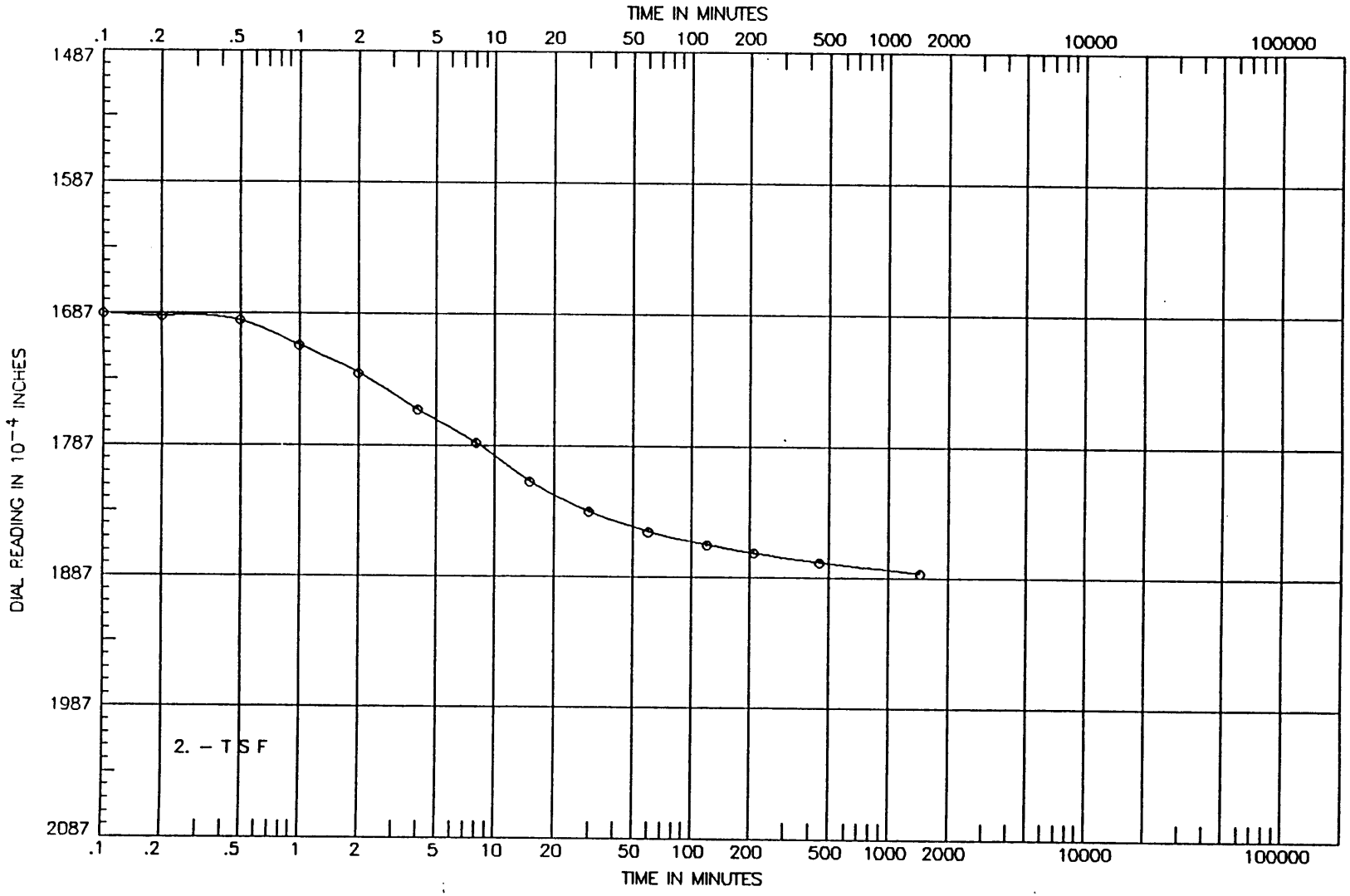


PROJECT EASTERN ARKANSAS	
BORING 13-EAPST-95	SAMPLE NO. 5
DEPTH/ELEV 12.5-13.5	DATE 01 AUG 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 6 OF 12

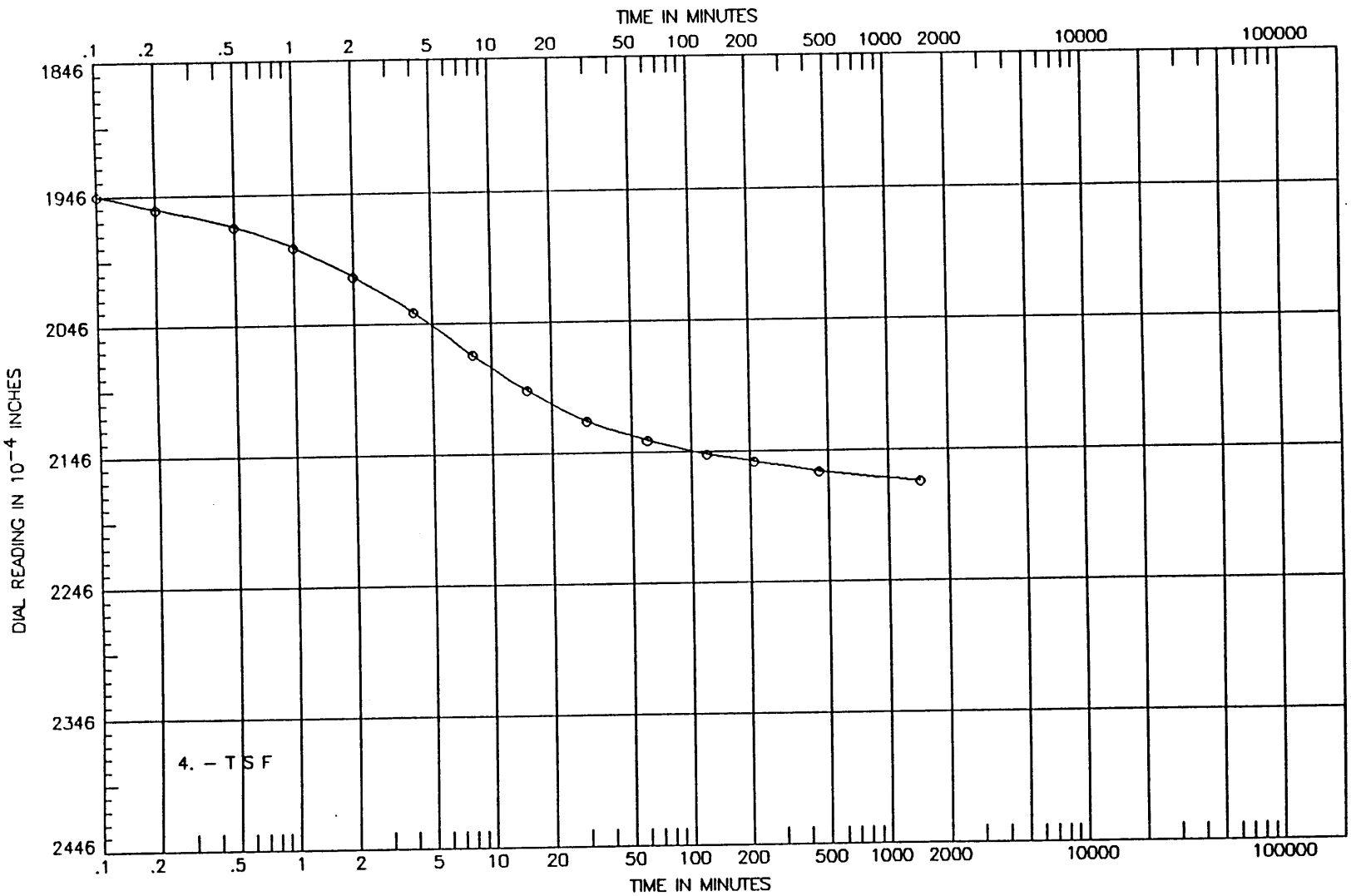


PROJECT	EASTERN ARKANSAS		
BORING	13–EAPST–95	SAMPLE NO.	5
DEPTH/ELEV	12.5–13.5	DATE	01 AUG 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

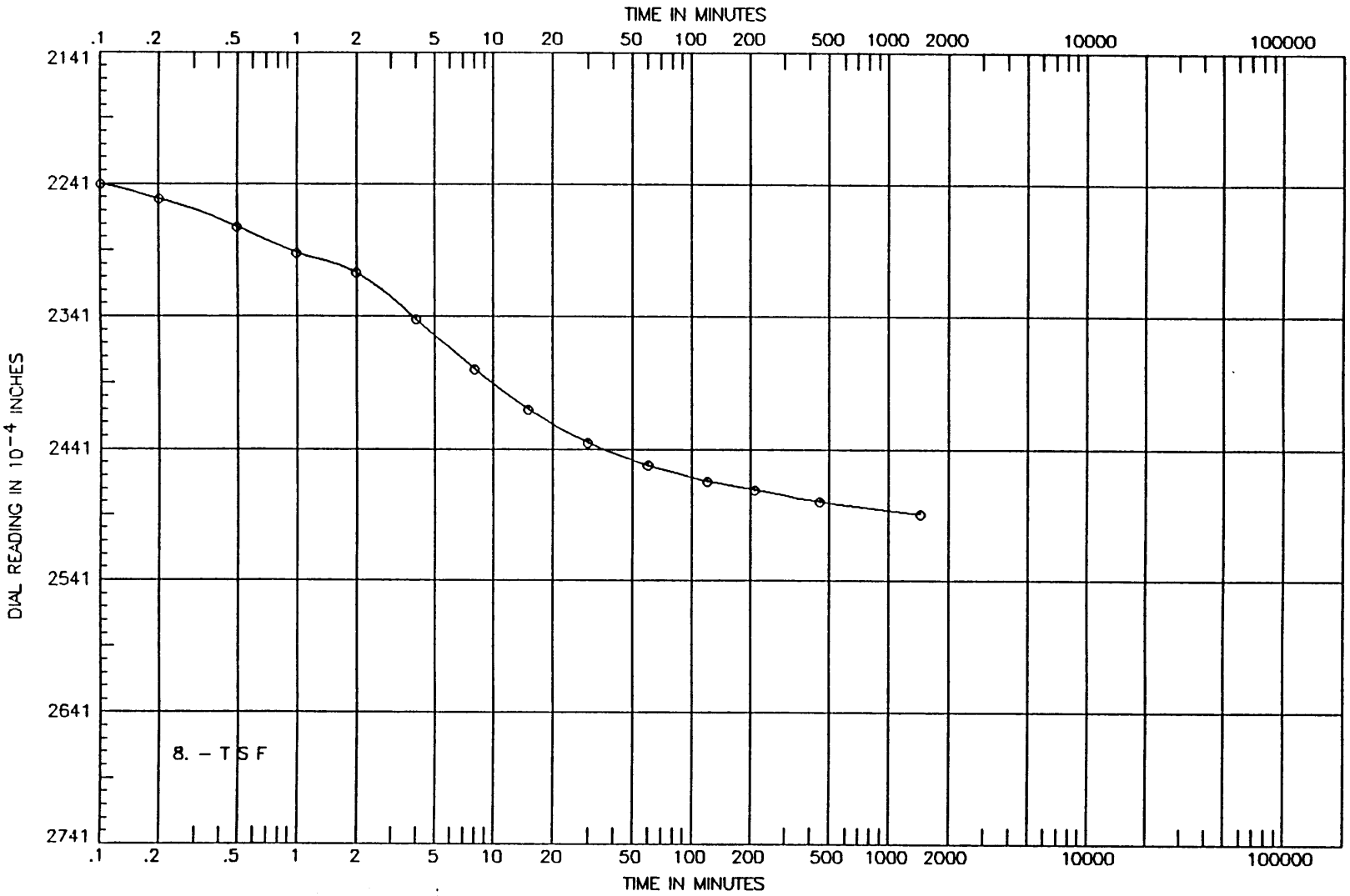
SHEET 7 OF 12



PROJECT	EASTERN ARKANSAS		
BORING	13-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.5-13.5	DATE	01 AUG 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

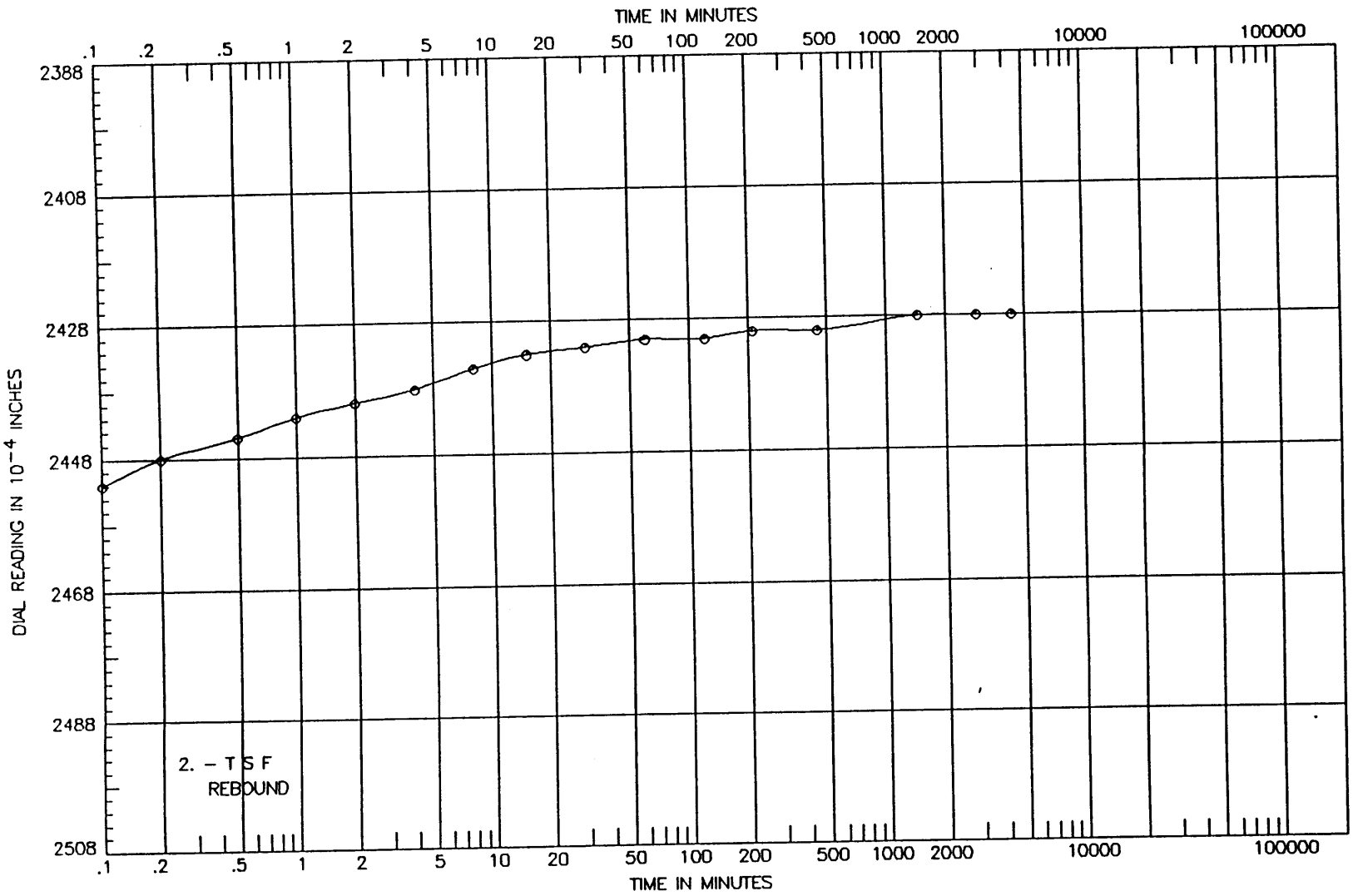


PROJECT EASTERN ARKANSAS	
BORING 13-EAPST-95	SAMPLE NO. 5
DEPTH/ELEV 12.5-13.5	DATE 01 AUG 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

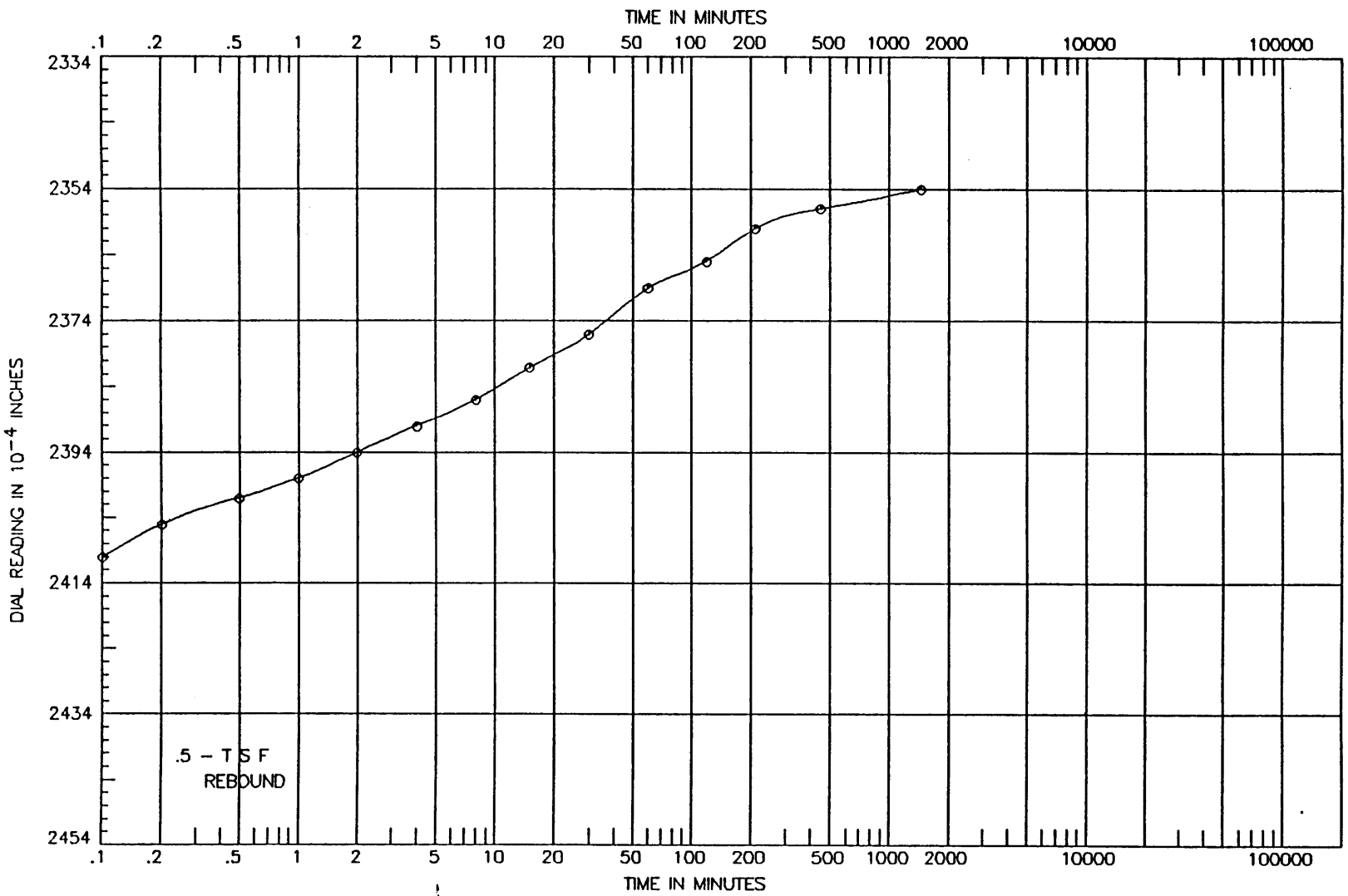
SHEET 9 OF 12



PROJECT	EASTERN ARKANSAS		
BORING	13-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.5-13.5	DATE	01 AUG 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

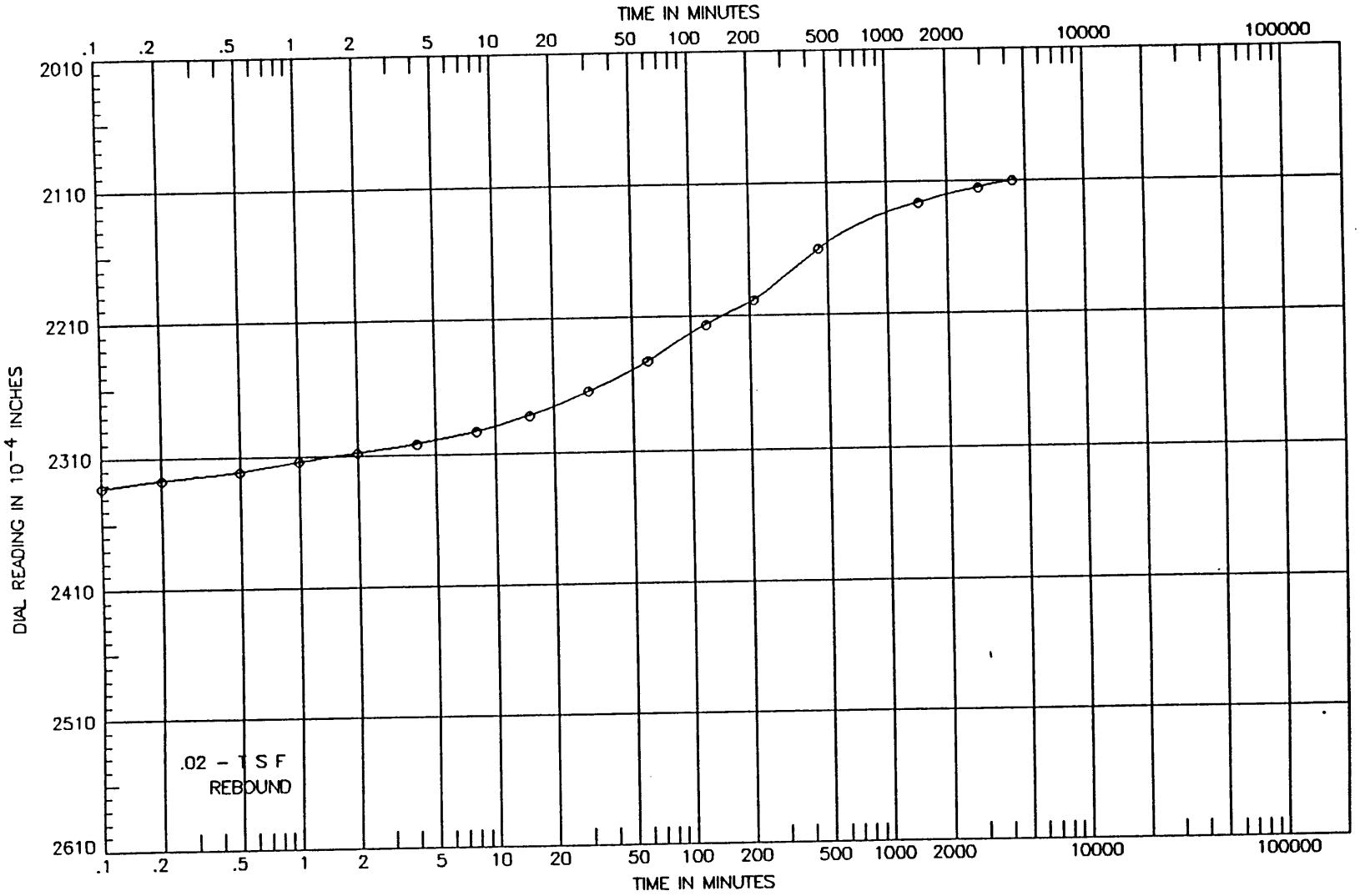


PROJECT EASTERN ARKANSAS	
BORING 13-EAPST-95	SAMPLE NO. 5
DEPTH/ELEV 12.5-13.5	DATE 01 AUG 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 11 OF 12

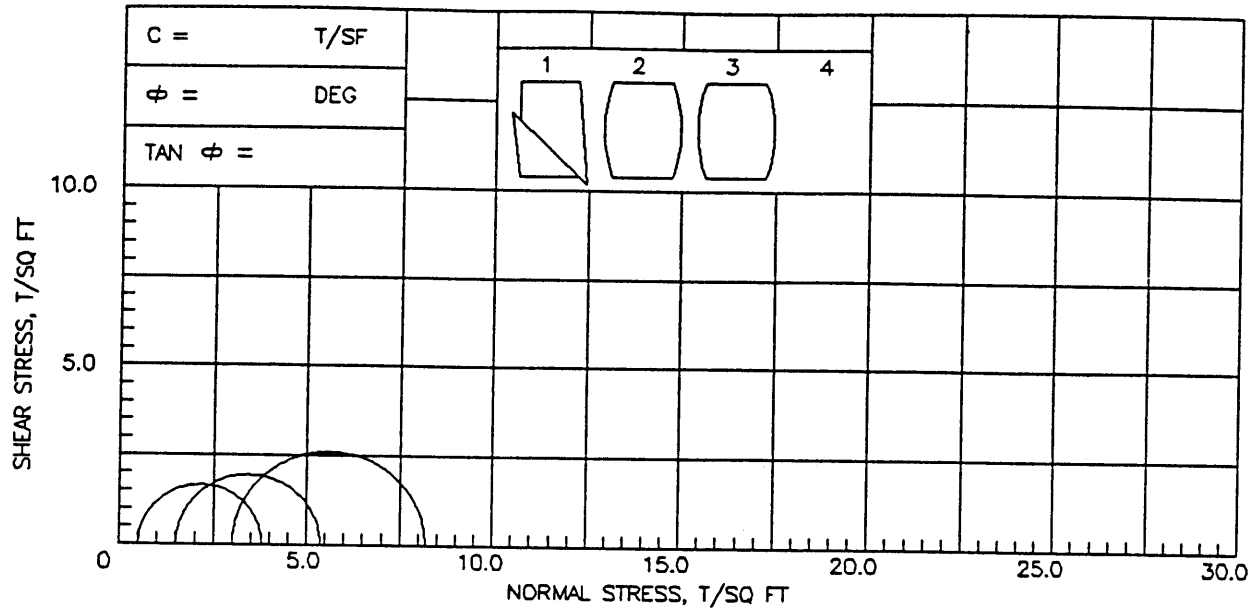


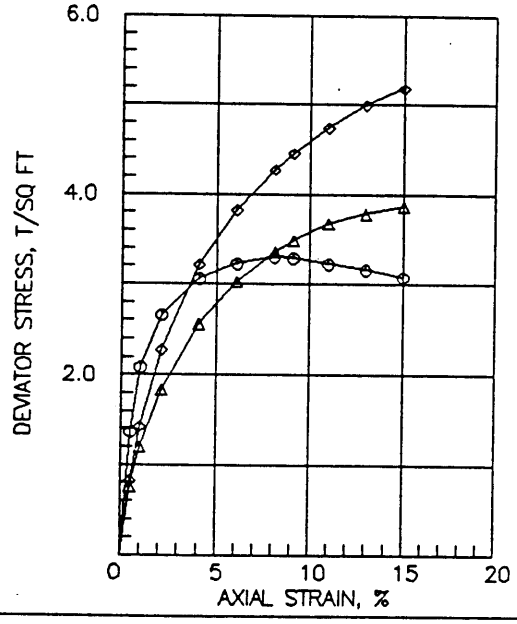
PROJECT	EASTERN ARKANSAS		
BORING	13-EAPST-95	SAMPLE NO.	5
DEPTH/ELEV	12.5-13.5	DATE	01 AUG 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 12 OF 12





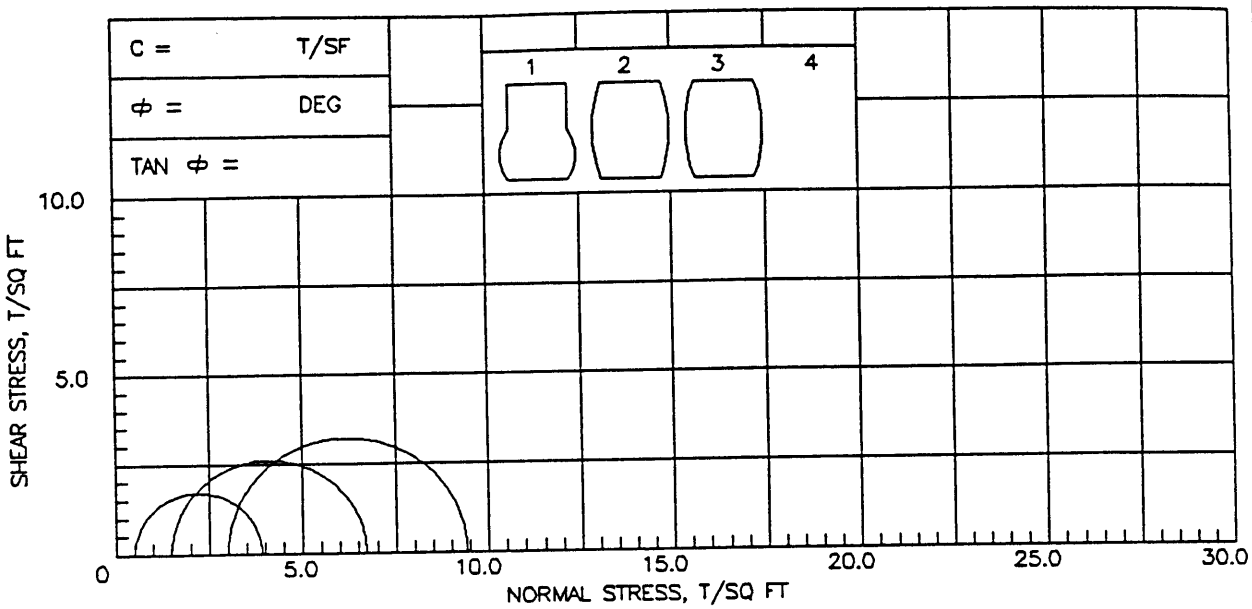
SPECIMEN NO.		○ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	17.9	18.0	18.3	
	DRY DENSITY, PCF	89.0	85.6	89.6	
	SATURATION, %	54.0	50.2	56.0	
	VOID RATIO	.895	.970	.882	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESSURE, TSF				
CHAMBER PRESSURE, TSF		.50	1.50	3.00	
MAX. DEV. STRESS, TSF		3.30	3.87	5.19	
TIME TO FAILURE, MIN.		17	31	31	
STRAIN RATE INCR., %					
INITIAL DIAMETER, IN.		1.38	1.39	1.38	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

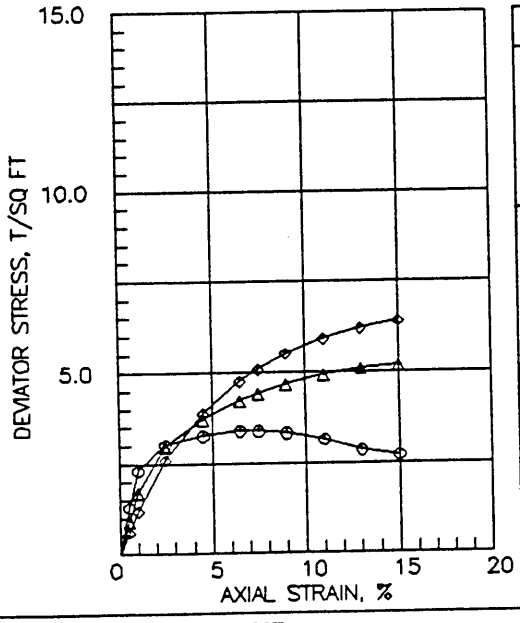
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), BROWN

LL 44	PL 15	PI 29	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	Q TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 1-EAU-94	SAMPLE NO. 3
	DEPTH/ELEV 6.0-7.0	TECH. US
	LABORATORY USAE WES - STF/GL	DATE 07 APR 95
	TRIAXIAL COMPRESSION TEST REPORT	





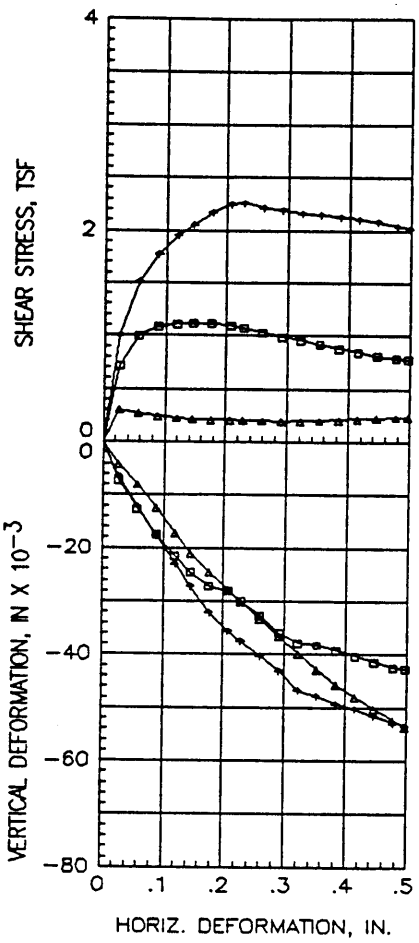
SPECIMEN NO.		○ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	13.0	12.9	12.9	
	DRY DENSITY, PCF	85.0	82.2	83.1	
	SATURATION, %	35.7	33.0	33.8	
	VOID RATIO	.983	1.051	1.028	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESSURE, TSF				
CHAMBER PRESSURE, TSF		.50	1.50	3.00	
MAX. DEV. STRESS, TSF		3.41	5.20	6.42	
TIME TO FAILURE, MIN.		13	31	31	
STRAIN RATE INCR., %					
INITIAL DIAMETER, IN.		1.40	1.38	1.36	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

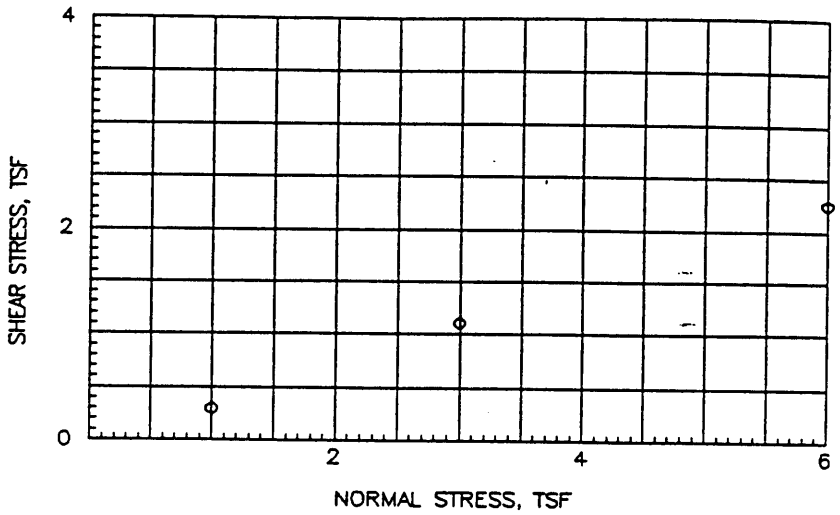
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), BROWN

LL 48	PL 15	PI 33	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	Q TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 2-EAU-94	SAMPLE NO. 3
	DEPTH/ELEV 6.5-7.0	TECH. US
	LABORATORY USAE WES - STF/GL	DATE 03 APR 95
	TRIAXIAL COMPRESSION TEST REPORT	





	TEST NO.	1 ▲	2 □	3 ✦	
INITAL	WATER CONTENT, %	19.9	19.2	19.0	
	VOID RATIO	.644	.636	.622	
	SATURATION, %	83.5	81.6	82.3	
	DRY DENSITY, PCF	102.5	103.0	103.9	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	26.8	22.9	20.2	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.30	1.11	2.26	
TIME TO FAILURE, MIN		126	712	1120	
RATE OF STRAIN, IN/MIN		.00020	.00020	.00020	
ULTIMATE SHEAR STRESS, TSF		.20	.78	2.03	

ϕ = _____ DEG

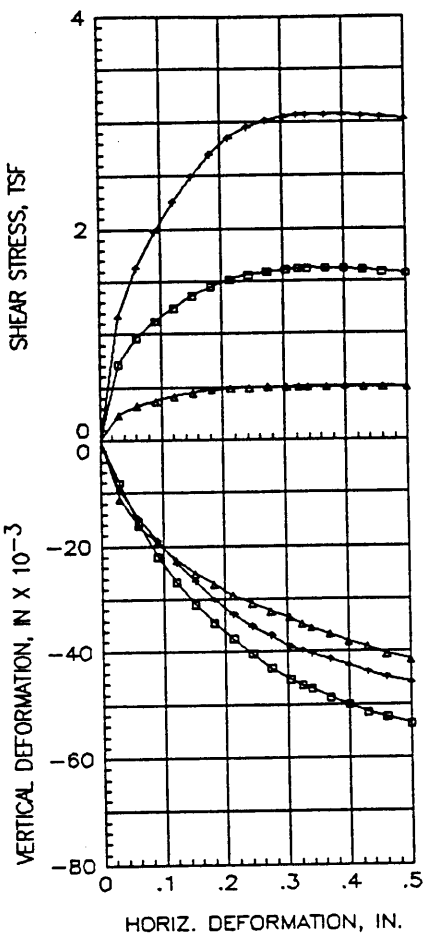
TAN ϕ = _____

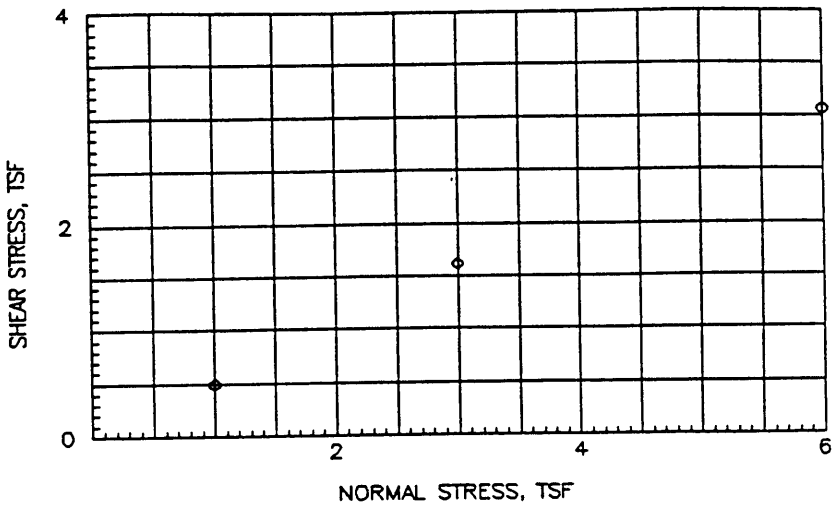
C = _____ T/SF

TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION CLAY (CL), REDDISH BROWN; FISSURED		

LL 42	PL 17	PI 25		GS 2.70 (EST)

REMARKS:	PROJECT EASTERN ARKANSAS	
	BORING NO. 2-EAU-94	SAMPLE 4
	DEPTH/ELEV 8.9-9.8	TECH. JL
	LABORATORY USAE WES - STF/GL	DATE 21 MAR 95
	DIRECT SHEAR TEST REPORT	





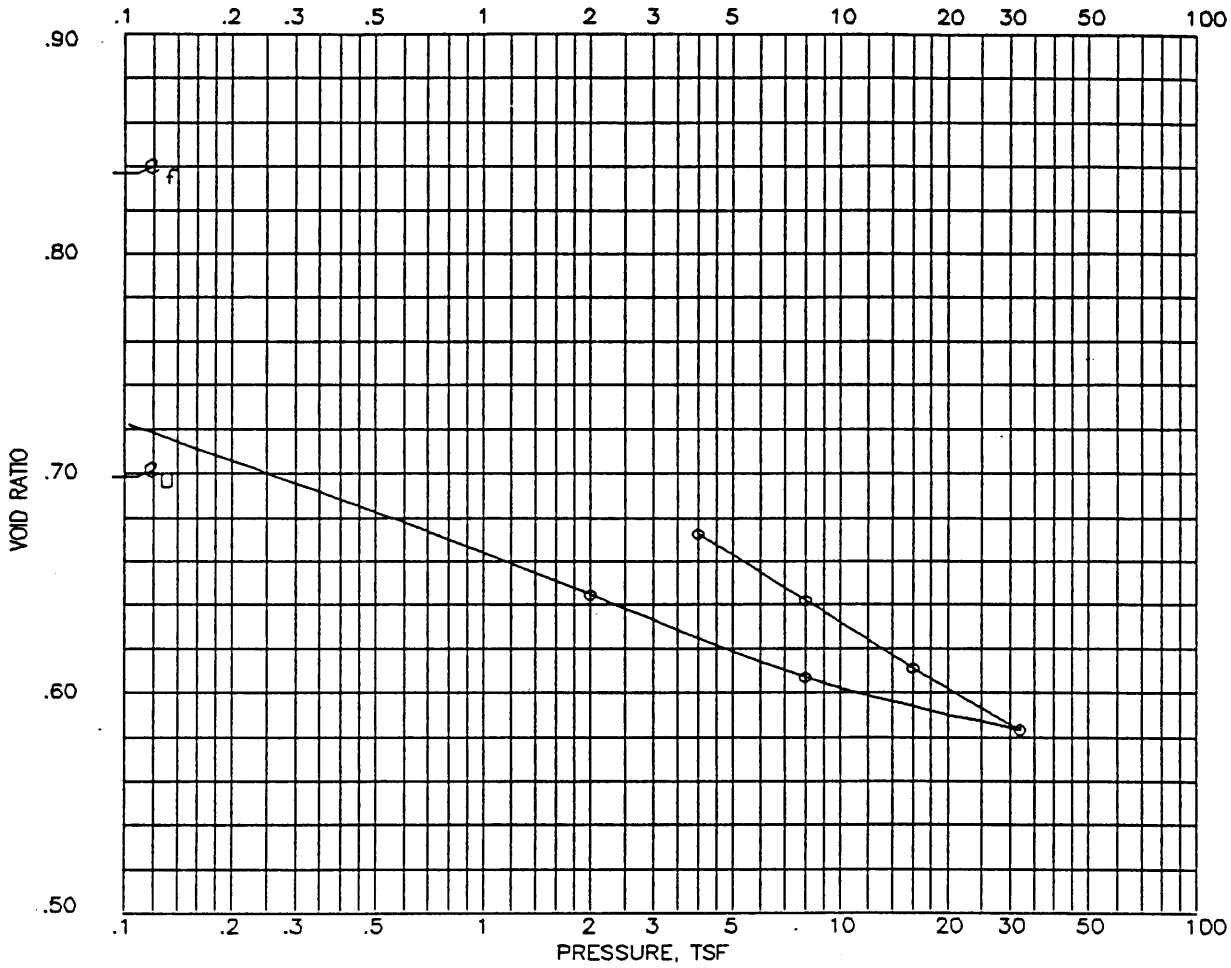
		TEST NO.	1 ▲	2 □	3 ✦	
INITAL		WATER CONTENT, %	12.9	12.9	12.9	
		VOID RATIO	.837	.843	.842	
		SATURATION, %	41.6	41.5	41.5	
		DRY DENSITY, PCF	91.7	91.4	91.5	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL		WATER CONTENT, %	22.4	19.7	18.9	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF			.50	1.63	3.07	
TIME TO FAILURE, MIN			1384	1717	1641	
RATE OF STRAIN, IN/MIN			.00020	.00020	.00020	
ULTIMATE SHEAR STRESS, TSF			.50	1.57	3.03	

ϕ = _____ DEG

TAN ϕ = _____

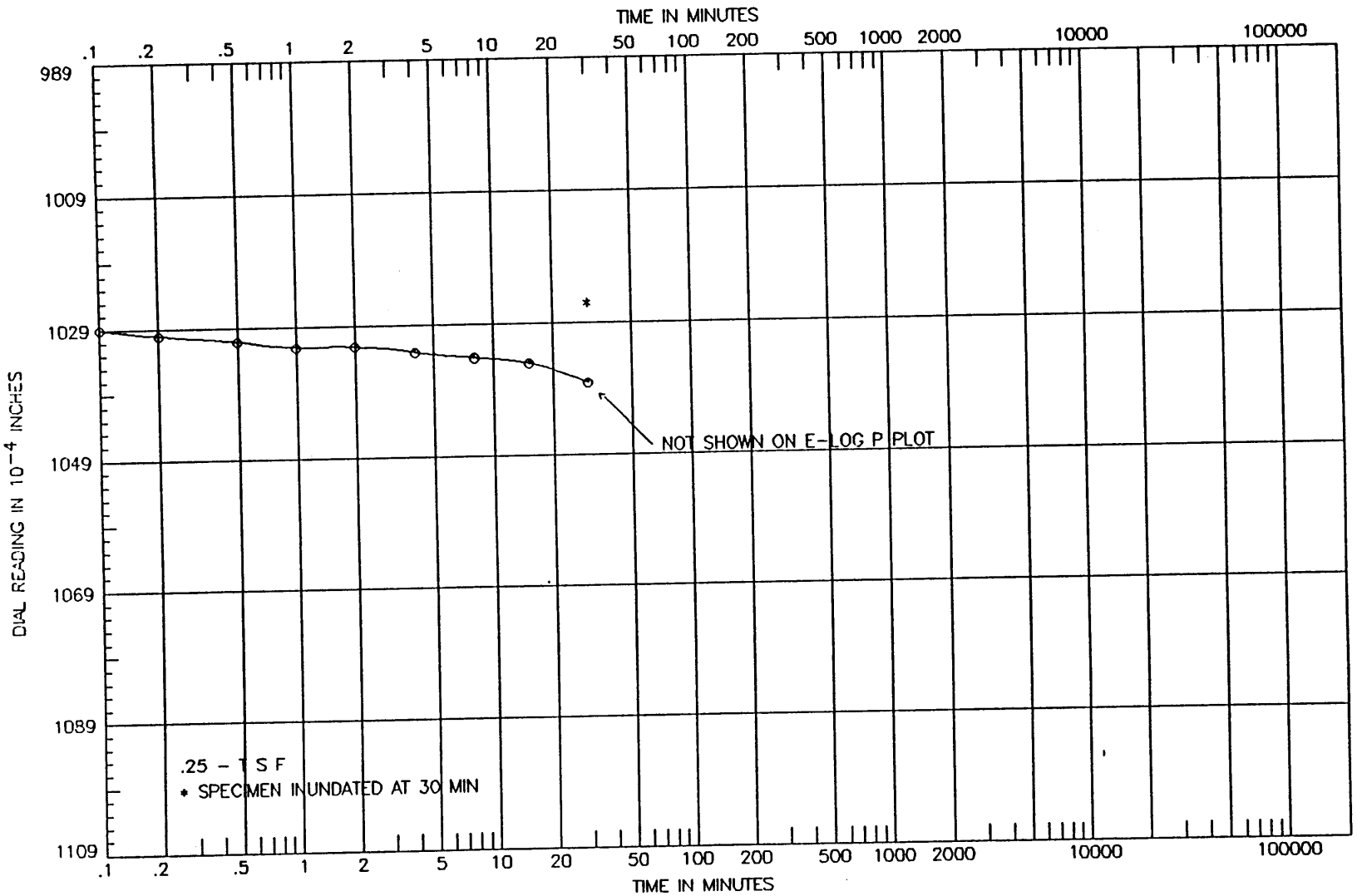
C = _____ T/SF

TYPE SPECIMEN	COMPACTED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION	CLAY (CL), REDDISH BROWN		
LL	PL	PI	GS 2.70 (EST)
REMARKS;		PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED			
AT 15 BLOW EFFORT		BORING NO. 2-EAU-94	SAMPLE 4
		DEPTH/ELEV 8.9-9.8	TECH. JL
		LABORATORY USAE WES - STF/GL	DATE 27 MAR 95
		DIRECT SHEAR TEST REPORT	



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	24.4	32.2
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	99.3	91.8
COMPRESSION INDEX		SATURATION, %	94.3	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	.698	.836
DIA. IN 4.25	HT. IN 1.165	BACK PRESSURE, TSF		
CLASSIFICATION	CLAY (CL), REDDISH BROWN			
LL / PL / PI		PROJECT EASTERN ARKANSAS		
GS 2.70 (EST)	D_{10}			
REMARKS:		BORING NO. 2-EAU-94	SAMPLE NO. 4	
		DEPTH/ELEV 8.9-9.8	TECH. JL	
		LABORATORY USAE WES - STF/GL	DATE 10 FEB 95	
		CONSOLIDATION TEST REPORT		

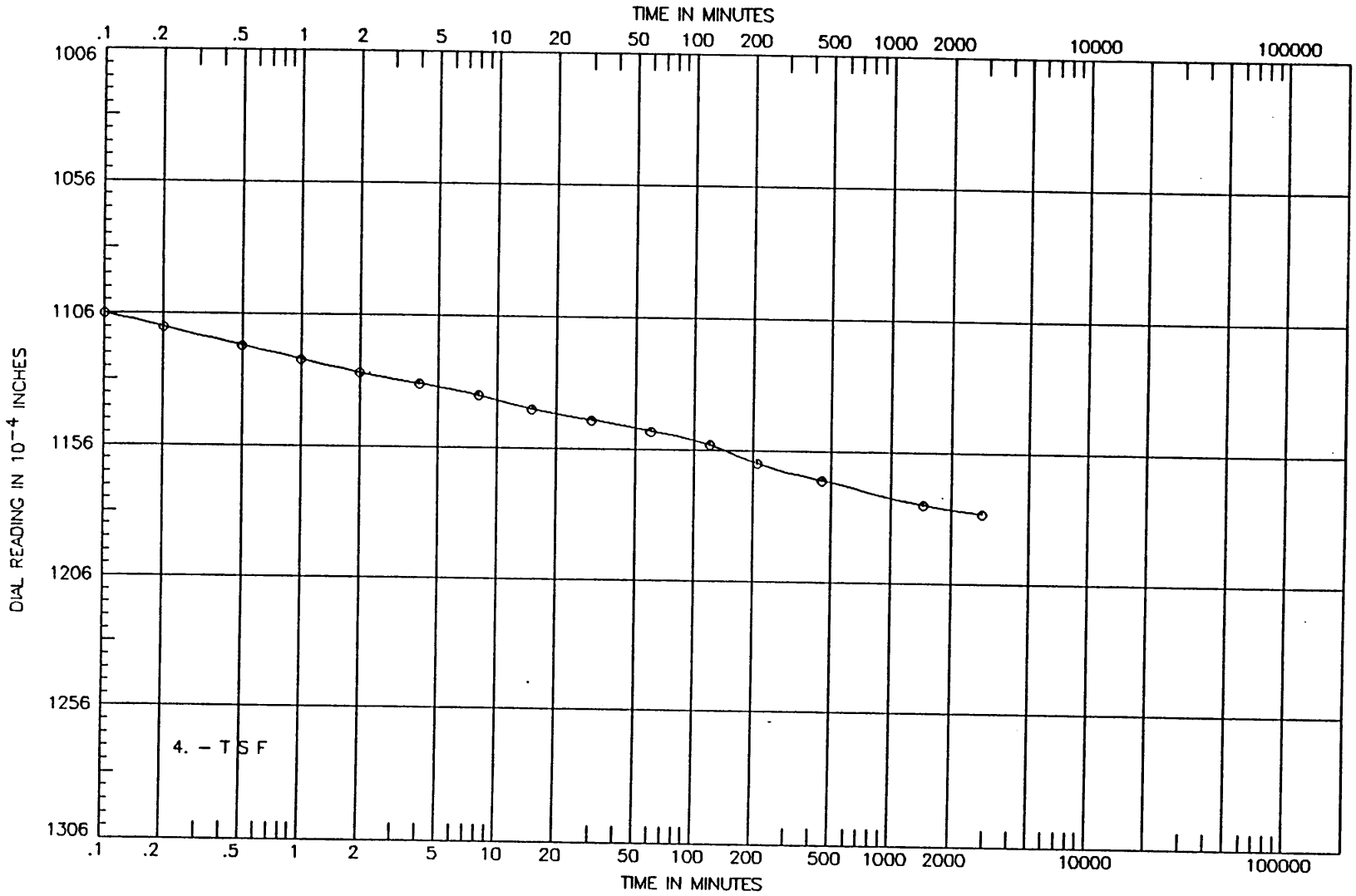
SHEET 1 OF 9



PROJECT	EASTERN ARKANSAS		
BORING	2-EAU-94	SAMPLE NO.	4
DEPTH/ELEV	8.9-9.8	DATE	10 FEB 95

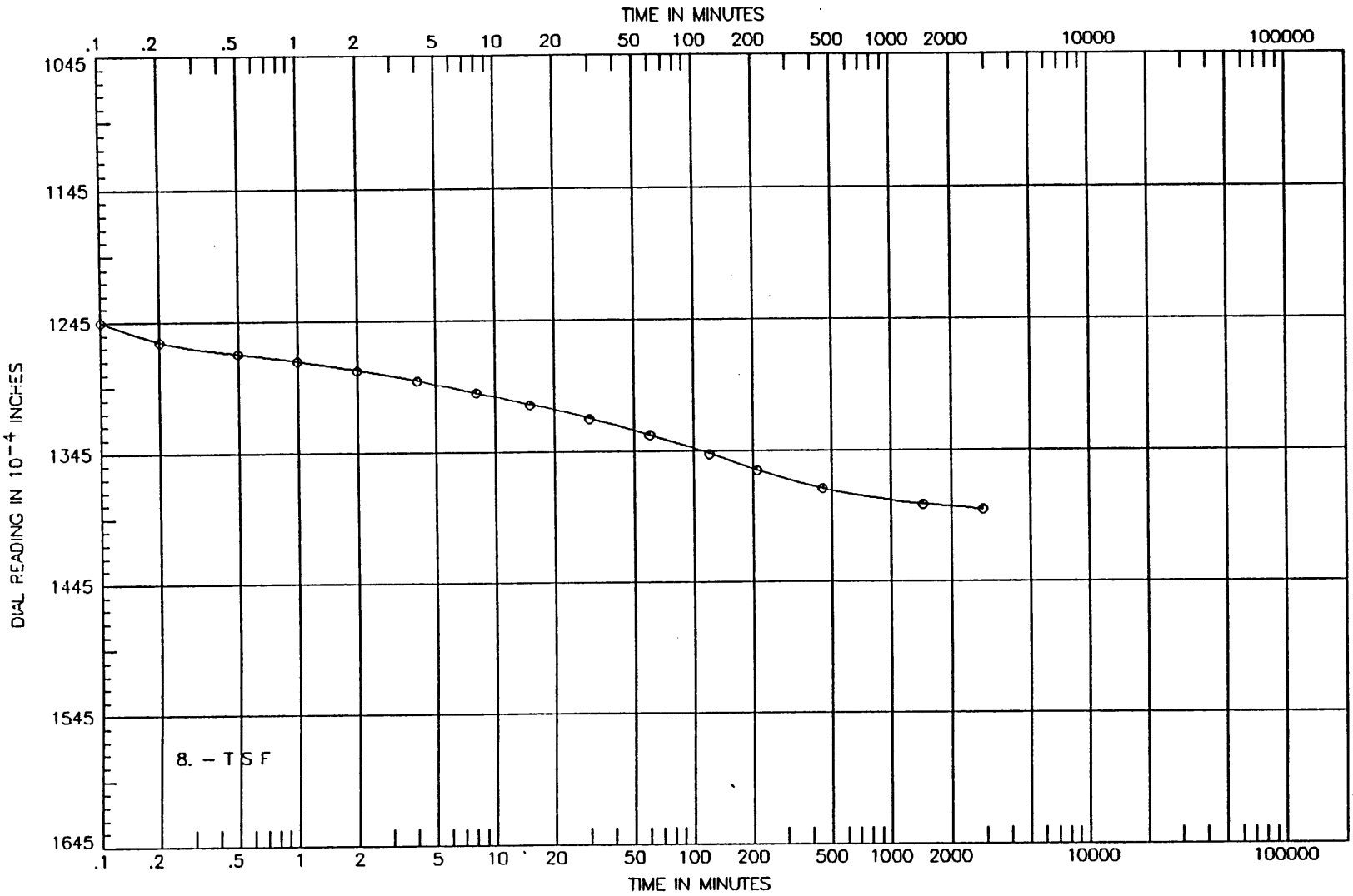
CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL



PROJECT EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
		LABORATORY USAE WES – STF/GL
BORING 2-EAU-94	SAMPLE NO. 4	
DEPTH/ELEV 8.9-9.8	DATE 10 FEB 95	

SHEET 3 OF 9

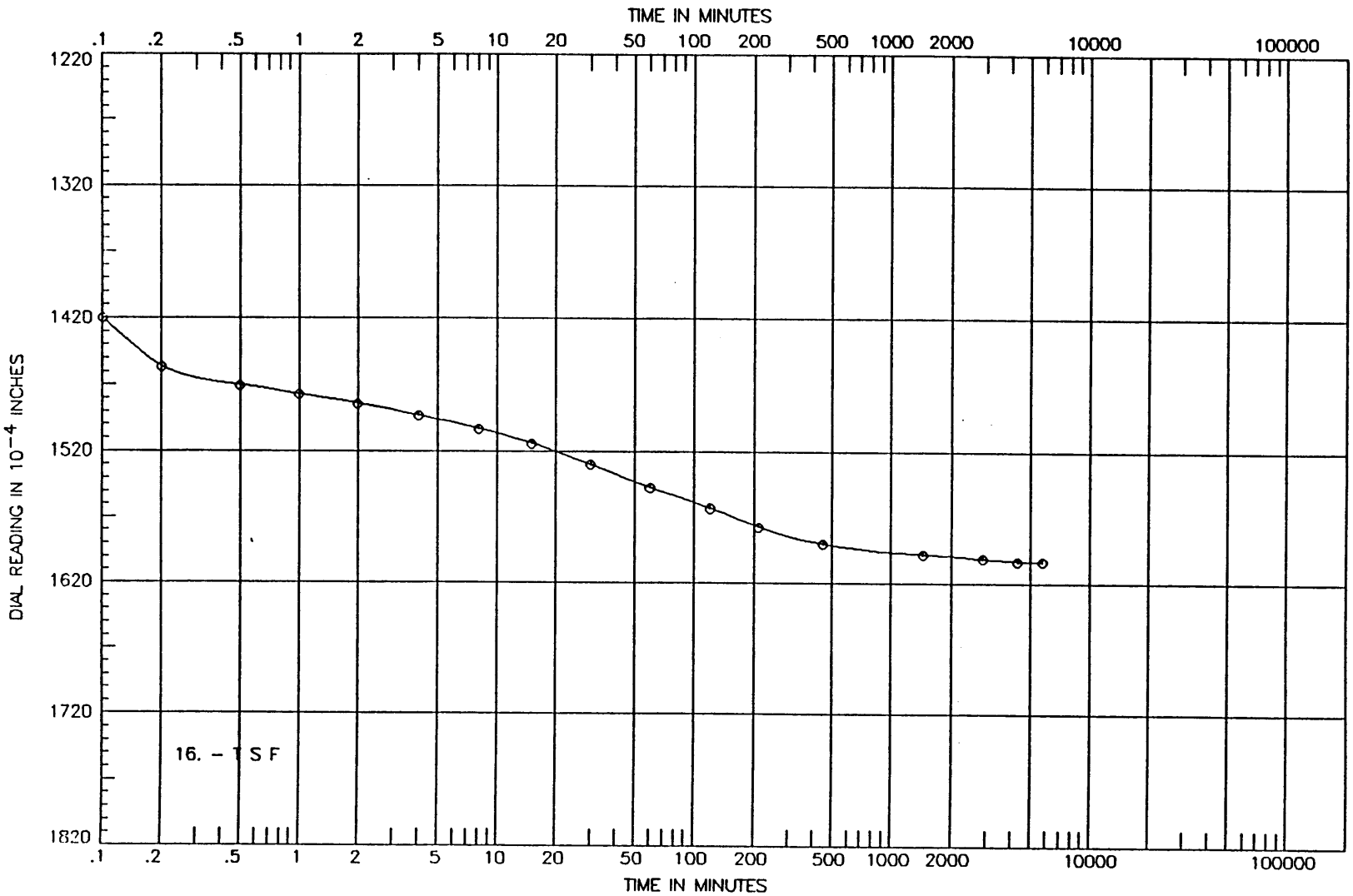


PROJECT	EASTERN ARKANSAS		
BORING	2-EAU-94	SAMPLE NO.	4
DEPTH/ELEV	8.9-9.8	DATE	10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 4 OF 9

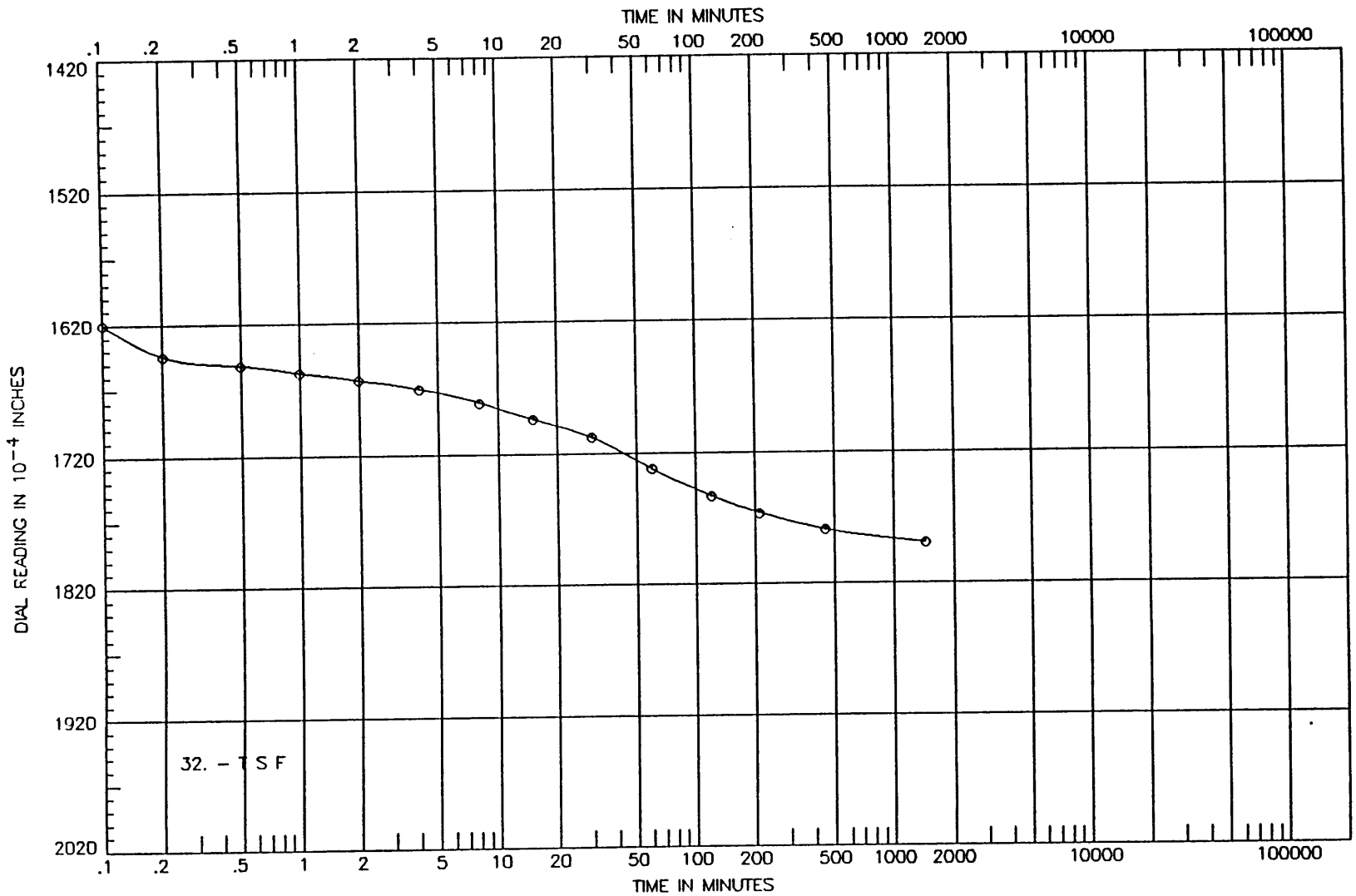


PROJECT	EASTERN ARKANSAS		
BORING	2-EAU-94	SAMPLE NO.	4
DEPTH/ELEV	8.9-9.8	DATE	10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

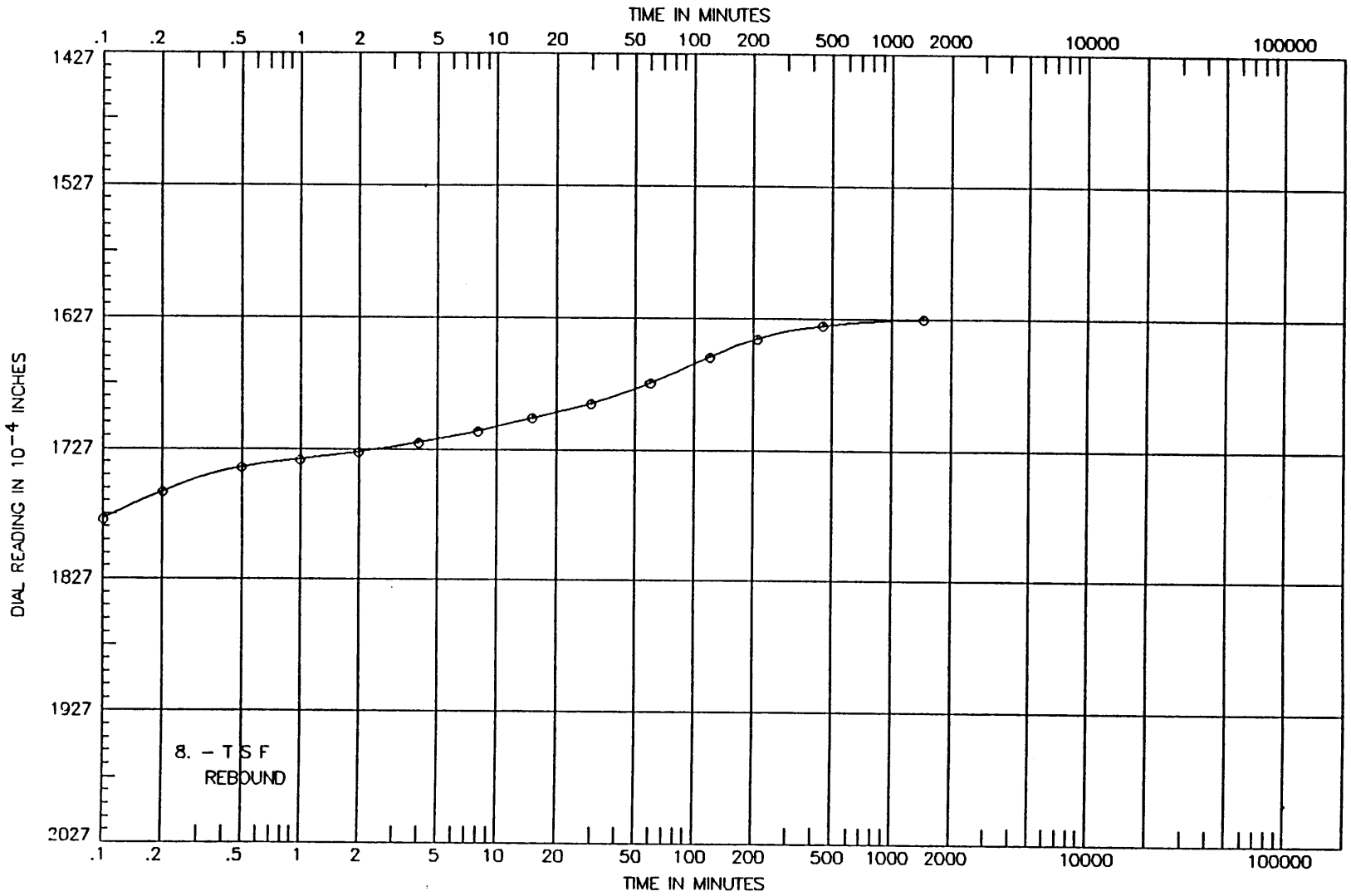
SHEET 5 OF 9



PROJECT EASTERN ARKANSAS	
BORING 2-EAU-94	SAMPLE NO. 4
DEPTH/ELEV 8.9-9.8	DATE 10 FEB 95

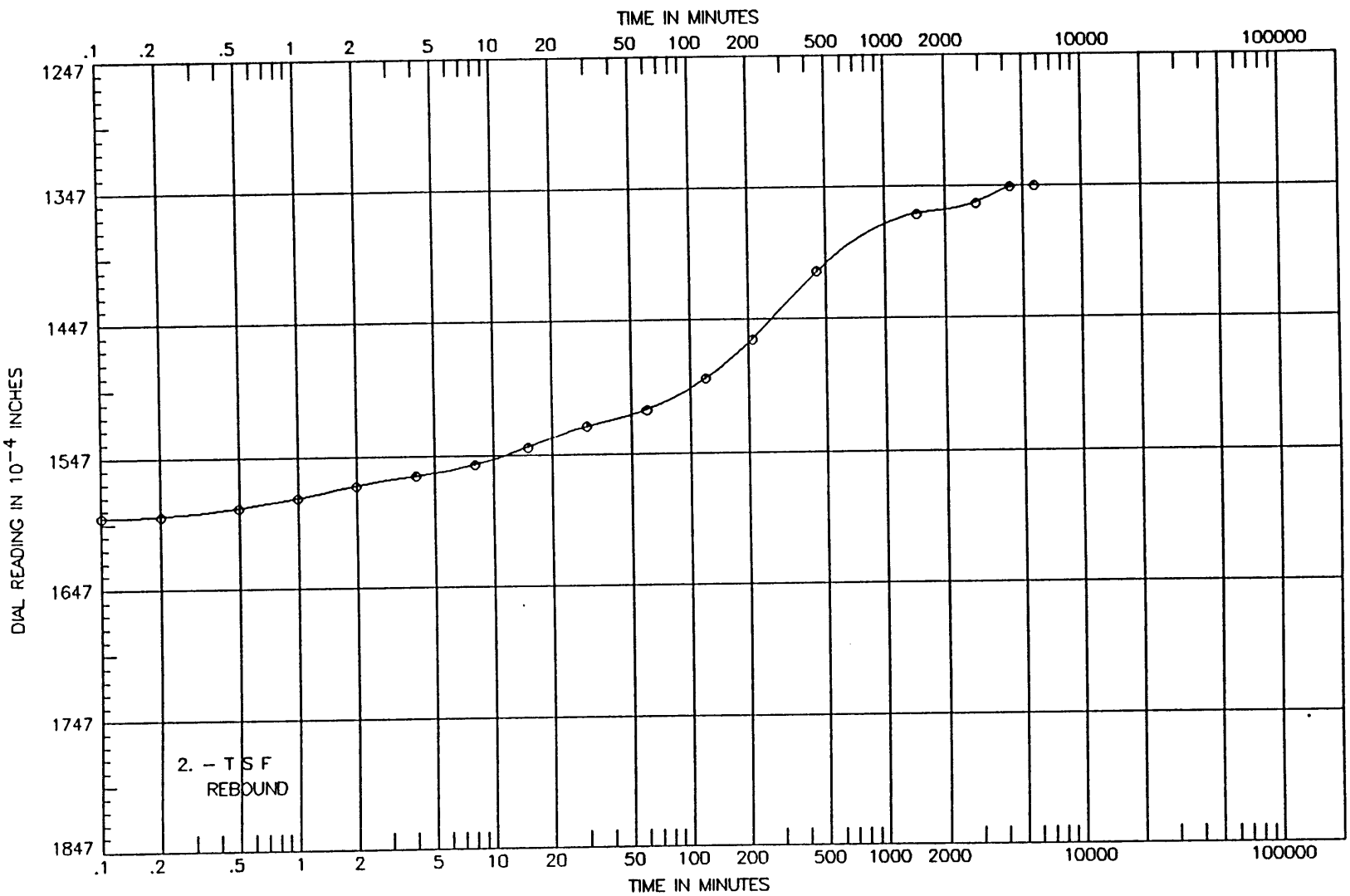
CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES LABORATORY USAE WES – STF/GL
BORING	2-EAU-94	SAMPLE NO. 4	
DEPTH/ELEV	8.9-9.8	DATE 10 FEB 95	

SHEET 7 OF 9

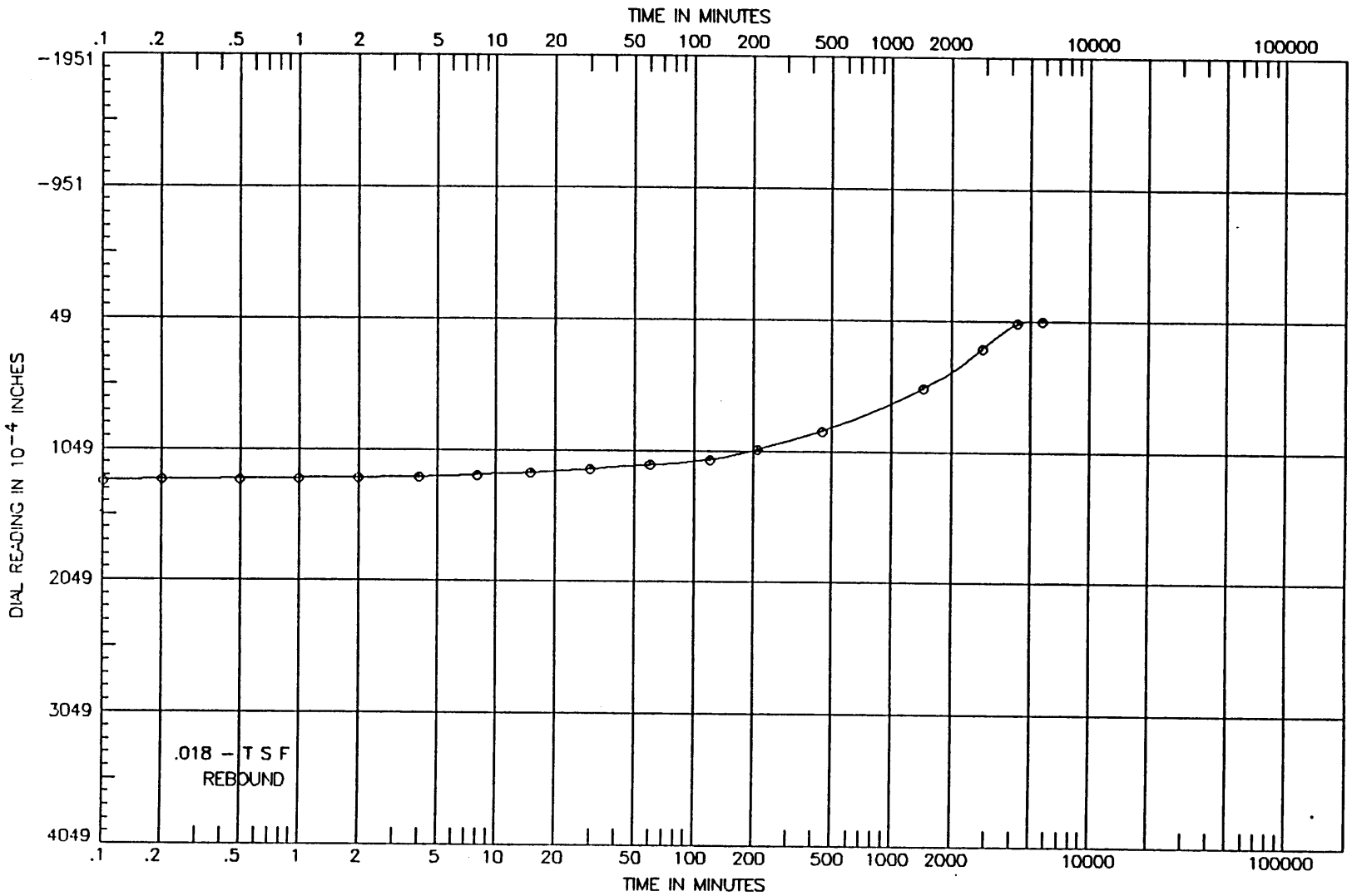


PROJECT EASTERN ARKANSAS	
BORING 2-EAU-94	SAMPLE NO. 4
DEPTH/ELEV 8.9-9.8	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 8 OF 9

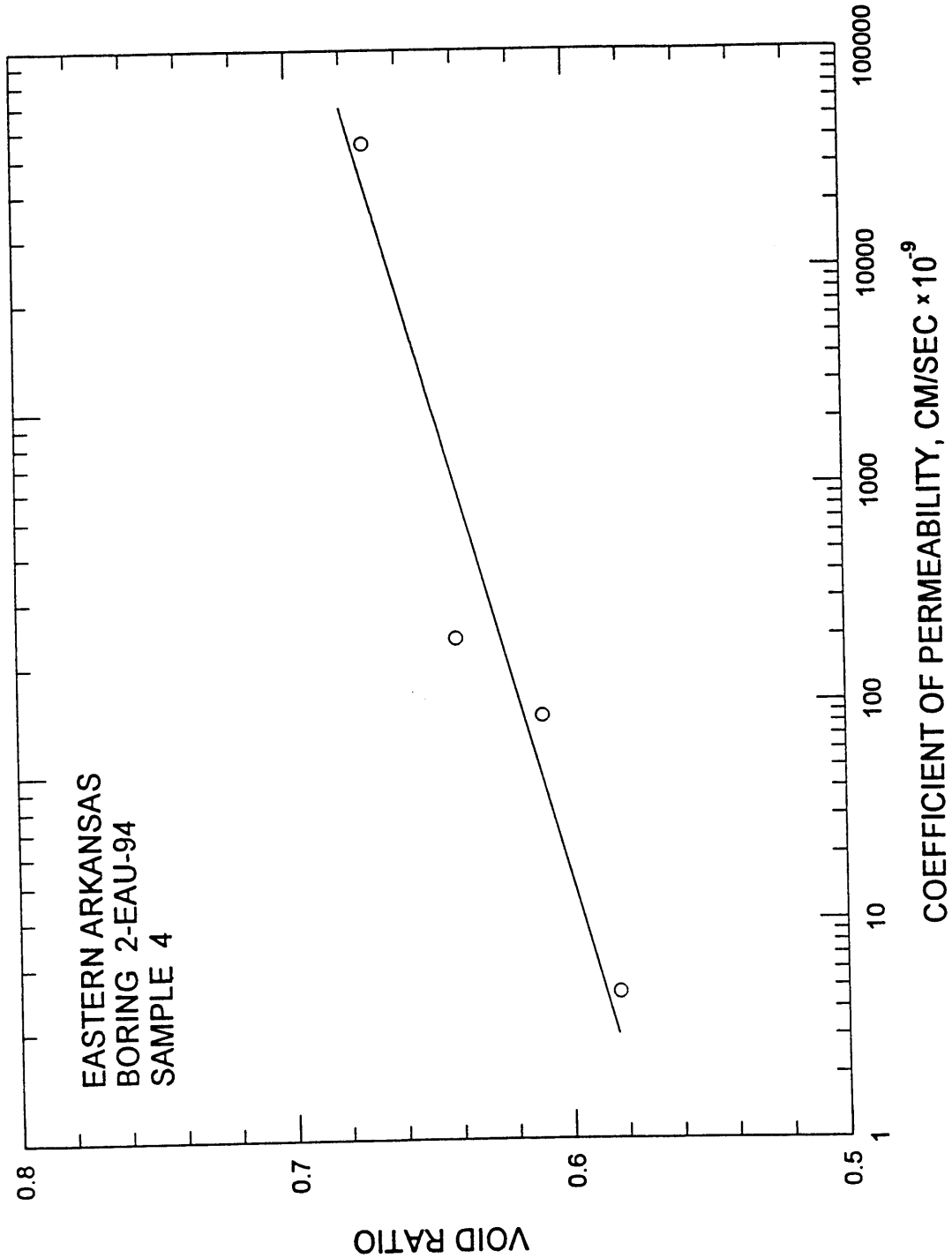


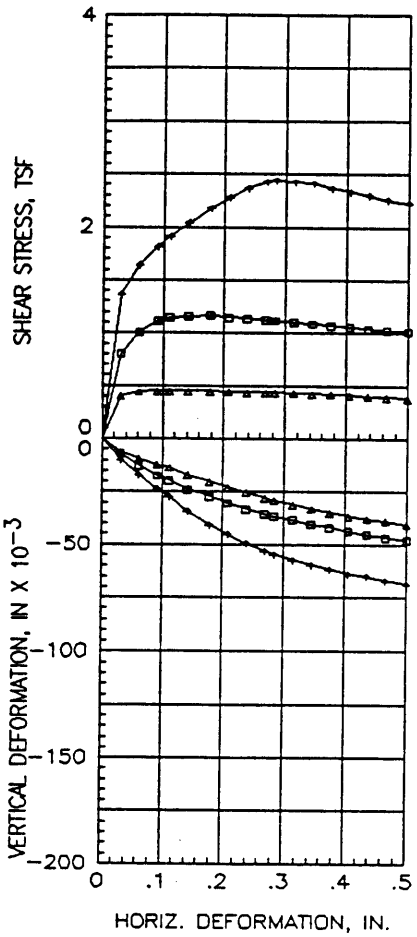
PROJECT EASTERN ARKANSAS	
BORING 2-EAU-94	SAMPLE NO. 4
DEPTH/ELEV 8.9-9.8	DATE 10 FEB 95

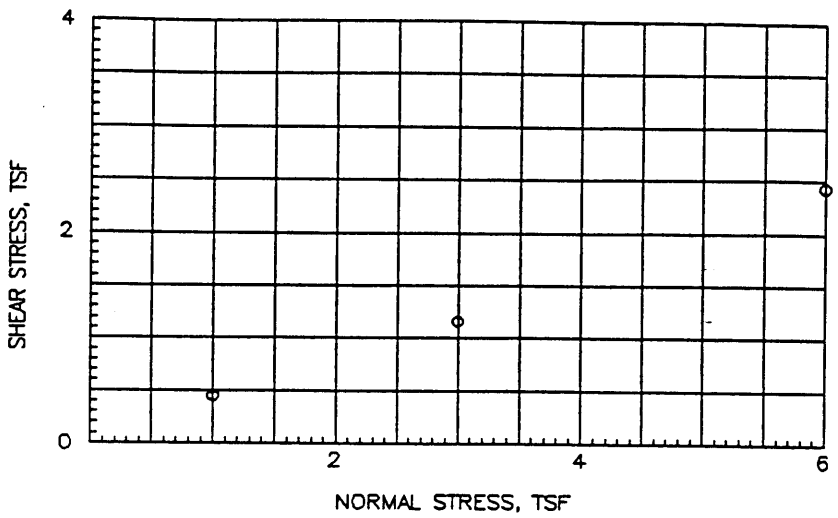
CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 9 OF 9


EASTERN ARKANSAS
BORING 2-EAU-94
SAMPLE 4
VOID RATIO
0.8
0.7
0.6
0.5
1
10
100
1000
10000
100000
COEFFICIENT OF PERMEABILITY, CM/SEC x 10^-9





ϕ = _____ DEG

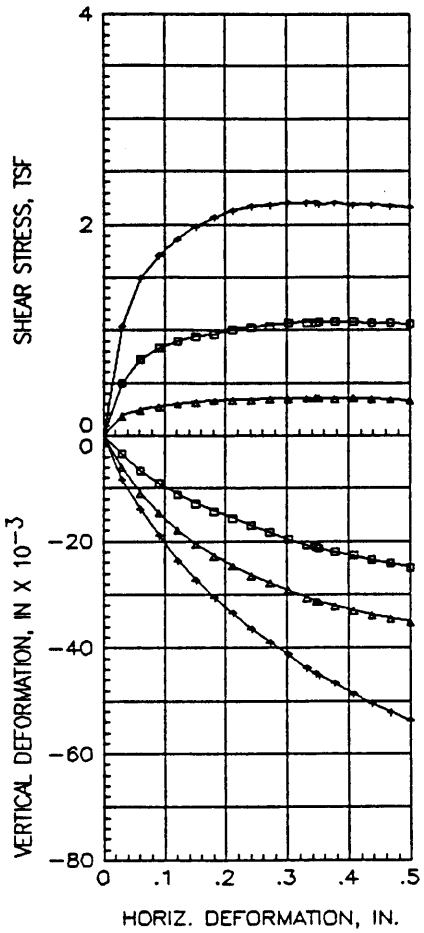
TAN ϕ = _____

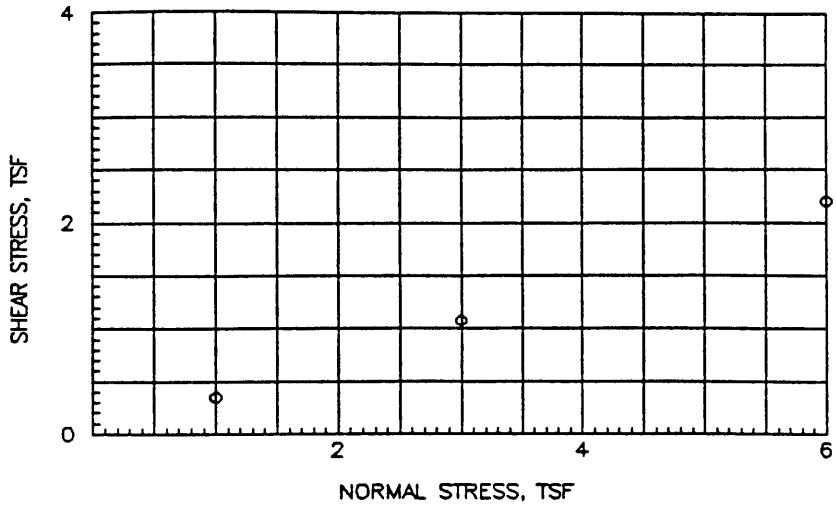
C = _____ T/SF

	TEST NO.	1 ▲	2 □	3 +	
INITAL	WATER CONTENT, %	23.0	23.5	22.7	
	VOID RATIO	.692	.692	.674	
	SATURATION, %	89.6	91.6	91.0	
	DRY DENSITY, PCF	99.6	99.6	100.6	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	23.1	22.3	20.6	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.45	1.17	2.44	
TIME TO FAILURE, MIN		554	880	1406	
RATE OF STRAIN, IN/MIN		.00020	.00020	.00020	
ULTIMATE SHEAR STRESS, TSF		.38	1.02	2.22	

TYPE SPECIMEN	UNDISTURBED		3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION	CLAY (CL), GRAY; IRON OXIDE PARTICLES			
LL 46	PL 20	PI 26		GS 2.70 (EST)

REMARKS:	PROJECT EASTERN ARKANSAS	
	BORING NO. 4-EAU-94	SAMPLE 3
	DEPTH/ELEV 5.0-6.0	TECH. JL
	LABORATORY USAE WES - STF/GL	DATE 21 MAR 95
	DIRECT SHEAR TEST REPORT	





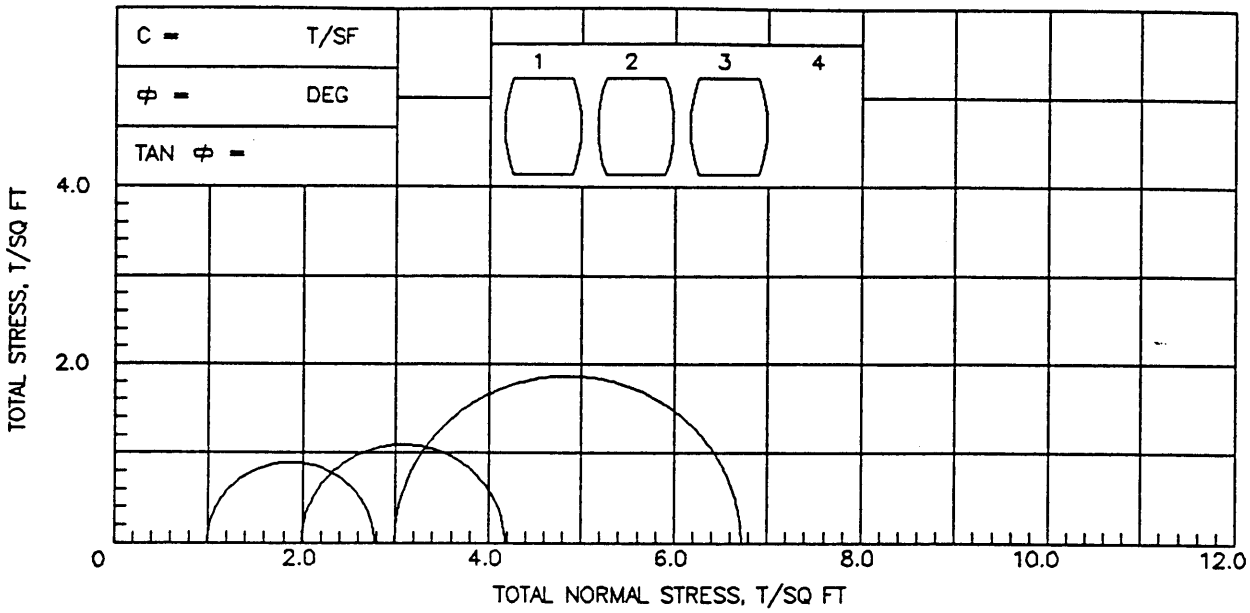
ϕ = _____ DEG

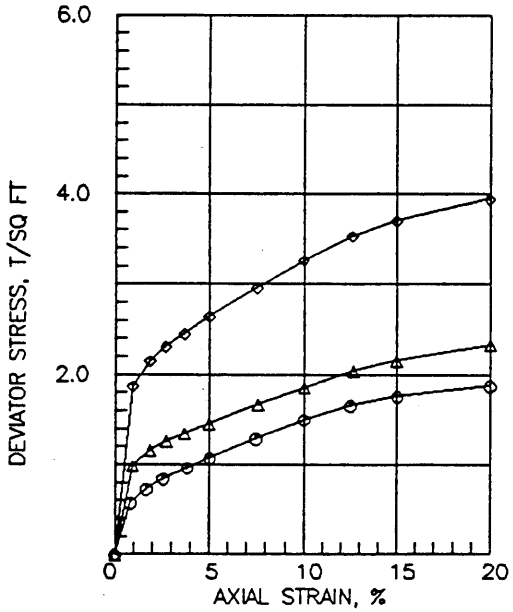
TAN ϕ = _____

C = _____ T/SF

	TEST NO.	1 ▲	2 □	3 ✦	
INITAL	WATER CONTENT, %	15.3	15.3	15.2	
	VOID RATIO	.927	.919	.908	
	SATURATION, %	44.5	44.8	45.3	
	DRY DENSITY, PCF	87.4	87.8	88.3	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	23.9	20.8	19.0	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.36	1.08	2.21	
TIME TO FAILURE, MIN		1927	2064	1900	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF		.34	1.06	2.16	

TYPE SPECIMEN	COMPACTED			3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION	CLAY (CL), GRAY				
LL	PL	PI		GS 2.70 (EST)	
REMARKS;			PROJECT EASTERN ARKANSAS		
SPECIMENS COMPACTED					
AT 15 BLOW EFFORT			BORING NO. 4-EAU-94	SAMPLE 3	
			DEPTH/ELEV 5.0-6.0	TECH. JL	
			LABORATORY USAE WES - STF/GL	DATE 04 APR 95	
			DIRECT SHEAR TEST REPORT		





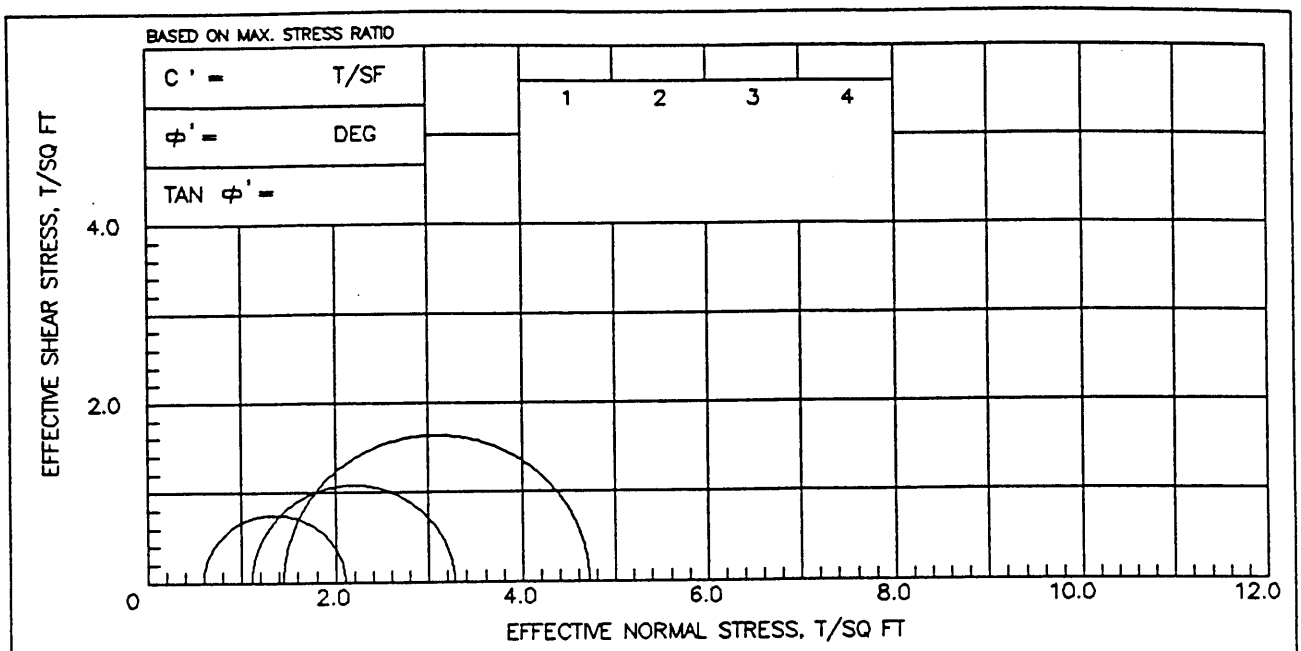
SPECIMEN NO.		⊙ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	16.8	16.5	16.4	
	DRY DENSITY, PCF	105.0	103.4	105.3	
	SATURATION, %	74.9	70.4	73.7	
	VOID RATIO	.605	.631	.600	
BEFORE SHEAR	WATER CONTENT, %	22.3	22.2	21.3	
	DRY DENSITY, PCF	108.6	111.0	111.3	
	SATURATION, %	100+	100+	100+	
	VOID RATIO	.552	.519	.514	
	BACK PRESS., TSF	5.04	5.04	5.04	
MIN. PRIN. STRESS, TSF		1.00	2.00	3.00	
MAX. DEV. STRESS, TSF		1.76	2.16	3.71	
TIME TO FAILURE, MIN.		958	969	966	
RATE OF STRAIN, %/MIN		.016	.016	.016	
INITIAL DIAMETER, IN.		1.37	1.37	1.38	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

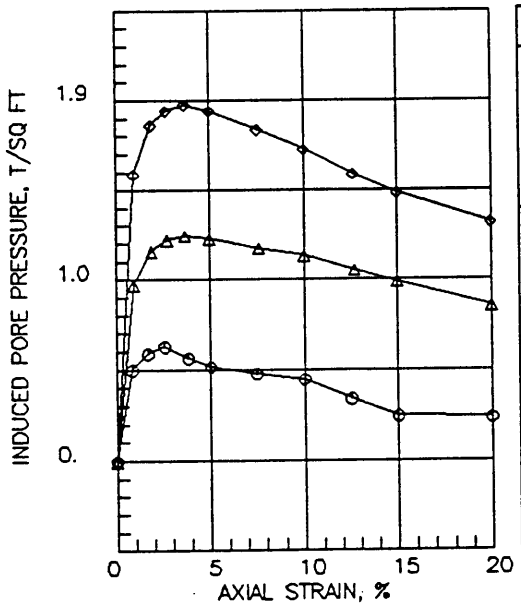
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: SANDY CLAY (CL), BROWN

LL 30	PL 14	PI 16	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	$\bar{R}$ TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 5-EAU-94	SAMPLE NO. 4
	DEPTH/ELEV 8.0-9.2	TECH. JH
	LABORATORY USAE WES - STF/GL	DATE 03 APR 95
	$\bar{R}$-TRIAXIAL COMPRESSION TEST REPORT	





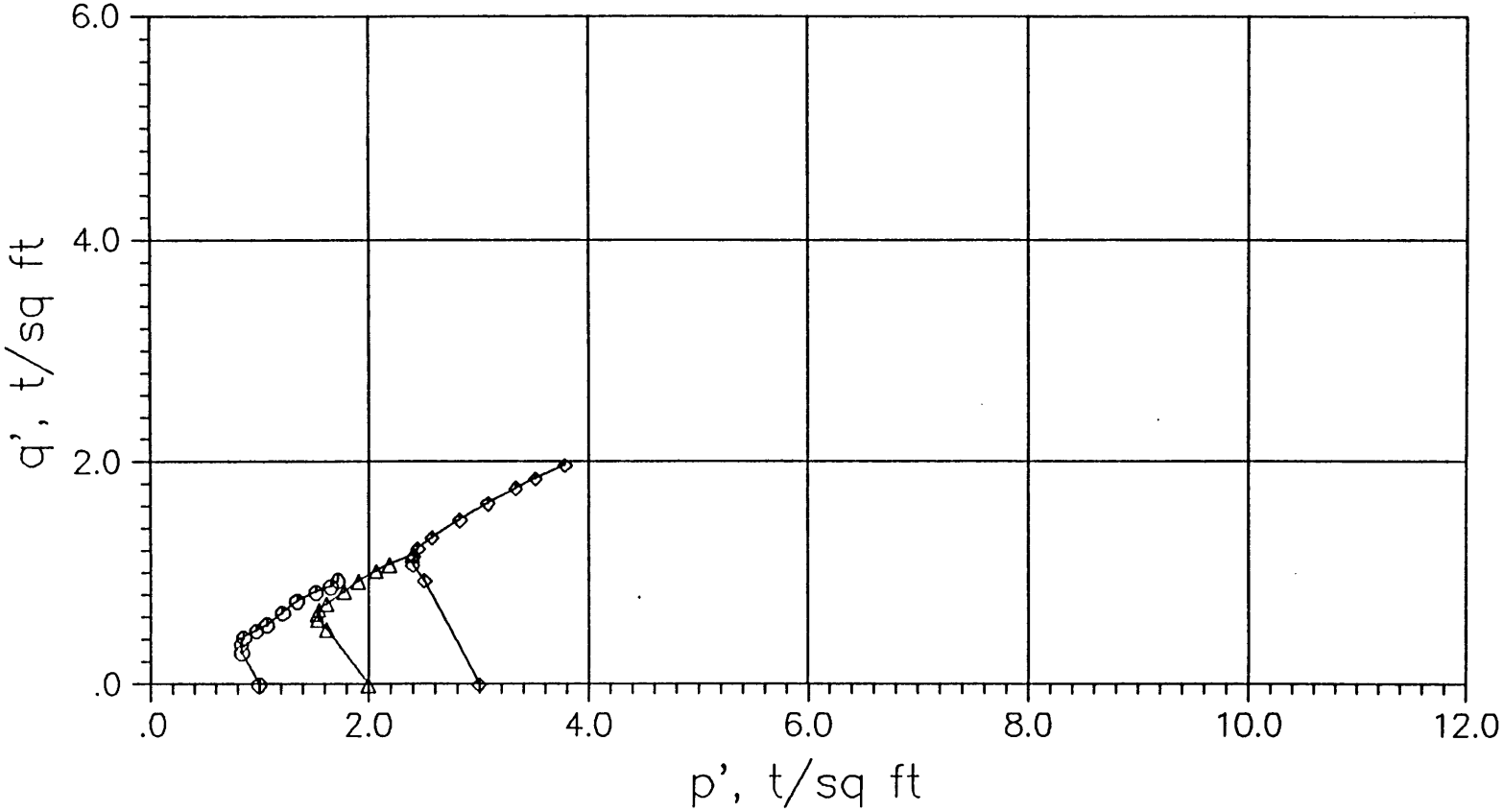
SPECIMEN NO.		⊙ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	16.8	16.5	16.4	
	DRY DENSITY, PCF	105.0	103.4	105.3	
	SATURATION, %	74.9	70.4	73.7	
	VOID RATIO	.605	.631	.600	
BEFORE SHEAR	WATER CONTENT, %	22.3	22.2	21.3	
	DRY DENSITY, PCF	108.6	111.0	111.3	
	SATURATION, %	100+	100+	100+	
	VOID RATIO	.552	.519	.514	
	BACK PRESS., TSF	5.04	5.04	5.04	
⊙ σ_1'/σ_3' MAX	MIN PRIN EFF STRESS, TSF	.60	1.11	1.44	
	DEV. STRESS, TSF	1.51	2.16	3.27	
	TIME TO FAILURE, MIN.	638	969	644	
RATE OF STRAIN, %/MIN		.016	.016	.016	
INITIAL DIAMETER, IN.		1.37	1.37	1.38	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: SANDY CLAY (CL), BROWN

LL 30	PL 14	PI 16	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	$\bar{R}$ TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 5-EAU-94	SAMPLE NO. 4
	DEPTH/ELEV 8.0-9.2	TECH. JH
	LABORATORY USAE WES - STF/GL	DATE 03 APR 95
	$\bar{R}$-TRIAXIAL COMPRESSION TEST REPORT	



PROJECT	EASTERN ARKANSAS		Stress Paths
BORING	5-EAU-94	SAMPLE NO. 4	LABORATORY USAE WES - STF/GL
DEPTH/ELEV	8.0-9.2	DATE 03 APR 95	

R-BAR TRIAXIAL COMPRESSION TEST REPORT

TLE: EASTERN ARKANSAS

BOR: 5-EAU-94 SAM: 4 DEP: 8.0-9.2 DAT: 03 APR 95 TEC: JH
DES: SANDY CLAY (CL), BROWN

REM:
SPECIMENS COMPACTED
AT 15 BLOW EFFORT
SAMPLE TYPE = COMPACTED
GS: 2.70 (ESTIMATED)
LL: 30 PL: 14 PI: 16

WEIGHT OF SOLIDS = 121.38 I. HEIGHT = 3.000" I. DIAMETER = 1.367"

HEIGHT CHANGES: PRE-CONS. = .01500" DURING CONS. = .01500"

VOLUME CHANGE DURING CONS. = 1.3 CC TIME OF TEST = 1264 MINS.

BACK PRESSURE = 70.00 PSI (5.04 TSF) CHAMBER PRESSURE = 83.89

EFF CONFINING PRESSURE, TSF = 1.00

	INITIAL	BEFORE SHEAR
WATER CONTENT, %	16.77	22.28
VOID RATIO	.605	.552
SATURATION, %	74.86	108.99
DRY DENSITY, PCF	105.03	108.61

V DEF IN.	AXIAL LOAD LBS	PORE PRESS PSI	STRAIN %	IND POR PRESS TSF	DEVIAT STRESS TSF	EFFECTIVE E1 - TSF	E3 -	RATIO E1/ E3	NORML STRES TSF	SHEAR STRES TSF
.000	.0	70.0	.0	.00	.00	1.000	1.000	1.000	1.00	.00
.025	11.6	76.3	.8	.45	.58	1.124	.546	2.057	.84	.29
.050	14.8	77.4	1.7	.53	.73	1.198	.467	2.564	.83	.37
.077	17.3	77.9	2.6	.57	.85	1.277	.431	2.962	.85	.42
.114	20.0	77.1	3.8	.51	.97	1.455	.489	2.976	.97	.48
.149	22.5	76.5	5.0	.47	1.07	1.605	.532	3.017	1.07	.54
.222	27.8	76.0	7.5	.43	1.29	1.860	.568	3.274	1.21	.65
.297	33.3	75.6	10.0	.40	1.51	2.102	.597	3.522	1.35	.75
.372	37.8	74.3	12.5	.31	1.66	2.351	.690	3.405	1.52	.83
.446	41.3	73.1	15.0	.22	1.76	2.539	.777	3.269	1.66	.88
.594	46.7	73.0	20.0	.22	1.88	2.660	.784	3.393	1.72	.94

RATE OF STRAIN = .016

R-BAR TRIAXIAL COMPRESSION TEST REPORT

TLE: EASTERN ARKANSAS

BOR: 5-EAU-94 SAM: 4 DEP: 8.0-9.2 DAT: 03 APR 95 TEC: JH
DES: SANDY CLAY (CL), BROWN

REM:
SPECIMENS COMPACTED
AT 15 BLOW EFFORT
SAMPLE TYPE = COMPACTED
GS: 2.70 (ESTIMATED)
LL: 30 PL: 14 PI: 16

WEIGHT OF SOLIDS = 119.97 I. HEIGHT = 3.000" I. DIAMETER = 1.370"

HEIGHT CHANGES: PRE-CONS. = .03600" DURING CONS. = .03500"

VOLUME CHANGE DURING CONS. = 2.4 CC TIME OF TEST = 1264 MINS.

BACK PRESSURE = 70.00 PSI (5.04 TSF) CHAMBER PRESSURE = 97.78

EFF CONFINING PRESSURE, TSF = 2.00

	INITIAL	BEFORE SHEAR
WATER CONTENT, %	16.46	22.21
VOID RATIO	.631	.519
SATURATION, %	70.45	115.63
DRY DENSITY, PCF	103.36	111.00

V DEF IN.	AXIAL LOAD LBS	PORE PRESS PSI	STRAIN %	IND POR PRESS TSF	DEVIAT STRESS TSF	EFFECTIVE E1 - TSF	E3 -	RATIO E1/ E3	NORML STRES TSF	SHEAR STRES TSF
.000	.0	70.0	.0	.00	.00	2.000	2.000	1.000	2.00	.00
.028	19.6	82.2	1.0	.88	.99	2.116	1.122	1.886	1.62	.50
.056	23.2	84.5	1.9	1.04	1.17	2.121	.956	2.219	1.54	.58
.080	25.4	85.3	2.7	1.10	1.27	2.164	.898	2.408	1.53	.63
.108	27.4	85.6	3.7	1.12	1.35	2.228	.877	2.541	1.55	.68
.146	29.9	85.4	5.0	1.11	1.45	2.346	.891	2.632	1.62	.73
.222	35.4	84.7	7.6	1.06	1.68	2.617	.942	2.779	1.78	.84
.293	40.4	84.2	10.0	1.02	1.86	2.840	.978	2.904	1.91	.93
.372	45.8	83.2	12.7	.95	2.05	3.097	1.050	2.951	2.07	1.02
.439	49.7	82.4	15.0	.89	2.16	3.271	1.107	2.954	2.19	1.08
.586	56.9	80.7	20.0	.77	2.33	3.560	1.230	2.895	2.40	1.17

RATE OF STRAIN = .016

R-BAR TRIAXIAL COMPRESSION TEST REPORT

TLE: EASTERN ARKANSAS

BOR: 5-EAU-94 SAM: 4 DEP: 8.0-9.2 DAT: 03 APR 95 TEC: JH
DES: SANDY CLAY (CL), BROWN

REM:
SPECIMENS COMPACTED
AT 15 BLOW EFFORT
SAMPLE TYPE = COMPACTED
GS: 2.70 (ESTIMATED)
LL: 30 PL: 14 PI: 16

WEIGHT OF SOLIDS = 123.32 I. HEIGHT = 3.000" I. DIAMETER = 1.376"

HEIGHT CHANGES: PRE-CONS. = .00900" DURING CONS. = .04900"

VOLUME CHANGE DURING CONS. = 3.3 CC TIME OF TEST = 1264 MINS.

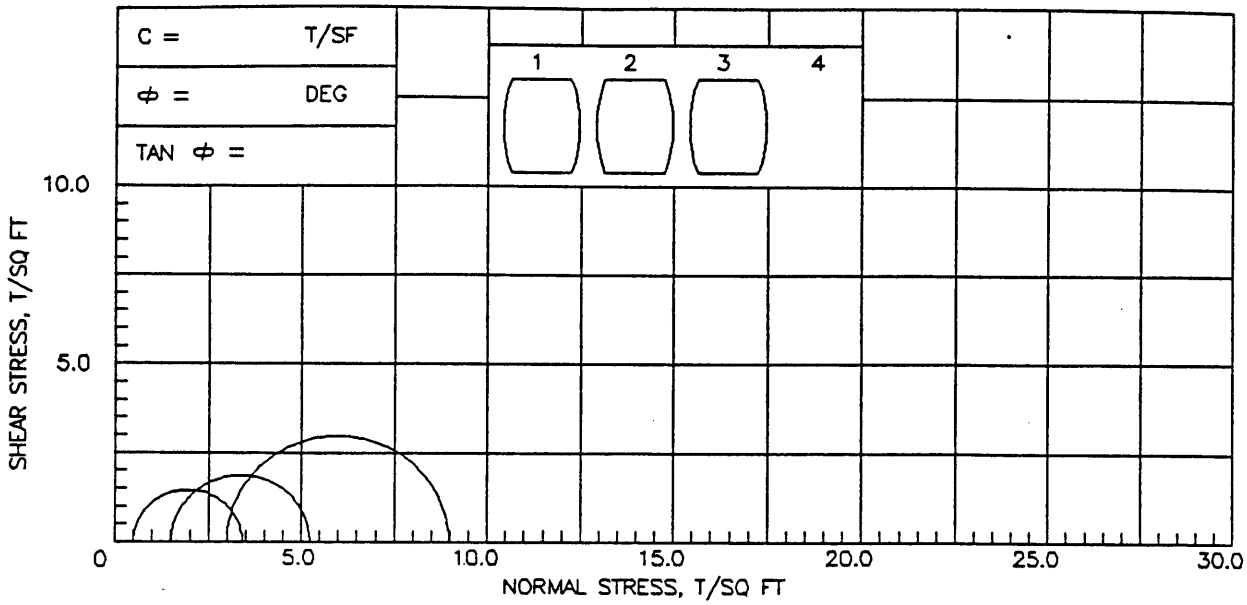
BACK PRESSURE = 70.00 PSI (5.04 TSF) CHAMBER PRESSURE = 111.67

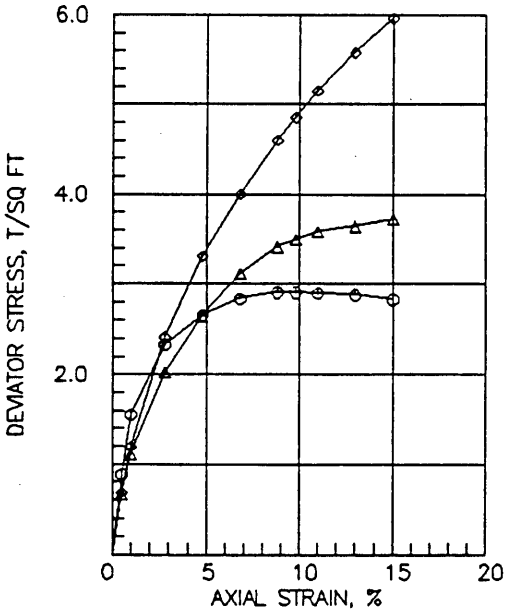
EFF CONFINING PRESSURE, TSF = 3.00

	INITIAL	BEFORE SHEAR
WATER CONTENT, %	16.40	21.29
VOID RATIO	.600	.514
SATURATION, %	73.74	111.86
DRY DENSITY, PCF	105.32	111.34

V DEF IN.	AXIAL LOAD LBS	PORE PRESS PSI	STRAIN %	IND POR PRESS TSF	DEVIAT STRESS TSF	EFFECTIVE E1 - TSF -	E3	RATIO E1/ E3	NORML STRES TSF	SHEAR STRES TSF
.000	.0	70.0	.0	.00	.00	3.000	3.000	1.000	3.00	.00
.028	37.7	89.9	1.0	1.43	1.87	3.442	1.567	2.196	2.50	.94
.056	43.8	93.3	1.9	1.68	2.16	3.479	1.323	2.631	2.40	1.08
.080	47.4	94.3	2.7	1.75	2.31	3.565	1.251	2.851	2.41	1.16
.108	50.7	94.7	3.7	1.78	2.45	3.673	1.222	3.006	2.45	1.23
.147	55.5	94.3	5.0	1.75	2.65	3.897	1.251	3.116	2.57	1.32
.222	63.9	93.0	7.5	1.66	2.97	4.310	1.344	3.206	2.83	1.48
.294	72.3	91.6	10.0	1.56	3.27	4.711	1.445	3.261	3.08	1.63
.372	80.6	89.9	12.6	1.43	3.53	5.101	1.567	3.255	3.33	1.77
.441	86.9	88.6	15.0	1.34	3.71	5.369	1.661	3.233	3.51	1.85
.588	98.3	86.5	20.0	1.19	3.95	5.760	1.812	3.179	3.79	1.97

RATE OF STRAIN = .016





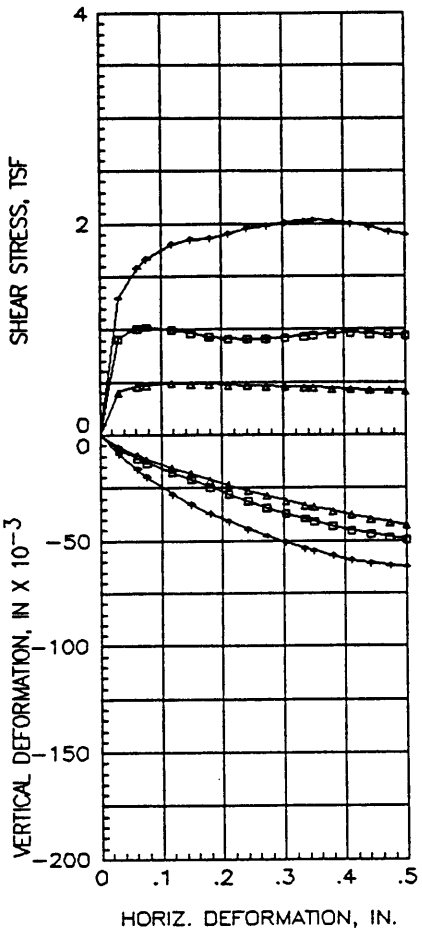
SPECIMEN NO.		○ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	17.1	17.1	16.8	
	DRY DENSITY, PCF	82.1	82.7	87.3	
	SATURATION, %	44.0	44.6	48.9	
	VOID RATIO	1.052	1.039	.931	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESSURE, TSF				
CHAMBER PRESSURE, TSF		.50	1.50	3.00	
MAX. DEV. STRESS, TSF		2.91	3.73	5.97	
TIME TO FAILURE, MIN.		18	31	31	
STRAIN RATE INCR., %					
INITIAL DIAMETER, IN.		1.38	1.38	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

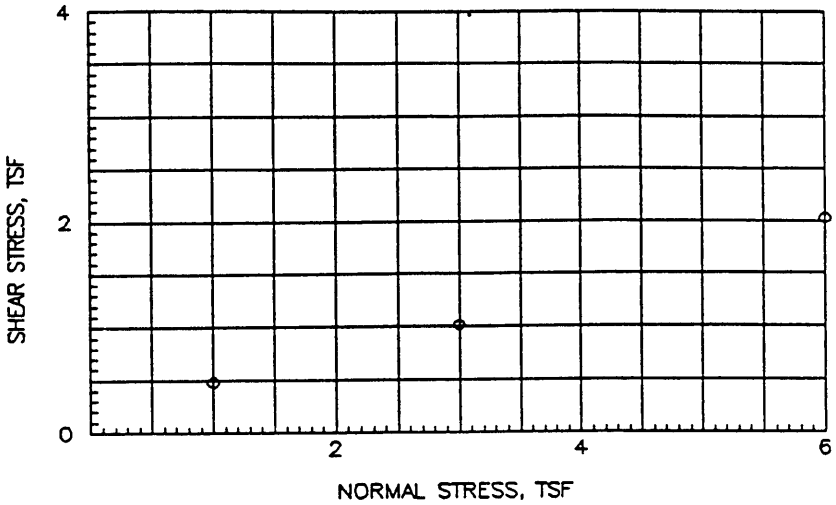
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CH), GRAY

LL 71	PL 19	PI 52	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	Q TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO.. 6-EAU-94	SAMPLE NO. 3
	DEPTH/ELEV 5.0-6.0	TECH. US
	LABORATORY USAE WES - STF/GL	DATE 06 APR 95
	TRIAXIAL COMPRESSION TEST REPORT	





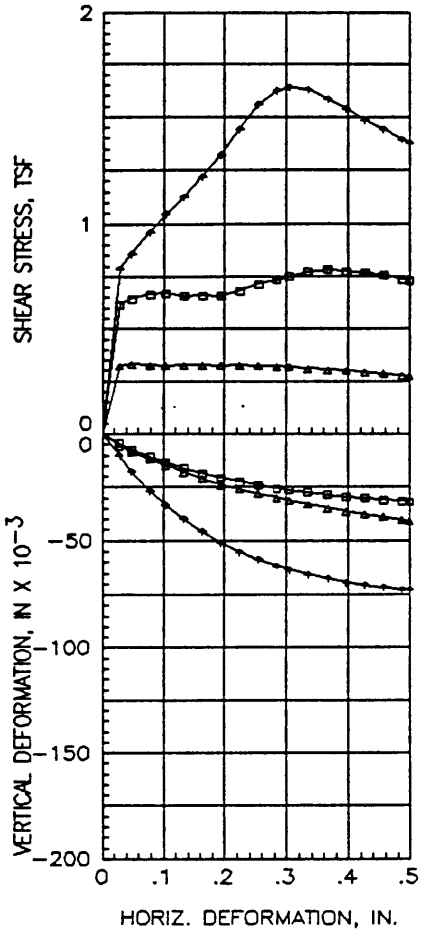
ϕ = _____ DEG

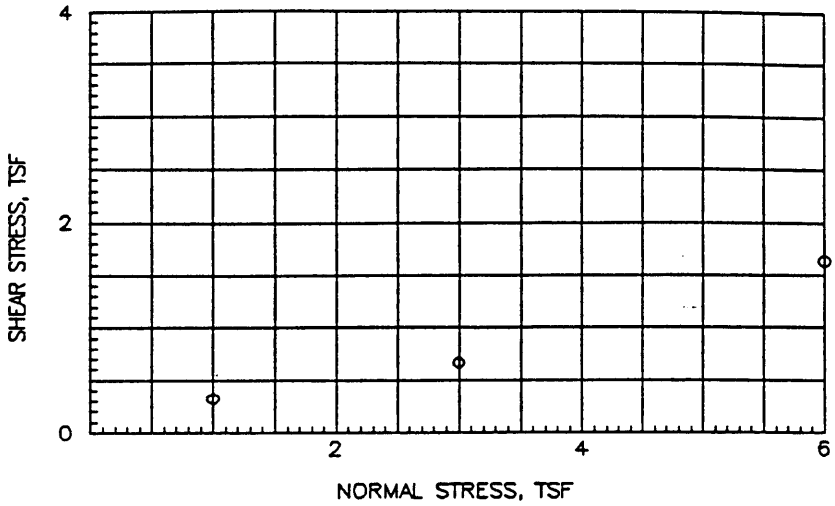
TAN ϕ = _____

C = _____ T/SF

	TEST NO.	1 ▲	2 □	3 ✦	
INITAL	WATER CONTENT, %	25.8	25.7	25.5	
	VOID RATIO	.767	.787	.760	
	SATURATION, %	90.7	88.3	90.5	
	DRY DENSITY, PCF	95.4	94.3	95.7	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	26.4	24.3	22.4	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.49	1.02	2.03	
TIME TO FAILURE, MIN		638	415	1890	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF		.42	.91	1.89	

TYPE SPECIMEN	UNDISTURBED		3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION	CLAY (CH), BROWN; IRON OXIDE PARTICLES			
LL 71	PL 19	PI 52		GS 2.70 (EST)
REMARKS;		PROJECT	EASTERN ARKANSAS	
		BORING NO.	6-EAU-94	SAMPLE 3
		DEPTH/ELEV	5.0-6.0	TECH. JL
		LABORATORY	USAE WES - STF/GL	DATE 27 MAR 95
		DIRECT SHEAR TEST REPORT		





	TEST NO.	1 ▲	2 □	3 ✦	
INITAL	WATER CONTENT, %	30.5	30.1	31.6	
	VOID RATIO	.856	.848	.851	
	SATURATION, %	96.2	95.9	100+	
	DRY DENSITY, PCF	90.8	91.1	91.0	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	32.6	31.5	29.3	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.33	.67	1.64	
TIME TO FAILURE, MIN		251	536	1577	
RATE OF STRAIN, IN/MIN		.00019	.00019	.00019	
ULTIMATE SHEAR STRESS, TSF		.27	.66	1.37	

ϕ = _____ DEG

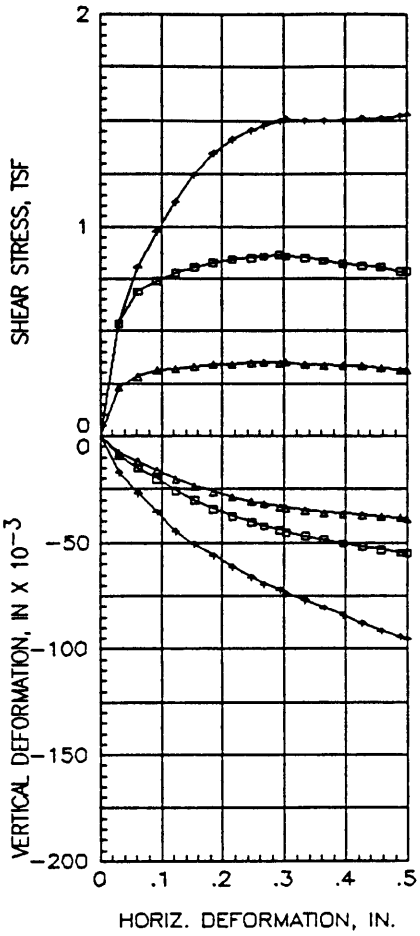
TAN ϕ = _____

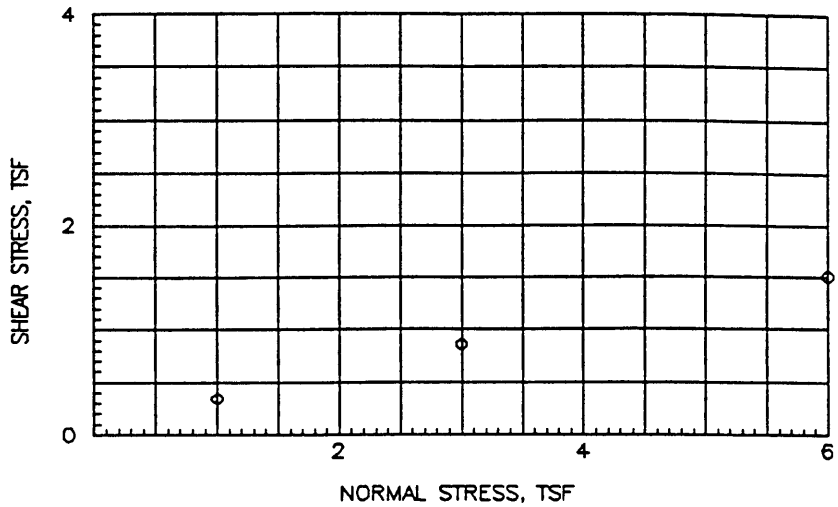
C = _____ T/SF

TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION CLAY (CH), REDDISH BROWN; FISSURED		

LL 62	PL 16	PI 46		GS 2.70 (EST)

REMARKS;	PROJECT EASTERN ARKANSAS	
	BORING NO. 6-EAU-94	SAMPLE 4
	DEPTH/ELEV 8.0-9.0	TECH. JL
	LABORATORY USAE WES - STF/GL	DATE 28 MAR 95
	DIRECT SHEAR TEST REPORT	





ϕ = _____ DEG

TAN ϕ = _____

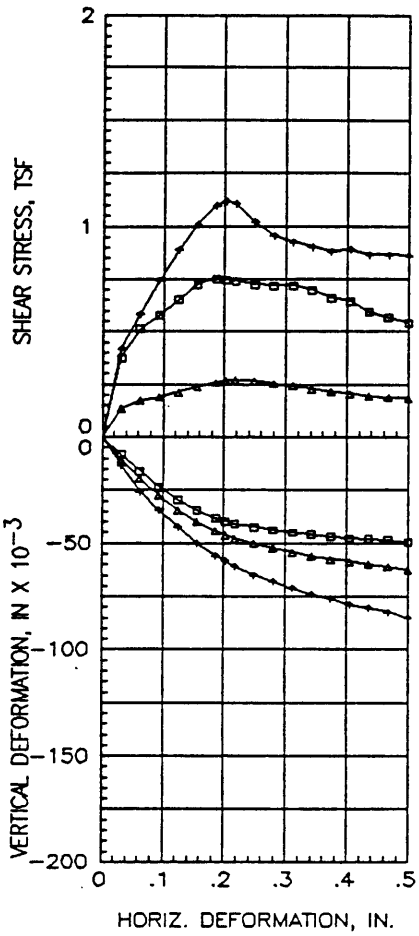
C = _____ T/SF

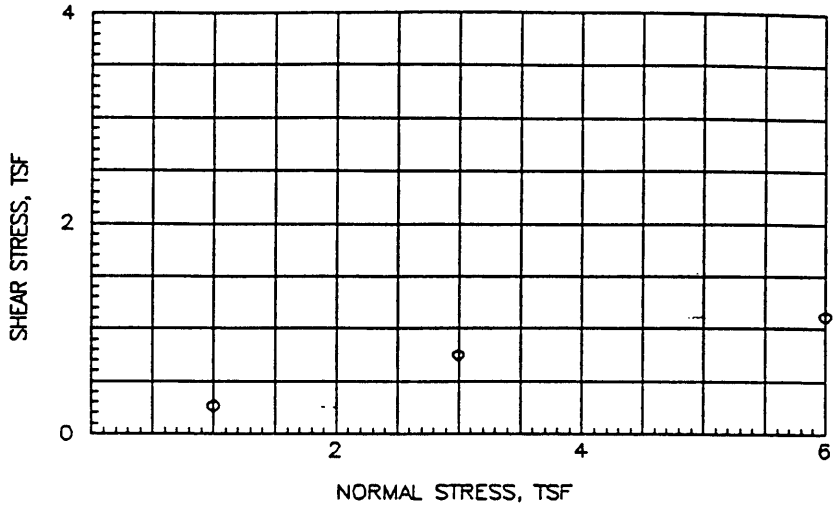
	TEST NO.	1 ▲	2 □	3 ◆	
INITAL	WATER CONTENT, %	17.1	17.2	17.0	
	VOID RATIO	.950	.906	.880	
	SATURATION, %	48.7	51.2	52.3	
	DRY DENSITY, PCF	86.4	88.4	89.6	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	27.1	23.7	21.9	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.35	.86	1.51	
TIME TO FAILURE, MIN		1484	1627	1684	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF		.32	.78	1.50	

TYPE SPECIMEN COMPACTED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION CLAY (CH), BROWN		

LL	PL	PI		GS 2.70 (EST)

REMARKS;	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 6-EAU-94	SAMPLE 3
	DEPTH/ELEV 5.0-6.0	TECH. JL
	LABORATORY USAE WES - STF/GL	DATE 17 APR 95
	DIRECT SHEAR TEST REPORT	





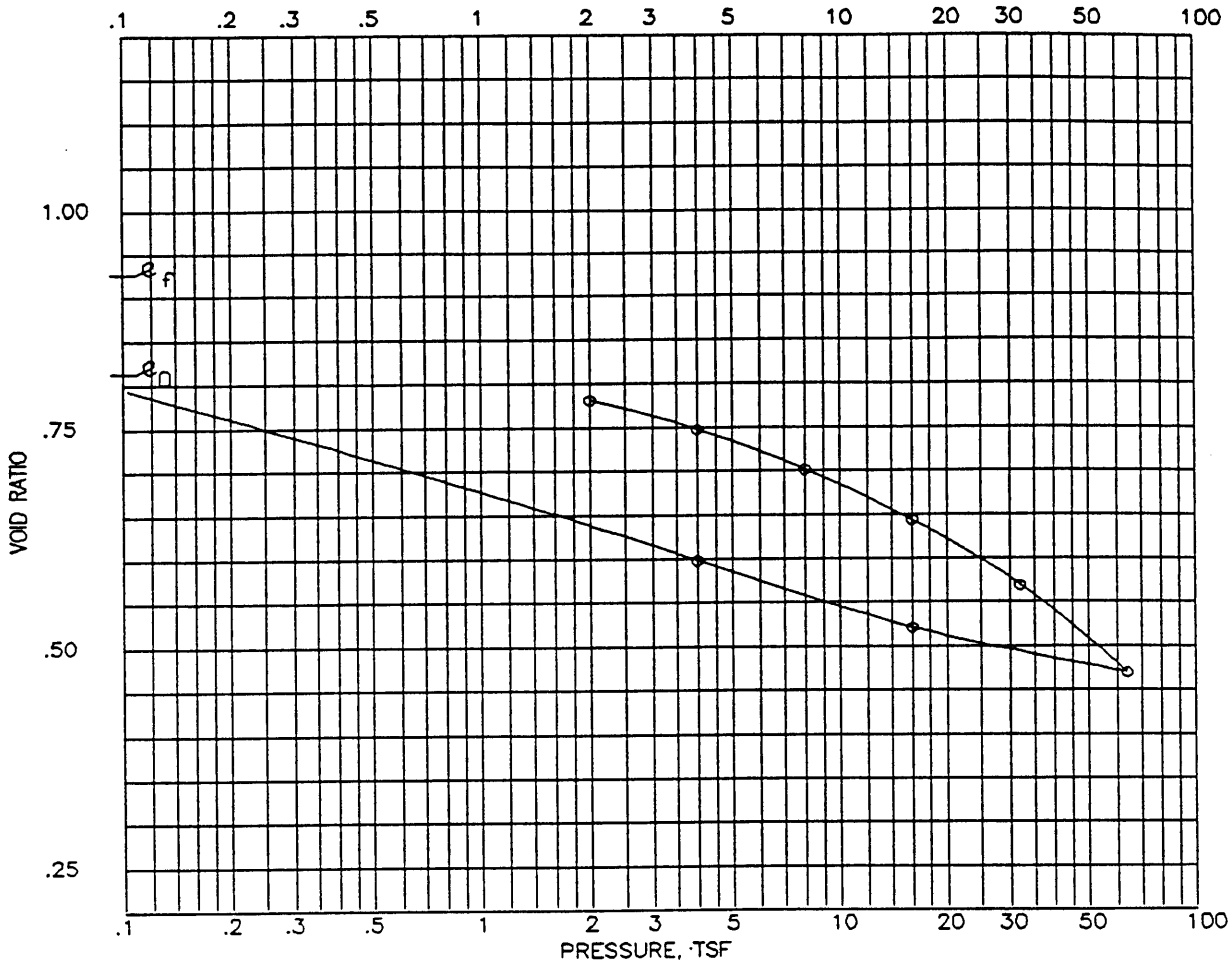
	TEST NO.	1 ▲	2 □	3 ✦	
INITAL	WATER CONTENT, %	26.3	26.1	26.4	
	VOID RATIO	.935	.934	.905	
	SATURATION, %	76.0	75.4	78.7	
	DRY DENSITY, PCF	87.1	87.1	88.4	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	33.9	28.9	26.4	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.27	.75	1.12	
TIME TO FAILURE, MIN		1302	1116	1209	
RATE OF STRAIN, IN/MIN		.00017	.00017	.00017	
ULTIMATE SHEAR STRESS, TSF		.19	.54	.86	

ϕ = _____ DEG

TAN ϕ = _____

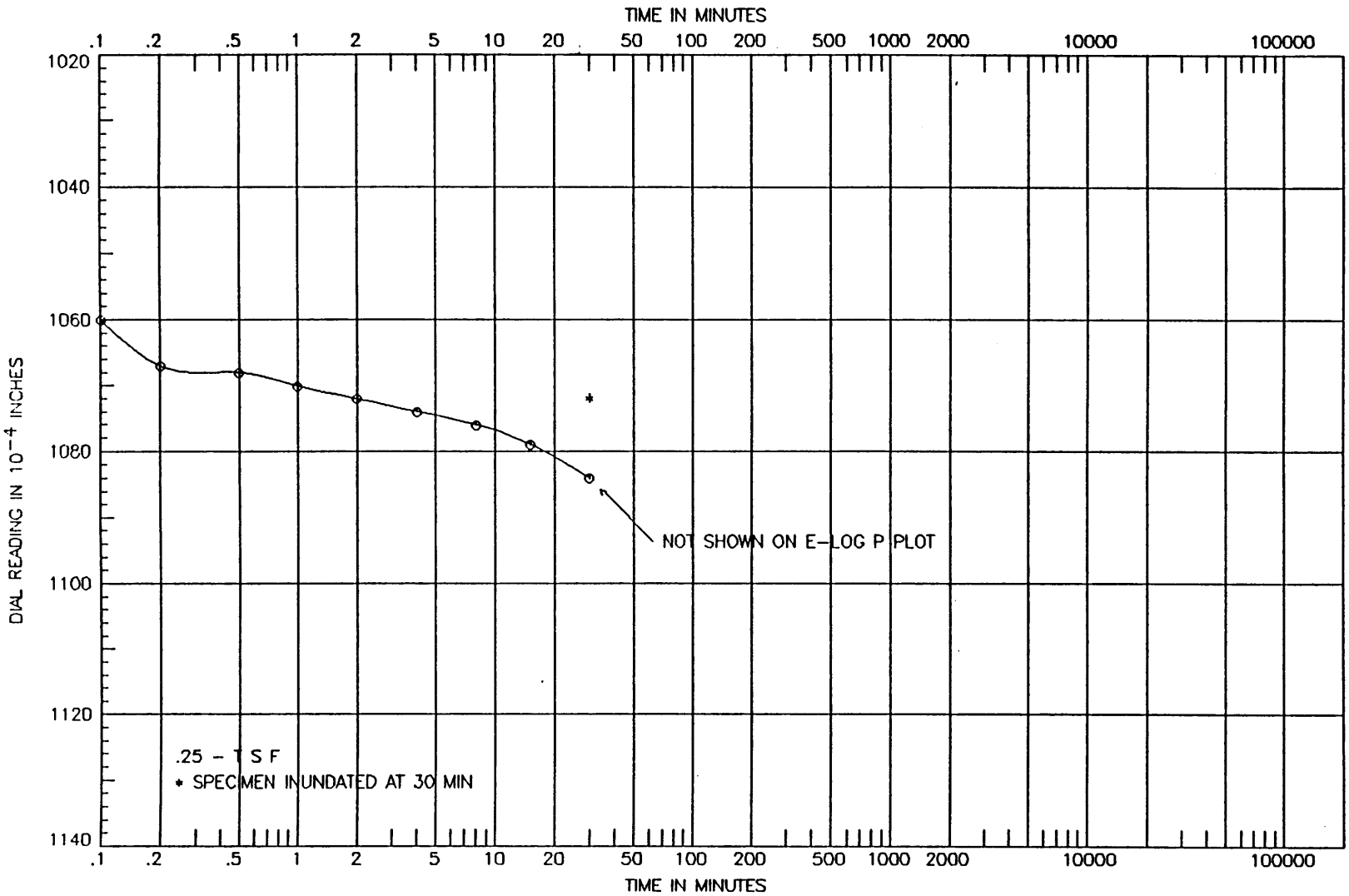
C = _____ T/SF

TYPE SPECIMEN COMPACTED			3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION CLAY (CH), REDDISH BROWN				
LL	PL	PI		GS 2.70 (EST)
REMARKS;			PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED				
AT 15 BLOW EFFORT			BORING NO. 6-EAU-94	SAMPLE 4
			DEPTH/ELEV 8.0-9.0	TECH. JL
			LABORATORY USAE WES - STF/GL	DATE 04 APR 95
			DIRECT SHEAR TEST REPORT	



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	29.6	36.3
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	93.1	87.6
COMPRESSION INDEX		SATURATION, %	98.6	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	.811	.924
DIA. IN 4.25	HT. IN 1.163	BACK PRESSURE, TSF		
CLASSIFICATION	CLAY (CH), REDDISH BROWN; SLICKENSIDED			
LL	PL / PI	PROJECT EASTERN ARKANSAS		
GS 2.70 (EST)	D_{10}			
REMARKS:		BORING NO. 6-EAU-94	SAMPLE NO. 4	
		DEPTH/ELEV 8.0-9.0	TECH. JL	
		LABORATORY USAE WES - STF/GL	DATE 10 FEB 95	
		CONSOLIDATION TEST REPORT		

SHEET 1 OF 11

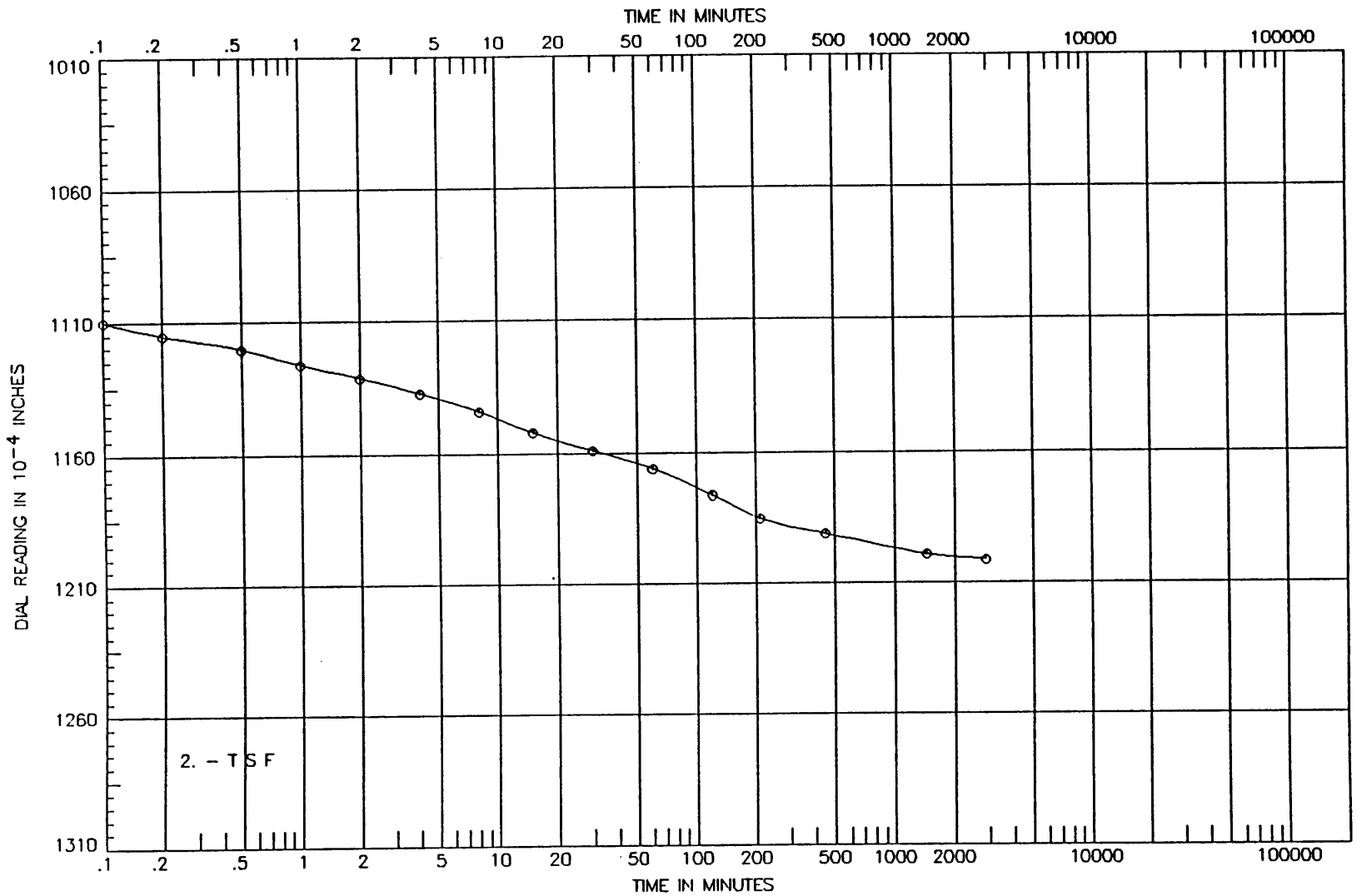


PROJECT EASTERN ARKANSAS	
BORING 6-EAU-94	SAMPLE NO. 4
DEPTH/ELEV 8.0-9.0	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 2 OF 11

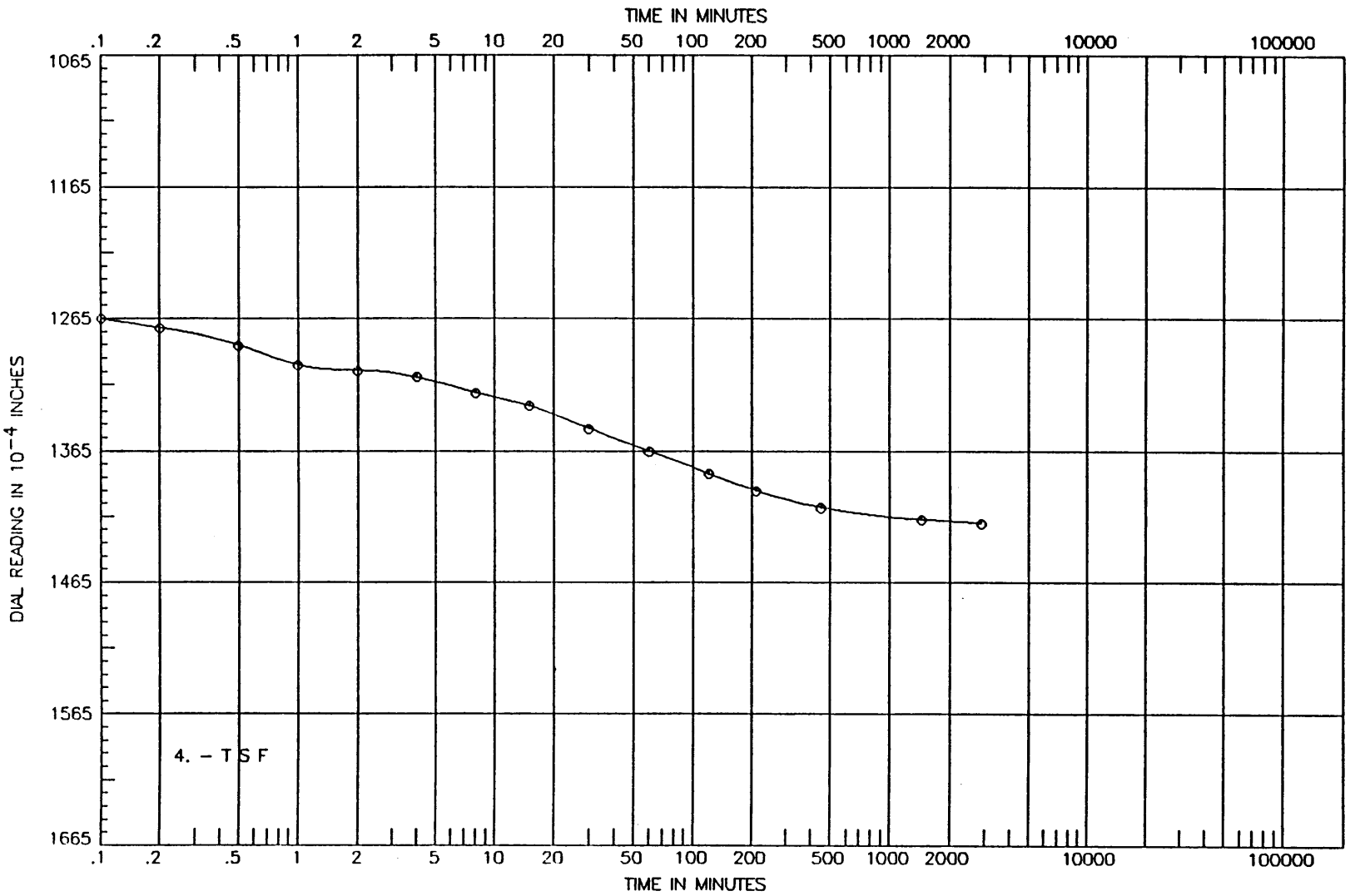


PROJECT	EASTERN ARKANSAS		
BORING	6-EAU-94	SAMPLE NO.	4
DEPTH/ELEV	8.0-9.0	DATE	10 FEB 95

CONSOLIDATION TEST TIME CURVES

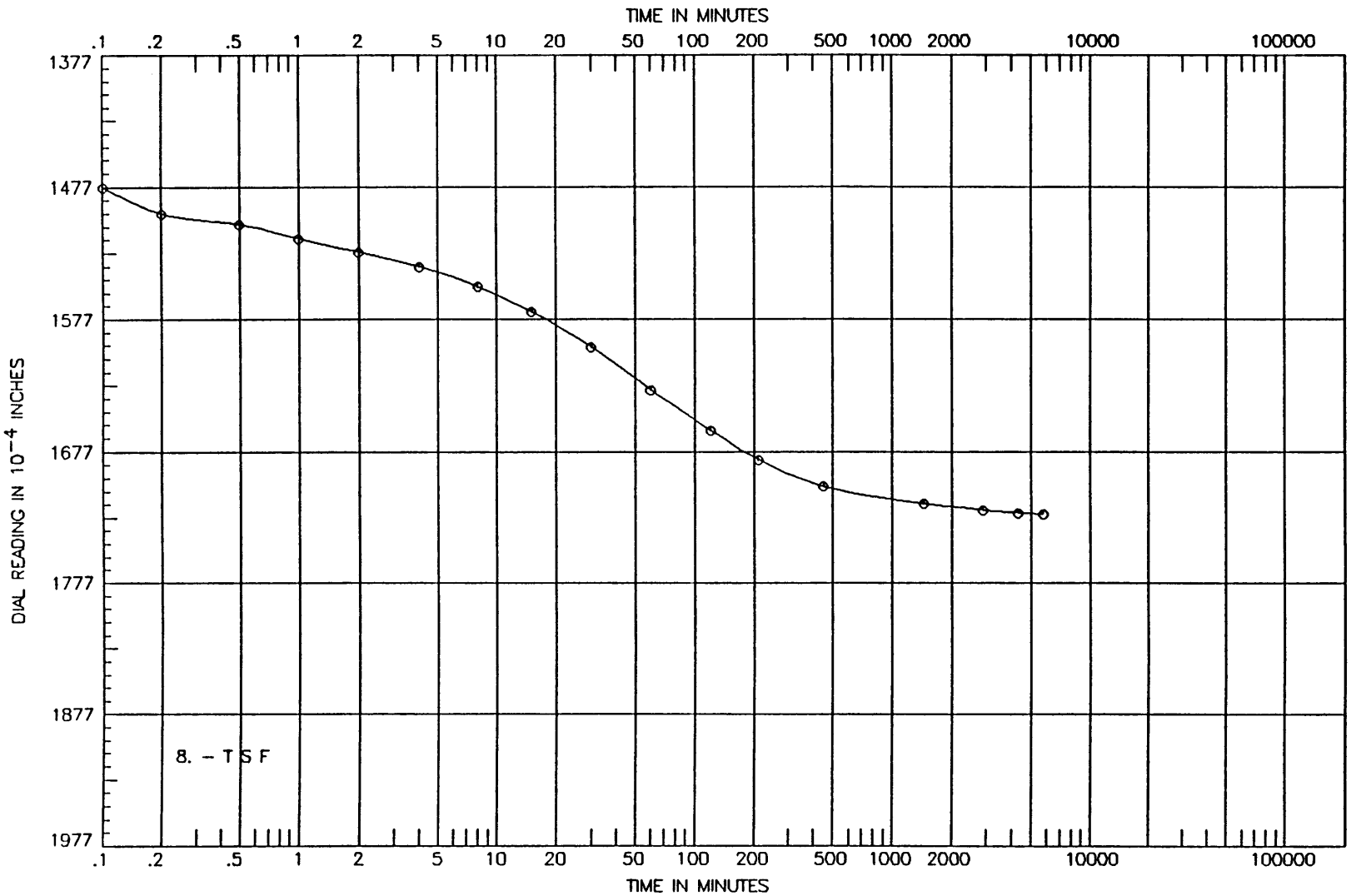
LABORATORY USAE WES - STF/GL

SHEET 3 OF 11



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING	6-EAU-94	SAMPLE NO. 4	
DEPTH/ELEV	8.0-9.0	DATE 10 FEB 95	

SHEET 4 OF 11

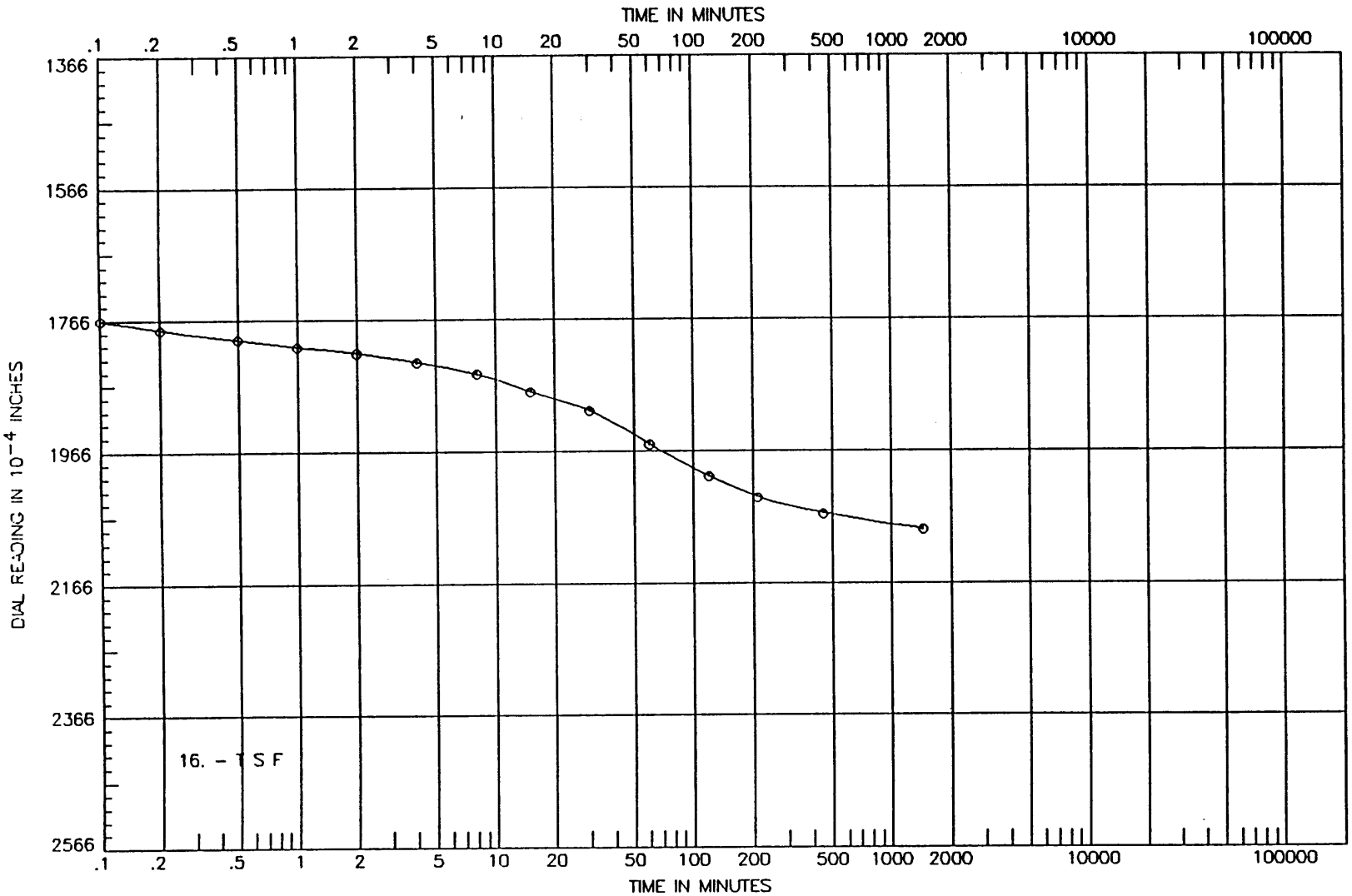


PROJECT	EASTERN ARKANSAS		
BORING	6-EAU-94	SAMPLE NO.	4
DEPTH/ELEV	8.0-9.0	DATE	10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 5 OF 11

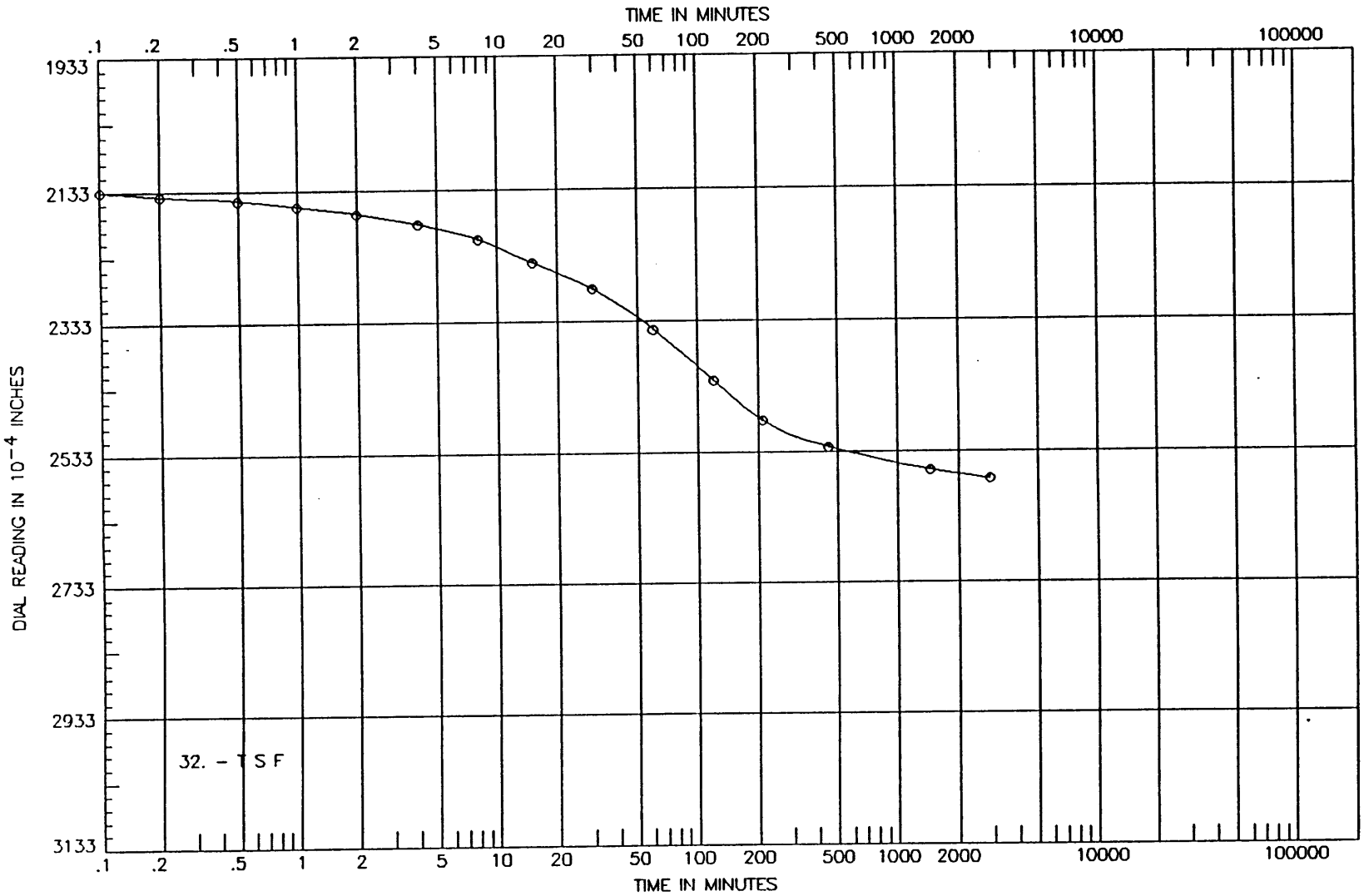


PROJECT	EASTERN ARKANSAS		
BORING	6-EAU-94	SAMPLE NO.	4
DEPTH/ELEV	8.0-9.0	DATE	10 FEB 95

CONSOLIDATION TEST TIME CURVES

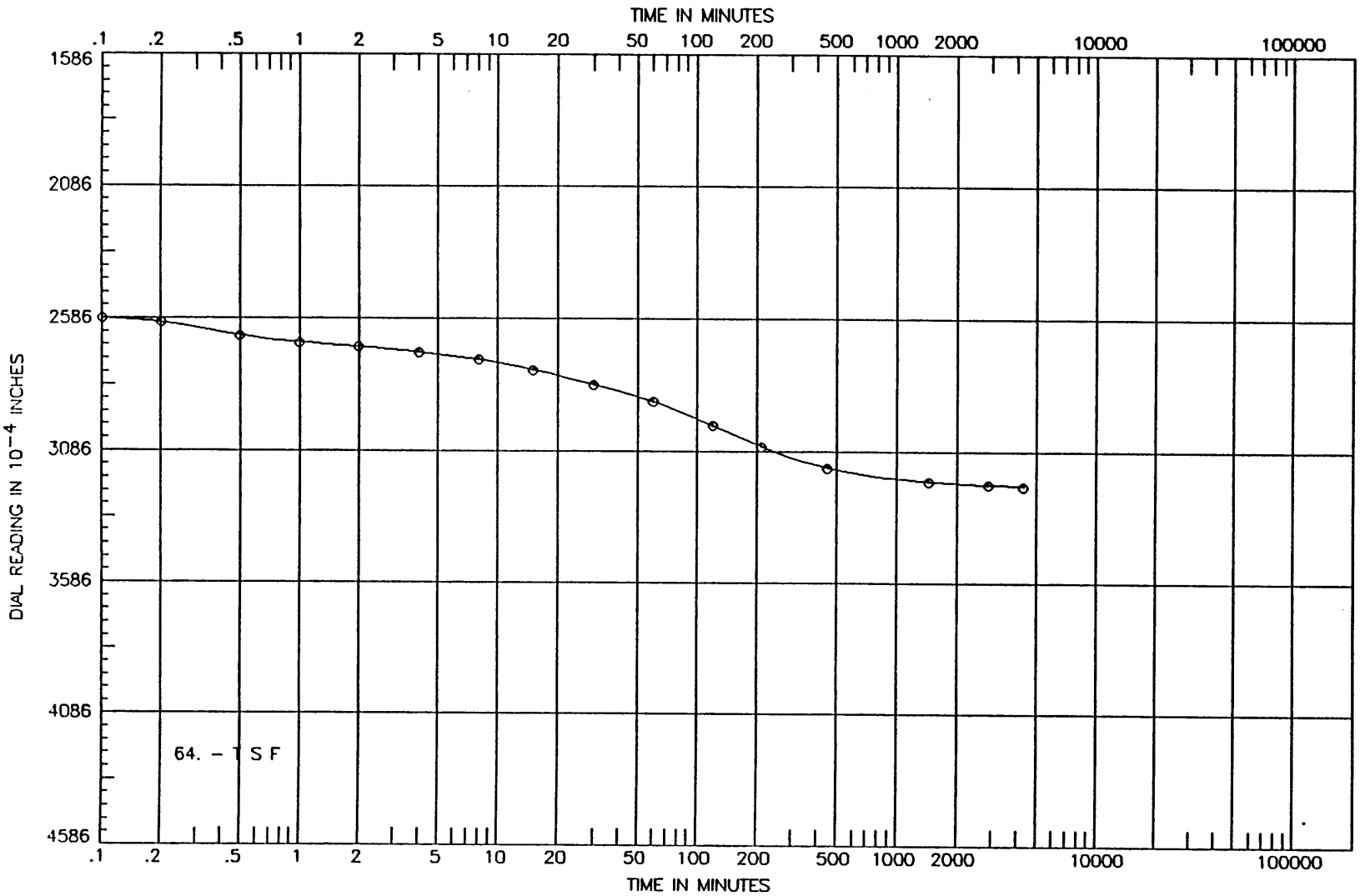
LABORATORY USAE WES - STF/GL

SHEET 6 OF 11



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING	6-EAU-94	SAMPLE NO. 4	
DEPTH/ELEV	8.0-9.0	DATE 10 FEB 95	

SHEET 7 OF 11

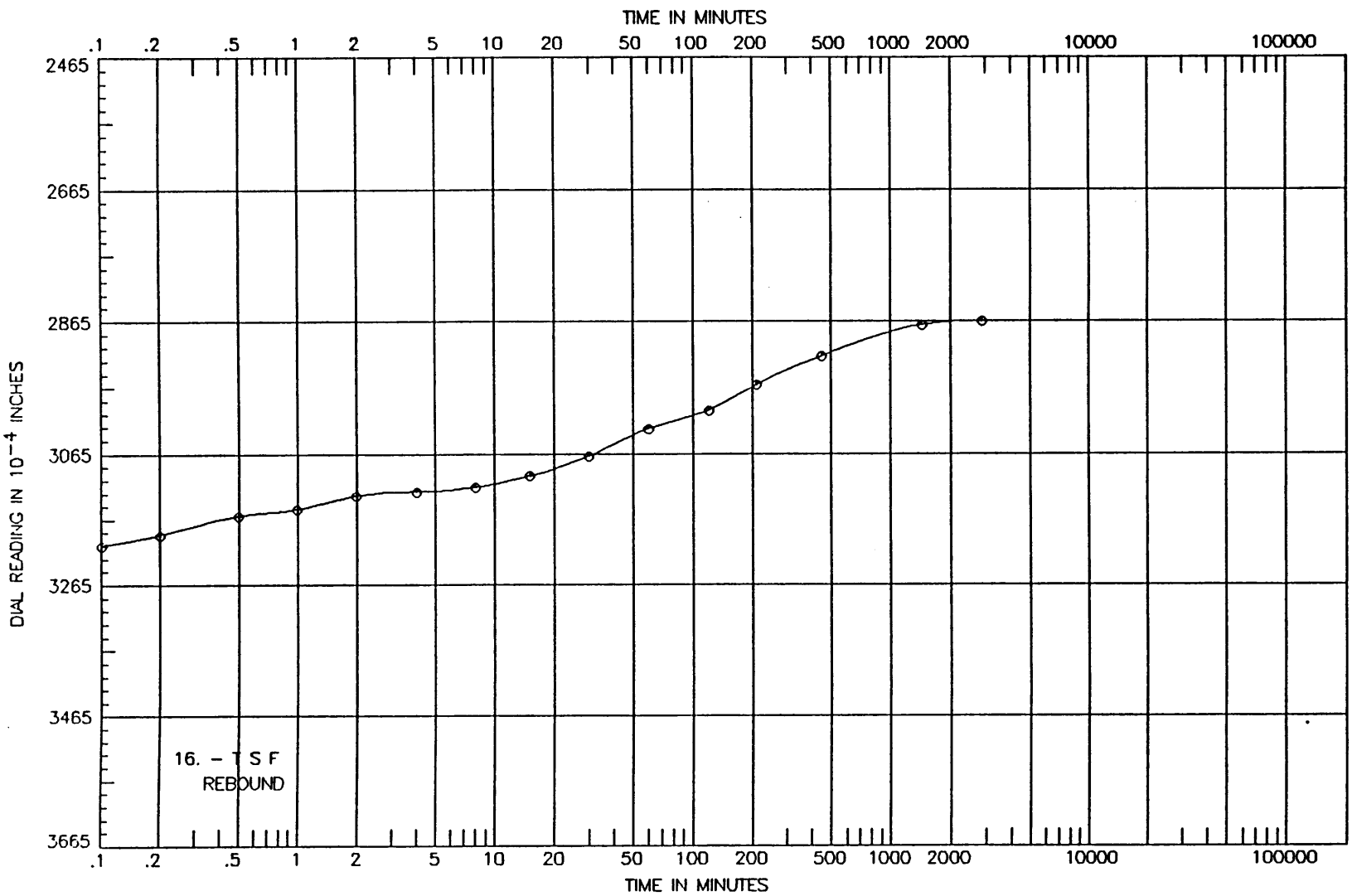


PROJECT EASTERN ARKANSAS	
BORING 6-EAU-94	SAMPLE NO. 4
DEPTH/ELEV 8.0-9.0	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 8 OF 11

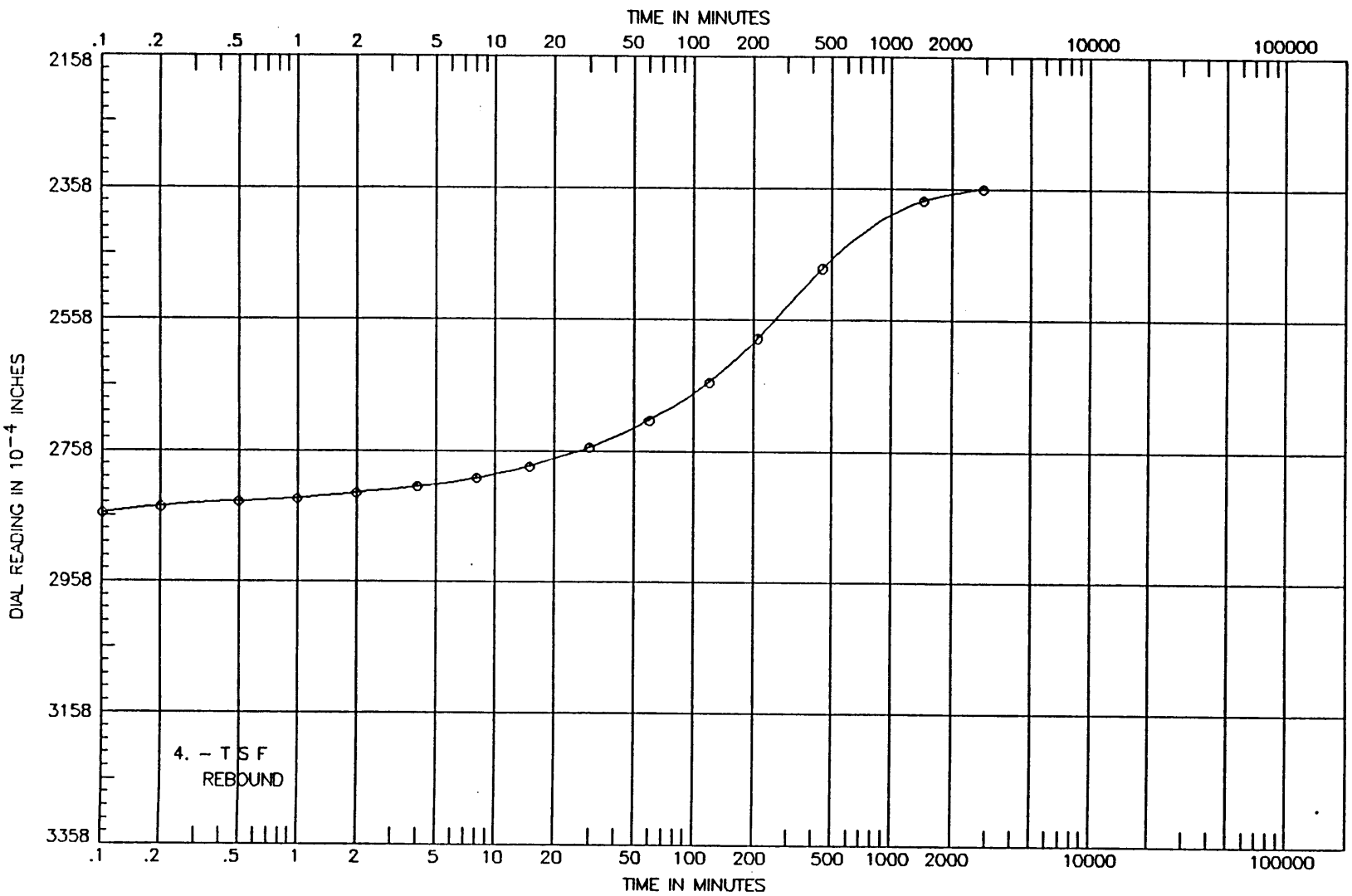


PROJECT EASTERN ARKANSAS	
BORING 6-EAU-94	SAMPLE NO. 4
DEPTH/ELEV 8.0-9.0	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 2 OF 11

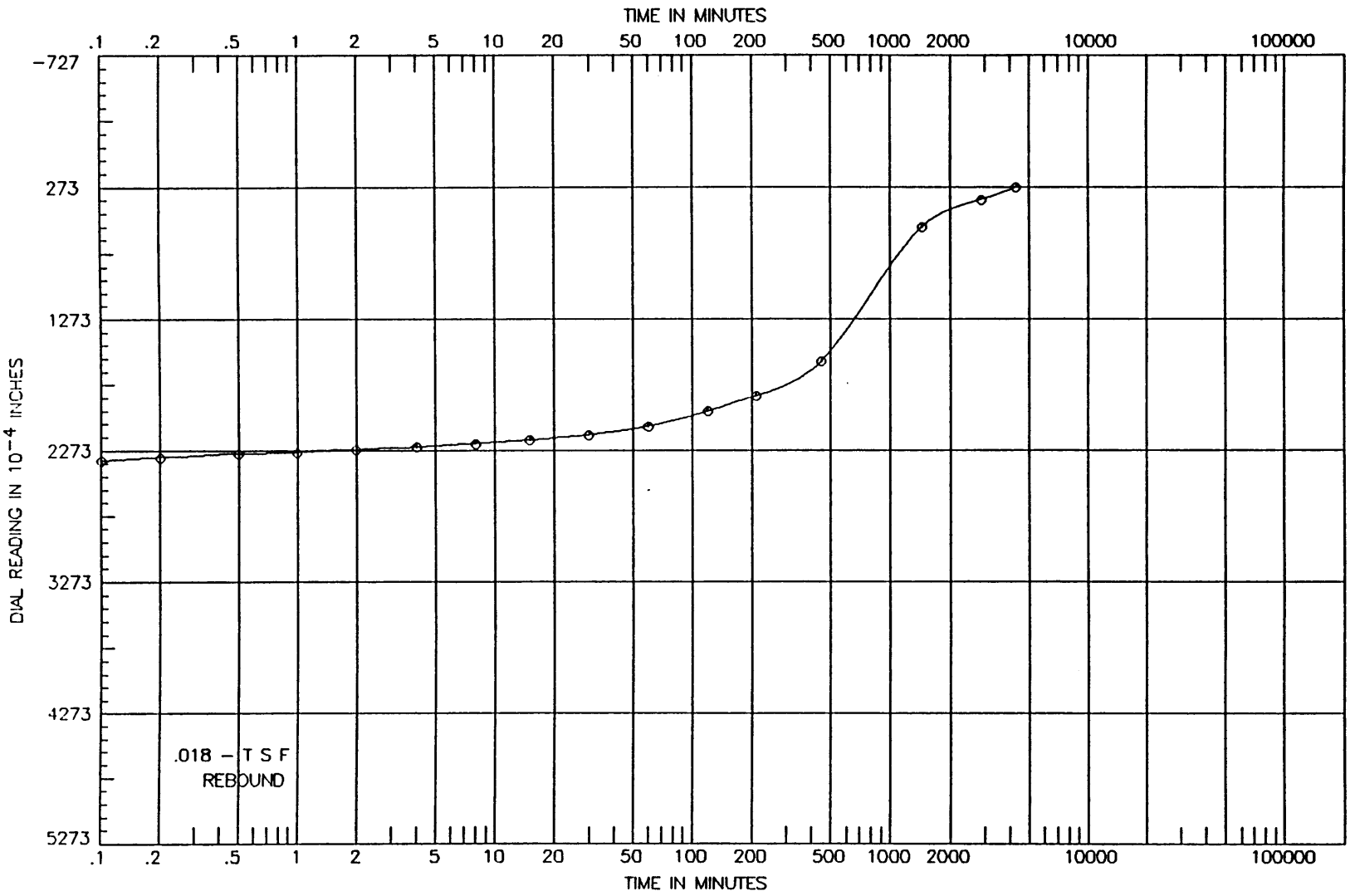


PROJECT EASTERN ARKANSAS	
BORING 6-EAU-94	SAMPLE NO. 4
DEPTH/ELEV 8.0-9.0	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

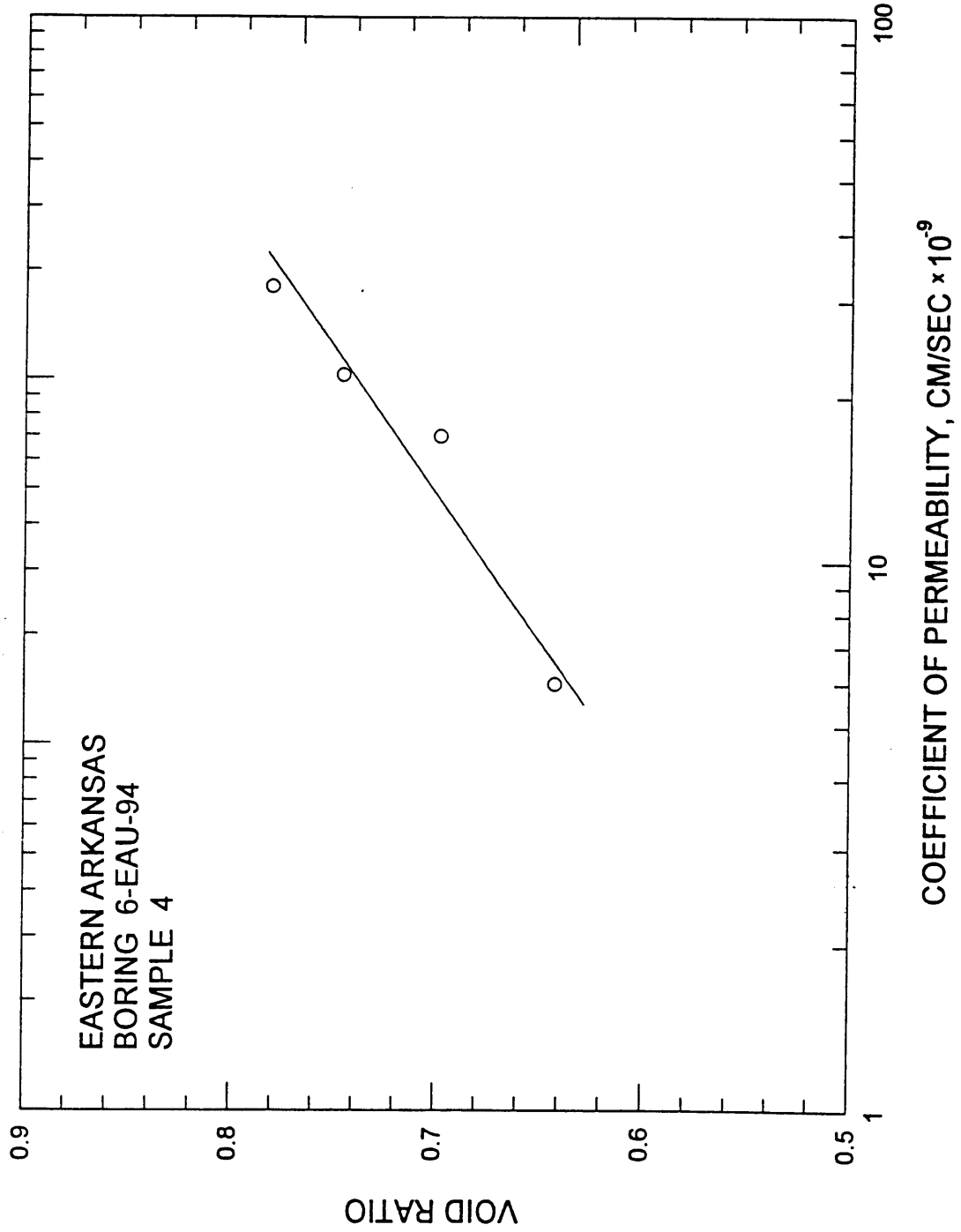
LABORATORY USAE WES - STF/GL

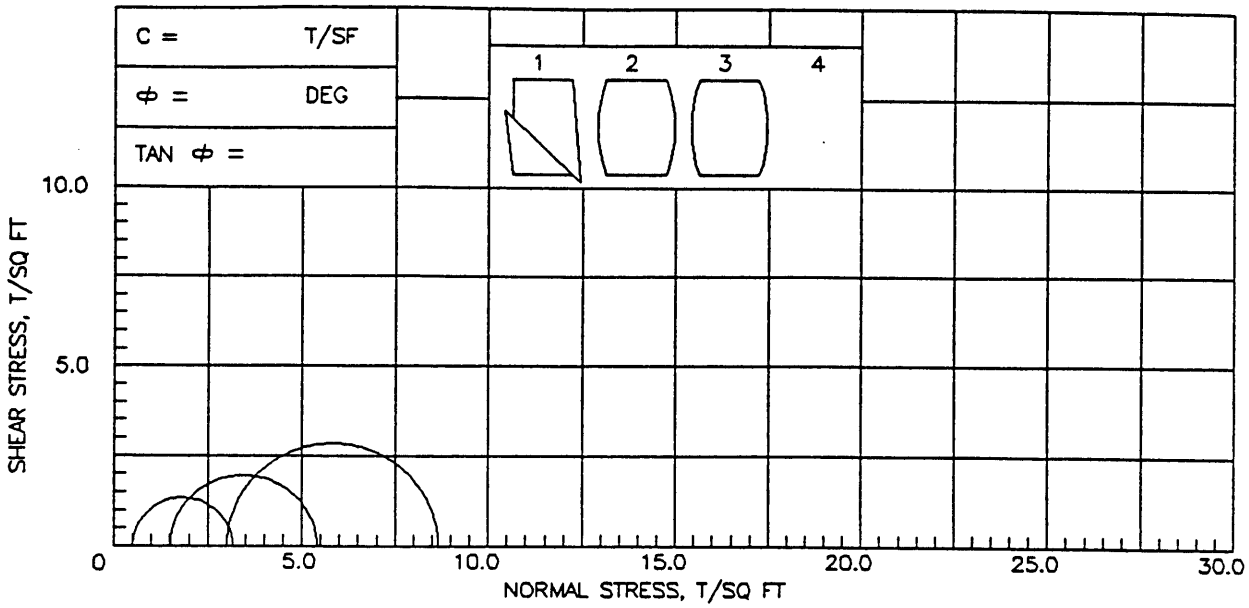
SHEET 10 OF 11

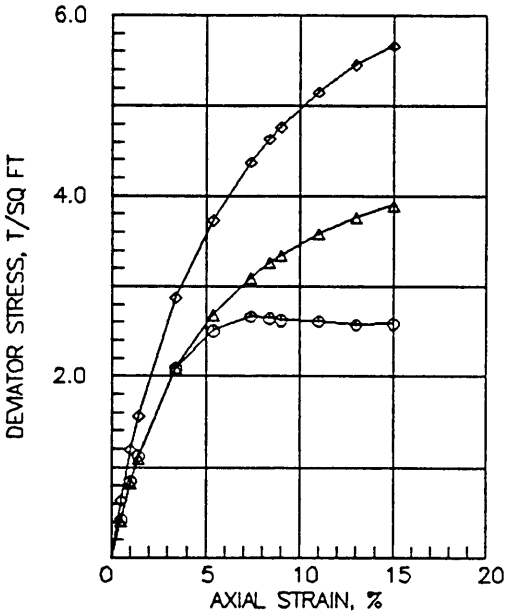


PROJECT EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
		LABORATORY USAE WES – STF/GL
BORING 6-EAU-94	SAMPLE NO. 4	
DEPTH/ELEV 8.0-9.0	DATE 10 FEB 95	

SHEET 11 OF 11


EASTERN ARKANSAS
BORING 6-EAU-94
SAMPLE 4
VOID RATIO
0.9
0.8
0.7
0.6
0.5
1
10
100
COEFFICIENT OF PERMEABILITY, CM/SEC × 10^-9





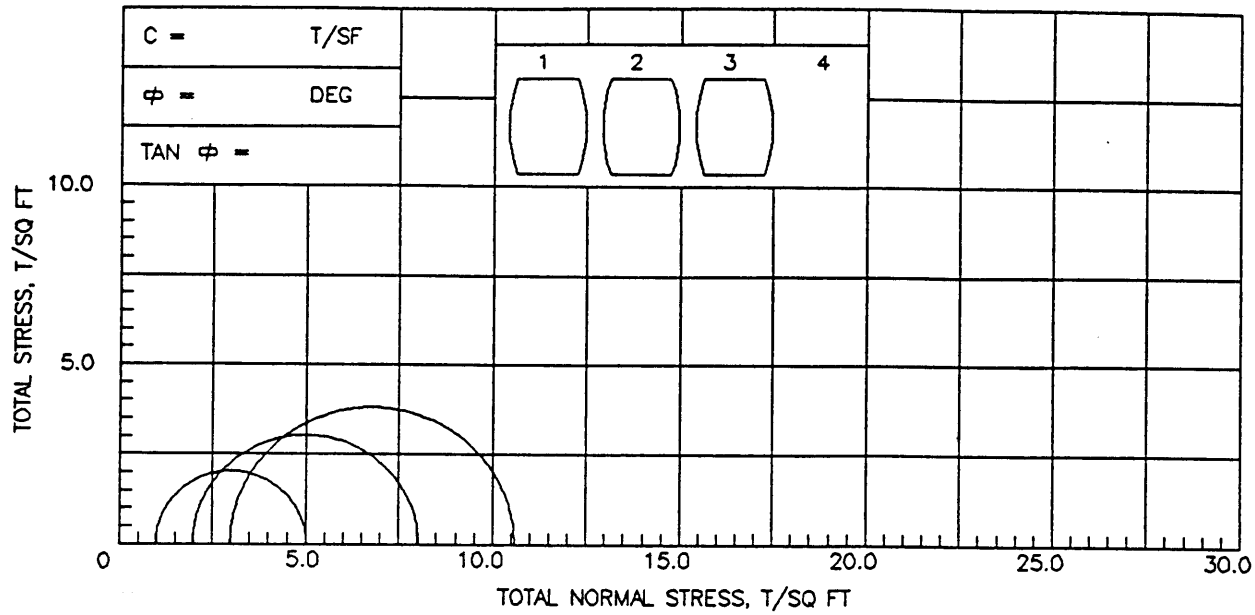
SPECIMEN NO.		○ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	15.6	15.5	15.4	
	DRY DENSITY, PCF	95.8	93.5	96.6	
	SATURATION, %	55.4	52.1	56.0	
	VOID RATIO	.759	.802	.744	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESSURE, TSF				
CHAMBER PRESSURE, TSF		.50	1.50	3.00	
MAX. DEV. STRESS, TSF		2.67	3.90	5.67	
TIME TO FAILURE, MIN.		15	31	31	
STRAIN RATE INCR., %					
INITIAL DIAMETER, IN.		1.39	1.38	1.38	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

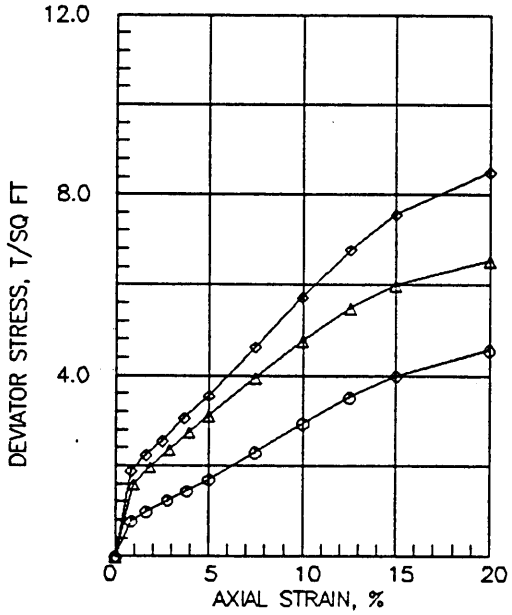
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), BROWN

LL 41	PL 15	PI 26	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	Q TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 7-EAU-94	SAMPLE NO. 3
	DEPTH/ELEV 5.0-6.2	TECH. US
	LABORATORY USAE WES - STF/GL	DATE 07 APR 95
	TRIAXIAL COMPRESSION TEST REPORT	





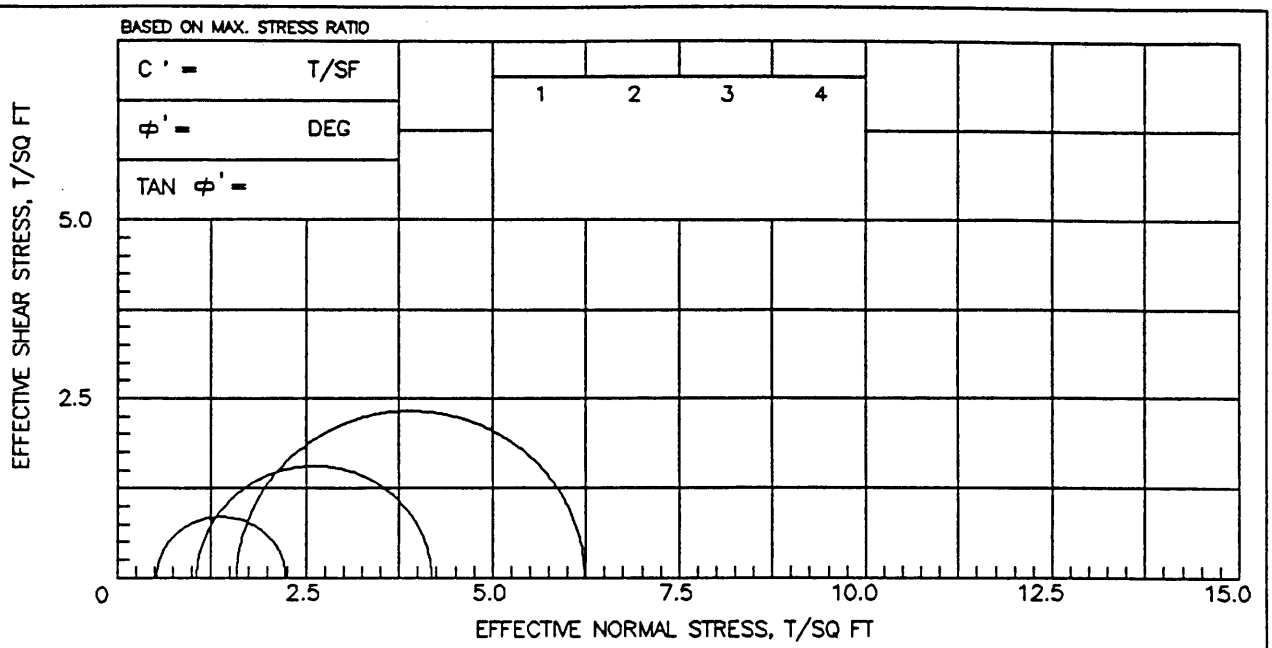
	SPECIMEN NO.	⊙ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	18.8	18.8	18.7	
	DRY DENSITY, PCF	106.3	106.4	106.5	
	SATURATION, %	86.7	86.7	86.7	
	VOID RATIO	.586	.584	.583	
BEFORE SHEAR	WATER CONTENT, %	20.9	19.8	18.9	
	DRY DENSITY, PCF	109.7	110.1	111.5	
	SATURATION, %	100+	100+	99.6	
	VOID RATIO	.537	.530	.512	
	BACK PRESS., TSF	6.48	6.48	6.48	
MIN. PRIN. STRESS, TSF		1.00	2.00	3.00	
MAX. DEV. STRESS, TSF		4.00	6.00	7.57	
TIME TO FAILURE, MIN.		973	972	976	
RATE OF STRAIN, %/MIN		.016	.016	.016	
INITIAL DIAMETER, IN.		1.37	1.36	1.36	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

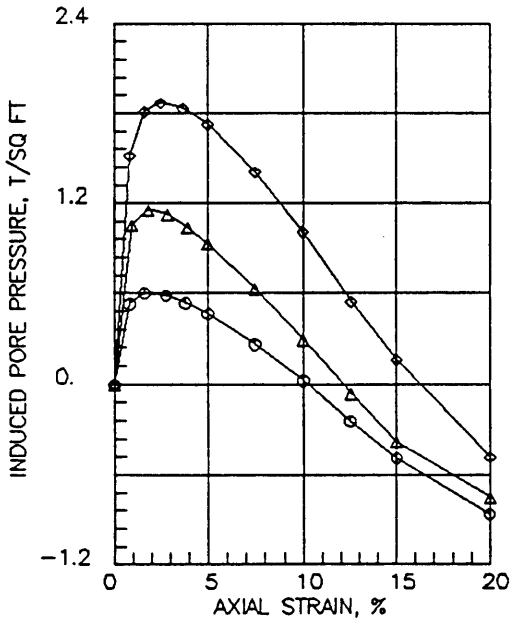
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), BROWN

LL	PL	PI	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	$\bar{R}$ TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 7-EAU-94	SAMPLE NO. 4
	DEPTH/ELEV 8.0-9.2	TECH. JH
	LABORATORY USAE WES - STF/GL	DATE 03 APR 95
	$\bar{R}$-TRIAXIAL COMPRESSION TEST REPORT	





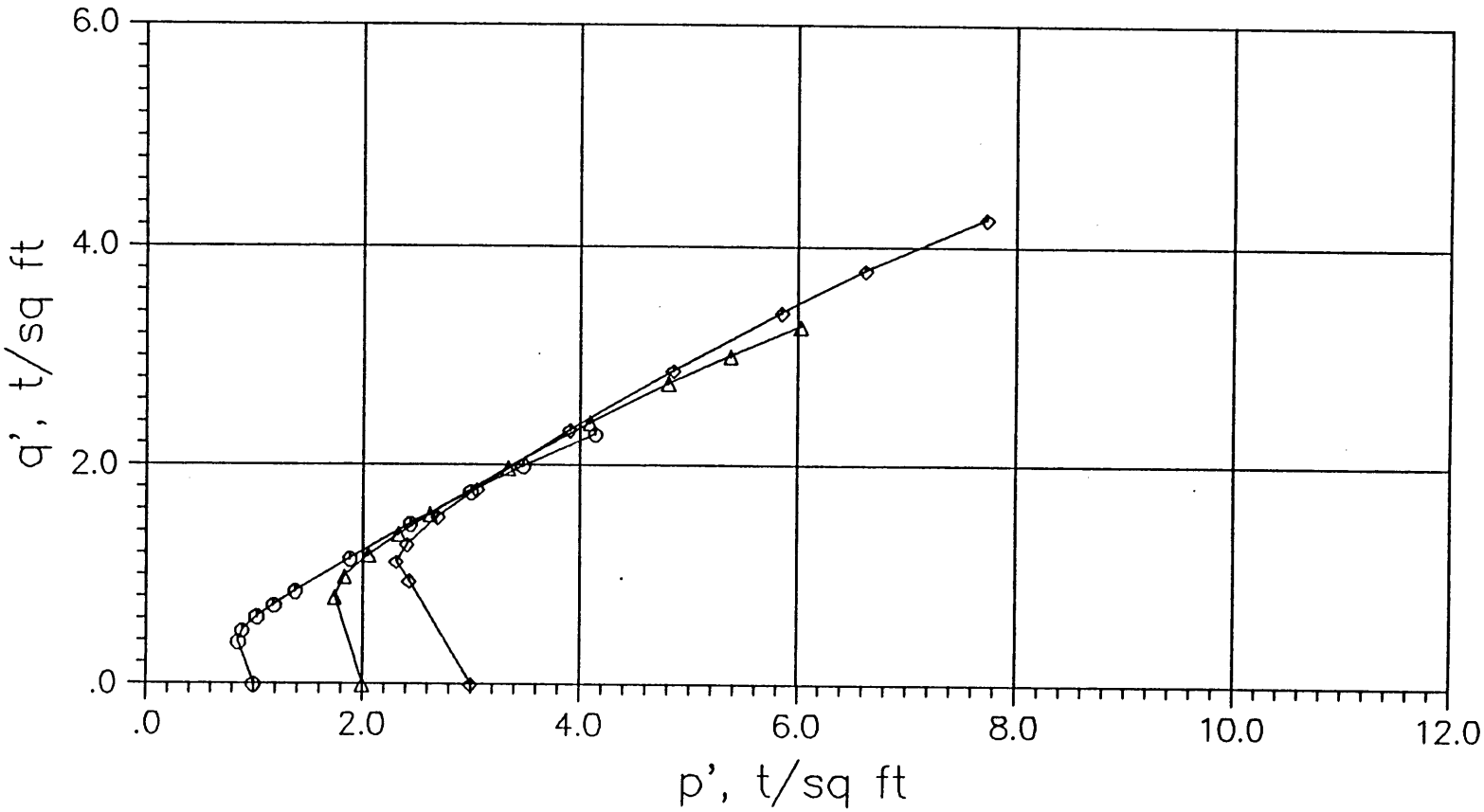
	SPECIMEN NO.	⊙ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	18.8	18.8	18.7	
	DRY DENSITY, PCF	106.3	106.4	106.5	
	SATURATION, %	86.7	86.7	86.7	
	VOID RATIO	.586	.584	.583	
BEFORE SHEAR	WATER CONTENT, %	20.9	19.8	18.9	
	DRY DENSITY, PCF	109.7	110.1	111.5	
	SATURATION, %	100+	100+	99.6	
	VOID RATIO	.537	.530	.512	
	BACK PRESS., TSF	6.48	6.48	6.48	
@ σ_1'/σ_3' MAX	MIN PRIN EFF STRESS, TSF	.53	1.06	1.59	
	DEV. STRESS, TSF	1.70	3.12	4.64	
	TIME TO FAILURE, MIN.	324	324	487	
RATE OF STRAIN, %/MIN		.016	.016	.016	
INITIAL DIAMETER, IN.		1.37	1.36	1.36	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), BROWN

LL	PL	PI	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	$\bar{R}$ TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 7-EAU-94	SAMPLE NO. 4
	DEPTH/ELEV 8.0-9.2	TECH. JH
	LABORATORY USAE WES - STF/GL	DATE 03 APR 95
	$\bar{R}$-TRIAXIAL COMPRESSION TEST REPORT	



PROJECT	EASTERN ARKANSAS		Stress Paths
BORING	7-EAU-94	SAMPLE NO. 4	LABORATORY USAE WES - STF/GL
DEPTH/ELEV	8.0-9.2	DATE 03 APR 95	

R-BAR TRIAXIAL COMPRESSION TEST REPORT

TLE: EASTERN ARKANSAS

BOR: 7-EAU-94 SAM: 4 DEP: 8.0-9.2 DAT: 03 APR 95 TEC: JH
DES: CLAY (CL), BROWN

REM:
SPECIMENS COMPACTED
AT 15 BLOW EFFORT
SAMPLE TYPE = COMPACTED
GS: 2.70 (ESTIMATED)
LL: 0 PL: 0 PI: 0

WEIGHT OF SOLIDS = 122.61 I. HEIGHT = 3.000" I. DIAMETER = 1.366"

HEIGHT CHANGES: PRE-CONS. = .01300" DURING CONS. = .01000"

VOLUME CHANGE DURING CONS. = 1.3 CC TIME OF TEST = 1286 MINS.

BACK PRESSURE = 90.00 PSI (6.48 TSF) CHAMBER PRESSURE = 103.89

EFF CONFINING PRESSURE, TSF = 1.00

	INITIAL	BEFORE SHEAR
WATER CONTENT, %	18.82	20.87
VOID RATIO	.586	.537
SATURATION, %	86.65	104.89
DRY DENSITY, PCF	106.25	109.65

V DEF IN.	AXIAL LOAD LBS	PORE PRESS PSI	STRAIN %	IND POR PRESS TSF	DEVIAT STRESS TSF	EFFECTIVE E1 - TSF -	E3	RATIO E1/ E3	NORML STRES TSF	SHEAR STRES TSF
.000	.0	90.0	.0	.00	.00	1.000	1.000	1.000	1.00	.00
.025	15.6	97.4	.8	.53	.78	1.245	.467	2.666	.86	.39
.049	20.0	98.4	1.6	.60	.99	1.385	.395	3.504	.89	.49
.083	25.3	98.2	2.8	.59	1.24	1.647	.410	4.020	1.03	.62
.114	30.0	97.5	3.8	.54	1.45	1.912	.460	4.155	1.19	.73
.149	35.6	96.5	5.0	.47	1.70	2.233	.532	4.198	1.38	.85
.222	49.4	93.7	7.5	.27	2.30	3.034	.734	4.135	1.88	1.15
.298	65.0	90.4	10.0	.03	2.94	3.914	.971	4.030	2.44	1.47
.373	80.1	86.7	12.5	-.24	3.52	4.762	1.238	3.848	3.00	1.76
.447	93.5	83.3	15.0	-.48	4.00	5.480	1.482	3.697	3.48	2.00
.595	113.6	78.1	20.0	-.86	4.57	6.430	1.857	3.463	4.14	2.29

RATE OF STRAIN = .016

R-BAR TRIAXIAL COMPRESSION TEST REPORT

TLE: EASTERN ARKANSAS

BOR: 7-EAU-94 SAM: 4 DEP: 8.0-9.2 DAT: 03 APR 95 TEC: JH
DES: CLAY (CL), BROWN

REM:
SPECIMENS COMPACTED
AT 15 BLOW EFFORT
SAMPLE TYPE = COMPACTED
GS: 2.70 (ESTIMATED)
LL: 0 PL: 0 PI: 0

WEIGHT OF SOLIDS = 122.59 I. HEIGHT = 3.000" I. DIAMETER = 1.365"

HEIGHT CHANGES: PRE-CONS. = .00900" DURING CONS. = .01800"

VOLUME CHANGE DURING CONS. = 1.8 CC TIME OF TEST = 1286 MINS.

BACK PRESSURE = 90.00 PSI (6.48 TSF) CHAMBER PRESSURE = 117.78

EFF CONFINING PRESSURE, TSF = 2.00

	INITIAL	BEFORE SHEAR
WATER CONTENT, %	18.76	19.77
VOID RATIO	.584	.530
SATURATION, %	86.68	100.62
DRY DENSITY, PCF	106.39	110.13

V DEF IN.	AXIAL LOAD LBS	PORE PRESS PSI	STRAIN %	IND POR PRESS TSF	DEVIAT STRESS TSF	EFFECTIVE E1 - TSF	E3 -	RATIO E1/ E3	NORML STRES TSF	SHEAR STRES TSF
.000	.0	90.0	.0	.00	.00	2.000	2.000	1.000	2.00	.00
.028	32.0	104.7	.9	1.06	1.60	2.542	.942	2.699	1.74	.80
.055	40.0	106.1	1.8	1.16	1.98	2.822	.841	3.356	1.83	.99
.086	48.4	105.7	2.9	1.13	2.37	3.242	.870	3.728	2.06	1.19
.117	56.8	104.5	3.9	1.04	2.75	3.710	.956	3.880	2.33	1.38
.149	65.0	103.0	5.0	.94	3.12	4.180	1.064	3.929	2.62	1.56
.222	84.8	98.8	7.5	.63	3.96	5.327	1.366	3.898	3.35	1.98
.297	105.2	94.1	10.0	.30	4.78	6.484	1.705	3.803	4.09	2.39
.373	124.6	89.2	12.5	-.06	5.50	7.557	2.058	3.673	4.81	2.75
.446	139.9	84.8	15.0	-.37	6.00	8.376	2.374	3.528	5.38	3.00
.595	162.2	79.6	20.0	-.75	6.55	9.297	2.749	3.382	6.02	3.27

RATE OF STRAIN = .016

R-BAR TRIAXIAL COMPRESSION TEST REPORT

TLE: EASTERN ARKANSAS

BOR: 7-EAU-94 SAM: 4 DEP: 8.0-9.2 DAT: 03 APR 95 TEC: JH
DES: CLAY (CL), BROWN

REM:
SPECIMENS COMPACTED
AT 15 BLOW EFFORT
SAMPLE TYPE = COMPACTED
GS: 2.70 (ESTIMATED)
LL: 0 PL: 0 PI: 0

WEIGHT OF SOLIDS = 122.49 I. HEIGHT = 3.000" I. DIAMETER = 1.364"

HEIGHT CHANGES: PRE-CONS. = .00500" DURING CONS. = .03100"

VOLUME CHANGE DURING CONS. = 2.9 CC TIME OF TEST = 1286 MINS.

BACK PRESSURE = 90.00 PSI (6.48 TSF) CHAMBER PRESSURE = 131.67

EFF CONFINING PRESSURE, TSF = 3.00

	INITIAL	BEFORE SHEAR
WATER CONTENT, %	18.74	18.87
VOID RATIO	.583	.512
SATURATION, %	86.74	99.60
DRY DENSITY, PCF	106.46	111.52

V DEF IN.	AXIAL LOAD LBS	PORE PRESS PSI	STRAIN %	IND POR PRESS TSF	DEVIAT STRESS TSF	EFFECTIVE E1 - TSF -	E3	RATIO E1/ E3	NORML STRES TSF	SHEAR STRES TSF
.000	.0	90.0	.0	.00	.00	3.000	3.000	1.000	3.00	.00
.025	37.5	111.1	.8	1.52	1.90	3.377	1.481	2.280	2.43	.95
.049	44.8	115.2	1.7	1.81	2.25	3.432	1.186	2.895	2.31	1.12
.074	51.6	116.0	2.5	1.87	2.57	3.694	1.128	3.274	2.41	1.28
.110	62.4	115.5	3.7	1.84	3.06	4.228	1.164	3.632	2.70	1.53
.148	73.6	114.0	5.0	1.73	3.57	4.838	1.272	3.803	3.05	1.78
.222	98.4	109.6	7.5	1.41	4.64	6.231	1.589	3.921	3.91	2.32
.296	124.9	104.1	10.0	1.02	5.73	7.718	1.985	3.888	4.85	2.87
.373	152.3	97.6	12.6	.55	6.79	9.241	2.453	3.768	5.85	3.39
.445	174.6	92.3	15.0	.17	7.57	10.401	2.834	3.669	6.62	3.78
.593	208.6	83.4	20.0	-.48	8.51	11.984	3.475	3.448	7.73	4.25

RATE OF STRAIN = .016

FALLING-HEAD PERMEABILITY TEST

PROJECT: EASTERN ARKANSAS

BORING: 7-EAU-94 SAMPLE: 4 DEPTH: 8.0-9.2 DATE: 24 MAR 95

INPUT DATA: CLAY (CL), REDDISH BROWN

	INITIAL	AFTER CONSOL.
WET SOIL & TARE	130.21	208.63
DRY SOIL & TARE		179.82
TARE		65.00

HEIGHT	3.000 IN
DIAMETER	1.379 IN
GRAVITY	2.70

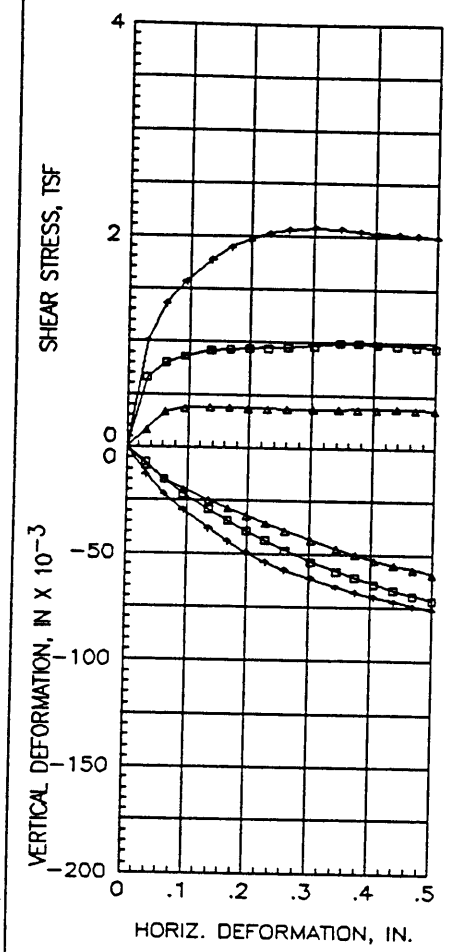
CHANGE IN HEIGHT .076

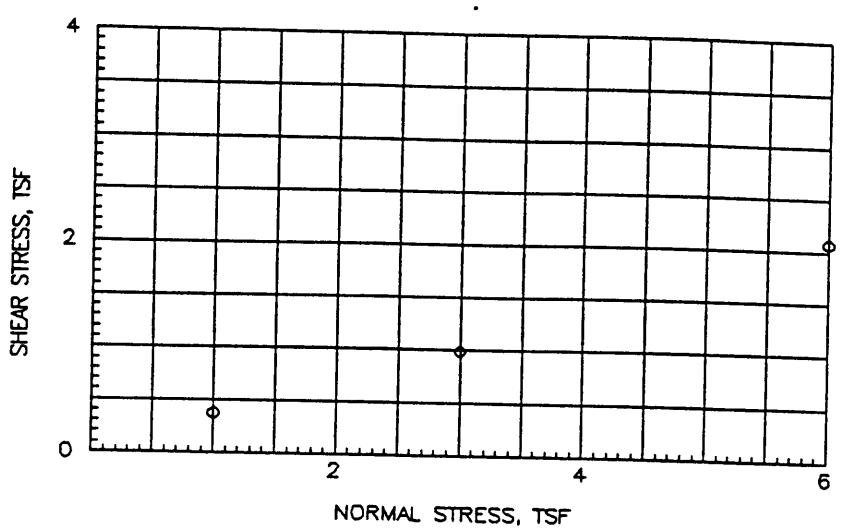
LINE	TIME	BUR #1	BUR #2	TEMP
106.	1006.	1.1	23.7	22.5
108.	1207.	1.2	23.6	22.5
110.	1207.	1.2	23.6	22.5
112.	1319.	1.3	23.5	22.5
114.	1319.	1.3	23.5	22.5
116.	1515.	1.4	23.4	22.0

OUTPUT:

	INITIAL	AFTER CONSOL.
WATER CONTENT, % =	13.4	25.1
VOID RATIO =		.859
SATURATION, % =		78.9
DRY DENSITY, PCF =	97.8	90.8

	COEFFICIENT OF PERMEABILITY
RUN #1	2.38E-07
RUN #2	4.03E-07
RUN #3	2.54E-07
AVERAGE	2.98E-07





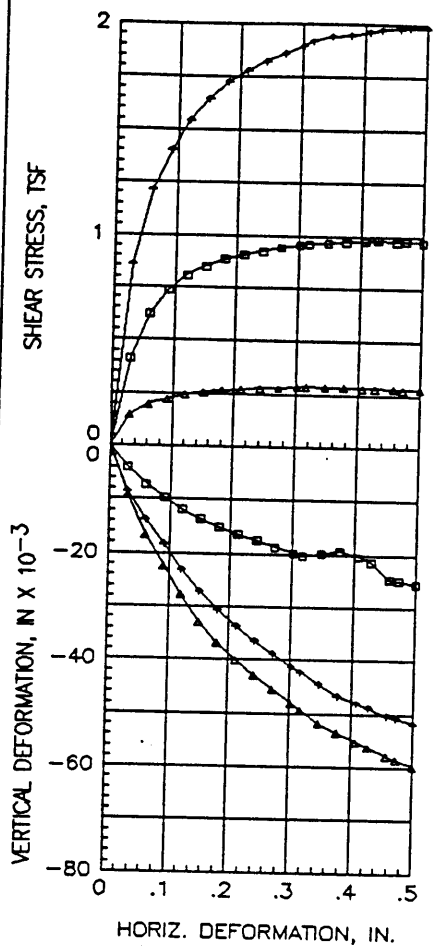
	TEST NO.	1 ▲	2 □	3 ◆	
INITIAL	WATER CONTENT, %	15.4	15.6	15.6	
	VOID RATIO	.562	.542	.552	
	SATURATION, %	73.9	77.8	76.3	
	DRY DENSITY, PCF	107.9	109.2	108.6	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	23.9	33.6	18.6	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.38	.99	2.08	
TIME TO FAILURE, MIN		739	1868	1642	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF		.37	.96	1.99	

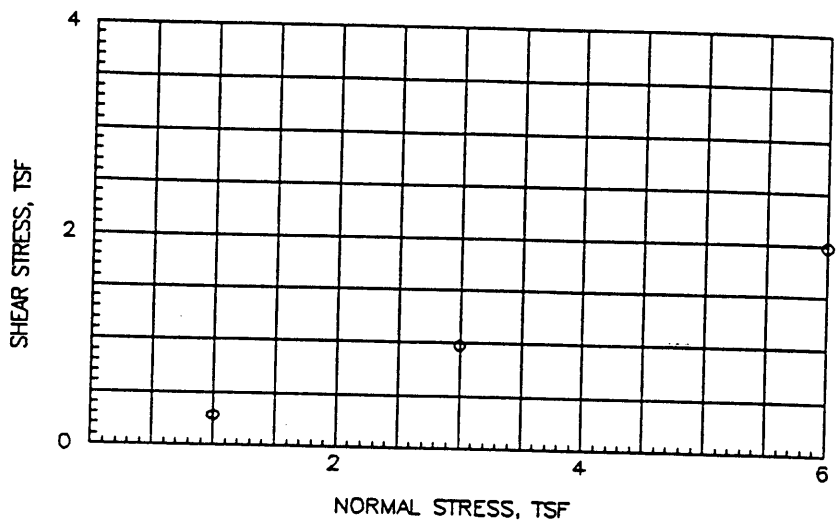
ϕ = _____ DEG

TAN ϕ = _____

C = _____ T/SF

TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION CLAY (CL), REDDISH GRAY		
LL 40	PL 15	PI 25	GS 2.70 (EST)
REMARKS;	PROJECT EASTERN ARKANSAS	
	BORING NO. 8-EAU-94	SAMPLE 4
	DEPTH/ELEV 9.0-10.2	TECH. JL
	LABORATORY USAE WES - STF/GL	DATE 27 MAR 95
	DIRECT SHEAR TEST REPORT	





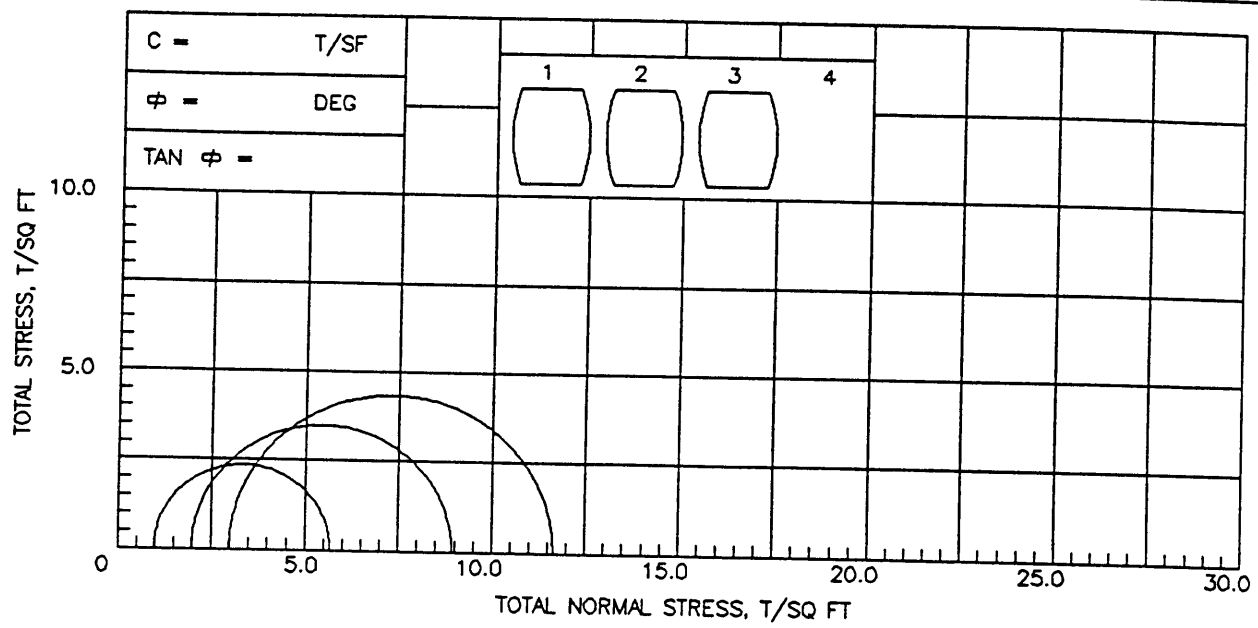
	TEST NO.	1 ▲	2 □	3 +	
INITAL	WATER CONTENT, %	14.7	14.8	14.8	
	VOID RATIO	.741	.745	.716	
	SATURATION, %	53.7	53.7	55.7	
	DRY DENSITY, PCF	96.8	96.6	98.2	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	24.1	19.6	17.5	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.29	.98	1.99	
TIME TO FAILURE, MIN		1747	2356	2606	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF		.28	.97	1.99	

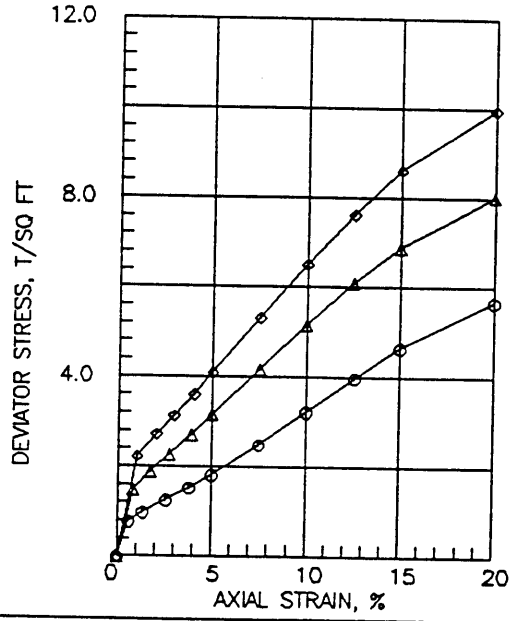
ϕ = _____ DEG

TAN ϕ = _____

C = _____ T/SF

TYPE SPECIMEN	COMPACTED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION	CLAY (CL), REDDISH GRAY		
LL	PL	PI	GS 2.70 (EST)
REMARKS:		PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED			
AT 15 BLOW EFFORT		BORING NO. 8-EAU-94	SAMPLE 4
		DEPTH/ELEV 9.0-10.2	TECH. JL
		LABORATORY USAE WES - STF/GL	DATE 17 APR 95
		DIRECT SHEAR TEST REPORT	





SPECIMEN NO.		⊙ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	22.4	22.5	22.9	
	DRY DENSITY, PCF	101.8	101.9	100.7	
	SATURATION, %	92.2	92.7	92.0	
	VOID RATIO	.656	.655	.674	
BEFORE SHEAR	WATER CONTENT, %	23.4	22.6	22.3	
	DRY DENSITY, PCF	103.8	106.0	106.1	
	SATURATION, %	100+	100+	100+	
	VOID RATIO	.624	.590	.589	
	BACK PRESS., TSF	6.48	6.48	6.48	
MIN. PRIN. STRESS, TSF		1.00	2.00	3.00	
MAX. DEV. STRESS, TSF		4.65	6.90	8.62	
TIME TO FAILURE, MIN.		970	971	976	
RATE OF STRAIN, %/MIN		.016	.016	.016	
INITIAL DIAMETER, IN.		1.35	1.36	1.36	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: SANDY CLAY (CL), BROWN

LL 29	PL 19	PI 10	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	$\bar{R}$ TEST

REMARKS:

SPECIMENS COMPACTED

AT 15 BLOW EFFORT

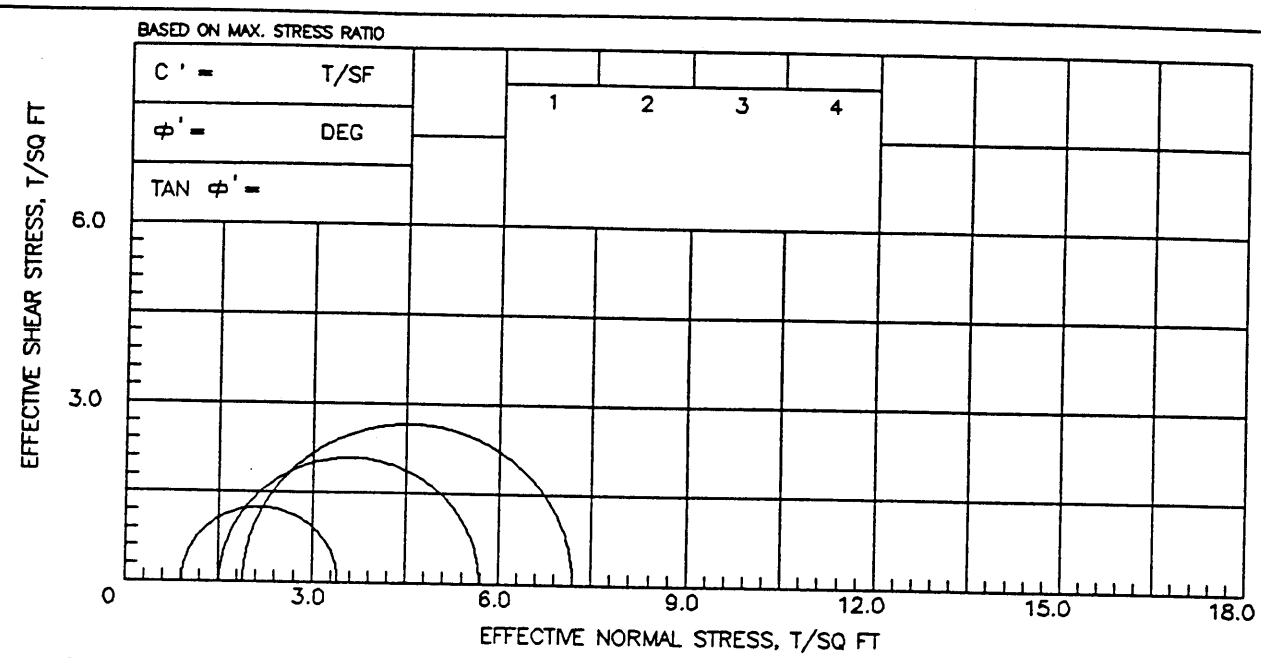
PROJECT EASTERN ARKANSAS

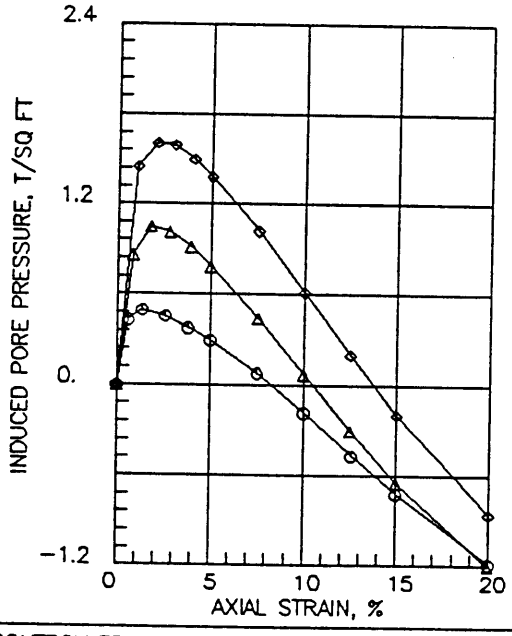
BORING NO. 10-EAU-94 | SAMPLE NO. 5

DEPTH/ELEV 11.0-12.0 | TECH. JH

LABORATORY USAE WES - STF/GL | DATE 06 APR 95

$\bar{R}$-TRIAXIAL COMPRESSION TEST REPORT





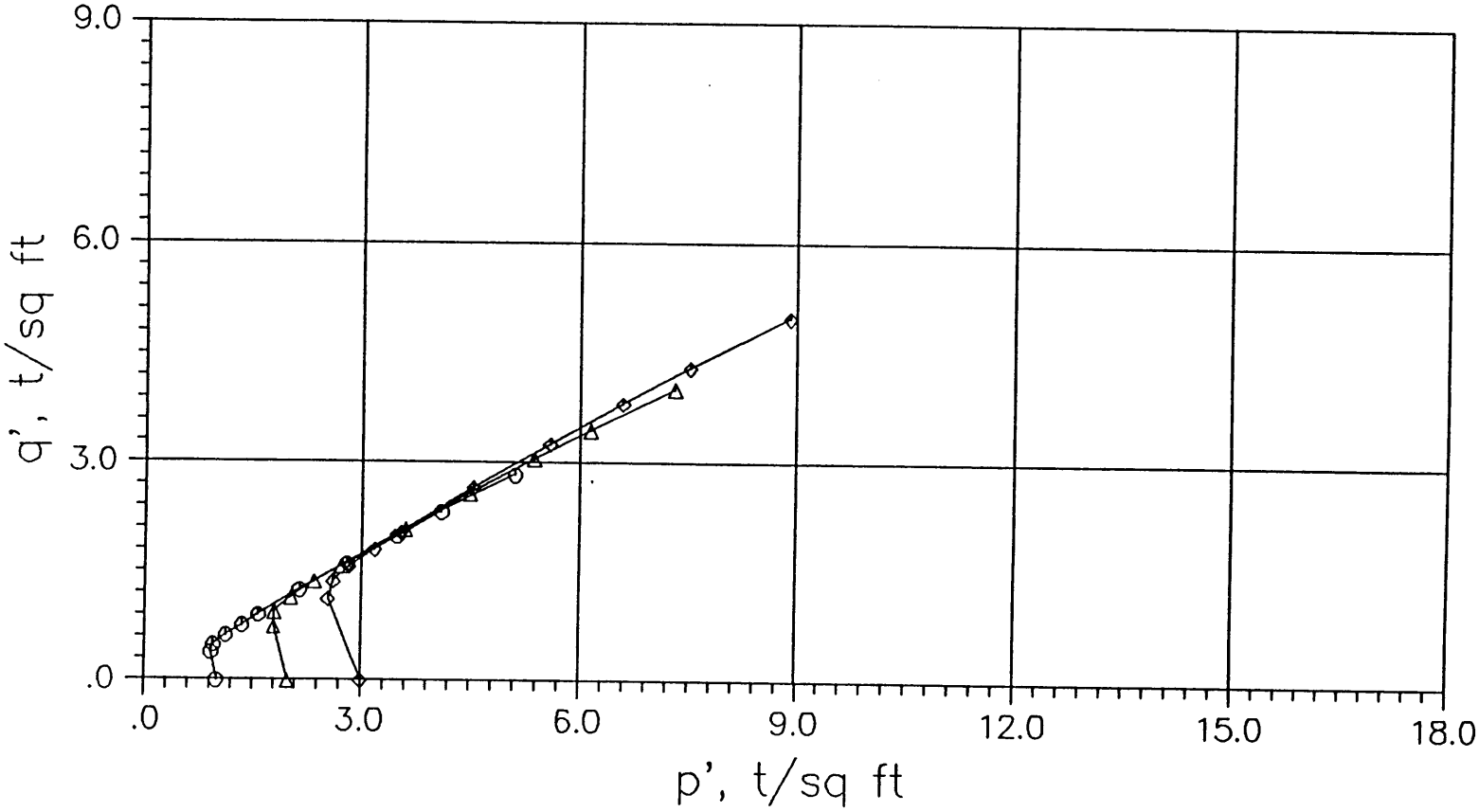
SPECIMEN NO.		⊙ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	22.4	22.5	22.9	
	DRY DENSITY, PCF	101.8	101.9	100.7	
	SATURATION, %	92.2	92.7	92.0	
	VOID RATIO	.656	.655	.674	
BEFORE SHEAR	WATER CONTENT, %	23.4	22.6	22.3	
	DRY DENSITY, PCF	103.8	106.0	106.1	
	SATURATION, %	100+	100+	100+	
	VOID RATIO	.624	.590	.589	
	BACK PRESS., TSF	6.48	6.48	6.48	
@ r_1'/r_3' MAX	MIN PRIN EFF STRESS, TSF	.91	1.52	1.89	
	DEV. STRESS, TSF	2.49	4.17	5.31	
	TIME TO FAILURE, MIN.	485	486	490	
RATE OF STRAIN, %/MIN		.016	.016	.016	
INITIAL DIAMETER, IN.		1.35	1.36	1.36	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: SANDY CLAY (CL), BROWN

LL 29	PL 19	PI 10	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	$\bar{R}$ TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 10-EAU-94	SAMPLE NO. 5
	DEPTH/ELEV 11.0-12.0	TECH. JH
	LABORATORY USAE WES - STF/GL	DATE 06 APR 95
	$\bar{R}$-TRIAXIAL COMPRESSION TEST REPORT	



PROJECT	EASTERN ARKANSAS		
BORING	10-EAU-94	SAMPLE NO.	5
DEPTH/ELEV	11.0-12.0	DATE	06 APR 95

Stress Paths

LABORATORY USAE WES - STF/GL

R-BAR TRIAXIAL COMPRESSION TEST REPORT

TLE: EASTERN ARKANSAS

BOR: 10-EAU-94 SAM: 5 DEP: 11.0-12.0 DAT: 06 APR 95 TEC: JH
DES: SANDY CLAY (CL), BROWN

REM:
SPECIMENS COMPACTED
AT 15 BLOW EFFORT
SAMPLE TYPE = COMPACTED
GS: 2.70 (ESTIMATED)
LL: 29 PL: 19 PI: 10

WEIGHT OF SOLIDS = 115.40 I. HEIGHT = 3.000" I. DIAMETER = 1.354"

HEIGHT CHANGES: PRE-CONS. = .00400" DURING CONS. = .01100"

VOLUME CHANGE DURING CONS. = 1.1 CC TIME OF TEST = 1287 MINS.

BACK PRESSURE = 90.00 PSI (6.48 TSF) CHAMBER PRESSURE = 103.89

EFF CONFINING PRESSURE, TSF = 1.00

	INITIAL	BEFORE SHEAR
WATER CONTENT, %	22.41	23.37
VOID RATIO	.656	.624
SATURATION, %	92.23	101.17
DRY DENSITY, PCF	101.78	103.81

V DEF IN.	AXIAL LOAD LBS	PORE PRESS PSI	STRAIN %	IND POR PRESS TSF	DEVIAT STRESS TSF	EFFECTIVE E1 - TSF -	E3	RATIO E1/ E3	NORML STRES TSF	SHEAR STRES TSF
.000	.0	90.0	.0	.00	.00	1.000	1.000	1.000	1.00	.00
.018	15.4	96.5	.6	.47	.78	1.309	.532	2.460	.92	.39
.040	19.6	97.5	1.3	.54	.98	1.441	.460	3.133	.95	.49
.077	25.3	96.9	2.6	.50	1.25	1.754	.503	3.485	1.13	.63
.114	31.2	95.7	3.8	.41	1.52	2.112	.590	3.582	1.35	.76
.149	37.6	94.5	5.0	.32	1.81	2.489	.676	3.681	1.58	.91
.224	53.1	91.2	7.5	.09	2.49	3.406	.914	3.728	2.16	1.25
.299	70.7	87.3	10.0	-.19	3.23	4.422	1.194	3.703	2.81	1.61
.375	89.6	83.0	12.6	-.50	3.98	5.479	1.504	3.643	3.49	1.99
.448	107.8	79.2	15.0	-.78	4.65	6.426	1.778	3.615	4.10	2.32
.597	139.8	72.2	20.0	-1.28	5.67	7.956	2.281	3.487	5.12	2.84

RATE OF STRAIN = .016

R-BAR TRIAXIAL COMPRESSION TEST REPORT

TLE: EASTERN ARKANSAS

BOR: 10-EAU-94 SAM: 5 DEP: 11.0-12.0 DAT: 06 APR 95 TEC: JH
DES: SANDY CLAY (CL), BROWN

REM:
SPECIMENS COMPACTED
AT 15 BLOW EFFORT
SAMPLE TYPE = COMPACTED
GS: 2.70 (ESTIMATED)
LL: 29 PL: 19 PI: 10

WEIGHT OF SOLIDS = 117.22 I. HEIGHT = 3.000" I. DIAMETER = 1.364"

HEIGHT CHANGES: PRE-CONS. = .00400" DURING CONS. = .01400"

VOLUME CHANGE DURING CONS. = 2.5 CC TIME OF TEST = 1287 MINS.

BACK PRESSURE = 90.00 PSI (6.48 TSF) CHAMBER PRESSURE = 117.78

EFF CONFINING PRESSURE, TSF = 2.00

	INITIAL	BEFORE SHEAR
WATER CONTENT, %	22.48	22.63
VOID RATIO	.655	.590
SATURATION, %	92.73	103.50
DRY DENSITY, PCF	101.88	105.99

V DEF IN.	AXIAL LOAD LBS	PORE PRESS PSI	STRAIN %	IND POR PRESS TSF	DEVIAT STRESS TSF	EFFECTIVE E1 - TSF	E3 -	RATIO E1/ E3	NORML STRES TSF	SHEAR STRES TSF
.000	.0	90.0	.0	.00	.00	2.000	2.000	1.000	2.00	.00
.025	29.3	103.0	.8	.94	1.48	2.544	1.064	2.391	1.80	.74
.052	37.8	105.8	1.7	1.14	1.89	2.755	.862	3.194	1.81	.95
.083	46.0	105.3	2.8	1.10	2.28	3.177	.898	3.536	2.04	1.14
.117	55.5	103.8	3.9	.99	2.72	3.723	1.006	3.699	2.36	1.36
.149	65.2	101.8	5.0	.85	3.16	4.306	1.150	3.743	2.73	1.58
.224	88.5	96.7	7.5	.48	4.17	5.688	1.518	3.748	3.60	2.09
.298	112.6	91.1	10.0	.08	5.16	7.084	1.921	3.688	4.50	2.58
.372	137.0	85.5	12.5	-.32	6.11	8.433	2.324	3.629	5.38	3.05
.447	159.4	80.3	15.0	-.70	6.90	9.602	2.698	3.559	6.15	3.45
.596	197.2	72.0	20.0	-1.30	8.04	11.335	3.296	3.439	7.32	4.02

RATE OF STRAIN = .016

R-BAR TRIAXIAL COMPRESSION TEST REPORT

TLE: EASTERN ARKANSAS

BOR: 10-EAU-94 SAM: 5 DEP: 11.0-12.0 DAT: 06 APR 95 TEC: JH
DES: SANDY CLAY (CL), BROWN

REM:
SPECIMENS COMPACTED
AT 15 BLOW EFFORT
SAMPLE TYPE = COMPACTED
GS: 2.70 (ESTIMATED)
LL: 29 PL: 19 PI: 10

WEIGHT OF SOLIDS = 114.53 I. HEIGHT = 3.000" I. DIAMETER = 1.356"

HEIGHT CHANGES: PRE-CONS. = .01000" DURING CONS. = .02000"

VOLUME CHANGE DURING CONS. = 2.9 CC TIME OF TEST = 1287 MINS.

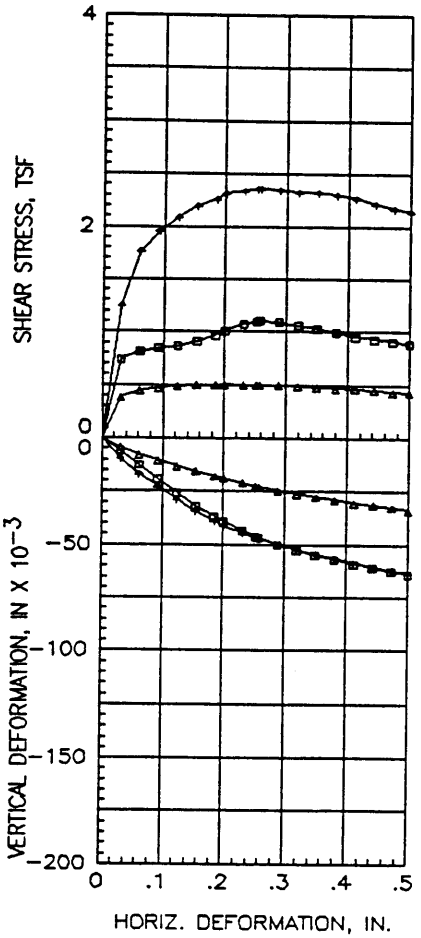
BACK PRESSURE = 90.00 PSI (6.48 TSF) CHAMBER PRESSURE = 131.67

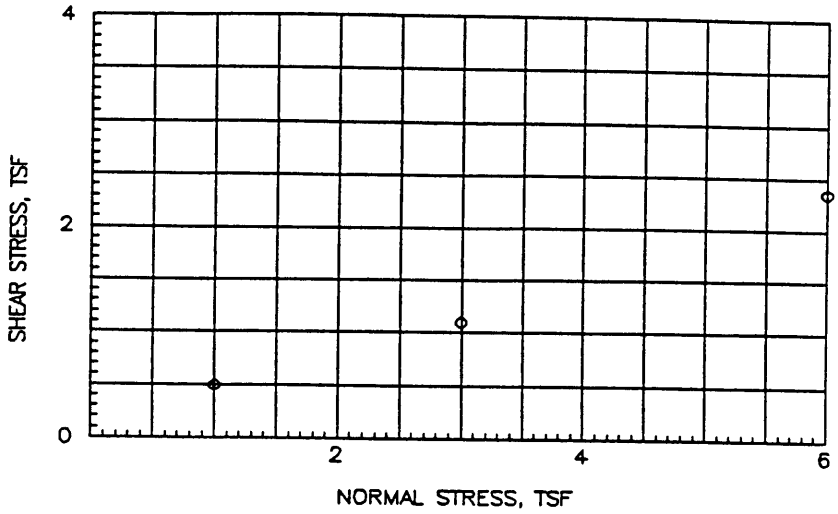
EFF CONFINING PRESSURE, TSF = 3.00

	INITIAL	BEFORE SHEAR
WATER CONTENT, %	22.94	22.33
VOID RATIO	.674	.589
SATURATION, %	91.95	102.44
DRY DENSITY, PCF	100.72	106.11

V DEF IN.	AXIAL LOAD LBS	PORE PRESS PSI	STRAIN %	IND POR PRESS TSF	DEVIAT STRESS TSF	EFFECTIVE E1 - TSF -	E3	RATIO E1/ E3	NORML STRES TSF	SHEAR STRES TSF
.000	.0	90.0	.0	.00	.00	3.000	3.000	1.000	3.00	.00
.031	43.5	111.8	1.0	1.57	2.24	3.669	1.431	2.565	2.55	1.12
.061	53.5	114.2	2.1	1.74	2.72	3.982	1.258	3.166	2.62	1.36
.089	62.2	114.0	3.0	1.73	3.14	4.409	1.272	3.466	2.84	1.57
.120	72.3	112.6	4.0	1.63	3.61	4.980	1.373	3.628	3.18	1.80
.149	82.7	110.8	5.0	1.50	4.08	5.587	1.503	3.718	3.54	2.04
.224	110.5	105.4	7.5	1.11	5.31	7.204	1.891	3.809	4.55	2.66
.297	139.5	99.3	10.0	.67	6.53	8.859	2.330	3.801	5.59	3.26
.372	167.9	93.1	12.5	.22	7.64	10.414	2.777	3.750	6.60	3.82
.446	195.1	87.1	15.0	-.21	8.62	11.830	3.209	3.687	7.52	4.31
.594	239.6	77.2	20.0	-.92	9.97	13.888	3.922	3.542	8.90	4.98

RATE OF STRAIN = .016





	TEST NO.	1 ▲	2 □	3 +	
INITIAL	WATER CONTENT, %	26.1	25.6	25.9	
	VOID RATIO	.757	.751	.730	
	SATURATION, %	93.3	92.0	95.9	
	DRY DENSITY, PCF	95.9	96.2	97.4	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	25.6	25.9	21.5	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.50	1.10	2.36	
TIME TO FAILURE, MIN		1090	1397	1369	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF		.43	.89	2.14	

ϕ = _____ DEG

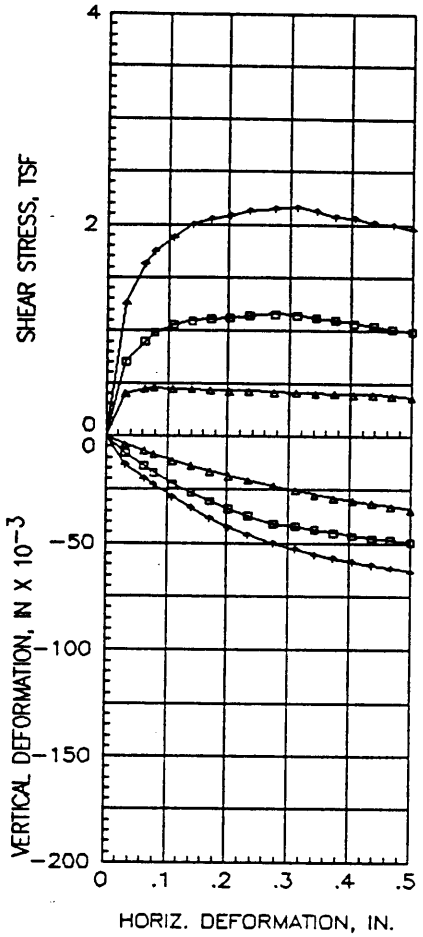
TAN ϕ = _____

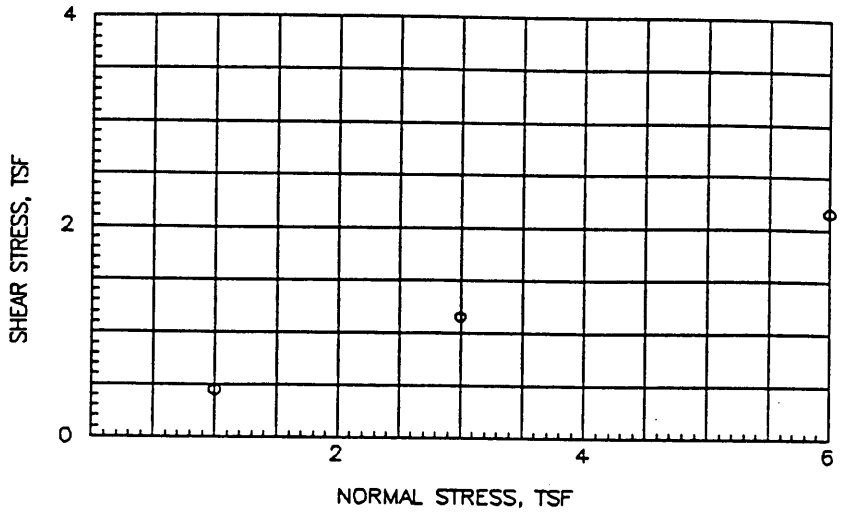
C = _____ T/SF

TYPE SPECIMEN	UNDISTURBED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION	CLAY (CH), REDDISH BROWN; CONCRETIONS		

LL 53	PL 22	PI 31		GS 2.70 (EST)

REMARKS;	PROJECT EASTERN ARKANSAS	
	BORING NO. 10-EAU-94	SAMPLE 4
	DEPTH/ELEV 8.0-9.0	TECH. JL
	LABORATORY USAE WES - STF/GL	DATE 04 APR 95
	DIRECT SHEAR TEST REPORT	





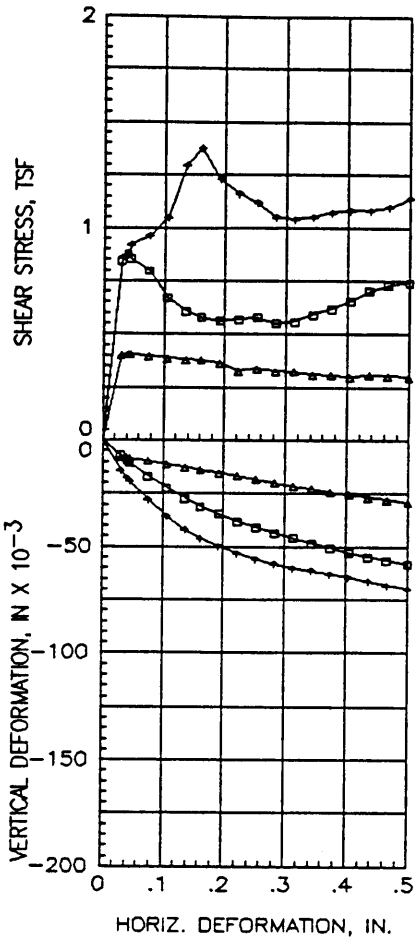
		TEST NO.	1 ▲	2 □	3 ◆	
INITAL		WATER CONTENT, %	23.9	23.9	24.1	
		VOID RATIO	.734	.723	.719	
		SATURATION, %	87.9	89.3	90.6	
		DRY DENSITY, PCF	97.2	97.8	98.0	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL		WATER CONTENT, %	26.3	23.3	21.3	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF			.45	1.16	2.16	
TIME TO FAILURE, MIN			431	1518	1718	
RATE OF STRAIN, IN/MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF			.37	.99	1.95	

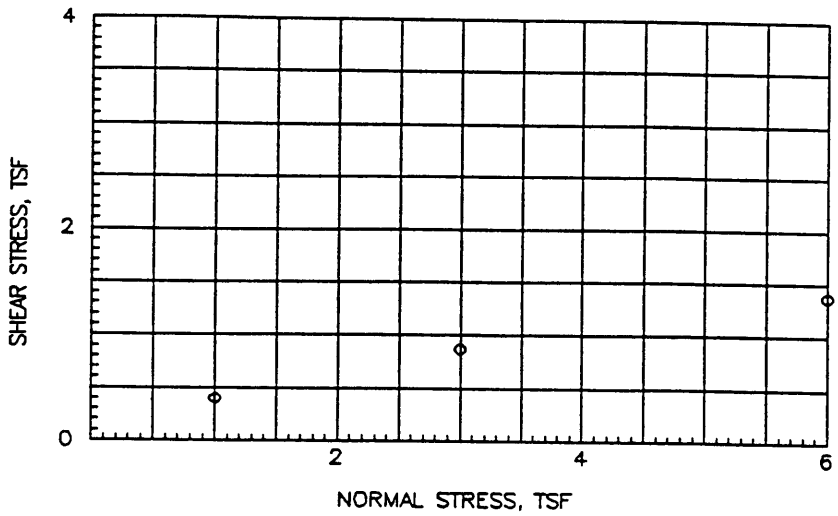
ϕ = _____ DEG

TAN ϕ = _____

C = _____ T/SF

TYPE SPECIMEN	COMPACTED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION	CLAY (CH), REDDISH BROWN		
LL	PL	PI	GS 2.70 (EST)
REMARKS:		PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED			
AT 15 BLOW EFFORT		BORING NO. 10-EAU-94	SAMPLE 4
		DEPTH/ELEV 8.0-9.0	TECH. JL
		LABORATORY USAE WES - STF/GL	DATE 17 APR 95
		DIRECT SHEAR TEST REPORT	





ϕ = _____ DEG

TAN ϕ = _____

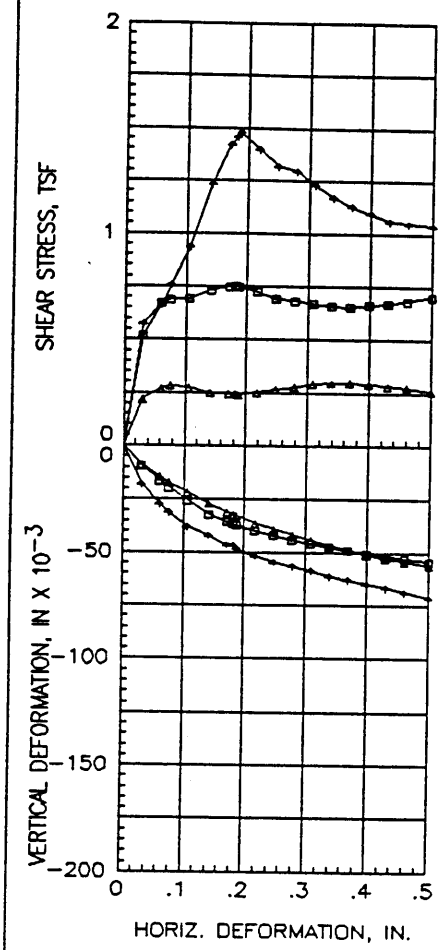
C = _____ T/SF

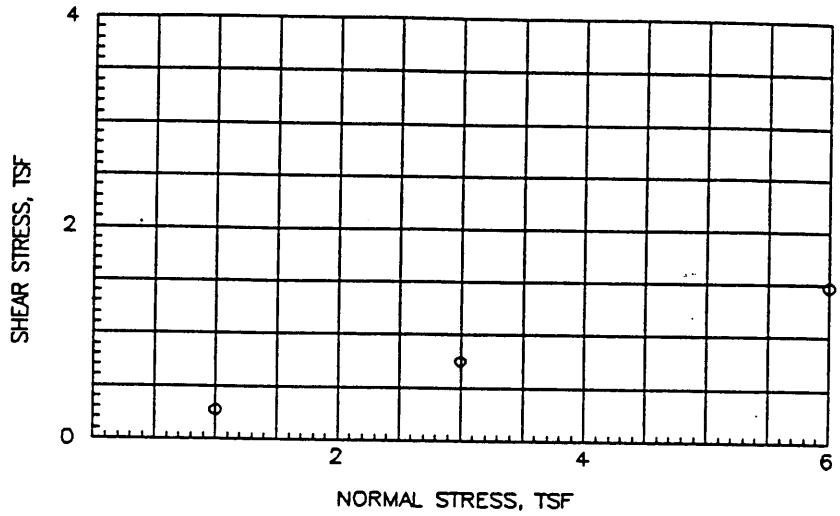
	TEST NO.	1 ▲	2 □	3 ◆	
INITAL	WATER CONTENT, %	27.3	27.0	27.0	
	VOID RATIO	.853	.842	.841	
	SATURATION, %	86.5	86.7	86.7	
	DRY DENSITY, PCF	90.9	91.5	91.5	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	31.0	28.4	27.6	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.41	.88	1.38	
TIME TO FAILURE, MIN		246	219	879	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF		.30	.55	1.04	

TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION CLAY (CH), REDDISH BROWN; SLICKENSIDED		

LL 57	PL 26	PI 31		GS 2.70 (EST)

REMARKS:	PROJECT EASTERN ARKANSAS	
	BORING NO. 11-EAU-94	SAMPLE 5
	DEPTH/ELEV 11.0-12.0	TECH. JL
	LABORATORY USAE WES - STF/GL	DATE 11 APR 95
	DIRECT SHEAR TEST REPORT	





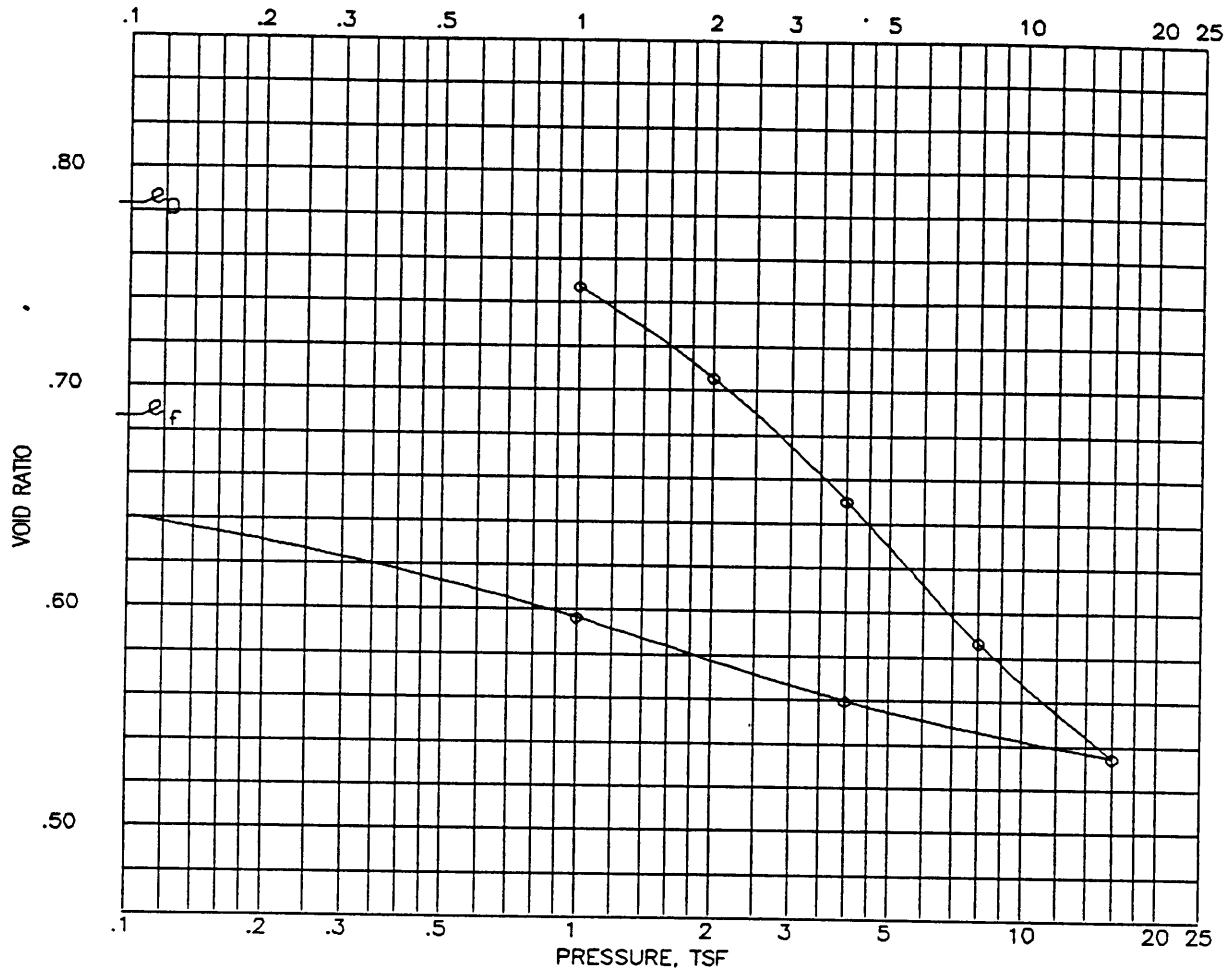
	TEST NO.	1 ▲	2 ▫	3 ✦	
INITAL	WATER CONTENT, %	24.2	24.3	24.2	
	VOID RATIO	.980	.957	.915	
	SATURATION, %	66.7	68.5	71.3	
	DRY DENSITY, PCF	85.1	86.1	88.0	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	32.9	29.8	27.2	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.28	.75	1.48	
TIME TO FAILURE, MIN		417	1003	1031	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF		.24	.66	1.04	

ϕ = _____ DEG

TAN ϕ = _____

C = _____ T/SF

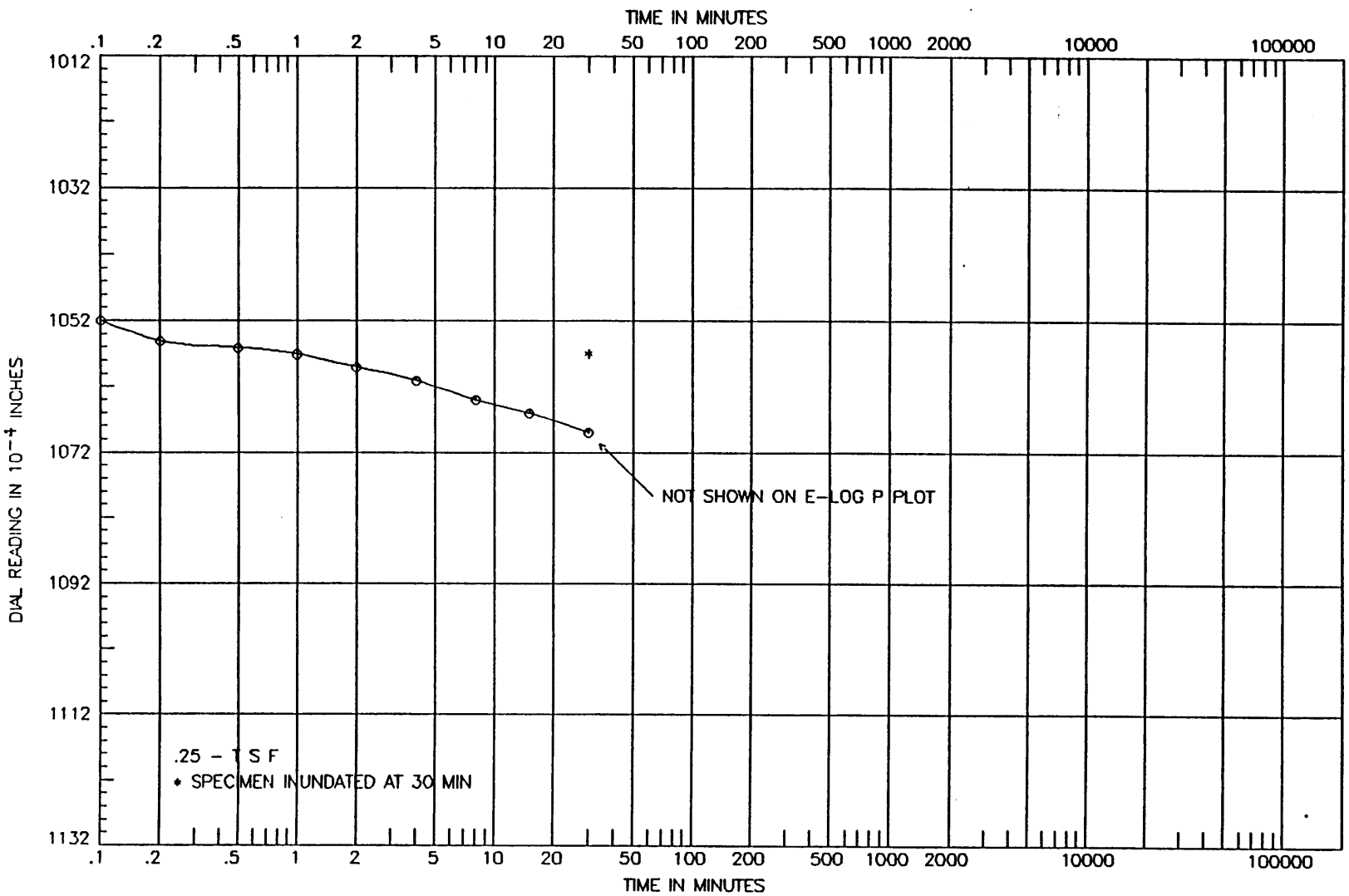
TYPE SPECIMEN	COMPACTED		3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION	CLAY (CH), REDDISH BROWN			
LL	PL	PI		GS 2.70 (EST)
REMARKS;			PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED				
AT 15 BLOW EFFORT			BORING NO. 11-EAU-94	SAMPLE 5
			DEPTH/ELEV 11.0-12.0	TECH. JL
			LABORATORY USAE WES - STF/GL	DATE 17 APR 95
			DIRECT SHEAR TEST REPORT	



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	24.3	26.0
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	94.6	100.0
COMPRESSION INDEX		SATURATION, %	84.0	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	.782	.685
DIA. IN 4.25	HT. IN 1.162	BACK PRESSURE, TSF		

CLASSIFICATION	CLAY (CH), BROWN			
LL 55	PL 17	PI 38	PROJECT EASTERN ARKANSAS	
GS 2.70 (EST)	D_{10}			
REMARKS:			BORING NO. 11-EAU-94	SAMPLE NO. 3
			DEPTH/ELEV 5.0-6.0	TECH. JL
			LABORATORY USAE WES - STF/GL	DATE 10 FEB 95
			CONSOLIDATION TEST REPORT	

SHEET 1 OF 10

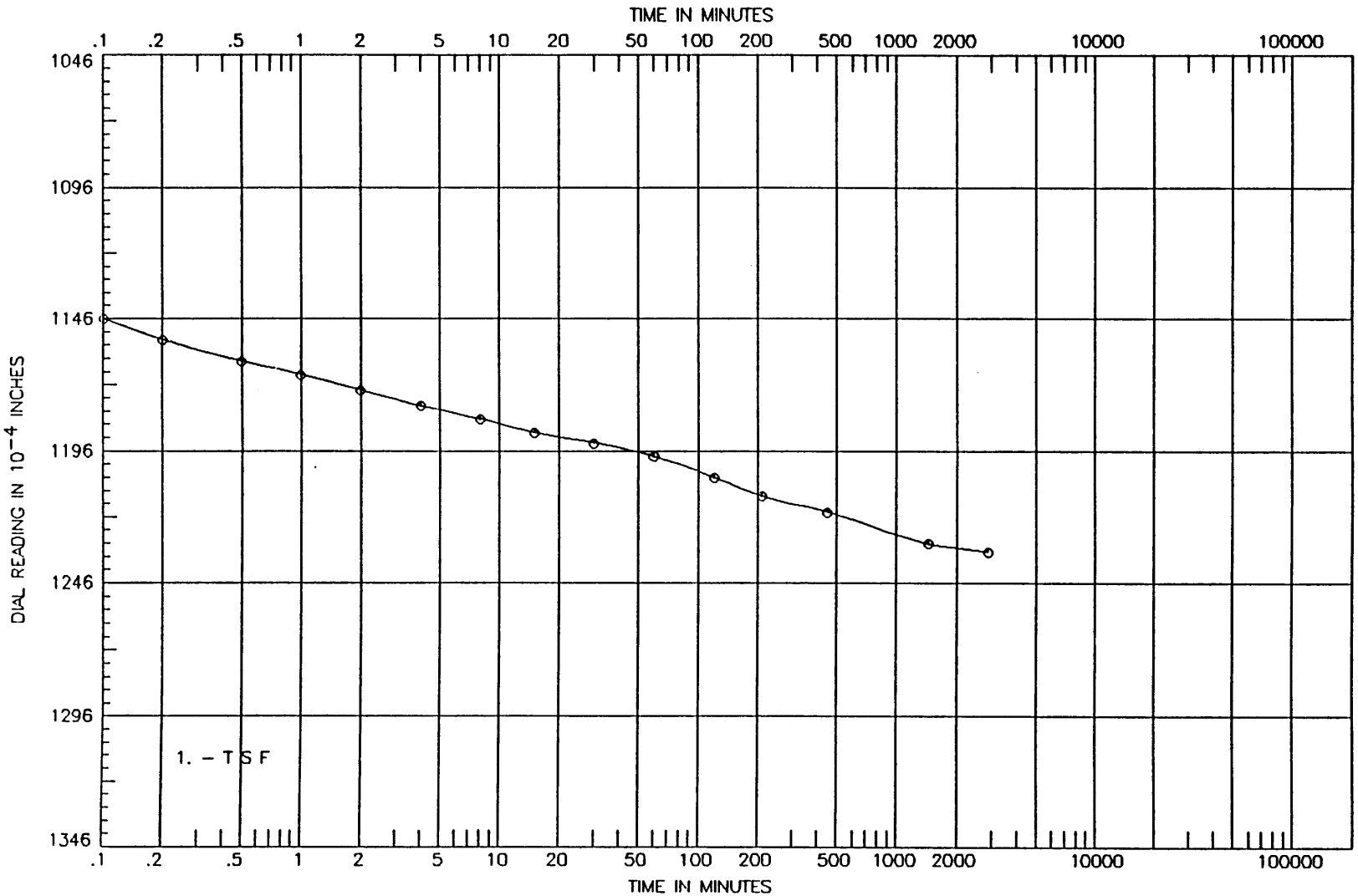


PROJECT EASTERN ARKANSAS	
BORING 11-EAU-94	SAMPLE NO. 3
DEPTH/ELEV 5.0-6.0	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 2 OF 10

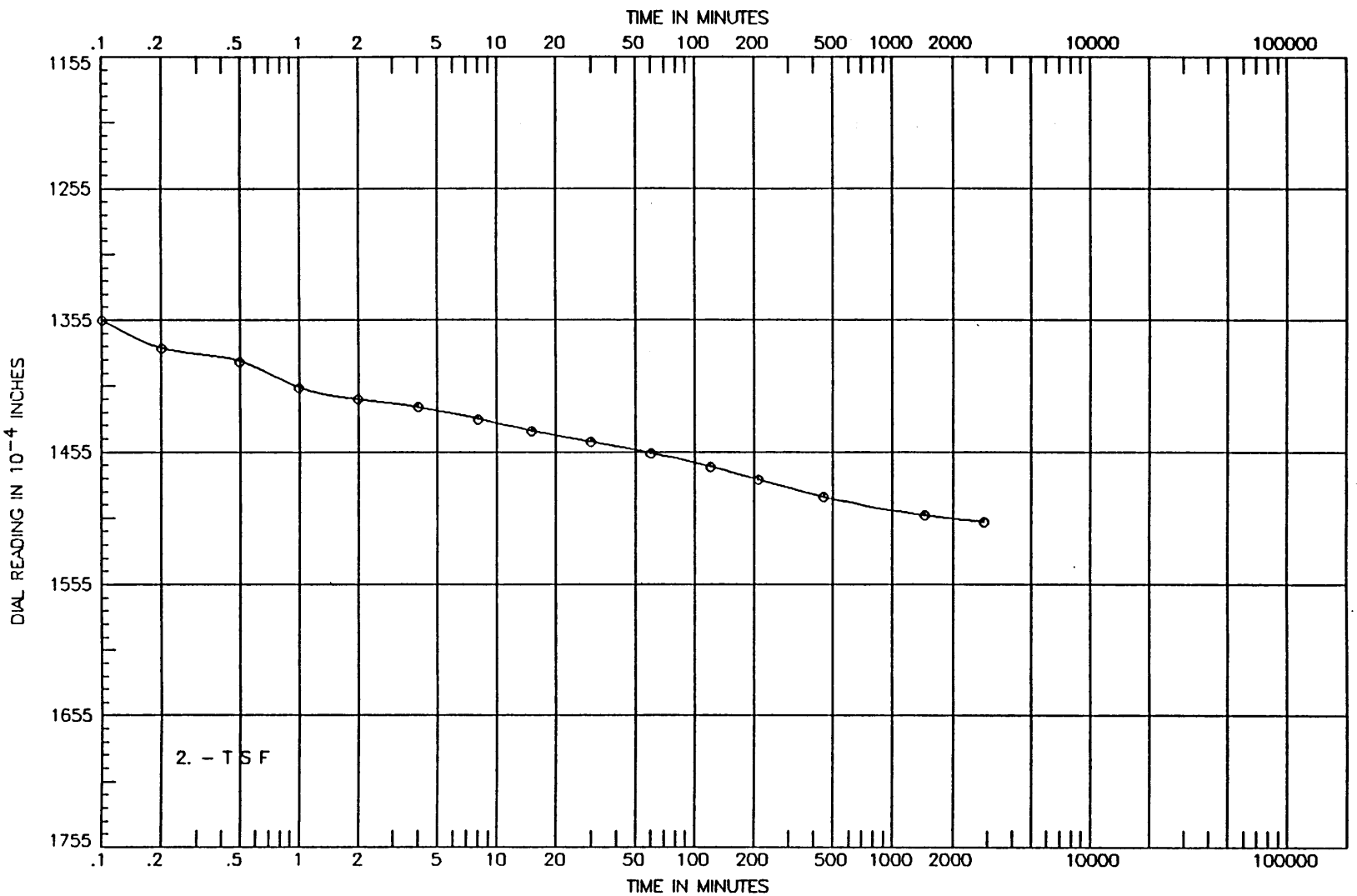


PROJECT EASTERN ARKANSAS	
BORING 11-EAU-94	SAMPLE NO. 3
DEPTH/ELEV 5.0-6.0	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 3 OF 10

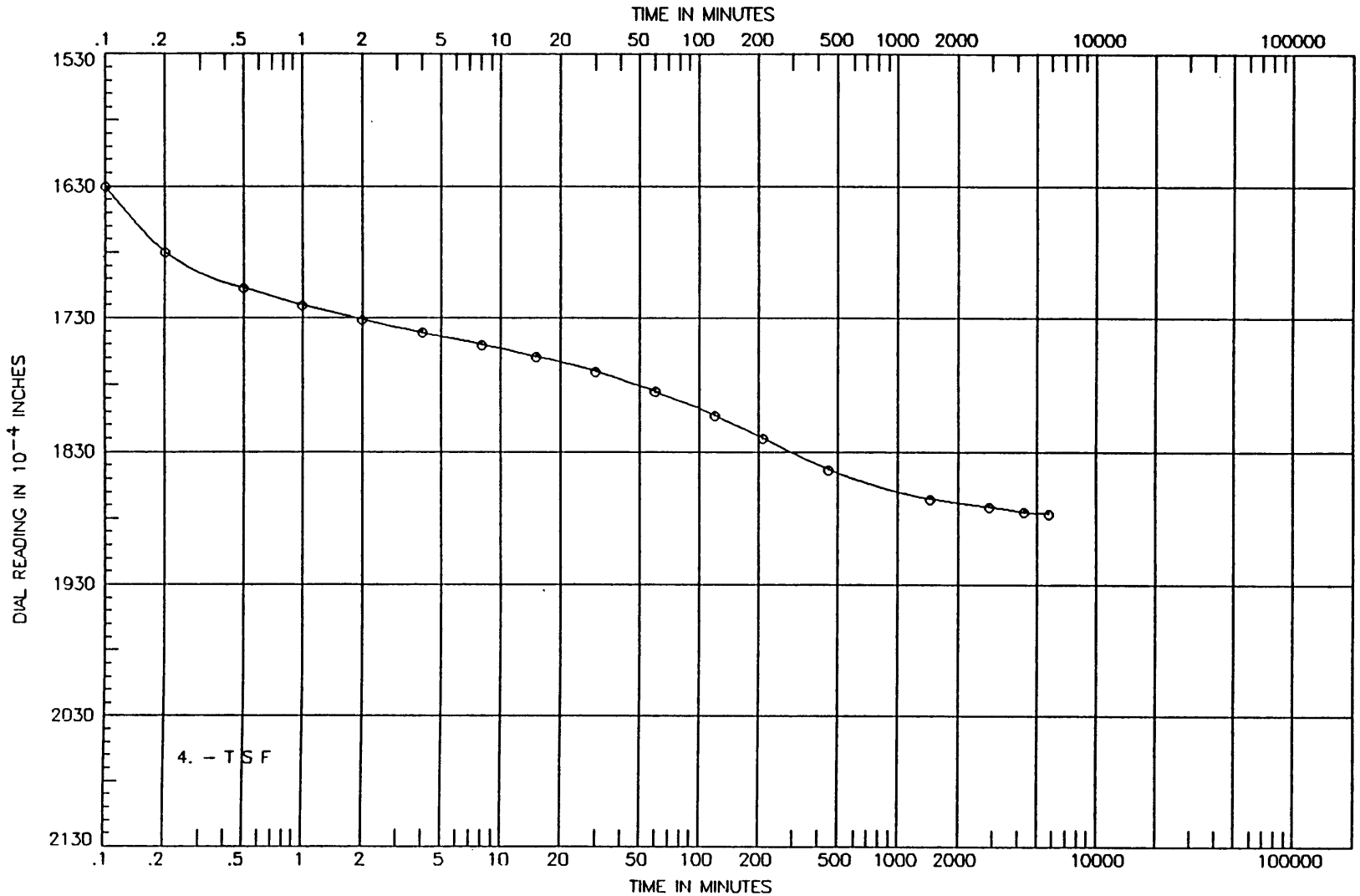


PROJECT	EASTERN ARKANSAS		
BORING	11-EAU-94	SAMPLE NO.	3
DEPTH/ELEV	5.0-6.0	DATE	10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 4 OF 10

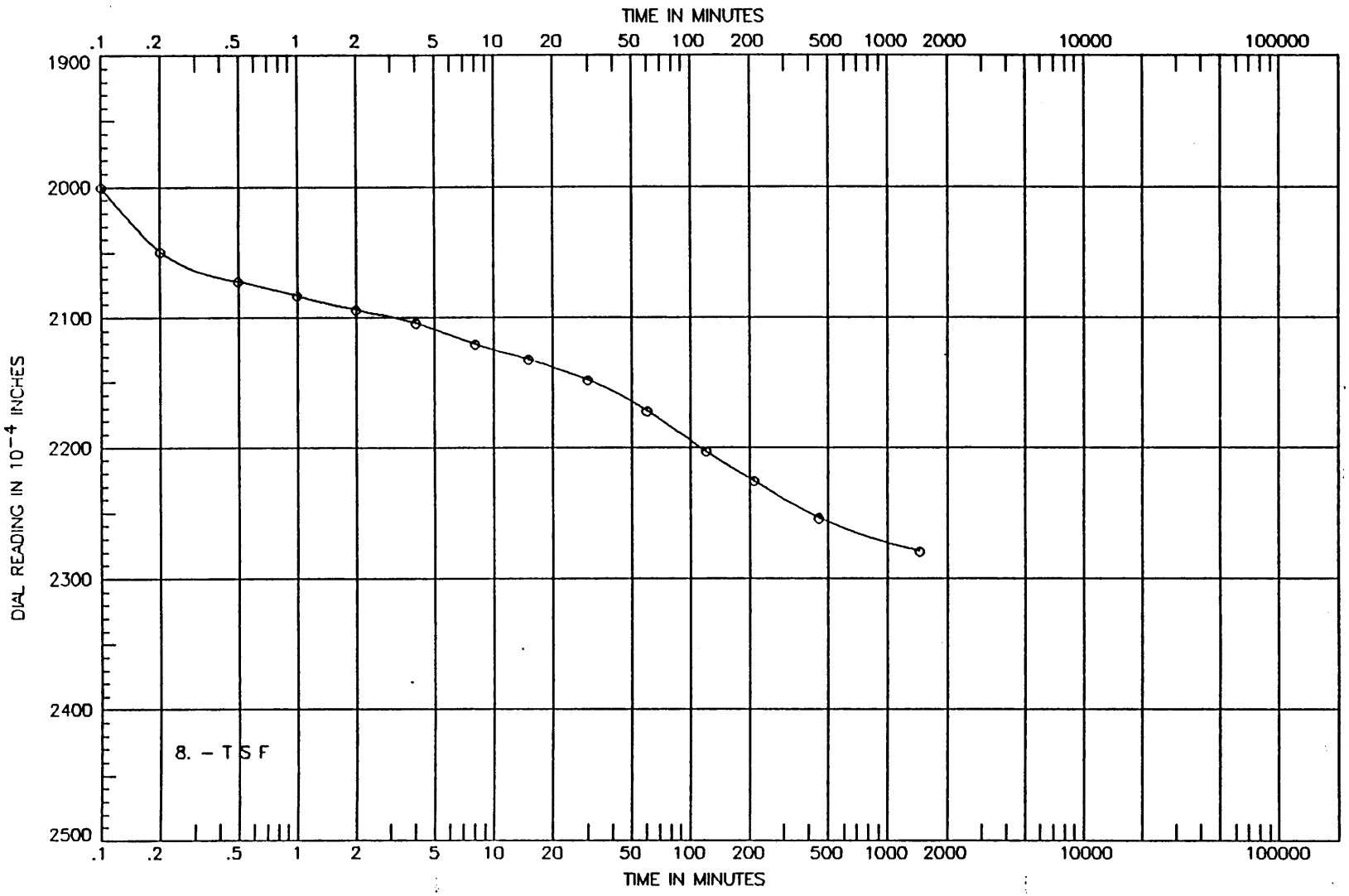


PROJECT EASTERN ARKANSAS	
BORING 11-EAU-94	SAMPLE NO. 3
DEPTH/ELEV 5.0-6.0	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 5 OF 10

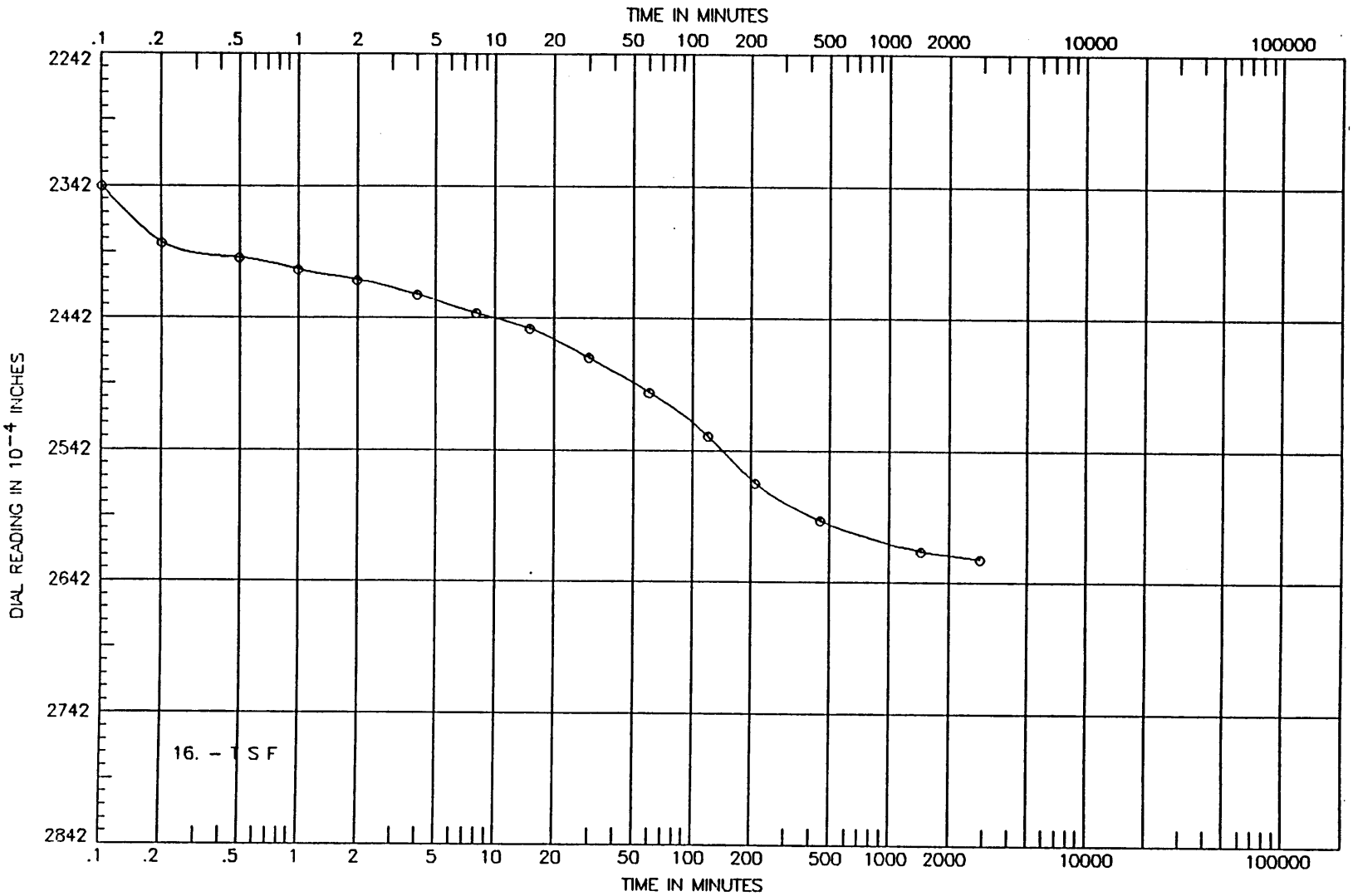


PROJECT	EASTERN ARKANSAS		
BORING	11-EAU-94	SAMPLE NO.	3
DEPTH/ELEV	5.0-6.0	DATE	10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 6 OF 10

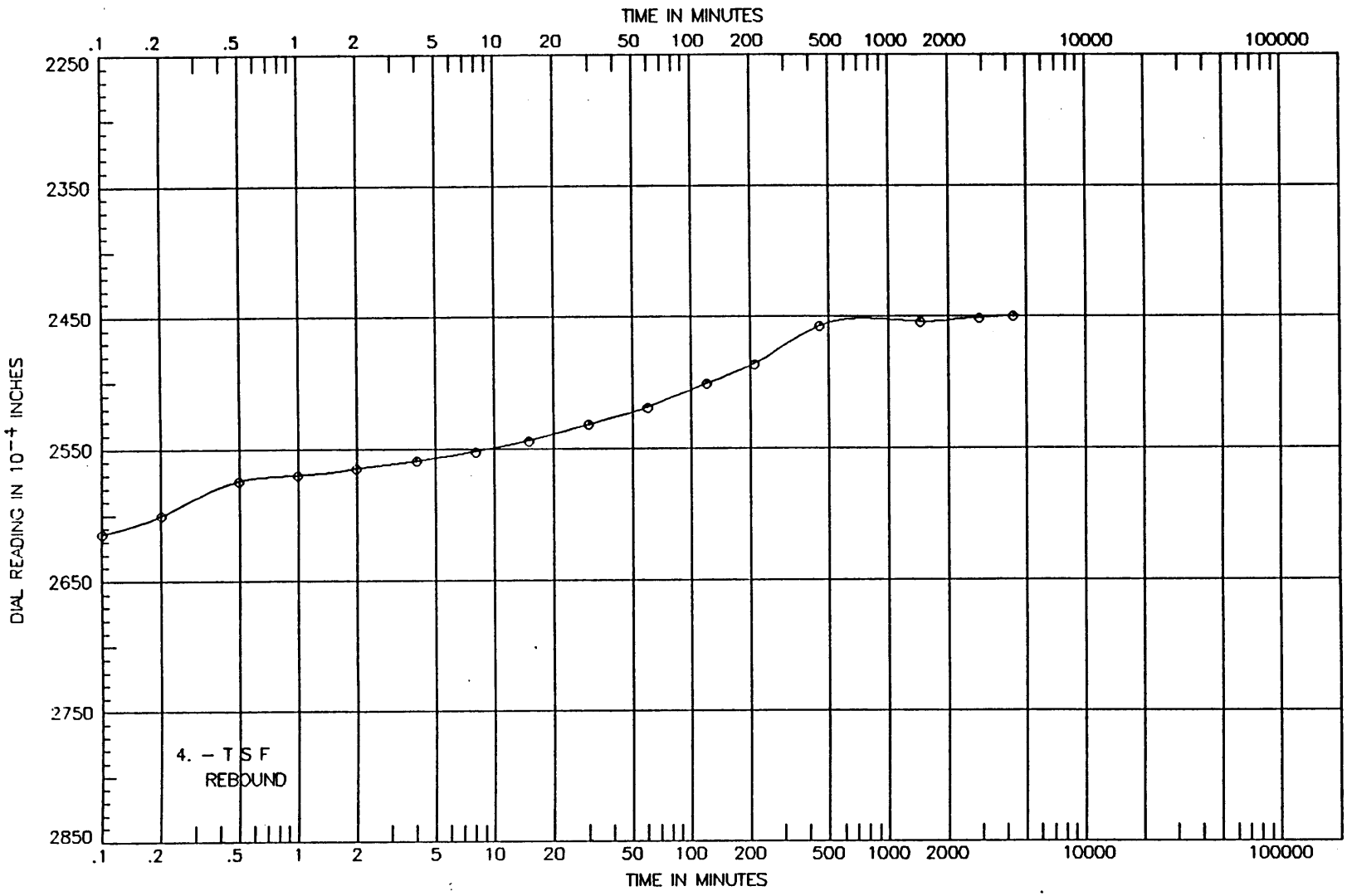


PROJECT EASTERN ARKANSAS	
BORING 11-EAU-94	SAMPLE NO. 3
DEPTH/ELEV 5.0-6.0	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

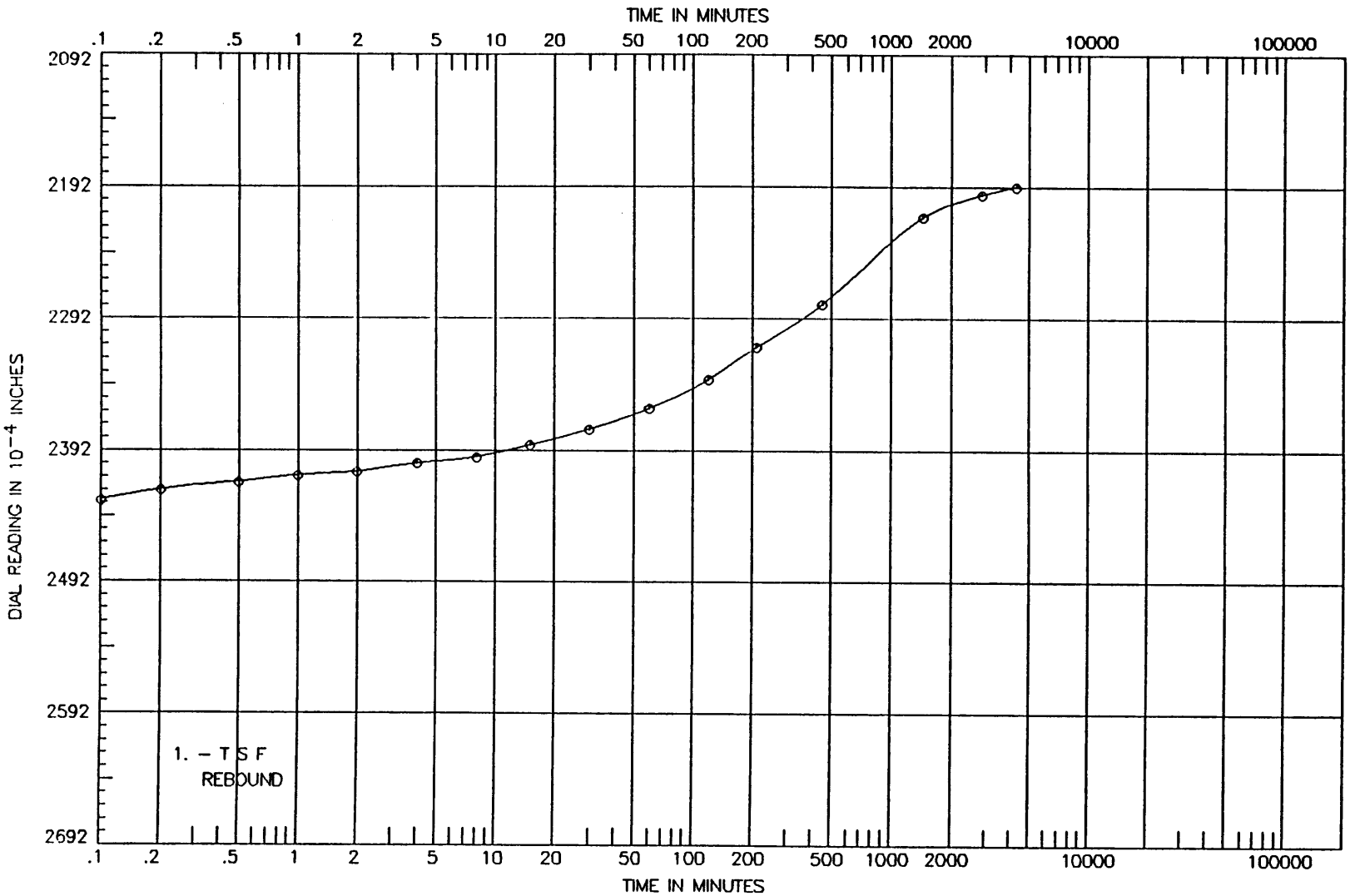
LABORATORY USAE WES - STF/GL

SHEET 7 OF 10



PROJECT EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
		LABORATORY USAE WES – STF/GL
BORING 11-EAU-94	SAMPLE NO. 3	
DEPTH/ELEV 5.0-6.0	DATE 10 FEB 95	

SHEET 8 OF 10

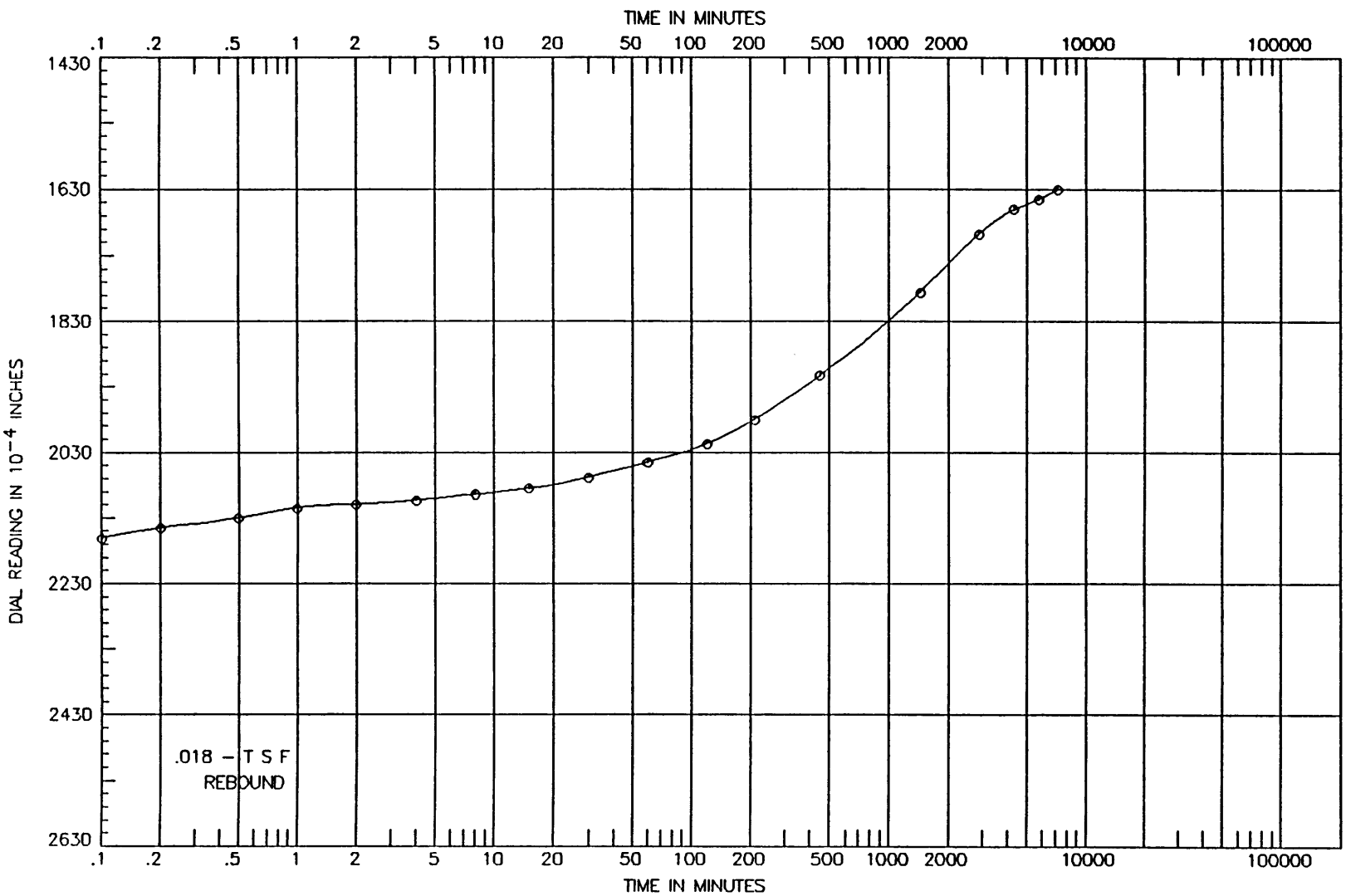


PROJECT EASTERN ARKANSAS	
BORING 11-EAU-94	SAMPLE NO. 3
DEPTH/ELEV 5.0-6.0	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

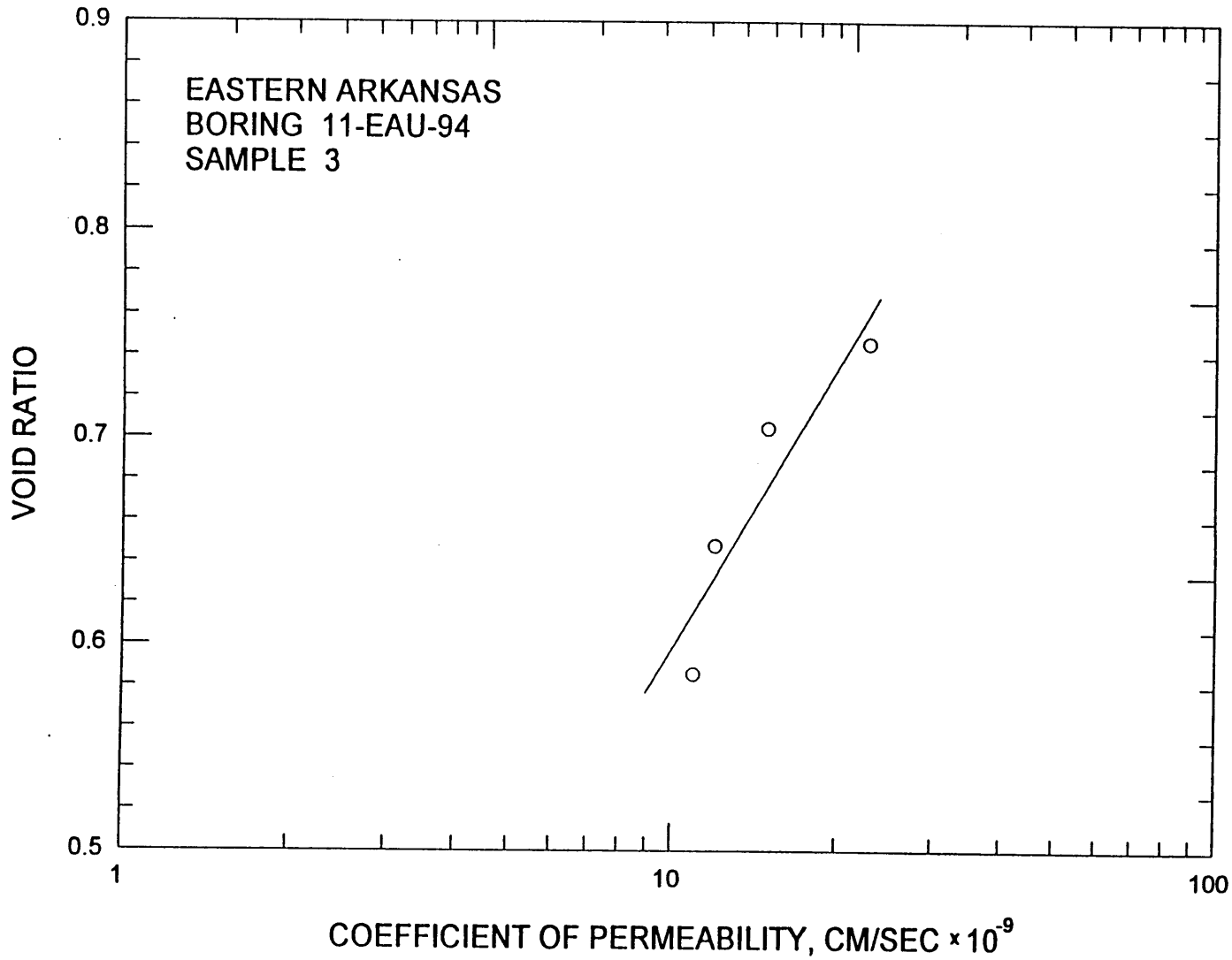
LABORATORY USAE WES – STF/GL

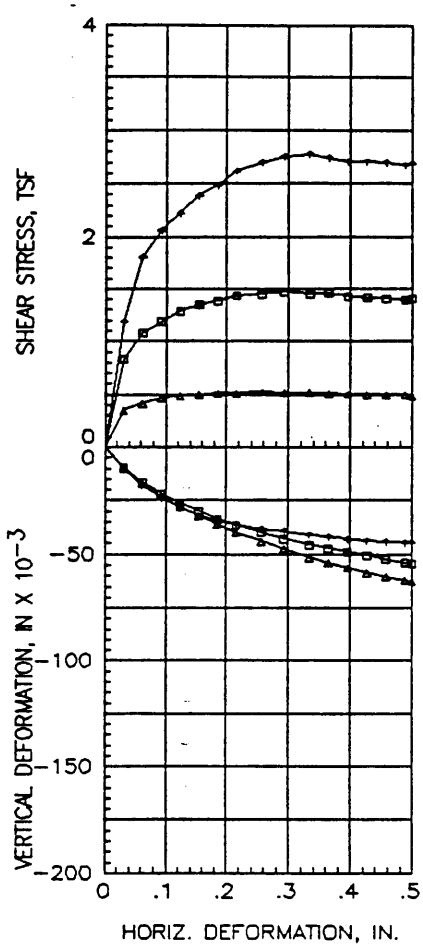
SHEET 2 OF 10

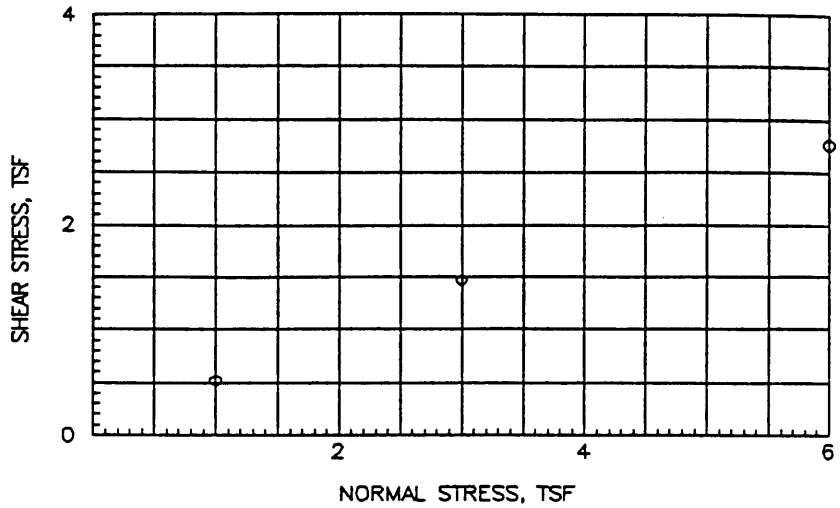


PROJECT EASTERN ARKANSAS			CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING 11-EAU-94	SAMPLE NO. 3		
DEPTH/ELEV 5.0-6.0	DATE 10 FEB 95		

SHEET 10 OF 10


EASTERN ARKANSAS
BORING 11-EAU-94
SAMPLE 3
VOID RATIO
0.9
0.8
0.7
0.6
0.5
1
10
100
COEFFICIENT OF PERMEABILITY, CM/SEC × 10^-9





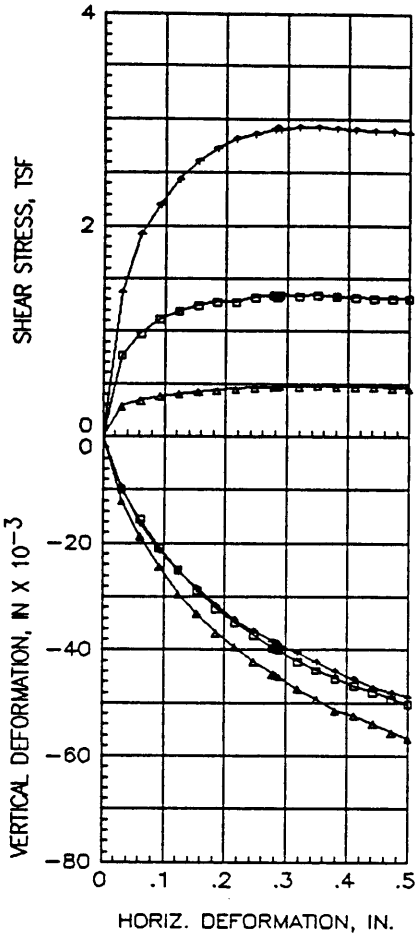
ϕ = _____ DEG

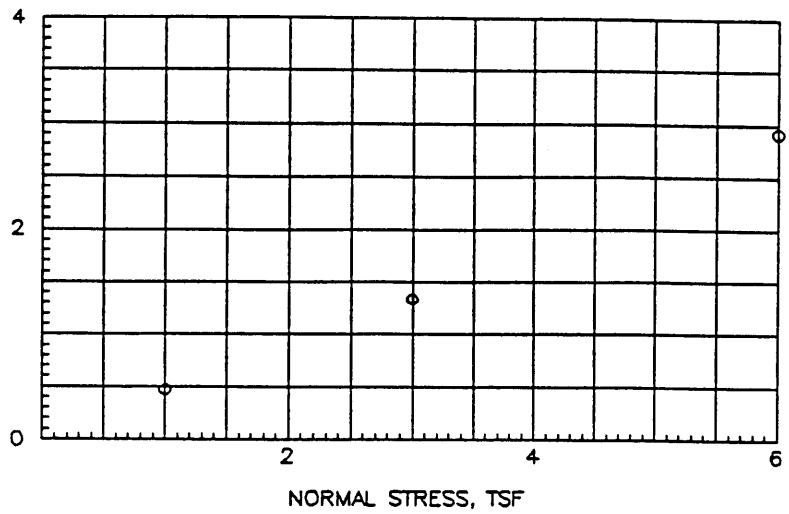
TAN ϕ = _____

C = _____ T/SF

	TEST NO.	1 ▲	2 □	3 +	
INITAL	WATER CONTENT, %	18.1	18.7	19.0	
	VOID RATIO	.750	.752	.741	
	SATURATION, %	65.1	67.1	69.1	
	DRY DENSITY, PCF	96.3	96.1	96.8	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	20.9	18.1	17.0	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.53	1.47	2.77	
TIME TO FAILURE, MIN		1396	1592	1815	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF		.49	1.39	2.67	

TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION CLAY (CL), BROWN		
LL 35 / PL 14 / PI 21		GS 2.70 (EST)
REMARKS;	PROJECT EASTERN ARKANSAS	
	BORING NO. 13-EAU-94	SAMPLE 3
	DEPTH/ELEV 5.0-6.0	TECH. JL
	LABORATORY USAE WES - STF/GL	DATE 11 APR 95
	DIRECT SHEAR TEST REPORT	





	TEST NO.	1 ▲	2 □	3 ✦	
INITAL	WATER CONTENT, %	18.7	18.8	19.0	
	VOID RATIO	.674	.663	.673	
	SATURATION, %	74.8	76.6	76.1	
	DRY DENSITY, PCF	100.6	101.3	100.7	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	21.6	18.4	16.6	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF		.48	1.34	2.92	
TIME TO FAILURE, MIN		1590	1533	1561	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF		.46	1.31	2.87	

ϕ = _____ DEG

TAN ϕ = _____

C = _____ T/SF

TYPE SPECIMEN COMPACTED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION CLAY (CL), BROWN		

LL	PL	PI		GS 2.70 (EST)

REMARKS;	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 13-EAU-94	SAMPLE 3
	DEPTH/ELEV 5.0-6.0	TECH. JL
	LABORATORY USAE WES - STF/GL	DATE 24 APR 95
	DIRECT SHEAR TEST REPORT	

FALLING-HEAD PERMEABILITY TEST

PROJECT: EASTERN ARKANSAS

BORING: 13-EAU-94 SAMPLE: 5 DEPTH: 11.0-12.2 DATE: 11 APR 95

INPUT DATA: SANDY CLAY (CL), GRAY LL:26 PL:16 PI:10

	INITIAL	AFTER CONSOL.
WET SOIL & TARE	125.69	207.36
DRY SOIL & TARE		179.11
TARE		65.00

HEIGHT	3.000 IN
DIAMETER	1.374 IN
GRAVITY	2.70

CHANGE IN HEIGHT .013

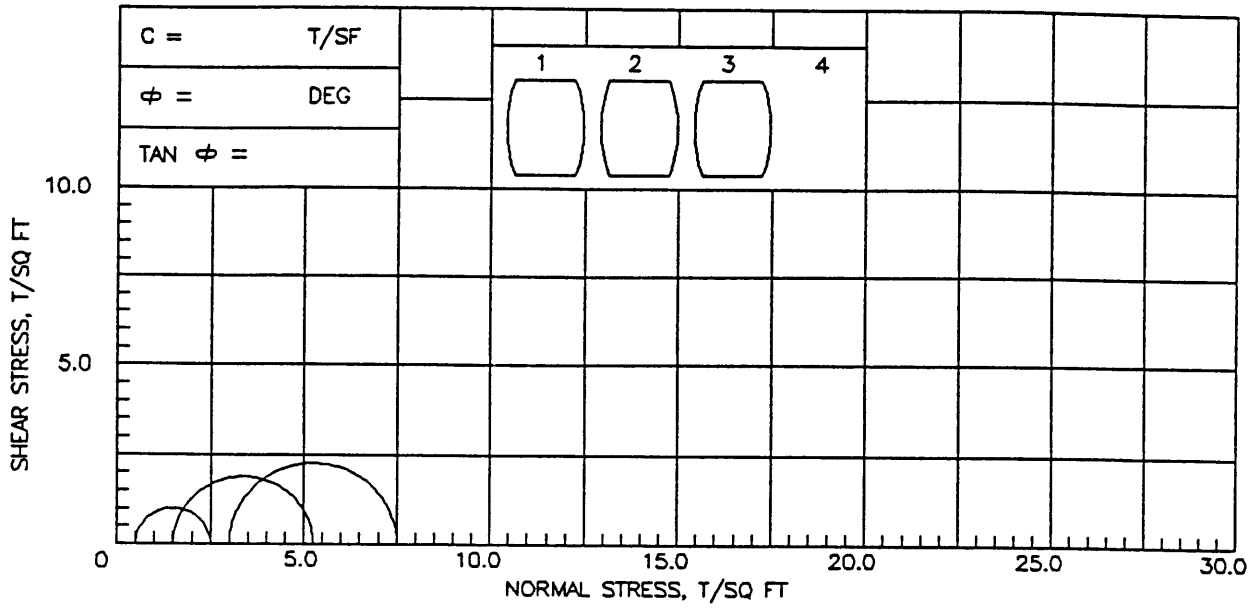
LINE	TIME	BUR #1	BUR #2	TEMP
122.	720.	3.0	23.9	21.5
124.	822.	3.4	23.5	22.0
126.	822.	3.4	23.5	22.0
128.	850.	3.6	23.3	22.0
130.	850.	3.6	23.3	22.0
132.	957.	4.0	22.9	22.5

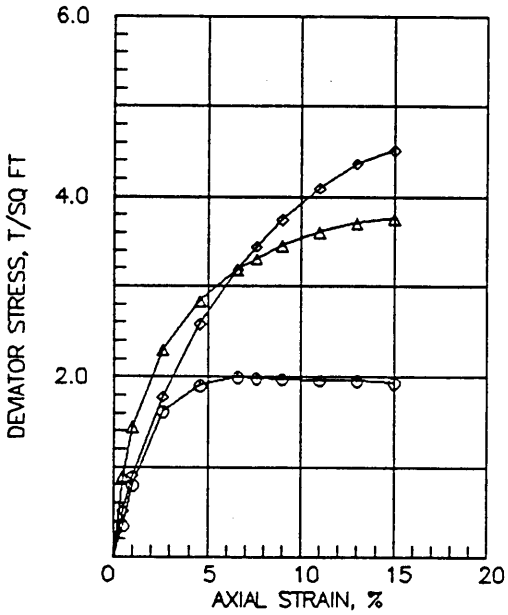
OUTPUT:

	INITIAL	AFTER CONSOL.
WATER CONTENT, % =	10.1	24.8
VOID RATIO =		.746
SATURATION, % =		89.6
DRY DENSITY, PCF =	97.9	96.6

COEFFICIENT OF PERMEABILITY

RUN #1	2.13E-06
RUN #2	2.42E-06
RUN #3	2.07E-06
AVERAGE	2.21E-06





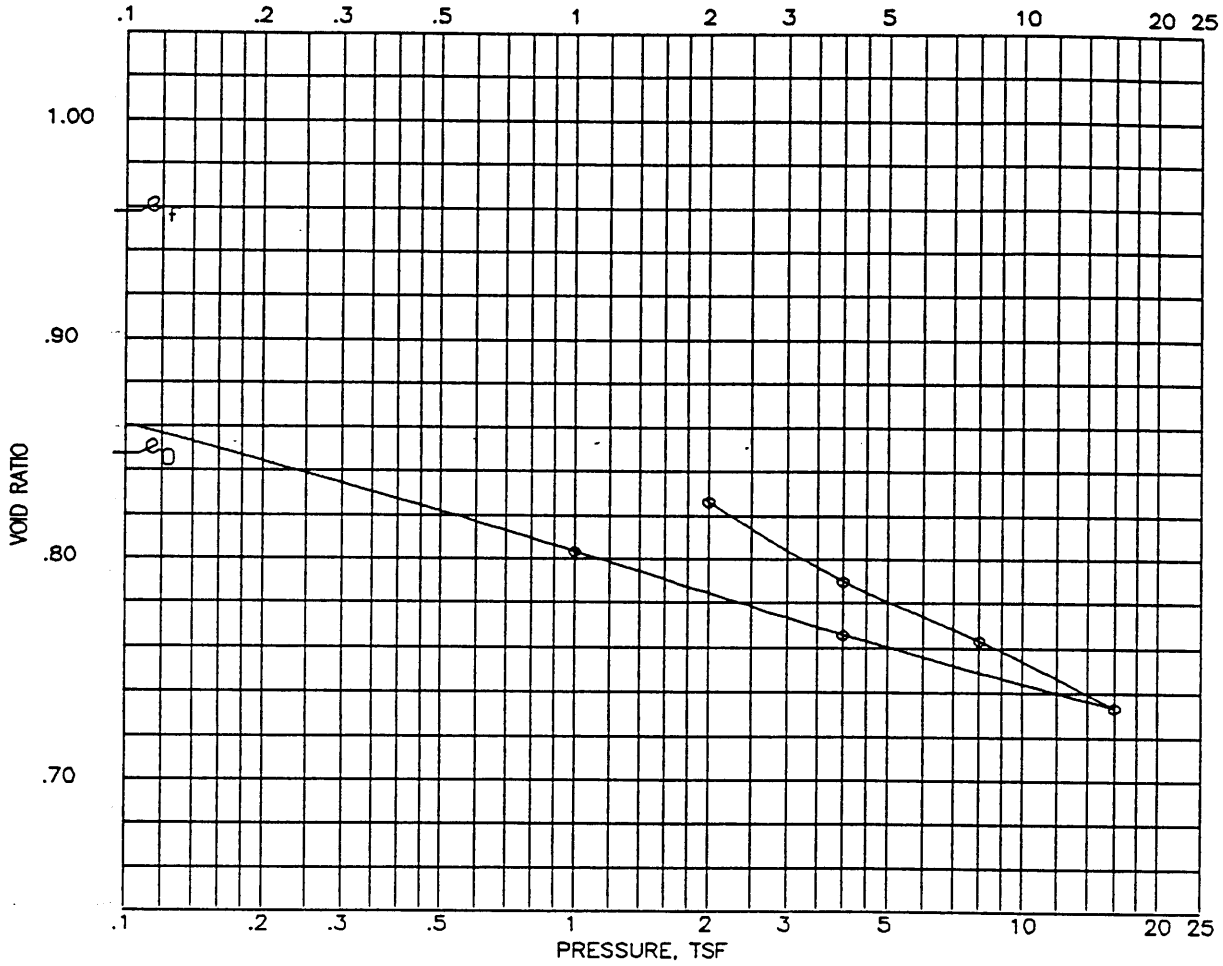
SPECIMEN NO.		○ 1	△ 2	◇ 3	4
INITIAL	WATER CONTENT, %	23.4	23.5	23.1	
	DRY DENSITY, PCF	76.2	80.2	82.5	
	SATURATION, %	52.2	57.5	59.6	
	VOID RATIO	1.212	1.101	1.044	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESSURE, TSF				
CHAMBER PRESSURE, TSF		.50	1.50	3.00	
MAX. DEV. STRESS, TSF		2.00	3.76	4.52	
TIME TO FAILURE, MIN.		14	32	32	
STRAIN RATE INCR., %					
INITIAL DIAMETER, IN.		1.38	1.39	1.39	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CH), BROWN

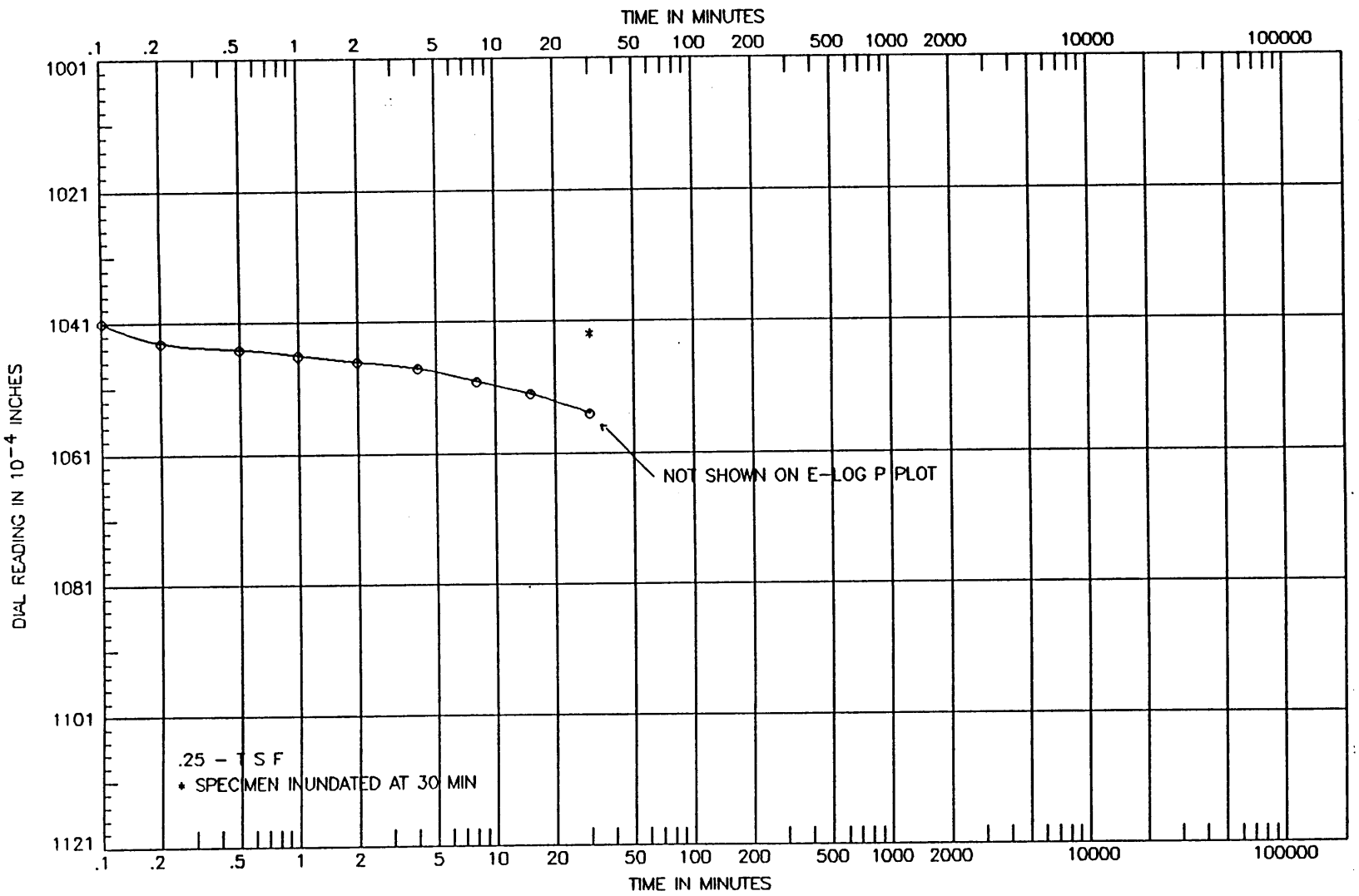
LL 65	PL 23	PI 42	GS 2.70 (ESTIMATED)	COMPACTED SPECIMEN	Q TEST

REMARKS:	PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED		
AT 15 BLOW EFFORT	BORING NO. 18-EAU-94	SAMPLE NO. 4
	DEPTH/ELEV 9.5-10.5	TECH. US
	LABORATORY USAE WES - STF/GL	DATE 10 APR 95
	TRIAXIAL COMPRESSION TEST REPORT	



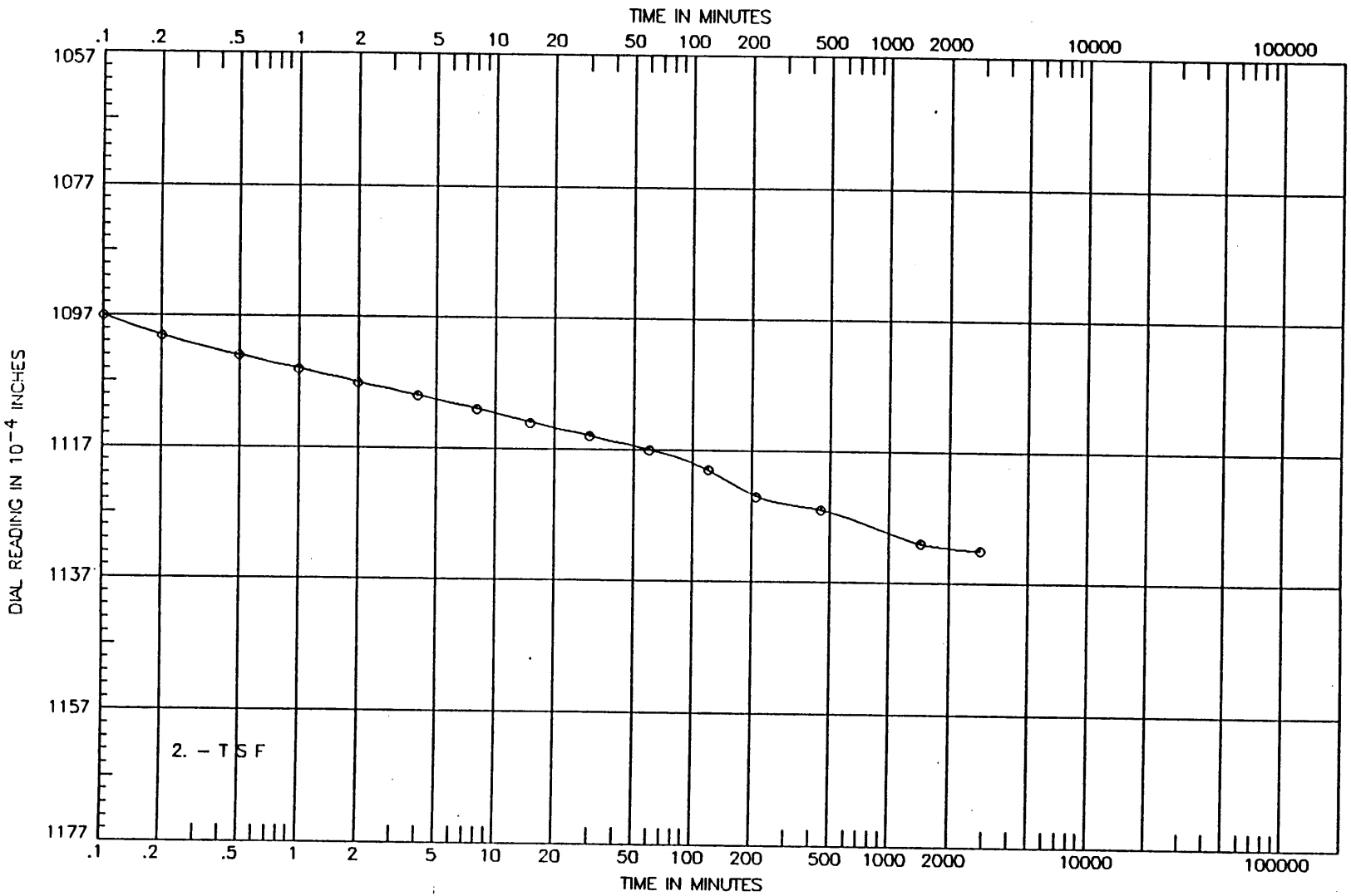
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	29.3	37.0
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	91.3	86.1
COMPRESSION INDEX		SATURATION, %	93.4	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	.846	.957
DIA. IN 4.25	HT. IN 1.167	BACK PRESSURE, TSF		
CLASSIFICATION	CLAY (CH), REDDISH BROWN			
LL 65	PL 23	PI 42	PROJECT EASTERN ARKANSAS	
GS 2.70 (EST)	D_{10}			
REMARKS:		BORING NO. 18-EAU-94	SAMPLE NO. 4	
		DEPTH/ELEV 9.5-10.5	TECH. JL	
		LABORATORY USAE WES - STF/GL	DATE 10 FEB 95	
		CONSOLIDATION TEST REPORT		

SHEET 1 OF 9



PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES LABORATORY USAE WES – STF/GL
BORING	18-EAU-94	SAMPLE NO. 4	
DEPTH/ELEV	9.5-10.5	DATE 10 FEB 95	

SHEET 2 OF 2

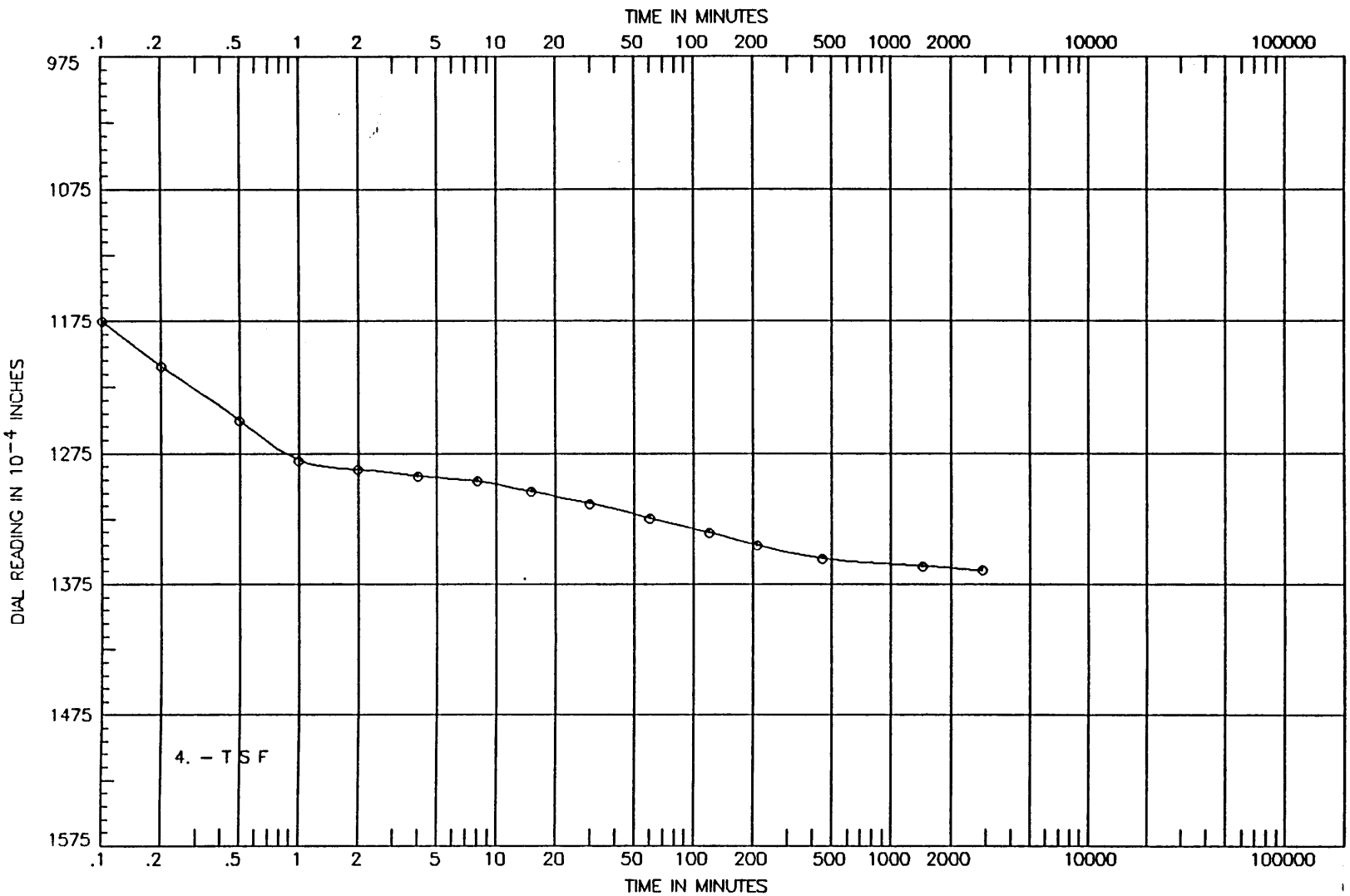


PROJECT	EASTERN ARKANSAS		
BORING	18-EAU-94	SAMPLE NO.	4
DEPTH/ELEV	9.5-10.5	DATE	10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 3 OF 9

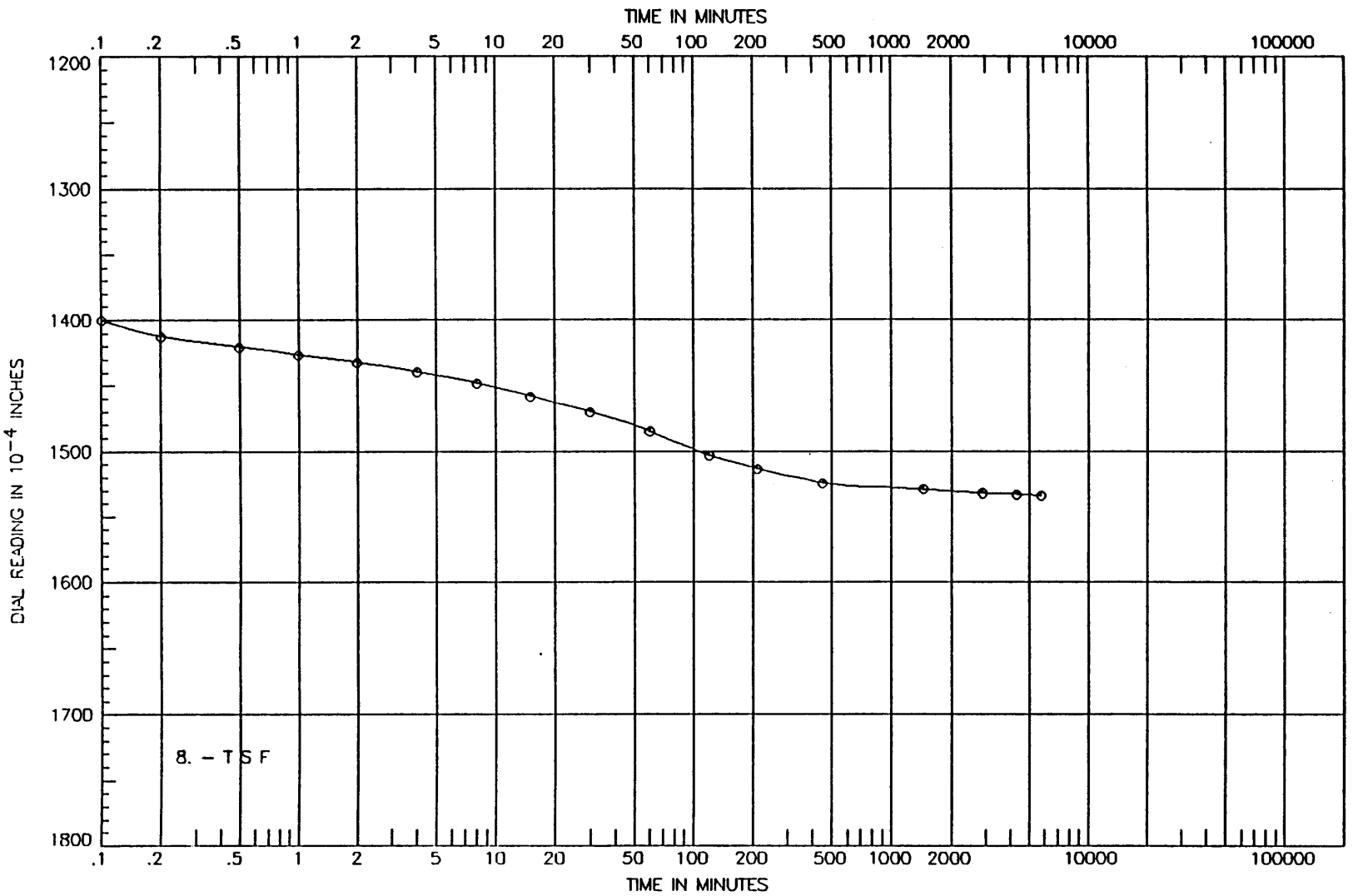


PROJECT EASTERN ARKANSAS	
BORING 18-EAU-94	SAMPLE NO. 4
DEPTH/ELEV 9.5-10.5	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 4 OF 9

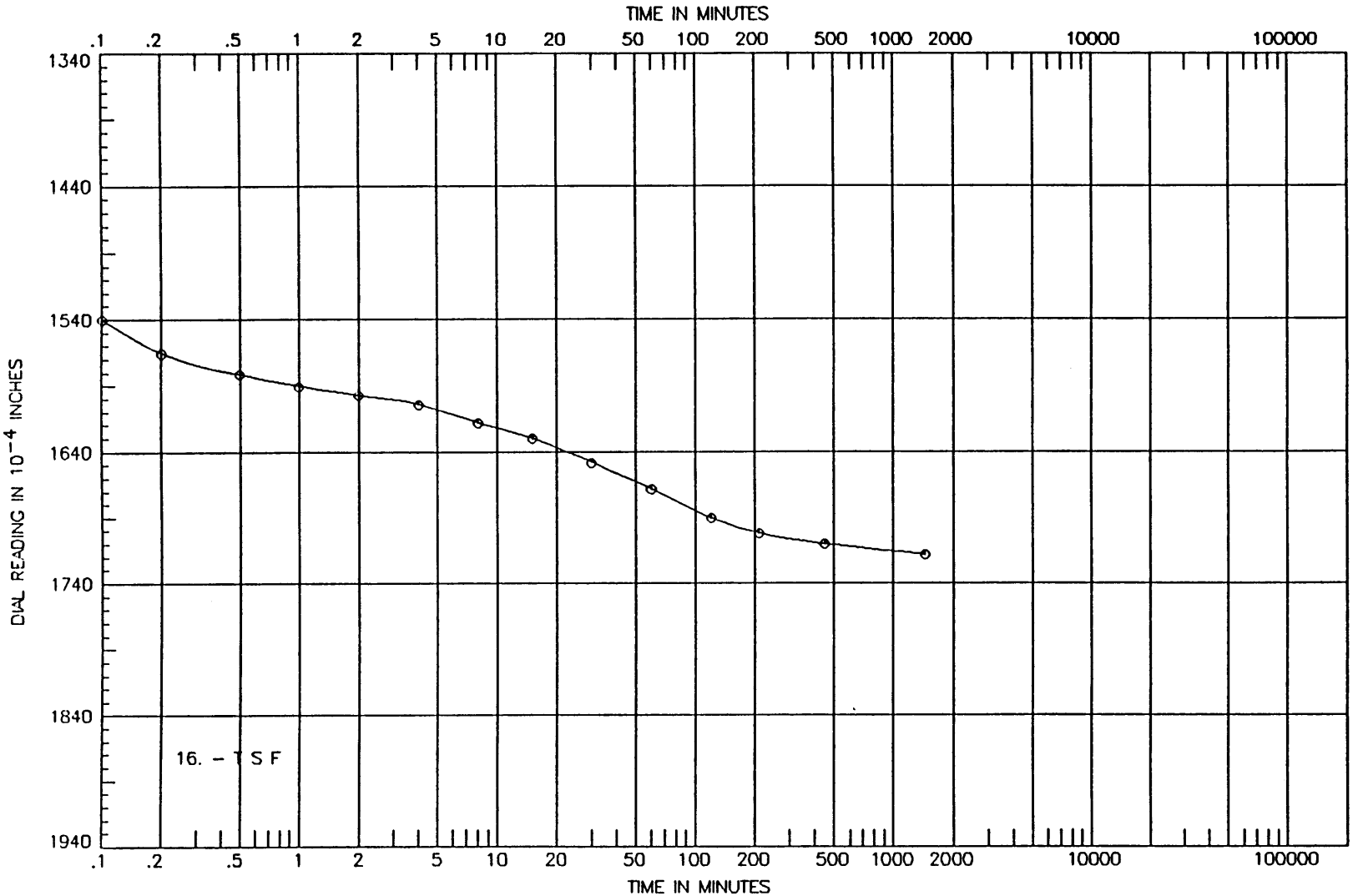


PROJECT EASTERN ARKANSAS	
BORING 18-EAU-94	SAMPLE NO. 4
DEPTH/ELEV 9.5-10.5	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL

SHEET 5 OF 9

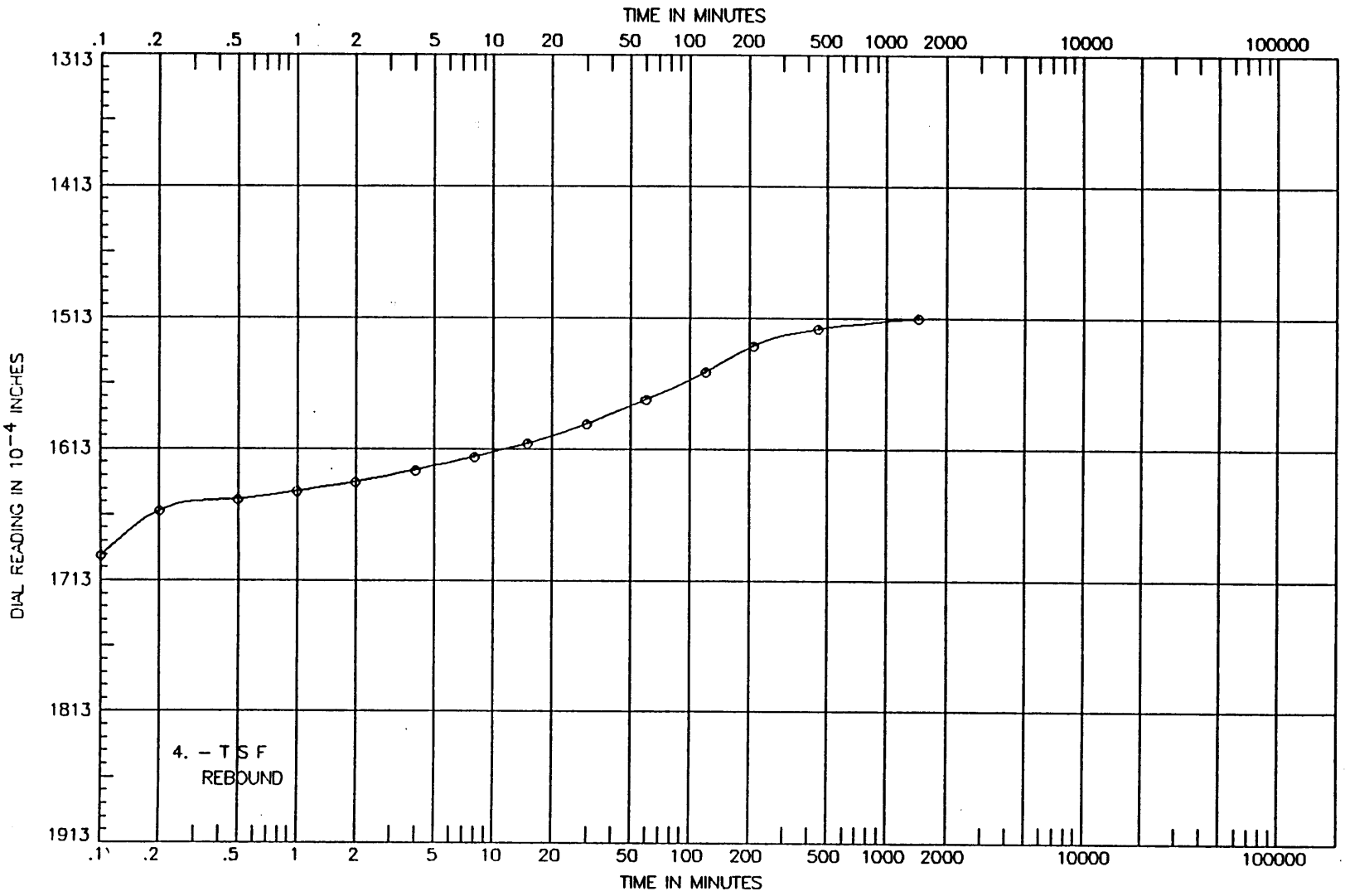


PROJECT EASTERN ARKANSAS	
BORING 18-EAU-94	SAMPLE NO. 4
DEPTH/ELEV 9.5-10.5	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES - STF/GL

SHEET 6 OF 9

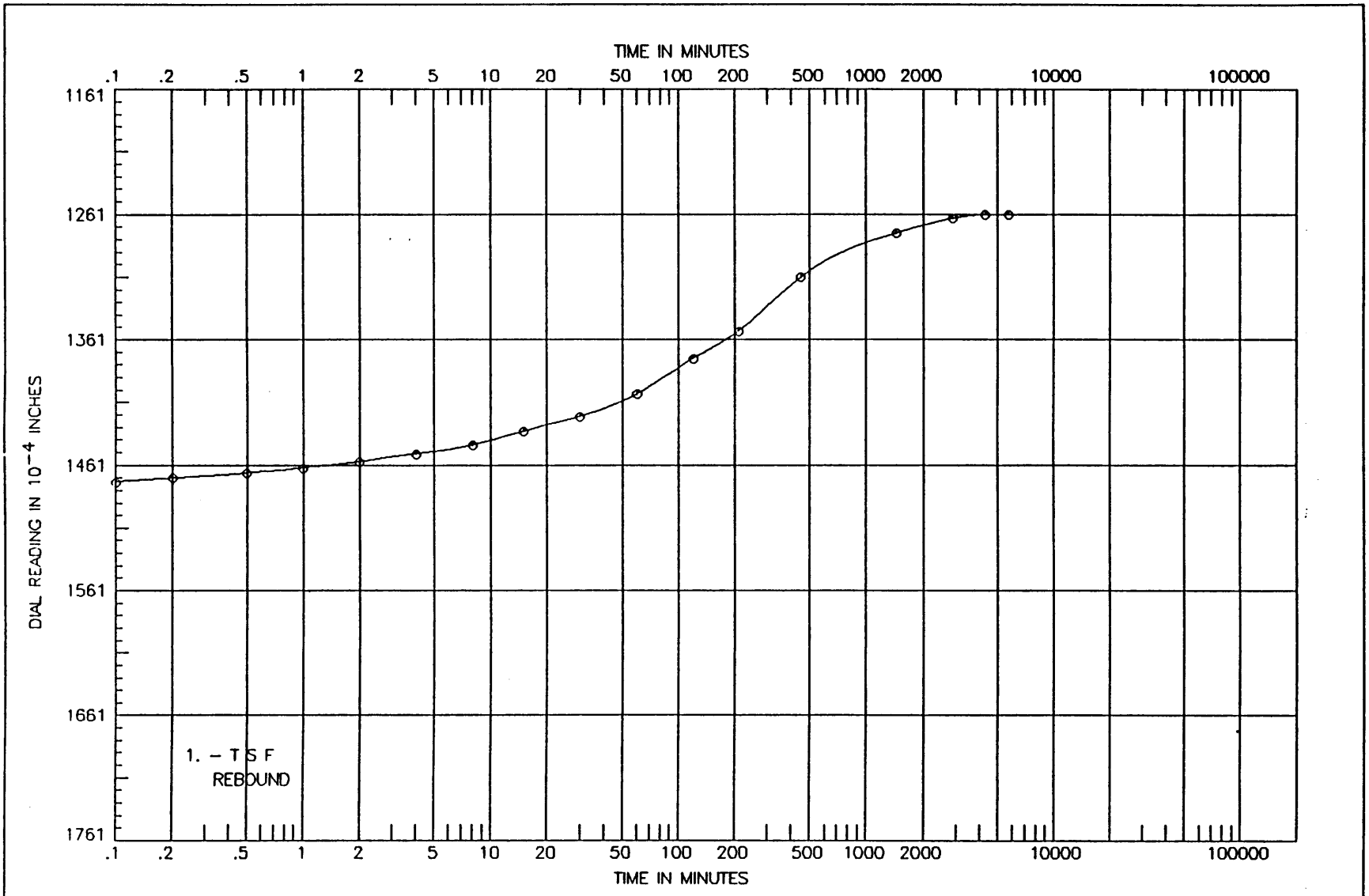


PROJECT EASTERN ARKANSAS	
BORING 18-EAU-94	SAMPLE NO. 4
DEPTH/ELEV 9.5-10.5	DATE 10 FEB 95

CONSOLIDATION TEST TIME CURVES

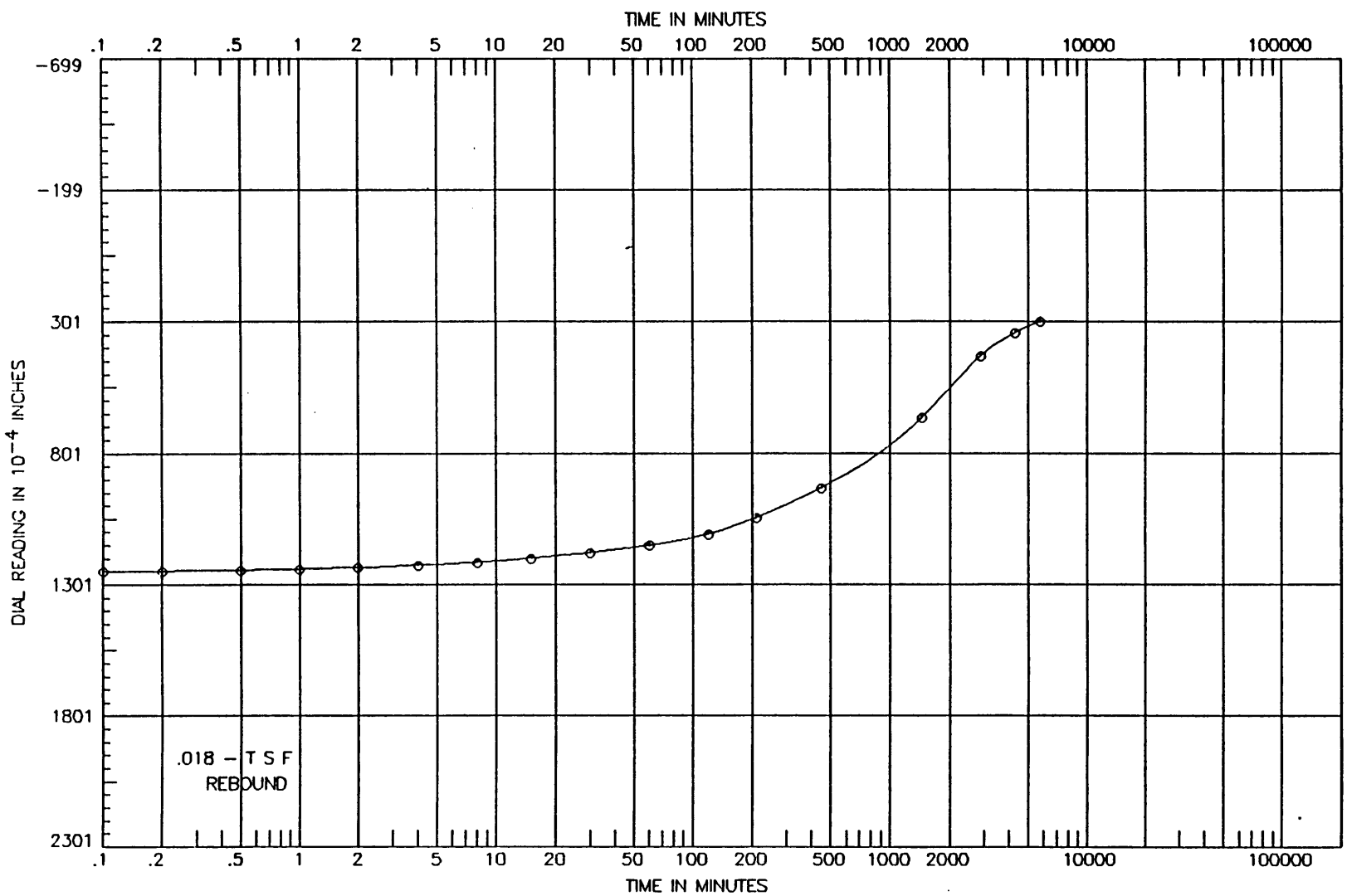
LABORATORY USAE WES – STF/GL

SHEET 7 OF 9



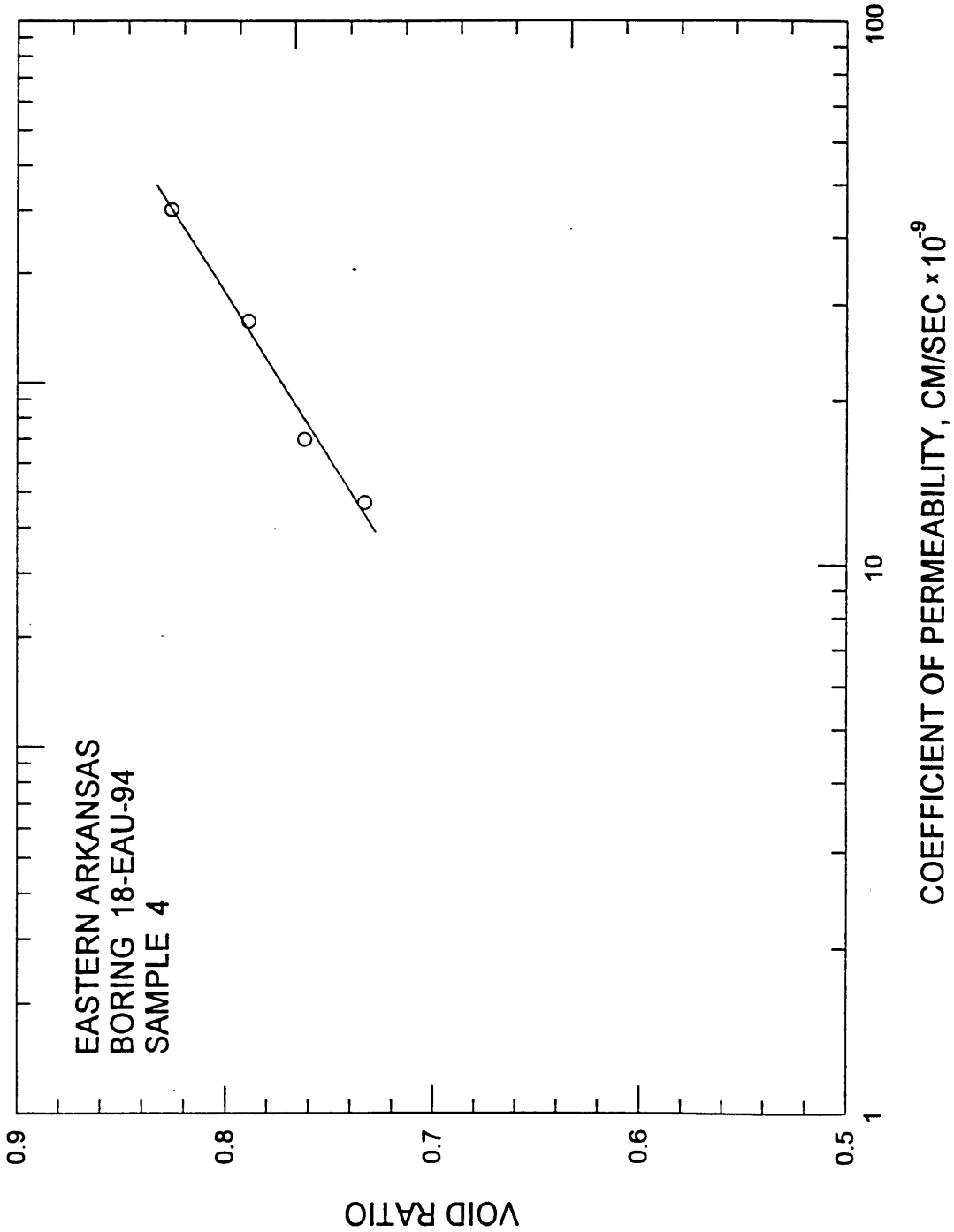
PROJECT EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
		LABORATORY USAE WES - STF/GL
BORING 18-EAU-94	SAMPLE NO. 4	
DEPTH/ELEV 9.5-10.5	DATE 10 FEB 95	

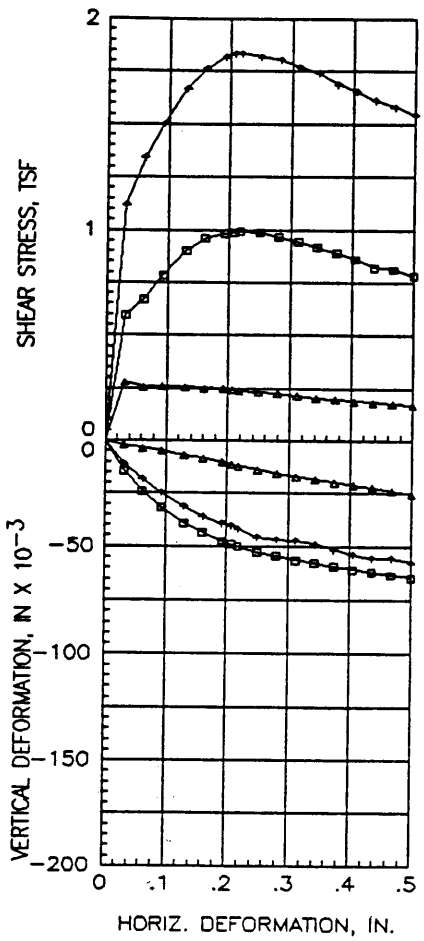
SHEET 8 OF 9

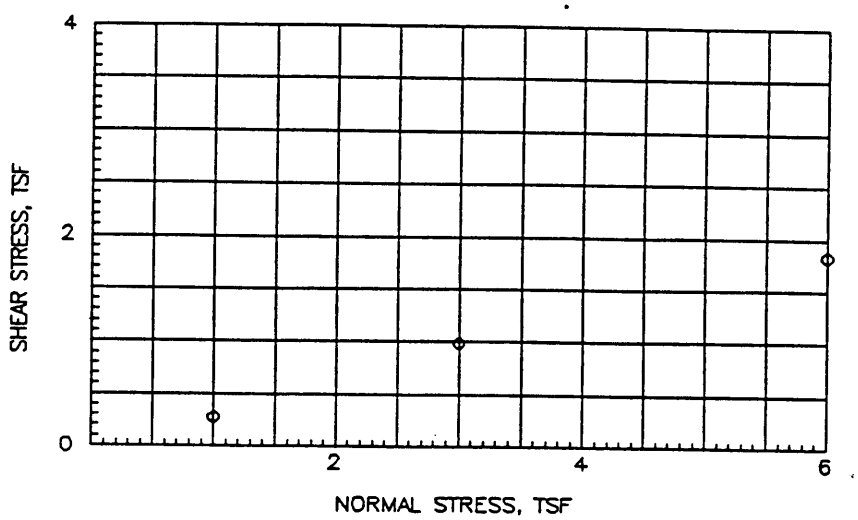


PROJECT	EASTERN ARKANSAS		CONSOLIDATION TEST TIME CURVES
			LABORATORY USAE WES – STF/GL
BORING	18-EAU-94	SAMPLE NO. 4	
DEPTH/ELEV	9.5-10.5	DATE 10 FEB 95	

SHEET 9 OF 9


EASTERN ARKANSAS
BORING 18-EAU-94
SAMPLE 4
VOID RATIO
0.9
0.8
0.7
0.6
0.5
1
10
100
COEFFICIENT OF PERMEABILITY, CM/SEC x 10^-9





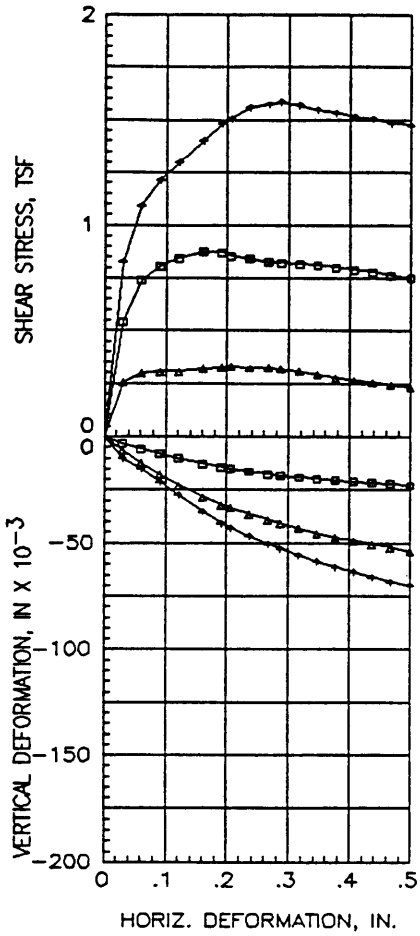
		TEST NO.	1 ▲	2 □	3 ◆	
INITIAL		WATER CONTENT, %	24.1	23.6	24.5	
		VOID RATIO	.736	.740	.693	
		SATURATION, %	88.5	86.3	95.6	
		DRY DENSITY, PCF	97.1	96.8	99.5	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL		WATER CONTENT, %	31.1	27.6	22.3	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF			.28	.99	1.84	
TIME TO FAILURE, MIN			162	1133	1079	
RATE OF STRAIN, IN/MIN			.00019	.00019	.00019	
ULTIMATE SHEAR STRESS, TSF			.17	.78	1.54	

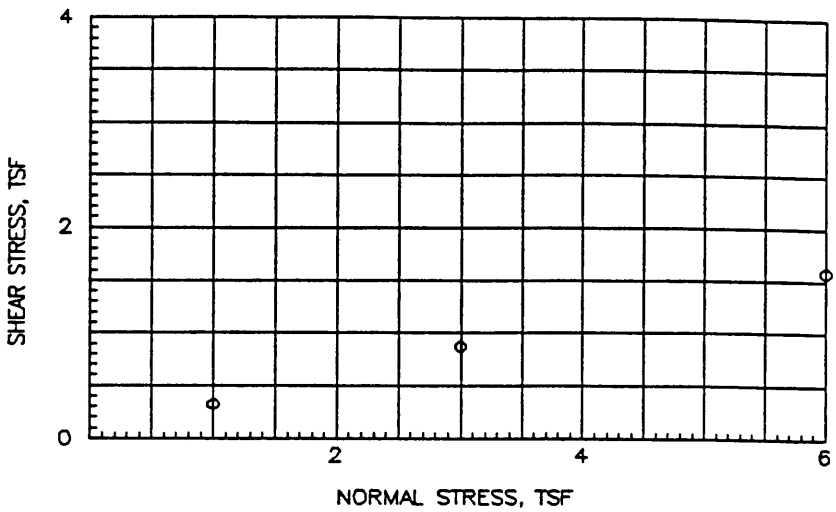
ϕ = _____ DEG

TAN ϕ = _____

C = _____ T/SF

TYPE SPECIMEN	UNDISTURBED	3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION	CLAY (CH), REDDISH BROWN		
LL 51	PL 22	PI 29	GS 2.70 (EST)
REMARKS;		PROJECT	EASTERN ARKANSAS
		BORING NO.	20-EAU-94
		SAMPLE	5
		DEPTH/ELEV	11.0-12.0
		TECH.	JL
		LABORATORY	USAE WES - STF/GL
		DATE	11 APR 95
		DIRECT SHEAR TEST REPORT	





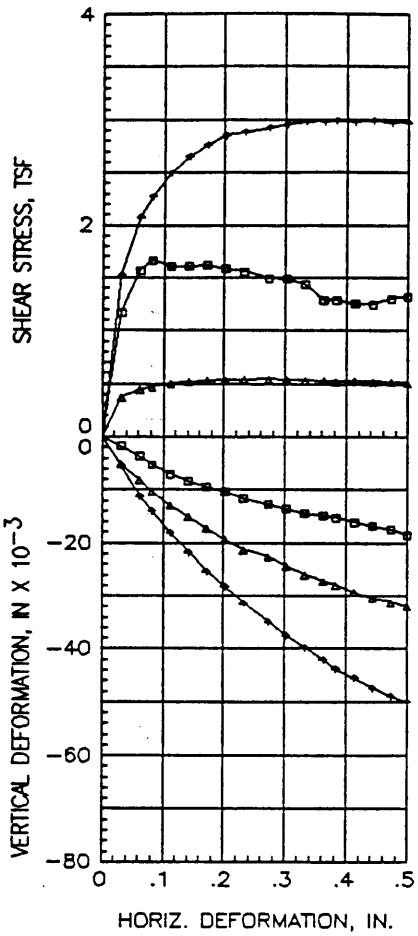
		TEST NO.	1 ▲	2 □	3 ✦	
INITAL		WATER CONTENT, %	22.7	22.7	22.8	
		VOID RATIO	.743	.726	.712	
		SATURATION, %	82.5	84.4	86.5	
		DRY DENSITY, PCF	96.7	97.6	98.4	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL		WATER CONTENT, %	27.1	23.8	21.9	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF			.33	.88	1.59	
TIME TO FAILURE, MIN			1107	864	1538	
RATE OF STRAIN, IN/MIN			.00019	.00019	.00019	
ULTIMATE SHEAR STRESS, TSF			.23	.75	1.48	

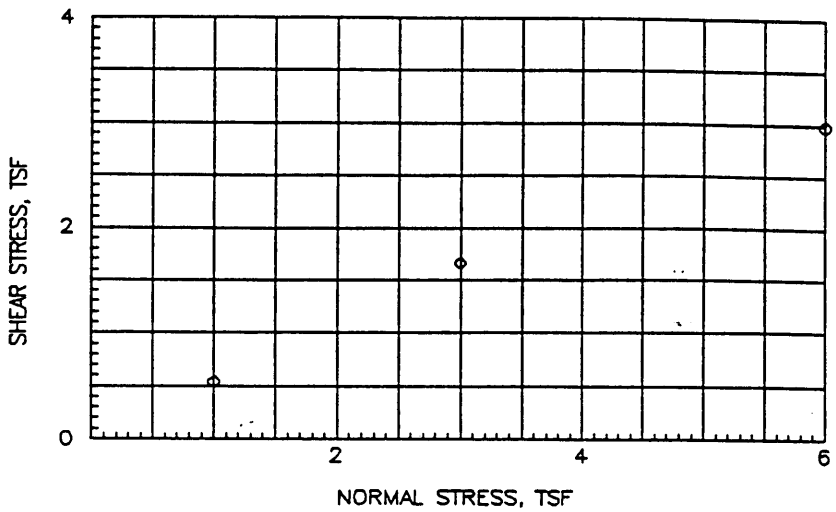
ϕ = _____ DEG

TAN ϕ = _____

C = _____ T/SF

TYPE SPECIMEN COMPACTED		3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION CLAY (CH), REDDISH BROWN			
LL	PL	PI	GS 2.70 (EST)
REMARKS;		PROJECT EASTERN ARKANSAS	
SPECIMENS COMPACTED			
AT 15 BLOW EFFORT		BORING NO. 20-EAU-94	SAMPLE 5
		DEPTH/ELEV 11.0-12.0	TECH. JL
		LABORATORY USAE WES - STF/GL	DATE 11 APR 95
		DIRECT SHEAR TEST REPORT	





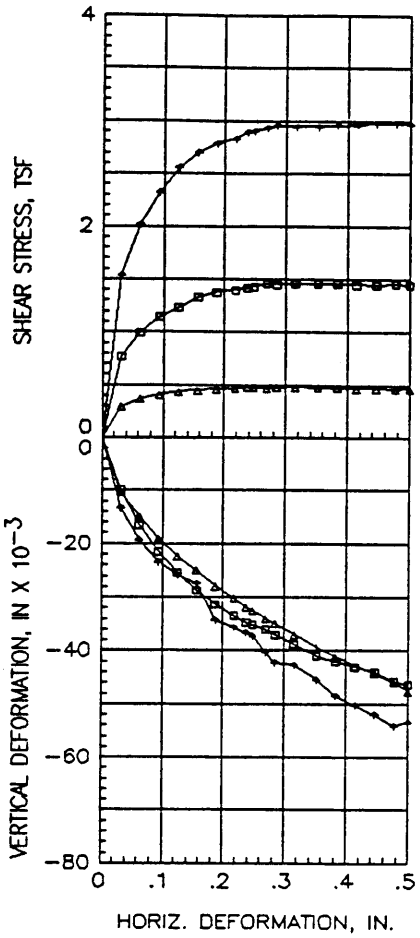
		TEST NO.	1 ▲	2 □	3 ◆	
INITAL		WATER CONTENT, %	20.9	20.9	21.1	
		VOID RATIO	.671	.653	.629	
		SATURATION, %	83.9	86.3	90.4	
		DRY DENSITY, PCF	100.8	101.9	103.4	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL		WATER CONTENT, %	22.4	21.0	18.3	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF			.55	1.67	2.99	
TIME TO FAILURE, MIN			1492	448	2096	
RATE OF STRAIN, IN/MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF			.51	1.25	2.97	

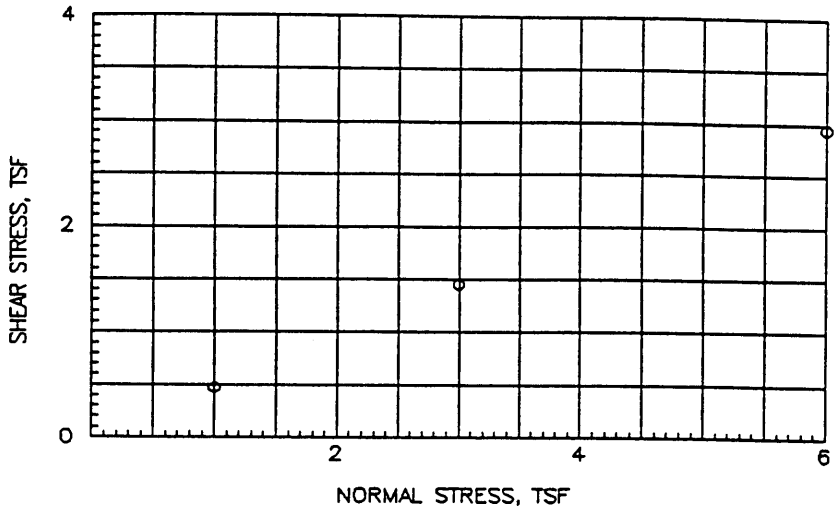
ϕ = _____ DEG

TAN ϕ = _____

C = _____ T/SF

TYPE SPECIMEN	UNDISTURBED		3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION	CLAY (CL), BROWN			
LL 40	PL 15	PI 25		GS 2.70 (EST)
REMARKS;		PROJECT EASTERN ARKANSAS		
		BORING NO. 23-EAU-94	SAMPLE 3	
		DEPTH/ELEV 6.0-7.5	TECH. JL	
		LABORATORY USAE WES - STF/GL	DATE 11 APR 95	
		DIRECT SHEAR TEST REPORT		





		TEST NO.	1 ▲	2 □	3 +	
INITAL		WATER CONTENT, %	17.4	17.1	17.2	
		VOID RATIO	.643	.601	.591	
		SATURATION, %	72.9	76.8	78.5	
		DRY DENSITY, PCF	102.5	105.3	105.9	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL		WATER CONTENT, %	20.8	18.0	16.6	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.00	3.00	6.00	
MAXIMUM SHEAR STRESS, TSF			.48	1.46	2.96	
TIME TO FAILURE, MIN			1305	1477	1562	
RATE OF STRAIN, IN/MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF			.47	1.45	2.95	

ϕ = _____ DEG

TAN ϕ = _____

C = _____ T/SF

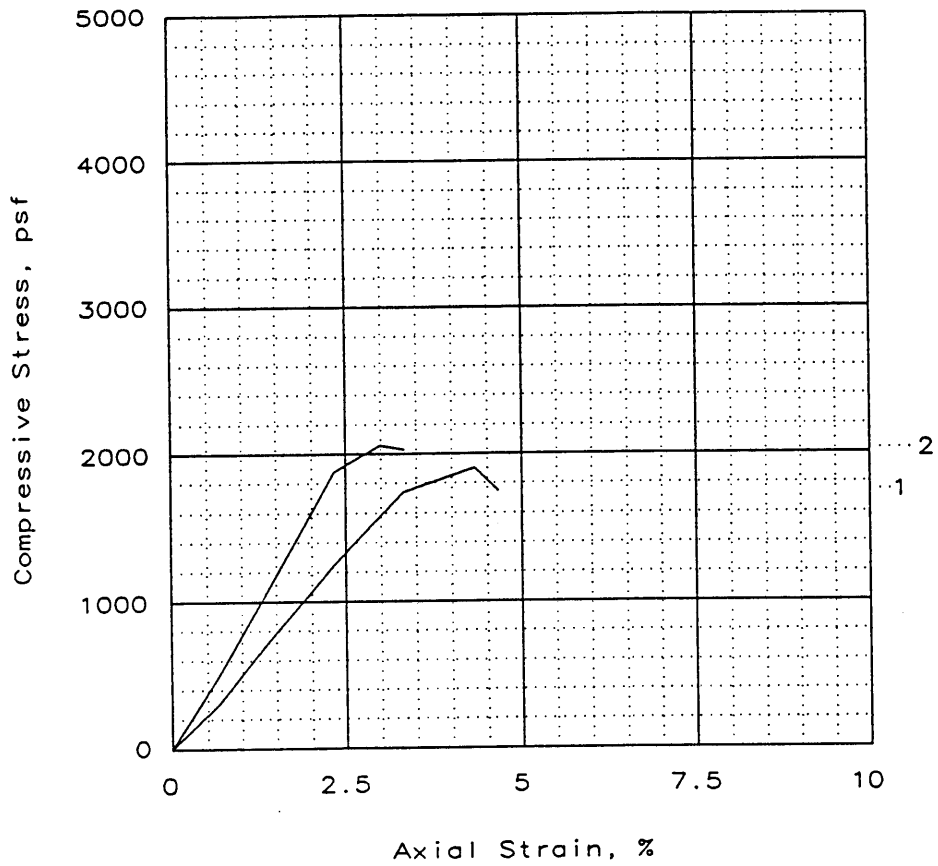
TYPE SPECIMEN	COMPACTED		3.00 IN. SQUARE	.552 IN. THICK
CLASSIFICATION	CLAY (CL), BROWN			
LL	PL	PI		GS 2.70 (EST)
REMARKS;		PROJECT	EASTERN ARKANSAS	
SPECIMENS COMPACTED				
AT 15 BLOW EFFORT		BORING NO.	23-EAU-94	SAMPLE 3
		DEPTH/ELEV	6.0-7.5	TECH. JL
		LABORATORY	USAE WES - STF/GL	DATE 24 APR 95
		DIRECT SHEAR TEST REPORT		

Eastern Arkansas Region Comprehensive Study
Grand Prairie Area
Demonstration Project

Memphis District Soils Laboratory
UC Test Data
Unconfined Compression Test Data

Section II - Geology and Soils
Appendix II - A

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1902	2058		
Undrained shear strength, psf	951	1029		
Rate of strain, %/min				
Water content, %	21.1	20.1		
Void ratio	0.6708	0.6662		
Saturation, %	84.8	81.0		
Dry density, pcf	100.5	100.8		
Specimen diameter, in	1.40	1.39		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CL) SILTY, IRON OXIDE

LL = 42	PL = 15	PI = 27.0	GS = 2.69	Type: UNDISTURBED

Project No.:

Date: 11-17-94

Remarks:

PENETROMETER - 1.5

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 1-EAUPS-94

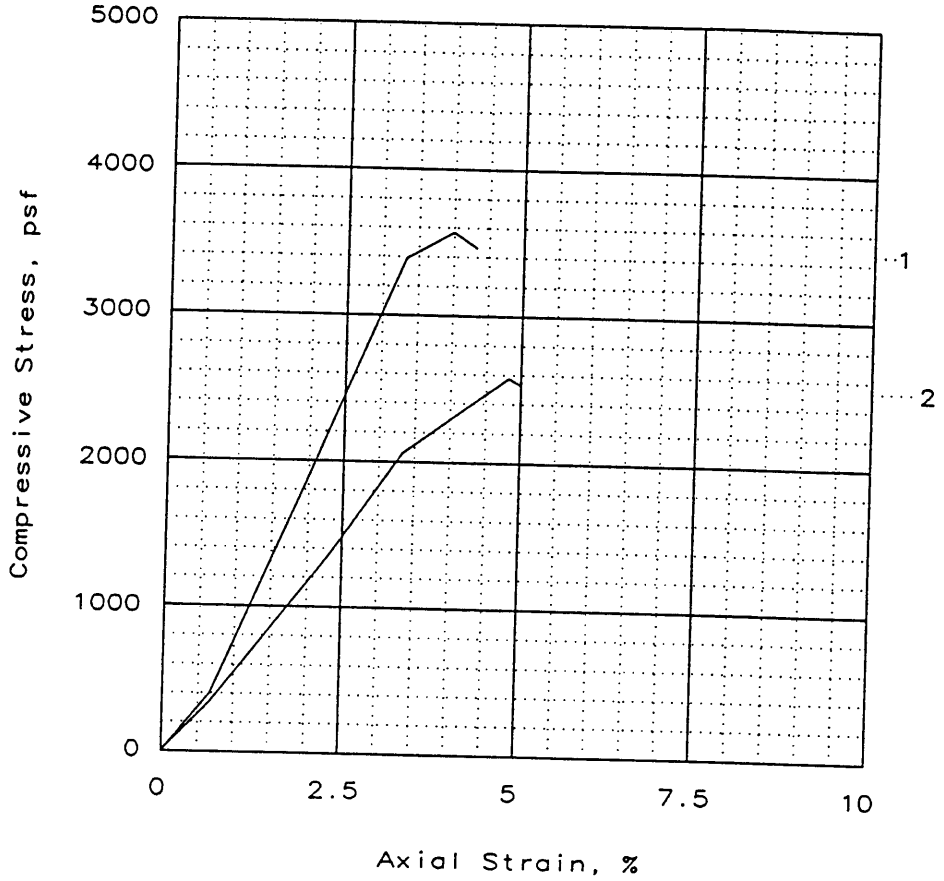
Sample No.: 3

Depth: 5.0 - 6.2

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3568	2575		
Undrained shear strength, psf	1784	1287		
Rate of strain, %/min				
Water content, %	20.0	20.6		
Void ratio	0.5710	0.6145		
Saturation, %	94.3	90.0		
Dry density, pcf	106.9	104.0		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CL) SILTY, IRON OXIDE.

LL = 45	PL = 16	PI = 29.0	GS = 2.69	Type: UNDISTURBED

Project No.:

Date: 11-17-94

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 1-EAPS-U-94

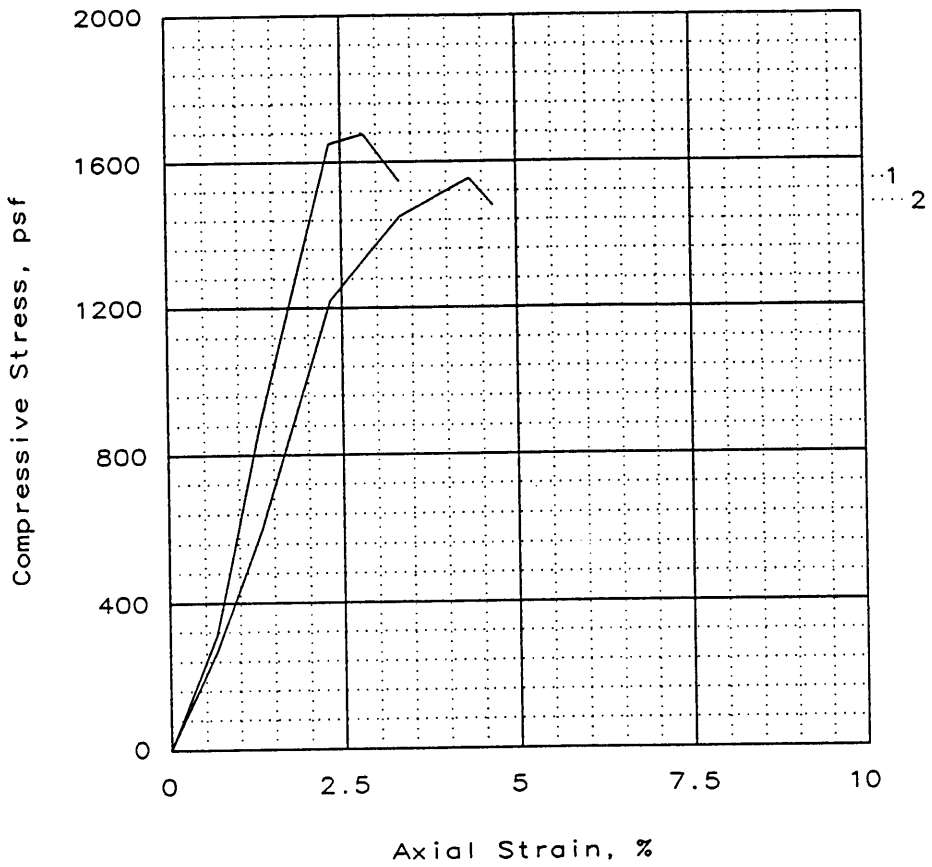
Sample No.: 4

Depth: 8.0 - 9.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1677	1553		
Undrained shear strength, psf	838	777		
Rate of strain, %/min				
Water content, %	22.3	23.2		
Void ratio	0.6407	0.6323		
Saturation, %	93.8	98.8		
Dry density, pcf	102.4	102.9		
Specimen diameter, in	1.37	1.38		
Specimen height, in	3.00	3.00		

Description: BR CLAY (CL) SILTY IRON OXIDE

LL = 44	PL = 17	PI = 27.0	GS = 2.69	Type: UNDISTURBED

Project No.:
Date: 11-17-94
Remarks:
PENETROMETER - 1.5
TORVAN - 0.83

Fig No.

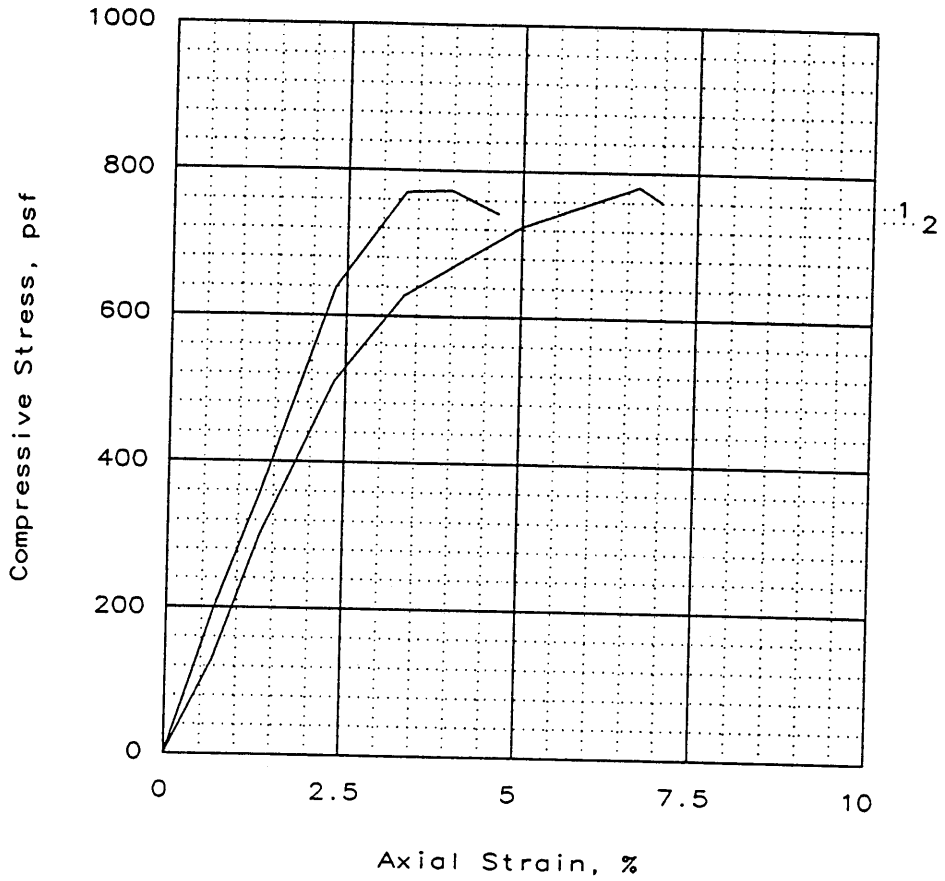
Project: EASTERN ARKANSAS

Boring No.: 1-EAPS-U-94
Sample No.: 5
Depth: 11.0 - 13.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	781	773		
Undrained shear strength, psf	390	387		
Rate of strain, %/min				
Water content, %	26.6	26.4		
Void ratio	0.6921	0.7313		
Saturation, %	103.1	96.8		
Dry density, pcf	98.9	96.6		
Specimen diameter, in	1.35	1.38		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CL) LEAN LENSES OF SILT, ROOTS.

LL = 31	PL = 21	PI = 10.0	GS = 2.68	Type: UNDISTURBED

Project No.:
Date: 11-17-94

Remarks:
PENETROMETER - 1.0
TORVAN - 0.24

Fig No.

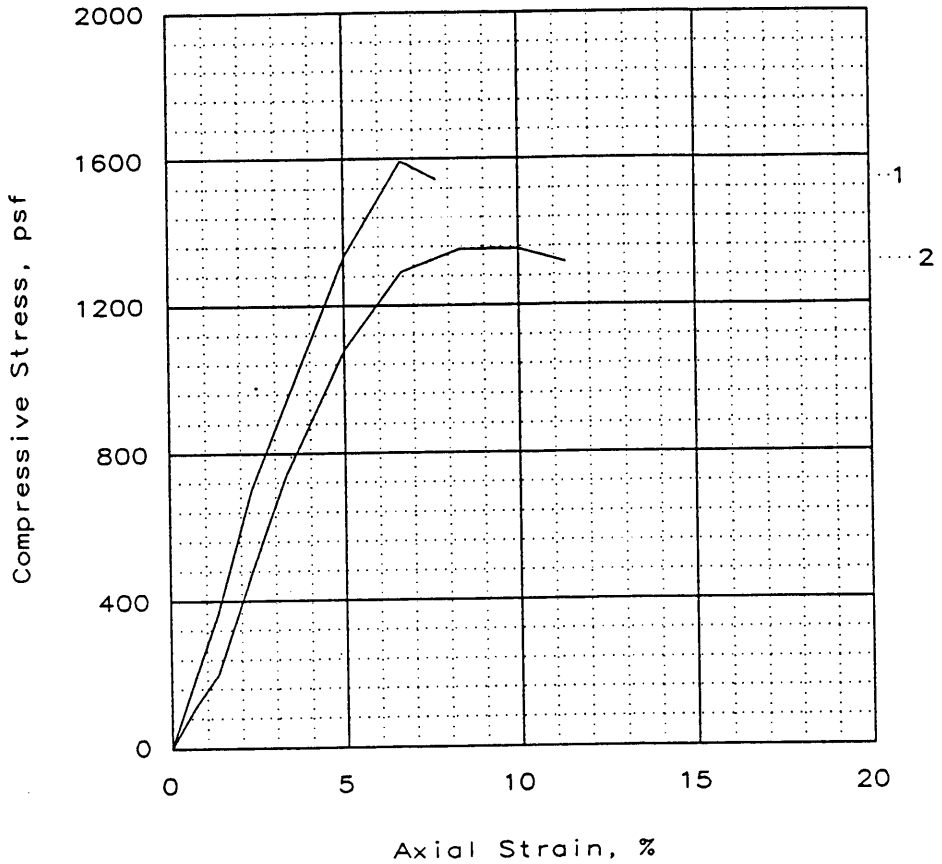
Project: EASTERN ARKANSAS

Boring No.: 1-EAPS-U-94
Sample No.: 6
Depth: 14.0 - 15.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1593	1354		
Undrained shear strength, psf	797	677		
Rate of strain, %/min				
Water content, %	28.3	29.2		
Void ratio	0.7034	0.7533		
Saturation, %	107.7	103.8		
Dry density, pcf	98.2	95.4		
Specimen diameter, in	1.36	1.36		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) LEAN IRON OXIDE.

LL = 36	PL = 20	PI = 16.0	GS = 2.68	Type: UNDISTURBED

Project No.:

Date: 11-17-94

Remarks:

PENETROMETER - 0.5

TORVAN - 0.28

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 1-EAPS-U-94

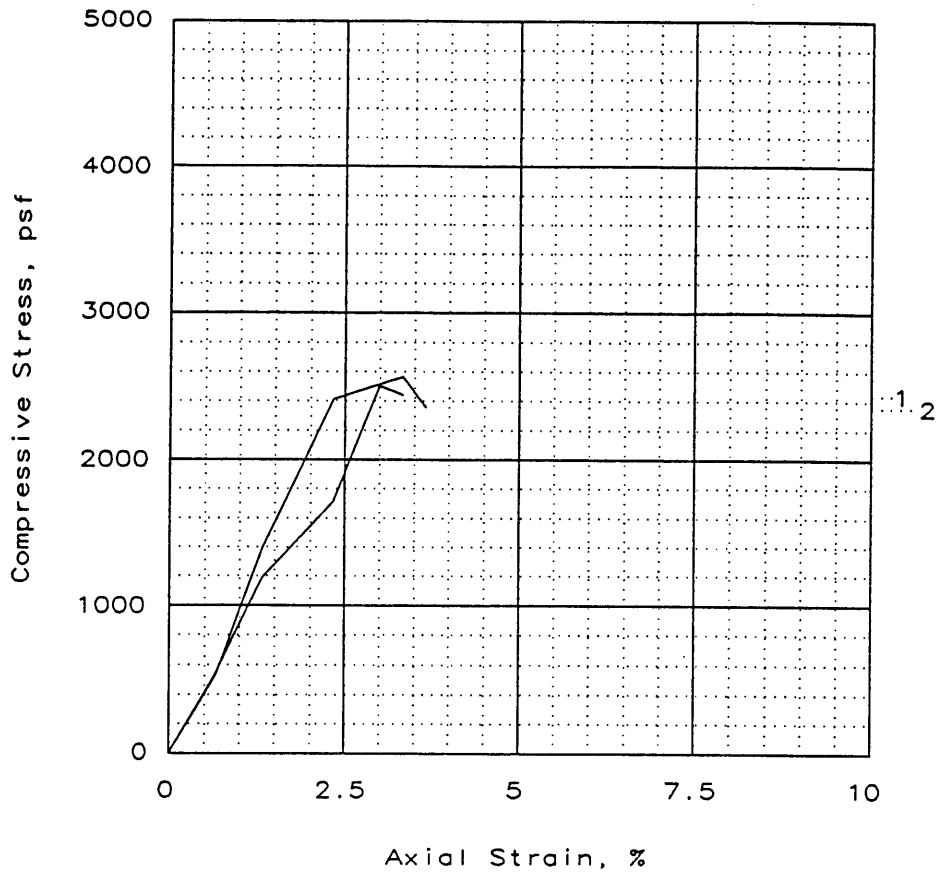
Sample No.: 7

Depth: 17.0 - 17.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1191	1396		
Undrained shear strength, psf	596	698		
Rate of strain, %/min				
Water content, %	24.4	25.7		
Void ratio	0.6071	0.6998		
Saturation, %	107.7	98.6		
Dry density, pcf	104.1	98.4		
Specimen diameter, in	1.36	1.39		
Specimen height, in	3.00	3.00		

Description: GR CLAY (CL) SILTY IRON OXIDE.

LL = 47	PL = 19	PI = 28.0	GS = 2.68	Type: UNDISTURBED

Project No.:
Date: 11-17-94
Remarks:
PENETROMETER - 1.25
TORVAN - 0.70

Fig No.

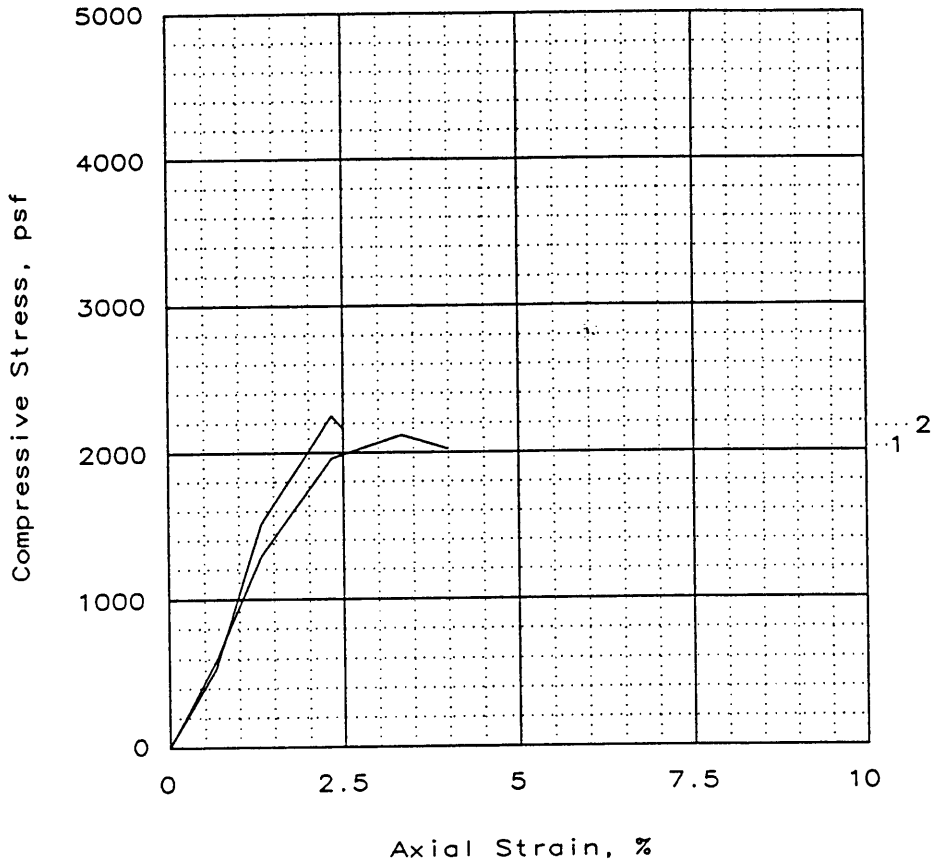
Project: EASTERN ARKANSAS

Boring No.: 1-EAPS-U-94
Sample No.: 7
Depth: 17.5 - 19.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2118	2251		
Undrained shear strength, psf	1059	1126		
Rate of strain, %/min				
Water content, %	23.0	23.4		
Void ratio	0.6001	0.6067		
Saturation, %	102.7	103.3		
Dry density, pcf	104.6	104.1		
Specimen diameter, in	1.37	1.37		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CL) LEAN IRON OXIDE

LL = 32	PL = 22	PI = 10.0	GS = 2.68	Type: UNDISTURBED

Project No.:

Date: 11-17-94

Remarks:

PENETROMETER - 2.0

TORVAN - 0.72

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 1-EAPS-U-94

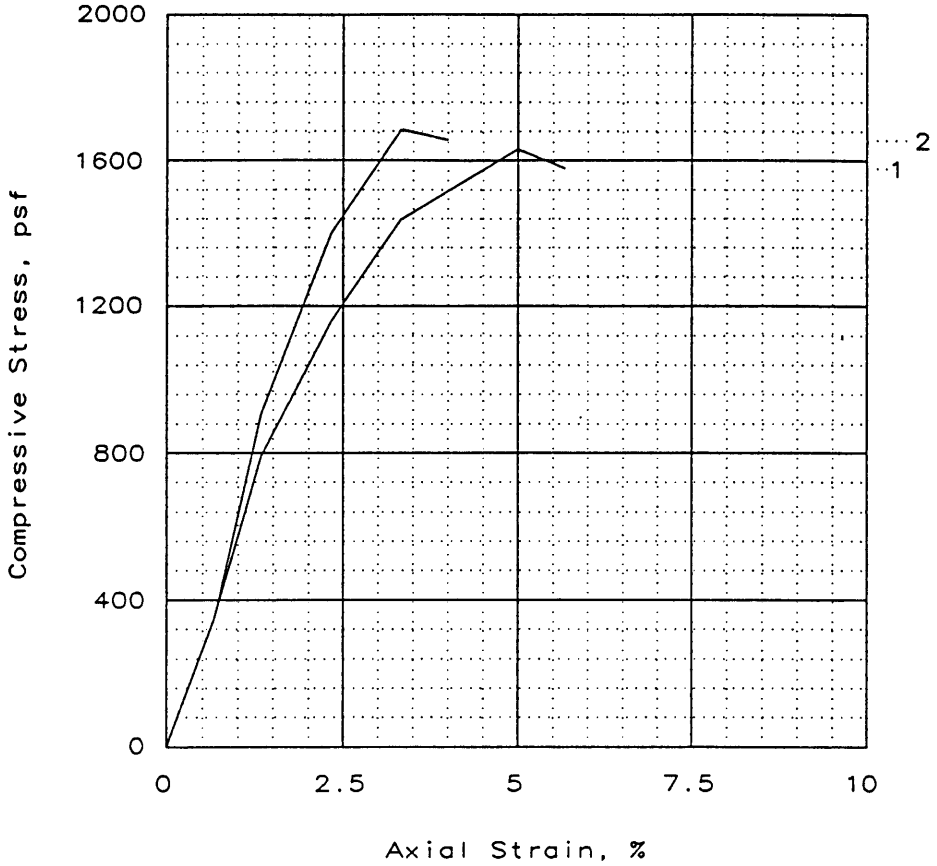
Sample No.: 8

Depth: 20.0 - 21.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1631	1684		
Undrained shear strength, psf	816	842		
Rate of strain, %/min				
Water content, %	24.4	24.9		
Void ratio	0.6873	0.7312		
Saturation, %	95.7	91.9		
Dry density, pcf	99.9	97.4		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CH) FAT IRON OXIDE.

LL = 51	PL = 23	PI = 28.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-18-94
Remarks:
PENETROMETER - 2.5
TORVAN - MAX.

Fig No.

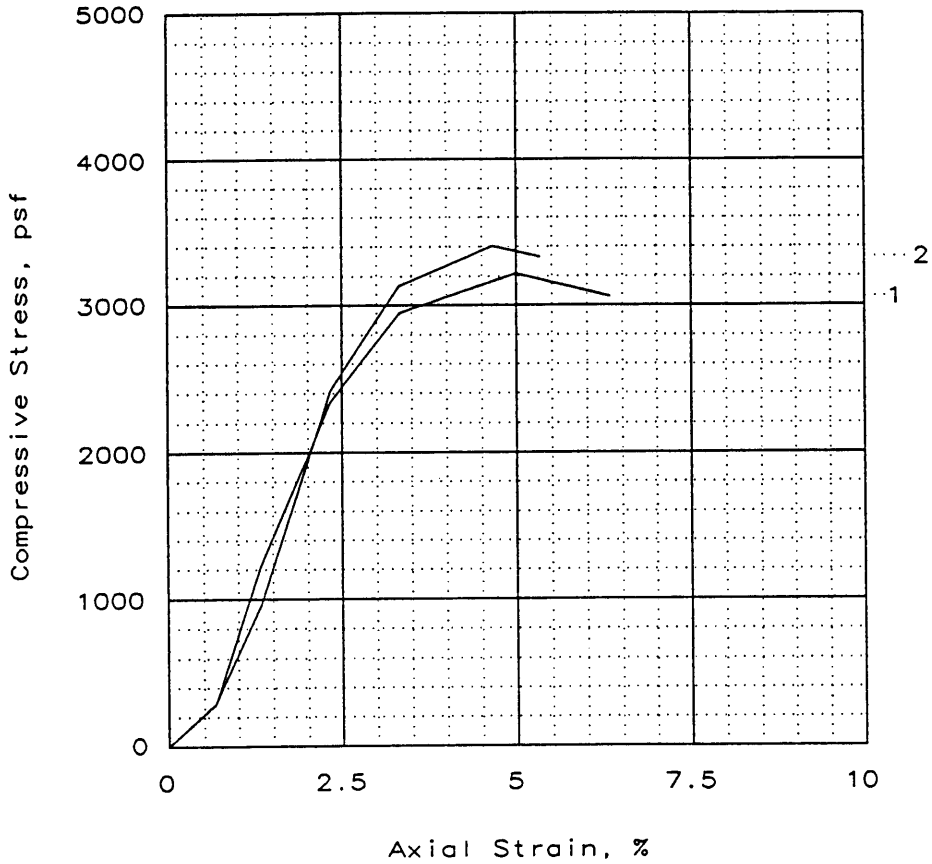
Project: EASTERN ARKANSAS

Boring No.: 1-EAPS-U-94
Sample No.: 9
Depth: 24.0 - 26.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3219	3407		
Undrained shear strength, psf	1610	1703		
Rate of strain, %/min				
Water content, %	22.9	22.6		
Void ratio	0.6607	0.6647		
Saturation, %	93.3	91.6		
Dry density, pcf	101.1	100.9		
Specimen diameter, in	1.38	1.39		
Specimen height, in	3.00	3.00		

Description: BR CLAY (CL) SILTY IRON OXIDE

LL = 43	PL = 18	PI = 25.0	GS = 2.69	Type: UNDISTURBED

Project No.:

Date: 11-18-94

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

PUSH OVER

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 2-EAPS-U-94

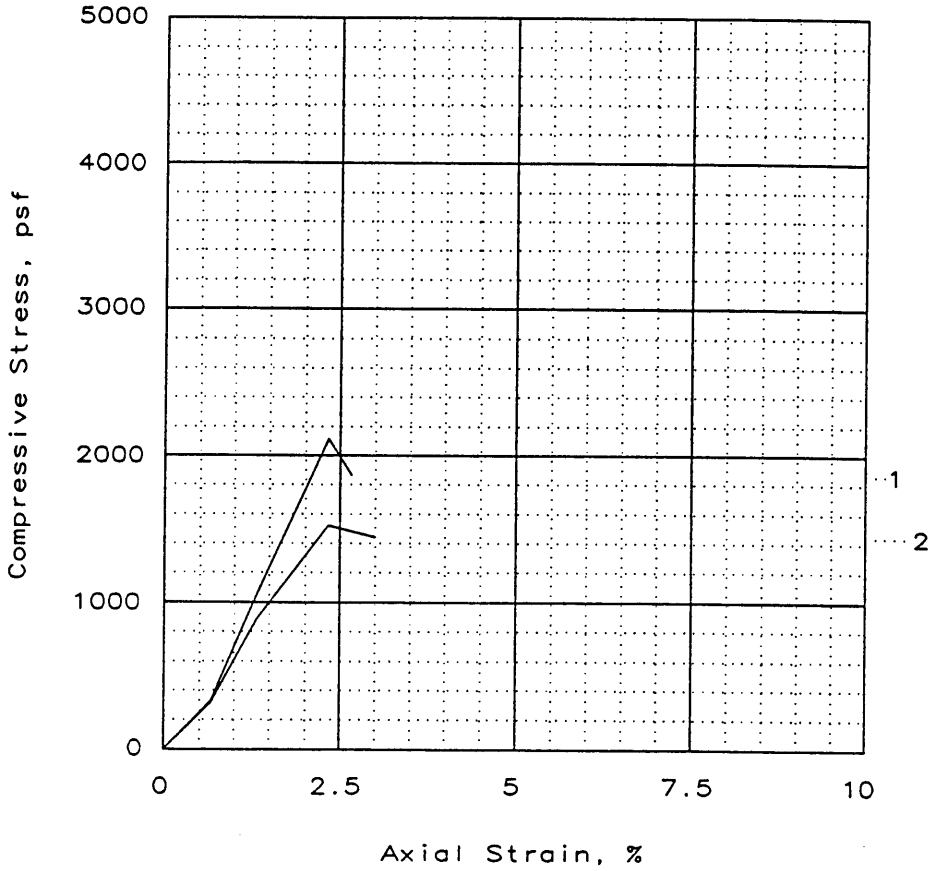
Sample No.: 3

Depth: 5.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2114	1523		
Undrained shear strength, psf	1057	761		
Rate of strain, %/min				
Water content, %	23.8	23.8		
Void ratio	0.7291	0.7146		
Saturation, %	88.1	89.8		
Dry density, pcf	97.5	98.3		
Specimen diameter, in	1.38	1.37		
Specimen height, in	3.00	3.00		

Description: BR CLAY (CL) SILTY

LL = 44	PL = 15	PI = 29.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-19-94

Remarks:

PENETROMETER - 1.0

TORVAN - 0.74

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 2-EAPS-U-94

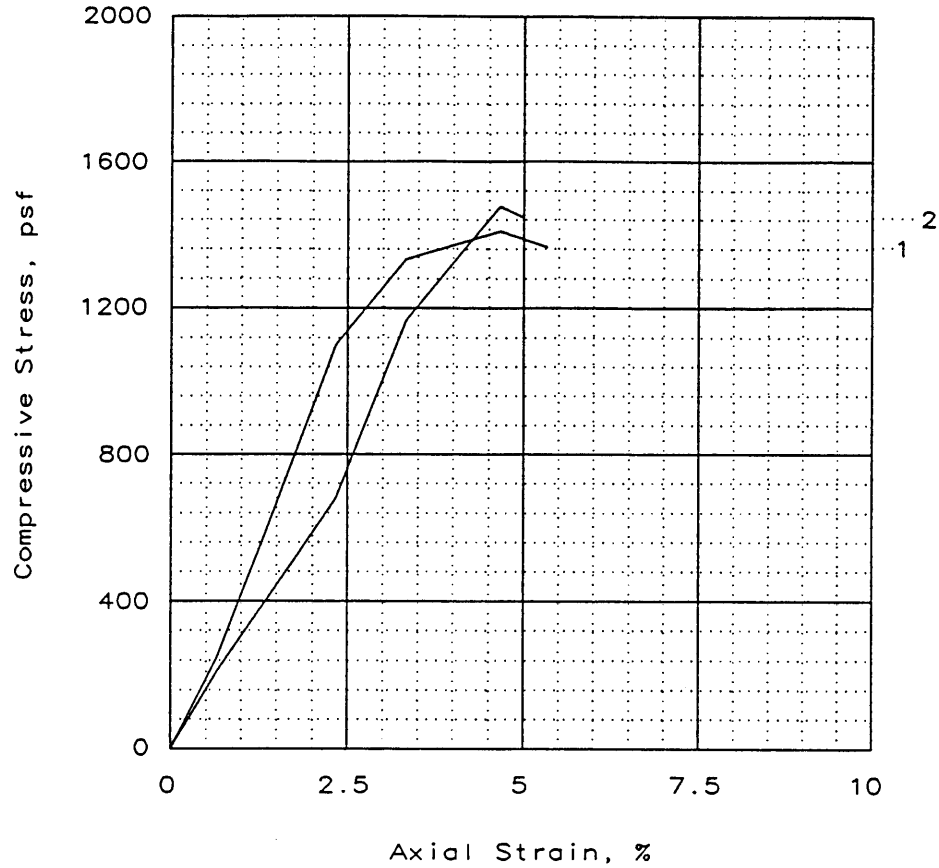
Sample No.: 4

Depth: 8.0 - 9.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1409	1478		
Undrained shear strength, psf	705	739		
Rate of strain, %/min				
Water content, %	25.2	25.4		
Void ratio	0.7092	0.6069		
Saturation, %	95.6	112.8		
Dry density, pcf	98.3	104.5		
Specimen diameter, in	1.37	1.35		
Specimen height, in	3.00	3.00		

Description: BR CLAY (CL) SILTY

LL = 40	PL = 18	PI = 22.0	GS = 2.69	Type: UNDISTURBED

Project No.:
Date: 11-19-94
Remarks:
PENETROMETER - 0.75
TORVAN - 0.45

Fig No.

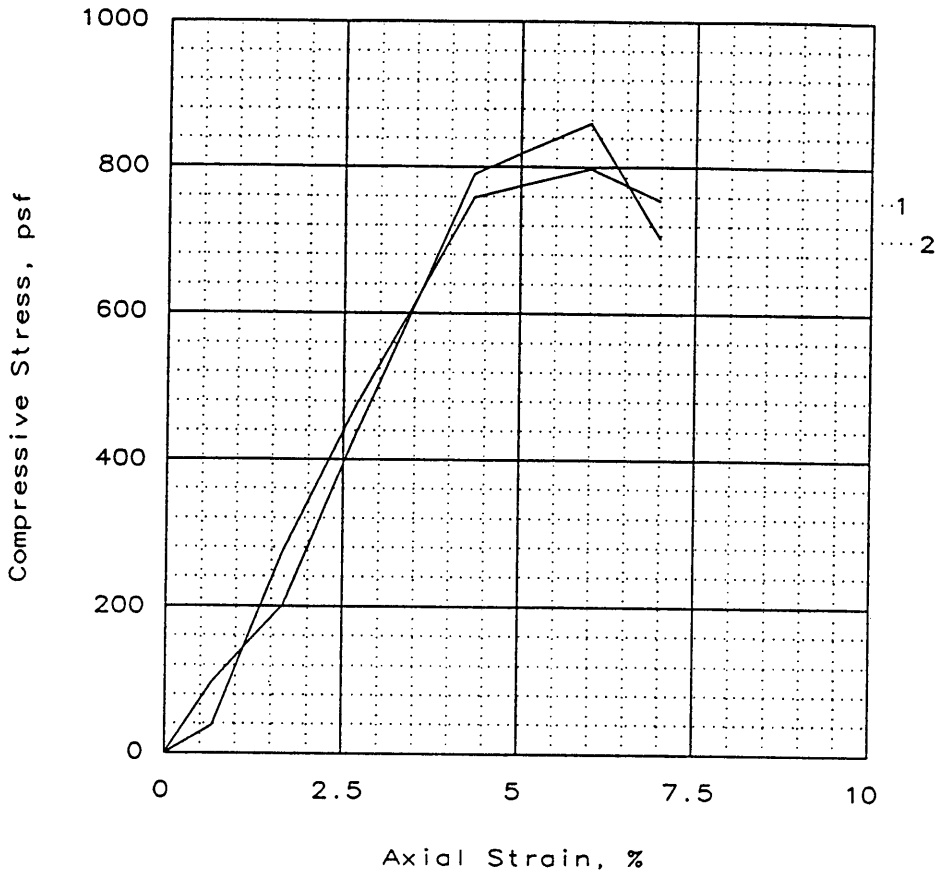
Project: EASTERN ARKANSAS

Boring No.: 2-EAPS-U-94
Sample No.: 5
Depth: 11.0 - 12.2

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	798	860		
Undrained shear strength, psf	399	430		
Rate of strain, %/min				
Water content, %	26.6	25.8		
Void ratio	0.6118	0.7074		
Saturation, %	116.6	97.7		
Dry density, pcf	103.8	98.0		
Specimen diameter, in	1.35	1.38		
Specimen height, in	3.00	3.00		

Description: BR. SILT (ML) LENSES OF CLAY & SAND, OXIDE

LL = 24	PL = 20	PI = 4.0	GS = 2.68	Type: UNDISTURBED

Project No.:
Date: 11-19-94
Remarks:
PENETROMETER - 0.50
TORVAN - 0.25

Fig No.

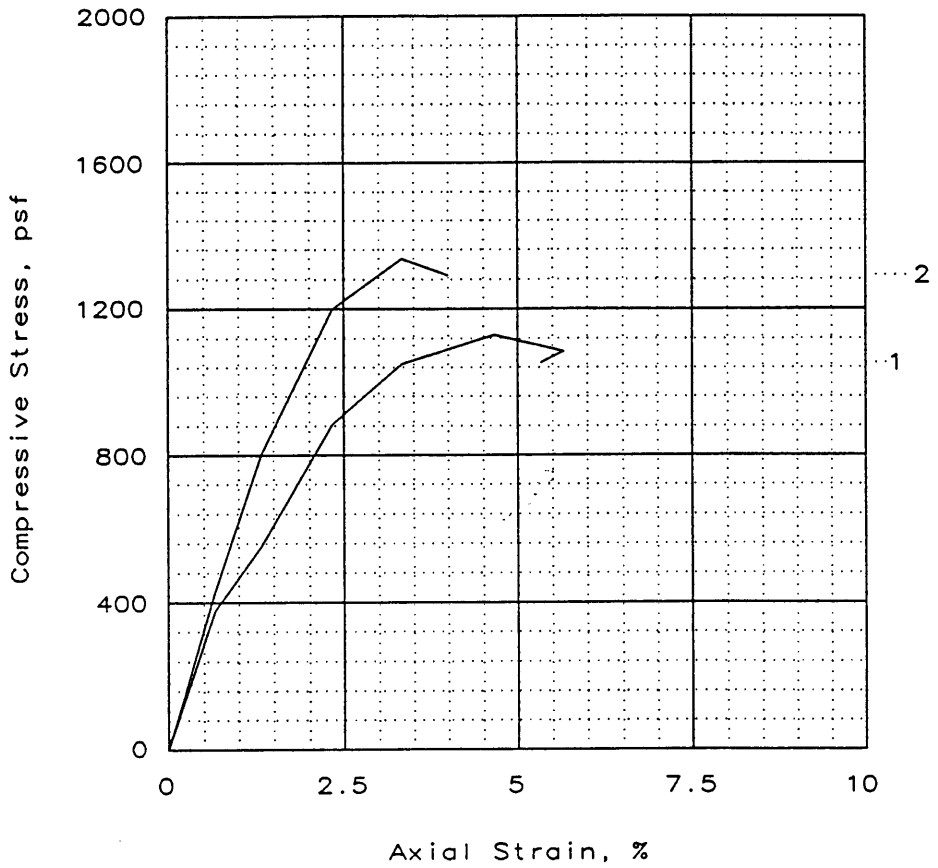
Project: EASTERN ARKANSAS

Boring No.: 2-EAPS-U-94
Sample No.: 6
Depth: 14.0 - 16.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1129	1335		
Undrained shear strength, psf	564	668		
Rate of strain, %/min				
Water content, %	30.9	30.4		
Void ratio	0.8871	0.9134		
Saturation, %	93.8	89.6		
Dry density, pcf	89.0	87.8		
Specimen diameter, in	1.37	1.37		
Specimen height, in	3.00	3.00		

Description: BR CLAY (CL) SILTY IRON OXIDE

LL = 48	PL = 21	PI = 27.0	GS = 2.69	Type: UNDISTURBED

Project No.:

Date: 11-19-94

Remarks:

PENETROMETER - 1.5

TORVAN - 0.70

BOX SAMPLE - DEPTH 6.0 - 7.5

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 3-EAPS-U-94

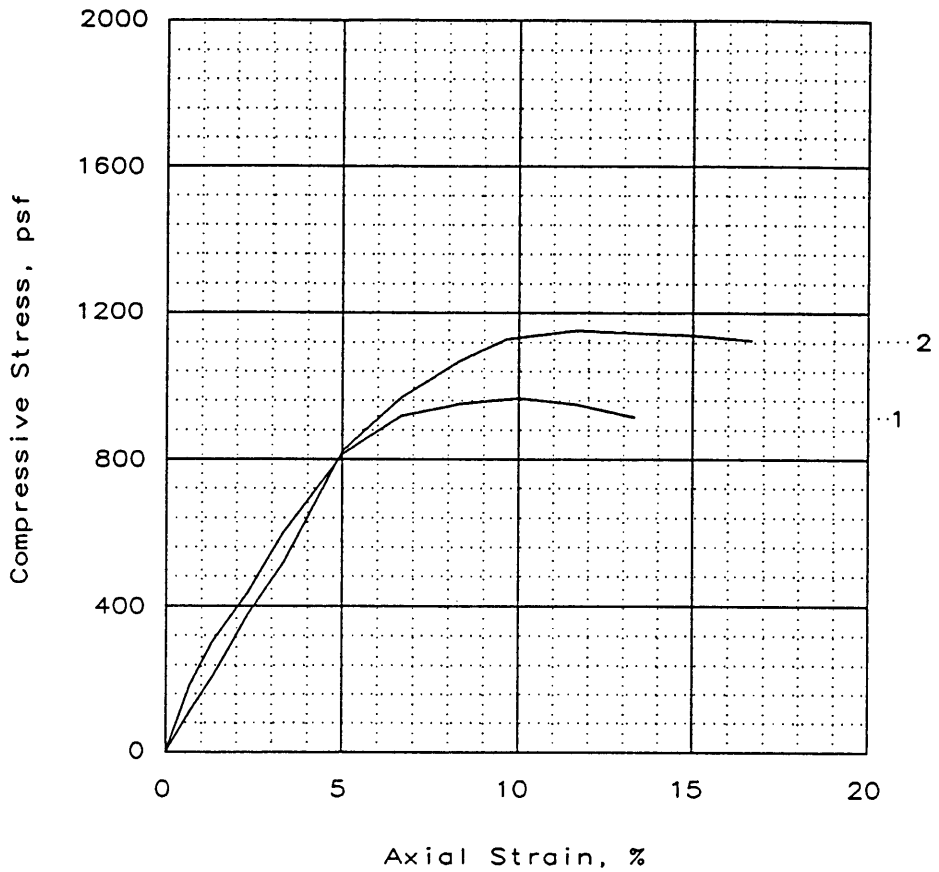
Sample No.: 3

Depth: 5.0 - 6.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	967	1152		
Undrained shear strength, psf	484	576		
Rate of strain, %/min				
Water content, %	36.3	35.9		
Void ratio	0.9712	0.9190		
Saturation, %	100.2	104.6		
Dry density, pcf	84.9	87.2		
Specimen diameter, in	1.37	1.36		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CL) SILTY, IRON OXIDE.

LL = 49	PL = 24	PI = 25.0	GS = 2.68	Type: UNDISTURBED

Project No.:

Date: 11-19-94

Remarks:

PENETROMETER - 0.5

TORVAN - 0.43

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 3-EAPS-U-94

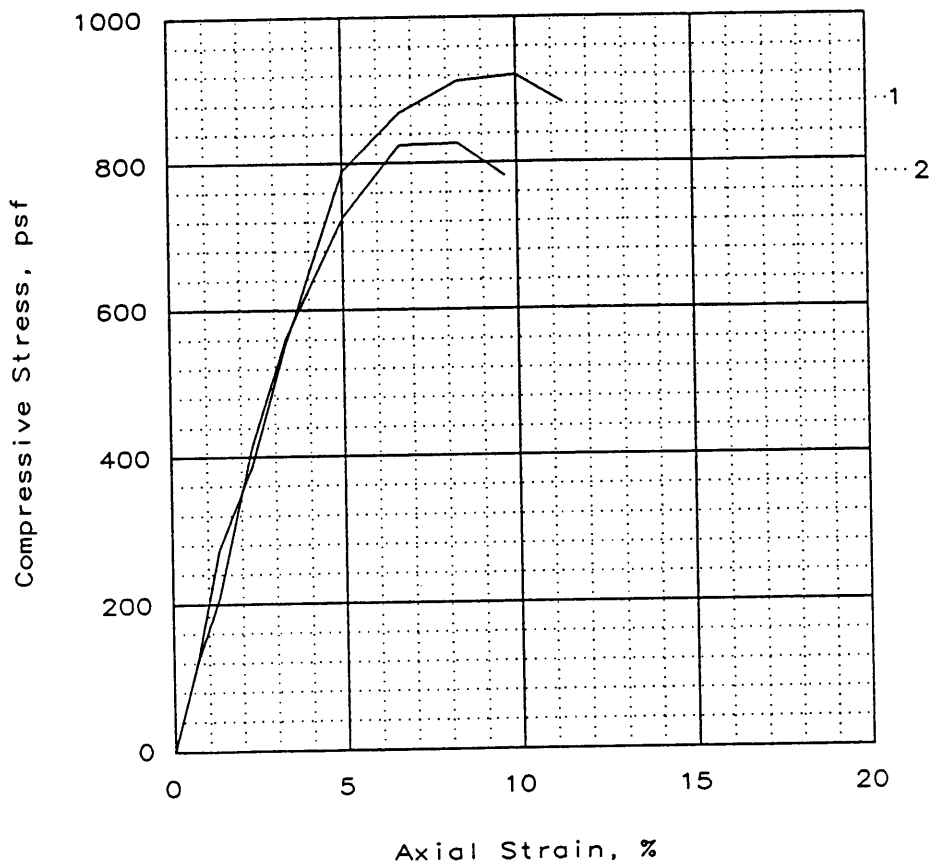
Sample No.: 4

Depth: 8.0 - 10.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	920	826		
Undrained shear strength, psf	460	413		
Rate of strain, %/min				
Water content, %	28.1	28.6		
Void ratio	0.7255	0.7725		
Saturation, %	103.9	99.4		
Dry density, pcf	97.0	94.4		
Specimen diameter, in	1.36	1.36		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CL) LEAN LENSES OF SILT.

LL = 33	PL = 21	PI = 12.0	GS = 2.68	Type: UNDISTURBED

Project No.:

Date: 11-19-94

Remarks:

PENETROMETER - 0.25

TORVAN - 0.25

BOX SAMPLE - DEPTH 12.3-13.5

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 3-EAPS-U-94

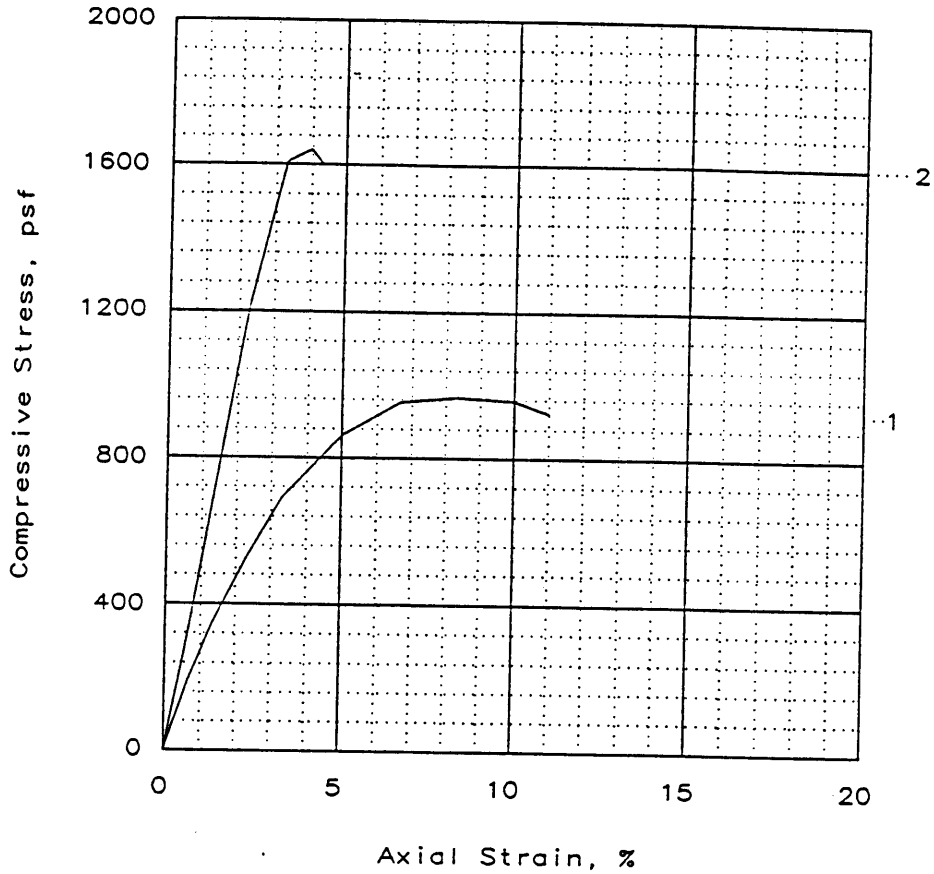
Sample No.: 5

Depth: 11.0 - 12.3

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	967	1641		
Undrained shear strength, psf	484	820		
Rate of strain, %/min				
Water content, %	27.2	23.1		
Void ratio	0.8045	0.6937		
Saturation, %	90.9	89.7		
Dry density, pcf	93.1	99.2		
Specimen diameter, in	1.40	1.38		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CL) SILTY, IRON OXIDE.

LL = 43	PL = 17	PI = 26.0	GS = 2.69	Type: UNDISTURBED

Project No.:

Date: 07-21-95

Remarks:

PENETROMETER - 1.0

TORVAN - 0.65

Fig No.

Project: EASTERN ARKANSAS PUMPING STATION

Boring No.: 12-EAPST-95

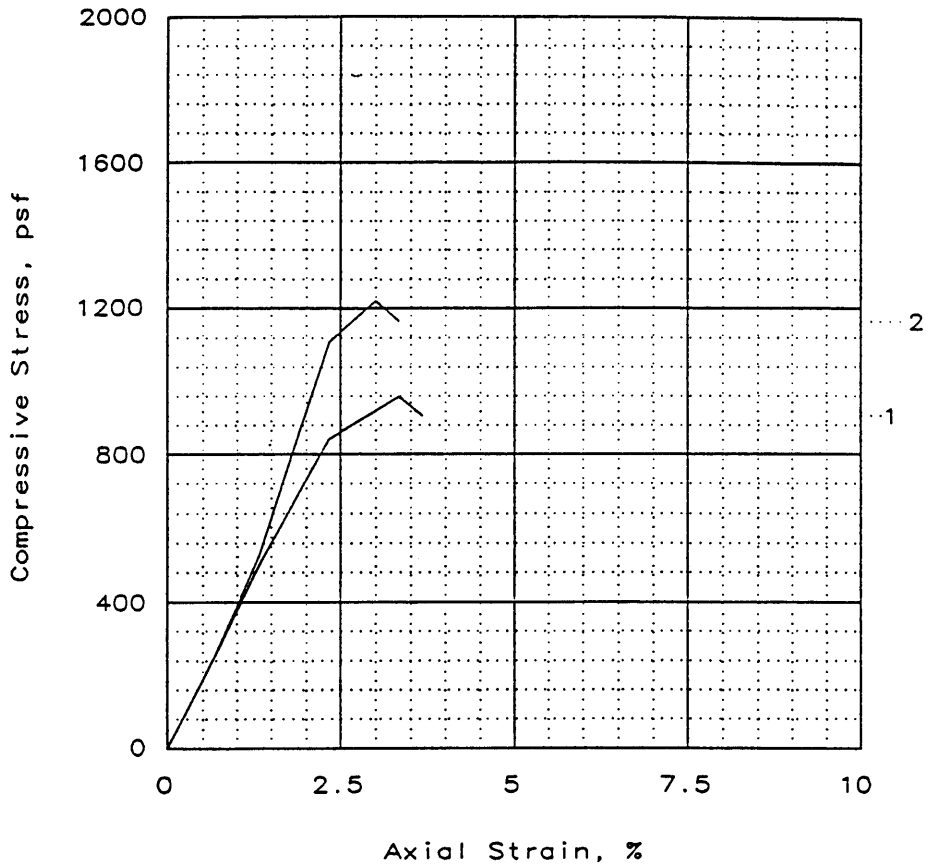
Sample No.: 3

Depth: 5.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	959	1220		
Undrained shear strength, psf	480	610		
Rate of strain, %/min				
Water content, %	26.3	22.8		
Void ratio	0.7905	0.7247		
Saturation, %	89.2	84.3		
Dry density, pcf	93.4	97.0		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CL) LEAN, IRON OXIDE.

LL = 39	PL = 17	PI = 22.0	GS = 2.68	Type: UNDISTURBED

Project No.:
Date: 07-21-95
Remarks:
PENETROMETER - 0.75
TORVAN - 0.50

Fig No.

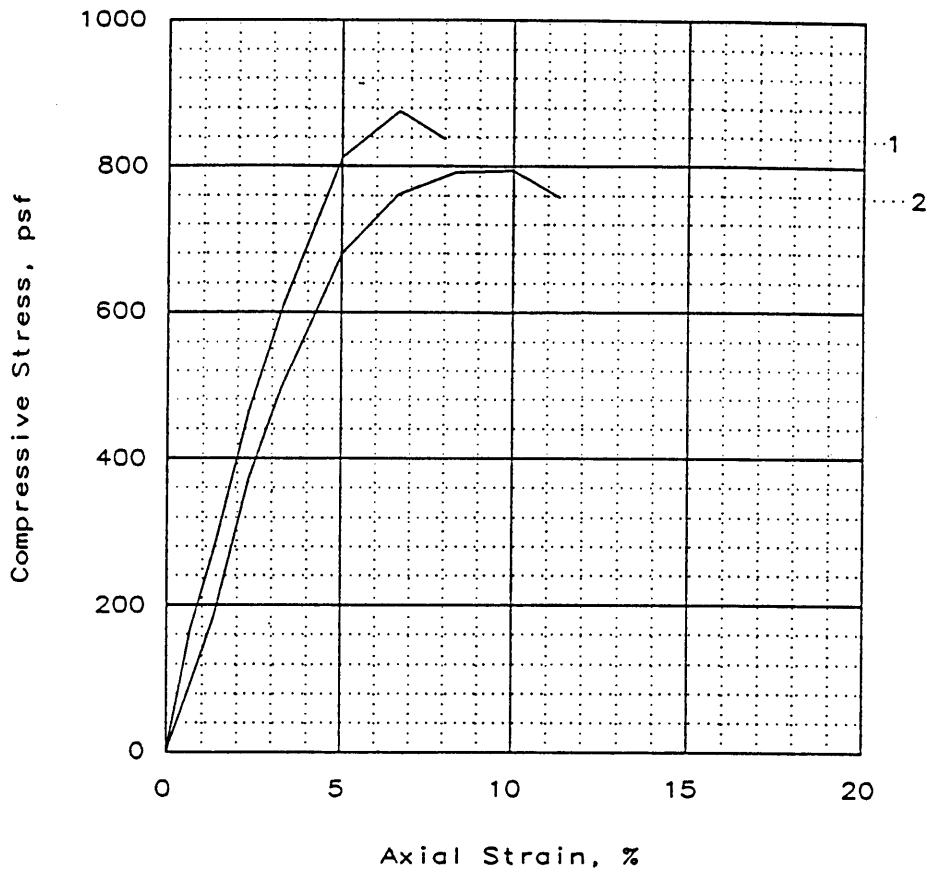
Project: EASTERN ARKANSAS PUMPING STATION

Boring No.: 12-EAPST-95
Sample No.: 4
Depth: 8.0 - 10.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	875	794		
Undrained shear strength, psf	437	397		
Rate of strain, %/min				
Water content, %	26.6	26.0		
Void ratio	0.7244	0.7236		
Saturation, %	98.6	96.2		
Dry density, pcf	97.0	97.1		
Specimen diameter, in	1.35	1.35		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CL) LEAN, IRON OXIDE.

LL = 33	PL = 18	PI = 15.0	GS = 2.68	Type: UNDISTURBED

Project No.:

Date: 07-21-95

Remarks:

PENETROMETER - 0.50

TORVAN - 0.32

Fig No.

Project: EASTERN ARKANSAS PUMPING STATION

Boring No.: 12-EAPST-95

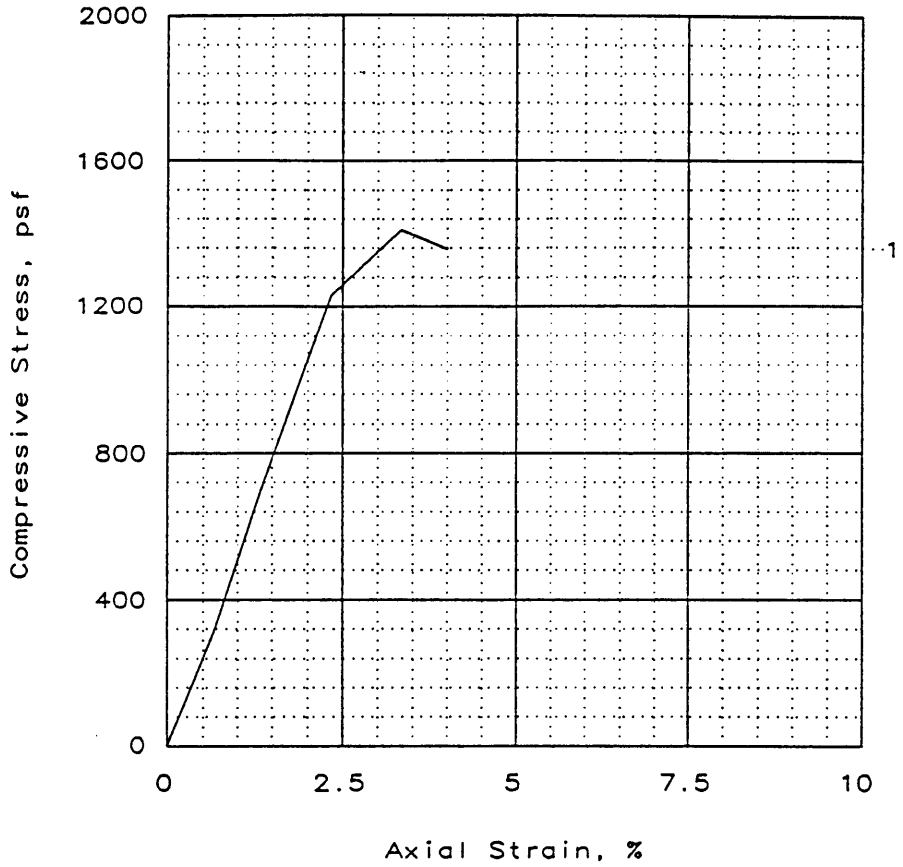
Sample No.: 5

Depth: 11.0 - 12.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1			
Unconfined strength, psf	1410			
Undrained shear strength, psf	705			
Rate of strain, %/min				
Water content, %	22.8			
Void ratio	0.7856			
Saturation, %	78.3			
Dry density, pcf	94.4			
Specimen diameter, in	1.36			
Specimen height, in	3.00			

Description: BR. CLAY (CH) FAT IRON OXIDE

LL = 51	PL = 19	PI = 32.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 07-21-95

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS PUMPING STATION

Boring No.: 13-EAPST-95

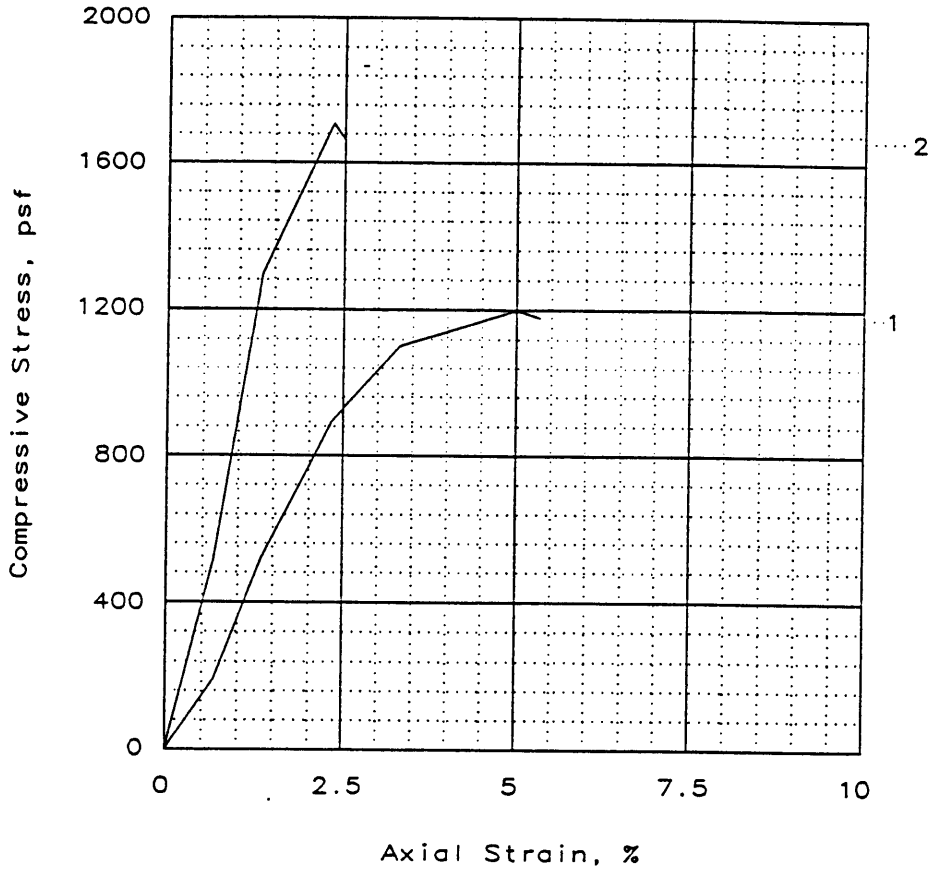
Sample No.: 3

Depth: 5.0 - 7.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1199	1708		
Undrained shear strength, psf	600	854		
Rate of strain, %/min				
Water content, %	26.7	26.5		
Void ratio	0.7973	0.7793		
Saturation, %	89.8	91.1		
Dry density, pcf	93.1	94.0		
Specimen diameter, in	1.40	1.39		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CL) LEAN IRON OXIDE

LL = 39	PL = 18	PI = 21.0	GS = 2.68	Type: UNDISTURBED

Project No.:
Date: 07-21-95
Remarks:
PENETROMETER - 0.75
TORVAN - 0.45

Fig No.

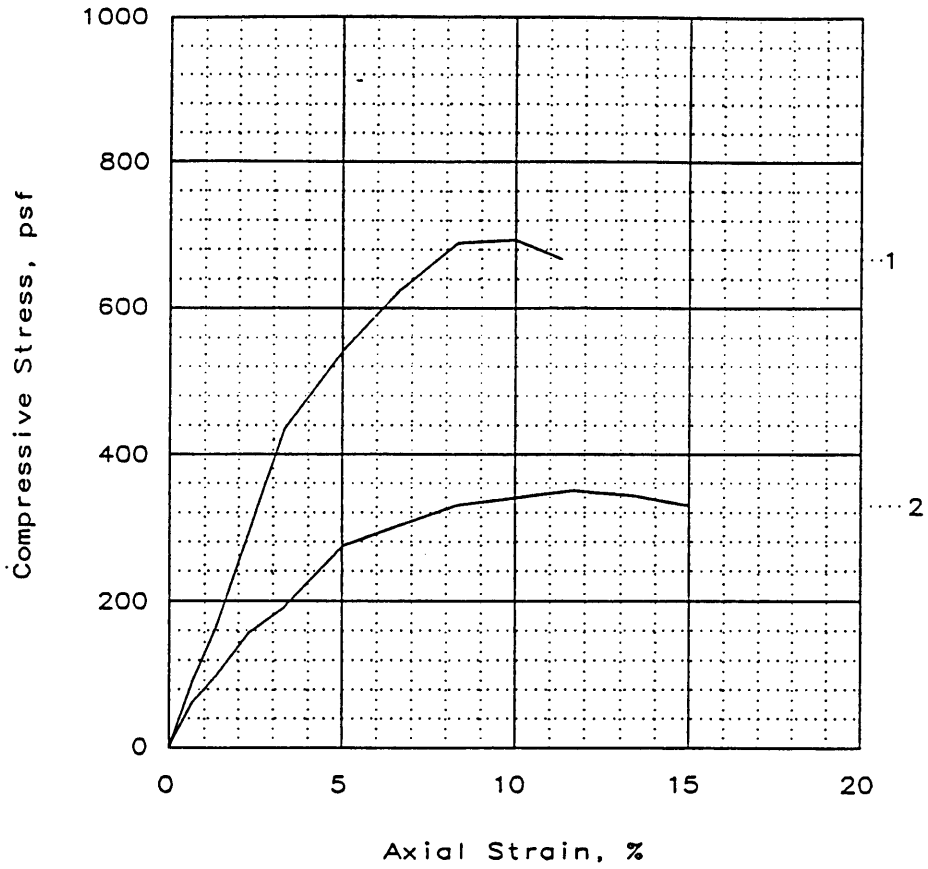
Project: EASTERN ARKANSAS PUMPING STATION

Boring No.: 13-EAPST-95
Sample No.: 4
Depth: 8.0 - 10.4

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	690	350		
Undrained shear strength, psf	345	175		
Rate of strain, %/min				
Water content, %	27.1	28.0		
Void ratio	0.7741	0.8038		
Saturation, %	94.0	93.4		
Dry density, pcf	94.3	92.8		
Specimen diameter, in	1.36	1.37		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CL) LEAN LENSES OF SILT

LL = 33	PL = 17	PI = 16.0	GS = 2.68	Type: UNDISTURBED

Project No.:
Date: 07-21-95
Remarks:
PENETROMETER - 0.25
TORVAN - 0.25

Fig No.

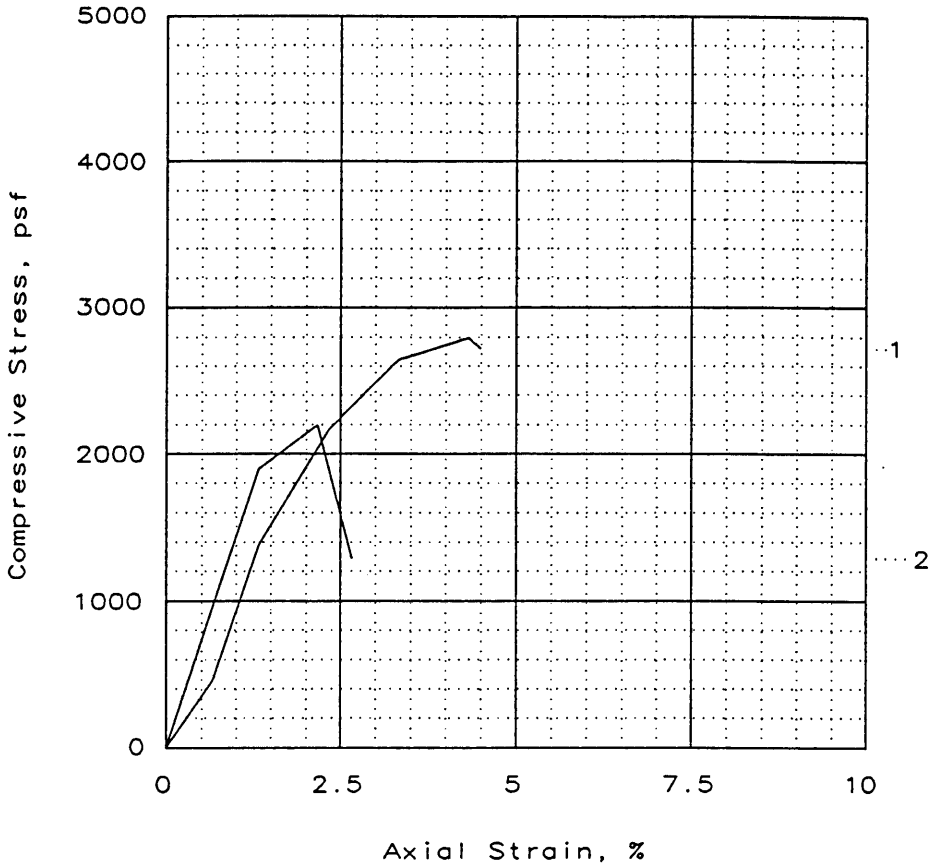
Project: EASTERN ARKANSAS PUMPING STATION

Boring No.: 13-EAPST-95
Sample No.: 5
Depth: 11.0 - 12.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2794	2195		
Undrained shear strength, psf	1397	1097		
Rate of strain, %/min				
Water content, %	39.0	39.7		
Void ratio	1.0220	1.0284		
Saturation, %	103.0	104.2		
Dry density, pcf	83.4	83.1		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 85	PL = 23	PI = 62.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-16-94
Remarks:
PENETROMETER - 1.5
TORVAN - 0.76

Fig No.

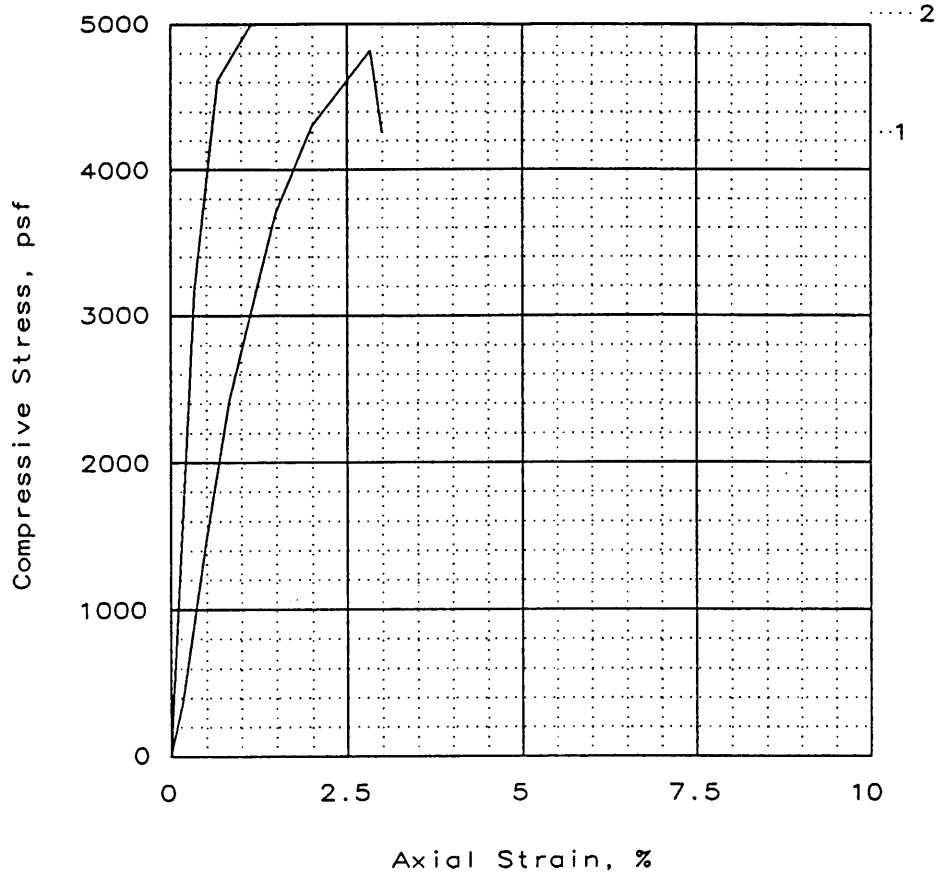
Project: EASTERN ARKANSAS

Boring No.: 1-EAU-94
Sample No.: 12
Depth: 38.0 - 39.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4815	5185		
Undrained shear strength, psf	2408	2593		
Rate of strain, %/min				
Water content, %	34.2	34.7		
Void ratio	0.8832	0.8767		
Saturation, %	104.7	106.9		
Dry density, pcf	89.5	89.8		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 85	PL = 21	PI = 64.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-16-94
Remarks:
PENETROMETER - 2.5
TORVAN - MAX.

Fig No.

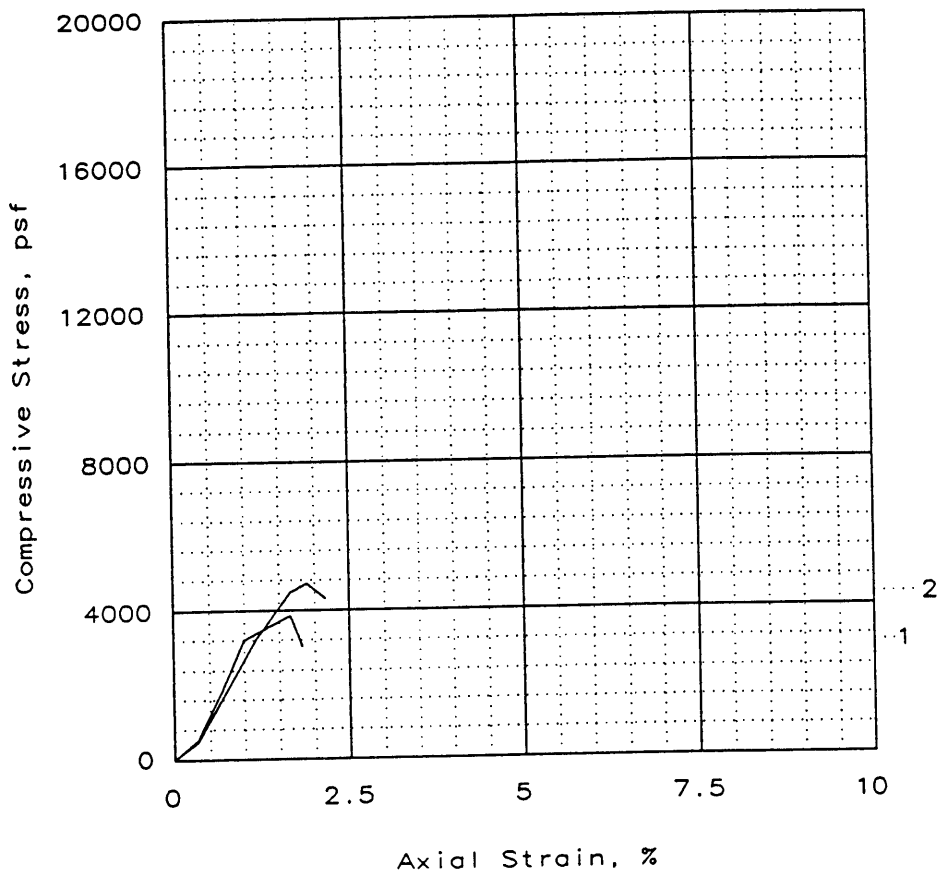
Project: EASTERN ARKANSAS

Boring No.: 1-EAU-94
Sample No.: 13
Depth: 43.0 - 45.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3861	3198		
Undrained shear strength, psf	1930	1599		
Rate of strain, %/min				
Water content, %	41.5	40.8		
Void ratio	1.0727	1.0776		
Saturation, %	104.5	102.3		
Dry density, pcf	81.3	81.1		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 89	PL = 26	PI = 63.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-19-94
Remarks:
PENETROMETER - 2.5
TORVAN - MAX.
BOTTOM OF SAMPLE - BR. SILT

Fig No.

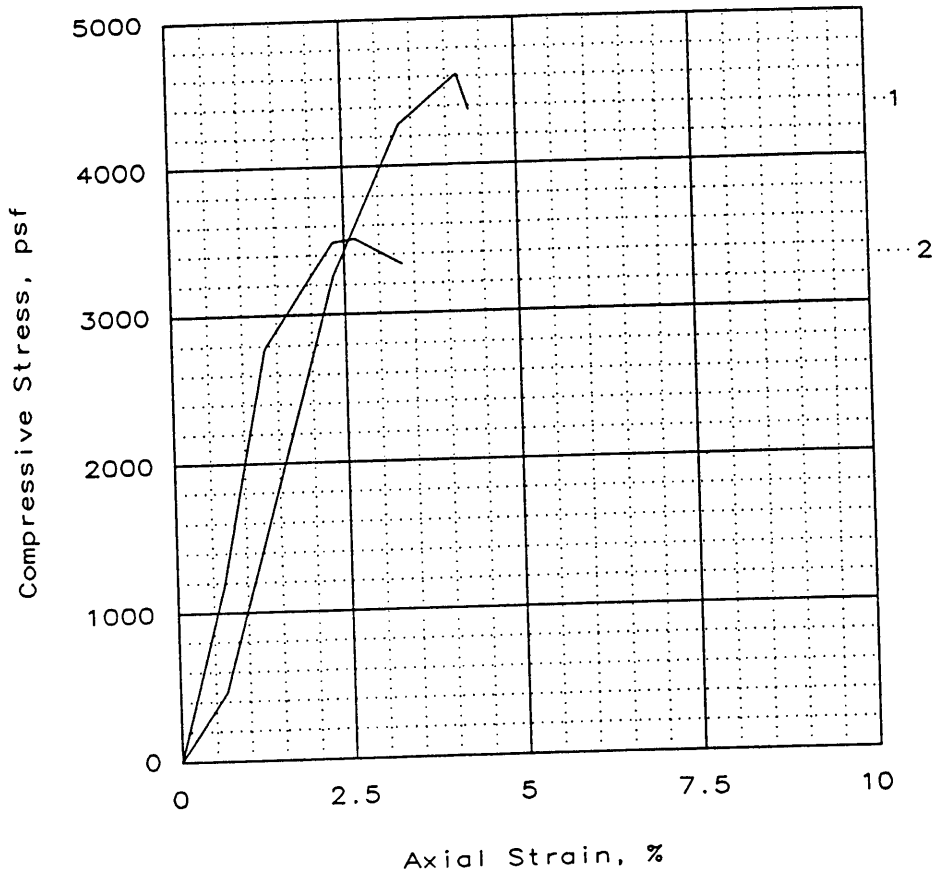
Project: EASTERN ARKANSAS

Boring No.: 1-EAU-94
Sample No.: 14
Depth: 48.0 - 49.8

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4614	3509		
Undrained shear strength, psf	2307	1755		
Rate of strain, %/min				
Water content, %	39.6	42.7		
Void ratio	0.8115	1.1268		
Saturation, %	131.8	102.4		
Dry density, pcf	93.0	79.3		
Specimen diameter, in	1.31	1.39		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 97	PL = 25	PI = 72.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-16-94

Remarks:

PENETROMETER - 2.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 1-EAU-94

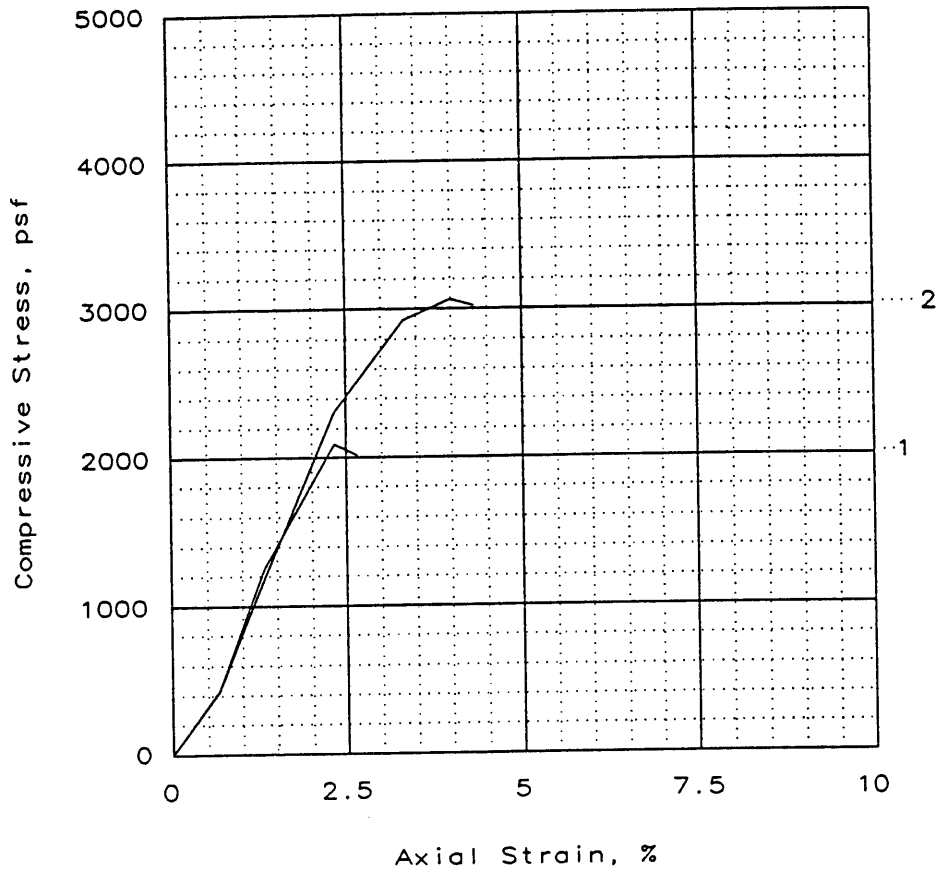
Sample No.: 16

Depth: 68.0 - 70.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2093	3064		
Undrained shear strength, psf	1047	1532		
Rate of strain, %/min				
Water content, %	21.1	25.8		
Void ratio	0.7322	0.7327		
Saturation, %	77.4	94.7		
Dry density, pcf	96.9	96.9		
Specimen diameter, in	1.39	1.37		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CL) SILTY

LL = 41	PL = 18	PI = 23.0	GS = 2.69	Type: UNDISTURBED

Project No.:
Date: 11-29-94
Remarks:
PENETROMETER - MAX.
TORVAN - MAX.
BOTTOM OS SAMPLE - BOXED

Fig No.

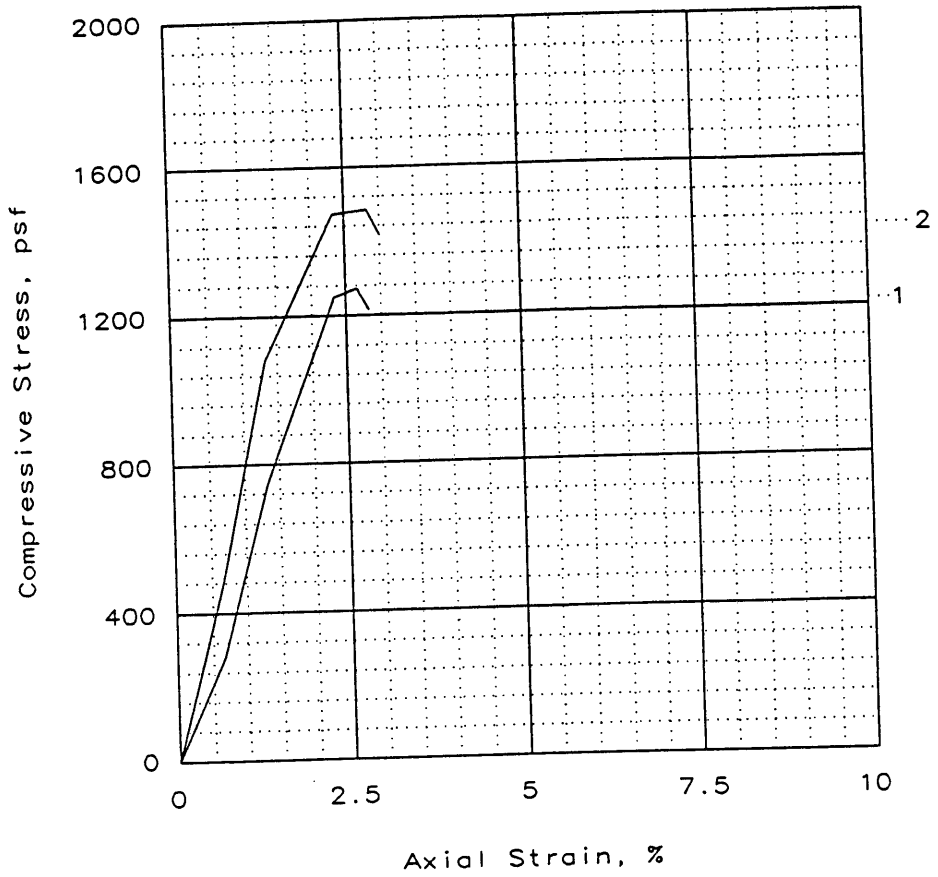
Project: EASTERN ARKANSAS

Boring No.: 2-EAU-94
Sample No.: 5
Depth: 12.0 - 12.8

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1271	481		
Undrained shear strength, psf	636	240		
Rate of strain, %/min				
Water content, %	28.0	29.0		
Void ratio	0.8196	0.8165		
Saturation, %	91.5	95.1		
Dry density, pcf	91.9	92.1		
Specimen diameter, in	1.36	1.36		
Specimen height, in	3.00	3.00		

Description: RD SILT (ML) LENSES OF CLAY

LL = 29	PL = 25	PI = 4.0	GS = 2.68	Type: UNDISTURBED

Project No.:

Date: 11-29-94

Remarks:

PENETROMETER - 1.25

TORVAN - 0.28

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 2-EAU-94

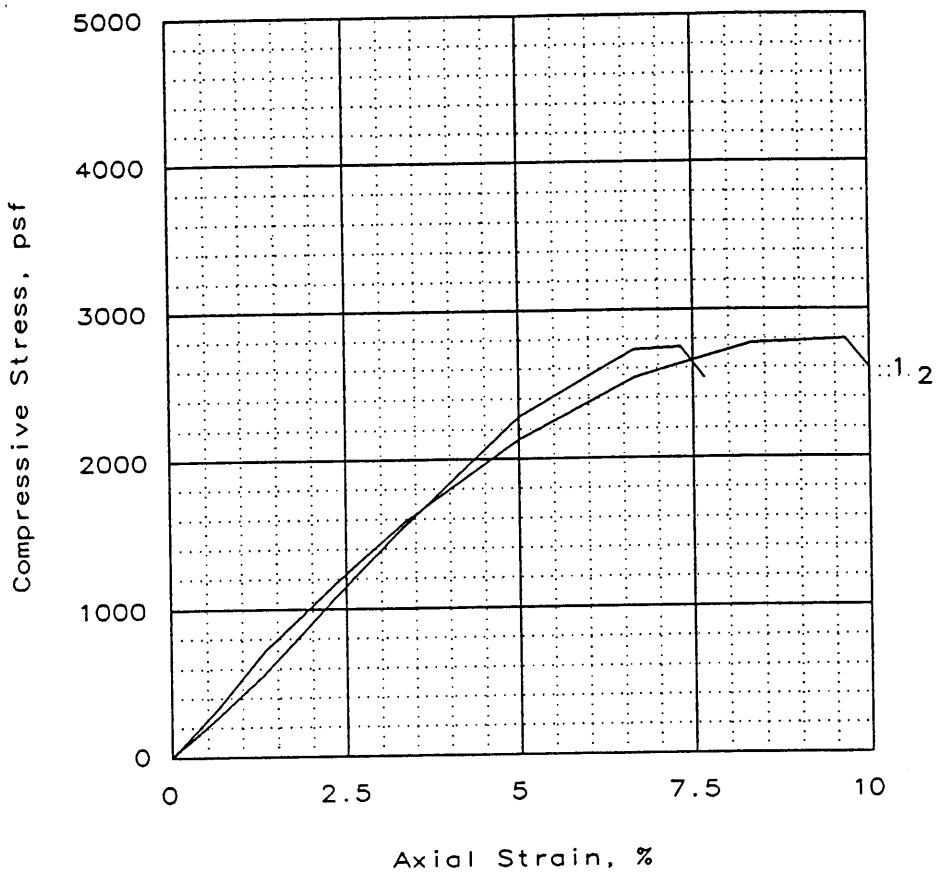
Sample No.: 7

Depth: 17.0 - 17.7

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2793	2742		
Undrained shear strength, psf	1396	1371		
Rate of strain, %/min				
Water content, %	26.2	24.6		
Void ratio	0.6792	0.6402		
Saturation, %	103.5	102.9		
Dry density, pcf	99.6	102.0		
Specimen diameter, in	1.36	1.36		
Specimen height, in	3.00	3.00		

Description: R. SILT (ML) LENSES OF CLAY

LL = 32	PL = 25	PI = 7.0	GS = 2.68	Type: UNDISTURBED

Project No.:
Date: 11-28-94
Remarks:
PENETROMETER - 1.5
TORVAN - 0.50
UPPER SAMPLE - SILT W/CLAY
BOTTOM SAMPLE - BOXED
Fig No.

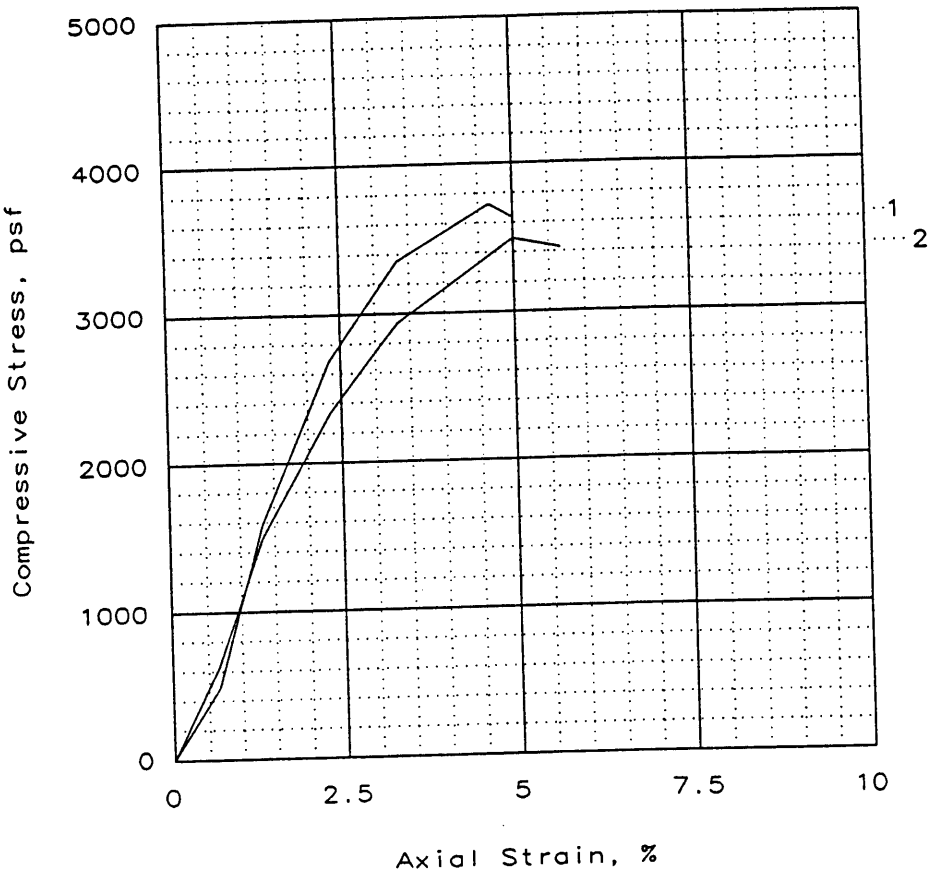
Project: EASTERN ARKANSAS

Boring No.: 2-EAU-94
Sample No.: 10
Depth: 30.0 - 30.7

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3723	3494		
Undrained shear strength, psf	1862	1747		
Rate of strain, %/min				
Water content, %	34.8	35.6		
Void ratio	0.9125	0.9299		
Saturation, %	103.1	103.4		
Dry density, pcf	88.1	87.3		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: R. CLAY (CH) FAT LENSES OF SILT

LL = 62	PL = 23	PI = 39.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-29-94

Remarks:

PENETORMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 2-EAU-94

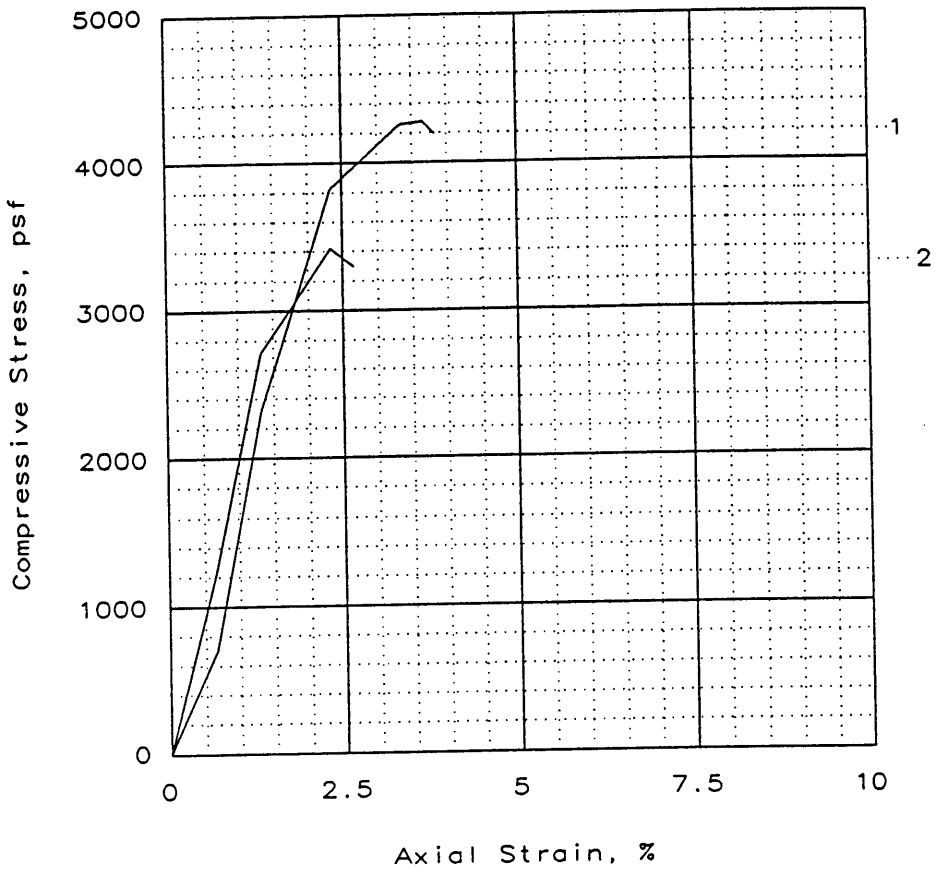
Sample No.: 11

Depth: 34.0 - 36.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4277	3422		
Undrained shear strength, psf	2138	1711		
Rate of strain, %/min				
Water content, %	31.3	33.0		
Void ratio	0.8522	0.8938		
Saturation, %	99.3	99.8		
Dry density, pcf	91.0	89.0		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: R. CLAY (CL) FAT

LL = 77	PL = 25	PI = 52.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-29-94
Remarks:
PENETROMETER - 2.75
TORVAN - MAX.
BOTTOM 0.3" - SILT

Fig No.

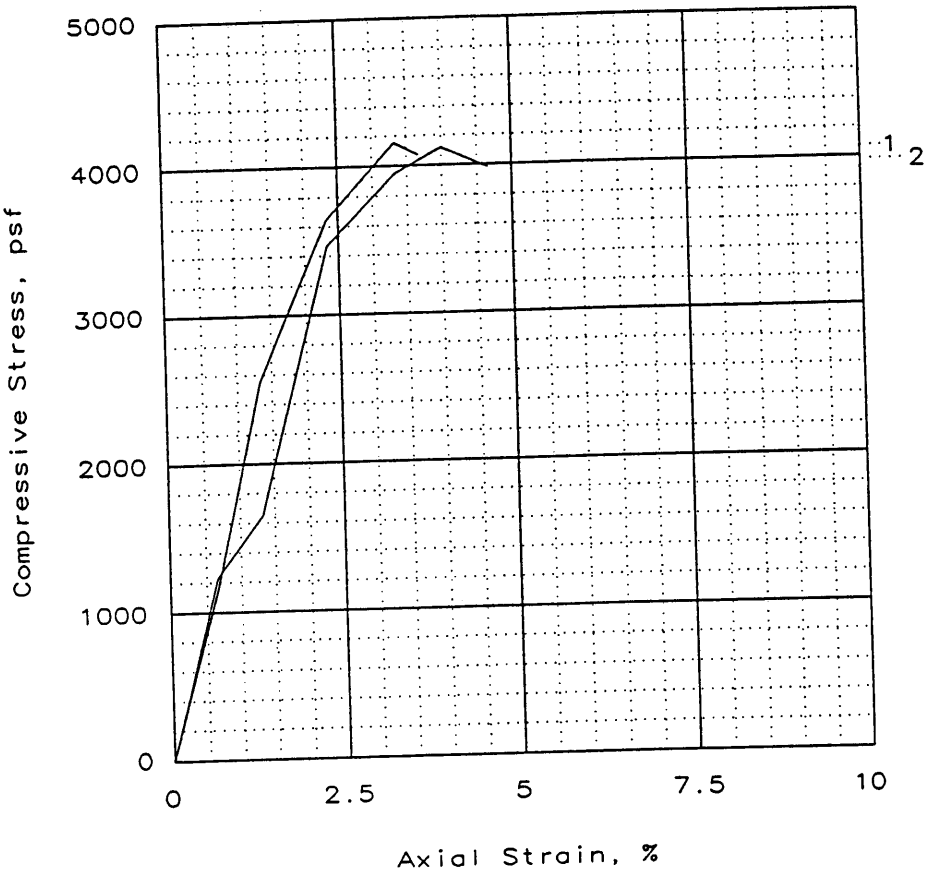
Project: EASTERN ARKANSAS

Boring No.: 2-EAU-94
Sample No.: 13
Depth: 42.0 - 44.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4154	4119		
Undrained shear strength, psf	2077	2060		
Rate of strain, %/min				
Water content, %	29.8	30.5		
Void ratio	0.7900	0.8232		
Saturation, %	101.8	100.0		
Dry density, pcf	94.2	92.5		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: R. CLAY (CH) FAT

LL = 65	PL = 27	PI = 38.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-29-94

Remarks:

PENETROMETER - 2.5

TORVAN - 0.92

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 2-EAU-94

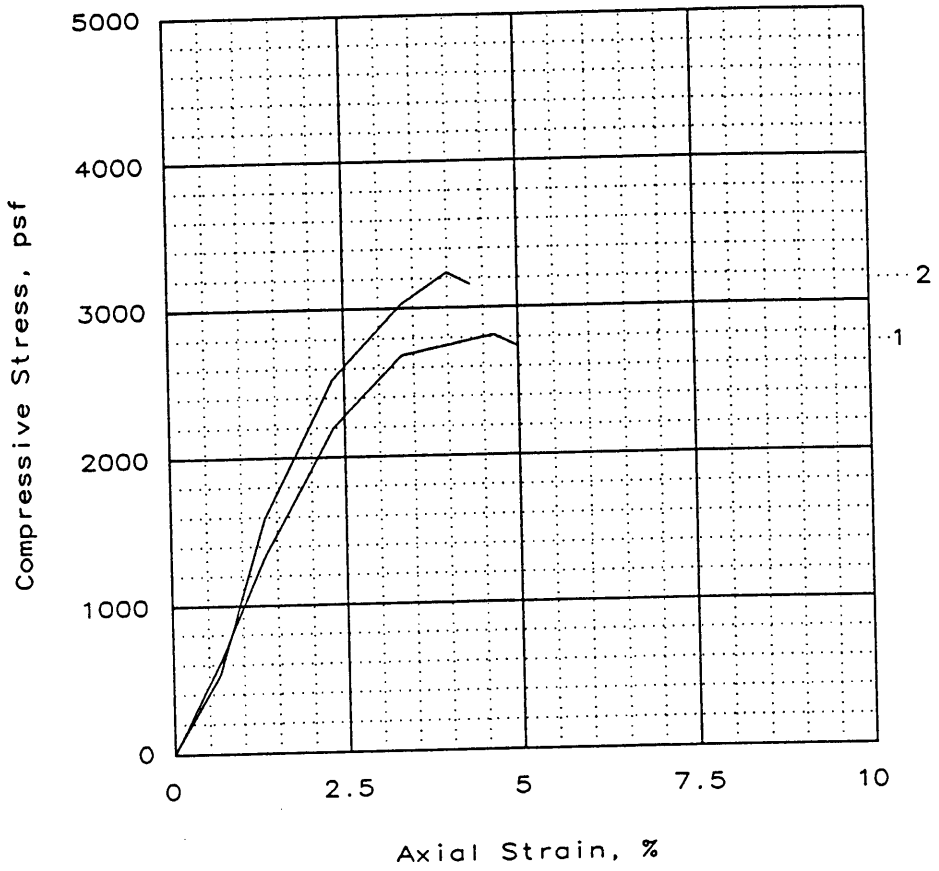
Sample No.: 14

Depth: 47.0 - 49.1

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2814	3238		
Undrained shear strength, psf	1407	1619		
Rate of strain, %/min				
Water content, %	23.8	25.2		
Void ratio	0.6821	0.7299		
Saturation, %	94.1	93.2		
Dry density, pcf	100.2	97.4		
Specimen diameter, in	1.37	1.38		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 62	PL = 19	PI = 43.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-12-95

Remarks:

PENETROMETER - 1.75

TORVAN - 0.90

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 3-EAU-94

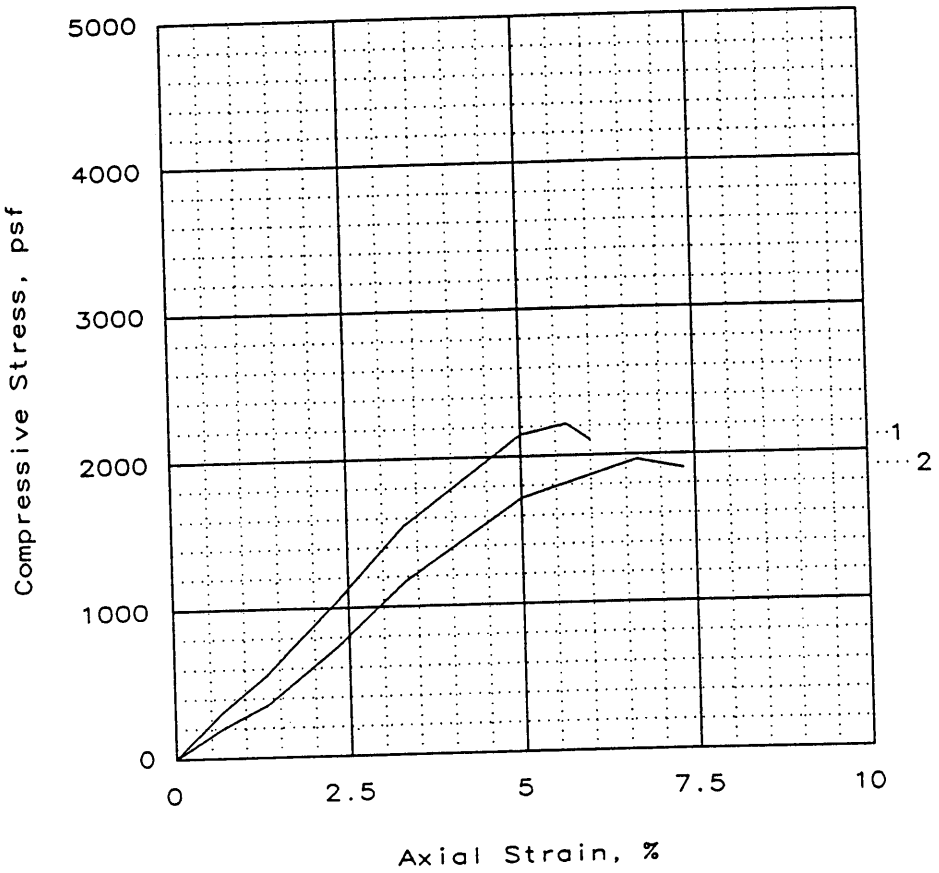
Sample No.: 3

Depth: 6.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2214	1966		
Undrained shear strength, psf	1107	983		
Rate of strain, %/min				
Water content, %	29.4	30.4		
Void ratio	0.7815	0.8217		
Saturation, %	101.6	99.9		
Dry density, pcf	94.6	92.5		
Specimen diameter, in	1.37	1.37		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 33	PL = 21	PI = 12.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-12-95

Remarks:

PENETROMETER - 1.5

TORVAN - 0.32

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 3-EAU-94

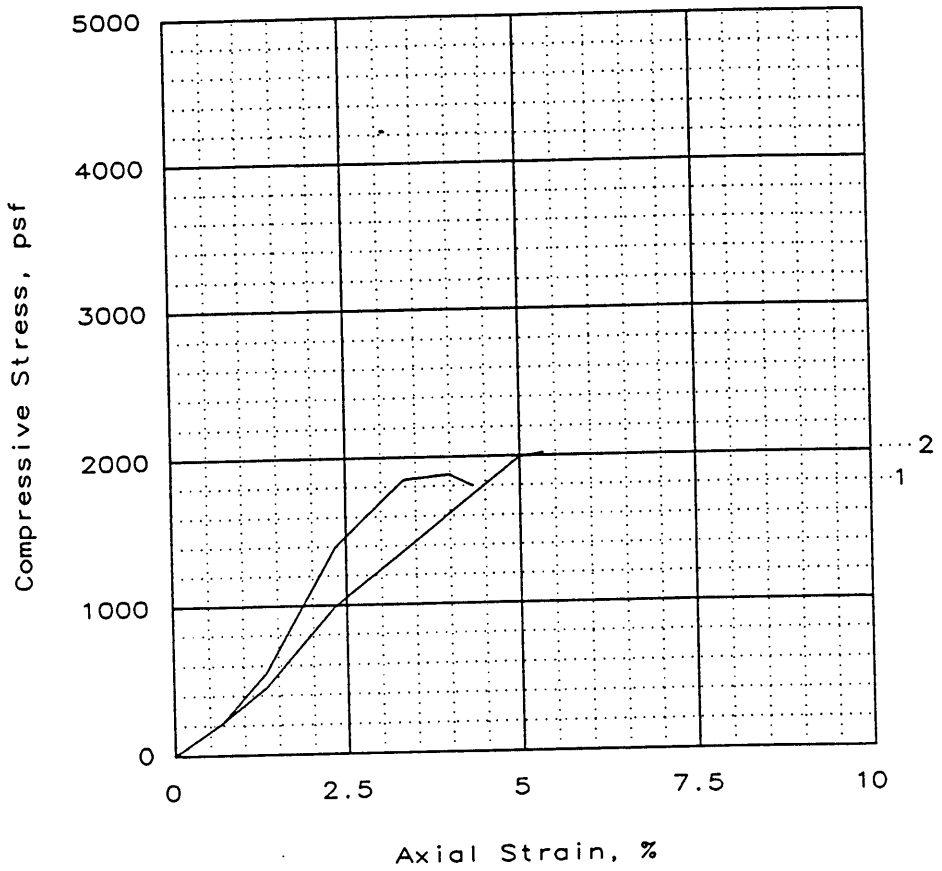
Sample No.: 10

Depth: 29.0 - 31.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1880	2021		
Undrained shear strength, psf	940	1010		
Rate of strain, %/min				
Water content, %	29.2	28.5		
Void ratio	0.7888	0.7507		
Saturation, %	99.1	101.8		
Dry density, pcf	93.5	95.6		
Specimen diameter, in	1.37	1.36		
Specimen height, in	3.00	3.00		

Description: RD CLAY (CL) LEAN

LL = 30	PL = 21	PI = 9.0	GS = 2.68	Type: UNDISTURBED

Project No.:
Date: 01-12-95
Remarks:
PENETROMETER - 1.0
TORVAN - 0.34

Fig No.

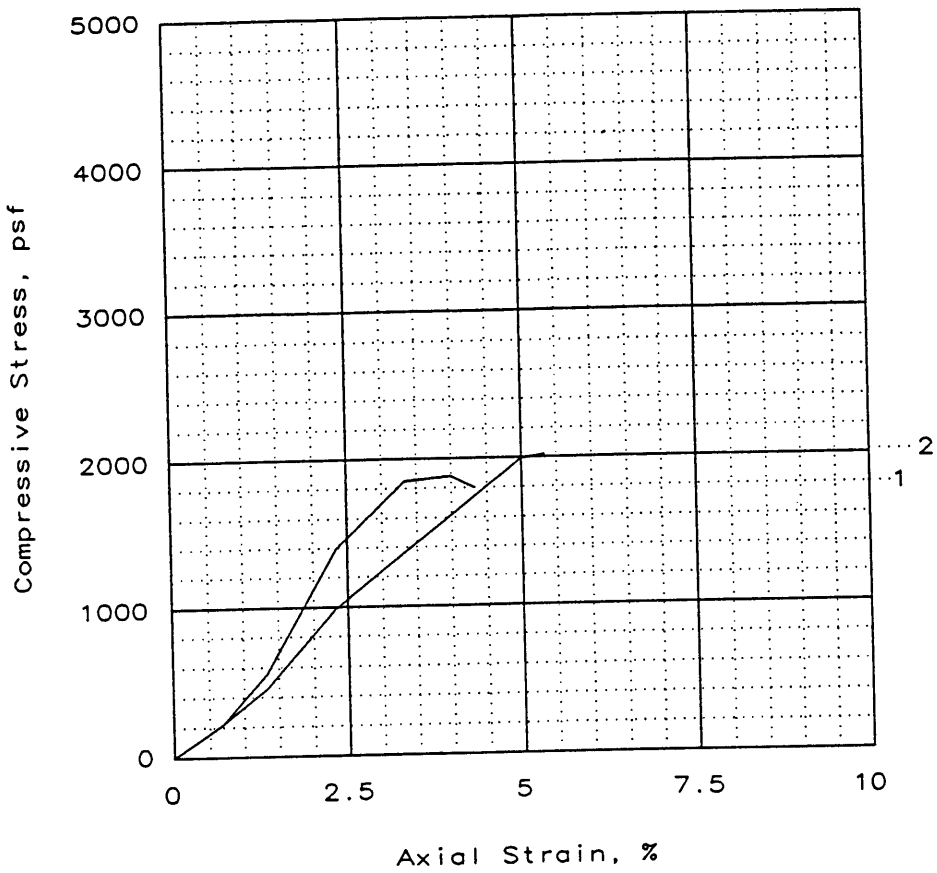
Project: EASTERN ARKANSAS

Boring No.: 3-EAU-94
Sample No.: 11
Depth: 34.0 - 36.1

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1880	2021		
Undrained shear strength, psf	940	1010		
Rate of strain, %/min				
Water content, %	29.2	28.5		
Void ratio	0.7888	0.7507		
Saturation, %	99.1	101.8		
Dry density, pcf	93.5	95.6		
Specimen diameter, in	1.37	1.36		
Specimen height, in	3.00	3.00		

Description: RD CLAY (CL) LEAN

LL = 30	PL = 21	PI = 9.0	GS = 2.68	Type: UNDISTURBED

Project No.:

Date: 01-12-95

Remarks:

PENETROMETER - 1.0

TORVAN - 0.34

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 3-EAU-94

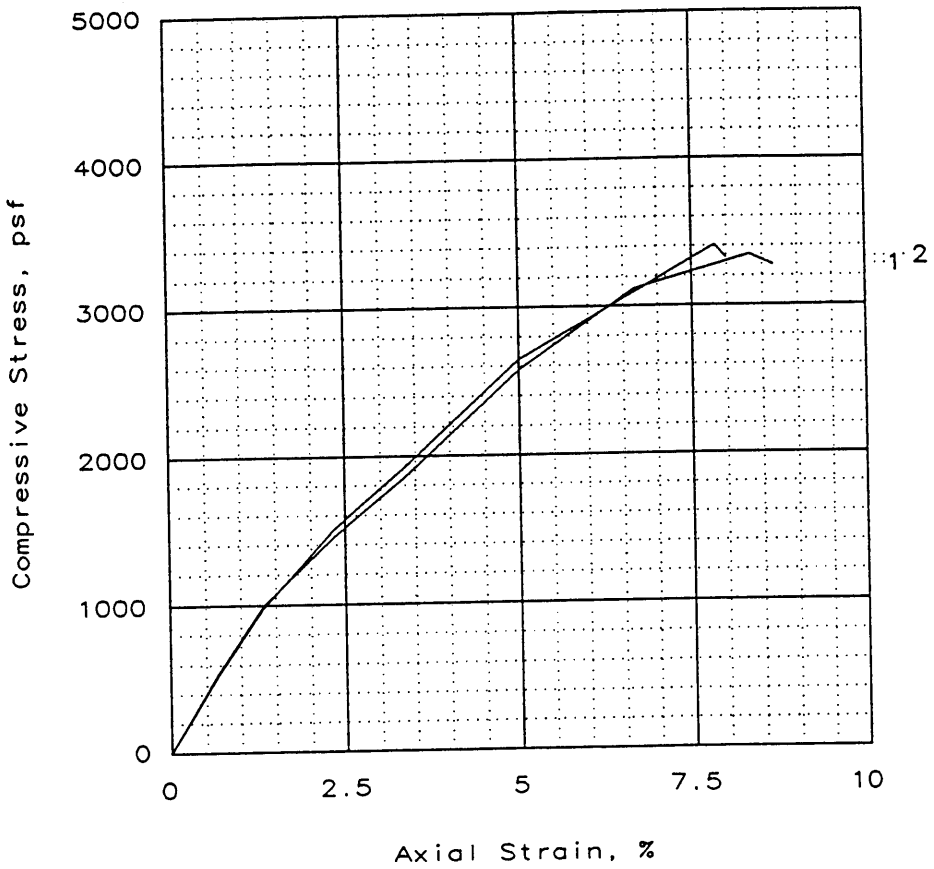
Sample No.: 11

Depth: 34.0 - 36.1

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3343	3411		
Undrained shear strength, psf	1671	1706		
Rate of strain, %/min				
Water content, %	37.5	38.8		
Void ratio	0.9576	0.9932		
Saturation, %	105.8	105.5		
Dry density, pcf	86.1	84.6		
Specimen diameter, in	1.37	1.37		
Specimen height, in	3.00	3.00		

Description: RD CLAY (CH) FAT

LL = 68	PL = 27	PI = 41.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-12-95

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 3-EAU-94

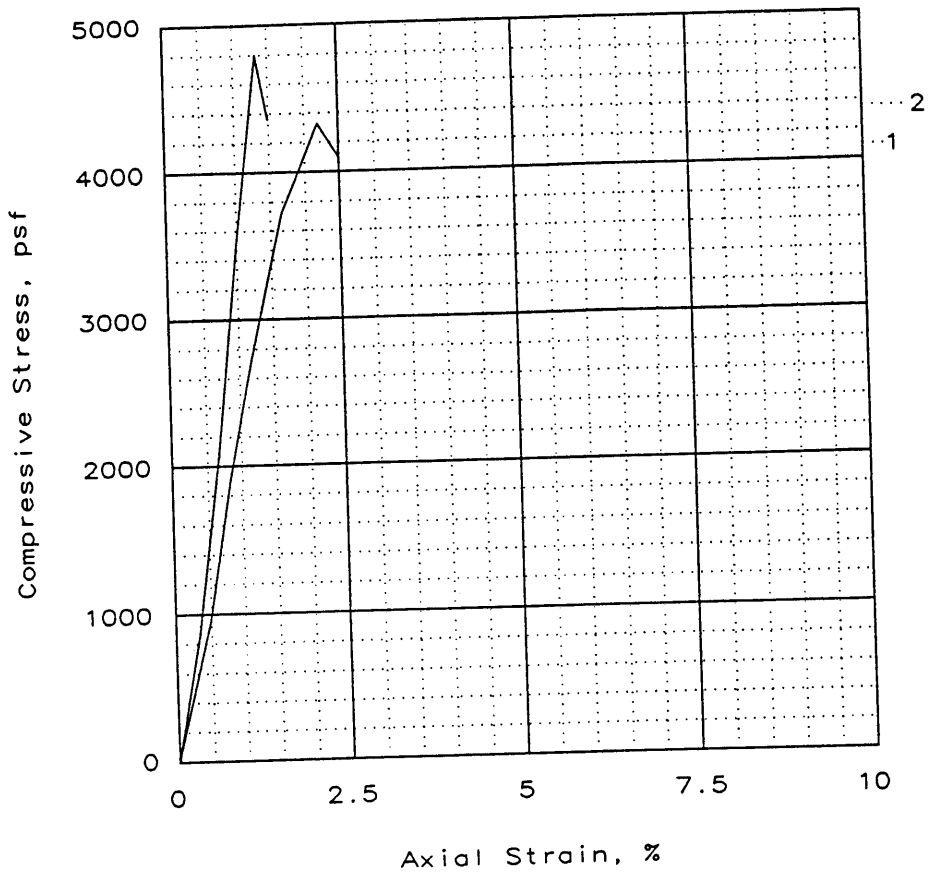
Sample No.: 14

Depth: 49.0 - 51.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4326	4800		
Undrained shear strength, psf	2163	2400		
Rate of strain, %/min				
Water content, %	26.7	26.1		
Void ratio	0.7485	0.7364		
Saturation, %	96.5	95.8		
Dry density, pcf	96.4	97.1		
Specimen diameter, in	1.38	1.39		
Specimen height, in	3.00	3.00		

Description: GR CLAY (CH) FAT

LL = 51	PL = 23	PI = 28.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-12-95

Remarks:

PENETROMETER - 3.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 3-EAU-94

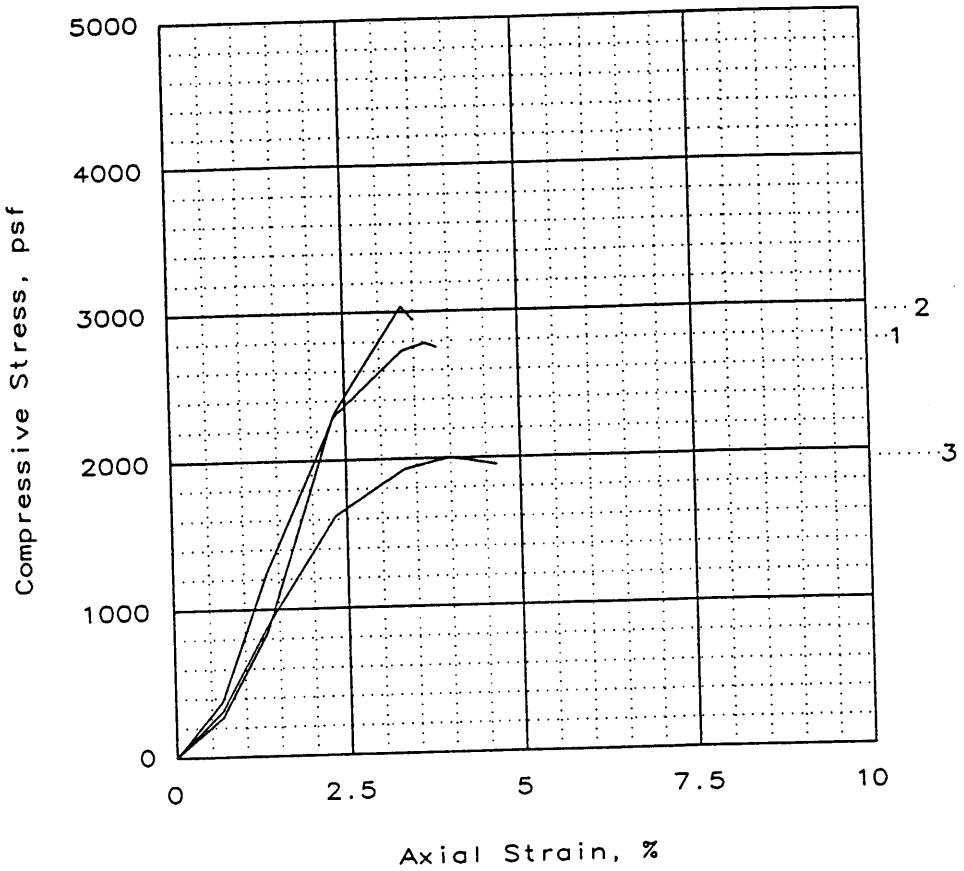
Sample No.: 15

Depth: 59.0 - 61.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2	3	
Unconfined strength, psf	2786	3036	2004	
Undrained shear strength, psf	1393	1518	1002	
Rate of strain, %/min				
Water content, %	23.6	21.7	26.0	
Void ratio	0.6626	0.5906	0.7212	
Saturation, %	96.0	99.2	97.2	
Dry density, pcf	101.4	106.0	97.9	
Specimen diameter, in	1.39	1.38	1.38	
Specimen height, in	3.00	3.00	3.00	

Description: GR. CLAY (CH) FAT IRON OXIDE

LL = 50	PL = 16	PI = 34.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-13-95

Remarks:

PENETROMETER - 2.75

TORVAN - MAX.

UPPER SAMPLE - BOXED

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 4-EAU-94

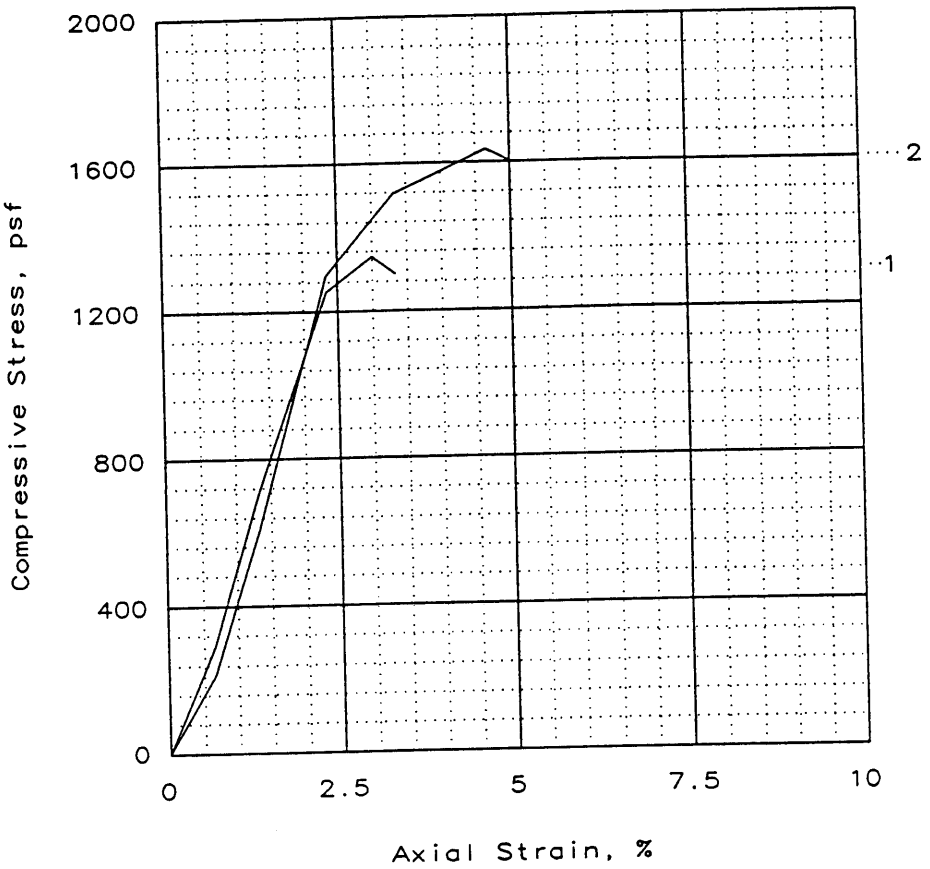
Sample No.: 3

Depth: 6.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1347	1635		
Undrained shear strength, psf	674	818		
Rate of strain, %/min				
Water content, %	20.3	22.6		
Void ratio	0.6992	0.7032		
Saturation, %	78.3	86.6		
Dry density, pcf	98.8	98.6		
Specimen diameter, in	1.38	1.37		
Specimen height, in	3.00	3.00		

Description: GR CLAY (CL) SILTY LENSES OF SILT

LL = 45	PL = 15	PI = 30.0	GS = 2.69	Type: UNDISTURBED

Project No.:

Date: 01-13-95

Remarks:

PENETROMETER - 2.0

TORVAN - 0.90

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 4-EAU-94

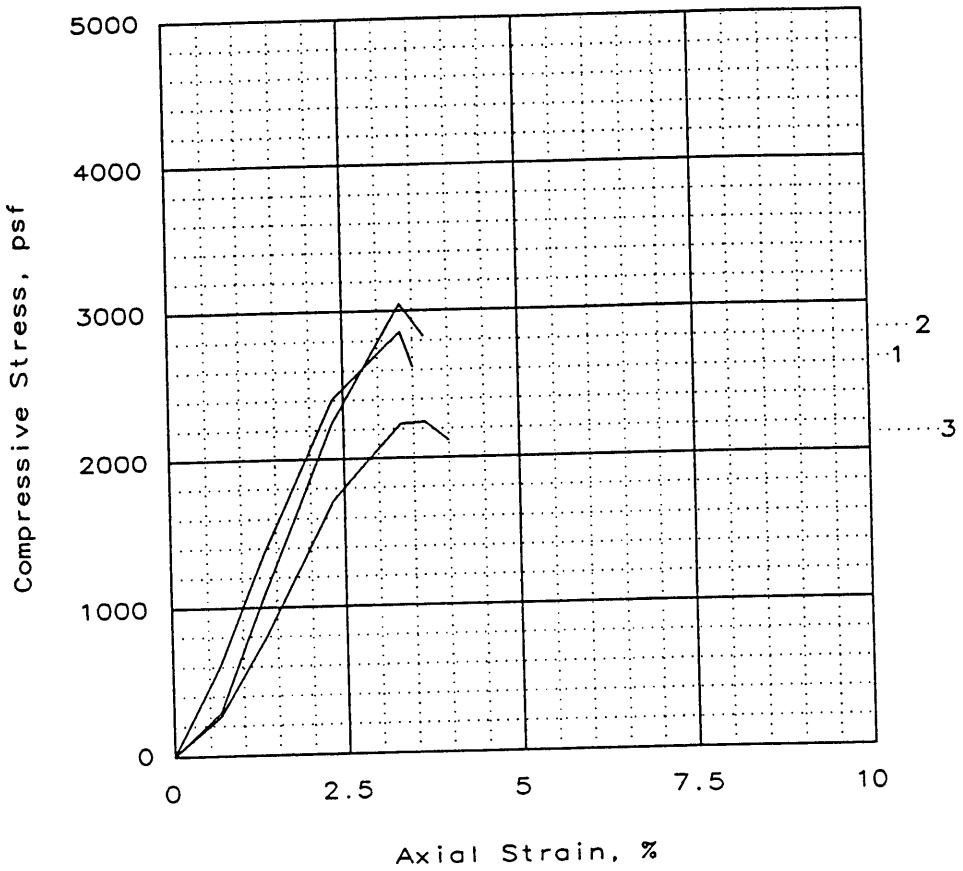
Sample No.: 4

Depth: 8.0 - 9.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2	3	
Unconfined strength, psf	2859	3044	2244	
Undrained shear strength, psf	1429	1522	1122	
Rate of strain, %/min				
Water content, %	31.2	31.2	32.1	
Void ratio	0.8644	0.8790	0.9110	
Saturation, %	97.3	95.8	95.2	
Dry density, pcf	90.4	89.7	88.2	
Specimen diameter, in	1.38	1.38	1.38	
Specimen height, in	3.00	3.00	3.00	

Description: RD CLAY (CH) FAT

LL = 66	PL = 18	PI = 48.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 01-13-95
Remarks:
PENETROMETER - 2.0
TORVAN - MAX.
BOTTOM OF SAMPLE - SILT

Fig No.

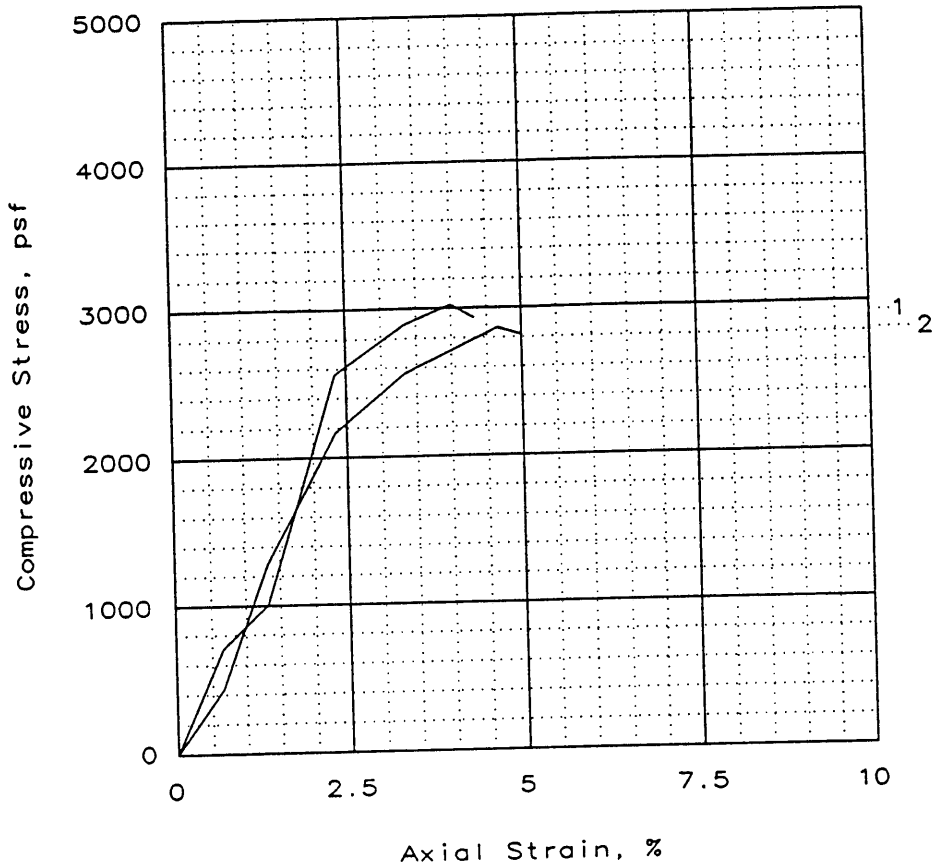
Project: EASTERN ARKANSAS

Boring No.: 4-EAU-94
Sample No.: 9
Depth: 24.0 - 25.3

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3023	2863		
Undrained shear strength, psf	1512	1431		
Rate of strain, %/min				
Water content, %	39.1	39.8		
Void ratio	1.0313	1.0527		
Saturation, %	102.5	102.1		
Dry density, pcf	83.0	82.1		
Specimen diameter, in	1.38	1.39		
Specimen height, in	3.00	3.00		

Description: RD CLAY (CH) FAT

LL = 87	PL = 24	PI = 63.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-13-95

Remarks:

PENETROMETER - 2.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 4-EAU-94

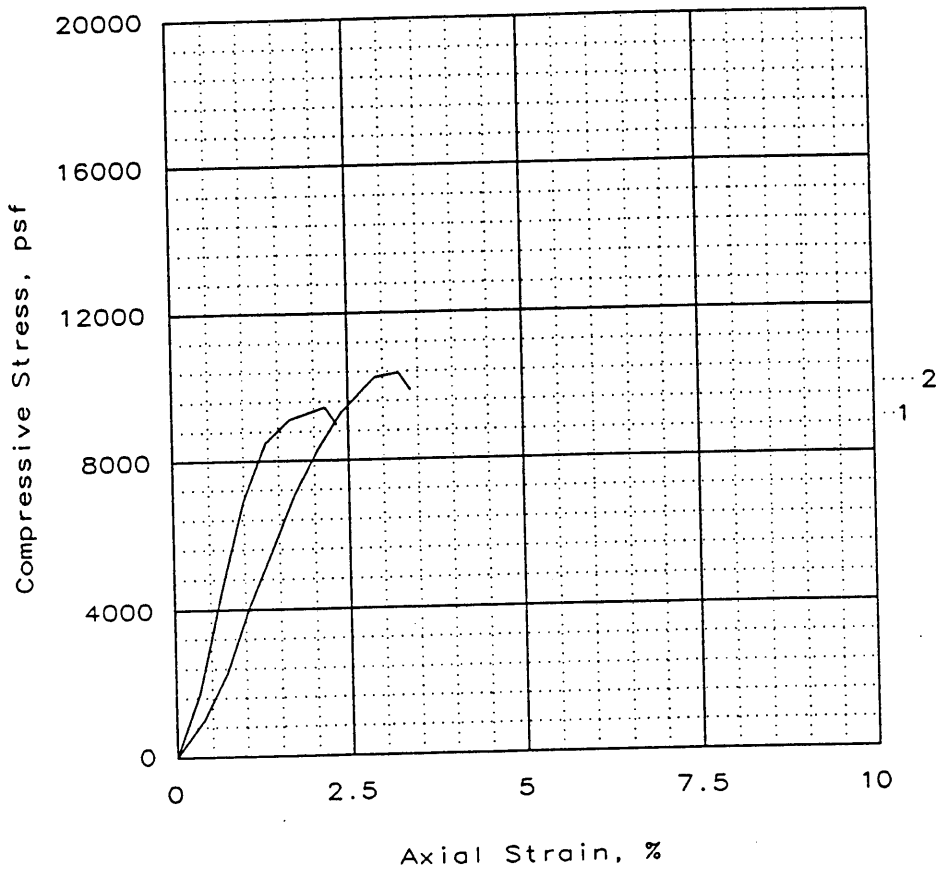
Sample No.: 15

Depth: 59.0 - 60.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	9454	10366		
Undrained shear strength, psf	4727	5183		
Rate of strain, %/min				
Water content, %	20.8	19.0		
Void ratio	0.5890	0.5755		
Saturation, %	95.3	89.0		
Dry density, pcf	106.1	107.0		
Specimen diameter, in	1.38	1.39		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CH) FAT

LL = 80	PL = 19	PI = 61.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-30-94

Remarks:

PENETROMETER - 4.5

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 5-EAU-94

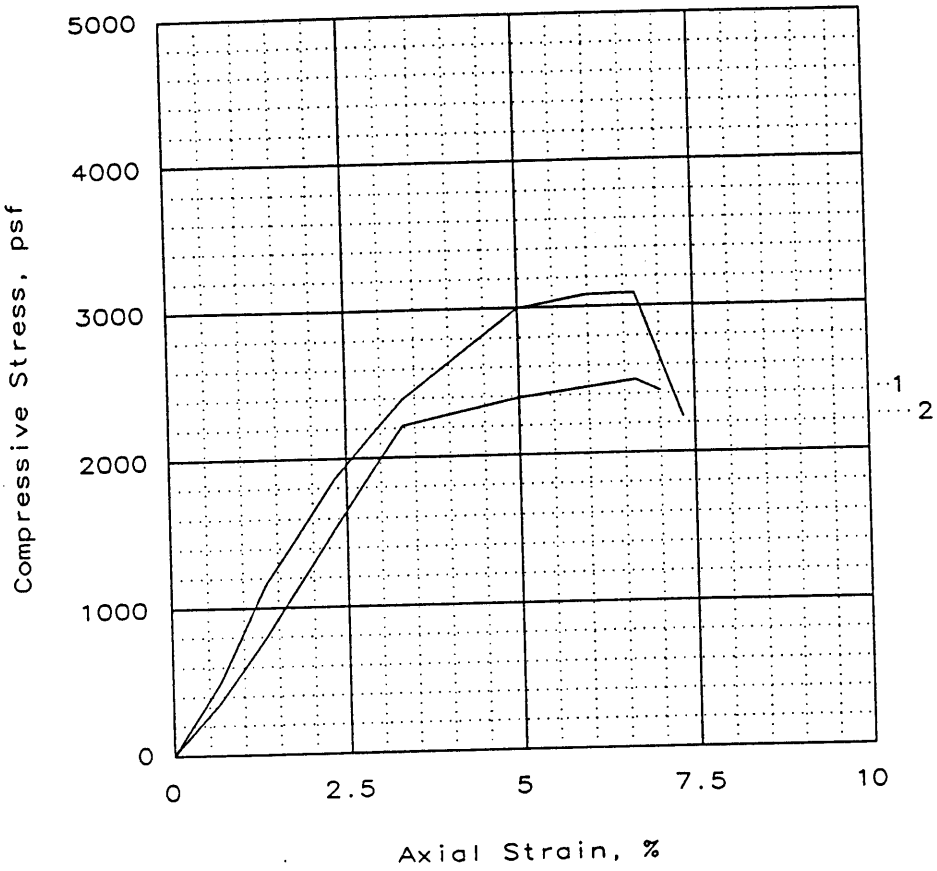
Sample No.: 3

Depth: 5.0 - 6.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2500	3087		
Undrained shear strength, psf	1250	1544		
Rate of strain, %/min				
Water content, %	52.2	49.6		
Void ratio	1.3873	1.3000		
Saturation, %	101.6	103.1		
Dry density, pcf	70.6	73.3		
Specimen diameter, in	1.37	1.37		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CH) FAT

LL = 85	PL = 29	PI = 56.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-30-94

Remarks:

PENTROMETER - 1.25

TORVAN - 0.66

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 5-EAU-94

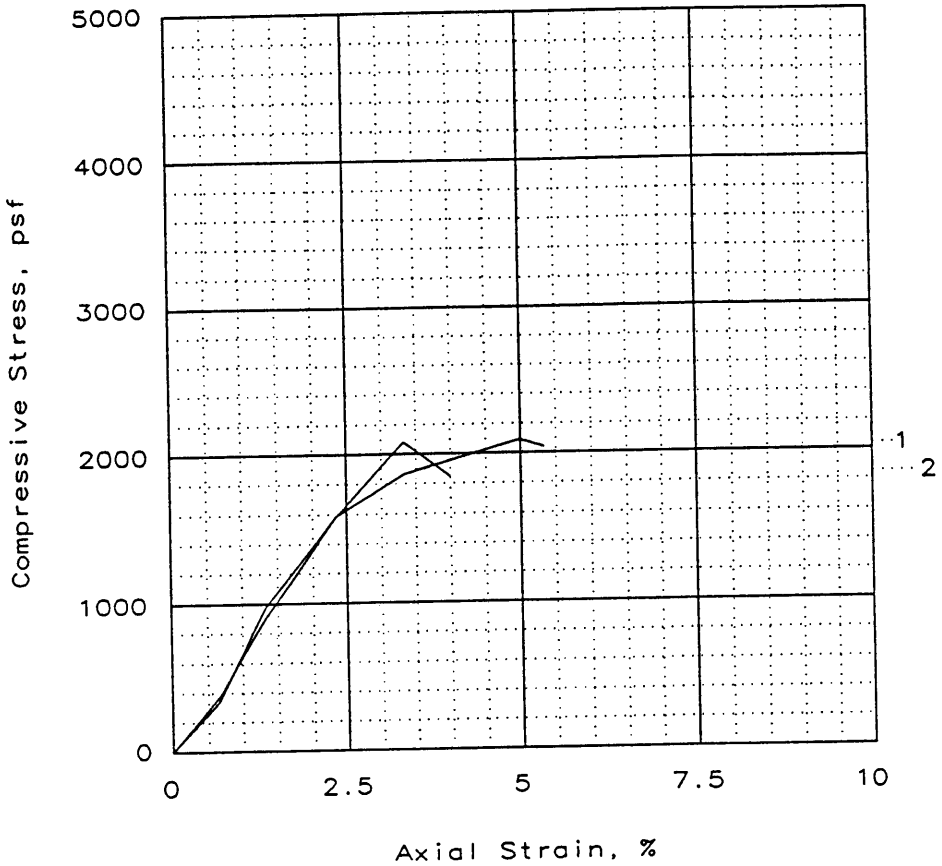
Sample No.: 12

Depth: 39.0 - 41.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2089	2079		
Undrained shear strength, psf	1044	1039		
Rate of strain, %/min				
Water content, %	40.7	38.0		
Void ratio	1.0463	0.9725		
Saturation, %	105.1	105.4		
Dry density, pcf	82.4	85.5		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CH) FAT, LENSES OF SILT

LL = 80	PL = 26	PI = 54.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-30-94

Remarks:

PENETROMETER - 1.75

TORVAN - 0.83

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 5-EAU-94

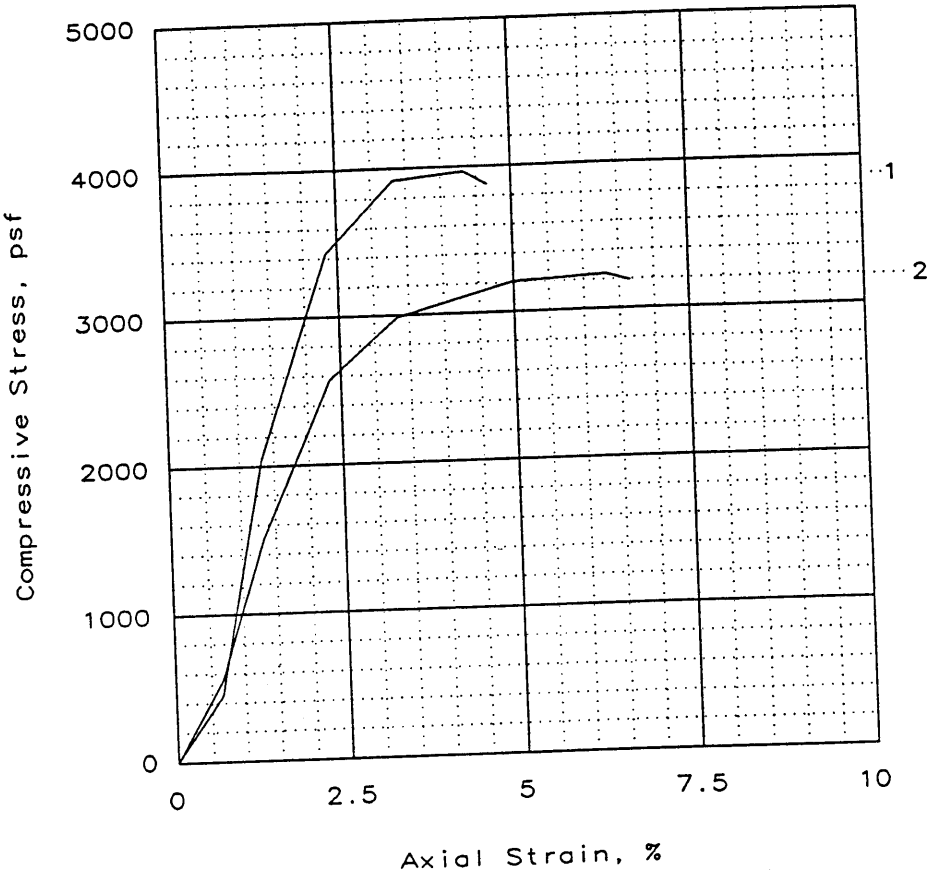
Sample No.: 14

Depth: 49.0 - 51.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3967	3236		
Undrained shear strength, psf	1983	1618		
Rate of strain, %/min				
Water content, %	25.2	25.9		
Void ratio	0.6849	0.7029		
Saturation, %	99.0	99.3		
Dry density, pcf	99.7	98.6		
Specimen diameter, in	1.37	1.39		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CL) SILTY, IRON OXIDE.

LL = 63	PL = 20	PI = 43.0	GS = 2.69	Type: UNDISTURBED

Project No.:

Date: 11-30-94

Remarks:

PENETROMETER - 2.0

TORVAN - 0.75

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 6-EAU-94

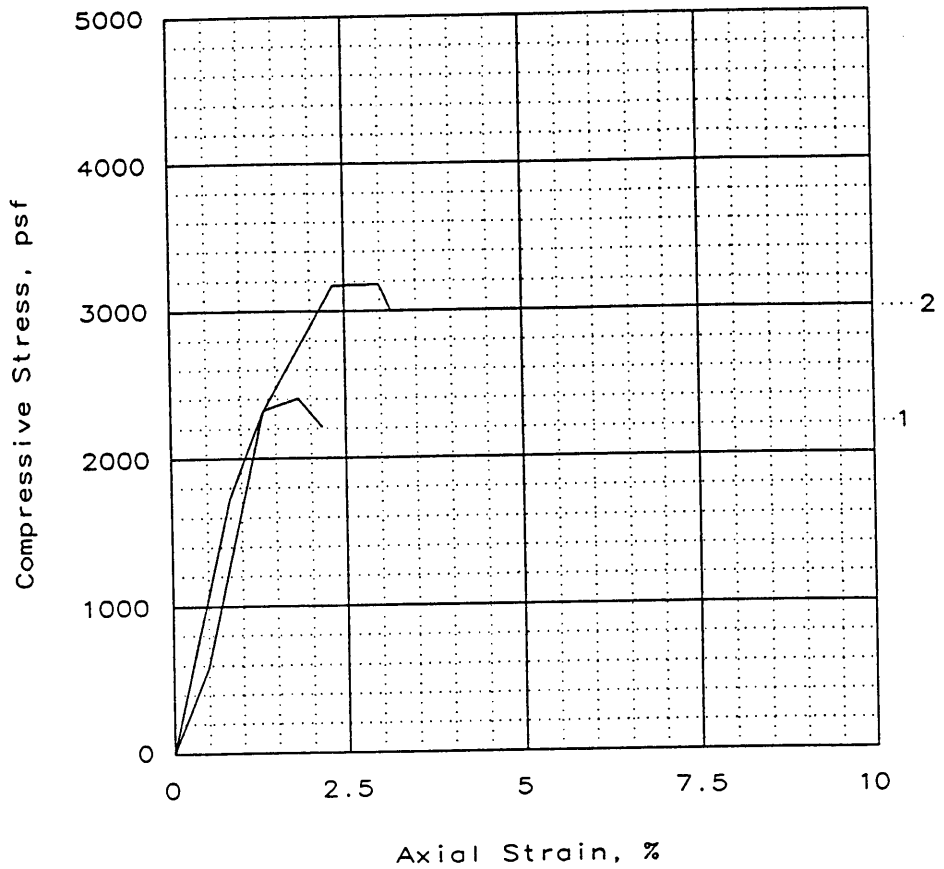
Sample No.: 3

Depth: 6.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2405	3179		
Undrained shear strength, psf	1203	1590		
Rate of strain, %/min				
Water content, %	27.5	28.8		
Void ratio	0.7706	0.7722		
Saturation, %	96.4	100.6		
Dry density, pcf	95.2	95.1		
Specimen diameter, in	1.37	1.40		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 69	PL = 23	PI = 46.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-30-94
Remarks:
PENETROMETER - 2.0
TORVAN - MAX.

Fig No.

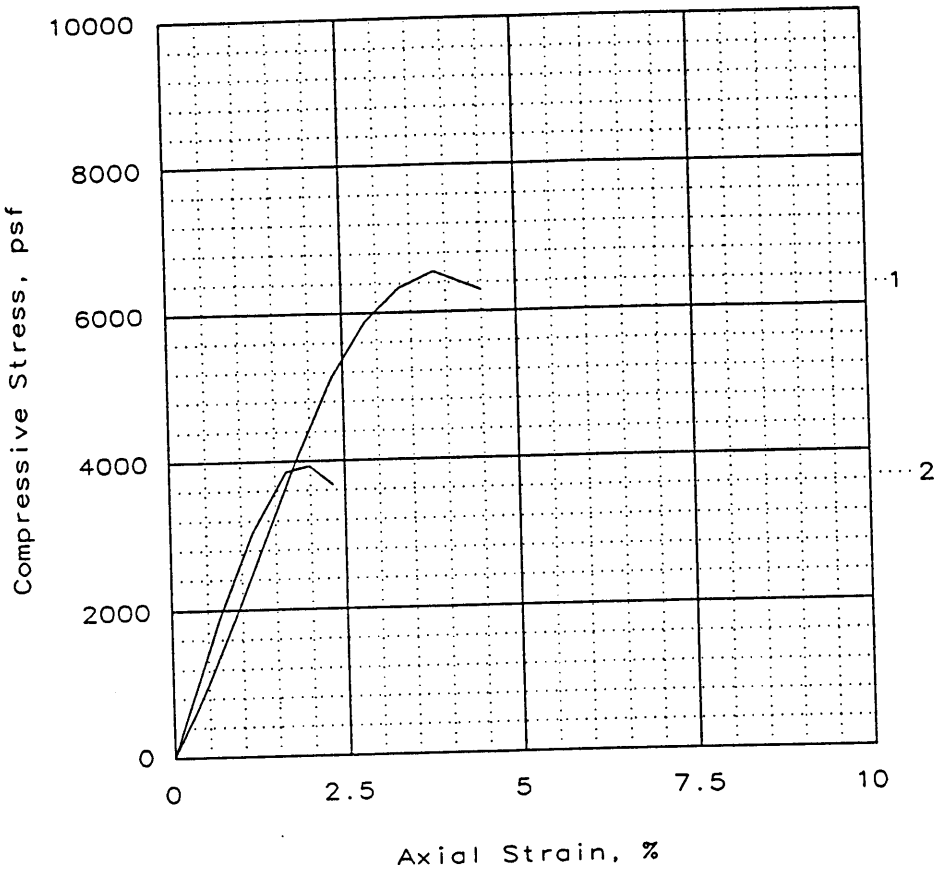
Project: EASTERN ARKANSAS

Boring No.: 6-EAU-94
Sample No.: 4
Depth: 9.0 - 10.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	6554	3929		
Undrained shear strength, psf	3277	1964		
Rate of strain, %/min				
Water content, %	29.3	31.2		
Void ratio	0.7780	0.8063		
Saturation, %	101.8	104.5		
Dry density, pcf	94.8	93.3		
Specimen diameter, in	1.37	1.39		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 58	PL = 24	PI = 34.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-30-94

Remarks:

PENETROMETER - 3.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 6-EAU-94

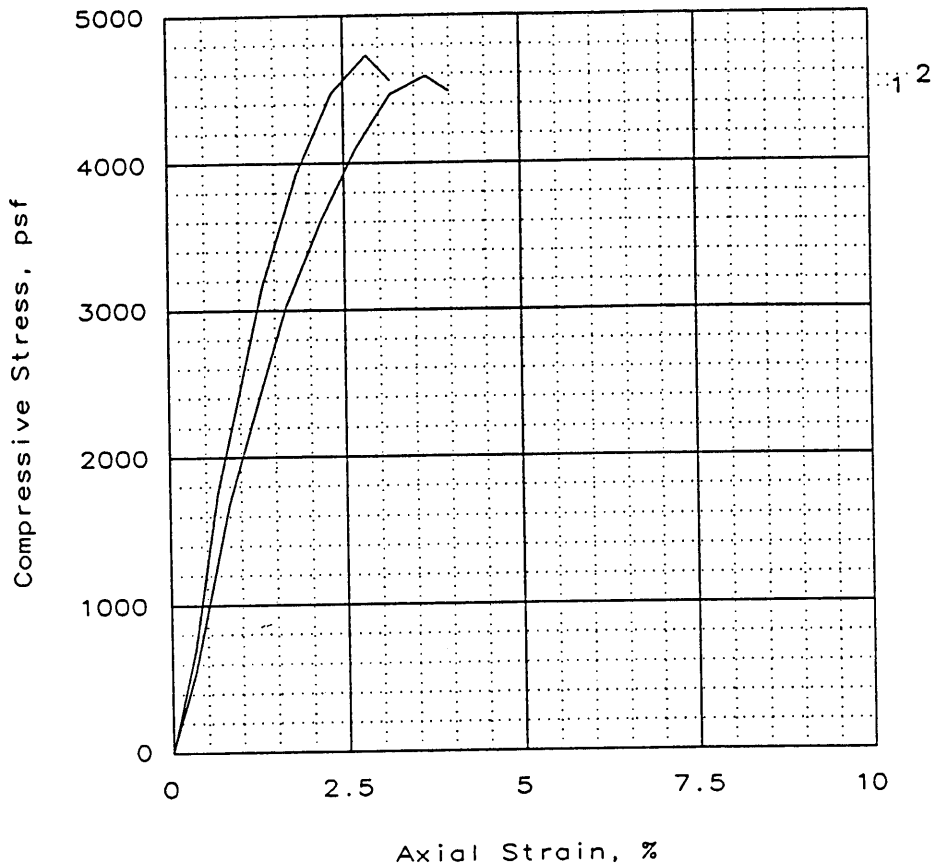
Sample No.: 10

Depth: 29.0 - 31.3

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4584	4727		
Undrained shear strength, psf	2292	2364		
Rate of strain, %/min				
Water content, %	33.5	35.4		
Void ratio	0.8872	0.9221		
Saturation, %	102.0	103.7		
Dry density, pcf	89.3	87.7		
Specimen diameter, in	1.41	1.38		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT LENSES OF SILT

LL = 53	PL = 21	PI = 32.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-30-94
Remarks:
PENETROMETER - 2.25
TORVAN - MAX.

Fig No.

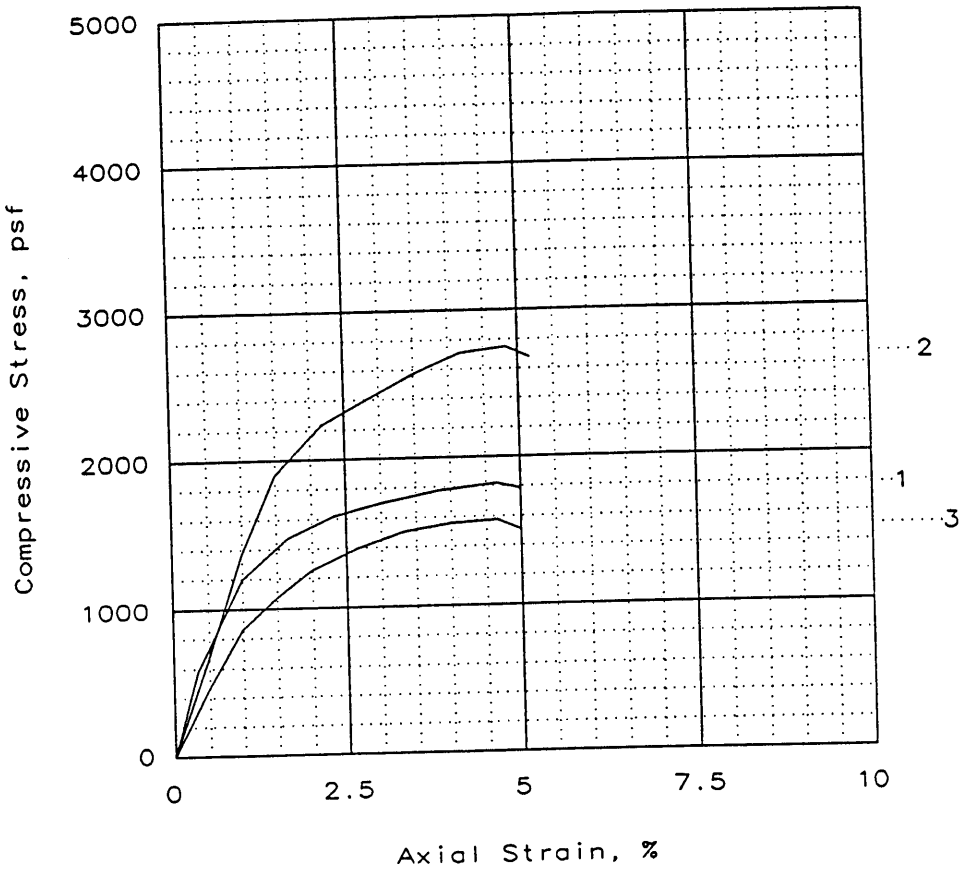
Project: EASTERN ARKANSAS

Boring No.: 6-EAU-94
Sample No.: 11
Depth: 34.0 - 36.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2	3	
Unconfined strength, psf	1823	2749	1576	
Undrained shear strength, psf	911	1375	788	
Rate of strain, %/min				
Water content, %	36.9	36.5	34.7	
Void ratio	0.9544	0.9466	0.9094	
Saturation, %	104.3	104.1	103.2	
Dry density, pcf	86.2	86.6	88.3	
Specimen diameter, in	1.38	1.38	1.40	
Specimen height, in	3.00	3.00	3.00	

Description: GR. CLAY (CH) FAT

LL = 57	PL = 24	PI = 33.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-30-94
Remarks:
PENETROMETER - 1.50
TORVAN - 0.81

Fig No.

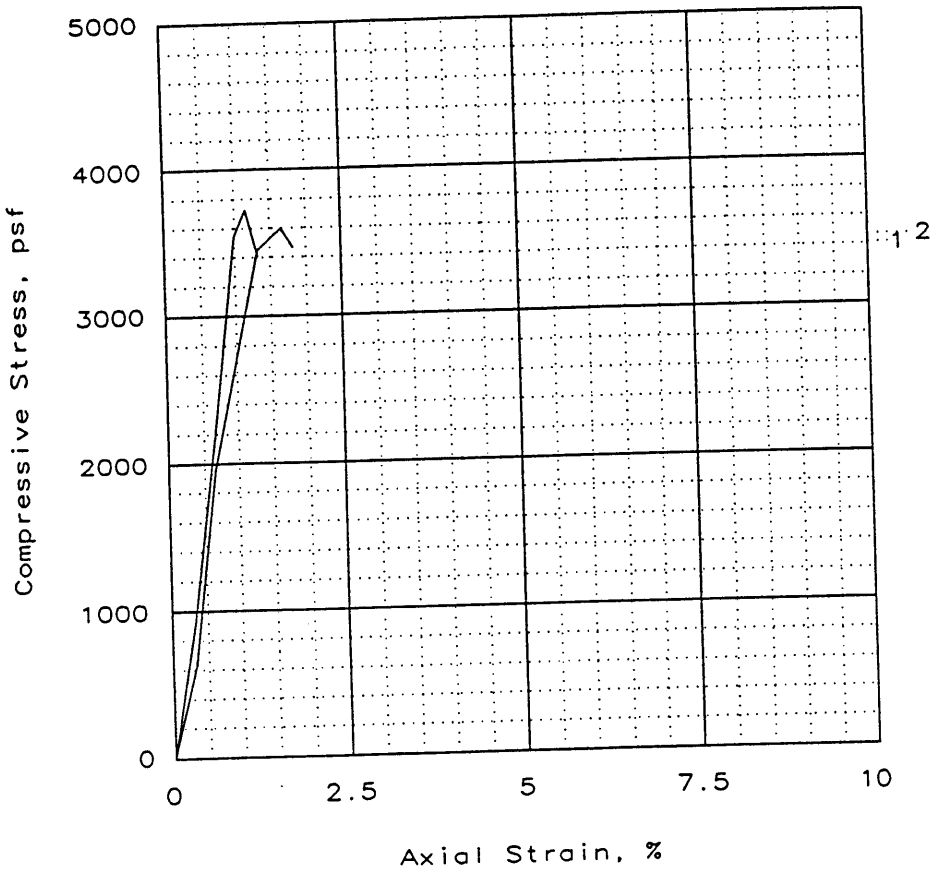
Project: EASTERN ARKANSAS

Boring No.: 6-EAU-94
Sample No.: 13
Depth: 44.0 - 45.7

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3725	3598		
Undrained shear strength, psf	1863	1799		
Rate of strain, %/min				
Water content, %	38.3	38.0		
Void ratio	1.0138	1.0111		
Saturation, %	102.1	101.4		
Dry density, pcf	83.7	83.8		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 78	PL = 26	PI = 52.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-30-94

Remarks:

PENETROMETER - 2.75

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 6-EAU-94

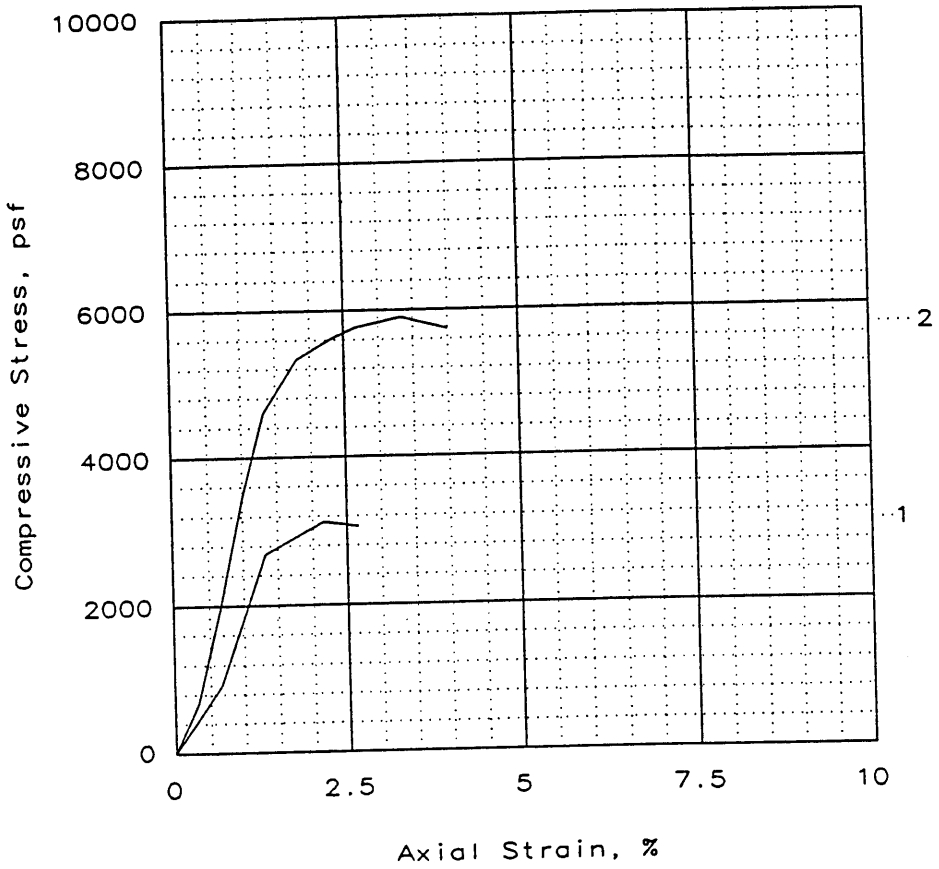
Sample No.: 14

Depth: 50.0 - 51.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3119	5899		
Undrained shear strength, psf	1560	2949		
Rate of strain, %/min				
Water content, %	23.4	22.4		
Void ratio	0.6579	0.6173		
Saturation, %	96.2	97.9		
Dry density, pcf	101.7	104.2		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CH) FAT, IRON OXIDE.

LL = 64	PL = 16	PI = 48.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-30-94

Remarks:
PENETROMETER - 3.25
TORVAN - 3.25
UPPER SAMPLE - BOXED

Fig No.

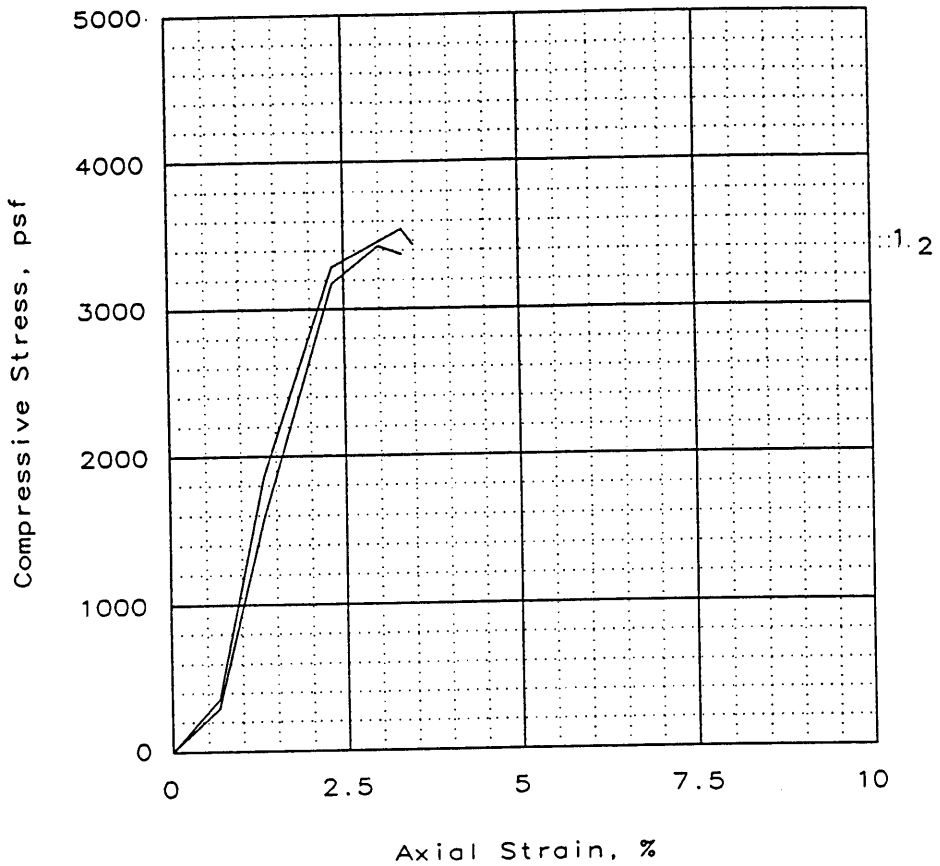
Project: EASTERN ARKANSAS

Boring No.: 7-EAU-94
Sample No.: 3
Depth: 6.2 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3548	3431		
Undrained shear strength, psf	1774	1715		
Rate of strain, %/min				
Water content, %	38.2	38.4		
Void ratio	0.9869	0.9931		
Saturation, %	104.4	104.4		
Dry density, pcf	84.8	84.6		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 89	PL = 25	PI = 64.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-30-94
Remarks:
PENETROMETER - 2.25
TORVAN - MAX.

Fig No.

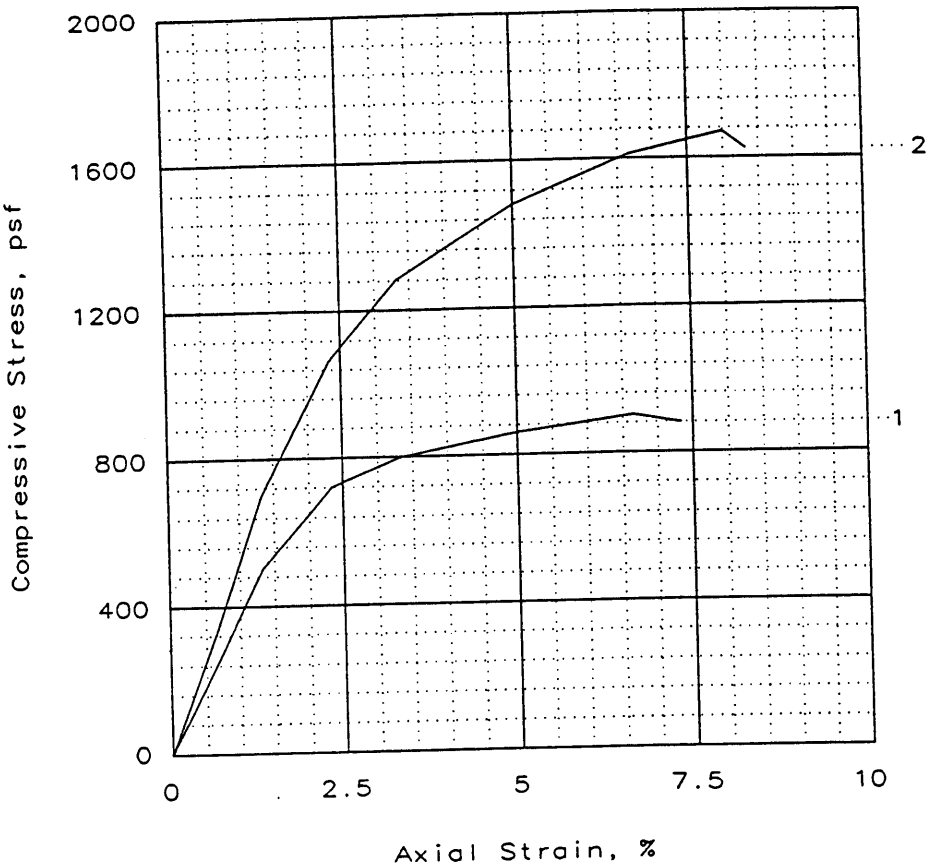
Project: EASTERN ARKANSAS

Boring No.: 7-EAU-94
Sample No.: 14
Depth: 49.0 - 51.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	902	1671		
Undrained shear strength, psf	451	835		
Rate of strain, %/min				
Water content, %	25.1	25.0		
Void ratio	0.7340	0.7348		
Saturation, %	91.8	91.3		
Dry density, pcf	96.5	96.4		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CL) LEAN

LL = 38	PL = 20	PI = 18.0	GS = 2.68	Type: UNDISTURBED

Project No.:

Date: 11-30-94

Remarks:

PENETROMETER - 3.0

TORVAN - MAX.

60.0 TO 60.2 - GR. SILT

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 7-EAU-94

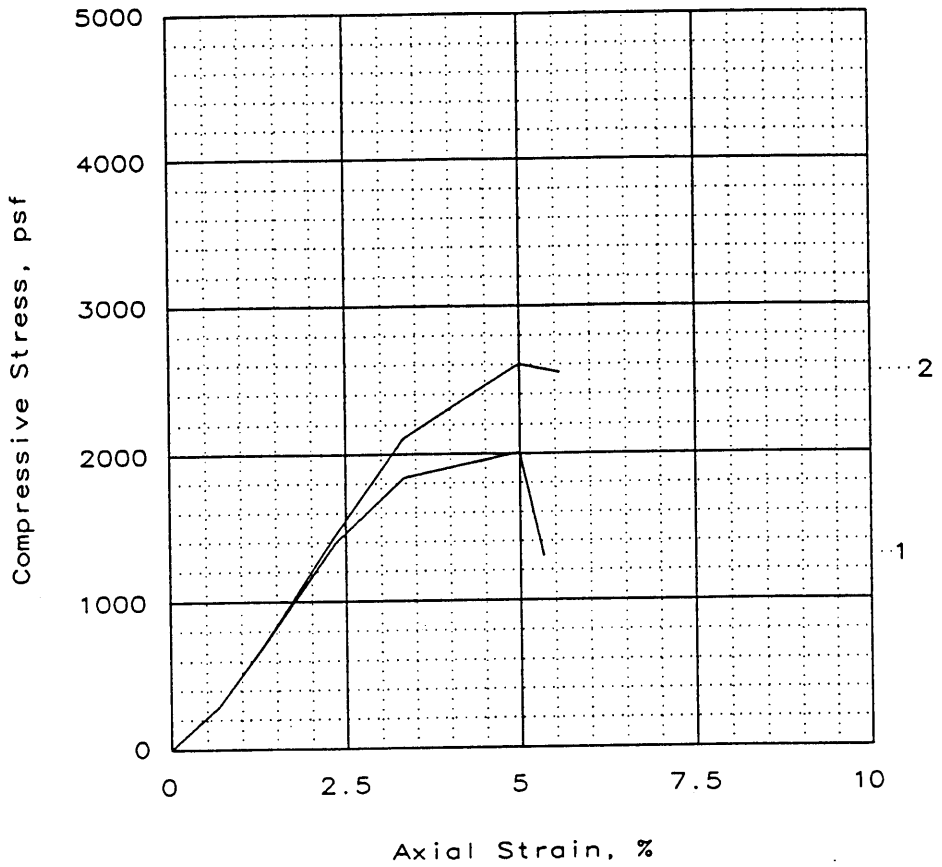
Sample No.: 15

Depth: 59.0 - 60.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2007	2603		
Undrained shear strength, psf	1004	1301		
Rate of strain, %/min				
Water content, %	26.9	25.7		
Void ratio	0.7457	0.6973		
Saturation, %	96.7	98.6		
Dry density, pcf	95.8	98.6		
Specimen diameter, in	1.36	1.36		
Specimen height, in	3.00	3.00		

Description: BR. SILT (ML) LENSES OF CLAY & SILT.

LL = 30	PL = 25	PI = 5.0	GS = 2.68	Type: UNDISTURBED

Project No.:

Date: 11-02-94

Remarks:

PENETROMETER - 1.0

TORVAN - 0.21

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 8-EAU-94

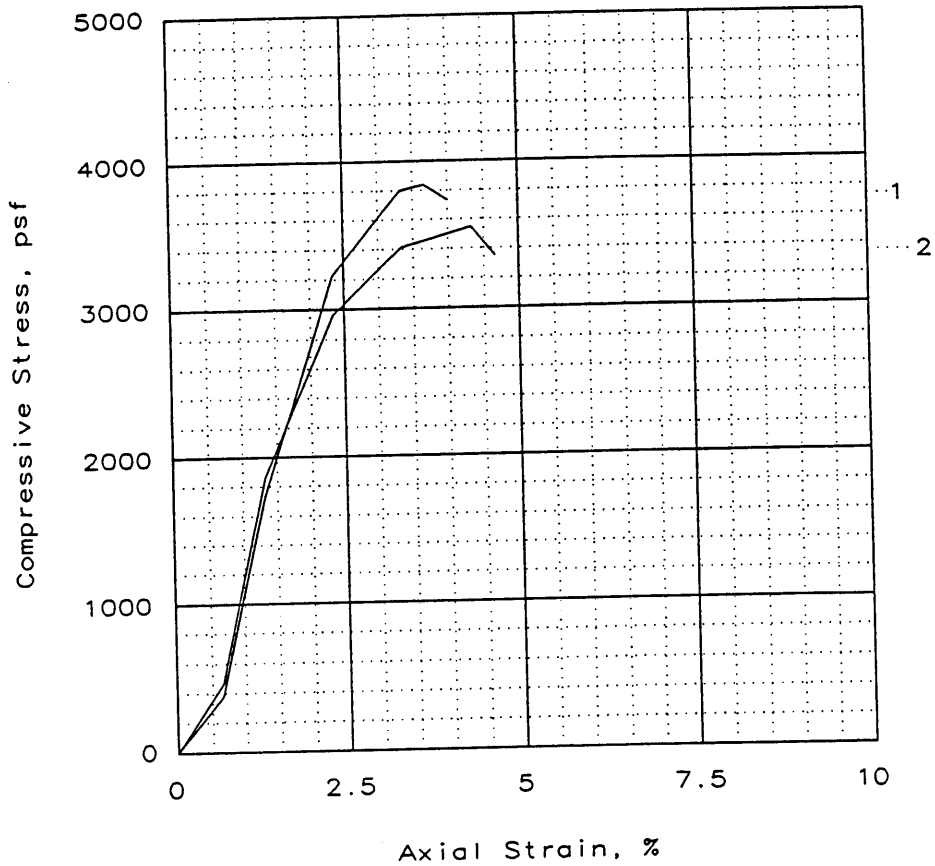
Sample No.: 8

Depth: 20.0 - 21.7

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3837	3545		
Undrained shear strength, psf	1919	1773		
Rate of strain, %/min				
Water content, %	28.8	28.9		
Void ratio	0.7499	0.7673		
Saturation, %	103.9	101.6		
Dry density, pcf	96.3	95.4		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 73	PL = 28	PI = 45.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-02-94

Remarks:

PENETROMETER - 3.75

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 8-EA~~R~~U-94

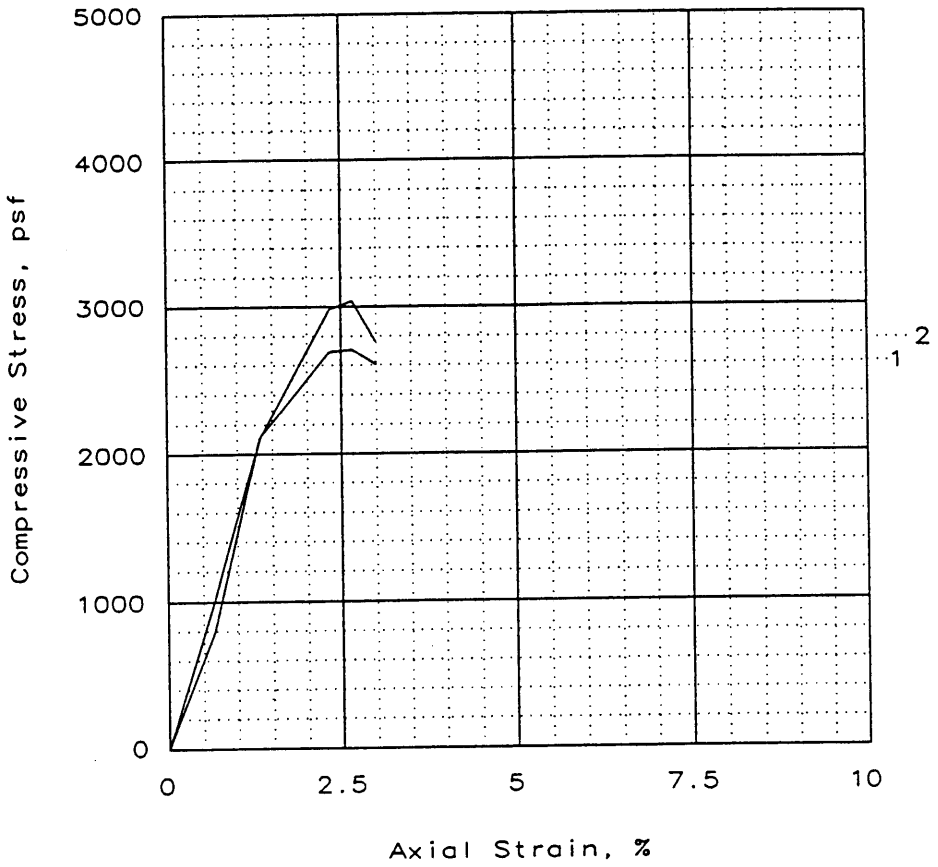
Sample No.: 11

Depth: 34.0 - 36.3

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2706	3039		
Undrained shear strength, psf	1353	1520		
Rate of strain, %/min				
Water content, %	31.8	32.2		
Void ratio	0.8515	0.8535		
Saturation, %	100.8	101.9		
Dry density, pcf	91.0	90.9		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 77	PL = 28	PI = 49.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-02-94
Remarks:
PENETROMETER - MAX.
TORVAN - MAX.

Fig No.

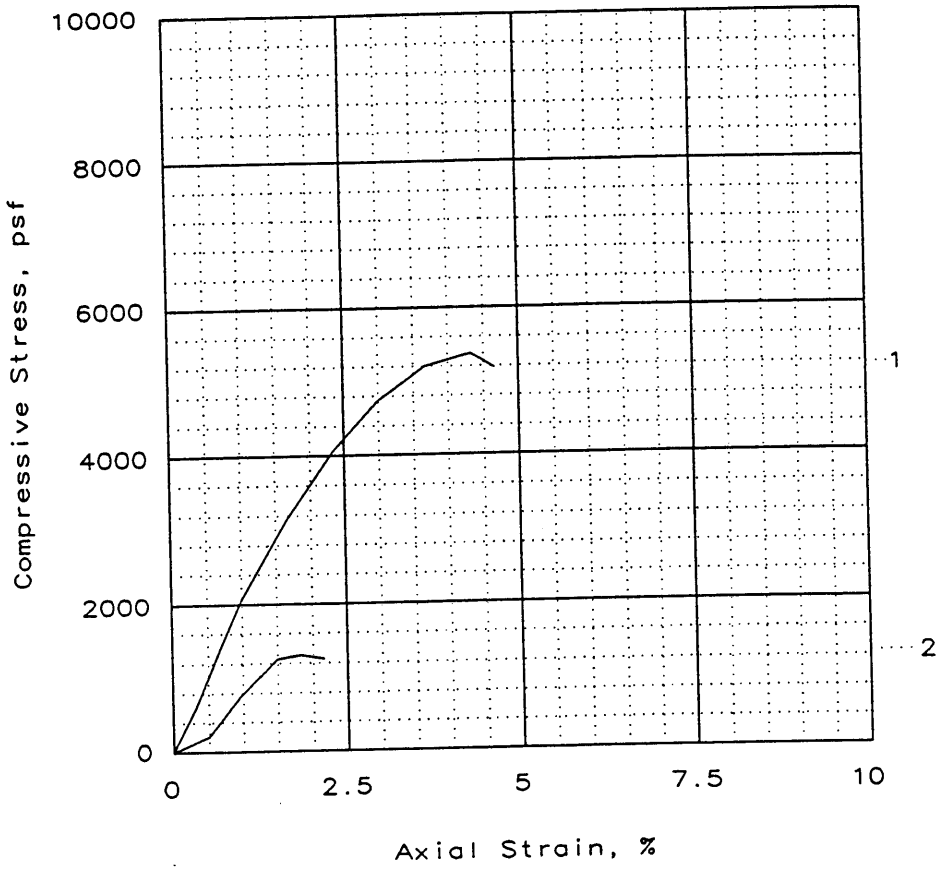
Project: EASTERN ARKANSAS

Boring No.: 8-EAU-94
Sample No.: 13
Depth: 44.0 - 46.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	5373	1305		
Undrained shear strength, psf	2687	653		
Rate of strain, %/min				
Water content, %	25.8	25.0		
Void ratio	0.7056	0.6950		
Saturation, %	98.6	97.2		
Dry density, pcf	98.8	99.4		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 52	PL = 24	PI = 28.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-02-94

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 8-EAU-94

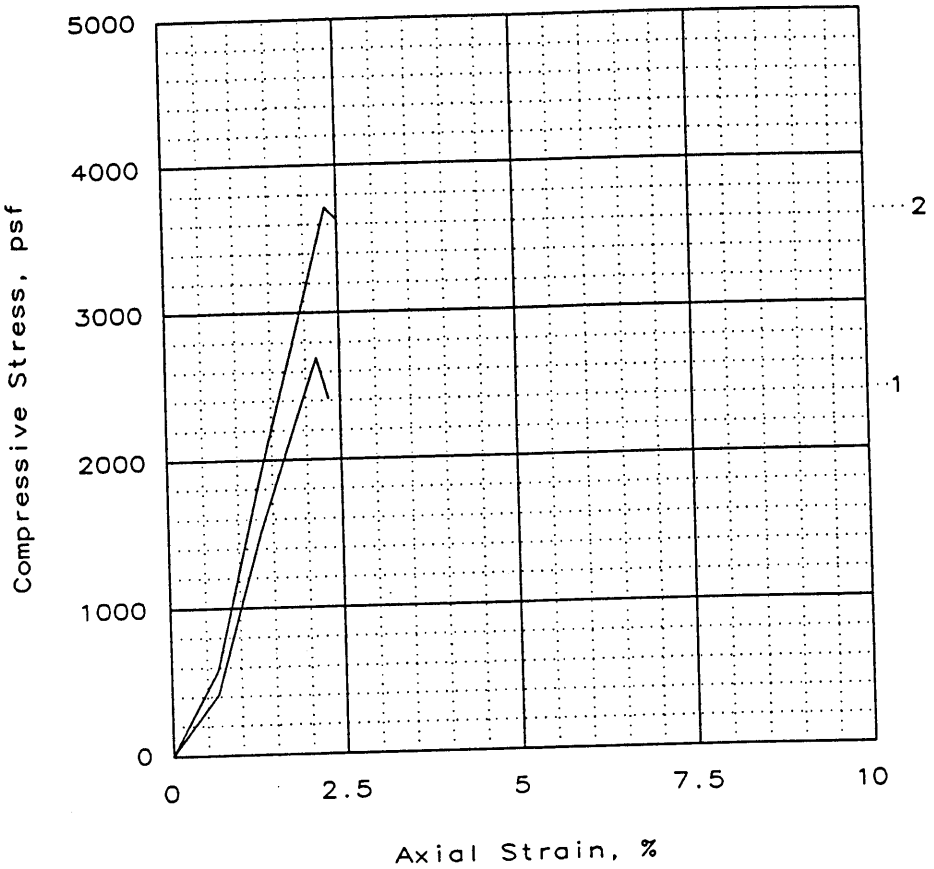
Sample No.: 14

Depth: 49.0 - 51.3

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2696	3716		
Undrained shear strength, psf	1348	1858		
Rate of strain, %/min				
Water content, %	21.1	21.4		
Void ratio	0.6395	0.6359		
Saturation, %	89.0	90.7		
Dry density, pcf	102.8	103.0		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CH) FAT IRON OXIDE, C.C.

LL = 58	PL = 19	PI = 39.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11/01/94

Remarks:

PENETROMETER - 3.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 9-EAU-94

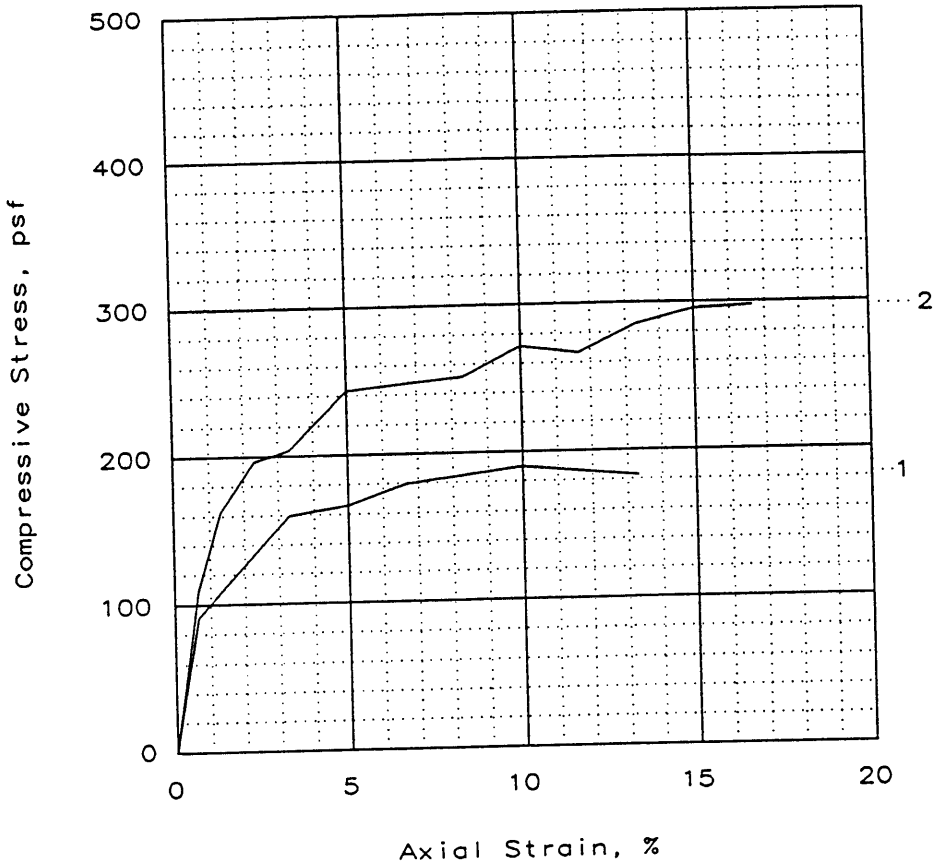
Sample No.: 3

Depth: 7.0 - 9.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	190	297		
Undrained shear strength, psf	95	149		
Rate of strain, %/min				
Water content, %	33.9	34.9		
Void ratio	0.9532	0.9863		
Saturation, %	96.0	95.4		
Dry density, pcf	86.3	84.9		
Specimen diameter, in	1.36	1.36		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 56	PL = 15	PI = 41.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-01-94

Remarks:

PENETROMETER - 0.25

TORVAN - 0.20

BOTTOM OF SAMPLE : RED SILT

AT DEPTH OF 10.7 - 11.9

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 9-EAU-94

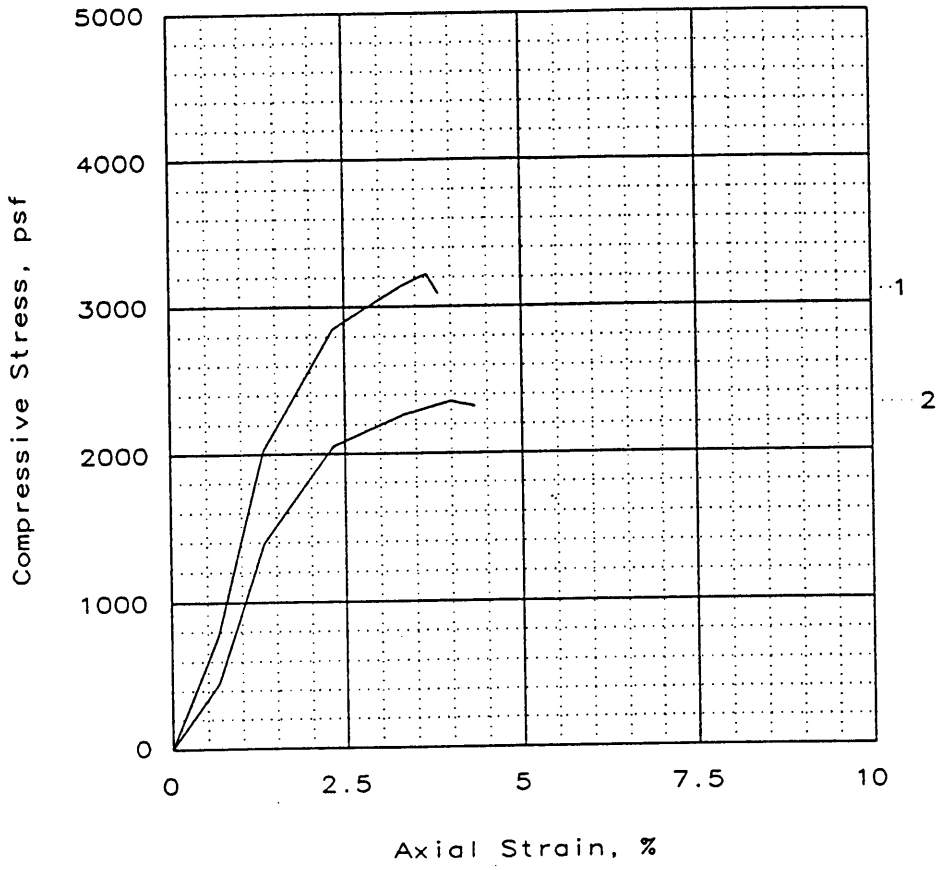
Sample No.: 4

Depth: 10.0 - 10.7

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3223	2354		
Undrained shear strength, psf	1612	1177		
Rate of strain, %/min				
Water content, %	32.0	33.6		
Void ratio	0.8536	0.8867		
Saturation, %	101.1	102.2		
Dry density, pcf	90.9	89.3		
Specimen diameter, in	1.38	1.37		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 75	PL = 28	PI = 47.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-30-94

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 9A-EAU-94

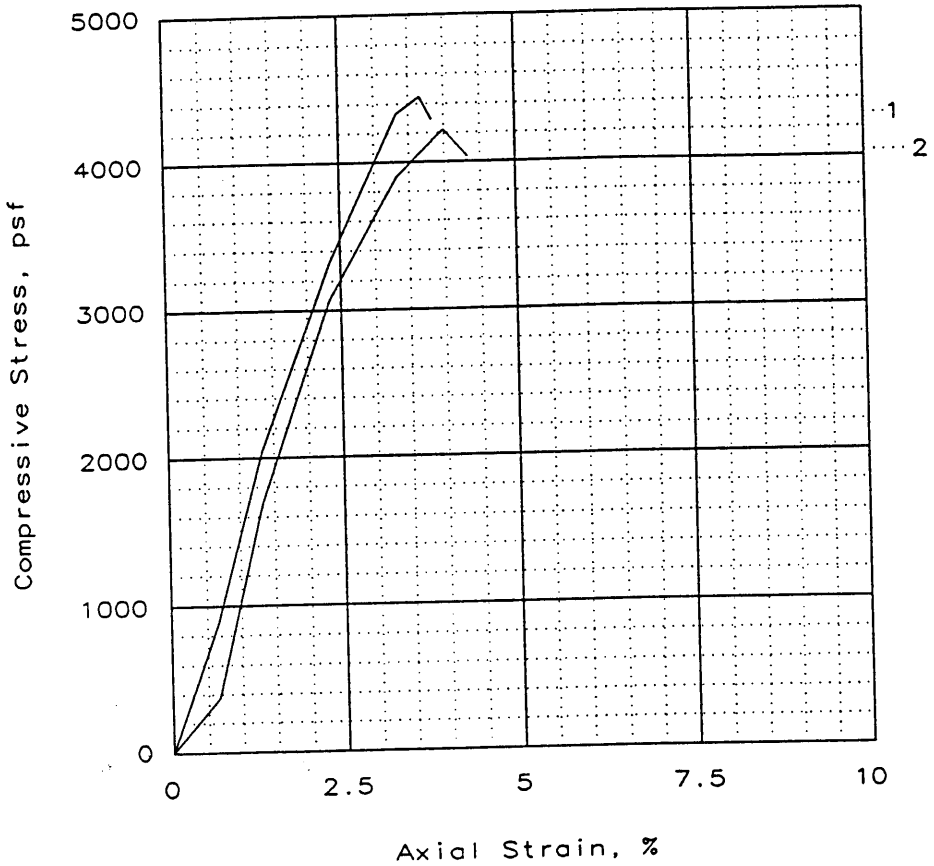
Sample No.: 11

Depth: 39.0 - 41.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4446	4221		
Undrained shear strength, psf	2223	2111		
Rate of strain, %/min				
Water content, %	39.1	39.7		
Void ratio	1.0193	1.0401		
Saturation, %	103.6	103.1		
Dry density, pcf	83.5	82.6		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 86	PL = 28	PI = 58.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-30-94

Remarks:

PENETROMETER - 2.5

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 9A-EAU-94

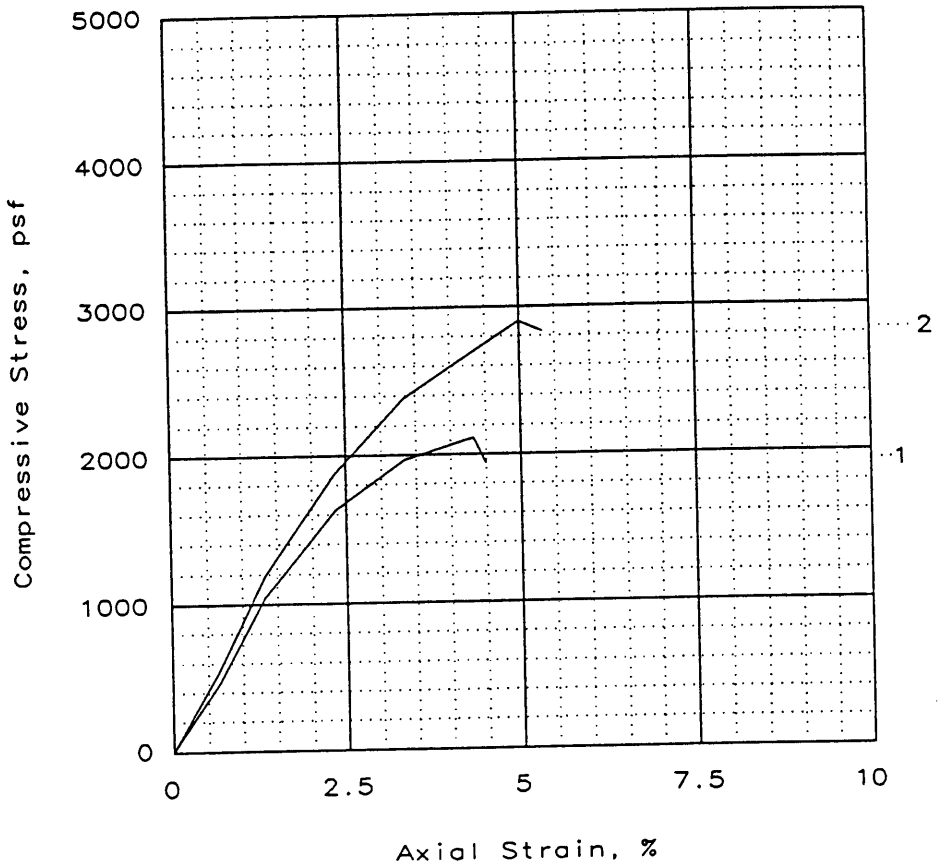
Sample No.: 12

Depth: 44.0 - 46.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2112	2899		
Undrained shear strength, psf	1056	1450		
Rate of strain, %/min				
Water content, %	37.4	38.3		
Void ratio	1.0263	1.0316		
Saturation, %	98.3	100.1		
Dry density, pcf	83.2	83.0		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 84	PL = 31	PI = 53.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-30-94
Remarks:
PENETROMETER - 1.75
TORVAN - MAX.

Fig No.

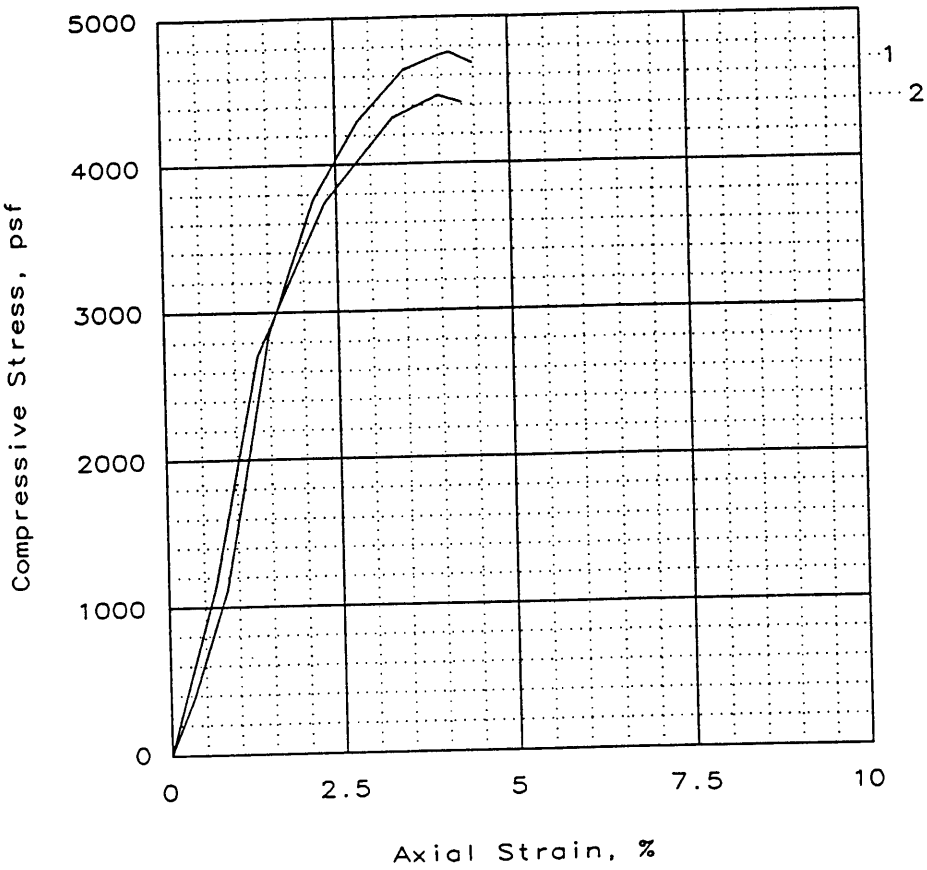
Project: EASTERN ARKANSAS

Boring No.: 9A-EAU-94
Sample No.: 13
Depth: 49.0 - 50.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4761	4465		
Undrained shear strength, psf	2381	2232		
Rate of strain, %/min				
Water content, %	30.6	30.4		
Void ratio	0.7832	0.7820		
Saturation, %	105.4	104.8		
Dry density, pcf	94.5	94.6		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT LENSES OF SILT.

LL = 65	PL = 25	PI = 40.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-30-94

Remarks:

PENETROMETER - 2.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 9A-EAU-94

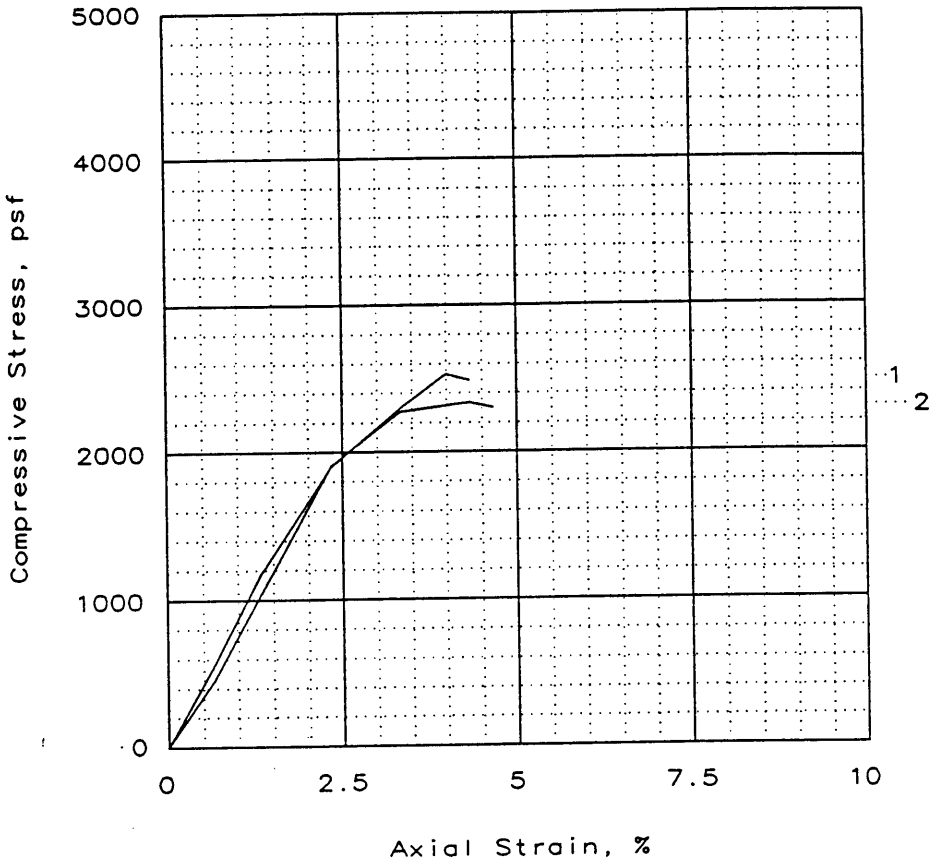
Sample No.: 14

Depth: 59.0 - 60.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2530	2334		
Undrained shear strength, psf	1265	1167		
Rate of strain, %/min				
Water content, %	23.6	23.4		
Void ratio	0.6778	0.6985		
Saturation, %	94.0	90.4		
Dry density, pcf	100.5	99.2		
Specimen diameter, in	1.37	1.38		
Specimen height, in	3.00	3.00		

Description: GR CLAY (CH) FAT

LL = 50	PL = 17	PI = 33.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-13-95

Remarks:

PENETROMETER - 2.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 10-EAU-94

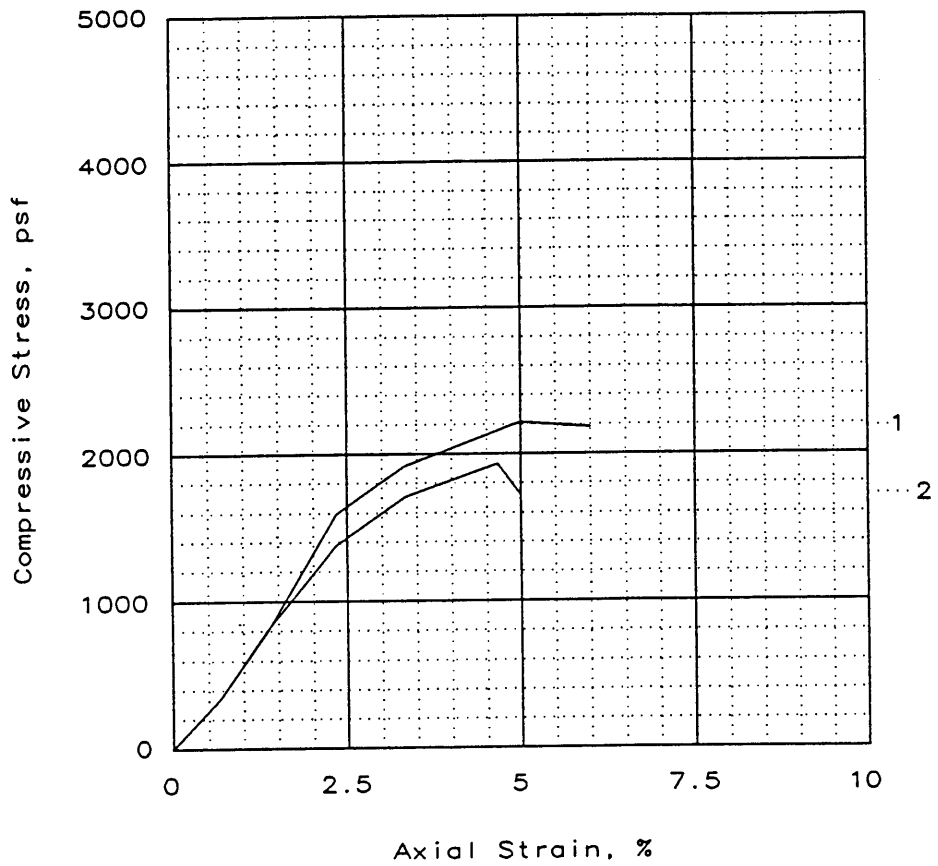
Sample No.: 3

Depth: 5.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2212	1931		
Undrained shear strength, psf	1106	965		
Rate of strain, %/min				
Water content, %	27.5	25.6		
Void ratio	0.7722	0.7357		
Saturation, %	96.3	94.1		
Dry density, pcf	95.1	97.1		
Specimen diameter, in	1.37	1.38		
Specimen height, in	3.00	3.00		

Description: RD & GR CLAY (CH) FAT. C.C.

LL = 55	PL = 20	PI = 35.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-13-95

Remarks:

PENETROMETER - 2.5

TORVAN - MAX.

UPPER SAMPLE - BOXED

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 10-EAU-94

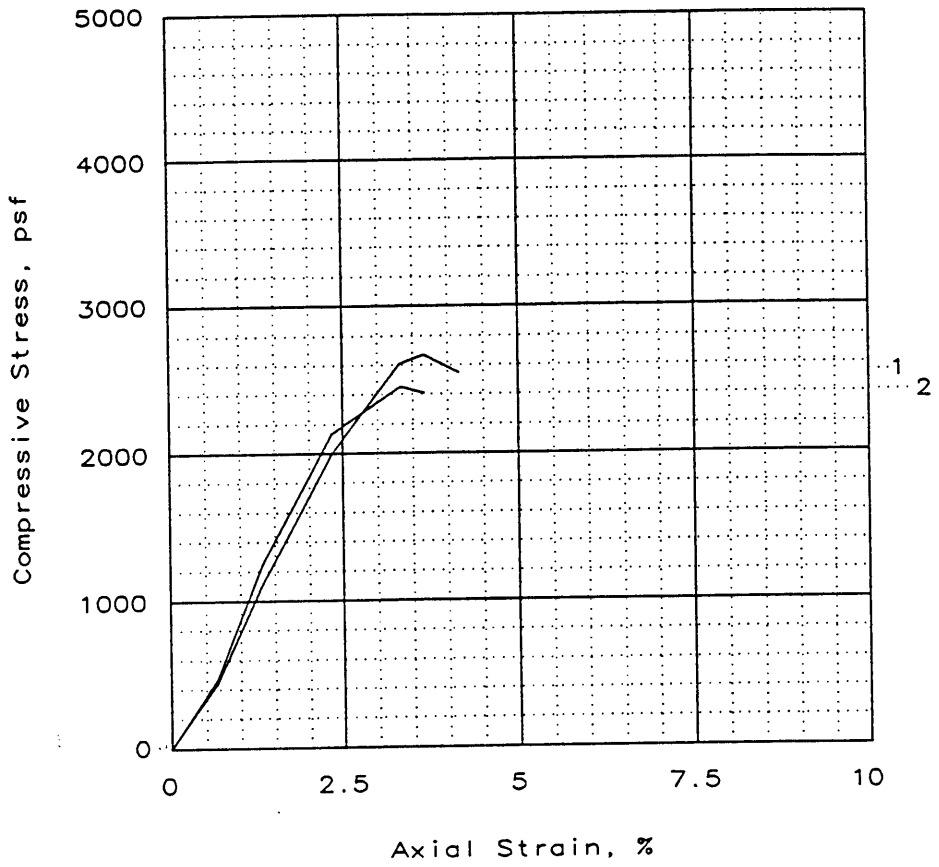
Sample No.: 4

Depth: 9.0 - 10.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2671	2451		
Undrained shear strength, psf	1335	1226		
Rate of strain, %/min				
Water content, %	25.5	26.5		
Void ratio	0.6803	0.7186		
Saturation, %	101.3	99.6		
Dry density, pcf	100.3	98.1		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD CLAY (CH) FAT

LL = 56	PL = 21	PI = 35.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-13-95

Remarks:

PENETROMETER - 2.75

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 10-EAU-94

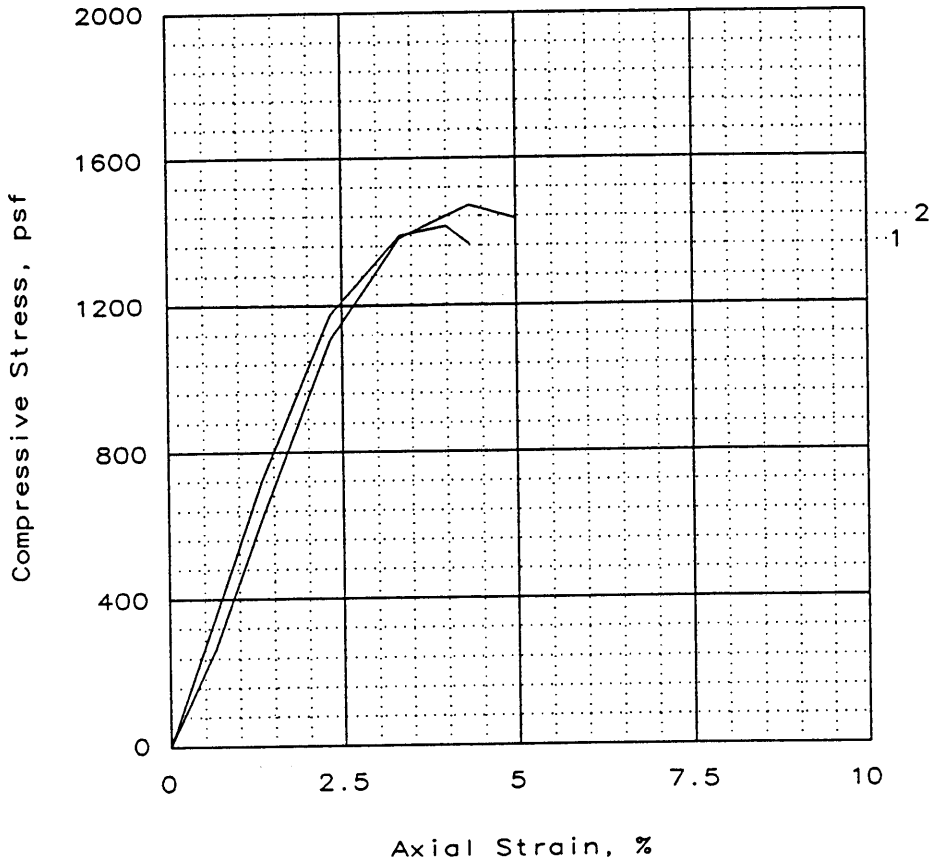
Sample No.: 6

Depth: 14.0 - 16.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1413	1470		
Undrained shear strength, psf	707	735		
Rate of strain, %/min				
Water content, %	28.2	27.4		
Void ratio	0.7535	0.7220		
Saturation, %	100.6	102.2		
Dry density, pcf	95.8	97.5		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD CLAY (CL) SILTY LENSES OF SILT

LL = 48	PL = 25	PI = 23.0	GS = 2.69	Type: UNDISTURBED

Project No.:

Date: 01-13-95

Remarks:

PENETROMETER - 1.75

TORVAN - 0.57

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 10-EAU-94

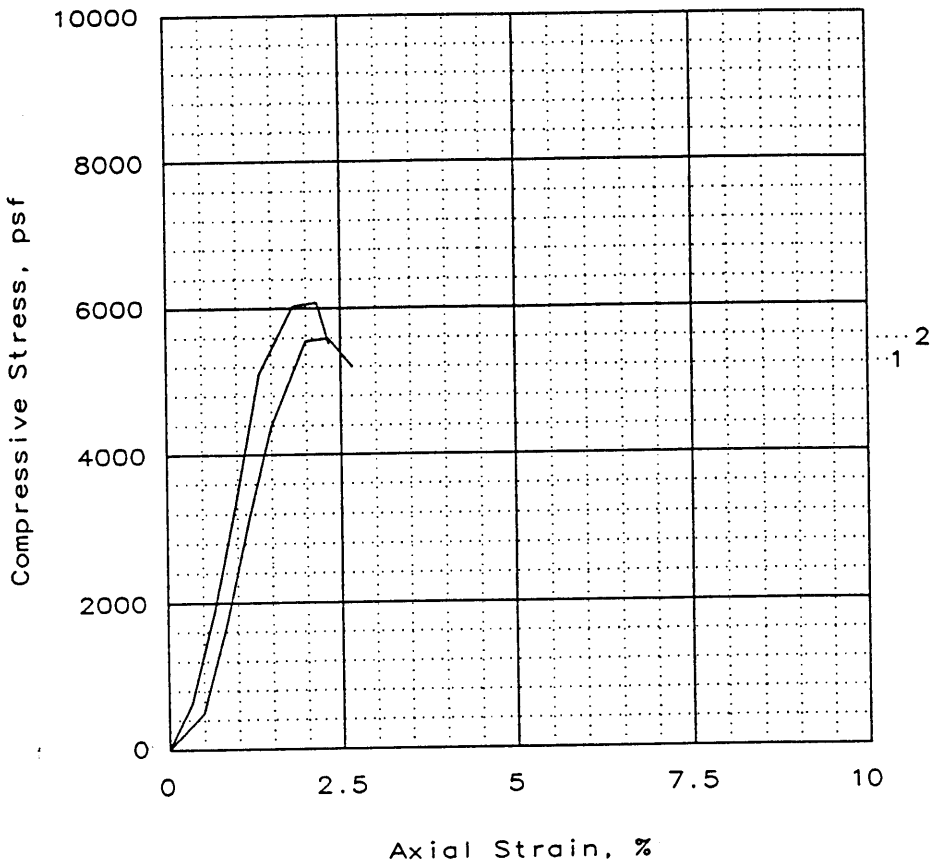
Sample No.: 7

Depth: 17.0 - 19.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	5588	6076		
Undrained shear strength, psf	2794	3038		
Rate of strain, %/min				
Water content, %	24.2	25.1		
Void ratio	0.7410	0.6769		
Saturation, %	88.1	100.1		
Dry density, pcf	96.8	100.5		
Specimen diameter, in	1.40	1.39		
Specimen height, in	3.00	3.00		

Description: BR & RD. CLAY (CH) FAT, SLICKENSIDE.

LL = 80	PL = 25	PI = 55.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 01-12-95
Remarks:
PENETROMETER - 2.50
TORVAN - MAX.

Fig No.

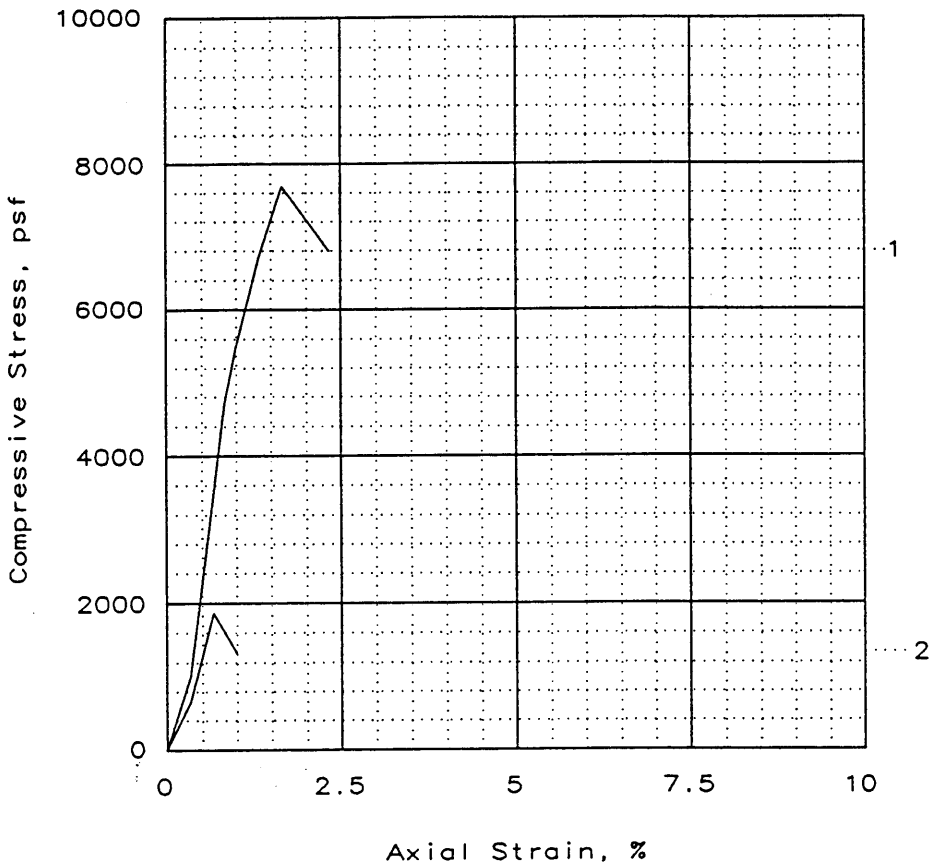
Project: EASTERN ARKANSAS

Boring No.: 11-EAU-95
Sample No.: 5
Depth: 12.0 - 13.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	7684	1869		
Undrained shear strength, psf	3842	935		
Rate of strain, %/min				
Water content, %	29.2	28.9		
Void ratio	0.7462	0.7457		
Saturation, %	105.6	104.5		
Dry density, pcf	96.5	96.6		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 93	PL = 26	PI = 67.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 01-12-95
Remarks:
PENETROMETER - 4.25
TORVAN - MAX.
ONLY TWO SAMPLES

Fig No.

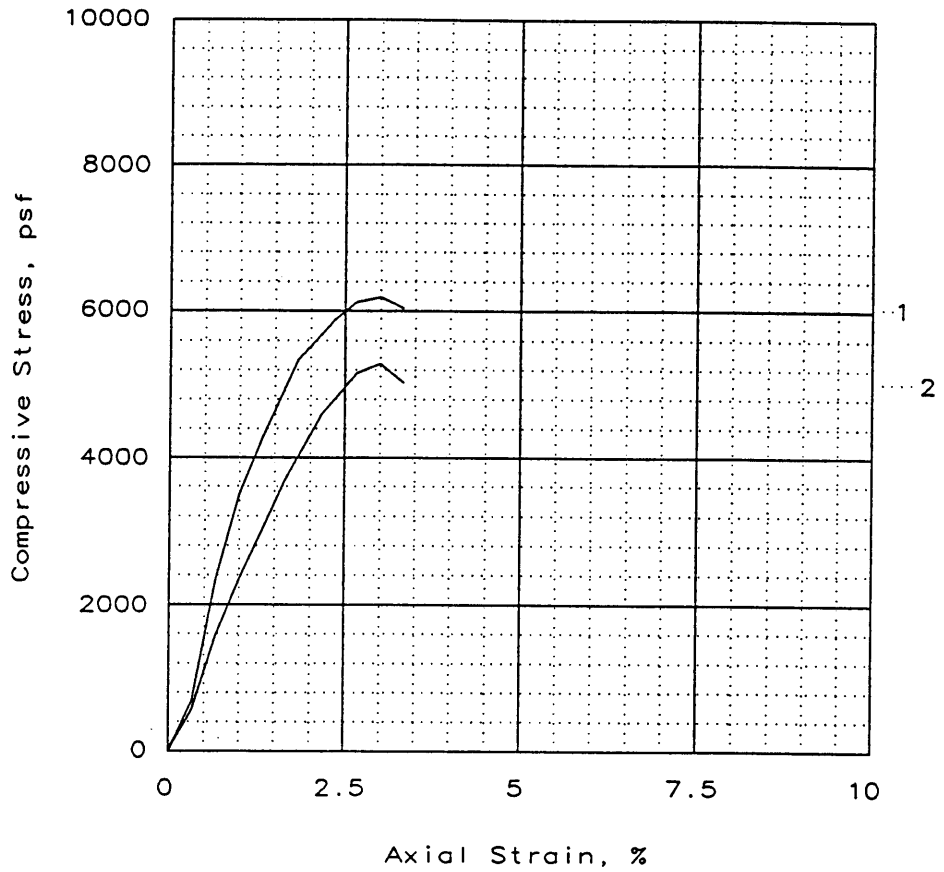
Project: EASTERN ARKANSAS

Boring No.: 11-EAU-94
Sample No.: 7
Depth: 17.0 - 19.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	6185	5286		
Undrained shear strength, psf	3092	2643		
Rate of strain, %/min				
Water content, %	27.3	27.6		
Void ratio	0.7349	0.7681		
Saturation, %	100.3	97.0		
Dry density, pcf	97.2	95.3		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT SLICKENSIDE.

LL = 95	PL = 28	PI = 67.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 01-12-95
Remarks:
PENETROMETER - 4.0
TORVAN - MAX.

Fig No.

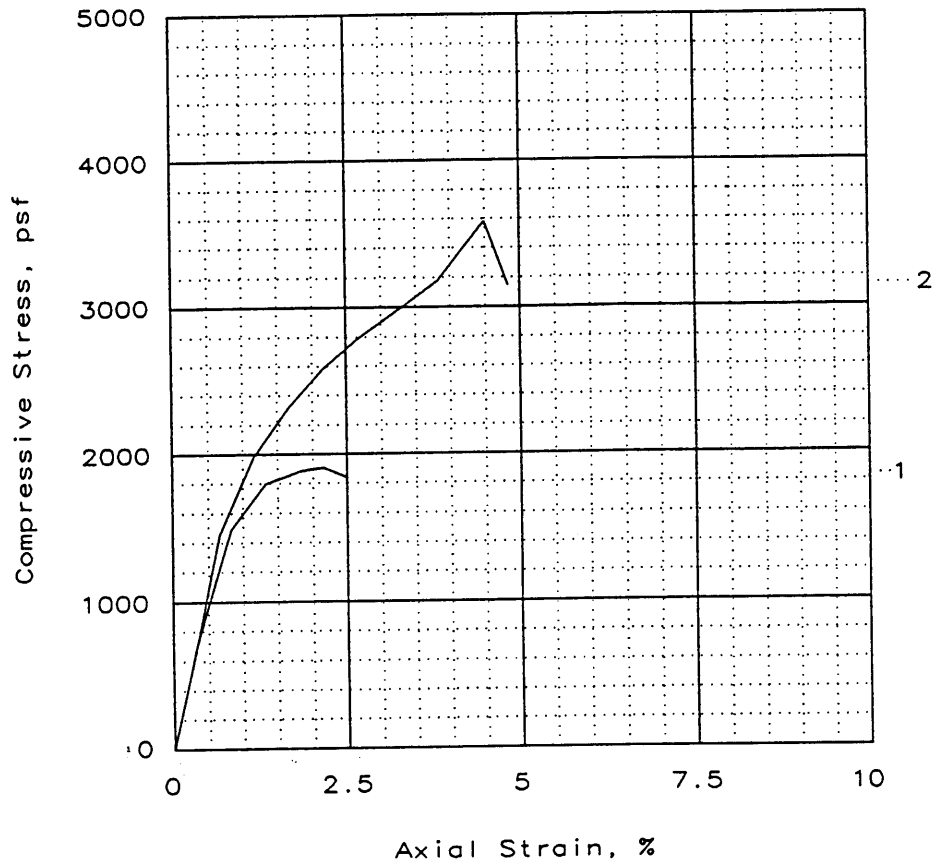
Project: EASTERN ARKANSAS

Boring No.: 11-EAU-94
Sample No.: 9
Depth: 24.0 - 26.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1907	3581		
Undrained shear strength, psf	954	1790		
Rate of strain, %/min				
Water content, %	31.0	30.6		
Void ratio	0.8739	0.8427		
Saturation, %	95.7	98.1		
Dry density, pcf	89.9	91.5		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD CLAY (CH) FAT

LL = 77	PL = 26	PI = 51.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-12-94

Remarks:

PENETROMETER - 3.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 11-EAU-94

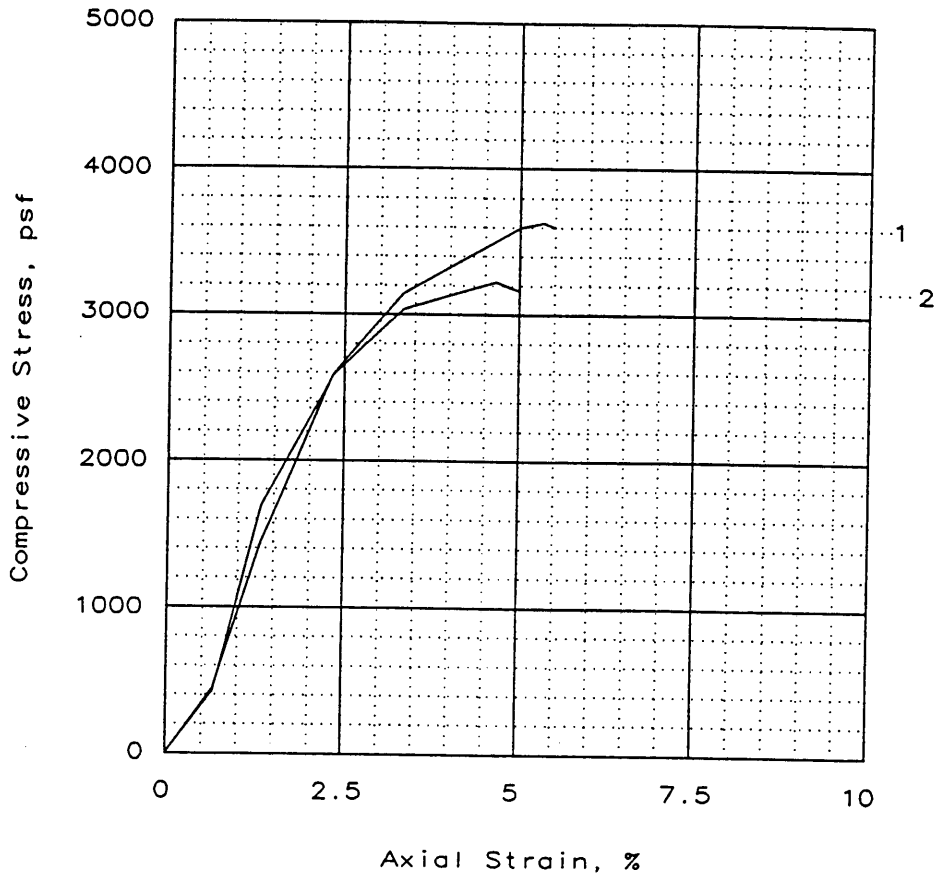
Sample No.: 11

Depth: 34.0 - 36.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3633	3225		
Undrained shear strength, psf	1817	1612		
Rate of strain, %/min				
Water content, %	41.0	40.1		
Void ratio	1.0202	1.0282		
Saturation, %	108.6	105.4		
Dry density, pcf	83.4	83.1		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD & GR CLAY (CH) FAT

LL = 81	PL = 24	PI = 57.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-12-95

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 11-EAU-94

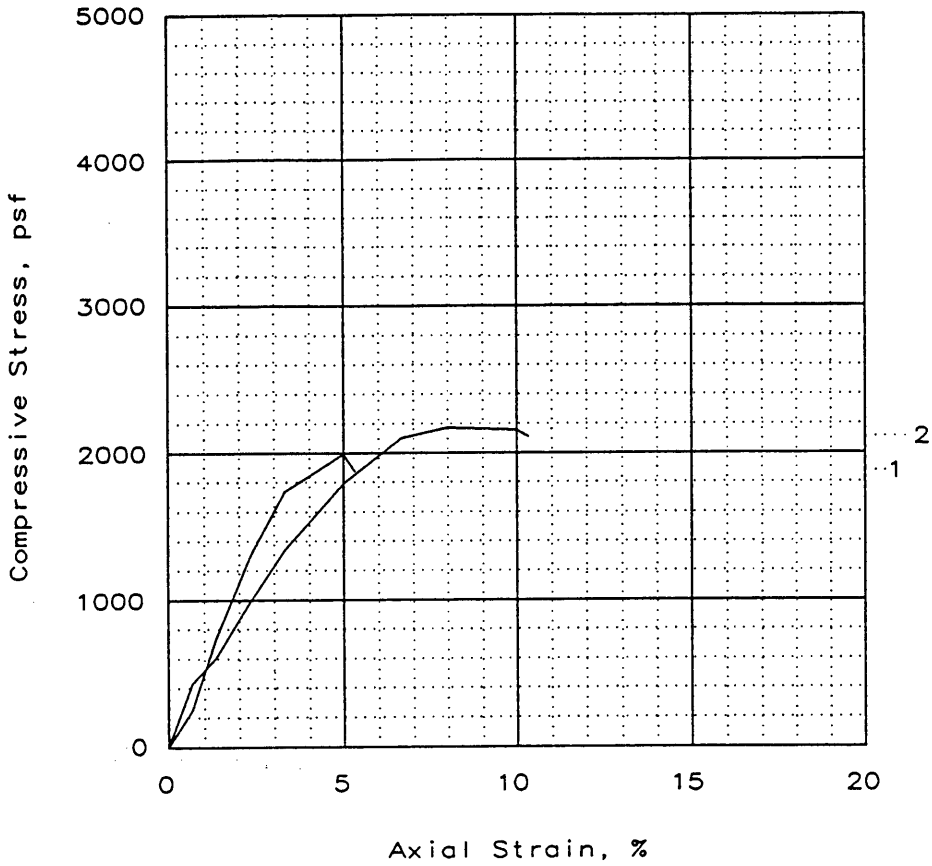
Sample No.: 13

Depth: 44.0 - 46.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1992	2171		
Undrained shear strength, psf	996	1086		
Rate of strain, %/min				
Water content, %	23.8	27.3		
Void ratio	0.7119	0.7321		
Saturation, %	90.3	100.6		
Dry density, pcf	98.5	97.3		
Specimen diameter, in	1.37	1.38		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CL) LEAN LENSES OF SILT.

LL = 30	PL = 21	PI = 9.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-12-95

Remarks:

PENETROMETER - 1.50

TORVAN - 0.55

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 11-EAU-94

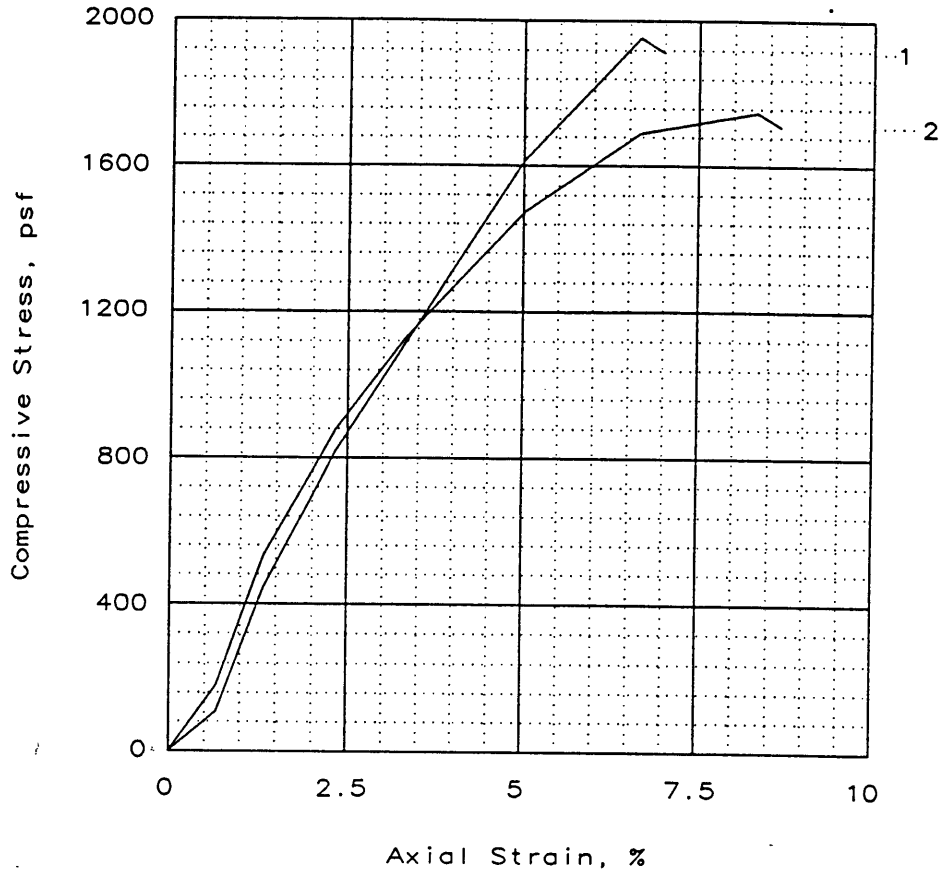
Sample No.: 14

Depth: 49.0 - 50.7

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1955	1749		
Undrained shear strength, psf	977	875		
Rate of strain, %/min				
Water content, %	21.7	22.0		
Void ratio	0.5555	0.5901		
Saturation, %	104.6	99.7		
Dry density, pcf	107.6	105.2		
Specimen diameter, in	1.37	1.37		
Specimen height, in	3.00	3.00		

Description: BR CLAY (CL) LEAN LENSES OF SILT

LL = 37	PL = 22	PI = 15.0	GS = 2.68	Type: UNDISTURBED

Project No.:
Date: 01-12-95
Remarks:
PENETROMETER - 1.0
TORVAN - 0.60

Fig No.

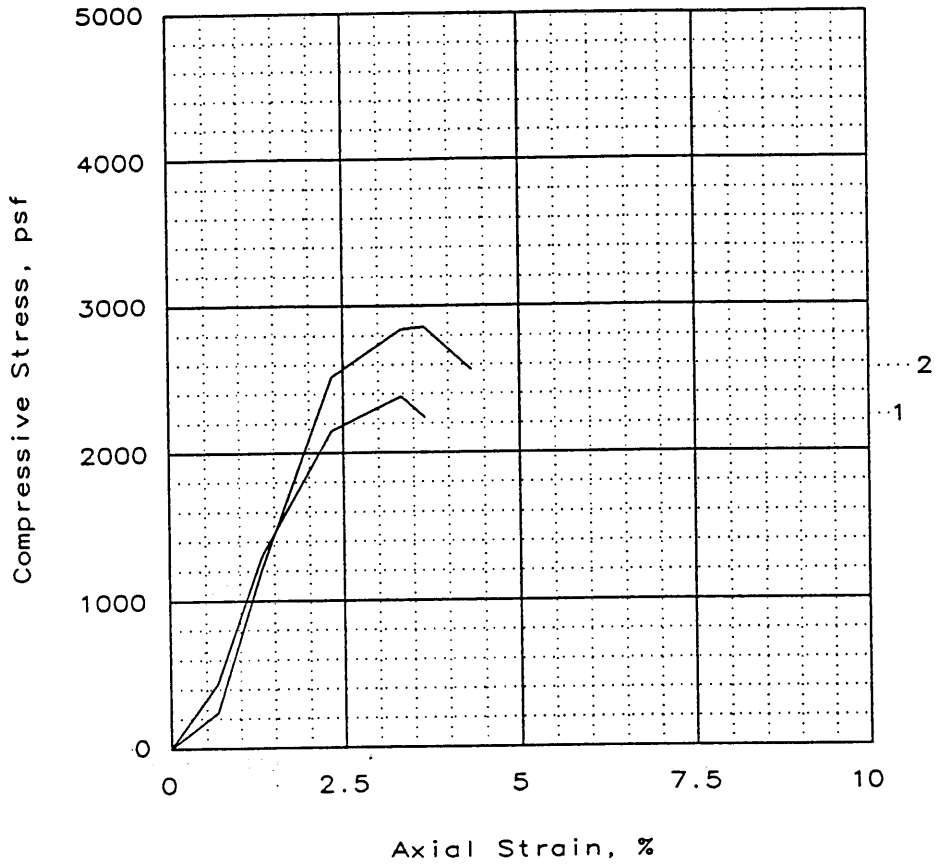
Project: EASTERN ARKANSAS

Boring No.: 11-EAU-94
Sample No.: 15
Depth: 59.0 - 61.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2382	2858		
Undrained shear strength, psf	1191	1429		
Rate of strain, %/min				
Water content, %	32.8	33.3		
Void ratio	0.9076	0.8994		
Saturation, %	97.5	100.0		
Dry density, pcf	88.4	88.7		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT LENSES OF SILT

LL = 63	PL = 23	PI = 40.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-02-94

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 12-EAU-94

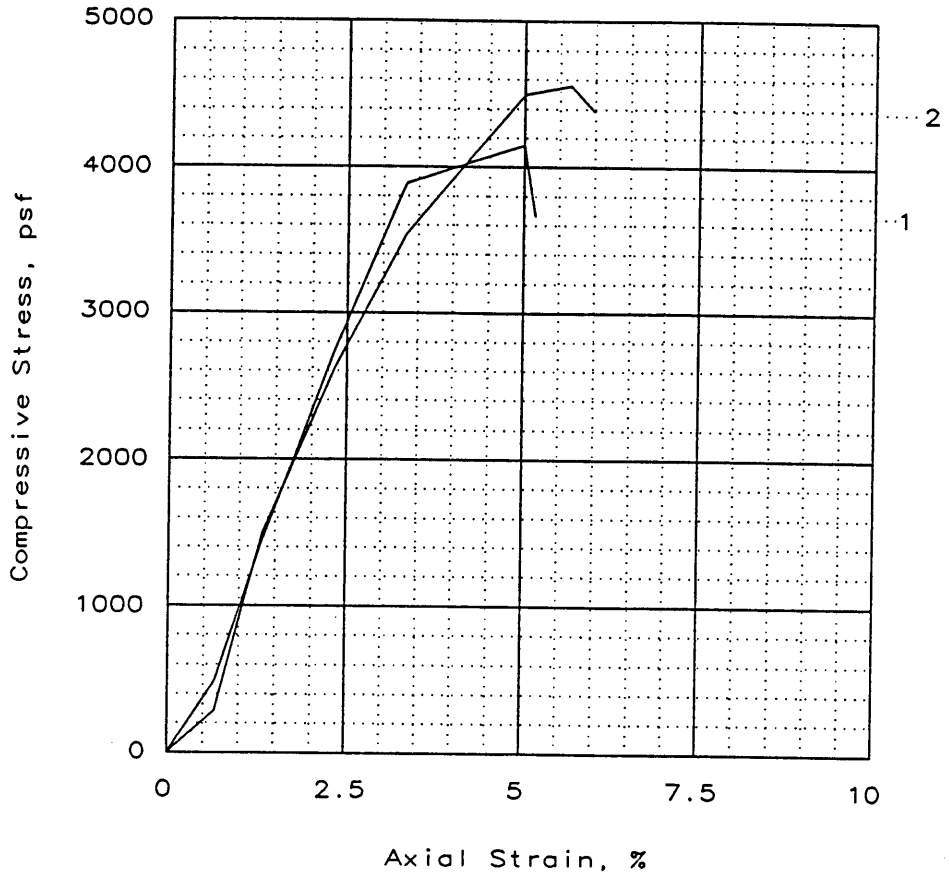
Sample No.: 9

Depth: 24.2 - 25.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4151	4556		
Undrained shear strength, psf	2075	2278		
Rate of strain, %/min				
Water content, %	38.2	36.6		
Void ratio	0.9905	0.9512		
Saturation, %	104.1	103.9		
Dry density, pcf	84.7	86.4		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 72	PL = 20	PI = 52.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-02-94
Remarks:
PENETROMETER - 1.75
TORVAN - MAX.

Fig No.

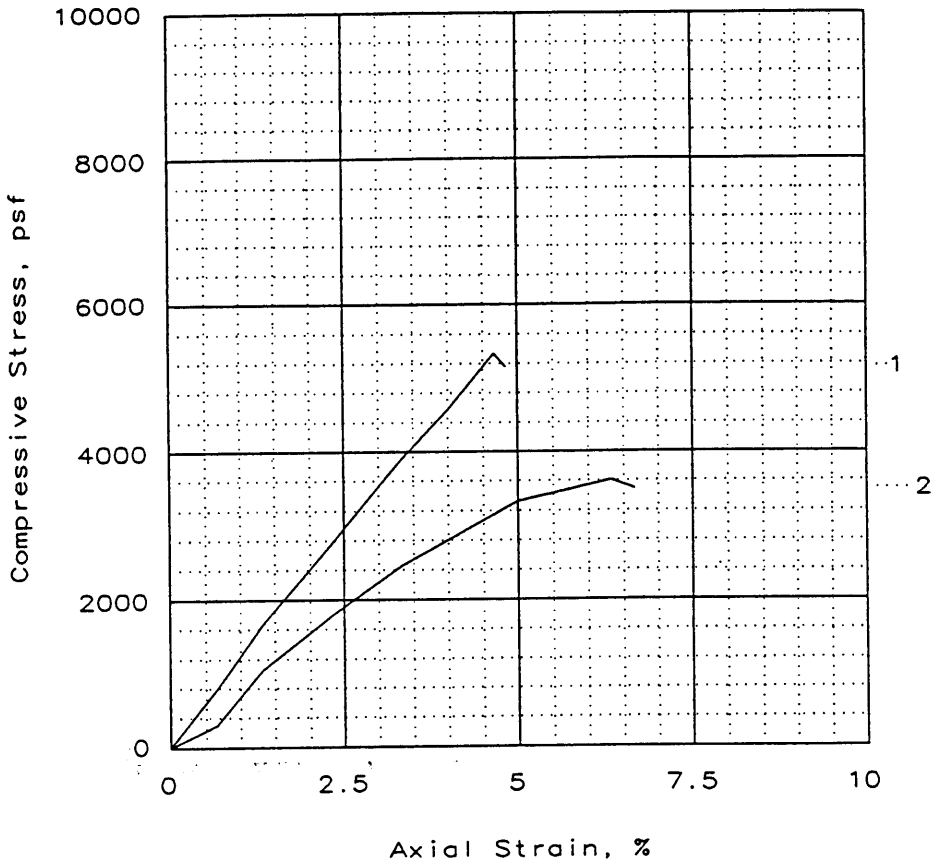
Project: EASTERN ARKANSAS

Boring No.: 12-EAU-94
Sample No.: 10
Depth: 28.0 - 30.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	5335	3613		
Undrained shear strength, psf	2668	1806		
Rate of strain, %/min				
Water content, %	35.7	35.7		
Void ratio	0.9232	0.9679		
Saturation, %	104.3	99.6		
Dry density, pcf	87.6	85.7		
Specimen diameter, in	1.38	1.40		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 71	PL = 23	PI = 48.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-02-94

Remarks:

PENETROMETER - 1.75

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 12-EAU-94

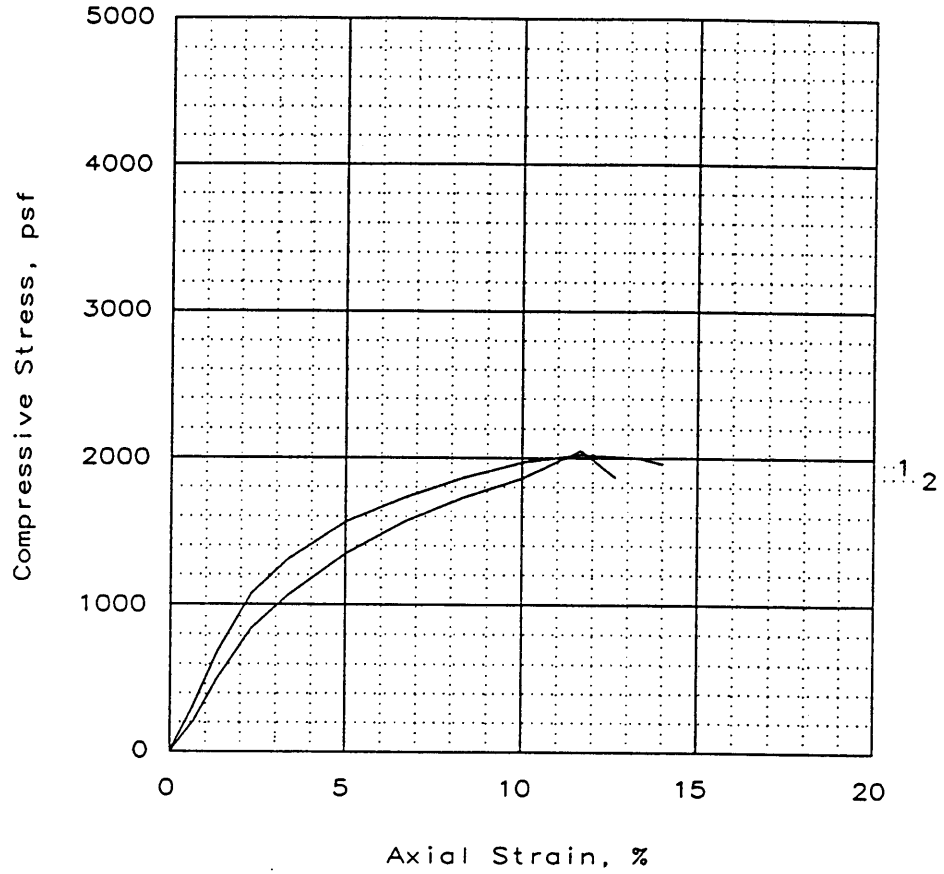
Sample No.: 12

Depth: 38.0 - 40.2

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2022	2051		
Undrained shear strength, psf	1011	1026		
Rate of strain, %/min				
Water content, %	31.0	34.7		
Void ratio	0.7778	0.8720		
Saturation, %	107.6	107.4		
Dry density, pcf	94.8	90.0		
Specimen diameter, in	1.36	1.37		
Specimen height, in	3.00	3.00		

Description; RED CLAY (CH) FAT LENSES OF SAND

LL = 61	PL = 20	PI = 41.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-02-94
Remarks:
PENETROMETER - 0.25
TORVAN - 0.25

Fig No.

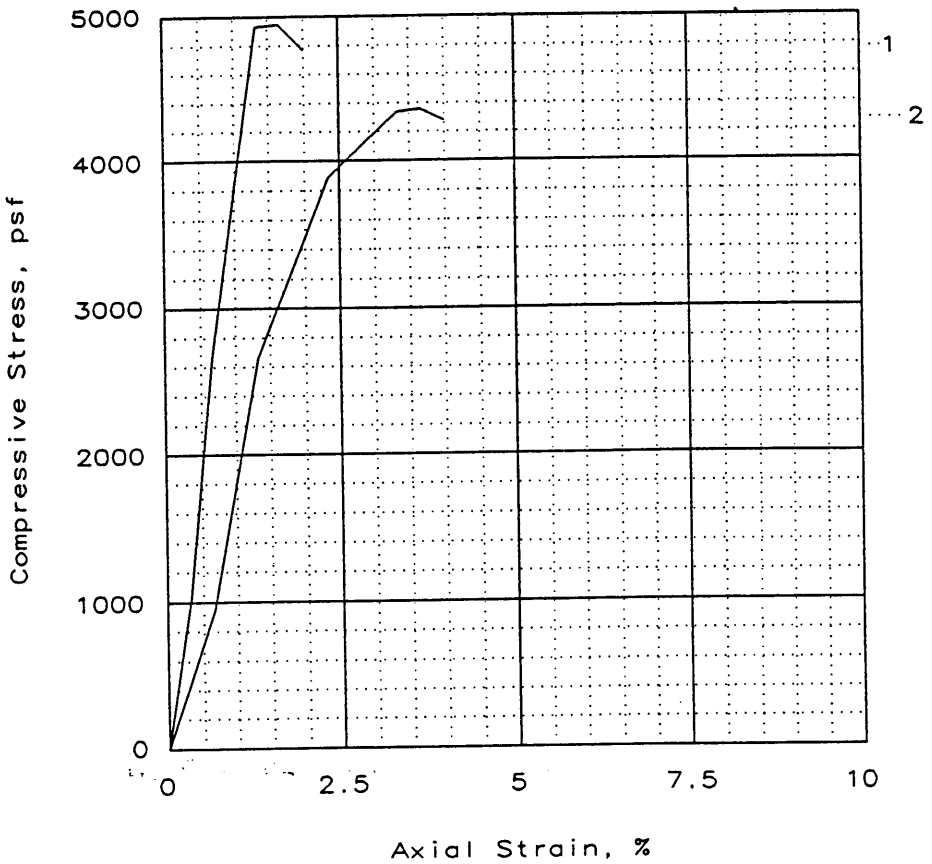
Project: EASTERN ARKANSAS

Boring No.: 12-EAU-94
Sample No.: 13
Depth: 43.0 - 44.2

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4946	4355		
Undrained shear strength, psf	2473	2177		
Rate of strain, %/min				
Water content, %	22.6	23.4		
Void ratio	0.6262	0.6338		
Saturation, %	97.6	99.6		
Dry density, pcf	103.6	103.2		
Specimen diameter, in	1.37	1.37		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CH) FAT, IRON OXIDE.

LL = 62	PL = 19	PI = 43.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-13-95

Remarks:

PENETROMETER - 3.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 13-EAU-94

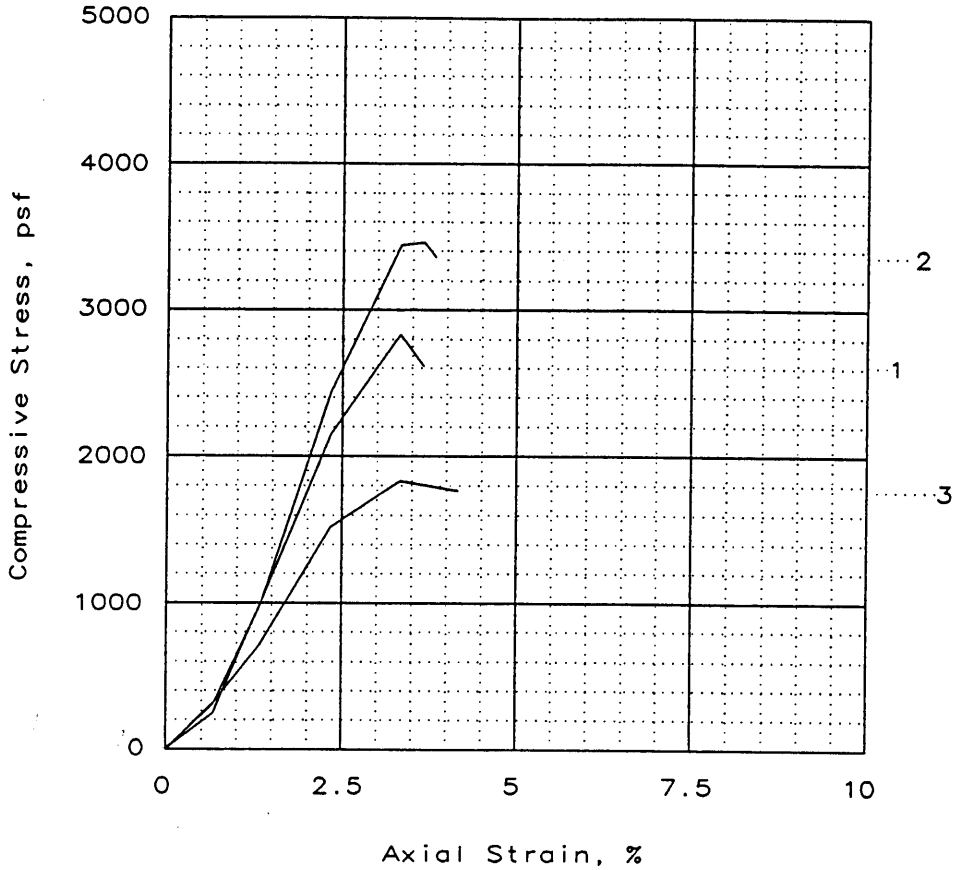
Sample No.: 3

Depth: 6.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2	3	
Unconfined strength, psf	2831	3462	1833	
Undrained shear strength, psf	1416	1731	917	
Rate of strain, %/min				
Water content, %	16.7	16.7	18.8	
Void ratio	0.5879	0.5792	0.6065	
Saturation, %	76.5	77.9	83.9	
Dry density, pcf	106.1	106.7	104.9	
Specimen diameter, in	1.37	1.38	1.37	
Specimen height, in	3.00	3.00	3.00	

Description: BR & GR CLAY (CH) FAT, IRON OXIDE.

LL = 57	PL = 20	PI = 37.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 01-13-95
Remarks:
PENETROMETER - 3.0
TORVAN - MAX.

Fig No.

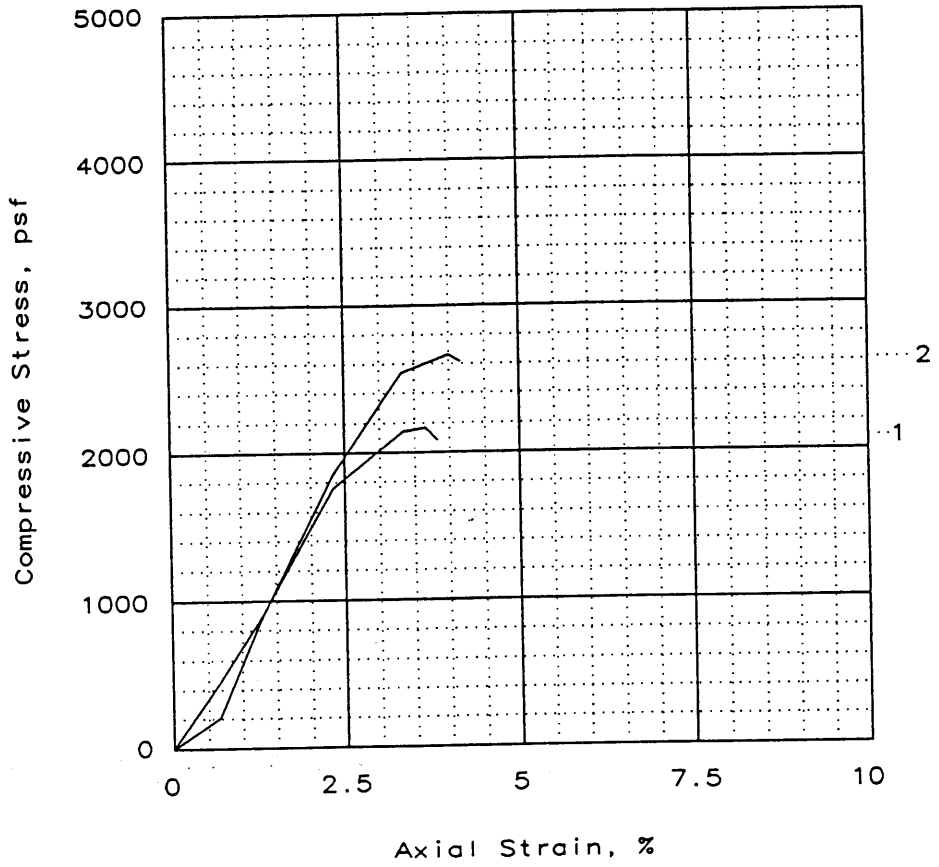
Project: EASTERN ARKANSAS

Boring No.: 13-EAU-94
Sample No.: 4
Depth: 8.0 - 10.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2166	2663		
Undrained shear strength, psf	1083	1331		
Rate of strain, %/min				
Water content, %	38.1	35.5		
Void ratio	1.0061	0.9488		
Saturation, %	102.2	100.9		
Dry density, pcf	84.0	86.5		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD CLAY (CH) FAT

LL = 73	PL = 23	PI = 50.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 01-13-95
Remarks:
PENETROMETER - 2.25
TORVAN - MAX.
UPPER SAMPLE - BOXED

Fig No.

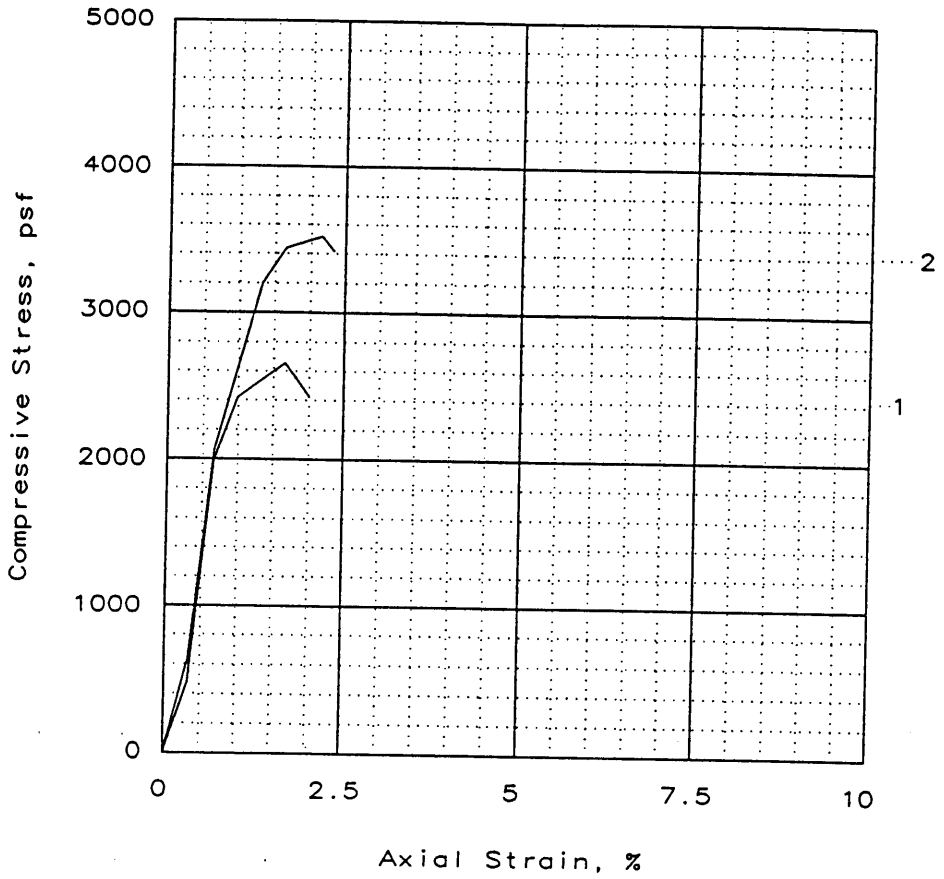
Project: EASTERN ARKANSAS

Boring No.: 13-EAU-94
Sample No.: 10
Depth: 30.0 - 31.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2656	3518		
Undrained shear strength, psf	1328	1759		
Rate of strain, %/min				
Water content, %	34.9	37.5		
Void ratio	0.9074	0.9082		
Saturation, %	103.7	111.5		
Dry density, pcf	88.4	88.3		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD CLAY (CH) FAT

LL = 69	PL = 24	PI = 45.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-13-95

Remarks:

PENETROMETER - 2.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 13-EAU-94

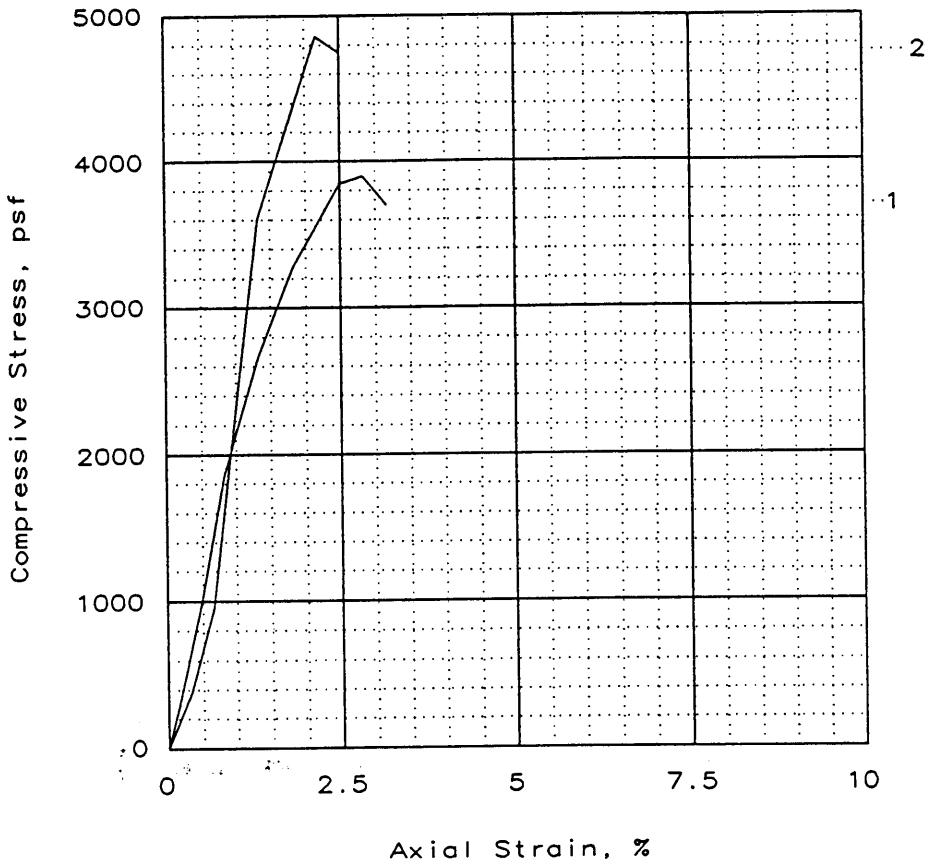
Sample No.: 12

Depth: 39.0 - 41.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3896	4861		
Undrained shear strength, psf	1948	2430		
Rate of strain, %/min				
Water content, %	27.0	27.4		
Void ratio	0.7235	0.7298		
Saturation, %	100.7	101.5		
Dry density, pcf	97.8	97.4		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 64	PL = 21	PI = 43.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-13-95

Remarks:

PENETROMETER - 3.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 13-EAU-94

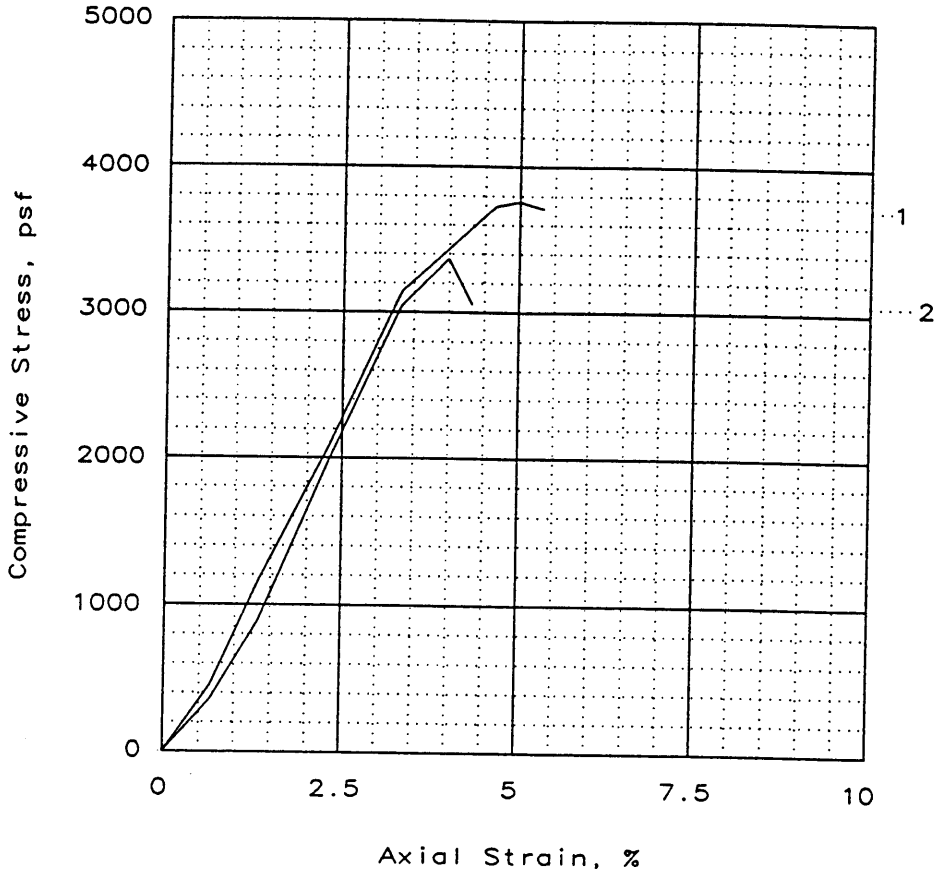
Sample No.: 13

Depth: 44.0 - 46.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3759	3370		
Undrained shear strength, psf	1880	1685		
Rate of strain, %/min				
Water content, %	30.1	30.1		
Void ratio	0.7834	0.8066		
Saturation, %	103.8	100.6		
Dry density, pcf	94.5	93.3		
Specimen diameter, in	1.36	1.37		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT LENSES OF SILT

LL = 63	PL = 21	PI = 42.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 01-13-95
Remarks:
PENETROMETER - 2.50
TORVAN - MAX.

Fig No.

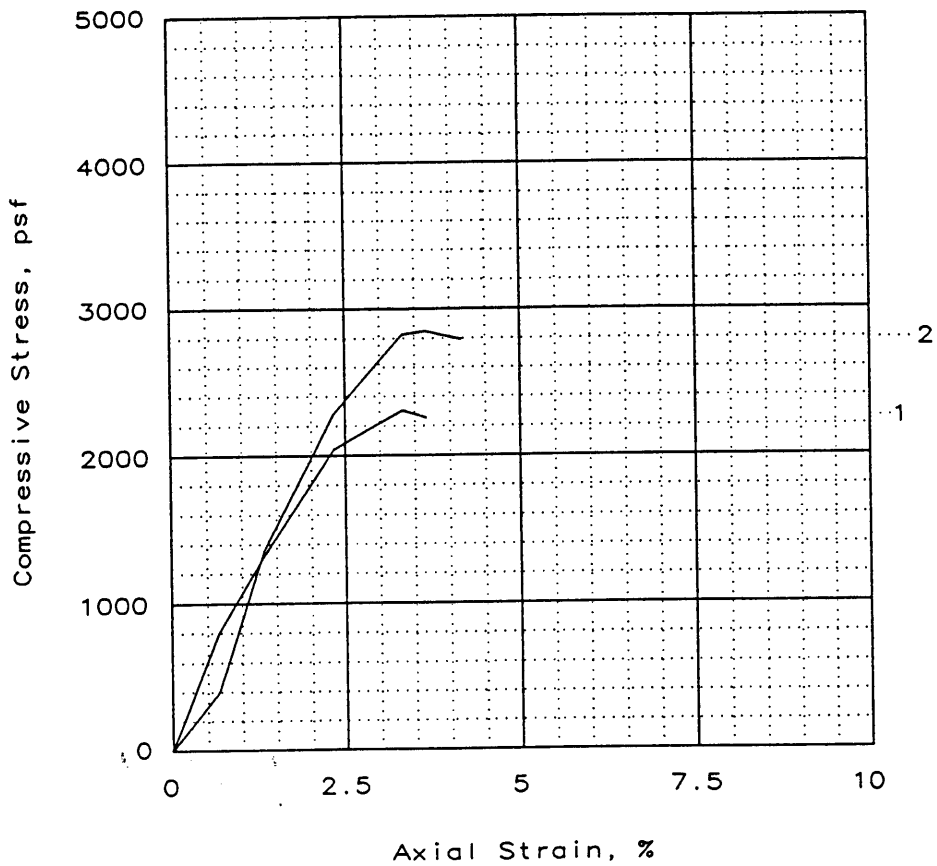
Project: EASTERN ARKANSAS

Boring No.: 13-EAU-94
Sample No.: 15
Depth: 59.0 - 61.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2304	2849		
Undrained shear strength, psf	1152	1425		
Rate of strain, %/min				
Water content, %	46.8	45.3		
Void ratio	1.2185	1.1846		
Saturation, %	103.8	103.3		
Dry density, pcf	76.0	77.2		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 98	PL = 28	PI = 70.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-13-95

Remarks:

PENETROMETER - 1.75

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 13-EAU-94

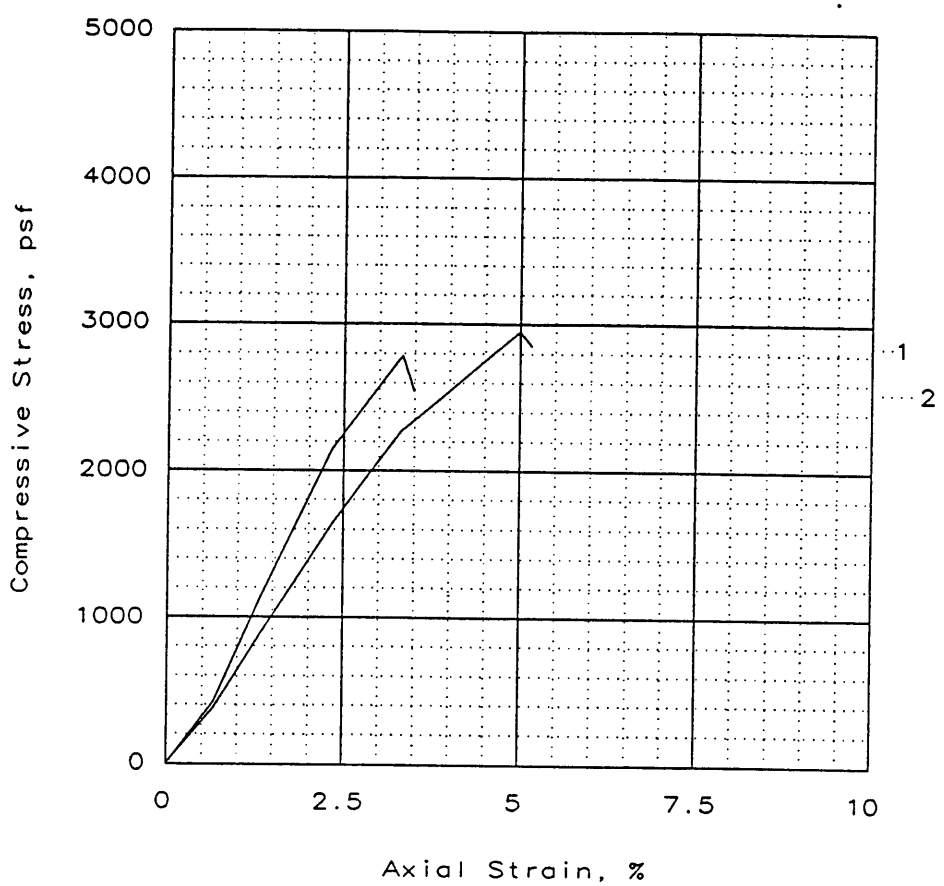
Sample No.: 16

Depth: 69.0 - 71.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2949	2784		
Undrained shear strength, psf	1475	1392		
Rate of strain, %/min				
Water content, %	22.0	20.5		
Void ratio	0.6209	0.6017		
Saturation, %	95.1	91.4		
Dry density, pcf	103.2	104.5		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CL) LEAN LENSES OF SILT

LL = 33	PL = 19	PI = 14.0	GS = 2.68	Type: UNDISTURBED

Project No.:

Date: 12-01-94

Remarks:

PENETROMETER - 3.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 14-EAU-94

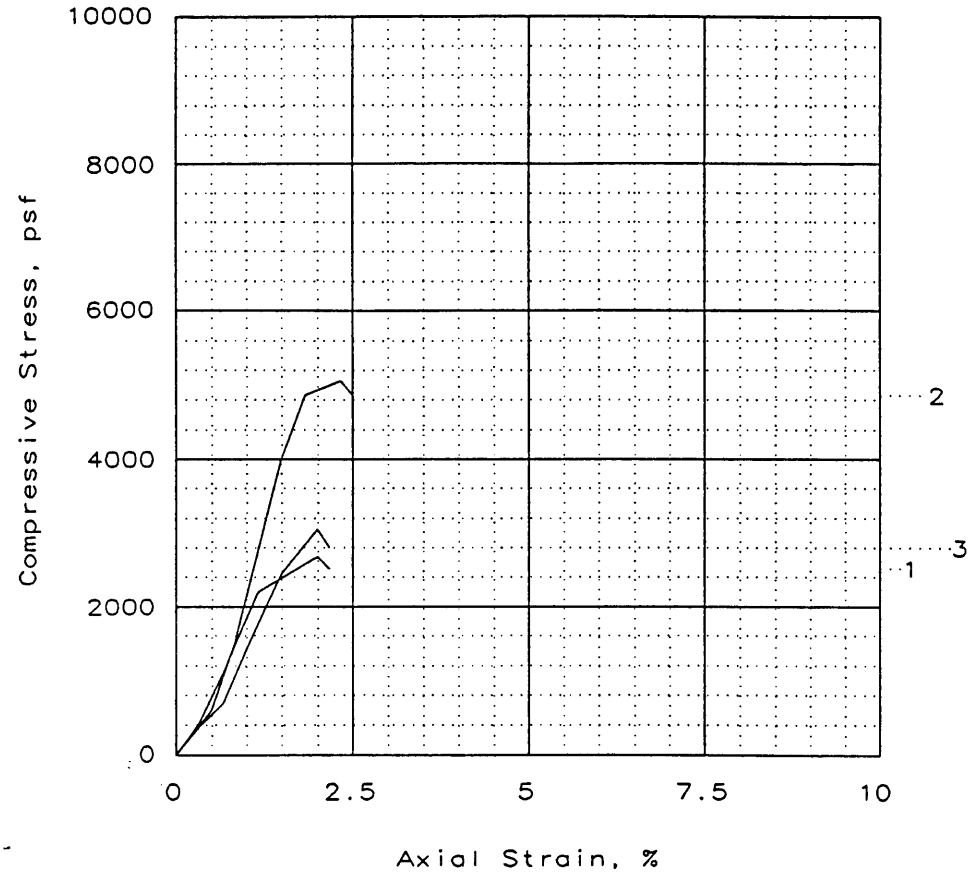
Sample No.: 3

Depth: 6.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2	3	
Unconfined strength, psf	2678	5058	3056	
Undrained shear strength, psf	1339	2529	1528	
Rate of strain, %/min				
Water content, %	41.5	39.1	44.2	
Void ratio	1.1114	1.0198	1.1964	
Saturation, %	100.7	103.4	99.7	
Dry density, pcf	79.8	83.5	76.7	
Specimen diameter, in	1.38	1.38	1.38	
Specimen height, in	3.00	3.00	3.00	

Description: RD. CLAY (CH) FAT LENSES OF SILT

LL = 89	PL = 28	PI = 61.0	GS = 2.70	Type: UNDISTUBED

Project No.:

Date: 12-01-94

Remarks:

PENETROMETER - 2.5

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 14-EAU-94

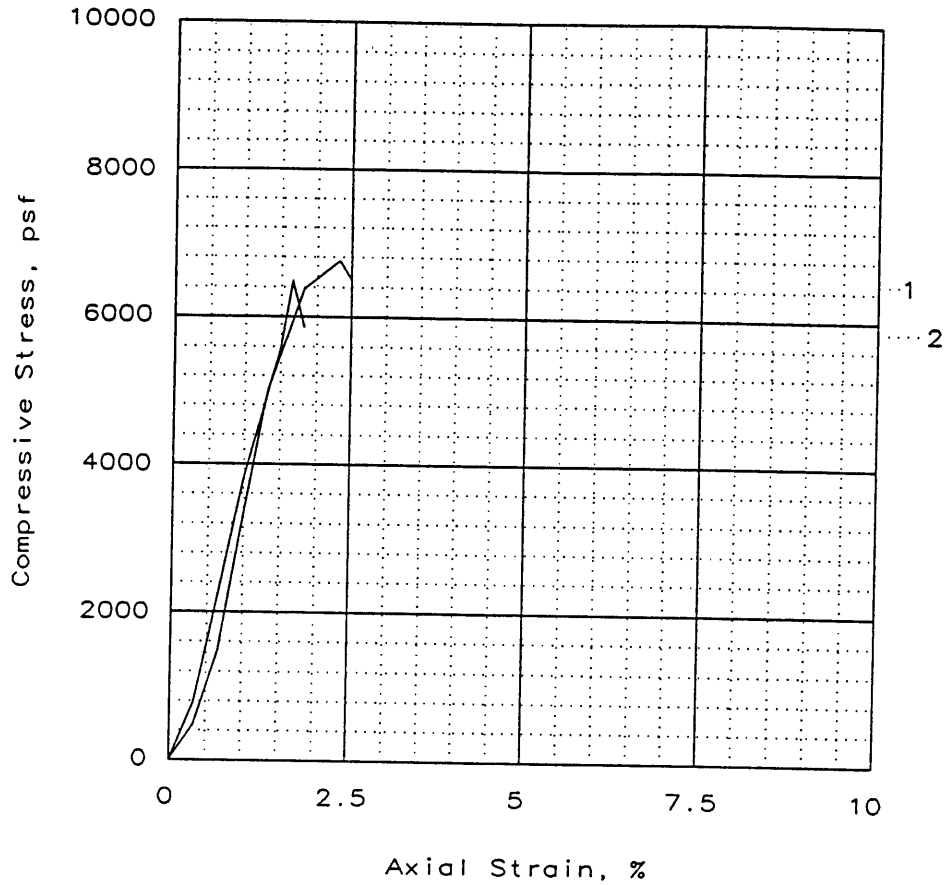
Sample No.: 15

Depth: 59.0 - 61.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	6756	6486		
Undrained shear strength, psf	3378	3243		
Rate of strain, %/min				
Water content, %	21.7	23.5		
Void ratio	0.5878	0.5047		
Saturation, %	99.9	125.7		
Dry density, pcf	106.2	112.0		
Specimen diameter, in	1.38	1.39		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT LENSES OF SILT

LL = 51	PL = 21	PI = 30.0	GS = 2.70	Type: UNDISTUBED

Project No.:
Date: 12-02-94
Remarks:
PENETROMETER - 3.00
TORVAN - MAX.

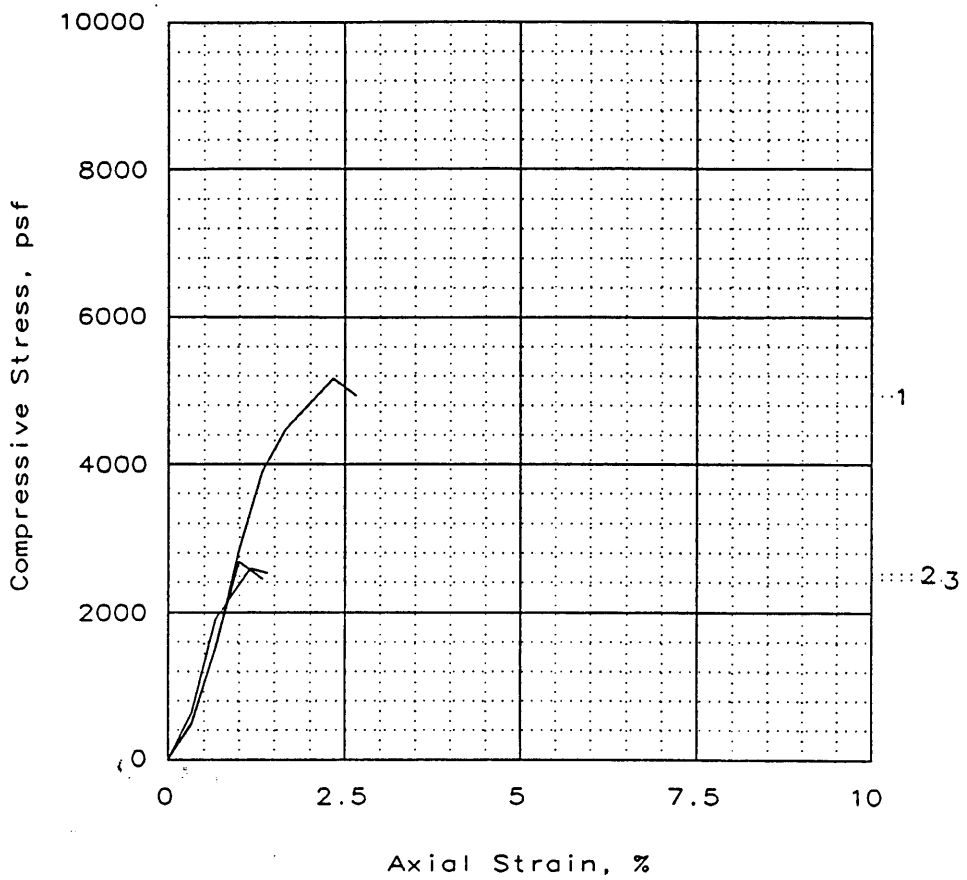
Fig No.

Project: EASTERN ARKANSAS

Boring No.: 15-EAU-94
Sample No.: 5
Depth: 11.0 - 13.5

UNCONFINED COMPRESSION TEST
MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2	3	
Unconfined strength, psf	5167	2594	2682	
Undrained shear strength, psf	2583	1297	1341	
Rate of strain, %/min				
Water content, %	36.4	26.7	27.4	
Void ratio	0.7264	0.6895	0.7097	
Saturation, %	135.3	104.6	104.2	
Dry density, pcf	97.6	99.8	98.6	
Specimen diameter, in	1.38	1.38	1.38	
Specimen height, in	3.00	3.00	3.00	

Description: RD. CLAY (CH) FAT LENSES OF SILT

LL = 68	PL = 23	PI = 45.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 12-02-94
Remarks:
PENETROMETER - 3.25
TORVAN - MAX.

Fig No.

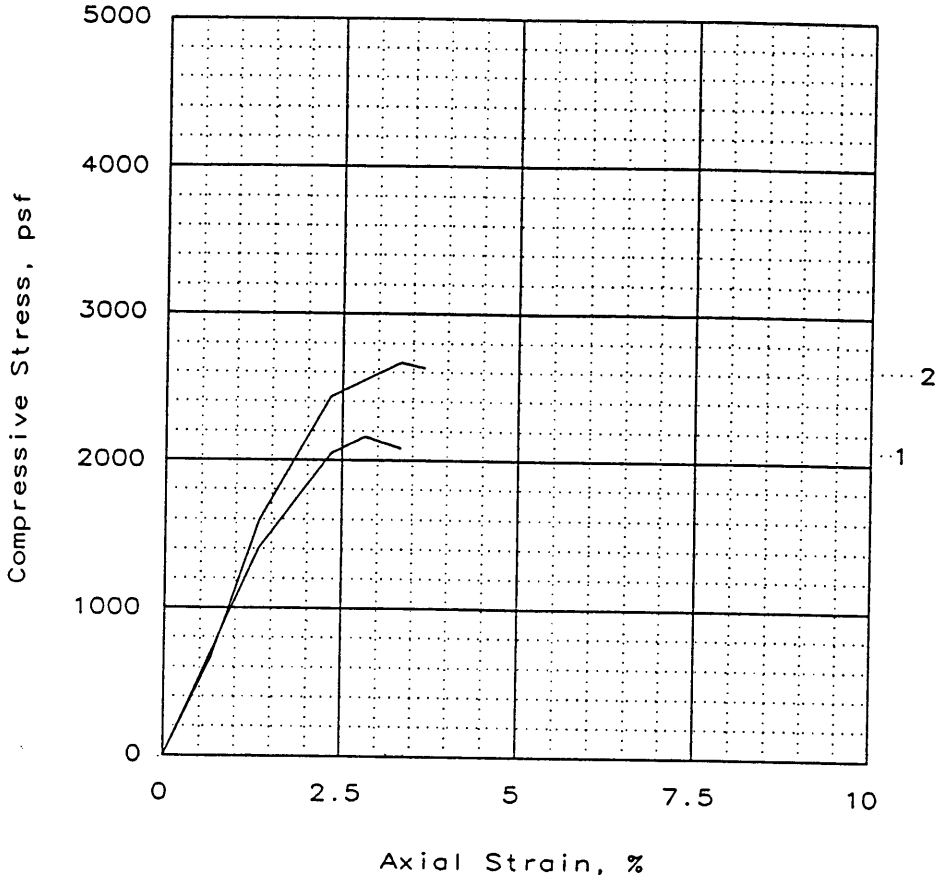
Project: EASTERN ARKANSAS

Boring No.: 15-EAU-94
Sample No.: 7
Depth: 17.0 - 19.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2161	2666		
Undrained shear strength, psf	1081	1333		
Rate of strain, %/min				
Water content, %	28.4	27.8		
Void ratio	0.8195	0.7598		
Saturation, %	93.7	99.0		
Dry density, pcf	92.6	95.8		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 71	PL = 21	PI = 50.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 12-02-94

Remarks:

PENETROMETER - 3.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 15-EAU-94

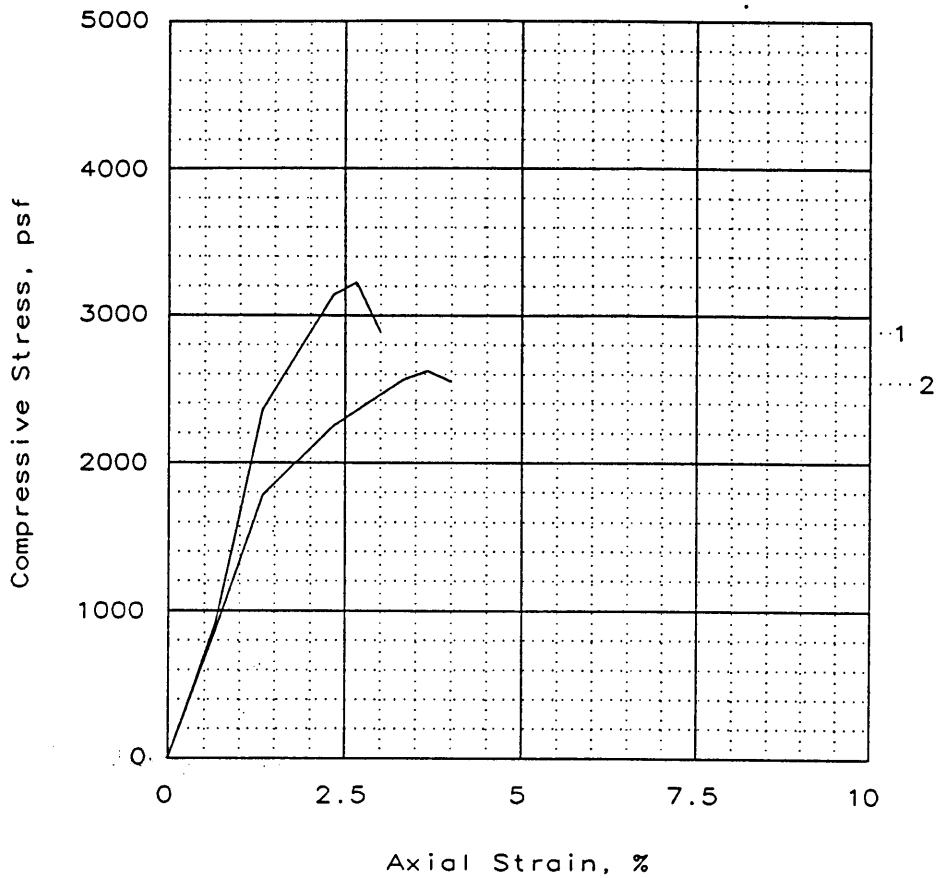
Sample No.: 11

Depth: 34.0 - 36.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3226	2624		
Undrained shear strength, psf	1613	1312		
Rate of strain, %/min				
Water content, %	33.0	34.4		
Void ratio	0.8624	0.9221		
Saturation, %	103.3	100.7		
Dry density, pcf	90.5	87.7		
Specimen diameter, in	1.38	1.39		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 91	PL = 25	PI = 66.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 12-02-94

Remarks:

PENETROMETER - 2.75

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 15-EAU-94

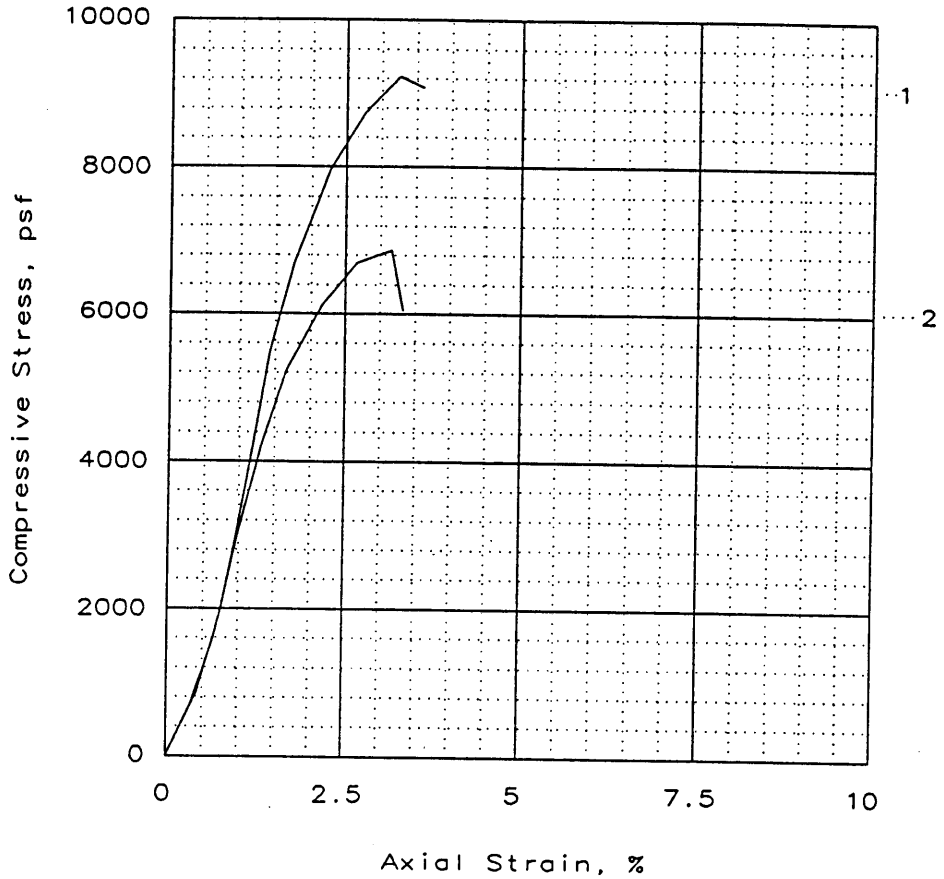
Sample No.: 12

Depth: 39.0 - 41.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	9225	6875		
Undrained shear strength, psf	4613	3437		
Rate of strain, %/min				
Water content, %	30.9	31.9		
Void ratio	0.8042	0.8440		
Saturation, %	103.6	102.1		
Dry density, pcf	93.4	91.4		
Specimen diameter, in	1.40	1.39		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CH) FAT

LL = 91	PL = 24	PI = 67.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 12-02-94
Remarks:
PENETROMETER - 4.25
TORVAN - MAX.

Fig No.

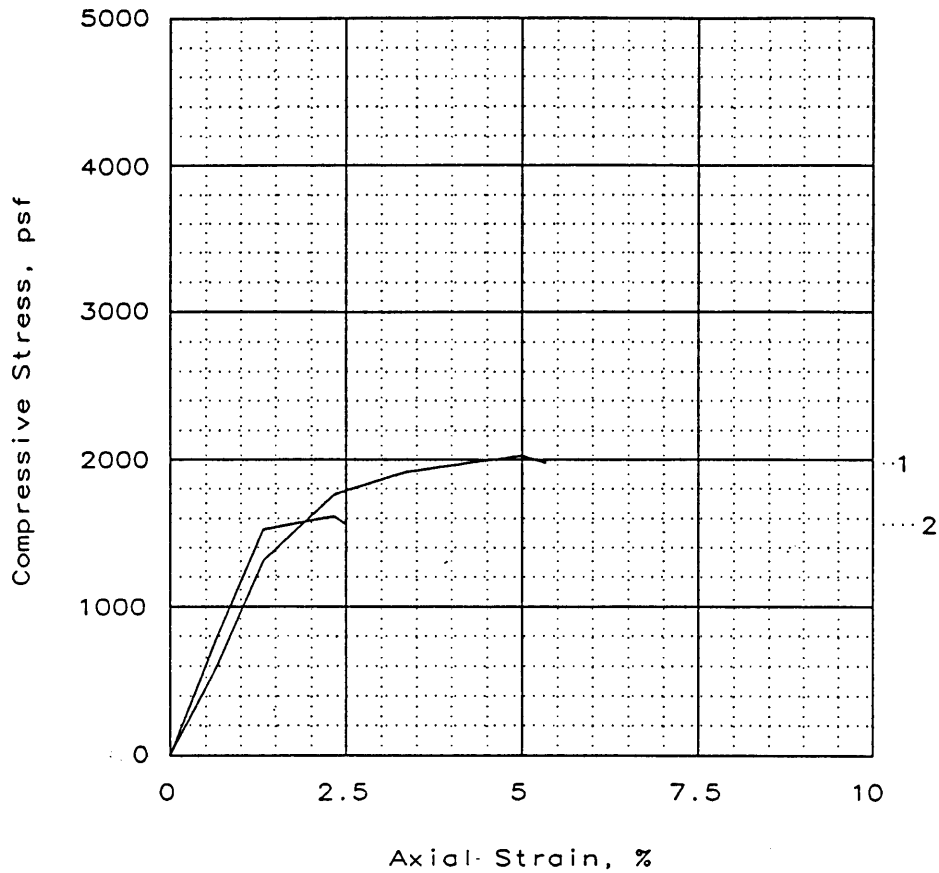
Project: EASTERN ARKANSAS

Boring No.: 15-EAU-94
Sample No.: 14
Depth: 49.0 - 51.3

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2025	1614		
Undrained shear strength, psf	1013	807		
Rate of strain, %/min				
Water content, %	34.5	33.7		
Void ratio	0.8990	0.9030		
Saturation, %	103.6	100.8		
Dry density, pcf	88.8	88.6		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CH) FAT

LL = 87	PL = 26	PI = 61.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 12-02-94

Remarks:

PENETROMETER - 2.75

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 15-EAU-94

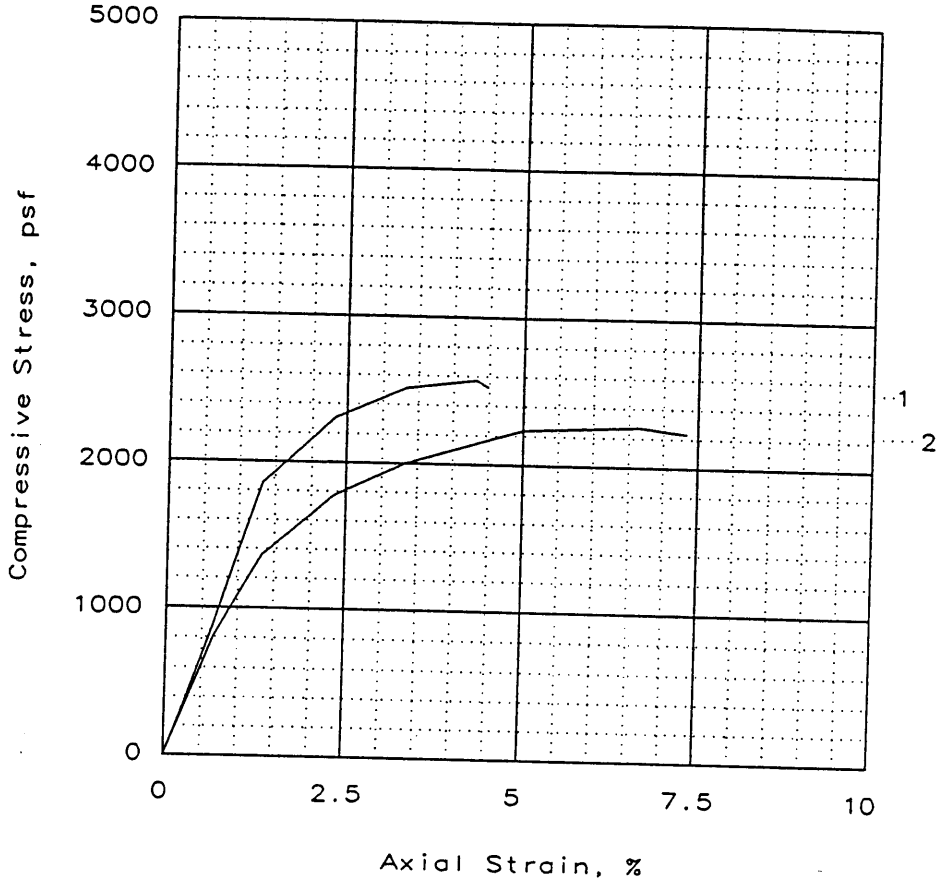
Sample No.: 15

Depth: 59.0 - 61.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2572	2273		
Undrained shear strength, psf	1286	1137		
Rate of strain, %/min				
Water content, %	38.6	38.6		
Void ratio	1.0035	1.0126		
Saturation, %	103.8	102.8		
Dry density, pcf	84.1	83.8		
Specimen diameter, in	1.38	1.37		
Specimen height, in	3.00	3.00		

Description: BR. CLAY (CH) FAT

LL = 80	PL = 28	PI = 52.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 12-02-94

Remarks:

PENETROMETER - 1.5

TORVAN - 0.83

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 15-EAU-94

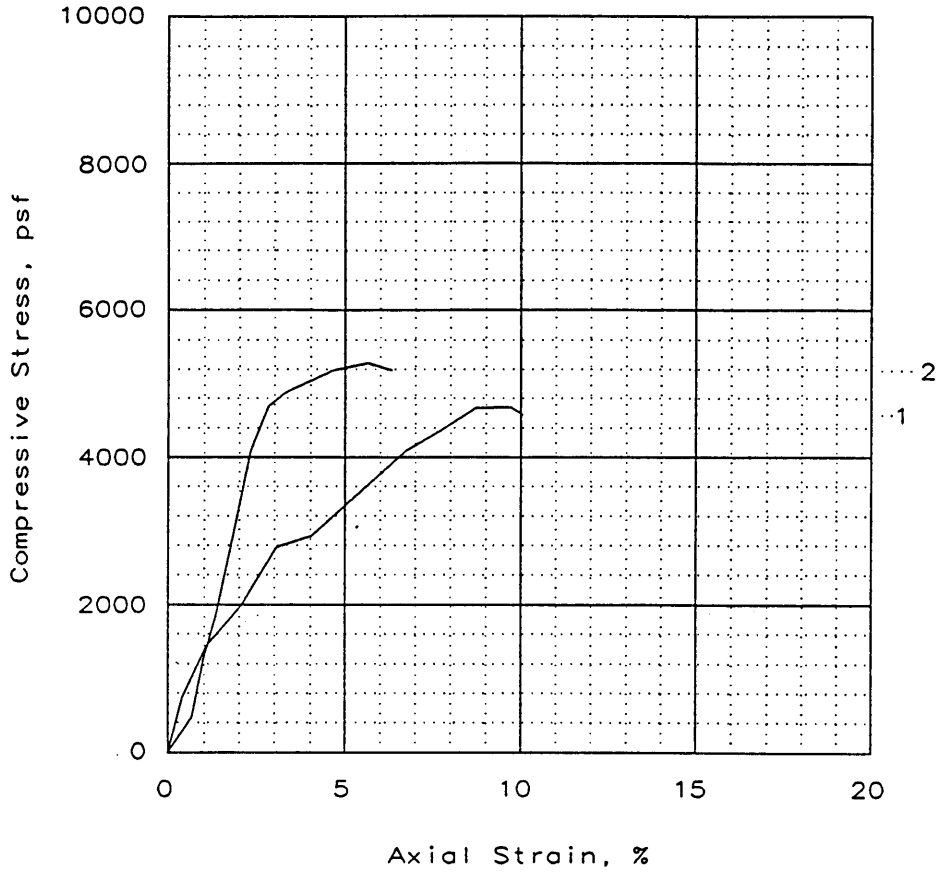
Sample No.: 16

Depth: 69.0 - 70.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4679	5284		
Undrained shear strength, psf	2339	2642		
Rate of strain, %/min				
Water content, %	25.6	26.6		
Void ratio	0.6911	0.7005		
Saturation, %	99.5	102.1		
Dry density, pcf	99.3	98.8		
Specimen diameter, in	1.37	1.37		
Specimen height, in	3.00	3.00		

Description: GR CLAY (CL) SILTY

LL = 45	PL = 23	PI = 22.0	GS = 2.69	Type: UNDISTURBED

Project No.:

Date: 12-02-94

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 15-EAU-94

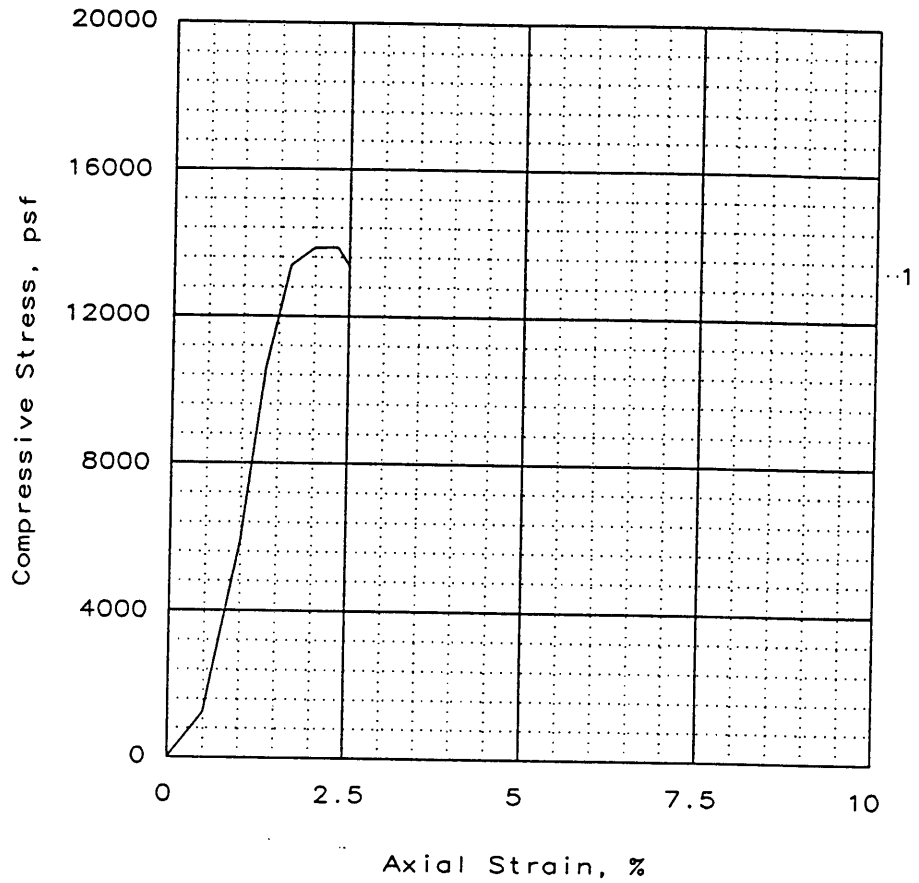
Sample No.: 16

Depth: 70.0 - 71.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1			
Unconfined strength, psf	13869			
Undrained shear strength, psf	6934			
Rate of strain, %/min				
Water content, %	16.7			
Void ratio	0.5341			
Saturation, %	84.2			
Dry density, pcf	109.9			
Specimen diameter, in	1.40			
Specimen height, in	3.00			

Description: GR. CLAY (CH) FAT

LL = 60	PL = 17	PI = 43.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-01-94
Remarks:
PENETROMETER - MAX.
TORVAN - MAX.
NEED TO BE CHECK WITH HAND COMPUTE
Fig No.

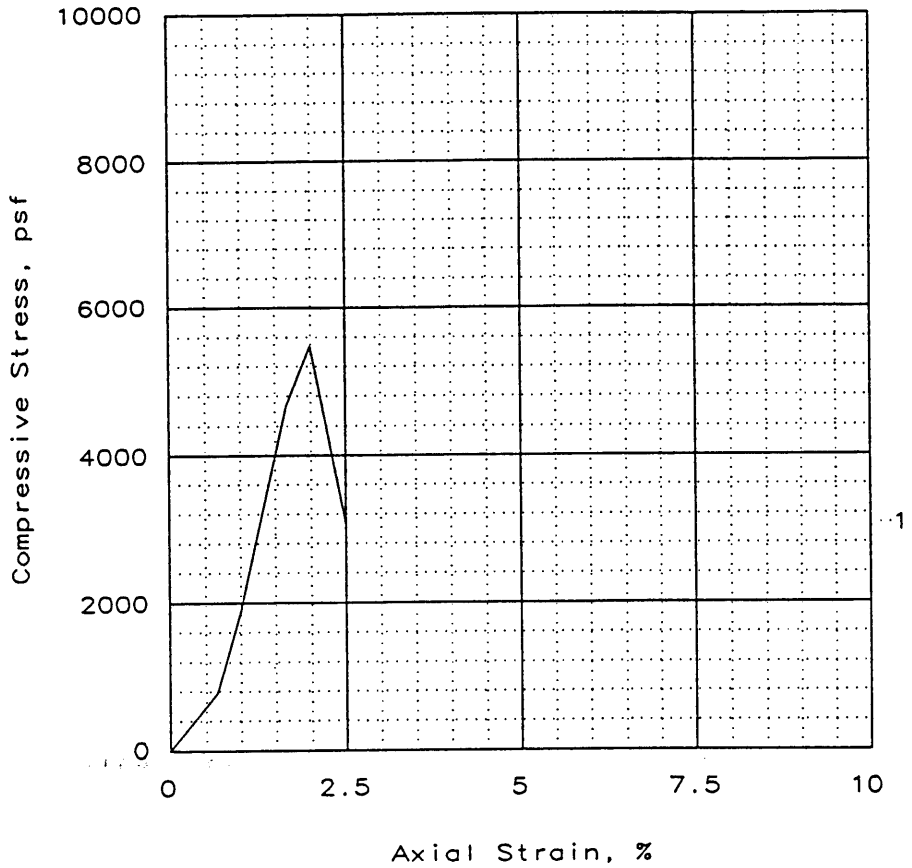
Project: EASTERN ARKANSAS

Boring No.: 16-EAU-94
Sample No.: 3
Depth: 5.0 - 6.6

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1			
Unconfined strength, psf	5479			
Undrained shear strength, psf	2740			
Rate of strain, %/min				
Water content, %	18.9			
Void ratio	0.5751			
Saturation, %	88.6			
Dry density, pcf	107.0			
Specimen diameter, in	1.39			
Specimen height, in	3.00			

Description: GR. CLAY (CH) FAT IRON OXIDE

LL = 55	PL = 16	PI = 39.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-01-94

Remarks:

PENETROMETER - MAX.

TORVAN - MAX.

BOTTOM OF SAMPLE - BOXED

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 16-EAU-94

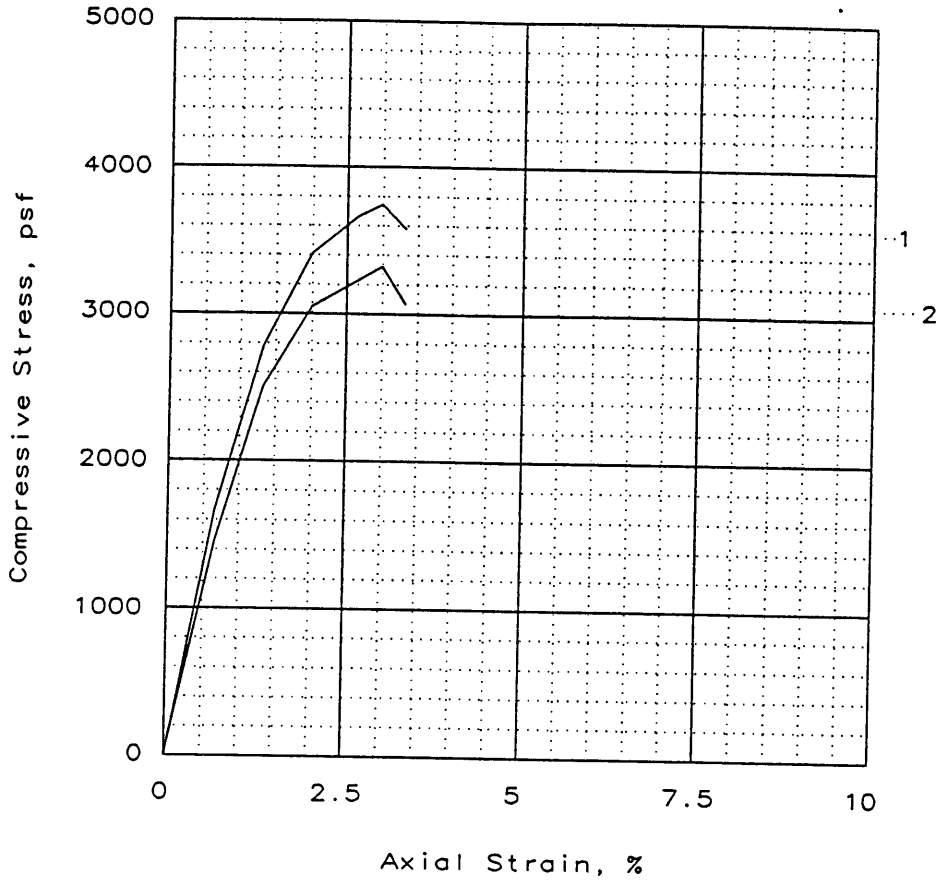
Sample No.: 4

Depth: 8.0 -9.1

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3744	3324		
Undrained shear strength, psf	1872	1662		
Rate of strain, %/min				
Water content, %	31.4	31.9		
Void ratio	0.8385	0.8463		
Saturation, %	100.9	101.8		
Dry density, pcf	91.7	91.3		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 88	PL = 24	PI = 64.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-01-94

Remarks:

PENETROMETER - 2.50

TORVAN - 0.93

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 16-EAU-94

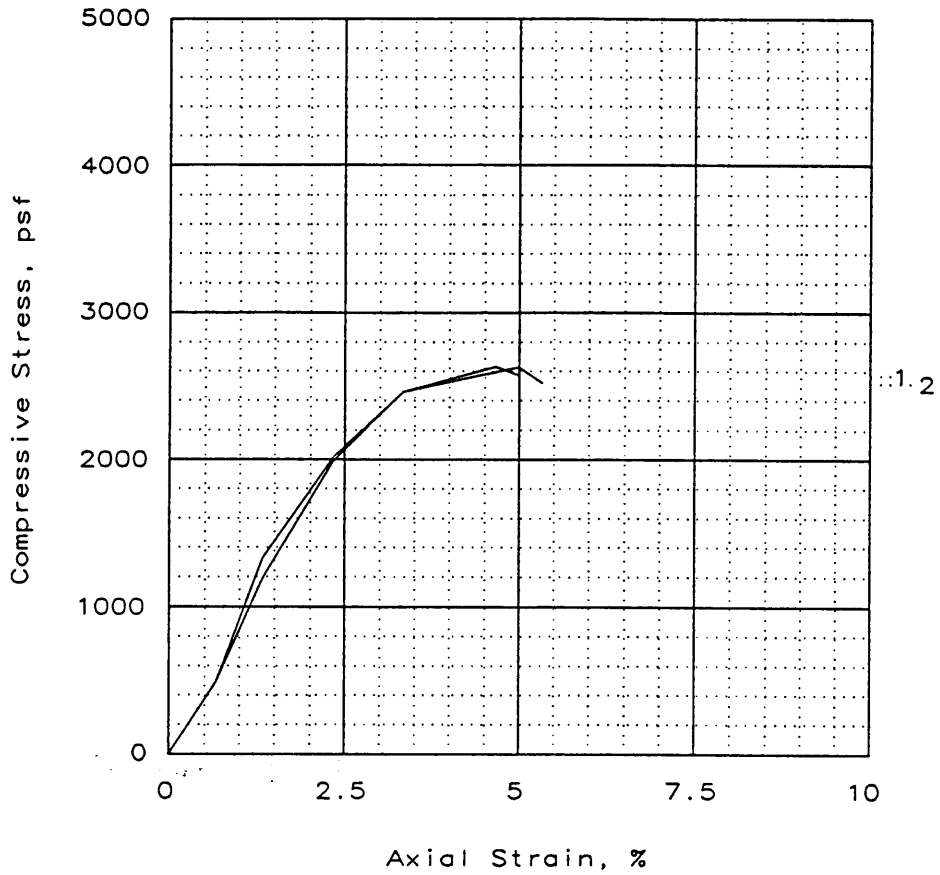
Sample No.: 11

Depth: 34.0 - 36.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2631	2628		
Undrained shear strength, psf	1316	1314		
Rate of strain, %/min				
Water content, %	38.7	37.6		
Void ratio	1.0209	0.9900		
Saturation, %	102.3	102.6		
Dry density, pcf	83.4	84.7		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 90	PL = 24	PI = 66.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-01-94

Remarks:

PENETROMETER - 1.75

TORVAN - 0.70

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 16-EAU-94

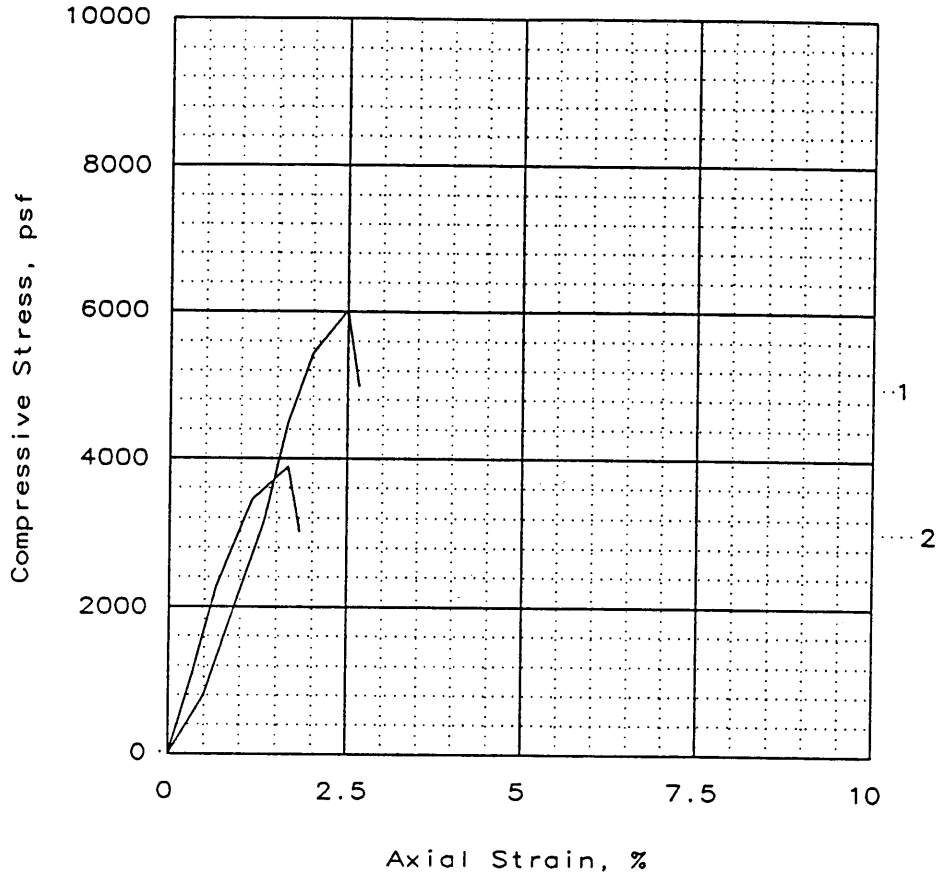
Sample No.: 12

Depth: 39.0 - 41.3

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	6023	3894		
Undrained shear strength, psf	3011	1947		
Rate of strain, %/min				
Water content, %	35.0	34.8		
Void ratio	0.8967	0.9213		
Saturation, %	105.3	102.0		
Dry density, pcf	88.9	87.7		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 90	PL = 25	PI = 65.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-01-94

Remarks:

PENETROMETER - 3.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 16-EAU-94

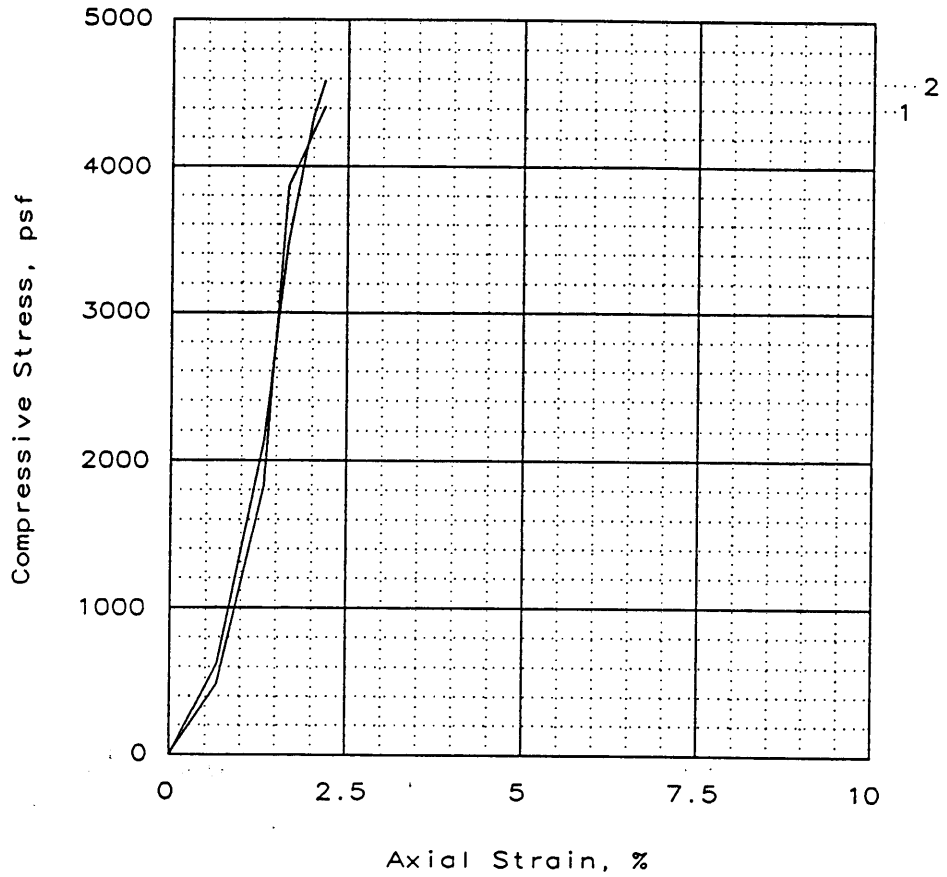
Sample No.: 14

Depth: 49.0 - 51.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4407	4586		
Undrained shear strength, psf	2203	2293		
Rate of strain, %/min				
Water content, %	28.3	28.7		
Void ratio	0.7655	0.7675		
Saturation, %	99.7	100.9		
Dry density, pcf	95.5	95.4		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 66	PL = 25	PI = 41.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-01-94

Remarks:

PENETROMETER - 3.25

TORVAN - MAX.

UPPER SAMPLE - BOXED

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 17-EAU-94

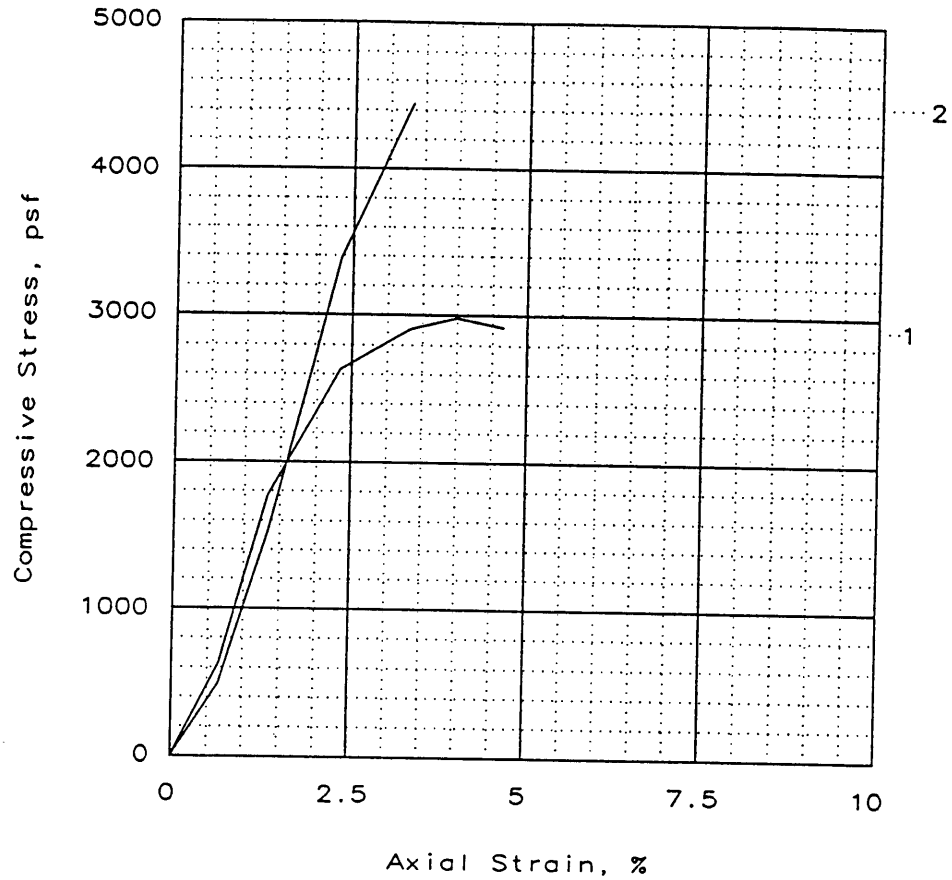
Sample No.: 9

Depth: 30.2 - 31.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2981	4444		
Undrained shear strength, psf	1490	2222		
Rate of strain, %/min				
Water content, %	38.2	36.4		
Void ratio	0.9965	0.9485		
Saturation, %	103.5	103.5		
Dry density, pcf	84.4	86.5		
Specimen diameter, in	1.38	1.37		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 92	PL = 25	PI = 67.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-01-94
Remarks:
PENETROMETER - 2.0
TORVAN - MAX.

Fig No.

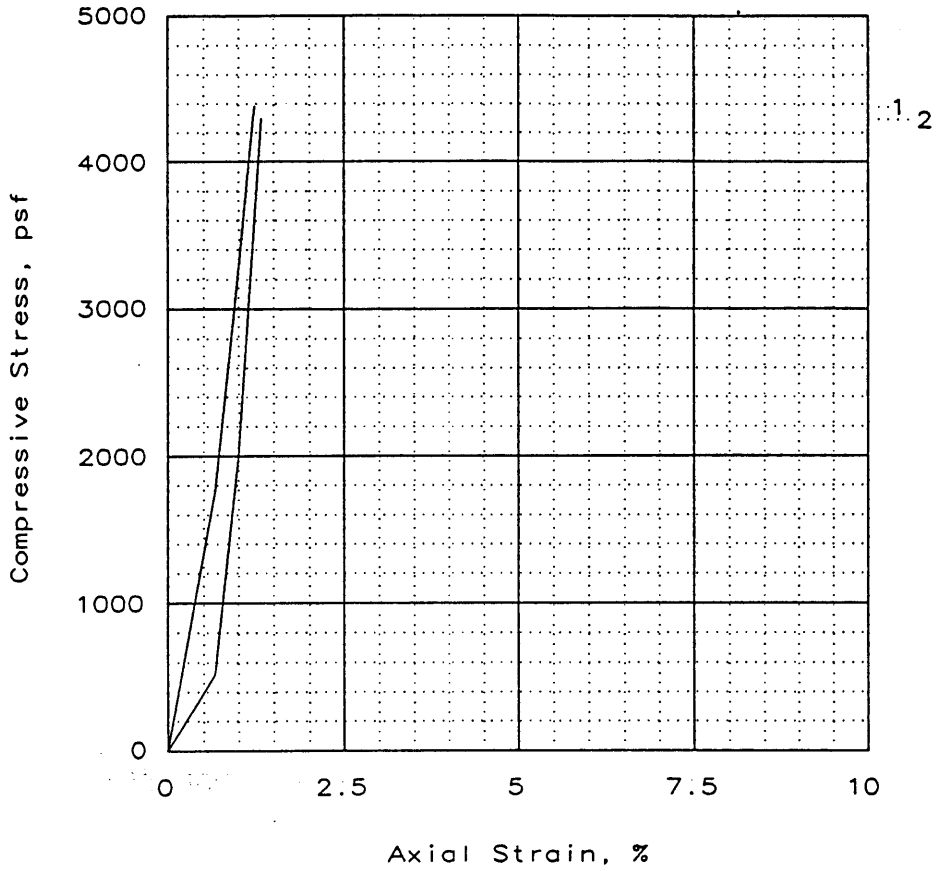
Project: EASTERN ARKANSAS

Boring No.: 17-EAU-94
Sample No.: 10
Depth: 34.0 - 36.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4381	4295		
Undrained shear strength, psf	2190	2148		
Rate of strain, %/min				
Water content, %	21.2	22.0		
Void ratio	0.6018	0.6349		
Saturation, %	94.9	93.8		
Dry density, pcf	105.2	103.1		
Specimen diameter, in	1.38	1.40		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 65	PL = 19	PI = 46.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-01-94
Remarks:
PENETROMETER - 3.25
TORVAN - MAX.
BOTTOM OF SAMPLE - BOXED

Fig No.

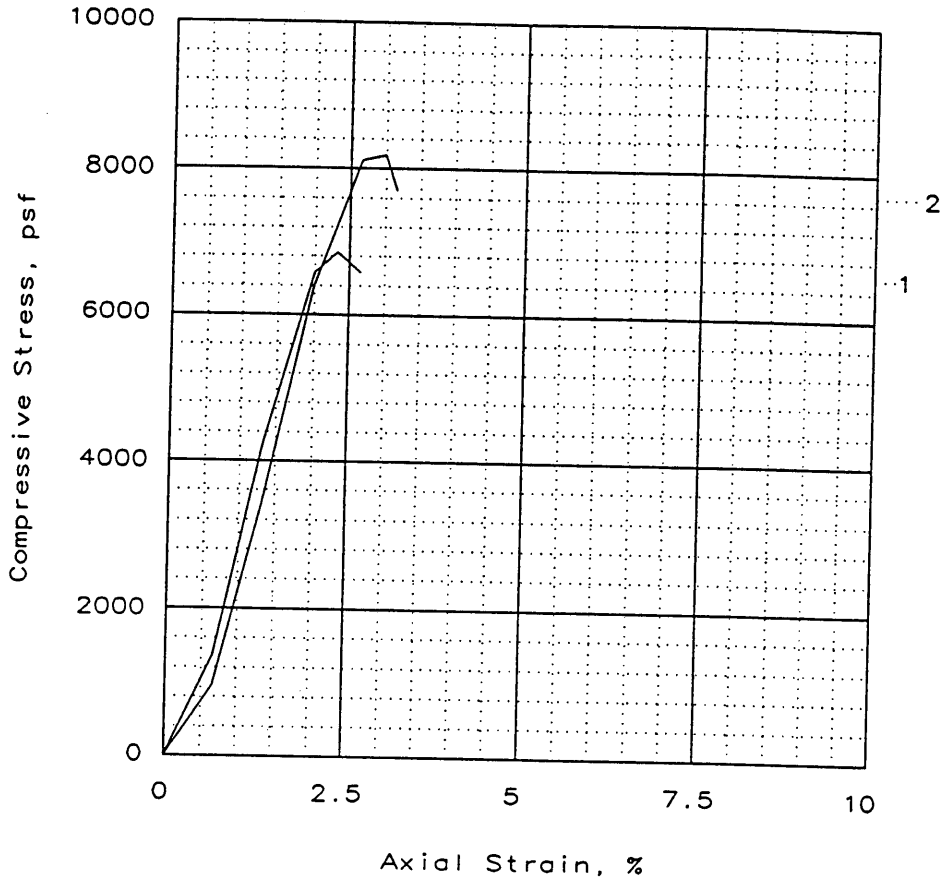
Project: EASTERN ARKANSAS

Boring No.: 18-EAU-94
Sample No.: 4
Depth: 8.0 - 9.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	6857	8180		
Undrained shear strength, psf	3429	4090		
Rate of strain, %/min				
Water content, %	30.0	30.6		
Void ratio	0.8021	0.8114		
Saturation, %	100.8	101.7		
Dry density, pcf	93.5	93.1		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 64	PL = 24	PI = 40.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-01-94
Remarks:
PENTROMETER - 3.75
TORVAN - MAX.

Fig No.

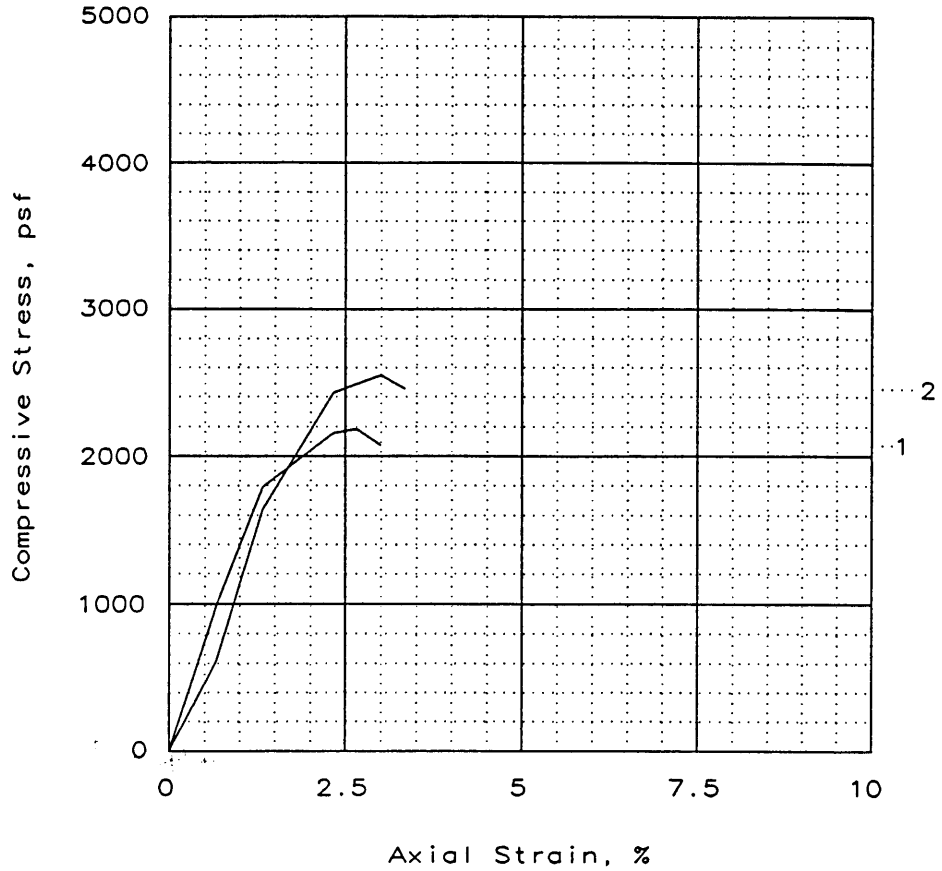
Project: EASTERN ARKANSAS

Boring No.: 18-EAU-94
Sample No.: 11
Depth: 34.0 - 36.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2184	2548		
Undrained shear strength, psf	1092	1274		
Rate of strain, %/min				
Water content, %	32.3	32.2		
Void ratio	0.9279	0.8886		
Saturation, %	93.9	98.0		
Dry density, pcf	87.4	89.3		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 72	PL = 30	PI = 42.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-01-94

Remarks:

PENETROMETER - 3.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 18-EAU-94

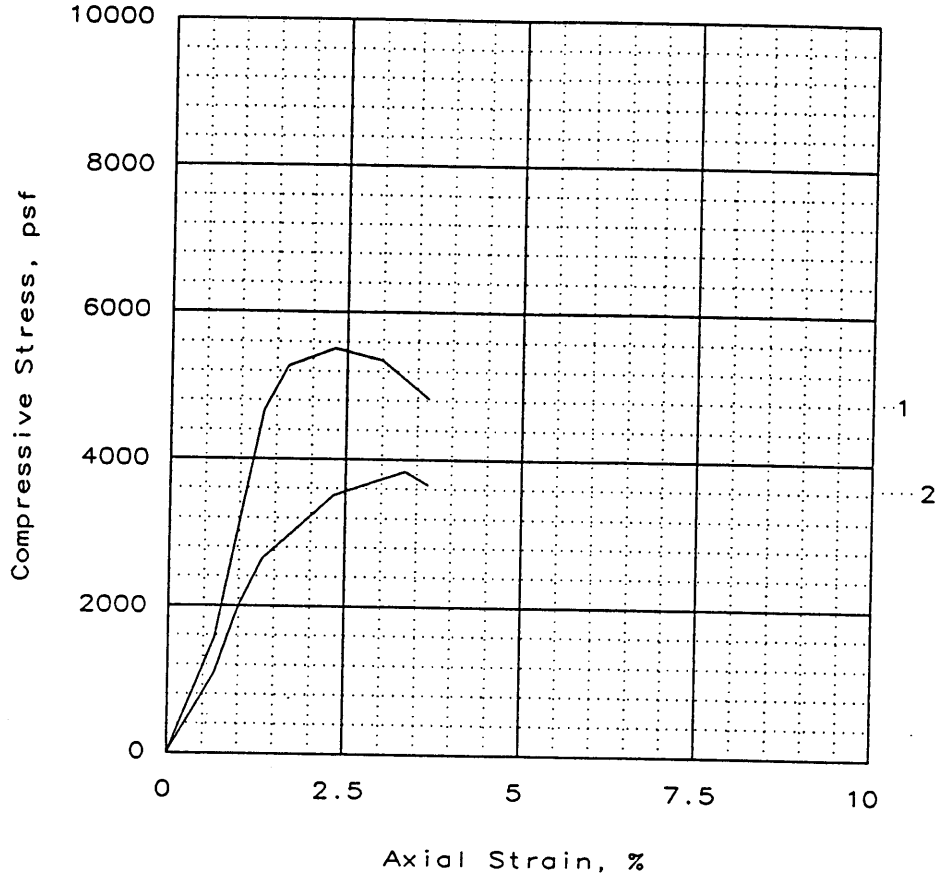
Sample No.: 12

Depth: 39.0 - 41.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	5507	3835		
Undrained shear strength, psf	2754	1917		
Rate of strain, %/min				
Water content, %	31.3	31.7		
Void ratio	0.8335	0.8876		
Saturation, %	101.4	96.6		
Dry density, pcf	91.9	89.3		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT

LL = 70	PL = 24	PI = 46.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-01-94

Remarks:
PENETROMETER - 3.5
TORVAN - MAX.

Fig No.

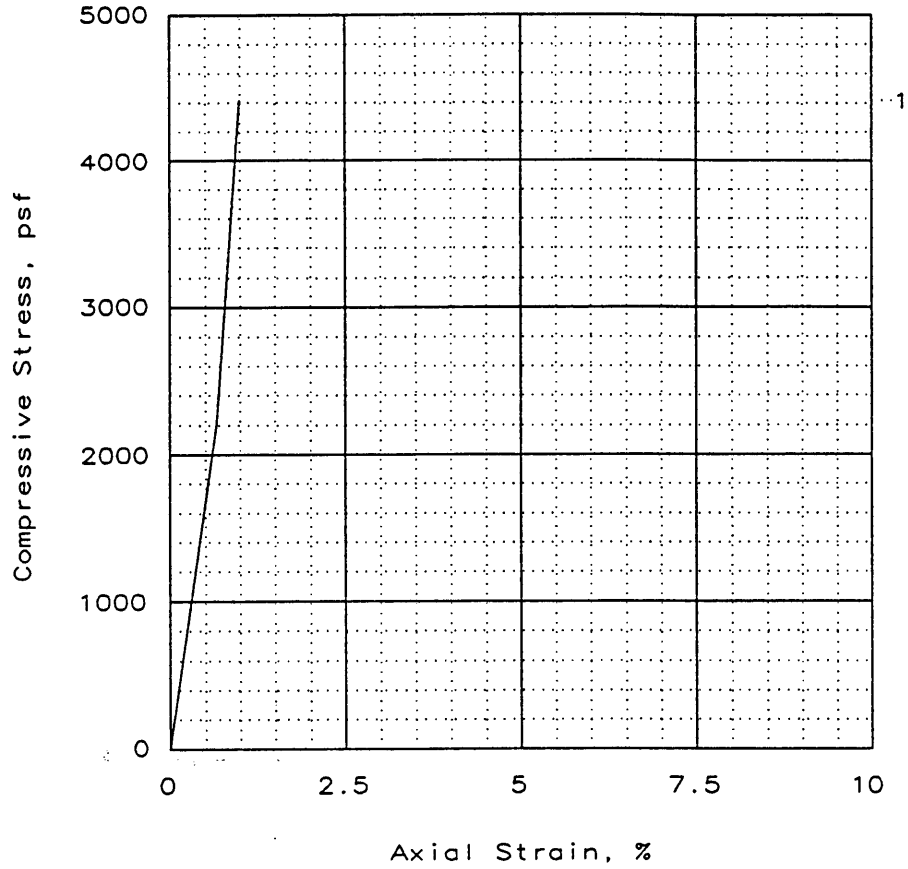
Project: EASTERN ARKANSAS

Boring No.: 18-EAU-94
Sample No.: 14
Depth: 49.0 - 51.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1			
Unconfined strength, psf	4417			
Undrained shear strength, psf	2208			
Rate of strain, %/min				
Water content, %	22.9			
Void ratio	0.6117			
Saturation, %	101.0			
Dry density, pcf	104.6			
Specimen diameter, in	1.38			
Specimen height, in	3.00			

Description: BR. CLAY (CH) FAT IRON OXIDE

LL = 62	PL = 19	PI = 43.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-01-94

Remarks:

PENETROMETER - 3.50

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 18-EAU-94

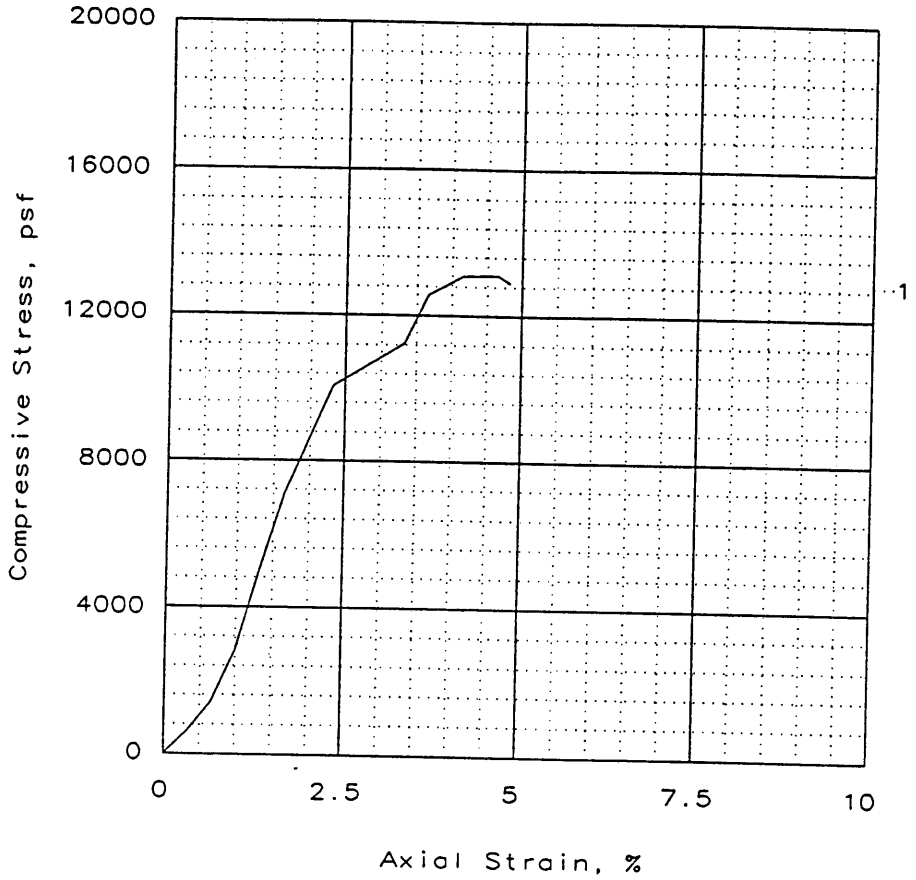
Sample No.: 3

Depth: 5.0 - 7.2

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1			
Unconfined strength, psf	13116			
Undrained shear strength, psf	6558			
Rate of strain, %/min				
Water content, %	22.1			
Void ratio	0.5867			
Saturation, %	101.7			
Dry density, pcf	106.2			
Specimen diameter, in	1.39			
Specimen height, in	3.00			

Description: GR. CLAY (CH) FAT

LL = 53	PL = 18	PI = 35.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 12-01-94
Remarks:
PENETROEMTER - MAX.
TORVAN - MAX.

Fig No.

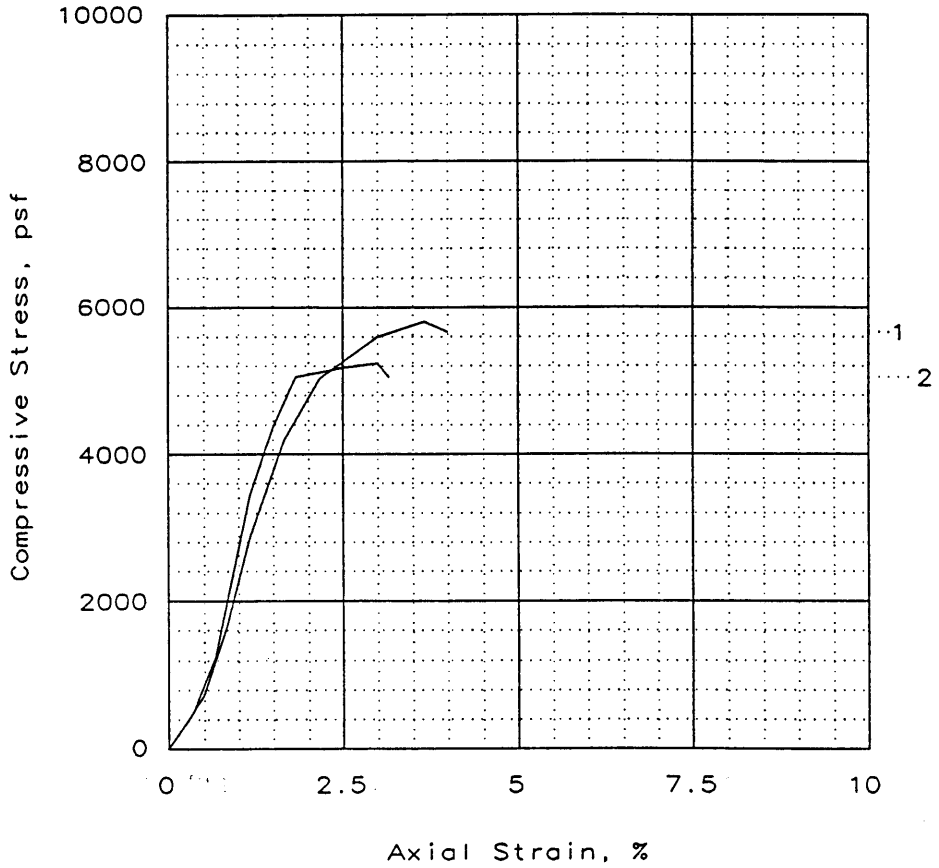
Project: EASTERN ARKANSAS

Boring No.: 19-EAU-94
Sample No.: 4
Depth: 9.0 - 10.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	5804	5240		
Undrained shear strength, psf	2902	2620		
Rate of strain, %/min				
Water content, %	31.2	29.7		
Void ratio	0.8312	0.7996		
Saturation, %	101.3	100.3		
Dry density, pcf	92.0	93.7		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 55	PL = 25	PI = 30.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 12-01-94
Remarks:
PENETROMETER - 1.50
TORVAN - 0.77
50.0 - 51.2 = R. CLAY W/SILT
BOXED
Fig No.

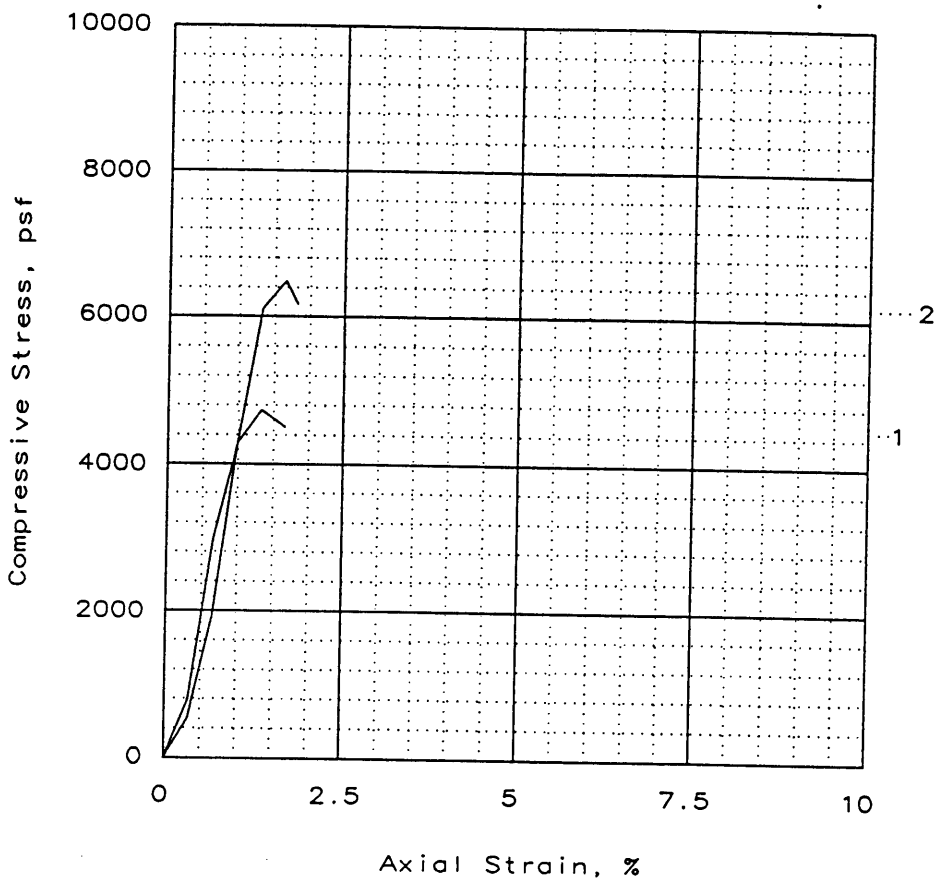
Project: EASTERN ARKANSAS

Boring No.: 19-EAU-94
Sample No.: 14
Depth: 49.0 - 50.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4735	6486		
Undrained shear strength, psf	2367	3243		
Rate of strain, %/min				
Water content, %	18.9	19.5		
Void ratio	0.5558	0.5825		
Saturation, %	92.0	90.2		
Dry density, pcf	108.3	106.5		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: GR CLAY (CH) FAT

LL = 61	PL = 22	PI = 39.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-12-95

Remarks:

PENETROMETER - 4.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 20-EAU-94

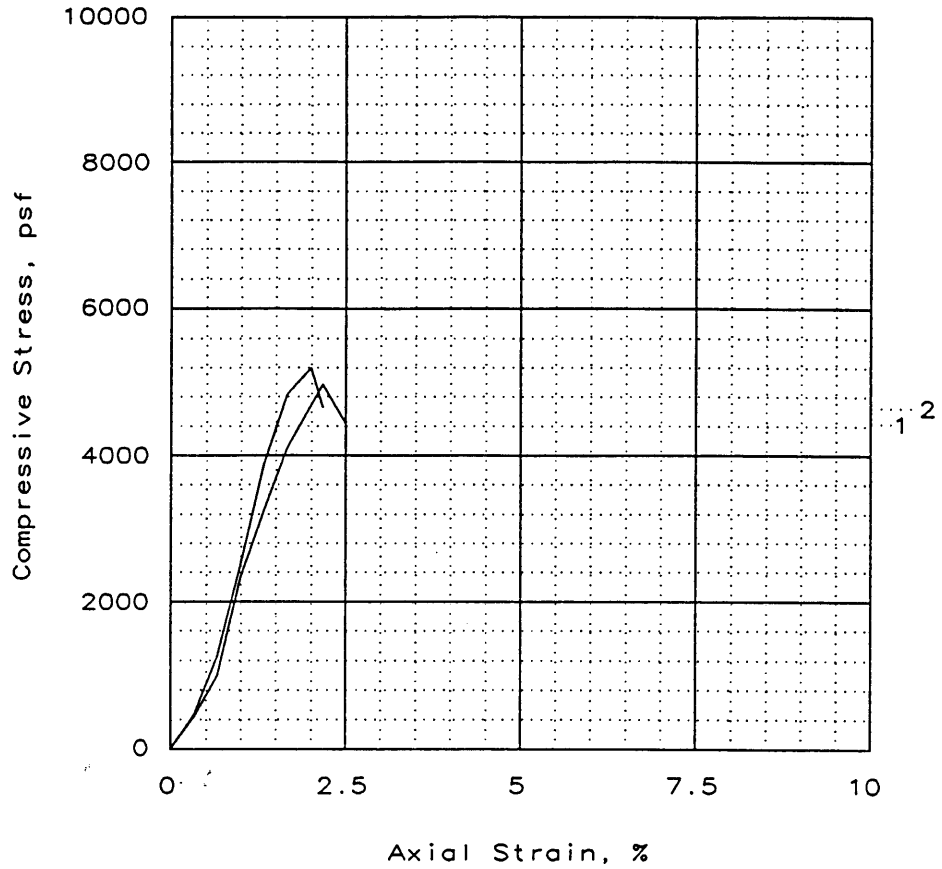
Sample No.: 4

Depth: 8.0 - 10.3

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4971	5193		
Undrained shear strength, psf	2486	2596		
Rate of strain, %/min				
Water content, %	22.3	22.6		
Void ratio	0.6312	0.6078		
Saturation, %	95.3	100.6		
Dry density, pcf	103.3	104.8		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: RD CLAY (CH) FAT

LL = 56	PL = 20	PI = 36.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 01-12-95
Remarks:
PENETROMETER - 3.25
TORVAN - MAX.

Fig No.

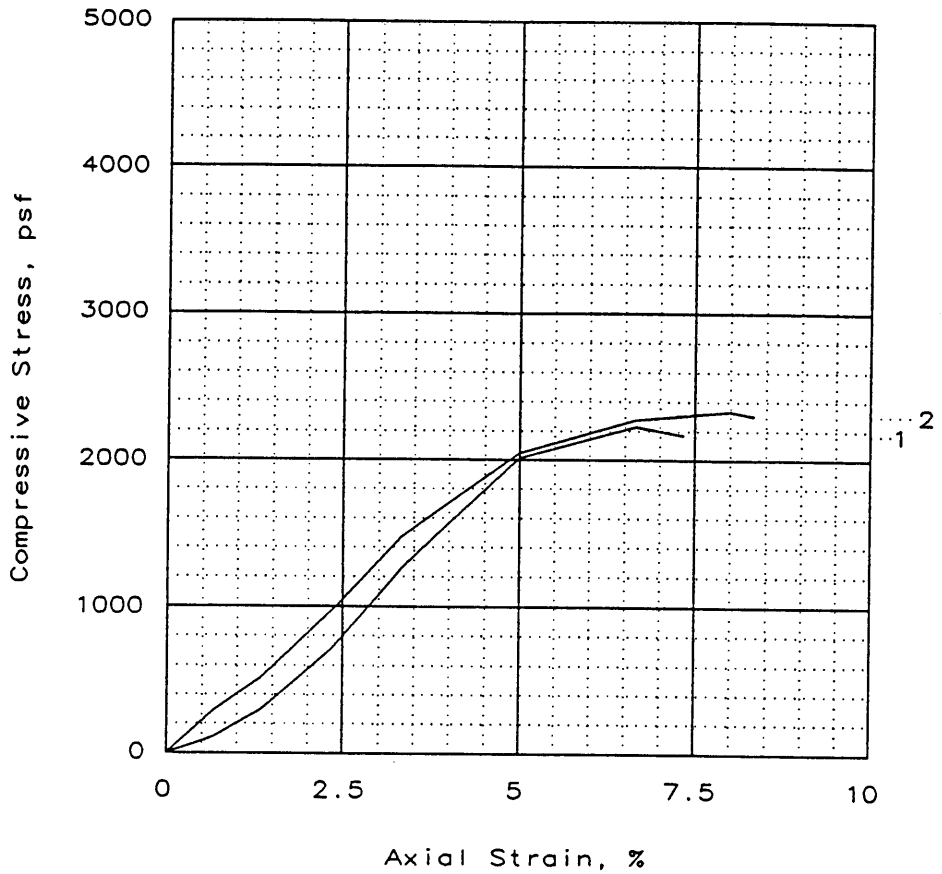
Project: EASTERN ARKANSAS

Boring No.: 20-EAU-94
Sample No.: 9
Depth: 24.0 - 26.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2229	2337		
Undrained shear strength, psf	1115	1168		
Rate of strain, %/min				
Water content, %	30.9	30.9		
Void ratio	0.8019	0.8201		
Saturation, %	103.8	101.4		
Dry density, pcf	93.2	92.3		
Specimen diameter, in	1.37	1.38		
Specimen height, in	3.00	3.00		

Description: GR CLAY (CL) SILTY LENSES OF SILT

LL = 40	PL = 21	PI = 19.0	GS = 2.69	Type: UNDISTURBED

Project No.:

Date: 01-12-95

Remarks:

PENETROMETER - 0.50

TORVAN - 0.39

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 20-EAU-94

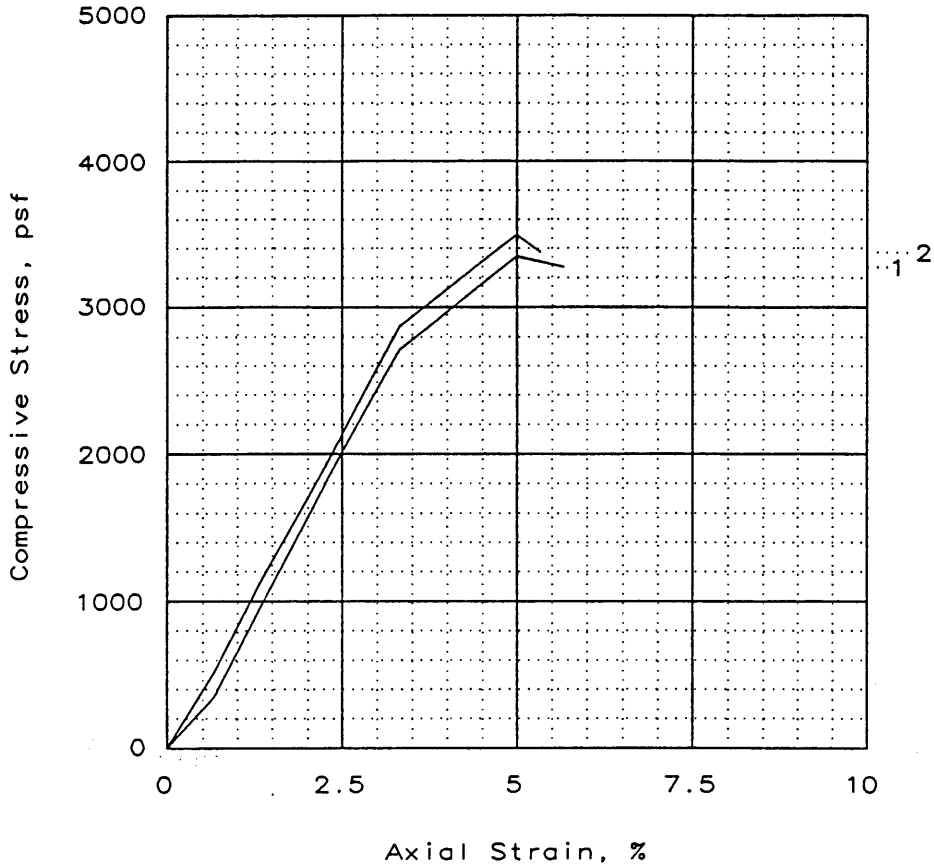
Sample No.: 12

Depth: 49.0 - 50.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3345	3496		
Undrained shear strength, psf	1673	1748		
Rate of strain, %/min				
Water content, %	43.0	43.2		
Void ratio	1.1565	1.1299		
Saturation, %	100.4	103.3		
Dry density, pcf	78.2	79.1		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: BR CLAY (CH) FAT ONE LENS OF SILT

LL = 67	PL = 25	PI = 42.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 01-12-95
Remarks:
PENETROMETER - 1.0
TORVAN - 0.65

Fig No.

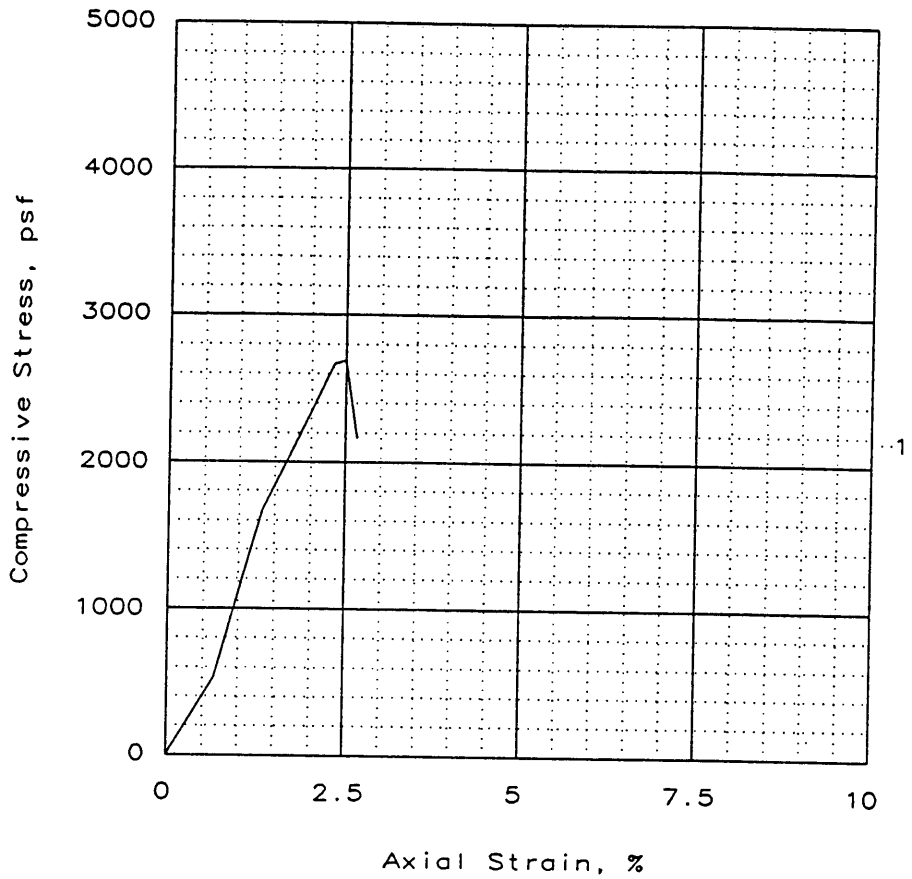
Project: EASTERN ARKANSAS

Boring No.: 20-EAU-94
Sample No.: 13
Depth: 59.0 - 61.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1			
Unconfined strength, psf	2689			
Undrained shear strength, psf	1344			
Rate of strain, %/min				
Water content, %	26.8			
Void ratio	0.8774			
Saturation, %	82.0			
Dry density, pcf	89.1			
Specimen diameter, in	1.38			
Specimen height, in	3.00			

Description: BR. CLAY (CL) LEAN LENSES OF SILT

LL = 38	PL = 21	PI = 17.0	GS = 2.68	Type: UNDISTURBED

Project No.:

Date: 01-24-94

Remarks:

PENETROMETER - 1.25

TORVAN - 0.84

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 21-EAU-94

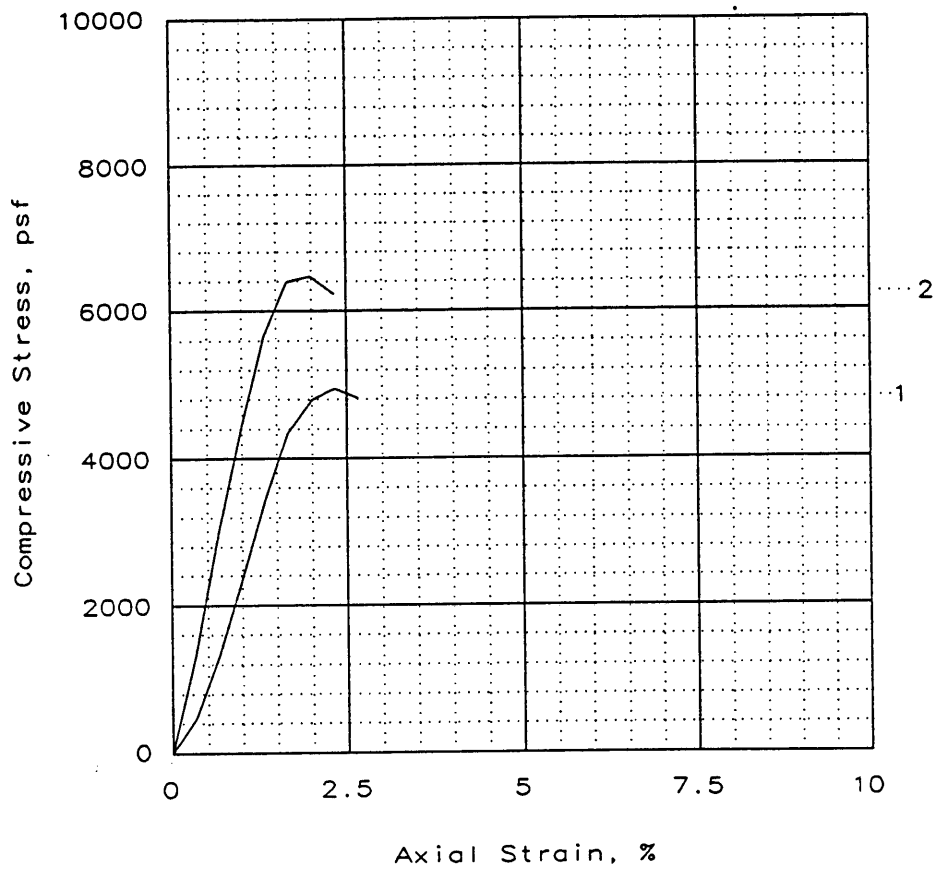
Sample No.: 3

Depth: 6.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4953	6465		
Undrained shear strength, psf	2477	3232		
Rate of strain, %/min				
Water content, %	17.1	18.8		
Void ratio	0.5874	0.5579		
Saturation, %	78.4	90.8		
Dry density, pcf	105.8	107.8		
Specimen diameter, in	1.39	1.38		
Specimen height, in	3.00	3.00		

Description: GR CLAY (CL) SILTY IRON OXIDE

LL = 43	PL = 18	PI = 25.0	GS = 2.69	Type: UNDISTURBED

Project No.:

Date: 01-26-95

Remarks:

PENETROMETER - 3.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 22-EAU-94

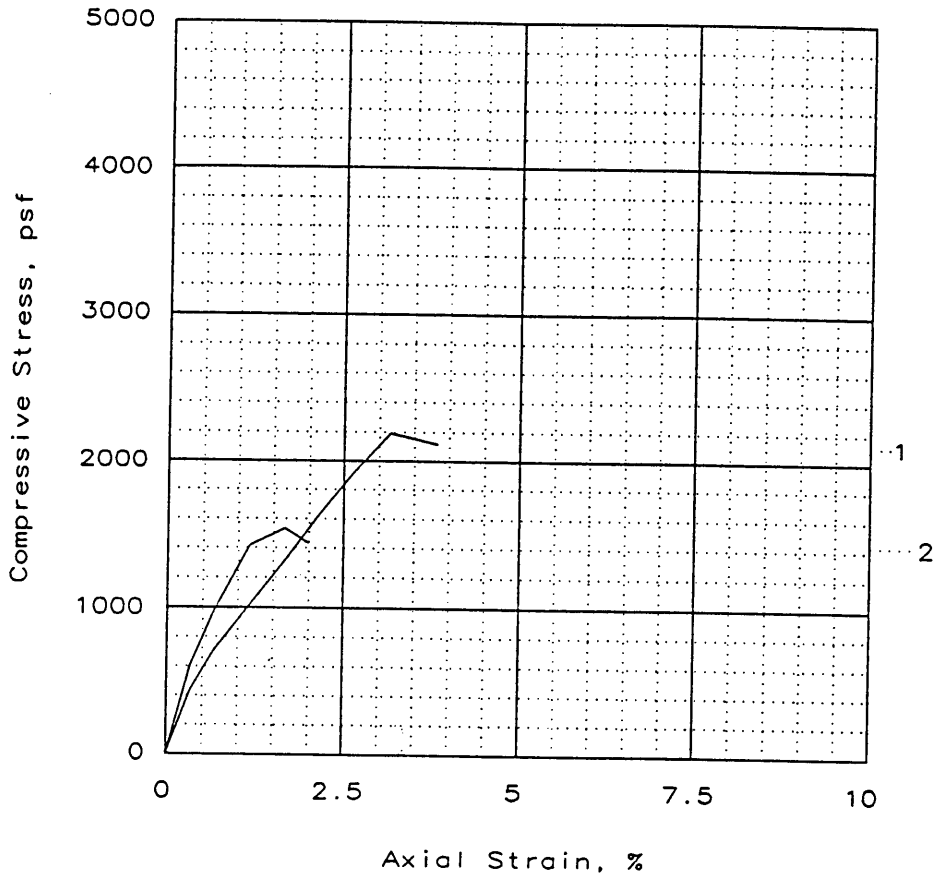
Sample No.: 3

Depth: 5.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2192	1533		
Undrained shear strength, psf	1096	767		
Rate of strain, %/min				
Water content, %	22.8	21.7		
Void ratio	0.7074	0.6505		
Saturation, %	87.2	90.1		
Dry density, pcf	98.7	102.1		
Specimen diameter, in	1.40	1.38		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT IRON OXIDE

LL = 56	PL = 16	PI = 40.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 01-26-95
Remarks:
PENETROMETER - 2.5
TORVAN - MAX.
UPPER SAMPLE - BOXED

Fig No.

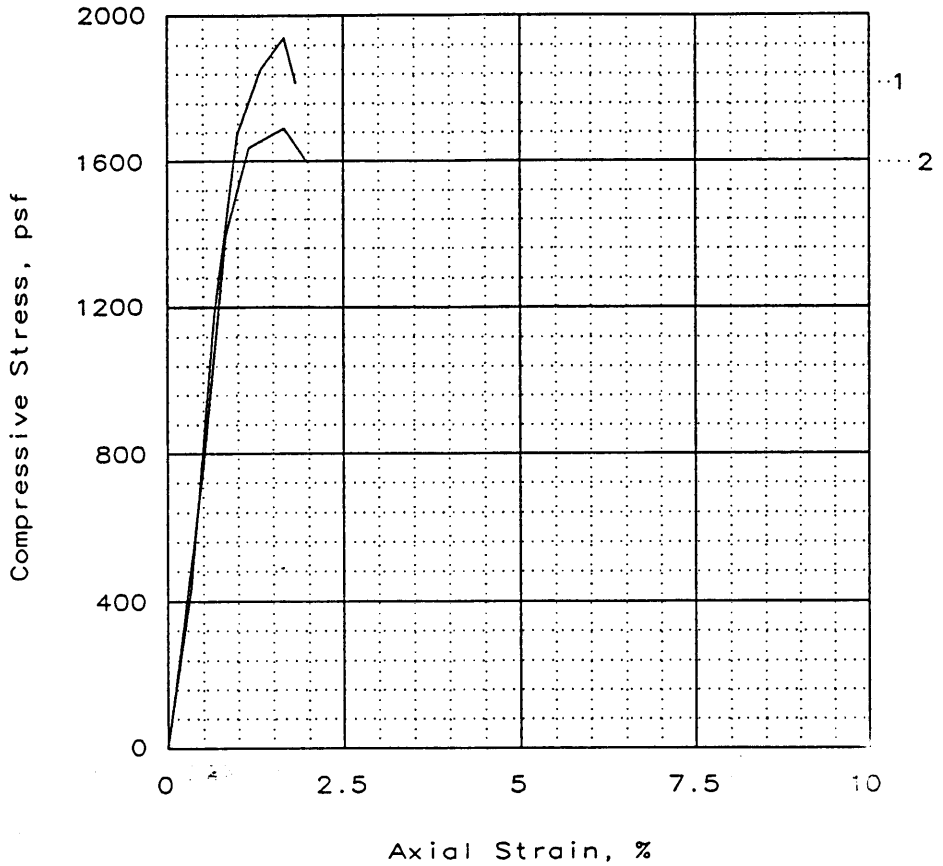
Project: EASTERN ARKANSAS

Boring No.: 22-EAU-94
Sample No.: 4
Depth: 9.0 - 10.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	1940	1691		
Undrained shear strength, psf	970	846		
Rate of strain, %/min				
Water content, %	35.1	34.4		
Void ratio	0.9317	0.8966		
Saturation, %	101.8	103.7		
Dry density, pcf	87.3	88.9		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT MOIST & STIFF

LL = 75	PL = 24	PI = 51.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 01-26-95

Remarks:

PENETROMETER - 2.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 22-EAU-94

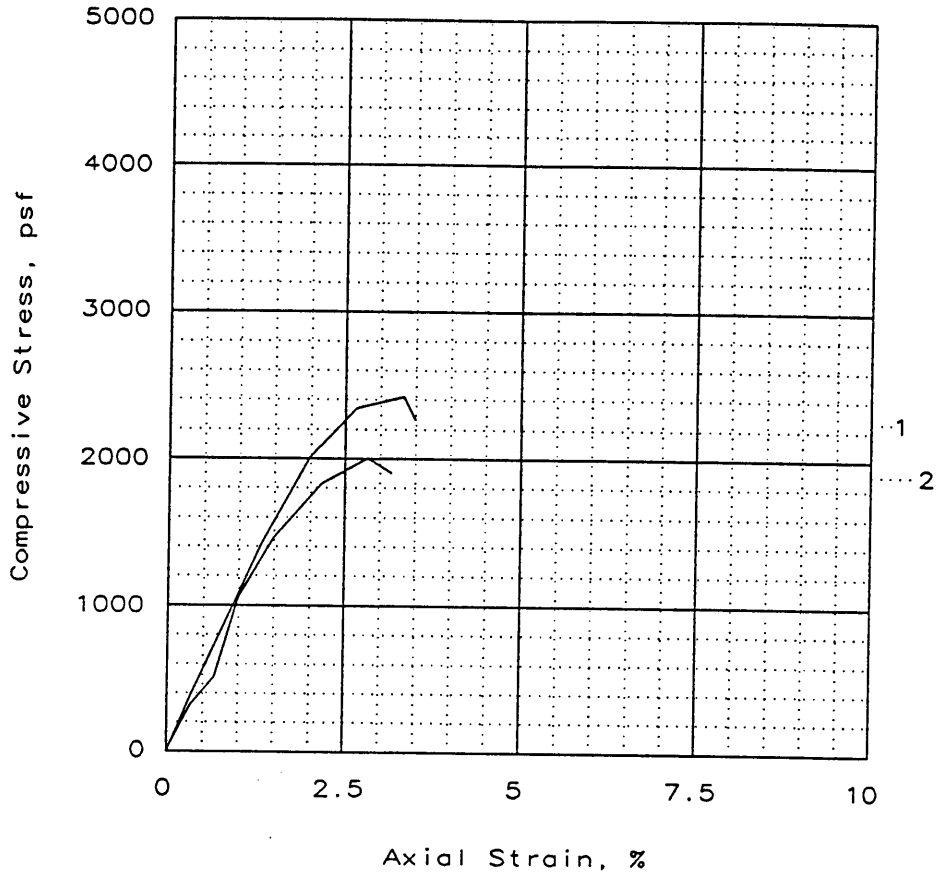
Sample No.: 5

Depth: 11.0 - 13.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2420	2005		
Undrained shear strength, psf	1210	1002		
Rate of strain, %/min				
Water content, %	18.2	18.6		
Void ratio	0.5872	0.6019		
Saturation, %	83.6	83.6		
Dry density, pcf	106.2	105.2		
Specimen diameter, in	1.38	1.37		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT SMALL LENSES OF SILT

LL = 35	PL = 18	PI = 17.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 01-26-95

Remarks:
PENETROMETER - 2.50
TORVAN - MAX.
UPPER SAMPLE - BOXED

Fig No.

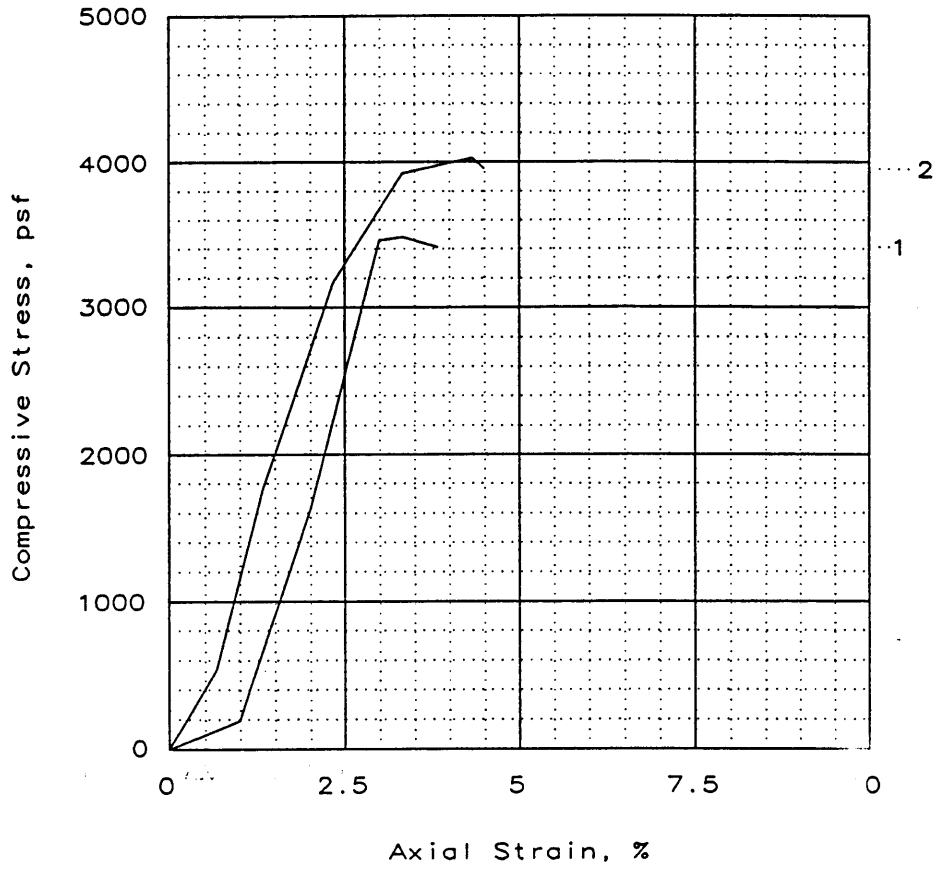
Project: EASTERN ARKANSAS

Boring No.: 24-EAU-94
Sample No.: 3
Depth: 6.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3482	4029		
Undrained shear strength, psf	1741	2015		
Rate of strain, %/min				
Water content, %	20.5	19.6		
Void ratio	0.5994	0.5783		
Saturation, %	91.8	91.4		
Dry density, pcf	105.0	106.4		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CH) SILTY MOIST & STIFF

LL = 49	PL = 15	PI = 34.0	GS = 2.69	Type: UNDISTURBED

Project No.:
Date: 11-02-94
Remarks:
PENETROMETER - 2.75
TORVAN - MAX.

Fig No.

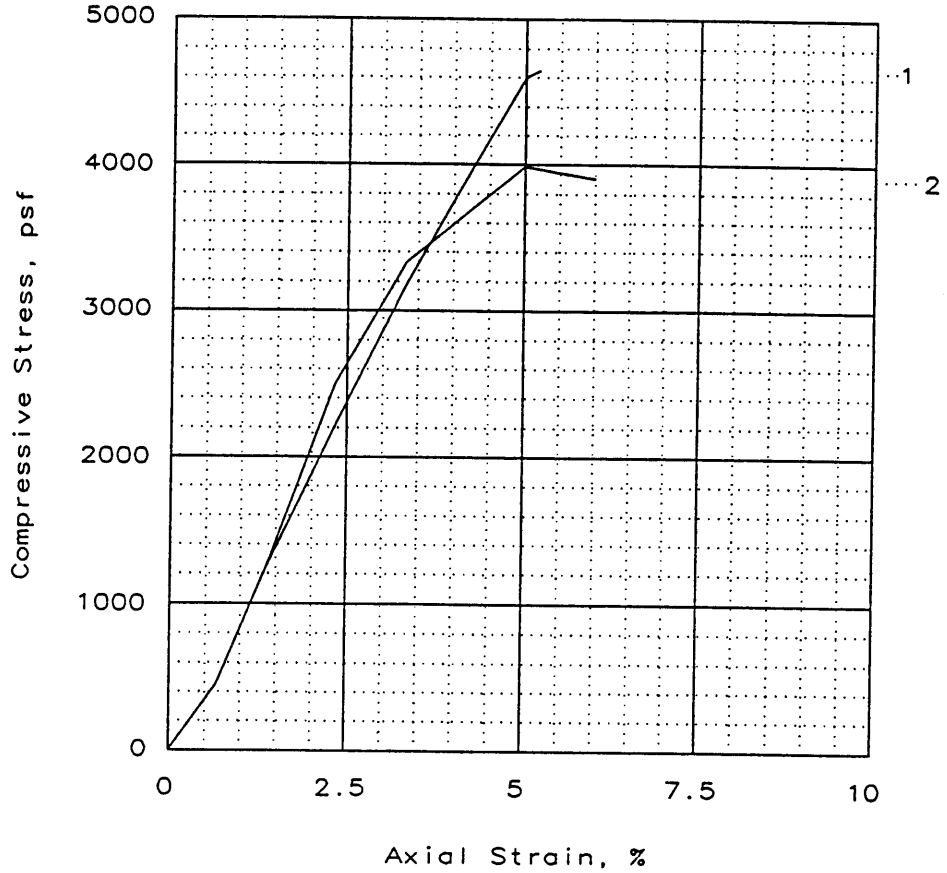
Project: EASTERN ARKANSAS

Boring No.: 23-EAU-94
Sample No.: 3
Depth: 5.0 - 7.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4649	3986		
Undrained shear strength, psf	2324	1993		
Rate of strain, %/min				
Water content, %	19.9	23.4		
Void ratio	0.5640	0.6499		
Saturation, %	95.2	97.1		
Dry density, pcf	107.8	102.2		
Specimen diameter, in	1.38	1.39		
Specimen height, in	3.00	3.00		

Description: BR & GR (CH) FAT MOIST & STIFF

LL = 53	PL = 17	PI = 36.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-02-94
Remarks:
PENETROMETER - 3.0
TORVAN - 3.0

Fig No.

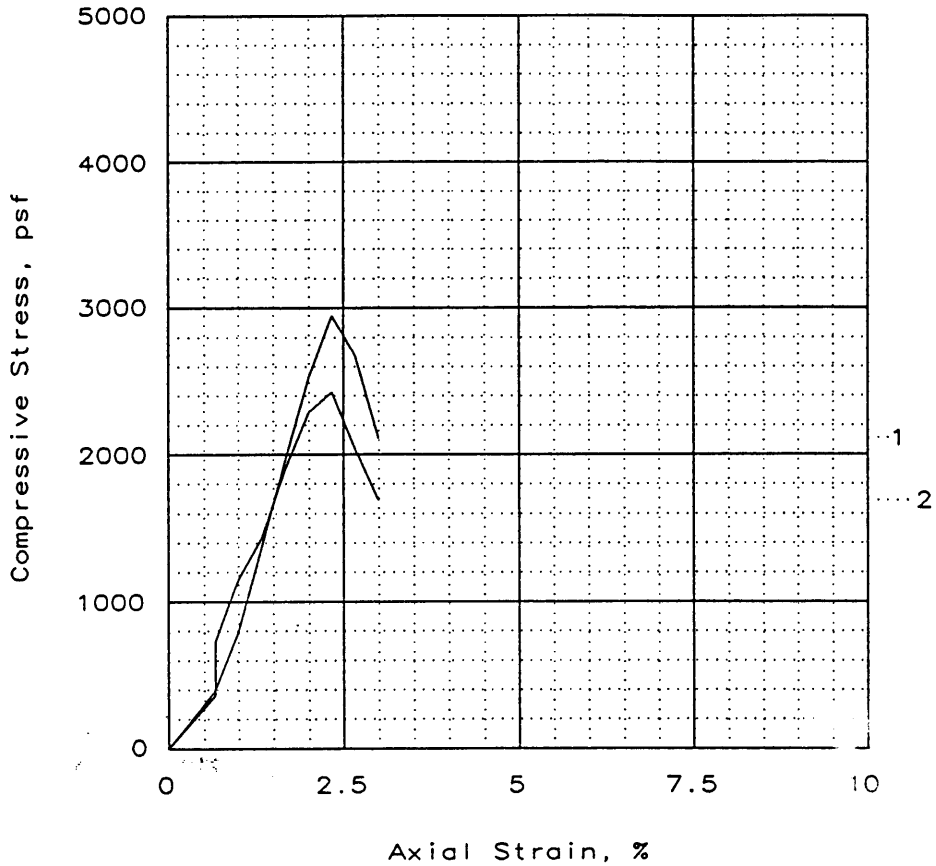
Project: EASTERN ARKANSAS

Boring No.: 23-EAU-94
Sample No.: 4
Depth: 8.0 - 10.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2950	2426		
Undrained shear strength, psf	1475	1213		
Rate of strain, %/min				
Water content, %	26.8	28.9		
Void ratio	0.7312	0.7828		
Saturation, %	98.9	99.7		
Dry density, pcf	97.4	94.5		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT SLICKENSIDE

LL = 71	PL = 22	PI = 49.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-02-94
Remarks:
UPPER PENETROMETER2.25
LOWER PENETROMETER 3.0
UPPER TORVAN MAX.
LOWER TORVAN 0.51
Fig No.

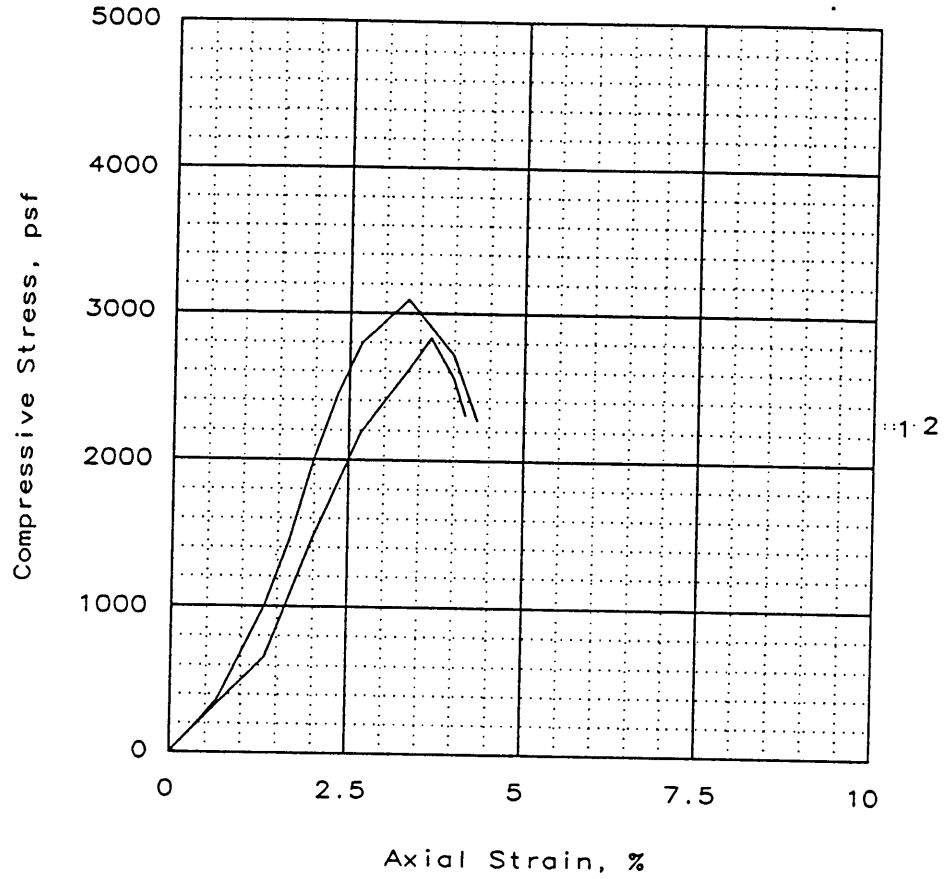
Project: EASTERN ARKANSAS

Boring No.: 23-EAU-94
Sample No.: 5
Depth: 11.0 - 13.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3096	2833		
Undrained shear strength, psf	1548	1416		
Rate of strain, %/min				
Water content, %	32.3	32.3		
Void ratio	0.8767	0.9083		
Saturation, %	99.4	96.1		
Dry density, pcf	89.8	88.3		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT MOIST & STIFF

LL = 76	PL = 22	PI = 54.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-02-94

Remarks:

PENETROMETER - 2.5

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 23-EAU-94

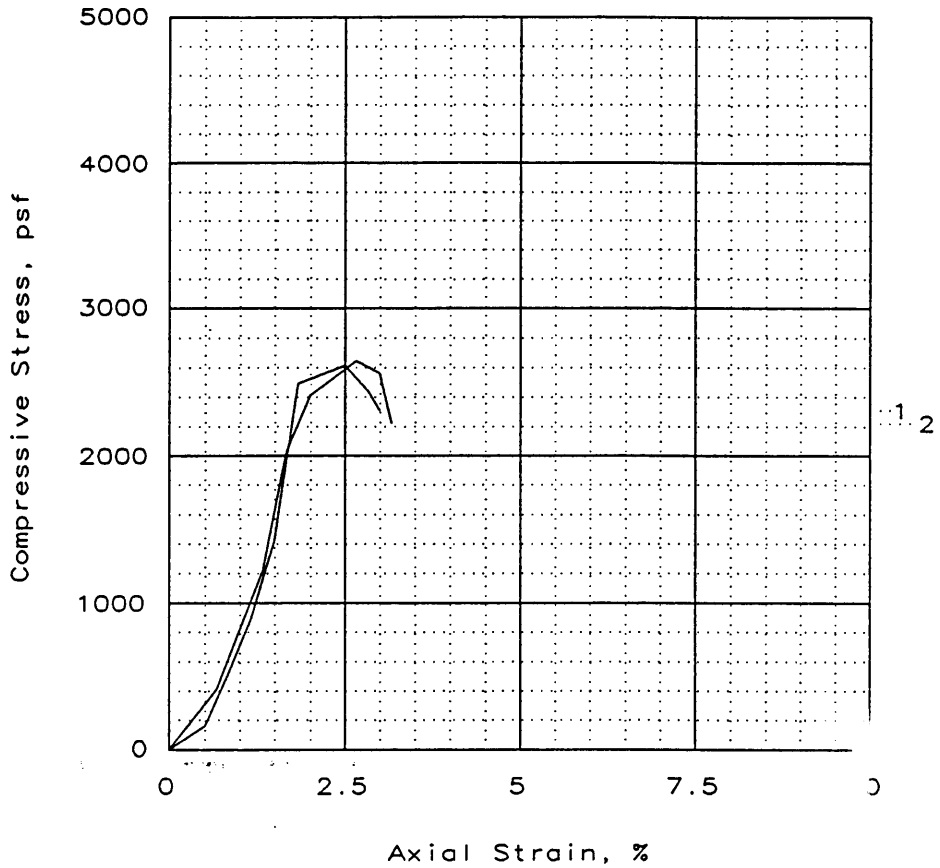
Sample No.: 6

Depth: 14.0 - 15.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2614	2645		
Undrained shear strength, psf	1307	1322		
Rate of strain, %/min				
Water content, %	28.6	28.5		
Void ratio	0.7465	0.7488		
Saturation, %	103.5	102.8		
Dry density, pcf	96.5	96.4		
Specimen diameter, in	1.39	1.39		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT C.C.

LL = 81	PL = 21	PI = 60.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-02-94

Remarks:

PENETROMETER - 3.25

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 23-EAU-94

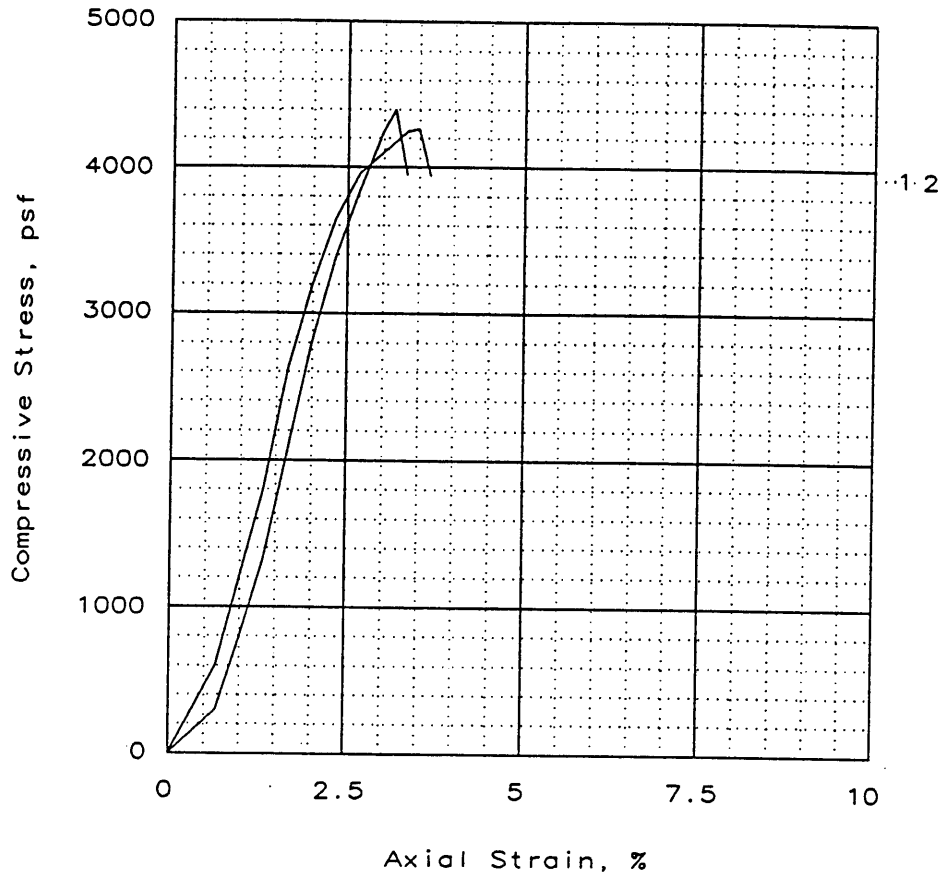
Sample No.: 8

Depth: 20.0 - 22.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	4395	4263		
Undrained shear strength, psf	2198	2131		
Rate of strain, %/min				
Water content, %	25.1	24.7		
Void ratio	0.6502	0.6748		
Saturation, %	104.1	98.9		
Dry density, pcf	102.1	100.6		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RED CLAY (CH) FAT SLICKENSIDE.

LL = 59	PL = 22	PI = 37.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-02-94
Remarks:
PENETROMETER - 4.25
TORVAN - MAX.

Fig No.

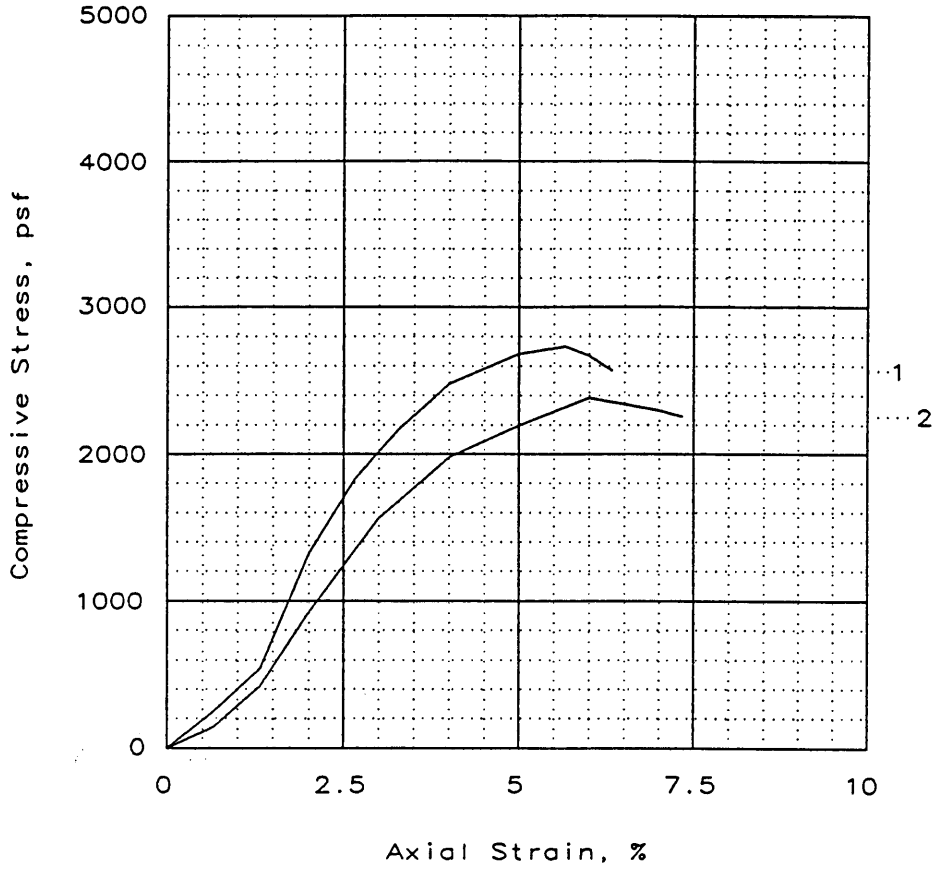
Project: EASTERN ARKANSAS

Boring No.: 23-EAU-94
Sample No.: 10
Depth: 29.0 - 31.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2730	2384		
Undrained shear strength, psf	1365	1192		
Rate of strain, %/min				
Water content, %	32.4	32.4		
Void ratio	0.8602	0.8905		
Saturation, %	101.6	98.3		
Dry density, pcf	90.6	89.2		
Specimen diameter, in	1.38	1.37		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT MOIST & STIFF

LL = 48	PL = 25	PI = 23.0	GS = 2.70	Type: UNDISTUBED

Project No.:

Date: 11-02-94

Remarks:

PENETROMETER - 1.5

TORVAN - 0.82

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 23-EAU-94

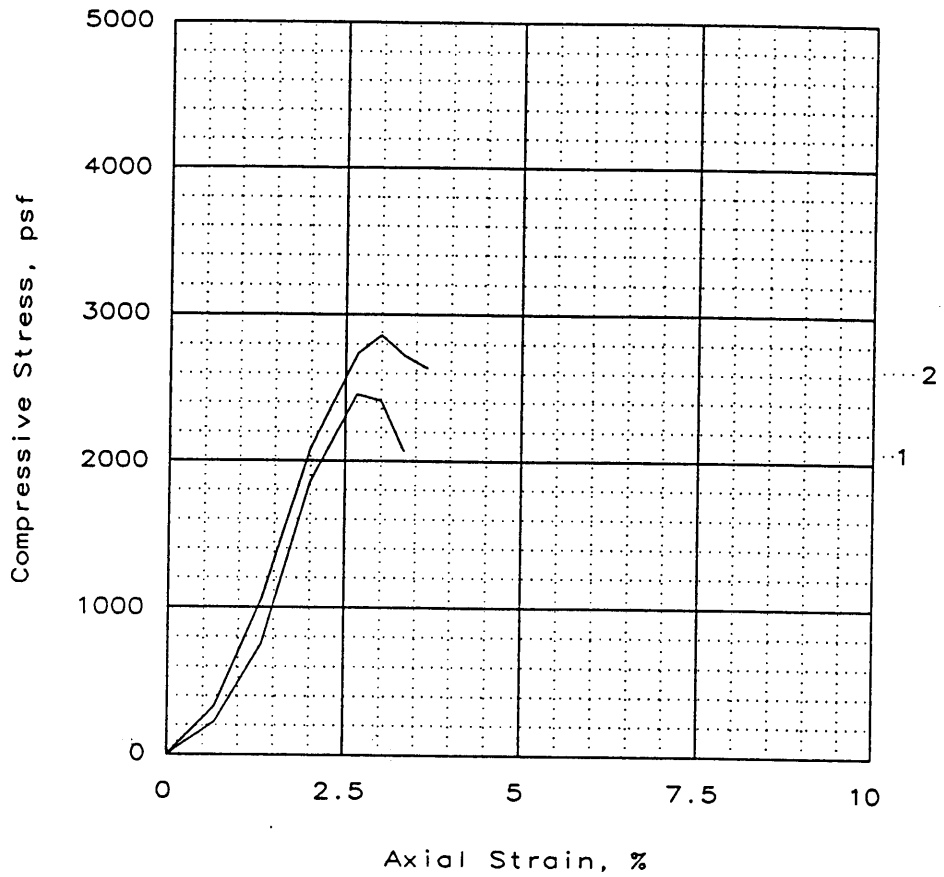
Sample No.: 13

Depth: 45.2 - 46.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2456	2861		
Undrained shear strength, psf	1228	1430		
Rate of strain, %/min				
Water content, %	37.5	37.1		
Void ratio	1.0128	0.9967		
Saturation, %	100.0	100.4		
Dry density, pcf	83.7	84.4		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT LIGNITE, MOIST & STIFF.

LL = 90	PL = 24	PI = 66.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-02-94

Remarks:

PENETROMETER - 1.75

TORVAN - 0.94

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 23-EAU-94

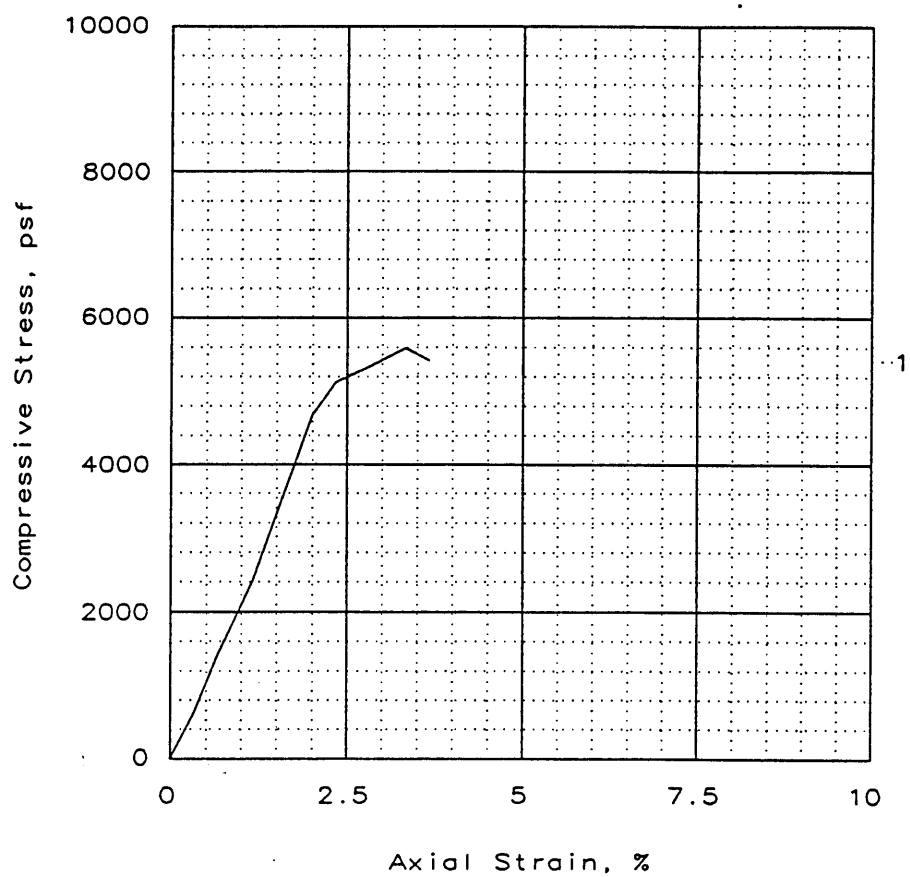
Sample No.: 15

Depth: 54.0 - 56.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1			
Unconfined strength, psf	5590			
Undrained shear strength, psf	2795			
Rate of strain, %/min				
Water content, %	16.8			
Void ratio	0.6943			
Saturation, %	65.5			
Dry density, pcf	99.5			
Specimen diameter, in	1.38			
Specimen height, in	3.00			

Description: BR & GR CLAY (CH) FAT

LL = 50	PL = 19	PI = 31.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-29-94

Remarks:

PENETROMETER - MAX.

TORVAN - MAX.

BOTTOM SAMPLE - BOXED

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 25-EAU-94

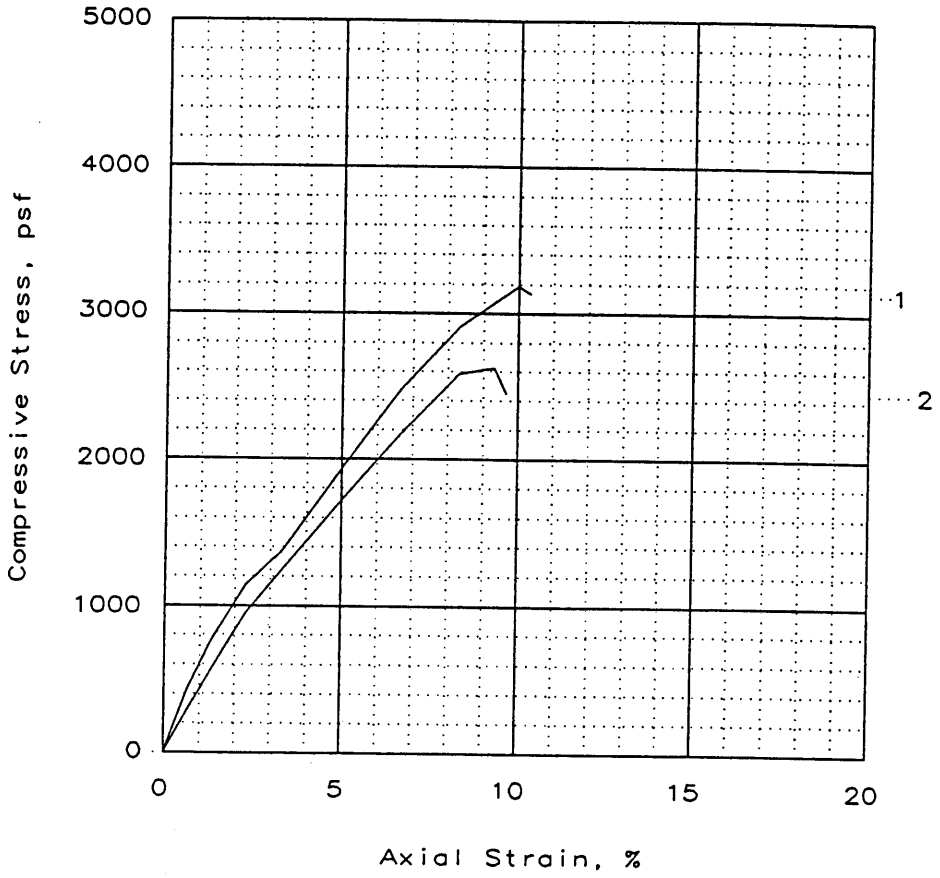
Sample No.: 3

Depth: 5.0 - 6.0

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3189	2623		
Undrained shear strength, psf	1595	1311		
Rate of strain, %/min				
Water content, %	19.3	19.1		
Void ratio	0.5037	0.5067		
Saturation, %	102.8	101.3		
Dry density, pcf	111.3	111.0		
Specimen diameter, in	1.37	1.37		
Specimen height, in	3.00	3.00		

Description: RD & GR CLAY (CL) LEAN, LENSES OF SILT.

LL = 27	PL = 18	PI = 9.0	GS = 2.68	Type: UNDISTURBED

Project No.:
Date: 11-29-94
Remarks:
PENETROMETER - 3.5
TORVAN - MAX.

Fig No.

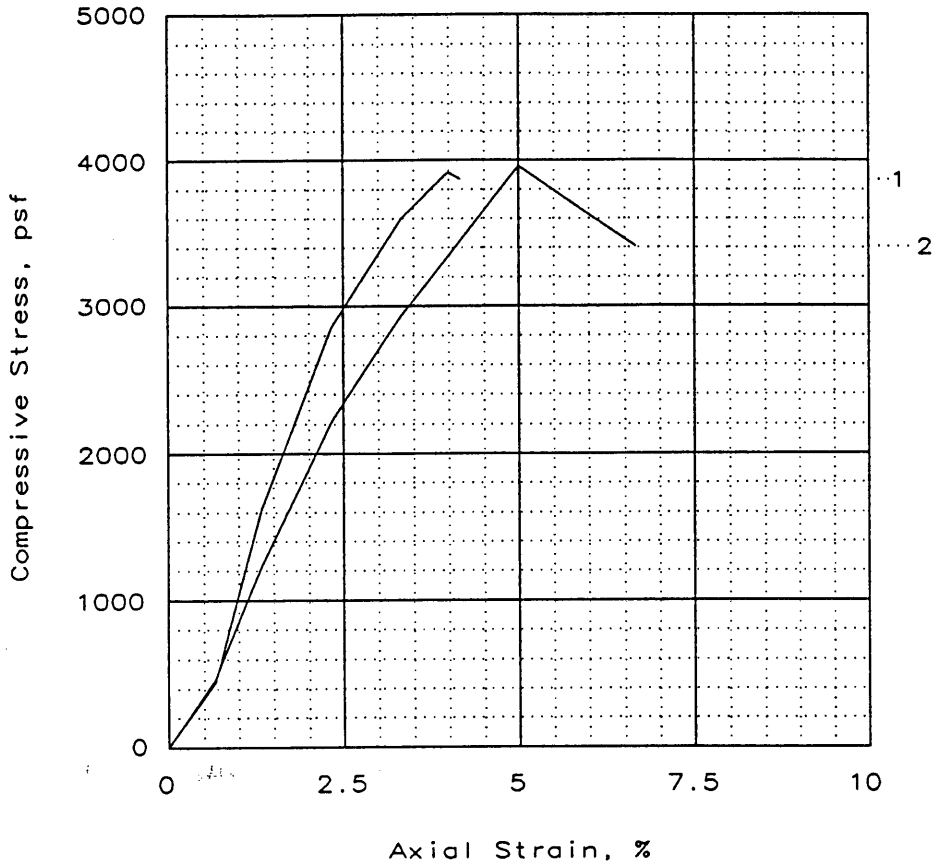
Project: EASTERN ARKANSAS

Boring No.: 25-EAU-94
Sample No.: 4
Depth: 8.0 - 9.6

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3917	3961		
Undrained shear strength, psf	1959	1981		
Rate of strain, %/min				
Water content, %	32.2	30.4		
Void ratio	0.8559	0.7954		
Saturation, %	101.5	103.2		
Dry density, pcf	90.8	93.9		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 72	PL = 26	PI = 46.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-29-94

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 25-EAU-94

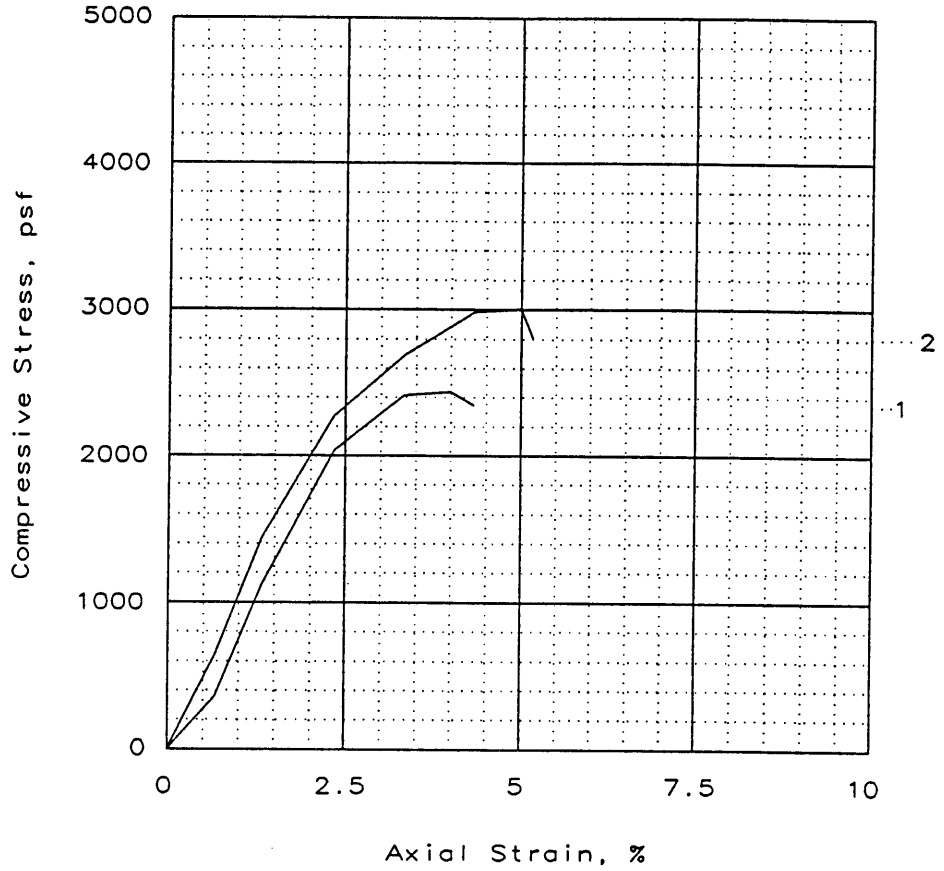
Sample No.: 10

Depth: 29.0 - 31.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2441	3004		
Undrained shear strength, psf	1221	1502		
Rate of strain, %/min				
Water content, %	34.8	34.2		
Void ratio	0.9379	0.9135		
Saturation, %	100.3	101.0		
Dry density, pcf	87.0	88.1		
Specimen diameter, in	1.38	1.39		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 76	PL = 29	PI = 47.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-29-94

Remarks:

PENETROMETER - 1.75

TORVAN - 0.91

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 25-EAU-94

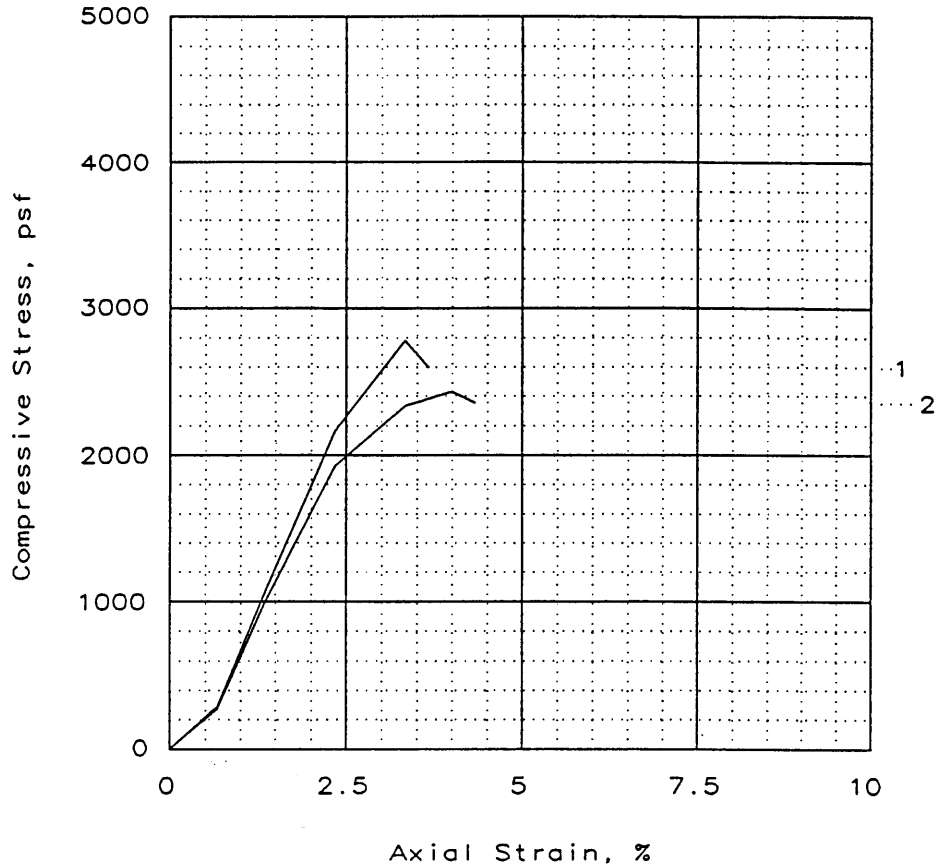
Sample No.: 11

Depth: 34.0 - 36.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	2780	2431		
Undrained shear strength, psf	1390	1216		
Rate of strain, %/min				
Water content, %	37.1	36.9		
Void ratio	0.9679	0.9612		
Saturation, %	103.6	103.6		
Dry density, pcf	85.7	85.9		
Specimen diameter, in	1.37	1.38		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 79	PL = 25	PI = 54.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-29-94

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 25-EAU-94

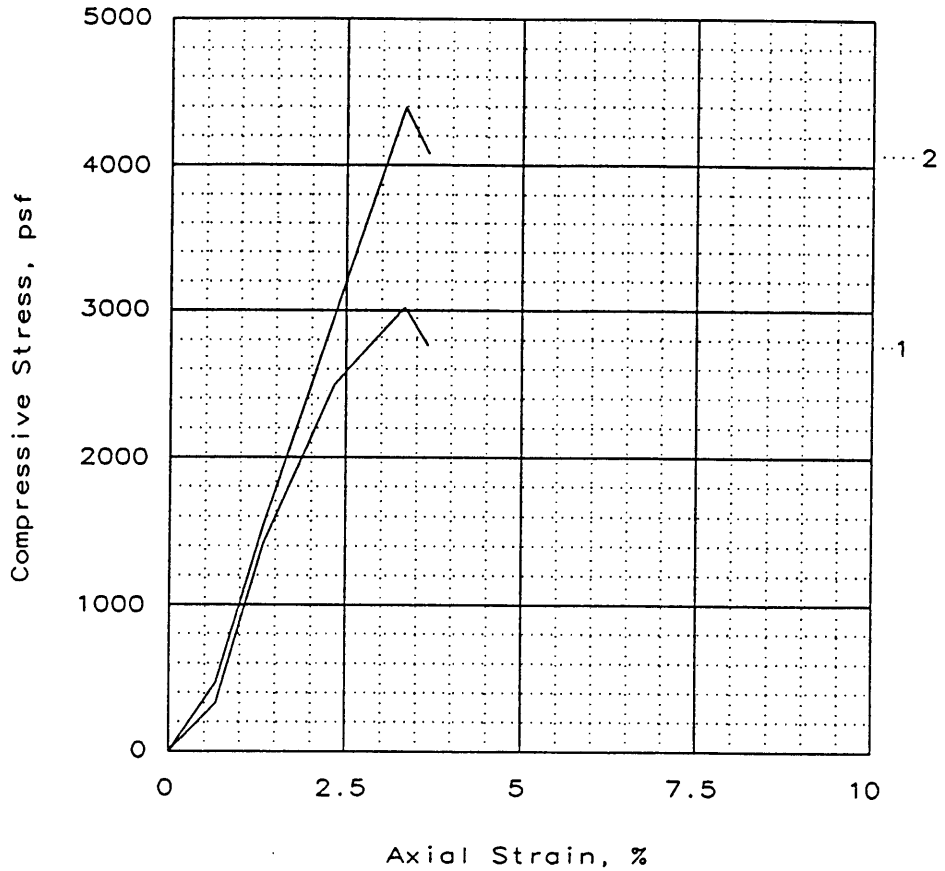
Sample No.: 13

Depth: 44.0 - 46.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3023	4392		
Undrained shear strength, psf	1512	2196		
Rate of strain, %/min				
Water content, %	36.8	36.6		
Void ratio	0.9656	0.9776		
Saturation, %	102.9	101.1		
Dry density, pcf	85.8	85.2		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: BR & GR CLAY (CH) FAT, SHELLS

LL = 84	PL = 28	PI = 56.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-29-94
Remarks:
PENETROMETER - 2.0
TORVAN - 0.88

Fig No.

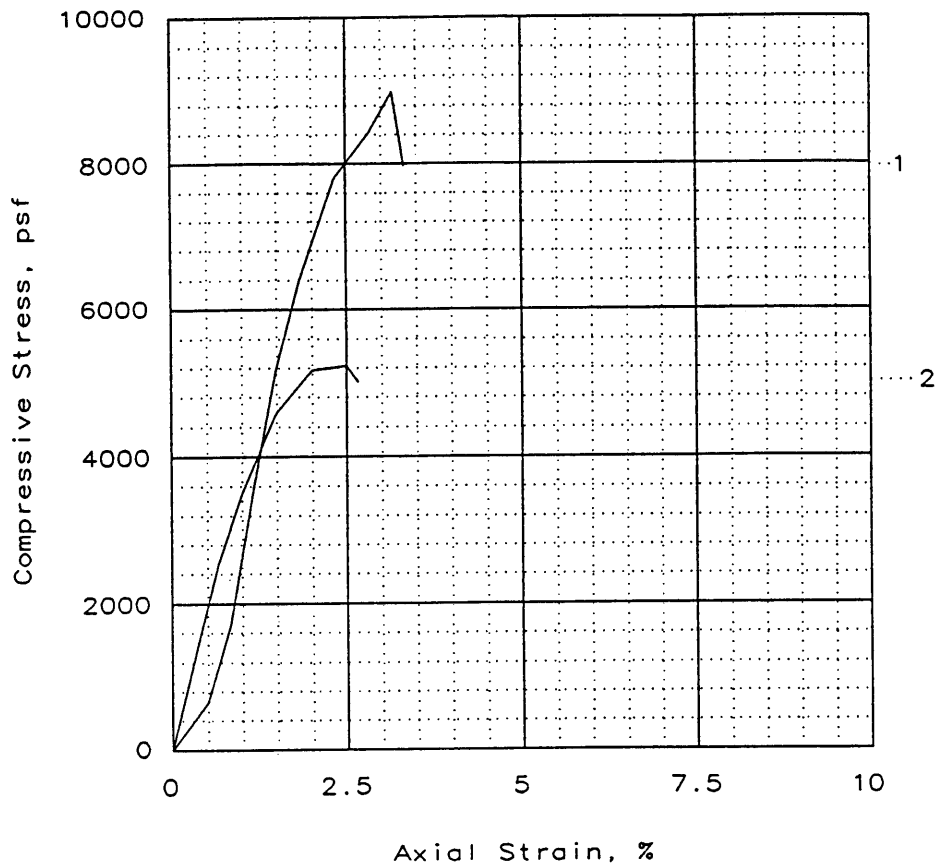
Project: EASTERN ARKANSAS

Boring No.: 25-EAU-94
Sample No.: 14
Depth: 49.0 - 51.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	8989	5234		
Undrained shear strength, psf	4494	2617		
Rate of strain, %/min				
Water content, %	32.0	34.1		
Void ratio	0.9266	0.9263		
Saturation, %	93.2	99.4		
Dry density, pcf	87.5	87.5		
Specimen diameter, in	1.37	1.37		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 75	PL = 29	PI = 46.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-29-94

Remarks:

PENETROMETER - 2.5

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 25-EAU-94

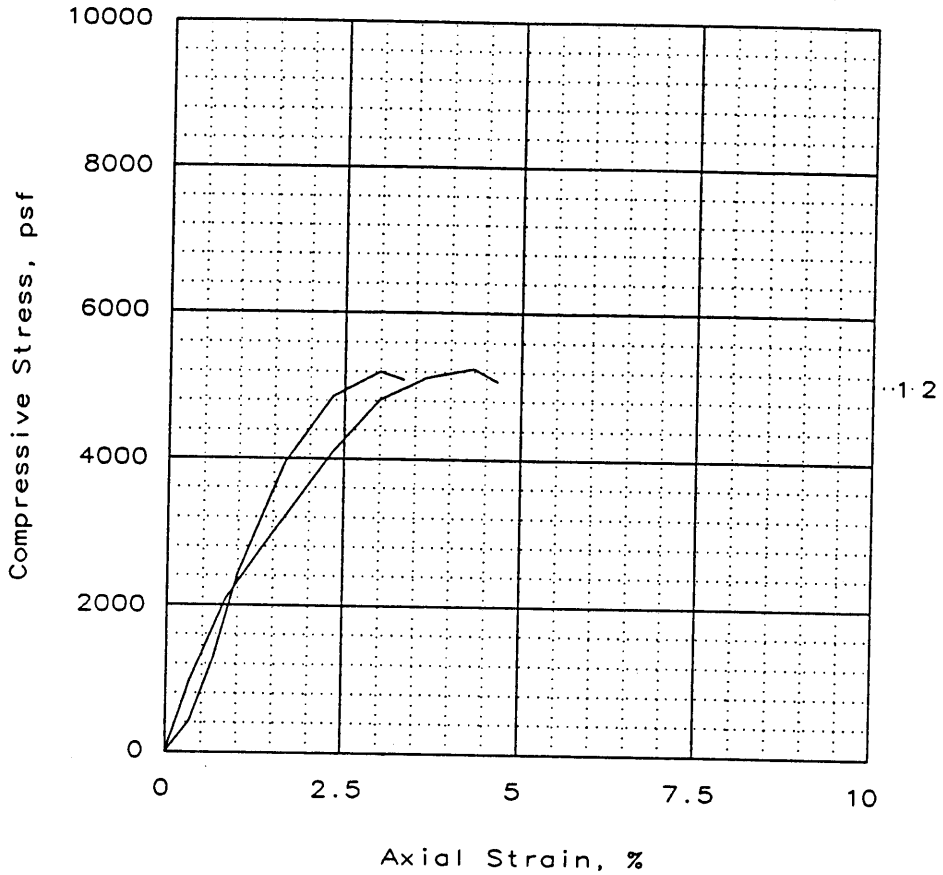
Sample No.: 15

Depth: 59.0 - 61.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	5243	5200		
Undrained shear strength, psf	2622	2600		
Rate of strain, %/min				
Water content, %	51.6	51.6		
Void ratio	1.3465	1.3624		
Saturation, %	103.5	102.2		
Dry density, pcf	71.8	71.3		
Specimen diameter, in	1.37	1.38		
Specimen height, in	3.00	3.00		

Description: GR. CLAY (CH) FAT

LL = 94	PL = 28	PI = 66.0	GS = 2.70	Type: UNDISTURBED

Project No.:
Date: 11-29-94

Remarks:
PENETROMETER - 1.5
TORVAN - 0.80
LOWER 0.5" - SHELLS

Fig No.

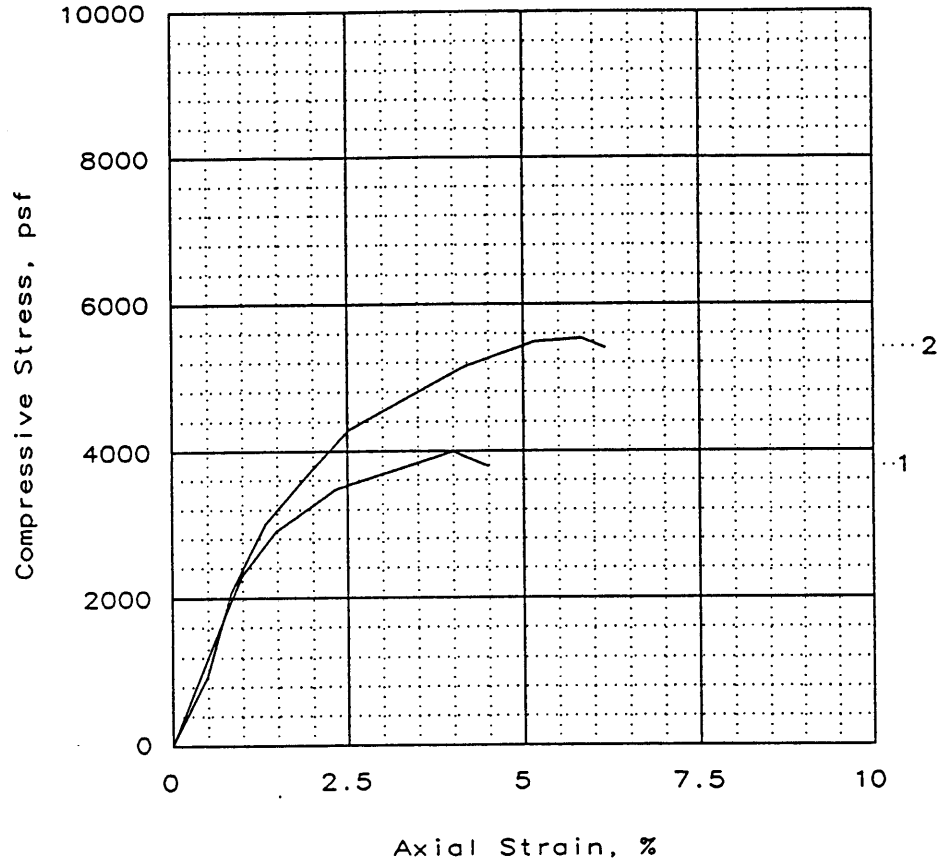
Project: EASTERN ARKANSAS

Boring No.: 25-EAU-94
Sample No.: 16
Depth: 69.0 - 71.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE

UNCONFINED COMPRESSION TEST



Specimen number:	1	2		
Unconfined strength, psf	3996	5538		
Undrained shear strength, psf	1998	2769		
Rate of strain, %/min				
Water content, %	34.5	33.4		
Void ratio	0.8885	0.8370		
Saturation, %	104.9	107.6		
Dry density, pcf	89.3	91.8		
Specimen diameter, in	1.38	1.38		
Specimen height, in	3.00	3.00		

Description: RD. CLAY (CH) FAT

LL = 76	PL = 26	PI = 50.0	GS = 2.70	Type: UNDISTURBED

Project No.:

Date: 11-29-94

Remarks:

PENETROMETER - 2.0

TORVAN - MAX.

Fig No.

Project: EASTERN ARKANSAS

Boring No.: 25-EAU-94

Sample No.: 17

Depth: 79.0 - 81.5

UNCONFINED COMPRESSION TEST

MEMPHIS DISTRICT - USACE