GEOTECHNICAL EXPLORATION REPORT
I-515 CHARLESTON BOULEVARD INTERCHANGE PROJECT – BRIDGES
I-515 NB OVER STEWART AVENUE,
I-515 NB OVER NORTH PECOS ROAD, AND
I-515 NB OVER NORTH MOJAVE ROAD
LAS VEGAS, NEVADA

NOVA PROJECT NO.: G-19-192
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1.0 INTRODUCTION

This report presents the results of our geotechnical exploration for the proposed widening of the bridges along I-515 North-bound over Stewart Avenue, North Pecos Road and North Mojave Road in City of Las Vegas, Nevada. The general location of the site is shown on Figure No. 1, Vicinity Map.

The purpose of our services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- General geology of the area
- Foundation design and construction
- Drilled shaft construction considerations

This report is for the purpose of providing geotechnical engineering and/or testing information and requirements. The scope of our services for this project did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic material in structures, soil, surface water, groundwater or air, below or around this site.

2.0 PROJECT INFORMATION

It is our understanding that the project consists of the widening of approximately 1.7 miles of Interstate-515 from I-515/Charleston Boulevard interchange to I-515/Eastern Avenue interchange in the City of Las Vegas and Clark County, Nevada. The project includes addition of one auxiliary lane in each direction, however, the widening of the I-515 will only be performed along North-bound I-515. The project also includes widening of interchange ramps, and reconstruction and improvements of Charleston Boulevard from Honolulu Street to Sacramento Drive. The roadway widening will necessitate the widening of bridges over Mojave Road, Pecos Road, and Stewart Avenue, as well as the construction of new embankment and MSE wall retained embankment on the northbound side of the roadway. Additional features will include new sound walls and new high mast lighting.

This report is specific to widening of bridges over Mojave Road, Pecos Road, and Stewart Avenue. The existing bridges over Mojave Road and Pecos Road are both single-span bridges approximately 155 feet and 161 feet long, respectively. The abutments of the bridge over Mojave Road is supported on shallow continuous/strip footing. Each abutment for the bridge over Pecos Road is supported by number of columns connected by a pile cap founded on two rows of pipe piles – one row consists of vertical piles only and the other row has both battered and vertical piles. The pipe piles are typically pre-bored 12.75-inch diameter pile piles. We understand the widening of bridges over Mojave Road and Pecos Road will have abutments supported on footing pads approximately 4 feet wide and 23.68 feet long for Mojave bridge abutments and approximately 24.98 to 25.46 feet long for Pecos bridge abutments. Structural loads for the bridges were provided by the structural engineers with Horrocks Engineers, the structural design team for this portion of the project. Anticipated structural loads are summarized in the table below:

ITEMS	Bridge H-1442R over Mojave Road			
	East Abutment (Abutment-1)		West Abutment (Abutment-2)	
	Axial Load on pile cap	Resultant Shear on pile cap	Axial Load on pile cap	Resultant Shear on pile cap
Service Limit Loading Condition	2304 kips	118 kips	2304 kips	118 kips
Strength Limit Loading Condition	3060 kips	133 kips	3060 kips	133 kips
Extreme Limit Loading Condition	3546 kips	305 kips	3546 kips	305 kips
Approximate Footing size	Two rows of 3 piers each 3.0 feet diameter spaced 8 feet center to center connected by pile cap approximately 21.18 feet long, 13 feet wide and 3 feet thick		Two rows of 3 piers each 3.0 feet diameter spaced 8 feet center to center connected by pile cap approximately 21.18 feet long, 13 feet wide and 3 feet thick	

ITEMS	Bridge H-1412R over Pecos Road			
	East Abutment (Abutment-1)		West Abutment (Abutment-2)	
	Axial Load on pile cap	Resultant Shear on pile cap	Axial Load on pile cap	Resultant Shear on pile cap
Service Limit Loading Condition	2754 kips	159 kips	2754 kips	159 kips
Strength Limit Loading Condition	3486 kips	237 kips	3486 kips	237 kips
Extreme Limit Loading Condition	4836 kips	436 kips	4836 kips	436 kips
Approximate Footing size	Two rows of 3 piers each 3.0 feet diameter spaced 8.25 feet center to center along length and 7.44 feet along width connected by pile cap approximately 22.85 feet long, 12.5 feet wide and 3 feet thick		Two rows of 3 piers each 3.0 feet diameter spaced 8.25 feet center to center along length and 7.6 feet along width connected by pile cap approximately 22.43 feet long, 12.5 feet wide and 3 feet thick	

The existing bridge over Stewart Avenue is a double-span bridge approximately 303 feet long with approximately 149 feet long span length on each side of the center support. The existing bridge abutments are supported by a number of columns connected by a pile cap founded on two rows of pipe piles. The pile caps are approximately 6 feet wide and the width of the bridge long. The bridge also consists of eight center columns on footing pads which in turn are supported on a number of pipe piles. We understand the widening of bridge over Stewart Avenue will require two new columns at the center, each supported on individual footing pad approximately 16 feet wide and 16 feet long. The abutments for the widening will include approximately 40.25 feet (Abutment 1) to 40.3125 feet (Abutment 2) long and 6 feet wide footings (pile caps). Structural loads for the bridges were provided by CA Group, the structural design team for this portion of the project. Anticipated structural loads are summarized in the table below:

ITEM	**Bridge H-1443R over Stewart Avenue**					
	South Abutment (Abutment-1)		**North Abutment (Abutment-2)**		**Center Piers (for two columns)**	
	Axial Load on pile cap	**Resultant Shear on pile cap**	**Axial Load on pile cap**	**Resultant Shear on pile cap**	**Axial Load on pile cap**	**Resultant Shear on pile cap**
Service Limit Loading Condition	1160 kips	432 kips	1248 kips	480 kips	3132 kips	396 kips
Strength Limit Loading Condition	1552 kips	376 kips	1664 kips	464 kips	2664 kips	244 kips
Extreme Limit Loading Condition	888 kips	240 kips	1160 kips	688 kips	3380 kips	416 kips
Approximate Footing Pad Size	One row of 4 piers each 3.0 feet diameter spaced 10.5 feet center to center connected by pile cap approximately 40.25 feet long, 6 feet wide and 2.5 feet thick		One row of 4 piers each 3.0 feet diameter spaced 12 feet center to center connected by pile cap approximately 46.3125 feet long, 6 feet wide and 2.5 feet thick		Two rows of 2 piers each 3.5 feet diameter spaced 10.5 feet center to center along length and width connected by pile cap approximately 16 feet long, 16 feet wide and 4 feet thick	

3.0 SITE EXPLORATION

The scope of our services for this project included a subsurface exploration program. The subsurface exploration program consisted of drilling seven (7) borings to depths of approximately 80 feet and 100 feet below existing site grades within Right-of-Way of the north-bound I-515 at the base of the I-515 embankments. Two (2) borings to 80 feet each were drilled for Mojave Road bridge, two (2) borings to 100 feet each were drilled for Pecos Road bridge, and another three (3) borings to 100 feet each were drilled for Stewart Avenue bridge – one near each abutment and one near the anticipated center pier location. The borings were logged during drilling by a graduate geologist and samples were obtained to aid in material classification and for possible laboratory testing. The approximate locations of the borings are shown on Figure No. 2a through

2c, Site Map. The locations of the borings were determined in the field by approximating distances from existing features or improvements. The locations of the borings should be considered accurate only to the degree implied by the method used. Results of the borings are presented in Appendix A.

4.0 SITE CONDITIONS

4.1 Surface

The bridges along I-515 over Mojave Road, Pecos Road and Stewart Avenue consisted of three-lane roads each direction with shoulders and median on each direction. The northbound and southbound lanes were separated by concrete barrier rails. Sound walls were present on both northbound and southbound along the stretch of the I-515 within the bridge limits and beyond from Stewart Avenue to Pecos Road and along southbound only from Pecos Road to Mojave Road.

The bridges over Mojave Road and Pecos Road were single-span bridges supported at the abutments, and the abutments were protected by concrete aprons which extended towards the roadways. The bridge over Stewart Avenue is a double span bridge supported on eight columns at the center piers and the abutments were protected by concrete aprons which extended towards the roadways.

Mojave Road was a fully developed two-lane road in each direction with median or center left-turn lane, shoulders, gutters, curbs, and sidewalks. Pecos Road was a fully developed three-lane road in each direction with median or center left-turn lane, gutters, curbs, and sidewalks but without shoulders. Stewart Avenue was a fully developed two-lane road in each direction with median and intermittent left-turn lane, shoulders, gutters, curbs, and sidewalks.

All borings were located at the base of the embankment of the northbound I-515 except one boring located along Stewart Avenue. Numerous mature trees are present at the base of the embankments and are barren otherwise.

4.2 Subsurface

Fill was encountered in all explorations. The fill generally consisted of silty sand to clayey sand with various amounts of gravel. Boring B-7 was drilled within the roadway of Stewart Avenue and encountered 8 inches of asphalt over 21 inches of aggregate base with a layer of geofabric at surface of the aggregate base. However, due to previous site development there could be deeper and/or poorer quality fill in other areas of the site beyond our explorations.

Natural soils at the site varied among the borings but generally consisted of lean (low-plasticity) to fat (high-plasticity) clay with various portions of sand varying to clayey sand soils. Silty sand soils were also encountered in the borings at various depth. Caliche (cemented sand and gravel) was not encountered in any explorations within the depths explored. Laboratory test results indicate that the on-site clay soils have a low expansion potential.

Groundwater was encountered in all explorations. The groundwater was measured at depths ranging from 7 feet to 15 feet below existing site grade during drilling operations. Groundwater levels can and should be considered to fluctuate due to seasonal variations, irrigation practices and due to groundwater withdrawal and recharge. The boring logs and laboratory test results presented in Appendix A should be referred to for more detailed information.

5.0 GEOLOGIC INFORMATION

The site is located in the central portion of the Las Vegas Valley. This location places the site in an area underlain by thick alluvial deposits (hundreds of feet).

Two faults are mapped within the proposed improvement area.[1] One fault is mapped crossing the I-515 alignment at the intersection of I-515 and Pecos Road and the other fault is mapped approximately 750 feet east of the intersection of I-515 and Mojave Road. The mapped faults are generally north-south trending, Quaternary age faults.

As indicated on the Clark County Soil Guidelines Map, the site is located within 2,000 feet of a fault. According to published information, 90% of all fissures in the Las Vegas Valley occur within this 2,000-foot zone. The cumulative evidence indicates that fissures are the result of a subsurface erosional process. The erosional process occurs in tensional fractures at or near the surface in uncemented, relatively fine-grained soils. A visual evaluation of the existing surface was performed, but no visible surface expressions of fissures were noted. The nearest mapped fissure zone is approximately 1 mile southeast of the eastern end of the alignment, i.e. I-515/Charleston Boulevard interchange.[2]

Liquefaction is defined as the condition when saturated, loose, finer-grained sand-type soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. However, the groundwater at the project site may be shallower, but due to nature and consistency of the on-site soils, liquefaction potential should be considered as low during the design seismic event.

6.0 RECOMMENDATIONS

6.1 General

Our recommendations are based on the available project information discussed in the report and the assumption that the soil conditions are similar to those disclosed by the explorations. If

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[1] Clark County Geographic Information System Management Office (GISMO), 2016

[2] Bell, John W., et. al., 2001, “Las Vegas Valley, 1998 Subsidence Report", Nevada Bureau of Mines and Geology, Open-File Report 01-4, Plate No. 1.

variations are noted during construction or if changes are made in site plan, structural loading, foundation type or floor level, we should be notified so we can supplement our recommendations, as applicable.

As indicated, there was fill on-site. Except for the existing embankment fill, the onsite fill would be considered uncontrolled fill unless observation and testing was performed during placement. All uncontrolled fill should be removed and replaced with properly compacted fill. The uncontrolled fill soils can be re-used for controlled fill provided almost all oversized material, unsuitable material (as determined by the resident engineer), vegetation and debris is removed.

6.2 Foundations

6.2.1 Wingwall Foundations

The wingwall for the bridges can be designed as cantilever retaining walls supported on conventional type foundations. The foundations should bear on properly prepared subgrade as recommended in the *NDOT Standard Specification for Road and Bridge Construction*.

The factored bearing resistance (q_R) of the foundation soil should be greater than the factored bearing pressure at the foundation soil (q_{str}).

The factored bearing resistance, in kips per square foot (ksf) to be used in the design for wingwalls may be calculated using the following formula:

$\mathbf{q_R = \varphi_b \cdot q_n}$
where, φ_b = resistance factor for bearing capacity
= 1.0 for service limits
= 0.45 for strength limits
= 1.0 for for strength limits
q_n = nominal bearing resistance

Nominal bearing resistance, $q_n = c_f \cdot N_{cm} + \gamma \cdot D_f \cdot N_{qm} \cdot C_{wq} + 0.5\,B' \cdot \gamma_f \cdot N_{\gamma m} \cdot C_{w\gamma}$
Where, c_f = cohesion of foundation soil = typically ignored for long term condition

Therefore, $q_n = \gamma \cdot D_f \cdot N_{qm} \cdot C_{wq} + 0.5\,B' \cdot \gamma_f \cdot N_\gamma \cdot C_{w\gamma}$
where, N_{qm}, N_γ = dimensionless bearing resistance factors
Df = embedment depth (in ft.)
$C_{w\gamma}$ = groundwater effect factor
= 0.5 for depth of water at 0 feet
= 1.0 for depth of water ≤ D_f
B' = effective foundation width (in ft.)
γ_f = unit weight of the foundation soil (in kcf)
$C_{w\gamma}$ = groundwater effect factor

= 0.5 for depth of water ≤ D_f

= 1.0 for depth of water > 1.5 B' + D_f

= interpolate between the values for intermediate depth to water; assuming a wingwall width of 8 feet (Section A-A), 6 feet (Section B-B), and 9 feet (Section C-C), a shallowest groundwater depth of 7 feet and minimum embedment depth as noted in table below, C_{wy} = 0.516, 0.572, 0.606 for Section A-A, B-B, and C-C, respectively.

Below is the footing size, embedment depth and loading on the wingwall as provided to us by the Client:

ITEM		Section A-A	Section B-B	Section C-C
Approximate footing size		B = 8 feet L = 11.75 feet	B = 6 feet L = 11.5 feet	B = 9 feet L = 15 feet
Minimum Embedment depth		6.5 feet	4.5 feet	3.0 feet
Service Limit	Total factored Vertical Load	274 kips	90 kips	436 kips
	Factored bearing pressure	3.0 ksf	1.3 ksf	3.225 ksf
Strength Limit	Total factored Vertical Load	385 kips	121 kips	608 kips
	Factored bearing pressure	4.1 ksf	1.75 ksf	4.5 ksf
Extreme Event Limit	Total factored Vertical Load	263 kips	79 kips	425 kips
	Factored bearing pressure	2.8 ksf	1.15 ksf	3.145 ksf

Considering the soil materials (foundation soil friction angle of 30° and unit weight of 0.115 kcf) encountered at the borings, the factored bearing resistance (q_R), in kips per square foot (ksf) to be used in the design for wingwall foundations are as follows:

ITEM	Section A-A	Section B-B	Section C-C
Factored Bearing Resistance – Service Limit State	5.3	6.2	4.4
Factored Bearing Resistance – Strength Limit State	10.4	7.2	6.3
Factored Bearing Resistance – Extreme Event Limit State	17.7	13.1	11.7

As can be noted, the factored bearing resistance in all three limit states – Service, Strength and Extreme events, are greater than the factored bearing pressure. Therefore, the proposed footing design is acceptable. Appendix B presents the results of analyses.

6.2.2 Mojave Road Bridge (Bridge H-1442R) Foundations

The proposed bridge structure should receive adequate support from a foundation system consisting of drilled shaft foundations. As previously discussed, both abutments – east abutment (Abutment-1) and west abutment (Abutment-2) – are anticipated to be supported on a pile cap approximately 21.18 feet long, 13 feet wide and 3 feet thick, which in turn can be supported on two rows of 3 3.0-foot diameter shafts spaced 8 feet center-to-center (2.68 diameters) along both length and width. The capacity of an individual pile is diminished when it is part of a pile group. As the piles are spaced more than 2.5 diameters center-to-center, group effect for axial capacity does not apply. Appendix C presents the capacity of individual pile. Specific design recommendations are provided as follows:

The compressive resistance for the strength limit state was computed for a single shaft with shaft diameters of 3.0 feet using the computer program SHAFT v2012 by Ensoft, Inc. The shaft axial resistance is based on the strength of the soils. The strength limit state shaft resistance was estimated using resistance factors from the AASHTO LRFD Bridge Design Specifications, Table 10.5.5.2.4-1. The following table summarizes the results of our axial resistance analysis based on the axial loads and diameter.

Drilled Shaft Axial Resistance Summary

Support	Shaft Diameter (ft)	Shaft Length* (ft)	Nominal Resistance (kips / tons)	Strength Limit Factored Load (kips / tons)	Strength Limit Factored Resistance (kips / tons)	Service Limit Factored Load (kips / tons)
Abutment-1 (B-2) East Abutment	3.0	66	1000 / 500	515 / 257.5	520/ 260	385 / 192.5
Abutment-2 (B-1) West Abutment	3.0	59	1040 / 520	515 / 257.5	520/ 260	385 / 192.5
* Shaft length presented here is considering the shaft from the base of the embankment and does not include the portion of shaft within the embankment.						

Compressive geotechnical resistances are based on combination of the estimated strength of the soils for side shear resistance (skin friction) and end bearing (tip resistance). Actual shaft capacities may be controlled by the structural strength of the drilled shafts.

Anticipated total settlements of properly designed and constructed drilled shafts are presented in the following table, for the minimum calculated shaft dimensions, as shown in the table:

Estimated Drilled Shaft Settlement

Support	Shaft Diameter (ft)	Minimum Shaft Length (ft)	Service Limit Factored Load (kips / tons)	Estimated Settlement (inch)
Abutment 1 (B-2) East Abutment	3.0	66	385 / 192.5	0.08
Abutment 2 (B-1) West Abutment	3.0	59	385 / 192.5	0.08

All drilled shafts should be properly reinforced to resist uplift and lateral loading. The lateral analysis of the drilled shaft foundations for this bridge was performed with the computer program GROUP from Ensoft, Inc. The software GROUP incorporates the group effect based on the spacings between the drilled shafts in the pile cap. The GROUP analysis input parameters and results are presented in Appendix C.

6.2.3 Pecos Road Bridge (Bridge H-1412R) Foundations

The proposed bridge structure should receive adequate support from a foundation system consisting of drilled shaft foundations. As previously discussed, the east abutment (Abutment-1) is anticipated to be supported on a pile cap approximately 22.85 feet long, 12.5 feet wide and 3 feet thick, which in turn can be supported on two rows of 3 3.0-foot diameter shafts spaced 8.25 feet (2.75 diameters) center-to-center along length and 7.5 feet (2.5 diameters) center-to-center along width. Similarly, the west abutment (Abutment-2) is anticipated to be supported on a pile cap approximately 22.43 feet long, 12.5 feet wide and 3 feet thick, which in turn can be supported on two rows of 3 3.0-foot diameter shafts spaced 8.25 feet (2.75 diameters) center-to-center along length and 7.6 feet (2.53 diameters) center-to-center along width. The capacity of an individual pile is diminished when it is part of a pile group. As the piles are spaced at least 2.5 diameters center-to-center, group effect for axial capacity does not apply. As the Appendix C presents the capacity of individual pile. Specific design recommendations are provided as follows:

The compressive resistance for the strength limit state was computed for a single shaft with shaft diameters of 3.0 feet using the computer program SHAFT v2012 by Ensoft, Inc. The shaft axial resistance is based on the strength of the soils. The strength limit state shaft resistance was estimated using resistance factors from the AASHTO LRFD Bridge Design Specifications, Table 10.5.5.2.4-1. The following table summarizes the results of our axial resistance analysis based on the axial loads and diameter.

Drilled Shaft Axial Resistance Summary

Support	Shaft Diameter (ft)	Shaft Length* (ft)	Nominal Resistance (kips / tons)	Strength Limit Factored Load (kips / tons)	Strength Limit Factored Resistance (kips / tons)	Service Limit Factored Load (kips / tons)
Abutment-1 (B-4) East Abutment	3.0	76	1270 / 635	570 / 285	600 / 300	450 / 225
Abutment-2 (B-3) West Abutment	3.0	84	1240 / 640	570 / 285	600 / 300	450 / 225
* Shaft length presented here is considering the shaft from the base of the embankment and does not include the portion of shaft within the embankment.						

Compressive geotechnical resistances are based on combination of the estimated strength of the soils for side shear resistance (skin friction) and end bearing (tip resistance). Actual shaft capacities may be controlled by the structural strength of the drilled shafts.

Anticipated total settlements of properly designed and constructed drilled shafts are presented in the following table, for the minimum calculated shaft dimensions, as shown in the table:

Estimated Drilled Shaft Settlement

Support	Shaft Diameter (ft)	Minimum Shaft Length (ft)	Service Limit Factored Load (kips / tons)	Estimated Settlement (inch)
Abutment-1 (B-2) East Abutment	3.0	76	450 / 225	0.08
Abutment-2 (B-1) West Abutment	3.0	84	450 / 225	0.1

All drilled shafts should be properly reinforced to resist uplift and lateral loading. The lateral analysis of the drilled shaft foundations for this bridge was performed with the computer program GROUP from Ensoft, Inc. The software GROUP incorporates the group effect based on the spacings between the drilled shafts in the pile cap. The GROUP analysis input parameters and results are presented in Appendix C.

6.2.4 Stewart Avenue Bridge (Bridge H-1443R) Foundations

The proposed bridge structure should receive adequate support from a foundation system consisting of drilled shaft foundations. The north abutment (Abutment-1) is anticipated to be supported on approximately 40.25 feet long, 6 feet wide and 2.5 feet thick footing pad/pile cap which in turn will be supported on four 3-foot diameter drilled shafts spaced approximately 10.5 feet center-to-center (3.5 diameters). The south abutment (Abutment-2) is anticipated to be supported on approximately 46.3 feet long, 6 feet wide and 2.5 feet thick footing pad/pile cap which in turn will be supported on four 4-foot diameter drilled shafts spaced approximately 12 feet center-to-center (3 diameters). The bridge widening will also include addition of two center columns. Each center column is anticipated to be supported on square footing pads approximately 16 feet wide and 4 feet thick pile cap at an embedment depth of approximately 6 feet, which in turn can be supported on two rows of 2 3.5-foot diameter shafts spaced approximately 10.5 feet center-to-center (3 diameters). Based on the geometry of the group of shafts, the center-to-center spacing is at least 2.5 diameters. Shafts in groups spaced more than 2.5 diameters center to center, do not need reduction in the axial shaft capacities due to group action and as such group effect is not applicable. The results are presented in Appendix C.

Specific design recommendations are provided as follows:

The compressive resistance for the strength limit state was computed for a single shaft with shaft diameters of 3.0 feet for Abutment-1 and Abutment-2, and 3.5 feet for center columns using the computer program SHAFT v2012 by Ensoft, Inc. The shaft axial resistance is based on the strength of the soils. The strength limit state shaft resistance was estimated using resistance factors from the AASHTO LRFD Bridge Design Specifications, Table 10.5.5.2.4-1. The following table summarizes the results of our axial resistance analysis based on the axial loads and diameter.

Drilled Shaft Axial Resistance Summary

Support	Shaft Diameter (ft)	Shaft Length (ft)	Nominal Resistance per pier (kips / tons)	Strength Limit Factored Load per pier (kips / tons)	Strength Limit Factored Resistance per pier (kips / tons)	Service Limit Factored Load per pier (kips / tons)
Abutment-1 (B-6) South Abutment	3.0	72*	850 / 425	388 / 194	392 / 196	290 / 145
Abutment-2 (B-5) North Abutment	3.0	49*	920 / 460	416 / 208	440 / 220	312 / 156
Center Pier (B-7)	3.5	72**	1400 / 700	662 / 331	676 / 338	784 / 392
* Shaft length is considering the shaft from the base of the embankment and does not include the portion of shaft within the embankment. ** Shaft length is from the top of existing pavement.						

Compressive geotechnical resistances are based on combination of the estimated strength of the soils for side shear resistance (skin friction) and end bearing (tip resistance). Actual shaft capacities may be controlled by the structural strength of the drilled shafts.

Anticipated total settlements of properly designed and constructed drilled shafts are presented in the following table, for the minimum calculated shaft dimensions, as shown in the table:

Estimated Drilled Shaft Settlement

Support	Shaft Diameter (ft)	Minimum Shaft Length (ft)	Service Limit Factored Load (kips / tons)	Estimated Settlement (inch)
Abutment-1 (B-6) South Abutment	3.0	72	290 / 145	0.06
Abutment-2 (B-5) North Abutment	3.0	49	312 / 156	0.06
Center Pier (B-7)	3.5	72	784 / 392	0.13

All drilled shafts should be properly reinforced to resist uplift and lateral loading. The lateral analysis of the drilled shaft foundations for this bridge was performed with the computer program GROUP from Ensoft, Inc. The software GROUP incorporates the group effect based on the spacings between the drilled shafts in the pile cap. The GROUP analysis input parameters and results are presented in Appendix C.

6.3 Drilled Shaft Construction Considerations

Drilled shaft construction should generally follow the recommendations in NDOT's Standard Specifications for Road and Bridge Construction, Section 509. Placement of concrete within drilled pile excavations should begin within 24 hours after completion of geotechnical/drilling inspection. If concreting is not begun within 24 hours the contractor shall remove the reinforcing cage, re-clean the bottom of the drilled shaft and have the shaft re-inspected prior to proceeding. Placement of concrete should begin within 12 hours of this re-cleaning and re-inspection procedure. Due to the relatively shallow groundwater, it is anticipated that water will be encountered during drilling. Free-fall concrete placement is not recommended. We recommend that the concrete be placed into the drilled shaft excavation using a tremie. Steps should be taken to ensure that the tip of the tremie remain at the bottom of the excavation until at least 5 feet of concrete has been placed and thereafter remains at least 5 feet below the top of the concrete.

Piles in groups, within 10 feet or less of adjacent piles, should be drilled and filled alternately allowing the concrete to set at least 8 hours before drilling an adjacent foundation. We recommend the installation contractor review this report, and the soils and conditions encountered. Based on our experience during drilling operations and the soil encountered, drilled shaft excavations within the clay soil should remain open and stable. Drilled shaft excavations within the granular soil primarily below the groundwater level may not remain open and stable and may require temporary casing.

Only specialty foundation subcontractors experienced in drilled pile construction should be considered for foundation installation. Contractors should satisfy themselves as to materials and conditions present, and applicable equipment and procedures to use.

The following inspections should be documented for each drilled shaft:

- Diameter of shaft
- Depth of shaft
- Depth and visual identification of soils encountered
- Depth groundwater was encountered
- Type of casing and length, if used
- Type of slurry, if used
- Any offset shaft is from design location (Should be verified by survey by others)
- Date and time of drilling completion
- Date and time of reinforcement placed
- Date and time of concrete placement started and completed
- Date and time of any casing removed
- Actual and theoretical concrete volume

6.4 Lateral Earth Pressures on Abutment Walls and Wing Walls

Lateral earth pressures for use in retaining wall design for abutment and wing walls may be computed using a coefficient of effective friction for soil (φ_r) of 34° and a soil unit weight (γ) of 0.125 kips per cubic foot (kcf) for the reinforced wall fill, assuming that all retaining walls will be backfilled with or will retain Granular Backfill conforming to Section 207.02.02 of the NDOT Standard Specifications for Road and Bridge Construction. Any soil cohesion should be neglected in determining the lateral earth pressures on retaining walls. In addition, wall drainage system should be provided along the entire alignment of the wall with suitable procedure to daylight/discharge the collected water. Drainage should also be provided at the base of the wall to drain surface water away from the wall toe and at the top of the wall within the reinforced zone such that surface water is diverted to a swale avoiding infiltration into the reinforced zone.

For soils above any free water surface or with wall drainage system, with level backfill and no surcharge loads, we recommend the following equivalent fluid pressures and coefficient of friction:

Active	35 psf/ft
At-Rest	55 psf/ft
Passive	440 psf/ft
Unit Weight of Backfill (granular backfill behind the walls)	125 pcf

Notes:

1. The above values do not include any factor of safety. The designer should use applicable factor of safety as required for the design.
2. Active pressure assumes unrestrained (cantilever) wall and assumes no loading from heavy compaction equipment.
3. The passive pressure and the frictional resistance of the soils may be combined without reduction in determining the total lateral resistance.

Seismic forces on retaining walls may be determined using the pseudo-static Mononobe-Okabe method or other accepted method for determining lateral soil loads during seismic events.

The frictional resistance against sliding should be determined using the internal angle of friction for the foundation soil of 30º. A coefficient of friction of 0.3 may be used between the cast-in-place concrete and foundation native soil. However, if the foundation subgrade will include at least 1 foot of granular fill (such as Type II), a friction coefficient of 0.4 may be used between the cast-in-place concrete and foundation granular fill. Passive earth pressures shall only be included for the portion of the wall footing cast directly against undisturbed ground, provided that no buried utilities are present for a distance of 3 times the embedment depth in front of the footing. The ultimate passive resistance within the native soil may be calculated using a coefficient of internal friction for soil (φ_f) of 30º, a soil unit weight (γ) of 0.12 kcf.

6.5 Site Class

Seismic forces should be determined using the following values obtained from Figure 12.3-H in Section 12.3.5 of the NDOT Structures Manual (2008): a Peak Ground Acceleration Coefficient (PGA) of 0.15 g, a Short-Period Spectral Acceleration Coefficient (S_s) of 0.40 g, and a Long-Period Spectral Acceleration Coefficient (S_1) of 0.15 g.

Based on the information presented on the Clark County Shear Wave Velocity Profile Map, a Site Class D may be used for seismic design of the bridges over Stewart Avenue and Pecos Road. The data for the other bridge is undocumented in the Map. In addition, based on the blow counts in the upper 100 feet of the site, a Site Class D is recommended.

6.6 Corrosivity

Based on test results and *Section 4.2* of *ACI 318*, the on-site soils classify as having a negligible (S0) to severe (S2) sulfate exposure and therefore Type V cement per ASTM C150, or equivalent high sulfate resistant cement, should be used in combination with a maximum water-cement ratio of 0.45. Consideration should be given to providing protection to buried metal pipes or use of nonmetallic pipe where permitted by local building codes. Non-corrosive backfill, protective coatings and wrappings, sacrificial anodes, or a combination of these methods could be considered. It should be understood that Universal Engineering Sciences personnel are not experts regarding corrosion and/or corrosion protection and that we recommend a "Corrosion Engineer" be consulted for actual recommendations regarding the necessity and/or method of cathodic protection.

7.0 OTHER SERVICES

Universal Engineering Sciences should be retained to provide a general review of final design plans and specifications in order that grading and foundation recommendations may be interpreted and implemented. In the event that any changes of the proposed project are planned, the conclusions and recommendations contained in this report should be reviewed and the report modified or supplemented as necessary.

Universal Engineering Sciences should also be retained to provide services during excavation, grading, foundation and construction phases of work. Observation of foundation excavations should be performed prior to placement of reinforcing and concrete to confirm that satisfactory bearing materials are present. Field and laboratory testing of concrete and soils should be performed to determine whether applicable requirements have been met.

The analyses and recommendations in this report are based in part upon data obtained from the field exploration. The nature and extent of variations beyond the locations of the explorations may not become evident until construction. If variations then appear evident, it may be necessary to re-evaluate the recommendations of this report.

8.0 CLOSURE

Our professional services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities. No warranties, either expressed or implied, are intended or made. We prepared this report as an aid in design of the proposed project. This report is not a bidding document. Any contractor reviewing this report must draw his own conclusions regarding site conditions and specific construction techniques to be used on this project.

NOVA GEOTECHNICAL & INSPECTION SERVICES
D.B.A.
UNIVERSAL ENGINEERING SCIENCES

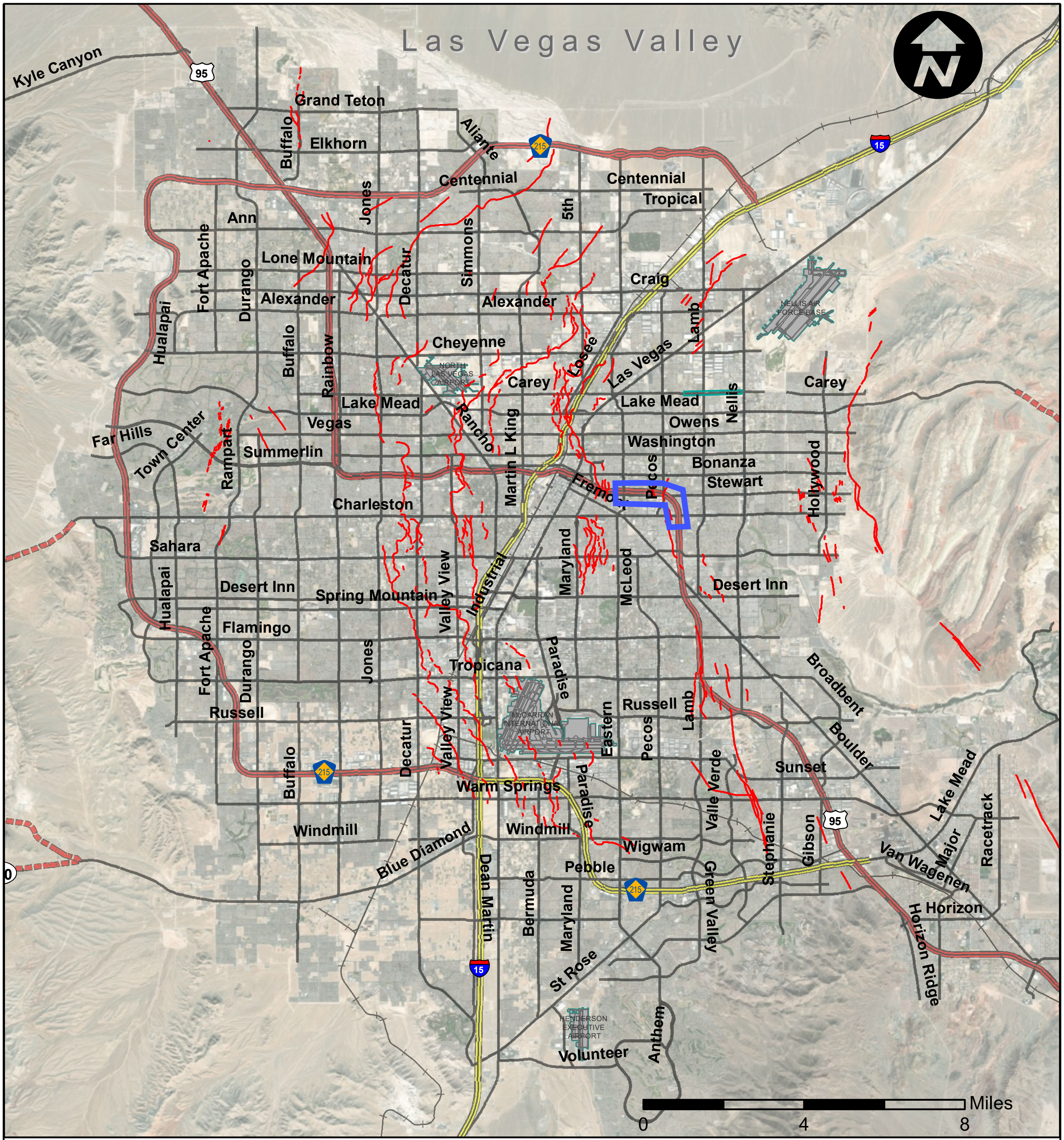
Prepared by:	Reviewed by:
Suchan Lamichhane, Ph.D., P.E.	Martin D. Jensen, P.E.
Senior Geotechnical Engineer/Project Manager	Principal/Geotechnical Department Manager

PROFESSIONAL ENGINEER STATE OF NEVADA
SUCHAN LAMICHHANE
Exp:12/31/21
CIVIL
No. 26679

Digitally signed by Suchan Lamichhane, Ph.D., P.E.
DN: cn=Suchan Lamichhane, Ph.D., P.E., o=Universal Engineering Sciences, ou=Geotechnical, email=slamichhane@universalengineering.com, c=US
Date: 2021.08.30 16:00:03 -07'00'

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
MARTIN D. JENSEN
CIVIL
Exp. 6/30/21
NO. 15673

DN: cn=Martin D. Jensen, P.E., o=Universal Engineering Sciences, email=mjensen@universalengineering.com, c=US
Date: 2021.08.31 09:52:13 -07'00'



Legend

🟥 Las Vegas Faults (CCBD GISMO, 2016)

▭ Approximate Project Location

The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD GISMO, CCFCD, GIS User Community among others. The GIS information is presented for information only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact NOVA.

NOVA
Geotechnical &
Inspection Services

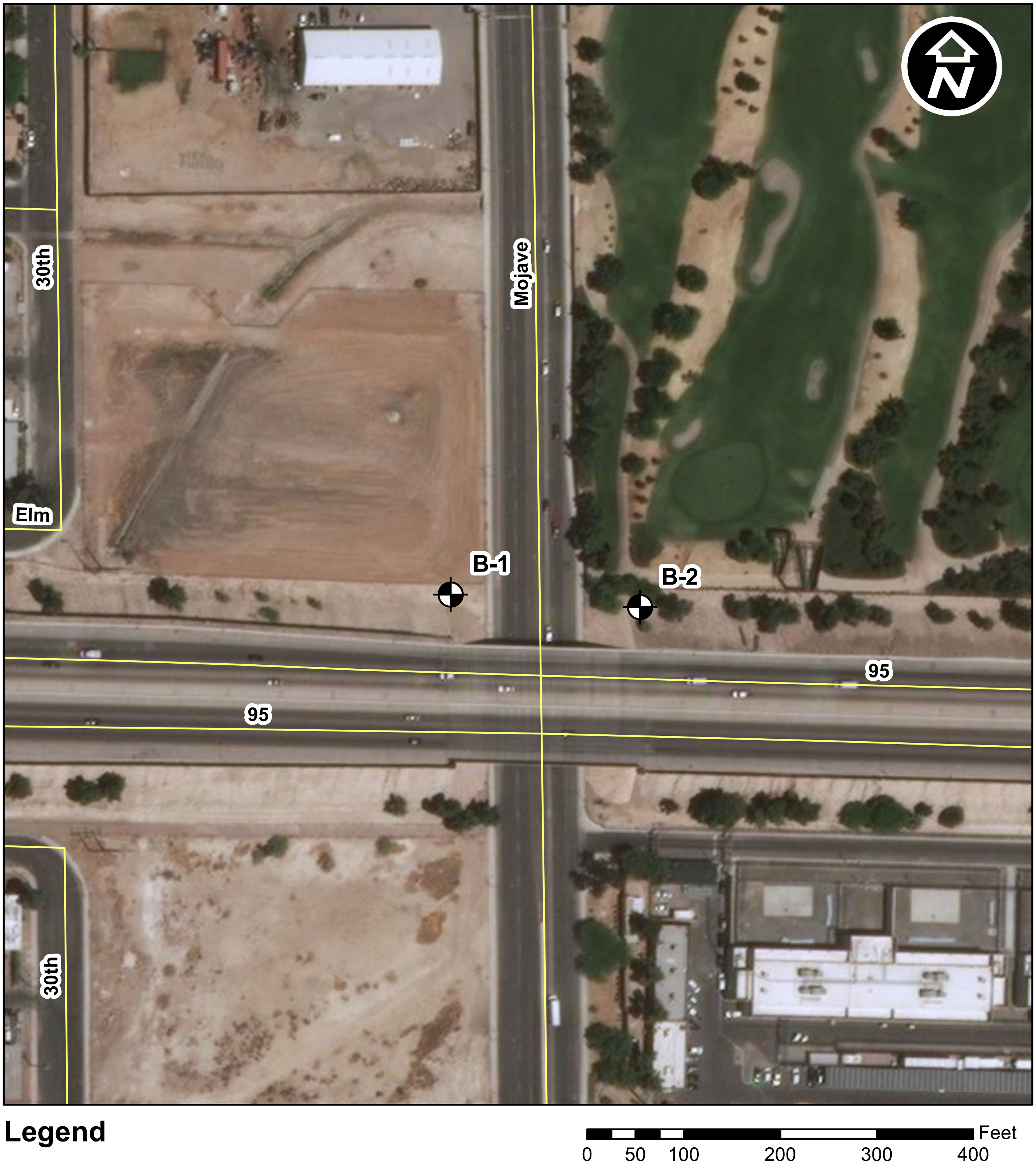
PROJECT:
I-515 & Charleston Interchange
Northbound I-515

VICINITY MAP

CLIENT:
C-A Group, Inc.

PROJECT NO:
G-19-192

FIGURE NO:
1



Legend

⌖ Approximate Boring Location

— Las Vegas Faults (CCBD GISMO, 2016)

The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD GISMO, CCFCD, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact NOVA.

NOVA Geotechnical & Inspection Services	PROJECT: **I-515 Charleston Interchange I-515 and Mojave Road**	SITE MAP	
	CLIENT: **C-A Group, Inc.**	PROJECT NO: **G-19-192**	FIGURE NO: **2a**

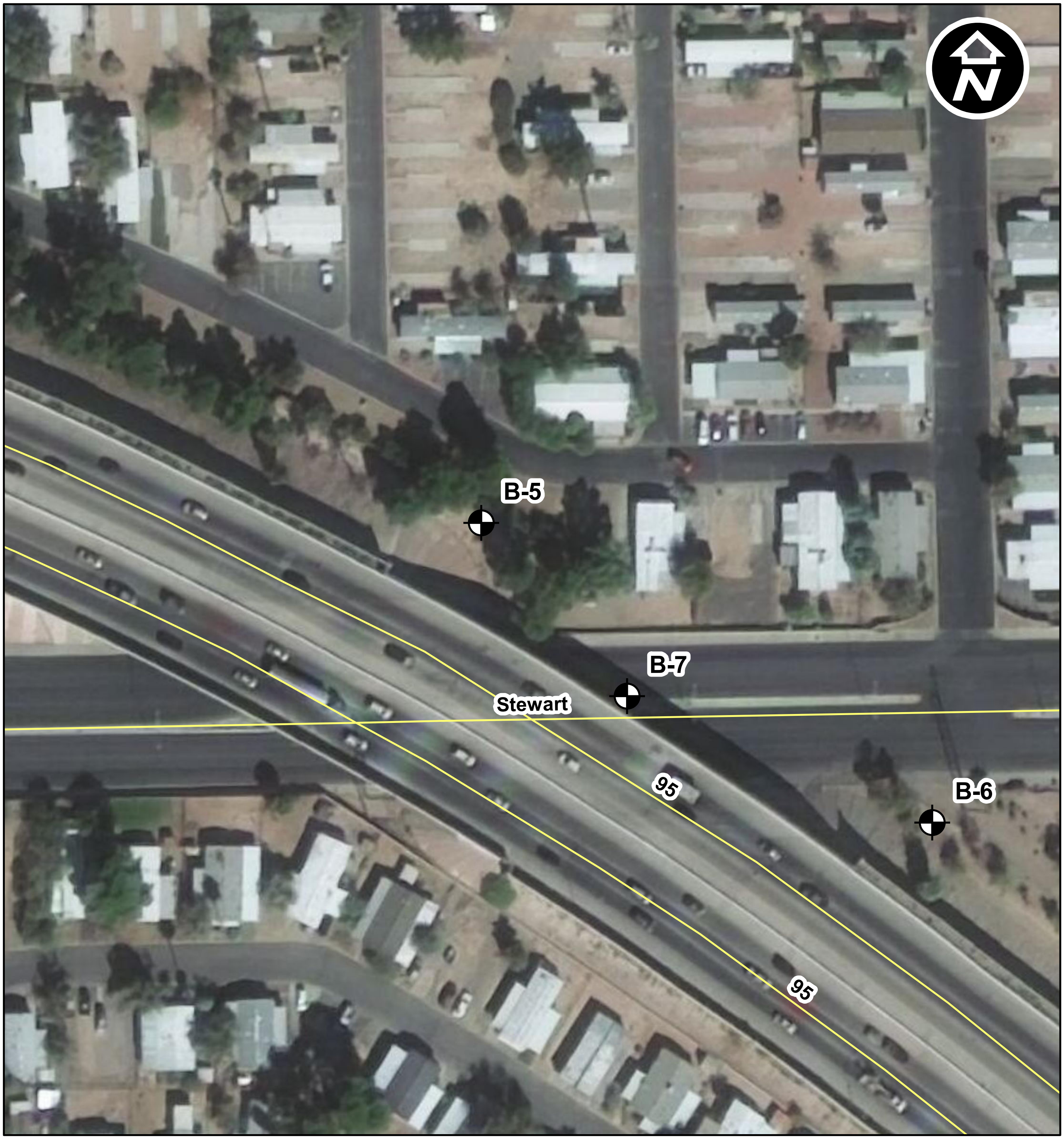
Legend

⌖ Approximate Boring Location

🟥 Las Vegas Faults (CCBD GISMO, 2016)

The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD GISMO, CCFCD, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact NOVA.

NOVA Geotechnical & Inspection Services	PROJECT: **I-515 Charleston Interchange** **I-515 and Pecos Road**	SITE MAP	
	CLIENT: **C-A Group, Inc.**	PROJECT NO: **G-19-192**	FIGURE NO: **2b**



Legend

⊕ Approximate Boring Location

— Las Vegas Faults (CCBD GISMO, 2016)

The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD GISMO, CCFCD, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact NOVA.

NOVA Geotechnical & Inspection Services	PROJECT: **I-515 Charleston Interchange** **Northbound I-515**	SITE MAP	
	CLIENT: **C-A Group, Inc.**	PROJECT NO: **G-19-192**	FIGURE NO: **2c**

APPENDIX A

APPENDIX A

Site Exploration

The subsurface conditions of the site were explored by drilling seven (7) borings to depths of approximately 81.50 feet and 101.50 feet below existing site grades. Borings were drilled using a rotary drill rig utilizing hollow-stem augers. The following table summarizes the drilling summary:

Boring No.	Boring Location	Boring Depth (feet)
B-1	Mojave Bridge West Abutment (Abutment-2)	81.5
B-2	Mojave Bridge East Abutment (Abutment-1)	81.5
B-3	Pecos Bridge West Abutment (Abutment-2)	101.5
B-4	Pecos Bridge East Abutment (Abutment-1)	101.5
B-5	Stewart Bridge North Abutment (Abutment-2)	101.5
B-6	Stewart Bridge South Abutment (Abutment-1)	101.5
B-7	Stewart Bridge Center Pier	101.5

Soils were logged during drilling by a graduate geologist and samples were obtained to aid in material classification and for possible laboratory testing. Boring logs are presented on Plates 1 through 5 and Plate 7. Sampling was performed using either a split spoon sampler ("SPT" in boring logs) or a ring-lined barrel sampler ("D&M" in boring logs). The SPT and ring-lined sampler was driven in three 6-inch intervals into the substrata with blows from a 140-pound automatic hammer free-falling 30 inches. Penetration resistance (blow counts) were recorded for each 6-inch drive. Blow counts for the final 12 inches of the total 18 inches are presented as blows per foot in boring logs at the respective depths the samples were taken. It should be noted that the blow counts from R sampler are not equivalent to blow counts from SPT sampler.

At select depths in each boring relatively undisturbed samples were obtained within soft to stiff, fine-grained soils, using hydraulically pushed, thin-walled Shelby tubes ("ST" on the boring logs). This sampling method includes using a thin-walled, steel tube sampler connected to a sampling head that is attached to the drill rods. The tube sampler is then pushed by the hydraulic rams of the drill rig into the soil below the bottom of the drill hole and then retracted to obtain a sample.

Pocket penetrometer tests were also performed on the clayey samples in field and are noted in the boring logs at the respective depth of the samples ("PP" in boring logs). Bag/bulk samples were also collected from the borings for laboratory testing. The soils are generally classified by the Unified Soil Classification System. Plate 8 presents an explanation of material classifications used in this report.

Laboratory Testing

Laboratory testing was performed on selected samples of on-site soils. Tests were performed in general accordance with applicable ASTM or local standards. Field moisture content and dry density determinations were performed on relatively undisturbed ring-lined samples. Results of these tests are presented on the boring logs at the respective depths the samples were taken.

Atterberg Limits tests (NV T210, T211, & T212) and sieve analyses (NV T206) or percent passing the No. 200 sieve (ASTM D1140) were performed to determine the grain-size distribution or percent finer and soil classification of representative materials. The test results are presented on attached laboratory result graphs and summarized in the table Summary of Laboratory Results.

Expansion Index (EI) tests were performed on remolded samples of the clayey soils. The tests were performed from 50 percent saturation moisture content to near saturated condition and a 1 psi (144 psf) surcharge load was applied. The test results are presented below:

SAMPLE	EXPANSION INDEX
B-4 @ 20 ft.	0
B-5 @ 35 ft.	6

Consolidation tests were performed on representative samples to illustrate the compressibility of on-site soils. Water was added during testing at 2,000 psf surcharge to determine the collapse potential and illustrate the influence of moisture on compressibility. The results are presented on attached graphs and the collapse potential is summarized below:

SAMPLE	APPROXIMATE COLLPASE (%) *
B-1 @ 70 ft.	1
B-2 @ 80 ft.	1.5
B-3 @ 90 ft.	0.8
B-4 @ 85 ft.	0.2
B-5 @ 60 ft.	0.7
B-6 @ 55 ft.	0.4
B-6 @ 75 ft.	0.1
B-7 @ 75 ft.	0.3
** Water added at surcharge of 2,000 psf*	

Direct shear tests were performed on samples to determine the strength of the soils. Tests were performed at field moisture content and at various surcharge pressures. Test results are presented on attached graphs and summarized below:

SAMPLE LOCATION	FRICTION ANGLE (degrees)	COHESION (psf)
B-1 @ 40 ft.	38.6	380
B-1 @ 70 ft.	6.2	1,710
B-2 @ 30 ft.	27.2	820
B-2 @ 60 ft.	30.6	780
B-3 @ 20 ft.	18.3	1,560
B-3 @ 60 ft.	29.8	190
B-4 @ 15 ft.	14.4	1,460
B-4 @ 25 ft.	26.0	670
B-4 @ 55 ft.	24.6	1,040
B-5 @ 10 ft.	27.1	550
B-5 @ 40 ft.	24.3	930
B-6 @ 15 ft.	11.2	830
B-6 @ 95 ft.	27.6	1,070
B-7 @ 5 ft.	1.6	1,630
B-7 @ 65 ft.	21.6	1,590

Unconfined Undrained Tri-axial (UU) tests were performed on the undisturbed clay soil samples obtained from Shelby tubes by Leighton Group, Inc. The UU tests were performed at near confining pressure of the in-situ overburden pressure calculated on depth of sample and an assumed uniform unit weight of the soil. The results of the UU tests are also attached to the report.

Chemical tests were performed on representative samples by Terracon. Tests were performed to determine the percent chloride, water soluble sodium, sulfate and sodium sulfate, as well as the soil solubility. Test results are presented on attached graphs and summarized below:

SAMPLE LOCATION	pH	Water Soluble Sulfate (SO4), %	Chlorides, %	Resistivity, ohm-cm
B-1@2'-6'	7.84	0.28	0.02	243
B-2@5'-9'	8.37	0.23	0.03	160
B-4@5'-9'	8.42	0.02	0.01	480
B-5@3'-8'	8.27	0.14	0.01	280
B-6@0'-5'	7.33	0.28	<0.01	394
B-7@5'-9'	8.27	0.06	0.01	347

BORING NUMBER B-1

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue
DATE STARTED 1/7/20 **COMPLETED** 1/7/20
GROUND ELEVATION 1816 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR CASCADE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Augers
AT TIME OF DRILLING ---
LOGGED BY JS **CHECKED BY** SL
▼ **AT END OF DRILLING** 15.00 ft / Elev 1801.00 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							FILL - Silty SAND, some gravel, slightly moist, brown
						1.0	1815.0
					SC		(SC) Clayey SAND, trace gypsum, slightly moist, light brown
	GB 1	100					
						4.0	1812.0
5					SM		(SM) Silty SAND, slightly moist, light brown
	CMS 2	33	5-4-8 (12)	MC = 15% DD = 97 pcf			- loose
						8.0	1808.0
					SC		(SC) Clayey SAND, wet, brown
10	SPT 3	100	5-6-12 (18)	PP = 4.5+ tsf LL = 29 PL = 16 Fines = 49%			- varies to sandy lean clay, medium dense, light gray
15	CMS 4	33	12-19-48 (67)	PP = 4.5+ tsf			▼ - dense
20	SPT 5	100	24-19-16 (35)	PP = 4.5+ tsf			
25	CMS 6	35	11-31-50/5"				- very dense
30							

(Continued Next Page)

BORING NUMBER B-1

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30							
	SPT 7	100	44-12-17 (29)	PP = 4.5+ tsf MC = 18%			- few caliche fragments
30.5					CH		1785.5 (CH) FAT CLAY, trace sand, hard, moist, light gray
35	SH 8	94		PP = 4.5+ tsf MC = 26% DD = 94 pcf			
	SPT 9	100	9-11-16 (27)	MC = 33% LL = 70 PL = 24 Fines = 87%			- very stiff
40 40.0					SC		1776.0 (SC) Clayey SAND, medium dense, wet, light gray
	CMS 10	28	8-16-34 (50)	MC = 28% DD = 104 pcf			
45							
	SPT 11	100	5-8-11 (19)	PP = 1.0 tsf			
45.5					CL		1770.5 (CL) Sandy LEAN CLAY, very stiff, moist, light brown
50	CMS 12	33	5-8-13 (21)	MC = 29% DD = 98 pcf			
51.0					SC		1765.0 (SC) Clayey SAND, medium dense, wet, light brown
55	SH 13	100					
	SPT 14	100	24-15-19 (34)	PP = 1.75 tsf LL = 27 PL = 16 Fines = 87%			
56.0					CL		1760.0 (CL) LEAN CLAY, trace sand, hard, moist, light brown
60	CMS 15	33	26-29-38 (67)				
60.5					SM		1755.5 (SM) Silty SAND, dense, wet, light brown - occasional clayey sand and sandy clay layers

(Continued Next Page)

BORING NUMBER B-1

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	
65					SM			(SM) Silty SAND, dense, wet, light brown *(continued)*	
	SPT 16	100	19-36- 50/5"	MC = 17% LL = NP PL = NP Fines = 39%				- very dense	
70	CMS 17	33	11-21-41 (62)	PP = 2.5 tsf MC = 26% DD = 96 pcf	CL		70.0	(CL) LEAN to FAT CLAY, with sand, hard, moist, brown	1746.0
75	SPT 18	100	4-7-8 (15)	PP = 2.5 tsf MC = 28%				- stiff	
80	CMS 19	33	17-32-23 (55)		SM		80.0	(SM) Silty SAND, dense, wet, light brown	1736.0
							81.5		1734.5

Bottom of borehole at 81.5 feet.

BORING NUMBER B-2

PAGE 1 OF 3

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue
DATE STARTED 1/6/20 **COMPLETED** 1/6/20
GROUND ELEVATION 1814 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR CASCADE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Augers
AT TIME OF DRILLING ---
LOGGED BY JS **CHECKED BY** SL
▼ **AT END OF DRILLING** 14.80 ft / Elev 1799.20 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							FILL - Clayey SAND with gravel, slightly moist, light brown	
						1.0	(SC) Clayey SAND, trace gypsum, slightly moist, light brown	1813.0
5	SPT 1	0	3-1-3 (4)				- loose, moist, brown	
	GB 2	100						
10	CMS 3	17	4-5-10 (15)	PP = 2.25 tsf			- medium dense, light gray	
					SC			
15							▼	
	SPT 4	100	5-8-13 (21)	PP = 3.5 tsf MC = 17% LL = 29 PL = 17 Fines = 48%				
20	CMS 5	33	5-11-25 (36)				- very moist to wet	
25						25.5	- olive gray	1788.5
	SPT 6	100	7-19-32 (51)	PP = 4.5+ tsf			(CL) Sandy LEAN CLAY, hard, moist, light gray	
					CL			
30						30.0		1784.0

(Continued Next Page)

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30	CMS 7	33	7-8-12 (20)		SC	▨	(SC) Clayey SAND, medium dense, wet, light gray
34.0					CH	▨	34.0 1780.0 (CH) FAT CLAY, hard, moist, light gray
35	SPT 8	100	5-16-20 (36)	PP = 3.25 tsf MC = 30% LL = 59 PL = 23 Fines = 97%			
40	CMS 9	33	5-11-22 (33)	PP = 4.5+ tsf	CL	▨	40.0 1774.0 (CL) Sandy LEAN CLAY, very stiff, moist, light gray
45	SH 10	94		MC = 26% DD = 95 pcf	SC	▨	45.0 1769.0 (SC) Clayey SAND, dense, very moist, light gray
	SPT 11	100	10-20-17 (37)	MC = 22% LL = 45 PL = 22 Fines = 41%			
50	CMS 12	33	14-17-32 (49)	PP = 2.5 tsf	CL	▨	50.0 1764.0 (CL) Sandy LEAN CLAY, hard, moist, light gray - light brown
55	SPT 13	100	3-4-8 (12)	PP = 1.25 tsf			- stiff
60	CMS 14	33	9-25-36 (61)				
60.5					SM	░	60.5 1753.5 (SM) Silty SAND, dense, wet, light brown

(Continued Next Page)

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

BORING NUMBER B-2

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
65					SM		65.0 (SM) Silty SAND, dense, wet, light brown *(continued)* 1749.0
	SPT 15	100	5-14-20 (34)	MC = 23% LL = NP PL = NP Fines = 52%	ML		(ML) Sandy SILT, varies to silty sand, hard, moist, light brown
70							
	CMS 16	33	15-21-30 (51)	PP = 2.75 tsf	CL		70.5 (CL) Sandy LEAN CLAY, hard, moist, brown 1743.5
75							
	SH 17	100		MC = 27% DD = 98 pcf	CL		75.0 (CL) Sandy LEAN to FAT CLAY, hard, moist, brown to reddish brown 1739.0
	SPT 18	100	11-13-19 (32)				
80							
	CMS 19	28	7-15-28 (43)	PP = 1.75 tsf MC = 24% DD = 102 pcf			81.5 1732.5

Bottom of borehole at 81.5 feet.

BORING NUMBER B-3

PAGE 1 OF 4

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue
DATE STARTED 1/8/20 **COMPLETED** 1/8/20
GROUND ELEVATION 1797 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR CASCADE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Augers
AT TIME OF DRILLING ---
LOGGED BY JS **CHECKED BY** SL
▼ **AT END OF DRILLING** 9.00 ft / Elev 1788.00 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							FILL - Clayey SAND with gravel, slightly moist, light brown to gray
1.0							1796.0
					SM		(SM) Silty SAND, slightly moist, light brown
4.0							1793.0
					CL		(CL) Sandy LEAN CLAY, moist, light brown
5	SPT 2	100	4-3-5 (8)	PP = 2.0 tsf			- stiff
	GB 1	100		MC = 22%			
							▼
10	CMS 3	33	7-11-22 (33)				
11.0							1786.0
					SC		(SC) Clayey SAND, few gravel, medium dense, very moist, light gray
15	SPT 4	100	7-4-7 (11)	MC = 19% LL = 24 PL = 15 Fines = 43%			- with clay layers, wet
16.0							1781.0
					CL		(CL) Sandy LEAN CLAY, stiff, moist, light gray
20	CMS 5	33	8-13-12 (25)	PP = 2.5 tsf			- very stiff, light gray and olive
25	SPT 6	100	5-6-10 (16)				- with clayey sand layers
30							

(Continued Next Page)

BORING NUMBER B-3

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30	CMS 7	33	12-24-12 (36)	MC = 18% DD = 114 pcf	SC		30.5 1766.5 (SC) Clayey SAND, medium dense, wet, light gray
35	SPT 8	100	6-7-9 (16)	LL = 39 PL = 17 Fines = 40%			- moist
					CL		36.0 1761.0 (CL) LEAN to FAT CLAY with Sand, very stiff, moist, light gray
40	CMS 9	183	7-12-13 (25)	MC = 37% DD = 84 pcf			
45	SH 10	100		MC = 28% DD = 92 pcf			
	SPT 11	100	5-6-12 (18)				- varies to clayey sand
50	CMS 12	33	6-8-14 (22)				- with silty sand and clayey sand layers
55	SPT 13	100	3-5-8 (13)	MC = 37% LL = 49 PL = 19 Fines = 77%			
60	CMS 14	33	4-5-12 (17)				
					SM		61.0 1736.0 (SM) Silty SAND, medium dense, wet, light brown

(Continued Next Page)

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

BORING NUMBER B-3

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	
65					SM		65.0	(SM) Silty SAND, medium dense, wet, light brown *(continued)*	1732.0
	SPT 15	100	4-6-10 (16)	MC = 44%	SC			(SC) Clayey SAND, medium dense, wet, light gray to brown	
70	CMS 16	33	8-12-19 (31)					- light brown	
75							75.5		1721.5
	SPT 17	100	9-8-12 (20)	MC = 68%	CL			(CL) Sandy LEAN CLAY, very stiff, wet, light gray - light brown	
80	CMS 18	100	8-13-18 (31)						
85	SH 19	100		MC = 32% DD = 91 pcf				- reddish brown	
							87.5		1709.5
	SPT 20	138	38-46-50/1"	MC = 18%	SM			(SM) Silty SAND, very dense, moist, light brown	
90							90.0		1707.0
	CMS 21	33	9-17-25 (42)	PP = 3.5 tsf MC = 35% DD = 89 pcf	CL			(CL) Sandy LEAN CLAY, very stiff, moist, light brown	
95							95.0		1702.0
	SPT 22	100	7-12-25 (37)		SC			(SC) Clayey SAND, dense, moist, light brown	
							96.5		1700.5
					CH			(CH) FAT CLAY, hard, moist, light brown	

(Continued Next Page)

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

BORING NUMBER B-3

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
100					CH	▨	(CH) FAT CLAY, hard, moist, light brown *(continued)*
	CMS 23	35	16-44- 50/5"	MC = 42% DD = 84 pcf LL = 52 PL = 27 Fines = 90%		▨	very hard
101.5							1695.5

Bottom of borehole at 101.5 feet.

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

BORING NUMBER B-4

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue
DATE STARTED 1/9/20 **COMPLETED** 1/10/20
GROUND ELEVATION 1792 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR CASCADE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Augers
AT TIME OF DRILLING ---
LOGGED BY JS **CHECKED BY** SL
▼ **AT END OF DRILLING** 7.00 ft / Elev 1785.00 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	
0						⊠	1.0	FILL - Clayey SAND, slightly moist, brown	1791.0
					SC	▨	4.0	(SC) Clayey SAND, slightly moist, light brown	1788.0
					CL	▨		(CL) Sandy LEAN CLAY, slightly moist, light brown	
5	CMS 2	33	8-11-16 (27)	PP = 4.5 tsf		▨		- very stiff, light gray	
	GB 1	100		MC = 28% DD = 96 pcf	CL	▨		▼	
						▨	10.0	- very moist	1782.0
10	SPT 3	100	8-6-4 (10)	MC = 22%	SM	▨	11.5	(SM) Silty SAND, medium dense, wet, brown to gray	1780.5
						▨		(CL) Sandy LEAN CLAY, moist, light gray	
15	CMS 4	33	7-8-8 (16)	PP = 1.5 tsf		▨		- stiff	
20	SPT 5	100	40-35-37 (72)	PP = 4.0 tsf MC = 16%	CL	▨		- very hard	
25	CMS 6	33	6-10-20 (30)	LL = 31 PL = 17 Fines = 61%		▨		- very stiff	
30						▨			

(Continued Next Page)

BORING NUMBER B-4

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30	SPT 7	100	4-7-10 (17)		CL	▨	(CL) Sandy LEAN CLAY, moist, light gray *(continued)* - trace gravel, very stiff - varies to lean clay with sand
35	CMS 8	33	7-8-11 (19)	MC = 37% DD = 76 pcf			
35.5					SC	▨	1756.5 (SC) Clayey SAND, medium dense, moist, light gray - light brown
40 (40.0)	SPT 9	100	4-5-6 (11)	PP = 1.25 tsf MC = 60% LL = 80 PL = 34 Fines = 59%	CH	▨	1752.0 (CH) Sandy FAT CLAY, stiff, moist, light gray
45 (45.0)	CMS 10	35	5-25-50/5"		SC	▨	1747.0 (SC) Clayey SAND, very dense, moist, light gray
46.0					SM	▨	1746.0 (SM) Silty SAND, very dense, moist, light brown
50 (50.0)	SPT 11	100	4-6-7 (13)	MC = 62%	SC	▨	1742.0 (SC) Clayey SAND, medium dense, moist, light gray - light brown
55	CMS 12	33	7-10-17 (27)				
60	SPT 13	100	6-11-18 (29)	MC = 46%			- dense, light gray

(Continued Next Page)

BORING NUMBER B-4

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
65					SC		(SC) Clayey SAND, medium dense, moist, light gray *(continued)*
	CMS 14	33	10-15-27 (42)				- light brown
68.0							1724.0
					CH		(CH) FAT CLAY with sand, moist, light gray
70	SPT 15	100	4-10-14 (24)	MC = 49% LL = 110 PL = 31 Fines = 85%			- light brown
75	CMS 16	35	10-27- 50/5"	PP = 2.0 tsf			- with clayey sand layers
80.0							1712.0
80	SH 17	100		MC = 25% DD = 98 pcf	SC		(SC) Clayey SAND, very dense, moist, light brown
	SPT 18	225	43-50/2"				- varies to silty sand
85.0							1707.0
85	CMS 19	33	14-22-27 (49)	PP = 3.0 tsf MC = 45% DD = 86 pcf	CL		(CL) Sandy LEAN CLAY, very stiff, moist, light brown
90.0							1702.0
90	SH 20	117		MC = 26% DD = 97 pcf	ML		(ML) SILT, hard, moist, brown
	SPT 21	100	16-18-29 (47)	MC = 27% LL = 40 PL = 35 Fines = 96%			
95.0							1697.0
95	CMS 22	33	9-24-50 (74)	PP = 2.0 tsf	CL		(CL) LEAN CLAY with Sand, hard, moist, brown

(Continued Next Page)

BORING NUMBER B-4

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
100					CL	▨	(CL) LEAN CLAY with Sand, hard, moist, brown *(continued)* 100.0 1692.0
	SPT 23	100	23-38-50 (88)	MC = 25%	SC	▨	(SC) Clayey SAND, very dense, moist, light brown 101.5 1690.5

Bottom of borehole at 101.5 feet.

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

BORING NUMBER B-5

PAGE 1 OF 4

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DATE STARTED 1/14/20 **COMPLETED** 1/14/20

GROUND ELEVATION 1789 ft **HOLE SIZE** 8 inches

DRILLING CONTRACTOR CASCADE

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Augers

AT TIME OF DRILLING ---

LOGGED BY JS **CHECKED BY** SL

▼ **AT END OF DRILLING** 7.00 ft / Elev 1782.00 ft

NOTES

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							FILL - Clayey SAND, slightly moist, brown
1.0							1788.0
					SC		(SC) Clayey SAND, slightly moist, light brown
5	GB 1 SPT 2	100 100	3-3-7 (10)	MC = 17% Fines = 49%			- medium dense, moist - light gray ▼
10	CMS 3	33	5-6-5 (11)	MC = 25% DD = 99 pcf			- few gravel, loose, very moist
15	SPT 4	100	1				- no gravel, very loose, wet
20	CMS 5	33	15-38-29 (67)				- dense, with gravel - large caliche nodule
25.0							1764.0
25	SPT 6	100	7-8-11 (19)	MC = 12%	SP-SC		(SP-SC) Poorly graded SAND with Clay and Gravel, medium dense, wet, gray
30.0							1759.0

(Continued Next Page)

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30	CMS 7	33	4-4-6 (10)	PP = 2.5 tsf	CL		(CL) Sandy LEAN CLAY, stiff, very moist, light gray
35	SPT 8	100	3-3-3 (6)	PP = 0.5 tsf			- medium stiff
40							40.0 1749.0
	CMS 9	33	11-13-19 (32)	MC = 31% DD = 85 pcf	SC		(SC) Clayey SAND, medium dense, moist, light gray
45							45.0 1744.0
	SPT 10	100	5-7-9 (16)	MC = 76% LL = 122 PL = 40 Fines = 71%	CH		(CH) FAT CLAY with Sand, very stiff, moist, light gray
50	CMS 11	38	11-37-50/4"				
							50.5 - light brown 1738.5
					SM		(SM) Silty SAND, very dense, moist, light brown
55							55.0 1734.0
	SPT 12	100	16-32-50 (82)		CL		(CL) Sandy LEAN CLAY, very hard, moist, light brown
							56.0 1733.0
					SM		(SM) Silty SAND, very dense, moist, light brown
60							60.0 1729.0
	CMS 13	33	12-17-16 (33)	MC = 25% DD = 95 pcf	CH		(CH) FAT CLAY with Sand, very stiff, moist, light brown

(Continued Next Page)

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
65					CH	▨	(CH) FAT CLAY with Sand, very stiff, moist, light brown *(continued)*
	SPT 14	100	6-6-11 (17)	MC = 29% DD = 94 pcf LL = 72 PL = 26 Fines = 85%		▨	
70						▨	70.0 1719.0
	CMS 15	100	31-25-32 (57)		SM	░	(SM) Silty SAND, dense, wet, light brown
							71.0 1718.0
					SC	▧	(SC) Clayey SAND, dense, moist, light brown
							71.5 1717.5
					CH	▨	(CH) Sandy FAT CLAY, stiff, moist, light brown
75	SPT 16	100	5-3-10 (13)			▨	
							76.0 1713.0
					SC	▧	(SC) Clayey SAND, moist, light brown
80	CMS 17	33	11-17-43 (60)	MC = 35% DD = 86 pcf		▧	
85						▧	85.0 1704.0
	SH 18	92		MC = 35% DD = 99 pcf	CL	▨	(CL) LEAN CLAY, hard, moist, brown
	SPT 19	100	10-15-17 (32)	PP = 4.5+ tsf MC = 32% LL = 46 PL = 23 Fines = 92%		▨	
90						▨	90.5 1698.5
	CMS 20	33	6-14-17 (31)		SC	▧	(SC) Clayey SAND, medium dense, moist, light brown
95	SPT 21	100	9-9-16 (25)			▧	- medium dense

(Continued Next Page)

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

BORING NUMBER B-5

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
100					SC	▨	(SC) Clayey SAND, medium dense, moist, light brown *(continued)*
	CMS 22	33	15-20-38 (58)	MC = 57% DD = 68 pcf		▨	- dense
101.5							1687.5

Bottom of borehole at 101.5 feet.

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

BORING NUMBER B-6

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue
DATE STARTED 4/9/20 **COMPLETED** 4/9/20
GROUND ELEVATION 1789 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR CASCADE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Augers
▽ **AT TIME OF DRILLING** 12.50 ft / Elev 1776.50 ft
LOGGED BY JLW **CHECKED BY** SL
▼ **AT END OF DRILLING** 9.20 ft / Elev 1779.80 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0	BULK						FILL: Silty sand, slight moist, brown	
1.0					CL		(CL) Sandy LEAN CLAY, trace gypsum, slightly moist, brown	1788.0
							- trace roots, organic seams	
5	CMS	0	5-3-4 (7)				- soft, moist	
						▼		
10	SPT	67	6-5-4 (9)	PP = 0.75 tsf			- medium stiff, very moist, light gray	
						▽		
15	CMS	28	2-3-6 (9)	MC = 24% DD = 117 pcf			- wet	
18.0					SM		(SM) Silty SAND, loose, wet, light gray and light brown	1771.0
20	SPT	56	2-2-3 (5)	LL = NP PL = NP Fines = 45%				
25	CMS	33	6-22-24 (46)	MC = 21% DD = 129 pcf			- trace caliche nodules, medium dense	
30.0								1759.0

(Continued Next Page)

BORING NUMBER B-6

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30	SPT	100	5-7-7 (14)	PP = 2.75 tsf	SC		(SC) Clayey SAND, trace gravel, medium dense, very moist, light brown
31.0					CL		1758.0 (CL) LEAN CLAY with Sand, stiff, very moist, light gray
35	CMS	33	12-12-13 (25)	PP = 3.5 tsf Fines = 83%			- light brown
40	SPT	100	5-3-4 (7)	PP = 2.5 tsf			- medium stiff, varies to clayey sand
45.0	CMS	28	11-18-26 (44)	PP = 2.0 tsf MC = 30% DD = 97 pcf LL = 41 PL = 17 Fines = 98%	CL		1744.0 (CL) LEAN CLAY, very stiff, moist, brown
50.0	SH	100		PP = 3.0 tsf LL = 42 PL = 19 Fines = 62% 400 psi max	CL		1739.0 (CL) Sandy LEAN CLAY, stiff, moist, brown
	SPT	100	4-6-8 (14)	PP = 1.5 tsf			
55	CMS	28	6-9-16 (25)	PP = 1.25 tsf MC = 41% DD = 79 pcf			
60	SPT	100	8-13-15 (28)	PP = 3.0 tsf Fines = 89%			- very stiff, varies to fat clay with sand, brown - light brown

(Continued Next Page)

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
65					CL		65.0 (CL) Sandy LEAN CLAY, stiff, moist, brown *(continued)* 1724.0
	CMS	33	6-7-19 (26)	PP = 0.75 tsf LL = 58 PL = 22 Fines = 73%	CH		(CH) FAT CLAY with Sand, very stiff, moist, brown
70							70.0 1719.0
	SH	100		PP = 3.75 tsf LL = 80 PL = 28 Fines = 17%	SC		(SC) Clayey SAND, medium dense, moist, light brown
							72.0 - trace cementation, dense 1717.0
	SPT	100	5-6-5 (11)	PP = 1.0 tsf Fines = 59%	CL		(CL) Sandy LEAN CLAY, stiff, moist, brown to light brown
75							75.0 1714.0
	CMS	33	12-36-43 (79)	PP = 3.5-4.0 tsf MC = 50% DD = 73 pcf	CH		(CH) FAT CLAY with Sand, hard, moist, light brown
80							80.0 1709.0
	SPT	100	11-10-12 (22)	MC = 48% LL = 98 PL = 44 Fines = 70%	MH		(MH) ELASTIC SILT with Sand, very stiff, moist, light gray
85							85.0 1704.0
	CMS	33	3-6-17 (23)	PP = 2.0 tsf	CL		(CL) Sandy LEAN CLAY, stiff, moist, light gray to light brown
90							90.0 1699.0
	SPT	44	12-24-30 (54)	MC = 66%	SC		(SC) Clayey SAND, dense, moist, light gray
95							95.0 1694.0
	CMS	50	28-50	MC = 63% DD = 80 pcf	SM		(SM) Silty SAND, very dense, very moist, brown

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NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

BORING NUMBER B-6

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
100					SM		(SM) Silty SAND, very dense, very moist, brown *(continued)*
	SPT	82	7-21-50/5"				101.4 1687.6

Bottom of borehole at 101.4 feet.

BORING NUMBER B-7

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue
DATE STARTED 1/17/20 **COMPLETED** 1/17/20
GROUND ELEVATION 1788 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR CASCADE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Augers
AT TIME OF DRILLING ---
LOGGED BY JS **CHECKED BY** SL
▼ **AT END OF DRILLING** 8.00 ft / Elev 1780.00 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	
0						■	0.7	FILL - 8 inches of asphalt	1787.3
						▩	2.4	FILL - 21 inches of aggregate base with a layer of geofabric	1785.6
					CL	▨		(CL) Sandy LEAN CLAY, soft, moist, light brown	
5	CMS 2	28	3-2-2 (4)	MC = 40% DD = 79 pcf					
	GB 1	100						▼	
							9.0		1779.0
10					SC	▨		(SC) Clayey SAND, loose, very moist, light brown	
	SPT 3	100	3-3-6 (9)	MC = 20% LL = 28 PL = 19 Fines = 39%				- light gray	
15							15.0		1773.0
	CMS 4	33	3-9-11 (20)	PP = 2.25 tsf	CL	▨		(CL) Sandy LEAN CLAY, stiff, moist, light gray	
20							20.0		1768.0
	SPT 5	100	13-19-20 (39)		SM	⁙		(SM) Silty SAND, dense, wet, light gray to brown	
25							25.0		1763.0
	CMS 6	33	26-29-21 (50)	PP = 4.5+ tsf MC = 21% DD = 108 pcf LL = 37 PL = 25 Fines = 92%	CL	▨		(CL) LEAN CLAY, trace sand, trace cementation, hard, moist, light gray	
30							30.0		1758.0

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CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30	SPT 7	100	3-5-5 (10)		SC		(SC) Clayey SAND, medium dense, very moist, light gray
35	CMS 8	33	6-11-20 (31)				36.0 1752.0
					SM		(SM) Silty SAND, medium dense, very moist, light brown
40	SPT 9	100	13-16-26 (42)				dense
45							45.0 1743.0
	CMS 10	33	10-23-37 (60)	MC = 22%	CH		(CH) FAT CLAY with sand, hard, moist, brown
50	SH 11	100		MC = 46% DD = 71 pcf			
	SPT 12	100	4-5-9 (14)	PP = 1.25 tsf MC = 41% LL = 55 PL = 20 Fines = 82%			- sandy, very stiff
55							55.0 1733.0
	CMS 13	35	21-45-50/5"		SM		(SM) Silty SAND, very dense, moist, light brown
60							60.0 1728.0
	SPT 14	100	6-8-12 (20)	PP = 2.5 tsf MC = 32%	CL		(CL) Sandy LEAN CLAY, very stiff, moist, light brown

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CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
65					CL		65.0 (CL) Sandy LEAN CLAY, very stiff, moist, light brown *(continued)* 1723.0
	CMS 15	33	14-26-30 (56)	MC = 23% DD = 106 pcf	SC		(SC) Clayey SAND, dense, moist, light brown
70	SPT 16	100	5-8-12 (20)		CH		70.0 (CH) FAT CLAY, with sand, very stiff, moist, brown 1718.0
75	CMS 17	33	7-24-24 (48)	PP = 3.75 tsf MC = 41% DD = 84 pcf			- hard, light brown
80	SH 18	117		PP = 2.5 tsf MC = 50% DD = 70 pcf			- reddish brown
	SPT 19	100	5-9-15 (24)	MC = 42% LL = 70 PL = 28 Fines = 86%			- very stiff
85	CMS 20	33	10-12-35 (47)	PP = 3.75 tsf			- hard, trace cementation
90	SPT 21	100	9-22-35 (57)	MC = 41%	SC		90.5 (SC) Clayey SAND, very dense, moist, light gray 1697.5
95	CMS 22	28	13-32-50 (82)				- dense

(Continued Next Page)

BORING NUMBER B-7

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
100					SC	▨	(SC) Clayey SAND, very dense, moist, light gray *(continued)*
	SPT 23	100	15-16-18 (34)	MC = 66%		▨	101.5 - dense, light brown 1686.5

Bottom of borehole at 101.5 feet.

KEY TO BORING LOGS

PARTICLE SIZE LIMITS								
CLAY	SILT	SAND			GRAVEL		COBBLES	BOULDERS
		FINE	MEDIUM	COARSE	FINE	COARSE		

.002 mm #200 #40 #10 #4 ¾ inch 3 inch 12 inch

USCS GROUP	TYPICAL SOIL DESCRIPTION
GW	Well graded gravels, gravel-sand mixtures, little or no fines
GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
GC	Clayey gravels, poorly graded gravel-sand-clay mixtures
SW	Well graded sands, gravelly sands, little or no fines
SP	Poorly graded sands, gravelly sands, little or no fines
SM	Silty sands, poorly graded sand-silt mixtures
SC	Clayey sands, poorly graded sand-clay mixtures
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL	Organic silts and organic silt-clays of low plasticity
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity
PT	Peat and other highly organic soils

MOISTURE CONDITION CRITERIA

Description	Criteria
Dry	Absence of moisture, dusty, dry to touch.
Moist	Damp, no visible free water.
Wet	Visible free water, usually below groundwater table.

∇ ▼ Groundwater Elevation Symbols

SOIL CEMENTATION CRITERIA

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Won't break or crumble w/finger pressure

STANDARD PENETRATION CLASSIFICATION*			
GRANULAR SOIL		CLAYEY SOIL	
BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY
0 - 4	VERY LOOSE	0 - 1	VERY SOFT
5 – 10	LOOSE	2 - 4	SOFT
11 - 30	MEDIUM DENSE	5 - 8	MEDIUM STIFF
31 - 50	DENSE	9 - 15	STIFF
OVER 50	VERY DENSE	16 - 30	VERY STIFF
		31 - 60	HARD
		OVER 60	VERY HARD

*Standard Penetration Test (N) 140 lb hammer 30 inch free fall on 2 inch O.D. x 1.4 inch I.D. sampler.

Field Blow counts on California Modified Sampler (N_{CMS}) for ($6<N_{CMS}<50$) can be converted to $N_{SPT\ field}$ by:

($N_{CMS\ field}$)(0.62) = $N_{SPT\ field}$

TEST ABBREVIATIONS

CD	CONSOLIDATED DRAINED	O	ORGANIC CONTENT
CH	CHEMICAL (CORROSIVENESS)	OC	CONSOLIDATION
CM	COMPACTION	PI	PLASTICITY INDEX
CU	CONSOLIDATED UNDRAINED	RQD	ROCK QUALITY DESIGNATION
D	DISPERSIVE SOILS	RV	R-VALUE
DS	DIRECT SHEAR	S	SIEVE ANALYSIS
E	EXPANSIVE SOIL	SL	SHRINKAGE LIMIT
G	SPECIFIC GRAVITY	U	UNCONFINED COMPRESSION
H	HYDROMETER	UU	UNCONSOLIDATED UNDRAINED
HC	HYDRO-COLLAPSE	UW	UNIT WEIGHT
K	PERMEABILITY	W	MOISTURE CONTENT

SOIL COLOR DESIGNATIONS ARE FROM THE MUNSELL SOIL/ROCK COLOR CHARTS.

EXAMPLE: (7.5 YR 5/3) BROWN

SAMPLER NOTATION

CMS	CALIF. MODIFIED SAMPLER[1]
CPT	CONE PENETRATION TEST
CS	CONTINUOUS SAMPLER[2]
PB	PITCHER BARREL
RC	ROCK CORE[3]
SH	SHELBY TUBE[4]
SPT	STANDARD PENETRATION TEST
TP	TEST PIT

1- I.D.= 2.421 inch

2- I.D.=3.228 inch with tube; 3.50 inch w/o tube

3- NXB I.D.= 1.875 inch

4- I.D.= 2.875 inch

Revised August 2010

ATTERBERG LIMITS' RESULTS

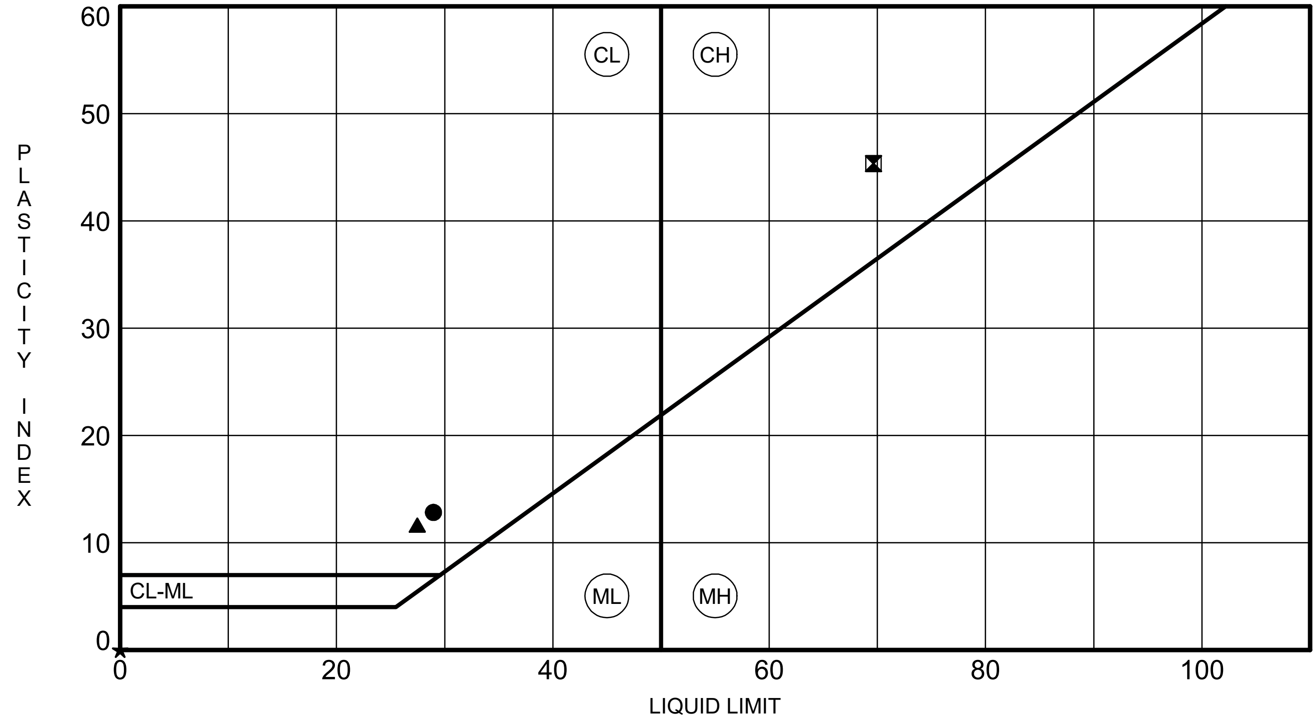
NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-1**	**10.0**	**29**	**16**	**13**	**49**	**CLAYEY SAND(SC)**
⊠	**B-1**	**36.4**	**70**	**24**	**46**	**87**	**FAT CLAY(CH)**
▲	**B-1**	**55.8**	**27**	**16**	**11**	**87**	**LEAN CLAY(CL)**
★	**B-1**	**65.0**	**NP**	**NP**	**NP**	**39**	**SILTY SAND(SM)**

ATTERBERG LIMITS' RESULTS

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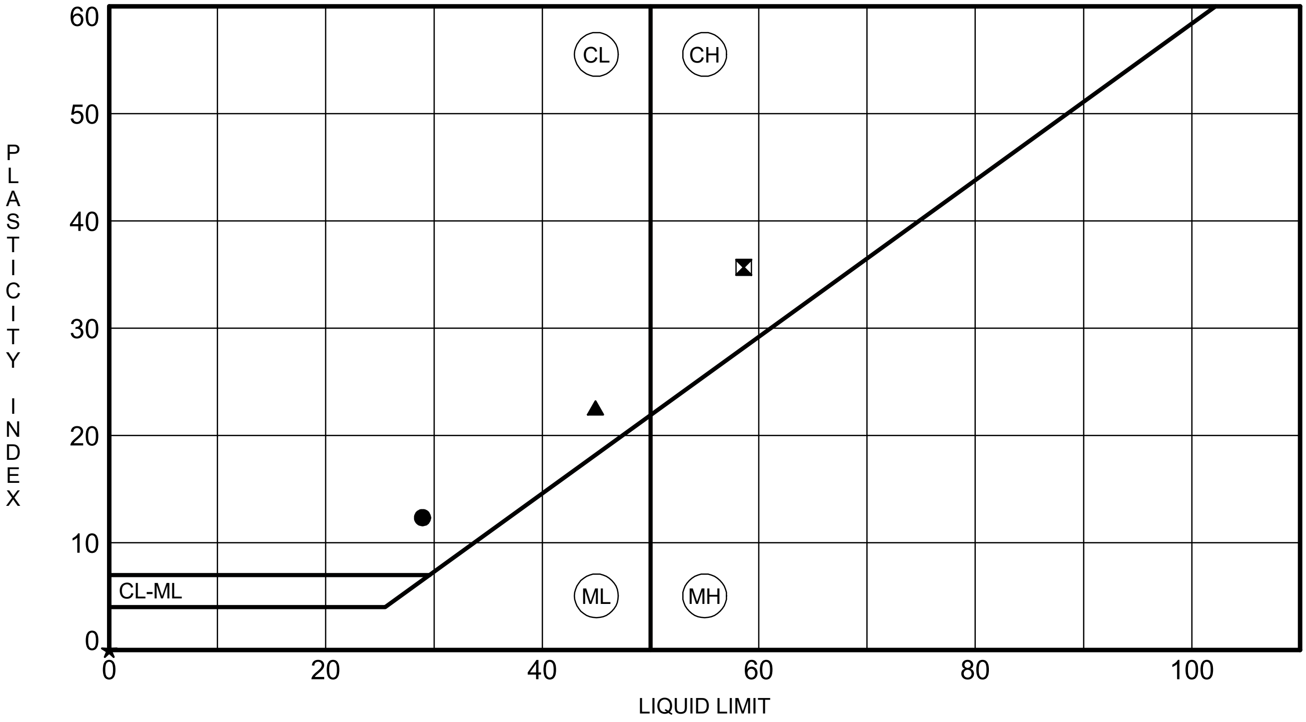

	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-2**	**15.0**	**29**	**17**	**12**	**48**	**CLAYEY SAND(SC)**
☒	**B-2**	**35.0**	**59**	**23**	**36**	**97**	**FAT CLAY(CH)**
▲	**B-2**	**46.4**	**45**	**22**	**23**	**41**	**CLAYEY SAND(SC)**
★	**B-2**	**65.0**	**NP**	**NP**	**NP**	**52**	**SANDY SILT(ML)**

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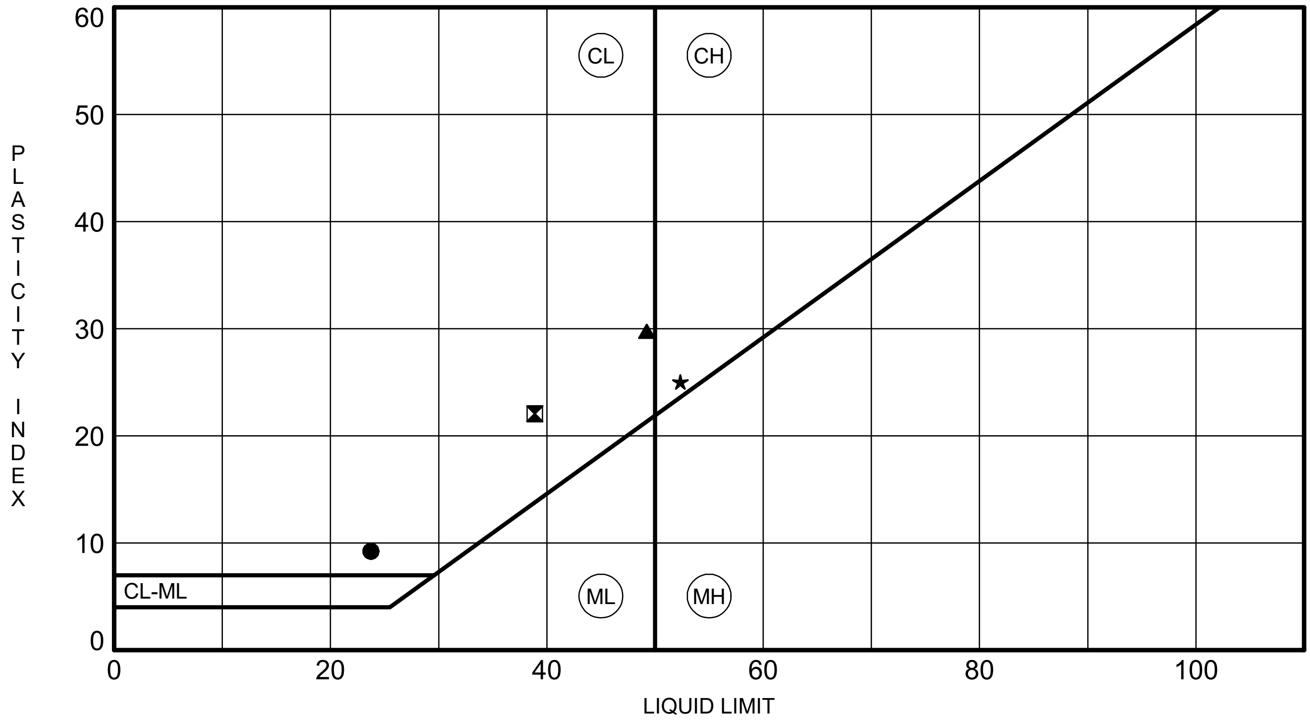

	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-3**	**15.0**	**24**	**15**	**9**	**43**	**CLAYEY SAND(SC)**
☒	**B-3**	**35.0**	**39**	**17**	**22**	**40**	**CLAYEY SAND(SC)**
▲	**B-3**	**55.0**	**49**	**19**	**30**	**77**	**LEAN CLAY with SAND(CL)**
★	**B-3**	**100.0**	**52**	**27**	**25**	**90**	**FAT CLAY(CH)**

ATTERBERG LIMITS' RESULTS

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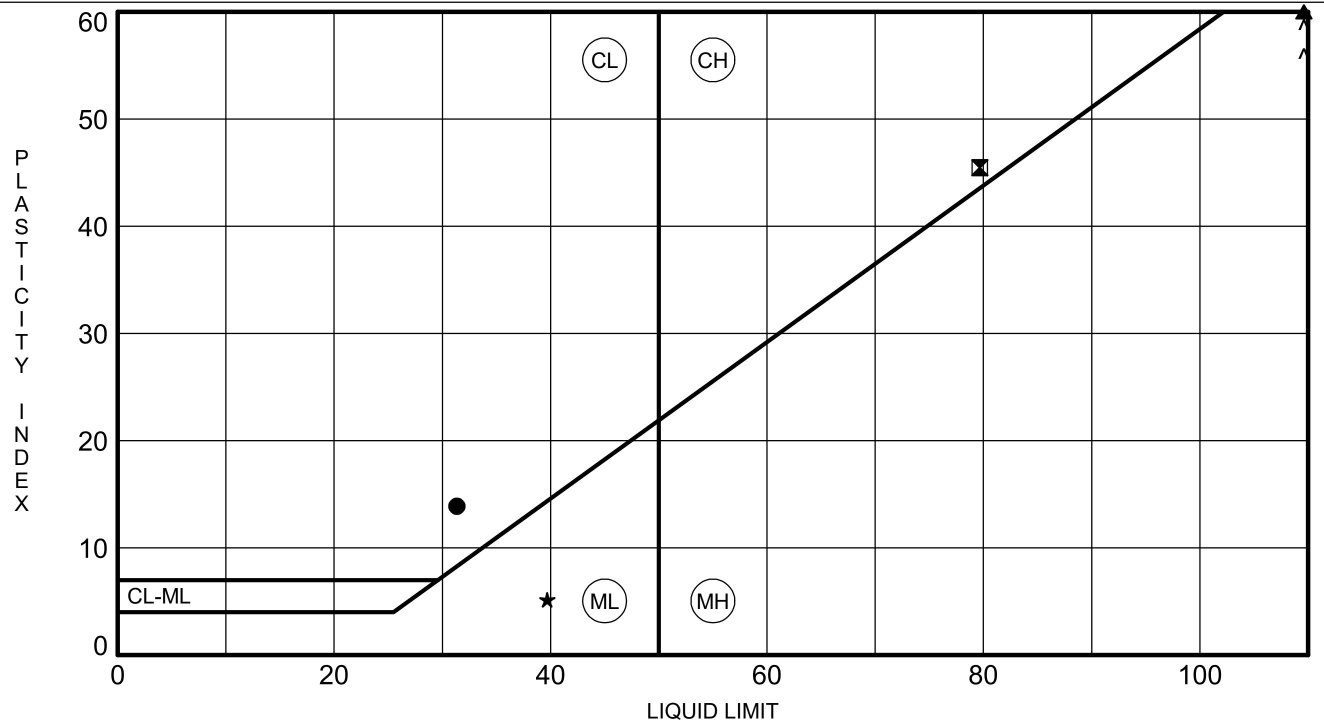

	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-4**	**25.0**	**31**	**17**	**14**	**61**	**SANDY LEAN CLAY(CL)**
⊠	**B-4**	**40.0**	**80**	**34**	**46**	**59**	**SANDY FAT CLAY(CH)**
▲	**B-4**	**70.0**	**110**	**31**	**79**	**85**	**FAT CLAY(CH)**
★	**B-4**	**91.8**	**40**	**35**	**5**	**96**	**SILT(ML)**

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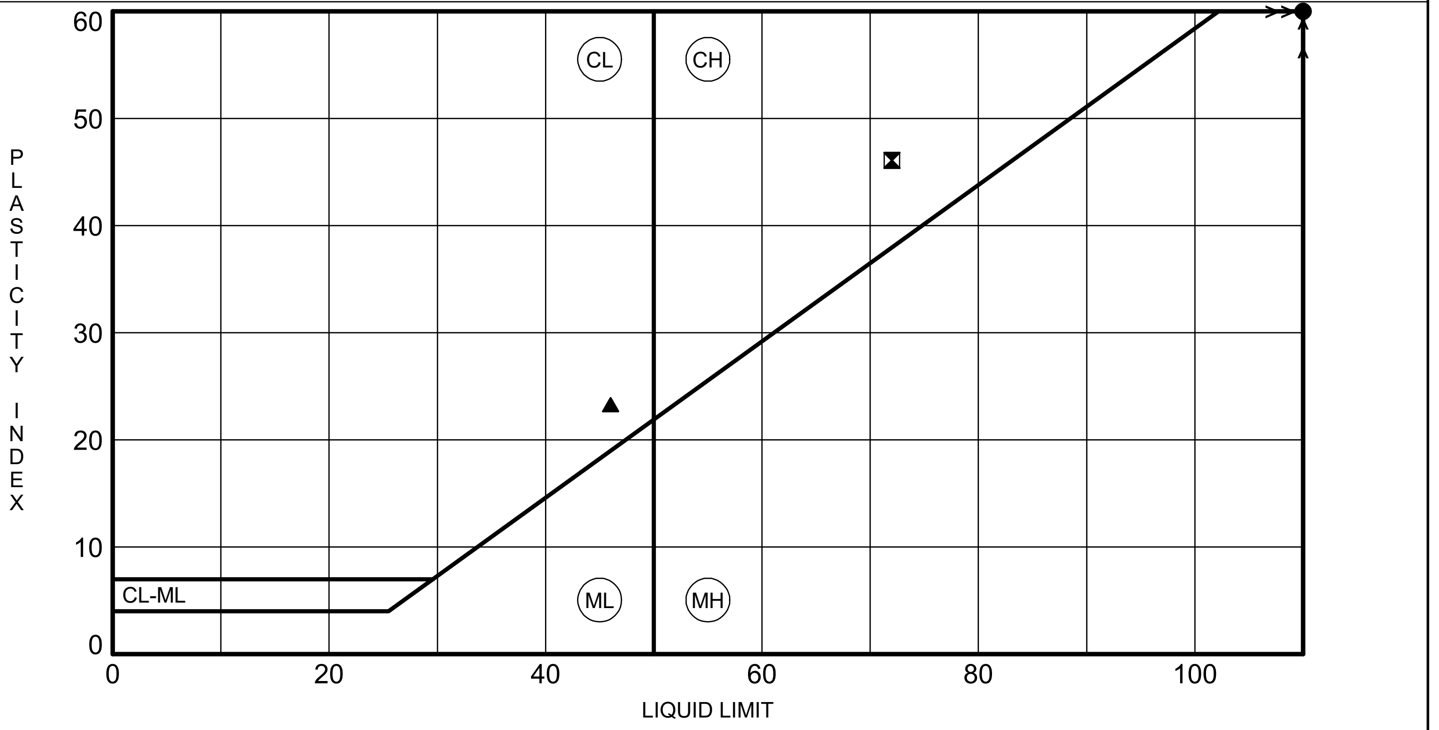

	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-5**	**45.0**	**122**	**40**	**82**	**71**	**FAT CLAY with SAND(CH)**
☒	**B-5**	**65.0**	**72**	**26**	**46**	**85**	**FAT CLAY with SAND(CH)**
▲	**B-5**	**86.8**	**46**	**23**	**23**	**92**	**LEAN CLAY(CL)**

ATTERBERG LIMITS' RESULTS

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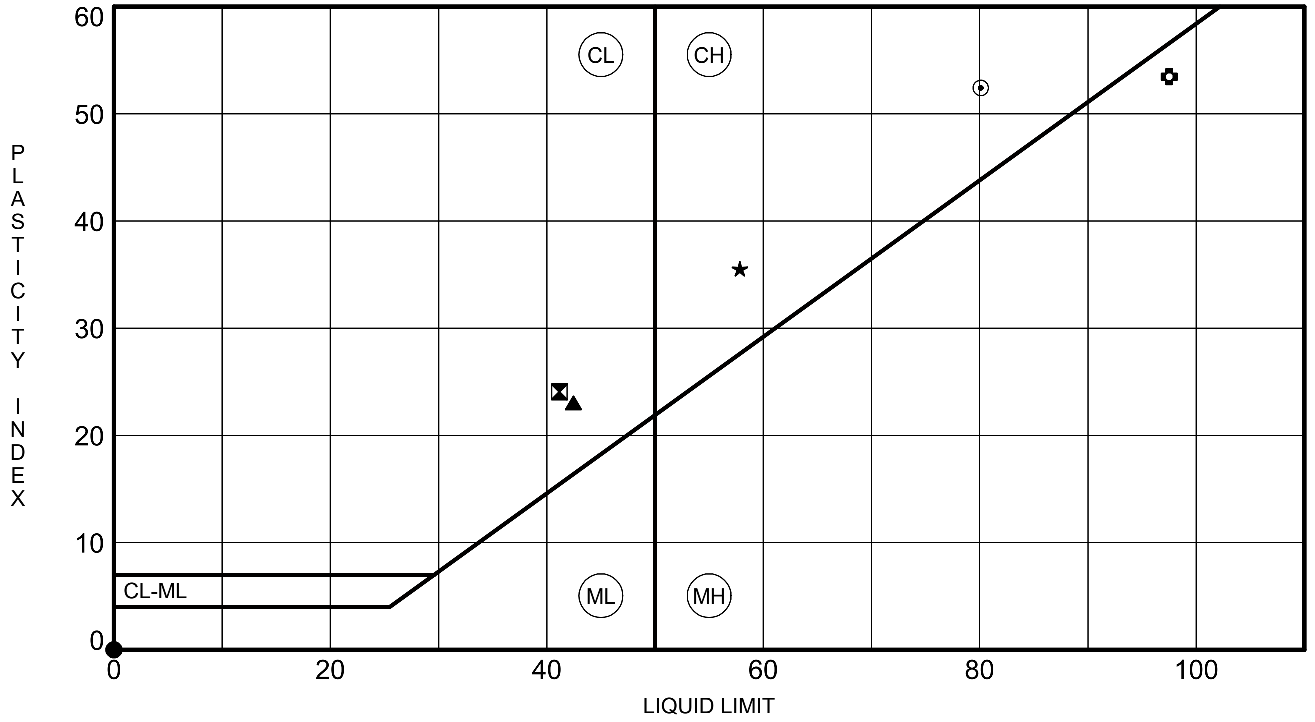

	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-6**	**20.0**	**NP**	**NP**	**NP**	**45**	**SILTY SAND(SM)**
⧗	**B-6**	**45.0**	**41**	**17**	**24**	**98**	**LEAN CLAY(CL)**
▲	**B-6**	**50.0**	**42**	**19**	**23**	**62**	**SANDY LEAN CLAY(CL)**
★	**B-6**	**65.0**	**58**	**22**	**36**	**73**	**FAT CLAY with SAND(CH)**
⊙	**B-6**	**70.0**	**80**	**28**	**52**	**17**	**CLAYEY SAND(SC)**
✿	**B-6**	**80.0**	**98**	**44**	**54**	**70**	**ELASTIC SILT with SAND(MH)**

ATTERBERG LIMITS' RESULTS

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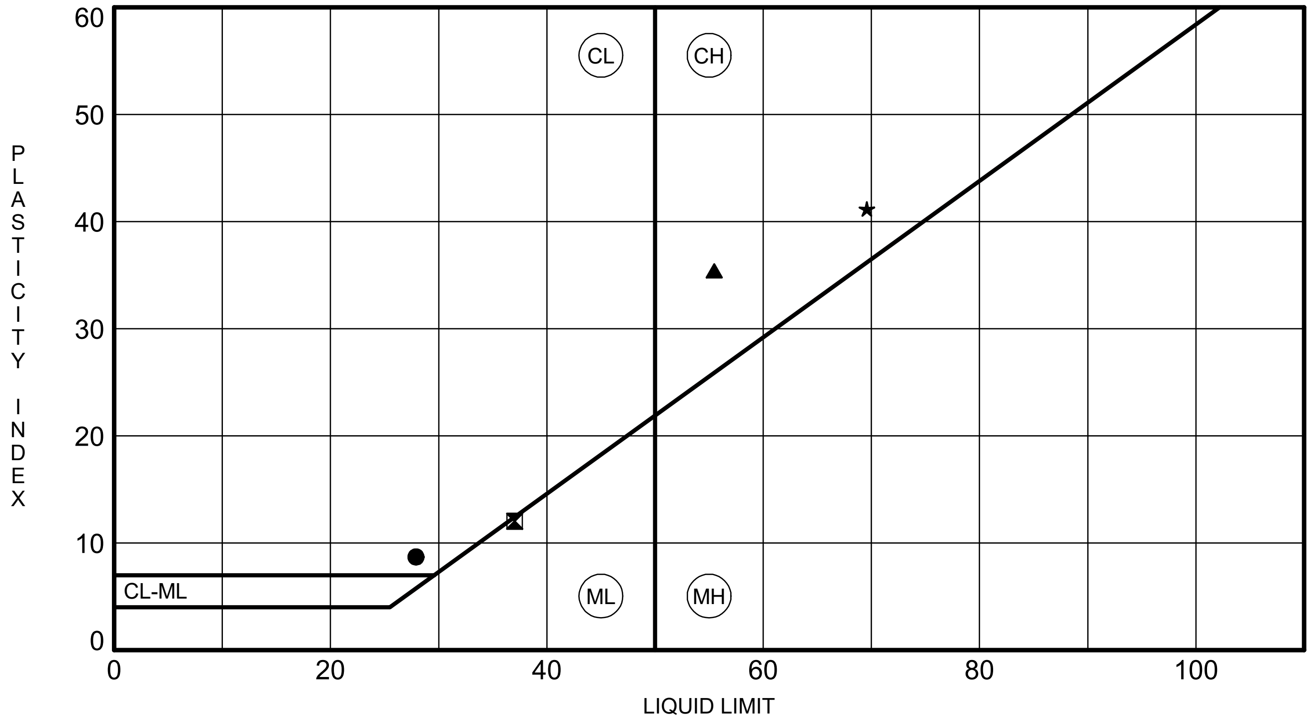

	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-7**	**10.0**	**28**	**19**	**9**	**39**	**CLAYEY SAND(SC)**
☒	**B-7**	**25.0**	**37**	**25**	**12**	**92**	**SILT(ML)**
▲	**B-7**	**52.0**	**55**	**20**	**35**	**82**	**FAT CLAY with SAND(CH)**
★	**B-7**	**81.8**	**70**	**28**	**42**	**86**	**FAT CLAY(CH)**

GRAIN SIZE DISTRIBUTION

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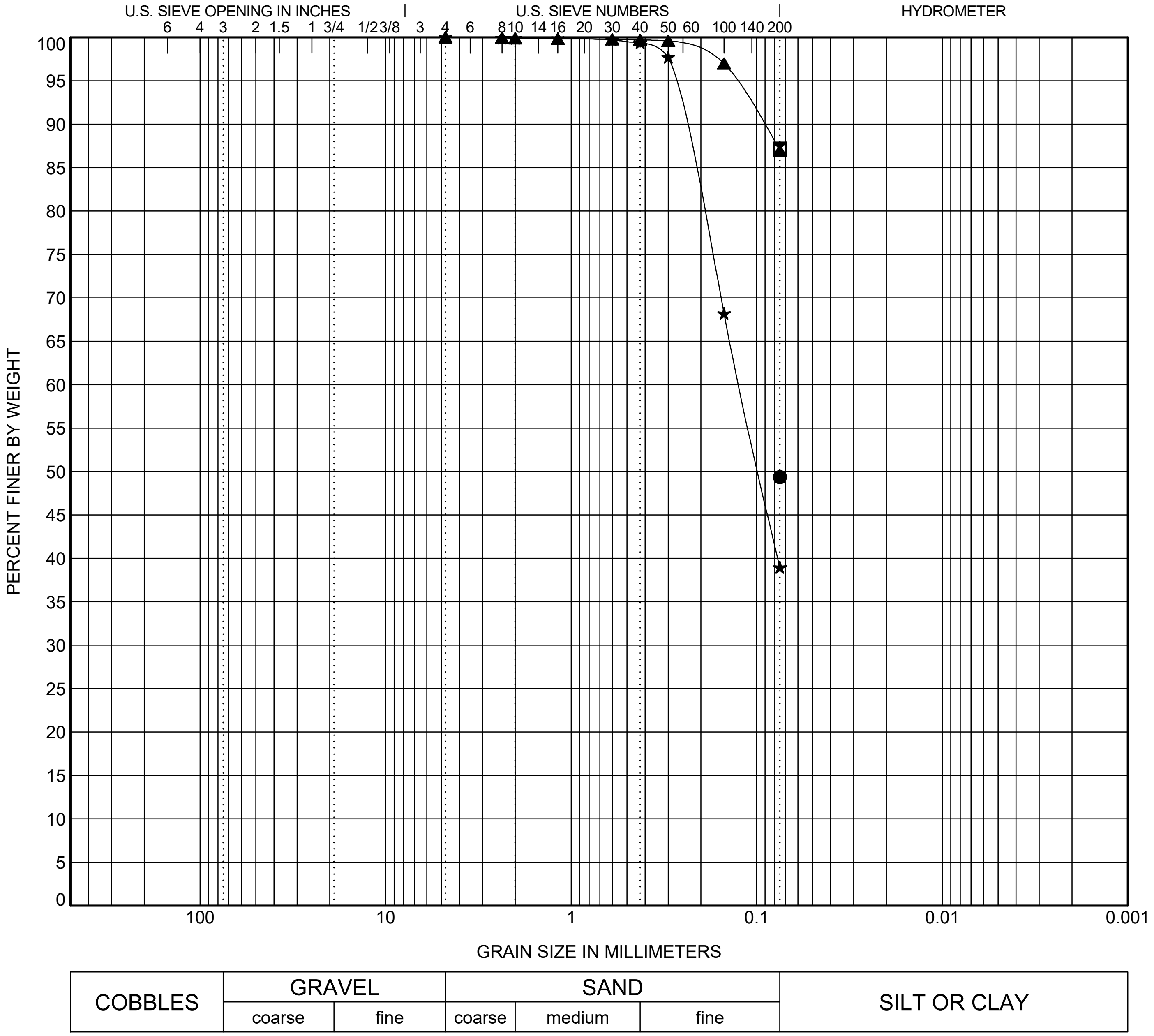

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-1**	**10.0**	**CLAYEY SAND(SC)**	**29**	**16**	**13**		
☒	**B-1**	**36.4**	**FAT CLAY(CH)**	**70**	**24**	**46**		
▲	**B-1**	**55.8**	**LEAN CLAY(CL)**	**27**	**16**	**11**		
★	**B-1**	**65.0**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1**	**10.0**	**0.075**						**49.4**	
☒	**B-1**	**36.4**	**0.075**						**87.2**	
▲	**B-1**	**55.8**	**4.75**				**0.0**	**13.0**	**87.0**	
★	**B-1**	**65.0**	**4.75**	**0.123**			**0.0**	**61.0**	**39.0**	

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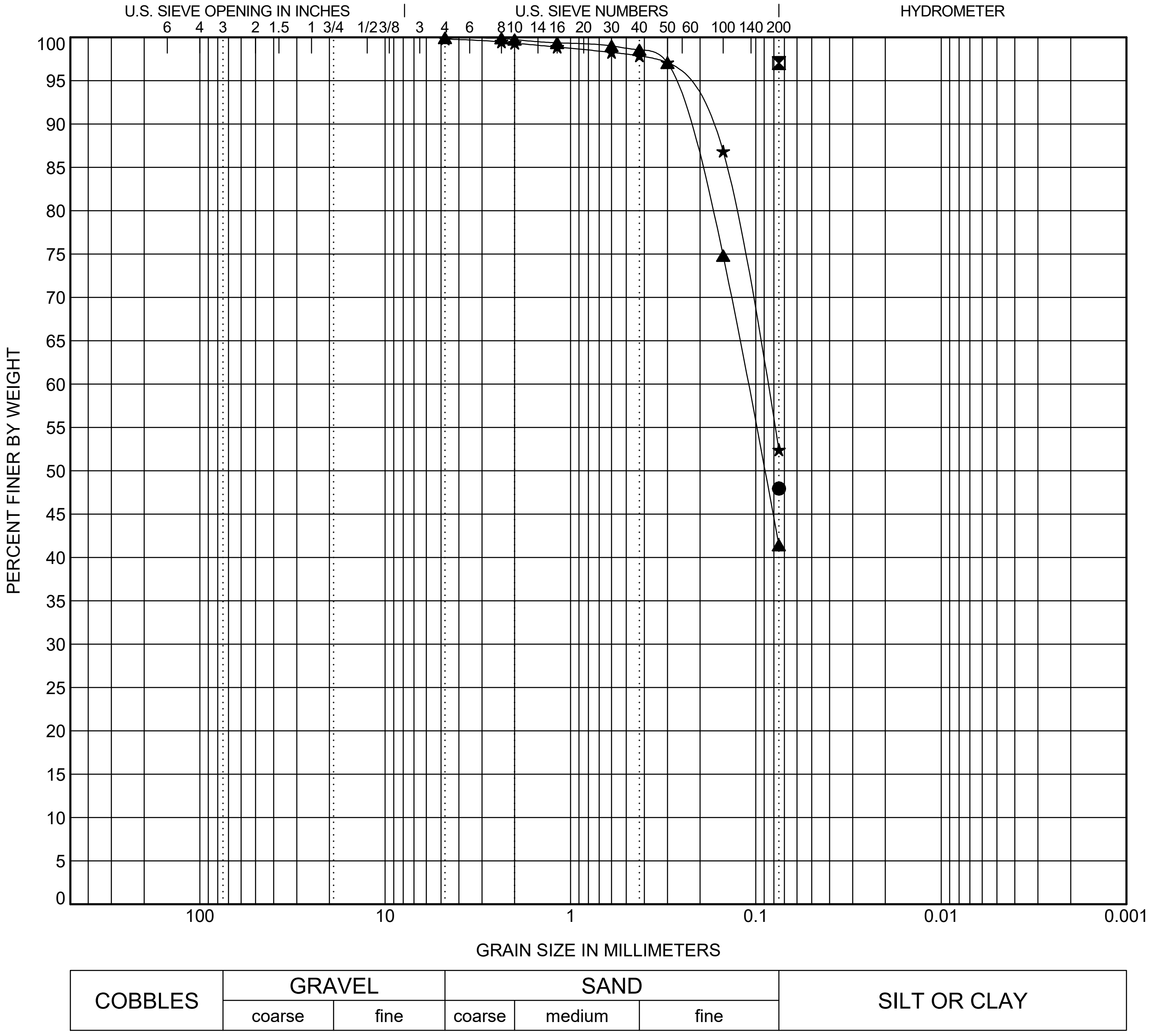

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-2**	**15.0**	**CLAYEY SAND(SC)**	**29**	**17**	**12**		
⊠	**B-2**	**35.0**	**FAT CLAY(CH)**	**59**	**23**	**36**		
▲	**B-2**	**46.4**	**CLAYEY SAND(SC)**	**45**	**22**	**23**		
★	**B-2**	**65.0**	**SANDY SILT(ML)**	**NP**	**NP**	**NP**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-2**	**15.0**	**0.075**						**47.9**	
⊠	**B-2**	**35.0**	**0.075**						**97.0**	
▲	**B-2**	**46.4**	**4.75**	**0.11**				**58.5**	**41.4**	
★	**B-2**	**65.0**	**4.75**	**0.087**				**47.4**	**52.4**	

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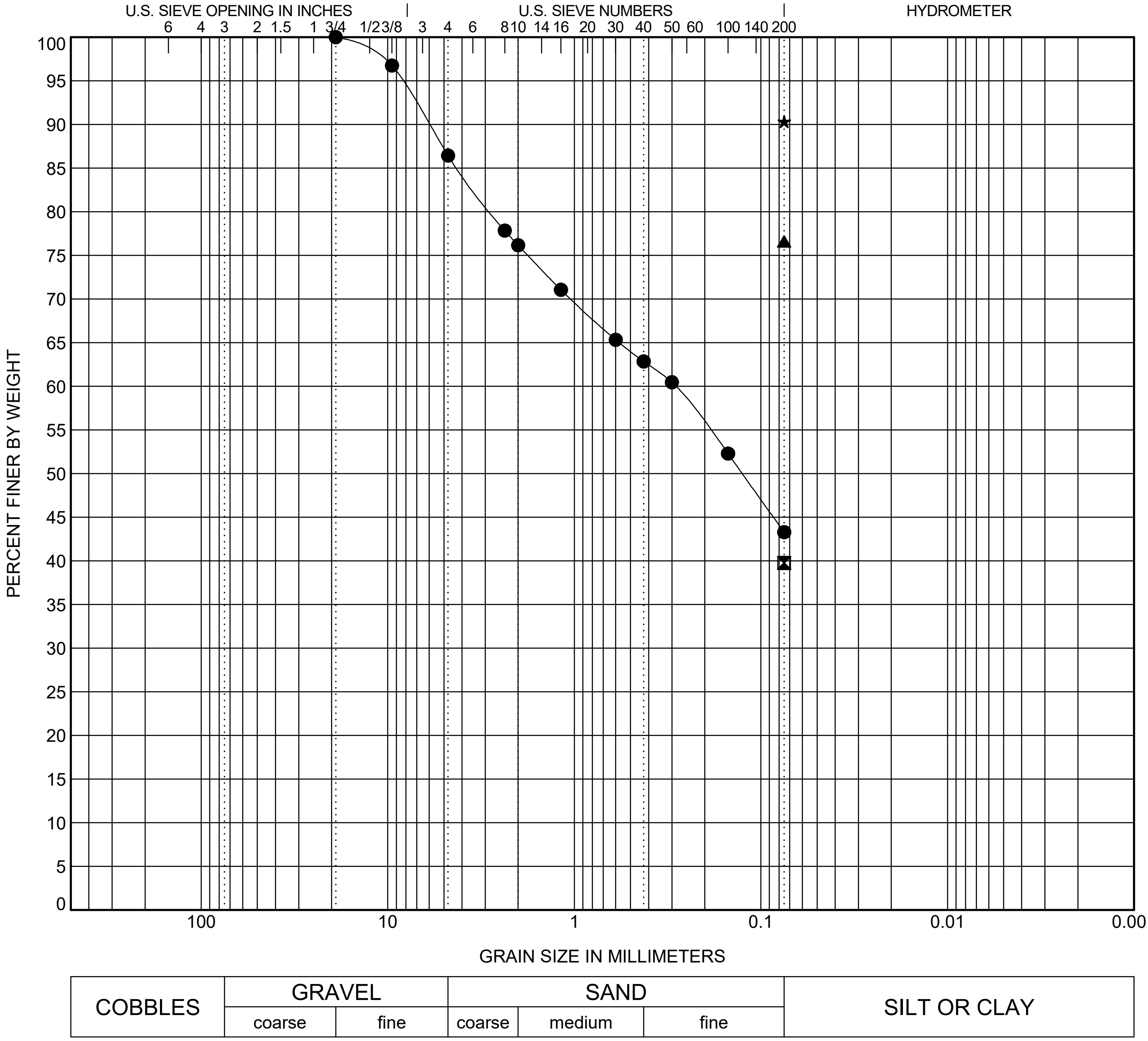

BOREHOLE		DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-3**	**15.0**	**CLAYEY SAND(SC)**	**24**	**15**	**9**		
⧗	**B-3**	**35.0**	**CLAYEY SAND(SC)**	**39**	**17**	**22**		
▲	**B-3**	**55.0**	**LEAN CLAY with SAND(CL)**	**49**	**19**	**30**		
★	**B-3**	**100.0**	**FAT CLAY(CH)**	**52**	**27**	**25**		

BOREHOLE		DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-3**	**15.0**	**19**	**0.289**			**13.6**	**43.1**	**43.3**	
⧗	**B-3**	**35.0**	**0.075**						**39.8**	
▲	**B-3**	**55.0**	**0.075**						**76.6**	
★	**B-3**	**100.0**	**0.075**						**90.3**	

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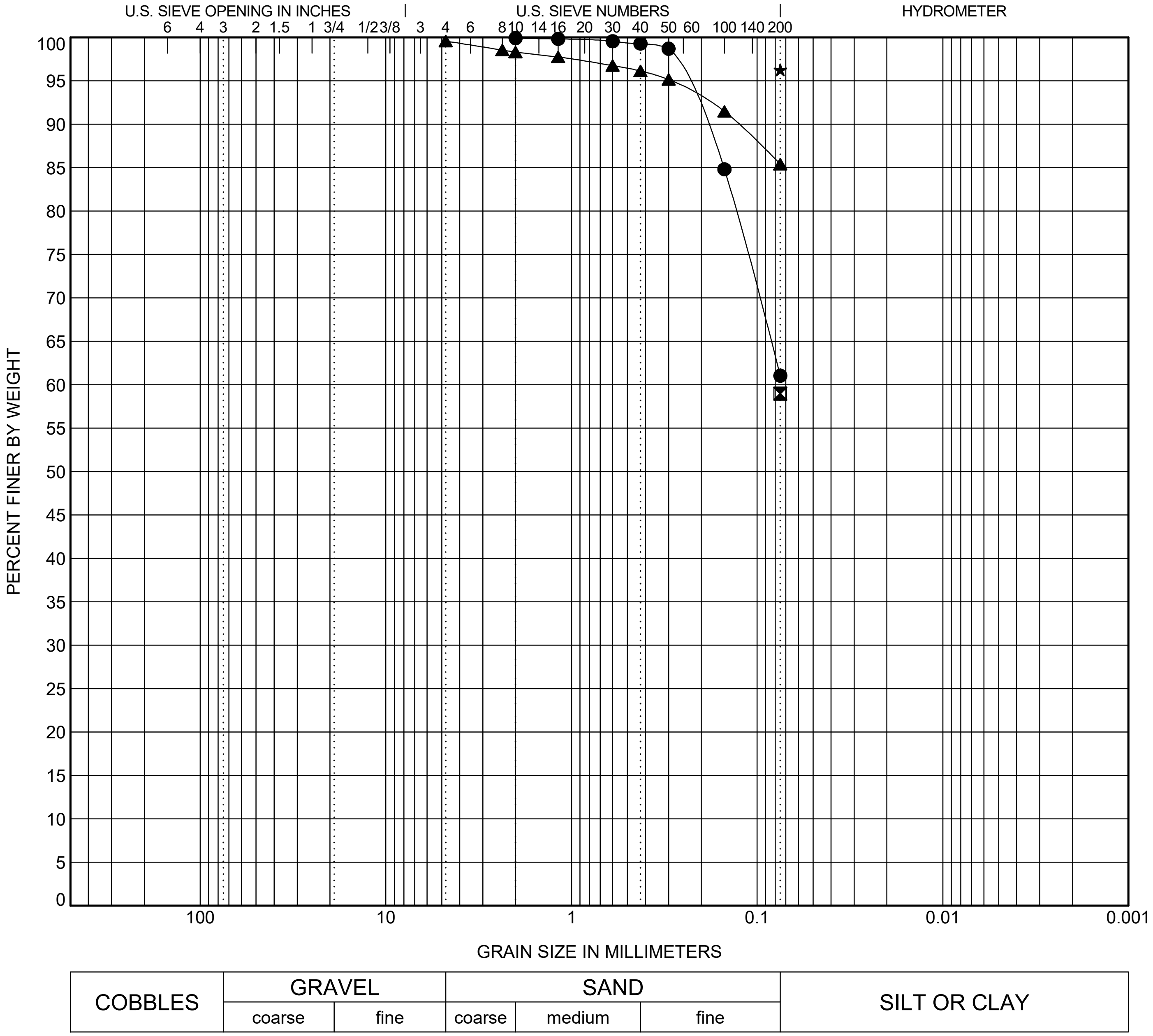

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-4**	**25.0**	**SANDY LEAN CLAY(CL)**	**31**	**17**	**14**		
⊠	**B-4**	**40.0**	**SANDY FAT CLAY(CH)**	**80**	**34**	**46**		
▲	**B-4**	**70.0**	**FAT CLAY(CH)**	**110**	**31**	**79**		
★	**B-4**	**91.8**	**SILT(ML)**	**40**	**35**	**5**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-4**	**25.0**	**2**					**38.9**	**61.0**	
⊠	**B-4**	**40.0**	**0.075**						**59.0**	
▲	**B-4**	**70.0**	**4.75**					**14.2**	**85.4**	
★	**B-4**	**91.8**	**0.075**						**96.3**	

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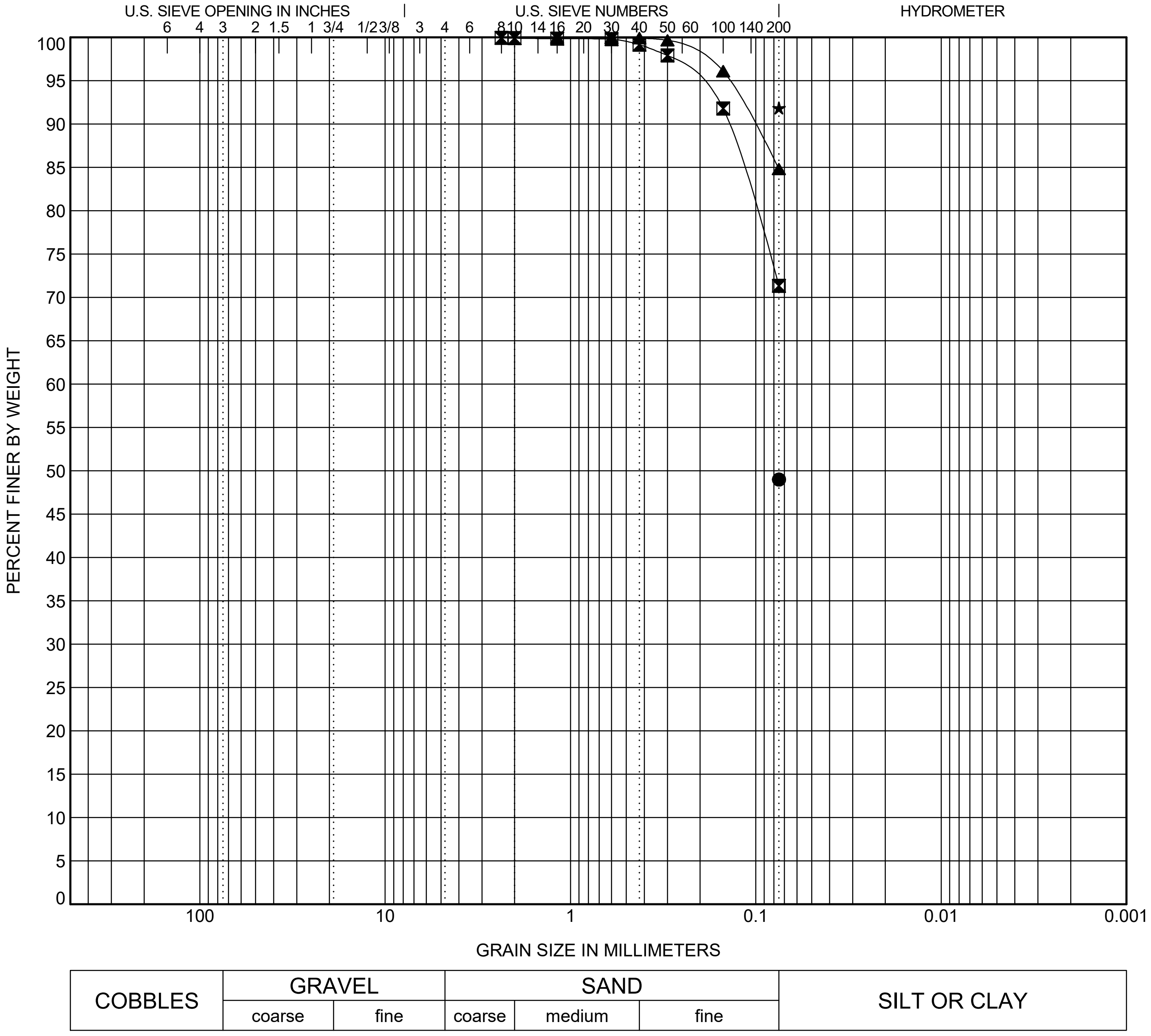

BOREHOLE		DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-5**	**5.0**	**Clayey SAND**					
⧗	**B-5**	**45.0**	**FAT CLAY with SAND(CH)**	**122**	**40**	**82**		
▲	**B-5**	**65.0**	**FAT CLAY with SAND(CH)**	**72**	**26**	**46**		
★	**B-5**	**86.8**	**LEAN CLAY(CL)**	**46**	**23**	**23**		

BOREHOLE		DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-5**	**5.0**	**0.075**						**49.0**	
⧗	**B-5**	**45.0**	**2.36**					**28.6**	**71.3**	
▲	**B-5**	**65.0**	**1.18**					**15.2**	**84.8**	
★	**B-5**	**86.8**	**0.075**						**91.8**	

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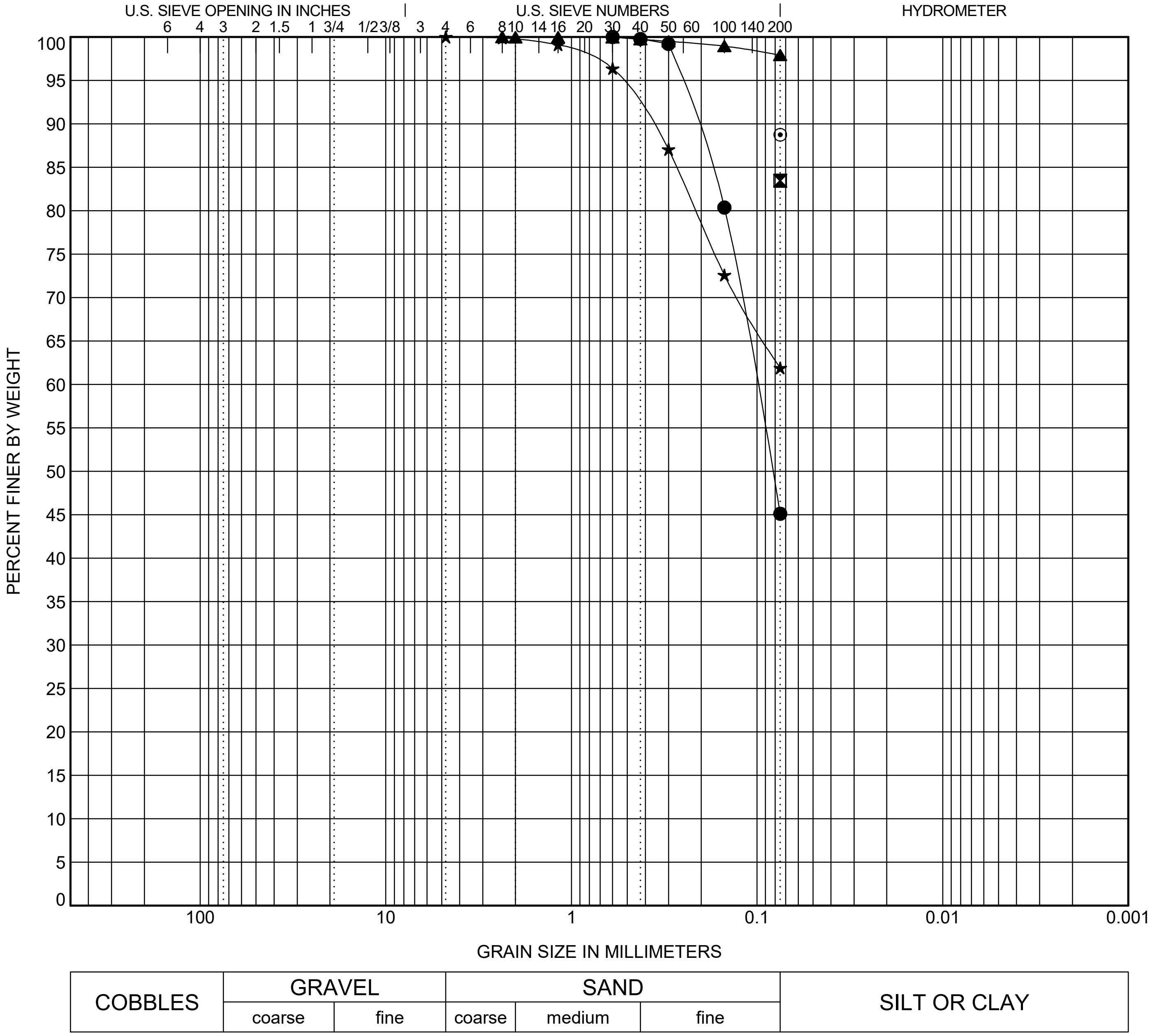

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-6**	**20.0**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
☒	**B-6**	**35.0**	**LEAN CLAY with Sand**					
▲	**B-6**	**45.0**	**LEAN CLAY(CL)**	**41**	**17**	**24**		
★	**B-6**	**50.0**	**SANDY LEAN CLAY(CL)**	**42**	**19**	**23**		
⊙	**B-6**	**60.0**	**Sandy LEAN CLAY**					

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-6**	**20.0**	**0.6**	**0.101**			**0.0**	**54.9**	**45.1**	
☒	**B-6**	**35.0**	**0.075**						**83.5**	
▲	**B-6**	**45.0**	**2.36**				**0.0**	**2.1**	**97.9**	
★	**B-6**	**50.0**	**4.75**				**0.0**	**38.1**	**61.9**	
⊙	**B-6**	**60.0**	**0.075**						**88.7**	

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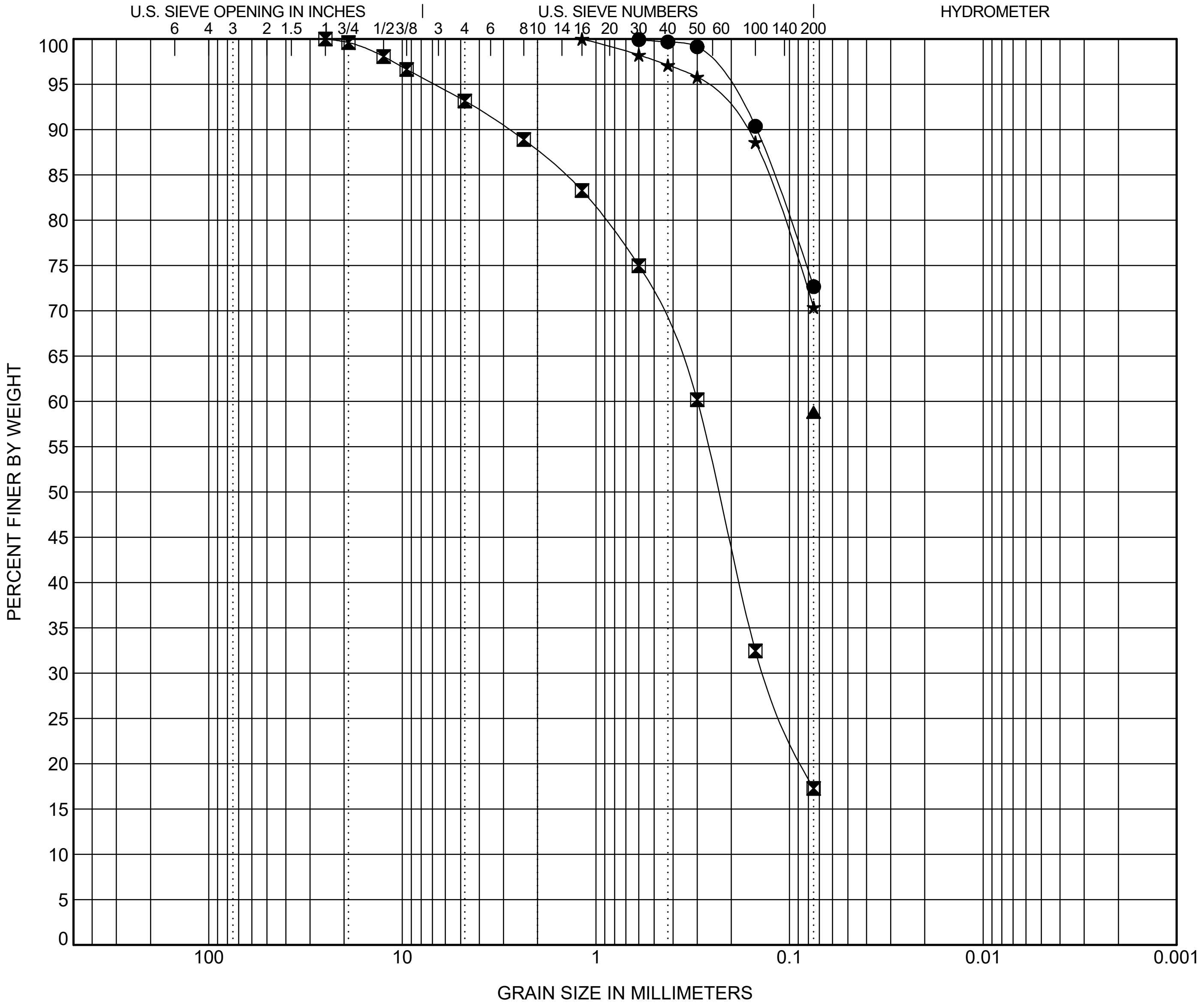

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-6**	**65.0**	**FAT CLAY with SAND(CH)**	**58**	**22**	**36**		
⧗	**B-6**	**70.0**	**CLAYEY SAND(SC)**	**80**	**28**	**52**		
▲	**B-6**	**72.0**	**Sandy LEAN CLAY**					
★	**B-6**	**80.0**	**ELASTIC SILT with SAND(MH)**	**98**	**44**	**54**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-6**	**65.0**	**0.6**					**27.3**	**72.7**	
⧗	**B-6**	**70.0**	**25**	**0.299**	**0.134**		**6.8**	**75.9**	**17.3**	
▲	**B-6**	**72.0**	**0.075**						**58.8**	
★	**B-6**	**80.0**	**1.18**				**0.0**	**29.6**	**70.4**	

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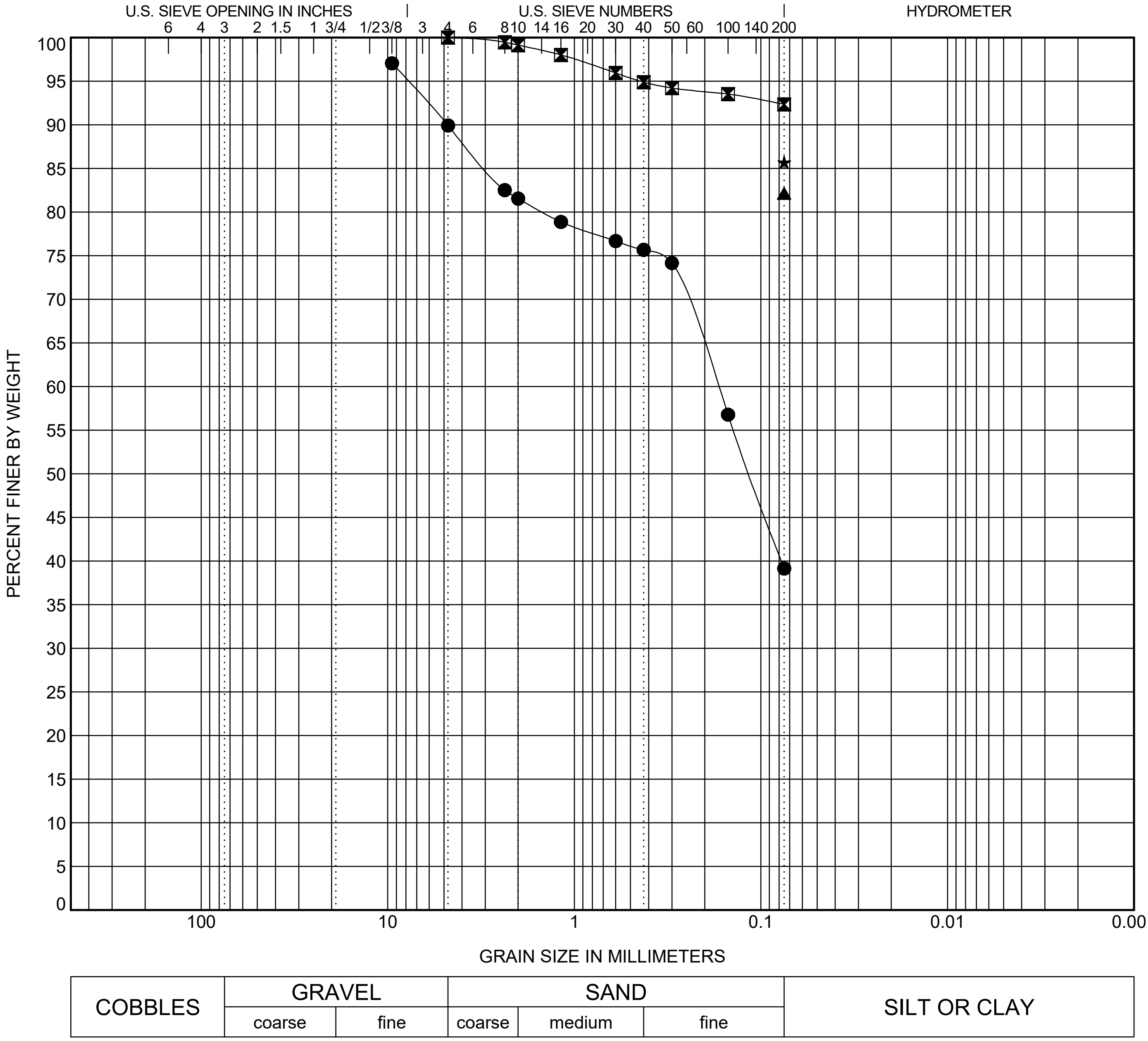
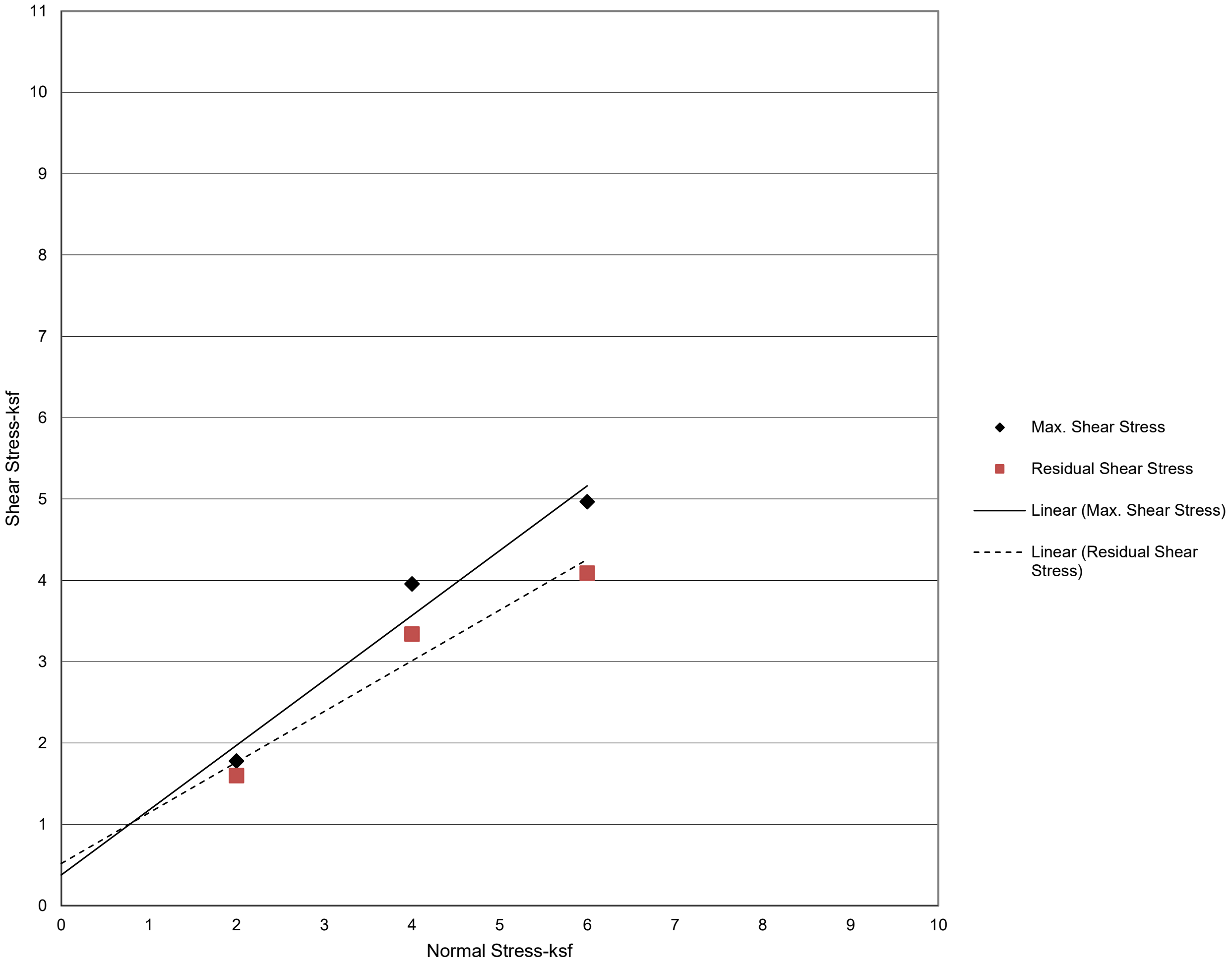


BOREHOLE		DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-7**	**10.0**	**CLAYEY SAND(SC)**	**28**	**19**	**9**		
☒	**B-7**	**25.0**	**SILT(ML)**	**37**	**25**	**12**		
▲	**B-7**	**52.0**	**FAT CLAY with SAND(CH)**	**55**	**20**	**35**		
★	**B-7**	**81.8**	**FAT CLAY(CH)**	**70**	**28**	**42**		

BOREHOLE		DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-7**	**10.0**	**9.5**	**0.171**			**7.1**	**50.8**	**39.1**	
☒	**B-7**	**25.0**	**4.75**				**0.0**	**7.7**	**92.3**	
▲	**B-7**	**52.0**	**0.075**						**82.1**	
★	**B-7**	**81.8**	**0.075**						**85.7**	

Direct Shear Test Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	1.8	1.6				
	4.0	4.0	3.3				
	6.0	5.0	4.1				

Sample Type: Ring **Test Condition:** In-situ **Sample Location:** B-1 @ 40 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	380
Friction Angle (degrees):	38.6
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	520
Friction Angle (degrees):	31.9
Shear Rate (in/min)	0.02

	Lab ID:	**Project No.** **G-19-192**
	Sample Date:	

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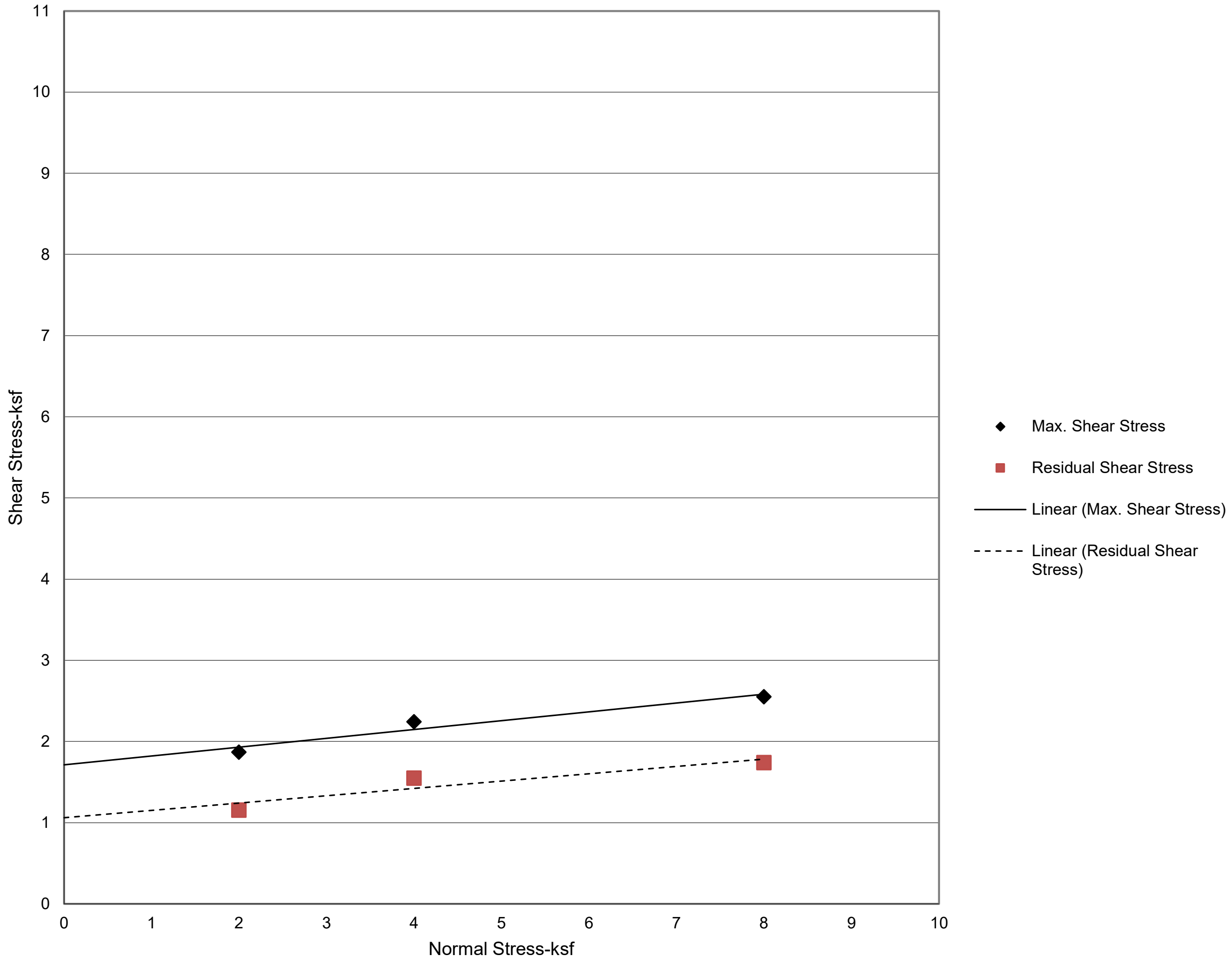
Project Engineer

Direct Shear Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	1.9	1.2				
	4.0	2.2	1.6				
	8.0	2.6	1.7				

Sample Type: Ring **Test Condition:** Submerged in water **Sample Location:** B1 @ 70 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	1710
Friction Angle (degrees):	6.2
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	1061
Friction Angle (degrees):	5.2
Shear Rate (in/min)	0.02

Lab ID:

Sample Date:

Project No.

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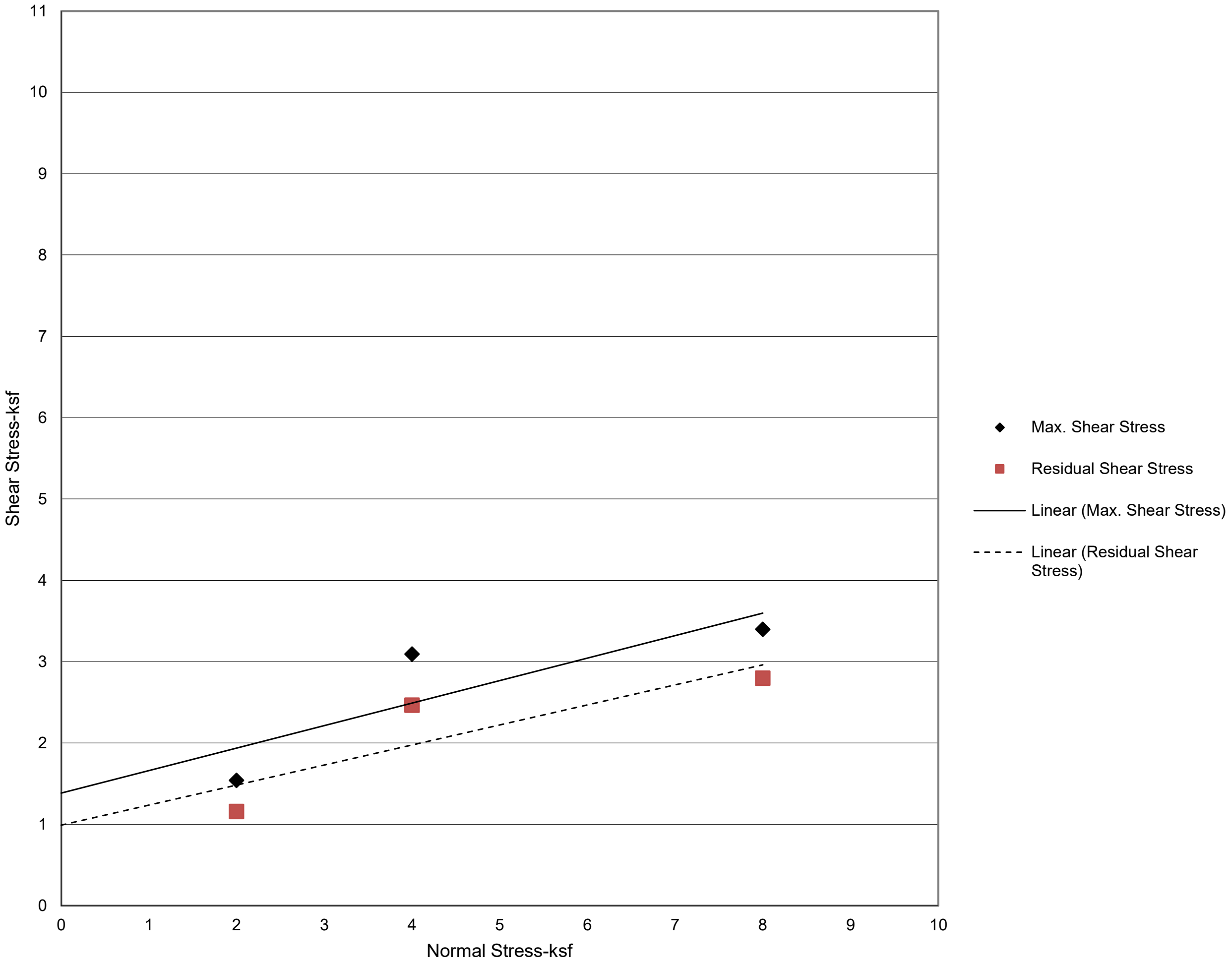
Direct Shear Test Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	1.5	1.2				
	4.0	3.1	2.5				
	8.0	3.3	2.8				

Sample Type: Ring **Test Condition:** Submerged in water **Sample Location:** B-2 @ 30 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	1390
Friction Angle (degrees):	15.5
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	991
Friction Angle (degrees):	13.8
Shear Rate (in/min)	0.02

Lab ID:

Sample Date: 1/6/2020

Project No.

G-19-192

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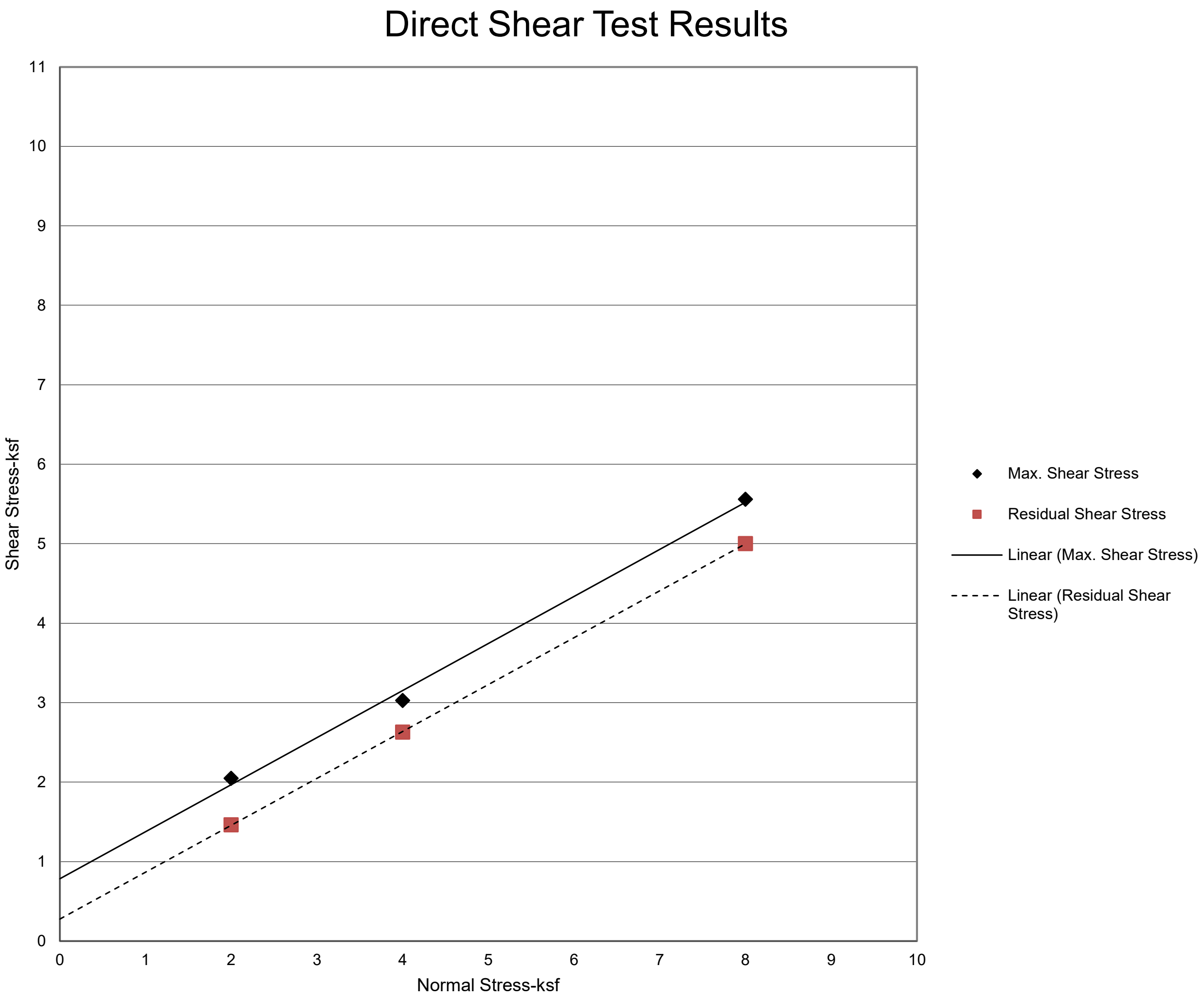

Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	2.0	1.5				
	4.0	3.0	2.6				
	8.0	5.6	5.0				

Sample Type: Ring **Test Condition:** Submerged in water **Sample Location:** B-2 @ 60 feet

Maximum Shear Stress Test Results

Cohesion (psf):	780
Friction Angle (degrees):	30.6
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	278
Friction Angle (degrees):	30.6
Shear Rate (in/min)	0.02

	Lab ID: **Sample Date: 1/6/2020**	**Project No.** **G-19-192**

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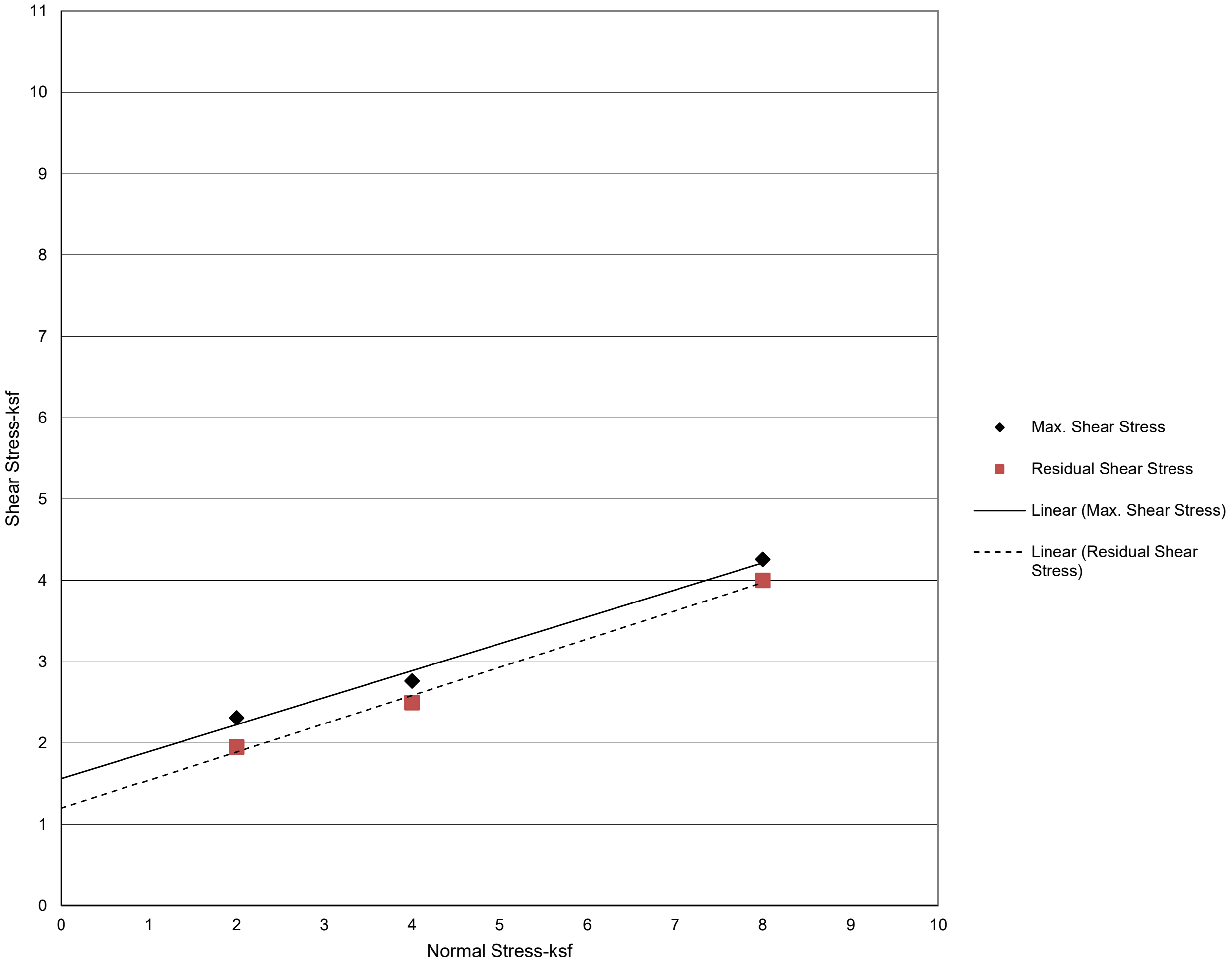
Direct Shear Test Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	2.3	2.0				
	4.0	2.8	2.5				
	8.0	4.3	4.0				

Sample Type: Ring **Test Condition:** Submerged in water **Sample Location:** B-3 @ 20 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	1560
Friction Angle (degrees):	18.3
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	1200
Friction Angle (degrees):	19.1
Shear Rate (in/min)	0.02

Lab ID:

Sample Date:

Project No.

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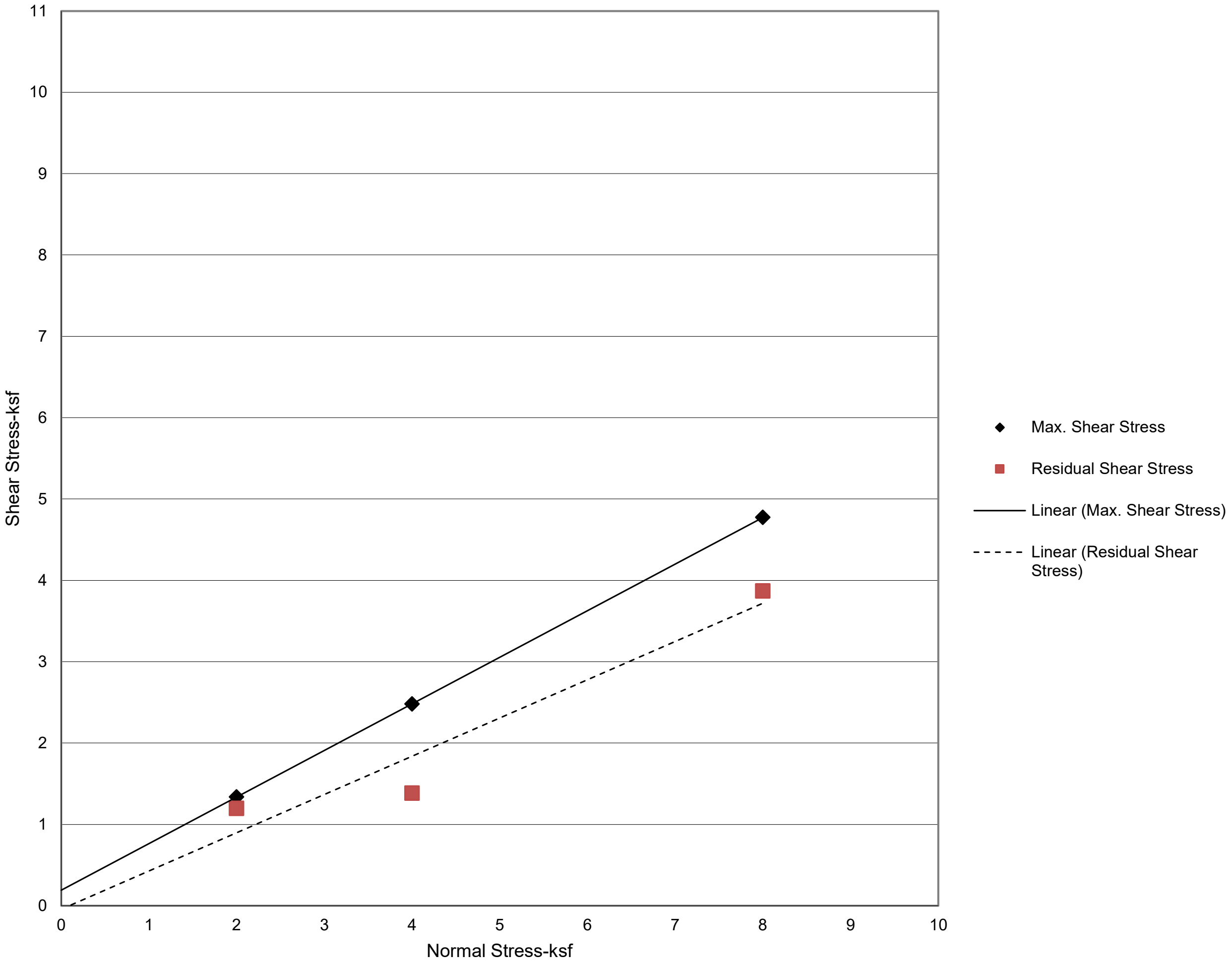
Direct Shear Test Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	1.3	1.2				
	4.0	2.5	1.4				
	8.0	4.8	3.9				

Sample Type: Ring **Test Condition:** Submerged in water **Sample Location:** B-3 @ 60 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	190
Friction Angle (degrees):	29.8
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	0
Friction Angle (degrees):	25.3
Shear Rate (in/min)	0.02

Lab ID:

Sample Date:

Project No.

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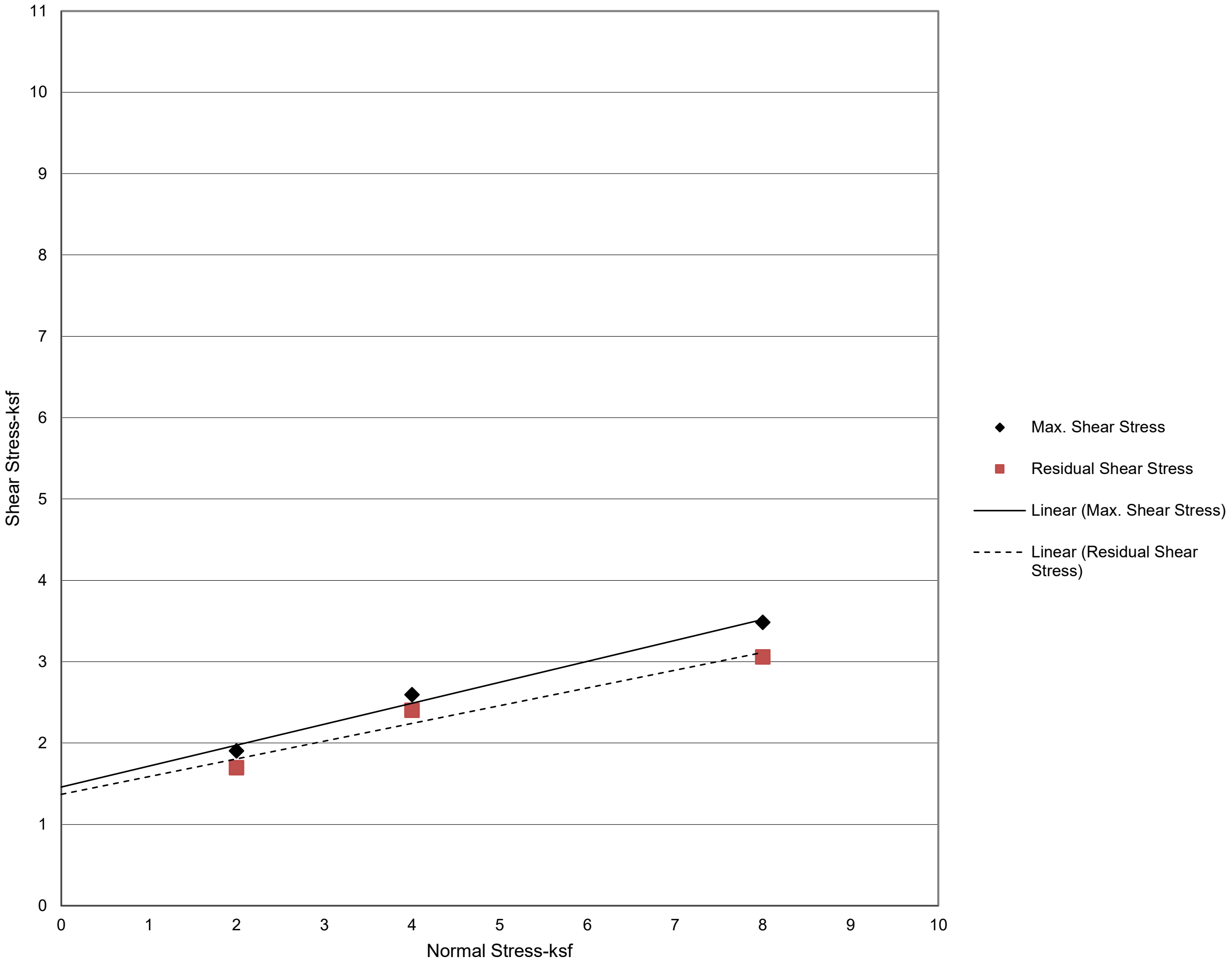
Direct Shear Test Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	1.9	1.7				
	4.0	2.6	2.4				
	8.0	3.5	3.1				

Sample Type: Ring **Test Condition:** Submerged in water **Sample Location:** B-4 @ 15 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	1460
Friction Angle (degrees):	14.4
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	1372
Friction Angle (degrees):	12.3
Shear Rate (in/min)	0.02

Lab ID:

Sample Date:

Project No.

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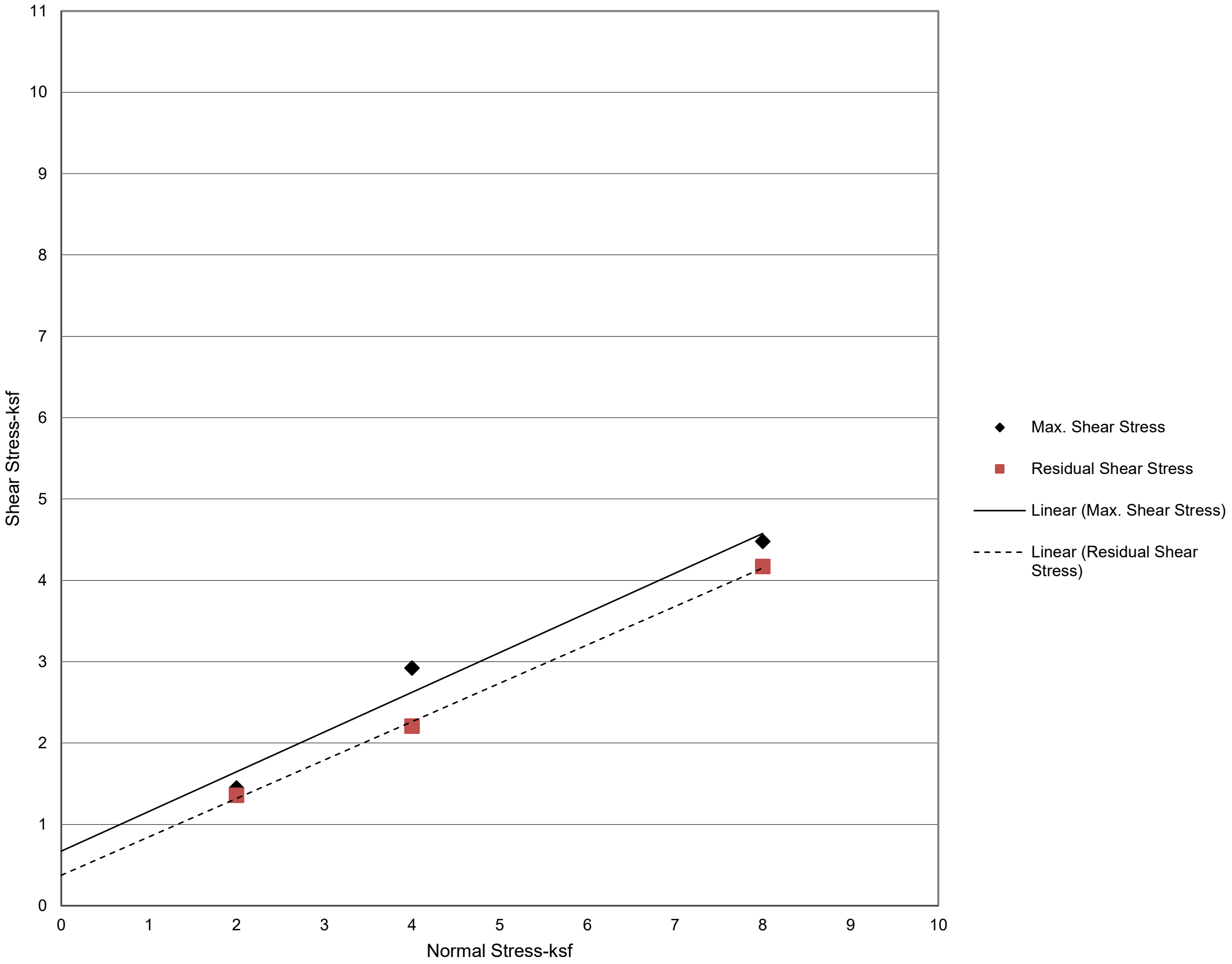
Direct Shear Test Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	1.4	1.4				
	4.0	2.9	2.2				
	8.0	4.5	4.2				

Sample Type: Ring **Test Condition:** Submerged in water **Sample Location:** B-4 @ 25 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	670
Friction Angle (degrees):	26.0
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	377
Friction Angle (degrees):	25.3
Shear Rate (in/min)	0.02

Lab ID:

Sample Date:

Project No.

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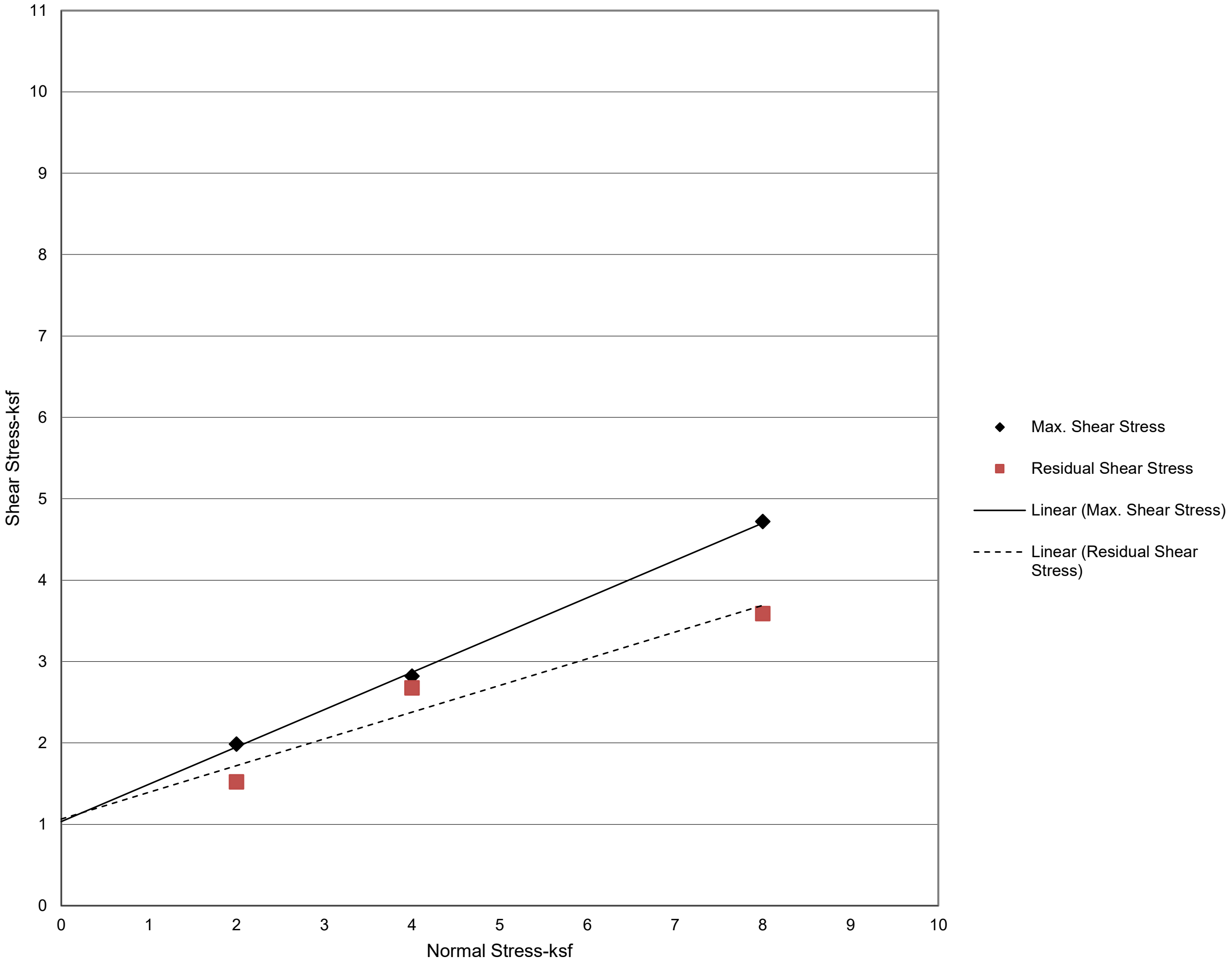
Direct Shear Test Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	2.0	1.5				
	4.0	2.8	2.7				
	8.0	4.7	3.6				

Sample Type: Ring **Test Condition:** Submerged in water **Sample Location:** B4 @ 55 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	1040
Friction Angle (degrees):	24.6
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	1065
Friction Angle (degrees):	18.2
Shear Rate (in/min)	0.02

Lab ID:

Sample Date:

Project No.

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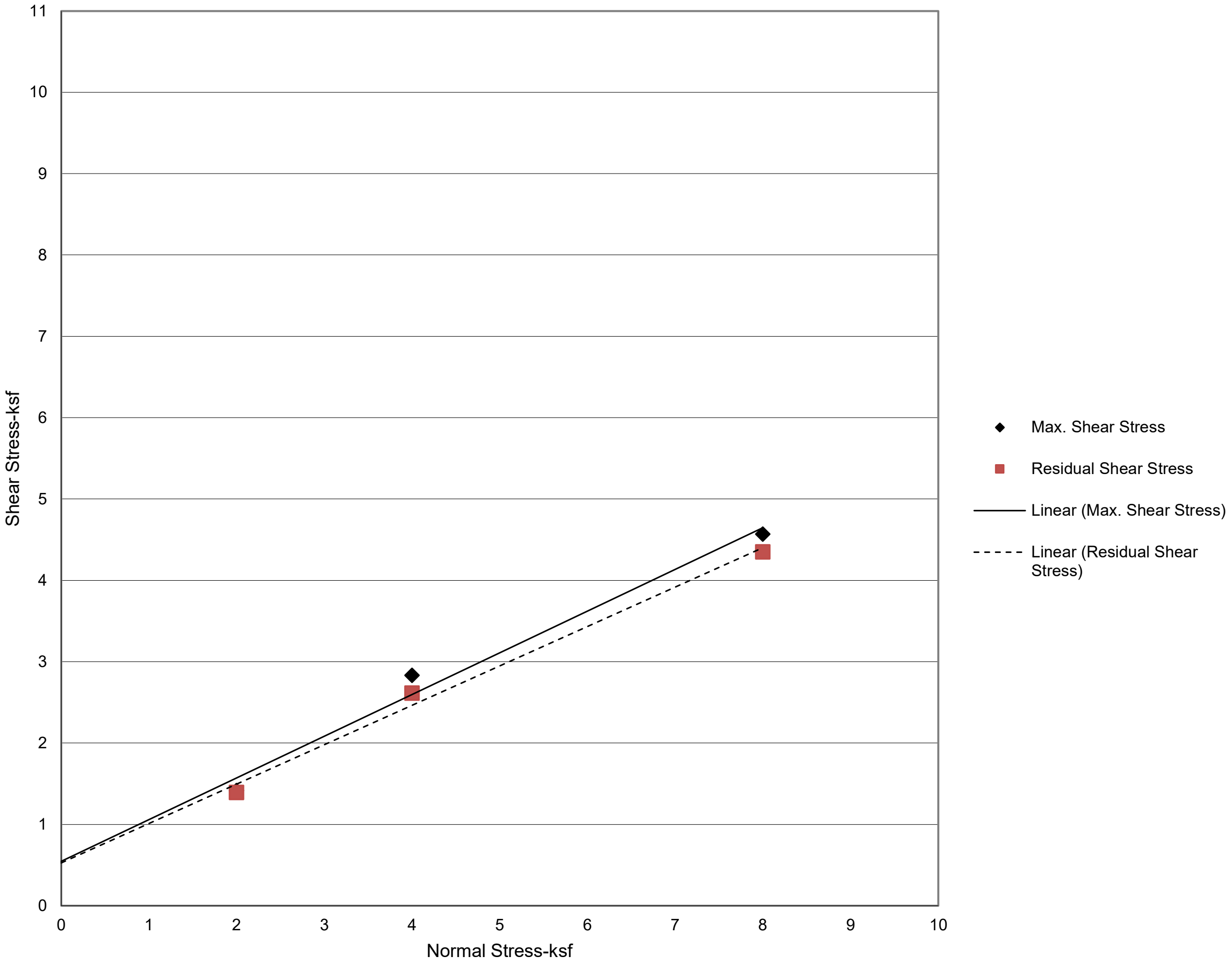
Direct Shear Test Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	1.4	1.4				
	4.0	2.8	2.6				
	8.0	4.6	4.4				

Sample Type: Ring **Test Condition:** Submergged in water **Sample Location:** B-5 @ 10 FT.

Maximum Shear Stress Test Results

Cohesion (psf):	550
Friction Angle (degrees):	27.1
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	526
Friction Angle (degrees):	25.8
Shear Rate (in/min)	0.02

	Lab ID:	**Project No.** **G-19-192**
	Sample Date:	

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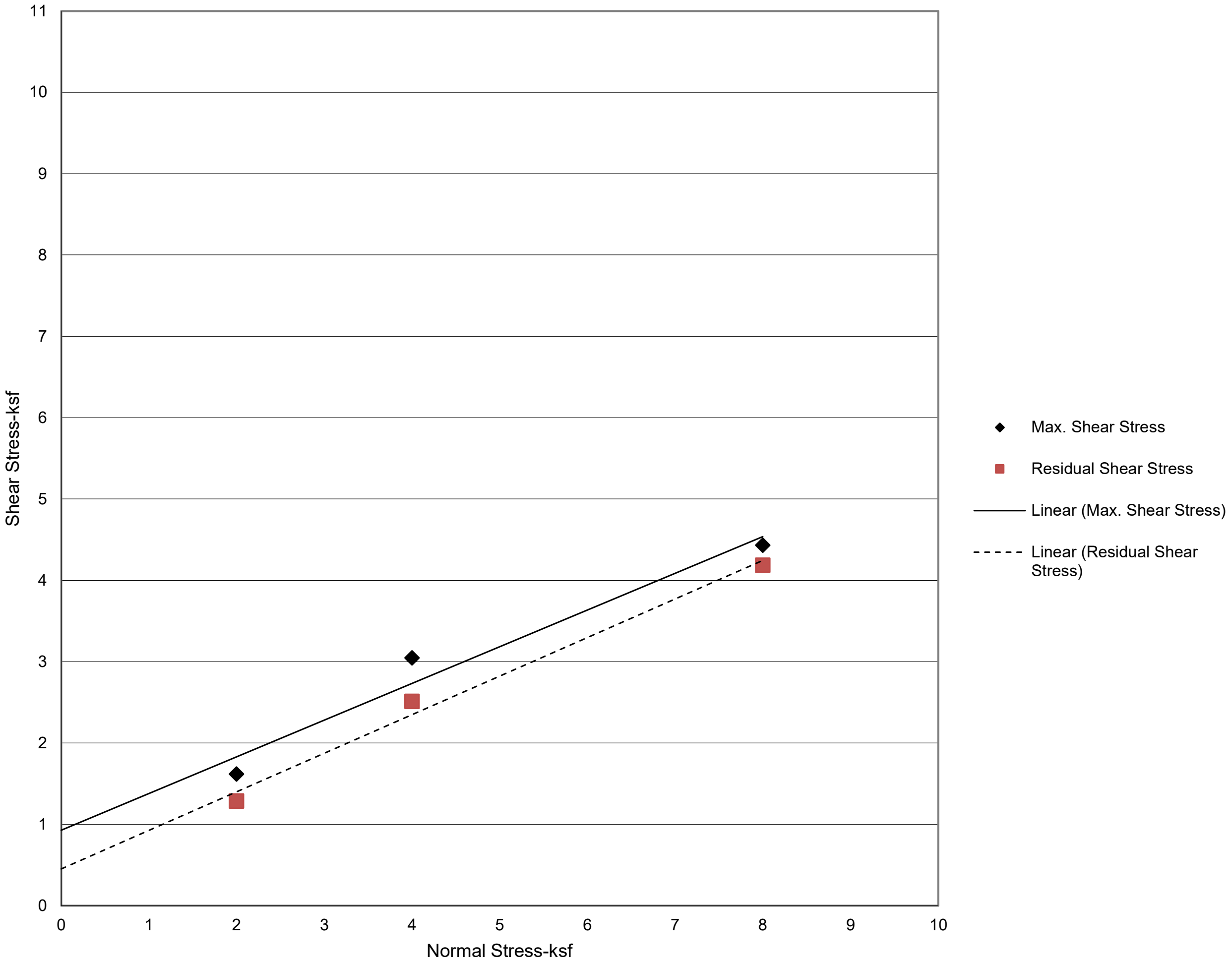

Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	1.6	1.3				
	4.0	3.0	2.5				
	8.0	4.4	4.2				

Sample Type: Ring **Test Condition:** Submerged in water **Sample Location:** B-5 @ 40 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	930
Friction Angle (degrees):	24.3
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	453
Friction Angle (degrees):	25.4
Shear Rate (in/min)	0.02

Lab ID:

Sample Date:

Project No.

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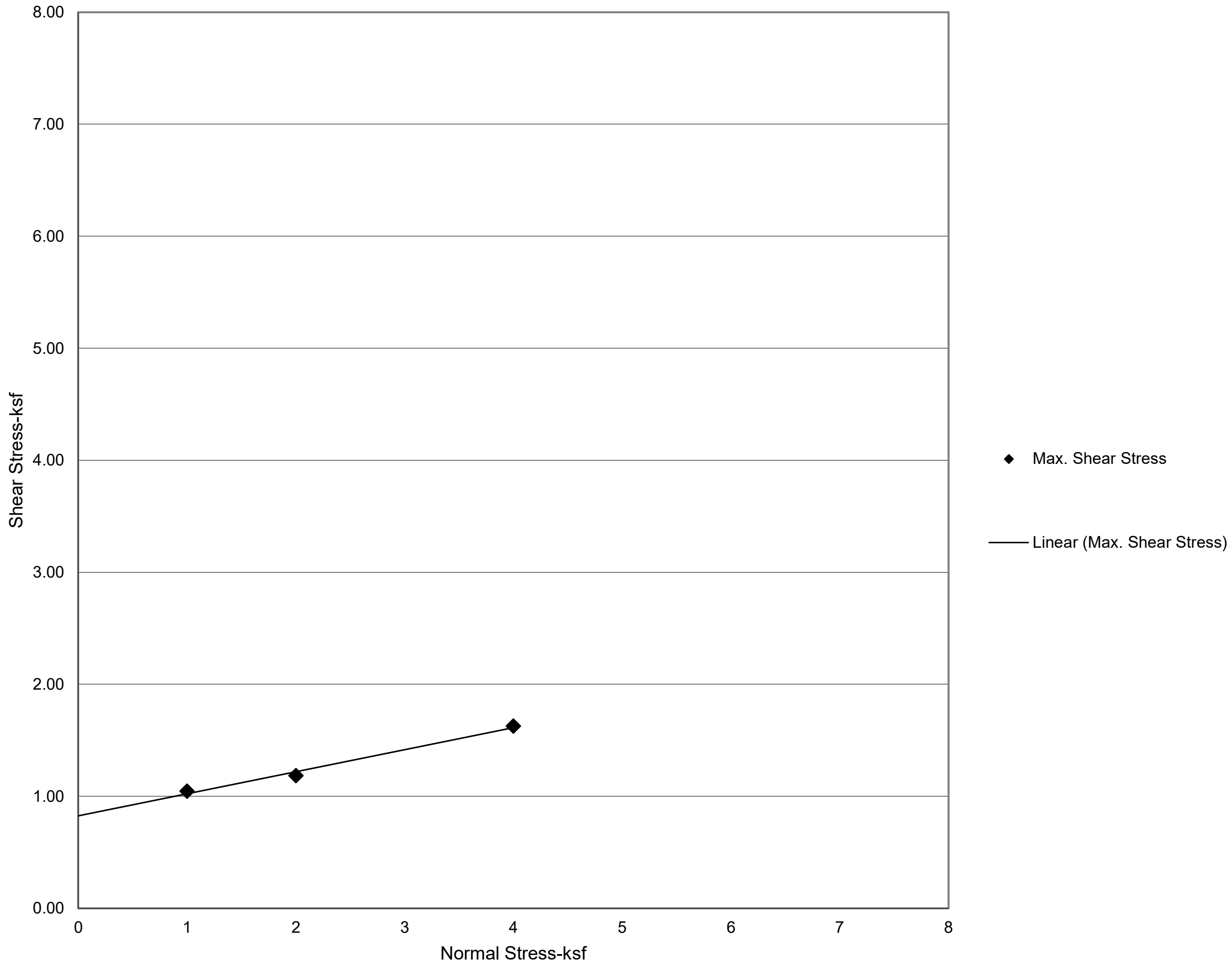
Direct Shear Test Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	1.0	1.0					
	2.0	1.2					
	4.0	1.6					

Sample Type: Ring **Test Condition:** Submergged in water **Sample Location:** B-6 @ 15 FT.

Maximum Shear Stress Test Results

Cohesion (psf):	830
Friction Angle (degrees):	11.2
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	
Friction Angle (degrees):	
Shear Rate (in/min)	

Lab ID:

Sample Date:

Project No.

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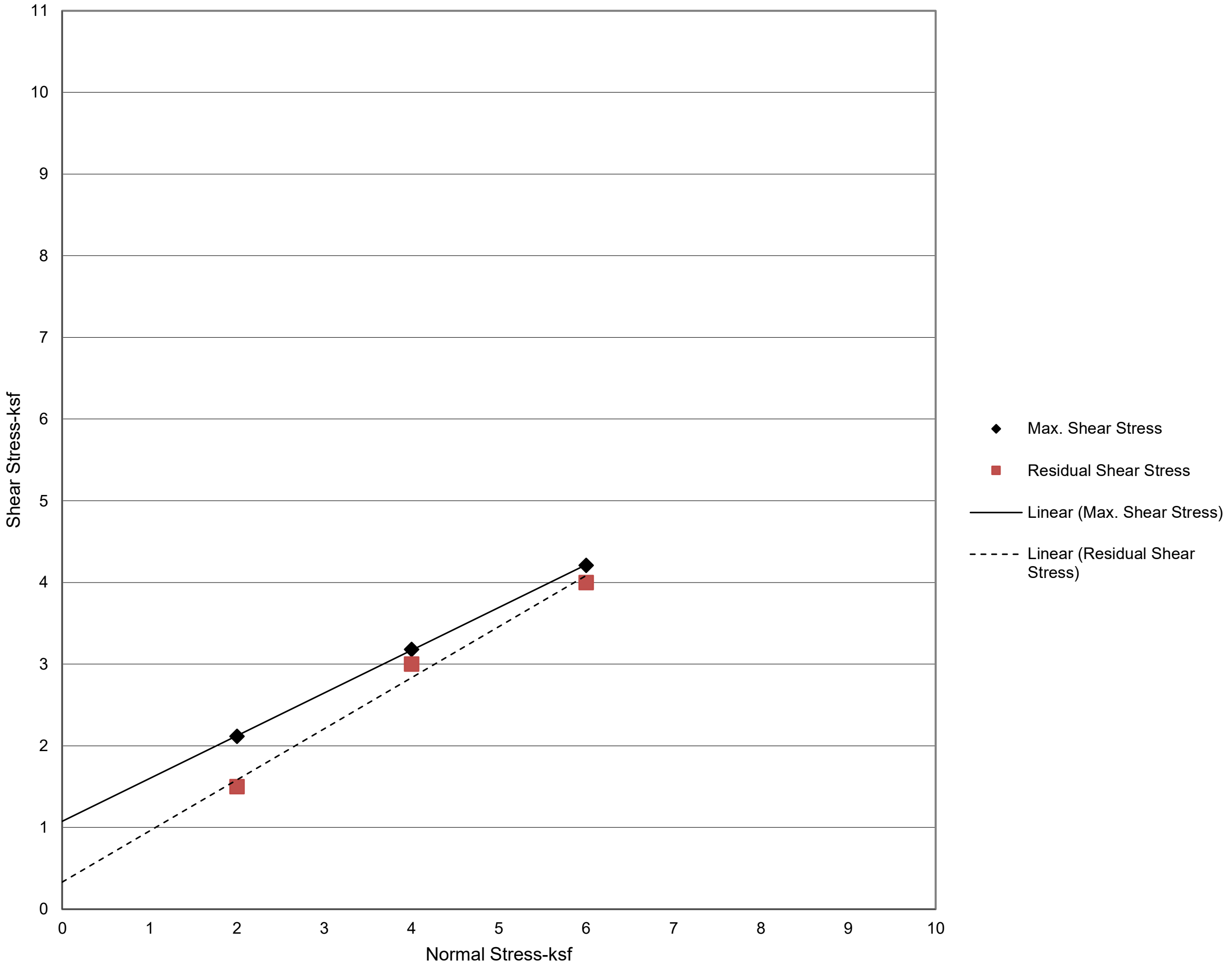

Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	2.1	1.5				
	4.0	3.2	3.0				
	6.0	4.2	4.0				

Sample Type: Ring **Test Condition:** In-situ **Sample Location:** B-6 @ 95 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	1070
Friction Angle (degrees):	27.6
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	333
Friction Angle (degrees):	32.0
Shear Rate (in/min)	0.02

Lab ID:

Sample Date:

Project No.

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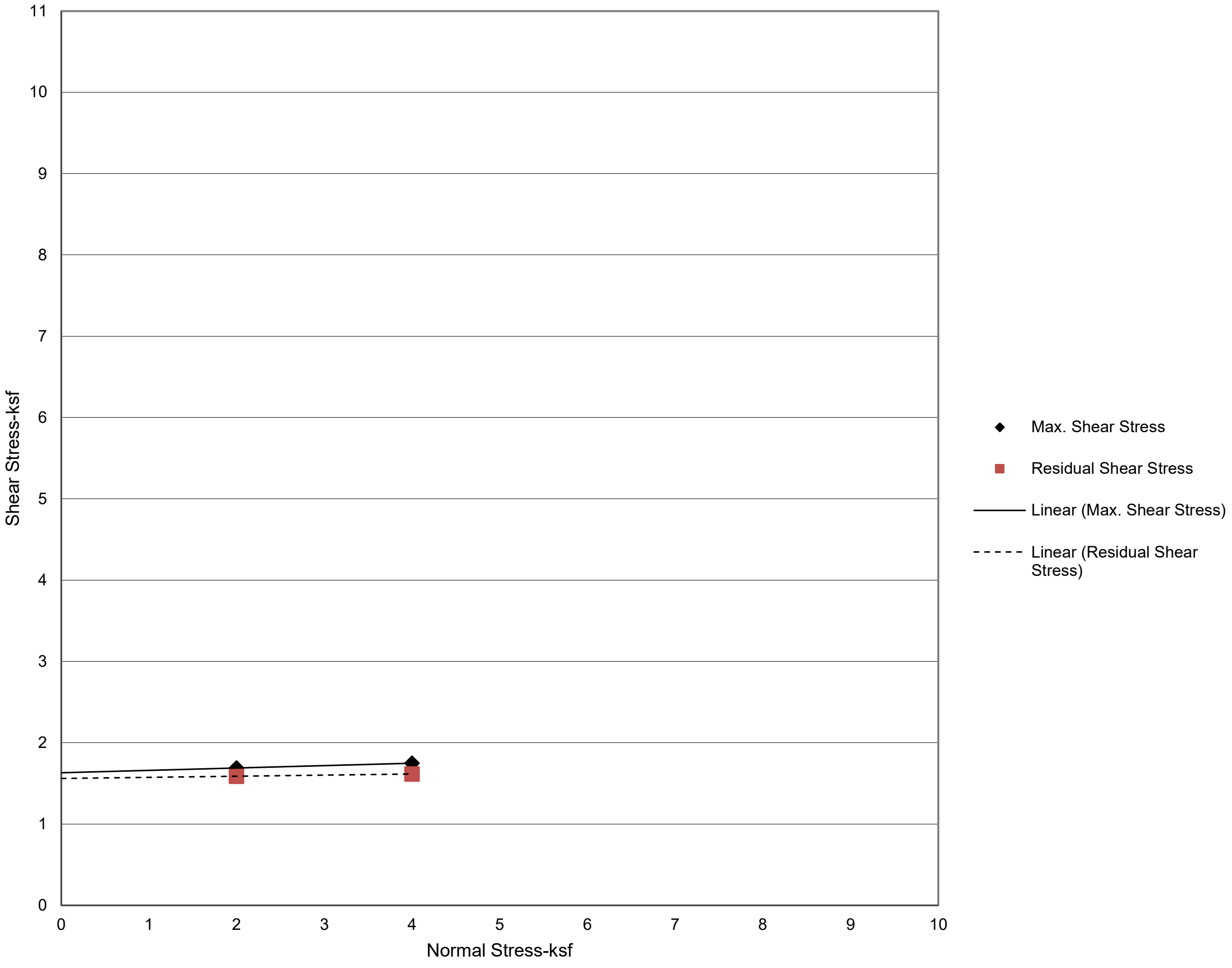
Direct Shear Test Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	1.7	1.6				
	4.0	1.7	1.6				

Sample Type: Ring **Test Condition:** Submerged in water **Sample Location:** B-7 @ 5 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	1630
Friction Angle (degrees):	1.6
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	1563
Friction Angle (degrees):	0.8
Shear Rate (in/min)	0.02

Lab ID:

Sample Date:

Project No.

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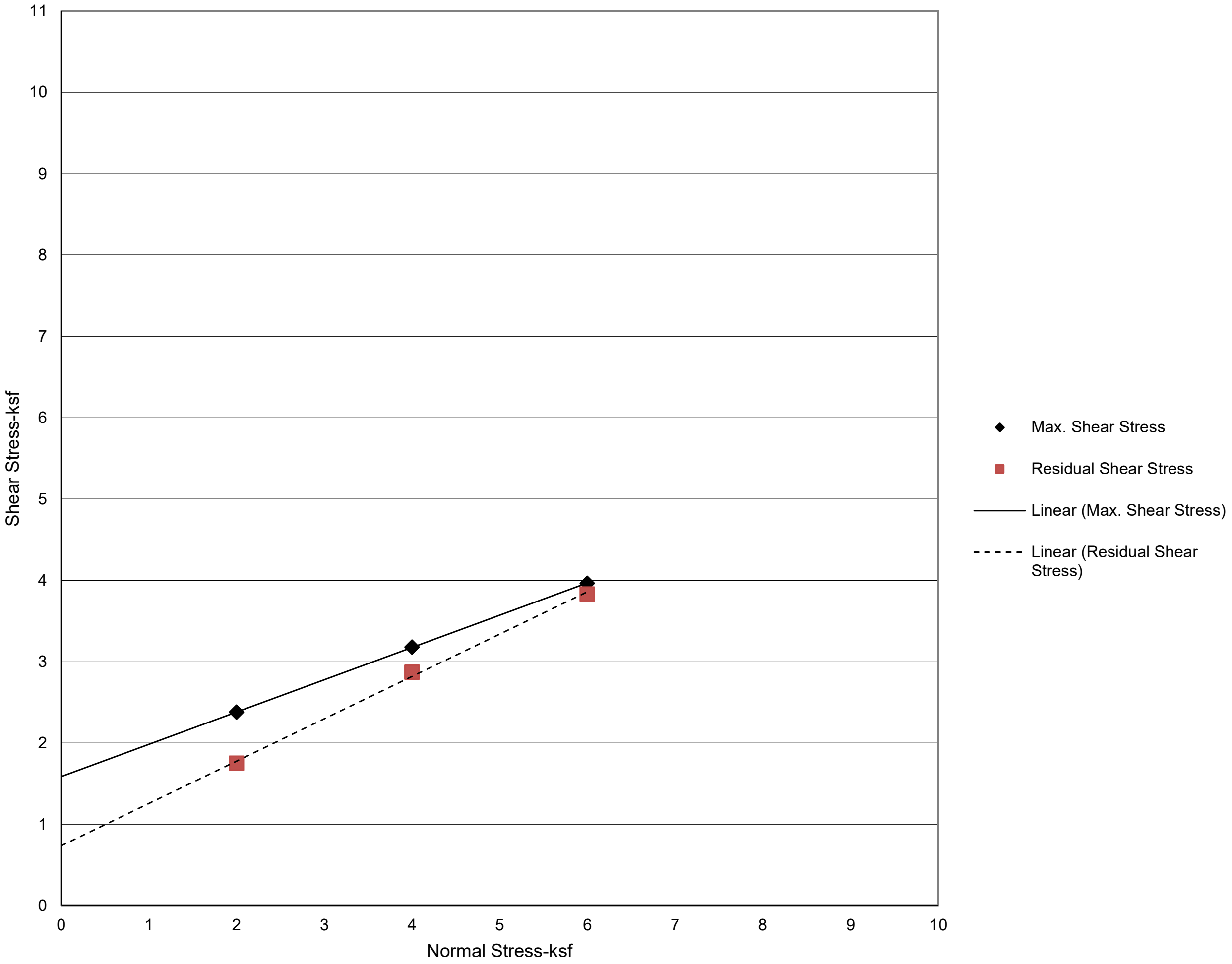
Direct Shear Test Results



Maximum Density= pcf Optimum Moisture %

Sample No.	Normal Stress (ksf)	Maximum Shear Stress (ksf)	Residual Shear Stress (ksf)	Wet Density (psf)	Moisture Content (%)	Dry Density (psf)	Compaction (%)
	2.0	2.4	1.8				
	4.0	3.2	2.9				
	6.0	4.0	3.8				

Sample Type: Ring **Test Condition:** In-situ **Sample Location:** B-7 @ 65 ft.

Maximum Shear Stress Test Results

Cohesion (psf):	1590
Friction Angle (degrees):	21.6
Shear Rate (in/min)	0.02

Residual Shear Stress Test Results

Cohesion (psf):	739
Friction Angle (degrees):	27.5
Shear Rate (in/min)	0.02

Lab ID:

Sample Date:

Project No.

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Project Engineer

Leighton

Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name: I-515 Charleston
Tested by: A. Santos
Date: 02/01/20
Project No: G-19-192
Checked by: J. Ward
Date: 02/06/20
Boring No.: B-1
Sample Type: Shelby
Sample No.: N/A
Depth(ft): 35.0
Sample Description: White lean clay (CL)

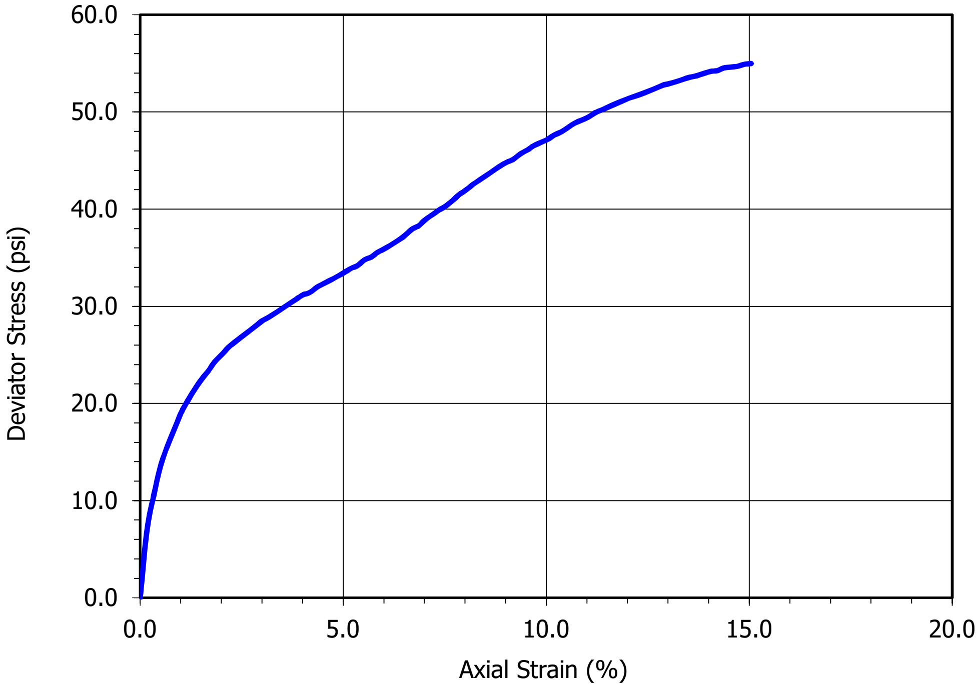
Diameter (in)	1	2.880
	2	2.885
	3	2.878
	Average	2.881
Height (in)	1	5.980
	2	5.982
	3	5.982
	Average	5.981
Weight of Sample + Tube / Rings (g)		1213.7
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1319.1
Weight of Dry Sample + Container (g)		1066.0
Weight of Container (g)		107.3
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		29.2
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	26.40
Dry Density (pcf)	93.8
Void Ratio	0.796
% Saturation	89.6

At Failure*	
Deviator stress (psi)	**54.99**
Minor principal total stress (psi)	**29.20**
Major principal total stress (psi)	**84.19**
Axial strain (%)	**15.05**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name:	I-515 Charleston	Tested by:	A. Santos	Date:	02/01/20
Project No:	G-19-192	Checked by:	J. Ward	Date:	02/06/20
Boring No.:	B-2	Sample Type:	Shelby		
Sample No.:	N/A	Depth(ft):	45.0		
Sample Description:	White clayey sand and lean clay (SC & CL)				

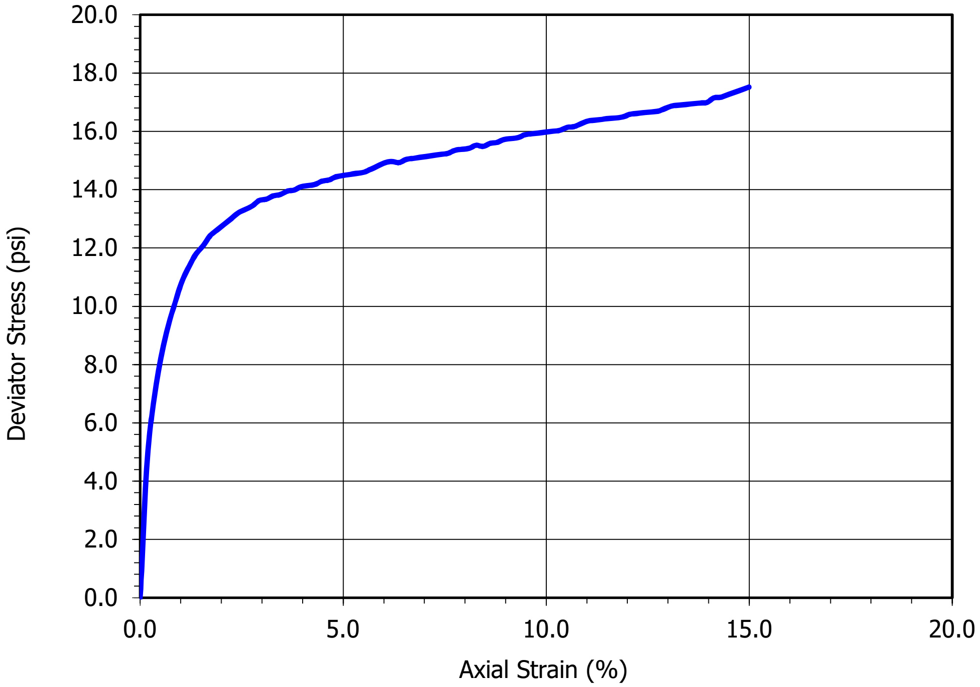
Diameter (in)	1	2.888
	2	2.875
	3	2.880
	Average	2.881
Height (in)	1	5.802
	2	5.801
	3	5.804
	Average	5.802
Weight of Sample + Tube / Rings (g)		1188.0
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1345.7
Weight of Dry Sample + Container (g)		1103.0
Weight of Container (g)		160.0
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		37.5
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	25.74
Dry Density (pcf)	95.2
Void Ratio	0.771
% Saturation	90.2

At Failure*	
Deviator stress (psi)	**17.52**
Minor principal total stress (psi)	**37.50**
Major principal total stress (psi)	**55.02**
Axial strain (%)	**14.99**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Leighton

Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name: I-515 Charleston
Project No: G-19-192
Boring No.: B-2
Sample No.: N/A
Sample Description: Reddish brown lean clay (CL)

Tested by: A. Santos Date: 02/01/20
Checked by: J. Ward Date: 02/06/20
Sample Type: Shelby
Depth(ft): 75.0

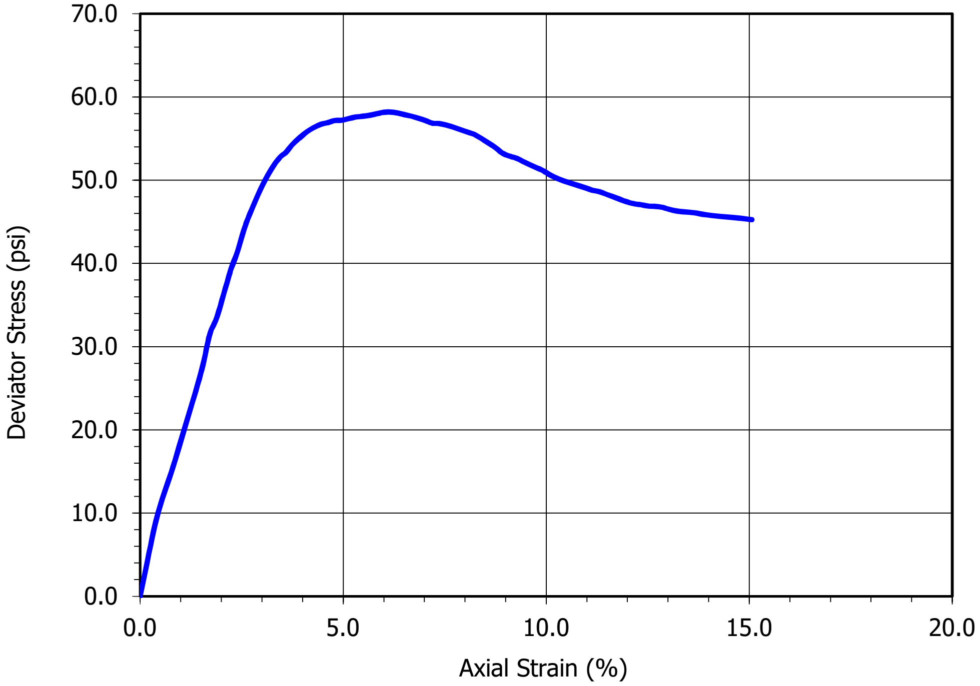
Diameter (in)	1	2.850
	2	2.860
	3	2.878
	Average	2.863
Height (in)	1	5.840
	2	5.841
	3	5.843
	Average	5.841
Weight of Sample + Tube / Rings (g)		1221.5
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1286.5
Weight of Dry Sample + Container (g)		1029.5
Weight of Container (g)		77.1
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		62.5
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	26.98
Dry Density (pcf)	97.5
Void Ratio	0.729
% Saturation	100.0

At Failure*	
Deviator stress (psi)	**58.19**
Minor principal total stress (psi)	**62.50**
Major principal total stress (psi)	**120.69**
Axial strain (%)	**6.16**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name:	I-515 Charleston	Tested by:	A. Santos	Date:	02/10/20
Project No:	G-19-192	Checked by:	J. Ward	Date:	02/13/20
Boring No.:	B-3	Sample Type:	Shelby		
Sample No.:	N/A	Depth(ft):	45.0		

Sample Description: White lean clay (CL), visible fracture noted

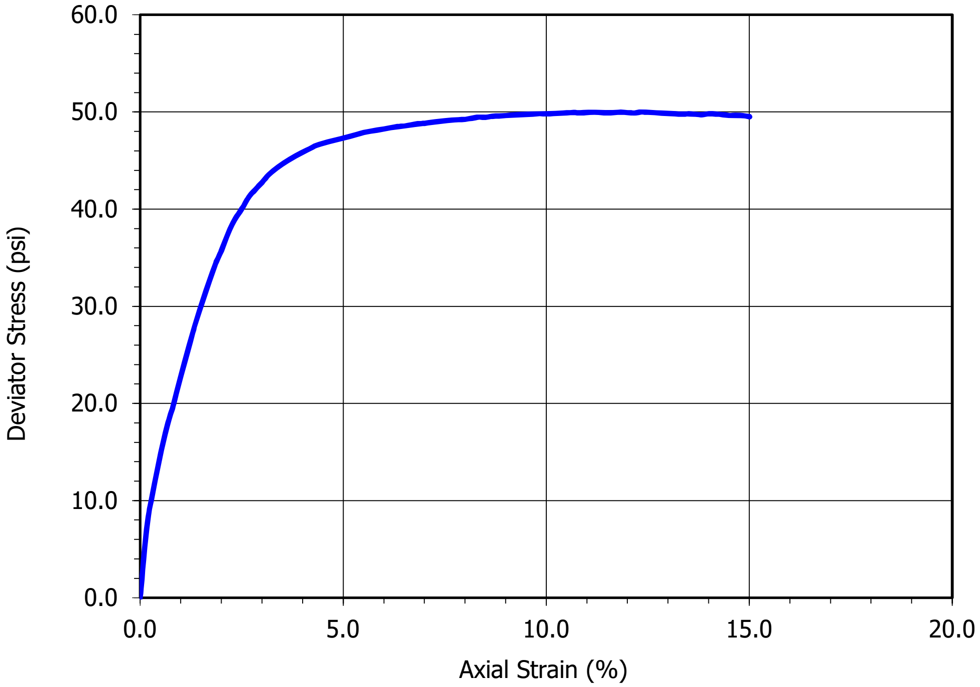
Diameter (in)	1	2.887
	2	2.886
	3	2.888
	Average	2.887
Height (in)	1	5.996
	2	5.996
	3	5.998
	Average	5.997
Weight of Sample + Tube / Rings (g)		1207.2
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1313.6
Weight of Dry Sample + Container (g)		1053.3
Weight of Container (g)		107.9
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		37.5
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	27.53
Dry Density (pcf)	91.9
Void Ratio	0.834
% Saturation	89.1

At Failure*	
Deviator stress (psi)	**50.00**
Minor principal total stress (psi)	**37.50**
Major principal total stress (psi)	**87.50**
Axial strain (%)	**12.34**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name:	I-515 Charleston	Tested by:	A. Santos	Date:	02/01/20
Project No:	G-19-192	Checked by:	J. Ward	Date:	02/06/20
Boring No.:	B-3	Sample Type:	Shelby		
Sample No.:	N/A	Depth(ft):	85.0		
Sample Description:	Reddish brown lean clay (CL)				

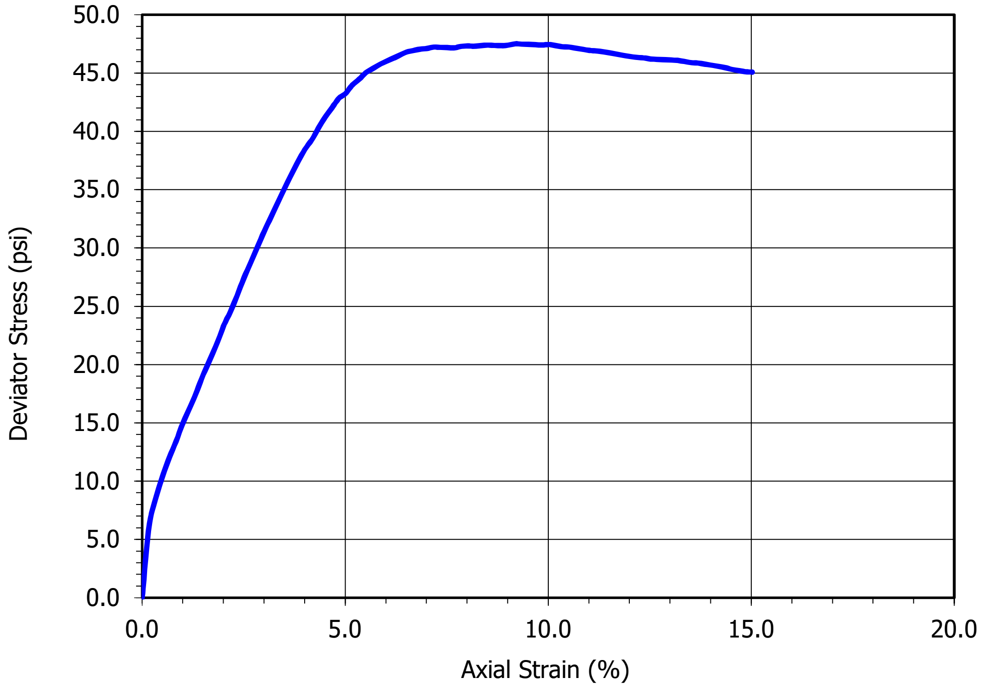
Diameter (in)	1	2.890
	2	2.885
	3	2.860
	Average	2.878
Height (in)	1	5.990
	2	5.990
	3	5.992
	Average	5.991
Weight of Sample + Tube / Rings (g)		1218.5
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1298.4
Weight of Dry Sample + Container (g)		1006.6
Weight of Container (g)		82.6
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		70.8
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	31.58
Dry Density (pcf)	90.5
Void Ratio	0.862
% Saturation	99.0

At Failure*	
Deviator stress (psi)	**47.51**
Minor principal total stress (psi)	**70.80**
Major principal total stress (psi)	**118.31**
Axial strain (%)	**9.18**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Leighton

Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name: I-515 Charleston
Project No: G-19-192
Boring No.: B-4
Sample No.: N/A
Sample Description: Reddish brown silty sand (SM)

Tested by: A. Santos
Checked by: J. Ward
Sample Type: Shelby
Depth(ft): 80.0

Date: 02/07/20
Date: 02/13/20

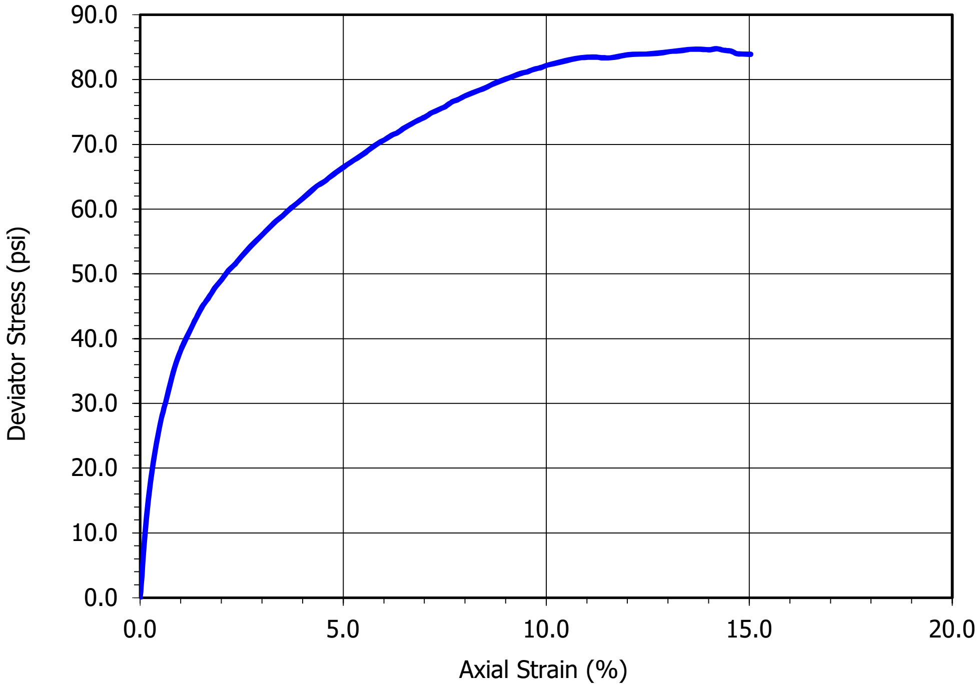
Diameter (in)	1	2.885
	2	2.885
	3	2.885
	Average	2.885
Height (in)	1	5.986
	2	5.985
	3	5.985
	Average	5.985
Weight of Sample + Tube / Rings (g)		1251.2
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1340.5
Weight of Dry Sample + Container (g)		1095.7
Weight of Container (g)		107.2
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		66.7
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	24.76
Dry Density (pcf)	97.6
Void Ratio	0.725
% Saturation	92.2

At Failure*	
Deviator stress (psi)	**84.77**
Minor principal total stress (psi)	**66.70**
Major principal total stress (psi)	**151.47**
Axial strain (%)	**14.20**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Leighton

Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name: I-515 Charleston
Project No: G-19-192
Boring No.: B-4
Sample No.: N/A
Sample Description: Reddish brown lean clay (CL)

Tested by: A. Santos
Checked by: J. Ward
Sample Type: Shelby
Depth(ft): 90.0

Date: 02/08/20
Date: 02/13/20

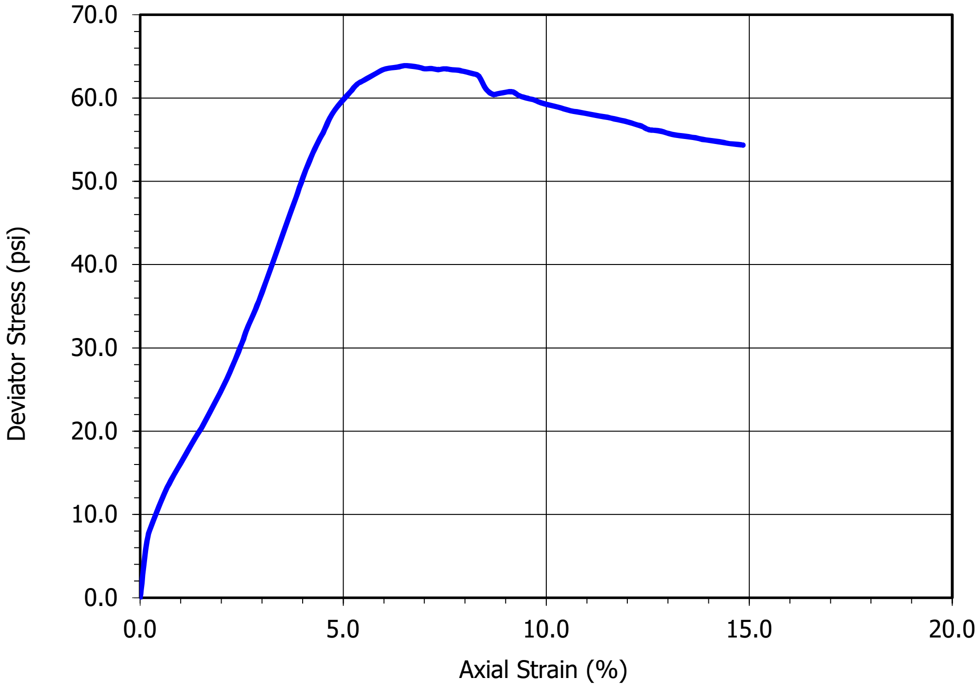
Diameter (in)	1	2.850
	2	2.855
	3	2.875
	Average	2.860
Height (in)	1	5.995
	2	5.994
	3	5.994
	Average	5.994
Weight of Sample + Tube / Rings (g)		1230.4
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1384.5
Weight of Dry Sample + Container (g)		1130.6
Weight of Container (g)		159.9
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		75.0
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	26.16
Dry Density (pcf)	96.5
Void Ratio	0.746
% Saturation	94.6

At Failure*	
Deviator stress (psi)	**63.89**
Minor principal total stress (psi)	**75.00**
Major principal total stress (psi)	**138.89**
Axial strain (%)	**6.51**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name: I-515 Charleston
Project No: G-19-192
Boring No.: B-5
Sample No.: N/A
Sample Description: Reddish brown lean clay (CL)

Tested by: A. Santos   Date: 02/12/20
Checked by: J. Ward   Date: 02/13/20
Sample Type: Shelby
Depth(ft): 85.0

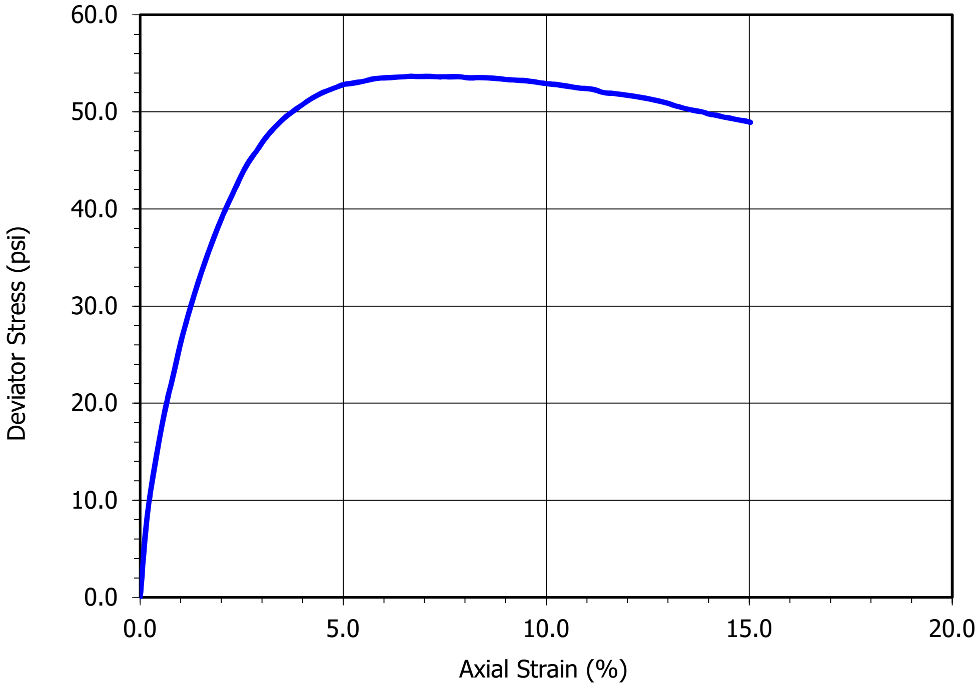
Diameter (in)	1	2.885
	2	2.885
	3	2.889
	Average	2.886
Height (in)	1	5.988
	2	5.989
	3	5.988
	Average	5.988
Weight of Sample + Tube / Rings (g)		1192.5
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1297.4
Weight of Dry Sample + Container (g)		988.0
Weight of Container (g)		109.6
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		70.8
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	35.22
Dry Density (pcf)	85.7
Void Ratio	0.965
% Saturation	98.6

At Failure*	
Deviator stress (psi)	**53.67**
Minor principal total stress (psi)	**70.80**
Major principal total stress (psi)	**124.47**
Axial strain (%)	**7.01**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name:	I-515 Charleston	Tested by:	A. Santos	Date:	05/08/20
Project No:	G-19-192	Checked by:	J. Ward	Date:	05/13/20
Boring No.:	B-6	Sample Type:	Shelby		
Sample No.:	N/A	Depth(ft):	50.0		
Sample Description:	Reddish brown sandy lean clay s(CL)				

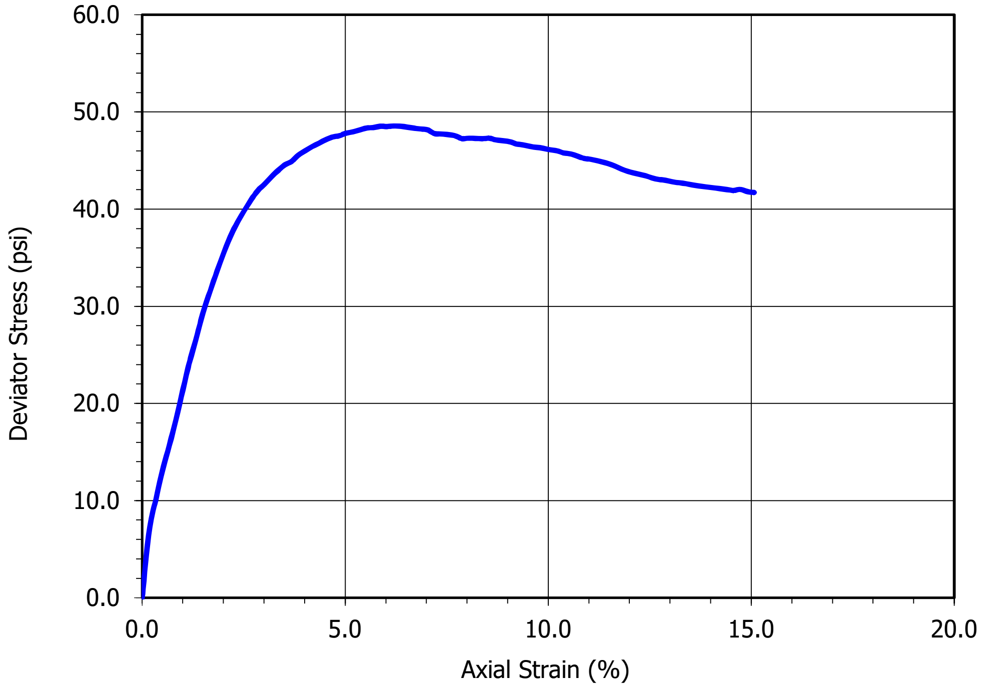
Diameter (in)	1	2.875
	2	2.875
	3	2.875
	Average	2.875
Height (in)	1	5.971
	2	5.972
	3	5.972
	Average	5.972
Weight of Sample + Tube / Rings (g)		1210.8
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1316.1
Weight of Dry Sample + Container (g)		1024.3
Weight of Container (g)		106.3
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		40.0
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	31.79
Dry Density (pcf)	90.3
Void Ratio	0.866
% Saturation	99.1

At Failure*	
Deviator stress (psi)	**48.55**
Minor principal total stress (psi)	**40.00**
Major principal total stress (psi)	**88.55**
Axial strain (%)	**6.20**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name: I-515 Charleston
Project No: G-19-192
Boring No.: B-6
Sample No.: N/A
Sample Description: Light brown clayey sand (SC)

Tested by: A. Santos
Checked by: J. Ward
Sample Type: Shelby
Depth(ft): 70.0

Date: 05/08/20
Date: 05/13/20

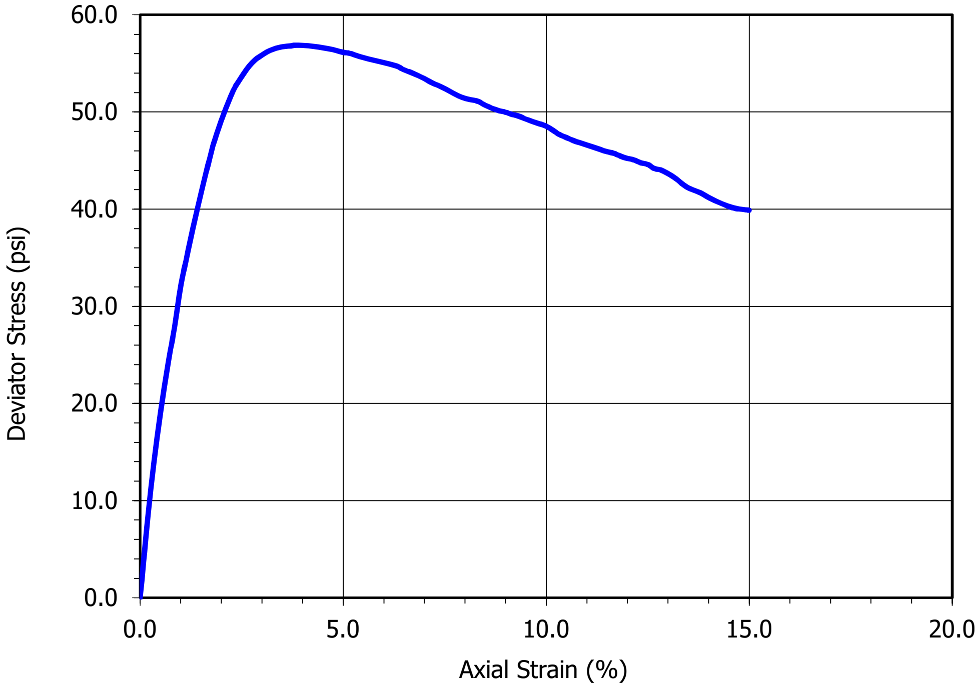
Diameter (in)	1	2.885
	2	2.885
	3	2.885
	Average	2.885
Height (in)	1	6.001
	2	6.002
	3	6.002
	Average	6.002
Weight of Sample + Tube / Rings (g)		972.8
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1080.4
Weight of Dry Sample + Container (g)		716.5
Weight of Container (g)		109.2
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		55.9
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	59.92
Dry Density (pcf)	59.1
Void Ratio	1.852
% Saturation	87.3

At Failure*	
Deviator stress (psi)	**56.88**
Minor principal total stress (psi)	**55.90**
Major principal total stress (psi)	**112.78**
Axial strain (%)	**3.83**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name: I-515 Charleston
Project No: G-19-192
Boring No.: B-7
Sample No.: N/A
Sample Description: Reddish brown lean clay (CL)

Tested by: A. Santos Date: 02/07/20
Checked by: J. Ward Date: 02/13/20
Sample Type: Shelby
Depth(ft): 50.0

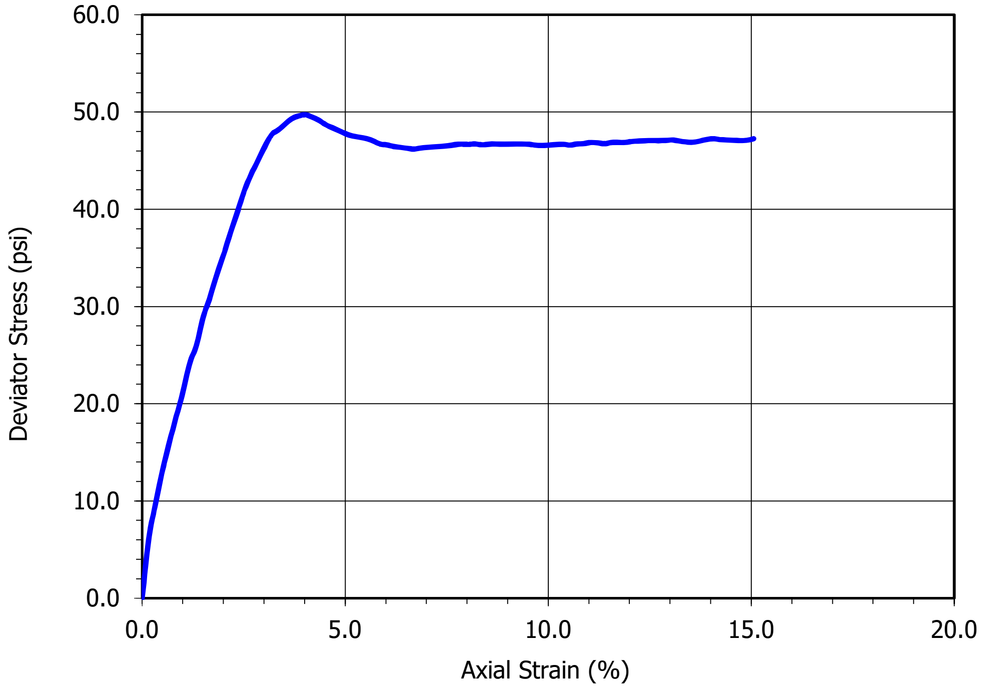
Diameter (in)	1	2.860
	2	2.863
	3	2.870
	Average	2.864
Height (in)	1	5.976
	2	5.978
	3	5.976
	Average	5.977
Weight of Sample + Tube / Rings (g)		1051.4
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1156.8
Weight of Dry Sample + Container (g)		824.7
Weight of Container (g)		106.1
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		41.7
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	46.21
Dry Density (pcf)	71.1
Void Ratio	1.369
% Saturation	91.2

At Failure*	
Deviator stress (psi)	**49.72**
Minor principal total stress (psi)	**41.70**
Major principal total stress (psi)	**91.42**
Axial strain (%)	**4.02**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Leighton

Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

AASHTO T 296

Project Name: I-515 Charleston
Project No: G-19-192
Boring No.: B-7
Sample No.: N/A
Sample Description: Reddish brown lean clay (CL)

Tested by: A. Santos Date: 02/10/20
Checked by: J. Ward Date: 02/13/20
Sample Type: Shelby
Depth(ft): 80.0

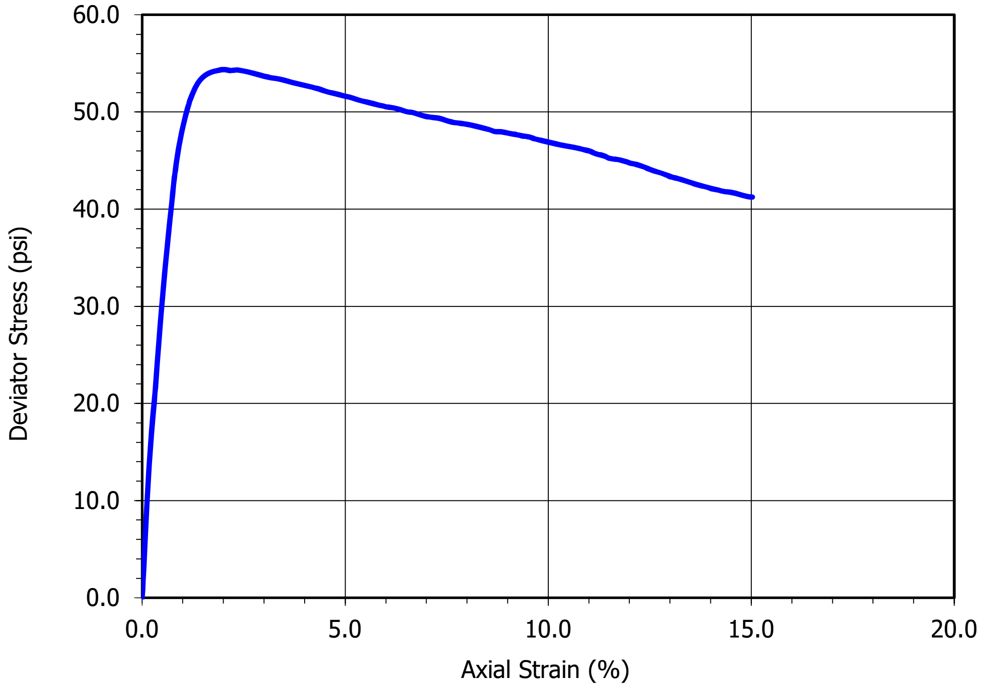
Diameter (in)	1	2.887
	2	2.886
	3	2.886
	Average	2.886
Height (in)	1	5.989
	2	5.989
	3	5.990
	Average	5.989
Weight of Sample + Tube / Rings (g)		1081.9
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		1239.7
Weight of Dry Sample + Container (g)		879.8
Weight of Container (g)		159.9
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		66.7
Rate of Deformation (in/min)		0.040

Sample Properties	
Moisture Content (%)	49.99
Dry Density (pcf)	70.1
Void Ratio	1.403
% Saturation	96.2

At Failure*	
Deviator stress (psi)	**54.37**
Minor principal total stress (psi)	**66.70**
Major principal total stress (psi)	**121.07**
Axial strain (%)	**2.00**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

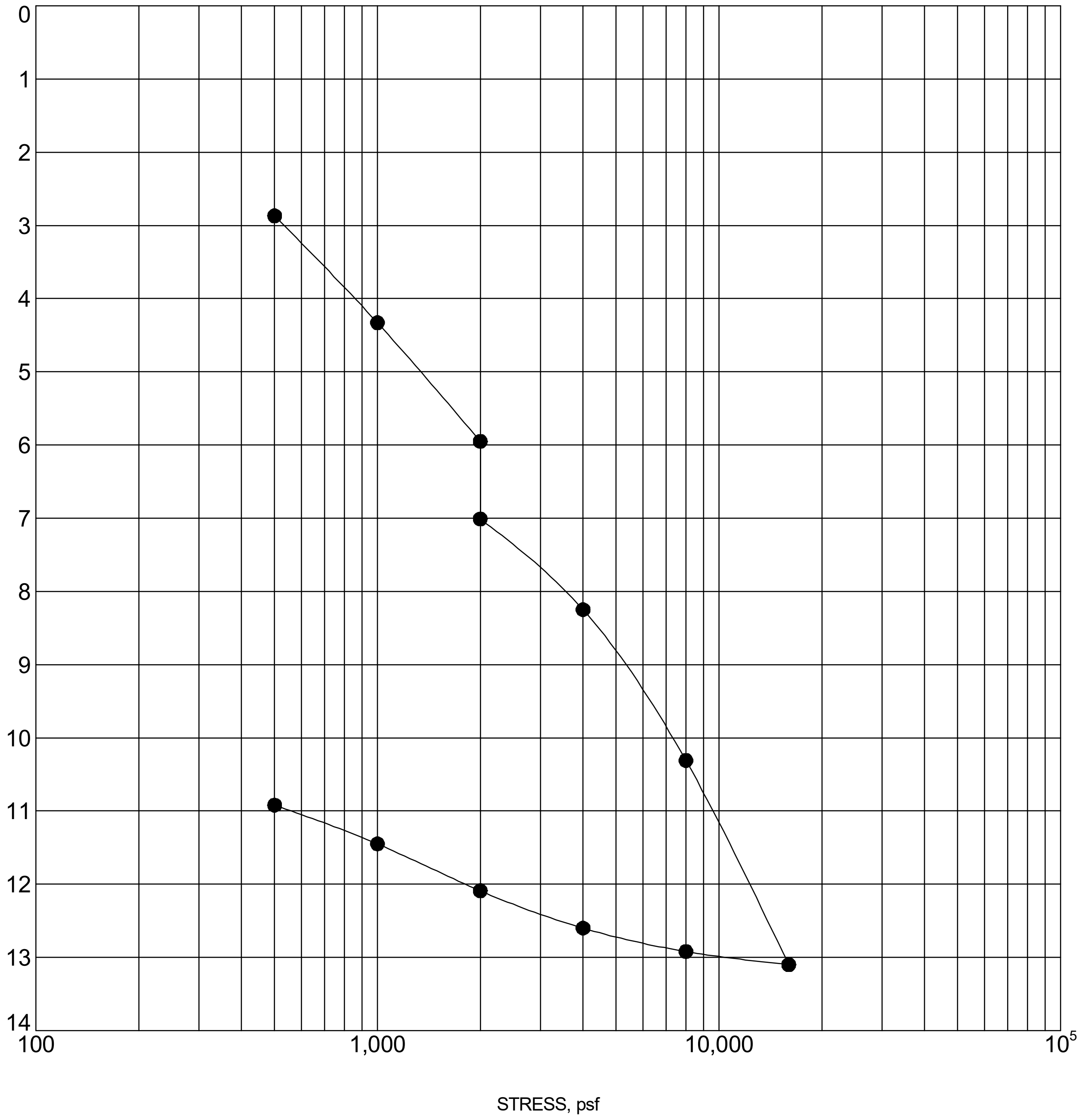
CONSOLIDATION TEST

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue



	BOREHOLE	DEPTH	Classification	γ_d	MC%
●	**B-1**	**70.0**	**Fat Clay**	**95**	**26**

CONSOL STRAIN - GINT STD US LAB.GDT - 2/14/20 11:40 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINTCL\PROJECTS\G-19-192.GPJ

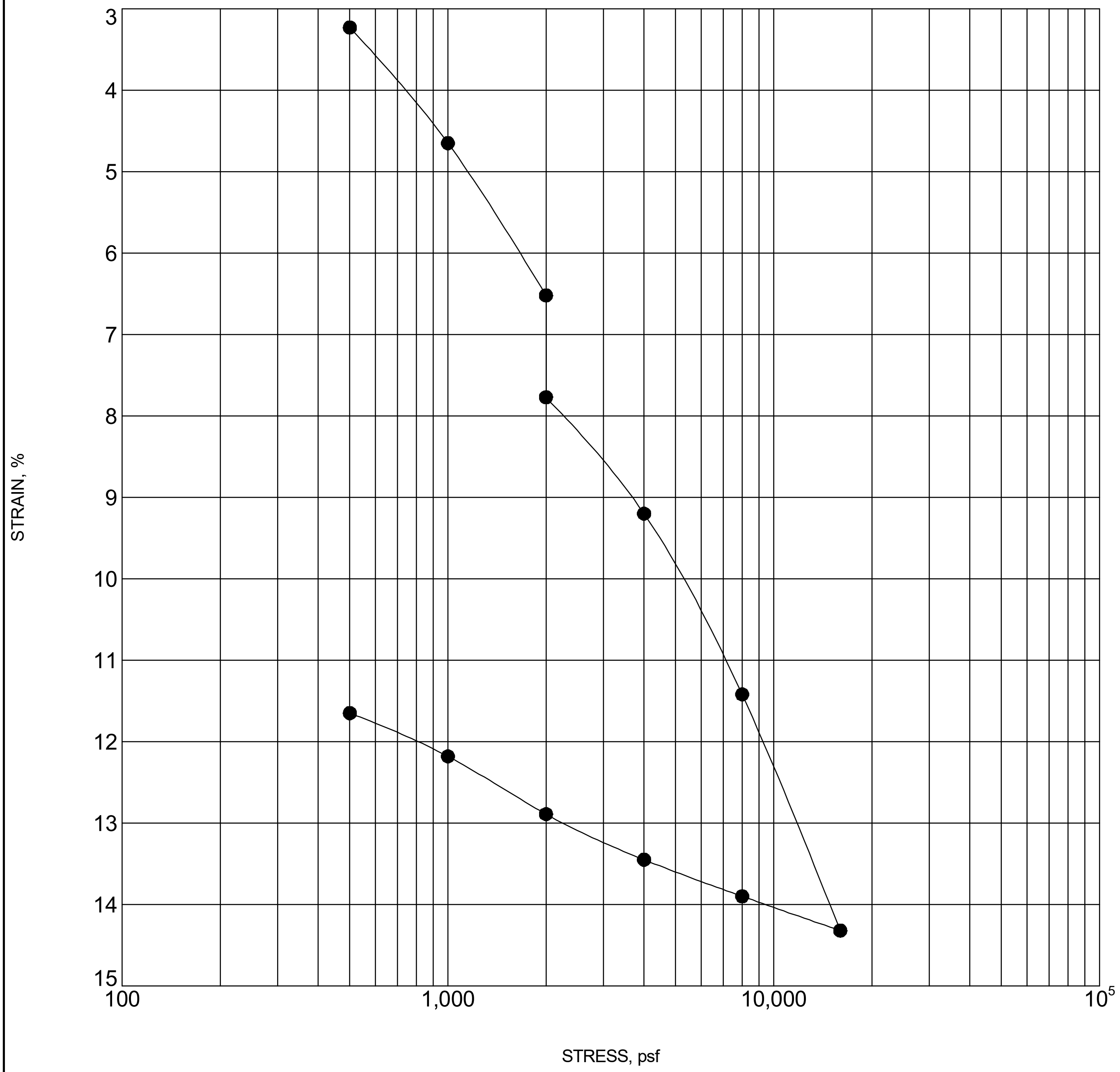
CONSOLIDATION TEST

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue



	BOREHOLE	DEPTH	Classification	γ_d	MC%
●	**B-2**	**80.0**	**Sandy Fat Clay**	**102**	**24**

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

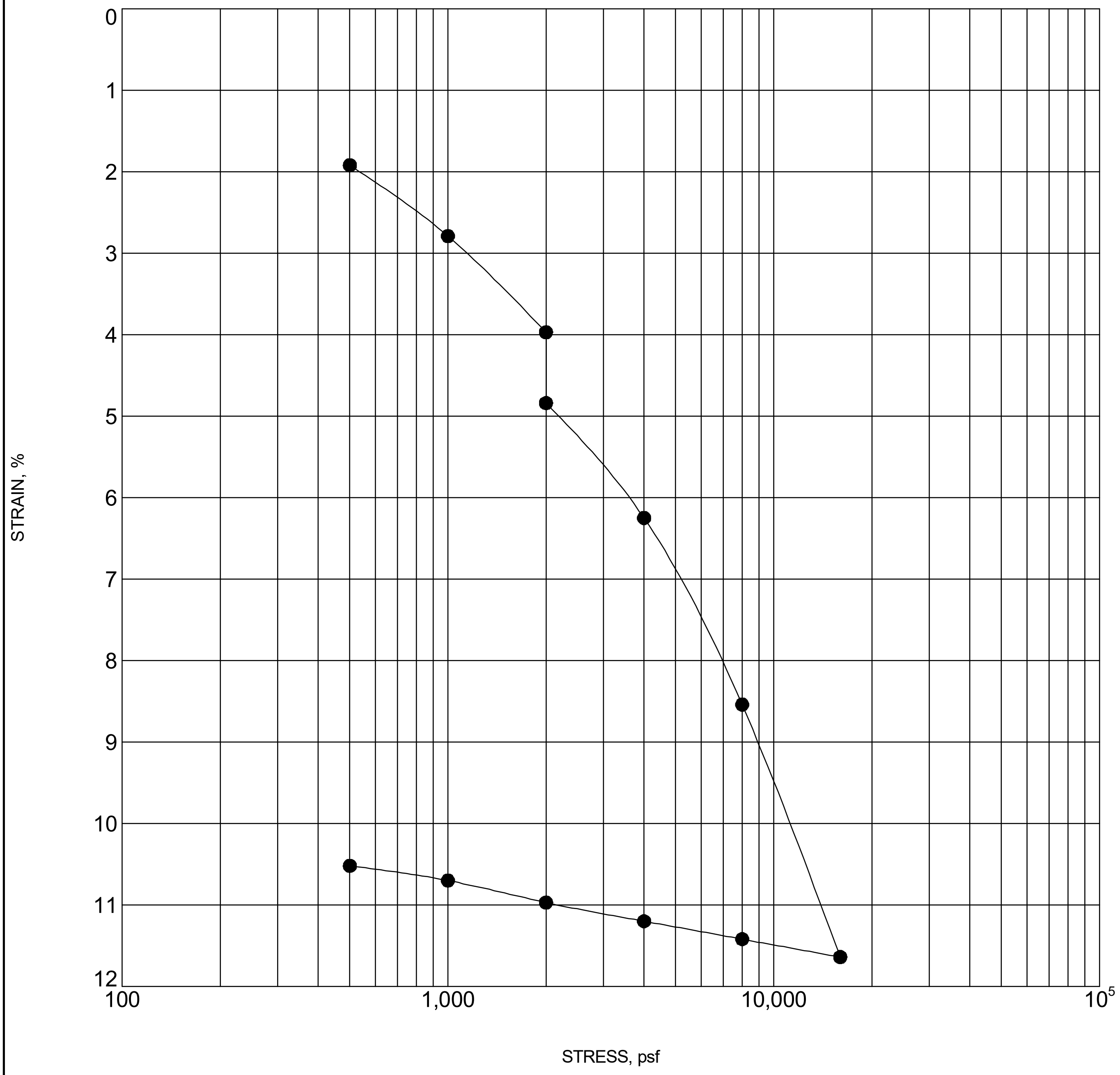
CONSOLIDATION TEST

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue



	BOREHOLE	DEPTH	Classification	γ_d	MC%
●	**B-3**	**90.0**	**Sandy Lean Clay**	**89**	**35**

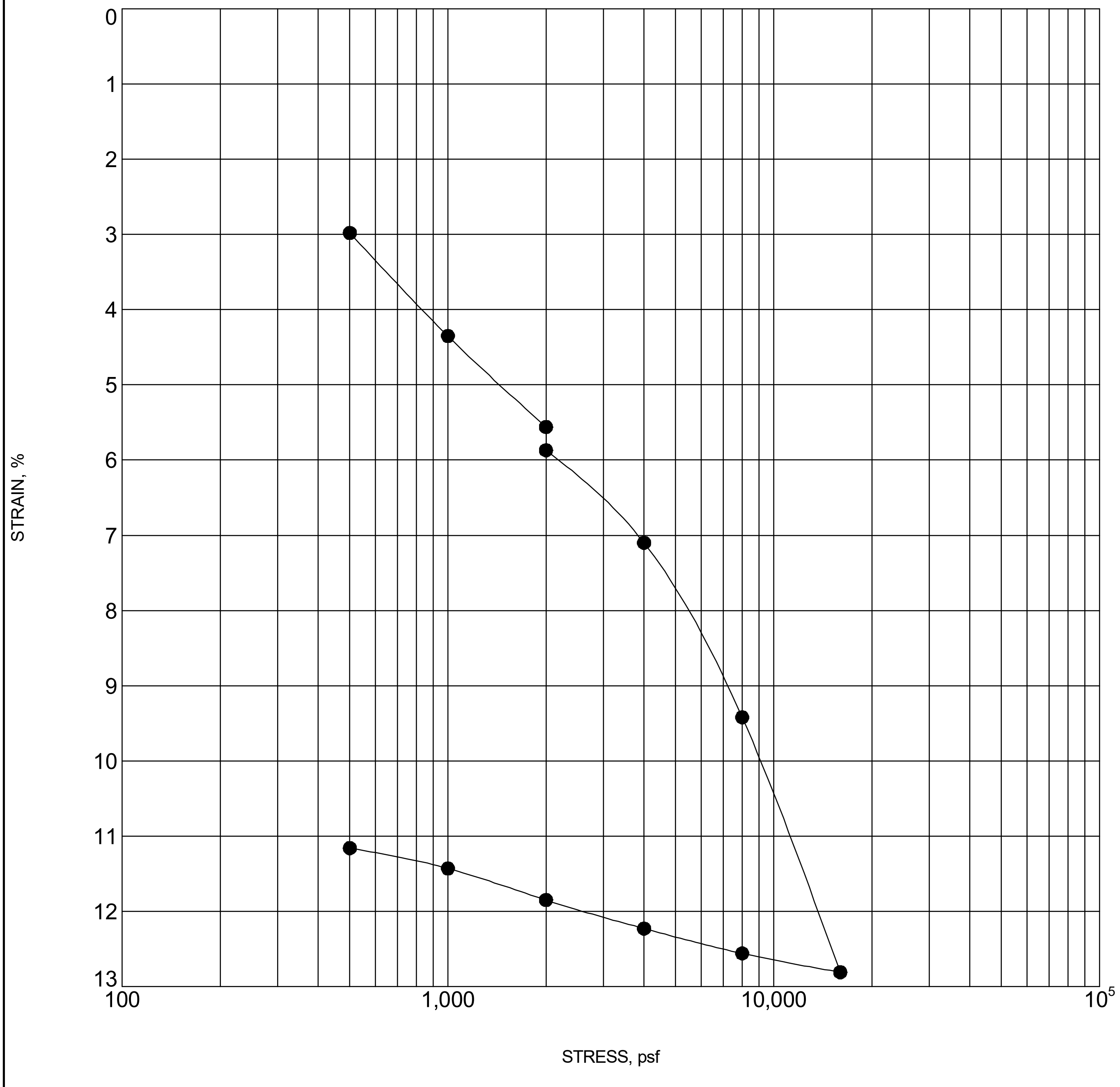
CONSOLIDATION TEST

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue



	BOREHOLE	DEPTH	Classification	γ_d	MC%
●	**B-4**	**85.0**	**Sandy Lean Clay**	**70**	**45**

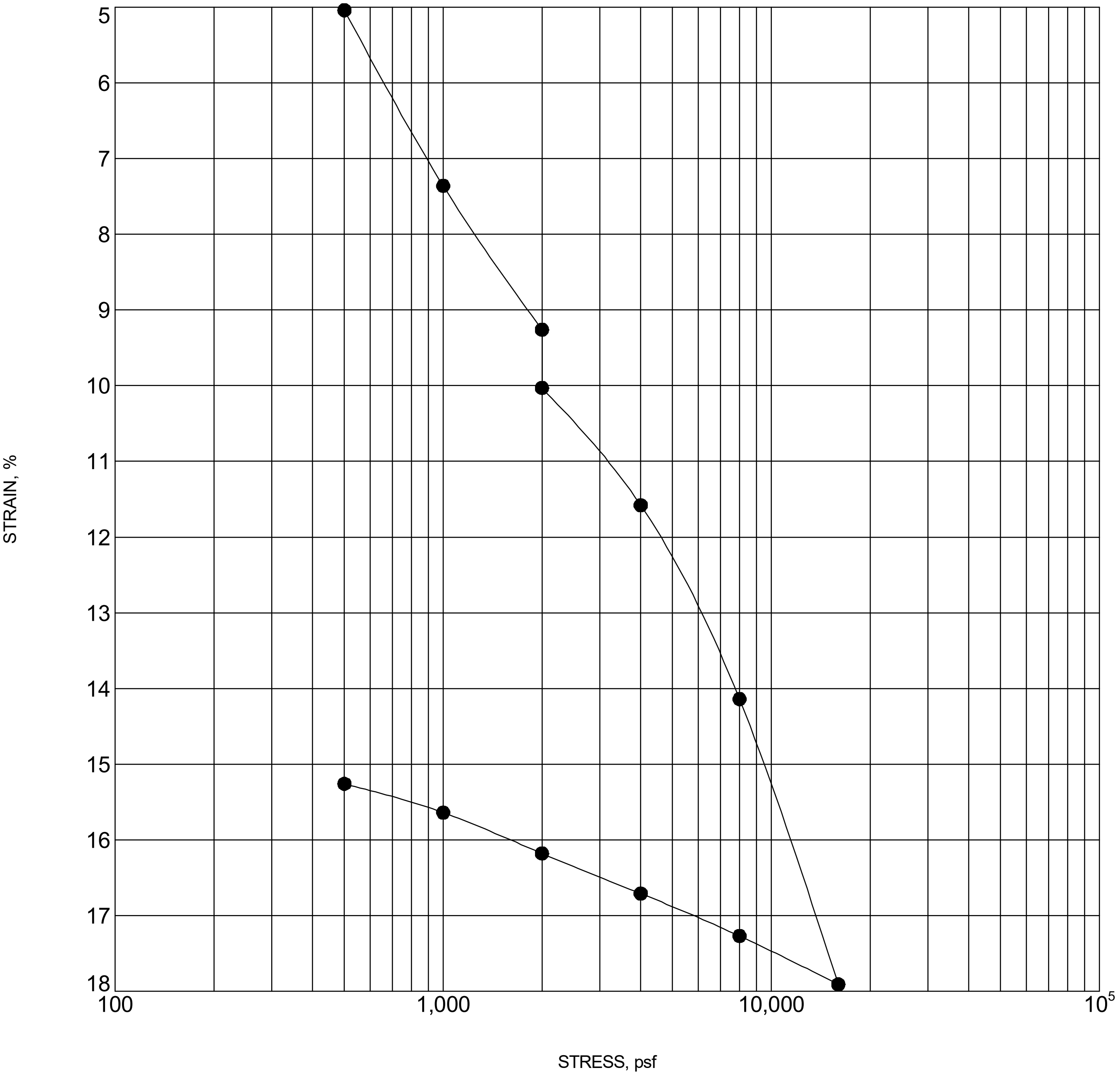
CONSOLIDATION TEST

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue



	BOREHOLE	DEPTH	Classification	γ_d	MC%
●	**B-5**	**60.0**	**Fat Clay with Sand**	**95**	**25**

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Las Vegas, Nevada

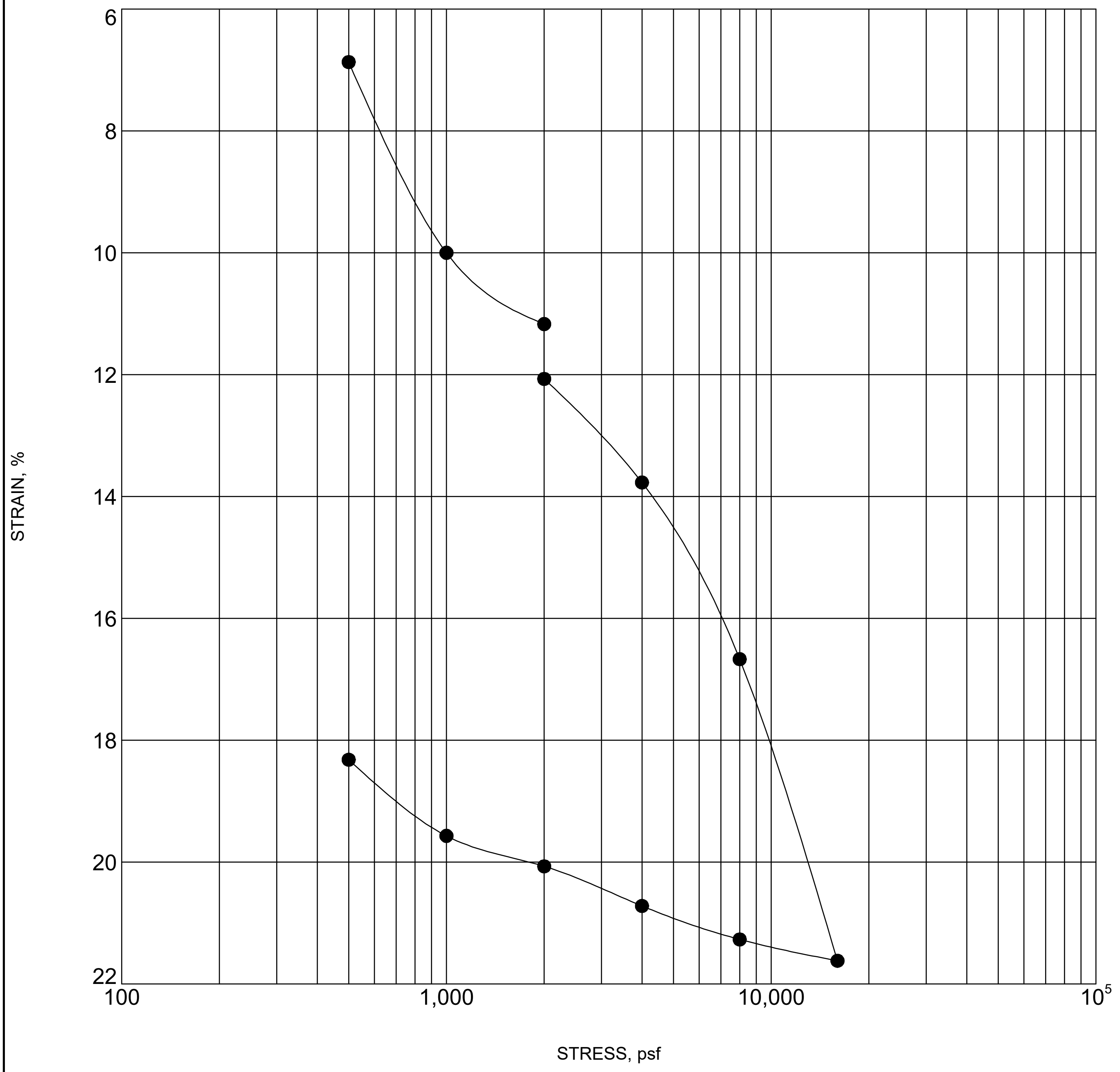
CONSOLIDATION TEST

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue



	BOREHOLE	DEPTH	Classification	γ_d	MC%
●	**B-6**	**55.0**	**Sandy LEAN CLAY**	**69**	**56**

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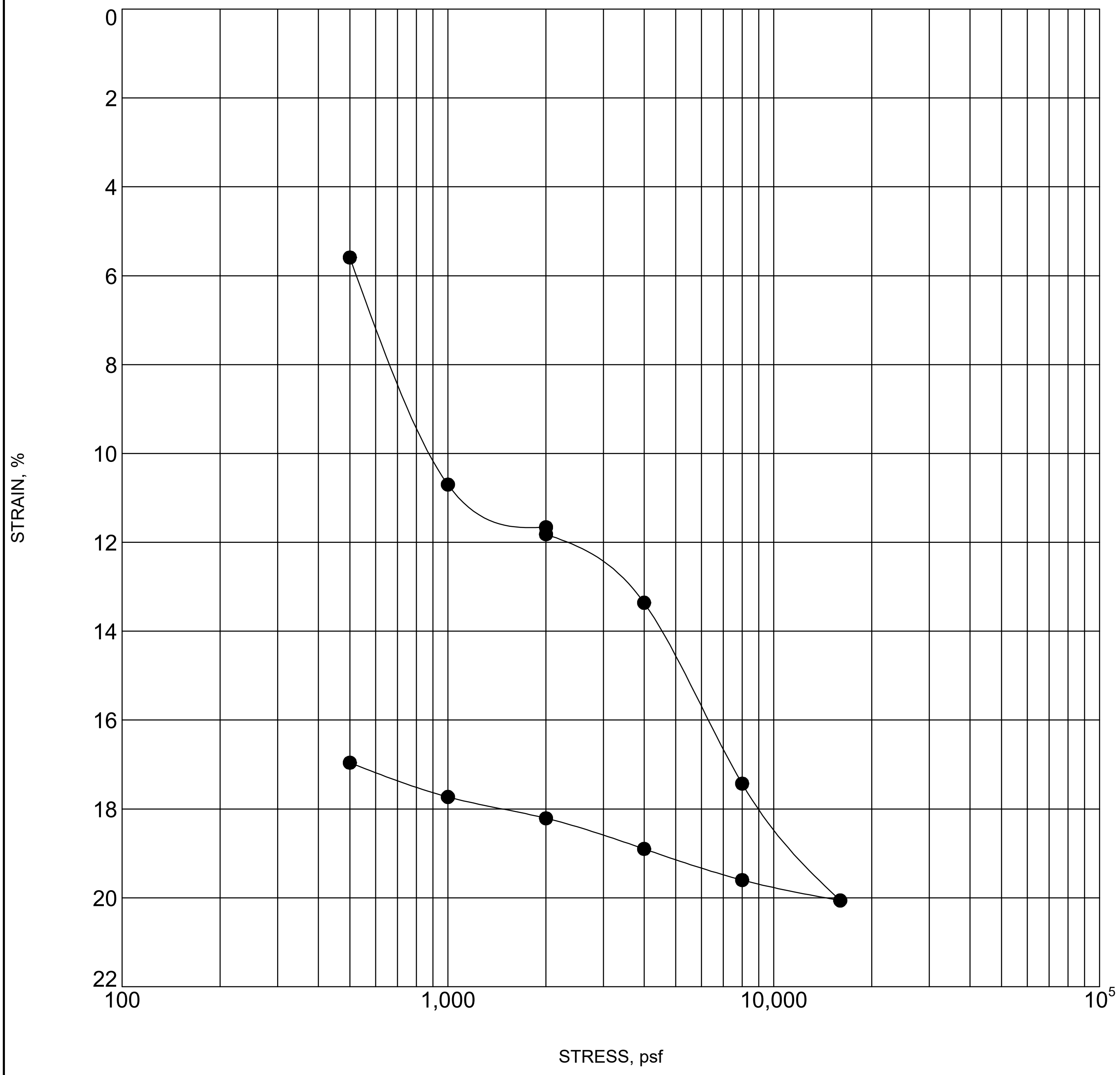
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

CONSOLIDATION TEST

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue



	BOREHOLE	DEPTH	Classification	γ_d	MC%
●	**B-6**	**75.0**	**FAT CLAY with Sand**	**77**	**25**

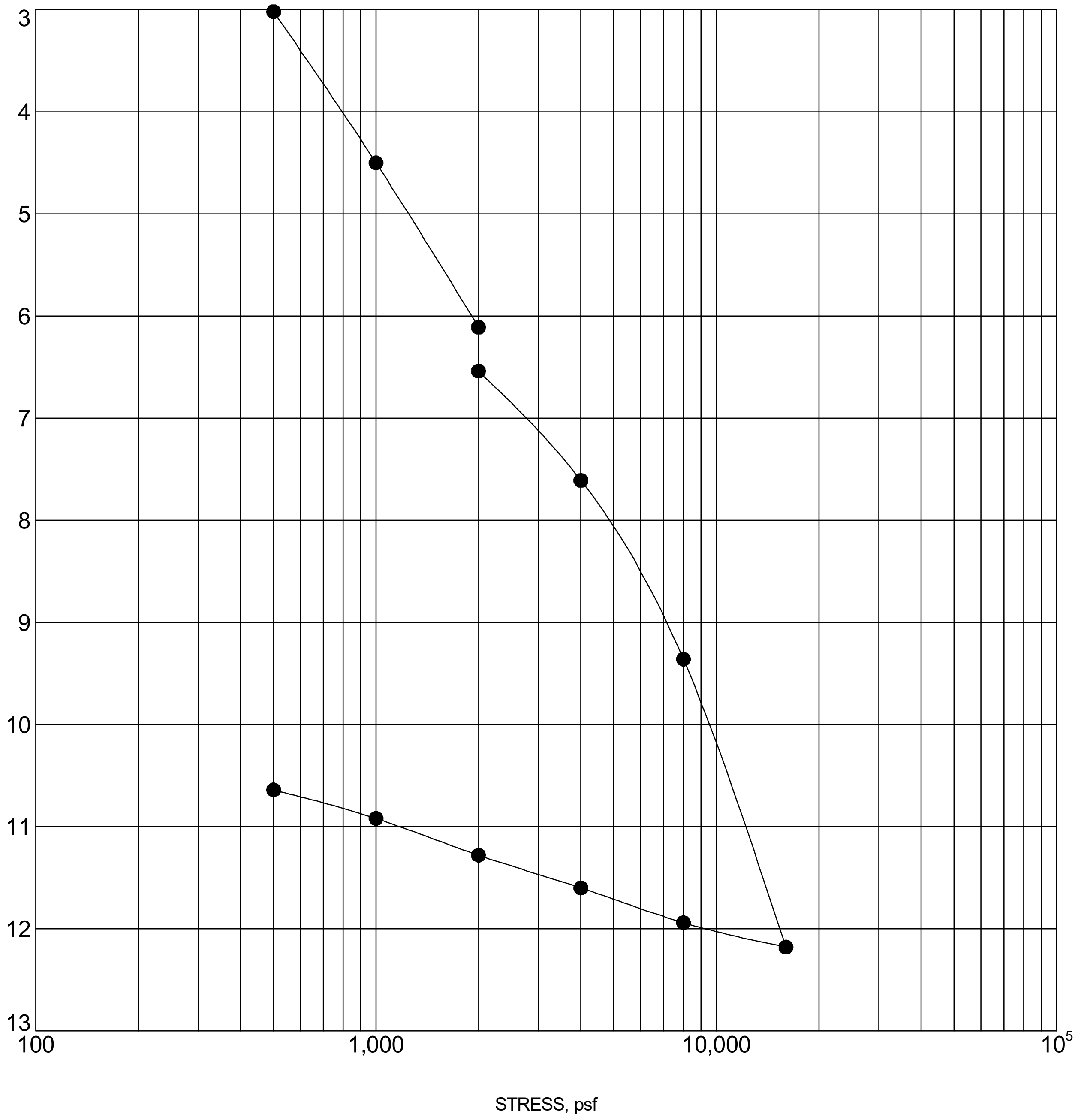
CONSOLIDATION TEST

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue



	BOREHOLE	DEPTH	Classification	γ_d	MC%
●	**B-7**	**75.0**	**Sandy Fat Clay**	**84**	**41**

CHEMICAL LABORATORY TEST REPORT

Report Number: 64171088.0007
Service Date: 01/29/20
Report Date: 01/29/20
Task:

Terracon
750 Pilot Rd, Ste F
Las Vegas, NV 89119-9007
702-597-9393

Client

Nova Geotechnical & Inspection Services LLC
Attn: Forest Grayson
4480 W. Hacienda Avenue Suite 104
Las Vegas, NV 89118

Project

G-19-192

Project No. 64171088 **Lab No.: 20-0070**

Results of Corrosivity Analysis

Sample No.:				
Sample Location:	B-1	B-2	B-4	B-5
Sample Depth:	2.0' - 6.0'	5.0' - 9.0'	5.0' - 9.0'	3.0' - 8.0'
pH Analysis, AASHTO T289	7.84	8.37	8.42	8.27
Water Soluble Sulfate (SO4), AASHTO T290 (percent %)	0.28	0.23	0.02	0.14
Chlorides, AASHTO T291, (percent %)	0.02	0.03	0.01	0.01
Resistivity, AASHTO T288, (ohm-cm)	243	160	480	280

Sample Submitted By Client **Date Received:** **1/22/2020**
Analyzed By: Trisha Campo
Title: Chemist

Started
Finished:
Lunch/NC:

Report Distribution

(1) Nova Geotechnical & Inspection Services

Trisha Campo

Reviewed By: ____________________
Trisha Campo
Chemist

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

CHEMICAL LABORATORY TEST REPORT

Report Number: 64171088.0007
Service Date: 01/29/20
Report Date: 01/29/20
Task:

Terracon
750 Pilot Rd, Ste F
Las Vegas, NV 89119-9007
702-597-9393

Client

Nova Geotechnical & Inspection Services LLC
Attn: Forest Grayson
4480 W. Hacienda Avenue Suite 104
Las Vegas, NV 89118

Project

G-19-192

Project No. 64171088 **Lab No.: 20-0070**

Results of Corrosivity Analysis

Sample No.:	
Sample Location:	B-7
Sample Depth:	5.0' - 9.0'
pH Analysis, AASHTO T289	8.27
Water Soluble Sulfate (SO4), AASHTO T290 (percent %)	0.06
Chlorides, AASHTO T291, (percent %)	0.01
Resistivity, AASHTO T288, (ohm-cm)	347

Sample Submitted By Client
Analyzed By: Trisha Campo
Title: Chemist

Date Received: **1/22/2020**

Started
Finished:
Lunch/NC:

Report Distribution

(1) Nova Geotechnical & Inspection Services

Trisha Campo

Reviewed By: ______________________
Trisha Campo
Chemist

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
Las Vegas, Nevada

SUMMARY OF LABORATORY RESULTS

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-1	5.0							15.5	97.3		
B-1	10.0	29	16	13	0.075	49	SC				
B-1	30.0							17.7			
B-1	35.0							26.4	93.8		
B-1	36.4	70	24	46	0.075	87	CH	32.7			
B-1	40.0							28.4	103.9		
B-1	50.0							28.7	98.0		
B-1	55.8	27	16	11	4.75	87	CL				
B-1	65.0	NP	NP	NP	4.75	39	SM	17.1			
B-1	70.0							26.0	96.2		
B-1	75.0							27.8			

NOVA Geotechnical and Inspection Services
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SUMMARY OF LABORATORY RESULTS

CLIENT CA Group, Inc.
PROJECT NAME I-515 Charleston Interchange
PROJECT NUMBER G-19-192
PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-2	15.0	29	17	12	0.075	48	SC	16.8			
B-2	35.0	59	23	36	0.075	97	CH	29.5			
B-2	45.0							25.7	95.2		
B-2	46.4	45	22	23	4.75	41	SC	21.9			
B-2	65.0	NP	NP	NP	4.75	52	ML	23.0			
B-2	75.0							27.0	97.5		
B-2	80.0							23.6	102.4		

NOVA Geotechnical and Inspection Services
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SUMMARY OF LABORATORY RESULTS

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-3	5.0							22.2			
B-3	15.0	24	15	9	19	43	SC	18.8			
B-3	30.0							18.2	113.6		
B-3	35.0	39	17	22	0.075	40	SC				
B-3	40.0							36.7	84.1		
B-3	45.0							27.5	91.9		
B-3	55.0	49	19	30	0.075	77	CL	37.4			
B-3	65.0							44.1			
B-3	75.0							67.8			
B-3	85.0							31.6	90.5		
B-3	87.0							18.3			
B-3	90.0							35.4	88.5		
B-3	100.0	52	27	25	0.075	90	CH	42.2	83.8		

NOVA Geotechnical and Inspection Services
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SUMMARY OF LABORATORY RESULTS

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CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-4	5.0							27.8	95.8		
B-4	10.0							22.3			
B-4	20.0							15.9			
B-4	25.0	31	17	14	2	61	CL				
B-4	35.0							37.5	75.7		
B-4	40.0	80	34	46	0.075	59	CH	59.8			
B-4	50.0							61.8			
B-4	60.0							45.7			
B-4	70.0	110	31	79	4.75	85	CH	48.7			
B-4	80.0							24.8	97.6		
B-4	85.0							45.1	85.8		
B-4	90.0							26.2	96.5		
B-4	91.8	40	35	5	0.075	96	ML	26.6			
B-4	100.0							24.7			

NOVA Geotechnical and Inspection Services
4480 W Hacienda Avenue, Ste 104
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SUMMARY OF LABORATORY RESULTS

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CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-5	5.0				0.075	49		17.4			
B-5	10.0							24.7	99.0		
B-5	25.0							11.6			
B-5	40.0							30.8	85.0		
B-5	45.0	122	40	82	2.36	71	CH	75.9			
B-5	60.0							24.7	95.2		
B-5	65.0	72	26	46	1.18	85	CH	29.3	94.4		
B-5	80.0							35.5	85.6		
B-5	85.0							35.2	98.6		
B-5	86.8	46	23	23	0.075	92	CL	31.5			
B-5	100.0							57.4	67.8		

NOVA Geotechnical and Inspection Services
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SUMMARY OF LABORATORY RESULTS

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-6	15.0							24.4	117.1		
B-6	20.0	NP	NP	NP	0.6	45	SM				
B-6	25.0							20.7	129.1		
B-6	35.0				0.075	83					
B-6	45.0	41	17	24	2.36	98	CL	30.3	96.6		
B-6	50.0	42	19	23	4.75	62	CL				
B-6	55.0							40.7	79.4		
B-6	60.0				0.075	89					
B-6	65.0	58	22	36	0.6	73	CH				
B-6	70.0	80	28	52	25	17	SC				
B-6	72.0				0.075	59					
B-6	75.0							49.6	73.4		
B-6	80.0	98	44	54	1.18	70	MH	48.2			
B-6	90.0							66.1			
B-6	95.0							63.4	79.6		

SUMMARY OF LABORATORY RESULTS

CLIENT CA Group, Inc.

PROJECT NAME I-515 Charleston Interchange

PROJECT NUMBER G-19-192

PROJECT LOCATION I-515 from Charleston Boulevard to Eastern Avenue

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-7	5.1							40.3	78.9		
B-7	10.0	28	19	9	9.5	39	SC	19.7			
B-7	25.0	37	25	12	4.75	92	ML	21.0	108.2		
B-7	45.0							22.1			
B-7	50.0							46.2	71.1		
B-7	52.0	55	20	35	0.075	82	CH	41.1			
B-7	60.0							32.4			
B-7	65.0							22.6	105.8		
B-7	75.0							41.1	83.5		
B-7	80.0							50.0	70.1		
B-7	81.8	70	28	42	0.075	86	CH	41.7			
B-7	90.0							40.8			
B-7	100.0							66.3			

APPENDIX B

Section A-A

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Soil Parameters: **Section A-A**

γ	0.115	kcf	= total unit weight of soil	
ϕ	30	degrees	= internal angle of friction of soil	

Footing Dimensions:

Depth, D_f	6.5	ft	= minimum depth of embedment	
B	8	ft	= footing width	
L'	11.75	ft	= effective footing length	

Factored Loads Provided by the Structural Engineer

For Service Limit State

Q_{ser}	277.3	kips		service limit vertical load
M_{ser}	0	kip-ft		total factored service limit moment load
e_{Bser}	0	ft	= M / Q	eccentricity in B dimension
B'_{ser}	8.00	ft	= effective footing width for service limit	Equation 10.6.1.3-1 B' = B-2e_B
L'/B'_{ser}	1.47	dim	= footing length to width ratio for service limit	
A'_{ser}	94	ft^2	= effective area of footing for service limit	
q_0	3.0	ksf	= factored bearing pressure for settlement analysis	

For Strength Limit State

Q_{str}	385	kips		total factored strength limit vertical load
M_{str}	0	kip-ft		total factored strength limit moment load
e_{Bstr}	0	ft	= M / Q	eccentricity in B dimension
B'_{str}	8.00	ft	= effective footing width for strength limit	Equation 10.6.1.3-1 B' = B-2e_B
L'/B'_{str}	1.47	dim	= footing length to width ratio for strength limit	
A'_{str}	94	ft^2	= effective area of footing for service limit	
q_{str}	4.100	ksf	= factored bearing pressure for strength limit	

For Extreme Event Limit State

Q_{ext}	263	kips		total factored extreme event limit vertical load
M_{ext}	0	kip-ft		total factored extreme event limit moment load
e_{Bext}	0	ft	= M / Q	eccentricity in B dimension
B'_{ext}	8.00	ft	= effective footing width for extreme event limit	Equation 10.6.1.3-1 B' = B-2e_B
L'/B'_{ext}	1.47	dim	= footing length to width ratio for extreme event limit	
A'_{ext}	94	ft^2	= effective area of footing for service limit	
q_{ext}	2.800	ksf	= factored bearing pressure for extreme event limit	

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Service Limit State Analysis

S_{max} 1 in x (1 ft/12 in) = 0.083 ft Maximum tolerable settlement

Settlement of footings bearing on soil per AASHTO *LRFD Bridge Design Specifications Section 10.6.2.4*

$S_t = S_e + S_c + S_s$ Equation 10.6.2.4.1-1 (Total Settlement, ft)

$$S_e = \frac{\left[q_0\left(1-\nu^2\right)\sqrt{A'}\right]}{144\,E_s\beta_z}$$

Equation 10.6.2.4.2-1 (Elastic Settlement, ft)

$S_c = 0$ ft Consolidation Settlement is not applicable for the soils encountered

$S_s = 0$ ft Secondary Settlement is not applicable for the soils encountered

B'_{ser} 8.00 ft = effective footing width for service limit

A' 94 ft^2 = effective area of footing for service limit

L'/B'_{ser} 1.47 dim = effective footing length to width ratio

β_z from Table 10.6.2.4.2-1 based on L'/B' for service limit, assuming rigid footing

Exerpt from Table 10.6.2.4.2-1 for linear interpolations for intermediate L'/B' ratio

	L'/B'	β_z	
from Table 10.6.2.4.2-1	1	1.08	
L'/B' for this footing from above	1.47	1.089	β_z for this footing, interpolated
from Table 10.6.2.4.2-1	2	1.10	

Elastic Constants for average of low range and mid range of "Stiff Clay" which is present within the zone of influence,

ν 0.40 = Poisson's ratio

E_s 3.30 ksi = Young's modulus

Footing Settlement

$S_t = S_e$ 0.047 ft x (12 in/1 ft) = 0.56 inches

$S_t \leq S_{Max} \longrightarrow \boxed{\text{OK}}$

Nominal Bearing Resistance - Service Limit State

$$q_n = \frac{144 S_{max} E_s \beta_z}{\left(1-\nu^2\right)\sqrt{A'}}$$

Equation 10.6.2.4.2-1 (Solved for Bearing Pressure, ksf)

q_n 5.3 ksf Factored Bearing Resistance for Service Limit State

Factored Bearing Resistance - Service Limit State

φ_b 1.0 resistance factor per Section 10.5.5.1

$q_R = \varphi_b q_n$ Equation 10.6.3.1.1-1 (Factored Bearing Resistance, ksf)

q_R 5.3 ksf q_0 3.0 ksf

$q_R \geq q_0 \longrightarrow \boxed{\text{OK}}$

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Strength Limit State Analysis

General Nominal Bearing Resistance Equation

q_n = $cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B' N_{\gamma m} C_{w\gamma}$ — Equation 10.6.3.1.2a-1 (Nominal Bearing Resistance, ksf)

c = 0 ksf — Cohesion neglected for granular soil contitions

C_{wq} = 1.0

$C_{w\gamma}$ = 0.516 — per Table 10.6.3.1.2a-2, depth to groundwater >1.5B+D_f

General Nominal Bearing Resistance Equation reduces to:

q_n = $\gamma D_f N_{qm} + 0.258\gamma B' N_{\gamma m}$

Bearing Capacity Factors

N_{qm} = $N_q s_q d_q i_q$ — Equation 10.6.3.1.2a-3 (Modified Surcharge Bearing Capacity Factor, dim)

$N_{\gamma m}$ = $N_\gamma s_\gamma i_\gamma$ — Equation 10.6.3.1.2a-4 (Modified Unit Weight Bearing Capacity Factor, dim)

d_q = 1.0 — Depth Correction Factor taken as 1.0 per discusion beneath Table 10.6.3.1.2a-4

i_q = 1.0

i_γ = 1.0 — Load Inclination Factors neglected per Commentary Section C10.6.3.1.2a

s_q = $1 + (B'/L') \tan \phi$

s_γ = $1 - 0.4\,(B'/L')$ — Shape Correction Factors per Table 10.6.3.1.2a-3

By substitution, General Nominal Bearing Resistance Equation further reduces to:

q_n = $\gamma D_f N_q[1+(B'/L') \tan\phi_f] + 0.258\gamma B' N_\gamma[1-0.4(B'/L')]$

Bearing Capacity Factors from ASSHTO LRFD Bridge Design Specifications Table 10.6.3.1.2a-1

N_q 18.4 N_γ 22.4

Strength Limit State Analysis (continued)

Nominal Bearing Resistance

q_n 23.0 ksf

Factored Bearing Resistance - Strength Limit State

q_R = $\varphi_b q_n$ — Equation 10.6.3.1.1-1 (Factored Bearing Resistance, ksf)

φ_b 0.45 resistance factor — per Table 10.5.5.2.2-1 for Theoretical Method, in Sand, Using SPT

q_R 10.4 ksf q_{str} 4.100 ksf

$q_R \geq q_{str}$ ⟶ OK

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Extreme Event Limit State Analysis

Reduced General Nominal Bearing Resistance Equation from Strength Limit State Analysis, above

q_n $= \gamma D_f N_q[1+(B/L)\tan\phi_f] + 0.258\gamma B N_\gamma[1-0.4(B/L)]$

Nominal Bearing Resistance - Extreme Event Limit State

q_n 17.7 ksf — Nominal Bearing Resistance for Extreme Event Limit State

Factored Bearing Resistance - Extreme Event Limit State

q_R $= \varphi_b q_n$ — Equation 10.6.3.1.1-1 (Factored Bearing Resistance, ksf)

φ_b 1.0 resistance factor — per Section 10.5.5.3.3

q_R 17.7 ksf q_{ext} 2.800 ksf

$q_R \geq q_{ext}$ → OK

Frictional Sliding Resistance

R_τ $= V \tan \phi_f$ — Equation 10.6.3.4-2 (Nominal Frictional Sliding Resistance modified for concrete cast against soil, kips)

V = total vertical force (kips)

ϕ_f 30 degrees — Soil friction angle

$R_\tau = 0.58\ V$

Section B-B

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Soil Parameters:

Section B-B

γ	0.115	kcf	= total unit weight of soil
ϕ	30	degrees	= internal angle of friction of soil

Footing Dimensions:

Depth, D_f	4.5	ft	= minimum depth of embedment
B	6	ft	= footing width
L'	11.5	ft	= effective footing length

Factored Loads Provided by the Structural Engineer

For Service Limit State

Q_{ser}	89.7	kips		service limit vertical load
M_{ser}	0	kip-ft		total factored service limit moment load
e_{Bser}	0	ft	= M / Q	eccentricity in B dimension
B'_{ser}	6.00	ft	= effective footing width for service limit	Equation 10.6.1.3-1 $B' = B-2e_B$
L'/B'_{ser}	1.92	dim	= footing length to width ratio for service limit	
A'_{ser}	69	ft^2	= effective area of footing for service limit	
q_0	1.3	ksf	= factored bearing pressure for settlement analysis	

For Strength Limit State

Q_{str}	121	kips		total factored strength limit vertical load
M_{str}	0	kip-ft		total factored strength limit moment load
e_{Bstr}	0	ft	= M / Q	eccentricity in B dimension
B'_{str}	6.00	ft	= effective footing width for strength limit	Equation 10.6.1.3-1 $B' = B-2e_B$
L'/B'_{str}	1.92	dim	= footing length to width ratio for strength limit	
A'_{str}	69	ft^2	= effective area of footing for service limit	
q_{str}	1.750	ksf	= factored bearing pressure for strength limit	

For Extreme Event Limit State

Q_{ext}	79	kips		total factored extreme event limit vertical load
M_{ext}	0	kip-ft		total factored extreme event limit moment load
e_{Bext}	0	ft	= M / Q	eccentricity in B dimension
B'_{ext}	6.00	ft	= effective footing width for extreme event limit	Equation 10.6.1.3-1 $B' = B-2e_B$
L'/B'_{ext}	1.92	dim	= footing length to width ratio for extreme event limit	
A'_{ext}	69	ft^2	= effective area of footing for service limit	
q_{ext}	1.150	ksf	= factored bearing pressure for extreme event limit	

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Service Limit State Analysis

S_{max} 1 in x (1 ft/12 in) = 0.083 ft — Maximum tolerable settlement

Settlement of footings bearing on soil per AASHTO *LRFD Bridge Design Specifications Section 10.6.2.4*

$S_t = S_e + S_c + S_s$ — Equation 10.6.2.4.1-1 (Total Settlement, ft)

$$S_e = \frac{\left[q_0\left(1-\nu^2\right)\sqrt{A'}\right]}{144\,E_s\beta_z}$$

Equation 10.6.2.4.2-1 (Elastic Settlement, ft)

$S_c = 0$ ft — Consolidation Settlement is not applicable for the soils encountered

$S_s = 0$ ft — Secondary Settlement is not applicable for the soils encountered

B'_{ser} 6.00 ft = effective footing width for service limit

A' 69 ft^2 = effective area of footing for service limit

L'/B'_{ser} 1.92 dim = effective footing length to width ratio

β_z from Table 10.6.2.4.2-1 based on L'/B' for service limit, assuming rigid footing

Exerpt from Table 10.6.2.4.2-1 for linear interpolations for intermediate L'/B' ratio

	L'/B'	β_z	
from Table 10.6.2.4.2-1	1	1.08	
L'/B' for this footing from above	1.92	1.098	β_z for this footing, interpolated
from Table 10.6.2.4.2-1	2	1.10	

Elastic Constants for mid range of "Stiff Clay" which is present within the zone of influence, per Table C10.4.6.3-1

ν 0.40 = Poisson's ratio

E_s 3.30 ksi = Young's modulus

Footing Settlement

$S_t = S_e$ 0.017 ft x (12 in/1 ft) = 0.20 inches

$S_t \leq S_{Max}$ → $\boxed{\text{OK}}$

Nominal Bearing Resistance - Service Limit State

$$q_n = \frac{144 S_{max} E_s \beta_z}{\left(1-\nu^2\right)\sqrt{A'}}$$

Equation 10.6.2.4.2-1 (Solved for Bearing Pressure, ksf)

q_n 6.2 ksf — Factored Bearing Resistance for Service Limit State

Factored Bearing Resistance - Service Limit State

φ_b 1.0 resistance factor — per Section 10.5.5.1

$q_R = \varphi_b q_n$ — Equation 10.6.3.1.1-1 (Factored Bearing Resistance, ksf)

q_R 6.2 ksf q_0 1.3 ksf

$q_R \geq q_0$ → $\boxed{\text{OK}}$

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Strength Limit State Analysis

General Nominal Bearing Resistance Equation

$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B' N_{\gamma m} C_{w\gamma}$ Equation 10.6.3.1.2a-1 (Nominal Bearing Resistance, ksf)

$c = 0$ ksf Cohesion neglected for granular soil contitions

$C_{wq} = 1.0$

$C_{w\gamma} = 0.572$ per Table 10.6.3.1.2a-2, depth to groundwater >1.5B+D_f

General Nominal Bearing Resistance Equation reduces to:

$q_n = \gamma D_f N_{qm} + 0.286\gamma B' N_{\gamma m}$

Bearing Capacity Factors

$N_{qm} = N_q s_q d_q i_q$ Equation 10.6.3.1.2a-3 (Modified Surcharge Bearing Capacity Factor, dim)

$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ Equation 10.6.3.1.2a-4 (Modified Unit Weight Bearing Capacity Factor, dim)

$d_q = 1.0$ Depth Correction Factor taken as 1.0 per discusion beneath Table 10.6.3.1.2a-4

$i_q = 1.0$

$i_\gamma = 1.0$ Load Inclination Factors neglected per Commentary Section C10.6.3.1.2a

$s_q = 1 + (B'/L') \tan \phi$

$s_\gamma = 1 - 0.4 (B'/L')$ Shape Correction Factors per Table 10.6.3.1.2a-3

By substitution, General Nominal Bearing Resistance Equation further reduces to:

$q_n = \gamma D_f N_q[1+(B'/L') \tan\phi_f] + 0.286\gamma B' N_\gamma[1-0.4(B'/L')]$

Bearing Capacity Factors from ASSHTO LRFD Bridge Design Specifications Table 10.6.3.1.2a-1

N_q 18.4 N_γ 22.4

Strength Limit State Analysis (continued)

Nominal Bearing Resistance

q_n 15.9 ksf

Factored Bearing Resistance - Strength Limit State

$q_R = \varphi_b q_n$ Equation 10.6.3.1.1-1 (Factored Bearing Resistance, ksf)

φ_b 0.45 resistance factor per Table 10.5.5.2.2-1 for Theoretical Method, in Sand, Using SPT

q_R 7.2 ksf q_{str} 1.750 ksf

$q_R \geq q_{str} \longrightarrow \boxed{\text{OK}}$

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Extreme Event Limit State Analysis

Reduced General Nominal Bearing Resistance Equation from Strength Limit State Analysis, above

q_n $= \gamma D_f N_q [1+(B/L) \tan\phi_f] + 0.286\gamma B N_\gamma [1-0.4(B/L)]$

Nominal Bearing Resistance - Extreme Event Limit State

q_n 13.1 ksf — Nominal Bearing Resistance for Extreme Event Limit State

Factored Bearing Resistance - Extreme Event Limit State

$q_R = \varphi_b q_n$ — Equation 10.6.3.1.1-1 (Factored Bearing Resistance, ksf)

φ_b 1.0 resistance factor — per Section 10.5.5.3.3

q_R 13.1 ksf q_{ext} 1.150 ksf

$q_R \geq q_{ext}$ → OK

Frictional Sliding Resistance

$R_\tau = V \tan \phi_f$ — Equation 10.6.3.4-2 (Nominal Frictional Sliding Resistance modified for concrete cast against soil, kips)

V = total vertical force (kips)

ϕ_f 30 degrees — Soil friction angle

$R_\tau = 0.58\ V$

Section C-C

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Soil Parameters: **Section C-C**

γ	0.115	kcf	= total unit weight of soil
ϕ	30	degrees	= internal angle of friction of soil

Footing Dimensions:

Depth, D_f	3	ft	= minimum depth of embedment
B	9	ft	= footing width
L'	15	ft	= effective footing length

Factored Loads Provided by the Structural Engineer

For Service Limit State

Q_{ser}	435.375	kips		service limit vertical load
M_{ser}	0	kip-ft		total factored service limit moment load
e_{Bser}	0	ft	= M / Q	eccentricity in B dimension
B'_{ser}	9.00	ft	= effective footing width for service limit	Equation 10.6.1.3-1 $B' = B-2e_B$
L'/B'_{ser}	1.67	dim	= footing length to width ratio for service limit	
A'_{ser}	135	ft^2	= effective area of footing for service limit	
q_0	3.225	ksf	= factored bearing pressure for settlement analysis	

For Strength Limit State

Q_{str}	608	kips		total factored strength limit vertical load
M_{str}	0	kip-ft		total factored strength limit moment load
e_{Bstr}	0	ft	= M / Q	eccentricity in B dimension
B'_{str}	9.00	ft	= effective footing width for strength limit	Equation 10.6.1.3-1 $B' = B-2e_B$
L'/B'_{str}	1.67	dim	= footing length to width ratio for strength limit	
A'_{str}	135	ft^2	= effective area of footing for service limit	
q_{str}	4.500	ksf	= factored bearing pressure for strength limit	

For Extreme Event Limit State

Q_{ext}	425	kips		total factored extreme event limit vertical load
M_{ext}	0	kip-ft		total factored extreme event limit moment load
e_{Bext}	0	ft	= M / Q	eccentricity in B dimension
B'_{ext}	9.00	ft	= effective footing width for extreme event limit	Equation 10.6.1.3-1 $B' = B-2e_B$
L'/B'_{ext}	1.67	dim	= footing length to width ratio for extreme event limit	
A'_{ext}	135	ft^2	= effective area of footing for service limit	
q_{ext}	3.145	ksf	= factored bearing pressure for extreme event limit	

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Service Limit State Analysis

S_{max} 1 in x (1 ft/12 in) = 0.083 ft — Maximum tolerable settlement

Settlement of footings bearing on soil per AASHTO *LRFD Bridge Design Specifications Section 10.6.2.4*

$S_t = S_e + S_c + S_s$ — Equation 10.6.2.4.1-1 (Total Settlement, ft)

$$S_e = \frac{\left[q_0\left(1-\nu^2\right)\sqrt{A'}\right]}{144 E_s \beta_z}$$

Equation 10.6.2.4.2-1 (Elastic Settlement, ft)

$S_c = 0$ ft — Consolidation Settlement is not applicable for the soils encountered

$S_s = 0$ ft — Secondary Settlement is not applicable for the soils encountered

B'_{ser} 9.00 ft = effective footing width for service limit

A' 135 ft^2 = effective area of footing for service limit

L'/B'_{ser} 1.67 dim = effective footing length to width ratio

β_z from Table 10.6.2.4.2-1 based on L'/B' for service limit, assuming rigid footing

Exerpt from Table 10.6.2.4.2-1 for linear interpolations for intermediate L'/B' ratio

	L'/B'	β_z	
from Table 10.6.2.4.2-1	1	1.08	
L'/B' for this footing from above	1.67	1.093	β_z for this footing, interpolated
from Table 10.6.2.4.2-1	2	1.10	

Elastic Constants for mid range of "Stiff Clay" which is present within the zone of influence, per Table C10.4.6.3-1

ν 0.40 = Poisson's ratio

E_s 3.30 ksi = Young's modulus

Footing Settlement

$S_t = S_e$ 0.061 ft x (12 in/1 ft) = 0.73 inches

$S_t \leq S_{Max}$ → OK

Nominal Bearing Resistance - Service Limit State

$$q_n = \frac{144 S_{max} E_s \beta_z}{\left(1-\nu^2\right)\sqrt{A'}}$$

Equation 10.6.2.4.2-1 (Solved for Bearing Pressure, ksf)

q_n 4.4 ksf — Factored Bearing Resistance for Service Limit State

Factored Bearing Resistance - Service Limit State

φ_b 1.0 resistance factor — per Section 10.5.5.1

$q_R = \varphi_b q_n$ — Equation 10.6.3.1.1-1 (Factored Bearing Resistance, ksf)

q_R 4.4 ksf q_0 3.2 ksf

$q_R \geq q_0$ → OK

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Strength Limit State Analysis

General Nominal Bearing Resistance Equation

$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B' N_{\gamma m} C_{w\gamma}$ Equation 10.6.3.1.2a-1 (Nominal Bearing Resistance, ksf)

$c = 0$ ksf Cohesion neglected for granular soil contitions

$C_{wq} = 1.0$

$C_{w\gamma} = 0.606$

per Table 10.6.3.1.2a-2, depth to groundwater >1.5B+D_f

General Nominal Bearing Resistance Equation reduces to:

$q_n = \gamma D_f N_{qm} + 0.303\gamma B' N_{\gamma m}$

Bearing Capacity Factors

$N_{qm} = N_q s_q d_q i_q$ Equation 10.6.3.1.2a-3 (Modified Surcharge Bearing Capacity Factor, dim)

$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ Equation 10.6.3.1.2a-4 (Modified Unit Weight Bearing Capacity Factor, dim)

$d_q = 1.0$ Depth Correction Factor taken as 1.0 per discusion beneath Table 10.6.3.1.2a-4

$i_q = 1.0$

$i_\gamma = 1.0$

Load Inclination Factors neglected per Commentary Section C10.6.3.1.2a

$s_q = 1 + (B'/L') \tan \phi$

$s_\gamma = 1 - 0.4\ (B'/L')$

Shape Correction Factors per Table 10.6.3.1.2a-3

By substitution, General Nominal Bearing Resistance Equation further reduces to:

$q_n = \gamma D_f N_q[1+(B'/L') \tan\phi_f] + 0.303\gamma B' N_\gamma[1-0.4(B'/L')]$

Bearing Capacity Factors from ASSHTO LRFD Bridge Design Specifications Table 10.6.3.1.2a-1

N_q 18.4 N_γ 22.4

Strength Limit State Analysis (continued)

Nominal Bearing Resistance

q_n 13.9 ksf

Factored Bearing Resistance - Strength Limit State

$q_R = \varphi_b q_n$ Equation 10.6.3.1.1-1 (Factored Bearing Resistance, ksf)

φ_b 0.45 resistance factor per Table 10.5.5.2.2-1 for Theoretical Method, in Sand, Using SPT

q_R 6.255 ksf q_{str} 4.500 ksf

$$q_R \geq q_{str} \longrightarrow \boxed{\text{OK}}$$

Footing Calculations per AASHTO LRFD Bridge Design Specifications Section 10

Extreme Event Limit State Analysis

Reduced General Nominal Bearing Resistance Equation from Strength Limit State Analysis, above

$q_n = \gamma D_f N_{qL}[1+(B/L) \tan\phi_f] + 0.303\gamma B N_\gamma[1-0.4(B/L)]$

Nominal Bearing Resistance - Extreme Event Limit State

q_n 11.7 ksf — Nominal Bearing Resistance for Extreme Event Limit State

Factored Bearing Resistance - Extreme Event Limit State

$q_R = \varphi_b q_n$ — Equation 10.6.3.1.1-1 (Factored Bearing Resistance, ksf)

φ_b 1.0 resistance factor — per Section 10.5.5.3.3

q_R 11.7 ksf q_{ext} 3.145 ksf

$$q_R \geq q_{ext} \longrightarrow \boxed{\text{OK}}$$

Frictional Sliding Resistance

$R_\tau = V \tan \phi_f$ — Equation 10.6.3.4-2 (Nominal Frictional Sliding Resistance modified for concrete cast against soil, kips)

V = total vertical force (kips)

ϕ_f 30 degrees — Soil friction angle

$$R_\tau = 0.58\ V$$

APPENDIX C

Axial and Lateral Analysis Results for

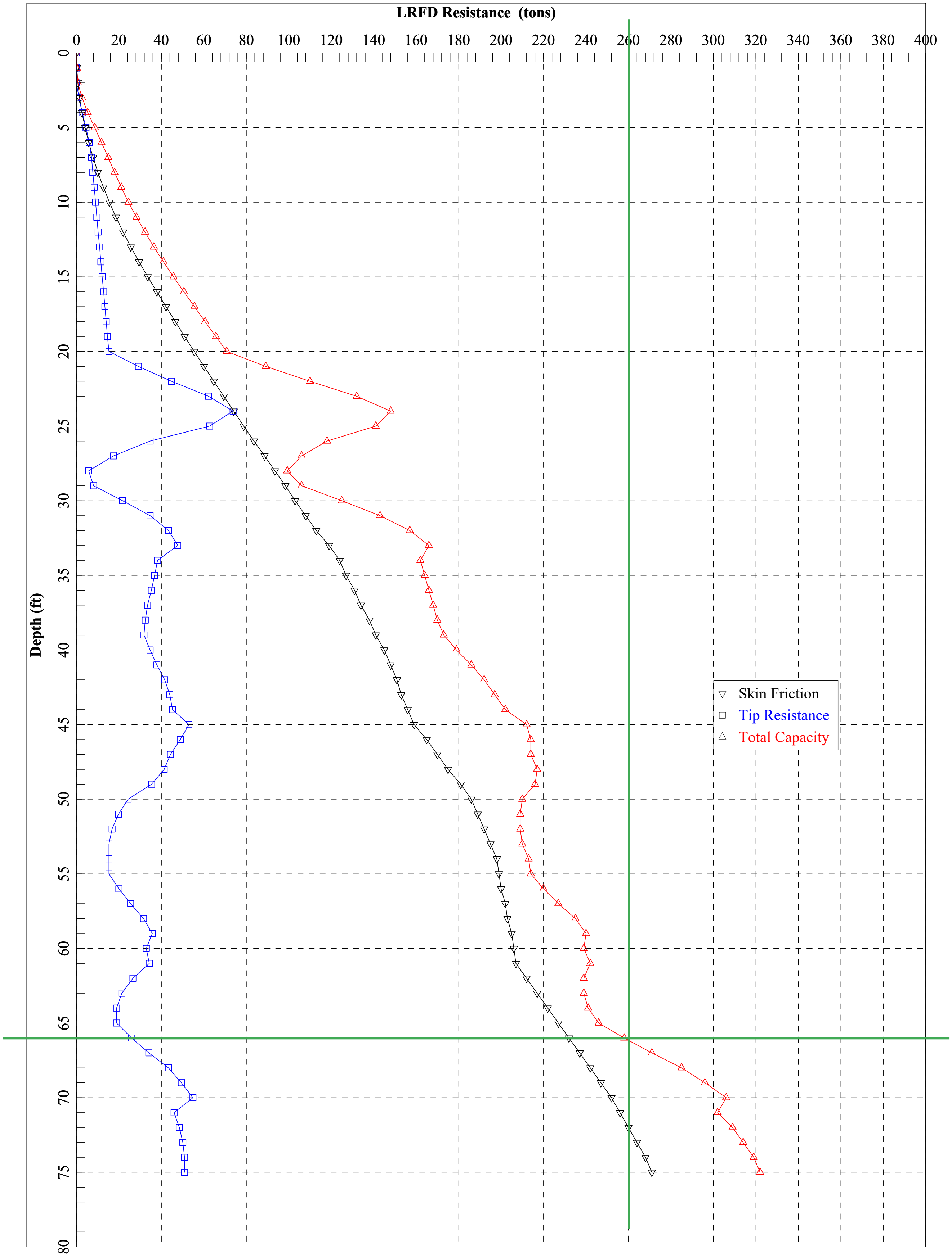
MOJAVE BRIDGE

MOJAVE BRIDGE -ABUTMENT 1

AXIAL CAPACITY ANALYSIS

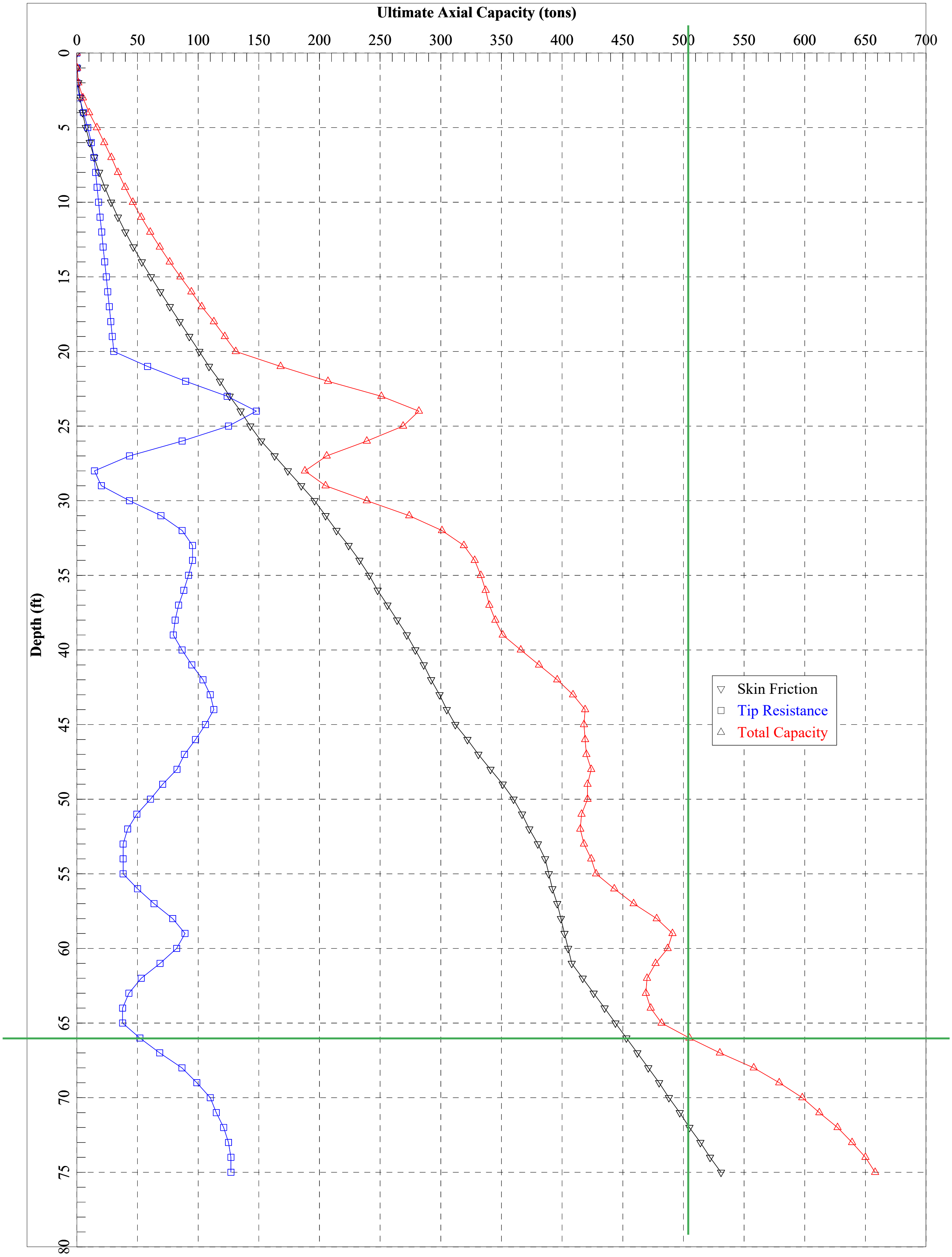
Mojave Bridge - Abutment1- Boring B-2 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8’-0” o.c.):

- Service = 385 kips = 192.5 tons
- Strength = 515 kips = 257.5 tons
- LRFD Factored Resistance of approximately 260 tons is provided by a shaft length of **66 feet**.



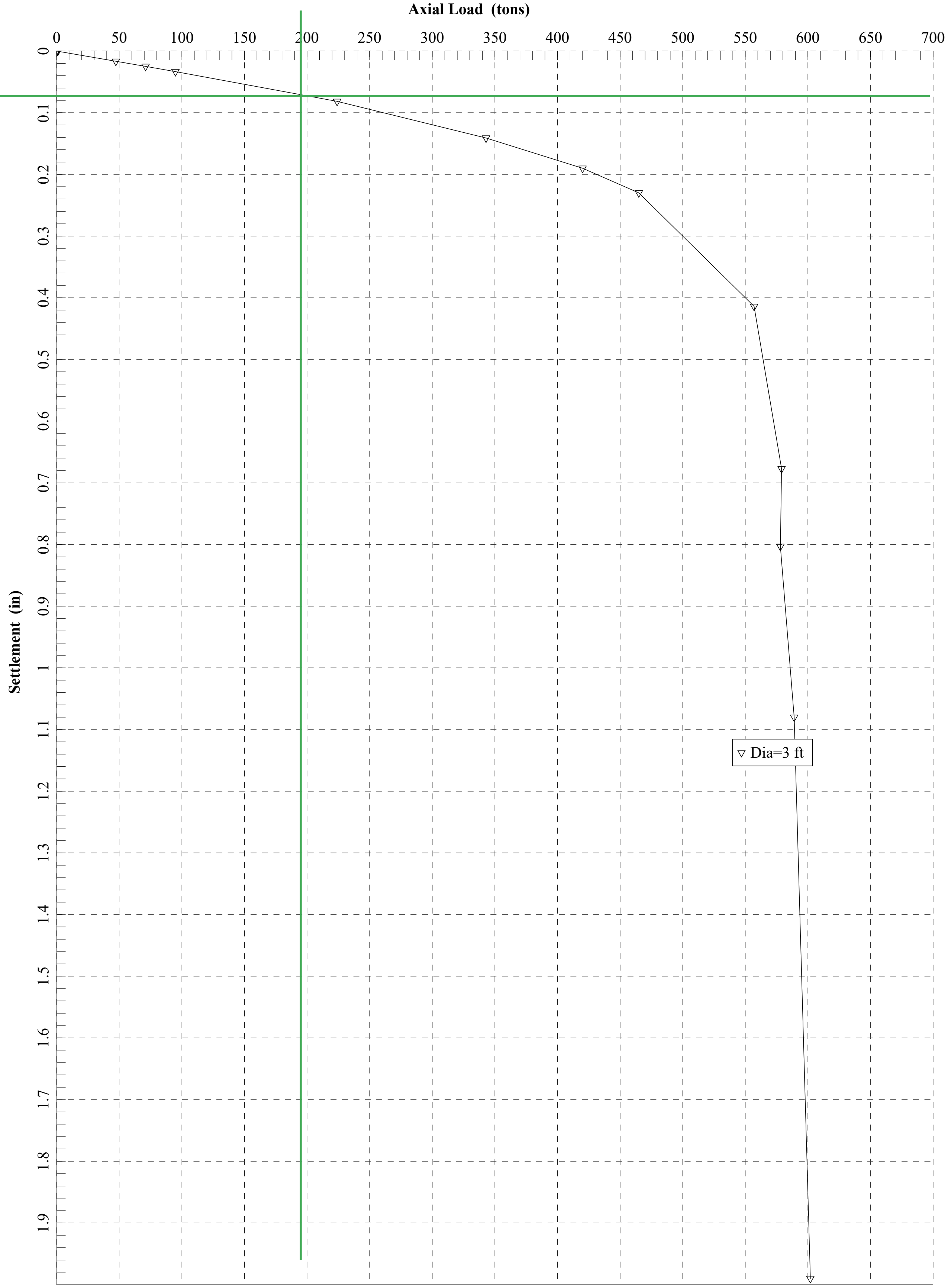
Mojave Bridge - Abutment1- Boring B-2 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8'-0" o.c.):

- Service = 385 kips = 192.5 tons
- Strength = 515 kips = 257.5 tons
- Ultimate Axial Resistance of approximately 500 tons is provided by a shaft length of **66 feet**.



Mojave Bridge - Abutment1- Boring B-2 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8’-0” o.c.):

- Service = 385 kips = 192.5 tons
- Strength = 515 kips = 257.5 tons
- At service limit load of 193 tons, settlement = **approx. 0.08 inch**



```
==========================================================================

                 SHAFT for Windows, Version 2012.7.17

                  Serial Number :  157290693

               VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                (c) Copyright ENSOFT, Inc., 1987-2012
                      All Rights Reserved

==========================================================================


Path to file locations      : H:\PROJECTS\Engineering & Enviro Projects\2019
Projects\G-19-192 I-515 Charleston Interchange - CA Group\DESIGN\1
Bridges-Revision2\Mojave-Bridge-Revised-5-26-2020\
Name of input data file     : Mojave-Abutment1_B-2-3feet.sfd
Name of output file         : Mojave-Abutment1_B-2-3feet.sfo
Name of plot output file    : Mojave-Abutment1_B-2-3feet.sfp
Name of runtime file        : Mojave-Abutment1_B-2-3feet.sfr


--------------------------------------------------------------------------
                     Time and Date of Analysis
--------------------------------------------------------------------------

          Date:  May 27, 2020     Time:  12:21:42

Mojave Bridge - Abutment1_Boring B-2 - 3.0 feet Shaft


PROPOSED DEPTH =      80.0 FT
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NUMBER OF LAYERS =   13
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WATER TABLE DEPTH =      15.0 FT.
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SOIL INFORMATION
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```
LAYER NO 1----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                    = 0.120E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                      = 0.280E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.000E+00


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                    = 0.112E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                      = 0.280E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.800E+01


  LRFD RESISTANCE FACTOR (SIDE FRICTION)             = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)            = 0.500E+00


LAYER NO 2----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                    = 0.112E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                      = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.800E+01


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                    = 0.818E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                      = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.120E+03
```

```
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.255E+02


   LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
   LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


 LAYER NO 3----CLAY

   AT THE TOP

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.464E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.500E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.255E+02


   AT THE BOTTOM

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.464E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.500E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.300E+02


   LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
   LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


 LAYER NO 4----SAND

   AT THE TOP

   SKIN FRICTION COEFFICIENT- BETA                   = 0.761E+00
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
   INTERNAL FRICTION ANGLE, DEG.                     = 0.300E+02
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
```

```
  DEPTH, FT                                         = 0.300E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.713E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.300E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.340E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 5----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.300E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.340E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.300E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.400E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00
```

```
LAYER NO 6----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00
  END BEARING COEFFICIENT-Nc                         = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.250E+04
  INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.400E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00
  END BEARING COEFFICIENT-Nc                         = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.250E+04
  INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.450E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)             = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)            = 0.400E+00


LAYER NO 7----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                    = 0.594E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                      = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.450E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                    = 0.545E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                      = 0.360E+02
```

```
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.500E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 8----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.250E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.500E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.250E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.540E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO 9----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.120E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
```

```
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.540E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.120E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.605E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO10----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.450E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.350E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.605E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.412E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.350E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.650E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00
```

```
LAYER NO11----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.412E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.650E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.366E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.705E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO12----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.544E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.330E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.705E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.544E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
```

```
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.330E+04
  INTERNAL FRICTION ANGLE, DEG.                       = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.750E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)              = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)             = 0.400E+00


LAYER NO13----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.511E+00
  END BEARING COEFFICIENT-Nc                          = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.400E+04
  INTERNAL FRICTION ANGLE, DEG.                       = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.750E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.511E+00
  END BEARING COEFFICIENT-Nc                          = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.400E+04
  INTERNAL FRICTION ANGLE, DEG.                       = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.815E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)              = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)             = 0.400E+00




DRILLED SHAFT INFORMATION
-------------------------

 DIAMETER OF STEM          =    3.000  FT.
```

```
 DIAMETER OF BASE          =    3.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    0.000  FT.
 IGNORED BOTTOM PORTION    =    0.000  FT.
 AREA OF ONE PERCENT STEEL =   10.180  SQ.IN.
 ELASTIC MODULUS, Ec       = 0.350E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.




PREDICTED RESULTS
-----------------

QS      = ULTIMATE SIDE RESISTANCE;
QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH  VOLUME     QS       QB       QU     LRFD QS  LRFD QB   LRFD QU
(FEET)  (CU.YDS) (TONS)   (TONS)  (TONS)   (TONS)   (TONS)    (TONS)
 1.0     0.26     0.30     0.00     0.30     0.16     0.00      0.16
 2.0     0.52     1.19     0.00     1.19     0.65     0.00      0.65
 3.0     0.79     2.67     2.40     5.07     1.47     1.20      2.67
 4.0     1.05     4.75     5.41    10.16     2.61     2.70      5.32
 5.0     1.31     7.42     9.07    16.48     4.08     4.53      8.61
 6.0     1.57    10.60    12.04    22.64     5.83     6.02     11.85
 7.0     1.83    14.28    14.21    28.48     7.85     7.10     14.96
 8.0     2.09    18.43    15.46    33.89    10.14     7.73     17.87
 9.0     2.36    23.07    16.72    39.79    12.69     8.36     21.05
10.0     2.62    28.23    17.98    46.21    15.53     8.99     24.52
11.0     2.88    33.88    19.24    53.12    18.64     9.62     28.25
12.0     3.14    40.01    20.49    60.51    22.01    10.25     32.25
13.0     3.40    46.60    21.75    68.35    25.63    10.87     36.51
14.0     3.67    53.64    23.01    76.64    29.50    11.50     41.00
15.0     3.93    61.10    24.26    85.36    33.60    12.13     45.74
16.0     4.19    68.83    25.52    94.35    37.86    12.76     50.62
17.0     4.45    76.68    26.78   103.46    42.18    13.39     55.56
18.0     4.71    84.65    28.03   112.69    46.56    14.02     60.58
19.0     4.97    92.74    29.29   122.03    51.01    14.65     65.65
20.0     5.24   100.93    30.55   131.48    55.51    15.27     70.79
21.0     5.50   109.22    58.35   167.57    60.07    29.17     89.25
```

```
22.0      5.76   117.62    89.67   207.29    64.69    44.84    109.52
23.0      6.02   126.10   124.48   250.58    69.36    62.24    131.60
24.0      6.28   134.68   147.57   282.25    74.07    73.79    147.86
25.0      6.55   143.34   125.32   268.66    78.84    62.66    141.50
26.0      6.81   152.08    86.76   238.84    83.64    34.70    118.35
27.0      7.07   163.01    43.38   206.39    88.56    17.35    105.91
28.0      7.33   173.94    14.46   188.40    93.48     5.78     99.26
29.0      7.59   184.87    20.24   205.11    98.40     8.10    106.50
30.0      7.86   195.80    43.38   239.18   103.32    21.69    125.01
31.0      8.12   205.00    69.41   274.41   108.38    34.70    143.08
32.0      8.38   214.24    86.76   301.01   113.46    43.38    156.84
33.0      8.64   223.52    95.44   318.95   118.56    47.72    166.28
34.0      8.90   232.81    95.44   328.25   123.68    38.18    161.85
35.0      9.16   240.59    92.06   332.66   127.18    36.83    164.00
36.0      9.43   248.37    88.21   336.58   130.68    35.28    165.96
37.0      9.69   256.14    83.87   340.01   134.17    33.55    167.72
38.0      9.95   263.92    80.98   344.90   137.67    32.39    170.07
39.0     10.21   271.70    79.53   351.23   141.17    31.81    172.99
40.0     10.47   279.47    86.66   366.13   144.67    34.66    179.34
41.0     10.74   285.95    94.80   380.76   147.59    37.92    185.51
42.0     11.00   292.43   103.96   396.40   150.51    41.59    192.09
43.0     11.26   298.91   110.07   408.99   153.42    44.03    197.45
44.0     11.52   305.39   113.13   418.52   156.34    45.25    201.59
45.0     11.78   311.88   106.00   417.88   159.25    53.00    212.25
46.0     12.04   321.57    97.86   419.42   164.58    48.93    213.51
47.0     12.31   331.27    88.69   419.96   169.92    44.35    214.27
48.0     12.57   340.97    82.59   423.55   175.25    41.29    216.55
49.0     12.83   350.66    70.76   421.42   180.59    35.38    215.97
50.0     13.09   360.35    60.73   421.09   185.92    24.29    210.21
51.0     13.35   366.83    49.45   416.29   188.83    19.78    208.61
52.0     13.62   373.31    41.93   415.25   191.75    16.77    208.52
53.0     13.88   379.79    38.18   417.97   194.66    15.27    209.93
54.0     14.14   386.27    38.18   424.45   197.58    15.27    212.85
55.0     14.40   389.38    38.18   427.56   198.98    15.27    214.25
56.0     14.66   392.50    50.07   442.57   200.38    20.03    220.41
57.0     14.92   395.61    63.67   459.28   201.78    25.47    227.25
58.0     15.19   398.72    78.97   477.69   203.18    31.59    234.77
59.0     15.45   401.83    89.17   491.00   204.58    35.67    240.25
60.0     15.71   404.94    82.27   487.21   205.98    32.91    238.89
61.0     15.97   408.05    68.56   476.61   207.38    34.28    241.66
62.0     16.23   417.22    53.14   470.35   212.42    26.57    238.99
63.0     16.50   426.33    42.85   469.18   217.43    21.43    238.86
64.0     16.76   435.39    37.71   473.10   222.42    18.85    241.27
65.0     17.02   444.39    37.71   482.10   227.37    18.85    246.22
66.0     17.28   453.32    51.98   505.30   232.28    25.99    258.27
67.0     17.54   462.19    68.29   530.48   237.16    34.14    271.30
68.0     17.80   470.99    86.63   557.62   242.00    43.32    285.31
69.0     18.07   479.71    98.87   578.58   246.79    49.43    296.23
```

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70.0    18.33   488.36   109.71   598.06   251.55    54.85    306.40
71.0    18.59   496.92   115.10   612.03   256.26    46.04    302.30
72.0    18.85   505.39   121.18   626.56   260.07    48.47    308.54
73.0    19.11   513.85   125.23   639.08   263.88    50.09    313.97
74.0    19.38   522.31   127.25   649.56   267.69    50.90    318.59
75.0    19.64   530.77   127.25   658.02   271.49    50.90    322.39



   RESULT FROM TREND (AVERAGED) LINE

   TOP  LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
      ton             IN.              ton             IN.
  0.9419E-01      0.3317E-04      0.2792E-02      0.1000E-04
  0.4709E+00      0.1658E-03      0.1396E-01      0.5000E-04
  0.9419E+00      0.3317E-03      0.2792E-01      0.1000E-03
  0.4729E+02      0.1660E-01      0.1396E+01      0.5000E-02
  0.7112E+02      0.2494E-01      0.2094E+01      0.7500E-02
  0.9493E+02      0.3328E-01      0.2792E+01      0.1000E-01
  0.2243E+03      0.8157E-01      0.6981E+01      0.2500E-01
  0.3434E+03      0.1406E+00      0.1396E+02      0.5000E-01
  0.4197E+03      0.1895E+00      0.2094E+02      0.7500E-01
  0.4653E+03      0.2300E+00      0.2792E+02      0.1000E+00
  0.5574E+03      0.4143E+00      0.5843E+02      0.2500E+00
  0.5792E+03      0.6767E+00      0.8512E+02      0.5000E+00
  0.5782E+03      0.8032E+00      0.9403E+02      0.6250E+00
  0.5892E+03      0.1085E+01      0.1101E+03      0.9000E+00
  0.6016E+03      0.1991E+01      0.1234E+03      0.1800E+01



   RESULT FROM UPPER-BOUND LINE

   TOP  LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
      ton             IN.              ton             IN.
  0.1535E+00      0.4619E-04      0.4171E-02      0.1000E-04
  0.7674E+00      0.2310E-03      0.2086E-01      0.5000E-04
  0.1535E+01      0.4619E-03      0.4171E-01      0.1000E-03
  0.7745E+02      0.2320E-01      0.2086E+01      0.5000E-02
  0.1164E+03      0.3485E-01      0.3128E+01      0.7500E-02
  0.1550E+03      0.4649E-01      0.4171E+01      0.1000E-01
  0.3368E+03      0.1090E+00      0.1043E+02      0.2500E-01
  0.4568E+03      0.1722E+00      0.2086E+02      0.5000E-01
  0.5136E+03      0.2181E+00      0.3128E+02      0.7500E-01
  0.5462E+03      0.2558E+00      0.4171E+02      0.1000E+00
  0.6122E+03      0.4356E+00      0.8300E+02      0.2500E+00
  0.6255E+03      0.6944E+00      0.1063E+03      0.5000E+00
  0.6247E+03      0.8203E+00      0.1124E+03      0.6250E+00
```

```
0.6318E+03      0.1099E+01      0.1222E+03      0.9000E+00
0.6362E+03      0.2002E+01      0.1266E+03      0.1800E+01



 RESULT FROM LOWER-BOUND LINE

 TOP  LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
    ton             IN.              ton             IN.
0.4900E-01      0.2255E-04      0.1414E-02      0.1000E-04
0.2450E+00      0.1127E-03      0.7070E-02      0.5000E-04
0.4900E+00      0.2255E-03      0.1414E-01      0.1000E-03
0.2450E+02      0.1127E-01      0.7070E+00      0.5000E-02
0.3681E+02      0.1692E-01      0.1060E+01      0.7500E-02
0.4916E+02      0.2257E-01      0.1414E+01      0.1000E-01
0.1219E+03      0.5637E-01      0.3535E+01      0.2500E-01
0.2203E+03      0.1077E+00      0.7070E+01      0.5000E-01
0.2983E+03      0.1547E+00      0.1060E+02      0.7500E-01
0.3554E+03      0.1964E+00      0.1414E+02      0.1000E+00
0.5015E+03      0.3928E+00      0.3386E+02      0.2500E+00
0.5269E+03      0.6572E+00      0.6391E+02      0.5000E+00
0.5289E+03      0.7851E+00      0.7563E+02      0.6250E+00
0.5467E+03      0.1070E+01      0.9798E+02      0.9000E+00
0.5664E+03      0.1980E+01      0.1196E+03      0.1800E+01
```

MOJAVE BRIDGE -ABUTMENT 1

LATERAL CAPACITY ANALYSIS

Lateral Analysis and Results – Mojave Bridge Abutment 1 (Boring B-2) and Abutment 2 (Boring B-1):

Lateral analyses were performed for the drilled shaft foundations for the project using software GROUP. The following table summarizes the geometry of the shafts and the pipe cap:

Loading Condition	**Bridge H-1442R over Mojave Road**					
	East Abutment (Abutment-1)			**West Abutment (Abutment-2)**		
	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure
Service Limit	2304 kips	117.9 kips	Fig. 1	2304	117.9	Fig. 4
Strength Limit	3060 kips	132.18 kips	Fig. 2	3060 kips	132.18 kips	Fig. 5
Extreme Limit	3546 kips	304.92 kips	Fig. 3	3546 kips	304.92 kips	Fig. 6
Drilled Shaft Lengths	66 feet			59 feet		
Reinforcement	8 - #11 bar			8 - #11 bar		
Pile Cap and Shaft geometry	Two rows of 3 piers each 3.0 feet diameter spaced 8 feet center to center connected by pile cap approximately 21.18 feet long, 13 feet wide and 3 feet thick			Two rows of 3 piers each 3.0 feet diameter spaced 8 feet center to center connected by pile cap approximately 21.18 feet long, 13 feet wide and 3 feet thick		

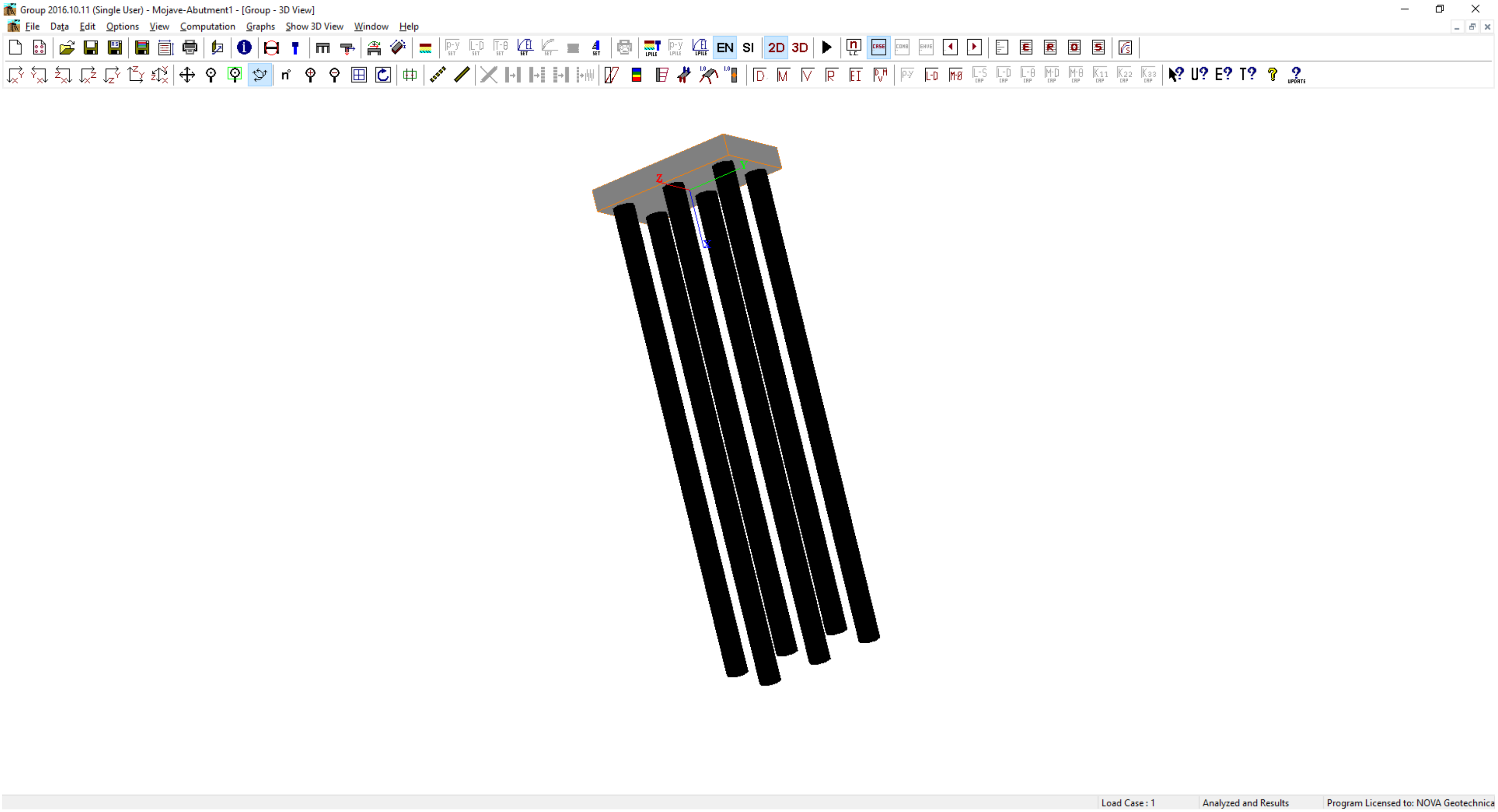
The input parameters for Abutment 1 are provided in the table below:

Mojave Bridge – Abutment 1 – Boring B-2 LPILE/GROUP Parameters

GROUP/LPILE Soil Type *	Approximate Formation Depths (ft)	Unit Weight (pcf)	Cohesion	Friction Angle	Soil Modulus K (pci)	Strain Factor E_{50}
Sand	0 – 3	105	Ignore	Ignore	Ignore	Ignore
Sand	3 – 8	105	-	28 degrees	25	N/A
Sand	8 – 15	120	-	32 degrees	90	N/A
Groundwater depth = 15 feet						
Sand	15 – 25.5	120	-	32 degrees	60	N/A
Clay	25.5 – 30	130	4,500 psf	-	Static – 2,000 Cyclic – 800	0.004
Sand	30 – 34	115	-	30 degrees	60	N/A
Clay	34 – 40	130	3,000 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	40 – 45	120	2,500 psf	-	Static – 1,000 Cyclic – 400	0.005
Sand	45 – 50	125	-	36 degrees	125	N/A
Clay	50 – 54	125	2,500 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	54 – 60.5	115	1,200 psf	-	Static – 500 Cyclic – 200	0.007
Sand	60.5 – 65	125	-	35 degrees	125	N/A
Sand	65 – 70.5	125	-	32 degrees	60	N/A
Clay	70.5 – 75	130	3,300 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	75 – 81.5	130	4,000 psf	-	Static – 1,000 Cyclic – 400	0.005

* Clay soils with cohesion less than 1,000 psf should be modeled as “Soft Clay (Matlock)”. And, clay soils with cohesion more than 1,000 psf should be modeled as “Stiff Clay without Free Water (Reese)”. Sand soils should be modeled as “Sand (Reese)”.
N/A – Not Applicable

The following figure shows a typical model:



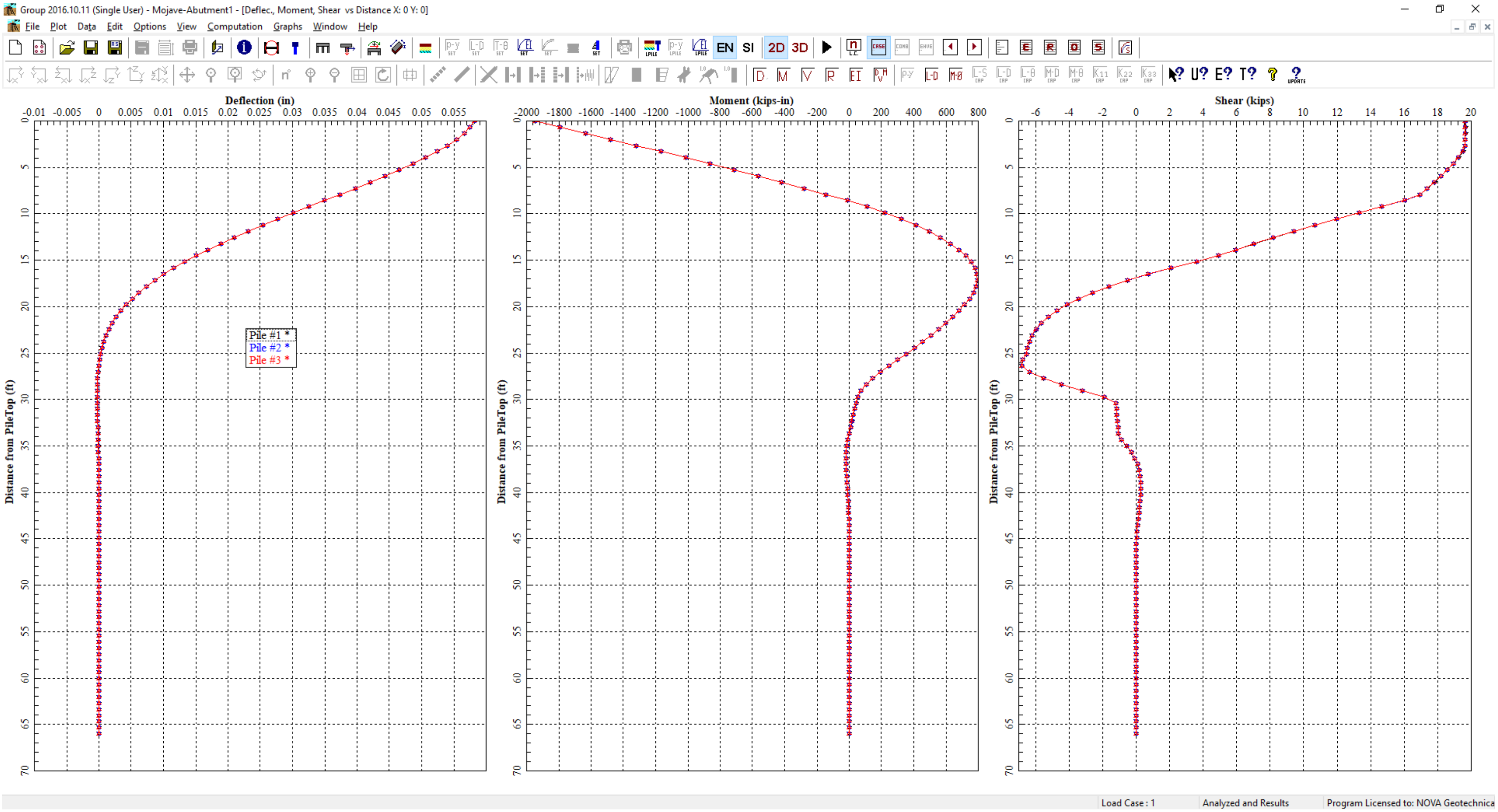


Figure 1. Results of Service Limit loading on Mojave Abutment 1

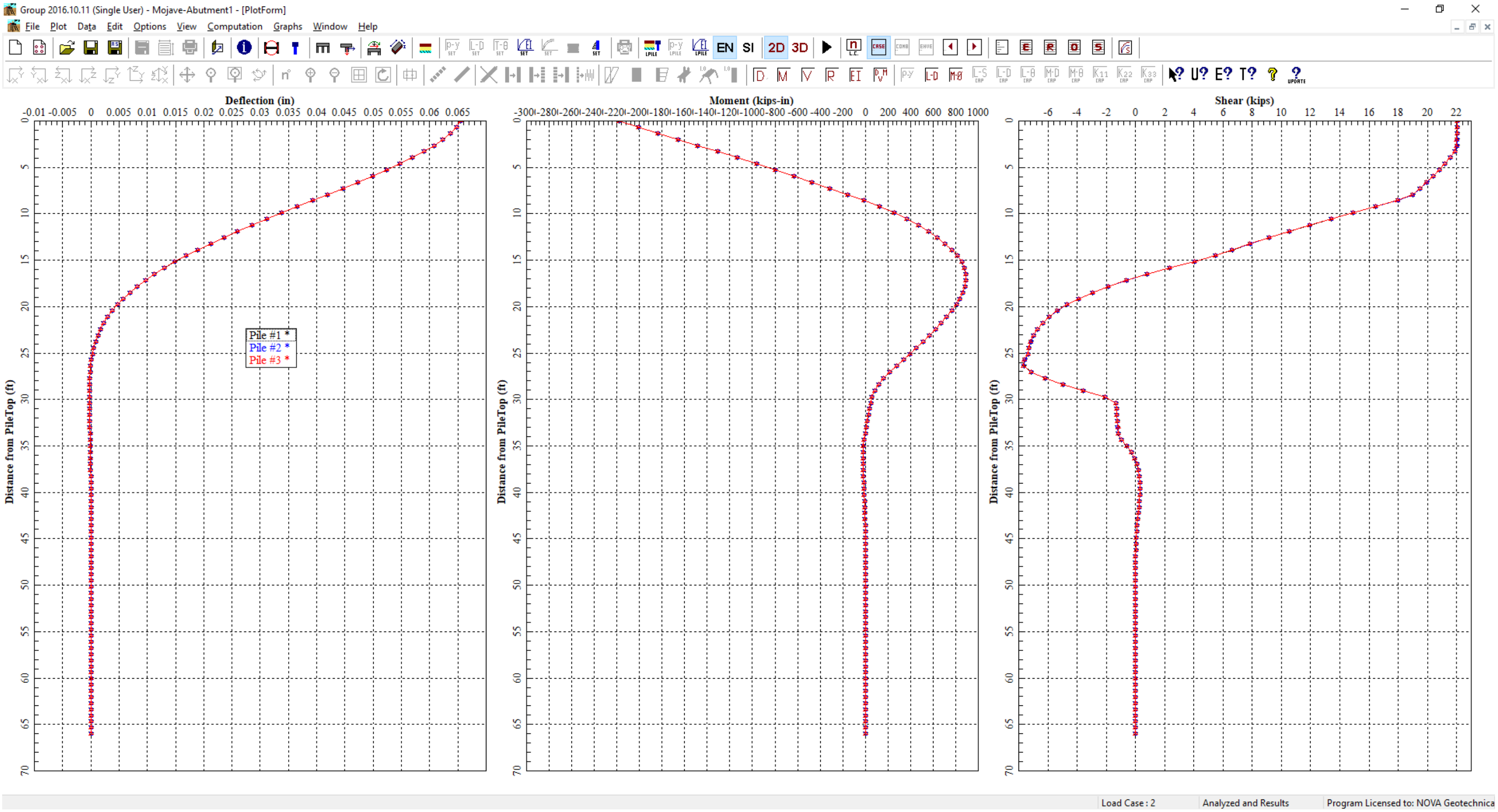


Figure 2. Results of Strength Limit loading on Mojave Abutment 1

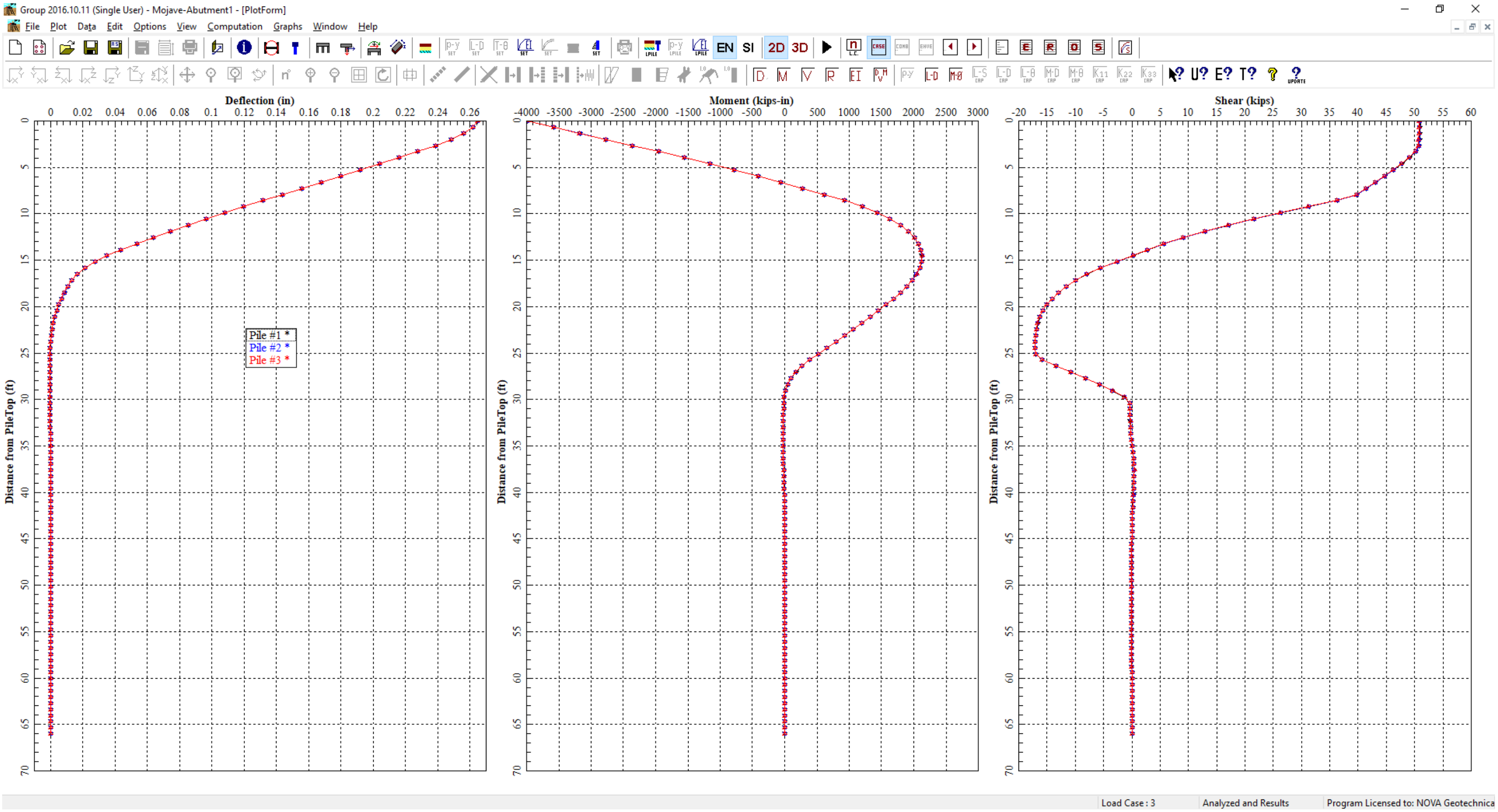


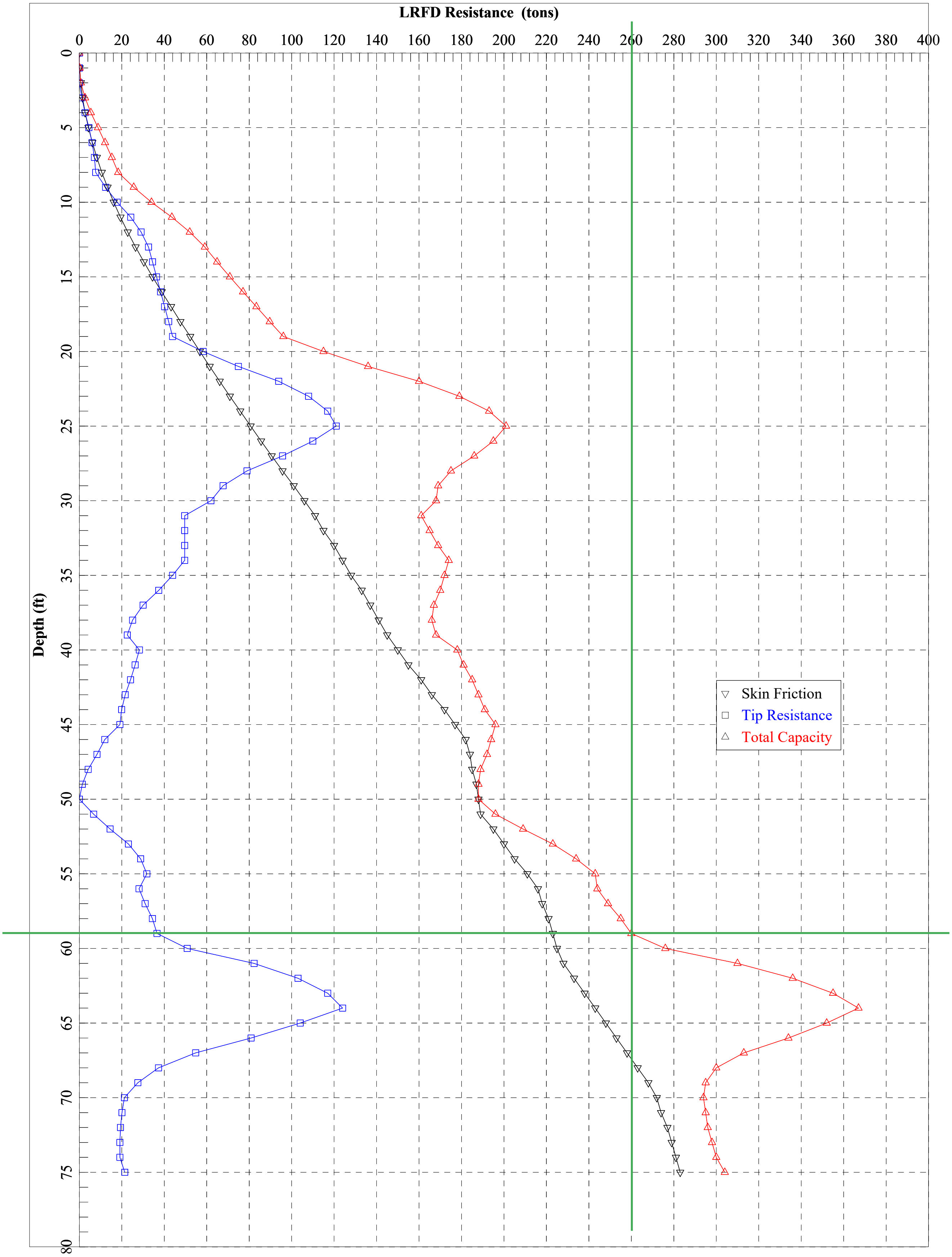
Figure 3. Results of Extreme Limit loading on Mojave Abutment 1

MOJAVE BRIDGE -ABUTMENT 2

AXIAL CAPACITY ANALYSIS

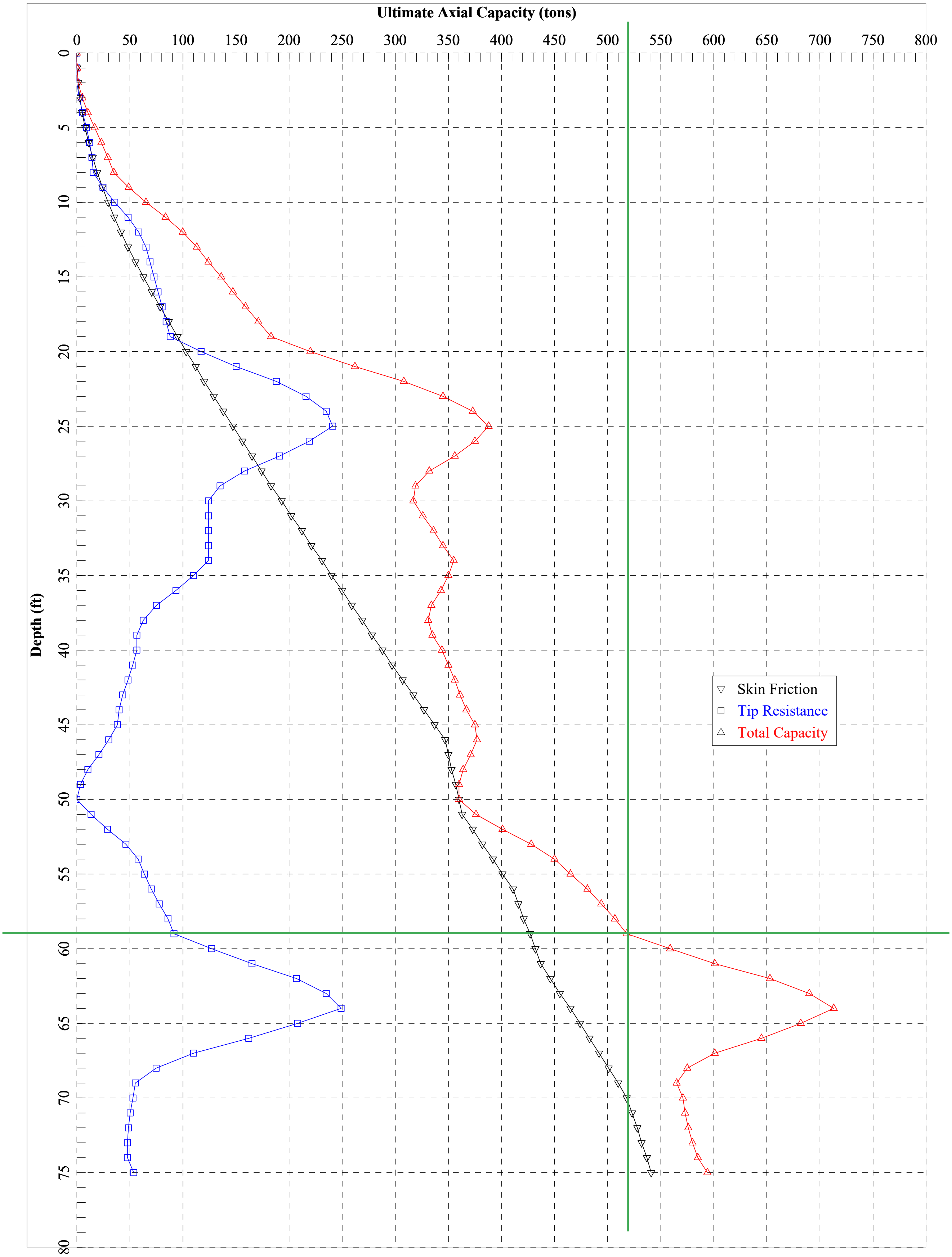
Mojave Bridge - Abutment2- Boring B-1 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8’-0” o.c.):

- Service = 385 kips = 192.5 tons
- Strength = 515 kips = 257.5 tons
- LRFD Factored Resistance of approximately 260 tons is provided by a shaft length of **59 feet**.



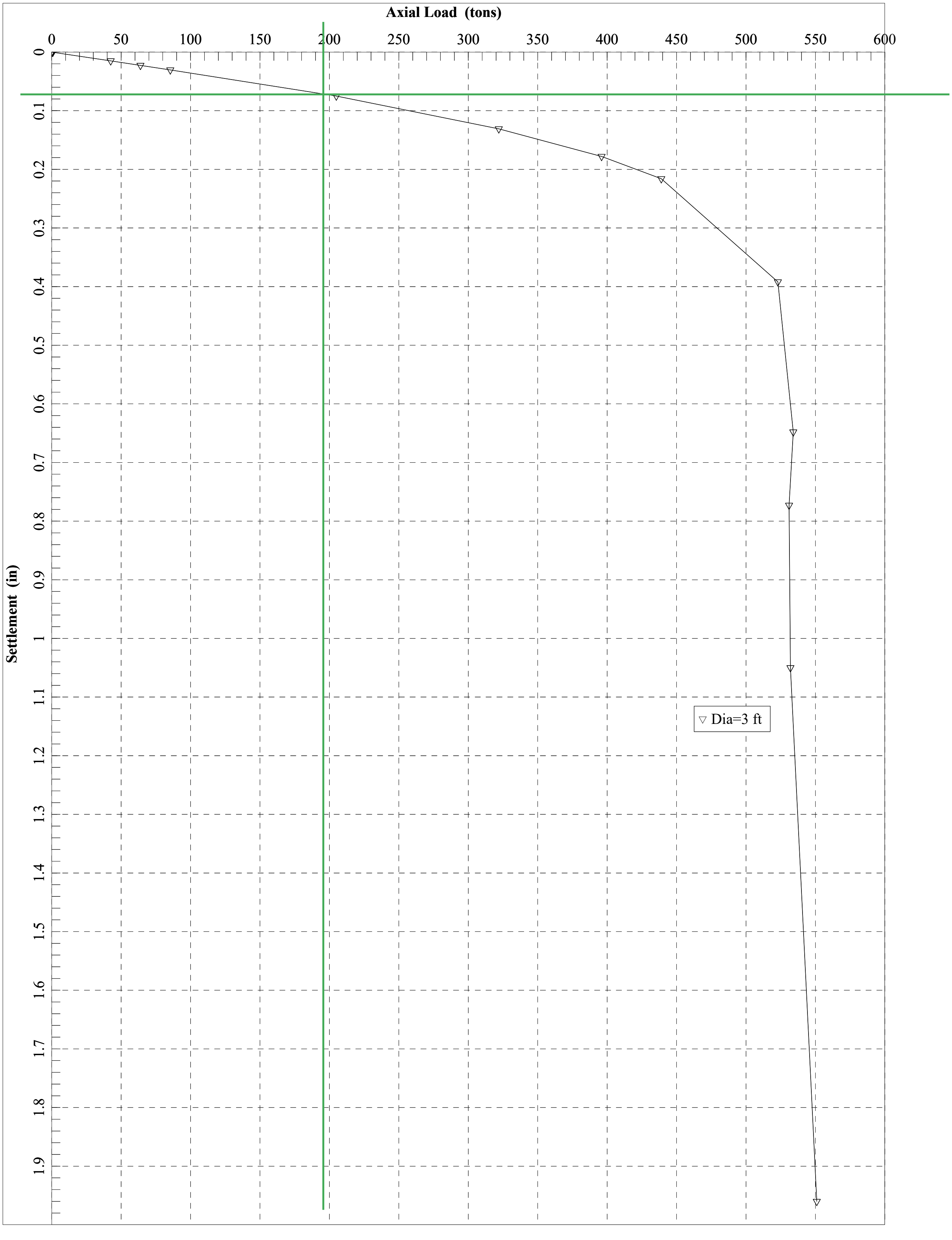
Mojave Bridge - Abutment2- Boring B-1 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8’-0” o.c.):

- Service = 385 kips = 192.5 tons
- Strength = 515 kips = 257.5 tons
- Ultimate Axial Resistance of approximately 520 tons is provided by a shaft length of **59 feet**.



Mojave Bridge - Abutment2- Boring B-1 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8'-0" o.c.):

- Service = 385 kips = 192.5 tons
- Strength = 515 kips = 257.5 tons
- At service limit load of 193 tons, settlement = **approx. 0.08 inch**



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==========================================================================

                  SHAFT for Windows, Version 2012.7.17

                   Serial Number :  157290693

                 VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                  (c) Copyright ENSOFT, Inc., 1987-2012
                        All Rights Reserved

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Projects\G-19-192 I-515 Charleston Interchange - CA Group\DESIGN\1
Bridges-Revision2\Mojave-Bridge-Revised-5-26-2020\
     Name of input data file     : Mojave-Abutment2_B-1-3feet.sfd
     Name of output file         : Mojave-Abutment2_B-1-3feet.sfo
     Name of plot output file    : Mojave-Abutment2_B-1-3feet.sfp
     Name of runtime file        : Mojave-Abutment2_B-1-3feet.sfr


     --------------------------------------------------------------------------
                           Time and Date of Analysis
     --------------------------------------------------------------------------

               Date:  May 27, 2020     Time:  11:53:04

     Mojave Bridge - Abutment2- Boring B-1 - 3 feet Shafts


     PROPOSED DEPTH =      80.0 FT
     ----------------


     NUMBER OF LAYERS =   14
     ------------------


     WATER TABLE DEPTH =      15.0 FT.
     -------------------




     SOIL INFORMATION
     ---------------
```

```
LAYER NO 1----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.120E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.290E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.110E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.000E+00


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.112E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.290E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.110E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.800E+01


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 2----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.112E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.800E+01


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.995E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
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  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.140E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 3----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.995E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.140E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.825E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.250E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 4----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.825E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.400E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.250E+02
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  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.754E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.400E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.305E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 5----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.516E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.390E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.305E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.516E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.390E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.400E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO 6----SAND
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  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                      = 0.646E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.330E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.400E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                      = 0.589E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.330E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.455E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.500E+00


LAYER NO 7----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.120E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.455E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.120E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
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  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.510E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO 8----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.536E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.300E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.510E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.490E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.300E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.560E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 9----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.200E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.560E+02
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  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                       = 0.550E+00
  END BEARING COEFFICIENT-Nc                            = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                    = 0.200E+04
  INTERNAL FRICTION ANGLE, DEG.                         = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST         = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                            = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT              = 0.100E+11
  DEPTH, FT                                             = 0.605E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)                = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)               = 0.400E+00


LAYER NO10----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                       = 0.450E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                    = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                         = 0.350E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST         = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                            = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT              = 0.100E+11
  DEPTH, FT                                             = 0.605E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                       = 0.412E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                    = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                         = 0.350E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST         = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                            = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT              = 0.100E+11
  DEPTH, FT                                             = 0.650E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)                = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)               = 0.500E+00


LAYER NO11----SAND
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  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                      = 0.412E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.400E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.650E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                      = 0.371E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.400E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.700E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.500E+00


LAYER NO12----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.180E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.700E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.180E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.125E+03
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  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.740E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO13----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.150E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.740E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.150E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.800E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO14----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.293E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.340E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
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  DEPTH, FT                                              = 0.800E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                        = 0.281E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                     = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                          = 0.340E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST          = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                             = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT               = 0.100E+11
  DEPTH, FT                                              = 0.815E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)                 = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)                = 0.500E+00




DRILLED SHAFT INFORMATION
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 DIAMETER OF STEM          =    3.000  FT.
 DIAMETER OF BASE          =    3.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    0.000  FT.
 IGNORED BOTTOM PORTION    =    0.000  FT.
 AREA OF ONE PERCENT STEEL =   10.180  SQ.IN.
 ELASTIC MODULUS, Ec       = 0.350E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.




PREDICTED RESULTS
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QS      = ULTIMATE SIDE RESISTANCE;
QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.
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LENGTH  VOLUME     QS       QB       QU     LRFD QS  LRFD QB   LRFD QU
(FEET)  (CU.YDS) (TONS)   (TONS)   (TONS)   (TONS)   (TONS)    (TONS)
  1.0     0.26     0.31     0.00     0.31     0.17     0.00      0.17
  2.0     0.52     1.24     0.00     1.24     0.68     0.00      0.68
  3.0     0.79     2.80     2.40     5.20     1.54     1.20      2.74
  4.0     1.05     4.98     5.41    10.39     2.74     2.70      5.44
  5.0     1.31     7.77     9.07    16.84     4.27     4.53      8.81
  6.0     1.57    11.11    12.04    23.14     6.11     6.02     12.13
  7.0     1.83    14.96    14.21    29.16     8.23     7.10     15.33
  8.0     2.09    19.30    15.46    34.77    10.62     7.73     18.35
  9.0     2.36    24.14    24.72    48.86    13.28    12.36     25.64
 10.0     2.62    29.47    35.65    65.12    16.21    17.83     34.03
 11.0     2.88    35.26    48.34    83.59    19.39    24.17     43.56
 12.0     3.14    41.50    58.28    99.77    22.82    29.14     51.96
 13.0     3.40    48.17    65.25   113.42    26.49    32.62     59.12
 14.0     3.67    55.26    69.02   124.28    30.39    34.51     64.90
 15.0     3.93    62.78    72.79   135.57    34.53    36.39     70.92
 16.0     4.19    70.59    76.56   147.15    38.82    38.28     77.10
 17.0     4.45    78.54    80.33   158.88    43.20    40.17     83.36
 18.0     4.71    86.64    84.10   170.74    47.65    42.05     89.70
 19.0     4.97    94.86    87.87   182.73    52.17    43.94     96.11
 20.0     5.24   103.21   116.59   219.80    56.76    58.30    115.06
 21.0     5.50   111.68   149.84   261.52    61.42    74.92    136.34
 22.0     5.76   120.27   187.75   308.01    66.15    93.87    160.02
 23.0     6.02   128.96   216.19   345.16    70.93   108.10    179.03
 24.0     6.28   137.77   234.77   372.54    75.77   117.39    193.16
 25.0     6.55   146.67   241.31   387.97    80.67   120.65    201.32
 26.0     6.81   155.68   219.36   375.04    85.62   109.68    195.30
 27.0     7.07   164.79   191.38   356.17    90.64    95.69    186.32
 28.0     7.33   174.01   158.10   332.11    95.71    79.05    174.76
 29.0     7.59   183.33   135.41   318.74   100.83    67.71    168.54
 30.0     7.86   192.74   124.07   316.81   106.01    62.03    168.04
 31.0     8.12   202.24   124.07   326.31   111.23    49.63    160.86
 32.0     8.38   211.72   124.07   335.79   115.50    49.63    165.12
 33.0     8.64   221.20   124.07   345.27   119.76    49.63    169.39
 34.0     8.90   230.68   124.07   354.75   124.03    49.63    173.66
 35.0     9.16   240.16   109.75   349.91   128.29    43.90    172.20
 36.0     9.43   249.64    93.38   343.02   132.56    37.35    169.91
 37.0     9.69   259.12    74.97   334.09   136.83    29.99    166.82
 38.0     9.95   268.60    62.70   331.30   141.09    25.08    166.17
 39.0    10.21   278.08    56.56   334.64   145.36    22.63    167.98
 40.0    10.47   287.56    56.56   344.12   149.63    28.28    177.91
 41.0    10.74   297.50    52.66   350.16   155.09    26.33    181.42
 42.0    11.00   307.45    48.20   355.65   160.56    24.10    184.67
 43.0    11.26   317.40    43.19   360.59   166.04    21.60    187.63
 44.0    11.52   327.34    39.85   367.19   171.51    19.92    191.43
 45.0    11.78   337.29    38.18   375.46   176.98    19.09    196.06
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46.0     12.04   347.22    30.08   377.30   182.44    12.03    194.47
47.0     12.31   350.33    20.82   371.15   183.84     8.33    192.17
48.0     12.57   353.44    10.41   363.85   185.24     4.16    189.40
49.0     12.83   356.55     3.47   360.02   186.64     1.39    188.03
50.0     13.09   359.66     0.00   359.66   188.04     0.00    188.04
51.0     13.35   362.77    13.50   376.27   189.44     6.75    196.19
52.0     13.62   372.51    28.92   401.43   194.79    14.46    209.26
53.0     13.88   382.21    46.27   428.48   200.13    23.14    223.26
54.0     14.14   391.86    57.84   449.70   205.43    28.92    234.35
55.0     14.40   401.45    63.63   465.08   210.71    31.81    242.53
56.0     14.66   411.00    70.13   481.13   215.96    28.05    244.01
57.0     14.92   416.18    77.56   493.74   218.30    31.02    249.32
58.0     15.19   421.37    85.91   507.28   220.63    34.37    254.99
59.0     15.45   426.55    91.49   518.04   222.96    36.59    259.56
60.0     15.71   431.74   127.06   558.80   225.29    50.82    276.12
61.0     15.97   436.92   164.53   601.45   227.63    82.27    309.89
62.0     16.23   446.20   206.69   652.89   232.73   103.34    336.08
63.0     16.50   455.43   234.79   690.22   237.81   117.40    355.20
64.0     16.76   464.59   248.85   713.44   242.85   124.42    367.27
65.0     17.02   473.70   208.21   681.91   247.85   104.10    351.96
66.0     17.28   482.74   161.76   644.51   252.83    80.88    333.71
67.0     17.54   491.73   109.51   601.24   257.77    54.76    312.53
68.0     17.80   500.65    74.68   575.33   262.68    37.34    300.02
69.0     18.07   509.50    55.24   564.74   267.55    27.62    295.17
70.0     18.33   518.28    52.92   571.21   272.38    21.17    293.55
71.0     18.59   522.95    50.32   573.27   274.48    20.13    294.60
72.0     18.85   527.62    48.59   576.20   276.58    19.43    296.01
73.0     19.11   532.28    47.72   580.00   278.68    19.09    297.76
74.0     19.38   536.95    47.72   584.67   280.78    19.09    299.86
75.0     19.64   540.84    53.59   594.43   282.52    21.44    303.96


   RESULT FROM TREND (AVERAGED) LINE

   TOP   LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
      ton              IN.              ton             IN.
  0.8475E-01      0.3027E-04      0.5211E-03      0.1000E-04
  0.4238E+00      0.1513E-03      0.2605E-02      0.5000E-04
  0.8475E+00      0.3027E-03      0.5211E-02      0.1000E-03
  0.4252E+02      0.1515E-01      0.2605E+00      0.5000E-02
  0.6394E+02      0.2275E-01      0.3908E+00      0.7500E-02
  0.8536E+02      0.3036E-01      0.5211E+00      0.1000E-01
  0.2055E+03      0.7509E-01      0.1303E+01      0.2500E-01
  0.3222E+03      0.1314E+00      0.2605E+01      0.5000E-01
  0.3957E+03      0.1779E+00      0.3908E+01      0.7500E-01
  0.4394E+03      0.2162E+00      0.5211E+01      0.1000E+00
  0.5228E+03      0.3925E+00      0.1292E+02      0.2500E+00
```

```
0.5339E+03      0.6484E+00      0.2433E+02      0.5000E+00
0.5306E+03      0.7731E+00      0.2795E+02      0.6250E+00
0.5321E+03      0.1050E+01      0.3430E+02      0.9000E+00
0.5511E+03      0.1960E+01      0.5440E+02      0.1800E+01



 RESULT FROM UPPER-BOUND LINE

 TOP   LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
    ton              IN.              ton             IN.
0.1337E+00      0.4077E-04      0.7444E-03      0.1000E-04
0.6686E+00      0.2038E-03      0.3722E-02      0.5000E-04
0.1337E+01      0.4077E-03      0.7444E-02      0.1000E-03
0.6739E+02      0.2046E-01      0.3722E+00      0.5000E-02
0.1013E+03      0.3073E-01      0.5583E+00      0.7500E-02
0.1352E+03      0.4101E-01      0.7444E+00      0.1000E-01
0.3070E+03      0.9862E-01      0.1861E+01      0.2500E-01
0.4321E+03      0.1598E+00      0.3722E+01      0.5000E-01
0.4888E+03      0.2037E+00      0.5583E+01      0.7500E-01
0.5168E+03      0.2380E+00      0.7444E+01      0.1000E+00
0.5594E+03      0.4041E+00      0.1819E+02      0.2500E+00
0.5679E+03      0.6599E+00      0.3365E+02      0.5000E+00
0.5662E+03      0.7850E+00      0.3705E+02      0.6250E+00
0.5672E+03      0.1061E+01      0.4073E+02      0.9000E+00
0.5844E+03      0.1970E+01      0.5788E+02      0.1800E+01



 RESULT FROM LOWER-BOUND LINE

 TOP   LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
    ton              IN.              ton             IN.
0.4618E-01      0.2148E-04      0.2977E-03      0.1000E-04
0.2309E+00      0.1074E-03      0.1489E-02      0.5000E-04
0.4618E+00      0.2148E-03      0.2977E-02      0.1000E-03
0.2309E+02      0.1074E-01      0.1489E+00      0.5000E-02
0.3467E+02      0.1611E-01      0.2233E+00      0.7500E-02
0.4630E+02      0.2149E-01      0.2977E+00      0.1000E-01
0.1151E+03      0.5371E-01      0.7444E+00      0.2500E-01
0.2086E+03      0.1029E+00      0.1489E+01      0.5000E-01
0.2831E+03      0.1479E+00      0.2233E+01      0.7500E-01
0.3388E+03      0.1883E+00      0.2977E+01      0.1000E+00
0.4856E+03      0.3806E+00      0.7652E+01      0.2500E+00
0.4961E+03      0.6358E+00      0.1501E+02      0.5000E+00
0.4924E+03      0.7603E+00      0.1886E+02      0.6250E+00
0.4971E+03      0.1039E+01      0.2787E+02      0.9000E+00
0.5178E+03      0.1950E+01      0.5091E+02      0.1800E+01
```

MOJAVE BRIDGE -ABUTMENT 2

LATERAL CAPACITY ANALYSIS

Lateral Analysis and Results – Mojave Bridge Abutment 1 (Boring B-2) and Abutment 2 (Boring B-1):

Lateral analyses were performed for the drilled shaft foundations for the project using software GROUP. The following table summarizes the geometry of the shafts and the pipe cap:

Loading Condition	**Bridge H-1442R over Mojave Road**					
	East Abutment (Abutment-1)			**West Abutment (Abutment-2)**		
	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure
Service Limit	2304 kips	117.9 kips	Fig. 1	2304	117.9	Fig. 4
Strength Limit	3060 kips	132.18 kips	Fig. 2	3060 kips	132.18 kips	Fig. 5
Extreme Limit	3546 kips	304.92 kips	Fig. 3	3546 kips	304.92 kips	Fig. 6
Drilled Shaft Lengths	66 feet			59 feet		
Reinforcement	8 - #11 bar			8 - #11 bar		
Pile Cap and Shaft geometry	Two rows of 3 piers each 3.0 feet diameter spaced 8 feet center to center connected by pile cap approximately 21.18 feet long, 13 feet wide and 3 feet thick			Two rows of 3 piers each 3.0 feet diameter spaced 8 feet center to center connected by pile cap approximately 21.18 feet long, 13 feet wide and 3 feet thick		

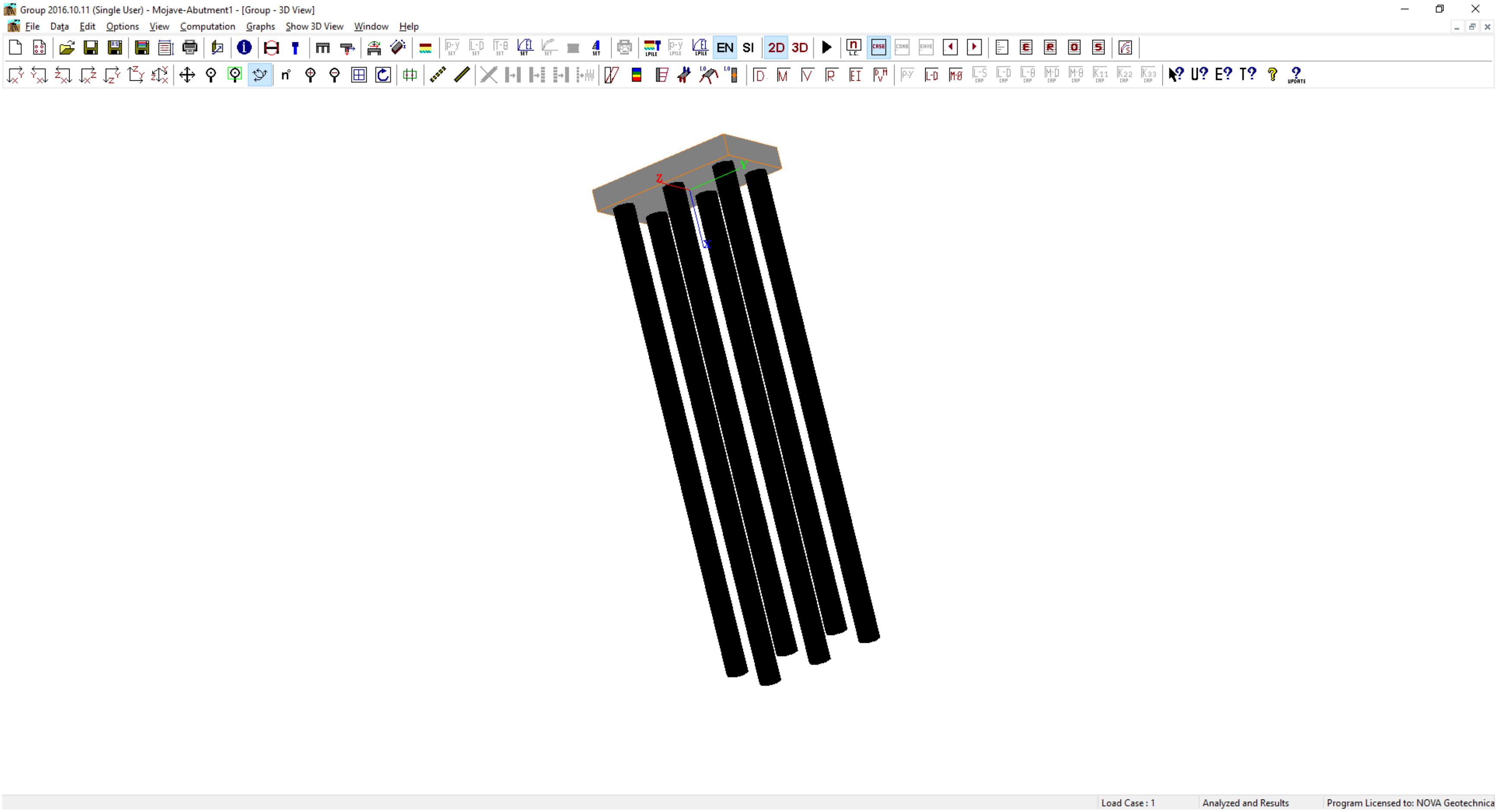
The input parameters for Abutment 2 are provided in the table below:

Mojave Bridge – Abutment 2 – Boring B-1 LPILE/GROUP Parameters

GROUP/LPILE Soil Type *	Approximate Formation Depths (ft)	Unit Weight (pcf)	Cohesion	Friction Angle	Soil Modulus K (pci)	Strain Factor E_{50}
Sand	0 – 3	110	Ignore	Ignore	Ignore	Ignore
Sand	3 – 8	110	-	29 degrees	25	N/A
Sand	8 – 14	115	-	32 degrees	60	N/A
Groundwater depth = 14 feet						
Sand	14 – 25	125	-	36 degrees	125	N/A
Sand	25 – 30.5	130	-	40 degrees	125	N/A
Clay	30.5 – 40	125	3,900 psf	-	Static – 1,000 Cyclic – 400	0.005
Sand	40 – 45.5	120	-	33 degrees	60	N/A
Clay	45.5 – 51	115	1,200 psf	-	Static – 500 Cyclic – 200	0.007
Sand	51 – 56	115	-	30 degrees	60	N/A
Clay	56 – 60.5	125	2,000 psf	-	Static – 500 Cyclic – 200	0.007
Sand	60.5 – 65	125	-	35 degrees	125	N/A
Sand	65 – 70	130	-	40 degrees	125	N/A
Clay	70 – 74	125	1,800 psf	-	Static – 500 Cyclic – 200	0.007
Clay	74 – 80	115	1,500 psf	-	Static – 500 Cyclic – 200	0.007
Sand	80 – 81.5	125	-	34 degrees	125	N/A

* Clay soils with cohesion less than 1,000 psf should be modeled as “Soft Clay (Matlock)”. And, clay soils with cohesion more than 1,000 psf should be modeled as “Stiff Clay without Free Water (Reese)”. Sand soils should be modeled as “Sand (Reese)”.
N/A – Not Applicable

The following figure shows a typical model:



Load Case : 1

Analyzed and Results

Program Licensed to: NOVA Geotechnica

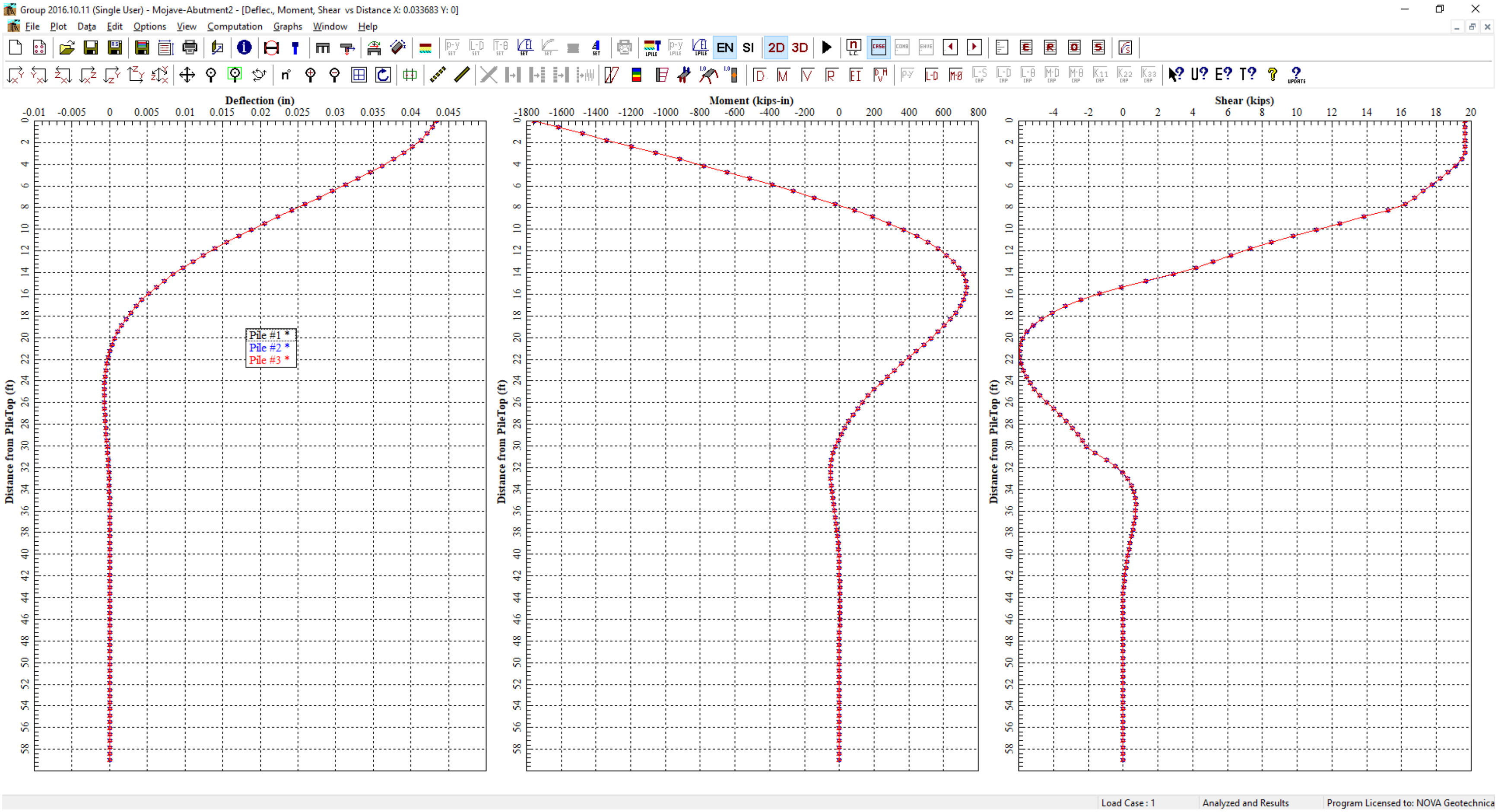
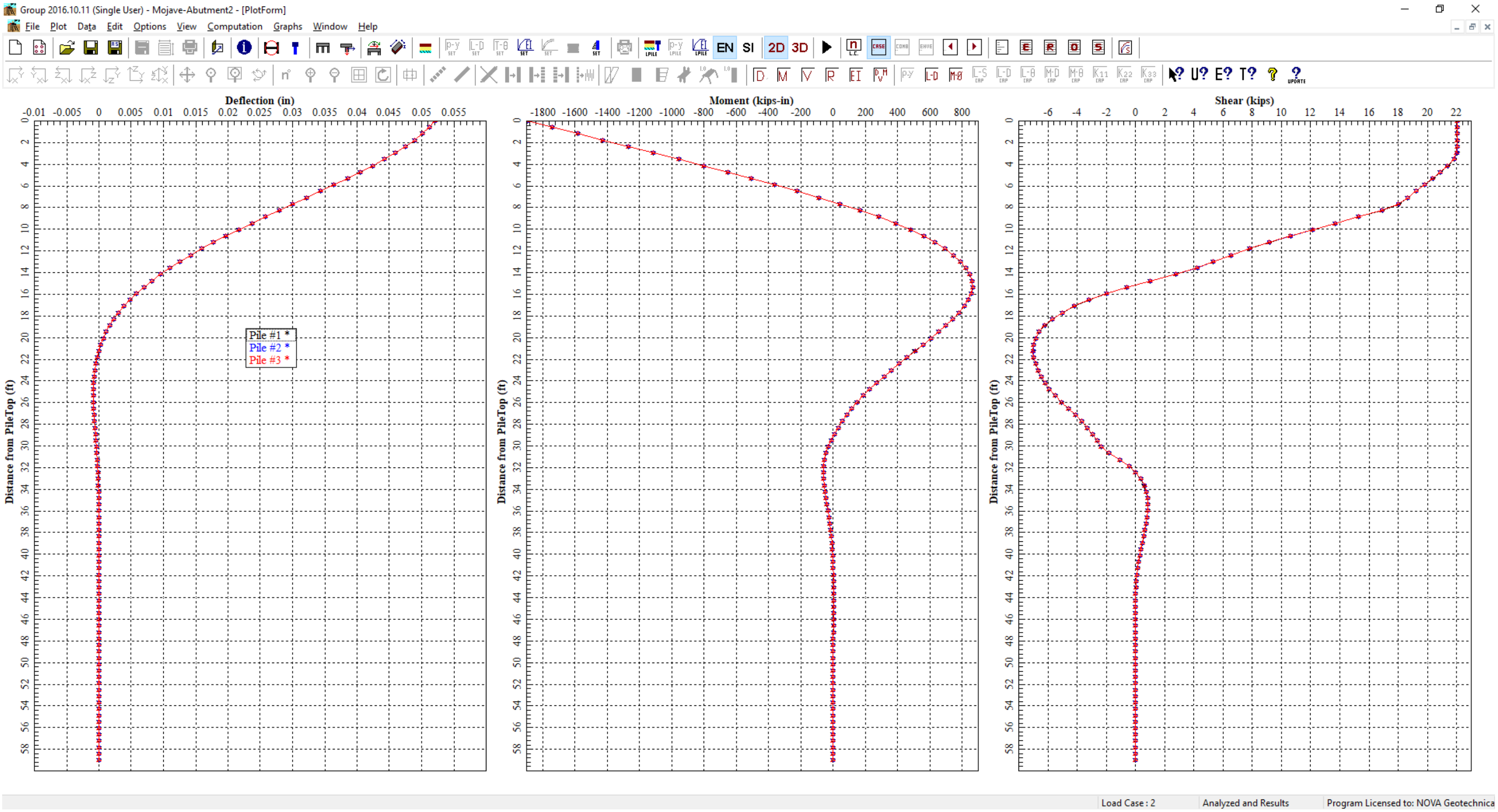


Figure 4. Results of Service Limit loading on Mojave Abutment 2



Load Case : 2

Analyzed and Results

Program Licensed to: NOVA Geotechnica

Figure 5. Results of Strength Limit loading on Mojave Abutment 2

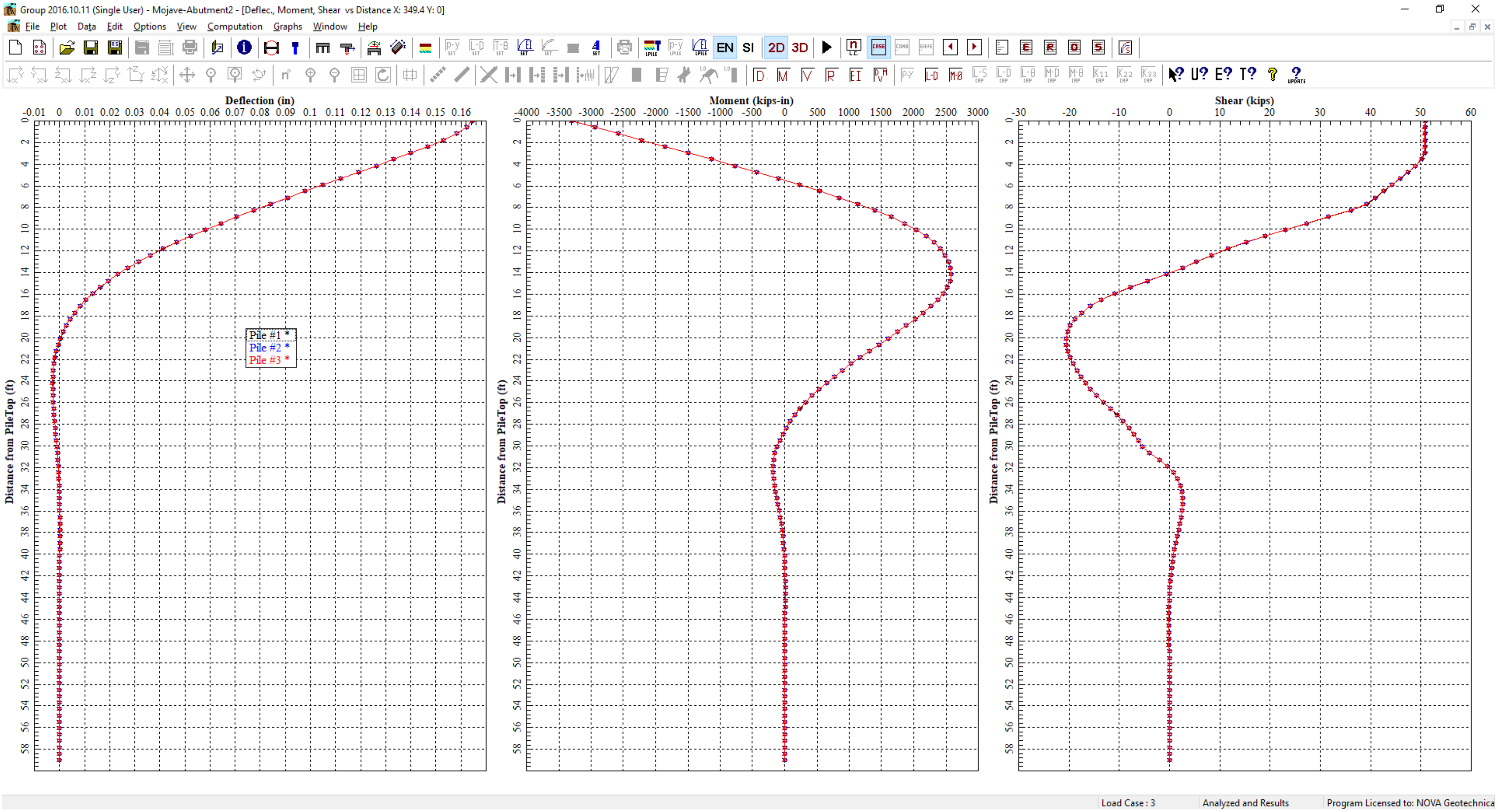


Figure 6. Results of Extreme Limit loading on Mojave Abutment 2

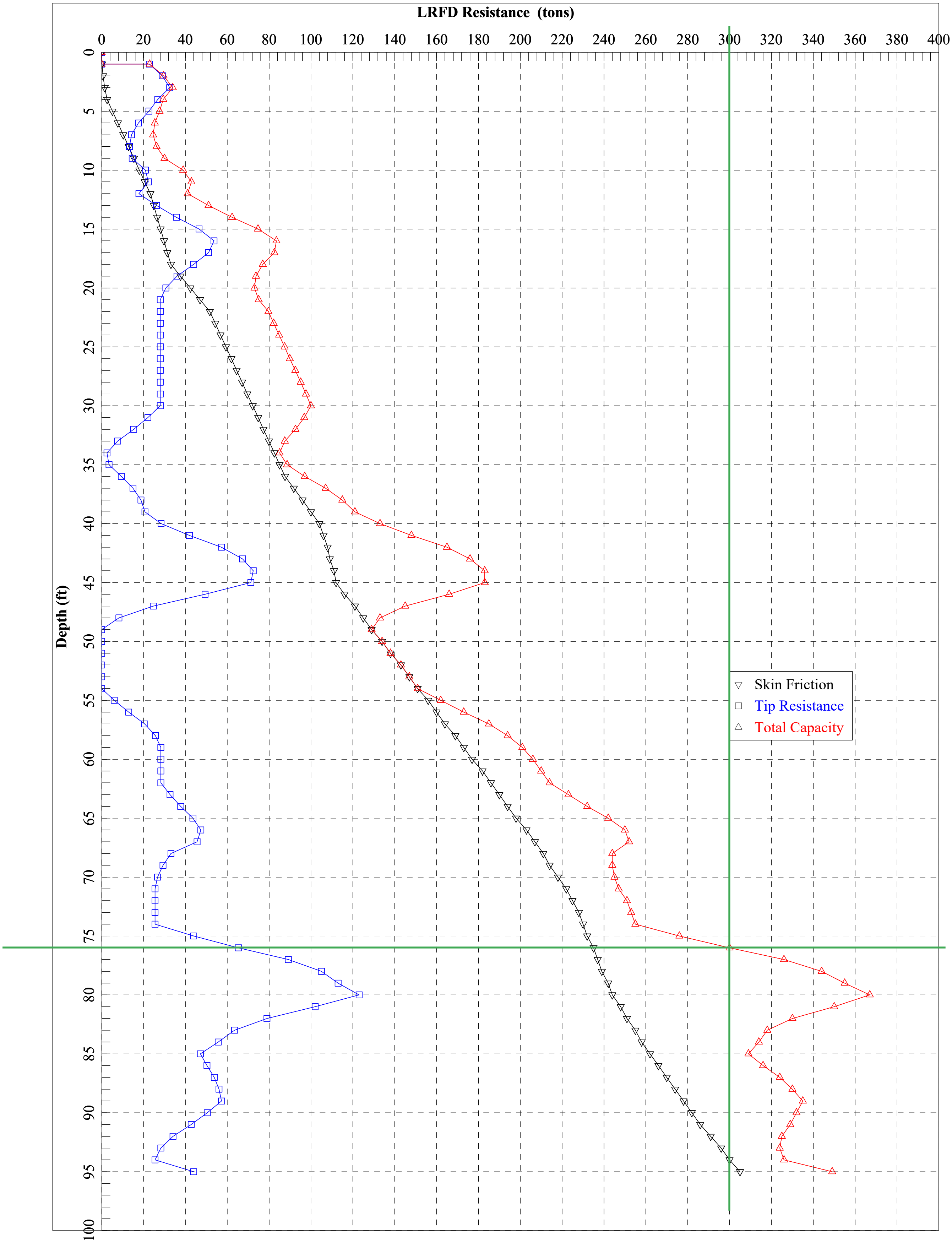
Axial and Lateral Analysis Results for
PECOS BRIDGE

PECOS BRIDGE -ABUTMENT 1

AXIAL CAPACITY ANALYSIS

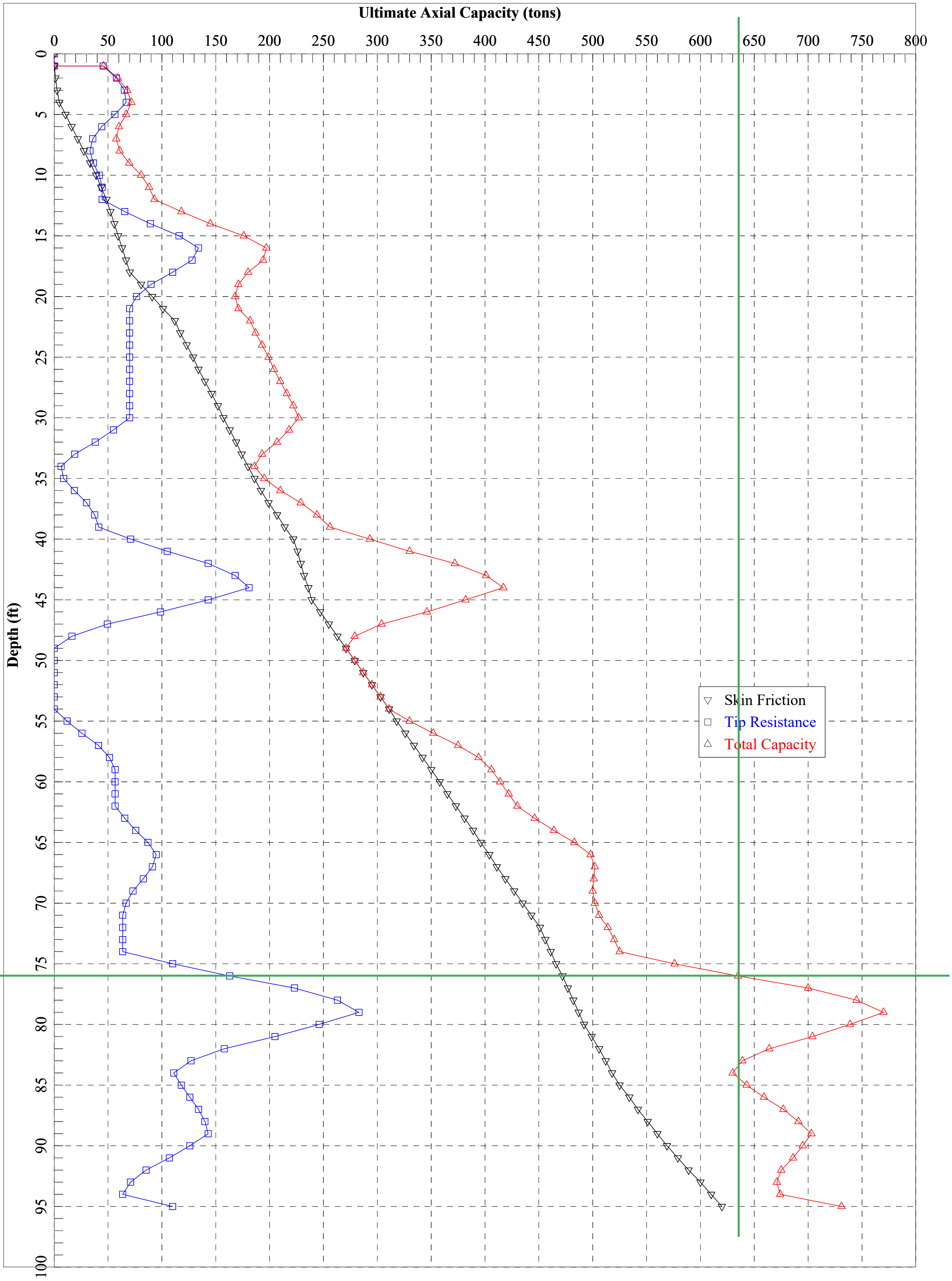
Pecos Bridge - Abutment1- Boring B-4 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8.25' o.c.):

- Service = 450 kips = 225 tons
- Strength = 570 kips = 285 tons
- LRFD Factored Resistance of approximately 300 tons is provided by a shaft length of **76 feet**.



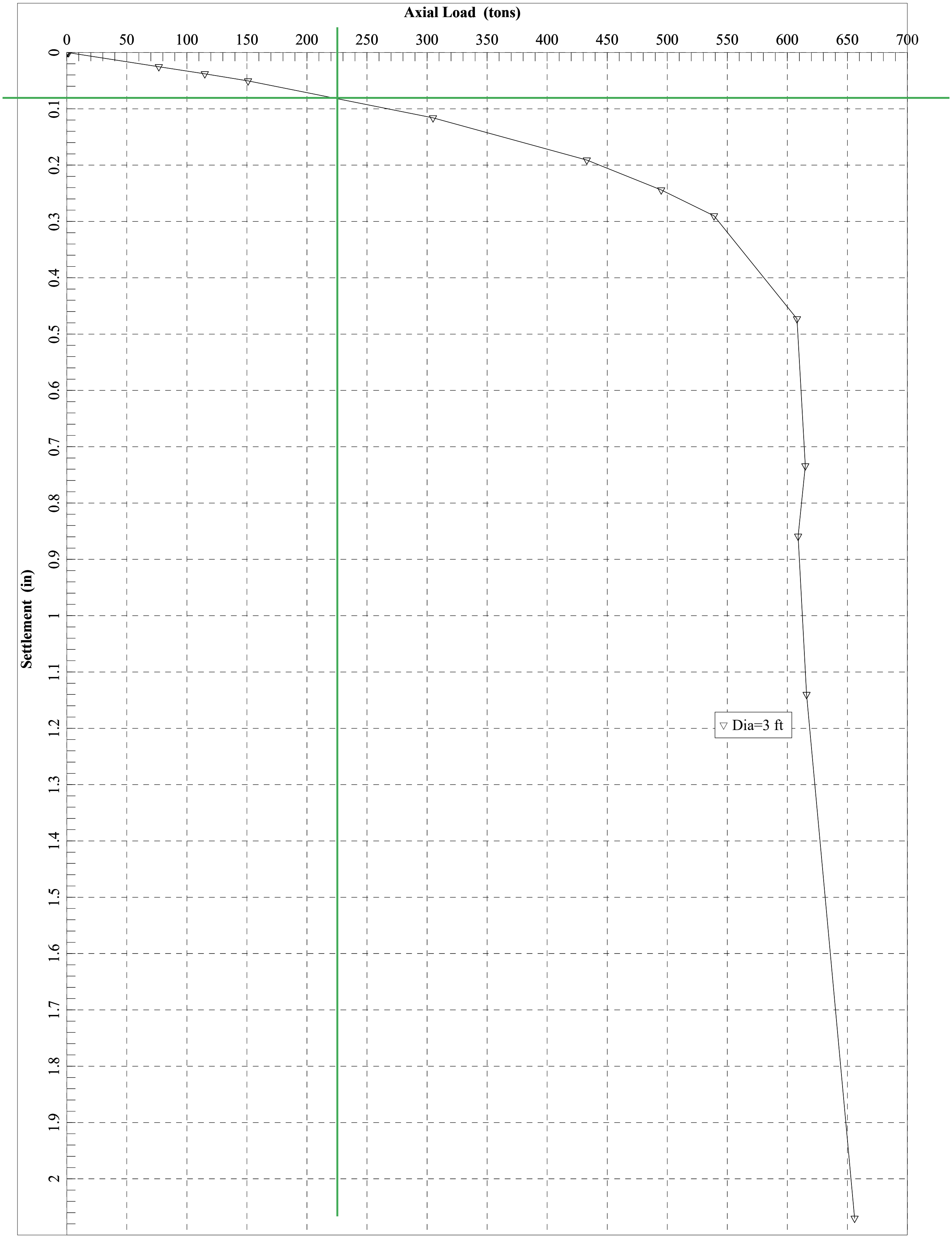
Pecos Bridge - Abutment1- Boring B-4 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8.25' o.c.):

- Service = 450 kips = 225 tons
- Strength = 570 kips = 285 tons
- Ultimate Axial Resistance of approximately 635 tons is provided by a shaft length of **76 feet**.



Pecos Bridge - Abutment1- Boring B-4 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8.25' o.c.):

- Service = 450 kips = 225 tons
- Strength = 570 kips = 285 tons
- At service limit load of 225 tons, settlement = **approx. 0.08 inch**



```
     =========================================================================

                      SHAFT for Windows, Version 2012.7.17

                       Serial Number :  157290693

                    VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                     (c) Copyright ENSOFT, Inc., 1987-2012
                           All Rights Reserved

     =========================================================================


     Path to file locations      : H:\PROJECTS\Engineering & Enviro Projects\2019
Projects\G-19-192 I-515 Charleston Interchange - CA Group\DESIGN\1
Bridges-Revision2\Pecos-Bridge-Revised-5-26-2020\
     Name of input data file     : Pecos-Abutment1_B-4-3feet.sfd
     Name of output file         : Pecos-Abutment1_B-4-3feet.sfo
     Name of plot output file    : Pecos-Abutment1_B-4-3feet.sfp
     Name of runtime file        : Pecos-Abutment1_B-4-3feet.sfr


     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  May 28, 2020     Time:  10:08:47

     Pecos Bridge - Abutment1_Boring B-4 - 3.0 feet Shaft


     PROPOSED DEPTH =     100.0 FT
     ----------------


     NUMBER OF LAYERS =   19
     ------------------


     WATER TABLE DEPTH =       7.0 FT.
     -------------------




     SOIL INFORMATION
     ---------------
```

```
LAYER NO 1----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                     = 0.120E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                       = 0.290E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.000E+00


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                     = 0.120E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                       = 0.290E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.400E+01


  LRFD RESISTANCE FACTOR (SIDE FRICTION)              = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)             = 0.500E+00


LAYER NO 2----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00
  END BEARING COEFFICIENT-Nc                          = 0.760E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.220E+04
  INTERNAL FRICTION ANGLE, DEG.                       = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.400E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00
  END BEARING COEFFICIENT-Nc                          = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.220E+04
  INTERNAL FRICTION ANGLE, DEG.                       = 0.000E+00
```

```
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.100E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO 3----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.107E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.100E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.104E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.115E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 4----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.140E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
```

```
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.115E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.140E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.180E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO 5----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.487E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.450E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.180E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.487E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.450E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.220E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00
```

```
 LAYER NO 6----CLAY

   AT THE TOP

   STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00
   END BEARING COEFFICIENT-Nc                         = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.220E+04
   INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                         = 0.115E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
   DEPTH, FT                                          = 0.220E+02


   AT THE BOTTOM

   STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00
   END BEARING COEFFICIENT-Nc                         = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.220E+04
   INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                         = 0.115E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
   DEPTH, FT                                          = 0.300E+02


   LRFD RESISTANCE FACTOR (SIDE FRICTION)             = 0.450E+00
   LRFD RESISTANCE FACTOR (TIP RESISTANCE)            = 0.400E+00


 LAYER NO 7----CLAY

   AT THE TOP

   STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00
   END BEARING COEFFICIENT-Nc                         = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.220E+04
   INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                         = 0.115E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
   DEPTH, FT                                          = 0.300E+02


   AT THE BOTTOM
```

```
  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.220E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.355E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO 8----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.696E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.300E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.355E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.646E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.300E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.400E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 9----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
```

```
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.130E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.400E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.130E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.450E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO10----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.594E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.380E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.450E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.545E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.380E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.500E+02
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  LRFD RESISTANCE FACTOR (SIDE FRICTION)           = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)          = 0.500E+00


LAYER NO11----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                  = 0.545E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT               = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                    = 0.300E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                       = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT         = 0.100E+11
  DEPTH, FT                                        = 0.500E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                  = 0.454E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT               = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                    = 0.300E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                       = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT         = 0.100E+11
  DEPTH, FT                                        = 0.600E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)           = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)          = 0.500E+00


LAYER NO12----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                  = 0.454E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT               = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                    = 0.330E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                       = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT         = 0.100E+11
  DEPTH, FT                                        = 0.600E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                  = 0.387E+00
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   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
   INTERNAL FRICTION ANGLE, DEG.                     = 0.330E+02
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.120E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.680E+02


   LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
   LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


 LAYER NO13----CLAY

   AT THE TOP

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.310E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.680E+02


   AT THE BOTTOM

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.310E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.720E+02


   LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
   LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


 LAYER NO14----CLAY

   AT THE TOP

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
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   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.200E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.720E+02


   AT THE BOTTOM

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.200E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.130E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.800E+02


   LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
   LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


 LAYER NO15----SAND

   AT THE TOP

   SKIN FRICTION COEFFICIENT- BETA                   = 0.293E+00
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
   INTERNAL FRICTION ANGLE, DEG.                     = 0.440E+02
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.135E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.800E+02


   AT THE BOTTOM

   SKIN FRICTION COEFFICIENT- BETA                   = 0.255E+00
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
   INTERNAL FRICTION ANGLE, DEG.                     = 0.440E+02
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.135E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.850E+02
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  LRFD RESISTANCE FACTOR (SIDE FRICTION)           = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)          = 0.500E+00


LAYER NO16----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.535E+00
  END BEARING COEFFICIENT-Nc                       = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT               = 0.350E+04
  INTERNAL FRICTION ANGLE, DEG.                    = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                       = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT         = 0.100E+11
  DEPTH, FT                                        = 0.850E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.535E+00
  END BEARING COEFFICIENT-Nc                       = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT               = 0.350E+04
  INTERNAL FRICTION ANGLE, DEG.                    = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                       = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT         = 0.100E+11
  DEPTH, FT                                        = 0.900E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)           = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)          = 0.400E+00


LAYER NO17----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.487E+00
  END BEARING COEFFICIENT-Nc                       = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT               = 0.450E+04
  INTERNAL FRICTION ANGLE, DEG.                    = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                       = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT         = 0.100E+11
  DEPTH, FT                                        = 0.900E+02
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```
  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                        = 0.487E+00
  END BEARING COEFFICIENT-Nc                             = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                     = 0.450E+04
  INTERNAL FRICTION ANGLE, DEG.                          = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST          = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                             = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT               = 0.100E+11
  DEPTH, FT                                              = 0.950E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)                 = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)                = 0.400E+00


LAYER NO18----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                        = 0.550E+00
  END BEARING COEFFICIENT-Nc                             = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                     = 0.200E+04
  INTERNAL FRICTION ANGLE, DEG.                          = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST          = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                             = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT               = 0.100E+11
  DEPTH, FT                                              = 0.950E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                        = 0.550E+00
  END BEARING COEFFICIENT-Nc                             = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                     = 0.200E+04
  INTERNAL FRICTION ANGLE, DEG.                          = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST          = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                             = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT               = 0.100E+11
  DEPTH, FT                                              = 0.100E+03


  LRFD RESISTANCE FACTOR (SIDE FRICTION)                 = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)                = 0.400E+00


LAYER NO19----SAND
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  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                      = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.440E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.135E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.100E+03


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                      = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.440E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.135E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.102E+03


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.500E+00




DRILLED SHAFT INFORMATION
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 DIAMETER OF STEM          =    3.000  FT.
 DIAMETER OF BASE          =    3.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    0.000  FT.
 IGNORED BOTTOM PORTION    =    0.000  FT.
 AREA OF ONE PERCENT STEEL =   10.180  SQ.IN.
 ELASTIC MODULUS, Ec       = 0.350E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.




PREDICTED RESULTS
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QS      = ULTIMATE SIDE RESISTANCE;
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QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH  VOLUME     QS      QB      QU     LRFD QS  LRFD QB   LRFD QU
(FEET)  (CU.YDS) (TONS)   (TONS)  (TONS)   (TONS)   (TONS)    (TONS)
  1.0     0.26     0.30    45.51    45.81     0.16    22.76     22.92
  2.0     0.52     1.19    57.91    59.09     0.65    28.95     29.61
  3.0     0.79     2.67    65.09    67.77     1.47    32.55     34.02
  4.0     1.05     4.75    66.91    71.66     2.61    26.76     29.38
  5.0     1.31    10.45    56.43    66.88     5.18    22.57     27.75
  6.0     1.57    16.16    44.07    60.22     7.75    17.63     25.37
  7.0     1.83    21.86    35.80    57.66    10.31    14.32     24.63
  8.0     2.09    27.56    33.23    60.80    12.88    13.29     26.17
  9.0     2.36    33.26    36.39    69.65    15.44    14.56     30.00
 10.0     2.62    38.97    41.86    80.83    18.01    20.93     38.94
 11.0     2.88    43.67    44.54    88.21    20.60    22.27     42.87
 12.0     3.14    48.55    44.54    93.09    23.28    17.82     41.09
 13.0     3.40    52.18    65.46   117.63    24.91    26.18     51.10
 14.0     3.67    55.81    89.36   145.17    26.55    35.75     62.29
 15.0     3.93    59.43   116.26   175.70    28.18    46.50     74.68
 16.0     4.19    63.06   134.19   197.26    29.81    53.68     83.49
 17.0     4.45    66.69   127.64   194.33    31.44    51.05     82.50
 18.0     4.71    70.32   109.90   180.22    33.08    43.96     77.04
 19.0     4.97    80.66    89.94   170.60    37.73    35.98     73.71
 20.0     5.24    91.00    76.64   167.64    42.38    30.66     73.04
 21.0     5.50   101.33    69.99   171.32    47.03    28.00     75.03
 22.0     5.76   111.67    69.99   181.66    51.69    28.00     79.68
 23.0     6.02   117.37    69.99   187.36    54.25    28.00     82.25
 24.0     6.28   123.08    69.99   193.06    56.82    28.00     84.81
 25.0     6.55   128.78    69.99   198.77    59.38    28.00     87.38
 26.0     6.81   134.48    69.99   204.47    61.95    28.00     89.95
 27.0     7.07   140.18    69.99   210.17    64.52    28.00     92.51
 28.0     7.33   145.89    69.99   215.88    67.08    28.00     95.08
 29.0     7.59   151.59    69.99   221.58    69.65    28.00     97.64
 30.0     7.86   157.29    69.99   227.28    72.21    28.00    100.21
 31.0     8.12   163.00    55.14   218.14    74.78    22.06     96.84
 32.0     8.38   168.70    38.18   206.87    77.35    15.27     92.62
 33.0     8.64   174.40    19.09   193.49    79.91     7.64     87.55
 34.0     8.90   180.10     6.36   186.47    82.48     2.55     85.02
 35.0     9.16   185.81     8.77   194.58    85.05     3.51     88.56
 36.0     9.43   191.51    18.80   210.31    87.61     9.40     97.01
 37.0     9.69   199.11    30.08   229.19    91.79    15.04    106.83
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38.0     9.95   206.76    37.60   244.36    96.00     18.80     114.80
39.0    10.21   214.44    41.36   255.80   100.23     20.68     120.90
40.0    10.47   222.16    70.97   293.14   104.47     28.39     132.86
41.0    10.74   225.53   104.82   330.35   105.99     41.93     147.92
42.0    11.00   228.90   142.90   371.80   107.50     57.16     164.66
43.0    11.26   232.27   168.29   400.56   109.02     67.31     176.33
44.0    11.52   235.64   180.98   416.62   110.54     72.39     182.93
45.0    11.78   239.01   142.59   381.60   112.05     71.29     183.35
46.0    12.04   246.87    98.72   345.59   116.38     49.36     165.74
47.0    12.31   254.77    49.36   304.13   120.72     24.68     145.40
48.0    12.57   262.71    16.45   279.16   125.09      8.23     133.31
49.0    12.83   270.67     0.00   270.67   129.46      0.00     129.46
50.0    13.09   278.65     0.00   278.65   133.85      0.00     133.85
51.0    13.35   286.64     0.00   286.64   138.25      0.00     138.25
52.0    13.62   294.62     0.00   294.62   142.64      0.00     142.64
53.0    13.88   302.58     0.00   302.58   147.02      0.00     147.02
54.0    14.14   310.53     0.00   310.53   151.39      0.00     151.39
55.0    14.40   318.46    12.00   330.46   155.75      6.00     161.75
56.0    14.66   326.37    25.71   352.08   160.10     12.86     172.96
57.0    14.92   334.25    41.14   375.39   164.44     20.57     185.01
58.0    15.19   342.11    51.42   393.53   168.76     25.71     194.47
59.0    15.45   349.93    56.56   406.49   173.06     28.28     201.34
60.0    15.71   357.72    56.56   414.28   177.34     28.28     205.62
61.0    15.97   365.47    56.56   422.03   181.60     28.28     209.89
62.0    16.23   373.19    56.56   429.75   185.85     28.28     214.13
63.0    16.50   380.88    65.48   446.36   190.08     32.74     222.82
64.0    16.76   388.53    75.68   464.21   194.29     37.84     232.13
65.0    17.02   396.14    87.15   483.28   198.47     43.57     242.05
66.0    17.28   403.70    94.80   498.49   202.63     47.40     250.03
67.0    17.54   411.21    91.20   502.41   206.77     45.60     252.36
68.0    17.80   418.68    82.71   501.39   210.87     33.09     243.96
69.0    18.07   426.71    73.17   499.88   214.49     29.27     243.75
70.0    18.33   434.75    66.81   501.56   218.10     26.72     244.83
71.0    18.59   442.78    63.63   506.41   221.72     25.45     247.17
72.0    18.85   450.82    63.63   514.45   225.33     25.45     250.78
73.0    19.11   456.00    63.63   519.63   227.67     25.45     253.12
74.0    19.38   461.19    63.63   524.81   230.00     25.45     255.45
75.0    19.64   466.37   110.11   576.49   232.33     44.05     276.38
76.0    19.90   471.56   163.24   634.80   234.67     65.30     299.96
77.0    20.16   476.74   223.01   699.75   237.00     89.20     326.20
78.0    20.42   481.93   262.86   744.78   239.33    105.14     344.47
79.0    20.68   487.11   282.78   769.89   241.66    113.11     354.78
80.0    20.95   492.30   246.41   738.71   244.00    123.21     367.21
81.0    21.21   498.95   204.85   703.80   247.66    102.43     350.08
82.0    21.47   505.52   158.10   663.62   251.27     79.05     330.32
83.0    21.73   512.00   126.93   638.93   254.84     63.46     318.30
84.0    21.99   518.40   111.34   629.75   258.36     55.67     314.03
85.0    22.26   524.71   118.09   642.80   261.83     47.24     309.06
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86.0    22.52   533.53   125.80   659.34   265.80    50.32    316.12
87.0    22.78   542.35   134.48   676.83   269.76    53.79    323.56
88.0    23.04   551.17   140.27   691.43   273.73    56.11    329.84
89.0    23.30   559.99   143.16   703.15   277.70    57.26    334.96
90.0    23.57   568.81   126.29   695.10   281.67    50.51    332.19
91.0    23.83   579.15   107.01   686.15   286.32    42.80    329.13
92.0    24.09   589.48    85.32   674.80   290.97    34.13    325.10
93.0    24.35   599.82    70.86   670.68   295.63    28.34    323.97
94.0    24.61   610.16    63.63   673.78   300.28    25.45    325.73
95.0    24.87   620.50   110.11   730.61   304.93    44.05    348.97


   RESULT FROM TREND (AVERAGED) LINE

   TOP  LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
      ton             IN.              ton              IN.
  0.1522E+00      0.5036E-04      0.1071E-02      0.1000E-04
  0.7610E+00      0.2518E-03      0.5353E-02      0.5000E-04
  0.1522E+01      0.5036E-03      0.1071E-01      0.1000E-03
  0.7665E+02      0.2525E-01      0.5353E+00      0.5000E-02
  0.1152E+03      0.3794E-01      0.8029E+00      0.7500E-02
  0.1514E+03      0.5052E-01      0.1071E+01      0.1000E-01
  0.3054E+03      0.1165E+00      0.2676E+01      0.2500E-01
  0.4331E+03      0.1909E+00      0.5353E+01      0.5000E-01
  0.4952E+03      0.2440E+00      0.8029E+01      0.7500E-01
  0.5387E+03      0.2895E+00      0.1071E+02      0.1000E+00
  0.6076E+03      0.4735E+00      0.2655E+02      0.2500E+00
  0.6149E+03      0.7344E+00      0.4998E+02      0.5000E+00
  0.6093E+03      0.8593E+00      0.5743E+02      0.6250E+00
  0.6158E+03      0.1139E+01      0.7047E+02      0.9000E+00
  0.6563E+03      0.2065E+01      0.1118E+03      0.1800E+01


   RESULT FROM UPPER-BOUND LINE

   TOP  LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
      ton             IN.              ton              IN.
  0.2768E+00      0.7696E-04      0.1529E-02      0.1000E-04
  0.1384E+01      0.3848E-03      0.7647E-02      0.5000E-04
  0.2768E+01      0.7696E-03      0.1529E-01      0.1000E-03
  0.1401E+03      0.3874E-01      0.7647E+00      0.5000E-02
  0.2028E+03      0.5780E-01      0.1147E+01      0.7500E-02
  0.2520E+03      0.7530E-01      0.1529E+01      0.1000E-01
  0.4289E+03      0.1588E+00      0.3823E+01      0.2500E-01
  0.5440E+03      0.2356E+00      0.7647E+01      0.5000E-01
  0.5913E+03      0.2831E+00      0.1147E+02      0.7500E-01
```

```
0.6128E+03      0.3186E+00      0.1529E+02      0.1000E+00
0.6564E+03      0.4940E+00      0.3738E+02      0.2500E+00
0.6681E+03      0.7585E+00      0.6913E+02      0.5000E+00
0.6662E+03      0.8841E+00      0.7612E+02      0.6250E+00
0.6700E+03      0.1162E+01      0.8369E+02      0.9000E+00
0.7052E+03      0.2084E+01      0.1189E+03      0.1800E+01


 RESULT FROM LOWER-BOUND LINE

 TOP   LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
    ton             IN.              ton             IN.
0.6967E-01      0.3057E-04      0.6117E-03      0.1000E-04
0.3483E+00      0.1528E-03      0.3059E-02      0.5000E-04
0.6967E+00      0.3057E-03      0.6117E-02      0.1000E-03
0.3487E+02      0.1529E-01      0.3059E+00      0.5000E-02
0.5243E+02      0.2295E-01      0.4588E+00      0.7500E-02
0.6999E+02      0.3061E-01      0.6117E+00      0.1000E-01
0.1687E+03      0.7584E-01      0.1529E+01      0.2500E-01
0.2933E+03      0.1419E+00      0.3059E+01      0.5000E-01
0.3763E+03      0.1984E+00      0.4588E+01      0.7500E-01
0.4357E+03      0.2474E+00      0.6117E+01      0.1000E+00
0.5583E+03      0.4527E+00      0.1572E+02      0.2500E+00
0.5546E+03      0.7077E+00      0.3083E+02      0.5000E+00
0.5486E+03      0.8324E+00      0.3875E+02      0.6250E+00
0.5615E+03      0.1116E+01      0.5726E+02      0.9000E+00
0.6073E+03      0.2046E+01      0.1046E+03      0.1800E+01
```

PECOS BRIDGE -ABUTMENT 1

LATERAL CAPACITY ANALYSIS

Lateral Analysis and Results – Pecos Bridge - Abutment 1 (Boring B-4) and Abutment 2 (Boring B-3):

Lateral analyses were performed for the drilled shaft foundations for the project using software GROUP. The following table summarizes the geometry of the shafts and the pipe cap:

Loading Condition	**Bridge H-1412R over Pecos Road**					
	East Abutment (Abutment-1)			**West Abutment (Abutment-2)**		
	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure
Service Limit	2754 kips	159 kips	Fig. 1	2754 kips	159 kips	Fig. 4
Strength Limit	3486 kips	237 kips	Fig. 2	3486 kips	237 kips	Fig. 5
Extreme Limit	4836 kips	436 kips	Fig. 3	4836 kips	436 kips	Fig. 6
Drilled Shaft Lengths	76 feet			84 feet		
Reinforcement	8 - #11 bar			8 - #11 bar		
Pile Cap and Shaft geometry	Two rows of 3 piers each 3.0 feet diameter spaced 8.25 feet center to center along length and 7.44 feet along width connected by pile cap approximately 22.85 feet long, 12.5 feet wide and 3 feet thick			Two rows of 3 piers each 3.0 feet diameter spaced 8.25 feet center to center along length and 7.6 feet along width connected by pile cap approximately 22.43 feet long, 12.5 feet wide and 3 feet thick		

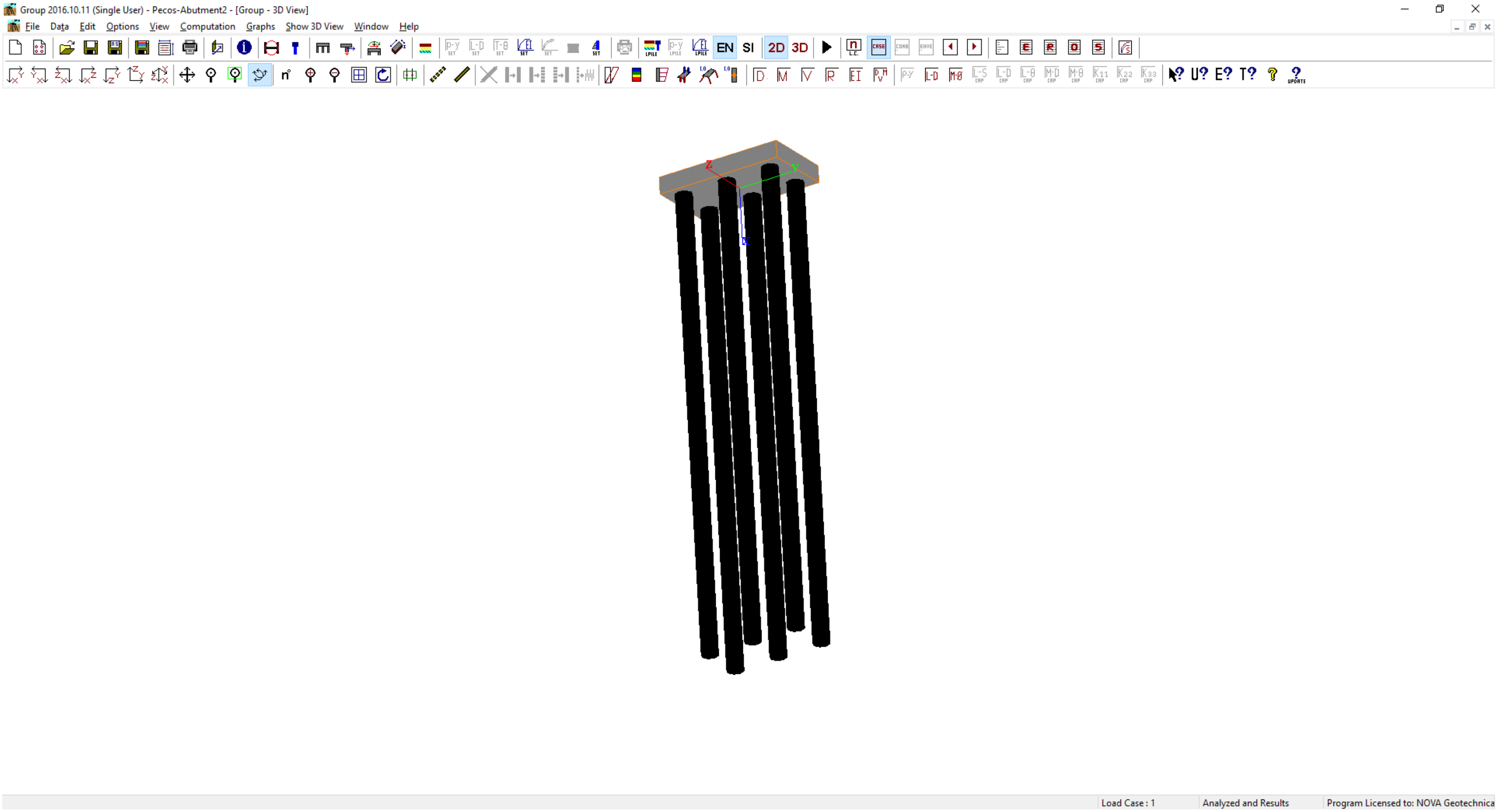
The input parameters for Abutment 1 are provided in the table below:

Pecos Bridge – Abutment 1 – Boring B-4 GROUP/LPILE Parameters

GROUP/LPILE Soil Type *	Approximate Formation Depths (ft)	Unit Weight (pcf)	Cohesion	Friction Angle	Soil Modulus K (pci)	Strain Factor E_{50}
Sand	0 – 4	105	Ignore	Ignore	Ignore	Ignore
Clay	4 – 7	115	2,200 psf	-	Static – 500 Cyclic – 200	0.007
Groundwater depth = 7 feet						
Clay	7 – 10	115	2,200 psf	-	Static – 500 Cyclic – 200	0.007
Sand	10 – 11.5	115	-	32 degrees	60	N/A
Clay	11.5 – 18	115	1,400 psf	-	Static – 500 Cyclic – 200	0.007
Clay	18 – 22	130	4,500 psf	-	Static – 2,000 Cyclic – 800	0.004
Clay	22 – 35.5	115	2,200 psf	-	Static – 1,000 Cyclic – 400	0.005
Sand	35.5 – 40	115	-	30 degrees	60	N/A
Clay	40 – 45	115	1,300 psf	-	Static – 500 Cyclic – 200	0.007
Sand	45 – 50	125	-	38 degrees	125	N/A
Sand	50 – 60	115	-	30 degrees	60	N/A
Sand	60 – 68	115	-	33 degrees	125	N/A
Clay	68 – 72	125	3,100 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	72 – 80	130	2,000 psf	-	Static – 500 Cyclic – 200	0.007
Sand	80 – 85	135	-	44 degrees	125	N/A
Clay	85 – 90	130	3,500 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	90 – 95	130	4,500 psf	-	Static – 2,000 Cyclic – 800	0.004
Clay	95 – 100	125	2,000 psf	-	Static – 500 Cyclic – 200	0.007
Sand	100 – 101.5	135	-	44 degrees	125	N/A

* Clay soils with cohesion less than 1,000 psf should be modeled as “Soft Clay (Matlock)”. And, clay soils with cohesion more than 1,000 psf should be modeled as “Stiff Clay without Free Water (Reese)”. Sand soils should be modeled as “Sand (Reese)”.
N/A – Not Applicable

The following figure shows a typical model:



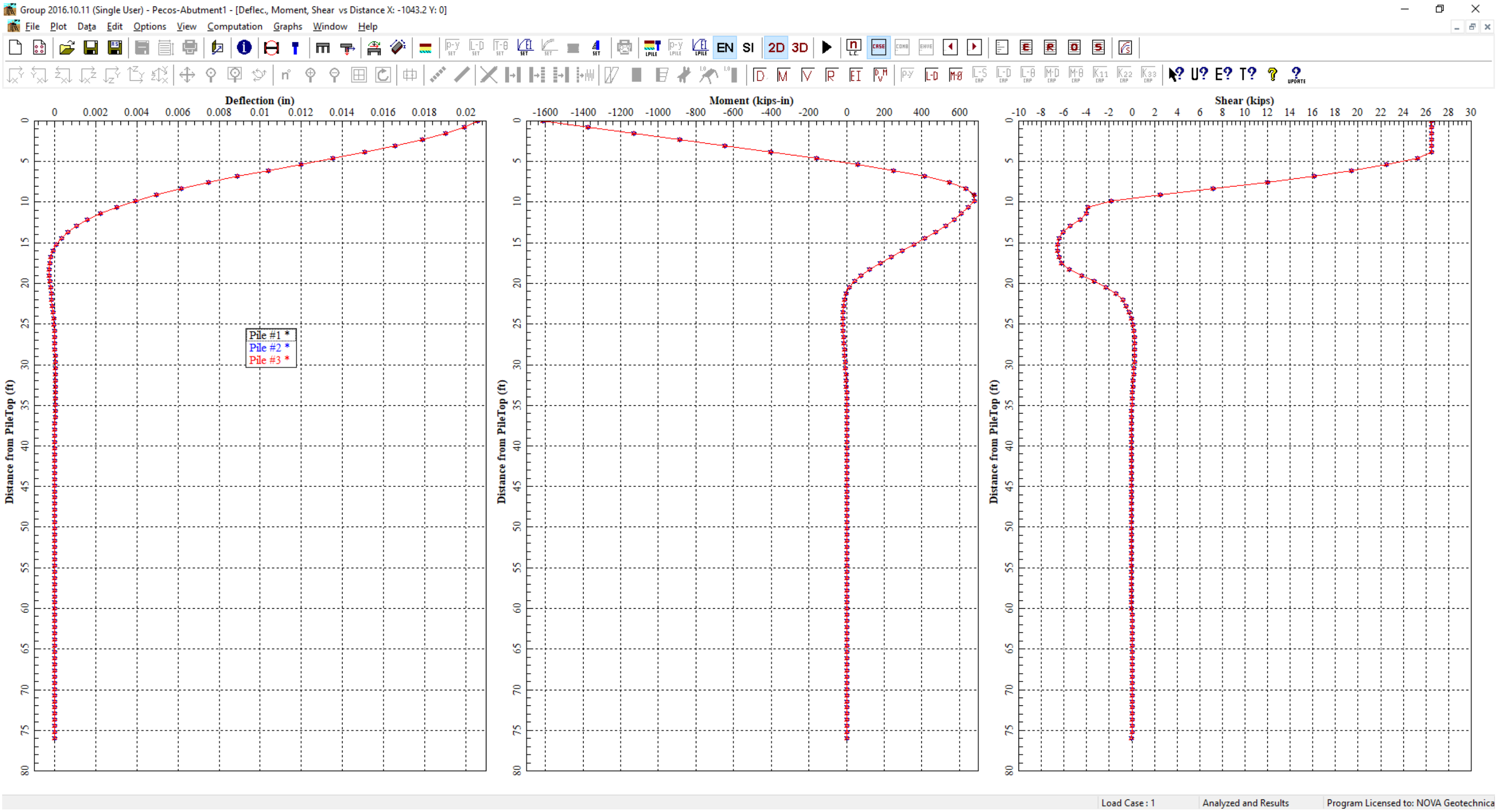


Figure 1. Results of Service Limit loading on Pecos Abutment 1

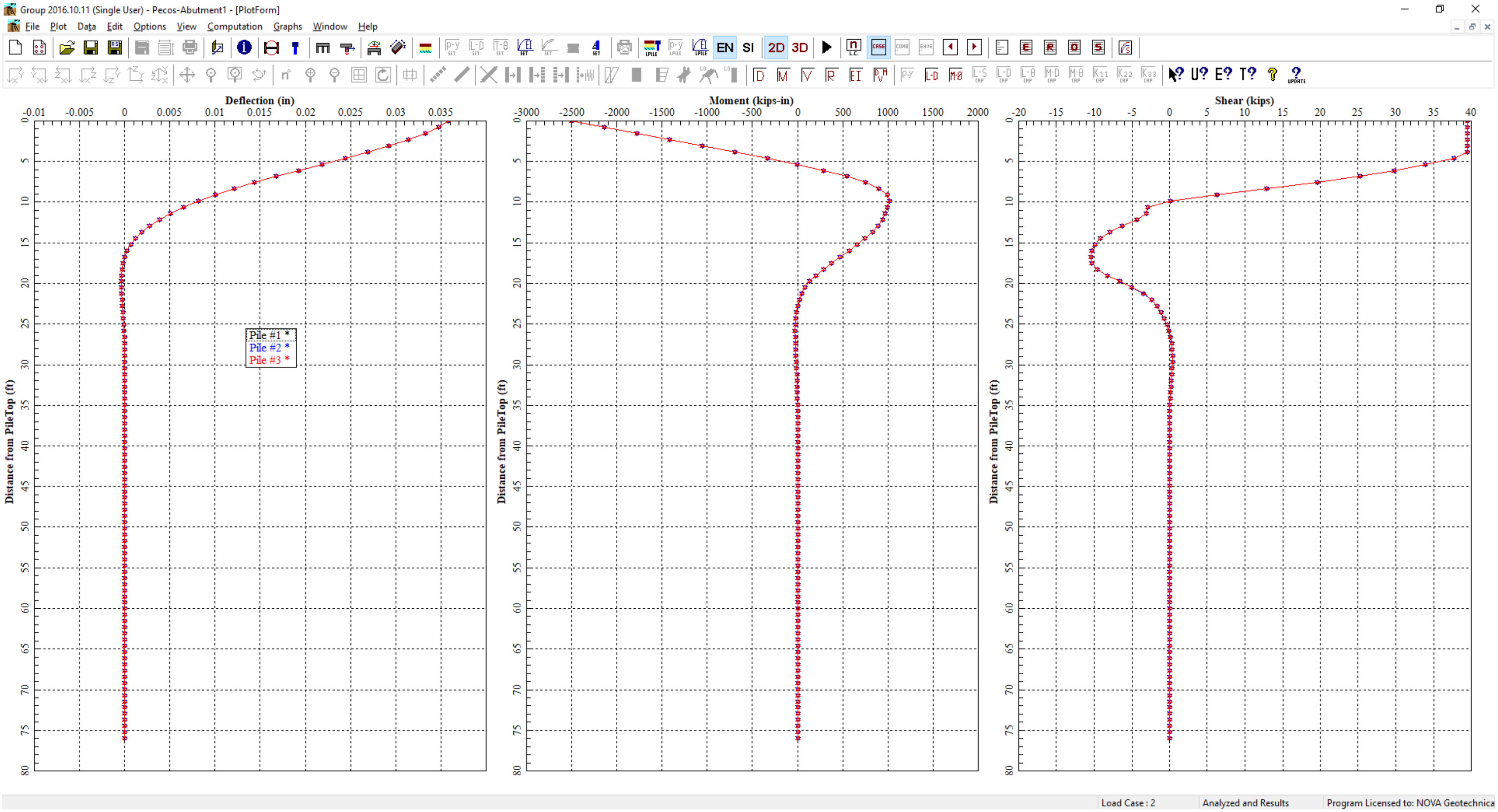


Figure 2. Results of Strength Limit loading on Pecos Abutment 1

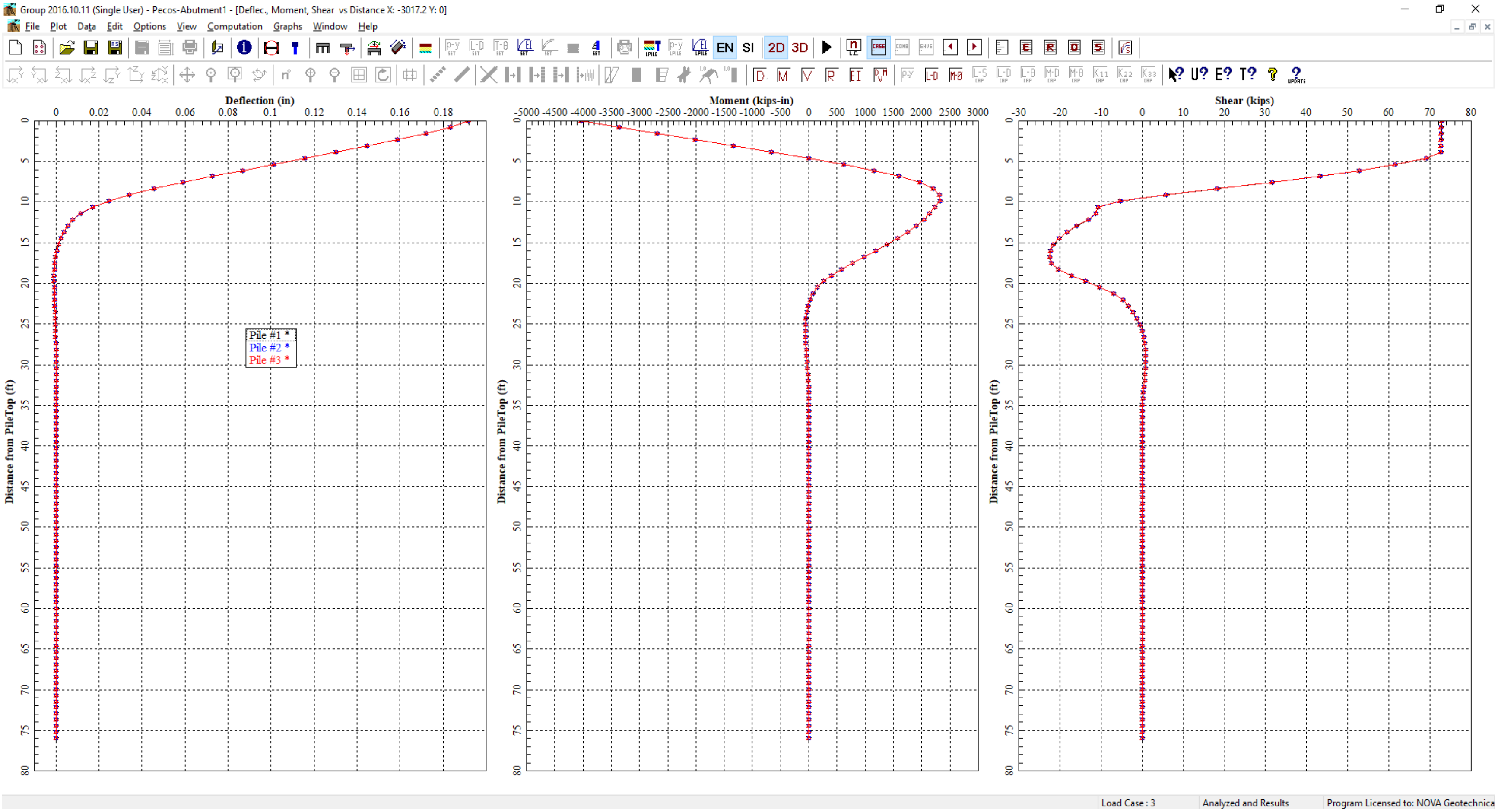


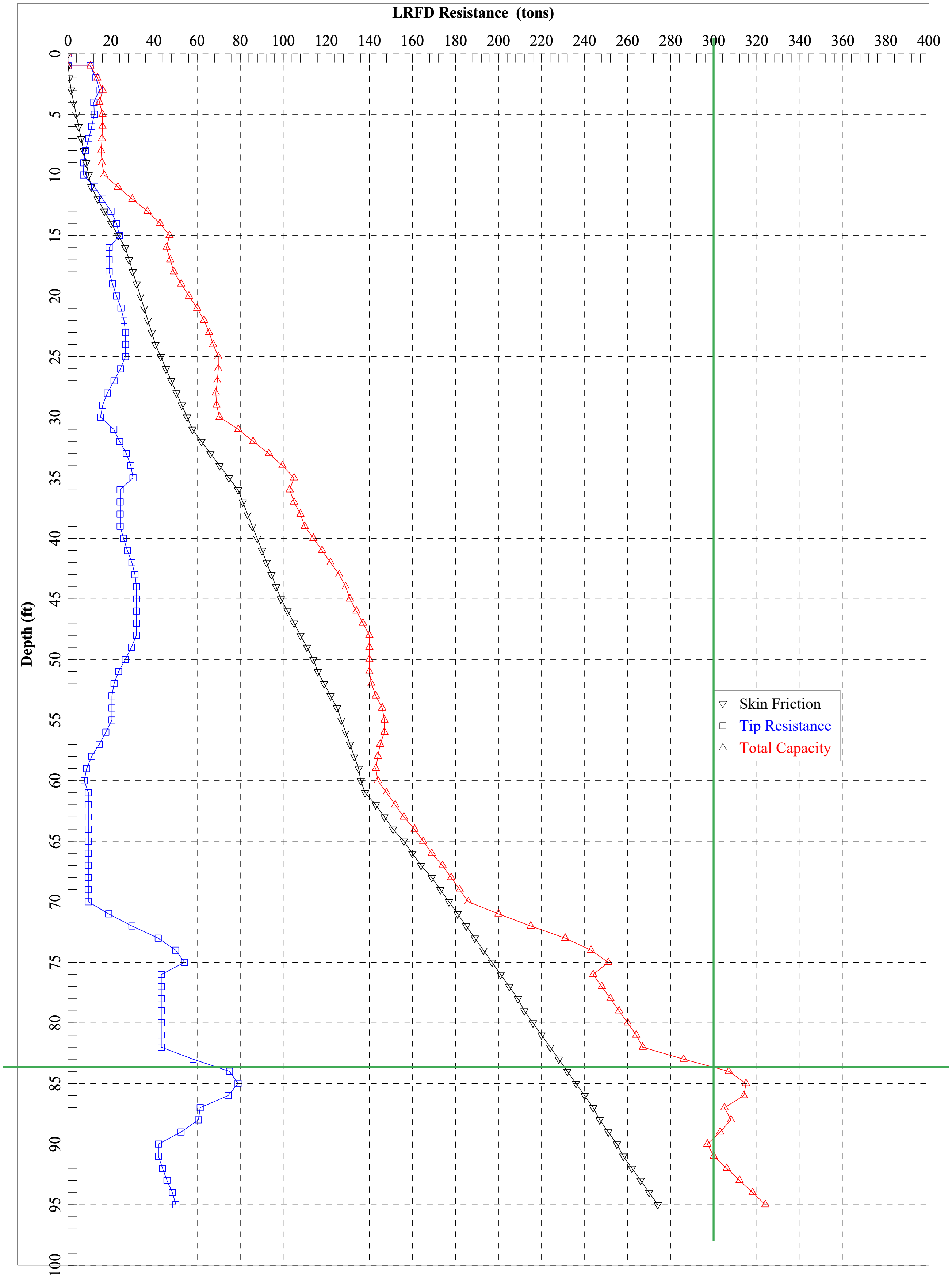
Figure 3. Results of Extreme Limit loading on Pecos Abutment 1

PECOS BRIDGE -ABUTMENT 2

AXIAL CAPACITY ANALYSIS

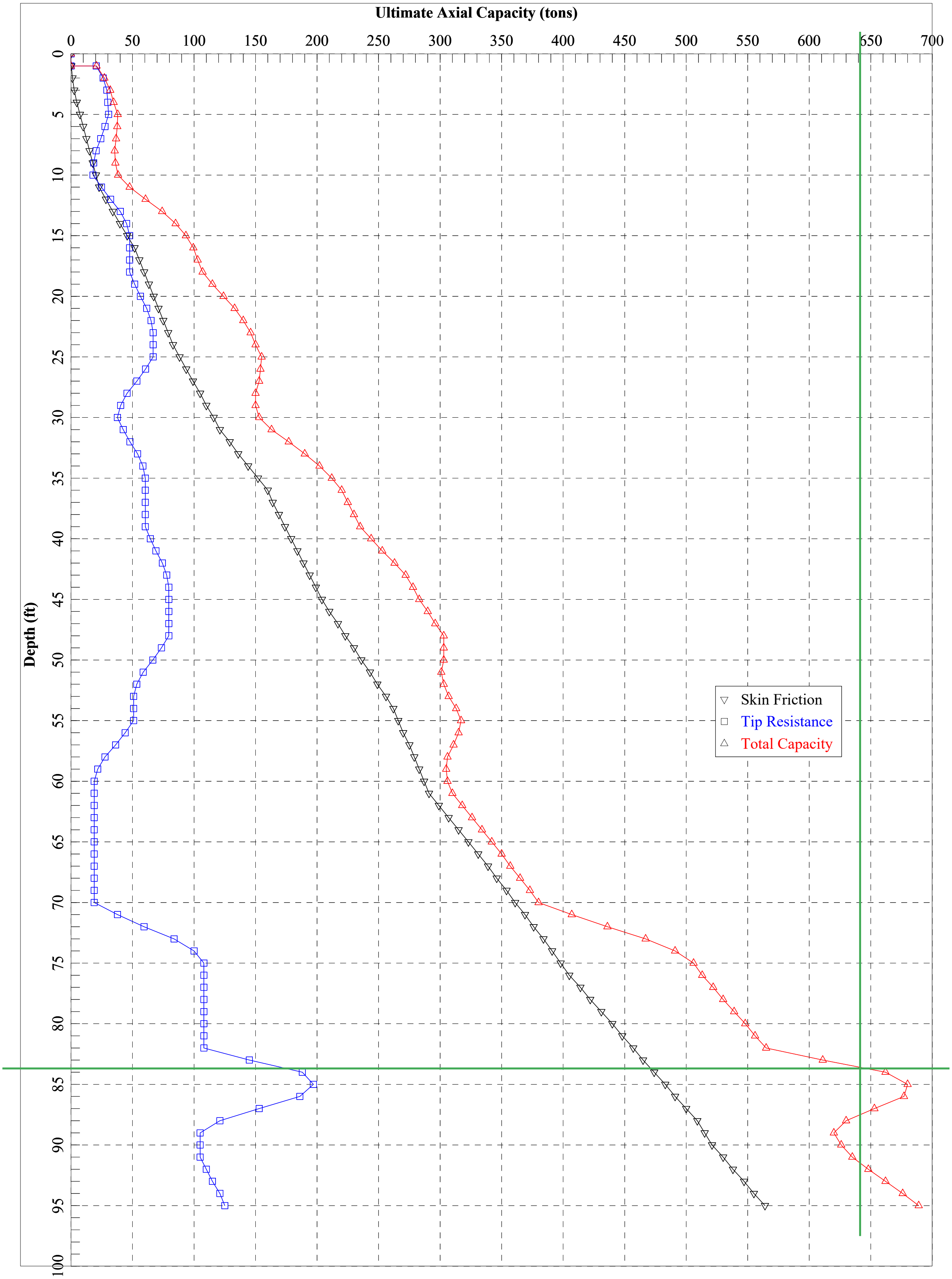
Pecos Bridge - Abutment2- Boring B-3 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8.25' o.c.):

- Service = 450 kips = 225 tons
- Strength = 570 kips = 285 tons
- LRFD Factored Resistance of approximately 300 tons is provided by a shaft length of **82 feet**.



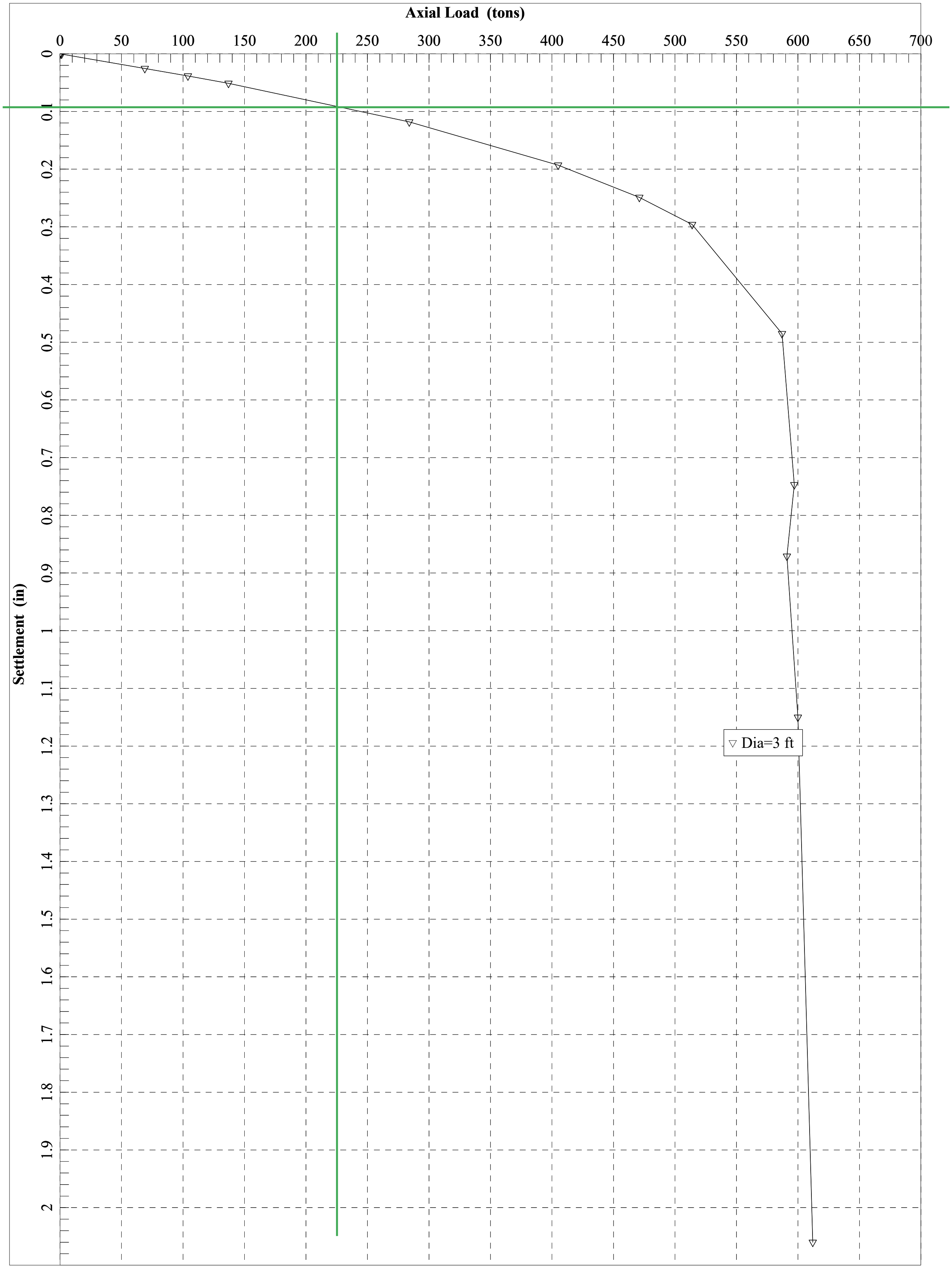
Pecos Bridge - Abutment2- Boring B-3 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8.25' o.c.):

- Service = 450 kips = 225 tons
- Strength = 570 kips = 285 tons
- Ultimate Axial Resistance of approximately 640 tons is provided by a shaft length of **84 feet**.



Pecos Bridge - Abutment2- Boring B-3 - Drilled Shaft Loads (2 rows of 3 feet Shafts spaced at 8.25’ o.c.):

- Service = 450 kips = 225 tons
- Strength = 570 kips = 285 tons
- At service limit load of 225 tons, settlement = **approx. 0.1 inch**



```
                           Pecos-Abutment2_B-3-3feet.sfo
     =========================================================================

                      SHAFT for Windows, Version 2012.7.17

                       Serial Number :  157290693

                    VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                     (c) Copyright ENSOFT, Inc., 1987-2012
                           All Rights Reserved

     =========================================================================


     Path to file locations      : H:\PROJECTS\Engineering & Enviro Projects\2019
Projects\G-19-192 I-515 Charleston Interchange - CA Group\DESIGN\1
Bridges-Revision2\Pecos-Bridge-Revised-5-26-2020\
     Name of input data file     : Pecos-Abutment2_B-3-3feet.sfd
     Name of output file         : Pecos-Abutment2_B-3-3feet.sfo
     Name of plot output file    : Pecos-Abutment2_B-3-3feet.sfp
     Name of runtime file        : Pecos-Abutment2_B-3-3feet.sfr


     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  May 28, 2020     Time:  14:01:55

     Pecos Bridge - Abutment2_Boring B-3 - 3.0 feet Shafts


     PROPOSED DEPTH =     100.0 FT
     ----------------


     NUMBER OF LAYERS =   14
     ------------------


     WATER TABLE DEPTH =       9.0 FT.
     -------------------




     SOIL INFORMATION
     ---------------
```

```
LAYER NO 1----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.120E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.290E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.000E+00


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.120E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.290E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.400E+01


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 2----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.760E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.100E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.400E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.100E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
```

```
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.110E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO 3----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.105E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.110E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.960E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.160E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 4----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.150E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
```

```
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.160E+02


   AT THE BOTTOM

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.150E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.240E+02


   LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
   LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


 LAYER NO 5----CLAY

   AT THE TOP

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.210E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.240E+02


   AT THE BOTTOM

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.210E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.305E+02


   LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
   LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00
```

```
LAYER NO 6----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.754E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.305E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.690E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.360E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 7----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.190E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.360E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
```

```
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.190E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.450E+02


   LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
   LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


 LAYER NO 8----CLAY

   AT THE TOP

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.250E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.120E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.450E+02


   AT THE BOTTOM

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
   UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.250E+04
   INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
   BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
   SOIL UNIT WEIGHT, LB/CU FT                        = 0.120E+03
   MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
   DEPTH, FT                                         = 0.540E+02


   LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
   LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


 LAYER NO 9----CLAY

   AT THE TOP

   STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
   END BEARING COEFFICIENT-Nc                        = 0.900E+01
```

```
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.160E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.540E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.160E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.610E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO10----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.446E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.310E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.610E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.327E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.310E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.755E+02
```

```
  LRFD RESISTANCE FACTOR (SIDE FRICTION)           = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)          = 0.500E+00


LAYER NO11----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.539E+00
  END BEARING COEFFICIENT-Nc                       = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT               = 0.340E+04
  INTERNAL FRICTION ANGLE, DEG.                    = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                       = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT         = 0.100E+11
  DEPTH, FT                                        = 0.755E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.539E+00
  END BEARING COEFFICIENT-Nc                       = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT               = 0.340E+04
  INTERNAL FRICTION ANGLE, DEG.                    = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                       = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT         = 0.100E+11
  DEPTH, FT                                        = 0.875E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)           = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)          = 0.400E+00


LAYER NO12----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                  = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT               = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                    = 0.440E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                       = 0.135E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT         = 0.100E+11
  DEPTH, FT                                        = 0.875E+02


  AT THE BOTTOM
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```
  SKIN FRICTION COEFFICIENT- BETA                      = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.440E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.135E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.900E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.500E+00


LAYER NO13----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.544E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.330E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.900E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.544E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.330E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.965E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.400E+00


LAYER NO14----CLAY

  AT THE TOP
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```
  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.511E+00
  END BEARING COEFFICIENT-Nc                         = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.400E+04
  INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.965E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.511E+00
  END BEARING COEFFICIENT-Nc                         = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.400E+04
  INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.102E+03


  LRFD RESISTANCE FACTOR (SIDE FRICTION)             = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)            = 0.400E+00



DRILLED SHAFT INFORMATION
-------------------------

 DIAMETER OF STEM          =    3.000  FT.
 DIAMETER OF BASE          =    3.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    0.000  FT.
 IGNORED BOTTOM PORTION    =    0.000  FT.
 AREA OF ONE PERCENT STEEL =   10.180  SQ.IN.
 ELASTIC MODULUS, Ec       = 0.350E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.



PREDICTED RESULTS
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QS      = ULTIMATE SIDE RESISTANCE;
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QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH  VOLUME     QS      QB      QU     LRFD QS  LRFD QB   LRFD QU
(FEET)  (CU.YDS) (TONS)   (TONS)  (TONS)   (TONS)   (TONS)    (TONS)
  1.0     0.26     0.30    20.52    20.82     0.16    10.26     10.42
  2.0     0.52     1.19    26.05    27.24     0.65    13.03     13.68
  3.0     0.79     2.67    29.20    31.87     1.47    14.60     16.07
  4.0     1.05     4.75    29.91    34.66     2.61    11.96     14.58
  5.0     1.31     7.34    30.61    37.96     3.78    12.25     16.02
  6.0     1.57     9.94    27.62    37.56     4.95    11.05     15.99
  7.0     1.83    12.53    24.22    36.75     6.11     9.69     15.80
  8.0     2.09    15.12    20.42    35.54     7.28     8.17     15.45
  9.0     2.36    17.71    18.36    36.07     8.45     7.34     15.79
 10.0     2.62    20.30    17.98    38.28     9.61     7.19     16.80
 11.0     2.88    22.90    24.82    47.72    10.78    12.41     23.19
 12.0     3.14    28.38    32.20    60.58    13.79    16.10     29.89
 13.0     3.40    34.01    40.08    74.08    16.89    20.04     36.93
 14.0     3.67    39.78    45.21    84.99    20.07    22.60     42.67
 15.0     3.93    45.70    47.72    93.42    23.32    23.86     47.18
 16.0     4.19    51.75    47.72    99.47    26.65    19.09     45.73
 17.0     4.45    55.63    47.72   103.35    28.40    19.09     47.48
 18.0     4.71    59.52    47.72   107.24    30.15    19.09     49.23
 19.0     4.97    63.41    51.77   115.18    31.89    20.71     52.60
 20.0     5.24    67.30    56.40   123.69    33.64    22.56     56.20
 21.0     5.50    71.19    61.60   132.79    35.39    24.64     60.03
 22.0     5.76    75.08    65.07   140.15    37.14    26.03     63.17
 23.0     6.02    78.96    66.81   145.77    38.89    26.72     65.62
 24.0     6.28    82.85    66.81   149.66    40.64    26.72     67.37
 25.0     6.55    88.30    66.81   155.10    43.09    26.72     69.82
 26.0     6.81    93.74    60.63   154.37    45.54    24.25     69.80
 27.0     7.07    99.18    53.58   152.76    47.99    21.43     69.42
 28.0     7.33   104.63    45.64   150.27    50.44    18.26     68.70
 29.0     7.59   110.07    40.35   150.42    52.89    16.14     69.03
 30.0     7.86   115.51    37.71   153.22    55.34    15.08     70.42
 31.0     8.12   120.96    42.53   163.49    57.79    21.27     79.06
 32.0     8.38   128.53    48.04   176.57    61.95    24.02     85.97
 33.0     8.64   136.17    54.24   190.41    66.16    27.12     93.28
 34.0     8.90   143.88    58.38   202.26    70.40    29.19     99.59
 35.0     9.16   151.66    60.44   212.11    74.68    30.22    104.90
 36.0     9.43   159.50    60.44   219.95    78.99    24.18    103.17
 37.0     9.69   164.43    60.44   224.87    81.21    24.18    105.39
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38.0      9.95   169.36    60.44   229.80    83.42    24.18    107.60
39.0     10.21   174.28    60.44   234.72    85.64    24.18    109.82
40.0     10.47   179.21    64.49   243.70    87.86    25.80    113.65
41.0     10.74   184.13    69.12   253.25    90.07    27.65    117.72
42.0     11.00   189.06    74.33   263.38    92.29    29.73    122.02
43.0     11.26   193.98    77.80   271.78    94.51    31.12    125.62
44.0     11.52   198.91    79.53   278.44    96.72    31.81    128.54
45.0     11.78   203.83    79.53   283.36    98.94    31.81    130.75
46.0     12.04   210.31    79.53   289.84   101.85    31.81    133.67
47.0     12.31   216.79    79.53   296.32   104.77    31.81    136.58
48.0     12.57   223.27    79.53   302.80   107.69    31.81    139.50
49.0     12.83   229.75    73.46   303.21   110.60    29.38    139.99
50.0     13.09   236.23    66.52   302.75   113.52    26.61    140.13
51.0     13.35   242.71    58.71   301.42   116.44    23.48    139.92
52.0     13.62   249.19    53.50   302.70   119.35    21.40    140.75
53.0     13.88   255.67    50.90   306.57   122.27    20.36    142.63
54.0     14.14   262.15    50.90   313.05   125.18    20.36    145.54
55.0     14.40   266.30    50.90   317.20   127.05    20.36    147.41
56.0     14.66   270.45    44.10   314.55   128.92    17.64    146.56
57.0     14.92   274.60    36.33   310.93   130.78    14.53    145.32
58.0     15.19   278.74    27.59   306.34   132.65    11.04    143.69
59.0     15.45   282.89    21.77   304.66   134.52     8.71    143.22
60.0     15.71   287.04    18.85   305.89   136.38     7.54    143.92
61.0     15.97   291.19    18.85   310.04   138.25     9.43    147.68
62.0     16.23   299.21    18.85   318.07   142.66     9.43    152.09
63.0     16.50   307.19    18.85   326.04   147.05     9.43    156.48
64.0     16.76   315.11    18.85   333.96   151.41     9.43    160.83
65.0     17.02   322.97    18.85   341.83   155.73     9.43    165.16
66.0     17.28   330.78    18.85   349.63   160.02     9.43    169.45
67.0     17.54   338.52    18.85   357.37   164.28     9.43    173.71
68.0     17.80   346.20    18.85   365.05   168.51     9.43    177.93
69.0     18.07   353.81    18.85   372.66   172.69     9.43    182.12
70.0     18.33   361.35    18.85   380.20   176.84     9.43    186.26
71.0     18.59   368.81    37.80   406.61   180.94    18.90    199.84
72.0     18.85   376.20    59.45   435.65   185.01    29.72    214.73
73.0     19.11   383.51    83.81   467.32   189.03    41.90    230.93
74.0     19.38   390.74   100.04   490.78   193.00    50.02    243.02
75.0     19.64   397.88   108.16   506.04   196.93    54.08    251.01
76.0     19.90   404.93   108.16   513.10   200.81    43.27    244.08
77.0     20.16   413.58   108.16   521.74   204.70    43.27    247.97
78.0     20.42   422.22   108.16   530.38   208.59    43.27    251.85
79.0     20.68   430.86   108.16   539.03   212.48    43.27    255.74
80.0     20.95   439.51   108.16   547.67   216.37    43.27    259.63
81.0     21.21   448.15   108.16   556.31   220.26    43.27    263.52
82.0     21.47   456.79   108.16   564.96   224.15    43.27    267.41
83.0     21.73   465.44   145.20   610.64   228.04    58.08    286.12
84.0     21.99   474.08   187.53   661.61   231.93    75.01    306.94
85.0     22.26   482.72   197.44   680.17   235.82    78.98    314.79
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86.0    22.52   491.37   186.09   677.45   239.70    74.44    314.14
87.0    22.78   500.01   153.47   653.48   243.59    61.39    304.98
88.0    23.04   508.65   121.15   629.80   247.48    60.57    308.06
89.0    23.30   515.00   104.98   619.98   250.97    52.49    303.47
90.0    23.57   521.43   104.98   626.41   254.51    41.99    296.50
91.0    23.83   529.89   104.98   634.88   258.32    41.99    300.31
92.0    24.09   538.36   109.71   648.06   262.13    43.88    306.01
93.0    24.35   546.82   115.10   661.92   265.94    46.04    311.98
94.0    24.61   555.28   121.18   676.46   269.74    48.47    318.22
95.0    24.87   563.74   125.23   688.97   273.55    50.09    323.64



   RESULT FROM TREND (AVERAGED) LINE

   TOP   LOAD      TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
      ton               IN.              ton             IN.
  0.1370E+00       0.5104E-04      0.2748E-02      0.1000E-04
  0.6851E+00       0.2552E-03      0.1374E-01      0.5000E-04
  0.1370E+01       0.5104E-03      0.2748E-01      0.1000E-03
  0.6895E+02       0.2559E-01      0.1374E+01      0.5000E-02
  0.1036E+03       0.3845E-01      0.2061E+01      0.7500E-02
  0.1368E+03       0.5123E-01      0.2748E+01      0.1000E-01
  0.2836E+03       0.1184E+00      0.6870E+01      0.2500E-01
  0.4051E+03       0.1934E+00      0.1374E+02      0.5000E-01
  0.4714E+03       0.2491E+00      0.2061E+02      0.7500E-01
  0.5141E+03       0.2956E+00      0.2748E+02      0.1000E+00
  0.5867E+03       0.4850E+00      0.5750E+02      0.2500E+00
  0.5968E+03       0.7467E+00      0.8376E+02      0.5000E+00
  0.5906E+03       0.8714E+00      0.9254E+02      0.6250E+00
  0.5997E+03       0.1153E+01      0.1083E+03      0.9000E+00
  0.6123E+03       0.2061E+01      0.1215E+03      0.1800E+01



   RESULT FROM UPPER-BOUND LINE

   TOP   LOAD      TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
      ton               IN.              ton             IN.
  0.2467E+00       0.7844E-04      0.4105E-02      0.1000E-04
  0.1234E+01       0.3922E-03      0.2052E-01      0.5000E-04
  0.2467E+01       0.7844E-03      0.4105E-01      0.1000E-03
  0.1248E+03       0.3948E-01      0.2052E+01      0.5000E-02
  0.1822E+03       0.5901E-01      0.3078E+01      0.7500E-02
  0.2304E+03       0.7730E-01      0.4105E+01      0.1000E-01
  0.4034E+03       0.1616E+00      0.1026E+02      0.2500E-01
  0.5110E+03       0.2382E+00      0.2052E+02      0.5000E-01
  0.5601E+03       0.2884E+00      0.3078E+02      0.7500E-01
```

```
 0.5865E+03      0.3277E+00      0.4105E+02      0.1000E+00
 0.6454E+03      0.5137E+00      0.8168E+02      0.2500E+00
 0.6489E+03      0.7717E+00      0.1046E+03      0.5000E+00
 0.6447E+03      0.8961E+00      0.1107E+03      0.6250E+00
 0.6505E+03      0.1175E+01      0.1202E+03      0.9000E+00
 0.6549E+03      0.2078E+01      0.1246E+03      0.1800E+01



  RESULT FROM LOWER-BOUND LINE

  TOP   LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
     ton              IN.              ton             IN.
 0.6307E-01      0.3058E-04      0.1391E-02      0.1000E-04
 0.3154E+00      0.1529E-03      0.6957E-02      0.5000E-04
 0.6307E+00      0.3058E-03      0.1391E-01      0.1000E-03
 0.3155E+02      0.1529E-01      0.6957E+00      0.5000E-02
 0.4744E+02      0.2295E-01      0.1044E+01      0.7500E-02
 0.6333E+02      0.3062E-01      0.1391E+01      0.1000E-01
 0.1536E+03      0.7597E-01      0.3479E+01      0.2500E-01
 0.2696E+03      0.1424E+00      0.6957E+01      0.5000E-01
 0.3519E+03      0.2001E+00      0.1044E+02      0.7500E-01
 0.4088E+03      0.2491E+00      0.1391E+02      0.1000E+00
 0.5274E+03      0.4559E+00      0.3332E+02      0.2500E+00
 0.5361E+03      0.7183E+00      0.6289E+02      0.5000E+00
 0.5328E+03      0.8446E+00      0.7442E+02      0.6250E+00
 0.5490E+03      0.1131E+01      0.9642E+02      0.9000E+00
 0.5691E+03      0.2044E+01      0.1177E+03      0.1800E+01
```

PECOS BRIDGE -ABUTMENT 2

LATERAL CAPACITY ANALYSIS

Lateral Analysis and Results – Pecos Bridge - Abutment 1 (Boring B-4) and Abutment 2 (Boring B-3):

Lateral analyses were performed for the drilled shaft foundations for the project using software GROUP. The following table summarizes the geometry of the shafts and the pipe cap:

Loading Condition	**Bridge H-1412R over Pecos Road**					
	East Abutment (Abutment-1)			**West Abutment (Abutment-2)**		
	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure
Service Limit	2754 kips	159 kips	Fig. 1	2754 kips	159 kips	Fig. 4
Strength Limit	3486 kips	237 kips	Fig. 2	3486 kips	237 kips	Fig. 5
Extreme Limit	4836 kips	436 kips	Fig. 3	4836 kips	436 kips	Fig. 6
Drilled Shaft Lengths	76 feet			84 feet		
Reinforcement	8 - #11 bar			8 - #11 bar		
Pile Cap and Shaft geometry	Two rows of 3 piers each 3.0 feet diameter spaced 8.25 feet center to center along length and 7.44 feet along width connected by pile cap approximately 22.85 feet long, 12.5 feet wide and 3 feet thick			Two rows of 3 piers each 3.0 feet diameter spaced 8.25 feet center to center along length and 7.6 feet along width connected by pile cap approximately 22.43 feet long, 12.5 feet wide and 3 feet thick		

The input parameters for Abutment 2 are provided in the table below:

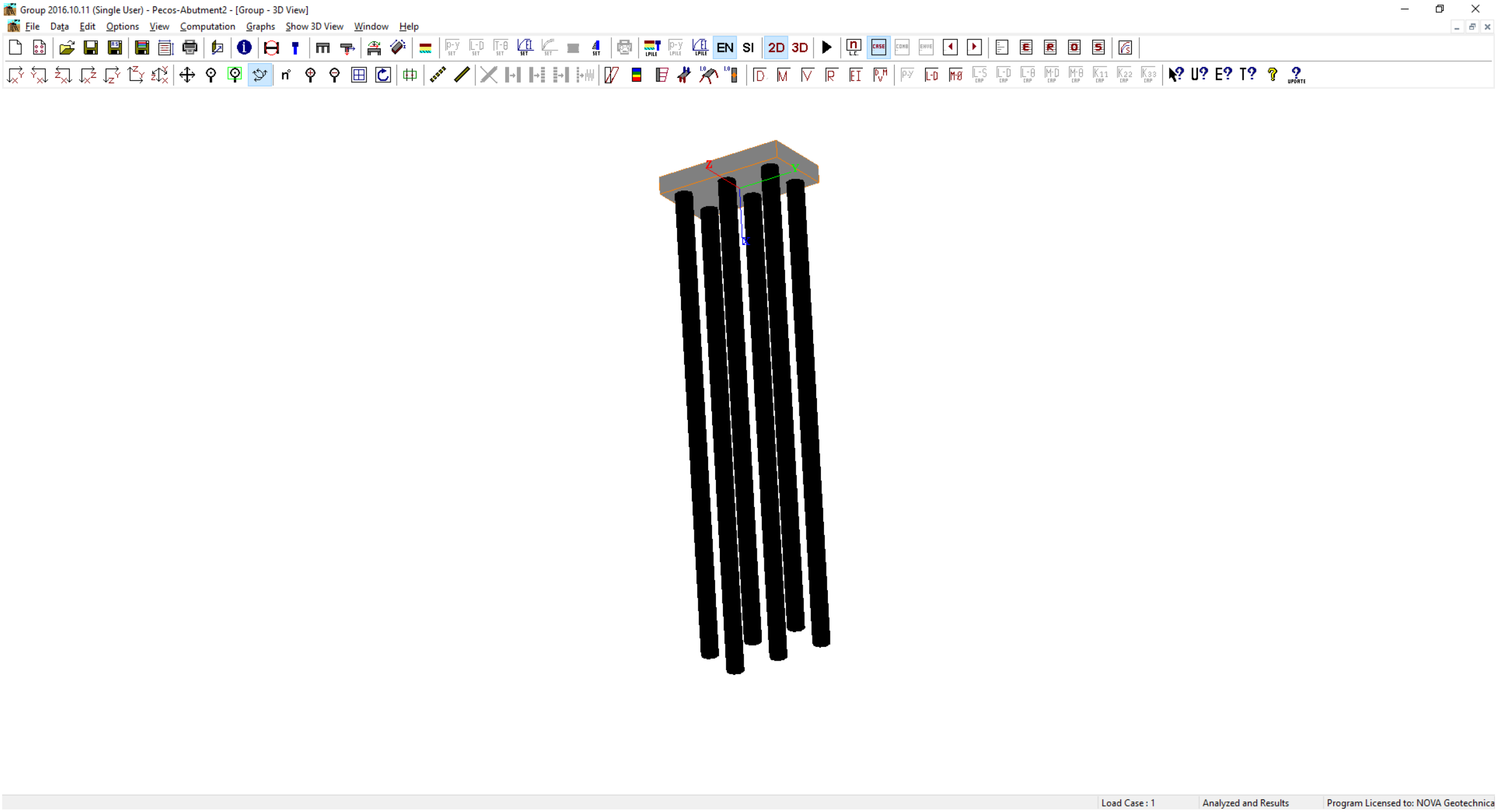
Pecos Bridge – Abutment 2 – Boring B-3 GROUP/LPILE Parameters

GROUP/LPILE Soil Type *	Approximate Formation Depths (ft)	Unit Weight (pcf)	Cohesion	Friction Angle	Soil Modulus K (pci)	Strain Factor E_{50}
Sand	0 – 4	105	Ignore	Ignore	Ignore	Ignore
Clay	4 – 9	115	1,000 psf	-	Static – 100 Cyclic – N/A	0.01
Groundwater depth = 9 feet						
Clay	9 – 11	115	1,000 psf	-	Static – 100 Cyclic – N/A	0.01
Sand	11 – 16	115	-	32 degrees	60	N/A
Clay	16 – 24	115	1,500 psf	-	Static – 500 Cyclic – 200	0.007
Clay	24 – 30.5	115	2,100 psf	-	Static – 1,000 Cyclic – 400	0.005
Sand	30.5 – 36	120	-	32 degrees	60	N/A
Clay	36 – 45	115	1,900 psf	-	Static – 500 Cyclic – 200	0.007
Clay	45 – 54	120	2,500 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	54 – 61	125	1,600 psf	-	Static – 500 Cyclic – 200	0.007
Sand	61 – 75.5	115	-	31 degrees	125	N/A
Clay	75.5 – 87.5	120	3,400 psf	-	Static – 1,000 Cyclic – 400	0.005
Sand	87.5 – 90	135	-	44 degrees	125	N/A
Clay	90 – 96.5	120	3,300 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	96.5 – 101.5	125	4,000 psf	-	Static – 2,000 Cyclic – 800	0.004

* Clay soils with cohesion less than 1,000 psf should be modeled as “Soft Clay (Matlock)”. And, clay soils with cohesion more than 1,000 psf should be modeled as “Stiff Clay without Free Water (Reese)”. Sand soils should be modeled as “Sand (Reese)”.

N/A – Not Applicable

The following figure shows a typical model:



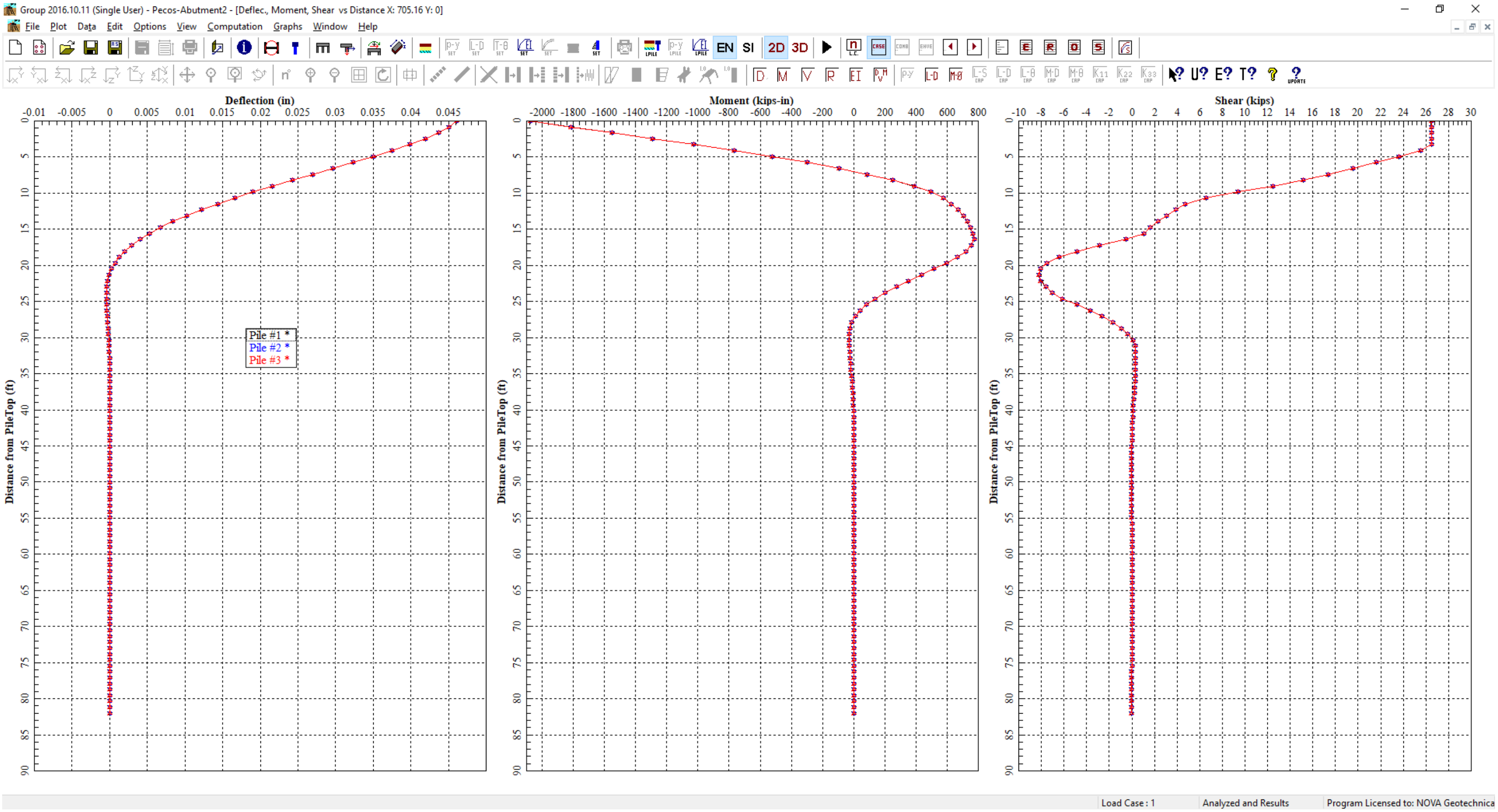


Figure 4. Results of Service Limit loading on Pecos Abutment 2

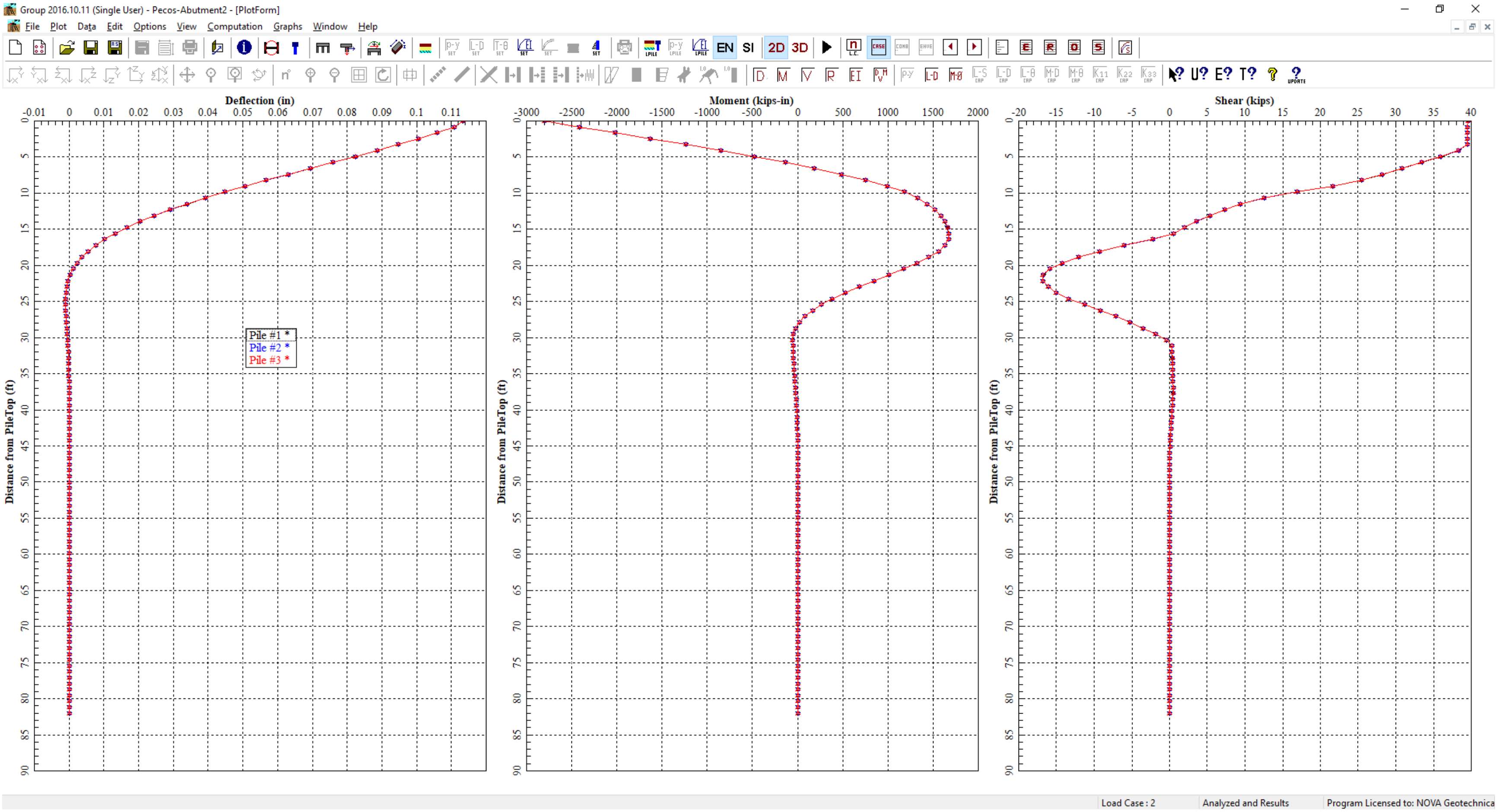
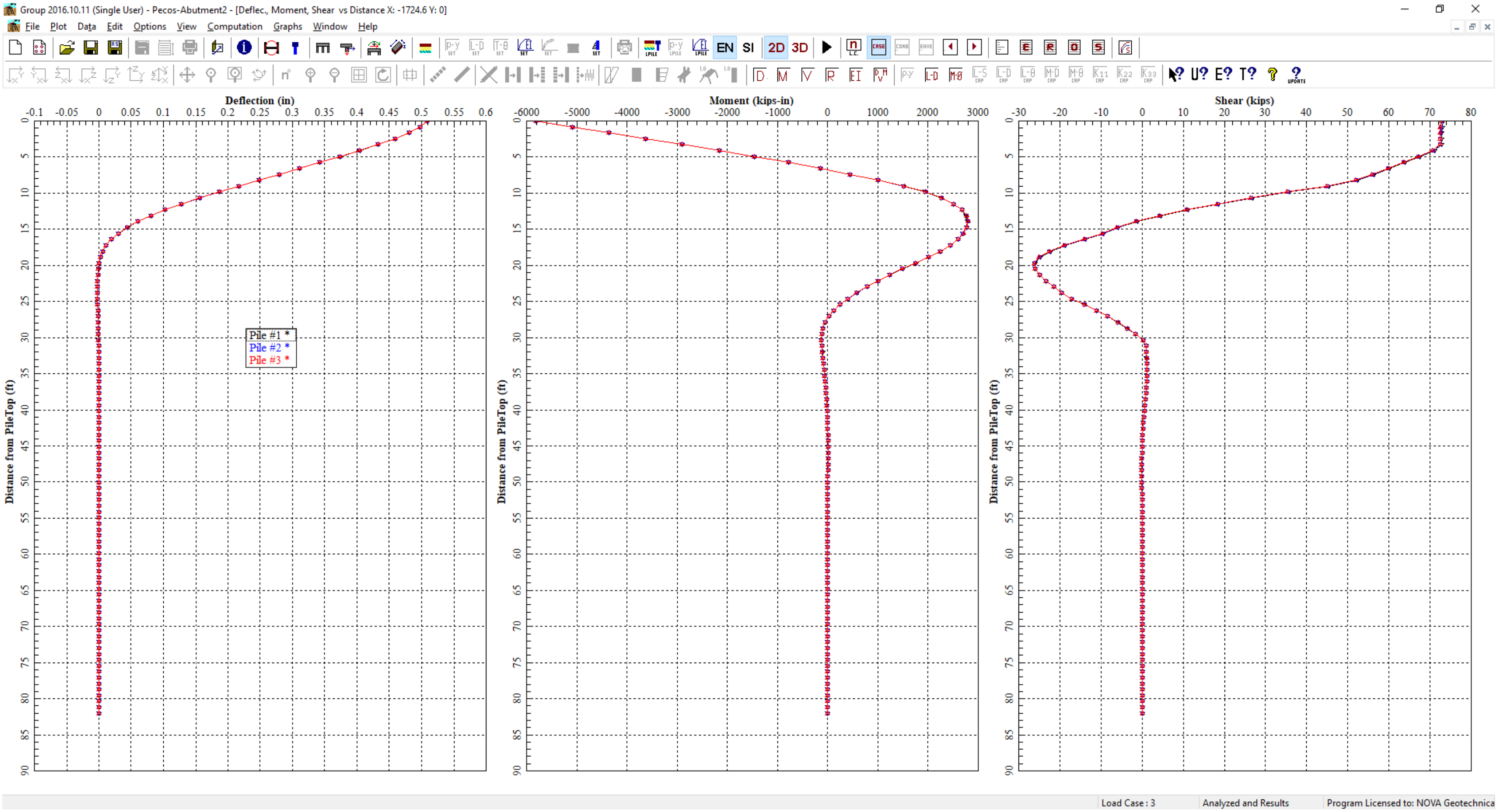


Figure 5. Results of Strength Limit loading on Pecos Abutment 2



Load Case : 3

Analyzed and Results

Program Licensed to: NOVA Geotechnica

Figure 6. Results of Extreme Limit loading on Pecos Abutment 2

Axial and Lateral Analysis Results for

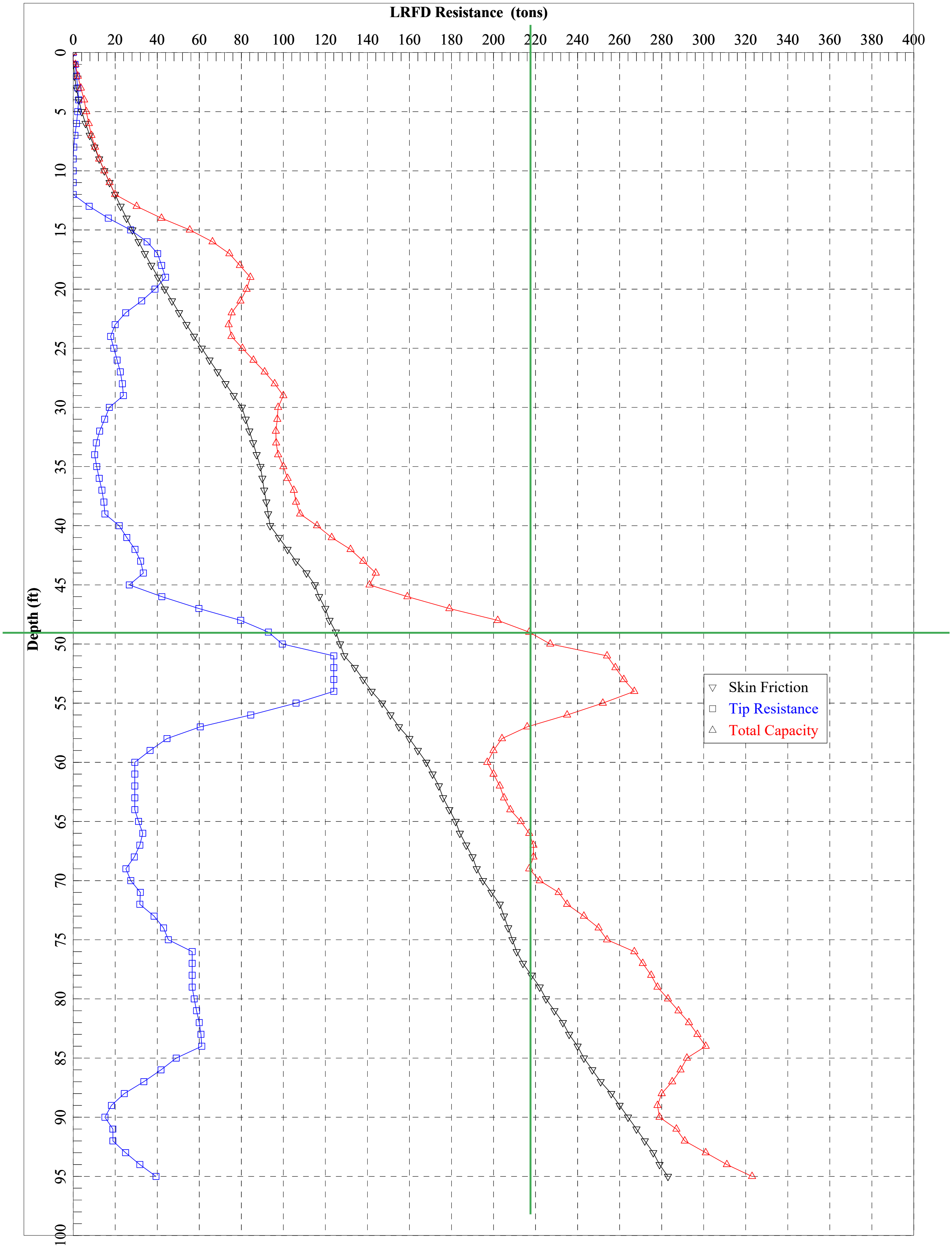
STEWART BRIDGE

Abutment 2 - North Abutment - Boring B-5

AXIAL CAPACITY
Abutment 2 - North Abutment - Boring B-5

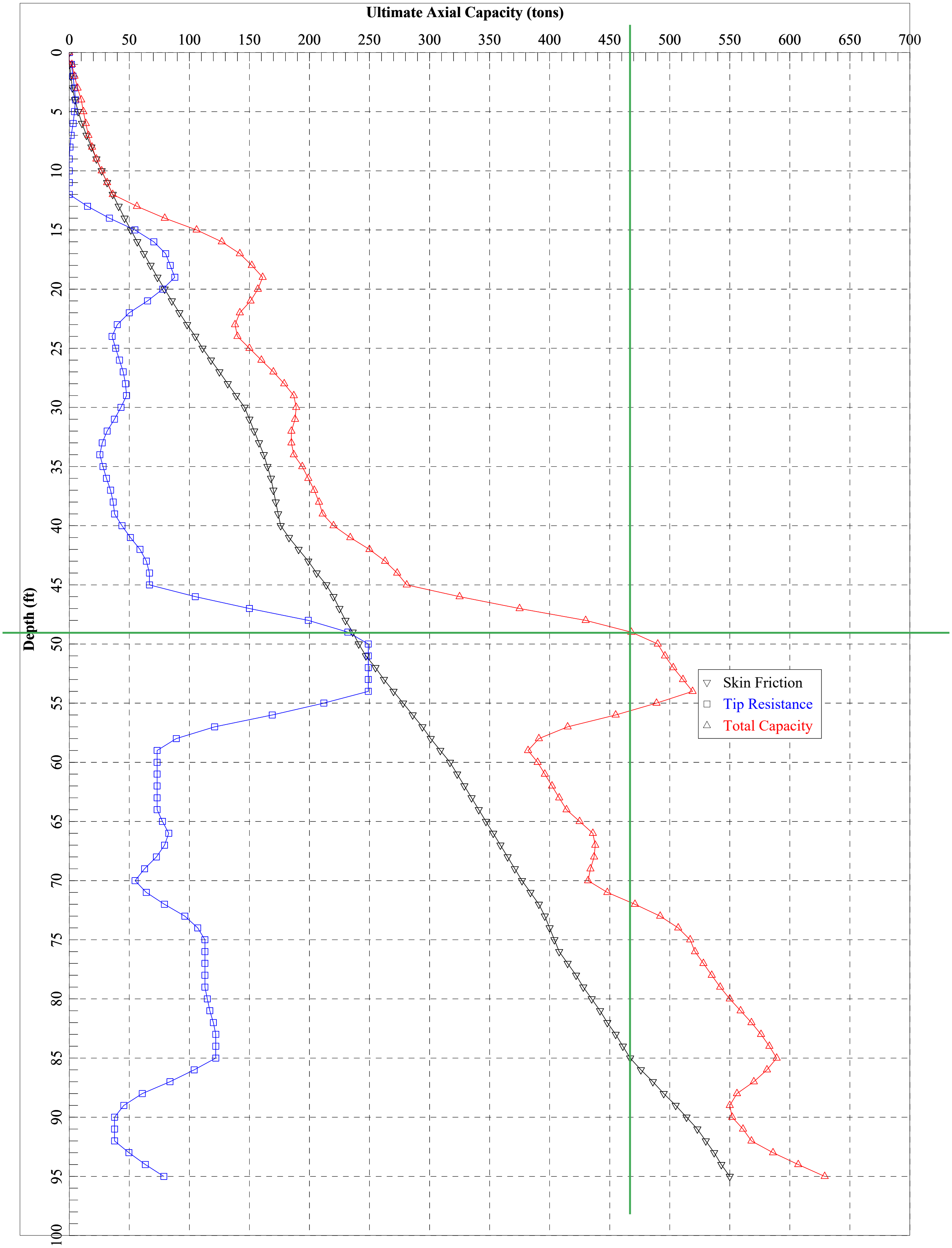
Stewart Bridge - Abutment2- North Abutment - Boring B-5 - Drilled Shaft Loads (1 row of four 3 feet Shafts spaced at 12 feet c.c.):

- Service = 156 tons
- Strength = 208 tons
- LRFD Factored Resistance of approximately 219 tons is provided by a shaft length of **49 feet**.



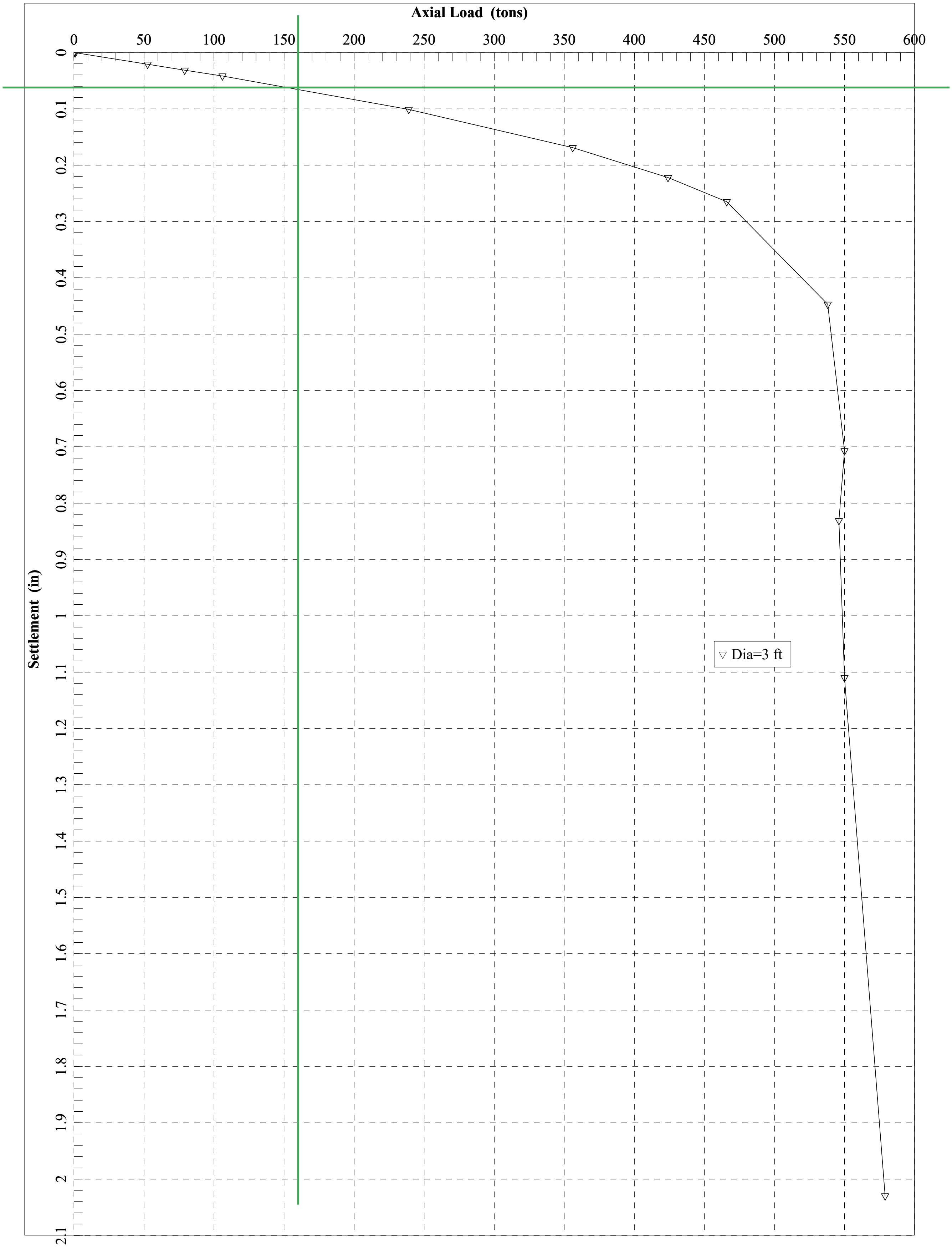
Stewart Bridge - Abutment2- North Abutment - Boring B-5 - Drilled Shaft Loads (1 row of four 3 feet Shafts spaced at 12 feet c.c.):

- Service = 156 tons
- Strength = 208 tons
- Ultimate Axial Resistance of approximately 465 tons is provided by a shaft length of **49 feet**.



Stewart Bridge - Abutment2- North Abutment - Boring B-5 - Drilled Shaft Loads (1 row of four 3 feet Shafts spaced at 12 feet c.c.):

- Service = 156 tons
- Strength = 208 tons
- At service limit load of 156 tons, settlement = **approx. 0.06 inch**



```
     =========================================================================

                      SHAFT for Windows, Version 2012.7.17

                       Serial Number :  157290693

                    VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                     (c) Copyright ENSOFT, Inc., 1987-2012
                           All Rights Reserved

     =========================================================================


     Path to file locations      : H:\PROJECTS\Engineering & Enviro Projects\2019
Projects\G-19-192 I-515 Charleston Interchange - CA Group\DESIGN\1 Bridges -
Stewart-Bridge-Revised-9-24-2020\Abutment2-North-B-5-Rev_9-24-2020\
     Name of input data file     : Stewart-Abutment2-North_B-5-3feet.sfd
     Name of output file         : Stewart-Abutment2-North_B-5-3feet.sfo
     Name of plot output file    : Stewart-Abutment2-North_B-5-3feet.sfp
     Name of runtime file        : Stewart-Abutment2-North_B-5-3feet.sfr


     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  September 24, 2020     Time:  13:14:24

     Stewart Bridge - Abutment1_B-5 - 3.0 feet Shaft


     PROPOSED DEPTH =     100.0 FT
     ----------------


     NUMBER OF LAYERS =   18
     ------------------


     WATER TABLE DEPTH =       7.0 FT.
     -------------------




     SOIL INFORMATION
     ---------------
```

```
LAYER NO 1----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.120E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.290E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.000E+00


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.120E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.290E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.500E+01


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 2----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.120E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.310E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.110E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.500E+01


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.107E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.310E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.110E+03
```

```
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.100E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 3----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.107E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.290E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.100E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.927E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.290E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.180E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 4----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.927E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.180E+02
```

```
  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                      = 0.825E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.250E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.500E+00


LAYER NO 5----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                      = 0.825E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.250E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                      = 0.761E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.300E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.500E+00


LAYER NO 6----CLAY

  AT THE TOP
```

```
    STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
    END BEARING COEFFICIENT-Nc                        = 0.900E+01
    UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.150E+04
    INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
    BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
    SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
    MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
    DEPTH, FT                                         = 0.300E+02


    AT THE BOTTOM

    STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
    END BEARING COEFFICIENT-Nc                        = 0.900E+01
    UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.150E+04
    INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
    BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
    SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
    MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
    DEPTH, FT                                         = 0.350E+02


    LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
    LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


  LAYER NO 7----CLAY

    AT THE TOP

    STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
    END BEARING COEFFICIENT-Nc                        = 0.900E+01
    UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.800E+03
    INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
    BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
    SOIL UNIT WEIGHT, LB/CU FT                        = 0.110E+03
    MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
    DEPTH, FT                                         = 0.350E+02


    AT THE BOTTOM

    STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
    END BEARING COEFFICIENT-Nc                        = 0.900E+01
    UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.800E+03
    INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
    BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
    SOIL UNIT WEIGHT, LB/CU FT                        = 0.110E+03
```

```
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.400E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO 8----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.646E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.400E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.594E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.450E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 9----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.210E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.450E+02
```

```
  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.210E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.505E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.400E+00


LAYER NO10----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                      = 0.541E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.400E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.505E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                      = 0.499E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.400E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.550E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.500E+00


LAYER NO11----SAND
```

```
  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                      = 0.499E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.400E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.550E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                      = 0.454E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.400E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.600E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.500E+00


LAYER NO12----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.230E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.600E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.230E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.120E+03
```

```
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.700E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO13----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.371E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.350E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.700E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.358E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.350E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.715E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO14----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.160E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.715E+02
```

```
  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00
  END BEARING COEFFICIENT-Nc                          = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.160E+04
  INTERNAL FRICTION ANGLE, DEG.                       = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.760E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)              = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)             = 0.400E+00


LAYER NO15----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                     = 0.323E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                       = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.760E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                     = 0.255E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                       = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.850E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)              = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)             = 0.500E+00


LAYER NO16----CLAY
```

```
  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.518E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.385E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.850E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.518E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.385E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.130E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.905E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.400E+00


LAYER NO17----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                      = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.905E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                      = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
```

```
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.980E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO18----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.350E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.980E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.350E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.102E+03


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00




DRILLED SHAFT INFORMATION
-------------------------

 DIAMETER OF STEM          =    3.000  FT.
 DIAMETER OF BASE          =    3.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    0.000  FT.
 IGNORED BOTTOM PORTION    =    0.000  FT.
 AREA OF ONE PERCENT STEEL =   10.180  SQ.IN.
```

```
 ELASTIC MODULUS, Ec       = 0.350E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.




PREDICTED RESULTS
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QS      = ULTIMATE SIDE RESISTANCE;
QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH  VOLUME     QS      QB      QU      LRFD QS  LRFD QB   LRFD QU
(FEET)  (CU.YDS) (TONS)   (TONS)  (TONS)   (TONS)   (TONS)    (TONS)
 1.0     0.26     0.30     1.85     2.14     0.16     0.92      1.09
 2.0     0.52     1.19     3.16     4.35     0.65     1.58      2.23
 3.0     0.79     2.67     4.30     6.98     1.47     2.15      3.62
 4.0     1.05     4.75     5.22     9.97     2.61     2.61      5.22
 5.0     1.31     7.42     4.38    11.80     4.08     2.19      6.27
 6.0     1.57    10.62     3.20    13.81     5.84     1.60      7.44
 7.0     1.83    14.33     1.66    15.99     7.88     0.83      8.71
 8.0     2.09    18.38     0.57    18.95    10.11     0.29     10.40
 9.0     2.36    22.60     0.00    22.60    12.43     0.00     12.43
10.0     2.62    26.97     0.00    26.97    14.83     0.00     14.83
11.0     2.88    31.50     0.00    31.50    17.32     0.00     17.32
12.0     3.14    36.20     0.00    36.20    19.91     0.00     19.91
13.0     3.40    41.07    15.20    56.27    22.59     7.60     30.19
14.0     3.67    46.10    33.37    79.46    25.35    16.68     42.04
15.0     3.93    51.27    54.62   105.90    28.20    27.31     55.51
16.0     4.19    56.60    70.39   126.99    31.13    35.19     66.33
17.0     4.45    62.07    80.33   142.40    34.14    40.17     74.30
18.0     4.71    67.67    84.10   151.77    37.22    42.05     79.27
19.0     4.97    73.43    87.87   161.30    40.39    43.94     84.32
20.0     5.24    79.35    77.78   157.13    43.64    38.89     82.53
21.0     5.50    85.44    65.17   150.61    46.99    32.59     79.58
22.0     5.76    91.68    49.97   141.65    50.42    24.99     75.41
23.0     6.02    98.07    40.03   138.10    53.94    20.02     73.95
24.0     6.28   104.60    35.58   140.18    57.53    17.79     75.32
25.0     6.55   111.27    38.69   149.96    61.20    19.34     80.54
26.0     6.81   118.06    41.80   159.86    64.93    20.90     85.83
27.0     7.07   124.93    44.87   169.80    68.71    22.44     91.15
```

```
28.0      7.33   131.88    46.81   178.69    72.53    23.40     95.94
29.0      7.59   138.92    47.72   186.63    76.40    23.86    100.26
30.0      7.86   146.03    43.00   189.02    80.31    17.20     97.51
31.0      8.12   149.91    37.60   187.51    82.06    15.04     97.10
32.0      8.38   153.80    31.52   185.33    83.81    12.61     96.42
33.0      8.64   157.69    27.47   185.16    85.56    10.99     96.55
34.0      8.90   161.58    25.45   187.03    87.31    10.18     97.49
35.0      9.16   165.47    28.05   193.52    89.06    11.22    100.28
36.0      9.43   167.54    31.02   198.56    90.00    12.41    102.40
37.0      9.69   169.61    34.37   203.98    90.93    13.75    104.68
38.0      9.95   171.69    36.59   208.28    91.86    14.64    106.50
39.0     10.21   173.76    37.71   211.47    92.80    15.08    107.88
40.0     10.47   175.84    43.88   219.72    93.73    21.94    115.67
41.0     10.74   183.44    50.94   234.37    97.91    25.47    123.38
42.0     11.00   191.06    58.87   249.94   102.10    29.44    131.54
43.0     11.26   198.72    64.16   262.88   106.32    32.08    138.40
44.0     11.52   206.40    66.81   273.20   110.54    33.40    143.94
45.0     11.78   214.09    66.81   280.90   114.77    26.72    141.49
46.0     12.04   219.54   105.42   324.96   117.22    42.17    159.39
47.0     12.31   224.98   149.55   374.53   119.67    59.82    179.49
48.0     12.57   230.43   199.20   429.62   122.12    79.68    201.80
49.0     12.83   235.87   232.30   468.17   124.57    92.92    217.49
50.0     13.09   241.31   248.85   490.16   127.02    99.54    226.56
51.0     13.35   246.76   248.85   495.60   129.47   124.42    253.89
52.0     13.62   254.51   248.85   503.35   133.73   124.42    258.15
53.0     13.88   262.28   248.85   511.13   138.01   124.42    262.43
54.0     14.14   270.08   248.85   518.93   142.30   124.42    266.72
55.0     14.40   277.90   211.58   489.48   146.60   105.79    252.39
56.0     14.66   285.74   168.99   454.73   150.91    84.50    235.40
57.0     14.92   293.58   121.08   414.66   155.22    60.54    215.76
58.0     15.19   301.43    89.14   390.57   159.54    44.57    204.11
59.0     15.45   309.28    73.17   382.44   163.85    36.58    200.44
60.0     15.71   317.12    73.17   390.29   168.17    29.27    197.44
61.0     15.97   323.08    73.17   396.25   170.85    29.27    200.12
62.0     16.23   329.04    73.17   402.21   173.53    29.27    202.80
63.0     16.50   335.01    73.17   408.18   176.22    29.27    205.49
64.0     16.76   340.97    73.17   414.14   178.90    29.27    208.17
65.0     17.02   346.93    77.65   424.58   181.58    31.06    212.64
66.0     17.28   352.89    82.76   435.65   184.27    33.10    217.37
67.0     17.54   358.85    79.32   438.17   186.95    31.73    218.68
68.0     17.80   364.82    72.64   437.45   189.63    29.06    218.69
69.0     18.07   370.78    62.73   433.51   192.31    25.09    217.41
70.0     18.33   376.74    54.84   431.58   195.00    27.42    222.42
71.0     18.59   384.09    64.10   448.19   199.04    32.05    231.09
72.0     18.85   391.39    79.18   470.58   203.06    31.67    234.73
73.0     19.11   395.54    96.16   491.69   204.92    38.46    243.38
74.0     19.38   399.69   107.47   507.16   206.79    42.99    249.78
75.0     19.64   403.83   113.13   516.96   208.66    45.25    253.91
```

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76.0    19.90   407.98   113.13   521.11   210.52    56.56    267.08
77.0    20.16   414.88   113.13   528.01   214.32    56.56    270.88
78.0    20.42   421.70   113.13   534.83   218.07    56.56    274.63
79.0    20.68   428.44   113.13   541.57   221.77    56.56    278.34
80.0    20.95   435.10   115.11   550.21   225.44    57.56    282.99
81.0    21.21   441.67   117.38   559.04   229.05    58.69    287.74
82.0    21.47   448.15   119.93   568.07   232.61    59.96    292.58
83.0    21.73   454.53   121.63   576.16   236.12    60.81    296.94
84.0    21.99   460.82   122.48   583.30   239.58    61.24    300.82
85.0    22.26   467.01   122.48   589.49   242.99    48.99    291.98
86.0    22.52   476.41   104.50   580.91   247.22    41.80    289.02
87.0    22.78   485.81    83.95   569.76   251.45    33.58    285.03
88.0    23.04   495.21    60.83   556.04   255.68    24.33    280.01
89.0    23.30   504.61    45.42   550.03   259.91    18.17    278.07
90.0    23.57   514.01    37.71   551.72   264.14    15.08    279.22
91.0    23.83   523.42    37.71   561.12   268.37    18.85    287.22
92.0    24.09   530.02    37.71   567.73   272.00    18.85    290.86
93.0    24.35   536.69    49.71   586.39   275.67    24.85    300.52
94.0    24.61   543.41    63.42   606.83   279.37    31.71    311.08
95.0    24.87   550.20    78.85   629.05   283.10    39.42    322.53


   RESULT FROM TREND (AVERAGED) LINE

   TOP   LOAD     TOP MOVEMENT      TIP LOAD      TIP  MOVEMENT
      ton             IN.             ton             IN.
  0.1048E+00      0.4158E-04      0.7666E-03      0.1000E-04
  0.5240E+00      0.2079E-03      0.3833E-02      0.5000E-04
  0.1048E+01      0.4158E-03      0.7666E-02      0.1000E-03
  0.5262E+02      0.2082E-01      0.3833E+00      0.5000E-02
  0.7911E+02      0.3127E-01      0.5749E+00      0.7500E-02
  0.1055E+03      0.4173E-01      0.7666E+00      0.1000E-01
  0.2394E+03      0.1007E+00      0.1916E+01      0.2500E-01
  0.3556E+03      0.1690E+00      0.3833E+01      0.5000E-01
  0.4243E+03      0.2219E+00      0.5749E+01      0.7500E-01
  0.4664E+03      0.2650E+00      0.7666E+01      0.1000E+00
  0.5380E+03      0.4474E+00      0.1901E+02      0.2500E+00
  0.5502E+03      0.7066E+00      0.3579E+02      0.5000E+00
  0.5464E+03      0.8312E+00      0.4113E+02      0.6250E+00
  0.5501E+03      0.1109E+01      0.5046E+02      0.9000E+00
  0.5786E+03      0.2028E+01      0.8003E+02      0.1800E+01


   RESULT FROM UPPER-BOUND LINE

   TOP   LOAD     TOP MOVEMENT      TIP LOAD      TIP  MOVEMENT
```

```
    ton              IN.               ton              IN.
0.1753E+00       0.5993E-04       0.1095E-02       0.1000E-04
0.8766E+00       0.2996E-03       0.5475E-02       0.5000E-04
0.1753E+01       0.5993E-03       0.1095E-01       0.1000E-03
0.8844E+02       0.3010E-01       0.5475E+00       0.5000E-02
0.1326E+03       0.4521E-01       0.8213E+00       0.7500E-02
0.1742E+03       0.6013E-01       0.1095E+01       0.1000E-01
0.3545E+03       0.1370E+00       0.2738E+01       0.2500E-01
0.4640E+03       0.2084E+00       0.5475E+01       0.5000E-01
0.5133E+03       0.2563E+00       0.8213E+01       0.7500E-01
0.5360E+03       0.2923E+00       0.1095E+02       0.1000E+00
0.5767E+03       0.4645E+00       0.2676E+02       0.2500E+00
0.5901E+03       0.7251E+00       0.4950E+02       0.5000E+00
0.5884E+03       0.8504E+00       0.5450E+02       0.6250E+00
0.5907E+03       0.1127E+01       0.5992E+02       0.9000E+00
0.6159E+03       0.2043E+01       0.8515E+02       0.1800E+01


 RESULT FROM LOWER-BOUND LINE

 TOP  LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
    ton              IN.               ton              IN.
0.5327E-01       0.2702E-04       0.4380E-03       0.1000E-04
0.2664E+00       0.1351E-03       0.2190E-02       0.5000E-04
0.5327E+00       0.2702E-03       0.4380E-02       0.1000E-03
0.2664E+02       0.1351E-01       0.2190E+00       0.5000E-02
0.4003E+02       0.2027E-01       0.3285E+00       0.7500E-02
0.5344E+02       0.2704E-01       0.4380E+00       0.1000E-01
0.1308E+03       0.6733E-01       0.1095E+01       0.2500E-01
0.2328E+03       0.1272E+00       0.2190E+01       0.5000E-01
0.3103E+03       0.1805E+00       0.3285E+01       0.7500E-01
0.3680E+03       0.2270E+00       0.4380E+01       0.1000E+00
0.4986E+03       0.4302E+00       0.1126E+02       0.2500E+00
0.5051E+03       0.6859E+00       0.2208E+02       0.5000E+00
0.5014E+03       0.8104E+00       0.2775E+02       0.6250E+00
0.5096E+03       0.1091E+01       0.4100E+02       0.9000E+00
0.5414E+03       0.2013E+01       0.7490E+02       0.1800E+01
```

LATERAL CAPACITY
Abutment 2 - North Abutment - Boring B-5

Lateral Analysis and Results – Stewart Bridge - Abutment 1 (South Abutment - Boring B-6), Abutment 2 (North Abutment - Boring B-5), and Center Piers (Boring B-7):

Lateral analyses were performed for the drilled shaft foundations for the project using software GROUP. The following table summarizes the geometry of the shafts and the pipe cap:

Loading Condition	**Bridge H-1443R over Stewart Avenue**					
	South Abutment (Abutment-1)			**North Abutment (Abutment-2)**		
	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure
Service Limit	1160 kips	432 kips	Fig. 1	1248 kips	480 kips	Fig. 4
Strength Limit	1552 kips	376 kips	Fig. 2	1664 kips	464 kips	Fig. 5
Extreme Limit	888 kips	240 kips	Fig. 3	1160 kips	688 kips	Fig. 6
Drilled Shaft Lengths*	72 feet			49 feet		
Reinforcement	12 - #10 bar plus spiral reinforcement with #5 bar spaced 2.33 feet			12 - #10 bar plus spiral reinforcement with #5 bar spaced 2.33 feet		
Pile Cap and Shaft geometry	One row of 4 piers each 3.0 feet diameter spaced 10.5 feet center to center connected by pile cap approximately 40.25 feet long, 6 feet wide and 2.5 feet thick			One row of 4 piers each 3.0 feet diameter spaced 12 feet center to center connected by pile cap approximately 46.3125 feet long, 6 feet wide and 2.5 feet thick		

Loading Condition	**Bridge H-1443R over Stewart Avenue**		
	Pier 1 and 2		
	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure
Service Limit	3132 kips	396 kips	Fig. 7
Strength Limit	2644 kips	244 kips	Fig. 8
Extreme Limit	3380 kips	416 kips	Fig. 9
Drilled Shaft Lengths*	72 feet		
Reinforcement	12 - #10 bar plus spiral reinforcement with #4 bar spaced 2.0 feet		
Pile Cap and Shaft geometry	Two rows of 2 piers each 3.5 feet diameter spaced 10.5 feet center to center along length and width connected by pile cap approximately 16 feet long, 16 feet wide and 4 feet thick		

* Design Shaft Lengths are the lengths required based on required axial capacity and are measured from the ground surface.

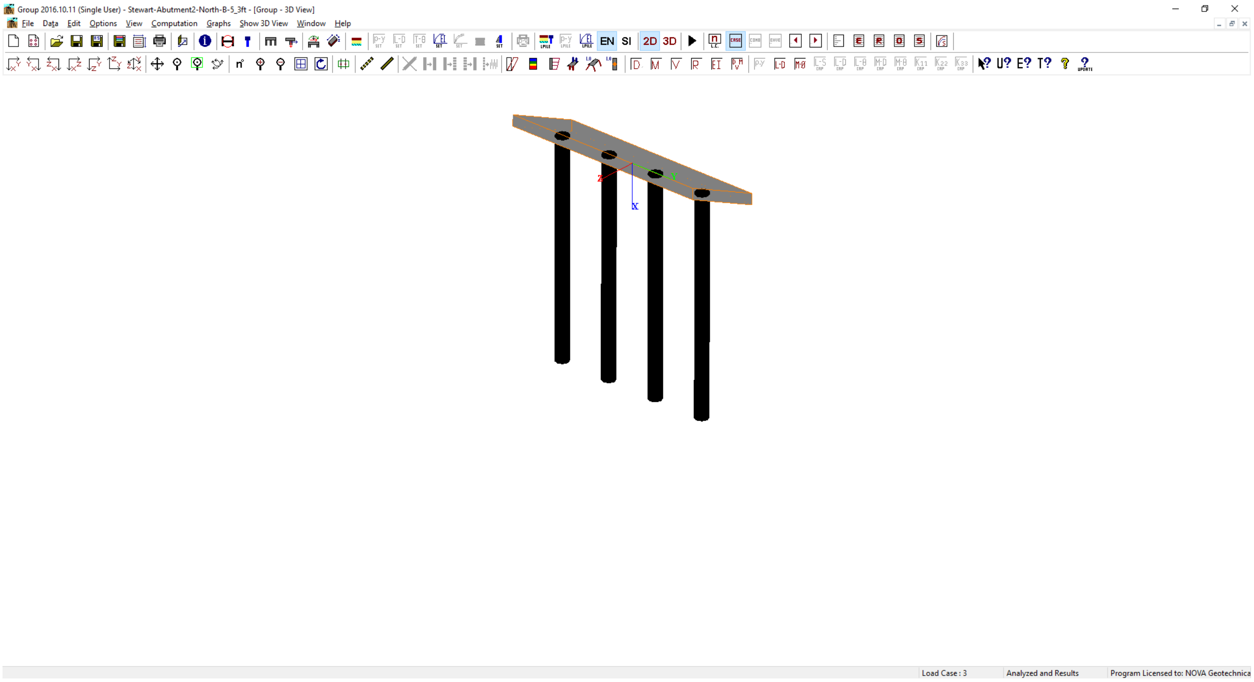
The input parameters for Abutment 2 (North Abutment) are provided in the table below:

Stewart Bridge – North Abutment – Abutment 2 – Boring B-5 GROUP/LPILE Parameters

GROUP/LPILE Soil Type *	Approximate Formation Depths (ft)	Unit Weight (pcf)	Cohesion	Friction Angle	Soil Modulus K (pci)	Strain Factor E_{50}
Sand	0 – 5	105	Ignore	Ignore	Ignore	Ignore
Sand	5 – 7	110	-	31 degrees	90	N/A
Groundwater depth = 7 feet						
Sand	7 – 10	110	-	31 degrees	60	N/A
Sand	10 – 18	110	-	29 degrees	20	N/A
Sand	18 – 25	125	-	36 degrees	125	N/A
Sand	25 – 30	115	-	32 degrees	60	N/A
Clay	30 – 35	115	1,500 psf	-	Static – 500 Cyclic – 200	0.007
Clay	35 – 40	110	800 psf	-	Static – 100 Cyclic – N/A	0.01
Sand	40 – 45	115	-	32 degrees	60	N/A
Clay	45 – 50.5	115	2,100 psf	-	Static – 1000 Cyclic – 400	0.005
Sand	50.5 – 60	130	-	40 degrees	125	N/A
Clay	60 – 70	120	2,300 psf	-	Static – 1000 Cyclic – 400	0.005
Sand	70 – 71.5	125	-	35 degrees	125	N/A
Clay	71.5 – 76	115	1,600 psf	-	Static – 500 Cyclic – 200	0.007
Sand	76 – 85	125	-	36 degrees	125	N/A
Clay	85 – 90.5	130	3,850 psf	-	Static – 1000 Cyclic – 400	0.005
Sand	90.5 – 98	115	-	32 degrees	60	N/A
Sand	98 – 101.5	125	-	35 degrees	125	N/A

* Clay soils with cohesion less than 1,000 psf should be modeled as “Soft Clay (Matlock)”. And, clay soils with cohesion more than 1,000 psf should be modeled as “Stiff Clay without Free Water (Reese)”. Sand soils should be modeled as “Sand (Reese)”.
N/A – Not Applicable

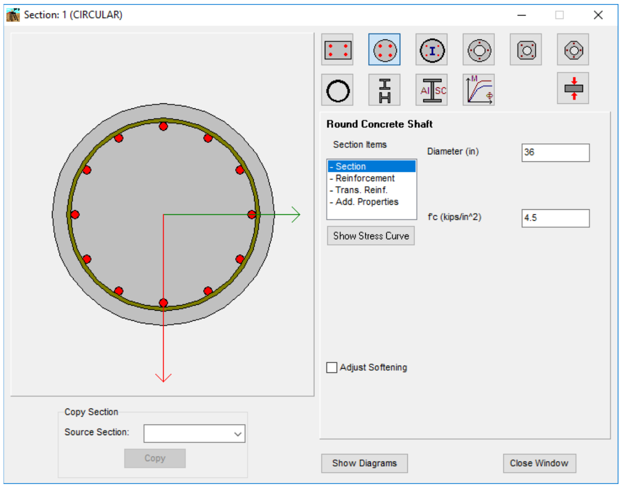
The following figure shows a typical model for Abutment 2 (North Abutment):



Load Case : 3

Analyzed and Results

Program Licensed to: NOVA Geotechnica

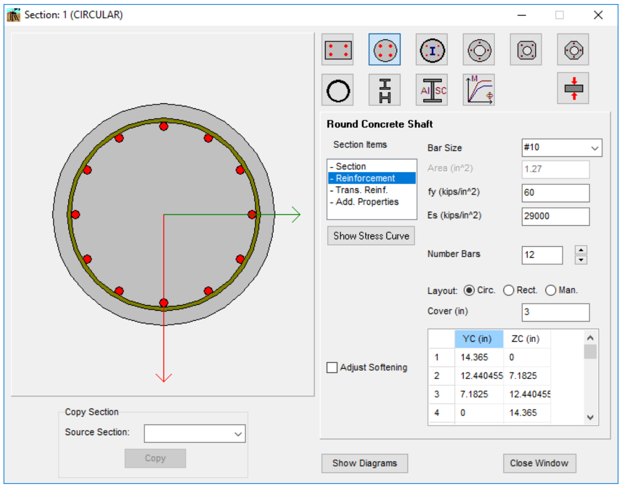


Round Concrete Shaft

Diameter (in): 36

f'c (kips/in^2): 4.5

☐ Adjust Softening



Round Concrete Shaft

Bar Size: #10

Area (in^2): 1.27

fy (kips/in^2): 60

Es (kips/in^2): 29000

Number Bars: 12

Layout: ● Circ. ○ Rect. ○ Man.

Cover (in): 3

☐ Adjust Softening

	YC (in)	ZC (in)
1	14.365	0
2	12.440455	7.1825
3	7.1825	12.44045
4	0	14.365

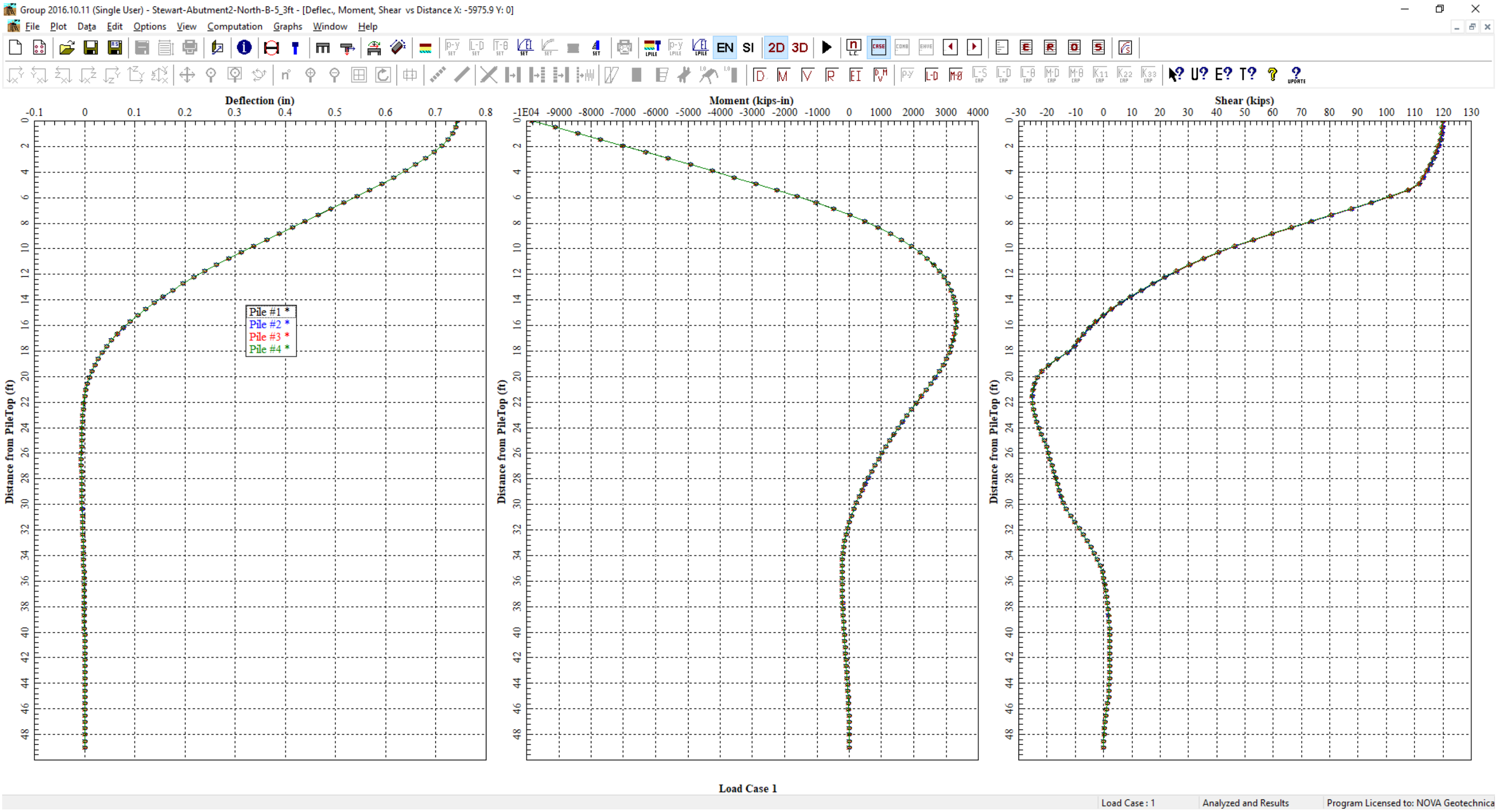


Figure 1. Results of Service Limit loading on Stewart Abutment 2 (North Abutment)

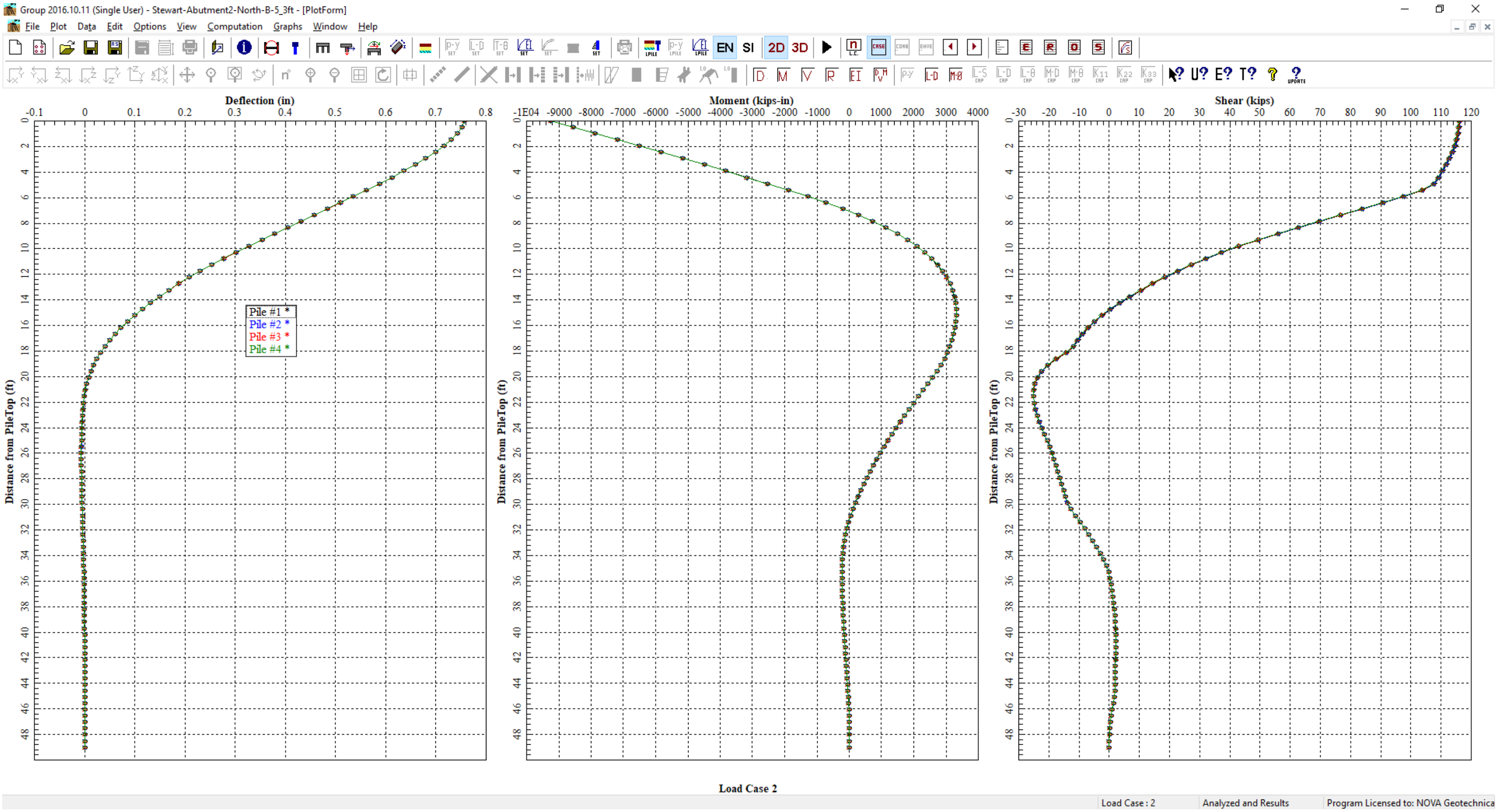


Figure 2. Results of Strength Limit loading on Stewart Abutment 2 (North Abutment)

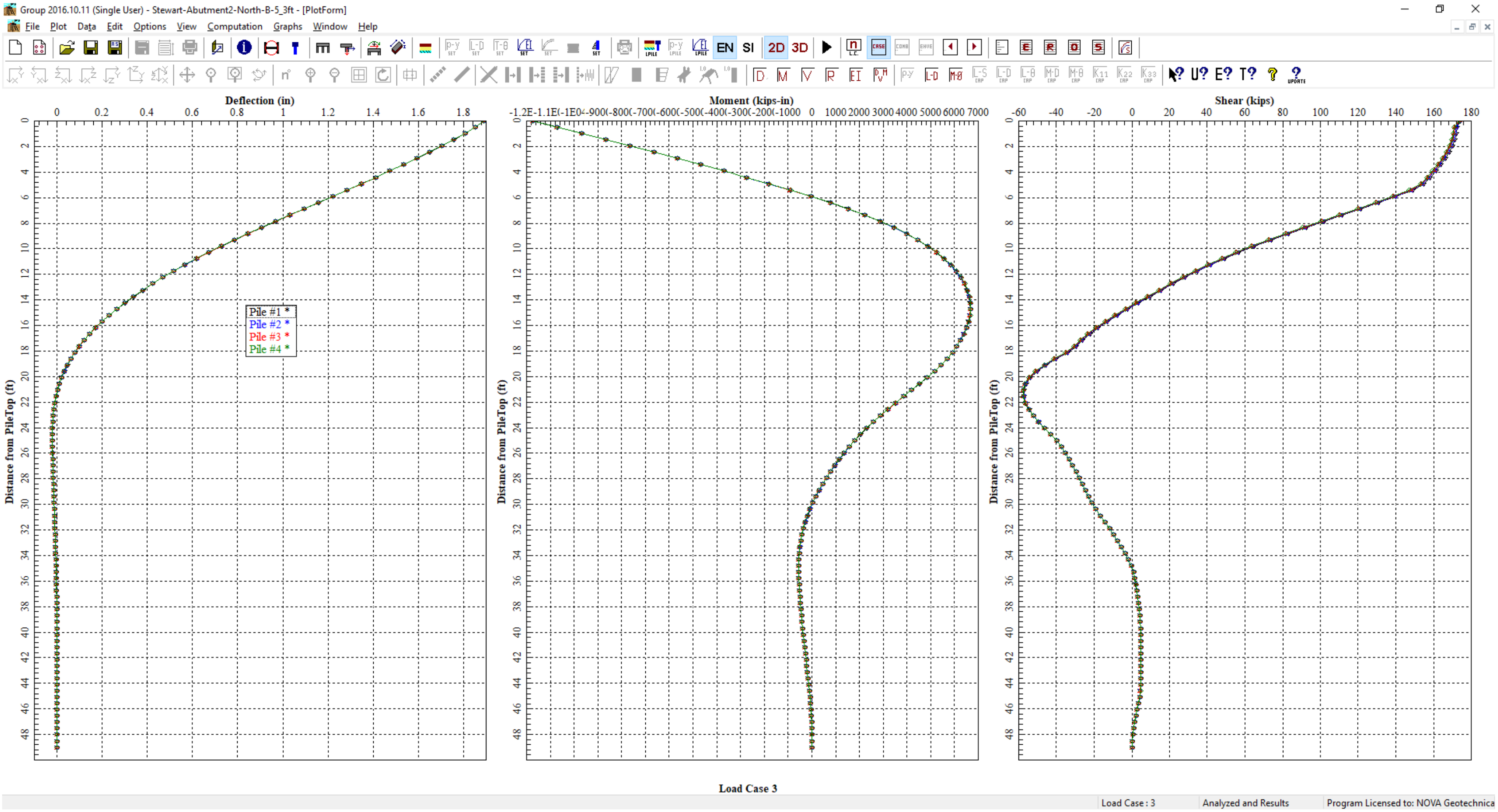


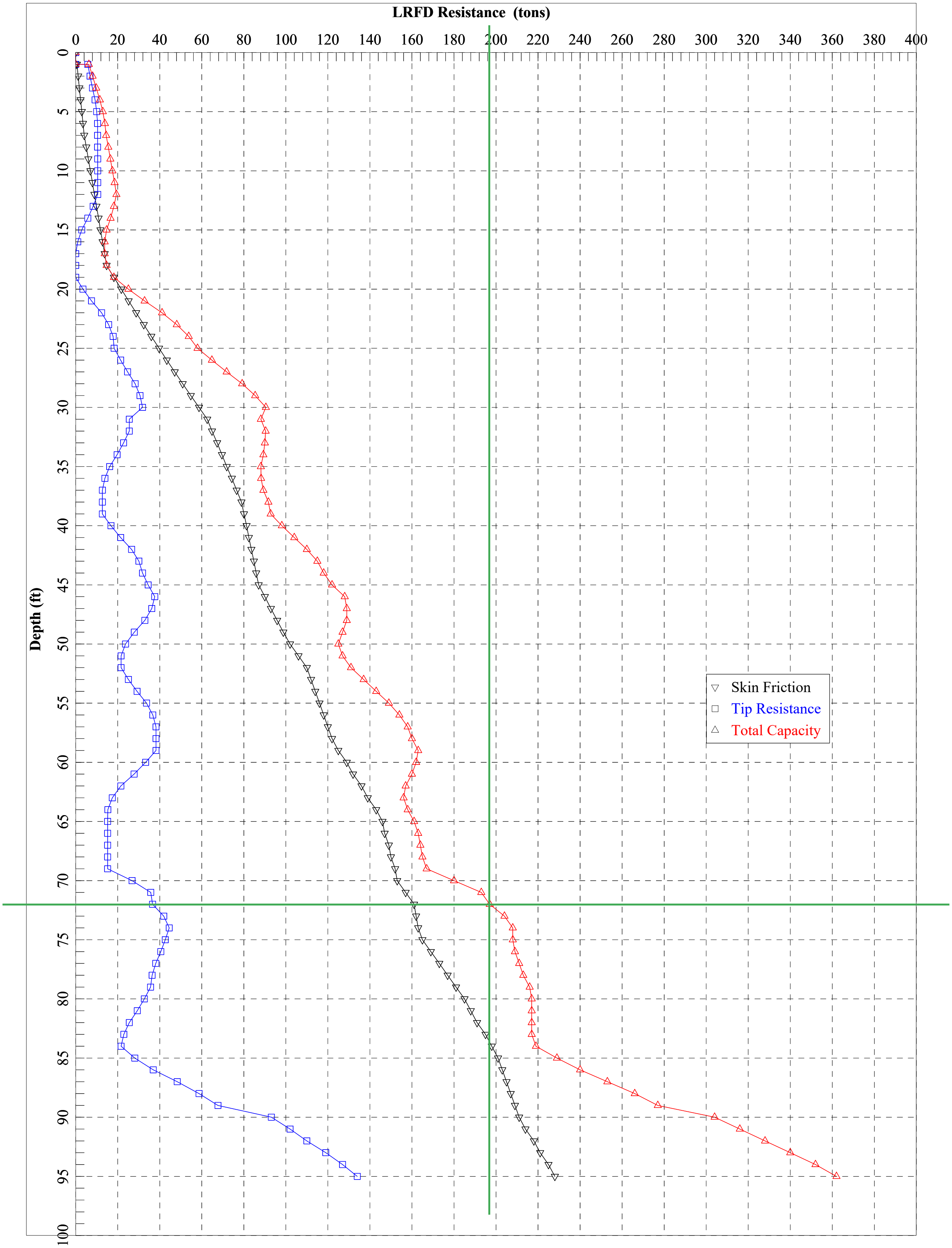
Figure 3. Results of Extreme Limit loading on Stewart Abutment 2 (North Abutment)

Abutment 1 - South Abutment - Boring B-6

AXIAL CAPACITY
Abutment 1 - South Abutment - Boring B-6

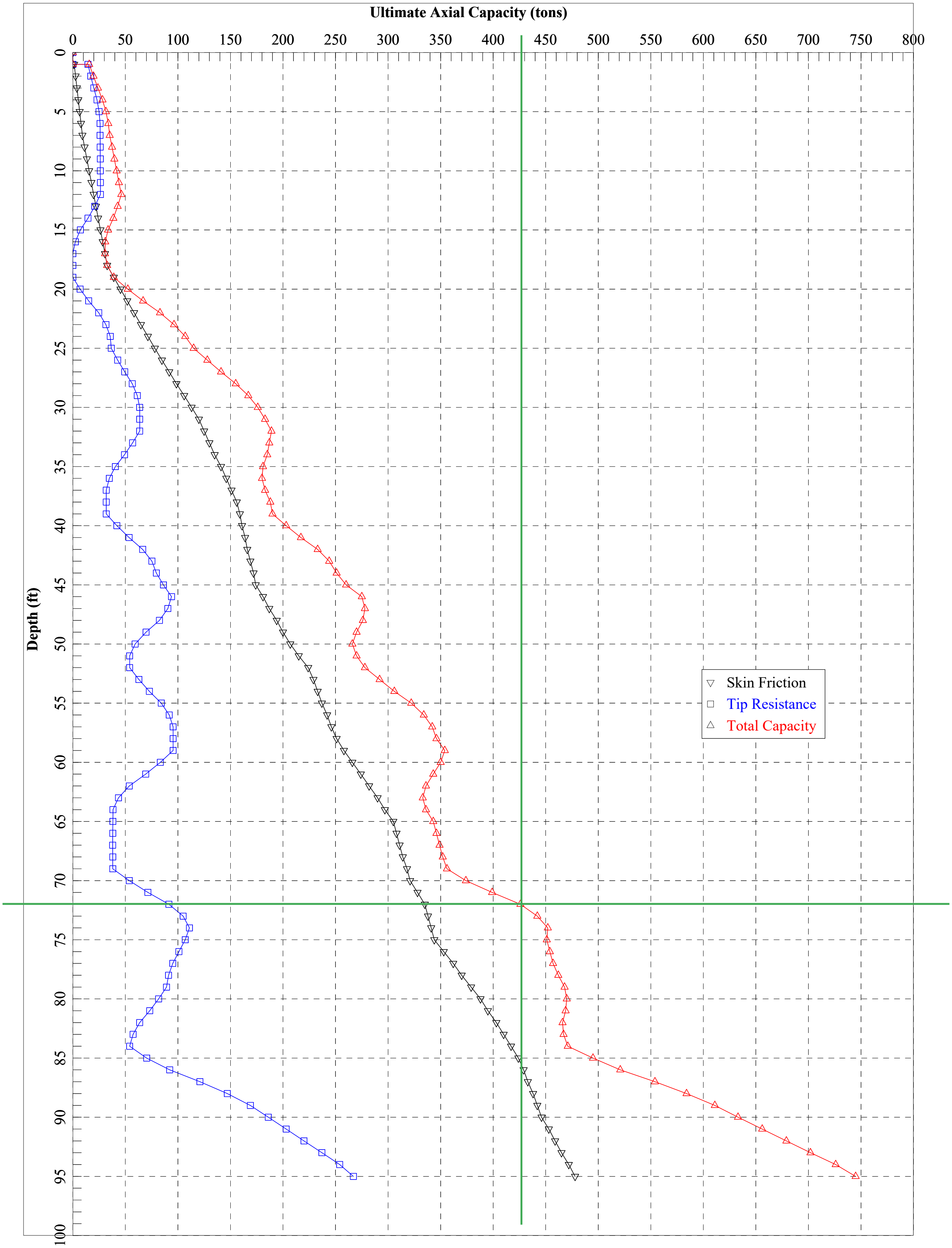
Stewart Bridge - Abutment1- South-Boring B-6 - Drilled Shaft Loads (One row of four 3 feet diameter Shafts spaced at 10.5 feet c.c.):

- Service = 145 tons
- Strength = 194 tons
- LRFD Factored Resistance of approximately 196 tons is provided by a shaft length of **72 feet**.



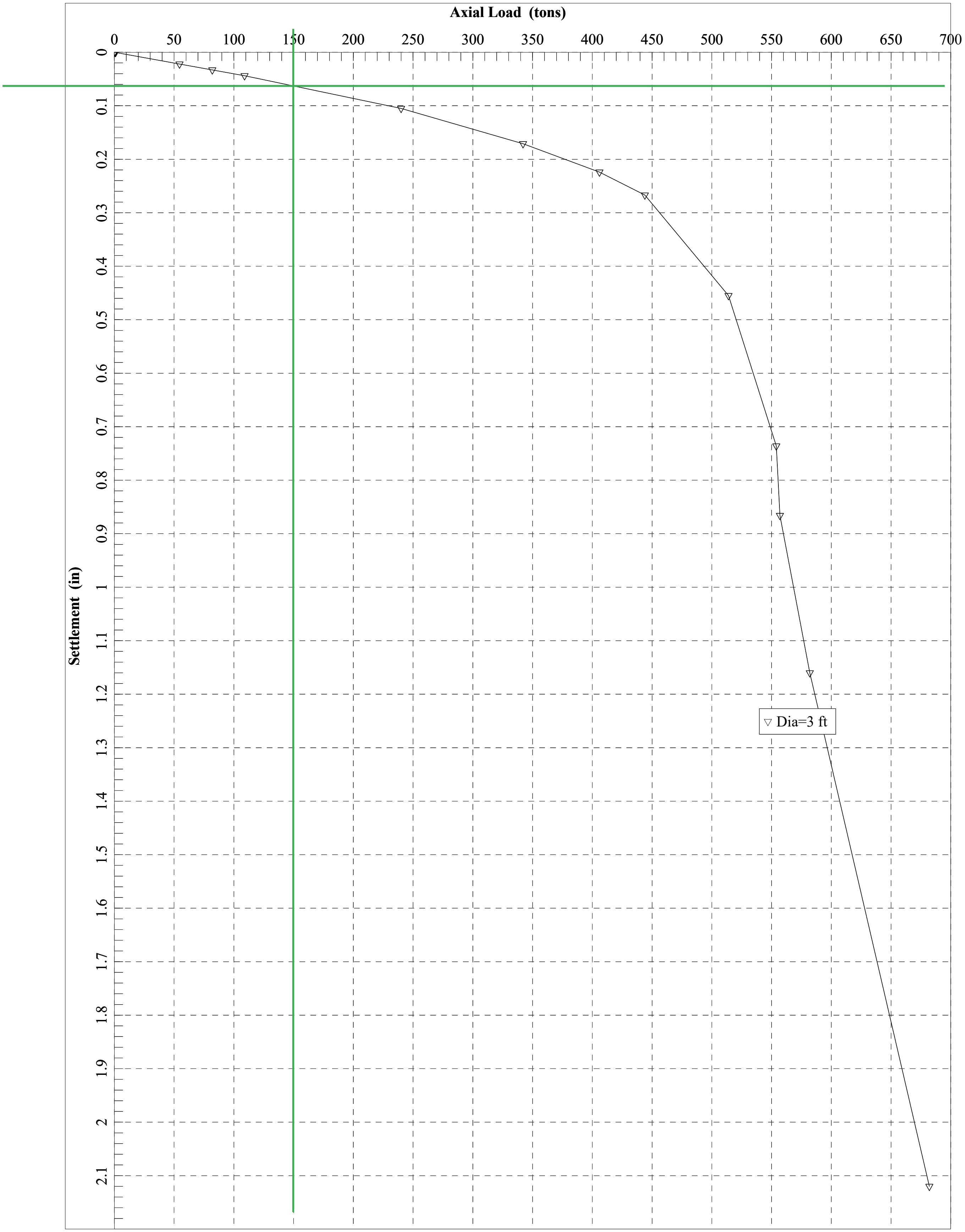
Stewart Bridge - Abutment1- South-Boring B-6 - Drilled Shaft Loads (One row of four 3 feet diameter Shafts spaced at 10.5 feet c.c.):

- Service = 145 tons
- Strength = 194 tons
- Ultimate Axial Resistance of approximately 425 tons is provided by a shaft length of **72 feet**.



Stewart Bridge - Abutment1- South-Boring B-6 - Drilled Shaft Loads (One row of four 3 feet diameter Shafts spaced at 10.5 feet c.c.):

- Service = 145 tons
- Strength = 194 tons
- At service limit load of 145 tons, settlement = **approx. 0.06 inch**



```
                       Stewart-Abutment1-South_B-6-3feet.sfo
     =========================================================================

                      SHAFT for Windows, Version 2012.7.17

                       Serial Number :  157290693

                    VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                     (c) Copyright ENSOFT, Inc., 1987-2012
                           All Rights Reserved

     =========================================================================


     Path to file locations      : H:\PROJECTS\Engineering & Enviro Projects\2019
Projects\G-19-192 I-515 Charleston Interchange - CA Group\DESIGN\1 Bridges -
Stewart-Bridge-Revised-9-24-2020\Abutment1-South-B-6-Rev_9-24-2020\
     Name of input data file     : Stewart-Abutment1-South_B-6-3feet.sfd
     Name of output file         : Stewart-Abutment1-South_B-6-3feet.sfo
     Name of plot output file    : Stewart-Abutment1-South_B-6-3feet.sfp
     Name of runtime file        : Stewart-Abutment1-South_B-6-3feet.sfr


     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  September 24, 2020     Time:  13:37:33

     Stewart Bridge Abutment2_B-6 - 3.0feet Shafts


     PROPOSED DEPTH =      95.0 FT
     ----------------


     NUMBER OF LAYERS =   17
     ------------------


     WATER TABLE DEPTH =       9.0 FT.
     -------------------




     SOIL INFORMATION
     ---------------
```

```
LAYER NO 1----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.600E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.500E+03
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.000E+00


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.880E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.500E+03
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.700E+01


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO 2----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.880E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.830E+03
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.700E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
```

```
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.830E+03
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.180E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO 3----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.927E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.270E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.180E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.825E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.270E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.250E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00


LAYER NO 4----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.825E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
```

```
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.250E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                      = 0.748E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                        = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.310E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.500E+00


LAYER NO 5----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.200E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.310E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.200E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.380E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.400E+00
```

```
LAYER NO 6----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.100E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.380E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.100E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.105E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.450E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)               = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)              = 0.400E+00


LAYER NO 7----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                      = 0.550E+00
  END BEARING COEFFICIENT-Nc                           = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                   = 0.250E+04
  INTERNAL FRICTION ANGLE, DEG.                        = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST        = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                           = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT             = 0.100E+11
  DEPTH, FT                                            = 0.450E+02


  AT THE BOTTOM
```

```
    STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
    END BEARING COEFFICIENT-Nc                        = 0.900E+01
    UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.250E+04
    INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
    BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
    SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
    MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
    DEPTH, FT                                         = 0.500E+02


    LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
    LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


  LAYER NO 8----CLAY

    AT THE TOP

    STRENGTH REDUCTION FACTOR-ALPHA                   = 0.535E+00
    END BEARING COEFFICIENT-Nc                        = 0.900E+01
    UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.350E+04
    INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
    BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
    SOIL UNIT WEIGHT, LB/CU FT                        = 0.120E+03
    MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
    DEPTH, FT                                         = 0.500E+02


    AT THE BOTTOM

    STRENGTH REDUCTION FACTOR-ALPHA                   = 0.535E+00
    END BEARING COEFFICIENT-Nc                        = 0.900E+01
    UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.350E+04
    INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
    BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
    SOIL UNIT WEIGHT, LB/CU FT                        = 0.120E+03
    MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
    DEPTH, FT                                         = 0.520E+02


    LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
    LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


  LAYER NO 9----CLAY

    AT THE TOP
```

```
  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00
  END BEARING COEFFICIENT-Nc                          = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.170E+04
  INTERNAL FRICTION ANGLE, DEG.                       = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.520E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00
  END BEARING COEFFICIENT-Nc                          = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.170E+04
  INTERNAL FRICTION ANGLE, DEG.                       = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.580E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)              = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)             = 0.400E+00


LAYER NO10----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00
  END BEARING COEFFICIENT-Nc                          = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.300E+04
  INTERNAL FRICTION ANGLE, DEG.                       = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT            = 0.100E+11
  DEPTH, FT                                           = 0.580E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00
  END BEARING COEFFICIENT-Nc                          = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                  = 0.300E+04
  INTERNAL FRICTION ANGLE, DEG.                       = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                          = 0.120E+03
```

```
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.650E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO11----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.120E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.650E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.120E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.700E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO12----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                   = 0.371E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
```

```
  DEPTH, FT                                          = 0.700E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                    = 0.354E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                      = 0.320E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.720E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)             = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)            = 0.500E+00


LAYER NO13----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00
  END BEARING COEFFICIENT-Nc                         = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.120E+04
  INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.720E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00
  END BEARING COEFFICIENT-Nc                         = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.120E+04
  INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.750E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)             = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)            = 0.400E+00
```

```
LAYER NO14----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.535E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.350E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.750E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.535E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.350E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.800E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.400E+00


LAYER NO15----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.280E+04
  INTERNAL FRICTION ANGLE, DEG.                     = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.800E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00
  END BEARING COEFFICIENT-Nc                        = 0.900E+01
```

```
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.280E+04
  INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.120E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.850E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)             = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)            = 0.400E+00


LAYER NO16----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00
  END BEARING COEFFICIENT-Nc                         = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.170E+04
  INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.850E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00
  END BEARING COEFFICIENT-Nc                         = 0.900E+01
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.170E+04
  INTERNAL FRICTION ANGLE, DEG.                      = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                         = 0.115E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT           = 0.100E+11
  DEPTH, FT                                          = 0.900E+02


  LRFD RESISTANCE FACTOR (SIDE FRICTION)             = 0.450E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)            = 0.400E+00


LAYER NO17----SAND

  AT THE TOP

  SKIN FRICTION COEFFICIENT- BETA                    = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                 = 0.000E+00
```

```
  INTERNAL FRICTION ANGLE, DEG.                     = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.900E+02


  AT THE BOTTOM

  SKIN FRICTION COEFFICIENT- BETA                   = 0.250E+00
  UNDRAINED SHEAR STRENGTH, LB/SQ FT                = 0.000E+00
  INTERNAL FRICTION ANGLE, DEG.                     = 0.420E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, LB/CU FT                        = 0.125E+03
  MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT          = 0.100E+11
  DEPTH, FT                                         = 0.102E+03


  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 0.550E+00
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 0.500E+00




DRILLED SHAFT INFORMATION
-------------------------

 DIAMETER OF STEM          =    3.000  FT.
 DIAMETER OF BASE          =    3.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    0.000  FT.
 IGNORED BOTTOM PORTION    =    0.000  FT.
 AREA OF ONE PERCENT STEEL =   10.180  SQ.IN.
 ELASTIC MODULUS, Ec       = 0.350E+07 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.




PREDICTED RESULTS
-----------------

QS      = ULTIMATE SIDE RESISTANCE;
QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
```

```
          TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH  VOLUME     QS      QB      QU     LRFD QS  LRFD QB   LRFD QU
(FEET)  (CU.YDS) (TONS)   (TONS)  (TONS)   (TONS)   (TONS)    (TONS)
  1.0     0.26     1.30   14.35    15.65     0.58     5.74      6.32
  2.0     0.52     2.59   17.10    19.69     1.17     6.84      8.01
  3.0     0.79     3.89   20.00    23.89     1.75     8.00      9.75
  4.0     1.05     5.18   23.03    28.21     2.33     9.21     11.54
  5.0     1.31     6.48   25.01    31.49     2.92    10.00     12.92
  6.0     1.57     7.78   25.99    33.77     3.50    10.40     13.90
  7.0     1.83     9.07   26.05    35.12     4.08    10.42     14.50
  8.0     2.09    11.22   26.10    37.32     5.05    10.44     15.49
  9.0     2.36    13.38   26.15    39.53     6.02    10.46     16.48
 10.0     2.62    15.53   26.21    41.73     6.99    10.48     17.47
 11.0     2.88    17.68   26.26    43.94     7.96    10.50     18.46
 12.0     3.14    19.83   26.31    46.14     8.92    10.53     19.45
 13.0     3.40    21.98   20.76    42.74     9.89     8.30     18.19
 14.0     3.67    24.13   14.38    38.52    10.86     5.75     16.61
 15.0     3.93    26.28    7.20    33.48    11.83     2.88     14.71
 16.0     4.19    28.44    2.40    30.84    12.80     0.96     13.76
 17.0     4.45    30.59    0.00    30.59    13.76     0.00     13.76
 18.0     4.71    32.74    0.00    32.74    14.73     0.00     14.73
 19.0     4.97    39.01    0.00    39.01    18.18     0.00     18.18
 20.0     5.24    45.36    6.93    52.29    21.67     3.47     25.14
 21.0     5.50    51.77   15.12    66.89    25.20     7.56     32.76
 22.0     5.76    58.26   24.61    82.86    28.77    12.30     41.07
 23.0     6.02    64.81   31.46    96.27    32.37    15.73     48.10
 24.0     6.28    71.42   35.58   107.00    36.01    17.79     53.79
 25.0     6.55    78.09   36.57   114.66    39.68    18.28     57.96
 26.0     6.81    84.83   42.75   127.58    43.38    21.37     64.76
 27.0     7.07    91.66   49.37   141.04    47.14    24.69     71.83
 28.0     7.33    98.58   56.56   155.14    50.95    28.28     79.22
 29.0     7.59   105.58   61.27   166.85    54.79    30.63     85.43
 30.0     7.86   112.65   63.63   176.28    58.69    31.81     90.50
 31.0     8.12   119.80   63.63   183.42    62.62    25.45     88.07
 32.0     8.38   124.98   63.63   188.61    64.95    25.45     90.40
 33.0     8.64   130.17   56.88   187.04    67.28    22.75     90.03
 34.0     8.90   135.35   49.17   184.52    69.61    19.67     89.28
 35.0     9.16   140.54   40.49   181.02    71.95    16.20     88.14
 36.0     9.43   145.72   34.70   180.42    74.28    13.88     88.16
 37.0     9.69   150.90   31.81   182.72    76.61    12.73     89.34
 38.0     9.95   156.09   31.81   187.90    78.95    12.73     91.67
 39.0    10.21   158.68   31.81   190.49    80.11    12.73     92.84
 40.0    10.47   161.27   41.93   203.21    81.28    16.77     98.05
 41.0    10.74   163.86   53.50   217.37    82.45    21.40    103.85
```

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42.0     11.00    166.46     66.52    232.97     83.61     26.61     110.22
43.0     11.26    169.05     75.19    244.24     84.78     30.08     114.86
44.0     11.52    171.64     79.53    251.17     85.94     31.81     117.76
45.0     11.78    174.23     86.25    260.48     87.11     34.50     121.61
46.0     12.04    180.71     93.92    274.63     90.03     37.57     127.60
47.0     12.31    187.19     90.44    277.63     92.94     36.18     129.12
48.0     12.57    193.67     82.35    276.03     95.86     32.94     128.80
49.0     12.83    200.15     69.66    269.81     98.78     27.86     126.64
50.0     13.09    206.64     59.27    265.91    101.69     23.71     125.40
51.0     13.35    215.45     54.08    269.53    105.66     21.63     127.29
52.0     13.62    224.26     54.08    278.34    109.62     21.63     131.25
53.0     13.88    228.66     62.85    291.52    111.60     25.14     136.75
54.0     14.14    233.07     72.88    305.95    113.59     29.15     142.74
55.0     14.40    237.48     84.16    321.64    115.57     33.66     149.23
56.0     14.66    241.88     91.68    333.56    117.55     36.67     154.22
57.0     14.92    246.29     95.44    341.73    119.54     38.18     157.71
58.0     15.19    250.70     95.44    346.13    121.52     38.18     159.69
59.0     15.45    258.47     95.44    353.91    125.02     38.18     163.19
60.0     15.71    266.25     83.29    349.54    128.52     33.32     161.83
61.0     15.97    274.03     69.41    343.44    132.02     27.76     159.78
62.0     16.23    281.80     53.79    335.59    135.52     21.52     157.03
63.0     16.50    289.58     43.38    332.96    139.02     17.35     156.37
64.0     16.76    297.36     38.18    335.53    142.52     15.27     157.79
65.0     17.02    305.13     38.08    343.21    146.02     15.23     161.25
66.0     17.28    308.24     37.96    346.21    147.41     15.19     162.60
67.0     17.54    311.35     37.93    349.29    148.81     15.17     163.99
68.0     17.80    314.46     37.96    352.43    150.21     15.19     165.40
69.0     18.07    317.57     38.05    355.62    151.61     15.22     166.83
70.0     18.33    320.68     53.65    374.34    153.01     26.83     179.84
71.0     18.59    327.70     71.43    399.14    156.87     35.72     192.59
72.0     18.85    334.66     91.39    426.05    160.70     36.56     197.26
73.0     19.11    337.77    104.69    442.46    162.10     41.88     203.98
74.0     19.38    340.88    111.34    452.23    163.50     44.54     208.04
75.0     19.64    343.99    106.62    450.61    164.90     42.65     207.55
76.0     19.90    352.81    101.22    454.03    168.87     40.49     209.36
77.0     20.16    361.63     95.15    456.78    172.84     38.06     210.90
78.0     20.42    370.45     91.10    461.55    176.81     36.44     213.25
79.0     20.68    379.27     89.08    468.35    180.77     35.63     216.40
80.0     20.95    388.09     81.65    469.74    184.74     32.66     217.40
81.0     21.21    395.35     73.17    468.52    188.01     29.27     217.28
82.0     21.47    402.60     63.63    466.23    191.28     25.45     216.73
83.0     21.73    409.86     57.26    467.13    194.54     22.91     217.45
84.0     21.99    417.12     54.08    471.20    197.81     21.63     219.44
85.0     22.26    424.38     70.20    494.58    201.07     28.08     229.15
86.0     22.52    428.79     92.22    521.01    203.06     36.89     239.95
87.0     22.78    433.19    120.66    553.86    205.04     48.27     253.31
88.0     23.04    437.60    146.82    584.42    207.02     58.73     265.75
89.0     23.30    442.01    169.15    611.16    209.01     67.66     276.67
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90.0    23.57   446.41   186.12   632.53   210.99    93.06    304.05
91.0    23.83   452.59   203.09   655.68   214.39   101.54    315.93
92.0    24.09   458.85   220.05   678.90   217.83   110.03    327.86
93.0    24.35   465.18   237.02   702.20   221.31   118.51    339.82
94.0    24.61   471.58   253.99   725.57   224.83   126.99    351.83
95.0    24.87   478.06   267.36   745.42   228.40   133.68    362.07


   RESULT FROM TREND (AVERAGED) LINE

   TOP  LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
      ton             IN.              ton             IN.
  0.1086E+00      0.4384E-04      0.2599E-02      0.1000E-04
  0.5428E+00      0.2192E-03      0.1300E-01      0.5000E-04
  0.1086E+01      0.4384E-03      0.2599E-01      0.1000E-03
  0.5453E+02      0.2196E-01      0.1300E+01      0.5000E-02
  0.8199E+02      0.3299E-01      0.1949E+01      0.7500E-02
  0.1091E+03      0.4401E-01      0.2599E+01      0.1000E-01
  0.2396E+03      0.1048E+00      0.6498E+01      0.2500E-01
  0.3424E+03      0.1707E+00      0.1300E+02      0.5000E-01
  0.4060E+03      0.2235E+00      0.1949E+02      0.7500E-01
  0.4443E+03      0.2669E+00      0.2599E+02      0.1000E+00
  0.5136E+03      0.4551E+00      0.6446E+02      0.2500E+00
  0.5542E+03      0.7360E+00      0.1213E+03      0.5000E+00
  0.5568E+03      0.8664E+00      0.1395E+03      0.6250E+00
  0.5822E+03      0.1159E+01      0.1711E+03      0.9000E+00
  0.6821E+03      0.2123E+01      0.2714E+03      0.1800E+01


   RESULT FROM UPPER-BOUND LINE

   TOP  LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
      ton             IN.              ton             IN.
  0.1897E+00      0.6546E-04      0.3713E-02      0.1000E-04
  0.9485E+00      0.3273E-03      0.1857E-01      0.5000E-04
  0.1897E+01      0.6546E-03      0.3713E-01      0.1000E-03
  0.9578E+02      0.3291E-01      0.1857E+01      0.5000E-02
  0.1421E+03      0.4937E-01      0.2785E+01      0.7500E-02
  0.1834E+03      0.6537E-01      0.3713E+01      0.1000E-01
  0.3509E+03      0.1435E+00      0.9283E+01      0.2500E-01
  0.4381E+03      0.2087E+00      0.1857E+02      0.5000E-01
  0.4778E+03      0.2538E+00      0.2785E+02      0.7500E-01
  0.5006E+03      0.2909E+00      0.3713E+02      0.1000E+00
  0.5693E+03      0.4832E+00      0.9075E+02      0.2500E+00
  0.6271E+03      0.7755E+00      0.1678E+03      0.5000E+00
  0.6336E+03      0.9069E+00      0.1848E+03      0.6250E+00
```

```
0.6489E+03      0.1192E+01      0.2032E+03      0.9000E+00
0.7344E+03      0.2147E+01      0.2887E+03      0.1800E+01



 RESULT FROM LOWER-BOUND LINE

 TOP   LOAD     TOP MOVEMENT       TIP LOAD      TIP  MOVEMENT
    ton             IN.               ton             IN.
0.5163E-01      0.2723E-04      0.1485E-02      0.1000E-04
0.2582E+00      0.1361E-03      0.7427E-02      0.5000E-04
0.5163E+00      0.2723E-03      0.1485E-01      0.1000E-03
0.2582E+02      0.1361E-01      0.7427E+00      0.5000E-02
0.3879E+02      0.2043E-01      0.1114E+01      0.7500E-02
0.5179E+02      0.2725E-01      0.1485E+01      0.1000E-01
0.1269E+03      0.6785E-01      0.3713E+01      0.2500E-01
0.2258E+03      0.1282E+00      0.7427E+01      0.5000E-01
0.2996E+03      0.1818E+00      0.1114E+02      0.7500E-01
0.3514E+03      0.2279E+00      0.1485E+02      0.1000E+00
0.4575E+03      0.4269E+00      0.3817E+02      0.2500E+00
0.4722E+03      0.6928E+00      0.7486E+02      0.5000E+00
0.4766E+03      0.8241E+00      0.9409E+02      0.6250E+00
0.5156E+03      0.1125E+01      0.1390E+03      0.9000E+00
0.6297E+03      0.2098E+01      0.2540E+03      0.1800E+01
```

LATERAL CAPACITY
Abutment 1 - South Abutment - Boring B-6

Lateral Analysis and Results – Stewart Bridge - Abutment 1 (South Abutment - Boring B-6), Abutment 2 (North Abutment - Boring B-5), and Center Piers (Boring B-7):

Lateral analyses were performed for the drilled shaft foundations for the project using software GROUP. The following table summarizes the geometry of the shafts and the pipe cap:

Loading Condition	**Bridge H-1443R over Stewart Avenue**					
	South Abutment (Abutment-1)			**North Abutment (Abutment-2)**		
	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure
Service Limit	1160 kips	432 kips	Fig. 1	1248 kips	480 kips	Fig. 4
Strength Limit	1552 kips	376 kips	Fig. 2	1664 kips	464 kips	Fig. 5
Extreme Limit	888 kips	240 kips	Fig. 3	1160 kips	688 kips	Fig. 6
Drilled Shaft Lengths*	72 feet			49 feet		
Reinforcement	12 - #10 bar plus spiral reinforcement with #5 bar spaced 2.33 feet			12 - #10 bar plus spiral reinforcement with #5 bar spaced 2.33 feet		
Pile Cap and Shaft geometry	One row of 4 piers each 3.0 feet diameter spaced 10.5 feet center to center connected by pile cap approximately 40.25 feet long, 6 feet wide and 2.5 feet thick			One row of 4 piers each 3.0 feet diameter spaced 12 feet center to center connected by pile cap approximately 46.3125 feet long, 6 feet wide and 2.5 feet thick		

Loading Condition	**Bridge H-1443R over Stewart Avenue**		
	Pier 1 and 2		
	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure
Service Limit	3132 kips	396 kips	Fig. 7
Strength Limit	2644 kips	244 kips	Fig. 8
Extreme Limit	3380 kips	416 kips	Fig. 9
Drilled Shaft Lengths*	72 feet		
Reinforcement	12 - #10 bar plus spiral reinforcement with #4 bar spaced 2.0 feet		
Pile Cap and Shaft geometry	Two rows of 2 piers each 3.5 feet diameter spaced 10.5 feet center to center along length and width connected by pile cap approximately 16 feet long, 16 feet wide and 4 feet thick		

* Design Shaft Lengths are the lengths required based on required axial capacity and are measured from the ground surface.

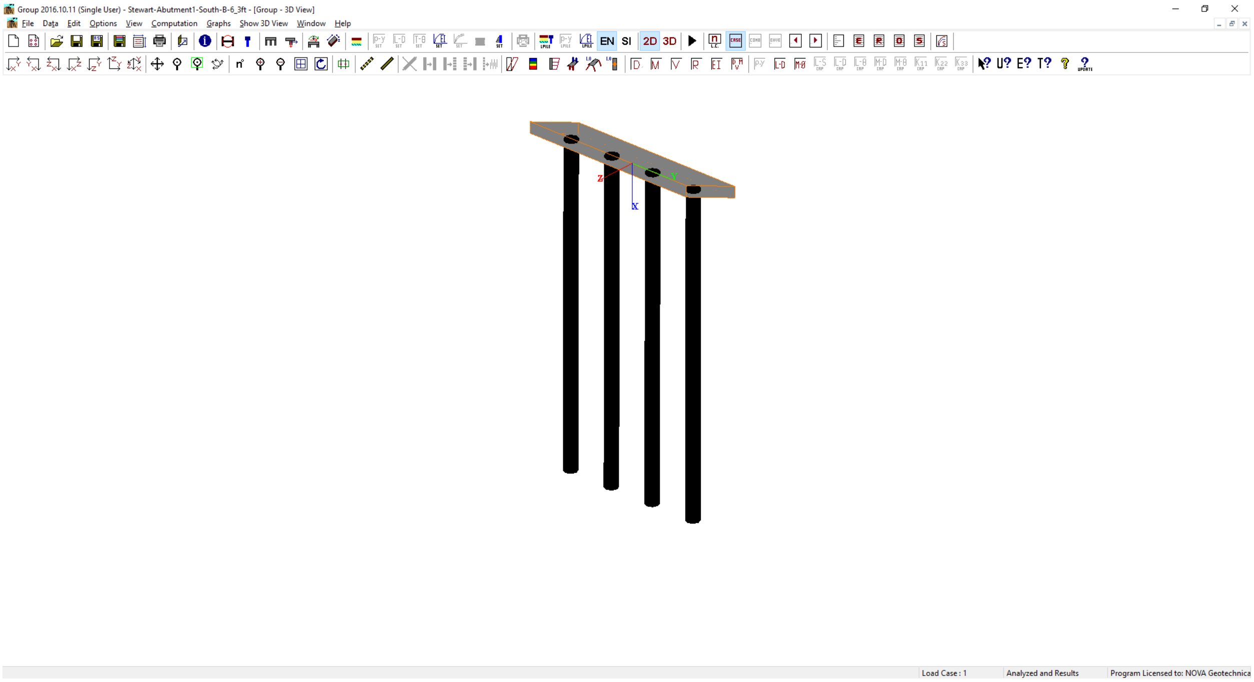
The input parameters for Abutment 1 (South Abutment) are provided in the table below:

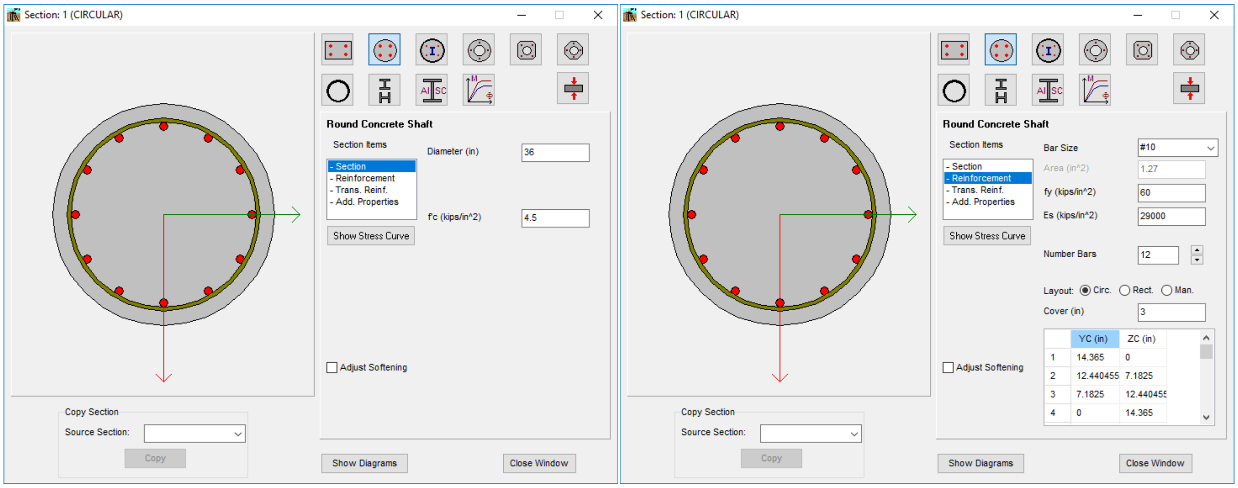
Stewart Bridge – South Abutment – Abutment 1 – Boring B-6 GROUP/LPILE Parameters

GROUP/LPILE Soil Type *	Approximate Formation Depths (ft)	Unit Weight (pcf)	Cohesion	Friction Angle	Soil Modulus K (pci)	Strain Factor E_{50}
Clay	0 – 5	105	Ignore	Ignore	Ignore	Ignore
Clay	5 – 7	105	500 psf	-	Static – 100 Cyclic – N/A	0.01
Clay	7 – 9	115	830 psf	-	Static – 100 Cyclic – N/A	0.01
Groundwater depth = 9 feet						
Clay	9 – 18	115	830 psf	-	Static – 100 Cyclic – N/A	0.01
Sand	18 – 25	105	-	27 degrees	20	N/A
Sand	25 – 31	115	-	32 degrees	60	N/A
Clay	31 – 38	115	2,000 psf	-	Static – 500 Cyclic – 200	0.007
Clay	38 – 45	105	1,000 psf	-	Static – 100 Cyclic – N/A	0.01
Clay	45 – 50	115	2,500 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	50 – 52	120	3,495 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	52 – 58	115	1,700 psf	-	Static – 500 Cyclic – 200	0.007
Clay	58 – 65	120	3,000 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	65 – 70	115	1,200 psf	-	Static – 500 Cyclic – 200	0.007
Sand	70 – 72	120	-	32 degrees	60	N/A
Clay	72 – 75	115	1,200 psf	-	Static – 500 Cyclic – 200	0.007
Clay	75 – 80	125	3,500 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	80 - 85	120	2,800 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	85 – 90	115	1,700 psf	-	Static – 500 Cyclic – 200	0.007
Sand	90 – 101.5	125	-	36 degrees	125	N/A

* Clay soils with cohesion less than 1,000 psf should be modeled as “Soft Clay (Matlock)”. And, clay soils with cohesion more than 1,000 psf should be modeled as “Stiff Clay without Free Water (Reese)”. Sand soils should be modeled as “Sand (Reese)”.
N/A – Not Applicable

The following figure shows a typical model for Abutment 1 (South Abutment):





Round Concrete Shaft

Diameter (in) 36

f'c (kips/in^2) 4.5

☐ Adjust Softening

Source Section:

Round Concrete Shaft

Bar Size #10

Area (in^2) 1.27

fy (kips/in^2) 60

Es (kips/in^2) 29000

Number Bars 12

Layout: ● Circ. ○ Rect. ○ Man.

Cover (in) 3

	YC (in)	ZC (in)
1	14.365	0
2	12.440455	7.1825
3	7.1825	12.440455
4	0	14.365

☐ Adjust Softening

Source Section:

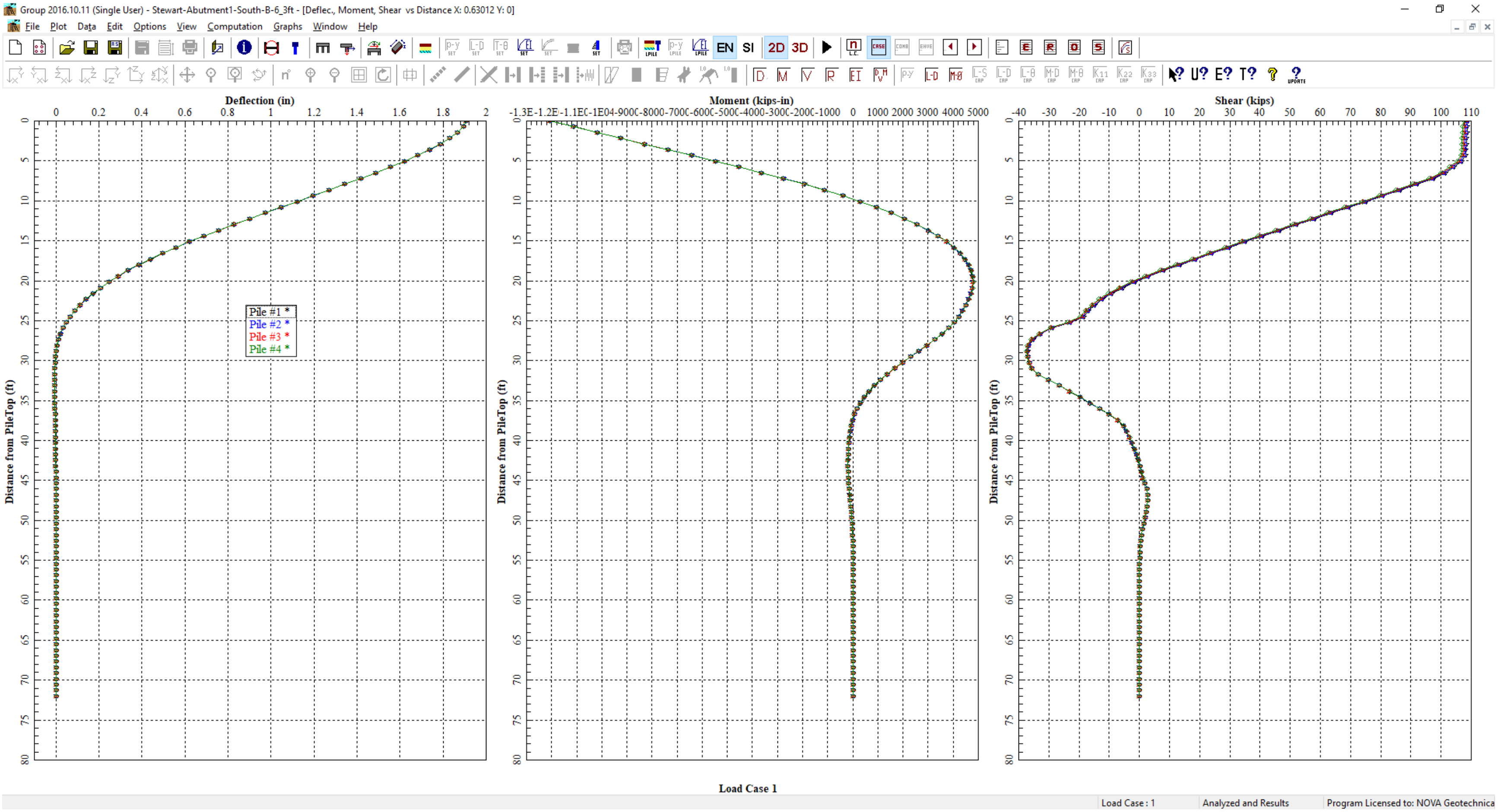


Figure 4. Results of Service Limit loading on Stewart Abutment 1 (South Abutment)

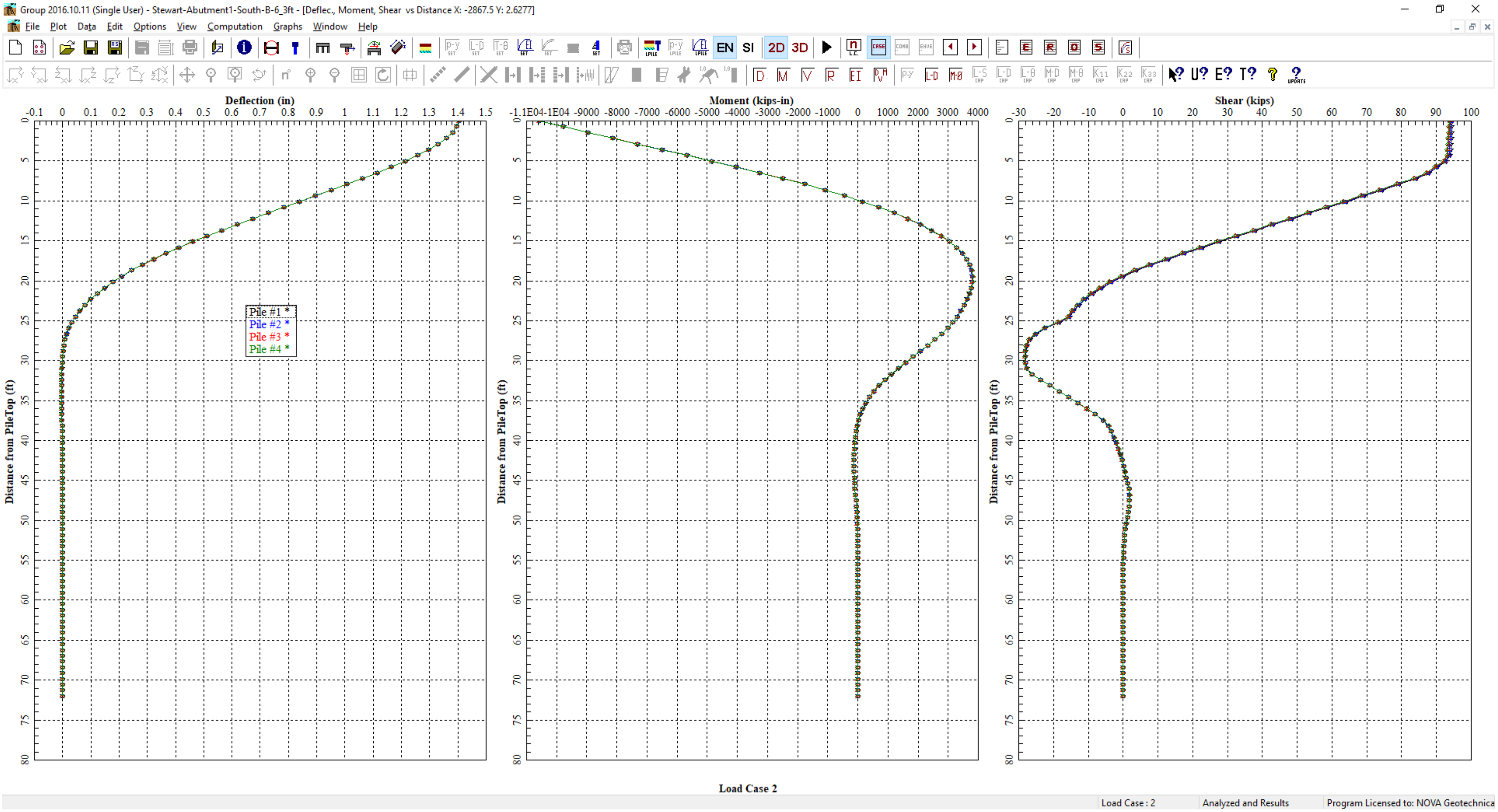


Figure 5. Results of Strength Limit loading on Stewart Abutment 1 (South Abutment)

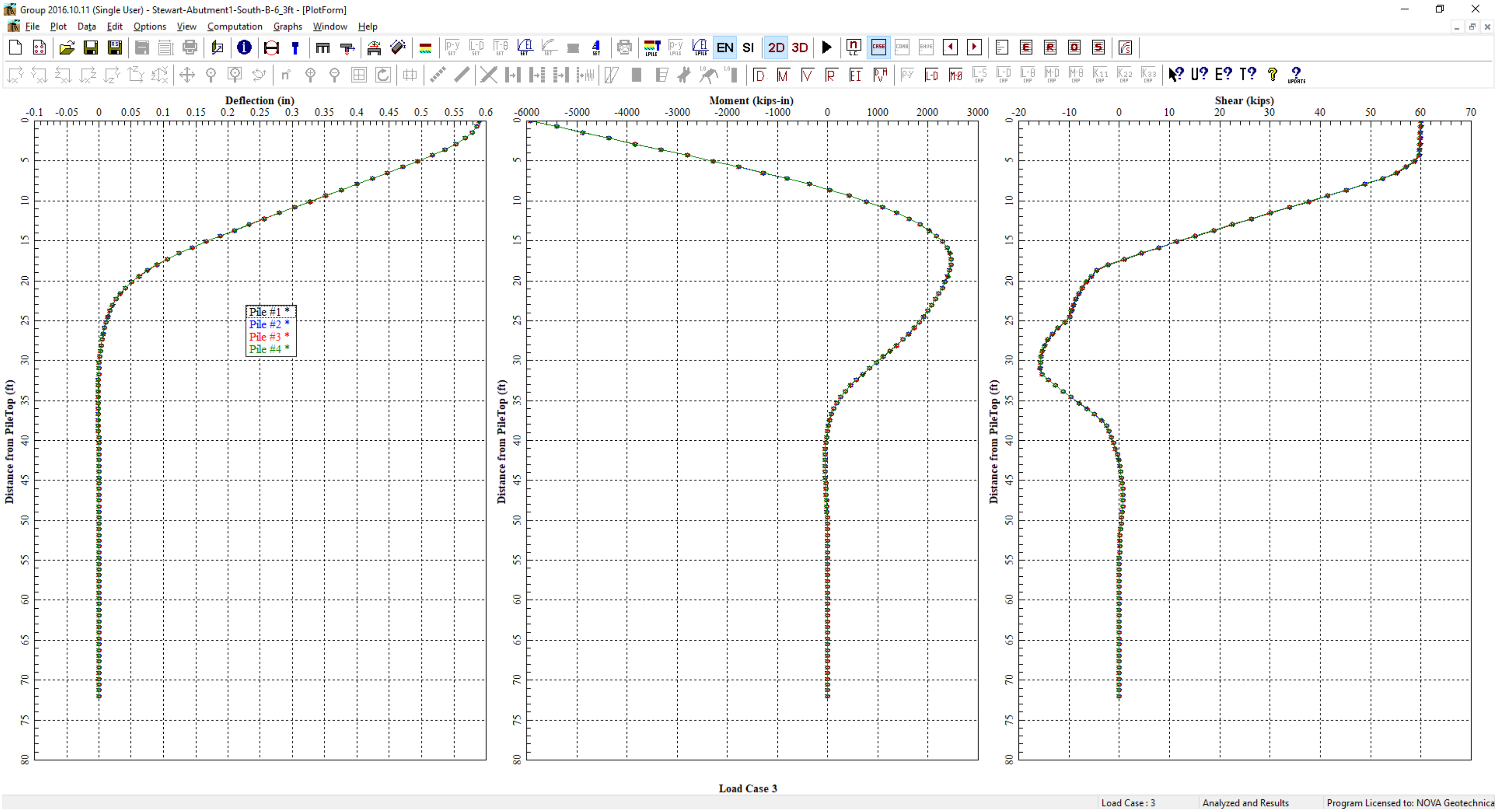


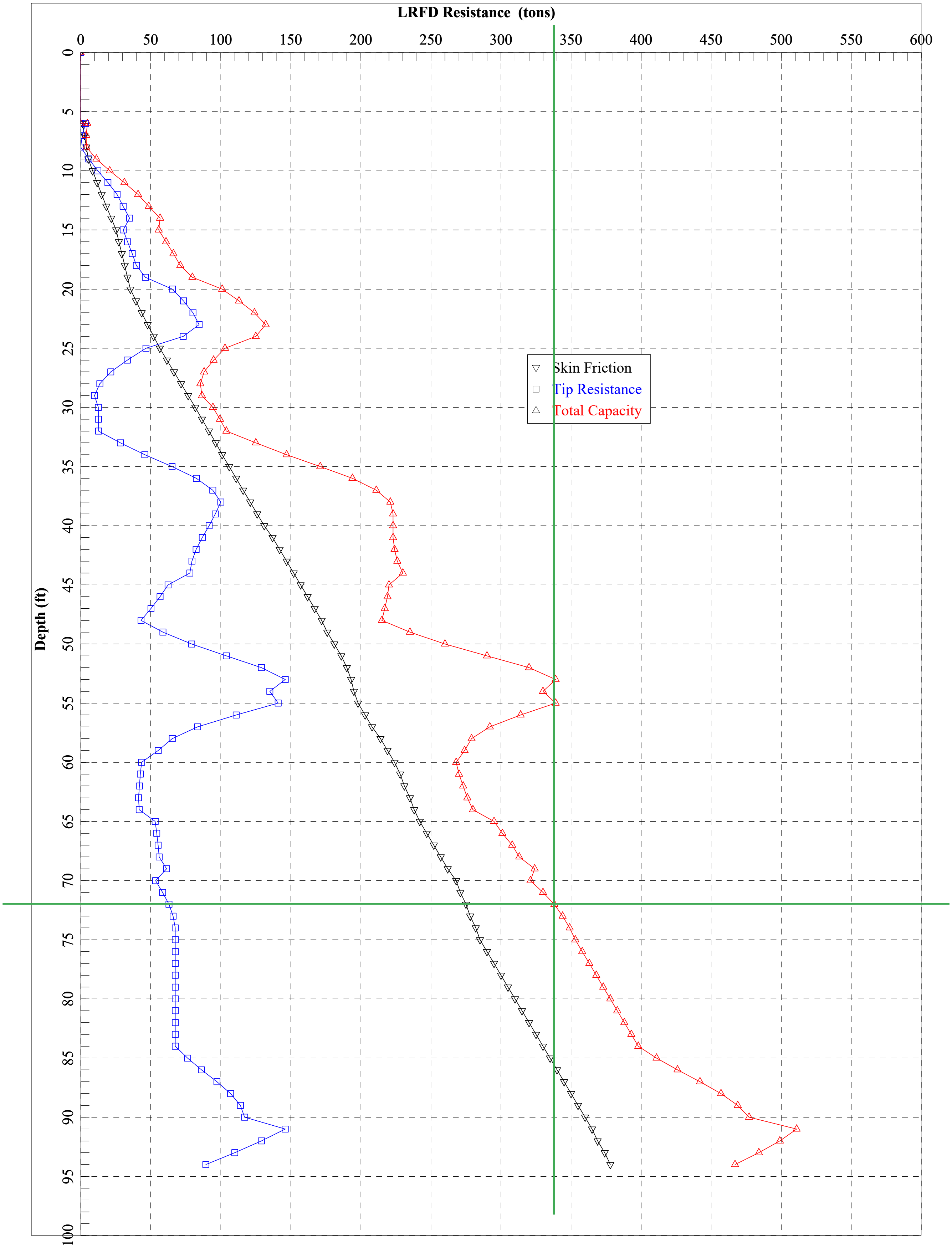
Figure 6. Results of Extreme Limit loading on Abutment 1 (South Abutment)

Center Piers - Boring B-7

AXIAL CAPACITY
Center Piers - Boring B-7

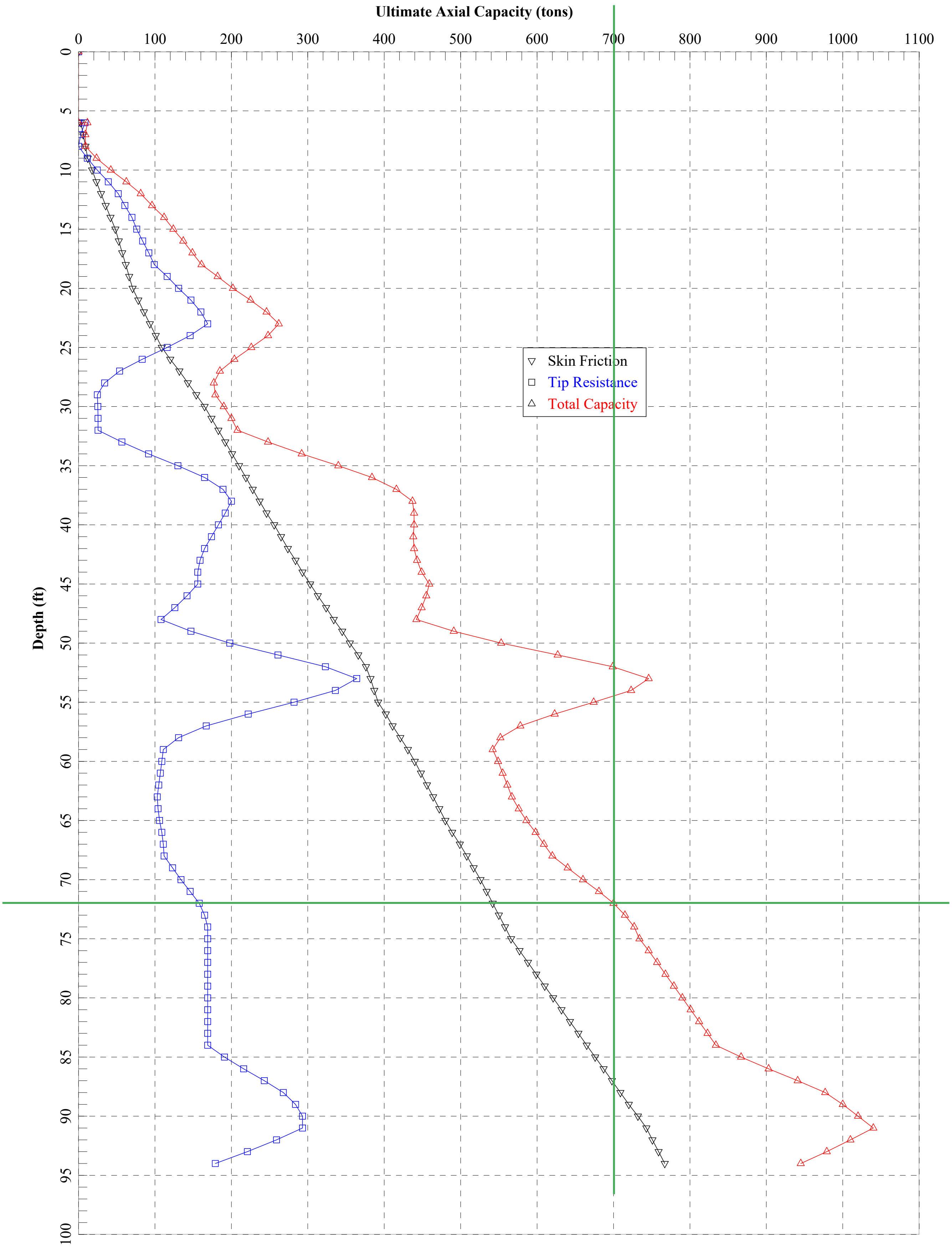
Stewart Bridge - Center Piers- Boring B-7 - Drilled Shaft Loads (2 rows of two 3.5 feet Shafts spaced at 10.5 feet c.c.):

- Service = 392 tons
- Strength = 331 tons
- LRFD Factored Resistance of approximately 338 tons is provided by a shaft length of **72 feet**.



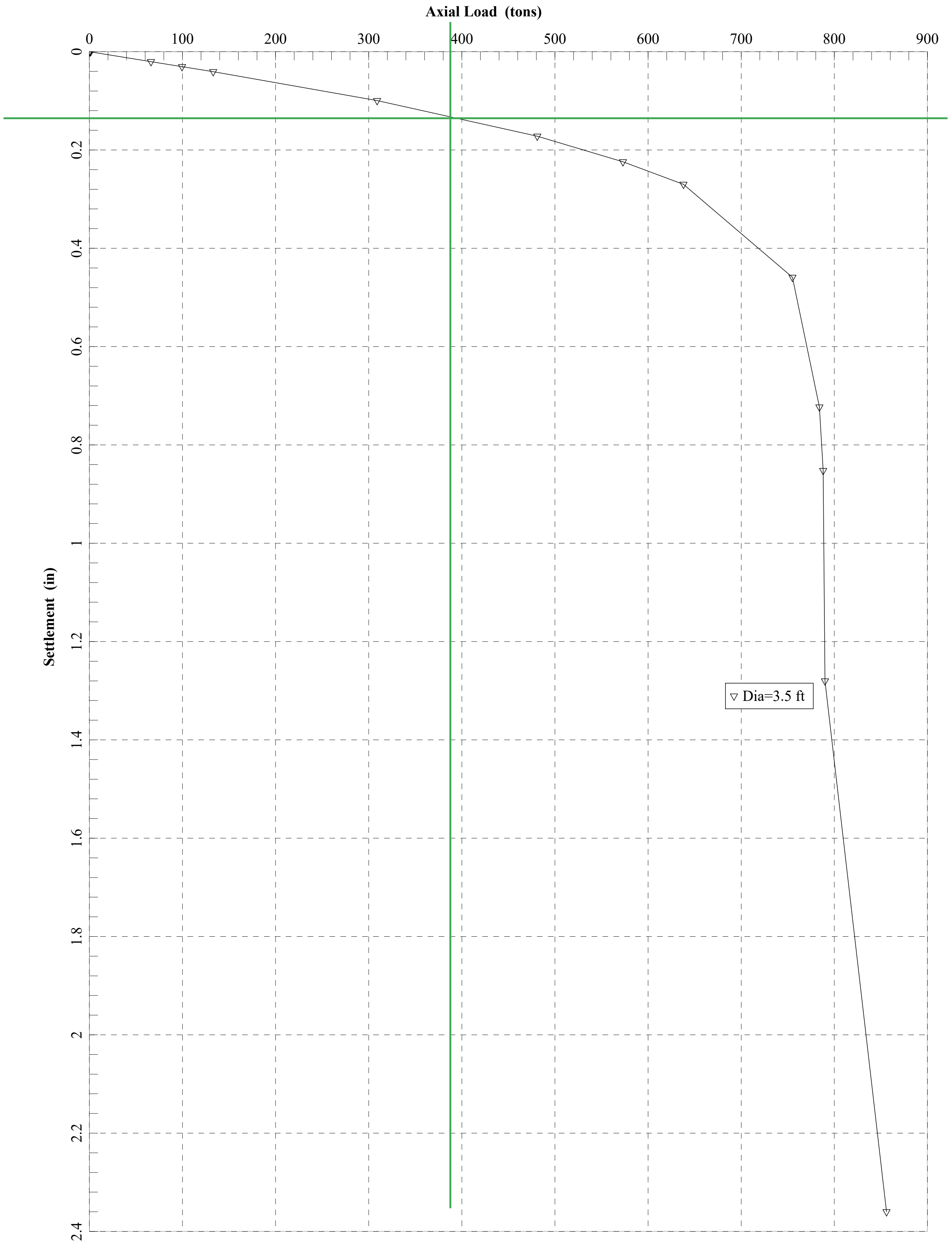
Stewart Bridge - Center Piers- Boring B-7 - Drilled Shaft Loads (2 rows of two 3.5 feet Shafts spaced at 10.5 feet c.c.):

- Service = 392 tons
- Strength = 331 tons
- Ultimate Axial Resistance of approximately 700 tons is provided by a shaft length of **72 feet**.



Stewart Bridge - Center Piers- Boring B-7 - Drilled Shaft Loads (2 rows of two 3.5 feet Shafts spaced at 10.5 feet c.c.):

- Service = 392 tons
- Strength = 331 tons
- At service limit load of 392 tons, settlement = **approx. 0.13 inch**



LATERAL CAPACITY
Center Piers - Boring B-7

Lateral Analysis and Results – Stewart Bridge - Abutment 1 (South Abutment - Boring B-6), Abutment 2 (North Abutment - Boring B-5), and Center Piers (Boring B-7):

Lateral analyses were performed for the drilled shaft foundations for the project using software GROUP. The following table summarizes the geometry of the shafts and the pipe cap:

Loading Condition	**Bridge H-1443R over Stewart Avenue**					
	South Abutment (Abutment-1)			**North Abutment (Abutment-2)**		
	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure
Service Limit	1160 kips	432 kips	Fig. 1	1248 kips	480 kips	Fig. 4
Strength Limit	1552 kips	376 kips	Fig. 2	1664 kips	464 kips	Fig. 5
Extreme Limit	888 kips	240 kips	Fig. 3	1160 kips	688 kips	Fig. 6
Drilled Shaft Lengths*	72 feet			49 feet		
Reinforcement	12 - #10 bar plus spiral reinforcement with #5 bar spaced 2.33 feet			12 - #10 bar plus spiral reinforcement with #5 bar spaced 2.33 feet		
Pile Cap and Shaft geometry	One row of 4 piers each 3.0 feet diameter spaced 10.5 feet center to center connected by pile cap approximately 40.25 feet long, 6 feet wide and 2.5 feet thick			One row of 4 piers each 3.0 feet diameter spaced 12 feet center to center connected by pile cap approximately 46.3125 feet long, 6 feet wide and 2.5 feet thick		

Loading Condition	**Bridge H-1443R over Stewart Avenue**		
	Pier 1 and 2		
	Axial load on pile cap	Resultant Shear on pile cap	Reference Result Figure
Service Limit	3132 kips	396 kips	Fig. 7
Strength Limit	2644 kips	244 kips	Fig. 8
Extreme Limit	3380 kips	416 kips	Fig. 9
Drilled Shaft Lengths*	72 feet		
Reinforcement	12 - #10 bar plus spiral reinforcement with #4 bar spaced 2.0 feet		
Pile Cap and Shaft geometry	Two rows of 2 piers each 3.5 feet diameter spaced 10.5 feet center to center along length and width connected by pile cap approximately 16 feet long, 16 feet wide and 4 feet thick		

* Design Shaft Lengths are the lengths required based on required axial capacity and are measured from the ground surface.

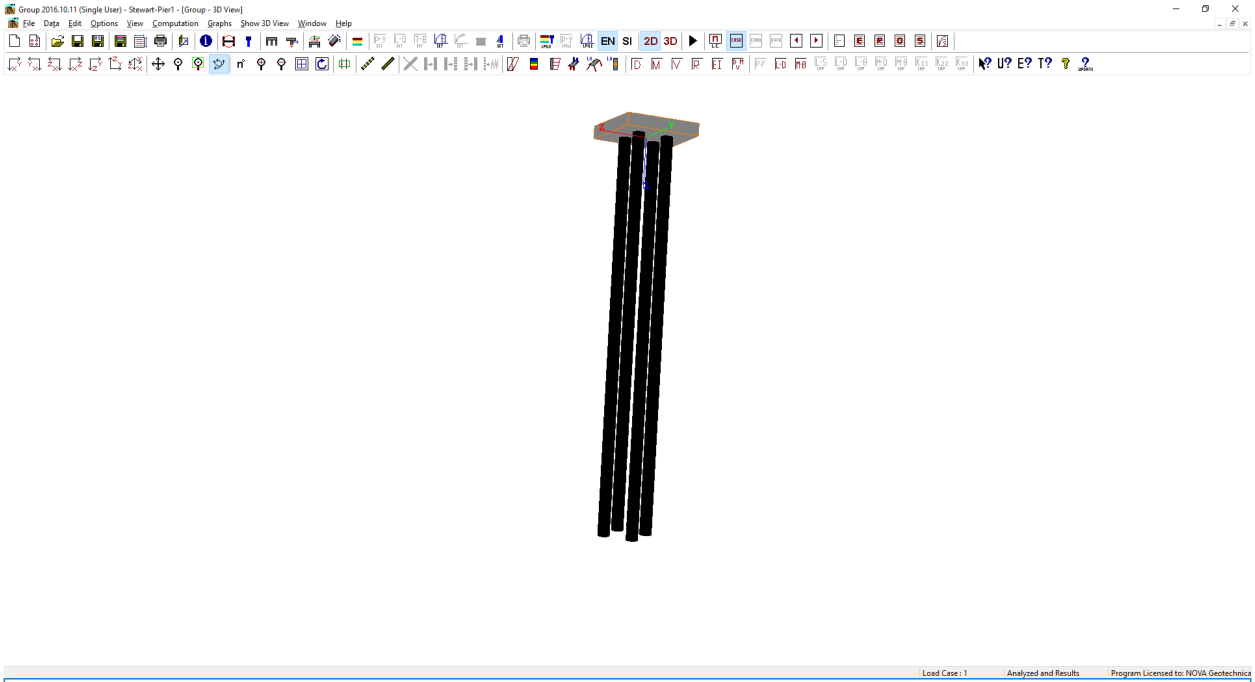
The input parameters for Center Piers (Pier 1 and Pier 2) are provided in the table below:

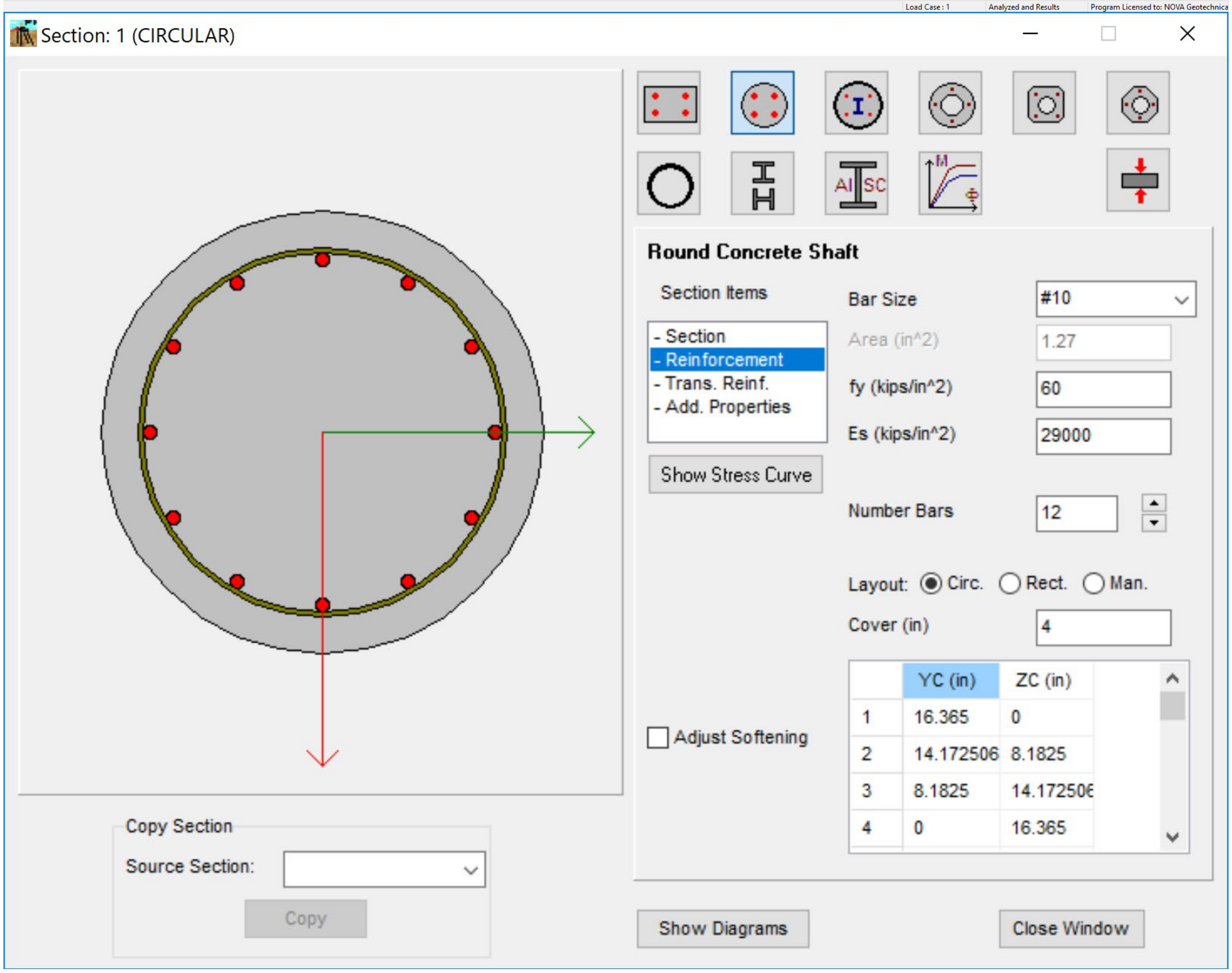
Stewart Bridge – Pier 1 and Pier 2 – Boring B-7 GROUP/LPILE Parameters

LPILE Soil Type *	Approximate Formation Depths (ft)	Unit Weight (pcf)	Cohesion	Friction Angle	Soil Modulus K (pci)	Strain Factor E_{50}
Clay	0 – 5	105	Ignore	Ignore	Ignore	Ignore
Clay	5 – 8	110	1,000 psf	-	Static – 100 Cyclic – N/A	0.01
Groundwater depth = 8 feet						
Clay	8 – 9	110	1,000 psf	-	Static – 100 Cyclic – N/A	0.01
Sand	9 – 15	110	-	30 degrees	20	N/A
Clay	15 – 20	115	1,500 psf	-	Static – 500 Cyclic – 200	0.007
Sand	20 – 25	125	-	36 degrees	125	N/A
Clay	25 – 30	125	4,000 psf	-	Static – 1,000 Cyclic – 400	0.005
Sand	30 – 39	115	-	31 degrees	60	N/A
Sand	39 – 45	125	-	37 degrees	125	N/A
Clay	45 – 52	125	3,600 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	52 – 55	115	1,750 psf	-	Static – 500 Cyclic – 200	0.007
Sand	55 – 60	135	-	44 degrees	125	N/A
Clay	60 – 65	125	2,600 psf	-	Static – 1,000 Cyclic – 400	0.005
Sand	65 – 70	125	-	34 degrees	125	N/A
Clay	70 – 75	125	2,600 psf	-	Static – 1,000 Cyclic – 400	0.005
Clay	75 – 90.5	120	3,900 psf	-	Static – 1,000 Cyclic – 400	0.005
Sand	90.5 – 98	130	-	39 degrees	125	N/A
Sand	98 – 101.5	125	-	34 degrees	125	N/A

* Clay soils with cohesion less than 1,000 psf should be modeled as “Soft Clay (Matlock)”. And, clay soils with cohesion more than 1,000 psf should be modeled as “Stiff Clay without Free Water (Reese)”. Sand soils should be modeled as “Sand (Reese)”.
N/A – Not Applicable

The following figure shows a typical model Pier:





Round Concrete Shaft

Bar Size: #10

Area (in^2): 1.27

fy (kips/in^2): 60

Es (kips/in^2): 29000

Number Bars: 12

Layout: ● Circ. ○ Rect. ○ Man.

Cover (in): 4

	YC (in)	ZC (in)
1	16.365	0
2	14.172506	8.1825
3	8.1825	14.17250
4	0	16.365

☐ Adjust Softening

Source Section:

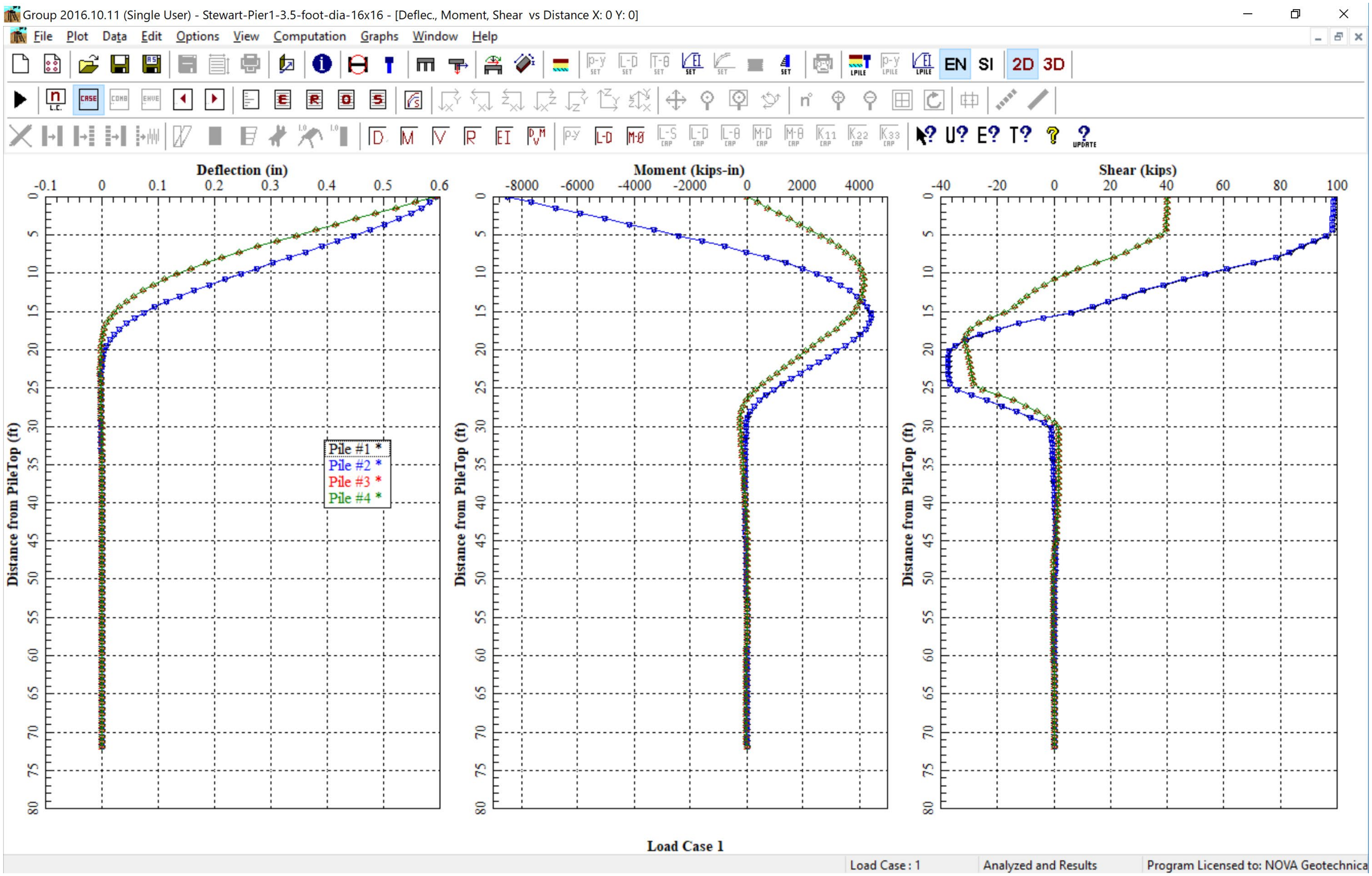


Figure 7. Results of Service Limit loading on Stewart Pier 1 and 2

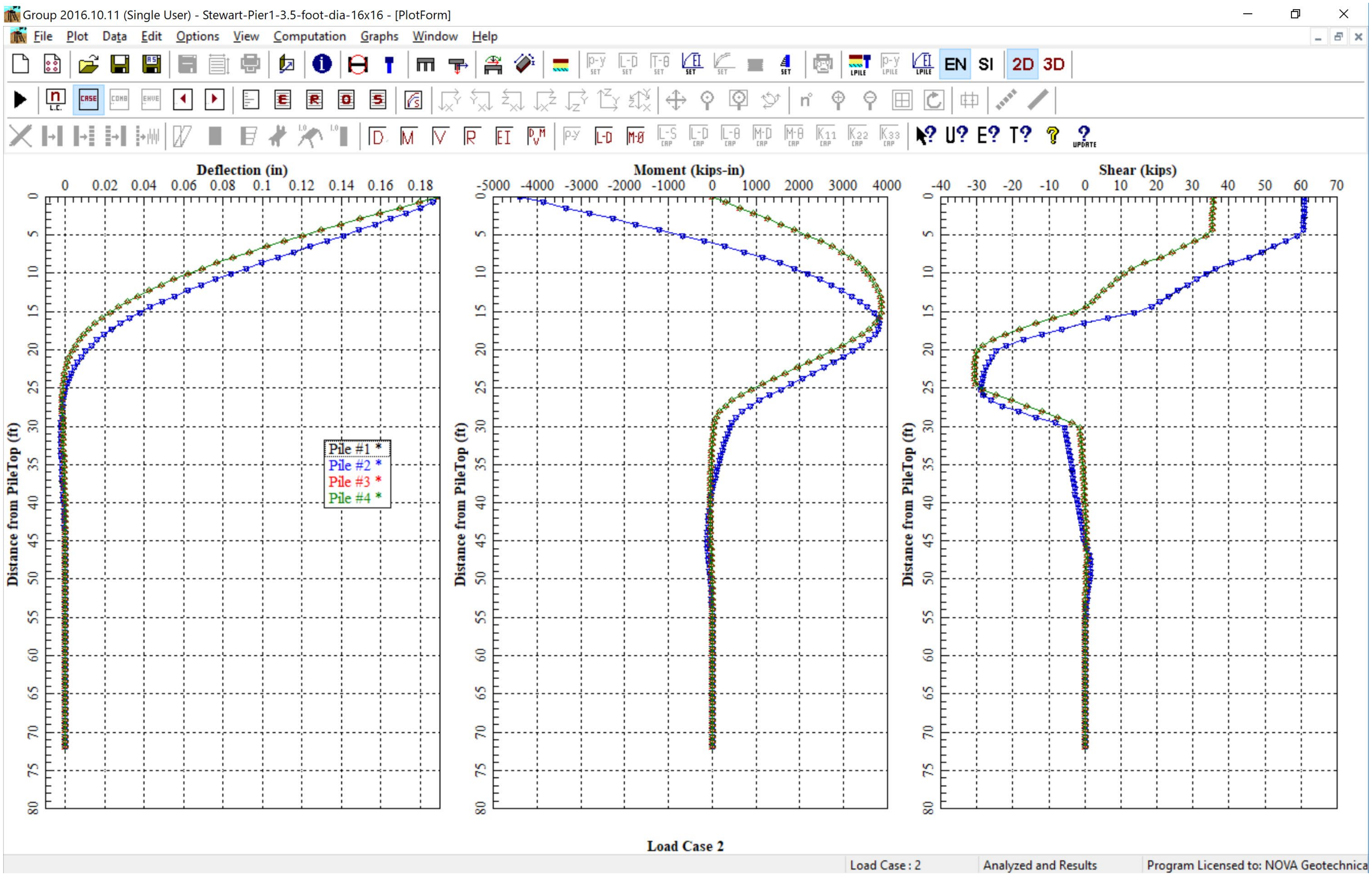
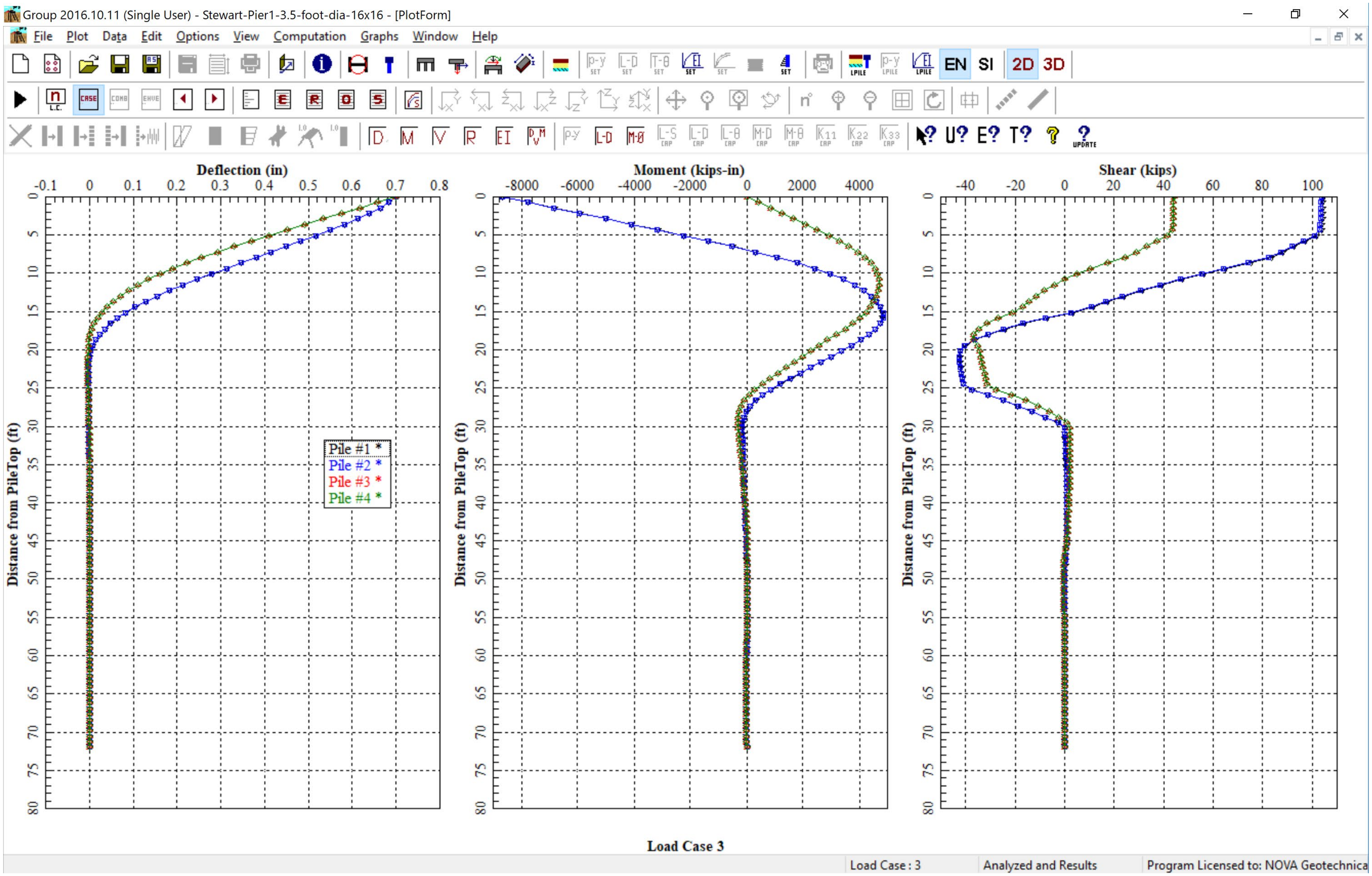


Figure 8. Results of Strength Limit loading on Stewart Pier 1 and 2



Group 2016.10.11 (Single User) - Stewart-Pier1-3.5-foot-dia-16x16 - [PlotForm]

Load Case : 3

Analyzed and Results

Program Licensed to: NOVA Geotechnica

Figure 9. Results of Extreme Limit loading on Stewart Pier 1 and 2

APPENDIX D

SPT HAMMER ENERGY MEASUREMENTS

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Date: 02/15/2020

Project Title: Cascade Las Vegas 2020
P.O. Number: 02/15/2020
CME 85 02-34463 Auto Hammer

Energy Transfer Ratio = 72.6 @ 45.0 blows per minute

Testing was performed on February 15, 2020 in Las Vegas, NV

Hammer Energy Measurements performed in accordance to ASTM D4633 using an approved and calibrated SPT Analyzer from Pile Dynamics, Inc.

PRESENTATION OF SPT ANALYZER TEST DATA

1. Introduction

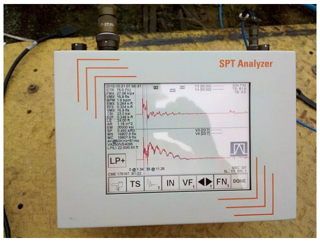
This report presents the results of SPT Hammer Energy Measurements recorded with an SPT Analyzer from Pile Dynamics carried out on February 15, 2020 in Las Vegas, NV

2. Field Equipment and Procedures

The CME 85 had a mounted CME Auto Hammer. The CME Auto Hammer uses a 140 lb. weight dropped 30” on to an anvil above the bore hole. AWJ drill rod connects the anvil to a split spoon type soil sampler inside an 8” o.d. hollow stem auger at the designated sample depth. After a seeding blow the sampler is driven 18”. The number of blows required to penetrate the last 12" is referred to as the “N value”, which is related to soil strength.

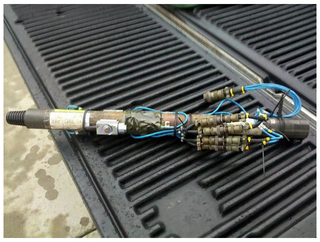
The first recording was taken at 3' below ground surface and then every 3' to final recording at 15'.

3. Instrumentation



An SPT Analyzer from Pile Dynamics was used to record and the process the data. The raw data was stored directly in the SPT Analyzer computer with subsequent analysis in the office with PDA-W and PDIPlot software. The measurements and analysis were conducted in general accordance with ASTM D4945 and ASTM D6066 test standards.

The SPT Analyzer is fully compliant with the minimum digital sampling frequency requirements of ASTM D4633-05 (50 kHz) and EN ISO 22476-3:2005 (100 kHz), as well as with the low pass filter, (cutoff frequency of 5000 Hz instead of 3000 Hz) requirements of ASTM D4633-05. All equipment and analysis also conform to ASTM D6066.



A 2' instrumented section of AWJ rod, with two sets of accelerometers and strain transducers mounted on opposite sides of the drill rod, was placed below the anvil. It measured strain and acceleration of every hammer blow. The SPT Analyzer then calculates the amount of energy transferred to the rod by force and velocity measurements.

4. Observations

The drill rig motor is diesel fueled. The drill and sample equipment looked to be well operated and maintained.

5. Results

Results from the SPT Hammer Energy Measurements are summarized below. It shows the Energy Transfer Ratio (ETR) at each sampling depth. ETR is the ratio of the measured maximum transferred energy to rated energy of the hammer which is the product of the weight of the hammer times the height of the fall. 140 lb x 30” = 4200 lb-in = 0.350 kip-ft.

Energy Transfer Ratio = 72.6 @ 45.0 blows per minute

N60=(ETR/60)N

Depth	**ETR%**	**BPM**
3	71.9	45.1
6	72.2	45.7
9	73.1	44.7
12	72.8	45.2
15	73.2	44.5
Average	72.6	45.0

If you have any questions please do not hesitate to call or email.

Thank you,

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