Report of:

Subsurface Exploration
SR 823 Bridge Over Slocum Avenue (TR 248)
(SCI-823-0229 L & R)
SCI-823-0.00 Portsmouth Bypass (PID 77366)
Scioto County, Ohio

STRUCTURAL ENGINEERING
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September 6, 2007

Prepared by:

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REPORT

OF

SUBSURFACE EXPLORATION

FOR

SR 823 BRIDGE OVER SLOCUM AVENUE (TR-248)

(SCI-823-0229 L & R)

PROJECT SCI-823-0.00 PORTSMOUTH BYPASS (PID 77366)

SCIOTO COUNTY, OHIO

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1.0 INTRODUCTION

This report includes the findings of evaluations and recommendations for foundations of the proposed SR 823 Bridge over Slocum Avenue, approximately between SR 823 Station 120+98 and Station 124+24, and associated MSE wall near the forward abutment. This bridge is planned as part of the Portsmouth bypass project. Subsurface explorations were performed for the other features of the project but the results are presented in separate reports.

The purpose of this exploration was to 1) determine the subsurface conditions to the depths of the borings, 2) evaluate the engineering characteristics of the subsurface materials, and 3) provide information to assist in the design of the structure foundations, the MSE wall, and the roadway approach embankments. The exploration presented in this report was performed essentially in accordance with DLZ Ohio, Inc.'s (DLZ) proposal for the project.

The geotechnical engineer has planned and supervised the performance of the geotechnical engineering services, considered the findings, and prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranties, either expressed or implied, are made as to the professional advice included in this report.

2.0 GENERAL PROJECT INFORMATION

This part of the project consists of constructing twin structures where the proposed SR 823 will cross over Slocum Avenue (TR-248). The two structures, as planned, are three-span structures using spill-through slopes at the abutments. An MSE wall is also proposed to retain the embankment on the east side of the bridge between Pier 2 and the forward abutment.

Based upon comments from ODOT's Office of Structural Engineering (OSE), it is understood that H-pile foundations are preferred to support the abutments and the piers of the proposed structures and that spill-through slopes will be used at the abutments. However, based upon similar site conditions found elsewhere for the Portsmouth bypass project, spread footings were also considered to support the abutments.

The embankment heights at the rear abutment (SR 823 Station 120+98) and the forward abutment (SR 823 Station 124+24) will be approximately 63.2 feet and 52.4 feet, respectively. These embankment heights are based upon the differences between the proposed grades of SR 823 and the existing grades, shown on the Structure Site Plan, which is included in Appendix I.

The analyses and recommendations presented in this report have been made on the basis of the foregoing information. If the proposed locations or structural concept are changed or differ from that assumed, DLZ should be informed of the changes so that recommendations and conclusions presented in this report may be revised as necessary.

3.0 FIELD EXPLORATION

The field exploration consisted of drilling a total of seven borings. Borings TR-36 through TR-38 were drilled between January 27 and February 10, 2005 for the preliminary bridge configuration. Borings B-31 and B-32 were drilled between January 11 and 16, 2007, for the currently proposed structure. Two additional borings, TR-35A and TR-38A, which were drilled for the forward abutment embankment and the rear abutment embankment, respectively, were also considered in the analyses. Boring TR-35A was drilled on January 12, 2006 and Boring TR-38A on January 9 and 10, 2006. The boring locations for TR-36 through TR-38, B-31, and B-32 are shown on the Structure Site Plan, which is presented in Appendix I.

The boring locations were determined by representatives of DLZ. The surveyed locations and ground surface elevations of the borings were determined by representatives from Lockwood, Lanier, Mathias & Noland, Inc. (2LMN) and are presented on the boring logs in Appendix II. Information concerning the drilling procedures is also presented in Appendix II.

4.0 FINDINGS

4.1 Geology of the Site

The project area is located in an area which is commonly called the Highland Bend. The area generally has a gently rolling terrain and is bounded on either side by steep slopes. The main drainage feature in the valley is the Little Scioto River, located at approximately Station 136+00. The ordinary high water elevation is reported to be 498.6 feet. The soil consists primarily of alluvial and lacustrine deposits. The overburden in this area is generally fine-grained soil and ranges from 70 to 90 feet deep. The area is located in the Shawnee-Mississippian Plateau, and can be found on the Minford 7.5-minute Quadrangle.

Bedrock is of the Mississippian Logan Formation. Generally, this formation consists of primarily sandstone or sandy siltstone with occasional areas of interbedded shale. The lithology of the sandstone varies both laterally and vertically. Within this area the Logan Formation typically consists of thick, massive sandstone units.

4.2 Subsurface Conditions

The following sections present the generalized subsurface conditions encountered by the borings. For more detailed information, refer to the boring logs presented in Appendix II. Laboratory test results are presented on the boring logs and also in Appendix III.

4.2.1 Soil Conditions

Borings TR-36 and B-31 were drilled near the forward abutment and Borings TR-38 and TR-38A were drilled near the rear abutment. Borings TR-37 and B-32 were drilled near Pier 1 and Pier 2, respectively.

At the ground surface, the borings encountered 2 to 9 inches thick of topsoil. Beneath the topsoil, the borings encountered mostly native cohesive soils with intermittent layers of native granular soil to the top of bedrock. The cohesive soils encountered generally consisted of stiff to hard silt and clay (A-6a), soft to medium stiff sandy silt (A-4a), medium stiff to hard silt (A-4b), stiff to hard silty clay (A-6b), and stiff to hard clay (A-7-6), while the granular soils encountered consisted mainly of very loose to medium dense sandy silt (A-4a), very loose to medium dense silt (A-4b) and loose to medium dense coarse and fine sand (A-3a). The native soils extended to depths ranging between 72 and 81 feet below the ground surface, where bedrock was encountered.

4.2.2 Bedrock Conditions

Bedrock encountered in the borings was mostly sandstone except in Boring B-31 where siltstone was encountered within the depth of boring. The bedrock encountered was mostly medium hard to hard, moderately weathered, and slightly to moderately fractured. However, a layer of severely weathered rock, approximately 2 feet thick, was encountered above the more competent, cored bedrock in Borings TR-36 and TR-37. The amount of rock recovered in each core run mostly varied from 96 to 100 percent and the rock quality designation (RQD) of the bedrock generally ranged from 65 to 97 percent with an average of 83 percent, indicating good quality rock. Relatively severe loss of recovery occurred in the core runs between depths of 90 and 100 feet in Boring TR-38. Recovery of the core sample was only 55 percent and the RQD value was 55 percent between the depths of 90 and 95 feet of the boring. However, the core sample was unable to be recovered between the depths of 95 and 100 feet.

Unconfined compressive strength of a core sample taken from a depth of 85.1 feet of Boring TR-35A was 341 pounds per square inch (psi).

4.2.3 Groundwater Conditions

Seepage was first encountered in the borings at depths ranging from 10.0 to 62.0 feet below the ground surface. A measurable water level was encountered in Borings B-31, B-32, TR-38 and TR-38A, prior to rock coring, at depths ranging from 9.8 to 59.5 feet below the ground surface. Water was used during rock coring and masked any seepage zones that might exist in the rock. Measurable water levels, upon the completion of coring, were present in all borings except Boring TR-37, at approximate depths between 7.3 and 24.6 feet. It should be noted that the final water levels included drilling water, and consequently, may not be representative of actual groundwater conditions.

It should be noted that groundwater levels may fluctuate with seasonal variations and following periods of heavy or prolonged precipitation, and therefore, the readings indicated on the boring logs may not be representative of the long-term groundwater level. Long-term monitoring would be needed to obtain a more accurate estimate of the groundwater table elevation.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The Highland Bend area traverses a fairly wide valley with deep highly compressible soils. A series of three bridges, including the SR 823 Bridge over Slocum Avenue, are proposed to be constructed across the valley with three new embankment sections, which will begin at Station 105+75 and end at Station 130+73. The findings pertaining to the three embankment sections are presented in a report titled "Report of Subsurface Exploration for Proposed Highland Bend Roadway Embankments," dated August 2, 2007, prepared by DLZ. This report will be referred to as "Highland Bend Report" hereafter. Since the abutments of the SR 823 Bridge over Slocum Avenue will be constructed in the new embankment sections between Station 117+64 and Station 130+73, the soil parameters and the maximum embankment heights used and the recommendations made pertaining to these embankment sections were considered in the analyses of the SR 823 Bridge over Slocum Avenue. Calculations are presented in Appendix IV.

It is understood that the proposed bridge will have three spans and utilize spill-through abutment slopes. Based upon comments from ODOT's Office of Structural Engineering (OSE), it is understood that H-pile foundations are preferred to support the abutments and the piers of the proposed structures. According to the Structure Site Plan in Appendix I, battered piles are being considered to provide lateral support for the structure. As an alternative to pile foundations, spread footings are also presented to support the abutments.

5.1 General Foundation Recommendations

It is understood that HP-14x73, 95-tons pile foundations may be used to support the abutments and the piers of the proposed structures. For comparison, the required pile lengths for 16-inch diameter, 90-tons cast-in-place (CIP) reinforced concrete piles were also determined. Analyses indicate that the required pile capacities can be achieved by installing the piles to less than 12 inches (at Boring TR-36, right forward abutment) to approximately 17 feet (at Boring B-32, Pier 2) above the underlying bedrock. Given the size of the structure and the anticipated high lateral and uplift loads, considerations should be given to driving all piles to the top of rock. Table 2 summarizes the estimated pile tip elevations based on the results of the analyses. Detailed recommendations for the bridge foundations and embankment construction are presented in the following sections.

It should be noted that the bedrock surface varies widely across the project area. The approximate bearing elevations presented in Table 2 indicate the elevations at the boring locations only. Variations in the elevation at which competent bedrock is encountered should be anticipated. Due to the likelihood of piles being driven near the top of rock, it is recommended that reinforced pile points be used to protect the piles while driving.

Table 2-Summary of Foundation Recommendations

Substructure	Structure / Boring	Existing Ground Surface Elevation (Feet)	Foundation Type	Approximate Bearing Elevation (Feet)	Approximate Top of Rock Elevation (Feet)	Allowable Bearing Capacity
Rear Abutment	Left / TR-38	554.0	HP-14x73 Piles	485.4	474.0	95 tons
			16” dia. CIP piles	485.8		90 tons
			Spread Footings	604.9^+		3.5 ksf
	Right / TR-38A	556.0	HP-14x73 Piles	485.8	475.0	95 tons
			16” dia. CIP piles	485.0		90 tons
			Spread Footings	604.9^+		3.5 ksf
Pier 1	Left / TR-37	556.1	HP-14x73 Piles	494.1	479.1	95 tons
			16” dia. CIP piles	494.1		90 tons
	Right / TR-37	556.1	HP-14x73 Piles	494.1		95 tons
			16” dia. CIP piles	494.1		90 tons
Pier 2	Left / B-32	555.0	HP-14x73 Piles	493.7	476.5	95 tons
			16” dia. CIP piles	492.7		90 tons
	Right / B-32	555.0	HP-14x73 Piles	493.7		95 tons
			16” dia. CIP piles	492.7		90 tons
Forward Abutment	Left / B-31	555.4	HP-14x73 Piles	487.2	476.4	95 tons
			16” dia. CIP piles	486.1		90 tons
			Spread Footings	592.8^+		3.5 ksf
	Right / TR-36	552.6	HP-14x73 Piles	481.5	480.6	95 tons
			16” dia. CIP piles	481.3		90 tons
			Spread Footings	592.8^+		3.5 ksf

[+] Spread footing founded on embankment fill, elevations as indicated on Structure Site Plan in Appendix I plan.

It should also be noted that the borings encountered fine sand and silt layers. When saturated, these layers may produce exaggerated blow counts during pile driving which do not reflect the actual load carrying ability of the strata. Therefore, piles should be driven to refusal, and then redriven to refusal after the excess pore pressures near the pile tip have had time to dissipate (usually less than 24 hours).

5.1.1 Bridge Foundation Recommendations-Abutments

Soil settlements due to primary consolidation for the rear abutment embankment and the forward abutment embankment were estimated to be approximately 31 and 39 inches, respectively. According to a FHWA publication, FHWA-NHI-97-013, "Design and Construction of Driven Pile Foundations," negative shaft resistance or downdrag forces should be considered in the design if the settlement of the ground surface after the piles are driven will be larger than approximately 0.4 inches. Based on the results of the settlement analyses, soil settlements greater than 0.4 inches can occur along the full embedment lengths of the piles. To offset the reduction in pile capacity from downdrag forces, piles could be driven to a higher capacity, which may require the use of larger piles. As a result, a pile design incorporating the downdrag forces would be very expensive. In addition, battered piles are generally avoided if downdrag forces are anticipated.

Because of the large downdrag forces, it is recommended that the foundation soils be allowed to consolidate prior to driving any piles. Given the estimated soil settlements and the FHWA's guideline for downdrag forces, it is estimated that a minimum of 99 percent of the total primary consolidation (U=99%) be achieved to eliminate the downdrag forces on the pile foundations. The percentage was determined by the ratio of the difference between the estimated settlement (31 inches at rear abutment and 39 inches at forward abutment) and 0.4 inches to the estimated settlements. To expedite the primary consolidation, wick drains in conjunction with staged construction should be used to construct the embankments as described in the Highland Bend Report. Analyses were performed to estimate the time-rate of consolidation based on various wick drain spacing patterns. It is estimated that waiting periods of approximately 55, 110 and 175 days would be required to achieve the 99 percent of the total primary consolidation with the wick drains spaced at 5, 7, and 9 feet, respectively for the rear abutment embankment while waiting periods of approximately 65, 125, and 205 days would be required for the forward abutment embankment. Note that these values are estimates only. Time rate of consolidation calculations beyond 90 percent may not be reliable. Additionally, the staged construction of the embankments may further complicate the determination of the time required to reach a specific percentage of consolidation. The ODOT construction representative may adjust the required waiting period (for a specified degree of consolidation) in the field based upon observations of instrumentation installed for the purposes of monitoring the consolidation of the foundation soils.

As an alternative to pile foundations, spread footings bearing in the embankment fill may also be considered to support the abutments. An allowable bearing capacity of 3.5 ksf may be used to design the footings provided the embankments are constructed in accordance with the applicable ODOT specifications and reflect the material properties assumed in this report.

5.1.2 Bridge Foundation Recommendations-Pier 1

As the Structure Site Plan indicates, the pile foundations will be constructed near the toe of the rear abutment. Assuming an embankment height of 63.2 feet near the rear abutment, the analyses indicated that 3.1 inches of settlement would occur at the toe of the embankment due to the embankment and footing loads. If the pile foundations were constructed before these settlements occur, an estimated downdrag force of approximately 333 kips would be imposed on the pile foundations. To eliminate these excessive downdrag forces, the total soil settlement would need to be reduced to less than 0.4 inches, which will require a minimum of 87 percent of the total primary consolidation (U=87%) to be achieved prior to driving any piles. Analyses using the estimated settlement of 3.1 inches were performed to estimate the time-rate of consolidation based on various wick drain spacing patterns. It is estimated that waiting periods of approximately 25, 45 and 75 days would be required to achieve the 87 percent of the total primary consolidation with the wick drains spaced at 5, 7, and 9 feet, respectively. Note that these values are estimates only. The ODOT construction representative may adjust the required waiting period (for a specified degree of consolidation) in the field based upon observations of instrumentation installed for the purposes of monitoring the consolidation of the foundation soils. It is recommended that battered piles be avoided if downdrag forces on the piles are anticipated.

5.1.3 Bridge Foundation Recommendations-Pier 2

As the Structure Site Plan indicates, the pile foundations will be constructed near the toe of the forward abutment. Assuming an embankment height of 52.4 feet near the forward abutment, the analyses indicated that 4.1 inches of settlement would occur at the toe of the embankment due to embankment and footing loads. If the pile foundations were constructed before these settlements occur, an estimated downdrag force of approximately 309 kips would be imposed on the pile foundations. To eliminate these excessive downdrag forces, the total soil settlement of 4.1 inches would need to be reduced to less than 0.4 inches, which will require a minimum of 90 percent of the total primary consolidation (U=90%) to be achieved prior to driving any piles. Analyses using the estimated settlement of 4.1 inches were performed to estimate the time-rate of consolidation based on various wick drain spacing patterns. It is estimated that waiting periods of approximately 35, 65 and 100 days would be required to achieve the 90 percent of the total primary consolidation with the wick drains spaced at 5, 7, and 9 feet, respectively. Note that these values are estimates only. The ODOT construction representative may adjust the required waiting period (for a specified degree of consolidation) in the field based upon observations of instrumentation installed for the purposes of monitoring the consolidation of the foundation soils. It is recommended that battered piles be avoided if downdrag forces on the piles are anticipated.

5.2 Stability Analysis of Spill-through Slope Embankment

A global stability analysis and settlement analysis were performed for each embankment location in accordance with ODOT and AASHTO guidelines. The stability analyses were performed using UTEXAS3 Version 1.204, a slope stability computer program using variations of the method of slices. UTEXAS3 was developed by Dr. Stephen Wright at the University of Texas for the U.S. Army Corps of Engineers.

Using a friction angle of 35 degrees for compacted embankment fill, the provided footing loads, the maximum embankment heights (72 feet at the rear abutment and 52.4 feet at the forward abutment) and a 2H:1V slope, global stability analyses of the rear and the forward abutment spill-through slopes were performed for undrained, drained, and seismic conditions. The drained analyses resulted in the critical failure surfaces with factors of safety of 1.55 and 1.61 for the rear and the forward abutments, respectively. These factors of safety exceed the minimum factor of safety of 1.5 recommended by ODOT for drained conditions. Seismic analyses were also performed using a horizontal acceleration of 0.03, in accordance with ODOT guidelines. The analyses resulted in critical factors of safety of 1.43 and 1.49, for the rear and the forward abutments, respectively. These factors of safety are greater than the minimum acceptable factor of safety of 1.1 for seismic condition. However, the undrained analyses resulted in the critical failure surfaces with factors of safety of 0.82 and 0.87 for the rear and the forward abutments, respectively. These factors of safety are below the minimum factor of safety of 1.5 recommended by ODOT for undrained conditions. As a result, staged construction in conjunction with wick drains is necessary to construct the embankments. Details of the construction of the embankments are presented in the Highland Bend Report. Calculations for the global stability analyses are presented in Appendix IV.

Please note that a friction angle of 35 degrees was assumed for the 2H:1V spill-through slopes. The results of the stability analyses are only valid provided the spill-through slopes are constructed in accordance with the applicable ODOT specifications and reflect the material properties assumed. In areas outside of the spill-through slopes of the embankments, a 2.5H:1V slope should be used. Details of the slope stability analyses of the embankments were presented in the Highland Bend Report.

5.3 Settlement Analyses of Approach Embankments

Analyses were performed to estimate the elastic settlement of the embankment fill and foundation soil settlements due to the anticipated footing loads. According to the AASHTO Standard Specifications for Highway Bridges, 17th Edition, 2002, Section 4.4.7.2.5, tolerable movement criteria for foundation settlement between adjacent footings shall be limited to 0.004 times the span length for continuous span bridges. Given the proposed span length of 107.5 feet, the allowable differential settlement between an abutment and the adjacent pier would be 5.1 inches.

In order to estimate the settlements within the area of influence of the footing loads, the embankment heights at the center of bearing of the abutments were used for the analyses. Assuming an embankment height of 63.2 feet at the rear abutment and 52.4 feet at the forward abutment, elastic settlements in the embankment fill at both the rear and forward abutments were estimated to be 3.1 inches and the foundation soil settlements due to primary consolidation were 1.4 inches at the rear abutment and 2.5 inches at the forward abutment. As a result, the total settlement at the rear abutment due to the anticipated footing loads was 4.5 inches, which is 0.6 inches less than the AASHTO's allowable settlement of 5.1 inches, while the estimated total settlement at the forward abutment was 5.6 inches, which slightly exceeds the AASHTO's allowable settlement of 5.1 inches.

The settlement analyses indicate that approximately 0.6 inches of foundation soil settlements would occur at the rear abutment due to the footing loads. This allowable soil settlement is significantly less than the estimated foundation soil settlement of 31.3 inches due to the embankment loads. As a result, the net soil settlement (31.4 inches minus 0.6 inches) due to the embankment load and the footing loads is approximately 30.8 inches. To reduce the amount of differential settlement that occurs after construction of the footings, it is recommended that at least 98 percent of this net settlement be achieved prior to constructing the footings at the rear abutment. To expedite the primary consolidation, wick drains in conjunction with staged construction should be used to construct the embankments as described in the Highland Bend Report. Analyses were performed to estimate the time-rate of consolidation based on various wick drain spacing patterns. It is estimated that waiting periods of approximately 50, 100 and 160 days would be required to achieve the 98 percent of the total primary consolidation, due to the embankment load, with the wick drains spaced at 5, 7, and 9 feet, respectively.

As indicated previously, the estimated total settlement at the forward abutment due to the footing loads was 5.6 inches, which slightly exceeds the AASHTO's allowable settlement of 5.1 inches. This implies that the anticipated footing loads will incur an unacceptable additional soil movement of 0.5 inches after the footings have been constructed. However, this additional settlement is only about 0.04% of the span length of 107.5 feet and is insignificant compared to the estimated settlement of 39.2 inches due to embankment load. Consequently, the additional settlement of 0.5 inches should not be a concern. To prevent excessive differential settlement to occur after construction of the footings, the estimated settlement of 39.2 inches due to embankment load must take place before constructing the footings. To expedite the primary consolidation, wick drains in conjunction with staged construction should be used to construct the embankments as described in the Highland Bend Report. It is estimated that waiting periods of approximately 70, 125 and 210 days would be required to achieve almost 100 percent of the total primary consolidation, due to the embankment load, with the wick drains spaced at 5, 7, and 9 feet, respectively

Note that these values are estimates only. Time rate of consolidation calculations beyond 90 percent may not be reliable. Additionally, the staged construction of the embankments may further complicate the determination of the time required to reach a specific percentage of consolidation. The ODOT construction representative may adjust the required waiting period (for a specified degree of consolidation) in the field based upon observations of instrumentation installed for the purposes of monitoring the consolidation of the foundation soils.

5.4 Embankment Retaining Wall

An MSE wall is currently planned on the east side of the bridge to contain the embankment fill between the forward abutment and Pier 2. According to the site plans provided, the MSE wall will be constructed approximately between Pershing Avenue Station 30+26.02 and Station 32+08.25. An MSE retaining wall essentially consists of good quality backfill material with layers of metal or plastic reinforcing that are attached to concrete facing panels. The MSE wall and associated backfill should be constructed in accordance with ODOT Supplemental Specification 840.

A global stability analysis, bearing capacity analysis and settlement analysis were performed for the MSE retaining wall, in accordance with ODOT and AASHTO guidelines. The MSE wall was also analyzed for sliding and overturning. The calculations are presented in Appendix IV. Internal stability analyses are required for the design of an MSE wall, but are considered outside the scope of this report. The parameters required to perform the stability analyses are presented below.

In accordance with ODOT guidelines, a unit weight of 120 pcf and friction angle of 34 degrees were selected for the backfill material in the reinforced zone. If the selected backfill material has properties significantly different from these values, DLZ Ohio, Inc. should be informed so that the analyses may be revised as necessary.

The existing foundation soils along the wall alignments consist primarily of stiff clay (A-7-6). The parameters selected for the foundation soil represent typical values for the cohesive soil. The parameters selected for the retained soil represent typical values for granular embankment fill. The soil parameters used in the analysis are summarized in the following table.

Soil Parameters Used in Stability Analysis

Zone	Soil Type	Unit Weight (pcf)	Strength Parameters			
			Undrained		Drained	
			c	Φ	c'	Φ'
Reinforced Fill	Compacted Granular Fill	120	0	34	0	34
Retained Soil	Compacted Embankment Fill	120	0	30	0	30
Foundation Soil	Stiff clay	125	1700	0	0	30

According to the site plans provided, both 2H:1V and 2.5H:1V backfill slopes will be constructed behind the wall and the greatest height of the wall section will be approximately 36.3 feet at Station 31+03.11. This wall height was measured from the top of the leveling pad to the top of the coping. In the wall analyses, a backfill slope as measured perpendicular to the walls was used and estimated to be 3.2H:1V at the maximum wall height location. The effective coefficient of active earth pressure, adjusted for the sloping backfill, was determined to be 0.42.

Assuming the soil profile at Boring B-32, selected soil parameters for the subsurface conditions, the maximum wall height of 36.3 feet, a reinforcing length of 36.3 feet or one times the wall height, and the proposed sloping backfill (3.2H:1V), analyses were performed to determine the global stability, bearing capacity and stability (sliding and overturning) of the MSE walls bearing on the existing soils. The results of the analyses indicate that the factors of safety for global stability for undrained condition and sliding were 1.1 and 1.0, respectively. These factors of safety are below the recommended minimum values of 1.3 for global stability and 1.5 for sliding. However, adequate factors of safety can be achieved by assuming increased shear strength through staged construction.

Assuming a reinforcing length of 36.3 feet, a maximum wall height of 27 feet can be constructed on the existing soils during the first stage of the wall construction. A waiting period will be required for the excess pore pressure to dissipate prior to adding the subsequent stage. In addition to observing the waiting period, water levels in the foundation soils should not be allowed to reach a level of 14 feet above the existing ground surface. Assuming a lineal relationship between shear strength and effective normal stress from the results of consolidation undrained tests, the undrained shear strength of the upper layer of foundation soil, after the first stage of the MSE wall construction, was estimated to be 2,636 psf at the end of 90 percent (U=90%) of the total primary consolidation. Assuming this increase in undrained shear strength of the subsurface soils, an undrained global stability analysis of the maximum wall height section (36.3 feet) with the proposed sloping backfill (3.2H:1V) resulted in a critical failure surface with a factor of safety of 1.9. Assuming the increase in undrained shear strength and a minimum reinforcement length of one times the full height (H+D), or 36.3 feet, the sliding analysis resulted in a factor of safety of 1.61. A length of 36.3 feet is a minimum for external stability and may be increased if necessary. Note that this length is based on the assumption that discontinuous reinforcing will be used in the MSE fill. If the selected wall system uses continuous reinforcing, i.e., sheets or grids, the minimum reinforcing length may need to be increased.

Using the increased undrained shear strength of 2,636 psf and the reinforcing length of 36.3 feet, the maximum wall height of 36.3 feet, and the proposed sloping backfill (3.2H:1V), bearing capacity calculations, however, indicate that the factor of safety for undrained bearing capacity was 2.26, which is less than the recommended minimum value of 2.5. However, because the top of the wall is sloping, only an approximate 65-foot long section of the MSE wall is higher than the first stage height. Because the second construction stage affects a relatively short section of the wall (one-third of the total length) and because of the short-term nature of the undrained condition, it is believed that a factor of safety of 2.26 will be adequate. Otherwise, the second stage of the MSE wall should be built to its full height but without the backslope to maintain an undrained bearing capacity factor of safety of at least 2.5. The sloping backfill should not be added until at least 80 percent (U=80%) of the excess pore pressures are allowed to dissipate. Calculations for the stability analyses are included in Appendix IV.

Settlements were calculated using the computer program EMBANK, using the "end of fill" option, to model the non-continuous embankment loading. The maximum settlement at the face of the proposed MSE wall on existing soil was estimated to be approximately 13.8 inches at the maximum wall height section (Station 31+03.11). Comparing the estimated settlement at the minimum wall height (5.3 feet) at the end of the wall (Station 32+08.25), differential settlement at the maximum wall height section was estimated to be approximately 0.73 percent, which is less than the typically cited maximum value. MSE retaining walls are able to withstand relatively large amounts of differential settlement, typically up to 100 millimeters per 10 meters of wall length (1.0 percent). However, comparing the estimated maximum settlement (13.8 inches) with the settlement at a wall section of 8 feet high at the beginning of the wall (Station 30+26.02), the differential settlement at the maximum wall height section was estimated to be approximately 1.24 percent, which is slightly greater than 1.0 percent. It is believed that this amount of differential settlement can be tolerated, particularly if slip joints are installed in the wall. If, however, the wall designer determines that either the total or differential settlement cannot be tolerated, then some remediation effort must be taken in order to reduce the total settlement.

Upon examination of the wall section between Station 30+26.02 (the beginning of the wall) and Station 31+03.11 (the highest point of the wall), it was determined that the maximum total settlement that could occur in this section and still maintain the allowable differential settlement of 1.0 percent or less is 8.2 inches. Therefore, 5.6 inches of settlement (13.8 inch maximum minus 8.2 inches) would need to occur prior to construction of this section of the MSE walls. The following options for producing 5.6 inches of settlement may be considered.

Option 1: The centerline of the wall alignment may be preloaded with a surcharge of 30 feet high or the height of the wall section, whichever is less, and an average of 100 feet wide. The surcharge height of 30 feet was chosen to be consistent with the proposed embankment height of the first stage of the staged construction of the forward abutment embankment as described in the Highland Bend Report. Side slopes of 2H:1V or flatter are required for the stability of the surcharge embankment. This option will require acquisition of right-of-way to the south and southeast of the wall. Wick drains should be used to expedite the consolidation process in conjunction with the embankment construction procedure described in the Highland Bend Report. It is estimated that waiting periods of approximately 35, 65 and 100 days would be required to achieve the 90 percent of the total primary consolidation with the wick drains spaced at 5, 7, and 9 feet, respectively. After the 90 percent of the total primary consolidation has been achieved, the MSE wall can be constructed to its full design height.

If this option is chosen for preloading and the actual configuration of the surcharge embankment is decided, additional settlement analyses should be performed to re-evaluate the estimated soil settlements. In addition, recommendations for instrumentation to monitor the actual soil settlements and pore pressures in the foundation soils during the construction should be prepared.

Option 2: A fabric-wrapped vertical wall may also used to preload the MSE wall area. The surcharge would be 27 feet high and average of 100 feet wide. This option will require acquisition of right-of-way to the south and southeast of the wall. Wick drains should also be used to expedite the consolidation process in conjunction with the embankment construction procedure described in the Highland Bend Report. It is estimated that waiting periods of approximately 35, 65 and 100 days would be required to achieve the 90 percent of the total primary consolidation with the wick drains spaced at 5, 7, and 9 feet, respectively. After the 90 percent of the total primary consolidation has been achieved, the MSE wall can be constructed to its full design height.

If this option is chosen for preloading and the actual configuration of the surcharge embankment is decided, additional settlement analyses should be performed to re-evaluate the estimated soil settlements. In addition, recommendations for instrumentation to monitor the actual soil settlements and pore pressures in the foundation soils during the construction should be prepared.

Option 3: Consideration may be given to relocating Pershing Avenue further away from the bridge to eliminate the need for the MSE wall.

MSE Retaining Wall Parameters and Analyses Results
(Embankment Retaining Wall)

Retained Soil (New Embankment)
Unit Weight = 120 pcf
Coefficient of Active Earth Pressure (K_a) = 0.42
(Based on Φ' = 30°, 3.2H:1V sloping backfill)

Sliding along base of MSE wall
Sliding Coefficient (μ) = tan 30° = 0.58*
*Note: for discontinuous reinforcement

Allowable Bearing Capacity – Undrained Condition
q_{all} = 5,420 psf, F.S. = 2.26 (Based on estimated undrained shear strength of 2,636 psf, a wall height of 36.3 feet and the proposed sloping backfill, 3.2H:1V)

Allowable Bearing Capacity – Drained Condition
q_{all} = 18,718 psf

Global Stability
Factor of Safety – Undrained Condition = 1.92 (Based on undrained shear strength of 2,636 psf)
Factor of Safety – Drained Condition = 1.56
Factor of Safety – Seismic Condition = 1.47

Estimated Settlement of MSE volume
Maximum Total Settlement ~ 13.8 inches
Differential Settlement ~ 0.7 – 1.2% (maximum allowable is 1.0% ODOT BDM 204.6.2.1)

Full Height of MSE Wall = 36.3 feet (including embedment depth)
Minimum Embedment Depth = 3.0 feet
Minimum Length of Reinforcement for External Stability = 36.3 feet (one times the wall height)

5.5 Groundwater Considerations

Water seepage and final water levels (excluding drilling water) were generally encountered at depths below 9.8 feet (elevation 544.2). Excavations for the MSE wall and pier foundations are generally expected to be limited to eight feet or less. Consequently, little, if any, seepage is anticipated for the foundation excavations. However, the Contractor should be prepared to deal with unexpected seepage and precipitation that enters any excavations, such as with sumping and pumping.

5.6 General Earthwork Recommendations

The proposed alignment of SR 823 over Slocum Avenue (TR 248) traverses a gently rolling terrain and is bounded on either end by steep slopes. Consequently, placement of fill will be required to construct the approach embankments for the bridges. The maximum fill anticipated is approximately 72 feet, near the proposed rear abutment.

Between 2 and 9 inches of topsoil were encountered at the ground surface. All topsoil and vegetation within the footprint of the new embankments and roadway should be removed prior to new fill placement. All pavements should also be removed prior to placing fill.

Organic soils were not encountered in any of the borings drilled for the bridge. However, since organic or very soft soils may be encountered at locations other than where the borings were drilled, the contractor should be prepared to perform overexcavation of any poor soils at other locations and replace the overexcavated soil with compacted engineered fill as needed.

The embankments should be constructed in accordance with ODOT Items 203. Details of the construction of the embankments were presented in the Highland Bend Report.

Excavations should be prepared in accordance with ODOT Item 503, "Excavation for Structures." Excavations deeper than 5.0 feet must be sloped or shored to protect workers entering the excavations. Refer to OSHA regulations (29CFR Part 1926) concerning sloping and shoring requirements for excavations.

Relative to the footing excavations, the following additional recommendations are presented:

1. All footings should be founded deep enough for frost protection, considered to be 36 inches in this area.

2. Excavation bottoms should be examined by the geotechnical engineer prior to placement of reinforcing steel and concrete in order to determine the suitability of the supporting soils.

3. Excavations should be undercut to suitable bearing material if such material is not encountered at the planned footing level. Such undercuts may be backfilled with a lean mix concrete (1,500 psi @ 28 days) or footing concrete.

4. All footing excavations should be cut to stable side walls and flat bottoms with the bottoms comprised of firm soil undisturbed by the method of excavation or softened by standing water. Concrete should be placed the same day that the footings are excavated.

While excavating for the footings, unsuitable soils may be encountered deeper than indicated by the borings. These unsuitable materials will need to be overexcavated until suitable bearing material is encountered. Overexcavations should be backfilled with compacted engineered fill.

6.0 CLOSING REMARKS

We appreciate having the opportunity to be of service to you on this project. Please do not hesitate to call if you have any questions concerning our report.

Respectfully submitted,

DLZ OHIO, INC.

Eric W. Tse, P.E
Senior Geotechnical Engineer

Dorothy A. Adams

Dorothy A. Adams, P.E.
Senior Geotechnical Engineer

EWT

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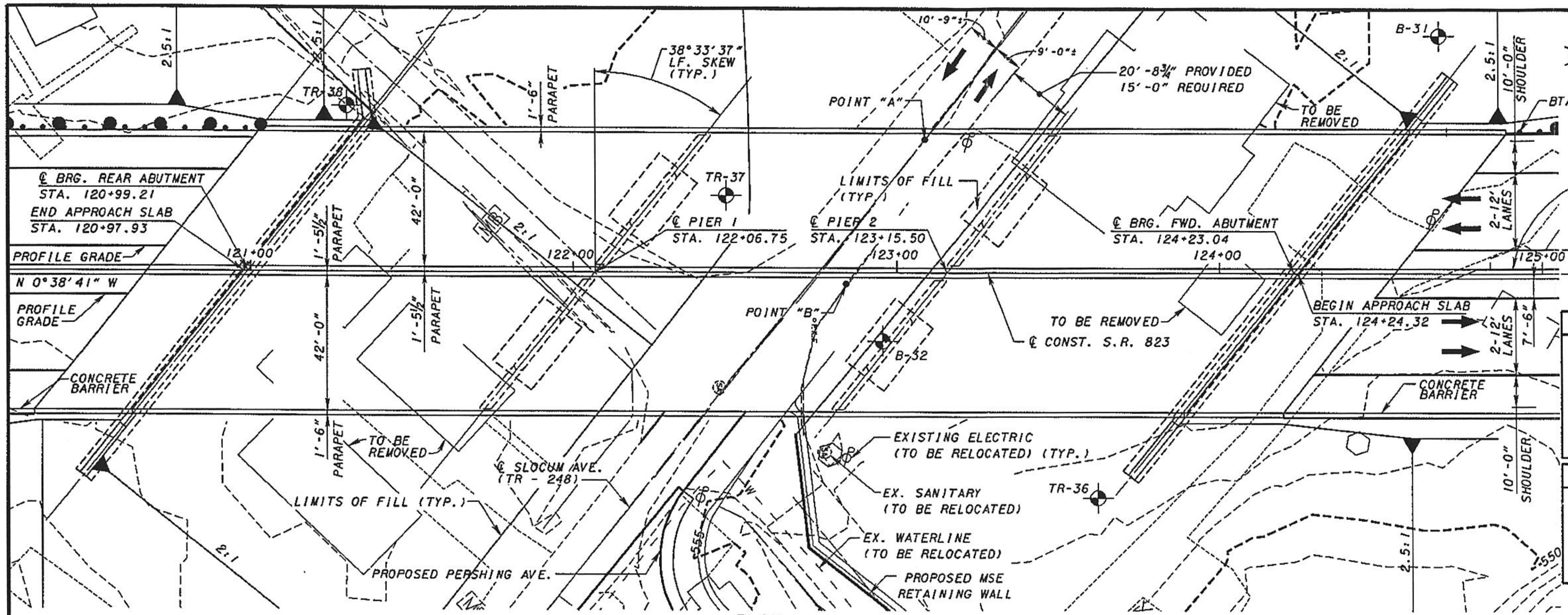
APPENDIX I

Structure Plan and Profile Drawing - 11”x17”



PLAN

FIRST GUARDRAIL POST OFF BRIDGE LOCATIONS		
LOCATION	STATION	OFFSET
REAR ABUT.	120+98.62	43.5′ LT.
FWD. ~~ABUT.~~	~~124+93.24~~	~~43.5′ LT.~~

BENCHMARK 1	BENCHMARK 2
(TO BE PROVIDED LATER)	(TO BE PROVIDED LATER)

TRAFFIC DATA

S.R. 823
CURRENT YEAR ADT (2010) = 21,200
DESIGN YEAR ADT (2030) = 31,200
CURRENT YEAR ADTT (2010) = 2,968
DESIGN YEAR ADTT (2030) = 4,368

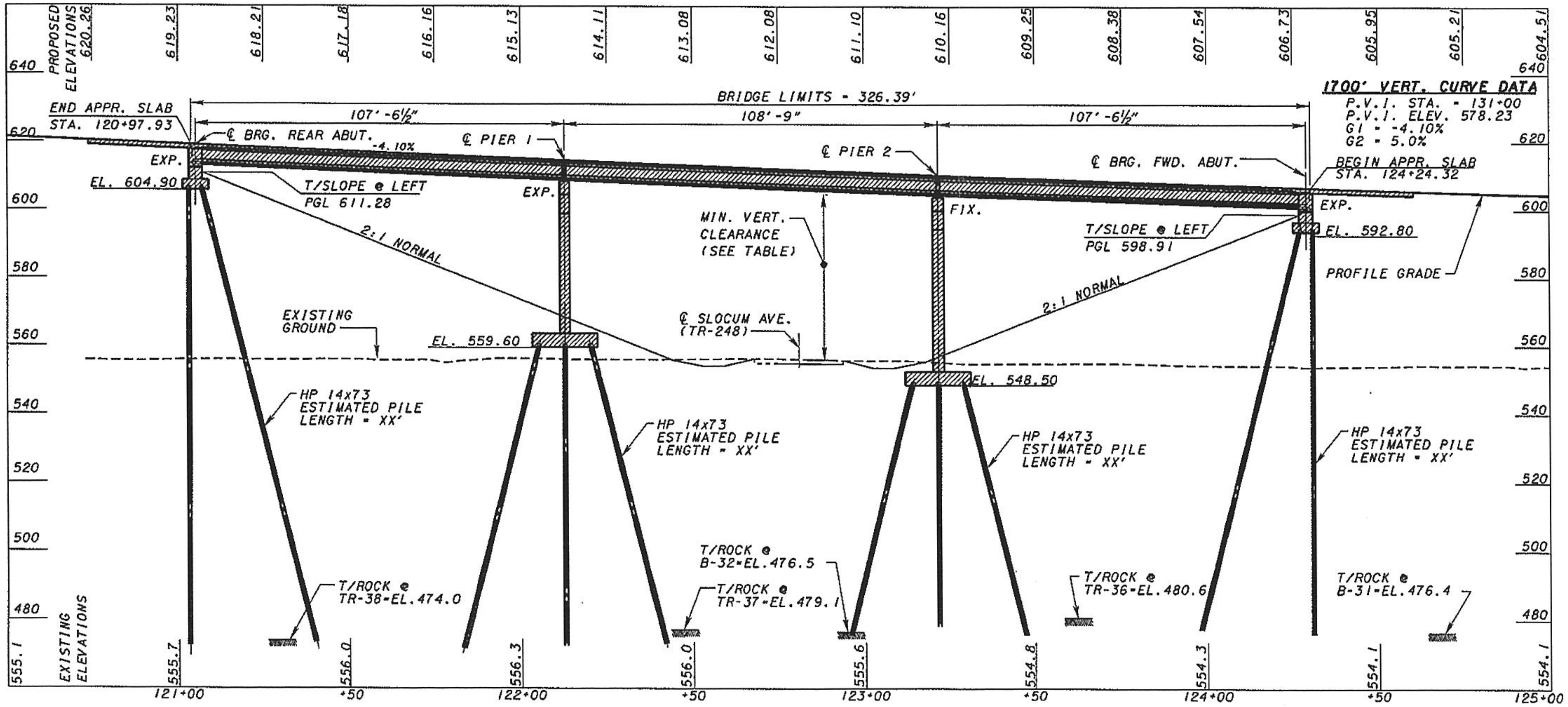
LEGEND

BTA-1 - BRIDGE TERMINAL ASSEMBLY TYPE 1
BTA-2 - BRIDGE TERMINAL ASSEMBLY TYPE 2
⊕ - BORING LOCATION

NOTES:

1. ALL SHEETS WITH PLAN DIMENSIONS ARE SHOWN HORIZONTAL.
2. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS..

TABLE OF VERTICAL CLEARANCES		
LOCATION	"A"	"B"
PROPOSED	48.35′	49.92′
PREFFERED	15.0′	15.0′



PROFILE ALONG PROFILE GRADE S.R. 823 LEFT BRIDGE

PROPOSED STRUCTURE

TYPE: 3 SPAN CONTINUOUS 60″ MODIFIED AASHTO TYPE 4 PRESTRESSED CONCRETE I-BEAM WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY REINFORCED CONCRETE T-TYPE PIERS AND SEMI-INTEGRAL ABUTMENTS.

SPANS: 106′-4″, 106′-4″, 106′-4″ (C/C BRG.)

ROADWAY: 2 - 42′-0″ T/T OF PARAPETS

LOADING: HS-25 AND ALTERNATE MILITARY LOADING, FWS=60 PSF

SKEW: 38°33′37″ LF

CROWN: 0.016 FT/FT

ALIGNMENT: TANGENT

WEARING SURFACE: MONOLITHIC CONCRETE

APPROACH SLABS: AS-1-81 (30′ LONG)

LATITUDE: 38°46′13″ N

LONGITUDE: 82°52′36″ W

DESIGN AGENCY
TranSystems
5717 PERIMETER DRIVE, SUITE 240
DUBLIN, OHIO 43017

DESIGNED	DRAWN	REVIEWED	DATE
PJP	AWB	JRC	11/20/06
CHECKED	REVISED	STRUCTURE FILE NUMBER	
MSL		7306342	

SCIOTO COUNTY
STA. 120+97.93
STA. 124+24.32

SITE PLAN

BRIDGE NO. SCI-823-0229 L
S.R. 823 OVER SLOCUM AVENUE (T.R.248)

SCI-823-0.00
PID 77366

1 / X

APPENDIX II

General Information – Drilling Procedures and Logs of Borings
Legend – Boring Log Terminology
Boring Logs – Seven (7) Borings

GENERAL INFORMATION
DRILLING PROCEDURES AND LOGS OF BORINGS

Drilling and sampling were conducted in accordance with procedures generally recognized and accepted as standardized methods of investigation of subsurface conditions concerning geotechnical engineering considerations. Borings were drilled with either a truck-mounted or ATV-mounted drill rig.

Drive split-barrel sampling was performed in 1.5 to 2 foot increments at intervals not exceeding 5 feet. In the event the sampler encountered resistance to penetration of 6 inches or less after 50 blows of the drop hammer, the sampling increment was discontinued. Standard penetration data were recorded and one or more representative samples were preserved from each sampling increment.

In borings where rock was cored, NXM or NQ size diamond coring tools were used.

In the laboratory all samples were visually classified by a geotechnical engineer. Moisture contents of representative fine-grained soil samples were determined. A limited number of samples, considered representative of foundation materials present, were selected for performance of grain-size analyses and plasticity characteristics tests. The results of these tests are shown on the boring logs.

The boring logs included in the Appendix have been prepared on the basis of the field record of drilling and sampling, and the results of the laboratory examination and testing of samples. Stratification lines on the boring logs indicating changes in soil stratigraphy represent depths of changes approximated by the driller, by sampling effort and recovery, and by laboratory test results. Actual depths to changes may differ somewhat from the estimated depths, or transitions may occur gradually and not be sharply defined. The boring logs presented in this report therefore contain both factual and interpretative information and are not an exact copy of the field log.

Although it is considered that the borings have disclosed information generally representative of site conditions, it should be expected that between borings conditions may occur which are not precisely represented by any one of the borings. Soil deposition processes and natural geologic forces are such that soil and rock types and conditions may change in short vertical intervals and horizontal distances.

Soil/rock samples will be stored at our laboratory for a period of six months. After this period of time, they will be discarded, unless notified to the contrary by the client.

LEGEND – BORING LOG TERMINOLOGY

Explanation of each column, progressing from left to right

1. Depth (in feet) – refers to distance below the ground surface.

2. Elevation (in feet) – is referenced to mean sea level, unless otherwise noted.

3. Standard Penetration (N) – the number of blows required to drive a 2-inch O.D., 1-3/8 inch I.D., split-barrel sampler, using a 140-pound hammer with a 30-inch free fall. The blows are recorded in 6-inch drive increments. Standard penetration resistance is determined from the total number of blows required for one foot of penetration by summing the second and third 6-inch increments of an 18-inch drive.

   50/n – indicates number of blows (50) to drive a split-barrel sampler a certain number of inches (n) other than the normal 6-inch increment.

4. The length of the sampler drive is indicated graphically by horizontal lines across the "Standard Penetration" and "Recovery" columns.

5. Sample recovery from each drive is indicated numerically in the column headed "Recovery".

6. The drive sample location is designated by the heavy vertical bar in the "Sample No., Drive" column.

7. The length of hydraulically pressed "Undisturbed" samples is indicated graphically by horizontal lines across the "Press" column.

8. Sample numbers are designated consecutively, increasing in depth.

9. Soil Description

   a. The following terms are used to describe the relative compactness and consistency of soils:

Granular Soils – Compactness

Term	Blows/Foot Standard Penetration
Very Loose	0 – 4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	over 50

Cohesive Soils – Consistency

Term	Unconfined Compression tons/sq.ft.	Blows/Foot Standard Penetration	Hand Manipulation
Very Soft	less than 0.25	below 2	Easily penetrated by fist
Soft	0.25 – 0.50	2 – 4	Easily penetrated by thumb
Medium Stiff	0.50 – 1.0	4 – 8	Penetrated by thumb with moderate pressure
Stiff	1.0 – 2.0	8 – 15	Readily indented by thumb but not penetrated
Very Stiff	2.0 – 4.0	15 – 30	Readily indented by thumb nail
Hard	over 4.0	over 30	Indented with difficulty by thumb nail

   b. Color – If a soil is a uniform color throughout, the term is single, modified by such adjective as light and dark. If the predominant color is shaded by a secondary color, the secondary color precedes the primary color. If two major and distinct colors are swirled throughout the soil, the colors are modified by the term "mottled".

   c. Texture is based on the Ohio Department of Transportation Classification System. Soil particle size definitions are as follows:

Description		Size	Description		Size
Boulders		Larger than 8"	Sand	– Coarse	2.0 mm to 0.42 mm
Cobbles		8" to 3"		– Fine	0.42 mm to 0.074 mm
Gravel	– Coarse	3" to ¾"	Silt		0.074 mm to 0.005 mm
	– Fine	¾" to 2.0 mm	Clay		smaller than 0.005 mm

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d. The main soil component is listed first. The minor components are listed in order of decreasing percentage of particle size.

e. Modifiers to main soil descriptions are indicated as a percentage by weight of particle sizes.

trace	0 to 10%
little	10 to 20%
some	20 to 35%
"and"	35 to 50%

f. Moisture content of **cohesionless soils** (sands and gravels) is described as follows:

Term	Relative Moisture or Appearance
Dry	No moisture present
Damp	Internal moisture, but none to little surface moisture
Moist	Free water on surface
Wet	Voids filled with free water

g. The moisture content of **cohesive soils** (silts and clays) is expressed relative to plastic properties.

Term	Relative Moisture or Appearance
Dry	Powdery
Damp	Moisture content slightly below plastic limit
Moist	Moisture content above plastic limit but below liquid limit
Wet	Moisture content above liquid limit

10. Rock Hardness and Rock Quality Designation

a. The following terms are used to describe the relative hardness of the **bedrock.**

Term	Description
Very Soft	Permits denting by moderate pressure of the fingers. Resembles hard soil but has rock structure. (Crushes under pressure of fingers and/or thumb)
Soft	Resists denting by fingers, but can be abraded and pierced to shallow depth by a pencil point. (Crushes under pressure of pressed hammer)
Medium Hard	Resists pencil point, but can be scratched with a knife blade. (Breaks easily under single hammer blow, but with crumbly edges.)
Hard	Can be deformed or broken by light to moderate hammer blows. (Breaks under one or two strong hammer blow, but with resistant sharp edges.)
Very Hard	Can be broken only by heavy and in some rocks repeated hammer blows.

b. Rock Quality Designation, RQD – This value is expressed in percent and is an indirect measure of rock soundness. It is obtained by summing the total length of all core pieces which are at least four inches long, and then dividing this sum by the total length of the core run.

11. Gradation – when tests are performed, the percentage of each particle size is listed in the appropriate column (defined in Item 9c).

12. When a test is performed to determine the natural moisture content, liquid limit moisture content, or plastic limit moisture content, the moisture content is indicated graphically.

13. The standard penetration (N) value in blows per foot is indicated graphically.

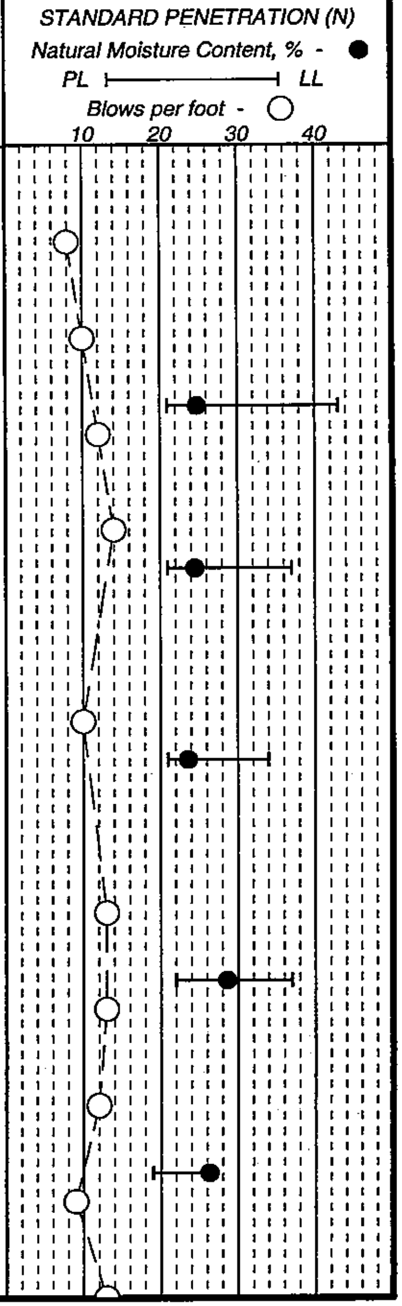
DLZ OHIO INC. * 6121 HUNTLEY ROAD, C MBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring B-31 | *Location:* Sta. 124+68.2, 74.1 ft. LT of SR 823 CL | *Date Drilled:* 1/11/07 to 1/12/07

WATER OBSERVATIONS:
Water seepage at: 14.8', 19.6'
Water level at completion: 30.2' (prior to coring)
24.6' (with augers removed, includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
	555.4												
0.2	555.2						Topsoil - 2"						
		3 4 4	11	1		2.75	Very stiff brown and gray SILT AND CLAY (A-6a), trace to little fine to coarse sand, trace gravel; damp to moist. @ 0.2'-5.0', contains trace organic material.						
		4 5 5	18	2		2.75							
5.5	549.9	3 5 7	18	3		3.75	Very stiff brown and gray CLAY (A-7-6), some silt, trace fine sand; moist.	0	0	--	6	29	65
8.0	547.4	4 6 8	18	4		3.5	Very stiff brown and gray SILTY CLAY (A-6b), trace fine to coarse sand; moist.						
					P1	2.5		0	1	--	6	37	56
13.0	542.4	3 4 6	18	5		3.25	Very stiff to hard brown and gray SILT AND CLAY (A-6a), trace fine to coarse sand; moist.						
					P2	4.5+		0	0	--	2	53	45
		5 5 8	18	6		3.5							
		3 5 8	18	7		2.25		0	2	--	2	31	65
		4 4 8	18	8		2.5							
25.5	529.9	3 4 5	18	9		1.5	Stiff brown and gray SILT (A-4b), some clay, trace fine sand; damp to moist.	0	0	--	6	65	29
28.0	527.4	4 5 8	18	10			Medium dense brown COARSE AND FINE SAND (A-3a), trace silty clay; moist.						



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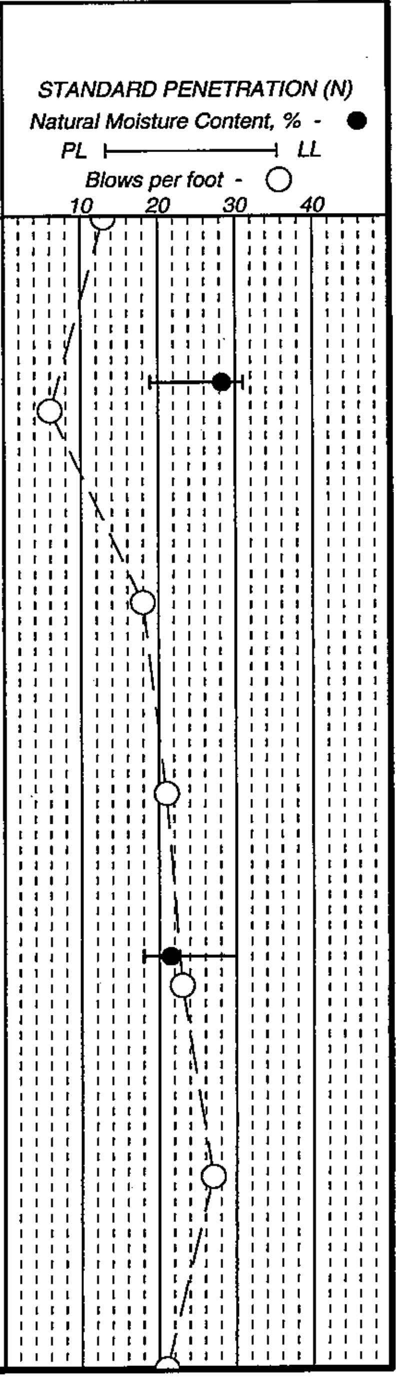
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring B-31 | Location: Sta. 124+68.2, 74.1 ft. LT of SR 823 CL | Date Drilled: 1/11/07 to 1/12/07

WATER OBSERVATIONS: Water seepage at: 14.8', 19.6'
Water level at completion: 30.2' (prior to coring)
24.6' (with augers removed, includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30	525.4						Medium dense brown COARSE AND FINE SAND (A-3a), trace silty clay; moist.						
32.0	523.4						Very stiff to hard gray SILT AND CLAY (A-6a), trace fine to coarse sand; damp to moist.						
		2 3 3	18	11		1.0		0	0	--	3	47	50
35													
		4 7 11	18	12		3.0							
40													
		5 8 13	18	13		4.25							
45													
		6 9 14	18	14		3.0		0	2	--	7	34	57
50													
		8 12 15	17	15		4.5+							
55													
		6 9 12	18	16		3.75							
60													



DLZ OHIO INC. * 6121 HUNTLEY ROAD, C MBUS, OHIO 43229 * (614)888-0040

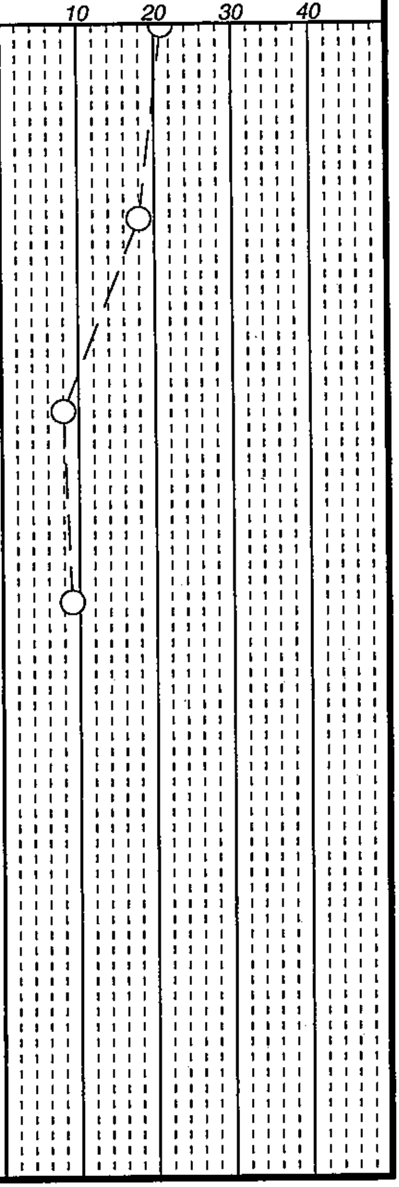
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring B-31
Location: Sta. 124+68.2, 74.1 ft. LT of SR 823 CL
Date Drilled: 1/11/07 to 1/12/07

WATER OBSERVATIONS:
Water seepage at: 14.8', 19.6'
Water level at completion: 30.2' (prior to coring)
24.6' (with augers removed, includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
60	495.4						Stiff gray SILT AND CLAY (A-6a), little fine to coarse sand; moist to wet.						
		6 8 10	18	17									
67.0	488.4						Loose gray COARSE AND FINE SAND (A-3a), little silt; wet.						
		3 5 3	15	18									
		5 3 6	13	19									
79.0	476.4	Core 63"	Rec 63"	RQD 97%	R1		Hard gray SILTSTONE; fine grained, slightly weathered, arenaceous, medium to thickly bedded. @ 79.4', 83.8', clay seams.						
84.3	471.2						Bottom of Boring - 84.3'						

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├───┤ *LL*
Blows per foot - ○



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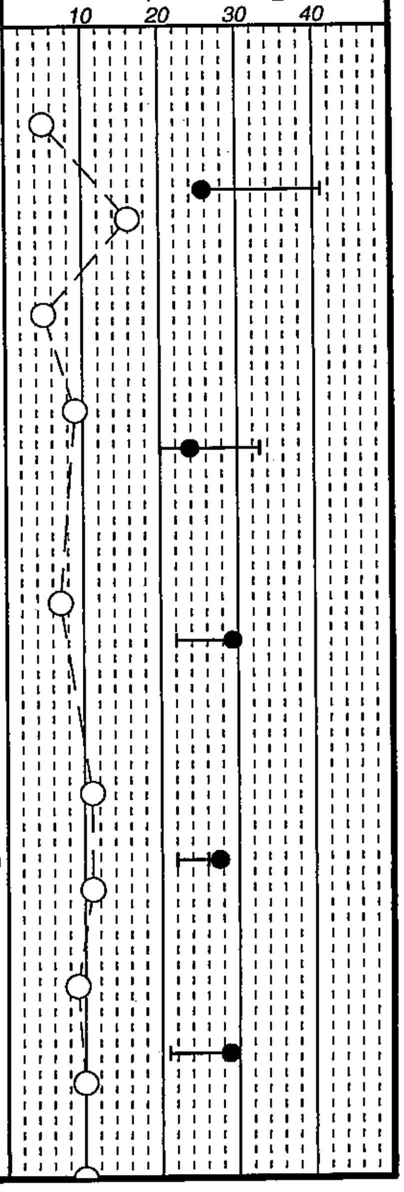
Client: TranSystems, Inc.	Project: SCI-823-0.00	Job No. 0121-3070.03
LOG OF: Boring B-32	Location: Sta. 122+95.4, 21.3 ft. RT of SR 823 CL	Date Drilled: 1/15/07 to 1/16/07

WATER OBSERVATIONS: Water seepage at: 28.0'-32.0', 68.0'-78.5'
Water level at completion: 59.5' (prior to coring)
21.1' (inside hollowstem augers)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	555.0												
0.3	554.7						Topsoil - 3"						
		1 2 3	18	1		1.5	Stiff brown SILTY CLAY (A-6b), trace to little fine to coarse sand, trace gravel; damp.						
3.0	552.0												
		4 7 9	18	2		3.5	Stiff to very stiff brown CLAY (A-7-6), some silt, trace fine sand; damp to moist.	0	0	--	1	29	70
5													
		2 2 3	18	3		1.5							
8.0	547.0												
		2 4 5	18	4		3.0	Stiff to very stiff brown SILT AND CLAY (A-6a), trace fine sand; damp.						
10					P1	1.25	@ 10.1', torvane=0.40 tsf	0	0	--	2	53	45
						3.0	@ 11.8', torvane=0.5 tsf						
12.5	542.5						Stiff to very stiff brown SILT (A-4b), little to some clay, trace fine to coarse sand; damp to moist.						
		3 3 4	18	5		1.75							
15					P2	1.0	@ 15.1', torvane=0.25 tsf	0	1	--	1	58	40
						3.5	@ 16.8', torvane=0.35 tsf						
		3 4 7	18	6		2.5							
20													
		3 4 7	18	7		1.25		0	0	--	1	80	19
		3 3 6	18	8		1.0							
25													
		3 5 5	18	9		2.0		0	0	--	1	68	31
		2 4 6	18	10		0.25							
30													

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○

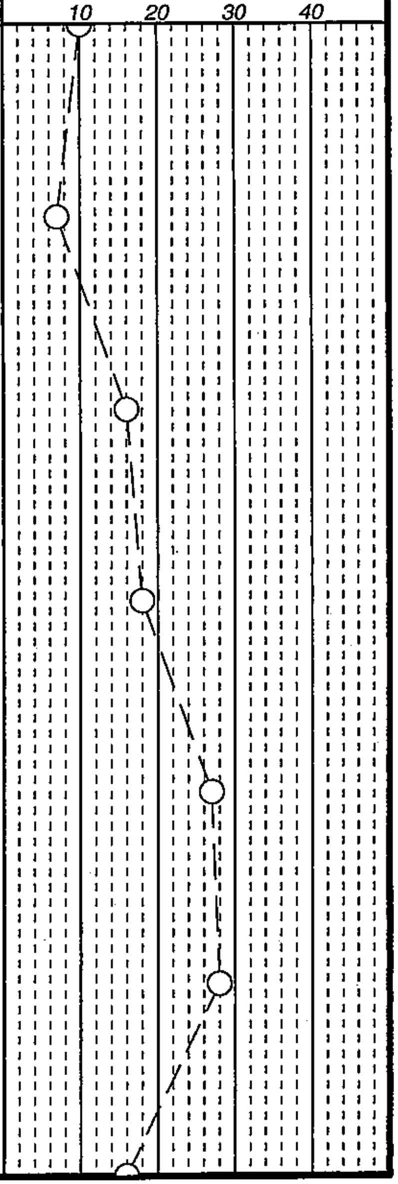


Client: TranSystems, Inc.	*Project:* SCI-823-0.00	*Job No.* 0121-3070.03
LOG OF: Boring B-32	*Location:* Sta. 122+95.4, 21.3 ft. RT of SR 823 CL	*Date Drilled:* 1/15/07 to 1/16/07

WATER OBSERVATIONS: Water seepage at: 28.0'-32.0', 68.0'-78.5'
Water level at completion: 59.5' (prior to coring)
21.1' (inside hollowstem augers)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf) / * Point-Load Strength (psi)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30.0	525.0						Stiff gray SILTY CLAY (A-6b), little fine to coarse sand; moist.						
35		3 3 4	18	11		1.0							
40		4 7 9	18	12		1.25							
42.0	513.0						Very stiff to hard gray CLAY (A-7-6), little to some silt, trace fine sand; damp.						
45		5 7 11	18	13		4.0							
50		10 11 16	18	14		3.5							
55		10 11 17	18	15		2.75							
60		5 7 9	18	16		2.25							

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○



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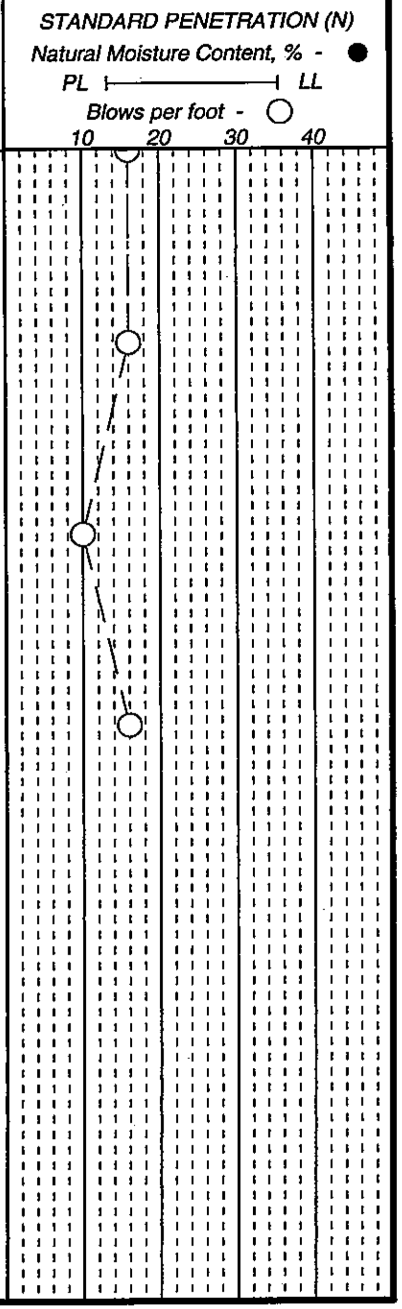
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring B-32

Location: Sta. 122+95.4, 21.3 ft. RT of SR 823 CL | Date Drilled: 1/15/07 to 1/16/07

WATER OBSERVATIONS:
Water seepage at: 28.0'-32.0', 68.0'-78.5'
Water level at completion: 59.5' (prior to coring)
21.1' (inside hollowstem augers)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf) / * Point-Load Strength (psi)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
60.0	495.0 495.0						Medium dense gray COARSE AND FINE SAND (A-3a), little to some silt, trace gravel, trace clay; contains sandstone fragments; damp to moist.						
65		6 7 9	18	17									
70		4 4 6	18	18			@ 78.5', auger refusal, sand heave, washed out.						
75		3 7 9	18	19			@ 78.5', auger refusal, sand heave, washed out.						
78.5 80	476.5	Core 66"	Rec 66"	RQD 93%	R1		Medium hard to hard gray SANDSTONE interbedded with SHALE; fine grained, slightly weathered, micaceous, medium bedded, slightly fractured. @ 78.8'-78.9', clay seam.						
84.0 85	471.0						Bottom of Boring - 84.0'						
90													



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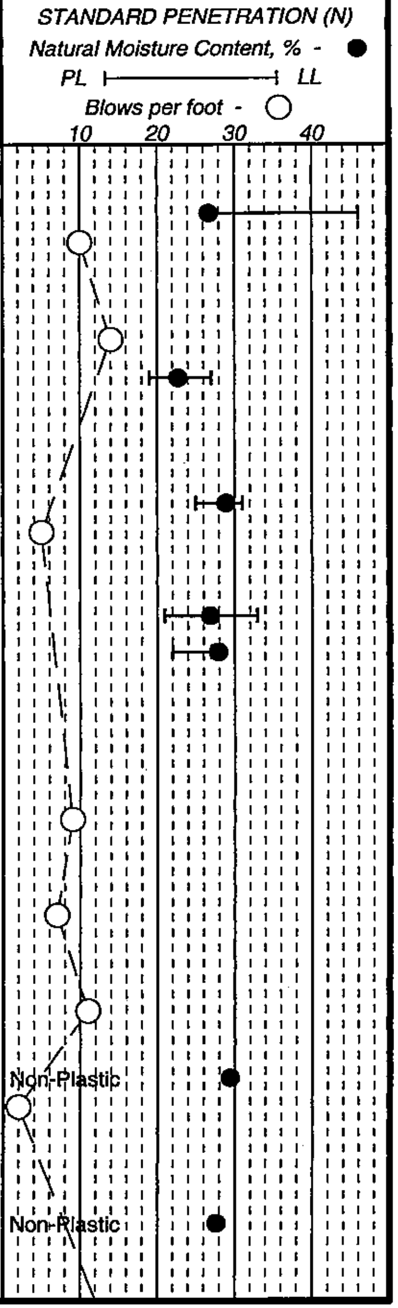
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring TR-35A | *Location:* Sta. 131+29.4, 14.1 ft. RT of SR 823 CL | *Date Drilled:* 1/12/06

WATER OBSERVATIONS: Water seepage at: 24.5'-25.0', 68.5'-79.0'
Water level at completion: 67.8' (prior to coring)
13.4' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	554.6												
0.3	554.3						Limestone gravel (driveway) - 3"						
		3 4 6	12	1		3.0	Very stiff yellowish brown CLAY (A-7-6), some silt, trace fine sand; damp to moist.	0	0	--	2	32	66
		6 6 8	13	2		2.25							
5.0	549.6				P-1 P-1	1.0	Stiff brown SILT (A-4b), little fine sand, little to some clay; contains thin clay seams; moist.	0	0	--	4	63	33
		2 2 3	18	3		1.5		0	0	--	1	71	28
10													
11.0	543.6						Medium stiff brown SILT AND CLAY (A-6a), trace fine to coarse sand; moist.						
12.4	542.2				P-2A	0.75		0	1	--	1	51	47
					P-2B	0.75	Medium stiff to stiff brown SILT (A-4b), some clay, trace fine to coarse sand; moist to wet.	0	2	--	2	66	30
15													
		2 4 5	18	4		1.25							
		12 3 4	18	5		1.00							
20													
20.5	534.1						Stiff gray CLAY (A-7-6), little to some silt, trace fine sand; damp.						
		3 5 6	18	6		1.5							
23.5	531.1						Very loose gray SILT (A-4b); moist to wet.						
		WOH 1 1	18	7				0	0	--	0	75	25
25													
					P-3			0	0	--	1	77	22
30													



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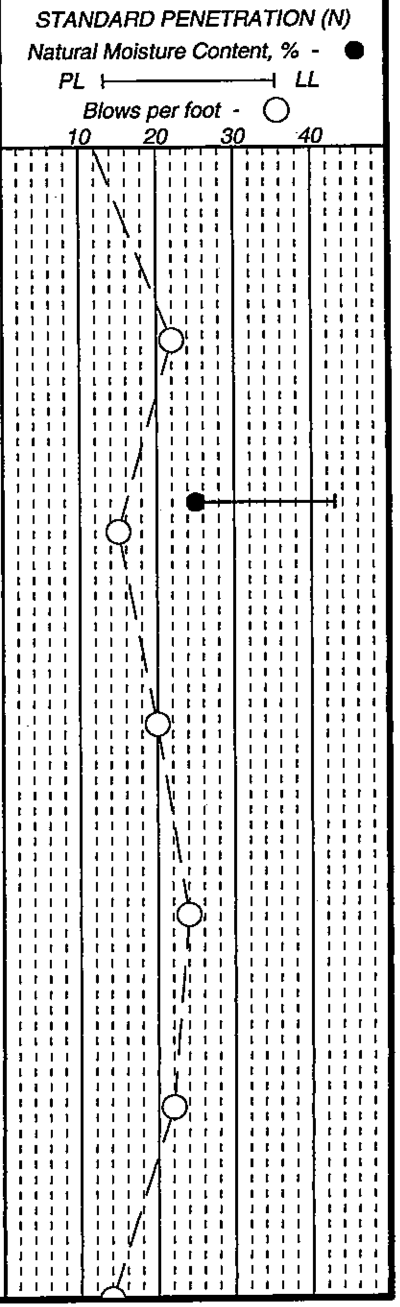
Client: TranSystems, Inc.	Project: SCI-823-0.00	Job No. 0121-3070.03
LOG OF: Boring TR-35A	Location: Sta. 131+29.4, 14.1 ft. RT of SR 823 CL	Date Drilled: 1/12/06

WATER OBSERVATIONS: Water seepage at: 24.5'-25.0', 68.5'-79.0'
Water level at completion: 67.8' (prior to coring)
13.4' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf) / * Point-Load Strength (psi)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30	524.6						Loose gray SILT (A-4b); moist to wet.						
32.0	522.6						Very stiff to hard grayish brown CLAY (A-7-6), trace fine sand; damp to moist.						
35		5 9 13	18	8		4.5+							
40		4 6 9	18	9		4.5+		0	0	--	1	20	79
45		5 9 11	18	10		3.0							
50		5 10 14	18	11		4.5+							
55		5 9 13	18	12		4.5+							
60		4 7 7	18	13		• 2.75							



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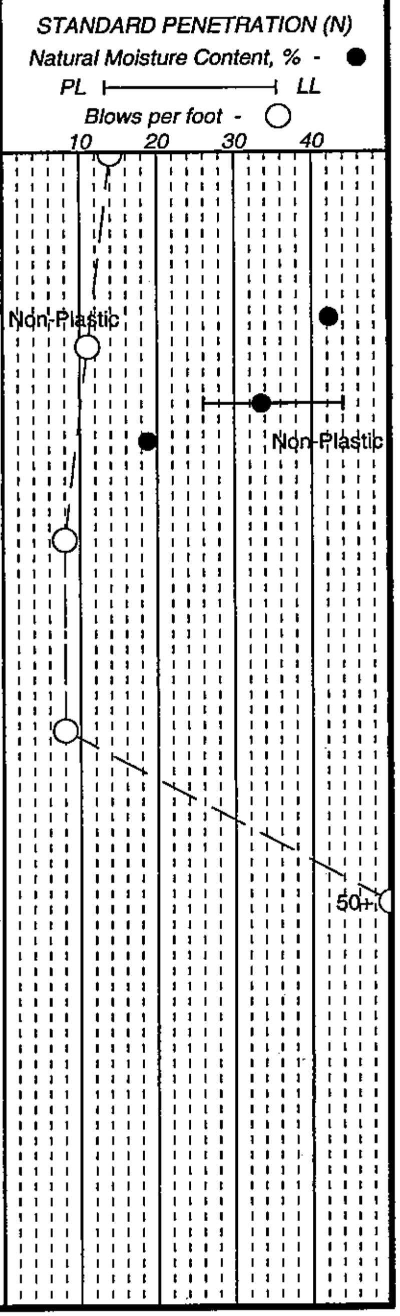
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring TR-35A | *Location:* Sta. 131+29.4, 14.1 ft. RT of SR 823 CL | *Date Drilled:* 1/12/06

WATER OBSERVATIONS:
Water seepage at: 24.5'-25.0', 68.5'-79.0'
Water level at completion: 67.8' (prior to coring)
13.4' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
60	494.6						Very stiff to hard grayish brown CLAY (A-7-6), trace fine sand; damp to moist.						
62.0	492.6						Stiff mottled dark brown and black ORGANIC SILT (A-4b), trace fine to coarse sand, trace gravel; moist.						
		4 5 6	18	14		1.5		1	2	--	2	66	29
65													
65.5	489.1				P-4A	1.0	Medium stiff to stiff dark brown CLAY (A-7-6), trace fine to coarse sand; moist.	0	6	--	3	64	27
66.9	487.7				P-4B	1.75	Stiff gray SILT (A-4b), little to some fine to coarse sand; damp to moist.	0	1	--	20	63	16
		3 4 4	18	15									
70													
72.0	482.6						Loose gray FINE SAND (A-3), trace silty clay; moist to wet.						
		WOH 3 5	18	16									
75													
77.0	477.6						Loose to medium dense brown COARSE AND FINE SAND (A-3a), trace to little silty clay, trace gravel; moist.						
		5 50/5	10	17a 17b			@ 79.5', some silt, trace clay.						
80													
81.0	473.6	Core 60"	Rec 60"	RQD 71%	R-1		Medium hard gray SANDSTONE; very fine to fine grained, highly weathered, argillaceous, micaceous, medium to thickly bedded, moderately fractured. @ 81.7', 82.6', 83.7', low angle fractures. @ 84.1'-84.7',84.3'-84.5', high angle fractures. @ 85.1', qu = 341 psi.						
85													
86.0	468.6						Bottom of Boring - 86.0'						
90													



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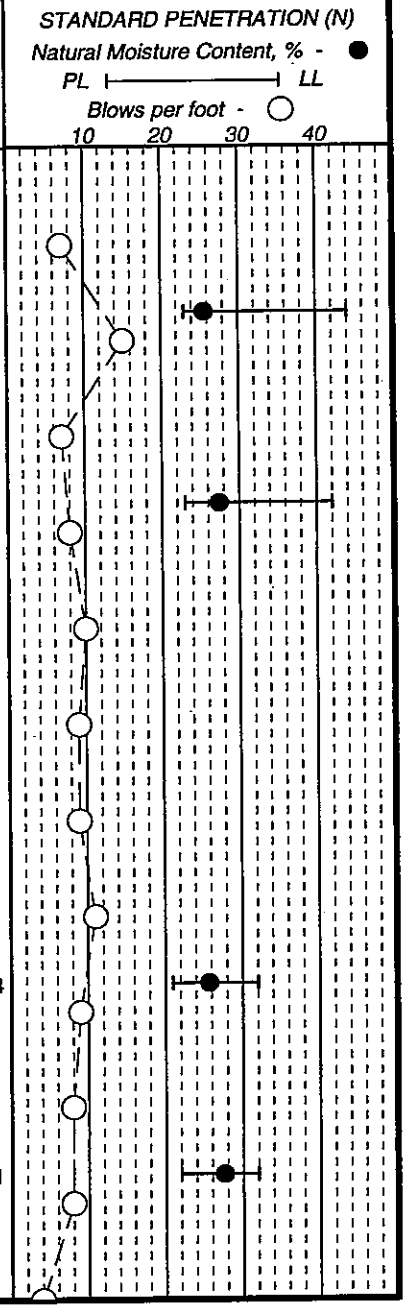
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-36
Location: Sta. 123+62.2, 70.4 ft. RT of SR 823 CL
Date Drilled: 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62.0'-73.0'
Water level at completion: 12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	552.6												
0.3	552.3						Topsoil - 4"						
		2 3 4	17	1		2.0	Very stiff brown and gray CLAY (A-7-6), trace fine sand; moist. @ 0.3'-1.8', contains root fragments.						
		6 7 8	16	2		3.0		0	0	--	1	31	68
5.5	547.1						Very stiff brown CLAY (A-7-6), trace fine sand; varved; moist.						
		3 3 4	18	3		3.0							
		2 3 5	16	4		3.0		0	0	--	1	38	61
		3 4 6	18	5		2.5							
		2 4 5	18	6		3.25							
		3 4 5	18	7		3.0							
		4 5 6	18	8		3.0							
20.5	532.1						Very stiff brown SILT AND CLAY (A-6a); varved; moist.						
		3 4 5	18	9		3.25		0	0	--	1	65	34
		3 4 4	18	10		3.0							
26.0	526.6	2 4 4	18	11		3.5	Very stiff brown SILT (A-4b); varved; moist.	0	0	--	2	67	31
28.5	524.1	2 2 2	18	12		2.75	Very stiff gray CLAY (A-7-6); varved; damp to moist.						
30													



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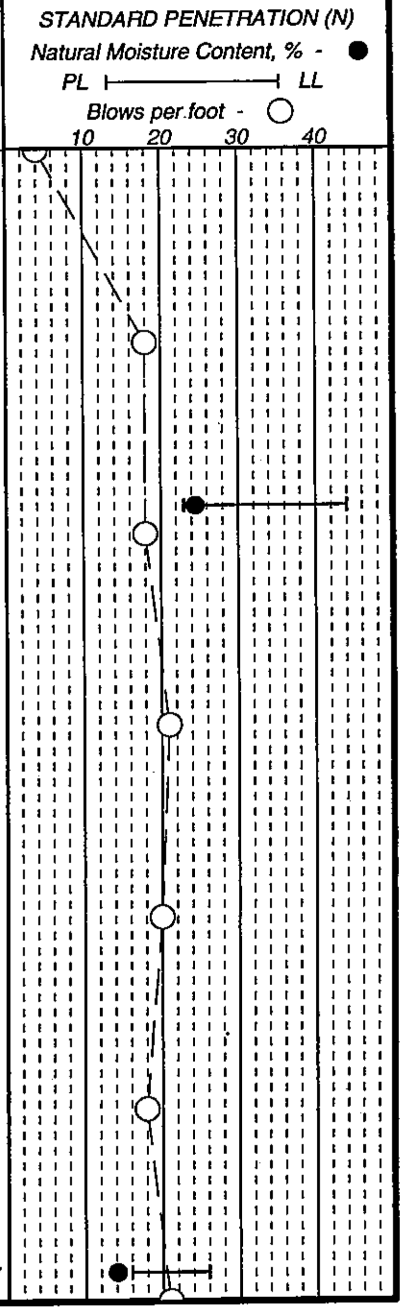
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-36
Location: Sta. 123+62.2, 70.4 ft. RT of SR 823 CL
Date Drilled: 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62.0'-73.0'
Water level at completion: 12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30	522.6						Very stiff gray CLAY (A-7-6); varved; damp to moist.						
35		5 8 10	11	13		3.75							
							@ 38.0', brownish gray.						
40		7 8 10	18	14		3.75		0	0	--	0	33	67
							@ 42.0'-47.0', hard.						
45		4 9 12	18	15		4.5+							
							@ 47.0', gray, damp to moist.						
50		7 10 10	18	16		2.75							
55		5 9 9	18	17		3.0							
57.0	495.6						Hard gray SILT (A-4b); damp.						
60		5 10 11	18	18		4.5+		0	1	--	9	53	37



DLZ OHIO INC. * 6121 HUNTLEY ROAD, C MBUS, OHIO 43229 * (614)888-0040

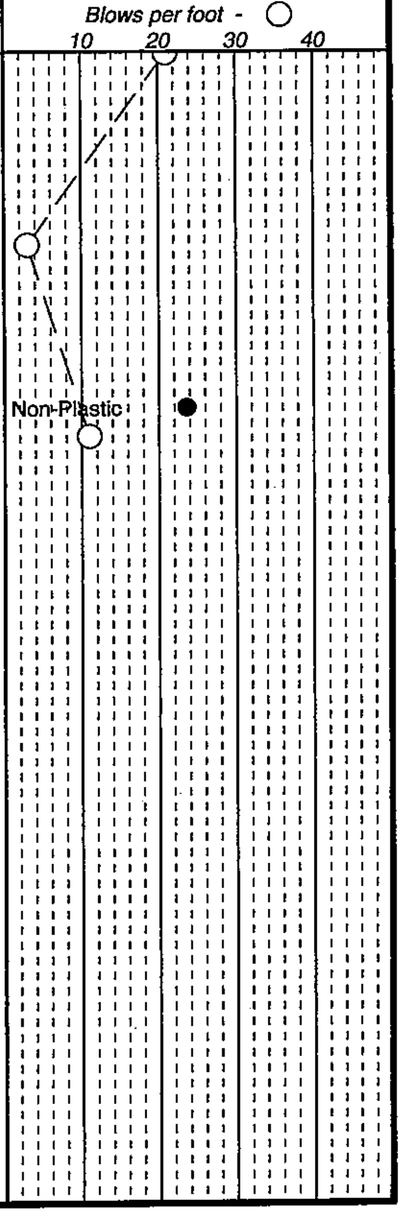
Client: TranSystems, Inc. *Project:* SCI-823-0.00 *Job No.* 0121-3070.03

LOG OF: Boring TR-36 *Location:* Sta. 123+62.2, 70.4 ft. RT of SR 823 CL *Date Drilled:* 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62.0'-73.0'
Water level at completion: 12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
60	492.6						Hard gray SILT (A-4b); damp.						
62.0	490.6						Very loose gray SANDY SILT (A-4a); wet.						
65		5 1 2	18	19									
70		0 4 7	18	20			@ 69.0', medium dense.	0	1	--	60	31	8
72.0	480.6						Severely weathered gray SANDSTONE, argillaceous.						
74.0	478.6	50/1	1	21			Hard light gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, massive, slightly fractured. @ 76.0', 76.3', 77.6', 77.7', low angle fractures.						
75													
80		Core 120"	Rec 116"	RQD 70%	R-1								
85							@ 83.4'-84.9', medium hard, very fine grained.						
90		Core 120"	Rec 119"	RQD 93%	R-2								

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○



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Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-36
Location: Sta. 123+62.2, 70.4 ft. RT of SR 823 CL
Date Drilled: 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62.0'-73.0'
Water level at completion: 12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.		Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	GRADATION						STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL ├──┤ LL Blows per foot - ○ 10 20 30 40
				Drive	Press / Core			% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	
90	462.6						Hard light gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, massive, slightly fractured. @ 90.2'-90.5', 92.6'-97.1', calcareous.							
94.0	458.6						Bottom of Boring - 94.0'							
95														
100														
105														
110														
115														
120														

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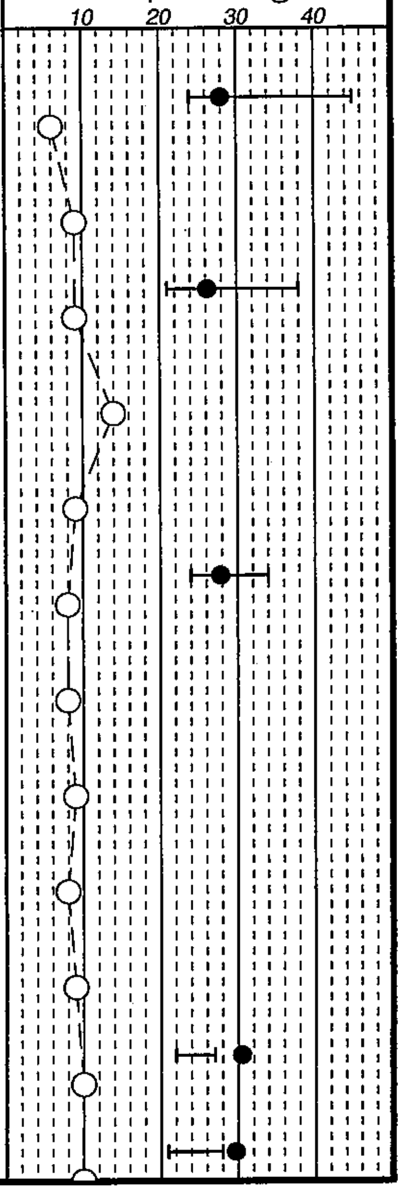
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-37 | Location: Sta. 122+47.3, 23.9 ft. LT of SR 823 CL | Date Drilled: 01/27/05 to 01/31/05

WATER OBSERVATIONS: Water seepage at: 16.0'-18.0', 28.5'-37.5', 68.0'
Water level at completion: Not Reported

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	556.1												
0.3	555.8						Topsoil - 3"						
		2 3 3	14	1		2.25	Very stiff brown CLAY (A-7-6); trace fine to coarse sand; moist.	0	1	--	4	41	54
		3 4 5	18	2		2.0	@ 3.5'-5.0', brown and gray.						
5 5.5	550.6												
		3 4 5	18	3		1.5	Stiff brown SILT CLAY (A-6b), trace fine to coarse sand; moist.	0	1	--	6	38	55
		3 6 8	17	4		4.5+	@ 8.5'-10.0', hard; damp.						
10 10.5	545.6												
		3 4 5	10	5		2.25	Very stiff brown SILT (A-4b), "and" clay, trace fine sand; varved; damp to moist.						
		2 3 5	18	6		3.0		0	0	--	1	61	38
15													
		2 4 4	18	7		0.5	@ 16.0'-18.0', soft to medium stiff; wet.						
		3 4 5	18	8		2.0							
20													
		2 3 5	18	9		2.25							
		2 4 5	18	10		2.0							
25 25.5	530.6												
		3 5 5	18	11		--	Stiff brown SILT (A-4b), some clay, trace fine sand; moist to wet.	0	0	--	0	79	21
		3 4 6	18	12		--		0	0	--	2	77	21
30													

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○



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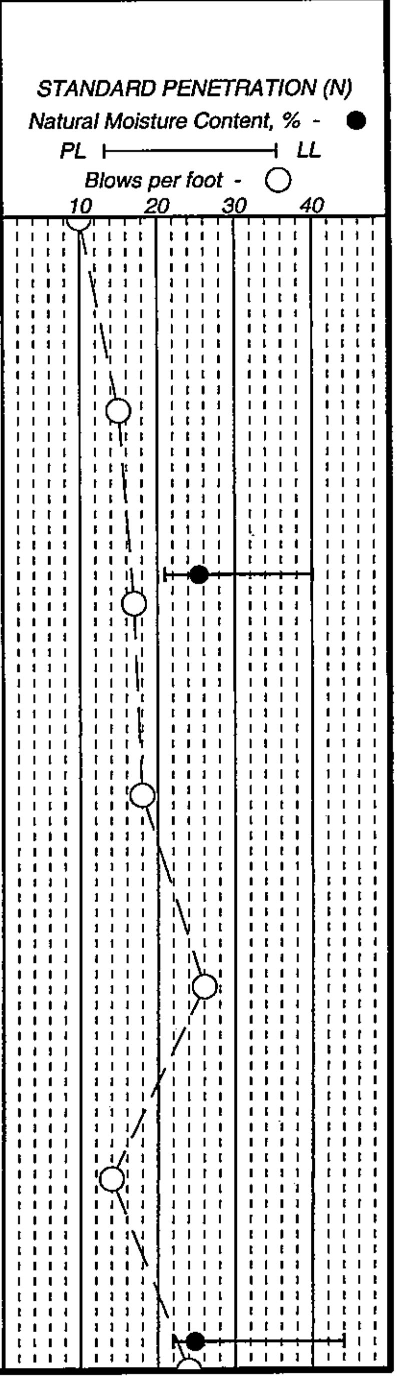
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-37
Location: Sta. 122+47.3, 23.9 ft. LT of SR 823 CL
Date Drilled: 01/27/05 to 01/31/05

WATER OBSERVATIONS: Water seepage at: 16.0'-18.0', 28.5'-37.5', 68.0'
Water level at completion: Not Reported

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30	526.1						Stiff brown SILT (A-4b); moist to wet.						
32.0	524.1						Hard brownish gray SILTY CLAY (A-6b), trace fine sand; moist.						
		4 6 9	18	13		4.5+							
35													
		6 8 9	18	14		4.25		0	0	--	1	38	61
40													
42.0	514.1						Hard gray CLAY (A-7-6); damp to moist.						
		4 7 11	18	15		4.25							
45													
		8 13 13	18	16		4.5+							
50													
		4 7 7	18	17		4.0							
55													
		8 12 12	18	18		4.5+		0	0	--	0	21	79
60													



DLZ OHIO INC. * 6121 HUNTLEY ROAD, C MBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc.

Project: SCI-823-0.00

Job No. 0121-3070.03

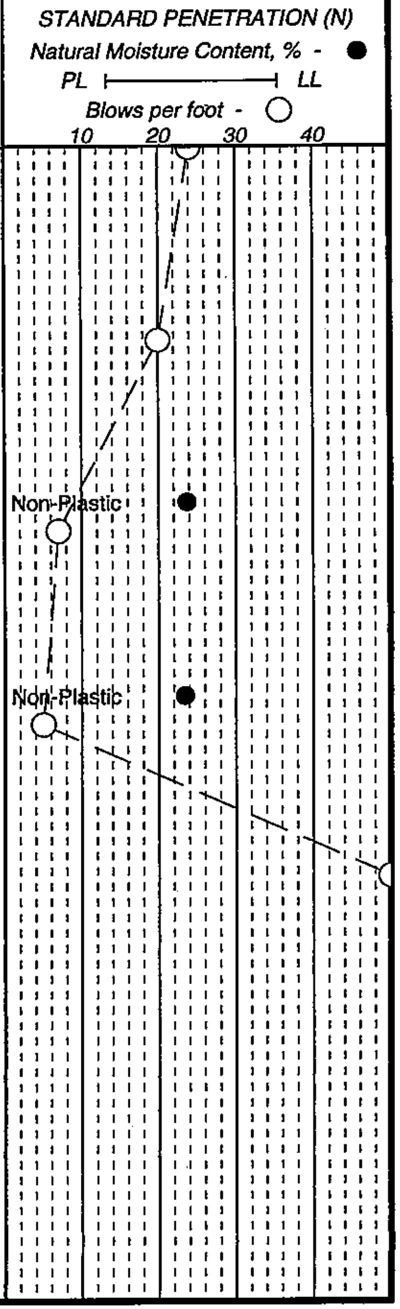
LOG OF: Boring TR-37

Location: Sta. 122+47.3, 23.9 ft. LT of SR 823 CL

Date Drilled: 01/27/05 to 01/31/05

WATER OBSERVATIONS: Water seepage at: 16.0'-18.0', 28.5'-37.5', 68.0'
Water level at completion: Not Reported

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
60	496.1						Hard gray CLAY (A-7-6); damp to moist.						
62.0	494.1						Medium dense light gray SILT (A-4b), some fine to coarse sand, little clay, trace gravel; moist.						
65		7 10 10	18	19									
70		3 3 4	18	20			@ 68.0', loose, wet.	1	2	--	30	57	10
72.0	484.1						Loose gray COARSE AND FINE SAND (A-3a), little gravel, trace clay; wet.						
75		0 1 4	18	21				17	3	--	53	21	6
77.0	479.1						Severely weathered gray SANDSTONE, argillaceous.						
79.0	477.1	50/2	1	22									
80							Medium hard to hard gray SANDSTONE; very fine to fine grained, moderately weathered, argillaceous, thinly to thickly bedded, slightly fractured. @ 79.0'-80.2', broken. @ 79.3'-79.4', 79.8'-80.1', iron stained bands. @ 80.8',86.0', low angle fractures.						
85		Core 120"	Rec 117"	RQD 74%	R-1								
90							@ 87.5'-89.2', contains moderate argillaceous laminations. @ 88.3'-88.6', decomposed argillaceous band.						



DLZ OHIO INC. * 6121 HUNTLEY ROAD, C MBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc.	*Project:* SCI-823-0.00	*Job No.* 0121-3070.03
LOG OF: Boring TR-37	*Location:* Sta. 122+47.3, 23.9 ft. LT of SR 823 CL	*Date Drilled:* 01/27/05 to 01/31/05

Depth (ft)	*Elev. (ft)*	*Blows per 6"*	*Recovery (in)*	*Sample No.* *Drive*	*Sample No.* *Press / Core*	*Hand Penetrometer (tsf) / * Point-Load Strength (psi)*	*WATER OBSERVATIONS:* Water seepage at: 16.0'-18.0', 28.5'-37.5', 68.0' Water level at completion: Not Reported *DESCRIPTION*	*GRADATION* *% Aggregate*	*% C. Sand*	*% M. Sand*	*% F. Sand*	*% Silt*	*% Clay*	*STANDARD PENETRATION (N)* *Natural Moisture Content, % -* ● *PL* ⊢—⊣ *LL* *Blows per foot -* ○ *10 20 30 40*
90	466.1	Core 120"	Rec 119"	RQD 99%	R-2		Medium hard to hard gray SANDSTONE; very fine to fine grained, moderately weathered, argillaceous, thinly to thickly bedded, slightly fractured. @ 91.9'-92.0', 94.4'-94.7', 96.9'-97.4', calcareous.							
95														
99.0	457.1						Bottom of Boring - 99.0'							
100														
105														
110														
115														
120														

FILE: 0121-3070-03 [8/1/2007 4:01 PM]

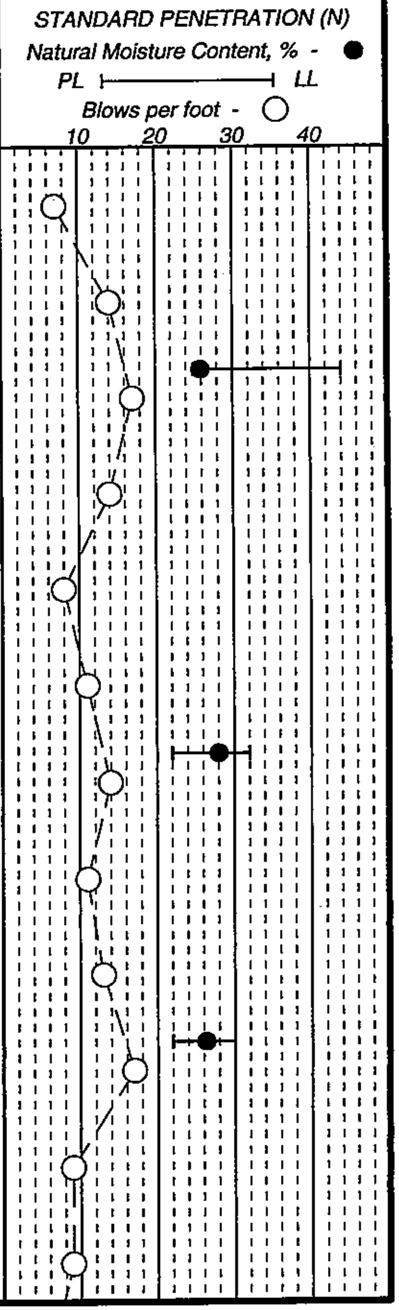
DLZ OHIO INC. * 6121 HUNTLEY ROAD, C MBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-38
Location: Sta. 121+30.1, 51.7 ft. LT of SR 823 CL
Date Drilled: 02/09/05 to 02/10/05

WATER OBSERVATIONS: Water seepage at: 10.0'-21.5' 33.0'-38.5', 65.0'-80.0'
Water level at completion: 9.8' (Prior to coring)
7.3' (Includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf) / * Point-Load Strength (psi)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	554.0												
0.3	553.7	WOH 3 4	18	1		2.5	Topsoil - 4" Very stiff CLAY (A-7-6), brown, trace fine sand; damp.						
		3 5 9	18	2		3.25							
5		4 6 11	18	3		3.5		0	0	--	1	29	70
		4 6 8	18	4		2.0							
10.0	544.0	2 3 5	18	5		1.5	Stiff brown SILT (A-4b), little to some clay, trace fine to coarse sand; moist.						
		3 5 6	18	6		1.5							
15		3 5 9	18	7		1.25		0	1	--	1	63	35
		2 5 6	18	8		1.25							
20		3 5 8	18	9		1.5							
		4 8 9	16	10		1.5		0	0	--	1	72	27
25		2 4 5	18	11		1.5							
		3 4 5	18	12		1.0							
30													



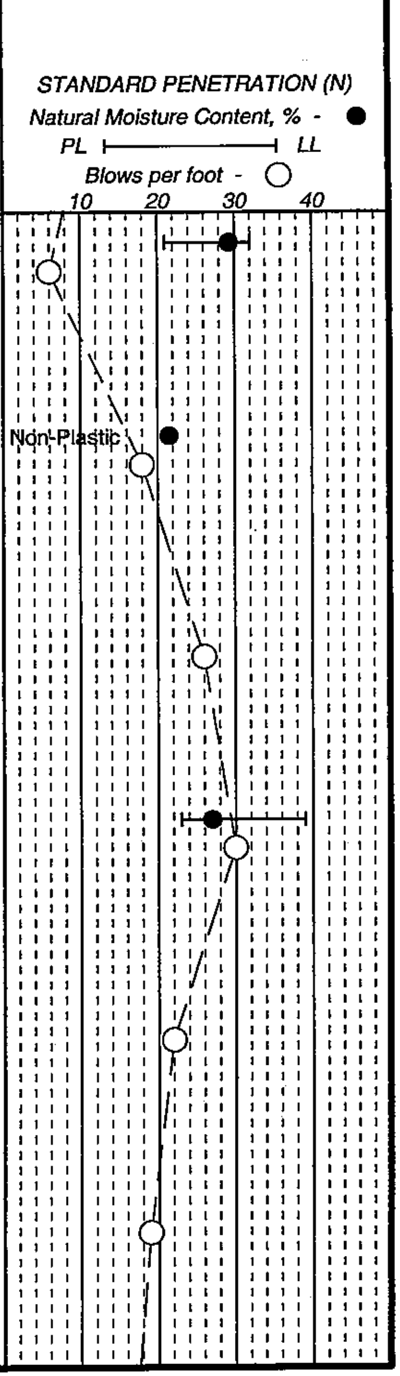
DLZ OHIO INC. * 6121 HUNTLEY ROAD, C MBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-38
Location: Sta. 121+30.1, 51.7 ft. LT of SR 823 CL
Date Drilled: 02/09/05 to 02/10/05

WATER OBSERVATIONS:
Water seepage at: 10.0'-21.5' 33.0'-38.5', 65.0'-80.0'
Water level at completion: 9.8' (Prior to coring)
7.3' (Includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
	524.0												
30.0	524.0	3 2 4	16	13		1.0	Stiff brown SILT AND CLAY (A-6a), little fine sand; moist.	0	0	--	5	59	36
33.0	521.0						Medium dense gray COARSE AND FINE SAND (A-3a); moist.						
35		4 7 11	18	14				0	21	--	49	20	10
38.0	516.0						Very stiff gray SILTY CLAY (A-6b), little fine sand; damp to moist.						
40		7 12 14	18	15		3.5							
45		10 13 17	18	16		3.0		0	0	--	1	31	68
50		5 9 13	18	17		4.0							
55.0	499.0	7 9 10	18	18		3.5	Very stiff gray SILT (A-4b), little fine sand, little silty clay; moist.						
60													



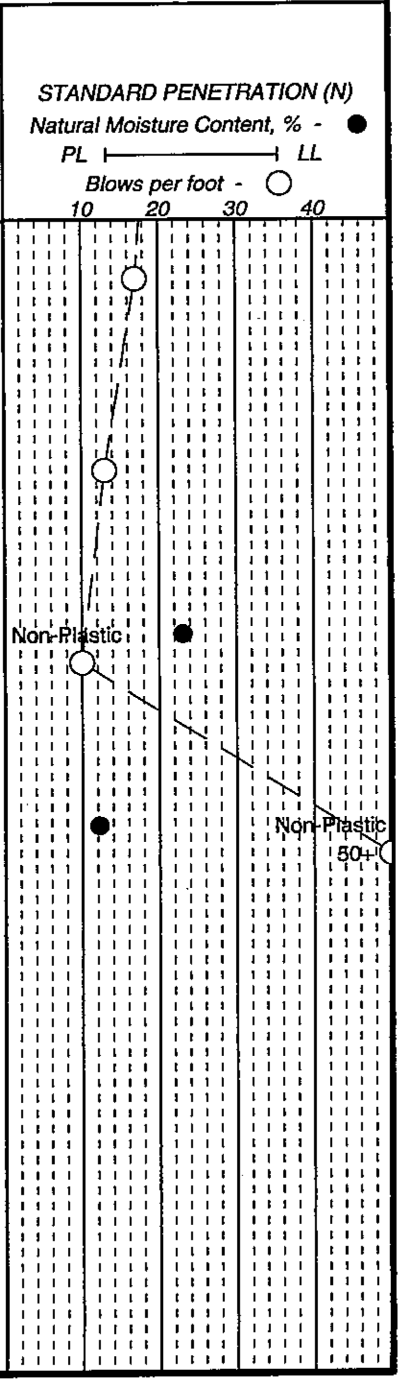
DLZ OHIO INC. * 6121 HUNTLEY ROAD, C MBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-38 | Location: Sta. 121+30.1, 51.7 ft. LT of SR 823 CL | Date Drilled: 02/09/05 to 02/10/05

WATER OBSERVATIONS: Water seepage at: 10.0'-21.5' 33.0'-38.5', 65.0'-80.0'
Water level at completion: 9.8' (Prior to coring)
7.3' (Includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
60.0	494.0 494.0	4 8 9	18	19			Medium dense gray COARSE AND FINE SAND (A-3a), some silt, little clay; moist.						
65		6 6 7	18	20			@ 65.0', wet.						
68.0	486.0						Loose gray SANDY SILT (A-4a); wet.						
70		WOH 5 5	15	21				0	1	--	54	45	
73.0	481.0						Very dense gray GRAVEL WITH SAND (A-1-b); wet.						
75		9 20 50/3	13	22				50	19	--	12	19	
80.0	474.0	Core 60"	Rec 60"	RQD 90%	R-1		Medium hard to hard gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, thinly to thickly bedded.						
85		Core 60"	Rec 60"	RQD 80%	R-2		@ 80.0'-80.2', argillaceous zone, broken. @ 85.9',86.2',86.7', low angle clay filled fractures.						
90													



DLZ OHIO INC. * 6121 HUNTLEY ROAD, UMBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-38
Location: Sta. 121+30.1, 51.7 ft. LT of SR 823 CL
Date Drilled: 02/09/05 to 02/10/05

WATER OBSERVATIONS: Water seepage at: 10.0'-21.5' 33.0'-38.5', 65.0'-80.0'
Water level at completion: 9.8' (Prior to coring)
7.3' (Includes drilling water)

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ *LL*
Blows per foot - ○

Depth (ft)	*Elev. (ft)*	*Blows per 6"*	*Recovery (in)*	*Sample No.* *Drive*	*Sample No.* *Press / Core*	*Hand Penetro-meter (tsf) / * Point-Load Strength (psi)*	*DESCRIPTION*	*GRADATION* *% Aggregate*	*% C. Sand*	*% M. Sand*	*% F. Sand*	*% Silt*	*% Clay*	*10 20 30 40*
90	464.0	Core 60"	Rec 33"	RQD 55%	R-3		Medium hard to hard gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, massive, slightly fractured. @ 92.8'-95.0', lost recovery.							
95		Core 60"	Rec 0"	RQD 0%	R-4		@ 95.0'-100.0', sample lodged in core barrel; unable to recover.							
100.0	454.0						Bottom of Boring - 100.0'							
105														
110														
115														
120														

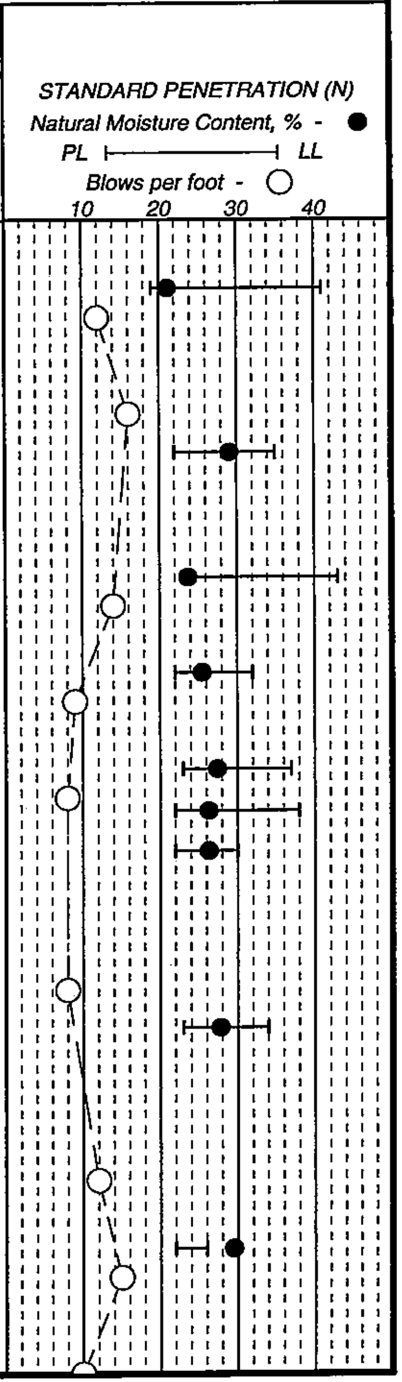
DLZ OHIO INC. * 6121 HUNTLEY ROAD, C MBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-38A | Location: Sta. 120+14.5, 4.7 ft. RT of SR 823 CL | Date Drilled: 1/9/06 to 1/10/06

WATER OBSERVATIONS: Water seepage at: 43.5', 73.5'
Water level at completion: 43.0' (prior to coring)
13.6' (includes drilling water)
41.5' (after 15 hours)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	556.0						Topsoil - 9"						
0.8	555.2	2 4 8	13	1		4.5+	Very stiff to hard mottled brown and gray CLAY (A-7-6), some to "and" silt, trace fine sand; damp to moist.	0	0	--	4	43	53
		6 7 9	18	2		2.75							
5.0	551.0				P-1	2.0	Stiff to very stiff mottled brown and gray SILT AND CLAY (A-6a), trace fine sand; moist.	0	0	--	4	47	49
7.5	548.5	4 6 8	16	3		4.0	Hard brown CLAY (A-7-6), trace fine sand, some silt; damp to moist.	0	0	--	1	27	72
10 10.5	545.5	3 4 5	18	4		1.25	Stiff brown SILT (A-4b), "and" clay, trace fine sand; moist.	0	0	--	3	54	43
13.0	543.0	3 3 5	18	5		2.0	Stiff to very stiff brown SILT AND CLAY (A-6a), trace fine sand; moist.	0	0	--	1	48	51
15.0	541.0				P-2A	1.5	Stiff brown SILTY CLAY (A-6b), trace fine sand; moist.	0	0	--	1	44	55
15.7	540.3				P-2B	1.0	Stiff brown SILT (A-4b), trace fine sand; moist.	0	0	--	1	74	25
		3 4 4	18	6		1.75							
20.0	536.0				P-3	1.0	Stiff brown SILT AND CLAY (A-6a), trace to little fine to coarse sand; moist.	0	7	--	4	53	36
		3 5 7	18	7		2.0							
25 25.5	530.5	5 6 9	18	8		0.75	Medium stiff brown SILT (A-4b), little clay; wet.	0	0	--	0	82	18
		3 4 6	18	9		0.75							
30													



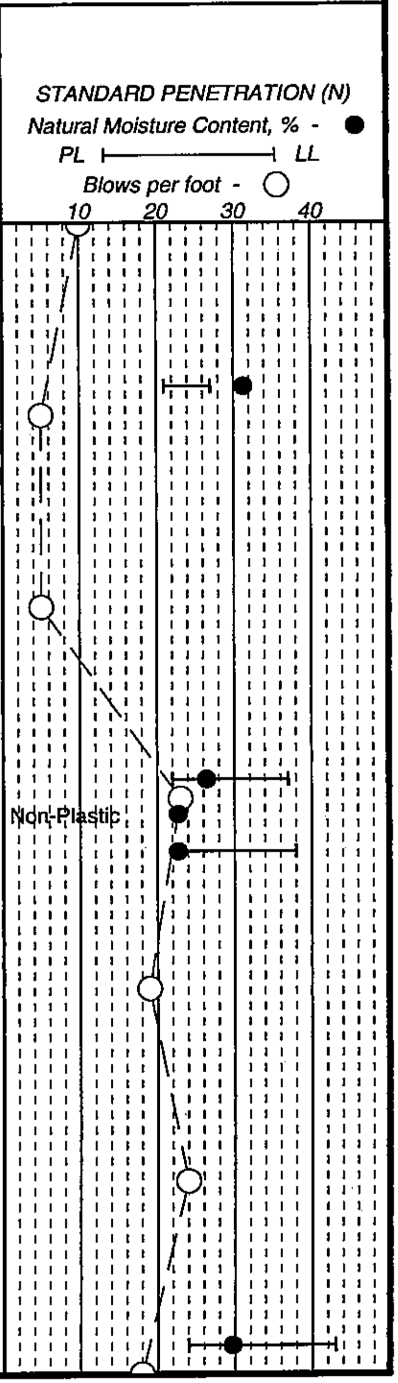
DLZ OHIO INC. * 6121 HUNTLEY ROAD, C MBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-38A | Location: Sta. 120+14.5, 4.7 ft. RT of SR 823 CL | Date Drilled: 1/9/06 to 1/10/06

WATER OBSERVATIONS: Water seepage at: 43.5', 73.5'
Water level at completion: 43.0' (prior to coring)
13.6' (includes drilling water)
41.5' (after 15 hours)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30	526.0						Medium stiff brown SILT (A-4b), little clay; wet.						
		WOH 2 3	18	10		0.75		0	0	--	0	69	31
35													
		1 1 4	18	11		0.75							
40													
42.0	514.0						Loose to medium dense brown FINE SAND (A-3), trace silty clay, trace coarse sand; wet.						
44.5	511.5	4 10 13	18	12a 12b		2.75	Very stiff brownish gray SILT AND CLAY (A-6a), some silt, trace fine sand; moist.	0	0	--	3	24	73
45.0	511.0				P-4A		Loose to medium dense brown FINE SAND (A-3), trace silty clay; wet.	0	0	--	91	9	
					P-4B			0	0	--	1	31	68
45.8	510.2						Very stiff to hard dark brown SILTY CLAY (A-6b), trace fine sand; damp to moist.						
		5 8 11	18	13		4.0							
50													
		7 10 14	15	14		2.75							
55													
57.0	499.0						Stiff dark brown CLAY (A-7-6), little to some silt, trace fine sand; moist.						
		6 8 10	18	15		1.5		0	0	--	1	23	76
60													



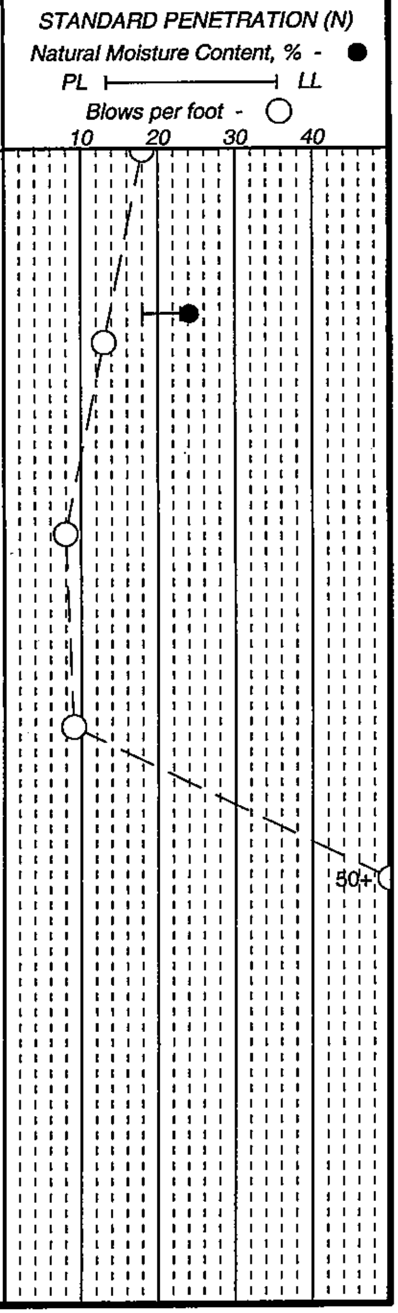
DLZ OHIO INC. * 6121 HUNTLEY ROAD, C MBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-38A
Location: Sta. 120+14.5, 4.7 ft. RT of SR 823 CL
Date Drilled: 1/9/06 to 1/10/06

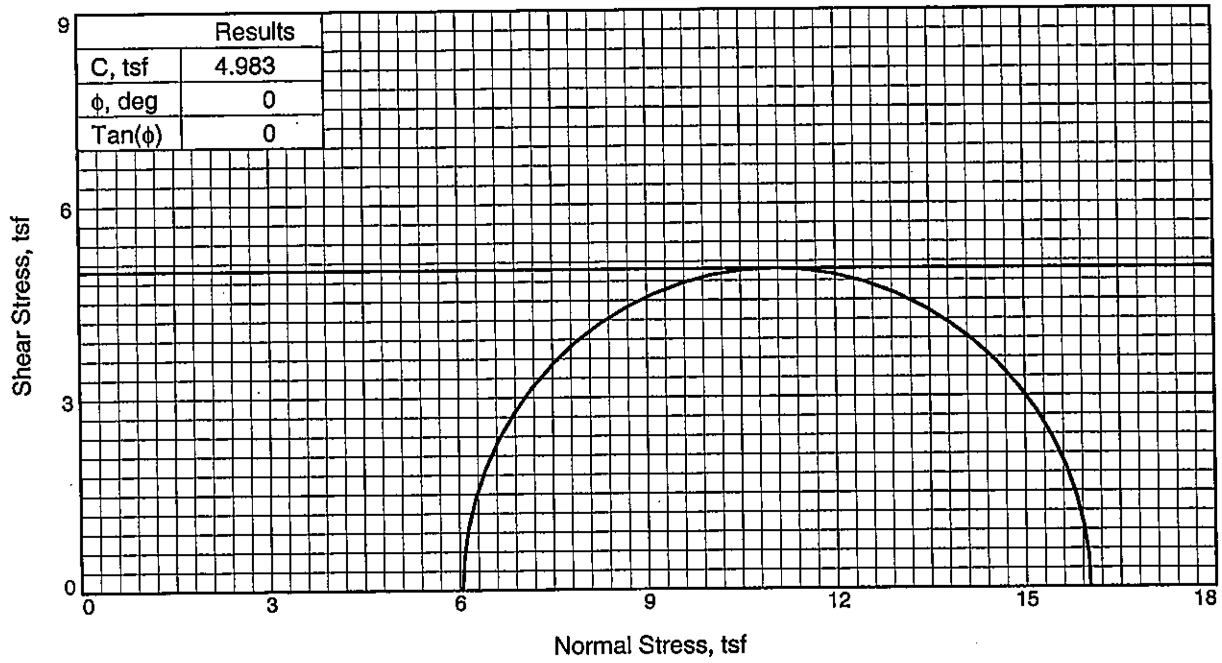
WATER OBSERVATIONS: Water seepage at: 43.5', 73.5'
Water level at completion: 43.0' (prior to coring)
13.6' (includes drilling water)
41.5' (after 15 hours)

Depth (ft)	*Elev. (ft)*	*Blows per 6"*	*Recovery (in)*	*Sample No. Drive*	*Sample No. Press / Core*	*Hand Penetrometer (tsf) / * Point-Load Strength (psi)*	*DESCRIPTION*	*GRADATION % Aggregate*	*% C. Sand*	*% M. Sand*	*% F. Sand*	*% Silt*	*% Clay*
60	496.0						Stiff dark brown CLAY (A-7-6), little to some silt, trace fine sand; moist.						
62.0	494.0	4 7 6	18	16		0.5	Soft to medium stiff bluish gray SANDY SILT (A-4a), some fine sand, some clay; moist to wet.	0	0	–	29	48	23
67.0	489.0	2 4 4	12	17			Loose gray SILT (A-4b), trace to little fine sand, trace clay; moist to wet.						
72.0	484.0	2 6 3	18	18			Loose brown COARSE AND FINE SAND (A-3a), little silty clay, trace gravel; moist to wet.						
77.0	479.0	50/3	2	19		4.0	Hard gray SILT AND CLAY (A-6a), trace to little fine sand; damp.						
81.0	475.0	Core 60"	Rec 60"	RQD 65%	R-1		Medium hard gray SANDSTONE; very fine to fine grained, moderately to highly weathered, argillaceous, micaceous, medium bedded, moderately to highly fractured. @ 91.4', 91.9', 92.2', low angle fractures.						
86.0	470.0						Bottom of Boring - 86.0'						
90													

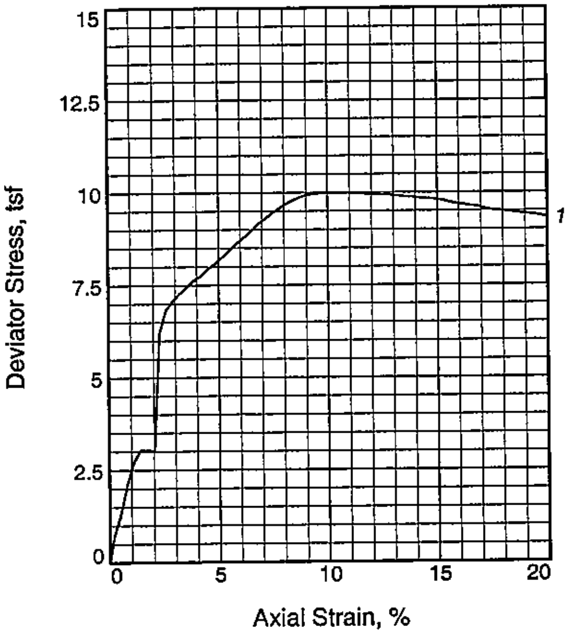


APPENDIX III

Laboratory Test Results



	Results
C, tsf	4.983
ϕ, deg	0
Tan(ϕ)	0



Sample No.		1
Initial	Water Content,	24.9
	Dry Density, pcf	98.3
	Saturation,	94.1
	Void Ratio	0.7143
	Diameter, in.	2.77
	Height, in.	4.35
At Test	Water Content,	25.5
	Dry Density, pcf	98.3
	Saturation,	96.3
	Void Ratio	0.7143
	Diameter, in.	2.77
	Height, in.	4.35
Strain rate, in./min.		0.06
Back Pressure, tsf		0.0
Cell Pressure, tsf		6.0
Fail. Stress, tsf		10.0
Ult. Stress, tsf		10.0
σ_1 Failure, tsf		16.0
σ_3 Failure, tsf		6.0

Type of Test:
Unconsolidated Undrained

Sample Type: 3" press tube

Description: Lean clay

LL= 37 **PL=** 21 **PI=** 16

Assumed Specific Gravity= 2.7

Remarks:

Figure ______

Client: TranSystems, Inc.

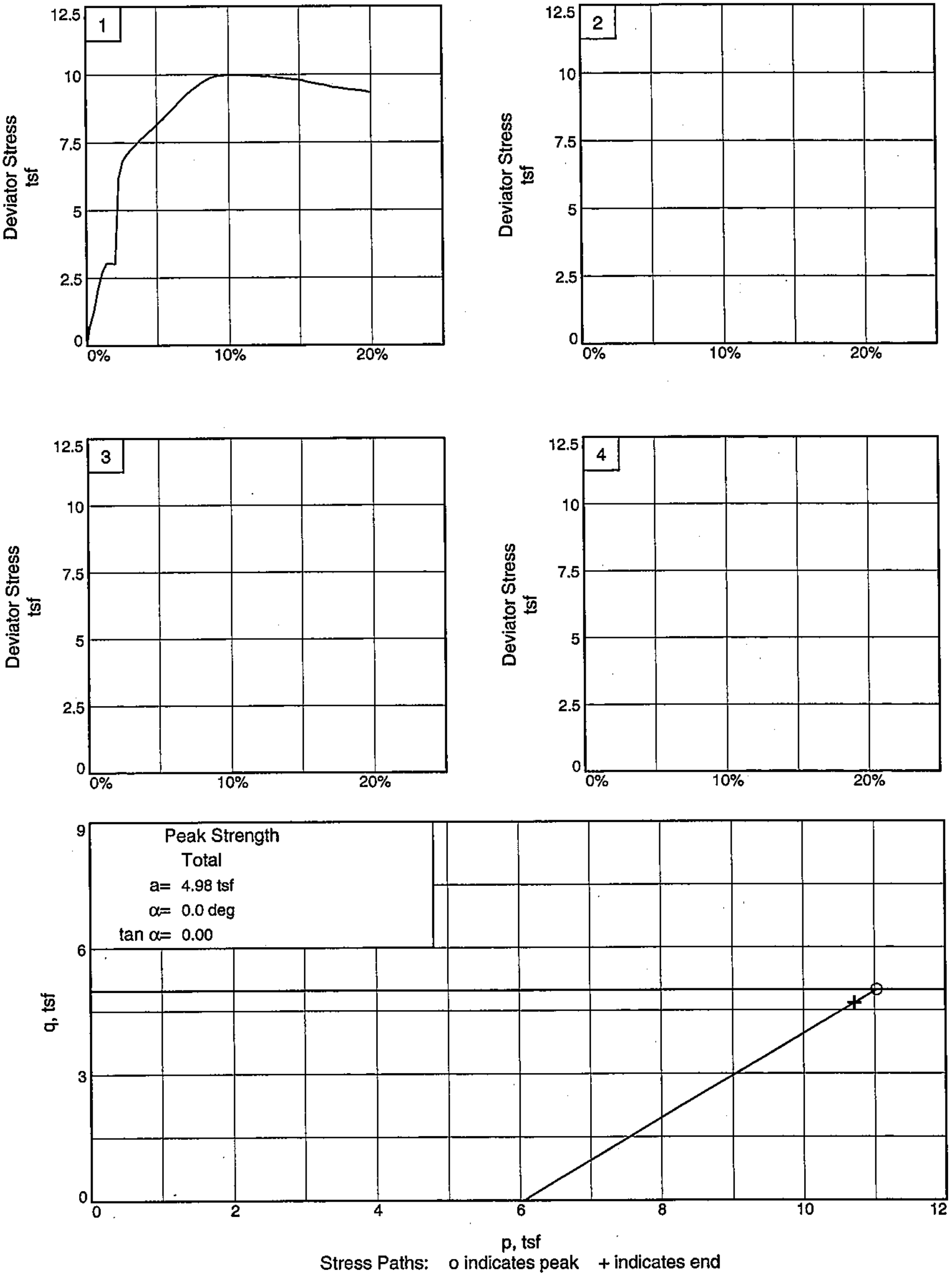
Project: SCI-823-0.00

Source of Sample: B-31 **Depth:** 10.0

Sample Number: P1

Proj. No.: 0121-3070.03 **Date:** 2/6/07

DLZ



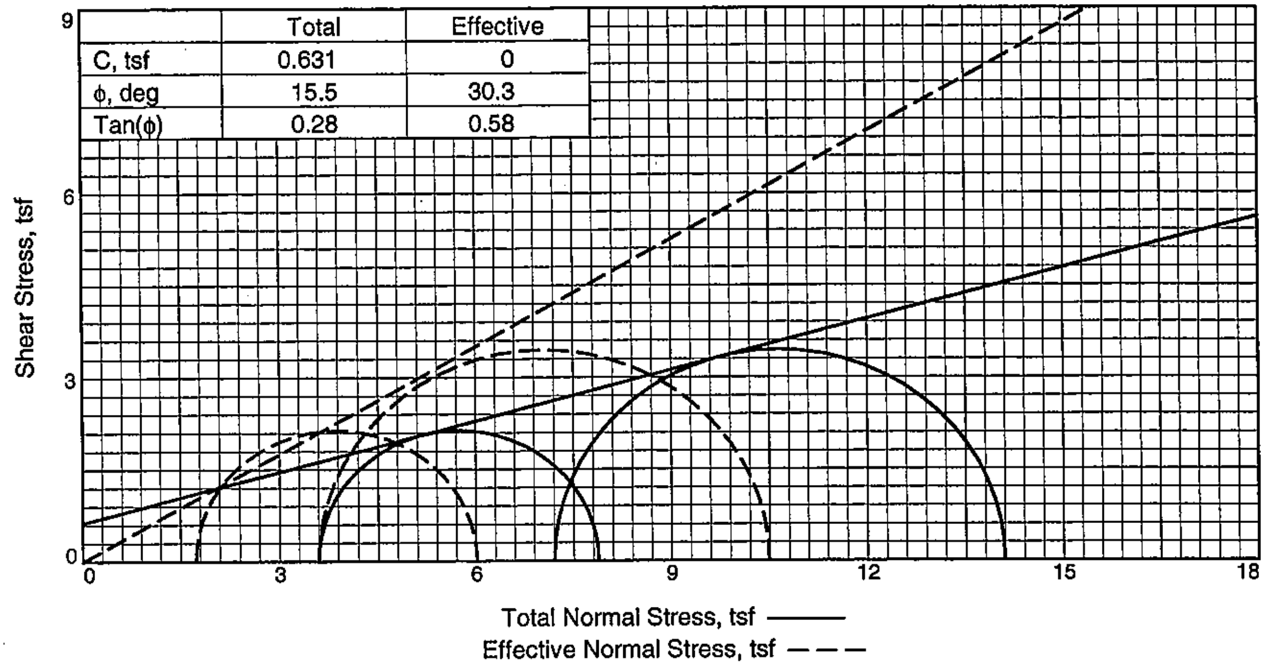
Client: TranSystems, Inc.

Project: SCI-823-0.00

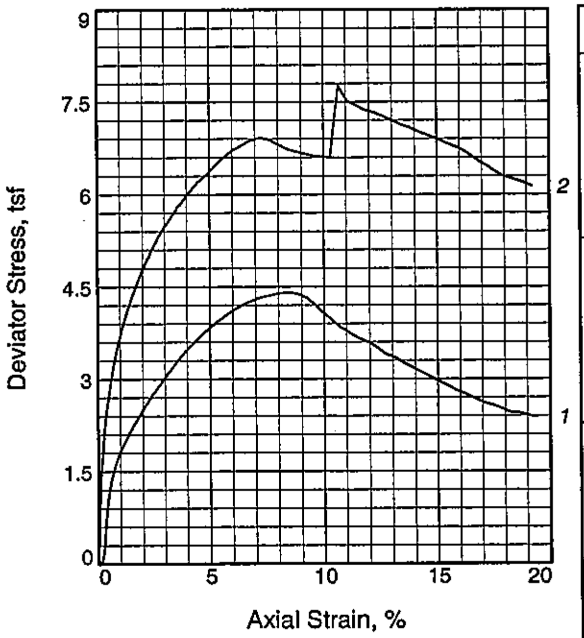
Source of Sample: B-31 **Depth:** 10.0 **Sample Number:** P1

Project No.: 0121-3070.03 **Figure** ______

DLZ, INC.



	Total	Effective
C, tsf	0.631	0
ϕ, deg	15.5	30.3
Tan(ϕ)	0.28	0.58



	Sample No.	1	2
Initial	Water Content,	25.1	27.4
	Dry Density, pcf	99.3	97.9
	Saturation,	97.3	102.6
	Void Ratio	0.6967	0.7218
	Diameter, in.	2.79	2.79
	Height, in.	5.59	5.59
At Test	Water Content,	26.9	25.7
	Dry Density, pcf	97.6	99.5
	Saturation,	100.0	100.0
	Void Ratio	0.7267	0.6935
	Diameter, in.	2.81	2.76
	Height, in.	5.59	5.59
	Strain rate, in./min.	0.01	0.01
	Back Pressure, tsf	1.2	1.2
	Cell Pressure, tsf	4.8	8.4
	Fail. Stress, tsf	4.3	6.9
	Total Pore Pr., tsf	3.0	4.8
	Ult. Stress, tsf	4.3	6.9
	Total Pore Pr., tsf	3.0	4.8
	$\bar{\sigma}_1$ Failure, tsf	6.0	10.5
	$\bar{\sigma}_3$ Failure, tsf	1.7	3.6

Type of Test:
CU with Pore Pressures

Sample Type: 3" press tube

Description:

LL= 34 **PL=** 21 **PI=** 13

Assumed Specific Gravity= 2.7

Remarks:

Figure ______

Client: TranSystems, Inc.

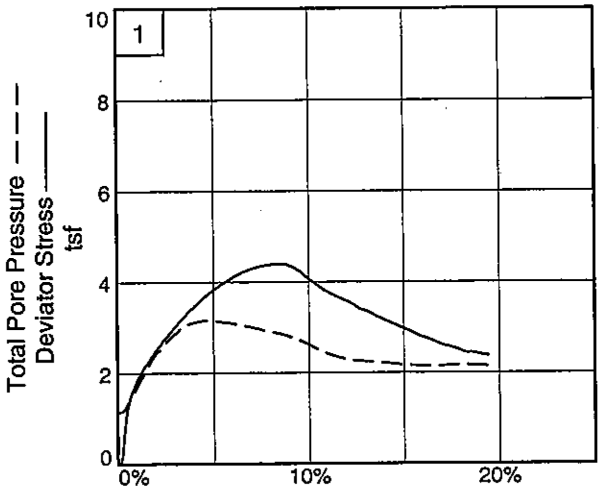
Project: SCI-823-0.00

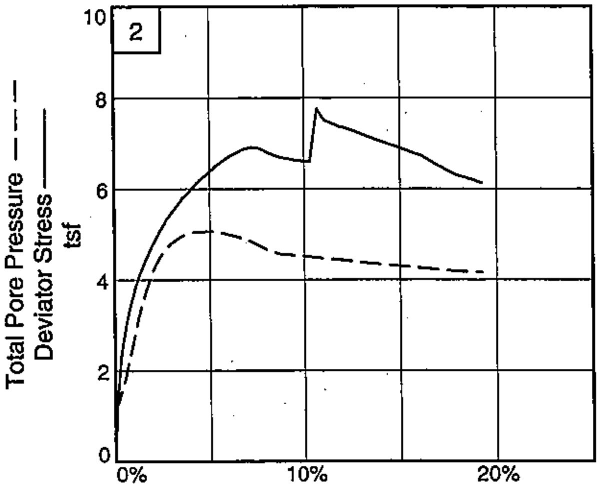
Source of Sample: B-31 **Depth:** 15.0

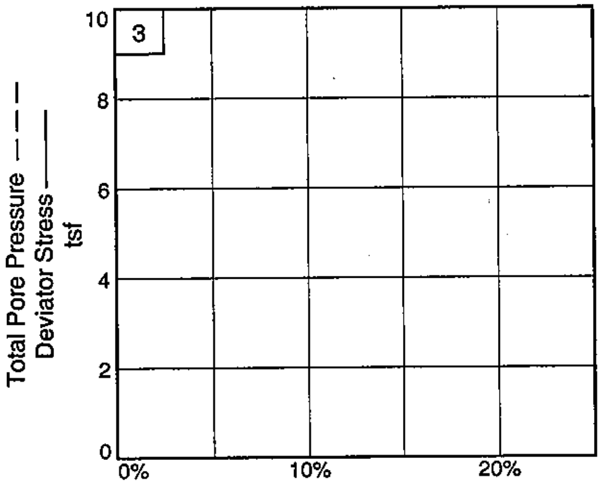
Sample Number: P2

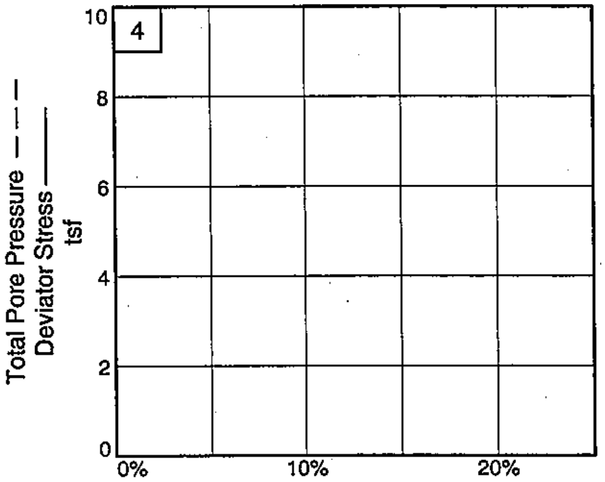
Proj. No.: 0121-3070.03 **Date:** 2/6/07

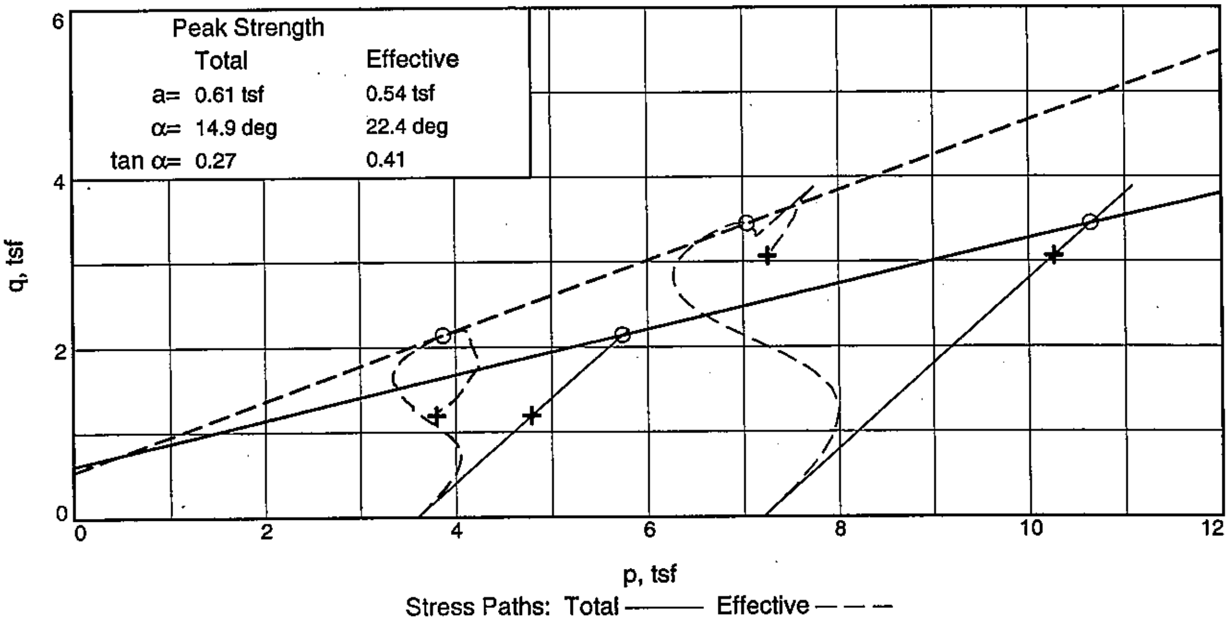
DLZ











Peak Strength

	Total	Effective
a=	0.61 tsf	0.54 tsf
α=	14.9 deg	22.4 deg
tan α=	0.27	0.41

Client: TranSystems, Inc.

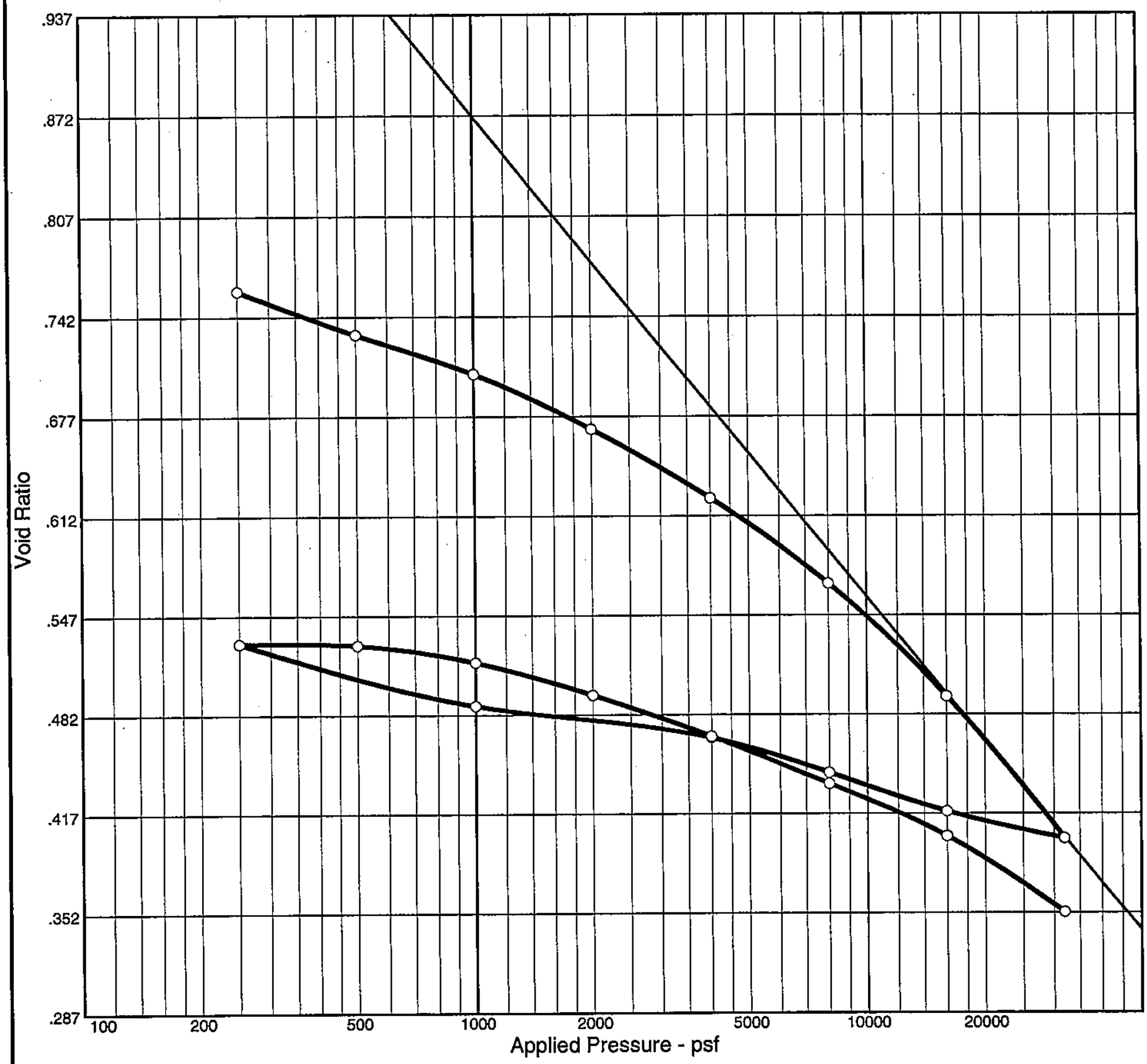
Project: SCI-823-0.00

Source of Sample: B-31 **Depth:** 15.0 **Sample Number:** P2

Project No.: 0121-3070.03 **Figure** ________

DLZ, INC.

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
88.4 %	24.3 %	98.7	37	16	2.8	CL	A-6(15)	0.771

MATERIAL DESCRIPTION

Lean clay

Project No. 0121- **Client:** TranSystems, Inc.

Project: SCI-823-0.00

Source: B-31 **Sample No.:** P1 **Elev./Depth:** 10.0

DLZ

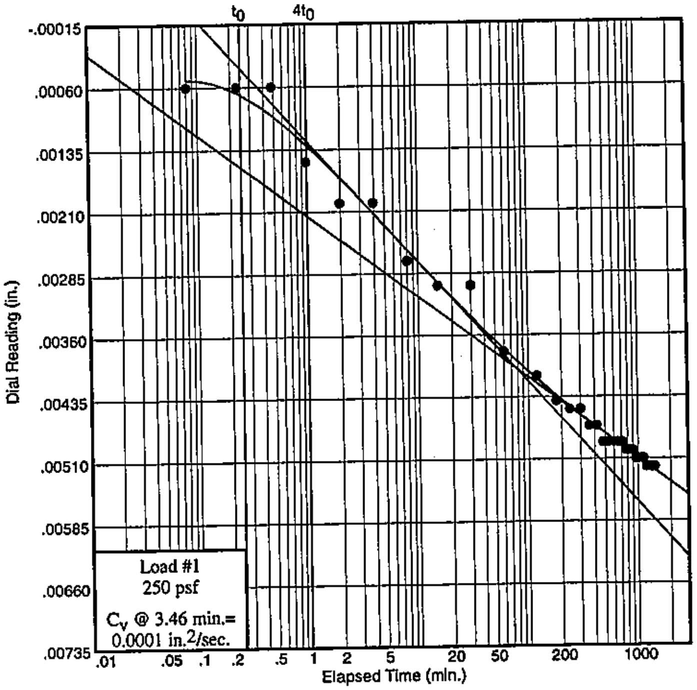
Remarks:

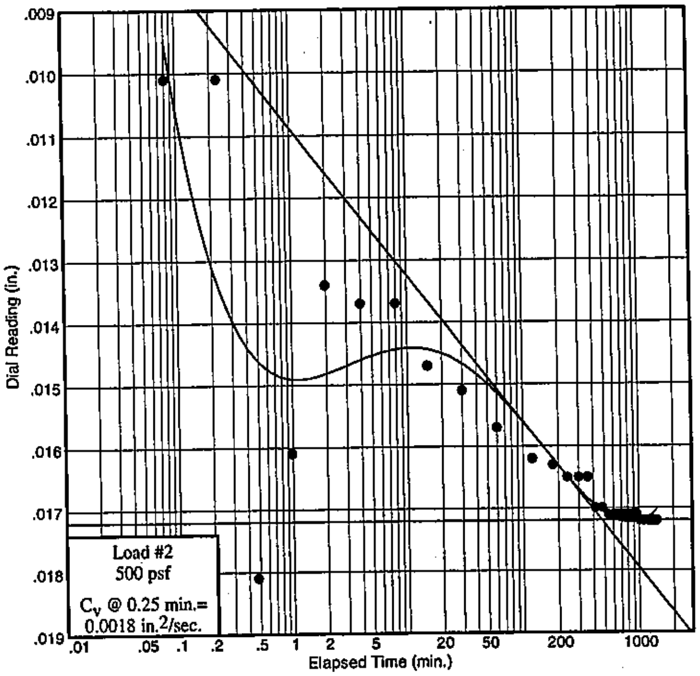
Figure

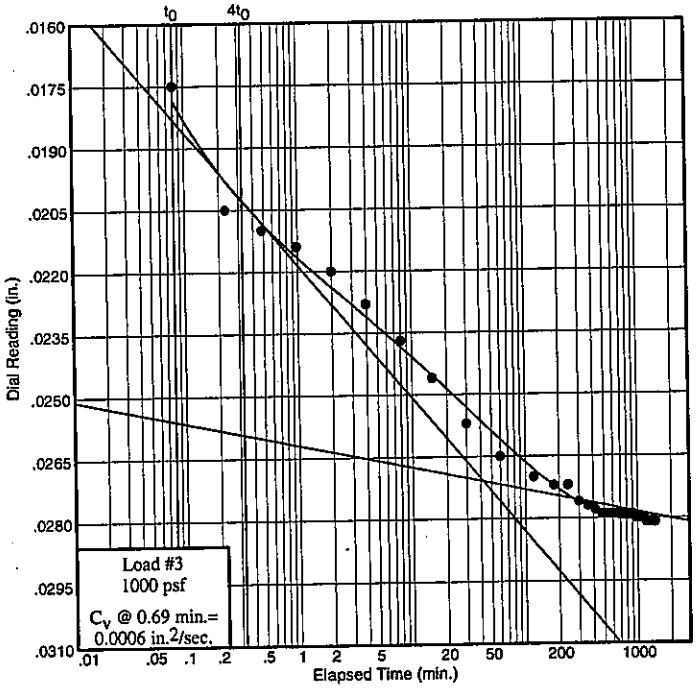
Dial Reading vs. Time

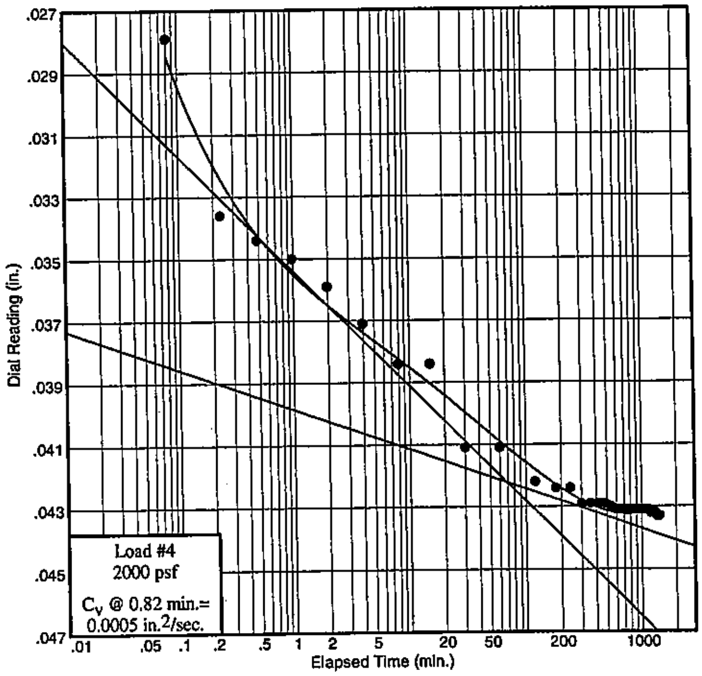
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-31 Sample No.: P1 Elev./Depth: 10.0









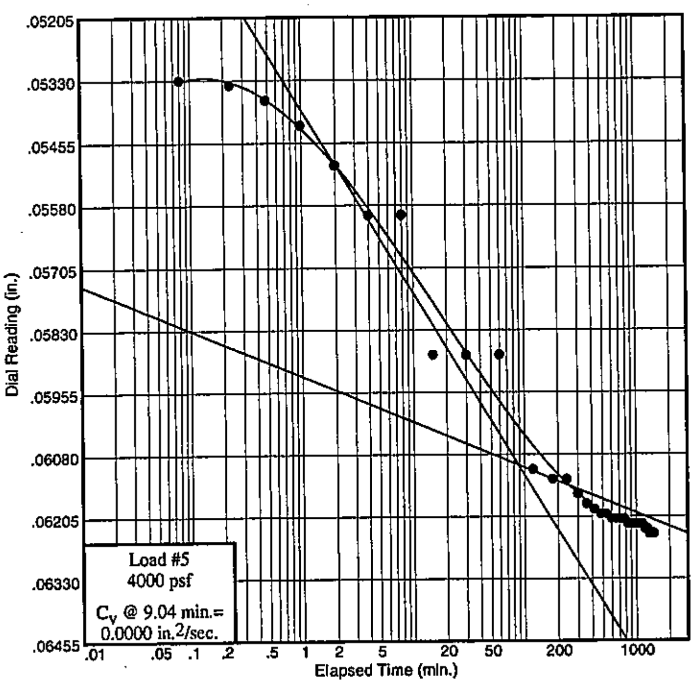
DLZ

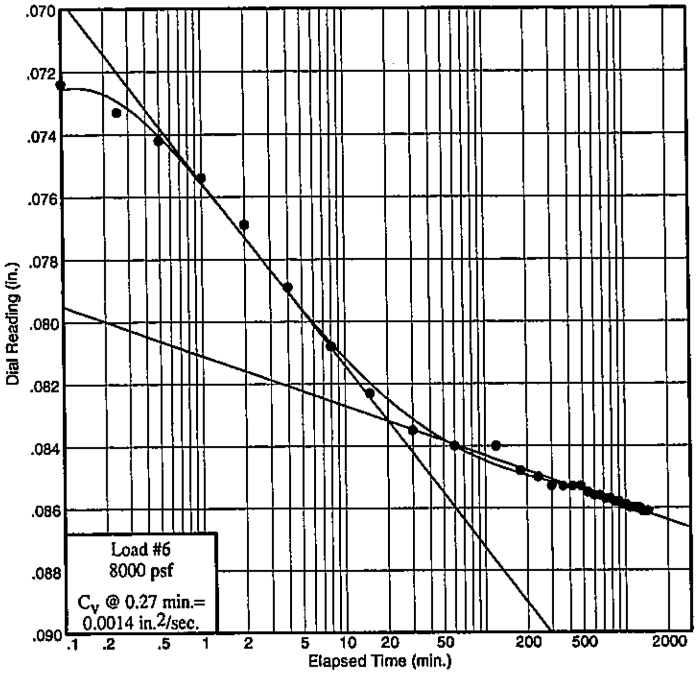
Figure

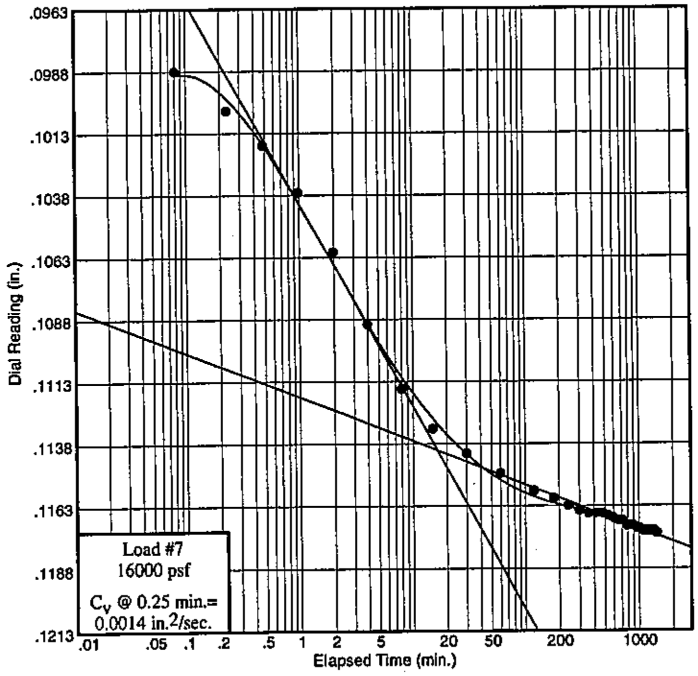
Dial Reading vs. Time

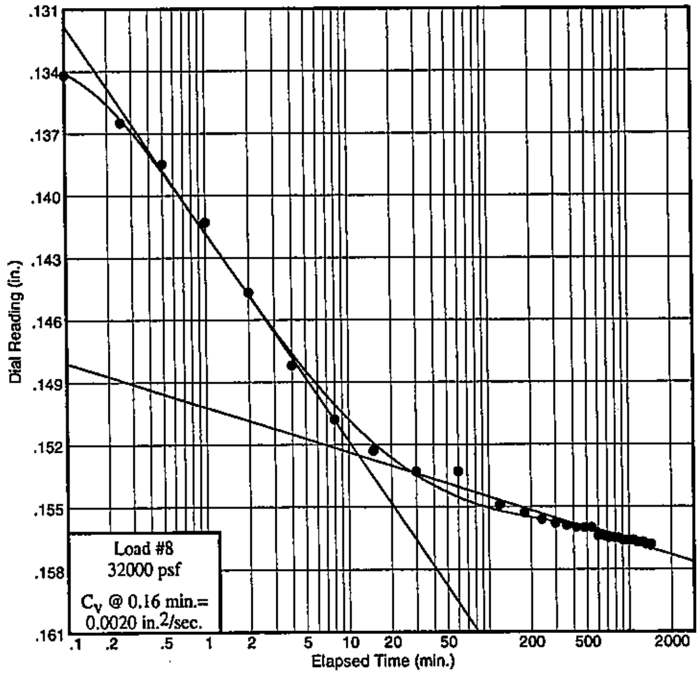
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-31 Sample No.: P1 Elev./Depth: 10.0









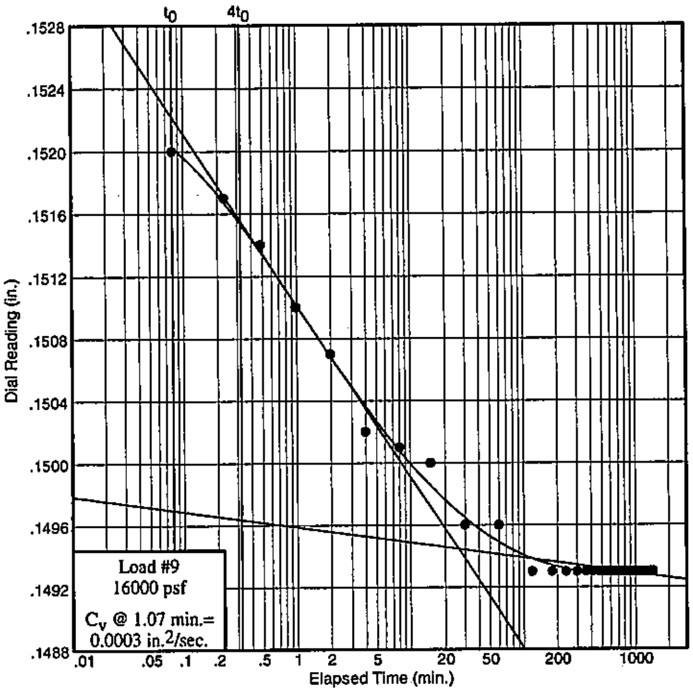
DLZ

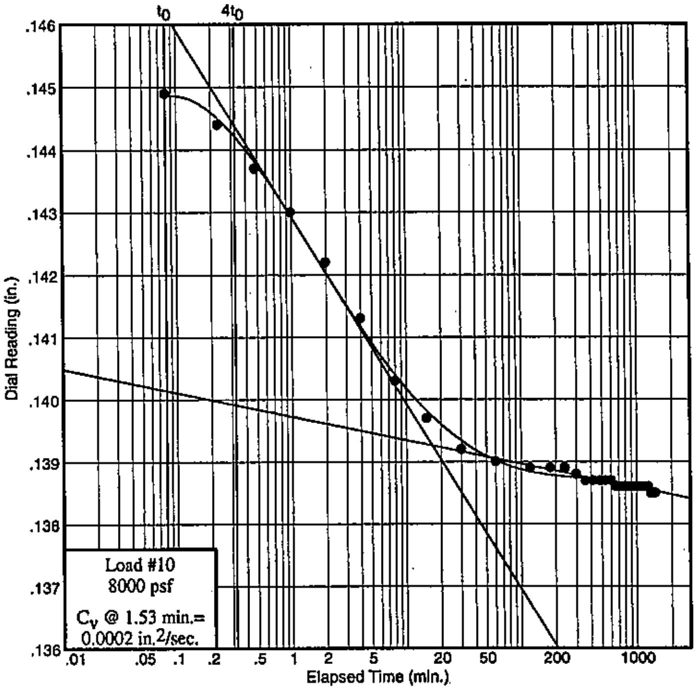
Figure

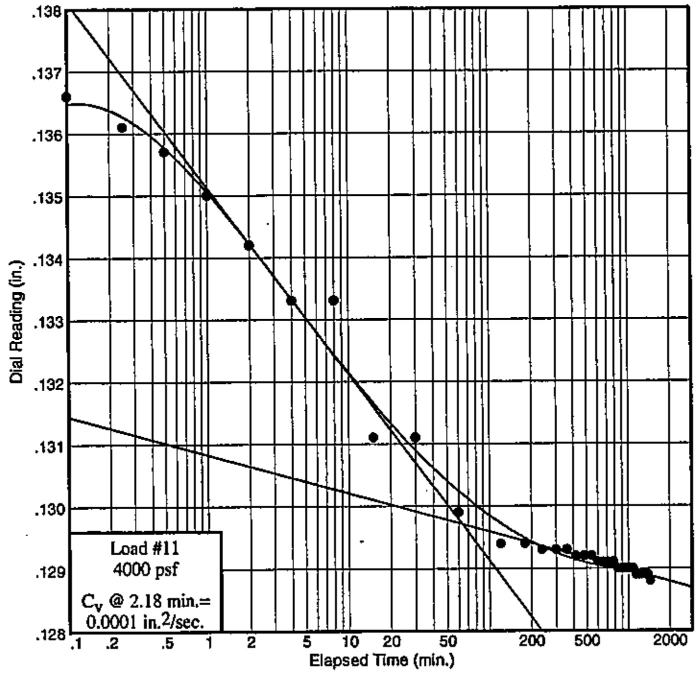
Dial Reading vs. Time

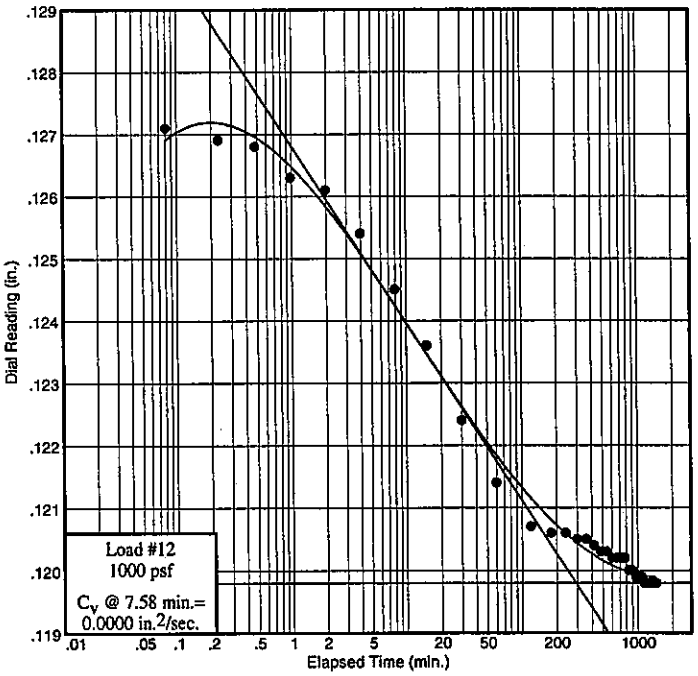
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-31 Sample No.: P1 Elev./Depth: 10.0









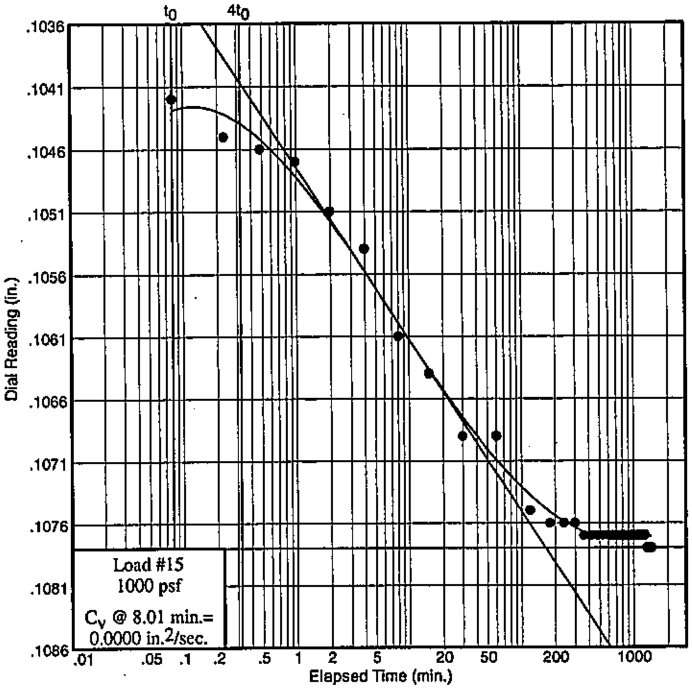
DLZ

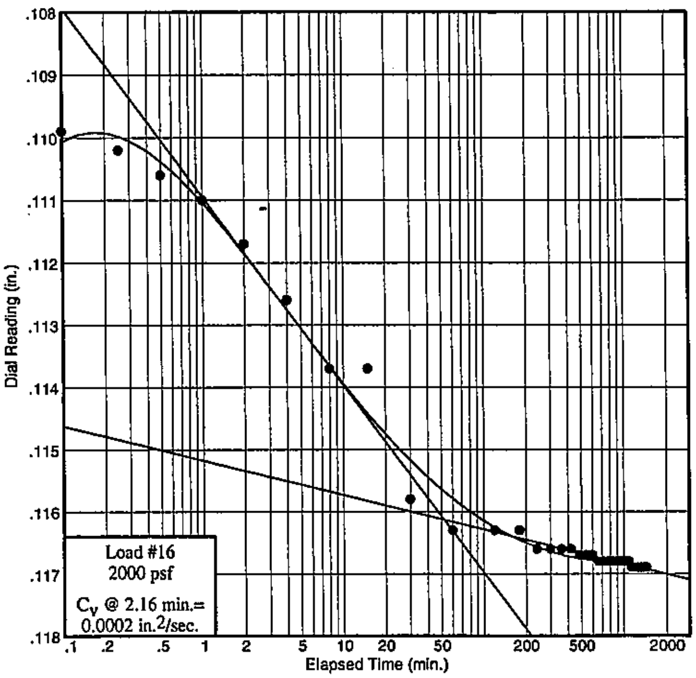
Figure

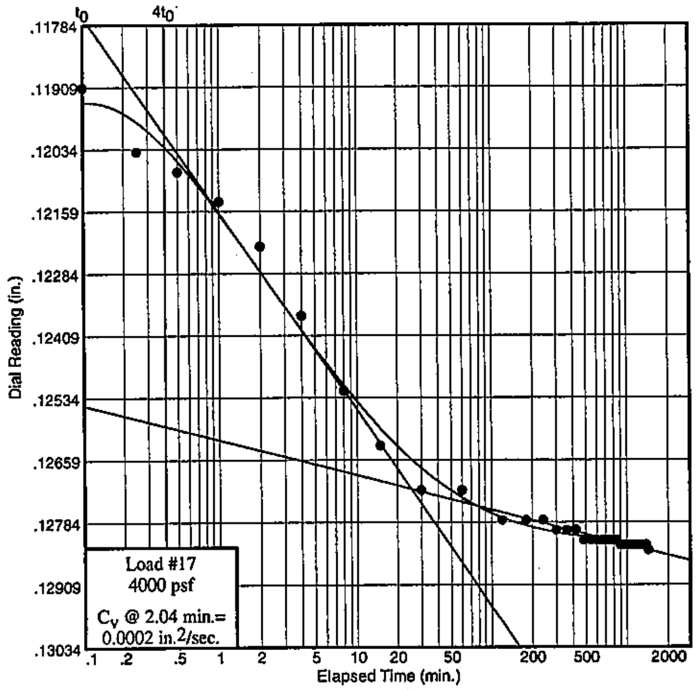
Dial Reading vs. Time

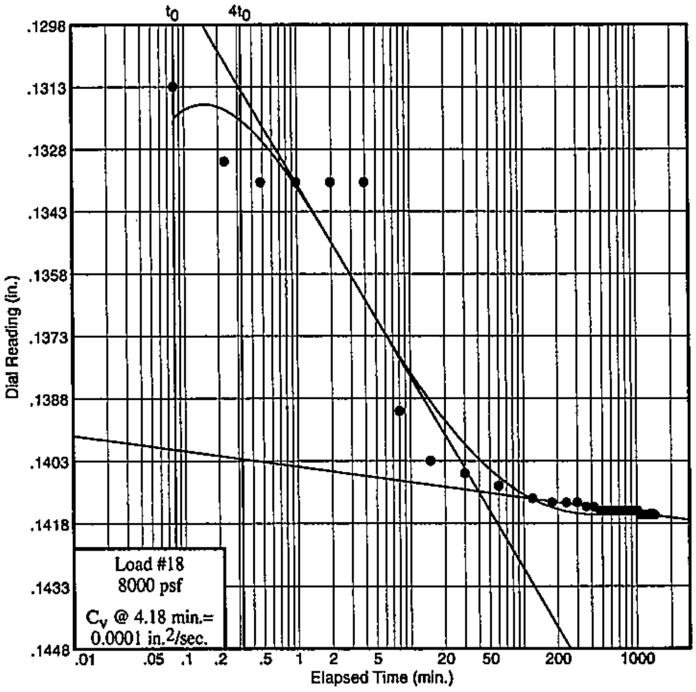
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-31 Sample No.: P1 Elev./Depth: 10.0









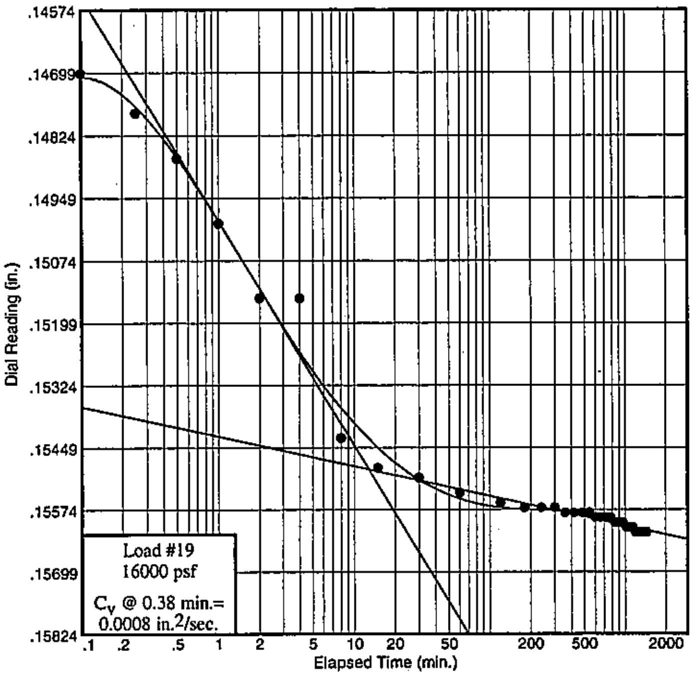
DLZ

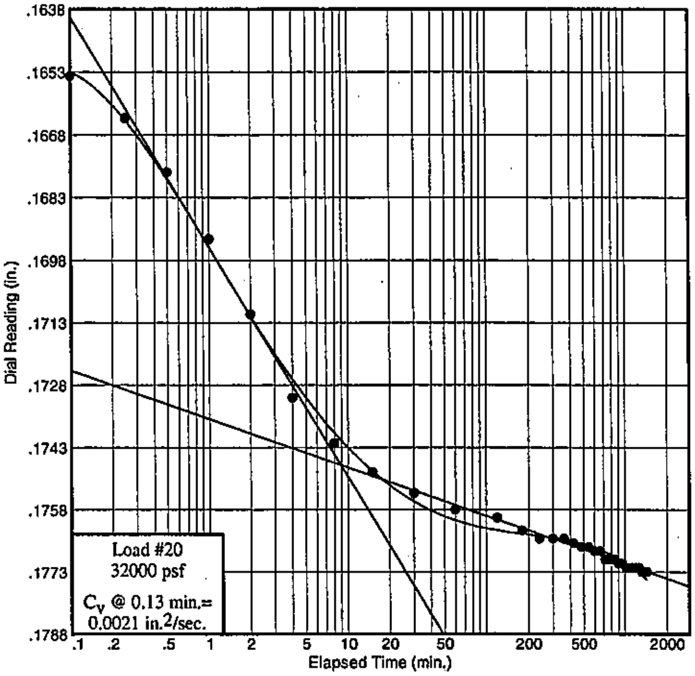
Figure

Dial Reading vs. Time

Project No.: 0121-3070.03
Project: SCI-823-0.00

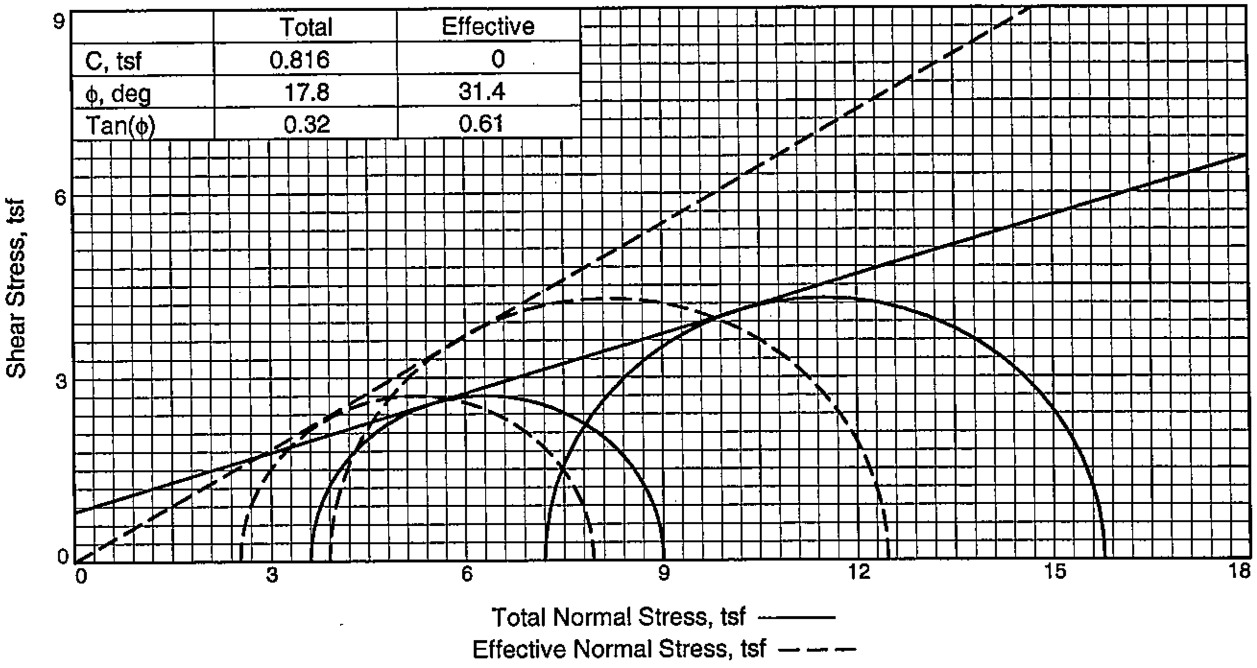
Source: B-31 Sample No.: P1 Elev./Depth: 10.0



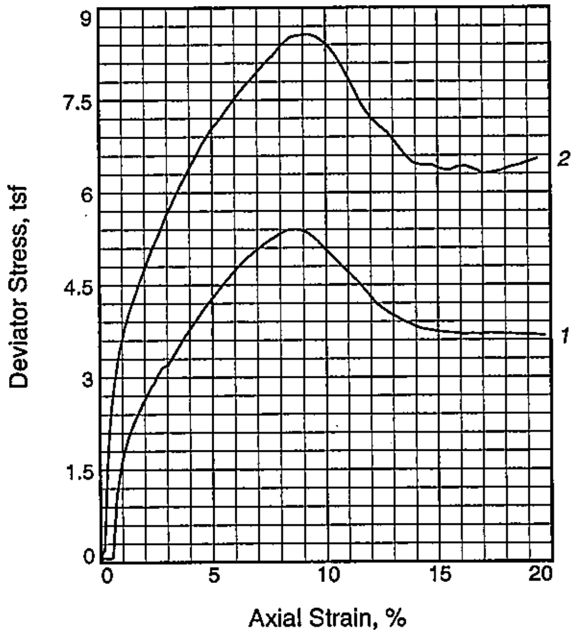


DLZ

Figure



	Total	Effective
C, tsf	0.816	0
ϕ, deg	17.8	31.4
Tan(ϕ)	0.32	0.61



	Sample No.	1	2
Initial	Water Content,	25.3	26.0
	Dry Density, pcf	100.9	100.0
	Saturation,	101.6	102.4
	Void Ratio	0.6712	0.6854
	Diameter, in.	2.80	2.80
	Height, in.	5.57	5.50
At Test	Water Content,	24.0	25.0
	Dry Density, pcf	102.3	100.7
	Saturation,	100.0	100.0
	Void Ratio	0.6482	0.6740
	Diameter, in.	2.78	2.79
	Height, in.	5.57	5.50
	Strain rate, in./min.	0.01	0.01
	Back Pressure, tsf	1.2	1.2
	Cell Pressure, tsf	4.8	8.4
	Fail. Stress, tsf	5.4	8.6
	Total Pore Pr., tsf	2.2	4.5
	Ult. Stress, tsf		
	Total Pore Pr., tsf		
	$\bar{\sigma}_1$ Failure, tsf	7.9	12.5
	$\bar{\sigma}_3$ Failure, tsf	2.5	3.9

Type of Test:
CU with Pore Pressures

Sample Type: 3" press tube

Description: Lean clay

LL= 33 **PL=** 20 **PI=** 13

Assumed Specific Gravity= 2.7

Remarks:

Figure ________

Client: TranSystems, Inc.

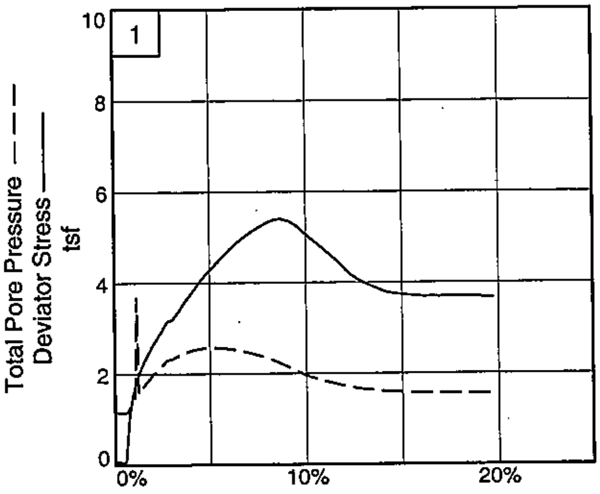
Project: SCI-823-0.00

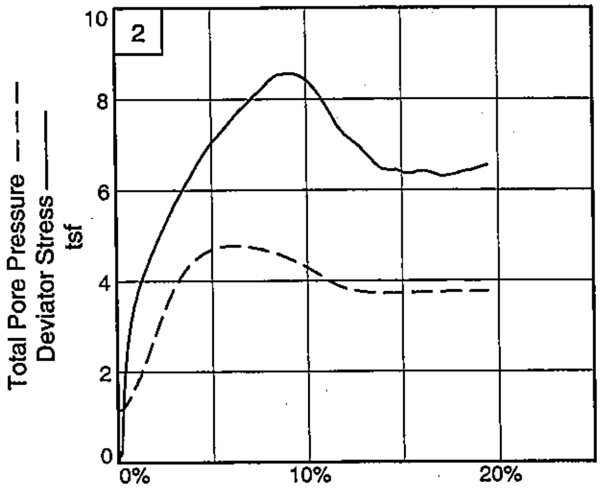
Source of Sample: B-32 **Depth:** 10.0

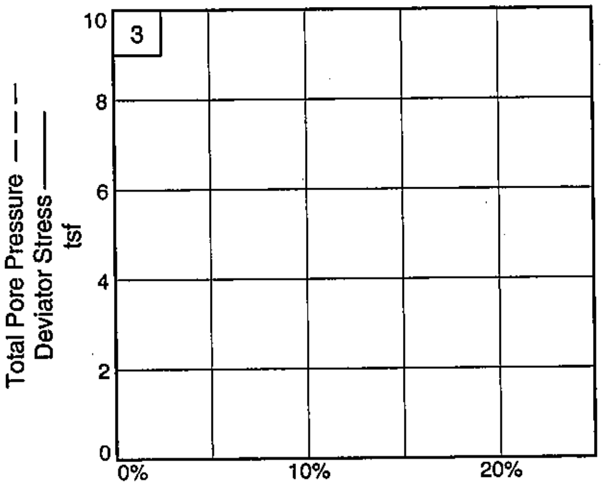
Sample Number: P1

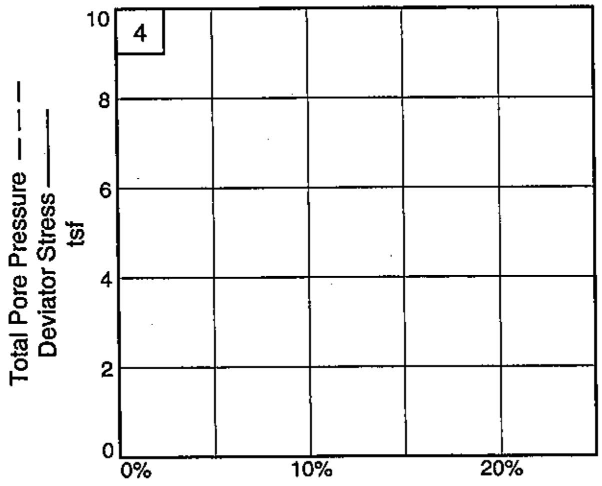
Proj. No.: 0121-3070.03 **Date:** 2/6/07

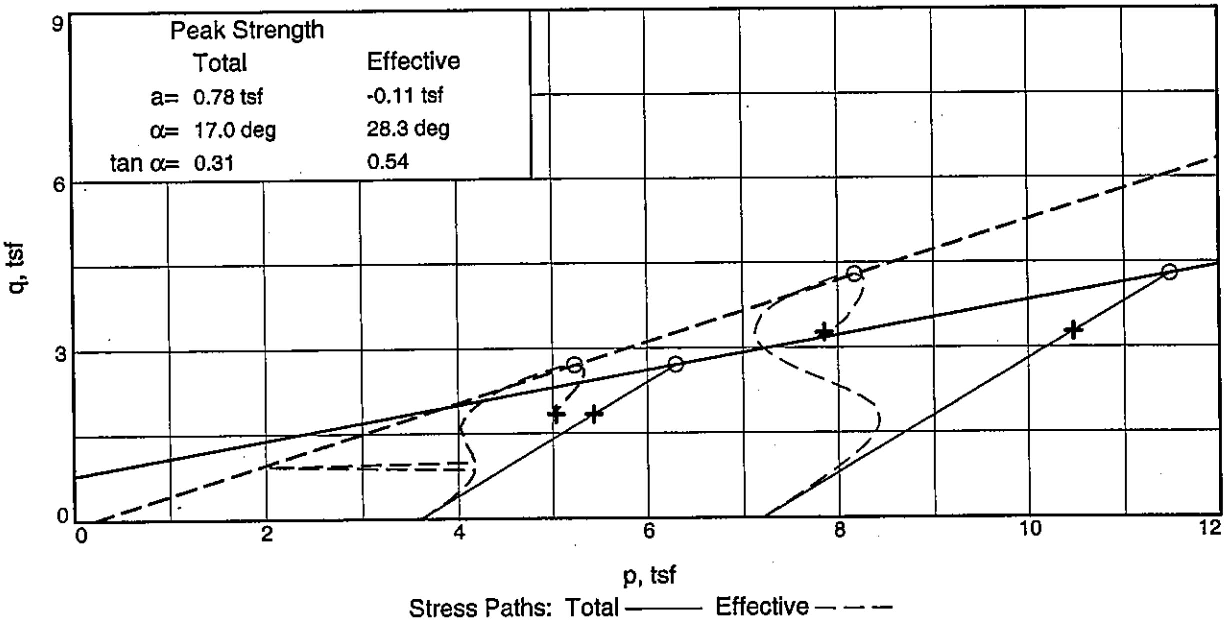
DLZ







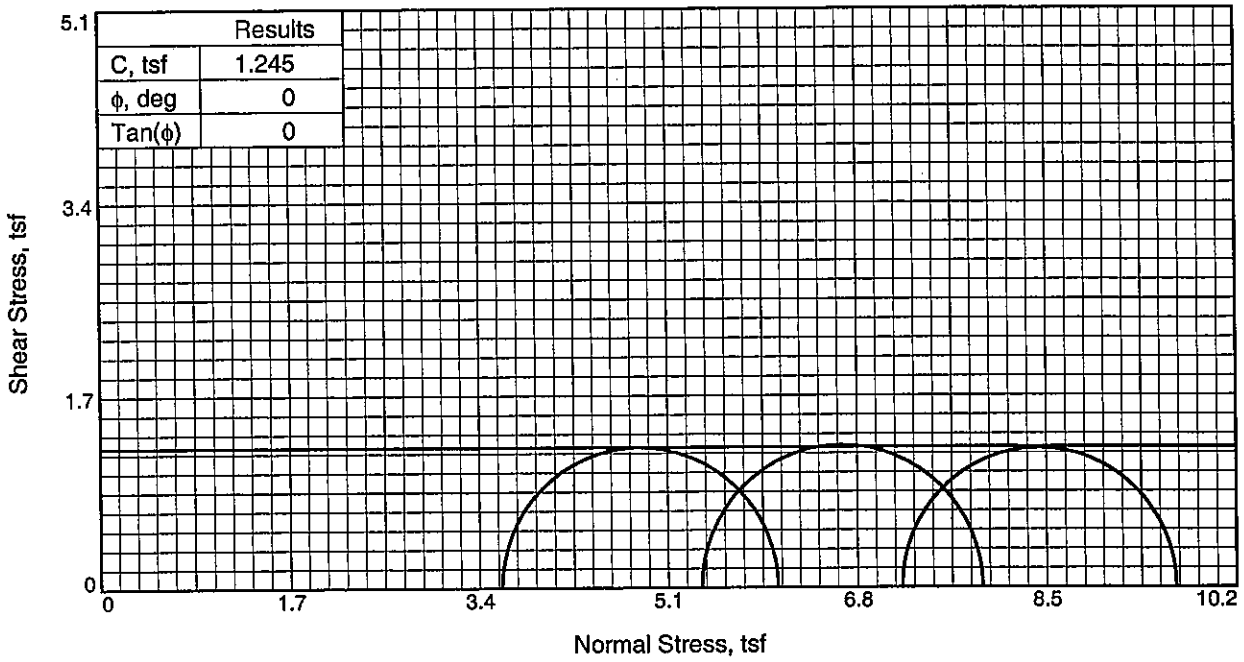



Peak Strength

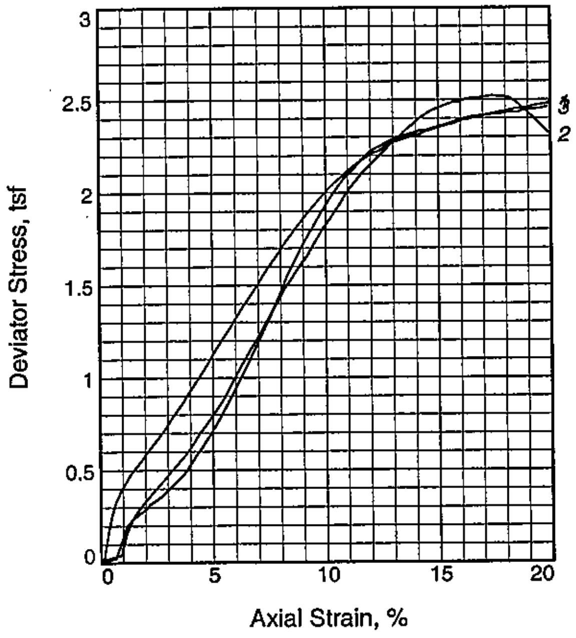
	Total	Effective
a=	0.78 tsf	-0.11 tsf
α=	17.0 deg	28.3 deg
tan α=	0.31	0.54

Client: TranSystems, Inc.
Project: SCI-823-0.00
Source of Sample: B-32 **Depth:** 10.0 **Sample Number:** P1
Project No.: 0121-3070.03 **Figure** ________

DLZ, INC.



	Results
C, tsf	1.245
ϕ, deg	0
Tan(ϕ)	0



Sample No.		1	2	3
Initial	Water Content,	26.1	28.3	26.6
	Dry Density, pcf	98.1	94.4	96.5
	Saturation,	98.1	97.4	96.2
	Void Ratio	0.7191	0.7854	0.7458
	Diameter, in.	2.77	2.78	2.77
	Height, in.	5.38	5.35	5.30
At Test	Water Content,	27.8	20.0	29.9
	Dry Density, pcf	98.1	94.4	96.5
	Saturation,	104.2	68.8	108.4
	Void Ratio	0.7191	0.7854	0.7458
	Diameter, in.	2.77	2.78	2.77
	Height, in.	5.38	5.35	5.30
Strain rate, in./min.		0.06	0.06	0.01
Back Pressure, tsf		0.00	0.00	0.00
Cell Pressure, tsf		3.60	5.40	7.20
Fail. Stress, tsf		2.48	2.52	2.46
Ult. Stress, tsf				
σ_1 Failure, tsf		6.08	7.92	9.66
σ_3 Failure, tsf		3.60	5.40	7.20

Type of Test:
Unconsolidated Undrained

Sample Type: 3" press tube

Description: Lean clay

LL= 30 **PL=** 22 **PI=** 8

Assumed Specific Gravity= 2.7

Remarks:

Figure ________

Client: TranSystems, Inc.

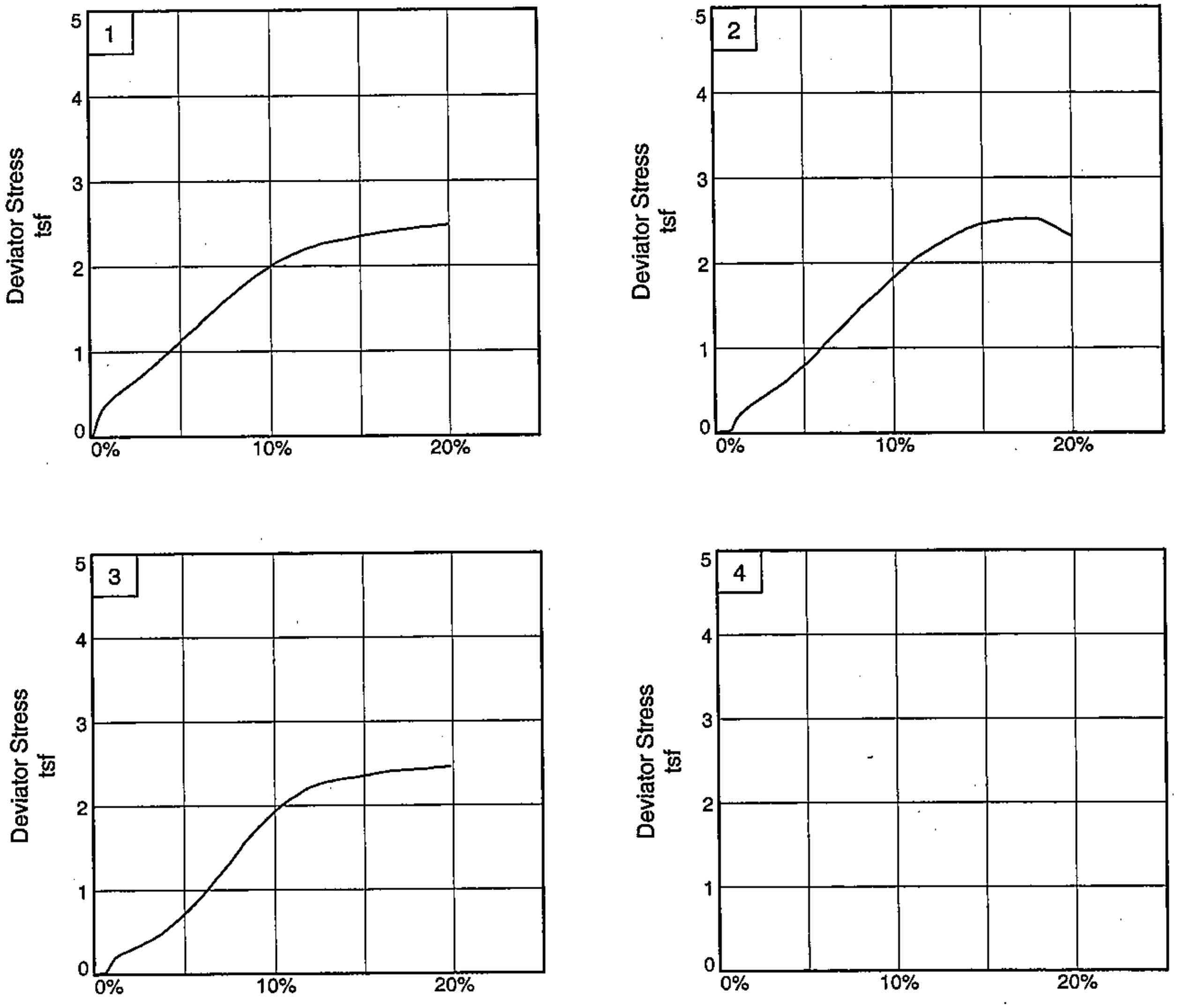
Project: SCI-823-0.00

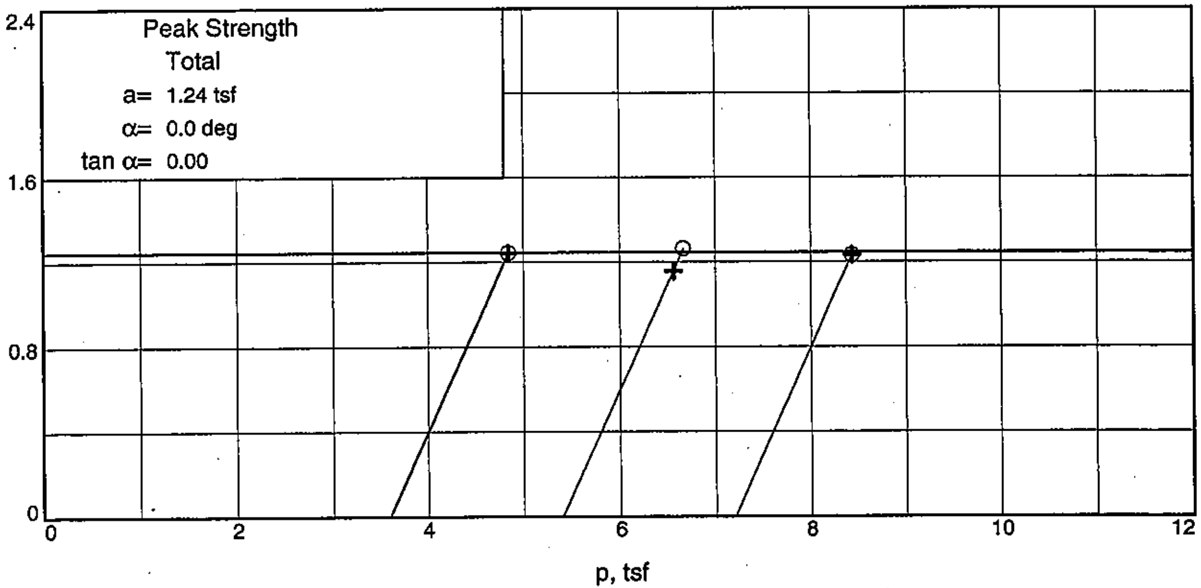
Source of Sample: B-32 **Depth:** 15.0

Sample Number: P2

Proj. No.: 0121-3070.03 **Date:** 2/6/07

DLZ





Stress Paths: o indicates peak + indicates end

Client: TranSystems, Inc.

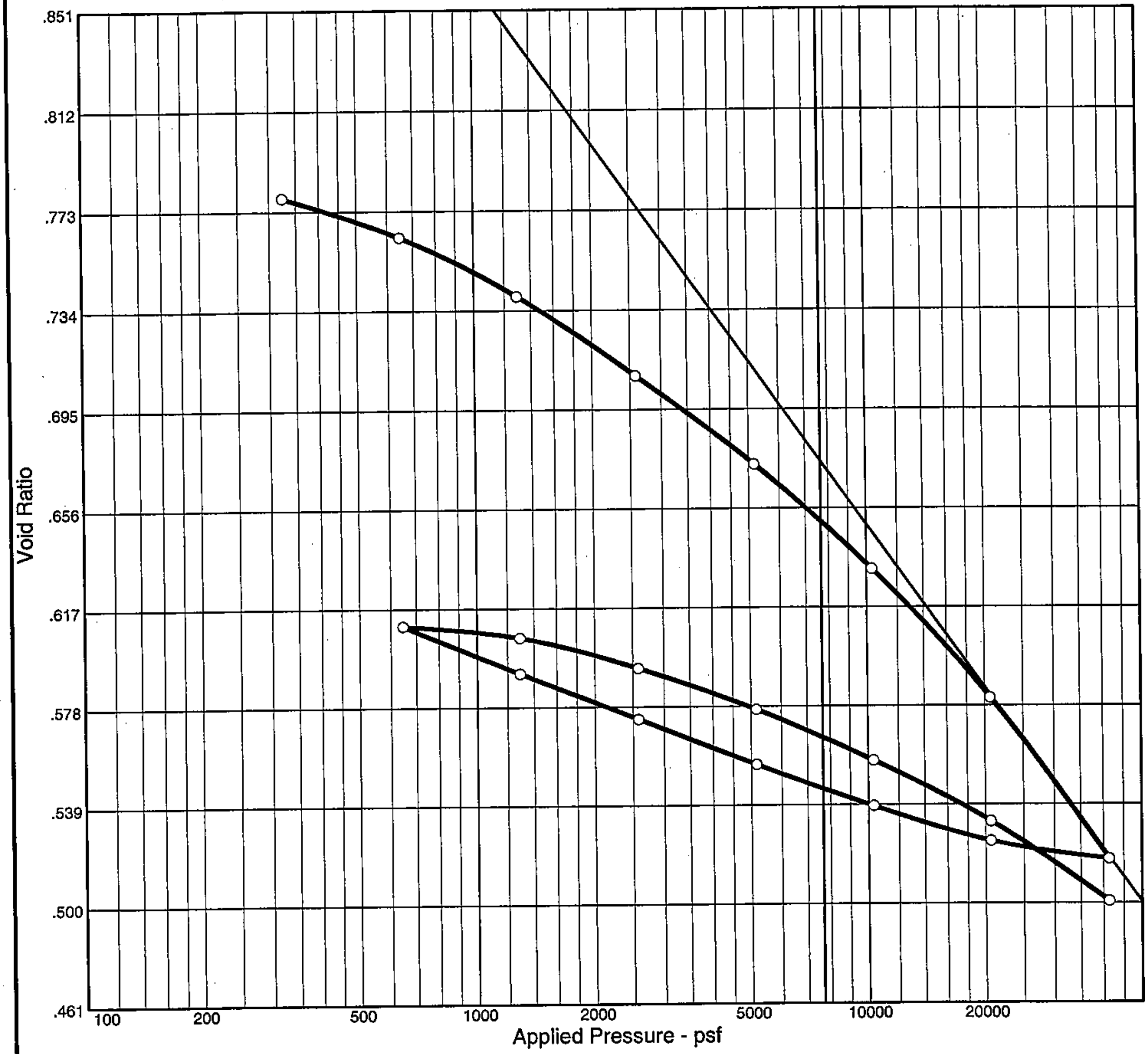
Project: SCI-823-0.00

Source of Sample: B-32 **Depth:** 15.0 **Sample Number:** P2

Project No.: 0121-3070.03 **Figure** ______

DLZ, INC.

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
86.9 %	24.9 %	96.4	33	13	2.77	CL	A-6(13)	0.793

MATERIAL DESCRIPTION

Lean clay

Project No. 0121- **Client:** TranSystems, Inc.

Project: SCI-823-0.00

Source: B-32 **Sample No.:** P1 **Elev./Depth:** 10.0

DLZ

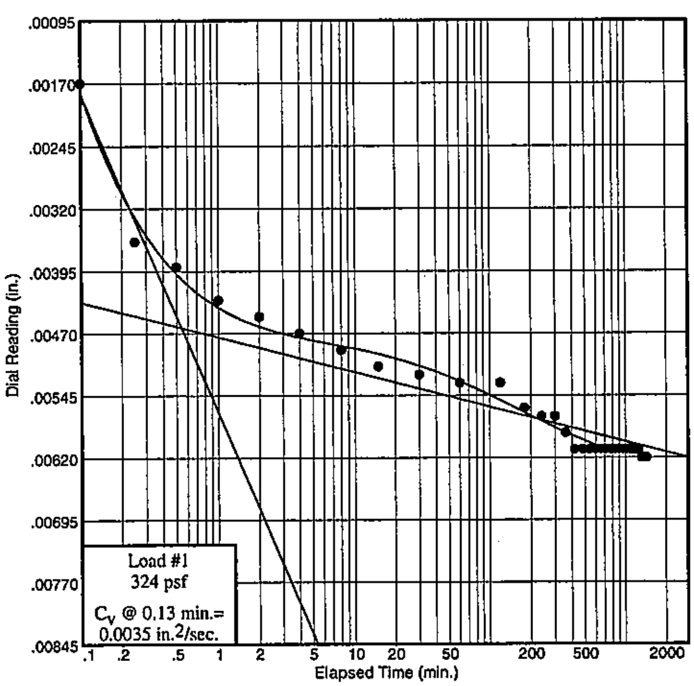
Remarks:

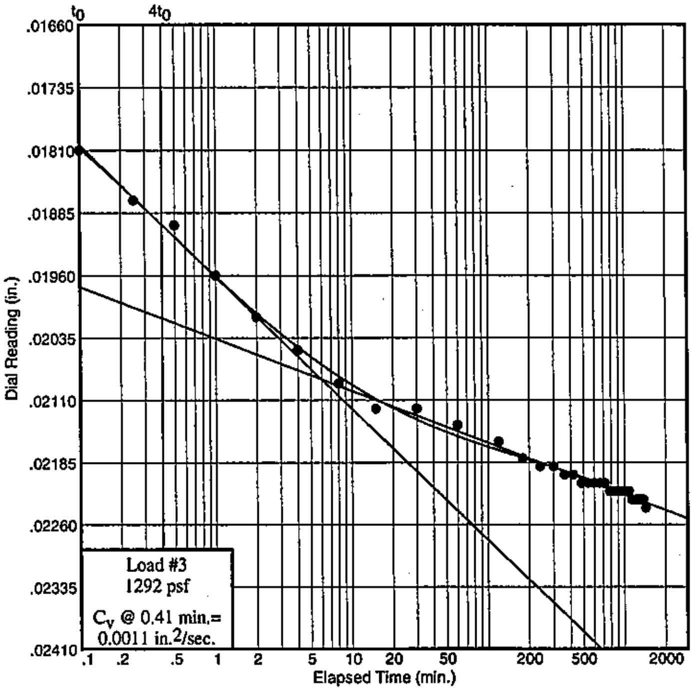
Figure

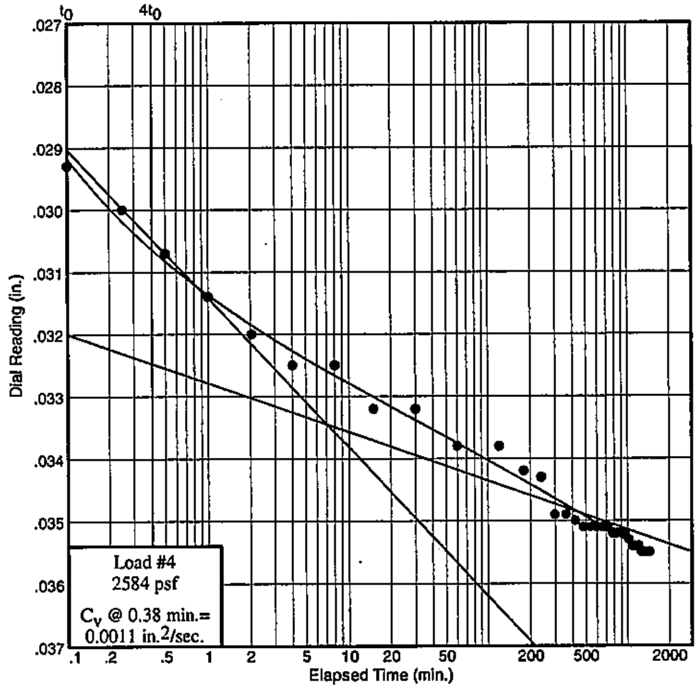
Dial Reading vs. Time

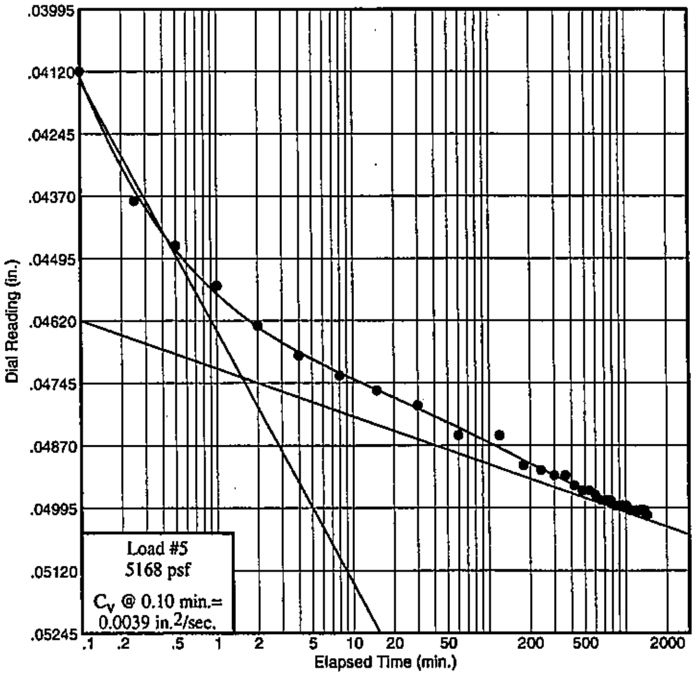
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-32 Sample No.: P1 Elev./Depth: 10.0









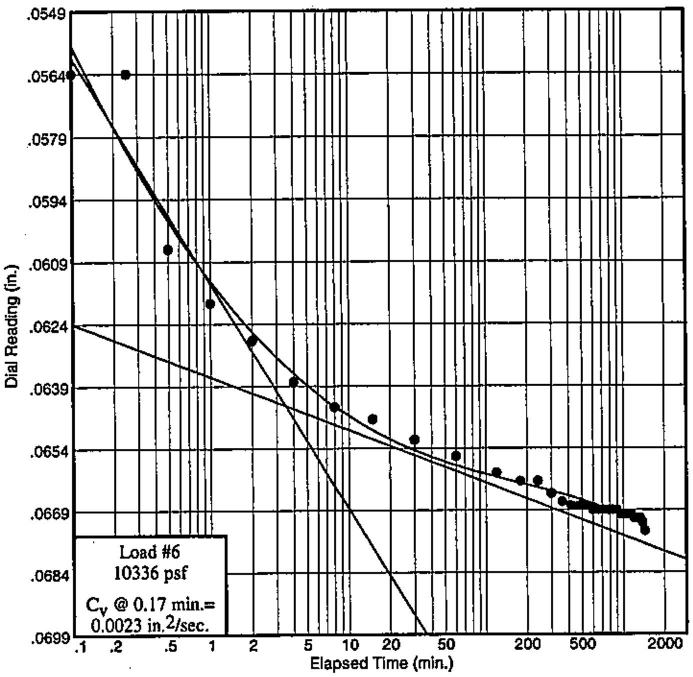
DLZ

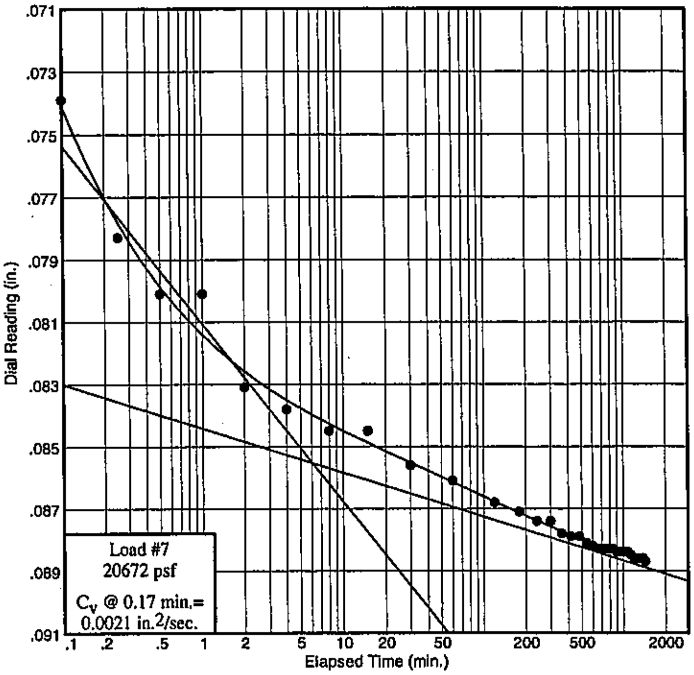
Figure

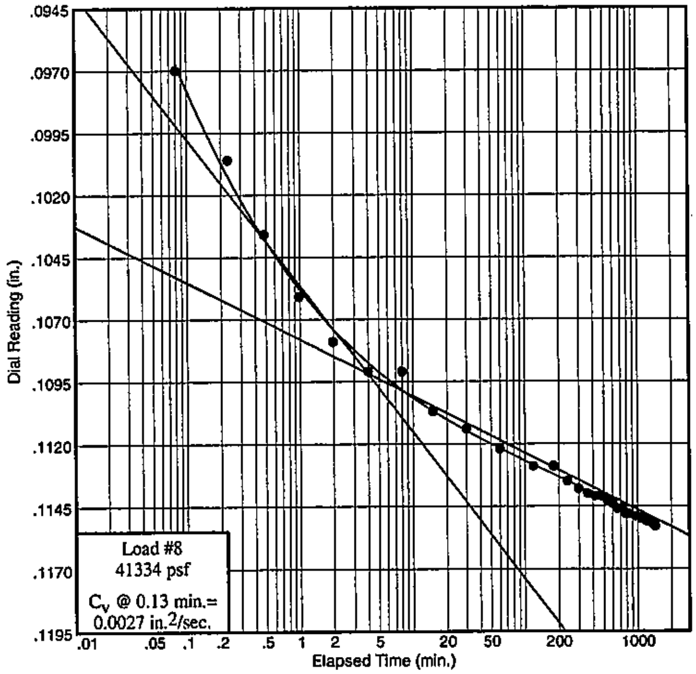
Dial Reading vs. Time

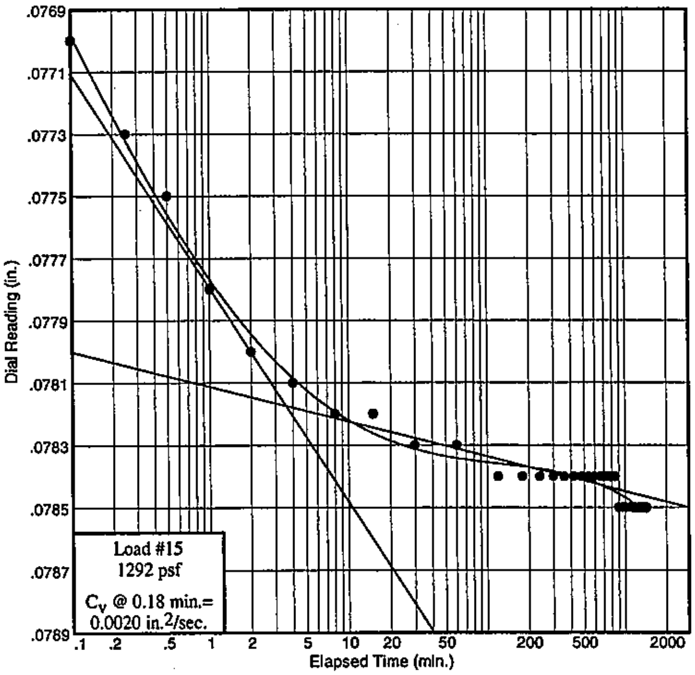
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-32 Sample No.: P1 Elev./Depth: 10.0









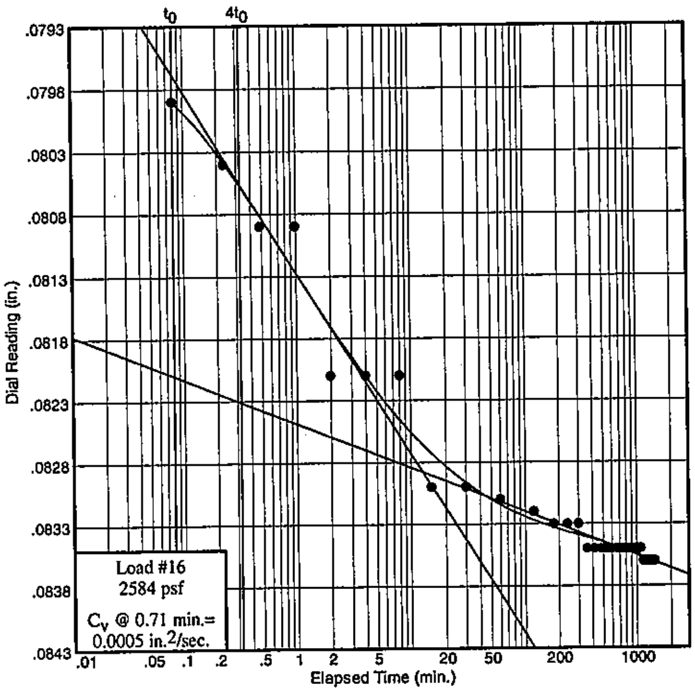
DLZ

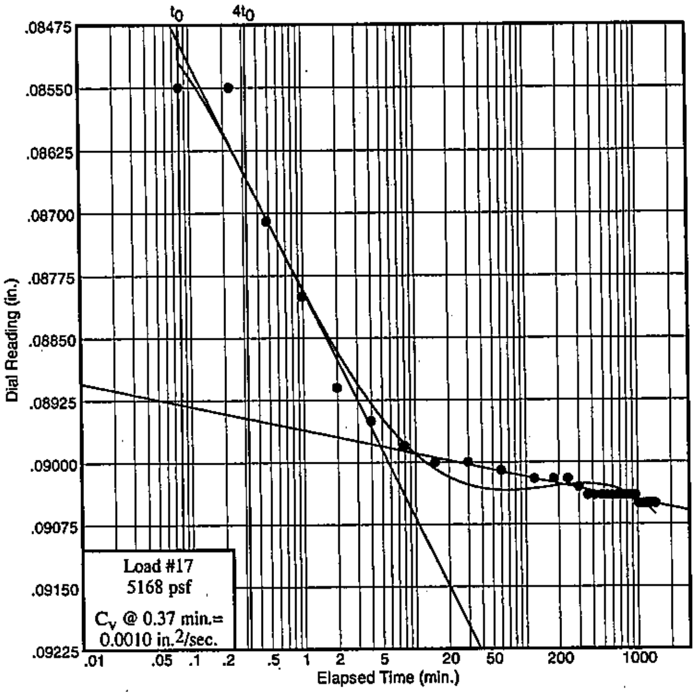
Figure

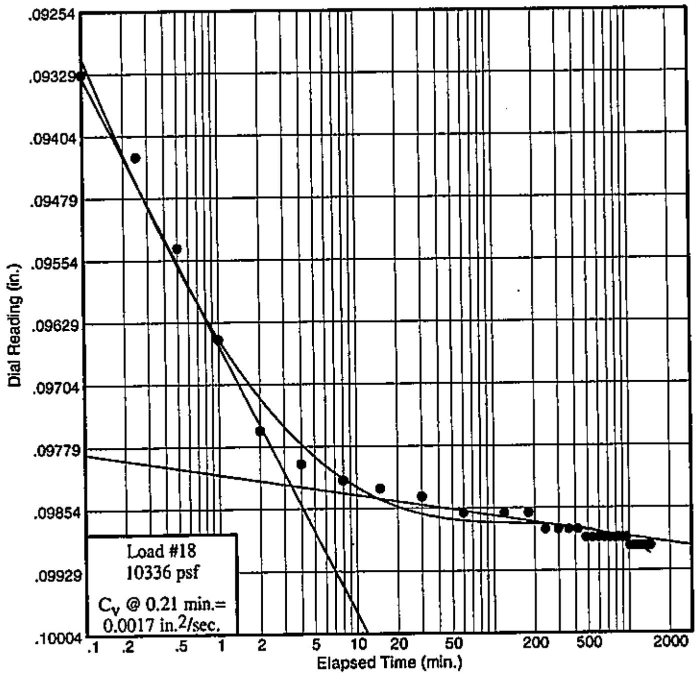
Dial Reading vs. Time

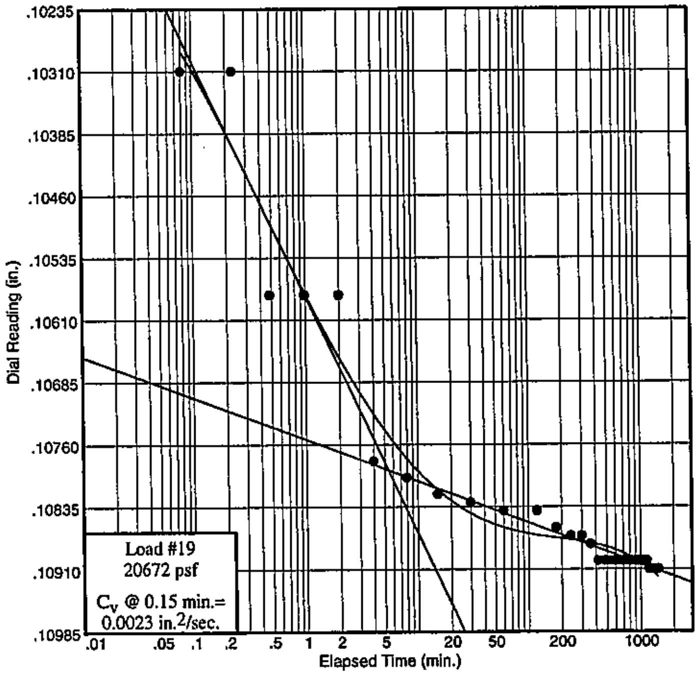
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: B-32 Sample No.: P1 Elev./Depth: 10.0



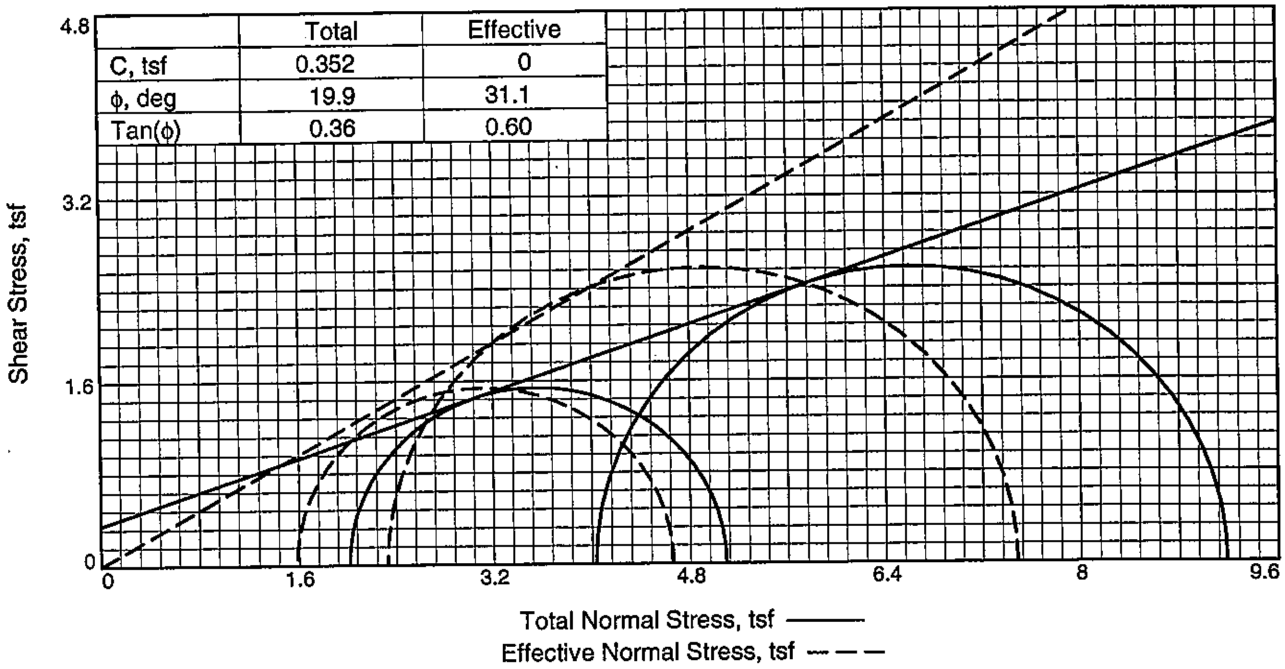




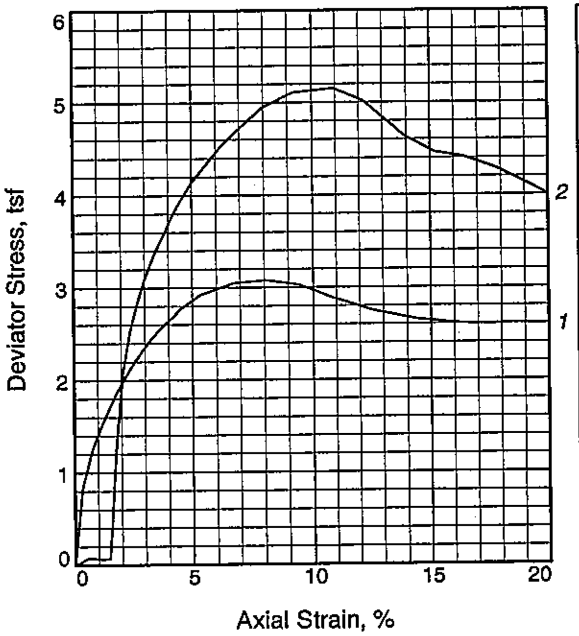


DLZ

Figure



	Total	Effective
C, tsf	0.352	0
ϕ, deg	19.9	31.1
Tan(ϕ)	0.36	0.60



Sample No.		1	2
Initial	Water Content,	22.6	22.9
	Dry Density, pcf	101.1	99.8
	Saturation,	91.2	89.8
	Void Ratio	0.6679	0.6885
	Diameter, in.	2.85	2.87
	Height, in.	5.21	5.57
At Test	Water Content,	26.7	24.9
	Dry Density, pcf	97.9	100.8
	Saturation,	100.0	100.0
	Void Ratio	0.7220	0.6729
	Diameter, in.	2.89	2.85
	Height, in.	5.21	5.57
Strain rate, in./min.		0.01	0.01
Back Pressure, tsf		4.03	4.03
Cell Pressure, tsf		6.05	8.06
Fail. Stress, tsf		3.08	5.15
Total Pore Pr., tsf		4.47	5.74
Ult. Stress, tsf			
Total Pore Pr., tsf			
$\bar{\sigma}_1$ Failure, tsf		4.66	7.48
$\bar{\sigma}_3$ Failure, tsf		1.58	2.33

Type of Test:
CU with Pore Pressures

Sample Type: 3" Press Tube

Description:

Specific Gravity= 2.7

Remarks:

Figure ______

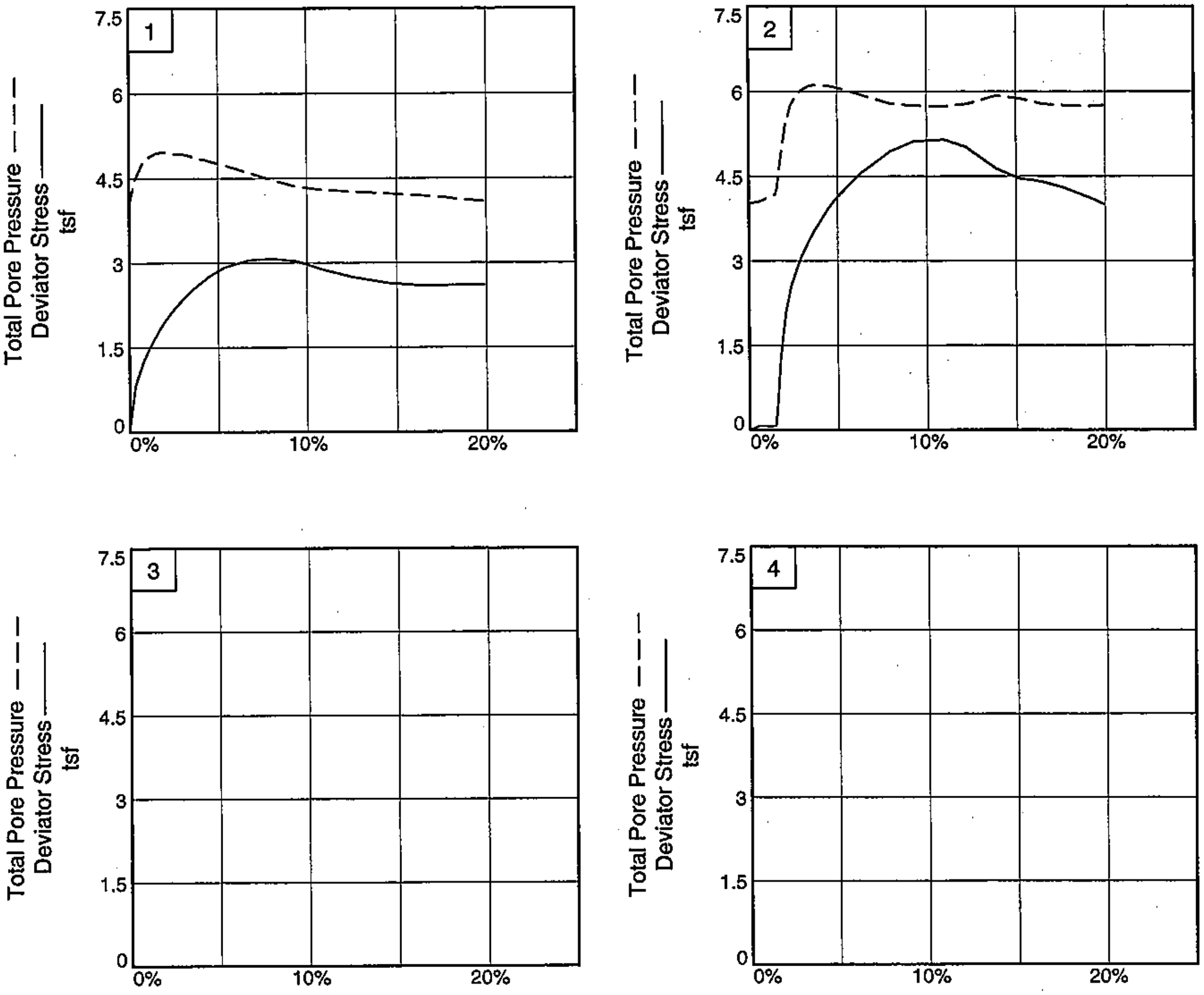
Client: TranSystems, Inc.

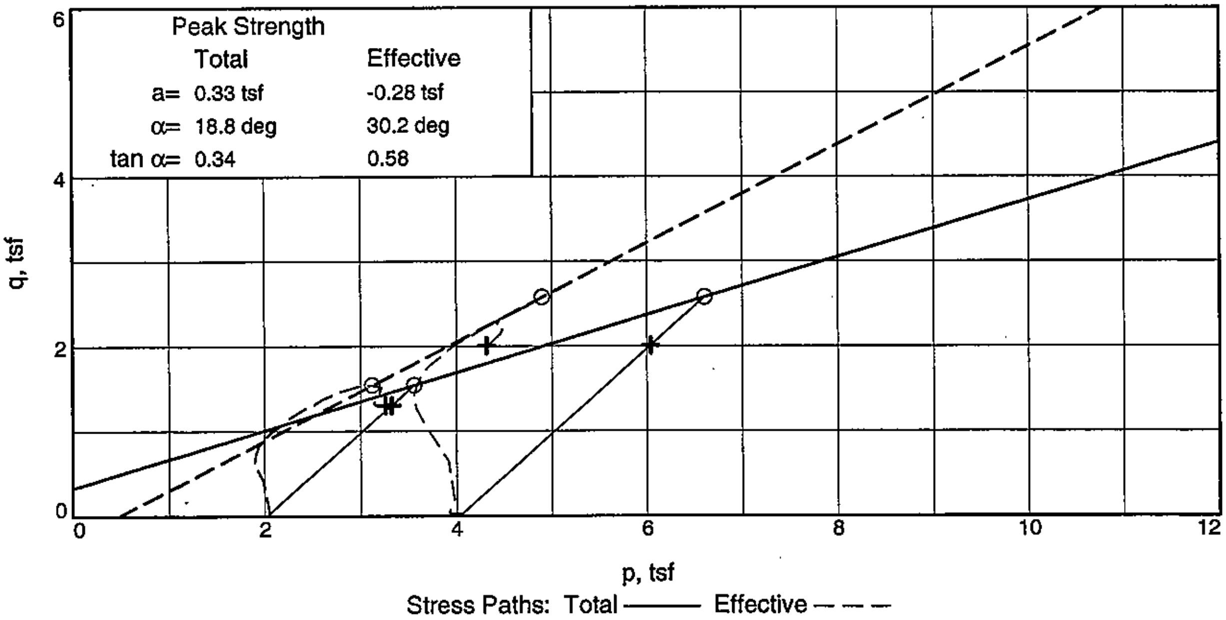
Project: SCI-823-0.00

Source of Sample: TR-35A **Depth:** 5.0

Sample Number: P-1

Proj. No.: 0121-3070.03 **Date:**



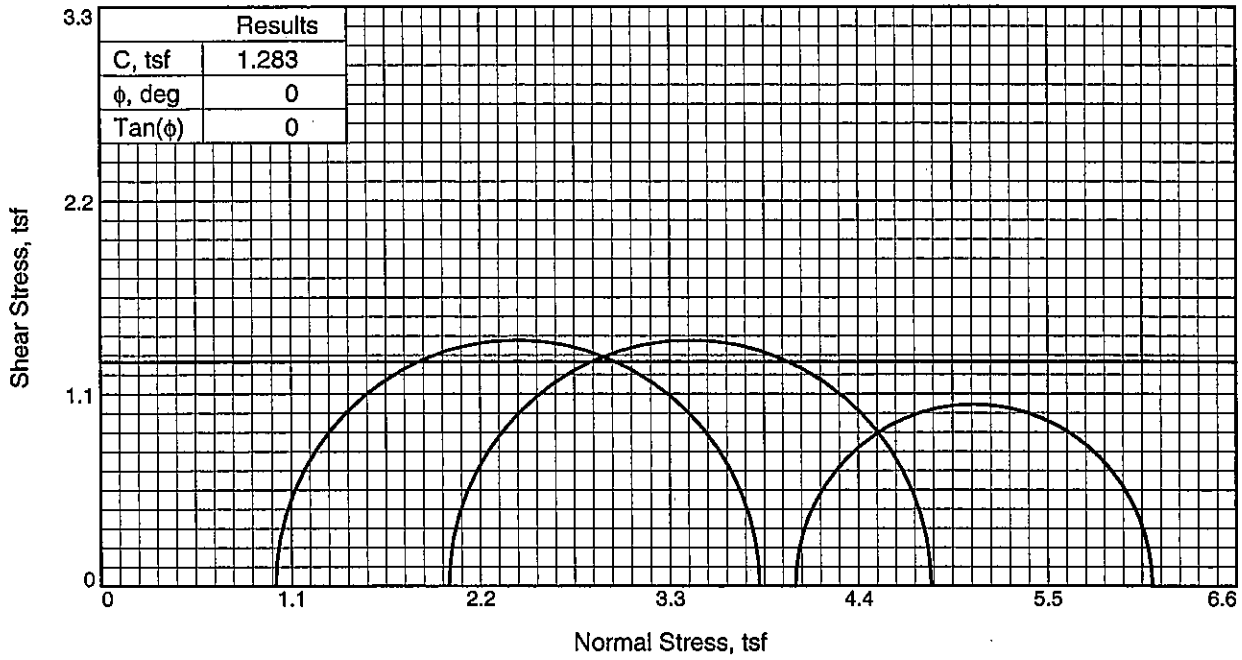


Peak Strength

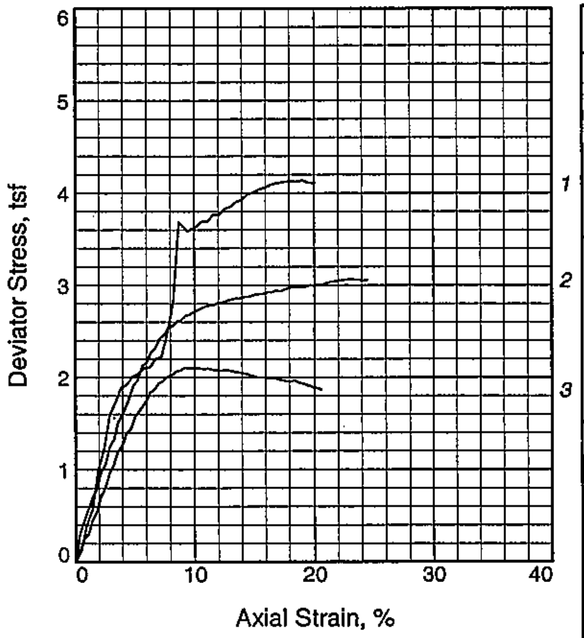
	Total	Effective
a=	0.33 tsf	-0.28 tsf
α=	18.8 deg	30.2 deg
tan α=	0.34	0.58

Client: TranSystems, Inc.
Project: SCI-823-0.00
Source of Sample: TR-35A **Depth:** 5.0 **Sample Number:** P-1
Project No.: 0121-3070.03 **Figure** ________

DLZ, INC.



	Results
C, tsf	1.283
ϕ, deg	0
Tan(ϕ)	0



	Sample No.	1	2	3
Initial	Water Content,	28.6	27.9	30.9
	Dry Density, pcf	97.4	96.2	92.4
	Saturation,	105.8	100.1	101.2
	Void Ratio	0.7300	0.7522	0.8243
	Diameter, in.	2.83	2.86	2.85
	Height, in.	4.14	5.51	5.55
At Test	Water Content,	27.0	27.9	30.5
	Dry Density, pcf	97.4	96.2	92.4
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.7300	0.7522	0.8243
	Diameter, in.	2.83	2.86	2.85
	Height, in.	4.14	5.51	5.55
Strain rate, in./min.		0.06	0.06	0.06
Back Pressure, tsf		0.00	0.00	0.00
Cell Pressure, tsf		1.01	2.02	4.03
Fail. Stress, tsf		2.81	2.81	2.08
Ult. Stress, tsf		2.81	2.81	2.08
σ_1 Failure, tsf		3.82	4.83	6.11
σ_3 Failure, tsf		1.01	2.02	4.03

Type of Test:
Unconsolidated Undrained

Sample Type: 3" Press Tube

Description: Silt

LL= 27 **PL=** 22 **PI=** 5

Assumed Specific Gravity= 2.7

Remarks:

Figure ________

Client: TranSystems, Inc.

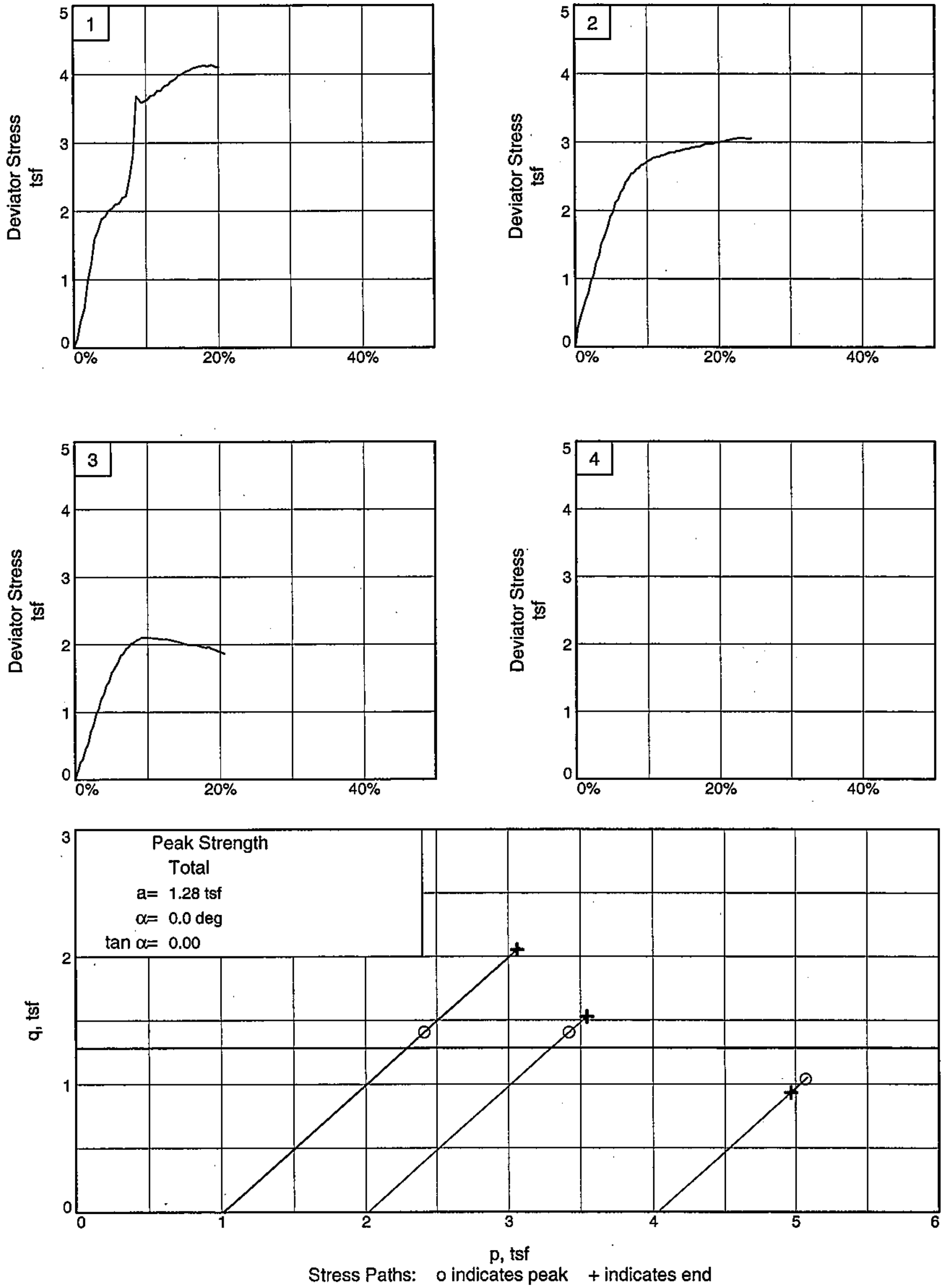
Project: SCI-823-0.00

Source of Sample: TR-35A **Depth:** 12.4

Sample Number: P-2B

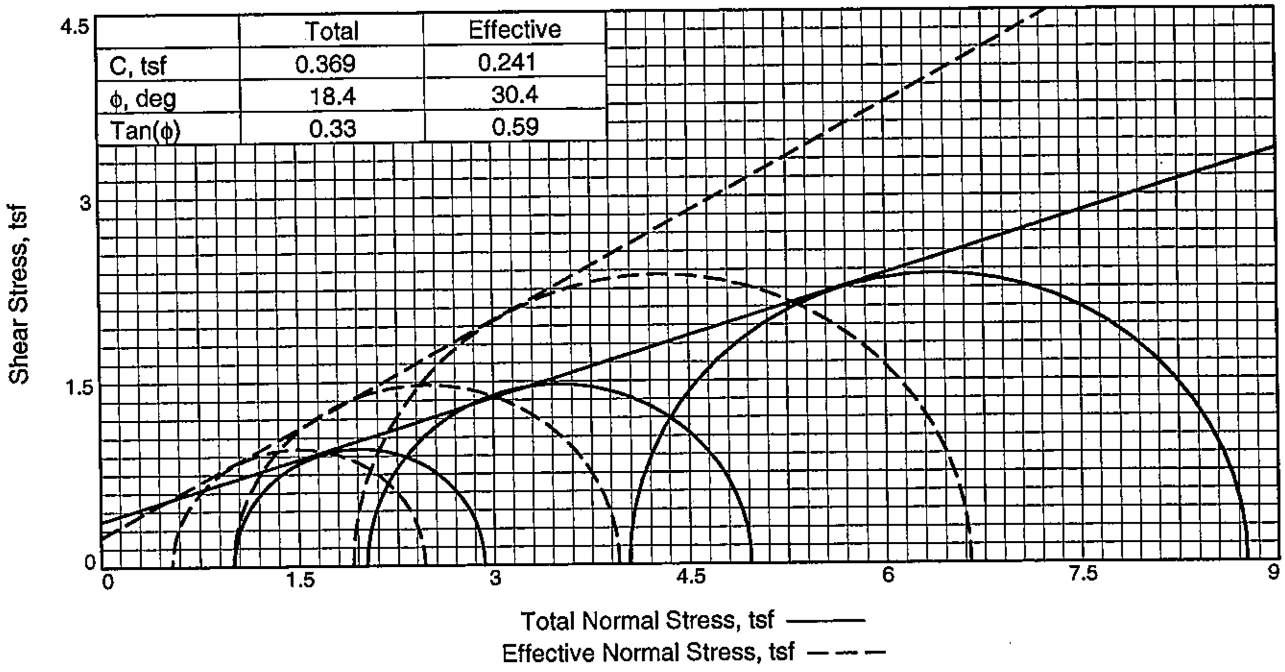
Proj. No.: 0121-3070.03 **Date:** 2/6/06

DLZ

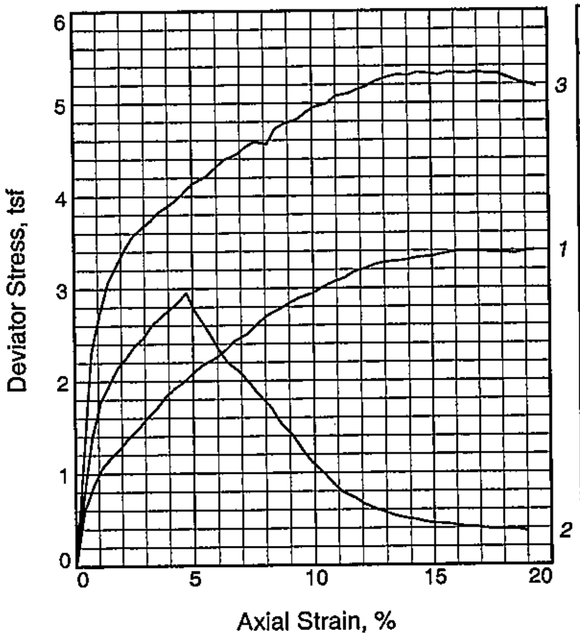


Client: TranSystems, Inc.
Project: SCI-823-0.00
Source of Sample: TR-35A **Depth:** 12.4 **Sample Number:** P-2B
Project No.: 0121-3070.03 **Figure** ________

DLZ, INC.



	Total	Effective
C, tsf	0.369	0.241
ϕ, deg	18.4	30.4
Tan(ϕ)	0.33	0.59



	Sample No.	1	2	3
Initial	Water Content,	27.6	27.6	27.6
	Dry Density, pcf	97.1	96.2	95.1
	Saturation,	98.8	96.7	94.3
	Void Ratio	0.7685	0.7852	0.8048
	Diameter, in.	2.85	2.83	2.83
	Height, in.	5.21	5.47	5.54
At Test	Water Content,	27.9	28.6	29.3
	Dry Density, pcf	97.1	96.2	95.1
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.7685	0.7852	0.8048
	Diameter, in.	2.85	2.83	2.83
	Height, in.	5.21	5.47	5.54
	Strain rate, in./min.	0.06	0.06	0.06
	Back Pressure, tsf	4.03	4.03	4.03
	Cell Pressure, tsf	5.04	6.05	8.06
	Fail. Stress, tsf	1.91	2.95	4.73
	Total Pore Pr., tsf	4.50	5.04	6.15
	Ult. Stress, tsf	1.91	2.95	4.73
	Total Pore Pr., tsf	4.50	5.04	6.15
	$\bar{\sigma}_1$ Failure, tsf	2.46	3.95	6.64
	$\bar{\sigma}_3$ Failure, tsf	0.54	1.00	1.91

Type of Test:
CU with Pore Pressures

Sample Type: 3" Press Tube

Description:

Assumed Specific Gravity= 2.75

Remarks:

Figure ______

Client: TranSystems, Inc.

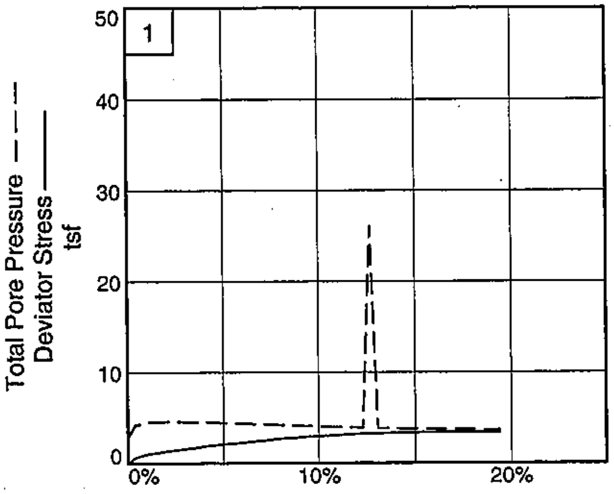
Project: SCI-823-0.00

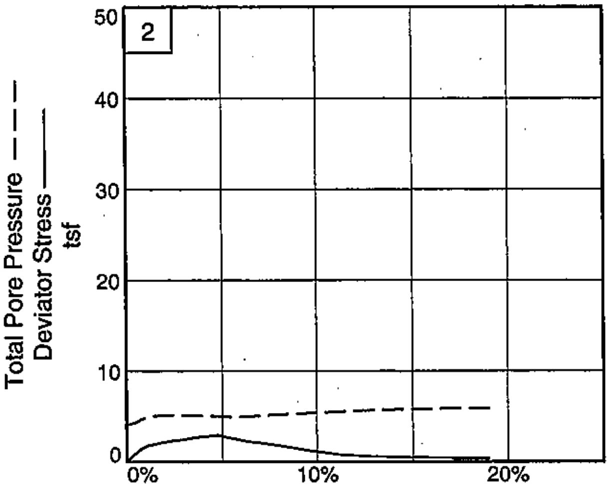
Source of Sample: TR-35A **Depth:** 27.0

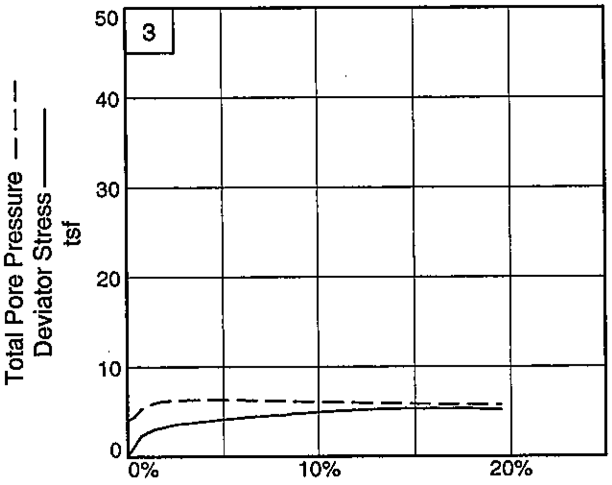
Sample Number: P-3

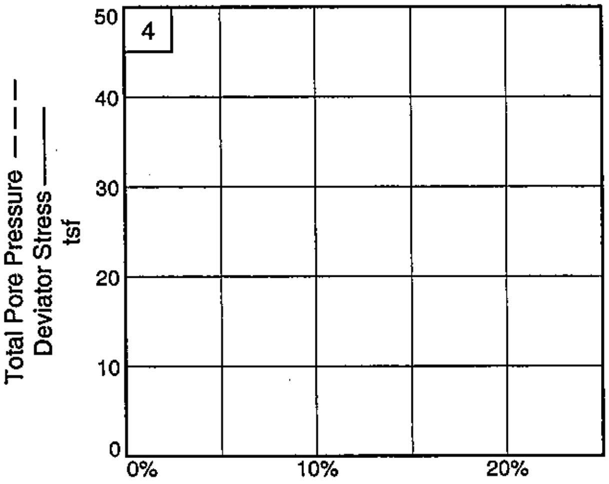
Proj. No.: 0121-3070.03 **Date:**

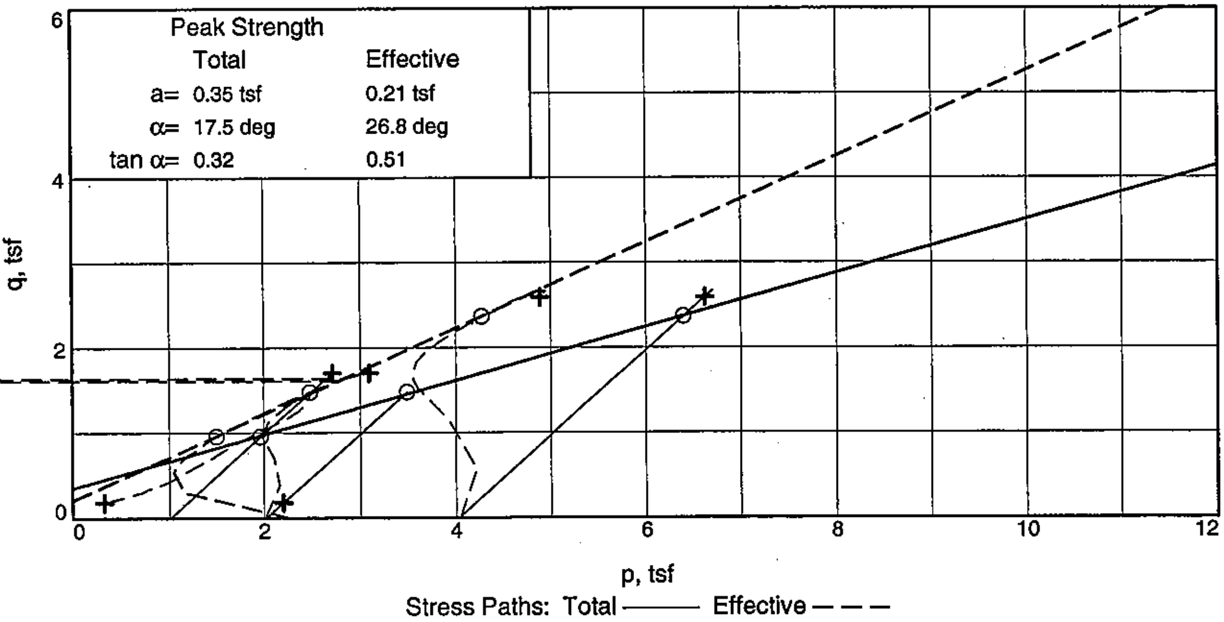
DLZ











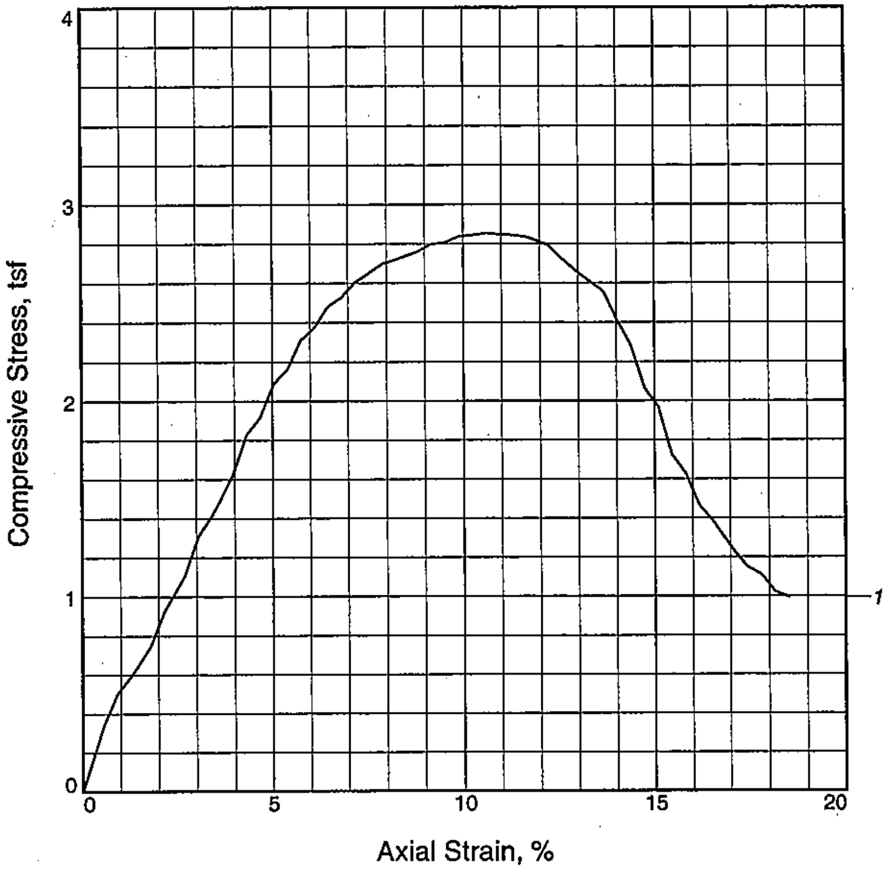
Peak Strength

	Total	Effective
a=	0.35 tsf	0.21 tsf
α=	17.5 deg	26.8 deg
tan α=	0.32	0.51

Client: TranSystems, Inc.
Project: SCI-823-0.00
Source of Sample: TR-35A **Depth:** 27.0 **Sample Number:** P-3
Project No.: 0121-3070.03 **Figure** ________

DLZ, INC.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, tsf	2.854			
Undrained shear strength, tsf	1.427			
Failure strain,	10.6			
Strain rate, in./min.	0.06			
Water content, %	25.5			
Wet density, pcf	118.2			
Dry density, pcf	94.2			
Saturation, %	87.3			
Void ratio	0.7894			
Specimen diameter, in.	2.85			
Specimen height, in.	5.56			
Height/diameter ratio	1.95			

Description: Lean clay

LL = 44	**PL** = 26	**PI** = 18	**Assumed GS=** 2.7	**Type:** 3" Press Tube

Project No.: 0121-3070.03

Date: 2/6/06

Remarks:

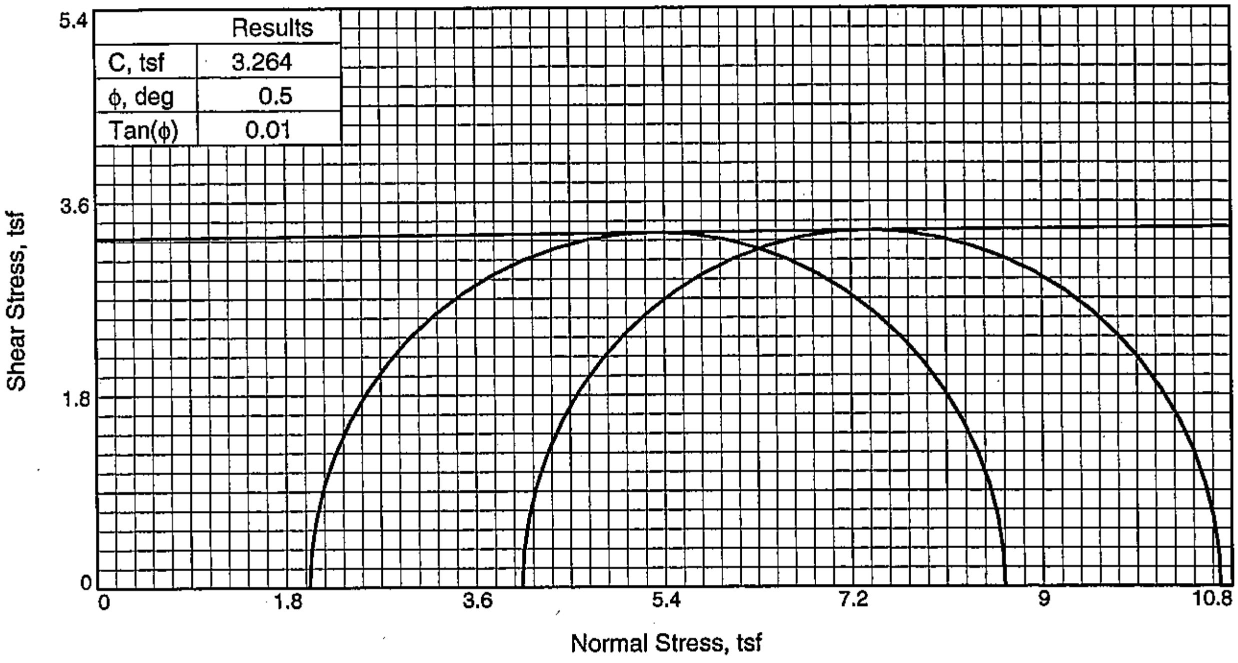
Figure _______

Client: TranSystems, Inc.

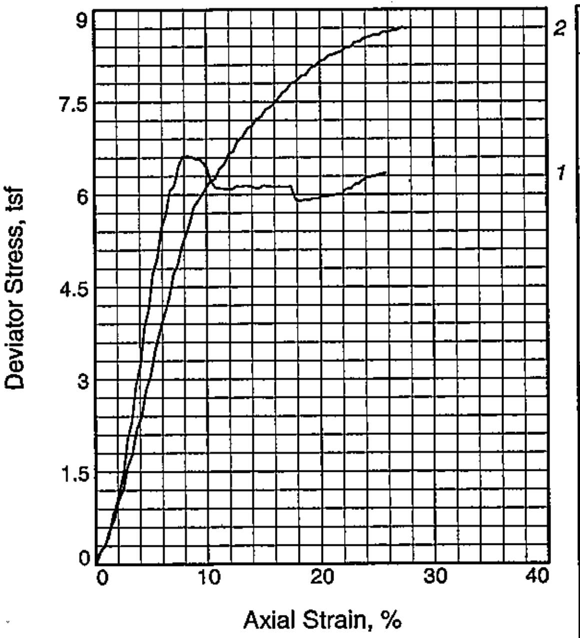
Project: SCI-823-0.00

Source of Sample: TR-35A **Depth:** 66.0
Sample Number: P-4A

DLZ



Results	
C, tsf	3.264
ϕ, deg	0.5
Tan(ϕ)	0.01



	Sample No.	1	2
Initial	Water Content,	18.8	18.8
	Dry Density, pcf	112.6	113.5
	Saturation,	101.9	104.4
	Void Ratio	0.4971	0.4855
	Diameter, in.	2.83	2.80
	Height, in.	5.21	4.85
At Test	Water Content,	18.4	18.0
	Dry Density, pcf	112.6	113.5
	Saturation,	100.0	100.0
	Void Ratio	0.4971	0.4855
	Diameter, in.	2.83	2.80
	Height, in.	5.21	4.85
	Strain rate, in./min.	0.06	0.06
	Back Pressure, tsf	0.0	0.0
	Cell Pressure, tsf	2.0	4.0
	Fail. Stress, tsf	6.6	6.7
	Ult. Stress, tsf	6.6	6.7
	σ_1 Failure, tsf	8.6	10.7
	σ_3 Failure, tsf	2.0	4.0

Type of Test:
Unconsolidated Undrained

Sample Type: 3" Press Tube

Description: Silt with sand

LL= NP **PI=** NP

Assumed Specific Gravity= 2.7

Remarks: Sample S3 - 66.0' - 66.9'

Figure ________

Client: TranSystems, Inc.

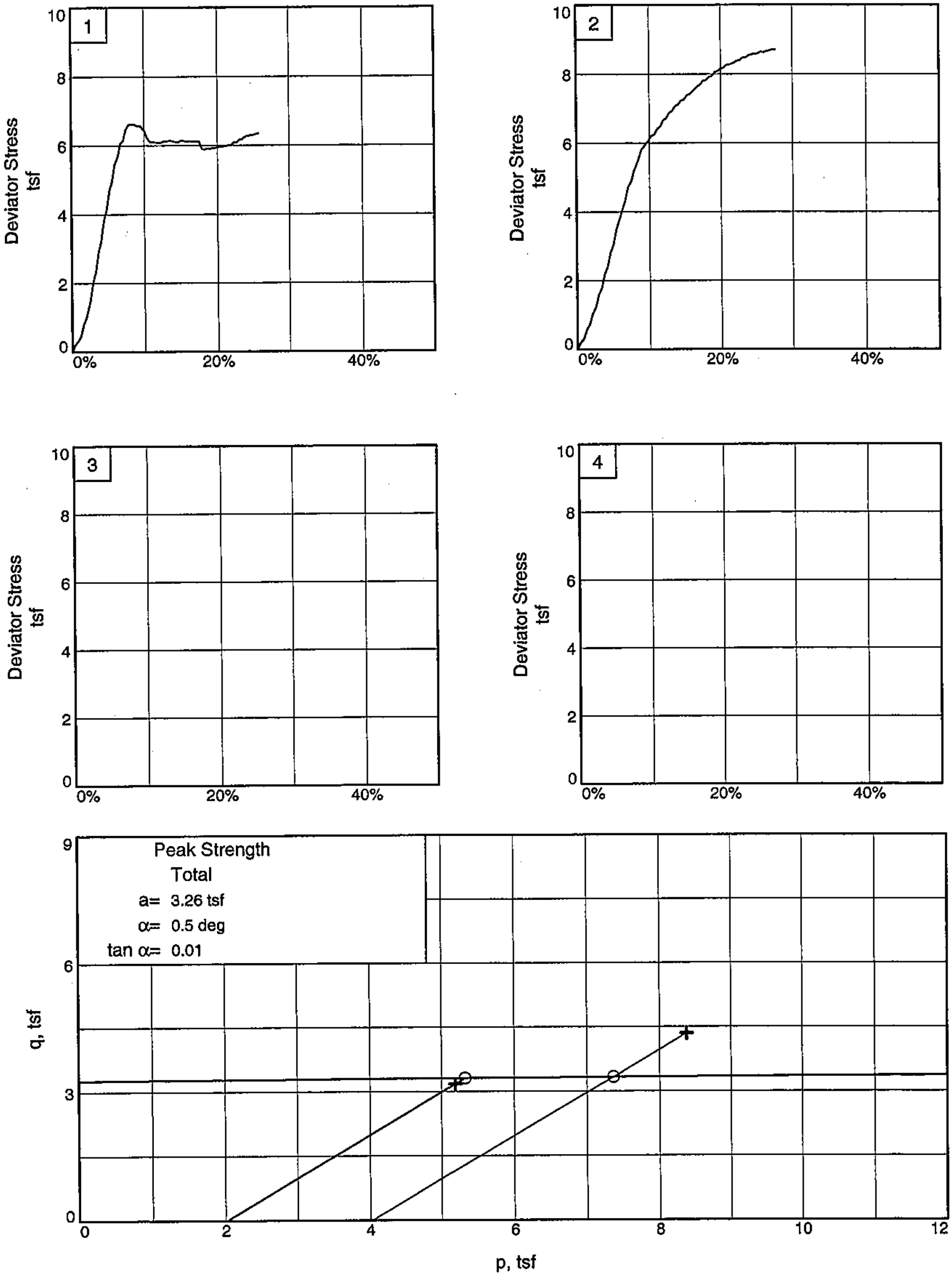
Project: SCI-823-0.00

Source of Sample: TR-35A **Depth:** 66.9

Sample Number: P-4B

Proj. No.: 0121-3070.03 **Date:** 2/6/06

DLZ



Stress Paths: o indicates peak + indicates end

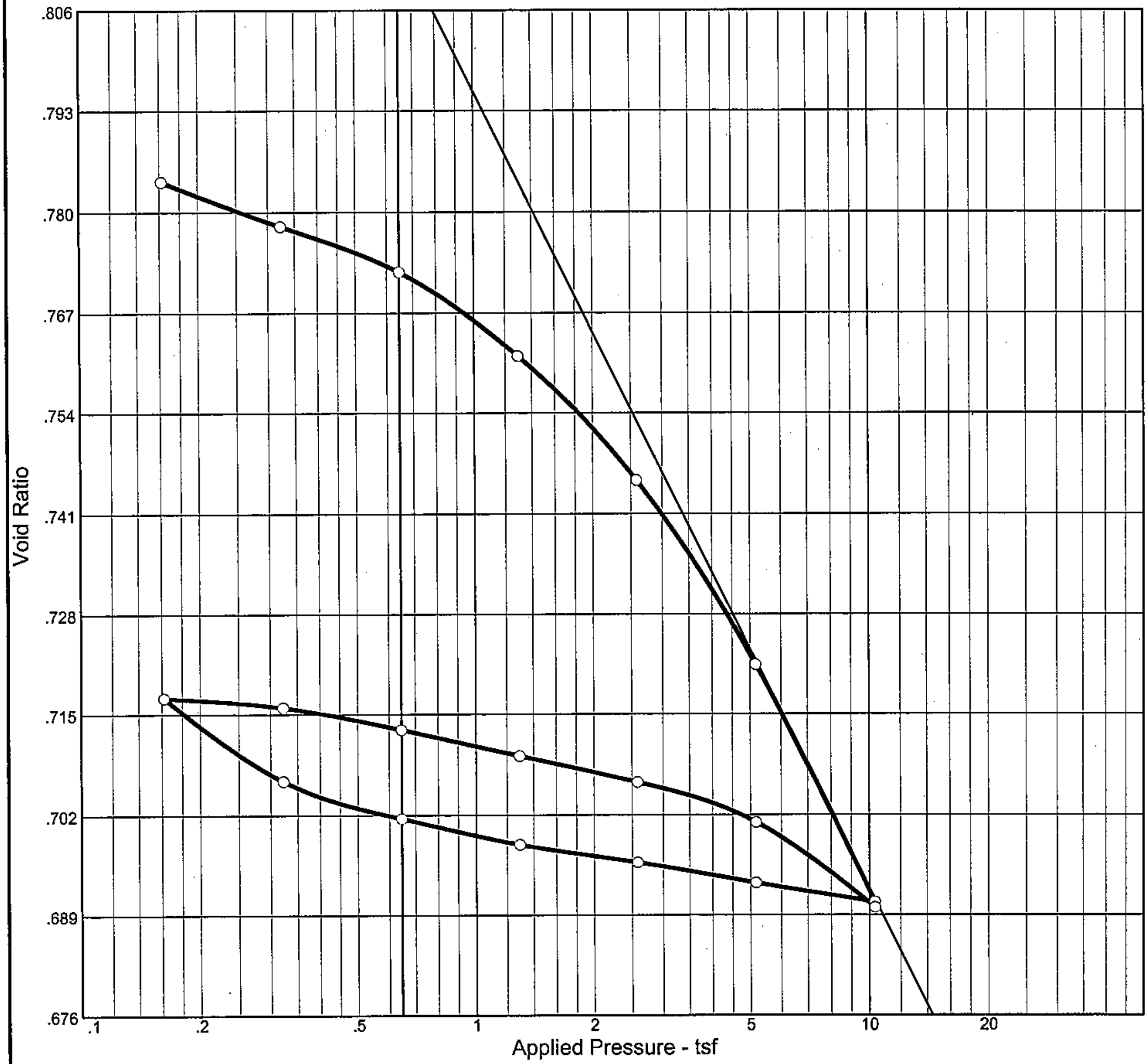
Client: TranSystems, Inc.
Project: SCI-823-0.00
Source of Sample: TR-35A
Project No.: 0121-3070.03

Depth: 66.9
Figure ______

Sample Number: P-4B

DLZ, INC.

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
94.9 %	27.0 %	96.5	27	5	2.76	ML	A-4(4)	0.786

MATERIAL DESCRIPTION

Silt

Project No. 0121- **Client:** TranSystems, Inc.

Project: SCI-823-0.00

Source: TR-35A **Sample No.:** P-2B **Elev./Depth:** 12.4

DLZ

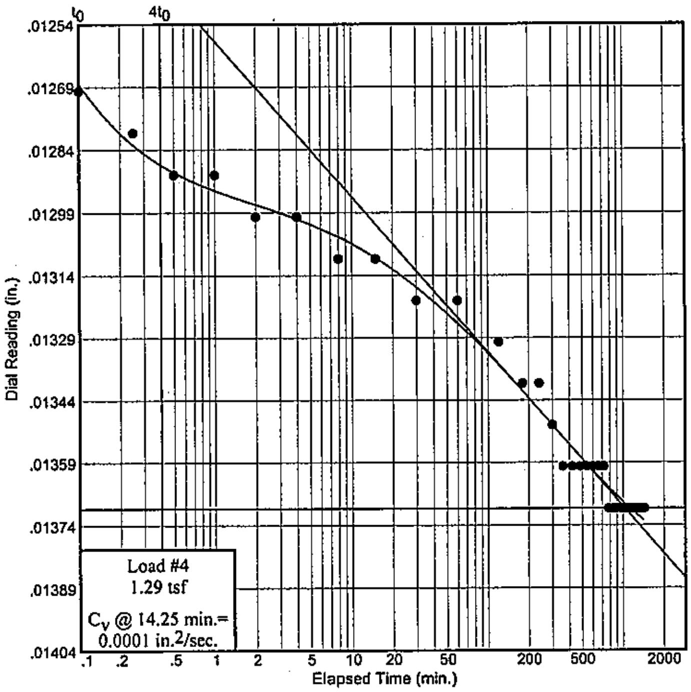
Remarks:

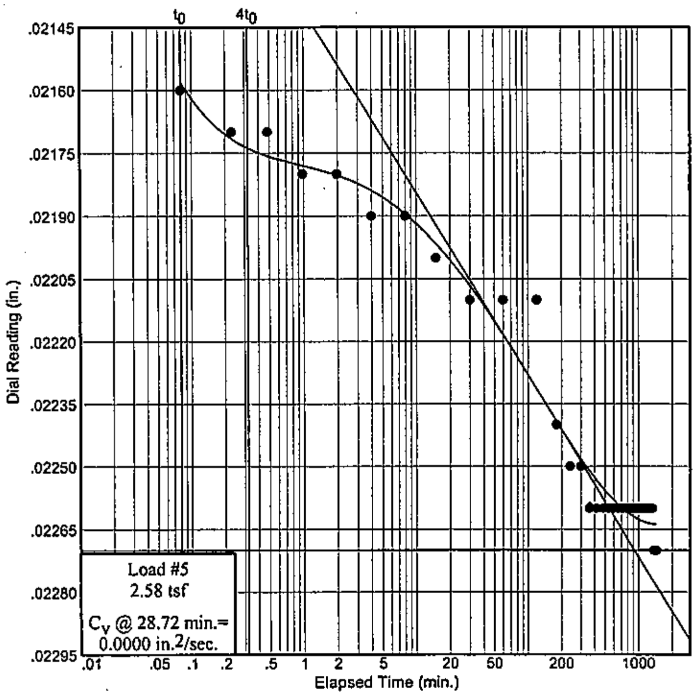
Figure

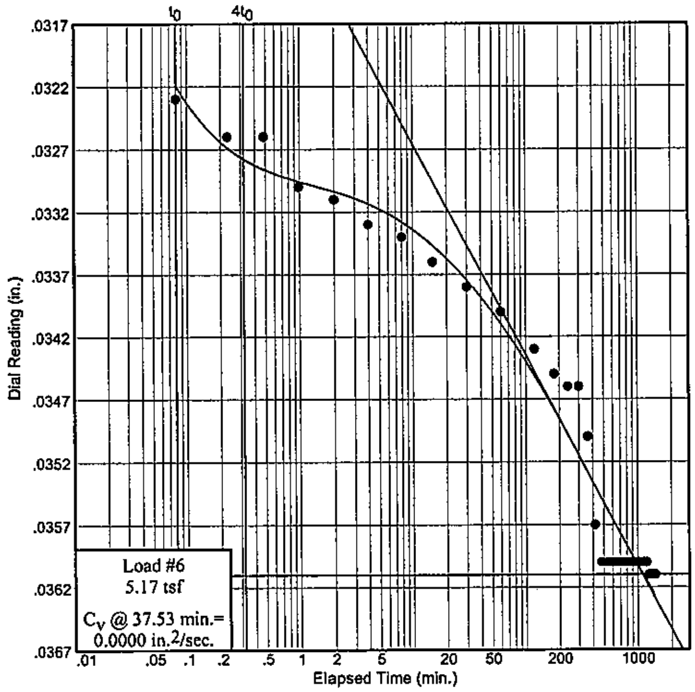
Dial Reading vs. Time

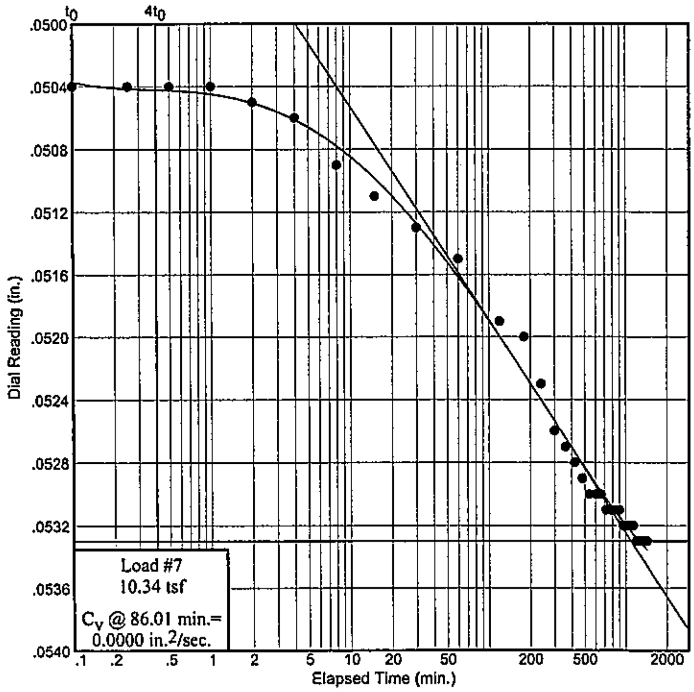
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-35A
Sample No.: P-2B
Elev./Depth: 12.4









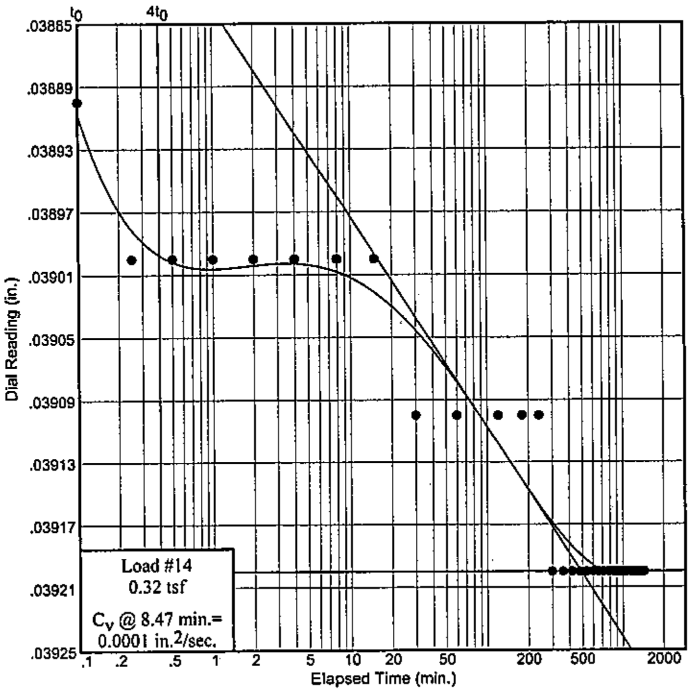
DLZ

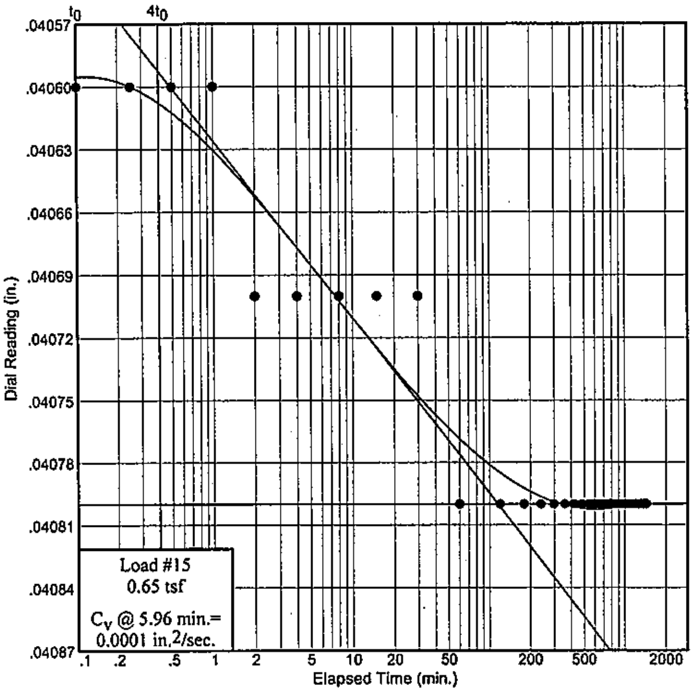
Figure

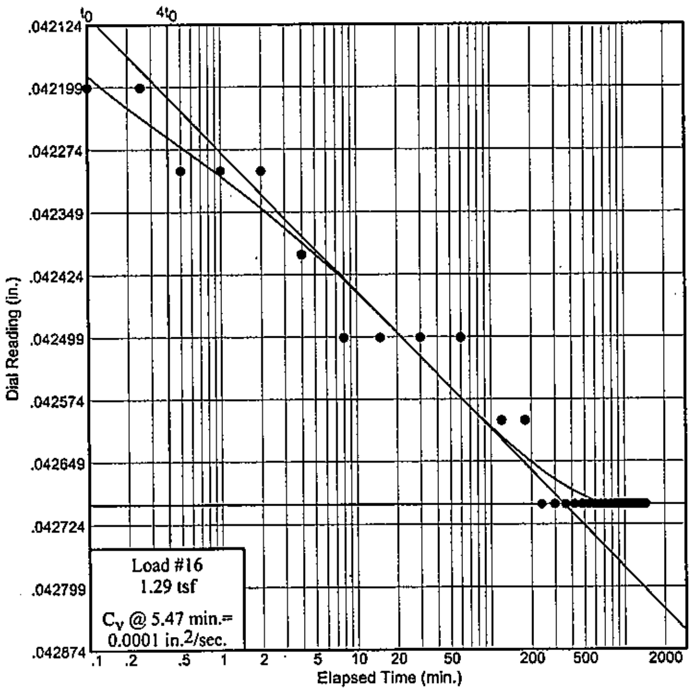
Dial Reading vs. Time

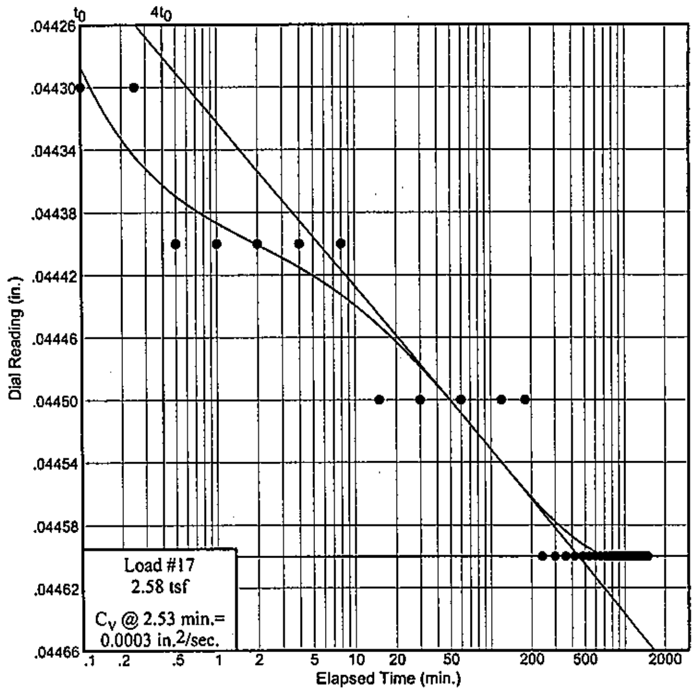
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-35A Sample No.: P-2B Elev./Depth: 12.4









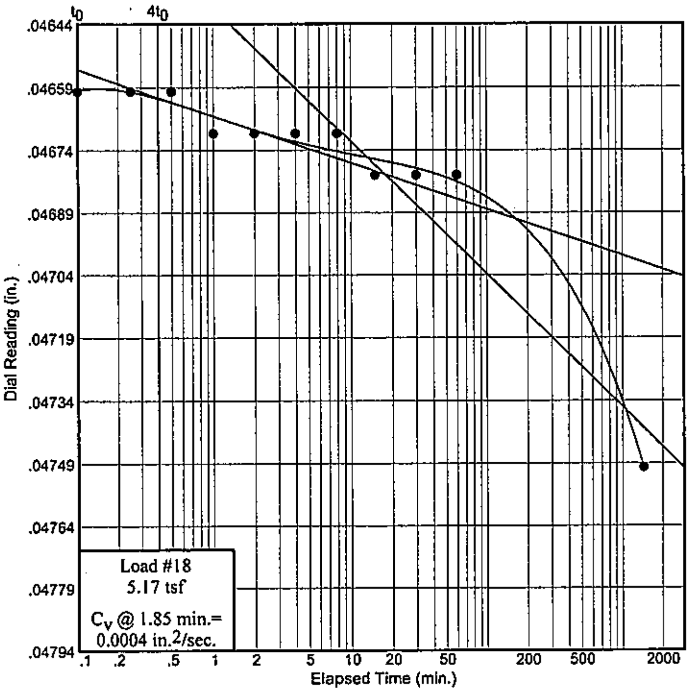
DLZ

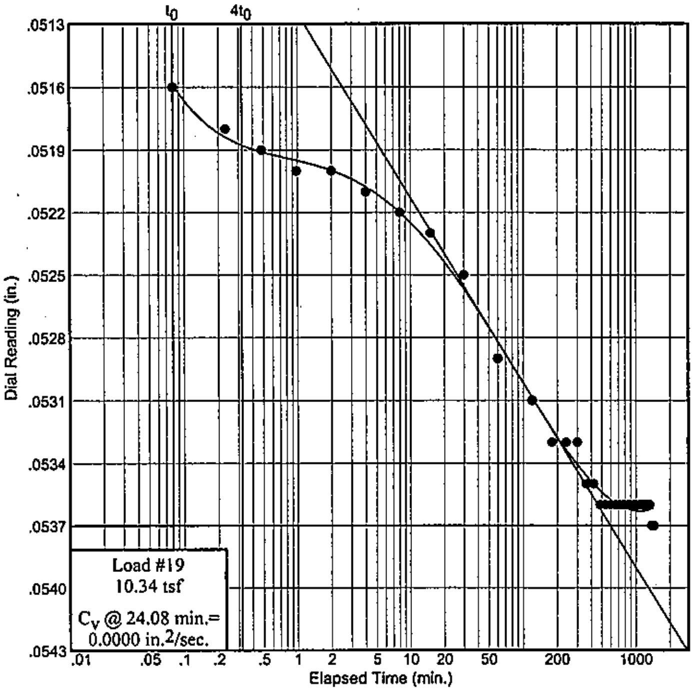
Figure

Dial Reading vs. Time

Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-35A Sample No.: P-2B Elev./Depth: 12.4





DLZ

Figure

CONSOLIDATION TEST REPORT

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
91.8 %	30.9 %	89.4	NP	NP	2.76	ML	A-4(0)	0.928

MATERIAL DESCRIPTION

Silt

Project No. 0121- **Client:** TranSystems, Inc.

Project: SCI-823-0.00

Source: TR-35A **Sample No.:** P-3 **Elev./Depth:** 27.0

DLZ

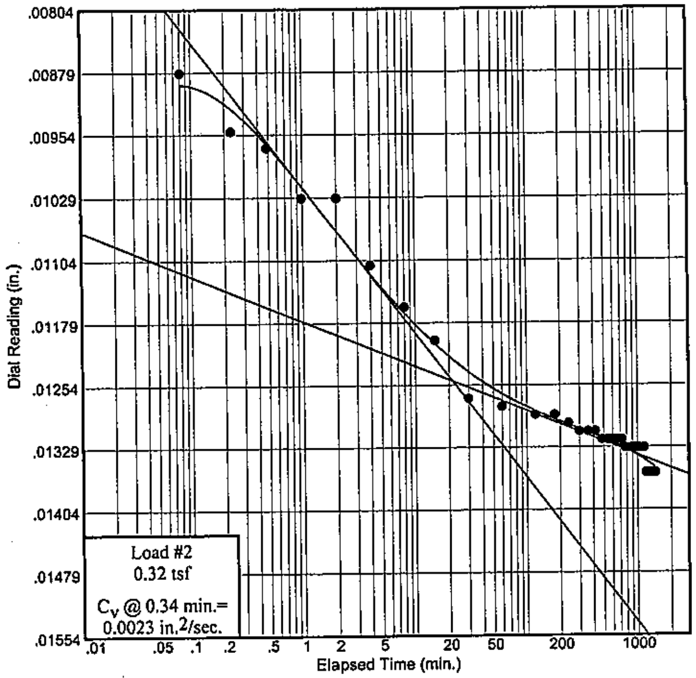
Remarks:

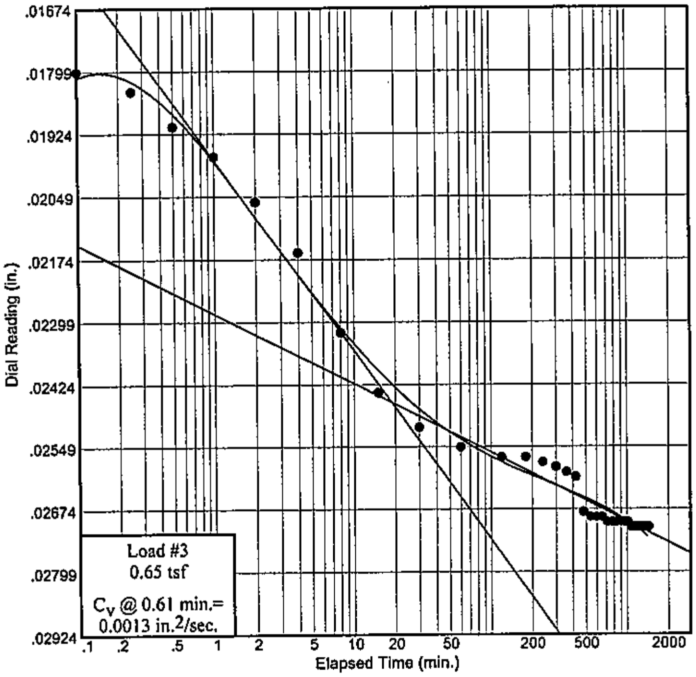
Figure

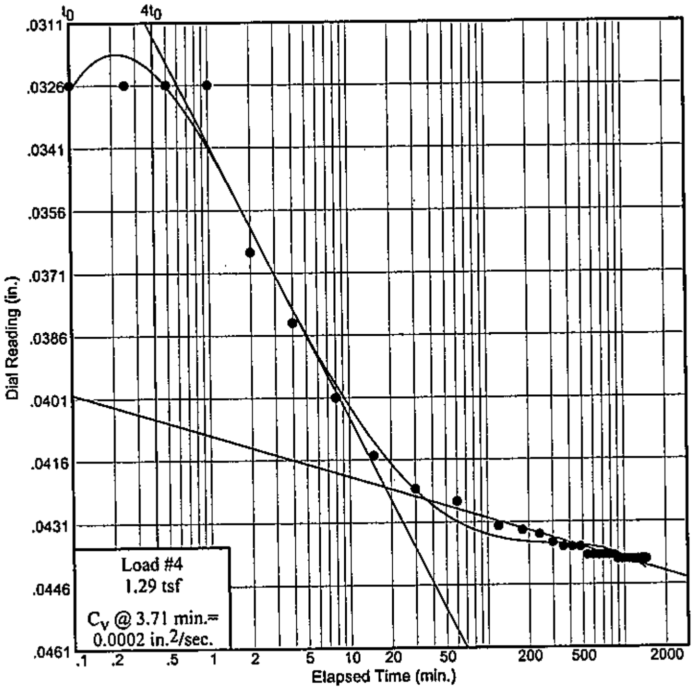
Dial Reading vs. Time

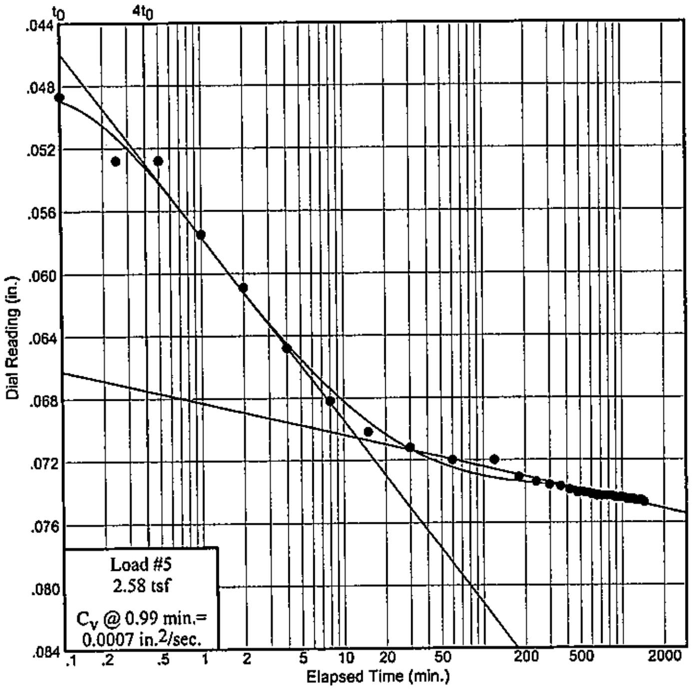
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-35A Sample No.: P-3 Elev./Depth: 27.0









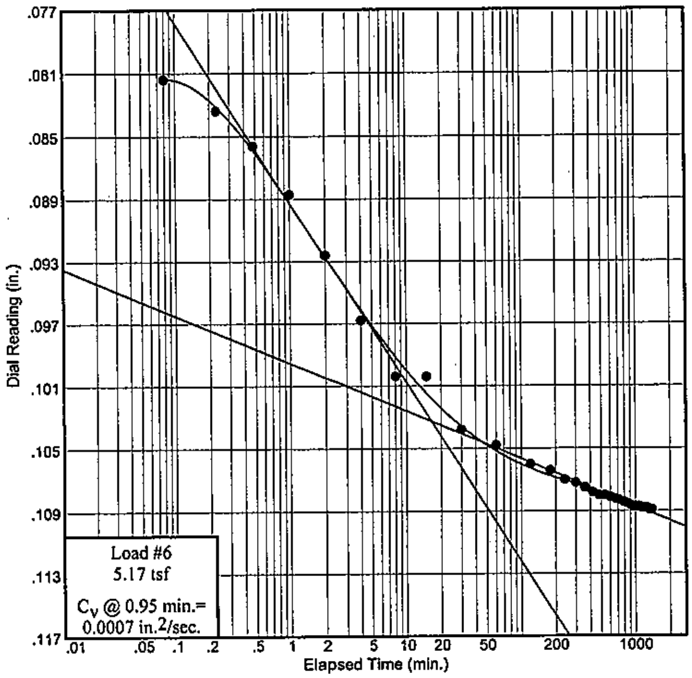
DLZ

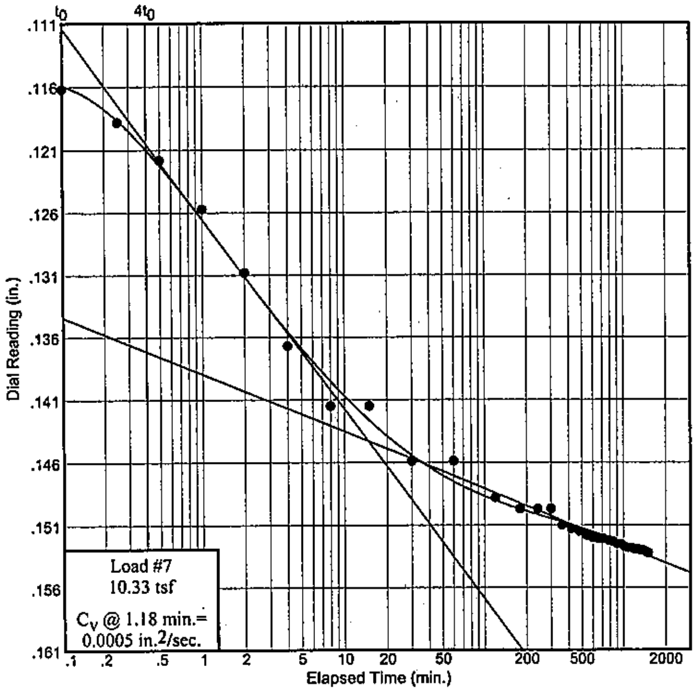
Figure

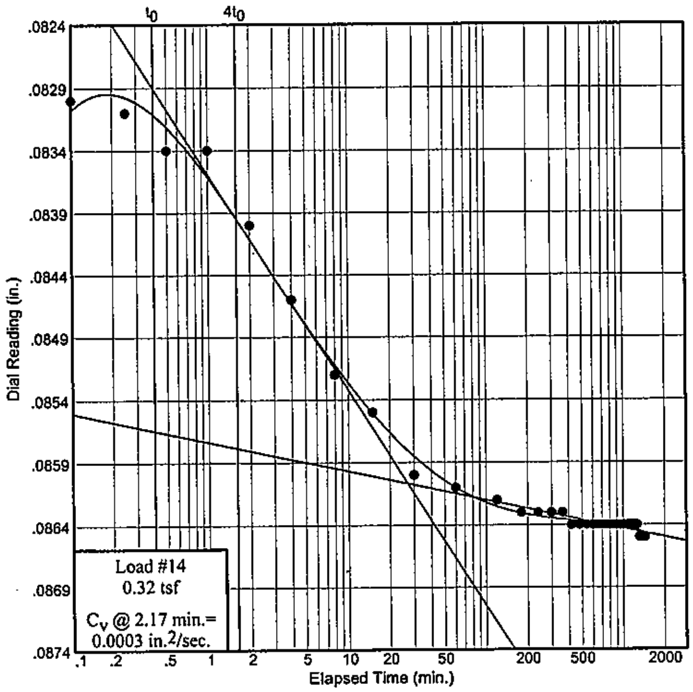
Dial Reading vs. Time

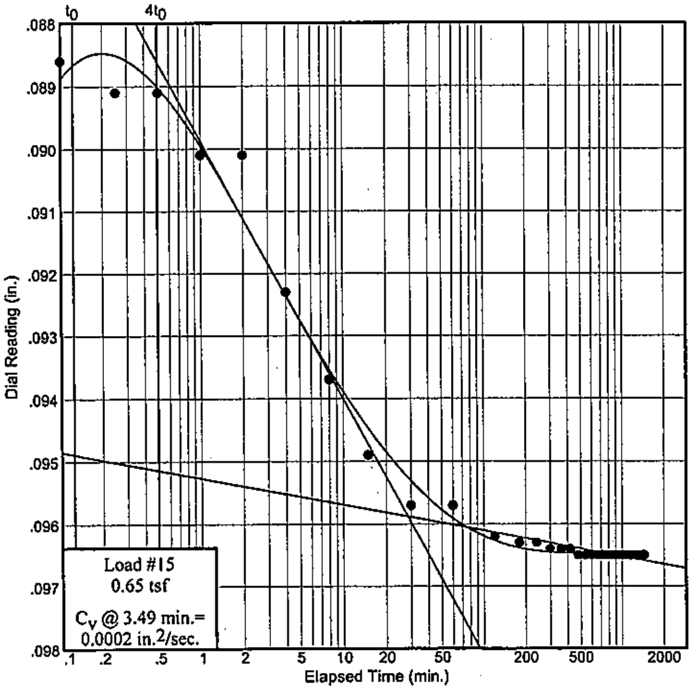
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-35A
Sample No.: P-3
Elev./Depth: 27.0









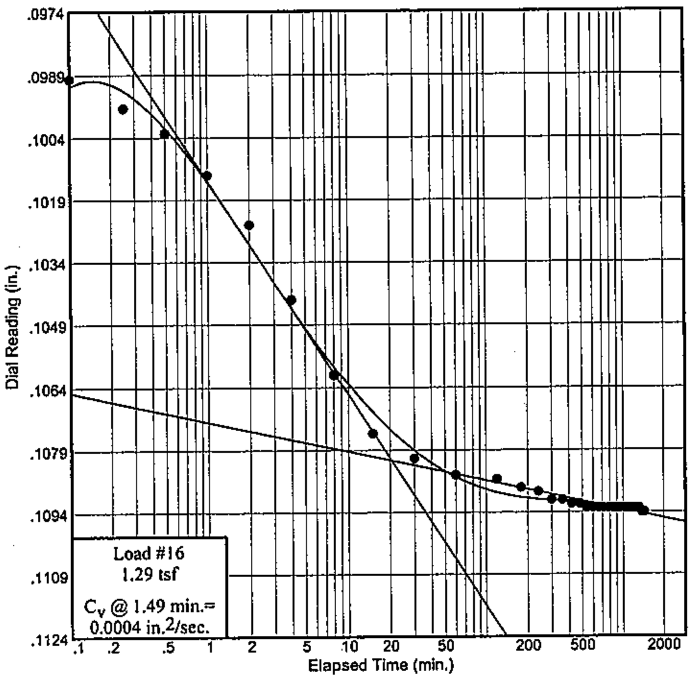
DLZ

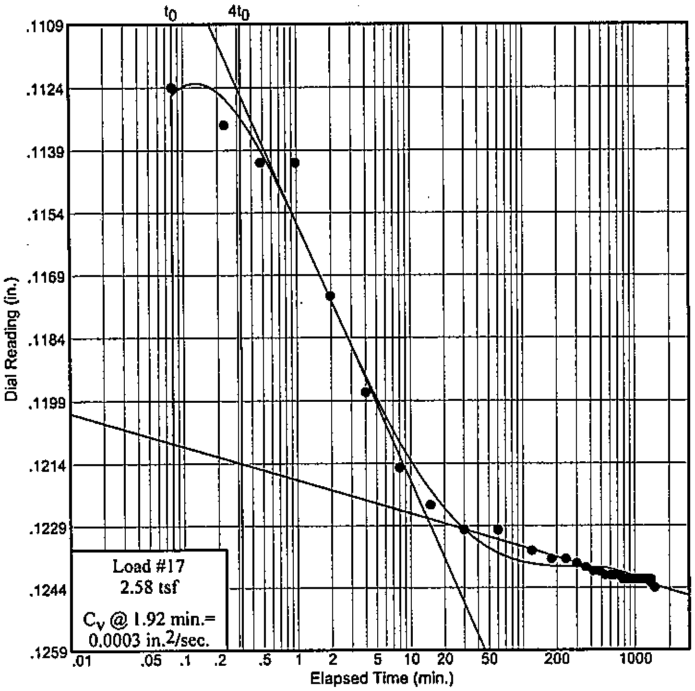
Figure

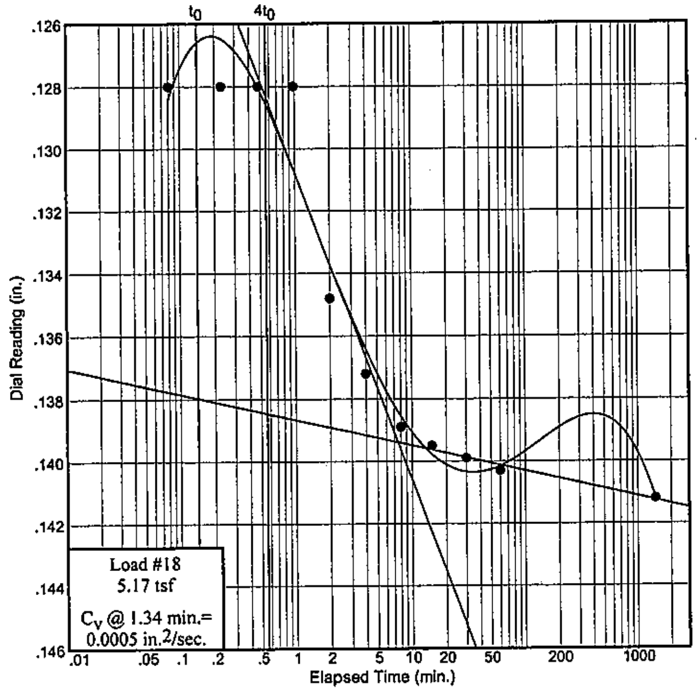
Dial Reading vs. Time

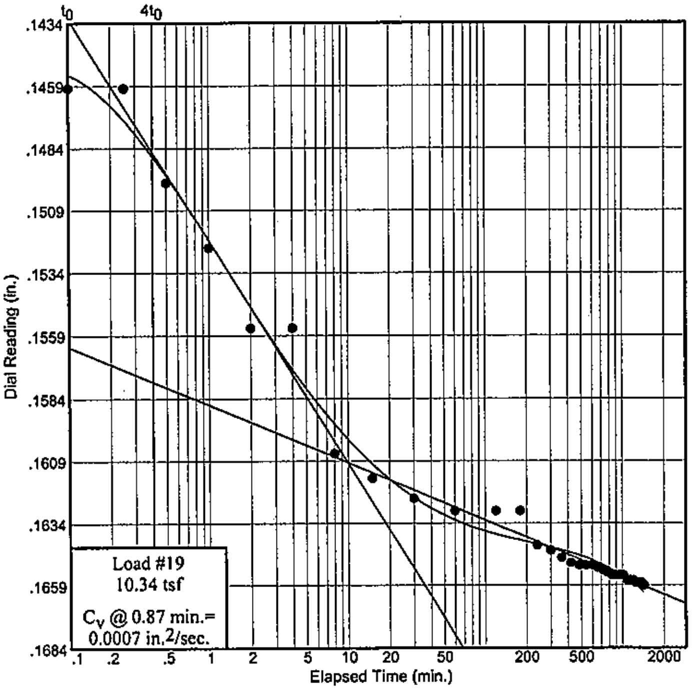
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-35A   Sample No.: P-3   Elev./Depth: 27.0





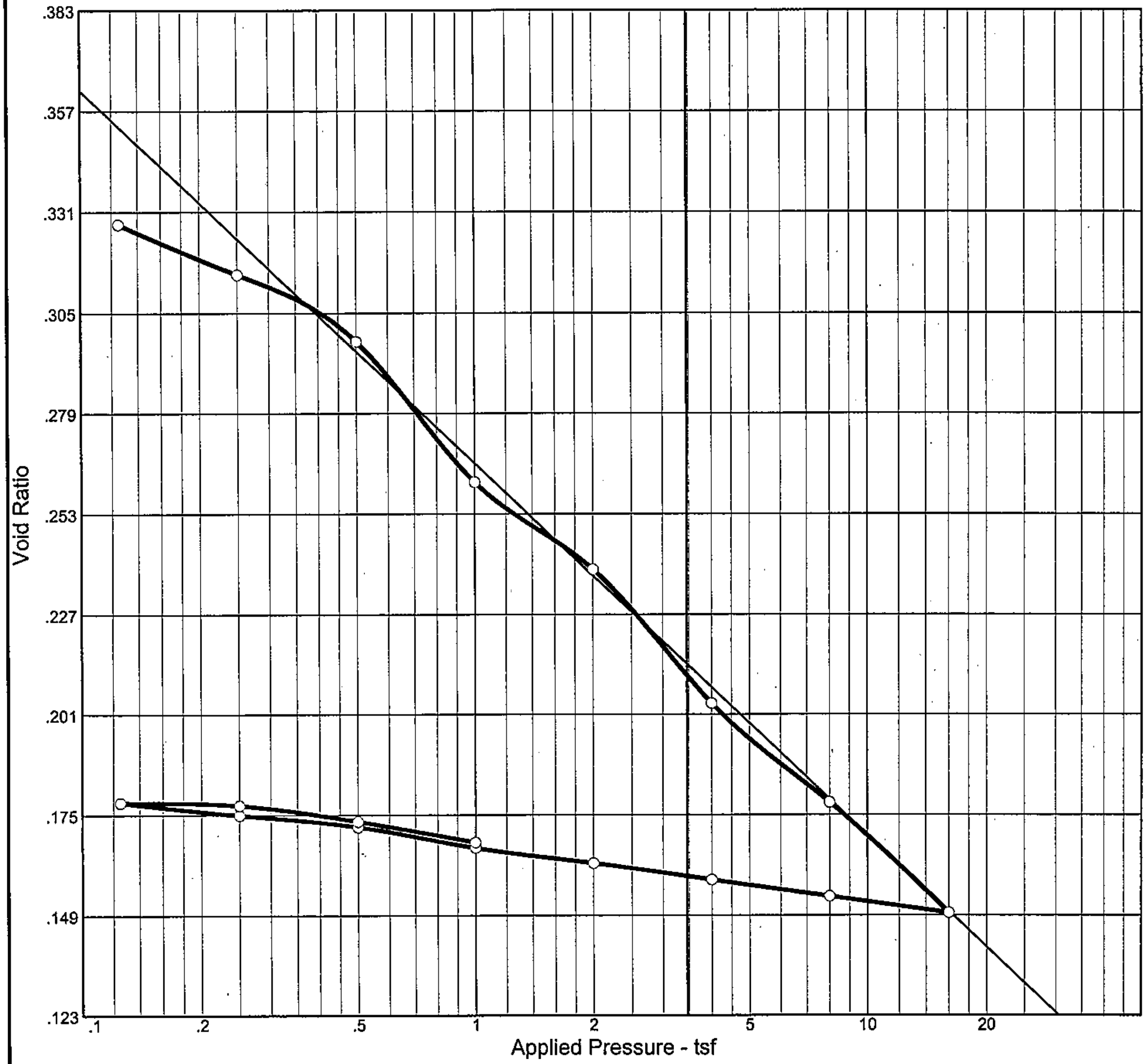




DLZ

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
108.9 %	13.8 %	127.4	NP	NP	2.75	ML	A-4(0)	0.347

MATERIAL DESCRIPTION

Silt with sand

Project No. 0121- **Client:** TranSystems, Inc.

Project: SCI-823-0.00

Source: TR-35A **Sample No.:** P-4B **Elev./Depth:** 66.9

DLZ

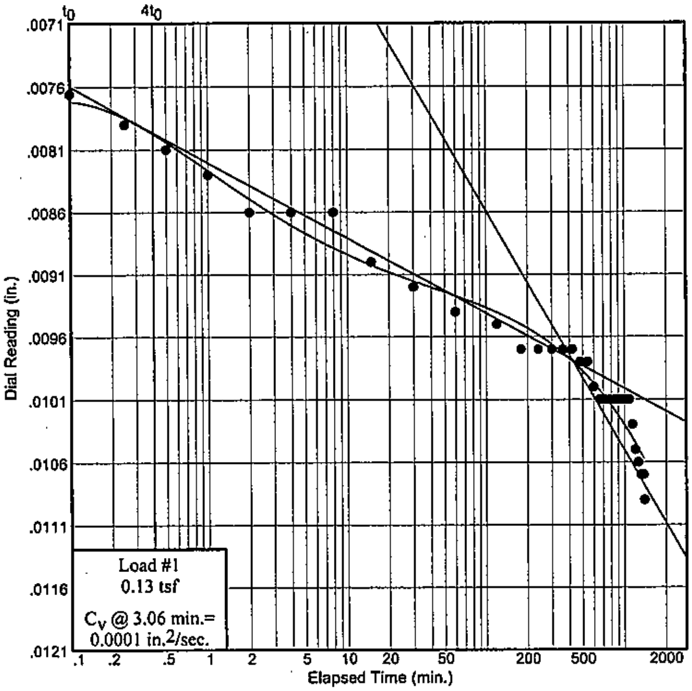
Remarks:

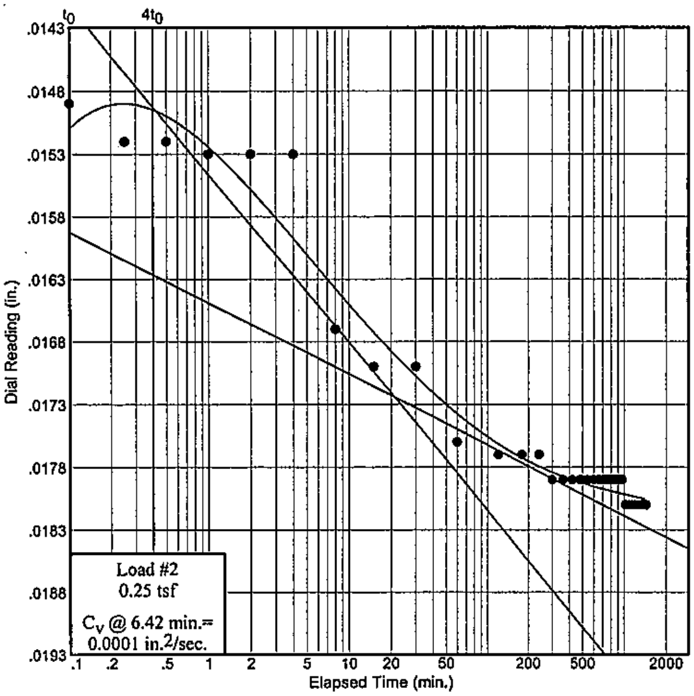
Figure

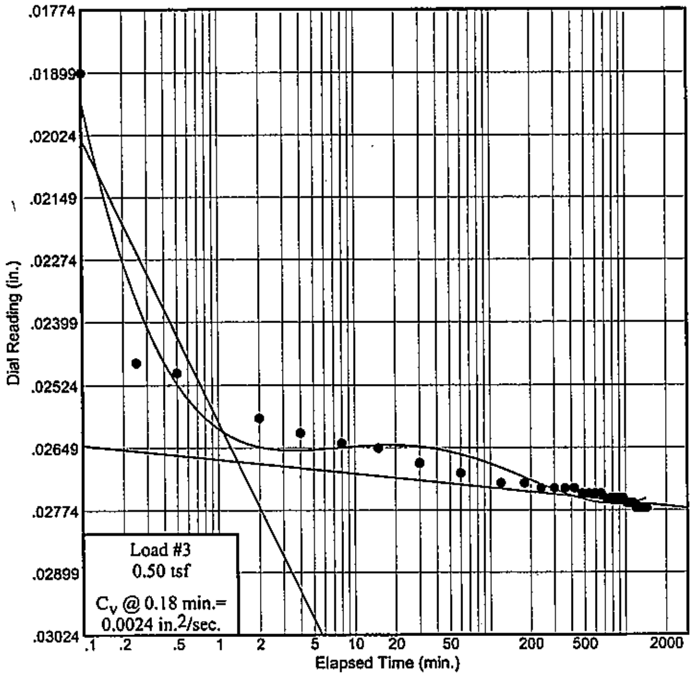
Dial Reading vs. Time

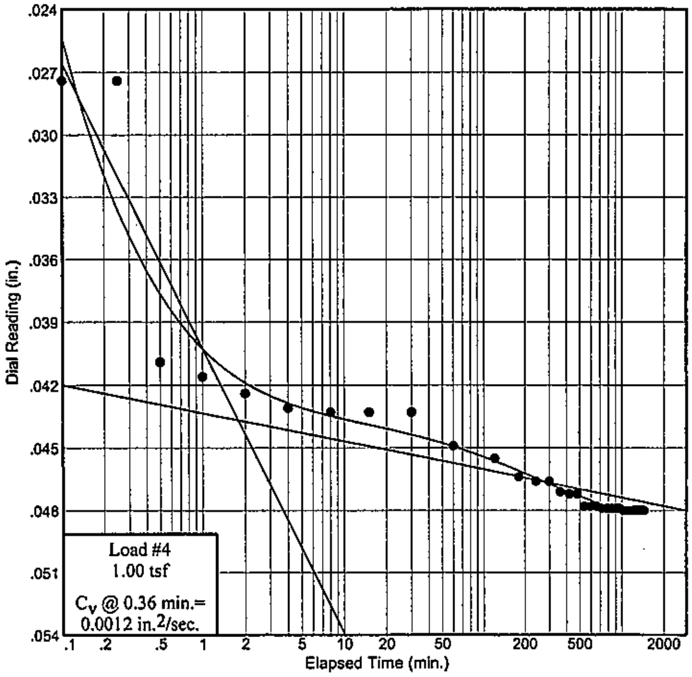
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-35A Sample No.: P-4B Elev./Depth: 66.9









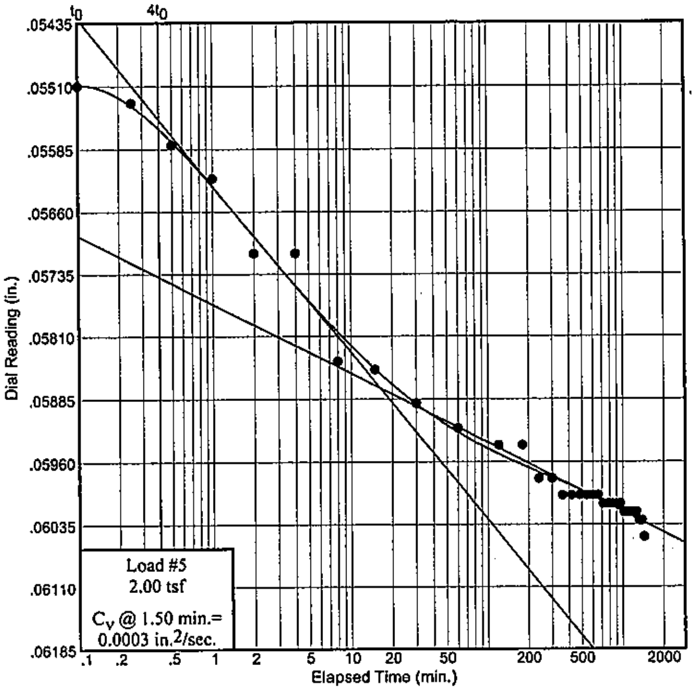
DLZ

Figure

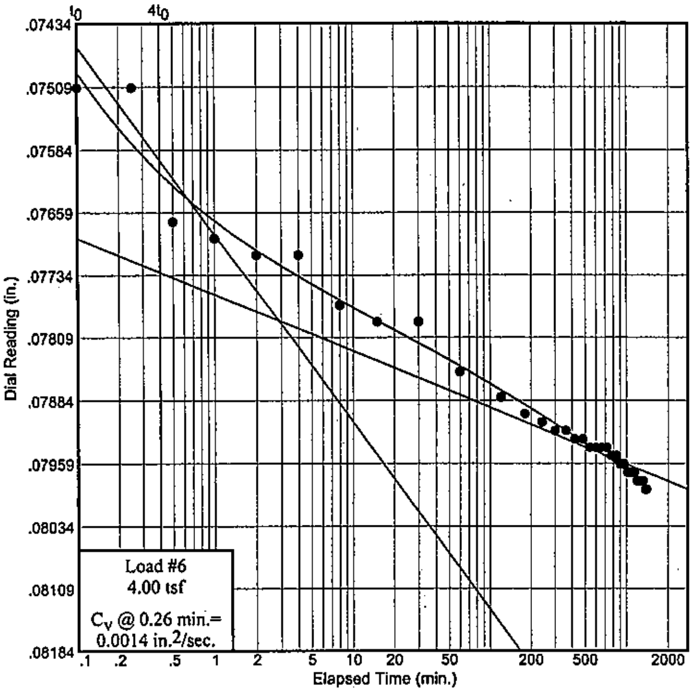
Dial Reading vs. Time

Project No.: 0121-3070.03
Project: SCI-823-0.00

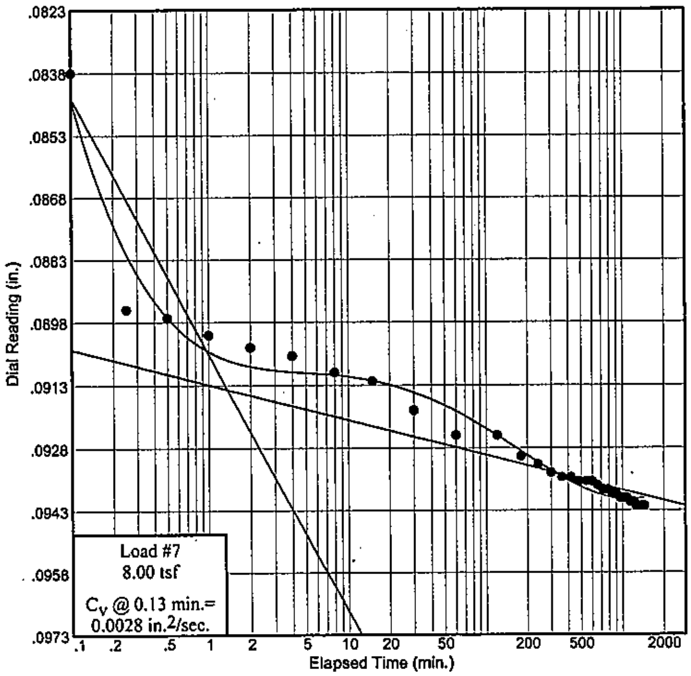
Source: TR-35A Sample No.: P-4B Elev./Depth: 66.9



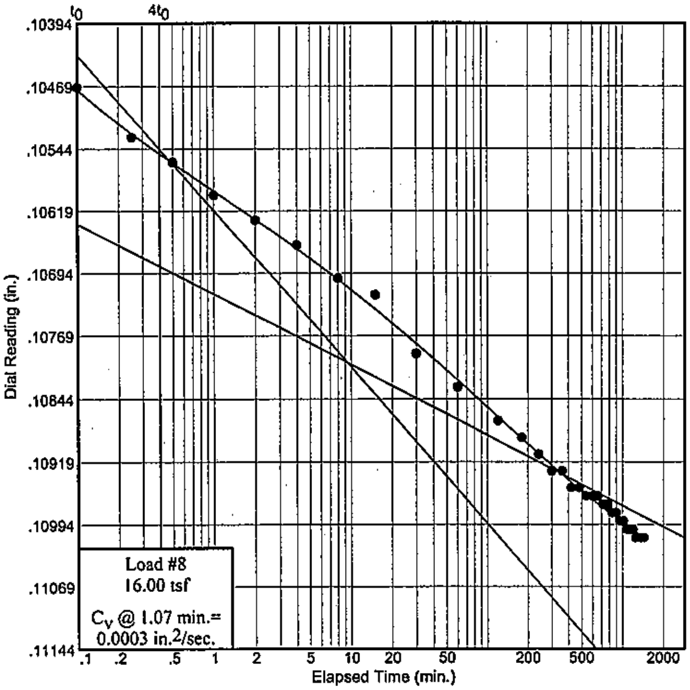
Load #5
2.00 tsf
C_v @ 1.50 min.=
0.0003 in.^{2}/sec.



Load #6
4.00 tsf
C_v @ 0.26 min.=
0.0014 in.^{2}/sec.



Load #7
8.00 tsf
C_v @ 0.13 min.=
0.0028 in.^{2}/sec.



Load #8
16.00 tsf
C_v @ 1.07 min.=
0.0003 in.^{2}/sec.

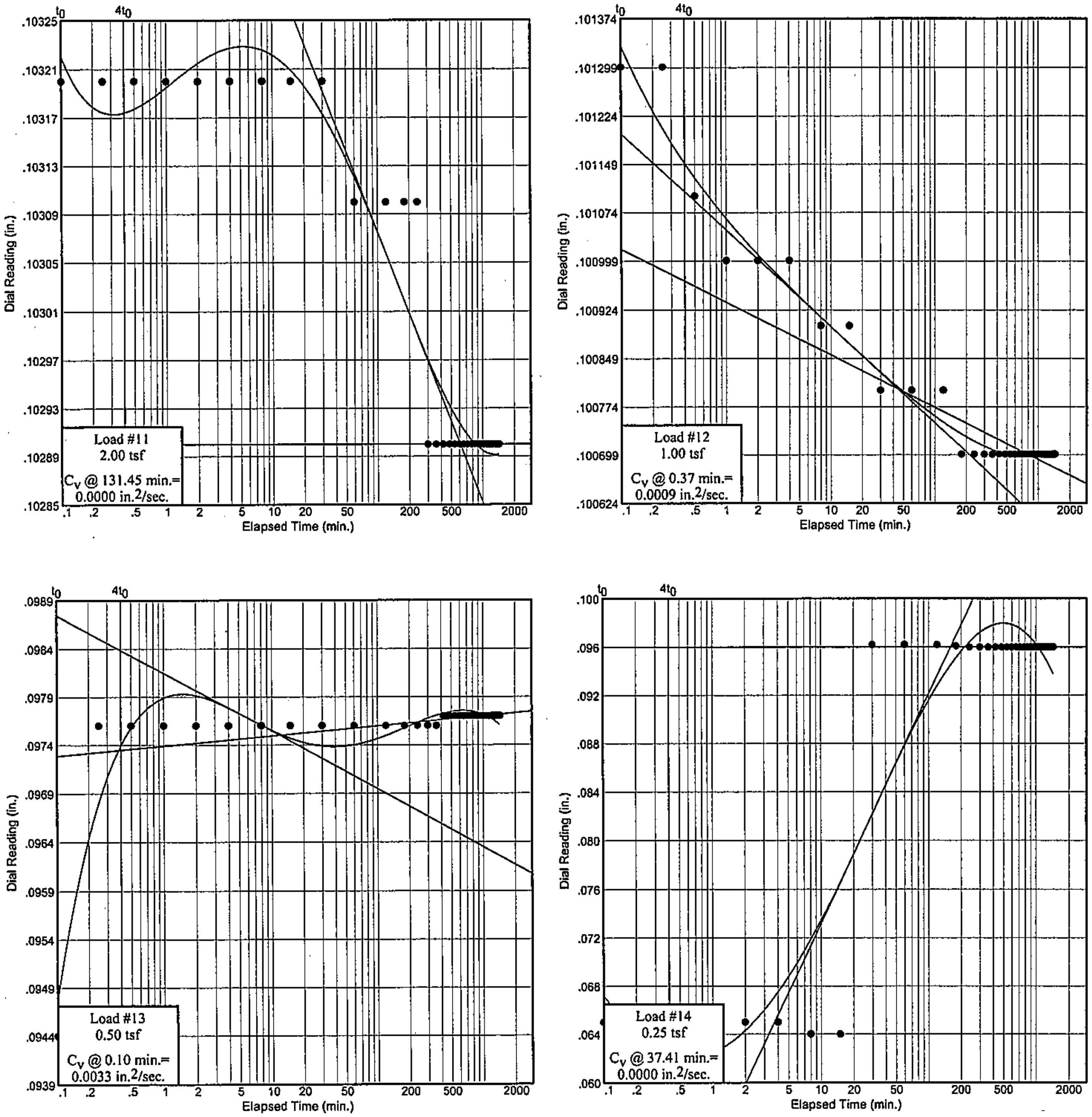
DLZ

Figure

Dial Reading vs. Time

Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-35A Sample No.: P-4B Elev./Depth: 66.9



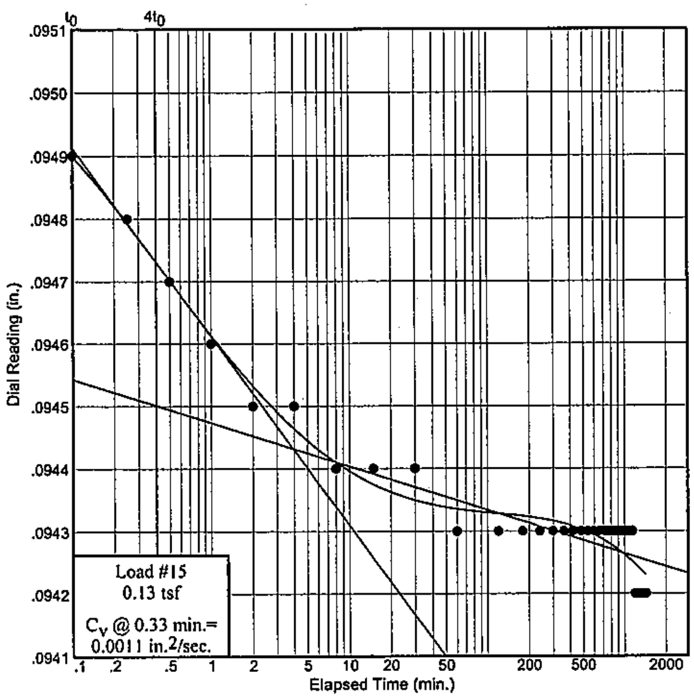
DLZ

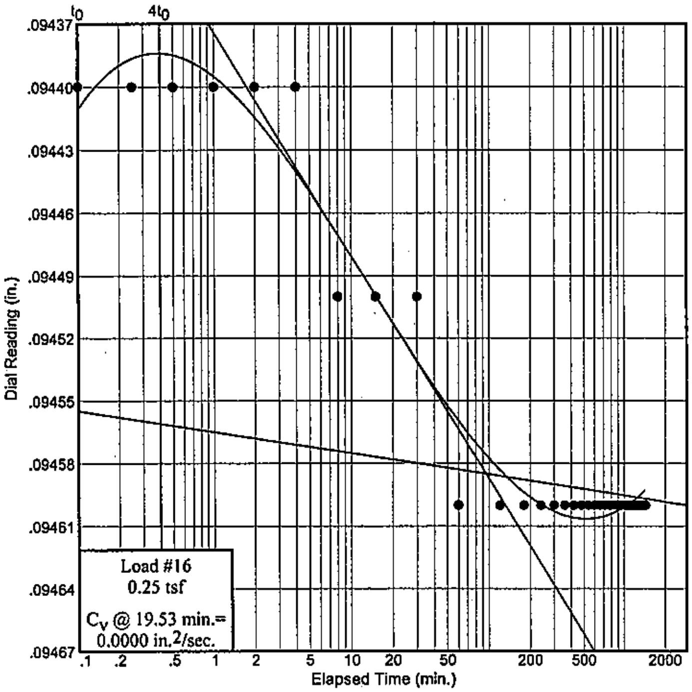
Figure

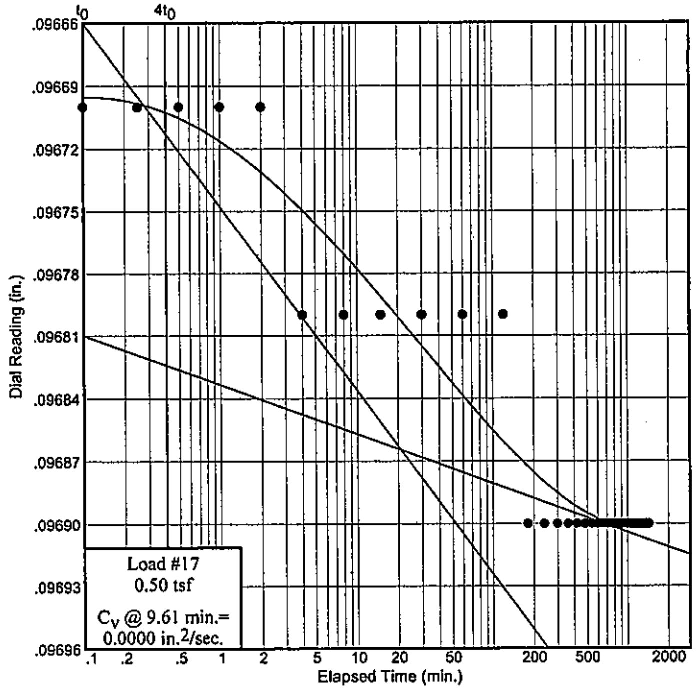
Dial Reading vs. Time

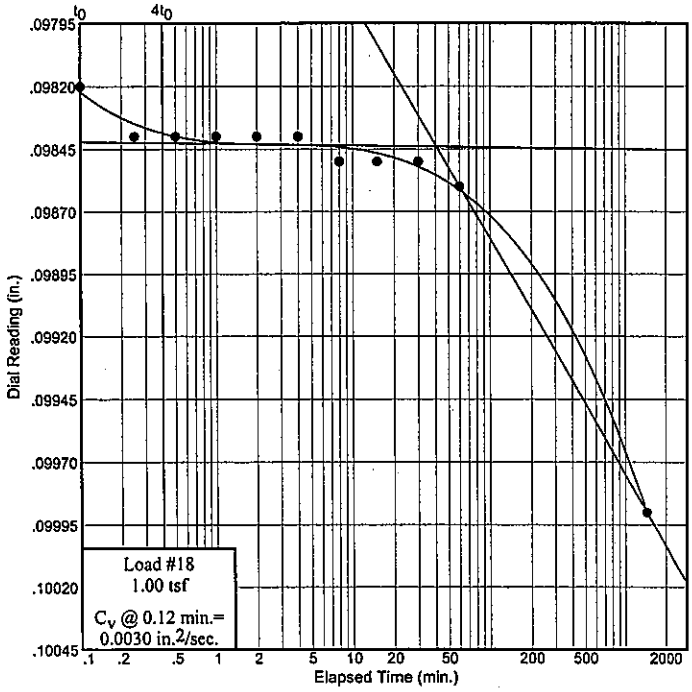
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-35A Sample No.: P-4B Elev./Depth: 66.9



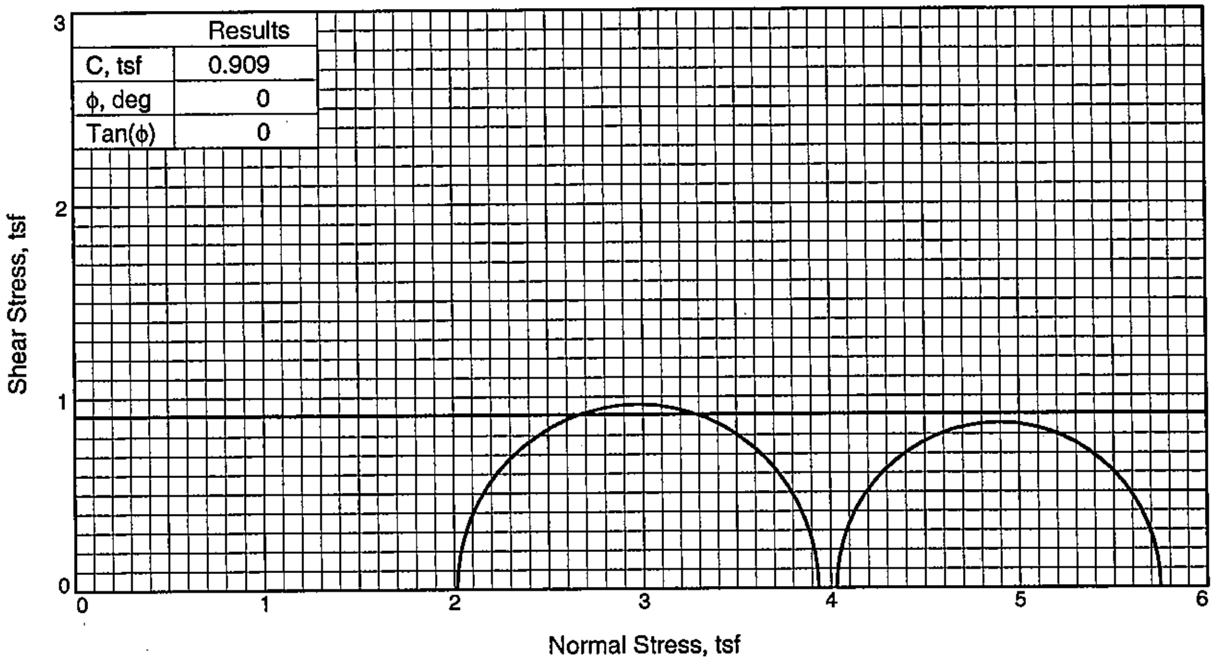




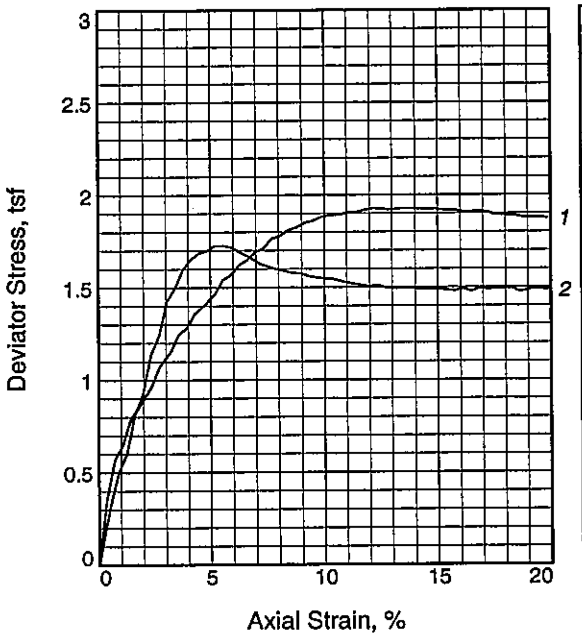


DLZ

Figure



	Results
C, tsf	0.909
ϕ, deg	0
Tan(ϕ)	0



	Sample No.	1	2
Initial	Water Content,	25.6	25.5
	Dry Density, pcf	97.5	97.3
	Saturation,	94.9	93.9
	Void Ratio	0.7291	0.7330
	Diameter, in.	2.85	2.85
	Height, in.	5.59	5.58
At Test	Water Content,	27.0	27.1
	Dry Density, pcf	97.5	97.3
	Saturation,	100.0	100.0
	Void Ratio	0.7291	0.7330
	Diameter, in.	2.85	2.85
	Height, in.	5.59	5.58
	Strain rate, in./min.		0.06
	Back Pressure, tsf	0.00	0.00
	Cell Pressure, tsf	2.02	4.03
	Fail. Stress, tsf	1.92	1.72
	Ult. Stress, tsf	1.92	1.72
	σ_1 Failure, tsf	3.93	5.75
	σ_3 Failure, tsf	2.02	4.03

Type of Test:
Unconsolidated Undrained

Sample Type: Press Tube

Description: Lean clay

LL= 35 **PL=** 22 **PI=** 13

Assumed Specific Gravity= 2.7

Remarks:

Figure ________

Client: TranSystems, Inc.

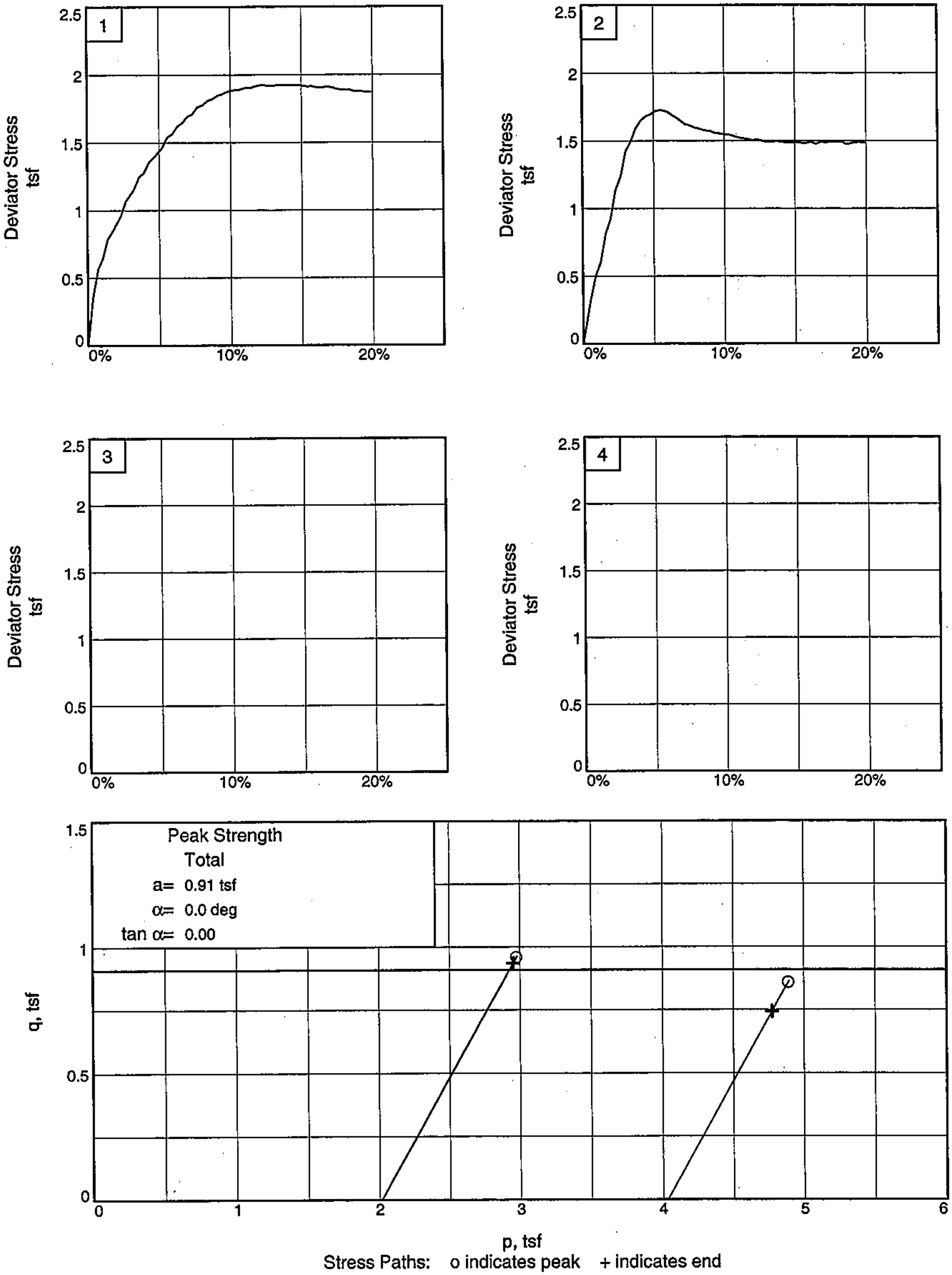
Project: SCI-823-0.00

Source of Sample: TR-38A **Depth:** 5.0

Sample Number: P-1

Proj. No.: 0121-3070.03 **Date:** 1/31/06

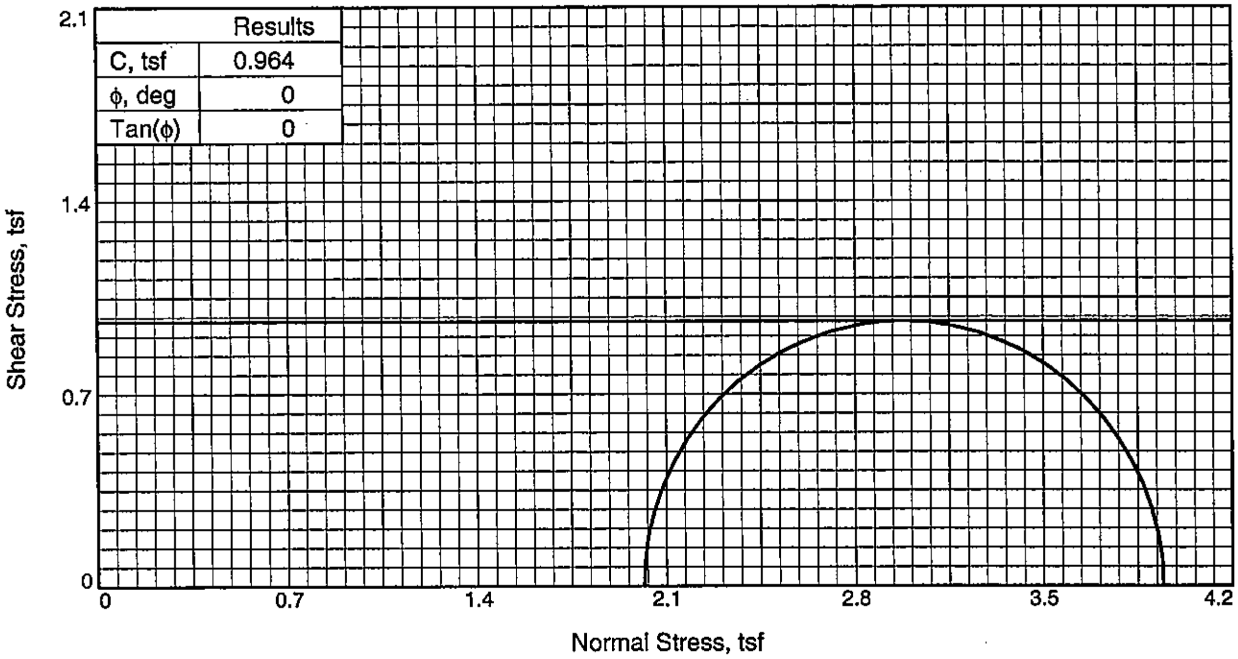
DLZ



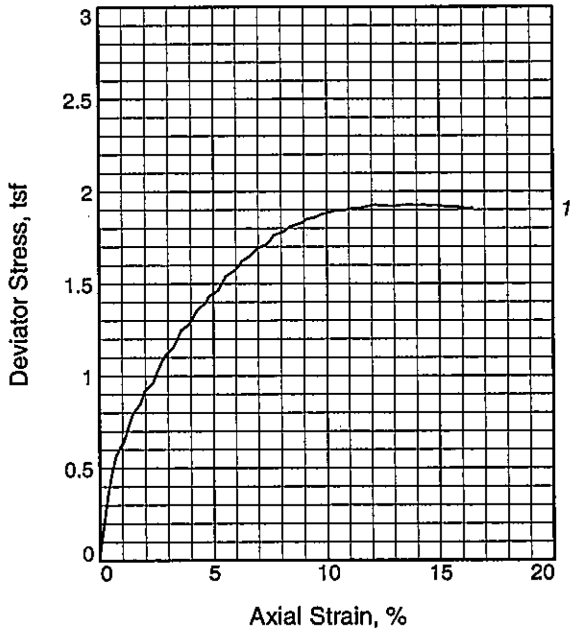
Peak Strength
Total
a= 0.91 tsf
α= 0.0 deg
tan α= 0.00

Client: TranSystems, Inc.
Project: SCI-823-0.00
Source of Sample: TR-38A **Depth:** 5.0 **Sample Number:** P-1
Project No.: 0121-3070.03 **Figure** ________

DLZ, INC.



Results	
C, tsf	0.964
ϕ, deg	0
Tan(ϕ)	0



Sample No.		1
Initial	Water Content,	25.6
	Dry Density, pcf	97.5
	Saturation,	92.6
	Void Ratio	0.7611
	Diameter, in.	2.85
	Height, in.	5.59
At Test	Water Content,	27.7
	Dry Density, pcf	97.5
	Saturation,	100.0
	Void Ratio	0.7611
	Diameter, in.	2.85
	Height, in.	5.59
Strain rate, in./min.		0.06
Back Pressure, tsf		0.00
Cell Pressure, tsf		2.02
Fail. Stress, tsf		1.93
Ult. Stress, tsf		
σ_1 Failure, tsf		3.94
σ_3 Failure, tsf		2.02

Type of Test:
Unconsolidated Undrained

Sample Type: 3" press tube

Description: Lean clay

LL= 43 **PL=** 24 **PI=** 19

Assumed Specific Gravity= 2.75

Remarks:

Figure ________

Client: TranSystems, Inc.

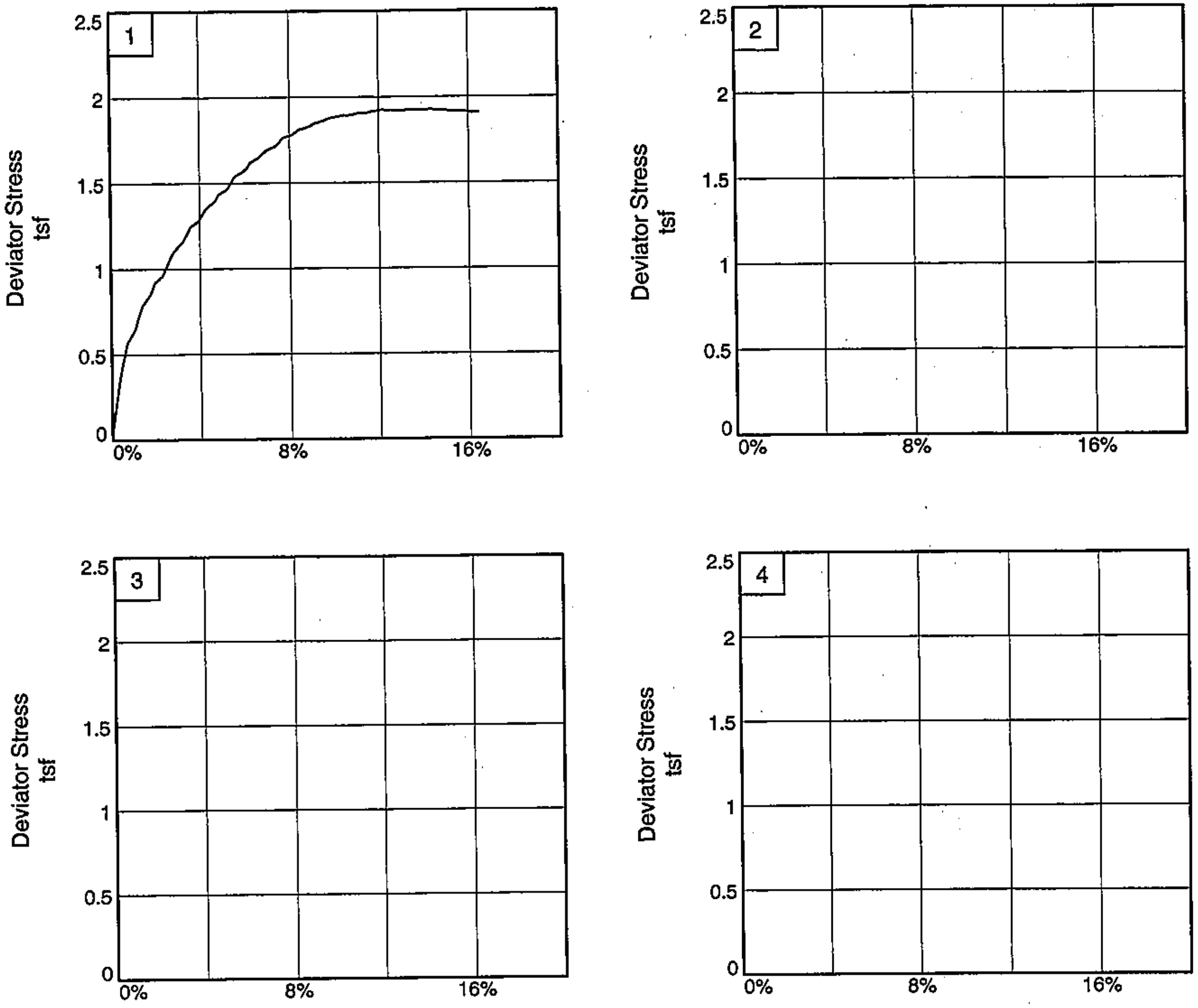
Project: SCI-823-0.00

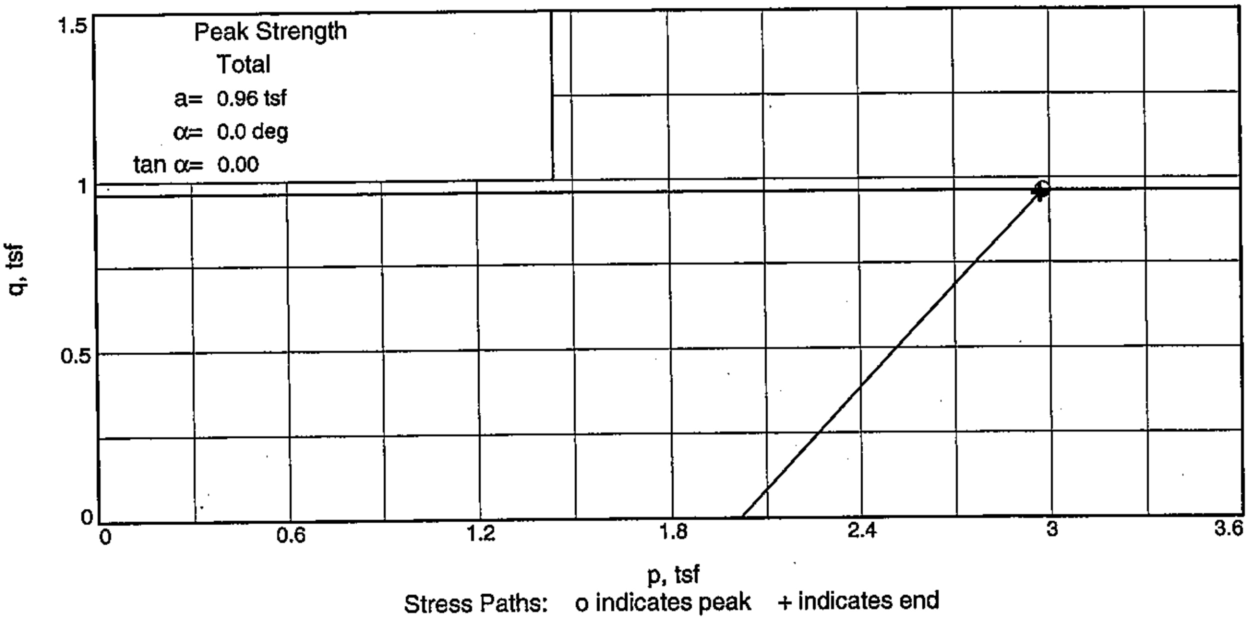
Source of Sample: TR-38A **Depth:** 8.5

Sample Number: 3

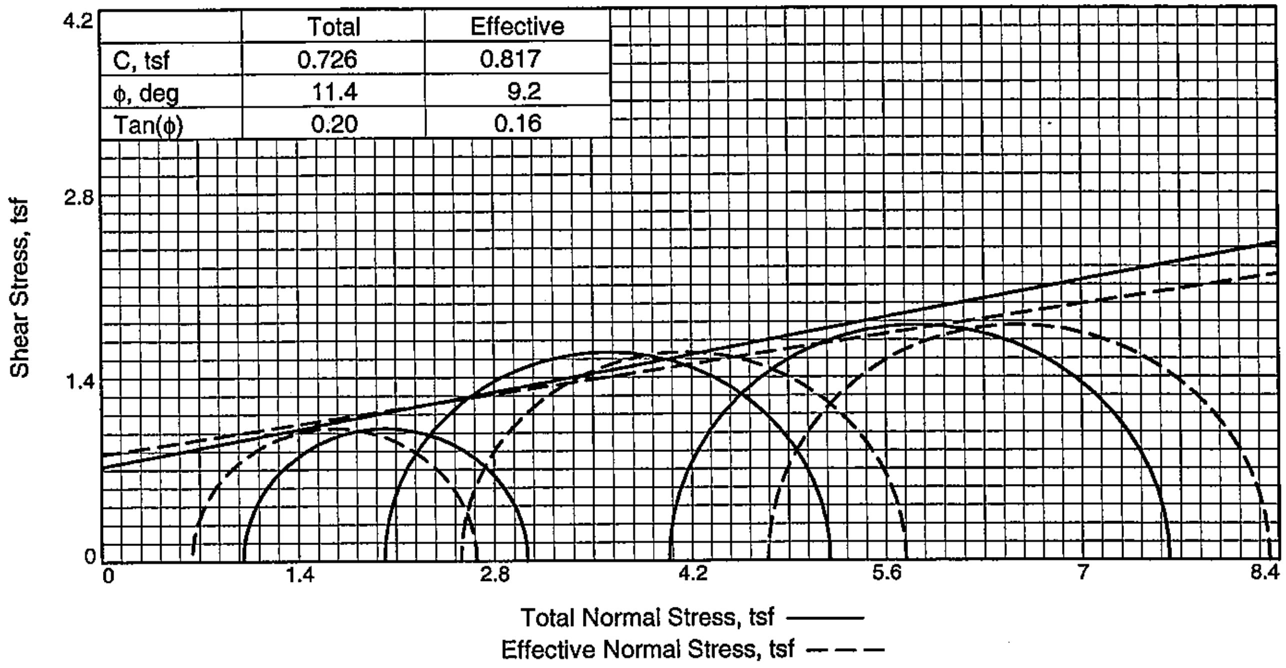
Proj. No.: 0121-3070.03 **Date:** 2/8/06

DLZ

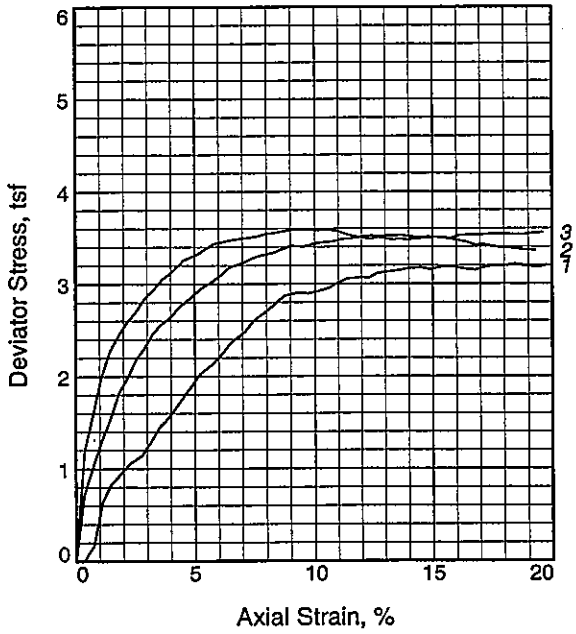




Client: TranSystems, Inc.
Project: SCI-823-0.00
Source of Sample: TR-38A
Depth: 8.5
Sample Number: 3
Project No.: 0121-3070.03
Figure ______
DLZ, INC.



	Total	Effective
C, tsf	0.726	0.817
ϕ, deg	11.4	9.2
Tan(ϕ)	0.20	0.16



	Sample No.	1	2	3
Initial	Water Content,	28.8	28.0	26.2
	Dry Density, pcf	96.9	96.7	98.4
	Saturation,	102.7	99.1	96.7
	Void Ratio	0.7711	0.7754	0.7454
	Diameter, in.	2.87	2.85	2.84
	Height, in.	5.37	5.55	5.51
At Test	Water Content,	28.0	28.2	27.1
	Dry Density, pcf	96.9	96.7	98.4
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.7711	0.7754	0.7454
	Diameter, in.	2.87	2.85	2.84
	Height, in.	5.37	5.55	5.51
	Strain rate, in./min.	0.06	0.06	0.06
	Back Pressure, tsf	4.03	4.03	4.03
	Cell Pressure, tsf	5.04	6.05	8.06
	Fail. Stress, tsf	2.03	3.18	3.59
	Total Pore Pr., tsf	4.39	3.49	3.32
	Ult. Stress, tsf	2.03	3.18	3.59
	Total Pore Pr., tsf	4.39	3.49	3.32
	$\bar{\sigma}_1$ Failure, tsf	2.67	5.74	8.33
	$\bar{\sigma}_3$ Failure, tsf	0.65	2.56	4.75

Type of Test:
CU with Pore Pressures

Sample Type: 3" Press Tube

Description:

Assumed Specific Gravity= 2.75

Remarks:

Figure ________

Client: TranSystems, Inc.

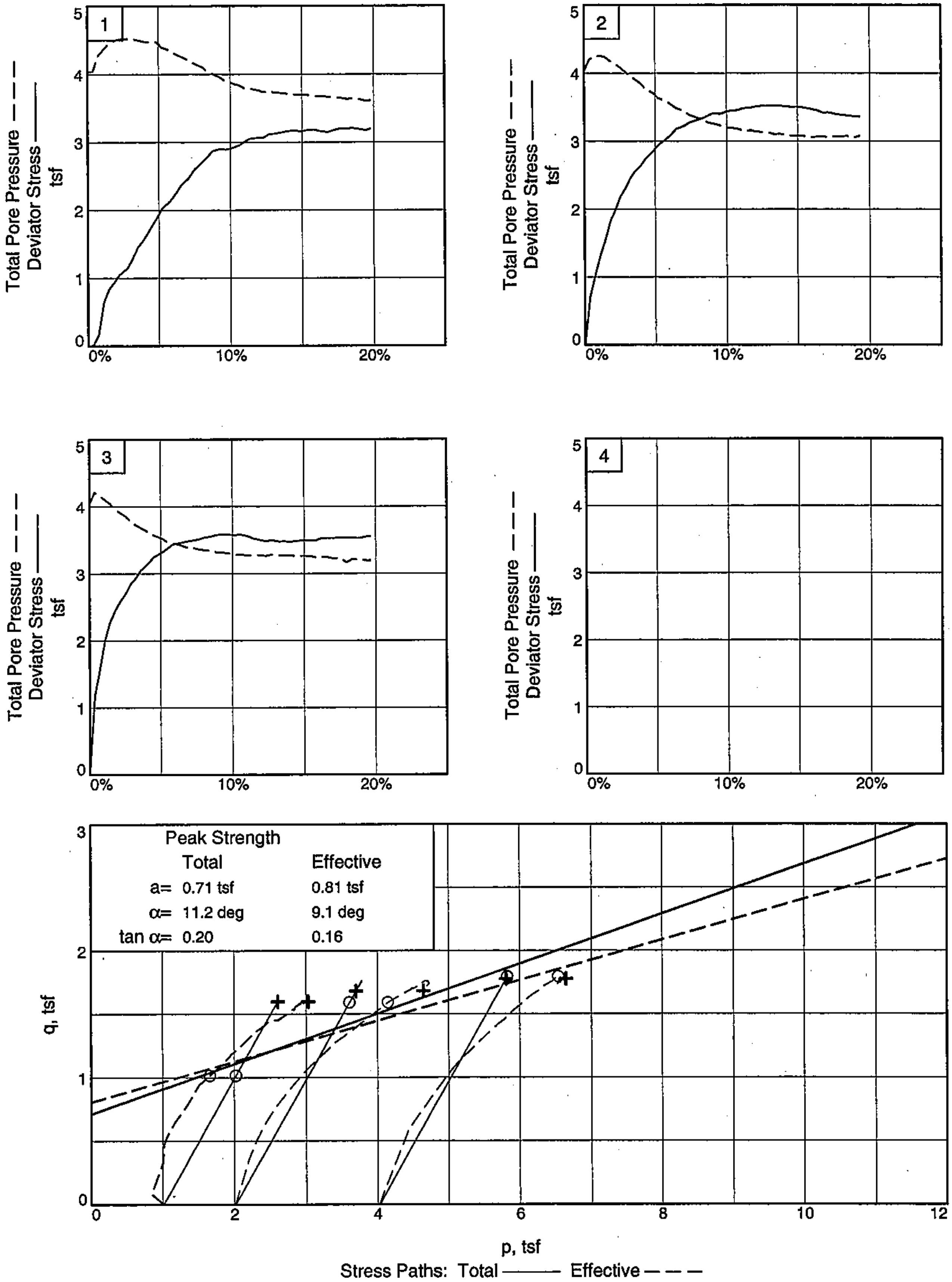
Project: SCI-823-0.00

Source of Sample: TR-38A **Depth:** 20.0

Sample Number: P-3A

Proj. No.: 0121-3070.03 **Date:**

DLZ



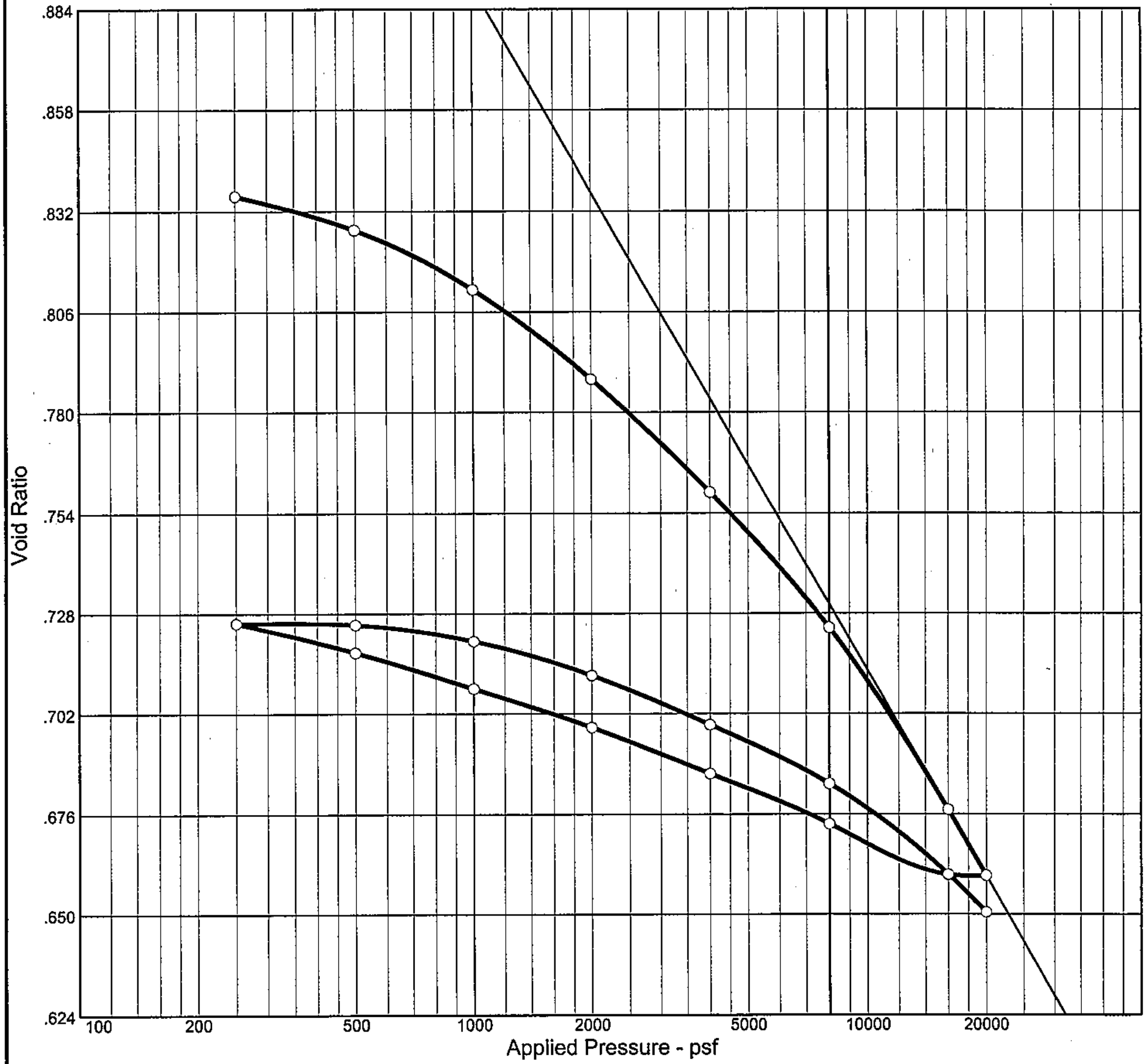
Peak Strength

	Total	Effective
a=	0.71 tsf	0.81 tsf
α=	11.2 deg	9.1 deg
tan α=	0.20	0.16

Client: TranSystems, Inc.
Project: SCI-823-0.00
Source of Sample: TR-38A
Depth: 20.0
Sample Number: P-3A
Project No.: 0121-3070.03
Figure ________

DLZ, INC.

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
88.6 %	26.8 %	94.1	30	8	2.77	CL	A-4(8)	0.838

MATERIAL DESCRIPTION

Lean clay

Project No. 0121- **Client:** TranSystems, Inc.

Project: SCI-823-0.00

Source: TR-38A **Sample No.:** P-2B **Elev./Depth:** 15.7

DLZ

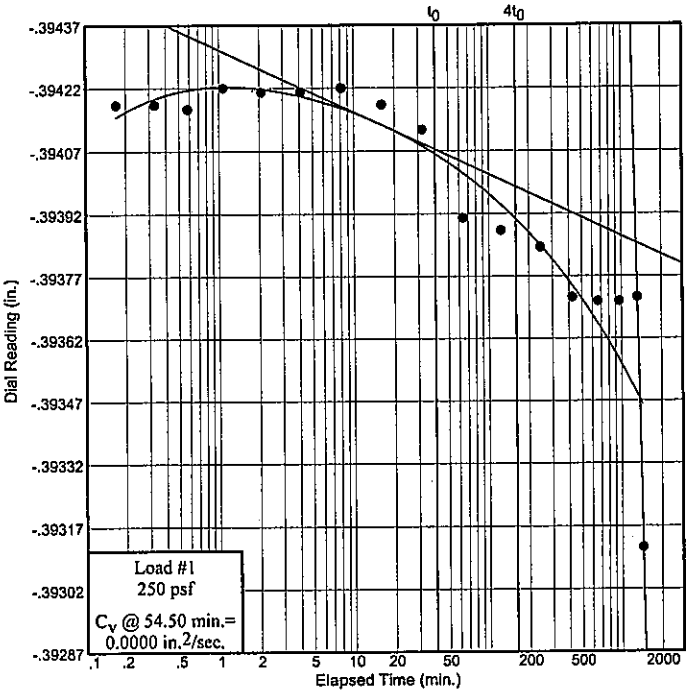
Remarks:

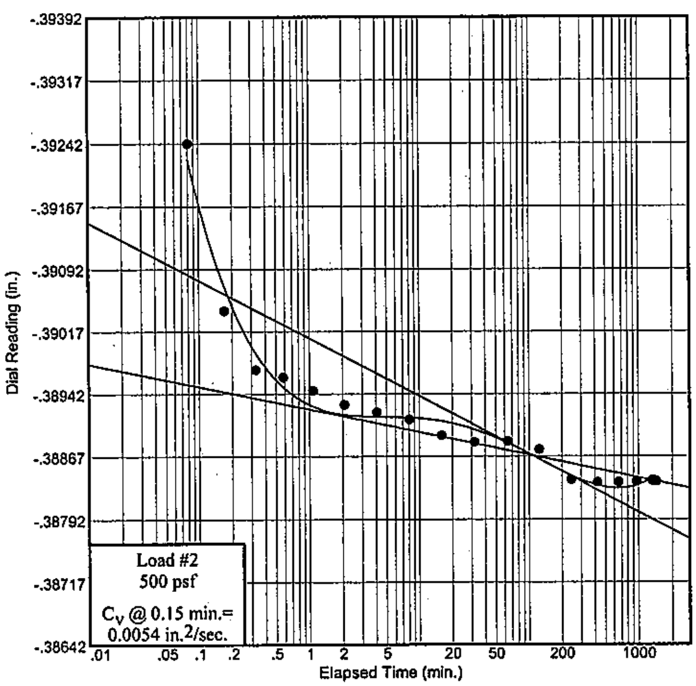
Figure

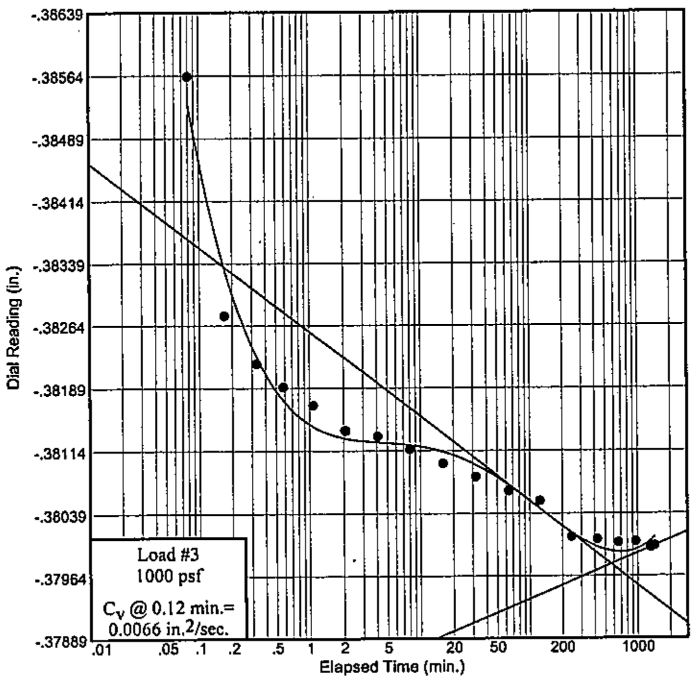
Dial Reading vs. Time

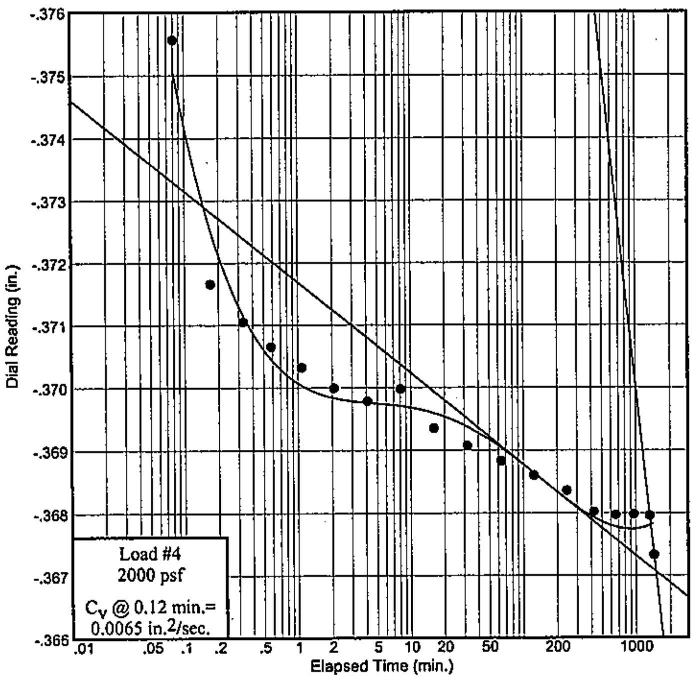
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-38A Sample No.: P-2B Elev./Depth: 15.7









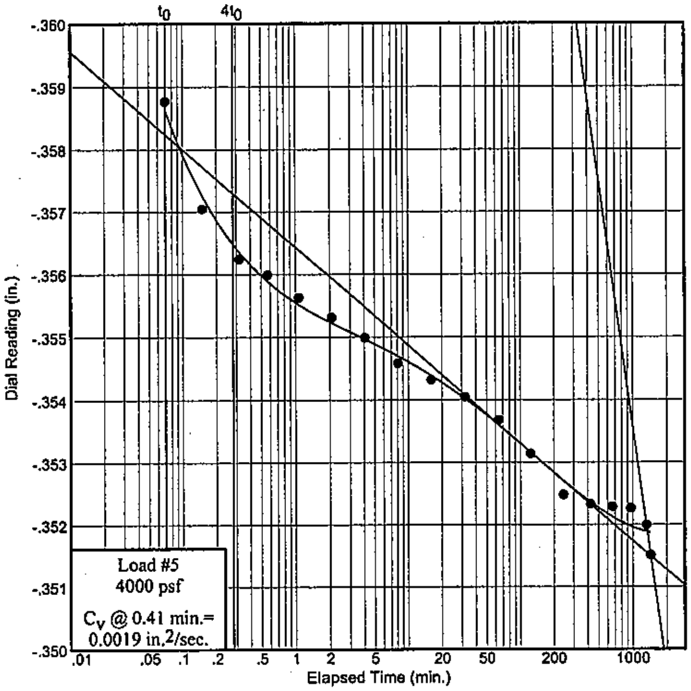
DLZ

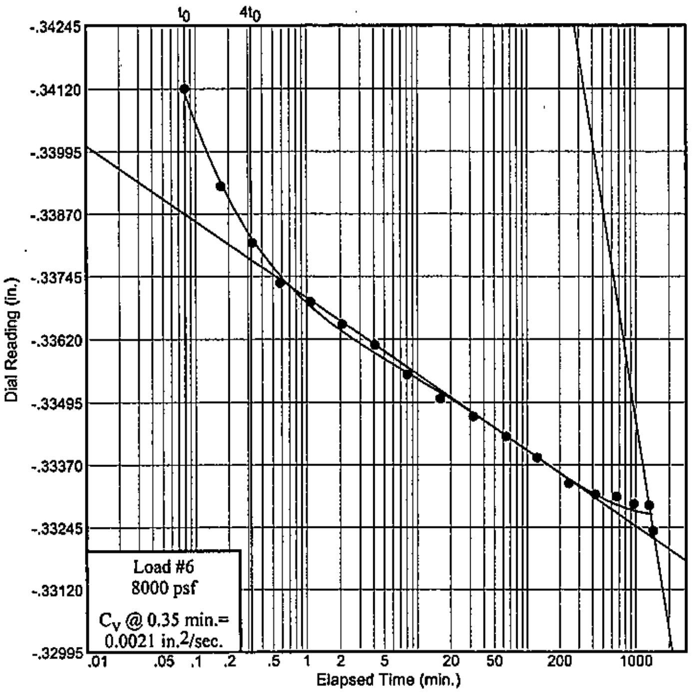
Figure

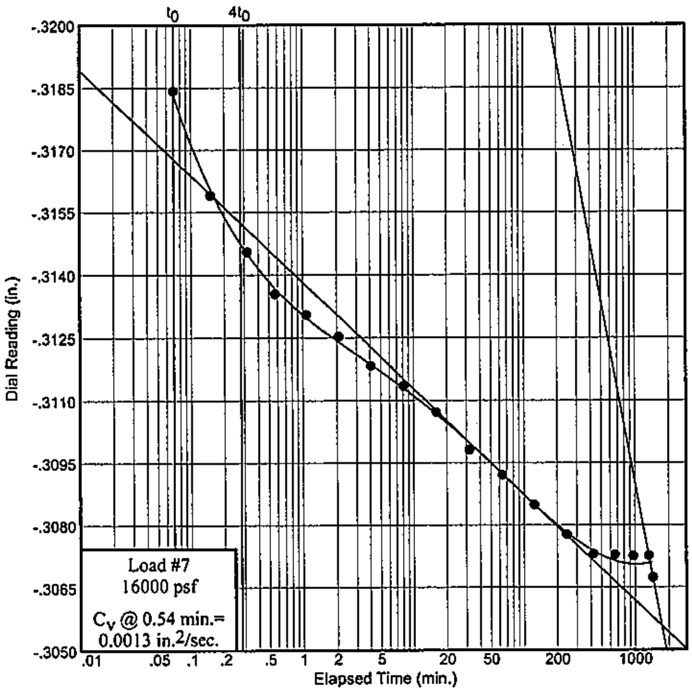
Dial Reading vs. Time

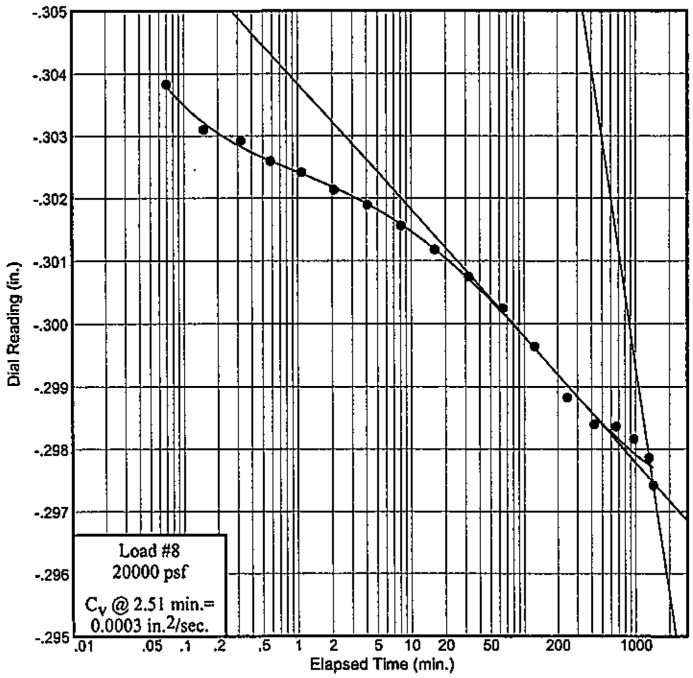
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-38A Sample No.: P-2B Elev./Depth: 15.7









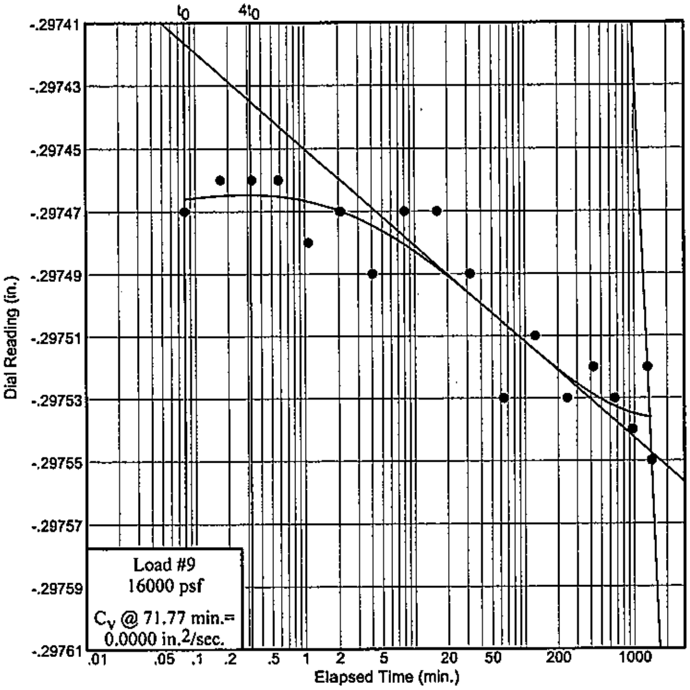
DLZ

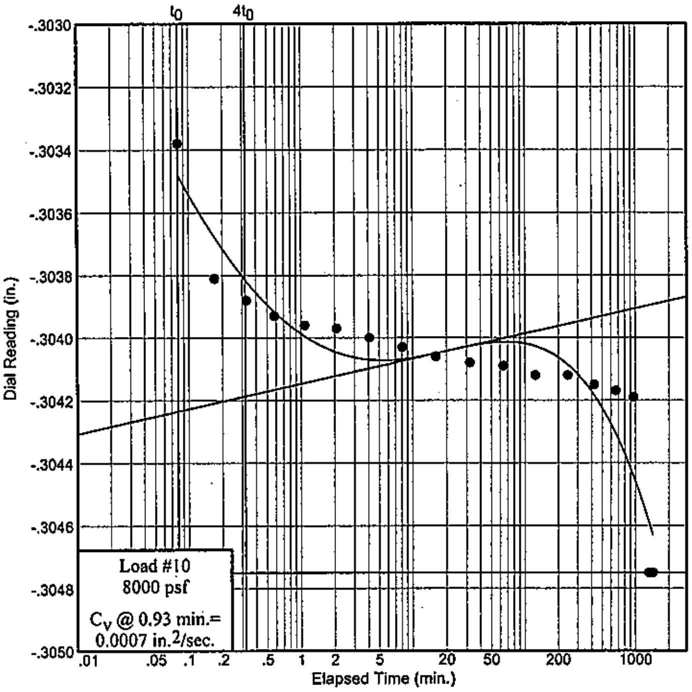
Figure

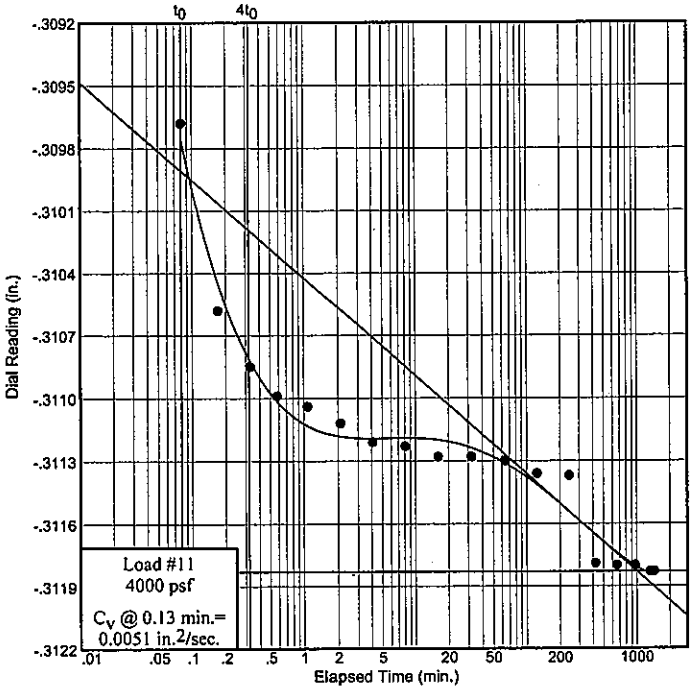
Dial Reading vs. Time

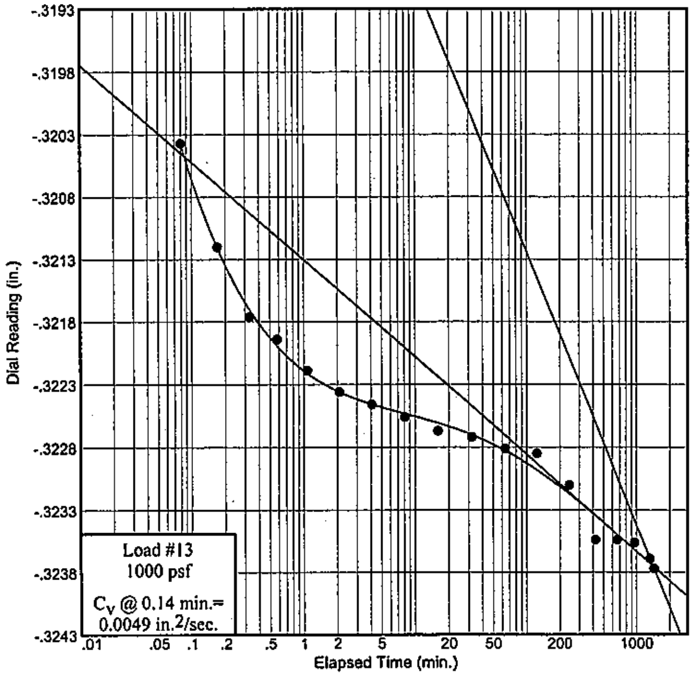
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-38A
Sample No.: P-2B
Elev./Depth: 15.7









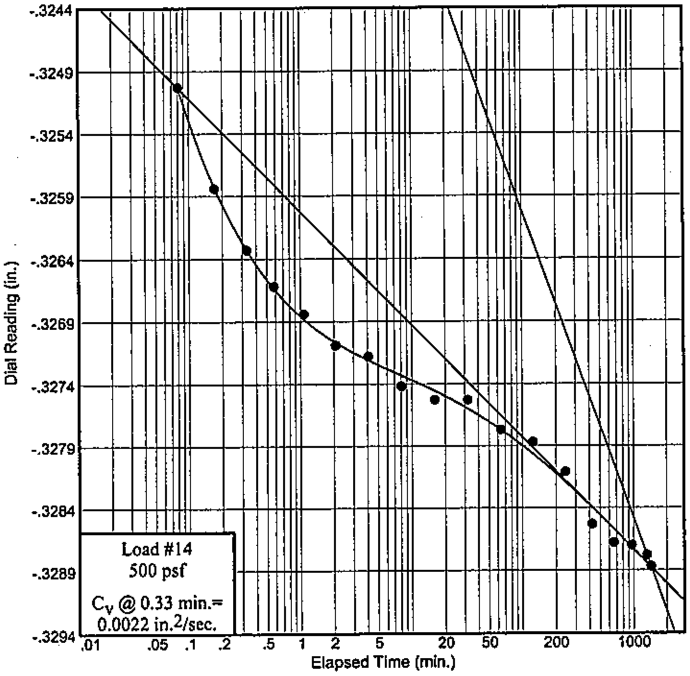
DLZ

Figure

Dial Reading vs. Time

Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-38A Sample No.: P-2B Elev./Depth: 15.7


Load #14
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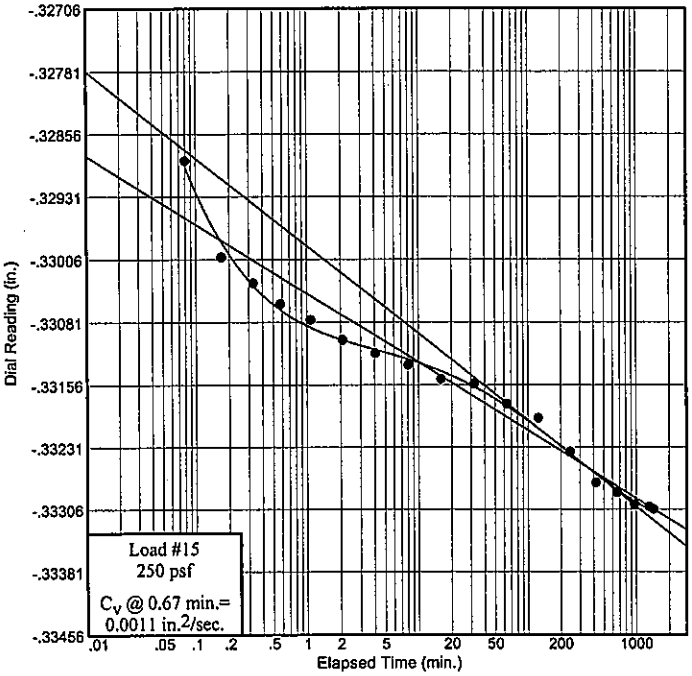
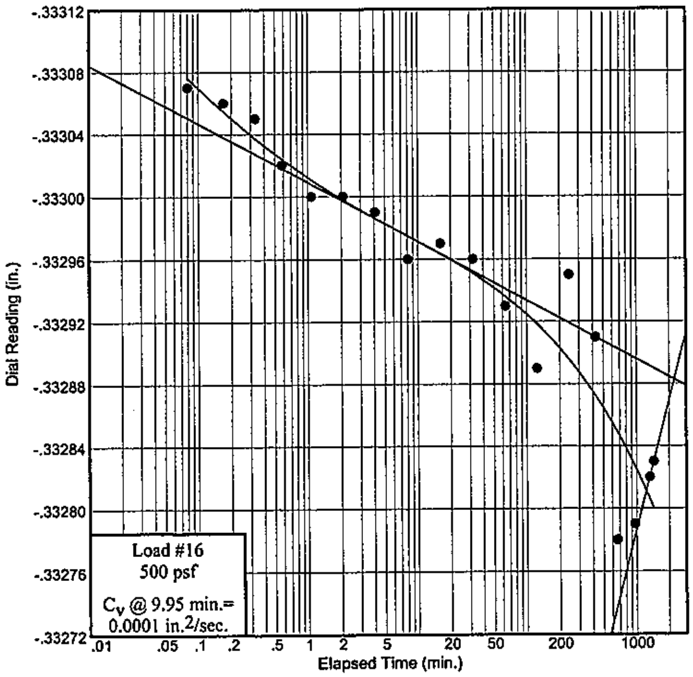
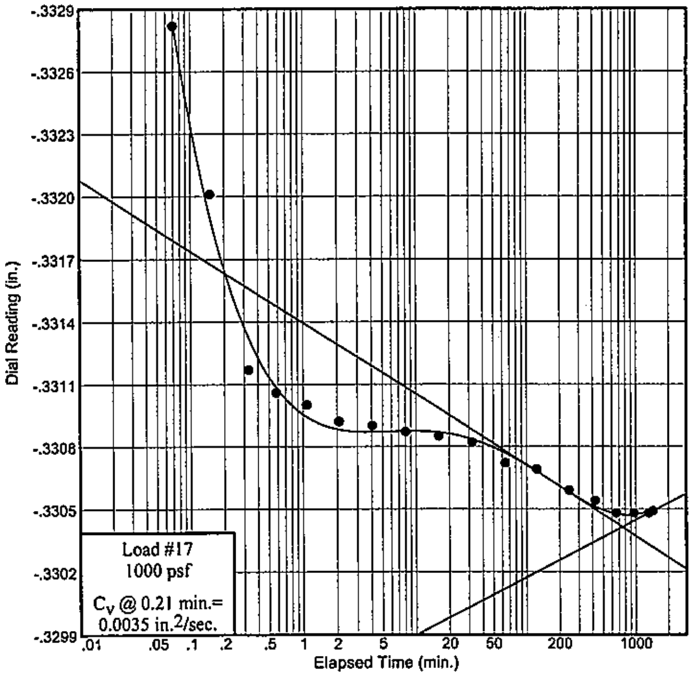
C_v @ 0.33 min.=
0.0022 in.^{2}/sec.


Load #15
250 psf
C_v @ 0.67 min.=
0.0011 in.^{2}/sec.


Load #16
500 psf
C_v @ 9.95 min.=
0.0001 in.^{2}/sec.


Load #17
1000 psf
C_v @ 0.21 min.=
0.0035 in.^{2}/sec.

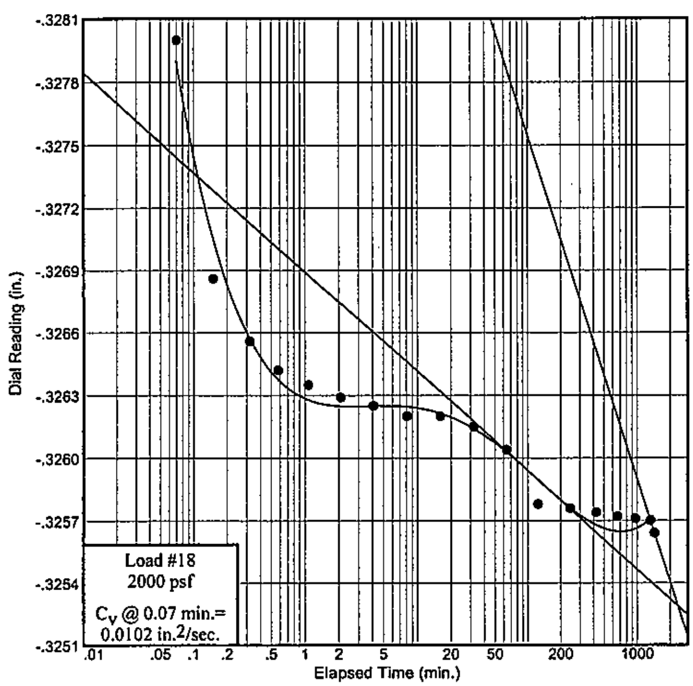
DLZ

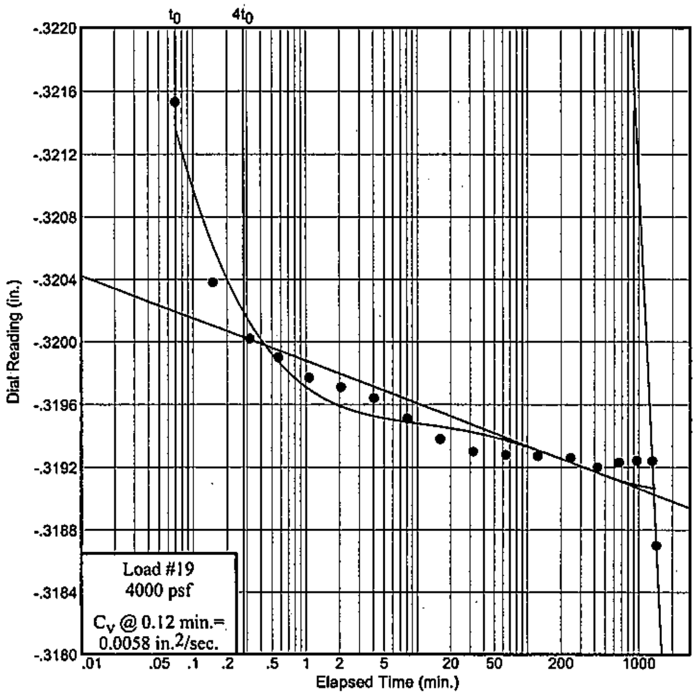
Figure

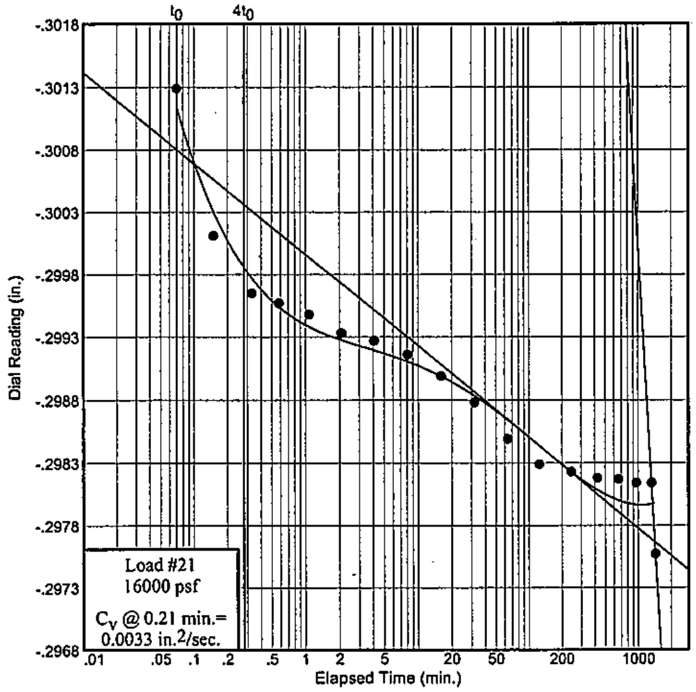
Dial Reading vs. Time

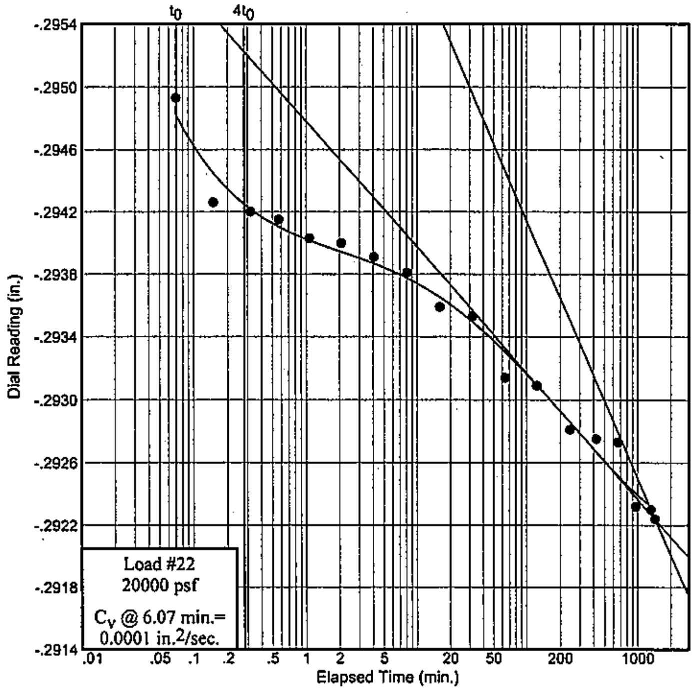
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-38A
Sample No.: P-2B
Elev./Depth: 15.7





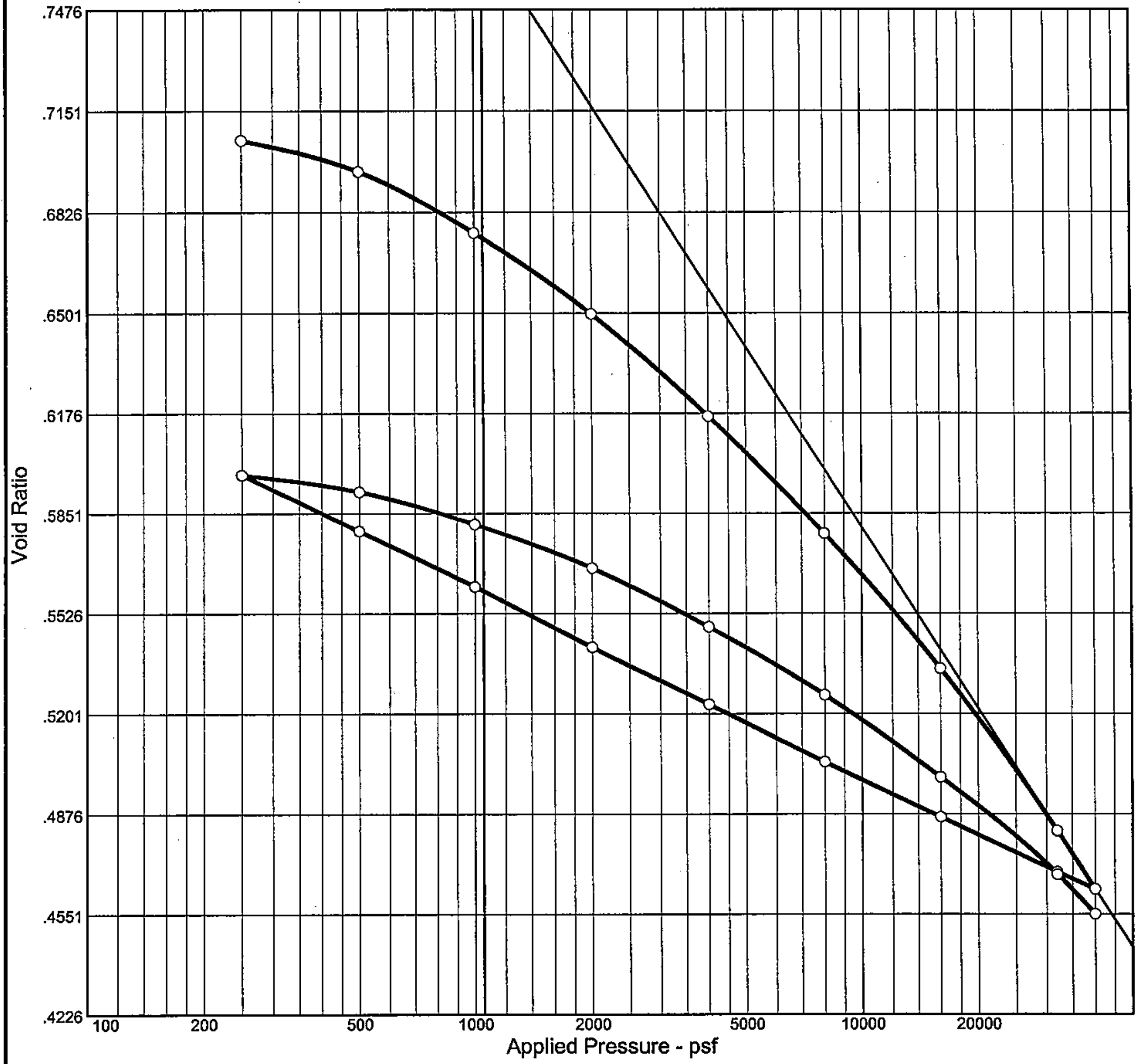




DLZ

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
88.1 %	22.5 %	101.0	38	15	2.76	CL	A-6(17)	0.706

MATERIAL DESCRIPTION

Project No. 0121-

Client: TranSystems, Inc.

Project: SCI-823-0.00

Source: TR-38A

Sample No.: P-4B

Elev./Depth: 45.8

DLZ

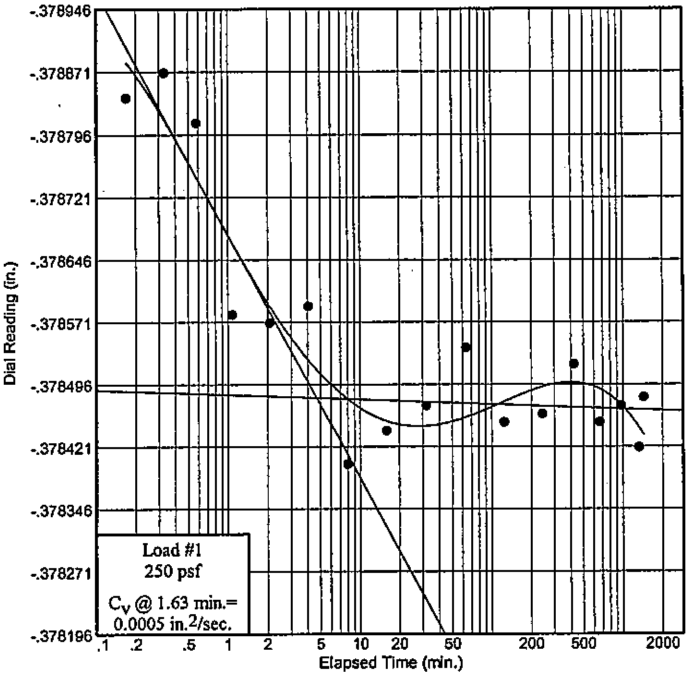
Remarks:

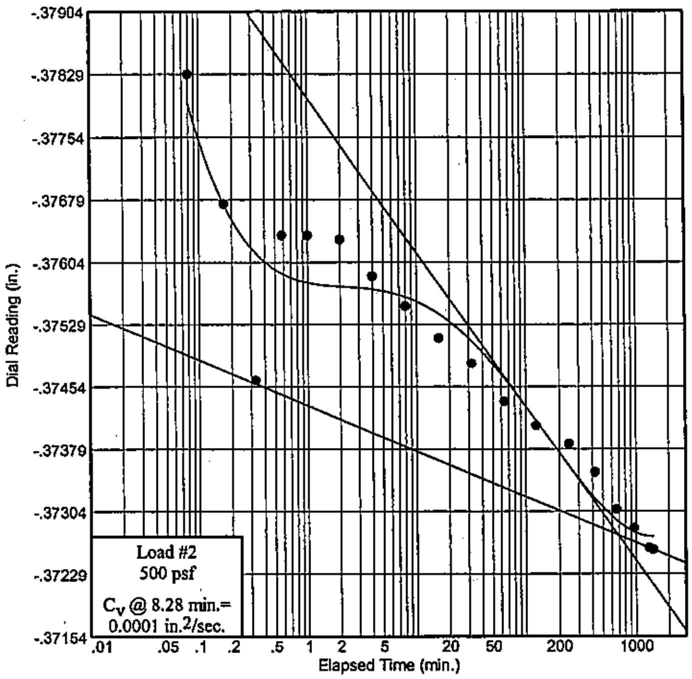
Figure

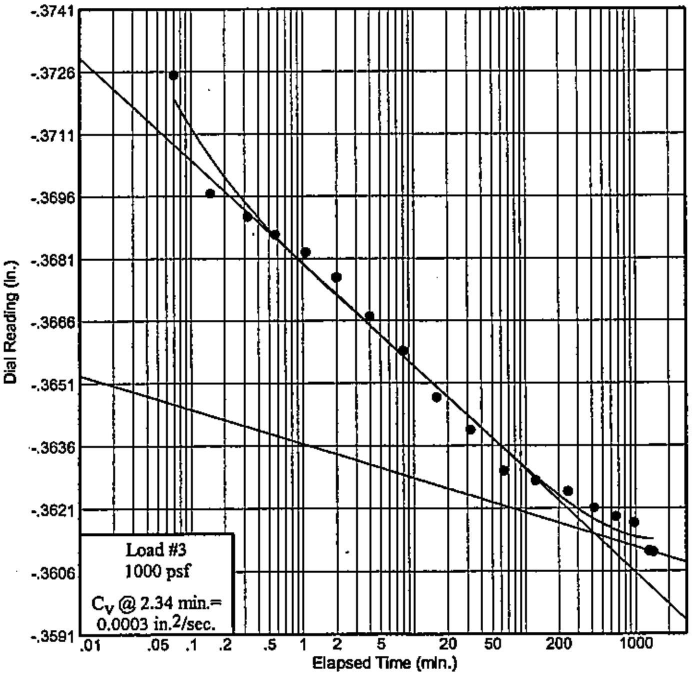
Dial Reading vs. Time

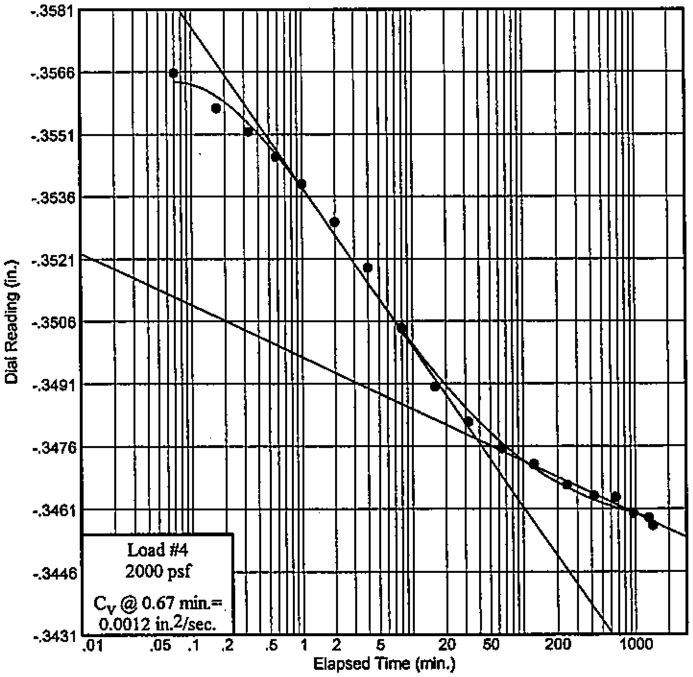
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-38A   Sample No.: P-4B   Elev./Depth: 45.8





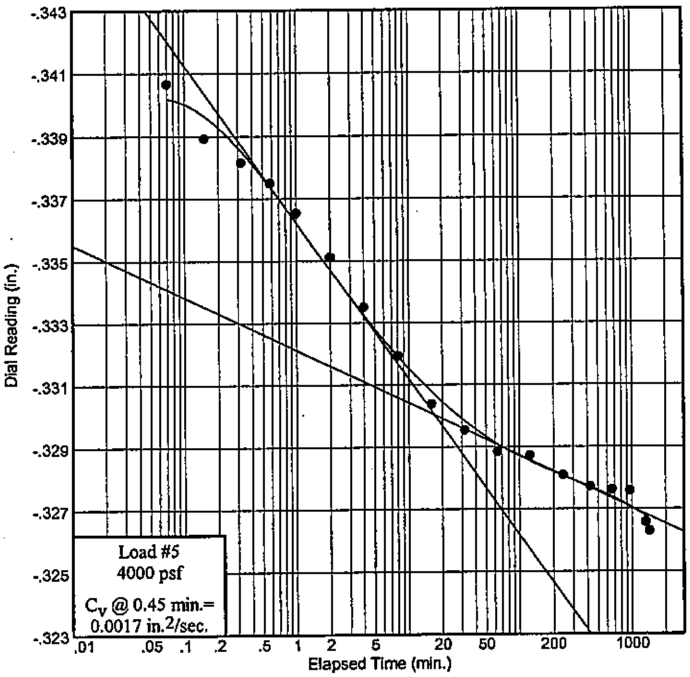


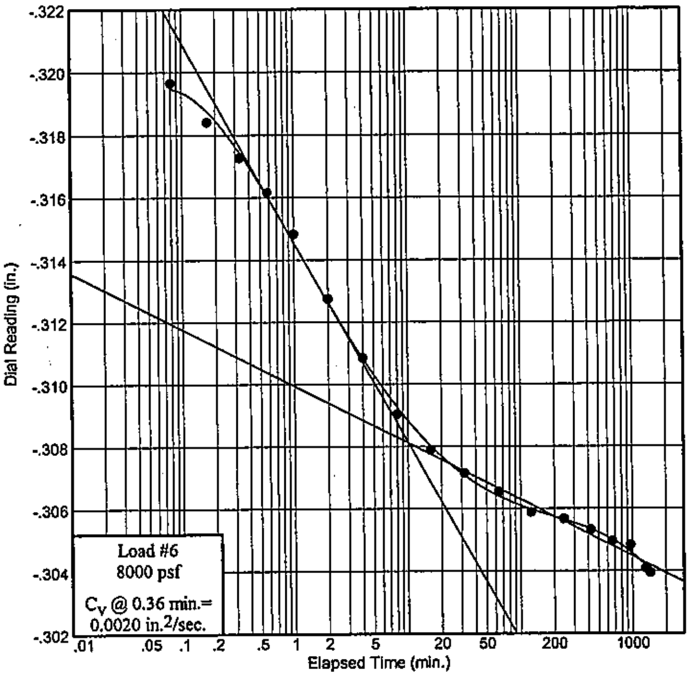


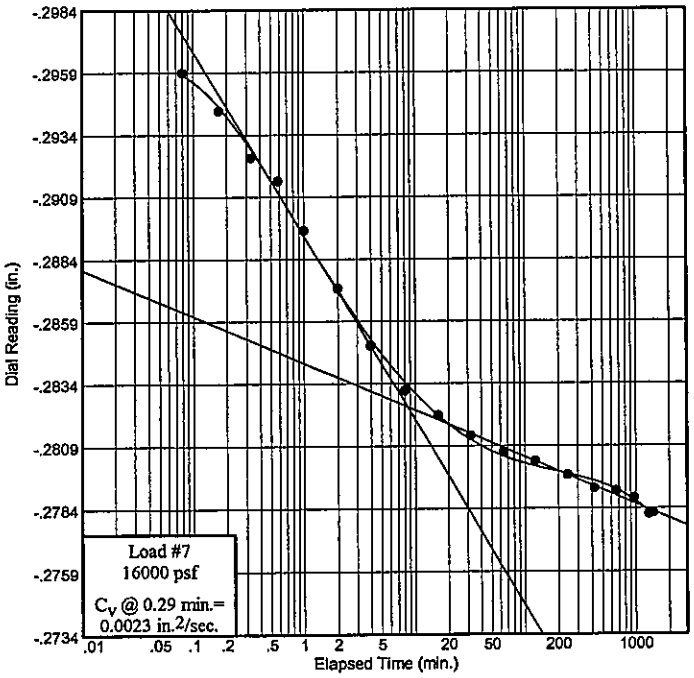
Dial Reading vs. Time

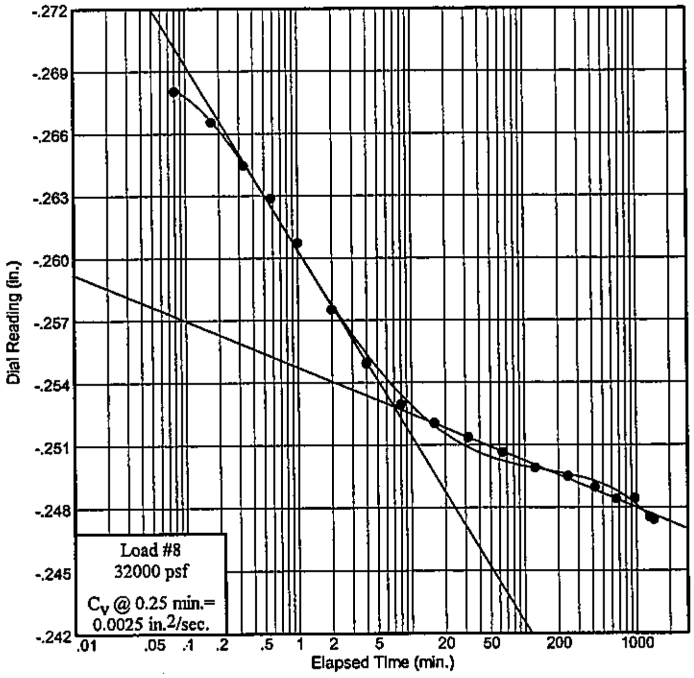
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-38A **Sample No.:** P-4B **Elev./Depth:** 45.8









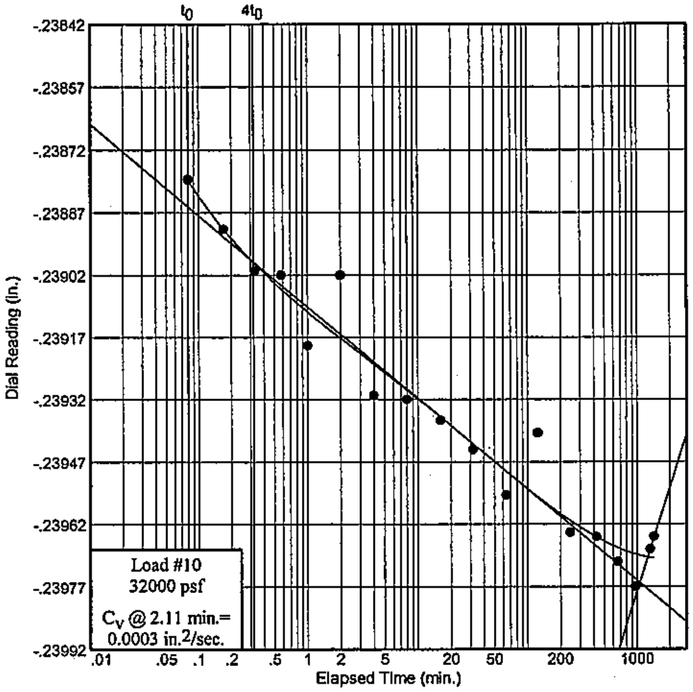
DLZ

Figure

Dial Reading vs. Time

Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-38A Sample No.: P-4B Elev./Depth: 45.8



Load #10
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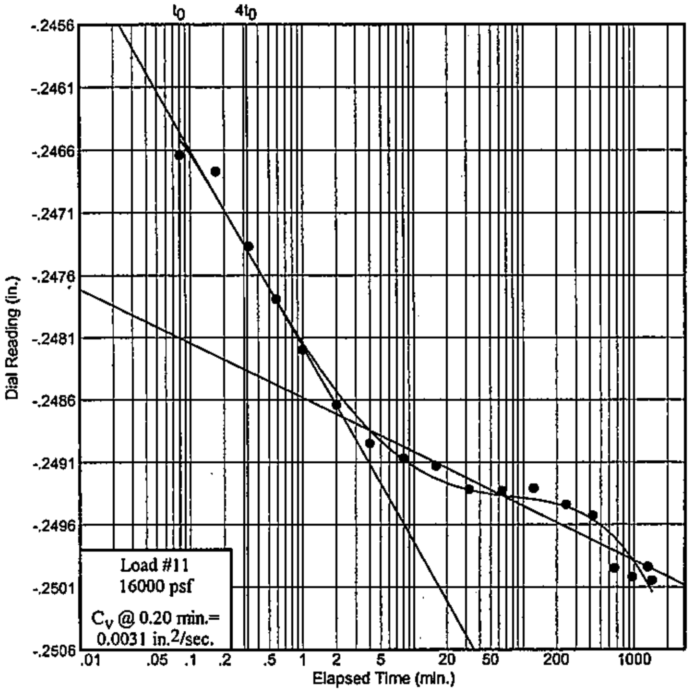
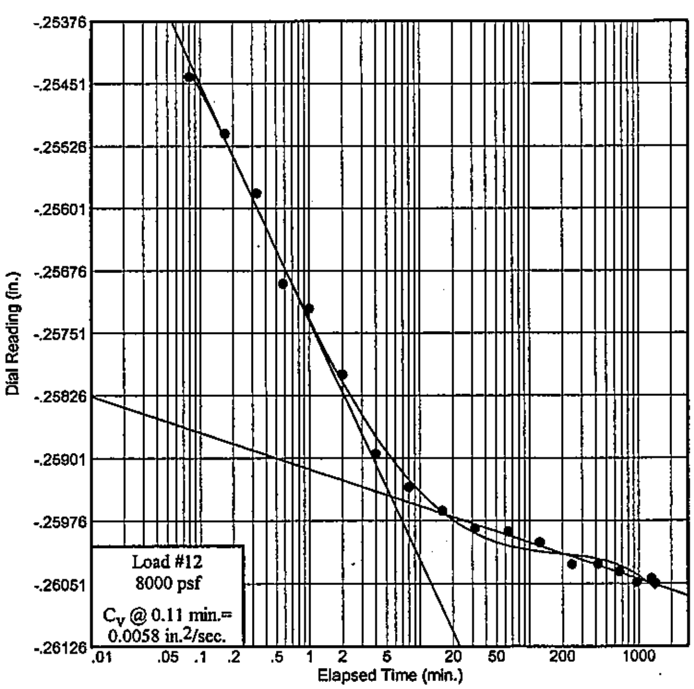


Load #11
16000 psf
C_V @ 0.20 min.=
0.0031 in.^{2}/sec.



Load #12
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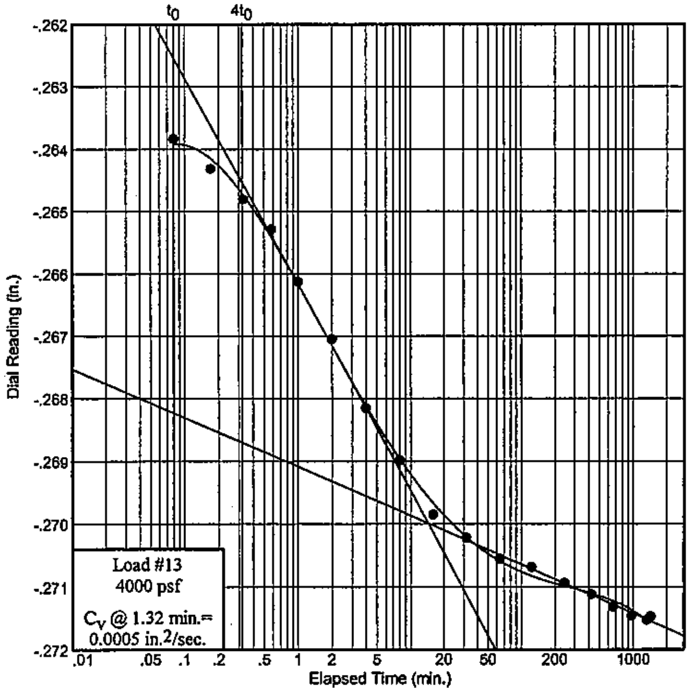
0.0058 in.^{2}/sec.



Load #13
4000 psf
C_V @ 1.32 min.=
0.0005 in.^{2}/sec.

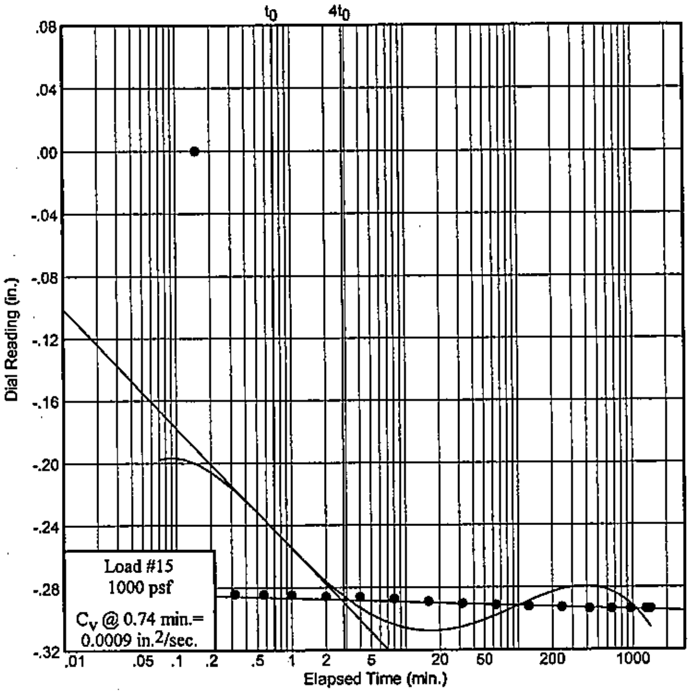
DLZ

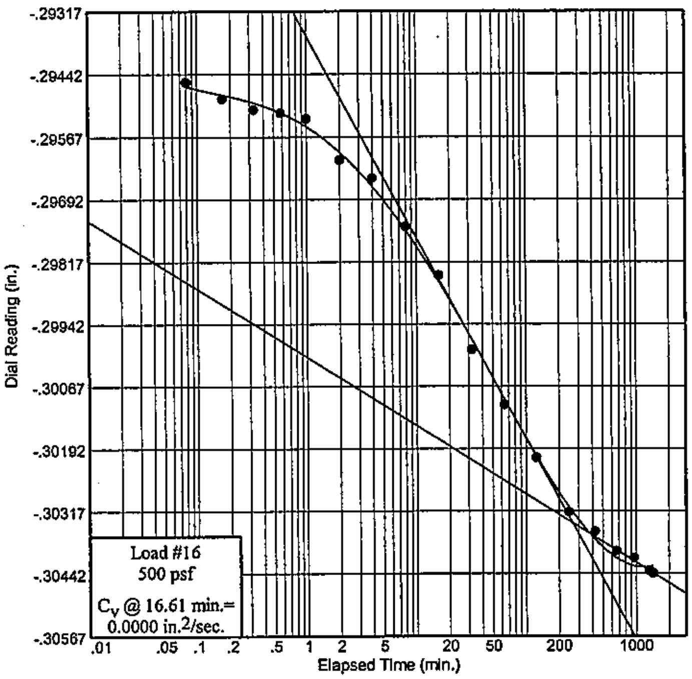
Figure

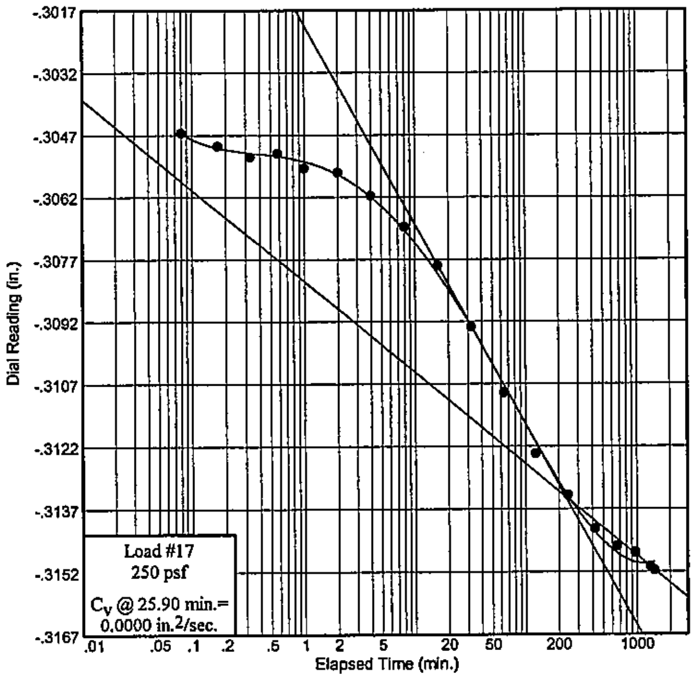
Dial Reading vs. Time

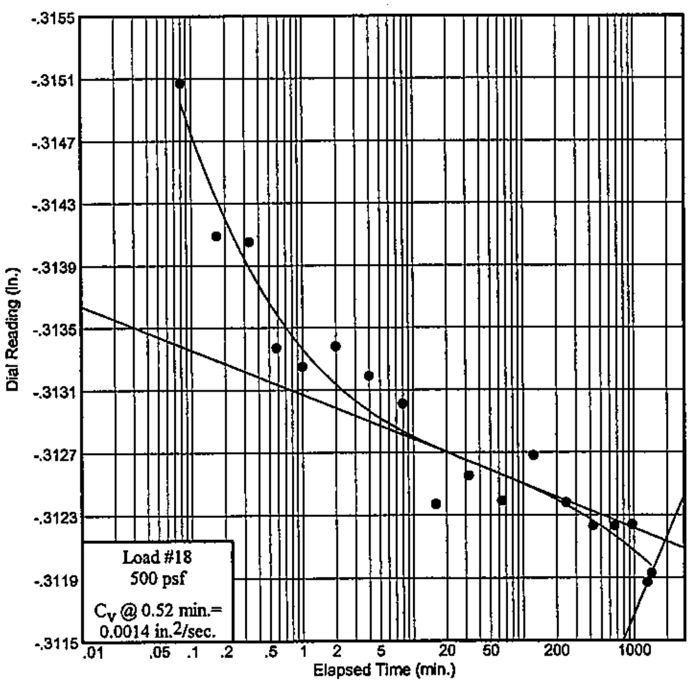
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-38A　　Sample No.: P-4B　　Elev./Depth: 45.8









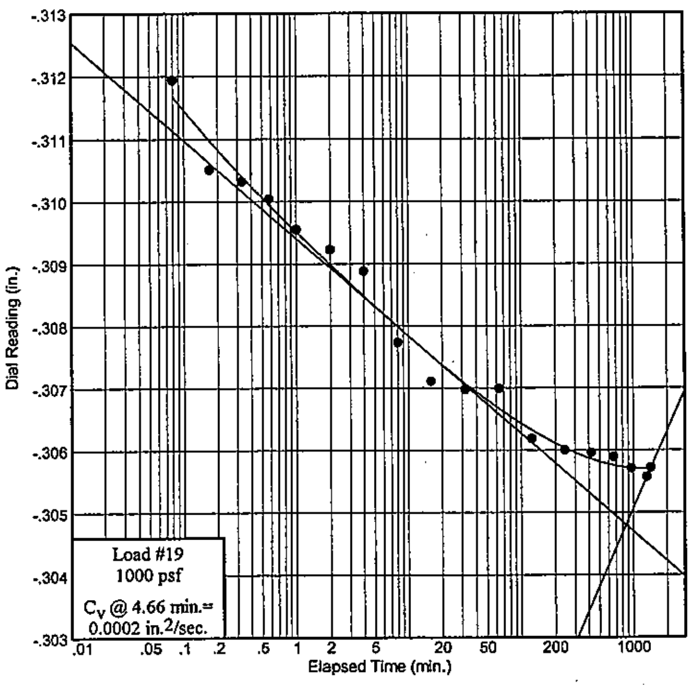
DLZ

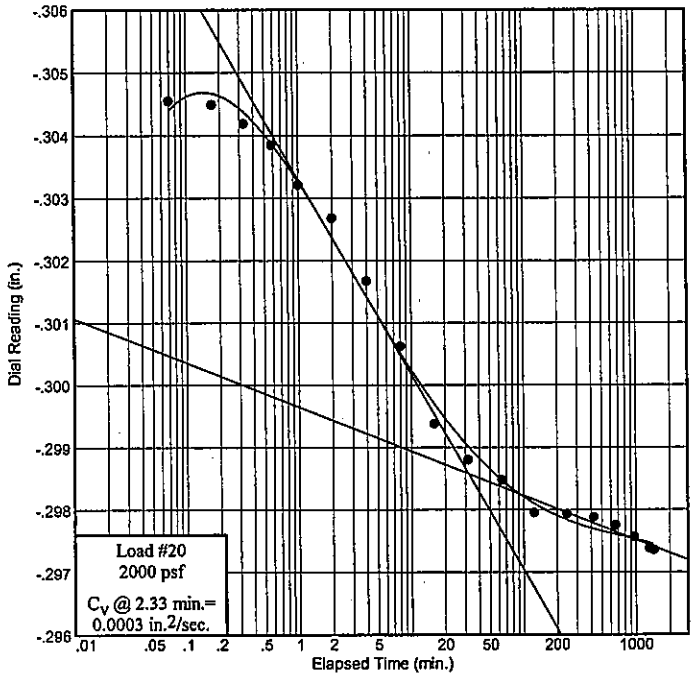
Figure

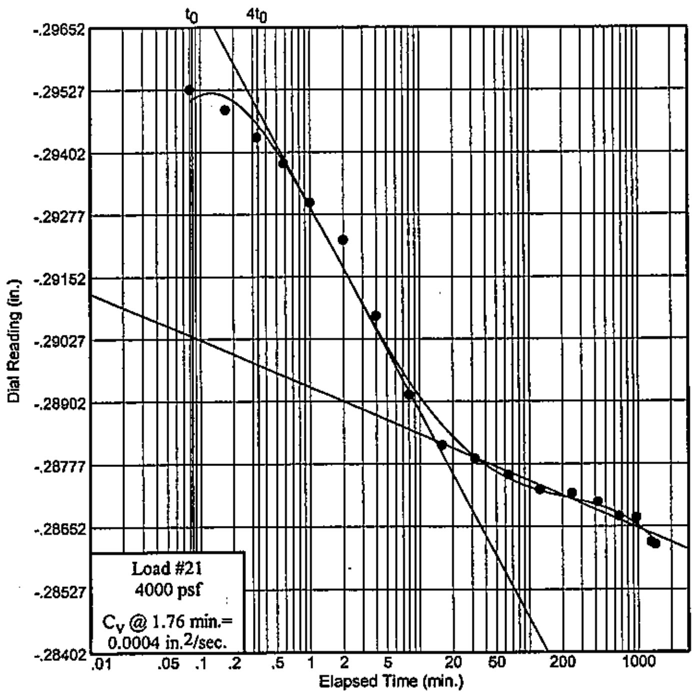
Dial Reading vs. Time

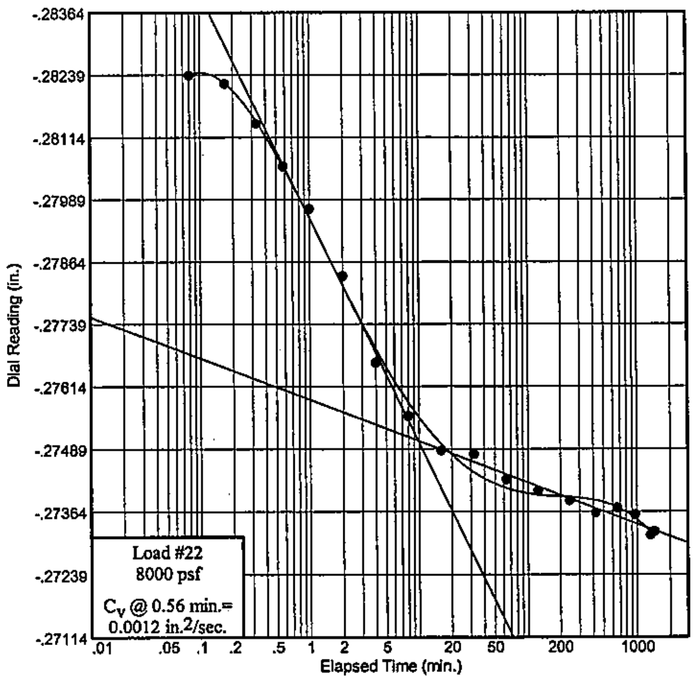
Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-38A   Sample No.: P-4B   Elev./Depth: 45.8







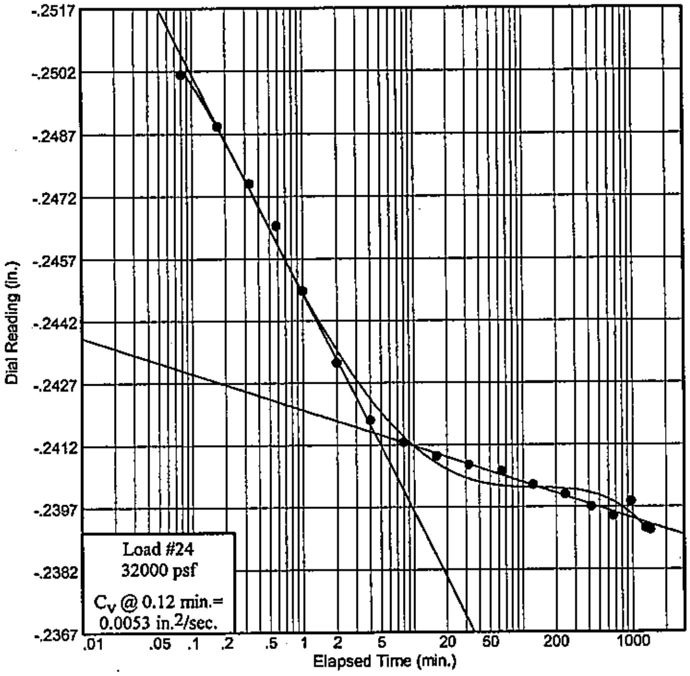


Figure

Dial Reading vs. Time

Project No.: 0121-3070.03
Project: SCI-823-0.00

Source: TR-38A Sample No.: P-4B Elev./Depth: 45.8



DLZ

Figure

APPENDIX IV

Driven-Pile Analysis
Settlement Calculations
Slope Stability Analysis
MSE Wall Analyses

Driven-Pile Analyses for Pile Foundations

Driven Piles (HP14 X73) Analyses

DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\REAR_A~1\TR-38HP.DVN
Project Name: Slocum Ave- TR-38 Project Date: 09/05/2007
Project Client: TranSystems/ODOT-9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: H Pile - HP14X73
Top of Pile: 5.00 ft
Perimeter Analysis: Box
Tip Analysis: Box Area

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	9.80 ft
	- Driving/Restrike	9.80 ft
	- Ultimate:	9.80 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	10.00 ft	0.00%	125.00 pcf	2812.00 psf	User Def.
2	Cohesive	23.00 ft	0.00%	120.00 pcf	1333.00 psf	User Def.
3	Cohesionless	5.00 ft	0.00%	120.00 pcf	32.0/32.0	Nordlund
4	Cohesive	22.00 ft	0.00%	130.00 pcf	3500.00 psf	User Def.
5	Cohesionless	8.00 ft	0.00%	125.00 pcf	32.0/32.0	Nordlund
6	Cohesionless	5.00 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund
7	Cohesionless	7.00 ft	0.00%	125.00 pcf	35.0/35.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	14.13 Kips
9.99 ft	Cohesive	N/A	N/A	750.00 psf	17.59 Kips
10.01 ft	Cohesive	N/A	N/A	1100.00 psf	17.67 Kips
19.01 ft	Cohesive	N/A	N/A	1100.00 psf	64.20 Kips
28.01 ft	Cohesive	N/A	N/A	1100.00 psf	110.72 Kips
32.99 ft	Cohesive	N/A	N/A	1100.00 psf	136.46 Kips
33.01 ft	Cohesionless	2562.61 psf	25.15	N/A	136.56 Kips
37.99 ft	Cohesionless	2706.03 psf	25.15	N/A	162.38 Kips
38.01 ft	Cohesive	N/A	N/A	1200.00 psf	162.49 Kips
47.01 ft	Cohesive	N/A	N/A	1200.00 psf	213.24 Kips
56.01 ft	Cohesive	N/A	N/A	1200.00 psf	263.99 Kips
59.99 ft	Cohesive	N/A	N/A	1200.00 psf	286.44 Kips
60.01 ft	Cohesionless	4337.83 psf	25.15	N/A	286.58 Kips
67.99 ft	Cohesionless	4587.61 psf	25.15	N/A	356.72 Kips
68.01 ft	Cohesionless	4838.61 psf	23.58	N/A	356.89 Kips
72.99 ft	Cohesionless	4982.03 psf	23.58	N/A	396.06 Kips
73.01 ft	Cohesionless	5126.63 psf	27.51	N/A	396.26 Kips
79.99 ft	Cohesionless	5345.11 psf	27.51	N/A	487.99 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	34.89 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	34.89 Kips
9.99 ft	Cohesive	N/A	N/A	N/A	34.89 Kips
10.01 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
19.01 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
28.01 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
32.99 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
33.01 ft	Cohesionless	2562.90 psf	40.40	45.49 Kips	45.49 Kips
37.99 ft	Cohesionless	2849.74 psf	40.40	45.49 Kips	45.49 Kips
38.01 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
47.01 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
56.01 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
60.01 ft	Cohesionless	4338.15 psf	40.40	45.49 Kips	45.49 Kips
67.99 ft	Cohesionless	4837.69 psf	40.40	45.49 Kips	45.49 Kips
68.01 ft	Cohesionless	4838.90 psf	30.00	18.36 Kips	18.36 Kips
72.99 ft	Cohesionless	5125.74 psf	30.00	18.36 Kips	18.36 Kips
73.01 ft	Cohesionless	5126.95 psf	64.00	148.32 Kips	148.32 Kips
79.99 ft	Cohesionless	5563.89 psf	64.00	148.32 Kips	148.32 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	34.89 Kips	34.89 Kips
9.01 ft	14.13 Kips	34.89 Kips	49.02 Kips
9.99 ft	17.59 Kips	34.89 Kips	52.47 Kips
10.01 ft	17.67 Kips	16.54 Kips	34.21 Kips
19.01 ft	64.20 Kips	16.54 Kips	80.73 Kips
28.01 ft	110.72 Kips	16.54 Kips	127.25 Kips
32.99 ft	136.46 Kips	16.54 Kips	153.00 Kips
33.01 ft	136.56 Kips	45.49 Kips	182.05 Kips
37.99 ft	162.38 Kips	45.49 Kips	207.87 Kips
38.01 ft	162.49 Kips	43.42 Kips	205.91 Kips
47.01 ft	213.24 Kips	43.42 Kips	256.66 Kips
56.01 ft	263.99 Kips	43.42 Kips	307.42 Kips
59.99 ft	286.44 Kips	43.42 Kips	329.86 Kips
60.01 ft	286.58 Kips	45.49 Kips	332.07 Kips
67.99 ft	356.72 Kips	45.49 Kips	402.21 Kips
68.01 ft	356.89 Kips	18.36 Kips	375.25 Kips
72.99 ft	396.06 Kips	18.36 Kips	414.42 Kips
73.01 ft	396.26 Kips	148.32 Kips	544.59 Kips
79.99 ft	487.99 Kips	148.32 Kips	636.31 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	14.13 Kips
9.99 ft	Cohesive	N/A	N/A	750.00 psf	17.59 Kips
10.01 ft	Cohesive	N/A	N/A	1100.00 psf	17.67 Kips
19.01 ft	Cohesive	N/A	N/A	1100.00 psf	64.20 Kips
28.01 ft	Cohesive	N/A	N/A	1100.00 psf	110.72 Kips
32.99 ft	Cohesive	N/A	N/A	1100.00 psf	136.46 Kips
33.01 ft	Cohesionless	2562.61 psf	25.15	N/A	136.56 Kips
37.99 ft	Cohesionless	2706.03 psf	25.15	N/A	162.38 Kips
38.01 ft	Cohesive	N/A	N/A	1200.00 psf	162.49 Kips
47.01 ft	Cohesive	N/A	N/A	1200.00 psf	213.24 Kips
56.01 ft	Cohesive	N/A	N/A	1200.00 psf	263.99 Kips
59.99 ft	Cohesive	N/A	N/A	1200.00 psf	286.44 Kips
60.01 ft	Cohesionless	4337.83 psf	25.15	N/A	286.58 Kips
67.99 ft	Cohesionless	4587.61 psf	25.15	N/A	356.72 Kips
68.01 ft	Cohesionless	4838.61 psf	23.58	N/A	356.89 Kips
72.99 ft	Cohesionless	4982.03 psf	23.58	N/A	396.06 Kips
73.01 ft	Cohesionless	5126.63 psf	27.51	N/A	396.26 Kips
79.99 ft	Cohesionless	5345.11 psf	27.51	N/A	487.99 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	34.89 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	34.89 Kips
9.99 ft	Cohesive	N/A	N/A	N/A	34.89 Kips
10.01 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
19.01 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
28.01 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
32.99 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
33.01 ft	Cohesionless	2562.90 psf	40.40	45.49 Kips	45.49 Kips
37.99 ft	Cohesionless	2849.74 psf	40.40	45.49 Kips	45.49 Kips
38.01 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
47.01 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
56.01 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
60.01 ft	Cohesionless	4338.15 psf	40.40	45.49 Kips	45.49 Kips
67.99 ft	Cohesionless	4837.69 psf	40.40	45.49 Kips	45.49 Kips
68.01 ft	Cohesionless	4838.90 psf	30.00	18.36 Kips	18.36 Kips
72.99 ft	Cohesionless	5125.74 psf	30.00	18.36 Kips	18.36 Kips
73.01 ft	Cohesionless	5126.95 psf	64.00	148.32 Kips	148.32 Kips
79.99 ft	Cohesionless	5563.89 psf	64.00	148.32 Kips	148.32 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	34.89 Kips	34.89 Kips
9.01 ft	14.13 Kips	34.89 Kips	49.02 Kips
9.99 ft	17.59 Kips	34.89 Kips	52.47 Kips
10.01 ft	17.67 Kips	16.54 Kips	34.21 Kips
19.01 ft	64.20 Kips	16.54 Kips	80.73 Kips
28.01 ft	110.72 Kips	16.54 Kips	127.25 Kips
32.99 ft	136.46 Kips	16.54 Kips	153.00 Kips
33.01 ft	136.56 Kips	45.49 Kips	182.05 Kips
37.99 ft	162.38 Kips	45.49 Kips	207.87 Kips
38.01 ft	162.49 Kips	43.42 Kips	205.91 Kips
47.01 ft	213.24 Kips	43.42 Kips	256.66 Kips
56.01 ft	263.99 Kips	43.42 Kips	307.42 Kips
59.99 ft	286.44 Kips	43.42 Kips	329.86 Kips
60.01 ft	286.58 Kips	45.49 Kips	332.07 Kips
67.99 ft	356.72 Kips	45.49 Kips	402.21 Kips
68.01 ft	356.89 Kips	18.36 Kips	375.25 Kips
72.99 ft	396.06 Kips	18.36 Kips	414.42 Kips
73.01 ft	396.26 Kips	148.32 Kips	544.59 Kips
79.99 ft	487.99 Kips	148.32 Kips	636.31 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	14.13 Kips
9.99 ft	Cohesive	N/A	N/A	750.00 psf	17.59 Kips
10.01 ft	Cohesive	N/A	N/A	1100.00 psf	17.67 Kips
19.01 ft	Cohesive	N/A	N/A	1100.00 psf	64.20 Kips
28.01 ft	Cohesive	N/A	N/A	1100.00 psf	110.72 Kips
32.99 ft	Cohesive	N/A	N/A	1100.00 psf	136.46 Kips
33.01 ft	Cohesionless	2562.61 psf	25.15	N/A	136.56 Kips
37.99 ft	Cohesionless	2706.03 psf	25.15	N/A	162.38 Kips
38.01 ft	Cohesive	N/A	N/A	1200.00 psf	162.49 Kips
47.01 ft	Cohesive	N/A	N/A	1200.00 psf	213.24 Kips
56.01 ft	Cohesive	N/A	N/A	1200.00 psf	263.99 Kips
59.99 ft	Cohesive	N/A	N/A	1200.00 psf	286.44 Kips
60.01 ft	Cohesionless	4337.83 psf	25.15	N/A	286.58 Kips
67.99 ft	Cohesionless	4587.61 psf	25.15	N/A	356.72 Kips
68.01 ft	Cohesionless	4838.61 psf	23.58	N/A	356.89 Kips
72.99 ft	Cohesionless	4982.03 psf	23.58	N/A	396.06 Kips
73.01 ft	Cohesionless	5126.63 psf	27.51	N/A	396.26 Kips
79.99 ft	Cohesionless	5345.11 psf	27.51	N/A	487.99 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	34.89 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	34.89 Kips
9.99 ft	Cohesive	N/A	N/A	N/A	34.89 Kips
10.01 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
19.01 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
28.01 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
32.99 ft	Cohesive	N/A	N/A	N/A	16.54 Kips
33.01 ft	Cohesionless	2562.90 psf	40.40	45.49 Kips	45.49 Kips
37.99 ft	Cohesionless	2849.74 psf	40.40	45.49 Kips	45.49 Kips
38.01 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
47.01 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
56.01 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	43.42 Kips
60.01 ft	Cohesionless	4338.15 psf	40.40	45.49 Kips	45.49 Kips
67.99 ft	Cohesionless	4837.69 psf	40.40	45.49 Kips	45.49 Kips
68.01 ft	Cohesionless	4838.90 psf	30.00	18.36 Kips	18.36 Kips
72.99 ft	Cohesionless	5125.74 psf	30.00	18.36 Kips	18.36 Kips
73.01 ft	Cohesionless	5126.95 psf	64.00	148.32 Kips	148.32 Kips
79.99 ft	Cohesionless	5563.89 psf	64.00	148.32 Kips	148.32 Kips

ULTIMATE - SUMMARY OF CAPACITIES

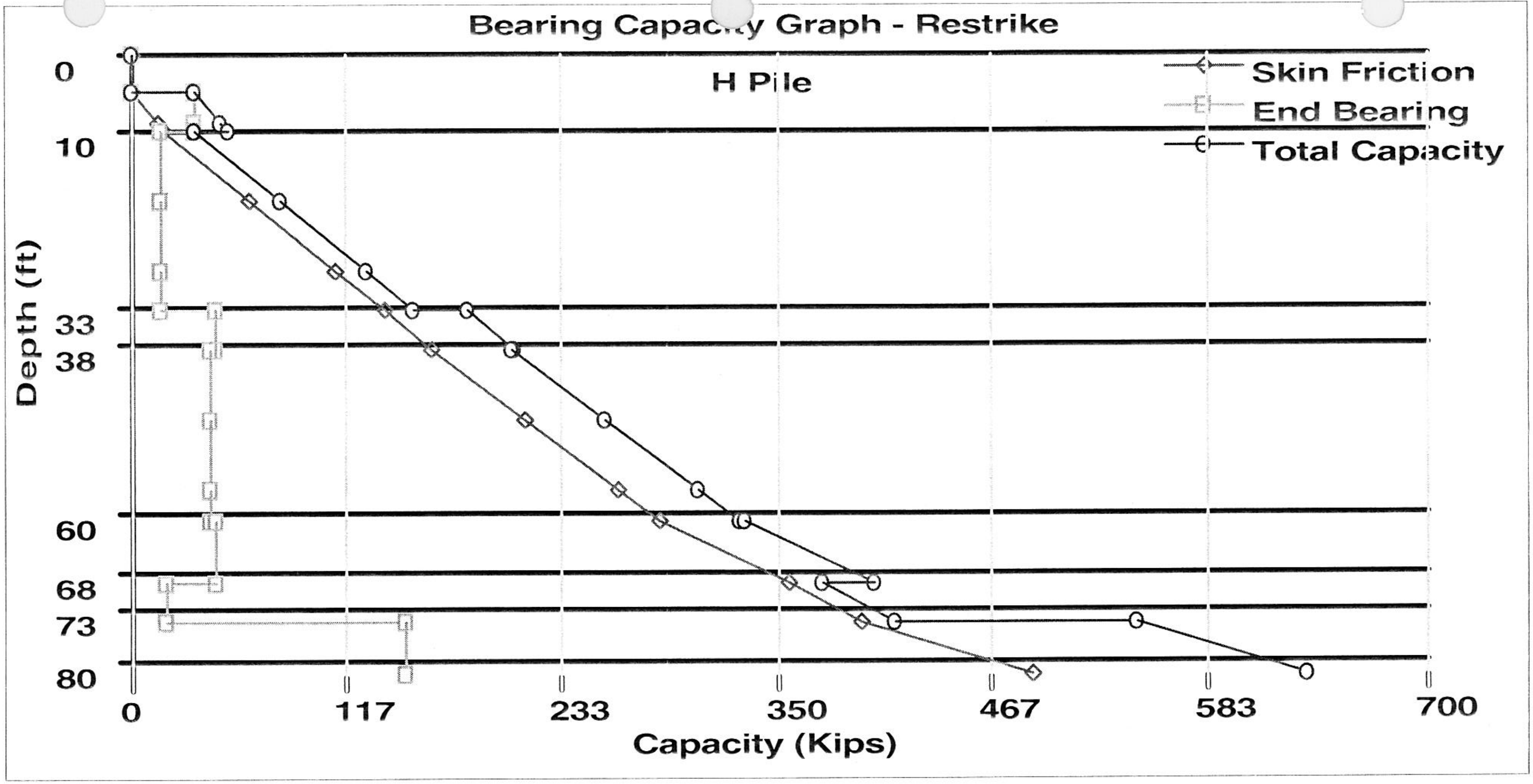
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	34.89 Kips	34.89 Kips
9.01 ft	14.13 Kips	34.89 Kips	49.02 Kips
9.99 ft	17.59 Kips	34.89 Kips	52.47 Kips
10.01 ft	17.67 Kips	16.54 Kips	34.21 Kips
19.01 ft	64.20 Kips	16.54 Kips	80.73 Kips
28.01 ft	110.72 Kips	16.54 Kips	127.25 Kips
32.99 ft	136.46 Kips	16.54 Kips	153.00 Kips
33.01 ft	136.56 Kips	45.49 Kips	182.05 Kips
37.99 ft	162.38 Kips	45.49 Kips	207.87 Kips
38.01 ft	162.49 Kips	43.42 Kips	205.91 Kips
47.01 ft	213.24 Kips	43.42 Kips	256.66 Kips
56.01 ft	263.99 Kips	43.42 Kips	307.42 Kips
59.99 ft	286.44 Kips	43.42 Kips	329.86 Kips
60.01 ft	286.58 Kips	45.49 Kips	332.07 Kips
67.99 ft	356.72 Kips	45.49 Kips	402.21 Kips
68.01 ft	356.89 Kips	18.36 Kips	375.25 Kips
72.99 ft	396.06 Kips	18.36 Kips	414.42 Kips
73.01 ft	396.26 Kips	148.32 Kips	544.59 Kips
79.99 ft	487.99 Kips	148.32 Kips	636.31 Kips

Allowable capacity = 380 kips

$$@ \text{ depth} = 68.01 + (72.99 - 68.01) \times \frac{380 - 375.25}{414.42 - 375.25}$$

$$= 68.61' \text{ or Elev } 485.4$$

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\REAR_A~1\TR-38HP.DVN



DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\REAR_A~1\TR-38AHP.DVN
Project Name: Slocum Ave-TR-38A Project Date: 09/05/2007
Project Client: TranSystems/ODOT-9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: H Pile - HP14X73
Top of Pile: 5.00 ft
Perimeter Analysis: Box
Tip Analysis: Box Area

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	41.50 ft
	- Driving/Restrike	41.50 ft
	- Ultimate:	41.50 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	10.50 ft	0.00%	125.00 pcf	3312.00 psf	User Def.
2	Cohesive	31.50 ft	0.00%	120.00 pcf	1227.00 psf	User Def.
3	Cohesionless	3.80 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund
4	Cohesive	6.20 ft	0.00%	130.00 pcf	4000.00 psf	User Def.
5	Cohesive	10.00 ft	0.00%	125.00 pcf	2125.00 psf	User Def.
6	Cohesive	5.00 ft	0.00%	115.00 pcf	500.00 psf	User Def.
7	Cohesionless	10.00 ft	0.00%	125.00 pcf	29.0/29.0	Nordlund
8	Cohesive	4.00 ft	0.00%	130.00 pcf	4000.00 psf	User Def.

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	700.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	700.00 psf	13.19 Kips
10.49 ft	Cohesive	N/A	N/A	700.00 psf	18.06 Kips
10.51 ft	Cohesive	N/A	N/A	1100.00 psf	18.14 Kips
19.51 ft	Cohesive	N/A	N/A	1100.00 psf	64.67 Kips
28.51 ft	Cohesive	N/A	N/A	1100.00 psf	111.19 Kips
37.51 ft	Cohesive	N/A	N/A	1100.00 psf	157.71 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	180.87 Kips
42.01 ft	Cohesionless	5061.59 psf	23.58	N/A	181.00 Kips
45.79 ft	Cohesionless	5170.45 psf	23.58	N/A	211.85 Kips
45.81 ft	Cohesive	N/A	N/A	1200.00 psf	211.99 Kips
51.99 ft	Cohesive	N/A	N/A	1200.00 psf	246.84 Kips
52.01 ft	Cohesive	N/A	N/A	1550.00 psf	246.97 Kips
61.01 ft	Cohesive	N/A	N/A	1550.00 psf	312.52 Kips
61.99 ft	Cohesive	N/A	N/A	1550.00 psf	319.66 Kips
62.01 ft	Cohesive	N/A	N/A	400.00 psf	319.75 Kips
66.99 ft	Cohesive	N/A	N/A	400.00 psf	329.11 Kips
67.01 ft	Cohesionless	6588.61 psf	22.79	N/A	329.23 Kips
76.01 ft	Cohesionless	6870.31 psf	22.79	N/A	420.36 Kips
76.99 ft	Cohesionless	6900.99 psf	22.79	N/A	430.73 Kips
77.01 ft	Cohesive	N/A	N/A	1200.00 psf	430.90 Kips
80.99 ft	Cohesive	N/A	N/A	1200.00 psf	453.34 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	41.09 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	41.09 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	41.09 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
28.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
37.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
42.01 ft	Cohesionless	5061.88 psf	30.00	18.36 Kips	18.36 Kips
45.79 ft	Cohesionless	5279.60 psf	30.00	18.36 Kips	18.36 Kips
45.81 ft	Cohesive	N/A	N/A	N/A	49.62 Kips
51.99 ft	Cohesive	N/A	N/A	N/A	49.62 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	26.36 Kips
61.01 ft	Cohesive	N/A	N/A	N/A	26.36 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	26.36 Kips
62.01 ft	Cohesive	N/A	N/A	N/A	6.20 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	6.20 Kips
67.01 ft	Cohesionless	6588.93 psf	26.40	18.36 Kips	18.36 Kips
76.01 ft	Cohesionless	7152.33 psf	26.40	18.36 Kips	18.36 Kips
76.99 ft	Cohesionless	7213.67 psf	26.40	18.36 Kips	18.36 Kips
77.01 ft	Cohesive	N/A	N/A	N/A	49.62 Kips
80.99 ft	Cohesive	N/A	N/A	N/A	49.62 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	41.09 Kips	41.09 Kips
9.01 ft	13.19 Kips	41.09 Kips	54.28 Kips
10.49 ft	18.06 Kips	41.09 Kips	59.15 Kips
10.51 ft	18.14 Kips	15.22 Kips	33.37 Kips
19.51 ft	64.67 Kips	15.22 Kips	79.89 Kips
28.51 ft	111.19 Kips	15.22 Kips	126.41 Kips
37.51 ft	157.71 Kips	15.22 Kips	172.93 Kips
41.99 ft	180.87 Kips	15.22 Kips	196.09 Kips
42.01 ft	181.00 Kips	18.36 Kips	199.36 Kips
45.79 ft	211.85 Kips	18.36 Kips	230.21 Kips
45.81 ft	211.99 Kips	49.62 Kips	261.62 Kips
51.99 ft	246.84 Kips	49.62 Kips	296.47 Kips
52.01 ft	246.97 Kips	26.36 Kips	273.33 Kips
61.01 ft	312.52 Kips	26.36 Kips	338.89 Kips
61.99 ft	319.66 Kips	26.36 Kips	346.03 Kips
62.01 ft	319.75 Kips	6.20 Kips	325.96 Kips
66.99 ft	329.11 Kips	6.20 Kips	335.32 Kips
67.01 ft	329.23 Kips	18.36 Kips	347.59 Kips
76.01 ft	420.36 Kips	18.36 Kips	438.72 Kips
76.99 ft	430.73 Kips	18.36 Kips	449.09 Kips
77.01 ft	430.90 Kips	49.62 Kips	480.52 Kips
80.99 ft	453.34 Kips	49.62 Kips	502.96 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	700.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	700.00 psf	13.19 Kips
10.49 ft	Cohesive	N/A	N/A	700.00 psf	18.06 Kips
10.51 ft	Cohesive	N/A	N/A	1100.00 psf	18.14 Kips
19.51 ft	Cohesive	N/A	N/A	1100.00 psf	64.67 Kips
28.51 ft	Cohesive	N/A	N/A	1100.00 psf	111.19 Kips
37.51 ft	Cohesive	N/A	N/A	1100.00 psf	157.71 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	180.87 Kips
42.01 ft	Cohesionless	5061.59 psf	23.58	N/A	181.00 Kips
45.79 ft	Cohesionless	5170.45 psf	23.58	N/A	211.85 Kips
45.81 ft	Cohesive	N/A	N/A	1200.00 psf	211.99 Kips
51.99 ft	Cohesive	N/A	N/A	1200.00 psf	246.84 Kips
52.01 ft	Cohesive	N/A	N/A	1550.00 psf	246.97 Kips
61.01 ft	Cohesive	N/A	N/A	1550.00 psf	312.52 Kips
61.99 ft	Cohesive	N/A	N/A	1550.00 psf	319.66 Kips
62.01 ft	Cohesive	N/A	N/A	400.00 psf	319.75 Kips
66.99 ft	Cohesive	N/A	N/A	400.00 psf	329.11 Kips
67.01 ft	Cohesionless	6588.61 psf	22.79	N/A	329.23 Kips
76.01 ft	Cohesionless	6870.31 psf	22.79	N/A	420.36 Kips
76.99 ft	Cohesionless	6900.99 psf	22.79	N/A	430.73 Kips
77.01 ft	Cohesive	N/A	N/A	1200.00 psf	430.90 Kips
80.99 ft	Cohesive	N/A	N/A	1200.00 psf	453.34 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	41.09 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	41.09 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	41.09 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
28.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
37.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
42.01 ft	Cohesionless	5061.88 psf	30.00	18.36 Kips	18.36 Kips
45.79 ft	Cohesionless	5279.60 psf	30.00	18.36 Kips	18.36 Kips
45.81 ft	Cohesive	N/A	N/A	N/A	49.62 Kips
51.99 ft	Cohesive	N/A	N/A	N/A	49.62 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	26.36 Kips
61.01 ft	Cohesive	N/A	N/A	N/A	26.36 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	26.36 Kips
62.01 ft	Cohesive	N/A	N/A	N/A	6.20 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	6.20 Kips
67.01 ft	Cohesionless	6588.93 psf	26.40	18.36 Kips	18.36 Kips
76.01 ft	Cohesionless	7152.33 psf	26.40	18.36 Kips	18.36 Kips
76.99 ft	Cohesionless	7213.67 psf	26.40	18.36 Kips	18.36 Kips
77.01 ft	Cohesive	N/A	N/A	N/A	49.62 Kips
80.99 ft	Cohesive	N/A	N/A	N/A	49.62 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	41.09 Kips	41.09 Kips
9.01 ft	13.19 Kips	41.09 Kips	54.28 Kips
10.49 ft	18.06 Kips	41.09 Kips	59.15 Kips
10.51 ft	18.14 Kips	15.22 Kips	33.37 Kips
19.51 ft	64.67 Kips	15.22 Kips	79.89 Kips
28.51 ft	111.19 Kips	15.22 Kips	126.41 Kips
37.51 ft	157.71 Kips	15.22 Kips	172.93 Kips
41.99 ft	180.87 Kips	15.22 Kips	196.09 Kips
42.01 ft	181.00 Kips	18.36 Kips	199.36 Kips
45.79 ft	211.85 Kips	18.36 Kips	230.21 Kips
45.81 ft	211.99 Kips	49.62 Kips	261.62 Kips
51.99 ft	246.84 Kips	49.62 Kips	296.47 Kips
52.01 ft	246.97 Kips	26.36 Kips	273.33 Kips
61.01 ft	312.52 Kips	26.36 Kips	338.89 Kips
61.99 ft	319.66 Kips	26.36 Kips	346.03 Kips
62.01 ft	319.75 Kips	6.20 Kips	325.96 Kips
66.99 ft	329.11 Kips	6.20 Kips	335.32 Kips
67.01 ft	329.23 Kips	18.36 Kips	347.59 Kips
76.01 ft	420.36 Kips	18.36 Kips	438.72 Kips
76.99 ft	430.73 Kips	18.36 Kips	449.09 Kips
77.01 ft	430.90 Kips	49.62 Kips	480.52 Kips
80.99 ft	453.34 Kips	49.62 Kips	502.96 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	700.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	700.00 psf	13.19 Kips
10.49 ft	Cohesive	N/A	N/A	700.00 psf	18.06 Kips
10.51 ft	Cohesive	N/A	N/A	1100.00 psf	18.14 Kips
19.51 ft	Cohesive	N/A	N/A	1100.00 psf	64.67 Kips
28.51 ft	Cohesive	N/A	N/A	1100.00 psf	111.19 Kips
37.51 ft	Cohesive	N/A	N/A	1100.00 psf	157.71 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	180.87 Kips
42.01 ft	Cohesionless	5061.59 psf	23.58	N/A	181.00 Kips
45.79 ft	Cohesionless	5170.45 psf	23.58	N/A	211.85 Kips
45.81 ft	Cohesive	N/A	N/A	1200.00 psf	211.99 Kips
51.99 ft	Cohesive	N/A	N/A	1200.00 psf	246.84 Kips
52.01 ft	Cohesive	N/A	N/A	1550.00 psf	246.97 Kips
61.01 ft	Cohesive	N/A	N/A	1550.00 psf	312.52 Kips
61.99 ft	Cohesive	N/A	N/A	1550.00 psf	319.66 Kips
62.01 ft	Cohesive	N/A	N/A	400.00 psf	319.75 Kips
66.99 ft	Cohesive	N/A	N/A	400.00 psf	329.11 Kips
67.01 ft	Cohesionless	6588.61 psf	22.79	N/A	329.23 Kips
76.01 ft	Cohesionless	6870.31 psf	22.79	N/A	420.36 Kips
76.99 ft	Cohesionless	6900.99 psf	22.79	N/A	430.73 Kips
77.01 ft	Cohesive	N/A	N/A	1200.00 psf	430.90 Kips
80.99 ft	Cohesive	N/A	N/A	1200.00 psf	453.34 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	41.09 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	41.09 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	41.09 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
28.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
37.51 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	15.22 Kips
42.01 ft	Cohesionless	5061.88 psf	30.00	18.36 Kips	18.36 Kips
45.79 ft	Cohesionless	5279.60 psf	30.00	18.36 Kips	18.36 Kips
45.81 ft	Cohesive	N/A	N/A	N/A	49.62 Kips
51.99 ft	Cohesive	N/A	N/A	N/A	49.62 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	26.36 Kips
61.01 ft	Cohesive	N/A	N/A	N/A	26.36 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	26.36 Kips
62.01 ft	Cohesive	N/A	N/A	N/A	6.20 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	6.20 Kips
67.01 ft	Cohesionless	6588.93 psf	26.40	18.36 Kips	18.36 Kips
76.01 ft	Cohesionless	7152.33 psf	26.40	18.36 Kips	18.36 Kips
76.99 ft	Cohesionless	7213.67 psf	26.40	18.36 Kips	18.36 Kips
77.01 ft	Cohesive	N/A	N/A	N/A	49.62 Kips
80.99 ft	Cohesive	N/A	N/A	N/A	49.62 Kips

ULTIMATE - SUMMARY OF CAPACITIES

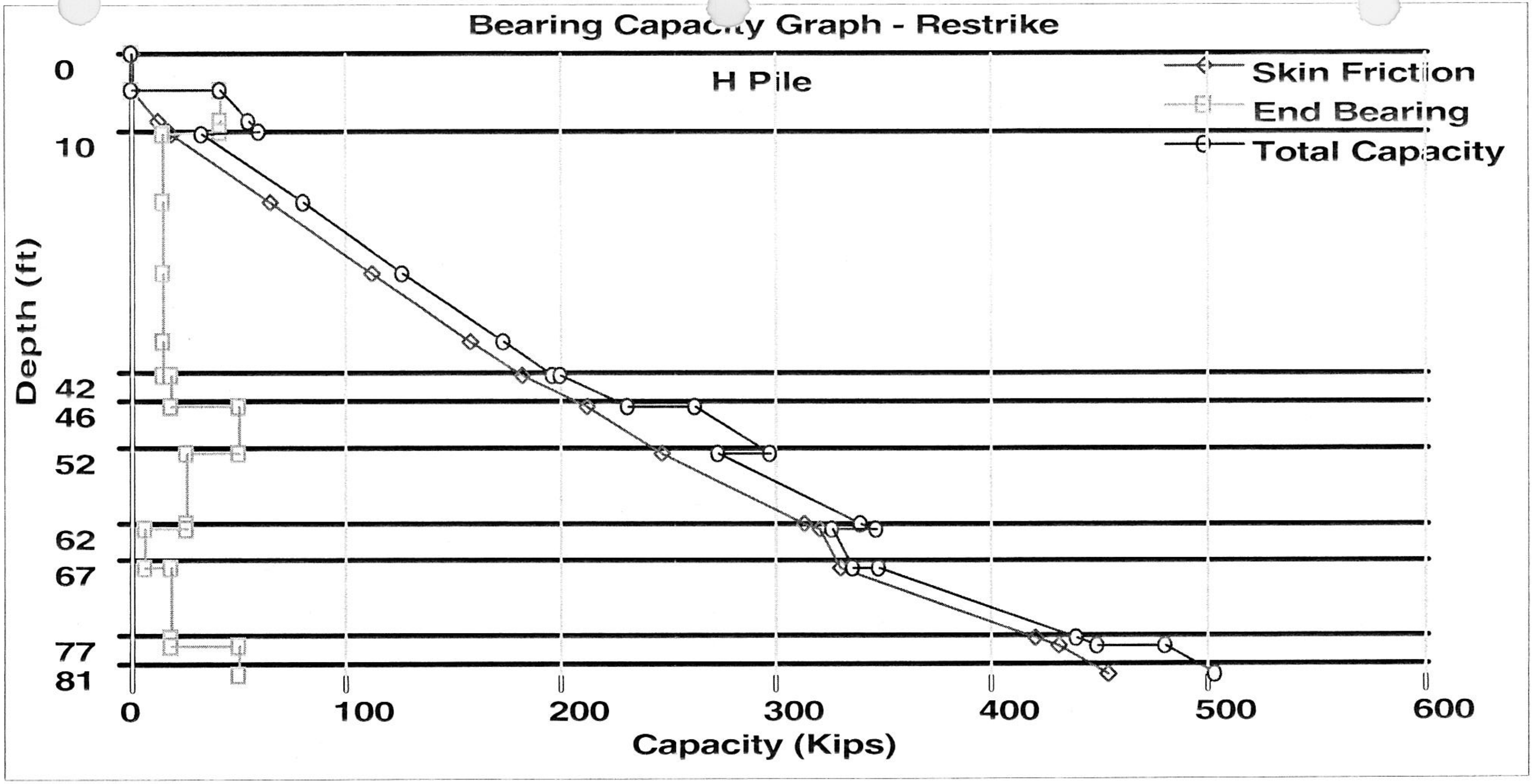
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	41.09 Kips	41.09 Kips
9.01 ft	13.19 Kips	41.09 Kips	54.28 Kips
10.49 ft	18.06 Kips	41.09 Kips	59.15 Kips
10.51 ft	18.14 Kips	15.22 Kips	33.37 Kips
19.51 ft	64.67 Kips	15.22 Kips	79.89 Kips
28.51 ft	111.19 Kips	15.22 Kips	126.41 Kips
37.51 ft	157.71 Kips	15.22 Kips	172.93 Kips
41.99 ft	180.87 Kips	15.22 Kips	196.09 Kips
42.01 ft	181.00 Kips	18.36 Kips	199.36 Kips
45.79 ft	211.85 Kips	18.36 Kips	230.21 Kips
45.81 ft	211.99 Kips	49.62 Kips	261.62 Kips
51.99 ft	246.84 Kips	49.62 Kips	296.47 Kips
52.01 ft	246.97 Kips	26.36 Kips	273.33 Kips
61.01 ft	312.52 Kips	26.36 Kips	338.89 Kips
61.99 ft	319.66 Kips	26.36 Kips	346.03 Kips
62.01 ft	319.75 Kips	6.20 Kips	325.96 Kips
66.99 ft	329.11 Kips	6.20 Kips	335.32 Kips
67.01 ft	329.23 Kips	18.36 Kips	347.59 Kips
76.01 ft	420.36 Kips	18.36 Kips	438.72 Kips
76.99 ft	430.73 Kips	18.36 Kips	449.09 Kips
77.01 ft	430.90 Kips	49.62 Kips	480.52 Kips
80.99 ft	453.34 Kips	49.62 Kips	502.96 Kips

Allowable capacity = 380 kips

$$@\ \text{depth} = 67.01 + (76.01-67.01) \times \frac{380-347.59}{438.72-347.59}$$

= 70.21' or Elev 485.8

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\REAR_A~1\TR-38AHP.DVN



DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\PIER_1~1\TR37HP.DVN
Project Name: Slocum Ave - TR-37 Project Date: 08/02/2007
Project Client: TranSystems/ODOT-9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: H Pile - HP14X73
Top of Pile: 5.00 ft
Perimeter Analysis: Box
Tip Analysis: Box Area

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	16.00 ft
	- Driving/Restrike	16.00 ft
	- Ultimate:	16.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	10.50 ft	0.00%	125.00 pcf	1920.00 psf	User Def.
2	Cohesive	15.00 ft	0.00%	125.00 pcf	2000.00 psf	User Def.
3	Cohesionless	6.50 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund
4	Cohesive	10.00 ft	0.00%	130.00 pcf	4375.00 psf	User Def.
5	Cohesive	20.00 ft	0.00%	130.00 pcf	4312.00 psf	User Def.
6	Cohesionless	5.00 ft	0.00%	125.00 pcf	34.0/34.0	Nordlund
7	Cohesionless	5.00 ft	0.00%	125.00 pcf	29.0/29.0	Nordlund
8	Cohesionless	5.00 ft	0.00%	120.00 pcf	28.0/28.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1200.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1200.00 psf	22.61 Kips
10.49 ft	Cohesive	N/A	N/A	1200.00 psf	30.96 Kips
10.51 ft	Cohesive	N/A	N/A	1500.00 psf	31.08 Kips
19.51 ft	Cohesive	N/A	N/A	1500.00 psf	94.52 Kips
25.49 ft	Cohesive	N/A	N/A	1500.00 psf	136.68 Kips
25.51 ft	Cohesionless	2594.99 psf	23.58	N/A	136.79 Kips
31.99 ft	Cohesionless	2781.61 psf	23.58	N/A	165.24 Kips
32.01 ft	Cohesive	N/A	N/A	1100.00 psf	165.34 Kips
41.01 ft	Cohesive	N/A	N/A	1100.00 psf	211.86 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	216.93 Kips
42.01 ft	Cohesive	N/A	N/A	1100.00 psf	217.03 Kips
51.01 ft	Cohesive	N/A	N/A	1100.00 psf	263.55 Kips
60.01 ft	Cohesive	N/A	N/A	1100.00 psf	310.08 Kips
61.99 ft	Cohesive	N/A	N/A	1100.00 psf	320.31 Kips
62.01 ft	Cohesionless	4997.41 psf	26.72	N/A	320.48 Kips
66.99 ft	Cohesionless	5153.29 psf	26.72	N/A	378.81 Kips
67.01 ft	Cohesionless	5310.41 psf	22.79	N/A	379.01 Kips
71.99 ft	Cohesionless	5466.29 psf	22.79	N/A	419.13 Kips
72.01 ft	Cohesionless	5623.39 psf	22.00	N/A	419.29 Kips
76.99 ft	Cohesionless	5766.81 psf	22.00	N/A	458.69 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	23.82 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	23.82 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	23.82 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	24.81 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	24.81 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	24.81 Kips
25.51 ft	Cohesionless	2595.28 psf	30.00	18.36 Kips	18.36 Kips
31.99 ft	Cohesionless	2968.52 psf	30.00	18.36 Kips	18.36 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	54.28 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	54.28 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	54.28 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
60.01 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
62.01 ft	Cohesionless	4997.73 psf	55.60	101.35 Kips	101.35 Kips
66.99 ft	Cohesionless	5309.47 psf	55.60	101.35 Kips	101.35 Kips
67.01 ft	Cohesionless	5310.73 psf	26.40	18.36 Kips	18.36 Kips
71.99 ft	Cohesionless	5622.47 psf	26.40	18.36 Kips	18.36 Kips
72.01 ft	Cohesionless	5623.68 psf	22.80	18.36 Kips	18.36 Kips
76.99 ft	Cohesionless	5910.52 psf	22.80	18.36 Kips	18.36 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	23.82 Kips	23.82 Kips
9.01 ft	22.61 Kips	23.82 Kips	46.43 Kips
10.49 ft	30.96 Kips	23.82 Kips	54.78 Kips
10.51 ft	31.08 Kips	24.81 Kips	55.90 Kips
19.51 ft	94.52 Kips	24.81 Kips	119.34 Kips
25.49 ft	136.68 Kips	24.81 Kips	161.49 Kips
25.51 ft	136.79 Kips	18.36 Kips	155.15 Kips
31.99 ft	165.24 Kips	18.36 Kips	183.61 Kips
32.01 ft	165.34 Kips	54.28 Kips	219.62 Kips
41.01 ft	211.86 Kips	54.28 Kips	266.14 Kips
41.99 ft	216.93 Kips	54.28 Kips	271.21 Kips
42.01 ft	217.03 Kips	53.50 Kips	270.53 Kips
51.01 ft	263.55 Kips	53.50 Kips	317.05 Kips
60.01 ft	310.08 Kips	53.50 Kips	363.57 Kips
61.99 ft	320.31 Kips	53.50 Kips	373.81 Kips
62.01 ft	320.48 Kips	101.35 Kips	421.82 Kips
66.99 ft	378.81 Kips	101.35 Kips	480.16 Kips
67.01 ft	379.01 Kips	18.36 Kips	397.37 Kips
71.99 ft	419.13 Kips	18.36 Kips	437.49 Kips
72.01 ft	419.29 Kips	18.36 Kips	437.65 Kips
76.99 ft	458.69 Kips	18.36 Kips	477.05 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1200.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1200.00 psf	22.61 Kips
10.49 ft	Cohesive	N/A	N/A	1200.00 psf	30.96 Kips
10.51 ft	Cohesive	N/A	N/A	1500.00 psf	31.08 Kips
19.51 ft	Cohesive	N/A	N/A	1500.00 psf	94.52 Kips
25.49 ft	Cohesive	N/A	N/A	1500.00 psf	136.68 Kips
25.51 ft	Cohesionless	2594.99 psf	23.58	N/A	136.79 Kips
31.99 ft	Cohesionless	2781.61 psf	23.58	N/A	165.24 Kips
32.01 ft	Cohesive	N/A	N/A	1100.00 psf	165.34 Kips
41.01 ft	Cohesive	N/A	N/A	1100.00 psf	211.86 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	216.93 Kips
42.01 ft	Cohesive	N/A	N/A	1100.00 psf	217.03 Kips
51.01 ft	Cohesive	N/A	N/A	1100.00 psf	263.55 Kips
60.01 ft	Cohesive	N/A	N/A	1100.00 psf	310.08 Kips
61.99 ft	Cohesive	N/A	N/A	1100.00 psf	320.31 Kips
62.01 ft	Cohesionless	4997.41 psf	26.72	N/A	320.48 Kips
66.99 ft	Cohesionless	5153.29 psf	26.72	N/A	378.81 Kips
67.01 ft	Cohesionless	5310.41 psf	22.79	N/A	379.01 Kips
71.99 ft	Cohesionless	5466.29 psf	22.79	N/A	419.13 Kips
72.01 ft	Cohesionless	5623.39 psf	22.00	N/A	419.29 Kips
76.99 ft	Cohesionless	5766.81 psf	22.00	N/A	458.69 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	23.82 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	23.82 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	23.82 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	24.81 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	24.81 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	24.81 Kips
25.51 ft	Cohesionless	2595.28 psf	30.00	18.36 Kips	18.36 Kips
31.99 ft	Cohesionless	2968.52 psf	30.00	18.36 Kips	18.36 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	54.28 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	54.28 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	54.28 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
60.01 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
62.01 ft	Cohesionless	4997.73 psf	55.60	101.35 Kips	101.35 Kips
66.99 ft	Cohesionless	5309.47 psf	55.60	101.35 Kips	101.35 Kips
67.01 ft	Cohesionless	5310.73 psf	26.40	18.36 Kips	18.36 Kips
71.99 ft	Cohesionless	5622.47 psf	26.40	18.36 Kips	18.36 Kips
72.01 ft	Cohesionless	5623.68 psf	22.80	18.36 Kips	18.36 Kips
76.99 ft	Cohesionless	5910.52 psf	22.80	18.36 Kips	18.36 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	23.82 Kips	23.82 Kips
9.01 ft	22.61 Kips	23.82 Kips	46.43 Kips
10.49 ft	30.96 Kips	23.82 Kips	54.78 Kips
10.51 ft	31.08 Kips	24.81 Kips	55.90 Kips
19.51 ft	94.52 Kips	24.81 Kips	119.34 Kips
25.49 ft	136.68 Kips	24.81 Kips	161.49 Kips
25.51 ft	136.79 Kips	18.36 Kips	155.15 Kips
31.99 ft	165.24 Kips	18.36 Kips	183.61 Kips
32.01 ft	165.34 Kips	54.28 Kips	219.62 Kips
41.01 ft	211.86 Kips	54.28 Kips	266.14 Kips
41.99 ft	216.93 Kips	54.28 Kips	271.21 Kips
42.01 ft	217.03 Kips	53.50 Kips	270.53 Kips
51.01 ft	263.55 Kips	53.50 Kips	317.05 Kips
60.01 ft	310.08 Kips	53.50 Kips	363.57 Kips
61.99 ft	320.31 Kips	53.50 Kips	373.81 Kips
62.01 ft	320.48 Kips	101.35 Kips	421.82 Kips
66.99 ft	378.81 Kips	101.35 Kips	480.16 Kips
67.01 ft	379.01 Kips	18.36 Kips	397.37 Kips
71.99 ft	419.13 Kips	18.36 Kips	437.49 Kips
72.01 ft	419.29 Kips	18.36 Kips	437.65 Kips
76.99 ft	458.69 Kips	18.36 Kips	477.05 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1200.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1200.00 psf	22.61 Kips
10.49 ft	Cohesive	N/A	N/A	1200.00 psf	30.96 Kips
10.51 ft	Cohesive	N/A	N/A	1500.00 psf	31.08 Kips
19.51 ft	Cohesive	N/A	N/A	1500.00 psf	94.52 Kips
25.49 ft	Cohesive	N/A	N/A	1500.00 psf	136.68 Kips
25.51 ft	Cohesionless	2594.99 psf	23.58	N/A	136.79 Kips
31.99 ft	Cohesionless	2781.61 psf	23.58	N/A	165.24 Kips
32.01 ft	Cohesive	N/A	N/A	1100.00 psf	165.34 Kips
41.01 ft	Cohesive	N/A	N/A	1100.00 psf	211.86 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	216.93 Kips
42.01 ft	Cohesive	N/A	N/A	1100.00 psf	217.03 Kips
51.01 ft	Cohesive	N/A	N/A	1100.00 psf	263.55 Kips
60.01 ft	Cohesive	N/A	N/A	1100.00 psf	310.08 Kips
61.99 ft	Cohesive	N/A	N/A	1100.00 psf	320.31 Kips
62.01 ft	Cohesionless	4997.41 psf	26.72	N/A	320.48 Kips
66.99 ft	Cohesionless	5153.29 psf	26.72	N/A	378.81 Kips
67.01 ft	Cohesionless	5310.41 psf	22.79	N/A	379.01 Kips
71.99 ft	Cohesionless	5466.29 psf	22.79	N/A	419.13 Kips
72.01 ft	Cohesionless	5623.39 psf	22.00	N/A	419.29 Kips
76.99 ft	Cohesionless	5766.81 psf	22.00	N/A	458.69 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	23.82 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	23.82 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	23.82 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	24.81 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	24.81 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	24.81 Kips
25.51 ft	Cohesionless	2595.28 psf	30.00	18.36 Kips	18.36 Kips
31.99 ft	Cohesionless	2968.52 psf	30.00	18.36 Kips	18.36 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	54.28 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	54.28 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	54.28 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
60.01 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	53.50 Kips
62.01 ft	Cohesionless	4997.73 psf	55.60	101.35 Kips	101.35 Kips
66.99 ft	Cohesionless	5309.47 psf	55.60	101.35 Kips	101.35 Kips
67.01 ft	Cohesionless	5310.73 psf	26.40	18.36 Kips	18.36 Kips
71.99 ft	Cohesionless	5622.47 psf	26.40	18.36 Kips	18.36 Kips
72.01 ft	Cohesionless	5623.68 psf	22.80	18.36 Kips	18.36 Kips
76.99 ft	Cohesionless	5910.52 psf	22.80	18.36 Kips	18.36 Kips

ULTIMATE - SUMMARY OF CAPACITIES

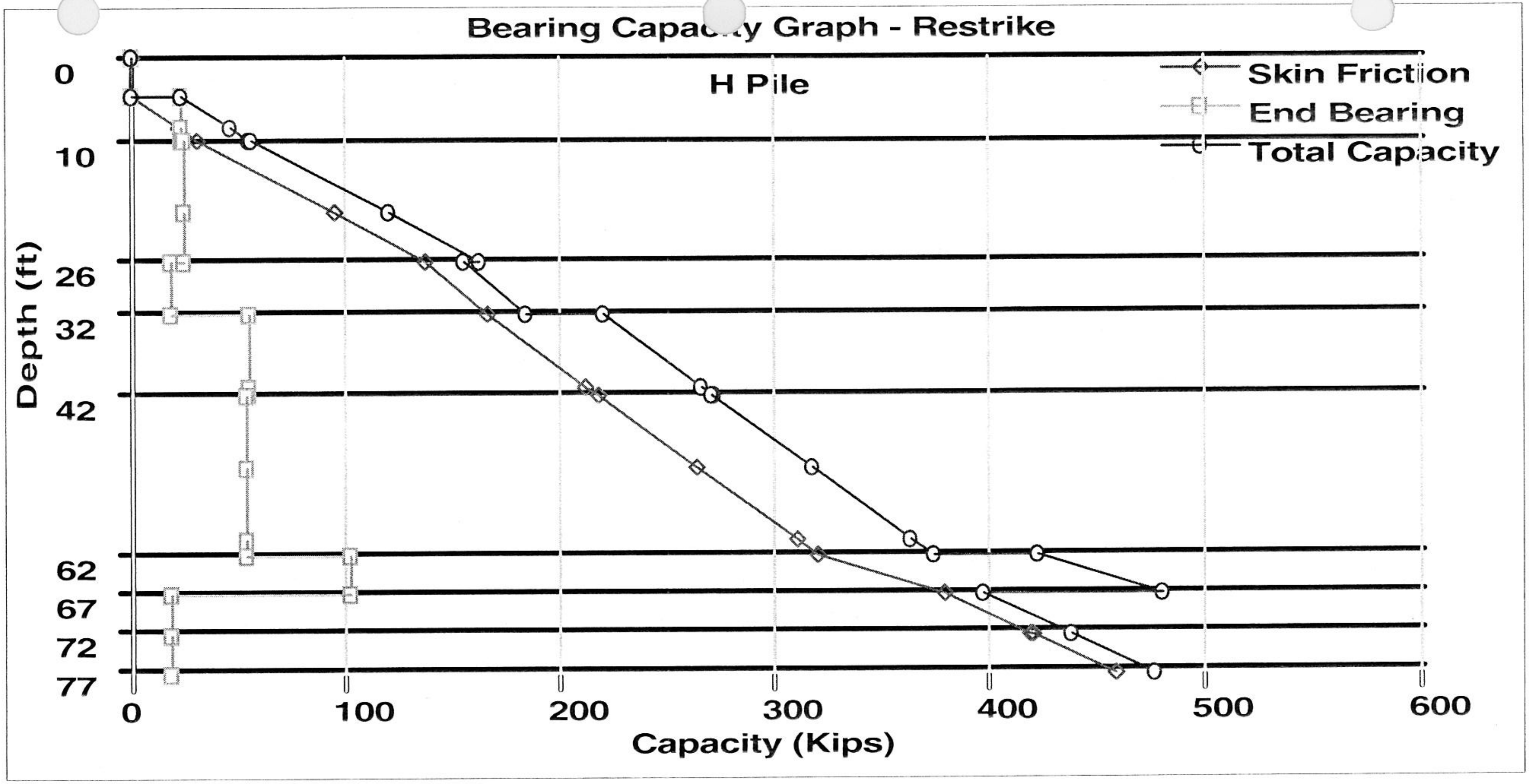
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	23.82 Kips	23.82 Kips
9.01 ft	22.61 Kips	23.82 Kips	46.43 Kips
10.49 ft	30.96 Kips	23.82 Kips	54.78 Kips
10.51 ft	31.08 Kips	24.81 Kips	55.90 Kips
19.51 ft	94.52 Kips	24.81 Kips	119.34 Kips
25.49 ft	136.68 Kips	24.81 Kips	161.49 Kips
25.51 ft	136.79 Kips	18.36 Kips	155.15 Kips
31.99 ft	165.24 Kips	18.36 Kips	183.61 Kips
32.01 ft	165.34 Kips	54.28 Kips	219.62 Kips
41.01 ft	211.86 Kips	54.28 Kips	266.14 Kips
41.99 ft	216.93 Kips	54.28 Kips	271.21 Kips
42.01 ft	217.03 Kips	53.50 Kips	270.53 Kips
51.01 ft	263.55 Kips	53.50 Kips	317.05 Kips
60.01 ft	310.08 Kips	53.50 Kips	363.57 Kips
61.99 ft	320.31 Kips	53.50 Kips	373.81 Kips
62.01 ft	320.48 Kips	101.35 Kips	421.82 Kips
66.99 ft	378.81 Kips	101.35 Kips	480.16 Kips
67.01 ft	379.01 Kips	18.36 Kips	397.37 Kips
71.99 ft	419.13 Kips	18.36 Kips	437.49 Kips
72.01 ft	419.29 Kips	18.36 Kips	437.65 Kips
76.99 ft	458.69 Kips	18.36 Kips	477.05 Kips

Allowable capacity = 380 kips

$$@\ \text{depth} = 61.99 + (62.01 - 61.99) \times \frac{380 - 373.81}{421.82 - 373.81}$$

$$= 62' \text{ or Elev. } 494.1$$

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\PIER_1~1\TR37HP.DVN



DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\PIER_2~1\B32HP.DVN
Project Name: Slocum Ave - TR32 Project Date: 08/02/2007
Project Client: TranSystems/ODOT9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: H Pile - HP14X73
Top of Pile: 5.00 ft
Perimeter Analysis: Box
Tip Analysis: Box Area

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	28.00 ft
	- Driving/Restrike	28.00 ft
	- Ultimate:	28.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	12.50 ft	0.00%	125.00 pcf	2291.00 psf	User Def.
2	Cohesive	17.50 ft	0.00%	125.00 pcf	1656.00 psf	User Def.
3	Cohesive	12.00 ft	0.00%	120.00 pcf	1125.00 psf	User Def.
4	Cohesive	18.00 ft	0.00%	125.00 pcf	3125.00 psf	User Def.
5	Cohesionless	18.50 ft	0.00%	120.00 pcf	32.0/32.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1100.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1100.00 psf	20.73 Kips
12.49 ft	Cohesive	N/A	N/A	1100.00 psf	38.72 Kips
12.51 ft	Cohesive	N/A	N/A	1400.00 psf	38.83 Kips
21.51 ft	Cohesive	N/A	N/A	1400.00 psf	98.04 Kips
29.99 ft	Cohesive	N/A	N/A	1400.00 psf	153.83 Kips
30.01 ft	Cohesive	N/A	N/A	1000.00 psf	153.94 Kips
39.01 ft	Cohesive	N/A	N/A	1000.00 psf	196.24 Kips
41.99 ft	Cohesive	N/A	N/A	1000.00 psf	210.24 Kips
42.01 ft	Cohesive	N/A	N/A	1300.00 psf	210.35 Kips
51.01 ft	Cohesive	N/A	N/A	1300.00 psf	265.33 Kips
59.99 ft	Cohesive	N/A	N/A	1300.00 psf	320.19 Kips
60.01 ft	Cohesionless	5443.49 psf	25.15	N/A	320.35 Kips
69.01 ft	Cohesionless	5702.69 psf	25.15	N/A	418.69 Kips
78.01 ft	Cohesionless	5961.89 psf	25.15	N/A	525.96 Kips
78.49 ft	Cohesionless	5975.71 psf	25.15	N/A	531.93 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	28.42 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	28.42 Kips
12.49 ft	Cohesive	N/A	N/A	N/A	28.42 Kips
12.51 ft	Cohesive	N/A	N/A	N/A	20.54 Kips
21.51 ft	Cohesive	N/A	N/A	N/A	20.54 Kips
29.99 ft	Cohesive	N/A	N/A	N/A	20.54 Kips
30.01 ft	Cohesive	N/A	N/A	N/A	13.96 Kips
39.01 ft	Cohesive	N/A	N/A	N/A	13.96 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	13.96 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	38.77 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	38.77 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	38.77 Kips
60.01 ft	Cohesionless	5443.78 psf	40.40	45.49 Kips	45.49 Kips
69.01 ft	Cohesionless	5962.18 psf	40.40	45.49 Kips	45.49 Kips
78.01 ft	Cohesionless	6480.58 psf	40.40	45.49 Kips	45.49 Kips
78.49 ft	Cohesionless	6508.22 psf	40.40	45.49 Kips	45.49 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	28.42 Kips	28.42 Kips
9.01 ft	20.73 Kips	28.42 Kips	49.15 Kips
12.49 ft	38.72 Kips	28.42 Kips	67.14 Kips
12.51 ft	38.83 Kips	20.54 Kips	59.38 Kips
21.51 ft	98.04 Kips	20.54 Kips	118.59 Kips
29.99 ft	153.83 Kips	20.54 Kips	174.38 Kips
30.01 ft	153.94 Kips	13.96 Kips	167.90 Kips
39.01 ft	196.24 Kips	13.96 Kips	210.19 Kips
41.99 ft	210.24 Kips	13.96 Kips	224.20 Kips
42.01 ft	210.35 Kips	38.77 Kips	249.12 Kips
51.01 ft	265.33 Kips	38.77 Kips	304.10 Kips
59.99 ft	320.19 Kips	38.77 Kips	358.96 Kips
60.01 ft	320.35 Kips	45.49 Kips	365.84 Kips
69.01 ft	418.69 Kips	45.49 Kips	464.18 Kips
78.01 ft	525.96 Kips	45.49 Kips	571.45 Kips
78.49 ft	531.93 Kips	45.49 Kips	577.42 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1100.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1100.00 psf	20.73 Kips
12.49 ft	Cohesive	N/A	N/A	1100.00 psf	38.72 Kips
12.51 ft	Cohesive	N/A	N/A	1400.00 psf	38.83 Kips
21.51 ft	Cohesive	N/A	N/A	1400.00 psf	98.04 Kips
29.99 ft	Cohesive	N/A	N/A	1400.00 psf	153.83 Kips
30.01 ft	Cohesive	N/A	N/A	1000.00 psf	153.94 Kips
39.01 ft	Cohesive	N/A	N/A	1000.00 psf	196.24 Kips
41.99 ft	Cohesive	N/A	N/A	1000.00 psf	210.24 Kips
42.01 ft	Cohesive	N/A	N/A	1300.00 psf	210.35 Kips
51.01 ft	Cohesive	N/A	N/A	1300.00 psf	265.33 Kips
59.99 ft	Cohesive	N/A	N/A	1300.00 psf	320.19 Kips
60.01 ft	Cohesionless	5443.49 psf	25.15	N/A	320.35 Kips
69.01 ft	Cohesionless	5702.69 psf	25.15	N/A	418.69 Kips
78.01 ft	Cohesionless	5961.89 psf	25.15	N/A	525.96 Kips
78.49 ft	Cohesionless	5975.71 psf	25.15	N/A	531.93 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	28.42 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	28.42 Kips
12.49 ft	Cohesive	N/A	N/A	N/A	28.42 Kips
12.51 ft	Cohesive	N/A	N/A	N/A	20.54 Kips
21.51 ft	Cohesive	N/A	N/A	N/A	20.54 Kips
29.99 ft	Cohesive	N/A	N/A	N/A	20.54 Kips
30.01 ft	Cohesive	N/A	N/A	N/A	13.96 Kips
39.01 ft	Cohesive	N/A	N/A	N/A	13.96 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	13.96 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	38.77 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	38.77 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	38.77 Kips
60.01 ft	Cohesionless	5443.78 psf	40.40	45.49 Kips	45.49 Kips
69.01 ft	Cohesionless	5962.18 psf	40.40	45.49 Kips	45.49 Kips
78.01 ft	Cohesionless	6480.58 psf	40.40	45.49 Kips	45.49 Kips
78.49 ft	Cohesionless	6508.22 psf	40.40	45.49 Kips	45.49 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	28.42 Kips	28.42 Kips
9.01 ft	20.73 Kips	28.42 Kips	49.15 Kips
12.49 ft	38.72 Kips	28.42 Kips	67.14 Kips
12.51 ft	38.83 Kips	20.54 Kips	59.38 Kips
21.51 ft	98.04 Kips	20.54 Kips	118.59 Kips
29.99 ft	153.83 Kips	20.54 Kips	174.38 Kips
30.01 ft	153.94 Kips	13.96 Kips	167.90 Kips
39.01 ft	196.24 Kips	13.96 Kips	210.19 Kips
41.99 ft	210.24 Kips	13.96 Kips	224.20 Kips
42.01 ft	210.35 Kips	38.77 Kips	249.12 Kips
51.01 ft	265.33 Kips	38.77 Kips	304.10 Kips
59.99 ft	320.19 Kips	38.77 Kips	358.96 Kips
60.01 ft	320.35 Kips	45.49 Kips	365.84 Kips
69.01 ft	418.69 Kips	45.49 Kips	464.18 Kips
78.01 ft	525.96 Kips	45.49 Kips	571.45 Kips
78.49 ft	531.93 Kips	45.49 Kips	577.42 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1100.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1100.00 psf	20.73 Kips
12.49 ft	Cohesive	N/A	N/A	1100.00 psf	38.72 Kips
12.51 ft	Cohesive	N/A	N/A	1400.00 psf	38.83 Kips
21.51 ft	Cohesive	N/A	N/A	1400.00 psf	98.04 Kips
29.99 ft	Cohesive	N/A	N/A	1400.00 psf	153.83 Kips
30.01 ft	Cohesive	N/A	N/A	1000.00 psf	153.94 Kips
39.01 ft	Cohesive	N/A	N/A	1000.00 psf	196.24 Kips
41.99 ft	Cohesive	N/A	N/A	1000.00 psf	210.24 Kips
42.01 ft	Cohesive	N/A	N/A	1300.00 psf	210.35 Kips
51.01 ft	Cohesive	N/A	N/A	1300.00 psf	265.33 Kips
59.99 ft	Cohesive	N/A	N/A	1300.00 psf	320.19 Kips
60.01 ft	Cohesionless	5443.49 psf	25.15	N/A	320.35 Kips
69.01 ft	Cohesionless	5702.69 psf	25.15	N/A	418.69 Kips
78.01 ft	Cohesionless	5961.89 psf	25.15	N/A	525.96 Kips
78.49 ft	Cohesionless	5975.71 psf	25.15	N/A	531.93 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	28.42 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	28.42 Kips
12.49 ft	Cohesive	N/A	N/A	N/A	28.42 Kips
12.51 ft	Cohesive	N/A	N/A	N/A	20.54 Kips
21.51 ft	Cohesive	N/A	N/A	N/A	20.54 Kips
29.99 ft	Cohesive	N/A	N/A	N/A	20.54 Kips
30.01 ft	Cohesive	N/A	N/A	N/A	13.96 Kips
39.01 ft	Cohesive	N/A	N/A	N/A	13.96 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	13.96 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	38.77 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	38.77 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	38.77 Kips
60.01 ft	Cohesionless	5443.78 psf	40.40	45.49 Kips	45.49 Kips
69.01 ft	Cohesionless	5962.18 psf	40.40	45.49 Kips	45.49 Kips
78.01 ft	Cohesionless	6480.58 psf	40.40	45.49 Kips	45.49 Kips
78.49 ft	Cohesionless	6508.22 psf	40.40	45.49 Kips	45.49 Kips

ULTIMATE - SUMMARY OF CAPACITIES

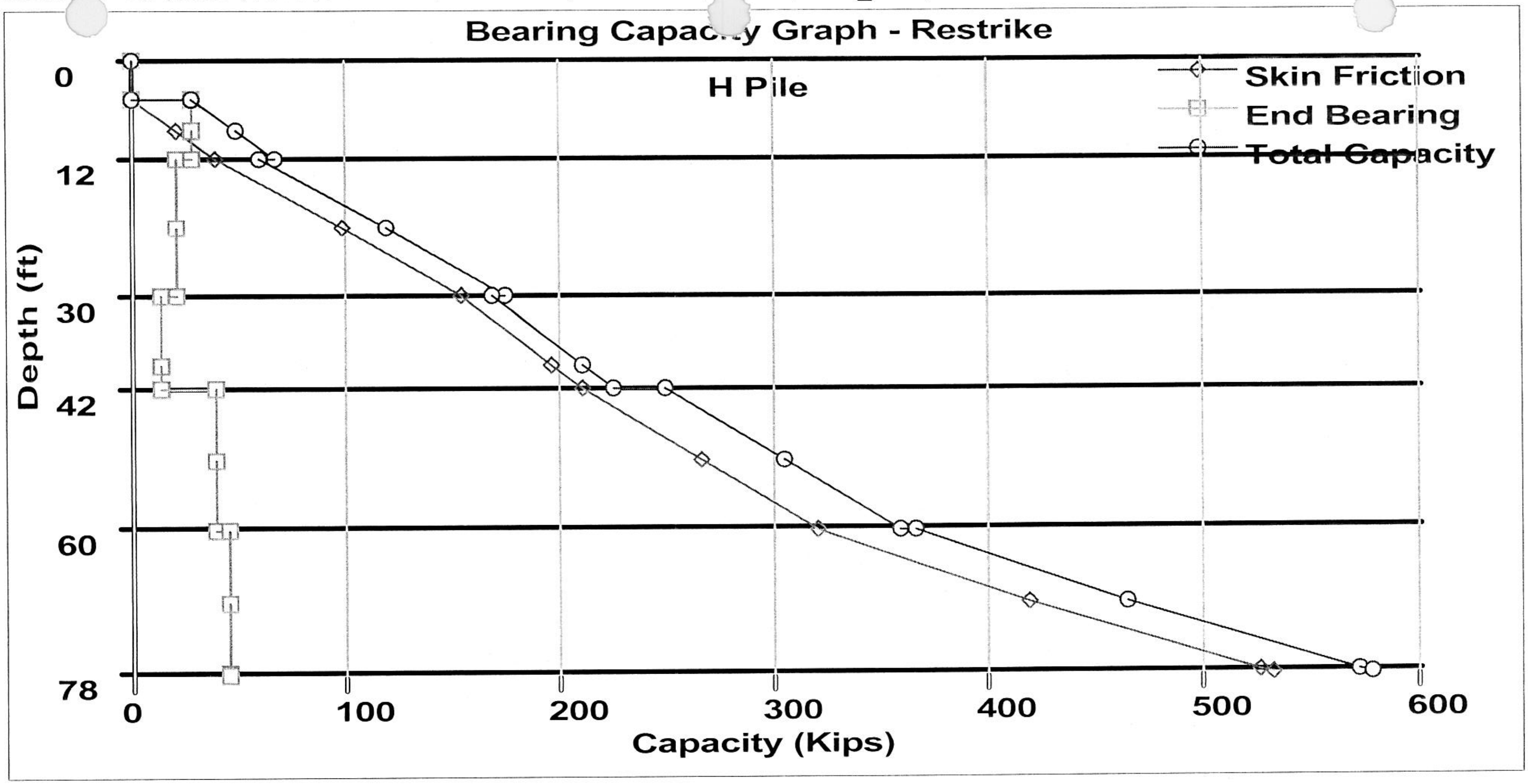
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	28.42 Kips	28.42 Kips
9.01 ft	20.73 Kips	28.42 Kips	49.15 Kips
12.49 ft	38.72 Kips	28.42 Kips	67.14 Kips
12.51 ft	38.83 Kips	20.54 Kips	59.38 Kips
21.51 ft	98.04 Kips	20.54 Kips	118.59 Kips
29.99 ft	153.83 Kips	20.54 Kips	174.38 Kips
30.01 ft	153.94 Kips	13.96 Kips	167.90 Kips
39.01 ft	196.24 Kips	13.96 Kips	210.19 Kips
41.99 ft	210.24 Kips	13.96 Kips	224.20 Kips
42.01 ft	210.35 Kips	38.77 Kips	249.12 Kips
51.01 ft	265.33 Kips	38.77 Kips	304.10 Kips
59.99 ft	320.19 Kips	38.77 Kips	358.96 Kips
60.01 ft	320.35 Kips	45.49 Kips	365.84 Kips
69.01 ft	418.69 Kips	45.49 Kips	464.18 Kips
78.01 ft	525.96 Kips	45.49 Kips	571.45 Kips
78.49 ft	531.93 Kips	45.49 Kips	577.42 Kips

Allowable capacity = 380 kips

$$@\ \text{depth} = 60.01 + (69.01 - 60.01) \times \frac{380 - 365.84}{464.18 - 365.84}$$

$$= 61.3' \text{ or Elev } 493.7$$

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\PIER_2~1\B32HP.DVN



DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\FORWAR~1\B31HP.DVN
Project Name: Slocum Ave-B-31 Project Date: 09/05/2007
Project Client: TranSystems/ODOT-9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: H Pile - HP14X73
Top of Pile: 5.00 ft
Perimeter Analysis: Box
Tip Analysis: Box Area

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	30.20 ft
	- Driving/Restrike	30.20 ft
	- Ultimate:	30.20 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	13.00 ft	0.00%	125.00 pcf	3050.00 psf	User Def.
2	Cohesive	12.50 ft	0.00%	125.00 pcf	3200.00 psf	User Def.
3	Cohesive	2.50 ft	0.00%	120.00 pcf	1500.00 psf	User Def.
4	Cohesionless	4.00 ft	0.00%	120.00 pcf	32.0/32.0	Nordlund
5	Cohesive	35.00 ft	0.00%	130.00 pcf	3250.00 psf	User Def.
6	Cohesionless	12.00 ft	0.00%	120.00 pcf	29.0/29.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	800.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	800.00 psf	15.07 Kips
12.99 ft	Cohesive	N/A	N/A	800.00 psf	30.04 Kips
13.01 ft	Cohesive	N/A	N/A	1200.00 psf	30.13 Kips
22.01 ft	Cohesive	N/A	N/A	1200.00 psf	80.88 Kips
25.49 ft	Cohesive	N/A	N/A	1200.00 psf	100.51 Kips
25.51 ft	Cohesive	N/A	N/A	1300.00 psf	100.62 Kips
27.99 ft	Cohesive	N/A	N/A	1300.00 psf	115.77 Kips
28.01 ft	Cohesionless	3488.10 psf	25.15	N/A	115.90 Kips
30.19 ft	Cohesionless	3618.90 psf	25.15	N/A	131.02 Kips
30.21 ft	Cohesionless	3751.79 psf	25.15	N/A	131.16 Kips
31.99 ft	Cohesionless	3803.05 psf	25.15	N/A	144.13 Kips
32.01 ft	Cohesive	N/A	N/A	1250.00 psf	144.26 Kips
41.01 ft	Cohesive	N/A	N/A	1250.00 psf	197.13 Kips
50.01 ft	Cohesive	N/A	N/A	1250.00 psf	250.00 Kips
59.01 ft	Cohesive	N/A	N/A	1250.00 psf	302.86 Kips
66.99 ft	Cohesive	N/A	N/A	1250.00 psf	349.74 Kips
67.01 ft	Cohesionless	6221.47 psf	22.79	N/A	349.89 Kips
76.01 ft	Cohesionless	6480.67 psf	22.79	N/A	435.85 Kips
78.99 ft	Cohesionless	6566.49 psf	22.79	N/A	465.82 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	37.84 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	37.84 Kips
12.99 ft	Cohesive	N/A	N/A	N/A	37.84 Kips
13.01 ft	Cohesive	N/A	N/A	N/A	39.70 Kips
22.01 ft	Cohesive	N/A	N/A	N/A	39.70 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	39.70 Kips
25.51 ft	Cohesive	N/A	N/A	N/A	18.61 Kips
27.99 ft	Cohesive	N/A	N/A	N/A	18.61 Kips
28.01 ft	Cohesionless	3488.70 psf	40.40	45.49 Kips	45.49 Kips
30.19 ft	Cohesionless	3750.30 psf	40.40	45.49 Kips	45.49 Kips
30.21 ft	Cohesionless	3752.08 psf	40.40	45.49 Kips	45.49 Kips
31.99 ft	Cohesionless	3854.60 psf	40.40	45.49 Kips	45.49 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
50.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
59.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
67.01 ft	Cohesionless	6221.76 psf	26.40	18.36 Kips	18.36 Kips
76.01 ft	Cohesionless	6740.16 psf	26.40	18.36 Kips	18.36 Kips
78.99 ft	Cohesionless	6911.80 psf	26.40	18.36 Kips	18.36 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	37.84 Kips	37.84 Kips
9.01 ft	15.07 Kips	37.84 Kips	52.91 Kips
12.99 ft	30.04 Kips	37.84 Kips	67.88 Kips
13.01 ft	30.13 Kips	39.70 Kips	69.83 Kips
22.01 ft	80.88 Kips	39.70 Kips	120.58 Kips
25.49 ft	100.51 Kips	39.70 Kips	140.21 Kips
25.51 ft	100.62 Kips	18.61 Kips	119.23 Kips
27.99 ft	115.77 Kips	18.61 Kips	134.38 Kips
28.01 ft	115.90 Kips	45.49 Kips	161.39 Kips
30.19 ft	131.02 Kips	45.49 Kips	176.51 Kips
30.21 ft	131.16 Kips	45.49 Kips	176.65 Kips
31.99 ft	144.13 Kips	45.49 Kips	189.62 Kips
32.01 ft	144.26 Kips	40.32 Kips	184.59 Kips
41.01 ft	197.13 Kips	40.32 Kips	237.45 Kips
50.01 ft	250.00 Kips	40.32 Kips	290.32 Kips
59.01 ft	302.86 Kips	40.32 Kips	343.18 Kips
66.99 ft	349.74 Kips	40.32 Kips	390.06 Kips
67.01 ft	349.89 Kips	18.36 Kips	368.25 Kips
76.01 ft	435.85 Kips	18.36 Kips	454.21 Kips
78.99 ft	465.82 Kips	18.36 Kips	484.19 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	800.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	800.00 psf	15.07 Kips
12.99 ft	Cohesive	N/A	N/A	800.00 psf	30.04 Kips
13.01 ft	Cohesive	N/A	N/A	1200.00 psf	30.13 Kips
22.01 ft	Cohesive	N/A	N/A	1200.00 psf	80.88 Kips
25.49 ft	Cohesive	N/A	N/A	1200.00 psf	100.51 Kips
25.51 ft	Cohesive	N/A	N/A	1300.00 psf	100.62 Kips
27.99 ft	Cohesive	N/A	N/A	1300.00 psf	115.77 Kips
28.01 ft	Cohesionless	3488.10 psf	25.15	N/A	115.90 Kips
30.19 ft	Cohesionless	3618.90 psf	25.15	N/A	131.02 Kips
30.21 ft	Cohesionless	3751.79 psf	25.15	N/A	131.16 Kips
31.99 ft	Cohesionless	3803.05 psf	25.15	N/A	144.13 Kips
32.01 ft	Cohesive	N/A	N/A	1250.00 psf	144.26 Kips
41.01 ft	Cohesive	N/A	N/A	1250.00 psf	197.13 Kips
50.01 ft	Cohesive	N/A	N/A	1250.00 psf	250.00 Kips
59.01 ft	Cohesive	N/A	N/A	1250.00 psf	302.86 Kips
66.99 ft	Cohesive	N/A	N/A	1250.00 psf	349.74 Kips
67.01 ft	Cohesionless	6221.47 psf	22.79	N/A	349.89 Kips
76.01 ft	Cohesionless	6480.67 psf	22.79	N/A	435.85 Kips
78.99 ft	Cohesionless	6566.49 psf	22.79	N/A	465.82 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	37.84 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	37.84 Kips
12.99 ft	Cohesive	N/A	N/A	N/A	37.84 Kips
13.01 ft	Cohesive	N/A	N/A	N/A	39.70 Kips
22.01 ft	Cohesive	N/A	N/A	N/A	39.70 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	39.70 Kips
25.51 ft	Cohesive	N/A	N/A	N/A	18.61 Kips
27.99 ft	Cohesive	N/A	N/A	N/A	18.61 Kips
28.01 ft	Cohesionless	3488.70 psf	40.40	45.49 Kips	45.49 Kips
30.19 ft	Cohesionless	3750.30 psf	40.40	45.49 Kips	45.49 Kips
30.21 ft	Cohesionless	3752.08 psf	40.40	45.49 Kips	45.49 Kips
31.99 ft	Cohesionless	3854.60 psf	40.40	45.49 Kips	45.49 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
50.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
59.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
67.01 ft	Cohesionless	6221.76 psf	26.40	18.36 Kips	18.36 Kips
76.01 ft	Cohesionless	6740.16 psf	26.40	18.36 Kips	18.36 Kips
78.99 ft	Cohesionless	6911.80 psf	26.40	18.36 Kips	18.36 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	37.84 Kips	37.84 Kips
9.01 ft	15.07 Kips	37.84 Kips	52.91 Kips
12.99 ft	30.04 Kips	37.84 Kips	67.88 Kips
13.01 ft	30.13 Kips	39.70 Kips	69.83 Kips
22.01 ft	80.88 Kips	39.70 Kips	120.58 Kips
25.49 ft	100.51 Kips	39.70 Kips	140.21 Kips
25.51 ft	100.62 Kips	18.61 Kips	119.23 Kips
27.99 ft	115.77 Kips	18.61 Kips	134.38 Kips
28.01 ft	115.90 Kips	45.49 Kips	161.39 Kips
30.19 ft	131.02 Kips	45.49 Kips	176.51 Kips
30.21 ft	131.16 Kips	45.49 Kips	176.65 Kips
31.99 ft	144.13 Kips	45.49 Kips	189.62 Kips
32.01 ft	144.26 Kips	40.32 Kips	184.59 Kips
41.01 ft	197.13 Kips	40.32 Kips	237.45 Kips
50.01 ft	250.00 Kips	40.32 Kips	290.32 Kips
59.01 ft	302.86 Kips	40.32 Kips	343.18 Kips
66.99 ft	349.74 Kips	40.32 Kips	390.06 Kips
67.01 ft	349.89 Kips	18.36 Kips	368.25 Kips
76.01 ft	435.85 Kips	18.36 Kips	454.21 Kips
78.99 ft	465.82 Kips	18.36 Kips	484.19 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	800.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	800.00 psf	15.07 Kips
12.99 ft	Cohesive	N/A	N/A	800.00 psf	30.04 Kips
13.01 ft	Cohesive	N/A	N/A	1200.00 psf	30.13 Kips
22.01 ft	Cohesive	N/A	N/A	1200.00 psf	80.88 Kips
25.49 ft	Cohesive	N/A	N/A	1200.00 psf	100.51 Kips
25.51 ft	Cohesive	N/A	N/A	1300.00 psf	100.62 Kips
27.99 ft	Cohesive	N/A	N/A	1300.00 psf	115.77 Kips
28.01 ft	Cohesionless	3488.10 psf	25.15	N/A	115.90 Kips
30.19 ft	Cohesionless	3618.90 psf	25.15	N/A	131.02 Kips
30.21 ft	Cohesionless	3751.79 psf	25.15	N/A	131.16 Kips
31.99 ft	Cohesionless	3803.05 psf	25.15	N/A	144.13 Kips
32.01 ft	Cohesive	N/A	N/A	1250.00 psf	144.26 Kips
41.01 ft	Cohesive	N/A	N/A	1250.00 psf	197.13 Kips
50.01 ft	Cohesive	N/A	N/A	1250.00 psf	250.00 Kips
59.01 ft	Cohesive	N/A	N/A	1250.00 psf	302.86 Kips
66.99 ft	Cohesive	N/A	N/A	1250.00 psf	349.74 Kips
67.01 ft	Cohesionless	6221.47 psf	22.79	N/A	349.89 Kips
76.01 ft	Cohesionless	6480.67 psf	22.79	N/A	435.85 Kips
78.99 ft	Cohesionless	6566.49 psf	22.79	N/A	465.82 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	37.84 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	37.84 Kips
12.99 ft	Cohesive	N/A	N/A	N/A	37.84 Kips
13.01 ft	Cohesive	N/A	N/A	N/A	39.70 Kips
22.01 ft	Cohesive	N/A	N/A	N/A	39.70 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	39.70 Kips
25.51 ft	Cohesive	N/A	N/A	N/A	18.61 Kips
27.99 ft	Cohesive	N/A	N/A	N/A	18.61 Kips
28.01 ft	Cohesionless	3488.70 psf	40.40	45.49 Kips	45.49 Kips
30.19 ft	Cohesionless	3750.30 psf	40.40	45.49 Kips	45.49 Kips
30.21 ft	Cohesionless	3752.08 psf	40.40	45.49 Kips	45.49 Kips
31.99 ft	Cohesionless	3854.60 psf	40.40	45.49 Kips	45.49 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
50.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
59.01 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	40.32 Kips
67.01 ft	Cohesionless	6221.76 psf	26.40	18.36 Kips	18.36 Kips
76.01 ft	Cohesionless	6740.16 psf	26.40	18.36 Kips	18.36 Kips
78.99 ft	Cohesionless	6911.80 psf	26.40	18.36 Kips	18.36 Kips

ULTIMATE - SUMMARY OF CAPACITIES

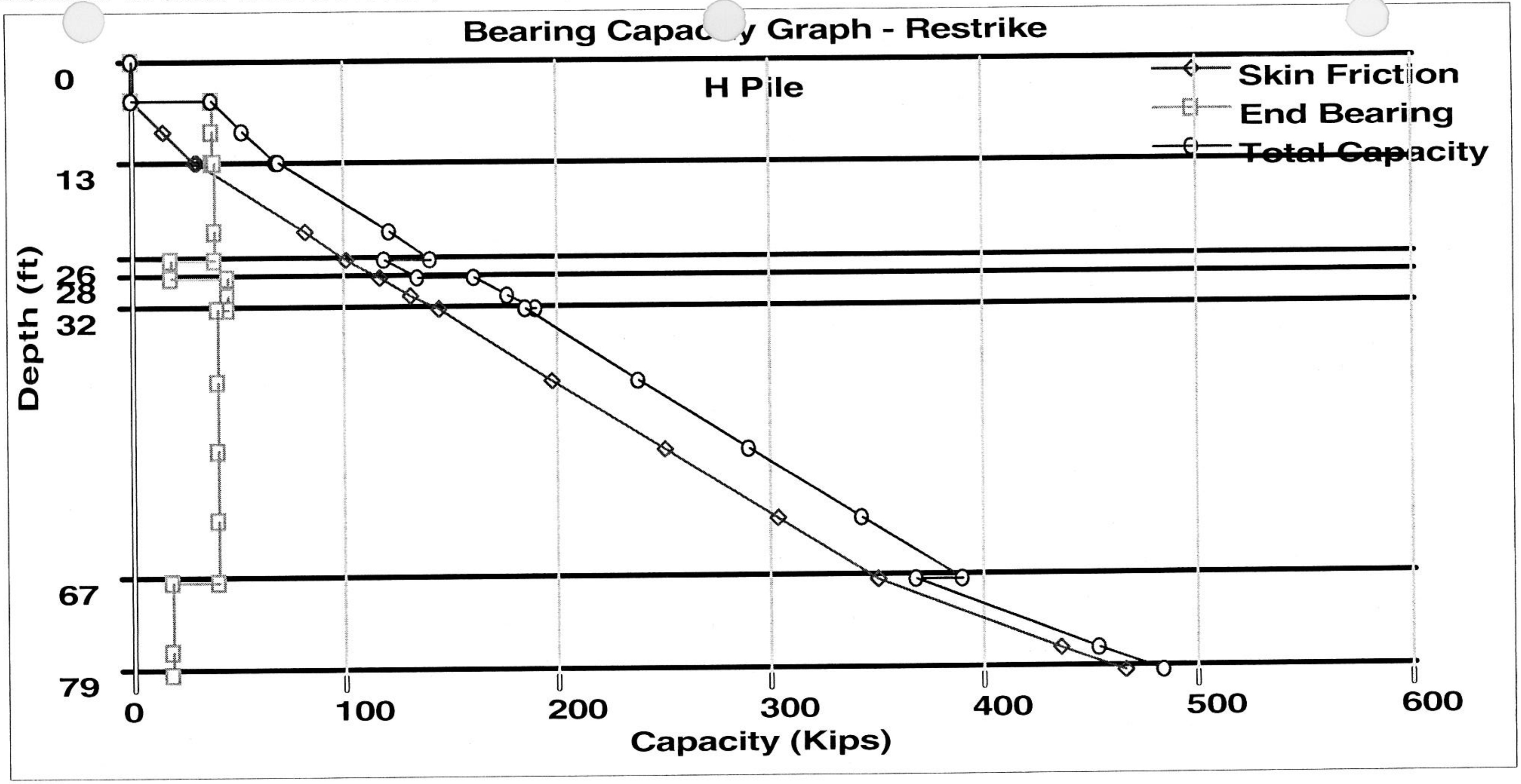
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	37.84 Kips	37.84 Kips
9.01 ft	15.07 Kips	37.84 Kips	52.91 Kips
12.99 ft	30.04 Kips	37.84 Kips	67.88 Kips
13.01 ft	30.13 Kips	39.70 Kips	69.83 Kips
22.01 ft	80.88 Kips	39.70 Kips	120.58 Kips
25.49 ft	100.51 Kips	39.70 Kips	140.21 Kips
25.51 ft	100.62 Kips	18.61 Kips	119.23 Kips
27.99 ft	115.77 Kips	18.61 Kips	134.38 Kips
28.01 ft	115.90 Kips	45.49 Kips	161.39 Kips
30.19 ft	131.02 Kips	45.49 Kips	176.51 Kips
30.21 ft	131.16 Kips	45.49 Kips	176.65 Kips
31.99 ft	144.13 Kips	45.49 Kips	189.62 Kips
32.01 ft	144.26 Kips	40.32 Kips	184.59 Kips
41.01 ft	197.13 Kips	40.32 Kips	237.45 Kips
50.01 ft	250.00 Kips	40.32 Kips	290.32 Kips
59.01 ft	302.86 Kips	40.32 Kips	343.18 Kips
66.99 ft	349.74 Kips	40.32 Kips	390.06 Kips
67.01 ft	349.89 Kips	18.36 Kips	368.25 Kips
76.01 ft	435.85 Kips	18.36 Kips	454.21 Kips
78.99 ft	465.82 Kips	18.36 Kips	484.19 Kips

Allowable capacity = 380 kips

$$@\ depth = 67.01 + (76.01 - 67.01) \times \frac{380 - 368.25}{454.21 - 368.25}$$

= 68.24' or Elev 487.2

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\FORWAR~1\B31HP.DVN



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GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\FORWAR~1\TR36HP.DVN
Project Name: Slocum Ave-TR-36 Project Date: 09/05/2007
Project Client: TranSystems/ODOT-9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: H Pile - HP14X73
Top of Pile: 5.00 ft
Perimeter Analysis: Box
Tip Analysis: Box Area

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	62.00 ft
	- Driving/Restrike	62.00 ft
	- Ultimate:	62.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	20.50 ft	0.00%	125.00 pcf	2844.00 psf	User Def.
2	Cohesive	36.50 ft	0.00%	125.00 pcf	3305.00 psf	User Def.
3	Cohesive	5.00 ft	0.00%	125.00 pcf	4500.00 psf	User Def.
4	Cohesionless	5.00 ft	0.00%	115.00 pcf	28.0/28.0	Nordlund
5	Cohesionless	5.00 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	14.13 Kips
18.01 ft	Cohesive	N/A	N/A	750.00 psf	45.85 Kips
20.49 ft	Cohesive	N/A	N/A	750.00 psf	54.59 Kips
20.51 ft	Cohesive	N/A	N/A	1000.00 psf	54.67 Kips
29.51 ft	Cohesive	N/A	N/A	1000.00 psf	96.97 Kips
38.51 ft	Cohesive	N/A	N/A	1000.00 psf	139.26 Kips
47.51 ft	Cohesive	N/A	N/A	1000.00 psf	181.55 Kips
56.51 ft	Cohesive	N/A	N/A	1000.00 psf	223.84 Kips
56.99 ft	Cohesive	N/A	N/A	1000.00 psf	226.10 Kips
57.01 ft	Cohesive	N/A	N/A	1200.00 psf	226.20 Kips
61.99 ft	Cohesive	N/A	N/A	1200.00 psf	254.29 Kips
62.01 ft	Cohesionless	7750.26 psf	22.00	N/A	254.45 Kips
66.99 ft	Cohesionless	7881.24 psf	22.00	N/A	308.29 Kips
67.01 ft	Cohesionless	8013.29 psf	23.58	N/A	308.53 Kips
71.99 ft	Cohesionless	8156.71 psf	23.58	N/A	372.65 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
20.49 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
20.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
29.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
38.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
47.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
56.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
56.99 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
57.01 ft	Cohesive	N/A	N/A	N/A	55.83 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	55.83 Kips
62.01 ft	Cohesionless	7750.53 psf	22.80	18.36 Kips	18.36 Kips
66.99 ft	Cohesionless	8012.47 psf	22.80	18.36 Kips	18.36 Kips
67.01 ft	Cohesionless	8013.58 psf	30.00	18.36 Kips	18.36 Kips
71.99 ft	Cohesionless	8300.42 psf	30.00	18.36 Kips	18.36 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	35.28 Kips	35.28 Kips
9.01 ft	14.13 Kips	35.28 Kips	49.42 Kips
18.01 ft	45.85 Kips	35.28 Kips	81.14 Kips
20.49 ft	54.59 Kips	35.28 Kips	89.88 Kips
20.51 ft	54.67 Kips	41.00 Kips	95.68 Kips
29.51 ft	96.97 Kips	41.00 Kips	137.97 Kips
38.51 ft	139.26 Kips	41.00 Kips	180.26 Kips
47.51 ft	181.55 Kips	41.00 Kips	222.55 Kips
56.51 ft	223.84 Kips	41.00 Kips	264.85 Kips
56.99 ft	226.10 Kips	41.00 Kips	267.10 Kips
57.01 ft	226.20 Kips	55.83 Kips	282.03 Kips
61.99 ft	254.29 Kips	55.83 Kips	310.11 Kips
62.01 ft	254.45 Kips	18.36 Kips	272.81 Kips
66.99 ft	308.29 Kips	18.36 Kips	326.65 Kips
67.01 ft	308.53 Kips	18.36 Kips	326.89 Kips
71.99 ft	372.65 Kips	18.36 Kips	391.02 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	14.13 Kips
18.01 ft	Cohesive	N/A	N/A	750.00 psf	45.85 Kips
20.49 ft	Cohesive	N/A	N/A	750.00 psf	54.59 Kips
20.51 ft	Cohesive	N/A	N/A	1000.00 psf	54.67 Kips
29.51 ft	Cohesive	N/A	N/A	1000.00 psf	96.97 Kips
38.51 ft	Cohesive	N/A	N/A	1000.00 psf	139.26 Kips
47.51 ft	Cohesive	N/A	N/A	1000.00 psf	181.55 Kips
56.51 ft	Cohesive	N/A	N/A	1000.00 psf	223.84 Kips
56.99 ft	Cohesive	N/A	N/A	1000.00 psf	226.10 Kips
57.01 ft	Cohesive	N/A	N/A	1200.00 psf	226.20 Kips
61.99 ft	Cohesive	N/A	N/A	1200.00 psf	254.29 Kips
62.01 ft	Cohesionless	7750.26 psf	22.00	N/A	254.45 Kips
66.99 ft	Cohesionless	7881.24 psf	22.00	N/A	308.29 Kips
67.01 ft	Cohesionless	8013.29 psf	23.58	N/A	308.53 Kips
71.99 ft	Cohesionless	8156.71 psf	23.58	N/A	372.65 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
20.49 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
20.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
29.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
38.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
47.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
56.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
56.99 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
57.01 ft	Cohesive	N/A	N/A	N/A	55.83 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	55.83 Kips
62.01 ft	Cohesionless	7750.53 psf	22.80	18.36 Kips	18.36 Kips
66.99 ft	Cohesionless	8012.47 psf	22.80	18.36 Kips	18.36 Kips
67.01 ft	Cohesionless	8013.58 psf	30.00	18.36 Kips	18.36 Kips
71.99 ft	Cohesionless	8300.42 psf	30.00	18.36 Kips	18.36 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	35.28 Kips	35.28 Kips
9.01 ft	14.13 Kips	35.28 Kips	49.42 Kips
18.01 ft	45.85 Kips	35.28 Kips	81.14 Kips
20.49 ft	54.59 Kips	35.28 Kips	89.88 Kips
20.51 ft	54.67 Kips	41.00 Kips	95.68 Kips
29.51 ft	96.97 Kips	41.00 Kips	137.97 Kips
38.51 ft	139.26 Kips	41.00 Kips	180.26 Kips
47.51 ft	181.55 Kips	41.00 Kips	222.55 Kips
56.51 ft	223.84 Kips	41.00 Kips	264.85 Kips
56.99 ft	226.10 Kips	41.00 Kips	267.10 Kips
57.01 ft	226.20 Kips	55.83 Kips	282.03 Kips
61.99 ft	254.29 Kips	55.83 Kips	310.11 Kips
62.01 ft	254.45 Kips	18.36 Kips	272.81 Kips
66.99 ft	308.29 Kips	18.36 Kips	326.65 Kips
67.01 ft	308.53 Kips	18.36 Kips	326.89 Kips
71.99 ft	372.65 Kips	18.36 Kips	391.02 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	14.13 Kips
18.01 ft	Cohesive	N/A	N/A	750.00 psf	45.85 Kips
20.49 ft	Cohesive	N/A	N/A	750.00 psf	54.59 Kips
20.51 ft	Cohesive	N/A	N/A	1000.00 psf	54.67 Kips
29.51 ft	Cohesive	N/A	N/A	1000.00 psf	96.97 Kips
38.51 ft	Cohesive	N/A	N/A	1000.00 psf	139.26 Kips
47.51 ft	Cohesive	N/A	N/A	1000.00 psf	181.55 Kips
56.51 ft	Cohesive	N/A	N/A	1000.00 psf	223.84 Kips
56.99 ft	Cohesive	N/A	N/A	1000.00 psf	226.10 Kips
57.01 ft	Cohesive	N/A	N/A	1200.00 psf	226.20 Kips
61.99 ft	Cohesive	N/A	N/A	1200.00 psf	254.29 Kips
62.01 ft	Cohesionless	7750.26 psf	22.00	N/A	254.45 Kips
66.99 ft	Cohesionless	7881.24 psf	22.00	N/A	308.29 Kips
67.01 ft	Cohesionless	8013.29 psf	23.58	N/A	308.53 Kips
71.99 ft	Cohesionless	8156.71 psf	23.58	N/A	372.65 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
20.49 ft	Cohesive	N/A	N/A	N/A	35.28 Kips
20.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
29.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
38.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
47.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
56.51 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
56.99 ft	Cohesive	N/A	N/A	N/A	41.00 Kips
57.01 ft	Cohesive	N/A	N/A	N/A	55.83 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	55.83 Kips
62.01 ft	Cohesionless	7750.53 psf	22.80	18.36 Kips	18.36 Kips
66.99 ft	Cohesionless	8012.47 psf	22.80	18.36 Kips	18.36 Kips
67.01 ft	Cohesionless	8013.58 psf	30.00	18.36 Kips	18.36 Kips
71.99 ft	Cohesionless	8300.42 psf	30.00	18.36 Kips	18.36 Kips

ULTIMATE - SUMMARY OF CAPACITIES

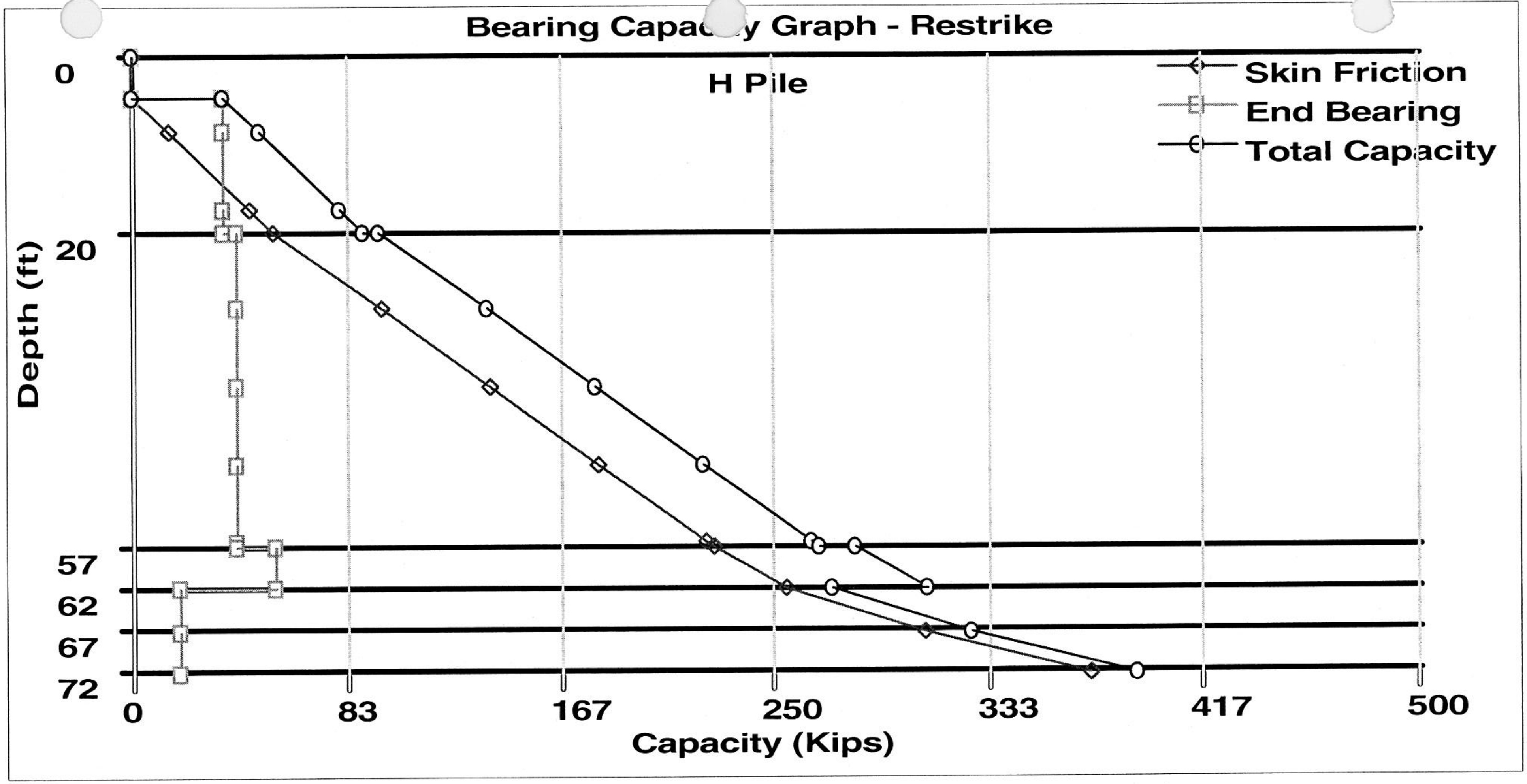
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	35.28 Kips	35.28 Kips
9.01 ft	14.13 Kips	35.28 Kips	49.42 Kips
18.01 ft	45.85 Kips	35.28 Kips	81.14 Kips
20.49 ft	54.59 Kips	35.28 Kips	89.88 Kips
20.51 ft	54.67 Kips	41.00 Kips	95.68 Kips
29.51 ft	96.97 Kips	41.00 Kips	137.97 Kips
38.51 ft	139.26 Kips	41.00 Kips	180.26 Kips
47.51 ft	181.55 Kips	41.00 Kips	222.55 Kips
56.51 ft	223.84 Kips	41.00 Kips	264.85 Kips
56.99 ft	226.10 Kips	41.00 Kips	267.10 Kips
57.01 ft	226.20 Kips	55.83 Kips	282.03 Kips
61.99 ft	254.29 Kips	55.83 Kips	310.11 Kips
62.01 ft	254.45 Kips	18.36 Kips	272.81 Kips
66.99 ft	308.29 Kips	18.36 Kips	326.65 Kips
67.01 ft	308.53 Kips	18.36 Kips	326.89 Kips
71.99 ft	372.65 Kips	18.36 Kips	391.02 Kips

Allowable capacity = 380 Kips

$$@ \text{ depth} = 67.01 + (71.99 - 67.01) \cdot \frac{380 - 326.89}{391.02 - 326.89}$$

$$= 71.13' \text{ or Elev } 481.5$$

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\FORWAR~1\TR36HP.DVN



16” Diameter, Cast-In-Place (CIP) Piles Analyses

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GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\REAR_A~1\TR-38CIP.DVN
Project Name: Slocum Ave- TR-38 Project Date: 09/05/2007
Project Client: TranSystems/ODOT-9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 5.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	9.80 ft
	- Driving/Restrike	9.80 ft
	- Ultimate:	9.80 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	10.00 ft	0.00%	125.00 pcf	2812.00 psf	User Def.
2	Cohesive	23.00 ft	0.00%	120.00 pcf	1333.00 psf	User Def.
3	Cohesionless	5.00 ft	0.00%	120.00 pcf	32.0/32.0	Nordlund
4	Cohesive	22.00 ft	0.00%	130.00 pcf	3500.00 psf	User Def.
5	Cohesionless	8.00 ft	0.00%	125.00 pcf	32.0/32.0	Nordlund
6	Cohesionless	5.00 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund
7	Cohesionless	7.00 ft	0.00%	125.00 pcf	35.0/35.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	12.60 Kips
9.99 ft	Cohesive	N/A	N/A	750.00 psf	15.68 Kips
10.01 ft	Cohesive	N/A	N/A	1100.00 psf	15.75 Kips
19.01 ft	Cohesive	N/A	N/A	1100.00 psf	57.22 Kips
28.01 ft	Cohesive	N/A	N/A	1100.00 psf	98.69 Kips
32.99 ft	Cohesive	N/A	N/A	1100.00 psf	121.64 Kips
33.01 ft	Cohesionless	2562.61 psf	23.44	N/A	121.74 Kips
37.99 ft	Cohesionless	2706.03 psf	23.44	N/A	150.55 Kips
38.01 ft	Cohesive	N/A	N/A	1200.00 psf	150.66 Kips
47.01 ft	Cohesive	N/A	N/A	1200.00 psf	195.90 Kips
56.01 ft	Cohesive	N/A	N/A	1200.00 psf	241.14 Kips
59.99 ft	Cohesive	N/A	N/A	1200.00 psf	261.14 Kips
60.01 ft	Cohesionless	4337.83 psf	23.44	N/A	261.29 Kips
67.99 ft	Cohesionless	4587.61 psf	23.44	N/A	339.55 Kips
68.01 ft	Cohesionless	4838.61 psf	21.97	N/A	339.74 Kips
72.99 ft	Cohesionless	4982.03 psf	21.97	N/A	381.48 Kips
73.01 ft	Cohesionless	5126.63 psf	25.63	N/A	381.72 Kips
79.99 ft	Cohesionless	5345.11 psf	25.63	N/A	488.75 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	35.34 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	35.34 Kips
9.99 ft	Cohesive	N/A	N/A	N/A	35.34 Kips
10.01 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
19.01 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
28.01 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
32.99 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
33.01 ft	Cohesionless	2562.90 psf	40.40	46.08 Kips	46.08 Kips
37.99 ft	Cohesionless	2849.74 psf	40.40	46.08 Kips	46.08 Kips
38.01 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
47.01 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
56.01 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
60.01 ft	Cohesionless	4338.15 psf	40.40	46.08 Kips	46.08 Kips
67.99 ft	Cohesionless	4837.69 psf	40.40	46.08 Kips	46.08 Kips
68.01 ft	Cohesionless	4838.90 psf	30.00	18.60 Kips	18.60 Kips
72.99 ft	Cohesionless	5125.74 psf	30.00	18.60 Kips	18.60 Kips
73.01 ft	Cohesionless	5126.95 psf	64.00	150.24 Kips	150.24 Kips
79.99 ft	Cohesionless	5563.89 psf	64.00	150.24 Kips	150.24 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	35.34 Kips	35.34 Kips
9.01 ft	12.60 Kips	35.34 Kips	47.93 Kips
9.99 ft	15.68 Kips	35.34 Kips	51.01 Kips
10.01 ft	15.75 Kips	16.75 Kips	32.50 Kips
19.01 ft	57.22 Kips	16.75 Kips	73.97 Kips
28.01 ft	98.69 Kips	16.75 Kips	115.44 Kips
32.99 ft	121.64 Kips	16.75 Kips	138.39 Kips
33.01 ft	121.74 Kips	46.08 Kips	167.82 Kips
37.99 ft	150.55 Kips	46.08 Kips	196.63 Kips
38.01 ft	150.66 Kips	43.98 Kips	194.64 Kips
47.01 ft	195.90 Kips	43.98 Kips	239.88 Kips
56.01 ft	241.14 Kips	43.98 Kips	285.12 Kips
59.99 ft	261.14 Kips	43.98 Kips	305.13 Kips
60.01 ft	261.29 Kips	46.08 Kips	307.36 Kips
67.99 ft	339.55 Kips	46.08 Kips	385.63 Kips
68.01 ft	339.74 Kips	18.60 Kips	358.34 Kips
72.99 ft	381.48 Kips	18.60 Kips	400.08 Kips
73.01 ft	381.72 Kips	150.24 Kips	531.95 Kips
79.99 ft	488.75 Kips	150.24 Kips	638.99 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	12.60 Kips
9.99 ft	Cohesive	N/A	N/A	750.00 psf	15.68 Kips
10.01 ft	Cohesive	N/A	N/A	1100.00 psf	15.75 Kips
19.01 ft	Cohesive	N/A	N/A	1100.00 psf	57.22 Kips
28.01 ft	Cohesive	N/A	N/A	1100.00 psf	98.69 Kips
32.99 ft	Cohesive	N/A	N/A	1100.00 psf	121.64 Kips
33.01 ft	Cohesionless	2562.61 psf	23.44	N/A	121.74 Kips
37.99 ft	Cohesionless	2706.03 psf	23.44	N/A	150.55 Kips
38.01 ft	Cohesive	N/A	N/A	1200.00 psf	150.66 Kips
47.01 ft	Cohesive	N/A	N/A	1200.00 psf	195.90 Kips
56.01 ft	Cohesive	N/A	N/A	1200.00 psf	241.14 Kips
59.99 ft	Cohesive	N/A	N/A	1200.00 psf	261.14 Kips
60.01 ft	Cohesionless	4337.83 psf	23.44	N/A	261.29 Kips
67.99 ft	Cohesionless	4587.61 psf	23.44	N/A	339.55 Kips
68.01 ft	Cohesionless	4838.61 psf	21.97	N/A	339.74 Kips
72.99 ft	Cohesionless	4982.03 psf	21.97	N/A	381.48 Kips
73.01 ft	Cohesionless	5126.63 psf	25.63	N/A	381.72 Kips
79.99 ft	Cohesionless	5345.11 psf	25.63	N/A	488.75 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	35.34 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	35.34 Kips
9.99 ft	Cohesive	N/A	N/A	N/A	35.34 Kips
10.01 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
19.01 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
28.01 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
32.99 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
33.01 ft	Cohesionless	2562.90 psf	40.40	46.08 Kips	46.08 Kips
37.99 ft	Cohesionless	2849.74 psf	40.40	46.08 Kips	46.08 Kips
38.01 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
47.01 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
56.01 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
60.01 ft	Cohesionless	4338.15 psf	40.40	46.08 Kips	46.08 Kips
67.99 ft	Cohesionless	4837.69 psf	40.40	46.08 Kips	46.08 Kips
68.01 ft	Cohesionless	4838.90 psf	30.00	18.60 Kips	18.60 Kips
72.99 ft	Cohesionless	5125.74 psf	30.00	18.60 Kips	18.60 Kips
73.01 ft	Cohesionless	5126.95 psf	64.00	150.24 Kips	150.24 Kips
79.99 ft	Cohesionless	5563.89 psf	64.00	150.24 Kips	150.24 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	35.34 Kips	35.34 Kips
9.01 ft	12.60 Kips	35.34 Kips	47.93 Kips
9.99 ft	15.68 Kips	35.34 Kips	51.01 Kips
10.01 ft	15.75 Kips	16.75 Kips	32.50 Kips
19.01 ft	57.22 Kips	16.75 Kips	73.97 Kips
28.01 ft	98.69 Kips	16.75 Kips	115.44 Kips
32.99 ft	121.64 Kips	16.75 Kips	138.39 Kips
33.01 ft	121.74 Kips	46.08 Kips	167.82 Kips
37.99 ft	150.55 Kips	46.08 Kips	196.63 Kips
38.01 ft	150.66 Kips	43.98 Kips	194.64 Kips
47.01 ft	195.90 Kips	43.98 Kips	239.88 Kips
56.01 ft	241.14 Kips	43.98 Kips	285.12 Kips
59.99 ft	261.14 Kips	43.98 Kips	305.13 Kips
60.01 ft	261.29 Kips	46.08 Kips	307.36 Kips
67.99 ft	339.55 Kips	46.08 Kips	385.63 Kips
68.01 ft	339.74 Kips	18.60 Kips	358.34 Kips
72.99 ft	381.48 Kips	18.60 Kips	400.08 Kips
73.01 ft	381.72 Kips	150.24 Kips	531.95 Kips
79.99 ft	488.75 Kips	150.24 Kips	638.99 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	12.60 Kips
9.99 ft	Cohesive	N/A	N/A	750.00 psf	15.68 Kips
10.01 ft	Cohesive	N/A	N/A	1100.00 psf	15.75 Kips
19.01 ft	Cohesive	N/A	N/A	1100.00 psf	57.22 Kips
28.01 ft	Cohesive	N/A	N/A	1100.00 psf	98.69 Kips
32.99 ft	Cohesive	N/A	N/A	1100.00 psf	121.64 Kips
33.01 ft	Cohesionless	2562.61 psf	23.44	N/A	121.74 Kips
37.99 ft	Cohesionless	2706.03 psf	23.44	N/A	150.55 Kips
38.01 ft	Cohesive	N/A	N/A	1200.00 psf	150.66 Kips
47.01 ft	Cohesive	N/A	N/A	1200.00 psf	195.90 Kips
56.01 ft	Cohesive	N/A	N/A	1200.00 psf	241.14 Kips
59.99 ft	Cohesive	N/A	N/A	1200.00 psf	261.14 Kips
60.01 ft	Cohesionless	4337.83 psf	23.44	N/A	261.29 Kips
67.99 ft	Cohesionless	4587.61 psf	23.44	N/A	339.55 Kips
68.01 ft	Cohesionless	4838.61 psf	21.97	N/A	339.74 Kips
72.99 ft	Cohesionless	4982.03 psf	21.97	N/A	381.48 Kips
73.01 ft	Cohesionless	5126.63 psf	25.63	N/A	381.72 Kips
79.99 ft	Cohesionless	5345.11 psf	25.63	N/A	488.75 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	35.34 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	35.34 Kips
9.99 ft	Cohesive	N/A	N/A	N/A	35.34 Kips
10.01 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
19.01 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
28.01 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
32.99 ft	Cohesive	N/A	N/A	N/A	16.75 Kips
33.01 ft	Cohesionless	2562.90 psf	40.40	46.08 Kips	46.08 Kips
37.99 ft	Cohesionless	2849.74 psf	40.40	46.08 Kips	46.08 Kips
38.01 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
47.01 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
56.01 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	43.98 Kips
60.01 ft	Cohesionless	4338.15 psf	40.40	46.08 Kips	46.08 Kips
67.99 ft	Cohesionless	4837.69 psf	40.40	46.08 Kips	46.08 Kips
68.01 ft	Cohesionless	4838.90 psf	30.00	18.60 Kips	18.60 Kips
72.99 ft	Cohesionless	5125.74 psf	30.00	18.60 Kips	18.60 Kips
73.01 ft	Cohesionless	5126.95 psf	64.00	150.24 Kips	150.24 Kips
79.99 ft	Cohesionless	5563.89 psf	64.00	150.24 Kips	150.24 Kips

ULTIMATE - SUMMARY OF CAPACITIES

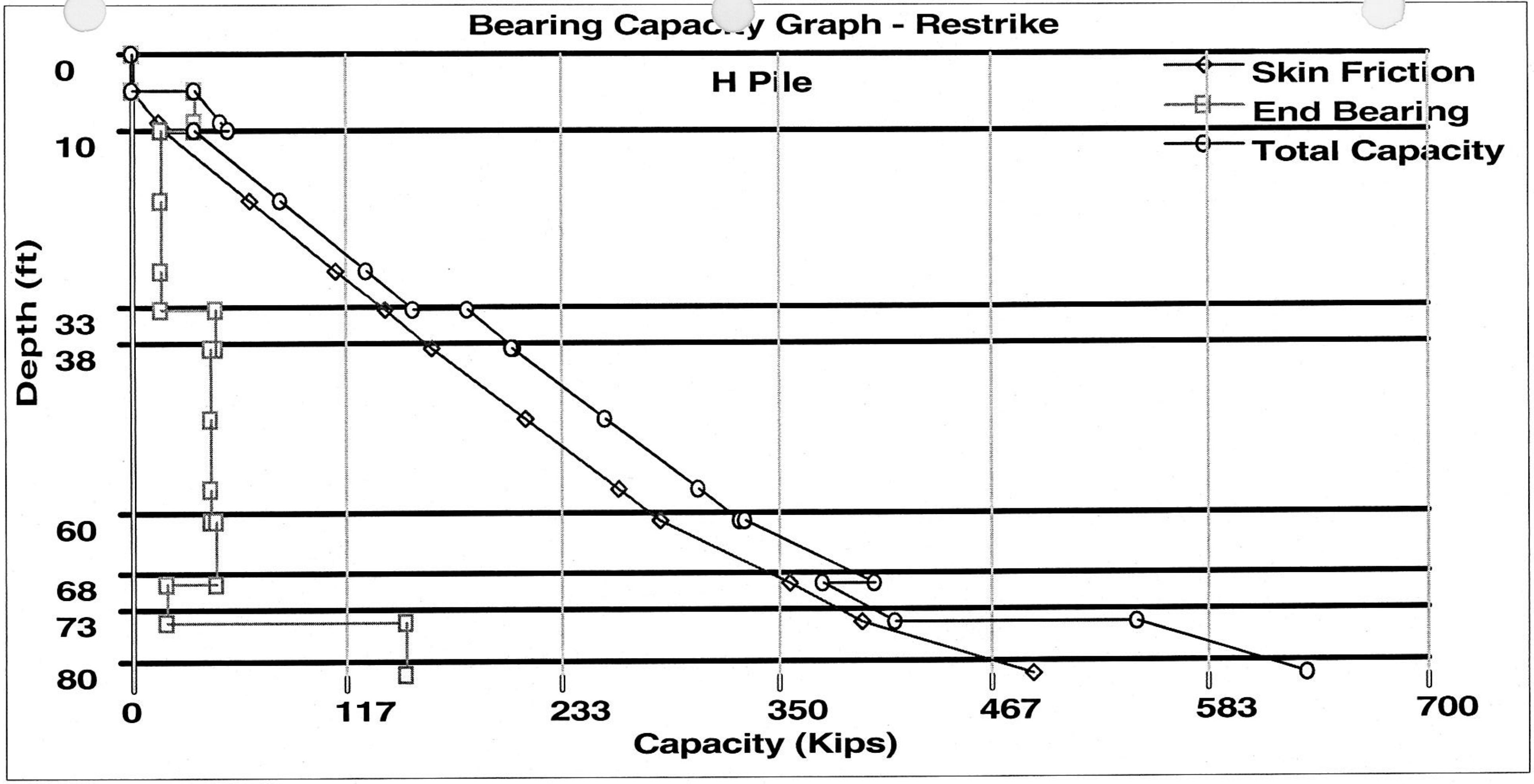
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	35.34 Kips	35.34 Kips
9.01 ft	12.60 Kips	35.34 Kips	47.93 Kips
9.99 ft	15.68 Kips	35.34 Kips	51.01 Kips
10.01 ft	15.75 Kips	16.75 Kips	32.50 Kips
19.01 ft	57.22 Kips	16.75 Kips	73.97 Kips
28.01 ft	98.69 Kips	16.75 Kips	115.44 Kips
32.99 ft	121.64 Kips	16.75 Kips	138.39 Kips
33.01 ft	121.74 Kips	46.08 Kips	167.82 Kips
37.99 ft	150.55 Kips	46.08 Kips	196.63 Kips
38.01 ft	150.66 Kips	43.98 Kips	194.64 Kips
47.01 ft	195.90 Kips	43.98 Kips	239.88 Kips
56.01 ft	241.14 Kips	43.98 Kips	285.12 Kips
59.99 ft	261.14 Kips	43.98 Kips	305.13 Kips
60.01 ft	261.29 Kips	46.08 Kips	307.36 Kips
67.99 ft	339.55 Kips	46.08 Kips	385.63 Kips
68.01 ft	339.74 Kips	18.60 Kips	358.34 Kips
72.99 ft	381.48 Kips	18.60 Kips	400.08 Kips
73.01 ft	381.72 Kips	150.24 Kips	531.95 Kips
79.99 ft	488.75 Kips	150.24 Kips	638.99 Kips

Allowable capacity = 360 kips

@ depths $= 68.01 + (72.99 - 68.01) \cdot \frac{360 - 358.34}{400.08 - 358.34}$

$= 68.2'$ or Elev 485.8

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\REAR_A~1\TR-38HP.DVN



Bearing Capacity Graph - Restrike

DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\REAR_A~1\TR-38ACP.DVN
Project Name: Slocum Ave-TR-38A Project Date: 09/05/2007
Project Client: TranSystems/ODOT-9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 5.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	41.50 ft
	- Driving/Restrike	41.50 ft
	- Ultimate:	41.50 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	10.50 ft	0.00%	125.00 pcf	3312.00 psf	User Def.
2	Cohesive	31.50 ft	0.00%	120.00 pcf	1227.00 psf	User Def.
3	Cohesionless	3.80 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund
4	Cohesive	6.20 ft	0.00%	130.00 pcf	4000.00 psf	User Def.
5	Cohesive	10.00 ft	0.00%	125.00 pcf	2125.00 psf	User Def.
6	Cohesive	5.00 ft	0.00%	115.00 pcf	500.00 psf	User Def.
7	Cohesionless	10.00 ft	0.00%	125.00 pcf	29.0/29.0	Nordlund
8	Cohesive	4.00 ft	0.00%	130.00 pcf	4000.00 psf	User Def.

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	700.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	700.00 psf	11.76 Kips
10.49 ft	Cohesive	N/A	N/A	700.00 psf	16.10 Kips
10.51 ft	Cohesive	N/A	N/A	1100.00 psf	16.17 Kips
19.51 ft	Cohesive	N/A	N/A	1100.00 psf	57.64 Kips
28.51 ft	Cohesive	N/A	N/A	1100.00 psf	99.11 Kips
37.51 ft	Cohesive	N/A	N/A	1100.00 psf	140.58 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	161.22 Kips
42.01 ft	Cohesionless	5061.59 psf	21.97	N/A	161.35 Kips
45.79 ft	Cohesionless	5170.45 psf	21.97	N/A	194.24 Kips
45.81 ft	Cohesive	N/A	N/A	1200.00 psf	194.38 Kips
51.99 ft	Cohesive	N/A	N/A	1200.00 psf	225.44 Kips
52.01 ft	Cohesive	N/A	N/A	1550.00 psf	225.56 Kips
61.01 ft	Cohesive	N/A	N/A	1550.00 psf	283.99 Kips
61.99 ft	Cohesive	N/A	N/A	1550.00 psf	290.35 Kips
62.01 ft	Cohesive	N/A	N/A	400.00 psf	290.43 Kips
66.99 ft	Cohesive	N/A	N/A	400.00 psf	298.78 Kips
67.01 ft	Cohesionless	6588.61 psf	21.24	N/A	298.90 Kips
76.01 ft	Cohesionless	6870.31 psf	21.24	N/A	394.64 Kips
76.99 ft	Cohesionless	6900.99 psf	21.24	N/A	405.54 Kips
77.01 ft	Cohesive	N/A	N/A	1200.00 psf	405.70 Kips
80.99 ft	Cohesive	N/A	N/A	1200.00 psf	425.70 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	41.62 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	41.62 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	41.62 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
28.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
37.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
42.01 ft	Cohesionless	5061.88 psf	30.00	18.60 Kips	18.60 Kips
45.79 ft	Cohesionless	5279.60 psf	30.00	18.60 Kips	18.60 Kips
45.81 ft	Cohesive	N/A	N/A	N/A	50.27 Kips
51.99 ft	Cohesive	N/A	N/A	N/A	50.27 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	26.70 Kips
61.01 ft	Cohesive	N/A	N/A	N/A	26.70 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	26.70 Kips
62.01 ft	Cohesive	N/A	N/A	N/A	6.28 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	6.28 Kips
67.01 ft	Cohesionless	6588.93 psf	26.40	18.60 Kips	18.60 Kips
76.01 ft	Cohesionless	7152.33 psf	26.40	18.60 Kips	18.60 Kips
76.99 ft	Cohesionless	7213.67 psf	26.40	18.60 Kips	18.60 Kips
77.01 ft	Cohesive	N/A	N/A	N/A	50.27 Kips
80.99 ft	Cohesive	N/A	N/A	N/A	50.27 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	41.62 Kips	41.62 Kips
9.01 ft	11.76 Kips	41.62 Kips	53.38 Kips
10.49 ft	16.10 Kips	41.62 Kips	57.72 Kips
10.51 ft	16.17 Kips	15.42 Kips	31.59 Kips
19.51 ft	57.64 Kips	15.42 Kips	73.06 Kips
28.51 ft	99.11 Kips	15.42 Kips	114.53 Kips
37.51 ft	140.58 Kips	15.42 Kips	156.00 Kips
41.99 ft	161.22 Kips	15.42 Kips	176.64 Kips
42.01 ft	161.35 Kips	18.60 Kips	179.95 Kips
45.79 ft	194.24 Kips	18.60 Kips	212.83 Kips
45.81 ft	194.38 Kips	50.27 Kips	244.64 Kips
51.99 ft	225.44 Kips	50.27 Kips	275.71 Kips
52.01 ft	225.56 Kips	26.70 Kips	252.26 Kips
61.01 ft	283.99 Kips	26.70 Kips	310.69 Kips
61.99 ft	290.35 Kips	26.70 Kips	317.05 Kips
62.01 ft	290.43 Kips	6.28 Kips	296.72 Kips
66.99 ft	298.78 Kips	6.28 Kips	305.06 Kips
67.01 ft	298.90 Kips	18.60 Kips	317.49 Kips
76.01 ft	394.64 Kips	18.60 Kips	413.24 Kips
76.99 ft	405.54 Kips	18.60 Kips	424.13 Kips
77.01 ft	405.70 Kips	50.27 Kips	455.96 Kips
80.99 ft	425.70 Kips	50.27 Kips	475.97 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	700.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	700.00 psf	11.76 Kips
10.49 ft	Cohesive	N/A	N/A	700.00 psf	16.10 Kips
10.51 ft	Cohesive	N/A	N/A	1100.00 psf	16.17 Kips
19.51 ft	Cohesive	N/A	N/A	1100.00 psf	57.64 Kips
28.51 ft	Cohesive	N/A	N/A	1100.00 psf	99.11 Kips
37.51 ft	Cohesive	N/A	N/A	1100.00 psf	140.58 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	161.22 Kips
42.01 ft	Cohesionless	5061.59 psf	21.97	N/A	161.35 Kips
45.79 ft	Cohesionless	5170.45 psf	21.97	N/A	194.24 Kips
45.81 ft	Cohesive	N/A	N/A	1200.00 psf	194.38 Kips
51.99 ft	Cohesive	N/A	N/A	1200.00 psf	225.44 Kips
52.01 ft	Cohesive	N/A	N/A	1550.00 psf	225.56 Kips
61.01 ft	Cohesive	N/A	N/A	1550.00 psf	283.99 Kips
61.99 ft	Cohesive	N/A	N/A	1550.00 psf	290.35 Kips
62.01 ft	Cohesive	N/A	N/A	400.00 psf	290.43 Kips
66.99 ft	Cohesive	N/A	N/A	400.00 psf	298.78 Kips
67.01 ft	Cohesionless	6588.61 psf	21.24	N/A	298.90 Kips
76.01 ft	Cohesionless	6870.31 psf	21.24	N/A	394.64 Kips
76.99 ft	Cohesionless	6900.99 psf	21.24	N/A	405.54 Kips
77.01 ft	Cohesive	N/A	N/A	1200.00 psf	405.70 Kips
80.99 ft	Cohesive	N/A	N/A	1200.00 psf	425.70 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	41.62 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	41.62 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	41.62 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
28.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
37.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
42.01 ft	Cohesionless	5061.88 psf	30.00	18.60 Kips	18.60 Kips
45.79 ft	Cohesionless	5279.60 psf	30.00	18.60 Kips	18.60 Kips
45.81 ft	Cohesive	N/A	N/A	N/A	50.27 Kips
51.99 ft	Cohesive	N/A	N/A	N/A	50.27 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	26.70 Kips
61.01 ft	Cohesive	N/A	N/A	N/A	26.70 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	26.70 Kips
62.01 ft	Cohesive	N/A	N/A	N/A	6.28 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	6.28 Kips
67.01 ft	Cohesionless	6588.93 psf	26.40	18.60 Kips	18.60 Kips
76.01 ft	Cohesionless	7152.33 psf	26.40	18.60 Kips	18.60 Kips
76.99 ft	Cohesionless	7213.67 psf	26.40	18.60 Kips	18.60 Kips
77.01 ft	Cohesive	N/A	N/A	N/A	50.27 Kips
80.99 ft	Cohesive	N/A	N/A	N/A	50.27 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	41.62 Kips	41.62 Kips
9.01 ft	11.76 Kips	41.62 Kips	53.38 Kips
10.49 ft	16.10 Kips	41.62 Kips	57.72 Kips
10.51 ft	16.17 Kips	15.42 Kips	31.59 Kips
19.51 ft	57.64 Kips	15.42 Kips	73.06 Kips
28.51 ft	99.11 Kips	15.42 Kips	114.53 Kips
37.51 ft	140.58 Kips	15.42 Kips	156.00 Kips
41.99 ft	161.22 Kips	15.42 Kips	176.64 Kips
42.01 ft	161.35 Kips	18.60 Kips	179.95 Kips
45.79 ft	194.24 Kips	18.60 Kips	212.83 Kips
45.81 ft	194.38 Kips	50.27 Kips	244.64 Kips
51.99 ft	225.44 Kips	50.27 Kips	275.71 Kips
52.01 ft	225.56 Kips	26.70 Kips	252.26 Kips
61.01 ft	283.99 Kips	26.70 Kips	310.69 Kips
61.99 ft	290.35 Kips	26.70 Kips	317.05 Kips
62.01 ft	290.43 Kips	6.28 Kips	296.72 Kips
66.99 ft	298.78 Kips	6.28 Kips	305.06 Kips
67.01 ft	298.90 Kips	18.60 Kips	317.49 Kips
76.01 ft	394.64 Kips	18.60 Kips	413.24 Kips
76.99 ft	405.54 Kips	18.60 Kips	424.13 Kips
77.01 ft	405.70 Kips	50.27 Kips	455.96 Kips
80.99 ft	425.70 Kips	50.27 Kips	475.97 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	700.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	700.00 psf	11.76 Kips
10.49 ft	Cohesive	N/A	N/A	700.00 psf	16.10 Kips
10.51 ft	Cohesive	N/A	N/A	1100.00 psf	16.17 Kips
19.51 ft	Cohesive	N/A	N/A	1100.00 psf	57.64 Kips
28.51 ft	Cohesive	N/A	N/A	1100.00 psf	99.11 Kips
37.51 ft	Cohesive	N/A	N/A	1100.00 psf	140.58 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	161.22 Kips
42.01 ft	Cohesionless	5061.59 psf	21.97	N/A	161.35 Kips
45.79 ft	Cohesionless	5170.45 psf	21.97	N/A	194.24 Kips
45.81 ft	Cohesive	N/A	N/A	1200.00 psf	194.38 Kips
51.99 ft	Cohesive	N/A	N/A	1200.00 psf	225.44 Kips
52.01 ft	Cohesive	N/A	N/A	1550.00 psf	225.56 Kips
61.01 ft	Cohesive	N/A	N/A	1550.00 psf	283.99 Kips
61.99 ft	Cohesive	N/A	N/A	1550.00 psf	290.35 Kips
62.01 ft	Cohesive	N/A	N/A	400.00 psf	290.43 Kips
66.99 ft	Cohesive	N/A	N/A	400.00 psf	298.78 Kips
67.01 ft	Cohesionless	6588.61 psf	21.24	N/A	298.90 Kips
76.01 ft	Cohesionless	6870.31 psf	21.24	N/A	394.64 Kips
76.99 ft	Cohesionless	6900.99 psf	21.24	N/A	405.54 Kips
77.01 ft	Cohesive	N/A	N/A	1200.00 psf	405.70 Kips
80.99 ft	Cohesive	N/A	N/A	1200.00 psf	425.70 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	41.62 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	41.62 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	41.62 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
28.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
37.51 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	15.42 Kips
42.01 ft	Cohesionless	5061.88 psf	30.00	18.60 Kips	18.60 Kips
45.79 ft	Cohesionless	5279.60 psf	30.00	18.60 Kips	18.60 Kips
45.81 ft	Cohesive	N/A	N/A	N/A	50.27 Kips
51.99 ft	Cohesive	N/A	N/A	N/A	50.27 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	26.70 Kips
61.01 ft	Cohesive	N/A	N/A	N/A	26.70 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	26.70 Kips
62.01 ft	Cohesive	N/A	N/A	N/A	6.28 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	6.28 Kips
67.01 ft	Cohesionless	6588.93 psf	26.40	18.60 Kips	18.60 Kips
76.01 ft	Cohesionless	7152.33 psf	26.40	18.60 Kips	18.60 Kips
76.99 ft	Cohesionless	7213.67 psf	26.40	18.60 Kips	18.60 Kips
77.01 ft	Cohesive	N/A	N/A	N/A	50.27 Kips
80.99 ft	Cohesive	N/A	N/A	N/A	50.27 Kips

ULTIMATE - SUMMARY OF CAPACITIES

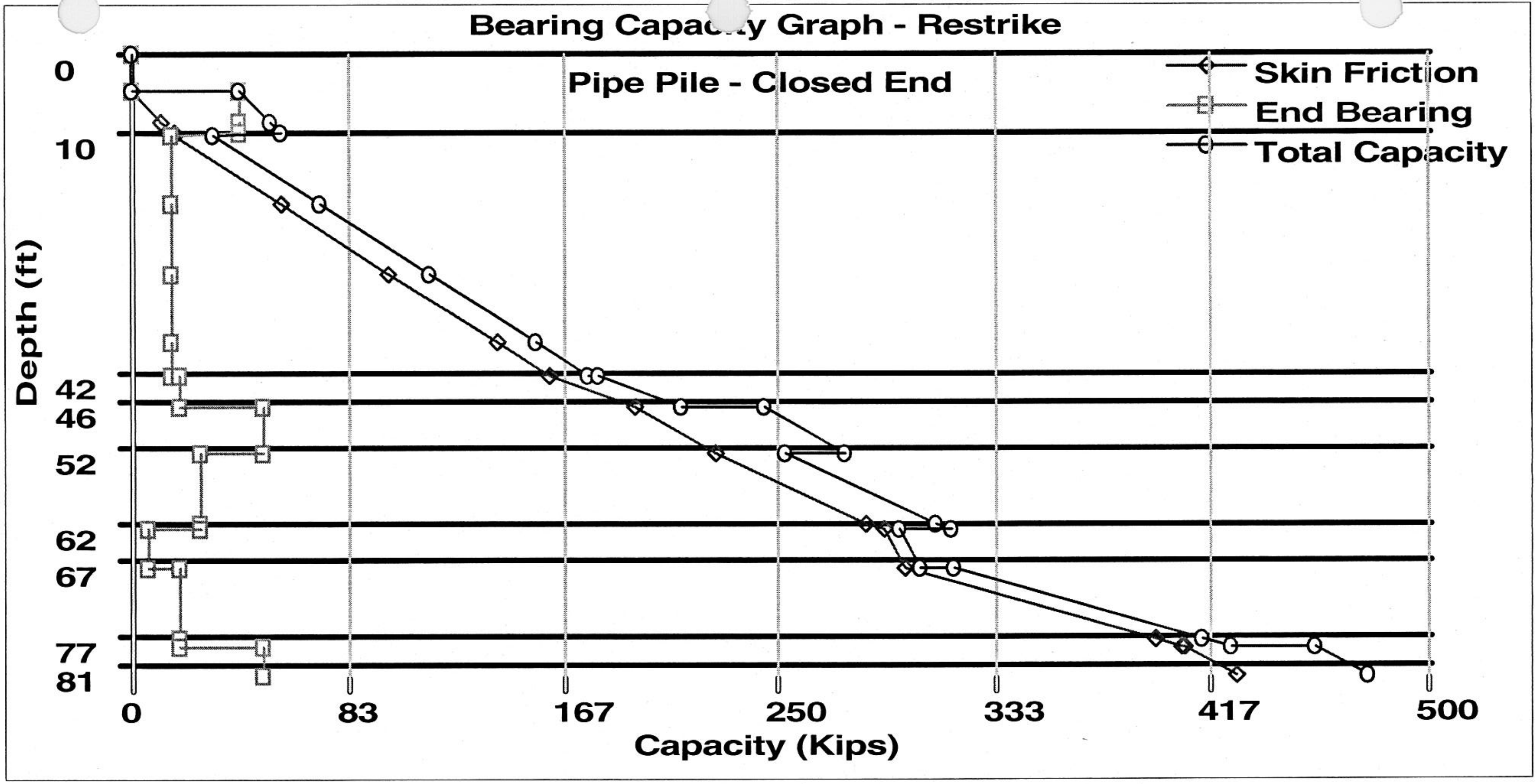
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	41.62 Kips	41.62 Kips
9.01 ft	11.76 Kips	41.62 Kips	53.38 Kips
10.49 ft	16.10 Kips	41.62 Kips	57.72 Kips
10.51 ft	16.17 Kips	15.42 Kips	31.59 Kips
19.51 ft	57.64 Kips	15.42 Kips	73.06 Kips
28.51 ft	99.11 Kips	15.42 Kips	114.53 Kips
37.51 ft	140.58 Kips	15.42 Kips	156.00 Kips
41.99 ft	161.22 Kips	15.42 Kips	176.64 Kips
42.01 ft	161.35 Kips	18.60 Kips	179.95 Kips
45.79 ft	194.24 Kips	18.60 Kips	212.83 Kips
45.81 ft	194.38 Kips	50.27 Kips	244.64 Kips
51.99 ft	225.44 Kips	50.27 Kips	275.71 Kips
52.01 ft	225.56 Kips	26.70 Kips	252.26 Kips
61.01 ft	283.99 Kips	26.70 Kips	310.69 Kips
61.99 ft	290.35 Kips	26.70 Kips	317.05 Kips
62.01 ft	290.43 Kips	6.28 Kips	296.72 Kips
66.99 ft	298.78 Kips	6.28 Kips	305.06 Kips
67.01 ft	298.90 Kips	18.60 Kips	317.49 Kips
76.01 ft	394.64 Kips	18.60 Kips	413.24 Kips
76.99 ft	405.54 Kips	18.60 Kips	424.13 Kips
77.01 ft	405.70 Kips	50.27 Kips	455.96 Kips
80.99 ft	425.70 Kips	50.27 Kips	475.97 Kips

Allowable capacity = 360 kips

$$@\ depth = 67.01+(7601-67.01)\times\frac{360-317.49}{413.24-317.49}$$

= 71.0 or Elev 485.0

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\REAR_A~1\TR-38ACP.DVN



Bearing Capacity Graph - Restrike

DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\PIER_1~1\TR37CIP.DVN
Project Name: Slocum Ave - TR-37 Project Date: 08/02/2007
Project Client: TranSystems/ODOT-9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 5.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	16.00 ft
	- Driving/Restrike	16.00 ft
	- Ultimate:	16.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	10.50 ft	0.00%	125.00 pcf	1920.00 psf	User Def.
2	Cohesive	15.00 ft	0.00%	125.00 pcf	2000.00 psf	User Def.
3	Cohesionless	6.50 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund
4	Cohesive	10.00 ft	0.00%	130.00 pcf	4375.00 psf	User Def.
5	Cohesive	20.00 ft	0.00%	130.00 pcf	4312.00 psf	User Def.
6	Cohesionless	5.00 ft	0.00%	125.00 pcf	34.0/34.0	Nordlund
7	Cohesionless	5.00 ft	0.00%	125.00 pcf	29.0/29.0	Nordlund
8	Cohesionless	5.00 ft	0.00%	120.00 pcf	28.0/28.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1200.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1200.00 psf	20.16 Kips
10.49 ft	Cohesive	N/A	N/A	1200.00 psf	27.60 Kips
10.51 ft	Cohesive	N/A	N/A	1500.00 psf	27.71 Kips
19.51 ft	Cohesive	N/A	N/A	1500.00 psf	84.26 Kips
25.49 ft	Cohesive	N/A	N/A	1500.00 psf	121.83 Kips
25.51 ft	Cohesionless	2594.99 psf	21.97	N/A	121.94 Kips
31.99 ft	Cohesionless	2781.61 psf	21.97	N/A	152.27 Kips
32.01 ft	Cohesive	N/A	N/A	1100.00 psf	152.36 Kips
41.01 ft	Cohesive	N/A	N/A	1100.00 psf	193.83 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	198.35 Kips
42.01 ft	Cohesive	N/A	N/A	1100.00 psf	198.44 Kips
51.01 ft	Cohesive	N/A	N/A	1100.00 psf	239.91 Kips
60.01 ft	Cohesive	N/A	N/A	1100.00 psf	281.38 Kips
61.99 ft	Cohesive	N/A	N/A	1100.00 psf	290.50 Kips
62.01 ft	Cohesionless	4997.41 psf	24.90	N/A	290.68 Kips
66.99 ft	Cohesionless	5153.29 psf	24.90	N/A	357.90 Kips
67.01 ft	Cohesionless	5310.41 psf	21.24	N/A	358.12 Kips
71.99 ft	Cohesionless	5466.29 psf	21.24	N/A	400.27 Kips
72.01 ft	Cohesionless	5623.39 psf	20.51	N/A	400.44 Kips
76.99 ft	Cohesionless	5766.81 psf	20.51	N/A	441.18 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	24.13 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	24.13 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	24.13 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	25.13 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	25.13 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	25.13 Kips
25.51 ft	Cohesionless	2595.28 psf	30.00	18.60 Kips	18.60 Kips
31.99 ft	Cohesionless	2968.52 psf	30.00	18.60 Kips	18.60 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	54.98 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	54.98 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	54.98 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
60.01 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
62.01 ft	Cohesionless	4997.73 psf	55.60	102.65 Kips	102.65 Kips
66.99 ft	Cohesionless	5309.47 psf	55.60	102.65 Kips	102.65 Kips
67.01 ft	Cohesionless	5310.73 psf	26.40	18.60 Kips	18.60 Kips
71.99 ft	Cohesionless	5622.47 psf	26.40	18.60 Kips	18.60 Kips
72.01 ft	Cohesionless	5623.68 psf	22.80	18.60 Kips	18.60 Kips
76.99 ft	Cohesionless	5910.52 psf	22.80	18.60 Kips	18.60 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	24.13 Kips	24.13 Kips
9.01 ft	20.16 Kips	24.13 Kips	44.28 Kips
10.49 ft	27.60 Kips	24.13 Kips	51.72 Kips
10.51 ft	27.71 Kips	25.13 Kips	52.84 Kips
19.51 ft	84.26 Kips	25.13 Kips	109.39 Kips
25.49 ft	121.83 Kips	25.13 Kips	146.96 Kips
25.51 ft	121.94 Kips	18.60 Kips	140.54 Kips
31.99 ft	152.27 Kips	18.60 Kips	170.86 Kips
32.01 ft	152.36 Kips	54.98 Kips	207.34 Kips
41.01 ft	193.83 Kips	54.98 Kips	248.81 Kips
41.99 ft	198.35 Kips	54.98 Kips	253.32 Kips
42.01 ft	198.44 Kips	54.19 Kips	252.62 Kips
51.01 ft	239.91 Kips	54.19 Kips	294.09 Kips
60.01 ft	281.38 Kips	54.19 Kips	335.56 Kips
61.99 ft	290.50 Kips	54.19 Kips	344.69 Kips
62.01 ft	290.68 Kips	102.65 Kips	393.33 Kips
66.99 ft	357.90 Kips	102.65 Kips	460.55 Kips
67.01 ft	358.12 Kips	18.60 Kips	376.72 Kips
71.99 ft	400.27 Kips	18.60 Kips	418.87 Kips
72.01 ft	400.44 Kips	18.60 Kips	419.03 Kips
76.99 ft	441.18 Kips	18.60 Kips	459.77 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1200.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1200.00 psf	20.16 Kips
10.49 ft	Cohesive	N/A	N/A	1200.00 psf	27.60 Kips
10.51 ft	Cohesive	N/A	N/A	1500.00 psf	27.71 Kips
19.51 ft	Cohesive	N/A	N/A	1500.00 psf	84.26 Kips
25.49 ft	Cohesive	N/A	N/A	1500.00 psf	121.83 Kips
25.51 ft	Cohesionless	2594.99 psf	21.97	N/A	121.94 Kips
31.99 ft	Cohesionless	2781.61 psf	21.97	N/A	152.27 Kips
32.01 ft	Cohesive	N/A	N/A	1100.00 psf	152.36 Kips
41.01 ft	Cohesive	N/A	N/A	1100.00 psf	193.83 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	198.35 Kips
42.01 ft	Cohesive	N/A	N/A	1100.00 psf	198.44 Kips
51.01 ft	Cohesive	N/A	N/A	1100.00 psf	239.91 Kips
60.01 ft	Cohesive	N/A	N/A	1100.00 psf	281.38 Kips
61.99 ft	Cohesive	N/A	N/A	1100.00 psf	290.50 Kips
62.01 ft	Cohesionless	4997.41 psf	24.90	N/A	290.68 Kips
66.99 ft	Cohesionless	5153.29 psf	24.90	N/A	357.90 Kips
67.01 ft	Cohesionless	5310.41 psf	21.24	N/A	358.12 Kips
71.99 ft	Cohesionless	5466.29 psf	21.24	N/A	400.27 Kips
72.01 ft	Cohesionless	5623.39 psf	20.51	N/A	400.44 Kips
76.99 ft	Cohesionless	5766.81 psf	20.51	N/A	441.18 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	24.13 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	24.13 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	24.13 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	25.13 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	25.13 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	25.13 Kips
25.51 ft	Cohesionless	2595.28 psf	30.00	18.60 Kips	18.60 Kips
31.99 ft	Cohesionless	2968.52 psf	30.00	18.60 Kips	18.60 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	54.98 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	54.98 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	54.98 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
60.01 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
62.01 ft	Cohesionless	4997.73 psf	55.60	102.65 Kips	102.65 Kips
66.99 ft	Cohesionless	5309.47 psf	55.60	102.65 Kips	102.65 Kips
67.01 ft	Cohesionless	5310.73 psf	26.40	18.60 Kips	18.60 Kips
71.99 ft	Cohesionless	5622.47 psf	26.40	18.60 Kips	18.60 Kips
72.01 ft	Cohesionless	5623.68 psf	22.80	18.60 Kips	18.60 Kips
76.99 ft	Cohesionless	5910.52 psf	22.80	18.60 Kips	18.60 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	24.13 Kips	24.13 Kips
9.01 ft	20.16 Kips	24.13 Kips	44.28 Kips
10.49 ft	27.60 Kips	24.13 Kips	51.72 Kips
10.51 ft	27.71 Kips	25.13 Kips	52.84 Kips
19.51 ft	84.26 Kips	25.13 Kips	109.39 Kips
25.49 ft	121.83 Kips	25.13 Kips	146.96 Kips
25.51 ft	121.94 Kips	18.60 Kips	140.54 Kips
31.99 ft	152.27 Kips	18.60 Kips	170.86 Kips
32.01 ft	152.36 Kips	54.98 Kips	207.34 Kips
41.01 ft	193.83 Kips	54.98 Kips	248.81 Kips
41.99 ft	198.35 Kips	54.98 Kips	253.32 Kips
42.01 ft	198.44 Kips	54.19 Kips	252.62 Kips
51.01 ft	239.91 Kips	54.19 Kips	294.09 Kips
60.01 ft	281.38 Kips	54.19 Kips	335.56 Kips
61.99 ft	290.50 Kips	54.19 Kips	344.69 Kips
62.01 ft	290.68 Kips	102.65 Kips	393.33 Kips
66.99 ft	357.90 Kips	102.65 Kips	460.55 Kips
67.01 ft	358.12 Kips	18.60 Kips	376.72 Kips
71.99 ft	400.27 Kips	18.60 Kips	418.87 Kips
72.01 ft	400.44 Kips	18.60 Kips	419.03 Kips
76.99 ft	441.18 Kips	18.60 Kips	459.77 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1200.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1200.00 psf	20.16 Kips
10.49 ft	Cohesive	N/A	N/A	1200.00 psf	27.60 Kips
10.51 ft	Cohesive	N/A	N/A	1500.00 psf	27.71 Kips
19.51 ft	Cohesive	N/A	N/A	1500.00 psf	84.26 Kips
25.49 ft	Cohesive	N/A	N/A	1500.00 psf	121.83 Kips
25.51 ft	Cohesionless	2594.99 psf	21.97	N/A	121.94 Kips
31.99 ft	Cohesionless	2781.61 psf	21.97	N/A	152.27 Kips
32.01 ft	Cohesive	N/A	N/A	1100.00 psf	152.36 Kips
41.01 ft	Cohesive	N/A	N/A	1100.00 psf	193.83 Kips
41.99 ft	Cohesive	N/A	N/A	1100.00 psf	198.35 Kips
42.01 ft	Cohesive	N/A	N/A	1100.00 psf	198.44 Kips
51.01 ft	Cohesive	N/A	N/A	1100.00 psf	239.91 Kips
60.01 ft	Cohesive	N/A	N/A	1100.00 psf	281.38 Kips
61.99 ft	Cohesive	N/A	N/A	1100.00 psf	290.50 Kips
62.01 ft	Cohesionless	4997.41 psf	24.90	N/A	290.68 Kips
66.99 ft	Cohesionless	5153.29 psf	24.90	N/A	357.90 Kips
67.01 ft	Cohesionless	5310.41 psf	21.24	N/A	358.12 Kips
71.99 ft	Cohesionless	5466.29 psf	21.24	N/A	400.27 Kips
72.01 ft	Cohesionless	5623.39 psf	20.51	N/A	400.44 Kips
76.99 ft	Cohesionless	5766.81 psf	20.51	N/A	441.18 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	24.13 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	24.13 Kips
10.49 ft	Cohesive	N/A	N/A	N/A	24.13 Kips
10.51 ft	Cohesive	N/A	N/A	N/A	25.13 Kips
19.51 ft	Cohesive	N/A	N/A	N/A	25.13 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	25.13 Kips
25.51 ft	Cohesionless	2595.28 psf	30.00	18.60 Kips	18.60 Kips
31.99 ft	Cohesionless	2968.52 psf	30.00	18.60 Kips	18.60 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	54.98 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	54.98 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	54.98 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
60.01 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	54.19 Kips
62.01 ft	Cohesionless	4997.73 psf	55.60	102.65 Kips	102.65 Kips
66.99 ft	Cohesionless	5309.47 psf	55.60	102.65 Kips	102.65 Kips
67.01 ft	Cohesionless	5310.73 psf	26.40	18.60 Kips	18.60 Kips
71.99 ft	Cohesionless	5622.47 psf	26.40	18.60 Kips	18.60 Kips
72.01 ft	Cohesionless	5623.68 psf	22.80	18.60 Kips	18.60 Kips
76.99 ft	Cohesionless	5910.52 psf	22.80	18.60 Kips	18.60 Kips

ULTIMATE - SUMMARY OF CAPACITIES

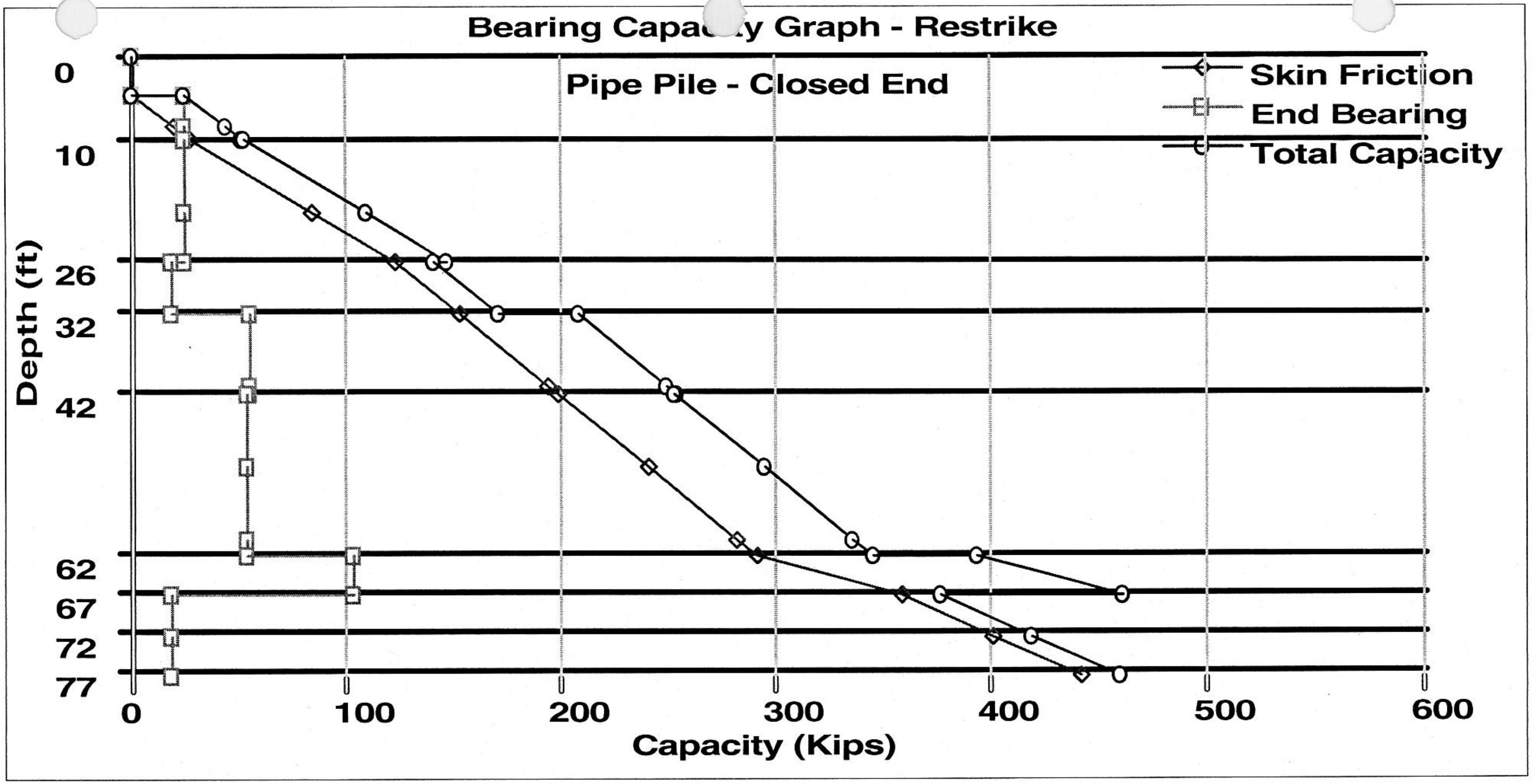
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	24.13 Kips	24.13 Kips
9.01 ft	20.16 Kips	24.13 Kips	44.28 Kips
10.49 ft	27.60 Kips	24.13 Kips	51.72 Kips
10.51 ft	27.71 Kips	25.13 Kips	52.84 Kips
19.51 ft	84.26 Kips	25.13 Kips	109.39 Kips
25.49 ft	121.83 Kips	25.13 Kips	146.96 Kips
25.51 ft	121.94 Kips	18.60 Kips	140.54 Kips
31.99 ft	152.27 Kips	18.60 Kips	170.86 Kips
32.01 ft	152.36 Kips	54.98 Kips	207.34 Kips
41.01 ft	193.83 Kips	54.98 Kips	248.81 Kips
41.99 ft	198.35 Kips	54.98 Kips	253.32 Kips
42.01 ft	198.44 Kips	54.19 Kips	252.62 Kips
51.01 ft	239.91 Kips	54.19 Kips	294.09 Kips
60.01 ft	281.38 Kips	54.19 Kips	335.56 Kips
61.99 ft	290.50 Kips	54.19 Kips	344.69 Kips
62.01 ft	290.68 Kips	102.65 Kips	393.33 Kips
66.99 ft	357.90 Kips	102.65 Kips	460.55 Kips
67.01 ft	358.12 Kips	18.60 Kips	376.72 Kips
71.99 ft	400.27 Kips	18.60 Kips	418.87 Kips
72.01 ft	400.44 Kips	18.60 Kips	419.03 Kips
76.99 ft	441.18 Kips	18.60 Kips	459.77 Kips

Allowable capacity = 360 kips

$$@\text{depth} = 61.99 + (62.01 - 61.99) \times \frac{360 - 344.69}{393.33 - 344.69}$$

$$= 62' \text{ or Elev} = 494.1$$

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\PIER_1~1\TR37CIP.DVN


Bearing Capacity Graph - Restrike

Pipe Pile - Closed End

DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\PIER_2~1\B32CIP.DVN
Project Name: Slocum Ave - TR32 Project Date: 08/02/2007
Project Client: TranSystems/ODOT9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 5.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	28.00 ft
	- Driving/Restrike	28.00 ft
	- Ultimate:	28.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	12.50 ft	0.00%	125.00 pcf	2291.00 psf	User Def.
2	Cohesive	17.50 ft	0.00%	125.00 pcf	1656.00 psf	User Def.
3	Cohesive	12.00 ft	0.00%	120.00 pcf	1125.00 psf	User Def.
4	Cohesive	18.00 ft	0.00%	125.00 pcf	3125.00 psf	User Def.
5	Cohesionless	18.50 ft	0.00%	120.00 pcf	32.0/32.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1100.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1100.00 psf	18.48 Kips
12.49 ft	Cohesive	N/A	N/A	1100.00 psf	34.51 Kips
12.51 ft	Cohesive	N/A	N/A	1400.00 psf	34.62 Kips
21.51 ft	Cohesive	N/A	N/A	1400.00 psf	87.39 Kips
29.99 ft	Cohesive	N/A	N/A	1400.00 psf	137.12 Kips
30.01 ft	Cohesive	N/A	N/A	1000.00 psf	137.22 Kips
39.01 ft	Cohesive	N/A	N/A	1000.00 psf	174.92 Kips
41.99 ft	Cohesive	N/A	N/A	1000.00 psf	187.41 Kips
42.01 ft	Cohesive	N/A	N/A	1300.00 psf	187.50 Kips
51.01 ft	Cohesive	N/A	N/A	1300.00 psf	236.51 Kips
59.99 ft	Cohesive	N/A	N/A	1300.00 psf	285.41 Kips
60.01 ft	Cohesionless	5443.49 psf	23.44	N/A	285.58 Kips
69.01 ft	Cohesionless	5702.69 psf	23.44	N/A	395.31 Kips
78.01 ft	Cohesionless	5961.89 psf	23.44	N/A	515.00 Kips
78.49 ft	Cohesionless	5975.71 psf	23.44	N/A	521.67 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	28.79 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	28.79 Kips
12.49 ft	Cohesive	N/A	N/A	N/A	28.79 Kips
12.51 ft	Cohesive	N/A	N/A	N/A	20.81 Kips
21.51 ft	Cohesive	N/A	N/A	N/A	20.81 Kips
29.99 ft	Cohesive	N/A	N/A	N/A	20.81 Kips
30.01 ft	Cohesive	N/A	N/A	N/A	14.14 Kips
39.01 ft	Cohesive	N/A	N/A	N/A	14.14 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	14.14 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	39.27 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	39.27 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	39.27 Kips
60.01 ft	Cohesionless	5443.78 psf	40.40	46.08 Kips	46.08 Kips
69.01 ft	Cohesionless	5962.18 psf	40.40	46.08 Kips	46.08 Kips
78.01 ft	Cohesionless	6480.58 psf	40.40	46.08 Kips	46.08 Kips
78.49 ft	Cohesionless	6508.22 psf	40.40	46.08 Kips	46.08 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	28.79 Kips	28.79 Kips
9.01 ft	18.48 Kips	28.79 Kips	47.27 Kips
12.49 ft	34.51 Kips	28.79 Kips	63.30 Kips
12.51 ft	34.62 Kips	20.81 Kips	55.43 Kips
21.51 ft	87.39 Kips	20.81 Kips	108.20 Kips
29.99 ft	137.12 Kips	20.81 Kips	157.93 Kips
30.01 ft	137.22 Kips	14.14 Kips	151.36 Kips
39.01 ft	174.92 Kips	14.14 Kips	189.06 Kips
41.99 ft	187.41 Kips	14.14 Kips	201.54 Kips
42.01 ft	187.50 Kips	39.27 Kips	226.77 Kips
51.01 ft	236.51 Kips	39.27 Kips	275.78 Kips
59.99 ft	285.41 Kips	39.27 Kips	324.68 Kips
60.01 ft	285.58 Kips	46.08 Kips	331.66 Kips
69.01 ft	395.31 Kips	46.08 Kips	441.38 Kips
78.01 ft	515.00 Kips	46.08 Kips	561.08 Kips
78.49 ft	521.67 Kips	46.08 Kips	567.74 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1100.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1100.00 psf	18.48 Kips
12.49 ft	Cohesive	N/A	N/A	1100.00 psf	34.51 Kips
12.51 ft	Cohesive	N/A	N/A	1400.00 psf	34.62 Kips
21.51 ft	Cohesive	N/A	N/A	1400.00 psf	87.39 Kips
29.99 ft	Cohesive	N/A	N/A	1400.00 psf	137.12 Kips
30.01 ft	Cohesive	N/A	N/A	1000.00 psf	137.22 Kips
39.01 ft	Cohesive	N/A	N/A	1000.00 psf	174.92 Kips
41.99 ft	Cohesive	N/A	N/A	1000.00 psf	187.41 Kips
42.01 ft	Cohesive	N/A	N/A	1300.00 psf	187.50 Kips
51.01 ft	Cohesive	N/A	N/A	1300.00 psf	236.51 Kips
59.99 ft	Cohesive	N/A	N/A	1300.00 psf	285.41 Kips
60.01 ft	Cohesionless	5443.49 psf	23.44	N/A	285.58 Kips
69.01 ft	Cohesionless	5702.69 psf	23.44	N/A	395.31 Kips
78.01 ft	Cohesionless	5961.89 psf	23.44	N/A	515.00 Kips
78.49 ft	Cohesionless	5975.71 psf	23.44	N/A	521.67 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	28.79 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	28.79 Kips
12.49 ft	Cohesive	N/A	N/A	N/A	28.79 Kips
12.51 ft	Cohesive	N/A	N/A	N/A	20.81 Kips
21.51 ft	Cohesive	N/A	N/A	N/A	20.81 Kips
29.99 ft	Cohesive	N/A	N/A	N/A	20.81 Kips
30.01 ft	Cohesive	N/A	N/A	N/A	14.14 Kips
39.01 ft	Cohesive	N/A	N/A	N/A	14.14 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	14.14 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	39.27 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	39.27 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	39.27 Kips
60.01 ft	Cohesionless	5443.78 psf	40.40	46.08 Kips	46.08 Kips
69.01 ft	Cohesionless	5962.18 psf	40.40	46.08 Kips	46.08 Kips
78.01 ft	Cohesionless	6480.58 psf	40.40	46.08 Kips	46.08 Kips
78.49 ft	Cohesionless	6508.22 psf	40.40	46.08 Kips	46.08 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	28.79 Kips	28.79 Kips
9.01 ft	18.48 Kips	28.79 Kips	47.27 Kips
12.49 ft	34.51 Kips	28.79 Kips	63.30 Kips
12.51 ft	34.62 Kips	20.81 Kips	55.43 Kips
21.51 ft	87.39 Kips	20.81 Kips	108.20 Kips
29.99 ft	137.12 Kips	20.81 Kips	157.93 Kips
30.01 ft	137.22 Kips	14.14 Kips	151.36 Kips
39.01 ft	174.92 Kips	14.14 Kips	189.06 Kips
41.99 ft	187.41 Kips	14.14 Kips	201.54 Kips
42.01 ft	187.50 Kips	39.27 Kips	226.77 Kips
51.01 ft	236.51 Kips	39.27 Kips	275.78 Kips
59.99 ft	285.41 Kips	39.27 Kips	324.68 Kips
60.01 ft	285.58 Kips	46.08 Kips	331.66 Kips
69.01 ft	395.31 Kips	46.08 Kips	441.38 Kips
78.01 ft	515.00 Kips	46.08 Kips	561.08 Kips
78.49 ft	521.67 Kips	46.08 Kips	567.74 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	1100.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1100.00 psf	18.48 Kips
12.49 ft	Cohesive	N/A	N/A	1100.00 psf	34.51 Kips
12.51 ft	Cohesive	N/A	N/A	1400.00 psf	34.62 Kips
21.51 ft	Cohesive	N/A	N/A	1400.00 psf	87.39 Kips
29.99 ft	Cohesive	N/A	N/A	1400.00 psf	137.12 Kips
30.01 ft	Cohesive	N/A	N/A	1000.00 psf	137.22 Kips
39.01 ft	Cohesive	N/A	N/A	1000.00 psf	174.92 Kips
41.99 ft	Cohesive	N/A	N/A	1000.00 psf	187.41 Kips
42.01 ft	Cohesive	N/A	N/A	1300.00 psf	187.50 Kips
51.01 ft	Cohesive	N/A	N/A	1300.00 psf	236.51 Kips
59.99 ft	Cohesive	N/A	N/A	1300.00 psf	285.41 Kips
60.01 ft	Cohesionless	5443.49 psf	23.44	N/A	285.58 Kips
69.01 ft	Cohesionless	5702.69 psf	23.44	N/A	395.31 Kips
78.01 ft	Cohesionless	5961.89 psf	23.44	N/A	515.00 Kips
78.49 ft	Cohesionless	5975.71 psf	23.44	N/A	521.67 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	28.79 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	28.79 Kips
12.49 ft	Cohesive	N/A	N/A	N/A	28.79 Kips
12.51 ft	Cohesive	N/A	N/A	N/A	20.81 Kips
21.51 ft	Cohesive	N/A	N/A	N/A	20.81 Kips
29.99 ft	Cohesive	N/A	N/A	N/A	20.81 Kips
30.01 ft	Cohesive	N/A	N/A	N/A	14.14 Kips
39.01 ft	Cohesive	N/A	N/A	N/A	14.14 Kips
41.99 ft	Cohesive	N/A	N/A	N/A	14.14 Kips
42.01 ft	Cohesive	N/A	N/A	N/A	39.27 Kips
51.01 ft	Cohesive	N/A	N/A	N/A	39.27 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	39.27 Kips
60.01 ft	Cohesionless	5443.78 psf	40.40	46.08 Kips	46.08 Kips
69.01 ft	Cohesionless	5962.18 psf	40.40	46.08 Kips	46.08 Kips
78.01 ft	Cohesionless	6480.58 psf	40.40	46.08 Kips	46.08 Kips
78.49 ft	Cohesionless	6508.22 psf	40.40	46.08 Kips	46.08 Kips

ULTIMATE - SUMMARY OF CAPACITIES

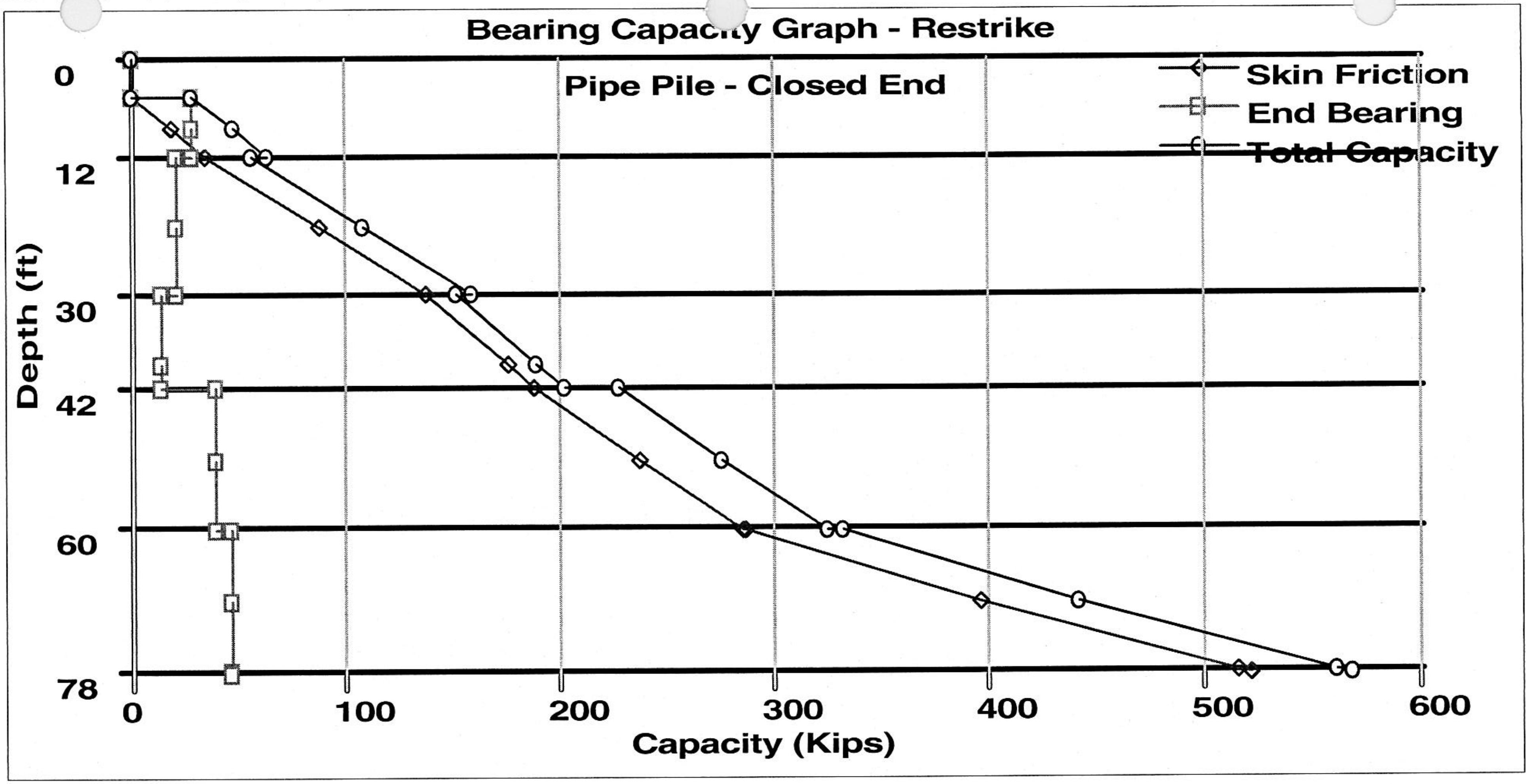
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	28.79 Kips	28.79 Kips
9.01 ft	18.48 Kips	28.79 Kips	47.27 Kips
12.49 ft	34.51 Kips	28.79 Kips	63.30 Kips
12.51 ft	34.62 Kips	20.81 Kips	55.43 Kips
21.51 ft	87.39 Kips	20.81 Kips	108.20 Kips
29.99 ft	137.12 Kips	20.81 Kips	157.93 Kips
30.01 ft	137.22 Kips	14.14 Kips	151.36 Kips
39.01 ft	174.92 Kips	14.14 Kips	189.06 Kips
41.99 ft	187.41 Kips	14.14 Kips	201.54 Kips
42.01 ft	187.50 Kips	39.27 Kips	226.77 Kips
51.01 ft	236.51 Kips	39.27 Kips	275.78 Kips
59.99 ft	285.41 Kips	39.27 Kips	324.68 Kips
60.01 ft	285.58 Kips	46.08 Kips	331.66 Kips
69.01 ft	395.31 Kips	46.08 Kips	441.38 Kips
78.01 ft	515.00 Kips	46.08 Kips	561.08 Kips
78.49 ft	521.67 Kips	46.08 Kips	567.74 Kips

Allowable capacity = 360 kips

@ depth $= 60.01 + (69.01 - 60.01) \times \frac{360 - 331.66}{441.38 - 331.66}$

$= 62.33$ or Elev 492.7

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\PIER_2~1\B32CIP.DVN



DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\FORWAR~1\B31CIP.DVN
Project Name: Slocum Ave-B-31 Project Date: 09/05/2007
Project Client: TranSystems/ODOT-9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 5.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	30.20 ft
	- Driving/Restrike	30.20 ft
	- Ultimate:	30.20 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	13.00 ft	0.00%	125.00 pcf	3050.00 psf	User Def.
2	Cohesive	12.50 ft	0.00%	125.00 pcf	3200.00 psf	User Def.
3	Cohesive	2.50 ft	0.00%	120.00 pcf	1500.00 psf	User Def.
4	Cohesionless	4.00 ft	0.00%	120.00 pcf	32.0/32.0	Nordlund
5	Cohesive	35.00 ft	0.00%	130.00 pcf	3250.00 psf	User Def.
6	Cohesionless	12.00 ft	0.00%	120.00 pcf	29.0/29.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	800.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	800.00 psf	13.44 Kips
12.99 ft	Cohesive	N/A	N/A	800.00 psf	26.77 Kips
13.01 ft	Cohesive	N/A	N/A	1200.00 psf	26.86 Kips
22.01 ft	Cohesive	N/A	N/A	1200.00 psf	72.10 Kips
25.49 ft	Cohesive	N/A	N/A	1200.00 psf	89.59 Kips
25.51 ft	Cohesive	N/A	N/A	1300.00 psf	89.69 Kips
27.99 ft	Cohesive	N/A	N/A	1300.00 psf	103.20 Kips
28.01 ft	Cohesionless	3488.10 psf	23.44	N/A	103.33 Kips
30.19 ft	Cohesionless	3618.90 psf	23.44	N/A	120.20 Kips
30.21 ft	Cohesionless	3751.79 psf	23.44	N/A	120.36 Kips
31.99 ft	Cohesionless	3803.05 psf	23.44	N/A	134.83 Kips
32.01 ft	Cohesive	N/A	N/A	1250.00 psf	134.96 Kips
41.01 ft	Cohesive	N/A	N/A	1250.00 psf	182.09 Kips
50.01 ft	Cohesive	N/A	N/A	1250.00 psf	229.21 Kips
59.01 ft	Cohesive	N/A	N/A	1250.00 psf	276.33 Kips
66.99 ft	Cohesive	N/A	N/A	1250.00 psf	318.12 Kips
67.01 ft	Cohesionless	6221.47 psf	21.24	N/A	318.27 Kips
76.01 ft	Cohesionless	6480.67 psf	21.24	N/A	408.58 Kips
78.99 ft	Cohesionless	6566.49 psf	21.24	N/A	440.07 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	38.33 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	38.33 Kips
12.99 ft	Cohesive	N/A	N/A	N/A	38.33 Kips
13.01 ft	Cohesive	N/A	N/A	N/A	40.21 Kips
22.01 ft	Cohesive	N/A	N/A	N/A	40.21 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	40.21 Kips
25.51 ft	Cohesive	N/A	N/A	N/A	18.85 Kips
27.99 ft	Cohesive	N/A	N/A	N/A	18.85 Kips
28.01 ft	Cohesionless	3488.70 psf	40.40	46.08 Kips	46.08 Kips
30.19 ft	Cohesionless	3750.30 psf	40.40	46.08 Kips	46.08 Kips
30.21 ft	Cohesionless	3752.08 psf	40.40	46.08 Kips	46.08 Kips
31.99 ft	Cohesionless	3854.60 psf	40.40	46.08 Kips	46.08 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
50.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
59.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
67.01 ft	Cohesionless	6221.76 psf	26.40	18.60 Kips	18.60 Kips
76.01 ft	Cohesionless	6740.16 psf	26.40	18.60 Kips	18.60 Kips
78.99 ft	Cohesionless	6911.80 psf	26.40	18.60 Kips	18.60 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	38.33 Kips	38.33 Kips
9.01 ft	13.44 Kips	38.33 Kips	51.77 Kips
12.99 ft	26.77 Kips	38.33 Kips	65.10 Kips
13.01 ft	26.86 Kips	40.21 Kips	67.07 Kips
22.01 ft	72.10 Kips	40.21 Kips	112.31 Kips
25.49 ft	89.59 Kips	40.21 Kips	129.80 Kips
25.51 ft	89.69 Kips	18.85 Kips	108.54 Kips
27.99 ft	103.20 Kips	18.85 Kips	122.05 Kips
28.01 ft	103.33 Kips	46.08 Kips	149.40 Kips
30.19 ft	120.20 Kips	46.08 Kips	166.27 Kips
30.21 ft	120.36 Kips	46.08 Kips	166.43 Kips
31.99 ft	134.83 Kips	46.08 Kips	180.91 Kips
32.01 ft	134.96 Kips	40.84 Kips	175.80 Kips
41.01 ft	182.09 Kips	40.84 Kips	222.93 Kips
50.01 ft	229.21 Kips	40.84 Kips	270.05 Kips
59.01 ft	276.33 Kips	40.84 Kips	317.18 Kips
66.99 ft	318.12 Kips	40.84 Kips	358.96 Kips
67.01 ft	318.27 Kips	18.60 Kips	336.87 Kips
76.01 ft	408.58 Kips	18.60 Kips	427.18 Kips
78.99 ft	440.07 Kips	18.60 Kips	458.67 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	800.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	800.00 psf	13.44 Kips
12.99 ft	Cohesive	N/A	N/A	800.00 psf	26.77 Kips
13.01 ft	Cohesive	N/A	N/A	1200.00 psf	26.86 Kips
22.01 ft	Cohesive	N/A	N/A	1200.00 psf	72.10 Kips
25.49 ft	Cohesive	N/A	N/A	1200.00 psf	89.59 Kips
25.51 ft	Cohesive	N/A	N/A	1300.00 psf	89.69 Kips
27.99 ft	Cohesive	N/A	N/A	1300.00 psf	103.20 Kips
28.01 ft	Cohesionless	3488.10 psf	23.44	N/A	103.33 Kips
30.19 ft	Cohesionless	3618.90 psf	23.44	N/A	120.20 Kips
30.21 ft	Cohesionless	3751.79 psf	23.44	N/A	120.36 Kips
31.99 ft	Cohesionless	3803.05 psf	23.44	N/A	134.83 Kips
32.01 ft	Cohesive	N/A	N/A	1250.00 psf	134.96 Kips
41.01 ft	Cohesive	N/A	N/A	1250.00 psf	182.09 Kips
50.01 ft	Cohesive	N/A	N/A	1250.00 psf	229.21 Kips
59.01 ft	Cohesive	N/A	N/A	1250.00 psf	276.33 Kips
66.99 ft	Cohesive	N/A	N/A	1250.00 psf	318.12 Kips
67.01 ft	Cohesionless	6221.47 psf	21.24	N/A	318.27 Kips
76.01 ft	Cohesionless	6480.67 psf	21.24	N/A	408.58 Kips
78.99 ft	Cohesionless	6566.49 psf	21.24	N/A	440.07 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	38.33 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	38.33 Kips
12.99 ft	Cohesive	N/A	N/A	N/A	38.33 Kips
13.01 ft	Cohesive	N/A	N/A	N/A	40.21 Kips
22.01 ft	Cohesive	N/A	N/A	N/A	40.21 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	40.21 Kips
25.51 ft	Cohesive	N/A	N/A	N/A	18.85 Kips
27.99 ft	Cohesive	N/A	N/A	N/A	18.85 Kips
28.01 ft	Cohesionless	3488.70 psf	40.40	46.08 Kips	46.08 Kips
30.19 ft	Cohesionless	3750.30 psf	40.40	46.08 Kips	46.08 Kips
30.21 ft	Cohesionless	3752.08 psf	40.40	46.08 Kips	46.08 Kips
31.99 ft	Cohesionless	3854.60 psf	40.40	46.08 Kips	46.08 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
50.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
59.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
67.01 ft	Cohesionless	6221.76 psf	26.40	18.60 Kips	18.60 Kips
76.01 ft	Cohesionless	6740.16 psf	26.40	18.60 Kips	18.60 Kips
78.99 ft	Cohesionless	6911.80 psf	26.40	18.60 Kips	18.60 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	38.33 Kips	38.33 Kips
9.01 ft	13.44 Kips	38.33 Kips	51.77 Kips
12.99 ft	26.77 Kips	38.33 Kips	65.10 Kips
13.01 ft	26.86 Kips	40.21 Kips	67.07 Kips
22.01 ft	72.10 Kips	40.21 Kips	112.31 Kips
25.49 ft	89.59 Kips	40.21 Kips	129.80 Kips
25.51 ft	89.69 Kips	18.85 Kips	108.54 Kips
27.99 ft	103.20 Kips	18.85 Kips	122.05 Kips
28.01 ft	103.33 Kips	46.08 Kips	149.40 Kips
30.19 ft	120.20 Kips	46.08 Kips	166.27 Kips
30.21 ft	120.36 Kips	46.08 Kips	166.43 Kips
31.99 ft	134.83 Kips	46.08 Kips	180.91 Kips
32.01 ft	134.96 Kips	40.84 Kips	175.80 Kips
41.01 ft	182.09 Kips	40.84 Kips	222.93 Kips
50.01 ft	229.21 Kips	40.84 Kips	270.05 Kips
59.01 ft	276.33 Kips	40.84 Kips	317.18 Kips
66.99 ft	318.12 Kips	40.84 Kips	358.96 Kips
67.01 ft	318.27 Kips	18.60 Kips	336.87 Kips
76.01 ft	408.58 Kips	18.60 Kips	427.18 Kips
78.99 ft	440.07 Kips	18.60 Kips	458.67 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	800.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	800.00 psf	13.44 Kips
12.99 ft	Cohesive	N/A	N/A	800.00 psf	26.77 Kips
13.01 ft	Cohesive	N/A	N/A	1200.00 psf	26.86 Kips
22.01 ft	Cohesive	N/A	N/A	1200.00 psf	72.10 Kips
25.49 ft	Cohesive	N/A	N/A	1200.00 psf	89.59 Kips
25.51 ft	Cohesive	N/A	N/A	1300.00 psf	89.69 Kips
27.99 ft	Cohesive	N/A	N/A	1300.00 psf	103.20 Kips
28.01 ft	Cohesionless	3488.10 psf	23.44	N/A	103.33 Kips
30.19 ft	Cohesionless	3618.90 psf	23.44	N/A	120.20 Kips
30.21 ft	Cohesionless	3751.79 psf	23.44	N/A	120.36 Kips
31.99 ft	Cohesionless	3803.05 psf	23.44	N/A	134.83 Kips
32.01 ft	Cohesive	N/A	N/A	1250.00 psf	134.96 Kips
41.01 ft	Cohesive	N/A	N/A	1250.00 psf	182.09 Kips
50.01 ft	Cohesive	N/A	N/A	1250.00 psf	229.21 Kips
59.01 ft	Cohesive	N/A	N/A	1250.00 psf	276.33 Kips
66.99 ft	Cohesive	N/A	N/A	1250.00 psf	318.12 Kips
67.01 ft	Cohesionless	6221.47 psf	21.24	N/A	318.27 Kips
76.01 ft	Cohesionless	6480.67 psf	21.24	N/A	408.58 Kips
78.99 ft	Cohesionless	6566.49 psf	21.24	N/A	440.07 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	38.33 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	38.33 Kips
12.99 ft	Cohesive	N/A	N/A	N/A	38.33 Kips
13.01 ft	Cohesive	N/A	N/A	N/A	40.21 Kips
22.01 ft	Cohesive	N/A	N/A	N/A	40.21 Kips
25.49 ft	Cohesive	N/A	N/A	N/A	40.21 Kips
25.51 ft	Cohesive	N/A	N/A	N/A	18.85 Kips
27.99 ft	Cohesive	N/A	N/A	N/A	18.85 Kips
28.01 ft	Cohesionless	3488.70 psf	40.40	46.08 Kips	46.08 Kips
30.19 ft	Cohesionless	3750.30 psf	40.40	46.08 Kips	46.08 Kips
30.21 ft	Cohesionless	3752.08 psf	40.40	46.08 Kips	46.08 Kips
31.99 ft	Cohesionless	3854.60 psf	40.40	46.08 Kips	46.08 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
50.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
59.01 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
66.99 ft	Cohesive	N/A	N/A	N/A	40.84 Kips
67.01 ft	Cohesionless	6221.76 psf	26.40	18.60 Kips	18.60 Kips
76.01 ft	Cohesionless	6740.16 psf	26.40	18.60 Kips	18.60 Kips
78.99 ft	Cohesionless	6911.80 psf	26.40	18.60 Kips	18.60 Kips

ULTIMATE - SUMMARY OF CAPACITIES

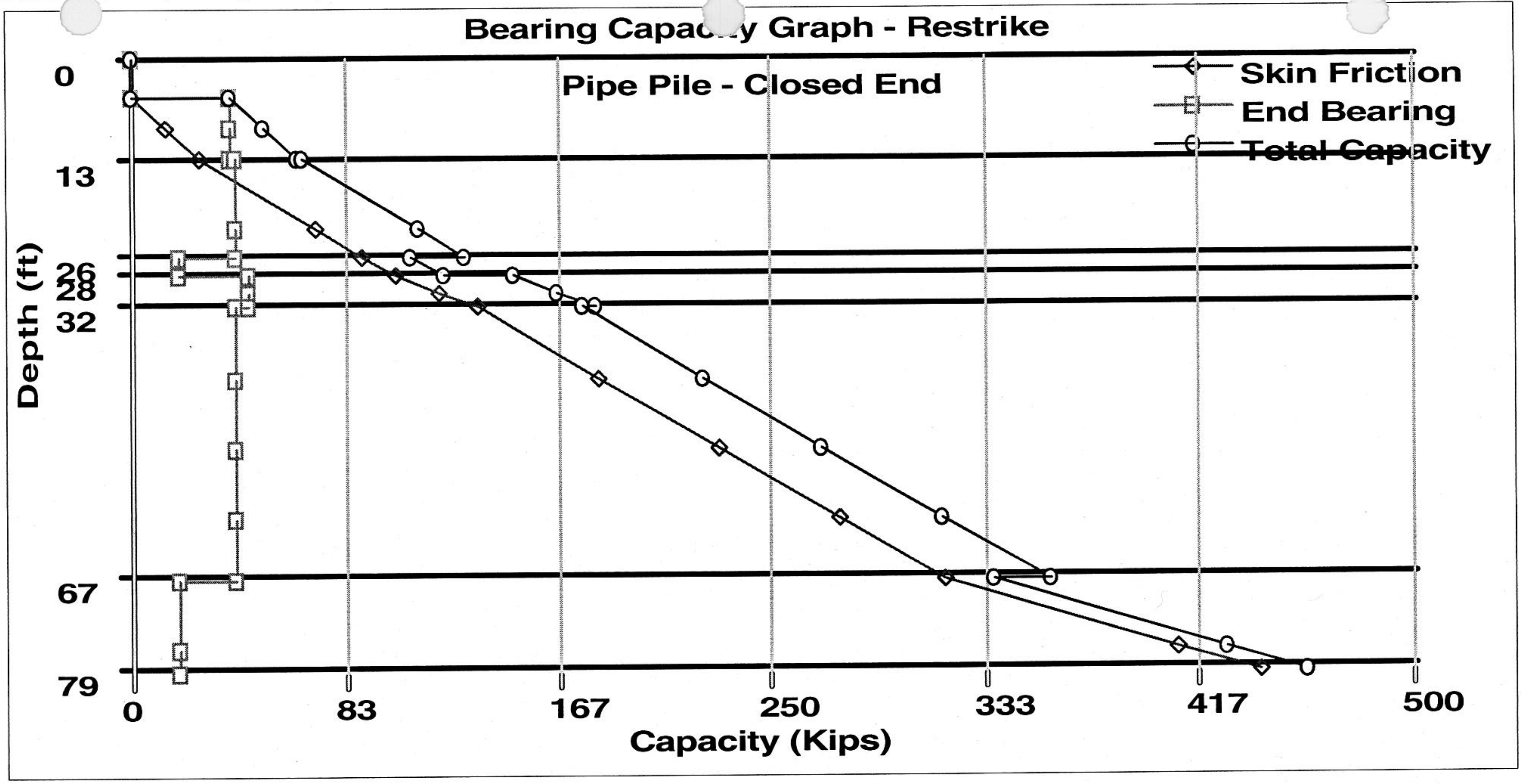
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	38.33 Kips	38.33 Kips
9.01 ft	13.44 Kips	38.33 Kips	51.77 Kips
12.99 ft	26.77 Kips	38.33 Kips	65.10 Kips
13.01 ft	26.86 Kips	40.21 Kips	67.07 Kips
22.01 ft	72.10 Kips	40.21 Kips	112.31 Kips
25.49 ft	89.59 Kips	40.21 Kips	129.80 Kips
25.51 ft	89.69 Kips	18.85 Kips	108.54 Kips
27.99 ft	103.20 Kips	18.85 Kips	122.05 Kips
28.01 ft	103.33 Kips	46.08 Kips	149.40 Kips
30.19 ft	120.20 Kips	46.08 Kips	166.27 Kips
30.21 ft	120.36 Kips	46.08 Kips	166.43 Kips
31.99 ft	134.83 Kips	46.08 Kips	180.91 Kips
32.01 ft	134.96 Kips	40.84 Kips	175.80 Kips
41.01 ft	182.09 Kips	40.84 Kips	222.93 Kips
50.01 ft	229.21 Kips	40.84 Kips	270.05 Kips
59.01 ft	276.33 Kips	40.84 Kips	317.18 Kips
66.99 ft	318.12 Kips	40.84 Kips	358.96 Kips
67.01 ft	318.27 Kips	18.60 Kips	336.87 Kips
76.01 ft	408.58 Kips	18.60 Kips	427.18 Kips
78.99 ft	440.07 Kips	18.60 Kips	458.67 Kips

Allowable capacity = 360 kips

@depth = $67.01+(76.01-67.01)\times\frac{360-336.87}{427.18-336.87}$

= 69.32' or Elev 486.1

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\FORWAR~1\B31CIP.DVN



DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\FORWAR~1\TR36CIP.DVN
Project Name: Slocum Ave-TR-36 Project Date: 09/05/2007
Project Client: TranSystems/ODOT-9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 5.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	62.00 ft
	- Driving/Restrike	62.00 ft
	- Ultimate:	62.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	20.50 ft	0.00%	125.00 pcf	2844.00 psf	User Def.
2	Cohesive	36.50 ft	0.00%	125.00 pcf	3305.00 psf	User Def.
3	Cohesive	5.00 ft	0.00%	125.00 pcf	4500.00 psf	User Def.
4	Cohesionless	5.00 ft	0.00%	115.00 pcf	28.0/28.0	Nordlund
5	Cohesionless	5.00 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	12.60 Kips
18.01 ft	Cohesive	N/A	N/A	750.00 psf	40.87 Kips
20.49 ft	Cohesive	N/A	N/A	750.00 psf	48.66 Kips
20.51 ft	Cohesive	N/A	N/A	1000.00 psf	48.74 Kips
29.51 ft	Cohesive	N/A	N/A	1000.00 psf	86.44 Kips
38.51 ft	Cohesive	N/A	N/A	1000.00 psf	124.13 Kips
47.51 ft	Cohesive	N/A	N/A	1000.00 psf	161.83 Kips
56.51 ft	Cohesive	N/A	N/A	1000.00 psf	199.53 Kips
56.99 ft	Cohesive	N/A	N/A	1000.00 psf	201.54 Kips
57.01 ft	Cohesive	N/A	N/A	1200.00 psf	201.64 Kips
61.99 ft	Cohesive	N/A	N/A	1200.00 psf	226.67 Kips
62.01 ft	Cohesionless	7750.26 psf	20.51	N/A	226.83 Kips
66.99 ft	Cohesionless	7881.24 psf	20.51	N/A	282.50 Kips
67.01 ft	Cohesionless	8013.29 psf	21.97	N/A	282.75 Kips
71.99 ft	Cohesionless	8156.71 psf	21.97	N/A	351.09 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
20.49 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
20.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
29.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
38.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
47.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
56.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
56.99 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
57.01 ft	Cohesive	N/A	N/A	N/A	56.55 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	56.55 Kips
62.01 ft	Cohesionless	7750.53 psf	22.80	18.60 Kips	18.60 Kips
66.99 ft	Cohesionless	8012.47 psf	22.80	18.60 Kips	18.60 Kips
67.01 ft	Cohesionless	8013.58 psf	30.00	18.60 Kips	18.60 Kips
71.99 ft	Cohesionless	8300.42 psf	30.00	18.60 Kips	18.60 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	35.74 Kips	35.74 Kips
9.01 ft	12.60 Kips	35.74 Kips	48.34 Kips
18.01 ft	40.87 Kips	35.74 Kips	76.61 Kips
20.49 ft	48.66 Kips	35.74 Kips	84.40 Kips
20.51 ft	48.74 Kips	41.53 Kips	90.27 Kips
29.51 ft	86.44 Kips	41.53 Kips	127.97 Kips
38.51 ft	124.13 Kips	41.53 Kips	165.67 Kips
47.51 ft	161.83 Kips	41.53 Kips	203.37 Kips
56.51 ft	199.53 Kips	41.53 Kips	241.06 Kips
56.99 ft	201.54 Kips	41.53 Kips	243.08 Kips
57.01 ft	201.64 Kips	56.55 Kips	258.18 Kips
61.99 ft	226.67 Kips	56.55 Kips	283.22 Kips
62.01 ft	226.83 Kips	18.60 Kips	245.43 Kips
66.99 ft	282.50 Kips	18.60 Kips	301.10 Kips
67.01 ft	282.75 Kips	18.60 Kips	301.35 Kips
71.99 ft	351.09 Kips	18.60 Kips	369.69 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	12.60 Kips
18.01 ft	Cohesive	N/A	N/A	750.00 psf	40.87 Kips
20.49 ft	Cohesive	N/A	N/A	750.00 psf	48.66 Kips
20.51 ft	Cohesive	N/A	N/A	1000.00 psf	48.74 Kips
29.51 ft	Cohesive	N/A	N/A	1000.00 psf	86.44 Kips
38.51 ft	Cohesive	N/A	N/A	1000.00 psf	124.13 Kips
47.51 ft	Cohesive	N/A	N/A	1000.00 psf	161.83 Kips
56.51 ft	Cohesive	N/A	N/A	1000.00 psf	199.53 Kips
56.99 ft	Cohesive	N/A	N/A	1000.00 psf	201.54 Kips
57.01 ft	Cohesive	N/A	N/A	1200.00 psf	201.64 Kips
61.99 ft	Cohesive	N/A	N/A	1200.00 psf	226.67 Kips
62.01 ft	Cohesionless	7750.26 psf	20.51	N/A	226.83 Kips
66.99 ft	Cohesionless	7881.24 psf	20.51	N/A	282.50 Kips
67.01 ft	Cohesionless	8013.29 psf	21.97	N/A	282.75 Kips
71.99 ft	Cohesionless	8156.71 psf	21.97	N/A	351.09 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
20.49 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
20.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
29.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
38.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
47.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
56.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
56.99 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
57.01 ft	Cohesive	N/A	N/A	N/A	56.55 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	56.55 Kips
62.01 ft	Cohesionless	7750.53 psf	22.80	18.60 Kips	18.60 Kips
66.99 ft	Cohesionless	8012.47 psf	22.80	18.60 Kips	18.60 Kips
67.01 ft	Cohesionless	8013.58 psf	30.00	18.60 Kips	18.60 Kips
71.99 ft	Cohesionless	8300.42 psf	30.00	18.60 Kips	18.60 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	35.74 Kips	35.74 Kips
9.01 ft	12.60 Kips	35.74 Kips	48.34 Kips
18.01 ft	40.87 Kips	35.74 Kips	76.61 Kips
20.49 ft	48.66 Kips	35.74 Kips	84.40 Kips
20.51 ft	48.74 Kips	41.53 Kips	90.27 Kips
29.51 ft	86.44 Kips	41.53 Kips	127.97 Kips
38.51 ft	124.13 Kips	41.53 Kips	165.67 Kips
47.51 ft	161.83 Kips	41.53 Kips	203.37 Kips
56.51 ft	199.53 Kips	41.53 Kips	241.06 Kips
56.99 ft	201.54 Kips	41.53 Kips	243.08 Kips
57.01 ft	201.64 Kips	56.55 Kips	258.18 Kips
61.99 ft	226.67 Kips	56.55 Kips	283.22 Kips
62.01 ft	226.83 Kips	18.60 Kips	245.43 Kips
66.99 ft	282.50 Kips	18.60 Kips	301.10 Kips
67.01 ft	282.75 Kips	18.60 Kips	301.35 Kips
71.99 ft	351.09 Kips	18.60 Kips	369.69 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	750.00 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	750.00 psf	12.60 Kips
18.01 ft	Cohesive	N/A	N/A	750.00 psf	40.87 Kips
20.49 ft	Cohesive	N/A	N/A	750.00 psf	48.66 Kips
20.51 ft	Cohesive	N/A	N/A	1000.00 psf	48.74 Kips
29.51 ft	Cohesive	N/A	N/A	1000.00 psf	86.44 Kips
38.51 ft	Cohesive	N/A	N/A	1000.00 psf	124.13 Kips
47.51 ft	Cohesive	N/A	N/A	1000.00 psf	161.83 Kips
56.51 ft	Cohesive	N/A	N/A	1000.00 psf	199.53 Kips
56.99 ft	Cohesive	N/A	N/A	1000.00 psf	201.54 Kips
57.01 ft	Cohesive	N/A	N/A	1200.00 psf	201.64 Kips
61.99 ft	Cohesive	N/A	N/A	1200.00 psf	226.67 Kips
62.01 ft	Cohesionless	7750.26 psf	20.51	N/A	226.83 Kips
66.99 ft	Cohesionless	7881.24 psf	20.51	N/A	282.50 Kips
67.01 ft	Cohesionless	8013.29 psf	21.97	N/A	282.75 Kips
71.99 ft	Cohesionless	8156.71 psf	21.97	N/A	351.09 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
5.00 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
20.49 ft	Cohesive	N/A	N/A	N/A	35.74 Kips
20.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
29.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
38.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
47.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
56.51 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
56.99 ft	Cohesive	N/A	N/A	N/A	41.53 Kips
57.01 ft	Cohesive	N/A	N/A	N/A	56.55 Kips
61.99 ft	Cohesive	N/A	N/A	N/A	56.55 Kips
62.01 ft	Cohesionless	7750.53 psf	22.80	18.60 Kips	18.60 Kips
66.99 ft	Cohesionless	8012.47 psf	22.80	18.60 Kips	18.60 Kips
67.01 ft	Cohesionless	8013.58 psf	30.00	18.60 Kips	18.60 Kips
71.99 ft	Cohesionless	8300.42 psf	30.00	18.60 Kips	18.60 Kips

ULTIMATE - SUMMARY OF CAPACITIES

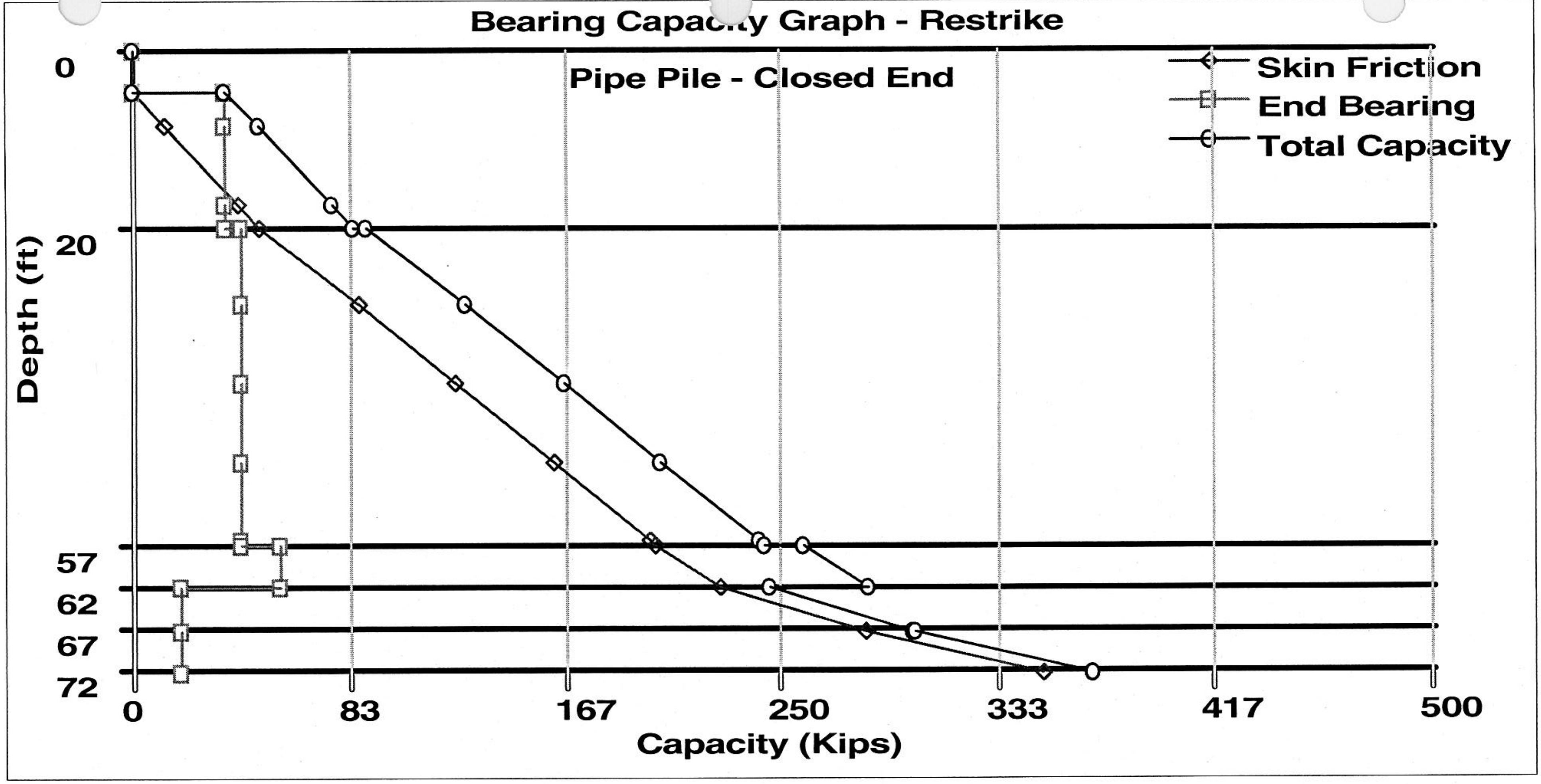
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
4.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
5.00 ft	0.00 Kips	35.74 Kips	35.74 Kips
9.01 ft	12.60 Kips	35.74 Kips	48.34 Kips
18.01 ft	40.87 Kips	35.74 Kips	76.61 Kips
20.49 ft	48.66 Kips	35.74 Kips	84.40 Kips
20.51 ft	48.74 Kips	41.53 Kips	90.27 Kips
29.51 ft	86.44 Kips	41.53 Kips	127.97 Kips
38.51 ft	124.13 Kips	41.53 Kips	165.67 Kips
47.51 ft	161.83 Kips	41.53 Kips	203.37 Kips
56.51 ft	199.53 Kips	41.53 Kips	241.06 Kips
56.99 ft	201.54 Kips	41.53 Kips	243.08 Kips
57.01 ft	201.64 Kips	56.55 Kips	258.18 Kips
61.99 ft	226.67 Kips	56.55 Kips	283.22 Kips
62.01 ft	226.83 Kips	18.60 Kips	245.43 Kips
66.99 ft	282.50 Kips	18.60 Kips	301.10 Kips
67.01 ft	282.75 Kips	18.60 Kips	301.35 Kips
71.99 ft	351.09 Kips	18.60 Kips	369.69 Kips

Allowable capacity = 360 kips

$$@\ \text{depth} = 67.01 + (71.99 - 67.01) \times \frac{360 - 301.35}{369.69 - 301.35}$$

= 71.28 or Elev 481.3

Filename: M:\PROJ\0121\3070.03\STRUCT~1\PERSHI~1\FINAL\FORWAR~1\TR36CIP.DVN



Bearing Capacity Graph - Restrike

Settlement Calculations Time-rate of Consolidation at Abutments

DLZ SUBJECT

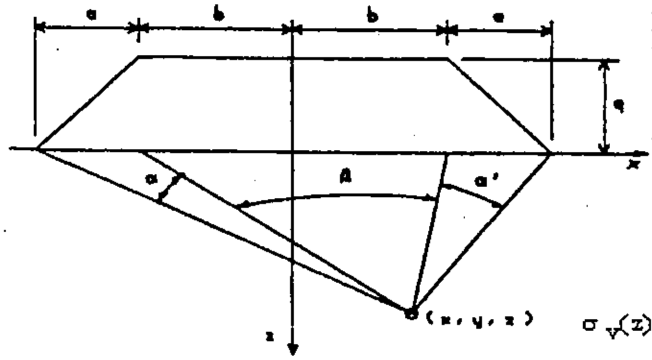
Client TranSystems ODOT9
Project SCI-823 Portsmouth ByPass
Item Settlement Analysis - Rear Abutment
SR823 over Slocum Ave, Based on TR-38A

JOB NUMBER 0121-3070.03
SHEET NO. 1 OF 8
COMP. BY EWT DATE 07/23/07
CHECKED BY SJR DATE 9-7-07

Parameters and Soil Strata based on those used for Highland Bend Embankments

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table: D= 41.5 ft

Embankment Loads only

Embankment Height: H = 63.2 ft

Fill Unit Weight: γ_{emb} = 120 pcf

q = 7,584 psf

Width of Slope: a = 126.4

Top half-width of Emb: b = 71

Distance from CL: x = 0

Output Range: z = 0 to 77 ft

**See Data output Attached*

$$\sigma_v(z) := \left(\frac{q}{\pi\ a}\right)(a\cdot(\alpha(z)+\beta(z)+\alpha'(z))+b\cdot(\alpha(z)+\alpha'(z))+x\cdot(\alpha(z)-\alpha'(z)))$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right]+\operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right]-\operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right]-\operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

									Cohesionless Soils	Cohesive Soils		
No.	Bot. of Laye		Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	C'	C_r	C_c	e_o
1	10.0	ft	Clay	125	4,480	625	7,584	8,209	0.0	0.07	0.18	0.718
2	20.0	ft	Silt	125	4,746	1,875	7,577	9,452	0.0	0.03	0.16	0.760
3	30.0	ft	Silt	125	4,746	3,125	7,554	10,679	0.0	0.03	0.16	0.760
4	40.0	ft	Silt	125	4,746	4,375	7,506	11,881	0.0	0.03	0.16	0.760
5	46.0	ft	Silt	125	4,746	5,281	7,444	12,725	0.0	0.03	0.16	0.760
6	56.0	ft	Silty Clay	120	4,428	5,757	7,371	13,128	0.0	0.07	0.19	0.706
7	61.0	ft	Silty Clay	120	4,428	6,189	7,283	13,472	0.0	0.07	0.19	0.706
8	71.0	ft	Silty Clay	120	4,428	6,621	7,183	13,804	40.0	0.00	0.00	0.000
9	77.0	ft	Sandy Silt	120	4,428	7,082	7,071	14,153	40.0	0.00	0.00	0.000
10												

No.	Settlement:	
1	0.624	ft
2	0.341	ft
3	0.351	ft
4	0.368	ft
5	0.208	ft
6	0.399	ft
7	0.188	ft
8	0.080	ft
9	.045	ft
10		

Total Settlement

$\boxed{2.604\ \text{ft}}$

$\boxed{31.3\ \text{in}}$

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0<\sigma'_c<\sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \sum\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right)+\frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \sum \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

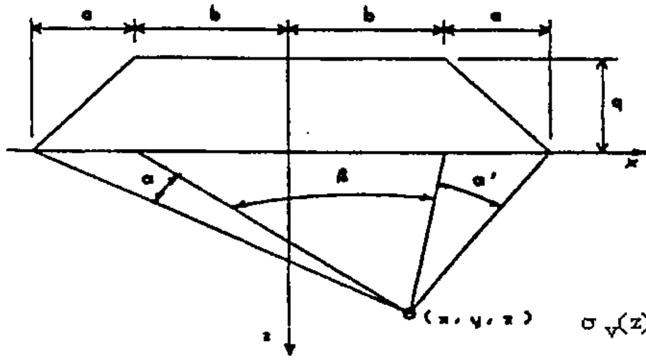
DLZ SUBJECT

Client TranSystems ODOT9	JOB NUMBER 0121-3070.03		
Project SCI-823 Portsmouth ByPass	SHEET NO.	2	OF 8
Item Settlement Analysis - Forward Abut	COMP. BY EWT	DATE	07/23/07
SR823 over Slocum Ave, Based on TR-35A	CHECKED BY SAK	DATE	9-7-07

Parameters and Soil Strata based on those used for Highland Bend Embankments

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table: D= 24.5 ft

Embankment Height: H = 52.4 ft

Fill Unit Weight: γ_{emb} = 120 pcf

Width of Slope: a = 104.8

Top half-width of Emb: b = 80

Distance from CL: x = 0

Output Range: z = 0 to 74 ft

Embankment Loads only

q = 6,288 psf

**See Data output Attached*

$$\sigma_v(z) := \left(\frac{q}{\pi\ a}\right)(a\cdot(\alpha(z)+\beta(z)+\alpha'(z))+b\cdot(\alpha(z)+\alpha'(z))+x\cdot(\alpha(z)-\alpha'(z)))$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right]+\operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right]-\operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right]-\operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

No.	Bot. of Laye		Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	Cohesionless Soils C'	Cohesive Soils C_r	C_c	e_0
1	5.0	ft	Clay	125	4,318	313	6,288	6,600	0.0	0.08	0.31	0.771
2	15.0	ft	Silt	125	4,000	1,250	6,287	7,537	0.0	0.08	0.27	0.928
3	25.0	ft	Silt	125	4,000	2,500	6,276	8,776	0.0	0.08	0.27	0.928
4	32.0	ft	Silt	125	4,000	3,313	6,255	9,568	0.0	0.08	0.27	0.928
5	42.0	ft	Silt	125	4,000	3,845	6,217	10,062	0.0	0.08	0.27	0.928
6	52.0	ft	Silty Clay	120	4,428	4,446	6,156	10,602	0.0	0.07	0.19	0.706
7	57.0	ft	Silty Clay	120	4,428	4,878	6,095	10,973	0.0	0.07	0.17	0.706
8	67.0	ft	Sandy Silt	120	4,428	5,310	6,024	11,334	42.5	0.00	0.00	0.000
9	74.0	ft	Sandy Silt	120	4,428	5,800	5,925	11,725	42.5	0.00	0.00	0.000
10												

No.	Settlement:	
1	0.419	ft
2	0.595	ft
3	0.563	ft
4	0.395	ft
5	0.568	ft
6	0.420	ft
7	0.175	ft
8	0.077	ft
9	0.050	ft
10		

Total Settlement

$\boxed{3.263\ \text{ft}}$

$\boxed{39.2\ \text{in}}$

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0<\sigma'_c<\sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \sum\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right)+\frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \sum \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

3/8

EWL 9-7-07

SJH 9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians

Slocum Avenue **Based upon boring TR-38A**

Reference: FHWA-RD-86-168 Rear Abutment

Wick Drain Spacing **5.0** feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	*Remaining* δ(inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	31.3	5.25	**0.44**	**30.5**	**31.3**
5	0.0798	0.0024	0.34	0.09	40.3	12.6	18.7				
10	0.1596	0.0047	0.57	0.10	60.9	19.1	12.2				
15	0.2395	0.0071	0.72	0.11	74.6	23.3	8.0				
20	0.3193	0.0095	0.81	0.11	83.2	26.0	5.3				
25	0.3991	0.0118	0.87	0.12	88.5	27.7	3.6				
30	0.4789	0.0142	0.90	0.13	91.7	28.7	2.6				
35	0.5587	0.0166	0.93	0.14	93.7	29.3	2.0				
40	0.6385	0.0189	0.94	0.14	95.3	29.8	1.5				
45	0.7184	0.0213	0.96	0.15	96.7	30.3	1.0				
50	0.7982	0.0236	0.98	0.16	98.0	30.7	0.6				
55	0.8780	0.0260	0.99	0.17	99.0	31.0	0.3				
60	0.9578	0.0284	0.99	0.17	99.1	31.0	0.3				

Assumes double drainage

Spacing = 5 ft (triangular)

4/8

SWT 9-7-07

SJK 9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Avenue | **Based upon boring TR-38A**
Reference: FHWA-RD-86-168 | Rear Abutment

Wick Drain Spacing **7.0** feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	*Remaining* δ(inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	31.3	7.35	**0.44**	**30.5**	**31.3**
5	0.0407	0.0024	0.20	0.09	27.3	8.5	22.8				
10	0.0814	0.0047	0.35	0.10	41.3	12.9	18.4				
15	0.1222	0.0071	0.47	0.11	52.9	16.5	14.8				
20	0.1629	0.0095	0.57	0.11	62.2	19.5	11.8				
25	0.2036	0.0118	0.66	0.12	69.8	21.9	9.4				
30	0.2443	0.0142	0.72	0.13	75.8	23.7	7.6				
35	0.2851	0.0166	0.78	0.14	80.6	25.2	6.1				
40	0.3258	0.0189	0.82	0.14	84.3	26.4	4.9				
45	0.3665	0.0213	0.85	0.15	87.2	27.3	4.0				
50	0.4072	0.0236	0.87	0.16	89.4	28.0	3.3				
55	0.4480	0.0260	0.89	0.17	91.0	28.5	2.8				
60	0.4887	0.0284	0.91	0.17	92.4	28.9	2.4				
65	0.5294	0.0307	0.92	0.18	93.4	29.2	2.1				
70	0.5701	0.0331	0.93	0.19	94.3	29.5	1.8				
75	0.6109	0.0355	0.94	0.19	95.1	29.8	1.5				
80	0.6516	0.0378	0.95	0.20	95.8	30.0	1.3				
85	0.6923	0.0402	0.96	0.21	96.5	30.2	1.1				
90	0.7330	0.0426	0.96	0.21	97.2	30.4	0.9				
95	0.7738	0.0449	0.97	0.22	97.8	30.6	0.7				
100	0.8145	0.0473	0.98	0.23	98.4	30.8	0.5				
105	0.8552	0.0497	0.98	0.23	98.8	30.9	0.4				
110	0.8959	0.0520	0.99	0.24	99.2	31.0	0.3				
115	0.9366	0.0544	0.99	0.25	99.3	31.1	0.2				

Assumes double drainage
Spacing = 7 ft (triangular)

5/8

9-7-07
9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Avenue **Based upon boring TR-38A**
Reference: FHWA-RD-86-168 Rear Abutment

Wick Drain Spacing **9.0** feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	*Remaining* δ(inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	31.3	9.45	0.44	30.5	31.3
5	0.0246	0.0024	0.13	0.09	21.2	6.6	24.7				
10	0.0493	0.0047	0.23	0.10	30.9	9.7	21.6				
15	0.0739	0.0071	0.32	0.11	39.5	12.4	18.9				
20	0.0985	0.0095	0.40	0.11	47.2	14.8	16.5				
25	0.1232	0.0118	0.48	0.12	53.9	16.9	14.4				
30	0.1478	0.0142	0.54	0.13	59.8	18.7	12.6				
35	0.1724	0.0166	0.60	0.14	65.0	20.4	10.9				
40	0.1971	0.0189	0.64	0.14	69.6	21.8	9.5				
45	0.2217	0.0213	0.69	0.15	73.5	23.0	8.3				
50	0.2464	0.0236	0.73	0.16	76.9	24.1	7.2				
55	0.2710	0.0260	0.76	0.17	79.9	25.0	6.3				
60	0.2956	0.0284	0.79	0.17	82.4	25.8	5.5				
65	0.3203	0.0307	0.81	0.18	84.5	26.5	4.8				
70	0.3449	0.0331	0.83	0.19	86.4	27.0	4.3				
75	0.3695	0.0355	0.85	0.19	88.0	27.5	3.8				
80	0.3942	0.0378	0.87	0.20	89.3	28.0	3.3				
85	0.4188	0.0402	0.88	0.21	90.4	28.3	3.0				
90	0.4434	0.0426	0.89	0.21	91.4	28.6	2.7				
95	0.4681	0.0449	0.90	0.22	92.3	28.9	2.4				
100	0.4927	0.0473	0.91	0.23	93.0	29.1	2.2				
105	0.5173	0.0497	0.92	0.23	93.6	29.3	2.0				
110	0.5420	0.0520	0.92	0.24	94.2	29.5	1.8				
115	0.5666	0.0544	0.93	0.25	94.7	29.6	1.7				
120	0.5912	0.0568	0.93	0.25	95.1	29.8	1.5				
125	0.6159	0.0591	0.94	0.26	95.6	29.9	1.4				
130	0.6405	0.0615	0.95	0.27	96.0	30.0	1.3				
135	0.6652	0.0639	0.95	0.27	96.4	30.2	1.1				
140	0.6898	0.0662	0.96	0.28	96.8	30.3	1.0				
145	0.7144	0.0686	0.96	0.28	97.1	30.4	0.9				
150	0.7391	0.0709	0.96	0.29	97.5	30.5	0.8				
155	0.7637	0.0733	0.97	0.30	97.9	30.6	0.7				
160	0.7883	0.0757	0.97	0.30	98.2	30.7	0.6				
165	0.8130	0.0780	0.98	0.31	98.5	30.8	0.5				
170	0.8376	0.0804	0.98	0.31	98.8	30.9	0.4				
175	0.8622	0.0828	0.99	0.32	99.0	31.0	0.3				
180	0.8869	0.0851	0.99	0.32	99.2	31.1	0.2				
185	0.9115	0.0875	0.99	0.33	99.3	31.1	0.2				
190	0.9361	0.0899	0.99	0.33	99.4	31.1	0.2				

Assumes double drainage
Spacing = 9 ft (triangular)

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GWT 9-7-07
SJM 9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Avenue **Based upon boring TR-35A**
Reference: FHWA-RD-86-168 Forward Abutment

Wick Drain Spacing **5.0** feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	*Remaining* δ(inches)	**d_e**	**c_v**	**H_v**	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	39.2	5.25	**0.37**	**28.5**	**39.2**
5	0.0671	0.0023	0.30	0.09	36.3	14.2	25.0				
10	0.1342	0.0046	0.51	0.10	55.3	21.7	17.5				
15	0.2014	0.0068	0.65	0.10	68.9	27.0	12.2				
20	0.2685	0.0091	0.76	0.11	78.3	30.7	8.5				
25	0.3356	0.0114	0.83	0.12	84.6	33.2	6.0				
30	0.4027	0.0137	0.87	0.13	88.7	34.8	4.4				
35	0.4698	0.0159	0.90	0.13	91.4	35.8	3.4				
40	0.5370	0.0182	0.92	0.14	93.3	36.6	2.6				
45	0.6041	0.0205	0.94	0.15	94.7	37.1	2.1				
50	0.6712	0.0228	0.95	0.16	95.9	37.6	1.6				
55	0.7383	0.0251	0.96	0.16	97.1	38.0	1.2				
60	0.8054	0.0273	0.98	0.17	98.1	38.5	0.7				
65	0.8726	0.0296	0.99	0.18	98.9	38.8	0.4				
70	0.9397	0.0319	0.99	0.18	99.2	38.9	0.3				

Assumes double drainage
Spacing = 5 ft (triangular)

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SWT 9-7-07
SJK 9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Avenue **Based upon boring TR-35A**
Reference: FHWA-RD-86-168 Forward Abutment

Wick Drain Spacing **7.0** feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	*Remaining* δ(inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	39.2	7.35	0.37	28.5	39.2
5	0.0342	0.0023	0.18	0.09	24.9	9.7	29.5				
10	0.0685	0.0046	0.31	0.10	37.3	14.6	24.6				
15	0.1027	0.0068	0.42	0.10	47.8	18.7	20.5				
20	0.1370	0.0091	0.51	0.11	56.7	22.2	17.0				
25	0.1712	0.0114	0.59	0.12	64.1	25.1	14.1				
30	0.2055	0.0137	0.66	0.13	70.3	27.6	11.6				
35	0.2397	0.0159	0.72	0.13	75.4	29.6	9.6				
40	0.2740	0.0182	0.76	0.14	79.6	31.2	8.0				
45	0.3082	0.0205	0.80	0.15	83.0	32.5	6.7				
50	0.3424	0.0228	0.83	0.16	85.7	33.6	5.6				
55	0.3767	0.0251	0.86	0.16	87.9	34.5	4.7				
60	0.4109	0.0273	0.88	0.17	89.7	35.1	4.1				
65	0.4452	0.0296	0.89	0.18	91.1	35.7	3.5				
70	0.4794	0.0319	0.90	0.18	92.2	36.1	3.1				
75	0.5137	0.0342	0.92	0.19	93.1	36.5	2.7				
80	0.5479	0.0364	0.92	0.20	93.9	36.8	2.4				
85	0.5822	0.0387	0.93	0.20	94.6	37.1	2.1				
90	0.6164	0.0410	0.94	0.21	95.3	37.3	1.9				
95	0.6507	0.0433	0.95	0.22	95.9	37.6	1.6				
100	0.6849	0.0456	0.95	0.22	96.4	37.8	1.4				
105	0.7191	0.0478	0.96	0.23	97.0	38.0	1.2				
110	0.7534	0.0501	0.97	0.23	97.5	38.2	1.0				
115	0.7876	0.0524	0.97	0.24	98.0	38.4	0.8				
120	0.8219	0.0547	0.98	0.25	98.5	38.6	0.6				
125	0.8561	0.0569	0.99	0.25	98.9	38.8	0.4				

Assumes double drainage
Spacing = 7 ft (triangular)

EWT 9-7-07
SJL 9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Avenue **Based upon boring TR-35A**
Reference: FHWA-RD-86-168 Forward Abutment

Wick Drain Spacing **9.0** feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	*Remaining* δ(inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	39.2	9.45	**0.37**	**28.5**	**39.2**
5	0.0207	0.0023	0.12	0.09	19.7	7.7	31.5				
10	0.0414	0.0046	0.20	0.10	28.1	11.0	28.2				
15	0.0621	0.0068	0.28	0.10	35.8	14.0	25.2				
20	0.0829	0.0091	0.35	0.11	42.7	16.7	22.5				
25	0.1036	0.0114	0.42	0.12	48.9	19.2	20.0				
30	0.1243	0.0137	0.48	0.13	54.5	21.4	17.8				
35	0.1450	0.0159	0.53	0.13	59.5	23.3	15.9				
40	0.1657	0.0182	0.58	0.14	64.0	25.1	14.1				
45	0.1864	0.0205	0.62	0.15	68.0	26.7	12.5				
50	0.2072	0.0228	0.66	0.16	71.5	28.0	11.2				
55	0.2279	0.0251	0.70	0.16	74.7	29.3	9.9				
60	0.2486	0.0273	0.73	0.17	77.5	30.4	8.8				
65	0.2693	0.0296	0.76	0.18	79.9	31.3	7.9				
70	0.2900	0.0319	0.78	0.18	82.1	32.2	7.0				
75	0.3107	0.0342	0.80	0.19	84.0	32.9	6.3				
80	0.3315	0.0364	0.82	0.20	85.7	33.6	5.6				
85	0.3522	0.0387	0.84	0.20	87.1	34.2	5.0				
90	0.3729	0.0410	0.85	0.21	88.4	34.6	4.6				
95	0.3936	0.0433	0.87	0.22	89.5	35.1	4.1				
100	0.4143	0.0456	0.88	0.22	90.5	35.5	3.7				
105	0.4350	0.0478	0.89	0.23	91.3	35.8	3.4				
110	0.4558	0.0501	0.90	0.23	92.0	36.1	3.1				
115	0.4765	0.0524	0.90	0.24	92.7	36.3	2.9				
120	0.4972	0.0547	0.91	0.25	93.3	36.6	2.6				
125	0.5179	0.0569	0.92	0.25	93.8	36.8	2.4				
130	0.5386	0.0592	0.92	0.26	94.2	36.9	2.3				
135	0.5593	0.0615	0.93	0.27	94.7	37.1	2.1				
140	0.5801	0.0638	0.93	0.27	95.1	37.3	1.9				
145	0.6008	0.0661	0.94	0.28	95.4	37.4	1.8				
150	0.6215	0.0683	0.94	0.28	95.8	37.5	1.7				
155	0.6422	0.0706	0.95	0.29	96.1	37.7	1.5				
160	0.6629	0.0729	0.95	0.29	96.5	37.8	1.4				
165	0.6836	0.0752	0.95	0.30	96.8	37.9	1.3				
170	0.7043	0.0774	0.96	0.31	97.1	38.1	1.1				
175	0.7251	0.0797	0.96	0.31	97.4	38.2	1.0				
180	0.7458	0.0820	0.97	0.32	97.7	38.3	0.9				
185	0.7665	0.0843	0.97	0.32	98.0	38.4	0.8				
190	0.7872	0.0865	0.97	0.33	98.3	38.5	0.7				
195	0.8079	0.0888	0.98	0.33	98.5	38.6	0.6				
200	0.8286	0.0911	0.98	0.34	98.7	38.7	0.5				
205	0.8494	0.0934	0.98	0.34	99.0	38.8	0.4				
210	0.8701	0.0957	0.99	0.35	99.1	38.9	0.3				

Assumes double drainage
Spacing = 9 ft (triangular)

Spread Footings Related Calculations – Settlement & Global Stability

CLIENT TranSystems / ODOT D-9
PROJECT SCI - 823 Portsmouth ByPass
SUBJECT Bearing Capacity of Spread Footing SR823 over Slocum Avenue

PROJECT NO. 0121-3070.03
SHEET NO. 1 OF 18
COMP. BY GWT DATE 7-25-07
CHECKED BY SJK DATE 9-7-07

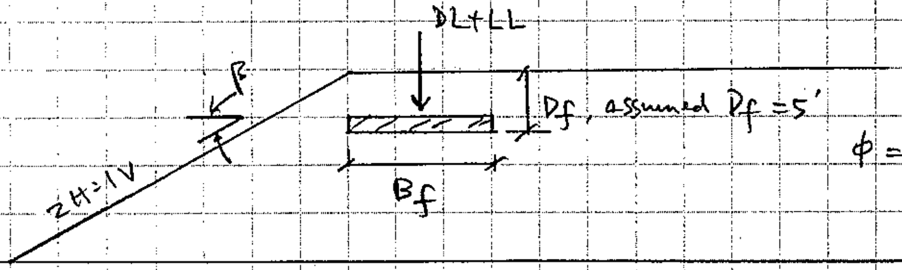
Spread Footings at abutment locations:

From TranSystems' e-mail (dated 7-20-07) : $B_f = 11'-0''$

$LL = 3.3$ k/ft
$DL = 32.93$ k/ft
} total = 36.23 (k/ft)

Rear & Forward Abutment: Assume $D_f = 5'$

$$\frac{D_f}{B_f} = \frac{5}{11} = 0.45$$



$\phi = \phi' = 30°$ (Embankment fill)
$c = 0$

Assume continuous footings, $\beta = \tan^{-1}(\frac{1}{2}) = 26.6°$

$$q_{uH} = c(N_{cq}) + \frac{1}{2}\gamma(B_f)(N_{\gamma q})$$ — Footings located on slopes or within $3B_f$ of a slope (AASHTO Eq. 4.4.7.1.1.4-1)

Use AASHTO Fig. 4.4.7.1.1.4B for $N_{\gamma q}$ (attached)

1) Interpolate between $\beta=0$ and $\beta=30°$ for solution to $\beta=26.6°$
2) Also, interpolate $D_f/B_f=0$ and $D_f/B_f=1$ for solution to $\frac{D_f}{B_f}=0.45$

$D_f = 5'$, $b=0$, $B_f = 11'$, $\phi = \phi' = 30°$, $\beta = 26.6°$

For $\beta = 0°$

$\frac{D_f}{B_f} = 0 \rightarrow N_{\gamma q} = 15$
$\frac{D_f}{B_f} = 1 \rightarrow N_{\gamma q} = 54$
} AASHTO Fig. 4.4.7.1.1.4B

for $\frac{D_f}{B_f} = 0.45 \Rightarrow N_{\gamma q} = 32.6$ (By interpolation)

CLIENT TransSystems / ODOT D-9
PROJECT SCI-823 Portsmouth ByPass
SUBJECT Bearing Capacity of Spread Footing SR823 over Slocum Avenue
PROJECT NO. 0121-3070.03
SHEET NO. 2 OF 18
COMP. BY SWT DATE 7-25-07
CHECKED BY S/K DATE 9-7-07

For $\beta = 30°$

$$\frac{D_f}{B_f} = 0 \longrightarrow N_{\gamma q} = 2$$ AASHTO, Fig. 4.4.7.1.1.4B

$$\frac{D_f}{B_f} = 1 \longrightarrow N_{\gamma q} = 24$$

for $\beta = 30°$ + $D_f/B_f = 0.45 \Rightarrow N_{\gamma q} = 11.9$ (By Interpolation)

For $\beta = 26.6°$

$$N_{\gamma q} = 11.9 + \left[\frac{32.6 - 11.9}{30}\right](30 - 26.6) = 14.2$$ use $N_{\gamma q} = 14$

$$q_{ult} = c N_{cq} + \frac{1}{2} \gamma B_f N_{\gamma q}$$, where $c = 0$

$$q_{ult} = \frac{1}{2}(120)(11)(14) = 9240 \text{ psf}$$

$$q_{allow} = \frac{q_{ult}}{F.S.} = \frac{9240}{2.5} = 3696 \text{ psf}$$ use $\boxed{q_a = 3.5 \text{ ksf}}$

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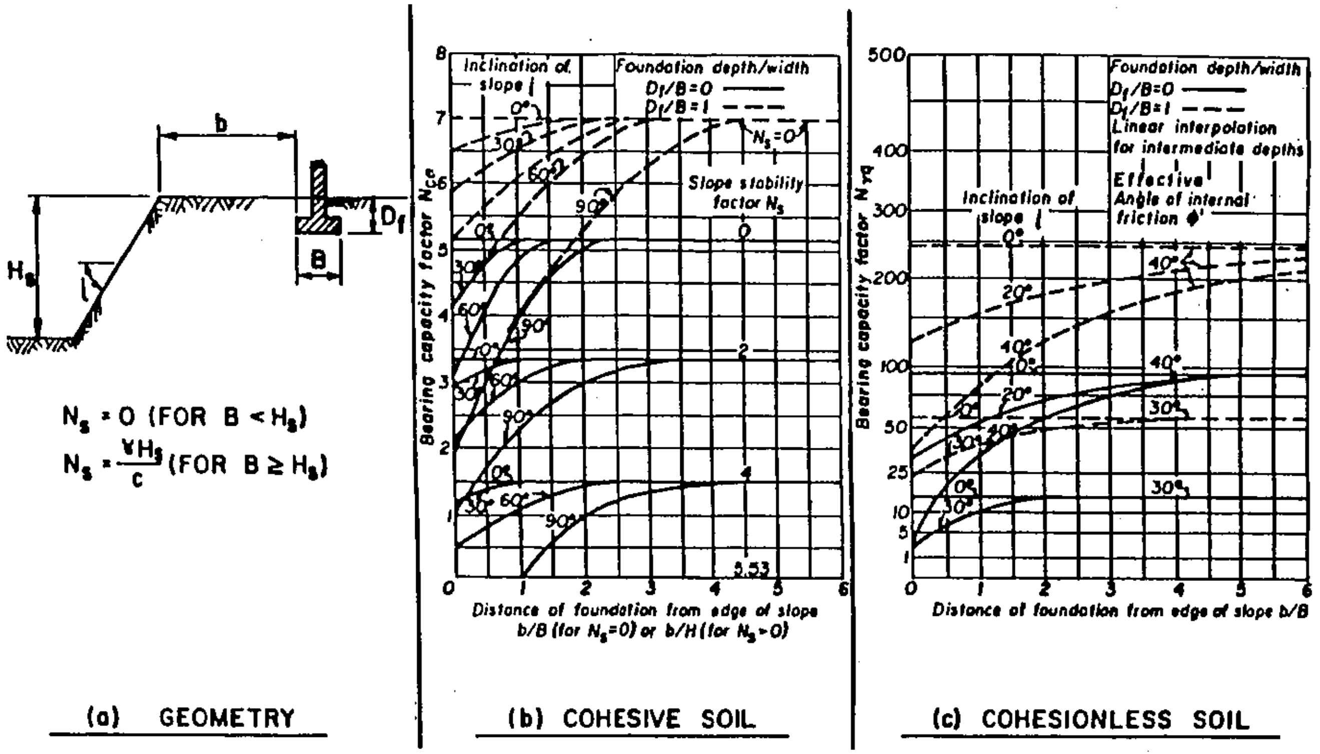
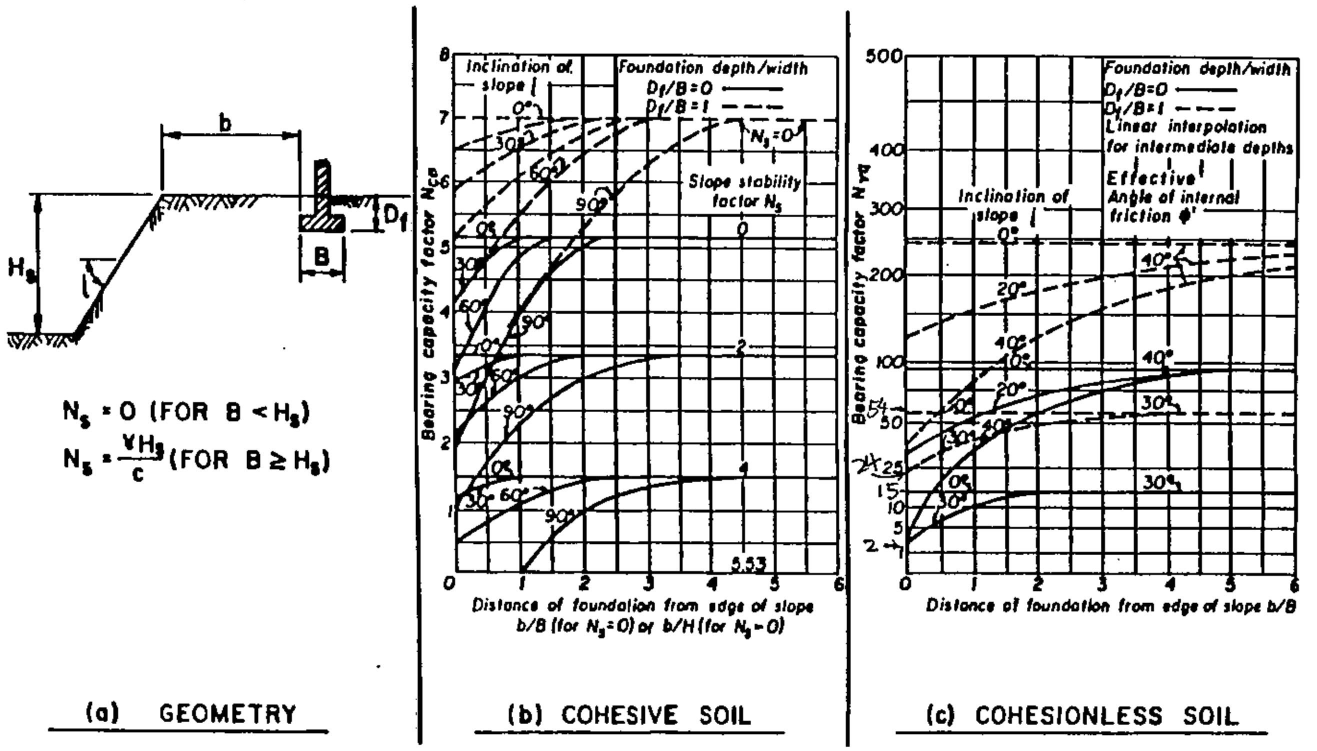
9-7-07



(a) GEOMETRY (b) COHESIVE SOIL (c) COHESIONLESS SOIL

FIGURE 4.4.7.1.1.4A Modified Bearing Capacity Factors for Footing on Sloping Ground Modified after Meyerhof (1957)



(a) GEOMETRY (b) COHESIVE SOIL (c) COHESIONLESS SOIL

FIGURE 4.4.7.1.1.4B Modified Bearing Capacity Factors for Footing Adjacent Sloping Ground Modified after Meyerhof (1957)

CLIENT Transystems Corp / ODOT D-9
PROJECT SCI - 823 Portsmouth ByPass
SUBJECT Settlement – Abutment w/ Footing
S.R 823 over Slocum Avenue
PROJECT NO. 0121-3070.03
SHEET NO. 4 OF 18
COMP. BY QWT DATE 7-25-07
CHECKED BY S/lc DATE 9-7-07

Immediate Settlement of Embankment Fill Material

Assume 1% settlement for well-compacted embankment fill; this settlement will occur prior to construction of abutments and application of footing loads.

- Rear Abutment, use embankment height = 63.2' at the center of bearing of rear abutment although embankment height is higher to the south of the rear abutment.

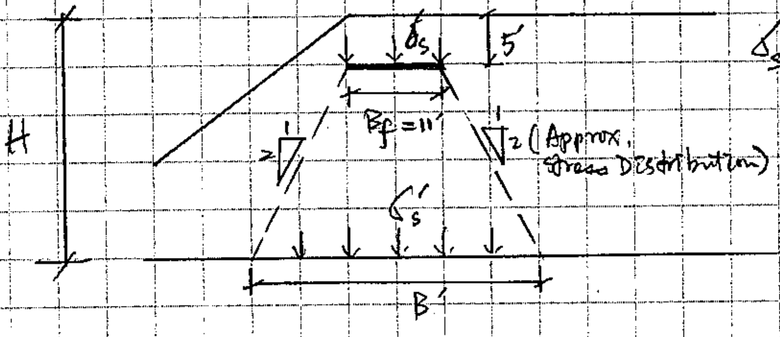
settlement of fill near rear abutment = $(0.01)(63.2)(12''/ft) = 7.6''$

- Forward Abutment, use embankment height = 52.4' at the center of bearing of forward abutment although embankment height is higher in the ravine area and lower to the north of the forward abutment.

Settlement of fill $\approx (0.01)(52.4)(12''/ft) = 6.3''$
(AASHTO 4.4.7.2)

Soil Settlement due to footing Loads (Dead Load only)

Assume $q_a = 3.5$ ksf for well compacted embankment fill



$D.L = 32.93\ ^k/ft$

σ_s = Applied pressure = $\frac{32.93}{11} = 3$ ksf

$B' = B + 2(H-5)(\frac{1}{2})$

$\& \ \sigma_s' = \frac{\sigma_s \times B_f}{B'}$

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EWT 9-7-07
SJK 9-7-07

SETTLEMENT ANALYSIS OF SHALLOW FOUNDATIONS
Schmertmann Method

Rear Abutment –
Elastic Settlement of
Embankment Fill
due to DL+LL.

Date August 1, 2007
Identification SR 823 over Slocum Ave

Input

Units E E or SI
Shape co SQ, CI, CO, or RE
B = 11 ft
L = 157 ft
D = 5 ft
P = 36.23 k/ft ← D.L+LL. = 32.93 + 3.3 = 36.23 k/ft
Dw = 104.7 ft ← Boring TR-38A, water table = 41.5' + 63.2 = 104.7'
gamma = 120 lb/ft^3
t = 0.1 yr

Results

q = 4044 lb/ft^2
delta = 3.14 in

↙ Assumed for compacted embankment fill
Es = 500 tsf

Depth to Soil Layer						
Top (ft)	Bottom (ft)	Es (lb/ft^2)	zf (ft)	I epsilon	strain (%)	delta (in)
0.0	5.0					
5.0	6.0	1000000	0.5	0.425	0.0974	0.0117
6.0	7.0	1000000	1.5	0.874	0.2005	0.0241
7.0	8.0	1000000	2.5	1.323	0.3035	0.0364
8.0	9.0	1000000	3.5	1.772	0.4066	0.0488
9.0	10.0	1000000	4.5	2.221	0.5096	0.0612
10.0	11.0	1000000	5.5	2.670	0.6126	0.0735
11.0	12.0	1000000	6.5	3.119	0.7157	0.0859
12.0	13.0	1000000	7.5	3.568	0.8187	0.0982
13.0	14.0	1000000	8.5	4.017	0.9218	0.1106
14.0	15.0	1000000	9.5	4.466	1.0248	0.1230
15.0	16.0	1000000	10.5	4.915	1.1279	0.1353
16.0	17.0	1000000	11.5	5.056	1.1604	0.1392
17.0	18.0	1000000	12.5	4.901	1.1247	0.1350
18.0	19.0	1000000	13.5	4.745	1.0889	0.1307
19.0	20.0	1000000	14.5	4.590	1.0532	0.1264
20.0	21.0	1000000	15.5	4.434	1.0175	0.1221
21.0	22.0	1000000	16.5	4.278	0.9818	0.1178
22.0	23.0	1000000	17.5	4.123	0.9461	0.1135
23.0	24.0	1000000	18.5	3.967	0.9104	0.1093
24.0	25.0	1000000	19.5	3.812	0.8747	0.1050
25.0	26.0	1000000	20.5	3.656	0.8390	0.1007
26.0	27.0	1000000	21.5	3.501	0.8033	0.0964
27.0	28.0	1000000	22.5	3.345	0.7676	0.0921
28.0	29.0	1000000	23.5	3.189	0.7319	0.0878
29.0	30.0	1000000	24.5	3.034	0.6962	0.0835
30.0	31.0	1000000	25.5	2.878	0.6605	0.0793
31.0	32.0	1000000	26.5	2.723	0.6248	0.0750
32.0	33.0	1000000	27.5	2.567	0.5891	0.0707
33.0	34.0	1000000	28.5	2.411	0.5534	0.0664
34.0	35.0	1000000	29.5	2.256	0.5177	0.0621
35.0	36.0	1000000	30.5	2.100	0.4820	0.0578
36.0	37.0	1000000	31.5	1.945	0.4463	0.0536
37.0	38.0	1000000	32.5	1.789	0.4106	0.0493
38.0	39.0	1000000	33.5	1.634	0.3749	0.0450
39.0	40.0	1000000	34.5	1.478	0.3392	0.0407
40.0	41.0	1000000	35.5	1.322	0.3035	0.0364
41.0	42.0	1000000	36.5	1.167	0.2678	0.0321
42.0	43.0	1000000	37.5	1.011	0.2321	0.0278
43.0	44.0	1000000	38.5	0.856	0.1964	0.0236

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44.0	45.0	1000000	39.5	0.700	0.1607	0.0193
45.0	46.0	1000000	40.5	0.545	0.1250	0.0150
46.0	47.0	1000000	41.5	0.389	0.0893	0.0107
47.0	48.0	1000000	42.5	0.233	0.0536	0.0064
48.0	49.0	1000000	43.5	0.078	0.0179	0.0021
49.0	50.0	1000000	44.5	0.000	0.0000	0.0000

Estimate Elastic Settlement Using AASHTO Eqn. 4.4.7.2.2-1

$$S_e = [q_0(1-\nu^2)\sqrt{A}) \times \beta_z / E_s$$

use $\nu = 0.3$; $A = L \times B = 157 \times 11' = 1727\ ft^2$

$$q_0 = \frac{DL+LL}{B} = \frac{(32.93+3.3)k/ft}{11\ ft} = 3.29\ ksf$$

$E_s = 1000$ ksf, compacted fill

AASHTO Table 4.4.7.2.2B

$$\frac{L}{B} = 10, \quad \beta_z (\text{rigid}) = 1.41$$

In this case $\frac{L}{B} = \frac{157}{11} = 14.3 > 10'$, use $\beta_z = 1.41$

$$S_e = 3.29(1-0.3^2)\sqrt{1727} \times 1.41/1000$$

$$= 0.175' = 2.11''\ *$$

* Elastic settlement estimated by Schmertmann method was 3.14" > 2.11" ; use Se = 3.14", be conservative.

AASHTO Std Spec for Hwy Bridges 17th Ed., 2002

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TABLE 4.4.7.2.2A Elastic Constants of Various Soils
Modified after U.S. Department of the Navy (1982) and Bowles (1982)

Typical Range of Values

Soil Type	Young's Modulus, E_s (ksf)	Poisson's Ratio, ν (dim)
Clay:		
Soft sensitive	50-300	0.4-0.5 (undrained)
Medium stiff to stiff	300-1,000	
Very stiff	1,000-2,000	
Loess	300-1,200	0.1-0.3
Silt	40-400	0.3-0.35
Fine sand:		
Loose	160-240	
Medium dense	240-400	0.25
Dense	400-600	
Sand:		
Loose	200-600	0.2-0.35
Medium dense	600-1,000	
Dense	1,000-1,600	0.3-0.4
Gravel:		
Loose	600-1,600	0.2-0.35
Medium dense	1,600-2,000	
Dense	2,000-4,000	0.3-0.4

Estimating E_s From N[1]

Soil Type	E_s (ksf)
Silts, sandy silts, slightly cohesive mixtures	$8N_1$[2]
Clean fine to medium sands and slightly silty sands	$14N_1$
Coarse sands and sands with little gravel	$20N_1$
Sandy gravel and gravels	$24N_1$

Estimating E_s From s_u[3]

Soft sensitive clay	$400s_u$-$1{,}000s_u$
Medium stiff to stiff clay	$1{,}500s_u$-$2{,}400s_u$
Very stiff clay	$3{,}000s_u$-$4{,}000s_u$

Estimating E_s From q_c[4]

Sandy soils	$4q_c$

[1] N = Standard Penetration Test (SPT) resistance.
[2] N_1 = SPT corrected for depth.
[3] s_u = Undrained shear strength (ksf).
[4] q_c = Cone penetration resistance (ksf).

use E_s = 1000 ksf or 500 tsf for compacted embankment granular fill.

TABLE 4.4.7.2.2B Elastic Shape and Rigidity Factors EPRI (1983)

L/B	β_z Flexible (average)	β_z Rigid
Circular	1.04	1.13
1	1.06	1.08
2	1.09	1.10
3	1.13	1.15
5	1.22	1.24
10	1.41	1.41

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4.4.7.2.2 Elastic Settlement

The elastic settlement of footings on cohesionless soils and stiff cohesive soils may be estimated using the following:

$$S_e = [q_o(1 - \nu^2)\sqrt{A}]/E_s\beta_z \quad (4.4.7.2.2\text{-}1)$$

Refer to Table 4.4.7.2.2A for approximate values of E_s and ν for various soil types, and Table 4.4.7.2.2B for values of β_z for various shapes of flexible and rigid footings. Unless E_s varies significantly with depth, E_s should be determined at a depth of about ½ to ⅔ of B below the footing. If the soil modulus varies significantly with depth, a weighted average value of E_s may be used.

Refer to Gifford, et al., (1987) for general guidance regarding the estimation of elastic settlement of footings on sand.

4.4.7.2.3 Consolidation Settlement

The consolidation settlement of footings on saturated or nearly saturated cohesive soils may be estimated using

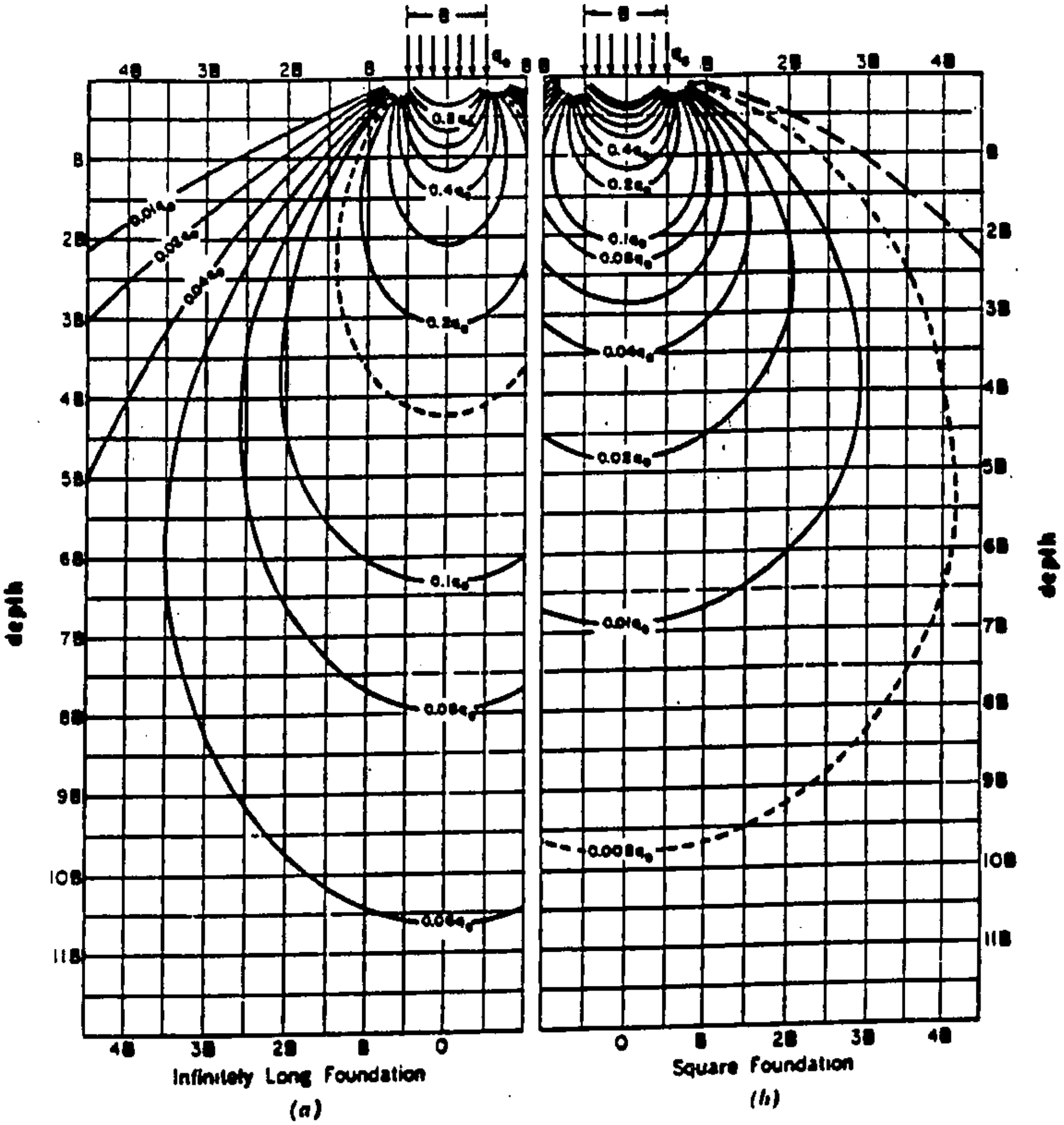


FIGURE 4.4.7.2.1A **Boussinesg Vertical Stress Contours for Continuous and Square Footings Modified after Sowers (1979)**

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

CLIENT Transystems /ODOT D-9
PROJECT SCI-823 Portsmouth By Pass
SUBJECT Settlement – Abutment w/ Footing
S.R. 823 over Slocum Avenue

PROJECT NO. 0121-3070203
SHEET NO. 9 OF 18
COMP. BY GWT DATE 7-25-07
CHECKED BY SJK DATE 9-7-07

Rear Abutment: $H = 63.2'$

$$B' = B + 2(H-5)(\tfrac{1}{2}) = 11 + 2(63.2-5)\tfrac{1}{2} = 69.2'$$

$$\sigma_s' = \frac{3 \text{ ksf}(11)}{69.2} = 0.477 \text{ ksf or } 477 \text{ psf}$$ due to DL only

Span Length = 107.5'

Per AASHTO section 4.4.7.2.5, differential settlement should be limited to 0.4% of span length for continuous span bridge

$$\Rightarrow 107.5 \times 12''/ft \times 0.004 = 5.16'' \text{ say } 5.1''$$

See attached calculations { Elastic settlement of embankment fill due to DL + LL = 3.14"
Settlement of foundation soils due to DL only = 1.4"

$\Rightarrow$ total settlement = 3.14 + 1.4 = 4.54"

i.e., Remaining allowable settlement at rear abutment

$= 5.16 - 4.54 = 0.62''$ say 0.6"

Determine Percentage of Consolidation required prior to constructing the footings

$$\frac{0.62''}{31.3''} = 0.0197 \quad U_{req'd} = 1 - 0.0198 \doteq 98 \text{ or } 98 \text{ percent.}$$

where 31.3" is soil settlement due to embankment loads (see following calculations)

Forward Abutment: $H = 52.4'$

$$B' = B + 2(H-5)\tfrac{1}{2} = 11 + 2(52.4-5)\tfrac{1}{2} = 58.4'$$

$$\sigma_s' = \frac{3 \text{ ksf}(11)}{58.4} = 0.565 \text{ ksf or } 565 \text{ psf}$$ due to DL only

Span length = 107.5'

Allowable differential settlement = 107.5 × 12"/ft × 0.004
= 5.16" say 5.1"

Elastic Settlement of embankment fill due to DL + LL = 3.14"
Settlement of foundation soils due to DL only = 2.5"

$\Rightarrow$ total settlement = 3.14" + 2.5" = 5.64"

This settlement exceeds the allowable differential settlement 5.16" by approximately 0.5 inches, approximately 0.04% of the span length of 107.5 feet, which is considered insignificant compared to the estimated settlement of 39.2 inches due to embankment load. – Considered not be a concern.

DLZ SUBJECT

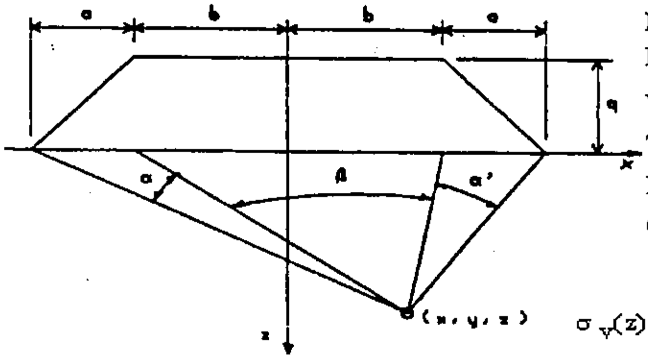
Client TranSystems ODOT9
Project SCI-823 Portsmouth ByPass
Item Settlement Analysis - Rear Abutment
SR823 over Slocum Ave, Based on TR-38A

JOB NUMBER 0121-3070.03
SHEET NO. 10 OF 18
COMP. BY EWT DATE 07/23/07
CHECKED BY SAK DATE 9-7-07

Parameters and Soil Strata based on those used for Highland Bend Embankments

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table: D= 41.5 ft

Embankment Height: H = 63.2 ft

Fill Unit Weight: γ_{emb} = 120 pcf

Width of Slope: a = 126.4

Top half-width of Emb: b = 71

Distance from CL: x = 0

Output Range: z = 0 to 77 ft

Embankment Loads only

q = 7,584 psf

**See Data output Attached*

$$\sigma_v(z) := \left(\frac{q}{\pi\ a}\right)\left(a\cdot(\alpha(z)+\beta(z)+\alpha'(z))+b\cdot(\alpha(z)+\alpha'(z))+x\cdot(\alpha(z)-\alpha'(z))\right)$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right]+\operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right]-\operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right]-\operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

									Cohesionless Soils	Cohesive Soils		
No.	Bot. of Laye		Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	C'	C_r	C_c	e_o
1	10.0	ft	Clay	125	4,480	625	7,584	8,209	0.0	0.07	0.18	0.718
2	20.0	ft	Silt	125	4,746	1,875	7,577	9,452	0.0	0.03	0.16	0.760
3	30.0	ft	Silt	125	4,746	3,125	7,554	10,679	0.0	0.03	0.16	0.760
4	40.0	ft	Silt	125	4,746	4,375	7,506	11,881	0.0	0.03	0.16	0.760
5	46.0	ft	Silt	125	4,746	5,281	7,444	12,725	0.0	0.03	0.16	0.760
6	56.0	ft	Silty Clay	120	4,428	5,757	7,371	13,128	0.0	0.07	0.19	0.706
7	61.0	ft	Silty Clay	120	4,428	6,189	7,283	13,472	0.0	0.07	0.19	0.706
8	71.0	ft	Silty Clay	120	4,428	6,621	7,183	13,804	40.0	0.00	0.00	0.000
9	77.0	ft	Sandy Silt	120	4,428	7,082	7,071	14,153	40.0	0.00	0.00	0.000
10												

No.	Settlement:	
1	0.624	ft
2	0.341	ft
3	0.351	ft
4	0.368	ft
5	0.208	ft
6	0.399	ft
7	0.188	ft
8	0.080	ft
9	.045	ft
10		

Total Settlement

2.604 ft

31.3 in

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0<\sigma'_c<\sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \sum\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right)+\frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \sum \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

DLZ SUBJECT

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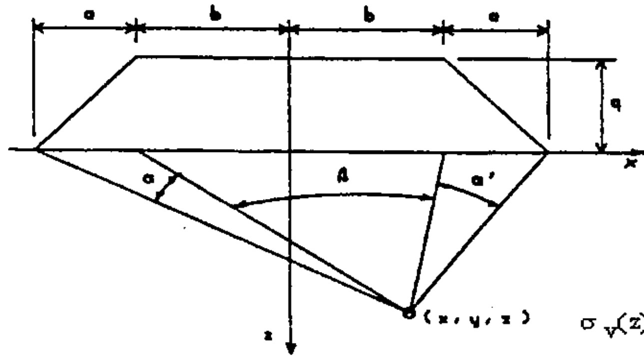

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Fill Unit Weight: γ_{emb} = 120 pcf
Width of Slope: a = 126.4
Top half-width of Emb: b = 71
Distance from CL: x = 0
Output Range: z = 0 to 77 ft

With Footing Loads,
477 psf
q = 8,061 psf

**See Data output Attached*

$$\sigma_v(z) := \left(\frac{q}{\pi\, a}\right)\left(a\cdot(\alpha(z)+\beta(z)+\alpha'(z)) + b\cdot(\alpha(z)+\alpha'(z)) + x\cdot(\alpha(z)-\alpha'(z))\right)$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right] + \operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right] - \operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right] - \operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

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3	30.0	ft	Silt	125	4,746	3,125	8,029	11,154	0.0	0.03	0.16	0.760
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7	61.0	ft	Silty Clay	120	4,428	6,189	7,741	13,931	0.0	0.07	0.19	0.706
8	71.0	ft	Silty Clay	120	4,428	6,621	7,634	14,256	40.0	0.00	0.00	0.000
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7	0.196	ft
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9	0.047	ft
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Total Settlement

2.721 ft

32.7 in

Settlements due to footing loads =
32.7 − 31.3 = 1.4"

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

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Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

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Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

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Dw = 76.9 ft ← Boring TR-35A, water table = 24.5' + 52.4 = 76.9'
gamma = 120 lb/ft^3
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Results
q = 4044 lb/ft^2
delta = 3.14 in

Assumed for compacted embankment fill Es = 500 tsf

Depth to Soil Layer Top (ft)	 Bottom (ft)	Es (lb/ft^2)	zf (ft)	I epsilon	strain (%)	delta (in)
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9.0	10.0	1000000	4.5	2.221	0.5096	0.0612
10.0	11.0	1000000	5.5	2.670	0.6126	0.0735
11.0	12.0	1000000	6.5	3.119	0.7157	0.0859
12.0	13.0	1000000	7.5	3.568	0.8187	0.0982
13.0	14.0	1000000	8.5	4.017	0.9218	0.1106
14.0	15.0	1000000	9.5	4.466	1.0248	0.1230
15.0	16.0	1000000	10.5	4.915	1.1279	0.1353
16.0	17.0	1000000	11.5	5.056	1.1604	0.1392
17.0	18.0	1000000	12.5	4.901	1.1247	0.1350
18.0	19.0	1000000	13.5	4.745	1.0889	0.1307
19.0	20.0	1000000	14.5	4.590	1.0532	0.1264
20.0	21.0	1000000	15.5	4.434	1.0175	0.1221
21.0	22.0	1000000	16.5	4.278	0.9818	0.1178
22.0	23.0	1000000	17.5	4.123	0.9461	0.1135
23.0	24.0	1000000	18.5	3.967	0.9104	0.1093
24.0	25.0	1000000	19.5	3.812	0.8747	0.1050
25.0	26.0	1000000	20.5	3.656	0.8390	0.1007
26.0	27.0	1000000	21.5	3.501	0.8033	0.0964
27.0	28.0	1000000	22.5	3.345	0.7676	0.0921
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29.0	30.0	1000000	24.5	3.034	0.6962	0.0835
30.0	31.0	1000000	25.5	2.878	0.6605	0.0793
31.0	32.0	1000000	26.5	2.723	0.6248	0.0750
32.0	33.0	1000000	27.5	2.567	0.5891	0.0707
33.0	34.0	1000000	28.5	2.411	0.5534	0.0664
34.0	35.0	1000000	29.5	2.256	0.5177	0.0621
35.0	36.0	1000000	30.5	2.100	0.4820	0.0578
36.0	37.0	1000000	31.5	1.945	0.4463	0.0536
37.0	38.0	1000000	32.5	1.789	0.4106	0.0493
38.0	39.0	1000000	33.5	1.634	0.3749	0.0450
39.0	40.0	1000000	34.5	1.478	0.3392	0.0407
40.0	41.0	1000000	35.5	1.322	0.3035	0.0364
41.0	42.0	1000000	36.5	1.167	0.2678	0.0321
42.0	43.0	1000000	37.5	1.011	0.2321	0.0278
43.0	44.0	1000000	38.5	0.856	0.1964	0.0236

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SMR 9-7-07

44.0	45.0	1000000	39.5	0.700	0.1607	0.0193
45.0	46.0	1000000	40.5	0.545	0.1250	0.0150
46.0	47.0	1000000	41.5	0.389	0.0893	0.0107
47.0	48.0	1000000	42.5	0.233	0.0536	0.0064
48.0	49.0	1000000	43.5	0.078	0.0179	0.0021
49.0	50.0	1000000	44.5	0.000	0.0000	0.0000

Estimate Elastic Settlement using AASHTO Eqn. 4.4.7.2.2-1

$S_e = [q_0 (1-\nu^2)\sqrt{A}) \times \beta_z / E_s$

use $\nu = 0.3$; $A = L \times B = 160 \times 11 = 1760\ ft^2$

$q_0 = \frac{DL+LL}{B} = \frac{(32.93 + 3.3)^{k}/ft}{11'} = 3.29$ ksf

$E_s = 1000$ ksf, compacted fill

AASHTO Table 4.4.7.2.2B

$\frac{L}{B} = 0$, β_z (rigid) $= 1.41$

In this case $\frac{L}{B} = \frac{160}{11} = 14.5 > 10$, use $\beta_z = 1.41$

$S_e = 3.29 (1 - 0.3^2) \sqrt{1760} \times 1.41 / 1000$

$= 0.177' = 2.13''$ *

* Elastic settlement estimated by Schmertmann method was 3.14" > 2.13" ; use Se = 3.14", be conservative.

DLZ SUBJECT

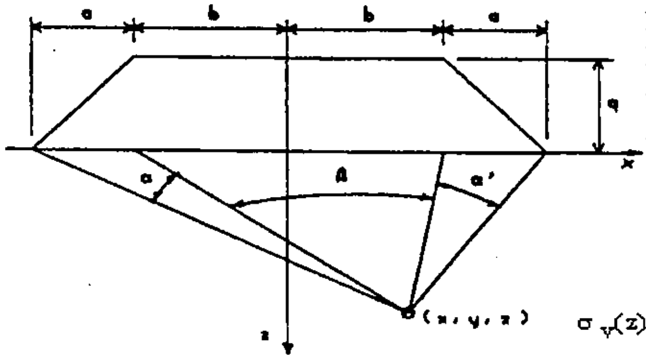
Client TranSystems ODOT9
Project SCI-823 Portsmouth ByPass
Item Settlement Analysis - Forward Abut
SR823 over Slocum Ave, Based on TR-35A

JOB NUMBER 0121-3070.03
SHEET NO. 14 OF 18
COMP. BY EWT DATE 07/23/07
CHECKED BY SYR DATE 9-7-07

Parameters and Soil Strata based on those used for Highland Bend Embankments

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table:	D=	24.5	ft	
Embankment Height:	H =	52.4	ft	**Embankment Loads only**
Fill Unit Weight:	γ_{emb} =	120	pcf	q = 6,288 psf
Width of Slope:	a =	104.8		
Top half-width of Emb:	b =	80		
Distance from CL:	x =	0		
Output Range:	z =	0 to 74	ft	

**See Data output Attached*

$$\sigma_v(z) := \left(\frac{q}{\pi\, a}\right)\left(a\cdot(\alpha(z)+\beta(z)+\alpha'(z))+b\cdot(\alpha(z)+\alpha'(z))+x\cdot(\alpha(z)-\alpha'(z))\right)$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right]+\operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right]-\operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right]-\operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

No.	Bot. of Laye		Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	Cohesionless Soils C'	Cohesive Soils C_r	C_c	e_o
1	5.0	ft	Clay	125	4,318	313	6,288	6,600	0.0	0.08	0.31	0.771
2	15.0	ft	Silt	125	4,000	1,250	6,287	7,537	0.0	0.08	0.27	0.928
3	25.0	ft	Silt	125	4,000	2,500	6,276	8,776	0.0	0.08	0.27	0.928
4	32.0	ft	Silt	125	4,000	3,313	6,255	9,568	0.0	0.08	0.27	0.928
5	42.0	ft	Silt	125	4,000	3,845	6,217	10,062	0.0	0.08	0.27	0.928
6	52.0	ft	Silty Clay	120	4,428	4,446	6,156	10,602	0.0	0.07	0.19	0.706
7	57.0	ft	Silty Clay	120	4,428	4,878	6,095	10,973	0.0	0.07	0.17	0.706
8	67.0	ft	Sandy Silt	120	4,428	5,310	6,024	11,334	42.5	0.00	0.00	0.000
9	74.0	ft	Sandy Silt	120	4,428	5,800	5,925	11,725	42.5	0.00	0.00	0.000
10												

No.	Settlement:		Total Settlement
1	0.419	ft	
2	0.595	ft	3.263 ft
3	0.563	ft	
4	0.395	ft	
5	0.568	ft	39.2 in
6	0.420	ft	
7	0.175	ft	
8	0.077	ft	
9	.050	ft	
10			

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0<\sigma'_c<\sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \sum\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right)+\frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \sum \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

DLZ SUBJECT

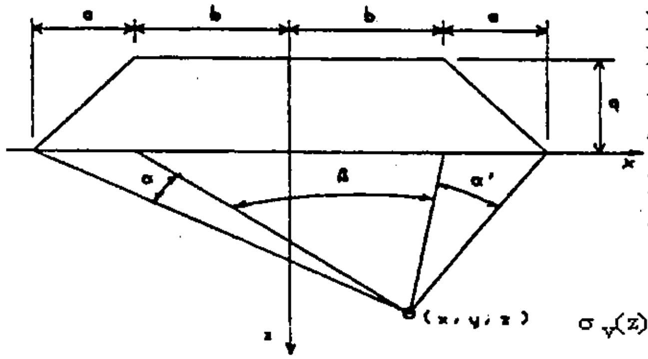
Client TranSystems ODOT9
Project SCI-823 Portsmouth ByPass
Item Settlement Analysis - Forward Abut
SR823 over Slocum Ave, Based on TR-35A

JOB NUMBER 0121-3070.03
SHEET NO. 15 OF 18
COMP. BY EWT DATE 07/23/07
CHECKED BY SJK DATE 9-7-07

Parameters and Soil Strata based on those used for Highland Bend Embankments

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table: D= 24.5 ft
Embankment Height: H = 52.4 ft
Fill Unit Weight: γ_{emb} = 120 pcf
Width of Slope: a = 104.8
Top half-width of Emb: b = 80
Distance from CL: x = 0
Output Range: z = 0 to 74 ft

**See Data output Attached*

Embankment & Footing
Footing Load = 565 psf
q = 6,853 psf

$$\sigma_v(z) := \left(\frac{q}{\pi\, a}\right)\left(a\cdot(\alpha(z)+\beta(z)+\alpha'(z)) + b\cdot(\alpha(z)+\alpha'(z)) + x\cdot(\alpha(z)-\alpha'(z))\right)$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right] + \operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right] - \operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right] - \operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

									Cohesionless Soils	Cohesive Soils		
No.	Bot. of Laye		Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	C'	C_r	C_c	e_o
1	5.0	ft	Clay	125	4,318	313	6,853	7,165	0.0	0.08	0.31	0.771
2	15.0	ft	Silt	125	4,000	1,250	6,851	8,101	0.0	0.08	0.27	0.928
3	25.0	ft	Silt	125	4,000	2,500	6,840	9,340	0.0	0.08	0.27	0.928
4	32.0	ft	Silt	125	4,000	3,313	6,817	10,130	0.0	0.08	0.27	0.928
5	42.0	ft	Silt	125	4,000	3,845	6,776	10,621	0.0	0.08	0.27	0.928
6	52.0	ft	Silty Clay	120	4,428	4,446	6,709	11,155	0.0	0.07	0.19	0.706
7	57.0	ft	Silty Clay	120	4,428	4,878	6,643	11,521	0.0	0.07	0.17	0.706
8	67.0	ft	Sandy Silt	120	4,428	5,310	6,565	11,875	42.5	0.00	0.00	0.000
9	74.0	ft	Sandy Silt	120	4,428	5,800	6,458	12,257	42.5	0.00	0.00	0.000
10												

No.	Settlement:	
1	0.450	ft
2	0.639	ft
3	0.600	ft
4	0.419	ft
5	0.601	ft
6	0.445	ft
7	0.186	ft
8	0.082	ft
	0.054	ft
10		

Total Settlement

3.476 ft

41.7 in

Settlements due to footing Loads:

41.7 - 39.2 = 2.5"

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0 < \sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0 < \sigma'_c < \sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \sum\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0 = \sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \sum \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0 = \sigma'_c$)

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

DLZ SUBJECT

Client TranSystems ODOT9

Project SCI-823 Portsmouth ByPass

Item Settlement Analysis - Rear Abutment-toe

SR823 over Slocum Ave, Based on TR-38A

JOB NUMBER 0121-3070.03

SHEET NO. 16 OF 68

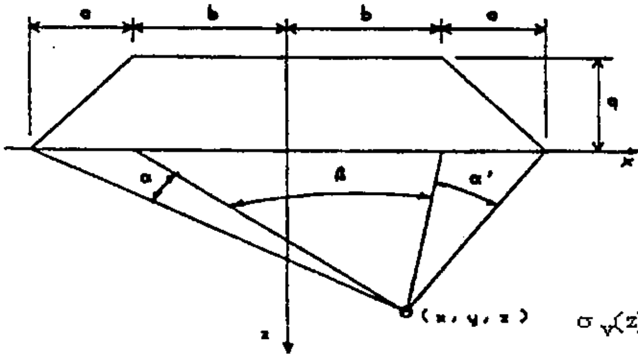
COMP. BY EWT DATE 07/23/07

CHECKED BY SJK DATE 9-7-07

Parameters and Soil Strata based on those used for Highland Bend Embankments

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table: D= 41.5 ft

Embankment Height: H = 63.2 ft

Fill Unit Weight: γ_{emb} = 120 pcf

Width of Slope: a = 126.4

Top half-width of Emb: b = 71

Distance from CL: x = 197.4

Output Range: z = 0 to 77 ft

Embankment & Footing

Footing Load =477 psf

q = 8,061 psf

**See Data output Attached*

$$\sigma_{v}(z) := \left(\frac{q}{\pi\, a}\right)\left(a\cdot(\alpha(z)+\beta(z)+\alpha'(z)) + b\cdot(\alpha(z)+\alpha'(z)) + x\cdot(\alpha(z)-\alpha'(z))\right)$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right] + \operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right] - \operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right] - \operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

								Cohesionless Soils	Cohesive Soils		
No.	Bot. of Laye	Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	C'	C_r	C_c	e_o
1	10.0 ft	Clay	125	4,480	625	93	718	0.0	0.07	0.18	0.718
2	20.0 ft	Silt	125	4,746	1,875	294	2,169	0.0	0.03	0.16	0.760
3	30.0 ft	Silt	125	4,746	3,125	491	3,616	0.0	0.03	0.16	0.760
4	40.0 ft	Silt	125	4,746	4,375	682	5,057	0.0	0.03	0.16	0.760
5	46.0 ft	Silt	125	4,746	5,281	837	6,118	0.0	0.03	0.16	0.760
6	56.0 ft	Silty Clay	120	4,428	5,757	971	6,728	0.0	0.07	0.19	0.706
7	61.0 ft	Silty Clay	120	4,428	6,189	1,099	7,288	0.0	0.07	0.19	0.706
8	71.0 ft	Silty Clay	120	4,428	6,621	1,220	7,842	40.0	0.00	0.00	0.000
9	77.0 ft	Sandy Silt	120	4,428	7,082	1,335	8,417	40.0	0.00	0.00	0.000
10											

No.	Settlement:
1	0.025 ft
2	0.011 ft
3	0.011 ft
4	0.031 ft
5	0.035 ft
6	0.075 ft
7	0.040 ft
8	0.018 ft
9	0.011 ft
10	

Total Settlement

$\boxed{0.257 \text{ ft}}$

$\boxed{3.1 \text{ in}}$

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0<\sigma'_c<\sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \sum\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \sum \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

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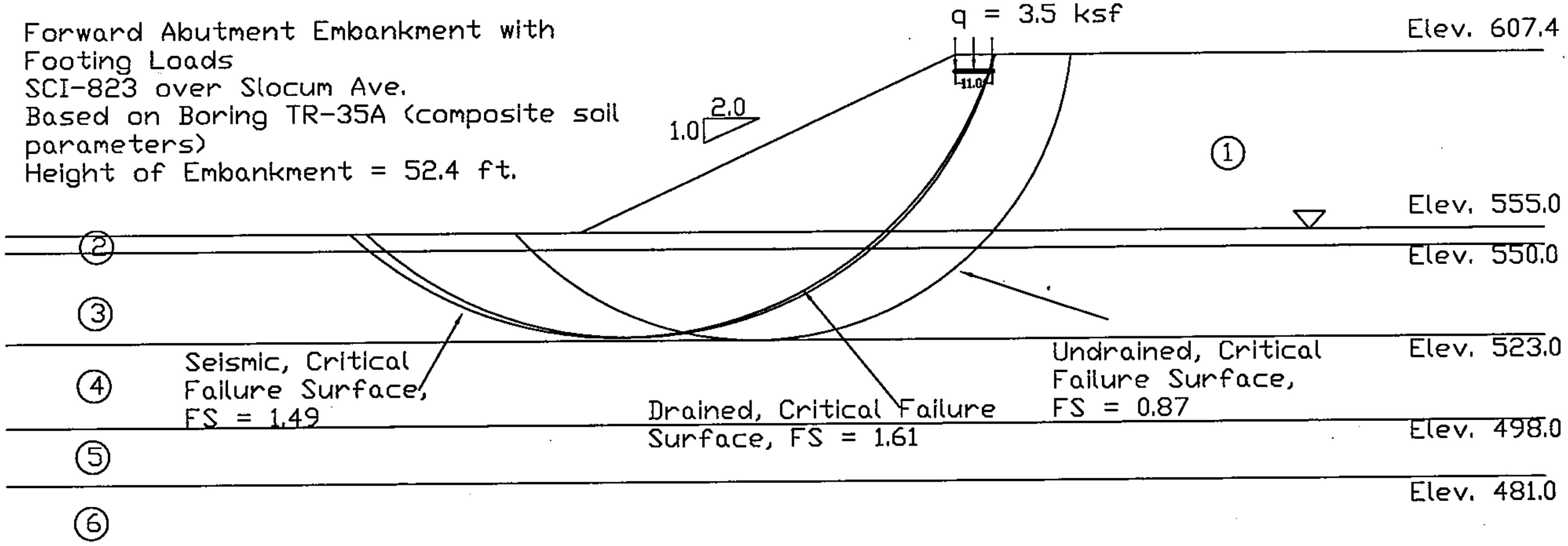
EWT 9-7-07

Material	Consistency	Soil Type	Undrained C (psf)	Undrained φ(deg)	Drained C'(psf)	Drained φ'(deg)	γ(pcf)
Material 1	Compacted	Emb. Fill	0	35	0	35	120
Material 2	Stiff	Clay	1700	0	0	30	125
Material 3	M. Stiff	Silt	900	0	0	29	120
Material 4	V. Stiff	Silty Clay	2700	0	0	29	120
Material 5	M. Dense	Silt & Grvl	0	30	0	30	120
Material 6		Bedrock	50000	50	50000	50	150

Forward Abutment Embankment with Footing Loads
SCI-823 over Slocum Ave.
Based on Boring TR-35A (composite soil parameters)
Height of Embankment = 52.4 ft.



SJK 9-7-07

SCI-823 OVER SLOCUM AVENUE
FORWARD ABUTMENT LOCATION
ANALYSES WITH SPREAD FOOTING LOADS

SPILL THROUGH SLOPE STABILITY ANALYSIS

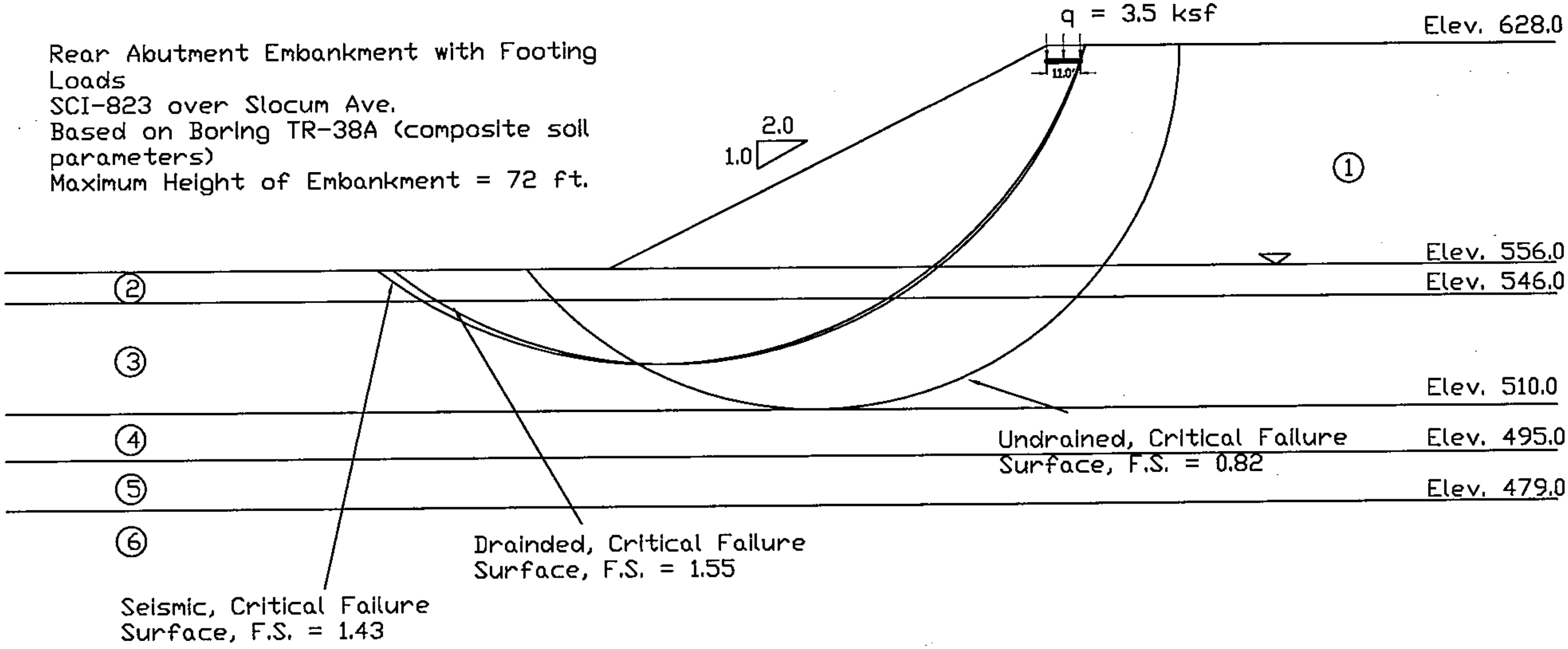
SCI-823-0.00

PROJECT NO. 0121-3070.03	CALC: EWT	DATE 07/30/07

CE -8
EWT 9-7-07

Material	Consistency	Soil Type	Undrained C (psf)	Undrained Φ(deg)	Drained C'(psf)	Drained Φ'(deg)	γ(pcf)
Material 1	Compacted	Emb. Fill	0	35	0	35	120
Material 2	Stiff	Clay	1700	0	0	30	125
Material 3	Stiff	Silt	1100	0	0	29	120
Material 4	V. Stiff	Silty Clay	2700	0	0	29	120
Material 5	M. Dense	Silt & Grvl	0	30	0	30	120
Material 6		Bedrock	50000	50	50000	50	150

Rear Abutment Embankment with Footing Loads
SCI-823 over Slocum Ave.
Based on Boring TR-38A (composite soil parameters)
Maximum Height of Embankment = 72 ft.



SAK 9-7-07

SCI-823 OVER SLOCUM AVENUE
REAR ABUTMENT LOCATION
ANALYSES WITH SPREAD FOOTING LOADS

SPILL THROUGH SLOPE STABILITY ANALYSIS

SCI-823-0.00

PROJECT NO. 0121-3070.03	CALC: EWT	DATE 07/30/07

Downdrag Force Estimates for Pier 1 and Pier 2

DLZ SUBJECT

Client TranSystems ODOT9

Project SCI-823 Portsmouth ByPass

Item Settlement Analysis - Rear Abutment-toe

SR823 over Slocum Ave, Based on TR-38A

JOB NUMBER 0121-3070.03

SHEET NO. 1 OF 26

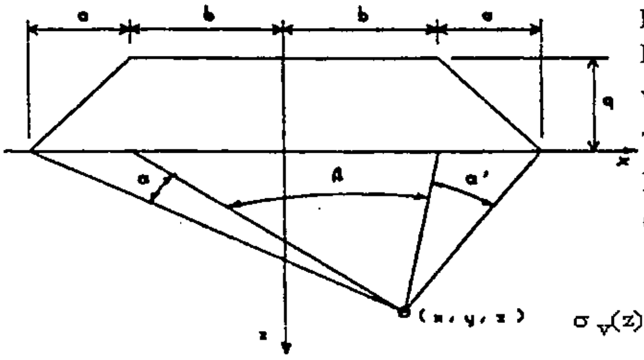
COMP. BY EWT DATE 07/23/07

CHECKED BY SJK DATE 9-7-07

Parameters and Soil Strata based on those used for Highland Bend Embankments

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table: D= 41.5 ft

Embankment Loads only

Embankment Height: H = 63.2 ft

Fill Unit Weight: γ_{emb} = 120 pcf

q = 7,584 psf

Width of Slope: a = 126.4

Top half-width of Emb: b = 71

Distance from CL: x = 197.4

Output Range: z = 0 to 77 ft

**See Data output Attached*

$$\sigma_v(z) := \left(\frac{q}{\pi\, a}\right)(a\cdot(\alpha(z)+\beta(z)+\alpha'(z)) + b\cdot(\alpha(z)+\alpha'(z)) + x\cdot(\alpha(z)-\alpha'(z)))$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right] + \operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right] - \operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right] - \operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

									Cohesionless Soils	Cohesive Soils		
No.	Bot. of Laye		Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	C'	C_r	C_c	e_o
1	10.0	ft	Clay	125	4,480	625	88	713	0.0	0.07	0.18	0.718
2	20.0	ft	Silt	125	4,746	1,875	277	2,152	0.0	0.03	0.16	0.760
3	30.0	ft	Silt	125	4,746	3,125	462	3,587	0.0	0.03	0.16	0.760
4	40.0	ft	Silt	125	4,746	4,375	642	5,017	0.0	0.03	0.16	0.760
5	46.0	ft	Silt	125	4,746	5,281	787	6,068	0.0	0.03	0.16	0.760
6	56.0	ft	Silty Clay	125	4,428	5,782	914	6,696	0.0	0.07	0.19	0.706
7	61.0	ft	Silty Clay	120	4,428	6,239	1,034	7,273	0.0	0.07	0.19	0.706
8	71.0	ft	Sandy Silt	120	4.428	6,671	1,148	7,819	40.0	0.00	0.00	0.000
9	77.0	ft	Sandy Silt	120	4.428	7,132	1,256	8,388	40.0	0.00	0.00	0.000
10												

No.	Settlement:	
1	0.023	ft
2	0.010	ft
3	0.010	ft
4	0.028	ft
5	0.033	ft
6	0.071	ft
7	0.037	ft
8	0.017	ft
	0.011	ft
10		

Total Settlement

0.240 ft

2.9 in

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \Sigma \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0<\sigma'_c<\sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \Sigma\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \Sigma \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \Sigma \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

DLZ SUBJECT

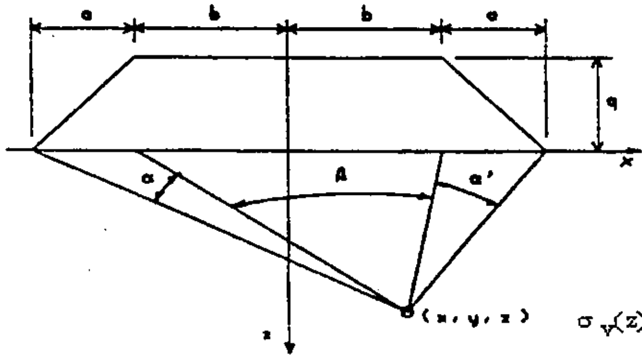
Client TranSystems ODOT9
Project SCI-823 Portsmouth ByPass
Item Settlement Analysis - Rear Abutment-toe
SR823 over Slocum Ave, Based on TR-38A

JOB NUMBER 0121-3070.03
SHEET NO. 2 OF 26
COMP. BY EWT DATE 07/23/07
CHECKED BY SJK DATE 9-7-07

Parameters and Soil Strata based on those used for Highland Bend Embankments

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table: D= 41.5 ft
Embankment Height: H = 63.2 ft
Fill Unit Weight: γ_{emb} = 120 pcf
Width of Slope: a = 126.4
Top half-width of Emb: b = 71
Distance from CL: x = 197.4
Output Range: z = 0 to 77 ft

Embankment & Footing
Footing Load =477 psf
q = 8,061 psf

**See Data output Attached*

$$\sigma_v(z) := \left(\frac{q}{\pi\, a}\right)\left(a\cdot(\alpha(z)+\beta(z)+\alpha'(z)) + b\cdot(\alpha(z)+\alpha'(z)) + x\cdot(\alpha(z)-\alpha'(z))\right)$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right] + \operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right] - \operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right] - \operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

									Cohesionless Soils	Cohesive Soils		
No.	Bot. of Laye		Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	C'	C_r	C_c	e_o
1	10.0	ft	Clay	125	4,480	625	93	718	0.0	0.07	0.18	0.718
2	20.0	ft	Silt	125	4,746	1,875	294	2,169	0.0	0.03	0.16	0.760
3	30.0	ft	Silt	125	4,746	3,125	491	3,616	0.0	0.03	0.16	0.760
4	40.0	ft	Silt	125	4,746	4,375	682	5,057	0.0	0.03	0.16	0.760
5	46.0	ft	Silt	125	4,746	5,281	837	6,118	0.0	0.03	0.16	0.760
6	56.0	ft	Silty Clay	120	4,428	5,757	971	6,728	0.0	0.07	0.19	0.706
7	61.0	ft	Silty Clay	120	4,428	6,189	1,099	7,288	0.0	0.07	0.19	0.706
8	71.0	ft	Sandy Silt	120	4,428	6,621	1,220	7,842	40.0	0.00	0.00	0.000
9	77.0	ft	Sandy Silt	120	4,428	7,082	1,335	8,417	40.0	0.00	0.00	0.000
10												

No.	Settlement:	
1	0.025	ft
2	0.011	ft
3	0.011	ft
4	0.031	ft
5	0.035	ft
6	0.075	ft
7	0.040	ft
8	0.018	ft
9	0.011	ft
10		

Total Settlement

0.257 ft

3.1 in

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \Sigma \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0<\sigma'_c<\sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \Sigma\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \Sigma \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \Sigma \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

DLZ SUBJECT

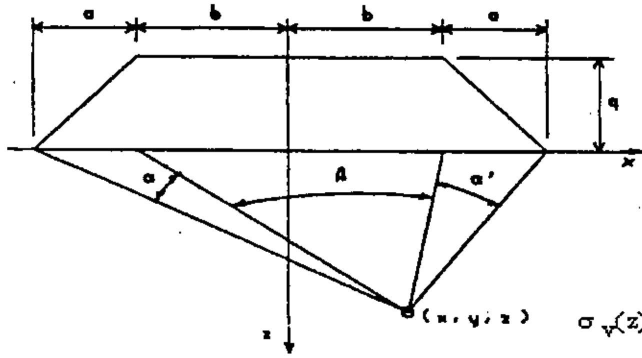
Client TranSystems ODOT9
Project SCI-823 Portsmouth ByPass
Item Settlement Analysis - Forward Abut-Toe
SR823 over Slocum Ave, Based on TR-35A

JOB NUMBER 0121-3070.03
SHEET NO. 3 OF 26
COMP. BY EWT DATE 07/23/07
CHECKED BY SJK DATE 9-7-07

Parameters and Soil Strata based on those used for Highland Bend Embankments

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table: D= 24.5 ft
Embankment Height: H = 52.4 ft
Fill Unit Weight: γ_{emb} = 120 pcf
Width of Slope: a = 104.8
Top half-width of Emb: b = 80
Distance from CL: x = 184.8
Output Range: z = 0 to 74 ft

Embankment Loads only
q = 6,288 psf

**See Data output Attached*

$$\sigma_v(z) := \left(\frac{q}{\pi\, a}\right)\left(a\cdot(\alpha(z)+\beta(z)+\alpha'(z)) + b\cdot(\alpha(z)+\alpha'(z)) + x\cdot(\alpha(z)-\alpha'(z))\right)$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right] + \operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right] - \operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right] - \operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

No.	Bot. of Laye		Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	Cohesionless Soils	Cohesive Soils		
									C'	C_r	C_c	e_o
1	5.0	ft	Clay	125	4,318	313	42	355	0.0	0.08	0.31	0.771
2	15.0	ft	Silt	125	4,000	1,250	183	1,433	0.0	0.08	0.27	0.928
3	25.0	ft	Silt	125	4,000	2,500	377	2,877	0.0	0.08	0.27	0.928
4	32.0	ft	Silt	125	4,000	3,313	524	3,837	0.0	0.08	0.27	0.928
5	42.0	ft	Silt	125	4,000	3,845	677	4,522	0.0	0.08	0.27	0.928
6	52.0	ft	Silty Clay	120	4,428	4,446	833	5,279	0.0	0.07	0.19	0.706
7	57.0	ft	Silty Clay	120	4,428	4,878	946	5,824	0.0	0.07	0.17	0.706
8	67.0	ft	Sandy Silt	120	4,428	5,310	1,051	6,361	42.5	0.00	0.00	0.000
9	74.0	ft	Sandy Silt	120	4,428	5,800	1,168	6,968	42.5	0.00	0.00	0.000
10												

No.	Settlement:	
1	0.012	ft
2	0.025	ft
3	0.025	ft
4	0.019	ft
5	0.082	ft
6	0.083	ft
7	0.038	ft
8	0.018	ft
9	0.013	ft
10		

Total Settlement

$\boxed{0.316 \text{ ft}}$

$\boxed{3.8 \text{ in}}$

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0<\sigma'_c<\sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \sum\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \sum \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

DLZ SUBJECT

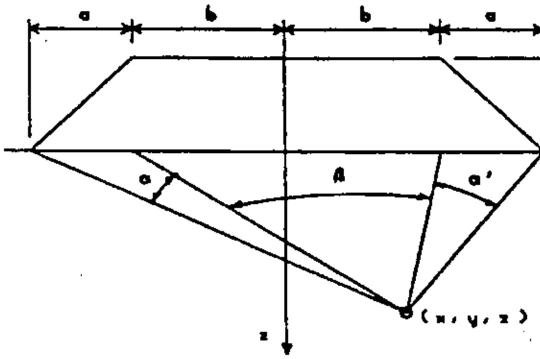
Client TranSystems ODOT9
Project SCI-823 Portsmouth ByPass
Item Settlement Analysis - Forward Abut-Toe
SR823 over Slocum Ave, Based on TR-35A

JOB NUMBER 0121-3070.03
SHEET NO. 4 OF 26
COMP. BY EWT DATE 07/23/07
CHECKED BY S1K DATE 9-7-07

Parameters and Soil Strata based on those used for Highland Bend Embankments

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table: D= 24.5 ft
Embankment Height: H = 52.4 ft
Fill Unit Weight: γ_{emb} = 120 pcf
Width of Slope: a = 104.8
Top half-width of Emb: b = 80
Distance from CL: x = 184.8
Output Range: z = 0 to 74 ft

**See Data output Attached*

Embankment & Footing
Footing Load = 565 psf
q = 6,853 psf

$$\sigma_v(z) := \left(\frac{q}{\pi a}\right)(a\cdot(\alpha(z) + \beta(z) + \alpha'(z)) + b\cdot(\alpha(z) + \alpha'(z)) + x\cdot(\alpha(z) - \alpha'(z)))$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right] + \operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right] - \operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right] - \operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

									Cohesionless Soils	Cohesive Soils		
No.	Bot. of Laye		Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	C'	C_r	C_c	e_o
1	5.0	ft	Clay	125	4,318	313	46	359	0.0	0.08	0.31	0.771
2	15.0	ft	Silt	125	4,000	1,250	200	1,450	0.0	0.08	0.27	0.928
3	25.0	ft	Silt	125	4,000	2,500	411	2,911	0.0	0.08	0.27	0.928
4	32.0	ft	Silt	125	4,000	3,313	571	3,884	0.0	0.08	0.27	0.928
5	42.0	ft	Silt	125	4,000	3,845	738	4,583	0.0	0.08	0.27	0.928
6	52.0	ft	Silty Clay	120	4,428	4,446	908	5,354	0.0	0.07	0.19	0.706
7	57.0	ft	Silty Clay	120	4,428	4,878	1,031	5,909	0.0	0.07	0.17	0.706
8	67.0	ft	Sandy Silt	120	4,428	5,310	1,146	6,456	42.5	0.00	0.00	0.000
9	74.0	ft	Sandy Silt	120	4,428	5,800	1,273	7,073	42.5	0.00	0.00	0.000
10												

No.	Settlement:	
1	0.014	ft
2	0.027	ft
3	0.027	ft
4	0.020	ft
5	0.090	ft
6	0.090	ft
7	0.041	ft
8	0.020	ft
	0.014	ft
10		

Total Settlement

$\boxed{0.343 \text{ ft}}$

$\boxed{4.1 \text{ in}}$

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \Sigma \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0<\sigma'_c<\sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \Sigma\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \Sigma \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \Sigma \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

5/26
gwt 9-7-07
9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Avenue **Based upon boring TR-38A**
Reference: FHWA-RD-86-168 Rear Abutment - Pier 1

Wick Drain Spacing **5.0** feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	*Remaining* δ(inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	3.1	5.25	**0.44**	**30.5**	**3.1**
5	0.0798	0.0024	0.34	0.09	40.3	1.2	1.9				
10	0.1596	0.0047	0.57	0.10	60.9	1.9	1.2				
15	0.2395	0.0071	0.72	0.11	74.6	2.3	0.8				
20	0.3193	0.0095	0.81	0.11	83.2	2.6	0.5				
25	0.3991	0.0118	0.87	0.12	88.5	2.7	0.4				
30	0.4789	0.0142	0.90	0.13	91.7	2.8	0.3				
35	0.5587	0.0166	0.93	0.14	93.7	2.9	0.2				
40	0.6385	0.0189	0.94	0.14	95.3	3.0	0.1				
45	0.7184	0.0213	0.96	0.15	96.7	3.0	0.1				
50	0.7982	0.0236	0.98	0.16	98.0	3.0	0.1				
55	0.8780	0.0260	0.99	0.17	99.0	3.1	0.0				
60	0.9578	0.0284	0.99	0.17	99.1	3.1	0.0				

Assumes double drainage
Spacing = 5 ft (triangular)

6/26
9-7-07
9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Avenue **Based upon boring TR-38A**
Reference: FHWA-RD-86-168 Rear Abutment - Pier 1

Wick Drain Spacing **7.0** feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	*Remaining* δ(inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	3.1	7.35	**0.44**	**30.5**	**3.1**
5	0.0407	0.0024	0.20	0.09	27.3	0.8	2.3				
10	0.0814	0.0047	0.35	0.10	41.3	1.3	1.8				
15	0.1222	0.0071	0.47	0.11	52.9	1.6	1.5				
20	0.1629	0.0095	0.57	0.11	62.2	1.9	1.2				
25	0.2036	0.0118	0.66	0.12	69.8	2.2	0.9				
30	0.2443	0.0142	0.72	0.13	75.8	2.4	0.7				
35	0.2851	0.0166	0.78	0.14	80.6	2.5	0.6				
40	0.3258	0.0189	0.82	0.14	84.3	2.6	0.5				
45	0.3665	0.0213	0.85	0.15	87.2	2.7	0.4				
50	0.4072	0.0236	0.87	0.16	89.4	2.8	0.3				
55	0.4480	0.0260	0.89	0.17	91.0	2.8	0.3				
60	0.4887	0.0284	0.91	0.17	92.4	2.9	0.2				
65	0.5294	0.0307	0.92	0.18	93.4	2.9	0.2				
70	0.5701	0.0331	0.93	0.19	94.3	2.9	0.2				
75	0.6109	0.0355	0.94	0.19	95.1	2.9	0.2				
80	0.6516	0.0378	0.95	0.20	95.8	3.0	0.1				
85	0.6923	0.0402	0.96	0.21	96.5	3.0	0.1				
90	0.7330	0.0426	0.96	0.21	97.2	3.0	0.1				
95	0.7738	0.0449	0.97	0.22	97.8	3.0	0.1				
100	0.8145	0.0473	0.98	0.23	98.4	3.0	0.1				
105	0.8552	0.0497	0.98	0.23	98.8	3.1	0.0				
110	0.8959	0.0520	0.99	0.24	99.2	3.1	0.0				
115	0.9366	0.0544	0.99	0.25	99.3	3.1	0.0				

Assumes double drainage
Spacing = 7 ft (triangular)

7/26

GWT 9-7-07

SJK 9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians

Slocum Avenue

Reference: FHWA-RD-86-168

Based upon boring TR-38A

Rear Abutment - Pier 1

Wick Drain Spacing 9.0 feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	*Remaining* δ(inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	3.1	9.45	**0.44**	**30.5**	**3.1**
5	0.0246	0.0024	0.13	0.09	21.2	0.7	2.4				
10	0.0493	0.0047	0.23	0.10	30.9	1.0	2.1				
15	0.0739	0.0071	0.32	0.11	39.5	1.2	1.9				
20	0.0985	0.0095	0.40	0.11	47.2	1.5	1.6				
25	0.1232	0.0118	0.48	0.12	53.9	1.7	1.4				
30	0.1478	0.0142	0.54	0.13	59.8	1.9	1.2				
35	0.1724	0.0166	0.60	0.14	65.0	2.0	1.1				
40	0.1971	0.0189	0.64	0.14	69.6	2.2	0.9				
45	0.2217	0.0213	0.69	0.15	73.5	2.3	0.8				
50	0.2464	0.0236	0.73	0.16	76.9	2.4	0.7				
55	0.2710	0.0260	0.76	0.17	79.9	2.5	0.6				
60	0.2956	0.0284	0.79	0.17	82.4	2.6	0.5				
65	0.3203	0.0307	0.81	0.18	84.5	2.6	0.5				
70	0.3449	0.0331	0.83	0.19	86.4	2.7	0.4				
75	0.3695	0.0355	0.85	0.19	88.0	2.7	0.4				
80	0.3942	0.0378	0.87	0.20	89.3	2.8	0.3				
85	0.4188	0.0402	0.88	0.21	90.4	2.8	0.3				
90	0.4434	0.0426	0.89	0.21	91.4	2.8	0.3				
95	0.4681	0.0449	0.90	0.22	92.3	2.9	0.2				
100	0.4927	0.0473	0.91	0.23	93.0	2.9	0.2				
105	0.5173	0.0497	0.92	0.23	93.6	2.9	0.2				
110	0.5420	0.0520	0.92	0.24	94.2	2.9	0.2				
115	0.5666	0.0544	0.93	0.25	94.7	2.9	0.2				
120	0.5912	0.0568	0.93	0.25	95.1	2.9	0.2				
125	0.6159	0.0591	0.94	0.26	95.6	3.0	0.1				
130	0.6405	0.0615	0.95	0.27	96.0	3.0	0.1				
135	0.6652	0.0639	0.95	0.27	96.4	3.0	0.1				
140	0.6898	0.0662	0.96	0.28	96.8	3.0	0.1				
145	0.7144	0.0686	0.96	0.28	97.1	3.0	0.1				
150	0.7391	0.0709	0.96	0.29	97.5	3.0	0.1				
155	0.7637	0.0733	0.97	0.30	97.9	3.0	0.1				
160	0.7883	0.0757	0.97	0.30	98.2	3.0	0.1				
165	0.8130	0.0780	0.98	0.31	98.5	3.1	0.0				
170	0.8376	0.0804	0.98	0.31	98.8	3.1	0.0				
175	0.8622	0.0828	0.99	0.32	99.0	3.1	0.0				
180	0.8869	0.0851	0.99	0.32	99.2	3.1	0.0				
185	0.9115	0.0875	0.99	0.33	99.3	3.1	0.0				
190	0.9361	0.0899	0.99	0.33	99.4	3.1	0.0				

Assumes double drainage
Spacing = 9 ft (triangular)

8/26

EWC 9-7-07
SJK 9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Avenue **Based upon boring TR-35A**
Reference: FHWA-RD-86-168 Forward Abutment - Pier 2

Wick Drain Spacing **5.0** feet Use $\eta = 10$

t (days)	**T_R**	**T_V**	**U_R**	**U_V**	**U_C**	δ(inches)	*Remaining* δ(inches)	**d_e**	**c_v**	**H_v**	**δ_{max}**
0	0.0000	0.0000	0.00	0.00	0.0	0.0	4.1	5.25	**0.37**	**28.5**	**4.1**
5	0.0671	0.0023	0.30	0.09	36.3	1.5	2.6				
10	0.1342	0.0046	0.51	0.10	55.3	2.3	1.8				
15	0.2014	0.0068	0.65	0.10	68.9	2.8	1.3				
20	0.2685	0.0091	0.76	0.11	78.3	3.2	0.9				
25	0.3356	0.0114	0.83	0.12	84.6	3.5	0.6				
30	0.4027	0.0137	0.87	0.13	88.7	3.6	0.5				
35	0.4698	0.0159	0.90	0.13	91.4	3.7	0.4				
40	0.5370	0.0182	0.92	0.14	93.3	3.8	0.3				
45	0.6041	0.0205	0.94	0.15	94.7	3.9	0.2				
50	0.6712	0.0228	0.95	0.16	95.9	3.9	0.2				
55	0.7383	0.0251	0.96	0.16	97.1	4.0	0.1				
60	0.8054	0.0273	0.98	0.17	98.1	4.0	0.1				
65	0.8726	0.0296	0.99	0.18	98.9	4.1	0.0				
70	0.9397	0.0319	0.99	0.18	99.2	4.1	0.0				

Assumes double drainage
Spacing = 5 ft (triangular)

9/26

SWT 9-7-07

SJK 9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians

Slocum Aveneue

Based upon boring TR-35A

Reference: FHWA-RD-86-168

Forward Abutment - Pier 2

Wick Drain Spacing **7.0** feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	*Remaining* δ(inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	4.1	7.35	**0.37**	**28.5**	**4.1**
5	0.0342	0.0023	0.18	0.09	24.9	1.0	3.1				
10	0.0685	0.0046	0.31	0.10	37.3	1.5	2.6				
15	0.1027	0.0068	0.42	0.10	47.8	2.0	2.1				
20	0.1370	0.0091	0.51	0.11	56.7	2.3	1.8				
25	0.1712	0.0114	0.59	0.12	64.1	2.6	1.5				
30	0.2055	0.0137	0.66	0.13	70.3	2.9	1.2				
35	0.2397	0.0159	0.72	0.13	75.4	3.1	1.0				
40	0.2740	0.0182	0.76	0.14	79.6	3.3	0.8				
45	0.3082	0.0205	0.80	0.15	83.0	3.4	0.7				
50	0.3424	0.0228	0.83	0.16	85.7	3.5	0.6				
55	0.3767	0.0251	0.86	0.16	87.9	3.6	0.5				
60	0.4109	0.0273	0.88	0.17	89.7	3.7	0.4				
65	0.4452	0.0296	0.89	0.18	91.1	3.7	0.4				
70	0.4794	0.0319	0.90	0.18	92.2	3.8	0.3				
75	0.5137	0.0342	0.92	0.19	93.1	3.8	0.3				
80	0.5479	0.0364	0.92	0.20	93.9	3.9	0.2				
85	0.5822	0.0387	0.93	0.20	94.6	3.9	0.2				
90	0.6164	0.0410	0.94	0.21	95.3	3.9	0.2				
95	0.6507	0.0433	0.95	0.22	95.9	3.9	0.2				
100	0.6849	0.0456	0.95	0.22	96.4	4.0	0.1				
105	0.7191	0.0478	0.96	0.23	97.0	4.0	0.1				
110	0.7534	0.0501	0.97	0.23	97.5	4.0	0.1				
115	0.7876	0.0524	0.97	0.24	98.0	4.0	0.1				
120	0.8219	0.0547	0.98	0.25	98.5	4.0	0.1				
125	0.8561	0.0569	0.99	0.25	98.9	4.1	0.0				

Assumes double drainage

Spacing = 7 ft (triangular)

10/26

9-7-07

SJR 9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Aveune
Reference: FHWA-RD-86-168

Based upon boring TR-35A
Forward Abutment - Pier 2

Wick Drain Spacing **9.0** feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	*Remaining* δ(inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	4.1	9.45	0.37	28.5	4.1
5	0.0207	0.0023	0.12	0.09	19.7	0.8	3.3				
10	0.0414	0.0046	0.20	0.10	28.1	1.2	2.9				
15	0.0621	0.0068	0.28	0.10	35.8	1.5	2.6				
20	0.0829	0.0091	0.35	0.11	42.7	1.7	2.4				
25	0.1036	0.0114	0.42	0.12	48.9	2.0	2.1				
30	0.1243	0.0137	0.48	0.13	54.5	2.2	1.9				
35	0.1450	0.0159	0.53	0.13	59.5	2.4	1.7				
40	0.1657	0.0182	0.58	0.14	64.0	2.6	1.5				
45	0.1864	0.0205	0.62	0.15	68.0	2.8	1.3				
50	0.2072	0.0228	0.66	0.16	71.5	2.9	1.2				
55	0.2279	0.0251	0.70	0.16	74.7	3.1	1.0				
60	0.2486	0.0273	0.73	0.17	77.5	3.2	0.9				
65	0.2693	0.0296	0.76	0.18	79.9	3.3	0.8				
70	0.2900	0.0319	0.78	0.18	82.1	3.4	0.7				
75	0.3107	0.0342	0.80	0.19	84.0	3.4	0.7				
80	0.3315	0.0364	0.82	0.20	85.7	3.5	0.6				
85	0.3522	0.0387	0.84	0.20	87.1	3.6	0.5				
90	0.3729	0.0410	0.85	0.21	88.4	3.6	0.5				
95	0.3936	0.0433	0.87	0.22	89.5	3.7	0.4				
100	0.4143	0.0456	0.88	0.22	90.5	3.7	0.4				
105	0.4350	0.0478	0.89	0.23	91.3	3.7	0.4				
110	0.4558	0.0501	0.90	0.23	92.0	3.8	0.3				
115	0.4765	0.0524	0.90	0.24	92.7	3.8	0.3				
120	0.4972	0.0547	0.91	0.25	93.3	3.8	0.3				
125	0.5179	0.0569	0.92	0.25	93.8	3.8	0.3				
130	0.5386	0.0592	0.92	0.26	94.2	3.9	0.2				
135	0.5593	0.0615	0.93	0.27	94.7	3.9	0.2				
140	0.5801	0.0638	0.93	0.27	95.1	3.9	0.2				
145	0.6008	0.0661	0.94	0.28	95.4	3.9	0.2				
150	0.6215	0.0683	0.94	0.28	95.8	3.9	0.2				
155	0.6422	0.0706	0.95	0.29	96.1	3.9	0.2				
160	0.6629	0.0729	0.95	0.29	96.5	4.0	0.1				
165	0.6836	0.0752	0.95	0.30	96.8	4.0	0.1				
170	0.7043	0.0774	0.96	0.31	97.1	4.0	0.1				
175	0.7251	0.0797	0.96	0.31	97.4	4.0	0.1				
180	0.7458	0.0820	0.97	0.32	97.7	4.0	0.1				
185	0.7665	0.0843	0.97	0.32	98.0	4.0	0.1				
190	0.7872	0.0865	0.97	0.33	98.3	4.0	0.1				
195	0.8079	0.0888	0.98	0.33	98.5	4.0	0.1				
200	0.8286	0.0911	0.98	0.34	98.7	4.0	0.1				
205	0.8494	0.0934	0.98	0.34	99.0	4.1	0.0				
210	0.8701	0.0957	0.99	0.35	99.1	4.1	0.0				

Assumes double drainage
Spacing = 9 ft (triangular)

11/26
EWT 9-7-07
DAA 9-7-07

DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: C:\DOCUME~1\DLZ\DESKTOP\PORTSM~2\REARAB~1\RA.DVN
Project Name: SCI-823-Slocum Ave-RA   Project Date: 08/01/2007
Project Client: TranSystems/ODOT9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: H Pile - HP14X73
Top of Pile: 0.00 ft
Perimeter Analysis: Box
Tip Analysis: Box Area

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	41.50 ft
	- Driving/Restrike	41.50 ft
	- Ultimate:	41.50 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	10.00 ft	0.00%	125.00 pcf	1700.00 psf	User Def.
2	Cohesive	36.00 ft	0.00%	120.00 pcf	1100.00 psf	User Def.
3	Cohesive	15.00 ft	0.00%	120.00 pcf	2700.00 psf	User Def.
4	Cohesionless	8.00 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund
5	Cohesionless	8.00 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund

Pier 1 – Downdrag Force

Total settlement = 3.1"
at the toe

@ ≈ 61' settlement ≈ 0.03' or 0.40"

=> downdrag force ≈ 333 kips

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RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	1145.00 psf	0.05 Kips
9.01 ft	Cohesive	N/A	N/A	1145.00 psf	48.48 Kips
9.99 ft	Cohesive	N/A	N/A	1145.00 psf	53.75 Kips
10.01 ft	Cohesive	N/A	N/A	1042.00 psf	53.85 Kips
19.01 ft	Cohesive	N/A	N/A	1042.00 psf	97.92 Kips
28.01 ft	Cohesive	N/A	N/A	1042.00 psf	141.99 Kips
37.01 ft	Cohesive	N/A	N/A	1042.00 psf	186.06 Kips
45.99 ft	Cohesive	N/A	N/A	1042.00 psf	230.03 Kips
46.01 ft	Cohesive	N/A	N/A	1458.00 psf	230.15 Kips
55.01 ft	Cohesive	N/A	N/A	1458.00 psf	291.81 Kips
60.99 ft	Cohesive	N/A	N/A	1458.00 psf	332.78 Kips
61.01 ft	Cohesionless	6153.49 psf	23.58	N/A	332.95 Kips
68.99 ft	Cohesionless	6383.31 psf	23.58	N/A	413.36 Kips
69.01 ft	Cohesionless	6614.29 psf	23.58	N/A	413.57 Kips
76.99 ft	Cohesionless	6844.11 psf	23.58	N/A	499.79 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
9.99 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
10.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
19.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
28.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
37.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
45.99 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
46.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
55.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
60.99 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
61.01 ft	Cohesionless	6153.78 psf	30.00	18.36 Kips	18.36 Kips
68.99 ft	Cohesionless	6613.42 psf	30.00	18.36 Kips	18.36 Kips
69.01 ft	Cohesionless	6614.58 psf	30.00	18.36 Kips	18.36 Kips
76.99 ft	Cohesionless	7074.22 psf	30.00	18.36 Kips	18.36 Kips

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RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.05 Kips	21.09 Kips	21.14 Kips
9.01 ft	48.48 Kips	21.09 Kips	69.57 Kips
9.99 ft	53.75 Kips	21.09 Kips	74.84 Kips
10.01 ft	53.85 Kips	13.65 Kips	67.50 Kips
19.01 ft	97.92 Kips	13.65 Kips	111.57 Kips
28.01 ft	141.99 Kips	13.65 Kips	155.64 Kips
37.01 ft	186.06 Kips	13.65 Kips	199.71 Kips
45.99 ft	230.03 Kips	13.65 Kips	243.68 Kips
46.01 ft	230.15 Kips	33.50 Kips	263.65 Kips
55.01 ft	291.81 Kips	33.50 Kips	325.31 Kips
60.99 ft	332.78 Kips	33.50 Kips	366.28 Kips
61.01 ft	332.95 Kips	18.36 Kips	351.31 Kips
68.99 ft	413.36 Kips	18.36 Kips	431.73 Kips
69.01 ft	413.57 Kips	18.36 Kips	431.93 Kips
76.99 ft	499.79 Kips	18.36 Kips	518.16 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	1145.00 psf	0.05 Kips
9.01 ft	Cohesive	N/A	N/A	1145.00 psf	48.48 Kips
9.99 ft	Cohesive	N/A	N/A	1145.00 psf	53.75 Kips
10.01 ft	Cohesive	N/A	N/A	1042.00 psf	53.85 Kips
19.01 ft	Cohesive	N/A	N/A	1042.00 psf	97.92 Kips
28.01 ft	Cohesive	N/A	N/A	1042.00 psf	141.99 Kips
37.01 ft	Cohesive	N/A	N/A	1042.00 psf	186.06 Kips
45.99 ft	Cohesive	N/A	N/A	1042.00 psf	230.03 Kips
46.01 ft	Cohesive	N/A	N/A	1458.00 psf	230.15 Kips
55.01 ft	Cohesive	N/A	N/A	1458.00 psf	291.81 Kips
60.99 ft	Cohesive	N/A	N/A	1458.00 psf	332.78 Kips
61.01 ft	Cohesionless	6153.49 psf	23.58	N/A	332.95 Kips
68.99 ft	Cohesionless	6383.31 psf	23.58	N/A	413.36 Kips
69.01 ft	Cohesionless	6614.29 psf	23.58	N/A	413.57 Kips
76.99 ft	Cohesionless	6844.11 psf	23.58	N/A	499.79 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
9.99 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
10.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
19.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
28.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
37.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
45.99 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
46.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
55.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
60.99 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
61.01 ft	Cohesionless	6153.78 psf	30.00	18.36 Kips	18.36 Kips
68.99 ft	Cohesionless	6613.42 psf	30.00	18.36 Kips	18.36 Kips
69.01 ft	Cohesionless	6614.58 psf	30.00	18.36 Kips	18.36 Kips
76.99 ft	Cohesionless	7074.22 psf	30.00	18.36 Kips	18.36 Kips

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DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.05 Kips	21.09 Kips	21.14 Kips
9.01 ft	48.48 Kips	21.09 Kips	69.57 Kips
9.99 ft	53.75 Kips	21.09 Kips	74.84 Kips
10.01 ft	53.85 Kips	13.65 Kips	67.50 Kips
19.01 ft	97.92 Kips	13.65 Kips	111.57 Kips
28.01 ft	141.99 Kips	13.65 Kips	155.64 Kips
37.01 ft	186.06 Kips	13.65 Kips	199.71 Kips
45.99 ft	230.03 Kips	13.65 Kips	243.68 Kips
46.01 ft	230.15 Kips	33.50 Kips	263.65 Kips
55.01 ft	291.81 Kips	33.50 Kips	325.31 Kips
60.99 ft	332.78 Kips	33.50 Kips	366.28 Kips
61.01 ft	332.95 Kips	18.36 Kips	351.31 Kips
68.99 ft	413.36 Kips	18.36 Kips	431.73 Kips
69.01 ft	413.57 Kips	18.36 Kips	431.93 Kips
76.99 ft	499.79 Kips	18.36 Kips	518.16 Kips

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ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	1145.00 psf	0.05 Kips
9.01 ft	Cohesive	N/A	N/A	1145.00 psf	48.48 Kips
9.99 ft	Cohesive	N/A	N/A	1145.00 psf	53.75 Kips
10.01 ft	Cohesive	N/A	N/A	1042.00 psf	53.85 Kips
19.01 ft	Cohesive	N/A	N/A	1042.00 psf	97.92 Kips
28.01 ft	Cohesive	N/A	N/A	1042.00 psf	141.99 Kips
37.01 ft	Cohesive	N/A	N/A	1042.00 psf	186.06 Kips
45.99 ft	Cohesive	N/A	N/A	1042.00 psf	230.03 Kips
46.01 ft	Cohesive	N/A	N/A	1458.00 psf	230.15 Kips
55.01 ft	Cohesive	N/A	N/A	1458.00 psf	291.81 Kips
60.99 ft	Cohesive	N/A	N/A	1458.00 psf	332.78 Kips
61.01 ft	Cohesionless	6153.49 psf	23.58	N/A	332.95 Kips
68.99 ft	Cohesionless	6383.31 psf	23.58	N/A	413.36 Kips
69.01 ft	Cohesionless	6614.29 psf	23.58	N/A	413.57 Kips
76.99 ft	Cohesionless	6844.11 psf	23.58	N/A	499.79 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
9.99 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
10.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
19.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
28.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
37.01 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
45.99 ft	Cohesive	N/A	N/A	N/A	13.65 Kips
46.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
55.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
60.99 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
61.01 ft	Cohesionless	6153.78 psf	30.00	18.36 Kips	18.36 Kips
68.99 ft	Cohesionless	6613.42 psf	30.00	18.36 Kips	18.36 Kips
69.01 ft	Cohesionless	6614.58 psf	30.00	18.36 Kips	18.36 Kips
76.99 ft	Cohesionless	7074.22 psf	30.00	18.36 Kips	18.36 Kips

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ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.05 Kips	21.09 Kips	21.14 Kips
9.01 ft	48.48 Kips	21.09 Kips	69.57 Kips
9.99 ft	53.75 Kips	21.09 Kips	74.84 Kips
10.01 ft	53.85 Kips	13.65 Kips	67.50 Kips
19.01 ft	97.92 Kips	13.65 Kips	111.57 Kips
28.01 ft	141.99 Kips	13.65 Kips	155.64 Kips
37.01 ft	186.06 Kips	13.65 Kips	199.71 Kips
45.99 ft	230.03 Kips	13.65 Kips	243.68 Kips
46.01 ft	230.15 Kips	33.50 Kips	263.65 Kips
55.01 ft	291.81 Kips	33.50 Kips	325.31 Kips
60.99 ft	332.78 Kips	33.50 Kips	366.28 Kips
61.01 ft	332.95 Kips	18.36 Kips	351.31 Kips
68.99 ft	413.36 Kips	18.36 Kips	431.73 Kips
69.01 ft	413.57 Kips	18.36 Kips	431.93 Kips
76.99 ft	499.79 Kips	18.36 Kips	518.16 Kips

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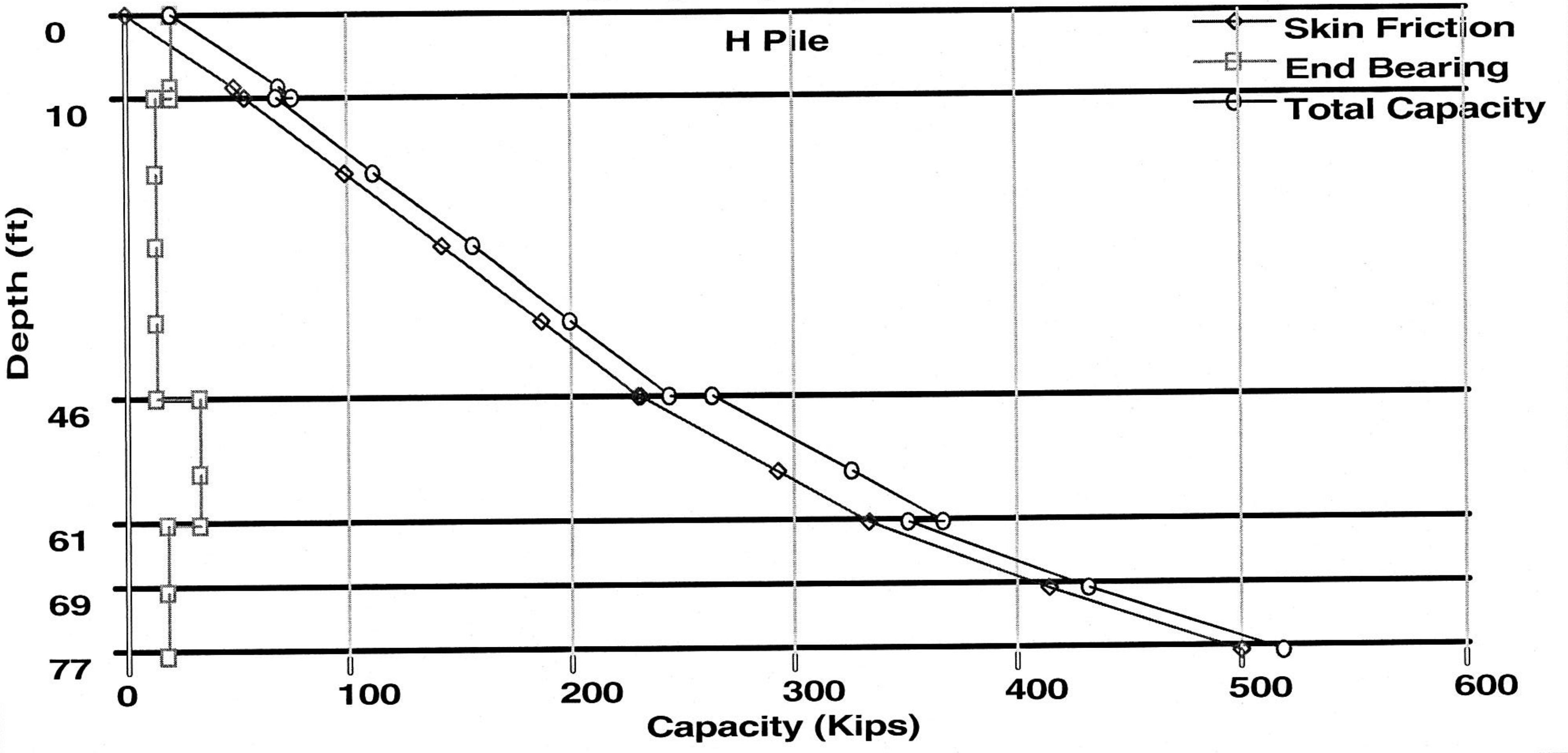
Bearing Capacity Graph - Restrike



18/26

19/26

DRIVEN 1.0

GENERAL PROJECT INFORMATION

Filename: C:\DOCUME~1\DLZ\DESKTOP\PORTSM~2\FORWAR~1\FA.DVN
Project Name: SCI-823-Slocum Ave-FA Project Date: 08/01/2007
Project Client: TranSystems/ODOT9
Computed By: EWT
Project Manager: PN

PILE INFORMATION

Pile Type: H Pile - HP14X73
Top of Pile: 0.00 ft
Perimeter Analysis: Box
Tip Analysis: Box Area

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	24.50 ft
	- Driving/Restrike	24.50 ft
	- Ultimate:	24.50 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	5.00 ft	0.00%	125.00 pcf	1700.00 psf	User Def.
2	Cohesive	27.00 ft	0.00%	120.00 pcf	900.00 psf	User Def.
3	Cohesive	25.00 ft	0.00%	120.00 pcf	2700.00 psf	User Def.
4	Cohesionless	8.50 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund
5	Cohesionless	8.50 ft	0.00%	120.00 pcf	30.0/30.0	Nordlund

Pier 2 - Downdrag Force

Total settlement at the toe = 4.1"

@ ≈ 57' settlement ≈ 0.03' or 0.4"

⇒ downdrag force ≈ 309 kips

20/26

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	1145.00 psf	0.05 Kips
4.99 ft	Cohesive	N/A	N/A	1145.00 psf	26.85 Kips
5.01 ft	Cohesive	N/A	N/A	875.00 psf	26.94 Kips
14.01 ft	Cohesive	N/A	N/A	875.00 psf	63.95 Kips
23.01 ft	Cohesive	N/A	N/A	875.00 psf	100.96 Kips
31.99 ft	Cohesive	N/A	N/A	875.00 psf	137.88 Kips
32.01 ft	Cohesive	N/A	N/A	1458.00 psf	137.99 Kips
41.01 ft	Cohesive	N/A	N/A	1458.00 psf	199.65 Kips
50.01 ft	Cohesive	N/A	N/A	1458.00 psf	261.31 Kips
56.99 ft	Cohesive	N/A	N/A	1458.00 psf	309.14 Kips
57.01 ft	Cohesionless	4837.29 psf	23.58	N/A	309.28 Kips
65.49 ft	Cohesionless	5081.51 psf	23.58	N/A	377.31 Kips
65.51 ft	Cohesionless	5326.89 psf	23.58	N/A	377.48 Kips
73.99 ft	Cohesionless	5571.11 psf	23.58	N/A	452.06 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
5.01 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
14.01 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
23.01 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
31.99 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
50.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
56.99 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
57.01 ft	Cohesionless	4837.58 psf	30.00	18.36 Kips	18.36 Kips
65.49 ft	Cohesionless	5326.02 psf	30.00	18.36 Kips	18.36 Kips
65.51 ft	Cohesionless	5327.18 psf	30.00	18.36 Kips	18.36 Kips
73.99 ft	Cohesionless	5815.62 psf	30.00	18.36 Kips	18.36 Kips

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RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.05 Kips	21.09 Kips	21.14 Kips
4.99 ft	26.85 Kips	21.09 Kips	47.94 Kips
5.01 ft	26.94 Kips	11.17 Kips	38.11 Kips
14.01 ft	63.95 Kips	11.17 Kips	75.12 Kips
23.01 ft	100.96 Kips	11.17 Kips	112.12 Kips
31.99 ft	137.88 Kips	11.17 Kips	149.05 Kips
32.01 ft	137.99 Kips	33.50 Kips	171.49 Kips
41.01 ft	199.65 Kips	33.50 Kips	233.15 Kips
50.01 ft	261.31 Kips	33.50 Kips	294.81 Kips
56.99 ft	309.14 Kips	33.50 Kips	342.63 Kips
57.01 ft	309.28 Kips	18.36 Kips	327.64 Kips
65.49 ft	377.31 Kips	18.36 Kips	395.67 Kips
65.51 ft	377.48 Kips	18.36 Kips	395.84 Kips
73.99 ft	452.06 Kips	18.36 Kips	470.42 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	1145.00 psf	0.05 Kips
4.99 ft	Cohesive	N/A	N/A	1145.00 psf	26.85 Kips
5.01 ft	Cohesive	N/A	N/A	875.00 psf	26.94 Kips
14.01 ft	Cohesive	N/A	N/A	875.00 psf	63.95 Kips
23.01 ft	Cohesive	N/A	N/A	875.00 psf	100.96 Kips
31.99 ft	Cohesive	N/A	N/A	875.00 psf	137.88 Kips
32.01 ft	Cohesive	N/A	N/A	1458.00 psf	137.99 Kips
41.01 ft	Cohesive	N/A	N/A	1458.00 psf	199.65 Kips
50.01 ft	Cohesive	N/A	N/A	1458.00 psf	261.31 Kips
56.99 ft	Cohesive	N/A	N/A	1458.00 psf	309.14 Kips
57.01 ft	Cohesionless	4837.29 psf	23.58	N/A	309.28 Kips
65.49 ft	Cohesionless	5081.51 psf	23.58	N/A	377.31 Kips
65.51 ft	Cohesionless	5326.89 psf	23.58	N/A	377.48 Kips
73.99 ft	Cohesionless	5571.11 psf	23.58	N/A	452.06 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
5.01 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
14.01 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
23.01 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
31.99 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
50.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
56.99 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
57.01 ft	Cohesionless	4837.58 psf	30.00	18.36 Kips	18.36 Kips
65.49 ft	Cohesionless	5326.02 psf	30.00	18.36 Kips	18.36 Kips
65.51 ft	Cohesionless	5327.18 psf	30.00	18.36 Kips	18.36 Kips
73.99 ft	Cohesionless	5815.62 psf	30.00	18.36 Kips	18.36 Kips

23/26

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.05 Kips	21.09 Kips	21.14 Kips
4.99 ft	26.85 Kips	21.09 Kips	47.94 Kips
5.01 ft	26.94 Kips	11.17 Kips	38.11 Kips
14.01 ft	63.95 Kips	11.17 Kips	75.12 Kips
23.01 ft	100.96 Kips	11.17 Kips	112.12 Kips
31.99 ft	137.88 Kips	11.17 Kips	149.05 Kips
32.01 ft	137.99 Kips	33.50 Kips	171.49 Kips
41.01 ft	199.65 Kips	33.50 Kips	233.15 Kips
50.01 ft	261.31 Kips	33.50 Kips	294.81 Kips
56.99 ft	309.14 Kips	33.50 Kips	342.63 Kips
57.01 ft	309.28 Kips	18.36 Kips	327.64 Kips
65.49 ft	377.31 Kips	18.36 Kips	395.67 Kips
65.51 ft	377.48 Kips	18.36 Kips	395.84 Kips
73.99 ft	452.06 Kips	18.36 Kips	470.42 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	1145.00 psf	0.05 Kips
4.99 ft	Cohesive	N/A	N/A	1145.00 psf	26.85 Kips
5.01 ft	Cohesive	N/A	N/A	875.00 psf	26.94 Kips
14.01 ft	Cohesive	N/A	N/A	875.00 psf	63.95 Kips
23.01 ft	Cohesive	N/A	N/A	875.00 psf	100.96 Kips
31.99 ft	Cohesive	N/A	N/A	875.00 psf	137.88 Kips
32.01 ft	Cohesive	N/A	N/A	1458.00 psf	137.99 Kips
41.01 ft	Cohesive	N/A	N/A	1458.00 psf	199.65 Kips
50.01 ft	Cohesive	N/A	N/A	1458.00 psf	261.31 Kips
56.99 ft	Cohesive	N/A	N/A	1458.00 psf	309.14 Kips
57.01 ft	Cohesionless	4837.29 psf	23.58	N/A	309.28 Kips
65.49 ft	Cohesionless	5081.51 psf	23.58	N/A	377.31 Kips
65.51 ft	Cohesionless	5326.89 psf	23.58	N/A	377.48 Kips
73.99 ft	Cohesionless	5571.11 psf	23.58	N/A	452.06 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
4.99 ft	Cohesive	N/A	N/A	N/A	21.09 Kips
5.01 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
14.01 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
23.01 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
31.99 ft	Cohesive	N/A	N/A	N/A	11.17 Kips
32.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
41.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
50.01 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
56.99 ft	Cohesive	N/A	N/A	N/A	33.50 Kips
57.01 ft	Cohesionless	4837.58 psf	30.00	18.36 Kips	18.36 Kips
65.49 ft	Cohesionless	5326.02 psf	30.00	18.36 Kips	18.36 Kips
65.51 ft	Cohesionless	5327.18 psf	30.00	18.36 Kips	18.36 Kips
73.99 ft	Cohesionless	5815.62 psf	30.00	18.36 Kips	18.36 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.05 Kips	21.09 Kips	21.14 Kips
4.99 ft	26.85 Kips	21.09 Kips	47.94 Kips
5.01 ft	26.94 Kips	11.17 Kips	38.11 Kips
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65.49 ft	377.31 Kips	18.36 Kips	395.67 Kips
65.51 ft	377.48 Kips	18.36 Kips	395.84 Kips
73.99 ft	452.06 Kips	18.36 Kips	470.42 Kips

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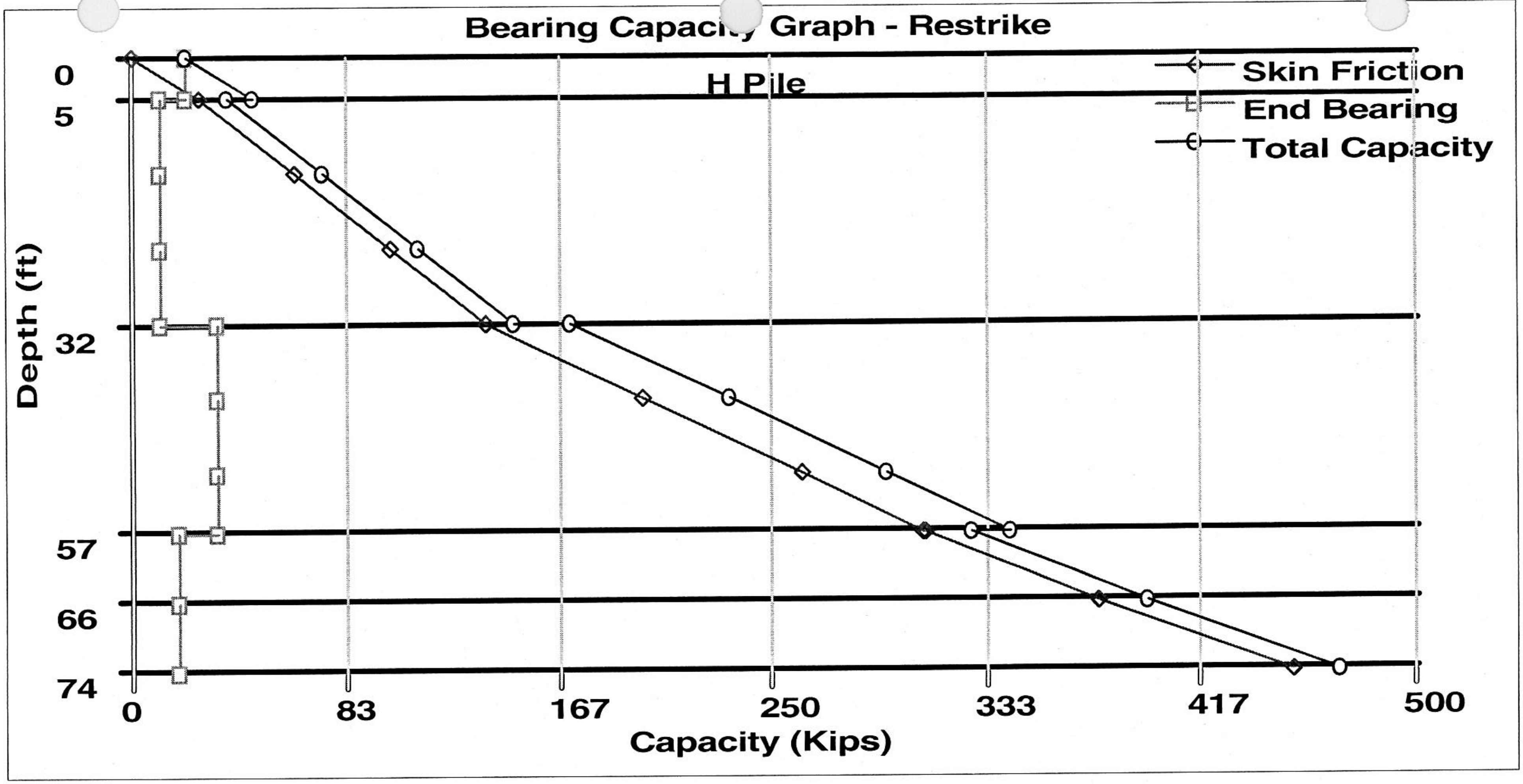
Bearing Capacity Graph - Restrike

MSE Walls – Stability Calculations

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PLANNERS • SURVEYORS

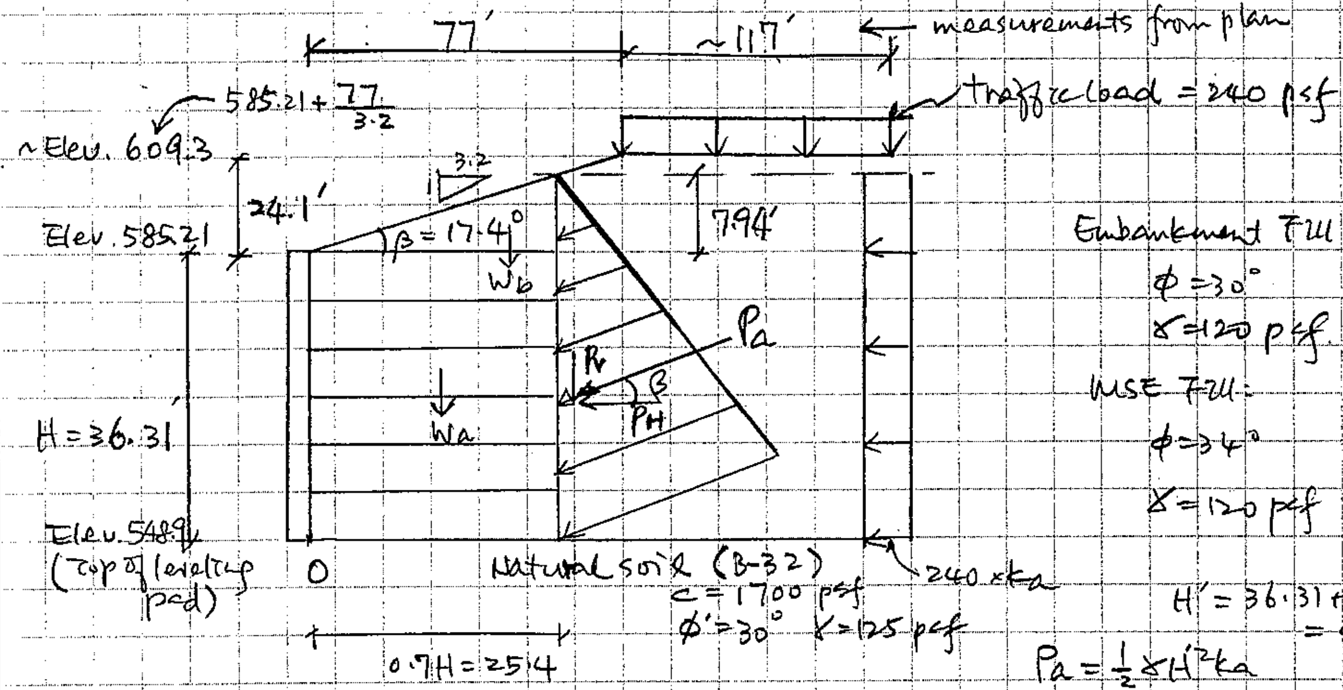
CLIENT Transystems Corps / ODOT D-9
PROJECT SCI-823 Portsmouth Bypass
SUBJECT MSE WALL over SLOCUM AVE

PROJECT NO. 0121-3070.03
SHEET NO. 1 OF 15
COMP. BY SWT DATE 7-26-07
CHECKED BY SJK DATE 9-7-07

Max wall height = 36.3' at Sta 31+03.11

$\beta \perp$ to wall $= \tan^{-1}\left(\frac{1}{3.2}\right) = 17.35°$, use 17.4°

the 1 : 3.2 slope was obtained by converting
the 1 : 2.5 slope perpendicular to the wall.



Embankment Fill:
$\phi = 30°$
$\gamma = 120$ pcf

MSE Fill:
$\phi = 34°$
$\gamma = 120$ pcf

$H' = 36.31 + 7.94$
$= 44.25'$

$P_a = \frac{1}{2}\gamma H'^2 k_a$
$= \frac{1}{2}(120)(36.31+7.94)^2 k_a$
$= 49343$ lb/ft for $k_a = 0.42$

NAVFAC 7.2 Figure 3 Pg. 7.2-64

$$K_a = \left[\frac{\cos\phi}{1+\sqrt{\sin\phi\,(\sin\phi - \cos\phi\tan\beta)}}\right]^2$$

$\phi = 30°$, $\beta = 17.4°$

$K_a = 0.4189$ use 0.42

Try $L = 0.7H = 0.7 \times 36.31 = 25.417$ use 25.4'

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CLIENT Transystems Corps / ODOT D-9
PROJECT SCI-823 Portsmouth ByPass over Slocum Ave
SUBJECT MSE WALL
PROJECT NO. 0121-3070.03
SHEET NO. 2 OF 15
COMP. BY SWT DATE 7-26-07
CHECKED BY SJK DATE 9-7-07

A. Overturning

$$F.S. = \frac{\Sigma \text{ Resisting Moments}}{\Sigma \text{ Overturning moments}}$$ (sum moments about "O")

$$= \frac{120 \times 25.4 \times 3631 \times \left(\frac{25.4}{2}\right) + \frac{1}{2}(120) \times 25.4 \times 7.94 \times \frac{2}{3} \times 25.4 + P_v \times 25.4}{\left(P_h \times \frac{1}{3} \times 44.25\right) + 240 \times 0.42 \times 44.25 \times \frac{44.25}{2}}$$

where $P_v = P_a \sin\beta = 49343 \times \sin 17.4^\circ = 14756$ lb/ft
$P_h = P_a \cos\beta = 49343 \cos 17.4^\circ = 47085$ lb/ft

$$F.S. = \frac{1985251}{793190} = 2.5 > 2.0$$ Good

B. Sliding

$$F.S. = \frac{\Sigma \text{ Resisting Forces } (P_r)}{\Sigma \text{ Driving Forces } (P_d)}$$

where P_r(drained) $= (W_a + W_b + P_v)\mu$
$+ \mu = \frac{2}{3}\tan\phi = 0.385$

P_r(drained) $= (120 \times 25.4 \times 36.1 + 120 \times \frac{1}{2} \times 25.4 \times 7.94 + 14756) \times 0.385$
$= 136889$ lb/ft $\times 0.385 = 52702$ lb/ft

P_r(undrained) $= cL = 1700 \times 25.4 = 43180$ lb/ft ← use this

$$F.S. = \frac{43180}{P_h + 240 \times 44.25 \times 0.42} = \frac{43180}{47085 + 4460} = \frac{43180}{51545}$$

$= 0.838 < 1.5$ No Good

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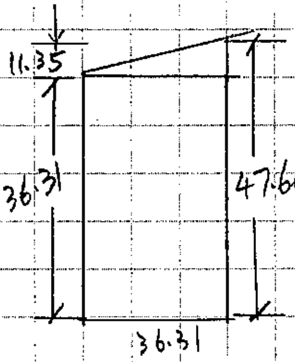
CLIENT TranSystems Corps / ODOT D-9
PROJECT SCI - 823 Portsmouth By Pass
SUBJECT over Slocum Ave
MSE wall
PROJECT NO. 0121-3070.03
SHEET NO. 3 OF 15
COMP. BY GWT DATE 7-26-07
CHECKED BY SJK DATE 9-7-07

Sliding (Cont'd)

Try $L = H = 36.31'$



P_r (drained) $= (120 \times 36.3 \times 36.3 + 120 \times \frac{1}{2} \times 36.3 \times 11.35 + P_v) \times 0.385$

Where $P_v = P_a \sin\beta$ & $P_a = \frac{1}{2}(120)(36.31 + 11.35)^2 K_a$
$= 57241$ lb/ft for $K_a = 0.42$

$= 57241 \sin 17.4°$
$= 17117$ lb/ft

$\Rightarrow P_r$ (drained) $= 76985$ lb/ft

P_r (undrained) $= cL = 1700 \times 36.3 = 61710$ lb/ft
← use this

$$F.S. = \frac{61710}{P_h + 240 \times 47.66 \times 0.42} = \frac{61710}{59426}$$

where $P_h = P_a \cos\beta = 57241 \cos 17.4° = 54622$ lb/ft

$\Rightarrow F.S. = 1.038 < 1.5$ No Good

Based on the slope stability analysis, the MSE wall will need to be constructed in stages. The following is to check the F.S. against sliding based on stage construction.

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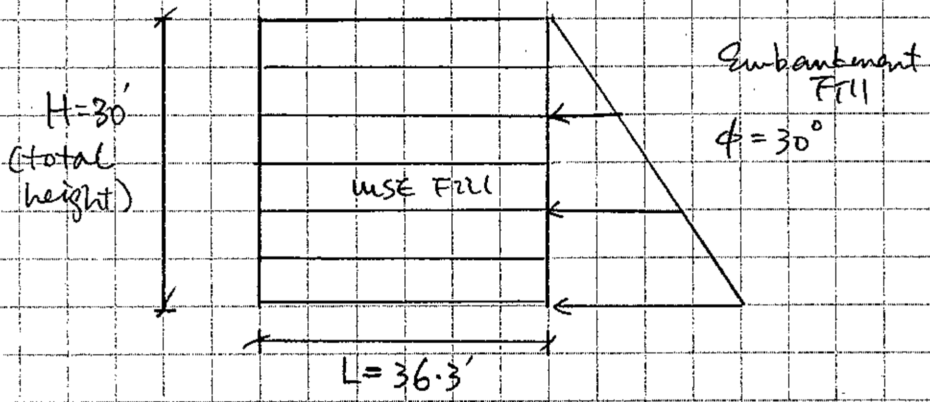
CLIENT Transystems Corps / ODOT D-9
PROJECT SCI-823 Portsmouth ByPass
SUBJECT over Slocum Ave
MSE wall

PROJECT NO. 0121-3070.03
SHEET NO. 4 OF 15
COMP. BY EWT DATE 7-26-07
CHECKED BY SJK DATE 9-7-07

* 1st Stage Construction : Try H = 30' w/ flat backslope
and L = 36.3' (reinforcing length)
without traffic load

➤ Try H = 30' (total height including embedment depth)



(see attached calculations)
for total height = 30'

- F.S. (undrained) for Bearing Capacity = 2.29 < 2.5 NG
- F.S. (undrained) for sliding = 2.86 ≥ 1.5 ok

L=36.3'

➤ Try H = 27' (total height including embedment depth)
(see Excel spreadsheets followed)

F.S. (undrained) for Bearing Capacity = 2.59 > 2.5 ok
F.S. (undrained) for sliding = 3.18 > 1.5 ok

* 2nd Stage Construction (Full Height = 36.3')
with increase in soil strength from c = 1700 psf
to c = 2636 psf (U = 90%)

See previous page for overturning, F.S. = 2.5 > 2.0 Good
with c = 1700 psf & H = 36.3'

sliding

See previous page, P_r (drained) = 76985 lb/ft for $\mu = \frac{2}{3} \tan\phi$
(for H = 36.3')
$= \frac{2}{3} \tan 30°$
$= 0.85$

& P_r (undrained) = CL = 2636 × 36.3
= 95687 lb/ft for c = 2636 psf

use P_r (drained) = 76985 lb/ft

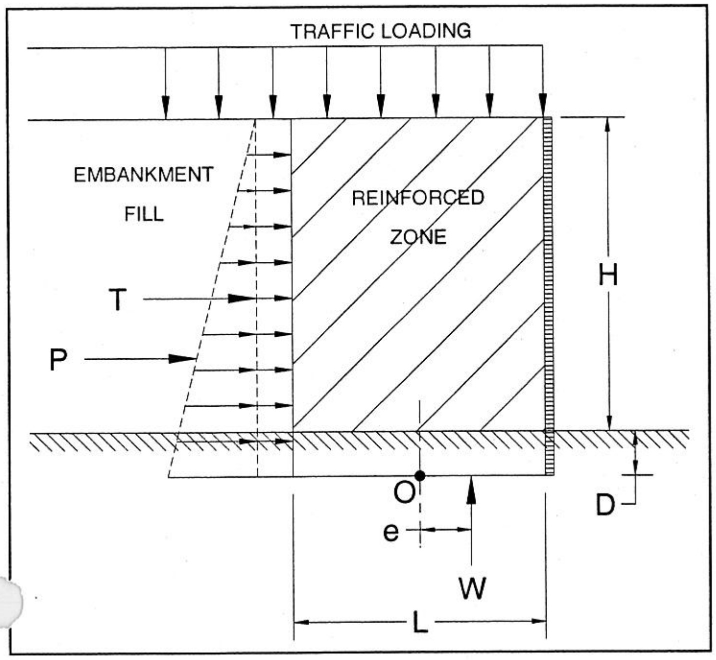
DLZ SUBJECT

Client ODOT9
Project SCI-823 Over Slocum Ave
Item MSE Wall Bearing Capacity-1st Stage H=30'

JOB NUMBER 0121-3070.03
SHEET NO. 5 OF 15
COMP. BY EWT DATE 7/27/07
CHECKED BY SJK DATE 9-7-07

BEARING CAPACITY OF A MSE WALL

Ref: {AASHTO; STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 17th Edition, 2002}



Effective Bearing Pressure

$$\sigma_v = \frac{W_t + W_{MSE}}{L - 2e}$$

σ_v = 3,892 psf

Ultimate undrained bearing capacity, q_{ult}

$$q_{ULT} = cN_c + \sigma'_D N_q + \frac{1}{2}\gamma' B N_\gamma$$

q_{ULT} = 8,926 psf

$$q_{ALL} = \frac{q_{ULT}}{FS}$$

q_{ALL} = 3,570 psf

Factor of Safety = **2.29** **No Good**

Ultimate drained bearing capacity, q_{ult}

$$q_{ULT} = c'N_c + \sigma'_D N_q + \frac{1}{2}\gamma' B N_\gamma$$

q_{ULT} = 26,999 psf

$$q_{ALL} = \frac{q_{ULT}}{FS}$$

q_{ALL} = 10,800 psf

Factor of Safety = **6.94** **OK**

Soil Properties

γ_{EMB}	=	120	pcf	Unit weight	Embankment fill
ϕ'_{EMB}	=	30	deg.	Friction ang.	Embankment fill
γ_{FDN}	=	125	pcf	Unit weight	Foundation soil
c	=	1700	psf	Cohesion	Foundation soil
ϕ	=	0	deg.	Friction ang.	Foundation soil
c'	=	0	psf	Cohesion	Foundation soil
ϕ'	=	30	deg.	Friction ang.	Foundation soil

Loads and Parameters

L factor based on H=30 ft

ω_t	=	0	psf	Traffic loading
L=B	=	36.3	ft	Length of MSE reinforcement
L factor	=	1.21		Length factor-range (0.7 - 1.0)
D	=	3	ft	Embedment depth
Dw	=	0	ft	Groundwater depth
H+D	=	30	ft	
H	=	27	ft	Height of wall
Ka	=	0.33		
Γ Pa	=	10	ft	Moment arm
Γ Wt	=	15	ft	Moment arm
B'	=	33.58	ft	
γ'	=	62.6	pcf	
W_t		0	lb/ft of wall	Weight from traffic
W_{mse}	=	130,680	lb/ft of wall	Weight from MSE wall

Bearing Capacity Factors for Equations (AASHTO)

Undrained		Drained	
N_c	5.14	N_c	30.14
N_q	1.00	N_q	18.40
N_γ	0.00	N_γ	22.40

Eccentricity of Resultant Force

e = 1.36 ft

Kern

e < L/6 = 6.05 ft

DLZ

SUBJECT
Client ODOT9
Project SCI-823 Over Slocum Ave
Item MSE Wall Stability-1st Stage H=30'

JOB NUMBER 0121-3070.03
SHEET NO. 6 OF 15
COMP. BY EWT DATE 07/27/07
CHECKED BY SJK DATE 9-7-07

STABILITY OF MSE WALL

Assumptions:

1 Estimated height of embankment; H=30'
2 Ground water; Dw=0.0'
3 No traffic loads
4
5

Wall Properties

$H+D$ = 30 feet
γ_{mse} = 120 pcf
L = 36.3 feet
L factor = 1.21
ϕ = 30 deg

Foundational Soil Properties

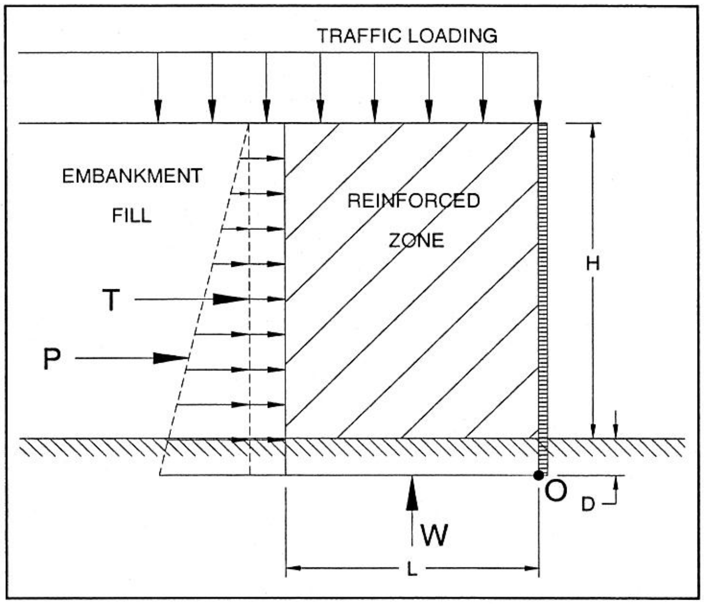
c = 1700 psf Cohesion
ϕ' = 30 deg Friction angle
ω_T = 0 psf Traffic loading
Length factor-range (0.7 - 1.0)
Friction Angle of Embankment Fill

RESISTANCE AGAINST SLIDING ALONG BASE

Thrust: $P_a = K_a\left[\frac{1}{2}\gamma H^2 + \omega_T H\right]$

where; $K_a = \tan^2(45 - \frac{\phi}{2})$ K_a = 0.33

P_a = 17,820 lbs per foot of wall



Resistance: $P_r = W(\mu)$ (Drained)

where; $\mu = \left(\frac{2}{3}\right)\tan(\phi)$ μ = 0.39

P_r = 50,965 lbs per foot of wall

USE THIS VALUE

$P_r = L(c)$ (Undrained)

P_r = 61,710 lbs per foot of wall

Use Drained Value

$FS = \frac{P_r}{P_a}$

Calculated FS = **2.86**

Required FS = 1.50

Resistance Against Sliding is **OK**

RESISTANCE AGAINST OVERTURNING

* Summation of Moments about point "O" (base of wall).

* Traffic loading is neglected in resisting forces

$\Sigma M_{resisting}$ = 2,371,842 lb-ft

$$\Sigma M_{resisting} = \gamma HL\left(\frac{L}{2}\right)$$

$\Sigma M_{overturning}$ = 178,200 lb-ft

$$\Sigma M_{overturning} = K_a\left[\frac{1}{2}\gamma H^2\left(\frac{H}{3}\right) + \omega_T H\left(\frac{H}{2}\right)\right]$$

$$FS = \frac{\Sigma M_{resisting}}{\Sigma M_{overtumin\ g}}$$

Calculated FS = **13.31**

Required FS = 2.00

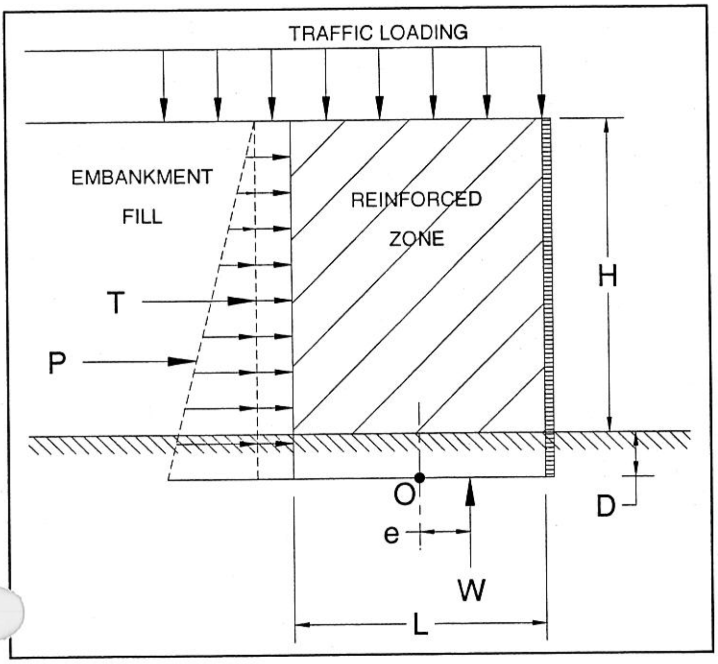
Resistance Against Overturning is **OK**

DLZ

SUBJECT			
Client	ODOT9	JOB NUMBER	0121-3070.03
Project	SCI-823 Over Slocum Ave	SHEET NO.	7 OF 15
Item	MSE Wall Bearing Capacity-1st Stage H=27'	COMP. BY	EWT DATE 7/27/07
		CHECKED BY	SJK DATE 9-7-07

BEARING CAPACITY OF A MSE WALL

Ref: {AASHTO; STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 17th Edition, 2002}



Effective Bearing Pressure

$$\sigma_v = \frac{W_t + W_{MSE}}{L - 2e}$$

σ_v = 3,449 psf

Ultimate undrained bearing capacity, q_{ult}

$$q_{ULT} = c N_c + \sigma'_D N_q + \frac{1}{2}\gamma' B N_\gamma$$

q_{ULT} = 8,926 psf

$$q_{ALL} = \frac{q_{ULT}}{FS}$$

q_{ALL} = 3,570 psf

Factor of Safety = **2.59** **OK**

Ultimate drained bearing capacity, q_{ult}

$$q_{ULT} = c' N_c + \sigma'_D N_q + \frac{1}{2}\gamma' B N_\gamma$$

q_{ULT} = 27,357 psf

$$q_{ALL} = \frac{q_{ULT}}{FS}$$

q_{ALL} = 10,943 psf

Factor of Safety = **7.93** **OK**

Soil Properties

γ_{EMB}	=	120	pcf	Unit weight	Embankment fill
ϕ'_{EMB}	=	30	deg.	Friction ang.	Embankment fill
γ_{FDN}	=	125	pcf	Unit weight	Foundation soil
c	=	1700	psf	Cohesion	Foundation soil
ϕ	=	0	deg.	Friction ang.	Foundation soil
c'	=	0	psf	Cohesion	Foundation soil
ϕ'	=	30	deg.	Friction ang.	Foundation soil

Loads and Parameters

ω_t	=	0	psf	Traffic loading
L=B	=	36.288	ft	Length of MSE reinforcement
L factor	=	1.344		Length factor-range (0.7 - 1.0)
D	=	3	ft	Embedment depth
Dw	=	0	ft	Groundwater depth
H+D	=	27	ft	
H	=	24	ft	Height of wall
Ka	=	0.33		
Γ Pa	=	9	ft	Moment arm
Γ Wt	=	13.5	ft	Moment arm
B'	=	34.09	ft	
γ'	=	62.6	pcf	
W_t		0	lb/ft of wall	Weight from traffic
W_{mse}	=	117,573	lb/ft of wall	Weight from MSE wall

Bearing Capacity Factors for Equations (AASHTO)

Undrained		Drained	
N_c	5.14	N_c	30.14
N_q	1.00	N_q	18.40
N_γ	0.00	N_γ	22.40

Eccentricity of Resultant Force

e = 1.10 ft

Kern

e < L/6 = 6.05 ft

DLZ

SUBJECT

Client ODOT9

Project SCI-823 Over Slocum Ave

Item MSE Wall Stability-1st Stage H=27'

JOB NUMBER 0121-3070.03

SHEET NO. 8 OF 15

COMP. BY EWT DATE 07/27/07

CHECKED BY SJK DATE 9-7-07

STABILITY OF MSE WALL

Assumptions:

1 Estimated height of embankment; H=27'
2 Ground water; Dw=0.0'
3 No traffic loads
4
5

Wall Properties

H+D	=	27	feet
γ_{mse}	=	120	pcf
L	=	36.288	feet
L factor	=	1.34	
ϕ	=	30	deg

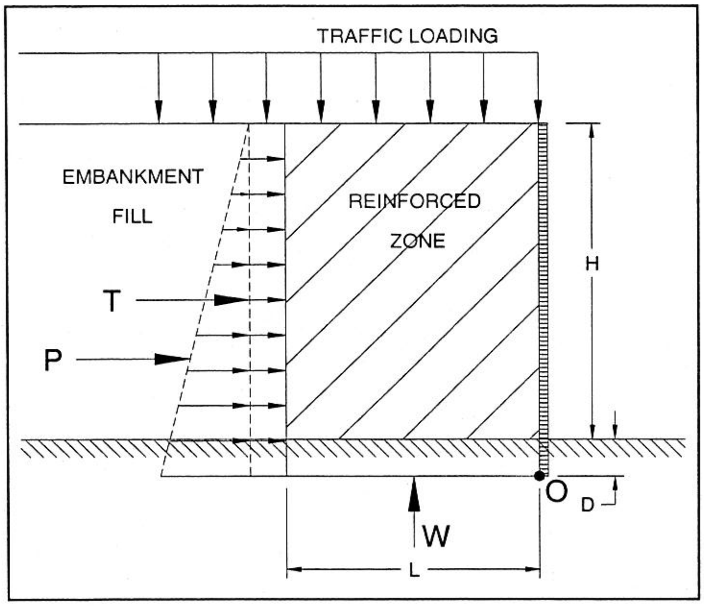
Foundational Soil Properties

c	=	1700	psf	Cohesion
ϕ'	=	30	deg	Friction angle
ω_T	=	0	psf	Traffic loading

Length factor-range (0.7 - 1.0)

Friction Angle of Embankment Fill

RESISTANCE AGAINST SLIDING ALONG BASE



Thrust: $P_a = K_a\left[\frac{1}{2}\gamma H^2 + \omega_T H\right]$

where; $K_a = \tan^2(45 - \frac{\phi}{2})$ K_a = 0.33

P_a = 14,434 lbs per foot of wall

Resistance: $P_r = W(\mu)$ (Drained)

where; $\mu = \left(\frac{2}{3}\right)\tan(\phi)$ μ = 0.39

P_r = 45,854 lbs per foot of wall

USE THIS VALUE

$P_r = L(c)$ (Undrained)

P_r = 61,690 lbs per foot of wall

Use Drained Value

$FS = \frac{P_r}{P_a}$

Calculated FS = **3.18**

Required FS = 1.50

Resistance Against Sliding is $\boxed{\text{OK}}$

RESISTANCE AGAINST OVERTURNING

* Summation of Moments about point "O" (base of wall).

* Traffic loading is neglected in resisting forces

$\Sigma M_{resisting}$ = 2,133,247 lb-ft

$\Sigma M_{resisting} = \gamma HL\left(\frac{L}{2}\right)$

$\Sigma M_{overturning}$ = 129,908 lb-ft

$\Sigma M_{overturnig} = K_a\left[\frac{1}{2}\gamma H^2\left(\frac{H}{3}\right) + \omega_T H\left(\frac{H}{2}\right)\right]$

$FS = \frac{\Sigma M_{resisting}}{\Sigma M_{overturnin\ g}}$

Calculated FS = **16.42**

Required FS = 2.00

Resistance Against Overturning is $\boxed{\text{OK}}$

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CLIENT Transystems Corps / ODOT D-9
PROJECT SCI-823 Portsmouth ByPass
SUBJECT Over Slocum Ave
MSE Wall
PROJECT NO. 0121-3070.03
SHEET NO. 9 OF 15
COMP. BY QWT DATE 7-26-07
CHECKED BY SJK DATE 9-7-07

Continued from page 4 of this section:

$F.S._{sliding} = \frac{76985}{59426} = 1.3 < 1.5$ **NG** (H=36.3')

$59426 = P_h + 240(47.66)(0.42)$

use $u = \tan\phi$ instead of $u = \frac{2}{3}\tan\phi$
for non-continuous reinforcement

$u = \tan\phi = 0.577$

$P_r(drained) = 76985 \times \frac{0.577}{0.385} = 115377$ lb/ft

$P_r(undrained) = 95687$ lb/ft for $c = 2636$ psf

use $P_r(undrained) = 95687$ lb/ft

$F.S._{sliding} = \frac{95687}{59426} = 1.61 > 1.5$ **Good**
(H=36.3')

Bearing Capacity

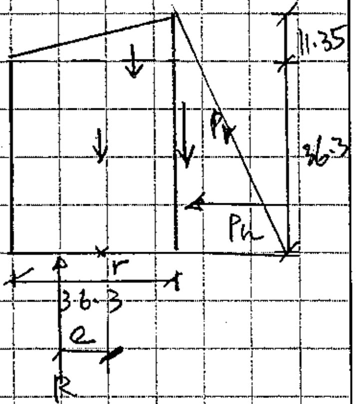
$\Sigma F_y = 0 = (120 \times 36.3 \times 36.3) + (120 \times \frac{1}{2} \times 36.3 \times 11.35)$
$+ 17117 - R$

$\Rightarrow R = 199960$ lb/ft

$\Sigma M_r = 0 = R \times e + \frac{1}{2}(120)(36.3)(11.35)\left(\frac{36.3}{2} - \frac{36.3}{3}\right)$
$+ 17117 \times \frac{36.3}{2} - 47085 \times \left(\frac{36.3 + 11.35}{3}\right)$

$\Rightarrow R \times e = 747867 - 149558 - 310674$
$= 287635$

$\Rightarrow e = 287635 / 199960 = 1.438$ ft
$< \frac{L}{6} = \frac{36.3}{6} = 6.05'$



$P_v = 17117$ lb/ft

$P_h = P_a \cos\beta$
$= 49343 \cos 17.4^{\circ}$
$= 47085$ lb/ft

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CLIENT TranSystems Corps / ODOT9
PROJECT SCI-823 Portsmouth ByPass
SUBJECT over Slocum Ave
MSE wall

PROJECT NO. 0121-3070.03
SHEET NO. 10 OF 15
COMP. BY EWT DATE 7-26-07
CHECKED BY SJR DATE 9-7-07

$$\sigma_v = \frac{R}{L-(2\times e)} = \frac{199960}{36.3-(2\times 1.438)} = 5982.5 \text{ psf}$$

say 5983 psf

$$q_{ult}\text{ (undrained)} = C N_c = 5.14(2636) = 13549 \text{ psf}$$

$$q_{all} = \frac{q_{ult}}{FS} = \frac{13549}{2.5} = 5420 < 5983 \quad \underline{\underline{NG}}$$

(H=36.3')

$$F.S. = \frac{13549}{5983} = 2.26 < 2.5 \quad \underline{\underline{NG}}$$

(H=36.3')

$$q_{ult}\text{ (drained)} = \frac{1}{2}\gamma B N_\gamma = \frac{1}{2}\times 125\times(36.3-2\times 1.438)\times \underset{\text{for } \phi=30^\circ}{22.4}$$

$$= 46794 \text{ psf}$$

$$q_{all} = \frac{q_{ult}}{2.5} = \frac{46794}{2.5} = 18718 > 5983 \quad \underline{\underline{OK}}$$

(H=36.3')

$$FS = \frac{46794}{5983} = 7.82 \quad \underline{\underline{OK}}$$

To achieve F.S. bearing capacity of 2.5, the required undrained shear strength is:

$$C = (2.5 \times 5983)/5.14 = 2910 \text{ psf}$$

Need staged construction to improve undrained shear strength

If $c = 2910$; $q_{ult}\text{ (undrained)} = 5.14 \times 2910 = 14957 \text{ psf}$

$$q_{all} = \frac{q_{ult}}{F.S.} = \frac{14957}{2.5} = 5983 = \underset{\text{req'd}}{5983}$$

$\underline{\underline{OK}}$

$$F.S. = \frac{14957}{5983} = 2.5 = \underset{\text{req'd}}{2.5} \quad \underline{\underline{ok}}$$

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SUBJECT

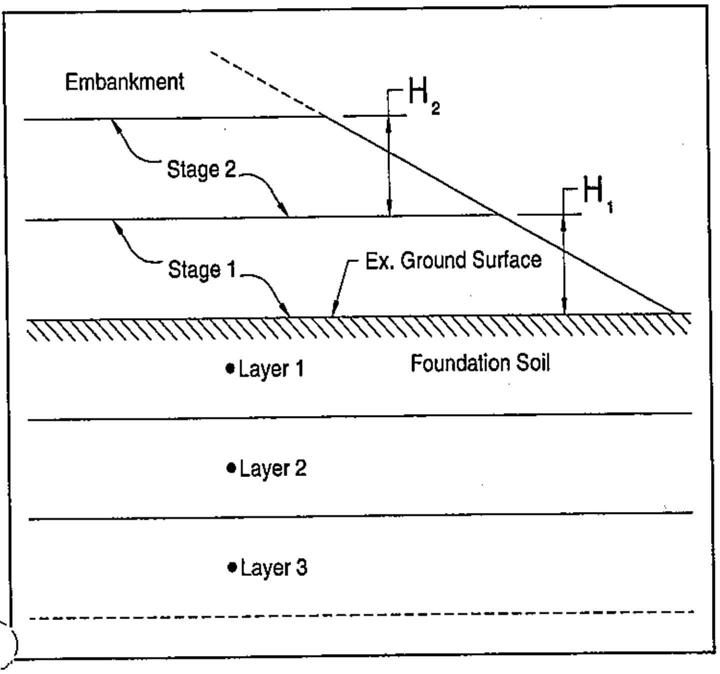
Client TranSystems/ODOT9
Project SCI-823 over Slocum Ave
Item Undrained Strength Analysis - Staged Const.
H1=27.0'

JOB NUMBER 0121-3070.03
SHEET NO. 11 OF 15
COMP. BY EWT DATE 9/6/07
CHECKED BY SJK DATE 9-7-07

Determine Increase in Undrained Shear Strength Due to Consolidation

Undrained Strength Analysis - Staged Construction

Ref: Ladd, Charles C. (1991). "Stability Evaluation During Staged Construction." *The Twenty-Second Karl Terzaghi Lecture.*, Journal of Geotechnical Engineering, ASCE, 117(4), 540-615



Increase in Undrained Shear Strength from consolidation

$$\boxed{c_u = c_{ui} + \Delta\sigma' \cdot \tan(\phi_{cu})}$$

Where: c_{ui} Initial undrained shear strength, UU or q_u testing
ϕ_{cu} Determined from CIU testing
$\Delta\sigma'$ Effective stress increase due to embankment loading

$$\boxed{\Delta\sigma' = (H_n \cdot \gamma_{emb}) \cdot U}$$

Where: U Average degree of consolidation (%)
H_n Height of Embankment, Stage n (ft)

Embankment Fill
γ_{fill} 120 pcf

It is assumed that fill material is granular

Construction Option: 27'/9'

Stage 1 Embankment First Stage Embankment Height H_1= 27.0 Average Percent Consolidation U= 90%

Depth	Soil Type	Initial Undrained Shear Strength, c_{ui} (psf)	$\Delta\sigma'$ (psf)	ϕ_{cu} (deg)	Δc_u (psf)	c_u (psf), *After Consolidation*	Percent Increase
	#1 Clay	1700	2916	17.8	936	2636	55%
	#2 Silt	1656	2916	17.0	892	2548	54%
	#3 Silty Clay	1125	2916	13.4	695	1820	62%

Stage 2 Embankment Second Stage Embankment Height H_2= 9.0 Average Percent Consolidation U= 80%

	#1 Clay	2636	864	17.8	277	2913 > 2910	11%
	#2 Silt	2548	864	17.0	264	2812 ok	10%
	#3 Silty Clay	1820	864	13.4	206	2026	11%

Stage 3 Embankment Third Stage Embankment Height H_3= Average Percent Consolidation U=

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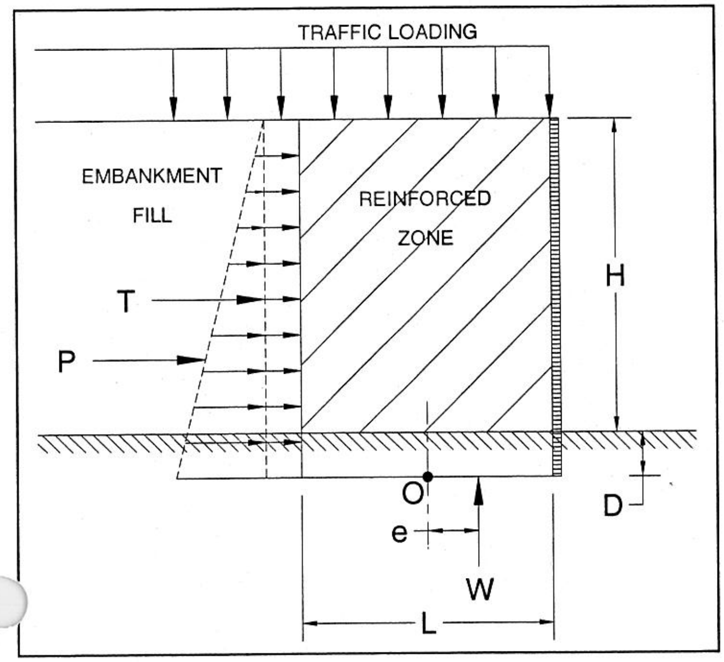
SUBJECT
Client ODOT9
Project SCI-823 Over Slocum Ave
Item MSE Wall Bearing Capacity-1st Stage H=36.3"
Flat backfill with increasd undrained shear strengtl

JOB NUMBER 0121-3070.03
SHEET NO. 12 OF 15
COMP. BY EWT DATE 7/27/07
CHECKED BY SJK DATE 9-7-07

BEARING CAPACITY OF A MSE WALL

Ref: {AASHTO; STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 17th Edition, 2002}



Effective Bearing Pressure

$$\sigma_v = \frac{W_t + W_{MSE}}{L - 2e}$$

σ_v = 4,895 psf

Ultimate undrained bearing capacity, q_{ult}

$$q_{ULT} = cN_c + \sigma'_D N_q + \frac{1}{2}\gamma' B N_\gamma$$

q_{ULT} = 13,737 psf

$$q_{ALL} = \frac{q_{ULT}}{FS}$$

q_{ALL} = 5,495 psf

Factor of Safety = **2.81** **OK**

Ultimate drained bearing capacity, q_{ult}

$$q_{ULT} = c'N_c + \sigma'_D N_q + \frac{1}{2}\gamma' B N_\gamma$$

q_{ULT} = 26,102 psf

$$q_{ALL} = \frac{q_{ULT}}{FS}$$

q_{ALL} = 10,441 psf

Factor of Safety = **5.33** **OK**

Soil Properties

γ_{EMB}	=	120	pcf	Unit weight	Embankment fill
ϕ'_{EMB}	=	30	deg.	Friction ang.	Embankment fill
γ_{FDN}	=	125	pcf	Unit weight	Foundation soil
c	=	2636	psf	Cohesion	Foundation soil
ϕ	=	0	deg.	Friction ang.	Foundation soil
c'	=	0	psf	Cohesion	Foundation soil
ϕ'	=	30	deg.	Friction ang.	Foundation soil

Loads and Parameters

ω_t	=	0	psf	Traffic loading
L=B	=	36.3	ft	Length of MSE reinforcement
L factor	=	1		Length factor-range (0.7 - 1.0)
D	=	3	ft	Embedment depth
Dw	=	0	ft	Groundwater depth
H+D	=	36.3	ft	
H	=	33.3	ft	Height of wall
Ka	=	0.33		
Γ Pa	=	12.1	ft	Moment arm
Γ Wt	=	18.15	ft	Moment arm
B'	=	32.30	ft	
γ'	=	62.6	pcf	
W_t		0	lb/ft of wall	Weight from traffic
W_{mse}	=	158,123	lb/ft of wall	Weight from MSE wall

Bearing Capacity Factors for Equations (AASHTO)

Undrained		Drained	
N_c	5.14	N_c	30.14
N_q	1.00	N_q	18.40
N_γ	0.00	N_γ	22.40

Eccentricity of Resultant Force

e = 2.00 ft

Kern

e < L/6 = 6.05 ft

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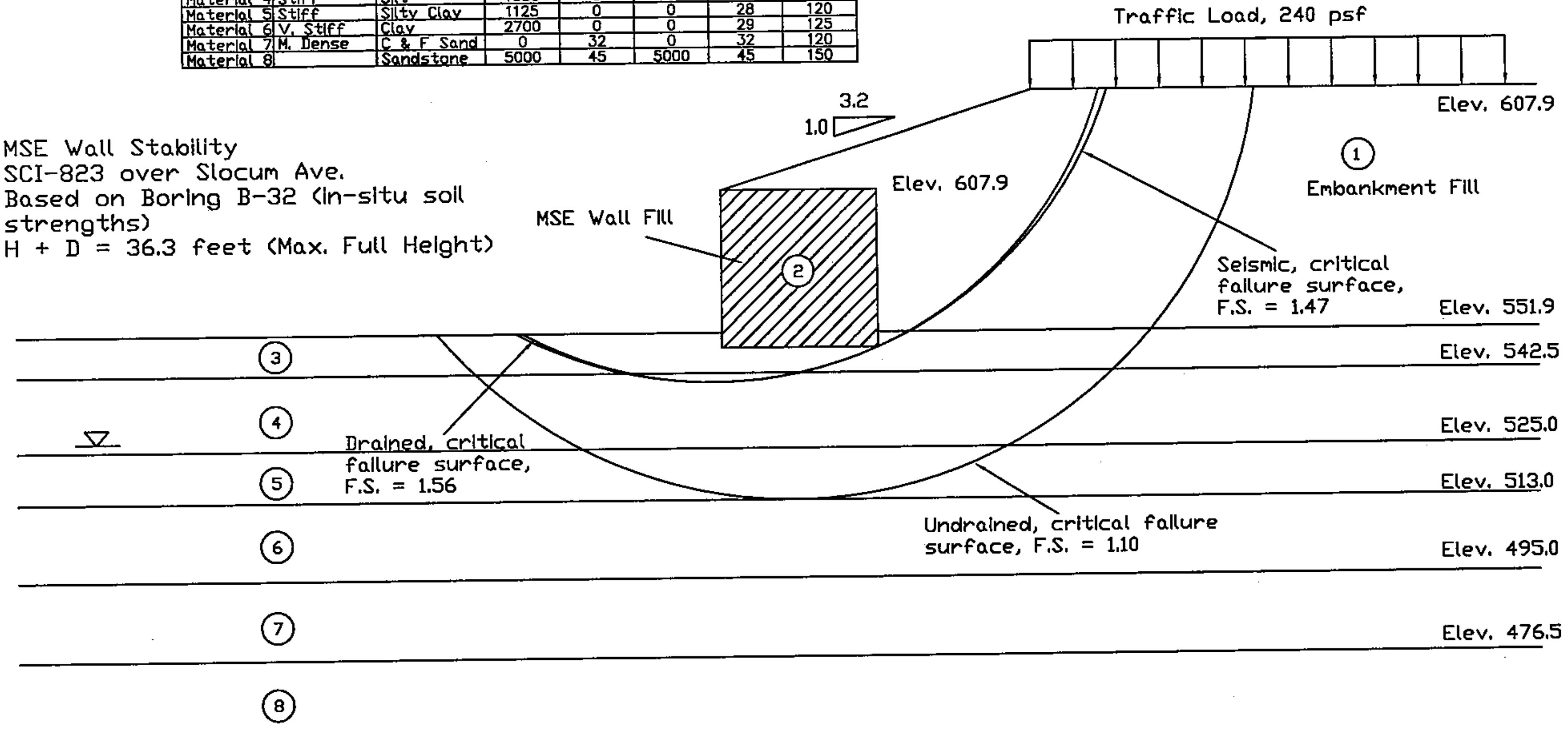
EWT 9-7-07

			Undrained		Drained		
Material	Consistency	Soil Type	C (psf)	ϕ (deg)	C' (psf)	ϕ' (deg)	γ (pcf)
Material 1	Compacted	Emb. Fill	0	30	0	30	120
Material 2		MSE Fill	0	34	0	34	120
Material 3	Stiff	Clay	1700	0	0	30	125
Material 4	Stiff	Silt	1656	0	0	30	125
Material 5	Stiff	Silty Clay	1125	0	0	28	120
Material 6	V. Stiff	Clay	2700	0	0	29	125
Material 7	M. Dense	C & F Sand	0	32	0	32	120
Material 8		Sandstone	5000	45	5000	45	150

MSE Wall Stability
SCI-823 over Slocum Ave.
Based on Boring B-32 (In-situ soil strengths)
H + D = 36.3 feet (Max. Full Height)



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SCI-823 OVER SLOCUM AVENUE
STABILITY ANALYSES
BORING B-32 (IN-SITU SOIL STRENGTHS)

MSE WALL STABILITY ANALYSES

PROJECT NO. 0121-3070.03	CALC: EWT	DATE 07/30/07

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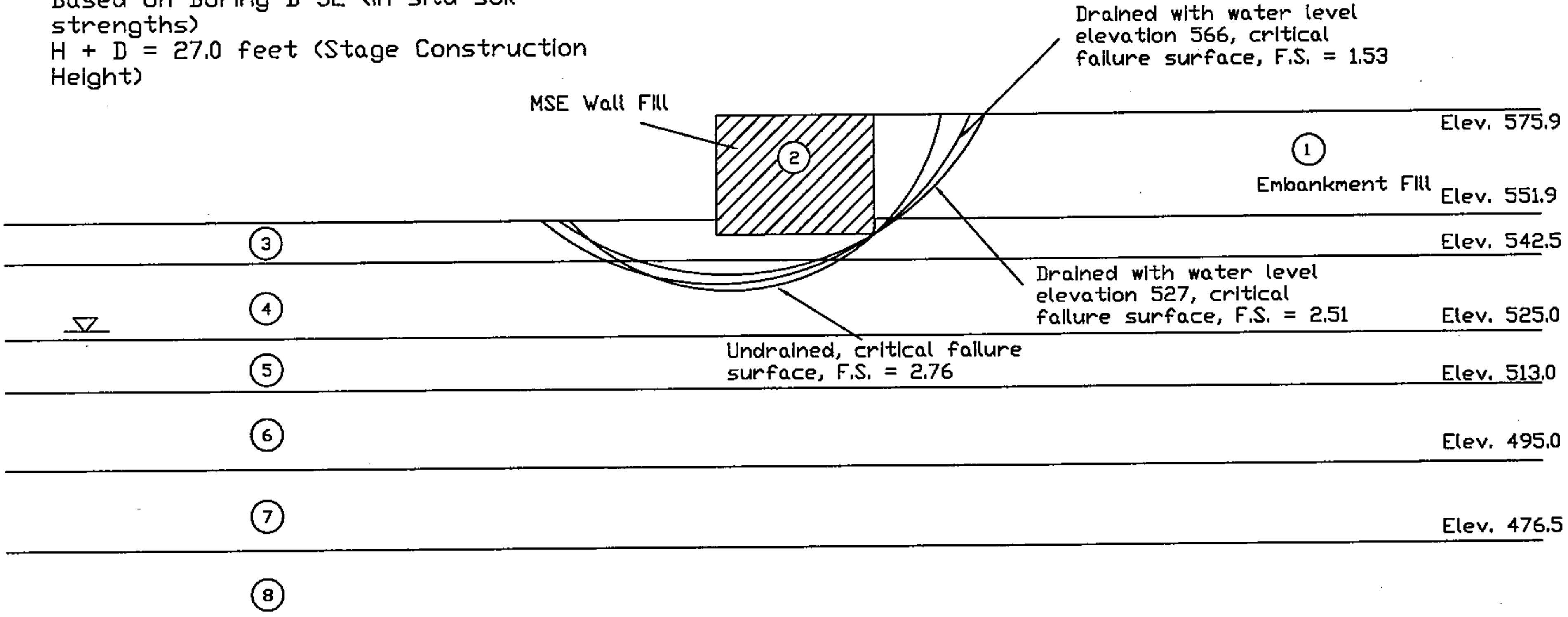
EWT 9-7-07

Material	Consistency	Soil Type	Undrained C (psf)	Undrained Φ (deg)	Drained C' (psf)	Drained Φ' (deg)	γ (pcf)
Material 1	Compacted	Emb. Fill	0	30	0	30	120
Material 2		MSE Fill	0	34	0	34	120
Material 3	Stiff	Clay	1700	0	0	30	125
Material 4	Stiff	Silt	1656	0	0	30	125
Material 5	Stiff	Silty Clay	1125	0	0	28	120
Material 6	V. Stiff	Clay	2700	0	0	29	125
Material 7	M. Dense	C & F Sand	0	32	0	32	120
Material 8		Sandstone	5000	45	5000	45	150

MSE Wall Stability - Stage Construction
SCI-823 over Slocum Ave.
Based on Boring B-32 (in-situ soil strengths)
H + D = 27.0 feet (Stage Construction Height)



9-7-07

SCI-823 OVER SLOCUM AVENUE
STAGE CONSTRUCTION
BORING B-32 (IN-SITU SOIL STRENGTHS)

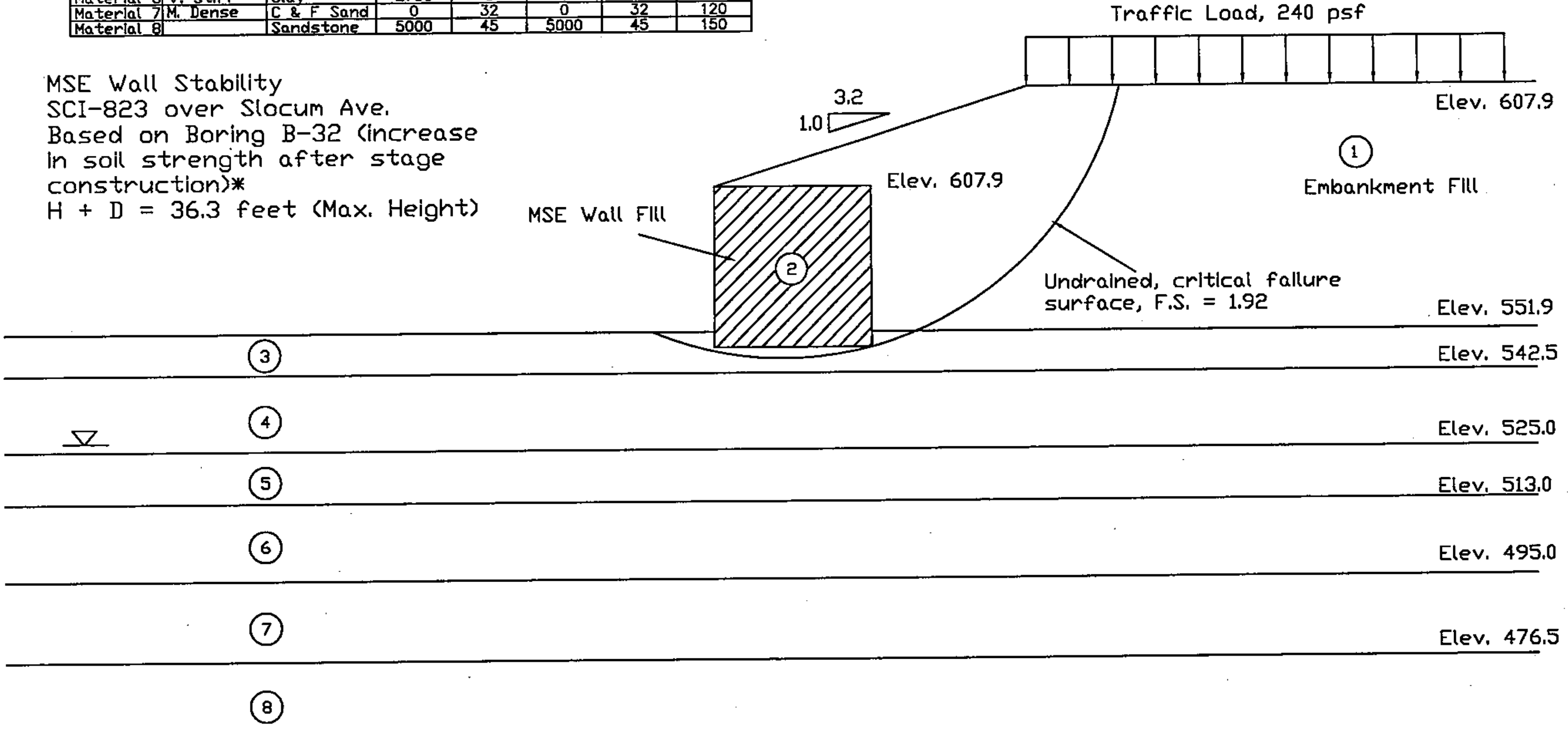
MSE WALL STABILITY ANALYSES

PROJECT NO. 0121-3070.03 | CALC: EWT | DATE 07/30/07

5/15
EWT 9-7-07

Material	Consistency	Soil Type	Undrained C (psf)	Undrained φ (deg)	Drained C' (psf)	Drained φ' (deg)	γ (pcf)
Material 1	Compacted	Emb. Fill	0	30	0	30	120
Material 2		MSE Fill	0	34	0	34	120
Material 3	Stiff	Clay	2636*	0	0	30	125
Material 4	Stiff	Silt	2548*	0	0	30	125
Material 5	Stiff	Silty Clay	1820*	0	0	28	120
Material 6	V. Stiff	Clay	2700	0	0	29	125
Material 7	M. Dense	C & F Sand	0	32	0	32	120
Material 8		Sandstone	5000	45	5000	45	150

MSE Wall Stability
SCI-823 over Slocum Ave.
Based on Boring B-32 (increase in soil strength after stage construction)*
H + D = 36.3 feet (Max. Height)



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SCI-823 OVER SLOCUM AVENUE
STABILITY ANALYSES - BORING B-32
WITH INCREASE IN SOIL STRENGTHS

MSE WALL STABILITY ANALYSES

PROJECT NO. 0121-3070. 03	CALC: EWT	DATE 07/30/07

MSE Walls – Settlement Calculations

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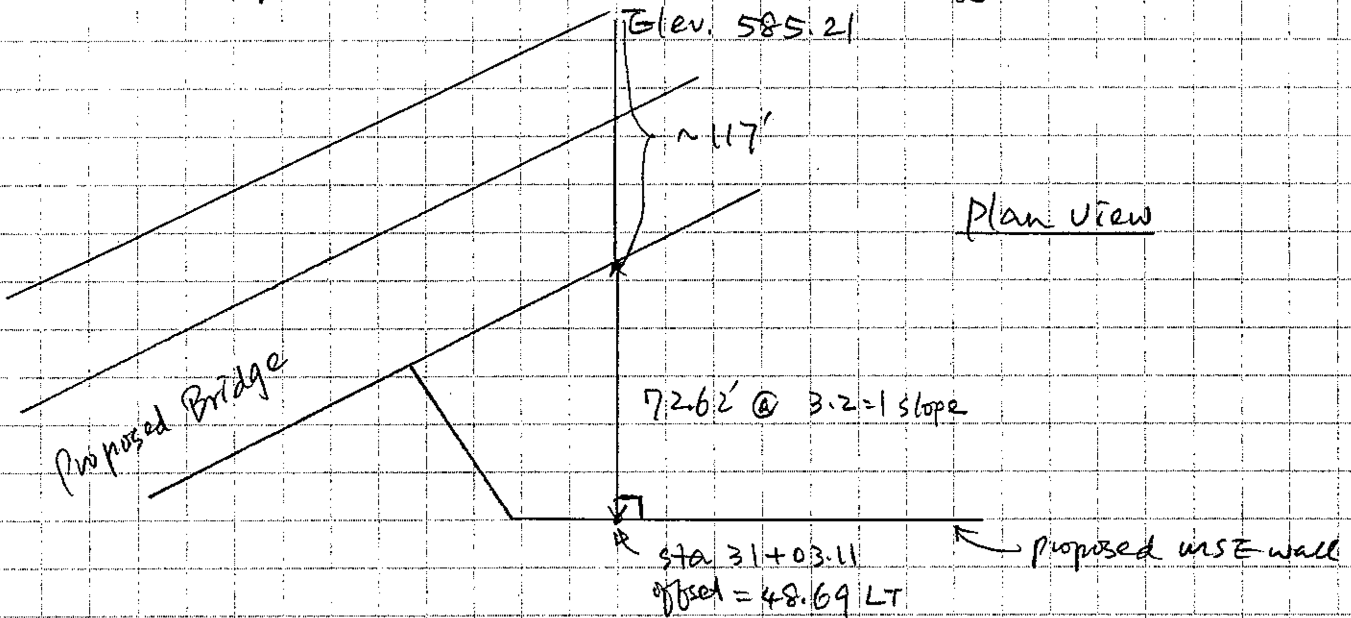
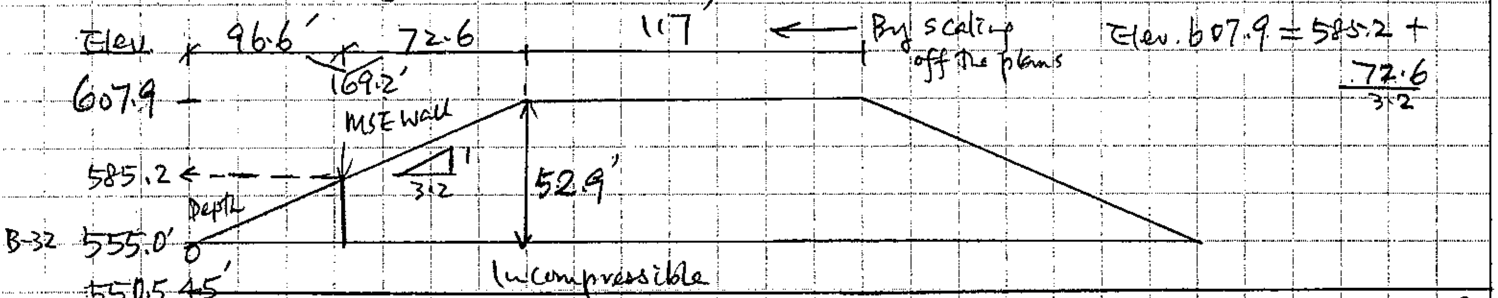
CLIENT TranSystems Corps / ODOT D-9
PROJECT SCI-823 – Portsmouth ByPass
SUBJECT over Slocum Ave.
Settlement – MSE wall

PROJECT NO. 0121-3070.03
SHEET NO. 1 OF 13
COMP. BY GMT DATE 7-27-07
CHECKED BY SJK DATE 9-7-07

Max height = 36.31' @ Sta 31+03.11 offset 48.69 LT



Boring B-32 considered most critical near the wall area
existing ground elevation @ B-32 = 555'



550.5 4.5'

clay* c=1700, φ'=30, γ=125, P_c=4480psf, e_o = 0.793, C_c = 0.21, C_r=0.060

542.5 12.5

silt $\gamma_d = 125/(1+0.287) = 97.1$
c=1656, φ'=30, γ=125, w_c=28.7%, C_c=0.29, C_r=0.029
$e = (G_s\gamma_w/\gamma_d) - 1 = \frac{2.65 \times 62.4}{97.1} - 1 = 0.70$ (NHI-00-045)

525.0 30.0

527.0 (Elev 527.0)

Silty clay c = 1125, φ' = 28, γ=120 w_c = 25.6% (Boring R-64A @ 40')
$e_0 = G_s w = 2.65 \times 0.256 = 0.678$ C_c = 0.256, C_r = 0.0256 (NHI-00-045)

513.0 42.0

clay* c=2700, φ'=29, γ=125, C_c = 0.19, C_r=0.07, e_o = 0.706, P_c = 4428psf

495.0 60'

Sand γ=120, e_0=1 (Assumed), N_{avg}=14, $\frac{N'}{N}$=0.62 ⇒ N' = 8.68
C' = 45 ⇒ $C_c = \frac{1+e_0}{C'}$ = 0.044 = C_r C' = 45 (NHI-00-045 Fig 6.5 & 6.6)

476.5 78.5'

Sandstone Incompressible

471.0 84'

* Composite data from Highland Bend Embankments report

Assume P_c = 4428 psf for all soils

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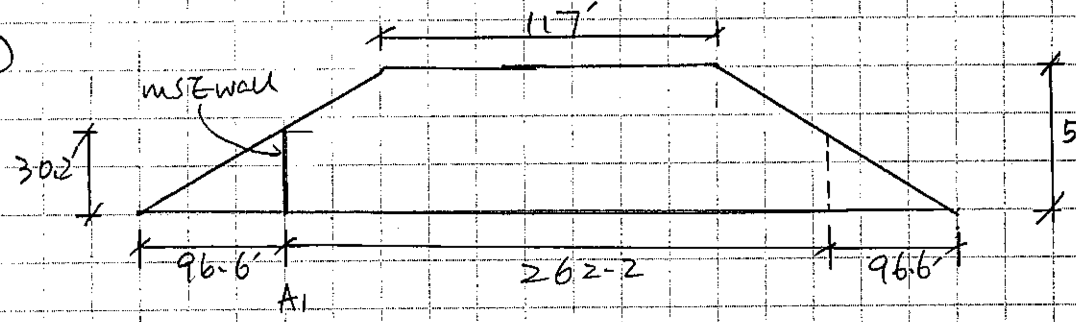
CLIENT Transystems Corps / ODOT D-9
PROJECT SCI-823-Portsmouth ByPass
SUBJECT Over Slocum Ave
Settlement — MSE wall

PROJECT NO. 0121-3070.03
SHEET NO. 2 OF 13
COMP. BY SWT DATE 7-27-07
CHECKED BY SJK DATE 9-7-07

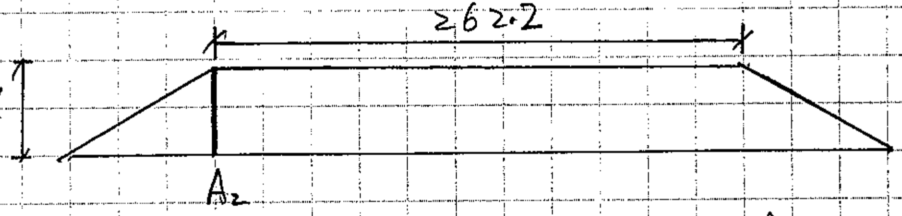
Settlement @ MSE wall location was determined by Superposition:

①



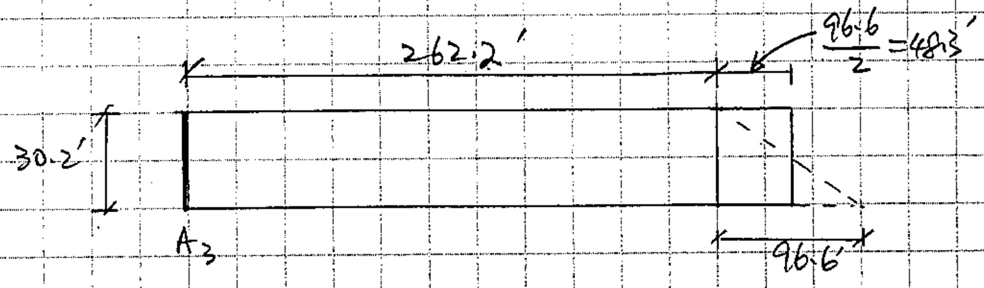
Settlement @ A_1 = A_1

②



Settlement @ A_2 = A_2

③



Settlement @ A_3 = A_3

Settlement @ MSE wall $= A_1 - A_2 + A_3$

$$= 21.05 - 17.02 + 9.79 = 13.82''$$

3/13
EWT 9-7-07
SJK 9-7-07

SLO W-B1

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ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿
3           INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION             3
3                                                                               3
3 Project Name    : SCI-823 Slocum Wall   Client           : ODOT9              3
3 File Name       : Point B1              Project Manager  : PN                 3
3 Date            : 08/08/07              Computed by      : EWT                3
3                                                                               3
3                                                                               3
```

assume 2:1 slope in y-direction → y = 105.8' (2 times embankment height)

```
3                        Settlement for X-Direction                             3
3                                                                               3
3 Embank. slope, x direc. = 169.20 (ft)  Height of fill H     =   52.90 (ft)    3
3                y direc. = 105.80 (ft)  Unit weight of fill =  120.00 (pcf)    3
3 Embankment top width    = 117.00 (ft)  p load/unit area     = 6348.00 (psf)   3
3 Embankment bottom width = 455.40 (ft)  Foundation Elev.     =  555.00 (ft)    3
3 Ground Surface Elev.    = 555.00 (ft)                                         3
3 Water table Elev.       = 527.00 (ft)  Unit weight of Wat. =   62.40 (pcf)    3
3                                                                               3
3                                                                               3
3            LAYER              COEFFICIENT            UNIT   SPECIFIC  VOID    3
3      N§.   TYPE  THICK.  COMP. RECOMP. SWELL.    WEIGHT  GRAVITY   RATIO      3
3                   (ft)                            (pcf)                       3
3                                                                               3
3      1   INCOMP.  4.5   -----  -----  -----     120.00    ----      ----      3
3      2    COMP.   8.0   0.210  0.060  0.000     125.00    2.65      0.79      3
3      3    COMP.  17.5   0.290  0.029  0.000     125.00    2.65      0.70      3
3      4    COMP.  12.0   0.256  0.026  0.000     120.00    2.65      0.67      3
3      5    COMP.  18.0   0.190  0.070  0.000     125.00    2.65      0.70      3
3      6    COMP.  18.5   0.044  0.044  0.000     120.00    2.65      1.00      3
3      7   INCOMP.  5.5   -----  -----  -----     145.00    ----      ----      3
3                                                                               3
3          SUBLAYER                      SOIL STRESSES                          3
3     N§.    THICK.          ELEV.          INITIAL       MAX.PAST PRESS.       3
3             (ft)           (ft)            (psf)             (psf)            3
3                                                                               3
3     1  INCOMP.                                                                3
3     2       8.00          546.50          1040.00          4480.00            3
3     3      17.50          533.75          2633.75          4480.00            3
3     4      12.00          519.00          3948.30          4480.00            3
3     5      18.00          504.00          4857.30          4480.00            3
3     6      18.50          485.75          5953.50          4480.00            3
3     7  INCOMP.                                                                3
3                                                                               3
3                                                                               3
3                                                                               3
3          X =      0.00      X =   358.80                                      3
3 Layer   Stress   Sett.    Stress   Sett.                                      3
3          (psf)   (in.)     (psf)   (in.)                                      3
3                                                                               3
3   1   INCOMP.  INCOMP.                                                        3
3   2     64.19    0.08    3656.76    2.27                                      3
3   3    233.51    0.13    3589.24    5.94                                      3
3   4    396.95    0.09    3492.04    4.99                                      3
3   5    538.91    1.95    3349.17    6.35                                      3
3   6    681.22    0.83    3153.41    1.50                                      3
3   7   INCOMP.  INCOMP.                                                        3
3                ------             ------                                      3
3                  3.09              21.05                                      3
3                                                                               3
3                                                                               3
3                                                                               3
ÀÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ
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4/13
EWT 9-7-07
SJK 9-7-07

SLO W-B2

```
ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿
3          INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION               3
3                                                                                3
3 Project Name    : SCI-823 Slocum Wall  Client           : ODOT9               3
3 File Name       : Point B2             Project Manager  : PN                  3
3 Date            : 07/27/07             Computed by      : EWT                 3
3                                                                                3
3                                                                                3
```

Assume 2:1 slope in y-direction → y = 60.40 (2 times height of embankment)

```
3                     Settlement for X-Direction                                 3
3                                                                                3
3 Embank. slope, x direc. =   96.60 (ft)  Height of fill H     =   30.20 (ft)   3
3                y direc. =   60.40 (ft)  Unit weight of fill  =  120.00 (pcf)  3
3 Embankment top width    =  262.20 (ft)  p load/unit area     = 3624.00 (psf)  3
3 Embankment bottom width =  455.40 (ft)  Foundation Elev.     =  555.00 (ft)   3
3 Ground Surface Elev.    =  555.00 (ft)                                        3
3 Water table Elev.       =  527.00 (ft)  Unit weight of Wat.  =   62.40 (pcf)  3
3                                                                                3
3                                                                                3
3         LAYER              COEFFICIENT          UNIT    SPECIFIC  VOID         3
3     N§.  TYPE  THICK.  COMP.  RECOMP. SWELL.   WEIGHT   GRAVITY   RATIO        3
3                 (ft)                            (pcf)                          3
3                                                                                3
3      1 INCOMP.  4.5   -----   -----   -----    120.00    ----     ----         3
3      2  COMP.   8.0   0.210   0.060   0.000    125.00    2.65     0.79         3
3      3  COMP.  17.5   0.290   0.029   0.000    125.00    2.65     0.70         3
3      4  COMP.  12.0   0.256   0.026   0.000    120.00    2.65     0.67         3
3      5  COMP.  18.0   0.190   0.070   0.000    125.00    2.65     0.70         3
3      6  COMP.  18.5   0.044   0.044   0.000    120.00    2.65     1.00         3
3      7 INCOMP.  5.5   -----   -----   -----    145.00    ----     ----         3
3                                                                                3
3          SUBLAYER                        SOIL STRESSES                         3
3    N§.    THICK.        ELEV.               INITIAL      MAX.PAST PRESS.      3
3            (ft)          (ft)                (psf)           (psf)             3
3                                                                                3
3    1  INCOMP.                                                                  3
3    2        8.00       546.50              1040.00          4480.00            3
3    3       17.50       533.75              2633.75          4480.00            3
3    4       12.00       519.00              3948.30          4480.00            3
3    5       18.00       504.00              4857.30          4480.00            3
3    6       18.50       485.75              5953.50          4480.00            3
3    7  INCOMP.                                                                  3
3                                                                                3
3                                                                                3
3                                                                                3
3          X =      0.00     X =    358.80                                       3
3 Layer   Stress   Sett.     Stress   Sett.                                      3
3          (psf)   (in.)     (psf)    (in.)                                      3
3                                                                                3
3   1   INCOMP.   INCOMP.                                                        3
3   2     87.45    0.11     3409.15    2.03                                      3
3   3    234.13    0.13     3077.07    4.60                                      3
3   4    365.33    0.09     2743.13    3.97                                      3
3   5    464.19    1.80     2460.62    5.14                                      3
3   6    549.77    0.79     2188.15    1.27                                      3
3   7   INCOMP.   INCOMP:                                                        3
3                 ------              ------                                     3
3                  2.93               17.02                                      3
3                                                                                3
3                                                                                3
3                                                                                3
ÀÄÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ
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5/13
EWT 9-7-07
SJK 9-7-07

SLO W-B4

→ assume 2:1 slope in y-direction

y=30.2' (2 times embankment height)

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ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿
3           INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION             3
3                                                                               3
3 Project Name    : SCI-823 Slocum Wall  Client            : ODOT9              3
3 File Name       : Point B4             Project Manager : PN                   3
3 Date            : 07/27/07             Computed by       : EWT                3
3                                                                               3
3                                                                               3
3                            Settlement for X-Direction                         3
3                                                                               3
3 Embank. slope, x direc. =    0.10 (ft)  Height of fill H     =   30.20 (ft)   3
3                 y direc. =    0.10 (ft)  Unit weight of fill =  120.00 (pcf)  3
3 Embankment top width    =  310.50 (ft)  p load/unit area     = 3624.00 (psf)  3
3 Embankment bottom width =  310.70 (ft)  Foundation Elev.     =  555.00 (ft)   3
3 Ground Surface Elev.    =  555.00 (ft)                                        3
3 Water table Elev.       =  527.00 (ft)  Unit weight of Wat. =   62.40 (pcf)   3
3                                                                               3
3                                                                               3
3           LAYER               COEFFICIENT          UNIT   SPECIFIC  VOID      3
3      N§.  TYPE  THICK.  COMP. RECOMP. SWELL.  WEIGHT  GRAVITY   RATIO         3
3                  (ft)                               (pcf)                     3
3                                                                               3
3       1  INCOMP.  4.5   -----  -----  -----   120.00    ----     ----         3
3       2   COMP.   8.0   0.210  0.060  0.000   125.00    2.65     0.79         3
3       3   COMP.  17.5   0.290  0.029  0.000   125.00    2.65     0.70         3
3       4   COMP.  12.0   0.256  0.026  0.000   120.00    2.65     0.67         3
3       5   COMP.  18.0   0.190  0.070  0.000   125.00    2.65     0.70         3
3       6   COMP.  18.5   0.044  0.044  0.000   120.00    2.65     1.00         3
3       7  INCOMP.  5.5   -----  -----  -----   145.00    ----     ----         3
3                                                                               3
3            SUBLAYER                         SOIL STRESSES                     3
3     N§.     THICK.         ELEV.              INITIAL       MAX.PAST PRESS.   3
3              (ft)          (ft)                (psf)            (psf)         3
3                                                                               3
3     1  INCOMP.                                                                3
3     2        8.00         546.50           1040.00          4480.00           3
3     3       17.50         533.75           2633.75          4480.00           3
3     4       12.00         519.00           3948.30          4480.00           3
3     5       18.00         504.00           4857.30          4480.00           3
3     6       18.50         485.75           5953.50          4480.00           3
3     7  INCOMP.                                                                3
3                                                                               3
3                                                                               3
3                                                                               3
3            X =     0.00       X =   310.50                                    3
3 Layer  Stress   Sett.     Stress   Sett.                                      3
3         (psf)   (in.)      (psf)   (in.)                                      3
3                                                                               3
3   1  INCOMP.  INCOMP.                                                         3
3   2   1797.37   1.40    1851.64   1.43                                        3
3   3   1791.85   0.81    1813.51   0.82                                        3
3   4   1751.67   2.43    1764.30   2.45                                        3
3   5   1687.50   3.97    1696.19   3.99                                        3
3   6   1598.74   1.11    1604.87   1.11                                        3
3   7  INCOMP.  INCOMP.                                                         3
3                 ------             ------                                     3
3                  9.72               9.79                                      3
3                                                                               3
3                                                                               3
3                                                                               3
ÀÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ
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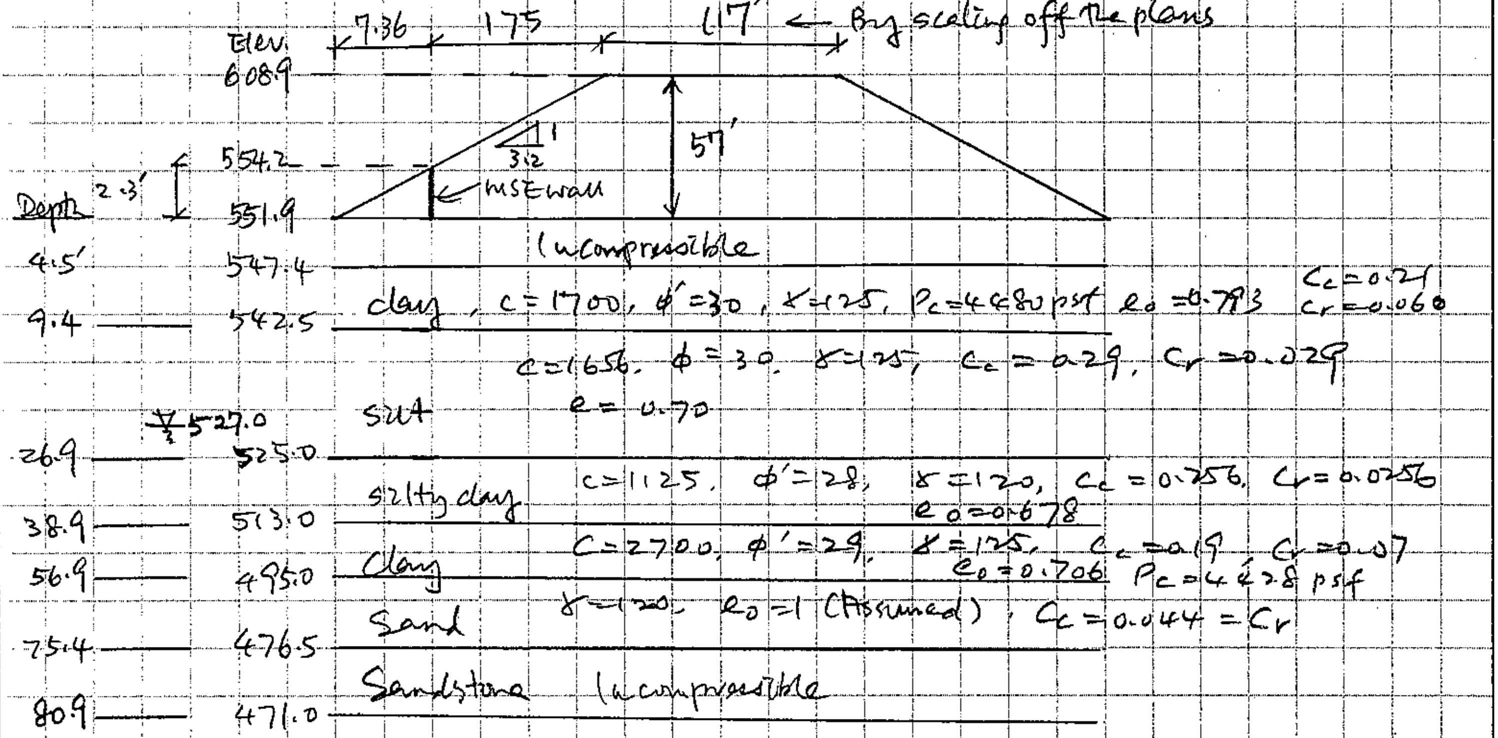
DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

CLIENT Transystems Corps / ODOT D-9
PROJECT SCI-823 – Portsmouth ByPass
SUBJECT over Slocum Ave
Settlement – MSE wall

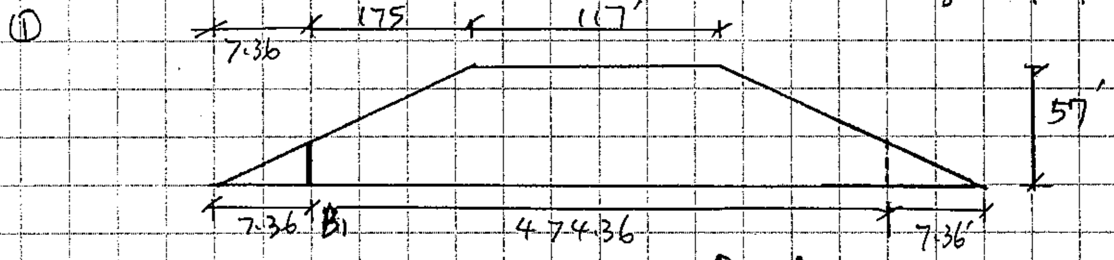
PROJECT NO. 0121-3070.03
SHEET NO. 6 OF 13
COMP. BY GWT DATE 7-29-07
CHECKED BY SJK DATE 9-7-07

Min height = 5.3' @ Sta 32+08.25, offset 33.47 LT.
Elevation @ top of leveling pad = 548.90 & top of wall elev = 554.20
Use soil profile @ B-32, ground elev. = 555.0 > top of wall elev. 554.20
Ground elevation = 548.9 + 3' = 551.9'



Settlement @ MSE wall location was determined by Superposition = $B_1 - B_2 + B_3$

①



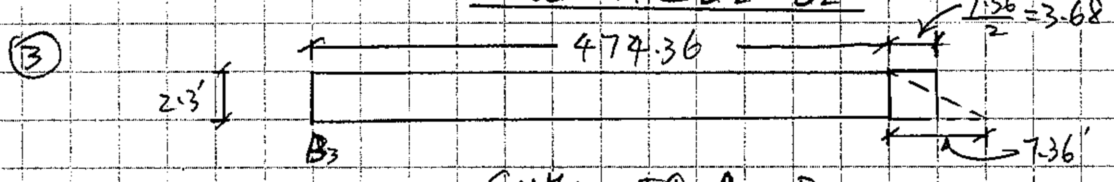
$= 2.77 - 0.89$
$+ 0.85$
$= 2.73''$

Settlement @ $B_1 = B_1$

②

Settlement @ $B_2 = B_2$

③



Settlement @ $B_3 = B_3$

7/13
EWT 9-7-07
SJR 9-7-07

SLO W-C1

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ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿
³            INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION            ³
³                                                                               ³
³ Project Name    : SCI-823 Slocum Wall  Client            : ODOT9              ³
³ File Name       : Point C1             Project Manager : PN                   ³
³ Date            : 07/29/07             Computed by       : EWT                ³
³                                                                               ³
³                                                                               ³
³                           Settlement for X-Direction                          ³
³                                                                               ³
³ Embank. slope, x direc. =  182.36 (ft)  Height of fill H     =   57.00 (ft)  ³
³                y direc. =  114.00 (ft)  Unit weight of fill =  120.00 (pcf)  ³
³ Embankment top width    =  117.00 (ft)  p load/unit area     = 6840.00 (psf)  ³
³ Embankment bottom width =  481.72 (ft)  Foundation Elev.     =  551.90 (ft)  ³
³ Ground Surface Elev.    =  551.90 (ft)                                        ³
³ Water table Elev.       =  527.00 (ft)  Unit weight of Wat. =   62.40 (pcf)  ³
³                                                                               ³
³                                                                               ³
³               LAYER              COEFFICIENT          UNIT    SPECIFIC   VOID  ³
³          N§.  TYPE   THICK.  COMP.  RECOMP.  SWELL.   WEIGHT  GRAVITY   RATIO ³
³                       (ft)                            (pcf)                   ³
³                                                                               ³
³           1  INCOMP.  4.5   -----   -----   -----    120.00    ----     ----  ³
³           2   COMP.   4.9   0.210   0.060   0.000    125.00    2.65     0.79  ³
³           3   COMP.  17.5   0.290   0.029   0.000    125.00    2.65     0.70  ³
³           4   COMP.  12.0   0.256   0.026   0.000    120.00    2.65     0.67  ³
³           5   COMP.  18.0   0.190   0.070   0.000    125.00    2.65     0.70  ³
³           6   COMP.  18.5   0.044   0.044   0.000    120.00    2.65     1.00  ³
³           7  INCOMP.  5.5   -----   -----   -----    145.00    ----     ----  ³
³                                                                               ³
³                SUBLAYER                     SOIL STRESSES                     ³
³         N§.     THICK.        ELEV.          INITIAL       MAX.PAST PRESS.    ³
³                  (ft)          (ft)           (psf)            (psf)          ³
³                                                                               ³
³         1   INCOMP.                                                           ³
³         2         4.90       544.95          846.25         4480.00           ³
³         3        17.50       533.75         2246.25         4480.00           ³
³         4        12.00       519.00         3560.80         4480.00           ³
³         5        18.00       504.00         4469.80         4480.00           ³
³         6        18.50       485.75         5566.00         4480.00           ³
³         7   INCOMP.                                                           ³
³                                                                               ³
³                                                                               ³
³                                                                               ³
³            X =     0.00      X =   474.36                                     ³
³ Layer   Stress   Sett.     Stress  Sett.                                      ³
³          (psf)   (in.)     (psf)   (in.)                                      ³
³                                                                               ³
³   1   INCOMP.  INCOMP.                                                        ³
³   2     39.80    0.04     242.83    0.22                                      ³
³   3    192.54    0.13     370.51    0.24                                      ³
³   4    365.50    0.10     521.98    0.13                                      ³
³   5    516.77    1.13     663.10    1.44                                      ³
³   6    671.75    0.70     807.95    0.75                                      ³
³   7   INCOMP.  INCOMP.                                                        ³
³                 ------             ------                                     ³
³                  2.10               2.77                                      ³
³                                                                               ³
³                                                                               ³
³                                                                               ³
ÀÄÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ
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8/13
EWT 9-7-07
SJH 9-7-07

SLO W-C2

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ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿
3            INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION             3
3                                                                                3
3 Project Name    : SCI-823 Slocum Wall  Client            : ODOT9               3
3 File Name       : Point C2             Project Manager : PN                    3
3 Date            : 07/29/07             Computed by       : EWT                 3
3                                                                                3
3                                                                                3
3                         Settlement for X-Direction                             3
3                                                                                3
3 Embank. slope, x direc. =    7.36 (ft)  Height of fill H    =    2.30 (ft)     3
3                y direc. =    4.60 (ft)  Unit weight of fill =  120.00 (pcf)    3
3 Embankment top width    =  467.00 (ft)  p load/unit area    =  276.00 (psf)    3
3 Embankment bottom width =  481.72 (ft)  Foundation Elev.    =  551.90 (ft)     3
3 Ground Surface Elev.    =  551.90 (ft)                                         3
3 Water table Elev.       =  527.00 (ft)  Unit weight of Wat. =   62.40 (pcf)    3
3                                                                                3
3                                                                                3
3           LAYER             COEFFICIENT          UNIT    SPECIFIC   VOID       3
3      N§.  TYPE   THICK.  COMP. RECOMP. SWELL.    WEIGHT  GRAVITY    RATIO      3
3                   (ft)                           (pcf)                         3
3                                                                                3
3       1  INCOMP.  4.5    -----  -----  -----    120.00    ----      ----       3
3       2   COMP.   4.9    0.210  0.060  0.000    125.00    2.65      0.79       3
3       3   COMP.  17.5    0.290  0.029  0.000    125.00    2.65      0.70       3
3       4   COMP.  12.0    0.256  0.026  0.000    120.00    2.65      0.67       3
3       5   COMP.  18.0    0.190  0.070  0.000    125.00    2.65      0.70       3
3       6   COMP.  18.5    0.044  0.044  0.000    120.00    2.65      1.00       3
3       7  INCOMP.  5.5    -----  -----  -----    145.00    ----      ----       3
3                                                                                3
3             SUBLAYER                      SOIL STRESSES                        3
3     N§.      THICK.        ELEV.            INITIAL      MAX.PAST PRESS.       3
3               (ft)          (ft)             (psf)           (psf)             3
3                                                                                3
3     1   INCOMP.                                                                3
3     2          4.90        544.95            846.25        4480.00             3
3     3         17.50        533.75           2246.25        4480.00             3
3     4         12.00        519.00           3560.80        4480.00             3
3     5         18.00        504.00           4469.80        4480.00             3
3     6         18.50        485.75           5566.00        4480.00             3
3     7   INCOMP.                                                                3
3                                                                                3
3                                                                                3
3                                                                                3
3             X =      0.00     X =    474.36                                    3
3 Layer    Stress   Sett.    Stress  Sett.                                       3
3           (psf)   (in.)    (psf)   (in.)                                       3
3                                                                                3
3   1    INCOMP.  INCOMP.                                                        3
3   2      47.52    0.05    148.61    0.14                                       3
3   3      60.83    0.04    100.88    0.07                                       3
3   4      64.75    0.02     86.09    0.02                                       3
3   5      66.16    0.14     80.51    0.17                                       3
3   6      66.94    0.49     77.17    0.49                                       3
3   7    INCOMP.  INCOMP.                                                        3
3                 ------            ------                                       3
3                   0.73              0.89                                       3
3                                                                                3
3                                                                                3
3                                                                                3
ÀÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ
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9/13
BWT 9-7-07
SPK 9-7-07

SLO W-C4

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ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿
³            INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION          ³
³                                                                              ³
³ Project Name   : SCI-823 Slocum Wall  Client          : ODOT9                ³
³ File Name      : Point C4             Project Manager : PN                   ³
³ Date           : 07/29/07             Computed by     : EWT                  ³
³                                                                              ³
³                                                                              ³
³                           Settlement for X-Direction                         ³
³                                                                              ³
³ Embank. slope, x direc. =    0.10 (ft)  Height of fill H    =    2.30 (ft)   ³
³                y direc. =    0.10 (ft)  Unit weight of fill =  120.00 (pcf)  ³
³ Embankment top width    =  478.04 (ft)  p load/unit area    =  276.00 (psf)  ³
³ Embankment bottom width =  478.24 (ft)  Foundation Elev.    =  551.90 (ft)   ³
³ Ground Surface Elev.    =  551.90 (ft)                                       ³
³ Water table Elev.       =  527.00 (ft)  Unit weight of Wat. =   62.40 (pcf)  ³
³                                                                              ³
³                                                                              ³
³            LAYER             COEFFICIENT        UNIT   SPECIFIC  VOID        ³
³       N§.  TYPE  THICK.  COMP. RECOMP. SWELL.  WEIGHT  GRAVITY   RATIO       ³
³                   (ft)                         (pcf)                         ³
³                                                                              ³
³        1  INCOMP.  4.5   -----  -----  -----   120.00    ----     ----       ³
³        2   COMP.   4.9   0.210  0.060  0.000   125.00    2.65     0.79       ³
³        3   COMP.  17.5   0.290  0.029  0.000   125.00    2.65     0.70       ³
³        4   COMP.  12.0   0.256  0.026  0.000   120.00    2.65     0.67       ³
³        5   COMP.  18.0   0.190  0.070  0.000   125.00    2.65     0.70       ³
³        6   COMP.  18.5   0.044  0.044  0.000   120.00    2.65     1.00       ³
³        7  INCOMP.  5.5   -----  -----  -----   145.00    ----     ----       ³
³                                                                              ³
³             SUBLAYER                   SOIL STRESSES                         ³
³      N§.     THICK.        ELEV.          INITIAL      MAX.PAST PRESS.       ³
³              (ft)          (ft)            (psf)           (psf)             ³
³                                                                              ³
³      1  INCOMP.                                                              ³
³      2         4.90        544.95          846.25        4480.00             ³
³      3        17.50        533.75         2246.25        4480.00             ³
³      4        12.00        519.00         3560.80        4480.00             ³
³      5        18.00        504.00         4469.80        4480.00             ³
³      6        18.50        485.75         5566.00        4480.00             ³
³      7  INCOMP.                                                              ³
³                                                                              ³
³                                                                              ³
³                                                                              ³
³         X =     0.00     X =   478.04                                        ³
³ Layer  Stress  Sett.    Stress  Sett.                                        ³
³        (psf)   (in.)    (psf)   (in.)                                        ³
³                                                                              ³
³   1  INCOMP.  INCOMP.                                                        ³
³   2    113.49   0.11    117.89   0.11                                        ³
³   3     89.82   0.06     91.13   0.06                                        ³
³   4     80.83   0.02     81.47   0.02                                        ³
³   5     77.16   0.16     77.58   0.17                                        ³
³   6     74.87   0.49     75.17   0.49                                        ³
³   7  INCOMP.  INCOMP.                                                        ³
³               ------           ------                                        ³
³                 0.84             0.85                                        ³
³                                                                              ³
³                                                                              ³
³                                                                              ³
ÀÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ
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CLIENT TranSystems Corps / ODOT D-9
PROJECT SCI-823 - Portsmouth ByPass
SUBJECT Over Slocum Ave
Settlement — MSE wall.

PROJECT NO. 0121-3070.03
SHEET NO. 10 OF 13
COMP. BY EWT DATE 7-29-07
CHECKED BY SJK DATE 9-7-07

Differential Settlement between wall sections
@ Sta 31+03.11 offset 48.69 LT and Sta 32+0.825, offset 33.47 LT :

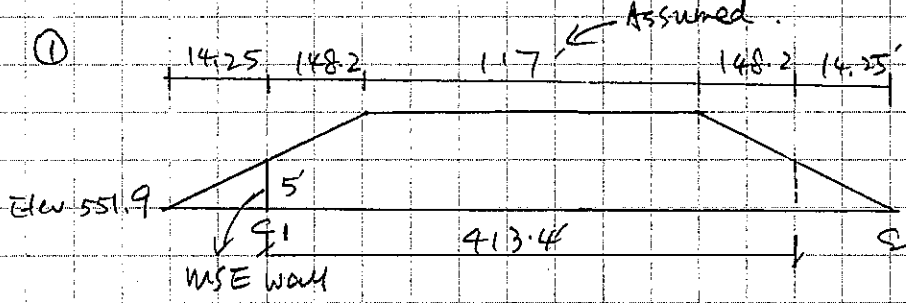
= 13.82 − 2.73 = 11.09"

Length of wall sections (By scaling off the plan) = 127'

% differential settlement = $\frac{11.09/12}{127}$ ×100% = 0.73%

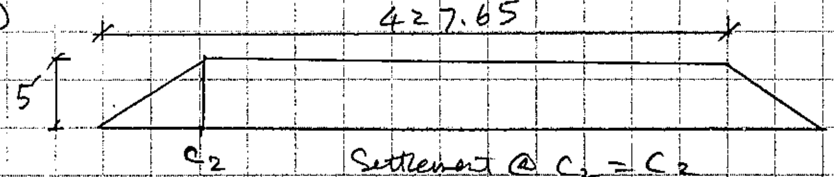
Check against station 30+26.02, L=68' (measured off the plan) between Sta 30+26.02 & Sta 31+03.11

①



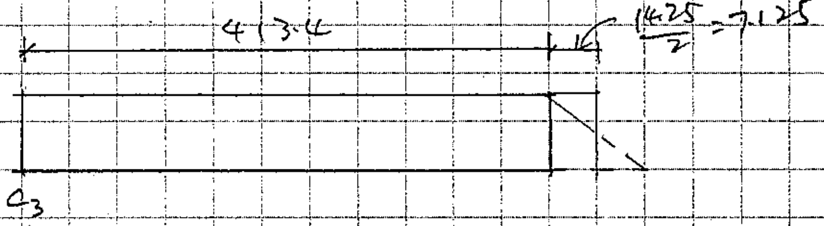
Settlement @ C1 = C1

②



Settlement @ C2 = C2

③



Settlement @ C3 = C3

Settlement at MSE wall was determined by Superposition

= C1 − C2 + C3 = 3.85 − 1.58 + 1.42 = 3.69"

Differential settlement with respect to station 31+03.11, L=68'

= $\frac{(13.82 - 3.69)/12}{68}$ ×100% = 1.24% > 1%.

11/13
GWT 9-7-07
SJK 9-7-07

SLO W-D1

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ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿
³           INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION             ³
³                                                                               ³
³ Project Name    : SCI-823 Slocum Wall  Client             : ODOT9             ³
³ File Name       : Point D1             Project Manager : PN                   ³
³ Date            : 07/29/07             Computed by       : EWT                ³
³                                                                               ³
³                                                                               ³
³                          Settlement for X-Direction                           ³
³                                                                               ³
³ Embank. slope, x direc. =  162.45 (ft)  Height of fill H     =   57.00 (ft)   ³
³                y direc. =  114.00 (ft)  Unit weight of fill =  120.00 (pcf)   ³
³ Embankment top width    =  117.00 (ft)  p load/unit area     = 6840.00 (psf)  ³
³ Embankment bottom width =  441.90 (ft)  Foundation Elev.     =  551.90 (ft)   ³
³ Ground Surface Elev.    =  551.90 (ft)                                        ³
³ Water table Elev.       =  527.00 (ft)  Unit weight of Wat. =   62.40 (pcf)   ³
³                                                                               ³
³                                                                               ³
³         LAYER                   COEFFICIENT          UNIT   SPECIFIC  VOID    ³
³    N§.  TYPE   THICK.  COMP.  RECOMP.  SWELL.      WEIGHT  GRAVITY   RATIO    ³
³                 (ft)                              (pcf)                       ³
³                                                                               ³
³     1  INCOMP.   4.5   -----   -----   -----     120.00    ----     ----      ³
³     2   COMP.    4.9   0.210   0.060   0.000     125.00    2.65     0.79      ³
³     3   COMP.   17.5   0.290   0.029   0.000     125.00    2.65     0.70      ³
³     4   COMP.   12.0   0.256   0.026   0.000     120.00    2.65     0.67      ³
³     5   COMP.   18.0   0.190   0.070   0.000     125.00    2.65     0.70      ³
³     6   COMP.   18.5   0.044   0.044   0.000     120.00    2.65     1.00      ³
³     7  INCOMP.   5.5   -----   -----   -----     145.00    ----     ----      ³
³                                                                               ³
³          SUBLAYER                        SOIL STRESSES                        ³
³    N§.    THICK.         ELEV.             INITIAL       MAX.PAST PRESS.      ³
³            (ft)          (ft)               (psf)             (psf)           ³
³                                                                               ³
³    1  INCOMP.                                                                 ³
³    2        4.90        544.95            846.25          4480.00             ³
³    3       17.50        533.75           2246.25          4480.00             ³
³    4       12.00        519.00           3560.80          4480.00             ³
³    5       18.00        504.00           4469.80          4480.00             ³
³    6       18.50        485.75           5566.00          4480.00             ³
³    7  INCOMP.                                                                 ³
³                                                                               ³
³                                                                               ³
³                                                                               ³
³            X =     0.00      X =   427.65                                     ³
³ Layer    Stress   Sett.    Stress   Sett.                                     ³
³          (psf)   (in.)     (psf)   (in.)                                      ³
³                                                                               ³
³   1   INCOMP.   INCOMP.                                                       ³
³   2     50.71    0.05     640.12    0.48                                      ³
³   3    221.19    0.15     661.09    0.40                                      ³
³   4    411.02    0.11     786.56    0.19                                      ³
³   5    576.80    1.26     918.58    1.94                                      ³
³   6    744.24    0.73    1054.63    0.83                                      ³
³   7   INCOMP.   INCOMP.                                                       ³
³                 ------             ------                                     ³
³                   2.29               3.85                                     ³
³                                                                               ³
³                                                                               ³
³                                                                               ³
ÀÄÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ
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12/13
EWT 9-7-07
SJK 9-7-07

SLO W-D2

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ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿
3          INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION               3
3                                                                                3
3 Project Name    : SCI-823 Slocum Wall  Client          : ODOT9                 3
3 File Name       : Point D2             Project Manager : PN                    3
3 Date            : 07/29/07             Computed by     : EWT                   3
3                                                                                3
3                                                                                3
3                          Settlement for X-Direction                            3
3                                                                                3
3 Embank. slope, x direc. =  14.25 (ft)  Height of fill H     =   5.00 (ft)      3
3                y direc. =  10.00 (ft)  Unit weight of fill = 120.00 (pcf)      3
3 Embankment top width    = 413.40 (ft)  p load/unit area     = 600.00 (psf)     3
3 Embankment bottom width = 441.90 (ft)  Foundation Elev.     = 551.90 (ft)      3
3 Ground Surface Elev.    = 551.90 (ft)                                          3
3 Water table Elev.       = 527.00 (ft)  Unit weight of Wat. =   62.40 (pcf)     3
3                                                                                3
3                                                                                3
3           LAYER              COEFFICIENT          UNIT   SPECIFIC  VOID        3
3      N§.  TYPE  THICK.  COMP. RECOMP. SWELL.    WEIGHT  GRAVITY   RATIO        3
3                  (ft)                           (pcf)                          3
3                                                                                3
3       1  INCOMP.  4.5   -----  -----  -----    120.00    ----     ----         3
3       2   COMP.   4.9   0.210  0.060  0.000    125.00    2.65     0.79         3
3       3   COMP.  17.5   0.290  0.029  0.000    125.00    2.65     0.70         3
3       4   COMP.  12.0   0.256  0.026  0.000    120.00    2.65     0.67         3
3       5   COMP.  18.0   0.190  0.070  0.000    125.00    2.65     0.70         3
3       6   COMP.  18.5   0.044  0.044  0.000    120.00    2.65     1.00         3
3       7  INCOMP.  5.5   -----  -----  -----    145.00    ----     ----         3
3                                                                                3
3            SUBLAYER                        SOIL STRESSES                       3
3     N§.     THICK.          ELEV.            INITIAL     MAX.PAST PRESS.       3
3              (ft)           (ft)              (psf)          (psf)             3
3                                                                                3
3     1  INCOMP.                                                                 3
3     2         4.90        544.95             846.25        4480.00             3
3     3        17.50        533.75            2246.25        4480.00             3
3     4        12.00        519.00            3560.80        4480.00             3
3     5        18.00        504.00            4469.80        4480.00             3
3     6        18.50        485.75            5566.00        4480.00             3
3     7  INCOMP.                                                                 3
3                                                                                3
3                                                                                3
3                                                                                3
3           X =     0.00      X =   427.65                                       3
3  Layer  Stress   Sett.    Stress   Sett.                                       3
3          (psf)   (in.)    (psf)    (in.)                                       3
3                                                                                3
3    1  INCOMP.  INCOMP.                                                         3
3    2    74.70    0.07     428.19    0.35                                       3
3    3   117.49    0.08     290.56    0.19                                       3
3    4   133.20    0.04     228.23    0.06                                       3
3    5   139.07    0.31     202.73    0.45                                       3
3    6   142.31    0.51     187.35    0.53                                       3
3    7  INCOMP.  INCOMP.                                                         3
3                ------             ------                                       3
3                  1.01               1.58                                       3
3                                                                                3
3                                                                                3
3                                                                                3
ÀÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ
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13/13
EWT 9-7-07
SJK 9-7-07

SLO W-D4

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ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿
³             INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION             ³
³                                                                                 ³
³ Project Name    : SCI-823 Slocum Wall   Client           : ODOT9                ³
³ File Name       : Point D4              Project Manager  : PN                   ³
³ Date            : 07/29/07              Computed by      : EWT                  ³
³                                                                                 ³
³                                                                                 ³
³                          Settlement for X-Direction                             ³
³                                                                                 ³
³ Embank. slope, x direc. =    0.10 (ft)  Height of fill H     =    5.00 (ft)     ³
³                y direc. =    0.10 (ft)  Unit weight of fill  =  120.00 (pcf)    ³
³ Embankment top width    =  420.53 (ft)  p load/unit area     =  600.00 (psf)    ³
³ Embankment bottom width =  420.73 (ft)  Foundation Elev.     =  551.90 (ft)     ³
³ Ground Surface Elev.    =  551.90 (ft)                                          ³
³ Water table Elev.       =  527.00 (ft)  Unit weight of Wat.  =   62.40 (pcf)    ³
³                                                                                 ³
³                                                                                 ³
³              LAYER               COEFFICIENT          UNIT   SPECIFIC  VOID     ³
³        N§.   TYPE   THICK.  COMP.  RECOMP.  SWELL.   WEIGHT  GRAVITY   RATIO    ³
³                      (ft)                             (pcf)                     ³
³                                                                                 ³
³         1  INCOMP.   4.5   -----   -----   -----    120.00    ----     ----     ³
³         2   COMP.    4.9   0.210   0.060   0.000    125.00    2.65     0.79     ³
³         3   COMP.   17.5   0.290   0.029   0.000    125.00    2.65     0.70     ³
³         4   COMP.   12.0   0.256   0.026   0.000    120.00    2.65     0.67     ³
³         5   COMP.   18.0   0.190   0.070   0.000    125.00    2.65     0.70     ³
³         6   COMP.   18.5   0.044   0.044   0.000    120.00    2.65     1.00     ³
³         7  INCOMP.   5.5   -----   -----   -----    145.00    ----     ----     ³
³                                                                                 ³
³              SUBLAYER                          SOIL STRESSES                    ³
³       N§.     THICK.         ELEV.                INITIAL      MAX.PAST PRESS.  ³
³                (ft)          (ft)                  (psf)           (psf)        ³
³                                                                                 ³
³       1  INCOMP.                                                                ³
³       2          4.90        544.95                846.25         4480.00       ³
³       3         17.50        533.75               2246.25         4480.00       ³
³       4         12.00        519.00               3560.80         4480.00       ³
³       5         18.00        504.00               4469.80         4480.00       ³
³       6         18.50        485.75               5566.00         4480.00       ³
³       7  INCOMP.                                                                ³
³                                                                                 ³
³                                                                                 ³
³                                                                                 ³
³          X =     0.00     X =    420.53                                         ³
³ Layer   Stress   Sett.    Stress   Sett.                                        ³
³          (psf)   (in.)    (psf)    (in.)                                        ³
³                                                                                 ³
³    1  INCOMP.  INCOMP.                                                          ³
³    2    283.92   0.25     294.66    0.26                                        ³
³    3    237.26   0.16     240.76    0.16                                        ³
³    4    204.06   0.05     205.71    0.05                                        ³
³    5    188.22   0.42     189.26    0.42                                        ³
³    6    177.88   0.53     178.58    0.53                                        ³
³    7  INCOMP.  INCOMP.                                                          ³
³                 ------              ------                                      ³
³                  1.40                1.42                                       ³
³                                                                                 ³
³                                                                                 ³
³                                                                                 ³
ÀÄÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ
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MSE Walls – Preloading

1/6
GWT 9-7-07
SJR 9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians

Slocum Ave - MSE Wall
Based upon boring B-32
Reference: FHWA-RD-86-168
Option 1 Preloading H=30'

Wick Drain Spacing **5.0** feet
Use $\eta = 10$

							Remaining				
t (days)	T_R	T_V	U_R	U_V	U_C	δ (inches)	δ (inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	7.3	5.25	0.37	30	7.3
5	0.0671	0.0021	0.30	0.09	36.2	2.6	4.7				
10	0.1342	0.0041	0.51	0.10	55.2	4.0	3.3				
15	0.2014	0.0062	0.65	0.10	68.8	5.0	2.3				
20	0.2685	0.0082	0.76	0.11	78.2	5.7	1.6				
25	0.3356	0.0103	0.83	0.12	84.5	6.2	1.1				
30	0.4027	0.0123	0.87	0.12	88.7	6.5	0.8				
35	0.4698	0.0144	0.90	0.13	91.4	6.7	0.6				
40	0.5370	0.0164	0.92	0.14	93.2	6.8	0.5				
45	0.6041	0.0185	0.94	0.14	94.6	6.9	0.4				
50	0.6712	0.0206	0.95	0.15	95.9	7.0	0.3				
55	0.7383	0.0226	0.96	0.15	97.0	7.1	0.2				
60	0.8054	0.0247	0.98	0.16	98.1	7.2	0.1				

Assumes double drainage
Spacing = 5 ft (triangular)

2/6
9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Ave - MSE Wall **Based upon boring B-32**
Reference: FHWA-RD-86-168 Option 1 Preloading H=30'

Wick Drain Spacing **7.0** feet Use $\eta = 10$

							Remaining				
t (days)	T_R	T_V	U_R	U_V	U_C	δ(inches)	δ(inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	7.3	7.35	0.37	30	7.3
5	0.0342	0.0021	0.18	0.09	24.8	1.8	5.5				
10	0.0685	0.0041	0.31	0.10	37.2	2.7	4.6				
15	0.1027	0.0062	0.42	0.10	47.7	3.5	3.8				
20	0.1370	0.0082	0.51	0.11	56.5	4.1	3.2				
25	0.1712	0.0103	0.59	0.12	64.0	4.7	2.6				
30	0.2055	0.0123	0.66	0.12	70.2	5.1	2.2				
35	0.2397	0.0144	0.72	0.13	75.3	5.5	1.8				
40	0.2740	0.0164	0.76	0.14	79.5	5.8	1.5				
45	0.3082	0.0185	0.80	0.14	82.9	6.0	1.3				
50	0.3424	0.0206	0.83	0.15	85.6	6.2	1.1				
55	0.3767	0.0226	0.86	0.15	87.8	6.4	0.9				
60	0.4109	0.0247	0.88	0.16	89.6	6.5	0.8				
65	0.4452	0.0267	0.89	0.17	91.0	6.6	0.7				
70	0.4794	0.0288	0.90	0.17	92.1	6.7	0.6				
75	0.5137	0.0308	0.92	0.18	93.1	6.8	0.5				
80	0.5479	0.0329	0.92	0.19	93.9	6.9	0.4				
85	0.5822	0.0349	0.93	0.19	94.6	6.9	0.4				
90	0.6164	0.0370	0.94	0.20	95.2	6.9	0.4				
95	0.6507	0.0391	0.95	0.20	95.8	7.0	0.3				
100	0.6849	0.0411	0.95	0.21	96.4	7.0	0.3				
105	0.7191	0.0432	0.96	0.22	96.9	7.1	0.2				
110	0.7534	0.0452	0.97	0.22	97.5	7.1	0.2				
115	0.7876	0.0473	0.97	0.23	98.0	7.2	0.1				

Assumes double drainage
Spacing = 7 ft (triangular)

3/6
9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Ave - MSE Wall **Based upon boring B-32**
Reference: FHWA-RD-86-168 Option 1 Preloading H=30'

Wick Drain Spacing 9.0 feet Use $\eta = 10$

t (days)	T_R	T_V	U_R	U_V	U_C	δ (inches)	*Remaining* δ (inches)	d_e	c_v	H_v	δ_{max}
0	0.0000	0.0000	0.00	0.00	0.0	0.0	7.3	9.45	0.37	30	7.3
5	0.0207	0.0021	0.12	0.09	19.6	1.4	5.9				
10	0.0414	0.0041	0.20	0.10	28.0	2.0	5.3				
15	0.0621	0.0062	0.28	0.10	35.6	2.6	4.7				
20	0.0829	0.0082	0.35	0.11	42.5	3.1	4.2				
25	0.1036	0.0103	0.42	0.12	48.7	3.6	3.7				
30	0.1243	0.0123	0.48	0.12	54.3	4.0	3.3				
35	0.1450	0.0144	0.53	0.13	59.3	4.3	3.0				
40	0.1657	0.0164	0.58	0.14	63.8	4.7	2.6				
45	0.1864	0.0185	0.62	0.14	67.8	4.9	2.4				
50	0.2072	0.0206	0.66	0.15	71.3	5.2	2.1				
55	0.2279	0.0226	0.70	0.15	74.5	5.4	1.9				
60	0.2486	0.0247	0.73	0.16	77.3	5.6	1.7				
65	0.2693	0.0267	0.76	0.17	79.7	5.8	1.5				
70	0.2900	0.0288	0.78	0.17	81.9	6.0	1.3				
75	0.3107	0.0308	0.80	0.18	83.8	6.1	1.2				
80	0.3315	0.0329	0.82	0.19	85.5	6.2	1.1				
85	0.3522	0.0349	0.84	0.19	86.9	6.3	1.0				
90	0.3729	0.0370	0.85	0.20	88.2	6.4	0.9				
95	0.3936	0.0391	0.87	0.20	89.3	6.5	0.8				
100	0.4143	0.0411	0.88	0.21	90.3	6.6	0.7				
105	0.4350	0.0432	0.89	0.22	91.1	6.7	0.6				
110	0.4558	0.0452	0.90	0.22	91.9	6.7	0.6				
115	0.4765	0.0473	0.90	0.23	92.5	6.8	0.5				
120	0.4972	0.0493	0.91	0.23	93.1	6.8	0.5				
125	0.5179	0.0514	0.92	0.24	93.7	6.8	0.5				
130	0.5386	0.0534	0.92	0.24	94.1	6.9	0.4				
135	0.5593	0.0555	0.93	0.25	94.6	6.9	0.4				
140	0.5801	0.0576	0.93	0.25	95.0	6.9	0.4				
145	0.6008	0.0596	0.94	0.26	95.3	7.0	0.3				
150	0.6215	0.0617	0.94	0.27	95.7	7.0	0.3				
155	0.6422	0.0637	0.95	0.27	96.0	7.0	0.3				
160	0.6629	0.0658	0.95	0.28	96.4	7.0	0.3				
165	0.6836	0.0678	0.95	0.28	96.7	7.1	0.2				
170	0.7043	0.0699	0.96	0.29	97.0	7.1	0.2				
175	0.7251	0.0719	0.96	0.29	97.3	7.1	0.2				
180	0.7458	0.0740	0.97	0.30	97.6	7.1	0.2				
185	0.7665	0.0761	0.97	0.30	97.9	7.1	0.2				
190	0.7872	0.0781	0.97	0.31	98.2	7.2	0.1				

Assumes double drainage
Spacing = 9 ft (triangular)

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9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Ave - MSE Wall **Based upon boring B-32**
Reference: FHWA-RD-86-168 Option 2 Preloading H=27'

Wick Drain Spacing **5.0** feet Use $\eta = 10$

t (days)	**T_R**	**T_V**	**U_R**	**U_V**	**U_C**	δ(inches)	*Remaining* δ(inches)	**d_e**	**c_v**	**H_v**	**δ_{max}**
0	0.0000	0.0000	0.00	0.00	0.0	0.0	8.3	5.25	**0.37**	**30**	**8.3**
5	0.0671	0.0021	0.30	0.09	36.2	3.0	5.3				
10	0.1342	0.0041	0.51	0.10	55.2	4.6	3.7				
15	0.2014	0.0062	0.65	0.10	68.8	5.7	2.6				
20	0.2685	0.0082	0.76	0.11	78.2	6.5	1.8				
25	0.3356	0.0103	0.83	0.12	84.5	7.0	1.3				
30	0.4027	0.0123	0.87	0.12	88.7	7.4	0.9				
35	0.4698	0.0144	0.90	0.13	91.4	7.6	0.7				
40	0.5370	0.0164	0.92	0.14	93.2	7.7	0.6				
45	0.6041	0.0185	0.94	0.14	94.6	7.9	0.4				
50	0.6712	0.0206	0.95	0.15	95.9	8.0	0.3				
55	0.7383	0.0226	0.96	0.15	97.0	8.1	0.2				
60	0.8054	0.0247	0.98	0.16	98.1	8.1	0.2				

Assumes double drainage
Spacing = 5 ft (triangular)

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9-7-07

DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Ave - MSE Wall **Based upon boring B-32**
Reference: FHWA-RD-86-168 Option 2 Preloading H=27'
Wick Drain Spacing 7.0 feet Use $\eta = 10$

t (days)	**T_R**	**T_V**	**U_R**	**U_V**	**U_C**	δ(inches)	*Remaining* δ(inches)	**d_e**	**c_v**	**H_v**	**δ_{max}**
0	0.0000	0.0000	0.00	0.00	0.0	0.0	8.3	7.35	0.37	30	8.3
5	0.0342	0.0021	0.18	0.09	24.8	2.1	6.2				
10	0.0685	0.0041	0.31	0.10	37.2	3.1	5.2				
15	0.1027	0.0062	0.42	0.10	47.7	4.0	4.3				
20	0.1370	0.0082	0.51	0.11	56.5	4.7	3.6				
25	0.1712	0.0103	0.59	0.12	64.0	5.3	3.0				
30	0.2055	0.0123	0.66	0.12	70.2	5.8	2.5				
35	0.2397	0.0144	0.72	0.13	75.3	6.2	2.1				
40	0.2740	0.0164	0.76	0.14	79.5	6.6	1.7				
45	0.3082	0.0185	0.80	0.14	82.9	6.9	1.4				
50	0.3424	0.0206	0.83	0.15	85.6	7.1	1.2				
55	0.3767	0.0226	0.86	0.15	87.8	7.3	1.0				
60	0.4109	0.0247	0.88	0.16	89.6	7.4	0.9				
65	0.4452	0.0267	0.89	0.17	91.0	7.6	0.7				
70	0.4794	0.0288	0.90	0.17	92.1	7.6	0.7				
75	0.5137	0.0308	0.92	0.18	93.1	7.7	0.6				
80	0.5479	0.0329	0.92	0.19	93.9	7.8	0.5				
85	0.5822	0.0349	0.93	0.19	94.6	7.8	0.5				
90	0.6164	0.0370	0.94	0.20	95.2	7.9	0.4				
95	0.6507	0.0391	0.95	0.20	95.8	8.0	0.3				
100	0.6849	0.0411	0.95	0.21	96.4	8.0	0.3				
105	0.7191	0.0432	0.96	0.22	96.9	8.0	0.3				
110	0.7534	0.0452	0.97	0.22	97.5	8.1	0.2				
115	0.7876	0.0473	0.97	0.23	98.0	8.1	0.2				

Assumes double drainage
Spacing = 7 ft (triangular)

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9-7-07

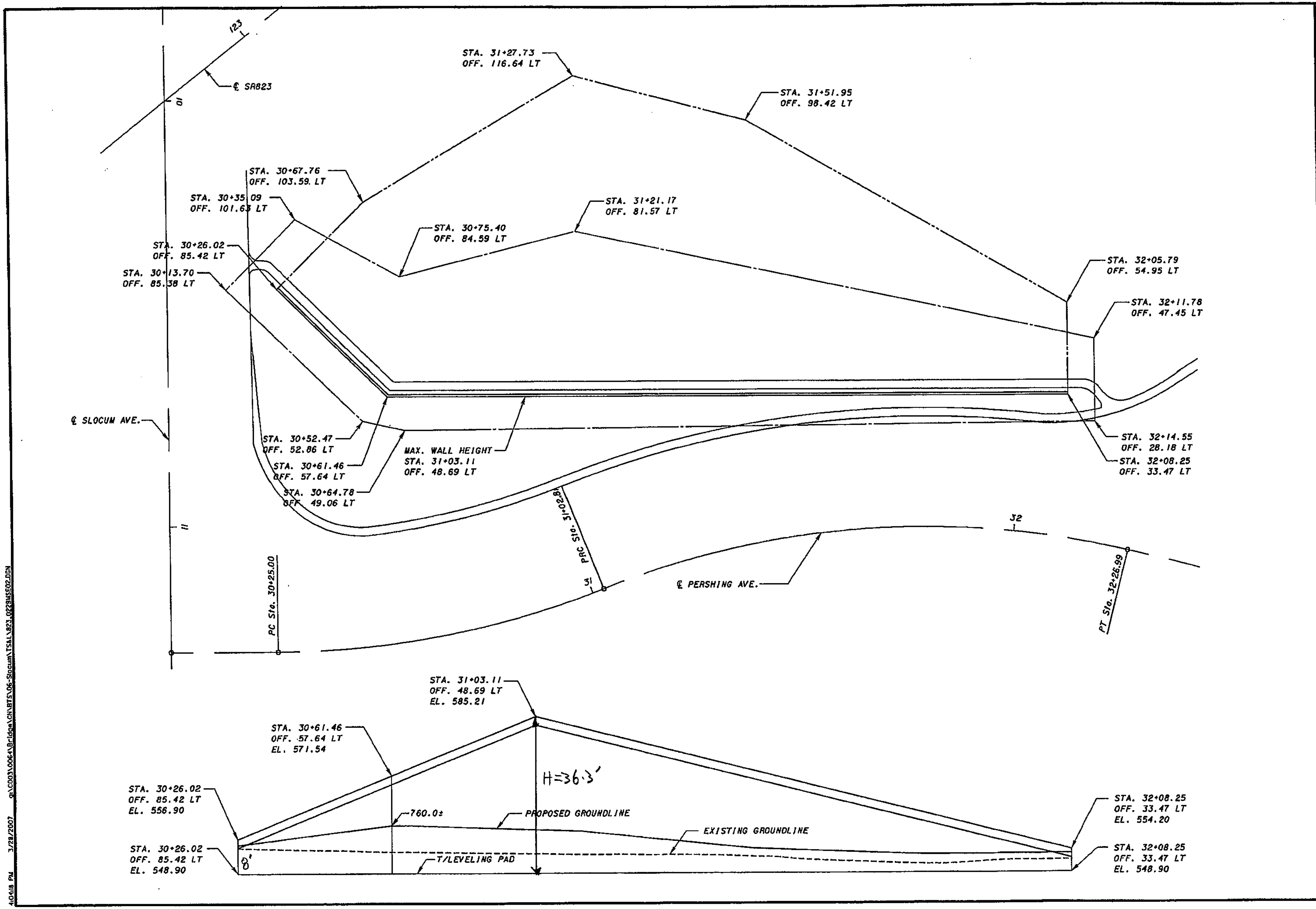
DLZ

Time Rate of Consolidation of Foundation Soils with Wick Drians
Slocum Ave - MSE Wall **Based upon boring B-32**
Reference: FHWA-RD-86-168 Option 2 Preloading H=27'

Wick Drain Spacing 9.0 feet Use $\eta = 10$

							Remaining				
t (days)	**T_R**	**T_V**	**U_R**	**U_V**	**U_C**	δ(inches)	δ(inches)	**d_e**	**c_v**	**H_v**	**δ_{max}**
0	0.0000	0.0000	0.00	0.00	0.0	0.0	8.3	9.45	0.37	30	8.3
5	0.0207	0.0021	0.12	0.09	19.6	1.6	6.7				
10	0.0414	0.0041	0.20	0.10	28.0	2.3	6.0				
15	0.0621	0.0062	0.28	0.10	35.6	3.0	5.3				
20	0.0829	0.0082	0.35	0.11	42.5	3.5	4.8				
25	0.1036	0.0103	0.42	0.12	48.7	4.0	4.3				
30	0.1243	0.0123	0.48	0.12	54.3	4.5	3.8				
35	0.1450	0.0144	0.53	0.13	59.3	4.9	3.4				
40	0.1657	0.0164	0.58	0.14	63.8	5.3	3.0				
45	0.1864	0.0185	0.62	0.14	67.8	5.6	2.7				
50	0.2072	0.0206	0.66	0.15	71.3	5.9	2.4				
55	0.2279	0.0226	0.70	0.15	74.5	6.2	2.1				
60	0.2486	0.0247	0.73	0.16	77.3	6.4	1.9				
65	0.2693	0.0267	0.76	0.17	79.7	6.6	1.7				
70	0.2900	0.0288	0.78	0.17	81.9	6.8	1.5				
75	0.3107	0.0308	0.80	0.18	83.8	7.0	1.3				
80	0.3315	0.0329	0.82	0.19	85.5	7.1	1.2				
85	0.3522	0.0349	0.84	0.19	86.9	7.2	1.1				
90	0.3729	0.0370	0.85	0.20	88.2	7.3	1.0				
95	0.3936	0.0391	0.87	0.20	89.3	7.4	0.9				
100	0.4143	0.0411	0.88	0.21	90.3	7.5	0.8				
105	0.4350	0.0432	0.89	0.22	91.1	7.6	0.7				
110	0.4558	0.0452	0.90	0.22	91.9	7.6	0.7				
115	0.4765	0.0473	0.90	0.23	92.5	7.7	0.6				
120	0.4972	0.0493	0.91	0.23	93.1	7.7	0.6				
125	0.5179	0.0514	0.92	0.24	93.7	7.8	0.5				
130	0.5386	0.0534	0.92	0.24	94.1	7.8	0.5				
135	0.5593	0.0555	0.93	0.25	94.6	7.8	0.5				
140	0.5801	0.0576	0.93	0.25	95.0	7.9	0.4				
145	0.6008	0.0596	0.94	0.26	95.3	7.9	0.4				
150	0.6215	0.0617	0.94	0.27	95.7	7.9	0.4				
155	0.6422	0.0637	0.95	0.27	96.0	8.0	0.3				
160	0.6629	0.0658	0.95	0.28	96.4	8.0	0.3				
165	0.6836	0.0678	0.95	0.28	96.7	8.0	0.3				
170	0.7043	0.0699	0.96	0.29	97.0	8.1	0.2				
175	0.7251	0.0719	0.96	0.29	97.3	8.1	0.2				
180	0.7458	0.0740	0.97	0.30	97.6	8.1	0.2				
185	0.7665	0.0761	0.97	0.30	97.9	8.1	0.2				
190	0.7872	0.0781	0.97	0.31	98.2	8.2	0.1				

Assumes double drainage
Spacing = 9 ft (triangular)



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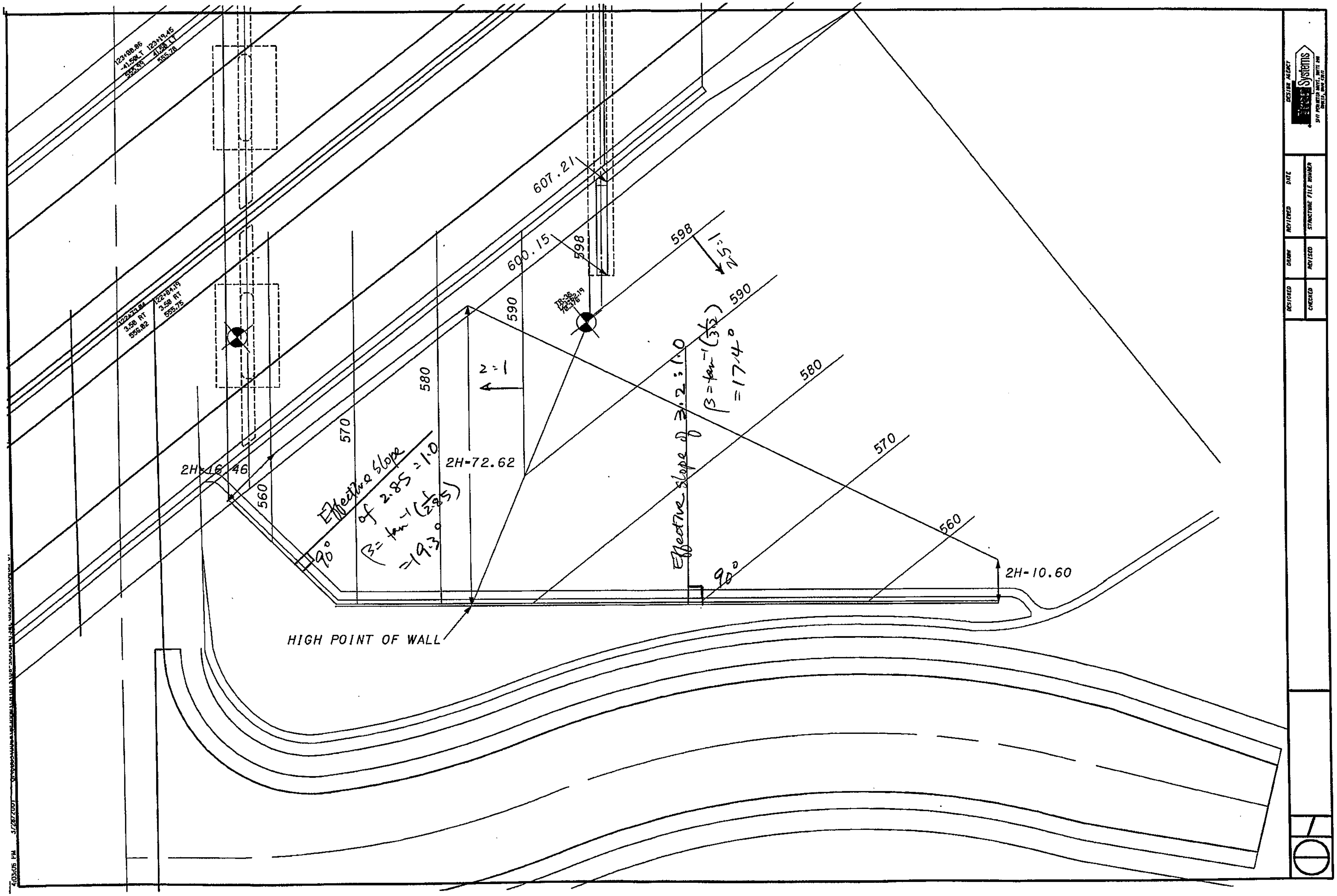
DESIGN AGENCY
Systems

DESIGNED	DRAWN	REVIEWED	DATE
PJP	CAS	JRC	
CHECKED	REVISED	STRUCTURE FILE NUMBER	

FWD. ABUTMENT MSE RETAINING WALL PLAN AND ELEVA

BRIDGE NO. SCI-823-0229 L&R
SR823 OVER SLOCUM AVENUE (TR 248)

SCI-823-0.00
PID 77366



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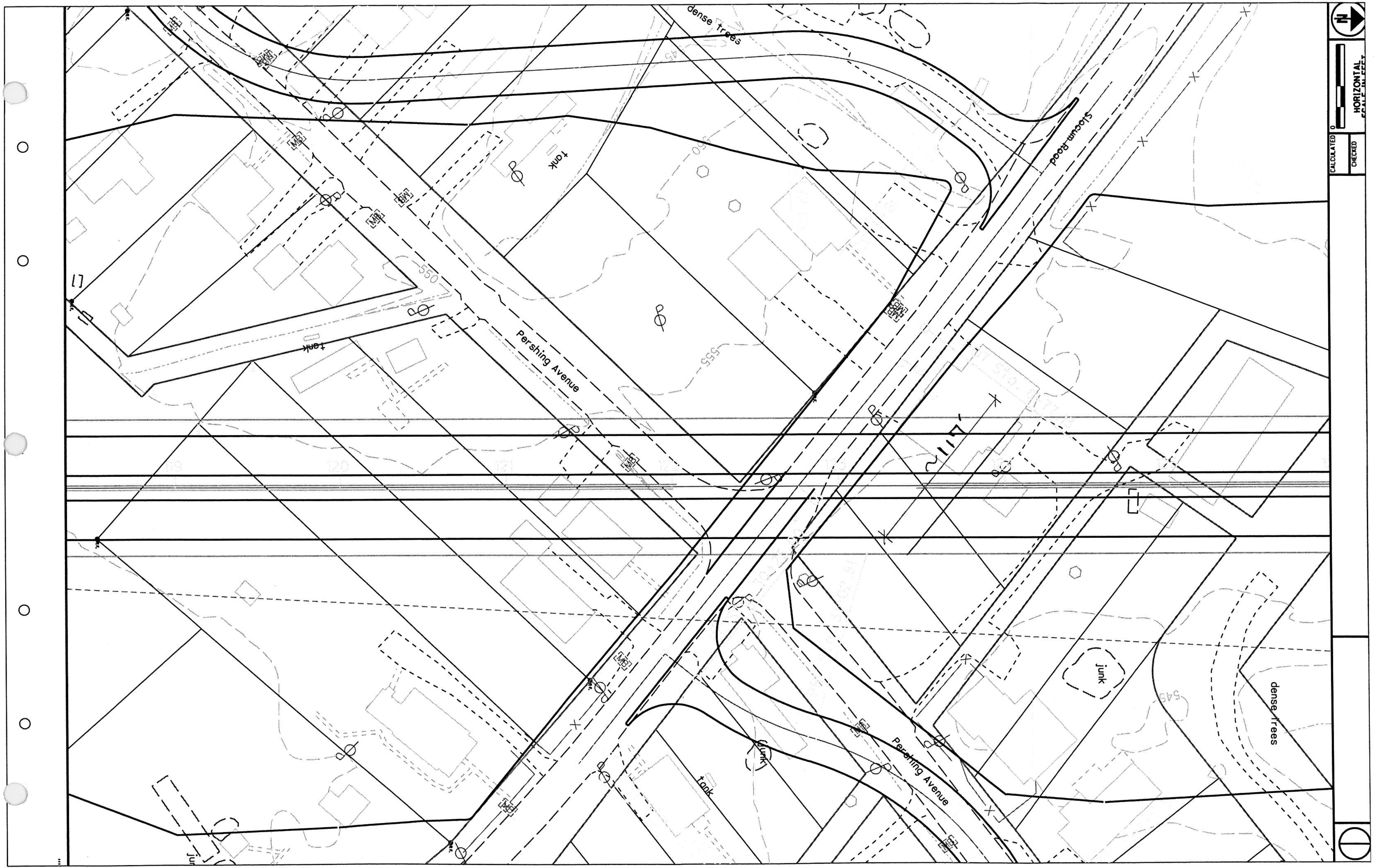

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