12-17-2010

Spiral Welded Pipe Piles For Structures In Southeastern Louisiana

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Spiral Welded Pipe Piles For Structures In Southeastern Louisiana

A Thesis

Submitted to the Graduate Faculty of the
University of New Orleans
in partial fulfillment of the
requirements for the degree of

Master of Science
in
Civil Engineering
Geotechnical Engineering

by

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B.S., University of New Orleans, 2004

December 2010

ACKNOWLEDGMENTS

Such a research of this nature would be impossible to complete without the help of others.

I would first like to thank my wife, partner, and best friend. Your sacrifice, unselfishness, support, and encouragement throughout my graduate studies and the undertaking of this research are truly what helped me succeed and are sincerely appreciated.

I would like to thank my thesis committee: Dr. Mysore Nataraj, Dr. Norma Jean Mattei, and Dr. Peter Cali. Your willingness to help and guide me through this research was invaluable.

I would like to give a special thanks to Dr. Richard Varuso. Your assistance and guidance with this research is much appreciated.

I would like to thank the U.S. Army Corps of Engineers Spiral Welded Pipe Pile Innovation Team for allowing my participation in the research of spiral welded pipe piles.

I would like to thank my family and friends for the support.

Finally, I would like to thank God for blessing me with the ability to complete my graduate studies and this research.

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ABSTRACT

In an effort to obtain 100-year level hurricane protection for southeastern Louisiana, the U.S. Army Corps of Engineers (USACE) has implemented design guidelines that both levees and structures shall be designed to. Historically, USACE has used concrete piles or steel H-piles as the foundations for these structures. Because of the magnitude of obtaining 100-year level hurricane protection, limited resources, and a condensed timeline, spiral welded pipe piles can be manufactured as an alternative to either the concrete piles or steel H-piles. This research will provide the necessary background for understanding pile foundations, will compare the behaviors of spiral welded pipe piles to that of other piles with respect to geotechnical concerns through a series of pile load tests, and will offer a current cost analysis. This background, testing, and cost analysis will show that spiral welded pipe piles are a viable alternative for USACE structures from a geotechnical and economic perspective.

Keywords: spiral welded pipe piles, pile capacity, pile load test, USACE Method for pile load test reductions, Suburban Canal Fronting Protection, Elmwood Canal Fronting Protection, West Closure Complex

OBJECTIVE OF RESEARCH

The objective of this research is to explore the option of using spiral welded pipe piles as deep-foundation solutions in hurricane protection projects in southeastern Louisiana. This research will provide a brief background for theoretical axial and lateral capacity for piles driven into different materials. The research will explain spiral welded pipe piles in general and then will focus on the testing of these spiral welded pipe piles in an effort to determine the behaviors of these piles compared to other pile foundations. Finally, a cost analysis will be provided comparing the feasibility of these piles to other pile foundations.

METHODOLOGY ADOPTED

The methodology that will be used to evaluate the behaviors of spiral welded pipe piles is a series of static pile load tests and dynamic tests. Specifically, the U.S. Army Corps of Engineers has set up three pile load test sites around the metropolitan New Orleans area. At each site a spiral welded pipe pile was driven under the same conditions as another type of pile foundation. Axial or lateral loads were applied and removed in cycles. Pile Driving Analyzers were used to perform initial and restrike dynamic analyses. Software was then used to evaluate the testing performed. Manufacturers were contacted regarding steel prices for various piles for input into the cost analysis.

LITERATURE REVIEW

After Hurricanes Katrina and Rita, devastated the Gulf Coast region, personnel representing the federal government, academia, and professional societies from across the nation developed Hurricane and Storm Damage Risk Reduction System (HSDRRS) Design Guidelines for obtaining 100-year level (i.e. a storm that had a 1% chance of being exceeded in any given year) of hurricane protection for southeastern Louisiana. The U.S. Army Corps of Engineers (USACE) has since then focused its efforts on designing and constructing hurricane protection according to these guidelines to achieve this level of protection. This protection will mainly be made of earthen levees, but some of the projects involved in this effort will be structural elements such as inverted T-wall or L-wall structures. This research will focus on the structural elements and how they behave geotechnically. More specifically, it will focus on the piles that provide the foundation support for the T-wall or L-wall.

Designers at USACE in general have several options for piles for these foundations including pre-cast pre-stressed concrete piles, steel H-piles, and steel pipe piles. Concrete piles are relatively cheaper to produce but are usually limited to lengths that will fit on trucks since splicing is an issue. They are also limited in length due to bending stresses and 2-point pick ups. Steel piles are more expensive to produce but any reasonable length can be obtained since splicing isn't usually an issue. However, concerns for corrosion in the vadose zone require coating which can be more expensive and time-consuming.

In a majority of the structural projects that are being designed and constructed, the plans show the foundational piles to be steel H-piles (e.g. HP 14x73, HP 14x89, etc.). Given an H-Pile's geometry, a designer may have to be concerned with asymmetry (i.e. strong axis vs. weak axis),

etc. since issues can arise when driving long H-piles due to this weak axis. It is theorized that a sheet of steel can be spirally-welded to form a pipe pile with similar properties and capacities of the H-pile (e.g. the perimeter of an 18" spiral welded pipe pile would be very similar to that of an HP 14 pile) but would be cheaper to have produced than either a steel H-pile or a longitudinally-welded (i.e. one straight longitudinal weld vs. a spiral weld) pipe pile. The spiral welded pipe pile does bring up concerns, however, especially with regards to the structural capacity and integrity of the weld and the weld's potential to reduce the permanent set-up of the pile from increased disturbance around the pile during driving.

This research will explore the viability of spiral-welded pipe piles in HSDRRS projects. With an increase in the demand for a viable alternative to the foundation types historically used in Corps projects, the Corps assembled a Spiral Welded Pipe Pile Innovation Team. The team consisted of technical experts from across the country. They set up full-scale pile load tests or modified existing ones to be able to test spiral welded pipe piles around the New Orleans Metropolitan area. The testing followed standards set forth by the American Society for Testing and Materials (ASTM) and in Department of Army's Engineering Manuals. At each pile load test site, a spiral-welded pipe pile along with an H-pile and a longitudinally-welded pipe pile were all tested to the same loading as would be normally done for just the H-pile. Also, since the weld itself is thought to be an issue both structurally and geotechnically, one spiral-welded pipe pile had the normal welded beads left on and another had it grinded down smoothly. All piles were tested up to 500% of the expected service load to ensure that all test piles fail and ultimate capacity was determined. The Spiral Welded Pipe Pile Innovation Team focused both on the structural and the geotechnical aspects of the behavior of the spiral welded pipe piles, while the work associated with this research will focus on the geotechnical aspects of the spiral welded pipe piles and briefly discuss the structural aspects.

Software, such as Pile Capacity developed by Danny Haggerty of USACE, Create_Mbe developed by Robert Jolissaint of USACE and CAPWAP, based on industry-accepted theory will be used to analyze the testing of these piles.

This research will also explain how capacities are developed in different types of piles. Theoretical pile capacity curves will be plotted for the above-mentioned piles based on the boring information for a specific site. The three methods that USACE uses to reduce pile load test data will be explained. The three USACE reduction methods will then be used to reduce the data to develop what capacities the piles actually held. The concern of the weld itself and what if any effect it had on capacity will be explained. An economic evaluation of the different piles to determine how much if any of a cost savings will be gained if spiral-welded piles are used for a typical project as theorized will also be included.

CHAPTER 1 PILE FOUNDATIONS

In the world of engineering, pile foundations often play a major role in the overall reliability of many structures. Though often unnoticeable to the general public, there are numerous applications for pile foundations. The most common application for pile foundations is to have them transfer some load through a soil mass that lacks enough capacity to support the load to a deeper soil that can adequately tolerate the load against a sliding, bearing, or uplift type of failure. Another common use for pile foundations is to resist a lateral load such as an earthquake force by mobilizing active and passive earth pressures in the soil surrounding each pile where the magnitude of these pressures are the result of the stiffness of the pile and soil and the fixity of the pile (Das, 2004). From a different perspective, pile foundations can be used to anchor large woody material or other ancillary structures against a bank stability failure (NRCS, 2007). On a similar note, they can be used for soil nailing steep slopes or excavations by intersecting potential failure surfaces. They can be used for port and harbor structures such as seawalls, dolphins, breakwaters, or jetties. One particular application for pile foundations used in other parts of the world is to allow the pile foundations to reduce the heaving of particular soils in the vicinity of the pile in freeze-prone environments (Shulyat'ev, 1991).

Depending on the site-specific conditions of the soil and the design of a particular structure, the design engineer can make use of what is referred to as shallow or deep foundations to support the structure. Though there is no hard-fast rule defining when to use a shallow versus a deep foundation solution, there are general rules of thumb that geotechnical professionals have come to adopt. Shallow foundations can be used primarily for smaller structures on soils capable of bearing the magnitude of the relatively lighter loads (French, 1999). When the upper foundation soils do not possess the capacity to bear the structure and/or the magnitudes of the loads are relatively large or concentrated, French, as well as geotechnical professionals around the world, agree that deep foundations can and should be used.

Shallow foundations are basically limited to spread footings, strip footings and mat foundations (French, 1999). A process that can also be classified under shallow foundations and is gaining acceptance is referred to as Deep Soil Mixing. This process strengthens the upper soil by mixing a cementous slurry with the in-situ soil. By doing so, it allows the upper soil to have greater capacity to resist relatively lighter loads as other types of shallow foundations do. With shallow foundations, it is not only important to design with respect to bearing, but it is imperative that the engineer consider overturning, sliding, and settlement of the shallow foundations as well.

Deep foundations may consist of piles mainly made of timber, concrete, or steel or in some instances a combination thereof. These piles can be further varied by the designated cross section that a designer proposes. More specifically, timber piles are usually circular but tapered in nature due to the growth patterns of forestry products. Concrete piles are usually pre-cast and prestressed or cast-in-place and can be circular or rectangular in nature. Steel piles can be W-type, I-type, H-type, circular, rectangular, or tapered in nature or a combination thereof. The performance and design of piles with an expanded bell-shaped base subjected to earthquake-like horizontal forces in open water environments has been studied by Maeno, et. al. (Maeno, et. al., 1999).

1.1 Timber Piles

Each type of deep foundation pile mentioned above has advantages and disadvantages associated with it. To begin with, timber piles differ from concrete or steel piles in that they are naturally-made instead of man-made. The majority of timber piles are relatively short. Because of the natural characteristics of timber, the density or unit weight of timber piles is variable and highly dependent on the species, specific gravity and water content of the timber itself. Timber unit weight can range from approximately 20 lbs/ft^3 to 80 lbs/ft^3 and possibly up to 100 lbs/ft^3 (Simpson, 1993). This range of unit weights for timber is substantially less than that of concrete or steel, and thus timber piles generally weigh less than concrete or steel ones. Furthermore, since timber piles are shorter and lighter, they are usually easier to transport and less expensive compared to concrete or steel piles. Timber piles can be used in environments prone to corrosion, but they are highly susceptible to decay and rot (Department of the Army, 1991). Given the nature of timber and its normal tapered cross-section, splicing timber piles to obtain long depths is difficult if not almost impossible. Also, timber piles are usually limited to less than 100 kips of capacity.

1.2 Concrete Piles

Concrete piles are both similar and different to timber piles and to steel piles. Concrete and timber piles are considered "displacement" piles, meaning as they are driven, they actually displace the in-situ soil. Concrete piles can be relatively long, but are usually limited in length by what can actually fit onto trucks safely according Department of Transportation and other highway regulations. Splicing this type of pile is often an issue. Concrete piles may also be limited in length by bending stresses and two-point pick ups. These piles are usually more expensive to produce compared to timber piles but may be less expensive than steel piles. Concrete piles usually correspond to a symmetric cross-section which simplifies an engineer's calculations. Concrete piles can usually withstand hard driving situations, but calculations are often required such as performing a wave analysis to ensure the driving stresses do not damage the concrete piles. Concrete piles are not prone to decay like timber piles or corrosion like steel ones (unless reinforcing steel is exposed), but they do not fare well in salt water environments. Concrete piles can also obtain capacities between 200-500 kips (Department of the Army, 1991).

1.3 Steel Piles

Steel piles, on the other hand, are again both similar and different to both timber and concrete piles. Most steel piles are not considered displacement piles like timber or concrete piles since steel piles slide past soil particles as they are being driven instead of displacing them. Steel piles can be made into any reasonable lengths since splicing is usually not an issue. Steel piles are often more expensive to produce than either timber or concrete ones. Steel piles, like concrete piles, can withstand hard driving situations but unlike concrete piles are not subject to a wave analysis because hardened steel can tolerate much higher axial stresses than concrete. Steel piles are not prone to decay but are very corrosive in nature especially in the vadose zone. Steel piles can obtain capacities between 400 and greater than 1000 kips (Department of the Army, 1991). Steel piles are not limited in cross-section like timber or concrete piles but can rolled to form H-

piles, square piles, circular pipe piles, or even tapered piles, of which several of these will be the focus of the majority of the rest of this research.

As mentioned above, there also exists a combination of the deep foundation types of piles such as concrete-filled steel piles that are at an engineer's disposal. Nevertheless, the selection of the type of pile to use for the pile foundation is based on subsurface conditions and experience while the preliminary size of the selected pile type is usually based on theoretical pile capacity calculations (Bell, et. al, 2002).

1.4 Foundations for HSDRRS Projects

In southeastern Louisiana, one of the U.S. Army Corps of Engineers' (USACE) primary missions is to provide hurricane protection to the residents of coastal communities. Though there are hundreds of miles of earthen levees in this hurricane protection system, there are also miles of structures that are part of the protection too. After Hurricane Katrina devastated the Gulf coast in 2005, the New Orleans District (MVN) of USACE mandated that levees as well as structures serving as hurricane protection be designed according to the Hurricane and Storm Damage Risk Reduction System (HSDRRS). These design guidelines were developed by personnel representing the federal government, academia, and professional societies. In these guidelines, there is a design shift away from sheet pile walls to L-shaped or the more preferred inverted-T-shaped pile-supported structures. Though T-Walls are usually more expensive to construct compared to L-walls, T-walls are usually more robust in that they are capable of not only tolerating very large loads, both in tension and compression, but also tolerating unbalanced loads from a deep-seated stability perspective. These types of structures are used where rights of way are limited or on the flood side of such things as pump stations to act as fronting protection against potential barge impacts or storm surges.

Because southeastern Louisiana is in the deltaic plains of the Mississippi River that flooded its banks regularly throughout history, the foundations in southeastern Louisiana for the structures mentioned above are highly-stratified and often weak in nature. Therefore, for the structural components of the HSDRRS, the deep foundations pile types mentioned above are required rather than shallow foundation solutions. Deep foundation piles and how they relate to the hurricane protection structures will now be thoroughly explored.

1.5 Use of Spiral Welded Pipe Piles

When the HSDRRS Design Guidelines were developed and implemented after Hurricane Katrina, the federal government also mandated that HSDRRS Design Guidelines be applied to the design and construction of hurricane protection from a storm event meeting the 1% chance of being exceeded, also known as the 100-year storm event, for the entire southeastern Louisiana area including the shores of Lake Pontchartrain and the parishes along the coastline and near the mouth of the Mississippi River. Furthermore, the federal government self-imposed a deadline of having this type of protection designed and constructed by June 1, 2011, the official start of the 2011 hurricane season. Because of the magnitude and complexity of completing this unprecedented task with numerous components under construction simultaneously, resources

would certainly become an issue. Furthermore, engineers at the USACE-MVN typically call for square concrete piles or steel H-piles to be used in the foundations which mean these types of resources will become even more of a concern in meeting the construction deadline. With the major differences for the different types of piles, the fast-approaching construction deadline, and this concern for particular resources in mind, an investigation of a different type of pile foundation for use in these particular types of structures was justified. One viable alternative was the spiral welded pipe pile. Unlike the steel H-piles that are rolled into shape or concrete piles that are poured, spiral welded piles are constructed just as their names imply by having a thin sheet of steel spirally bent to a certain diameter and welded along the spiral. This is not to be confused with a steel pipe pile constructed with one continuous, straight longitudinal weld (Figure 1-1).

Historically, USACE engineers along with the industry in general did not use spiral welded piles for foundations in hurricane protection structures for fear that the following two results might occur: 1) the weld would unravel structurally once loaded due to the dynamic stresses associated with loading and handling the pile and 2) the weld would adversely affect the soil-structure interaction geotechnically (USACE-MVN[2], 2010). The first result was feared to occur since there was not a method developed in the industry that could ensure the weld was fully-penetrating to the inner diameter of the spiral welded pipe pile as the sheet of steel was spirally bent and welded. Thus, the failure would occur at the weld instead of in the gross section of the steel sheet. The second result was feared to occur since as the sheet of steel was spirally bent and welded, the weld itself would protrude 1/8 inch greater than the desired outer perimeter of the pile and 1/8 inch from the inner perimeter of the pile, potentially affecting skin friction along the exterior and interior of the pile and soil plugging on the interior of the pile. Furthermore, because the sheet of steel was spirally-bent, this weld would also follow a spiral path for the length of the pipe, unlike a normal pipe pile that has a single, longitudinal weld. In cross-section, this would mean that the soil could possibly not set up, or adhere to the pile correctly around the entire perimeter of both the exterior and interior of a spiral welded pipe pile versus only at the weld if at all for a longitudinally-welded pipe pile, and adequate skin friction would not develop. This can be seen in Figure 1-1.

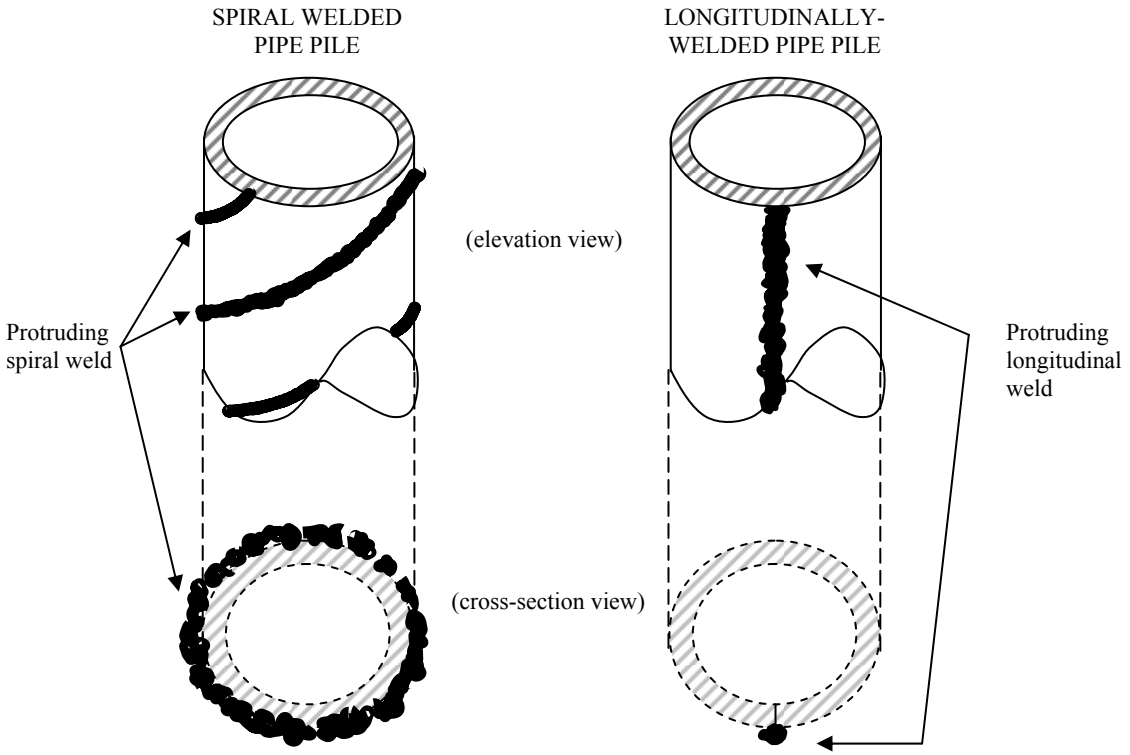

Figure 1.1. Elevation view and cross-section view of spiral welded pipe pile and longitudinally-welded pipe pile

Historically, these concerns prevailed and spiral welded pipe piles were not considered in such projects. However, the benefits to using the spiral welded piles include not having strong-vs.-weak-axis-bending issues as is the case with H-piles. To investigate the issues, USACE formulated a Spiral Welded Pipe Pile Innovation Team made up of technical experts from across the country (USACE-MVN[2], 2010). This team theorizes that a spiral welded pipe pile can be formed to have similar properties and capacities to that of an H-pile but may be significantly cheaper to produce. The objective of this research will be to investigate this non-traditional use of spiral welded pipe piles in HSDRRS structures. They will be compared to H-piles and longitudinally-welded pipe piles through different testing set up by the Innovation Team. The issues of the continuous weld along the spiral will be explored and an economic analysis will be included. First, however, the spiral welded pipe pile itself will be explained.

1.6 The Spiral Welded Pipe Pile

1.6.1 Geometry

As briefly mentioned above, the spiral welded pipe pile is simply a sheet of steel that is bent in a spiral fashion to form a longitudinal, hollow pipe pile. Because it is a sheet of steel, the sheet can be manufactured to any exact thickness within reason but usually is in the range of 5/16" to 1" thick (USACE-MVN[2], 2010). The diameter, usually measured by the outer diameter, of the spiral welded pipe pile can vary significantly, but for foundations of hurricane protection projects, they are usually manufactured to have an outer diameter of approximately 18" or 24."

However, it is worth mentioning that the Innovation Team recommended the ratio of the outer diameter of the pipe pile to the thickness of the spiral welded sheet not exceed a value of 55, unless special conditions are met, to avoid local buckling with respect to axial compression and bending (USACE-MVN[2], 2010). The width of the "sheet," also referred to as the "strip," can vary, but typically manufacturers manufacture the strips of flat steel to be approximately 18" wide. Obviously, the thinner the strips, the more spiral welded strips are needed to create a pile of a certain length. The length of the pipe pile depends on the job and the contractor's ability to transport and handle the pipe pile without deforming its roundness, but lengths of approximately 100 feet or so are very common in the industry. In fact, state-of-the-art practices make splicing spiral welded pipe piles quite convenient. The weld itself usually protrudes 1/8" from the surface of the bent steel sheet. A spiral welded pipe pile can be made from a variety of grades of steel such as Grades A252 and A139.

1.6.2 Manufacturing

Current state-of-the-art practices allow manufacturers to manufacture spiral welded pipe piles for large stress levels as is encountered in the foundations of HSDRRS structural components. The state-of-the-art practice normally involves a "submerged arc welding" process (Foster, 2010). For this process, the manufacturer hot-rolls a sufficiently-sized strip of steel from a large coil through a de-coiling device to some type of straightening rollers. This ensures the width and required thickness of the steel sheet or strip that eventually will be spirally bent to form the pipe pile. Once the material passes through the straightening rollers, the strip then passes through shearing, trimming, and pre-bending tools before it is forced into the bending machine. A trained technician skillfully controls the required diameter of the spiral welded pipe pile by adjusting the angle that the flat steel sheet or strip enters the bending machine. As the strip is bent, the submerged arc welding machine welds two strips together continuously in a spiral fashion. It is referred to as "submerged arc welding" because the welding arc is submerged in flux during the welding process. This submerged arc weld is applied to both the interior and exterior of the spiraled pipe (Foster, 2010). Since the weld protrudes 1/8 inch from the outer diameter and the inner diameter of the spiral welded pipe pile, it follows the spiral path along the pile, and it is a focus of this research, a special manufacturing technique can be used to grind the welds flush with the outer and inner diameters of the pile, either as the submerged arc welding takes place or more commonly afterwards. Once the welds are complete, they are ultrasonically tested to ensure strict compliance with standard guidelines. The spiral welded pipe pile is symmetrical, has no weak axis with respect to bending, and is very straight, all due to the method of manufacturing. The production of large hot-rolled coils of sufficient width and the use of the submerged arc weld permitted the manufacturing process for spiral welded pipe piles to become extremely efficient (USACE-MNV[2], 14).

CHAPTER 2 PILE CAPACITIES

2.1 Axial Capacity

Prior to discussing the actual pile load tests performed and the results and conclusions from those tests, a brief review of pile capacity in general is provided. In general, as mentioned earlier, a pile in soil is effective as a deep-foundation solution because it most often transfers some axially-applied load to usually deeper soils and reduces settlement. This transfer of the load is a phenomenon that takes place due to the interaction of the soil and pile and the soil near the base of the pile. In other words, the ultimate axial capacity, Q_u, that a pile can have is the summation of the skin friction developed between the sides of the pile and the soil, Q_s, and the bearing capacity of the soil at the tip of the pile, Q_p (Das, 2004) such that

$$Q_u = Q_p + Q_s \quad \text{(Eq. 2.1)}$$

This is shown in Figure 2.1 for a pile driven into a soil a distance, L, from the surface and summing axial forces.

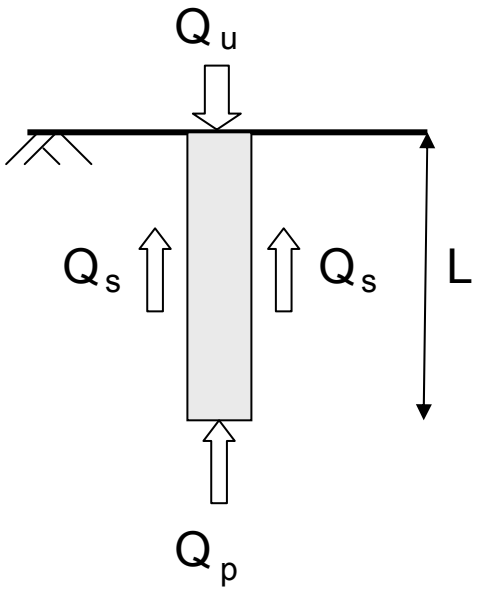

Figure 2.1 Schematic showing a typical pile driven into soil and the forces involved in determining pile capacity.

Once the pile is driven and sets up and the load that the pile must resist is increased, the load-carrying capacities along the shaft and at the tip are mobilized. The part of the load carried by the shaft varies along the length of the pile such that it is maximum near the ground surface and curvilinearly decreases down to the part of the load carried by the pile tip. Lymon Reese and his colleagues capture this generally-accepted explanation in Figure 2.2 (Reese et. al, 2006).

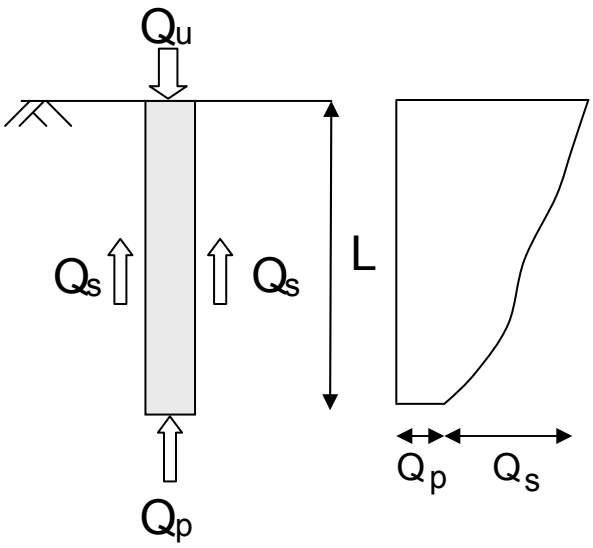

Figure 2.2 Schematic showing a typical pile driven into soil, the forces involved in determining pile capacity, and the variation of the skin friction capacity with depth.

The unit frictional resistance along the shaft, f, on the other hand, is a ratio of the unit load-carrying capacity along the shaft, ΔQ_s, to the product of the perimeter of the pile, p, and the unit length along the shaft, ΔL, such that

$$f = \frac{\Delta Q_s}{p \times \Delta L} \quad \text{.....(Eq. 2.2)}$$

This unit friction along the shaft varies such that it is zero near the ground surface, increases curvilinearly to some maximum value near 65% of the depth of the pile from the ground surface then curvilinearly decreases to some value greater than zero at the tip of the pile as shown in Figure 2.3.

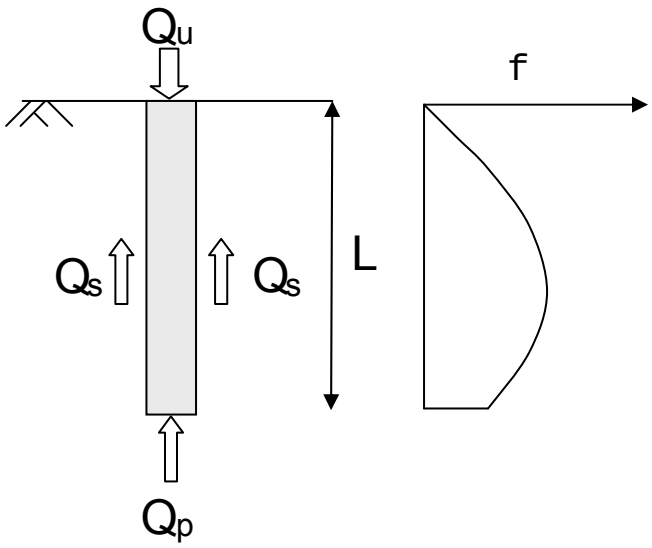

Figure 2.3 Schematic showing a typical pile driven into soil, the forces involved in determining pile capacity, and the variation of the unit friction resistance with depth.

The phenomenon of the axially-applied load being transferred to the soil and hence the load-carrying capacity of the pile is highly dependent on the method of installation (Reese et. al, 2006). Though piles can be installed via boring and vibrating, the piles that this research will focus on were installed via the common technique of driving. Other aspects that could affect the load-transfer process are the material the piles are being driven into and the types of piles themselves. Next, the types of soils and the manner in which axial pile capacities are developed in each will be explained. Afterwards, the actual piles used at each pile load test site and their theoretical capacities will be discussed.

2.1.1 Piles in Clays

Because of the deltaic nature of the Mississippi River over time in southeastern Louisiana, the majority of the soils found are highly-stratified and composed of clays, sands, and silts that are relatively weak, especially the upper soils, when compared to soils across the nation. Nevertheless, with the above general description of axial pile capacity in mind, the axial capacity in each of these soils is derived differently. To begin with, clay is a material that has cohesion among the particles that make it up. Clay particles are considered fine-grained (Coduto, 1999) and have relatively low permeabilities since the particles are closely spaced. Because of its cohesive nature, the skin friction part of the equation is based on the unit skin friction resistance, f, described above and the side surface area of pile. Though there are numerous methods to determine each of these parts, only the method that will be used to determine actual axial capacities will be discussed. The unit skin friction resistance, f, developed between the pile and the clay is a function of the undrained shear strength of the normally-consolidated clay, c, and the effective overburden on the stratum of clay, σ'_o, in question. This method is referred to as the Revised API Method (1987) (Reese, 2006) and the equation is

$$\alpha = 0.5\Psi^{-0.5} \quad \text{if} \quad \Psi \le 1.0 \text{ ……..……(Eq. 2.3)}$$
$$\alpha = 0.5\Psi^{-0.25} \quad \text{if} \quad \Psi > 1.0 \text{ ……..……...(Eq. 2.4)}$$

where

$$\Psi = \frac{c}{\sigma_o'} \text{ ……..……..(Eq. 2.5)}$$

Once the alpha coefficient is determined, it is combined with the cohesion value to produce the unit skin friction resistance value (Reese, 2006) such that

$$f = \alpha c \text{ ……(Eq. 2.6)}$$

This is then combined with the side surface area of the pile, A_s, which is simply the product of the perimeter of the pile, p, and the length of clay along the pile, L, to obtain the load-carrying capacity along the pile shaft such that

$$Q_s = fA_s = \alpha cpL \text{ ……(Eq. 2.7)}$$

If there are varying clay strata present that the pile in question is driven into, Equation 2.7 can be modified (Das, 2004) such that

$$Q_s = \int_0^L p\alpha c \Delta L \text{ ……..……..(Eq. 2.8)}$$

For cohesive materials, the bearing part of the axial-load-carrying capacity, Q_p, is based on the cohesion of the soil that a pile would be tipped in and the end area of the pile. The API Method simply states the unit end-bearing resistance, q, to be 9 times the undrained shear strength (Das, 2004) or

$$q = 9c \text{ ……..……..(Eq. 2.9)}$$

It is worth noting that for this method, the undrained shear strength is taken as the average over a distance of two pile diameters below the tip of the pile. Once the unit end-bearing is determined, one can determine the end-bearing for a particular pile if the cross-sectional area of the tip of the pile, A_p, is known such that

$$Q_p = qA_p \text{ ……..……...(Eq. 2.10)}$$

Depending on the type of pile in question, this cross-sectional area may require some engineering judgment to calculate. For most prestressed precast concrete piles and timber piles, the piles themselves are solid. Therefore, they are considered displacement piles since, as they are driven, they actually displace the soil in their path. For these the cross-sectional area is taken as the true pile tip. However, for H-piles or pipe piles, there are parts of the cross-section that are hollow as can be seen in Figure 2.4.

Figure 2.4 Typical H-pile and pipe pile that both have hollow segments in their cross-sections.

Consequently, instead of displacing the soil as they are driven, these piles interact with the soil. Especially given the nature of the soils in southeastern Louisiana, there is a good possibility the hollow parts of the tips of these types of piles will be filled with what is referred to as a soil plug unless the contractor elects to weld a plate at the pile tip across the hollow section creating a displacement-like effect. Nonetheless, for the open-ended steel piles, the soil plug complicates the end-bearing calculation because the cross-section at the tip is now composed of steel and some form of a soil plug. This soil plug is often conservatively assumed to have remolded strength since it is disturbed. This is left to engineering judgment.

Nevertheless, once the soil plug does develop and the engineer decides to include this in the calculations, the engineer has to compute the end-bearing by taking the product of the unit friction developed along the hollow part by the remolded clay and the surface area of the hollow part in contact with the soil plug and adding this to the end-bearing of the material area only. This load is compared to the end-bearing from the full area of the base neglecting the friction along the hollow part, and the engineer shall use the lesser of the two compared values (Reese, et. al, 2006). Theoretically, the length it takes these two calculations to be equal is the length from the tip of the pile that the plug should develop. However, it is worth mentioning that the engineering judgment mentioned above would definitely come in to play in deciding how far up the hollow part of the pile the soil plug actually develops compared to the theory because this would affect the unit friction and the surface area of the hollow part calculations. For instance, the standard operating procedures for the U.S. Army Corps of Engineers with respect to steel H-piles is for the engineer to assume the soil plug forms on both sides of the web and the soil inside the web is disturbed, meaning no skin friction is assumed to develop between the soil and the web. Furthermore, for unit skin friction calculations, the USACE engineer assumes half of the cross-section to be represented by steel-to-soil contact and the other half to be represented by soil-to-soil contact as shown in Figure 2.5.

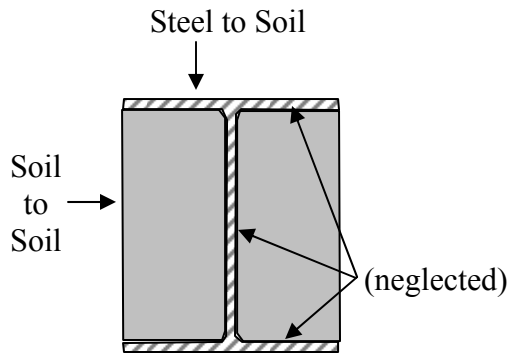

Figure 2.5 Cross-section of a typical H-pile and schematic showing conservative method for determining unit skin friction for typical H-pile.

It is worth mentioning that in theory the weight of the soil plug itself can affect the ultimate load-carrying capacity of the steel pile. As the open-ended steel pile mechanically becomes a displacement pile when the soil plug no longer moves up the shaft, the weight of the soil plug becomes added weight applied to the foundation soils. To account for this additional weight, the pile capacity (i.e. in tons) should be reduced by the weight of the soil plug (i.e. also in tons).

2.1.2 Piles in Sands

With the major two parts of the axial load-carrying capacity defined for piles in cohesive material such as clay, it is fitting to compare this to that for piles in cohesionless material such as sands. The two parts are similar but the manner in which each is obtained is different for sands. To start with the frictional resistance can again be generally stated as

$$Q_s = \sum fA_s = \sum fpL \quad \text{.....(Eq. 2.11)}$$

The perimeter, p, and the unit length, L, of a particular stratum of sand along the shaft of the driven pile is fairly straight-forward and is explained above. The unit friction, f, is more complex. Unlike cohesive soils, as a pile is driven into sands and the vibrations from the driving hammer travel down the pile, researchers have field-verified that the soil immediately adjacent to the pile gets densified. This means that the effective internal angle of friction of the sand, φ', increases by approximately 6-15% (Das, 2004). In general, the unit friction, f, starts from zero at the intersection of the ground surface and the driven pile, increases with depth slightly curvilinearly to a critical depth 10-20 pile diameters from the ground surface depending on the relative density of the soil, then remains constant to the tip of the pile (Reese, 2006). This can be seen pictorially in Figure 2.6.

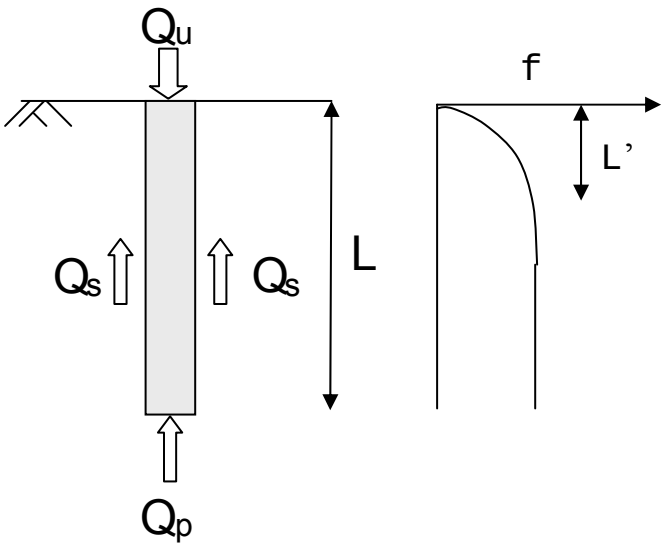

Figure 2.6 Schematic showing a typical pile driven into sand, the forces involved in determining pile capacity, and the variation of the unit friction with depth.

The unit friction, f, is not only a function of the angle of friction between the cohesionless soil and the pile, δ, but also the effective overburden pressure at a particular stratum, σ_o', and the lateral earth pressure coefficient, k, (Das, 2004) such that

$$f = k\sigma_o' \tan\delta \quad \text{.....(Eq. 2.12)}$$

It is worth mentioning that the vertical effective stress will vary down to the critical depth and then will remain constant helping to produce the general variation shown in Figure 2.6. The values of the lateral earth pressure coefficient using the U.S. Army Corps of Engineers Method can be taken as 1.00-2.00 if the pile is in compression, k_c, and 0.50-0.70 if the pile is in tension, k_t (Reese, 2006). Also, the values of the adhesion between the cohesionless soil and the pile depend on the soil's own internal angle of friction and the material of the pile driven (Department of the Army, 1991) as stated in Table 2.1

Table 2.1 Adhesion values between cohesionless soils and piles

Pile Type	Δ
Steel	0.67φ to 0.83φ
Concrete	0.90φ to 1.00φ
Timber	0.80φ to 1.00φ

The values for δ in Table 2.1 apply to piles that are driven rather than vibrated or jetted.

The second part of the load-carrying capacity of a pile driven into cohesionless soil such as sand is the end-bearing. Similar to that of a cohesive material, the end-bearing is again based on the

unit end-bearing resistance, q, of the cohesionless soil at the tip of the pile which is further a function of the angle of internal friction of the soil, φ, at the tip of the pile and a bearing capacity factor, N_q, that can be simply read from a chart similar to Figure 2.7 (Reese, 2006).

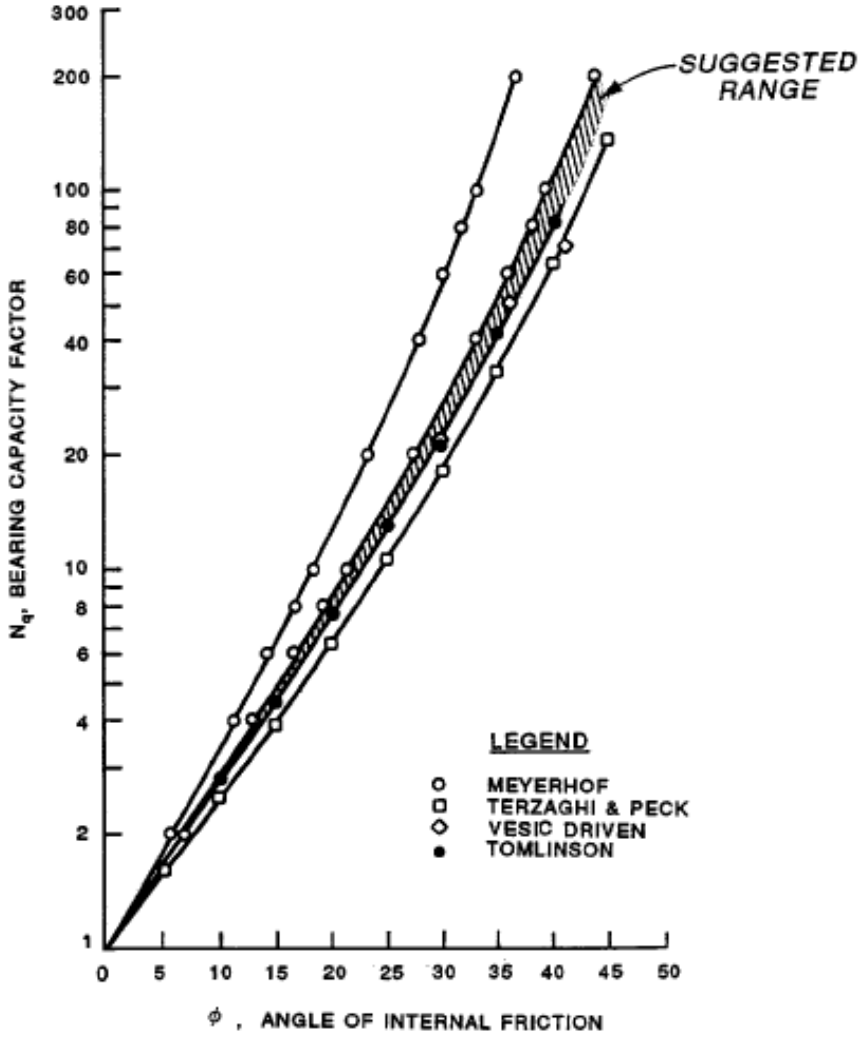

Figure 2.7 Angle of internal friction vs. bearing capacity factor for cohesionless soils

Once the soil's angle of internal friction is known and the bearing capacity factor is read from Figure 2.7, this factor is multiplied by the effective overburden at the pile's tip to give the unit bearing capacity (Department of the Army, 1991) and this unit bearing capacity is then multiplied by the area of the pile tip to give the end-bearing load-carrying capacity of that particular pile driven in that particular cohesionless soil such that

$$Q_p = qA_p = \sigma_o^{'} N_q A_p \quad \text{.....(Eq. 2.13)}$$

With respect to the end area of a pile, a pile driven into a cohesionless soil is similar to a pile driven into a cohesive soil. The pile is not a true displacement pile. Once the engineer conservatively determines the end area and Equation 2.13 is calculated, the total capacity of the pile driven into that cohesionless soil can be determined by combining Equations 2.11 and 2.13 such that

$$Q_u = Q_s + Q_p = (\sum fA_s) + (qA_p) = (\sum fpL) + (\sigma_o^{'} N_q A_p) = [\sum (k\sigma_o^{'} \tan\delta)\, pL] + (\sigma_o^{'} N_q A_p) \text{ …...}$$

……(Eq. 2.14)

2.1.3 Piles in Silts

Because southeastern Louisiana is alluvial, there is a good chance that a particular area in southeastern Louisiana will have some silt present. Therefore, the method for determining the axial load-carrying capacity of a pile driven into a silt material will be described. Silt material is unique in that it is similar to both cohesive and cohesionless soils. Silt has cohesion but individual particles are larger than clay particles causing larger void spaces and less contact area between particles (Spector, 2001). Because of the voids and the orientation of these particles, silt will usually have less cohesion than clay. On the other hand, silt also has an internal angle of friction. Though silt particles are usually larger than clay particles, they are usually smaller and usually have smaller void spaces than sand-type particles. This results in silt having a smaller internal angle of friction than that of the sand. Therefore, since silt material has both cohesion and internal friction, if a pile is driven into this type of material, accepted practice is for the engineer to use both sets of equations described above for both friction along the shaft and end-bearing. Thus, the load-carrying capacity along the shaft in silt can be determined using the following equation (Department of the Army, 1991)

$$Q_s = pL(k\gamma^{'} D \tan\delta + \alpha c) \text{ ……..……(Eq. 2.15)}$$

where again k is the lateral earth pressure coefficient and γ'D is the product of the effective unit weight and the depth from the ground surface collectively referred to as the vertical effective stress as explained in Equation2.12. The axial load-carrying capacity near the tip of the pile bearing on the silt can be determined using the following equation (Department of the Army, 1991)

$$Q_p = A_p \sigma_o^{'} N_q \text{ ……..……..(Eq. 2.16)}$$

The engineer should be aware that the effective overburden pressure in Equation 2.16 is based on a critical depth similar to that determined for a cohesionless (sand) material. Also, the end-bearing equation for a pile whose cross-section has hollow components and is driven into a silt is similar to that driven into a pure cohesive or pure cohesionless soil.

2.1.4 Piles in Stratified Soils

The above discussion is theoretical and quite practical for piles driven in homogenous clay, sand, or silt individually. However, as also stated several times above, the soil native to southeastern Louisiana is highly stratified, which means it is very common to find clay, sand, silt, and other minor classifications of soil in layers on top of one another varying in thicknesses. Determining the axial load-carrying capacity of a pile in this scenario is not any more complicated than of a pile driven into one of the homogenous materials, but it is a little more time-consuming because the engineer has to perform the appropriate set of calculations at each strata. Also the end-bearing capacity is determined from whatever strata the pile is tipped into.

The U.S. Army Corps of Engineers expands on these general concepts and applies conservatism to the determination of the axial load-carrying capacity via the following guidelines. End-bearing can be counted if the tip is in cohesive material if the cohesion is greater than 1000 psf. Effective overburden for a particular stratum is usually limited to 3500 psf. Finally, end-bearing can only be counted on if the pile is 8 pile diameters or five feet up from the bottom of that strata to avoid what is referred to as "punch through," especially if the soil beneath the bearing strata is weaker in nature than the bearing strata. Computers make applying these guidelines and theory to a unit length along the pile shaft easy. The software Pile Capacity allows the user to input a particular pile's properties and the foundation material the pile will be driven into. Based on the theories explained throughout Section 2.1 above and the specified pile and foundation material types, the software incrementally calculates the pile's theoretical ultimate capacity and a pile curve is developed.

It is clear that the perimeter of the pile is a major part of the unit skin friction determination regardless if the soil is cohesive, cohesionless, or both. H-piles (i.e. HP 14x73) were historically the primary choice for the deep foundation for T-Walls, and an H-pile cross-section is typically analyzed with a steel-to-soil component and a soil-to-soil component as shown in Figure 2.5. An HP 14x73 has a flange width of 14.585 in. and a depth of 13.61 in. With the soil plugs considered, the perimeter of the cross-section of an HP 14x73 can then be conservatively taken to be 56.39 in. USACE's Spiral Welded Pipe Pile Innovation Team calculated that a spiral welded pipe pile with an outer diameter of 18 in. will result in a perimeter of 56.5 in., which is very close to that of the HP 14x73. Likewise, Table 2.2 provides perimeter information for types of piles associated with this research.

Table 2.2 Perimeters for typical piles

PILE TYPE	DIMENSIONAL NOTES	PERIMETER, in.
HP 14x73	d=13.6 in., b=14.6 in.	56.4
HP 14x89	d=13.8 in., b=14.7 in.	57
18 in. o.d. pipe	b=18 in.	56.5
20 in. o.d. pipe	b=20 in.	62.8
24 in. o.d. pipe	b=24 in.	75.4
30 in. o.d. pipe	b=30 in.	94.2

Hence, if the perimeters are the same, both are made of steel, and both are driven into the same foundation material, load-carrying capacities of the two should be the same. This theory and its results will be discussed later in the research. It is worth mentioning that the Spiral Welded Pipe Pile Innovation team tested other diameter spiral welded pipe piles in addition to the 18 in. o.d. under the same principles. The Innovation team also determined that the ratio of the outer diameter of a spiral welded pipe pile to the thickness of the walls of that spiral welded pipe pile should be less than or equal to a non-dimensional value of 55 (USACE-MVN[2], 2010).

2.2 Lateral Capacity

Deep foundations are not only useful for transferring axial loads from a weaker stratum and reducing settlement, but they are also useful in resisting horizontal or lateral loads, such as earthquake forces or horizontal wave loads. From a structural engineering perspective, this type of load in essence creates a bending force in the pile that can be related to bending in a beam. In some instances, the axially-applied load discussed above can affect the lateral considerations such that the pile has to be treated as a beam-column, but this is only in special instances. The pile's ability to safely resist this bending, or in other words the pile's lateral capacity, is a function of the stiffness of the pile and the soil, the fixity of the ends of the pile, and the interaction between the pile and the soil. Because of the variability of these factors with depth, a complex differential calculation has to be made to obtain the theoretical lateral capacity of the pile.

The overall governing form of the differential equation including effects from an axial load can be stated as follows (Reese, et. al, 2006):

$$E_p I_p \frac{d^4 y}{dx^4} + P_x \frac{d^2 y}{dx^2} + E_{py} y = 0 \quad \text{.....(Eq. 2.17)}$$

where E_p and I_p are the elastic modulus and moment of inertia of the pile, respectively, or combined is the lateral stiffness of the pile, x is the distance along the pile, y is the lateral deflection of the pile, P_x is the axial load if applicable, and E_{py} is the lateral stiffness of the soil. The lateral stiffness of the pile will be discussed first. The governing differential equation stated in Equation 2.17 can be managed by first making simplifying assumptions. Reese, et. al. offer the following key assumptions to be implored when addressing lateral loads on piles and Equation 2.17 (Reese, et. al, 2006):

a) the pile has a uniform, homogenous, isotropic cross-section
b) the pile's modulus of elasticity is the same in both compression and tension
c) dynamic loading of the pile is not considered
d) axial loads do not affect the pile
e) shear and moment equal zero at the pile tip

With these assumptions in place, the engineer then has to determine boundary conditions for the top of the pile in order to solve the differential equation. The top of the pile is normally considered free, fixed, or partially-restrained, and each case correlates to a specific set of boundary conditions. It is worth noting that the bending stiffness of a particular pile will be

reduced, especially for concrete piles, as bending moment along the pile's shaft increases (Reese, et. al., 2006).

With that above assumptions and published equations, an engineer would be able to correlate a deflection of the top of the pile to the anticipated lateral load. He or she would also be able to calculate slope, moment, and shear along the length of the pile.

Professional geotechnical engineers have acknowledged and it is now standard accepted practice that in order for an engineer to get a complete feel for the behavior of a pile under lateral loading, the reaction of the soil adjacent to the pile with respect to the laterally-applied load needs to be calculated as well. The engineer can accomplish this by producing a family of "p-y" (or soil response-pile deflection) curves at different depths along the pile for varying loads. A typical p-y curve can be broken into several portions. The beginning portion of the curve is linear and nearly vertical and is sometimes considered to resemble the stress-strain relationship of the soil in question. The end portion of the curve is also linear but is nearly horizontal and can be taken to resemble the ultimate bearing capacity of the soil in question. This near horizontal portion indicates that as strain increases, the shear strength remains constant, or in other words, as the pile deflection increases, the soil response remains constant. The middle portion is curved and connects the beginning portion to the end portion in a calculated fashion. For the middle portion of the curve, the engineer again uses published equations to determine the deflection corresponding to half of the ultimate soil resistance, the deflections corresponding to the ends of the middle portion of the curve, and then deflections corresponding to different soil resistances that would complete the middle portion of the curve. The shape of this middle portion signifies that the soil response increases at a decreasing rate as the deflection of the pile increases. The shape of the p-y curve overall can indicate to the engineer if the soil will remain in its elastic state or be deformed due to the applied loading. Typical p-y curves can be seen in Figure 2.8.

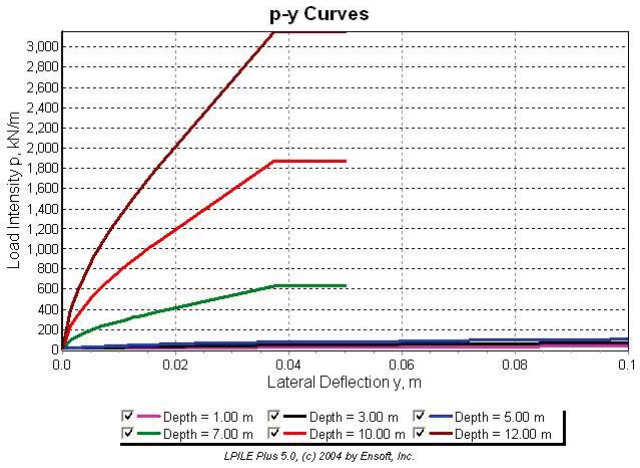

Figure 2.8 Typical p-y curves at different depths along a pile's shaft

It is worth mentioning that if the lateral loads anticipated are considered "sustained" in nature and the soil adjacent to the pile is clay of soft to medium consistency, which again is very typical for the southeastern Louisiana region, the lateral load will actually increase the pore water pressure in the soil adjacent to the pile. As this pore water pressure is released, consolidation of

that soil will actually occur, even though consolidation is usually thought to occur in the vertical direction, and the deflection of the pile will increase (Reese, et. al., 2006). Also, if the loads are cyclical, the p-y curves will not be affected for small deflections, but for larger deflections, the soil will actually lose resistance.

It is also worth mentioning that modifications to the p-y curve should be made if the ground is sloping instead of horizontal, if the pile is battered instead of vertical, if the pile is founded in rock, if free water is present, and if a considerable axial load that affects the bending moment of the pile is present. However, these special considerations will not be addressed in this research.

With these guidelines, the pile stiffness and the p-y curves can be developed and the engineer can predict how the lateral load is resisted. Example lateral response calculations performed on an 18" outer-diameter spiral welded pipe pile from one of the pile load test sites described in Chapter 3 can be found in Appendix C. The above theories for determining pile capacity related to both axially-applied and laterally-applied loads are used to help predict the behavior of the piles that the remainder of this research will focus on.

2.3 Field Capacity of Piles

Theoretical behaviors of piles are quite useful when an engineer has to design a structural component using those piles. However, theory is worthless to society if it is not tested and thus proved or disproved and if the results are not documented for future reference. Piles can be statically or dynamically tested, and analyses associated with each can be performed. Below, static testing and analyses will be explained as well as dynamic testing and analyses.

2.3.1 Static Testing

For any of the piles tested that are associated with this research, a schematic of the pile load test setup for compression (Davisson), tension (USACE-MVN[1], 2009), and lateral loading (Macro, 2009-2010) is depicted in Figures 2.9, 2.10, and 2.11 respectively.

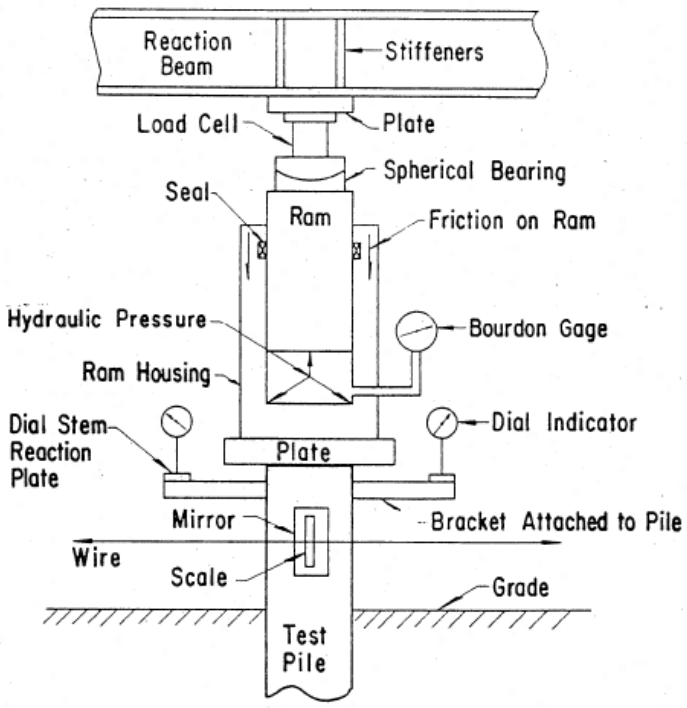

Figure 2.9 Schematic showing a typical axial compression pile load test setup.

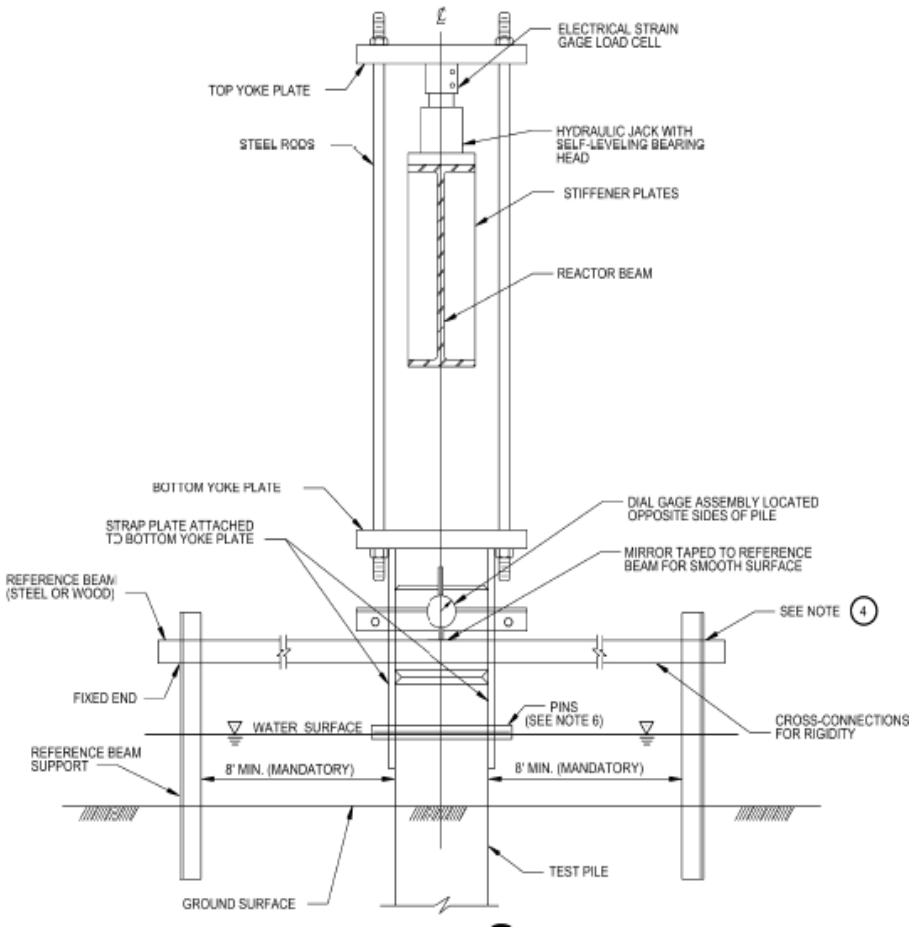

Figure 2.10 Schematic showing a typical tension pile load test setup.

Figure 2.11 Schematic showing a typical laterally-loaded pile load test setup

For all three pile load tests types, a hydraulic ram (i.e. jack) creates the required loading force for the test to proceed, while some sort of reaction system forces this load to the test pile.

For a typical compression pile load test, the ram is placed between the test pile and the reaction beam. As the ram extends, it pushes downward on the test pile essentially putting it into compression while pushing up on the reaction beam, which is connected to the reaction piles putting them essentially into tension. Similarly, for a typical tension pile load test, the reaction beam is placed between the test pile and the ram, and the ram is separately connected to the test pile by a plate and large threaded bolts. As the ram extends, it pushes downward on the reaction beam and hence on the reaction piles putting them into compression while pushing up on a plate connected to the test pile putting it in tension.

For a typical lateral pile load test, the ram is placed in a horizontal orientation adjacent to test pile. The "reaction system" can either be another test pile or reaction piles. For instance, the set-up in Figure 2.11 is for two test piles. If the set-up is two test piles, as the ram extends, it loads and tests both piles simultaneously. Otherwise, as in a compression or tension test, as the ram extends, the load is applied to the single test pile, while the reaction system's behavior is noted for information only. This explanation of axial and lateral load testing is applicable to all pile load tests that were performed in conjunction with this research and that will be discussed below.

2.3.2 Static Analyses

Once the pile load test is performed in the field on a particular pile, the raw data is made available to the engineer. It is then up to the engineer to determine if the test pile has satisfactorily resisted the design service load, which is normally considered to be the worst axially load the pile will see multiplied by a factor of safety. There are numerous methods accepted and used by engineers to make this specific determination; however, all methods normally start by having the engineer plot the raw "load versus deflection" data, which is the result of the pile being loaded and unloaded to specific percentages of the service load and the top of the pile moving with respect to its original elevation depending on these specific loadings. The U.S. Army Corps of Engineers' pile load test specifications (Sec 31 62 18.00 12) for load/unload cycles are given in Table 2.3.

Table 2.3 USACE typical load-and-unload cycles for pile load tests

Load/Unload Cycle	% of Service Load	Load/Unload Cycle	% of Service Load
50%	0%	200%	0%
	25%		50%
	50%		100%
	25%		150%
	0%		175%
100%	0%		200%
	50%		150%
	75%		100%
	100%		50%
	75%		0%
	50%	300-500%	0%
	0%		50%
150%	0%		100%
	50%		150%
	100%		200%
	125%		210%
	150%		220%
	125%		230%
	100%		…
	50%		n%
	0%		75%n
			50%n
			25%n
			0%

Within each cycle, each percentage of the design service load is recorded at different time intervals according to ASTM D1143 (2007) or ASTM D3689 (2007), depending on whether the pile is axially loaded in compression or tension respectively, in an effort to make later plots of this data meaningful. A complete blank worksheet showing the above cycles and the time elapsed for readings to be taken according to the USACE specifications can be found in Table 2.4.

PAGE 1	DESIGN		LOAD=	30	tons	TEST PILE DIAL GAGES			INSTRUMENT READINGS						Dial Beams		Reaction Piles	
DATE/DAY	TIME	LOAD, TONS	Percent of Design	HYDRAULIC GAGE: TARGET/ ACTUAL	ACTION	DIAL GAGE NO.1 READING	DIAL GAGE NO. 2 READING	AVERAGE Uplift DIAL GAGES	BM LEFT	BM REAR	HEIGHT OF INSTRUMNT	TEST PILE	ELEV.	DEC.	1	2	1 / 2	3 / 4
7/27/2009	8:00 PM	0.0	0.0	0	Start test													
"	8:00 PM	7.50	25.0%		**Start to Apply Load**	X	X	X	X	X	X	X	X	X	X	X	x	x
"	8:04 PM	7.50	25.0%	ACTUAL	**Complete** Loading	X	X	X	X	X	X	X	X	X	X	X	x	x
"	8:06 PM	7.50	25.0%		Take Readings										X	X	x	x
"	8:12 PM	7.50	25.0%	"	Take Readings										X	X	x	x
"	8:19 PM	7.50	25.0%	"	Take Readings										X	X	x	x
"	8:34 PM	7.50	25.0%	"	Take Readings										X	X	x	x
"	9:04 PM	7.50	25.0%	"	Take Readings													
"	10:04 PM	7.50	25.0%	"	Take Readings										X	X	x	x
"	10:04 PM	15.00	50.0%		**Start to Apply Load**	X	X	X	X	X	X	X	X	X	X	X	x	x
"	10:08 PM	15.00	50.0%	ACTUAL	**Complete** Loading	X	X	X	X	X	X	X	X	X	X	X	x	x
"	10:10 PM	15.00	50.0%		Take Readings										X	X	x	x
"	10:16 PM	15.00	50.0%	"	Take Readings										X	X	x	x
"	10:23 PM	15.00	50.0%	"	Take Readings										X	X	x	x
"	10:38 PM	15.00	50.0%	"	Take Readings										X	X	x	x
"	11:08 PM	15.00	50.0%	"	Take Readings													
7/28/2009	12:08 AM	15.00	50.0%	"	Take Readings										X	X	x	x
"	12:08 AM	7.50	25.0%	0	**Begin** Unload	X	X	X	X	X	X	X	X	X	X	X	x	x
"	12:12 AM	7.50	25.0%	ACTUAL	**Complete** Unload	X	X	X	X	X	X	X	X	X	X	X	x	x
7/28/2009	12:32 AM	7.50	25.0%		Take Readings										X	X	x	x

Table 2.4 Sample pile load test field log

All the pile load tests associated with this research followed these exact specifications. An electronic form of this spreadsheet is very helpful in managing the readings and later making plots of this data.

Once the raw data is obtained by the engineer from the pile load test, the load and deflection values are plotted both on arithmetic scales. The applied load can then be increasingly plotted on the x-axis and the deflection can increasingly be plotted downward on the y-axis. If these methods of plotting are adopted, the curve that normally results can be broken into distinct parts. The test results will normally have a positively-decreasing-sloped curve for the loading portion of the test up to a maximum. The test results will often have a near-vertical component representing a change from loading to unloading and meaning that for the same load a relative amount of deflection occurs. Finally, the test results will normally have a rebound-type negatively-increasing-sloped curve from the unloading. The path that this curve takes represents the elasticity of the pile itself (FHWA[1], 2006). If the unloading curve doesn't get back to the exact deflection value that loading portion started out with, the difference between the unloading and loading can be attributed to a rearrangement of Hooke's Law in one dimension that states the stress is the resultant of a strain and the modulus of elasticity (Beer, et. al, 2001)

$$\sigma = \varepsilon E \quad \text{.....(Eq. 2.47)}$$

such that the sustained deformation, δ, is

$$\delta = \frac{PL}{AE} \quad \text{.....(Eq. 2.48)}$$

These concepts are better explained pictorially using fictitious values as in Figure 2.12.

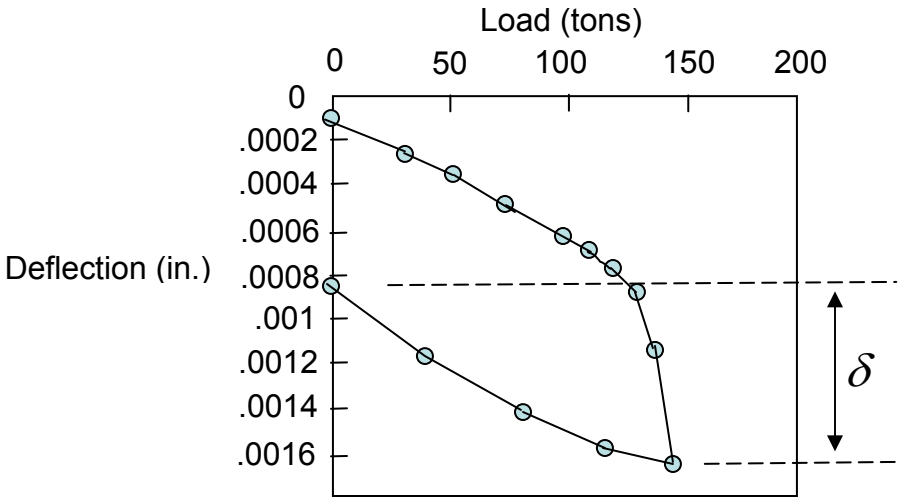

Figure 2.12 Schematic showing a typical load-and-unload cycle for a pile load test

Once the original data is plotted in the above format for each of the loading cycles, there is no industry-accepted single method for evaluating the test pile's load-carrying axial capacity. One such method is referred to as the Davisson Method and was developed by M.T. Davisson in the early 1970s (FHWA[2], 2006). For this method, the engineer constructs a line starting at a point with zero load and approximate deflection of 0.3 inches. In some cases, the deflection point is calculated as

$$S_f = \frac{PL}{AE} + (0.38 + 0.008D) \quad \text{.....(Eq. 2.49)}$$

in the case that 100% of the load, P, is transferred to the toe and D being the diameter of the pile (FHWA[2], 2006). Once this initial point is determined, a slope parallel to the unloading/reloading cycle of the pile load test's raw data is constructed. Where this sloped constructed line intersects the plotted raw data on the final-loading curve is considered to be the ultimate axial capacity of that pile (FHWA[1], 2006). Though this method does take into account the properties of the pile and the load-transfer along the pile, it often overestimates the deflection or settlement of the top of the pile for load-settlement records based on holding the main design load for 24 hours or longer (Peck, et. al., 1974) and is not practical for load-and-unload cycle tests. Since all of the static pile load tests associated with this research follow this exact criteria of holding the main design load for 24 hours and going through the load-and-unload cycles, Davisson's Method will not be used in the determination of the capacities for these piles.

A second method is referred to as the Hansen Method or the Hansen's 80% Criteria Method. It was developed by J. Brinch Hansen in 1963 (Fellenius, 2001). In this method, for each load-deflection reading, the square root of each deflection is divided by its corresponding load and this quotient is plotted against deflection on the original load-deflection curve. The engineer can then best-fit a straight line through the plotted quotients and determine the slope of the straight line, C_1, and this line's intercept of the "load" axis, C_2. Hansen's interpreted ultimate capacity,

Q_u, for that test pile at an associated ultimate load, δ_u, can then be determined from the following relationships (Fellenius, 2001):

$$Q_u = \frac{1}{2\sqrt{C_1 C_2}} \quad \text{.....(Eq. 2.50)}$$

and

$$\delta_u = \frac{C_2}{C_1} \quad \text{.....(Eq. 2.51)}$$

In some cases, the point (Q_u, δ_u) incorrectly falls a distance from the raw-data curve and should be corrected if necessary.

A third method is referred to as the De Beer Method (Abdelrahman, et. al., 2003). It was developed by E.E. De Beer. In this method, each load-deflection point obtained during the pile load test is plotted on a log-log scale. Once these are plotted, an engineer best fits a straight line through the top group of readings and a second through the bottom group of readings, since there theoretically should be an obvious break in the plotted data (Abdelrahman, et. al., 2003). The intersection of these two straight lines is considered the pile's "yield" load, which is considered to mean something different than the ultimate load which all of the other methods use.

A fourth method is referred to as the Chin-Konder or Modified Chin Method (Sands, 1992). It was developed by Chin Fung Kee in 1970 and presented at the Second Structural Engineering Conference of Soil Engineers. With this method, the engineer calculates the ratio of deflection or settlement to load for every load-deflection reading of the pile load test and plots this ratio value on one axis against the associated deflection or settlement value on the other axis and best fits a straight line through these plotted values. The engineer then calculates the inverse slope of this best-fit line which gives the ultimate capacity for that test pile (Sands, 1992).

A fifth method of interpreting the data is the Mazurkiewicz Method. This method was developed by B.K. Mazurkiewicz in 1972 (Abdelrahman, et. al., 2003). For this method, equal intervals of pile deflection or settlement are selected on the load-deflection curve and loads corresponding to these deflections are marked on the load axis. From each mark on the load axis, a line with a 45° angle counterclockwise from horizontal is drawn to intersect the next marked load value until all marked load values are intersected. The engineer then constructs a best fit line through these intersection points of the 45° line and the next vertical marked load line, and where this best-fit line crosses the axis is considered the ultimate capacity for that test pile (Abdelrahman, et. al., 2003).

A sixth method is referred to as the Corps of Engineers Method. This method is actually comprised of three techniques that are weighted together based on engineering judgment to produce an ultimate capacity of a particular test pile. To make use of the three techniques for this method, the engineer first has to connect the "net" values of the final load for each cycle with a best-fit curve. The net values are the ultimate settlement minus the elastic compression of the pile and the soil (Department of the Army, 1991) as shown pictorially in Figure 2.8.

Similarly, the "gross" values of the same final load for each cycle are then connected by a separate best-fit curve. To better explain the difference between net and gross values, Table 2.6 provides a set of load and deflection points from a hypothetical cycle of loading and unloading.

Table 2.5 Example load and unload cycle for a pile load test

% of Service Load	Elapsed Time, min	Deflection, in
0%	0	0
25%	2	0.0135
	8	0.014
	15	0.0155
	30	0.0185
	60	0.0225
	120	0.029
50%	2	0.042
	8	0.0435
	15	0.0425
	30	0.0455
	60	0.048
	120	0.0585
25%	20	0.0255
0%	20	0.0135

From this hypothetical 50% load/unload cycle, this pile was subjected to 25% of the design service load and readings were recorded at specific increments of time. The pile was then subjected to 50% of the design service load and readings were again recorded at specific increments of time. The pile was then unloaded back down to 25% and ultimately 0% of the design service load and readings were again recorded at specific increments of time. Since this is a 50% load/unload cycle, the deflection at the last reading of the 50% loading, in this case a value of 0.0585 in., would be plotted for the "gross" curve. Also, for any load/unload cycle, once the pile is loaded and then unloaded, the deflection once the load is completely removed is considered the net value of the curve. Thus, for this hypothetical example, a value of 0.0135 in. would be plotted for the "net" curve. Likewise, the gross and net points associated with all the load/unload cycles for the test pile are determined and gross and net curves are formed.

With these two curves plotted, the first technique under the Corps of Engineers Method is referred to as the "gross curve" technique. Here, a line with a 0.01 in/ton creep rate is constructed and the location where this sloped line is tangent to the "gross" curve is considered the ultimate capacity of that test pile for this technique. The second technique is referred to as the "tangent" technique. Here, a line is constructed tangent to the beginning portion of the gross curve and another line is constructed tangent to the "near-vertical" portion (i.e. just before the final unloading) of the gross curve. The intersection of these two tangent lines is considered the ultimate capacity of that test pile for this second technique. The third technique is the "net curve" technique. Simply stated, the intersection of 0.25 inches deflection and the net curve is

again considered the ultimate capacity of that test pile for this technique (Department of the Army, 1991).

Once the three techniques are performed and the corresponding three ultimate capacities are determined, the engineer then decides if all three should be used. The techniques that are used are normally averaged together resulting in a final ultimate load-carrying capacity of the test pile. Though the first five methods mentioned will not be directly used to reduce each pile load test associated with this research, several of these methods were performed on one selected pile load test and the results are presented for comparative purposes in Table 2.6.

Table 2.6 Comparison of several reduction methods on a selected pile load test

METHOD	ULTIMATE CAPACITY
USACE	127 Tons
Gross Curve (Creep)	121 Tons
Tangent	132 Tons
0.25 Inch	127 Tons
DAVISSON	132 Tons
HANSEN	94 Tons

Six methods were discussed above, but it is worth mentioning that there are numerous other methods used world-wide to interpret pile load test results and determine a pile's ultimate capacity that will not be listed here. An engineer may also be concerned with dynamic analyses as explained below.

2.3.3 Dynamic Testing

Besides the two types of static pile load tests described above, another type of test that can be performed on the pile to obtain capacity is considered a dynamic test. Dynamic testing can actually be broken into two types, initial testing and restrike testing. For both types, standard procedures call for calibrated transducers and accelerometers (i.e. at least two of each if the USACE specifications are followed) to be securely attached to the pile near the top of the pile.

For the initial testing, once the transducers and accelerometers are attached to the pile, the contractor applies impacts or blows via an impact driving hammer axially and concentrically to the pile. As the impacts are applied, the contractor in charge of the dynamic testing records number of blows, the driving stresses, the force and acceleration signals at the top of the pile, the integrity of the pile and driving system, performance of the cushion and hammer, and the soil's resistance to those blows.

If a restike test is scheduled, which is normally the case if the initial dynamic test is performed, the pile and soil must be allowed to set up a certain period of time, meaning no load can be applied to the pile during that time. For instances, if the contractor is performing dynamic testing for USACE and following the USACE specification, the pile must be allowed to set up

for 21 days before the restrike dynamic test can be performed (USACE Guide Specification, Section 02355-23). After the set up is allowed to occur, the contractor shall warm the impact driving hammer up then apply 50 blows to the pile or until the pile is driven an additional three inches into the ground.

2.3.4 Dynamic Analyses

Any dynamic test associated with this research and most that USACE are associated with follow ASTM D4945 (2008). Before a test pile or production pile is ever driven, a critical piece of information needed for dynamic testing comes from the development of a wave equation specific to the pile type being tested. This wave equation is a one-dimensional differential equation that takes the following form (Warrington, 1999):

$$u_{tt}(x,t) = \left(\frac{E}{\rho}\right) u_{xx}(x,t) \quad \text{.....(Eq. 2.52)}$$

where u(x,t) is the displacement of pile particle in meters, x is the distance from the top of the pile in meters, t is the amount of time in seconds, E is Young's Modulus of Elasticity of the pile in Pascals, and ρ is the density of the pile in kg/m^3. This equation is transformed by introducing boundary conditions of the specific system, especially whether it is a dampened or undampened case. For the case where dampening along the pile shaft is not present, the critical equation becomes (Warrington, 1999)

$$u(x,t) = \sum_{n=1}^{\infty} \cos\left(\frac{\lambda_n x}{L}\right)\left(C_{1n}\cos\left(\lambda_n\left(\frac{tc}{L}-1\right)\right) + C_{2n}\sin\left(\lambda_n\left(\frac{tc}{L}-1\right)\right)\right), t > \frac{L}{c}$$

.....(Eq. 2.53)

and for the case where there is dampening along the pile shaft, the critical equation becomes (Warrington, 1999)

$$u(x,t) = \frac{1}{Z}\int_0^t e^{-b\tau} I_o\left(\sqrt{(b^2-a)(\tau^2)}\right) F_o(t-\tau)d\tau, t > 0 \quad \text{.....(Eq. 2.54)}$$

where λn is the Constant of Eigenvalue, L is the length of the pile in meters, C_{1n} and C_{2n} are Constants of Fourier Coefficients, c is the acoustic speed of pile material in m/sec, Z is the pile impedance in N-s/m, b is the pile shaft dampening constant in 1/sec, τ is a dummy variable, a is the pile shaft elasticity constant in 1/sec^2, and F_o is the force at the top of the pile in Newtons.

Once either the initial or restrike dynamic test is performed, the engineer uses the recorded information along with the properties of the pile and soil to perform what is referred to as a "Case Pile Wave Analysis Program" (CAPWAP) to determine the static capacity of the pile by verifying the soil dampening coefficients, quake values (i.e. displacement at which the soil changes from elastic to plastic), and distribution of capacity along the shaft and at the toe of the pile. It is worth mentioning that the dynamic resistance is a function of a damping parameter and the velocity. The CAPWAP software essentially compares the pile/soil response from the wave

equation done before the dynamic test and the pile/soil response of the dynamic test and tries to modify the input parameters described above until the two reasonably agree with as little variation between the two curves as possible (FHWA[2], 2006). Also, the pile dynamic analyzer, or PDA, that is sometimes used during the dynamic test only produces estimated load-carrying capacity of the pile for the specific blow recorded rather than for built-in residual stresses or time-dependent gains in capacity (Department of Army, 1991).

CHAPTER 3 PILE LOAD TEST SITES

To help evaluate the behaviors of the spiral welded pipe piles and compare them to other piles, USACE's Spiral Welded Pipe Pile Innovation Team put out contracts or modified existing contracts to be able to set up pile load tests in southeastern Louisiana. Specifically, the Suburban Canal, the Elmwood Canal, and the West Closure Complex were chosen as the sites where these pile load tests were performed. These pile load test sites will be explained in the paragraphs to follow. For these pile load test sites, numerous types and sized of steel piles were tested. Furthermore, it is worth mentioning that all steel piles, including the spiral welded pipe piles, associated with this research remained open-ended, meaning no steel plates were welded at the tips of the piles to effectively make the piles become displacement in nature. Also, the ultimate capacities of the open-ended steel piles were not reduced by the weight of the soil plug as discussed at the end of Section 2.1.1. However, since all piles associated with this research would have had this reduction, the reduction is relative and thus insignificant with respect to the objective of this research.

3.1 Suburban Canal

The first pile load test was conducted at the Suburban Outfall Canal Pump Station. This pump station is located on the south shore of Lake Pontchartrain in Metairie, Louisiana. It is part of the Lake Pontchartrain and Vicinity HSDRRS. This specific pile load test was performed to determine pile capacities since fronting protection is required to maintain the HSDRRS without cutting off drainage capabilities, and that fronting protection will require pile foundations. At the site of the pump station, the pile load test was set up on the east side of the discharge channel between an existing pedestrian access bridge and the pump station, and the existing ground surface of the pile load test site varied from El+4 North American Vertical Datum of 1988 (NAVD88) to EL+8 NAVD88 (USACE-GEC, 2009). Geologically, this specific pile load test site consists of a Holocene Marsh veneer made up of highly compressible clays, silts, and peats, a deposit of Lacustrine highly-plastic clays with interbedded silts, a Bay-Sound deposit composed of low plastic clays and silts, and a Pleistocene deposit comprised of high plastic clays and low plastic silts and sands (USACE-MVN[2], 2010). For this particular pile load test, designers tested HP 14x89 piles, 20-inch-diameter longitudinally-welded pipe piles, 18-inch-diameter spiral welded piles, and 20-inch-diameter spiral welded piles in both compression and tension (Eustis[1], 2009) Specifically, the test pile schedule is stated in Table 3-1 with "SWG" signifying the spiral weld was grinded flush with the pile.

Table 3.1 Suburban pile load test pile schedule.

SUBURBAN TEST PILE SCHEDULE						
					SERVICE LOAD	
PILE NUMBER	PILE TYPE	PILE Location (SITE)	REQ'D TIP EL	TYPE OF TEST	Compression (Tons)	Tension (Tons)
S-1A	HP 14x89	SE	-80	C	45	N/A
S-1B (Opt)	HP 14x89	SE	-90	C or T	45	30
S-1T	HP 14x89	SE	-80	T	N/A	30
S-2A	HP 14x89	SE	-100	C	100	N/A
S-2B (Opt)	HP 14x89	SE	-125	C or T	100	62.5
S-2T	HP 14x89	SE	-100	T	N/A	62.5
S-3A	20" Dia Steel LW	SE*	-100	C	110	N/A
S-3B (Opt)	20" Dia Steel LW	SE*	-125	C or T	110	65
S-3T	20" Dia Steel LW	SE*	-100	T	N/A	65
S-P18	18" Dia Steel SW	SE	-80	T	N/A	30
S-P18G	18" Dia Steel SWG	SE	-80	T	N/A	30
S-P20	20" Dia Steel SW	SE	-100	T	N/A	65
S-P20G	20" Dia Steel SWG	SE	-100	T	N/A	65

*Casing was installed and the soil removed down to El-19 for test piles S-3A, S-3B, and S-3T

All of the piles listed in the Table 3.1 were statically load tested. As per the design specifications, the loads were applied in increments corresponding to 25% of the service load of the test pile, and each increment was held for 60 to 120 minutes with the unloading increments held for 20 minutes (Eustis[1], 2009). As is typical of any pile load test program, if the test pile didn't fail beforehand, the test pile was then held for 24 hours with 200% of the design service load applied with subsequent increments of 10% of the loading each held for 20 minutes up to either 300% or 500% of the design service load with an unloading period following failure. At each reading, two strain gauges along with a scale on each of the reaction piles and each of 3-4 reference bench marks are read and the load and deflections are recorded in a tabular form. Dynamic load tests were also performed on all of the piles listed in the table except for S-P18, S-P18G, S-P20, and S-P20G. These tests were performed when the piles were initially installed and after the static load tests were completed. The method used to perform these tests was the Pile Driving Analyzer® (PDA) that consists of an accelerometer and a strain gauge transducer.

The load frame at this site for each test comprised of either four or eight steel HP 14x89 piles attached to a steel frame with a cross beam. Specifically, S-1T and S-2T, S-2A and S-2B, S-3A and S-3B, and S-P20 and S-P20G were paired off under individual frames with 8 reaction piles for each frame driven to El-90; S-1A and S-1B and S-P18 and S-P18G were again paired off under the individual frames but with 4 reaction piles driven to EL-90; and S-3T was installed adjacent to S-3B and used four of the piles for the S-3A and S-3B frame driven to EL-90 and four new piles driven to EL-75. Each test pile was allowed to set-up between 29 and 58 days after being driven, depending on the testing schedule (Eustis[1], 2009). The load was applied to

each pile with either a 300-ton or a 500-ton hydraulic ram (Eustis[1], 2009). Each ram was calibrated by Southern Earth Sciences, Inc. prior to the testing program beginning at this location.

The borings in the pile load test vicinity that were used to determine the theoretical pile capacities are as follows: Borings 83U, JLF-32PU, PS-21U, PS-22U, PS-23U, JLF-33FU, JLF-33CU. Boring logs, a design soil parameter plate, and theoretical pile curves applicable to the fronting protection at this pump station can be found in APPENDIX A.

3.2 Elmwood Canal

The second pile load test was conducted at the Elmwood Canal Pump Station Outfall Canal. This pump station is located on the south shore of Lake Pontchartrain near the boundary line separating Kenner and Metairie, Louisiana. It is part of the Lake Pontchartrain and Vicinity Hurricane and Storm Damage Risk Reduction System. This specific pile load test was performed to determine pile capacities since fronting protection is required to maintain the HSDRRS without cutting off drainage capabilities, and that fronting protection will require pile foundations. At the site of the pump station, the pile load test was set up on the west side of the discharge channel between an existing pedestrian access bridge and the pump station, and the existing ground surface across the entire pile load test site was approximately EL+6 NAVD (USACE-GEC, 2009). Geologically, the foundation of this pile load test site consists of the same environments mentioned above for the Suburban Outfall Canal. For this particular pile load test, designers tested HP 14x89 piles in both compression and tension and a steel PZ-27 sheetpile in tension. Two 18”-diameter spiral welded pipe piles, one with the outer spiral weld remaining and the other with the spiral weld grinded flush with the pile, were also driven at the test pile site. It is worth mentioning that these two spiral welded piles were solely driven to evaluate the drivability of such a pile in typical soils of southeastern Louisiana to both itself and in this case to HP 14x89 steel H-piles and PZ-27 steel sheet piles. The test pile schedule is stated in Table 3.2.

Table 3.2 Elmwood pile load test schedule.

ELMWOOD TEST PILE SCHEDULE						
					SERVICE LOAD	
PILE NUMBER	PILE TYPE	PILE Location (SITE)	REQ'D TIP EL	TYPE OF TEST	Compression (Tons)	Tension (Tons)
E-1A	HP 14x89	EW	-80	C	64	N/A
E-1B (Opt)	HP 14x89	EW	-90	C or T	64	45
E-1T	HP 14x89	EW	-80	T	N/A	45
E-2A	HP 14x89	EW	-105	C	107	N/A
E-2B	HP 14x89	EW	-127	C	150	N/A
E-2T	HP 14x89	EW	-105	T	N/A	66
E-3U	HP 14x89	EW	-36	T	N/A	16
E-3PZ	PZ-27	EW	-40	T	N/A	16
E-D20-1	18" Dia SWP	EW	-130	DRIVE	N/A	N/A
E-D20-2-G	18" Dia SWP	EW	-130	DRIVE	N/A	N/A

The load frame at this site for each test comprised of either four or eight steel HP 14x89 piles attached to a steel frame with a cross beam. Specifically, E-1A and E-1B were paired off under a single frame with 4 reaction piles driven to El-90. E-2A and E-2T were paired off under a single frame with 8 reaction piles driven to El-90. E-2B was then added adjacent to this particular frame, sharing 4 of the reaction piles but having 4 additional reaction piles, for a total of 8 reaction piles driven to El-90. E-1T, E-3U, and E-3PZ were placed under a single frame with 4 reaction piles driven to El-90. The steel H-piles were installed via a Conmaco 65E Diesel Hammer, the pipe piles were installed via a Pileco D30-32 Diesel Hammer, and the sheet pile was installed using the vibratory method (Eustis[2], 2009). Each test pile was allowed to set-up between 46 and 56 days after being driven, depending on the testing schedule (Eustis[2], 2009). The load was applied to each pile with either a 300-ton or a 500-ton hydraulic ram (Eustis[2], 2009). Each ram was calibrated by Versabar, Inc. prior to the testing program beginning at this location.

The borings in the pile load test vicinity that were used to determine the theoretical pile capacities are as follows: Borings JLF-21CU, JLf-21PU, PS3-1U, PS-33U, PS-33UA, PS-32U, PS-31U, and possibly JLF-20FU and JLF-20CU. Though boring logs, soil parameters and theoretical pile curves were developed, they will not be included in an appendix since the spiral welded pipe piles were only tested for drivability compared to the other piles as stated above.

3.3 West Closure Complex

The third pile load test was conducted at the West Closure Complex Site. The site is located at the confluence of the Harvey and Algiers Canal on the right descending bank of the Mississippi River in Belle Chasse, Louisiana. Here, the U.S. Army Corps of Engineers will construct the largest pump station in the world with ultimate pumping capacity of nearly 20,000 cfs along with

sector gates, transition T-walls, and a water control structure that must adhere to the latest HSDRRS Design Criteria. This complex of structural components is part of the West Bank and Vicinity Hurricane and Storm Damage Risk Reduction System. Geologically, the entire complex is made up of an overlying fill deposit consisting of mostly silt, a Holocene Swamp Marsh consisting of an upper silt and lower peat, an Intradelta silty sand deposit, an intradistributary deposit consisting of high plasticity clays, a deposit of Near Shore Gulf soil consisting of an upper clay a middle loose sand and a lower clay of low plasticity, and finally a Pleistocene deposit of stiff to very stiff clay (USACE-MVN[2], 2010).

For this particular complex, there were seven separate pile load test sites scheduled. The first pile load test site was located on the east side of the Algiers Canal on the east side of Bayou Road at approximately project baseline Station 293+00. This site was set up to test piles that would be used for the large pump station. The second pile load test site was located on the east side of the Algiers Canal between the existing HSDRRS levee system and Bayou Road at approximately project baseline Station 290+00. This site was also set up to test piles that would also be used for the large pump station. The third site was located in the Algiers Canal along the eastern banks of the existing HSDRRS levee system approximately between project baseline Stations 288+00 to 295+00. This site was set up to test piles that would be used for the large sector gates. The fourth site was located in the Algiers Canal along the opposite bank of the existing Algiers HSDRRS levee system approximately at project baseline Station 296+00. This site was set up to test piles that would be used for the "404C" transition T-wall. The fifth site was also located in the Algiers Canal along the opposite bank of the existing Algiers HSDRRS levee system approximately at project baseline Station 289+00. This site was set up to test piles for the small sector gate. The sixth site was located similar to the first site, east of the existing Algiers HSDRRS levee system, and east of Bayou Road between approximately project baseline Stations 295+00 and 298+00. This site was set up to test piles for the eastern transition T-wall. The seventh site was located in the Harvey Canal near its western banks and adjacent to the Jean Lafitte National Park and Estelle Canal. This site was set up to test piles for the water control structure of the complex. Many of these sites can be seen in Figure 3.1 (USACE-MVN[1], 2009).

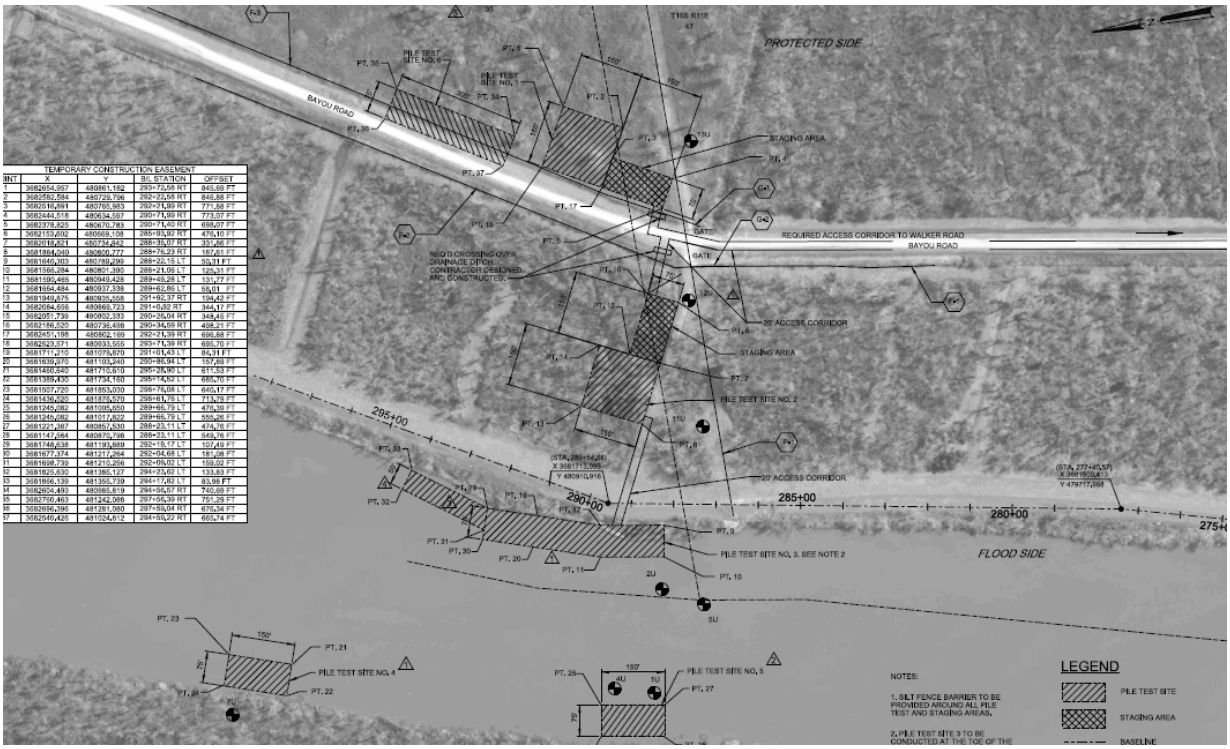

Figure 3.1 West Closure Complex pile load test sites

For the entire complex, engineers tested 18", 24", and 30" diameter longitudinally-welded (LW) steel pipe piles, 18" and 30" diameter spirally-welded (SW) steel pipe piles with the weld remaining and grinded flush (G), 18"x18" precast prestressed concrete piles (PPC), and 54" diameter longitudinally-welded steel pipe piles. They performed tension (T), compression (C), and even lateral (L) testing on the piles for the complex. The test pile schedule for the complex is stated in Table 3.3. (It is worth noting for clarity that TP#1, TP#2, T#14, TP#15, and TP#16 were conceptually thought to be part of the pile load test program at this complex but were removed for one reason or another by the U.S. Army Corps of Engineers prior to any of the pile load tests being conducted.)

Table 3.3 West Closure Complex pile load test schedule

WCC TEST PILE SCHEDULE							
					SERVICE LOAD		
PILE No.	PILE TYPE	PILE LOAD TEST SITE	REQ'D TIP EL	TYPE OF TEST	Compression (Tons)	Tension (Tons)	Lateral (Tons)
TP#3	30" Dia Steel LW	SITE 1	-140	C	173	N/A	N/A
TP#4*	30" Dia Steel LW	SITE 1	-160	C	212	N/A	N/A
TP#5	30" Dia Steel SW	SITE 1	-140	C	173	N/A	N/A
TP#6	30" Dia Steel SWG	SITE 1	-140	C	173	N/A	N/A
TP#7	30" Dia Steel LW	SITE 2	-140	PDA	N/A	N/A	N/A
TP#8	30" Dia Steel SW	SITE 2	-140	PDA	N/A	N/A	N/A
TP#9	24" Dia Steel LW	SITE 3	-166	C	169	N/A	N/A
TP#10*	24" Dia Steel LW	SITE 3	-176	C	169	N/A	N/A
TP#11	30" Dia Steel LW	SITE 3	-174	C	225	N/A	N/A
TP#12*	30" Dia Steel LW	SITE 3	-182	C	225	N/A	N/A
TP#13	30" Dia Steel SW	SITE 3	-174	C	225	N/A	N/A
TP#17	24" Dia Steel LW	SITE 5	-166	PDA	N/A	N/A	N/A
TP#18*	24" Dia Steel LW	SITE 5	-176	PDA	N/A	N/A	N/A
TP#19	18" Dia Steel LW	SITE 4	-129	C	71	N/A	N/A
TP#20	18" Dia Steel LW	SITE 4	-136	C	99	N/A	N/A
TP#21	18" Dia Steel SW	SITE 4	-105	T	N/A	48	N/A
TP#22	18" Dia Steel SWG	SITE 4	-105	T	N/A	48	N/A
TP#23	18"x18" PPC	SITE 4	-106	C	71	N/A	N/A
TP#24	18"x18" PPC	SITE 4	-129	C	75	N/A	N/A
TP#25	18"x18" PPC	SITE 4	-97	T&C	53	40	N/A
TP#26	54" Dia Steel LW	SITE 3	-123	T	N/A	160	N/A
TP#27	54" Dia Steel LW	SITE 3	-123	C	210	N/A	N/A
TP#28	54" Dia Steel LW	SITE 3	-130	L	N/A	N/A	100
TP#29	54" Dia Steel LW	SITE 3	-130	L	N/A	N/A	100
TP#30	18"x18" PPC	SITE 6	-120	T&C	108	60	N/A
TP#31	18"x18" PPC	SITE 6	-130	C	96	N/A	N/A
TP#32	18" Dia Steel LW	SITE 7	-160	T&C	130	80	N/A

*Denotes optional pile that was tested only at Contracting Officer Representative's directive.

The loading frame for each pile load test site for the complex was relatively intricate. Each test pile was accompanied with 8 reaction piles 4 being on each side of each pile. On top of each set of four reaction piles, was a support beam. On top of and spanning between the two support beams were 6-8 load frame support beams. Finally, on top of the load frame support beams, the contractor was instructed to place the required dead-load that would facilitate each test. The contractor could create this required dead load by constructing a box and placing steel, concrete or other materials in it.

The borings in the pile load test vicinity that were used to determine the theoretical pile capacities are as follows: Borings 1U, 2U, 4U, 5U, 7U, 11U, 12U, 13U, and 19U. Boring logs, design soil parameter plates, and theoretical pile capacity curves applicable to the West Closure Complex can be found in APPENDIX D.

CHAPTER 4 RESULTS

For each pile load test site that the USACE Spiral Welded Pipe Pile Innovation Team set up, theoretical pile load capacity curves were developed for each type of pile tested at the site. Actual test pile tips were chosen from the theoretical pile capacity curves based on two times the anticipated service load, as is standard practice for geotechnical engineers at USACE-MVN. As stated at the beginning of Chapter 3, ultimate capacities were not reduced by the weight of the soil plug. However, since all piles associated with this research would have had this reduction, the reduction is relative and thus insignificant with respect to the objective of this research. Nevertheless, as described earlier, once each pile load test was complete, the raw data was graphed and reduced appropriately to determine the actual ultimate capacity of the pile. Most piles were dynamically tested and some piles were laterally tested, all to gain an understanding of the behavior of spiral welded pipe piles compared to other commonly-used piles. Results of the service load, again based on the theoretical capacity, and actual testing will be explained and compared where appropriate in the following paragraphs.

To start with, the ultimate capacity resulting from each of the three techniques of the Corps Method of reduction for static testing for each pile at each pile load test site can be tabulated and compared to the required service load of the axially-loaded pile. For the Suburban Outfall Canal pile load test site, such a summary can be found in Table 4.1.

Table 4.1 Suburban pile load test results

Suburban Pile Load Test							
				ESTIMATED CAPACITY (TONS)			
Test Pile	Pile Type	Pile Tip Elev	Service Load, tons	0.25 inch Net Deflection Method	0.01 inch/Ton Gross Deflection Method	Tangent Gross Method	**Ultimate Avg**
S-1A	HP14x89	-80	45 ('C)	111	112	112	112
S-1B	HP14x89	-90	45 ('C)/ 30 (T)	-	-	-	-
S-1T	HP14x89	-80	30 (T)	102	110	120	110
S-2A	HP14x89	-100	100 ('C)	155	151	158	154
S-2B	HP14x89	-125	100 ('C)/ 62.5 (T)	234	248	248	243
S-2T	HP14x89	-100	62.5 (T)	152	152	165	156
S-3A	20" Pipe	-100	110 ('C)	174	165	167	169
S-3B	20" Pipe	-125	110 ('C)/ 65 (T)	333	321	271	308
S-3T	20" Pipe	-100	65 (T)	178	198	189	188
S-P18	18" SWP	-80	30 (T)	127	121	132	127
S-P18G	18" SWP-G	-80	30 (T)	126	121	132	127
S-P20	20" SWP	-100	65 (T)	205	205	200	204
S-P20G	20" SWP-G	-100	65 (T)	185	217	222	208

For this particular pile load site, as shown in Table 4.1, four types of piles were tested that provided important results. To begin with, it is worth mentioning that the three techniques under the Corps Method of reducing static pile load test data produced relatively consistent results for each pile tested, meaning any one method did not cause a skew in the ultimate average capacity determined for any given pile.

From Table 4.1, the behaviors of specific piles can also be compared. For both the HP 14x89 (i.e. pile labeled S-2A) and the 20" diameter longitudinally-welded pipe pile (S-3A) tipped at El-100 and tested for compression, neither was reduced to obtain two times its design service load and both needed an option pile tested, but the 20" diameter longitudinally-welded pipe pile (S-3A) did have a reduced ultimate capacity greater than that of the HP 14x89 (S-2A) for the same depth (i.e. 169 tons vs. 154 tons, respectively). The optional pile for each was then tipped at El-125. At this optional depth, both the 20" diameter longitudinally-welded pipe pile (S-3B) and the HP 14x89 (S-2B) were reduced to have greater than two times the design service load of each. However, the ultimate reduced capacity of the 20" diameter longitudinally-welded pipe pile (S-3B) was once again greater than the HP 14x89 (S-2B) (i.e. 308 tons vs. 243 tons, respectively). These comparisons can be seen in Table 4.2.

Table 4.2 Suburban pile load test comparison

Suburban Pile Load Test Comparison							
				ESTIMATED CAPACITY (TONS)			
Test Pile	Pile Type	Pile Tip Elev	Service Load, tons	0.25 inch Net Deflection Method	0.01 inch/Ton Gross Deflection Method	Tangent Gross Method	Ultimate Avg
S-2A	HP14x89	-100	100 ('C)	155	151	158	154
S-3A	20" Pipe	-100	110 ('C)	174	165	167	169
S-2B	HP14x89	-125	100 ('C)/ 62.5 (T)	234	248	248	243
S-3B	20" Pipe	-125	110 ('C)/ 65 (T)	333	321	271	308

This means that the longitudinally-welded pipe pile could have a shorter tip than the HP 14x89 to get the same reduced capacity as the HP 14x89. In fact, this is further validated if the design service loads, or theoretical capacities, of the two piles at, say, El-100 are compared. If a shorter pile can be implored, this has huge implications on cost. This will be discussed at the end of this chapter.

For the tension test, an HP 14x89 (S-2T), a 20" diameter longitudinally-welded pipe pile (S-3T), a 20" diameter spiral welded pipe pile with the weld remaining (S-P20), and a 20" diameter spiral welded pipe pile with the weld grinded flush (S-P20G) were all tipped at El-100. All piles were reduced to have greater than two times the design service load of each, but again the ultimate reduced capacity of the pipe piles were greater than that of the HP 14x89 (S-2T), that of the spiral welded pipe piles were greater than that of the longitudinally-welded pipe pile (S-3T), and that of the spiral welded pipe piles with the weld grinded flush (S-P20G) was ever so slightly

greater than that of the spiral welded pipe pile with the weld remaining (S-P20) but are essentially the same for discussion purposes. Tables 4.3 displays this comparison.

Table 4.3 Suburban pile load test comparison

Suburban Pile Load Test Comparison							
				ESTIMATED CAPACITY (TONS)			
Test Pile	Pile Type	Pile Tip Elev	Service Load, tons	0.25 inch Net Deflection Method	0.01 inch/Ton Gross Deflection Method	Tangent Gross Method	Ultimate Avg
S-2T	HP14x89	-100	62.5 (T)	152	152	165	156
S-3T	20" Pipe	-100	65 (T)	178	198	189	188
S-P20	20" SWP	-100	65 (T)	205	205	200	204
S-P20G	20" SWP-G	-100	65 (T)	185	217	222	208

Finally, for the HP 14x89 (S-1T), the 18" diameter spiral welded pipe pile with the weld remaining (S-P18), and the 18" diameter spiral welded pipe pile with the weld grinded flush (S-P18G), all were tipped at El-80, and all were reduced to obtain two times the design service load of each. Also, once again, the ultimate reduced capacities of the 18" diameter spiral welded pipe piles were greater than that of the HP 14x89 (S-1T) (i.e. 127 tons vs. 110 tons, respectively), and that of the 18" diameter spiral welded pipe pile with the weld remaining (S-P18) had exactly the same ultimate reduced capacity as that of the 18" diameter spiral welded pipe pile with the weld grinded flush (S-P18G). This comparison is tabulated in Table 4.4.

Table 4.4 Suburban pile load test comparison

Suburban Pile Load Test Comparison							
				ESTIMATED CAPACITY (TONS)			
Test Pile	Pile Type	Pile Tip Elev	Service Load, tons	0.25 inch Net Deflection Method	0.01 inch/Ton Gross Deflection Method	Tangent Gross Method	Ultimate Avg
S-1T	HP14x89	-80	30 (T)	102	110	120	110
S-P18	18" SWP	-80	30 (T)	127	121	132	127
S-P18G	18" SWP-G	-80	30 (T)	126	121	132	127

For the West Closure Complex pile load test site, a summary of the ultimate pile capacities for all of the piles that were statically tested and axially loaded can be found in Table 4.5.

Table 4.5 West Closure Complex pile load test results

West Closure Complex							
				ESTIMATED CAPACITY (TONS)			
Test Pile	Pile Type	Pile Tip Elev	Service Load, tons	0.25 inch Net Deflection Method	0.01 inch/Ton Gross Deflection Method	Tangent Gross Method	**Ultimate Avg**
TP-3	30" pipe	-140	173	401	380	413	398
TP-4	30" pipe	-160	212	484	514	527	508
TP-5	30" SWP	-140	173	401	387	411	400
TP-6	30" SWP-G	-140	173	375	363	381	373
TP-9	24" pipe	-166	169	365	363	407	378
TP-10	24" pipe	-176	169	-	-	-	-
TP-11	30" pipe	-174	225	519	572	604	565
TP-12	30"pipe	-182	225	-	-	-	-
TP-13	30" SWP	-174	225	561	620	643	608
TP-19	18" pipe	-129	71	152	166	197	171
TP-20	18" pipe	-136	99	-	-	-	-
TP-21 tension	18" SWP	-105	48	92	85	115	98
TP-22 tension	18" SWP-G	-105	48	92	75	95	88
TP-23	18" PCP	-106	71	110	116	123	116
TP-24	18" PCP	-129	75	189	186	205	193
TP-25	18" PCP	-97	53	94	83	96	91
TP-25 tension	18" PCP	-97	40	85	87	99	90
TP-26 tension	54" Pipe	-123	160	410	364	408	394
TP-27	54" Pipe	-123	210	300	270	314	294
TP-30	18"PCP	-120	108	157	146	161	155
TP-30 tension	18" PCP	-120	60	121	116	145	127
TP-31	18"PCP	-130	96	237	243	248	243
TP-32	18" pipe	-160	130	313	326	351	330
TP-32 tension	18" pipe	-160	80	156	234	239	210

As can be seen from Table 4.5 and explained previously, numerous piles were tested at the pile load test sites at this complex including 18”, 24”, and 30” longitudinally-welded pipe piles, 30” spiral welded pipe piles with the weld remaining, 30” spiral welded pipe piles with the weld grinded flush, 18” precast prestressed concrete piles, and 54” longitudinally-welded pipe piles.

From this table as was for the Suburban pile load test results, the three techniques under the Corps Method of reducing static pile load test data produced relatively consistent results for each pile tested, meaning any one method did not cause a skew in the ultimate average capacity determined for any given pile. Three of these piles, namely, a 30" diameter longitudinally-welded pipe pile (TP-3), a 30" diameter spiral welded pipe pile with the weld remaining (TP-5), and a 30" diameter spiral welded pipe pile with the weld grinded flush (TP-6), were all tipped at El-140 and tested in compression. The reduced ultimate capacities of all three were more than two times the design service load; however, the 30" diameter spiral welded pipe pile with the weld grinded flush (TP-6) yielded the least reduced ultimate capacity of the three (i.e. 373 tons) while the 30" diameter longitudinally-welded pipe pile (TP-3) yielded essentially the same reduced ultimate capacity as the 30" diameter spiral welded pipe pile with the weld remaining (TP-5) (i.e. 398 tons vs. 400 tons, respectively). This comparison is tabulated in Table 4.6.

Table 4.6 West Closure Complex pile load test comparison

West Closure Complex Comparison							
				ESTIMATED CAPACITY (TONS)			
Test Pile	Pile Type	Pile Tip Elev	Service Load, tons	0.25 inch Net Deflection Method	0.01 inch/Ton Gross Deflection Method	Tangent Gross Method	Ultimate Avg
TP-3	30" pipe	-140	173	401	380	413	398
TP-5	30" SWP	-140	173	401	387	411	400
TP-6	30" SWP-G	-140	173	375	363	381	373

Two different piles, namely a 30" diameter longitudinally-welded pipe pile (TP-11) and a 30" diameter spiral welded pipe pile with the weld remaining (TP-13), were both tipped at El-160 and were both tested in compression for comparison. Both piles were reduced to have greater than two times the design service load of each, but again the ultimate reduced capacity of the 30" diameter spiral welded pipe pile with the weld remaining (TP-13) was greater than that of the 30" diameter longitudinally-welded pipe pile (TP-11) (i.e. 608 tons vs. 565 tons, respectively). This comparison can be seen in Table 4.7.

Table 4.7 West Closure Complex pile load test comparison

West Closure Complex Comparison							
				ESTIMATED CAPACITY (TONS)			
Test Pile	Pile Type	Pile Tip Elev	Service Load, tons	0.25 inch Net Deflection Method	0.01 inch/Ton Gross Deflection Method	Tangent Gross Method	Ultimate Avg
TP-11	30" pipe	-174	225	519	572	604	565
TP-13	30" SWP	-174	225	561	620	643	608

Two more of the piles, namely an 18" diameter spiral welded pipe pile with the weld remaining (TP-21) and another with the weld grinded flush (TP-22), were both tipped at El-105 and both tested in tension. It is quite interesting to note that for these two piles, the one with the weld remaining (TP-21) was reduced to barely obtain two times the design service load, while the one with the weld grinded flush (TP-22) did not reduce to an ultimate capacity equal to two times the design service load (i.e. 98 tons vs. 88 tons, respectively). This comparison is shown in Table 4.8.

Table 4.8 West Closure Complex pile load test comparison

West Closure Complex Comparison							
				ESTIMATED CAPACITY (TONS)			
Test Pile	Pile Type	Pile Tip Elev	Service Load, tons	0.25 inch Net Deflection Method	0.01 inch/Ton Gross Deflection Method	Tangent Gross Method	Ultimate Avg
TP-21tension	18" SWP	-105	48	92	85	115	98
TP-22tension	18" SWP-G	-105	48	92	75	95	88

A final comparison worth noting from Table 4.5 is between two piles, namely a 30" diameter longitudinally-welded pipe pile (TP-4) and an 18" diameter longitudinally-welded pipe pile (TP-32). Though each was from a different pile load test site, they were both still tested on the complex (meaning the soil is not drastically different from one pile load test site to another), both tipped at El-160, and both tested in compression. The reduced ultimate capacity of both were greater than two times the design service load, but that of the 30" diameter longitudinally-welded pipe pile (TP-4) was much greater than that of the 18" diameter longitudinally-welded pipe pile (TP-32) (i.e. 508 tons vs. 330 tons). Though this is expected, it is important because it signifies that slightly larger diameter pipe pile that may not cost a tremendous amount more to manufacture vs. typical H-piles could possibly reduce the number of piles required to resist a load, which ultimately could save a large amount of project funds. More observations can be

made from Table 4.2, but the emphasis of this research and of these results is the behaviors of spiral welded pipe piles both with the weld remaining and with the weld grinded flush and how they compare to other piles for similar conditions. This comparison is summarized in Table 4.9.

Table 4.9 West Closure Complex pile load test comparison

West Closure Complex Comparison							
				ESTIMATED CAPACITY (TONS)			
Test Pile	Pile Type	Pile Tip Elev	Service Load, tons	0.25 inch Net Deflection Method	0.01 inch/Ton Gross Deflection Method	Tangent Gross Method	Ultimate Avg
TP-4	30" pipe	-160	212	484	514	527	508
TP-32	18" pipe	-160	130	313	326	351	330

A main objective of this research was to compare the behaviors of spiral welded pipe piles to longitudinally-welded pipe piles with the same outer diameter and driven in the same foundation conditions to the same elevation. Several results earlier in this chapter emphasize this exact comparison, and in all cases, the spiral welded pipe pile typically had more load-carrying capacity than the longitudinally-welded pipe pile. Though there is no clear explanation for this phenomenon, one theory that attempts to explain it is for the spiral welded pipe piles with the weld remaining, the protruding weld effectively makes the diameter of that pile slightly bigger allowing that pile to obtain more end-bearing capacity than the longitudinally-welded counter part.

Though it was widely-believed that the protruding weld would affect the skin friction (i.e. both along the exterior and along the interior of the pile) and the interior soil plugging, numerous results comparing a spiral welded pipe pile with the weld remaining to that with the weld grinded flush, at a minimum, showed the exterior weld had little to no affect on the load-carrying capacity of the pile. It is unclear to what extent the protruding weld affected the soil plugging and inner skin friction of the pile as this was not the focus of the research.

As emphasized by the USACE Innovation Team, for all spiral welded pipe piles with and without the weld grinded flush, maximum compressive stresses developed in the pipe piles resulting from driving and restrike tests were below the Federal Highway Administration recommendation of 0.9 f_y for steel piles (USACE-MVN[2], 2010). This means that spiral welded pipe piles were able to withstand the same driving stresses that H-piles and longitudinally-welded pipe piles withstood, at least in southeastern Louisiana foundation soils.

One result that is important to this research is the cost analysis. This cost analysis will focus on the typical steel piles associated with this research and most USACE projects, specifically HP 14x89 and three different outer diameter pipe piles. By consulting a steel manufacturer, a current price for these types of piles associated with this research was derived. To start with, the current cost of steel is approximately $0.60/pound, but since these types of piles have different

cross-sections and thus different volumes, costs will vary. Therefore, it is appropriate to briefly describe the volumes of these different piles.

The cross-sectional area of a typical HP 14x89 is 26.1 in^2. For this cost comparison for both spiral welded and longitudinally-welded pipe piles, the wall thicknesses will be assumed at ½ in. The cross-sectional area of a typical 18 in. outer diameter spiral welded or longitudinally-welded pipe pile is 27.5 in^2. The cross-sectional area of a typical 20 in. outer diameter spiral welded or longitudinally-welded pipe pile is 30.6 in^2. Also, the cross-sectional area of a typical 24 in. outer diameter spiral welded or longitudinally-welded pipe pile is 36.9 in^2. If these cross-sections are converted to a volume on a per-foot basis, the volumes are calculated to be 0.18 ft^3 for HP 14x89, 0.19 ft^3 for 18 in. outer diameter, 0.21 ft^3 for 20 in. outer diameter, and 0.26 ft^3 for 24 in. outer diameter pipe piles. Assuming the unit weight of steel to be 490 lb/ft^3, the weight per foot for each is calculated to be approximately 89 lb/ft for HP 14x89, 93.1 lb/ft for 18 in. outer diameter, 102.9 lb/ft for 20 in. outer diameter, and 127.4 lb/ft for 24 in. outer diameter pipe piles. It is worth noting that for this discussion, the weight of any protruding weld is neglected.

Specific manufacturing process for piles may also affect costs. It is worth mentioning that there are two welding methods associated with longitudinally-welded pipe piles, namely the Electric Resonance Weld (ERW) and the Double Submerged Arc Weld (DSAW), whereas, for the spiral welded pipe pile, there is only the DSAW. The ERW is used when the longitudinally-welded pipe pile is less than 20 in. outer diameter, and the DSAW is used for outer diameters greater than or equal to 20 in. The cost for the ERW versus the DSAW will be accordingly different as will be explained in the following paragraph.

When the material cost is added to the manufacturing cost, a steel manufacturer can get the piles to an average job site in southeastern Louisiana at an approximate cost of $53.40/ft for HP 14x89, $41.85/ft for 18 in. outer diameter spiral welded pipe pile, $47.25/ft for 20 in. outer diameter spiral welded pipe pile, $50.40/ft for 20 in. outer diameter longitudinally-welded pipe pile, $56.55/ft for 24 in. outer diameter spiral welded pipe pile, and $75.00/ft for 24 in. outer diameter longitudinally-welded pipe pile. It is also worth mentioning that normally no more than 40,000 lbs. can safely be loaded on a truck to be delivered to a site. This could be a major factor if savings can be

CHAPTER 5 CONCLUSIONS/RECOMMENDATIONS

After Hurricanes Katrina and Rita devastated the Gulf Coast Region, the U.S. Army Corps of Engineers implemented the Hurricane and Storm Damage Risk Reduction Design Guidelines in an effort to ensure the level of hurricane protection in southeastern Louisiana would be designed to withstand a storm that had a 1% chance of being exceeded in any given year, commonly referred to as a 100-year storm. With this in mind, the specific objective of determining if spiral welded pipe piles were a viable alternative to the pile foundations for the HSDRRS structures in southeastern Louisiana from a geotechnical perspective came about. From the results, it is proven that a spiral welded pipe pile with similar outer surface dimensions to that of a typical H-pile yields more capacity than the H-pile if driven in the same manner, to the same depth, and in the same foundation soils. Essentially, this infers that for a given capacity of a driven H-pile to a certain depth, the same capacity can be obtained in a spiral welded pipe pile driven to a shorter depth. Shorter piles lead to project savings. Furthermore, it is also concluded that if a slightly larger diameter spiral welded pipe pile (i.e. 24" vs. 18" outer diameter) is selected rather than the one that approximates the outer surface dimensions of the H-pile, an even shorter length of pile can be used to obtain the same capacity, or even more importantly, the number of piles required can potentially be reduced for a given depth.

Another objective of this research was to compare spiral welded pipe piles to longitudinally-welded pipe piles. Specifically, testing was conducted to determine if the weld itself that followed the spiral path on the spiral welded pipe piles would affect the set-up along the shaft of the pile from a geotechnical perspective compared to the single, longitudinal weld along the shaft of the longitudinally-welded pipe pile. From the results, spiral welded pipe piles consistently yielded higher capacities than longitudinally welded pipe piles. Again, this infers that for a given capacity of a driven longitudinally welded pipe pile to a certain depth, the same capacity can be obtained in a spiral welded pipe pile driven to a slightly shorter depth, which again would lead to project savings.

A third objective of this research was to investigate the weld itself. Specifically, testing was conducted to determine if allowing the weld, which protrudes 1/8 inch, to remain versus grinding the weld flush with the outer diameter of the spiral welded pipe pile would again affect the set-up along the shaft of the pile from a geotechnical perspective. The results showed that spiral welded pipe piles with the 1/8 inch protruding weld remaining consistently yielded the same if not higher capacities than that of the spiral welded pipe piles with the weld grinded flush, given all other aspects are the same. This is important because grinding the weld flush requires special techniques that would cost a manufacturer and hence a project slightly more to produce.

A fourth objective of this research was to determine if spiral welded pipe piles were feasible to have manufactured for HSDRRS projects in southeastern Louisiana. Manufacturers have attested that the state-of-the-art process of spiral welding pipe piles is cheaper than rolling H-piles or manufacturing longitudinally-welded pipe pile, assuming material costs are the same. Therefore, project savings, even if relatively small, can again be realized by using spiral welded pipe piles.

In conclusion, this research has proven that spiral welded pipe piles, at least from a geotechnical and an economical perspective, are a viable alternative for pile foundations in HSDRRS structural projects in southeastern Louisiana.

CHAPTER 6 FUTURE RESEARCH

Piles have been used in foundations of structures for many, many years. Quite often, the pile foundations supporting structures are driven at some battered angle rather than truly vertical. Similar to many things in life, there are pros and cons to using battered piles. Because of its batter, a battered pile has both vertical and horizontal components of resistance. However, also because of its batter, a battered pile is more subject to down drag and bending stresses as the batter of the pile increases away from vertical. Nevertheless, when a geotechnical engineer attempts to model the behavior of a particular pile, it is standard practice for him or her to conservatively assume the pile is vertical. The theoretical capacity analyses for the piles as well as the static and dynamic testing of the piles associated with this research all considered the pile to be truly vertical. It would be interesting for research to be completed, again on spiral welded pipe piles, but focusing in on the batter of the piles and the behavior of the battered spiral welded pipe piles compared to other types of battered piles.

It is well-known in the world of engineering that piles can be loaded axially or laterally, or both axially and laterally at the same time. The majority of the field-testing associated with this research focused on axially-loaded piles, with only one pair of piles being loaded laterally. Therefore, another suggestion for future research would be for someone to extend this spiral welded pipe pile research and focus on lateral loads on the piles. Behaviors of the spiral welded pipe pile due to the lateral loading could be compared to that for other type of piles.

As stated numerous times throughout this research, piles associated with this research were tested in highly-stratified and relatively weak foundation material. With this in mind, a third recommendation for future research is to study the behaviors of spiral welded pipe piles as well as other types of piles all driven into stiffer soils. Though load-carrying capacities may increase and pile lengths may decrease, stress in the pile itself may increase significantly due to driving into stiffer soils, which may in turn affect the structural integrity of the spiral welded pipe pile.

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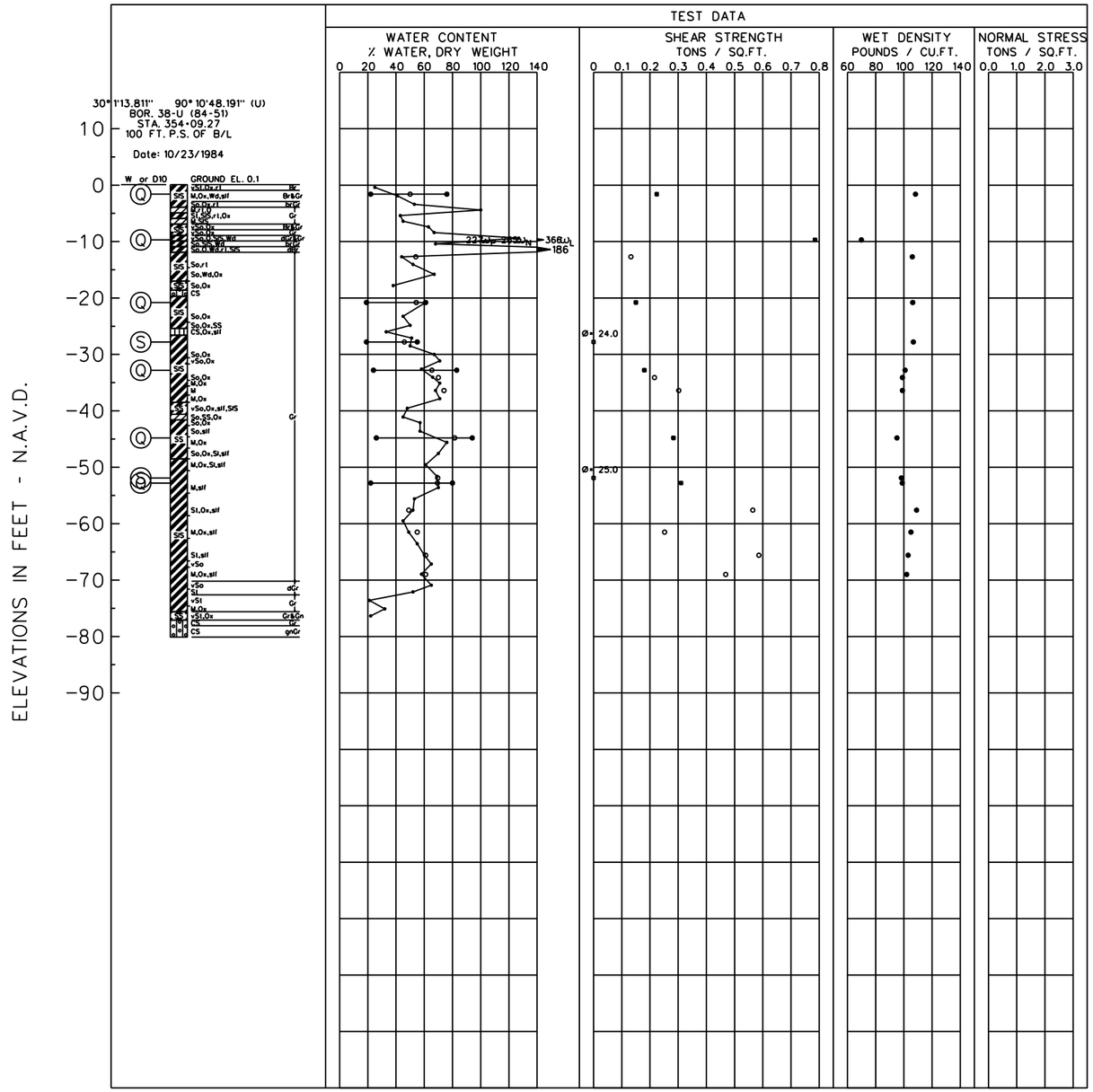
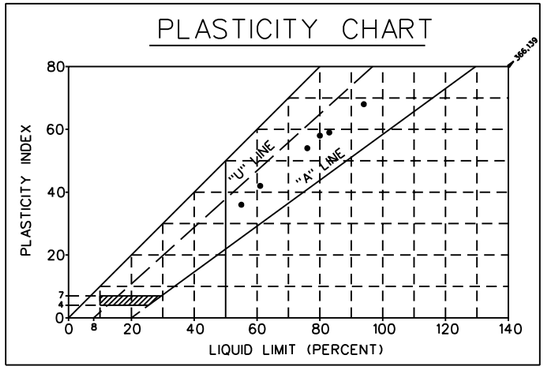
APPENDIX A



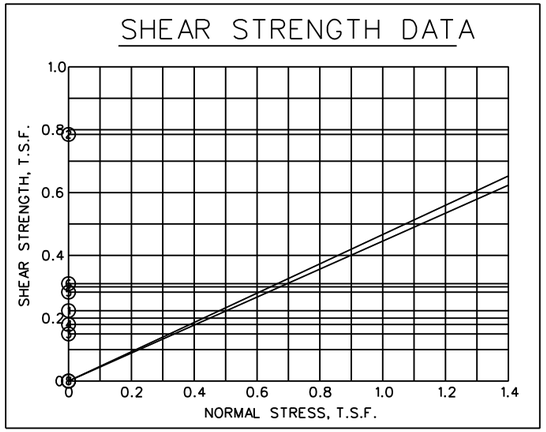
PLASTICITY CHART



TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH c - TSF	CLASS
1	-1.6	Q	0.0	0.224	CH
2	-9.7	Q	0.0	0.785	PT
3	-20.8	Q	0.0	0.150	CH
4	-32.8	Q	0.0	0.180	CH
5	-44.8	Q	0.0	0.283	CH
6	-52.8	Q	0.0	0.310	CH
7	-27.8	S	24.0	0.000	CH
8	-51.9	S	25.0	0.000	CH

SHEAR STRENGTH DATA



NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST

ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

PLATE A-1

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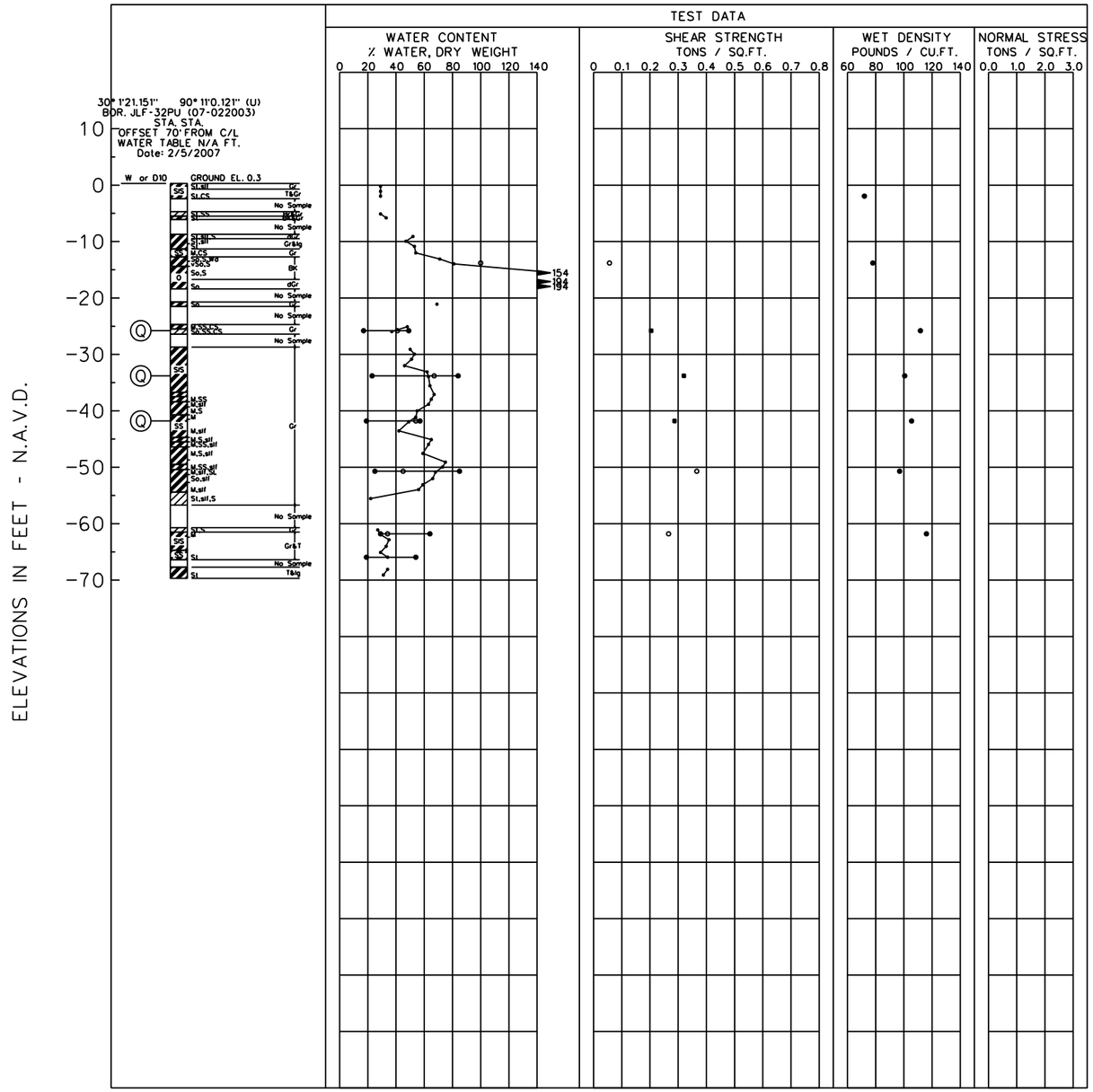

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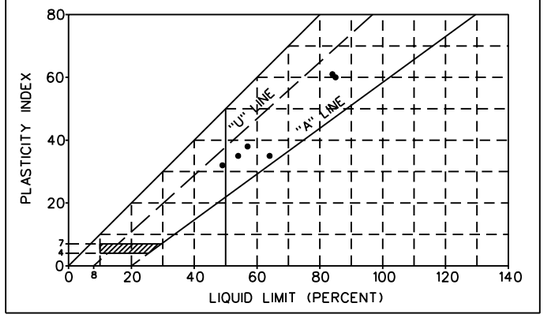

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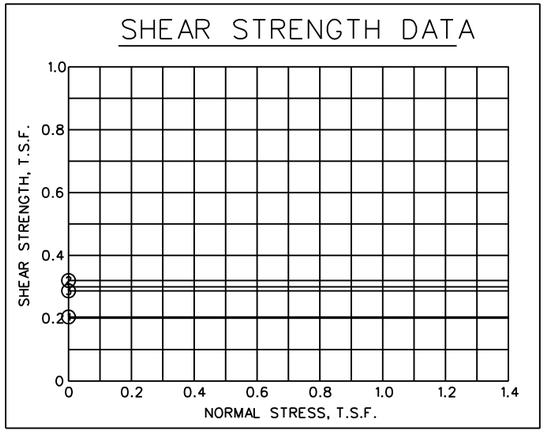

TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH c - TSF	CLASS
1	-25.8	0	0.0	0.204	CL
2	-33.8	0	0.0	0.320	CH
3	-41.8	0	0.0	0.287	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST

ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

PLATE A-2

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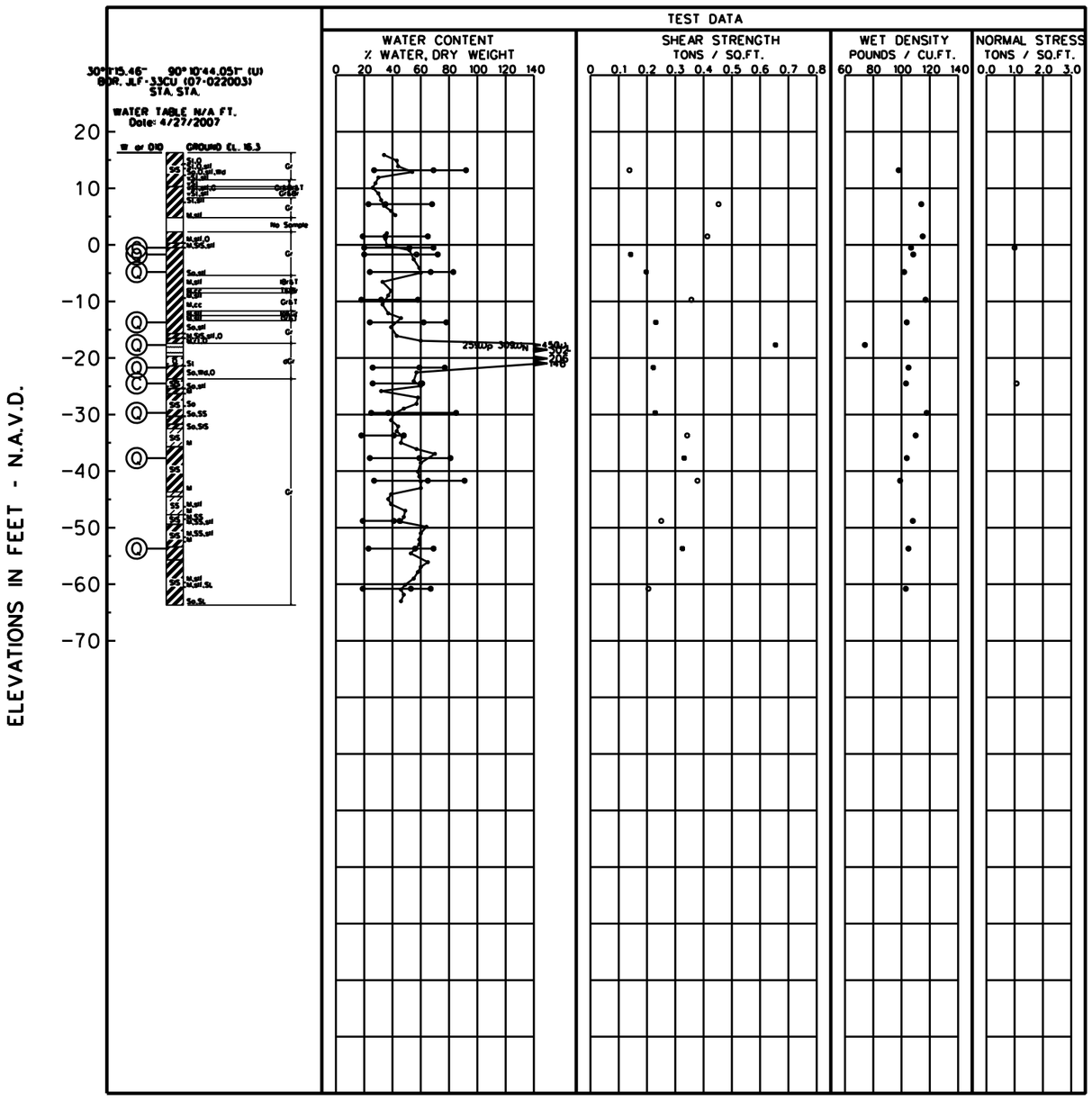

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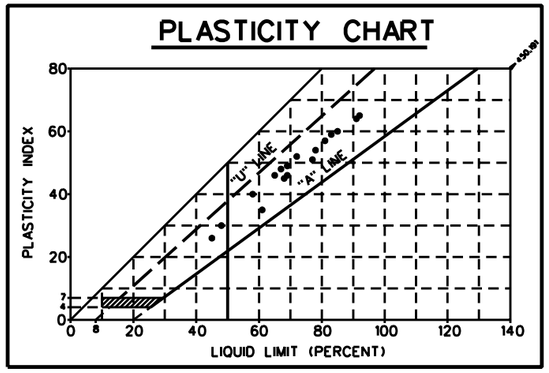

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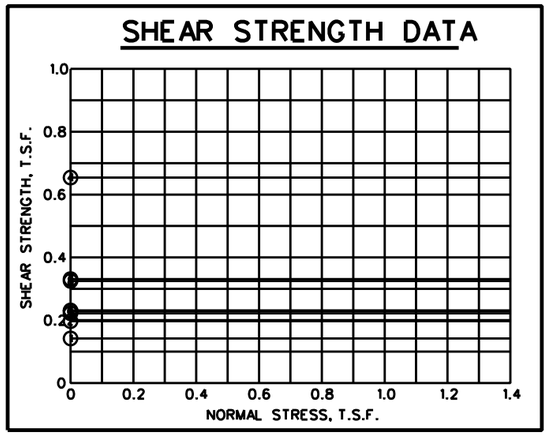

TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C · TSF	CLASS
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2	-4.8	Q	0.0	0.197	CH
3	-13.7	Q	0.0	0.231	CH
4	-17.7	Q	0.0	0.654	PT
5	-21.7	Q	0.0	0.222	CH
6	-29.7	Q	0.0	0.229	CH
7	-37.7	Q	0.0	0.331	CH
8	-53.7	Q	0.0	0.325	CH
9	-0.5	C	0.0	0.000	CH
10	-24.5	C	0.0	0.000	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST

ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

PLATE A-3

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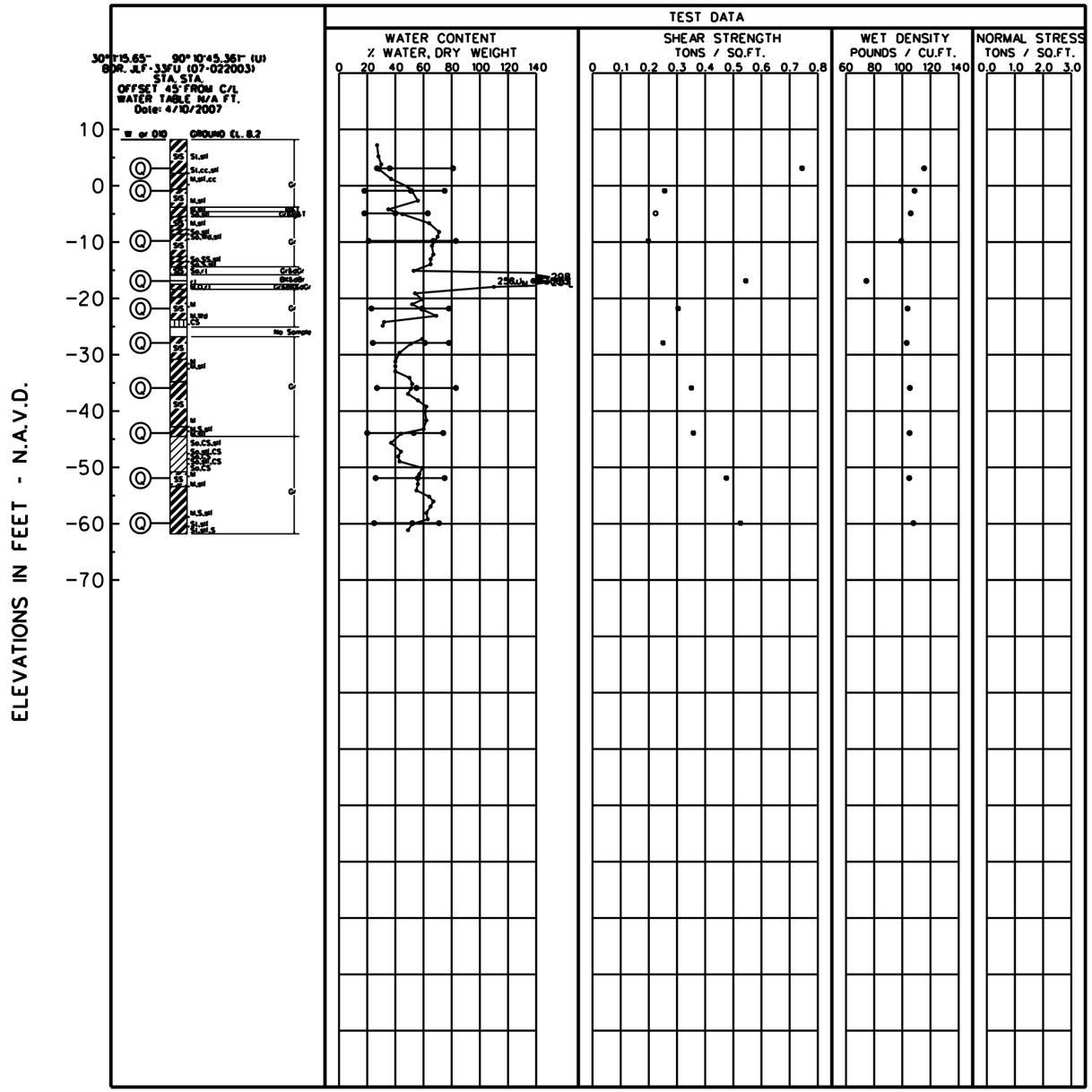

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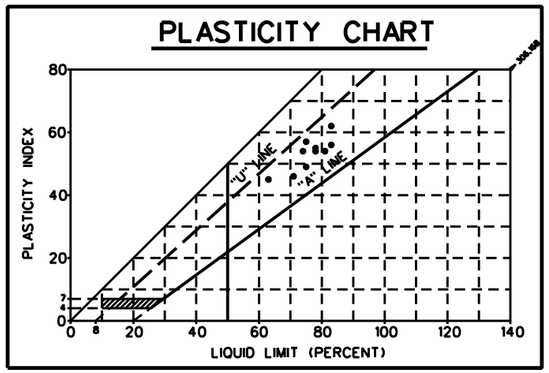

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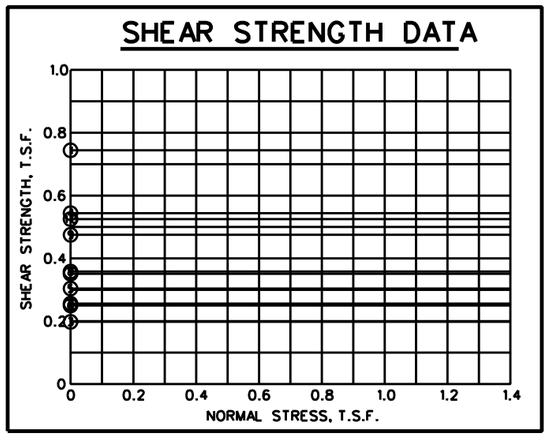

TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH c · TSF	CLASS
1	3.1	0	0.0	0.744	CH
2	-0.9	0	0.0	0.256	CH
3	-9.8	0	0.0	0.198	CH
4	-16.9	0	0.0	0.544	PT
5	-21.8	0	0.0	0.304	CH
6	-27.9	0	0.0	0.250	CH
7	-35.9	0	0.0	0.351	CH
8	-43.9	0	0.0	0.358	CH
9	-51.9	0	0.0	0.475	CH
10	-59.9	0	0.0	0.525	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST

ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

PLATE A-4

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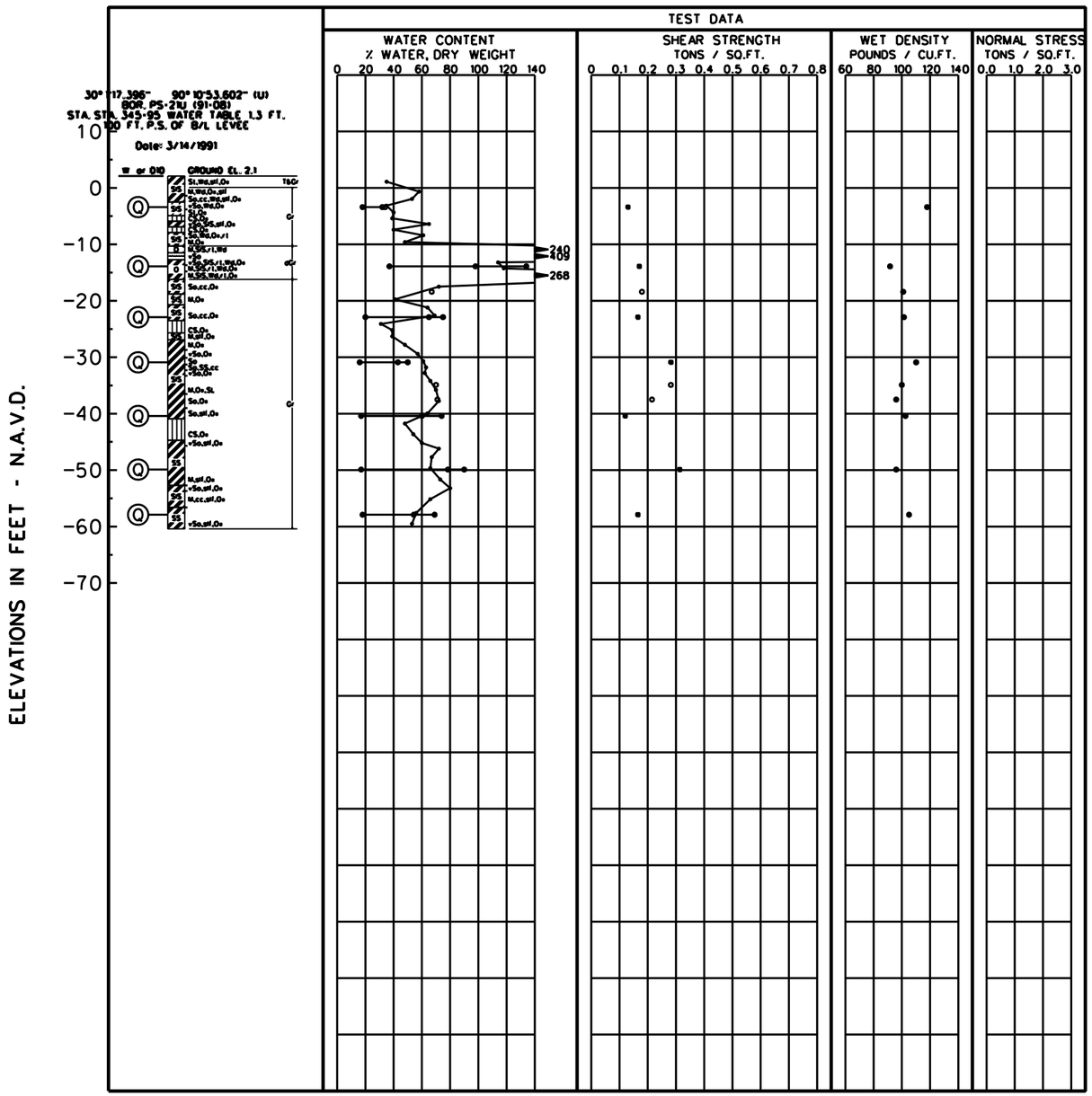

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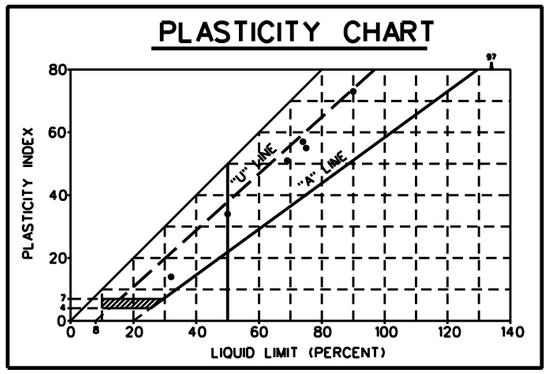

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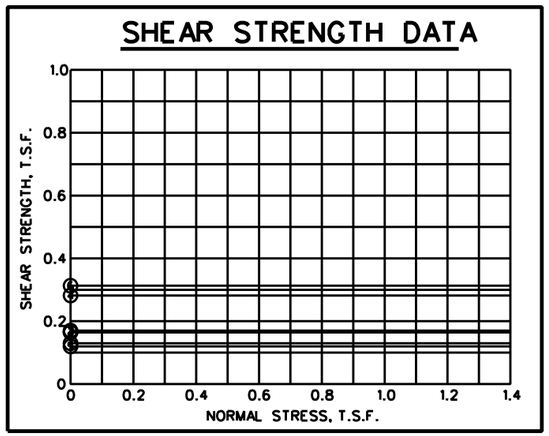

TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C · TSF	CLASS
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2	-13.9	0	0.0	0.170	CH
3	-22.9	0	0.0	0.165	CH
4	-30.9	0	0.0	0.282	CH
5	-40.4	0	0.0	0.120	CH
6	-49.9	0	0.0	0.313	CH
7	-57.9	0	0.0	0.165	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST

ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

PLATE A-5

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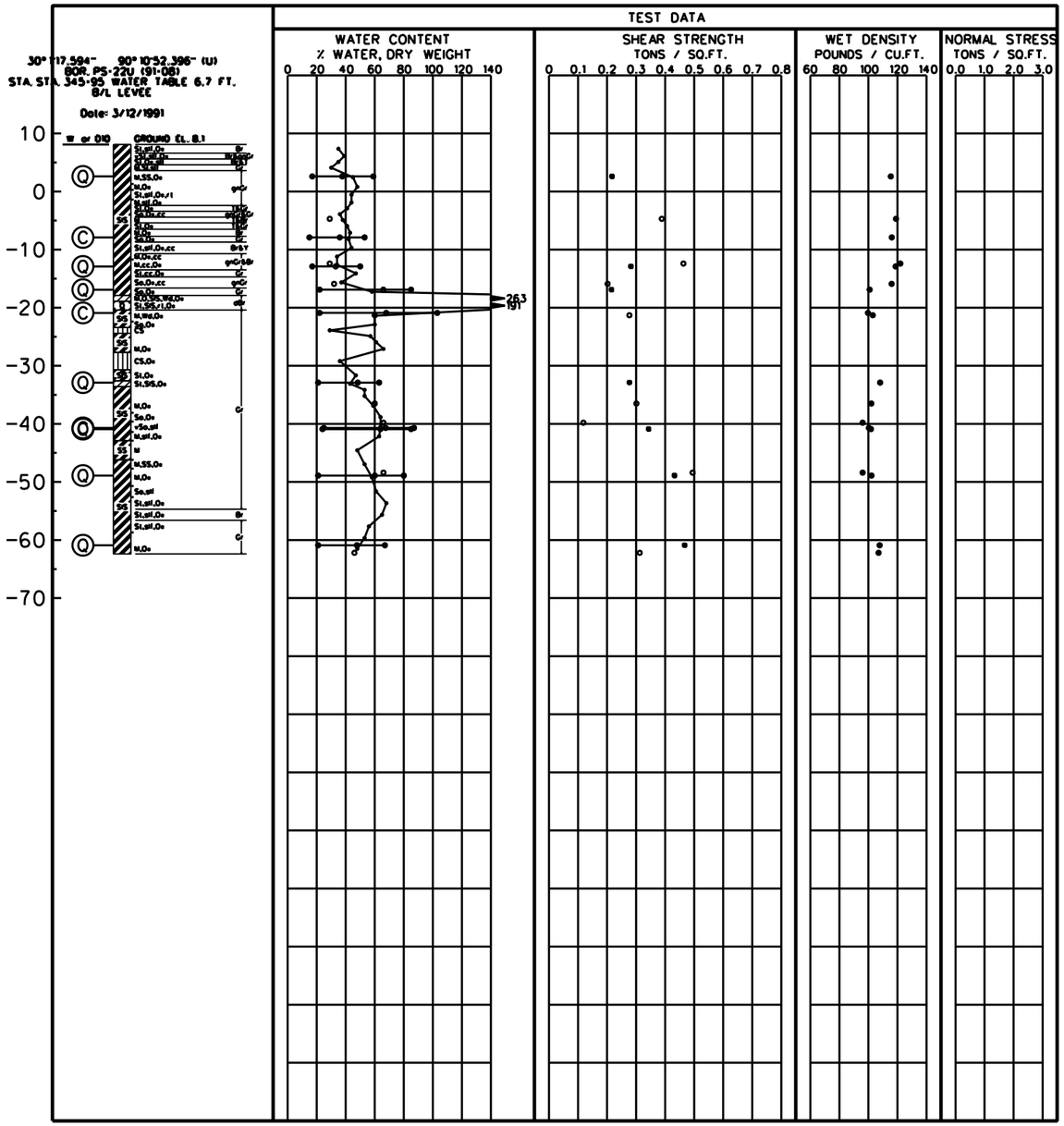

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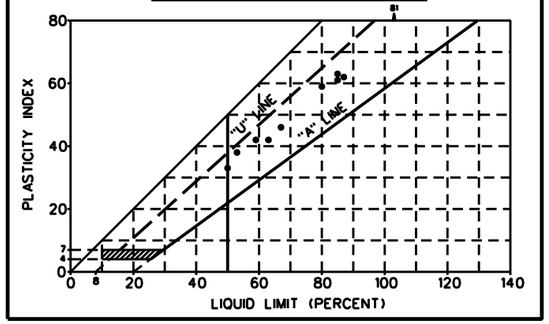

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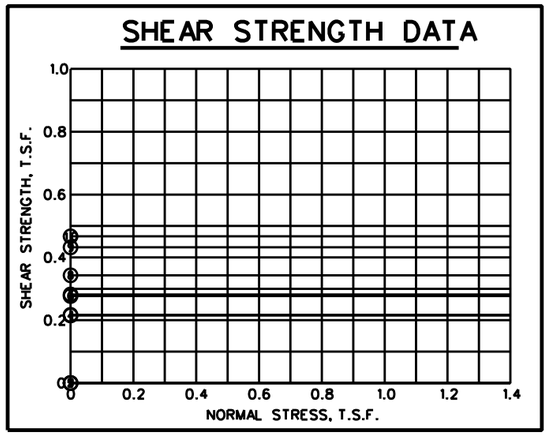


TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C · TSF	CLASS
1	2.6	0	0.0	0.217	CH
2	-7.9	C	0.0	0.000	CH
3	-12.9	0	0.0	0.282	CH
4	-16.9	0	0.0	0.215	CH
5	-20.9	C	0.0	0.000	CH
6	-32.9	0	0.0	0.277	CH
7	-40.7	C	0.0	0.000	CH
8	-40.9	0	0.0	0.343	CH
9	-48.9	0	0.0	0.432	CH
10	-60.9	0	0.0	0.467	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST
- ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

PLATE A-6

30° 1'17.796" 90° 10'51.103" (U)
BOR. PS-23U (91-08)
STA. STA. 345+95 WATER TABLE 1.0 FT.
95 FT. F.S. OF B/L LEVEE
Date: 3/7/1991

W or D10 GROUND EL. 4

ELEVATIONS IN FEET - N.A.V.D.

TEST DATA

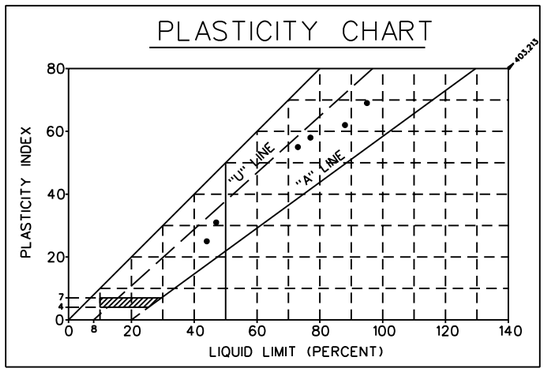
WATER CONTENT
% WATER, DRY WEIGHT

SHEAR STRENGTH
TONS / SQ.FT.

WET DENSITY
POUNDS / CU.FT.

NORMAL STRESS
TONS / SQ.FT.

PLASTICITY CHART



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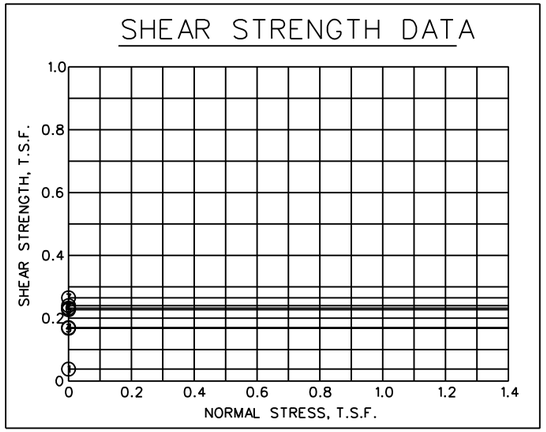


TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH c - TSF	CLASS
1	-1.5	Q	0.0	0.038	CH
2	-9.0	Q	0.0	0.240	PT
3	-17.0	Q	0.0	0.168	CH
4	-30.0	Q	0.0	0.170	CL
5	-37.0	Q	0.0	0.227	CH
6	-45.0	Q	0.0	0.232	CL
7	-53.0	Q	0.0	0.265	CH

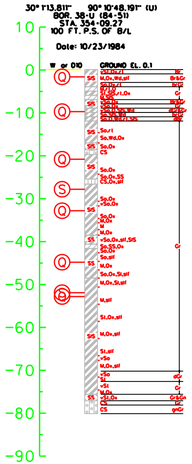
NOTES

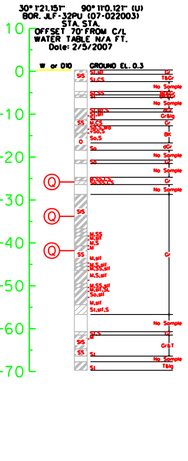
- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST

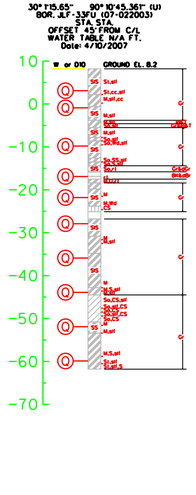
ω_P ω_N ω_L ATTERBERG LIMITS

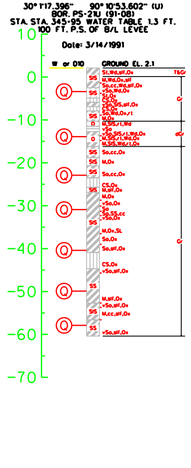
BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

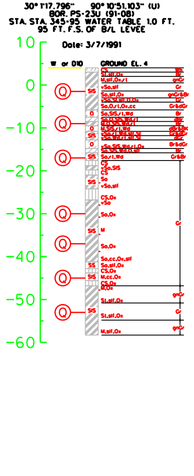
PLATE A-7

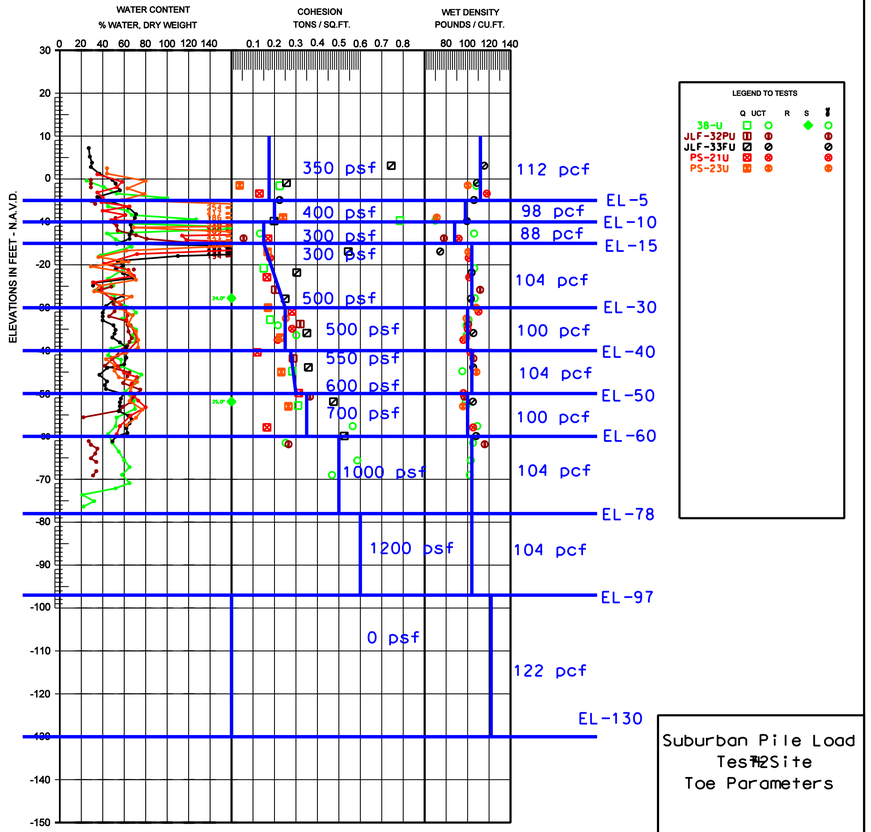












Suburban Pile Load Test Site
Toe Parameters

PLATE A-8

Suburban_SHEAR_PLATE_Moisture_V8 (TOE).dgn 10/7/2010 1:13:40 PM

Suburban 18" Spiral Welded Pipe Pile

Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	Q-CASE													
								Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
1	4.5	0	112	49.5	0	0	0	350	350	0	0	1.00	1.00	1.00	9.00	No	0.000	0.000	0.000	0.000	0.000	0.000
1	4	0.5	112	49.5	28	28	56	350	350	0	0	1.00	1.00	1.00	9.00	No	0.412	0.000	0.000	0.000	0.412	0.412
1	3	1	112	49.5	112	112	168	350	350	0	0	1.00	1.00	1.00	9.00	No	1.237	0.000	0.000	0.000	1.237	1.237
1	2	1	112	49.5	224	224	280	350	350	0	0	1.00	1.00	1.00	9.00	No	2.062	0.000	0.000	0.000	2.062	2.062
1	1	1	112	49.5	336	336	392	350	350	0	0	1.00	1.00	1.00	9.00	No	2.886	0.000	0.000	0.000	2.886	2.886
1	0	1	112	49.5	448	448	504	350	350	0	0	1.00	1.00	1.00	9.00	No	3.711	0.000	0.000	0.000	3.711	3.711
1	-1	1	112	49.5	528.75	528.75	553.5	350	350	0	0	1.00	1.00	1.00	9.00	No	4.536	0.000	0.000	0.000	4.536	4.536
1	-2	1	112	49.5	578.25	578.25	603	350	350	0	0	1.00	1.00	1.00	9.00	No	5.360	0.000	0.000	0.000	5.360	5.360
1	-3	1	112	49.5	627.75	627.75	652.5	350	350	0	0	1.00	1.00	1.00	9.00	No	6.185	0.000	0.000	0.000	6.185	6.185
1	-4	1	112	49.5	677.25	677.25	702	350	350	0	0	1.00	1.00	1.00	9.00	No	7.010	0.000	0.000	0.000	7.010	7.010
1	-5	1	112	49.5	726.75	726.75	751.5	350	350	0	0	1.00	1.00	1.00	9.00	No	7.834	0.000	0.000	0.000	7.834	7.834
2	-6	1	98	35.5	769.25	769.25	787	400	400	0	0	1.00	1.00	1.00	9.00	No	8.777	0.000	0.000	0.000	8.777	8.777
2	-7	1	98	35.5	804.75	804.75	822.5	400	400	0	0	1.00	1.00	1.00	9.00	No	9.719	0.000	0.000	0.000	9.719	9.719
2	-8	1	98	35.5	840.25	840.25	858	400	400	0	0	1.00	1.00	1.00	9.00	No	10.662	0.000	0.000	0.000	10.662	10.662
2	-9	1	98	35.5	875.75	875.75	893.5	400	400	0	0	1.00	1.00	1.00	9.00	No	11.604	0.000	0.000	0.000	11.604	11.604
2	-10	1	98	35.5	911.25	911.25	929	400	400	0	0	1.00	1.00	1.00	9.00	No	12.547	0.000	0.000	0.000	12.547	12.547
3	-11	1	88	25.5	941.75	941.75	954.5	300	300	0	0	1.00	1.00	1.00	9.00	No	13.254	0.000	0.000	0.000	13.254	13.254
3	-12	1	88	25.5	967.25	967.25	980	300	300	0	0	1.00	1.00	1.00	9.00	No	13.960	0.000	0.000	0.000	13.960	13.960
3	-13	1	88	25.5	992.75	992.75	1005.5	300	300	0	0	1.00	1.00	1.00	9.00	No	14.667	0.000	0.000	0.000	14.667	14.667
3	-14	1	88	25.5	1018.25	1018.25	1031	300	300	0	0	1.00	1.00	1.00	9.00	No	15.374	0.000	0.000	0.000	15.374	15.374
3	-15	1	88	25.5	1043.75	1043.75	1056.5	300	300	0	0	1.00	1.00	1.00	9.00	No	16.081	0.000	0.000	0.000	16.081	16.081
4	-16	1	104	41.5	1077.25	1077.25	1098	313.333344	306.666687	0	0	1.00	1.00	1.00	9.00	No	16.804	0.000	0.000	0.000	16.804	16.804
4	-17	1	104	41.5	1118.75	1118.75	1139.5	326.666656	320	0	0	1.00	1.00	1.00	9.00	No	17.558	0.000	0.000	0.000	17.558	17.558
4	-18	1	104	41.5	1160.25	1160.25	1181	340	333.333313	0	0	1.00	1.00	1.00	9.00	No	18.343	0.000	0.000	0.000	18.343	18.343
4	-19	1	104	41.5	1201.75	1201.75	1222.5	353.333344	346.666687	0	0	1.00	1.00	1.00	9.00	No	19.160	0.000	0.000	0.000	19.160	19.160
4	-20	1	104	41.5	1243.25	1243.25	1264	366.666656	360	0	0	1.00	1.00	1.00	9.00	No	20.008	0.000	0.000	0.000	20.008	20.008
4	-21	1	104	41.5	1284.75	1284.75	1305.5	380	373.333313	0	0	1.00	1.00	1.00	9.00	No	20.888	0.000	0.000	0.000	20.888	20.888
4	-22	1	104	41.5	1326.25	1326.25	1347	393.333344	386.666687	0	0	1.00	1.00	1.00	9.00	No	21.799	0.000	0.000	0.000	21.799	21.799
4	-23	1	104	41.5	1367.75	1367.75	1388.5	406.666656	400	0	0	1.00	1.00	1.00	9.00	No	22.741	0.000	0.000	0.000	22.741	22.741
4	-24	1	104	41.5	1409.25	1409.25	1430	420	413.333313	0	0	1.00	1.00	1.00	9.00	No	23.715	0.000	0.000	0.000	23.715	23.715
4	-25	1	104	41.5	1450.75	1450.75	1471.5	433.333344	426.666687	0	0	1.00	1.00	1.00	9.00	No	24.720	0.000	0.000	0.000	24.720	24.720
4	-26	1	104	41.5	1492.25	1492.25	1513	446.666656	440	0	0	1.00	1.00	1.00	9.00	No	25.757	0.000	0.000	0.000	25.757	25.757
4	-27	1	104	41.5	1533.75	1533.75	1554.5	460	453.333313	0	0	1.00	1.00	1.00	9.00	No	26.825	0.000	0.000	0.000	26.825	26.825
4	-28	1	104	41.5	1575.25	1575.25	1596	473.333344	466.666687	0	0	1.00	1.00	1.00	9.00	No	27.925	0.000	0.000	0.000	27.925	27.925
4	-29	1	104	41.5	1616.75	1616.75	1637.5	486.666656	480	0	0	1.00	1.00	1.00	9.00	No	29.056	0.000	0.000	0.000	29.056	29.056
4	-30	1	104	41.5	1658.25	1658.25	1679	500	493.333313	0	0	1.00	1.00	1.00	9.00	No	30.218	0.000	0.000	0.000	30.218	30.218
5	-31	1	100	37.5	1697.75	1697.75	1716.5	500	500	0	0	1.00	1.00	1.00	9.00	No	31.396	0.000	0.000	0.000	31.396	31.396
5	-32	1	100	37.5	1735.25	1735.25	1754	500	500	0	0	1.00	1.00	1.00	9.00	No	32.574	0.000	0.000	0.000	32.574	32.574
5	-33	1	100	37.5	1772.75	1772.75	1791.5	500	500	0	0	1.00	1.00	1.00	9.00	No	33.752	0.000	0.000	0.000	33.752	33.752
5	-34	1	100	37.5	1810.25	1810.25	1829	500	500	0	0	1.00	1.00	1.00	9.00	No	34.931	0.000	0.000	0.000	34.931	34.931
5	-35	1	100	37.5	1847.75	1847.75	1866.5	500	500	0	0	1.00	1.00	1.00	9.00	No	36.109	0.000	0.000	0.000	36.109	36.109
5	-36	1	100	37.5	1885.25	1885.25	1904	500	500	0	0	1.00	1.00	1.00	9.00	No	37.287	0.000	0.000	0.000	37.287	37.287
5	-37	1	100	37.5	1922.75	1922.75	1941.5	500	500	0	0	1.00	1.00	1.00	9.00	No	38.465	0.000	0.000	0.000	38.465	38.465
5	-38	1	100	37.5	1960.25	1960.25	1979	500	500	0	0	1.00	1.00	1.00	9.00	No	39.643	0.000	0.000	0.000	39.643	39.643
5	-39	1	100	37.5	1997.75	1997.75	2016.5	500	500	0	0	1.00	1.00	1.00	9.00	No	40.821	0.000	0.000	0.000	40.821	40.821
5	-40	1	100	37.5	2035.25	2035.25	2054	500	500	0	0	1.00	1.00	1.00	9.00	No	41.999	0.000	0.000	0.000	41.999	41.999
6	-41	1	104	41.5	2074.75	2074.75	2095.5	555	526.25	0	0	1.00	1.00	1.00	9.00	No	43.239	0.000	0.000	0.000	43.239	43.239
6	-42	1	104	41.5	2116.25	2116.25	2137	560	528.75	0	0	1.00	1.00	1.00	9.00	No	44.485	0.000	0.000	0.000	44.485	44.485
6	-43	1	104	41.5	2157.75	2157.75	2178.5	565	531.25	0	0	1.00	1.00	1.00	9.00	No	45.737	0.000	0.000	0.000	45.737	45.737
6	-44	1	104	41.5	2199.25	2199.25	2220	570	533.75	0	0	1.00	1.00	1.00	9.00	No	46.994	0.000	0.000	0.000	46.994	46.994
6	-45	1	104	41.5	2240.75	2240.75	2261.5	575	536.25	0	0	1.00	1.00	1.00	9.00	No	48.258	0.000	0.000	0.000	48.258	48.258
6	-46	1	104	41.5	2282.25	2282.25	2303	580	538.75	0	0	1.00	1.00	1.00	9.00	No	49.527	0.000	0.000	0.000	49.527	49.527
6	-47	1	104	41.5	2323.75	2323.75	2344.5	585	541.25	0	0	1.00	1.00	1.00	9.00	No	50.803	0.000	0.000	0.000	50.803	50.803
6	-48	1	104	41.5	2365.25	2365.25	2386	590	543.75	0	0	1.00	1.00	1.00	9.00	No	52.084	0.000	0.000	0.000	52.084	52.084
6	-49	1	104	41.5	2406.75	2406.75	2427.5	595	546.25	0	0	1.00	1.00	1.00	9.00	No	53.371	0.000	0.000	0.000	53.371	53.371
6	-50	1	104	41.5	2448.25	2448.25	2469	600	548.75	0	0	1.00	1.00	1.00	9.00	No	54.664	0.000	0.000	0.000	54.664	54.664
7	-51	1	100	37.5	2487.75	2487.75	2506.5	700	600	0	0	1.00	1.00	1.00	9.00	No	56.077	0.000	0.000	0.000	56.077	56.077
7	-52	1	100	37.5	2525.25	2525.25	2544	700	600	0	0	1.00	1.00	1.00	9.00	No	57.491	0.000	0.000	0.000	57.491	57.491
7	-53	1	100	37.5	2562.75	2562.75	2581.5	700	600	0	0	1.00	1.00	1.00	9.00	No	58.905	0.000	0.000	0.000	58.905	58.905

PLATE A-9-a

Suburban 18" Spiral Welded Pipe Pile

Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	Q-CASE													
								Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
7	-54	1	100	37.5	2600.25	2600.25	2619	700	600	0	0	1.00	1.00	1.00	9.00	No	60.319	0.000	0.000	0.000	60.319	60.319
7	-55	1	100	37.5	2637.75	2637.75	2656.5	700	600	0	0	1.00	1.00	1.00	9.00	No	61.732	0.000	0.000	0.000	61.732	61.732
7	-56	1	100	37.5	2675.25	2675.25	2694	700	600	0	0	1.00	1.00	1.00	9.00	No	63.146	0.000	0.000	0.000	63.146	63.146
7	-57	1	100	37.5	2712.75	2712.75	2731.5	700	600	0	0	1.00	1.00	1.00	9.00	No	64.560	0.000	0.000	0.000	64.560	64.560
7	-58	1	100	37.5	2750.25	2750.25	2769	700	600	0	0	1.00	1.00	1.00	9.00	No	65.973	0.000	0.000	0.000	65.973	65.973
7	-59	1	100	37.5	2787.75	2787.75	2806.5	700	600	0	0	1.00	1.00	1.00	9.00	No	67.387	0.000	0.000	0.000	67.387	67.387
7	-60	1	100	37.5	2825.25	2825.25	2844	700	600	0	0	1.00	1.00	1.00	9.00	No	68.801	0.000	0.000	0.000	68.801	68.801
8	-61	1	104	41.5	2864.75	2864.75	2885.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	70.568	0.000	0.000	10.502	81.070	70.568
8	-62	1	104	41.5	2906.25	2906.25	2927	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	72.335	0.000	0.000	10.538	82.874	72.335
8	-63	1	104	41.5	2947.75	2947.75	2968.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	74.102	0.000	0.000	10.575	84.677	74.102
8	-64	1	104	41.5	2989.25	2989.25	3010	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	75.869	0.000	0.000	10.612	86.481	75.869
8	-65	1	104	41.5	3030.75	3030.75	3051.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	77.637	0.000	0.000	10.648	88.285	77.637
8	-66	1	104	41.5	3072.25	3072.25	3093	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	79.404	0.000	0.000	10.685	90.089	79.404
8	-67	1	104	41.5	3113.75	3113.75	3134.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	81.171	0.000	0.000	10.722	91.893	81.171
8	-68	1	104	41.5	3155.25	3155.25	3176	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	82.938	0.000	0.000	10.758	93.696	82.938
8	-69	1	104	41.5	3196.75	3196.75	3217.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	84.705	0.000	0.000	10.795	95.500	84.705
8	-70	1	104	41.5	3238.25	3238.25	3259	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	86.472	0.000	0.000	10.832	97.304	86.472
8	-71	1	104	41.5	3279.75	3279.75	3300.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	88.239	0.000	0.000	10.868	99.108	88.239
8	-72	1	104	41.5	3321.25	3321.25	3342	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	90.007	0.000	0.000	10.905	100.912	90.007
8	-73	1	104	41.5	3362.75	3362.75	3383.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	91.774	0.000	0.000	10.942	102.715	91.774
8	-74	1	104	41.5	3404.25	3404.25	3425	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	93.541	0.000	0.000	10.978	104.519	93.541
8	-75	1	104	41.5	3445.75	3445.75	3466.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	95.308	0.000	0.000	11.015	106.323	95.308
8	-76	1	104	41.5	3487.25	3487.25	3500	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	97.075	0.000	0.000	11.045	108.120	97.075
8	-77	1	104	41.5	3528.75	3500	3500	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	98.842	0.000	0.000	11.045	109.887	98.842
8	-78	1	104	41.5	3570.25	3500	3500	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	100.609	0.000	0.000	11.045	111.654	100.609
9	-79	1	104	41.5	3611.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	102.377	0.000	0.000	12.635	115.012	102.377
9	-80	1	104	41.5	3653.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	104.144	0.000	0.000	12.635	116.779	104.144
9	-81	1	104	41.5	3694.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	105.911	0.000	0.000	12.635	118.546	105.911
9	-82	1	104	41.5	3736.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	107.678	0.000	0.000	12.635	120.313	107.678
9	-83	1	104	41.5	3777.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	109.445	0.000	0.000	12.635	122.080	109.445
9	-84	1	104	41.5	3819.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	111.212	0.000	0.000	12.635	123.847	111.212
9	-85	1	104	41.5	3860.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	112.979	0.000	0.000	12.635	125.615	112.979
9	-86	1	104	41.5	3902.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	114.747	0.000	0.000	12.635	127.382	114.747
9	-87	1	104	41.5	3943.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	116.514	0.000	0.000	12.635	129.149	116.514
9	-88	1	104	41.5	3985.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	118.281	0.000	0.000	12.635	130.916	118.281
9	-89	1	104	41.5	4026.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	120.048	0.000	0.000	12.635	132.683	120.048
9	-90	1	104	41.5	4068.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	121.815	0.000	0.000	12.635	134.450	121.815
9	-91	1	104	41.5	4109.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	123.582	0.000	0.000	12.635	136.217	123.582
9	-92	1	104	41.5	4151.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	125.349	0.000	0.000	12.635	137.985	125.349
9	-93	1	104	41.5	4192.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	127.117	0.000	0.000	12.635	139.752	127.117
9	-94	1	104	41.5	4234.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	128.884	0.000	0.000	12.635	141.519	128.884
9	-95	1	104	41.5	4275.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	130.651	0.000	0.000	12.635	143.286	130.651
9	-96	1	104	41.5	4317.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	132.418	0.000	0.000	12.635	145.053	132.418
9	-97	1	104	41.5	4358.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	134.185	0.000	0.000	12.635	146.820	134.185
10	-98	1	122	59.5	4409.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	3.752	2.101	69.581	207.519	136.286
10	-99	1	122	59.5	4468.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	7.504	4.202	69.581	211.270	138.387
10	-100	1	122	59.5	4528.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	11.256	6.303	69.581	215.022	140.488
10	-101	1	122	59.5	4587.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	15.008	8.404	69.581	218.774	142.590
10	-102	1	122	59.5	4647.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	18.760	10.505	69.581	222.526	144.691
10	-103	1	122	59.5	4706.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	22.512	12.606	69.581	226.278	146.792
10	-104	1	122	59.5	4766.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	26.264	14.708	69.581	230.030	148.893
10	-105	1	122	59.5	4825.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	30.015	16.809	69.581	233.782	150.994
10	-106	1	122	59.5	4885.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	33.767	18.910	69.581	237.534	153.095
10	-107	1	122	59.5	4944.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	37.519	21.011	69.581	241.286	155.196
10	-108	1	122	59.5	5004.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	41.271	23.112	69.581	245.038	157.297
10	-109	1	122	59.5	5063.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	45.023	25.213	69.581	248.790	159.398
10	-110	1	122	59.5	5123.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	48.775	27.314	69.581	252.542	161.499
10	-111	1	122	59.5	5182.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	52.527	29.415	69.581	256.294	163.600
10	-112	1	122	59.5	5242.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	56.279	31.516	69.581	260.046	165.702

PLATE A-9-b

Suburban 18" Spiral Welded Pipe Pile

Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	Q-CASE													
								Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
10	-113	1	122	59.5	5301.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	60.031	33.617	69.581	263.798	167.803
10	-114	1	122	59.5	5361.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	63.783	35.718	69.581	267.550	169.904
10	-115	1	122	59.5	5420.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	67.535	37.819	69.581	271.301	172.005
10	-116	1	122	59.5	5480.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	71.287	39.921	69.581	275.053	174.106
10	-117	1	122	59.5	5539.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	75.039	42.022	69.581	278.805	176.207
10	-118	1	122	59.5	5599.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	78.791	44.123	69.581	282.557	178.308
10	-119	1	122	59.5	5658.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	82.543	46.224	69.581	286.309	180.409
10	-120	1	122	59.5	5718.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	86.294	48.325	69.581	290.061	182.510
10	-121	1	122	59.5	5777.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	90.046	50.426	69.581	293.813	184.611
10	-122	1	122	59.5	5837.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	93.798	52.527	69.581	297.565	186.712
10	-123	1	122	59.5	5896.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	97.550	54.628	69.581	301.317	188.814
10	-124	1	122	59.5	5956.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	101.302	56.729	69.581	305.069	190.915
10	-125	1	122	59.5	6015.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	105.054	58.830	69.581	308.821	193.016
10	-126	1	122	59.5	6075.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	108.806	60.931	69.581	312.573	195.117
10	-127	1	122	59.5	6134.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	112.558	63.032	69.581	316.325	197.218
10	-128	1	122	59.5	6194.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	116.310	65.134	69.581	320.077	199.319
10	-129	1	122	59.5	6253.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	120.062	67.235	69.581	323.829	201.420
10	-130	1	122	59.5	6313.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	134.185	123.814	69.336	69.581	327.581	203.521

PLATE A-9-c

Suburban 18" Spiral Welded Pipe Pile

Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	S-CASE Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
1	4.5	0	112	49.5	0	0	0	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.000	0.000	0.000	0.000	0.000
1	4	0.5	112	49.5	28	28	56	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.009	0.006	0.000	0.009	0.006
1	3	1	112	49.5	112	112	168	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.081	0.057	0.000	0.081	0.057
1	2	1	112	49.5	224	224	280	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.226	0.158	0.000	0.226	0.158
1	1	1	112	49.5	336	336	392	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.442	0.310	0.000	0.442	0.310
1	0	1	112	49.5	448	448	504	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.731	0.512	0.000	0.731	0.512
1	-1	1	112	49.5	528.75	528.75	553.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	1.072	0.750	0.000	1.072	0.750
1	-2	1	112	49.5	578.25	578.25	603	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	1.445	1.011	0.000	1.445	1.011
1	-3	1	112	49.5	627.75	627.75	652.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	1.849	1.294	0.000	1.849	1.294
1	-4	1	112	49.5	677.25	677.25	702	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	2.286	1.600	0.000	2.286	1.600
1	-5	1	112	49.5	726.75	726.75	751.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	2.754	1.928	0.000	2.754	1.928
2	-6	1	98	35.5	769.25	769.25	787	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	3.250	2.275	0.000	3.250	2.275
2	-7	1	98	35.5	804.75	804.75	822.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	3.769	2.638	0.000	3.769	2.638
2	-8	1	98	35.5	840.25	840.25	858	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	4.310	3.017	0.000	4.310	3.017
2	-9	1	98	35.5	875.75	875.75	893.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	4.875	3.412	0.000	4.875	3.412
2	-10	1	98	35.5	911.25	911.25	929	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	5.462	3.824	0.000	5.462	3.824
3	-11	1	88	25.5	941.75	941.75	954.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	6.069	4.248	0.000	6.069	4.248
3	-12	1	88	25.5	967.25	967.25	980	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	6.693	4.685	0.000	6.693	4.685
3	-13	1	88	25.5	992.75	992.75	1005.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	7.333	5.133	0.000	7.333	5.133
3	-14	1	88	25.5	1018.25	1018.25	1031	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	7.989	5.592	0.000	7.989	5.592
3	-15	1	88	25.5	1043.75	1043.75	1056.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	8.662	6.063	0.000	8.662	6.063
4	-16	1	104	41.5	1077.25	1077.25	1098	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	9.356	6.549	0.000	9.356	6.549
4	-17	1	104	41.5	1118.75	1118.75	1139.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	10.077	7.054	0.000	10.077	7.054
4	-18	1	104	41.5	1160.25	1160.25	1181	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	10.825	7.578	0.000	10.825	7.578
4	-19	1	104	41.5	1201.75	1201.75	1222.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	11.600	8.120	0.000	11.600	8.120
4	-20	1	104	41.5	1243.25	1243.25	1264	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	12.401	8.681	0.000	12.401	8.681
4	-21	1	104	41.5	1284.75	1284.75	1305.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	13.229	9.260	0.000	13.229	9.260
4	-22	1	104	41.5	1326.25	1326.25	1347	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	14.084	9.859	0.000	14.084	9.859
4	-23	1	104	41.5	1367.75	1367.75	1388.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	14.966	10.476	0.000	14.966	10.476
4	-24	1	104	41.5	1409.25	1409.25	1430	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	15.874	11.112	0.000	15.874	11.112
4	-25	1	104	41.5	1450.75	1450.75	1471.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	16.809	11.766	0.000	16.809	11.766
4	-26	1	104	41.5	1492.25	1492.25	1513	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	17.771	12.440	0.000	17.771	12.440
4	-27	1	104	41.5	1533.75	1533.75	1554.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	18.760	13.132	0.000	18.760	13.132
4	-28	1	104	41.5	1575.25	1575.25	1596	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	19.775	13.843	0.000	19.775	13.843
4	-29	1	104	41.5	1616.75	1616.75	1637.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	20.817	14.572	0.000	20.817	14.572
4	-30	1	104	41.5	1658.25	1658.25	1679	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	21.886	15.320	0.000	21.886	15.320
5	-31	1	100	37.5	1697.75	1697.75	1716.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	22.980	16.086	0.000	22.980	16.086
5	-32	1	100	37.5	1735.25	1735.25	1754	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	24.099	16.869	0.000	24.099	16.869
5	-33	1	100	37.5	1772.75	1772.75	1791.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	25.242	17.669	0.000	25.242	17.669
5	-34	1	100	37.5	1810.25	1810.25	1829	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	26.409	18.486	0.000	26.409	18.486
5	-35	1	100	37.5	1847.75	1847.75	1866.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	27.600	19.320	0.000	27.600	19.320
5	-36	1	100	37.5	1885.25	1885.25	1904	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	28.815	20.170	0.000	28.815	20.170
5	-37	1	100	37.5	1922.75	1922.75	1941.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	30.054	21.038	0.000	30.054	21.038
5	-38	1	100	37.5	1960.25	1960.25	1979	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	31.318	21.922	0.000	31.318	21.922
5	-39	1	100	37.5	1997.75	1997.75	2016.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	32.605	22.824	0.000	32.605	22.824
5	-40	1	100	37.5	2035.25	2035.25	2054	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	33.917	23.742	0.000	33.917	23.742
6	-41	1	104	41.5	2074.75	2074.75	2095.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	35.255	24.678	0.000	35.255	24.678
6	-42	1	104	41.5	2116.25	2116.25	2137	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	36.619	25.633	0.000	36.619	25.633
6	-43	1	104	41.5	2157.75	2157.75	2178.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	38.010	26.607	0.000	38.010	26.607
6	-44	1	104	41.5	2199.25	2199.25	2220	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	39.427	27.599	0.000	39.427	27.599
6	-45	1	104	41.5	2240.75	2240.75	2261.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	40.871	28.610	0.000	40.871	28.610
6	-46	1	104	41.5	2282.25	2282.25	2303	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	42.343	29.640	0.000	42.343	29.640
6	-47	1	104	41.5	2323.75	2323.75	2344.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	43.840	30.688	0.000	43.840	30.688
6	-48	1	104	41.5	2365.25	2365.25	2386	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	45.365	31.756	0.000	45.365	31.756
6	-49	1	104	41.5	2406.75	2406.75	2427.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	46.916	32.841	0.000	46.916	32.841
6	-50	1	104	41.5	2448.25	2448.25	2469	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	48.494	33.946	0.000	48.494	33.946
7	-51	1	100	37.5	2487.75	2487.75	2506.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	50.098	35.069	0.000	50.098	35.069
7	-52	1	100	37.5	2525.25	2525.25	2544	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	51.726	36.208	0.000	51.726	36.208
7	-53	1	100	37.5	2562.75	2562.75	2581.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	53.378	37.364	0.000	53.378	37.364

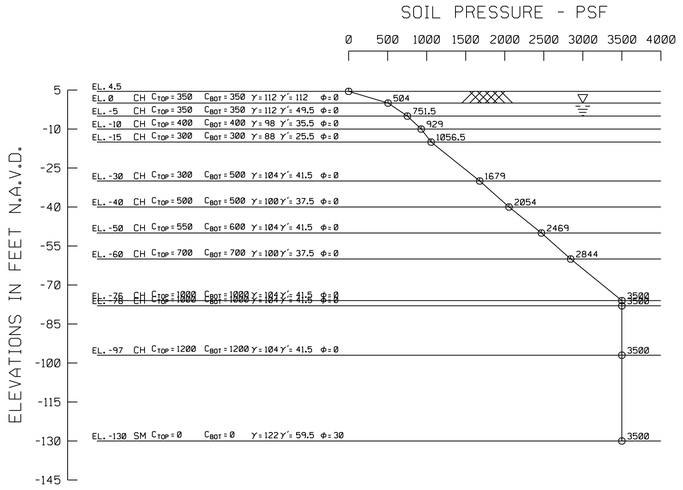
PLATE A-9-d

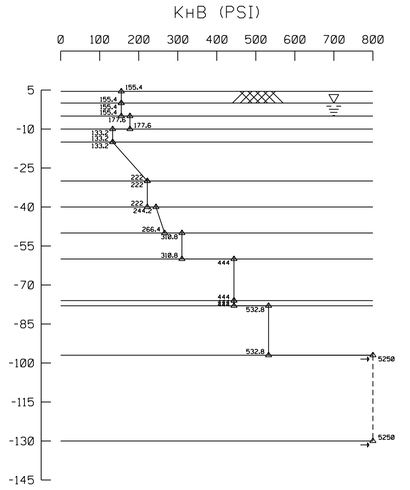
Suburban 18" Spiral Welded Pipe Pile								S-CASE														
Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
7	-54	1	100	37.5	2600.25	2600.25	2619	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	55.054	38.538	0.000	55.054	38.538
7	-55	1	100	37.5	2637.75	2637.75	2656.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	56.754	39.728	0.000	56.754	39.728
7	-56	1	100	37.5	2675.25	2675.25	2694	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	58.478	40.935	0.000	58.478	40.935
7	-57	1	100	37.5	2712.75	2712.75	2731.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	60.227	42.159	0.000	60.227	42.159
7	-58	1	100	37.5	2750.25	2750.25	2769	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	62.000	43.400	0.000	62.000	43.400
7	-59	1	100	37.5	2787.75	2787.75	2806.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	63.797	44.658	0.000	63.797	44.658
7	-60	1	100	37.5	2825.25	2825.25	2844	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	65.618	45.932	0.000	65.618	45.932
8	-61	1	104	41.5	2864.75	2864.75	2885.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	67.464	47.225	25.495	92.960	47.225
8	-62	1	104	41.5	2906.25	2906.25	2927	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	69.338	48.536	25.862	95.200	48.536
8	-63	1	104	41.5	2947.75	2947.75	2968.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	71.238	49.866	26.229	97.467	49.866
8	-64	1	104	41.5	2989.25	2989.25	3010	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	73.165	51.215	26.596	99.760	51.215
8	-65	1	104	41.5	3030.75	3030.75	3051.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	75.118	52.583	26.962	102.080	52.583
8	-66	1	104	41.5	3072.25	3072.25	3093	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	77.098	53.969	27.329	104.427	53.969
8	-67	1	104	41.5	3113.75	3113.75	3134.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	79.105	55.374	27.696	106.801	55.374
8	-68	1	104	41.5	3155.25	3155.25	3176	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	81.139	56.798	28.062	109.202	56.798
8	-69	1	104	41.5	3196.75	3196.75	3217.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	83.200	58.240	28.429	111.629	58.240
8	-70	1	104	41.5	3238.25	3238.25	3259	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	85.287	59.701	28.796	114.083	59.701
8	-71	1	104	41.5	3279.75	3279.75	3300.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	87.401	61.181	29.162	116.564	61.181
8	-72	1	104	41.5	3321.25	3321.25	3342	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	89.542	62.679	29.529	119.071	62.679
8	-73	1	104	41.5	3362.75	3362.75	3383.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	91.710	64.197	29.896	121.605	64.197
8	-74	1	104	41.5	3404.25	3404.25	3425	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	93.904	65.733	30.262	124.166	65.733
8	-75	1	104	41.5	3445.75	3445.75	3466.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	96.125	67.288	30.629	126.754	67.288
8	-76	1	104	41.5	3487.25	3487.25	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	98.373	68.861	30.925	129.298	68.861
8	-77	1	104	41.5	3528.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	100.629	70.440	30.925	131.554	70.440
8	-78	1	104	41.5	3570.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	102.885	72.019	30.925	133.810	72.019
9	-79	1	104	41.5	3611.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	105.141	73.599	30.925	136.066	73.599
9	-80	1	104	41.5	3653.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	107.397	75.178	30.925	138.322	75.178
9	-81	1	104	41.5	3694.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	109.653	76.757	30.925	140.578	76.757
9	-82	1	104	41.5	3736.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	111.909	78.336	30.925	142.834	78.336
9	-83	1	104	41.5	3777.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	114.165	79.916	30.925	145.090	79.916
9	-84	1	104	41.5	3819.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	116.421	81.495	30.925	147.346	81.495
9	-85	1	104	41.5	3860.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	118.677	83.074	30.925	149.602	83.074
9	-86	1	104	41.5	3902.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	120.933	84.653	30.925	151.858	84.653
9	-87	1	104	41.5	3943.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	123.189	86.232	30.925	154.114	86.232
9	-88	1	104	41.5	3985.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	125.445	87.812	30.925	156.370	87.812
9	-89	1	104	41.5	4026.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	127.701	89.391	30.925	158.626	89.391
9	-90	1	104	41.5	4068.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	129.957	90.970	30.925	160.882	90.970
9	-91	1	104	41.5	4109.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	132.213	92.549	30.925	163.138	92.549
9	-92	1	104	41.5	4151.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	134.469	94.129	30.925	165.394	94.129
9	-93	1	104	41.5	4192.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	136.725	95.708	30.925	167.651	95.708
9	-94	1	104	41.5	4234.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	138.982	97.287	30.925	169.907	97.287
9	-95	1	104	41.5	4275.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	141.238	98.866	30.925	172.163	98.866
9	-96	1	104	41.5	4317.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	143.494	100.445	30.925	174.419	100.445
9	-97	1	104	41.5	4358.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	145.750	102.025	30.925	176.675	102.025
10	-98	1	122	59.5	4409.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	149.502	104.126	69.581	219.083	104.126
10	-99	1	122	59.5	4468.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	153.254	106.227	69.581	222.835	106.227
10	-100	1	122	59.5	4528.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	157.005	108.328	69.581	226.587	108.328
10	-101	1	122	59.5	4587.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	160.757	110.429	69.581	230.339	110.429
10	-102	1	122	59.5	4647.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	164.509	112.530	69.581	234.091	112.530
10	-103	1	122	59.5	4706.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	168.261	114.631	69.581	237.843	114.631
10	-104	1	122	59.5	4766.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	172.013	116.732	69.581	241.595	116.732
10	-105	1	122	59.5	4825.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	175.765	118.833	69.581	245.347	118.833
10	-106	1	122	59.5	4885.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	179.517	120.934	69.581	249.098	120.934
10	-107	1	122	59.5	4944.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	183.269	123.036	69.581	252.850	123.036
10	-108	1	122	59.5	5004.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	187.021	125.137	69.581	256.602	125.137
10	-109	1	122	59.5	5063.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	190.773	127.238	69.581	260.354	127.238
10	-110	1	122	59.5	5123.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	194.525	129.339	69.581	264.106	129.339
10	-111	1	122	59.5	5182.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	198.277	131.440	69.581	267.858	131.440
10	-112	1	122	59.5	5242.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	202.029	133.541	69.581	271.610	133.541

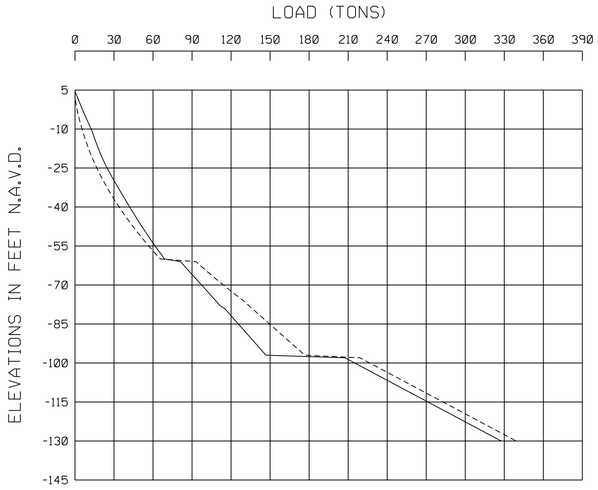
PLATE A-9-e

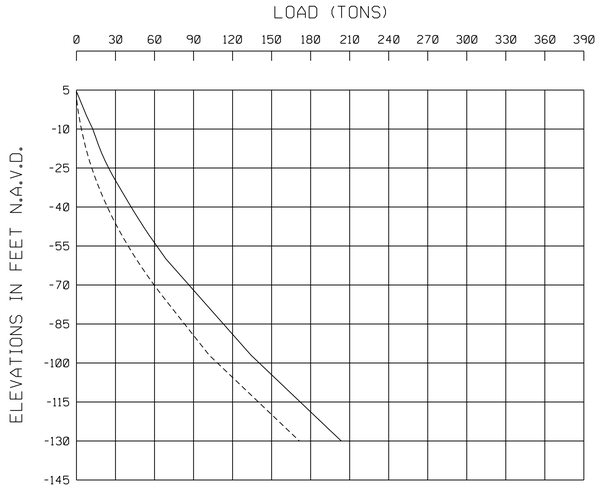
Suburban 18" Spiral Welded Pipe Pile								S-CASE													
Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
10	-113	1	122	59.5	5301.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	205.781	135.642	69.581	275.362	135.642
10	-114	1	122	59.5	5361.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	209.533	137.743	69.581	279.114	137.743
10	-115	1	122	59.5	5420.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	213.285	139.844	69.581	282.866	139.844
10	-116	1	122	59.5	5480.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	217.036	141.945	69.581	286.618	141.945
10	-117	1	122	59.5	5539.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	220.788	144.046	69.581	290.370	144.046
10	-118	1	122	59.5	5599.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	224.540	146.147	69.581	294.122	146.147
10	-119	1	122	59.5	5658.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	228.292	148.249	69.581	297.874	148.249
10	-120	1	122	59.5	5718.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	232.044	150.350	69.581	301.626	150.350
10	-121	1	122	59.5	5777.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	235.796	152.451	69.581	305.378	152.451
10	-122	1	122	59.5	5837.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	239.548	154.552	69.581	309.129	154.552
10	-123	1	122	59.5	5896.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	243.300	156.653	69.581	312.881	156.653
10	-124	1	122	59.5	5956.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	247.052	158.754	69.581	316.633	158.754
10	-125	1	122	59.5	6015.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	250.804	160.855	69.581	320.385	160.855
10	-126	1	122	59.5	6075.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	254.556	162.956	69.581	324.137	162.956
10	-127	1	122	59.5	6134.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	258.308	165.057	69.581	327.889	165.057
10	-128	1	122	59.5	6194.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	262.060	167.158	69.581	331.641	167.158
10	-129	1	122	59.5	6253.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	265.812	169.259	69.581	335.393	169.259
10	-130	1	122	59.5	6313.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	269.564	171.361	69.581	339.145	171.361

PLATE A-9-f









D	PILE SPACING IN DIRECTION OF LOADING
1.00	8B
.85	7B
.70	6B
.55	5B
.40	4B
.25	3B
C	LOADING CONDITION
1.00	INITIAL LOADING
0.30	CYCLIC LOADING

NOTES: KH = α K1/B=(0.2222qu/B)(C)(D) COHESIVE
α = 0.4 = Factor of material properties of soil and pile
k1 = Modulus of subgrade reaction for test plate (pci)
B1 = Width or diameter of test plate (in)
K1 = k1B1 = 80qu(pcf) = 0.5556qu(psi)
qu = 2 c = Unconfined compressive strength (psf)
C = Reduction for cyclic loading-not applicable
D = Group effect reduction factor
B = Width of pile measured at right angles to the direction of displacement (in)
KH = (nh)(Z/B)(C)(D) COHESIONLESS
nh = Coeficient of horizontal subgrade reaction (pci)
Z = Depth below equivalent ground surface (in)

THE FACTOR SHOWN, (MODULUS OF HORIZONTAL SUBGRADE K_h, TIMES THE PILE WIDTH IN INCHES (B), MEASURED AT RIGHT ANGLES TO THE DIRECTION OF DISPLACEMENT) MUST BE MODIFIED BY A REDUCTION FACTOR FOR THE EFFECT OF GROUP ACTION (D) AND A REDUCTION FACTOR FOR CYCLIC LOADING (C) EX: $K_h = \frac{0.2222\alpha qu(C)(D)}{(B)}$

Suburban Canal
18" Spiral Welded Pipe Pile
Pile Capacity Curves

PLATE A-10

Suburban HP 14x89 Pile

Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	Q-CASE														
								Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
1	4.5	0	112	49.5	0	0	0	350	350	0	0	1.00	1.00	1.00	9.00	No	0.000	0.000	0.000	0.000	0.000	0.000
1	4	0.5	112	49.5	28	28	56	350	350	0	0	1.00	1.00	1.00	9.00	No	0.416	0.000	0.000	0.000	0.416	0.416
1	3	1	112	49.5	112	112	168	350	350	0	0	1.00	1.00	1.00	9.00	No	1.247	0.000	0.000	0.000	1.247	1.247
1	2	1	112	49.5	224	224	280	350	350	0	0	1.00	1.00	1.00	9.00	No	2.078	0.000	0.000	0.000	2.078	2.078
1	1	1	112	49.5	336	336	392	350	350	0	0	1.00	1.00	1.00	9.00	No	2.909	0.000	0.000	0.000	2.909	2.909
1	0	1	112	49.5	448	448	504	350	350	0	0	1.00	1.00	1.00	9.00	No	3.741	0.000	0.000	0.000	3.741	3.741
1	-1	1	112	49.5	528.75	528.75	553.5	350	350	0	0	1.00	1.00	1.00	9.00	No	4.572	0.000	0.000	0.000	4.572	4.572
1	-2	1	112	49.5	578.25	578.25	603	350	350	0	0	1.00	1.00	1.00	9.00	No	5.403	0.000	0.000	0.000	5.403	5.403
1	-3	1	112	49.5	627.75	627.75	652.5	350	350	0	0	1.00	1.00	1.00	9.00	No	6.234	0.000	0.000	0.000	6.234	6.234
1	-4	1	112	49.5	677.25	677.25	702	350	350	0	0	1.00	1.00	1.00	9.00	No	7.066	0.000	0.000	0.000	7.066	7.066
1	-5	1	112	49.5	726.75	726.75	751.5	350	350	0	0	1.00	1.00	1.00	9.00	No	7.897	0.000	0.000	0.000	7.897	7.897
2	-6	1	98	35.5	769.25	769.25	787	400	400	0	0	1.00	1.00	1.00	9.00	No	8.847	0.000	0.000	0.000	8.847	8.847
2	-7	1	98	35.5	804.75	804.75	822.5	400	400	0	0	1.00	1.00	1.00	9.00	No	9.797	0.000	0.000	0.000	9.797	9.797
2	-8	1	98	35.5	840.25	840.25	858	400	400	0	0	1.00	1.00	1.00	9.00	No	10.747	0.000	0.000	0.000	10.747	10.747
2	-9	1	98	35.5	875.75	875.75	893.5	400	400	0	0	1.00	1.00	1.00	9.00	No	11.697	0.000	0.000	0.000	11.697	11.697
2	-10	1	98	35.5	911.25	911.25	929	400	400	0	0	1.00	1.00	1.00	9.00	No	12.647	0.000	0.000	0.000	12.647	12.647
3	-11	1	88	25.5	941.75	941.75	954.5	300	300	0	0	1.00	1.00	1.00	9.00	No	13.359	0.000	0.000	0.000	13.359	13.359
3	-12	1	88	25.5	967.25	967.25	980	300	300	0	0	1.00	1.00	1.00	9.00	No	14.072	0.000	0.000	0.000	14.072	14.072
3	-13	1	88	25.5	992.75	992.75	1005.5	300	300	0	0	1.00	1.00	1.00	9.00	No	14.784	0.000	0.000	0.000	14.784	14.784
3	-14	1	88	25.5	1018.25	1018.25	1031	300	300	0	0	1.00	1.00	1.00	9.00	No	15.497	0.000	0.000	0.000	15.497	15.497
3	-15	1	88	25.5	1043.75	1043.75	1056.5	300	300	0	0	1.00	1.00	1.00	9.00	No	16.209	0.000	0.000	0.000	16.209	16.209
4	-16	1	104	41.5	1077.25	1077.25	1098	313.333344	306.666687	0	0	1.00	1.00	1.00	9.00	No	16.938	0.000	0.000	0.000	16.938	16.938
4	-17	1	104	41.5	1118.75	1118.75	1139.5	326.666656	320	0	0	1.00	1.00	1.00	9.00	No	17.698	0.000	0.000	0.000	17.698	17.698
4	-18	1	104	41.5	1160.25	1160.25	1181	340	333.333313	0	0	1.00	1.00	1.00	9.00	No	18.489	0.000	0.000	0.000	18.489	18.489
4	-19	1	104	41.5	1201.75	1201.75	1222.5	353.333344	346.666687	0	0	1.00	1.00	1.00	9.00	No	19.313	0.000	0.000	0.000	19.313	19.313
4	-20	1	104	41.5	1243.25	1243.25	1264	366.666656	360	0	0	1.00	1.00	1.00	9.00	No	20.168	0.000	0.000	0.000	20.168	20.168
4	-21	1	104	41.5	1284.75	1284.75	1305.5	380	373.333313	0	0	1.00	1.00	1.00	9.00	No	21.054	0.000	0.000	0.000	21.054	21.054
4	-22	1	104	41.5	1326.25	1326.25	1347	393.333344	386.666687	0	0	1.00	1.00	1.00	9.00	No	21.973	0.000	0.000	0.000	21.973	21.973
4	-23	1	104	41.5	1367.75	1367.75	1388.5	406.666656	400	0	0	1.00	1.00	1.00	9.00	No	22.923	0.000	0.000	0.000	22.923	22.923
4	-24	1	104	41.5	1409.25	1409.25	1430	420	413.333313	0	0	1.00	1.00	1.00	9.00	No	23.904	0.000	0.000	0.000	23.904	23.904
4	-25	1	104	41.5	1450.75	1450.75	1471.5	433.333344	426.666687	0	0	1.00	1.00	1.00	9.00	No	24.918	0.000	0.000	0.000	24.918	24.918
4	-26	1	104	41.5	1492.25	1492.25	1513	446.666656	440	0	0	1.00	1.00	1.00	9.00	No	25.963	0.000	0.000	0.000	25.963	25.963
4	-27	1	104	41.5	1533.75	1533.75	1554.5	460	453.333313	0	0	1.00	1.00	1.00	9.00	No	27.039	0.000	0.000	0.000	27.039	27.039
4	-28	1	104	41.5	1575.25	1575.25	1596	473.333344	466.666687	0	0	1.00	1.00	1.00	9.00	No	28.148	0.000	0.000	0.000	28.148	28.148
4	-29	1	104	41.5	1616.75	1616.75	1637.5	486.666656	480	0	0	1.00	1.00	1.00	9.00	No	29.288	0.000	0.000	0.000	29.288	29.288
4	-30	1	104	41.5	1658.25	1658.25	1679	500	493.333313	0	0	1.00	1.00	1.00	9.00	No	30.459	0.000	0.000	0.000	30.459	30.459
5	-31	1	100	37.5	1697.75	1697.75	1716.5	500	500	0	0	1.00	1.00	1.00	9.00	No	31.647	0.000	0.000	0.000	31.647	31.647
5	-32	1	100	37.5	1735.25	1735.25	1754	500	500	0	0	1.00	1.00	1.00	9.00	No	32.834	0.000	0.000	0.000	32.834	32.834
5	-33	1	100	37.5	1772.75	1772.75	1791.5	500	500	0	0	1.00	1.00	1.00	9.00	No	34.022	0.000	0.000	0.000	34.022	34.022
5	-34	1	100	37.5	1810.25	1810.25	1829	500	500	0	0	1.00	1.00	1.00	9.00	No	35.209	0.000	0.000	0.000	35.209	35.209
5	-35	1	100	37.5	1847.75	1847.75	1866.5	500	500	0	0	1.00	1.00	1.00	9.00	No	36.397	0.000	0.000	0.000	36.397	36.397
5	-36	1	100	37.5	1885.25	1885.25	1904	500	500	0	0	1.00	1.00	1.00	9.00	No	37.584	0.000	0.000	0.000	37.584	37.584
5	-37	1	100	37.5	1922.75	1922.75	1941.5	500	500	0	0	1.00	1.00	1.00	9.00	No	38.772	0.000	0.000	0.000	38.772	38.772
5	-38	1	100	37.5	1960.25	1960.25	1979	500	500	0	0	1.00	1.00	1.00	9.00	No	39.959	0.000	0.000	0.000	39.959	39.959
5	-39	1	100	37.5	1997.75	1997.75	2016.5	500	500	0	0	1.00	1.00	1.00	9.00	No	41.147	0.000	0.000	0.000	41.147	41.147
5	-40	1	100	37.5	2035.25	2035.25	2054	500	500	0	0	1.00	1.00	1.00	9.00	No	42.334	0.000	0.000	0.000	42.334	42.334
6	-41	1	104	41.5	2074.75	2074.75	2095.5	555	526.25	0	0	1.00	1.00	1.00	9.00	No	43.615	0.000	0.000	0.000	43.615	43.615
6	-42	1	104	41.5	2116.25	2116.25	2137	560	528.75	0	0	1.00	1.00	1.00	9.00	No	44.905	0.000	0.000	0.000	44.905	44.905
6	-43	1	104	41.5	2157.75	2157.75	2178.5	565	531.25	0	0	1.00	1.00	1.00	9.00	No	46.204	0.000	0.000	0.000	46.204	46.204
6	-44	1	104	41.5	2199.25	2199.25	2220	570	533.75	0	0	1.00	1.00	1.00	9.00	No	47.512	0.000	0.000	0.000	47.512	47.512
6	-45	1	104	41.5	2240.75	2240.75	2261.5	575	536.25	0	0	1.00	1.00	1.00	9.00	No	48.829	0.000	0.000	0.000	48.829	48.829
6	-46	1	104	41.5	2282.25	2282.25	2303	580	538.75	0	0	1.00	1.00	1.00	9.00	No	50.154	0.000	0.000	0.000	50.154	50.154
6	-47	1	104	41.5	2323.75	2323.75	2344.5	585	541.25	0	0	1.00	1.00	1.00	9.00	No	51.489	0.000	0.000	0.000	51.489	51.489
6	-48	1	104	41.5	2365.25	2365.25	2386	590	543.75	0	0	1.00	1.00	1.00	9.00	No	52.832	0.000	0.000	0.000	52.832	52.832
6	-49	1	104	41.5	2406.75	2406.75	2427.5	595	546.25	0	0	1.00	1.00	1.00	9.00	No	54.184	0.000	0.000	0.000	54.184	54.184
6	-50	1	104	41.5	2448.25	2448.25	2469	600	548.75	0	0	1.00	1.00	1.00	9.00	No	55.545	0.000	0.000	0.000	55.545	55.545
7	-51	1	100	37.5	2487.75	2487.75	2506.5	700	600	0	0	1.00	1.00	1.00	9.00	No	57.089	0.000	0.000	0.000	57.089	57.089
7	-52	1	100	37.5	2525.25	2525.25	2544	700	600	0	0	1.00	1.00	1.00	9.00	No	58.633	0.000	0.000	0.000	58.633	58.633
7	-53	1	100	37.5	2562.75	2562.75	2581.5	700	600	0	0	1.00	1.00	1.00	9.00	No	60.177	0.000	0.000	0.000	60.177	60.177

PLATE A-11-a

Suburban HP 14x89 Pile

Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	Q-CASE													
								Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
7	-54	1	100	37.5	2600.25	2600.25	2619	700	600	0	0	1.00	1.00	1.00	9.00	No	61.720	0.000	0.000	0.000	61.720	61.720
7	-55	1	100	37.5	2637.75	2637.75	2656.5	700	600	0	0	1.00	1.00	1.00	9.00	No	63.264	0.000	0.000	0.000	63.264	63.264
7	-56	1	100	37.5	2675.25	2675.25	2694	700	600	0	0	1.00	1.00	1.00	9.00	No	64.808	0.000	0.000	0.000	64.808	64.808
7	-57	1	100	37.5	2712.75	2712.75	2731.5	700	600	0	0	1.00	1.00	1.00	9.00	No	66.352	0.000	0.000	0.000	66.352	66.352
7	-58	1	100	37.5	2750.25	2750.25	2769	700	600	0	0	1.00	1.00	1.00	9.00	No	67.895	0.000	0.000	0.000	67.895	67.895
7	-59	1	100	37.5	2787.75	2787.75	2806.5	700	600	0	0	1.00	1.00	1.00	9.00	No	69.439	0.000	0.000	0.000	69.439	69.439
7	-60	1	100	37.5	2825.25	2825.25	2844	700	600	0	0	1.00	1.00	1.00	9.00	No	70.983	0.000	0.000	0.000	70.983	70.983
8	-61	1	104	41.5	2864.75	2864.75	2885.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	73.061	0.000	0.000	8.379	81.440	73.061
8	-62	1	104	41.5	2906.25	2906.25	2927	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	75.139	0.000	0.000	8.409	83.548	75.139
8	-63	1	104	41.5	2947.75	2947.75	2968.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	77.217	0.000	0.000	8.438	85.655	77.217
8	-64	1	104	41.5	2989.25	2989.25	3010	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	79.295	0.000	0.000	8.467	87.762	79.295
8	-65	1	104	41.5	3030.75	3030.75	3051.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	81.373	0.000	0.000	8.496	89.870	81.373
8	-66	1	104	41.5	3072.25	3072.25	3093	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	83.452	0.000	0.000	8.526	91.977	83.452
8	-67	1	104	41.5	3113.75	3113.75	3134.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	85.530	0.000	0.000	8.555	94.085	85.530
8	-68	1	104	41.5	3155.25	3155.25	3176	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	87.608	0.000	0.000	8.584	96.192	87.608
8	-69	1	104	41.5	3196.75	3196.75	3217.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	89.686	0.000	0.000	8.613	98.299	89.686
8	-70	1	104	41.5	3238.25	3238.25	3259	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	91.764	0.000	0.000	8.643	100.407	91.764
8	-71	1	104	41.5	3279.75	3279.75	3300.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	93.842	0.000	0.000	8.672	102.514	93.842
8	-72	1	104	41.5	3321.25	3321.25	3342	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	95.920	0.000	0.000	8.701	104.621	95.920
8	-73	1	104	41.5	3362.75	3362.75	3383.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	97.998	0.000	0.000	8.730	106.729	97.998
8	-74	1	104	41.5	3404.25	3404.25	3425	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	100.077	0.000	0.000	8.760	108.836	100.077
8	-75	1	104	41.5	3445.75	3445.75	3466.5	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	102.155	0.000	0.000	8.789	110.944	102.155
8	-76	1	104	41.5	3487.25	3487.25	3500	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	104.233	0.000	0.000	8.813	113.045	104.233
8	-77	1	104	41.5	3528.75	3500	3500	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	106.311	0.000	0.000	8.813	115.123	106.311
8	-78	1	104	41.5	3570.25	3500	3500	1000	750	0	0	1.00	1.00	1.00	9.00	Yes	108.389	0.000	0.000	8.813	117.202	108.389
9	-79	1	104	41.5	3611.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	110.705	0.000	0.000	10.082	120.786	110.705
9	-80	1	104	41.5	3653.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	113.020	0.000	0.000	10.082	123.102	113.020
9	-81	1	104	41.5	3694.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	115.336	0.000	0.000	10.082	125.417	115.336
9	-82	1	104	41.5	3736.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	117.652	0.000	0.000	10.082	127.733	117.652
9	-83	1	104	41.5	3777.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	119.967	0.000	0.000	10.082	130.049	119.967
9	-84	1	104	41.5	3819.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	122.283	0.000	0.000	10.082	132.364	122.283
9	-85	1	104	41.5	3860.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	124.598	0.000	0.000	10.082	134.680	124.598
9	-86	1	104	41.5	3902.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	126.914	0.000	0.000	10.082	136.996	126.914
9	-87	1	104	41.5	3943.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	129.230	0.000	0.000	10.082	139.311	129.230
9	-88	1	104	41.5	3985.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	131.545	0.000	0.000	10.082	141.627	131.545
9	-89	1	104	41.5	4026.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	133.861	0.000	0.000	10.082	143.942	133.861
9	-90	1	104	41.5	4068.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	136.177	0.000	0.000	10.082	146.258	136.177
9	-91	1	104	41.5	4109.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	138.492	0.000	0.000	10.082	148.574	138.492
9	-92	1	104	41.5	4151.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	140.808	0.000	0.000	10.082	150.889	140.808
9	-93	1	104	41.5	4192.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	143.123	0.000	0.000	10.082	153.205	143.123
9	-94	1	104	41.5	4234.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	145.439	0.000	0.000	10.082	155.521	145.439
9	-95	1	104	41.5	4275.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	147.755	0.000	0.000	10.082	157.836	147.755
9	-96	1	104	41.5	4317.25	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	150.070	0.000	0.000	10.082	160.152	150.070
9	-97	1	104	41.5	4358.75	3500	3500	1200	750	0	0	1.00	1.00	1.00	9.00	Yes	152.386	0.000	0.000	10.082	162.467	152.386
10	-98	1	122	59.5	4409.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	4.890	2.739	55.519	212.795	155.125
10	-99	1	122	59.5	4468.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	9.781	5.477	55.519	217.686	157.863
10	-100	1	122	59.5	4528.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	14.671	8.216	55.519	222.576	160.602
10	-101	1	122	59.5	4587.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	19.562	10.955	55.519	227.467	163.341
10	-102	1	122	59.5	4647.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	24.452	13.693	55.519	232.357	166.079
10	-103	1	122	59.5	4706.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	29.343	16.432	55.519	237.247	168.818
10	-104	1	122	59.5	4766.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	34.233	19.171	55.519	242.138	171.557
10	-105	1	122	59.5	4825.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	39.124	21.909	55.519	247.028	174.295
10	-106	1	122	59.5	4885.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	44.014	24.648	55.519	251.919	177.034
10	-107	1	122	59.5	4944.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	48.905	27.387	55.519	256.809	179.772
10	-108	1	122	59.5	5004.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	53.795	30.125	55.519	261.700	182.511
10	-109	1	122	59.5	5063.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	58.685	32.864	55.519	266.590	185.250
10	-110	1	122	59.5	5123.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	63.576	35.603	55.519	271.481	187.988
10	-111	1	122	59.5	5182.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	68.466	38.341	55.519	276.371	190.727
10	-112	1	122	59.5	5242.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	73.357	41.080	55.519	281.262	193.466

PLATE A-11-b

Suburban HP 14x89 Pile								Q-CASE														
Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
10	-113	1	122	59.5	5301.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	78.247	43.818	55.519	286.152	196.204
10	-114	1	122	59.5	5361.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	83.138	46.557	55.519	291.043	198.943
10	-115	1	122	59.5	5420.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	88.028	49.296	55.519	295.933	201.682
10	-116	1	122	59.5	5480.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	92.919	52.034	55.519	300.823	204.420
10	-117	1	122	59.5	5539.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	97.809	54.773	55.519	305.714	207.159
10	-118	1	122	59.5	5599.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	102.700	57.512	55.519	310.604	209.898
10	-119	1	122	59.5	5658.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	107.590	60.250	55.519	315.495	212.636
10	-120	1	122	59.5	5718.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	112.480	62.989	55.519	320.385	215.375
10	-121	1	122	59.5	5777.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	117.371	65.728	55.519	325.276	218.114
10	-122	1	122	59.5	5837.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	122.261	68.466	55.519	330.166	220.852
10	-123	1	122	59.5	5896.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	127.152	71.205	55.519	335.057	223.591
10	-124	1	122	59.5	5956.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	132.042	73.944	55.519	339.947	226.329
10	-125	1	122	59.5	6015.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	136.933	76.682	55.519	344.837	229.068
10	-126	1	122	59.5	6075.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	141.823	79.421	55.519	349.728	231.807
10	-127	1	122	59.5	6134.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	146.714	82.160	55.519	354.618	234.545
10	-128	1	122	59.5	6194.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	151.604	84.898	55.519	359.509	237.284
10	-129	1	122	59.5	6253.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	156.495	87.637	55.519	364.399	240.023
10	-130	1	122	59.5	6313.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	152.386	161.385	90.376	55.519	369.290	242.761

PLATE A-11-c

Suburban HP 14x89 Pile

Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	S-CASE													
								Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
1	4.5	0	112	49.5	0	0	0	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.000	0.000	0.000	0.000	0.000
1	4	0.5	112	49.5	28	28	56	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.012	0.008	0.000	0.012	0.008
1	3	1	112	49.5	112	112	168	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.104	0.073	0.000	0.104	0.073
1	2	1	112	49.5	224	224	280	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.290	0.203	0.000	0.290	0.203
1	1	1	112	49.5	336	336	392	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.569	0.398	0.000	0.569	0.398
1	0	1	112	49.5	448	448	504	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	0.940	0.658	0.000	0.940	0.658
1	-1	1	112	49.5	528.75	528.75	553.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	1.378	0.965	0.000	1.378	0.965
1	-2	1	112	49.5	578.25	578.25	603	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	1.858	1.300	0.000	1.858	1.300
1	-3	1	112	49.5	627.75	627.75	652.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	2.378	1.665	0.000	2.378	1.665
1	-4	1	112	49.5	677.25	677.25	702	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	2.939	2.058	0.000	2.939	2.058
1	-5	1	112	49.5	726.75	726.75	751.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	3.542	2.479	0.000	3.542	2.479
2	-6	1	98	35.5	769.25	769.25	787	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	4.179	2.926	0.000	4.179	2.926
2	-7	1	98	35.5	804.75	804.75	822.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	4.847	3.393	0.000	4.847	3.393
2	-8	1	98	35.5	840.25	840.25	858	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	5.543	3.880	0.000	5.543	3.880
2	-9	1	98	35.5	875.75	875.75	893.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	6.269	4.388	0.000	6.269	4.388
2	-10	1	98	35.5	911.25	911.25	929	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	7.024	4.917	0.000	7.024	4.917
3	-11	1	88	25.5	941.75	941.75	954.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	7.805	5.463	0.000	7.805	5.463
3	-12	1	88	25.5	967.25	967.25	980	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	8.607	6.025	0.000	8.607	6.025
3	-13	1	88	25.5	992.75	992.75	1005.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	9.430	6.601	0.000	9.430	6.601
3	-14	1	88	25.5	1018.25	1018.25	1031	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	10.274	7.192	0.000	10.274	7.192
3	-15	1	88	25.5	1043.75	1043.75	1056.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	11.139	7.797	0.000	11.139	7.797
4	-16	1	104	41.5	1077.25	1077.25	1098	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	12.032	8.422	0.000	12.032	8.422
4	-17	1	104	41.5	1118.75	1118.75	1139.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	12.959	9.071	0.000	12.959	9.071
4	-18	1	104	41.5	1160.25	1160.25	1181	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	13.921	9.745	0.000	13.921	9.745
4	-19	1	104	41.5	1201.75	1201.75	1222.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	14.917	10.442	0.000	14.917	10.442
4	-20	1	104	41.5	1243.25	1243.25	1264	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	15.948	11.163	0.000	15.948	11.163
4	-21	1	104	41.5	1284.75	1284.75	1305.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	17.013	11.909	0.000	17.013	11.909
4	-22	1	104	41.5	1326.25	1326.25	1347	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	18.112	12.678	0.000	18.112	12.678
4	-23	1	104	41.5	1367.75	1367.75	1388.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	19.246	13.472	0.000	19.246	13.472
4	-24	1	104	41.5	1409.25	1409.25	1430	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	20.414	14.290	0.000	20.414	14.290
4	-25	1	104	41.5	1450.75	1450.75	1471.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	21.617	15.132	0.000	21.617	15.132
4	-26	1	104	41.5	1492.25	1492.25	1513	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	22.854	15.997	0.000	22.854	15.997
4	-27	1	104	41.5	1533.75	1533.75	1554.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	24.125	16.887	0.000	24.125	16.887
4	-28	1	104	41.5	1575.25	1575.25	1596	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	25.431	17.801	0.000	25.431	17.801
4	-29	1	104	41.5	1616.75	1616.75	1637.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	26.771	18.740	0.000	26.771	18.740
4	-30	1	104	41.5	1658.25	1658.25	1679	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	28.145	19.702	0.000	28.145	19.702
5	-31	1	100	37.5	1697.75	1697.75	1716.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	29.553	20.687	0.000	29.553	20.687
5	-32	1	100	37.5	1735.25	1735.25	1754	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	30.991	21.694	0.000	30.991	21.694
5	-33	1	100	37.5	1772.75	1772.75	1791.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	32.461	22.722	0.000	32.461	22.722
5	-34	1	100	37.5	1810.25	1810.25	1829	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	33.961	23.773	0.000	33.961	23.773
5	-35	1	100	37.5	1847.75	1847.75	1866.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	35.493	24.845	0.000	35.493	24.845
5	-36	1	100	37.5	1885.25	1885.25	1904	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	37.056	25.939	0.000	37.056	25.939
5	-37	1	100	37.5	1922.75	1922.75	1941.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	38.649	27.055	0.000	38.649	27.055
5	-38	1	100	37.5	1960.25	1960.25	1979	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	40.274	28.192	0.000	40.274	28.192
5	-39	1	100	37.5	1997.75	1997.75	2016.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	41.930	29.351	0.000	41.930	29.351
5	-40	1	100	37.5	2035.25	2035.25	2054	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	43.617	30.532	0.000	43.617	30.532
6	-41	1	104	41.5	2074.75	2074.75	2095.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	45.337	31.736	0.000	45.337	31.736
6	-42	1	104	41.5	2116.25	2116.25	2137	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	47.091	32.964	0.000	47.091	32.964
6	-43	1	104	41.5	2157.75	2157.75	2178.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	48.880	34.216	0.000	48.880	34.216
6	-44	1	104	41.5	2199.25	2199.25	2220	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	50.703	35.492	0.000	50.703	35.492
6	-45	1	104	41.5	2240.75	2240.75	2261.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	52.560	36.792	0.000	52.560	36.792
6	-46	1	104	41.5	2282.25	2282.25	2303	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	54.452	38.117	0.000	54.452	38.117
6	-47	1	104	41.5	2323.75	2323.75	2344.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	56.378	39.465	0.000	56.378	39.465
6	-48	1	104	41.5	2365.25	2365.25	2386	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	58.339	40.837	0.000	58.339	40.837
6	-49	1	104	41.5	2406.75	2406.75	2427.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	60.334	42.234	0.000	60.334	42.234
6	-50	1	104	41.5	2448.25	2448.25	2469	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	62.364	43.654	0.000	62.364	43.654
7	-51	1	100	37.5	2487.75	2487.75	2506.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	64.426	45.098	0.000	64.426	45.098
7	-52	1	100	37.5	2525.25	2525.25	2544	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	66.519	46.563	0.000	66.519	46.563
7	-53	1	100	37.5	2562.75	2562.75	2581.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	68.643	48.050	0.000	68.643	48.050

PLATE A-11-d

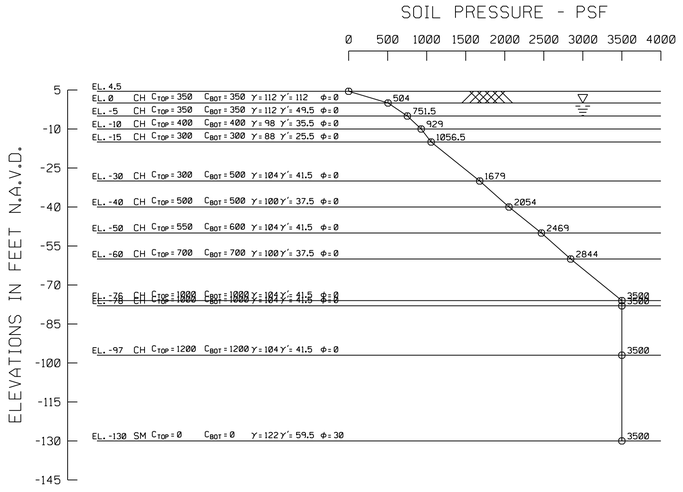
Suburban HP 14x89 Pile

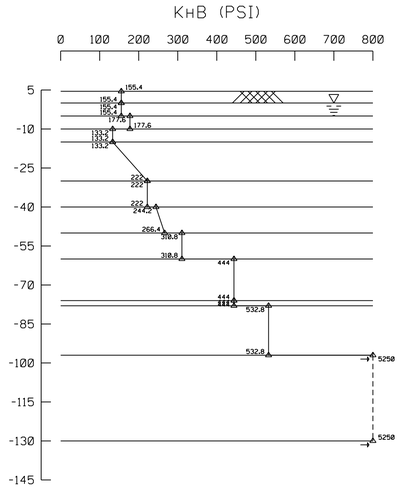
Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	S-CASE Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
7	-54	1	100	37.5	2600.25	2600.25	2619	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	70.799	49.559	0.000	70.799	49.559
7	-55	1	100	37.5	2637.75	2637.75	2656.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	72.985	51.090	0.000	72.985	51.090
7	-56	1	100	37.5	2675.25	2675.25	2694	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	75.203	52.642	0.000	75.203	52.642
7	-57	1	100	37.5	2712.75	2712.75	2731.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	77.451	54.216	0.000	77.451	54.216
7	-58	1	100	37.5	2750.25	2750.25	2769	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	79.731	55.812	0.000	79.731	55.812
7	-59	1	100	37.5	2787.75	2787.75	2806.5	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	82.042	57.429	0.000	82.042	57.429
7	-60	1	100	37.5	2825.25	2825.25	2844	0	0	23	15.3	1.00	0.70	10.00	0.00	No	0.000	84.384	59.069	0.000	84.384	59.069
8	-61	1	104	41.5	2864.75	2864.75	2885.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	86.759	60.731	20.343	107.101	60.731
8	-62	1	104	41.5	2906.25	2906.25	2927	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	89.168	62.417	20.635	109.803	62.417
8	-63	1	104	41.5	2947.75	2947.75	2968.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	91.611	64.128	20.928	112.539	64.128
8	-64	1	104	41.5	2989.25	2989.25	3010	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	94.089	65.862	21.220	115.310	65.862
8	-65	1	104	41.5	3030.75	3030.75	3051.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	96.601	67.621	21.513	118.114	67.621
8	-66	1	104	41.5	3072.25	3072.25	3093	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	99.148	69.404	21.806	120.954	69.404
8	-67	1	104	41.5	3113.75	3113.75	3134.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	101.729	71.210	22.098	123.827	71.210
8	-68	1	104	41.5	3155.25	3155.25	3176	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	104.345	73.041	22.391	126.735	73.041
8	-69	1	104	41.5	3196.75	3196.75	3217.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	106.994	74.896	22.683	129.678	74.896
8	-70	1	104	41.5	3238.25	3238.25	3259	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	109.679	76.775	22.976	132.655	76.775
8	-71	1	104	41.5	3279.75	3279.75	3300.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	112.397	78.678	23.269	135.666	78.678
8	-72	1	104	41.5	3321.25	3321.25	3342	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	115.150	80.605	23.561	138.712	80.605
8	-73	1	104	41.5	3362.75	3362.75	3383.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	117.938	82.557	23.854	141.792	82.557
8	-74	1	104	41.5	3404.25	3404.25	3425	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	120.760	84.532	24.146	144.906	84.532
8	-75	1	104	41.5	3445.75	3445.75	3466.5	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	123.616	86.531	24.439	148.055	86.531
8	-76	1	104	41.5	3487.25	3487.25	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	126.507	88.555	24.675	151.182	88.555
8	-77	1	104	41.5	3528.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	129.408	90.586	24.675	154.083	90.586
8	-78	1	104	41.5	3570.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	132.309	92.616	24.675	156.984	92.616
9	-79	1	104	41.5	3611.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	135.210	94.647	24.675	159.885	94.647
9	-80	1	104	41.5	3653.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	138.112	96.678	24.675	162.787	96.678
9	-81	1	104	41.5	3694.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	141.013	98.709	24.675	165.688	98.709
9	-82	1	104	41.5	3736.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	143.914	100.740	24.675	168.589	100.740
9	-83	1	104	41.5	3777.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	146.815	102.771	24.675	171.490	102.771
9	-84	1	104	41.5	3819.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	149.717	104.802	24.675	174.392	104.802
9	-85	1	104	41.5	3860.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	152.618	106.833	24.675	177.293	106.833
9	-86	1	104	41.5	3902.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	155.519	108.863	24.675	180.194	108.863
9	-87	1	104	41.5	3943.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	158.420	110.894	24.675	183.095	110.894
9	-88	1	104	41.5	3985.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	161.322	112.925	24.675	185.997	112.925
9	-89	1	104	41.5	4026.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	164.223	114.956	24.675	188.898	114.956
9	-90	1	104	41.5	4068.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	167.124	116.987	24.675	191.799	116.987
9	-91	1	104	41.5	4109.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	170.025	119.018	24.675	194.700	119.018
9	-92	1	104	41.5	4151.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	172.927	121.049	24.675	197.602	121.049
9	-93	1	104	41.5	4192.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	175.828	123.079	24.675	200.503	123.079
9	-94	1	104	41.5	4234.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	178.729	125.110	24.675	203.404	125.110
9	-95	1	104	41.5	4275.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	181.630	127.141	24.675	206.305	127.141
9	-96	1	104	41.5	4317.25	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	184.532	129.172	24.675	209.207	129.172
9	-97	1	104	41.5	4358.75	3500	3500	0	0	23	15.3	1.00	0.70	10.00	0.00	Yes	0.000	187.433	131.203	24.675	212.108	131.203
10	-98	1	122	59.5	4409.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	192.323	133.942	55.519	247.842	133.942
10	-99	1	122	59.5	4468.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	197.214	136.680	55.519	252.733	136.680
10	-100	1	122	59.5	4528.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	202.104	139.419	55.519	257.623	139.419
10	-101	1	122	59.5	4587.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	206.995	142.158	55.519	262.513	142.158
10	-102	1	122	59.5	4647.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	211.885	144.896	55.519	267.404	144.896
10	-103	1	122	59.5	4706.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	216.776	147.635	55.519	272.294	147.635
10	-104	1	122	59.5	4766.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	221.666	150.373	55.519	277.185	150.373
10	-105	1	122	59.5	4825.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	226.557	153.112	55.519	282.075	153.112
10	-106	1	122	59.5	4885.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	231.447	155.851	55.519	286.966	155.851
10	-107	1	122	59.5	4944.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	236.337	158.589	55.519	291.856	158.589
10	-108	1	122	59.5	5004.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	241.228	161.328	55.519	296.747	161.328
10	-109	1	122	59.5	5063.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	246.118	164.067	55.519	301.637	164.067
10	-110	1	122	59.5	5123.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	251.009	166.805	55.519	306.528	166.805
10	-111	1	122	59.5	5182.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	255.899	169.544	55.519	311.418	169.544
10	-112	1	122	59.5	5242.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	260.790	172.283	55.519	316.308	172.283

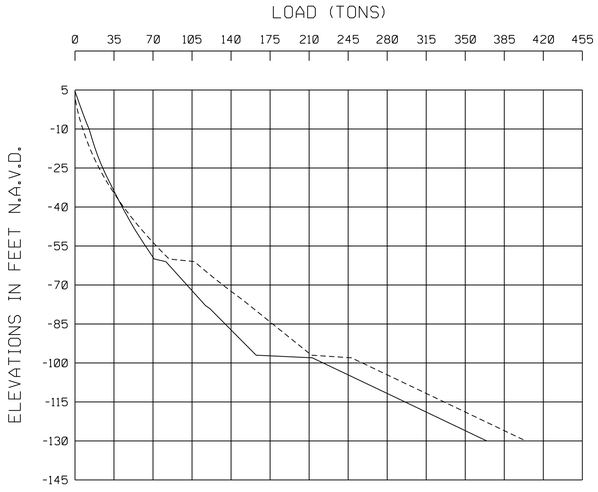
PLATE A-11-e

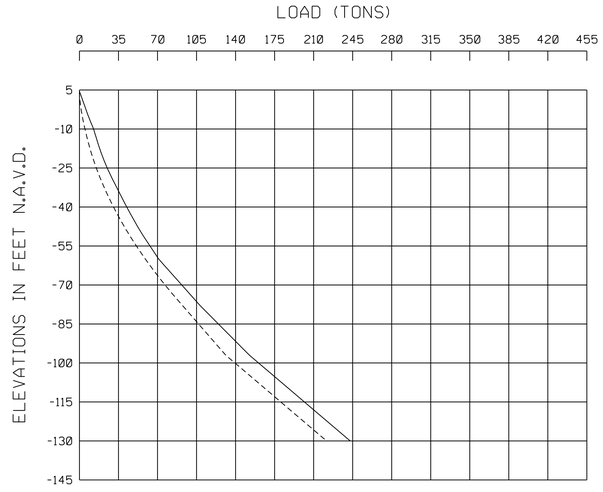
Suburban HP 14x89 Pile								S-CASE														
Stratum	Tip	Increment	$\gamma_{(moist)}$	$\gamma_{(sub)}$	γh	Mid-layer γh (used)	Bottom γh (used)	Cohesion	Mid-Layer Adhesion	ϕ	δ	Kc	Kt	Nq	Nc	End Bearing	Coh./Adh Resistance	Friction Compression	Friction Tension	End Bearing	Pile Capacity Compression	Pile Capacity Tension
10	-113	1	122	59.5	5301.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	265.680	175.021	55.519	321.199	175.021
10	-114	1	122	59.5	5361.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	270.571	177.760	55.519	326.089	177.760
10	-115	1	122	59.5	5420.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	275.461	180.499	55.519	330.980	180.499
10	-116	1	122	59.5	5480.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	280.351	183.237	55.519	335.870	183.237
10	-117	1	122	59.5	5539.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	285.242	185.976	55.519	340.761	185.976
10	-118	1	122	59.5	5599.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	290.132	188.715	55.519	345.651	188.715
10	-119	1	122	59.5	5658.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	295.023	191.453	55.519	350.542	191.453
10	-120	1	122	59.5	5718.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	299.913	194.192	55.519	355.432	194.192
10	-121	1	122	59.5	5777.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	304.804	196.930	55.519	360.322	196.930
10	-122	1	122	59.5	5837.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	309.694	199.669	55.519	365.213	199.669
10	-123	1	122	59.5	5896.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	314.585	202.408	55.519	370.103	202.408
10	-124	1	122	59.5	5956.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	319.475	205.146	55.519	374.994	205.146
10	-125	1	122	59.5	6015.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	324.365	207.885	55.519	379.884	207.885
10	-126	1	122	59.5	6075.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	329.256	210.624	55.519	384.775	210.624
10	-127	1	122	59.5	6134.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	334.146	213.362	55.519	389.665	213.362
10	-128	1	122	59.5	6194.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	339.037	216.101	55.519	394.556	216.101
10	-129	1	122	59.5	6253.75	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	343.927	218.840	55.519	399.446	218.840
10	-130	1	122	59.5	6313.25	3500	3500	0	0	30	20	1.25	0.70	22.50	0.00	Yes	0.000	348.818	221.578	55.519	404.336	221.578

PLATE A-11-f









D	PILE SPACING IN DIRECTION OF LOADING
1.00	8B
.85	7B
.70	6B
.55	5B
.40	4B
.25	3B

C	LOADING CONDITION
1.00	INITIAL LOADING
0.30	CYCLIC LOADING

NOTES: KH = α K1/B=(0.2222qu/B)(C)(D) COHESIVE
α = 0.4 = Factor of material properties of soil and pile
k1 = Modulus of subgrade reaction for test plate (pci)
B1 = Width or diameter of test plate (in)
K1 = k1B1 = 80qu(pcf) = 0.5556qu(psi)
qu = 2 c = Unconfined compressive strength (psf)
C = Reduction for cyclic loading-not applicable
D = Group effect reduction factor
B = Width of pile measured at right angles to the direction of displacement (in)
KH = (nh)(Z/B)(C)(D) COHESIONLESS
nh = Coeficient of horizontal subgrade reaction (pci)
Z = Depth below equivalent ground surface (in)

THE FACTOR SHOWN, (MODULUS OF HORIZONTAL SUBGRADE K_h, TIMES THE PILE WIDTH IN INCHES (B), MEASURED AT RIGHT ANGLES TO THE DIRECTION OF DISPLACEMENT) MUST BE MODIFIED BY A REDUCTION FACTOR FOR THE EFFECT OF GROUP ACTION (D) AND A REDUCTION FACTOR FOR CYCLIC LOADING (C) EX: $K_h = \frac{0.2222\alpha qu(C)(D)}{(B)}$

Suburban Canal
HP 14x89
Pile Capacity Curves

PLATE A-12

APPENDIX B

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-1A, Compression, 500%"

14" H-Pile, Tip Elevation = -80

Service Load = 45.00 Tons

Estimated Pile Capacity = 112 Tons

Pile Information	
Type	H-Pile
Dia/Size (in)	14
Area (in^2)	26.2
Top Ele. (ft)	6.5
Tip Ele. (ft)	-80
Length (ft)	87
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	22.50	0.0005
100%	45.00	0.0005
150%	67.50	0.0000
200%	90.00	0.0010
260%	117.00	2.7895

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	11.3	0.0095	25%	11.3	0.0003	0.015	0.009
50%	22.5	0.0235	50%	22.5	0.0005	0.031	0.023
75%	33.8	0.0390	75%	33.8	0.0005	0.046	0.039
100%	45.0	0.0605	100%	45.0	0.0005	0.061	0.060
125%	56.3	0.0745	125%	56.3	0.0003	0.077	0.074
150%	67.5	0.0980	150%	67.5	0.0000	0.092	0.098
175%	78.8	0.1130	175%	78.8	0.0100	0.108	0.103
200%	90.0	0.1460	200%	90.0	**0.0010**	0.123	0.145
210%	94.5	0.1570	210%	94.5	0.0140	0.129	0.143
220%	99.0	0.1710	220%	99.0	0.0280	0.135	0.143
230%	103.5	0.1850	230%	103.5	0.0530	0.141	0.132
240%	108.0	0.2055	240%	108.0	0.1330	0.148	0.073
250%	112.5	0.2310	250%	112.5	0.4500	0.154	-0.219
260%	117.0	2.9685	260%	117.0	2.7895	0.160	0.179

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	110.8	0.25		
☑	**.01 inch/Ton Creep Rate**	111.68	0.202	100.5 130.5	0.083 0.383
☑	**Tangent Method**	112.4	0.165	0 157.2 0.001374	0 0.216

Capacity	Deflection	Line T1 points		Line T2 points	
		0	0	112.8	0.064
		157.2	0.216	117	2.9685
		0.001374		0.6915476	-77.942571

PILE CAPACITY **111.6** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**

Values in RED cannot be adjusted

PLATE B-1-a

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	1.54
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	0.000	0.000	0.0000		1.540	0.0000
25%	11.25	2	0.0090	0.0110	0.0100		1.550	0.0100
	11.25	8	0.0090	0.0110	0.0100		1.550	0.0100
	11.25	15	0.0080	0.0100	0.0090		1.550	0.0100
	11.25	30	0.0070	0.0100	0.0085		1.550	0.0100
	11.25	60	0.0050	0.0120	0.0085		1.550	0.0100
	11.25	120	0.0050	0.0140	0.0095		1.550	0.0100
50%	22.50	2	0.0150	0.0240	0.0195		1.570	0.0300
	22.50	8	0.0150	0.0250	0.0200		1.570	0.0300
	22.50	15	0.0160	0.0260	0.0210		1.570	0.0300
	22.50	30	0.0170	0.0270	0.0220		1.570	0.0300
	22.50	60	0.0180	0.0290	0.0235		1.570	0.0300
	22.50	120	0.0180	0.0290	0.0235		1.570	0.0300
25%	11.25	20	0.0040	0.0150	0.0095		1.560	0.0200
0%	0.00	20	0.0000	0.0010	0.0005		1.540	0.0000
50%	22.50	20	0.0190	0.0250	0.0220		1.570	0.0300
75%	33.75	2	0.0350	0.0390	0.0370		1.59	0.0500
	33.75	8	0.0360	0.0410	0.0385		1.59	0.0500
	33.75	15	0.0360	0.0420	0.0390		1.59	0.0500
	33.75	30	0.0360	0.0400	0.0380		1.59	0.0500
	33.75	60	0.0360	0.0390	0.0375		1.59	0.0500
	33.75	120	0.0390	0.0390	0.0390		1.59	0.0500
100%	45.00	2	0.0550	0.0560	0.0555		1.620	0.0800
	45.00	8	0.0560	0.0570	0.0565		1.620	0.0800
	45.00	15	0.0570	0.0580	0.0575		1.620	0.0800
	45.00	30	0.0580	0.0590	0.0585		1.640	0.1000
	45.00	60	0.0590	0.0610	0.0600		1.620	0.0800
	45.00	120	0.0600	0.0610	0.0605		1.620	0.0800
75%	33.75	20	0.0460	0.0470	0.0465		1.600	0.0600
50%	22.50	20	0.0300	0.0310	0.0305		1.590	0.0500
0%	0.00	20	0.0000	0.0010	0.0005		1.550	0.0100
50%	22.50	20	0.0230	0.0230	0.0230		1.590	0.0500
100%	45.00	20	0.0560	0.0560	0.0560		1.630	0.0900
125%	56.25	2	0.0750	0.0740	0.0745		1.640	0.1000
	56.25	8	0.0750	0.0740	0.0745		1.640	0.1000
	56.25	15	0.0750	0.0740	0.0745		1.640	0.1000
	56.25	30	0.0750	0.0740	0.0745		1.640	0.1000
	56.25	60	0.0750	0.0740	0.0745		1.640	0.1000
	56.25	120	0.0750	0.0740	0.0745		1.640	0.1000
150%	67.50	2	0.0960	0.0930	0.0945		1.660	0.1200
	67.50	8	0.0990	0.0950	0.0970		1.660	0.1200
	67.50	15	0.0990	0.0960	0.0975		1.660	0.1200
	67.50	30	0.1000	0.0970	0.0985		1.660	0.1200
	67.50	60	0.1000	0.0970	0.0985		1.660	0.1200
	67.50	120	0.1000	0.0960	0.0980		1.670	0.1300
125%	56.25	20	0.0860	0.0810	0.0835		1.650	0.1100
100%	45.00	20	0.0670	0.0630	0.0650		1.640	0.1000
50%	22.50	20	0.0290	0.0260	0.0275		1.600	0.0600
0%	0.00	20	0.0000	0.0000	0.0000		1.560	0.0200
50%	22.50	20	0.0170	0.0120	0.0145		1.590	0.0500
100%	45.00	20	0.0510	0.0550	0.0530		1.630	0.0900
150%	67.50	20	0.0890	0.0830	0.0860		1.670	0.1300
175%	78.75	2	0.1110	0.1050	0.1080		1.700	0.1600
	78.75	8	0.1120	0.1060	0.1090		1.700	0.1600
	78.75	15	0.1140	0.1080	0.1110		1.700	0.1600
	78.75	30	0.1160	0.1100	0.1130		1.700	0.1600
	78.75	60	0.1170	0.1100	0.1135		1.700	0.1600
	78.75	120	0.1170	0.1090	0.1130		1.700	0.1600
200%	90.00	2	0.1430	0.1340	0.1385		1.73	0.1900
	90.00	8	0.1400	0.1360	0.1380		1.73	0.1900
	90.00	15	0.1460	0.1380	0.1420		1.73	0.1900
	90.00	30	0.1480	0.1390	0.1435		1.74	0.2000
	90.00	60	0.1490	0.1400	0.1445		1.74	0.2000
	90.00	120	0.1500	0.1480	0.1490		1.75	0.2100
	90.00	180	0.1530	0.1480	0.1505		1.75	0.2100
	90.00	240	0.1550	0.1550	0.1550		1.76	0.2200
	90.00	300	0.1590	0.1560	0.1575		1.76	0.2200
	90.00	360	0.1630	0.1590	0.1610		1.77	0.2300
	90.00	420	0.1650	0.1610	0.1630		1.78	0.2400
	90.00	480	0.1680	0.1620	0.1650		1.78	0.2400
	90.00	540	0.1700	0.1640	0.1670		1.79	0.2500

PLATE B-1-b

	90.00	600	0.1720	0.1660	0.1690			1.79	0.2500
	90.00	660	0.1740	0.1690	0.1715			1.79	0.2500
	90.00	720	0.1750	0.1700	0.1725			1.79	0.2500
	90.00	780	0.1760	0.1720	0.1740			1.79	0.2500
	90.00	840	0.1770	0.1740	0.1755			1.79	0.2500
	90.00	900	0.1810	0.1780	0.1795			1.79	0.2500
	90.00	960	0.1820	0.1770	0.1795			1.79	0.2500
	90.00	1020	0.1800	0.1750	0.1775			1.79	0.2500
	90.00	1080	0.1780	0.1720	0.1750			1.79	0.2500
	90.00	1140	0.1740	0.1680	0.1710			1.79	0.2500
	90.00	1200	0.1730	0.1670	0.1700			1.79	0.2500
	90.00	1260	0.1710	0.1640	0.1675			1.79	0.2500
	90.00	1320	0.1690	0.1590	0.1640			1.79	0.2500
	90.00	1380	0.1710	0.1600	0.1655			1.80	0.2600
	90.00	1440	0.1650	0.1510	0.1580			1.80	0.2600
150%	67.50	20	0.1320	0.1170	0.1245			1.76	0.2200
	67.50	40	0.1300	0.1140	0.1220			1.76	0.2200
	67.50	60	0.1290	0.1120	0.1205			1.76	0.2200
100%	45.00	20	0.0910	0.0750	0.0830			1.730	0.1900
	45.00	40	0.0870	0.0720	0.0795			1.730	0.1900
	45.00	60	0.0870	0.0720	0.0795			1.730	0.1900
50%	22.50	20	0.0420	0.0330	0.0375			1.680	0.1400
	22.50	40	0.0390	0.0350	0.0370			1.680	0.1400
	22.50	60	0.0390	0.0360	0.0375			1.680	0.1400
0%	0.00	20	0.0090	0.0070	0.0080			1.640	0.1000
	0.00	40	0.0040	0.0020	0.0030	0.005		1.630	0.0900
	0.00	60	0.0020	0.0000	0.0010	0.002		1.630	0.0900
50%	22.50	20	0.0150	0.0210	0.0180	0.017		1.660	0.1200
100%	45.00	20	0.0540	0.0610	0.0575	0.040		1.700	0.1600
150%	67.50	20	0.0890	0.1020	0.0955	0.038		1.750	0.2100
200%	90.00	20	0.1400	0.1520	0.1460	0.051		1.790	0.2500
210%	94.50	20	0.1510	0.1630	0.1570	0.011		1.800	0.2600
220%	99.00	20	0.1650	0.1770	0.1710	0.014		1.830	0.2900
230%	103.50	20	0.1770	0.1930	0.1850	0.014		1.830	0.2900
240%	108.00	20	0.1990	0.2120	0.2055	0.021		1.850	0.3100
250%	112.50	20	0.2230	0.2390	0.2310	0.026		1.880	0.3400
260%	117.00	20	0.2830	0.2970	0.2900	0.059		1.940	0.4000
260%	117.00	20	2.9610	2.9760	2.9685	2.679		4.540	3.0000
170%	76.50	20	2.9610	2.9760	2.9685	0.000		4.540	3.0000
114%	51.30	20	2.9140	2.9270	2.9205	0.048		4.490	2.9500
57%	25.65	20	2.8600	2.8670	2.8635	0.057		4.430	2.8900
0%	0.00	20	2.7860	2.7930	2.7895	0.074		4.350	2.8100

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-1A, Compression, 300%
Tip at El-80

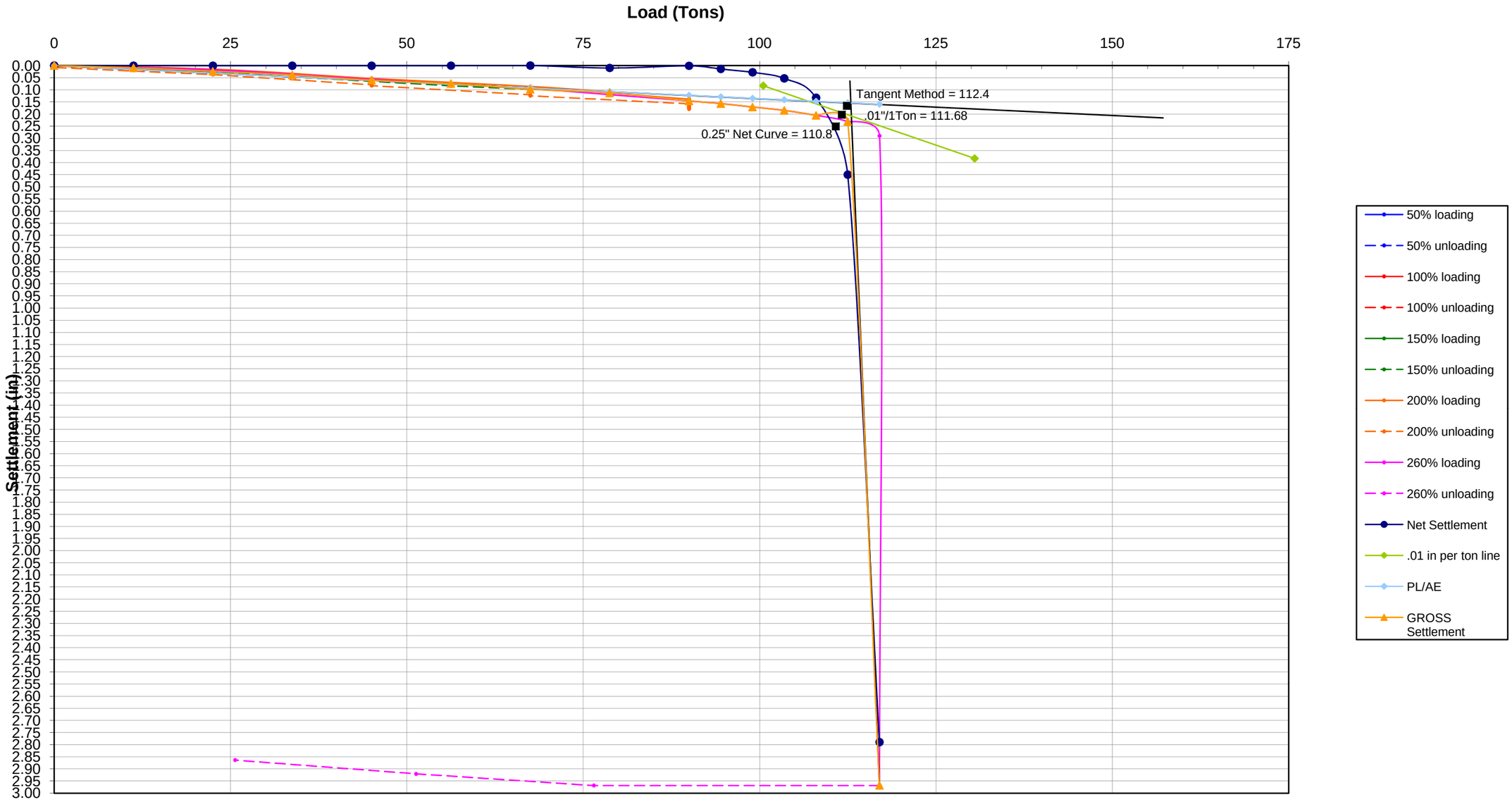


PLATE B-1-d

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-1T, Tension, 500%"

14" H-Pile, Tip Elevation = -80

Service Load = **30.00** **Tons**

Estimated Pile Capacity = **110 Tons**

Pile Information	
Type	H-Pile
Dia/Size (in)	14
Area (in^2)	26.2
Top Ele. (ft)	6.5
Tip Ele. (ft)	-80
Length (ft)	87
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	15.00	0.0115
100%	30.00	0.0210
150%	45.00	0.0715
200%	60.00	0.1425
400%	120.00	1.7620

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	7.5	0.0160	25%	7.5	0.0057	0.010	0.010
50%	15.0	0.0305	50%	15.0	0.0115	0.020	0.019
75%	22.5	0.0470	75%	22.5	0.0162	0.031	0.031
100%	30.0	0.0645	100%	30.0	0.0210	0.041	0.044
125%	37.5	0.1010	125%	37.5	0.0463	0.051	0.055
150%	45.0	0.1360	150%	45.0	0.0715	0.061	0.064
175%	52.5	0.1480	175%	52.5	0.1070	0.072	0.041
200%	60.0	0.1800	200%	60.0	0.1425	0.082	0.038
250%	75.0	0.2300	250%	75.0	0.1700	0.102	0.060
280%	84.0	0.2660	280%	84.0	0.1870	0.115	0.079
330%	99.0	0.3400	330%	99.0	0.2320	0.135	0.108
385%	115.5	0.4770	385%	115.5	0.4500	0.158	0.027
400%	120.0	0.7815	400%	120.0	1.3000	0.164	-0.519
400%	120.0	1.9790	400%	120.0	1.7620	0.164	0.217

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection				
☑	**.25 inch Net Deflection**	102	0.25				
☑	**.01 inch/Ton Creep Rate**	109.6	0.404	94.3 124.3	0.25 0.55		
☑	**Tangent Method**	119.5	0.37	0 137.3 0.0031173	0 0.428	119.7 120 5.9733333	0.187 1.979 -714.821

PILE CAPACITY **110.4** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**

Values in RED cannot be adjusted

PLATE B-2-a

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	1.95
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	2.0000	2.0000	0.0000		1.95	0.0000
25%	7.50	2	1.9850	1.9870	0.0140		1.96	0.0100
	7.50	8	1.9850	1.9860	0.0145		1.96	0.0100
	7.50	15	1.9850	1.9860	0.0145		1.96	0.0100
	7.50	30	1.9850	1.9840	0.0155		1.96	0.0100
	7.50	60	1.9850	1.9840	0.0155		1.96	0.0100
	7.50	120	1.9850	1.9830	0.0160		1.96	0.0100
50%	15.00	2	1.9720	1.9710	0.0285		1.97	0.0200
	15.00	8	1.9720	1.9710	0.0285		1.97	0.0200
	15.00	15	1.9720	1.9710	0.0285		1.97	0.0200
	15.00	30	1.9710	1.9700	0.0295		1.97	0.0200
	15.00	60	1.9700	1.9700	0.0300		1.97	0.0200
	15.00	120	1.9700	1.9690	0.0305		1.97	0.0200
25%	7.50	20	1.9800	1.9760	0.0220		1.97	0.0200
0%	0.00	20	1.9920	1.9850	0.0115		1.96	0.0100
50%	15.00	20	1.9710	1.9690	0.0300		1.97	0.0200
75%	22.50	2	1.9570	1.9570	0.0430		1.98	0.0300
	22.50	8	1.9570	1.9570	0.0430		1.98	0.0300
	22.50	15	1.9550	1.9560	0.0445		1.98	0.0300
	22.50	30	1.9540	1.9540	0.0460		1.98	0.0300
	22.50	60	1.9540	1.9540	0.0460		1.98	0.0300
	22.50	120	1.9530	1.9530	0.0470		1.98	0.0300
100%	30.00	2	1.9380	1.9400	0.0610		1.99	0.0400
	30.00	8	1.9380	1.9400	0.0610		1.99	0.0400
	30.00	15	1.9380	1.9400	0.0610		1.99	0.0400
	30.00	30	1.9350	1.9380	0.0635		1.99	0.0400
	30.00	60	1.9340	1.9370	0.0645		2.00	0.0500
	30.00	120	1.9340	1.9370	0.0645		2.00	0.0500
75%	22.50	20	1.9440	1.9450	0.0555		1.99	0.0400
50%	15.00	20	1.9540	1.9550	0.0455		1.98	0.0300
0%	0.00	20	1.9830	1.9750	0.0210		1.96	0.0100
50%	15.00	20	1.9610	1.9580	0.0405		1.98	0.0300
100%	30.00	20	1.9330	1.9350	0.0660		2.00	0.0500
125%	37.50	2	1.9200	1.9240	0.0780		2.01	0.0600
	37.50	8	1.9170	1.9210	0.0810		2.01	0.0600
	37.50	15	1.9160	1.9190	0.0825		2.01	0.0600
	37.50	30	1.9140	1.9170	0.0845		2.01	0.0600
	37.50	60	1.9110	1.9090	0.0900		2.01	0.0600
	37.50	120	1.8990	1.8990	0.1010		2.02	0.0700
150%	45.00	2	1.8830	1.8840	0.1165		2.03	0.0800
	45.00	8	1.8820	1.8830	0.1175		2.03	0.0800
	45.00	15	1.8810	1.8820	0.1185		2.03	0.0800
	45.00	30	1.8790	1.8790	0.1210		2.03	0.0800
	45.00	60	1.8750	1.8750	0.1250		2.03	0.0800
	45.00	120	1.8640	1.8640	0.1360		2.04	0.0900
125%	37.50	20	1.8700	1.8690	0.1305		2.02	0.0700
100%	30.00	20	1.8800	1.8780	0.1210		2.02	0.0700
50%	15.00	20	1.9040	1.8950	0.1005		2.00	0.0500
0%	0.00	20	1.9390	1.9180	0.0715		1.98	0.0300
50%	15.00	20	1.9160	1.9100	0.0870		2.00	0.0500
100%	30.00	20	1.8900	1.8820	0.1140		2.02	0.0700
150%	45.00	20	1.8670	1.8670	0.1330		2.04	0.0900
175%	52.50	2	1.8530	1.8540	0.1465		2.05	0.1000
	52.50	8	1.8510	1.8520	0.1485		2.05	0.1000
	52.50	15	1.8510	1.8520	0.1485		2.05	0.1000
	52.50	30	1.8510	1.8520	0.1485		2.05	0.1000
	52.50	60	1.8510	1.8550	0.1470		2.06	0.1100
	52.50	120	1.8450	1.8590	0.1480		2.06	0.1100
200%	60.00	2	1.8330	1.8480	0.1595		2.07	0.1200
	60.00	8	1.8310	1.8460	0.1615		2.07	0.1200
	60.00	15	1.8290	1.8440	0.1635		2.07	0.1200
	60.00	30	1.8280	1.8440	0.1640		2.07	0.1200
	60.00	60	1.8250	1.8410	0.1670		2.07	0.1200
	60.00	120	1.8250	1.8400	0.1675		2.07	0.1200
	60.00	180	1.8220	1.8380	0.1700		2.08	0.1300
	60.00	240	1.8220	1.8380	0.1700		2.08	0.1300
	60.00	300	1.8220	1.8370	0.1705		2.08	0.1300
	60.00	360	1.8220	1.8360	0.1710		2.08	0.1300
	60.00	420	1.8220	1.8360	0.1710		2.08	0.1300
	60.00	480	1.8220	1.8360	0.1710		2.09	0.1400

	60.00	540	1.8220	1.8350	0.1715		2.09	0.1400
	60.00	600	1.8220	1.8340	0.1720		2.09	0.1400
	60.00	660	1.8220	1.8330	0.1725		2.09	0.1400
	60.00	720	1.8210	1.8320	0.1735		2.09	0.1400
	60.00	780	1.8220	1.8320	0.1730		2.09	0.1400
	60.00	840	1.8220	1.8310	0.1735		2.09	0.1400
	60.00	900	1.8190	1.8280	0.1765		2.10	0.1500
	60.00	960	1.8120	1.8210	0.1835		2.10	0.1500
	60.00	1020	1.8040	1.8120	0.1920		2.10	0.1500
	60.00	1080	1.8000	1.8090	0.1955		2.10	0.1500
	60.00	1140	1.7910	1.8010	0.2040		2.10	0.1500
	60.00	1200	1.7810	1.7910	0.2140		2.10	0.1500
	60.00	1260	1.7740	1.7830	0.2215		2.10	0.1500
	60.00	1320	1.7660	1.7760	0.2290		2.10	0.1500
	60.00	1380	1.7570	1.7690	0.2370		2.10	0.1500
	60.00	1440	1.7550	1.7640	0.2405		2.10	0.1500
150%	45.00	20	1.7730	1.6800	0.2300		2.08	0.1300
	45.00	40	1.7720	1.7770	0.2255		2.08	0.1300
	45.00	60	1.7720	1.7770	0.2255		2.08	0.1300
100%	30.00	20	1.7970	1.7970	0.2030		2.06	0.1100
	30.00	40	1.7970	1.7970	0.2030		2.06	0.1100
	30.00	60	1.7980	1.7970	0.2025		2.06	0.1100
50%	15.00	20	1.8260	1.8200	0.1770		2.04	0.0900
	15.00	40	1.8270	1.8200	0.1765		2.04	0.0900
	15.00	60	1.8280	1.8210	0.1755		2.04	0.0900
0%	0.00	20	1.8620	1.8480	0.1450		2.02	0.0700
	0.00	40	1.8650	1.8490	0.1430	0.002	2.02	0.0700
	0.00	60	1.8660	1.8490	0.1425	0.001	2.02	0.0700
50%	15.00	20	1.8430	1.8300	0.1635	0.021	2.03	0.0800
100%	30.00	20	1.8150	1.8050	0.1900	0.027	2.05	0.1000
150%	45.00	20	1.7890	1.7810	0.2150	0.025	2.06	0.1100
200%	60.00	20	1.7580	1.7540	0.2440	0.029	2.09	0.1400
210%	63.00	20	1.7500	1.7470	0.2515	0.007	2.10	0.1500
220%	66.00	20	1.7410	1.7390	0.2600	0.008	2.11	0.1600
230%	69.00	20	1.7340	1.7320	0.2670	0.007	2.12	0.1700
240%	72.00	20	1.7230	1.7250	0.2760	0.009	2.13	0.1800
250%	75.00	20	1.7150	1.7150	0.2850	0.009	2.14	0.1900
260%	78.00	20	1.7060	1.7060	0.2940	0.009	2.15	0.2000
270%	81.00	20	1.6940	1.6950	0.3055	0.012	2.15	0.2000
280%	84.00	20	1.6830	1.6840	0.3165	0.011	2.16	0.2100
290%	87.00	20	1.6720	1.6740	0.3270	0.011	2.17	0.2200
300%	90.00	20	1.6580	1.6610	0.3405	0.014	2.19	0.2400
310%	93.00	20	1.6450	1.6470	0.3540	0.014	2.20	0.2500
320%	96.00	20	1.6290	1.6330	0.3690	0.015	2.20	0.2500
330%	99.00	20	1.6120	1.6150	0.3865	0.018	2.23	0.2800
340%	102.00	20	1.5930	1.5970	0.4050	0.019	2.25	0.3000
350%	105.00	20	1.5720	1.5770	0.4255	0.021	2.27	0.3200
360%	108.00	20	1.5460	1.5530	0.4505	0.025	2.29	0.3400
370%	111.00	20	1.5200	1.5280	0.4760	0.026	2.32	0.3700
380%	114.00	20	1.4800	1.4850	0.5175	0.042	2.36	0.4100
390%	117.00	20	1.4030	1.4120	0.5925	0.075	2.44	0.4900
400%	120.00	20	1.2140	1.2230	0.7815	0.189	2.62	0.6700
400%	120.00	20	0.0420	0.0000	1.9790	1.198	3.85	1.9000
305%	91.50	20	0.0420	0.0000	1.9790	0.000	3.85	1.9000
263%	78.75	20	0.0220	0.0230	1.9775	0.002	3.82	1.8700
175%	52.50	20	0.0780	0.0730	1.9245	0.053	3.76	1.8100
88%	26.25	20	0.1580	0.1440	1.8490	0.075	3.70	1.7500
0%	0.00	20	0.2510	0.2250	1.7620	0.087	3.62	1.6700

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-1T, Tension, 500%
Tip at El-80

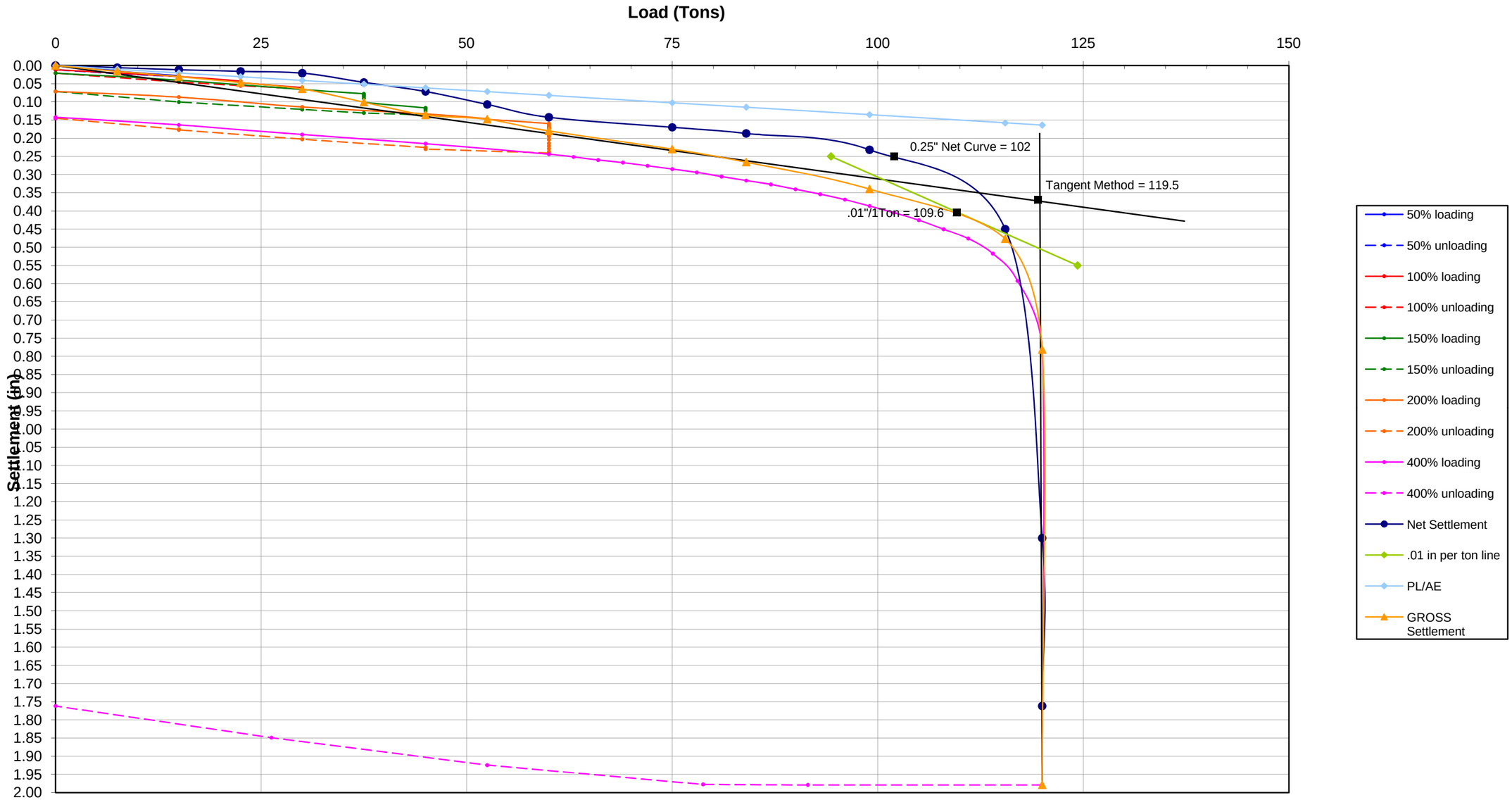


PLATE B-2-d

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-2A, Compression, 300%"
14" H-Pile, Tip Elevation = -100

Service Load = **100.00** **Tons**

Estimated Pile Capacity = **154 Tons**

Pile Information	
Type	H-Pile
Dia/Size (in)	14
Area (in^2)	26.2
Top Ele. (ft)	6.5
Tip Ele. (ft)	-100
Length (ft)	107
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	50.00	0.0035
100%	100.00	0.0155
150%	150.00	0.1040
155%	155.00	0.0000
160%	160.00	1.6475

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	25.0	0.0265	25%	25.0	0.0018	0.042	0.025
50%	50.0	0.0645	50%	50.0	0.0035	0.084	0.061
75%	75.0	0.1330	75%	75.0	0.0095	0.126	0.124
100%	100.0	0.1925	100%	100.0	0.0155	0.168	0.177
125%	125.0	0.2820	125%	125.0	0.0598	0.210	0.222
150%	150.0	0.4080	150%	150.0	0.1040	0.252	0.304
152%	152.0	0.4200	152%	152.0	0.1400	0.256	0.280
155%	155.0	0.4900	155%	155.0	**0.2300**	0.261	0.260
158%	158.0	0.6800	158%	158.0	0.5200	0.266	0.160
160%	160.0	1.9950	160%	160.0	1.6475	0.269	0.348

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	155.1	0.25		
☑	**.01 inch/Ton Creep Rate**	150.6	0.408	132.4 162.4	0.228 0.528
☑	**Tangent Method**	157.5	0.2	0 168.6 0.0012811	0 0.216	157.2 160.0 0.6896429	0.064 1.9950 -108.34786

(Creep Rate: Capacity / Deflection / .01"/Ton line points; Tangent Method: Capacity / Deflection / Line T1 points / Line T2 points)

PILE CAPACITY **154.4** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE B-3-a

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	2.50
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	0.000	0.000	0.0000		2.500	0.0000
25%	25.00	2	0.0310	0.0310	0.0310		2.530	0.0300
	25.00	8	0.0310	0.0310	0.0310		2.530	0.0300
	25.00	15	0.0310	0.0310	0.0310		2.530	0.0300
	25.00	30	0.0300	0.0300	0.0300		2.530	0.0300
	25.00	60	0.0300	0.0280	0.0290		2.530	0.0300
	25.00	120	0.0260	0.0270	0.0265		2.530	0.0300
50%	50.00	2	0.0660	0.0660	0.0660		2.560	0.0600
	50.00	8	0.0660	0.0670	0.0665		2.560	0.0600
	50.00	15	0.0660	0.0660	0.0660		2.560	0.0600
	50.00	30	0.0660	0.0660	0.0660		2.560	0.0600
	50.00	60	0.0660	0.0670	0.0665		2.560	0.0600
	50.00	120	0.0640	0.0650	0.0645		2.560	0.0600
25%	25.00	20	0.0250	0.0270	0.0260		2.520	0.0200
0%	0.00	20	0.0040	0.0030	0.0035		2.500	0.0000
50%	50.00	20	0.0740	0.0770	0.0755		2.570	0.0700
75%	75.00	2	0.1200	0.1220	0.1210		2.62	0.1200
	75.00	8	0.1220	0.1220	0.1220		2.62	0.1200
	75.00	15	0.1220	0.1240	0.1230		2.62	0.1200
	75.00	30	0.1240	0.1260	0.1250		2.63	0.1300
	75.00	60	0.1260	0.1280	0.1270		2.63	0.1300
	75.00	120	0.1320	0.1340	0.1330		2.63	0.1300
100%	100.00	2	0.1830	0.1850	0.1840		2.700	0.2000
	100.00	8	0.1840	0.1870	0.1855		2.700	0.2000
	100.00	15	0.1850	0.1880	0.1865		2.700	0.2000
	100.00	30	0.1860	0.1890	0.1875		2.700	0.2000
	100.00	60	0.1870	0.1930	0.1900		2.700	0.2000
	100.00	120	0.1890	0.1960	0.1925		2.700	0.2000
75%	75.00	20	0.1520	0.1620	0.1570		2.660	0.1600
50%	50.00	20	0.1090	0.1200	0.1145		2.630	0.1300
0%	0.00	20	0.0130	0.0180	0.0155		2.530	0.0300
50%	50.00	20	0.0950	0.1030	0.0990		2.600	0.1000
100%	100.00	20	0.1980	0.1960	0.1970		2.700	0.2000
125%	125.00	2	0.2650	0.2660	0.2655		2.770	0.2700
	125.00	8	0.2670	0.2690	0.2680		2.770	0.2700
	125.00	15	0.2710	0.2730	0.2720		2.770	0.2700
	125.00	30	0.2730	0.2760	0.2745		2.770	0.2700
	125.00	60	0.2760	0.2780	0.2770		2.780	0.2800
	125.00	120	0.2800	0.2840	0.2820		2.780	0.2800
150%	150.00	2	0.3720	0.3770	0.3745		2.890	0.3900
	150.00	8	0.3770	0.3840	0.3805		2.900	0.4000
	150.00	15	0.3850	0.3910	0.3880		2.900	0.4000
	150.00	30	0.3990	0.3930	0.3960		2.910	0.4100
	150.00	60	0.4020	0.4090	0.4055		2.920	0.4200
	150.00	120	0.4050	0.4110	0.4080		2.930	0.4300
125%	125.00	20	0.3680	0.3750	0.3715		2.870	0.3700
100%	100.00	20	0.3270	0.3340	0.3305		2.830	0.3300
50%	50.00	20	0.2210	0.2300	0.2255		2.720	0.2200
0%	0.00	20	0.1030	0.1050	0.1040		2.600	0.1000
50%	50.00	20	0.1800	0.1900	0.1850		2.690	0.1900
100%	100.00	20	0.2910	0.2920	0.2915		2.800	0.3000
150%	150.00	20	0.4210	0.4240	0.4225		2.940	0.4400
160%	160.00	2	0.6250	0.6290	0.6270		3.140	0.6400
	160.00	8	0.7600	0.7620	0.7610		3.390	0.8900
	160.00	15	1.0260	1.0250	1.0255		3.550	1.0500
	160.00	30	1.5340	1.5420	1.5380		4.060	1.5600
	160.00	60	1.9900	2.0000	1.9950		4.510	2.0100
	160.00	120	1.9280	1.9420	1.9350		4.440	1.9400
117%	117.00	2	1.9280	1.9420	1.9350		4.44	1.9400
78%	78.00	8	1.8510	1.8670	1.8590		4.36	1.8600
39%	39.00	15	1.7500	1.7690	1.7595		4.27	1.7700
0%	0.00	30	1.6440	1.6510	1.6475		4.16	1.6600

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-2A, Compression, 300%
Tip at El-100

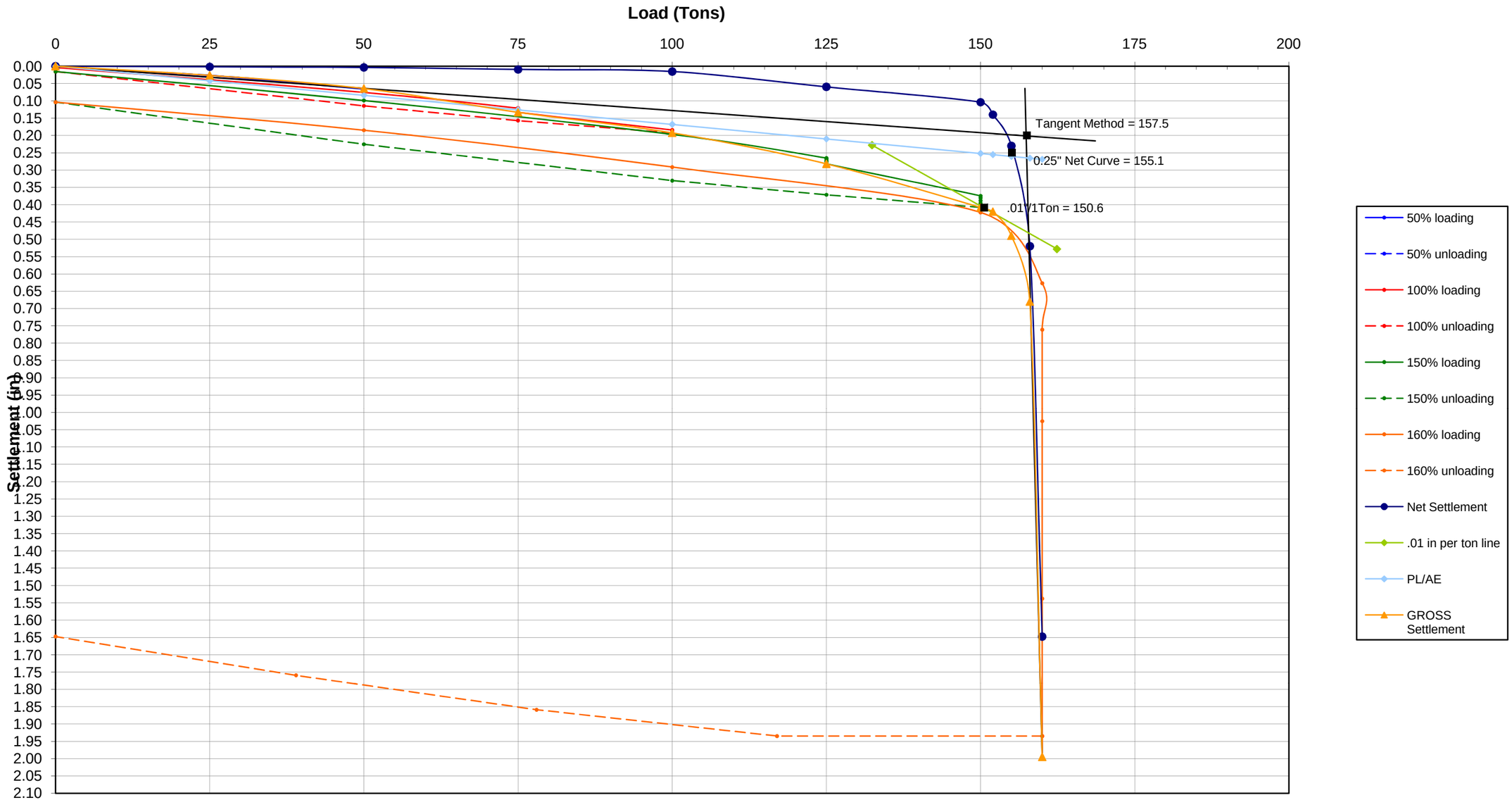


PLATE B-3-c

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-2B, Compression, 500%"
14" H-Pile, Tip Elevation = -125

Service Load = **100.00** **Tons**

Estimated Pile Capacity = **243 Tons**

Pile Information	
Type	H-Pile
Dia/Size (in)	14
Area (in^2)	26.2
Top Ele. (ft)	6.5
Tip Ele. (ft)	-125
Length (ft)	132
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	50.00	0.0060
100%	100.00	0.0250
150%	150.00	0.0260
200%	200.00	0.1535
260%	260.00	1.3960

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	25.0	0.0365	25%	25.0	0.0030	0.052	0.034
50%	50.0	0.0765	50%	50.0	0.0060	0.104	0.071
75%	75.0	0.1355	75%	75.0	0.0155	0.156	0.120
100%	100.0	0.1970	100%	100.0	0.0250	0.208	0.172
125%	125.0	0.2740	125%	125.0	0.0255	0.260	0.249
150%	150.0	0.3345	150%	150.0	0.0260	0.312	0.309
175%	175.0	0.4010	175%	175.0	0.0898	0.363	0.311
200%	200.0	0.5570	200%	200.0	0.1535	0.415	0.404
210%	210.0	0.6435	210%	210.0	0.1830	0.436	0.461
220%	220.0	0.6745	220%	220.0	0.2080	0.457	0.467
230%	230.0	0.7135	230%	230.0	0.2320	0.478	0.482
240%	240.0	0.7515	240%	240.0	0.2840	0.498	0.468
250%	250.0	0.8075	250%	250.0	0.4200	0.519	0.388
260%	260.0	1.8765	260%	260.0	1.3960	0.540	0.481

PILE CAPACITY CALCULATIONS

Select

.25 inch Net Deflection

Capacity	Deflection
234.4	0.25

.01 inch/Ton Creep Rate

Capacity	Deflection	.01"/Ton line points	
247.7	0.768	229.7	0.584
		259.7	0.884

Tangent Method

Capacity	Deflection	Line T1 points		Line T2 points	
247.5	0.382	0	0	246.5	0.21
		260.4	0.407	260	1.8765
		0.001563		0.1234444	-30.219056

PILE CAPACITY **243.2** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	1.13
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	0.0000	0.0000	0.0000		1.13	0.0000
25%	25.00	2	0.0410	0.0300	0.0355		1.17	0.0400
	25.00	8	0.0380	0.0300	0.0340		1.17	0.0400
	25.00	15	0.0380	0.0310	0.0345		1.17	0.0400
	25.00	30	0.0380	0.0310	0.0345		1.17	0.0400
	25.00	60	0.0380	0.0310	0.0345		1.17	0.0400
	25.00	120	0.0390	0.0340	0.0365		1.18	0.0500
50%	50.00	2	0.0770	0.0660	0.0715		1.22	0.0900
	50.00	8	0.0770	0.0660	0.0715		1.22	0.0900
	50.00	15	0.0780	0.0660	0.0720		1.22	0.0900
	50.00	30	0.0790	0.0670	0.0730		1.22	0.0900
	50.00	60	0.0810	0.0690	0.0750		1.22	0.0900
	50.00	120	0.0840	0.0690	0.0765		1.22	0.0900
25%	25.00	20	0.0460	0.0330	0.0395		1.19	0.0600
0%	0.00	20	0.0050	0.0070	0.0060		1.15	0.0200
50%	50.00	20	0.0860	0.0780	0.0820		1.22	0.0900
75%	75.00	2	0.1340	0.1190	0.1265		1.27	0.1400
	75.00	8	0.1360	0.1200	0.1280		1.27	0.1400
	75.00	15	0.1380	0.1210	0.1295		1.27	0.1400
	75.00	30	0.1390	0.1210	0.1300		1.27	0.1400
	75.00	60	0.1400	0.1220	0.1310		1.27	0.1400
	75.00	120	0.1460	0.1250	0.1355		1.27	0.1400
100%	100.00	2	0.2040	0.1770	0.1905		1.32	0.1900
	100.00	8	0.2040	0.1770	0.1905		1.32	0.1900
	100.00	15	0.2040	0.1770	0.1905		1.32	0.1900
	100.00	30	0.2050	0.1770	0.1910		1.32	0.1900
	100.00	60	0.2090	0.1770	0.1930		1.32	0.1900
	100.00	120	0.2130	0.1810	0.1970		1.32	0.1900
75%	75.00	20	0.1730	0.1490	0.1610		1.30	0.1700
50%	50.00	20	0.1310	0.1100	0.1205		1.25	0.1200
0%	0.00	20	0.0310	0.0190	0.0250		1.15	0.0200
50%	50.00	20	0.1110	0.0930	0.1020		1.25	0.1200
100%	100.00	20	0.2210	0.1890	0.2050		1.32	0.1900
125%	125.00	2	0.2820	0.2410	0.2615		1.39	0.2600
	125.00	8	0.2840	0.2430	0.2635		1.39	0.2600
	125.00	15	0.2870	0.2450	0.2660		1.39	0.2600
	125.00	30	0.2880	0.2450	0.2665		1.39	0.2600
	125.00	60	0.2890	0.2420	0.2655		1.39	0.2600
	125.00	120	0.2970	0.2510	0.2740		1.40	0.2700
150%	150.00	2	0.3570	0.3100	0.3335		1.46	0.3300
	150.00	8	0.3640	0.3190	0.3415		1.47	0.3400
	150.00	15	0.3650	0.3210	0.3430		1.47	0.3400
	150.00	30	0.3660	0.3210	0.3435		1.47	0.3400
	150.00	60	0.3640	0.3220	0.3430		1.47	0.3400
	150.00	120	0.3620	0.3070	0.3345		1.46	0.3300
125%	125.00	20	0.3250	0.2710	0.2980		1.42	0.2900
100%	100.00	20	0.2750	0.2260	0.2505		1.38	0.2500
50%	50.00	20	0.1710	0.1330	0.1520		1.28	0.1500
0%	0.00	20	0.0400	0.0120	0.0260		1.18	0.0500
50%	50.00	20	0.1290	0.0940	0.1115		1.24	0.1100
100%	100.00	20	0.2340	0.1810	0.2075		1.34	0.2100
150%	150.00	20	0.3560	0.2880	0.3220		1.48	0.3500
175%	175.00	2	0.4260	0.3510	0.3885		1.53	0.4000
	175.00	8	0.4270	0.3530	0.3900		1.54	0.4100
	175.00	15	0.4280	0.3530	0.3905		1.54	0.4100
	175.00	30	0.4340	0.3580	0.3960		1.56	0.4300
	175.00	60	0.4370	0.3580	0.3975		1.56	0.4300
	175.00	120	0.4400	0.3620	0.4010		1.56	0.4300
200%	200.00	2	0.5200	0.4360	0.4780		1.65	0.5200
	200.00	8	0.5230	0.4390	0.4810		1.65	0.5200
	200.00	15	0.5240	0.4410	0.4825		1.65	0.5200
	200.00	30	0.5250	0.4410	0.4830		1.65	0.5200
	200.00	60	0.5290	0.4450	0.4870		1.65	0.5200
	200.00	120	0.5350	0.4490	0.4920		1.65	0.5200
	200.00	180	0.5410	0.4530	0.4970		1.65	0.5200
	200.00	240	0.5950	0.4570	0.5260		1.65	0.5200
	200.00	300	0.5490	0.4600	0.5045		1.65	0.5200
	200.00	360	0.5540	0.4640	0.5090		1.65	0.5200
	200.00	420	0.5580	0.4650	0.5115		1.65	0.5200
	200.00	480	0.5620	0.4650	0.5135		1.65	0.5200

	200.00	540	0.5680	0.4690	0.5185		1.65	0.5200
	200.00	600	0.5690	0.4780	0.5235		1.67	0.5400
	200.00	660	0.5710	0.4800	0.5255		1.67	0.5400
	200.00	720	0.5720	0.4820	0.5270		1.67	0.5400
	200.00	780	0.5720	0.4830	0.5275		1.67	0.5400
	200.00	840	0.5780	0.4870	0.5325		1.67	0.5400
	200.00	900	0.5750	0.4880	0.5315		1.67	0.5400
	200.00	960	0.5750	0.4860	0.5305		1.68	0.5500
	200.00	1020	0.5650	0.4800	0.5225		1.67	0.5400
	200.00	1080	0.5700	0.4830	0.5265		1.67	0.5400
	200.00	1140	0.5660	0.4780	0.5220		1.68	0.5500
	200.00	1200	0.6180	0.5310	0.5745		1.69	0.5600
	200.00	1260	0.6110	0.5260	0.5685		1.69	0.5600
	200.00	1320	0.6280	0.5580	0.5930		1.68	0.5500
	200.00	1380	0.6320	0.5600	0.5960		1.68	0.5500
	200.00	1440	0.6370	0.5610	0.5990		1.69	0.5600
150%	150.00	20	0.5530	0.4870	0.5200		1.61	0.4800
	150.00	40	0.5530	0.4870	0.5200		1.61	0.4800
	150.00	60	0.5570	0.4870	0.5220		1.61	0.4800
100%	100.00	20	0.4440	0.3900	0.4170		1.50	0.3700
	100.00	40	0.4450	0.3880	0.4165		1.50	0.3700
	100.00	60	0.4460	0.3890	0.4175		1.50	0.3700
50%	50.00	20	0.3220	0.2820	0.3020		1.37	0.2400
	50.00	40	0.3240	0.2810	0.3025		1.37	0.2400
	50.00	60	0.3240	0.2810	0.3025		1.37	0.2400
0%	0.00	20	0.1710	0.1390	0.1550		1.23	0.1000
	0.00	40	0.1710	0.1390	0.1550	0.000	1.23	0.1000
	0.00	60	0.1700	0.1370	0.1535	0.002	1.23	0.1000
50%	50.00	20	0.2670	0.2180	0.2425	0.089	1.33	0.2000
100%	100.00	20	0.3820	0.3200	0.3510	0.109	1.42	0.2900
150%	150.00	20	0.5120	0.4370	0.4745	0.124	1.55	0.4200
200%	200.00	20	0.6510	0.5630	0.6070	0.133	1.68	0.5500
210%	210.00	20	0.6890	0.5980	0.6435	0.037	1.71	0.5800
220%	220.00	20	0.7210	0.6280	0.6745	0.031	1.75	0.6200
230%	230.00	20	0.7610	0.6660	0.7135	0.039	1.78	0.6500
240%	240.00	20	0.8000	0.7030	0.7515	0.038	1.83	0.7000
250%	250.00	20	0.8570	0.7580	0.8075	0.056	1.88	0.7500
260%	260.00	20	0.9280	0.8270	0.8775	0.070	1.95	0.8200
260%	260.00	20	1.9180	1.8350	1.8765	0.999	3.04	1.9100
179%	178.50	20	1.9180	1.8350	1.8765	0.000	3.04	1.9100
119%	119.00	20	1.7800	1.6100	1.6950	0.182	2.86	1.7300
60%	59.50	20	1.6120	1.5580	1.5850	0.110	2.75	1.6200
0%	0.00	20	1.4180	1.3740	1.3960	0.189	2.54	1.4100

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-2B, Tension, 300%
Tip at El-125

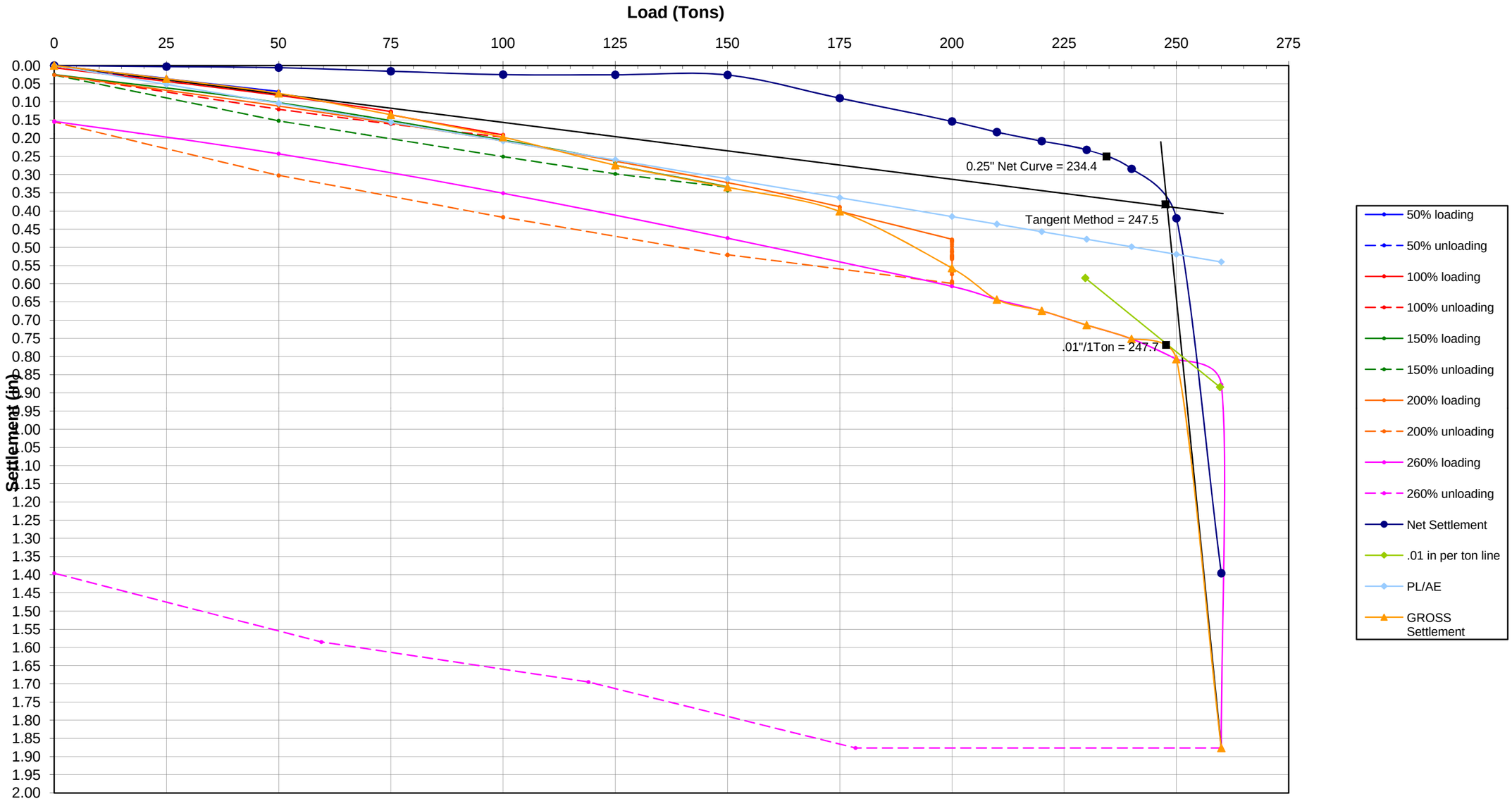


PLATE B-4-d

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-2T, Tension, 500%"
14" H-Pile, Tip Elevation = -100

Service Load = **62.50** **Tons**

Estimated Pile Capacity = **156 Tons**

Pile Information	
Type	H-Pile
Dia/Size (in)	14
Area (in^2)	26.2
Top Ele. (ft)	6.5
Tip Ele. (ft)	-100
Length (ft)	107
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	31.25	0.0425
100%	62.50	0.0595
150%	93.75	0.1040
200%	125.00	0.2095
270%	168.75	1.6960

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	15.6	0.0375	25%	15.6	0.0213	0.026	0.016
50%	31.3	0.0815	50%	31.3	0.0425	0.053	0.039
75%	46.9	0.1325	75%	46.9	0.0510	0.079	0.082
100%	62.5	0.1725	100%	62.5	0.0595	0.105	0.113
125%	78.1	0.2245	125%	78.1	0.0818	0.131	0.143
150%	93.8	0.2745	150%	93.8	0.1040	0.158	0.171
175%	109.4	0.3545	175%	109.4	0.1568	0.184	0.198
200%	125.0	0.4300	200%	125.0	0.2095	0.210	0.221
220%	137.5	0.4700	220%	137.5	0.2260	0.231	0.244
240%	150.0	0.5200	240%	150.0	0.2480	0.252	0.272
255%	159.4	0.6200	255%	159.4	0.2840	0.268	0.336
260%	162.5	0.7580	260%	162.5	0.3460	0.273	0.412
265%	165.6	0.9900	265%	165.6	0.5050	0.279	0.485
270%	168.8	1.9885	270%	168.8	1.6960	0.284	0.293

PILE CAPACITY CALCULATIONS

Select

.25 inch Net Deflection

Capacity	Deflection
152.4	0.25

.01 inch/Ton Creep Rate

Capacity	Deflection	.01"/Ton line points	
152.1	0.532	138	0.39
		168	0.69

Tangent Method

Capacity	Deflection	Line T1 points		Line T2 points	
164.5	0.45	0	0	163.4	0.21
		172.1	0.465	168.75	1.9885
		0.0027019		0.3324299	-54.109047

PILE CAPACITY **156.3** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE B-5-a

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	2.62
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	2.000	2.000	0.0000		2.62	0.0000
25%	15.63	2	1.968	1.980	0.0260		2.64	0.0200
	15.63	8	1.970	1.980	0.0250		2.64	0.0200
	15.63	15	1.969	1.979	0.0260		2.64	0.0200
	15.63	30	1.971	1.981	0.0240		2.64	0.0200
	15.63	60	1.961	1.975	0.0320		2.64	0.0200
	15.63	120	1.954	1.971	0.0375		2.65	0.0300
50%	31.25	2	1.924	1.944	0.0660		2.67	0.0500
	31.25	8	1.922	1.942	0.0680		2.67	0.0500
	31.25	15	1.921	1.941	0.0690		2.67	0.0500
	31.25	30	1.921	1.939	0.0700		2.68	0.0600
	31.25	60	1.961	1.935	0.0520		2.68	0.0600
	31.25	120	1.909	1.928	0.0815		2.68	0.0600
25%	15.63	20	1.930	1.947	0.0615		2.66	0.0400
0%	0.00	20	1.952	1.963	0.0425		2.64	0.0200
50%	31.25	20	1.903	1.918	0.0895		2.68	0.0600
75%	46.88	2	1.869	1.850	0.1405		2.70	0.0800
	46.88	8	1.867	1.883	0.1250		2.71	0.0900
	46.88	15	1.864	1.879	0.1285		2.71	0.0900
	46.88	30	1.863	1.878	0.1295		2.71	0.0900
	46.88	60	1.863	1.875	0.1310		2.71	0.0900
	46.88	120	1.862	1.873	0.1325		2.71	0.0900
100%	62.50	2	1.831	1.839	0.1650		2.75	0.1300
	62.50	8	1.830	1.838	0.1660		2.75	0.1300
	62.50	15	1.827	1.837	0.1680		2.75	0.1300
	62.50	30	1.825	1.835	0.1700		2.75	0.1300
	62.50	60	1.824	1.834	0.1710		2.75	0.1300
	62.50	120	1.826	1.829	0.1725		2.75	0.1300
75%	46.88	20	1.840	1.846	0.1570		2.73	0.1100
50%	31.25	20	1.869	1.874	0.1285		2.70	0.0800
0%	0.00	20	1.954	1.927	0.0595		2.65	0.0300
50%	31.25	20	1.880	1.878	0.1210		2.70	0.0800
100%	62.50	20	1.820	1.816	0.1820		2.75	0.1300
125%	78.13	2	1.786	1.781	0.2165		2.79	0.1700
	78.13	8	1.785	1.780	0.2175		2.79	0.1700
	78.13	15	1.784	1.778	0.2190		2.79	0.1700
	78.13	30	1.783	1.775	0.2210		2.79	0.1700
	78.13	60	1.871	1.772	0.1785		2.79	0.1700
	78.13	120	1.780	1.771	0.2245		2.79	0.1700
150%	93.75	2	1.744	1.732	0.2620		2.83	0.2100
	93.75	8	1.741	1.731	0.2640		2.83	0.2100
	93.75	15	1.740	1.730	0.2650		2.83	0.2100
	93.75	30	1.737	1.725	0.2690		2.83	0.2100
	93.75	60	1.724	1.722	0.2770		2.83	0.2100
	93.75	120	1.732	1.719	0.2745		2.83	0.2100
125%	78.13	20	1.755	1.740	0.2525		2.84	0.2200
100%	62.50	20	1.780	1.765	0.2275		2.82	0.2000
50%	31.25	20	1.837	1.824	0.1695		2.75	0.1300
0%	0.00	20	1.905	1.887	0.1040		2.68	0.0600
50%	31.25	20	1.839	1.846	0.1575		2.73	0.1100
100%	62.50	20	1.780	1.778	0.2210		2.78	0.1600
150%	93.75	20	1.707	1.706	0.2935		2.85	0.2300
175%	109.38	2	1.669	1.672	0.3295		2.88	0.2600
	109.38	8	1.667	1.674	0.3295		2.88	0.2600
	109.38	15	1.665	1.664	0.3355		2.89	0.2700
	109.38	30	1.660	1.660	0.3400		2.89	0.2700
	109.38	60	1.657	1.658	0.3425		2.89	0.2700
	109.38	120	1.643	1.648	0.3545		2.89	0.2700
200%	125.00	2	1.621	1.601	0.3890		2.93	0.3100
	125.00	8	1.601	1.605	0.3970		2.93	0.3100
	125.00	15	1.603	1.607	0.3950		2.93	0.3100
	125.00	30	1.609	1.608	0.3915		2.93	0.3100
	125.00	60	1.609	1.605	0.3930		2.94	0.3200
	125.00	120	1.605	1.609	0.3930		2.95	0.3300
	125.00	180	1.598	1.609	0.3965		2.95	0.3300
	125.00	240	1.589	1.612	0.3995		2.96	0.3400
	125.00	300	1.583	1.606	0.4055		2.96	0.3400
	125.00	360	1.571	1.597	0.4160		2.96	0.3400
	125.00	420	1.568	1.595	0.4185		2.96	0.3400
	125.00	480	1.564	1.590	0.4230		2.97	0.3500

PLATE B-5-b

	125.00	540	1.564	1.585	0.4255		2.97	0.3500
	125.00	600	1.564	1.581	0.4275		2.97	0.3500
	125.00	660	1.565	1.579	0.4280		2.97	0.3500
	125.00	720	1.565	1.577	0.4290		2.97	0.3500
	125.00	780	1.565	1.574	0.4305		2.97	0.3500
	125.00	840	1.656	1.573	0.3855		2.98	0.3600
	125.00	900	1.565	1.569	0.4330		2.98	0.3600
	125.00	960	1.565	1.568	0.4335		2.98	0.3600
	125.00	1020	1.566	1.566	0.4340		2.98	0.3600
	125.00	1080	1.566	1.564	0.4350		2.98	0.3600
	125.00	1140	1.563	1.562	0.4375		2.98	0.3600
	125.00	1200	1.556	1.555	0.4445		2.98	0.3600
	125.00	1260	1.549	1.552	0.4495		2.98	0.3600
	125.00	1320	1.538	1.547	0.4575		2.99	0.3700
	125.00	1380	1.535	1.545	0.4600		2.99	0.3700
	125.00	1440	1.530	1.540	0.4650		2.99	0.3700
150%	93.75	20	1.580	1.594	0.4130		2.95	0.3300
	93.75	40	1.581	1.594	0.4125		2.95	0.3300
	93.75	60	1.593	1.582	0.4125		2.95	0.3300
100%	62.50	20	1.654	1.643	0.3515		2.89	0.2700
	62.50	40	1.652	1.645	0.3515		2.89	0.2700
	62.50	60	1.652	1.645	0.3515		2.89	0.2700
50%	31.25	20	1.720	1.714	0.2830		2.82	0.2000
	31.25	40	1.721	1.714	0.2825		2.82	0.2000
	31.25	60	1.720	1.714	0.2830		2.82	0.2000
0%	0.00	20	1.795	1.786	0.2095		2.76	0.1400
	0.00	40	1.795	1.786	0.2095	0.000	2.76	0.1400
	0.00	60	1.795	1.786	0.2095	0.000	2.76	0.1400
50%	31.25	20	1.738	1.738	0.2620	0.053	2.79	0.1700
100%	62.50	20	1.671	1.674	0.3275	0.066	2.85	0.2300
150%	93.75	20	1.601	1.601	0.3990	0.072	2.92	0.3000
200%	125.00	20	1.528	1.527	0.4725	0.074	2.99	0.3700
210%	131.25	20	1.504	1.504	0.4960	0.024	3.01	0.3900
220%	137.50	20	1.492	1.485	0.5115	0.016	3.04	0.4200
230%	143.75	20	1.457	1.453	0.5450	0.034	3.06	0.4400
240%	150.00	20	1.426	1.420	0.5770	0.032	3.09	0.4700
250%	156.25	20	1.382	1.376	0.6210	0.044	3.13	0.5100
260%	162.50	20	1.305	1.300	0.6975	0.076	3.21	0.5900
270%	168.75	20	1.039	1.025	0.9680	0.271	3.49	0.8700
270%	168.75	20	0.006	0.000	1.9970	1.029	4.54	1.9200
208%	130.00	20	0.006	0.000	1.9970	0.000	4.54	1.9200
156%	97.50	20	0.050	0.044	1.9530	0.044	4.50	1.8800
104%	65.00	20	0.121	0.116	1.8815	0.071	1.43	-1.1900
52%	32.50	20	0.210	0.213	1.7885	0.093	4.35	1.7300
0%	0.00	20	0.315	0.293	1.6960	0.092	4.26	1.6400

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-1T, Tension, 500%
Tip at El-100

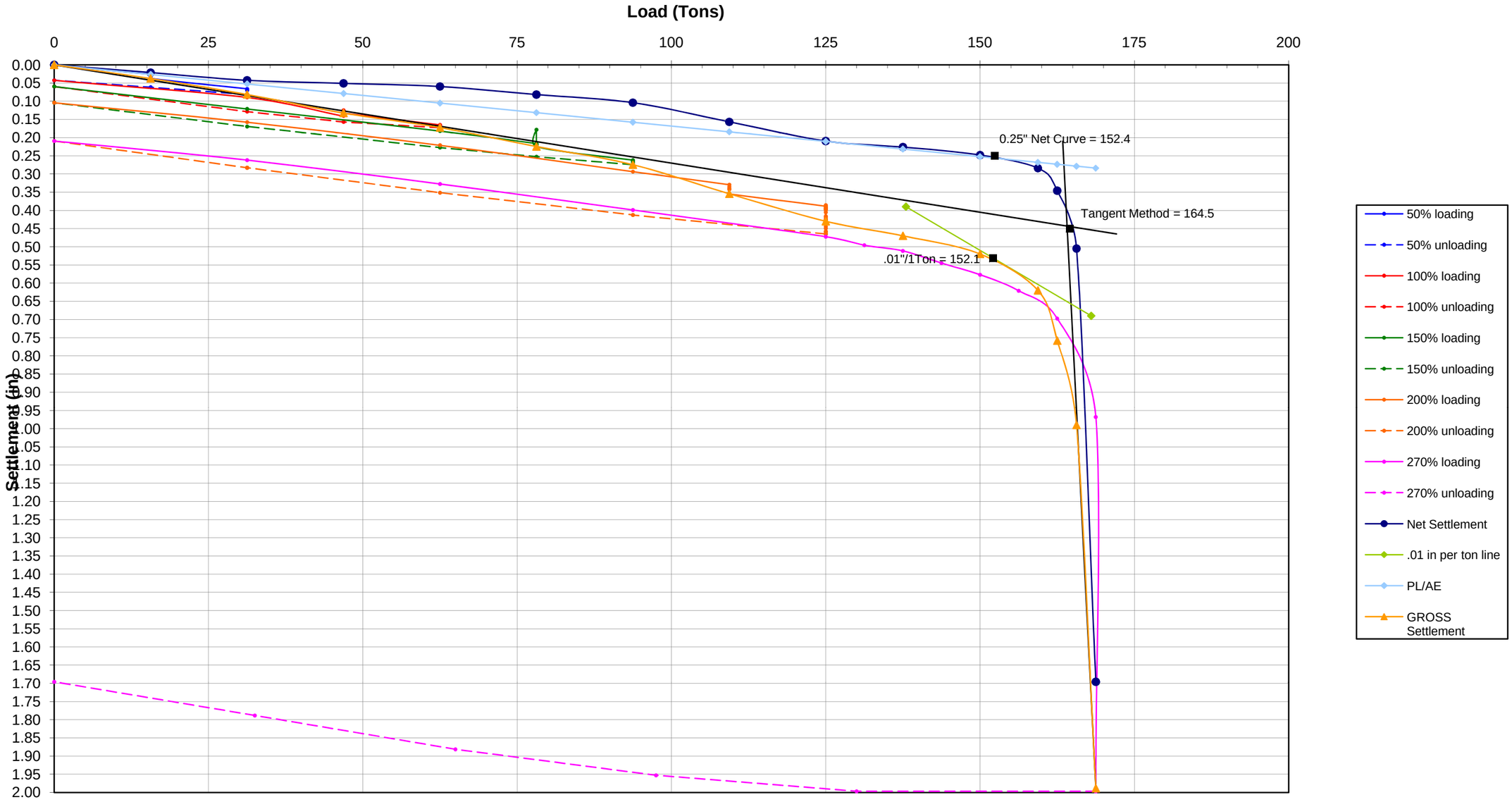


PLATE B-5-d

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-3A Compression 300%"

20" Pipe, Tip Elevation = -100

Service Load = 110.00 **Tons**

Estimated Pile Capacity = 169 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	20
Area (in^2)	314.2
Top Ele. (ft)	6.5
Tip Ele. (ft)	-100
Length (ft)	107
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	55.00	0.0500
100%	110.00	0.0345
150%	165.00	0.1265
175%	192.50	1.5650
x	x	x

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	27.5	0.0425	25%	27.5	0.0250	0.004	0.018
50%	55.0	0.0970	50%	55.0	0.0500	0.008	0.047
75%	82.5	0.1650	75%	82.5	0.0423	0.012	0.123
100%	110.0	0.2480	100%	110.0	0.0345	0.015	0.213
125%	137.5	0.3585	125%	137.5	0.0805	0.019	0.278
150%	165.0	0.5100	150%	165.0	0.1265	0.023	0.384
155%	170.5	0.6420	155%	170.5	0.1530	0.024	0.489
160%	176.0	0.9000	160%	176.0	0.3500	0.025	0.550
165%	181.5	1.1700	170%	181.5	0.5960	0.025	0.574
168%	184.8	1.4000	172%	184.8	0.9140	0.026	0.486
175%	192.5	1.9680	175%	192.5	1.5600	0.027	0.408

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	173.6	0.25		
☑	**.01 inch/Ton Creep Rate**	165	0.492	150.4 180.4	0.358 0.658
☑	**Tangent Method**	167	0.328	0 234.6 0.0019309	0 0.453

Line T2 points	
166.5	0.21
192.5	1.9680
0.0676154	-11.047962

PILE CAPACITY **168.5** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**

Values in RED cannot be adjusted

PLATE B-6-a

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	1.38
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	0.000	0.000	0.0000		1.38	0.0000
25%	27.50	2	0.046	0.040	0.0430		1.42	0.0400
	27.50	8	0.046	0.041	0.0435		1.42	0.0400
	27.50	15	0.047	0.041	0.0440		1.42	0.0400
	27.50	30	0.048	0.041	0.0445		1.42	0.0400
	27.50	60	0.046	0.040	0.0430		1.42	0.0400
	27.50	120	0.045	0.040	0.0425		1.42	0.0400
50%	55.00	2	0.095	0.090	0.0925		1.47	0.0900
	55.00	8	0.096	0.091	0.0935		1.47	0.0900
	55.00	15	0.095	0.091	0.0930		1.48	0.1000
	55.00	30	0.099	0.093	0.0960		1.48	0.1000
	55.00	60	0.097	0.092	0.0945		1.48	0.1000
	55.00	120	0.099	0.095	0.0970		1.48	0.1000
25%	27.50	20	0.051	0.049	0.0500		1.44	0.0600
0%	0.00	20	0.051	0.049	0.0500		1.39	0.0100
50%	55.00	20	0.101	0.097	0.0990		1.48	0.1000
75%	82.50	2	0.157	0.156	0.1565		1.55	0.1700
	82.50	8	0.157	0.156	0.1565		1.55	0.1700
	82.50	15	0.159	0.158	0.1585		1.55	0.1700
	82.50	30	0.161	0.160	0.1605		1.55	0.1700
	82.50	60	0.163	0.162	0.1625		1.55	0.1700
	82.50	120	0.165	0.165	0.1650		1.55	0.1700
100%	110.00	2	0.233	0.233	0.2330		1.62	0.2400
	110.00	8	0.235	0.235	0.2350		1.62	0.2400
	110.00	15	0.238	0.239	0.2385		1.62	0.2400
	110.00	30	0.241	0.241	0.2410		1.62	0.2400
	110.00	60	0.242	0.243	0.2425		1.63	0.2500
	110.00	120	0.247	0.249	0.2480		1.63	0.2500
75%	82.50	20	0.199	0.200	0.1995		1.58	0.2000
50%	55.00	20	0.141	0.142	0.1415		1.55	0.1700
0%	0.00	20	0.033	0.036	0.0345		1.42	0.0400
50%	55.00	20	0.138	0.134	0.1360		1.51	0.1300
100%	110.00	20	0.261	0.253	0.2570		1.63	0.2500
125%	137.50	2	0.341	0.329	0.3350		1.71	0.3300
	137.50	8	0.348	0.337	0.3425		1.70	0.3200
	137.50	15	0.349	0.338	0.3435		1.70	0.3200
	137.50	30	0.351	0.340	0.3455		1.70	0.3200
	137.50	60	0.354	0.343	0.3485		1.70	0.3200
	137.50	120	0.365	0.352	0.3585		1.72	0.3400
150%	165.00	2	0.466	0.448	0.4570		1.82	0.4400
	165.00	8	0.484	0.466	0.4750		1.82	0.4400
	165.00	15	0.488	0.470	0.4790		1.82	0.4400
	165.00	30	0.496	0.478	0.4870		1.85	0.4700
	165.00	60	0.510	0.491	0.5005		1.86	0.4800
	165.00	120	0.521	0.499	0.5100		1.87	0.4900
125%	137.50	20	0.455	0.442	0.4485		1.87	0.4900
100%	110.00	20	0.341	0.340	0.3405		1.73	0.3500
50%	55.00	20	0.261	0.257	0.2590		1.65	0.2700
0%	0.00	20	0.122	0.131	0.1265		1.53	0.1500
50%	55.00	20	0.241	0.233	0.2370		1.63	0.2500
100%	110.00	20	0.366	0.347	0.3565		1.75	0.3700
150%	165.00	20	0.511	0.486	0.4985		1.88	0.5000
175%	192.50	2	0.637	0.604	0.6205		2.00	0.6200
	192.50	8	0.674	0.640	0.6570		2.03	0.6500
	192.50	15	0.698	0.652	0.6750		2.04	0.6600
	192.50	30	0.712	0.680	0.6960		2.06	0.6800
	192.50	60	0.748	0.708	0.7280		2.10	0.7200
	192.50	120	0.796	0.734	0.7650		2.15	0.7700
175%	192.50	2	1.012	0.949	0.9805		2.34	0.9600
	192.50	8	1.131	1.072	1.1015		2.46	1.0800
	192.50	15	1.300	1.234	1.2670		2.65	1.2700
	192.50	30	1.512	1.449	1.4805		2.84	1.4600
	192.50	60	1.820	1.752	1.7860		3.08	1.7000
	192.50	120	2.000	1.936	1.9680		3.33	1.9500
175%	192.50	180	1.921	1.850	1.8855		3.25	1.8700
168%	184.47	240	1.921	1.850	1.8855		3.25	1.8700
126%	138.38	300	1.921	1.850	1.8855		3.25	1.8700
84%	92.29	360	1.812	1.749	1.7805		3.15	1.7700
42%	46.09	420	1.701	1.640	1.6705		3.02	1.6400
0%	0.00	480	1.596	1.534	1.5650		2.94	1.5600

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-3A Compression 300%
Tip at El-100

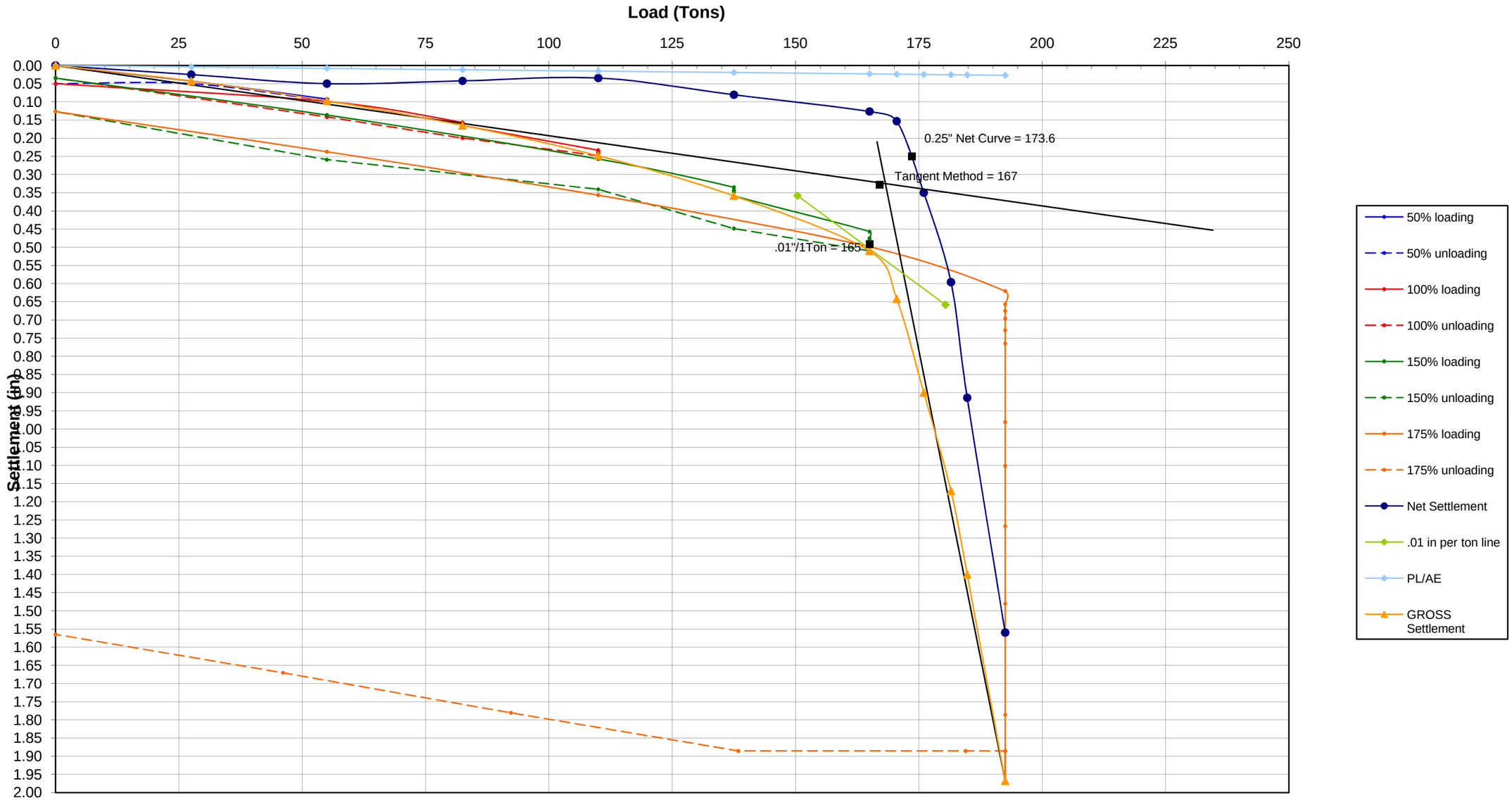


PLATE B-6-c

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-3B, Compression, 300%"
20" Pipe, Tip Elevation = -125

Service Load = 110.00 **Tons**

Estimated Pile Capacity = 308 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	20
Area (in^2)	314.2
Top Ele. (ft)	6.5
Tip Ele. (ft)	-125
Length (ft)	132
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	55.00	0.0000
100%	110.00	0.0030
150%	165.00	0.0285
200%	220.00	0.0520
300%	330.00	0.2225

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	27.5	0.0335	25%	27.5	0.0000	0.005	0.034
50%	55.0	0.0890	50%	55.0	0.0000	0.010	0.089
75%	82.5	0.1555	75%	82.5	0.0015	0.014	0.154
100%	110.0	0.2170	100%	110.0	0.0030	0.019	0.214
125%	137.5	0.3000	125%	137.5	0.0158	0.024	0.284
150%	165.0	0.3880	150%	165.0	0.0285	0.029	0.360
175%	192.5	0.4675	175%	192.5	0.0403	0.033	0.427
200%	220.0	0.5620	200%	220.0	0.0520	0.038	0.510
220%	242.0	0.6295	220%	242.0	0.0770	0.042	0.553
240%	264.0	0.7040	240%	264.0	0.1010	0.046	0.603
260%	286.0	0.7875	260%	286.0	0.1310	0.050	0.657
280%	308.0	0.8820	280%	308.0	0.1600	0.053	0.722
290%	319.0	0.9355	290%	319.0	0.1870	0.055	0.749
300%	330.0	1.0390	300%	330.0	0.2225	0.057	0.817

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection				
☑	**.25 inch Net Deflection**	332.7	0.25				
		Capacity	Deflection	.01"/Ton line points			
☑	**.01 inch/Ton Creep Rate**	321	0.95	300	0.732		
				330	1.032		
		Capacity	Deflection	Line T1 points		Line T2 points	
☑	**Tangent Method**	270.9	0.427	0	0	250	0.21
				315.3	0.494	330	1.039
				0.0015668		0.0103625	-2.380625

PILE CAPACITY **308.2** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	2.41
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	0.000	0.000	0.0000		2.41	0.0000
25%	27.50	2	0.047	0.036	0.0415		2.42	0.0100
	27.50	8	0.048	0.035	0.0415		2.42	0.0100
	27.50	15	0.047	0.034	0.0405		2.43	0.0200
	27.50	30	0.047	0.033	0.0400		2.43	0.0200
	27.50	60	0.047	0.030	0.0385		2.44	0.0300
	27.50	120	0.043	0.024	0.0335		2.46	0.0500
50%	55.00	2	0.099	0.079	0.0890		2.53	0.1200
	55.00	8	0.099	0.080	0.0895		2.53	0.1200
	55.00	15	0.100	0.079	0.0895		2.53	0.1200
	55.00	30	0.100	0.077	0.0885		2.53	0.1200
	55.00	60	0.100	0.077	0.0885		2.53	0.1200
	55.00	120	0.101	0.077	0.0890		2.53	0.1200
25%	27.50	20	0.049	0.025	0.0370		2.44	0.0300
0%	0.00	20	0.000	0.000	0.0000		2.42	0.0100
50%	55.00	20	0.104	0.072	0.0880		2.53	0.1200
75%	82.50	2	0.162	0.123	0.1425		2.59	0.1800
	82.50	8	0.163	0.128	0.1455		2.59	0.1800
	82.50	15	0.164	0.128	0.1460		2.59	0.1800
	82.50	30	0.165	0.129	0.1470		2.59	0.1800
	82.50	60	0.169	0.131	0.1500		2.59	0.1800
	82.50	120	0.175	0.136	0.1555		2.59	0.1800
100%	110.00	2	0.222	0.190	0.2060		2.65	0.2400
	110.00	8	0.226	0.192	0.2090		2.65	0.2400
	110.00	15	0.227	0.193	0.2100		2.65	0.2400
	110.00	30	0.228	0.194	0.2110		2.65	0.2400
	110.00	60	0.230	0.198	0.2140		2.65	0.2400
	110.00	120	0.233	0.201	0.2170		2.66	0.2500
75%	82.50	20	0.184	0.148	0.1660		2.63	0.2200
50%	55.00	20	0.127	0.100	0.1135		2.56	0.1500
0%	0.00	20	0.006	0.000	0.0030		2.43	0.0200
50%	55.00	20	0.114	0.089	0.1015		2.55	0.1400
100%	110.00	20	0.234	0.208	0.2210		2.67	0.2600
125%	137.50	2	0.306	0.275	0.2905		2.74	0.3300
	137.50	8	0.308	0.278	0.2930		2.75	0.3400
	137.50	15	0.309	0.279	0.2940		2.75	0.3400
	137.50	30	0.311	0.281	0.2960		2.75	0.3400
	137.50	60	0.313	0.282	0.2975		2.75	0.3400
	137.50	120	0.315	0.285	0.3000		2.75	0.3400
150%	165.00	2	0.385	0.356	0.3705		2.81	0.4000
	165.00	8	0.388	0.360	0.3740		2.81	0.4000
	165.00	15	0.390	0.361	0.3755		2.82	0.4100
	165.00	30	0.391	0.362	0.3765		2.82	0.4100
	165.00	60	0.395	0.366	0.3805		2.82	0.4100
	165.00	120	0.404	0.372	0.3880		2.83	0.4200
125%	137.50	20	0.352	0.321	0.3365		2.78	0.3700
100%	110.00	20	0.294	0.264	0.2790		2.72	0.3100
50%	55.00	20	0.171	0.142	0.1565		2.59	0.1800
0%	0.00	20	0.043	0.014	0.0285		2.46	0.0500
50%	55.00	20	0.153	0.121	0.1370		2.58	0.1700
100%	110.00	20	0.274	0.241	0.2575		2.70	0.2900
150%	165.00	20	0.402	0.367	0.3845		2.83	0.4200
175%	192.50	2	0.473	0.438	0.4555		2.90	0.4900
	192.50	8	0.475	0.441	0.4580		2.90	0.4900
	192.50	15	0.476	0.441	0.4585		2.90	0.4900
	192.50	30	0.478	0.444	0.4610		2.91	0.5000
	192.50	60	0.480	0.446	0.4630		2.91	0.5000
	192.50	120	0.484	0.451	0.4675		2.91	0.5000
200%	220.00	2	0.559	0.525	0.5420		2.99	0.5800
	220.00	8	0.562	0.527	0.5445		2.99	0.5800
	220.00	15	0.564	0.529	0.5465		2.99	0.5800
	220.00	30	0.568	0.533	0.5505		2.99	0.5800
	220.00	60	0.570	0.535	0.5525		3.00	0.5900
	220.00	120	0.572	0.531	0.5515		3.00	0.5900
	220.00	180	0.579	0.532	0.5555		3.01	0.6000
	220.00	240	0.585	0.533	0.5590		3.01	0.6000
	220.00	300	0.585	0.533	0.5590		3.01	0.6000
	220.00	360	0.590	0.533	0.5615		3.02	0.6100
	220.00	420	0.592	0.534	0.5630		3.02	0.6100
	220.00	480	0.595	0.538	0.5665		3.02	0.6100

	220.00	540	0.597	0.542	0.5695		3.02	0.6100
	220.00	600	0.598	0.545	0.5715		3.02	0.6100
	220.00	660	0.600	0.548	0.5740		3.02	0.6100
	220.00	720	0.601	0.550	0.5755		3.02	0.6100
	220.00	780	0.602	0.552	0.5770		3.02	0.6100
	220.00	840	0.603	0.554	0.5785		3.02	0.6100
	220.00	900	0.604	0.555	0.5795		3.02	0.6100
	220.00	960	0.605	0.555	0.5800		3.02	0.6100
	220.00	1020	0.609	0.559	0.5840		3.02	0.6100
	220.00	1080	0.610	0.558	0.5840		3.02	0.6100
	220.00	1140	0.614	0.562	0.5880		3.02	0.6100
	220.00	1200	0.610	0.558	0.5840		3.03	0.6200
	220.00	1260	0.598	0.558	0.5780		3.03	0.6200
	220.00	1320	0.592	0.557	0.5745		3.03	0.6200
	220.00	1380	0.591	0.555	0.5730		3.03	0.6200
	220.00	1440	0.591	0.555	0.5730		3.03	0.6200
150%	165.00	20	0.478	0.443	0.4605		2.93	0.5200
	165.00	40	0.477	0.440	0.4585		2.93	0.5200
	165.00	60	0.476	0.438	0.4570		2.93	0.5200
100%	110.00	20	0.349	0.312	0.3305		2.79	0.3800
	110.00	40	0.349	0.310	0.3295		2.79	0.3800
	110.00	60	0.350	0.311	0.3305		2.80	0.3900
50%	55.00	20	0.209	0.169	0.1890		2.67	0.2600
	55.00	40	0.209	0.169	0.1890		2.67	0.2600
	55.00	60	0.207	0.167	0.1870		2.67	0.2600
0%	0.00	20	0.071	0.032	0.0515		2.53	0.1200
	0.00	40	0.071	0.033	0.0520	0.001	2.53	0.1200
	0.00	60	0.071	0.033	0.0520	0.000	2.53	0.1200
50%	55.00	20	0.186	0.148	0.1670	0.115	2.64	0.2300
100%	110.00	20	0.311	0.273	0.2920	0.125	2.77	0.3600
150%	165.00	20	0.442	0.401	0.4215	0.130	2.90	0.4900
200%	220.00	20	0.583	0.541	0.5620	0.141	3.04	0.6300
210%	231.00	20	0.617	0.575	0.5960	0.034	3.07	0.6600
220%	242.00	20	0.651	0.608	0.6295	0.034	3.10	0.6900
230%	253.00	20	0.690	0.647	0.6685	0.039	3.14	0.7300
240%	264.00	20	0.726	0.682	0.7040	0.036	3.18	0.7700
250%	275.00	20	0.769	0.722	0.7455	0.042	3.22	0.8100
260%	286.00	20	0.811	0.764	0.7875	0.042	3.25	0.8400
270%	297.00	20	0.859	0.810	0.8345	0.047	3.32	0.9100
280%	308.00	20	0.907	0.857	0.8820	0.048	3.36	0.9500
290%	319.00	20	0.961	0.910	0.9355	0.054	2.41	0.0000
300%	330.00	20	1.040	0.988	1.0140	0.079	3.49	1.0800
300%	330.00	20	1.055	1.003	1.0290	0.015	3.50	1.0900
300%	330.00	20	1.059	1.007	1.0330	0.004	3.50	1.0900
300%	330.00	20	1.062	1.010	1.0360	0.003	3.51	1.1000
300%	330.00	20	1.062	1.011	1.0365	0.000	3.51	1.1000
300%	330.00	20	1.065	1.013	1.0390	0.002	3.51	1.1000
300%	330.00	20	1.065	1.013	1.0390	0.000	3.51	1.1000
225%	247.50	20	0.902	0.847	0.8745	0.165	3.34	0.9300
150%	165.00	20	0.693	0.648	0.6705	0.204	3.14	0.7300
75%	82.50	20	0.475	0.437	0.4560	0.215	2.92	0.5100
0%	0.00	20	0.239	0.206	0.2225	0.234	2.69	0.2800

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-3B, Compression, 300%
Tip at El-125

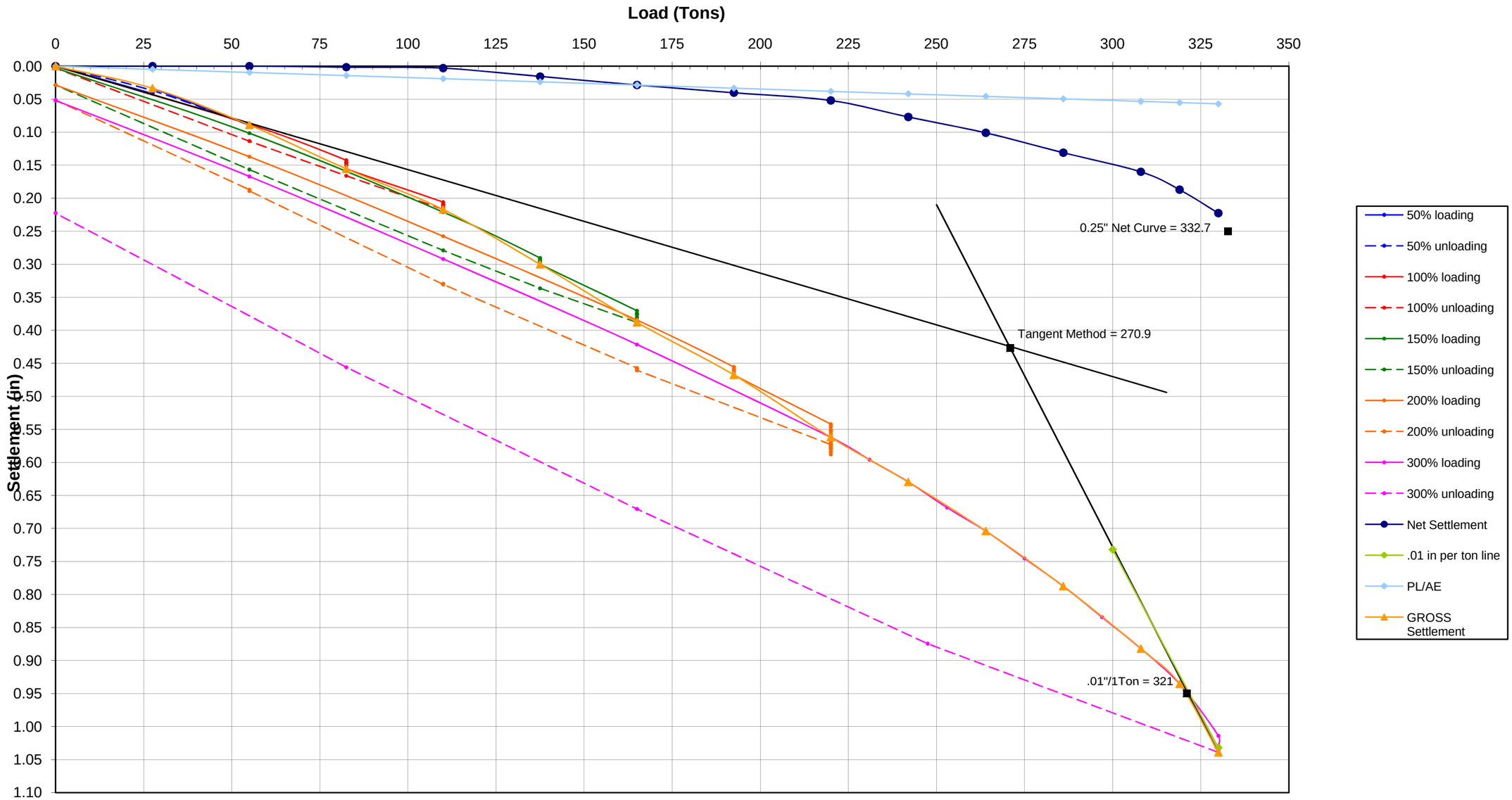


PLATE B-7-d

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-3T, Tension, 500%"
20" Pipe, Tip Elevation = -100

Service Load = **65.00** **Tons**

Estimated Pile Capacity = **188 Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	20
Area (in^2)	314.2
Top Ele. (ft)	6.5
Tip Ele. (ft)	-100
Length (ft)	107
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	32.50	0.0230
100%	65.00	0.0500
150%	97.50	0.0660
200%	130.00	0.1880
320%	208.00	0.3950

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	16.3	0.0430	25%	16.3	0.0115	0.002	0.032
50%	32.5	0.0780	50%	32.5	0.0230	0.005	0.055
75%	48.8	0.1160	75%	48.8	0.0365	0.007	0.080
100%	65.0	0.1650	100%	65.0	0.0500	0.009	0.115
125%	81.3	0.2040	125%	81.3	0.0580	0.011	0.146
150%	97.5	0.2520	150%	97.5	0.0660	0.014	0.186
175%	113.8	0.3085	175%	113.8	0.0910	0.016	0.218
200%	130.0	0.3820	200%	130.0	0.1160	0.018	0.266
220%	143.0	0.4950	220%	143.0	0.1500	0.020	0.345
240%	156.0	0.5390	240%	156.0	0.1830	0.022	0.356
260%	169.0	0.5905	260%	169.0	0.2170	0.024	0.374
280%	182.0	0.6645	280%	182.0	0.2630	0.026	0.402
310%	201.5	0.8165	310%	201.5	0.3360	0.028	0.481
320%	208.0	0.9510	320%	208.0	0.3950	0.029	0.556

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection				
☑	**.25 inch Net Deflection**	178.4	0.25				
		Capacity	Deflection	.01"/Ton line points			
☑	**.01 inch/Ton Creep Rate**	197.6	0.76	180.2	0.6		
				210.2	0.9		
		Capacity	Deflection	Line T1 points		Line T2 points	
☑	**Tangent Method**	189.1	0.483	0	0	178.8	0.21
				202.9	0.523	208	0.951
				0.0025776		0.0253767	-4.3273562

PILE CAPACITY **188.4** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	1.25
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	2.000	2.000	0.0000		1.25	0.0000
25%	16.25	2	1.965	1.971	0.0320		1.28	0.0300
	16.25	8	1.964	1.971	0.0325		1.28	0.0300
	16.25	15	1.963	1.970	0.0335		1.28	0.0300
	16.25	30	1.961	1.969	0.0350		1.28	0.0300
	16.25	60	1.954	1.968	0.0390		1.28	0.0300
	16.25	120	1.950	1.964	0.0430		1.29	0.0400
50%	32.50	2	1.921	1.937	0.0710		1.32	0.0700
	32.50	8	1.920	1.937	0.0715		1.32	0.0700
	32.50	15	1.920	1.936	0.0720		1.32	0.0700
	32.50	30	1.919	1.935	0.0730		1.32	0.0700
	32.50	60	1.917	1.934	0.0745		1.32	0.0700
	32.50	120	1.914	1.930	0.0780		1.32	0.0700
25%	16.25	20	1.941	1.955	0.0520		1.29	0.0400
0%	0.00	20	1.972	1.982	0.0230		1.27	0.0200
50%	32.50	20	1.912	1.927	0.0805		1.32	0.0700
75%	48.75	2	1.880	1.896	0.1120		1.35	0.1000
	48.75	8	1.880	1.896	0.1120		1.35	0.1000
	48.75	15	1.878	1.895	0.1135		1.35	0.1000
	48.75	30	1.877	1.895	0.1140		1.35	0.1000
	48.75	60	1.876	1.893	0.1155		1.35	0.1000
	48.75	120	1.873	1.895	0.1160		1.35	0.1000
100%	65.00	2	1.840	1.854	0.1530		1.38	0.1300
	65.00	8	1.837	1.850	0.1565		1.38	0.1300
	65.00	15	1.836	1.848	0.1580		1.38	0.1300
	65.00	30	1.835	1.846	0.1595		1.38	0.1300
	65.00	60	1.834	1.841	0.1625		1.39	0.1400
	65.00	120	1.832	1.838	0.1650		1.39	0.1400
75%	48.75	20	1.853	1.859	0.1440		1.37	0.1200
50%	32.50	20	1.885	1.888	0.1135		1.34	0.0900
0%	0.00	20	1.952	1.948	0.0500		1.27	0.0200
50%	32.50	20	1.894	1.895	0.1055		1.33	0.0800
100%	65.00	20	1.828	1.836	0.1680		1.39	0.1400
125%	81.25	2	1.793	1.803	0.2020		1.42	0.1700
	81.25	8	1.792	1.802	0.2030		1.42	0.1700
	81.25	15	1.792	1.802	0.2030		1.42	0.1700
	81.25	30	1.792	1.801	0.2035		1.42	0.1700
	81.25	60	1.792	1.801	0.2035		1.43	0.1800
	81.25	120	1.792	1.800	0.2040		1.43	0.1800
150%	97.50	2	1.752	1.764	0.2420		1.46	0.2100
	97.50	8	1.750	1.761	0.2445		1.46	0.2100
	97.50	15	1.749	1.759	0.2460		1.46	0.2100
	97.50	30	1.748	1.758	0.2470		1.47	0.2200
	97.50	60	1.747	1.757	0.2480		1.47	0.2200
	97.50	120	1.744	1.752	0.2520		1.47	0.2200
125%	81.25	20	1.770	1.775	0.2275		1.45	0.2000
100%	65.00	20	1.803	1.805	0.1960		1.42	0.1700
50%	32.50	20	1.868	1.864	0.1340		1.35	0.1000
0%	0.00	20	1.940	1.928	0.0660		1.28	0.0300
50%	32.50	20	1.879	1.874	0.1235		1.34	0.0900
100%	65.00	20	1.811	1.811	0.1890		1.41	0.1600
150%	97.50	20	1.744	1.748	0.2540		1.47	0.2200
175%	113.75	2	1.706	1.711	0.2915		1.51	0.2600
	113.75	8	1.704	1.709	0.2935		1.51	0.2600
	113.75	15	1.703	1.707	0.2950		1.51	0.2600
	113.75	30	1.704	1.707	0.2945		1.51	0.2600
	113.75	60	1.699	1.701	0.3000		1.52	0.2700
	113.75	120	1.690	1.693	0.3085		1.52	0.2700
200%	130.00	2	1.654	1.660	0.3430		1.55	0.3000
	130.00	8	1.651	1.655	0.3470		1.55	0.3000
	130.00	15	1.648	1.653	0.3495		1.56	0.3100
	130.00	30	1.645	1.650	0.3525		1.56	0.3100
	130.00	60	1.639	1.644	0.3585		1.56	0.3100
	130.00	120	1.623	1.637	0.3700		1.57	0.3200
	130.00	180	1.618	1.629	0.3765		1.58	0.3300
	130.00	240	1.615	1.625	0.3800		1.59	0.3400
	130.00	300	1.611	1.618	0.3855		1.59	0.3400
	130.00	360	1.609	1.612	0.3895		1.60	0.3500
	130.00	420	1.606	1.606	0.3940		1.60	0.3500
	130.00	480	1.604	1.599	0.3985		1.60	0.3500

	130.00	540	1.602	1.589	0.4045		1.60	0.3500
	130.00	600	1.602	1.587	0.4055		1.60	0.3500
	130.00	660	1.602	1.585	0.4065		1.60	0.3500
	130.00	720	1.597	1.582	0.4105		1.60	0.3500
	130.00	780	1.594	1.573	0.4165		1.60	0.3500
	130.00	840	1.593	1.568	0.4195		1.60	0.3500
	130.00	900	1.591	1.565	0.4220		1.60	0.3500
	130.00	960	1.590	1.562	0.4240		1.60	0.3500
	130.00	1020	1.590	1.560	0.4250		1.60	0.3500
	130.00	1080	1.588	1.556	0.4280		1.60	0.3500
	130.00	1140	1.587	1.554	0.4295		1.60	0.3500
	130.00	1200	1.585	1.549	0.4330		1.61	0.3600
	130.00	1260	1.584	1.548	0.4340		1.61	0.3600
	130.00	1320	1.586	1.546	0.4340		1.61	0.3600
	130.00	1380	1.582	1.543	0.4375		1.61	0.3600
	130.00	1440	1.576	1.538	0.4430		1.61	0.3600
150%	97.50	20	1.636	1.593	0.3855		1.56	0.3100
	97.50	40	1.635	1.592	0.3865		1.56	0.3100
	97.50	60	1.631	1.591	0.3890		1.56	0.3100
100%	65.00	20	1.687	1.652	0.3305		1.50	0.2500
	65.00	40	1.692	1.653	0.3275		1.50	0.2500
	65.00	60	1.692	1.652	0.3280		1.50	0.2500
50%	32.50	20	1.764	1.715	0.2605		1.43	0.1800
	32.50	40	1.764	1.715	0.2605		1.43	0.1800
	32.50	60	1.764	1.714	0.2610		1.43	0.1800
0%	0.00	20	1.840	1.782	0.1890		1.35	0.1000
	0.00	40	1.842	1.782	0.1880	0.001	1.35	0.1000
	0.00	60	1.842	1.782	0.1880	0.000	1.35	0.1000
50%	32.50	20	1.780	1.721	0.2495	0.062	1.41	0.1600
100%	65.00	20	1.713	1.660	0.3135	0.064	1.48	0.2300
150%	97.50	20	1.639	1.589	0.3860	0.073	1.55	0.3000
200%	130.00	20	1.561	1.514	0.4625	0.077	1.62	0.3700
210%	136.50	20	1.547	1.498	0.4775	0.015	1.63	0.3800
220%	143.00	20	1.530	1.478	0.4960	0.019	1.65	0.4000
230%	149.50	20	1.509	1.456	0.5175	0.022	1.67	0.4200
240%	156.00	20	1.490	1.432	0.5390	0.022	1.68	0.4300
250%	162.50	20	1.463	1.406	0.5655	0.027	1.71	0.4600
260%	169.00	20	1.439	1.380	0.5905	0.025	1.73	0.4800
270%	175.50	20	1.403	1.345	0.6260	0.036	1.76	0.5100
280%	182.00	20	1.365	1.306	0.6645	0.039	1.78	0.5300
290%	188.50	20	1.324	1.264	0.7060	0.042	1.84	0.5900
300%	195.00	20	1.284	1.223	0.7465	0.041	1.88	0.6300
310%	201.50	20	1.214	1.153	0.8165	0.070	1.95	0.7000
320%	208.00	20	1.116	1.054	0.9150	0.098	2.05	0.8000
320%	208.00	20	1.116	1.054	0.9150	0.000	2.05	0.8000
237%	153.73	20	1.675	1.655	0.3350	0.580	2.96	1.7100
158%	102.51	20	1.648	1.628	0.3620	0.027	2.84	1.5900
79%	51.22	20	1.631	1.610	0.3795	0.017	2.72	1.4700
0%	0.00	20	1.616	1.594	0.3950	0.016	2.59	1.3400

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-3T, Tension, 500%
Tip at El-100

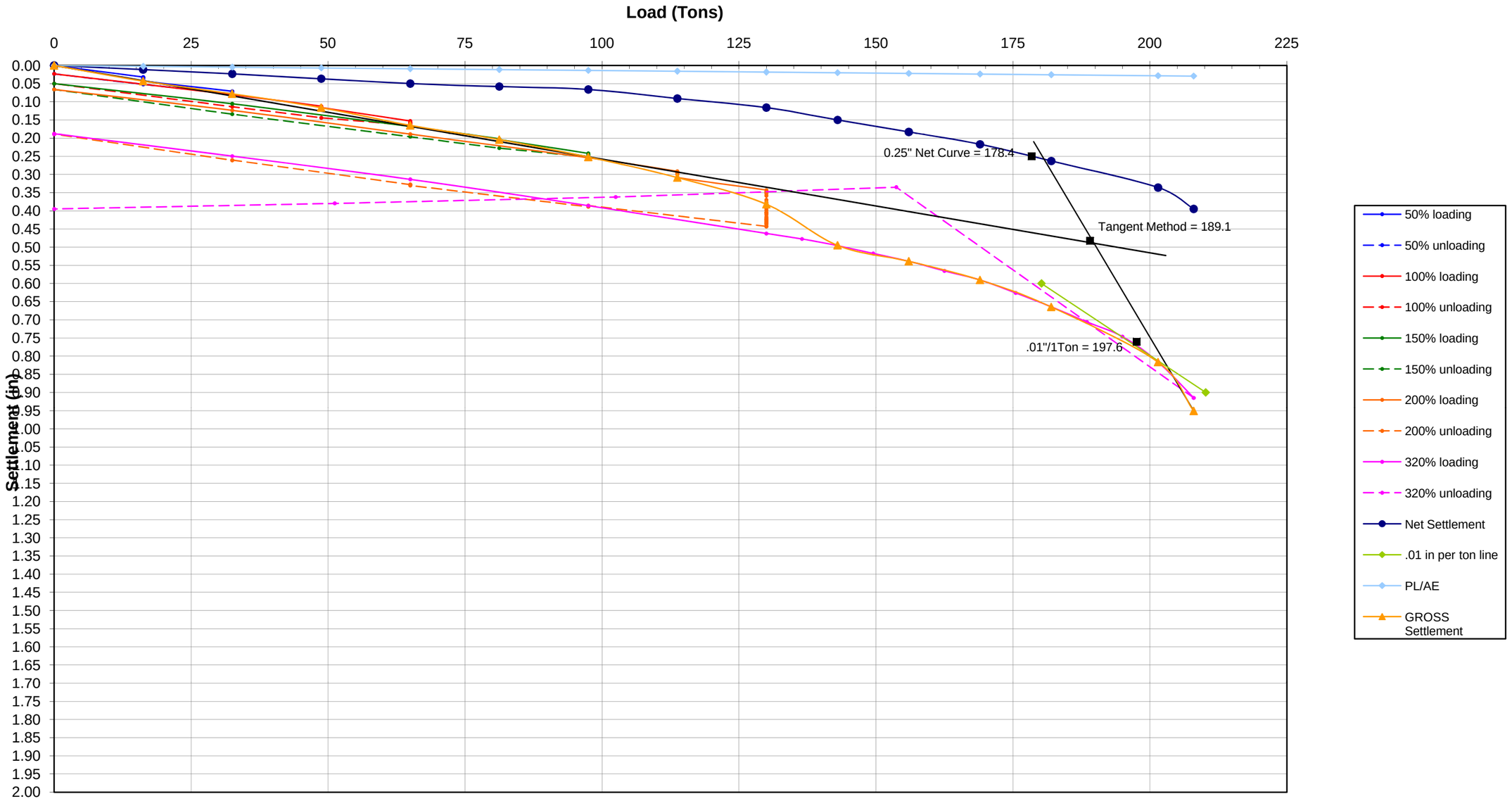


PLATE B-8-d

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-P18, Tension, 500%"
18" Pipe, Tip Elevation = -80

Service Load = **30.00** **Tons**

Estimated Pile Capacity = **127 Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	18
Area (in^2)	254.5
Top Ele. (ft)	6.5
Tip Ele. (ft)	-80
Length (ft)	87
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	15.00	0.0125
100%	30.00	0.0155
150%	45.00	0.0235
200%	60.00	0.0550
440%	132.00	1.7520

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	7.5	0.0170	25%	7.5	0.0062	0.001	0.011
50%	15.0	0.0330	50%	15.0	0.0125	0.002	0.021
75%	22.5	0.0480	75%	22.5	0.0140	0.003	0.034
100%	30.0	0.0635	100%	30.0	0.0155	0.004	0.048
125%	37.5	0.0770	125%	37.5	0.0195	0.005	0.058
150%	45.0	0.0940	150%	45.0	0.0235	0.006	0.071
175%	52.5	0.1225	175%	52.5	0.0393	0.007	0.083
200%	60.0	0.1440	200%	60.0	0.0550	0.008	0.089
250%	75.0	0.1900	250%	75.0	0.0750	0.011	0.115
340%	102.0	0.2865	340%	102.0	0.0750	0.014	0.212
380%	114.0	0.3525	380%	114.0	0.1120	0.016	0.241
410%	123.0	0.4195	410%	124.4	0.1980	0.017	0.222
440%	132.0	0.7250	440%	129.8	0.4200	0.019	0.305
440%	132.0	1.9870	440%	132.0	1.7520	0.019	0.235

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection				
☑	**.25 inch Net Deflection**	126.9	0.25				
		Capacity	Deflection	.01"/Ton line points			
☑	**.01 inch/Ton Creep Rate**	121.34	0.382	110.8	0.284		
				140.8	0.584		
		Capacity	Deflection	Line T1 points		Line T2 points	
☑	**Tangent Method**	132.4	0.257	0	0	132.42	0.21
				138.6	0.266	132	1.987
				0.0019192		-4.2309524	560.472714

PILE CAPACITY **126.9** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE B-9-a

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	2.33
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	2.0000	2.0000	0.0000		2.33	0.0000
25%	7.50	2	1.9890	1.9860	0.0125		2.34	0.0100
	7.50	8	1.9890	1.9860	0.0125		2.34	0.0100
	7.50	15	1.9880	1.9860	0.0130		2.34	0.0100
	7.50	30	1.9870	1.9850	0.0140		2.34	0.0100
	7.50	60	1.9850	1.9830	0.0160		2.34	0.0100
	7.50	120	1.9840	1.9820	0.0170		2.34	0.0100
50%	15.00	2	1.9740	1.9700	0.0280		2.35	0.0200
	15.00	8	1.9730	1.9700	0.0285		2.35	0.0200
	15.00	15	1.9720	1.9700	0.0290		2.35	0.0200
	15.00	30	1.9720	1.9690	0.0295		2.35	0.0200
	15.00	60	1.9700	1.9670	0.0315		2.35	0.0200
	15.00	120	1.9690	1.9650	0.0330		2.35	0.0200
25%	7.50	20	1.9780	1.9750	0.0235		2.34	0.0100
0%	0.00	20	1.9890	1.9860	0.0125		2.33	0.0000
50%	15.00	20	1.9690	1.9650	0.0330		2.35	0.0200
75%	22.50	2	1.9610	1.9590	0.0400		2.36	0.0300
	22.50	8	1.9690	1.9540	0.0385		2.36	0.0300
	22.50	15	1.9570	1.9520	0.0455		2.36	0.0300
	22.50	30	1.9560	1.9500	0.0470		2.36	0.0300
	22.50	60	1.9560	1.9480	0.0480		2.36	0.0300
	22.50	120	1.9560	1.9480	0.0480		2.36	0.0300
100%	30.00	2	1.9460	1.9350	0.0595		2.37	0.0400
	30.00	8	1.9460	1.9340	0.0600		2.37	0.0400
	30.00	15	1.9450	1.9340	0.0605		2.37	0.0400
	30.00	30	1.9440	1.9340	0.0610		2.37	0.0400
	30.00	60	1.9430	1.9330	0.0620		2.37	0.0400
	30.00	120	1.9420	1.9310	0.0635		2.37	0.0400
75%	22.50	20	1.9550	1.9440	0.0505		2.37	0.0400
50%	15.00	20	1.9650	1.9550	0.0400		2.36	0.0300
0%	0.00	20	1.9880	1.9810	0.0155		2.34	0.0100
50%	15.00	20	1.9680	1.9570	0.0375		2.35	0.0200
100%	30.00	20	1.9460	1.9320	0.0610		2.38	0.0500
125%	37.50	2	1.9360	1.9200	0.0720		2.39	0.0600
	37.50	8	1.9340	1.9180	0.0740		2.39	0.0600
	37.50	15	1.9320	1.9170	0.0755		2.39	0.0600
	37.50	30	1.9310	1.9160	0.0765		2.39	0.0600
	37.50	60	1.9310	1.9160	0.0765		2.39	0.0600
	37.50	120	1.9310	1.9150	0.0770		2.39	0.0600
150%	45.00	2	1.9230	1.9010	0.0880		2.40	0.0700
	45.00	8	1.9200	1.9000	0.0900		2.40	0.0700
	45.00	15	1.9190	1.9000	0.0905		2.40	0.0700
	45.00	30	1.9190	1.8990	0.0910		2.40	0.0700
	45.00	60	1.9170	1.8950	0.0940		2.40	0.0700
	45.00	120	1.9170	1.8950	0.0940		2.40	0.0700
125%	37.50	20	1.9270	1.9060	0.0835		2.40	0.0700
100%	30.00	20	1.9380	1.9180	0.0720		2.39	0.0600
50%	15.00	20	1.9600	1.9430	0.0485		2.36	0.0300
0%	0.00	20	1.9840	1.9690	0.0235		2.34	0.0100
50%	15.00	20	1.9610	1.9430	0.0480		2.36	0.0300
100%	30.00	20	1.9340	1.9040	0.0810		2.39	0.0600
150%	45.00	20	1.9120	1.8900	0.0990		2.40	0.0700
175%	52.50	2	1.8990	1.8760	0.1125		2.42	0.0900
	52.50	8	1.8980	1.8750	0.1135		2.42	0.0900
	52.50	15	1.8970	1.8740	0.1145		2.42	0.0900
	52.50	30	1.8960	1.8740	0.1150		2.42	0.0900
	52.50	60	1.8930	1.8710	0.1180		2.42	0.0900
	52.50	120	1.8880	1.8670	0.1225		2.42	0.0900
200%	60.00	2	1.8750	1.8600	0.1325		2.44	0.1100
	60.00	8	1.8740	1.8590	0.1335		2.44	0.1100
	60.00	15	1.8740	1.8590	0.1335		2.44	0.1100
	60.00	30	1.8730	1.8580	0.1345		2.44	0.1100
	60.00	60	1.8730	1.8580	0.1345		2.44	0.1100
	60.00	120	1.8690	1.8530	0.1390		2.45	0.1200
	60.00	180	1.8690	1.8370	0.1470		2.45	0.1200
	60.00	240	1.8690	1.8330	0.1490		2.45	0.1200
	60.00	300	1.8680	1.8250	0.1535		2.45	0.1200
	60.00	360	1.8680	1.8190	0.1565		2.45	0.1200
	60.00	420	1.8680	1.8160	0.1580		2.45	0.1200
	60.00	480	1.8690	1.8140	0.1585		2.45	0.1200

	60.00	540	1.8680	1.8150	0.1585		2.45	0.1200
	60.00	600	1.8690	1.8160	0.1575		2.45	0.1200
	60.00	660	1.8690	1.8170	0.1570		2.45	0.1200
	60.00	720	1.8680	1.8190	0.1565		2.45	0.1200
	60.00	780	1.8680	1.8180	0.1570		2.45	0.1200
	60.00	840	1.8690	1.8190	0.1560		2.45	0.1200
	60.00	900	1.8690	1.8200	0.1555		2.45	0.1200
	60.00	960	1.8700	1.8210	0.1545		2.45	0.1200
	60.00	1020	1.8700	1.8210	0.1545		2.45	0.1200
	60.00	1080	1.8700	1.8220	0.1540		2.45	0.1200
	60.00	1140	1.8710	1.8250	0.1520		2.46	0.1300
	60.00	1200	1.8550	1.8350	0.1550		2.46	0.1300
	60.00	1260	1.8500	1.8340	0.1580		2.46	0.1300
	60.00	1320	1.8470	1.8370	0.1580		2.46	0.1300
	60.00	1380	1.8500	1.8390	0.1555		2.46	0.1300
	60.00	1440	1.8570	1.8390	0.1520		2.46	0.1300
150%	45.00	20	1.8750	1.8590	0.1330		2.44	0.1100
	45.00	40	1.8750	1.8590	0.1330		2.44	0.1100
	45.00	60	1.8720	1.8570	0.1355		2.44	0.1100
100%	30.00	20	1.8930	1.8800	0.1135		2.42	0.0900
	30.00	40	1.8920	1.8800	0.1140		2.42	0.0900
	30.00	60	1.8900	1.8780	0.1160		2.42	0.0900
50%	15.00	20	1.9240	1.9170	0.0795		2.38	0.0500
	15.00	40	1.9240	1.9210	0.0775		2.38	0.0500
	15.00	60	1.9240	1.9250	0.0755		2.38	0.0500
0%	0.00	20	1.9450	1.9450	0.0550		2.36	0.0300
	0.00	40	1.9450	1.9450	0.0550	0.000	2.36	0.0300
	0.00	60	1.9450	1.9450	0.0550	0.000	2.36	0.0300
50%	15.00	20	1.9260	1.9230	0.0755	0.021	2.38	0.0500
100%	30.00	20	1.9030	1.8990	0.0990	0.024	2.41	0.0800
150%	45.00	20	1.8790	1.8730	0.1240	0.025	2.43	0.1000
200%	60.00	20	1.8520	1.8420	0.1530	0.029	2.46	0.1300
210%	63.00	20	1.8460	1.8360	0.1590	0.006	2.46	0.1300
220%	66.00	20	1.8390	1.8270	0.1670	0.008	2.48	0.1500
230%	69.00	20	1.8340	1.8190	0.1735	0.006	2.48	0.1500
240%	72.00	20	1.8270	1.8110	0.1810	0.008	2.49	0.1600
250%	75.00	20	1.8190	1.8010	0.1900	0.009	2.50	0.1700
260%	78.00	20	1.8120	1.7950	0.1965	0.006	2.50	0.1700
270%	81.00	20	1.8030	1.7850	0.2060	0.010	2.51	0.1800
280%	84.00	20	1.7940	1.7760	0.2150	0.009	2.52	0.1900
290%	87.00	20	1.7840	1.7650	0.2255	0.011	2.53	0.2000
300%	90.00	20	1.7740	1.7550	0.2355	0.010	2.54	0.2100
310%	93.00	20	1.7620	1.7430	0.2475	0.012	2.55	0.2200
320%	96.00	20	1.7510	1.7310	0.2590	0.012	2.57	0.2400
330%	99.00	20	1.7390	1.7190	0.2710	0.012	2.58	0.2500
340%	102.00	20	1.7240	1.7030	0.2865	0.016	2.60	0.2700
350%	105.00	20	1.7100	1.6880	0.3010	0.015	2.61	0.2800
360%	108.00	20	1.6950	1.6730	0.3160	0.015	2.62	0.2900
370%	111.00	20	1.6780	1.6560	0.3330	0.017	2.64	0.3100
380%	114.00	20	1.6590	1.6360	0.3525	0.020	2.67	0.3400
390%	117.00	20	1.6380	1.6140	0.3740	0.022	2.69	0.3600
400%	120.00	20	1.6170	1.5920	0.3955	0.022	2.70	0.3700
410%	123.00	20	1.5920	1.5690	0.4195	0.024	2.73	0.4000
420%	126.00	20	1.5640	1.5400	0.4480	0.029	2.73	0.4000
430%	129.00	20	1.5310	1.5060	0.4815	0.034	2.79	0.4600
440%	132.00	20	1.4820	1.4570	0.5305	0.049	2.83	0.5000
440%	132.00	20	0.0260	0.0000	1.9870	1.457	4.29	1.9600
353%	105.90	20	0.0260	0.0000	1.9870	0.000	4.29	1.9600
265%	79.50	20	0.0600	0.0350	1.9525	0.035	4.25	1.9200
177%	53.10	20	0.1150	0.0910	1.8970	0.056	4.20	1.8700
88%	26.40	20	0.1790	0.1610	1.8300	0.067	4.13	1.8000
0%	0.00	20	0.2560	0.2400	1.7520	0.078	4.05	1.7200

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-P18, Tension, 500%
Tip at El-80

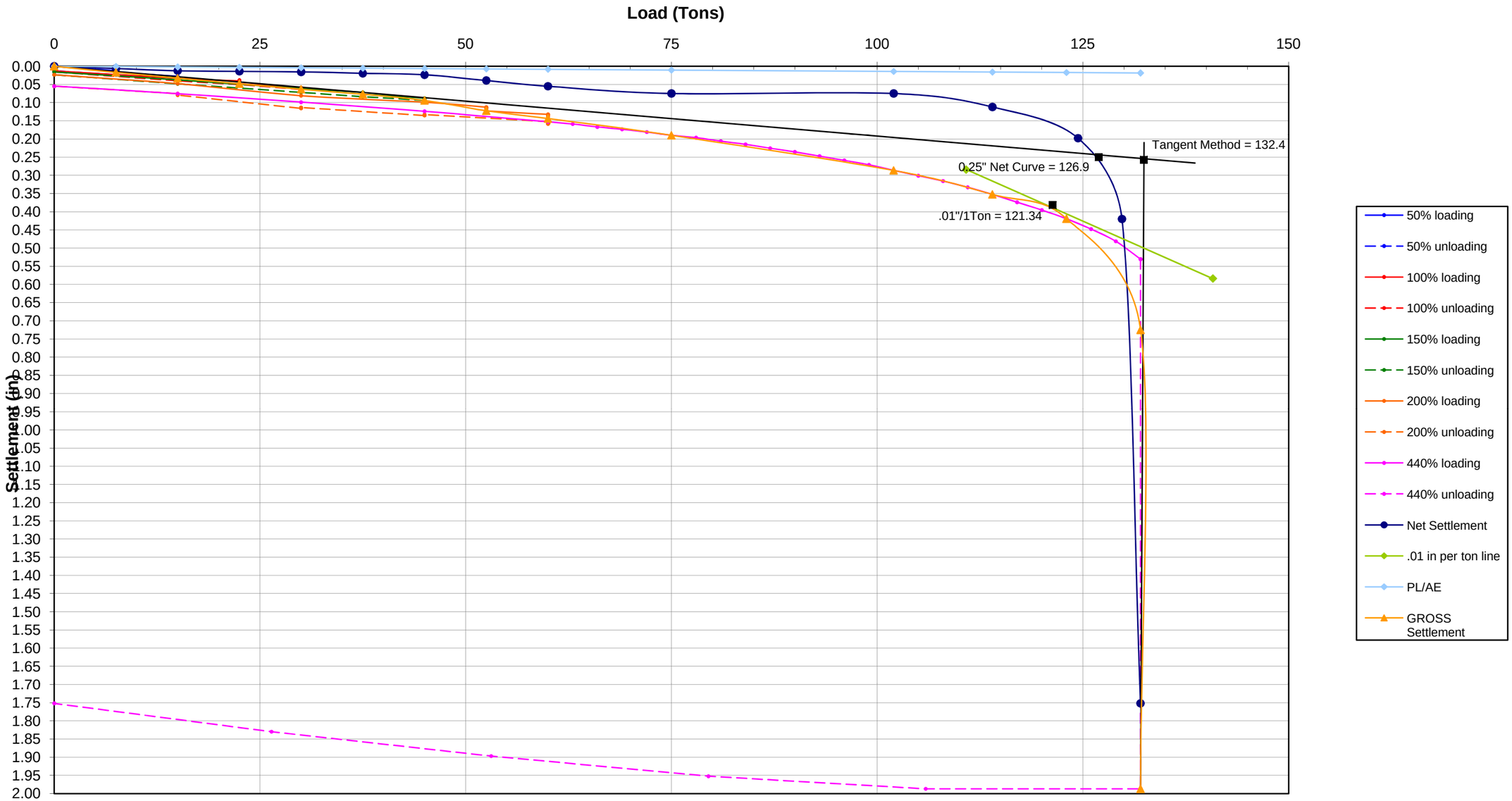


PLATE B-9-d

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-P18G, Tension, 500%"
18" Pipe, Tip Elevation = -80

Service Load = **30.00** **Tons**

Estimated Pile Capacity = **127 Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	18
Area (in^2)	254.5
Top Ele. (ft)	6.5
Tip Ele. (ft)	-80
Length (ft)	87
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	15.00	0.0135
100%	30.00	0.0460
150%	45.00	0.0520
200%	60.00	0.0760
440%	132.00	1.7015

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	7.5	0.0290	25%	7.5	0.0067	0.001	0.022
50%	15.0	0.0585	50%	15.0	0.0135	0.002	0.045
75%	22.5	0.0775	75%	22.5	0.0297	0.003	0.048
100%	30.0	0.0960	100%	30.0	0.0460	0.004	0.050
125%	37.5	0.1090	125%	37.5	0.0490	0.005	0.060
150%	45.0	0.1275	150%	45.0	0.0520	0.006	0.076
175%	52.5	0.1485	175%	52.5	0.0640	0.007	0.085
200%	60.0	0.1875	200%	60.0	0.0760	0.008	0.112
250%	75.0	0.2410	250%	75.0	0.0750	0.011	0.166
340%	102.0	0.3350	340%	102.0	0.0750	0.014	0.260
380%	114.0	0.4000	380%	114.0	0.1120	0.016	0.288
410%	123.0	0.4770	410%	124.4	0.1980	0.017	0.279
440%	132.0	0.6310	440%	129.8	0.4200	0.019	0.211
440%	132.0	1.9885	440%	132.0	1.7015	0.019	0.287

PILE CAPACITY CALCULATIONS

Select

	Capacity	Deflection		
☑ **.25 inch Net Deflection**	126.4	0.25		
☑ **.01 inch/Ton Creep Rate**	121.34	0.46	107.05	0.312
			137.05	0.612
☑ **Tangent Method**	132.4	0.328	0	0
			138.6	0.342
			0.0024675	

Line T2 points	
132.42	0.21
132	1.9885
-4.2345238	560.945643

PILE CAPACITY **126.7** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	2.33
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	2.000	2.000	0.0000		1.720	0.6100
25%	7.50	2	1.986	1.987	0.0135		1.730	-0.6000
	7.50	8	1.986	1.986	0.0140		1.730	-0.6000
	7.50	15	1.985	1.984	0.0155		1.740	-0.5900
	7.50	30	1.982	1.981	0.0185		1.740	-0.5900
	7.50	60	1.980	1.975	0.0225		1.740	-0.5900
	7.50	120	1.979	1.963	0.0290		1.750	-0.5800
50%	15.00	2	1.964	1.952	0.0420		1.760	-0.5700
	15.00	8	1.962	1.951	0.0435		1.760	-0.5700
	15.00	15	1.964	1.951	0.0425		1.760	-0.5700
	15.00	30	1.963	1.946	0.0455		1.760	-0.5700
	15.00	60	1.960	1.944	0.0480		1.760	-0.5700
	15.00	120	1.951	1.932	0.0585		1.770	-0.5600
25%	7.50	20	1.978	1.971	0.0255		1.740	-0.5900
0%	0.00	20	1.989	1.984	0.0135		1.730	-0.6000
50%	15.00	20	1.956	1.921	0.0615		1.750	-0.5800
75%	22.50	2	1.941	1.906	0.0765		1.760	-0.5700
	22.50	8	1.944	1.906	0.0750		1.760	-0.5700
	22.50	15	1.942	1.906	0.0760		1.760	-0.5700
	22.50	30	1.942	1.906	0.0760		1.760	-0.5700
	22.50	60	1.941	1.904	0.0775		1.760	-0.5700
	22.50	120	1.941	1.904	0.0775		1.760	-0.5700
100%	30.00	2	1.921	1.889	0.0950		1.770	-0.5600
	30.00	8	1.921	1.888	0.0955		1.770	-0.5600
	30.00	15	1.921	1.888	0.0955		1.770	-0.5600
	30.00	30	1.921	1.887	0.0960		1.770	-0.5600
	30.00	60	1.921	1.887	0.0960		1.770	-0.5600
	30.00	120	1.921	1.887	0.0960		1.770	-0.5600
75%	22.50	20	1.939	1.901	0.0800		1.750	-0.5800
50%	15.00	20	1.950	1.912	0.0690		1.750	-0.5800
0%	0.00	20	1.975	1.933	0.0460		1.730	-0.6000
50%	15.00	20	1.951	1.914	0.0675		1.750	-0.5800
100%	30.00	20	1.925	1.892	0.0915		1.770	-0.5600
125%	37.50	2	1.910	1.881	0.1045		1.780	-0.5500
	37.50	8	1.910	1.879	0.1055		1.780	-0.5500
	37.50	15	1.909	1.878	0.1065		1.780	-0.5500
	37.50	30	1.909	1.877	0.1070		1.780	-0.5500
	37.50	60	1.907	1.877	0.1080		1.780	-0.5500
	37.50	120	1.905	1.877	0.1090		1.780	-0.5500
150%	45.00	2	1.891	1.866	0.1215		1.810	-0.5200
	45.00	8	1.890	1.865	0.1225		1.810	-0.5200
	45.00	15	1.889	1.864	0.1235		1.810	-0.5200
	45.00	30	1.888	1.864	0.1240		1.810	-0.5200
	45.00	60	1.886	1.862	0.1260		1.810	-0.5200
	45.00	120	1.883	1.862	0.1275		1.810	-0.5200
125%	37.50	20	1.898	1.875	0.1135		1.800	-0.5300
100%	30.00	20	1.910	1.885	0.1025		1.790	-0.5400
50%	15.00	20	1.935	1.906	0.0795		1.770	-0.5600
0%	0.00	20	1.965	1.931	0.0520		1.740	-0.5900
50%	15.00	20	1.940	1.912	0.0740		1.760	-0.5700
100%	30.00	20	1.915	1.890	0.0975		1.780	-0.5500
150%	45.00	20	1.886	1.867	0.1235		1.810	-0.5200
175%	52.50	2	1.865	1.848	0.1435		1.830	-0.5000
	52.50	8	1.867	1.849	0.1420		1.830	-0.5000
	52.50	15	1.869	1.852	0.1395		1.830	-0.5000
	52.50	30	1.868	1.851	0.1405		1.830	-0.5000
	52.50	60	1.866	1.848	0.1429		1.830	-0.5000
	52.50	120	1.861	1.842	0.1485		1.830	-0.5000
200%	60.00	2	1.847	1.830	0.1615		1.85	-0.4800
	60.00	8	1.846	1.829	0.1625		1.85	-0.4800
	60.00	15	1.844	1.828	0.1640		1.85	-0.4800
	60.00	30	1.841	1.825	0.1670		1.85	-0.4800
	60.00	60	1.840	1.819	0.1705		1.86	-0.4700
	60.00	120	1.835	1.812	0.1765		1.86	-0.4700
	60.00	180	1.831	1.807	0.1810		1.87	-0.4600
	60.00	240	1.830	1.803	0.1835		1.87	-0.4600
	60.00	300	1.826	1.799	0.1875		1.87	-0.4600
	60.00	360	1.828	1.846	0.1630		1.86	-0.4700
	60.00	420	1.828	1.832	0.1700		1.87	-0.4600
	60.00	480	1.829	1.838	0.1665		1.87	-0.4600
	60.00	540	1.828	1.838	0.1670		1.87	-0.4600

	60.00	600	1.828	1.839	0.1665		1.87	-0.4600
	60.00	660	1.828	1.838	0.1670		1.87	-0.4600
	60.00	720	1.830	1.837	0.1665		1.87	-0.4600
	60.00	780	1.832	1.831	0.1685		1.83	-0.5000
	60.00	840	1.831	1.832	0.1685		1.84	-0.4900
	60.00	900	1.829	1.831	0.1700		1.85	-0.4800
	60.00	960	1.827	1.833	0.1700		1.86	-0.4700
	60.00	1020	1.826	1.832	0.1710		1.86	-0.4700
	60.00	1080	1.826	1.831	0.1715		1.86	-0.4700
	60.00	1140	1.825	1.832	0.1715		1.86	-0.4700
	60.00	1200	1.826	1.832	0.1710		1.86	-0.4700
	60.00	1260	1.825	1.834	0.1705		1.86	-0.4700
	60.00	1320	1.827	1.834	0.1695		1.86	-0.4700
	60.00	1380	1.825	1.830	0.1725		1.86	-0.4700
	60.00	1440	1.821	1.826	0.1765		1.87	-0.4600
150%	45.00	20	1.843	1.845	0.1560		1.86	-0.4700
	45.00	40	1.842	1.845	0.1565		1.86	-0.4700
	45.00	60	1.842	1.844	0.1570		1.86	-0.4700
100%	30.00	20	1.870	1.866	0.1320		1.840	-0.4900
	30.00	40	1.870	1.866	0.1320		1.840	-0.4900
	30.00	60	1.869	1.865	0.1330		1.840	-0.4900
50%	15.00	20	1.901	1.893	0.1030		1.790	-0.5400
	15.00	40	1.901	1.892	0.1035		1.790	-0.5400
	15.00	60	1.902	1.891	0.1035		1.790	-0.5400
0%	0.00	20	1.933	1.915	0.0760		1.770	-0.5600
	0.00	40	1.934	1.914	0.0760	0.000	1.770	-0.5600
	0.00	60	1.935	1.913	0.0760	0.000	1.770	-0.5600
50%	15.00	20	1.909	1.891	0.1000	0.024	1.820	-0.5100
100%	30.00	20	1.879	1.866	0.1275	0.028	1.830	-0.5000
150%	45.00	20	1.848	1.839	0.1565	0.029	1.850	-0.4800
200%	60.00	20	1.810	1.792	0.1990	0.043	1.880	-0.4500
210%	63.00	20	1.799	1.788	0.2065	0.008	1.890	-0.4400
220%	66.00	20	1.792	1.775	0.2165	0.010	1.900	-0.4300
230%	69.00	20	1.787	1.768	0.2225	0.006	1.900	-0.4300
240%	72.00	20	1.781	1.760	0.2295	0.007	1.910	-0.4200
250%	75.00	20	1.769	1.749	0.2410	0.012	1.920	-0.4100
260%	78.00	20	1.759	1.736	0.2525	0.012	1.920	-0.4100
270%	81.00	20	1.745	1.724	0.2655	0.013	1.940	-0.3900
280%	84.00	20	1.735	1.717	0.2740	0.008	1.940	-0.3900
290%	87.00	20	1.722	1.701	0.2885	0.015	1.960	-0.3700
300%	90.00	20	1.716	1.696	0.2940	0.006	1.970	-0.3600
310%	93.00	20	1.708	1.688	0.3020	0.008	1.980	-0.3500
320%	96.00	20	1.701	1.679	0.3100	0.008	1.990	-0.3400
330%	99.00	20	1.691	1.668	0.3205	0.011	2.000	-0.3300
340%	102.00	20	1.675	1.655	0.3350	0.015	2.010	-0.3200
350%	105.00	20	1.648	1.628	0.3620	0.027	2.030	-0.3000
360%	108.00	20	1.631	1.610	0.3795	0.017	2.050	-0.2800
370%	111.00	20	1.616	1.594	0.3950	0.016	2.070	-0.2600
380%	114.00	20	1.598	1.576	0.4130	0.018	2.080	-0.2500
390%	117.00	20	1.575	1.554	0.4355	0.023	2.100	-0.2300
400%	120.00	20	1.555	1.539	0.4530	0.018	2.120	-0.2100
410%	123.00	20	1.531	1.511	0.4790	0.026	2.140	-0.1900
420%	126.00	20	1.497	1.479	0.5120	0.033	2.170	-0.1600
430%	129.00	20	1.460	1.443	0.5485	0.037	2.210	-0.1200
440%	132.00	20	1.426	1.408	0.5830	0.035	2.250	-0.0800
440%	132.00	20	0.023	0.000	1.9885	1.406	2.250	-0.0800
360%	108.00	20	0.023	0.000	1.9885	0.000	3.660	1.3300
270%	81.00	20	0.042	0.015	1.9715	0.017	3.650	1.3200
180%	54.00	20	0.101	0.068	1.9155	0.056	3.590	1.2600
90%	27.00	20	0.285	0.147	1.7840	0.132	3.510	1.1800
0%	0.00	20	0.371	0.226	1.7015	0.083	3.430	1.1000

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-P18G, Tension, 500%
Tip at El-80

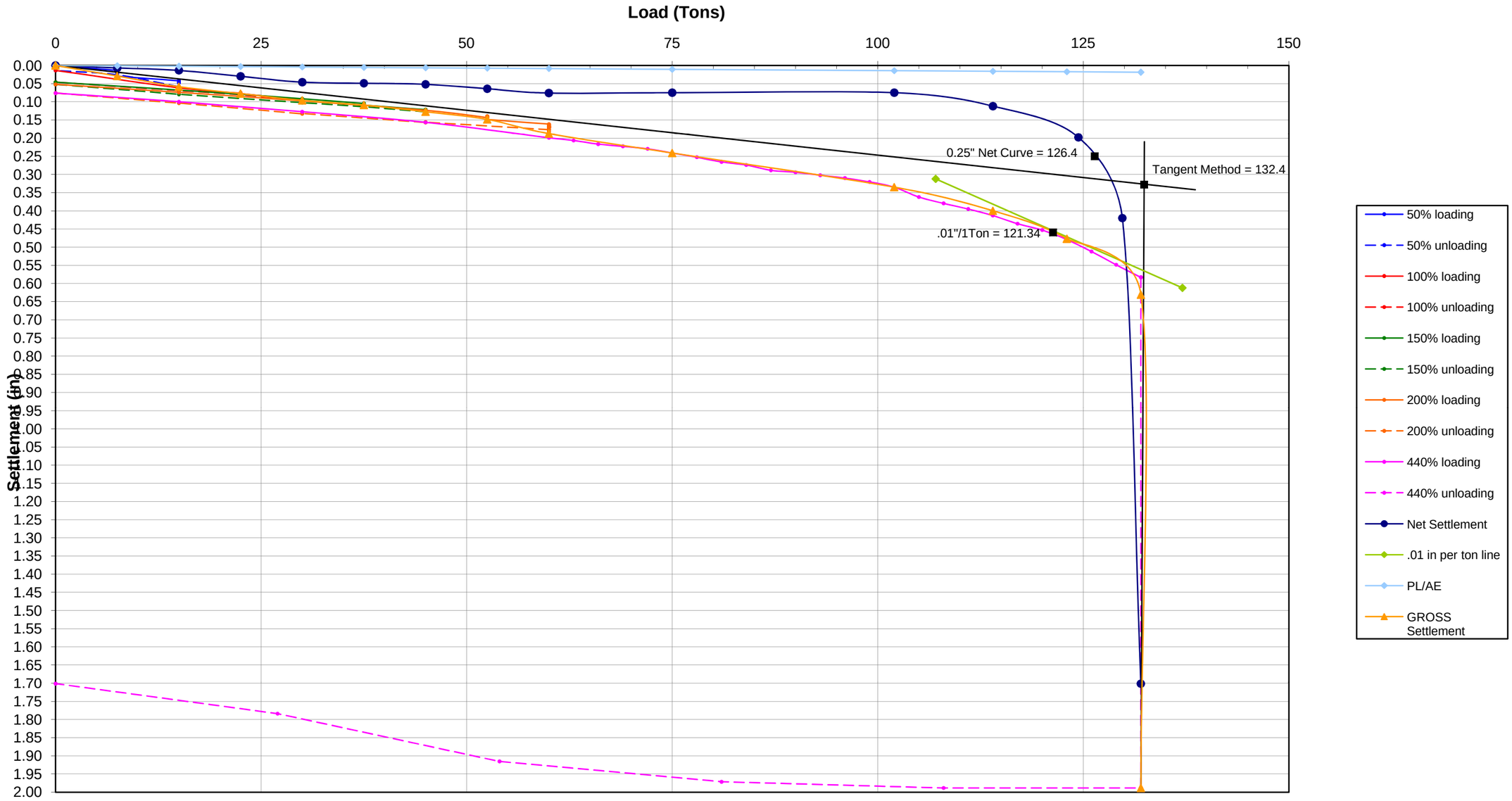


PLATE B-10-d

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-P20, Tension, 500%"
20" Pipe, Tip Elevation = -100

Service Load = **65.00** **Tons**

Estimated Pile Capacity = **204 Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	20
Area (in^2)	314.2
Top Ele. (ft)	6.5
Tip Ele. (ft)	-100
Length (ft)	107
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	32.50	0.0335
100%	65.00	0.0435
150%	97.50	0.0445
200%	130.00	0.0835
350%	227.50	1.4695

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	16.3	0.0480	25%	16.3	0.0168	0.002	0.031
50%	32.5	0.0760	50%	32.5	0.0335	0.005	0.043
75%	48.8	0.1085	75%	48.8	0.0385	0.007	0.070
100%	65.0	0.1430	100%	65.0	0.0435	0.009	0.100
125%	81.3	0.1725	125%	81.3	0.0440	0.011	0.129
150%	97.5	0.2050	150%	97.5	0.0445	0.014	0.161
175%	113.8	0.2445	175%	113.8	0.0460	0.016	0.199
200%	130.0	0.3055	200%	130.0	**0.0460**	0.018	0.260
240%	156.0	0.3215	240%	156.0	0.0550	0.022	0.267
280%	182.0	0.3385	280%	182.0	0.0750	0.026	0.264
300%	195.0	0.3370	300%	195.0	0.1210	0.027	0.216
320%	208.0	0.4195	320%	208.0	0.2960	0.029	0.124
340%	221.0	0.6015	340%	221.0	0.6010	0.031	0.001
350%	227.5	0.6745	350%	227.5	1.4695	0.032	-0.795

PILE CAPACITY CALCULATIONS

Select

.25 inch Net Deflection

Capacity	Deflection
205.2	0.25

.01 inch/Ton Creep Rate

Capacity	Deflection	.01"/Ton line points	
205.4	0.398	190	0.245
		220	0.545

Tangent Method

Capacity	Deflection	Line T1 points		Line T2 points	
200	0.306	0	0	192	0.21
		205.6	0.317	227.5	0.6745
		0.0015418		0.0130845	-2.3022254

PILE CAPACITY **203.5** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	2.33
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	2.000	2.000	0.0000		3.120	-0.7900
25%	16.25	2	1.9640	1.9850	0.0255		3.130	0.8000
	16.25	8	1.9640	1.9830	0.0265		3.130	0.8000
	16.25	15	1.9610	1.9820	0.0285		3.130	0.8000
	16.25	30	1.9610	1.9800	0.0295		3.130	0.8000
	16.25	60	1.9570	1.9760	0.0335		3.130	0.8000
	16.25	120	1.9350	1.9690	0.0480		3.140	0.8100
50%	32.50	2	1.9050	1.9530	0.0710		3.210	0.8800
	32.50	8	1.9040	1.9530	0.0715		3.210	0.8800
	32.50	15	1.9040	1.9520	0.0720		3.210	0.8800
	32.50	30	1.9020	1.9510	0.0735		3.210	0.8800
	32.50	60	1.9010	1.9500	0.0745		3.210	0.8800
	32.50	120	1.9000	1.9480	0.0760		3.220	0.8900
25%	16.25	20	1.9270	1.9650	0.0540		3.200	0.8700
0%	0.00	20	1.9550	1.9780	0.0335		3.170	0.8400
50%	32.50	20	1.8990	1.9500	0.0755		3.210	0.8800
75%	48.75	2	1.8640	1.9290	0.1035		3.23	0.9000
	48.75	8	1.8640	1.9290	0.1035		3.23	0.9000
	48.75	15	1.8630	1.9290	0.1040		3.23	0.9000
	48.75	30	1.8620	1.9290	0.1045		3.23	0.9000
	48.75	60	1.8600	1.9280	0.1060		3.24	0.9100
	48.75	120	1.8580	1.9250	0.1085		3.24	0.9100
100%	65.00	2	1.8230	1.9030	0.1370		3.270	0.9400
	65.00	8	1.8230	1.9030	0.1370		3.270	0.9400
	65.00	15	1.8220	1.9020	0.1380		3.270	0.9400
	65.00	30	1.8200	1.8990	0.1405		3.270	0.9400
	65.00	60	1.8170	1.8980	0.1425		3.270	0.9400
	65.00	120	1.8160	1.8980	0.1430		3.270	0.9400
75%	48.75	20	1.8430	1.9160	0.1205		3.260	0.9300
50%	32.50	20	1.8750	1.9370	0.0940		3.240	0.9100
0%	0.00	20	1.9400	1.9730	0.0435		3.190	0.8600
50%	32.50	20	1.8830	1.9440	0.0865		3.230	0.9000
100%	65.00	20	1.8170	1.9020	0.1405		3.280	0.9500
125%	81.25	2	1.7830	1.8800	0.1685		3.300	0.9700
	81.25	8	1.7810	1.8790	0.1700		3.300	0.9700
	81.25	15	1.7810	1.8790	0.1700		3.300	0.9700
	81.25	30	1.7810	1.8790	0.1700		3.310	0.9800
	81.25	60	1.7790	1.8780	0.1715		3.310	0.9800
	81.25	120	1.7780	1.8770	0.1725		3.310	0.9800
150%	97.50	2	1.7440	1.8540	0.2010		3.300	0.9700
	97.50	8	1.7430	1.8540	0.2015		3.300	0.9700
	97.50	15	1.7430	1.8540	0.2015		3.300	0.9700
	97.50	30	1.7420	1.8530	0.2025		3.300	0.9700
	97.50	60	1.7400	1.8510	0.2045		3.300	0.9700
	97.50	120	1.7390	1.8510	0.2050		3.400	1.0700
125%	81.25	20	1.7650	1.8680	0.1835		3.320	0.9900
100%	65.00	20	1.7960	1.8900	0.1570		3.300	0.9700
50%	32.50	20	1.8650	1.9360	0.0995		3.250	0.9200
0%	0.00	20	1.9380	1.9730	0.0445		3.190	0.8600
50%	32.50	20	1.8780	1.9430	0.0895		3.230	0.9000
100%	65.00	20	1.8100	1.9000	0.1450		3.290	0.9600
150%	97.50	20	1.7410	1.8530	0.2030		3.340	1.0100
175%	113.75	2	1.7040	1.8270	0.2345		3.370	1.0400
	113.75	8	1.7040	1.8270	0.2345		3.370	1.0400
	113.75	15	1.7020	1.8260	0.2360		3.370	1.0400
	113.75	30	1.7000	1.8250	0.2375		3.370	1.0400
	113.75	60	1.6980	1.8220	0.2400		3.370	1.0400
	113.75	120	1.6950	1.8160	0.2445		3.370	1.0400
200%	130.00	2	1.6560	1.7900	0.2770		3.41	1.0800
	130.00	8	1.6540	1.7890	0.2785		3.41	1.0800
	130.00	15	1.6520	1.7870	0.2805		3.41	1.0800
	130.00	30	1.6510	1.7860	0.2815		3.41	1.0800
	130.00	60	1.6470	1.7860	0.2835		3.41	1.0800
	130.00	120	1.6340	1.7760	0.2950		3.42	1.0900
	130.00	180	1.6270	1.7710	0.3010		3.42	1.0900
	130.00	240	1.6240	1.7670	0.3045		3.42	1.0900
	130.00	300	1.6210	1.7640	0.3075		3.43	1.1000
	130.00	360	1.6180	1.7600	0.3110		3.43	1.1000
	130.00	420	1.6180	1.7590	0.3115		3.43	1.1000
	130.00	480	1.6170	1.7580	0.3125		3.43	1.1000
	130.00	540	1.6160	1.7570	0.3135		3.43	1.1000

	130.00	600	1.6150	1.7740	0.3055		3.43	1.1000
	130.00	660	1.6180	1.7800	0.3010		3.43	1.1000
	130.00	720	1.6180	1.7820	0.3000		3.43	1.1000
	130.00	780	1.6170	1.7840	0.2995		3.43	1.1000
	130.00	840	1.6160	1.7840	0.3000		3.43	1.1000
	130.00	900	1.6160	1.7840	0.3000		3.43	1.1000
	130.00	960	1.6160	1.7840	0.3000		3.43	1.1000
	130.00	1020	1.6160	1.7840	0.3000		3.43	1.1000
	130.00	1080	1.6160	1.7840	0.3000		3.43	1.1000
	130.00	1140	1.6160	1.7840	0.3000		3.43	1.1000
	130.00	1200	1.6150	1.7830	0.3010		3.43	1.1000
	130.00	1260	1.6150	1.7830	0.3010		3.43	1.1000
	130.00	1320	1.6140	1.7820	0.3020		3.43	1.1000
	130.00	1380	1.6130	1.7810	0.3030		3.43	1.1000
	130.00	1440	1.6120	1.7770	0.3055		3.43	1.1000
150%	97.50	20	1.6630	1.8170	0.2600		3.39	1.0600
	97.50	40	1.6630	1.8150	0.2610		3.39	1.0600
	97.50	60	1.6620	1.8130	0.2625		3.39	1.0600
100%	65.00	20	1.7260	1.8630	0.2055		3.330	1.0000
	65.00	40	1.7260	1.8620	0.2060		3.330	1.0000
	65.00	60	1.7250	1.8610	0.2070		3.330	1.0000
50%	32.50	20	1.7990	1.9120	0.1445		3.270	0.9400
	32.50	40	1.8000	1.9130	0.1435		3.270	0.9400
	32.50	60	1.8010	1.9140	0.1425		3.270	0.9400
0%	0.00	20	1.8780	1.9550	0.0835		3.210	0.8800
	0.00	40	1.8780	1.9550	0.0835	0.000	3.210	0.8800
	0.00	60	1.8780	1.9550	0.0835	0.000	3.210	0.8800
50%	32.50	20	1.8120	1.9210	0.1335	0.050	3.250	0.9200
100%	65.00	20	1.7450	1.8770	0.1890	0.056	3.310	0.9800
150%	97.50	20	1.6730	1.8280	0.2495	0.061	3.370	1.0400
200%	130.00	20	1.5980	1.7740	0.3140	0.065	3.430	1.1000
210%	136.50	20	1.5820	1.7610	0.3285	0.015	3.440	1.1100
220%	143.00	20	1.5660	1.7480	0.3430	0.015	3.460	1.1300
230%	149.50	20	1.5480	1.7350	0.3585	0.016	3.470	1.1400
240%	156.00	20	1.5300	1.7190	0.3755	0.017	3.480	1.1500
250%	162.50	20	1.5140	1.7060	0.3900	0.015	3.500	1.1700
260%	169.00	20	1.4930	1.6910	0.4080	0.018	3.520	1.1900
270%	175.50	20	1.4710	1.6780	0.4255	0.018	3.540	1.2100
280%	182.00	20	1.4510	1.6620	0.4435	0.018	3.560	1.2300
290%	188.50	20	1.4260	1.6430	0.4655	0.022	3.580	1.2500
300%	195.00	20	1.4010	1.6220	0.4885	0.023	3.600	1.2700
310%	201.50	20	1.3780	1.6030	0.5095	0.021	3.620	1.2900
320%	208.00	20	1.3480	1.5780	0.5370	0.027	3.650	1.3200
330%	214.50	20	1.3150	1.5510	0.5670	0.030	3.680	1.3500
340%	221.00	20	1.2790	1.5180	0.6015	0.035	3.720	1.3900
350%	227.50	20	1.2030	1.4480	0.6745	0.073	3.780	1.4500
350%	227.50	20	0.0000	0.2440	1.8780	1.204	4.990	2.6600
233%	151.65	20	0.0890	0.3160	1.7975	0.081	4.920	2.5900
156%	101.10	20	0.2070	0.4040	1.6945	0.103	4.820	2.4900
78%	50.55	20	0.3370	0.4930	1.5850	0.110	4.710	2.3800
0%	0.00	20	0.4860	0.5750	1.4695	0.116	4.600	2.2700

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-P20, Tension, 500%
Tip at El-100

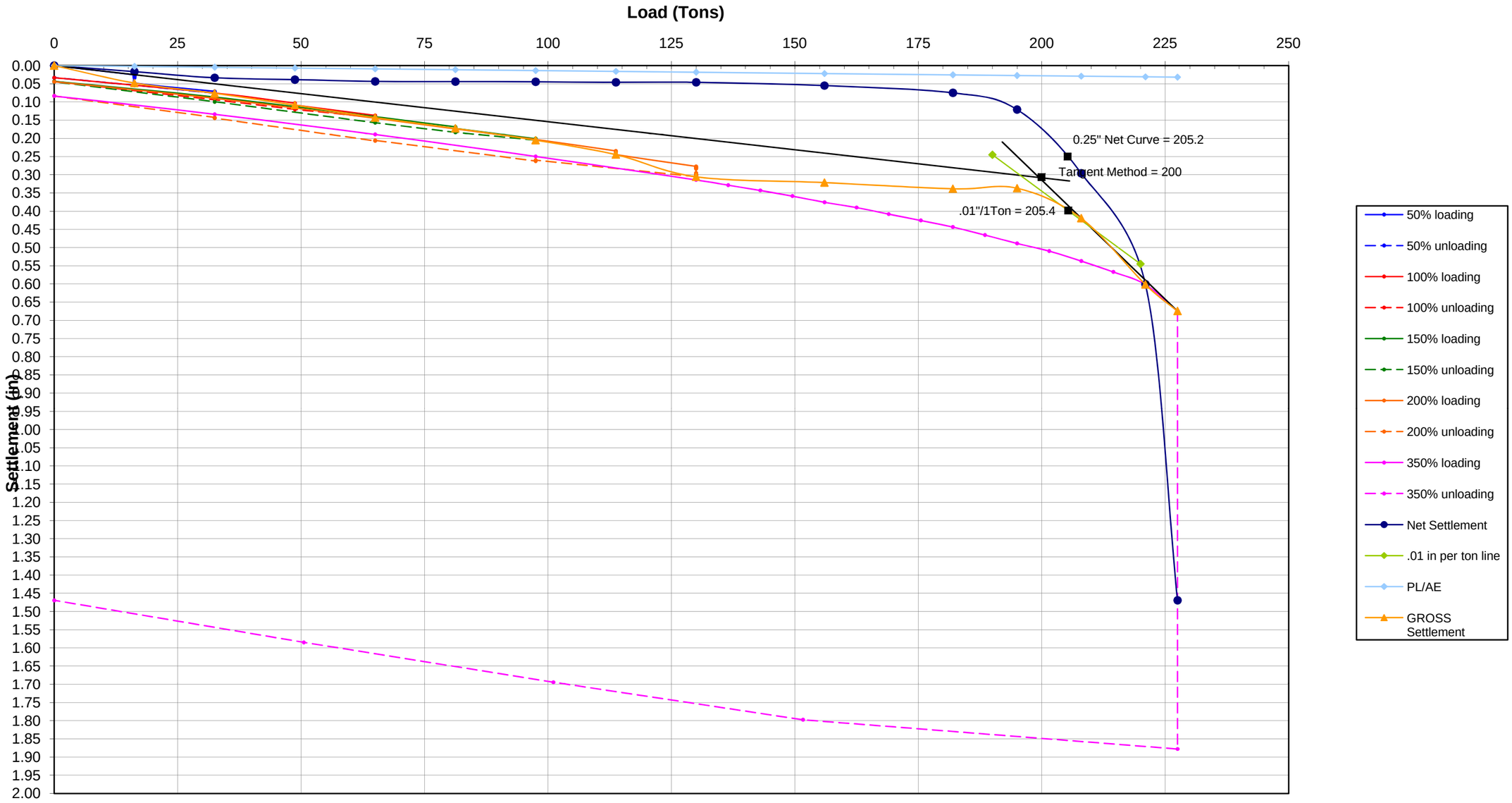


PLATE B-11-d

"Spiral Welded Pipe Pile Innovation Team, Lakefront, Suburban, S-P20G, Tension, 500%"
20" Pipe, Tip Elevation = -100

Service Load = **65.00** **Tons**

Estimated Pile Capacity = **208 Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	20
Area (in^2)	314.2
Top Ele. (ft)	6.5
Tip Ele. (ft)	-100
Length (ft)	107
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	32.50	0.0270
100%	65.00	0.0700
150%	97.50	0.1075
200%	130.00	0.2165
350%	227.50	1.5645

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)	Gross - Net (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000	0.000
25%	16.3	0.0325	25%	16.3	0.0135	0.002	0.019
50%	32.5	0.0600	50%	32.5	0.0270	0.005	0.033
75%	48.8	0.0950	75%	48.8	0.0485	0.007	0.046
100%	65.0	0.1430	100%	65.0	0.0700	0.009	0.073
125%	81.3	0.2180	125%	81.3	0.0888	0.011	0.129
150%	97.5	0.2535	150%	97.5	0.1075	0.014	0.146
175%	113.8	0.2990	175%	113.8	0.1350	0.016	0.164
200%	130.0	0.3850	200%	130.0	**0.1700**	0.018	0.215
240%	156.0	0.4940	240%	156.0	0.2100	0.022	0.284
280%	182.0	0.5850	280%	182.0	0.2480	0.026	0.337
300%	195.0	0.6510	300%	195.0	0.2660	0.027	0.385
320%	208.0	0.7200	320%	208.0	0.3200	0.029	0.400
340%	221.0	0.8150	340%	221.0	0.6400	0.031	0.175
350%	227.5	1.9150	350%	227.5	1.5645	0.032	0.351

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection				
☑	**.25 inch Net Deflection**	184.5	0.25				
		Capacity	Deflection	.01"/Ton line points			
☑	**.01 inch/Ton Creep Rate**	217.3	0.752	200.9	0.584		
				230.9	0.884		
		Capacity	Deflection	Line T1 points		Line T2 points	
☑	**Tangent Method**	221.6	0.453	0	0	220.5	0.16
				228.2	0.474	227.5	1.915
				0.0020771		0.2507143	-55.1225

PILE CAPACITY **207.8** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA				SCALE/LEVEL DATA	
							Initial Reading =	1.29
Percent Load	Load (tons)	Incr. Time (min)	Side A (in)	Side B (in)	Average (in)	Differential	Reading (in)	Settlement (in)
0%	0.00	0	2.000	2.000	0.0000		1.290	0.0000
25%	16.25	2	1.9800	1.9710	0.0245		1.320	0.0300
	16.25	8	1.9790	1.9690	0.0260		1.320	0.0300
	16.25	15	1.9790	1.9680	0.0265		1.320	0.0300
	16.25	30	1.9790	1.9670	0.0270		1.320	0.0300
	16.25	60	1.9780	1.9630	0.0295		1.320	0.0300
	16.25	120	1.9760	1.9590	0.0325		1.330	0.0400
50%	32.50	2	1.9550	1.9350	0.0550		1.350	0.0600
	32.50	8	1.9540	1.9340	0.0560		1.350	0.0600
	32.50	15	1.9530	1.9340	0.0565		1.350	0.0600
	32.50	30	1.9520	1.9330	0.0575		1.350	0.0600
	32.50	60	1.9520	1.9320	0.0580		1.350	0.0600
	32.50	120	1.9510	1.9290	0.0600		1.350	0.0600
25%	16.25	20	1.9680	1.9420	0.0450		1.330	0.0400
0%	0.00	20	1.9860	1.9600	0.0270		1.310	0.0200
50%	32.50	20	1.9500	1.9230	0.0635		1.350	0.0600
75%	48.75	2	1.9230	1.8920	0.0925		1.37	0.0800
	48.75	8	1.9220	1.8910	0.0935		1.37	0.0800
	48.75	15	1.9210	1.8900	0.0945		1.37	0.0800
	48.75	30	1.9210	1.8890	0.0950		1.37	0.0800
	48.75	60	1.9200	1.8860	0.0970		1.37	0.0800
	48.75	120	1.9250	1.8850	0.0950		1.37	0.0800
100%	65.00	2	1.8890	1.8440	0.1335		1.410	0.1200
	65.00	8	1.8870	1.8420	0.1355		1.410	0.1200
	65.00	15	1.8800	1.8330	0.1435		1.410	0.1200
	65.00	30	1.8200	1.8990	0.1405		3.270	1.9800
	65.00	60	1.8170	1.8980	0.1425		3.270	1.9800
	65.00	120	1.8160	1.8980	0.1430		3.270	1.9800
75%	48.75	20	1.8940	1.8490	0.1285		1.390	0.1000
50%	32.50	20	1.9090	1.8670	0.1120		1.360	0.0700
0%	0.00	20	1.9420	1.9180	0.0700		1.320	0.0300
50%	32.50	20	1.9000	1.8770	0.1115		1.370	0.0800
100%	65.00	20	1.8500	1.8240	0.1630		1.420	0.1300
125%	81.25	2	1.8210	1.7890	0.1950		1.450	0.1600
	81.25	8	1.8170	1.7870	0.1980		1.450	0.1600
	81.25	15	1.8150	1.7850	0.2000		1.450	0.1600
	81.25	30	1.8130	1.7810	0.2030		1.450	0.1600
	81.25	60	1.8120	1.7790	0.2045		1.450	0.1600
	81.25	120	1.7920	1.7720	0.2180		1.460	0.1700
150%	97.50	2	1.7560	1.7400	0.2520		1.490	0.2000
	97.50	8	1.7460	1.7400	0.2570		1.490	0.2000
	97.50	15	1.7450	1.7450	0.2550		1.490	0.2000
	97.50	30	1.7550	1.7490	0.2480		1.490	0.2000
	97.50	60	1.7520	1.7510	0.2485		1.490	0.2000
	97.50	120	1.7480	1.7450	0.2535		1.460	0.1700
125%	81.25	20	1.7620	1.7590	0.2395		1.420	0.1300
100%	65.00	20	1.7850	1.7820	0.2165		1.390	0.1000
50%	32.50	20	1.8320	1.8390	0.1645		1.340	0.0500
0%	0.00	20	1.8850	1.9000	0.1075		1.290	0.0000
50%	32.50	20	1.8520	1.8600	0.1440		1.330	0.0400
100%	65.00	20	1.8060	1.8040	0.1950		1.380	0.0900
150%	97.50	20	1.7510	1.7420	0.2535		1.440	0.1500
175%	113.75	2	1.7200	1.7090	0.2855		1.470	0.1800
	113.75	8	1.7180	1.7060	0.2880		1.470	0.1800
	113.75	15	1.7160	1.7040	0.2900		1.470	0.1800
	113.75	30	1.7140	1.7010	0.2925		1.470	0.1800
	113.75	60	1.7110	1.6980	0.2955		1.470	0.1800
	113.75	120	1.7100	1.6920	0.2990		1.480	0.1900
200%	130.00	2	1.6790	1.6580	0.3315		1.52	0.2300
	130.00	8	1.6760	1.6560	0.3340		1.52	0.2300
	130.00	15	1.6740	1.6540	0.3360		1.52	0.2300
	130.00	30	1.6730	1.6520	0.3375		1.52	0.2300
	130.00	60	1.6690	1.6480	0.3415		1.52	0.2300
	130.00	120	1.6650	1.6420	0.3465		1.52	0.2300
	130.00	180	1.6620	1.6370	0.3505		1.53	0.2400
	130.00	240	1.6600	1.6310	0.3545		1.53	0.2400
	130.00	300	1.6570	1.6270	0.3580		1.54	0.2500
	130.00	360	1.6550	1.6240	0.3605		1.54	0.2500
	130.00	420	1.6530	1.6210	0.3630		1.54	0.2500
	130.00	480	1.6520	1.6180	0.3650		1.54	0.2500
	130.00	540	1.6520	1.6150	0.3665		1.54	0.2500

	130.00	600	1.6490	1.6110	0.3700		1.54	0.2500
	130.00	660	1.6430	1.6060	0.3755		1.54	0.2500
	130.00	720	1.6350	1.6040	0.3805		1.55	0.2600
	130.00	780	1.6290	1.5990	0.3860		1.55	0.2600
	130.00	840	1.6200	1.5970	0.3915		1.56	0.2700
	130.00	900	1.6170	1.5940	0.3945		1.56	0.2700
	130.00	960	1.6070	1.5900	0.4015		1.56	0.2700
	130.00	1020	1.5980	1.5880	0.4070		1.56	0.2700
	130.00	1080	1.5960	1.5840	0.4100		1.56	0.2700
	130.00	1140	1.5860	1.5800	0.4170		1.56	0.2700
	130.00	1200	1.5810	1.5790	0.4200		1.56	0.2700
	130.00	1260	1.5770	1.5770	0.4230		1.56	0.2700
	130.00	1320	1.5730	1.5760	0.4255		1.56	0.2700
	130.00	1380	1.5720	1.5750	0.4265		1.56	0.2700
	130.00	1440	1.5710	1.5740	0.4275		1.56	0.2700
150%	97.50	20	1.6050	1.6180	0.3885		1.51	0.2200
	97.50	40	1.6060	1.6190	0.3875		1.51	0.2200
	97.50	60	1.6070	1.6170	0.3880		1.51	0.2200
100%	65.00	20	1.6580	1.6690	0.3365		1.470	0.1800
	65.00	40	1.6580	1.6700	0.3360		1.470	0.1800
	65.00	60	1.6590	1.6710	0.3350		1.470	0.1800
50%	32.50	20	1.7140	1.7300	0.2780		1.390	0.1000
	32.50	40	1.7150	1.7310	0.2770		1.390	0.1000
	32.50	60	1.7170	1.7320	0.2755		1.390	0.1000
0%	0.00	20	1.7710	1.7900	0.2195		1.340	0.0500
	0.00	40	1.7730	1.7910	0.2180	0.001	1.340	0.0500
	0.00	60	1.7740	1.7930	0.2165	0.002	1.340	0.0500
50%	32.50	20	1.7340	1.7510	0.2575	0.041	1.370	0.0800
100%	65.00	20	1.6820	1.6910	0.3135	0.056	1.430	0.1400
150%	97.50	20	1.6260	1.6290	0.3725	0.059	1.490	0.2000
200%	130.00	20	1.5660	1.5620	0.4360	0.063	1.550	0.2600
210%	136.50	20	1.5520	1.5470	0.4505	0.015	1.570	0.2800
220%	143.00	20	1.5380	1.5310	0.4655	0.015	1.580	0.2900
230%	149.50	20	1.5240	1.5210	0.4775	0.012	1.600	0.3100
240%	156.00	20	1.5090	1.5030	0.4940	0.017	1.610	0.3200
250%	162.50	20	1.4880	1.4790	0.5165	0.022	1.630	0.3400
260%	169.00	20	1.4670	1.4620	0.5355	0.019	1.650	0.3600
270%	175.50	20	1.4430	1.4310	0.5630	0.028	1.670	0.3800
280%	182.00	20	1.4180	1.4120	0.5850	0.022	1.690	0.4000
290%	188.50	20	1.3880	1.3810	0.6155	0.031	1.720	0.4300
300%	195.00	20	1.3580	1.3400	0.6510	0.035	1.750	0.4600
310%	201.50	20	1.3260	1.3080	0.6830	0.032	1.780	0.4900
320%	208.00	20	1.2900	1.2700	0.7200	0.037	1.800	0.5100
330%	214.50	20	1.2550	1.2280	0.7585	0.039	1.850	0.5600
340%	221.00	20	1.1910	1.1790	0.8150	0.056	1.900	0.6100
350%	227.50	20	1.1120	1.0980	0.8950	0.080	1.980	0.6900
350%	227.50	20	0.0690	0.1010	1.9150	1.020	2.410	1.1200
248%	161.20	20	0.0690	0.1010	1.9150	0.000	3.010	1.7200
166%	107.90	20	0.1750	0.2080	1.8085	0.107	2.900	1.6100
83%	53.95	20	0.2870	0.3250	1.6940	0.115	2.770	1.4800
0%	0.00	20	0.4090	0.4620	1.5645	0.130	2.650	1.3600

PLATE B-12-c

Spiral Welded Pipe Pile Innovation Team
Lakefront Protection, Suburban, S-P20G, Tension, 500%
Tip at El-100

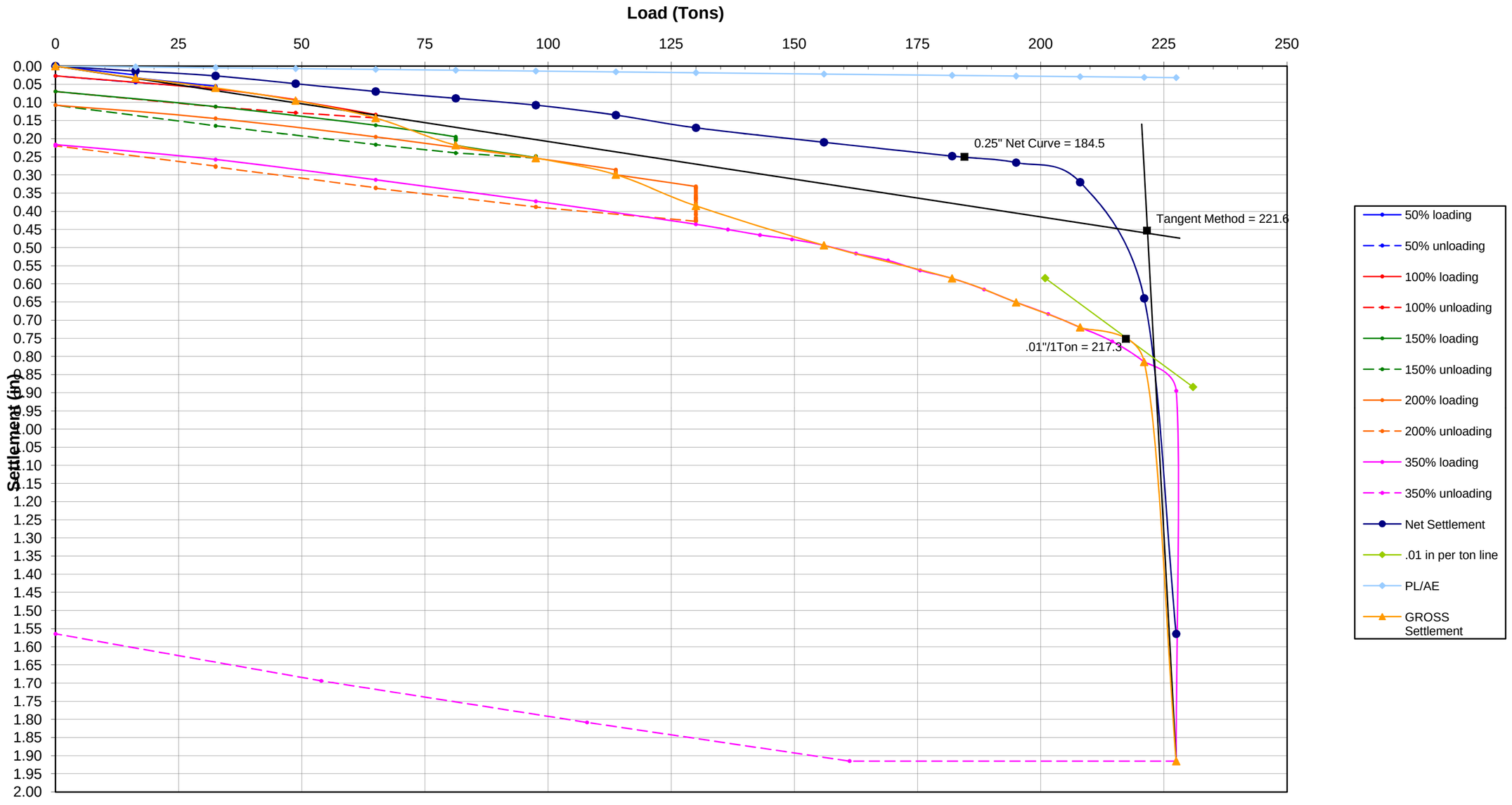


PLATE B-12-d

APPENDIX C

18" SWP at Suburban Canal - Example Lateral Response Calculations

Pt, lbs=	125000
kpy, pcf=	2000
kpy, pci=	1.16
α=Epy=kpy*x	
Ep, psi=	29000000
Ip, in^4=	1053
EpIp, lb-in^2=	30537000000
β^4=(α/4EpIp)	
A1=(e^(-βx))*((cosβx+sinβx)	
B1=(e^(-βx))*((cosβx-sinβx)	
C1=(e^(-βx))*(cosβx)	
D1=(e^(-βx))*(sinβx)	
y=[2(Pt)β(C1)]/α	
S=[2(Pt)β^2(A1)]/α	
M=[(Pt)(D1)]/β	
V=(Pt)(B1)	
p=-2(Pt)β(C1)	

x, ft	x, in	α, psi	β, in^-1	A1	B1	C1	D1	y, in	S	M, lb-in	V	p
1	12	13.92	0.00327	0.962	0.961	0.962	0.00066	56	0	25229	120125	-786
2	24	27.84	0.00389	0.912	0.909	0.911	0.00148	32	0	47558	113625	-886
3	36	41.76	0.0043	0.859	0.854	0.857	0.00231	22	0	67151	106750	-921
4	48	55.68	0.00462	0.804	0.798	0.801	0.0031	17	0	83874	99750	-925
5	60	69.6	0.00489	0.75	0.742	0.746	0.00382	13	0	97648	92750	-912
6	72	83.52	0.00511	0.697	0.688	0.692	0.00444	11	0	108611	86000	-884
7	84	97.44	0.00531	0.645	0.635	0.64	0.00498	9	0	117232	79375	-850
8	96	111.36	0.00549	0.596	0.585	0.59	0.00543	7	0	123634	73125	-810
9	108	125.28	0.00566	0.548	0.537	0.543	0.00579	6	0	127871	67125	-768
10	120	139.2	0.00581	0.504	0.492	0.498	0.00606	5	0	130379	61500	-723
11	132	153.12	0.00595	0.462	0.45	0.456	0.00625	4	0	131303	56250	-678
12	144	167.04	0.00608	0.423	0.41	0.417	0.00637	4	0	130962	51250	-634
13	156	180.96	0.0062	0.387	0.374	0.38	0.00642	3	0	129435	46750	-589
14	168	194.88	0.00632	0.352	0.339	0.346	0.00641	3	0	126780	42375	-547
15	180	208.8	0.00643	0.321	0.308	0.314	0.00635	2	0	123445	38500	-505
16	192	222.72	0.00653	0.292	0.279	0.285	0.00625	2	0	119640	34875	-465
17	204	236.64	0.00663	0.265	0.252	0.259	0.0061	2	0	115008	31500	-429
18	216	250.56	0.00673	0.24	0.228	0.234	0.00593	2	0	110141	28500	-394
19	228	264.48	0.00682	0.217	0.205	0.211	0.00573	1	0	105022	25625	-360
20	240	278.4	0.00691	0.196	0.185	0.19	0.00551	1	0	99674	23125	-328
21	252	292.32	0.00699	0.177	0.166	0.172	0.00528	1	0	94421	20750	-301
22	264	306.24	0.00708	0.159	0.149	0.154	0.00503	1	0	88806	18625	-273
23	276	320.16	0.00716	0.143	0.134	0.139	0.00478	1	0	83450	16750	-249
24	288	334.08	0.00723	0.129	0.12	0.125	0.00453	1	0	78320	15000	-226
25	300	348	0.00731	0.116	0.107	0.111	0.00427	1	0	73016	13375	-203
26	312	361.92	0.00738	0.104	0.096	0.1	0.00402	1	0	68089	12000	-185
27	324	375.84	0.00745	0.093	0.086	0.089	0.00377	0	0	63255	10750	-166
28	336	389.76	0.00752	0.083	0.076	0.08	0.00352	0	0	58511	9500	-150
29	348	403.68	0.00758	0.075	0.068	0.071	0.00329	0	0	54255	8500	-135
30	360	417.6	0.00765	0.067	0.061	0.064	0.00306	0	0	50000	7625	-122
31	372	431.52	0.00771	0.06	0.054	0.057	0.00284	0	0	46044	6750	-110
32	384	445.44	0.00777	0.053	0.048	0.051	0.00263	0	0	42310	6000	-99
33	396	459.36	0.00783	0.047	0.043	0.045	0.00244	0	0	38953	5375	-88
34	408	473.28	0.00789	0.042	0.038	0.04	0.00225	0	0	35646	4750	-79
35	420	487.2	0.00795	0.037	0.033	0.035	0.00207	0	0	32547	4125	-70
36	432	501.12	0.008	0.033	0.03	0.031	0.0019	0	0	29688	3750	-62
37	444	515.04	0.00806	0.03	0.026	0.028	0.00174	0	0	26985	3250	-56
38	456	528.96	0.00811	0.026	0.023	0.025	0.0016	0	0	24661	2875	-51
39	468	542.88	0.00816	0.023	0.02	0.022	0.00146	0	0	22365	2500	-45
40	480	556.8	0.00822	0.021	0.018	0.019	0.00133	0	0	20225	2250	-39

PLATE C-1-a

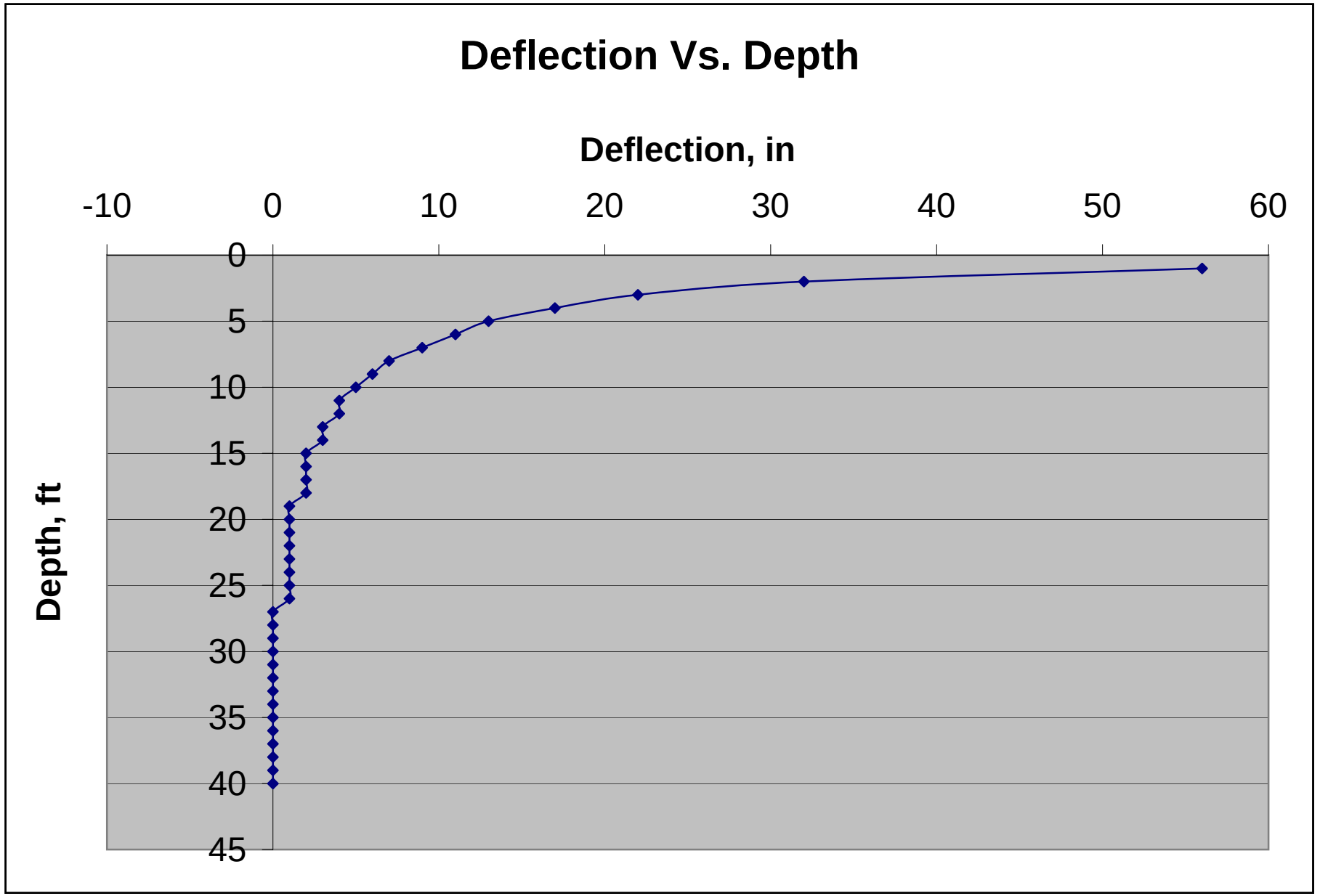

Deflection Vs. Depth
Deflection, in
-10
0
10
20
30
40
50
60
Depth, ft
0
5
10
15
20
25
30
35
40
45

PLATE C-1-b

z, ft=	5

b, in=	18
c, psf=	400
c, psi=	2.78
pu=9cb,	450
ε50=	0.02
y50=2.5*(ε50)*b	0.9
y50*8=, in	7.2

p=(pu*0.5)*[(y/y50)^(1/3)]

y	p
0	0
0.4	172
0.5	185
1	233
1.5	267
2	294
2.5	316
3	336
3.5	354
4	370
4.5	385
5	398
5.5	411
6	423
6.5	435
7	446
7.2	450
12	450

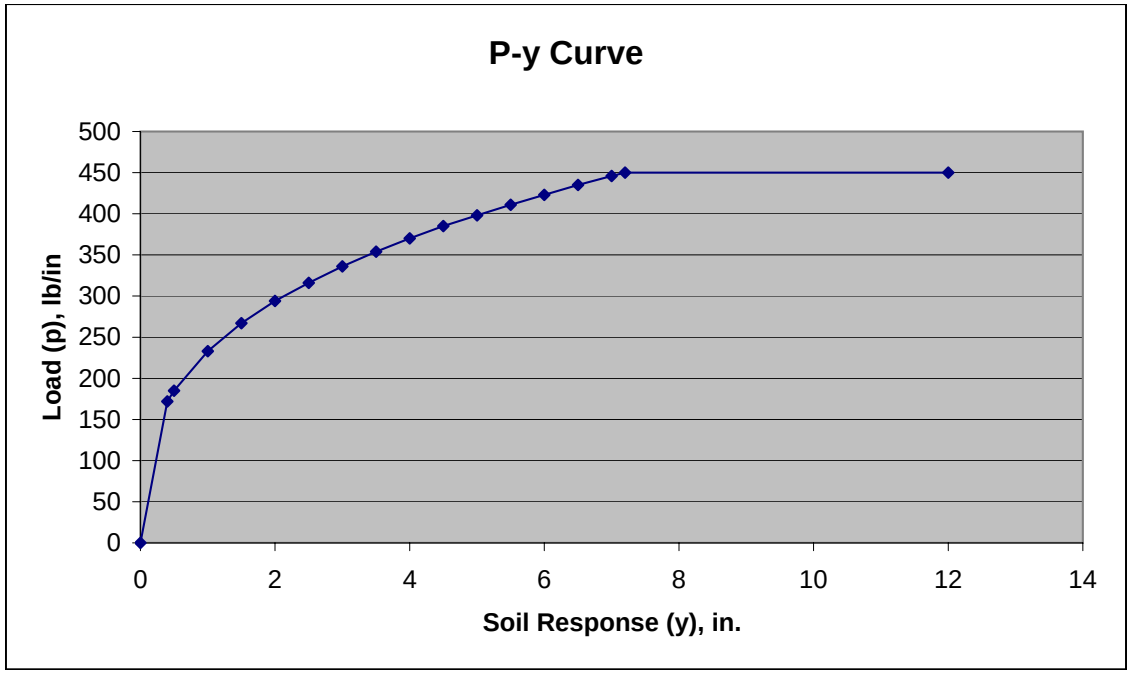
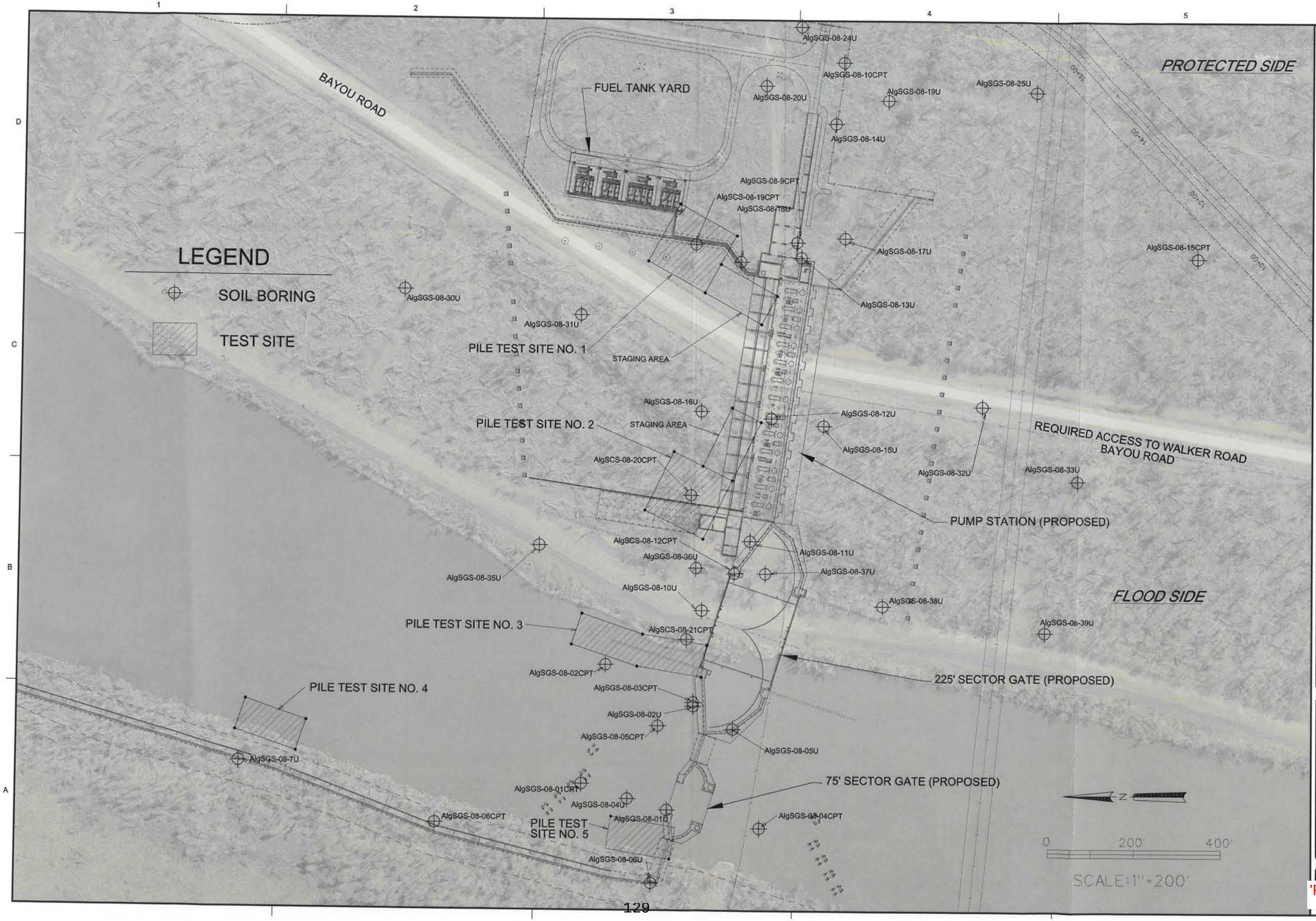
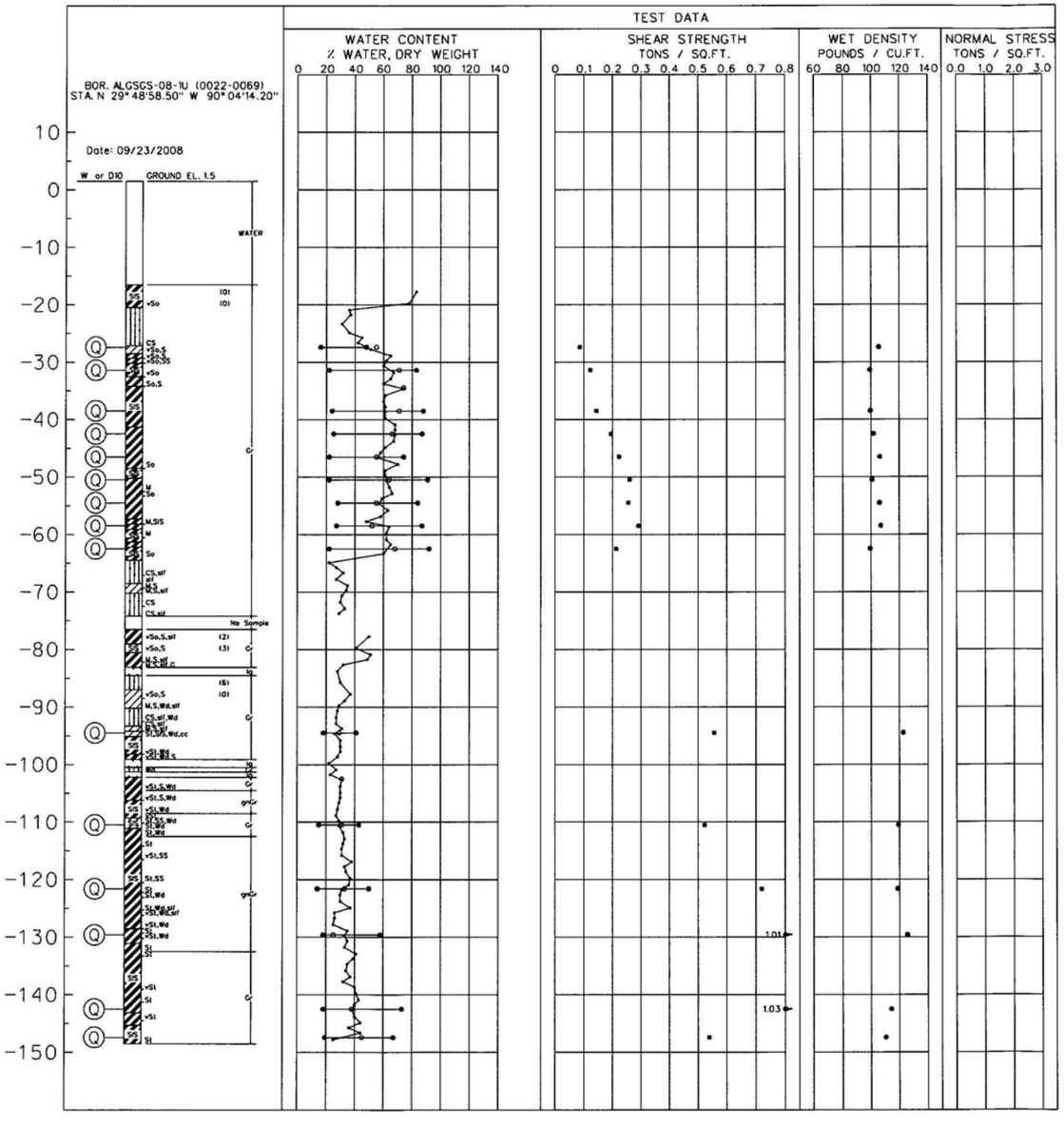


PLATE C-1-c

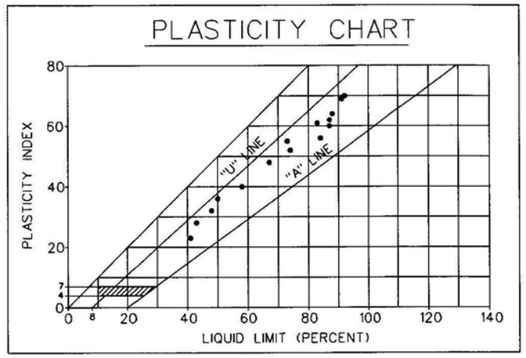
APPENDIX D


PROTECTED SIDE
BAYOU ROAD
FUEL TANK YARD
AlgSGS-08-24U
AlgSGS-08-10CPT
AlgSGS-08-20U
AlgSGS-08-19U
AlgSGS-08-25U
AlgSGS-08-14U
AlgSGS-08-9CPT
AlgSCS-08-19CPT
AlgSGS-08-18U
AlgSGS-08-17U
AlgSGS-08-15CPT
AlgSGS-08-13U
AlgSGS-08-30U
AlgSGS-08-31U
PILE TEST SITE NO. 1
STAGING AREA
AlgSGS-08-16U
AlgSGS-08-12U
PILE TEST SITE NO. 2
STAGING AREA
AlgSGS-08-15U
REQUIRED ACCESS TO WALKER ROAD
BAYOU ROAD
AlgSCS-08-20CPT
AlgSGS-08-32U
AlgSGS-08-33U
PUMP STATION (PROPOSED)
AlgSCS-08-12CPT
AlgSGS-08-11U
AlgSGS-08-36U
AlgSGS-08-35U
AlgSGS-08-37U
AlgSGS-08-10U
AlgSGS-08-38U
FLOOD SIDE
PILE TEST SITE NO. 3
AlgSCS-08-21CPT
AlgSGS-08-39U
AlgSGS-08-02CPT
225' SECTOR GATE (PROPOSED)
PILE TEST SITE NO. 4
AlgSGS-08-03CPT
AlgSGS-08-02U
AlgSGS-08-05CPT
AlgSGS-08-05U
AlgSGS-08-7U
75' SECTOR GATE (PROPOSED)
AlgSGS-08-01CRT
AlgSGS-08-04U
AlgSGS-08-06CPT
PILE TEST SITE NO. 5
AlgSGS-08-01D
AlgSGS-08-04CPT
AlgSGS-08-06U
LEGEND
SOIL BORING
TEST SITE
N
0
200'
400'
SCALE:1"=200'
US Army Corps of Engineers®
New Orleans District
U.S. ARMY CORPS OF ENGINEERS
MISSISSIPPI VALLEY DIVISION
NEW ORLEANS DISTRICT
Bioengineering Group
ARCADIS
HNTB
Westbank and Vicinity, New Orleans, Louisiana
Hurricane Protection Project
WBV-80 GIWW West Closure Complex
PILE LOAD TEST REPORT
Jefferson and Plaquemines Parishes, Louisiana
SHEET

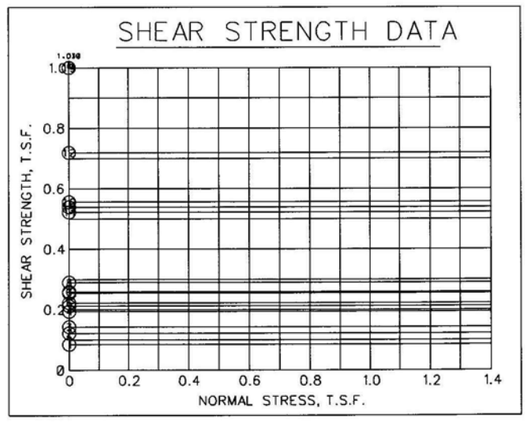
'PLATE D-1



PLASTICITY CHART



SHEAR STRENGTH DATA



TABULAR TEST DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
1	-27.4	Q	0.0	0.085	CL
2	-31.4	Q	0.0	0.122	CH
3	-38.5	Q	0.0	0.143	CH
4	-42.5	Q	0.0	0.194	CH
5	-46.5	Q	0.0	0.222	CH
6	-50.5	Q	0.0	0.259	CH
7	-54.5	Q	0.0	0.255	CH
8	-58.5	Q	0.0	0.290	CH
9	-62.5	Q	0.0	0.212	CH
10	-94.5	Q	0.0	0.556	CL
11	-110.5	Q	0.0	0.522	CL
12	-121.6	Q	0.0	0.719	CH
13	-129.6	Q	0.0	1.012	CH
14	-142.5	Q	0.0	1.030	CH
15	-147.4	Q	0.0	0.539	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST
- ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

US Army Corps of Engineers®
xxx District

DESIGNED BY: DAVID LOVETT
DRAWN BY: J. DAHBY Jr.
SUBMITTED BY: MARK T. FOSS, P.E.
PLOT SCALE: NTS
PLOT DATE: Feb 09
SIZE: ANSI D
FILE NAME: H446925_070108--S-109--dgn
DATE: Feb 09
SOLICITATION NO.: W912P9-08-R-0035
CONTRACT NO.:
FILE NUMBER: H-446925
CHD BY: CL. DUNN

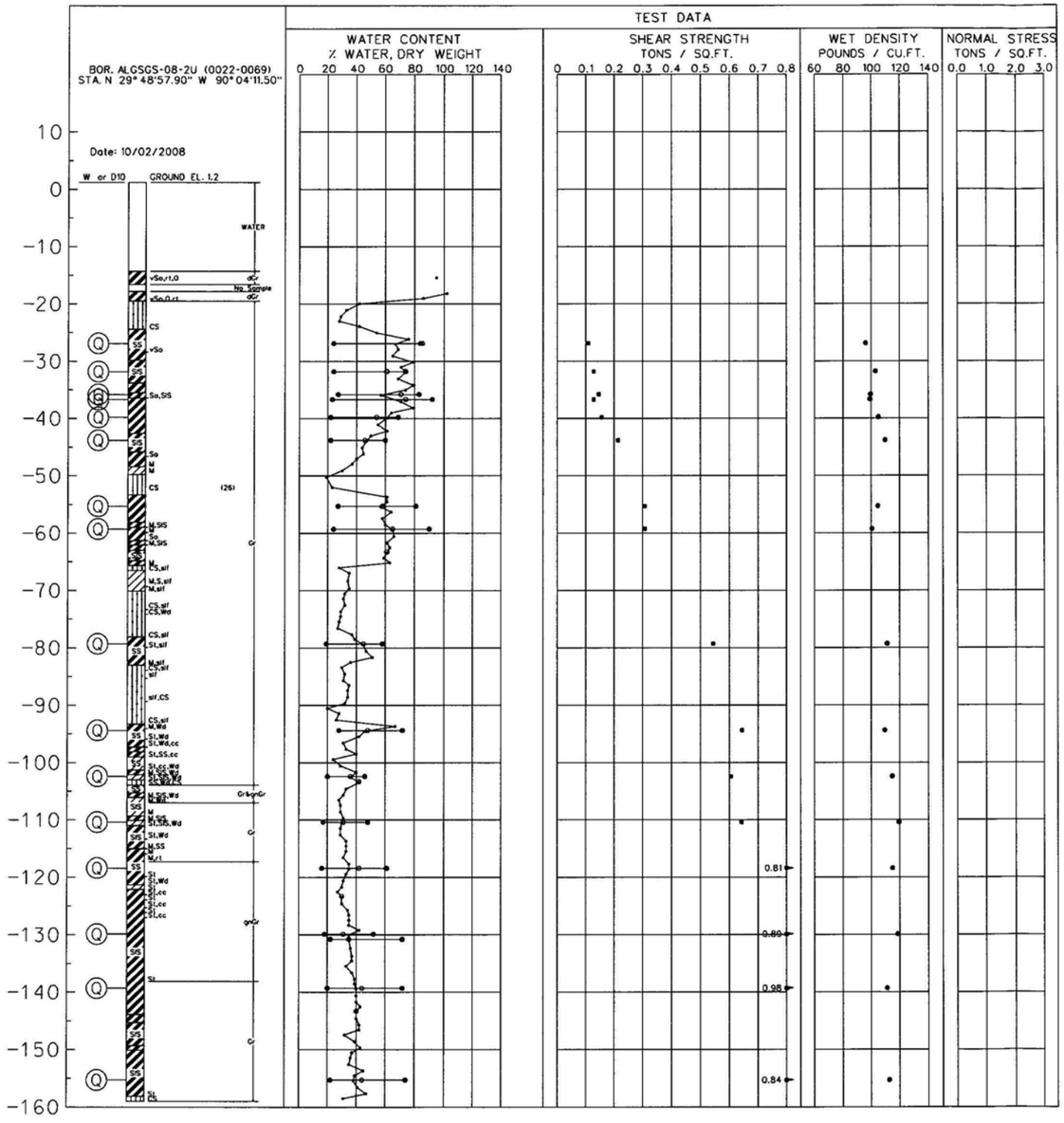
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
NEW ORLEANS, LOUISIANA

WESTBANK & VICINITY, NEW ORLEANS, LA
HURRICANE PROTECTION PROJECT
WBV-90 GIWW WEST CLOSURE COMPLEX
PLAQUEMINES AND JEFFERSON PARISHES, LA

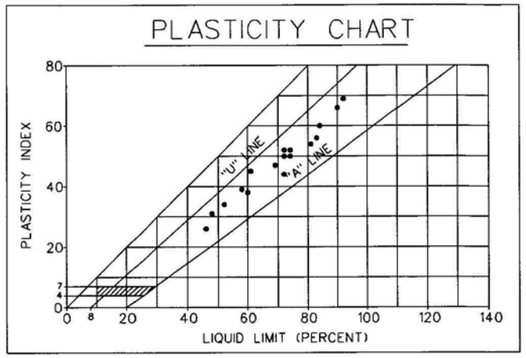
SOIL BORING LOG 1U

SHEET IDENTIFICATION
S-108

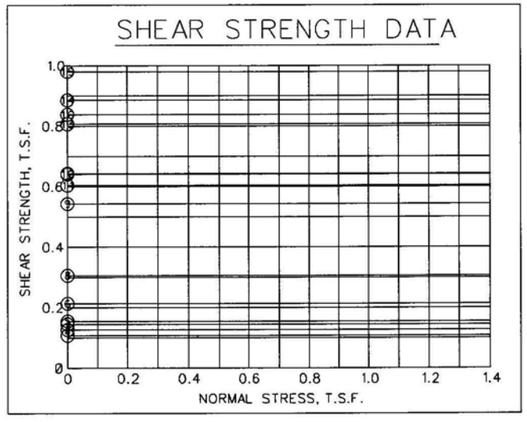
PLATE D-2



PLASTICITY CHART



SHEAR STRENGTH DATA



TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
1	-26.9	0	0.0	0.108	CH
2	-31.8	0	0.0	0.127	CH
3	-35.8	0	0.0	0.145	CH
4	-36.7	0	0.0	0.127	CH
5	-39.8	0	0.0	0.155	CH
6	-43.8	0	0.0	0.213	CH
7	-55.3	0	0.0	0.306	CH
8	-59.3	0	0.0	0.306	CH
9	-79.3	0	0.0	0.543	CH
10	-94.4	0	0.0	0.643	CH
11	-102.4	0	0.0	0.604	CL
12	-110.4	0	0.0	0.641	CL
13	-118.4	0	0.0	0.807	CH
14	-129.9	0	0.0	0.886	CH
15	-139.3	0	0.0	0.980	CH
16	-155.3	0	0.0	0.838	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST

ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

US Army Corps of Engineers®
xxx District

MARK	DESCRIPTION	DATE	APPR

DESIGNED BY: DAVID LOVETT
DRWN BY: J. DRARY Jr.
CKD BY: CL. DUNN
SUBMITTED BY: MARK C. GOODE, P.E.
PLOT SCALE: NTS
PLOT DATE: Feb 09
FILE NUMBER: H4-46025
CONTRACT NO.:
SOLICITATION NO.: W91P98-09-R-0035
DATE: Feb 09
SIZE: ANSI D
FILE NAME: H446025_075100--S-109--.dgn

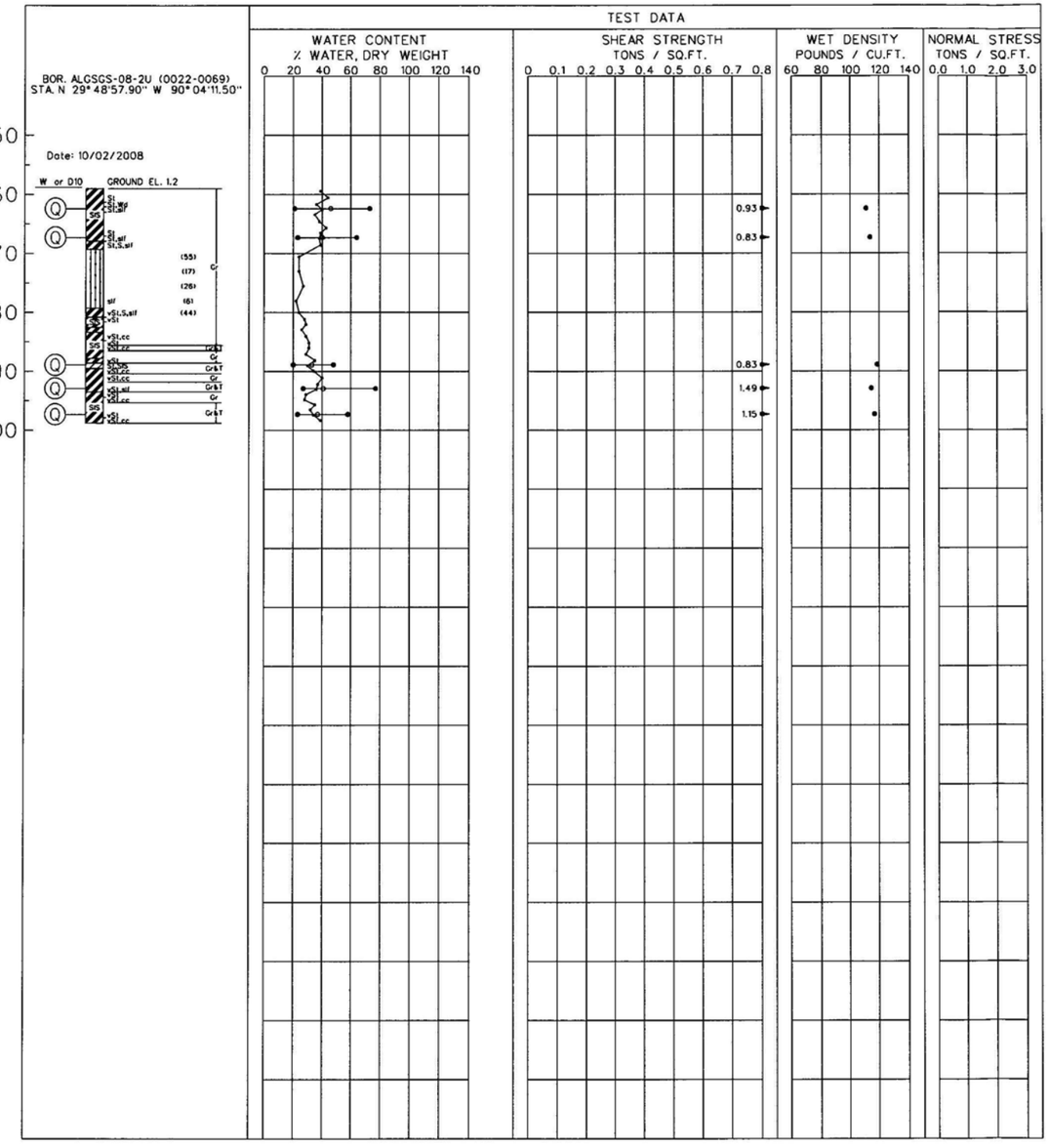
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
NEW ORLEANS, LOUISIANA

WESTBANK & VICINITY, NEW ORLEANS, LA
HURRICANE PROTECTION PROJECT
WBV-90 GIWW WEST CLOSURE COMPLEX
PLAQUEMINES AND JEFFERSON PARISHES, LA

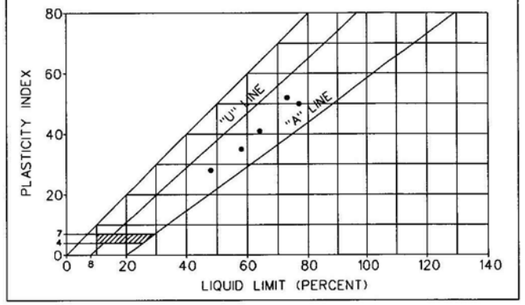
SOIL BORING LOG 2U

SHEET IDENTIFICATION
S-109

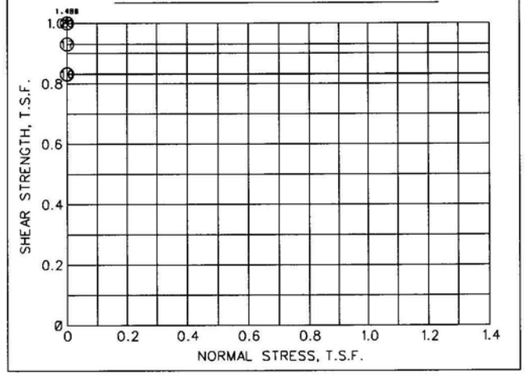
PLATE D-3



PLASTICITY CHART



SHEAR STRENGTH DATA



TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
17	-162.4	Q	0.0	0.930	CH
18	-167.3	Q	0.0	0.831	CH
19	-188.9	Q	0.0	0.832	CL
20	-192.9	Q	0.0	1.488	CH
21	-197.3	Q	0.0	1.154	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST

ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

US Army Corps of Engineers®
xxx District

MARK | DESCRIPTION | DATE | APPR'D

U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
NEW ORLEANS, LOUISIANA

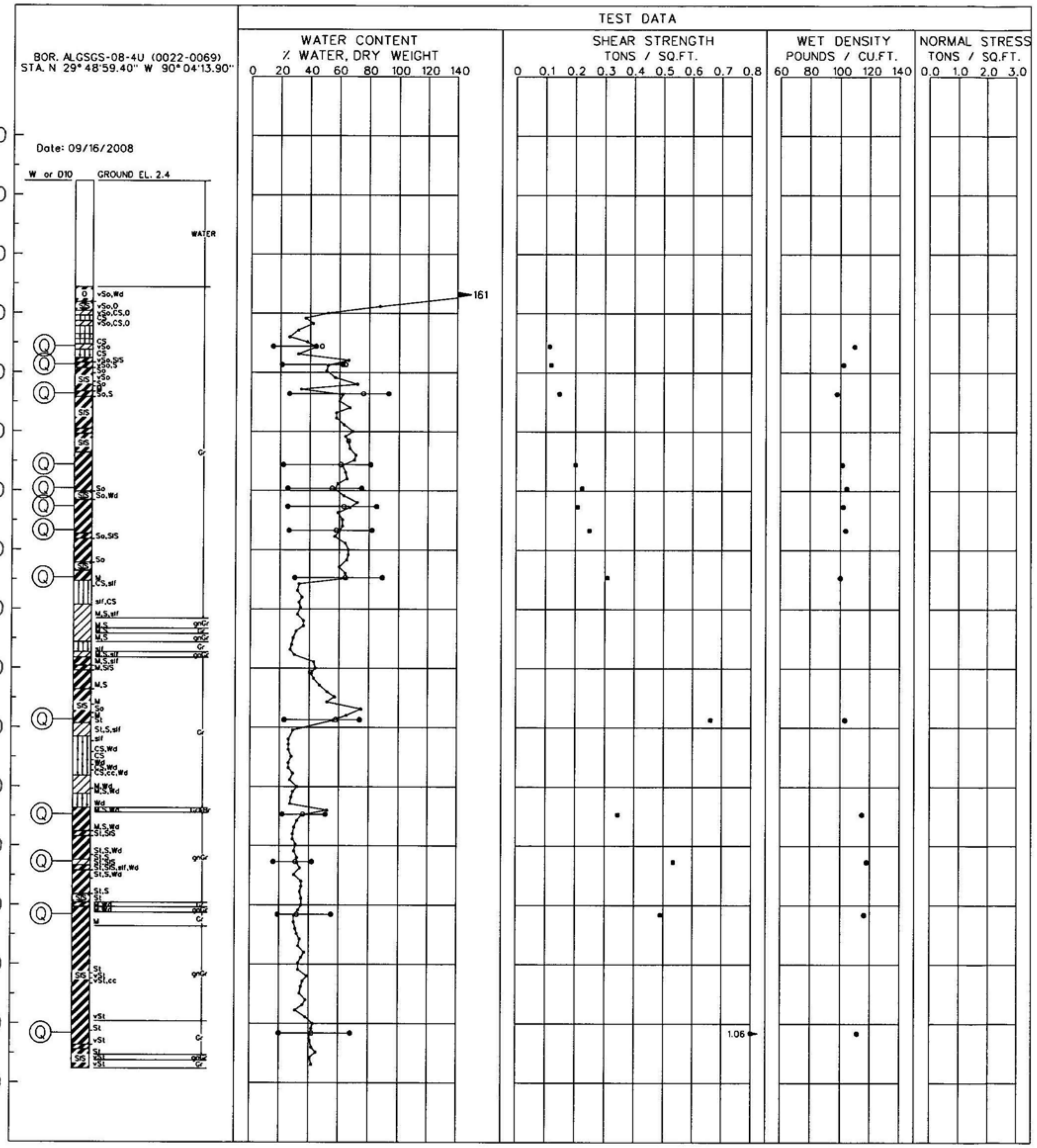
DESIGNED BY: DAVID LOVETT
DWN BY: J. DABBY Jr.
CKD BY: C.L. DUNN
SUBMITTED BY: MARK C. GOMEZ, P.E.
PLOT SCALE: NTS
PLOT DATE: Feb 09
SOLICITATION NO.: W912P8-08-X-0035
CONTRACT NO.:
FILE NUMBER: H4-46625
FILE NAME: H446625_GTS110--S-110--.dgn
SIZE: ANSI D

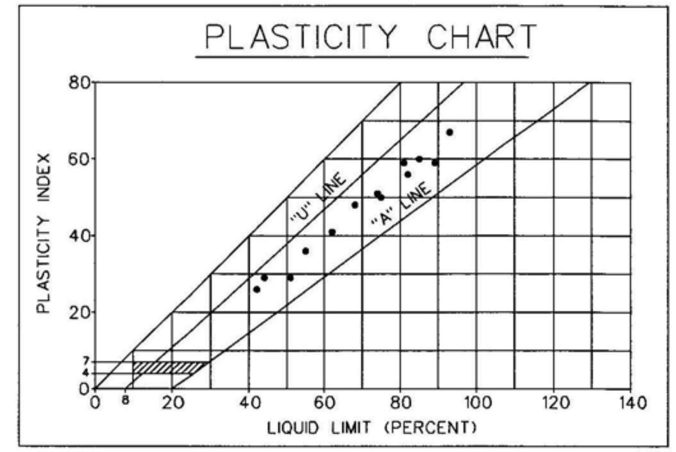
WESTBANK & VICINITY, NEW ORLEANS, LA
HURRICANE PROTECTION PROJECT
WBV-90 GIWW WEST CLOSURE COMPLEX
PLAQUEMINES AND JEFFERSON PARISHES, LA

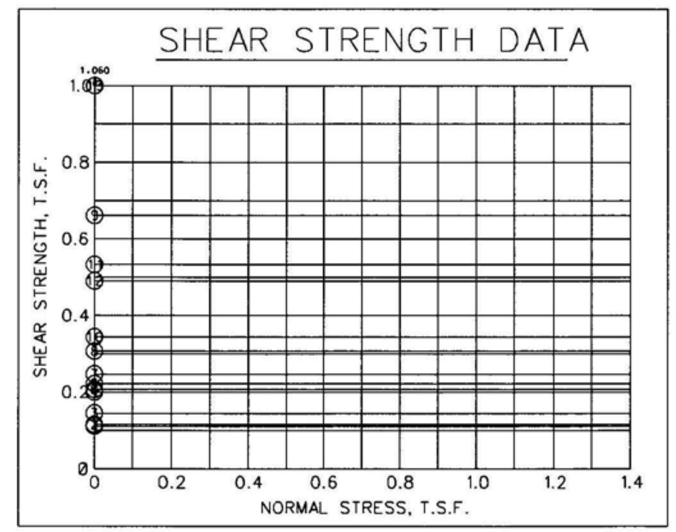
SOIL BORING LOG 2U

SHEET IDENTIFICATION
S-110

PLATE D-4







TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
1	-25.6	Q	0.0	0.111	CL
2	-28.7	Q	0.0	0.116	CH
3	-33.6	Q	0.0	0.145	CH
4	-45.6	Q	0.0	0.200	CH
5	-49.6	Q	0.0	0.222	CH
6	-52.7	Q	0.0	0.207	CH
7	-56.7	Q	0.0	0.247	CH
8	-64.7	Q	0.0	0.307	CH
9	-88.7	Q	0.0	0.661	CH
10	-104.7	Q	0.0	0.344	CH
11	-112.7	Q	0.0	0.533	CL
12	-121.6	Q	0.0	0.490	CH
13	-141.6	Q	0.0	1.060	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST
- ω_P — ω_N — ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

US Army Corps of Engineers
xxx District

MARK	DESCRIPTION	DATE	APPR

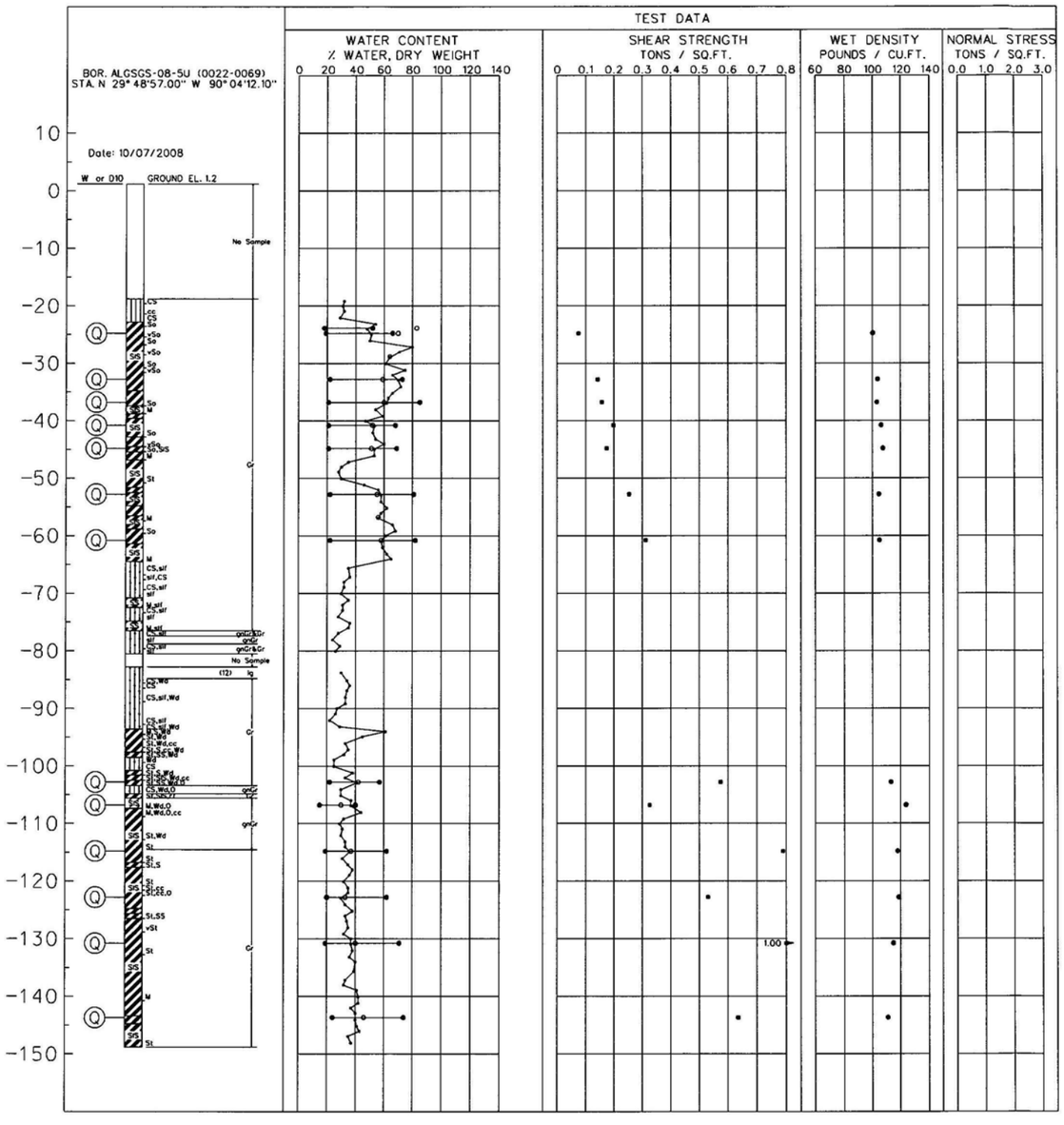
DESIGNED BY: DAVID LOVETT
DWN BY: J. DARBY Jr.
CKD BY: C.L. DUNN
SUBMITTED BY: MARK H. GONSKI, P.E.
PLOT SCALE: NTS
PLOT DATE: Feb 09
SIZE: ANSI D
FILE NAME: H446925_07S111—S-111—.dgn
DATE: Feb 09
SOLICITATION NO.: W912P8-09-R-0035
CONTRACT NO.:
FILE NUMBER: H4-46925

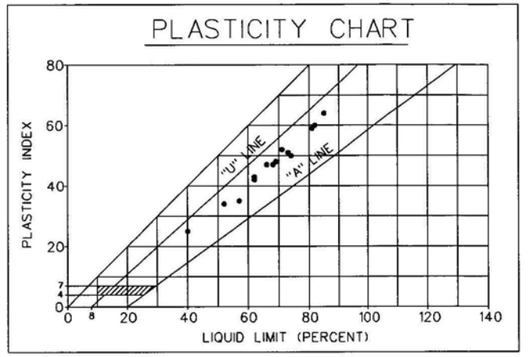
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
NEW ORLEANS, LOUISIANA

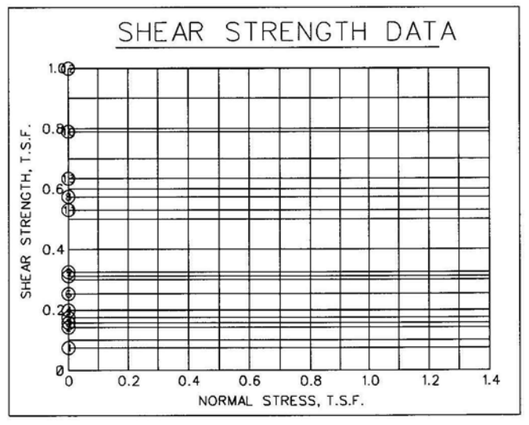
WESTBANK & VICINITY, NEW ORLEANS, LA
HURRICANE PROTECTION PROJECT
WBV-90 GIWW WEST CLOSURE COMPLEX
PLAQUEMINES AND JEFFERSON PARISHES, LA

SOIL BORING LOG 4U

SHEET IDENTIFICATION
S-111







TABULAR TEST DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
1	-24.8	Q	0.0	0.074	CH
2	-32.8	Q	0.0	0.142	CH
3	-36.8	Q	0.0	0.157	CH
4	-40.8	Q	0.0	0.198	CH
5	-44.8	Q	0.0	0.174	CH
6	-52.8	Q	0.0	0.253	CH
7	-60.8	Q	0.0	0.311	CH
8	-102.8	Q	0.0	0.574	CH
9	-106.8	Q	0.0	0.325	CL
10	-114.8	Q	0.0	0.789	CH
11	-122.8	Q	0.0	0.530	CH
12	-130.8	Q	0.0	0.998	CH
13	-143.7	Q	0.0	0.634	CH

NOTES

- o - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST
- ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

US Army Corps of Engineers®
xxx District

MARK	DESCRIPTION	DATE	APP'D

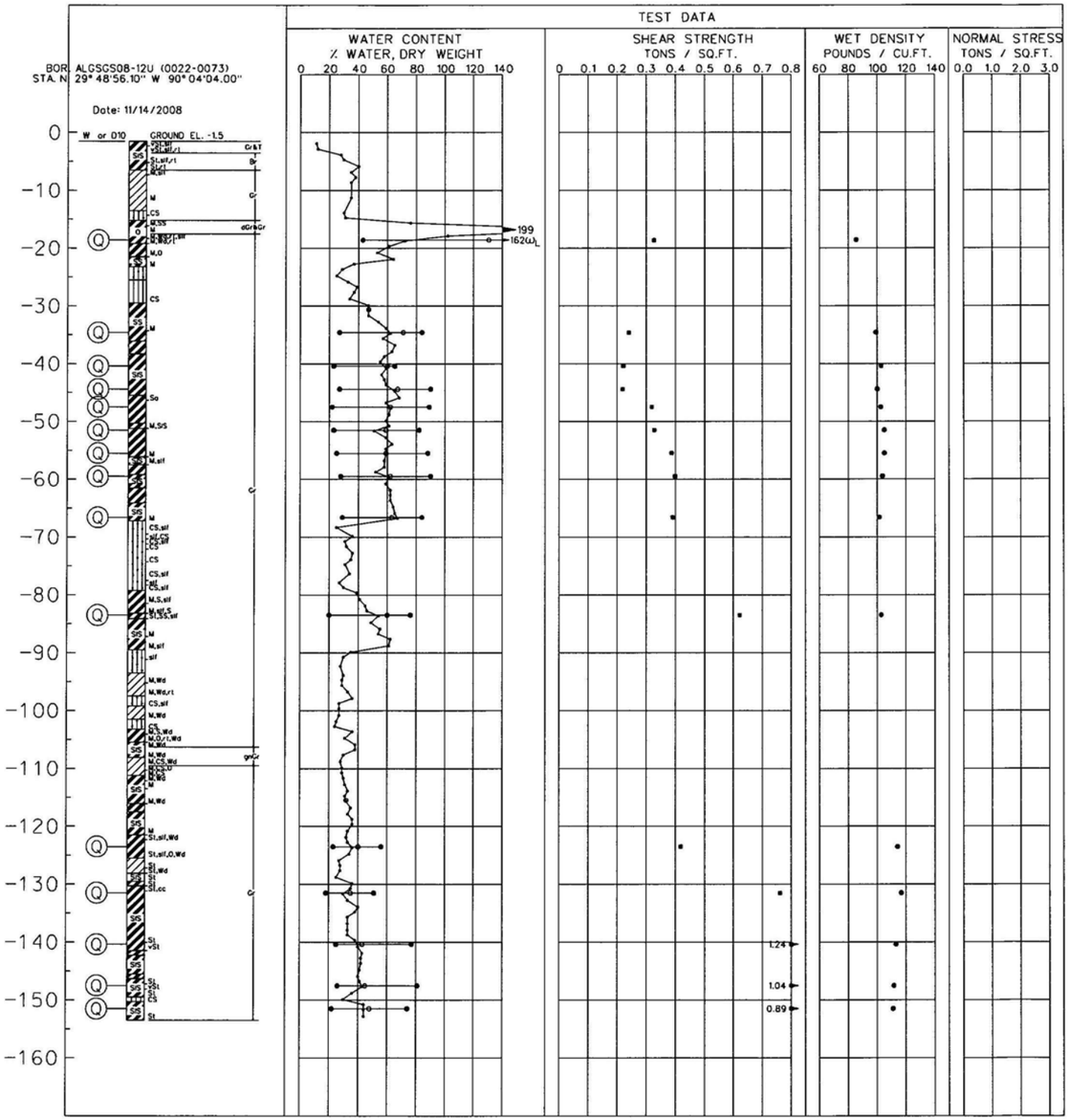
DESIGNED BY: DAVID LOVETT
DRAWN BY: J. DANBY et al.
CKD BY: C.L. DUNN
SUBMITTED BY: MARK C. FOX, P.E.
DATE: Feb 09
SOLICITATION NO.: W912P8-08-R-0035
CONTRACT NO.:
PLOT SCALE: NTS
PLOT DATE: Feb 09
FILE NUMBER: H446925
FILE NAME: H446925_GTS112-S112--.dgn
SIZE: ANSI D

U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
NEW ORLEANS, LOUISIANA

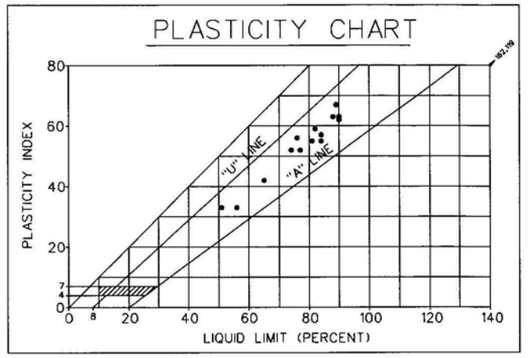
WESTBANK & VICINITY, NEW ORLEANS, LA
HURRICANE PROTECTION PROJECT
WBV-80 GIWW WEST CLOSURE COMPLEX
PLAQUEMINES AND JEFFERSON PARISHES, LA

SOIL BORING LOG 5U

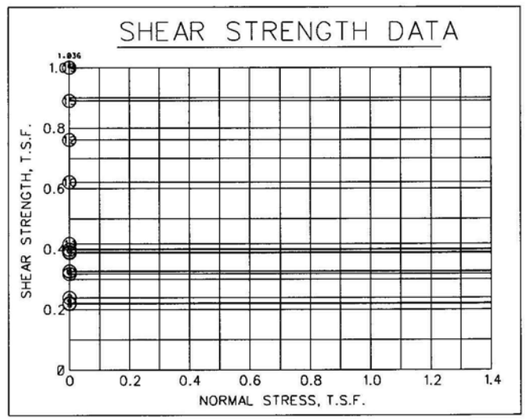
SHEET IDENTIFICATION
S-112



PLASTICITY CHART



SHEAR STRENGTH DATA



TABULAR TEST DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
1	-18.6	Q	0.0	0.326	CH
2	-34.6	Q	0.0	0.239	CH
3	-40.4	Q	0.0	0.221	CH
4	-44.4	Q	0.0	0.219	CH
5	-47.5	Q	0.0	0.318	CH
6	-51.5	Q	0.0	0.327	CH
7	-55.5	Q	0.0	0.387	CH
8	-59.5	Q	0.0	0.398	CH
9	-66.6	Q	0.0	0.390	CH
10	-83.5	Q	0.0	0.621	CH
11	-123.5	Q	0.0	0.417	CH
12	-131.5	Q	0.0	0.761	CH
13	-140.4	Q	0.0	1.236	CH
14	-147.5	Q	0.0	1.036	CH
15	-151.5	Q	0.0	0.890	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST
- ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

US Army Corps of Engineers®
xxx District

MARK	DESCRIPTION	DATE	APPR
MARK	DESCRIPTION	DATE	APPR

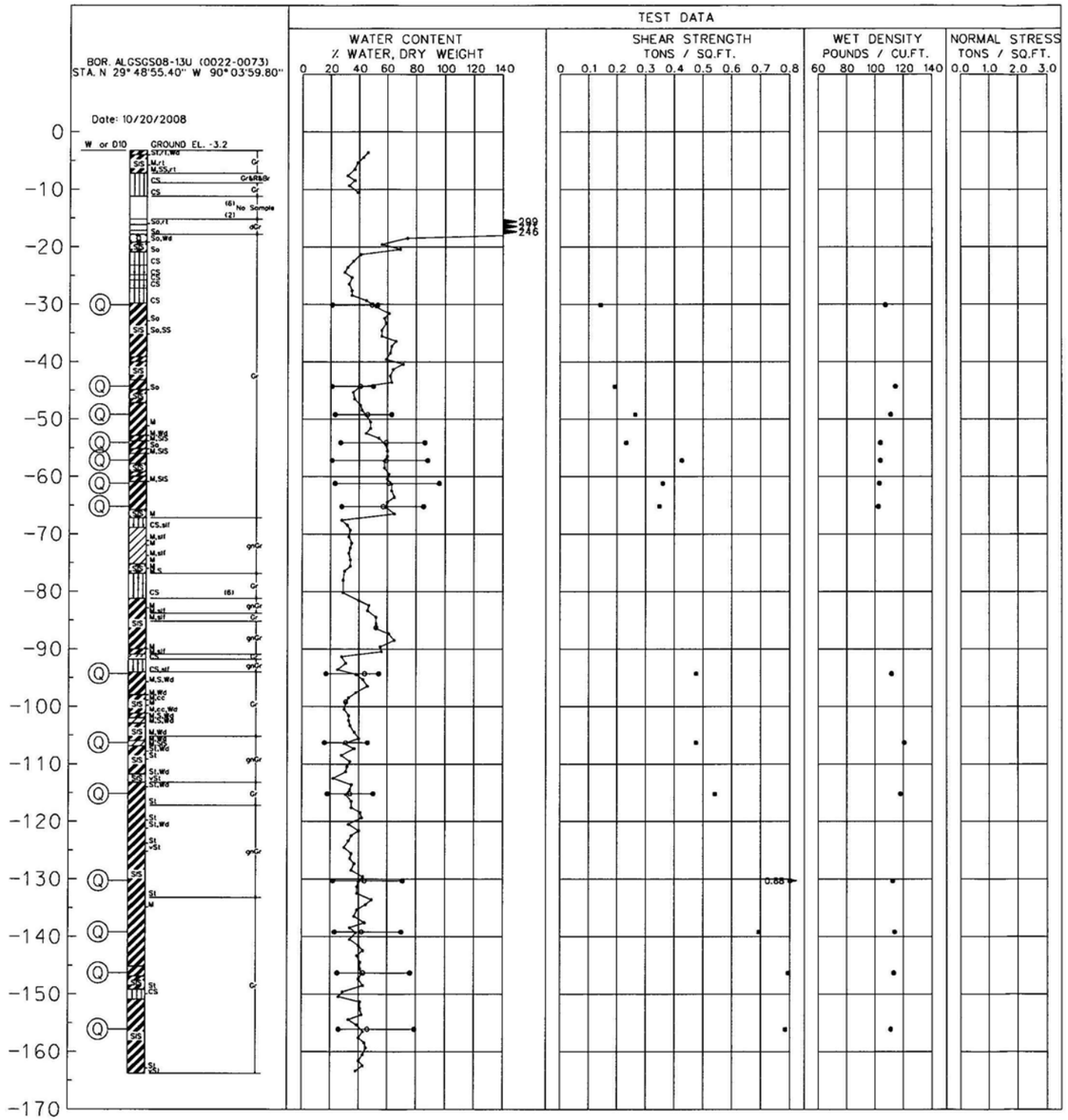
DESIGNED BY: DAVID LOVETT
DRAWN BY: J. DARBY Jr.
SUBMITTED BY: MARK A. DOSKEY, P.E.
DATE: Feb 09
SOLICITATION NO.: W912P8-09-R-0005
CHIEF, ENGINEERING DIV.
CONTRACT NO.:
SCALE: AS NOTED
FILE NUMBER: 144-49028
FILE NAME: 144-49028_07S13-S113-.dgn

U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
NEW ORLEANS, LOUISIANA

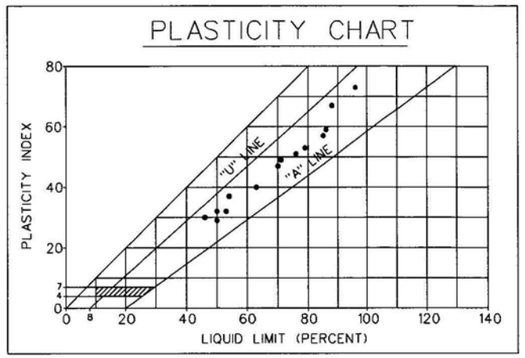
WESTBANK & VICINITY, NEW ORLEANS, LA
HURRICANE PROTECTION PROJECT
WBV-90 GIWW WEST CLOSURE COMPLEX
PLAQUEMINES AND JEFFERSON PARISHES, LA

SOIL BORING LOG 12U

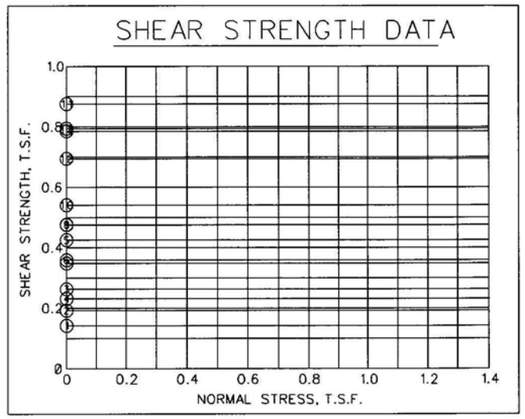
SHEET IDENTIFICATION
S-113



PLASTICITY CHART



SHEAR STRENGTH DATA



TABULAR TEST DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH Φ	STRENGTH c - TSF	CLASS
1	-30.1	Q	0.0	0.142	CH
2	-44.3	Q	0.0	0.192	CH
3	-49.2	Q	0.0	0.263	CH
4	-54.1	Q	0.0	0.231	CH
5	-57.2	Q	0.0	0.425	CH
6	-61.2	Q	0.0	0.359	CH
7	-65.2	Q	0.0	0.348	CH
8	-94.3	Q	0.0	0.476	CH
9	-106.3	Q	0.0	0.475	CL
10	-115.2	Q	0.0	0.541	CH
11	-130.3	Q	0.0	0.875	CH
12	-139.2	Q	0.0	0.694	CH
13	-146.3	Q	0.0	0.794	CH
14	-156.1	Q	0.0	0.785	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST
- ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

US Army Corps of Engineers®
xxx District

MARK	DESCRIPTION	DATE	APPR

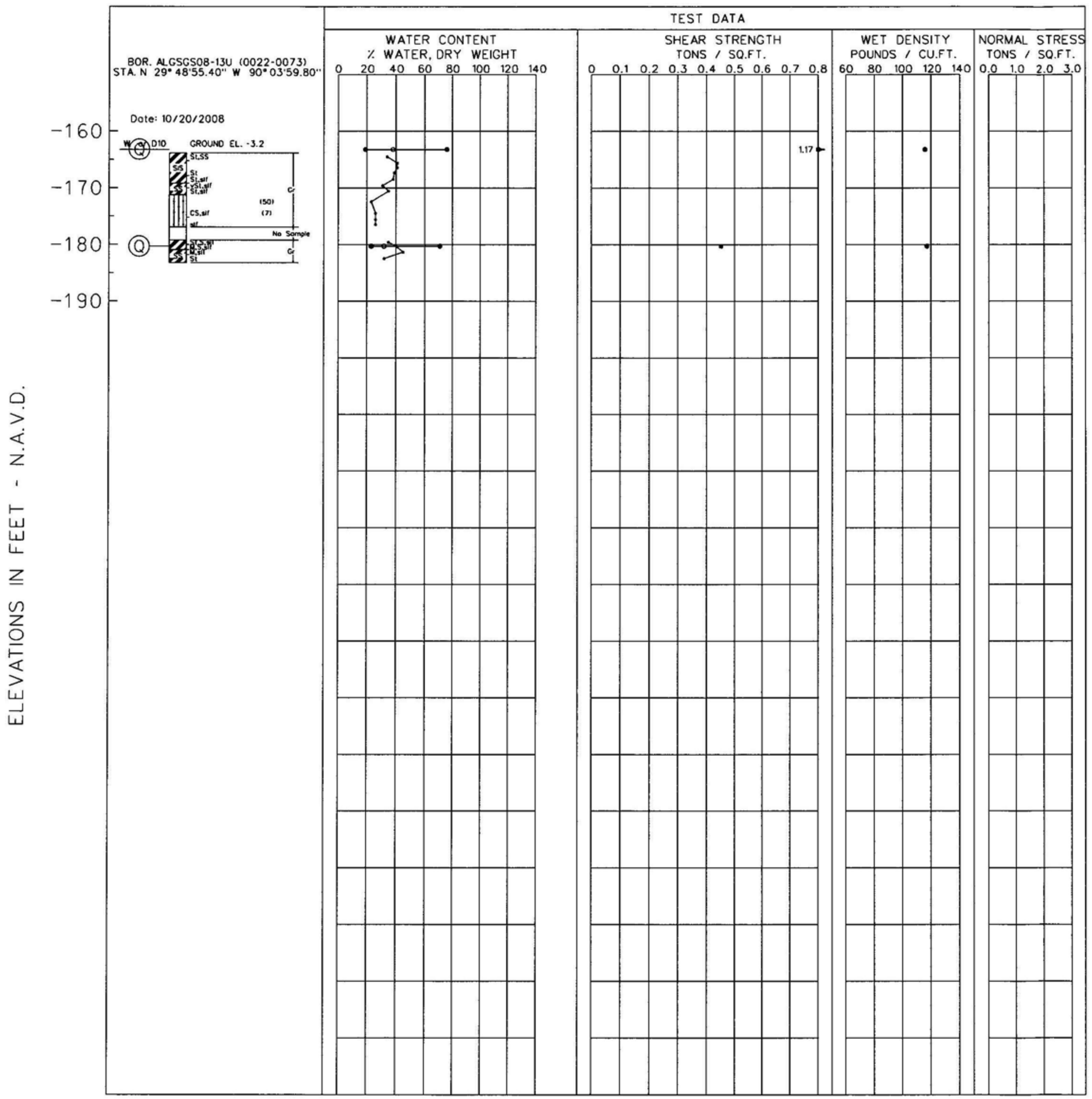
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
NEW ORLEANS, LOUISIANA

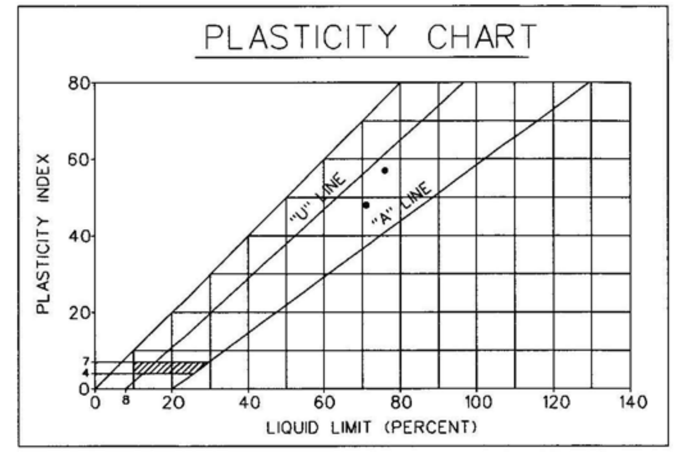
DESIGNED BY: DAVID LOVETT
DRAWN BY: J. DAIGLE
SUBMITTED BY: CHIEF, ENGINEERING
DATE: Feb 09
CKD BY: C.L. DUNN
PLOT SCALE: N/S
PLOT DATE: Feb 09
SIZE: ANSI D
FILE NAME: H44925_078114--S114--.dgn
SOLICITATION NO.: W912P9-08-R-0035
CONTRACT NO.:
FILE NUMBER: H4-46925

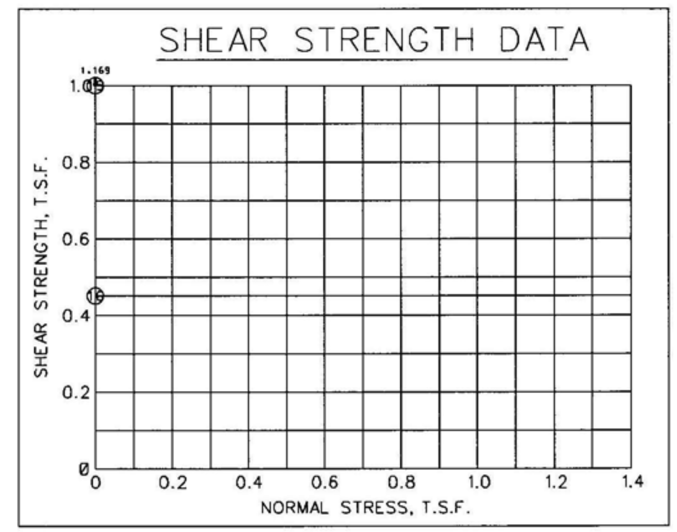
WESTBANK & VICINITY, NEW ORLEANS, LA
HURRICANE PROTECTION PROJECT
WBV-90 GIWW WEST CLOSURE COMPLEX
PLAQUEMINES AND JEFFERSON PARISHES, LA

SOIL BORING LOG 13U

SHEET IDENTIFICATION
S-114







TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
15	-163.2	Q	0.0	1.169	CH
16	-180.3	Q	0.0	0.451	CH

NOTES

○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST
ω_P — ω_N — ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

US Army Corps of Engineers®
xxx District

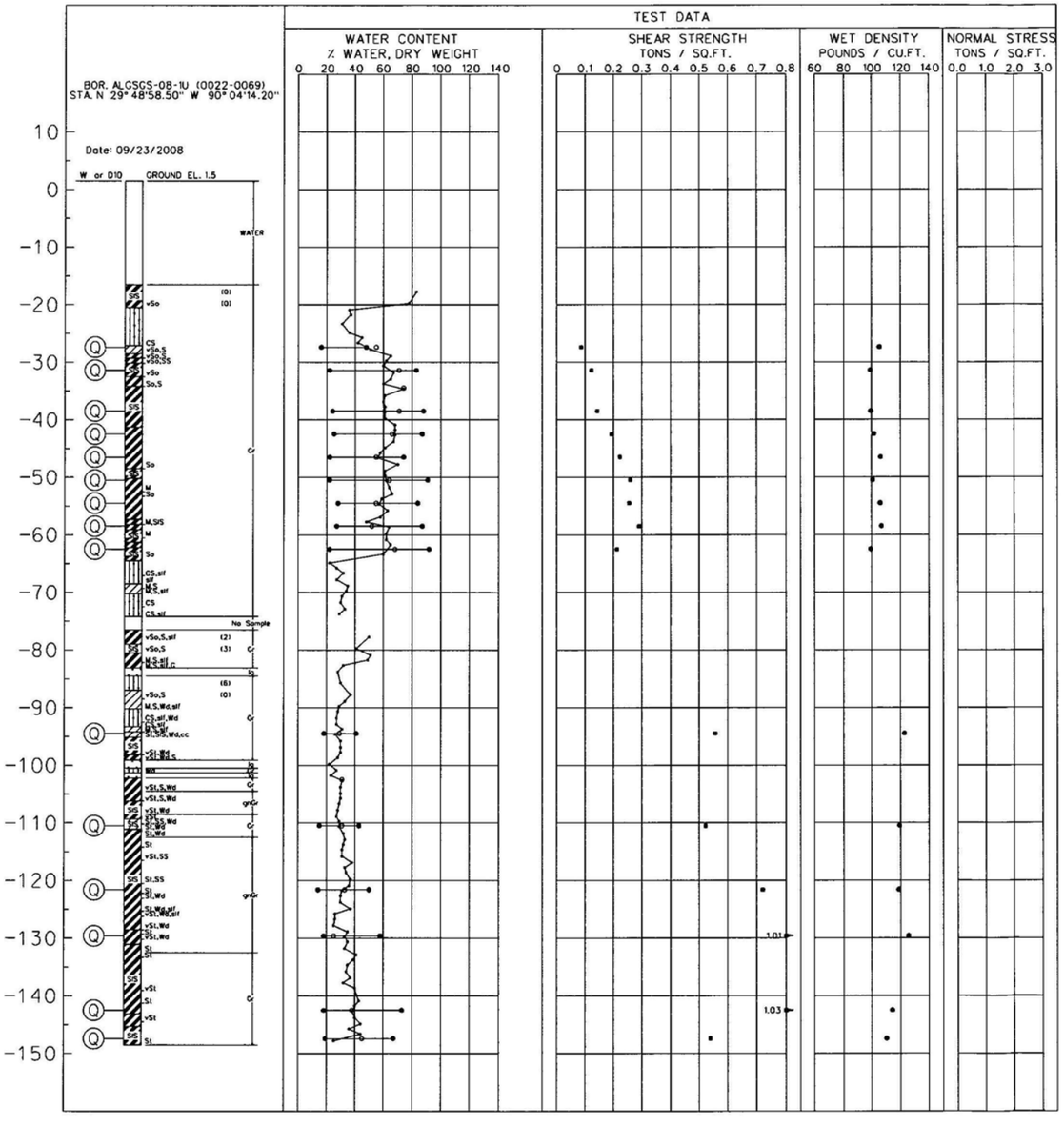
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
NEW ORLEANS, LOUISIANA

DESIGNED BY: DAVID LOVETT
DWN BY: J. DARBY Jr. | CKD BY: C.L. DUNN
SUBMITTED BY: MARK H. GONSKI, P.E.
PLOT SCALE: NTS | PLOT DATE: Feb 09
SIZE: ANSI D | FILE NAME: H446925_07S115—S-115—.dgn
DATE: Feb 09
SOLICITATION NO.: W912P8-09-R-0035
CONTRACT NO.:
FILE NUMBER: H4-46925

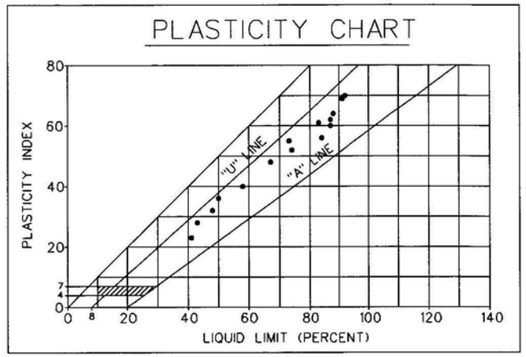
WESTBANK & VICINITY, NEW ORLEANS, LA
HURRICANE PROTECTION PROJECT
WBV-90 GIWW WEST CLOSURE COMPLEX
PLAQUEMINES AND JEFFERSON PARISHES, LA

SOIL BORING LOG 13U

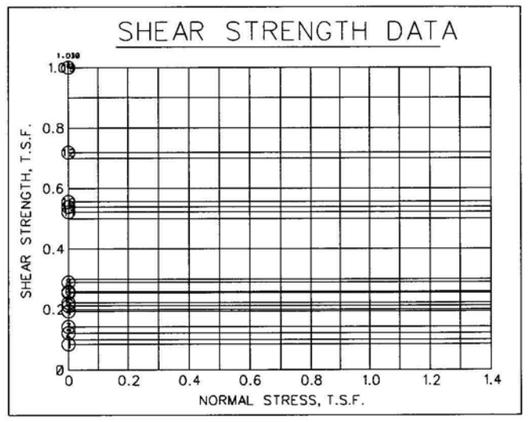
SHEET IDENTIFICATION
S-115



PLASTICITY CHART



SHEAR STRENGTH DATA



TABULAR TEST DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH Φ	STRENGTH c - TSF	CLASS
1	-27.4	Q	0.0	0.085	CL
2	-31.4	Q	0.0	0.122	CH
3	-38.5	Q	0.0	0.143	CH
4	-42.5	Q	0.0	0.194	CH
5	-46.5	Q	0.0	0.222	CH
6	-50.5	Q	0.0	0.259	CH
7	-54.5	Q	0.0	0.255	CH
8	-58.5	Q	0.0	0.290	CH
9	-62.5	Q	0.0	0.212	CH
10	-94.5	Q	0.0	0.556	CL
11	-110.5	Q	0.0	0.522	CL
12	-121.6	Q	0.0	0.719	CH
13	-129.6	Q	0.0	1.012	CH
14	-142.5	Q	0.0	1.030	CH
15	-147.4	Q	0.0	0.539	CH

NOTES

- o - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST

ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

US Army Corps of Engineers
xxx District

MARK	DESCRIPTION	DATE	APPD

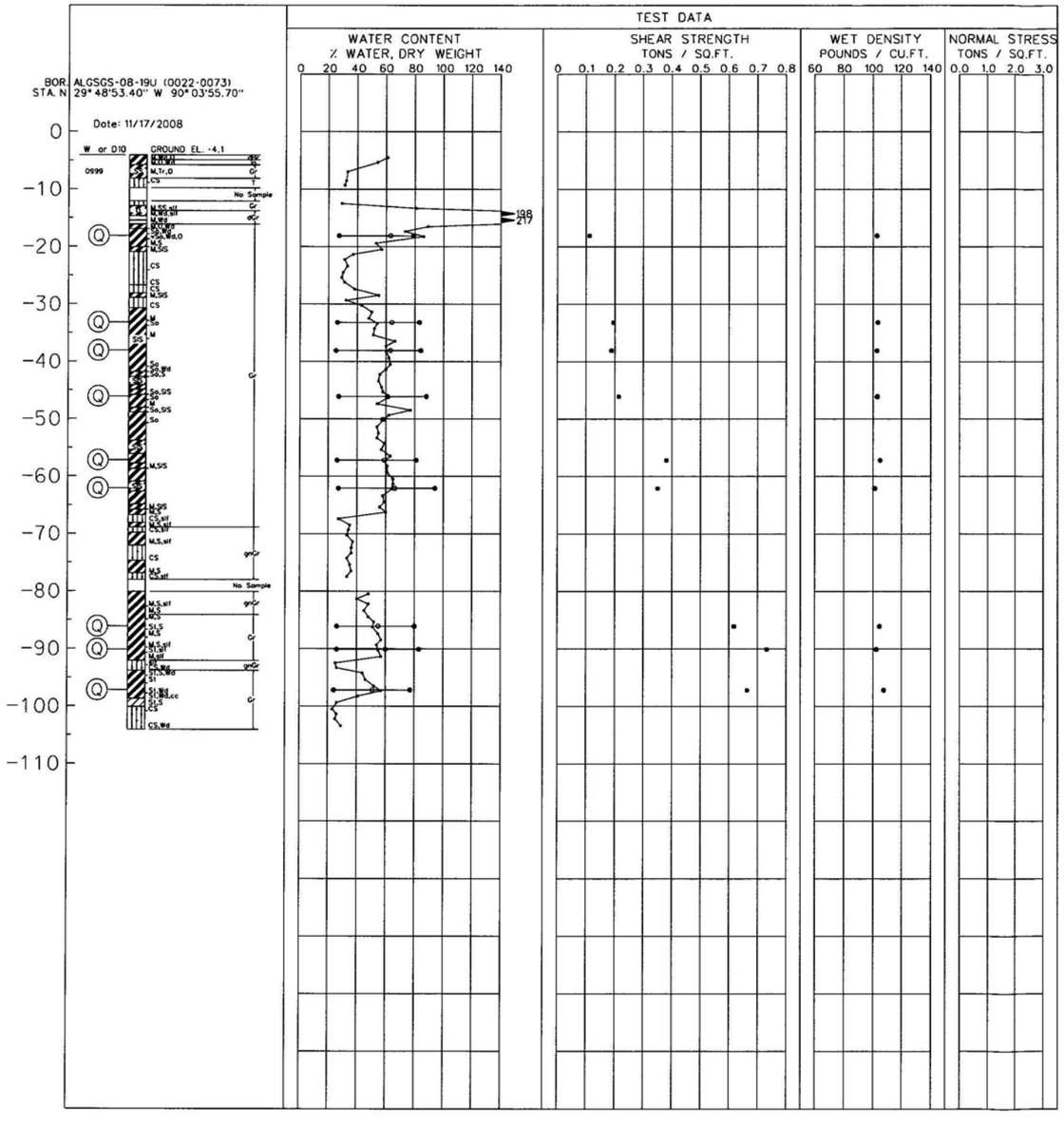
DESIGNED BY: DAVID LOWETT
DRN BY: J. DAVEY Jr.
SUBMITTED BY: CHIEF, ENGR. DIV.
PLOT SCALE: NTS
PLOT DATE: Feb 09
SIZE: ANSI D
FILE NAME: 1444925_07S116-S-116.dgn
DATE: Feb 09
SOLICITATION NO.: W912P8-09-X-0033
CONTRACT NO.:
FILE NUMBER: 144-4925

U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
NEW ORLEANS, LOUISIANA

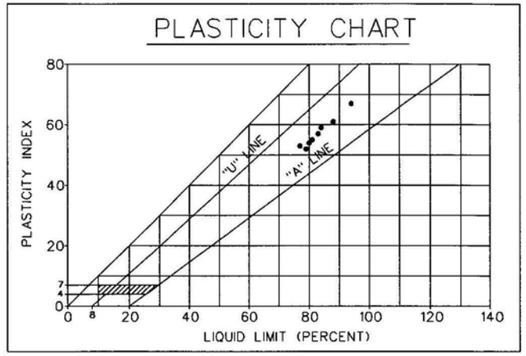
WESTBANK & VICINITY, NEW ORLEANS, LA
HURRICANE PROTECTION PROJECT
WBV-90 GIWW WEST CLOSURE COMPLEX
PLAQUEMINES AND JEFFERSON PARISHES, LA

SOIL BORING LOG 11U

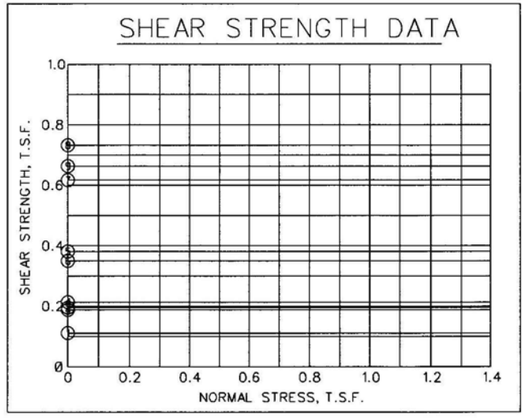
SHEET IDENTIFICATION
S-116



PLASTICITY CHART



SHEAR STRENGTH DATA



TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C · TSF	CLASS
1	-18.1	Q	0.0	0.111	CH
2	-33.2	Q	0.0	0.195	CH
3	-38.1	Q	0.0	0.188	CH
4	-46.1	Q	0.0	0.213	CH
5	-57.2	Q	0.0	0.381	CH
6	-62.1	Q	0.0	0.350	CH
7	-86.1	Q	0.0	0.617	CH
8	-90.1	Q	0.0	0.732	CH
9	-97.2	Q	0.0	0.663	CH

NOTES

- o - (UC) UNCONFINED COMPRESSION TEST
- ■ - (Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST
- ω_P ω_N ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

US Army Corps of Engineers®
xxx District

MARK	DESCRIPTION	DATE	APP'D

DESIGNED BY: DAVID LOVETT
DWN BY: J. DARBY Jr.
CKD BY: C.L. DUNN
SUBMITTED BY: MICHAEL HALL, P.E.
PLOT SCALE: NTS
PLOT DATE: Feb 09
SIZE: ANSI D
DATE: Feb 09
SOLICITATION NO.: W912P8-09-R-0035
CONTRACT NO.:
FILE NUMBER: H4-49825
FILE NAME: H449825_0751117—S-117—.dgn

U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
NEW ORLEANS, LOUISIANA

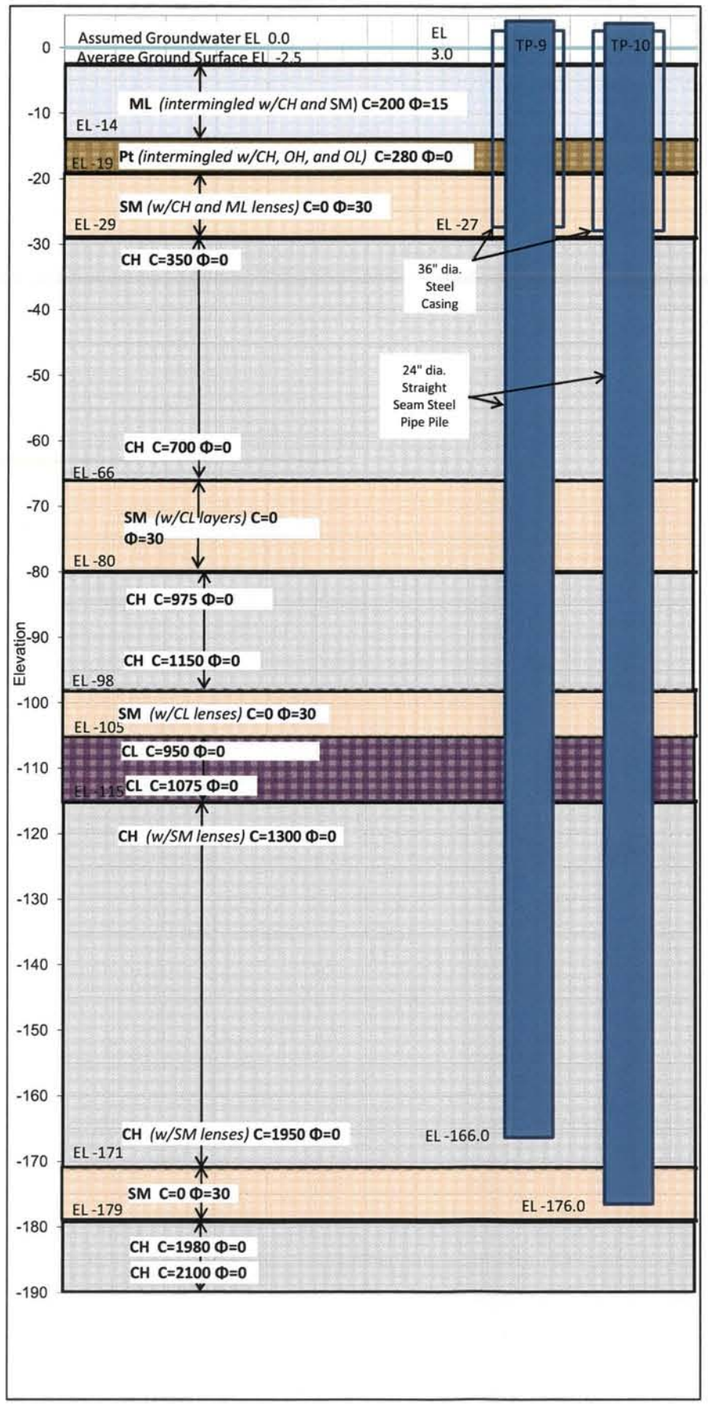
WESTBANK & VICINITY, NEW ORLEANS, LA
HURRICANE PROTECTION PROJECT
WBV-90 GIWW WEST CLOSURE COMPLEX
PLAQUEMINES AND JEFFERSON PARISHES, LA

SOIL BORING LOG 19U

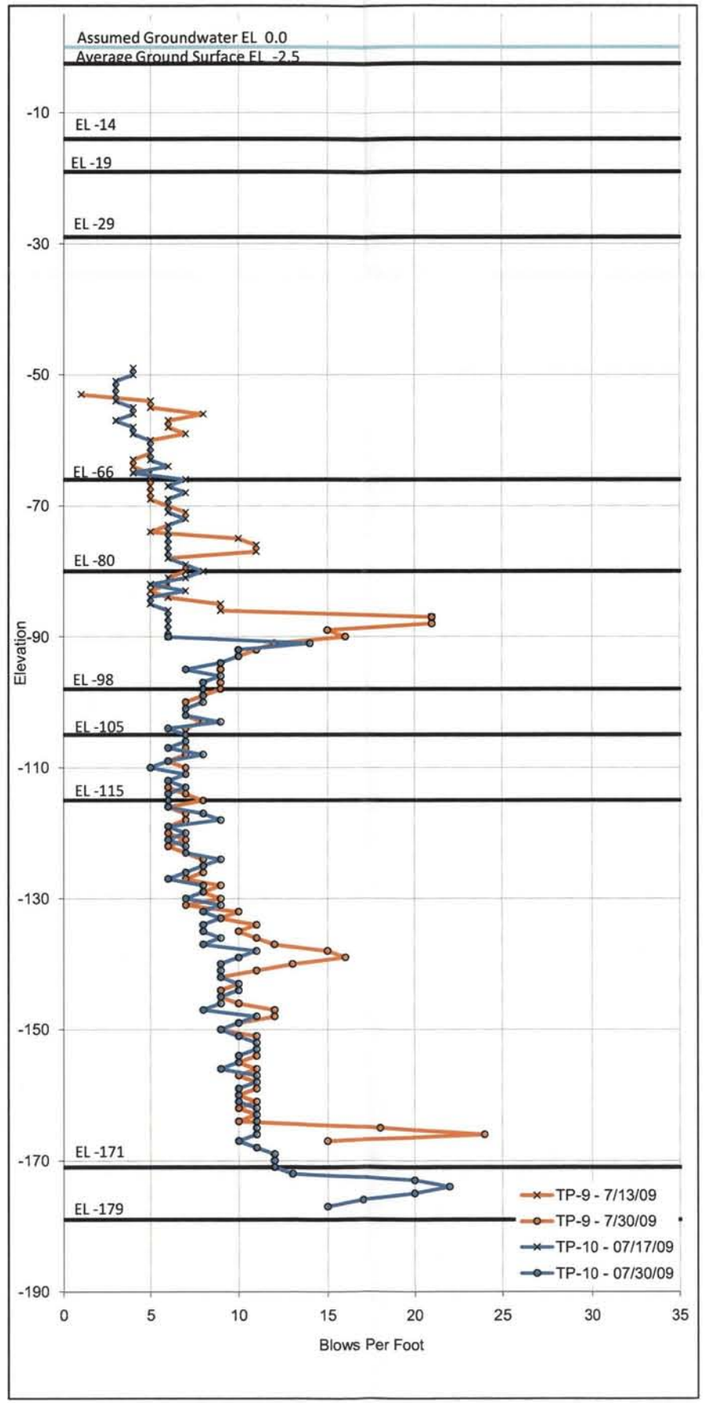
SHEET IDENTIFICATION
S-117

Figure 4
GIWW WCC Pump Station Pile Load Test
Test Pile TP-9 & TP-10 - Test Site 3 - PDA & Blow Per Foot Results

Soil Profile



Pile Driving Record



PDA Results

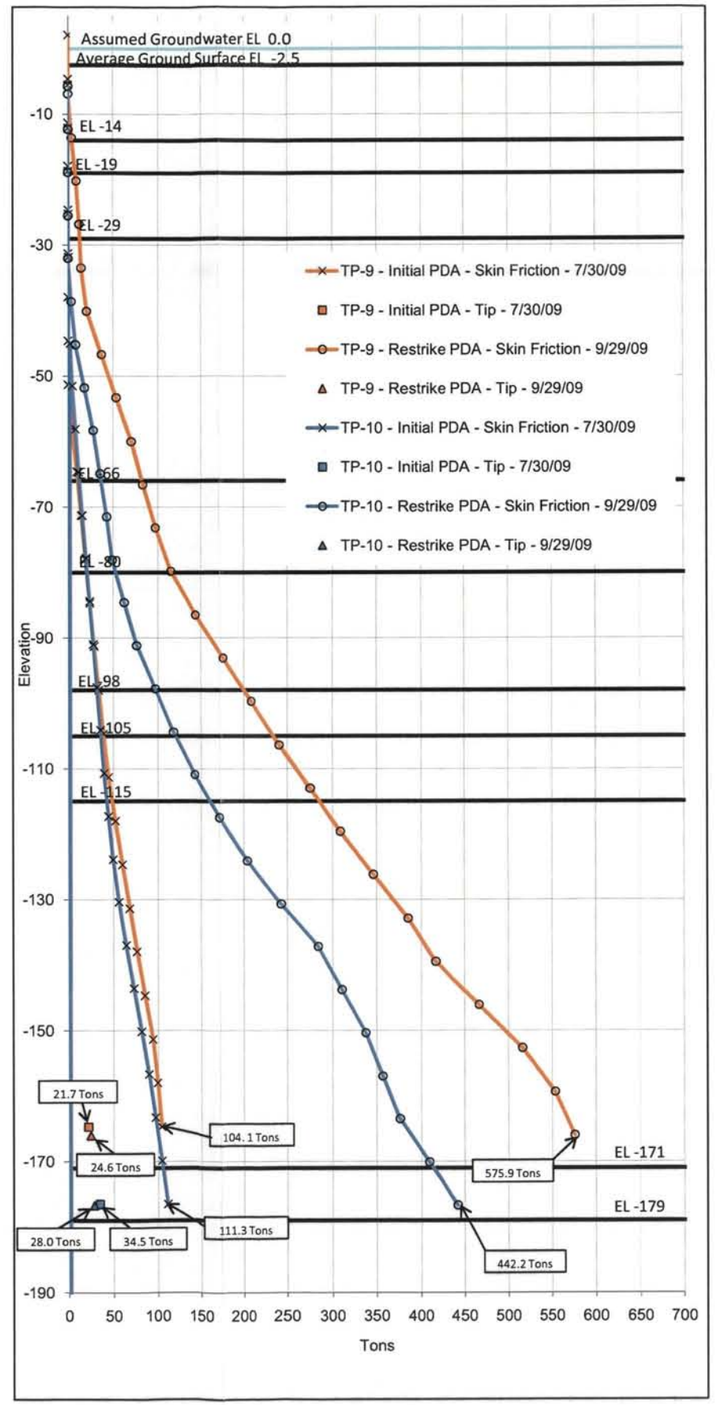
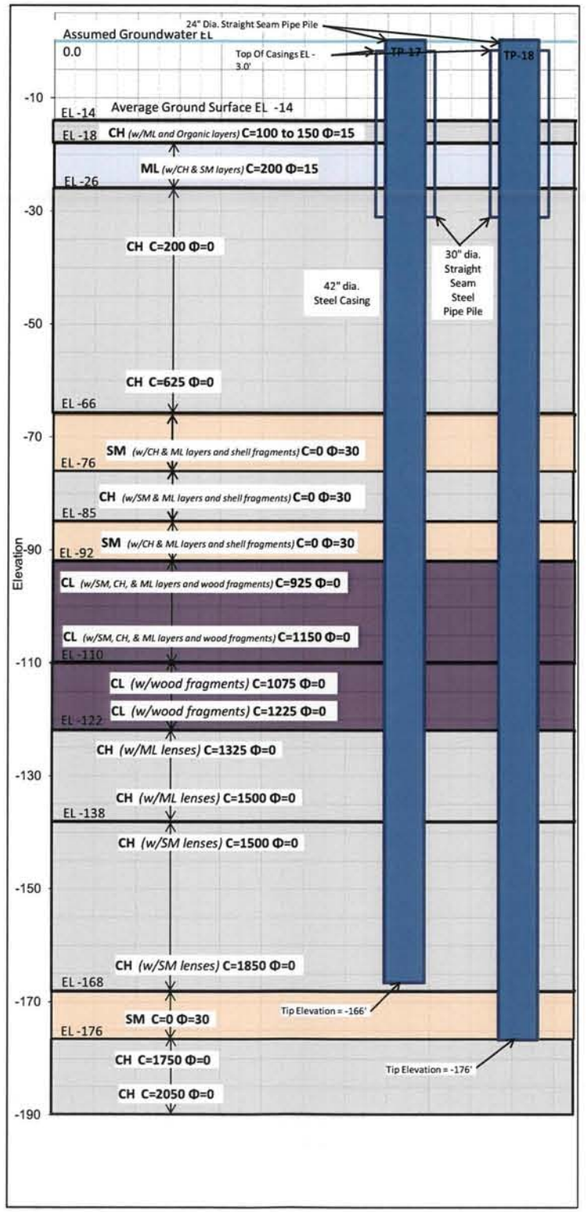
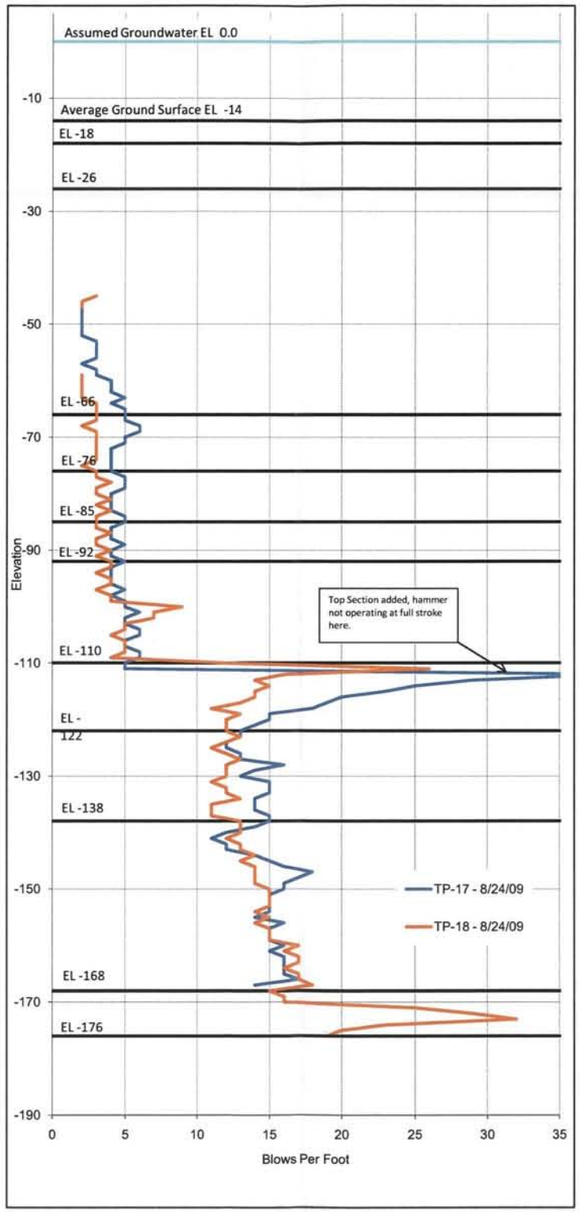


Figure 5
GIWW WICC Pump Station Pile Load Test
Test Pile TP-17 & TP-18 - Test Site 5 - PDA & Blow Per Foot Results

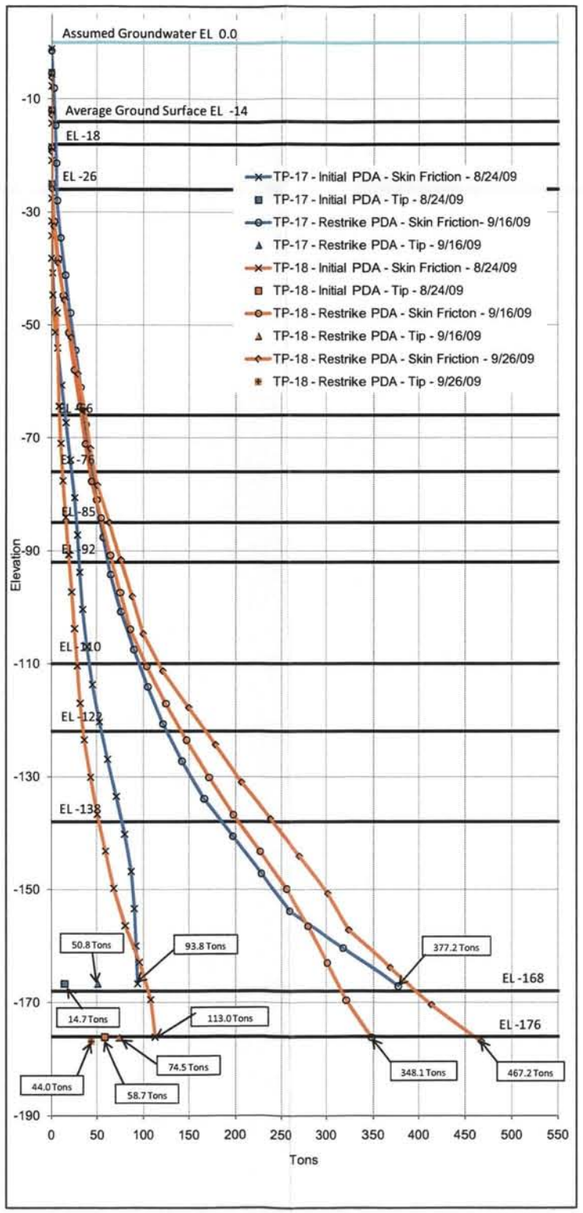
Soil Profile



Pile Driving Record



PDA Results



APPENDIX E

WCC - Pump Station - TP-3

30" Pipe, Tip Elevation = -140

Service Load = 173.00 **Tons**

Estimated Pile Capacity = 398 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	30
Wall Size (in)	0.625
Area (in^2)	57.7
Top Ele. (ft)	0
Tip Ele. (ft)	-140
Length (ft)	140
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	86.50	0.0155
100%	173.00	0.0025
150%	259.50	0.0070
200%	346.00	0.0235
240%	415.20	3.9640

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	43.3	0.0790	50%	86.5	0.0155	0.043
50%	86.5	0.1475	100%	173.0	0.0025	0.087
75%	129.8	0.1635	150%	259.5	0.0070	0.130
100%	173.0	0.2245		321.0	0.0100	0.174
125%	216.3	0.2990	200%	346.0	0.0235	0.217
150%	259.5	0.3805		397.0	0.2090	0.261
175%	302.8	0.5110		410.0	0.6610	0.304
	321.0	0.5500		414.0	0.8500	0.322
200%	346.0	0.6680	240%	415.2	3.9640	0.348
	384.1	0.9460				0.386
	409.0	1.4750				0.411
	413.0	2.0270				0.415
240%	415.2	4.4955				0.417

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**400.7**	0.25		
☑	**.01 inch/Ton Creep Rate**	**379.5**	0.892	366.6 396.6	0.754 1.054
☑	**Tangent Method**	**412.7**	0.67	0 582.3 0.0016315	0 0.95

Line T2 points	
412.2	0.471
415.20	4.496
1.3415	-552.4953

PILE CAPACITY	**397.6**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE E-1-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading				Initial Reading =	
			2.824	2.991	Dial 1	Dial 2		1.45	
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.824	2.991	0.000	0.000	0.0000	1.450	0.0000
25%	43.25	2	2.760	2.929	0.064	0.062	0.0630	1.52	0.0700
	43.25	8	2.760	2.929	0.064	0.062	0.0630	1.52	0.0700
	43.25	15	2.760	2.929	0.064	0.062	0.0630	1.52	0.0700
	43.25	30	2.758	2.927	0.066	0.064	0.0650	1.52	0.0700
	43.25	60	2.754	2.922	0.070	0.069	0.0695	1.52	0.0700
	43.25	120	2.743	2.914	0.081	0.077	0.0790	1.52	0.0700
50%	86.50	2	2.686	2.855	0.138	0.136	0.1370	1.57	0.1200
	86.50	8	2.686	2.854	0.138	0.137	0.1375	1.57	0.1200
	86.50	15	2.685	2.853	0.139	0.138	0.1385	1.57	0.1200
	86.50	30	2.682	2.852	0.142	0.139	0.1405	1.57	0.1200
	86.50	60	2.675	2.845	0.149	0.146	0.1475	1.57	0.1200
	86.50	120	2.677	2.843	0.147	0.148	0.1475	1.57	0.1200
25%	43.25	20	2.736	2.902	0.088	0.089	0.0885	1.53	0.0800
0%	0.00	20	2.810	2.974	0.014	0.017	0.0155	1.45	0.0000
50%	86.50	20	2.700	2.866	0.124	0.125	0.1245	1.57	0.1200
75%	129.75	2	2.653	2.817	0.171	0.174	0.1725	1.63	0.1800
	129.75	8	2.653	2.817	0.171	0.174	0.1725	1.63	0.1800
	129.75	15	2.653	2.818	0.171	0.173	0.1720	1.63	0.1800
	129.75	30	2.654	2.819	0.170	0.172	0.1710	1.63	0.1800
	129.75	60	2.656	2.821	0.168	0.170	0.1690	1.64	0.1900
	129.75	120	2.663	2.825	0.161	0.166	0.1635	1.64	0.1900
100%	173.00	2	2.602	2.770	0.222	0.221	0.2215	1.70	0.2500
	173.00	8	2.601	2.770	0.223	0.221	0.2220	1.70	0.2500
	173.00	15	2.600	2.769	0.224	0.222	0.2230	1.70	0.2500
	173.00	30	2.600	2.768	0.224	0.223	0.2235	1.70	0.2500
	173.00	60	2.600	2.768	0.224	0.223	0.2235	1.70	0.2500
	173.00	120	2.600	2.766	0.224	0.225	0.2245	1.70	0.2500
75%	129.75	20	2.653	2.813	0.171	0.178	0.1745	1.65	0.2000
50%	86.50	20	2.698	2.866	0.126	0.125	0.1255	1.60	0.1500
0%	0.00	20	2.821	2.989	0.003	0.002	0.0025	1.45	0.0000
50%	86.50	20	2.709	2.877	0.115	0.114	0.1145	1.60	0.1500
100%	173.00	20	2.600	2.766	0.224	0.225	0.2245	1.70	0.2500
125%	216.25	2	2.537	2.701	0.287	0.290	0.2885	1.75	0.3000
	216.25	8	2.536	2.700	0.288	0.291	0.2895	1.75	0.3000
	216.25	15	2.535	2.699	0.289	0.292	0.2905	1.75	0.3000
	216.25	30	2.532	2.695	0.292	0.296	0.2940	1.75	0.3000
	216.25	60	2.529	2.692	0.295	0.299	0.2970	1.76	0.3100
	216.25	120	2.527	2.690	0.297	0.301	0.2990	1.77	0.3200
150%	259.50	2	2.458	2.620	0.366	0.371	0.3685	1.85	0.4000
	259.50	8	2.457	2.620	0.367	0.371	0.3690	1.85	0.4000
	259.50	15	2.454	2.615	0.370	0.376	0.3730	1.85	0.4000
	259.50	30	2.452	2.613	0.372	0.378	0.3750	1.85	0.4000
	259.50	60	2.449	2.611	0.375	0.380	0.3775	1.85	0.4000
	259.50	120	2.446	2.608	0.378	0.383	0.3805	1.86	0.4100
125%	216.25	20	2.499	2.663	0.325	0.328	0.3265	1.80	0.3500
100%	173.00	20	2.555	2.720	0.269	0.271	0.2700	1.75	0.3000
50%	86.50	20	2.669	2.835	0.155	0.156	0.1555	1.65	0.2000
0%	0.00	20	2.821	2.980	0.003	0.011	0.0070	1.49	0.0400
50%	86.50	20	2.688	2.853	0.136	0.138	0.1370	1.63	0.1800
100%	173.00	20	2.566	2.734	0.258	0.257	0.2575	1.74	0.2900
150%	259.50	20	2.530	2.704	0.294	0.287	0.2905	1.87	0.4200
175%	302.75	2	2.356	2.530	0.468	0.461	0.4645	1.94	0.4900
	302.75	8	2.351	2.525	0.473	0.466	0.4695	1.95	0.5000
	302.75	15	2.347	2.522	0.477	0.469	0.4730	1.95	0.5000
	302.75	30	2.352	2.521	0.472	0.470	0.4710	1.95	0.5000
	302.75	60	2.330	2.505	0.494	0.486	0.4900	1.95	0.5000
	302.75	120	2.301	2.492	0.523	0.499	0.5110	1.95	0.5000
200%	346.00	2	2.226	2.420	0.598	0.571	0.5845	2.04	0.5900
	346.00	8	2.216	2.413	0.608	0.578	0.5930	2.04	0.5900
	346.00	15	2.215	2.411	0.609	0.580	0.5945	2.04	0.5900
	346.00	30	2.208	2.401	0.616	0.590	0.6030	2.05	0.6000
	346.00	60	2.197	2.391	0.627	0.600	0.6135	2.05	0.6000
	346.00	120	2.175	2.355	0.649	0.636	0.6425	2.06	0.6100
	346.00	180	2.191	2.350	0.633	0.641	0.6370	2.06	0.6100
	346.00	240	2.201	2.356	0.623	0.635	0.6290	2.06	0.6100
	346.00	300	2.213	2.373	0.611	0.618	0.6145	2.07	0.6200
	346.00	360	2.212	2.371	0.612	0.620	0.6160	2.08	0.6300
	346.00	420	2.218	2.371	0.606	0.620	0.6130	2.08	0.6300
	346.00	480	2.218	2.370	0.606	0.621	0.6135	2.09	0.6400
	346.00	540	2.217	2.372	0.607	0.619	0.6130	2.09	0.6400
	346.00	600	2.219	2.374	0.605	0.617	0.6110	2.10	0.6500
	346.00	660	2.218	2.372	0.606	0.619	0.6125	2.10	0.6500
	346.00	720	2.217	2.373	0.607	0.618	0.6125	2.10	0.6500
	346.00	780	2.217	2.374	0.607	0.617	0.6120	2.10	0.6500
	346.00	840	2.219	2.375	0.605	0.616	0.6105	2.10	0.6500
	346.00	900	2.219	2.375	0.605	0.616	0.6105	2.10	0.6500
	346.00	960	2.219	2.375	0.605	0.616	0.6105	2.10	0.6500
	346.00	1020	2.219	2.375	0.605	0.616	0.6105	2.10	0.6500
	346.00	1080	2.218	2.374	0.606	0.617	0.6115	2.10	0.6500
	346.00	1140	2.214	2.371	0.610	0.620	0.6150	2.10	0.6500
	346.00	1200	2.214	2.368	0.610	0.623	0.6165	2.10	0.6500

	346.00	1260	2.210	2.359	0.614	0.632	0.6230	2.10	0.6500
	346.00	1320	2.200	2.343	0.624	0.648	0.6360	2.10	0.6500
	346.00	1380	2.169	2.310	0.655	0.681	0.6680	2.10	0.6500
	346.00	1440	2.169	2.310	0.655	0.681	0.6680	2.10	0.6500
150%	259.50	60	2.246	2.414	0.578	0.577	0.5775	1.98	0.5300
100%	173.00	60	2.395	2.570	0.429	0.421	0.4250	1.85	0.4000
50%	86.50	60	2.555	2.729	0.269	0.262	0.2655	1.73	0.2800
0%	0.00	60	2.801	2.967	0.023	0.024	0.0235	1.55	0.1000
50%	86.50	20	2.586	2.768	0.238	0.223	0.2305	1.73	0.2800
100%	173.00	20	2.450	2.628	0.374	0.363	0.3685	1.80	0.3500
150%	259.50	20	2.353	2.551	0.471	0.440	0.4555	1.95	0.5000
200%	346.00	20	2.209	2.369	0.615	0.622	0.6185	2.10	0.6500
210%	363.30	20	2.178	2.337	0.646	0.654	0.6500	2.12	0.6700
220%	380.60	20	2.145	2.302	0.679	0.689	0.6840	2.16	0.7100
230%	397.90	20	2.091	2.247	0.733	0.744	0.7385	2.21	0.7600
240%	415.20	20	2.072	2.199	1.752	1.792	1.7720	2.29	0.8400
	415.20	4	1.815	1.974	2.009	2.017	2.0130	2.46	1.0100
	415.20	20	1.346	1.500	2.478	2.491	2.4845	2.95	1.5000
	415.20	4	1.326	1.488	2.498	2.503	2.5005	2.99	1.5400
	415.20	20	2.670	2.913	2.154	2.078	2.1160	3.54	2.0900
	415.20	4	2.659	2.828	2.165	2.163	2.1640	3.64	2.1900
	415.20	20	2.647	2.819	2.177	2.172	2.1745	4.24	2.7900
	415.20	5	2.163	2.321	2.661	2.670	2.6655	4.53	3.0800
	415.20	10	1.994	2.176	2.830	2.815	2.8225	4.64	3.1900
	415.20	10	1.892	2.089	2.932	2.902	2.9170	4.93	3.4800
	415.20	10	0.617	0.781	4.207	4.210	4.2085	5.39	3.9400
	415.20	10	0.325	0.499	4.499	4.492	4.4955	5.95	4.5000
180%	311.40	20	0.467	0.628	4.357	4.363	4.3600	5.85	4.4000
120%	207.60	20	0.580	0.743	4.244	4.248	4.2460	5.75	4.3000
60%	103.80	20	0.608	0.872	4.216	4.119	4.1675	5.62	4.1700
0%	0.00	20	0.863	1.024	3.961	3.967	3.9640	5.46	4.0100

PLATE E-1-c

WCC - Pump Station
TP#3 - Steel 30" Pipe Pile - Straight Seam - Tip EL -140.0 - Service Load = 173 Tons

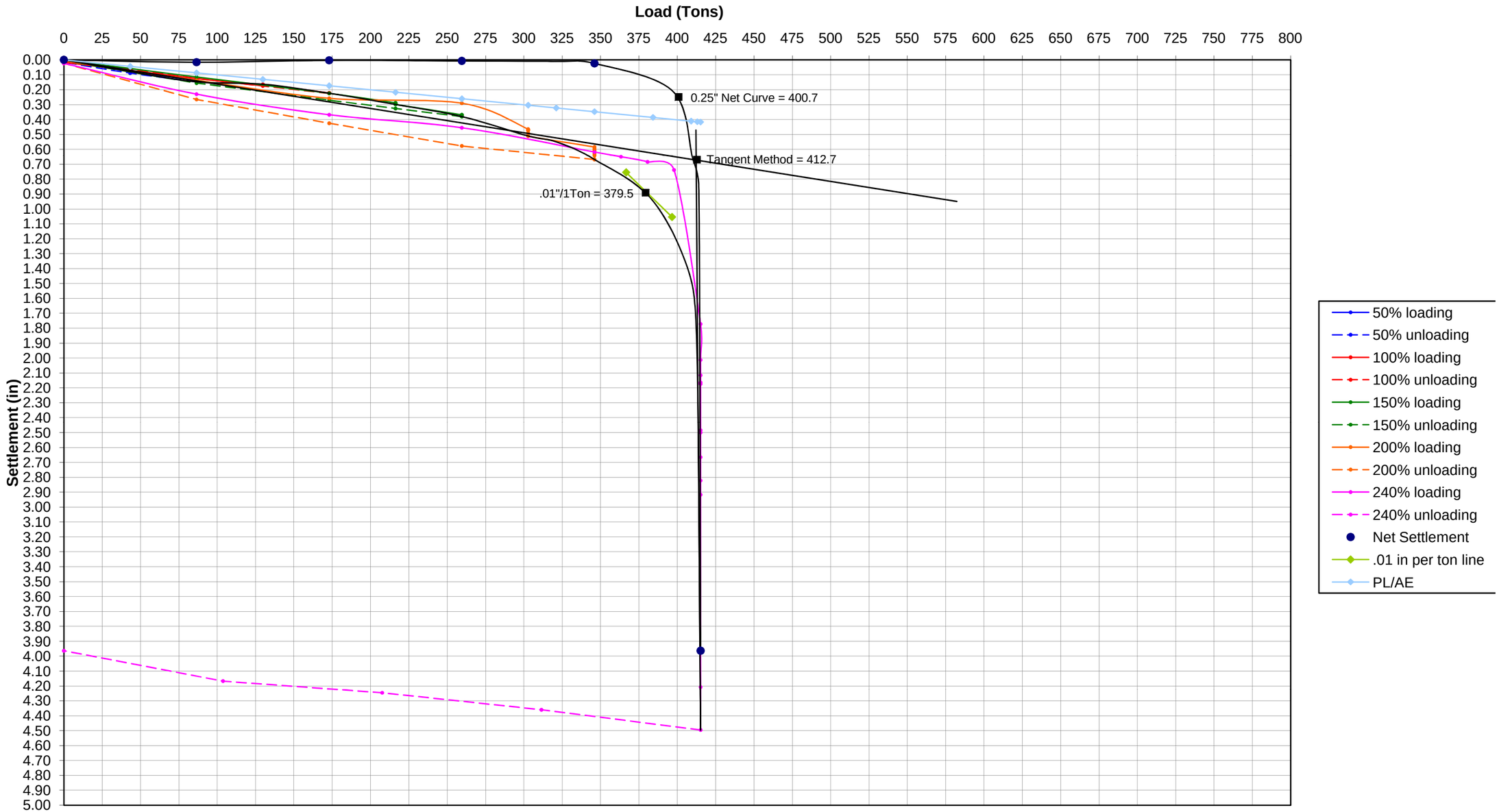


PLATE E-1-d

WCC - Pump Station - TP-4

30" Pipe, Tip Elevation = -160

Service Load = 212.00 **Tons**

Estimated Pile Capacity = 508 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	30
Wall Size (in)	0.625
Area (in^2)	57.7
Top Ele. (ft)	0
Tip Ele. (ft)	-160
Length (ft)	160
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	106.00	0.0210
100%	212.00	-0.0135
150%	318.00	0.0040
200%	424.00	0.0695
250%	530.00	3.8460

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	53.0	0.0720	50%	106.0	0.0210	0.061
50%	106.0	0.1615	100%	212.0	-0.0135	0.122
75%	159.0	0.2350	150%	318.0	0.0040	0.183
100%	212.0	0.3190		371.0	0.0100	0.243
125%	265.0	0.4195	200%	424.0	0.0695	0.304
150%	318.0	0.5215		480.0	0.2370	0.365
175%	371.0	0.7010		515.0	0.5000	0.426
	399.8	0.7710		527.8	0.8500	0.459
200%	424.0	0.8510	250%	530.0	3.8460	0.487
	511.4	1.1820				0.587
	526.6	1.7470				0.604
	528.0	2.0270				0.606
250%	530.0	4.4980				0.608

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**483.7**	0.25		
☑	**.01 inch/Ton Creep Rate**	**514.1**	1.205	501.7 531.7	1.074 1.374
☑	**Tangent Method**	**526.6**	0.744	0 582.3 0.0013996	0 0.815	526.6 530.00 1.1891176	0.455 4.498 -625.73435

PILE CAPACITY	**508.1**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE E-2-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.895	2.899	Dial 1	Dial 2			1.66
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.895	2.899	0.000	0.000	0.0000	1.660	0.0000
25%	53.00	2	2.820	2.839	0.075	0.060	0.0675	1.74	0.0800
	53.00	8	2.820	2.839	0.075	0.060	0.0675	1.74	0.0800
	53.00	15	2.820	2.839	0.075	0.060	0.0675	1.74	0.0800
	53.00	30	2.819	2.839	0.076	0.060	0.0680	1.74	0.0800
	53.00	60	2.821	2.829	0.074	0.070	0.0720	1.74	0.0800
	53.00	120	2.821	2.829	0.074	0.070	0.0720	1.74	0.0800
50%	106.00	2	2.754	2.734	0.141	0.165	0.1530	1.82	0.1600
	106.00	8	2.758	2.734	0.137	0.165	0.1510	1.82	0.1600
	106.00	15	2.760	2.734	0.135	0.165	0.1500	1.82	0.1600
	106.00	30	2.761	2.734	0.134	0.165	0.1495	1.82	0.1600
	106.00	60	2.758	2.735	0.137	0.164	0.1505	1.82	0.1600
	106.00	120	2.736	2.735	0.159	0.164	0.1615	1.82	0.1600
25%	53.00	20	2.814	2.824	0.081	0.075	0.0780	1.75	0.0900
0%	0.00	20	2.874	2.878	0.021	0.021	0.0210	1.68	0.0200
50%	106.00	20	2.732	2.746	0.163	0.153	0.1580	1.83	0.1700
75%	159.00	2	2.655	2.672	0.240	0.227	0.2335	1.90	0.2400
	159.00	8	2.655	2.671	0.240	0.228	0.2340	1.90	0.2400
	159.00	15	2.655	2.671	0.240	0.228	0.2340	1.91	0.2500
	159.00	30	2.655	2.671	0.240	0.228	0.2340	1.91	0.2500
	159.00	60	2.652	2.671	0.243	0.228	0.2355	1.91	0.2500
	159.00	120	2.652	2.672	0.243	0.227	0.2350	1.91	0.2500
100%	212.00	2	2.575	2.593	0.320	0.306	0.3130	1.99	0.3300
	212.00	8	2.575	2.592	0.320	0.307	0.3135	1.99	0.3300
	212.00	15	2.575	2.592	0.320	0.307	0.3135	1.99	0.3300
	212.00	30	2.573	2.589	0.322	0.310	0.3160	1.99	0.3300
	212.00	60	2.571	2.588	0.324	0.311	0.3175	2.00	0.3400
	212.00	120	2.568	2.588	0.327	0.311	0.3190	2.00	0.3400
75%	159.00	20	2.642	2.679	0.253	0.220	0.2365	1.93	0.2700
50%	106.00	20	2.729	2.748	0.166	0.151	0.1585	1.84	0.1800
0%	0.00	20	2.902	2.919	-0.007	-0.020	-0.0135	1.67	0.0100
50%	106.00	20	2.735	2.754	0.160	0.145	0.1525	1.84	0.1800
100%	212.00	20	2.564	2.582	0.331	0.317	0.3240	2.00	0.3400
125%	265.00	2	2.476	2.494	0.419	0.405	0.4120	2.09	0.4300
	265.00	8	2.476	2.494	0.419	0.405	0.4120	2.09	0.4300
	265.00	15	2.472	2.490	0.423	0.409	0.4160	2.09	0.4300
	265.00	30	2.472	2.490	0.423	0.409	0.4160	2.09	0.4300
	265.00	60	2.471	2.488	0.424	0.411	0.4175	2.10	0.4400
	265.00	120	2.469	2.486	0.426	0.413	0.4195	2.10	0.4400
150%	318.00	2	2.378	2.395	0.517	0.504	0.5105	2.20	0.5400
	318.00	8	2.375	2.391	0.520	0.508	0.5140	2.20	0.5400
	318.00	15	2.373	2.389	0.522	0.510	0.5160	2.20	0.5400
	318.00	30	2.372	2.387	0.523	0.512	0.5175	2.20	0.5400
	318.00	60	2.370	2.385	0.525	0.514	0.5195	2.20	0.5400
	318.00	120	2.368	2.383	0.527	0.516	0.5215	2.20	0.5400
125%	265.00	20	2.437	2.453	0.458	0.446	0.4520	2.14	0.4800
100%	212.00	20	2.517	2.534	0.378	0.365	0.3715	2.06	0.4000
50%	106.00	20	2.698	2.710	0.197	0.189	0.1930	1.89	0.2300
0%	0.00	20	2.892	2.894	0.003	0.005	0.0040	1.71	0.0500
50%	106.00	20	2.718	2.708	0.177	0.191	0.1840	1.87	0.2100
100%	212.00	20	2.521	2.521	0.374	0.378	0.3760	2.06	0.4000
150%	318.00	20	2.521	2.521	0.374	0.378	0.3760	2.06	0.4000
175%	371.00	2	2.231	2.228	0.664	0.671	0.6675	2.33	0.6700
	371.00	8	2.219	2.219	0.676	0.680	0.6780	2.33	0.6700
	371.00	15	2.217	2.218	0.678	0.681	0.6795	2.33	0.6700
	371.00	30	2.205	2.211	0.690	0.688	0.6890	2.34	0.6800
	371.00	60	2.205	2.210	0.690	0.689	0.6895	2.34	0.6800
	371.00	120	2.190	2.202	0.705	0.697	0.7010	2.34	0.6800
200%	424.00	2	2.094	2.100	0.801	0.799	0.8000	2.45	0.7900
	424.00	8	2.079	2.084	0.816	0.815	0.8155	2.45	0.7900
	424.00	15	2.074	2.080	0.821	0.819	0.8200	2.46	0.8000
	424.00	30	2.065	2.070	0.830	0.829	0.8295	2.46	0.8000
	424.00	60	2.060	2.069	0.835	0.830	0.8325	2.47	0.8100
	424.00	120	2.073	2.078	0.822	0.821	0.8215	2.47	0.8100
	424.00	180	2.085	2.088	0.810	0.811	0.8105	2.48	0.8200
	424.00	240	2.082	2.096	0.813	0.803	0.8080	2.48	0.8200
	424.00	300	2.086	2.100	0.809	0.799	0.8040	2.48	0.8200
	424.00	360	2.094	2.097	0.801	0.802	0.8015	2.48	0.8200
	424.00	420	2.092	2.096	0.803	0.803	0.8030	2.48	0.8200
	424.00	480	2.092	2.100	0.803	0.799	0.8010	2.48	0.8200
	424.00	540	2.094	2.101	0.801	0.798	0.7995	2.48	0.8200
	424.00	600	2.094	2.101	0.801	0.798	0.7995	2.48	0.8200
	424.00	660	2.094	2.102	0.801	0.797	0.7990	2.48	0.8200
	424.00	720	2.095	2.103	0.800	0.796	0.7980	2.48	0.8200
	424.00	780	2.097	2.105	0.798	0.794	0.7960	2.48	0.8200
	424.00	840	2.097	2.105	0.798	0.794	0.7960	2.48	0.8200
	424.00	900	2.098	2.106	0.797	0.793	0.7950	2.48	0.8200
	424.00	960	2.097	2.106	0.798	0.793	0.7955	2.48	0.8200
	424.00	1020	2.097	2.106	0.798	0.793	0.7955	2.48	0.8200
	424.00	1080	2.092	2.100	0.803	0.799	0.8010	2.48	0.8200
	424.00	1140	2.095	2.097	0.800	0.802	0.8010	2.48	0.8200
	424.00	1200	2.086	2.084	0.809	0.815	0.8120	2.49	0.8300

	424.00	1260	2.074	2.084	0.821	0.815	0.8180	2.49	0.8300
	424.00	1320	2.057	2.068	0.838	0.831	0.8345	2.49	0.8300
	424.00	1380	2.042	2.053	0.853	0.846	0.8495	2.49	0.8300
	424.00	1440	2.042	2.050	0.853	0.849	0.8510	2.50	0.8400
150%	318.00	60	2.201	2.210	0.694	0.689	0.6915	2.34	0.6800
100%	212.00	60	2.400	2.414	0.495	0.485	0.4900	2.17	0.5100
50%	106.00	60	2.584	2.630	0.311	0.269	0.2900	1.97	0.3100
0%	0.00	60	2.816	2.839	0.079	0.060	0.0695	1.76	0.1000
50%	106.00	20	2.648	2.667	0.247	0.232	0.2395	1.92	0.2600
100%	212.00	20	2.473	2.487	0.422	0.412	0.4170	2.10	0.4400
150%	318.00	20	2.301	2.309	0.594	0.590	0.5920	2.28	0.6200
200%	424.00	20	2.096	2.100	0.799	0.799	0.7990	2.48	0.8200
210%	445.20	20	2.052	2.055	0.843	0.844	0.8435	2.53	0.8700
220%	466.40	20	2.000	2.006	0.895	0.893	0.8940	2.58	0.9200
230%	487.60	20	1.951	1.950	0.944	0.949	0.9465	2.63	0.9700
240%	508.80	20	1.878	1.876	1.017	1.023	1.0200	2.70	1.0400
250%	530.00	5	1.741	1.739	1.154	1.160	1.1570	2.81	1.1500
	530.00	8	1.541	1.540	1.354	1.359	1.3565	3.04	1.3800
	530.00	18	1.352	1.350	1.543	1.549	1.5460	3.20	1.5400
	530.00	28	1.147	1.145	1.748	1.754	1.7510	3.50	1.8400
	530.00	33	0.946	0.946	1.949	1.953	1.9510	3.70	2.0400
	530.00	43	0.698	0.699	2.197	2.200	2.1985	3.85	2.1900
	530.00	53	0.524	0.530	2.371	2.369	2.3700	4.06	2.4000
	530.00	63	2.265	2.270	2.630	2.629	2.6295	4.30	2.6400
	530.00	78	1.730	1.732	3.165	3.167	3.1660	4.85	3.1900
	530.00	88	1.270	1.272	3.625	3.627	3.6260	5.32	3.6600
	530.00	93	0.903	0.904	3.992	3.995	3.9935	5.67	4.0100
	530.00	98	0.720	0.721	4.175	4.178	4.1765	5.85	4.1900
	530.00	103	0.398	0.400	4.497	4.499	4.4980	6.18	4.5200
188%	397.50	20	0.413	0.415	4.482	4.484	4.4830	6.16	4.5000
125%	265.00	20	0.552	0.555	4.343	4.344	4.3435	6.04	4.3800
63%	132.50	20	0.776	0.780	4.119	4.119	4.1190	5.82	4.1600
0%	0.00	20	1.048	1.054	3.847	3.845	3.8460	5.55	3.8900

WCC - Pump Station
TP#4 - Steel 30" Pipe Pile - Straight Seam - Tip EL -160.0 - Service Load = 212 Tons

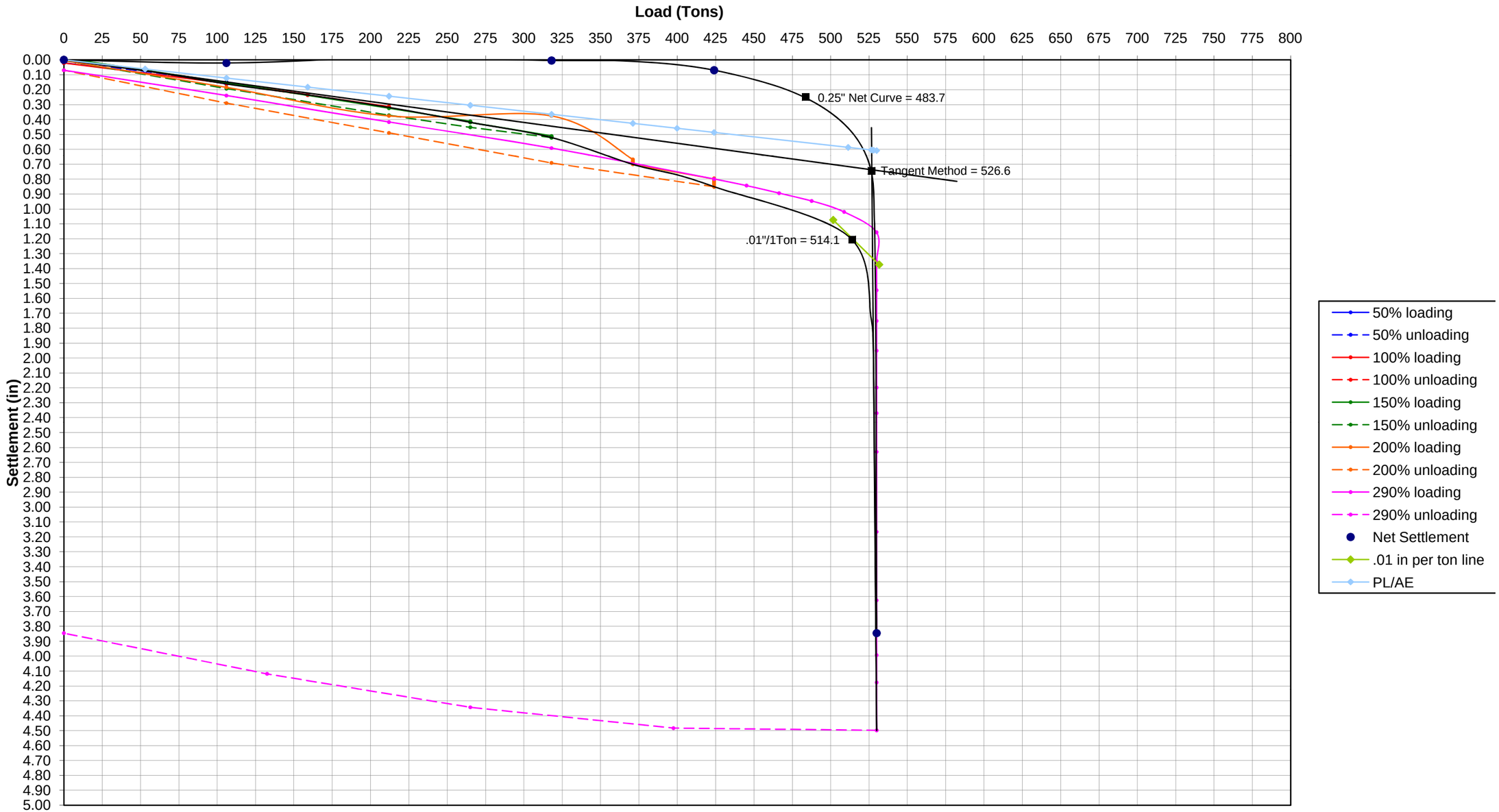


PLATE E-2-d

WCC - Pump Station - TP-5

30" Pipe,SWP, Tip Elevation = -140

Service Load = 173.00 **Tons**

Estimated Pile Capacity = 400 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	30
Wall Size (in)	0.625
Area (in^2)	57.7
Top Ele. (ft)	0
Tip Ele. (ft)	-140
Length (ft)	140
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	86.50	0.0015
100%	173.00	-0.0300
150%	259.50	0.0040
200%	346.00	0.0240
260%	449.80	4.1445

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	43.3	0.0915	50%	86.5	0.0015	0.043
50%	86.5	0.1790	100%	173.0	-0.0300	0.087
75%	129.8	0.1695	150%	259.5	0.0040	0.130
100%	173.0	0.2245		321.0	0.0100	0.174
125%	216.3	0.2835	200%	346.0	0.0240	0.217
150%	259.5	0.3575		397.0	0.2090	0.261
175%	302.8	0.5175		410.0	0.6610	0.304
	321.0	0.5500		414.0	0.8500	0.322
200%	346.0	0.6250	260%	449.8	4.1445	0.348
	384.1	0.7690				0.386
	409.0	1.1760				0.411
	420.5	2.0270				0.422
260%	449.8	4.5865				0.452

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**400.7**	0.25		
☑	**.01 inch/Ton Creep Rate**	**386.6**	0.8	375 / 405	0.675 / 0.975
☑	**Tangent Method**	**411.3**	0.67	0 / 582.3 / 0.0016315	0 / 0.95

Line T2 points	
407.1	0.385
449.80	4.587
0.0983958	-39.671924

PILE CAPACITY	**399.5**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE E-3-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading				Initial Reading =	
			2.793	2.79	Dial 1	Dial 2		1.50	
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.793	2.790	0.000	0.000	0.0000	1.50	0.0000
25%	43.25	2	2.727	2.720	0.066	0.070	0.0680	1.57	0.0700
	43.25	8	2.725	2.718	0.068	0.072	0.0700	1.57	0.0700
	43.25	15	2.721	2.715	0.072	0.075	0.0735	1.57	0.0700
	43.25	30	2.715	2.710	0.078	0.080	0.0790	1.57	0.0700
	43.25	60	2.710	2.706	0.083	0.084	0.0835	1.57	0.0700
	43.25	120	2.705	2.695	0.088	0.095	0.0915	1.57	0.0700
50%	86.50	2	2.634	2.636	0.159	0.154	0.1565	1.63	0.1300
	86.50	8	2.622	2.629	0.171	0.161	0.1660	1.63	0.1300
	86.50	15	2.622	2.621	0.171	0.169	0.1700	1.63	0.1300
	86.50	30	2.628	2.620	0.165	0.170	0.1675	1.63	0.1300
	86.50	60	2.618	2.612	0.175	0.178	0.1765	1.63	0.1300
	86.50	120	2.615	2.610	0.178	0.180	0.1790	1.63	0.1300
25%	43.25	20	2.726	2.712	0.067	0.078	0.0725	1.56	0.0600
0%	0.00	20	2.790	2.790	0.003	0.000	0.0015	1.50	0.0000
50%	86.50	20	2.658	2.651	0.135	0.139	0.1370	1.63	0.1300
75%	129.75	2	2.636	2.633	0.157	0.157	0.1570	1.68	0.1800
	129.75	8	2.636	2.633	0.157	0.157	0.1570	1.68	0.1800
	129.75	15	2.629	2.630	0.164	0.160	0.1620	1.68	0.1800
	129.75	30	2.629	2.627	0.164	0.163	0.1635	1.68	0.1800
	129.75	60	2.628	2.623	0.165	0.167	0.1660	1.68	0.1800
	129.75	120	2.627	2.617	0.166	0.173	0.1695	1.68	0.1800
100%	173.00	2	2.574	2.564	0.219	0.226	0.2225	1.74	0.2400
	173.00	8	2.574	2.564	0.219	0.226	0.2225	1.74	0.2400
	173.00	15	2.574	2.564	0.219	0.226	0.2225	1.74	0.2400
	173.00	30	2.574	2.564	0.219	0.226	0.2225	1.74	0.2400
	173.00	60	2.573	2.563	0.220	0.227	0.2235	1.74	0.2400
	173.00	120	2.571	2.563	0.222	0.227	0.2245	1.74	0.2400
75%	129.75	20	2.624	2.616	0.169	0.174	0.1715	1.69	0.1900
50%	86.50	20	2.682	2.672	0.111	0.118	0.1145	1.64	0.1400
0%	0.00	20	2.828	2.815	-0.035	-0.025	-0.0300	1.50	0.0000
50%	86.50	20	2.693	2.684	0.100	0.106	0.1030	1.63	0.1300
100%	173.00	20	2.578	2.570	0.215	0.220	0.2175	1.74	0.2400
125%	216.25	2	2.518	2.508	0.275	0.282	0.2785	1.80	0.3000
	216.25	8	2.518	2.508	0.275	0.282	0.2785	1.80	0.3000
	216.25	15	2.517	2.507	0.276	0.283	0.2795	1.80	0.3000
	216.25	30	2.516	2.506	0.277	0.284	0.2805	1.80	0.3000
	216.25	60	2.515	2.504	0.278	0.286	0.2820	1.80	0.3000
	216.25	120	2.513	2.503	0.280	0.287	0.2835	1.80	0.3000
150%	259.50	2	2.449	2.437	0.344	0.353	0.3485	1.88	0.3800
	259.50	8	2.448	2.436	0.345	0.354	0.3495	1.88	0.3800
	259.50	15	2.448	2.436	0.345	0.354	0.3495	1.88	0.3800
	259.50	30	2.446	2.433	0.347	0.357	0.3520	1.88	0.3800
	259.50	60	2.444	2.432	0.349	0.358	0.3535	1.88	0.3800
	259.50	120	2.440	2.428	0.353	0.362	0.3575	1.89	0.3900
125%	216.25	20	2.495	2.481	0.298	0.309	0.3035	1.84	0.3400
100%	173.00	20	2.554	2.537	0.239	0.253	0.2460	1.78	0.2800
50%	86.50	20	2.674	2.654	0.119	0.136	0.1275	1.67	0.1700
0%	0.00	20	2.790	2.785	0.003	0.005	0.0040	1.53	0.0300
50%	86.50	20	2.650	2.650	0.143	0.140	0.1415	1.66	0.1600
100%	173.00	20	2.536	2.515	0.257	0.275	0.2660	1.78	0.2800
150%	259.50	20	2.495	2.472	0.298	0.318	0.3080	1.90	0.4000
175%	302.75	2	2.328	2.302	0.465	0.488	0.4765	1.97	0.4700
	302.75	8	2.324	2.297	0.469	0.493	0.4810	1.97	0.4700
	302.75	15	2.319	2.294	0.474	0.496	0.4850	1.97	0.4700
	302.75	30	2.310	2.288	0.483	0.502	0.4925	1.97	0.4700
	302.75	60	2.294	2.279	0.499	0.511	0.5050	1.97	0.4700
	302.75	120	2.280	2.268	0.513	0.522	0.5175	1.97	0.4700
200%	346.00	2	2.212	2.198	0.581	0.592	0.5865	2.05	0.5500
	346.00	8	2.214	2.195	0.579	0.595	0.5870	2.05	0.5500
	346.00	15	2.218	2.203	0.575	0.587	0.5810	2.05	0.5500
	346.00	30	2.223	2.203	0.570	0.587	0.5785	2.05	0.5500
	346.00	60	2.200	2.182	0.593	0.608	0.6005	2.05	0.5500
	346.00	120	2.187	2.168	0.606	0.622	0.6140	2.05	0.5500
	346.00	180	2.187	2.166	0.606	0.624	0.6150	2.05	0.5500
	346.00	240	2.222	2.197	0.571	0.593	0.5820	2.05	0.5500
	346.00	300	2.219	2.189	0.574	0.601	0.5875	2.05	0.5500
	346.00	360	2.238	2.200	0.555	0.590	0.5725	2.05	0.5500
	346.00	420	2.248	2.214	0.545	0.576	0.5605	2.06	0.5600
	346.00	480	2.257	2.225	0.536	0.565	0.5505	2.06	0.5600
	346.00	540	2.270	2.240	0.523	0.550	0.5365	2.06	0.5600
	346.00	600	2.270	2.242	0.523	0.548	0.5355	2.06	0.5600
	346.00	660	2.270	2.242	0.523	0.548	0.5355	2.06	0.5600
	346.00	720	2.270	2.244	0.523	0.546	0.5345	2.06	0.5600
	346.00	780	2.270	2.244	0.523	0.546	0.5345	2.06	0.5600
	346.00	840	2.269	2.243	0.524	0.547	0.5355	2.06	0.5600
	346.00	900	2.268	2.242	0.525	0.548	0.5365	2.06	0.5600
	346.00	960	2.267	2.241	0.526	0.549	0.5375	2.07	0.5700
	346.00	1020	2.266	2.241	0.527	0.549	0.5380	2.07	0.5700
	346.00	1080	2.265	2.240	0.528	0.550	0.5390	2.07	0.5700
	346.00	1140	2.264	2.238	0.529	0.552	0.5405	2.07	0.5700
	346.00	1200	2.254	2.229	0.539	0.561	0.5500	2.07	0.5700

PLATE E-3-b

	346.00	1260	2.236	2.212	0.557	0.578	0.5675	2.07	0.5700
	346.00	1320	2.212	2.193	0.581	0.597	0.5890	2.08	0.5800
	346.00	1380	2.188	2.170	0.605	0.620	0.6125	2.08	0.5800
	346.00	1440	2.173	2.160	0.620	0.630	0.6250	2.08	0.5800
150%	259.50	60	2.300	2.276	0.493	0.514	0.5035	1.96	0.4600
100%	173.00	60	2.411	2.389	0.382	0.401	0.3915	1.84	0.3400
50%	86.50	60	2.508	2.475	0.285	0.315	0.3000	1.75	0.2500
0%	0.00	60	2.781	2.754	0.012	0.036	0.0240	1.55	0.0500
50%	86.50	20	2.632	2.606	0.161	0.184	0.1725	1.70	0.2000
100%	173.00	20	2.516	2.494	0.277	0.296	0.2865	1.80	0.3000
150%	259.50	20	2.392	2.366	0.401	0.424	0.4125	1.93	0.4300
200%	346.00	20	2.262	2.235	0.531	0.555	0.5430	2.06	0.5600
210%	363.30	20	2.237	2.210	0.556	0.580	0.5680	2.09	0.5900
220%	380.60	20	2.212	2.182	0.581	0.608	0.5945	2.12	0.6200
230%	397.90	20	2.175	2.142	0.618	0.648	0.6330	2.16	0.6600
240%	415.20	20	2.151	2.116	1.642	1.674	1.6580	2.18	0.6800
250%	432.50	20	2.107	2.075	1.686	1.715	1.7005	2.23	0.7300
260%	449.80	17	1.895	1.850	1.898	1.940	1.9190	2.51	1.0100
	449.80	23	1.384	1.379	2.409	2.411	2.4100	3.08	1.5800
	449.80	28	0.576	0.537	4.217	4.253	4.2350	3.75	2.2500
	449.80	33	2.576	2.537	2.217	2.253	2.2350	3.79	2.2900
	449.80	38	1.787	1.773	3.006	3.017	3.0115	4.54	3.0400
	449.80	43	1.083	1.059	3.710	3.731	3.7205	5.20	3.7000
	449.80	48	0.208	0.190	4.585	4.600	4.5925	6.11	4.6100
	449.80	20	0.214	0.196	4.579	4.594	4.5865	6.10	4.6000
195%	337.35	20	0.214	0.196	4.579	4.594	4.5865	6.10	4.6000
130%	224.90	20	0.298	0.279	4.495	4.511	4.5030	6.04	4.5400
65%	112.45	20	0.455	0.438	4.338	4.352	4.3450	5.88	4.3800
0%	0.00	20	0.654	0.640	4.139	4.150	4.1445	5.68	4.1800

WCC - Pump Station
TP#5 - Steel 30" Pipe Pile - Spiral Welded - Tip EL -140.0 - Service Load = 173 Tons

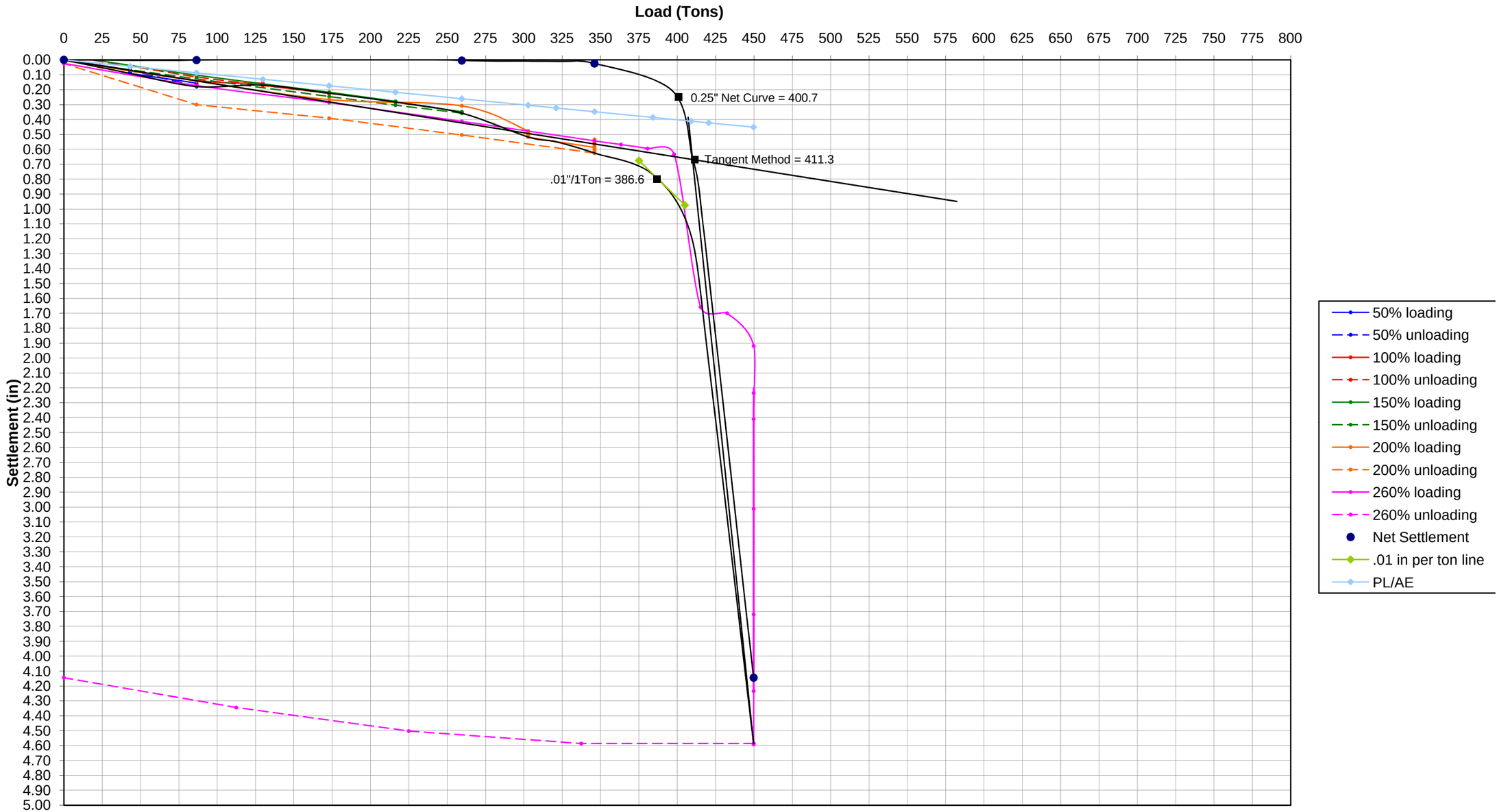


PLATE E-3-d

WCC - Pump Station - TP-6

30" Pipe,SWP Grounded, Tip Elevation = -140

Service Load = 173.00 **Tons**

Estimated Pile Capacity = 373 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	30
Wall Size (in)	0.625
Area (in^2)	57.7
Top Ele. (ft)	0
Tip Ele. (ft)	-140
Length (ft)	140
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	-0.0055
50%	86.50	-0.0085
100%	173.00	-0.0475
150%	259.50	0.0190
200%	346.00	0.0420
230%	397.90	4.0155

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	43.3	0.0915	50%	86.5	-0.0085	0.043
50%	86.5	0.1790	100%	173.0	-0.0475	0.087
75%	129.8	0.1695	150%	259.5	0.0190	0.130
100%	173.0	0.2245		321.0	0.0100	0.174
125%	216.3	0.2835	200%	346.0	0.0420	0.217
150%	259.5	0.3575		362.6	0.1310	0.261
175%	302.8	0.5175		373.9	0.2610	0.304
	321.0	0.5500		385.0	0.8500	0.322
200%	346.0	0.6250	230%	397.9	4.0155	0.348
	362.6	0.7180				0.364
	378.1	0.9800				0.380
	385.0	2.0270				0.387
230%	397.9	4.5865				0.400

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**374.6**	0.25		
☑	**.01 inch/Ton Creep Rate**	**363.3**	0.726	347.1 377.1	0.559 0.859
☑	**Tangent Method**	**381**	0.486	0 548.9 0.0013081	0 0.718

Line T2 points	
379.5	0.094
397.90	4.473
0.237962	-90.212563

PILE CAPACITY	**373.0**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE E-4-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading				Initial Reading =	
			2.793	2.79	Dial 1	Dial 2			2.17
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.794	2.800	-0.001	-0.010	-0.0055	2.17	0.0000
25%	43.25	2	2.747	2.752	0.046	0.038	0.0420	2.21	0.0400
	43.25	8	2.749	2.752	0.044	0.038	0.0410	2.21	0.0400
	43.25	15	2.742	2.747	0.051	0.043	0.0470	2.21	0.0400
	43.25	30	2.712	2.747	0.081	0.043	0.0620	2.21	0.0400
	43.25	60	2.733	2.742	0.060	0.048	0.0540	2.21	0.0400
	43.25	120	2.722	2.731	0.071	0.059	0.0650	2.21	0.0400
50%	86.50	2	2.654	2.666	0.139	0.124	0.1315	2.28	0.1100
	86.50	8	2.654	2.666	0.139	0.124	0.1315	2.28	0.1100
	86.50	15	2.654	2.666	0.139	0.124	0.1315	2.28	0.1100
	86.50	30	2.682	2.852	0.111	-0.062	0.0245	2.28	0.1100
	86.50	60	2.638	2.645	0.155	0.145	0.1500	2.28	0.1100
	86.50	120	2.655	2.662	0.138	0.128	0.1330	2.28	0.1100
25%	43.25	20	2.734	2.743	0.059	0.047	0.0530	2.21	0.0400
0%	0.00	20	2.794	2.806	-0.001	-0.016	-0.0085	2.17	0.0000
50%	86.50	20	2.686	2.696	0.107	0.094	0.1005	2.28	0.1100
75%	129.75	2	2.620	2.623	0.173	0.167	0.1700	2.34	0.1700
	129.75	8	2.630	2.627	0.163	0.163	0.1630	2.34	0.1700
	129.75	15	2.630	2.627	0.163	0.163	0.1630	2.34	0.1700
	129.75	30	2.625	2.636	0.168	0.154	0.1610	2.34	0.1700
	129.75	60	2.625	2.636	0.168	0.154	0.1610	2.34	0.1700
	129.75	120	2.614	2.624	0.179	0.166	0.1725	2.35	0.1800
100%	173.00	2	2.572	2.583	0.221	0.207	0.2140	2.41	0.2400
	173.00	8	2.572	2.583	0.221	0.207	0.2140	2.41	0.2400
	173.00	15	2.572	2.584	0.221	0.206	0.2135	2.41	0.2400
	173.00	30	2.573	2.584	0.220	0.206	0.2130	2.42	0.2500
	173.00	60	2.574	2.585	0.219	0.205	0.2120	2.42	0.2500
	173.00	120	2.575	2.585	0.218	0.205	0.2115	2.43	0.2600
75%	129.75	20	2.640	2.648	0.153	0.142	0.1475	2.36	0.1900
50%	86.50	20	2.708	2.715	0.085	0.075	0.0800	2.30	0.1300
0%	0.00	20	2.832	2.846	-0.039	-0.056	-0.0475	2.16	-0.0100
50%	86.50	20	2.724	2.730	0.069	0.060	0.0645	2.29	0.1200
100%	173.00	20	2.587	2.593	0.206	0.197	0.2015	2.42	0.2500
125%	216.25	2	2.518	2.524	0.275	0.266	0.2705	2.49	0.3200
	216.25	8	2.518	2.523	0.275	0.267	0.2710	2.50	0.3300
	216.25	15	2.516	2.522	0.277	0.268	0.2725	2.50	0.3300
	216.25	30	2.512	2.519	0.281	0.271	0.2760	2.50	0.3300
	216.25	60	2.510	2.518	0.283	0.272	0.2775	2.50	0.3300
	216.25	120	2.510	2.518	0.283	0.272	0.2775	2.50	0.3300
150%	259.50	2	2.442	2.449	0.351	0.341	0.3460	2.56	0.3900
	259.50	8	2.440	2.446	0.353	0.344	0.3485	2.56	0.3900
	259.50	15	2.440	2.446	0.353	0.344	0.3485	2.56	0.3900
	259.50	30	2.436	2.443	0.357	0.347	0.3520	2.56	0.3900
	259.50	60	2.431	2.437	0.362	0.353	0.3575	2.57	0.4000
	259.50	120	2.428	2.435	0.365	0.355	0.3600	2.59	0.4200
125%	216.25	20	2.485	2.489	0.308	0.301	0.3045	2.54	0.3700
100%	173.00	20	2.551	2.555	0.242	0.235	0.2385	2.46	0.2900
50%	86.50	20	2.694	2.696	0.099	0.094	0.0965	2.32	0.1500
0%	0.00	20	2.770	2.775	0.023	0.015	0.0190	2.24	0.0700
50%	86.50	20	2.706	2.708	0.087	0.082	0.0845	2.30	0.1300
100%	173.00	20	2.556	2.554	0.237	0.236	0.2365	2.45	0.2800
150%	259.50	20	2.497	2.498	0.296	0.292	0.2940	2.59	0.4200
175%	302.75	2	2.312	2.313	0.481	0.477	0.4790	2.66	0.4900
	302.75	8	2.310	2.312	0.483	0.478	0.4805	2.67	0.5000
	302.75	15	2.295	2.300	0.498	0.490	0.4940	2.68	0.5100
	302.75	30	2.290	2.294	0.503	0.496	0.4995	2.68	0.5100
	302.75	60	2.271	2.283	0.522	0.507	0.5145	2.68	0.5100
	302.75	120	2.253	2.264	0.540	0.526	0.5330	2.68	0.5100
200%	346.00	2	2.162	2.175	0.631	0.615	0.6230	2.78	0.6100
	346.00	8	2.149	2.161	0.644	0.629	0.6365	2.78	0.6100
	346.00	15	2.146	2.155	0.647	0.635	0.6410	2.78	0.6100
	346.00	30	2.147	2.153	0.646	0.637	0.6415	2.79	0.6200
	346.00	60	2.141	2.145	0.652	0.645	0.6485	2.79	0.6200
	346.00	120	2.121	2.122	0.672	0.668	0.6700	2.79	0.6200
	346.00	180	2.116	2.111	0.677	0.679	0.6780	2.80	0.6300
	346.00	240	2.119	2.125	0.674	0.665	0.6695	2.80	0.6300
	346.00	300	2.133	2.137	0.660	0.653	0.6565	2.80	0.6300
	346.00	360	2.140	2.131	0.653	0.659	0.6560	2.81	0.6400
	346.00	420	2.162	2.160	0.631	0.630	0.6305	2.82	0.6500
	346.00	480	2.164	2.167	0.629	0.623	0.6260	2.83	0.6600
	346.00	540	2.183	2.188	0.610	0.602	0.6060	2.83	0.6600
	346.00	600	2.186	2.191	0.607	0.599	0.6030	2.83	0.6600
	346.00	660	2.189	2.194	0.604	0.596	0.6000	2.83	0.6600
	346.00	720	2.190	2.195	0.603	0.595	0.5990	2.83	0.6600
	346.00	780	2.191	2.195	0.602	0.595	0.5985	2.83	0.6600
	346.00	840	2.190	2.195	0.603	0.595	0.5990	2.83	0.6600
	346.00	900	2.189	2.194	0.604	0.596	0.6000	2.83	0.6600
	346.00	960	2.188	2.194	0.605	0.596	0.6005	2.83	0.6600
	346.00	1020	2.188	2.193	0.605	0.597	0.6010	2.83	0.6600
	346.00	1080	2.187	2.192	0.606	0.598	0.6020	2.83	0.6600
	346.00	1140	2.184	2.190	0.609	0.600	0.6045	2.83	0.6600
	346.00	1200	2.179	2.184	0.614	0.606	0.6100	2.83	0.6600

PLATE E-4-b

	346.00	1260	2.171	2.173	0.622	0.617	0.6195	2.83	0.6600
	346.00	1320	2.153	2.155	0.640	0.635	0.6375	2.83	0.6600
	346.00	1380	2.111	2.122	0.682	0.668	0.6750	2.83	0.6600
	346.00	1440	2.094	2.106	0.699	0.684	0.6915	2.83	0.6600
150%	259.50	60	2.216	2.221	0.577	0.569	0.5730	2.70	0.5300
100%	173.00	60	2.353	2.352	0.440	0.438	0.4390	2.56	0.3900
50%	86.50	60	2.564	2.565	0.229	0.225	0.2270	2.41	0.2400
0%	0.00	60	2.744	2.755	0.049	0.035	0.0420	2.25	0.0800
50%	86.50	20	2.619	2.620	0.174	0.170	0.1720	2.39	0.2200
100%	173.00	20	2.475	2.475	0.318	0.315	0.3165	2.54	0.3700
150%	259.50	20	2.340	2.338	0.453	0.452	0.4525	2.68	0.5100
200%	346.00	20	2.183	2.185	0.610	0.605	0.6075	2.84	0.6700
210%	363.30	20	2.142	2.145	0.651	0.645	0.6480	2.88	0.7100
220%	380.60	20	2.100	2.101	0.693	0.689	0.6910	2.91	0.7400
230%	397.90	20	2.042	2.044	0.751	0.746	0.7485	2.99	0.8200
230%	397.90	20	1.808	1.808	1.985	1.982	1.9835	3.22	1.0500
230%	397.90	20	1.517	1.509	2.276	2.281	2.2785	3.52	1.3500
230%	397.90	17	0.866	0.865	2.927	2.925	2.9260	4.15	1.9800
230%	397.90	23	0.647	0.643	3.146	3.147	3.1465	4.17	2.0000
230%	397.90	28	0.316	0.322	4.477	4.468	4.4725	6.67	4.5000
173%	298.43	33	0.421	0.418	4.372	4.372	4.3720	6.60	4.4300
115%	198.95	38	0.541	0.538	4.252	4.252	4.2520	6.50	4.3300
58%	99.48	43	0.666	0.664	4.127	4.126	4.1265	6.36	4.1900
0%	0.00	48	0.774	0.778	4.019	4.012	4.0155	6.25	4.0800

WCC - Pump Station
TP#6 - Steel 30" Pipe Pile - Spiral Welded Grounded- Tip EL -140.0 - Service Load = 173 Tons

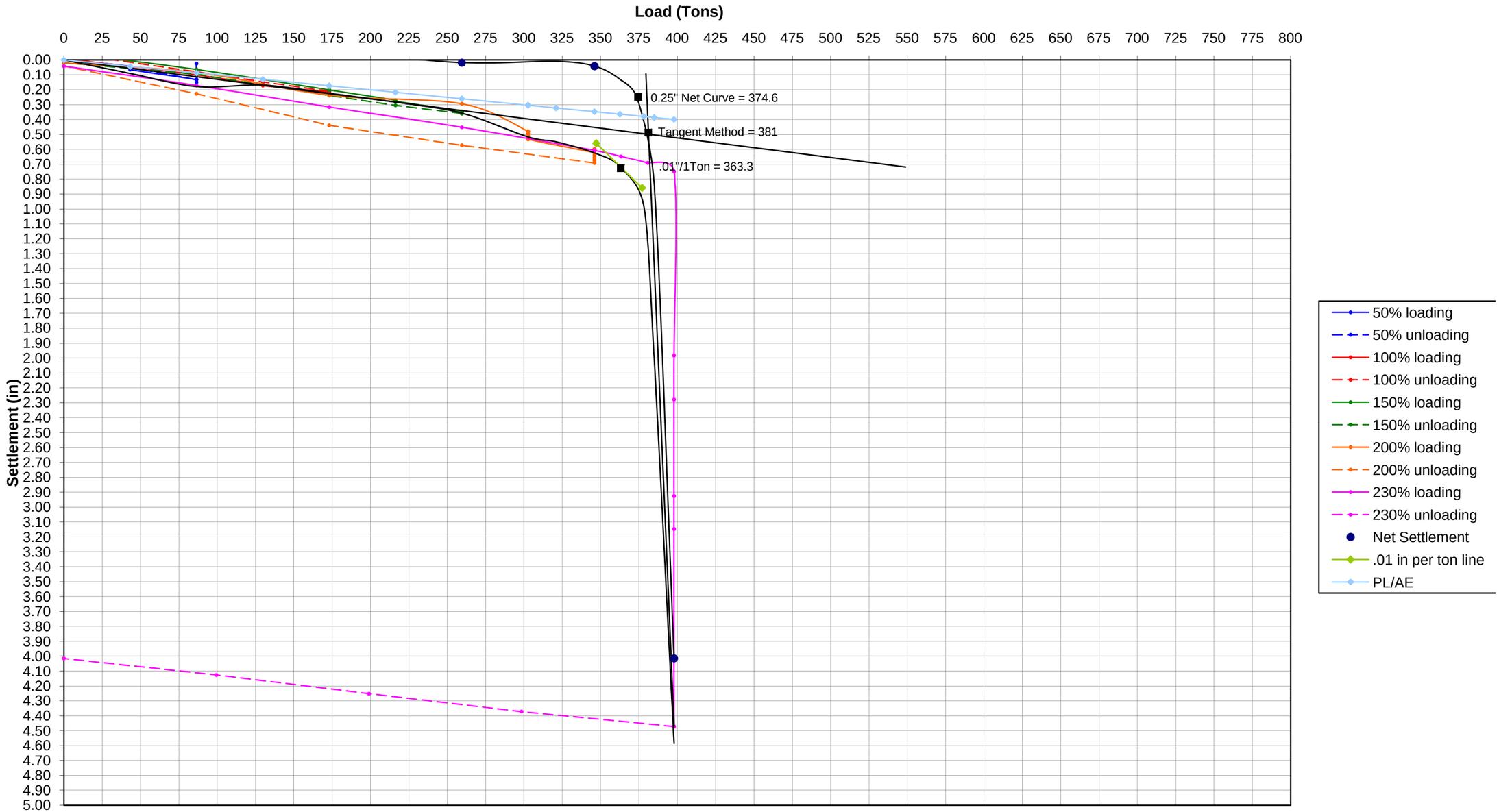


PLATE E-4-d

WCC - 225-ft Sector Gate - TP-9

24" Pipe, Tip Elevation = -166

Service Load = 169.00 **Tons**

Estimated Pile Capacity = 378 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	24
Wall Size (in)	0.500
Area (in^2)	36.9
Top Ele. (ft)	0
Tip Ele. (ft)	-166
Length (ft)	166
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	84.50	-0.0235
100%	169.00	0.0040
150%	253.50	0.0495
200%	338.00	0.1325
240%	405.60	2.9215

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	42.3	0.1110	50%	84.5	-0.0235	0.079
50%	84.5	0.2165	100%	169.0	0.0040	0.157
75%	126.8	0.3260	150%	253.5	0.0495	0.236
100%	169.0	0.4580		300.0	0.0700	0.314
125%	211.3	0.5570	200%	338.0	0.1325	0.393
150%	253.5	0.7555		383.0	0.4000	0.472
175%	295.8	0.9270		397.0	0.7500	0.550
	315.0	1.0190		400.0	0.8500	0.586
200%	338.0	1.1660	240%	405.6	2.9215	0.629
	367.0	1.3930				0.683
	397.0	1.7960				0.739
	403.0	2.0270				0.750
240%	405.6	3.6475				0.755

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**365**	0.25		
☑	**.01 inch/Ton Creep Rate**	**363.1**	1.35	351.4 381.4	1.216 1.516
☑	**Tangent Method**	**406.5**	0.757	0 582.3 0.0018616	0 1.084	407.2 405.60 -1.8696875	0.656 3.648 761.99275

PILE CAPACITY	**378.2**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.888	2.684	Dial 1	Dial 2			3.95
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.888	2.684	0.000	0.000	0.0000	3.950	0.0000
25%	42.25	2	2.785	2.588	0.103	0.096	0.0995	4.05	0.1000
	42.25	8	2.784	2.587	0.104	0.097	0.1005	4.05	0.1000
	42.25	15	2.787	2.589	0.101	0.095	0.0980	4.05	0.1000
	42.25	30	2.790	2.592	0.098	0.092	0.0950	4.05	0.1000
	42.25	60	2.782	2.586	0.106	0.098	0.1020	4.05	0.1000
	42.25	120	2.776	2.574	0.112	0.110	0.1110	4.05	0.1000
50%	84.50	2	2.662	2.464	0.226	0.220	0.2230	4.15	0.2000
	84.50	8	2.660	2.464	0.228	0.220	0.2240	4.15	0.2000
	84.50	15	2.661	2.466	0.227	0.218	0.2225	4.18	0.2300
	84.50	30	2.662	2.468	0.226	0.216	0.2210	4.18	0.2300
	84.50	60	2.663	2.471	0.225	0.213	0.2190	4.18	0.2300
	84.50	120	2.665	2.474	0.223	0.210	0.2165	4.18	0.2300
25%	42.25	20	2.785	2.594	0.103	0.090	0.0965	4.05	0.1000
0%	0.00	20	2.905	2.714	-0.017	-0.030	-0.0235	3.90	-0.0500
50%	84.50	20	2.681	2.494	0.207	0.190	0.1985	4.10	0.1500
75%	126.75	2	2.663	2.672	0.225	0.012	0.2690	4.23	0.2800
	126.75	8	2.660	2.374	0.228	0.310	0.2690	4.22	0.2700
	126.75	15	2.556	2.370	0.332	0.314	0.3230	4.22	0.2700
	126.75	30	2.556	2.370	0.332	0.314	0.3230	4.22	0.2700
	126.75	60	2.556	2.370	0.332	0.314	0.3230	4.22	0.2700
	126.75	120	2.550	2.370	0.338	0.314	0.3260	4.24	0.2900
100%	169.00	2	2.434	2.246	0.454	0.438	0.4460	4.36	0.4100
	169.00	8	2.431	2.243	0.457	0.441	0.4490	4.35	0.4000
	169.00	15	2.429	2.241	0.459	0.443	0.4510	4.38	0.4300
	169.00	30	2.428	2.239	0.460	0.445	0.4525	4.39	0.4400
	169.00	60	2.426	2.238	0.462	0.446	0.4540	4.39	0.4400
	169.00	120	2.422	2.234	0.466	0.450	0.4580	4.39	0.4400
75%	126.75	20	2.520	2.332	0.368	0.352	0.3600	4.29	0.3400
50%	84.50	20	2.628	2.440	0.260	0.244	0.2520	4.19	0.2400
0%	0.00	20	2.878	2.686	0.010	-0.002	0.0040	3.91	-0.0400
50%	84.50	20	2.656	2.468	0.232	0.216	0.2240	4.15	0.2000
100%	169.00	20	2.416	2.226	0.472	0.458	0.4650	4.40	0.4500
125%	211.25	2	2.391	2.100	0.497	0.584	0.5405	4.50	0.5500
	211.25	8	2.389	2.098	0.499	0.586	0.5425	4.50	0.5500
	211.25	15	2.383	2.092	0.505	0.592	0.5485	4.51	0.5600
	211.25	30	2.378	2.086	0.510	0.598	0.5540	4.51	0.5600
	211.25	60	2.378	2.087	0.510	0.597	0.5535	4.51	0.5600
	211.25	120	2.375	2.083	0.513	0.601	0.5570	4.52	0.5700
150%	253.50	2	2.143	1.952	0.745	0.732	0.7385	4.65	0.7000
	253.50	8	2.135	1.945	0.753	0.739	0.7460	4.65	0.7000
	253.50	15	2.133	1.941	0.755	0.743	0.7490	4.66	0.7100
	253.50	30	2.130	1.939	0.758	0.745	0.7515	4.66	0.7100
	253.50	60	2.130	1.939	0.758	0.745	0.7515	4.66	0.7100
	253.50	120	2.125	1.936	0.763	0.748	0.7555	4.68	0.7300
125%	211.25	20	2.213	2.025	0.675	0.659	0.6670	4.60	0.6500
100%	169.00	20	2.320	2.132	0.568	0.552	0.5600	4.50	0.5500
50%	84.50	20	2.562	2.380	0.326	0.304	0.3150	4.25	0.3000
0%	0.00	20	2.830	2.643	0.058	0.041	0.0495	4.00	0.0500
50%	84.50	20	2.615	2.416	0.273	0.268	0.2705	4.21	0.2600
100%	169.00	20	2.493	2.300	0.395	0.384	0.3895	4.33	0.3800
150%	253.50	20	2.139	2.029	0.749	0.655	0.7020	4.70	0.7500
175%	295.75	2	1.980	1.790	0.908	0.894	0.9010	4.80	0.8500
	295.75	8	1.979	1.789	0.909	0.895	0.9020	4.80	0.8500
	295.75	15	1.978	1.788	0.910	0.896	0.9030	4.80	0.8500
	295.75	30	1.966	1.778	0.922	0.906	0.9140	4.82	0.8700
	295.75	60	1.958	1.771	0.930	0.913	0.9215	4.85	0.9000
	295.75	120	1.952	1.766	0.936	0.918	0.9270	4.85	0.9000
200%	338.00	2	1.790	1.606	1.098	1.078	1.0880	5.00	1.0500
	338.00	8	1.793	1.594	1.095	1.090	1.0925	5.05	1.1000
	338.00	15	1.777	1.590	1.111	1.094	1.1025	5.00	1.0500
	338.00	30	1.770	1.579	1.118	1.105	1.1115	5.03	1.0800
	338.00	60	1.760	1.570	1.128	1.114	1.1210	5.05	1.1000
	338.00	120	1.757	1.560	1.131	1.124	1.1275	5.05	1.1000
	338.00	180	1.650	1.561	1.238	1.123	1.1805	5.06	1.1100
	338.00	240	1.641	1.559	1.247	1.125	1.1860	5.06	1.1100
	338.00	300	1.638	1.555	1.250	1.129	1.1895	5.06	1.1100
	338.00	360	1.741	1.547	1.147	1.137	1.1420	5.05	1.1000
	338.00	420	1.741	1.544	1.147	1.140	1.1435	5.05	1.1000
	338.00	480	1.741	1.543	1.147	1.141	1.1440	5.05	1.1000
	338.00	540	1.740	1.540	1.148	1.144	1.1460	5.05	1.1000
	338.00	600	1.739	1.539	1.149	1.145	1.1470	5.05	1.1000
	338.00	660	1.737	1.538	1.151	1.146	1.1485	5.05	1.1000
	338.00	720	1.735	1.536	1.153	1.148	1.1505	5.05	1.1000
	338.00	780	1.735	1.535	1.153	1.149	1.1510	5.05	1.1000
	338.00	840	1.735	1.535	1.153	1.149	1.1510	5.05	1.1000
	338.00	900	1.734	1.536	1.154	1.148	1.1510	5.05	1.1000
	338.00	960	1.733	1.537	1.155	1.147	1.1510	5.05	1.1000
	338.00	1020	1.733	1.536	1.155	1.148	1.1515	5.05	1.1000
	338.00	1080	1.732	1.536	1.156	1.148	1.1520	5.05	1.1000
	338.00	1140	1.732	1.536	1.156	1.148	1.1520	5.05	1.1000
	338.00	1200	1.728	1.527	1.160	1.157	1.1585	5.05	1.1000

	338.00	1260	1.730	1.529	1.158	1.155	1.1565	5.10	1.1500
	338.00	1320	1.733	1.516	1.155	1.168	1.1615	5.05	1.1000
	338.00	1380	1.727	1.509	1.161	1.175	1.1680	5.11	1.1600
	338.00	1440	1.720	1.520	1.168	1.164	1.1660	5.12	1.1700
150%	253.50	60	1.924	1.703	0.964	0.981	0.9725	4.95	1.0000
100%	169.00	60	2.391	2.165	0.497	0.519	0.5080	4.55	0.6000
50%	84.50	60	2.562	2.235	0.326	0.449	0.3875	4.38	0.4300
0%	0.00	60	2.763	2.544	0.125	0.140	0.1325	4.05	0.1000
50%	84.50	20	2.533	2.323	0.355	0.361	0.3580	4.28	0.3300
100%	169.00	20	2.404	2.198	0.484	0.486	0.4850	4.40	0.4500
150%	253.50	20	2.015	1.813	0.873	0.871	0.8720	4.79	0.8400
200%	338.00	20	1.729	1.527	1.159	1.157	1.1580	5.08	1.1300
210%	354.90	20	1.665	1.463	1.223	1.221	1.2220	5.15	1.2000
220%	371.80	20	1.584	1.382	1.304	1.302	1.3030	5.20	1.2500
230%	388.70	20	1.498	1.292	1.390	1.392	1.3910	5.28	1.3300
240%	405.60	20	1.771	1.570	2.117	2.114	2.1155	6.00	2.0500
240%	405.60	20	1.277	1.273	2.611	2.411	2.5110	6.30	2.3500
240%	405.60	20	0.096	0.795	3.792	2.889	3.3405	6.77	2.8200
240%	405.60	20	0.610	0.406	3.278	3.278	3.2780	7.20	3.2500
240%	405.60	20	0.149	0.072	3.739	3.612	3.6755	7.65	3.7000
240%	405.60	20	0.240	0.037	3.648	3.647	3.6475	7.55	3.6000
86%	146.00	20	0.470	0.266	3.418	3.418	3.4180	7.35	3.4000
45%	75.70	20	0.700	0.496	3.188	3.188	3.1880	7.10	3.1500
0%	0.00	20	0.972	0.757	2.916	2.927	2.9215	6.85	2.9000

WCC - 225-ft Sector Gate
TP#9 - Steel 24" Pipe Pile - Straight Seam - Tip EL -166.0 - Service Load = 169 Tons

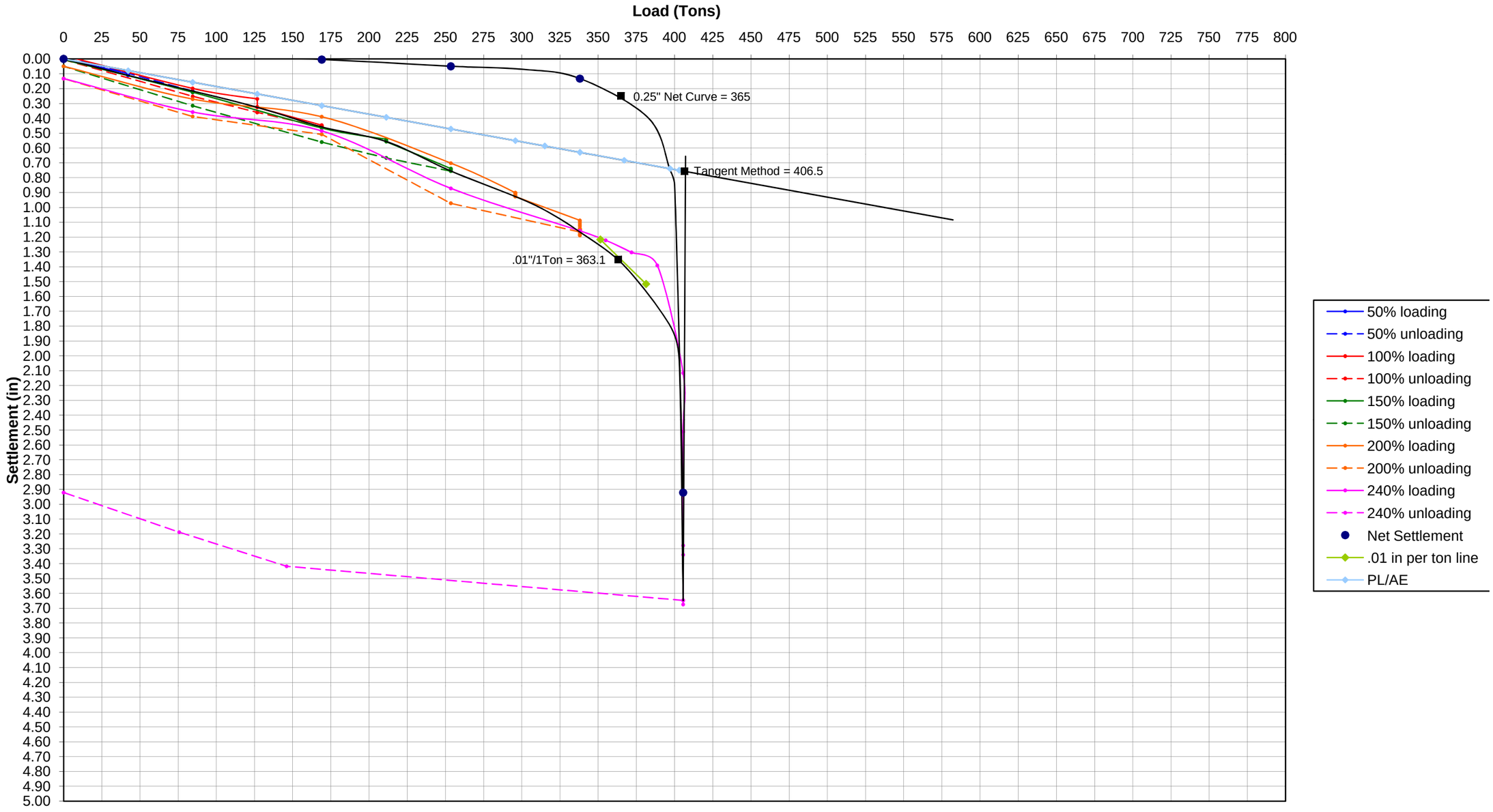


PLATE E-5-d

WCC - 225-ft Sector Gate - TP-11

30" Pipe, Tip Elevation = -174

Service Load = 225.00 **Tons**

Estimated Pile Capacity = 565 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	30
Wall Size (in)	0.625
Area (in^2)	57.7
Top Ele. (ft)	0
Tip Ele. (ft)	-174
Length (ft)	174
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	112.50	-0.0105
100%	225.00	0.0030
150%	337.50	0.0800
200%	450.00	0.0990
270%	607.50	3.6100

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	56.3	0.0805	50%	112.5	-0.0105	0.070
50%	112.5	0.1790	100%	225.0	0.0030	0.140
75%	168.8	0.2880	150%	337.5	0.0500	0.211
100%	225.0	0.4015		393.2	0.0700	0.281
125%	281.3	0.5220	200%	450.0	0.1140	0.351
150%	337.5	0.6690		536.9	0.3500	0.421
175%	393.8	0.8640		591.4	1.1950	0.492
	422.4	0.9500		604.4	2.8000	0.527
200%	450.0	1.0380	270%	607.5	3.6100	0.562
	533.3	1.3290				0.666
	588.4	1.8390				0.735
	604.4	2.7310				0.754
270%	607.5	4.5240				0.758

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**519.3**	0.25		
☑	**.01 inch/Ton Creep Rate**	**572**	1.607	559 / 589	1.474 / 1.774
☑	**Tangent Method**	**603.6**	1.012	0 / 648.5 / 0.0016715	0 / 1.084

Line T2 points	
603.1 / 607.50 / 0.8461364	0.773 / 4.496 / -509.53184

PILE CAPACITY **565.0** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**

Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.702	2.926	Dial 1	Dial 2			3.25
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.702	2.926	0.000	0.000	0.0000	3.250	0.0000
25%	56.25	2	2.612	2.842	0.090	0.084	0.0870	3.330	0.0800
	56.25	8	2.613	2.844	0.089	0.082	0.0855	3.330	0.0800
	56.25	15	2.615	2.845	0.087	0.081	0.0840	3.330	0.0800
	56.25	30	2.615	2.845	0.087	0.081	0.0840	3.330	0.0800
	56.25	60	2.617	2.846	0.085	0.080	0.0825	3.330	0.0800
	56.25	120	2.618	2.849	0.084	0.077	0.0805	3.320	0.0700
50%	112.50	2	2.515	2.754	0.187	0.172	0.1795	3.420	0.1700
	112.50	8	2.515	2.754	0.187	0.172	0.1795	3.420	0.1700
	112.50	15	2.516	2.753	0.186	0.173	0.1795	3.420	0.1700
	112.50	30	2.516	2.753	0.186	0.173	0.1795	3.410	0.1600
	112.50	60	2.514	2.753	0.188	0.173	0.1805	3.410	0.1600
	112.50	120	2.515	2.755	0.187	0.171	0.1790	3.410	0.1600
25%	56.25	20	2.613	2.851	0.089	0.075	0.0820	3.320	0.0700
0%	0.00	20	2.707	2.942	-0.005	-0.016	-0.0105	3.210	-0.0400
50%	112.50	20	2.510	2.750	0.192	0.176	0.1840	3.400	0.1500
75%	168.75	2	2.408	2.655	0.294	0.271	0.2825	3.520	0.2700
	168.75	8	2.406	2.654	0.296	0.272	0.2840	3.520	0.2700
	168.75	15	2.405	2.652	0.297	0.274	0.2855	3.520	0.2700
	168.75	30	2.405	2.652	0.297	0.274	0.2855	3.520	0.2700
	168.75	60	2.403	2.651	0.299	0.275	0.2870	3.520	0.2700
	168.75	120	2.402	2.650	0.300	0.276	0.2880	3.520	0.2700
100%	225.00	2	2.299	2.554	0.403	0.372	0.3875	3.600	0.3500
	225.00	8	2.295	2.550	0.407	0.376	0.3915	3.600	0.3500
	225.00	15	2.293	2.549	0.409	0.377	0.3930	3.600	0.3500
	225.00	30	2.291	2.548	0.411	0.378	0.3945	3.600	0.3500
	225.00	60	2.287	2.544	0.415	0.382	0.3985	3.600	0.3500
	225.00	120	2.284	2.541	0.418	0.385	0.4015	3.610	0.3600
75%	168.75	20	2.373	2.625	0.329	0.301	0.3150	3.550	0.3000
50%	112.50	20	2.475	2.723	0.227	0.203	0.2150	3.420	0.1700
0%	0.00	20	2.692	2.930	0.010	-0.004	0.0030	3.260	0.0100
50%	112.50	20	2.485	2.730	0.217	0.196	0.2065	3.450	0.2000
100%	225.00	20	2.276	2.532	0.426	0.394	0.4100	3.640	0.3900
125%	281.25	2	2.169	2.431	0.533	0.495	0.5140	3.780	0.5300
	281.25	8	2.166	2.429	0.536	0.497	0.5165	3.780	0.5300
	281.25	15	2.164	2.427	0.538	0.499	0.5185	3.780	0.5300
	281.25	30	2.162	2.425	0.540	0.501	0.5205	3.780	0.5300
	281.25	60	2.161	2.424	0.541	0.502	0.5215	3.770	0.5200
	281.25	120	2.162	2.422	0.540	0.504	0.5220	3.760	0.5100
150%	337.50	2	2.033	2.304	0.669	0.622	0.6455	3.880	0.6300
	337.50	8	2.033	2.303	0.669	0.623	0.6460	3.880	0.6300
	337.50	15	2.033	2.303	0.669	0.623	0.6460	3.880	0.6300
	337.50	30	2.029	2.296	0.673	0.630	0.6515	3.880	0.6300
	337.50	60	2.028	2.296	0.674	0.630	0.6520	3.880	0.6300
	337.50	120	2.012	2.278	0.690	0.648	0.6690	3.880	0.6300
125%	281.25	20	2.099	2.356	0.603	0.570	0.5865	3.850	0.6000
100%	225.00	20	2.186	2.438	0.516	0.488	0.5020	3.780	0.5300
50%	112.50	20	2.398	2.640	0.304	0.286	0.2950	3.530	0.2800
0%	0.00	20	2.622	2.846	0.080	0.080	0.0800	3.320	0.0700
50%	112.50	20	2.411	2.640	0.291	0.286	0.2885	3.550	0.3000
100%	225.00	20	2.198	2.439	0.504	0.487	0.4955	3.750	0.5000
150%	337.50	20	1.960	2.216	0.742	0.710	0.7260	3.950	0.7000
175%	393.75	2	1.823	2.090	0.879	0.836	0.8575	4.080	0.8300
	393.75	8	1.823	2.090	0.879	0.836	0.8575	4.080	0.8300
	393.75	15	1.823	2.090	0.879	0.836	0.8575	4.080	0.8300
	393.75	30	1.821	2.090	0.881	0.836	0.8585	4.080	0.8300
	393.75	60	1.817	2.087	0.885	0.839	0.8620	4.080	0.8300
	393.75	120	1.815	2.085	0.887	0.841	0.8640	4.080	0.8300
200%	450.00	2	1.702	1.987	1.000	0.939	0.9695	4.200	0.9500
	450.00	8	1.702	1.987	1.000	0.939	0.9695	4.200	0.9500
	450.00	15	1.702	1.987	1.000	0.939	0.9695	4.200	0.9500
	450.00	30	1.701	1.986	1.001	0.940	0.9705	4.200	0.9500
	450.00	60	1.702	1.989	1.000	0.937	0.9685	4.200	0.9500
	450.00	120	1.703	1.988	0.999	0.938	0.9685	4.200	0.9500
	450.00	180	1.703	1.986	0.999	0.940	0.9695	4.200	0.9500
	450.00	240	1.701	1.986	1.001	0.940	0.9705	4.200	0.9500
	450.00	300	1.700	1.986	1.002	0.940	0.9710	4.200	0.9500
	450.00	360	1.697	1.983	1.005	0.943	0.9740	4.200	0.9500
	450.00	420	1.693	1.980	1.009	0.946	0.9775	4.210	0.9600
	450.00	480	1.694	1.980	1.008	0.946	0.9770	4.210	0.9600
	450.00	540	1.694	1.979	1.008	0.947	0.9775	4.210	0.9600
	450.00	600	1.693	1.978	1.009	0.948	0.9785	4.210	0.9600
	450.00	660	1.692	1.977	1.010	0.949	0.9795	4.220	0.9700
	450.00	720	1.691	1.976	1.011	0.950	0.9805	4.220	0.9700
	450.00	780	1.691	1.976	1.011	0.950	0.9805	4.220	0.9700
	450.00	840	1.687	1.973	1.015	0.953	0.9840	4.220	0.9700
	450.00	900	1.680	1.967	1.022	0.959	0.9905	4.250	1.0000
	450.00	960	1.678	1.959	1.024	0.967	0.9955	4.260	1.0100
	450.00	1020	1.665	1.942	1.037	0.984	1.0105	4.290	1.0400
	450.00	1080	1.654	1.926	1.048	1.000	1.0240	4.290	1.0400
	450.00	1140	1.640	1.909	1.062	1.017	1.0395	4.300	1.0500
	450.00	1200	1.641	1.920	1.061	1.006	1.0335	4.300	1.0500

PLATE E-6-b

	450.00	1260	1.647	1.927	1.055	0.999	1.0270	4.290	1.0400
	450.00	1320	1.633	1.905	1.069	1.021	1.0450	4.300	1.0500
	450.00	1380	1.623	1.911	1.079	1.015	1.0470	4.300	1.0500
	450.00	1440	1.653	1.929	1.049	0.997	1.0230	4.250	1.0000
150%	337.50	60	1.876	2.156	0.826	0.770	0.7980	4.020	0.7700
100%	225.00	60	2.100	2.372	0.602	0.554	0.5780	3.740	0.4900
50%	112.50	60	2.336	2.591	0.366	0.335	0.3505	3.500	0.2500
0%	0.00	60	2.596	2.834	0.106	0.092	0.0990	3.260	0.0100
50%	112.50	20	2.384	2.634	0.318	0.292	0.3050	3.460	0.2100
100%	225.00	20	2.164	2.427	0.538	0.499	0.5185	3.680	0.4300
150%	337.50	20	1.935	2.208	0.767	0.718	0.7425	3.920	0.6700
200%	450.00	20	1.677	1.958	1.025	0.968	0.9965	4.180	0.9300
210%	472.50	20	1.620	1.903	1.082	1.023	1.0525	4.240	0.9900
220%	495.00	20	1.556	1.844	1.146	1.082	1.1140	4.300	1.0500
230%	517.50	20	1.492	1.785	1.210	1.141	1.1755	4.370	1.1200
240%	540.00	20	1.418	1.710	1.284	1.216	1.2500	4.450	1.2000
250%	562.50	20	1.368	1.660	1.334	1.266	1.3000	4.540	1.2900
260%	585.00	20	1.277	1.566	1.425	1.360	1.3925	4.640	1.3900
270%	607.50	20	0.640	0.920	2.062	2.006	2.0340	5.300	2.0500
270%	607.50	20	0.290	0.580	2.412	2.346	2.3790	5.630	2.3800
270%	607.50	20	1.602	2.000	3.100	2.926	3.0130	6.310	3.0600
270%	607.50	20	1.030	1.315	3.672	3.611	3.6415	6.880	3.6300
270%	607.50	20	0.150	0.430	4.552	4.496	4.5240	7.750	4.5000
203%	455.70	20	0.014	0.414	4.688	4.512	4.6000	7.800	4.5500
135%	303.80	20	0.414	0.670	4.288	4.256	4.2720	7.520	4.2700
68%	151.90	20	0.720	0.962	3.982	3.964	3.9730	7.210	3.9600
0%	0.00	20	1.087	1.321	3.615	3.605	3.6100	6.820	3.5700

WCC - 225-ft Sector Gate
TP#11 - Steel 30" Pipe Pile - Straight Seam - Tip EL -174.0 - Service Load = 225 Tons

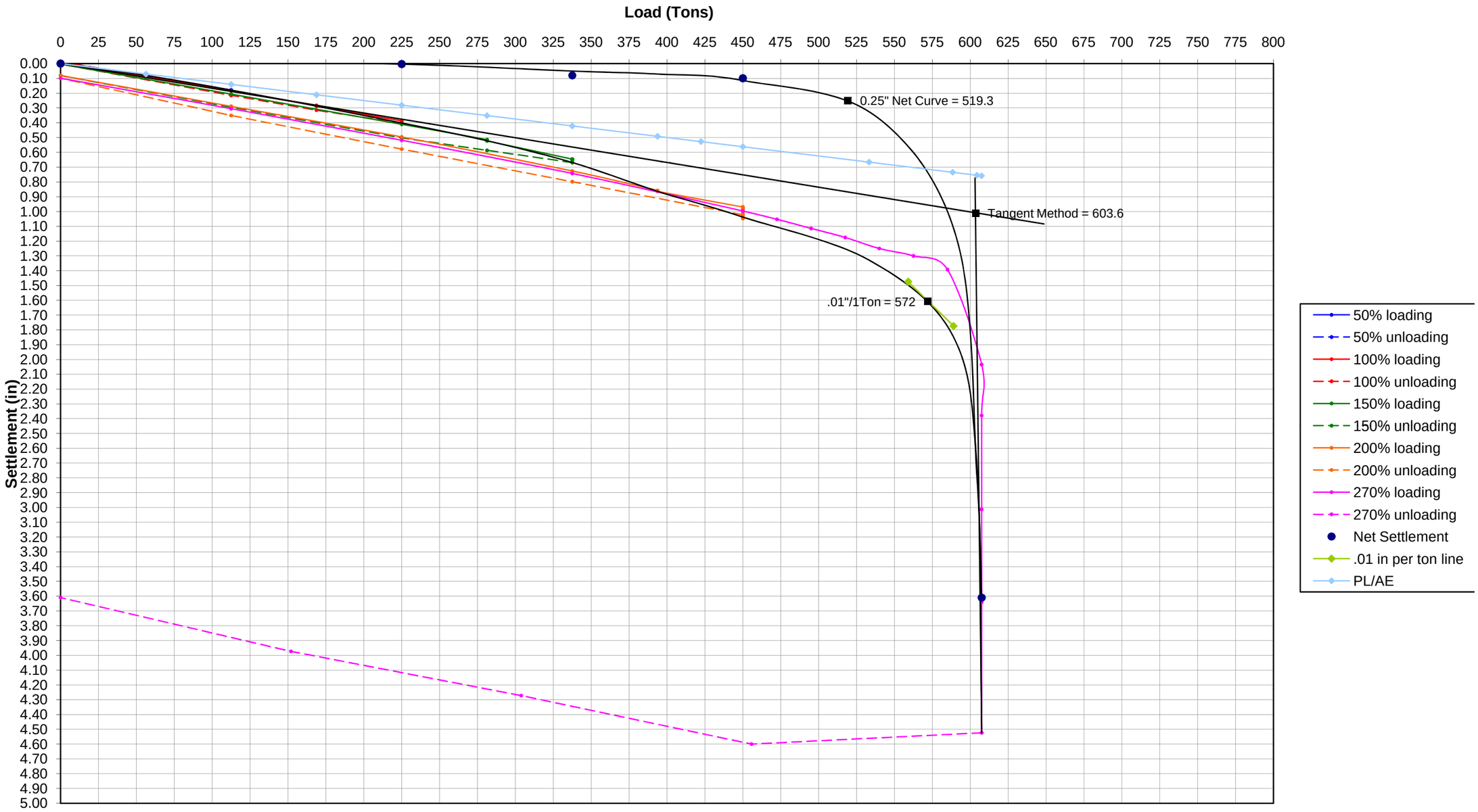


PLATE E-6-d

WCC - 225-ft Sector Gate - TP-13

30" SWP Pipe, Tip Elevation = -174

Service Load = 225.00 **Tons**

Estimated Pile Capacity = 608 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	30
Wall Size (in)	0.625
Area (in^2)	57.7
Top Ele. (ft)	0
Tip Ele. (ft)	-174
Length (ft)	174
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	112.50	-0.0180
100%	225.00	-0.0060
150%	337.50	0.0610
200%	450.00	0.0570
290%	652.50	3.8395

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	56.3	0.0795	50%	112.5	-0.0180	0.070
50%	112.5	0.1610	100%	225.0	-0.0060	0.140
75%	168.8	0.2405	150%	337.5	0.0610	0.211
100%	225.0	0.3395		400.0	0.0550	0.281
125%	281.3	0.4490	200%	450.0	0.0570	0.351
150%	337.5	0.6075		628.4	0.7110	0.421
175%	393.8	0.6825		648.4	3.6000	0.492
	425.0	0.7400		650.0	3.7000	0.531
200%	450.0	0.8020	290%	652.0	3.8395	0.562
	620.0	1.3670				0.774
	645.0	2.9000				0.805
	650.0	4.2000				0.811
290%	652.0	4.6245				0.814

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection				
☑	**.25 inch Net Deflection**	561.3	0.25				
☑	**.01 inch/Ton Creep Rate**	Capacity	Deflection	.01"/Ton line points			
		619.5	1.347	606	1.211		
				636	1.511		
☑	**Tangent Method**	Capacity	Deflection	Line T1 points		Line T2 points	
		643.3	0.92	0	0	642.9	0.842
				757.5	1.084	652.50	4.625
				0.001431		0.3940104	-252.4673

PILE CAPACITY	608.0	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.831	2.912	Dial 1	Dial 2			3.23
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.831	2.912	0.000	0.000	0.0000	3.230	0.0000
25%	56.25	2	2.739	2.822	0.092	0.090	0.0910	3.33	0.1000
	56.25	8	2.739	2.823	0.092	0.089	0.0905	3.33	0.1000
	56.25	15	2.739	2.823	0.092	0.089	0.0905	3.33	0.1000
	56.25	30	2.740	2.822	0.091	0.090	0.0905	3.33	0.1000
	56.25	60	2.740	2.824	0.091	0.088	0.0895	3.33	0.1000
	56.25	120	2.755	2.829	0.076	0.083	0.0795	3.33	0.1000
50%	112.50	2	2.670	2.751	0.161	0.161	0.1610	3.39	0.1600
	112.50	8	2.670	2.751	0.161	0.161	0.1610	3.39	0.1600
	112.50	15	2.670	2.751	0.161	0.161	0.1610	3.39	0.1600
	112.50	30	2.670	2.751	0.161	0.161	0.1610	3.39	0.1600
	112.50	60	2.670	2.751	0.161	0.161	0.1610	3.39	0.1600
	112.50	120	2.670	2.751	0.161	0.161	0.1610	3.39	0.1600
25%	56.25	20	2.752	2.829	0.079	0.083	0.0810	3.30	0.0700
0%	0.00	20	2.849	2.930	-0.018	-0.018	-0.0180	3.20	-0.0300
50%	112.50	20	2.673	2.781	0.158	0.131	0.1445	3.35	0.1200
75%	168.75	2	2.597	2.686	0.234	0.226	0.2300	3.41	0.1800
	168.75	8	2.597	2.597	0.234	0.315	0.2745	3.41	0.1800
	168.75	15	2.595	2.684	0.236	0.228	0.2320	3.42	0.1900
	168.75	30	2.592	2.681	0.239	0.231	0.2350	3.43	0.2000
	168.75	60	2.591	2.678	0.240	0.234	0.2370	3.43	0.2000
	168.75	120	2.587	2.675	0.244	0.237	0.2405	3.43	0.2000
100%	225.00	2	2.497	2.585	0.334	0.327	0.3305	3.55	0.3200
	225.00	8	2.497	2.585	0.334	0.327	0.3305	3.55	0.3200
	225.00	15	2.495	2.581	0.336	0.331	0.3335	3.55	0.3200
	225.00	30	2.494	2.580	0.337	0.332	0.3345	3.55	0.3200
	225.00	60	2.491	2.579	0.340	0.333	0.3365	3.55	0.3200
	225.00	120	2.488	2.576	0.343	0.336	0.3395	3.57	0.3400
75%	168.75	20	2.569	2.656	0.262	0.256	0.2590	3.49	0.2600
50%	112.50	20	2.645	2.731	0.186	0.181	0.1835	3.41	0.1800
0%	0.00	20	2.838	2.917	-0.007	-0.005	-0.0060	3.23	0.0000
50%	112.50	20	2.656	2.743	0.175	0.169	0.1720	3.40	0.1700
100%	225.00	20	2.484	2.571	0.347	0.341	0.3440	3.55	0.3200
125%	281.25	2	2.388	2.472	0.443	0.440	0.4415	3.65	0.4200
	281.25	8	2.388	2.471	0.443	0.441	0.4420	3.67	0.4400
	281.25	15	2.384	2.469	0.447	0.443	0.4450	3.67	0.4400
	281.25	30	2.380	2.465	0.451	0.447	0.4490	3.67	0.4400
	281.25	60	2.380	2.465	0.451	0.447	0.4490	3.67	0.4400
	281.25	120	2.358	2.440	0.473	0.472	0.4725	3.68	0.4500
150%	337.50	2	2.254	2.339	0.577	0.573	0.5750	3.79	0.5600
	337.50	8	2.251	2.337	0.580	0.575	0.5775	3.79	0.5600
	337.50	15	2.250	2.336	0.581	0.576	0.5785	3.79	0.5600
	337.50	30	2.241	2.332	0.590	0.580	0.5850	3.81	0.5800
	337.50	60	2.230	2.321	0.601	0.591	0.5960	3.81	0.5800
	337.50	120	2.218	2.310	0.613	0.602	0.6075	3.82	0.5900
125%	281.25	20	2.285	2.375	0.546	0.537	0.5415	3.75	0.5200
100%	225.00	20	2.368	2.450	0.463	0.462	0.4625	3.65	0.4200
50%	112.50	20	2.548	2.635	0.283	0.277	0.2800	3.53	0.3000
0%	0.00	20	2.776	2.845	0.055	0.067	0.0610	3.30	0.0700
50%	112.50	20	2.608	2.690	0.223	0.222	0.2225	3.47	0.2400
100%	225.00	20	2.441	2.526	0.390	0.386	0.3880	3.64	0.4100
150%	337.50	20	2.255	2.338	0.576	0.574	0.5750	3.80	0.5700
175%	393.75	2	2.159	2.329	0.672	0.583	0.6275	3.89	0.6600
	393.75	8	2.159	2.324	0.672	0.588	0.6300	3.89	0.6600
	393.75	15	2.159	2.222	0.672	0.690	0.6810	3.89	0.6600
	393.75	30	2.153	2.216	0.678	0.696	0.6870	3.89	0.6600
	393.75	60	2.147	2.216	0.684	0.696	0.6900	3.89	0.6600
	393.75	120	2.153	2.225	0.678	0.687	0.6825	3.87	0.6400
200%	450.00	2	2.052	2.127	0.779	0.785	0.7820	3.95	0.7200
	450.00	8	2.052	2.127	0.779	0.785	0.7820	3.95	0.7200
	450.00	15	2.048	2.123	0.783	0.789	0.7860	3.95	0.7200
	450.00	30	2.044	2.120	0.787	0.792	0.7895	3.96	0.7300
	450.00	60	2.042	2.118	0.789	0.794	0.7915	3.96	0.7300
	450.00	120	2.040	2.116	0.791	0.796	0.7935	3.96	0.7300
	450.00	180	2.039	2.115	0.792	0.797	0.7945	3.98	0.7500
	450.00	240	2.037	2.112	0.794	0.800	0.7970	3.99	0.7600
	450.00	300	2.036	2.108	0.795	0.804	0.7995	4.00	0.7700
	450.00	360	2.033	2.107	0.798	0.805	0.8015	4.00	0.7700
	450.00	420	2.038	2.106	0.793	0.806	0.7995	4.00	0.7700
	450.00	480	2.036	2.104	0.795	0.808	0.8015	4.00	0.7700
	450.00	540	2.036	2.105	0.795	0.807	0.8010	4.00	0.7700
	450.00	600	2.034	2.103	0.797	0.809	0.8030	4.00	0.7700
	450.00	660	2.035	2.107	0.796	0.805	0.8005	4.00	0.7700
	450.00	720	2.031	2.098	0.800	0.814	0.8070	4.00	0.7700
	450.00	780	2.031	2.087	0.800	0.825	0.8125	4.00	0.7700
	450.00	840	2.009	2.073	0.822	0.839	0.8305	4.05	0.8200
	450.00	900	1.988	2.062	0.843	0.850	0.8465	4.05	0.8200
	450.00	960	1.958	2.030	0.873	0.882	0.8775	4.05	0.8200
	450.00	1020	1.944	2.018	0.887	0.894	0.8905	4.09	0.8600
	450.00	1080	1.978	2.052	0.853	0.860	0.8565	4.08	0.8500
	450.00	1140	1.994	2.066	0.837	0.846	0.8415	4.06	0.8300
	450.00	1200	2.008	2.075	0.823	0.837	0.8300	4.06	0.8300

	450.00	1260	2.015	2.089	0.816	0.823	0.8195	4.05	0.8200
	450.00	1320	2.046	2.080	0.785	0.832	0.8085	4.02	0.7900
	450.00	1380	2.040	2.085	0.791	0.827	0.8090	4.00	0.7700
	450.00	1440	2.046	2.093	0.785	0.819	0.8020	3.91	0.6800
150%	337.50	60	2.209	2.261	0.622	0.651	0.6365	3.74	0.5100
100%	225.00	60	2.395	2.445	0.436	0.467	0.4515	3.59	0.3600
50%	112.50	60	2.581	2.628	0.250	0.284	0.2670	3.41	0.1800
0%	0.00	60	2.796	2.833	0.035	0.079	0.0570	3.21	-0.0200
50%	112.50	20	2.612	2.654	0.219	0.258	0.2385	3.39	0.1600
100%	225.00	20	2.433	2.475	0.398	0.437	0.4175	3.57	0.3400
150%	337.50	20	2.239	2.381	0.592	0.531	0.5615	3.78	0.5500
200%	450.00	20	2.043	2.181	0.788	0.731	0.7595	3.97	0.7400
210%	472.50	20	2.000	2.044	0.831	0.868	0.8495	4.01	0.7800
220%	495.00	20	1.957	2.001	0.874	0.911	0.8925	4.05	0.8200
230%	517.50	20	1.917	1.959	0.914	0.953	0.9335	4.09	0.8600
240%	540.00	20	1.881	1.916	0.950	0.996	0.9730	4.13	0.9000
250%	562.50	20	1.836	1.862	0.995	1.050	1.0225	4.19	0.9600
260%	585.00	20	1.778	1.802	1.053	1.110	1.0815	4.24	1.0100
270%	607.50	20	1.733	1.718	1.098	1.194	1.1460	4.31	1.0800
280%	630.00	20	1.647	1.651	1.184	1.261	1.2225	4.38	1.1500
290%	652.50	20	1.510	1.511	1.321	1.401	1.3610	4.49	1.2600
290%	652.50	20	1.430	1.450	1.401	1.462	1.4315	4.53	1.3000
290%	652.50	20	1.390	1.330	1.441	1.582	1.5115	4.62	1.3900
290%	652.50	20	1.144	1.131	1.687	1.781	1.7340	4.96	1.7300
290%	652.50	20	0.825	0.822	2.006	2.090	2.0480	5.20	1.9700
290%	652.50	20	2.725	2.720	2.106	2.192	2.1490	5.29	2.0600
290%	652.50	20	1.970	1.965	2.861	2.947	2.9040	6.06	2.8300
290%	652.50	20	1.325	1.320	3.506	3.592	3.5490	6.81	3.5800
290%	652.50	20	0.810	0.810	4.021	4.102	4.0615	7.19	3.9600
290%	652.50	20	0.471	0.472	4.360	4.440	4.4000	7.53	4.3000
290%	652.50	20	0.250	0.244	4.581	4.668	4.6245	7.78	4.5500
166%	374.50	20	0.396	0.406	4.435	4.506	4.4705	7.63	4.4000
111%	249.70	20	0.663	0.679	4.168	4.233	4.2005	7.35	4.1200
56%	124.90	20	0.802	0.821	4.029	4.091	4.0600	7.22	3.9900
0%	0.00	20	1.010	1.054	3.821	3.858	3.8395	6.98	3.7500

WCC - 225-ft Sector Gate
TP#13 - Steel 30" Pipe Pile - Straight Seam - Tip EL -174.0 - Service Load = 225 Tons

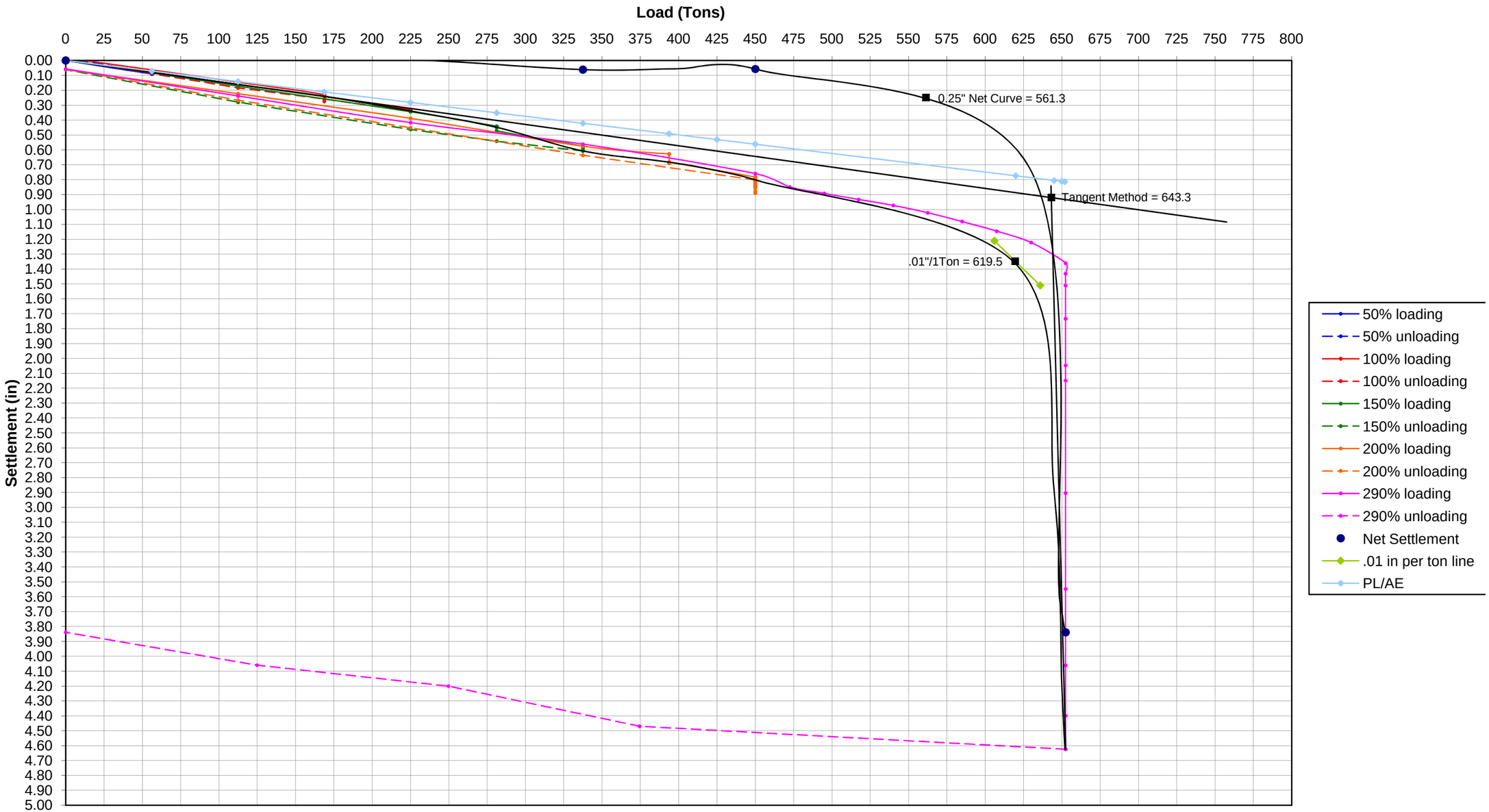


PLATE E-7-d

WCC - 404c Wall - TP-19

18" Pipe, Tip Elevation = -129

Service Load = 71.00 **Tons**

Estimated Pile Capacity = 171 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	18
Wall Size (in)	0.500
Area (in^2)	27.5
Top Ele. (ft)	0
Tip Ele. (ft)	-129
Length (ft)	129
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	35.50	0.0860
100%	71.00	0.0785
150%	106.50	0.0400
200%	142.00	0.1860
280%	198.80	2.3355

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	17.8	0.1730	50%	35.5	0.0860	0.034
50%	35.5	0.2155	100%	71.0	0.0785	0.069
75%	53.3	0.2425	150%	106.5	0.0870	0.103
100%	71.0	0.2985		125.3	0.0910	0.138
125%	88.8	0.3625	200%	142.0	0.1860	0.172
150%	106.5	0.4330		172.1	0.4450	0.207
175%	124.3	0.5260		193.3	0.8900	0.241
	134.4	0.5720		199.5	1.7700	0.261
200%	142.0	0.6200	280%	198.8	2.3355	0.276
	175.7	0.9500				0.341
	195.9	1.5000				0.380
	198.0	2.0980				0.384
280%	198.8	2.9225				0.386

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**151.7**	0.25		
☑	**.01 inch/Ton Creep Rate**	**165.6**	0.829	152.7 182.7	0.687 0.987
☑	**Tangent Method**	**196.9**	0.796	0 232.2 0.0040138	0 0.932

Line T2 points	
196.9	0.578
198.80	2.923
1.2339474	-242.38624

PILE CAPACITY	**171.4**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.996	2.98	Dial 1	Dial 2			2.00
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.996	2.980	0.000	0.000	0.0000	2.000	0.0000
25%	17.75	2	2.829	2.831	0.167	0.149	0.1580	2.07	0.0700
	17.75	8	2.828	2.830	0.168	0.150	0.1590	2.08	0.0800
	17.75	15	2.827	2.829	0.169	0.151	0.1600	2.08	0.0800
	17.75	30	2.820	2.823	0.176	0.157	0.1665	2.08	0.0800
	17.75	60	2.812	2.818	0.184	0.162	0.1730	2.08	0.0800
	17.75	120	2.812	2.818	0.184	0.162	0.1730	2.08	0.0800
50%	35.50	2	2.759	2.754	0.237	0.226	0.2315	2.14	0.1400
	35.50	8	2.759	2.754	0.237	0.226	0.2315	2.14	0.1400
	35.50	15	2.758	2.755	0.238	0.225	0.2315	2.14	0.1400
	35.50	30	2.756	2.756	0.240	0.224	0.2320	2.14	0.1400
	35.50	60	2.752	2.755	0.244	0.225	0.2345	2.14	0.1400
	35.50	120	2.768	2.777	0.228	0.203	0.2155	2.14	0.1400
25%	17.75	20	2.832	2.838	0.164	0.142	0.1530	2.08	0.0800
0%	0.00	20	2.898	2.906	0.098	0.074	0.0860	2.00	0.0000
50%	35.50	20	2.793	2.791	0.203	0.189	0.1960	2.12	0.1200
75%	53.25	2	2.751	2.745	0.245	0.235	0.2400	2.18	0.1800
	53.25	8	2.748	2.744	0.248	0.236	0.2420	2.18	0.1800
	53.25	15	2.742	2.742	0.254	0.238	0.2460	2.18	0.1800
	53.25	30	2.748	2.741	0.248	0.239	0.2435	2.18	0.1800
	53.25	60	2.742	2.739	0.254	0.241	0.2475	2.19	0.1900
	53.25	120	2.750	2.741	0.246	0.239	0.2425	2.19	0.1900
100%	71.00	2	2.702	2.691	0.294	0.289	0.2915	2.21	0.2100
	71.00	8	2.701	2.688	0.295	0.292	0.2935	2.21	0.2100
	71.00	15	2.700	2.686	0.296	0.294	0.2950	2.21	0.2100
	71.00	30	2.699	2.685	0.297	0.295	0.2960	2.22	0.2200
	71.00	60	2.698	2.685	0.298	0.295	0.2965	2.22	0.2200
	71.00	120	2.697	2.682	0.299	0.298	0.2985	2.22	0.2200
75%	53.25	20	2.739	2.728	0.257	0.252	0.2545	2.19	0.1900
50%	35.50	20	2.786	2.777	0.210	0.203	0.2065	2.12	0.1200
0%	0.00	20	2.909	2.910	0.087	0.070	0.0785	1.99	-0.0100
50%	35.50	20	2.793	2.786	0.203	0.194	0.1985	2.11	0.1100
100%	71.00	20	2.698	2.684	0.298	0.296	0.2970	2.22	0.2200
125%	88.75	2	2.645	2.625	0.351	0.355	0.3530	2.29	0.2900
	88.75	8	2.642	2.623	0.354	0.357	0.3555	2.29	0.2900
	88.75	15	2.641	2.621	0.355	0.359	0.3570	2.29	0.2900
	88.75	30	2.640	2.620	0.356	0.360	0.3580	2.29	0.2900
	88.75	60	2.637	2.616	0.359	0.364	0.3615	2.29	0.2900
	88.75	120	2.636	2.615	0.360	0.365	0.3625	2.29	0.2900
150%	106.50	2	2.581	2.555	0.415	0.425	0.4200	2.34	0.3400
	106.50	8	2.577	2.552	0.419	0.428	0.4235	2.35	0.3500
	106.50	15	2.577	2.552	0.419	0.428	0.4235	2.35	0.3500
	106.50	30	2.573	2.574	0.423	0.406	0.4145	2.35	0.3500
	106.50	60	2.571	2.544	0.425	0.436	0.4305	2.35	0.3500
	106.50	120	2.568	2.542	0.428	0.438	0.4330	2.36	0.3600
125%	88.75	20	2.616	2.591	0.380	0.389	0.3845	2.31	0.3100
100%	71.00	20	2.663	2.644	0.333	0.336	0.3345	2.25	0.2500
50%	35.50	20	2.766	2.755	0.230	0.225	0.2275	2.15	0.1500
0%	0.00	20	2.898	2.998	0.098	-0.018	0.0400	2.00	0.0000
50%	35.50	20	2.774	2.768	0.222	0.212	0.2170	2.13	0.1300
100%	71.00	20	2.671	2.657	0.325	0.323	0.3240	2.22	0.2200
150%	106.50	20	2.561	2.537	0.435	0.443	0.4390	2.35	0.3500
175%	124.25	2	2.503	2.474	0.493	0.506	0.4995	2.42	0.4200
	124.25	8	2.500	2.471	0.496	0.509	0.5025	2.42	0.4200
	124.25	15	2.498	2.470	0.498	0.510	0.5040	2.41	0.4100
	124.25	30	2.498	2.469	0.498	0.511	0.5045	2.40	0.4000
	124.25	60	2.492	2.462	0.504	0.518	0.5110	2.42	0.4200
	124.25	120	2.480	2.444	0.516	0.536	0.5260	2.42	0.4200
200%	142.00	2	2.423	2.379	0.573	0.601	0.5870	2.50	0.5000
	142.00	8	2.420	2.375	0.576	0.605	0.5905	2.50	0.5000
	142.00	15	2.416	2.371	0.580	0.609	0.5945	2.50	0.5000
	142.00	30	2.411	2.365	0.585	0.615	0.6000	2.50	0.5000
	142.00	60	2.396	2.363	0.600	0.617	0.6085	2.50	0.5000
	142.00	120	2.383	2.353	0.613	0.627	0.6200	2.53	0.5300
	142.00	180	2.361	2.335	0.635	0.645	0.6400	2.53	0.5300
	142.00	240	2.375	2.340	0.621	0.640	0.6305	2.54	0.5400
	142.00	300	2.381	2.340	0.615	0.640	0.6275	2.55	0.5500
	142.00	360	2.380	2.348	0.616	0.632	0.6240	2.53	0.5300
	142.00	420	2.398	2.360	0.598	0.620	0.6090	2.53	0.5300
	142.00	480	2.402	2.362	0.594	0.618	0.6060	2.52	0.5200
	142.00	540	2.404	2.365	0.592	0.615	0.6035	2.51	0.5100
	142.00	600	2.407	2.367	0.589	0.613	0.6010	2.51	0.5100
	142.00	660	2.406	2.367	0.590	0.613	0.6015	2.51	0.5100
	142.00	720	2.405	2.365	0.591	0.615	0.6030	2.51	0.5100
	142.00	780	2.405	2.365	0.591	0.615	0.6030	2.51	0.5100
	142.00	840	2.405	2.365	0.591	0.615	0.6030	2.51	0.5100
	142.00	900	2.403	2.361	0.593	0.619	0.6060	2.51	0.5100
	142.00	960	2.403	2.361	0.593	0.619	0.6060	2.52	0.5200
	142.00	1020	2.403	2.361	0.593	0.619	0.6060	2.51	0.5100
	142.00	1080	2.398	2.353	0.598	0.627	0.6125	2.52	0.5200
	142.00	1140	2.393	2.353	0.603	0.627	0.6150	2.52	0.5200
	142.00	1200	2.395	2.354	0.601	0.626	0.6135	2.52	0.5200

	142.00	1260	2.395	2.356	0.601	0.624	0.6125	2.53	0.5300
	142.00	1320	2.394	2.356	0.602	0.624	0.6130	2.54	0.5400
	142.00	1380	2.385	2.357	0.611	0.623	0.6170	2.54	0.5400
	142.00	1440	2.389	2.347	0.607	0.633	0.6200	2.57	0.5700
150%	106.50	60	2.480	2.449	0.516	0.531	0.5235	2.40	0.4000
100%	71.00	60	2.570	2.554	0.426	0.426	0.4260	2.31	0.3100
50%	35.50	60	2.662	2.654	0.334	0.326	0.3300	2.20	0.2000
0%	0.00	60	2.793	2.811	0.203	0.169	0.1860	2.05	0.0500
50%	35.50	20	2.678	2.686	0.318	0.294	0.3060	2.18	0.1800
100%	71.00	20	2.586	2.578	0.410	0.402	0.4060	2.29	0.2900
150%	106.50	20	2.483	2.470	0.513	0.510	0.5115	2.40	0.4000
200%	142.00	20	2.375	2.345	0.621	0.635	0.6280	2.54	0.5400
210%	149.10	20	2.356	2.316	0.640	0.664	0.6520	2.57	0.5700
220%	156.20	20	2.329	2.288	0.667	0.692	0.6795	2.58	0.5800
230%	163.30	20	2.299	2.251	0.697	0.729	0.7130	2.63	0.6300
240%	170.40	20	2.277	2.211	0.719	0.769	0.7440	2.68	0.6800
250%	177.50	20	2.219	2.164	0.777	0.816	0.7965	2.72	0.7200
260%	184.60	20	2.172	2.114	0.824	0.866	0.8450	2.77	0.7700
270%	191.70	20	2.110	2.050	0.886	0.930	0.9080	2.82	0.8200
280%	198.80	20	1.572	1.512	1.424	1.468	1.4460	3.28	1.2800
	198.80	20	0.472	0.314	2.524	2.666	2.5950	4.58	2.5800
	198.80	20	0.095	0.036	2.901	2.944	2.9225	4.84	2.8400
220%	156.00	20	0.116	0.062	2.880	2.918	2.8990	4.82	2.8200
150%	106.50	20	0.254	0.212	2.742	2.768	2.7550	4.68	2.6800
75%	53.00	20	0.437	0.412	2.559	2.568	2.5635	4.48	2.4800
0%	0.00	20	0.655	0.650	2.341	2.330	2.3355	4.23	2.2300

WCC - 404c Wall
TP#19 - Steel 18" Pipe Pile - Straight Seam - Tip EL -129.0 - Service Load = 71 Tons

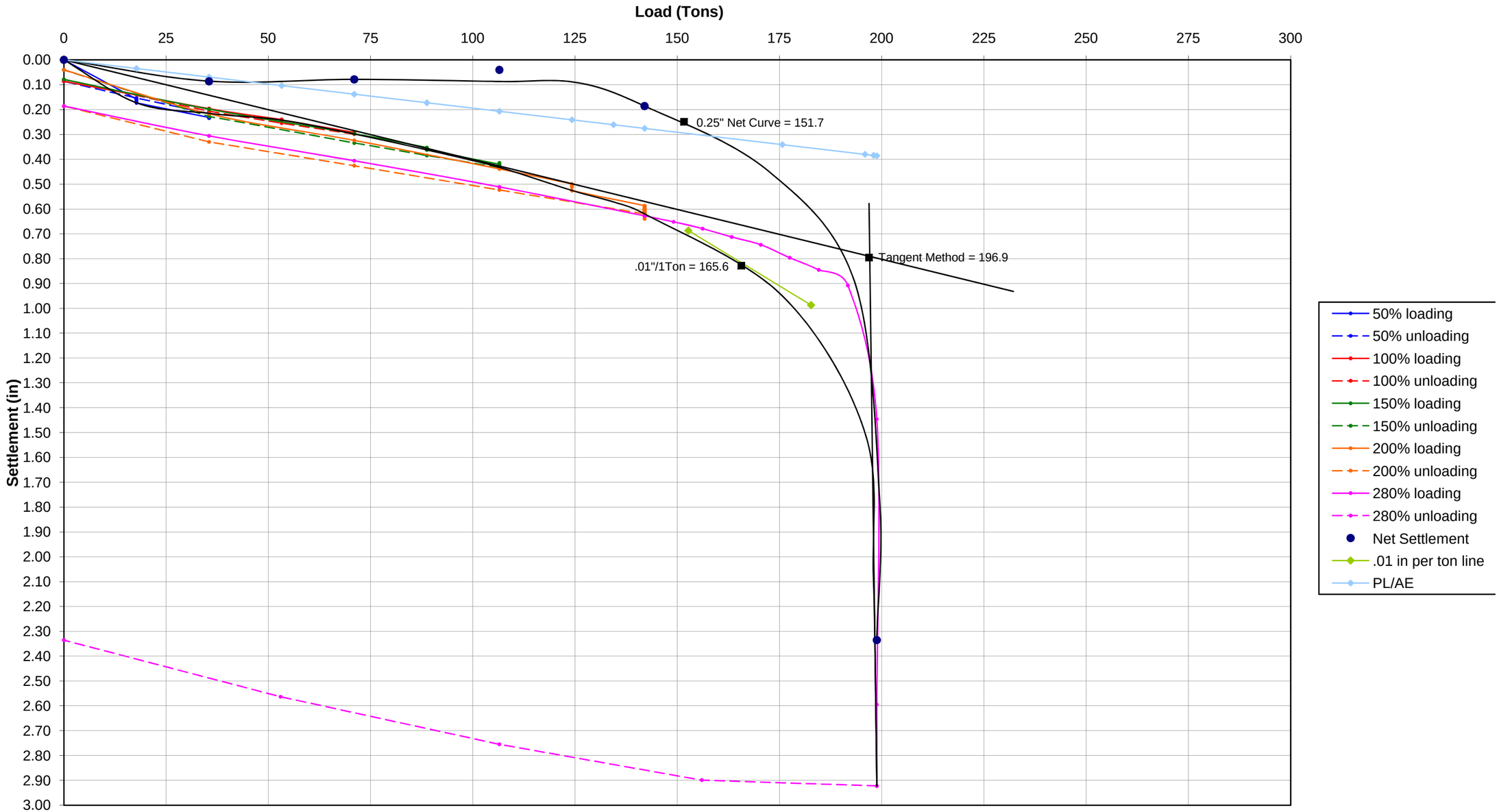


PLATE E-8-d

WCC -404c Wall - TP-21

18" Pipe, Tip Elevation = -105

Service Load = 48.00 **Tons**

Estimated Pile Capacity = 98 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	18
Wall Size (in)	0.500
Area (in^2)	27.5
Top Ele. (ft)	0
Tip Ele. (ft)	-105
Length (ft)	105
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	24.00	0.1180
100%	48.00	0.1355
150%	72.00	0.1390
200%	96.00	0.2965
240%	115.20	2.5950

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	12.0	0.1460	50%	24.0	0.1180	0.019
50%	24.0	0.1995	100%	48.0	0.1355	0.038
75%	36.0	0.2470	150%	72.0	0.1390	0.057
100%	48.0	0.2955		85.3	0.1950	0.076
125%	60.0	0.3380	200%	96.0	0.2965	0.095
150%	72.0	0.4010		106.4	0.4950	0.114
175%	84.0	0.4370		114.0	0.8740	0.133
	90.9	0.5230		115.0	1.7000	0.144
200%	96.0	0.6255	240%	115.2	2.5950	0.152
	107.0	0.9060				0.169
	114.0	1.3430				0.180
	115.0	2.0000				0.182
240%	115.2	2.8485				0.182

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**92.4**	0.25		
☑	**.01 inch/Ton Creep Rate**	**85**	0.448	71.9 101.9	0.307 0.607
☑	**Tangent Method**	**115.3**	0.596	0 138.8 0.0051513	0 0.715

Line T2 points	
115.3	0.235
115.20	2.849
-26.135	3013.6005

PILE CAPACITY	**97.6**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**

Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.995	2.995	Dial 1	Dial 2			1.02
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.995	2.995	0.000	0.000	0.0000	1.020	0.0000
25%	12.00	2	2.860	2.855	0.135	0.140	0.1375	1.05	0.0300
	12.00	8	2.860	2.855	0.135	0.140	0.1375	1.05	0.0300
	12.00	15	2.858	2.854	0.137	0.141	0.1390	1.05	0.0300
	12.00	30	2.855	2.851	0.140	0.144	0.1420	1.05	0.0300
	12.00	60	2.853	2.849	0.142	0.146	0.1440	1.05	0.0300
	12.00	120	2.851	2.847	0.144	0.148	0.1460	1.06	0.0400
50%	24.00	2	2.806	2.801	0.189	0.194	0.1915	1.09	0.0700
	24.00	8	2.806	2.801	0.189	0.194	0.1915	1.09	0.0700
	24.00	15	2.805	2.800	0.190	0.195	0.1925	1.09	0.0700
	24.00	30	2.804	2.798	0.191	0.197	0.1940	1.09	0.0700
	24.00	60	2.802	2.799	0.193	0.196	0.1945	1.10	0.0800
	24.00	120	2.798	2.793	0.197	0.202	0.1995	1.10	0.0800
25%	12.00	20	2.836	2.836	0.159	0.159	0.1590	1.070	0.0500
0%	0.00	20	2.876	2.878	0.119	0.117	0.1180	1.040	0.0200
50%	24.00	20	2.796	2.794	0.199	0.201	0.2000	1.100	0.0800
75%	36.00	2	2.755	2.753	0.240	0.242	0.2410	1.14	0.1200
	36.00	8	2.753	2.752	0.242	0.243	0.2425	1.14	0.1200
	36.00	15	2.752	2.751	0.243	0.244	0.2435	1.14	0.1200
	36.00	30	2.751	2.749	0.244	0.246	0.2450	1.14	0.1200
	36.00	60	2.750	2.748	0.245	0.247	0.2460	1.14	0.1200
	36.00	120	2.749	2.747	0.246	0.248	0.2470	1.14	0.1200
100%	48.00	2	2.710	2.709	0.285	0.286	0.2855	1.17	0.1500
	48.00	8	2.708	2.707	0.287	0.288	0.2875	1.17	0.1500
	48.00	15	2.705	2.703	0.290	0.292	0.2910	1.17	0.1500
	48.00	30	2.704	2.702	0.291	0.293	0.2920	1.17	0.1500
	48.00	60	2.703	2.700	0.292	0.295	0.2935	1.17	0.1500
	48.00	120	2.702	2.697	0.293	0.298	0.2955	1.17	0.1500
75%	36.00	20	2.728	2.724	0.267	0.271	0.2690	1.160	0.1400
50%	24.00	20	2.766	2.763	0.229	0.232	0.2305	1.130	0.1100
0%	0.00	20	2.859	2.860	0.136	0.135	0.1355	1.160	0.1400
50%	24.00	20	2.781	2.778	0.214	0.217	0.2155	1.120	0.1000
100%	48.00	20	2.708	2.703	0.287	0.292	0.2895	1.180	0.1600
125%	60.00	2	2.671	2.664	0.324	0.331	0.3275	1.19	0.1700
	60.00	8	2.669	2.663	0.326	0.332	0.3290	1.19	0.1700
	60.00	15	2.666	2.660	0.329	0.335	0.3320	1.20	0.1800
	60.00	30	2.664	2.656	0.331	0.339	0.3350	1.20	0.1800
	60.00	60	2.661	2.654	0.334	0.341	0.3375	1.21	0.1900
	60.00	120	2.661	2.653	0.334	0.342	0.3380	1.21	0.1900
150%	72.00	2	2.621	2.613	0.374	0.382	0.3780	1.25	0.2300
	72.00	8	2.620	2.611	0.375	0.384	0.3795	1.25	0.2300
	72.00	15	2.614	2.607	0.381	0.388	0.3845	1.25	0.2300
	72.00	30	2.612	2.605	0.383	0.390	0.3865	1.25	0.2300
	72.00	60	2.611	2.603	0.384	0.392	0.3880	1.26	0.2400
	72.00	120	2.601	2.587	0.394	0.408	0.4010	1.26	0.2400
125%	60.00	20	2.632	2.632	0.363	0.363	0.3630	1.230	0.2100
100%	48.00	20	2.664	2.678	0.331	0.317	0.3240	1.200	0.1800
50%	24.00	20	2.737	2.759	0.258	0.236	0.2470	1.040	0.0200
0%	0.00	20	2.847	2.865	0.148	0.130	0.1390	1.000	-0.0200
50%	24.00	20	2.769	2.778	0.226	0.217	0.2215	1.030	0.0100
100%	48.00	20	2.709	2.708	0.286	0.287	0.2865	1.170	0.1500
150%	72.00	20	2.622	2.638	0.373	0.357	0.3650	1.230	0.2100
175%	84.00	2	2.577	2.596	0.418	0.399	0.4085	1.40	0.3800
	84.00	8	2.573	2.593	0.422	0.402	0.4120	1.27	0.2500
	84.00	15	2.573	2.588	0.422	0.407	0.4145	1.28	0.2600
	84.00	30	2.570	2.587	0.425	0.408	0.4165	1.28	0.2600
	84.00	60	2.571	2.576	0.424	0.419	0.4215	1.29	0.2700
	84.00	120	2.563	2.553	0.432	0.442	0.4370	1.30	0.2800
200%	96.00	2	2.509	2.501	0.486	0.494	0.4900	1.35	0.3300
	96.00	8	2.500	2.491	0.495	0.504	0.4995	1.36	0.3400
	96.00	15	2.494	2.484	0.501	0.511	0.5060	1.37	0.3500
	96.00	30	2.478	2.468	0.517	0.527	0.5220	1.38	0.3600
	96.00	60	2.463	2.456	0.532	0.539	0.5355	1.38	0.3600
	96.00	120	2.433	2.423	0.562	0.572	0.5670	1.42	0.4000
	96.00	180	2.411	2.405	0.584	0.590	0.5870	1.42	0.4000
	96.00	240	2.409	2.400	0.586	0.595	0.5905	1.43	0.4100
	96.00	300	2.400	2.391	0.595	0.604	0.5995	1.44	0.4200
	96.00	360	2.392	2.383	0.603	0.612	0.6075	1.45	0.4300
	96.00	420	2.389	2.380	0.606	0.615	0.6105	1.45	0.4300
	96.00	480	2.382	2.375	0.613	0.620	0.6165	1.45	0.4300
	96.00	540	2.381	2.374	0.614	0.621	0.6175	1.45	0.4300
	96.00	600	2.380	2.371	0.615	0.624	0.6195	1.45	0.4300
	96.00	660	2.376	2.362	0.619	0.633	0.6260	1.45	0.4300
	96.00	720	2.374	2.366	0.621	0.629	0.6250	1.45	0.4300
	96.00	780	2.370	2.361	0.625	0.634	0.6295	1.46	0.4400
	96.00	840	2.368	2.359	0.627	0.636	0.6315	1.47	0.4500
	96.00	900	2.366	2.357	0.629	0.638	0.6335	1.47	0.4500
	96.00	960	2.363	2.354	0.632	0.641	0.6365	1.47	0.4500
	96.00	1020	2.366	2.356	0.629	0.639	0.6340	1.47	0.4500
	96.00	1080	2.372	2.363	0.623	0.632	0.6275	1.47	0.4500
	96.00	1140	2.379	2.368	0.616	0.627	0.6215	1.47	0.4500
	96.00	1200	2.384	2.375	0.611	0.620	0.6155	1.47	0.4500

	96.00	1260	2.380	2.370	0.615	0.625	0.6200	1.47	0.4500
	96.00	1320	2.376	2.366	0.619	0.629	0.6240	1.47	0.4500
	96.00	1380	2.378	2.363	0.617	0.632	0.6245	1.47	0.4500
	96.00	1440	2.377	2.362	0.618	0.633	0.6255	1.47	0.4500
150%	72.00	60	2.441	2.429	0.554	0.566	0.5600	1.420	0.4000
100%	48.00	60	2.506	2.512	0.489	0.483	0.4860	1.350	0.3300
50%	24.00	60	2.589	2.576	0.406	0.419	0.4125	1.300	0.2800
0%	0.00	60	2.701	2.696	0.294	0.299	0.2965	1.200	0.1800
50%	24.00	20	2.615	2.605	0.380	0.390	0.3850	1.270	0.2500
100%	48.00	20	2.532	2.542	0.463	0.453	0.4580	1.340	0.3200
150%	72.00	20	2.449	2.438	0.546	0.557	0.5515	1.390	0.3700
200%	96.00	20	2.352	2.345	0.643	0.650	0.6465	1.490	0.4700
210%	100.80	20	2.326	2.319	0.669	0.676	0.6725	1.510	0.4900
220%	105.60	20	2.306	2.296	0.689	0.699	0.6940	1.530	0.5100
230%	110.40	20	2.249	2.241	0.746	0.754	0.7500	1.570	0.5500
240%	115.20	20	1.741	1.732	1.254	1.263	1.2585	2.040	1.0200
	115.20	20	1.490	1.478	1.505	1.517	1.5110	2.300	1.2800
	115.20	20	2.285	2.276	1.710	1.719	1.7145	2.55	1.5300
	115.20	20	2.229	2.221	1.766	1.774	1.7700	2.60	1.5800
	115.20	20	2.056	1.939	1.939	2.056	1.9975	2.78	1.7600
	115.20	20	1.152	1.146	2.843	2.849	2.8460	3.79	2.7700
	115.20	20	1.150	1.143	2.845	2.852	2.8485	3.78	2.7600
146%	70.00	20	1.111	1.107	2.884	2.888	2.8860	3.730	2.7100
83%	40.00	20	1.199	1.195	2.796	2.800	2.7980	3.670	2.6500
42%	20.00	20	1.199	1.195	2.796	2.800	2.7980	3.670	2.6500
0%	0.00	20	1.402	1.398	2.593	2.597	2.5950	3.500	2.4800

WCC - 404c Wall
TP#21 - Steel 18" Pipe Pile - Spiral Seam - Tip EL -105.0 - Service Load = 48 Tons Tension

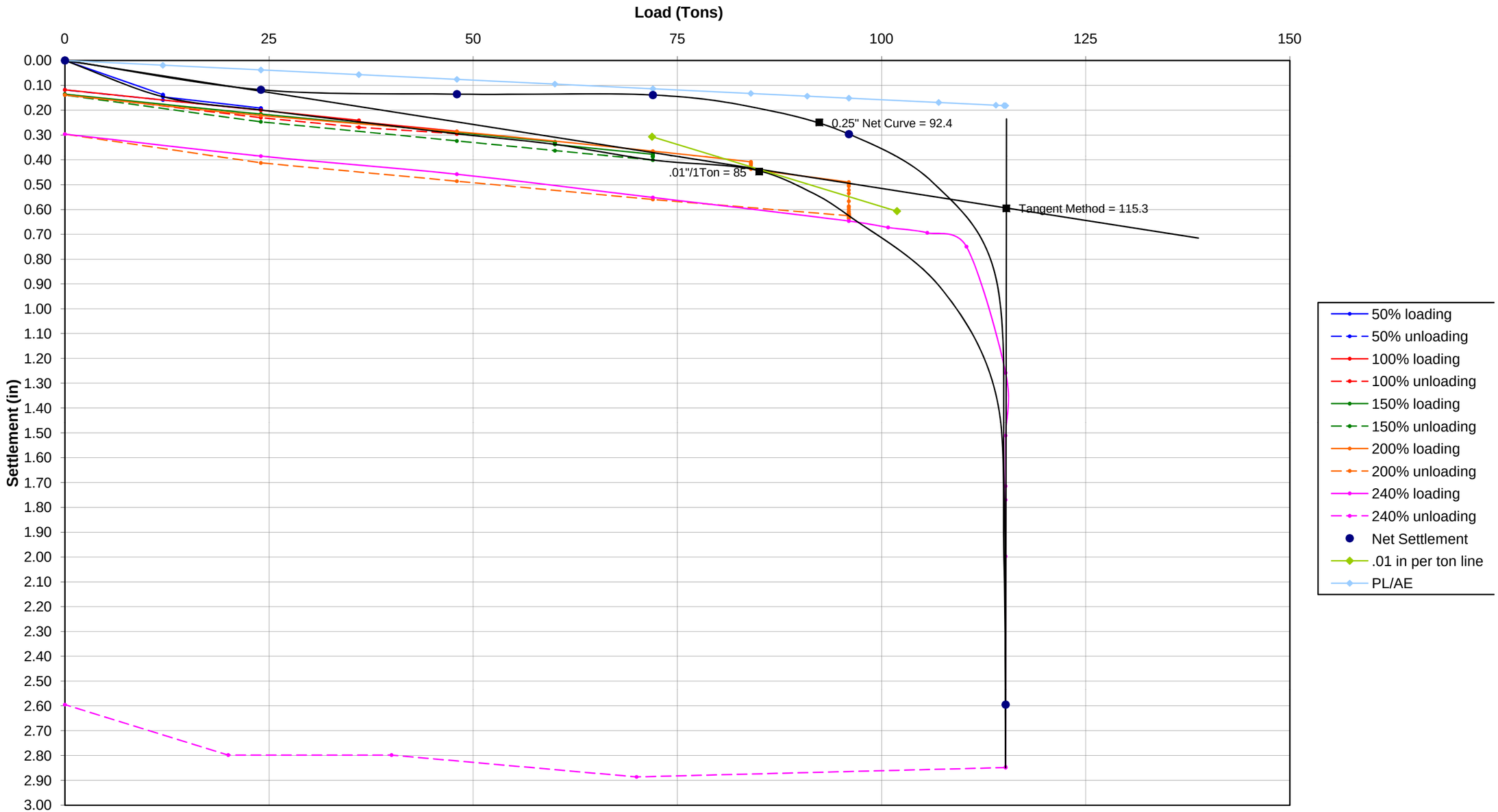


PLATE E-9-d

WCC - 404c Wall - TP-21 (Tension)

18" Pipe, Tip Elevation = -105

Service Load = 48.00 **Tons**

Estimated Pile Capacity = 88 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	18
Wall Size (in)	0.500
Area (in^2)	27.5
Top Ele. (ft)	0
Tip Ele. (ft)	-105
Length (ft)	105
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	24.00	0.0405
100%	48.00	0.0715
150%	72.00	0.0410
200%	96.00	2.7410

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	12.0	0.0655	50%	24.0	0.0405	0.019
50%	24.0	0.1195	100%	48.0	0.0715	0.038
75%	36.0	0.1750	150%	72.0	0.0410	0.057
100%	48.0	0.2235		93.2	0.2920	0.076
125%	60.0	0.2250		95.5	1.4950	0.095
150%	72.0	0.2485	200%	96.0	2.7410	0.114
175%	84.0	0.4225				0.133
	93.9	0.8630				0.148
200%	96.0	2.9190				0.152

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**92.4**	0.25		
☑	**.01 inch/Ton Creep Rate**	**75.3**	0.267	60 / 90	0.116 / 0.416
☑	**Tangent Method**	**94.9**	0.448	0 / 138.8 / 0.0046542	0 / 0.646
				Line T2 points: 94.7 / 96.00 / 2.1869231	0.076 / 2.919 / -207.02562

PILE CAPACITY **87.5** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**

Values in RED cannot be adjusted

PLATE E-10-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.898	2.897	Dial 1	Dial 2			1.02
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.898	2.897	0.000	0.000	0.0000	1.02	0.0000
25%	12.00	2	2.861	2.848	0.037	0.049	0.0430	1.05	0.0300
	12.00	8	2.859	2.845	0.039	0.052	0.0455	1.05	0.0300
	12.00	15	2.856	2.842	0.042	0.055	0.0485	1.05	0.0300
	12.00	30	2.854	2.837	0.044	0.060	0.0520	1.05	0.0300
	12.00	60	2.847	2.830	0.051	0.067	0.0590	1.07	0.0500
	12.00	120	2.842	2.822	0.056	0.075	0.0655	1.08	0.0600
50%	24.00	2	2.805	2.775	0.093	0.122	0.1075	1.11	0.0900
	24.00	8	2.806	2.775	0.092	0.122	0.1070	1.12	0.1000
	24.00	15	2.803	2.773	0.095	0.124	0.1095	1.12	0.1000
	24.00	30	2.802	2.772	0.096	0.125	0.1105	1.12	0.1000
	24.00	60	2.797	2.766	0.101	0.131	0.1160	1.13	0.1100
	24.00	120	2.793	2.763	0.105	0.134	0.1195	1.12	0.1000
25%	12.00	20	2.829	2.809	0.069	0.088	0.0785	1.10	0.0800
0%	0.00	20	2.866	2.848	0.032	0.049	0.0405	1.05	0.0300
50%	24.00	20	2.790	2.759	0.108	0.138	0.1230	1.12	0.1000
75%	36.00	2	2.754	2.719	0.144	0.178	0.1610	1.19	0.1700
	36.00	8	2.752	2.718	0.146	0.179	0.1625	1.19	0.1700
	36.00	15	2.751	2.717	0.147	0.180	0.1635	1.19	0.1700
	36.00	30	2.748	2.712	0.150	0.185	0.1675	1.19	0.1700
	36.00	60	2.746	2.709	0.152	0.188	0.1700	1.19	0.1700
	36.00	120	2.740	2.705	0.158	0.192	0.1750	1.19	0.1700
100%	48.00	2	2.710	2.667	0.188	0.230	0.2090	1.22	0.2000
	48.00	8	2.709	2.666	0.189	0.231	0.2100	1.22	0.2000
	48.00	15	2.708	2.665	0.190	0.232	0.2110	1.22	0.2000
	48.00	30	2.708	2.664	0.190	0.233	0.2115	1.22	0.2000
	48.00	60	2.705	2.660	0.193	0.237	0.2150	1.22	0.2000
	48.00	120	2.696	2.652	0.202	0.245	0.2235	1.22	0.2000
75%	36.00	20	2.722	2.683	0.176	0.214	0.1950	1.20	0.1800
50%	24.00	20	2.752	2.719	0.146	0.178	0.1620	1.17	0.1500
0%	0.00	20	2.836	2.816	0.062	0.081	0.0715	1.06	0.0400
50%	24.00	20	2.755	2.721	0.143	0.176	0.1595	1.16	0.1400
100%	48.00	20	2.691	2.647	0.207	0.250	0.2285	1.20	0.1800
125%	60.00	2	2.653	2.605	0.245	0.292	0.2685	1.25	0.2300
	60.00	8	2.653	2.605	0.245	0.292	0.2685	1.26	0.2400
	60.00	15	2.651	2.603	0.247	0.294	0.2705	1.27	0.2500
	60.00	30	2.648	2.602	0.250	0.295	0.2725	1.28	0.2600
	60.00	60	2.645	2.598	0.253	0.299	0.2760	1.27	0.2500
	60.00	120	2.645	2.596	0.253	0.301	0.2770	1.28	0.2600
150%	72.00	2	2.609	2.555	0.289	0.342	0.3155	1.32	0.3000
	72.00	8	2.603	2.552	0.295	0.345	0.3200	1.33	0.3100
	72.00	15	2.599	2.547	0.299	0.350	0.3245	1.33	0.3100
	72.00	30	2.597	2.541	0.301	0.356	0.3285	1.34	0.3200
	72.00	60	2.628	2.564	0.270	0.333	0.3015	1.33	0.3100
	72.00	120	2.639	2.659	0.259	0.238	0.2485	1.33	0.3100
125%	60.00	20	2.679	2.671	0.219	0.226	0.2225	1.29	0.2700
100%	48.00	20	2.701	2.723	0.197	0.174	0.1855	1.25	0.2300
50%	24.00	20	2.760	2.793	0.138	0.104	0.1210	1.18	0.1600
0%	0.00	20	2.849	2.864	0.049	0.033	0.0410	1.08	0.0600
50%	24.00	20	2.762	2.741	0.136	0.156	0.1460	1.16	0.1400
100%	48.00	20	2.693	2.659	0.205	0.238	0.2215	1.24	0.2200
150%	72.00	20	2.622	2.574	0.276	0.323	0.2995	1.30	0.2800
175%	84.00	2	2.582	2.526	0.316	0.371	0.3435	1.35	0.3300
	84.00	8	2.573	2.519	0.325	0.378	0.3515	1.35	0.3300
	84.00	15	2.560	2.504	0.338	0.393	0.3655	1.37	0.3500
	84.00	30	2.555	2.595	0.343	0.302	0.3225	1.38	0.3600
	84.00	60	2.514	2.578	0.384	0.319	0.3515	1.40	0.3800
	84.00	120	2.492	2.458	0.406	0.439	0.4225	1.43	0.4100
200%	96.00	2	2.441	2.494	0.457	0.403	0.4300	1.48	0.4600
	96.00	8	2.421	2.471	0.477	0.426	0.4515	1.50	0.4800
	96.00	15	2.383	2.328	0.515	0.569	0.5420	1.54	0.5200
	96.00	30	2.316	2.257	0.582	0.640	0.6110	1.60	0.5800
	96.00	60	2.158	2.195	0.740	0.702	0.7210	1.79	0.7700
	96.00	120	2.148	2.089	0.750	0.808	0.7790	1.81	0.7900
	96.00	180	2.101	2.034	0.797	0.863	0.8300	1.83	0.8100
	96.00	240	2.068	2.001	0.830	0.896	0.8630	1.88	0.8600
	96.00	300	2.041	1.975	0.857	0.922	0.8895	1.90	0.8800
	96.00	360	2.026	1.959	0.872	0.938	0.9050	1.90	0.8800
	96.00	420	1.998	1.952	0.900	0.945	0.9225	1.92	0.9000
	96.00	480	1.986	1.941	0.912	0.956	0.9340	1.95	0.9300
	96.00	540	1.975	1.920	0.923	0.977	0.9500	1.96	0.9400
	96.00	600	1.970	1.903	0.928	0.994	0.9610	1.97	0.9500
	96.00	660	1.964	1.898	0.934	0.999	0.9665	1.97	0.9500
	96.00	720	1.945	1.879	0.953	1.018	0.9855	2.00	0.9800
	96.00	780	1.897	1.829	1.001	1.068	1.0345	2.04	1.0200
	96.00	840	1.839	1.771	1.059	1.126	1.0925	2.09	1.0700
	96.00	900	1.805	1.728	1.093	1.169	1.1310	2.28	1.2600
	96.00	960	0.109	0.039	2.789	2.858	2.8235	3.92	2.9000
	96.00	1020	0.986	0.971	2.912	2.926	2.9190	4.05	3.0300
150%	72.00	1080	0.998	0.988	2.900	2.909	2.9045	4.05	3.0300
100%	48.00	1140	1.009	1.007	2.889	2.890	2.8895	3.96	2.9400
50%	24.00	1200	1.035	1.029	2.863	2.868	2.8655	3.88	2.8600

	0%	0.00	1260	1.160	1.153	2.738	2.744	2.7410	3.76	2.7400

PLATE E-10-c

WCC - 404c Wall
TP#22 - Steel 18" Pipe Pile - Spiral Seam - Tip EL -105.0 - Service Load = 48 Tons Tension

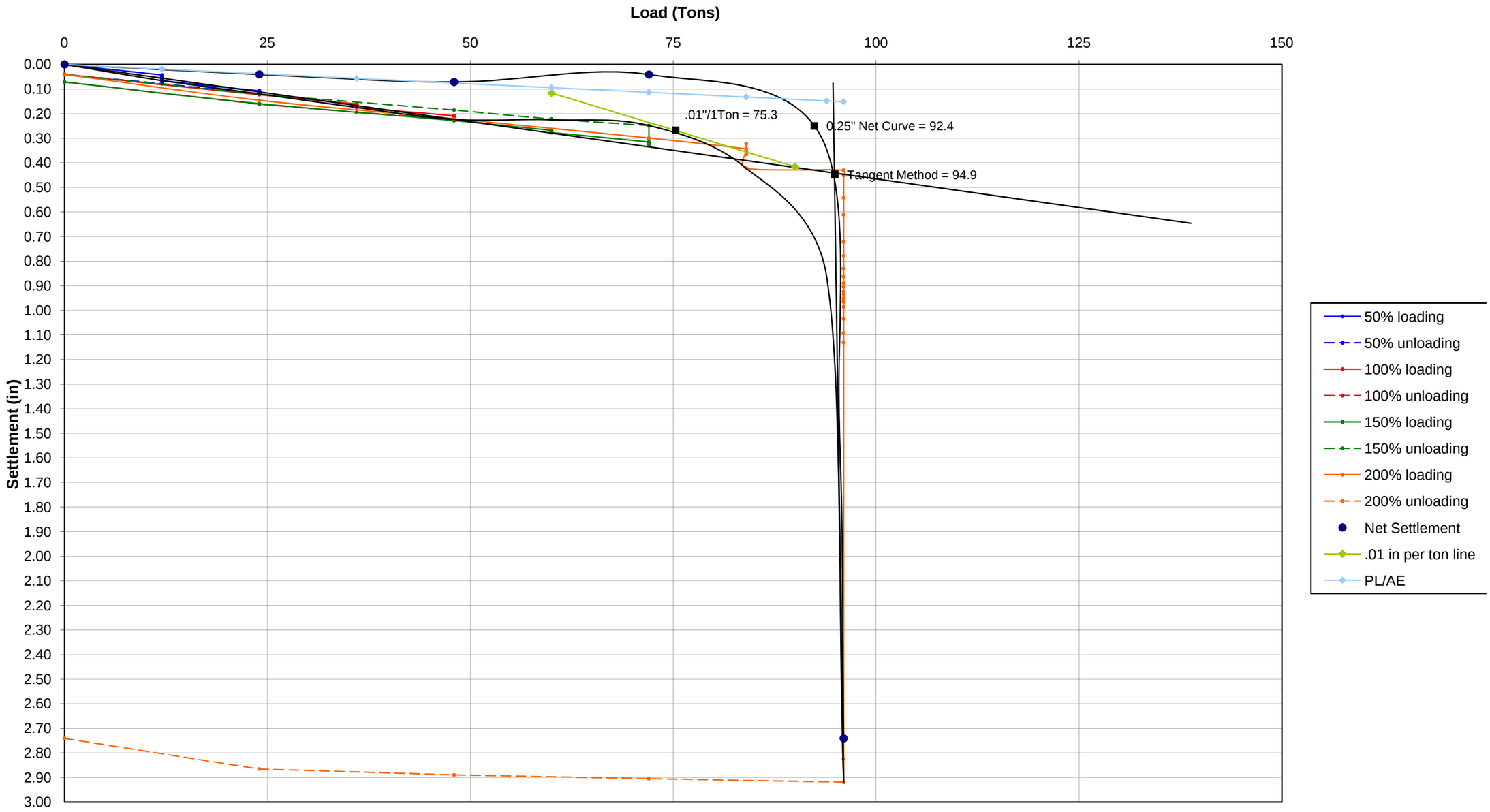


PLATE E-10-d

WCC - 404c Wall - TP-23

18" PCP, Tip Elevation = -106

Service Load = 71.00 **Tons**

Estimated Pile Capacity = 116 **Tons**

Pile Information	
Type	PCP
	18
Wall Size (in)	18.000
Area (in^2)	324.0
Top Ele. (ft)	0
Tip Ele. (ft)	-106
Length (ft)	106
Modulus (psi)	4030509

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	35.50	0.0375
100%	71.00	0.0345
150%	106.50	0.1395
175%	124.25	2.5565

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	17.8	0.0480	50%	35.5	0.0375	0.017
50%	35.5	0.0990	100%	71.0	0.0345	0.035
75%	53.3	0.1370	150%	106.5	0.1395	0.052
100%	71.0	0.1625		120.0	1.1000	0.069
125%	88.8	0.2600	175%	124.3	2.5565	0.086
150%	106.5	0.3290				0.104
	120.3	0.5340				0.117
175%	124.3	2.7545				0.121

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**110.4**	0.25		
☑	**.01 inch/Ton Creep Rate**	**115.7**	0.4	103.3	0.276
				133.3	0.576
☑	**Tangent Method**	**122.6**	0.298	0	0
				175.2	0.422
				0.0024087	

Line T2 points	
122.6	0.194
124.25	2.755
1.5518182	-190.05891

PILE CAPACITY	**116.2**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.688	2.42	Dial 1	Dial 2			5.77
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.688	2.420	0.000	0.000	0.0000	5.77	0.0000
25%	17.75	2	2.660	2.386	0.028	0.034	0.0310	5.77	0.0000
	17.75	8	2.660	2.386	0.028	0.034	0.0310	5.78	0.0100
	17.75	15	2.659	2.385	0.029	0.035	0.0320	5.78	0.0100
	17.75	30	2.659	2.382	0.029	0.038	0.0335	5.79	0.0200
	17.75	60	2.654	2.374	0.034	0.046	0.0400	5.80	0.0300
	17.75	120	2.644	2.368	0.044	0.052	0.0480	5.85	0.0800
50%	35.50	2	2.616	2.338	0.072	0.082	0.0770	5.83	0.0600
	35.50	8	2.613	2.334	0.075	0.086	0.0805	5.85	0.0800
	35.50	15	2.612	2.332	0.076	0.088	0.0820	5.83	0.0600
	35.50	30	2.605	2.323	0.083	0.097	0.0900	5.85	0.0800
	35.50	60	2.599	2.314	0.089	0.106	0.0975	5.85	0.0800
	35.50	120	2.600	2.310	0.088	0.110	0.0990	5.82	0.0500
25%	17.75	20	2.631	2.349	0.057	0.071	0.0640	5.80	0.0300
0%	0.00	20	2.657	2.376	0.031	0.044	0.0375	5.80	0.0300
50%	35.50	20	2.628	2.333	0.060	0.087	0.0735	5.85	0.0800
75%	53.25	2	2.573	2.271	0.115	0.149	0.1320	5.87	0.1000
	53.25	8	2.569	2.265	0.119	0.155	0.1370	5.90	0.1300
	53.25	15	2.562	2.255	0.126	0.165	0.1455	5.90	0.1300
	53.25	30	2.558	2.245	0.130	0.175	0.1525	5.90	0.1300
	53.25	60	2.559	2.254	0.129	0.166	0.1475	5.90	0.1300
	53.25	120	2.566	2.268	0.122	0.152	0.1370	5.90	0.1300
100%	71.00	2	2.544	2.247	0.144	0.173	0.1585	5.90	0.1300
	71.00	8	2.542	2.246	0.146	0.174	0.1600	5.90	0.1300
	71.00	15	2.539	2.244	0.149	0.176	0.1625	5.91	0.1400
	71.00	30	2.536	2.240	0.152	0.180	0.1660	5.91	0.1400
	71.00	60	2.537	2.245	0.151	0.175	0.1630	5.91	0.1400
	71.00	120	2.536	2.247	0.152	0.173	0.1625	5.92	0.1500
75%	53.25	20	2.562	2.275	0.126	0.145	0.1355	5.89	0.1200
50%	35.50	20	2.588	2.303	0.100	0.117	0.1085	5.87	0.1000
0%	0.00	20	2.656	2.383	0.032	0.037	0.0345	5.78	0.0100
50%	35.50	20	2.600	2.318	0.088	0.102	0.0950	5.84	0.0700
100%	71.00	20	2.546	2.257	0.142	0.163	0.1525	5.91	0.1400
125%	88.75	2	2.460	2.171	0.228	0.249	0.2385	6.01	0.2400
	88.75	8	2.447	2.156	0.241	0.264	0.2525	6.01	0.2400
	88.75	15	2.437	2.146	0.251	0.274	0.2625	6.02	0.2500
	88.75	30	2.426	2.135	0.262	0.285	0.2735	6.03	0.2600
	88.75	60	2.411	2.120	0.277	0.300	0.2885	6.05	0.2800
	88.75	120	2.392	2.101	0.296	0.319	0.3075	6.05	0.2800
150%	106.50	2	2.386	2.094	0.302	0.326	0.3140	6.08	0.3100
	106.50	8	2.384	2.093	0.304	0.327	0.3155	6.08	0.3100
	106.50	15	2.380	2.088	0.308	0.332	0.3200	6.08	0.3100
	106.50	30	2.377	2.085	0.311	0.335	0.3230	6.09	0.3200
	106.50	60	2.369	2.076	0.319	0.344	0.3315	6.09	0.3200
	106.50	120	2.358	2.065	0.330	0.355	0.3425	6.10	0.3300
125%	88.75	20	2.360	2.068	0.328	0.352	0.3400	6.09	0.3200
100%	71.00	20	2.408	2.118	0.280	0.302	0.2910	6.03	0.2600
50%	35.50	20	2.464	2.179	0.224	0.241	0.2325	5.98	0.2100
0%	0.00	20	2.550	2.279	0.138	0.141	0.1395	5.88	0.1100
50%	35.50	20	2.490	2.208	0.198	0.212	0.2050	5.96	0.1900
100%	71.00	20	2.433	2.145	0.255	0.275	0.2650	6.02	0.2500
150%	106.50	20	2.354	2.062	0.334	0.358	0.3460	6.10	0.3300
175%	124.25	2	2.288	1.995	0.400	0.425	0.4125	6.18	0.4100
	124.25	8	2.259	1.965	0.429	0.455	0.4420	6.20	0.4300
	124.25		2.236	1.941	0.452	0.479	0.4655	6.22	0.4500
	124.25		2.135	1.838	0.553	0.582	0.5675	6.29	0.5200
	124.25		1.081	0.078	1.607	2.342	1.9743	7.40	1.6300
	124.25		0.649	0.350	2.039	2.070	2.0545	7.83	2.0600
	124.25		2.230	1.935	2.458	2.485	2.4715	8.24	2.4700
	124.25		1.945	1.654	2.743	2.766	2.7545	8.52	2.7500
125%	88.75		1.950	1.660	2.738	2.760	2.7490	8.50	2.7300
75%	53.25		2.003	1.719	2.685	2.701	2.6930	8.46	2.6900
25%	17.75		2.072	1.797	2.616	2.623	2.6195	8.39	2.6200
0%	0.00		2.132	1.863	2.556	2.557	2.5565	8.30	2.5300

PLATE E-11-b

WCC - 404c Wall
TP#23 - PCP 18" - Tip EL -106 - Service Load = 71 Tons

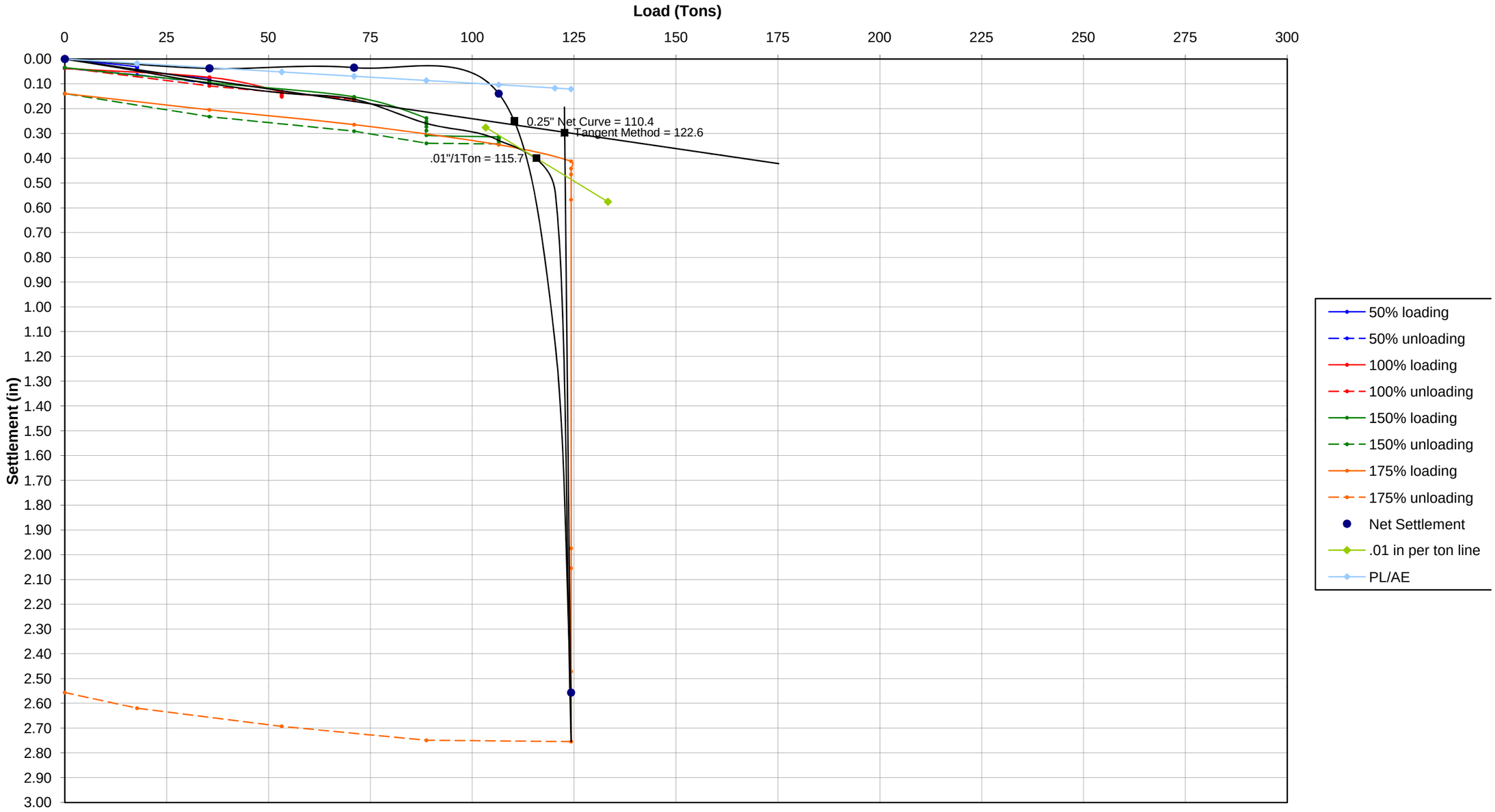


PLATE E-11-c

WCC - 404c Wall - TP-24

18" PCP, Tip Elevation = -129

Service Load = 75.00 **Tons**

Estimated Pile Capacity = 193 **Tons**

Pile Information	
Type	PCP
	18
Wall Size (in)	18.000
Area (in^2)	324.0
Top Ele. (ft)	0
Tip Ele. (ft)	-129
Length (ft)	129
Modulus (psi)	4030509

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	37.50	-0.0400
100%	75.00	-0.0320
150%	112.50	-0.0175
200%	150.00	0.0920
290%	217.50	2.4540

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	18.8	0.0200	50%	37.5	-0.0400	0.022
50%	37.5	0.0135	100%	75.0	-0.0320	0.044
75%	56.3	0.0465	150%	112.5	-0.0175	0.067
100%	75.0	0.0780		145.0	0.0890	0.089
125%	93.8	0.1160	200%	150.0	0.0920	0.111
150%	112.5	0.1575		200.0	0.4500	0.133
175%	131.3	0.2085		216.0	2.4400	0.156
	149.0	0.2975	290%	217.5	2.4540	0.177
200%	150.0	0.2995				0.178
	200.0	0.7590				0.237
	217.0	2.6700				0.257
	217.2	2.7600				0.257
290%	217.5	2.7790				0.258

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**188.7**	0.25		
☑	**.01 inch/Ton Creep Rate**	**186.2**	0.512	172.2 202.2	0.372 0.672
☑	**Tangent Method**	**205**	0.214	0 418.7 0.0010533	0 0.441

Capacity	Deflection	Line T1 points		Line T2 points	
		0	0	204.4	0.072
		418.7	0.441	217.50	2.779
		0.0010533		0.2066412	-42.165466

PILE CAPACITY	**193.3**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE E-12-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.75	2.808	Dial 1	Dial 2			3.03
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.750	2.808	0.000	0.000	0.0000	3.03	0.0000
25%	18.75	2	2.720	2.779	0.030	0.029	0.0295	3.06	0.0300
	18.75	8	2.721	2.781	0.029	0.027	0.0280	3.06	0.0300
	18.75	15	2.719	2.782	0.031	0.026	0.0285	3.06	0.0300
	18.75	30	2.723	2.789	0.027	0.019	0.0230	3.05	0.0200
	18.75	60	2.720	2.792	0.030	0.016	0.0230	3.05	0.0200
	18.75	120	2.719	2.799	0.031	0.009	0.0200	3.05	0.0200
50%	37.50	2	2.697	2.770	0.053	0.038	0.0455	3.08	0.0500
	37.50	8	2.695	2.769	0.055	0.039	0.0470	3.08	0.0500
	37.50	15	2.696	2.769	0.054	0.039	0.0465	3.08	0.0500
	37.50	30	2.695	2.769	0.055	0.039	0.0470	3.08	0.0500
	37.50	60	2.704	2.779	0.046	0.029	0.0375	3.07	0.0400
	37.50	120	2.726	2.805	0.024	0.003	0.0135	3.05	0.0200
25%	18.75	20	2.751	2.832	-0.001	-0.024	-0.0125	3.02	-0.0100
0%	0.00	20	2.775	2.863	-0.025	-0.055	-0.0400	2.99	-0.0400
50%	37.50	20	2.724	2.802	0.026	0.006	0.0160	3.05	0.0200
75%	56.25	2	2.703	2.776	0.047	0.032	0.0395	3.08	0.0500
	56.25	8	2.703	2.774	0.047	0.034	0.0405	3.08	0.0500
	56.25	15	2.702	2.773	0.048	0.035	0.0415	3.08	0.0500
	56.25	30	2.700	2.772	0.050	0.036	0.0430	3.08	0.0500
	56.25	60	2.699	2.771	0.051	0.037	0.0440	3.08	0.0500
	56.25	120	2.694	2.771	0.056	0.037	0.0465	3.08	0.0500
100%	75.00	2	2.673	2.745	0.077	0.063	0.0700	3.10	0.0700
	75.00	8	2.672	2.742	0.078	0.066	0.0720	3.10	0.0700
	75.00	15	2.670	2.740	0.080	0.068	0.0740	3.10	0.0700
	75.00	30	2.669	2.740	0.081	0.068	0.0745	3.10	0.0700
	75.00	60	2.667	2.738	0.083	0.070	0.0765	3.10	0.0700
	75.00	120	2.666	2.736	0.084	0.072	0.0780	3.11	0.0800
75%	56.25	20	2.686	2.758	0.064	0.050	0.0570	3.09	0.0600
50%	37.50	20	2.709	2.786	0.041	0.022	0.0315	3.07	0.0400
0%	0.00	20	2.764	2.858	-0.014	-0.050	-0.0320	3.00	-0.0300
50%	37.50	20	2.712	2.796	0.038	0.012	0.0250	3.06	0.0300
100%	75.00	20	2.665	2.737	0.085	0.071	0.0780	3.12	0.0900
125%	93.75	2	2.638	2.705	0.112	0.103	0.1075	3.15	0.1200
	93.75	8	2.637	2.703	0.113	0.105	0.1090	3.15	0.1200
	93.75	15	2.635	2.702	0.115	0.106	0.1105	3.15	0.1200
	93.75	30	2.634	2.700	0.116	0.108	0.1120	3.15	0.1200
	93.75	60	2.633	2.699	0.117	0.109	0.1130	3.15	0.1200
	93.75	120	2.630	2.696	0.120	0.112	0.1160	3.15	0.1200
150%	112.50	2	2.603	2.668	0.147	0.140	0.1435	3.18	0.1500
	112.50	8	2.601	2.665	0.149	0.143	0.1460	3.18	0.1500
	112.50	15	2.600	2.664	0.150	0.144	0.1470	3.18	0.1500
	112.50	30	2.598	2.662	0.152	0.146	0.1490	3.18	0.1500
	112.50	60	2.594	2.658	0.156	0.150	0.1530	3.19	0.1600
	112.50	120	2.589	2.654	0.161	0.154	0.1575	3.19	0.1600
125%	93.75	20	2.610	2.675	0.140	0.133	0.1365	3.17	0.1400
100%	75.00	20	2.639	2.706	0.111	0.102	0.1065	3.15	0.1200
50%	37.50	20	2.688	2.765	0.062	0.043	0.0525	3.09	0.0600
0%	0.00	20	2.750	2.843	0.000	-0.035	-0.0175	3.02	-0.0100
50%	37.50	20	2.698	2.780	0.052	0.028	0.0400	3.09	0.0600
100%	75.00	20	2.619	2.716	0.131	0.092	0.1115	3.14	0.1100
150%	112.50	20	2.590	2.650	0.160	0.158	0.1590	3.20	0.1700
175%	131.25	2	2.563	2.620	0.187	0.188	0.1875	3.22	0.1900
	131.25	8	2.560	2.618	0.190	0.190	0.1900	3.22	0.1900
	131.25	15	2.559	2.616	0.191	0.192	0.1915	3.24	0.2100
	131.25	30	2.554	2.610	0.196	0.198	0.1970	3.23	0.2000
	131.25	60	2.548	2.603	0.202	0.205	0.2035	3.24	0.2100
	131.25	120	2.544	2.597	0.206	0.211	0.2085	3.24	0.2100
200%	150.00	2	2.515	2.561	0.235	0.247	0.2410	3.29	0.2600
	150.00	8	2.513	2.559	0.237	0.249	0.2430	3.29	0.2600
	150.00	15	2.507	2.551	0.243	0.257	0.2500	3.29	0.2600
	150.00	30	2.498	2.543	0.252	0.265	0.2585	3.29	0.2600
	150.00	1	2.488	2.532	0.262	0.276	0.2690	3.29	0.2600
	150.00	2	2.482	2.513	0.268	0.295	0.2815	3.31	0.2800
	150.00	3	2.486	2.525	0.264	0.283	0.2735	3.31	0.2800
	150.00	4	2.469	2.513	0.281	0.295	0.2880	3.32	0.2900
	150.00	5	2.460	2.516	0.290	0.292	0.2910	3.34	0.3100
	150.00	6	2.468	2.534	0.282	0.274	0.2780	3.29	0.2600
	150.00	7	2.500	2.549	0.250	0.259	0.2545	3.31	0.2800
	150.00	8	2.496	2.544	0.254	0.264	0.2590	3.31	0.2800
	150.00	9	2.492	2.540	0.258	0.268	0.2630	3.32	0.2900
	150.00	10	2.490	2.540	0.260	0.268	0.2640	3.32	0.2900
	150.00	11	2.488	2.538	0.262	0.270	0.2660	3.32	0.2900
	150.00	12	2.486	2.536	0.264	0.272	0.2680	3.32	0.2900
	150.00	13	2.484	2.534	0.266	0.274	0.2700	3.33	0.3000
	150.00	14	2.482	2.532	0.268	0.276	0.2720	3.33	0.3000
	150.00	15	2.480	2.531	0.270	0.277	0.2735	3.33	0.3000
	150.00	16	2.477	2.528	0.273	0.280	0.2765	3.33	0.3000
	150.00	17	2.475	2.526	0.275	0.282	0.2785	3.33	0.3000
	150.00	18	2.473	2.524	0.277	0.284	0.2805	3.33	0.3000
	150.00	19	2.470	2.522	0.280	0.286	0.2830	3.33	0.3000
	150.00	20	2.469	2.522	0.281	0.286	0.2835	3.33	0.3000

	150.00	21	2.468	2.521	0.282	0.287	0.2845	3.33	0.3000
	150.00	22	2.460	2.519	0.290	0.289	0.2895	3.34	0.3100
	150.00	23	2.467	2.507	0.283	0.301	0.2920	3.34	0.3100
	150.00	24	2.454	2.505	0.296	0.303	0.2995	3.38	0.3500
150%	112.50	60	2.476	2.542	0.274	0.266	0.2700	3.31	0.2800
100%	75.00	60	2.528	2.597	0.222	0.211	0.2165	3.25	0.2200
50%	37.50	60	2.587	2.648	0.163	0.160	0.1615	3.22	0.1900
0%	0.00	60	2.654	2.720	0.096	0.088	0.0920	3.11	0.0800
50%	37.50	20	2.601	2.658	0.149	0.150	0.1495	3.19	0.1600
100%	75.00	20	2.553	2.598	0.197	0.210	0.2035	3.23	0.2000
150%	112.50	20	2.506	2.536	0.244	0.272	0.2580	3.30	0.2700
200%	150.00	20	2.454	2.480	0.296	0.328	0.3120	3.33	0.3000
210%	157.50	20	2.445	2.478	0.305	0.330	0.3175	3.34	0.3100
220%	165.00	20	2.432	2.475	0.318	0.333	0.3255	3.38	0.3500
230%	172.50	20	2.428	2.468	0.322	0.340	0.3310	3.38	0.3500
240%	180.00	20	2.418	2.455	0.332	0.353	0.3425	3.39	0.3600
250%	187.50	20	2.398	2.437	0.352	0.371	0.3615	3.41	0.3800
260%	195.00	20	2.378	2.418	0.372	0.390	0.3810	3.43	0.4000
270%	202.50	20	2.352	2.388	0.398	0.420	0.4090	3.45	0.4200
280%	210.00	20	2.322	2.358	0.428	0.450	0.4390	3.470	0.4400
290%	217.50	20	2.100	2.140	0.650	0.668	0.6590	3.700	0.6700
	217.50	15	1.685	1.725	1.065	1.083	1.0740	4.10	1.0700
	217.50	25	1.560	1.600	1.190	1.208	1.1990	4.25	1.2200
	217.50	52	1.560	1.600	1.190	1.208	1.1990	4.79	1.7600
	217.50	62	0.115	0.155	2.635	2.653	2.6440	5.70	2.6700
	217.50	72	1.980	2.020	2.770	2.788	2.7790	5.800	2.7700
217%	163.10		2.025	2.060	2.725	2.748	2.7365	5.800	2.7700
145%	108.80		2.110	2.150	2.640	2.658	2.6490	5.700	2.6700
73%	54.40		2.210	2.210	2.540	2.598	2.5690	5.600	2.5700
0%	0.00		2.325	2.325	2.425	2.483	2.4540	5.470	2.4400

WCC - 404c Wall
TP#24 - PCP 18" - Tip EL -129.0 - Service Load = 53 Tons

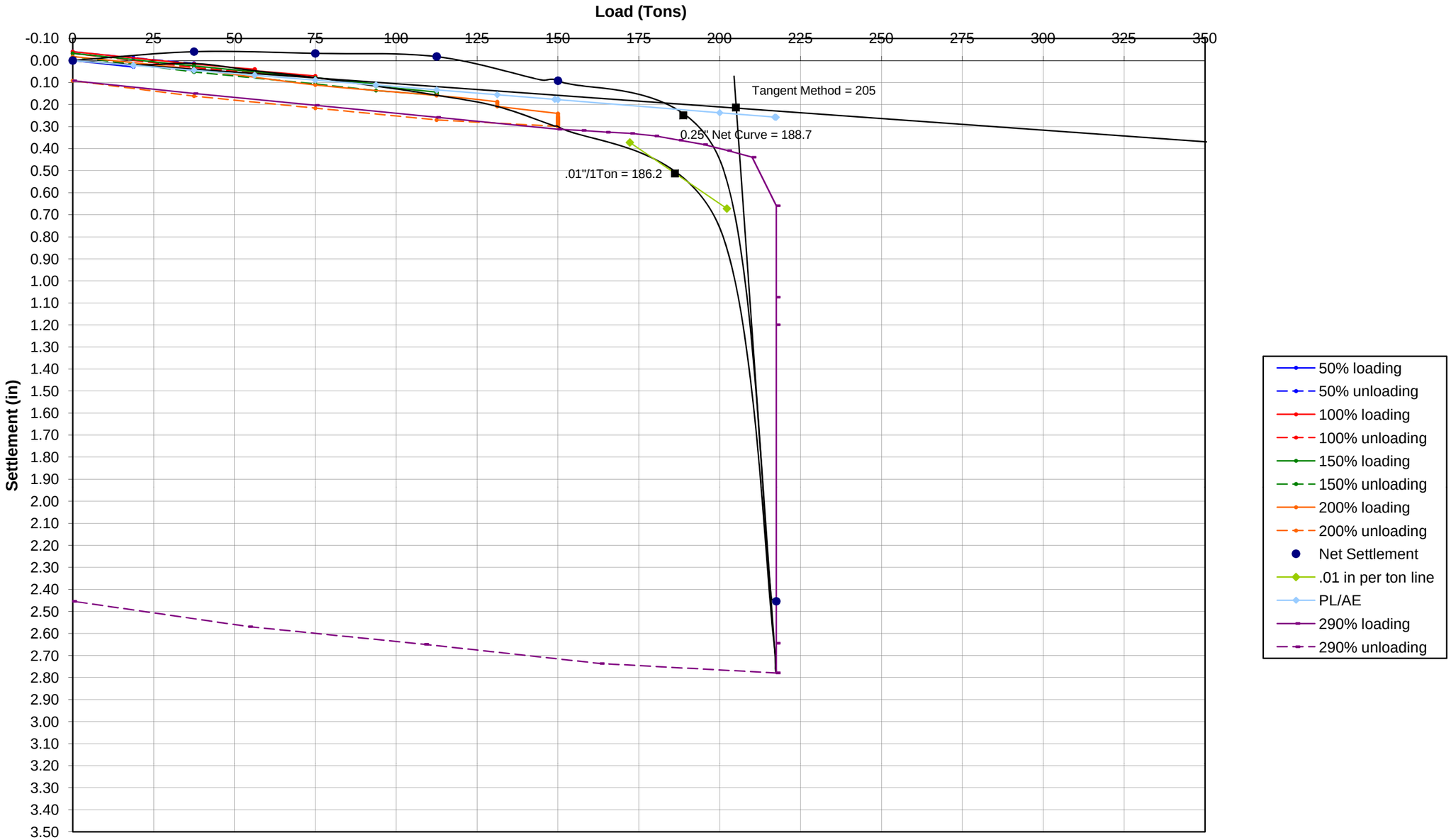


PLATE E-12-d

WCC - 404c Wall - TP-25

18" PCP, Tip Elevation = -97

Service Load = 53.00 **Tons**

Estimated Pile Capacity = 91 **Tons**

Pile Information	
Type	PCP
	18
Wall Size (in)	18.000
Area (in^2)	324.0
Top Ele. (ft)	0
Tip Ele. (ft)	-97
Length (ft)	97
Modulus (psi)	4030509

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	26.50	0.0075
100%	53.00	0.0110
150%	79.50	0.1060
200%	106.00	2.9085

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Defl. (in)	Percent Load	Net Curve** Load (Tons)	Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	13.3	0.0500	50%	26.5	0.0075	0.012
50%	26.4	0.0635	100%	53.0	0.0110	0.024
75%	39.8	0.0540	150%	79.5	0.1060	0.035
100%	53.0	0.0945		98.0	0.4150	0.047
125%	66.3	0.1480	200%	106.0	2.9085	0.059
150%	79.5	0.2495				0.071
175%	92.8	0.4415				0.083
	98.0	0.8610				0.087
200%	106.0	3.0310				0.094

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection				
☑	**.25 inch Net Deflection**	**94.15**	0.25				
☑	**.01 inch/Ton Creep Rate**	**83.46**	0.29	70.96	0.164		
				100.96	0.464		
☑	**Tangent Method**	**95.97**	0.162	0	0	95.24	0.044
				127.7	0.217	106.00	3.031
				0.0016993		0.2776022	-26.394836

PILE CAPACITY	**91.2**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.678	2.814	Dial 1	Dial 2			5.65
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.678	2.814	0.000	0.000	0.0000	3.950	5.6500
25%	13.25	2	2.657	2.793	0.021	0.021	0.0210	5.66	0.0100
	13.25	8	2.657	2.793	0.021	0.021	0.0210	5.66	0.0100
	13.25	15	2.658	2.792	0.020	0.022	0.0210	5.66	0.0100
	13.25	30	2.650	2.786	0.028	0.028	0.0280	5.66	0.0100
	13.25	60	2.648	2.782	0.030	0.032	0.0310	5.66	0.0100
	13.25	120	2.628	2.764	0.050	0.050	0.0500	5.70	0.0500
50%	26.50	2	2.628	2.764	0.050	0.050	0.0500	5.70	0.0500
	26.50	8	2.628	2.764	0.050	0.050	0.0500	5.70	0.0500
	26.50	15	2.630	2.760	0.048	0.054	0.0510	5.70	0.0500
	26.50	30	2.630	2.750	0.048	0.064	0.0560	5.70	0.0500
	26.50	60	2.628	2.742	0.050	0.072	0.0610	5.70	0.0500
	26.50	120	2.625	2.740	0.053	0.074	0.0635	5.70	0.0500
25%	13.25	20	2.656	2.771	0.022	0.043	0.0325	5.67	0.0200
0%	0.00	20	2.676	2.801	0.002	0.013	0.0075	5.65	0.0000
50%	26.50	20	2.649	2.781	0.029	0.033	0.0310	5.65	0.0000
75%	39.75	2	2.630	2.762	0.048	0.052	0.0500	5.70	0.0500
	39.75	8	2.628	2.761	0.050	0.053	0.0515	5.70	0.0500
	39.75	15	2.628	2.761	0.050	0.053	0.0515	5.70	0.0500
	39.75	30	2.628	2.761	0.050	0.053	0.0515	5.70	0.0500
	39.75	60	2.626	2.761	0.052	0.053	0.0525	5.70	0.0500
	39.75	120	2.624	2.760	0.054	0.054	0.0540	5.70	0.0500
100%	53.00	2	2.602	2.738	0.076	0.076	0.0760	5.70	0.0500
	53.00	8	2.601	2.738	0.077	0.076	0.0765	5.70	0.0500
	53.00	15	2.598	2.733	0.080	0.081	0.0805	5.70	0.0500
	53.00	30	2.595	2.731	0.083	0.083	0.0830	5.70	0.0500
	53.00	60	2.590	2.724	0.088	0.090	0.0890	5.70	0.0500
	53.00	120	2.583	2.720	0.095	0.094	0.0945	5.70	0.0500
75%	39.75	20	2.599	2.736	0.079	0.078	0.0785	5.70	0.0500
50%	26.50	20	2.616	2.754	0.062	0.060	0.0610	5.70	0.0500
0%	0.00	20	2.664	2.806	0.014	0.008	0.0110	5.65	0.0000
50%	26.50	20	2.622	2.762	0.056	0.052	0.0540	5.69	0.0400
100%	53.00	20	2.578	2.717	0.100	0.097	0.0985	5.71	0.0600
125%	66.25	2	2.562	2.695	0.116	0.119	0.1175	5.73	0.0800
	66.25	8	2.549	2.695	0.129	0.119	0.1240	5.75	0.1000
	66.25	15	2.546	2.690	0.132	0.124	0.1280	5.75	0.1000
	66.25	30	2.542	2.686	0.136	0.128	0.1320	5.75	0.1000
	66.25	60	2.528	2.679	0.150	0.135	0.1425	5.76	0.1100
	66.25	120	2.521	2.675	0.157	0.139	0.1480	5.76	0.1100
150%	79.50	2	2.495	2.640	0.183	0.174	0.1785	5.80	0.1500
	79.50	8	2.485	2.630	0.193	0.184	0.1885	5.80	0.1500
	79.50	15	2.476	2.621	0.202	0.193	0.1975	5.81	0.1600
	79.50	30	2.462	2.606	0.216	0.208	0.2120	5.82	0.1700
	79.50	60	2.449	2.593	0.229	0.221	0.2250	5.83	0.1800
	79.50	120	2.425	2.568	0.253	0.246	0.2495	5.88	0.2300
125%	66.25	20	2.442	2.585	0.236	0.229	0.2325	5.89	0.2400
100%	53.00	20	2.460	2.603	0.218	0.211	0.2145	5.84	0.1900
50%	26.50	20	2.505	2.647	0.173	0.167	0.1700	5.80	0.1500
0%	0.00	20	2.570	2.710	0.108	0.104	0.1060	5.74	0.0900
50%	26.50	20	2.528	2.664	0.150	0.150	0.1500	5.78	0.1300
100%	53.00	20	2.478	2.613	0.200	0.201	0.2005	5.83	0.1800
150%	79.50	20	2.422	2.555	0.256	0.259	0.2575	5.88	0.2300
175%	92.75	2	2.372	2.508	0.306	0.306	0.3060	5.93	0.2800
	92.75	8	2.365	2.500	0.313	0.314	0.3135	5.94	0.2900
	92.75	15	2.365	2.500	0.313	0.314	0.3135	5.94	0.2900
	92.75	30	2.315	2.448	0.363	0.366	0.3645	6.00	0.3500
	92.75	60	2.272	2.405	0.406	0.409	0.4075	6.04	0.3900
	92.75	120	2.239	2.370	0.439	0.444	0.4415	6.06	0.4100
200%	106.00	2	1.108	1.235	1.570	1.579	1.5745	7.20	1.5500
	106.00	8	1.005	1.131	1.673	1.683	1.6780	7.30	1.6500
	106.00	15	0.905	1.028	1.773	1.786	1.7795	7.40	1.7500
	106.00		0.772	0.895	1.906	1.919	1.9125	7.49	1.8400
	106.00		0.768	0.889	1.910	1.925	1.9175	7.53	1.8800
	106.00		0.762	0.882	1.916	1.932	1.9240	7.55	1.9000
	106.00		0.566	0.684	2.112	2.130	2.1210	7.70	2.0500
	106.00		1.412	1.530	2.266	2.284	2.2750	8.64	2.9900
	106.00		0.658	0.777	3.020	3.037	3.0285	8.64	2.9900
	106.00		0.656	0.774	3.022	3.040	3.0310	8.65	3.0000
150%	79.50		0.669	0.778	3.009	3.036	3.0225	8.65	3.0000
100%	53.00		0.676	0.785	3.002	3.029	3.0155	8.65	3.0000
50%	26.50		0.750	0.820	2.928	2.994	2.9610	8.58	2.9300
0%	0.00		0.780	0.895	2.898	2.919	2.9085	8.51	2.8600

WCC - 404c Wall
TP#25 - PCP 18" - Tip EL -97.0 - Service Load = 53 Tons

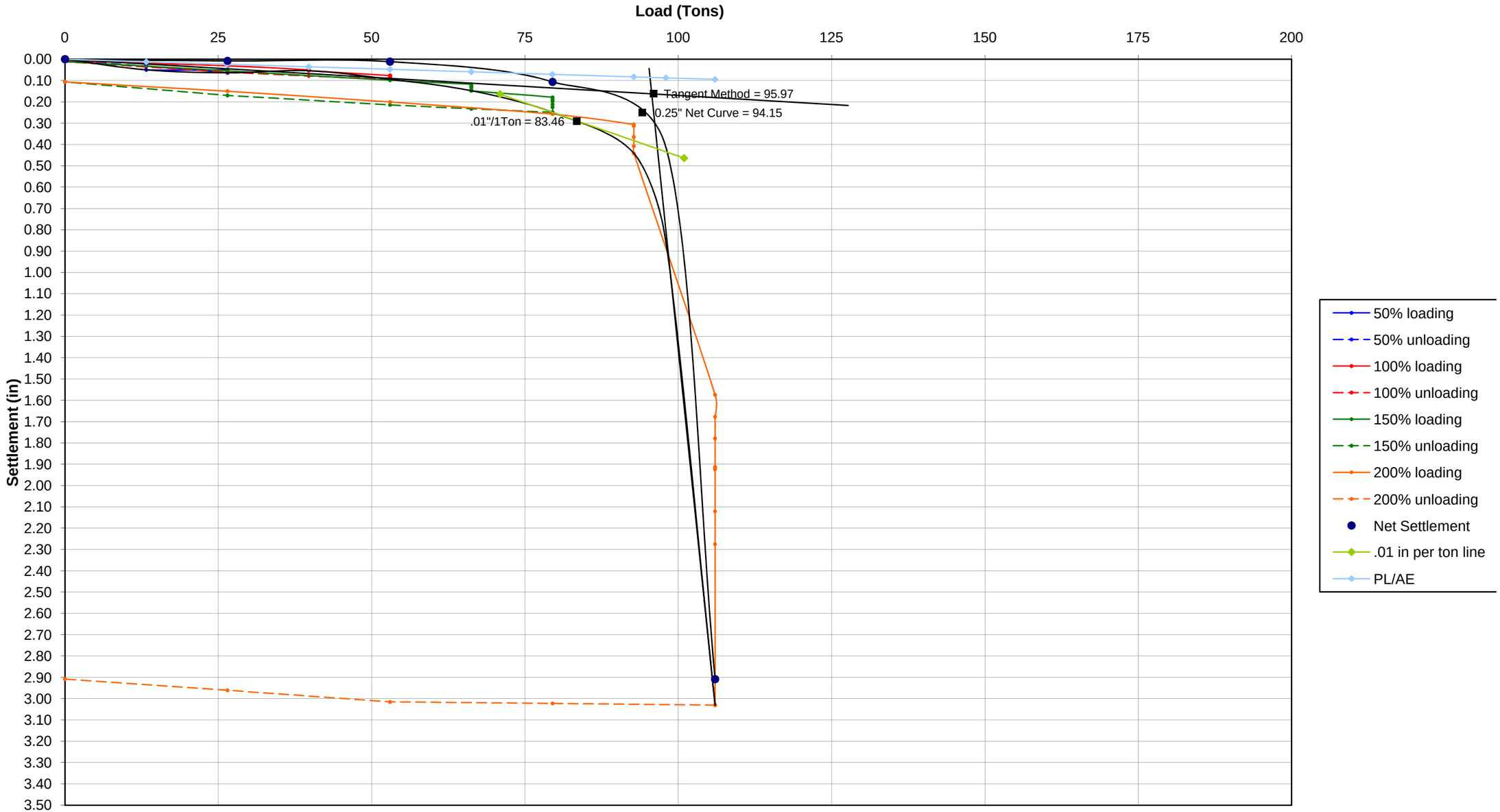


PLATE E-13-c

WCC - 404c Wall - TP-25 (Tension)

18" PCP, Tip Elevation = -97

Service Load = 40.00 **Tons**

Estimated Pile Capacity = 90 **Tons**

Pile Information	
Type	PCP
	18
Wall Size (in)	18.000
Area (in^2)	324.0
Top Ele. (ft)	0
Tip Ele. (ft)	-97
Length (ft)	97
Modulus (psi)	4030509

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	20.00	0.0255
100%	40.00	0.0720
150%	60.00	0.1155
200%	80.00	0.2070
250%	100.00	2.6130

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	10.0	0.0055	50%	20.0	0.0255	0.009
50%	20.0	0.0535	100%	40.0	0.0720	0.018
75%	30.0	0.1070	150%	60.0	0.1150	0.027
100%	40.0	0.1370		75.0	0.1820	0.036
125%	50.0	0.1765	200%	80.0	0.2070	0.045
150%	60.0	0.2245		90.8	0.3300	0.053
175%	70.0	0.2710		97.1	0.6170	0.062
	75.3	0.2980		99.9	2.5700	0.067
200%	80.0	0.3480	250%	100.0	2.6130	0.071
	94.9	0.6130				0.085
	99.4	1.7460				0.089
	99.7	2.6900				0.089
250%	100.0	2.7660				0.089

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**85.37**	0.256		
☑	**.01 inch/Ton Creep Rate**	**86.87**	0.408	71.19	0.245
				101.19	0.545
☑	**Tangent Method**	**98.9**	0.369	0	0
				108.5	0.398
				0.0036682	

Line T2 points	
98.8	0.018
100.00	2.766
2.29	-226.234

PILE CAPACITY 90.4 TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE E-14-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.416	2.417	Dial 1	Dial 2			1.00
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.416	2.417	0.000	0.000	0.0000	1.000	0.0000
25%	10.00	2	2.408	2.405	0.008	0.012	0.0100	1.00	0.0000
	10.00	8	2.410	2.406	0.006	0.011	0.0085	1.00	0.0000
	10.00	15	2.409	2.402	0.007	0.015	0.0110	1.00	0.0000
	10.00	30	2.415	2.406	0.001	0.011	0.0060	1.00	0.0000
	10.00	60	2.421	2.410	-0.005	0.007	0.0010	1.00	0.0000
	10.00	120	2.418	2.404	-0.002	0.013	0.0055	1.00	0.0000
50%	20.00	2	2.399	2.389	0.017	0.028	0.0225	1.03	0.0300
	20.00	8	2.399	2.390	0.017	0.027	0.0220	1.03	0.0300
	20.00	15	2.401	2.391	0.015	0.026	0.0205	1.03	0.0300
	20.00	30	2.398	2.388	0.018	0.029	0.0235	1.03	0.0300
	20.00	60	2.381	2.368	0.035	0.049	0.0420	1.04	0.0400
	20.00	120	2.369	2.357	0.047	0.060	0.0535	1.04	0.0400
25%	10.00	20	2.385	2.371	0.031	0.046	0.0385	1.03	0.0300
0%	0.00	20	2.397	2.385	0.019	0.032	0.0255	1.00	0.0000
50%	20.00	20	2.356	2.341	0.060	0.076	0.0680	1.03	0.0300
75%	30.00	2	2.333	2.317	0.083	0.100	0.0915	1.03	0.0300
	30.00	8	2.332	2.315	0.084	0.102	0.0930	1.04	0.0400
	30.00	15	2.329	2.313	0.087	0.104	0.0955	1.04	0.0400
	30.00	30	2.326	2.309	0.090	0.108	0.0990	1.04	0.0400
	30.00	60	2.324	2.307	0.092	0.110	0.1010	1.04	0.0400
	30.00	120	2.318	2.301	0.098	0.116	0.1070	1.04	0.0400
100%	40.00	2	2.303	2.284	0.113	0.133	0.1230	1.09	0.0900
	40.00	8	2.302	2.283	0.114	0.134	0.1240	1.10	0.1000
	40.00	15	2.300	2.281	0.116	0.136	0.1260	1.10	0.1000
	40.00	30	2.299	2.280	0.117	0.137	0.1270	1.10	0.1000
	40.00	60	2.293	2.274	0.123	0.143	0.1330	1.10	0.1000
	40.00	120	2.289	2.270	0.127	0.147	0.1370	1.10	0.1000
75%	30.00	20	2.297	2.275	0.119	0.142	0.1305	1.08	0.0800
50%	20.00	20	2.311	2.292	0.105	0.125	0.1150	1.08	0.0800
0%	0.00	20	2.351	2.338	0.065	0.079	0.0720	1.03	0.0300
50%	20.00	20	2.320	2.302	0.096	0.115	0.1055	1.03	0.0300
100%	40.00	20	2.265	2.282	0.151	0.135	0.1430	1.07	0.0700
125%	50.00	2	2.267	2.246	0.149	0.171	0.1600	1.09	0.0900
	50.00	8	2.264	2.241	0.152	0.176	0.1640	1.09	0.0900
	50.00	15	2.262	2.237	0.154	0.180	0.1670	1.10	0.1000
	50.00	30	2.260	2.233	0.156	0.184	0.1700	1.10	0.1000
	50.00	60	2.257	2.229	0.159	0.188	0.1735	1.11	0.1100
	50.00	120	2.255	2.225	0.161	0.192	0.1765	1.12	0.1200
150%	60.00	2	2.225	2.204	0.191	0.213	0.2020	1.12	0.1200
	60.00	8	2.220	2.198	0.196	0.219	0.2075	1.14	0.1400
	60.00	15	2.217	2.195	0.199	0.222	0.2105	1.14	0.1400
	60.00	30	2.214	2.190	0.202	0.227	0.2145	1.16	0.1600
	60.00	60	2.209	2.186	0.207	0.231	0.2190	1.18	0.1800
	60.00	120	2.204	2.180	0.212	0.237	0.2245	1.18	0.1800
125%	50.00	20	2.212	2.190	0.204	0.227	0.2155	1.18	0.1800
100%	40.00	20	2.228	2.205	0.188	0.212	0.2000	1.18	0.1800
50%	20.00	20	2.265	2.240	0.151	0.177	0.1640	1.12	0.1200
0%	0.00	20	2.309	2.293	0.107	0.124	0.1155	1.09	0.0900
50%	20.00	20	2.274	2.254	0.142	0.163	0.1525	1.12	0.1200
100%	40.00	20	2.238	2.215	0.178	0.202	0.1900	1.16	0.1600
150%	60.00	20	2.198	2.175	0.218	0.242	0.2300	1.20	0.2000
175%	70.00	2	2.172	2.148	0.244	0.269	0.2565	1.23	0.2300
	70.00	8	2.168	2.144	0.248	0.273	0.2605	1.23	0.2300
	70.00	15	2.164	2.141	0.252	0.276	0.2640	1.23	0.2300
	70.00	30	2.161	2.138	0.255	0.279	0.2670	1.24	0.2400
	70.00	60	2.152	2.135	0.264	0.282	0.2730	1.25	0.2500
	70.00	120	2.146	2.145	0.270	0.272	0.2710	1.26	0.2600
200%	80.00	2	2.120	2.118	0.296	0.299	0.2975	1.27	0.2700
	80.00	8	2.112	2.113	0.304	0.304	0.3040	1.27	0.2700
	80.00	15	2.108	2.106	0.308	0.311	0.3095	1.28	0.2800
	80.00	30	2.106	2.096	0.310	0.321	0.3155	1.29	0.2900
	80.00	60	2.094	2.080	0.322	0.337	0.3295	1.32	0.3200
	80.00	120	2.080	2.063	0.336	0.354	0.3450	1.34	0.3400
	80.00	180	2.069	2.047	0.347	0.370	0.3585	1.35	0.3500
	80.00	240	2.057	2.034	0.359	0.383	0.3710	1.36	0.3600
	80.00	300	2.039	2.016	0.377	0.401	0.3890	1.37	0.3700
	80.00	360	2.024	2.002	0.392	0.415	0.4035	1.38	0.3800
	80.00	420	2.016	1.994	0.400	0.423	0.4115	1.39	0.3900
	80.00	480	2.008	1.985	0.408	0.432	0.4200	1.40	0.4000
	80.00	540	2.006	1.983	0.410	0.434	0.4220	1.40	0.4000
	80.00	600	1.900	1.980	0.516	0.437	0.4765	1.40	0.4000
	80.00	660	1.996	1.975	0.420	0.442	0.4310	1.40	0.4000
	80.00	720	1.992	1.970	0.424	0.447	0.4355	1.40	0.4000
	80.00	780	1.990	1.967	0.426	0.450	0.4380	1.40	0.4000
	80.00	840	1.998	1.964	0.418	0.453	0.4355	1.40	0.4000
	80.00	900	1.981	1.959	0.435	0.458	0.4465	1.40	0.4000
	80.00	960	1.978	1.955	0.438	0.462	0.4500	1.40	0.4000
	80.00	1020	1.977	1.955	0.439	0.462	0.4505	1.40	0.4000
	80.00	1080	1.973	1.952	0.443	0.465	0.4540	1.41	0.4100
	80.00	1140	1.965	1.944	0.451	0.473	0.4620	1.42	0.4200
	80.00	1200	1.961	1.939	0.455	0.478	0.4665	1.44	0.4400

	80.00	1260	1.964	1.941	0.452	0.476	0.4640	1.44	0.4400
	80.00	1320	1.964	1.947	0.452	0.470	0.4610	1.44	0.4400
	80.00	1380	1.967	1.954	0.449	0.463	0.4560	1.44	0.4400
	80.00	1440	1.982	1.973	0.434	0.444	0.4390	1.44	0.4400
150%	60.00	60	2.020	2.015	0.396	0.402	0.3990	1.38	0.3800
100%	40.00	60	2.072	2.070	0.344	0.347	0.3455	1.34	0.3400
50%	20.00	60	2.147	2.141	0.269	0.276	0.2725	1.31	0.3100
0%	0.00	60	2.205	2.214	0.211	0.203	0.2070	1.24	0.2400
50%	20.00	20	2.162	2.168	0.254	0.249	0.2515	1.28	0.2800
100%	40.00	20	2.115	2.119	0.301	0.298	0.2995	1.32	0.3200
150%	60.00	20	2.061	2.067	0.355	0.350	0.3525	1.36	0.3600
200%	80.00	20	2.003	2.014	0.413	0.403	0.4080	1.43	0.4300
210%	84.00	20	1.987	1.990	0.429	0.427	0.4280	1.43	0.4300
220%	88.00	20	1.970	1.964	0.446	0.453	0.4495	1.44	0.4400
230%	92.00	20	1.933	1.916	0.483	0.501	0.4920	1.47	0.4700
240%	96.00	20	1.880	1.860	0.536	0.557	0.5465	1.51	0.5100
250%	100.00	10	0.568	0.540	1.848	1.877	1.8625	2.60	1.6000
	100.00	15	1.549	1.520	1.867	1.897	1.8820	2.90	1.9000
	100.00	20	1.222	1.282	2.194	2.135	2.1645	3.20	2.2000
	100.00	27	0.665	0.636	2.751	2.781	2.7660	3.72	2.7200
75%	30.00		0.616	0.583	2.800	2.834	2.8170	3.80	2.8000
50%	20.00		0.653	0.622	2.763	2.795	2.7790	3.78	2.7800
25%	10.00		0.726	0.697	2.690	2.720	2.7050	3.69	2.6900
0%	0.00		0.812	0.795	2.604	2.622	2.6130	3.60	2.6000

WCC - 404c Wall
TP#25 - PCP 18" - Tip EL -97.0 - Service Load = 40 Tons Tension

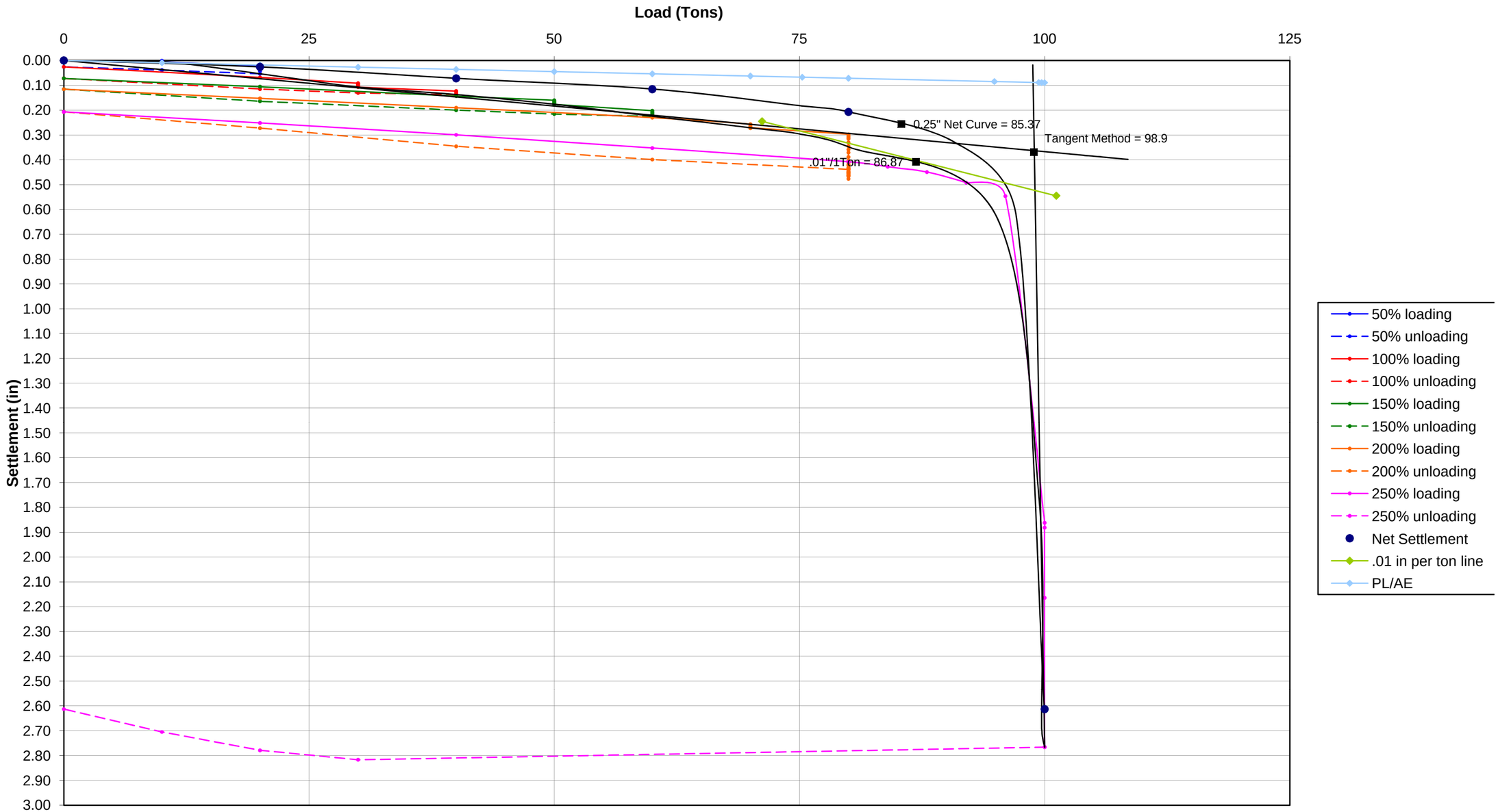


PLATE E-14-d

WCC - Cofferdam - TP-26 (Tension)

54" Pipe, Tip Elevation = -123

Service Load = 160.00 **Tons**

Estimated Pile Capacity = 394 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	54
Wall Size (in)	1.000
Area (in^2)	166.5
Top Ele. (ft)	0
Tip Ele. (ft)	-123
Length (ft)	123
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
100%	160.00	0.0195
150%	240.00	-0.0085
200%	320.00	0.0930
260%	416.00	7.7550

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	40.0	0.0210	100%	160.0	0.0195	0.012
50%	80.0	0.0495	150%	240.0	-0.0085	0.024
75%	120.0	0.0855		292.9	0.0750	0.037
100%	160.0	0.1190	200%	320.0	0.0930	0.049
125%	200.0	0.1490		380.7	0.1580	0.061
150%	240.0	0.1635		415.0	0.3370	0.073
175%	280.0	0.2060		415.9	7.5000	0.086
	306.2	0.2530	260%	416.0	7.7550	0.094
200%	320.0	0.2995				0.098
	373.0	0.6040				0.114
	405.3	1.6350				0.124
	413.4	5.9180				0.126
260%	416.0	8.0740				0.127

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**410**	0.25		
☑	**.01 inch/Ton Creep Rate**	**363.8**	0.485	354.4	0.403
				384.4	0.703
☑	**Tangent Method**	**407.8**	0.232	0	0
				469.4	0.261
				0.000556	

Line T2 points	
407.8	0.025
416.00	8.074
0.9815854	-400.26551

PILE CAPACITY	**393.9**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE E-15-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading				Initial Reading =	
			2.74	2.791	Dial 1	Dial 2		1.24	
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.740	2.791	0.000	0.000	0.0000	1.240	0.0000
25%	40.00	20	2.718	2.771	0.022	0.020	0.0210	1.26	0.0200
50%	80.00	20	2.688	2.744	0.052	0.047	0.0495	1.30	0.0600
75%	120.00	2	2.660	2.721	0.080	0.070	0.0750	1.31	0.0700
	120.00	8	2.657	2.719	0.083	0.072	0.0775	1.31	0.0700
	120.00	15	2.656	2.718	0.084	0.073	0.0785	1.31	0.0700
	120.00	30	2.655	2.717	0.085	0.074	0.0795	1.32	0.0800
	120.00	60	2.652	2.714	0.088	0.077	0.0825	1.32	0.0800
	120.00	120	2.649	2.711	0.091	0.080	0.0855	1.33	0.0900
100%	160.00	2	2.620	2.684	0.120	0.107	0.1135	1.36	0.1200
	160.00	8	2.619	2.684	0.121	0.107	0.1140	1.36	0.1200
	160.00	15	2.619	2.683	0.121	0.108	0.1145	1.36	0.1200
	160.00	30	2.618	2.683	0.122	0.108	0.1150	1.36	0.1200
	160.00	60	2.615	2.680	0.125	0.111	0.1180	1.36	0.1200
	160.00	120	2.615	2.678	0.125	0.113	0.1190	1.37	0.1300
75%	120.00	20	2.640	2.702	0.100	0.089	0.0945	1.34	0.1000
50%	80.00	20	2.667	2.726	0.073	0.065	0.0690	1.31	0.0700
0%	0.00	20	2.722	2.770	0.018	0.021	0.0195	1.26	0.0200
50%	80.00	20	2.672	2.730	0.068	0.061	0.0645	1.31	0.0700
100%	160.00	20	2.618	2.681	0.122	0.110	0.1160	1.36	0.1200
125%	200.00	2	2.585	2.654	0.155	0.137	0.1460	1.40	0.1600
	200.00	8	2.584	2.653	0.156	0.138	0.1470	1.40	0.1600
	200.00	15	2.584	2.652	0.156	0.139	0.1475	1.40	0.1600
	200.00	30	2.583	2.650	0.157	0.141	0.1490	1.40	0.1600
	200.00	60	2.580	2.646	0.160	0.145	0.1525	1.40	0.1600
	200.00	120	2.583	2.650	0.157	0.141	0.1490	1.41	0.1700
150%	240.00	2	2.554	2.628	0.186	0.163	0.1745	1.43	0.1900
	240.00	8	2.553	2.620	0.187	0.171	0.1790	1.44	0.2000
	240.00	15	2.552	2.625	0.188	0.166	0.1770	1.44	0.2000
	240.00	30	2.552	2.625	0.188	0.166	0.1770	1.44	0.2000
	240.00	60	2.554	2.626	0.186	0.165	0.1755	1.44	0.2000
	240.00	120	2.565	2.639	0.175	0.152	0.1635	1.44	0.2000
125%	200.00	20	2.597	2.670	0.143	0.121	0.1320	1.42	0.1800
100%	160.00	20	2.619	2.691	0.121	0.100	0.1105	1.39	0.1500
50%	80.00	20	2.673	2.740	0.067	0.051	0.0590	1.35	0.1100
0%	0.00	20	2.744	2.804	-0.004	-0.013	-0.0085	1.27	0.0300
50%	80.00	20	2.699	2.767	0.041	0.024	0.0325	1.31	0.0700
100%	160.00	20	2.640	2.718	0.100	0.073	0.0865	1.38	0.1400
150%	240.00	20	2.574	2.662	0.166	0.129	0.1475	1.40	0.1600
175%	280.00	2	2.536	2.625	0.204	0.166	0.1850	1.48	0.2400
	280.00	8	2.523	2.621	0.217	0.170	0.1935	1.49	0.2500
	280.00	15	2.532	2.619	0.208	0.172	0.1900	1.49	0.2500
	280.00	30	2.528	2.617	0.212	0.174	0.1930	1.49	0.2500
	280.00	60	2.524	2.609	0.216	0.182	0.1990	1.49	0.2500
	280.00	120	2.516	2.603	0.224	0.188	0.2060	1.49	0.2500
200%	320.00	2	2.482	2.574	0.258	0.217	0.2375	1.52	0.2800
	320.00	8	2.481	2.574	0.259	0.217	0.2380	1.52	0.2800
	320.00	15	2.476	2.570	0.264	0.221	0.2425	1.52	0.2800
	320.00	30	2.470	2.564	0.270	0.227	0.2485	1.53	0.2900
	320.00	60	2.463	2.553	0.277	0.238	0.2575	1.53	0.2900
	320.00	120	2.444	2.526	0.296	0.265	0.2805	1.55	0.3100
	320.00	180	2.430	2.511	0.310	0.280	0.2950	1.55	0.3100
	320.00	240	2.422	2.502	0.318	0.289	0.3035	1.55	0.3100
	320.00	300	2.416	2.497	0.324	0.294	0.3090	1.56	0.3200
	320.00	360	2.414	2.495	0.326	0.296	0.3110	1.57	0.3300
	320.00	420	2.410	2.490	0.330	0.301	0.3155	1.57	0.3300
	320.00	480	2.408	2.488	0.332	0.303	0.3175	1.57	0.3300
	320.00	540	2.405	2.485	0.335	0.306	0.3205	1.57	0.3300
	320.00	600	2.400	2.480	0.340	0.311	0.3255	1.57	0.3300
	320.00	660	2.400	2.480	0.340	0.311	0.3255	1.57	0.3300
	320.00	720	2.396	2.476	0.344	0.315	0.3295	1.58	0.3400
	320.00	780	2.395	2.475	0.345	0.316	0.3305	1.58	0.3400
	320.00	840	2.397	2.478	0.343	0.313	0.3280	1.59	0.3500
	320.00	900	2.398	2.477	0.342	0.314	0.3280	1.59	0.3500
	320.00	960	2.409	2.492	0.331	0.299	0.3150	1.58	0.3400
	320.00	1020	2.415	2.511	0.325	0.280	0.3025	1.57	0.3300
	320.00	1080	2.449	2.544	0.291	0.247	0.2690	1.57	0.3300
	320.00	1140	2.433	2.576	0.307	0.215	0.2610	1.58	0.3400
	320.00	1200	2.446	2.555	0.294	0.236	0.2650	1.58	0.3400
	320.00	1260	2.487	2.555	0.253	0.236	0.2445	1.57	0.3300
	320.00	1320	2.428	2.541	0.312	0.250	0.2810	1.57	0.3300
	320.00	1380	2.420	2.531	0.320	0.260	0.2900	1.57	0.3300
	320.00	1440	2.411	2.521	0.329	0.270	0.2995	1.57	0.3300
150%	240.00	60	2.478	2.549	0.262	0.242	0.2520	1.51	0.2700
100%	160.00	60	2.533	2.595	0.207	0.196	0.2015	1.45	0.2100
50%	80.00	60	2.587	2.648	0.153	0.143	0.1480	1.39	0.1500
0%	0.00	60	2.646	2.699	0.094	0.092	0.0930	1.33	0.0900
50%	80.00	20	2.594	2.654	0.146	0.137	0.1415	1.38	0.1400
100%	160.00	20	2.532	2.600	0.208	0.191	0.1995	1.45	0.2100
150%	240.00	20	2.466	2.542	0.274	0.249	0.2615	1.52	0.2800
200%	320.00	20	2.398	2.480	0.342	0.311	0.3265	1.58	0.3400
210%	336.00	20	2.381	2.466	0.359	0.325	0.3420	1.59	0.3500

220%	352.00	20	2.364	2.451	0.376	0.340	0.3580	1.61	0.3700
230%	368.00	20	2.345	2.433	0.395	0.358	0.3765	1.62	0.3800
240%	384.00	20	2.322	2.410	0.418	0.381	0.3995	1.65	0.4100
250%	400.00	20	2.220	2.303	0.520	0.488	0.5040	1.76	0.5200
260%	416.00		1.820	1.903	0.920	0.888	0.9040	2.16	0.9200
	416.00		0.690	0.760	2.050	2.031	2.0405	3.27	2.0300
	416.00		0.050	0.122	2.690	2.669	2.6795	3.90	2.6600
	416.00		1.160	1.241	3.580	3.550	3.5650	4.80	3.5600
	416.00		0.760	0.836	3.980	3.955	3.9675	5.20	3.9600
	416.00		1.803	1.887	3.937	3.904	3.9205	6.10	4.8600
	416.00		1.171	1.251	5.569	5.540	5.5545	6.80	5.5600
	416.00		0.140	0.190	6.600	6.601	6.6005	7.86	6.6200
	416.00		1.300	1.370	7.440	7.421	7.4305	8.66	7.4200
	416.00		0.653	0.730	8.087	8.061	8.0740	9.25	8.0100
189%	303.00	20	0.685	0.764	8.055	8.027	8.0410	9.30	8.0600
128%	205.00	20	0.770	0.840	7.970	7.951	7.9605	9.21	7.9700
46%	74.00	20	0.903	0.961	7.837	7.830	7.8335	9.08	7.8400
0%	0.00	20	0.984	1.037	7.756	7.754	7.7550	9.00	7.7600

WCC - Cofferdam
TP#26 (Tension) - Steel 54" Pipe Pile - Spiral Weld - Tip EL -123.0 - Service Load = 160 Tons

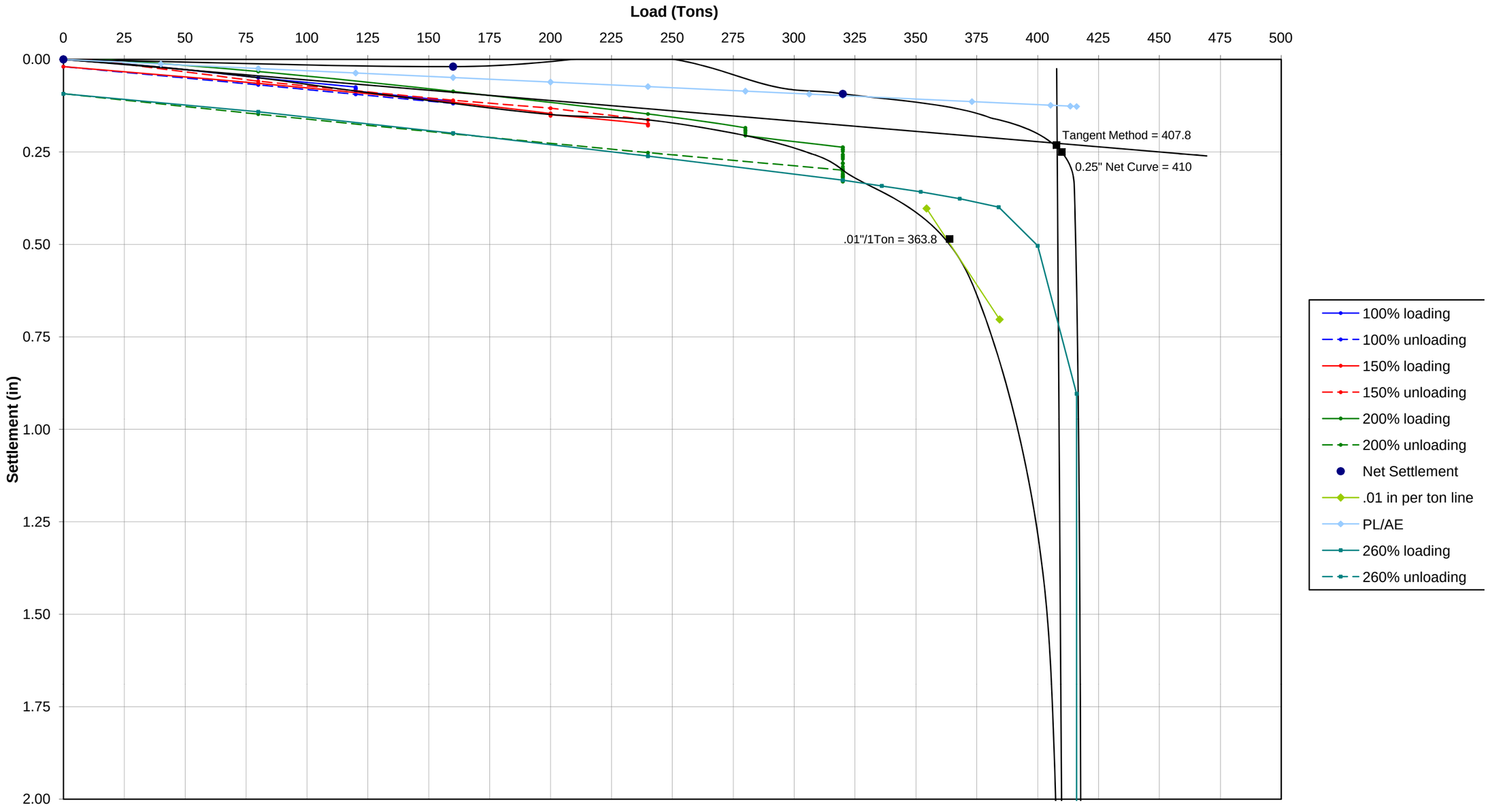


PLATE E-15-d

WCC - Cofferdam - TP-27? Or TP-26Compression

54" Pipe, Tip Elevation = -123

Service Load = 210.00 **Tons**

Estimated Pile Capacity = 294 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	54
Wall Size (in)	1.000
Area (in^2)	166.5
Top Ele. (ft)	0
Tip Ele. (ft)	-123
Length (ft)	123
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	105.00	-0.0300
100%	210.00	-0.0015
150%	315.00	7.7490

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	52.5	0.0305	50%	105.0	-0.0300	0.016
50%	105.0	0.0775	100%	210.0	-0.0015	0.032
75%	157.5	0.1220		304.5	0.3260	0.048
100%	210.0	0.1895		314.5	2.7000	0.064
125%	262.5	0.2825	150%	315.0	7.7490	0.080
	301.9	1.0720				0.092
	314.4	3.6450				0.096
150%	315.0	8.0065				0.096

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**299.7**	0.25		
☑	**.01 inch/Ton Creep Rate**	**270**	0.343	255	0.18
				285	0.48
☑	**Tangent Method**	**313.5**	0.2	0	0
				390	0.25
				0.000641	

Line T2 points	
314	0.1
315.00	8.007
7.9065	-2482.541

PILE CAPACITY	**294.4**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE E-16-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.981	2.972	Dial 1	Dial 2			1.85
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.981	2.972	0.000	0.000	0.0000	1.850	0.0000
25%	52.50	2	2.943	2.936	0.038	0.036	0.0370	1.90	0.0500
	52.50	8	2.947	2.940	0.034	0.032	0.0330	1.89	0.0400
	52.50	15	2.946	2.942	0.035	0.030	0.0325	1.90	0.0500
	52.50	30	2.945	2.946	0.036	0.026	0.0310	1.90	0.0500
	52.50	60	2.948	2.952	0.033	0.020	0.0265	1.90	0.0500
	52.50	120	2.941	2.951	0.040	0.021	0.0305	1.90	0.0500
50%	105.00	2	2.889	2.911	0.092	0.061	0.0765	1.94	0.0900
	105.00	8	2.889	2.911	0.092	0.061	0.0765	1.95	0.1000
	105.00	15	2.888	2.910	0.093	0.062	0.0775	1.95	0.1000
	105.00	30	2.888	2.909	0.093	0.063	0.0780	1.96	0.1100
	105.00	60	2.887	2.907	0.094	0.065	0.0795	1.96	0.1100
	105.00	120	2.887	2.911	0.094	0.061	0.0775	1.96	0.1100
25%	52.50	20	2.946	2.956	0.035	0.016	0.0255	1.93	0.0800
0%	0.00	20	3.010	3.003	-0.029	-0.031	-0.0300	1.88	0.0300
50%	105.00	20	2.907	2.914	0.074	0.058	0.0660	1.94	0.0900
75%	157.50	2	2.859	2.870	0.122	0.102	0.1120	2.00	0.1500
	157.50	8	2.856	2.868	0.125	0.104	0.1145	2.00	0.1500
	157.50	15	2.854	2.867	0.127	0.105	0.1160	2.00	0.1500
	157.50	30	2.852	2.865	0.129	0.107	0.1180	2.00	0.1500
	157.50	60	2.849	2.862	0.132	0.110	0.1210	2.00	0.1500
	157.50	120	2.847	2.862	0.134	0.110	0.1220	2.00	0.1500
100%	210.00	2	2.797	2.815	0.184	0.157	0.1705	2.06	0.2100
	210.00	8	2.793	2.811	0.188	0.161	0.1745	2.06	0.2100
	210.00	15	2.791	2.809	0.190	0.163	0.1765	2.06	0.2100
	210.00	30	2.788	2.806	0.193	0.166	0.1795	2.06	0.2100
	210.00	60	2.782	2.800	0.199	0.172	0.1855	2.07	0.2200
	210.00	120	2.778	2.796	0.203	0.176	0.1895	2.07	0.2200
75%	157.50	20	2.820	2.833	0.161	0.139	0.1500	2.04	0.1900
50%	105.00	20	2.864	2.874	0.117	0.098	0.1075	2.00	0.1500
0%	0.00	20	2.980	2.976	0.001	-0.004	-0.0015	1.89	0.0400
50%	105.00	20	2.871	2.880	0.110	0.092	0.1010	2.00	0.1500
100%	210.00	20	2.772	2.790	0.209	0.182	0.1955	2.08	0.2300
125%	262.50	2	2.715	2.734	0.266	0.238	0.2520	2.15	0.3000
	262.50	8	2.708	2.727	0.273	0.245	0.2590	2.15	0.3000
	262.50	15	2.705	2.723	0.276	0.249	0.2625	2.15	0.3000
	262.50	30	2.698	2.718	0.283	0.254	0.2685	2.15	0.3000
	262.50	60	2.693	2.713	0.288	0.259	0.2735	2.16	0.3100
	262.50	120	2.684	2.704	0.297	0.268	0.2825	2.17	0.3200
150%	315.00	2	2.570	2.580	0.411	0.392	0.4015	2.37	0.5200
	315.00	8	2.260	2.280	0.721	0.692	0.7065	2.62	0.7700
	315.00	15	1.442	1.462	1.539	1.510	1.5245	3.41	1.5600
	315.00	30	0.240	0.260	2.741	2.712	2.7265	4.61	2.7600
	315.00	60	0.370	0.380	4.611	4.592	4.6015	6.49	4.6400
	315.00	85	0.250	0.270	6.731	6.702	6.7165	8.60	6.7500
	315.00	95	0.960	0.980	8.021	7.992	8.0065	9.92	8.0700
100%	210.00	20	0.980	1.002	8.001	7.970	7.9855	9.88	8.0300
64%	135.00	20	1.053	1.070	7.928	7.902	7.9150	9.80	7.9500
31%	65.00	20	1.126	1.136	7.855	7.836	7.8455	9.72	7.8700
0%	0.00	20	1.228	1.227	7.753	7.745	7.7490	9.65	7.8000

PLATE E-16-b

WCC - Cofferdam
TP#26 - Steel 54" Pipe Pile - Spiral Weld - Tip EL -123.0 - Service Load = 210 Tons

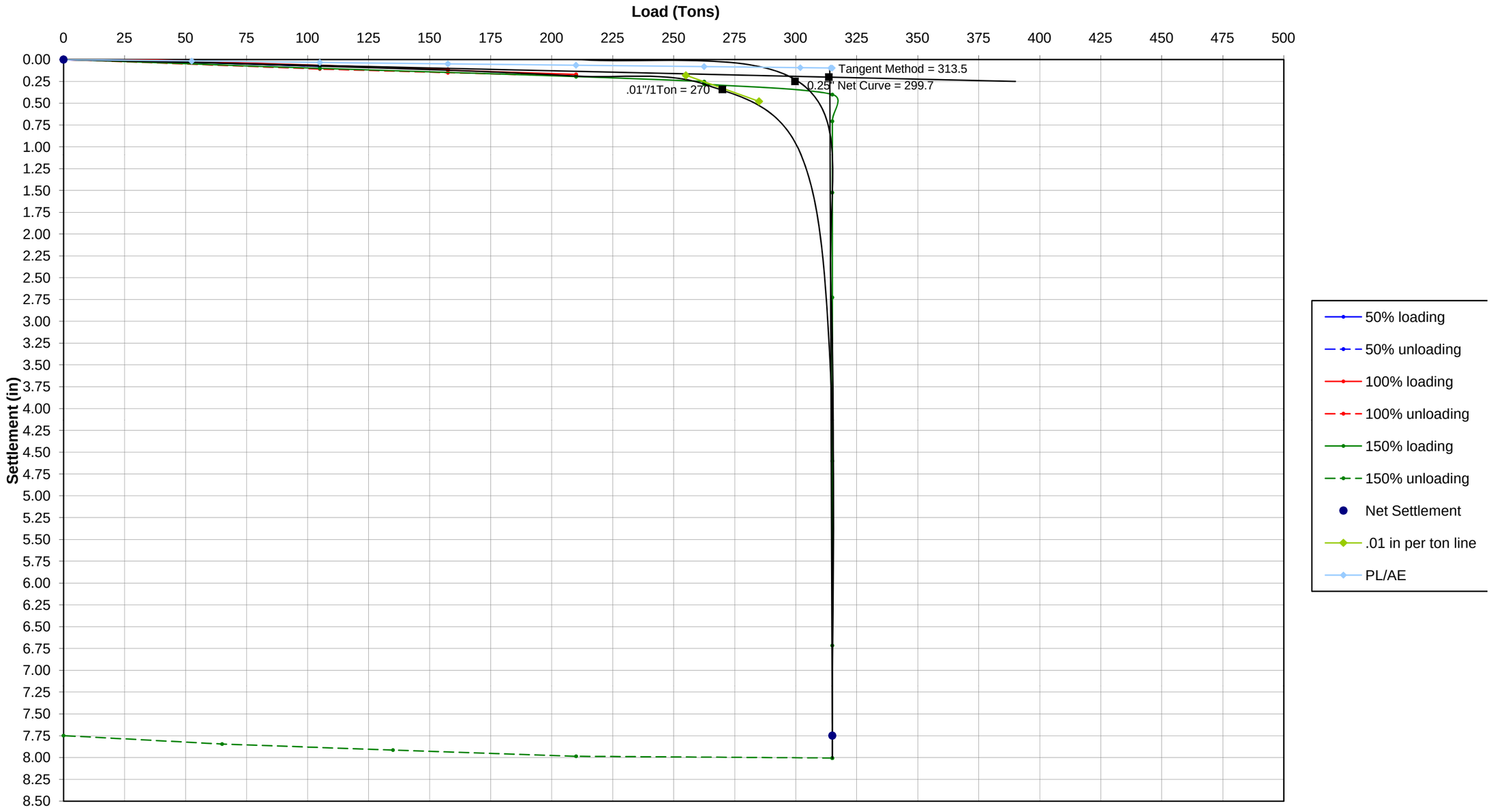


PLATE E-16-c

WCC - East T-Wall - TP-30

18" PCP, Tip Elevation = -120

Service Load = 108.00 **Tons**

Estimated Pile Capacity = 155 **Tons**

Pile Information	
Type	PCP
	18
Wall Size (in)	18.000
Area (in^2)	324.0
Top Ele. (ft)	0
Tip Ele. (ft)	-120
Length (ft)	120
Modulus (psi)	4030509

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	54.00	-0.0120
100%	108.00	0.0055
150%	162.00	2.5395

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	27.0	0.0010	50%	54.0	-0.0120	0.030
50%	54.0	0.0505	100%	108.0	0.0055	0.060
75%	81.0	0.0720		152.5	0.1430	0.089
100%	108.0	0.1350		161.8	0.7430	0.119
125%	135.0	0.2305	150%	162.0	2.5395	0.149
	155.4	0.4940				0.171
	160.5	1.6350				0.177
150%	162.0	2.7520				0.179

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**157.3**	0.25		
☑	**.01 inch/Ton Creep Rate**	**145.6**	0.314	132.4 / 162.4	0.171 / 0.471
☑	**Tangent Method**	**160.6**	0.135	Line T1: 0 / 227.4 / 0.0008223	0 / 0.187 / —
				Line T2: 160.5 / 162.00 / 1.8286667	0.009 / 2.752 / -293.492

PILE CAPACITY **154.5** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.158	1.886	Dial 1	Dial 2			2.00
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.158	1.886	0.000	0.000	0.0000	2.00	0.0000
25%	27.00	2	2.131	1.862	0.027	0.024	0.0255	2.01	0.0100
	27.00	8	2.129	1.859	0.029	0.027	0.0280	2.01	0.0100
	27.00	15	2.129	1.857	0.029	0.029	0.0290	2.01	0.0100
	27.00	30	2.130	1.857	0.028	0.029	0.0285	2.01	0.0100
	27.00	60	2.168	1.858	-0.010	0.028	0.0090	2.01	0.0100
	27.00	120	2.180	1.862	-0.022	0.024	0.0010	2.02	0.0200
50%	54.00	2	2.155	1.837	0.003	0.049	0.0260	2.05	0.0500
	54.00	8	2.153	1.838	0.005	0.048	0.0265	2.05	0.0500
	54.00	15	2.151	1.841	0.007	0.045	0.0260	2.05	0.0500
	54.00	30	2.149	1.839	0.009	0.047	0.0280	2.05	0.0500
	54.00	60	2.140	1.844	0.018	0.042	0.0300	2.05	0.0500
	54.00	120	2.129	1.814	0.029	0.072	0.0505	2.05	0.0500
25%	27.00	20	2.154	1.832	0.004	0.054	0.0290	2.05	0.0500
0%	0.00	20	2.187	1.881	-0.029	0.005	-0.0120	2.01	0.0100
50%	54.00	20	2.144	1.845	0.014	0.041	0.0275	2.05	0.0500
75%	81.00	2	2.111	1.810	0.047	0.076	0.0615	2.09	0.0900
	81.00	8	2.110	1.810	0.048	0.076	0.0620	2.09	0.0900
	81.00	15	2.110	1.808	0.048	0.078	0.0630	2.09	0.0900
	81.00	30	2.106	1.804	0.052	0.082	0.0670	2.09	0.0900
	81.00	60	2.102	1.801	0.056	0.085	0.0705	2.10	0.1000
	81.00	120	2.101	1.799	0.057	0.087	0.0720	2.10	0.1000
100%	108.00	2	2.064	1.761	0.094	0.125	0.1095	2.14	0.1400
	108.00	8	2.058	1.756	0.100	0.130	0.1150	2.14	0.1400
	108.00	15	2.053	1.750	0.105	0.136	0.1205	2.15	0.1500
	108.00	30	2.049	1.746	0.109	0.140	0.1245	2.15	0.1500
	108.00	60	2.045	1.741	0.113	0.145	0.1290	2.15	0.1500
	108.00	120	2.039	1.735	0.119	0.151	0.1350	2.17	0.1700
75%	81.00	20	2.064	1.716	0.094	0.170	0.1320	2.13	0.1300
50%	54.00	20	2.099	1.795	0.059	0.091	0.0750	2.10	0.1000
0%	0.00	20	2.166	1.867	-0.008	0.019	0.0055	2.04	0.0400
50%	54.00	20	2.112	1.816	0.046	0.070	0.0580	2.09	0.0900
100%	108.00	20	2.041	1.735	0.117	0.151	0.1340	2.17	0.1700
125%	135.00	2	2.090	1.685	0.068	0.201	0.1345	2.20	0.2000
	135.00	8	2.079	1.674	0.079	0.212	0.1455	2.21	0.2100
	135.00	15	2.077	1.673	0.081	0.213	0.1470	2.22	0.2200
	135.00	30	2.063	1.660	0.095	0.226	0.1605	2.23	0.2300
	135.00	60	2.056	1.651	0.102	0.235	0.1685	2.24	0.2400
	135.00	120	1.944	1.639	0.214	0.247	0.2305	2.25	0.2500
150%	162.00	2	1.838	1.529	0.320	0.357	0.3385	2.35	0.3500
	162.00	8	1.760	1.448	0.398	0.438	0.4180	2.42	0.4200
	162.00	15	1.531	1.214	0.627	0.672	0.6495	2.68	0.6800
	162.00	30	1.433	1.126	2.725	2.760	2.7425	4.74	2.7400
	162.00	60	1.422	1.118	2.736	2.768	2.7520	4.78	2.7800
75%	81.00	120	1.494	1.190	2.664	2.696	2.6800	4.70	2.7000
50%	54.00	20	1.536	1.232	2.622	2.654	2.6380	4.67	2.6700
25%	27.00	20	1.573	1.270	2.585	2.616	2.6005	4.67	2.6700
0%	0.00	20	1.632	1.333	2.526	2.553	2.5395	4.57	2.5700

WCC - East T-Wall
TP#30 - PCP 18" - Tip EL -120 - Service Load = 108 Tons

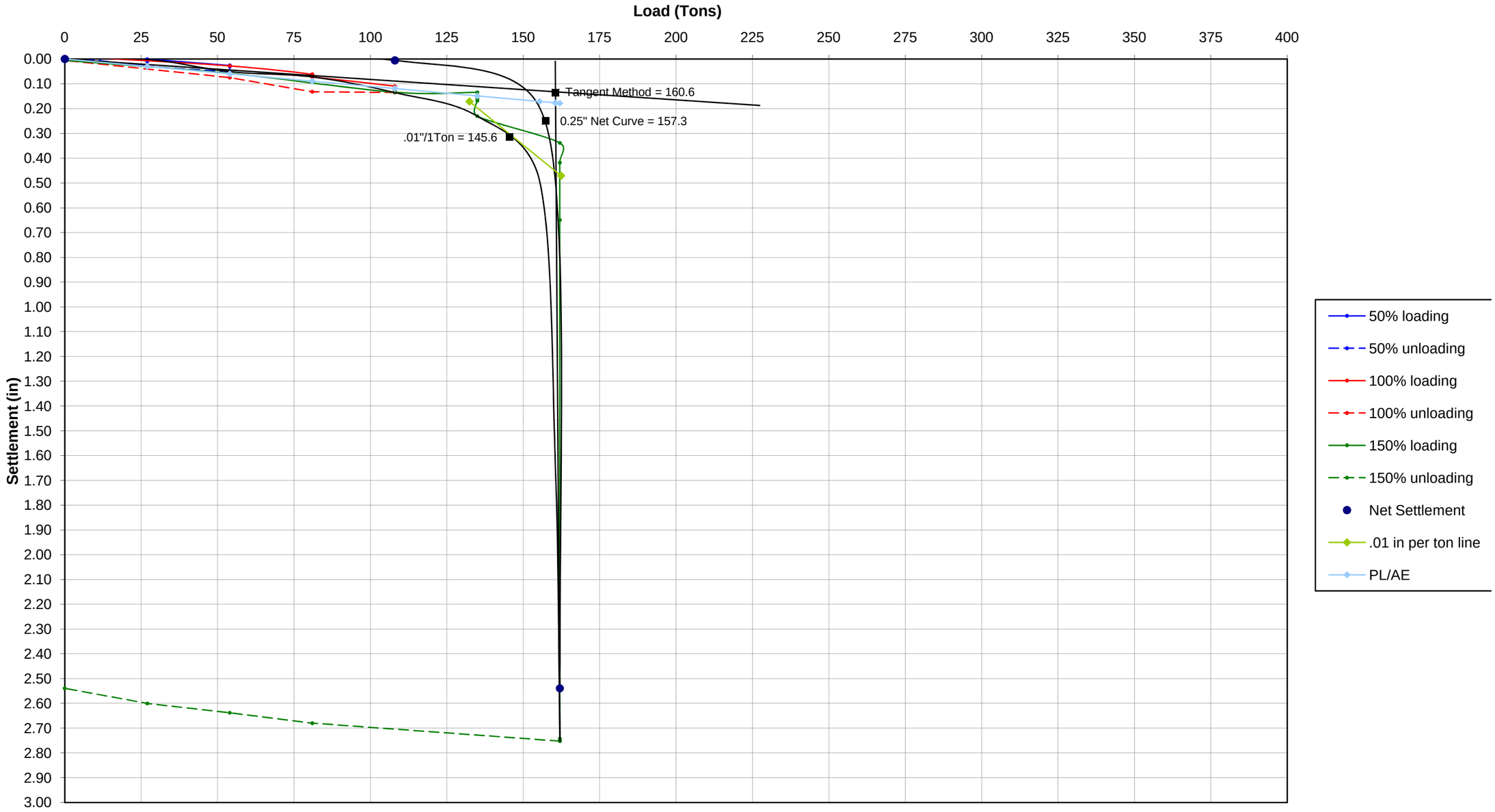


PLATE E-17-c

WCC - East T-Wall - TP-30 (Tension)

18" PCP, Tip Elevation = -120

Service Load = 60.00 **Tons**

Estimated Pile Capacity = 127 **Tons**

Pile Information	
Type	PCP
	18
Wall Size (in)	18.000
Area (in^2)	324.0
Top Ele. (ft)	0
Tip Ele. (ft)	-120
Length (ft)	120
Modulus (psi)	4030509

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	30.00	0.0305
100%	60.00	0.0530
150%	90.00	0.0965
200%	120.00	0.2405
260%	156.00	2.6285

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	15.0	0.0330	50%	30.0	0.0305	0.017
50%	30.0	0.0655	100%	60.0	0.0530	0.033
75%	45.0	0.0940	150%	90.0	0.0965	0.050
100%	60.0	0.1300		113.1	0.1960	0.066
125%	75.0	0.1760	200%	120.0	0.2405	0.083
150%	90.0	0.2255		145.0	0.5000	0.099
175%	105.0	0.2710		155.1	1.0170	0.116
	113.5	0.3250		155.9	1.8200	0.125
200%	120.0	0.4020	260%	156.0	2.6285	0.132
	134.0	0.6800				0.148
	145.0	1.1640				0.160
	151.2	1.9260				0.167
260%	156.0	2.8405				0.172

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**121.2**	0.25		
☑	**.01 inch/Ton Creep Rate**	**115.7**	0.34	102.3 132.3	0.205 0.505
☑	**Tangent Method**	**144.8**	0.265	0 159.6 0.0018296	0 0.292	144 156.00 0.2309583	0.069 2.841 -33.189

(.01"/Ton line points: Capacity / Deflection; Line T1 points; Line T2 points)

PILE CAPACITY **127.2** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE E-18-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.891	2.892	Dial 1	Dial 2			2.85
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.891	2.892	0.000	0.000	0.0000	2.850	0.0000
25%	15.00	2	2.884	2.884	0.007	0.008	0.0075	2.86	0.0100
	15.00	8	2.872	2.873	0.019	0.019	0.0190	2.87	0.0200
	15.00	15	2.870	2.872	0.021	0.020	0.0205	2.87	0.0200
	15.00	30	2.869	2.870	0.022	0.022	0.0220	2.87	0.0200
	15.00	60	2.864	2.865	0.027	0.027	0.0270	2.87	0.0200
	15.00	120	2.858	2.859	0.033	0.033	0.0330	2.87	0.0200
50%	30.00	2	2.834	2.834	0.057	0.058	0.0575	2.90	0.0500
	30.00	8	2.833	2.833	0.058	0.059	0.0585	2.90	0.0500
	30.00	15	2.830	2.831	0.061	0.061	0.0610	2.90	0.0500
	30.00	30	2.827	2.827	0.064	0.065	0.0645	2.90	0.0500
	30.00	60	2.826	2.826	0.065	0.066	0.0655	2.90	0.0500
	30.00	120	2.826	2.826	0.065	0.066	0.0655	2.90	0.0500
25%	15.00	20	2.849	2.850	0.042	0.042	0.0420	2.88	0.0300
0%	0.00	20	2.864	2.858	0.027	0.034	0.0305	2.86	0.0100
50%	30.00	20	2.824	2.825	0.067	0.067	0.0670	2.89	0.0400
75%	45.00	2	2.805	2.806	0.086	0.086	0.0860	2.90	0.0500
	45.00	8	2.805	2.805	0.086	0.087	0.0865	2.90	0.0500
	45.00	15	2.803	2.803	0.088	0.089	0.0885	2.91	0.0600
	45.00	30	2.801	2.804	0.090	0.088	0.0890	2.91	0.0600
	45.00	60	2.799	2.801	0.092	0.091	0.0915	2.92	0.0700
	45.00	120	2.797	2.798	0.094	0.094	0.0940	2.93	0.0800
100%	60.00	2	2.776	2.777	0.115	0.115	0.1150	2.92	0.0700
	60.00	8	2.773	2.776	0.118	0.116	0.1170	2.94	0.0900
	60.00	15	2.770	2.772	0.121	0.120	0.1205	2.95	0.1000
	60.00	30	2.767	2.768	0.124	0.124	0.1240	2.96	0.1100
	60.00	60	2.764	2.765	0.127	0.127	0.1270	2.96	0.1100
	60.00	120	2.761	2.762	0.130	0.130	0.1300	2.97	0.1200
75%	45.00	20	2.776	2.777	0.115	0.115	0.1150	2.95	0.1000
50%	30.00	20	2.796	2.796	0.095	0.096	0.0955	2.94	0.0900
0%	0.00	20	2.839	2.838	0.052	0.054	0.0530	2.89	0.0400
50%	30.00	20	2.799	2.798	0.092	0.094	0.0930	2.93	0.0800
100%	60.00	20	2.756	2.756	0.135	0.136	0.1355	2.96	0.1100
125%	75.00	2	2.735	2.734	0.156	0.158	0.1570	2.99	0.1400
	75.00	8	2.733	2.733	0.158	0.159	0.1585	2.99	0.1400
	75.00	15	2.730	2.731	0.161	0.161	0.1610	2.99	0.1400
	75.00	30	2.726	2.725	0.165	0.167	0.1660	3.00	0.1500
	75.00	60	2.721	2.720	0.170	0.172	0.1710	3.00	0.1500
	75.00	120	2.716	2.715	0.175	0.177	0.1760	3.01	0.1600
150%	90.00	2	2.694	2.693	0.197	0.199	0.1980	3.03	0.1800
	90.00	8	2.690	2.689	0.201	0.203	0.2020	3.03	0.1800
	90.00	15	2.686	2.685	0.205	0.207	0.2060	3.03	0.1800
	90.00	30	2.680	2.679	0.211	0.213	0.2120	3.04	0.1900
	90.00	60	2.673	2.670	0.218	0.222	0.2200	3.04	0.1900
	90.00	120	2.667	2.665	0.224	0.227	0.2255	3.05	0.2000
125%	75.00	20	2.682	2.680	0.209	0.212	0.2105	3.04	0.1900
100%	60.00	20	2.702	2.699	0.189	0.193	0.1910	3.03	0.1800
50%	30.00	20	2.746	2.747	0.145	0.145	0.1450	2.99	0.1400
0%	0.00	20	2.794	2.796	0.097	0.096	0.0965	2.97	0.1200
50%	30.00	20	2.754	2.756	0.137	0.136	0.1365	3.00	0.1500
100%	60.00	20	2.712	2.713	0.179	0.179	0.1790	3.02	0.1700
150%	90.00	20	2.665	2.664	0.226	0.228	0.2270	3.08	0.2300
175%	105.00	2	2.642	2.640	0.249	0.252	0.2505	3.10	0.2500
	105.00	8	2.635	2.634	0.256	0.258	0.2570	3.10	0.2500
	105.00	15	2.629	2.628	0.262	0.264	0.2630	3.11	0.2600
	105.00	30	2.621	2.620	0.270	0.272	0.2710	3.11	0.2600
	105.00	60	2.612	2.614	0.279	0.278	0.2785	3.12	0.2700
	105.00	120	2.602	2.605	0.289	0.287	0.2880	3.12	0.2700
200%	120.00	2	2.576	2.577	0.315	0.315	0.3150	3.15	0.3000
	120.00	8	2.568	2.567	0.323	0.325	0.3240	3.17	0.3200
	120.00	15	2.555	2.554	0.336	0.338	0.3370	3.18	0.3300
	120.00	30	2.540	2.542	0.351	0.350	0.3505	3.20	0.3500
	120.00	60	2.526	2.528	0.365	0.364	0.3645	3.20	0.3500
	120.00	120	2.513	2.514	0.378	0.378	0.3780	3.22	0.3700
	120.00	180	2.502	2.504	0.389	0.388	0.3885	3.24	0.3900
	120.00	240	2.496	2.498	0.395	0.394	0.3945	3.24	0.3900
	120.00	300	2.492	2.493	0.399	0.399	0.3990	3.25	0.4000
	120.00	360	2.488	2.490	0.403	0.402	0.4025	3.25	0.4000
	120.00	420	2.485	2.486	0.406	0.406	0.4060	3.25	0.4000
	120.00	480	2.482	2.484	0.409	0.408	0.4085	3.22	0.3700
	120.00	540	2.481	2.484	0.410	0.408	0.4090	3.21	0.3600
	120.00	600	2.479	2.482	0.412	0.410	0.4110	3.20	0.3500
	120.00	660	2.478	2.479	0.413	0.413	0.4130	3.20	0.3500
	120.00	720	2.476	2.477	0.415	0.415	0.4150	3.20	0.3500
	120.00	780	2.475	2.476	0.416	0.416	0.4160	3.20	0.3500
	120.00	840	2.476	2.476	0.415	0.416	0.4155	3.20	0.3500
	120.00	900	2.474	2.475	0.417	0.417	0.4170	3.20	0.3500
	120.00	960	2.472	2.474	0.419	0.418	0.4185	3.20	0.3500
	120.00	1020	2.471	2.473	0.420	0.419	0.4195	3.20	0.3500
	120.00	1080	2.469	2.472	0.422	0.420	0.4210	3.20	0.3500
	120.00	1140	2.468	2.472	0.423	0.420	0.4215	3.20	0.3500
	120.00	1200	2.466	2.470	0.425	0.422	0.4235	3.20	0.3500

	120.00	1260	2.463	2.466	0.428	0.426	0.4270	3.22	0.3700
	120.00	1320	2.475	2.475	0.416	0.417	0.4165	3.22	0.3700
	120.00	1380	2.484	2.482	0.407	0.410	0.4085	3.22	0.3700
	120.00	1440	2.492	2.487	0.399	0.405	0.4020	3.23	0.3800
150%	90.00	60	2.548	2.532	0.343	0.360	0.3515	3.19	0.3400
100%	60.00	60	2.567	2.576	0.324	0.316	0.3200	3.15	0.3000
50%	30.00	60	2.594	2.615	0.297	0.277	0.2870	3.10	0.2500
0%	0.00	60	2.650	2.652	0.241	0.240	0.2405	3.05	0.2000
50%	30.00	20	2.622	2.641	0.269	0.251	0.2600	3.07	0.2200
100%	60.00	20	2.562	2.592	0.329	0.300	0.3145	3.12	0.2700
150%	90.00	20	2.514	2.555	0.377	0.337	0.3570	3.17	0.3200
200%	120.00	20	2.461	2.482	0.430	0.410	0.4200	3.20	0.3500
210%	126.00	20	2.450	2.465	0.441	0.427	0.4340	3.20	0.3500
220%	132.00	20	2.433	2.445	0.458	0.447	0.4525	3.24	0.3900
230%	138.00	20	2.410	2.423	0.481	0.469	0.4750	3.28	0.4300
240%	144.00	20	2.346	2.353	0.545	0.539	0.5420	3.35	0.5000
250%	150.00	20	1.060	1.058	1.831	1.834	1.8325	3.76	0.9100
260%	156.00	19	0.064	0.057	2.827	2.835	2.8310	5.61	2.7600
	156.00	31	0.055	0.047	2.836	2.845	2.8405	5.62	2.7700
200%	120.00	20	0.071	0.066	2.820	2.826	2.8230	5.61	2.7600
125%	75.00	20	0.120	0.119	2.771	2.773	2.7720	5.57	2.7200
47%	28.00	20	0.196	0.199	2.695	2.693	2.6940	5.49	2.6400
0%	0.00	20	0.261	0.265	2.630	2.627	2.6285	5.43	2.5800

WCC - East T-Wall
TP#30 - PCP 18" - Tip EL -120.0 - Service Load = 60 Tons Tension

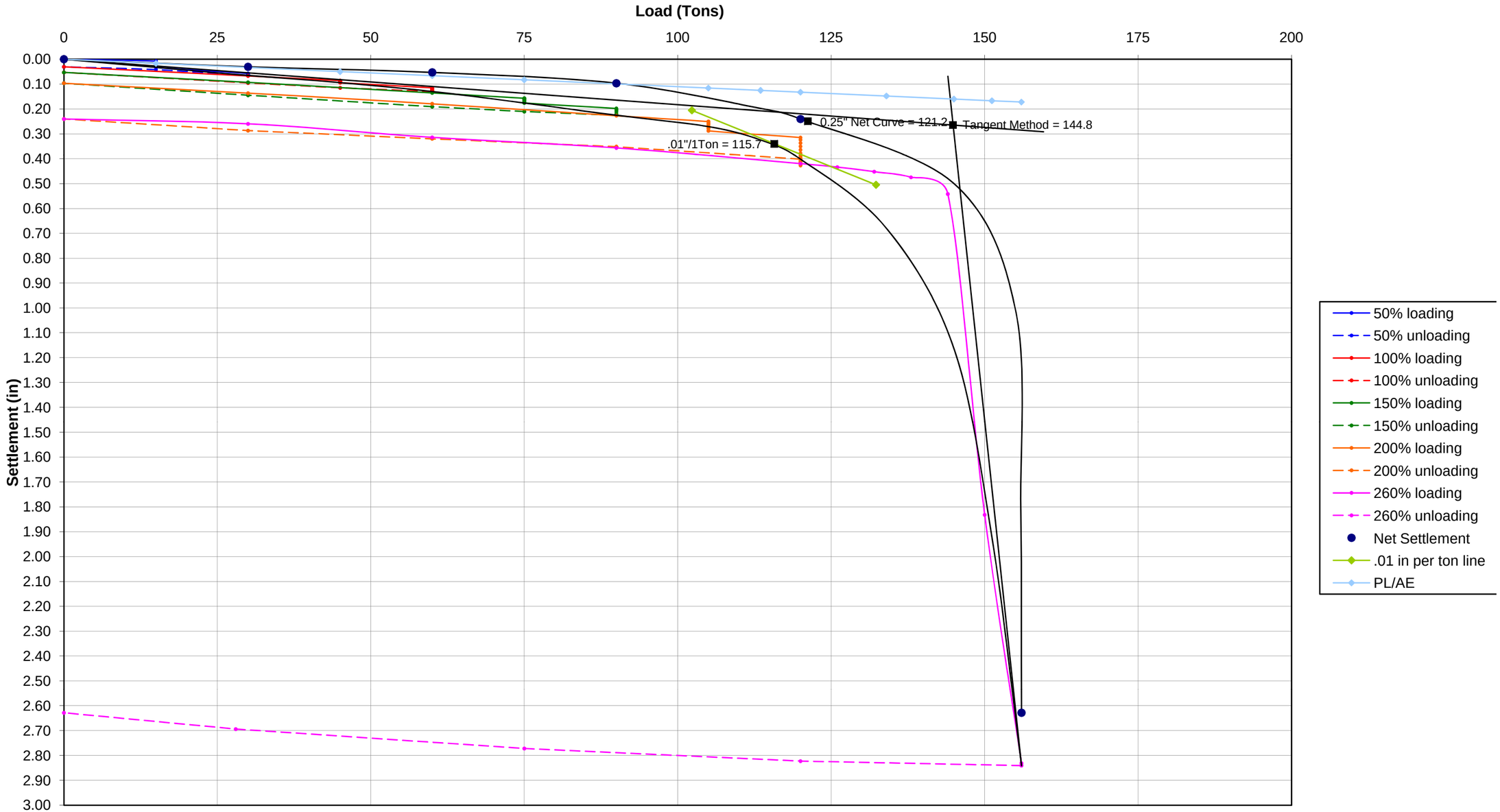


PLATE E-18-d

WCC - East T-Wall - TP-31

18" PCP, Tip Elevation = -130

Service Load = 96.00 **Tons**

Estimated Pile Capacity = 243 **Tons**

Pile Information	
Type	PCP
	18
Wall Size (in)	18.000
Area (in^2)	324.0
Top Ele. (ft)	0
Tip Ele. (ft)	-130
Length (ft)	130
Modulus (psi)	4030509

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	48.00	-0.0010
100%	96.00	0.0200
150%	144.00	0.0390
200%	192.00	0.1080
280%	268.80	1.0770

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	24.0	0.0160	50%	48.0	-0.0010	0.029
50%	48.0	0.0380	100%	96.0	0.0200	0.057
75%	72.0	0.0690	150%	144.0	0.0390	0.086
100%	96.0	0.1060		172.8	0.0720	0.115
125%	120.0	0.1565	200%	192.0	0.1080	0.143
150%	144.0	0.2135		235.0	0.2390	0.172
175%	167.3	0.2680		262.7	0.5300	0.200
	178.5	0.3020	280%	268.8	1.0770	0.213
200%	193.1	0.3500				0.231
	231.0	0.4770				0.276
	250.7	0.6500				0.299
	259.3	0.8480				0.310
280%	268.8	1.3890				0.321

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**236.5**	0.25		
☑	**.01 inch/Ton Creep Rate**	**243.1**	0.563	233.2 263.2	0.461 0.761
☑	**Tangent Method**	**248.1**	0.2	0 283.5 0.0008078	0 0.229

Line T2 points	
246.4	0.072
268.80	1.389
0.0587946	-14.415

PILE CAPACITY	**242.6**	TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE E-19-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading				Initial Reading =	
			2.8	2.7	Dial 1	Dial 2		3.25	
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.800	2.700	0.000	0.000	0.0000	3.25	0.0000
25%	24.00	2	2.781	2.683	0.019	0.017	0.0180	3.28	0.0300
	24.00	8	2.781	2.683	0.019	0.017	0.0180	3.28	0.0300
	24.00	15	2.782	2.684	0.018	0.016	0.0170	3.28	0.0300
	24.00	30	2.782	2.684	0.018	0.016	0.0170	3.28	0.0300
	24.00	60	2.782	2.685	0.018	0.015	0.0165	3.28	0.0300
	24.00	120	2.783	2.685	0.017	0.015	0.0160	3.28	0.0300
50%	48.00	2	2.761	2.665	0.039	0.035	0.0370	3.30	0.0500
	48.00	8	2.761	2.664	0.039	0.036	0.0375	3.30	0.0500
	48.00	15	2.761	2.664	0.039	0.036	0.0375	3.30	0.0500
	48.00	30	2.761	2.664	0.039	0.036	0.0375	3.30	0.0500
	48.00	60	2.761	2.661	0.039	0.039	0.0390	3.30	0.0500
	48.00	120	2.759	2.665	0.041	0.035	0.0380	3.30	0.0500
25%	24.00	20	2.778	2.684	0.022	0.016	0.0190	3.28	0.0300
0%	0.00	20	2.800	2.702	0.000	-0.002	-0.0010	3.25	0.0000
50%	48.00	20	2.761	2.664	0.039	0.036	0.0375	3.30	0.0500
75%	72.00	2	2.736	2.638	0.064	0.062	0.0630	3.32	0.0700
	72.00	8	2.736	2.638	0.064	0.062	0.0630	3.32	0.0700
	72.00	15	2.735	2.638	0.065	0.062	0.0635	3.32	0.0700
	72.00	30	2.734	2.637	0.066	0.063	0.0645	3.32	0.0700
	72.00	60	2.729	2.632	0.071	0.068	0.0695	3.32	0.0700
	72.00	120	2.730	2.632	0.070	0.068	0.0690	3.32	0.0700
100%	96.00	2	2.704	2.607	0.096	0.093	0.0945	3.35	0.1000
	96.00	8	2.704	2.606	0.096	0.094	0.0950	3.35	0.1000
	96.00	15	2.704	2.606	0.096	0.094	0.0950	3.35	0.1000
	96.00	30	2.701	2.603	0.099	0.097	0.0980	3.35	0.1000
	96.00	60	2.696	2.597	0.104	0.103	0.1035	3.35	0.1000
	96.00	120	2.694	2.594	0.106	0.106	0.1060	3.35	0.1000
75%	72.00	20	2.715	2.616	0.085	0.084	0.0845	3.33	0.0800
50%	48.00	20	2.739	2.640	0.061	0.060	0.0605	3.31	0.0600
0%	0.00	20	2.770	2.690	0.030	0.010	0.0200	3.27	0.0200
50%	48.00	20	2.732	2.646	0.068	0.054	0.0610	3.30	0.0500
100%	96.00	20	2.694	2.591	0.106	0.109	0.1075	3.37	0.1200
125%	120.00	2	2.670	2.575	0.130	0.125	0.1275	3.39	0.1400
	120.00	8	2.669	2.574	0.131	0.126	0.1285	3.39	0.1400
	120.00	15	2.667	2.566	0.133	0.134	0.1335	3.39	0.1400
	120.00	30	2.664	2.557	0.136	0.143	0.1395	3.40	0.1500
	120.00	60	2.656	2.553	0.144	0.147	0.1455	3.39	0.1400
	120.00	120	2.641	2.546	0.159	0.154	0.1565	3.40	0.1500
150%	144.00	2	2.614	2.519	0.186	0.181	0.1835	3.41	0.1600
	144.00	8	2.613	2.518	0.187	0.182	0.1845	3.41	0.1600
	144.00	15	2.612	2.518	0.188	0.182	0.1850	3.41	0.1600
	144.00	30	2.597	2.501	0.203	0.199	0.2010	3.42	0.1700
	144.00	60	2.594	2.496	0.206	0.204	0.2050	3.43	0.1800
	144.00	120	2.588	2.485	0.212	0.215	0.2135	3.42	0.1700
125%	120.00	20	2.611	2.506	0.189	0.194	0.1915	3.41	0.1600
100%	96.00	20	2.639	2.532	0.161	0.168	0.1645	3.38	0.1300
50%	48.00	20	2.698	2.590	0.102	0.110	0.1060	3.34	0.0900
0%	0.00	20	2.764	2.658	0.036	0.042	0.0390	3.28	0.0300
50%	48.00	20	2.719	2.612	0.081	0.088	0.0845	3.32	0.0700
100%	96.00	20	2.665	2.558	0.135	0.142	0.1385	3.36	0.1100
150%	144.00	20	2.608	2.503	0.192	0.197	0.1945	3.42	0.1700
175%	168.00	2	2.576	2.472	0.224	0.228	0.2260	3.45	0.2000
	168.00	8	2.568	2.464	0.232	0.236	0.2340	3.46	0.2100
	168.00	15	2.568	2.464	0.232	0.236	0.2340	3.47	0.2200
	168.00	30	2.565	2.462	0.235	0.238	0.2365	3.47	0.2200
	168.00	60	2.561	2.460	0.239	0.240	0.2395	3.47	0.2200
	168.00	120	2.559	2.455	0.241	0.245	0.2430	3.48	0.2300
200%	192.00	2	2.521	2.420	0.279	0.280	0.2795	3.51	0.2600
	192.00	8	2.519	2.418	0.281	0.282	0.2815	3.51	0.2600
	192.00	15	2.512	2.411	0.288	0.289	0.2885	3.52	0.2700
	192.00	30	2.509	2.406	0.291	0.294	0.2925	3.53	0.2800
	192.00	1	2.499	2.398	0.301	0.302	0.3015	3.55	0.3000
	192.00	2	2.489	2.391	0.311	0.309	0.3100	3.55	0.3000
	192.00	3	2.489	2.382	0.311	0.318	0.3145	3.56	0.3100
	192.00	4	2.485	2.382	0.315	0.318	0.3165	3.56	0.3100
	192.00	5	2.480	2.382	0.320	0.318	0.3190	3.56	0.3100
	192.00	6	2.476	2.372	0.324	0.328	0.3260	3.56	0.3100
	192.00	7	2.469	2.369	0.331	0.331	0.3310	3.56	0.3100
	192.00	8	2.468	2.362	0.332	0.338	0.3350	3.57	0.3200
	192.00	9	2.465	2.358	0.335	0.342	0.3385	3.58	0.3300
	192.00	10	2.462	2.355	0.338	0.345	0.3415	3.58	0.3300
	192.00	11	2.477	2.358	0.323	0.342	0.3325	3.59	0.3400
	192.00	12	2.466	2.355	0.334	0.345	0.3395	3.59	0.3400
	192.00	13	2.464	2.353	0.336	0.347	0.3415	3.59	0.3400
	192.00	14	2.458	2.346	0.342	0.354	0.3480	3.59	0.3400
	192.00	15	2.458	2.344	0.342	0.356	0.3490	3.59	0.3400
	192.00	16	2.455	2.343	0.345	0.357	0.3510	3.59	0.3400
	192.00	17	2.448	2.341	0.352	0.359	0.3555	3.59	0.3400
	192.00	18	2.449	2.339	0.351	0.361	0.3560	3.59	0.3400
	192.00	19	2.449	2.339	0.351	0.361	0.3560	3.59	0.3400
	192.00	20	2.449	2.338	0.351	0.362	0.3565	3.59	0.3400

	192.00	21	2.449	2.339	0.351	0.361	0.3560	3.59	0.3400
	192.00	22	2.448	2.337	0.352	0.363	0.3575	3.59	0.3400
	192.00	23	2.448	2.337	0.352	0.363	0.3575	3.59	0.3400
	192.00	24	2.444	2.336	0.356	0.364	0.3600	3.60	0.3500
150%	144.00	60	2.495	2.386	0.305	0.314	0.3095	3.54	0.2900
100%	96.00	60	2.563	2.448	0.237	0.252	0.2445	3.49	0.2400
50%	48.00	60	2.628	2.514	0.172	0.186	0.1790	3.43	0.1800
0%	0.00	60	2.699	2.585	0.101	0.115	0.1080	3.39	0.1400
50%	48.00	20	2.645	2.535	0.155	0.165	0.1600	3.40	0.1500
100%	96.00	20	2.589	2.480	0.211	0.220	0.2155	3.45	0.2000
150%	144.00	20	2.523	2.420	0.277	0.280	0.2785	3.51	0.2600
200%	192.00	20	2.451	2.345	0.349	0.355	0.3520	3.58	0.3300
210%	201.60	20	2.429	2.324	0.371	0.376	0.3735	3.61	0.3600
220%	211.20	20	2.413	2.309	0.387	0.391	0.3890	3.62	0.3700
230%	220.80	20	2.389	2.283	0.411	0.417	0.4140	3.63	0.3800
240%	230.40	20	2.361	2.258	0.439	0.442	0.4405	3.67	0.4200
250%	240.00	20	2.331	2.225	0.469	0.475	0.4720	3.71	0.4600
260%	249.60	20	2.275	2.169	0.525	0.531	0.5280	3.74	0.4900
270%	259.20	20	2.201	2.115	0.599	0.585	0.5920	3.84	0.5900
280%	268.80	20	1.414	1.308	1.386	1.392	1.3890	4.630	1.3800
224%	215.00	20	1.411	1.308	1.389	1.392	1.3905	4.630	1.3800
150%	144.00	15	1.501	1.397	1.299	1.303	1.3010	4.54	1.2900
75%	72.00	25	1.601	1.493	1.199	1.207	1.2030	4.44	1.1900
0%	0.00	52	1.727	1.619	1.073	1.081	1.0770	4.30	1.0500

WCC - East T-Wall
TP#31 - PCP 18" - Tip EL -130.0 - Service Load = 96 Tons

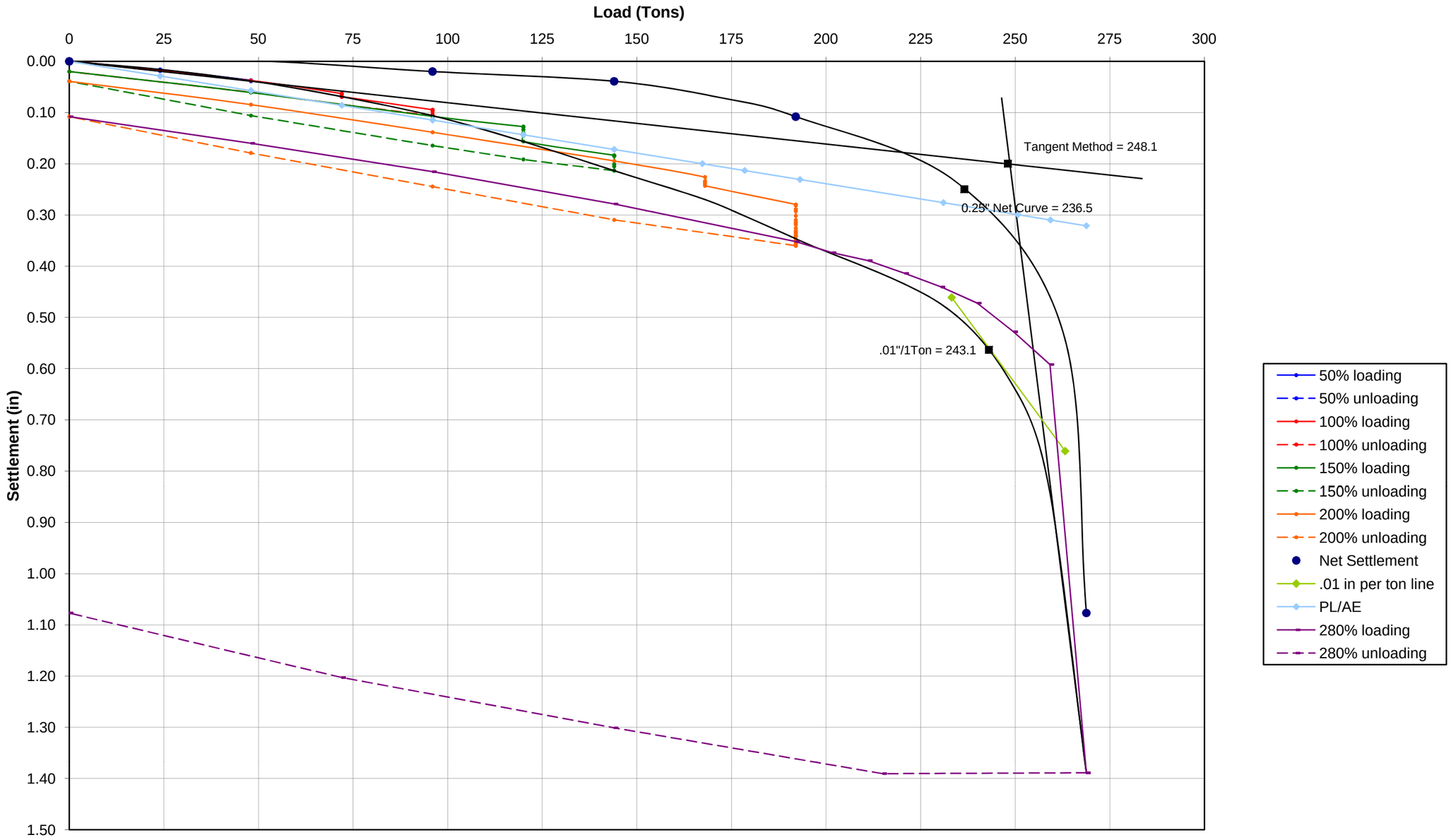


PLATE E-19-d

WCC - 225-ft Sector Gate - TP-32

18" Pipe, Tip Elevation = -161

Service Load = 130.00 **Tons**

Estimated Pile Capacity = 330 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	18
Wall Size (in)	0.500
Area (in^2)	27.5
Top Ele. (ft)	0
Tip Ele. (ft)	-161
Length (ft)	161
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	65.00	-0.0005
100%	130.00	-0.0930
150%	195.00	-0.0170
200%	260.00	0.0530
270%	351.00	1.9630

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	32.5	0.0775	50%	65.0	-0.0005	0.079
50%	65.0	0.1595	100%	130.0	-0.0930	0.158
75%	97.5	0.1965	150%	195.0	-0.0170	0.236
100%	130.0	0.3020		226.0	0.0110	0.315
125%	162.5	0.4190	200%	260.0	0.0530	0.394
150%	195.0	0.5460		305.0	0.2130	0.473
175%	227.5	0.7140		330.0	0.4330	0.551
	243.0	0.7950		348.7	1.0610	0.589
200%	260.0	0.9270	270%	351.0	1.9630	0.630
	305.0	1.2240				0.739
	336.8	1.5700				0.816
	350.0	2.2170				0.848
270%	351.0	2.2585				0.851

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**312.5**	0.25		
☑	**.01 inch/Ton Creep Rate**	**325.7**	1.408	311.7 341.7	1.26 1.56
☑	**Tangent Method**	**351.1**	0.787	0 377.4 0.0022284	0 0.841

Line T2 points	
350.3	0.15
351.00	2.759
3.7264286	-1305.2179

PILE CAPACITY **329.8** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

PLATE E-20-a

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.875	2.49	Dial 1	Dial 2			5.30
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.875	2.490	0.000	0.000	0.0000	5.300	0.0000
25%	32.50	2	2.796	2.420	0.079	0.070	0.0745	5.38	0.0800
	32.50	8	2.793	2.418	0.082	0.072	0.0770	5.38	0.0800
	32.50	15	2.793	2.418	0.082	0.072	0.0770	5.38	0.0800
	32.50	30	2.793	2.418	0.082	0.072	0.0770	5.38	0.0800
	32.50	60	2.793	2.418	0.082	0.072	0.0770	5.38	0.0800
	32.50	120	2.792	2.418	0.083	0.072	0.0775	5.38	0.0800
50%	65.00	2	2.717	2.346	0.158	0.144	0.1510	5.45	0.1500
	65.00	8	2.714	2.343	0.161	0.147	0.1540	5.46	0.1600
	65.00	15	2.712	2.341	0.163	0.149	0.1560	5.46	0.1600
	65.00	30	2.709	2.338	0.166	0.152	0.1590	5.46	0.1600
	65.00	60	2.709	2.338	0.166	0.152	0.1590	5.46	0.1600
	65.00	120	2.708	2.338	0.167	0.152	0.1595	5.46	0.1600
25%	32.50	20	2.784	2.409	0.091	0.081	0.0860	5.390	0.0900
0%	0.00	20	2.875	2.491	0.000	-0.001	-0.0005	5.300	0.0000
50%	65.00	20	2.715	2.344	0.160	0.146	0.1530	5.450	0.1500
75%	97.50	2	2.629	2.362	0.246	0.128	0.1870	5.55	0.2500
	97.50	8	2.625	2.358	0.250	0.132	0.1910	5.55	0.2500
	97.50	15	2.623	2.356	0.252	0.134	0.1930	5.56	0.2600
	97.50	30	2.622	2.355	0.253	0.135	0.1940	5.56	0.2600
	97.50	60	2.621	2.354	0.254	0.136	0.1950	5.56	0.2600
	97.50	120	2.620	2.352	0.255	0.138	0.1965	5.56	0.2600
100%	130.00	2	2.525	2.266	0.350	0.224	0.2870	5.65	0.3500
	130.00	8	2.519	2.263	0.356	0.227	0.2915	5.67	0.3700
	130.00	15	2.519	2.259	0.356	0.231	0.2935	5.67	0.3700
	130.00	30	2.515	2.256	0.360	0.234	0.2970	5.67	0.3700
	130.00	60	2.513	2.253	0.362	0.237	0.2995	5.67	0.3700
	130.00	120	2.511	2.250	0.364	0.240	0.3020	5.67	0.3700
75%	97.50	20	2.588	2.327	0.287	0.163	0.2250	5.600	0.3000
50%	65.00	20	2.678	2.410	0.197	0.080	0.1385	5.500	0.2000
0%	0.00	20	2.868	2.683	0.007	-0.193	-0.0930	5.310	0.0100
50%	65.00	20	2.698	2.431	0.177	0.059	0.1180	5.470	0.1700
100%	130.00	20	2.413	2.253	0.462	0.237	0.3495	5.680	0.3800
125%	162.50	2	2.304	2.151	0.571	0.339	0.4550	5.78	0.4800
	162.50	8	2.301	2.152	0.574	0.338	0.4560	5.78	0.4800
	162.50	15	2.300	2.152	0.575	0.338	0.4565	5.78	0.4800
	162.50	30	2.397	2.144	0.478	0.346	0.4120	5.78	0.4800
	162.50	60	2.393	2.140	0.482	0.350	0.4160	5.78	0.4800
	162.50	120	2.390	2.137	0.485	0.353	0.4190	5.78	0.4800
150%	195.00	2	2.276	2.030	0.599	0.460	0.5295	5.90	0.6000
	195.00	8	2.270	2.028	0.605	0.462	0.5335	5.90	0.6000
	195.00	15	2.267	2.025	0.608	0.465	0.5365	5.91	0.6100
	195.00	30	2.265	2.021	0.610	0.469	0.5395	5.91	0.6100
	195.00	60	2.263	2.019	0.612	0.471	0.5415	5.92	0.6200
	195.00	120	2.258	2.015	0.617	0.475	0.5460	5.93	0.6300
125%	162.50	20	2.340	2.095	0.535	0.395	0.4650	5.840	0.5400
100%	130.00	20	2.534	2.184	0.341	0.306	0.3235	5.780	0.4800
50%	65.00	20	2.627	2.364	0.248	0.126	0.1870	5.560	0.2600
0%	0.00	20	2.841	2.558	0.034	-0.068	-0.0170	5.330	0.0300
50%	65.00	20	2.673	2.404	0.202	0.086	0.1440	5.510	0.2100
100%	130.00	20	2.471	2.219	0.404	0.271	0.3375	5.710	0.4100
150%	195.00	20	2.249	2.005	0.626	0.485	0.5555	5.930	0.6300
175%	227.50	2	2.113	1.875	0.762	0.615	0.6885	6.08	0.7800
	227.50	8	2.113	1.875	0.762	0.615	0.6885	6.08	0.7800
	227.50	15	2.113	1.875	0.762	0.615	0.6885	6.08	0.7800
	227.50	30	2.110	1.871	0.765	0.619	0.6920	6.08	0.7800
	227.50	60	2.090	1.854	0.785	0.636	0.7105	6.08	0.7800
	227.50	120	2.087	1.850	0.788	0.640	0.7140	6.08	0.7800
200%	260.00	2	1.954	1.722	0.921	0.768	0.8445	6.21	0.9100
	260.00	8	1.954	1.722	0.921	0.768	0.8445	6.21	0.9100
	260.00	15	1.954	1.722	0.921	0.768	0.8445	6.21	0.9100
	260.00	30	1.934	1.703	0.941	0.787	0.8640	6.22	0.9200
	260.00	60	1.919	1.691	0.956	0.799	0.8775	6.23	0.9300
	260.00	120	1.919	1.686	0.956	0.804	0.8800	6.23	0.9300
	260.00	180	1.909	1.677	0.966	0.813	0.8895	6.24	0.9400
	260.00	240	1.909	1.676	0.966	0.814	0.8900	6.24	0.9400
	260.00	300	1.913	1.679	0.962	0.811	0.8865	6.48	1.1800
	260.00	360	1.914	1.679	0.961	0.811	0.8860	6.48	1.1800
	260.00	420	1.916	1.682	0.959	0.808	0.8835	6.48	1.1800
	260.00	480	1.911	1.686	0.964	0.804	0.8840	6.46	1.1600
	260.00	540	1.920	1.699	0.955	0.791	0.8730	6.45	1.1500
	260.00	600	1.914	1.686	0.961	0.804	0.8825	6.45	1.1500
	260.00	660	1.912	1.682	0.963	0.808	0.8855	6.46	1.1600
	260.00	720	1.910	1.678	0.965	0.812	0.8885	6.47	1.1700
	260.00	780	1.909	1.675	0.966	0.815	0.8905	6.47	1.1700
	260.00	840	1.907	1.672	0.968	0.818	0.8930	6.47	1.1700
	260.00	900	1.906	1.669	0.969	0.821	0.8950	6.47	1.1700
	260.00	960	1.905	1.667	0.970	0.823	0.8965	6.47	1.1700
	260.00	1020	1.901	1.665	0.974	0.825	0.8995	6.47	1.1700
	260.00	1080	1.900	1.666	0.975	0.824	0.8995	6.47	1.1700
	260.00	1140	1.900	1.666	0.975	0.824	0.8995	6.47	1.1700
	260.00	1200	1.901	1.665	0.974	0.825	0.8995	6.47	1.1700

	260.00	1260	1.902	1.666	0.973	0.824	0.8985	6.47	1.1700
	260.00	1320	1.902	1.665	0.973	0.825	0.8990	6.47	1.1700
	260.00	1380	1.889	1.661	0.986	0.829	0.9075	6.47	1.1700
	260.00	1440	1.866	1.645	1.009	0.845	0.9270	6.47	1.1700
150%	195.00	60	2.067	1.837	0.808	0.653	0.7305	6.280	0.9800
100%	130.00	60	2.285	2.039	0.590	0.451	0.5205	6.060	0.7600
50%	65.00	60	2.531	2.262	0.344	0.228	0.2860	5.840	0.5400
0%	0.00	60	2.776	2.483	0.099	0.007	0.0530	5.600	0.3000
50%	65.00	20	2.605	2.307	0.270	0.183	0.2265	5.770	0.4700
100%	130.00	20	2.302	2.109	0.573	0.381	0.4770	5.980	0.6800
150%	195.00	20	2.173	1.923	0.702	0.567	0.6345	6.200	0.9000
200%	260.00	20	1.908	1.672	0.967	0.818	0.8925	6.470	1.1700
210%	273.00	20	1.847	1.616	1.028	0.874	0.9510	6.530	1.2300
220%	286.00	20	1.774	1.545	1.101	0.945	1.0230	6.600	1.3000
230%	299.00	20	1.699	1.478	1.176	1.012	1.0940	6.670	1.3700
240%	312.00	20	1.641	1.424	1.234	1.066	1.1500	6.740	1.4400
250%	325.00	20	1.557	1.347	1.318	1.143	1.2305	6.820	1.5200
260%	338.00	20	1.465	1.261	1.410	1.229	1.3195	6.910	1.6100
270%	351.00	20	1.191	0.945	1.684	1.545	1.6145	7.220	1.9200
270%	351.00	20	1.113	0.651	1.762	1.839	1.8005	7.510	2.2100
270%	351.00	20	1.079	0.301	1.796	2.189	1.9925	7.78	2.4800
270%	351.00	20	0.127	0.721	2.748	2.769	2.7585	8.45	3.1500
150%	195.00	20	0.218	0.888	2.657	2.602	2.6295	8.370	3.0700
75%	97.50	20	0.435	0.996	2.440	2.494	2.4670	8.150	2.8500
50%	65.00	20	0.677	0.223	2.198	2.267	2.2325	7.920	2.6200
0%	0.00	20	0.957	0.482	1.918	2.008	1.9630	7.650	2.3500

WCC - East T-Wall
TP#32 - Steel 18" Pipe Pile - Straight Seam - Tip EL -161.0 - Service Load = 130 Tons

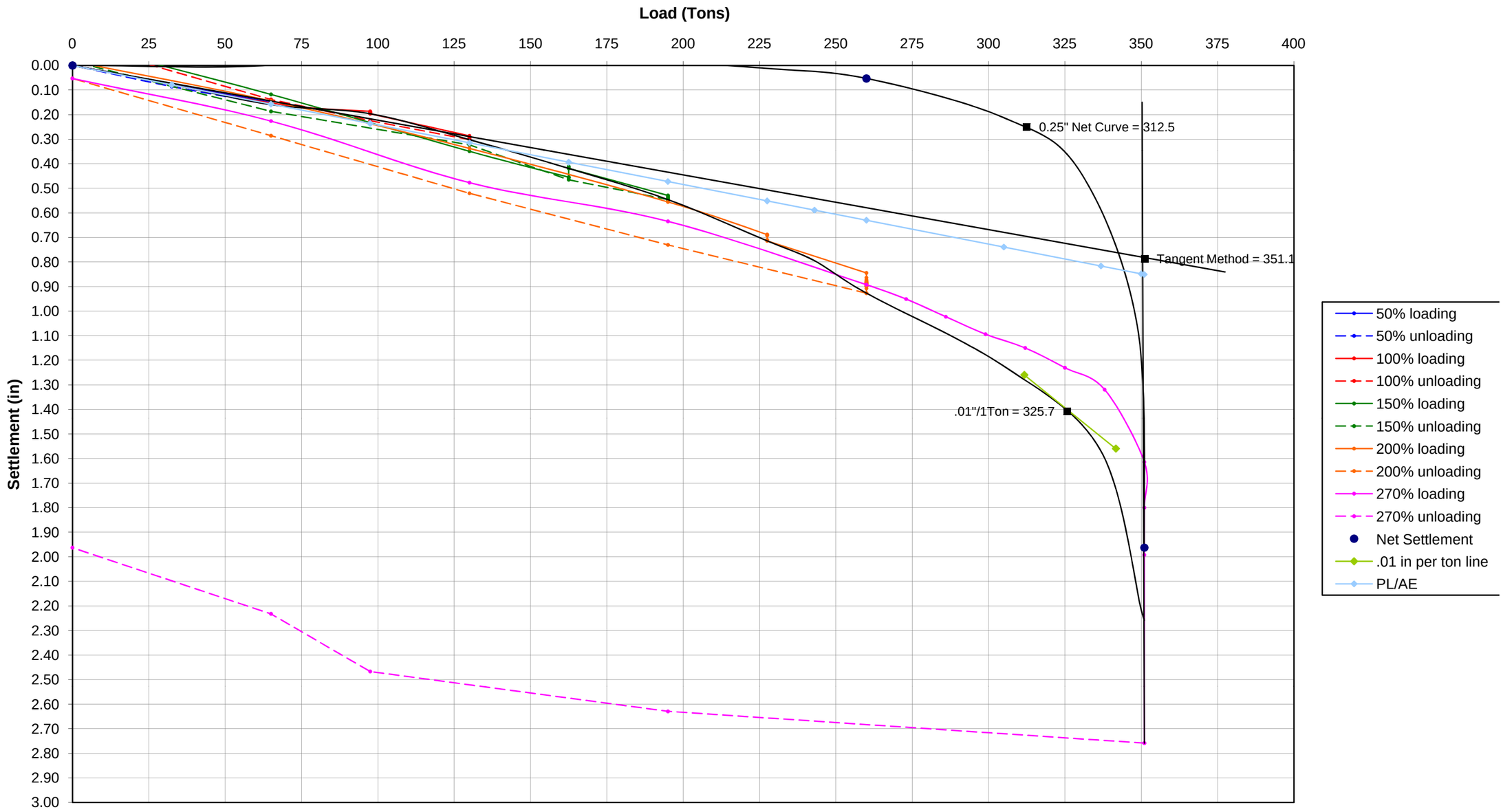


PLATE E-20-d

WCC - East T-Wall - TP-32 (Tension)

18" Pipe, Tip Elevation = -160

Service Load = 80.00 **Tons**

Estimated Pile Capacity = 209 **Tons**

Pile Information	
Type	Pipe
Dia/Size (in)	18
Wall Size (in)	0.500
Area (in^2)	27.5
Top Ele. (ft)	0
Tip Ele. (ft)	-160
Length (ft)	160
Modulus (psi)	29000000

Net Settlement*		
Load (%)	Load (Tons)	Settlement (in)
0%	0.00	0.0000
50%	40.00	0.0590
100%	80.00	0.1085
150%	120.00	0.1635
200%	160.00	0.2565
300%	240.00	0.3710

REDUCED CURVE DATA

Percent Load	Gross Curve*** Load (Tons)	Gross Curve*** Defl. (in)	Percent Load	Net Curve** Load (Tons)	Net Curve** Defl. (in)	PL/AE (in)
0%	0.0	0.0000	0%	0.0	0.0000	0.000
25%	20.0	0.0715	50%	40.0	0.0590	0.048
50%	40.0	0.1670	100%	80.0	0.1085	0.096
75%	60.0	0.2320	150%	120.0	0.1635	0.145
100%	80.0	0.3240		141.7	0.2130	0.193
125%	100.0	0.4255	200%	160.0	0.2565	0.241
150%	120.0	0.5250		200.0	0.3140	0.289
175%	140.0	0.6120		225.5	0.3470	0.337
	151.2	0.6840		236.2	0.3630	0.364
200%	160.0	0.7290	300%	240.0	0.3710	0.385
	200.0	0.8990				0.482
	225.8	1.0180				0.544
	238.1	1.1230				0.573
300%	240.0	1.2200				0.578

PILE CAPACITY CALCULATIONS

Select		Capacity	Deflection		
☑	**.25 inch Net Deflection**	**155.9**	0.25		
☑	**.01 inch/Ton Creep Rate**	**233.8**	1.078	220.2 250.2	0.935 1.235
☑	**Tangent Method**	**238.7**	0.771	0 278.4 0.0032292	0 0.899

Line T2 points	
238.7	0.726
240.00	1.220
0.38	-89.98

PILE CAPACITY **209.5** TONS

Estimated Pile Capacity From Each Method Highlighted in **BLUE**
Values in RED cannot be adjusted

LOAD DATA			DIAL GAGE DATA					SCALE/LEVEL DATA	
			Initial Reading	Initial Reading					Initial Reading =
			2.69	2.885	Dial 1	Dial 2			6.60
Percent Load	Load (tons)	Incr. Time (min)	Dial 1 (in)	Dial 2 (in)	Settlement (in)	Settlement (in)	Average (in)	Reading (in)	Settlement (in)
0%	0.00	0	2.690	2.885	0.000	0.000	0.0000	6.600	0.0000
25%	20.00	2	2.634	2.827	0.056	0.058	0.0570	6.65	0.0500
	20.00	8	2.632	2.824	0.058	0.061	0.0595	6.65	0.0500
	20.00	15	2.632	2.822	0.058	0.063	0.0605	6.65	0.0500
	20.00	30	2.633	2.820	0.057	0.065	0.0610	6.65	0.0500
	20.00	60	2.633	2.799	0.057	0.086	0.0715	6.65	0.0500
	20.00	120	2.633	2.799	0.057	0.086	0.0715	6.65	0.0500
50%	40.00	2	2.559	2.722	0.131	0.163	0.1470	6.73	0.1300
	40.00	8	2.554	2.715	0.136	0.170	0.1530	6.73	0.1300
	40.00	15	2.553	2.716	0.137	0.169	0.1530	6.73	0.1300
	40.00	30	2.548	2.710	0.142	0.175	0.1585	6.73	0.1300
	40.00	60	2.543	2.705	0.147	0.180	0.1635	6.73	0.1300
	40.00	120	2.537	2.704	0.153	0.181	0.1670	6.73	0.1300
25%	20.00	20	2.586	2.753	0.104	0.132	0.1180	6.680	0.0800
0%	0.00	20	2.648	2.809	0.042	0.076	0.0590	6.600	0.0000
50%	40.00	20	2.536	2.705	0.154	0.180	0.1670	6.730	0.1300
75%	60.00	2	2.477	2.650	0.213	0.235	0.2240	6.79	0.1900
	60.00	8	2.473	2.646	0.217	0.239	0.2280	6.79	0.1900
	60.00	15	2.469	2.642	0.221	0.243	0.2320	6.80	0.2000
	60.00	30	2.469	2.641	0.221	0.244	0.2325	6.80	0.2000
	60.00	60	2.469	2.640	0.221	0.245	0.2330	6.80	0.2000
	60.00	120	2.471	2.640	0.219	0.245	0.2320	6.80	0.2000
100%	80.00	2	2.398	2.568	0.292	0.317	0.3045	6.88	0.2800
	80.00	8	2.394	2.563	0.296	0.322	0.3090	6.89	0.2900
	80.00	15	2.393	2.562	0.297	0.323	0.3100	6.89	0.2900
	80.00	30	2.392	2.561	0.298	0.324	0.3110	6.89	0.2900
	80.00	60	2.391	2.559	0.299	0.326	0.3125	6.89	0.2900
	80.00	120	2.379	2.548	0.311	0.337	0.3240	6.89	0.2900
75%	60.00	20	2.431	2.597	0.259	0.288	0.2735	6.840	0.2400
50%	40.00	20	2.474	2.639	0.216	0.246	0.2310	6.810	0.2100
0%	0.00	20	2.599	2.759	0.091	0.126	0.1085	6.680	0.0800
50%	40.00	20	2.481	2.647	0.209	0.238	0.2235	6.800	0.2000
100%	80.00	20	2.373	2.541	0.317	0.344	0.3305	6.890	0.2900
125%	100.00	2	2.299	2.469	0.391	0.416	0.4035	6.98	0.3800
	100.00	8	2.299	2.469	0.391	0.416	0.4035	6.98	0.3800
	100.00	15	2.289	2.460	0.401	0.425	0.4130	6.99	0.3900
	100.00	30	2.284	2.456	0.406	0.429	0.4175	6.99	0.3900
	100.00	60	2.280	2.453	0.410	0.432	0.4210	6.99	0.3900
	100.00	120	2.276	2.448	0.414	0.437	0.4255	6.99	0.3900
150%	120.00	2	2.199	2.372	0.491	0.513	0.5020	7.08	0.4800
	120.00	8	2.193	2.366	0.497	0.519	0.5080	7.09	0.4900
	120.00	15	2.188	2.361	0.502	0.524	0.5130	7.09	0.4900
	120.00	30	2.185	2.358	0.505	0.527	0.5160	7.09	0.4900
	120.00	60	2.179	2.349	0.511	0.536	0.5235	7.10	0.5000
	120.00	120	2.176	2.349	0.514	0.536	0.5250	7.10	0.5000
125%	100.00	20	2.229	2.399	0.461	0.486	0.4735	7.050	0.4500
100%	80.00	20	2.284	2.454	0.406	0.431	0.4185	7.000	0.4000
50%	40.00	20	2.394	2.562	0.296	0.323	0.3095	6.900	0.3000
0%	0.00	20	2.542	2.706	0.148	0.179	0.1635	6.750	0.1500
50%	40.00	20	2.423	2.591	0.267	0.294	0.2805	6.850	0.2500
100%	80.00	20	2.312	2.483	0.378	0.402	0.3900	6.980	0.3800
150%	120.00	20	2.173	2.349	0.517	0.536	0.5265	7.100	0.5000
175%	140.00	2	2.115	2.291	0.575	0.594	0.5845	7.16	0.5600
	140.00	8	2.111	2.208	0.579	0.677	0.6280	7.17	0.5700
	140.00	15	2.110	2.287	0.580	0.598	0.5890	7.17	0.5700
	140.00	30	2.110	2.287	0.580	0.598	0.5890	7.18	0.5800
	140.00	60	2.095	2.273	0.595	0.612	0.6035	7.19	0.5900
	140.00	120	2.087	2.264	0.603	0.621	0.6120	7.19	0.5900
200%	160.00	2	2.009	2.187	0.681	0.698	0.6895	7.30	0.7000
	160.00	8	1.999	2.177	0.691	0.708	0.6995	7.30	0.7000
	160.00	15	1.997	2.176	0.693	0.709	0.7010	7.30	0.7000
	160.00	30	1.993	2.172	0.697	0.713	0.7050	7.30	0.7000
	160.00	60	1.986	2.166	0.704	0.719	0.7115	7.30	0.7000
	160.00	120	1.983	2.162	0.707	0.723	0.7150	7.30	0.7000
	160.00	180	1.978	2.158	0.712	0.727	0.7195	7.30	0.7000
	160.00	240	1.976	2.157	0.714	0.728	0.7210	7.30	0.7000
	160.00	300	1.974	2.156	0.716	0.729	0.7225	7.30	0.7000
	160.00	360	1.978	2.156	0.712	0.729	0.7205	7.26	0.6600
	160.00	420	1.976	2.155	0.714	0.730	0.7220	7.26	0.6600
	160.00	480	1.975	2.155	0.715	0.730	0.7225	7.26	0.6600
	160.00	540	1.973	2.155	0.717	0.730	0.7235	7.26	0.6600
	160.00	600	1.973	2.151	0.717	0.734	0.7255	7.26	0.6600
	160.00	660	1.975	2.156	0.715	0.729	0.7220	7.25	0.6500
	160.00	720	1.975	2.151	0.715	0.734	0.7245	7.25	0.6500
	160.00	780	1.973	2.151	0.717	0.734	0.7255	7.25	0.6500
	160.00	840	1.971	2.150	0.719	0.735	0.7270	7.25	0.6500
	160.00	900	1.974	2.150	0.716	0.735	0.7255	7.25	0.6500
	160.00	960	1.970	2.149	0.720	0.736	0.7280	7.26	0.6600
	160.00	1020	1.969	2.148	0.721	0.737	0.7290	7.26	0.6600
	160.00	1080	1.966	2.150	0.724	0.735	0.7295	7.26	0.6600
	160.00	1140	1.959	2.139	0.731	0.746	0.7385	7.26	0.6600
	160.00	1200	1.961	2.138	0.729	0.747	0.7380	7.26	0.6600

	160.00	1260	2.013	2.156	0.677	0.729	0.7030	7.27	0.6700
	160.00	1320	2.034	2.158	0.656	0.727	0.6915	7.27	0.6700
	160.00	1380	1.996	2.147	0.694	0.738	0.7160	7.27	0.6700
	160.00	1440	1.985	2.132	0.705	0.753	0.7290	7.27	0.6700
150%	120.00	60	2.057	2.221	0.633	0.664	0.6485	7.160	0.5600
100%	80.00	60	2.180	2.372	0.510	0.513	0.5115	7.050	0.4500
50%	40.00	60	2.291	2.475	0.399	0.410	0.4045	6.980	0.3800
0%	0.00	60	2.446	2.616	0.244	0.269	0.2565	6.770	0.1700
50%	40.00	20	2.336	2.509	0.354	0.376	0.3650	6.890	0.2900
100%	80.00	20	2.222	2.398	0.468	0.487	0.4775	6.990	0.3900
150%	120.00	20	2.090	2.268	0.600	0.617	0.6085	7.110	0.5100
200%	160.00	20	1.949	2.130	0.741	0.755	0.7480	7.280	0.6800
210%	168.00	20	1.909	2.090	0.781	0.795	0.7880	7.300	0.7000
220%	176.00	20	1.868	2.051	0.822	0.834	0.8280	7.340	0.7400
230%	184.00	20	1.830	2.013	0.860	0.872	0.8660	7.390	0.7900
240%	192.00	20	1.784	1.968	0.906	0.917	0.9115	7.410	0.8100
250%	200.00	20	1.742	1.925	0.948	0.960	0.9540	7.470	0.8700
260%	208.00	20	1.694	1.880	0.996	1.005	1.0005	7.510	0.9100
270%	216.00	20	1.649	1.837	1.041	1.048	1.0445	7.560	0.9600
280%	224.00	20	1.601	1.789	1.089	1.096	1.0925	7.600	1.0000
290%	232.00	20	1.552	1.741	1.138	1.144	1.1410	7.600	1.0000
300%	240.00	2	1.506	1.696	1.184	1.189	1.1865	7.70	1.1000
	240.00	8	1.504	1.695	1.186	1.190	1.1880	7.70	1.1000
	240.00	15	1.499	1.690	1.191	1.195	1.1930	7.71	1.1100
	240.00	30	1.497	1.687	1.193	1.198	1.1955	7.71	1.1100
	240.00	60	1.484	1.675	1.206	1.210	1.2080	7.72	1.1200
	240.00	120	1.473	1.662	1.217	1.223	1.2200	7.73	1.1300
225%	180.00	20	1.681	1.868	1.009	1.017	1.0130	7.510	0.9100
150%	120.00	20	1.867	2.050	0.823	0.835	0.8290	7.340	0.7400
75%	60.00	20	2.085	2.262	0.605	0.623	0.6140	7.120	0.5200
0%	0.00	20	2.331	2.502	0.359	0.383	0.3710	6.880	0.2800

WCC - East T-Wall
TP#32 - Steel 18" Pipe Pile - Straight Seam - Tip EL -160.0 - Service Load = 80 Tons Tension

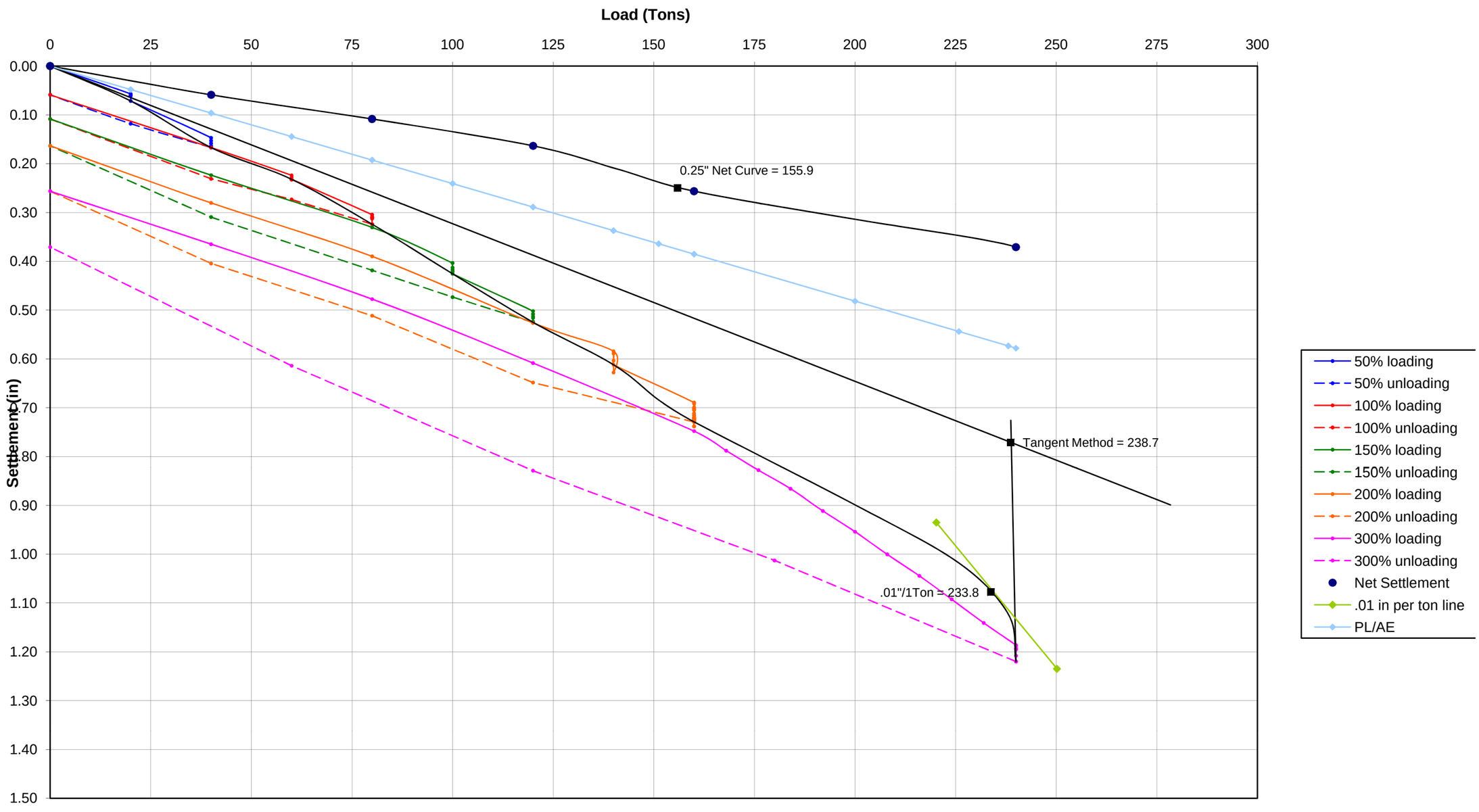


PLATE E-21-d

VITA

Leeland Joseph Richard was born on 15 March 1982, in Marrero, Louisiana. After graduating Salutatorian from Archbishop Shaw High School in Marrero, Louisiana, he attended and graduated from the University of New Orleans with a Bachelor of Science in Engineering. While at the University of New Orleans, he was elected to the Phi Eta Sigma Freshman National Honor Society and the Tau Beta Pi National Engineering Honor Society, was named to the Dean's List two semesters, and was awarded the Louisiana Engineering Society's Robert C. Byrd Scholarship for Juniors in Engineering. While a full-time undergraduate student, he was a Co-op employee with the U.S. Attorney's Office and the U.S. Army Corps of Engineers. He is presently a senior geotechnical engineer with the U.S. Army Corps of Engineers. He is also a registered Engineer Intern in the State of Louisiana.