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# Pile Loading Test Program
# Conventional Static, Bidirectional, and PDA
# AL-DOT Site, Mobile, Alabama

**Revision 1**

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# TABLE OF CONTENTS

Page No.



## APPENDICES:

# 1.0 INTRODUCTION

Scientific Applied Concepts Ltd. (SACL) was retained by The Loren Group LTD. to provide testing services under the direction of Dr. Bengt H. Fellenius for a proposed pile foundation testing program at the AL-DOT site in Mobile, Alabama. The test, termed TSFP, was conducted on Tapered and Uniform steel piles. The test site was in a parking lot belonging to AL-DOT at the corner of Dunlap Dr. and Austal Way, as shown in Figure 1.

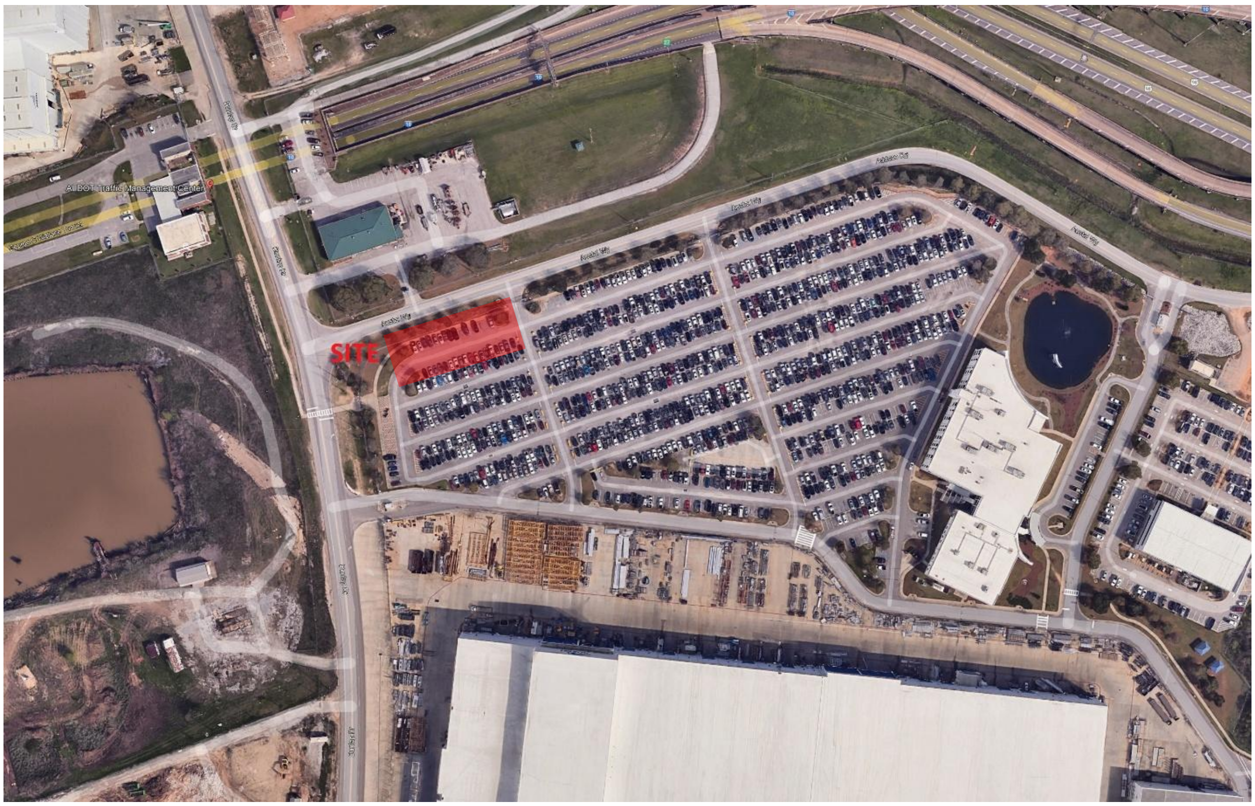



Figure 1. Site of TSFP Pile Testing Program

The pile installation and test reaction setup were performed by Jordan Pile Driving Inc. A total of five piles (two Uniform and three Tapered) were installed and tested. The pile installation was done on 26 and 27 March 2025, whereby the piles were driven to a predetermined depth while monitored with a Pile Driving Analyser (PDA) throughout (initial driving test). The piles were then instrumented and filled with concrete following a second PDA test (restrike test) on 28 March 2025. Static testing was then performed between 04 April 2025 and 16 April 2025. A second restrike test with the PDA (third PDA test overall) was performed on 29 April 2025.

This report describes the testing program and activities performed. The analysis of the test results will be reported independently by Dr. Fellenius.

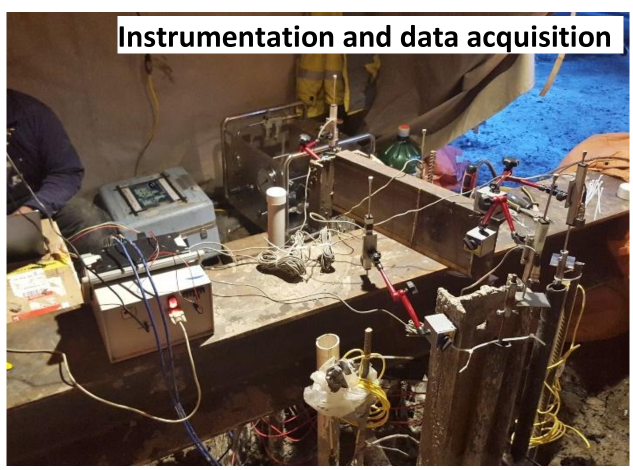
## 2.0 QUALIFICATIONS

Scientific Applied Concepts Limited. (SACL) is a geotechnical engineering firm specializing in deep foundations and shoring. Our highly qualified engineers have acquired extensive specialized experience in all aspects of deep foundation design, testing, analysis, and quality control. We also provide loading and measuring systems rental, calibration, and other engineering services.

SACL provides advanced engineering design and fabrication of custom-built bidirectional load cells of any capacity, tailored for special testing requirements and maximized cost-benefit for the project.

For over 30 years, SACL's engineers have performed thousands of tests on deep foundations including dynamic (PDA) with highest PDCA certification levels, static (head-down and bidirectional), Pulse-Echo (PIT), crosshole sonic/tomography (CSL), and thermal integrity testing (TIP). Our engineers pioneered the foundation testing industry in Canada in developing modern state-of-the-art devices including specialized data acquisition systems, pile base inspection tool (SACL-BIT), laser caliper device (SACL-CT), and other innovations. SACL also provides base inspection services and caliper services such as SQUID and SHAPE along with Quality Verification Engineering services.





SACL is also active in research and development, resulting in many technical publications. Our engineers stay on top of the evolving industry by adapting innovative technologies, software and electronics to advance geotechnical and foundation engineering. We also encourage continuing education and innovation within the company to provide our clients with the best possible services. We are committed to client satisfaction and our ever-growing list of returning clients is a proof of our commitment.

SACL has a permit to practice, and several Professional Engineers licensed to practice across Canada, and in some US states. CVs and certifications of our key personnel that would be involved in this project are enclosed in Appendix 1, along with a summary of similar recent testing projects conducted by SACL.

## 3.0 SITE CHARACTERISTICS

The site is at the north-west corner of the AL-DOT parking lot close to the Mobile River. Based on the soil information provided to SACL, the soil consists of 90 % of sand size grains, with the exception of a 2-m thick zone of soil with high fines content between 15 and 21 ft (4.5 m and 6.5 m) depth. The consistency of the sand is compact to about 21 ft depth, loose to about 54 ft (16 m), and then dense (sudden change at 54 ft depth). A CPT sounding supplemented with SPT N-Value distribution, as provided by Dr. Fellenius, is shown in Figure 2.

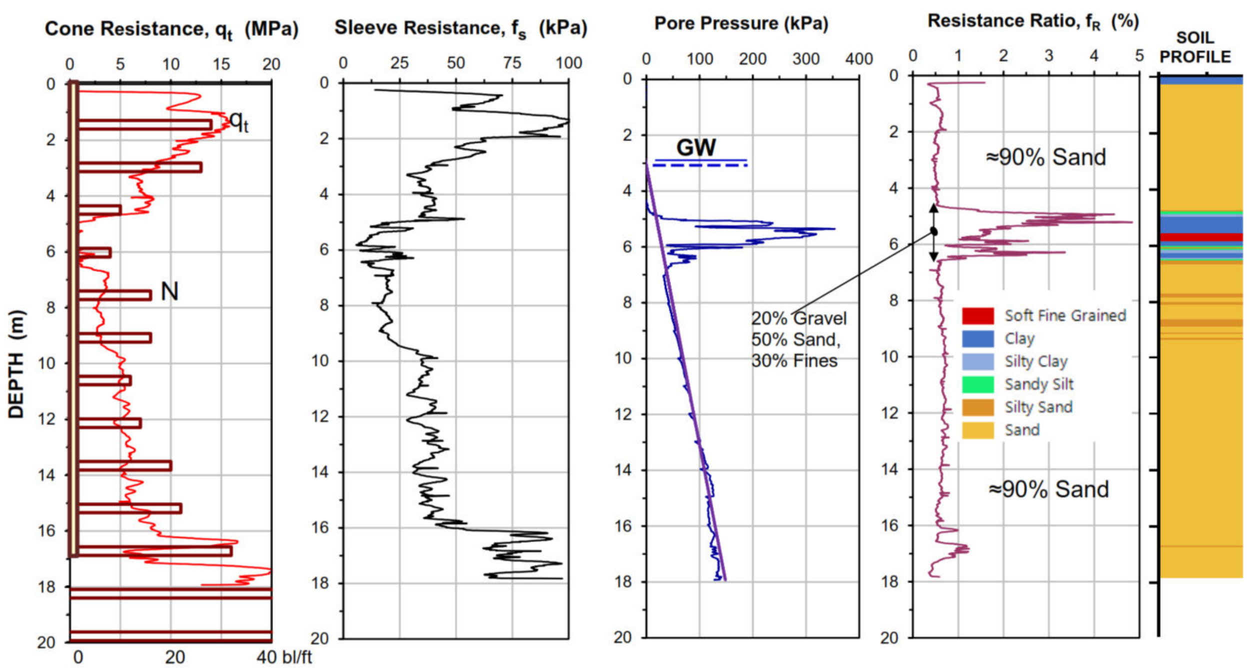



Figure 2. CPT data with corresponding SPT N-Value distribution (after Dr. Bengt H. Fellenius)

When the tests were carried out, the groundwater table was at 16 ft (5 m) depth, as reported to us by AL-DOT.

# 4.0 DESCRIPTION OF TEST PILES AND INSTRUMENTATION

The test piles consisted of 18-inch (0.457 m) diameter o.d. pipe piles with a wall thickness of 3/8 inch (9.5 mm). Three of the piles (Piles TP3, TP4, and TP5) were constructed with a 25-ft long (7.62 m) bottom segment tapering down to 8-inch diameter at the toe. The pile toes were closed with a thick steel plates welded to the toe. All piles were driven through square holes (about 2 ft by 2 ft) cut in the asphalt.

Pile TP5 was comprised of two separate segments to facilitate bidirectional testing; a lower segment consisting of a 25 ft (7.62 m) tapered pile, as described earlier, extended with a 1 ft (0.3 m) length of uniform 18-inch (0.457 m) pipe. The remainder of the pile consists of a uniform 18-inch diameter pipe. The two segments were joined with minimal stitch welding and restrained laterally by six 12-inch-long (300 mm) knife-plates welded on the inside of the lower segment and protruding 6 inches (150 mm) into the upper segment. The plates were 1 inch (25 mm) thick and 1.75-inch (45 mm) wide.

The piles were driven using an APE D30-32 open-end diesel hammer, with a rated energy of 74.7 k-ft (100.9 kJ), to a predetermined depth of 57 ft (17.38 m) below grade.

The test piles were instrumented in accordance with the general specifications communicated to SACL. A copy of the SACL drawings depicting the pile and designed instrumentation details is enclosed in Appendix 2, along with the as-built instrumentation profiles. In piles TP1 through TP4, five levels of strain gages (Geovan Model GV-2410) were installed on a rebar cage with four #5 bars (15M). The gage distribution is as shown in Table 1. These piles were also equipped with a telltale, anchored at the same depth as Strain Gage Level 1.

Table 1: Strain gage distribution, TP1 through TP4

| Strain Gage Level # | Depth (m) (m) | Depth (ft) (ft) | Gage Pairs |
|---|---|---|---|
| SG 1 | 16.89 | 55.40 | 2 |
| SG 2 | 14.42 | 47.30 | 1 |
| SG 3 | 9.41 | 30.86 | 2 |
| SG 4 | 6.42 | 21.06 | 1 |
| SG 5 | 0.42 | 1.38 | 2 |

In pile TP5, six levels of strain gages were installed on a C-channel frame. The gage distribution is as shown in Table 2.

Table 2: Strain Gage Distribution, TP5

| Strain Gage Level # | Depth (m) | Depth (ft) | Gage (No. of Pairs) |
|---|---|---|---|
| SG 1 | 14.64 | 48.01 | 2 |
| SG 2 | 14.07 | 46.16 | 1 |
| SG 3 | 9.82 | 32.22 | 2 |
| SG 4 | 8.27 | 27.14 | 2 |
| SG 5 | 6.42 | 21.07 | 1 |
| SG 6 | 0.52 | 1.72 | 2 |

Pile TP5 is also equipped with a 300-ton bidirectional load cell (BD Cell), about 1.5 ft above the taper, i.e. 26.5 ft above the toe, which was meant to jack the upper and lower segments apart. As shown in the drawings in Appendix 2, four telltales (two diametrically opposite pairs), were installed in pile TP5. One pair was anchored at the upper plate of the BD-Cell, and the second pair was anchored at the same depth as Strain Gage Level 1. The BD Cell was equipped with two vibrating-wire extensometers (Roctest Model JM-S) to measure the cell opening.

Calibrations of embedded instruments can be found in Appendix 3.

The initial design by SACL had called for the piles to be filled with liquid grout pumped through a grout hose discharging at the bottom of the piles; however, the grouting equipment was not available on site and the piles were filled by pouring concrete from the pile head.

In the case of pile TP5, which was full of water infiltrating from the joint between the two segments, SACL opted to tremie-fill the pile with concrete then sinking the steel frame with the instrumentation after pouring to prevent the segregation of concrete during the pour. A 4-inch diameter flexible tremie pipe was available to the contractor; however, it was about 10 ft (3 m) short of the pile toe. Despite all efforts to compensate, including cutting about 7.5 ft (2.3 m) off the bottom of the instrumented frame and moving the instruments upward, segregated concrete at the bottom resulted in the BD-Cell sitting about 3 ft higher into the upper pile segment which compromised the bidirectional test. The as-built drawing in Appendix 2 shows the estimated instrumentation profile after pile construction.

## 5.0 OBJECTIVE OF THE TESTING

The objective of the testing program was to investigate the difference in response between the straight shaft (uniform section) piles, and the piles with the tapered section in the bottom 25 ft (7.62 m). As all piles were driven through the same soil profile and to the same depth, the effect of the tapered pile segment can be identified by comparing the measured resistance distribution between the two pile types, in the lower 25 ft (7.62 m). Data from dynamic testing (PDA) on multiple occasions and static testing are being analyzed by Dr. Fellenius to investigate the behavioral differences between the pile types.

# 6.0 TESTING

As stated earlier, the pile installation was done on 26 and 27 March 2025 while monitored with a Pile Driving Analyser (PDA). A second PDA test (restrike test) was performed on 28 March 2025, allowing one to two days of driving-induced excess pore water pressure to dissipate. Static testing was then performed between 04 April 2025 and 16 April 2025. A second restrike test with the PDA (third test overall) was performed on 29 April 2025; this test was not initially scheduled.

## 6.1 PDA TESTING

Pile driving was monitored starting at a depth of 10 ft (3 m) for the straight shaft piles (TP1 and TP2) and starting at a depth of 15 ft for the partially tapered piles (TP3, TP4, and TP5). The driving setup is shown in Figure 3. Results of this test are labelled "Initial Driving tests" or ID tests.

The first restrike (R) test was conducted to investigate the dissipation of excess pore water pressure in the soil, induced by the pile driving. A second restrike test was conducted about one month after the end of driving and following the static testing to investigate the continued recovery from the driving effects and the long-term performance of the piles. CAPWAP signal matching analyses were performed on impact records from the end of initial driving and from the beginning of the restrike on both occasions (before and after the static testing), as described earlier. CAPWAP results are enclosed in Appendix 4 and will be addressed by Dr. Fellenius in a detailed test program report.

The data for the second restrike was difficult to analyze due to the concrete in the pile below the pile head and the rupture of the bond between the steel and concrete (delamination) that occurred after the static testing near the top of the pile, as will be discussed later in the report.

Pile driving logs throughout the monitored driven depth are provided in Appendix 5, along with PDAPLOT graphics illustrating recorded blow count, preliminary estimate of resistance, and computed hammer stroke and driving stresses from the PDA.

Figure 3. Tapered pile driving with PDA monitoring

It is important to note that the data for the second restrike of pile TP3 was not useful as the hammer impact was uneven. Our engineers tried repeatedly to align the leads, but with every impact, one of the PDA strain gages does not unload, implying yielding, and the pile head would deform. After several attempts the test was terminated. We suspect the cut that was made after the first restrike (before concreting) was not planar, but we cannot say for sure, as it was not obvious and the pile head deformed after the first set of blows, as shown in Figure 4.

Figure 4. Deformed pile head of TP3 during second restrike test

## 6.2 CONVENTIONAL STATIC TESTING

These tests were conducted by jacking down the pile head against a kentledge supported on a steel frame, which is in turn sitting on timber cribbing on both sides of the test pile. The kentledge was supplied and installed by Jordan Piling and consisted of concrete blocks placed on the steel frame. The timber cribbing support was about 4 ft (1.2 m) from the test pile on each side, face to face. A typical setup is shown in Figure 5. The layout of installed test piles and a typical layout of the test pile with the kentledge system are shown in Appendix 2.

SACL Engineers opted to terminate the concrete pour below the top of pile to be able to measure the displacement of the telltales (pile compression) from inside the piles. This resulted in the test load being applied to the steel rim and compromised the measurements of the upper two strain gage levels at different stages of the test procedure.


Figure 5. Static test setup

The testing and the interpretation provided in this report are in accordance with ASTM Standard D1143-20, Procedure A: Quick Test Method. The loading was based on a 675 kip (3,000 kN) presumed maximum test load, i.e. load increments of 34 kips (150 kN). Each increment was sustained for 15 minutes. The test was continued until a substantial pile head movement was recorded and no additional load could be sustained by the pile. The pile was then unloaded in five equal decrements, each sustained for 5 minutes.

All embedded vibrating-wire strain gages were sampled simultaneously along with the load cell reading and all displacement measurements. Readings were performed at one second interval, however, one reading every 30 seconds was recorded for analysis.

When performing the test, three Novotechnik TR and TRS electronic displacement transducers were used to monitor the displacement of pile head at two opposite locations and the telltale. Pile head displacement measurements were referenced to a steel W-section supported at a minimum of 5 pile diameters away from the test pile. Telltale displacement is referenced to the pile head, therefore, directly measuring the pile compression. Pile-head instrumentation setup can be seen in Figure 5.

Recorded applied load and pile head displacement measured simultaneously by SACL datalogger are enclosed in Appendix 6. The analysis of the static test results will also be reported independently by Dr. Fellenius.

### 6.2.1 Static test results

The individual test results presented in Appendix 6 are summarised graphically in Figure 6. Note that the test of Pile TP3 was stopped at a smaller movement and the load was allowed to recede due to observed lifting of the reaction kentledge (possible uneven positioning of the frame)

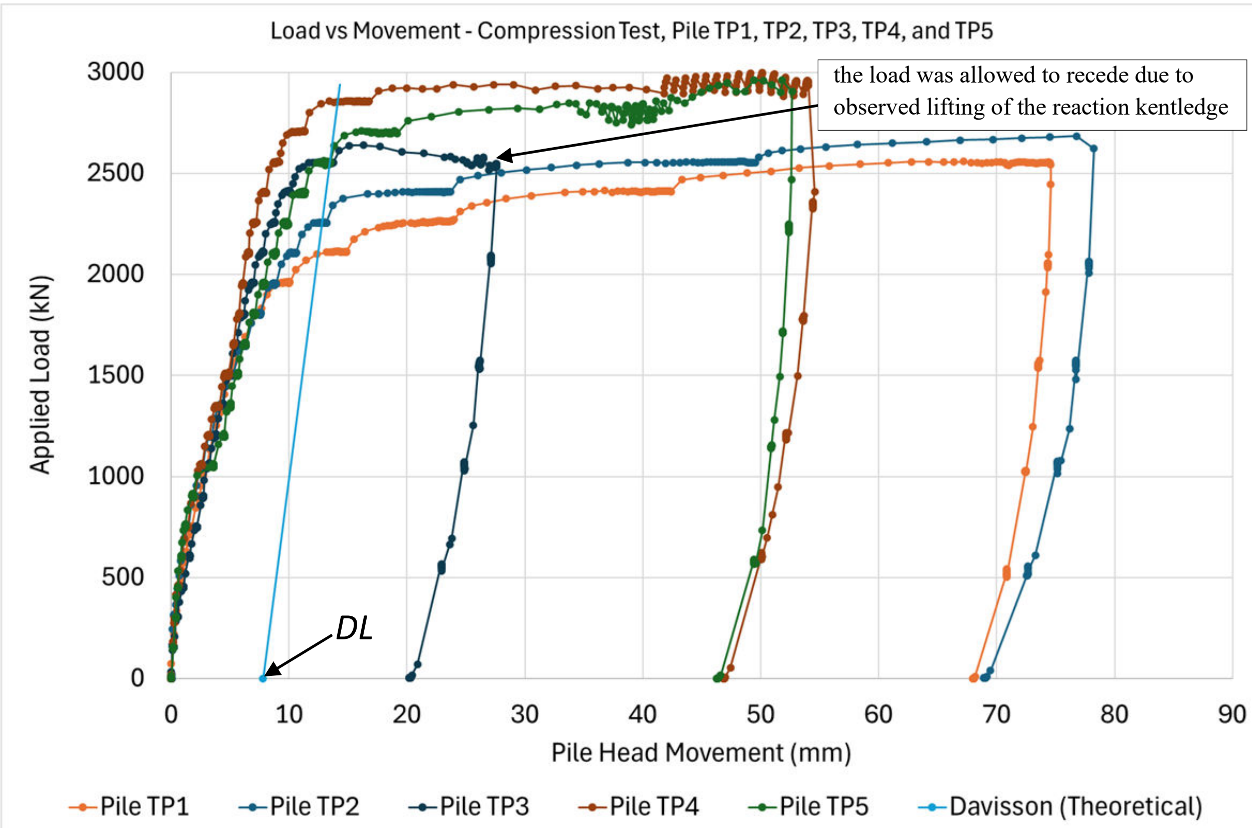



Figure 6. Load v. Pile Head Movement - All Piles

To simplify the comparison in performance between the different pile types, a generic "capacity" value was selected for each pile using the Davisson Offset method. In simple terms, this method uses an acceptable limit of plastic pile head displacement, which is a function of the pile size (diameter), such as:

$DL$ (mm) = 4 mm + $d$ (mm)/120 or $DL$ (in) = 0.1575 in + $d$ (in)/120 Eq. 1

Where $DL$ is the Davisson Offset Limit, and $d$ is the diameter of the piles (18 in, 457 mm).

The Davisson interpreted capacity is obtained by tracing a line passing through the *DL* point and parallel to the elastic compression line, which can be obtained from the unloading curve. The intersection of this line with the load-displacement curve determines the interpreted capacity from the Davisson method.

The interpreted capacity of the five piles and a comparison between the Uniform and Tapered pile performance are illustrated in Table 3.

Table 3: Performance comparison between the Uniform and Tapered piles

| Pile No. | Pile Type | Measured Capacity* in kips (kN) | | % greater than average Uniform pile capacity |
|---|---|---|---|---|
| | | Uniform Pile | Tapered Pile | |
| TP1 | Uniform | 474.15 (2,109) | - | - |
| TP2 | Uniform | 507.19 (2,256) | - | - |
| TP3 | Tapered | - | 574.64 (2,556) | 17.11 |
| TP4 | Tapered | - | 642.31 (2,857) | 30.90 |
| TP5 | Tapered | - | 592.63 (2,636) | 20.78 |
| | Average => | 490.67 (2,182) | 603.19 (2,683) | 23 |

*: Interpreted using the Davisson Offset method

Based on the comparison compiled in Table 3, the Tapered piles appear to have outperformed the Uniform piles by 17 % to 31 %, showing on average 23 % higher capacity than the Uniform piles in the same soil conditions. It is important to note that this is a somewhat lower bound performance comparison. As described in Section 3.0 (Site Characteristics), a sudden change is soil conditions was identified in the geotechnical investigation at 54 ft (16.46 m) depth. This change implies a much denser soil at the pile toe, which was verified in the PDA testing. Such condition is in favor of the Uniform piles which boast a much larger toe area that can benefit from the higher bearing. In the absence of such bearing layer, we expect a larger performance gap between the two pile types, as will be discussed in more detail later in this report.

### 6.2.2 Resistance distribution

The resistance distribution along the pile depth can be interpreted from strain gage measurements. From basic physics:

$$\sigma = E\varepsilon \rightarrow \frac{F}{A} = E\varepsilon \rightarrow F = EA\varepsilon \qquad \text{Eq. 2}$$

Where $\sigma$ is the stress across the pile section where the strain gage is installed, $E$ is the elastic modulus of the composite section, $\varepsilon$ and $F$ are the strain and the force in the pile section at the measurement depth, and A is the total cross-section area of the pile at the measurement depth. Let us call the value $EA$ the "Modulus" relating strain to force in the pile section. There are methods to calculate the Modulus or its components theoretically for the composite section, however, within the uniform portions of the piles, there are ways to estimate the actual Modulus as confined in the pile, which will be shown in this section of the report. The Moduli at the various tapered sections can then be calculated from the resulting in-situ material properties.

Considering an ideal Mohr-Coulomb shaft friction model, a pile segment between two strain gage levels (SG1 and SG2) and its response to loading can be illustrated as shown in Figure 7.

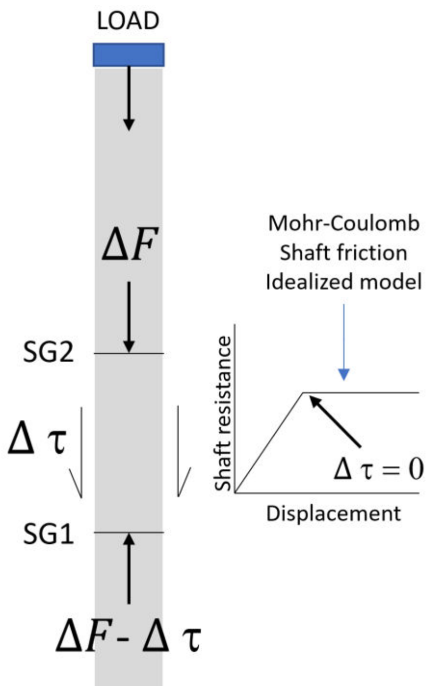



Figure 7. Load transfer in pile segment between strain gages

As can be seen in Figure 7, as equal load increments are applied to the pile head, and while the pile movement against the soil generates additional shaft resistance ($\Delta\,\tau$) within the referenced pile segment, the change in force at SG2 is larger than the change in force at SG1. Once the movement of the pile segment reaches the plastic range (movement at constant friction, $\Delta\,\tau = 0$), then the change in force at SG2 is equal to the change in force at SG1 with every load increment at the pile head. Therefore, the following equality (from Eq. 2) becomes true at SG1 (considering that the same had occurred at SG2 earlier):

$$\Delta F = EA\,\Delta\varepsilon \;\rightarrow\; \frac{\Delta F}{\Delta\varepsilon} = EA\;(constant) \qquad \text{Eq. 3}$$

At this point, the plot of $\frac{\Delta F}{\Delta \varepsilon}$ against $\varepsilon$, for the remainder of the test, becomes a constant, provided the soil continues to follow the Mohr-Coulomb model and does not exhibit any strain hardening or strain softening.

It is important to note as well that, at this point, the force increase in the pile with each load increment at the pile head can be predicted, with or without strain gage readings (same increase in force with each equal load increment).

When instrumenting the piles, SACL Engineers opted to terminate the concreting below the pile head in lieu of elaborate setups to read the telltales from the side of the pile. This is because the pile head is covered with the Jack and the bearing plate and standard telltales would not be accessible. While such setup can result in delamination between the steel pile and the concrete infill in the upper segment of the pile due to applying the load on the steel rim, we believe that the delamination would occur gradually, and after the maximum soil resistance above the strain gage level is reached (plastic zone). We therefore expect the effect of the delamination to be minimal.

Based on the actual strain gage measurements, we noted that the Tapered piles faired better than the Uniform piles in terms of the delamination which only affected the top gage level (SG5), less than 1 m below grade (see Table 1). No delamination was noted at the SG4 level or below. We believe that the difference is due to the type of pipe used in the Tapered piles which produced a better bond with the concrete (spiral-welded).

The complete strain gage data for all five piles are enclosed in Appendix 7. Using the data for Pile TP3 (Tapered), the Modulus of the uniform segment of the pile, which consists of the upper 32 ft can be determined in two independent ways.

The first method is by dividing the force increment by the strain increment (Eq. 3) at the top gage level (Level SG5), which is expected to reflect the applied load at the pile head (shallow gage). The measured strains averaged per gage level are shown in Figure 8. Skipping the first load increment in the data from SG5, where possible initial gaps are compressed, and applying the relationship in Eq. 3 with a change in force of 151.24 kN and a change in strain of 15.42 microstrain, a modulus EA is calculated at 9.98 GN.

The other independent method to calculate the modulus is by looking at the data from levels SG3 and SG4, which are within the uniform segment of the pile. The values of $\Delta F/\Delta\varepsilon$ plotted against $\varepsilon$ are expected to reach a constant value once the shaft resistance above the respective gage level has reached its maximum value (plastic zone, see Eq. 3). The constant value is the Modulus of the pile section (uniform segment). For obvious reason, these methods do not apply to the tapered segment since we expect the shaft resistance along this segment to continue to increase with pile movement against the soil. The Moduli of the tapered segment at various depths must be calculated manually using the composite area method with the concrete confined modulus back calculated from the uniform segment Modulus determined from the data. These calculations are shown for Pile TP3 on the plot of the Modulus ($\Delta F/\Delta\varepsilon$)

against the strain (ε) in Figure 9, where similar values of the Modulus can be verified from strain gage data at levels SG3 and SG4. As explained earlier, the data from levels SG1 and SG2 will not submit to the same rules as the resistance along the tapered pile segment is constantly increasing with pile movement. As tabulated in Figure 9, a confined elastic modulus of 44,000 MPa is back calculated from the Modulus EA of the uniform section (9.89 GN). The high elastic modulus of the concrete is due to the confinement inside the steel tube preventing the lateral expansion of the core, which is often observed in concrete piles in hard or dense materials like in a rock socket. The section Moduli at levels SG1 and SG2 are therefore calculated at 2.94 GN and 4.87 GN, respectively.

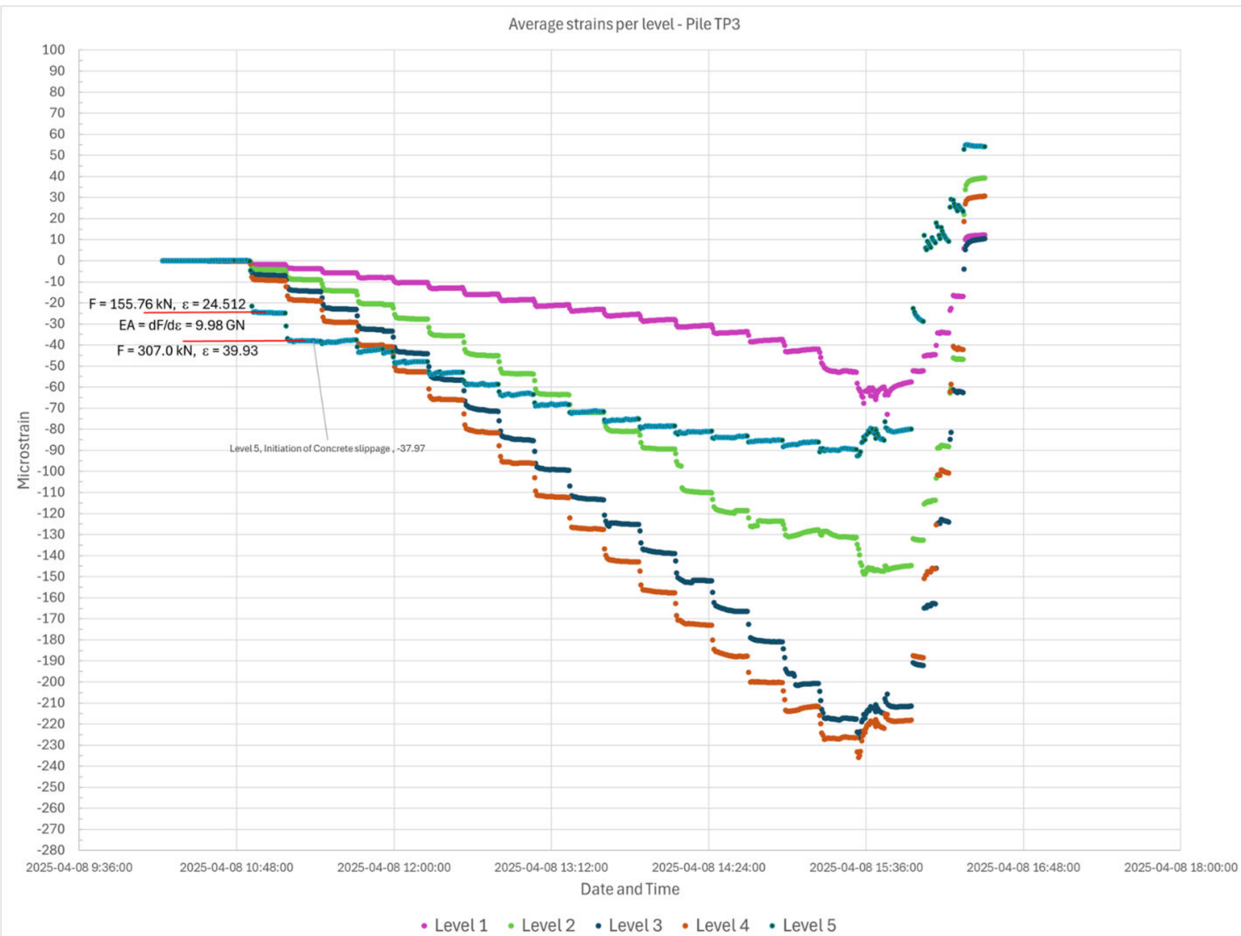



Figure 8. Strain measurements for Pile TP3, averaged per instrumented level

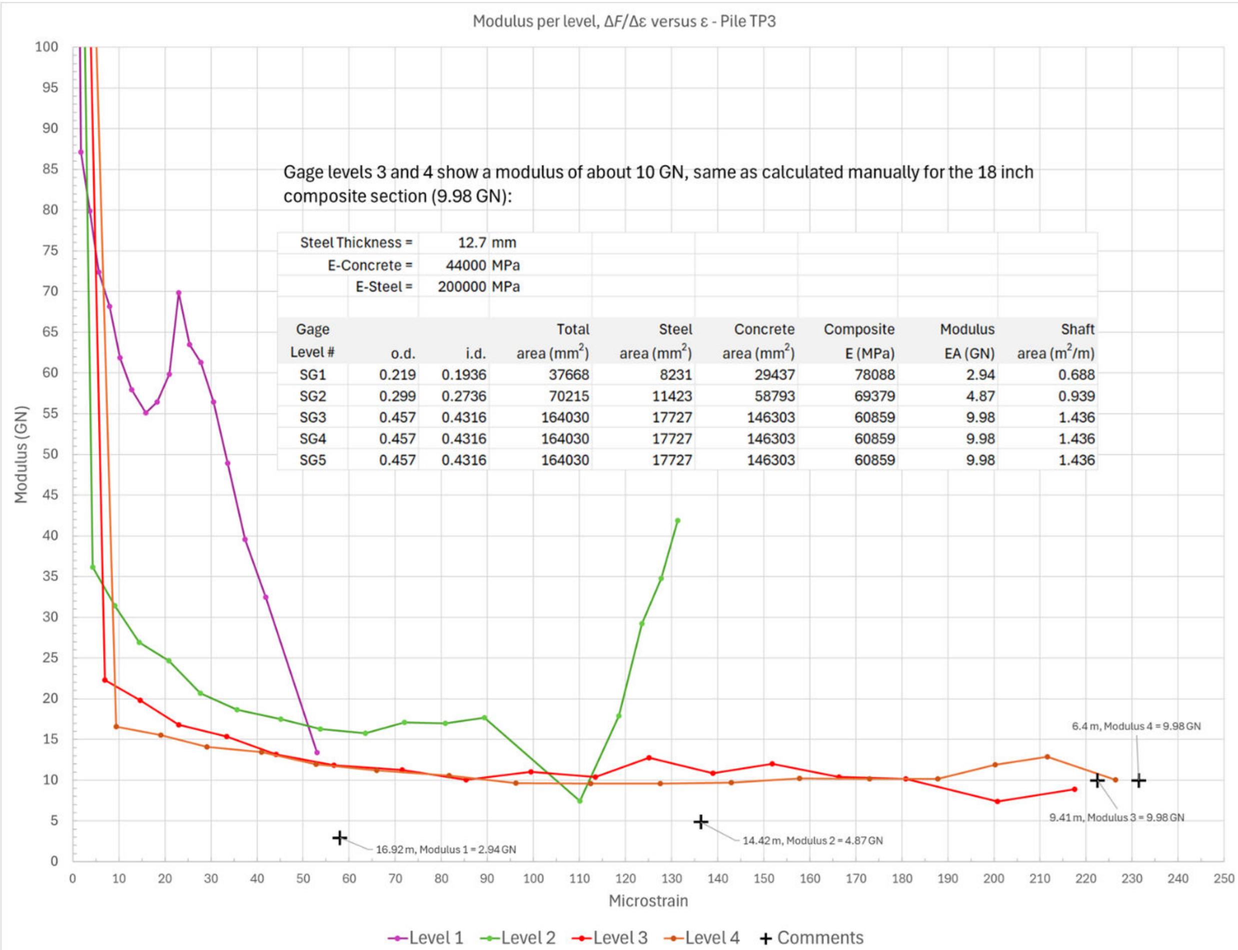



Figure 9. Tangent Modulus plot, Pile TP3

The same conclusions can be drawn for Pile TP4, as shown in Figure 10 and Figure 11. While the second strain increment at level SG5 reflects a computed section Modulus of 9.384 GN (Figure 10), the Tangent Modulus plot in Figure 11 still supports a section Modulus of 9.98 GN, similar to Pile TP3. This Modulus value, and the calculated Moduli at levels SG1 and SG2 will therefore be adopted for computing the resistance distribution in all Tapered piles. This is a reasonable assumption as all piles were filled with the same concrete batch.

It is important to note that while a section Modulus is determined, there are always variations between different depths and different locations across the pile section due to construction conditions. This is especially true when the concrete is dumped through the small cage like in this case. There is a high probability that spots with varying stiffness exist near or around the gages due to segregation, restricted concrete flow, or deterioration during loading (micro-cracks), causing small variations in section moduli and affecting the conversion from strain to force. A design curve is then fitted to the data and interpolating between gage levels where needed to provide an approximate resistance distribution.

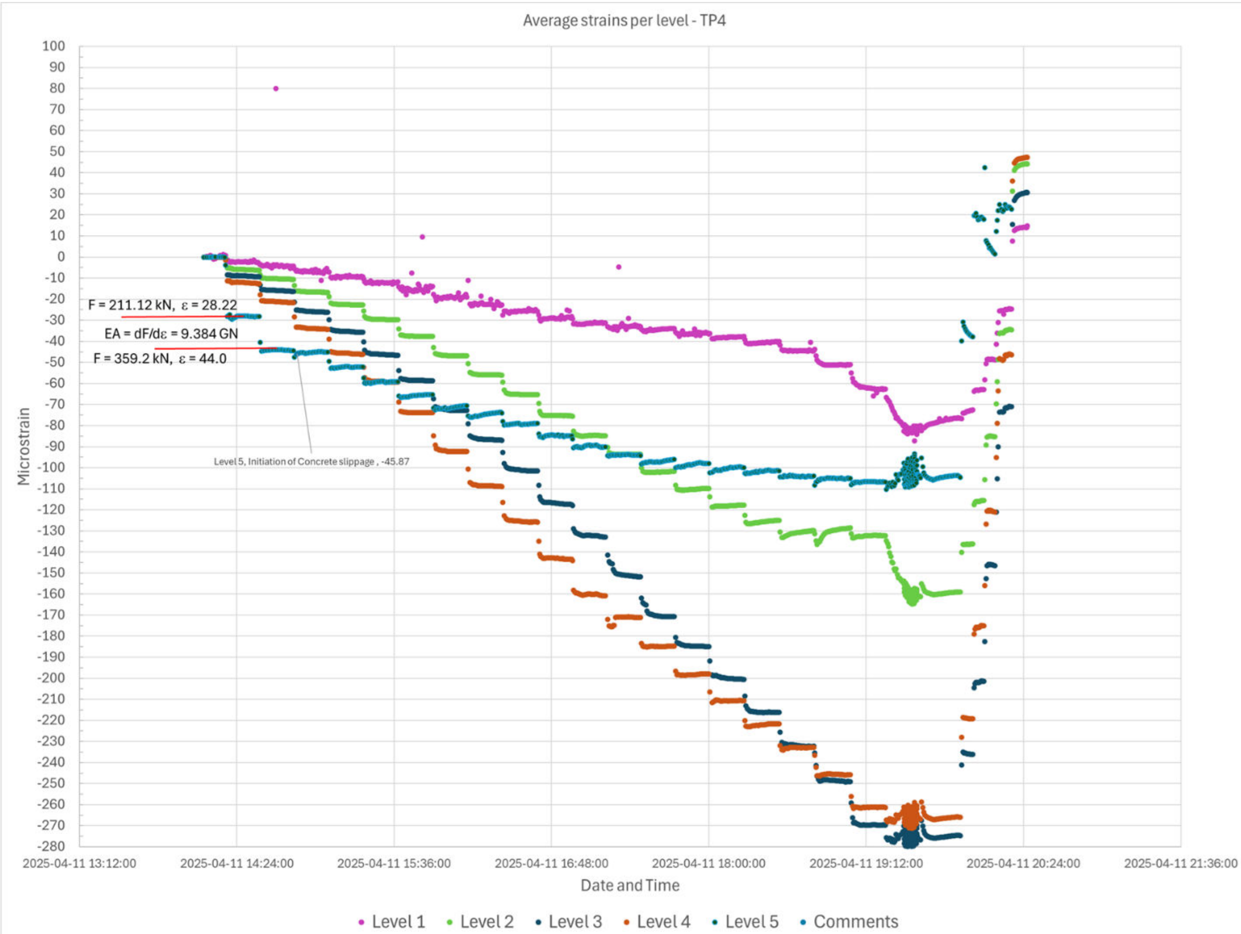



Figure 10. Strain measurements for Pile TP4, averaged per instrumented level

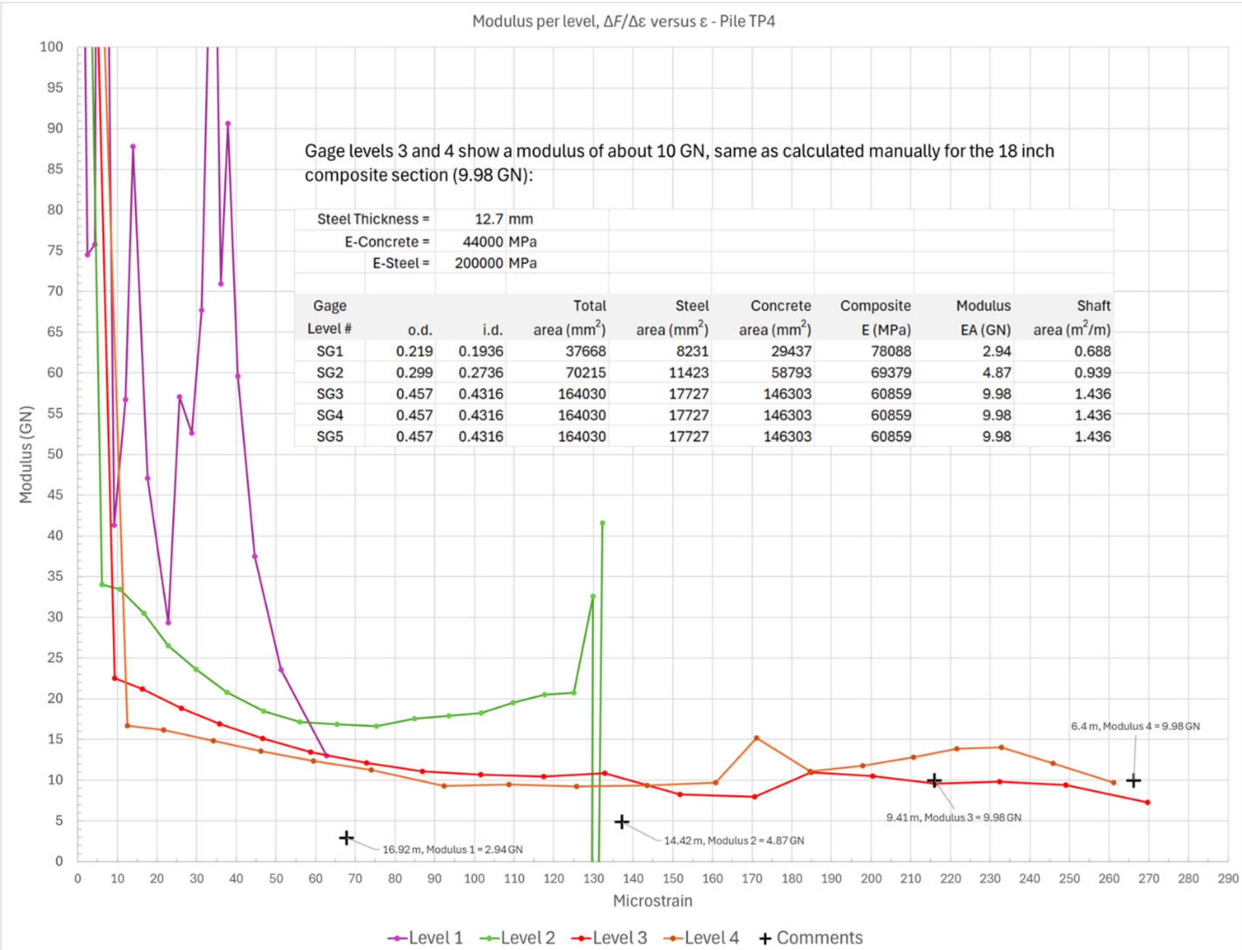



Figure 11. Tangent Modulus plot, Pile TP4

The treatment of the strain data from the Uniform piles is similar to the procedure detailed above with some modification to account for the difference in tube type (smooth pipe throughout) and the consistent shape of the pile section from the head to the toe. As stated earlier, the upper gage level in these pipes was compromised early in the test, especially in pile TP1, which had to be tested a short time after pouring, implying a weaker concrete bond to the steel. As such, deeper delamination was observed in TP1 reaching gage level SG3. Pile TP2, which had more time for concrete hydration before testing showed a much better response with delamination noted only in the uppermost gage level (level SG5).

The plot of the Modulus ($\Delta F/\Delta\varepsilon$) against the strain ($\varepsilon$) for pile TP1 is shown in Figure 12. The inferred section Moduli at different gage levels are noted, however, only the Moduli determined for SG1 and SG2 are useable to the end of the loading sequence as the strain gages at levels SG3 and SG4 were compromised during the test. Similarly, the plot of the Modulus ($\Delta F/\Delta\varepsilon$) against the strain ($\varepsilon$) for pile TP2 is shown in Figure 13. The section Moduli determined from the data are shown on the plot. While the Moduli at levels SG3 and SG4 are close to those determined for the uniform section of the Tapered piles, the Moduli for levels SG1 and SG2 in both Uniform piles were quite lower, and specifically in Pile

TP2, the tangent moduli dropped in the last 2 to 3 load increments. It is not known for certain why this change occurred and the reason for the apparent lower Moduli; however, we can speculate on possible causes:

1. Deterioration in the concrete as the compression increases against the large toe resistance.
2. A reduction in shaft resistance somewhere between SG2 and SG3 (strain softening) with substantial movement of the pile and a transfer of the resistance to the toe

This response is also observed at SG3 level in pile TP2 at the end of loading, but to a lesser degree.

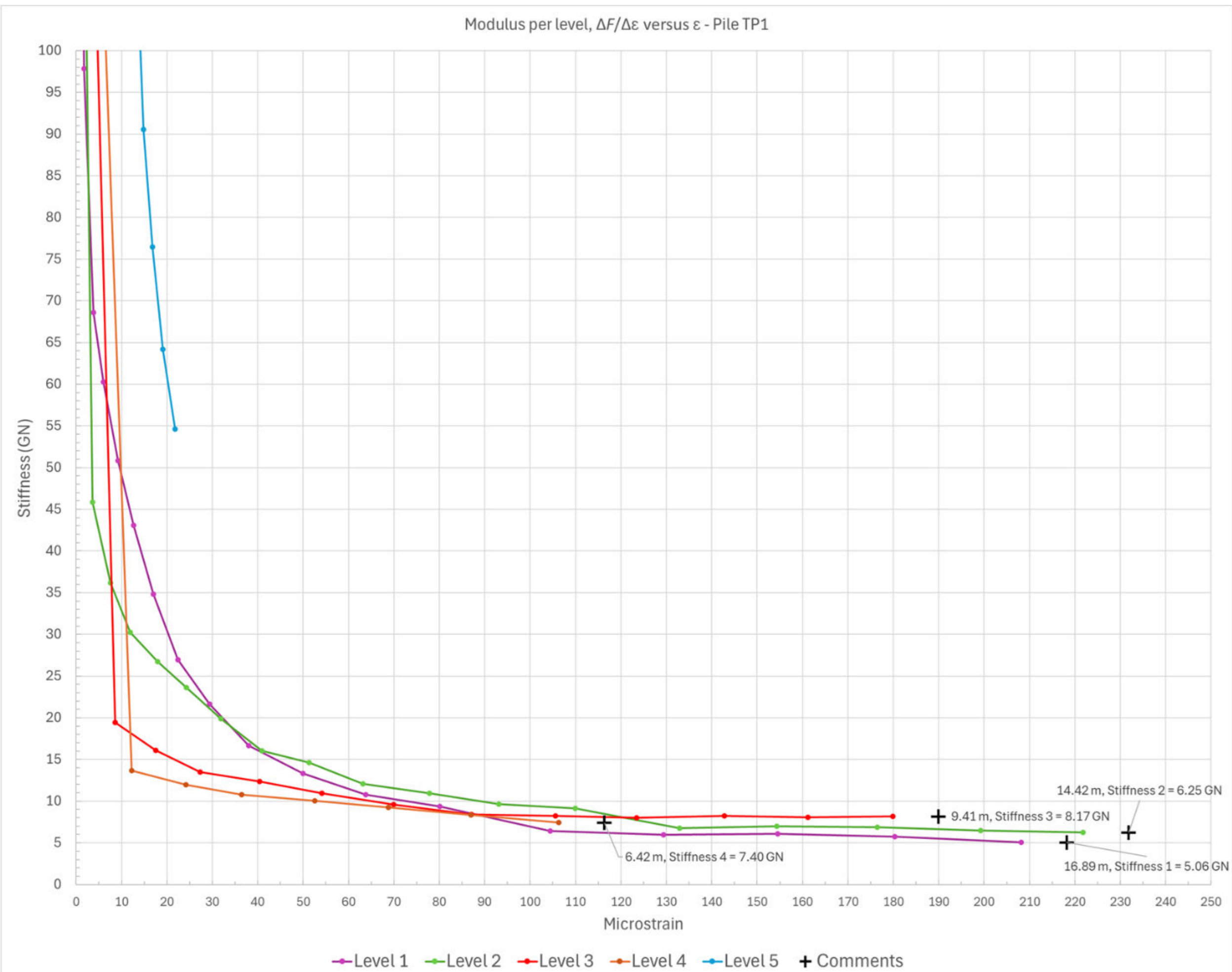



Figure 12. Tangent Modulus plot, Pile TP1

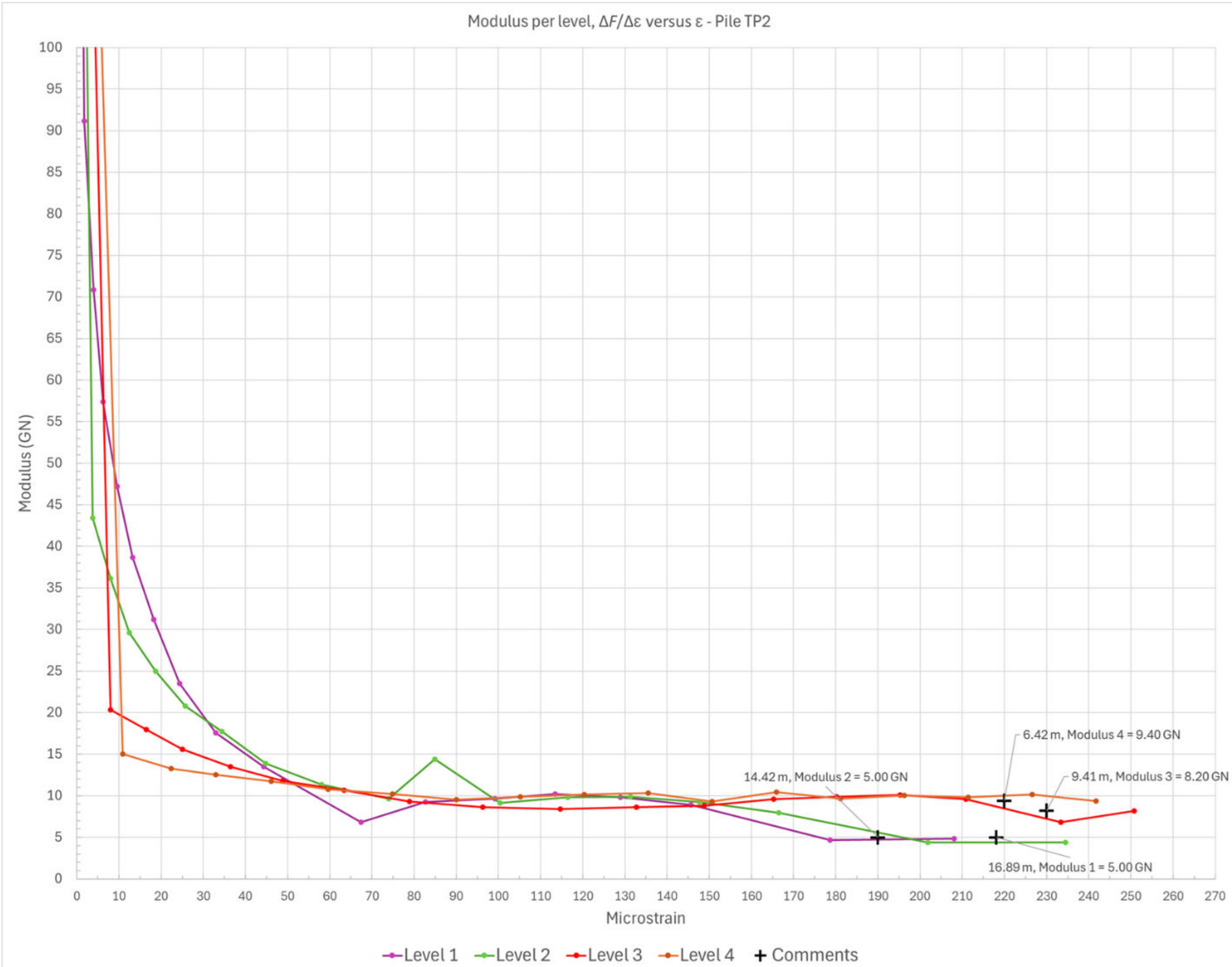



Figure 13. Tangent Modulus plot, Pile TP2

The moduli determined from the data in Figure 12 and Figure 13 will be used to assess the resistance distribution for the corresponding Uniform piles.

As the section Moduli for all strain levels are estimated, the strain data can be converted to force through multiplying by the corresponding Moduli, as per Eq. 2. The effects of delamination described earlier and apparent non-homogeneity of the concrete, i.e. potential variation of actual Moduli from established general values, will be overcome by interpolating between levels with a suggested design profile of the resistance distribution. The calculated resistance distribution during each load increment is shown graphically in Figure 14 (TP1), Figure 15 (TP2), Figure 16 (TP3), Figure 17 (TP4), and Figure 18 (TP5). Note that the instrumentation in the uniform portion of TP5 was further compromised as the BD Cell was pressurized up to a load of 400 metric tons (880 kips) in attempting to open the cell which got embedded in the upper segment, as explained earlier in this report.

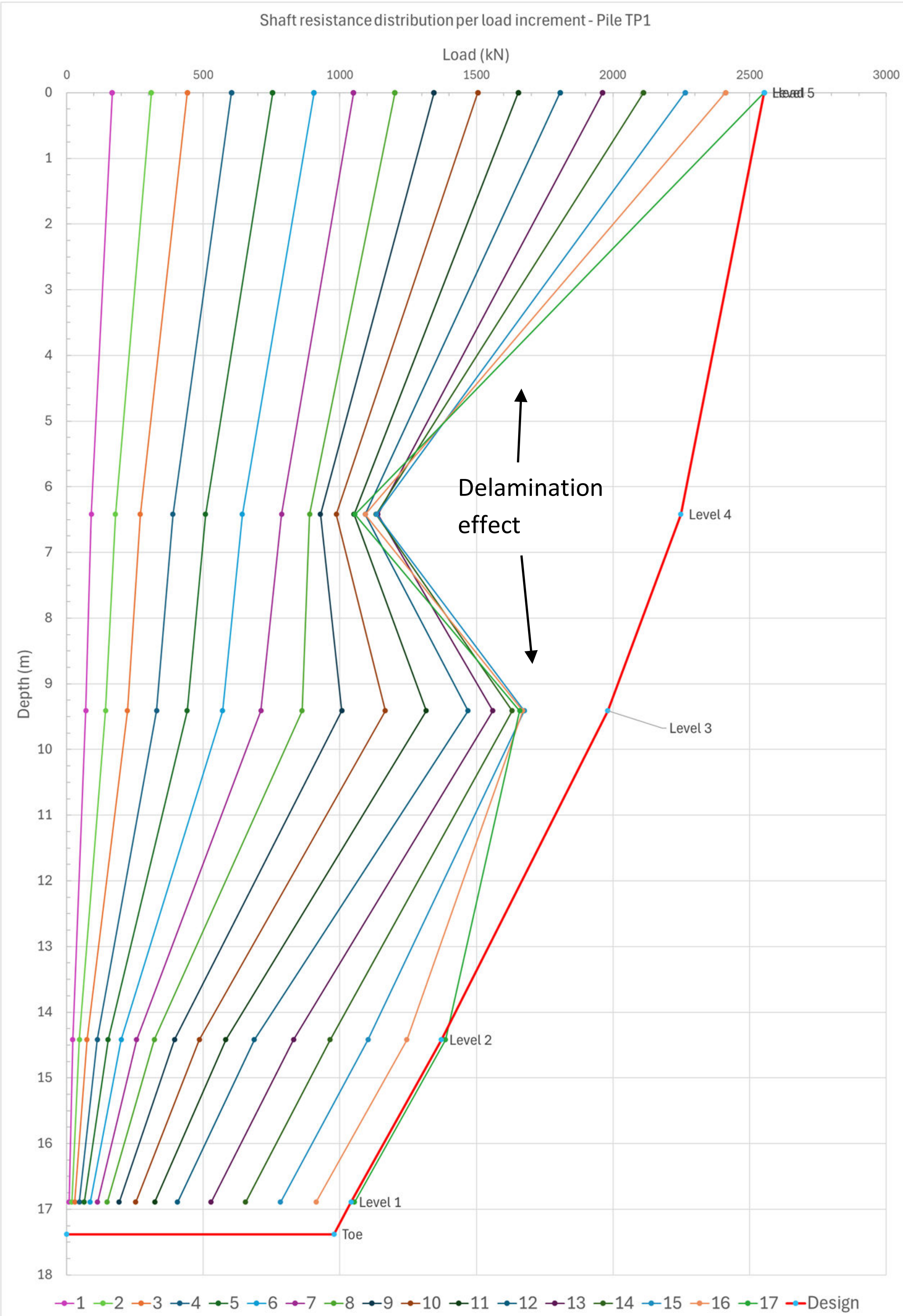



Figure 14. Resistance distribution, TP1

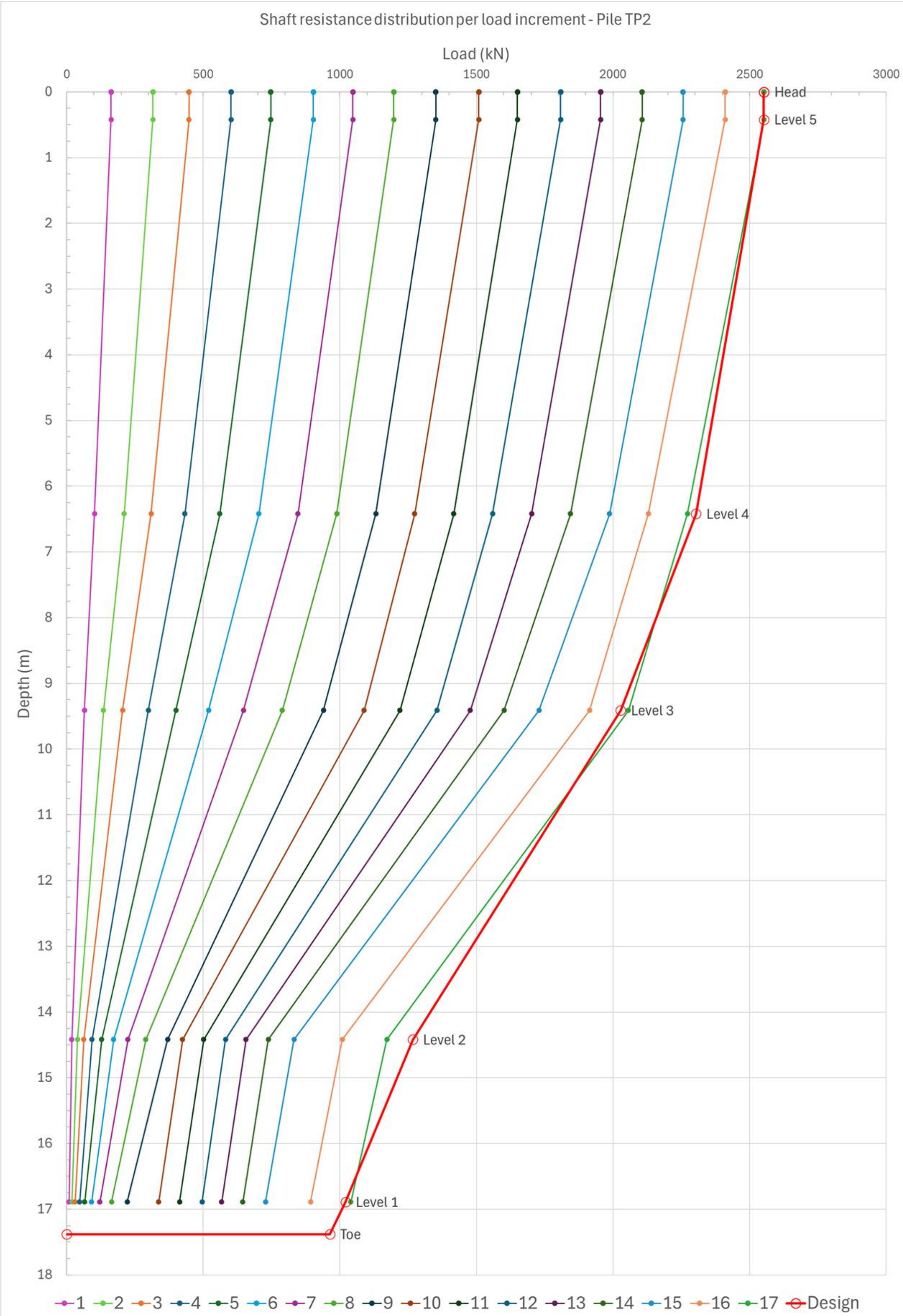



Figure 15. Resistance distribution, TP2

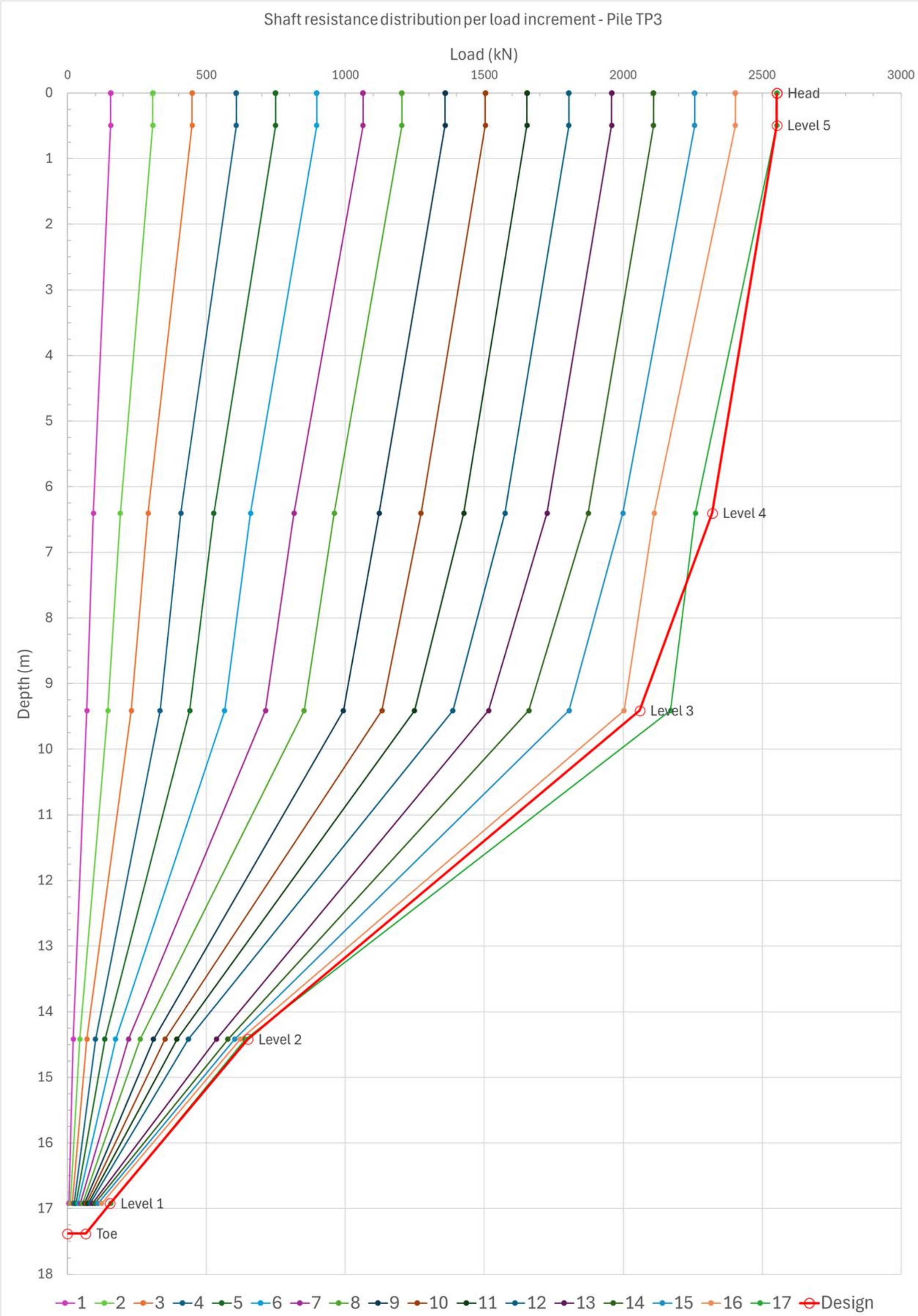



Figure 16. Resistance distribution, TP3

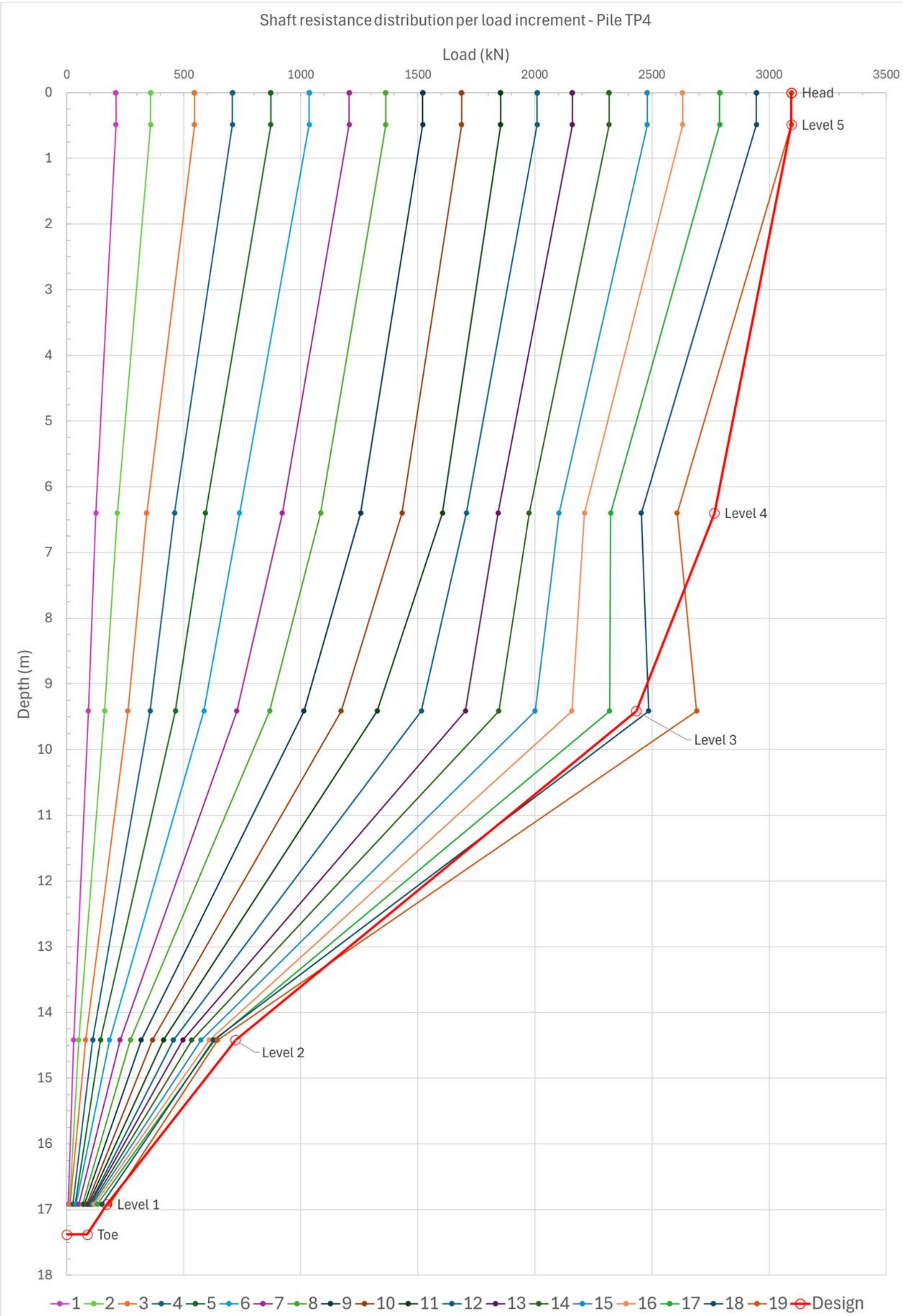



Figure 17. Resistance distribution, TP4

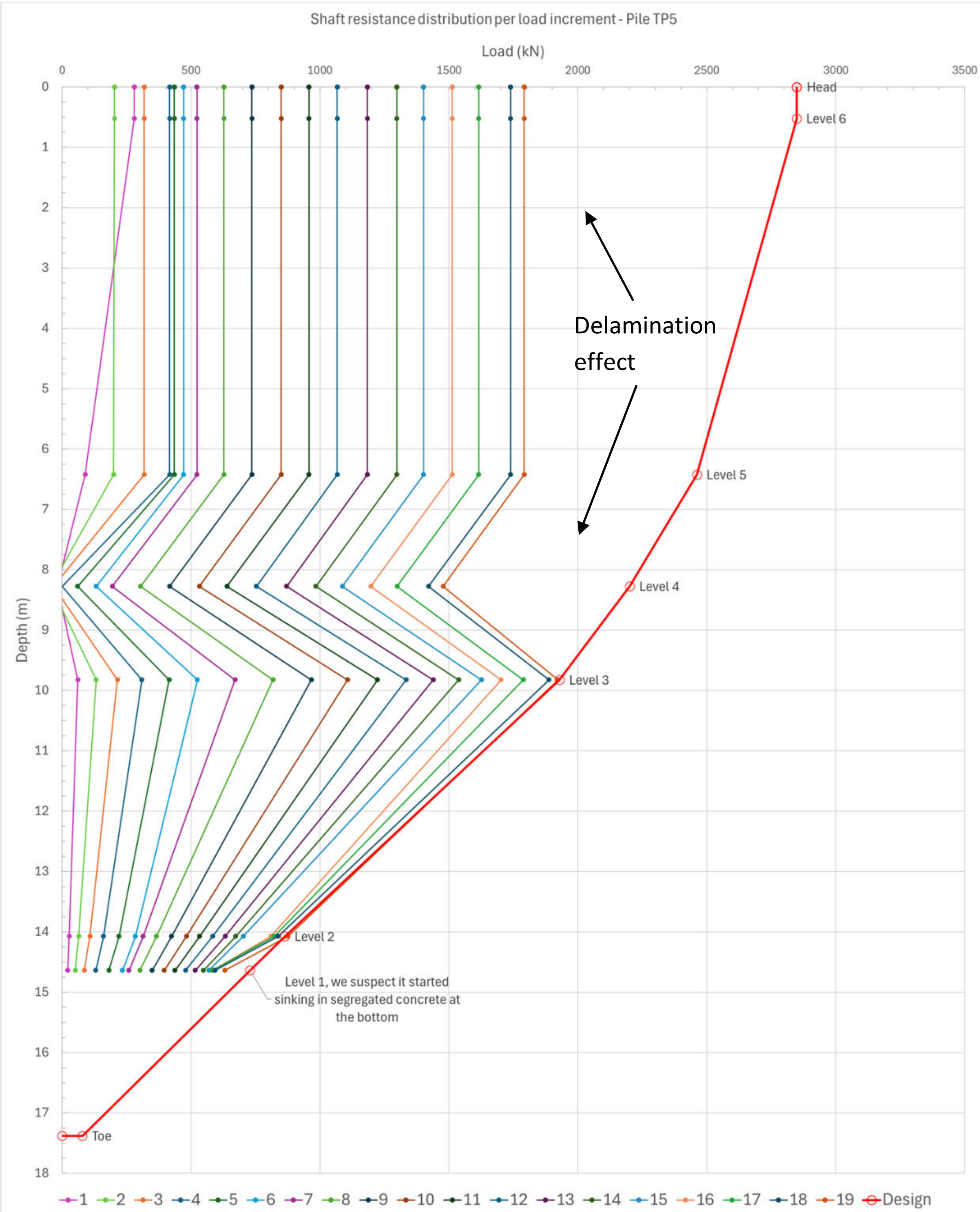



Figure 18. Resistance distribution, TP5

# 7.0 EFFECT OF BEARING LAYER ON PILE EVALUATION

As stated earlier in this report, the evaluation of the two pile types conducted in this study is a lower bound performance comparison with respect to the Tapered piles. As described in Section 3.0 (Site Characteristics), a sudden change is soil conditions was identified in the geotechnical investigation at 54 ft (16.46 m) depth. This change implies a much denser soil at the pile toe, which was verified in the PDA testing. This effect is best illustrated in the driving profile recorded by the PDA during the driving of pile TP1. The driving profile of all five piles are enclosed in Appendix 5, showing for every hammer blow the values of estimated resistance, stresses, transferred energy, and hammer stroke with every blow, as well as the blow count (blows per foot) with depth. In particular, the profile showing a representative estimate of measured pile resistance, RSP CASE method with a damping factor of 0.2 (RP2), along with a profile of the observed blow count, is shown in Figure 19. It is clear from Figure 19 that a substantial increase in resistance is measured below the depth of 54 ft, confirming the soil description from the geotechnical investigation.

Such condition is in favor of the Uniform piles which boast a much larger toe area that can benefit from the higher bearing. In the absence of such bearing layer, we expect a larger performance gap between the two pile types. As shown in Figure 19, the increase in resistance in the bottom 4 ft of driving is about 105 kips, out of which about 25 kips originate from shaft resistance along the lower 4 ft, as can be estimated from the established resistance profile (see Figure 14). Therefore, we can account for about 80 kips of increased toe resistance in the last 4 ft of driving in the dense bearing layer, which represents an increase in toe resistance of about 36.5%, i.e. from about 220 kips to 300 kips. A similar reduction in the average toe resistance of the Tapered piles results in a reduction in resistance of about 8 kips.

Using the values in Table 3, and subtracting 80 kips from the average Uniform pile resistance and 8 kips from the average Tapered pile resistance, the advantage of the average Tapered pile type increases to **44.93%** higher resistance than the average Uniform pile. This is a substantial advantage to be considered where no special bearing strata are available in the local soil profile. It is important to note that the calculation to account for the effect of the bearing layer is approximate.

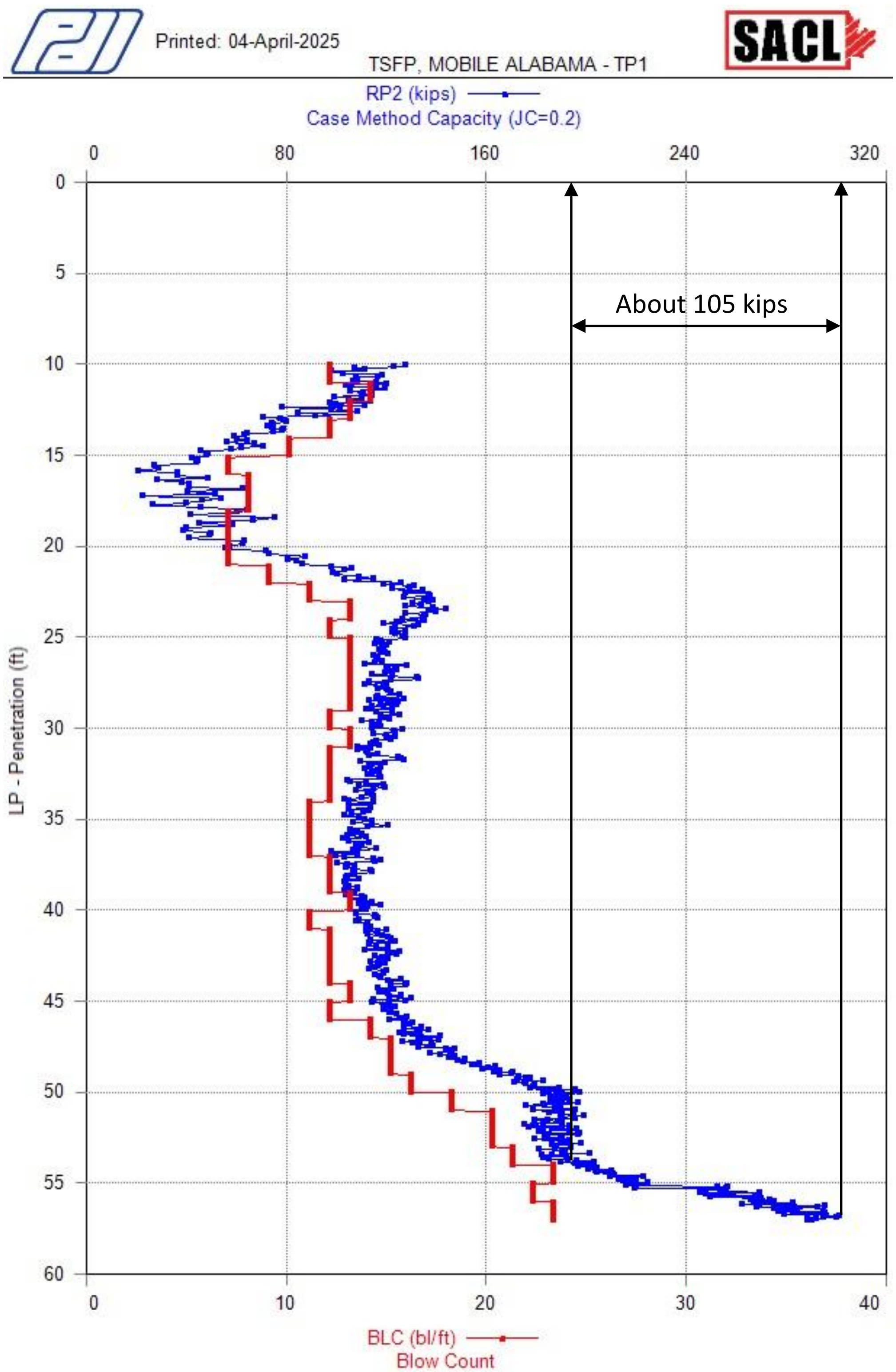



Figure 19. Measured resistance (RP2 estimate) and blow count with depth, Pile TP1

## 7.1 BIDIRECTIONAL STATIC

As stated earlier, pile TP5 was designed as a bidirectional test pile and was comprised of two separate segments to facilitate bidirectional testing; a lower segment consisting of a 25 ft (7.62 m) tapered pile, extended with a 1 ft (0.3 m) of uniform 18-inch (0.457 m) pipe. The remainder of the pile consists of a uniform 18-inch diameter pipe. The two segments were joined with minimal stitch welding and restrained laterally by six 12-inch-long (300 mm) knife-plates welded on the inside of the lower segment and protruding 6 inches (150 mm) into the upper segment. The plates were 1 inch (25 mm) thick and 1.75-inch (45 mm) wide. The photos in Figure 20 show the connection style.

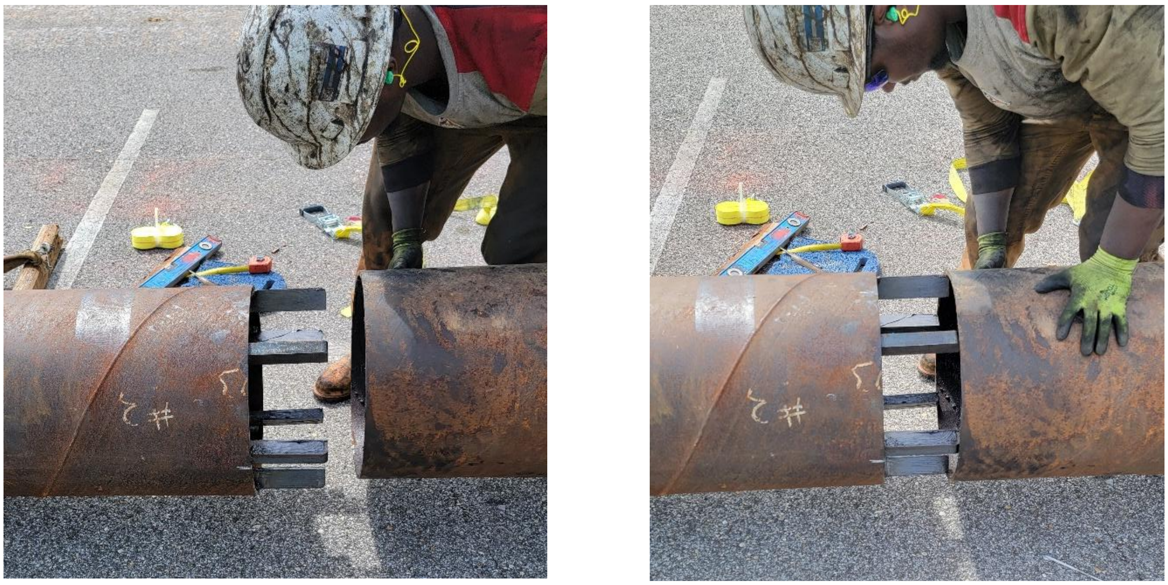


Figure 20. Pile TP5 splice for bidirectional testing

A 4-inch diameter flexible tremie pipe was the only tremie tool available to the contractor and it was about 10 ft (3 m) short of the pile toe. Despite all efforts to compensate, including cutting about 7.5 ft (2.3 m) off the bottom of the instrumented frame and moving the instruments upward, segregated concrete at the bottom resulted in the BD-Cell sitting about 3 ft higher into the upper pile segment which compromised the bidirectional test. The as-built drawing in Appendix 2 shows the estimated instrumentation profile after pile construction.

While the installed hydraulic cell was able to create an opening with 400 tons of applied force, the opening was internal to the upper pile segment and was not representative of the soil resistance. The bidirectional test data will therefore not be reported.

# Appendix 1

# SACL Expertise

PDCA
PILE DRIVING CONTRACTORS ASSOCIATION

Pile Dynamics, Inc.

This documents that

**Hicham Salem**
**Scientific Applied Concepts Ltd. (SACL)**

has on July 17, 2024 achieved the rank of

# EXPERT

on the **Dynamic Measurement and Analysis Proficiency Test**

The individual identified on this document demonstrated to the degree granted above an understanding of theory, data quality evaluation, interpretation and signal matching for high strain dynamic testing of deep foundations. ***It is recommended*** **that individuals at the Basic level seek Intermediate, Advanced, Master or Expert levels through additional study within two years of the date of this document**

The ability of the individual named to provide appropriate knowledge and advice on a specific project is not implied or warranted by the Pile Driving Contractors Association or Pile Dynamics, Inc. The Pile Driving Contractors Association or Pile Dynamics, Inc. assumes no liability for foundation testing and analysis work performed by the bearer of this certificate. This certificate can be verified at www.PDAproficiencytest.com.

Frank T. Peters, Executive Director
Pile Driving Contractors Association

PILE DYNAMICS INC
CORPORATE SEAL
1972
OHIO

Garland Likins, Senior Partner
Pile Dynamics, Inc.

No. 3820

PDCA

PILE DRIVING CONTRACTORS ASSOCIATION

Pile Dynamics, Inc.

This documents that

## Mudasser Noor
## Scientific Applied Concepts Ltd. (SACL)

has on July 17, 2024 achieved the rank of

# ADVANCED

on the **Dynamic Measurement and Analysis Proficiency Test**

The individual identified on this document demonstrated to the degree granted above an understanding of theory, data quality evaluation, interpretation and signal matching for high strain dynamic testing of deep foundations. ***It is recommended*** **that individuals at the Basic level seek Intermediate, Advanced, Master or Expert levels through additional study within two years of the date of this document**

The ability of the individual named to provide appropriate knowledge and advice on a specific project is not implied or warranted by the Pile Driving Contractors Association or Pile Dynamics, Inc. The Pile Driving Contractors Association or Pile Dynamics, Inc. assumes no liability for foundation testing and analysis work performed by the bearer of this certificate. This certificate can be verified at www.PDAproficiencytest.com.

Frank T. Peters, Executive Director
Pile Driving Contractors Association

Garland Likins, Senior Partner
Pile Dynamics, Inc.

No. 3821

5360 Canotek Rd., Unit 5, Ottawa, ON, K1J 9E3 | 1-613-762-6210 | sam@saclcanada.com

## Synopsis

President and Principal Engineer at AATech Scientific Inc. (ASI) since 1997; President and Principal Engineer at Scientific Applied Concepts Limited (SACL) since 2020. Dr. Salem has extensive specialized experience in geotechnical engineering spanning over 29 years with active involvement in thousands of construction projects across North America and overseas. Dr. Salem's main career focus includes foundations, shoring and retaining structures, ground improvement and stabilization, geotechnical instrumentation, advanced load testing systems, erosion assessment and control, and other related civil engineering fields. He had major contributions in high profile projects such as the stabilization of the 99 Street landslide in Peace River, AB; the rehabilitation of MSE walls (OPP walls, Plant 85) at SUNCOR main plant, Fort McMurray; Walterdale Bridge, Edmonton; Long Lake oil sands project (multiple structures), Fort McMurray; Seawall platform replacement, US Navy Yard, Washington D.C., foundations of Berths 324 & 325 of the container wharf, Port of Los Angeles, California, National Solid Waste Landfill in Greenland, Barbados, Sheraton Convention Center, San Juan, Puerto Rico, Cambalache Power Plant, Arecibo, Puerto Rico, and many others. Dr. Salem also has extensive specialized experience in designing and implementing automated instrumentation and datalogging, special load testing setups, high-capacity reaction frames, and high-precision measurement systems. He is a leading expert on dynamic testing and analysis of pile foundations (Master PDCA Certification) as well as low-strain pulse-echo (PIT), cross-hole sonic (CSL), and thermal integrity profile (TIP) testing of caissons and other concrete structures, with experience spanning over more than two thousand projects. Dr. Salem is also active in research and development for engineering innovation and has authored several publications.

## Education

### DOCTORATE IN CIVIL ENGINEERING | 2019 | THE UNIVERSITY OF OTTAWA

Research focus on the erosion of river and creek banks, especially in cohesive soils. As part of his research, Dr. Salem developed new devices and instruments to measure the erodibility of soils both in the field and in the laboratory and to facilitate quick and practical determination of critical shear (erodibility threshold) of soils in banks and flood zones. He continues to be active in research and development in through joint projects with the University of Ottawa on erosion and scour problems.

### MASTER'S IN APPLIED SCIENCE IN CIVIL ENGINEERING | 1998 | THE UNIVERSITY OF OTTAWA

Research focus on buried pipelines in adverse and sloping terrain. Performed numerical modelling and parametric studies to assess the effects of surcharge loading and earth pressure from adjacent slopes on buried pipelines. The role of backfill and compaction in increasing pipeline resilience against adverse pressures was also investigated in the study.

### BACCALAUREAT IN CIVIL ENGINEERING | 1993 | THE UNIVERSITY OF OTTAWA

Graduated with a bachelor's degree in the Civil Engineering COOP program. COOP assignments included several positions within the Transportation Planning Department of the Regional Municipality of Ottawa-Carleton (currently the City of Ottawa).

## Experience

Dr. Salem has led the engineering team at AATech Scientific Inc. ASI since 1997 and through its transitioning to Scientific Applied Concepts (SACL) in 2020 through to the present day.

**PRINCIPAL ENGINEER | SCIENTIFIC APPLIED CONCEPTS LIMITED (SACL) | 2020 - PRESENT**

**PRINCIPAL ENGINEER | AATECH SCIENTIFIC INC. | 1997 – 2020**

President and Principal Engineer at AATech Scientific Inc. (ASI) since 1997; President and Principal Engineer at Scientific Applied Concepts Limited (SACL) since 2020. Dr. Salem had a leading role in thousands of projects across North America and overseas involving foundations, shoring, retaining structures, ground improvement and stabilization, geotechnical instrumentation, advanced load testing systems, erosion assessment and control, and other related civil engineering fields. Dr. Salem also has also led the design and implementation of automated instrumentation and datalogging, special load testing setups, high-capacity reaction frames, and high-precision measurement systems. He is a leading expert on dynamic testing and analysis of pile foundations (Master PDCA Certification) as well as low-strain pulse-echo (PIT), cross-hole sonic (CSL), and thermal integrity profile (TIP) testing of caissons and other concrete structures, with experience spanning over more than two thousand projects. Dr. Salem is also active in research and development for engineering innovation and has authored several papers and journal articles. Some selected projects involving geotechnical instrumentation and vibration monitoring are summarized below.

<u>Pattullo Bridge, Fraser River Crossing Constructors Group, Vancouver, BC – 2022</u>

SACL Engineers are providing ongoing consulting and design work for many segments of the bridge project including the design of shoring, working platforms, assessing the effect of intrusive operations such as pile driving and vibratory soil densification on nearby bridges roadways, and other infrastructure. Our mandates include designing monitoring plans tailored to various operations and environments (settlement and vibration monitoring, ground and structure movement, distress, and other effects). Our engineering team is charged with reviewing daily monitoring data and assessing current or future effects on the health of impacted infrastructure. SACL Engineers are also conducting thermal integrity and CSL testing on bridge piles.

<u>Grand River Bridge, Hwy 401, Cambridge, ON – Bauer Foundations/MTO (2021)</u>

SACL was retained to conduct bidirectional static loading test on a test pile at the Grand River Bridge near Waterloo. The test consisted of instrumentation of the test pile with strain gages, telltales, extensometers, bidirectional cell as well as inclinometer casings. SACL instrumented the pile with six levels of four strain gauges diametrically opposed pairs per level along with two extensometers between the upper and lower plates of the bidirectional cell. Two pairs of telltale rods were also instrumented to reflect upper plate and pile toe movement during the test. SACL also performed the lateral loading test on the same test pile after the bidirectional static loading test was performed. The inclinometer was read during the loading test as well as 5-days after the test was concluded. The inclinometer data showed a close agreement with the estimated movements predicted by SACL.

<u>Stabilization of the 99 Street landslide in Peace River, AB (2018)</u>

Dr. Salem and his engineering team designed a new stable profile of the slope, west of 99 Street. The slope had exhibited a large-scale slip failure endangering a residential building on the east side of 99 Street and as well as 98 Street and existing cycle shop at the toe of the slope. The mitigation included the design of dual secant pile walls to produce a stable profile. The upper stabilizing wall was secured by three rows of deep tiebacks. While overseeing the construction, the design team implemented a substantial instrumentation program to monitor the performance of the retaining walls and the stability of the slope. The instrumentation included series of strain gages embedded in selected secant piles (to monitor bending strains), inclinometer casings embedded in other secant piles for manual monitoring (pile flexure), and vibrating-wire load cells installed on selected tieback rods (three per row) to monitor the tension in the tieback rods. The design team routed all instrumentation in electrical conduits to a central logging system and collected the background readings before handing over the monitoring to City representatives. We believe the instrumentation is still in operation to date and being monitored by the City of Peace River

<u>Highway 27 bridge over the Athabasca River near Morin, AB (2017)</u>

Dr. Salem and his engineering team designed and implemented an instrumentation and monitoring plan in addition to piling inspection at the site of Highway 27 bridge. ASI Engineers installed slope inclinometer casings in newly cast bridge piles, vibrating wire piezometers and settlement cells around the abutment site with remote monitoring capability. ASI monitored the instrumentation for 3 months before handing over the remote monitoring to client. ASI was also involved in conducting CSL, PIT and Dynamic PDA testing on the bridge piles.

<u>The rehabilitation of MSE walls (OPP walls, Plant 85) at SUNCOR main plant, Fort McMurray, AB (2015)</u>

Dr. Salem and his engineering team designed three retaining walls, 16 m in height, to replace distressed MSE walls. The walls retain the fill platform accessed by heavy hauling trucks carrying ore to the crusher. The pre-design assessment included vibration monitoring at the heavily reinforced concrete slab forming the crusher approach. The objective of the monitoring was to estimate the dynamic forces acting on the walls as the 700-ton hauling trucks maneuver over the slab and impact the concrete barrier before unloading the ore. Also, as part of the design, the engineering team designed a permanent monitoring system to identify a rising water head at the base of the fill, which is an indication of drainage issues such as pooling water on top of the platform or clogging of the fill drainage system. The monitoring system consisted of a series of vibrating-wire piezometers embedded at the base of the fill behind the new retaining wall. The piezometers (17 per wall) were monitored in real-time via a network of spread-spectrum radio communication.

<u>Walterdale Bridge Foundatons, Edmonton, AB (2014)</u>

Dr. Salem and his engineering team designed four deep-excavation cofferdams along the North Saskatchewan riverbanks for building the foundation seats of the two arches carrying the bridge. The excavation to the underside of the abutment was about 18 m below the top of berm elevation. Dr. Salem designed and implemented an instrumentation and monitoring plan for each of the four bridge seats. The monitoring setup included in-place inclinometers between the existing bridge abutment and the excavated cofferdam, vibrating wire piezometers between the poured footing and the bedrock to monitor water pressure at the interface, and strain gages installed at strategic locations on the wales and struts to monitor the performance of the shoring system during the construction of the bearing blocks. The design team set up remote data collection monitored in real time and automated alarms to ensure secure access to the excavations. A combination of spread-spectrum radio and cellular communication was used to relay the live data to ASI, office remotely. The design team also consulted on the stability of clay berms and other geotechnical issues at this site. The design team also conducted vibration monitoring to establish PPV due to vibratory hammer operation on site and established safe distance of operation to freshly poured concrete.

Syncrude MLMR project site in Fort McMurray, AB (2013)

ASI was retained to perform vibration monitoring services at the Syncrude MLMR project site in Fort McMurray, AB. Vibration monitoring was carried out to record PPV due to drilling as a function of distance from drilling operations. The objective was to establish safe distance where newly cast piles would not be adversely affected by drilling operations nearby.

National Solid Waste Landfill, Greenland, Barbados (2002)

ASI was retained RJ Burnside to investigate slope movements as part of a peer review of the design of the Greenland National Solid Waste Landfill. Several strategic locations across the cut slopes were instrumented with in-place-inclinometers and vibrating-wire piezometers. The instrumentation was designed and implemented by Dr. Salem and remotely monitored for several years using landline telephone at the time.

**ASSOCIATE AND PROJECT ENGINEER | URKKADA TECHNOLOGY LTD. | DEC. 1994 - OCT. 1997**

Worked on foundation design and testing, embankment design, geotechnical instrumentation systems (design, installation, and monitoring), stability analysis, site investigation, laboratory testing, engineering research and development, and other engineering services. Following are select relevant projects:

River Road overpass over HWY 416 (MTO)

Dr. Salem designed and implemented a monitoring system consisting of electronic piezometers and settlement cells, inclinometers, and survey monuments. The monitoring system was intended to track the effect of placing a large embankment on thick clay deposit improved with vertical (wick) drains as an alternative to polystyrene light-weight fill.

New Berths 324 & 325 of the container wharf, Port of Los Angeles, California

Dr. Salem conducted an extended pile testing program involving complete monitoring of hexagonal prestressed concrete offshore test piles (28 in total). The piles were jetted through an existing thick layer of rockfill covering the footprint of the proposed berths then driven to a depth of about 30 m below mudline. The monitoring involved using the pile driving analyzer for observing the tensile stresses induced by pile driving and ensuring they do not exceed the tensile capacity of the pile section, as well as providing the developed resistance of the piles in short and long term, as well as calibrating against a fully instrumented static loading test on a similar pile on-shore.

**PROJECT ENGINEER | ANNA GEODYNAMICS INC. | DEC. 1992 - DEC. 1994**

Worked on foundation design and testing, geophysical survey, stability analysis, site investigation, rock mass stability investigation, laboratory testing, engineering research and development, and other engineering services

## Associations

- Association of Professional Engineers of Ontario
- Association of Professional Engineers of Québec
- Association of Professional Engineers of Alberta
- Association of Professional Engineers of British Columbia
- Association of Professional Engineers of Saskatchewan

- American Society of Civil Engineers (ASCE)
- Canadian Geotechnical Society
- Ottawa Geotechnical Group

## Publications

- Salem, H. "., & Rennie, C. D. (2020). Effect of pressure gradient on critical shear stress of cohesive soils. *Journal of Hydraulic Engineering*, *146*(6). https://doi.org/10.1061/(asce)hy.1943-7900.0001750
- Salem, H. (., & Rennie, C. D. (2017). Practical determination of critical shear stress in cohesive soils. *Journal of Hydraulic Engineering*, *143*(10). https://doi.org/10.1061/(asce)hy.1943-7900.0001363
- Noor, M.A., Metaferia, G.A, Salem, H. (2017, October). Correlation between concrete properties and sonic wave speed using non-destructive field testing procedures [Paper presentation]. Proceedings of the 70th Canadian Geotechnical Conference and the 12th Joint CGS/IAH-CNC Groundwater Conference held from October 2017 in Ottawa, Ontario, Canada.
- Salem, H., Fellenius, B.H. (2017, October). Bidirectional pile testing: what to expect [Paper presentation]. Proceedings of the 70th Canadian Geotechnical Conference and the 12th Joint CGS/IAH-CNC Groundwater Conference held from October 2017 in Ottawa, Ontario, Canada.
- Salem, H., Ghirian, A., Teplitsky, R. (2017, October). Effects of freeze-thaw cycles on earth pressure acting on shoring system [Paper presentation]. Proceedings of the 70th Canadian Geotechnical Conference and the 12th Joint CGS/IAH-CNC Groundwater Conference held from October 2017 in Ottawa, Ontario, Canada.
- Salem, H., Agharazi, F., Warith, M.A. (2002, October). CASE STUDY; DESIGN OF SOLID WASTE LANDFILL ON FLOOD PLANE FINE DEPOSITS [Paper presentation]. Proceedings of the 55th Canadian Geotechnical and 3rd Joint IAH-CNC and CGS Groundwater Specialty Conferences, Niagara Falls, Ontario, October 20-23, 2002.
- Salem, H., Garga, V.K. (1999, October). Nonlinear elastic modeling of pipeline in clay under high Ko [Paper presentation]. Proceedings of the 52nd Canadian Geotechnical Conference, October 1999, Regina, Saskatchewan, Canada.
- Salem, H., Lavergne, H., Fellenius, B.H. (1998, September). USING DYNAMIC PILE TESTING TO OVERCOME SURPRISING SOIL VARIATIONS [Paper presentation]. 33rdAnnual Conference on Deep Foundations, 11th International Conference on Piling and Deep Foundations, October 2008, New York, NY, USA.
- Salem, H., Warith, M.A. (1996, September). ESTIMATION OF LANDFILL SETTLEMENT USING A FINITE ELEMENT APPROACH [Paper presentation]. Proceedings of the 49th Canadian Geotechnical Conference, October 1996, Ottawa, Ontario, Canada.

# Mudasser Noor, B.A.Sc., P.Eng.

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## Synopsis

Mr. Mudasser Noor, P. Eng., is a Senior Geotechnical Engineer at Scientific Applied Concepts Limited (SACL) since 2020. Mr. Noor has extensive knowledge and specialized experience in foundations including grouting, shoring and retaining structures, slope stabilization, and testing and analysis of deep foundations over hundreds of construction projects across North America and overseas. He had major contributions in high profile projects such as the stabilization of the 99 Street landslide in Peace River, AB, the rehabilitation of MSE walls (OPP walls, Plant 85) at Suncor Energy main plant, Fort McMurray, Walterdale Bridge foundations, Edmonton, Utilities & Farm tank at Kearl Lake, Fort McMurray, and many others. Mr. Noor has extensive specialized experience in designing and implementing automated instrumentation and datalogging, vibration and sound monitoring, special load testing setups, high-capacity reaction frames, and high-precision measurement systems. Mr. Noor has been involved in conducting dozens of static loading (Static) and bidirectional static loading test (BDSLT), hundreds of pile integrity test (PIT), cross-hole sonic logging (CSL) test, dynamic testing analysis (PDA), and thermal integrity profiling (TIP) tests. Mr. Noor has managed, and field supervised many projects involving anchor installation with gravity grouting methods as well as pressure grouting methods.

## Education

**BACCALAUREATE IN APPLIED SCIENCES IN CIVIL ENGINEERING | 2011 | UNIVERSITY OF OTTAWA**

Mr. Noor completed his Bachelors' with Magna Cum Laude from the University of Ottawa. His specialization was in the field of Geotech. Mr. Noor's final year project consisted of proposing a state-of-the-art facility in the National Capital Region of Canada. Planning and developing a Multi-Sport City for Olympic purposes. Mr. Noor's team created pleasing architectural views and CAD drawings along with final animated views. It also involved in evaluation and analyzing financial aspects of the project i.e. cost evaluation during construction, post-construction costs etc. It also involved in simulating evacuation plans and budgets according to the proposed by-laws, city, provincial and federal regulations. The team also helped design the main stadium with fully functioning retractable roof in accordance with National Building Code of Canada. Designing of roof system, stadium stands and various beams and columns. Also designing for the new roadway system in and around the city considering potential traffic flow for an Olympic city in the National Capital Region. Mr. Noor's team received many accolades for the final year project.

- "Best Overall Engineering Project" [2011] - Faculty of Engineering University of Ottawa.
- Professional Engineers Ontario 2011– Student Paper Night Winner- University of Ottawa
- Professional Engineers Ontario 2011– Student Paper Night "Best Technical and Innovation Paper" Award
- Canadian Society for Civil Engineering Conference 2011 – Undergraduate Poster Competition: 2nd Position

Mr. Noor was also involved in volunteering his time and provide assistance to a PhD candidate at the University of Ottawa during his undergraduate studies.

**MASTER'S IN APPLIED SCIENCES IN CIVIL ENGINEERING | ONGOING | CARLETON UNIVERISTY**

Mr. Noor is currently enrolled in the master's program at the Carleton University in Ottawa, ON. His proposed research is in the field of Geotechnical Engineering specifically around the Expander Body Technology. The Expander Body (EB) technology was initially developed in Sweden during the 1980's by Mr. Bo Skoberg and later evolved by Mr. Mario H Terceros in Bolivia. The EB consists of a folded steel "balloon" that is installed at the tip of a deep foundation element (pile) or a tieback. Once installed in a bored pile, the device is injected with grout, producing an expanded element. The EB technology has been used successfully to increase the pile toe capacity of bored piles in different soil conditions. The expansion process compacts the surrounding soil to its critical state density, and increases the toe size, thereby increasing the resistance of the pile. While the EB technology has been used extensively in many projects, the exploration of its full effects and potential is still in its infancy. Mr. Noor's research is to better understand the effects of EB inflation (pressure and compaction) on the surrounding soil including the extent of its influence, long-term performance, potential benefits, etc. The study will look at the induced soil movements, deformations, generation, and dissipation of excess pore-water pressures at various distances from the installed device. Other non-destructive tests such as dynamic pile loading test with the Pile Driving Analyzer (PDA), low pulse echo test using the Pile Integrity Tester (PIT), and thermal integrity profiling (TIP) shall be conducted.

## Experience

**GEOTECHNICAL ENGINEER | AATECH SCIENTIFIC INC. | 2011-2020**

**SENIOR GEOTECHNICAL ENGINEER | SCIENTIFIC APPLIED CONCEPTS LTD. |2020-PRESENT**

- Mr. Noor has worked on a multitude of company projects in the fields of foundation design and analysis, geotechnical instrumentation systems (design, installation, and monitoring), slope stability analysis, subsurface investigations, laboratory testing, and other engineering services. Mr. Noor has also undertaken the management and coordination of several projects across North America and overseas. The vast span and diversity of AATech's/SACL's projects has provided Mr. Noor with a rich experience in foundation behavior in a multitude of soil conditions. Mr. Noor is highly experienced in performing non-destructive test on deep foundations and has been involved in over hundreds of tests across North America & overseas. Mr. Noor has also been involved in design of tiebacks/anchor and shoring systems. Mr. Noor has been involved in conducting dozens of static loadings (Static) and bidirectional static loading test (BDSLT), hundreds of pile integrity test (PIT), cross-hole sonic logging (CSL) test, dynamic testing analysis (PDA), and thermal integrity profiling (TIP) tests. Managed, and field supervised many projects involving anchor installation with gravity grouting methods as well as pressure grouting methods. Mr. Noor has also been involved in research activities and has conference papers published.
- Mr. Noor has had major contributions in the field of geotechnical design, instrumentation and advanced deep foundation testing at AATech/SACL. A few projects have been listed below of the vast experience in Mr. Noor has in the field of geotechnical design and testing.

  - **<u>Patullo Bridge, Fraser River Crossing Constructors Group, Vancouver, BC – 2022</u>**

  SACL Engineers are providing ongoing consulting and design work for many segments of the bridge project including the design of shoring, working platforms, controlled settlement of existing infrastructure during pile driving and ground densification. Our mandate includes predicting settlement and distress to roadways, overpasses, and buried infrastructure based on settlement and vibration monitoring plans designed by SACL. SACL Engineers are also conducting thermal integrity and CSL testing on bridge piles.

  - **<u>Athabasca River Bridge, Construction Drilling, Norland Group, Athabasca, AB – 2022</u>**

  The Athabasca River bridge is an on-going project where SACL has been retained in the design of a temporary cofferdam at the Highway 813 Athabasca River Bridge. The proposed project consists of designing a temporary cofferdam system to maintain a differential grade of about 8.0m within the Pier footprints. The project also consists of SACL conducting CSL tests across the entire project.

  - **<u>Grand River Bridge, Hwy 401, Waterloo, ON – Bauer Foundations – 2021</u>**

  SACL was retained to conduct bidirectional static loading test on a test pile at the Grand River Bridge near Waterloo. The test consisted of instrumentation of the test pile with strain gages, telltales, extensometers, bidirectional cell as well as inclinometer casings. SACL instrumented the pile with six levels of four strain gauges diametrically opposed pairs per level along with two extensometers between the upper and lower plates of the bidirectional cell. Two pairs of telltale rods were also instrumented to reflect upper plate and pile toe movement during the test. SACL also performed the lateral loading test on the same test pile after the bidirectional static loading test was performed. The lateral loading test consisted of placement of in-place inclinometers in the test pile to record the lateral movement of the pile during loading. The loading was implemented using calibrated hydraulic double-acting jacks by SACL. The loading was measured using a load cell and verified using a calibrated pressure meter. The inclinometer was read during the loading test as well as 5-days after the test was concluded. The inclinometer data showed a close agreement with the estimated movements predicted by SACL.

- **Muskrat Creek Instrumentation - MTO, Renfrew County, Cobden, ON – WOOD PLC – 2021**

SACL was retained to install multi point borehole extensometer at the Muskrat Creek Culvert replacement project. The scope involved the installation of the multi point borehole extensometer and layout of extensometer wires to data housing about 8 m away. Installation notes and initial data was submitted to the client as part of the scope.

- **Highway 27 bridge over the Athabasca River near Morin, AB - 2017**

ASI designed and implemented an instrumentation and monitoring plan in addition to piling inspection at the site of Highway 27 bridge. ASI Engineers installed slope inclinometer casings in newly cast bridge piles, vibrating wire piezometers and settlement cells around the abutment site with remote monitoring capability. ASI monitored the instrumentation for 3 months before handing over the remote monitoring to client. ASI was also involved in conducting CSL, PIT and Dynamic PDA testing on the bridge piles.

- **99th Street Peace River Retaining Walls, Mastec Canada – Peace River, AB –2018**

The Engineering team at ASI headed by Dr. Salem, designed a new stable profile of the slope, west of 99 Street. The slope had exhibited a large-scale slip failure endangering a residential building on the east side of 99 Street and as well as 98 Street and existing cycle shop at the toe of the slope. The mitigation included the design of dual secant pile walls to produce a stable profile. The upper stabilizing wall was secured by three rows of deep tiebacks. While overseeing the construction, the design team implemented a substantial instrumentation program to monitor the performance of the retaining walls and the stability of the slope. The instrumentation included series of strain gages embedded in selected secant piles (to monitor bending strains), inclinometer casings embedded in other secant piles for manual monitoring (pile flexure), and vibrating-wire load cells installed on selected tieback rods (three per row) to monitor the tension in the tieback rods. The design team routed all instrumentation in electrical conduits to a central logging system and collected the background readings before handing over the monitoring to City representatives. We believe the instrumentation is still in operation to date and being monitored by the City of Peace River.

- Crusher Area Walls Suncor Energy, Pacer Foundations – Fort McMurray, AB – February 2016
- **Walterdale Bridge, Pacer Foundations, - Edmonton, AB – 2014**

The project involved in the design of four cofferdams along the North Saskatchewan riverbanks for bridge abutments construction. The excavation to the underside of the abutment was about 18m below the top of berm elevation. Our involvement was monitoring the construction and excavation of the cofferdams. We instrumented the walers at strategic locations with strain gages and setup remote data collection monitored in real time and automated alarms to ensure secure access to the excavations. ASI also consulted on the stability of clay berms and other geotechnical issues at this site including but not limited to pile driving, PDA testing, slope stabilization issues etc. We also conducted vibration monitoring to establish PPV due to vibratory hammer operation on site and established safe distance of operation from newly cast piles.

- **Botanica Buildings, Red Deer Piling, Edmonton, AB –2014**

ASI was involved in the temporary shoring design and deep foundation design of the Botanica buildings in Edmonton. ASI was involved in carrying out Dynamic testing, inspection of deep foundation construction and sign-off on the design and construction of the deep foundation elements at this site. The project also involved in ASI designing and implementation of a vibration and noise study during the construction of the deep foundations (driven piles). The objective was to install equipment to measure and collect noise and vibration levels at the subject project site within and adjacent to the construction site, including buildings or structures, that may potentially be impacted by noise and vibrations emanating from construction activities where the noise (measured in dBA) and vibrations (measured in peak particle velocity) may exceed the prescribed limits set by municipal bylaws and industry standards.

- **Suncor Energy Rehabilitation of MSE Walls (OPP A, B & C), Mastec– Fort McMurray, AB –2015**

ASI team designed three retaining walls, 16 m in height, to replace distressed MSE walls. The walls retain the fill platform accessed by heavy hauling trucks carrying ore to the crusher. The pre-design assessment included vibration monitoring at the heavily reinforced concrete slab forming the crusher approach. The objective of the monitoring was to estimate the dynamic forces acting on the walls as the 700-ton hauling trucks maneuver over the slab and impact the concrete barrier before unloading the ore. Also, as part of the design, the engineering team designed a permanent monitoring system to identify a rising water head at the base of the fill, which is an indication of drainage issues such as pooling water on top of the platform or clogging of the fill drainage system. The monitoring system consisted of a series of vibrating-wire piezometers embedded at the base of the fill behind the new retaining wall. The piezometers (17 per wall) were monitored in real-time via a network of spread-spectrum radio communication.

- **Vibration Monitoring Program - Syncrude, NACG – Fort McMurray, AB –2012**

ASI was retained to perform vibration monitoring services at the Syncrude MLMR project site in Fort McMurray, AB. Vibration monitoring was carried out to record peak particle velocity due to drilling as a function of distance from drilling operations. The objective was to establish safe distance where newly cast piles would not be adversely affected by drilling operations nearby. A test plan with different shaft sizes were monitored during this study and sensors were placed at various distances as a function of diameter. Once the test program was completed, results of the study were provided to the client establishing the safe distances where pile construction could be completed without having an adverse effect on newly cast piles.

## Software & Technical Environment

1. SAP2000 - Extensive knowledge in analyzing various structural elements using the software
2. AutoCAD & Draft Sight (Dassault Systems) - Advance level of utilizing software options and created plan views of structures
3. RS Means Cost Works- Widely used in cost estimation of various projects
4. ArcGIS - Used software for analyzing flood flow levels and other hydrological purposes
5. GeoStudio 2007- Widely used in analyzing slopes by finite element method (Bishop, Janbu etc)
6. MS-Office Suite – Excel, Word, PowerPoint, Project, Outlook, etc.
7. Adobe Acrobat Professional & NitroPDF
8. GRLWEAP – GRL Engineers Software for analyzing hammer requirements, and dynamic analysis of piles.
9. CAPWAP2006, 2014 – Pile Dynamics Software for analyzing pile capacities using dynamic data
10. CHA2015– Pile Dynamics Software for analyzing cross-hole sonic data
11. PIT2009 – Pile Dynamics Software for analyzing integrity of piles using low-echo sonic data
12. TIP – Thermal Integrity Profiler for analyzing integrity of piles using thermal data
13. Ensoft – LPile (lateral capacity of piles) and PYWall (retaining wall design)
14. UniPile – Design of piles and pile groups using CPT, CPTu data, and theoretical analysis of pile capacities and simulation of load-movement (by choosing appropriate t-z and q-z functions) response of a test pile in bidirectional test
15. GSlope (Mitre Software) – Carry out limit-equilibrium slope stability analysis of existing natural slopes

## Associations

1. Association of Professional Engineers Ontario
2. Association of Professional Engineers & Geoscientists of Alberta

3. Association of Professional Engineers British Columbia
4. Canadian Geotechnical Society
5. Deep Foundation Institute
6. Ottawa Geotechnical Group
7. Golden Key International Honor Society
8. University of Ottawa Alumni Association

## Publications

- Noor, M.A., Metaferia, G.A, Salem, H. (2017, October). Correlation between concrete properties and sonic wave speed using non-destructive field testing procedures [Paper presentation]. Proceedings of the 70th Canadian Geotechnical Conference and the 12th Joint CGS/IAH-CNC Groundwater Conference held from October 2017 in Ottawa, Ontario, Canada.

# Richard Hérard, M.A.Sc., P.Eng.

46 Bain Avenue, Cache Bay, ON P0H 1G0 | 1-705-840-6807 | richard@saclcanada.com

## Synopsis

Mr. Richard Hérard, is a Professional Engineer at Scientific Applied Concepts Ltd. (SACL) since 2020. Mr. Hérard has extensive knowledge and training experience in testing and analysis of deep foundations over dozens of construction projects across Canada. He had major contributions in high profile projects such as the Metrolinx Project, Toronto, Highway 29, Fort St. John, Ottawa LRT, and many others. Mr. Hérard has extensive specialized experience in conducting bi-directional test (BD), dozens of pile integrity test (PIT), cross-hole sonic logging (CSL) test, dynamic testing analysis (PDA), and thermal integrity profiling (TIP) tests.

## Education

**BACCALAUREATE OF APPLIED SCIENCES IN CIVIL ENGINEERING | 2018 | UNIVERSITY OF OTTAWA**

**MASTER OF APPLIED SCIENCES IN CIVIL ENGINEERING | 2023 | UNIVERSITY OF OTTAWA**

## Experience

**GEOTECHNICAL ENGINEER | SCIENTIFIC APPLIED CONCEPTS LTD. | 2020-PRESENT**

- Mr. Hérard has worked on various projects in the field of deep foundation testing. Working on projects across the country, Mr. Hérard tests multiple foundations a week with various non-destructive methods proficiently. Being a problem solver by nature, he optimises his process with every site while providing the most professional service and collaborating with the client. Doing the testing at such a high rate, he has mastered multiple testing methods far exceeding contractual minimum requirements. A selected list of past project experience in this field has been listed below:

  1. Montreal REM Light Rail – NouvLR
  2. Kingston 3rd Crossing Bridge – Bauer Foundation
  3. Toronto Cherry Street Bridge – GFL Infrastructure
  4. Toronto Commissioner Street Bridge – GFL Infrastructure
  5. Metrolinx Davenport Project – Graham
  6. Vancouver Centrum Port – Henry Drilling
  7. Burnaby Terminal – KLTP
  8. Fort Saint John Highway 29 – Henry Drilling, Formula Construction, Construction Drilling
  9. Ottawa LRT – HCM

## Associations

1. Association of Professional Engineers Ontario

| Previous experience for Bidirectional Loading Test (Selected List) - SACL Engineers | | | | |
|---|---|---|---|---|
| **Year Awarded** | **Location** | **Owner** | **Client** | **Max. Specified Load** |
| 2015 | Waterloo, ON | City of Waterloo | Deep Foundations Inc. | 22MN |
| 2016 | Calgary, AB | Western Securities Ltd. | EXP Services Inc. | 5MN |
| 2016 | Calgary, AB | City of Calgary | KGL/Thurber | 18MN |
| 2016 | Calgary, AB | City of Calgary | KGL/EXP Services Inc. | 30MN |
| 2017 | Calgary, AB | City of Calgary | KGL/Golder Associates | 12MN |
| 2017 | Edmonton, AB | Kinder Morgan | Mastec Canada Construction Inc. | 4MN |
| 2018 | Edmonton, AB | Edmonton Lab Hub | Shelby Engineering | 2MN |
| 2019 | Calgary, AB | Auburn Bay Elementary School | Red Deer Piling | 4MN |
| 2019 | Calgary, AB | Skypointe Estates | Red Deer Piling | 4MN |
| 2020 | Fort St. John, BC | Ministry of Transportation & Infrastructure BC & BC Hydro | Construction Drilling Inc. | 50MN |
| 2020 | Fort St. John, BC | Ministry of Transportation & Infrastructure BC & BC Hydro | Construction Drilling Inc. | 50MN |
| 2020 | Fort St. John, BC | Minisrty of Transportation & Infrastructure BC & BC Hydro | Construction Drilling Inc. | 50MN |
| 2020 | Fort McMurray, AB | Suncor Energy | TR-Ledcor Partnership | 8MN |
| 2020 | Fort McMurray, AB | Suncor Energy | TR-Ledcor Partnership | 8MN |
| 2020 | Fort McMurray, AB | Suncor Energy | TR-Ledcor Partnership | 8MN |
| 2020 | Fort McMurray, AB | Suncor Energy | TR-Ledcor Partnership | 8MN |
| 2020 | Fort McMurray, AB | Suncor Energy | TR-Ledcor Partnership | 8MN |
| 2020 | San Juan, PR | Puerto Rico 181 Bridge, PRHTA | GMTS | 4MN |
| 2020 | Fort St. John, BC | Ministry of Transportation & Infrastructure BC & BC Hydro | Construction Drilling Inc. | 52MN |
| 2021 | Fort St. John, BC | Ministry of Transportation & Infrastructure BC & BC Hydro | Construction Drilling Inc. | 52MN |
| 2021 | Fort St. John, BC | Ministry of Transportation & Infrastructure BC & BC Hydro | Henry Foundation Drilling Inc. | 50MN |
| 2021 | Fort St. John, BC | Ministry of Transportation & Infrastructure BC & BC Hydro | Henry Foundation Drilling Inc. | 50MN |
| 06 - 2021 | Calgary, AB | ElisDon | Red Deer Piling | 4MN |
| 04 - 2021 | Waterloo, ON | Ministry of Transportation Ontario | Bauer Foundations (Eastern) Canada | 48MN |
| 06 - 2023 | St.Catherines, ON | Ministry of Transportation Ontario | HC Matcon | 40MN |
| 06 - 2023 | St.Catherines, ON | Ministry of Transportation Ontario | HC Matcon | 40MN |
| 07 - 2023 | San Juan, PR | La Puntilla Building, San Juan | Cimientos/MRD Drilling | 4MN |
| 07 - 2023 | San Juan, PR | La Puntilla Building, San Juan | Cimientos/MRD Drilling | 4MN |
| 06 - 2024 | Ottawa, ON | Lady Grey Drive | HC Matcon | 4MN |
| 06 - 2024 | Edmonton, AB | Alta Steel Craneway | Midwest Caissons | 2MN |
| Ongoing | Langley, BC | Surrey Langley Skytrain | Henry Foundation Drilling Inc. | 32MN |
| Ongoing | Langley, BC | Surrey Langley Skytrain | Henry Foundation Drilling Inc. | 32MN |
| Ongoing | Langley, BC | Surrey Langley Skytrain | Henry Foundation Drilling Inc. | 32MN |
| Ongoing | Langley, BC | Surrey Langley Skytrain | Henry Foundation Drilling Inc. | 48MN |

| Previous Experience (Selected List) for Static Loading Test - SACL Engineers | | | | |
|---|---|---|---|---|
| **Year** | **Location** | **Owner** | **Client** | **Type of Test** |
| 1999 | Washington, DC | Modern Continental | Compression | ASTM D1143-07 |
| 1999 | Washington, DC | Modern Continental | Tension | ASTM D3689-07 |
| 1999 | Washington, DC | Modern Continental | Compression | ASTM D1143-07 |
| 1999 | Washington, DC | Modern Continental | Tension | ASTM D3689-07 |
| 1999 | Washington, DC | Modern Continental | Compression | ASTM D1143-07 |
| 1999 | Washington, DC | Modern Continental | Tension | ASTM D3689-07 |
| 2000 | Washington, DC | Modern Continental | Compression | ASTM D1143-07 |
| 2000 | Washington, DC | Modern Continental | Compression | ASTM D1143-07 |
| 2000 | Washington, DC | Modern Continental | Compression | ASTM D1143-07 |
| 2000 | Washington, DC | Modern Continental | Tension | ASTM D3689-07 |
| 2000 | Washington, DC | Modern Continental | Tension | ASTM D3689-07 |
| 2000 | Washington, DC | Modern Continental | Compression | ASTM D1143-07 |
| 2000 | Washington, DC | Modern Continental | Compression | ASTM D1143-07 |
| 2000 | Washington, DC | Modern Continental | Compression | ASTM D1143-07 |
| 2000 | Washington, DC | Modern Continental | Compression | ASTM D1143-07 |
| 2000 | Pennsylvania, DC | HRI | Compression | ASTM D1143-07 |
| 2000 | Pennsylvania, DC | HRI | Compression | ASTM D1143-07 |
| .... | .... | .... | .... | |
| .... | .... | .... | .... | |
| .... | .... | .... | .... | |
| .... | .... | .... | .... | |
| 2010 | Fort McKay, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2010 | Fort McKay, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2011 | Conklin, AB | Red Deer Piling Inc. | Compression | ASTM D1143-07 |
| 2011 | Conklin, AB | Red Deer Piling Inc. | Compression | ASTM D1143-07 |
| 2011 | Edmonton, AB | NACG | Compression | ASTM D1143-07 |
| 2011 | Cold Lake, AB | Red Deer Piling Inc. | Compression | ASTM D1143-07 |
| 2011 | Cold Lake, AB | Red Deer Piling Inc. | Tensile | ASTM D3689-07 |
| 2011 | Cold Lake, AB | Red Deer Piling Inc. | Lateral | ASTM D3966-07 |
| 2011 | Cold Lake, AB | Red Deer Piling Inc. | Compression | ASTM D1143-07 |
| 2011 | Cold Lake, AB | Red Deer Piling Inc. | Tensile | ASTM D3689-07 |
| 2011 | Cold Lake, AB | Red Deer Piling Inc. | Lateral | ASTM D3966-07 |
| 2012 | Logan Lake, BC | NACG | Lateral | ASTM D3966-07 |
| 2012 | Logan Lake, BC | NACG | Lateral | ASTM D3966-07 |
| 2012 | Logan Lake, BC | NACG | Lateral | ASTM D3966-07 |
| 2012 | Edmonton, AB | NACG | Compression | ASTM D1143-07 |
| 2012 | Edmonton, AB | Double Star Drilling | Compression | ASTM D1143-07 |
| 2012 | Fort McKay, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2012 | Fort McKay, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2012 | Fort McKay, AB | Pacer Foundation Corporation | Lateral | ASTM D3966-07 |
| 2012 | Saint Nicolas, QB | Pomerleau | Lateral | ASTM D3966-07 |
| 2012 | Fort McMurray, AB | BAUER Foundations Canada Inc. | Compression | ASTM D1143-07 |
| 2012 | Fort McMurray, AB | BAUER Foundations Canada Inc. | Compression | ASTM D1143-07 |
| 2012 | Kitamat, BC | NACG | Lateral | ASTM D3966-07 |
| 2012 | Kitamat, BC | NACG | Lateral | ASTM D3966-07 |
| 2013 | Santa Cruz, Bolivia | INCOTEC | Compression | ASTM D1143-07 |
| 2013 | Santa Cruz, Bolivia | INCOTEC | Compression | ASTM D1143-07 |
| 2013 | Santa Cruz, Bolivia | INCOTEC | Compression | ASTM D1143-07 |
| 2013 | Santa Cruz, Bolivia | INCOTEC | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Edmonton, AB | Double Star Drilling | Compression | ASTM D1143-07 |
| 2013 | Edmonton, AB | Double Star Drilling | Compression | ASTM D1143-07 |
| 2013 | Edmonton, AB | Double Star Drilling | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | North American Constructors Ltd. | Compression | ASTM D1143-07 |

**Previous Experience (Selected List) for Static Loading Test - SACL Engineers**

| | | | | |
|---|---|---|---|---|
| 2013 | Fort McMurray, AB | North American Constructors Ltd. | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | North American Constructors Ltd. | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Tensile | ASTM D3689-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Tensile | ASTM D3689-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Lateral | ASTM D3966-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Lateral | ASTM D3966-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Tensile | ASTM D3689-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Tensile | ASTM D3689-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Lateral | ASTM D3966-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Lateral | ASTM D3966-07 |
| 2013 | Conklin, AB | Red Deer Piling Inc. | Compression | ASTM D1143-07 |
| 2013 | Conklin, AB | Red Deer Piling Inc. | Tensile | ASTM D3689-07 |
| 2013 | Conklin, AB | Red Deer Piling Inc. | Compression | ASTM D1143-07 |
| 2013 | Conklin, AB | Red Deer Piling Inc. | Tensile | ASTM D3689-07 |
| 2013 | Conklin, AB | Red Deer Piling Inc. | Compression | ASTM D1143-07 |
| 2013 | Conklin, AB | Red Deer Piling Inc. | Tensile | ASTM D3689-07 |
| 2013 | Conklin, AB | Red Deer Piling Inc. | Compression | ASTM D1143-07 |
| 2013 | Conklin, AB | Red Deer Piling Inc. | Tensile | ASTM D3689-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2013 | Fort McMurray, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2013 | Saskatoon, SK | Keller Foundations | Compression | ASTM D1143-07 |
| 2013 | Saskatoon, SK | Keller Foundations | Compression | ASTM D1143-07 |
| 2014 | Acheson, AB | Shelby Engineering Ltd. | Compression | ASTM D1143-07 |
| 2014 | Edmonton, AB | Shelby Engineering Ltd. | Compression | ASTM D1143-07 |
| 2014 | Edmonton, AB | Shelby Engineering Ltd. | Compression | ASTM D1143-07 |
| 2014 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2014 | Fort McMurray, AB | Keller Foundations | Compression | ASTM D1143-07 |
| 2014 | Colonsay, SK | Keller Foundations | Compression | ASTM D1143-07 |
| 2014 | Spruce Grove, AB | Shelby Engineering Ltd. | Compression | ASTM D1143-07 |
| 2014 | Fort McMurray, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2014 | Fort McMurray, AB | Pacer Foundation Corporation | Lateral | ASTM D3966-07 |
| 2015 | Prince Rupert, BC | Fraser River Piling & Dredge | Compression | ASTM D1143-07 |
| 2015 | Prince Rupert, BC | Fraser River Piling & Dredge | Compression | ASTM D1143-07 |
| 2015 | Gillam, MB | Pacer Foundation Corporation | Tensile | ASTM D3689-07 |
| 2015 | Gillam, MB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2015 | Gillam, MB | Pacer Foundation Corporation | Lateral | ASTM D3966-07 |
| 2015 | Gillam, MB | Pacer Foundation Corporation | Tensile | ASTM D3689-07 |
| 2015 | Gillam, MB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2015 | Gillam, MB | Pacer Foundation Corporation | Lateral | ASTM D3966-07 |
| 2015 | Fort McMurray, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2015 | Fort McMurray, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |

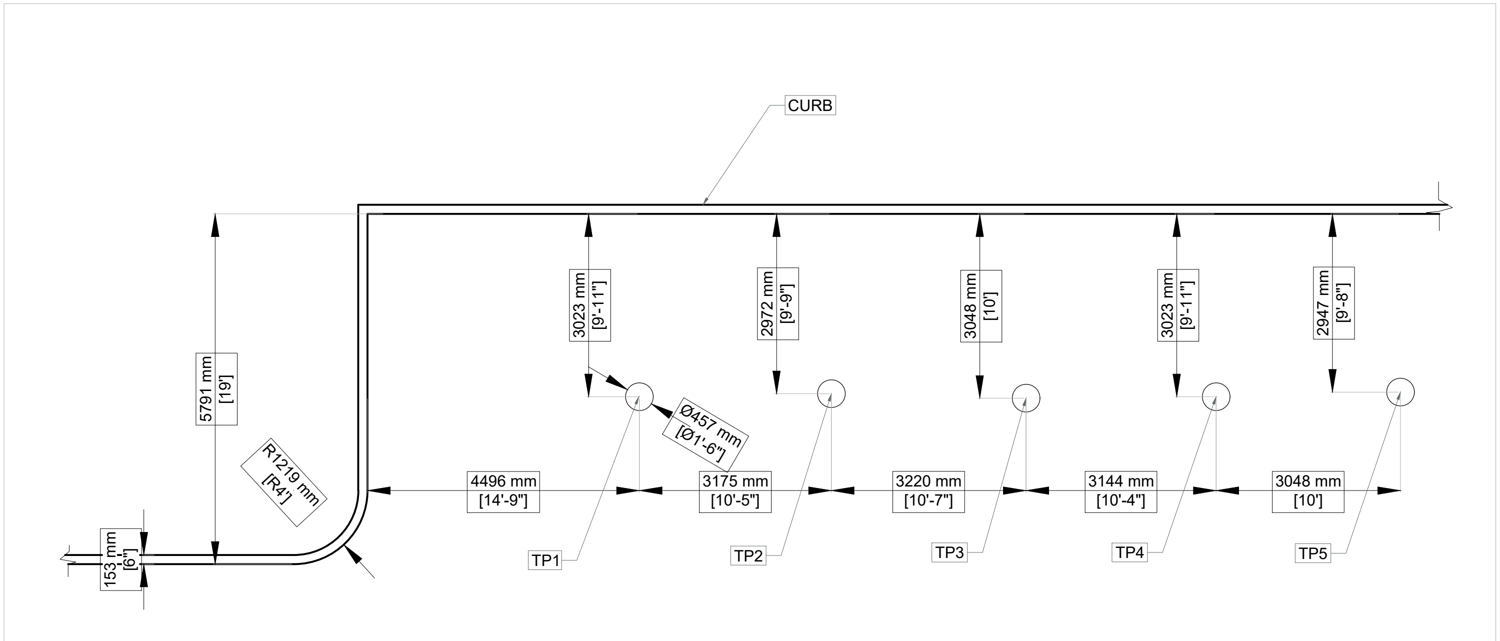
**Previous Experience (Selected List) for Static Loading Test - SACL Engineers**

| | | | | |
|---|---|---|---|---|
| 2016 | Fort McMurray, AB | Pacer Foundation Corporation | Compression | ASTM D1143-07 |
| 2016 | Edmonton, AB | AMEC Foster Wheeler | Compression | ASTM D1143-07 |
| 2016 | Edmonton, AB | AMEC Foster Wheeler | Compression | ASTM D1143-07 |
| 2016 | Edmonton, AB | AMEC Foster Wheeler | Compression | ASTM D1143-07 |
| 2016 | Keewatinohk, MB | Pacer Foundation Corporarion | Tensile | ASTM D3689-07 |
| 2017 | St. Georges, Bermuda | AECON | Compression | ASTM D1143-07 |
| 2017 | St. Georges, Bermuda | AECON | Tensile | ASTM D3689-07 |
| 2017 | St. Georges, Bermuda | AECON | Compression | ASTM D1143-07 |
| 2017 | St. Georges, Bermuda | AECON | Tensile | ASTM D3689-07 |
| 2018 | Bainsville Hwy 401, ON | Dufresne Piling | Compression | ASTM D1143-07 |
| 2018 | Bainsville Hwy 401, ON | Dufresne Piling | Lateral | ASTM D3966-07 |
| 2018 | Bainsville Hwy 401, ON | Dufresne Piling | Lateral | ASTM D3966-07 |
| 2019 | Ottawa, ON | Bing Fing Li Engineering | Compression | ASTM D1143-07 |
| 2019 | Ottawa, ON | Bing Fing Li Engineering | Compression | ASTM D1143-07 |
| 2021 | Waterloo, ON | BAUER Foundations Canada Inc. | Lateral | ASTM D3966-07 |
| 2021 | Ottawa, ON | Tomlinson Group/Dufresne Piling - Expander Body International | Tensile | ASTM D3689-07 |
| 2022 | Ottawa, ON | Marathon Underground/Kiewet Infrastructure - Expander Body International | Tensile | ASTM D3689-07 |
| 2022 | Ottawa, ON | Marathon Underground/Kiewet Infrastructure - Expander Body International | Tensile | ASTM D3689-07 |
| 2023 | Edmonton, AB | AECON Foundations | Compression | ASTM D1143-20 |
| 2023 | Edmonton, AB | AECON Foundations | Compression | ASTM D1143-20 |
| 2023 | Edmonton, AB | AECON Foundations | Compression | ASTM D1143-20 |
| 2023 | Edmonton, AB | AECON Foundations | Compression | ASTM D1143-20 |
| 2023 | Edmonton, AB | AECON Foundations | Compression | ASTM D1143-20 |
| 2023 | St. Catherines, ON | HC Matcon - Ministry of Transportation ON | Compression | ASTM D1143-20 |
| 2023 | St. Catherines, ON | HC Matcon - Ministry of Transportation ON | Compression | ASTM D1143-20 |
| 2023 | Prince Rupert, BC | Pacific Piling & Marine Contractors - Advisian | Tensile | ASTM D3689-20 |
| 2023 | Prince Rupert, BC | Pacific Piling & Marine Contractors - Advisian | Tensile | ASTM D3689-20 |
| 2024 | Sudbury, ON | PRECO-MSE | Compression | ASTM D1143-20 |
| 2024 | Sudbury, ON | PRECO-MSE | Tensile | ASTM D3689-20 |
| 2024 | Ottawa, ON | PRECO-MSE | Tensile | ASTM D3689-20 |

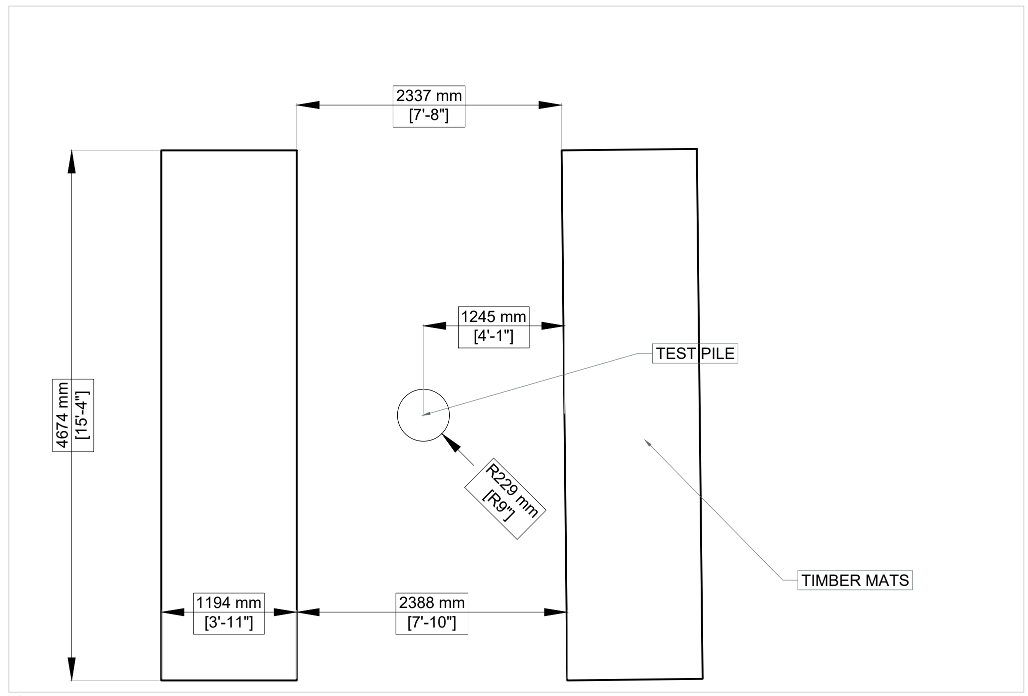
# Appendix 2

## Test pile instrumentation drawings and as-builts

Layout of installed test piles and a typical layout of the test pile with the kentledge system




A BD1D PLAN VIEW OF TEST PILES




B BD1D TYPICAL TESTING LAYOUT


DIMENSIONS ON PLANS ARE APPROXIMATE AND BASED ON INFORMATION PROVDED BY CLIENT. SHOULD ANY DIMENSIONS DIFFER, DESIGN ENGINEER MUST BE NOTIFIED IMMEDIATELY FOR RE-ASSESSMENT.

STAMP

STAMP

PERMIT TO PRACTICE

| REV. | DATE | REVISION | BY |
|---|---|---|---|
| 0 | 2025-03-04 | ISSUED FOR REVIEW | M.N |
| 1 | 2025-05-05 | AS-BUILT | R.H. |

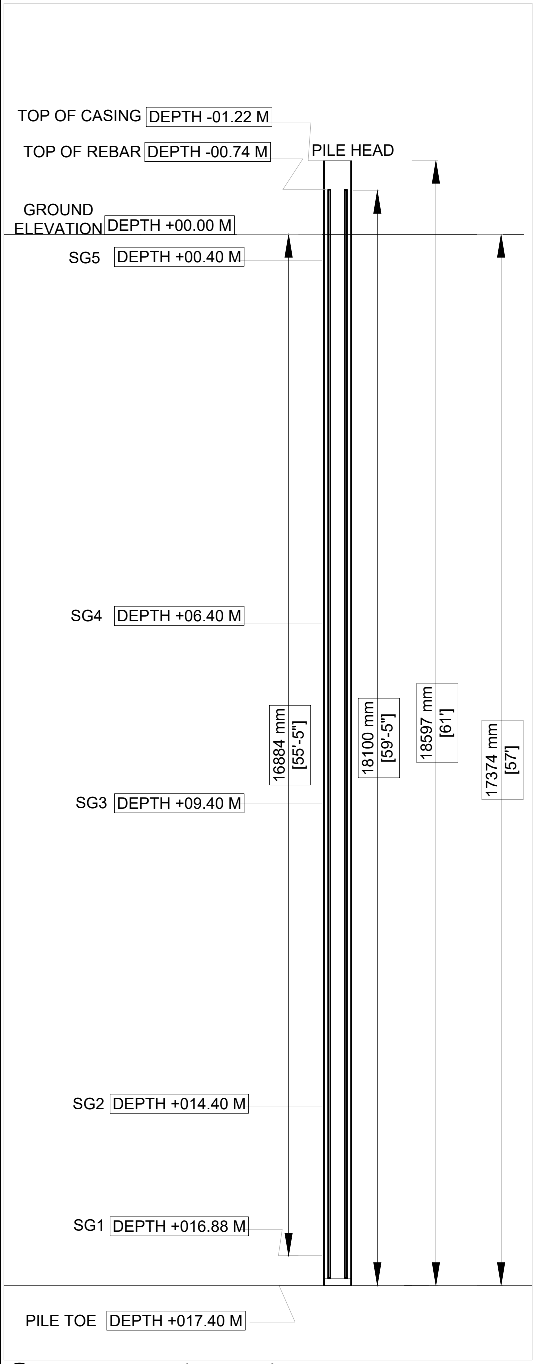
CLIENT
TLG.
100 – 7th Ave SW, P.O.Box, Attalla, AL 35954 USA

PROJECT
TSFP, MOBILE, ALABAMA

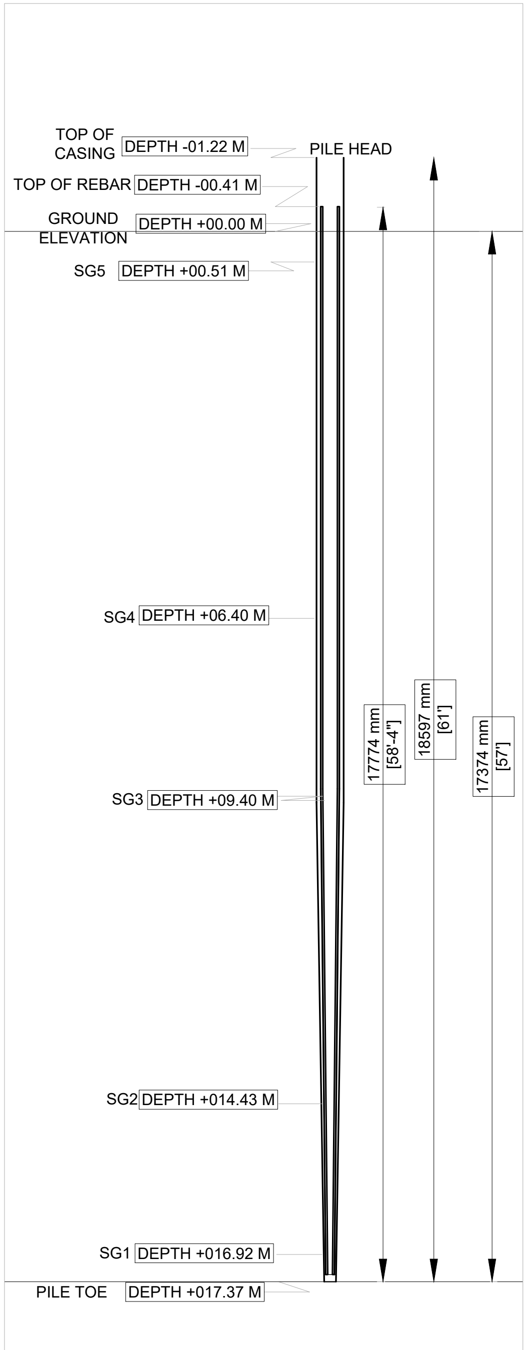
TITLE
AS BUILT SETUP

SCIENTIFIC APPLIED CONCEPTS LTD
5360 CANOTEK ROAD, UNIT #5, GLOUCESTER, ON K1J9E3
807-700-7225
WWW.SACLCANADA.COM | INFO@SACLCANADA.COM
SACL

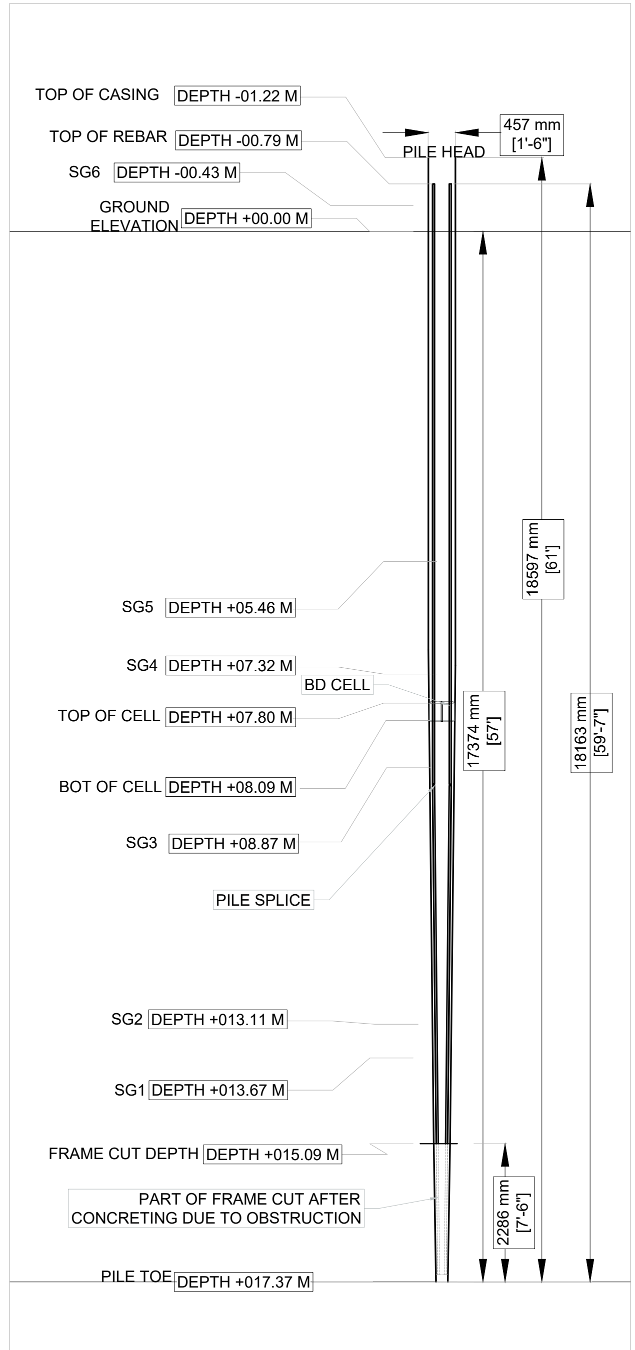
| | | | |
|---|---|---|---|
| DESIGNED BY | R.H. | DRAWING NO. | bd1d |
| | M.N. | SCALE: | |
| DRAWN BY | D.A. | DATE: 5 MAY 2025 | ISSUED |



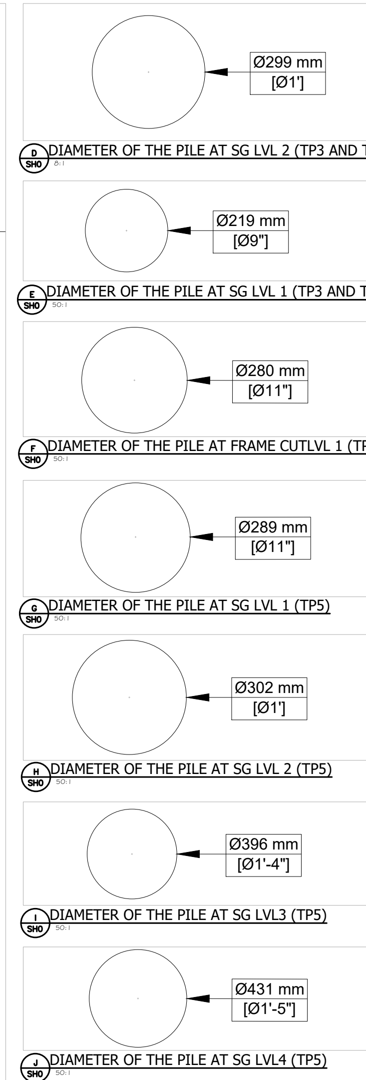

A STRAIN GAUGE LEVEL (TP1AND TP2)




B STRAIN GAUGE LEVEL (TP3 AND TP4)




C STRAIN GAUGE LEVEL (TP5)






STAMP

STAMP

PERMIT TO PRACTICE

| REV. | DATE | REVISION | BY |
|---|---|---|---|
| 0 | 2025-03-04 | ISSUED FOR REVIEW | M.N |
| 1 | 2025-05-05 | AS-BUILT | R.H. |
| 2 | 2025-05-29 | ISSUED FOR REVIEW | M.N |

CLIENT
TLG.
100 – 7th Ave SW, P.O.Box, Attalla, AL
35954 USA

PROJECT
TSFP, MOBILE, ALABAMA

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5360 CANOTEK ROAD, UNIT #5, GLOUCESTER, ON K1J9E3
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TITLE
AS BUILT SG LEVEL

| | | | |
|---|---|---|---|
| DESIGNED BY | R.H. | DRAWING NO. | |
| | M.N. | SCALE: | |
| DRAWN BY | D.A. | DATE: 5 MAY 2025 | ISSUED |

**PROJECT INFORMATION:**

**DESIGNER:**

# SCIENTIFIC APPLIED CONCEPTS LTD

UNIT 8, 5330 CANOTEK ROAD
GLOUCESTER, ON K1J9E3

**CONTRACTOR:**

# Bidirectional test pile schematics

**REFERENCED CODES AND DOCUMENTS**

- G40.20-13/G40.21-13 (R2018) - GENERAL REQUIREMENTS FOR ROLLED OR WELDED STRUCTURAL QUALITY STEEL / STRUCTURAL QUALITY STEEL
- ALL RELEVANT LOCAL HEALTH AND SAFETY GUIDELINES
- TEST IS BASED ON ASTM D8169 (LAST UPDATED FEBRUARY 2018):
    - ALL INSTRUMENTATION, TIMING, TEST PROCEDURES ARE TO BE AS PER ASTM D8169

**GENERAL NOTES**

- VALUES IN THE TABLE BELOW ARE BASED ON INFORMATION PROVIDED IN THE REFERENCE DOCUMENTS AND BOREHOLES. ANY CHANGES MUST BE COMMUNICATED TO SACL PRIOR TO DESIGN APPROVAL, INSTALLATION AND TESTING
- ALL MATERIAL TO BE PROVIDED BY CONTRACTOR UNLESS OTHERWISE NOTED ON THE DRAWINGS
- ALL DIMENSIONS SHOWN ARE IN METERS UNLESS OTHERWISE NOTED
- TEMPORARY ENCLOSURE MUST BE PROVIDED TO SHELTER THE INSTRUMENTS AND TESTING PERSONNEL
- REFERENCE BEAM NOTED ON SHEET BD-A MUST BE PROTECTED FROM WEATHER (RAIN, SUN, WIND, TEMPERATURE CHANGES, ETC.)

**BD CELL CONSTRUCTION:**

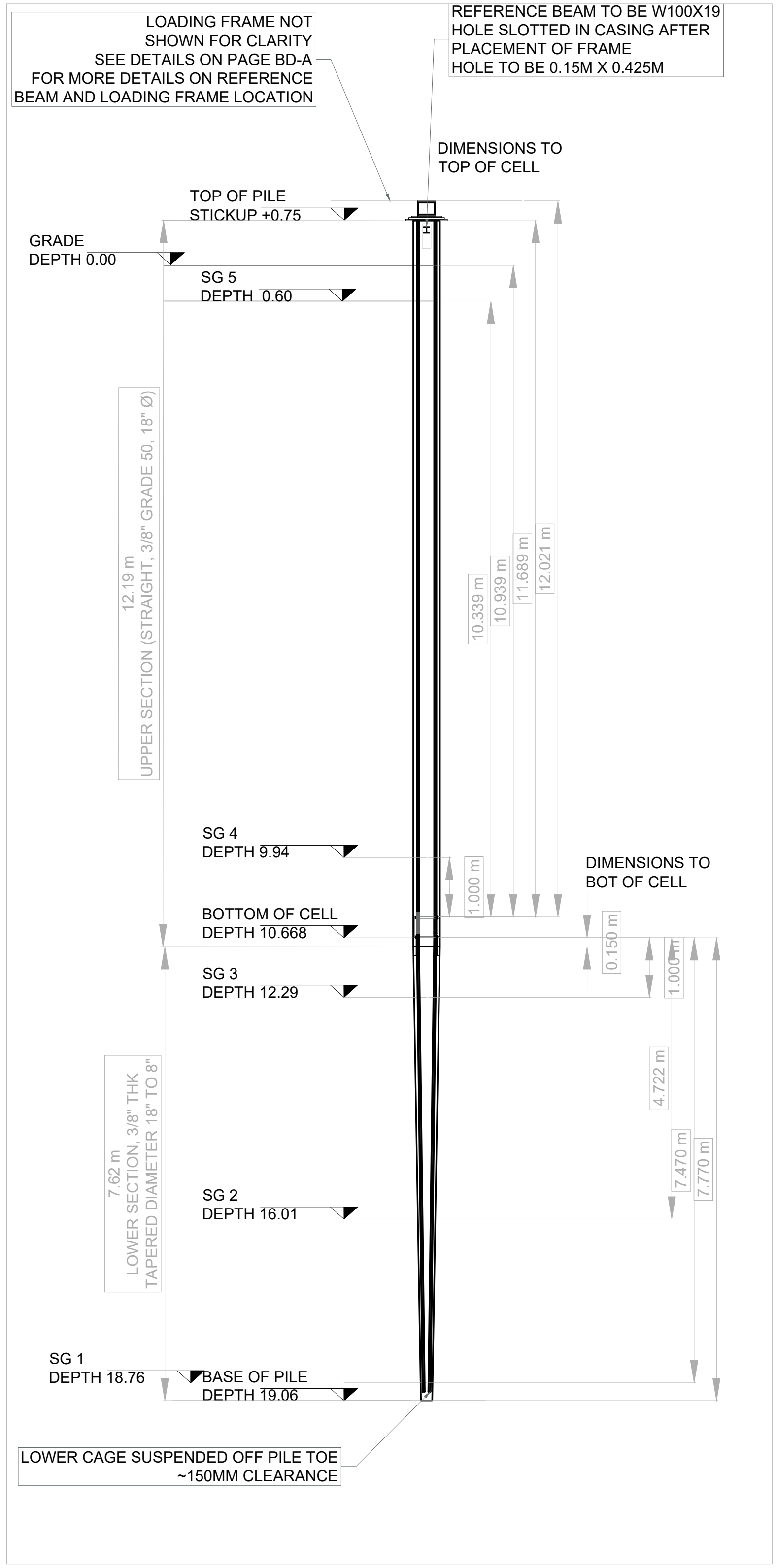
- THE BD CELL WILL BE CONSTRUCTED AND DELIVERED TO SITE FOR ASSEMBLY TO C-CHANNEL FRAME BY CONTRACTOR
- INSTALLATION OF BD CELL TO CAGE MUST BE SUPERVISED BY AN ENGINEER FROM SACL
- REVISED STRAIN GAUGE LOCATIONS MAY BE USED AT DISCRETION OF DESIGN ENGINEER BASED ON DRILLING LOGS FROM SITE
- SACL ENGINEER WILL SUPPLY AND INSTALL THE FOLLOWING: STRAIN GAUGES, EXTENSOMETERS, TELLTALES, BD CELL, HYDRAULIC EQUIPMENT.
- CONTRACTOR TO SUPPLY AND INSTALL THE FOLLOWING: C-CHANNEL FRAME AS PER ATTACHED DRAWINGS ON PAGE BD1-C, TELLTALE HOUSINGS AS PER BD1-C, WELDING OF FRAME TO CELL (UNDER SUPERVISION OF SACL ENGINEER);
- CONTRACTOR TO SUPPLY AND INSTALL (WELD) GUSSET PLATES ON LOWER TAPERED SECTION AS PER THE DRAWINGS.
- CARE SHOULD BE TAKEN TO REMOVE SHARP EDGES FROM ANY CUT HOLES TO PREVENT DAMAGE TO THE INSTRUMENTATION, HYDRAULIC HOSES, ETC.
- CARE SHOULD BE TAKEN DURING ERECTION SO AS TO NOT DAMAGE INSTRUMENTATION AND EMBEDDED EQUIPMENT. INSTRUMENTATION SHOULD BE MONITORED AS CAGE IS LOWERED INTO THE DRILLED SHAFT TO ENSURE NO DAMAGE TO EMBEDDED EQUIPMENT
- CONTRACTOR TO PROVIDE INTENDED PILE POUR PROCEDURE USING AN APPROVED TREMIE-TYPE METHODOLOGY
- CAGE WEIGHT (INCLUDING CELL) OF TP-01 IS APPROXIMATELY 5,000 KG, NOT INCLUDING ANY RIGGING, ETC. THE BASE PLATES AND L-ANGLES PROVIDED ARE 150MM DIAMETER.

**MATERIALS:**

- STEEL
    - STRUCTURAL STEEL TO BE NEW OR SOUND USED MATERIAL CONFORMING TO EITHER:
        - G40.21-13 (R2019) GRADE 350W
        - ASTM A572 GRADE 50
    - REBARS SHALL BE GRADE 400W AS PER LOCAL CODES (OR CSA G30.18:21)
    - ALL WELDING TO COMPLY WITH THE LOCAL CODES (OR NEWEST VERSION OF CSA W59 AND CSA W47.1) AND TO BE CARRIED OUT BY CERTIFIED WELDERS
    - ALTERNATIVE STEEL GRADES OR SECTIONS OF EQUIVALENT STRENGTH MAY BE SUBSTITUTED SUBJECT TO THE DESIGN ENGINEER'S WRITTEN APPROVAL
    - ALL WELDING THROATS ARE MINIMUM 8MM FILLET WELDED ALL AROUND UNLESS OTHERWISE INDICATED ON THE DRAWINGS
    - WELDING ELECTRODES TENSILE STRENGTH SHALL BE MINIMUM 480MPa
- CONCRETE
    - GENERAL GROUT TO BE 25 MPA (MAXIMUM 35 MPA). TEST MAY PROCEED ONCE CONCRETE REACHES 40% DESIGN STRENGTH OR AS APPROVED BY SACL. MIX DESIGN TO BE APPROVED BY THE DESIGN ENGINEER
    - PERFORM CONCRETE TESTING AS PER ACI SPECIFICATION/LOCAL CODES
    - IF COLD OR HOT WEATHER CONCRETING IS TO BE PERFORMED, FOLLOW APPROPRIATE ACI GUIDELINES
    - ALL CONCRETE TESTING (IF REQ'D) TO PROVIDED BY OTHERS
- BI-DIRECTIONAL EMBEDDED CELL/PILE INSTRUMENTATION
    - ALL INSTRUMENTATION IS CALIBRATED WITHIN 3 MONTHS OF PROJECTED TEST DATE TO BE PROVIDED PRIOR TO INSTALLATION OF INSTRUMENTATION
    - BD CELL IS INSTRUMENTED AS PER ASTM D8169 WITH:
        - 2 STRAIN GAUGES PER LEVEL
        - 2 TELLTALES FOR TOP PLATE MOVEMENT AND 2 TELLTALES FOR BOTTOM OF PILE MOVEMENT (LVDT TO BE LMP300 OR HRS100, NOVO TECHNIK)
        - 2 DISPLACEMENT TRANSDUCERS TO MEASURE CELL EXPANSION
        - MAXIMUM CELL CAPACITY IS TO BE TESTED TO A MINIMUM 10% OVER REQUIRED TEST LOAD
        - OPTICAL SURVEY INSTRUMENTATION OF REFERENCE BEAM AND PILE HEAD MOVEMENT TO BE PROVIDED BY SACL
- BI-DIRECTIONAL TEMPORARY CELL/PILE INSTRUMENTATION
    - SACL TO PROVIDE EXTENSOMETERS, DATA ACQUISITION SYSTEMS AND OPTICAL SURVEY INSTRUMENTATION AS PER ASTM D8169 FOR TESTING.
    - OPTICAL SURVEY POINTS ARE TO BE TAKEN, BASED ON SITE CONSTRAINTS, USING SURVEY TARGETS OR STICKERS FASTENED TO PILE HEAD AND REFERENCE BEAM. NOT TO BE USED AS PRIMARY MEASUREMENT AS PER ASTM
- ADDITIONAL LOADING FRAME SETUP MAY BE USED TO INCREASE TESTED LOAD CAPACITY AT THE DISCRETION OF SACL. SEE PAGE BD-A FOR MORE DETAILS ABOUT REFERENCE BEAM AND LOAD TEST SETUP

**HEALTH AND SAFETY**

- ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH THE OCCUPATIONAL HEALTH AND SAFETY ACT LATEST REVISION.
- RISK ASSESSMENT MUST BE PERFORMED ON-SITE BY THE CONTRACTOR IN ACCORDANCE WITH APPROPRIATE SAFETY POLICIES.




## TP01 TEST PILE

BD1A 1:5:1

| TITLE: TP01 (2 MN) | REV. | DATE | REVISION | BY | DRAWING NO. PROPOSAL* |
|---|---|---|---|---|---|
| | 0 | 2024-06-25 | ISSUED FOR REVIEW | SC | |



STAMP

| DESIGNED BY | MN | SCALE: |
|---|---|---|
| | DA | NTS |
| DRAWN BY | SC | DATE 2024-12-09 / ISSUED |

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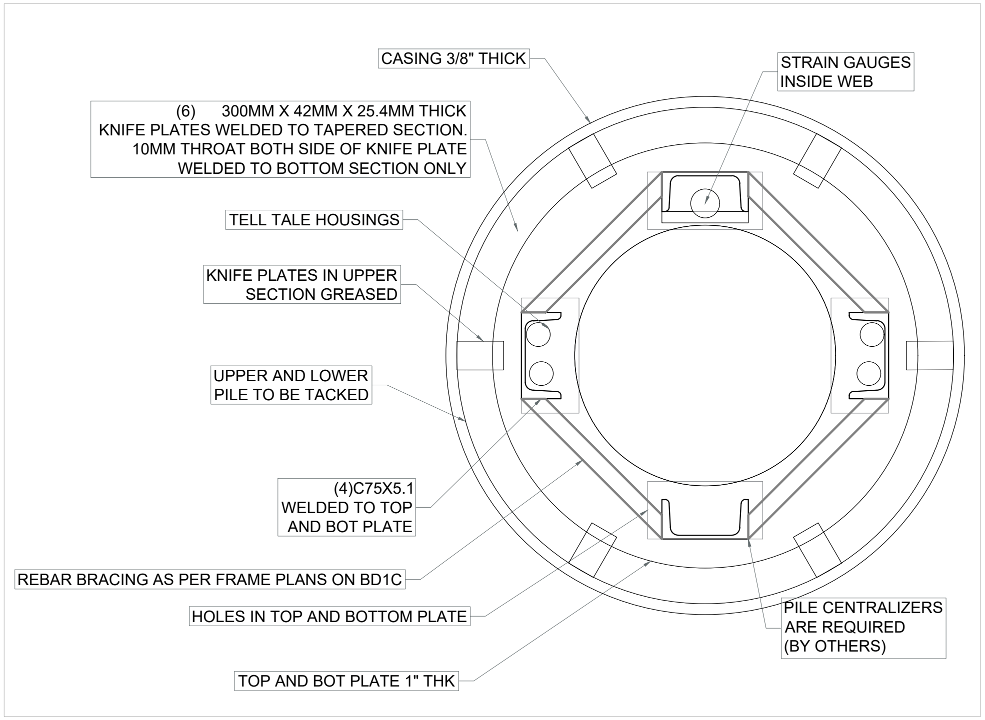
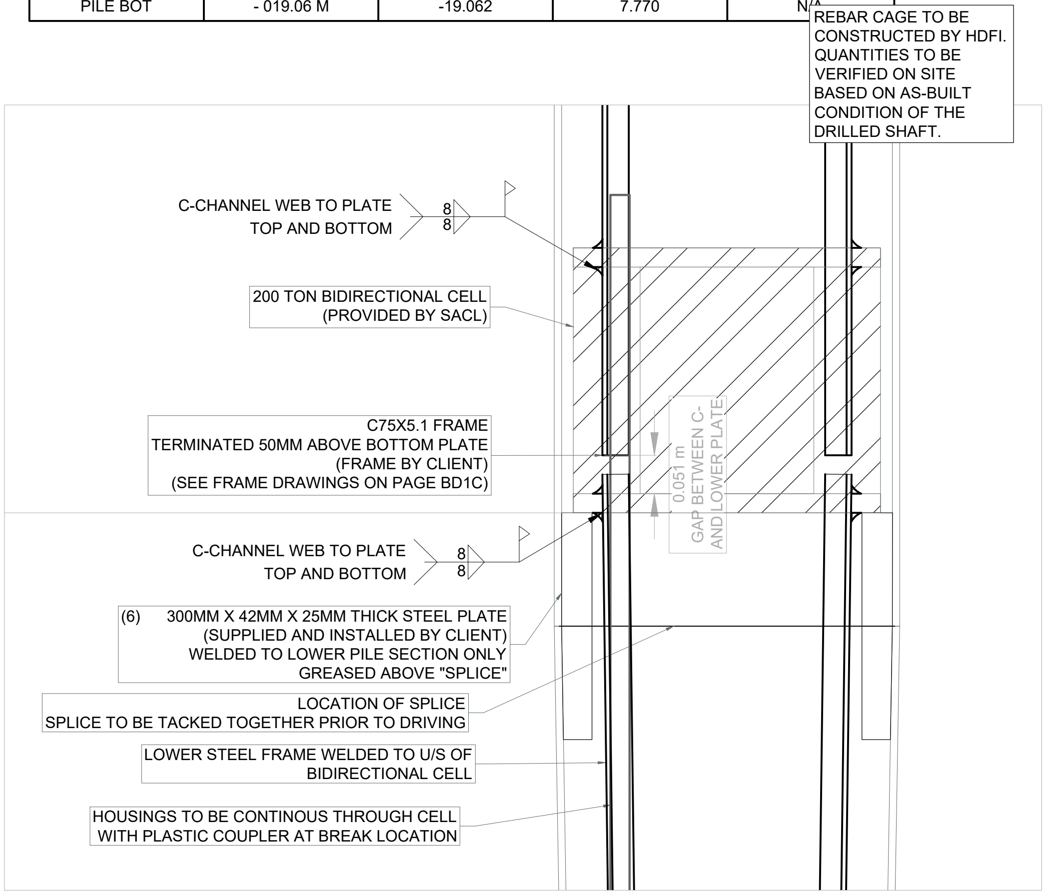



A / BD1B PLAN VIEW TEST PILE @ SPLICE LOCATION

40:1

TABLE 1 - BD CELL AND STRAIN GAUGE ELEVATIONS

| | DEPTH | ELEVATION | "DISTANCE FROM CELL" M | # STRAIN GAUGES |
|---|---|---|---|---|
| TOP OF CASING | + 000.75 M | + 000.75 M | 11.691 | N/A |
| GROUND LEVEL | - 000.00 M | 0 | 10.941 | N/A |
| SG LEVEL 5 | - 000.30 M | -0.300 | 10.641 | 2 |
| SG LEVEL 4 | - 009.94 M | -9.941 | 1.000 | 4 |
| SG LEVEL 3 | - 012.29 M | -12.292 | 1.351 | 2 |
| SG LEVEL 2 | - 016.01 M | -16.014 | 4.722 | 2 |
| SG LEVEL 1 | - 018.06 M | -18.062 | 6.770 | 4 |
| BD CELL TOP | - 010.94 M | -10.941 | 0.000 | N/A |
| BD CELL BOT | - 011.29 M | -11.292 | 0.000 | N/A |
| PILE SPLICE LEVEL | - 011.44 M | -11.442 | 0.150 | N/A |
| PILE BOT | - 019.06 M | -19.062 | 7.770 | N/A |




C / BD1B SECTIONAL VIEW PILE SPLICE

30:1



STAMP

| REV. | DATE | REVISION | BY |
|---|---|---|---|
| 0 | 2024-12-10 | ISSUED FOR PROPOSAL | D.A. |

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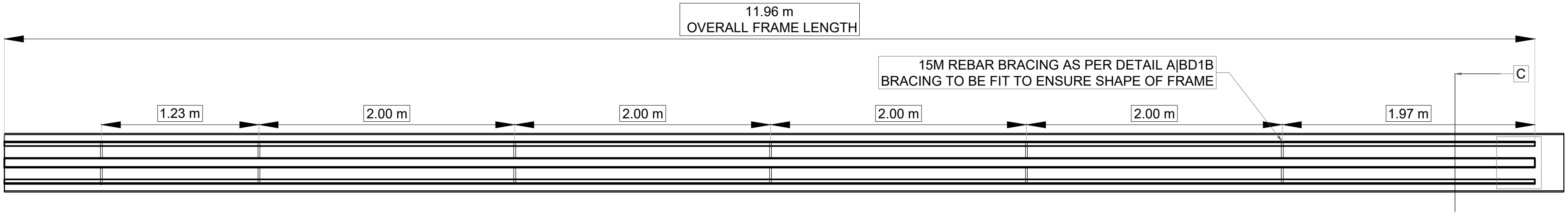
TITLE: PILE/CELL DETAILS-TP01

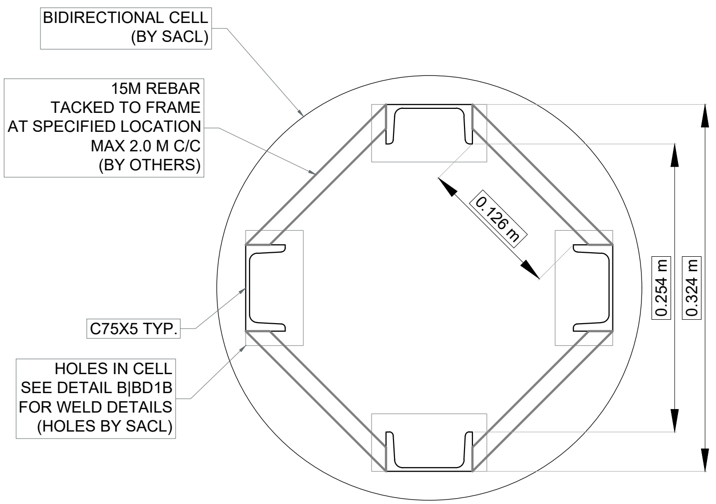
DESIGNED BY: M.N.
D.A.
DRAWN BY: S.C.
DRAWING NO.: 2408273-BD1B
SCALE: NTS
DATE: 2024-12-10
ISSUED

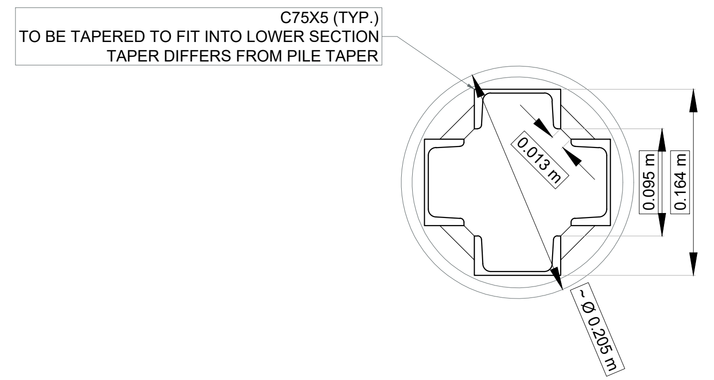



A
BD1C

# UPPER CAGE DETAILS

20:1




C
BD1B

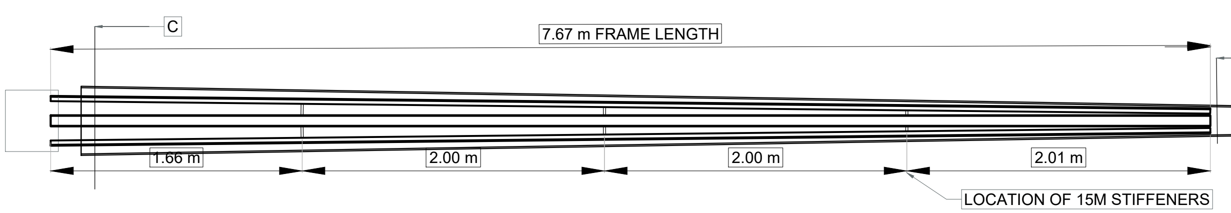
# FRAME DETAIL AT SPLICE

150:1

D
BD1B

# FRAME DETAIL AT BASE

150:1




B
BD1C

# LOWER CAGE DETAILS

20:1

 DIMENSIONS ON PLANS ARE APPROXIMATE AND BASED ON INFORMATION PROVDED BY CLIENT. SHOULD ANY DIMENSIONS DIFFER, DESIGN ENGINEER MUST BE NOTIFIED IMMEDIATELY FOR RE-ASSESSMENT.

STAMP

| REV. | DATE | REVISION | BY |
|---|---|---|---|
| 0 | 2024-12-10 | ISSUED FOR PROPOSAL | D.A. |

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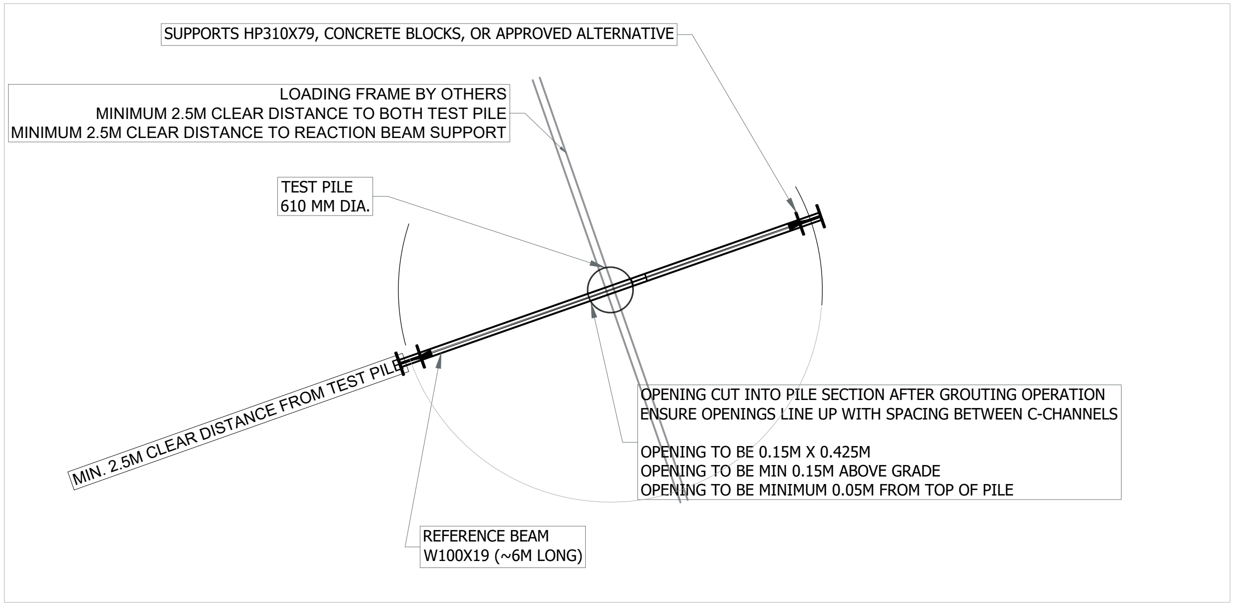
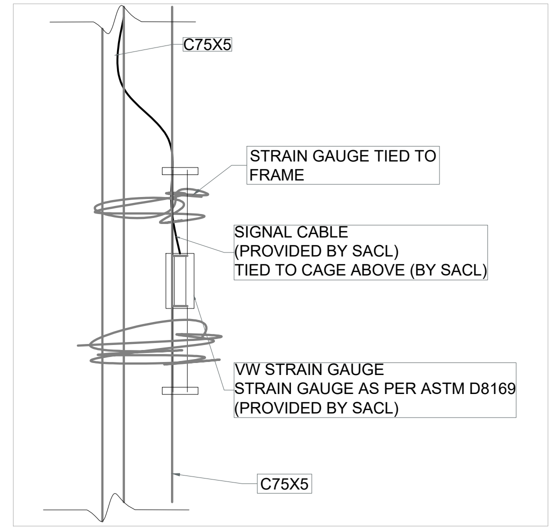
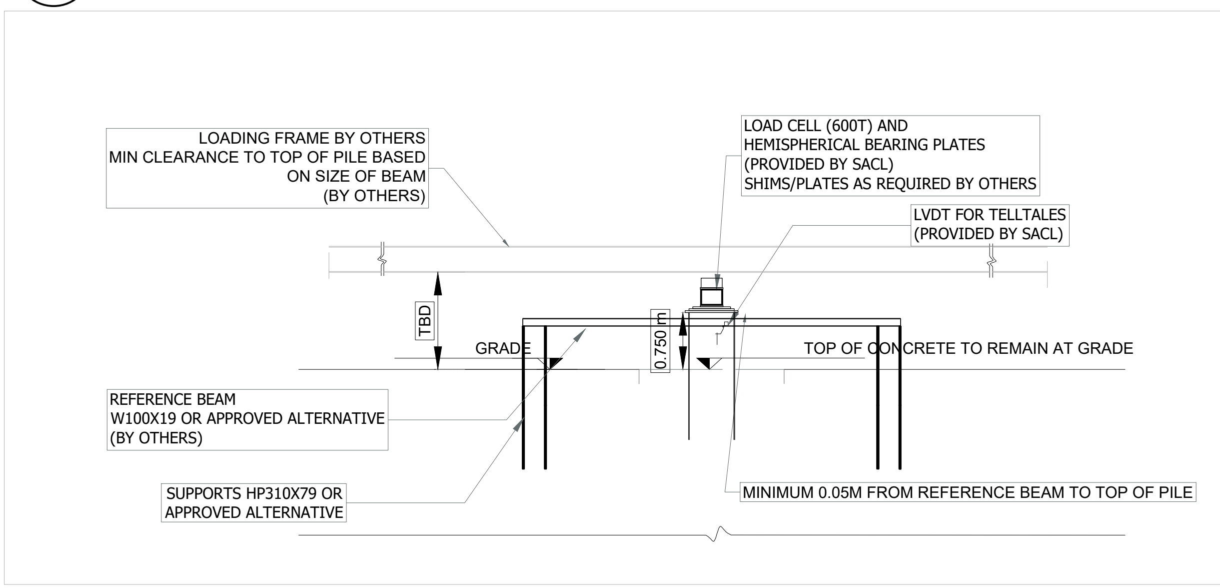
| | | | |
|---|---|---|---|
| TITLE: FRAME DIMS-TP01 | DESIGNED BY: M.N. | DRAWING NO.: 2408273-BD1C | |
| | D.A. | SCALE: NTS | |
| | DRAWN BY: S.C. | DATE: 2024-12-10 | ISSUED |



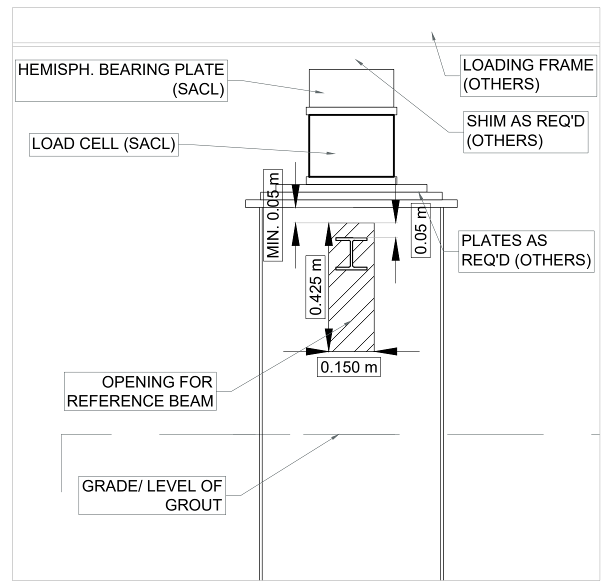

A / BD–A **GENERAL PLAN VIEW**
10:1




C / BD–A **TYPICAL STRAIN GAUGE**
200:1




B / BD–A **ELEVATION**
10:1




D / BD–A **PILE HEAD ELEVATION**
40:1



STAMP

| REV. | DATE | REVISION | BY |
|---|---|---|---|
| 0 | 2024-12-10 | ISSUED FOR PROPOSAL | D.A. |

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TITLE: DETAILS (TYP)

| | | | |
|---|---|---|---|
| DESIGNED BY | M.N. | DRAWING NO. | 2408273-BDA |
| | D.A. | SCALE: | NTS |
| DRAWN BY | S.C. | DATE: 2024-12-10 | ISSUED |

# Appendix 3

# Calibration Sheets

Embedded strain gages

# BATCH CALIBRATION

Model : GV-2410

Date : 10-Jan-25

Batch : 250110D

Type : VW Embedment Strain Gauge

Temperature : 23℃

Inspector : Dong Young Kim

Calibration Gage Factor 1 : 0.9809

Calibration Gage Factor 2 : 0.9835

Calibration Gage Factor 3 : 0.9768

Average Batch Calibration Gage Factor B : 0.9804

Strain Gage Factor K : 3.304

Precise micro_strain(με) = $F^2 \times 10^{-3} \times K \times B$

Note : Above calibration certificate on the accuracy and precision of the instrument affecting factors (load, temperature, humidity, etc.) in the event of a sudden change will be invalid.

QC PASSED INSPECTION Geovan®

SACL

BD-Cell

# Scientific Applied Concepts Ltd.

## Hydraulic Ram Calibration (S/N: 202307-01-01-033TI-0-0-103)

| Project/ Client | | |
|---|---|---|
| | **Number:** | 2501305 |
| | **Name:** | TLG |
| | **Contact:** | Mudasser Noor, P.Eng.<br>5330 Canotek Road, Ottawa, ON |

| Reference Information | | |
|---|---|---|
| **Reference Load Cell:** 3000-1200-5 | **S/N:** 2322[1] | |
| **Reference Piezometer:** 15,000 PSI Model WIKA S-20 | **S/N:** S-1A00MWO4X3[1] | |

*[1]Traceable to N.I.S.T*

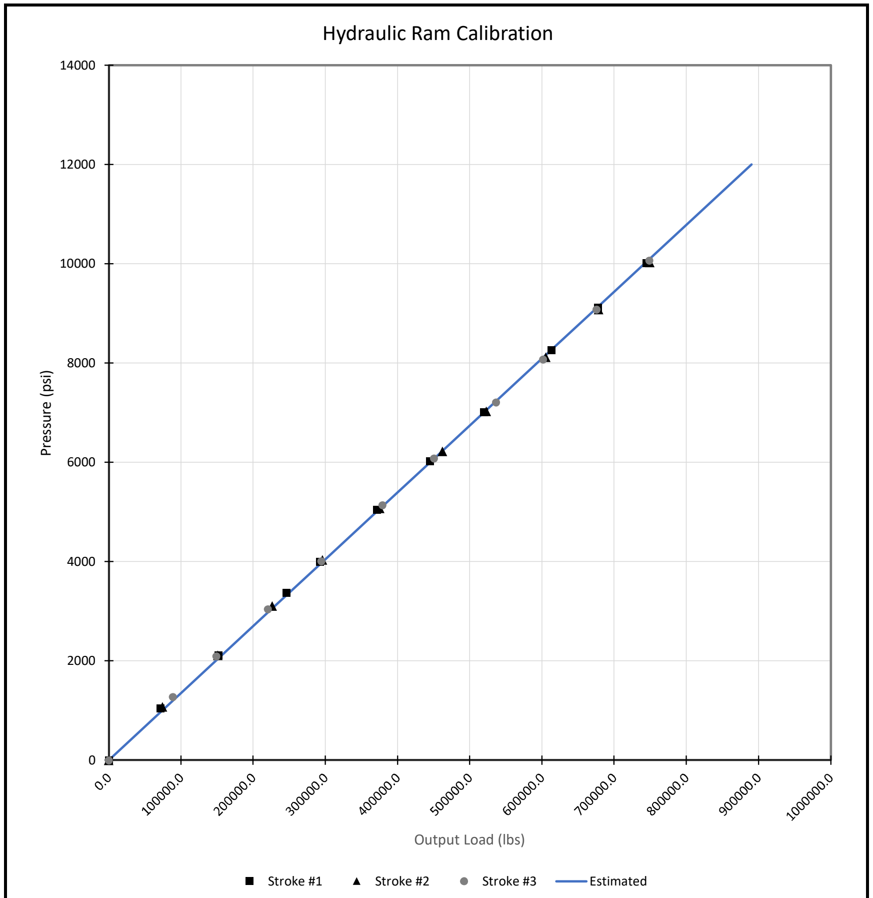
| Calibration Factor = | 74.201 | Sq.In. |
|---|---|---|

| Stroke #1 1.00 inch | | Stroke #2 3.00 inch | | Stroke #3 4.00 inch | | Stroke #4 N/A | |
|---|---|---|---|---|---|---|---|
| Indicated Pressure | Applied Load | Indicated Pressure | Applied Load | Indicated Pressure | Applied Load | Indicated Pressure | Applied Load |
| *(psi)* | *(lbs)* | *(psi)* | *(lbs)* | *(psi)* | *(lbs)* | *(psi)* | *(lbs)* |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 1044.78 | 71795.71 | 1079.14 | 74168.06 | 1277.93 | 88441.33 | | |
| 2118.08 | 151695.20 | 2114.60 | 151254.90 | 2094.31 | 148843.90 | | |
| 3376.77 | 246387.10 | 3111.65 | 226336.90 | 3046.38 | 220192.50 | | |
| 4001.89 | 292338.50 | 4034.80 | 296169.70 | 4014.80 | 294423.90 | | |
| 5051.33 | 371301.20 | 5076.15 | 375353.30 | 5139.88 | 378849.50 | | |
| 6027.40 | 444966.40 | 6226.14 | 462375.10 | 6083.07 | 450390.80 | | |
| 7014.03 | 519294.70 | 7031.06 | 523066.40 | 7210.11 | 536291.70 | | |
| 8267.39 | 613379.10 | 8120.98 | 605502.20 | 8075.85 | 601630.40 | | |
| 9120.72 | 677466.80 | 9084.44 | 678390.30 | 9080.77 | 675614.60 | | |
| 10015.53 | 744943.20 | 10030.54 | 749577.80 | 10068.21 | 748778.30 | | |
| | 74.034 | | 74.393 | | 74.175 | | |

**Hydraulic Ram** 330 T Hydraulic Jack
**Action:** Single Acting
**Model:** SACL Custom
**Ram S/N:** 202307-01-01-033TI-0-0-103
**Ram Stroke:** 150.0 mm

**Calibrated by:** Jaskirat Singh, M.A.Sc.
**Checked by:** Mudasser Noor, P.Eng
**Calibrated on:** January 22, 2025
**Temperature** 23.0 °C

**Remarks and Observations:** Jack Calibrations, visual inspection carried out prior to and post calibration. No leaks or visible damage on the hydraulic ram at the time of calibration.




[2025-01-22 - Jack Calibration - 202307-01-01-033TI-0-0-103 -JS.xlsx]Calibration

Test Jack

# Scientific Applied Concepts Ltd.

## Hydraulic Ram Calibration (S/N: 202103-01-01-0500TI-0-1-140)

| Project/ Client | |
|---|---|
| | **Number:** 251305<br>**Name:** TLG |
| | Mudasser Noor, P.Eng.<br>**Contact:** 5330 Canotek Road, Ottawa, ON |

| Reference Information | | |
|---|---|---|
| | **Reference Load Cell:** 3000-1200-5<br>**Reference Piezometer:** 15,000 PSI Model WIKA S-20 | **S/N:** 2322[1]<br>**S/N:** S-1A00MWO4X3[1] |
| | | *[1]Traceable to N.I.S.T* |

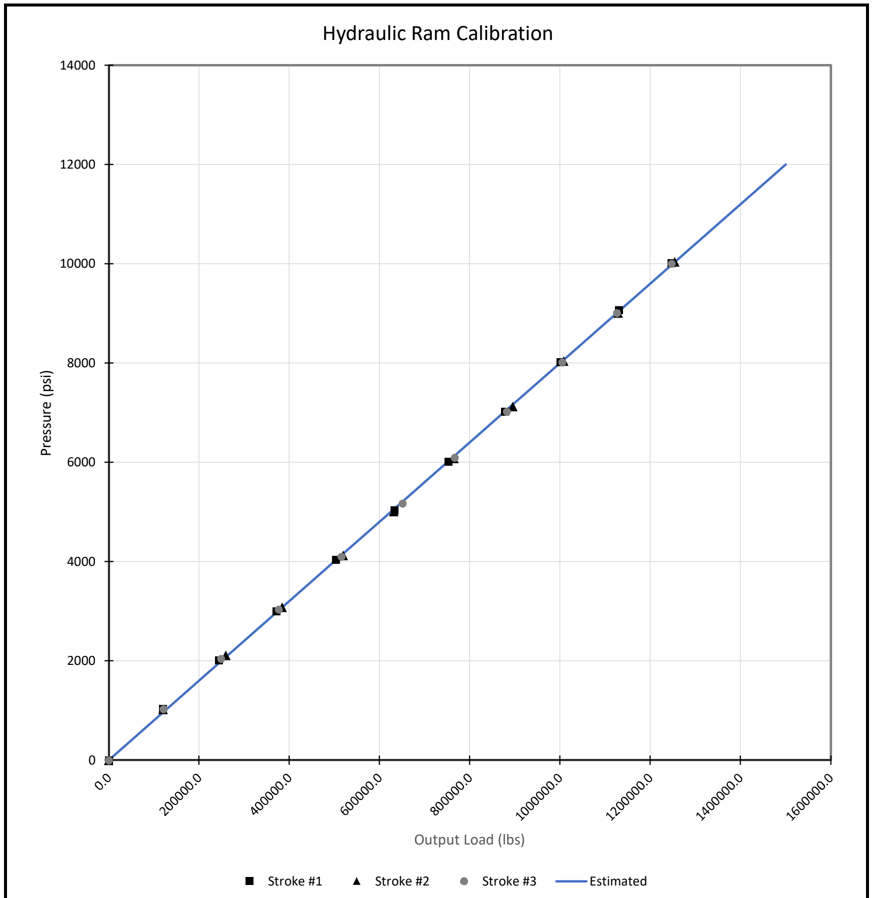
| **Calibration Factor =** | **125.037** | **Sq.In.** |
|---|---|---|

| Stroke #1 | | Stroke #2 | | Stroke #3 | | Stroke #4 | |
|---|---|---|---|---|---|---|---|
| 1.00 inch | | 3.00 inch | | 4.00 inch | | N/A | |
| Indicated Pressure | Applied Load | Indicated Pressure | Applied Load | Indicated Pressure | Applied Load | Indicated Pressure | Applied Load |
| *(psi)* | *(lbs)* | *(psi)* | *(lbs)* | *(psi)* | *(lbs)* | *(psi)* | *(lbs)* |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 1037.06 | 119634.90 | 1023.31 | 120270.00 | 1034.37 | 121277.90 | | |
| 2014.67 | 244301.90 | 2114.42 | 259515.80 | 2042.95 | 248768.10 | | |
| 3004.58 | 371652.80 | 3083.46 | 384381.70 | 3036.17 | 376436.60 | | |
| 4036.69 | 503757.00 | 4130.10 | 519615.70 | 4105.13 | 515259.50 | | |
| 5045.49 | 632174.10 | 5010.12 | 631613.90 | 5175.14 | 651256.30 | | |
| 6017.66 | 753375.00 | 6081.08 | 765387.50 | 6094.97 | 766249.30 | | |
| 7025.01 | 878080.90 | 7129.74 | 895912.00 | 7027.23 | 881965.10 | | |
| 8022.27 | 1001516.00 | 8041.69 | 1008731.00 | 8017.77 | 1004649.00 | | |
| 9076.83 | 1131059.00 | 9011.52 | 1128736.00 | 9013.15 | 1126386.00 | | |
| 10021.23 | 1247366.00 | 10043.24 | 1254855.00 | 10003.99 | 1247345.00 | | |
| | 124.687 | | 125.328 | | 125.096 | | |

**Hydraulic Ram** 500 T Hydraulic Jack
**Action:** Double Acting
**Model:** SACL Custom
**Ram S/N:** 202103-01-01-0500TI-0-1-140
**Ram Stroke:** 200.0 mm

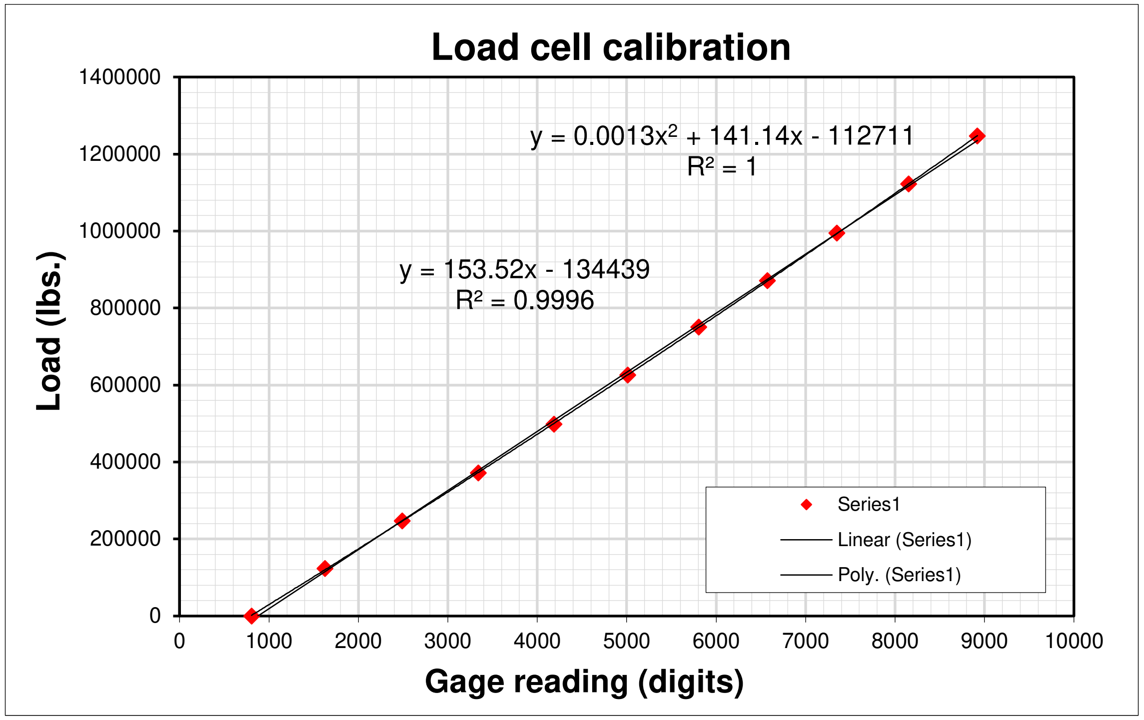
**Calibrated by:** Jaskirat Singh, M.A.Sc.
**Checked by:** Mudasser Noor, P.Eng
**Calibrated on:** January 25, 2025
**Temperature** 20.0 °C

**Remarks and Observations:** Jack Calibrations, visual inspection carried out prior to and post calibration.
No leaks or visible damage on the hydraulic ram at the time of calibration.



# Scientific Applied Concepts Ltd.

## Calibration of Load Cell (S/N: SC3322)




| Lab Conditions | |
|---|---|
| **Temperature:** | 21.0 °C |

| 1<br>**Applied load (lbs)** | 2<br>**Gage Reading (digits)** | 3<br>**Computed Gage Factor Lbs./digit** |
|---|---|---|
| 0 | 805 | N/A |
| 123,643 | 1628 | 150.255 |
| 247,210 | 2489 | 143.471 |
| 371,425 | 3339 | 146.063 |
| 498,127 | 4186 | 149.739 |
| 625,415 | 5010 | 154.336 |
| 750,187 | 5805 | 156.977 |
| 871,369 | 6573 | 157.766 |
| 994,395 | 7348 | 158.849 |
| 1,122,150 | 8151 | 159.069 |
| 1,246,568 | 8921 | 161.494 |

| **Test Setup** | |
|---|---|
| **Manufacturer:** | RST |
| **Model No.:** | SC |
| **Gage Type:** | Resistive strain gage |
| **Serial No.:** | SC3322 |
| **Piezometer (Ref.):** | WIKA - S20 - (SN 1A01M2MH72A*) |
| **Load Cell (Ref.):** | GEOKON 3000X-2000-0 (SN 1532417*) |
| **Jack (Ref.):** | 202409-01-01-1000TI-0-1-127 |

*Traceable to NIST standards

Polynomial gage factors: A = 0.00127161 !! C = -112,710.7697 !!
B = 141.140335

$L = A R^2 + B R + C$

L = Load in lbs
R = Cell reading in digits

!! Recalculate C based on your field setup by setting L = 0 and R = initial field zero reading in the polynomial equation below

$$C = -(A * R_0^2 + BR_0)$$

**Gage Factor (G): (Linear)**
153.519 lbs./digit (1 mV/V = 4,000 digits)
0.6829 kN/digit 1 kN = 224.82 lbs

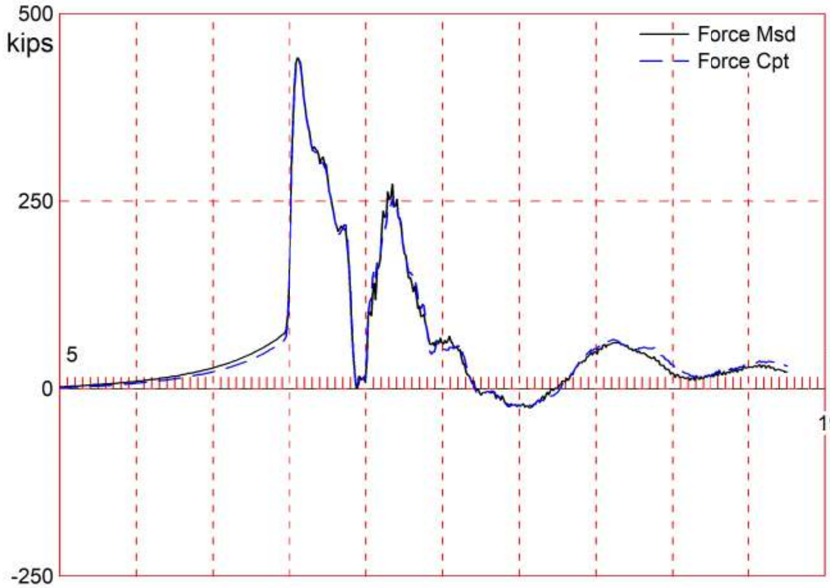
**Linear Function:**
$L = (R - R_0) * G$
L = Load in lbs or kN, depending on G
R = Cell reading in digits
$R_0$ = No load digit reading
G = Gage Factor in lbs./digit or kN/digit

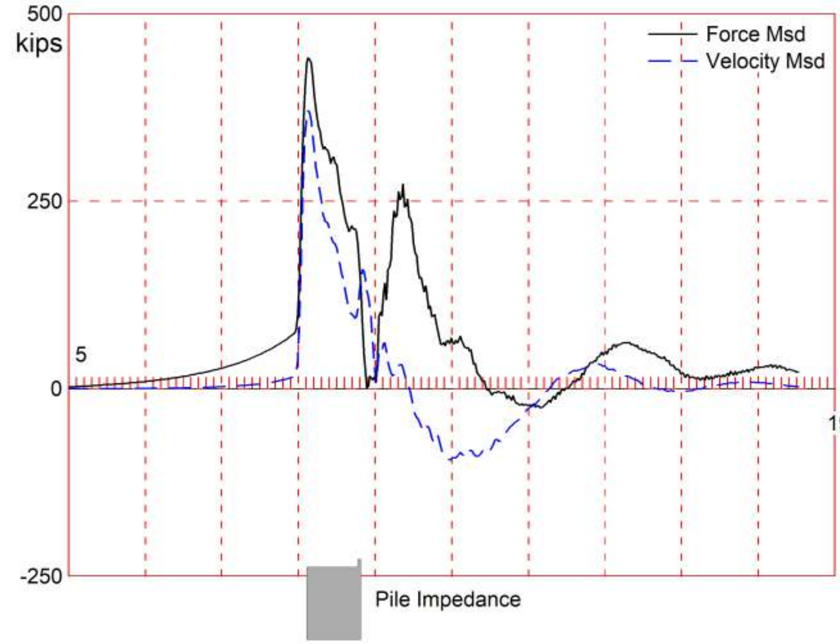
Important note:
When testing within a low range of load (below 10,000 lbs), use the polynomial factors for calculating the load. Readings for specific loads can be computed using:

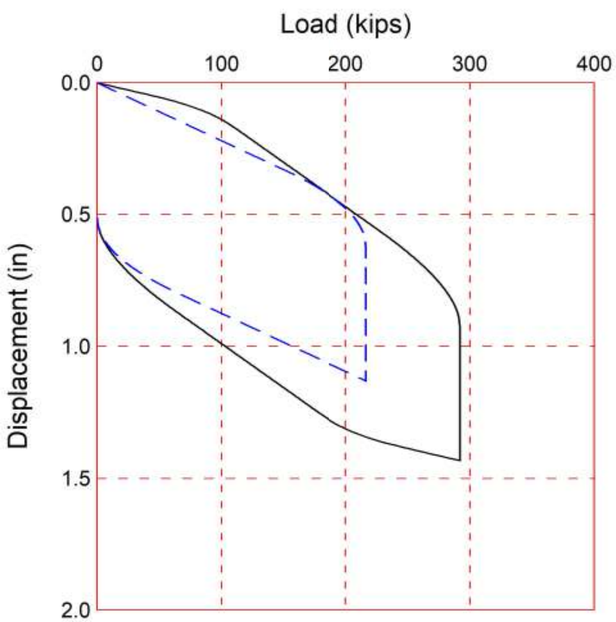
Calibrated by: J.Singh
Checked by: M. Noor
Calibrated on: February 10, 2025

# Appendix 4

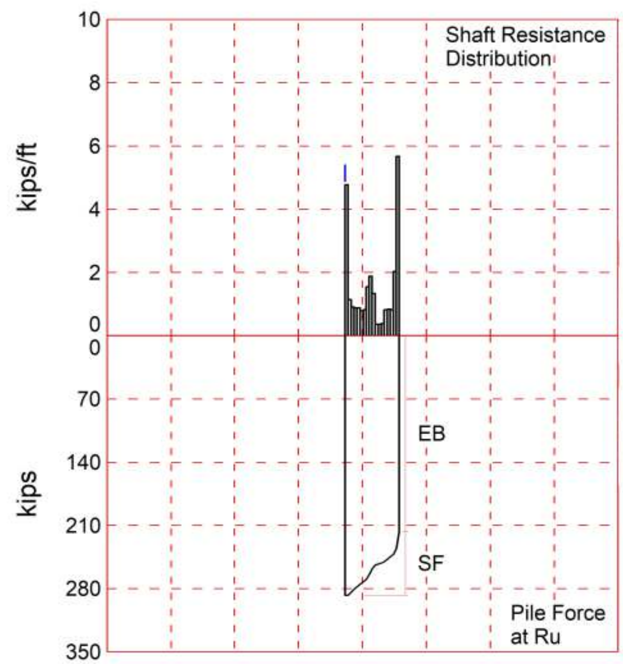
# CAPWAP Analysis results




| | |
|---|---|
| RU = | 292.2 kips |
| SF = | 75.6 kips |
| EB = | 216.6 kips |
| Dy = | 0.92 in |
| Dx = | 1.43 in |
| SET/Bl = | 0.51 in |




| | |
|---|---|
| Length b. Sensors | 59.3 ft |
| Embedment | 57.0 ft |
| Top Area | 20.7 $in^2$ |
| End Bearing Area | 254.2 $in^2$ |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 $lb/ft^3$ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 16808 ft/s |
| Match Quality | 2.40 |
| Top Compr. Stress | 21.3 ksi |
| Max Compr. Stress | 21.3 ksi |
| Max Tension Stress | -1.27 ksi |
| Avg. Shaft Quake | 0.06 in |
| Toe Quake | 0.48 in |
| Avg. Shaft Smith Dpg. | 0.11 s/ft |
| Toe Smith Damping | 0.06 s/ft |

## CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 292.2; along Shaft 75.6; at Toe 216.6 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Smith Damping Factor s/ft |
|---|---|---|---|---|---|---|---|---|
| | | | | 292.2 | | | | |
| 1 | 3.3 | 1.0 | 4.7 | 287.5 | 4.7 | 4.78 | 1.01 | 0.10 |
| 2 | 6.6 | 4.3 | 3.8 | 283.7 | 8.5 | 1.15 | 0.24 | 0.10 |
| 3 | 9.9 | 7.6 | 3.0 | 280.7 | 11.5 | 0.91 | 0.19 | 0.10 |
| 4 | 13.2 | 10.9 | 2.9 | 277.8 | 14.4 | 0.88 | 0.19 | 0.10 |
| 5 | 16.5 | 14.2 | 2.9 | 274.9 | 17.3 | 0.88 | 0.19 | 0.15 |
| 6 | 19.8 | 17.5 | 2.6 | 272.3 | 19.9 | 0.79 | 0.17 | 0.20 |
| 7 | 23.1 | 20.8 | 2.7 | 269.6 | 22.6 | 0.82 | 0.17 | 0.20 |
| 8 | 26.4 | 24.1 | 5.1 | 264.5 | 27.7 | 1.55 | 0.33 | 0.15 |
| 9 | 29.7 | 27.4 | 6.2 | 258.3 | 33.9 | 1.88 | 0.40 | 0.10 |
| 10 | 33.0 | 30.7 | 4.4 | 253.9 | 38.3 | 1.33 | 0.28 | 0.10 |
| 11 | 36.3 | 33.9 | 1.2 | 252.7 | 39.5 | 0.36 | 0.08 | 0.10 |
| 12 | 39.6 | 37.2 | 1.2 | 251.5 | 40.7 | 0.36 | 0.08 | 0.10 |
| 13 | 42.9 | 40.5 | 1.3 | 250.2 | 42.0 | 0.39 | 0.08 | 0.10 |
| 14 | 46.1 | 43.8 | 2.7 | 247.5 | 44.7 | 0.82 | 0.17 | 0.10 |
| 15 | 49.4 | 47.1 | 2.8 | 244.7 | 47.5 | 0.85 | 0.18 | 0.10 |
| 16 | 52.7 | 50.4 | 2.7 | 242.0 | 50.2 | 0.82 | 0.17 | 0.10 |
| 17 | 56.0 | 53.7 | 6.7 | 235.3 | 56.9 | 2.03 | 0.43 | 0.10 |
| 18 | 59.3 | 57.0 | 18.7 | 216.6 | 75.6 | 5.67 | 1.20 | 0.10 |
| Avg. Shaft | | | 4.2 | | | 1.33 | 0.28 | 0.11 |
| Toe | | | 216.6 | | | | 122.68 | 0.06 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Quake | (in) | 0.06 | 0.48 |
| Case Damping Factor | | 0.22 | 0.36 |
| Damping Type | | Viscous | Viscous |
| Unloading Quake | (% of loading quake) | 20 | 48 |
| Reloading Level | (% of Ru) | 100 | 100 |
| Unloading Level | (% of Ru) | 65 | |
| Resistance Gap (included in Toe Quake) (in) | | | 0.10 |
| Soil Plug Weight | (kips) | 0.153 | 0.292 |
| Soil Support Dashpot | | 0.000 | 10.000 |
| Soil Support Weight | (kips) | 0.00 | 1.62 |

CAPWAP match quality = 2.40 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.51 in; Blow Count = 23 b/ft
Computed: Final Set = 0.17 in; Blow Count = 70 b/ft
Transducer F1 (U971) CAL: 144.2; RF: 1.00; F4 (U970) CAL: 143.9; RF: 1.00
A2 (K11820) CAL: 434; RF: 1.00; A3 (K11831) CAL: 428; RF: 1.00

| | | | |
|---|---|---|---|
| max. Top Comp. Stress | = | 21.3 ksi | (T= 36.5 ms, max= 1.000 x Top) |
| max. Comp. Stress | = | 21.3 ksi | (Z= 3.3 ft, T= 36.5 ms) |
| max. Tens. Stress | = | -1.27 ksi | (Z= 23.1 ft, T= 67.9 ms) |
| max. Energy (EMX) | = | 16.0 kip-ft; | max. Measured Top Displ. (DMX)= 0.69 in |

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 441.1 | -25.5 | 21.3 | -1.23 | 16.0 | 10.0 | 0.73 |
| 2 | 6.6 | 434.0 | -24.4 | 21.0 | -1.18 | 15.5 | 10.0 | 0.71 |
| 3 | 9.9 | 428.7 | -24.0 | 20.7 | -1.16 | 15.0 | 9.9 | 0.70 |
| 4 | 13.2 | 425.3 | -25.2 | 20.5 | -1.22 | 14.6 | 9.8 | 0.69 |
| 5 | 16.5 | 423.0 | -25.6 | 20.4 | -1.23 | 14.3 | 9.7 | 0.68 |
| 6 | 19.8 | 419.6 | -25.8 | 20.3 | -1.25 | 13.9 | 9.6 | 0.67 |
| 7 | 23.1 | 415.4 | -26.3 | 20.1 | -1.27 | 13.5 | 9.5 | 0.66 |
| 8 | 26.4 | 410.0 | -26.0 | 19.8 | -1.26 | 13.1 | 9.5 | 0.65 |
| 9 | 29.7 | 399.4 | -25.0 | 19.3 | -1.21 | 12.5 | 9.4 | 0.64 |
| 10 | 33.0 | 388.6 | -22.1 | 18.8 | -1.07 | 12.0 | 9.4 | 0.64 |
| 11 | 36.3 | 381.4 | -19.4 | 18.4 | -0.94 | 11.5 | 9.4 | 0.63 |
| 12 | 39.6 | 380.5 | -20.7 | 18.4 | -1.00 | 11.3 | 9.3 | 0.61 |
| 13 | 42.9 | 379.8 | -21.8 | 18.3 | -1.05 | 11.1 | 9.3 | 0.60 |
| 14 | 46.1 | 389.0 | -22.7 | 18.8 | -1.10 | 11.0 | 9.5 | 0.59 |
| 15 | 49.4 | 395.0 | -22.2 | 19.1 | -1.07 | 10.7 | 10.1 | 0.57 |
| 16 | 52.7 | 383.8 | -20.6 | 18.5 | -1.00 | 10.4 | 10.9 | 0.56 |
| 17 | 56.0 | 338.6 | -20.1 | 16.4 | -0.97 | 10.1 | 11.9 | 0.55 |
| 18 | 59.3 | 258.5 | -16.1 | 12.5 | -0.78 | 8.3 | 12.3 | 0.54 |
| Absolute | 3.3 | | | 21.3 | | | (T = | 36.5 ms) |
| | 23.1 | | | | -1.27 | | (T = | 67.9 ms) |

CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 377.6 | 333.8 | 290.0 | 246.2 | 202.4 | 158.6 | 114.8 | 71.0 | 27.2 | 0.0 |
| RX | 377.6 | 333.8 | 308.8 | 296.2 | 284.6 | 276.1 | 269.5 | 264.8 | 262.1 | 259.3 |
| RU | 377.6 | 333.8 | 290.0 | 246.2 | 202.4 | 158.6 | 114.8 | 71.0 | 27.2 | 0.0 |

RAU = 184.6 (kips); RA2 = 300.0 (kips)

Current CAPWAP Ru = 292.2 (kips); Corresponding J(RP)= 0.20; J(RX) = 0.33

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 10.1 | 36.28 | 371.6 | 444.0 | 444.0 | 0.69 | 0.51 | 0.51 | 16.0 | 318.3 | 579 |

PILE PROFILE AND PILE MODEL

| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 59.3 | 20.7 | 30000.0 | 492.000 | 4.71 |

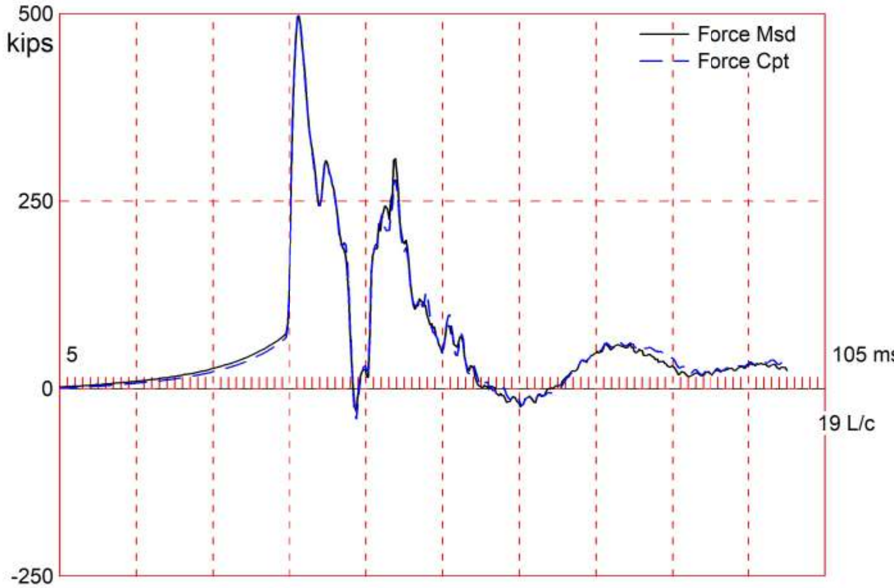
Toe Area 254.2 $in^2$

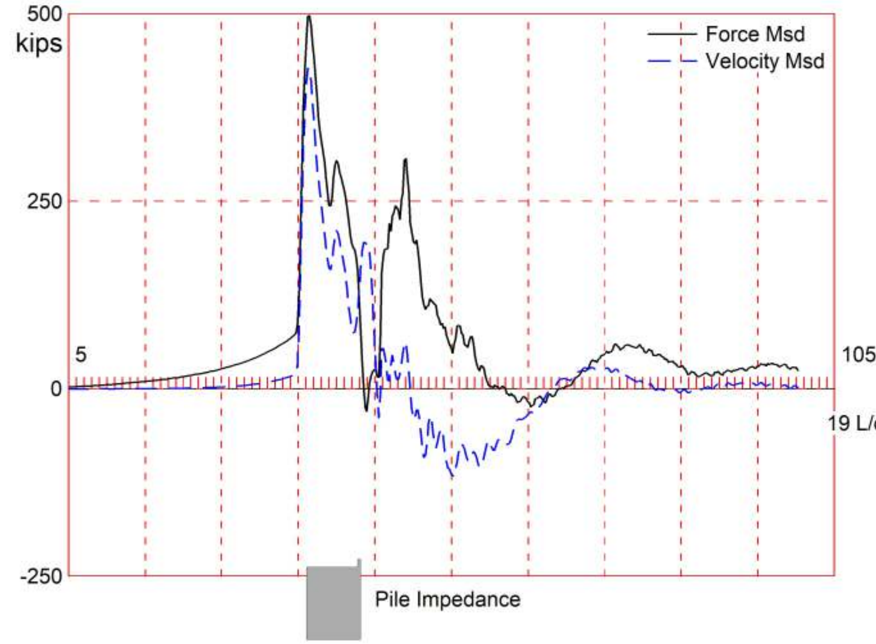
| Segmnt Number | Dist. B.G. | Impedance | Imped. Change | Tension Slack | Tension Eff. | Compression Slack | Compression Eff. | Perim. | Wave Speed | Soil Plug |
|---|---|---|---|---|---|---|---|---|---|---|
| | ft | kips/ft/s | % | in | | in | | ft | ft/s | kips |
| 1 | 3.3 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.000 |
| 2 | 6.6 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.009 |
| 18 | 59.3 | 41.11 | 11.27 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.009 |

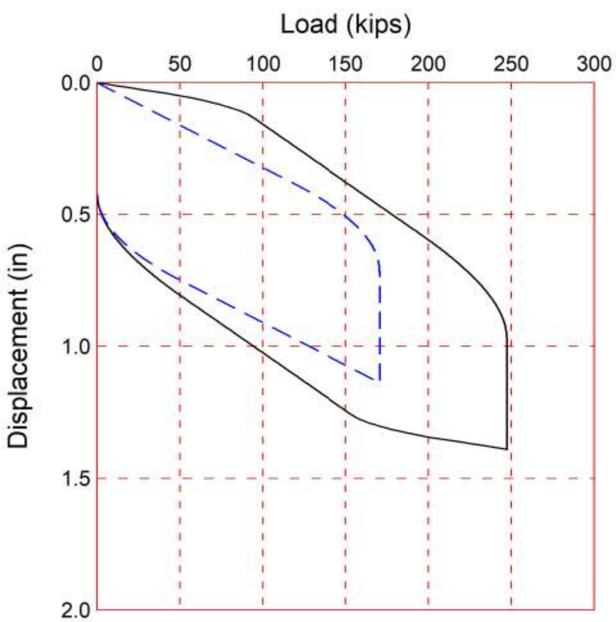
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.8 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 7.1 ms
Total volume: 8.583 $ft^3$; Volume ratio considering added impedance: 1.006

TSFP, MOBILE ALABAMA; Pile: TP2; ID; Blow: 584 (Test: 27-Mar-2025 10:13:)
Scientific Applied Concepts Lmited (SACL)

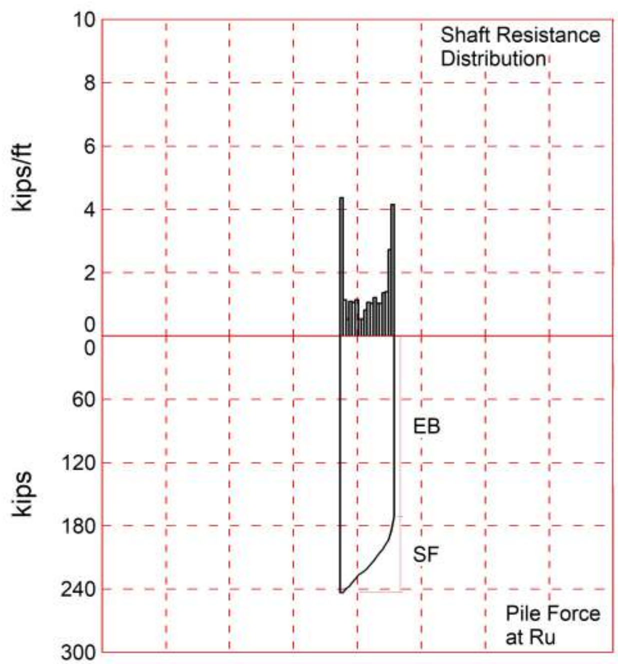
04-Apr-2025
CAPWAP(R) 2014-3




| | |
|---|---|
| RU = | 247.5 kips |
| SF = | 76.6 kips |
| EB = | 170.9 kips |
| Dy = | 0.97 in |
| Dx = | 1.39 in |
| SET/Bl = | 0.42 in |




| | |
|---|---|
| Length b. Sensors | 59.3 ft |
| Embedment | 57.0 ft |
| Top Area | 20.7 in² |
| End Bearing Area | 254.2 in² |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 lb/ft³ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 16808 ft/s |
| Match Quality | 2.11 |
| Top Compr. Stress | 24.2 ksi |
| Max Compr. Stress | 24.2 ksi |
| Max Tension Stress | -1.50 ksi |
| Avg. Shaft Quake | 0.04 in |
| Toe Quake | 0.55 in |
| Avg. Shaft Smith Dpg. | 0.09 s/ft |
| Toe Smith Damping | 0.16 s/ft |

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 247.5; along Shaft 76.6; at Toe 170.9 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf |
|---|---|---|---|---|---|---|---|
| | | | | 247.5 | | | |
| 1 | 3.3 | 1.0 | 4.3 | 243.2 | 4.3 | 4.37 | 0.93 |
| 2 | 6.6 | 4.3 | 3.8 | 239.4 | 8.1 | 1.15 | 0.24 |
| 3 | 9.9 | 7.6 | 1.8 | 237.6 | 9.9 | 0.55 | 0.12 |
| 4 | 13.2 | 10.9 | 3.6 | 234.0 | 13.5 | 1.09 | 0.23 |
| 5 | 16.5 | 14.2 | 3.5 | 230.5 | 17.0 | 1.06 | 0.23 |
| 6 | 19.8 | 17.5 | 3.8 | 226.7 | 20.8 | 1.15 | 0.24 |
| 7 | 23.1 | 20.8 | 1.8 | 224.9 | 22.6 | 0.55 | 0.12 |
| 8 | 26.4 | 24.1 | 1.8 | 223.1 | 24.4 | 0.55 | 0.12 |
| 9 | 29.7 | 27.4 | 2.7 | 220.4 | 27.1 | 0.82 | 0.17 |
| 10 | 33.0 | 30.7 | 3.5 | 216.9 | 30.6 | 1.06 | 0.23 |
| 11 | 36.3 | 33.9 | 3.4 | 213.5 | 34.0 | 1.03 | 0.22 |
| 12 | 39.6 | 37.2 | 4.0 | 209.5 | 38.0 | 1.21 | 0.26 |
| 13 | 42.9 | 40.5 | 3.4 | 206.1 | 41.4 | 1.03 | 0.22 |
| 14 | 46.1 | 43.8 | 3.4 | 202.7 | 44.8 | 1.03 | 0.22 |
| 15 | 49.4 | 47.1 | 4.5 | 198.2 | 49.3 | 1.37 | 0.29 |
| 16 | 52.7 | 50.4 | 4.6 | 193.6 | 53.9 | 1.40 | 0.30 |
| 17 | 56.0 | 53.7 | 9.0 | 184.6 | 62.9 | 2.73 | 0.58 |
| 18 | 59.3 | 57.0 | 13.7 | 170.9 | 76.6 | 4.16 | 0.88 |
| Avg. Shaft | | | 4.3 | | | 1.34 | 0.29 |
| Toe | | | 170.9 | | | | 96.79 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Smith Damping Factor | | 0.09 | 0.16 |
| Quake | (in) | 0.04 | 0.55 |
| Case Damping Factor | | 0.19 | 0.76 |
| Damping Type | | Viscous | Sm+Visc |
| Unloading Quake | (% of loading quake) | 30 | 25 |
| Reloading Level | (% of Ru) | 100 | 100 |
| Unloading Level | (% of Ru) | 40 | |
| Soil Plug Weight | (kips) | 0.187 | 0.337 |

CAPWAP match quality = 2.11 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.42 in; Blow Count = 28 b/ft
Computed: Final Set = 0.44 in; Blow Count = 27 b/ft
Transducer F1 (U971) CAL: 144.2; RF: 1.00; F4 (U970) CAL: 143.9; RF: 1.00
A2 (K11820) CAL: 434; RF: 1.00; A3 (K11831) CAL: 428; RF: 1.00

max. Top Comp. Stress = 24.2 ksi (T= 36.7 ms, max= 1.000 x Top)
max. Comp. Stress = 24.2 ksi (Z= 3.3 ft, T= 36.7 ms)
max. Tens. Stress = -1.50 ksi (Z= 56.0 ft, T= 65.9 ms)
max. Energy (EMX) = 17.4 kip-ft; max. Measured Top Displ. (DMX)= 0.74 in

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 501.3 | -27.8 | 24.2 | -1.34 | 17.4 | 11.5 | 0.77 |
| 2 | 6.6 | 494.3 | -19.0 | 23.9 | -0.92 | 16.9 | 11.4 | 0.76 |
| 3 | 9.9 | 489.2 | -20.4 | 23.6 | -0.99 | 16.4 | 11.3 | 0.75 |
| 4 | 13.2 | 488.0 | -23.4 | 23.6 | -1.13 | 16.2 | 11.3 | 0.73 |
| 5 | 16.5 | 482.7 | -25.0 | 23.3 | -1.21 | 15.7 | 11.2 | 0.72 |
| 6 | 19.8 | 477.6 | -23.9 | 23.1 | -1.15 | 15.3 | 11.2 | 0.71 |
| 7 | 23.1 | 472.0 | -24.5 | 22.8 | -1.18 | 14.9 | 11.1 | 0.70 |
| 8 | 26.4 | 470.7 | -27.6 | 22.7 | -1.33 | 14.6 | 11.1 | 0.69 |
| 9 | 29.7 | 469.4 | -29.5 | 22.7 | -1.43 | 14.3 | 11.0 | 0.67 |
| 10 | 33.0 | 466.4 | -29.6 | 22.5 | -1.43 | 14.0 | 10.9 | 0.66 |
| 11 | 36.3 | 461.6 | -28.0 | 22.3 | -1.35 | 13.6 | 10.9 | 0.65 |
| 12 | 39.6 | 457.0 | -27.8 | 22.1 | -1.34 | 13.2 | 10.8 | 0.64 |
| 13 | 42.9 | 451.3 | -28.0 | 21.8 | -1.35 | 12.8 | 10.7 | 0.63 |
| 14 | 46.1 | 453.8 | -25.9 | 21.9 | -1.25 | 12.4 | 11.0 | 0.62 |
| 15 | 49.4 | 457.6 | -28.7 | 22.1 | -1.39 | 12.0 | 12.0 | 0.61 |
| 16 | 52.7 | 426.6 | -30.6 | 20.6 | -1.48 | 11.5 | 13.4 | 0.59 |
| 17 | 56.0 | 351.4 | -31.0 | 17.0 | -1.50 | 11.0 | 14.7 | 0.58 |
| 18 | 59.3 | 281.2 | -27.8 | 13.6 | -1.34 | 9.0 | 15.3 | 0.57 |
| Absolute | 3.3 | | | 24.2 | | | (T = | 36.7 ms) |
| | 56.0 | | | | -1.50 | | (T = | 65.9 ms) |

CASE METHOD

| J = | 0.0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 381.3 | 271.4 | 161.5 | 51.5 | 0.0 | | | | | |
| RX | 381.3 | 342.0 | 315.4 | 290.8 | 269.5 | 267.0 | 264.5 | 262.1 | 259.6 | 257.1 |
| RU | 381.3 | 271.4 | 161.5 | 51.5 | 0.0 | | | | | |

RAU = 236.2 (kips); RA2 = 303.8 (kips)

Current CAPWAP Ru = 247.5 (kips); Corresponding J(RP)= 0.24; matches RX20 within 5%

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 11.6 | 36.28 | 430.1 | 500.9 | 500.9 | 0.74 | 0.42 | 0.42 | 17.4 | 358.9 | 310 |

PILE PROFILE AND PILE MODEL

| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 59.3 | 20.7 | 30000.0 | 492.000 | 4.71 |

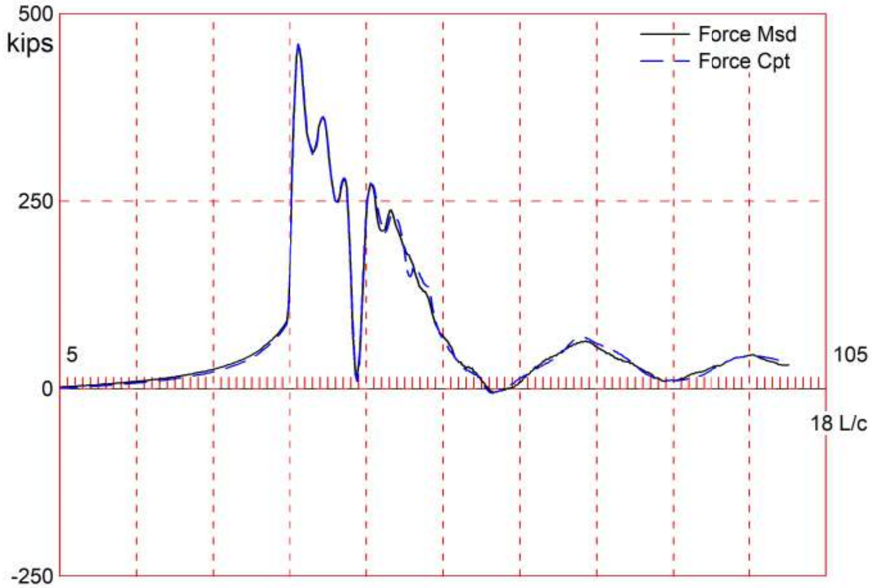
Toe Area 254.2 $in^2$

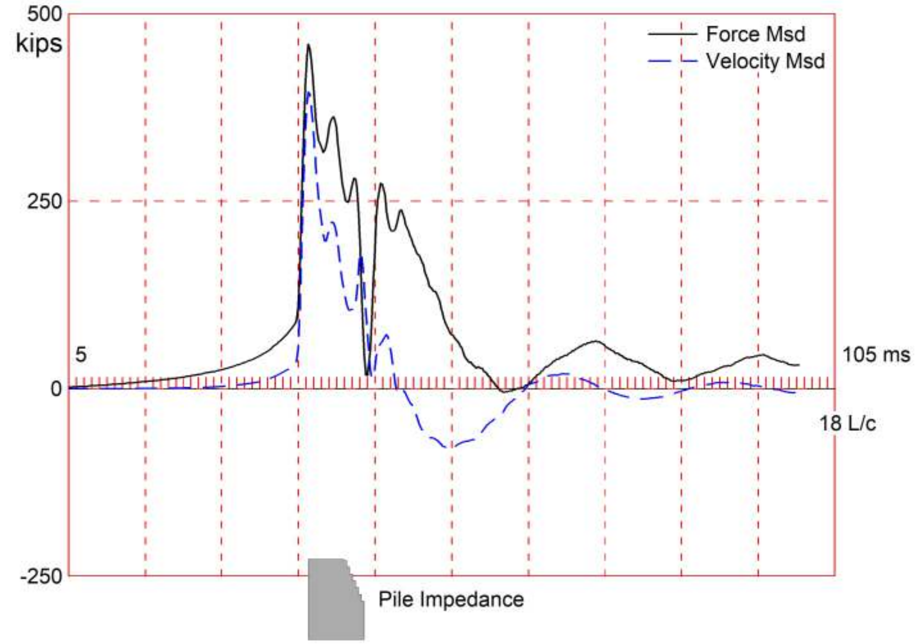
| Segmnt Number | Dist. B.G. | Impedance | Imped. Change | Tension Slack | Tension Eff. | Compression Slack | Compression Eff. | Perim. | Wave Speed | Soil Plug |
|---|---|---|---|---|---|---|---|---|---|---|
| | ft | kips/ft/s | % | in | | in | | ft | ft/s | kips |
| 1 | 3.3 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.000 |
| 2 | 6.6 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.011 |
| 18 | 59.3 | 41.11 | 11.27 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.011 |

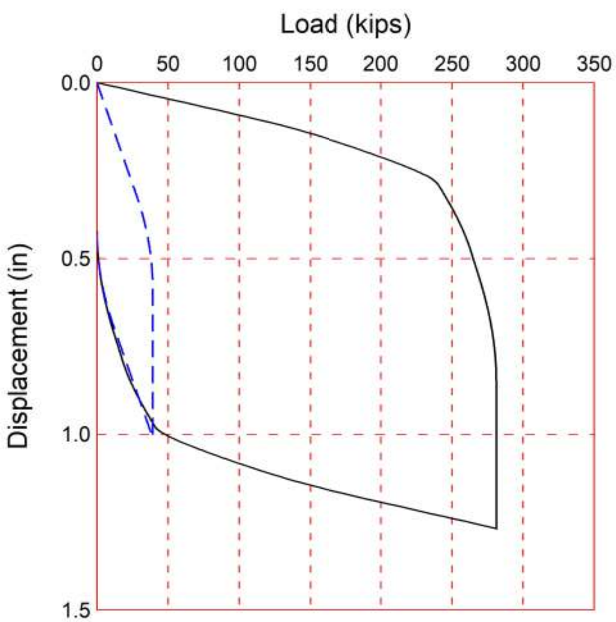
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.8 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 7.1 ms
Total volume: 8.583 $ft^3$; Volume ratio considering added impedance: 1.006

TSFP, MOBILE ALABAMA; Pile: TP3; ID; Blow: 879 (Test: 26-Mar-2025 18:55:)
Scientific Applied Concepts Lmited (SACL)

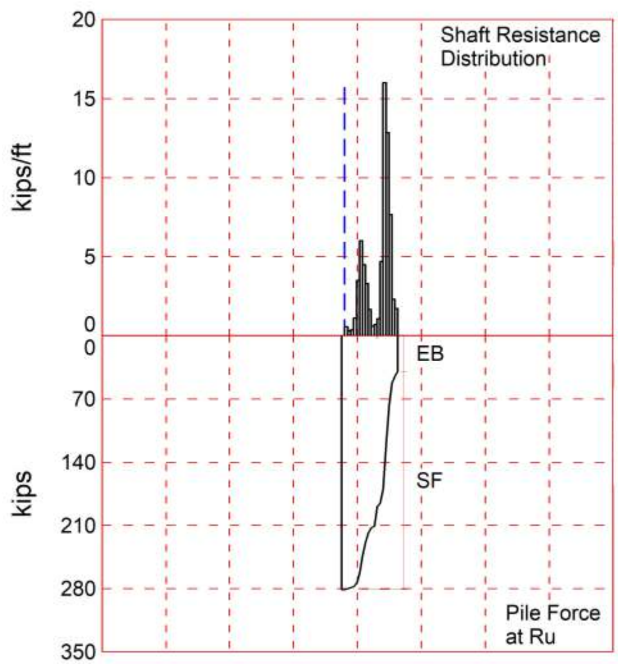
04-Apr-2025
CAPWAP(R) 2014-3




| | |
|---|---|
| RU = | 281.2 kips |
| SF = | 222.5 kips |
| EB1 = | 39.3 kips |
| EB2 = | 19.4 kips |
| Dy = | 0.85 in |
| Dx = | 1.27 in |
| SET/Bl = | 0.42 in |




| | |
|---|---|
| Length b. Sensors | 61.4 ft |
| Embedment | 57.0 ft |
| Top Area | 20.7 $in^2$ |
| End Bearing Area | 254.2 $in^2$ |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 $lb/ft^3$ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 16808 ft/s |
| Match Quality | 1.91 |
| Top Compr. Stress | 22.2 ksi |
| Max Compr. Stress | 22.9 ksi |
| Max Tension Stress | -2.57 ksi |
| Avg. Shaft Quake | 0.07 in |
| Toe Quake | 0.45 in |
| Avg. Shaft Smith Dpg. | 0.06 s/ft |
| Toe Smith Damping | 0.31 s/ft |

## CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 281.2; along Shaft 222.5; at Toe 58.7 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf |
|---|---|---|---|---|---|---|---|
| | | | | 281.2 | | | |
| 1 | 6.5 | 2.1 | 1.2 | 280.0 | 1.2 | 0.56 | 0.12 |
| 2 | 9.7 | 5.4 | 1.1 | 278.9 | 2.3 | 0.34 | 0.07 |
| 3 | 12.9 | 8.6 | 1.2 | 277.7 | 3.5 | 0.37 | 0.08 |
| 4 | 16.1 | 11.8 | 3.6 | 274.1 | 7.1 | 1.11 | 0.24 |
| 5 | 19.4 | 15.0 | 11.3 | 262.8 | 18.4 | 3.50 | 0.74 |
| 6 | 22.6 | 18.3 | 19.4 | 243.4 | 37.8 | 6.01 | 1.28 |
| 7 | 25.8 | 21.5 | 14.5 | 228.9 | 52.3 | 4.49 | 0.95 |
| 8 | 29.1 | 24.7 | 10.7 | 218.2 | 63.0 | 3.31 | 0.70 |
| 9 | 32.3 | 28.0 | 5.4 | 212.8 | 68.4 | 1.67 | 0.35 |
| 10 | 35.5 | 31.2 | 2.0 | 210.8 | 70.4 | 0.62 | 0.13 |
| 11 | 38.7 | 34.4 | 2.3 | 208.5 | 72.7 | 0.71 | 0.15 |
| 2nd | Toe | | 19.4 | | | | |
| 12 | 42.0 | 37.6 | 3.5 | 185.6 | 95.6 | 1.08 | 0.23 |
| 13 | 45.2 | 40.9 | 15.2 | 170.4 | 110.8 | 4.71 | 1.11 |
| 14 | 48.4 | 44.1 | 51.7 | 118.7 | 162.5 | 16.01 | 4.14 |
| 15 | 51.7 | 47.3 | 41.5 | 77.2 | 204.0 | 12.85 | 3.70 |
| 16 | 54.9 | 50.6 | 24.8 | 52.4 | 228.8 | 7.68 | 2.50 |
| 17 | 58.1 | 53.8 | 7.5 | 44.9 | 236.3 | 2.32 | 0.87 |
| 18 | 61.4 | 57.0 | 5.6 | 39.3 | 241.9 | 1.73 | 0.76 |
| Avg. Shaft | | | 12.4 | | | 3.90 | 0.93 |
| Toe | | | 39.3 | | | | 22.26 |

| Soil Model Parameters/Extensions | | Shaft | Toe | 2nd |
|---|---|---|---|---|
| Smith Damping Factor | | 0.06 | 0.31 | 0.17 |
| Quake | (in) | 0.07 | 0.45 | 0.24 |
| Case Damping Factor | | 0.35 | 0.32 | 0.09 |
| Damping Type | | Viscous | Sm+Visc | Sm+Visc |
| Unloading Quake | (% of loading quake) | 30 | 60 | |
| Reloading Level | (% of Ru) | 100 | 100 | |
| Unloading Level | (% of Ru) | 15 | | |
| Resistance Gap (included in Toe Quake) (in) | | | 0.24 | |
| Soil Plug Weight | (kips) | | 0.062 | |

CAPWAP match quality = 1.91 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.42 in; Blow Count = 28 b/ft
Computed: Final Set = 0.47 in; Blow Count = 26 b/ft
Transducer F1 (U971) CAL: 144.2; RF: 1.00; F4 (U970) CAL: 143.9; RF: 1.00
A2 (K11820) CAL: 434; RF: 1.00; A3 (K11831) CAL: 428; RF: 1.00

| | | | |
|---|---|---|---|
| max. Top Comp. Stress | = | 22.2 ksi | (T= 36.5 ms, max= 1.030 x Top) |
| max. Comp. Stress | = | 22.9 ksi | (Z= 19.4 ft, T= 37.5 ms) |
| max. Tens. Stress | = | -2.57 ksi | (Z= 58.1 ft, T= 40.7 ms) |
| max. Energy (EMX) | = | 17.3 kip-ft; | max. Measured Top Displ. (DMX)= 0.70 in |

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.2 | 460.5 | -7.8 | 22.2 | -0.38 | 17.3 | 10.7 | 0.71 |
| 2 | 6.5 | 462.8 | -9.3 | 22.4 | -0.45 | 17.1 | 10.6 | 0.69 |
| 3 | 9.7 | 464.0 | -10.1 | 22.4 | -0.49 | 16.9 | 10.5 | 0.68 |
| 4 | 12.9 | 467.2 | -10.9 | 22.6 | -0.52 | 16.7 | 10.4 | 0.67 |
| 5 | 16.1 | 472.5 | -11.0 | 22.8 | -0.53 | 16.5 | 10.2 | 0.65 |
| 6 | 19.4 | 474.4 | -10.3 | 22.9 | -0.50 | 16.2 | 10.0 | 0.64 |
| 7 | 22.6 | 463.0 | -8.5 | 22.4 | -0.41 | 15.3 | 9.8 | 0.63 |
| 8 | 25.8 | 437.6 | -4.6 | 21.1 | -0.22 | 13.9 | 9.6 | 0.62 |
| 9 | 29.1 | 418.2 | -1.9 | 20.2 | -0.09 | 12.9 | 9.5 | 0.61 |
| 10 | 32.3 | 402.6 | -0.8 | 19.4 | -0.04 | 12.2 | 9.5 | 0.60 |
| 11 | 35.5 | 392.4 | -0.4 | 19.0 | -0.02 | 11.7 | 9.6 | 0.58 |
| 12 | 38.7 | 388.5 | -0.7 | 18.8 | -0.03 | 11.5 | 9.6 | 0.57 |
| 13 | 42.0 | 362.9 | -9.1 | 17.9 | -0.45 | 9.9 | 9.5 | 0.56 |
| 14 | 45.2 | 364.9 | -9.0 | 19.6 | -0.48 | 9.6 | 9.3 | 0.55 |
| 15 | 48.4 | 346.3 | -6.8 | 20.5 | -0.40 | 8.7 | 9.4 | 0.54 |
| 16 | 51.7 | 258.7 | 0.0 | 17.1 | 0.00 | 5.7 | 11.2 | 0.54 |
| 17 | 54.9 | 167.7 | -27.7 | 12.5 | -2.07 | 3.4 | 13.0 | 0.53 |
| 18 | 58.1 | 98.3 | -29.9 | 8.5 | -2.57 | 2.0 | 14.4 | 0.52 |
| 19 | 61.4 | 82.7 | -3.1 | 8.4 | -0.31 | 1.2 | 15.4 | 0.52 |
| Absolute | 19.4 | | | 22.9 | | | (T = | 37.5 ms) |
| | 58.1 | | | | -2.57 | | (T = | 40.7 ms) |

CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 385.2 | 338.0 | 290.8 | 243.5 | 196.3 | 149.1 | 101.8 | 54.6 | 7.4 | 0.0 |
| RX | 393.2 | 361.6 | 342.9 | 324.1 | 305.8 | 289.3 | 275.5 | 265.6 | 257.0 | 248.4 |
| RU | 385.2 | 338.0 | 290.8 | 243.5 | 196.3 | 149.1 | 101.8 | 54.6 | 7.4 | 0.0 |

RAU = 219.0 (kips); RA2 = 346.8 (kips)

Current CAPWAP Ru = 281.2 (kips); Corresponding J(RP)= 0.22; J(RX) = 0.56

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 10.8 | 36.50 | 397.6 | 460.0 | 462.5 | 0.70 | 0.42 | 0.42 | 17.4 | 373.6 | 181 |

PILE PROFILE AND PILE MODEL

| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 39.9 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 61.4 | 9.0 | 30000.0 | 492.000 | 2.09 |

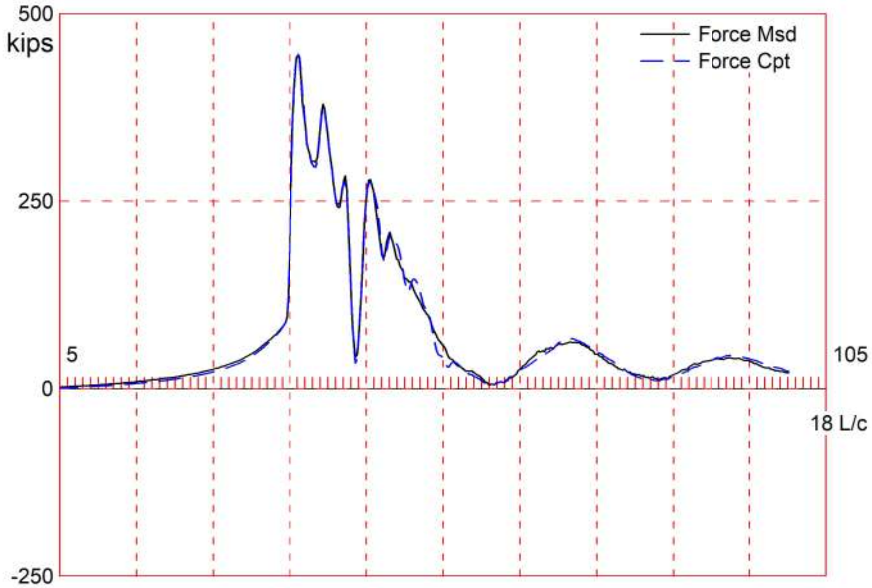
Toe Area 254.2 $in^2$

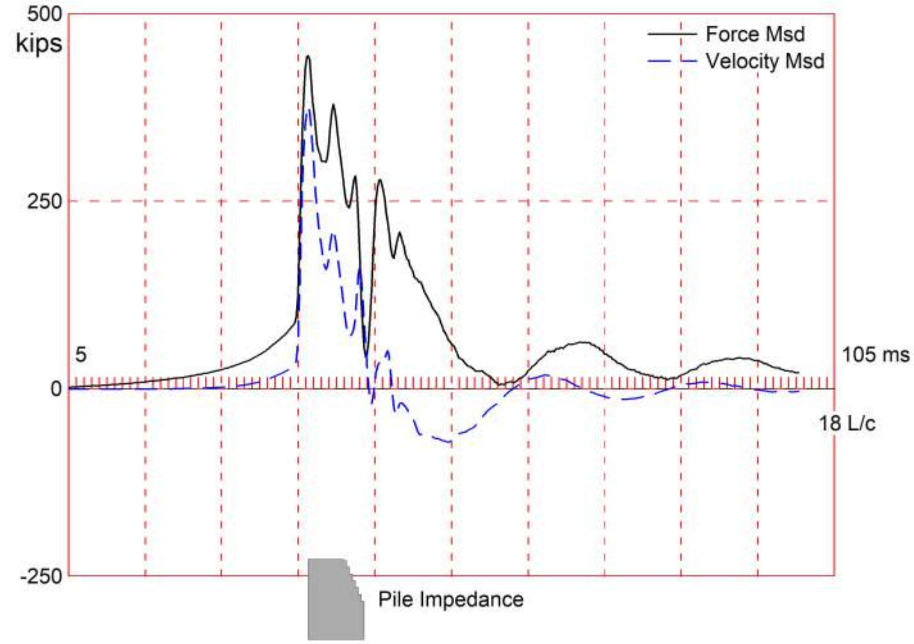
| Segmnt Number | Dist. B.G. | Impedance | Imped. Change | Tension Slack | Tension Eff. | Compression Slack | Compression Eff. | Perim. | Wave Speed |
|---|---|---|---|---|---|---|---|---|---|
| | ft | kips/ft/s | % | in | | in | | ft | ft/s |
| 1 | 3.2 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 |
| 13 | 42.0 | 36.27 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.63 | 16807.8 |
| 14 | 45.2 | 33.31 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.26 | 16807.8 |
| 15 | 48.4 | 30.16 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.86 | 16807.8 |
| 16 | 51.7 | 27.01 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.47 | 16807.8 |
| 17 | 54.9 | 23.87 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.08 | 16807.8 |
| 18 | 58.1 | 20.72 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.68 | 16807.8 |
| 19 | 61.4 | 17.57 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.29 | 16807.8 |

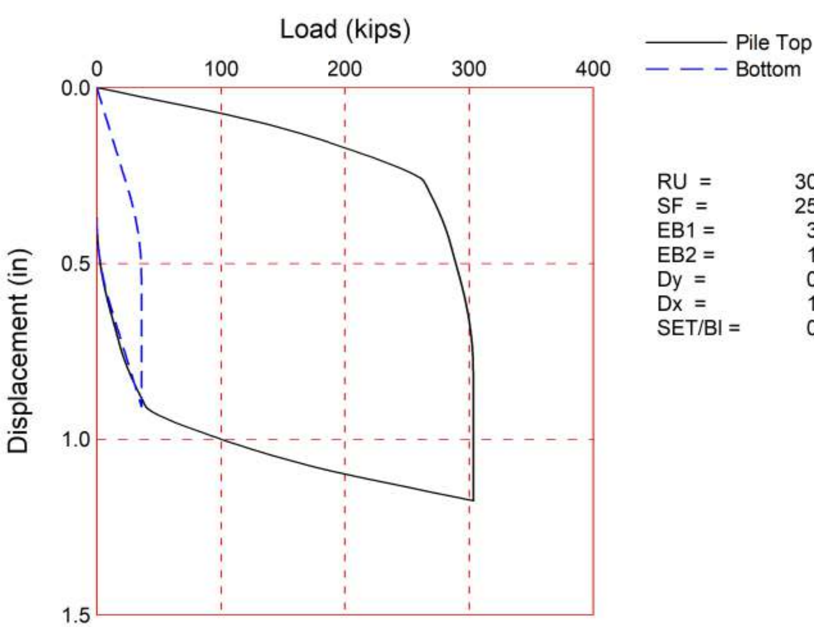
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.8 ft/s
Pile Damping 1.00 %, Time Incr 0.192 ms, 2L/c 7.3 ms
Total volume: 7.944 $ft^3$; Volume ratio considering added impedance: 1.000

TSFP, MOBILE ALABAMA; Pile: TP4; ID; Blow: 1080 (Test: 27-Mar-2025 11:49:)
Scientific Applied Concepts Lmited (SACL)

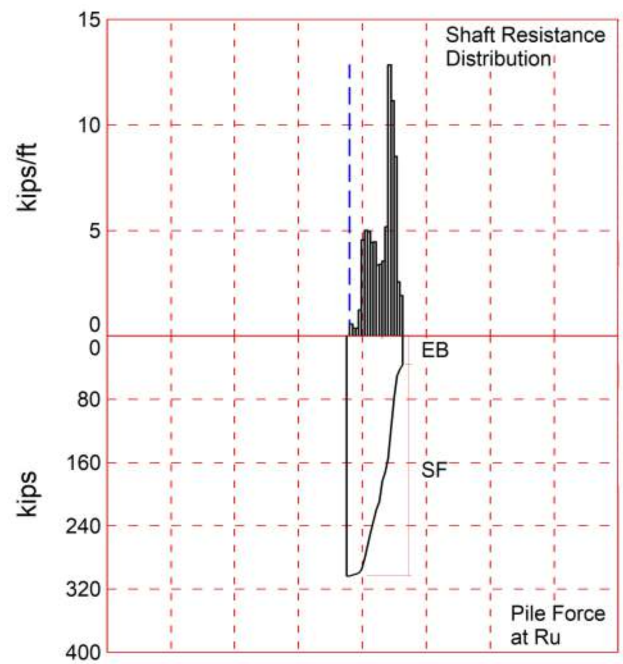
04-Apr-2025
CAPWAP(R) 2014-3




| | |
|---|---|
| RU = | 303.4 kips |
| SF = | 252.8 kips |
| EB1 = | 36.0 kips |
| EB2 = | 14.6 kips |
| Dy = | 0.81 in |
| Dx = | 1.17 in |
| SET/Bl = | 0.37 in |




| | |
|---|---|
| Length b. Sensors | 61.3 ft |
| Embedment | 57.0 ft |
| Top Area | 20.7 $in^2$ |
| End Bearing Area | 254.2 $in^2$ |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 $lb/ft^3$ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 16808 ft/s |
| Match Quality | 1.95 |
| Top Compr. Stress | 21.7 ksi |
| Max Compr. Stress | 22.4 ksi |
| Max Tension Stress | -1.76 ksi |
| Avg. Shaft Quake | 0.04 in |
| Toe Quake | 0.41 in |
| Avg. Shaft Smith Dpg. | 0.05 s/ft |
| Toe Smith Damping | 0.30 s/ft |

## CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 303.4; along Shaft 252.8; at Toe 50.6 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf |
|---|---|---|---|---|---|---|---|
| | | | | 303.4 | | | |
| 1 | 6.5 | 2.1 | 1.2 | 302.2 | 1.2 | 0.56 | 0.12 |
| 2 | 9.7 | 5.4 | 1.2 | 301.0 | 2.4 | 0.37 | 0.08 |
| 3 | 12.9 | 8.6 | 1.2 | 299.8 | 3.6 | 0.37 | 0.08 |
| 4 | 16.1 | 11.8 | 4.0 | 295.8 | 7.6 | 1.24 | 0.26 |
| 5 | 19.4 | 15.0 | 14.7 | 281.1 | 22.3 | 4.55 | 0.97 |
| 6 | 22.6 | 18.3 | 16.2 | 264.9 | 38.5 | 5.02 | 1.06 |
| 7 | 25.8 | 21.5 | 16.0 | 248.9 | 54.5 | 4.96 | 1.05 |
| 8 | 29.1 | 24.7 | 14.3 | 234.6 | 68.8 | 4.43 | 0.94 |
| 9 | 32.3 | 28.0 | 14.4 | 220.2 | 83.2 | 4.46 | 0.95 |
| 10 | 35.5 | 31.2 | 10.9 | 209.3 | 94.1 | 3.38 | 0.72 |
| 11 | 38.7 | 34.4 | 11.0 | 198.3 | 105.1 | 3.41 | 0.72 |
| 2nd | Toe | | 14.6 | | | | |
| 12 | 42.0 | 37.6 | 11.5 | 172.2 | 131.2 | 3.56 | 0.77 |
| 13 | 45.2 | 40.9 | 16.7 | 155.5 | 147.9 | 5.17 | 1.21 |
| 14 | 48.4 | 44.1 | 41.5 | 114.0 | 189.4 | 12.85 | 3.33 |
| 15 | 51.7 | 47.3 | 36.0 | 78.0 | 225.4 | 11.15 | 3.21 |
| 16 | 54.9 | 50.6 | 27.5 | 50.5 | 252.9 | 8.52 | 2.77 |
| 17 | 58.1 | 53.8 | 8.3 | 42.2 | 261.2 | 2.57 | 0.96 |
| 18 | 61.3 | 57.0 | 6.2 | 36.0 | 267.4 | 1.92 | 0.84 |
| Avg. Shaft | | | 14.0 | | | 4.43 | 1.05 |
| Toe | | | 36.0 | | | | 20.39 |

| Soil Model Parameters/Extensions | | Shaft | Toe | 2nd |
|---|---|---|---|---|
| Smith Damping Factor | | 0.05 | 0.30 | 0.17 |
| Quake | (in) | 0.04 | 0.41 | 0.20 |
| Case Damping Factor | | 0.33 | 0.30 | 0.07 |
| Damping Type | | Viscous | Sm+Visc | Sm+Visc |
| Unloading Quake | (% of loading quake) | 60 | 90 | |
| Reloading Level | (% of Ru) | 100 | 100 | |
| Unloading Level | (% of Ru) | 10 | | |
| Resistance Gap (included in Toe Quake) (in) | | | 0.18 | |
| Soil Plug Weight | (kips) | | 0.063 | |

CAPWAP match quality = 1.95 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.37 in; Blow Count = 33 b/ft
Computed: Final Set = 0.40 in; Blow Count = 30 b/ft
Transducer F2 (U971) CAL: 144.2; RF: 1.00; F4 (U970) CAL: 143.9; RF: 1.00
A1 (K11820) CAL: 434; RF: 1.00; A3 (K11831) CAL: 428; RF: 1.00

max. Top Comp. Stress = 21.7 ksi (T= 36.5 ms, max= 1.034 x Top)
max. Comp. Stress = 22.4 ksi (Z= 19.4 ft, T= 37.5 ms)
max. Tens. Stress = -1.76 ksi (Z= 58.1 ft, T= 40.5 ms)
max. Energy (EMX) = 15.3 kip-ft; max. Measured Top Displ. (DMX)= 0.60 in

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.2 | 449.4 | 0.0 | 21.7 | 0.00 | 15.3 | 10.0 | 0.61 |
| 2 | 6.5 | 452.2 | 0.0 | 21.8 | 0.00 | 15.2 | 9.9 | 0.60 |
| 3 | 9.7 | 454.4 | -0.4 | 22.0 | -0.02 | 15.0 | 9.8 | 0.58 |
| 4 | 12.9 | 458.4 | -0.9 | 22.1 | -0.04 | 14.8 | 9.7 | 0.57 |
| 5 | 16.1 | 463.4 | -1.4 | 22.4 | -0.07 | 14.6 | 9.5 | 0.56 |
| 6 | 19.4 | 464.6 | -0.9 | 22.4 | -0.05 | 14.2 | 9.3 | 0.54 |
| 7 | 22.6 | 450.0 | 0.0 | 21.7 | 0.00 | 13.3 | 9.1 | 0.53 |
| 8 | 25.8 | 433.3 | 0.0 | 20.9 | 0.00 | 12.4 | 8.9 | 0.52 |
| 9 | 29.1 | 416.0 | 0.0 | 20.1 | 0.00 | 11.5 | 8.8 | 0.51 |
| 10 | 32.3 | 398.8 | 0.0 | 19.3 | 0.00 | 10.7 | 8.7 | 0.50 |
| 11 | 35.5 | 378.3 | 0.0 | 18.3 | 0.00 | 9.9 | 8.7 | 0.49 |
| 12 | 38.7 | 363.2 | 0.0 | 17.5 | 0.00 | 9.3 | 8.7 | 0.48 |
| 13 | 42.0 | 332.7 | 0.0 | 16.4 | 0.00 | 7.9 | 8.6 | 0.47 |
| 14 | 45.2 | 323.3 | 0.0 | 17.3 | 0.00 | 7.3 | 8.4 | 0.46 |
| 15 | 48.4 | 302.5 | 0.0 | 17.9 | 0.00 | 6.4 | 8.7 | 0.46 |
| 16 | 51.7 | 238.6 | -0.2 | 15.8 | -0.02 | 4.6 | 10.4 | 0.45 |
| 17 | 54.9 | 164.4 | -17.8 | 12.3 | -1.33 | 2.9 | 12.1 | 0.44 |
| 18 | 58.1 | 100.4 | -20.5 | 8.6 | -1.76 | 1.7 | 13.3 | 0.44 |
| 19 | 61.3 | 77.7 | -0.0 | 7.9 | -0.00 | 0.9 | 14.1 | 0.44 |
| Absolute | 19.4 | | | 22.4 | | | (T = | 37.5 ms) |
| | 58.1 | | | | -1.76 | | (T = | 40.5 ms) |

CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 396.2 | 353.7 | 311.2 | 268.7 | 226.2 | 183.7 | 141.2 | 98.7 | 56.2 | 13.7 |
| RX | 398.3 | 362.9 | 348.0 | 333.0 | 318.1 | 305.3 | 293.6 | 281.9 | 270.2 | 258.5 |
| RU | 396.2 | 353.7 | 311.2 | 268.7 | 226.2 | 183.7 | 141.2 | 98.7 | 56.2 | 13.7 |

RAU = 190.2 (kips); RA2 = 363.8 (kips)

Current CAPWAP Ru = 303.4 (kips); Corresponding J(RP)= 0.22; J(RX) = 0.52

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 10.2 | 36.50 | 376.3 | 445.0 | 445.6 | 0.60 | 0.37 | 0.37 | 15.5 | 383.2 | 152 |

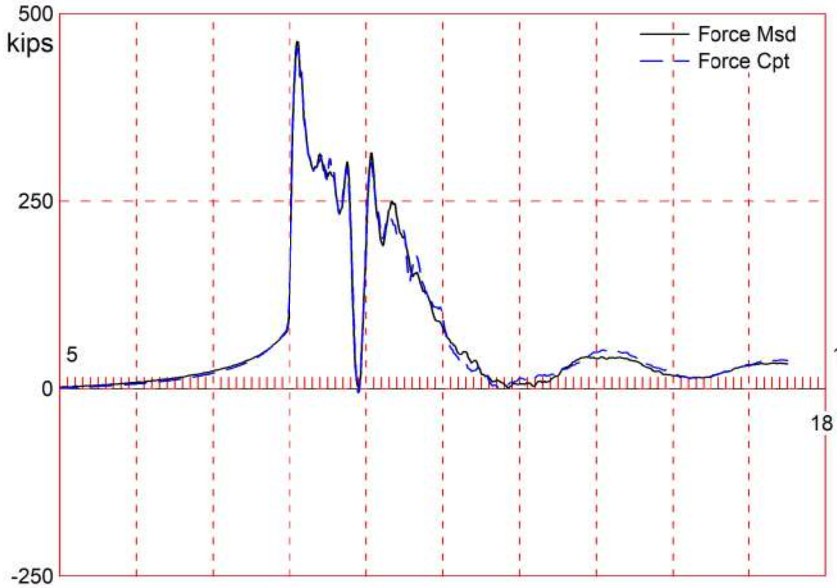
PILE PROFILE AND PILE MODEL

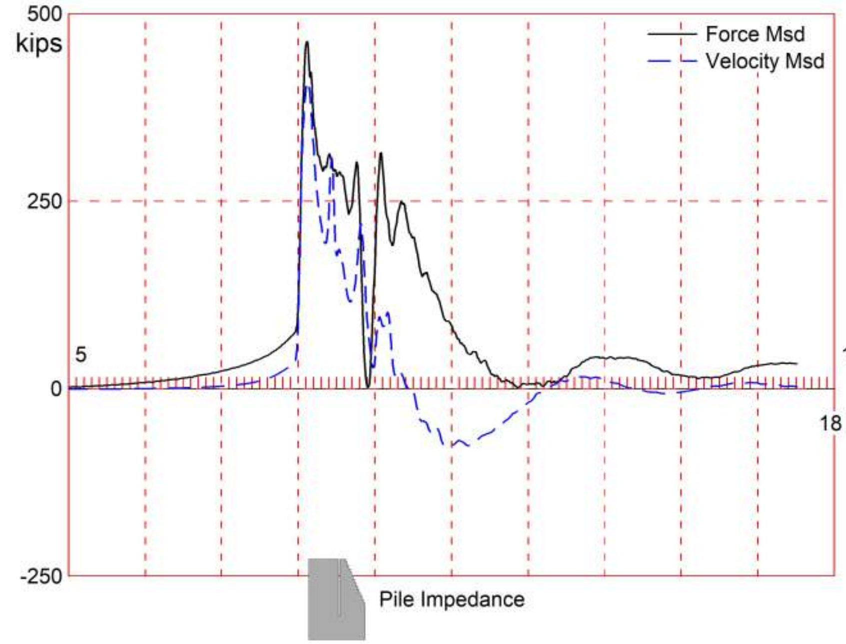
| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 39.9 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 61.3 | 9.0 | 30000.0 | 492.000 | 2.09 |

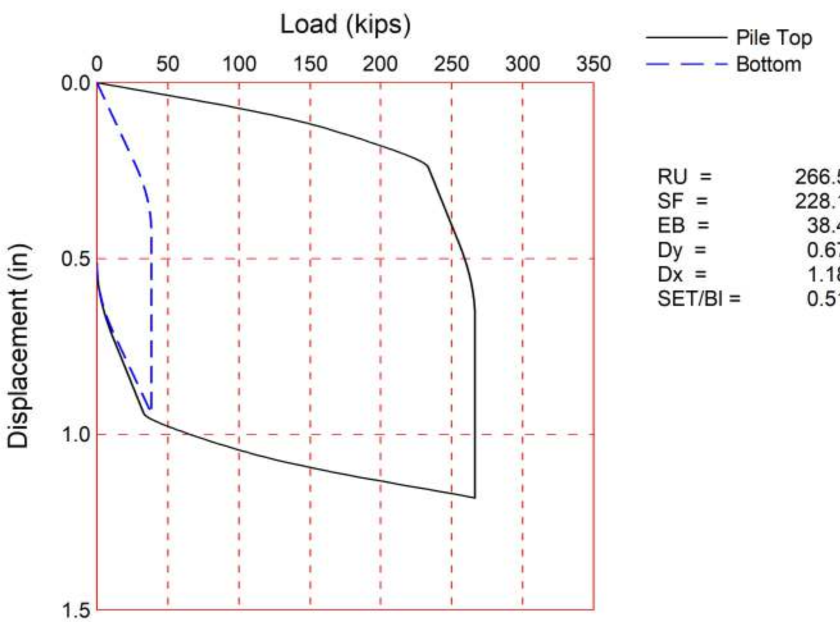
Toe Area 254.2 $in^2$

| Segmnt Number | Dist. B.G. ft | Impedance kips/ft/s | Imped. Change % | Tension Slack in | Tension Eff. | Compression Slack in | Compression Eff. | Perim. ft | Wave Speed ft/s |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.2 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 |
| 13 | 42.0 | 36.28 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.63 | 16807.8 |
| 14 | 45.2 | 33.31 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.26 | 16807.8 |
| 15 | 48.4 | 30.17 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.86 | 16807.8 |
| 16 | 51.7 | 27.02 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.47 | 16807.8 |
| 17 | 54.9 | 23.87 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.08 | 16807.8 |
| 18 | 58.1 | 20.72 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.68 | 16807.8 |
| 19 | 61.3 | 17.57 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.29 | 16807.8 |

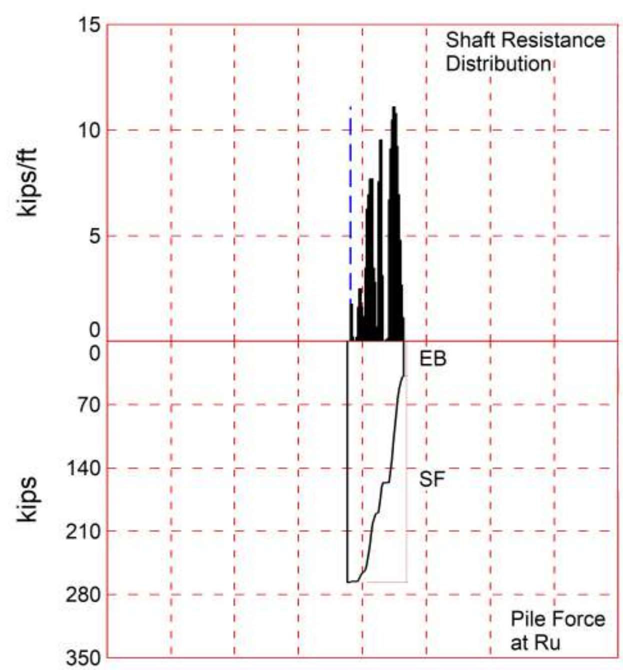
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.8 ft/s
Pile Damping 1.00 %, Time Incr 0.192 ms, 2L/c 7.3 ms
Total volume: 7.944 $ft^3$; Volume ratio considering added impedance: 1.000




| | |
|---|---|
| RU = | 266.5 kips |
| SF = | 228.1 kips |
| EB = | 38.4 kips |
| Dy = | 0.67 in |
| Dx = | 1.18 in |
| SET/Bl = | 0.51 in |




| | |
|---|---|
| Length b. Sensors | 61.3 ft |
| Embedment | 57.0 ft |
| Top Area | 20.7 $in^2$ |
| End Bearing Area | 254.2 $in^2$ |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 $lb/ft^3$ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 16808 ft/s |
| Match Quality | 2.86 |
| Top Compr. Stress | 22.0 ksi |
| Max Compr. Stress | 22.4 ksi |
| Max Tension Stress | -1.86 ksi |
| Avg. Shaft Quake | 0.04 in |
| Toe Quake | 0.33 in |
| Avg. Shaft Smith Dpg. | 0.05 s/ft |
| Toe Smith Damping | 0.12 s/ft |

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 266.5; along Shaft 228.1; at Toe 38.4 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Smith Damping Factor s/ft |
|---|---|---|---|---|---|---|---|---|
| | | | | 266.5 | | | | |
| 1 | 4.8 | 0.5 | 0.9 | 265.6 | 0.9 | 1.74 | 0.37 | 0.06 |
| 2 | 6.5 | 2.1 | 0.3 | 265.3 | 1.2 | 0.19 | 0.04 | 0.06 |
| 3 | 8.1 | 3.7 | 0.0 | 265.3 | 1.2 | 0.00 | 0.00 | 0.00 |
| 4 | 9.7 | 5.4 | 0.0 | 265.3 | 1.2 | 0.00 | 0.00 | 0.00 |
| 5 | 11.3 | 7.0 | 0.3 | 265.0 | 1.5 | 0.19 | 0.04 | 0.06 |
| 6 | 12.9 | 8.6 | 2.6 | 262.4 | 4.1 | 1.61 | 0.34 | 0.06 |
| 7 | 14.5 | 10.2 | 4.0 | 258.4 | 8.1 | 2.48 | 0.53 | 0.06 |
| 8 | 16.1 | 11.8 | 2.6 | 255.8 | 10.7 | 1.61 | 0.34 | 0.06 |
| 9 | 17.8 | 13.4 | 1.0 | 254.8 | 11.7 | 0.62 | 0.13 | 0.06 |
| 10 | 19.4 | 15.0 | 1.9 | 252.9 | 13.6 | 1.18 | 0.25 | 0.06 |
| 11 | 21.0 | 16.7 | 5.6 | 247.3 | 19.2 | 3.47 | 0.74 | 0.06 |
| 12 | 22.6 | 18.3 | 10.1 | 237.2 | 29.3 | 6.26 | 1.33 | 0.06 |
| 13 | 24.2 | 19.9 | 11.2 | 226.0 | 40.5 | 6.94 | 1.47 | 0.06 |
| 14 | 25.8 | 21.5 | 12.4 | 213.6 | 52.9 | 7.68 | 1.63 | 0.06 |
| 15 | 27.4 | 23.1 | 12.4 | 201.2 | 65.3 | 7.68 | 1.63 | 0.06 |
| 16 | 29.1 | 24.7 | 5.6 | 195.6 | 70.9 | 3.47 | 0.74 | 0.01 |
| 17 | 30.7 | 26.3 | 4.5 | 191.1 | 75.4 | 2.79 | 0.59 | 0.01 |
| 18 | 32.3 | 28.0 | 1.1 | 190.0 | 76.5 | 0.68 | 0.14 | 0.01 |
| 19 | 33.9 | 29.6 | 1.1 | 188.9 | 77.6 | 0.68 | 0.14 | 0.01 |
| 20 | 35.5 | 31.2 | 12.2 | 176.7 | 89.8 | 7.56 | 1.60 | 0.01 |
| 21 | 37.1 | 32.8 | 15.4 | 161.3 | 105.2 | 9.54 | 2.02 | 0.01 |
| 22 | 38.7 | 34.4 | 5.0 | 156.3 | 110.2 | 3.10 | 0.66 | 0.01 |
| 23 | 40.4 | 36.0 | 0.0 | 156.3 | 110.2 | 0.00 | 0.00 | 0.00 |
| 24 | 42.0 | 37.6 | 0.0 | 156.3 | 110.2 | 0.00 | 0.00 | 0.00 |
| 25 | 43.6 | 39.3 | 0.1 | 156.2 | 110.3 | 0.06 | 0.01 | 0.01 |
| 26 | 45.2 | 40.9 | 0.2 | 156.0 | 110.5 | 0.12 | 0.03 | 0.01 |
| 27 | 46.8 | 42.5 | 10.8 | 145.2 | 121.3 | 6.69 | 1.69 | 0.06 |
| 28 | 48.4 | 44.1 | 14.7 | 130.5 | 136.0 | 9.11 | 2.42 | 0.06 |
| 29 | 50.0 | 45.7 | 16.9 | 113.6 | 152.9 | 10.47 | 2.93 | 0.06 |
| 30 | 51.7 | 47.3 | 17.9 | 95.7 | 170.8 | 11.09 | 3.29 | 0.06 |
| 31 | 53.3 | 48.9 | 17.4 | 78.3 | 188.2 | 10.78 | 3.39 | 0.06 |
| 32 | 54.9 | 50.6 | 14.9 | 63.4 | 203.1 | 9.23 | 3.10 | 0.06 |
| 33 | 56.5 | 52.2 | 11.2 | 52.2 | 214.3 | 6.94 | 2.49 | 0.06 |
| 34 | 58.1 | 53.8 | 7.7 | 44.5 | 222.0 | 4.77 | 1.85 | 0.06 |
| 35 | 59.7 | 55.4 | 4.3 | 40.2 | 226.3 | 2.66 | 1.12 | 0.06 |
| 36 | 61.3 | 57.0 | 1.8 | 38.4 | 228.1 | 1.11 | 0.51 | 0.06 |
| Avg. Shaft | | | 6.3 | | | 4.00 | 0.95 | 0.05 |
| Toe | | | 38.4 | | | | 21.75 | 0.12 |

Soil Model Parameters/Extensions Shaft Toe

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Quake | (in) | 0.04 | 0.33 |
| Case Damping Factor | | 0.28 | 0.13 |
| Damping Type | | Viscous | Sm+Visc |
| Unloading Quake | (% of loading quake) | 60 | 40 |
| Reloading Level | (% of Ru) | 100 | 100 |
| Unloading Level | (% of Ru) | 0 | |
| Resistance Gap (included in Toe Quake) (in) | | | 0.13 |
| Soil Plug Weight | (kips) | | 0.112 |

CAPWAP match quality = 2.86 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.51 in; Blow Count = 23 b/ft
Computed: Final Set = 0.48 in; Blow Count = 25 b/ft
Transducer F2 (U971) CAL: 144.2; RF: 1.00; F4 (U970) CAL: 143.9; RF: 1.00
A1 (K11820) CAL: 434; RF: 1.00; A3 (K11831) CAL: 428; RF: 1.00

max. Top Comp. Stress = 22.0 ksi (T= 36.3 ms, max= 1.022 x Top)
max. Comp. Stress = 22.4 ksi (Z= 19.4 ft, T= 37.4 ms)
max. Tens. Stress = -1.86 ksi (Z= 58.1 ft, T= 47.4 ms)
max. Energy (EMX) = 18.9 kip-ft; max. Measured Top Displ. (DMX)= 0.80 in

**EXTREMA TABLE**

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 1.6 | 454.4 | -0.1 | 22.0 | -0.01 | 18.9 | 11.3 | 0.81 |
| 2 | 3.2 | 455.6 | -0.1 | 22.0 | -0.01 | 17.5 | 10.5 | 0.74 |
| 4 | 6.5 | 457.1 | -2.8 | 22.1 | -0.14 | 17.4 | 10.4 | 0.73 |
| 6 | 9.7 | 460.0 | -3.8 | 22.2 | -0.18 | 17.3 | 10.3 | 0.72 |
| 8 | 12.9 | 464.0 | -3.1 | 22.4 | -0.15 | 17.1 | 10.2 | 0.71 |
| 10 | 16.1 | 461.2 | -3.4 | 22.3 | -0.16 | 16.5 | 10.0 | 0.70 |
| 12 | 19.4 | 464.3 | -3.8 | 22.4 | -0.19 | 16.1 | 9.8 | 0.68 |
| 14 | 22.6 | 445.9 | -3.1 | 21.5 | -0.15 | 15.4 | 10.3 | 0.67 |
| 16 | 25.8 | 378.6 | -0.1 | 18.3 | -0.00 | 13.8 | 11.0 | 0.66 |
| 18 | 29.1 | 361.9 | -0.2 | 17.5 | -0.01 | 12.0 | 10.6 | 0.65 |
| 20 | 32.3 | 381.0 | -0.0 | 18.4 | -0.00 | 11.4 | 9.7 | 0.64 |
| 22 | 35.5 | 375.7 | -0.1 | 18.1 | -0.00 | 11.2 | 10.4 | 0.62 |
| 24 | 38.7 | 336.5 | -0.2 | 16.3 | -0.01 | 9.8 | 10.1 | 0.61 |
| 26 | 42.0 | 328.8 | -2.4 | 16.5 | -0.12 | 9.5 | 9.6 | 0.60 |
| 28 | 45.2 | 333.7 | -3.5 | 18.3 | -0.19 | 9.4 | 9.5 | 0.60 |
| 30 | 48.4 | 321.9 | -4.1 | 19.6 | -0.25 | 8.7 | 9.4 | 0.58 |
| 32 | 51.7 | 273.9 | -4.3 | 18.6 | -0.29 | 6.6 | 10.7 | 0.57 |
| 34 | 54.9 | 201.6 | -13.8 | 15.6 | -1.07 | 4.4 | 12.8 | 0.57 |
| 35 | 56.5 | 162.0 | -20.9 | 13.4 | -1.73 | 3.5 | 13.8 | 0.57 |
| 36 | 58.1 | 124.6 | -20.7 | 11.2 | -1.86 | 2.7 | 14.7 | 0.57 |
| 37 | 59.7 | 106.3 | -13.9 | 10.3 | -1.35 | 2.2 | 15.4 | 0.57 |

## EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 38 | 61.3 | 91.7 | -2.9 | 9.8 | -0.31 | 1.8 | 16.1 | 0.56 |
| Absolute | 19.4 | | | 22.4 | | | (T = | 37.4 ms) |
| | 58.1 | | | | -1.86 | | (T = | 47.4 ms) |

## CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 378.7 | 329.4 | 280.1 | 230.8 | 181.5 | 132.3 | 83.0 | 33.7 | 0.0 | 0.0 |
| RX | 378.7 | 346.4 | 333.2 | 319.9 | 306.6 | 293.3 | 280.0 | 266.7 | 253.4 | 243.8 |
| RU | 378.7 | 329.4 | 280.1 | 230.8 | 181.5 | 132.3 | 83.0 | 33.7 | 0.0 | 0.0 |

RAU = 195.5 (kips); RA2 = 331.2 (kips)

Current CAPWAP Ru = 266.5 (kips); Corresponding J(RP)= 0.23; J(RX) = 0.70

| VMX ft/s | TVP ms | VT1*Z kips | FT1 kips | FMX kips | DMX in | DFN in | SET in | EMX kip-ft | QUS kips | KEB kips/in |
|---|---|---|---|---|---|---|---|---|---|---|
| 11.1 | 36.50 | 409.4 | 462.1 | 465.3 | 0.80 | 0.51 | 0.51 | 18.8 | 345.3 | 195 |

## PILE PROFILE AND PILE MODEL

| Depth ft | Area $in^2$ | E-Modulus ksi | Spec. Weight $lb/ft^3$ | Perim. ft |
|---|---|---|---|---|
| 0.0 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 39.9 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 61.3 | 9.0 | 30000.0 | 492.000 | 2.09 |

Toe Area 254.2 $in^2$

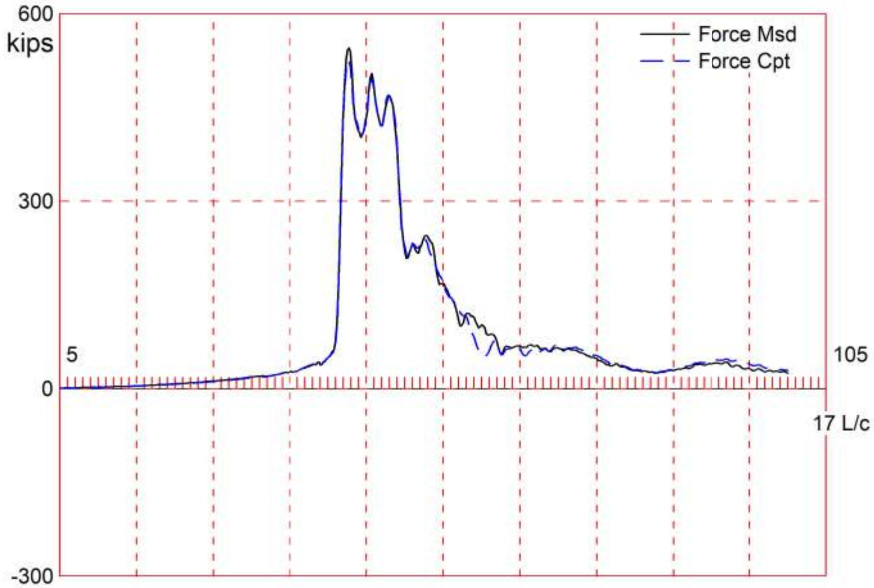
| Segmnt Number | Dist. B.G. ft | Impedance kips/ft/s | Imped. Change % | Tension Slack in | Tension Eff. | Compression Slack in | Compression Eff. | Perim. ft | Wave Speed ft/s |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.6 | 36.95 | 0.00 | 0.00 | 0.000 | -0.06 | 0.030 | 4.71 | 16807.8 |
| 2 | 3.2 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 |
| 3 | 4.8 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 1.000 | 4.71 | 16807.8 |
| 4 | 6.5 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 |
| 9 | 14.5 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 1.000 | 4.71 | 16807.8 |
| 10 | 16.1 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 |
| 21 | 33.9 | 10.96 | -70.33 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 |
| 22 | 35.5 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 |
| 25 | 40.4 | 36.88 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.8 |
| 26 | 42.0 | 35.68 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.55 | 16807.8 |
| 27 | 43.6 | 34.10 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.36 | 16807.8 |

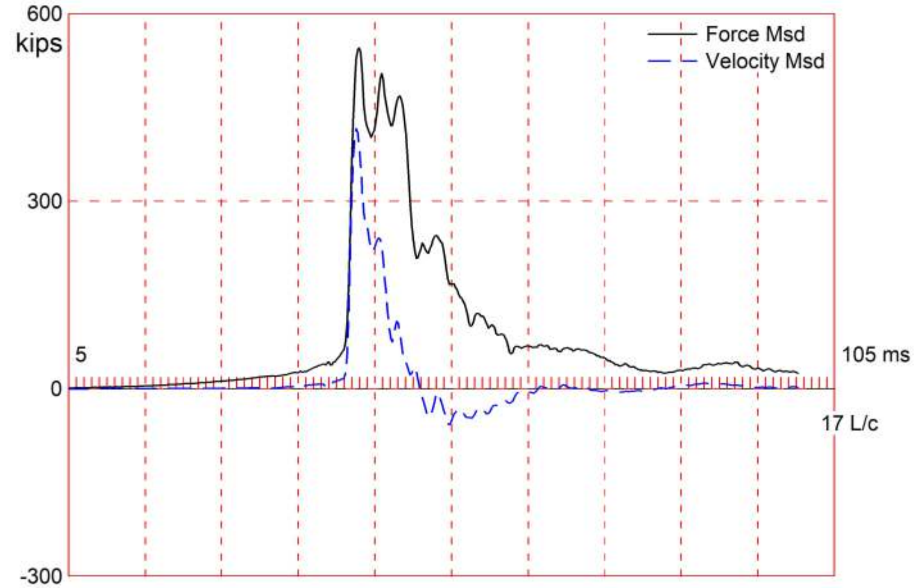
| Segmnt Number | Dist. B.G. ft | Impedance kips/ft/s | Imped. Change % | Slack in | Tension Eff. | Compression Slack in | Compression Eff. | Perim. ft | Wave Speed ft/s |
|---|---|---|---|---|---|---|---|---|---|
| 28 | 45.2 | 32.53 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.16 | 16807.8 |
| 29 | 46.8 | 30.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.96 | 16807.8 |
| 30 | 48.4 | 29.38 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.77 | 16807.8 |
| 31 | 50.0 | 27.81 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.57 | 16807.8 |
| 32 | 51.7 | 26.23 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.37 | 16807.8 |
| 33 | 53.3 | 24.65 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.18 | 16807.8 |
| 34 | 54.9 | 23.08 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.98 | 16807.8 |
| 35 | 56.5 | 21.50 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.78 | 16807.8 |
| 36 | 58.1 | 19.93 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.58 | 16807.8 |
| 37 | 59.7 | 18.36 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.39 | 16807.8 |
| 38 | 61.3 | 16.78 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.19 | 16807.8 |

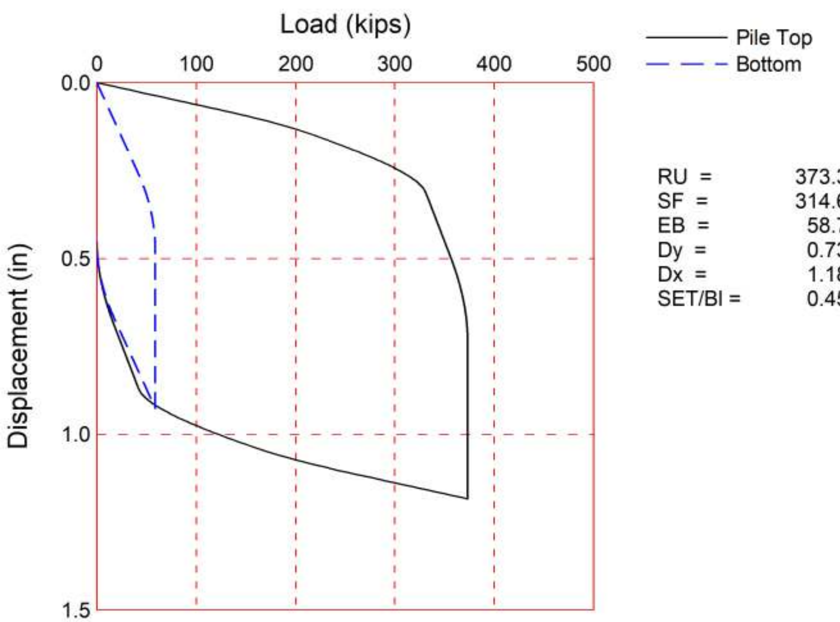
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.8 ft/s
Pile Damping 1.00 %, Time Incr 0.096 ms, 2L/c 7.3 ms
Total volume: 7.780 $ft^3$; Volume ratio considering added impedance: 0.979

TSFP; Pile: TP1; R; Blow: 1 (Test: 28-Mar-2025 08:30:)
Scientific Applied Concepts Lmited (SACL)

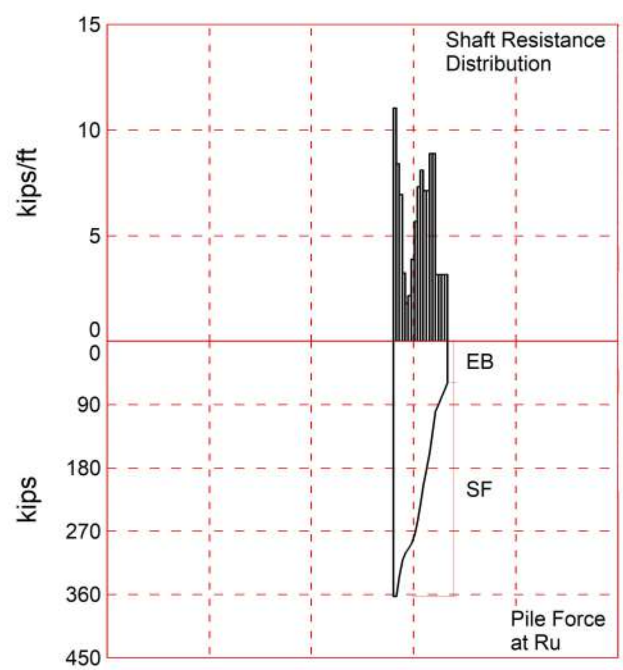
04-Apr-2025
CAPWAP(R) 2014-3




| | | |
|---|---|---|
| RU | = | 373.3 kips |
| SF | = | 314.6 kips |
| EB | = | 58.7 kips |
| Dy | = | 0.73 in |
| Dx | = | 1.18 in |
| SET/Bl | = | 0.45 in |




| | |
|---|---|
| Length b. Sensors | 59.3 ft |
| Embedment | 57.0 ft |
| Top Area | 20.7 $in^2$ |
| End Bearing Area | 254.2 $in^2$ |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 $lb/ft^3$ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 16808 ft/s |
| Match Quality | 2.22 |
| Top Compr. Stress | 26.2 ksi |
| Max Compr. Stress | 26.2 ksi |
| Max Tension Stress | -0.05 ksi |
| Avg. Shaft Quake | 0.09 in |
| Toe Quake | 0.36 in |
| Avg. Shaft Smith Dpg. | 0.09 s/ft |
| Toe Smith Damping | 0.13 s/ft |

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 373.3; along Shaft 314.6; at Toe 58.7 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf |
|---|---|---|---|---|---|---|---|
| | | | | 373.3 | | | |
| 1 | 3.3 | 1.0 | 10.8 | 362.5 | 10.8 | 11.06 | 2.35 |
| 2 | 6.6 | 4.3 | 27.7 | 334.8 | 38.5 | 8.40 | 1.78 |
| 3 | 9.9 | 7.6 | 22.9 | 311.9 | 61.4 | 6.95 | 1.47 |
| 4 | 13.2 | 10.9 | 10.7 | 301.2 | 72.1 | 3.25 | 0.69 |
| 5 | 16.5 | 14.2 | 5.9 | 295.3 | 78.0 | 1.79 | 0.38 |
| 6 | 19.8 | 17.5 | 7.1 | 288.2 | 85.1 | 2.15 | 0.46 |
| 7 | 23.1 | 20.8 | 12.8 | 275.4 | 97.9 | 3.88 | 0.82 |
| 8 | 26.4 | 24.1 | 18.7 | 256.7 | 116.6 | 5.67 | 1.20 |
| 9 | 29.7 | 27.3 | 24.1 | 232.6 | 140.7 | 7.31 | 1.55 |
| 10 | 33.0 | 30.6 | 26.7 | 205.9 | 167.4 | 8.10 | 1.72 |
| 11 | 36.3 | 33.9 | 23.5 | 182.4 | 190.9 | 7.13 | 1.51 |
| 12 | 39.6 | 37.2 | 23.5 | 158.9 | 214.4 | 7.13 | 1.51 |
| 13 | 42.9 | 40.5 | 29.3 | 129.6 | 243.7 | 8.89 | 1.89 |
| 14 | 46.1 | 43.8 | 29.3 | 100.3 | 273.0 | 8.89 | 1.89 |
| 15 | 49.4 | 47.1 | 10.4 | 89.9 | 283.4 | 3.16 | 0.67 |
| 16 | 52.7 | 50.4 | 10.4 | 79.5 | 293.8 | 3.16 | 0.67 |
| 17 | 56.0 | 53.7 | 10.4 | 69.1 | 304.2 | 3.16 | 0.67 |
| 18 | 59.3 | 57.0 | 10.4 | 58.7 | 314.6 | 3.16 | 0.67 |
| Avg. Shaft | | | 17.5 | | | 5.52 | 1.17 |
| Toe | | | 58.7 | | | | 33.25 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Smith Damping Factor | | 0.09 | 0.13 |
| Quake | (in) | 0.09 | 0.36 |
| Case Damping Factor | | 0.78 | 0.21 |
| Damping Type | | Viscous | Viscous |
| Unloading Quake | (% of loading quake) | 50 | 120 |
| Reloading Level | (% of Ru) | 100 | 100 |
| Resistance Gap (included in Toe Quake) (in) | | | 0.01 |
| Soil Plug Weight | (kips) | | 0.411 |
| Soil Support Dashpot | | 0.000 | 4.000 |
| Soil Support Weight | (kips) | 0.00 | 1.62 |

CAPWAP match quality = 2.22 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.45 in; Blow Count = 27 b/ft
Computed: Final Set = 0.42 in; Blow Count = 29 b/ft
Transducer F2 (U971) CAL: 144.2; RF: 1.00; F4 (U970) CAL: 143.9; RF: 1.00
A1 (K11820) CAL: 434; RF: 1.00; A3 (K11831) CAL: 428; RF: 1.00

max. Top Comp. Stress = 26.2 ksi (T= 43.0 ms, max= 1.000 x Top)
max. Comp. Stress = 26.2 ksi (Z= 3.3 ft, T= 43.0 ms)
max. Tens. Stress = -0.05 ksi (Z= 59.3 ft, T= 42.2 ms)
max. Energy (EMX) = 19.8 kip-ft; max. Measured Top Displ. (DMX)= 0.56 in

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 542.6 | 0.0 | 26.2 | 0.00 | 19.8 | 11.2 | 0.56 |
| 2 | 6.6 | 534.0 | 0.0 | 25.8 | 0.00 | 18.9 | 10.8 | 0.54 |
| 3 | 9.9 | 488.2 | 0.0 | 23.6 | 0.00 | 17.0 | 10.5 | 0.53 |
| 4 | 13.2 | 459.2 | 0.0 | 22.2 | 0.00 | 15.4 | 10.3 | 0.52 |
| 5 | 16.5 | 452.5 | 0.0 | 21.9 | 0.00 | 14.7 | 10.1 | 0.50 |
| 6 | 19.8 | 451.2 | 0.0 | 21.8 | 0.00 | 14.2 | 9.8 | 0.49 |
| 7 | 23.1 | 452.9 | 0.0 | 21.9 | 0.00 | 13.7 | 9.4 | 0.48 |
| 8 | 26.4 | 441.2 | 0.0 | 21.3 | 0.00 | 12.9 | 8.9 | 0.46 |
| 9 | 29.7 | 425.3 | 0.0 | 20.5 | 0.00 | 11.9 | 8.4 | 0.46 |
| 10 | 33.0 | 402.3 | 0.0 | 19.4 | 0.00 | 10.6 | 7.9 | 0.45 |
| 11 | 36.3 | 375.3 | 0.0 | 18.1 | 0.00 | 9.3 | 7.5 | 0.44 |
| 12 | 39.6 | 352.2 | 0.0 | 17.0 | 0.00 | 8.1 | 7.0 | 0.43 |
| 13 | 42.9 | 326.6 | 0.0 | 15.8 | 0.00 | 7.0 | 6.7 | 0.43 |
| 14 | 46.1 | 295.9 | 0.0 | 14.3 | 0.00 | 5.6 | 6.5 | 0.42 |
| 15 | 49.4 | 267.3 | -0.0 | 12.9 | -0.00 | 4.3 | 6.4 | 0.42 |
| 16 | 52.7 | 261.8 | -0.0 | 12.6 | -0.00 | 3.9 | 7.3 | 0.42 |
| 17 | 56.0 | 233.5 | -0.1 | 11.3 | -0.00 | 3.4 | 8.4 | 0.42 |
| 18 | 59.3 | 178.8 | -1.1 | 8.6 | -0.05 | 2.4 | 9.0 | 0.42 |
| Absolute | 3.3 | | | 26.2 | | | (T = | 43.0 ms) |
| | 59.3 | | | | -0.05 | | (T = | 42.2 ms) |

CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 609.8 | 575.0 | 540.1 | 505.3 | 470.5 | 435.6 | 400.8 | 366.0 | 331.1 | 296.3 |
| RX | 609.8 | 575.0 | 540.1 | 505.3 | 470.5 | 435.6 | 400.8 | 366.0 | 331.1 | 296.3 |
| RU | 609.8 | 575.0 | 540.1 | 505.3 | 470.5 | 435.6 | 400.8 | 366.0 | 331.1 | 296.3 |

RAU = 104.6 (kips); RA2 = 441.6 (kips)

Current CAPWAP Ru = 373.3 (kips); Corresponding J(RP)= 0.68; J(RX) = 0.68

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 11.4 | 42.56 | 420.9 | 537.2 | 548.2 | 0.56 | 0.45 | 0.45 | 19.9 | 473.3 | 164 |

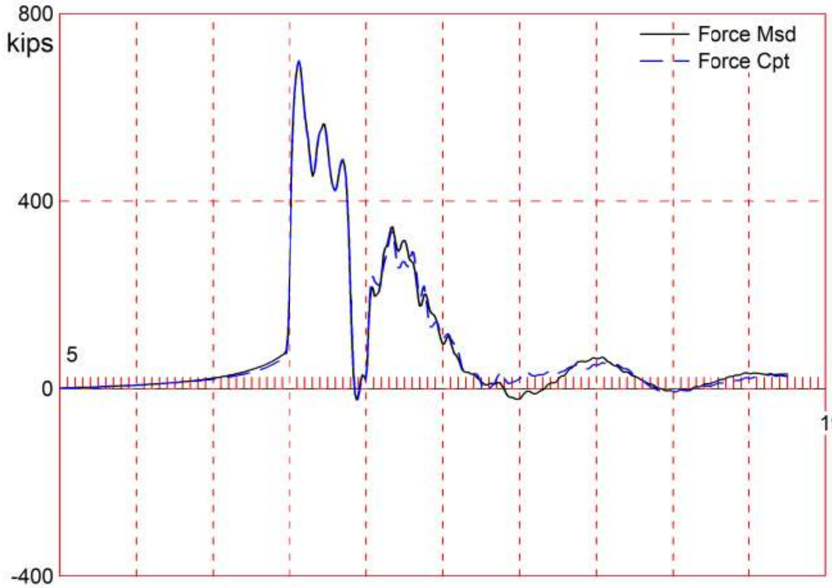
PILE PROFILE AND PILE MODEL

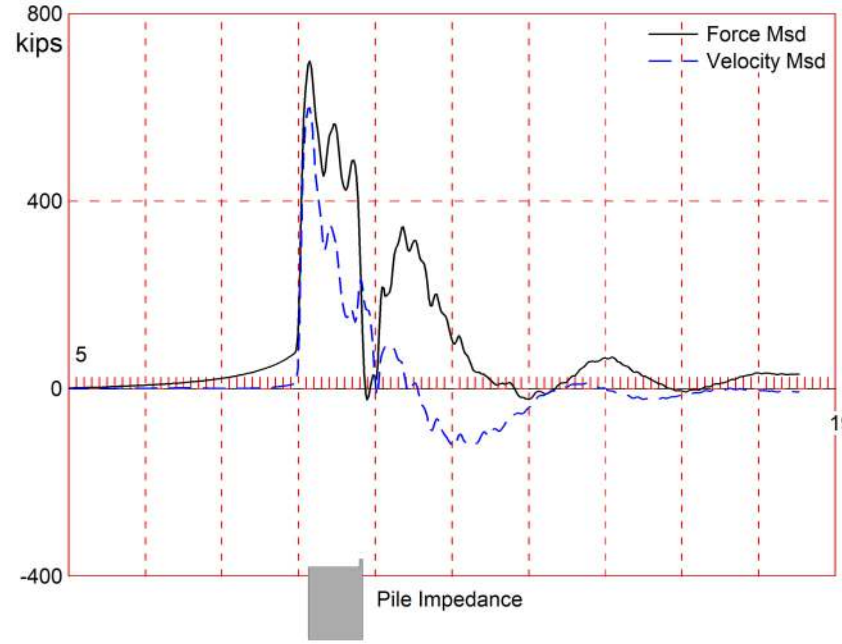
| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 59.3 | 20.7 | 30000.0 | 492.000 | 4.71 |

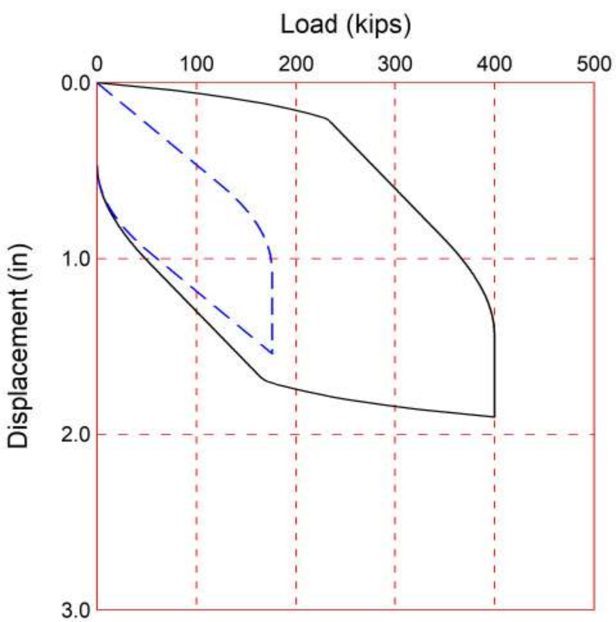
Toe Area 254.2 $in^2$

Top Segment Length 3.30 ft, Top Impedance 37 kips/ft/s

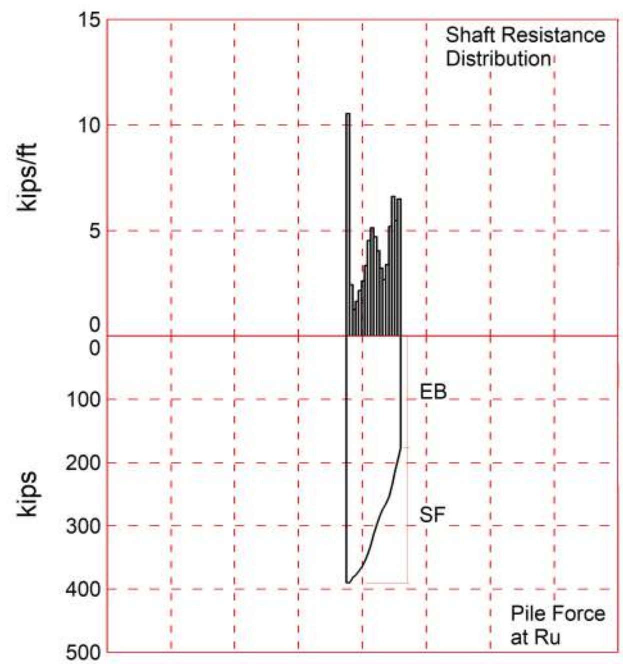
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.8 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 7.1 ms
Total volume: 8.530 $ft^3$; Volume ratio considering added impedance: 1.000




| | |
|---|---|
| RU = | 400.0 kips |
| SF = | 224.1 kips |
| EB = | 175.9 kips |
| Dy = | 1.43 in |
| Dx = | 1.90 in |
| SET/Bl = | 0.47 in |




| | |
|---|---|
| Length b. Sensors | 59.3 ft |
| Embedment | 57.0 ft |
| Top Area | 20.7 $in^2$ |
| End Bearing Area | 254.2 $in^2$ |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 $lb/ft^3$ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 16808 ft/s |
| Match Quality | 3.60 |
| Top Compr. Stress | 34.1 ksi |
| Max Compr. Stress | 34.1 ksi |
| Max Tension Stress | -0.81 ksi |
| Avg. Shaft Quake | 0.04 in |
| Toe Quake | 0.82 in |
| Avg. Shaft Smith Dpg. | 0.08 s/ft |
| Toe Smith Damping | 0.04 s/ft |

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 400.0; along Shaft 224.1; at Toe 175.9 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf |
|---|---|---|---|---|---|---|---|
| | | | | 400.0 | | | |
| 1 | 3.3 | 1.0 | 10.3 | 389.7 | 10.3 | 10.54 | 2.24 |
| 2 | 6.6 | 4.3 | 8.0 | 381.7 | 18.3 | 2.43 | 0.52 |
| 3 | 9.9 | 7.6 | 4.2 | 377.5 | 22.5 | 1.27 | 0.27 |
| 4 | 13.2 | 10.9 | 5.4 | 372.1 | 27.9 | 1.64 | 0.35 |
| 5 | 16.5 | 14.2 | 7.1 | 365.0 | 35.0 | 2.15 | 0.46 |
| 6 | 19.8 | 17.5 | 8.6 | 356.4 | 43.6 | 2.61 | 0.55 |
| 7 | 23.1 | 20.8 | 11.0 | 345.4 | 54.6 | 3.34 | 0.71 |
| 8 | 26.4 | 24.1 | 14.9 | 330.5 | 69.5 | 4.52 | 0.96 |
| 9 | 29.7 | 27.3 | 16.9 | 313.6 | 86.4 | 5.13 | 1.09 |
| 10 | 33.0 | 30.6 | 15.5 | 298.1 | 101.9 | 4.70 | 1.00 |
| 11 | 36.3 | 33.9 | 13.3 | 284.8 | 115.2 | 4.03 | 0.86 |
| 12 | 39.6 | 37.2 | 10.6 | 274.2 | 125.8 | 3.22 | 0.68 |
| 13 | 42.9 | 40.5 | 8.8 | 265.4 | 134.6 | 2.67 | 0.57 |
| 14 | 46.1 | 43.8 | 11.2 | 254.2 | 145.8 | 3.40 | 0.72 |
| 15 | 49.4 | 47.1 | 17.1 | 237.1 | 162.9 | 5.19 | 1.10 |
| 16 | 52.7 | 50.4 | 21.8 | 215.3 | 184.7 | 6.61 | 1.40 |
| 17 | 56.0 | 53.7 | 18.0 | 197.3 | 202.7 | 5.46 | 1.16 |
| 18 | 59.3 | 57.0 | 21.4 | 175.9 | 224.1 | 6.49 | 1.38 |
| Avg. Shaft | | | 12.5 | | | 3.93 | 0.83 |
| Toe | | | 175.9 | | | | 99.63 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Smith Damping Factor | | 0.08 | 0.04 |
| Quake | (in) | 0.04 | 0.82 |
| Case Damping Factor | | 0.48 | 0.18 |
| Damping Type | | Viscous | Sm+Visc |
| Unloading Quake | (% of loading quake) | 85 | 50 |
| Reloading Level | (% of Ru) | 100 | 100 |
| Unloading Level | (% of Ru) | 17 | |
| Resistance Gap (included in Toe Quake) (in) | | | 0.04 |
| Soil Plug Weight | (kips) | 0.085 | 0.335 |

CAPWAP match quality = 3.60 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.47 in; Blow Count = 25 b/ft
Computed: Final Set = 0.55 in; Blow Count = 22 b/ft
Transducer F2 (U971) CAL: 144.2; RF: 1.00; F4 (U970) CAL: 143.9; RF: 1.00
A1 (K11820) CAL: 434; RF: 1.00; A3 (K11831) CAL: 428; RF: 1.00

max. Top Comp. Stress = 34.1 ksi (T= 36.7 ms, max= 1.000 x Top)
max. Comp. Stress = 34.1 ksi (Z= 3.3 ft, T= 36.7 ms)
max. Tens. Stress = -0.81 ksi (Z= 3.3 ft, T= 43.9 ms)
max. Energy (EMX) = 40.8 kip-ft; max. Measured Top Displ. (DMX)= 1.04 in

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 705.4 | -16.7 | 34.1 | -0.81 | 40.8 | 16.1 | 1.07 |
| 2 | 6.6 | 687.6 | -4.2 | 33.2 | -0.20 | 39.1 | 15.9 | 1.05 |
| 3 | 9.9 | 676.6 | -4.1 | 32.7 | -0.20 | 37.6 | 15.7 | 1.03 |
| 4 | 13.2 | 675.8 | -3.9 | 32.6 | -0.19 | 36.8 | 15.5 | 1.01 |
| 5 | 16.5 | 674.5 | -2.4 | 32.6 | -0.12 | 35.8 | 15.2 | 0.99 |
| 6 | 19.8 | 671.8 | -1.5 | 32.5 | -0.07 | 34.5 | 14.9 | 0.97 |
| 7 | 23.1 | 667.0 | -0.3 | 32.2 | -0.01 | 33.1 | 14.5 | 0.96 |
| 8 | 26.4 | 656.4 | -0.0 | 31.7 | -0.00 | 31.5 | 14.2 | 0.94 |
| 9 | 29.7 | 636.3 | -0.0 | 30.7 | -0.00 | 29.4 | 13.9 | 0.93 |
| 10 | 33.0 | 610.6 | -0.0 | 29.5 | -0.00 | 27.0 | 14.4 | 0.92 |
| 11 | 36.3 | 587.2 | -0.0 | 28.4 | -0.00 | 24.8 | 14.8 | 0.91 |
| 12 | 39.6 | 570.4 | -0.0 | 27.6 | -0.00 | 22.9 | 14.9 | 0.90 |
| 13 | 42.9 | 564.9 | -0.0 | 27.3 | -0.00 | 21.3 | 14.6 | 0.89 |
| 14 | 46.1 | 575.3 | -0.0 | 27.8 | -0.00 | 20.1 | 13.7 | 0.88 |
| 15 | 49.4 | 559.7 | -0.0 | 27.0 | -0.00 | 18.5 | 15.2 | 0.87 |
| 16 | 52.7 | 493.8 | -0.0 | 23.9 | -0.00 | 16.2 | 16.6 | 0.86 |
| 17 | 56.0 | 383.5 | -0.2 | 18.5 | -0.01 | 13.3 | 18.4 | 0.85 |
| 18 | 59.3 | 234.6 | -0.1 | 11.3 | -0.01 | 8.1 | 19.4 | 0.85 |
| Absolute | 3.3 | | | 34.1 | | | (T = | 36.7 ms) |
| | 3.3 | | | | -0.81 | | (T = | 43.9 ms) |

CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 575.6 | 502.9 | 430.2 | 357.5 | 284.8 | 212.1 | 139.4 | 66.8 | 0.0 | 0.0 |
| RX | 575.6 | 502.9 | 446.2 | 428.9 | 411.5 | 394.1 | 376.8 | 359.4 | 342.1 | 324.7 |
| RU | 575.6 | 502.9 | 430.2 | 357.5 | 284.8 | 212.1 | 139.4 | 66.8 | 0.0 | 0.0 |

RAU = 298.7 (kips); RA2 = 457.6 (kips)

Current CAPWAP Ru = 400.0 (kips); Corresponding J(RP)= 0.24; J(RX) = 0.47

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 16.3 | 36.48 | 602.6 | 699.8 | 702.3 | 1.04 | 0.47 | 0.47 | 40.5 | 643.6 | 225 |

PILE PROFILE AND PILE MODEL

| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 59.3 | 20.7 | 30000.0 | 492.000 | 4.71 |

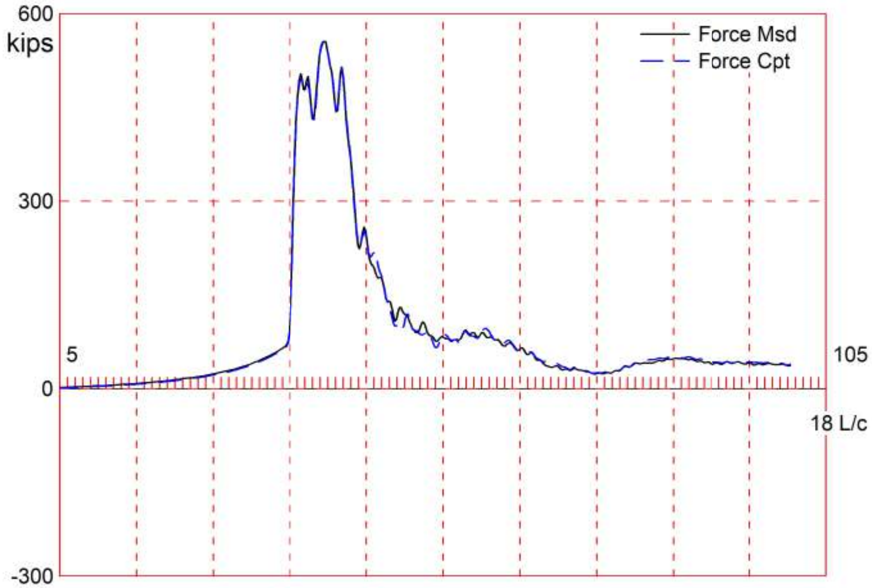
Toe Area 254.2 $in^2$

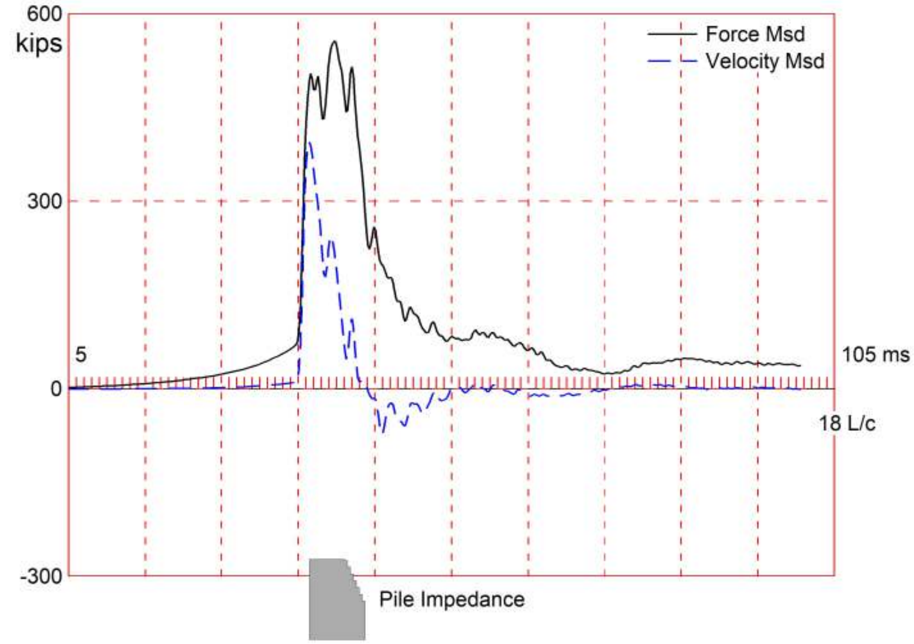
| Segmnt Number | Dist. B.G. | Impedance | Imped. Change | Tension Slack | Tension Eff. | Compression Slack | Compression Eff. | Perim. | Wave Speed | Soil Plug |
|---|---|---|---|---|---|---|---|---|---|---|
| | ft | kips/ft/s | % | in | | in | | ft | ft/s | kips |
| 1 | 3.3 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.000 |
| 2 | 6.6 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.005 |
| 18 | 59.3 | 41.11 | 11.27 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.005 |

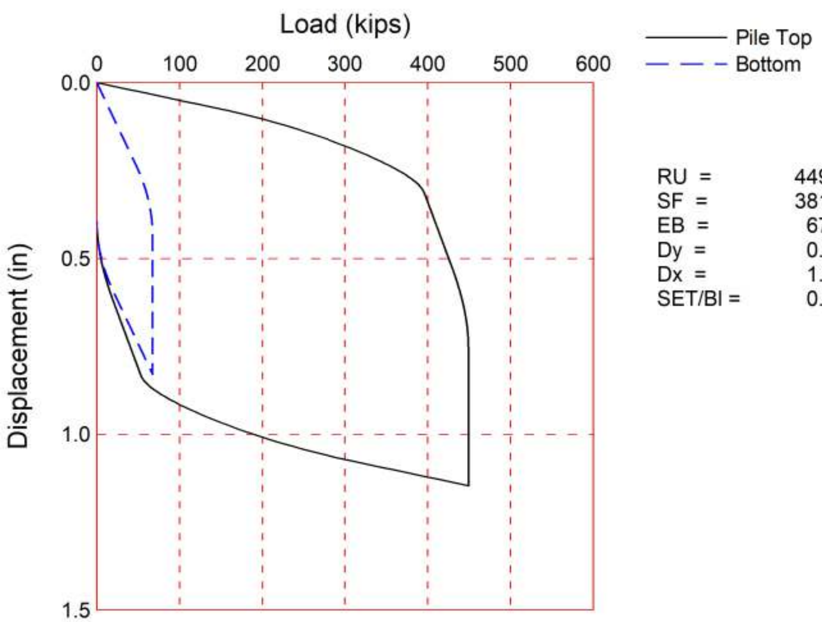
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.8 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 7.1 ms
Total volume: 8.583 $ft^3$; Volume ratio considering added impedance: 1.006

TSFP; Pile: TP3; R; Blow: 1 (Test: 28-Mar-2025 09:03:)
Scientific Applied Concepts Lmited (SACL)

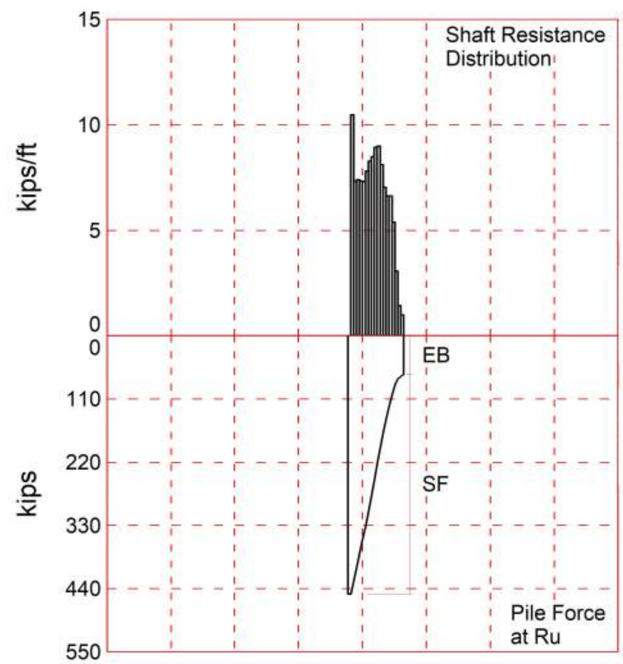
04-Apr-2025
CAPWAP(R) 2014-3




| | |
|---|---|
| RU = | 449.3 kips |
| SF = | 381.9 kips |
| EB = | 67.4 kips |
| Dy = | 0.75 in |
| Dx = | 1.15 in |
| SET/Bl = | 0.39 in |




| | |
|---|---|
| Length b. Sensors | 61.3 ft |
| Embedment | 57.0 ft |
| Top Area | 20.7 in$^2$ |
| End Bearing Area | 254.2 in$^2$ |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 lb/ft$^3$ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 16808 ft/s |
| Match Quality | 1.56 |
| Top Compr. Stress | 27.5 ksi |
| Max Compr. Stress | 28.1 ksi |
| Max Tension Stress | -2.92 ksi |
| Avg. Shaft Quake | 0.06 in |
| Toe Quake | 0.33 in |
| Avg. Shaft Smith Dpg. | 0.09 s/ft |
| Toe Smith Damping | 0.18 s/ft |

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 449.3; along Shaft 381.9; at Toe 67.4 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf |
|---|---|---|---|---|---|---|---|
| | | | | 449.3 | | | |
| 1 | 6.4 | 2.2 | 23.2 | 426.1 | 23.2 | 10.49 | 2.23 |
| 2 | 9.7 | 5.4 | 23.6 | 402.5 | 46.8 | 7.32 | 1.55 |
| 3 | 12.9 | 8.7 | 23.9 | 378.6 | 70.7 | 7.41 | 1.57 |
| 4 | 16.1 | 11.9 | 23.7 | 354.9 | 94.4 | 7.35 | 1.56 |
| 5 | 19.3 | 15.1 | 23.6 | 331.3 | 118.0 | 7.32 | 1.55 |
| 6 | 22.6 | 18.3 | 25.2 | 306.1 | 143.2 | 7.82 | 1.66 |
| 7 | 25.8 | 21.6 | 26.7 | 279.4 | 169.9 | 8.28 | 1.76 |
| 8 | 29.0 | 24.8 | 27.4 | 252.0 | 197.3 | 8.50 | 1.80 |
| 9 | 32.2 | 28.0 | 28.8 | 223.2 | 226.1 | 8.93 | 1.90 |
| 10 | 35.5 | 31.2 | 29.0 | 194.2 | 255.1 | 9.00 | 1.91 |
| 11 | 38.7 | 34.4 | 26.2 | 168.0 | 281.3 | 8.13 | 1.73 |
| 12 | 41.9 | 37.7 | 22.7 | 145.3 | 304.0 | 7.04 | 1.52 |
| 13 | 45.1 | 40.9 | 21.4 | 123.9 | 325.4 | 6.64 | 1.56 |
| 14 | 48.4 | 44.1 | 21.4 | 102.5 | 346.8 | 6.64 | 1.72 |
| 15 | 51.6 | 47.3 | 17.4 | 85.1 | 364.2 | 5.40 | 1.55 |
| 16 | 54.8 | 50.6 | 9.9 | 75.2 | 374.1 | 3.07 | 1.00 |
| 17 | 58.0 | 53.8 | 4.6 | 70.6 | 378.7 | 1.43 | 0.53 |
| 18 | 61.3 | 57.0 | 3.2 | 67.4 | 381.9 | 0.99 | 0.43 |
| Avg. Shaft | | | 21.2 | | | 6.70 | 1.59 |
| Toe | | | 67.4 | | | | 38.17 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Smith Damping Factor | | 0.09 | 0.18 |
| Quake | (in) | 0.06 | 0.33 |
| Case Damping Factor | | 0.95 | 0.33 |
| Damping Type | | Viscous | Sm+Visc |
| Unloading Quake | (% of loading quake) | 30 | 90 |
| Reloading Level | (% of Ru) | 100 | 100 |
| Unloading Level | (% of Ru) | 20 | |
| Resistance Gap (included in Toe Quake) (in) | | | 0.24 |
| Soil Plug Weight | (kips) | | 0.180 |

CAPWAP match quality = 1.56 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.39 in; Blow Count = 30 b/ft
Computed: Final Set = 0.37 in; Blow Count = 32 b/ft
Transducer F2 (U971) CAL: 144.2; RF: 1.00; F4 (U970) CAL: 143.9; RF: 1.00
A1 (K11820) CAL: 434; RF: 1.00; A3 (K11831) CAL: 428; RF: 1.00

max. Top Comp. Stress = 27.5 ksi (T= 39.9 ms, max= 1.021 x Top)
max. Comp. Stress = 28.1 ksi (Z= 6.4 ft, T= 39.9 ms)
max. Tens. Stress = -2.92 ksi (Z= 58.0 ft, T= 41.8 ms)
max. Energy (EMX) = 19.6 kip-ft; max. Measured Top Displ. (DMX)= 0.52 in

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.2 | 569.3 | 0.0 | 27.5 | 0.00 | 19.6 | 10.4 | 0.52 |
| 2 | 6.4 | 581.0 | 0.0 | 28.1 | 0.00 | 19.5 | 9.9 | 0.51 |
| 3 | 9.7 | 554.6 | 0.0 | 26.8 | 0.00 | 17.9 | 9.5 | 0.49 |
| 4 | 12.9 | 525.3 | 0.0 | 25.4 | 0.00 | 16.4 | 9.0 | 0.48 |
| 5 | 16.1 | 494.9 | 0.0 | 23.9 | 0.00 | 15.0 | 8.5 | 0.47 |
| 6 | 19.3 | 464.3 | 0.0 | 22.4 | 0.00 | 13.6 | 8.0 | 0.45 |
| 7 | 22.6 | 433.1 | 0.0 | 20.9 | 0.00 | 12.3 | 7.5 | 0.44 |
| 8 | 25.8 | 400.0 | 0.0 | 19.3 | 0.00 | 11.0 | 7.0 | 0.42 |
| 9 | 29.0 | 361.8 | 0.0 | 17.5 | 0.00 | 9.6 | 6.5 | 0.41 |
| 10 | 32.2 | 329.7 | 0.0 | 15.9 | 0.00 | 8.4 | 6.5 | 0.40 |
| 11 | 35.5 | 294.8 | 0.0 | 14.2 | 0.00 | 7.0 | 6.9 | 0.39 |
| 12 | 38.7 | 258.0 | 0.0 | 12.5 | 0.00 | 5.8 | 6.9 | 0.39 |
| 13 | 41.9 | 224.5 | 0.0 | 11.0 | 0.00 | 4.6 | 6.9 | 0.38 |
| 14 | 45.1 | 194.4 | 0.0 | 10.4 | 0.00 | 3.7 | 6.5 | 0.37 |
| 15 | 48.4 | 165.0 | 0.0 | 9.7 | 0.00 | 2.8 | 6.7 | 0.37 |
| 16 | 51.6 | 139.6 | -21.4 | 9.2 | -1.41 | 1.9 | 7.5 | 0.36 |
| 17 | 54.8 | 119.4 | -29.8 | 8.9 | -2.23 | 1.2 | 7.9 | 0.35 |
| 18 | 58.0 | 100.7 | -33.9 | 8.7 | -2.92 | 0.8 | 8.8 | 0.34 |
| 19 | 61.3 | 94.0 | -27.0 | 9.6 | -2.75 | 0.4 | 9.4 | 0.33 |
| Absolute | 6.4 | | | 28.1 | | | (T = | 39.9 ms) |
| | 58.0 | | | | -2.92 | | (T = | 41.8 ms) |

## CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 579.1 | 547.5 | 515.8 | 484.2 | 452.5 | 420.9 | 389.3 | 357.6 | 326.0 | 294.3 |
| RX | 579.1 | 547.5 | 515.8 | 484.2 | 452.5 | 420.9 | 389.3 | 357.6 | 326.4 | 301.2 |
| RU | 579.1 | 547.5 | 515.8 | 484.2 | 452.5 | 420.9 | 389.3 | 357.6 | 326.0 | 294.3 |

RAU = 80.2 (kips); RA2 = 460.5 (kips)

Current CAPWAP Ru = 449.3 (kips); Corresponding J(RP)= 0.41; J(RX) = 0.41

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 10.7 | 36.63 | 395.2 | 500.3 | 557.2 | 0.52 | 0.40 | 0.39 | 19.8 | 518.9 | 685 |

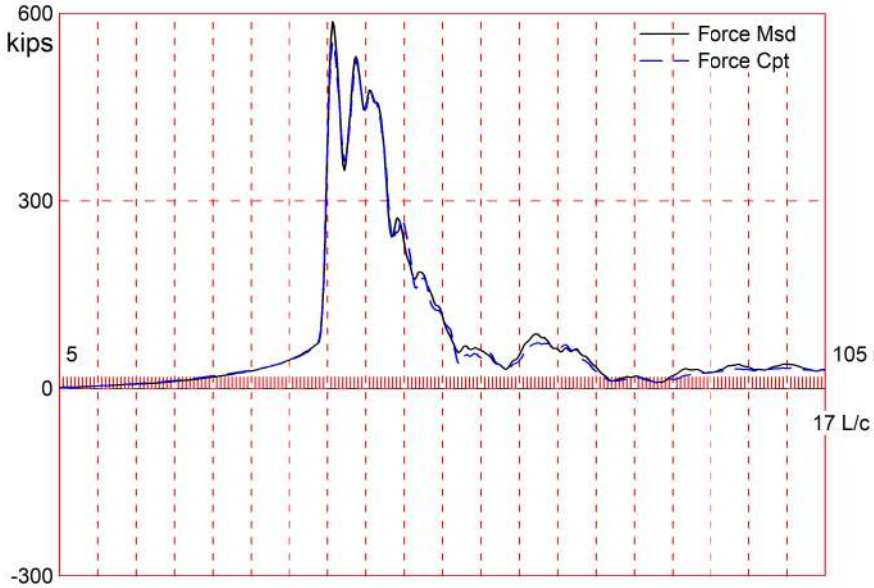
## PILE PROFILE AND PILE MODEL

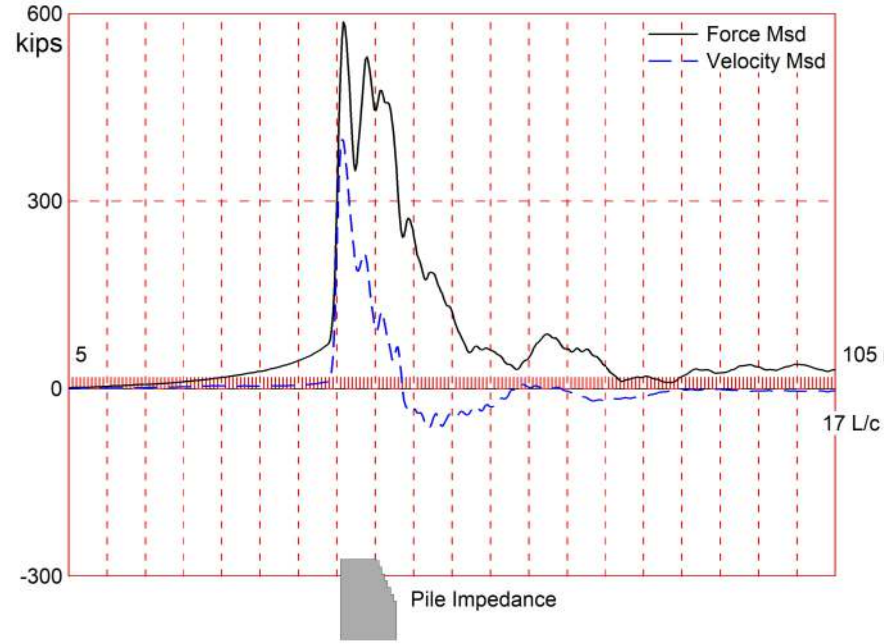
| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 39.9 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 61.3 | 9.0 | 30000.0 | 492.000 | 2.09 |

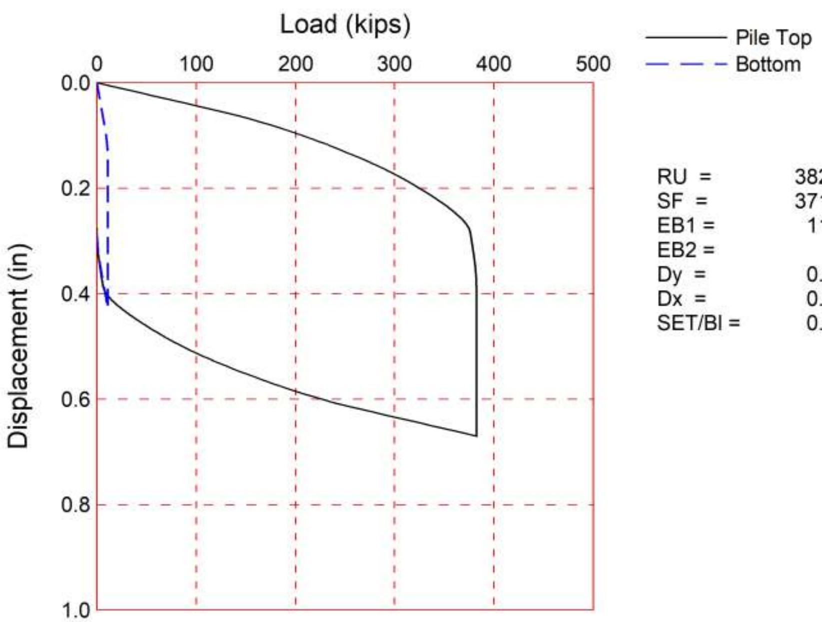
Toe Area 254.2 $in^2$

| Segmnt Number | Dist. B.G. | Impedance | Imped. Change | Slack | Tension Eff. | Slack | Compression Eff. | Perim. | Wave Speed |
|---|---|---|---|---|---|---|---|---|---|
| | ft | kips/ft/s | % | in | | in | | ft | ft/s |
| 1 | 3.2 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 |
| 13 | 41.9 | 36.31 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.63 | 16807.8 |
| 14 | 45.1 | 33.37 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.26 | 16807.8 |
| 15 | 48.4 | 30.21 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.87 | 16807.8 |
| 16 | 51.6 | 27.05 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.47 | 16807.8 |
| 17 | 54.8 | 23.89 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.08 | 16807.8 |
| 18 | 58.0 | 20.73 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.69 | 16807.8 |
| 19 | 61.3 | 17.57 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.29 | 16807.8 |

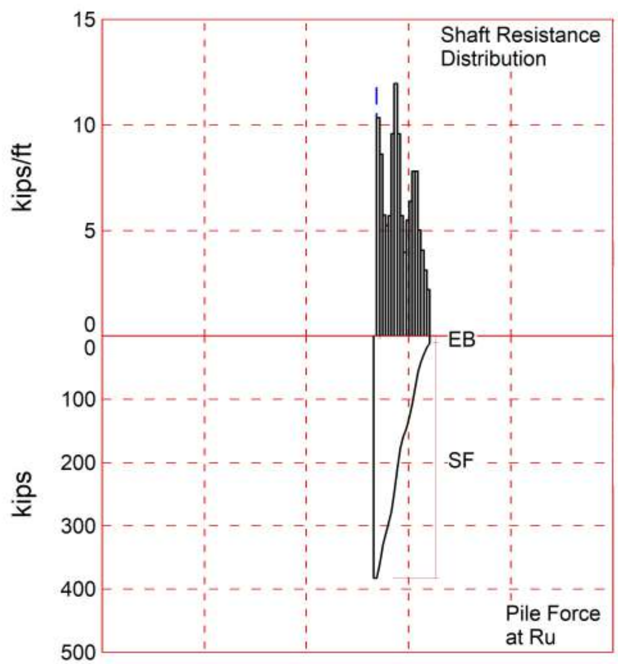
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.8 ft/s
Pile Damping 1.00 %, Time Incr 0.192 ms, 2L/c 7.3 ms
Total volume: 7.934 $ft^3$; Volume ratio considering added impedance: 1.000




| | |
|---|---|
| RU = | 382.5 kips |
| SF = | 371.3 kips |
| EB1 = | 11.2 kips |
| EB2 = | kips |
| Dy = | 0.39 in |
| Dx = | 0.67 in |
| SET/Bl = | 0.28 in |




| | |
|---|---|
| Length b. Sensors | 61.3 ft |
| Embedment | 57.0 ft |
| Top Area | 20.7 in² |
| End Bearing Area | 254.2 in² |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 lb/ft³ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 16808 ft/s |
| Match Quality | 2.48 |
| Top Compr. Stress | 27.5 ksi |
| Max Compr. Stress | 27.8 ksi |
| Max Tension Stress | -0.29 ksi |
| Avg. Shaft Quake | 0.04 in |
| Toe Quake | 0.12 in |
| Avg. Shaft Smith Dpg. | 0.09 s/ft |
| Toe Smith Damping | 0.24 s/ft |

## CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 382.5; along Shaft 371.3; at Toe 11.2 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf |
|---|---|---|---|---|---|---|---|
| | | | | 382.5 | | | |
| 1 | 6.4 | 2.2 | 22.9 | 359.6 | 22.9 | 10.35 | 2.20 |
| 2 | 9.7 | 5.4 | 27.8 | 331.8 | 50.7 | 8.62 | 1.83 |
| 3 | 12.9 | 8.7 | 18.5 | 313.3 | 69.2 | 5.74 | 1.22 |
| 4 | 16.1 | 11.9 | 16.9 | 296.4 | 86.1 | 5.24 | 1.11 |
| 5 | 19.3 | 15.1 | 18.4 | 278.0 | 104.5 | 5.71 | 1.21 |
| 6 | 22.6 | 18.3 | 30.9 | 247.1 | 135.4 | 9.59 | 2.03 |
| 7 | 25.8 | 21.6 | 38.6 | 208.5 | 174.0 | 11.97 | 2.54 |
| 8 | 29.0 | 24.8 | 30.9 | 177.6 | 204.9 | 9.59 | 2.03 |
| 9 | 32.2 | 28.0 | 18.4 | 159.2 | 223.3 | 5.71 | 1.21 |
| 10 | 35.5 | 31.2 | 12.8 | 146.4 | 236.1 | 3.97 | 0.84 |
| 11 | 38.7 | 34.4 | 17.7 | 128.7 | 253.8 | 5.49 | 1.17 |
| 12 | 41.9 | 37.7 | 20.6 | 108.1 | 274.4 | 6.39 | 1.38 |
| 13 | 45.1 | 40.9 | 25.2 | 82.9 | 299.6 | 7.82 | 1.83 |
| 14 | 48.4 | 44.1 | 25.2 | 57.7 | 324.8 | 7.82 | 2.02 |
| 15 | 51.6 | 47.3 | 16.2 | 41.5 | 341.0 | 5.03 | 1.45 |
| 16 | 54.8 | 50.6 | 13.1 | 28.4 | 354.1 | 4.06 | 1.32 |
| 17 | 58.0 | 53.8 | 10.1 | 18.3 | 364.2 | 3.13 | 1.17 |
| 18 | 61.3 | 57.0 | 7.1 | 11.2 | 371.3 | 2.20 | 0.96 |
| Avg. Shaft | | | 20.6 | | | 6.51 | 1.54 |
| Toe | | | 11.2 | | | | 6.34 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Smith Damping Factor | | 0.09 | 0.24 |
| Quake | (in) | 0.04 | 0.12 |
| Case Damping Factor | | 0.89 | 0.07 |
| Damping Type | | Viscous | Viscous |
| Unloading Quake | (% of loading quake) | 90 | 60 |
| Reloading Level | (% of Ru) | 100 | 100 |
| Unloading Level | (% of Ru) | 0 | |
| Resistance Gap (included in Toe Quake) (in) | | | 0.04 |
| Soil Plug Weight | (kips) | 0.414 | |

CAPWAP match quality = 2.48 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.28 in; Blow Count = 44 b/ft
Computed: Final Set = 0.25 in; Blow Count = 49 b/ft

Transducer F2 (U971) CAL: 144.2; RF: 1.00; F4 (U970) CAL: 143.9; RF: 1.00
A1 (K11820) CAL: 434; RF: 1.00; A3 (K11831) CAL: 428; RF: 1.00

max. Top Comp. Stress = 27.5 ksi (T= 41.0 ms, max= 1.012 x Top)
max. Comp. Stress = 27.8 ksi (Z= 6.4 ft, T= 41.2 ms)
max. Tens. Stress = -0.29 ksi (Z= 6.4 ft, T= 162.6 ms)
max. Energy (EMX) = 19.6 kip-ft; max. Measured Top Displ. (DMX)= 0.55 in

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.2 | 568.7 | -6.0 | 27.5 | -0.29 | 19.6 | 11.2 | 0.54 |
| 2 | 6.4 | 575.4 | -6.0 | 27.8 | -0.29 | 19.4 | 11.0 | 0.53 |
| 3 | 9.7 | 535.6 | -5.7 | 25.9 | -0.28 | 17.8 | 10.9 | 0.51 |
| 4 | 12.9 | 491.6 | -5.3 | 23.7 | -0.26 | 15.9 | 10.6 | 0.49 |
| 5 | 16.1 | 477.1 | -5.1 | 23.0 | -0.25 | 13.8 | 9.1 | 0.44 |
| 6 | 19.3 | 470.5 | -4.9 | 22.7 | -0.24 | 12.8 | 8.6 | 0.42 |
| 7 | 22.6 | 462.0 | -4.7 | 22.3 | -0.23 | 11.8 | 8.0 | 0.41 |
| 8 | 25.8 | 428.3 | -4.2 | 20.7 | -0.20 | 10.3 | 7.5 | 0.40 |
| 9 | 29.0 | 378.6 | -3.7 | 18.3 | -0.18 | 8.7 | 7.1 | 0.39 |
| 10 | 32.2 | 338.2 | -3.3 | 16.3 | -0.16 | 7.4 | 6.9 | 0.39 |
| 11 | 35.5 | 315.5 | -3.2 | 15.2 | -0.15 | 6.6 | 6.7 | 0.38 |
| 12 | 38.7 | 301.4 | -3.0 | 14.6 | -0.14 | 6.0 | 6.6 | 0.38 |
| 13 | 41.9 | 279.9 | -2.6 | 13.8 | -0.13 | 5.3 | 6.4 | 0.37 |
| 14 | 45.1 | 253.8 | -2.2 | 13.6 | -0.12 | 4.5 | 6.2 | 0.37 |
| 15 | 48.4 | 217.8 | -1.8 | 12.9 | -0.11 | 3.5 | 6.2 | 0.37 |
| 16 | 51.6 | 170.6 | -2.0 | 11.3 | -0.14 | 2.5 | 7.1 | 0.37 |
| 17 | 54.8 | 127.7 | -1.7 | 9.5 | -0.13 | 1.9 | 8.3 | 0.36 |
| 18 | 58.0 | 82.9 | -0.9 | 7.1 | -0.08 | 1.4 | 9.0 | 0.36 |
| 19 | 61.3 | 44.7 | -0.6 | 4.5 | -0.06 | 0.7 | 8.9 | 0.36 |
| Absolute | 6.4 | | | 27.8 | | | (T = | 41.2 ms) |
| | 6.4 | | | | -0.29 | | (T = | 162.6 ms) |

CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 606.6 | 569.8 | 532.9 | 496.1 | 459.3 | 422.5 | 385.7 | 348.9 | 312.0 | 275.2 |
| RX | 609.3 | 571.2 | 533.2 | 496.1 | 459.3 | 422.5 | 386.3 | 363.1 | 342.0 | 326.8 |
| RU | 606.6 | 569.8 | 532.9 | 496.1 | 459.3 | 422.5 | 385.7 | 348.9 | 312.0 | 275.2 |

RAU = 29.6 (kips); RA2 = 431.2 (kips)

Current CAPWAP Ru = 382.5 (kips); Corresponding J(RP)= 0.61; J(RX) = 0.62

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 10.9 | 40.66 | 402.0 | 572.7 | 590.4 | 0.55 | 0.28 | 0.28 | 19.6 | 569.6 | 142 |

PILE PROFILE AND PILE MODEL

| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.7 | 30000.1 | 492.000 | 4.71 |
| 39.9 | 20.7 | 30000.1 | 492.000 | 4.71 |
| 61.3 | 9.0 | 30000.1 | 492.000 | 2.09 |

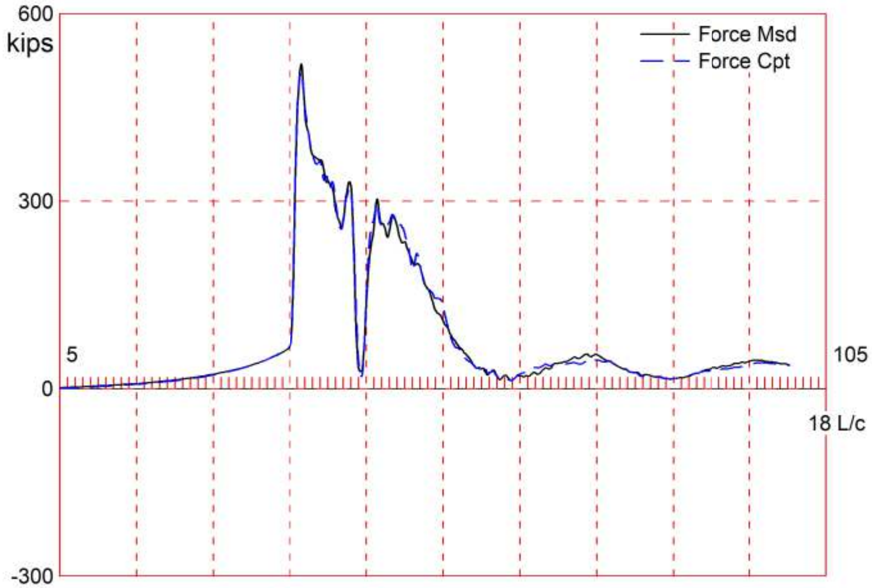
Toe Area 254.2 $in^2$

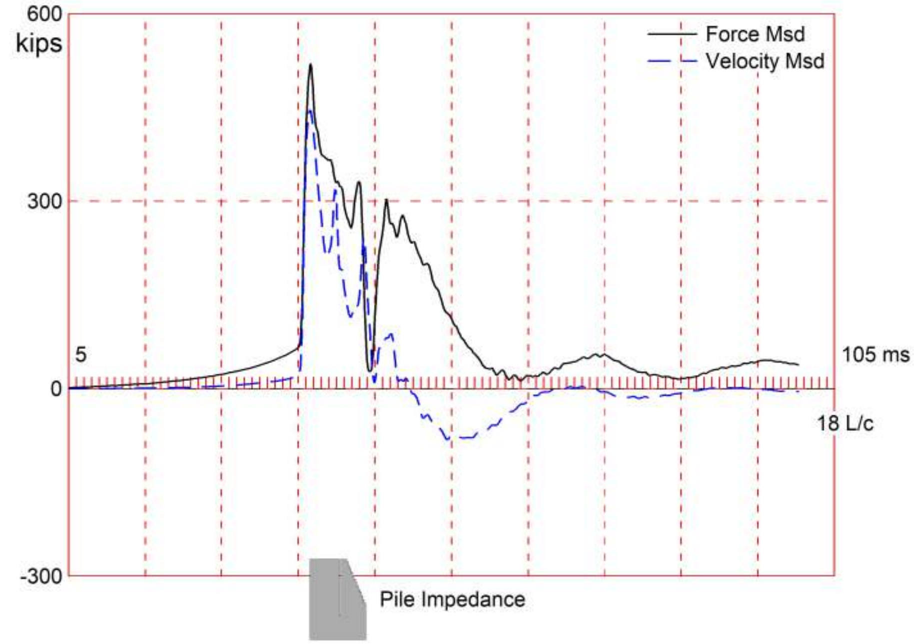
| Segmnt Number | Dist. B.G. | Impedance | Imped. Change | Slack | Tension Eff. | Compression Slack | Eff. | Perim. | Wave Speed | Soil Plug |
|---|---|---|---|---|---|---|---|---|---|---|
| | ft | kips/ft/s | % | in | | in | | ft | ft/s | kips |
| 1 | 3.2 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.000 |
| 2 | 6.4 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.023 |
| 4 | 12.9 | 36.95 | 0.00 | 0.00 | 0.000 | -0.05 | 0.040 | 4.71 | 16807.8 | 0.023 |
| 5 | 16.1 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16807.8 | 0.023 |
| 13 | 41.9 | 36.31 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.63 | 16807.8 | 0.023 |
| 14 | 45.1 | 33.37 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.26 | 16807.8 | 0.023 |
| 15 | 48.4 | 30.21 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.87 | 16807.8 | 0.023 |
| 16 | 51.6 | 27.05 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.47 | 16807.8 | 0.023 |
| 17 | 54.8 | 23.89 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.08 | 16807.8 | 0.023 |
| 18 | 58.0 | 20.73 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.69 | 16807.8 | 0.023 |
| 19 | 61.3 | 17.57 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.29 | 16807.8 | 0.023 |

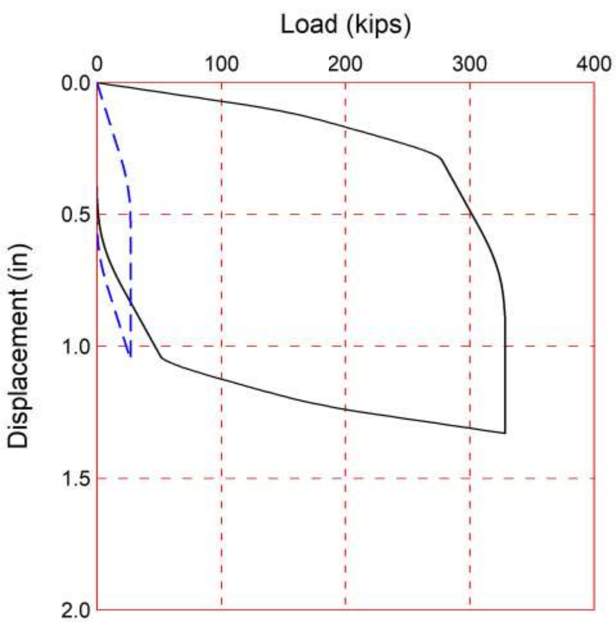
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.8 ft/s
Pile Damping 1.00 %, Time Incr 0.192 ms, 2L/c 7.3 ms
Total volume: 7.934 $ft^3$; Volume ratio considering added impedance: 1.000

TSFP; Pile: TP5; R; Blow: 1 (Test: 28-Mar-2025 09:30:)
Scientific Applied Concepts Lmited (SACL)

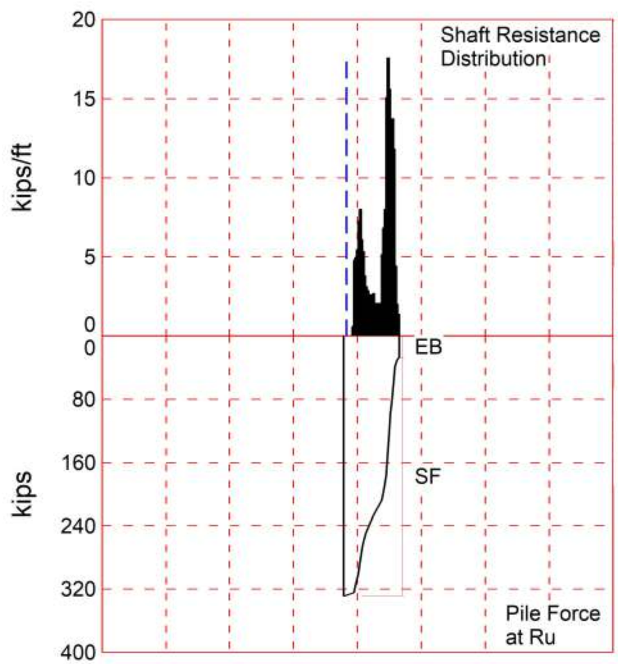
04-Apr-2025
CAPWAP(R) 2014-3




| | |
|---|---|
| RU = | 328.5 kips |
| SF = | 301.5 kips |
| EB = | 27.0 kips |
| Dy = | 0.94 in |
| Dx = | 1.33 in |
| SET/Bl = | 0.39 in |




| | |
|---|---|
| Length b. Sensors | 61.3 ft |
| Embedment | 57.0 ft |
| Top Area | 20.7 in² |
| End Bearing Area | 254.2 in² |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 lb/ft³ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 16896 ft/s |
| Match Quality | 2.32 |
| Top Compr. Stress | 24.5 ksi |
| Max Compr. Stress | 25.6 ksi |
| Max Tension Stress | -3.14 ksi |
| Avg. Shaft Quake | 0.11 in |
| Toe Quake | 0.40 in |
| Avg. Shaft Smith Dpg. | 0.04 s/ft |
| Toe Smith Damping | 0.18 s/ft |

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 328.5; along Shaft 301.5; at Toe 27.0 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Smith Damping Factor s/ft | Quake in |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 328.5 | | | | | |
| 1 | 11.3 | 7.0 | 4.2 | 324.3 | 4.2 | 0.60 | 0.13 | 0.05 | 0.06 |
| 2 | 12.9 | 8.7 | 7.7 | 316.6 | 11.9 | 4.78 | 1.01 | 0.05 | 0.06 |
| 3 | 14.5 | 10.3 | 8.0 | 308.6 | 19.9 | 4.96 | 1.05 | 0.05 | 0.06 |
| 4 | 16.1 | 11.9 | 8.8 | 299.8 | 28.7 | 5.46 | 1.16 | 0.05 | 0.06 |
| 5 | 17.7 | 13.5 | 11.7 | 288.1 | 40.4 | 7.26 | 1.54 | 0.05 | 0.06 |
| 6 | 19.3 | 15.1 | 12.9 | 275.2 | 53.3 | 8.00 | 1.70 | 0.05 | 0.06 |
| 7 | 21.0 | 16.7 | 9.8 | 265.4 | 63.1 | 6.08 | 1.29 | 0.05 | 0.06 |
| 8 | 22.6 | 18.3 | 8.6 | 256.8 | 71.7 | 5.34 | 1.13 | 0.05 | 0.06 |
| 9 | 24.2 | 19.9 | 6.1 | 250.7 | 77.8 | 3.78 | 0.80 | 0.05 | 0.06 |
| 10 | 25.8 | 21.6 | 5.0 | 245.7 | 82.8 | 3.10 | 0.66 | 0.05 | 0.06 |
| 11 | 27.4 | 23.2 | 4.6 | 241.1 | 87.4 | 2.85 | 0.61 | 0.05 | 0.06 |
| 12 | 29.0 | 24.8 | 4.2 | 236.9 | 91.6 | 2.61 | 0.55 | 0.00 | 0.06 |
| 13 | 30.6 | 26.4 | 4.2 | 232.7 | 95.8 | 2.61 | 0.55 | 0.00 | 0.06 |
| 14 | 32.2 | 28.0 | 4.2 | 228.5 | 100.0 | 2.61 | 0.55 | 0.00 | 0.06 |
| 15 | 33.8 | 29.6 | 4.3 | 224.2 | 104.3 | 2.67 | 0.57 | 0.00 | 0.06 |
| 16 | 35.5 | 31.2 | 3.3 | 220.9 | 107.6 | 2.05 | 0.43 | 0.00 | 0.55 |
| 17 | 37.1 | 32.8 | 3.3 | 217.6 | 110.9 | 2.05 | 0.43 | 0.00 | 0.55 |
| 18 | 38.7 | 34.4 | 3.3 | 214.3 | 114.2 | 2.05 | 0.43 | 0.00 | 0.55 |
| 19 | 40.3 | 36.1 | 3.3 | 211.0 | 117.5 | 2.05 | 0.44 | 0.00 | 0.55 |
| 20 | 41.9 | 37.7 | 3.3 | 207.7 | 120.8 | 2.05 | 0.45 | 0.00 | 0.55 |
| 21 | 43.5 | 39.3 | 8.3 | 199.4 | 129.1 | 5.15 | 1.18 | 0.00 | 0.55 |
| 22 | 45.1 | 40.9 | 11.0 | 188.4 | 140.1 | 6.82 | 1.64 | 0.00 | 0.55 |
| 23 | 46.7 | 42.5 | 12.9 | 175.5 | 153.0 | 8.00 | 2.02 | 0.05 | 0.06 |
| 24 | 48.4 | 44.1 | 24.3 | 151.2 | 177.3 | 15.08 | 4.00 | 0.05 | 0.06 |
| 25 | 50.0 | 45.7 | 28.3 | 122.9 | 205.6 | 17.56 | 4.91 | 0.05 | 0.06 |
| 26 | 51.6 | 47.3 | 25.1 | 97.8 | 230.7 | 15.57 | 4.61 | 0.05 | 0.06 |
| 27 | 53.2 | 49.0 | 17.2 | 80.6 | 247.9 | 10.67 | 3.36 | 0.05 | 0.06 |
| 28 | 54.8 | 50.6 | 22.1 | 58.5 | 270.0 | 13.71 | 4.60 | 0.05 | 0.06 |
| 29 | 56.4 | 52.2 | 19.0 | 39.5 | 289.0 | 11.79 | 4.23 | 0.05 | 0.06 |
| 30 | 58.0 | 53.8 | 7.1 | 32.4 | 296.1 | 4.40 | 1.70 | 0.05 | 0.06 |
| 31 | 59.6 | 55.4 | 3.2 | 29.2 | 299.3 | 1.99 | 0.83 | 0.05 | 0.06 |
| 32 | 61.3 | 57.0 | 2.2 | 27.0 | 301.5 | 1.36 | 0.62 | 0.05 | 0.06 |
| Avg. Shaft | | | 9.4 | | | 5.29 | 1.25 | 0.04 | 0.11 |
| Toe | | | 27.0 | | | | 15.29 | 0.18 | 0.40 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Case Damping Factor | | 0.32 | 0.13 |
| Damping Type | | Viscous | Sm+Visc |
| Unloading Quake | (% of loading quake) | 75 | 20 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Reloading Level | (% of Ru) | 100 | 100 |
| Unloading Level | (% of Ru) | 0 | |
| Resistance Gap (included in Toe Quake) (in) | | | 0.20 |
| Soil Plug Weight | (kips) | | 0.090 |
| Soil Support Dashpot | | 0.000 | 3.000 |
| Soil Support Weight | (kips) | 0.00 | 0.79 |

CAPWAP match quality = 2.32 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.39 in; Blow Count = 30 b/ft
Computed: Final Set = 0.44 in; Blow Count = 27 b/ft
Transducer F2 (U971) CAL: 144.2; RF: 1.00; F4 (U970) CAL: 143.9; RF: 1.00
A1 (K11820) CAL: 434; RF: 1.00; A3 (K11831) CAL: 428; RF: 1.00

max. Top Comp. Stress = 24.5 ksi (T= 36.7 ms, max= 1.042 x Top)
max. Comp. Stress = 25.6 ksi (Z= 11.3 ft, T= 37.3 ms)
max. Tens. Stress = -3.14 ksi (Z= 58.0 ft, T= 47.6 ms)
max. Energy (EMX) = 21.7 kip-ft; max. Measured Top Displ. (DMX)= 0.81 in

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 1.6 | 507.8 | 0.0 | 24.5 | 0.00 | 21.7 | 12.4 | 0.79 |
| 2 | 3.2 | 509.2 | 0.0 | 24.6 | 0.00 | 21.2 | 12.0 | 0.76 |
| 4 | 6.4 | 515.1 | 0.0 | 24.9 | 0.00 | 21.0 | 11.9 | 0.75 |
| 6 | 9.7 | 523.9 | 0.0 | 25.3 | 0.00 | 20.8 | 11.7 | 0.73 |
| 8 | 12.9 | 528.4 | 0.0 | 25.5 | 0.00 | 20.3 | 11.4 | 0.72 |
| 10 | 16.1 | 514.4 | 0.0 | 24.8 | 0.00 | 19.0 | 11.1 | 0.70 |
| 12 | 19.3 | 489.6 | 0.0 | 23.7 | 0.00 | 17.3 | 10.9 | 0.69 |
| 14 | 22.6 | 445.9 | 0.0 | 21.5 | 0.00 | 15.6 | 11.8 | 0.67 |
| 16 | 25.8 | 384.3 | 0.0 | 18.6 | 0.00 | 14.4 | 12.5 | 0.66 |
| 18 | 29.0 | 392.4 | 0.0 | 19.0 | 0.00 | 13.7 | 12.0 | 0.65 |
| 20 | 32.2 | 410.1 | 0.0 | 19.8 | 0.00 | 13.2 | 11.0 | 0.64 |
| 22 | 35.5 | 397.4 | 0.0 | 19.2 | 0.00 | 12.6 | 10.8 | 0.62 |
| 24 | 38.7 | 383.9 | 0.0 | 18.5 | 0.00 | 12.3 | 11.1 | 0.61 |
| 26 | 41.9 | 381.8 | -1.2 | 19.1 | -0.06 | 12.1 | 11.1 | 0.60 |
| 28 | 45.1 | 392.7 | -9.2 | 21.5 | -0.50 | 11.7 | 10.7 | 0.59 |
| 30 | 48.4 | 381.2 | -16.3 | 23.1 | -0.99 | 10.5 | 10.5 | 0.58 |
| 32 | 51.6 | 306.4 | -13.0 | 20.8 | -0.89 | 7.2 | 12.2 | 0.58 |
| 34 | 54.8 | 223.6 | -15.0 | 17.3 | -1.16 | 4.6 | 14.2 | 0.57 |
| 35 | 56.4 | 171.2 | -26.3 | 14.2 | -2.18 | 3.2 | 15.1 | 0.57 |
| 36 | 58.0 | 130.1 | -35.1 | 11.6 | -3.14 | 2.0 | 15.9 | 0.57 |
| 37 | 59.6 | 98.1 | -29.2 | 9.5 | -2.84 | 1.6 | 16.7 | 0.57 |
| 38 | 61.3 | 67.1 | -16.8 | 7.1 | -1.79 | 1.2 | 17.4 | 0.57 |
| Absolute | 11.3 | | | 25.6 | | | (T = | 37.3 ms) |

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| | 58.0 | | | | -3.14 | | (T = | 47.6 ms) |

CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 422.4 | 368.0 | 313.7 | 259.3 | 205.0 | 150.6 | 96.3 | 41.9 | 0.0 | 0.0 |
| RX | 425.8 | 391.4 | 372.6 | 354.1 | 335.6 | 317.1 | 298.5 | 288.0 | 280.8 | 273.6 |
| RU | 422.4 | 368.0 | 313.7 | 259.3 | 205.0 | 150.6 | 96.3 | 41.9 | 0.0 | 0.0 |

RAU = 231.7 (kips); RA2 = 367.9 (kips)

Current CAPWAP Ru = 328.5 (kips); Corresponding J(RP)= 0.17; J(RX) = 0.44

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 12.1 | 36.63 | 446.4 | 519.5 | 522.2 | 0.81 | 0.39 | 0.39 | 21.9 | 438.8 | 132 |

PILE PROFILE AND PILE MODEL

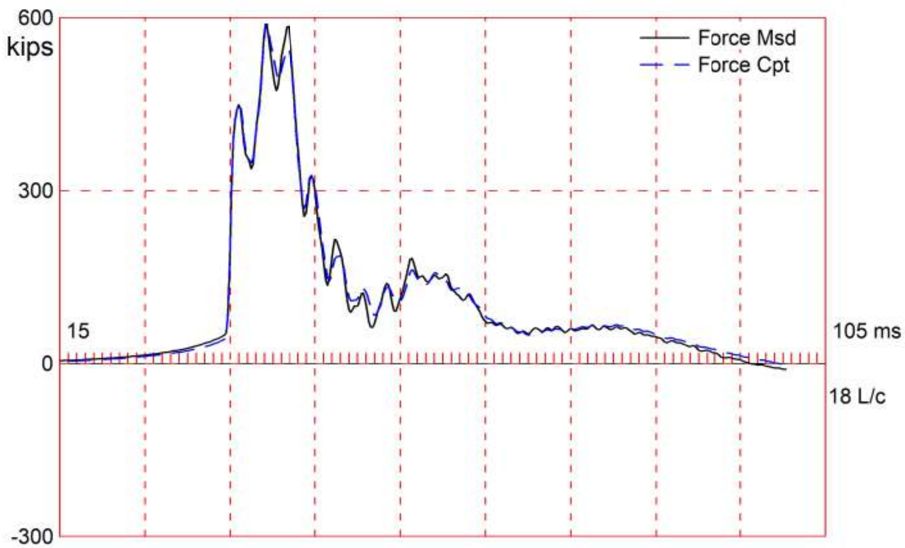
| Depth ft | Area $in^2$ | E-Modulus ksi | Spec. Weight $lb/ft^3$ | Perim. ft |
|---|---|---|---|---|
| 0.0 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 39.9 | 20.7 | 30000.0 | 492.000 | 4.71 |
| 61.3 | 9.0 | 30000.0 | 492.000 | 2.09 |

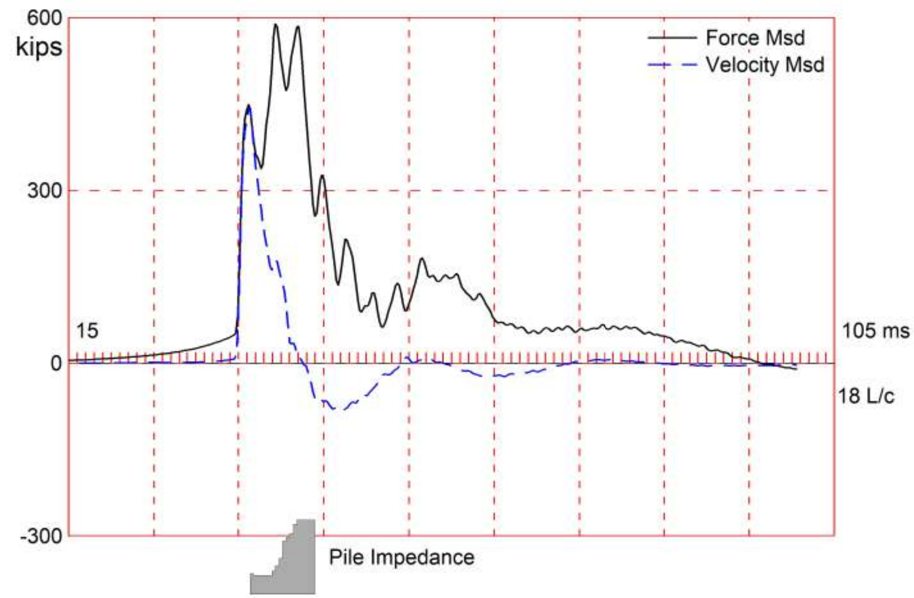
Toe Area 254.2 $in^2$

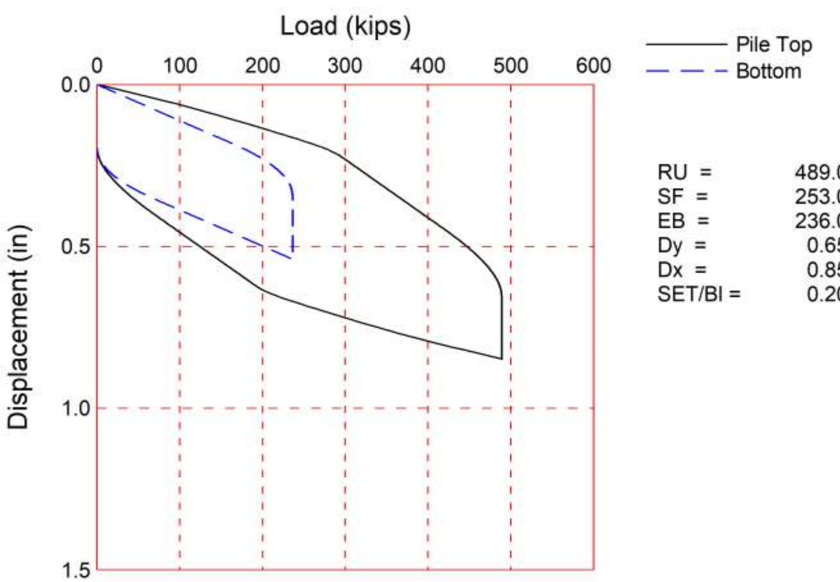
| Segmnt Number | Dist. B.G. ft | Impedance kips/ft/s | Imped. Change % | Slack in | Tension Eff. | Compression Slack in | Compression Eff. | Perim. ft | Wave Speed ft/s |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.6 | 36.95 | 0.00 | 0.00 | 0.000 | -0.04 | 0.010 | 4.71 | 16896.4 |
| 2 | 3.2 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16896.4 |
| 21 | 33.8 | 10.97 | -70.32 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16896.4 |
| 22 | 35.5 | 36.95 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16896.4 |
| 25 | 40.3 | 36.89 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16896.4 |
| 26 | 41.9 | 35.74 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.56 | 16896.4 |
| 27 | 43.5 | 34.16 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.36 | 16896.4 |
| 28 | 45.1 | 32.58 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.16 | 16896.4 |
| 29 | 46.7 | 31.00 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.97 | 16896.4 |
| 30 | 48.4 | 29.42 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.77 | 16896.4 |
| 31 | 50.0 | 27.84 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.57 | 16896.4 |
| 32 | 51.6 | 26.26 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.38 | 16896.4 |
| 33 | 53.2 | 24.68 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.18 | 16896.4 |
| 34 | 54.8 | 23.10 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.98 | 16896.4 |

| Segmnt Number | Dist. B.G. ft | Impedance kips/ft/s | Imped. Change % | Slack in | Tension Eff. | Compression Slack in | Compression Eff. | Perim. ft | Wave Speed ft/s |
|---|---|---|---|---|---|---|---|---|---|
| 35 | 56.4 | 21.52 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.78 | 16896.4 |
| 36 | 58.0 | 19.94 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.59 | 16896.4 |
| 37 | 59.6 | 18.36 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.39 | 16896.4 |
| 38 | 61.3 | 16.78 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.19 | 16896.4 |

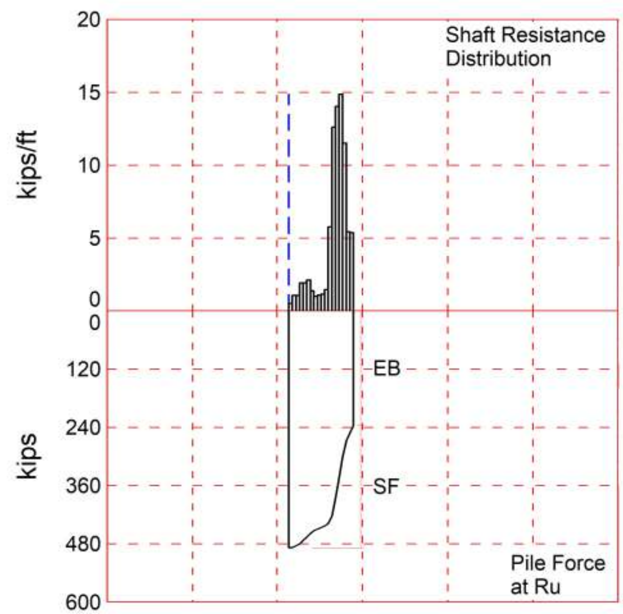
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16896.4 ft/s
Pile Damping 1.00 %, Time Incr 0.095 ms, 2L/c 7.3 ms
Total volume: 7.771 $ft^3$; Volume ratio considering added impedance: 0.979




| | |
|---|---|
| RU = | 489.0 kips |
| SF = | 253.0 kips |
| EB = | 236.0 kips |
| Dy = | 0.65 in |
| Dx = | 0.85 in |
| SET/Bl = | 0.20 in |




| | |
|---|---|
| Length b. Sensors | 58.4 ft |
| Embedment | 57.0 ft |
| Top Area | 20.8 $in^2$ |
| End Bearing Area | 254.2 $in^2$ |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 $lb/ft^3$ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 15420 ft/s |
| Match Quality | 2.83 |
| Top Compr. Stress | 28.6 ksi |
| Max Compr. Stress | 28.7 ksi |
| Max Tension Stress | -0.11 ksi |
| Avg. Shaft Quake | 0.04 in |
| Toe Quake | 0.26 in |
| Avg. Shaft Smith Dpg. | 0.14 s/ft |
| Toe Smith Damping | 0.26 s/ft |

## CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 489.0; along Shaft 253.0; at Toe 236.0 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Smith Damping Factor s/ft |
|---|---|---|---|---|---|---|---|---|
| | | | | 489.0 | | | | |
| 1 | 3.7 | 2.3 | 1.2 | 487.8 | 1.2 | 0.52 | 0.11 | 0.14 |
| 2 | 7.4 | 6.0 | 3.9 | 483.9 | 5.1 | 1.06 | 0.22 | 0.14 |
| 3 | 11.0 | 9.7 | 3.9 | 480.0 | 9.0 | 1.06 | 0.22 | 0.14 |
| 4 | 14.7 | 13.4 | 7.1 | 473.0 | 16.1 | 1.92 | 0.41 | 0.14 |
| 5 | 18.4 | 17.1 | 7.1 | 465.9 | 23.1 | 1.92 | 0.41 | 0.14 |
| 6 | 22.1 | 20.7 | 7.8 | 458.1 | 30.9 | 2.11 | 0.45 | 0.11 |
| 7 | 25.7 | 24.3 | 4.9 | 453.2 | 35.8 | 1.37 | 0.29 | 0.11 |
| 8 | 29.1 | 27.7 | 3.4 | 449.8 | 39.2 | 1.00 | 0.21 | 0.11 |
| 9 | 32.2 | 30.8 | 3.4 | 446.5 | 42.6 | 1.09 | 0.23 | 0.11 |
| 10 | 35.1 | 33.7 | 3.4 | 443.1 | 45.9 | 1.16 | 0.25 | 0.11 |
| 11 | 38.0 | 36.6 | 4.3 | 438.8 | 50.2 | 1.47 | 0.31 | 0.14 |
| 12 | 40.9 | 39.5 | 16.8 | 422.0 | 67.0 | 5.76 | 1.22 | 0.14 |
| 13 | 43.8 | 42.5 | 36.7 | 385.3 | 103.7 | 12.60 | 2.68 | 0.14 |
| 14 | 46.7 | 45.4 | 40.9 | 344.4 | 144.6 | 14.04 | 2.98 | 0.14 |
| 15 | 49.6 | 48.3 | 43.3 | 301.1 | 187.9 | 14.88 | 3.16 | 0.14 |
| 16 | 52.5 | 51.2 | 33.5 | 267.5 | 221.5 | 11.52 | 2.44 | 0.14 |
| 17 | 55.5 | 54.1 | 15.8 | 251.7 | 237.3 | 5.44 | 1.15 | 0.14 |
| 18 | 58.4 | 57.0 | 15.6 | 236.0 | 253.0 | 5.37 | 1.14 | 0.14 |
| Avg. Shaft | | | 14.1 | | | 4.44 | 0.94 | 0.14 |
| Toe | | | 236.0 | | | | 133.69 | 0.26 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Quake | (in) | 0.04 | 0.26 |
| Case Damping Factor | | 0.94 | 1.65 |
| Damping Type | | Viscous | Viscous |
| Unloading Quake | (% of loading quake) | 30 | 96 |
| Reloading Level | (% of Ru) | 100 | 100 |
| Unloading Level | (% of Ru) | 0 | |
| Resistance Gap (included in Toe Quake) | (in) | | 0.15 |
| Soil Plug Weight | (kips) | | 0.026 |
| Soil Support Dashpot | | 1.800 | 10.000 |
| Soil Support Weight | (kips) | 1.44 | 1.43 |

CAPWAP match quality = 2.83 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.20 in; Blow Count = 61 b/ft
Computed: Final Set = 0.21 in; Blow Count = 58 b/ft
Transducer F1 (W064) CAL: 92.1; RF: 1.00; F2 (Z051) CAL: 89.4; RF: 1.10
A3 (K14584) CAL: 416; RF: 1.00; A4 (K11820) CAL: 434; RF: 1.00

max. Top Comp. Stress = 28.6 ksi (T= 39.5 ms, max= 1.001 x Top)
max. Comp. Stress = 28.7 ksi (Z= 7.4 ft, T= 39.7 ms)
max. Tens. Stress = -0.11 ksi (Z= 22.1 ft, T= 100.5 ms)
max. Energy (EMX) = 17.2 kip-ft; max. Measured Top Displ. (DMX)= 0.50 in

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.7 | 594.3 | -1.9 | 28.6 | -0.09 | 17.2 | 11.7 | 0.50 |
| 2 | 7.4 | 595.0 | -1.9 | 28.7 | -0.09 | 16.7 | 11.5 | 0.47 |
| 3 | 11.0 | 591.1 | -1.8 | 28.5 | -0.09 | 16.0 | 11.2 | 0.45 |
| 4 | 14.7 | 590.1 | -2.0 | 28.4 | -0.09 | 15.3 | 10.5 | 0.42 |
| 5 | 18.4 | 589.7 | -2.1 | 28.4 | -0.10 | 14.5 | 9.5 | 0.39 |
| 6 | 22.1 | 592.3 | -2.3 | 28.5 | -0.11 | 13.7 | 8.3 | 0.36 |
| 7 | 25.7 | 589.8 | -2.0 | 13.6 | -0.05 | 13.2 | 7.2 | 0.35 |
| 8 | 29.1 | 604.3 | -1.4 | 5.1 | -0.01 | 12.9 | 6.0 | 0.34 |
| 9 | 32.2 | 621.8 | -1.3 | 3.1 | -0.01 | 12.7 | 5.4 | 0.33 |
| 10 | 35.1 | 652.7 | -1.7 | 2.6 | -0.01 | 12.5 | 5.1 | 0.32 |
| 11 | 38.0 | 677.6 | -1.9 | 2.7 | -0.01 | 12.3 | 4.8 | 0.31 |
| 12 | 40.9 | 697.2 | -1.6 | 2.7 | -0.01 | 12.1 | 4.5 | 0.31 |
| 13 | 43.8 | 697.1 | -0.9 | 2.7 | -0.00 | 11.5 | 4.3 | 0.30 |
| 14 | 46.7 | 666.7 | -0.5 | 2.6 | -0.00 | 10.3 | 4.1 | 0.30 |
| 15 | 49.6 | 612.6 | -0.1 | 2.4 | -0.00 | 9.1 | 4.2 | 0.30 |
| 16 | 52.5 | 545.8 | 0.0 | 2.1 | 0.00 | 7.8 | 4.9 | 0.29 |
| 17 | 55.5 | 431.1 | 0.0 | 1.7 | 0.00 | 6.7 | 5.1 | 0.29 |
| 18 | 58.4 | 329.8 | 0.0 | 1.3 | 0.00 | 5.8 | 5.2 | 0.29 |
| Absolute | 7.4 | | | 28.7 | | | (T = | 39.7 ms) |
| | 22.1 | | | | -0.11 | | (T = | 100.5 ms) |

CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 636.5 | 610.6 | 584.7 | 558.8 | 532.9 | 507.1 | 481.2 | 455.3 | 429.4 | 403.5 |
| RX | 636.5 | 610.6 | 584.7 | 558.8 | 532.9 | 507.1 | 481.2 | 455.3 | 429.4 | 408.1 |
| RU | 653.2 | 629.0 | 604.7 | 580.5 | 556.3 | 532.1 | 507.9 | 483.7 | 459.5 | 435.3 |

RAU = 121.8 (kips); RA2 = 489.3 (kips)

Current CAPWAP Ru = 489.0 (kips); Corresponding J(RP)= 0.57; J(RX) = 0.57

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 12.1 | 36.59 | 448.4 | 446.9 | 594.0 | 0.50 | 0.19 | 0.20 | 17.2 | 596.1 | 1999 |

PILE PROFILE AND PILE MODEL

| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.8 | 30000.1 | 492.000 | 4.71 |
| 23.0 | 20.8 | 30000.1 | 492.000 | 4.71 |
| 32.8 | 254.2 | 7015.8 | 183.783 | 4.71 |
| 58.4 | 254.2 | 7015.8 | 183.783 | 4.71 |

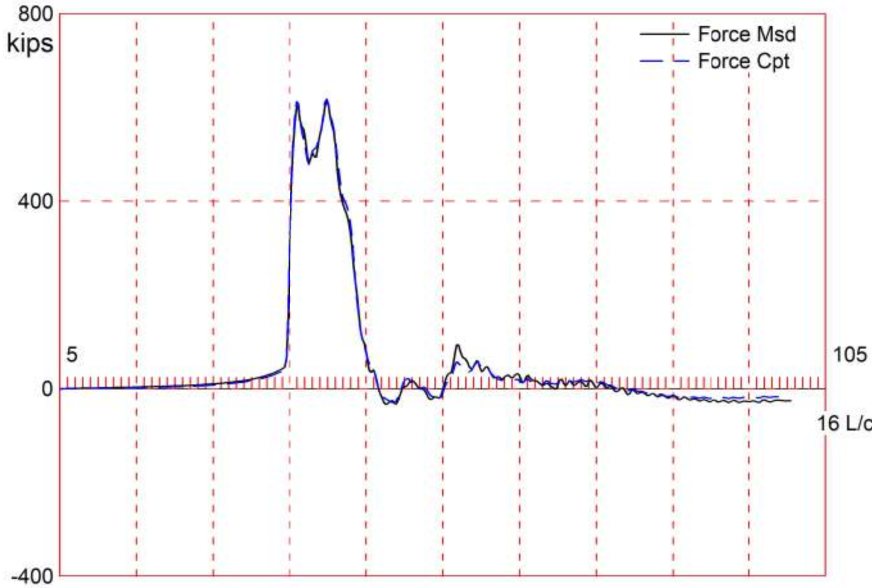
Toe Area 254.2 $in^2$

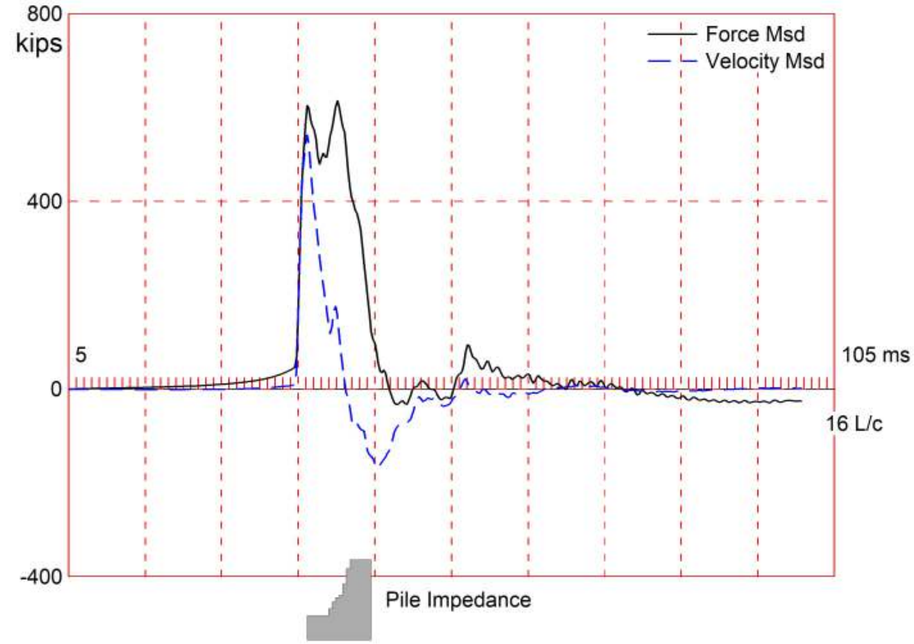
| Segmnt Number | Dist. B.G. ft | Impedance kips/ft/s | Imped. Change % | Tension Slack in | Tension Eff. | Compression Slack in | Compression Eff. | Perim. ft | Wave Speed ft/s |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.7 | 37.04 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 17504.7 |
| 2 | 7.4 | 34.26 | -7.51 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 17504.7 |
| 7 | 25.7 | 41.63 | -10.42 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 17149.7 |
| 8 | 29.1 | 51.39 | -34.18 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 15960.4 |
| 9 | 32.2 | 65.10 | -41.14 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 14736.2 |
| 10 | 35.1 | 95.93 | -28.04 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13881.0 |
| 11 | 38.0 | 102.78 | -23.37 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13850.4 |
| 12 | 40.9 | 109.63 | -18.26 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13850.4 |
| 13 | 43.8 | 126.77 | -5.49 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13850.4 |
| 14 | 46.7 | 134.12 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13850.4 |
| 18 | 58.4 | 134.12 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13850.4 |

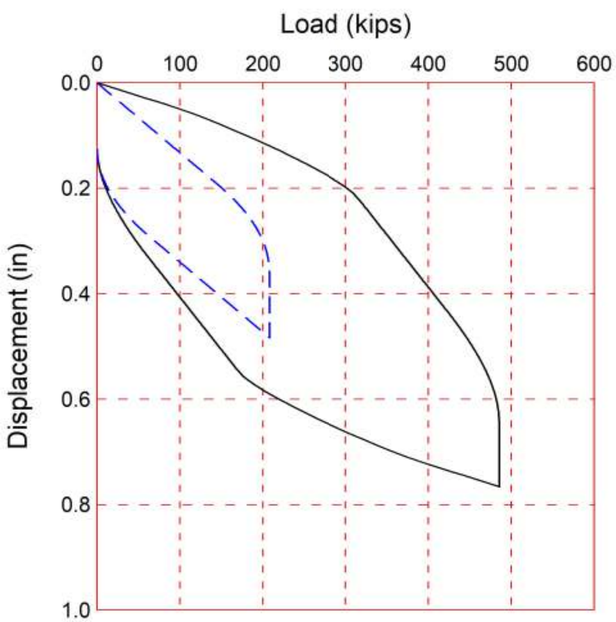
Wave Speed: Pile Top 16807.8, Elastic 14806.1, Overall 15419.9 ft/s
Pile Damping 1.00 %, Time Incr 0.210 ms, 2L/c 7.6 ms
Total volume: 50.696 $ft^3$; Volume ratio considering added impedance: 0.881

TSFP; Pile: TP2; R; Blow: 8 (Test: 29-Apr-2025 10:20:)
Scientific Applied Concepts Lmited (SACL)

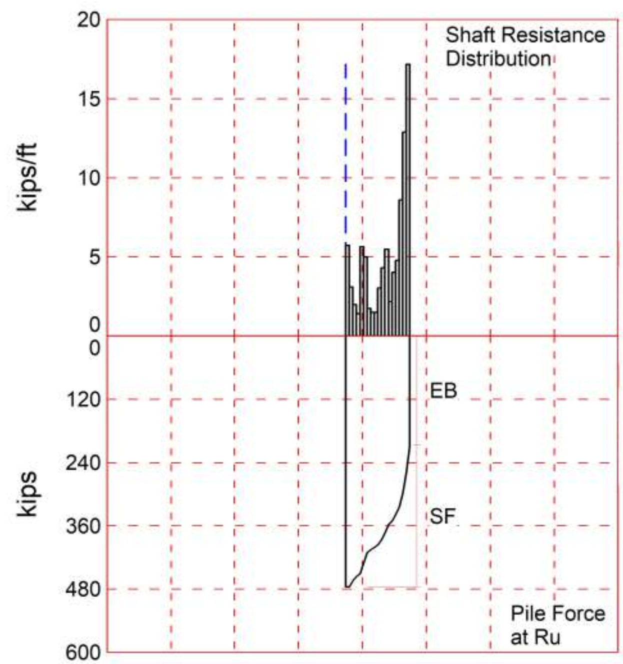
20-May-2025
CAPWAP(R) 2014-3




| | |
|---|---|
| RU = | 485.6 kips |
| SF = | 277.7 kips |
| EB = | 207.9 kips |
| Dy = | 0.64 in |
| Dx = | 0.77 in |
| SET/Bl = | 0.12 in |




| | |
|---|---|
| Length b. Sensors | 59.1 ft |
| Embedment | 57.0 ft |
| Top Area | 20.8 $in^2$ |
| End Bearing Area | 254.2 $in^2$ |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 $lb/ft^3$ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 14166 ft/s |
| Match Quality | 2.22 |
| Top Compr. Stress | 30.9 ksi |
| Max Compr. Stress | 31.6 ksi |
| Max Tension Stress | -1.72 ksi |
| Avg. Shaft Quake | 0.04 in |
| Toe Quake | 0.28 in |
| Avg. Shaft Smith Dpg. | 0.15 s/ft |
| Toe Smith Damping | 0.29 s/ft |

## CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 485.6; along Shaft 277.7; at Toe 207.9 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Smith Damping Factor s/ft |
|---|---|---|---|---|---|---|---|---|
| | | | | 485.6 | | | | |
| 1 | 3.8 | 1.7 | 9.8 | 475.9 | 9.8 | 5.72 | 1.21 | 0.18 |
| 2 | 7.6 | 5.5 | 11.8 | 464.0 | 21.6 | 3.11 | 0.66 | 0.18 |
| 3 | 11.4 | 9.3 | 7.6 | 456.4 | 29.2 | 1.99 | 0.42 | 0.18 |
| 4 | 15.2 | 13.1 | 5.4 | 451.0 | 34.6 | 1.42 | 0.30 | 0.18 |
| 5 | 19.0 | 16.9 | 21.6 | 429.5 | 56.2 | 5.66 | 1.20 | 0.18 |
| 6 | 22.7 | 20.6 | 18.3 | 411.1 | 74.5 | 5.00 | 1.06 | 0.18 |
| 7 | 26.0 | 23.9 | 5.7 | 405.4 | 80.2 | 1.75 | 0.37 | 0.04 |
| 8 | 29.0 | 26.9 | 4.5 | 400.9 | 84.8 | 1.51 | 0.32 | 0.04 |
| 9 | 32.0 | 29.9 | 4.5 | 396.3 | 89.3 | 1.51 | 0.32 | 0.04 |
| 10 | 35.0 | 32.9 | 9.2 | 387.1 | 98.5 | 3.05 | 0.65 | 0.04 |
| 11 | 38.0 | 35.9 | 13.0 | 374.1 | 111.5 | 4.31 | 0.92 | 0.04 |
| 12 | 41.0 | 38.9 | 16.5 | 357.6 | 128.0 | 5.48 | 1.16 | 0.04 |
| 13 | 44.1 | 42.0 | 6.6 | 351.0 | 134.6 | 2.18 | 0.46 | 0.18 |
| 14 | 47.1 | 45.0 | 12.2 | 338.9 | 146.8 | 4.04 | 0.86 | 0.18 |
| 15 | 50.1 | 48.0 | 14.4 | 324.5 | 161.1 | 4.77 | 1.01 | 0.18 |
| 16 | 53.1 | 51.0 | 25.9 | 298.5 | 187.1 | 8.60 | 1.83 | 0.18 |
| 17 | 56.1 | 54.0 | 38.8 | 259.7 | 225.9 | 12.89 | 2.74 | 0.18 |
| 18 | 59.1 | 57.0 | 51.8 | 207.9 | 277.7 | 17.17 | 3.64 | 0.18 |
| Avg. Shaft | | | 15.4 | | | 4.87 | 1.03 | 0.15 |
| Toe | | | 207.9 | | | | 117.78 | 0.29 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Quake | (in) | 0.04 | 0.28 |
| Case Damping Factor | | 1.14 | 1.63 |
| Damping Type | | Viscous | Viscous |
| Unloading Quake | (% of loading quake) | 30 | 56 |
| Reloading Level | (% of Ru) | 100 | 100 |
| Unloading Level | (% of Ru) | 0 | |
| Resistance Gap (included in Toe Quake) (in) | | | 0.20 |
| Soil Support Dashpot | | 1.800 | 6.525 |
| Soil Support Weight | (kips) | 1.48 | 1.49 |

CAPWAP match quality = 2.22 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.12 in; Blow Count = 96 b/ft
Computed: Final Set = 0.16 in; Blow Count = 74 b/ft
Transducer F1 (W064) CAL: 92.1; RF: 1.00; F2 (Z051) CAL: 89.4; RF: 1.00
A3 (K14584) CAL: 416; RF: 1.00; A4 (K11820) CAL: 434; RF: 1.00

max. Top Comp. Stress = 30.9 ksi (T= 40.3 ms, max= 1.023 x Top)
max. Comp. Stress = 31.6 ksi (Z= 19.0 ft, T= 37.6 ms)
max. Tens. Stress = -1.72 ksi (Z= 11.4 ft, T= 47.8 ms)
max. Energy (EMX) = 22.5 kip-ft; max. Measured Top Displ. (DMX)= 0.55 in

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.8 | 641.8 | -33.7 | 30.9 | -1.63 | 22.5 | 14.0 | 0.52 |
| 2 | 7.6 | 642.5 | -35.1 | 31.0 | -1.69 | 20.7 | 13.7 | 0.48 |
| 3 | 11.4 | 628.4 | -35.8 | 30.3 | -1.72 | 18.8 | 13.1 | 0.44 |
| 4 | 15.2 | 626.7 | -30.6 | 30.2 | -1.48 | 17.5 | 11.7 | 0.41 |
| 5 | 19.0 | 656.4 | -34.5 | 31.6 | -1.66 | 16.9 | 10.3 | 0.39 |
| 6 | 22.7 | 630.5 | -32.3 | 10.0 | -0.51 | 15.5 | 9.3 | 0.37 |
| 7 | 26.0 | 614.3 | -26.0 | 3.4 | -0.14 | 14.4 | 8.7 | 0.36 |
| 8 | 29.0 | 656.1 | -33.1 | 2.6 | -0.13 | 14.2 | 7.9 | 0.35 |
| 9 | 32.0 | 708.5 | -43.0 | 2.8 | -0.17 | 14.1 | 7.0 | 0.35 |
| 10 | 35.0 | 742.4 | -49.7 | 2.9 | -0.20 | 13.9 | 6.3 | 0.34 |
| 11 | 38.0 | 754.5 | -52.6 | 3.0 | -0.21 | 13.6 | 5.9 | 0.34 |
| 12 | 41.0 | 752.7 | -70.0 | 3.0 | -0.28 | 13.2 | 5.7 | 0.33 |
| 13 | 44.1 | 741.6 | -71.9 | 2.9 | -0.28 | 12.8 | 5.6 | 0.33 |
| 14 | 47.1 | 742.9 | -75.2 | 2.9 | -0.30 | 12.5 | 5.5 | 0.33 |
| 15 | 50.1 | 733.3 | -88.8 | 2.9 | -0.35 | 11.9 | 5.5 | 0.32 |
| 16 | 53.1 | 647.8 | -99.6 | 2.5 | -0.39 | 11.3 | 6.0 | 0.31 |
| 17 | 56.1 | 552.3 | -96.4 | 2.2 | -0.38 | 10.2 | 6.2 | 0.31 |
| 18 | 59.1 | 458.8 | -85.2 | 1.8 | -0.34 | 6.9 | 6.3 | 0.30 |
| Absolute | 19.0 | | | 31.6 | | | (T = | 37.6 ms) |
| | 11.4 | | | | -1.72 | | (T = | 47.8 ms) |

CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 787.0 | 750.8 | 714.7 | 678.5 | 642.4 | 606.2 | 570.1 | 533.9 | 497.8 | 461.6 |
| RX | 787.5 | 750.8 | 714.7 | 678.5 | 642.4 | 606.2 | 570.1 | 533.9 | 497.8 | 461.6 |
| RU | 889.9 | 864.0 | 838.2 | 812.3 | 786.5 | 760.6 | 734.8 | 708.9 | 683.1 | 657.2 |

RAU = 43.6 (kips); RA2 = 499.4 (kips)

Current CAPWAP Ru = 485.6 (kips); Corresponding J(RP)= 0.83; J(RX) = 0.83

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 14.8 | 36.40 | 547.2 | 601.2 | 618.3 | 0.55 | 0.12 | 0.12 | 23.7 | 848.8 | 2640 |

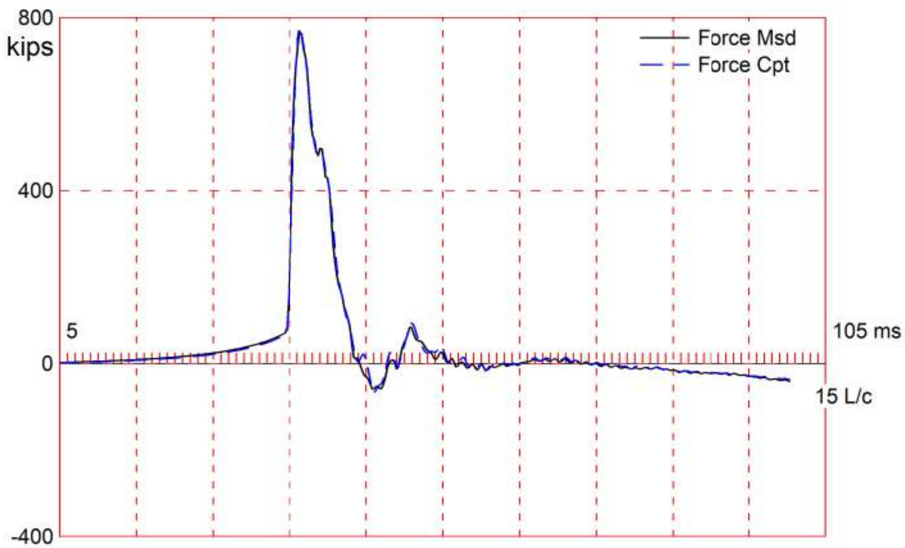
PILE PROFILE AND PILE MODEL

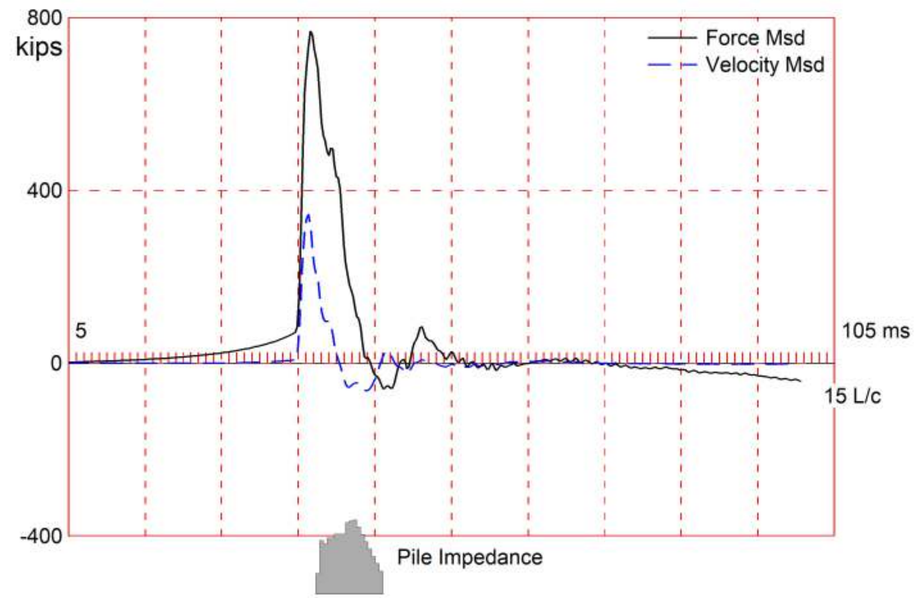
| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.8 | 30000.1 | 492.000 | 4.71 |
| 19.7 | 20.8 | 30000.1 | 492.000 | 4.71 |
| 26.2 | 254.2 | 7015.8 | 183.783 | 4.71 |
| 59.1 | 254.2 | 7015.8 | 183.783 | 4.71 |

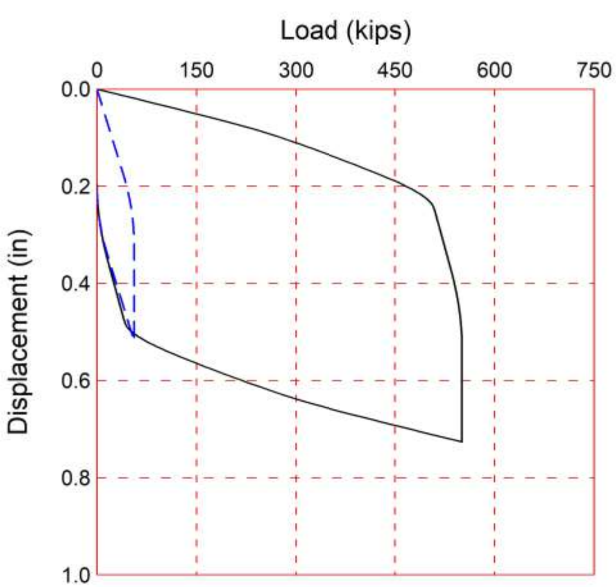
Toe Area 254.2 $in^2$

| Segmnt Number | Dist. B.G. | Impedance | Imped. Change | Tension Slack | Tension Eff. | Compression Slack | Compression Eff. | Perim. | Wave Speed |
|---|---|---|---|---|---|---|---|---|---|
| | ft | kips/ft/s | % | in | | in | | ft | ft/s |
| 1 | 3.8 | 37.04 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16427.4 |
| 2 | 7.6 | 37.00 | -0.12 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16427.4 |
| 7 | 26.0 | 47.97 | -54.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 14052.4 |
| 8 | 29.0 | 58.24 | -56.51 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13005.4 |
| 9 | 32.0 | 65.10 | -51.47 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12998.0 |
| 10 | 35.0 | 68.52 | -48.91 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12998.0 |
| 11 | 38.0 | 85.65 | -36.14 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12998.0 |
| 12 | 41.0 | 109.64 | -18.26 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12998.0 |
| 13 | 44.1 | 123.34 | -8.04 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12998.0 |
| 18 | 59.1 | 123.34 | -8.04 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12998.0 |

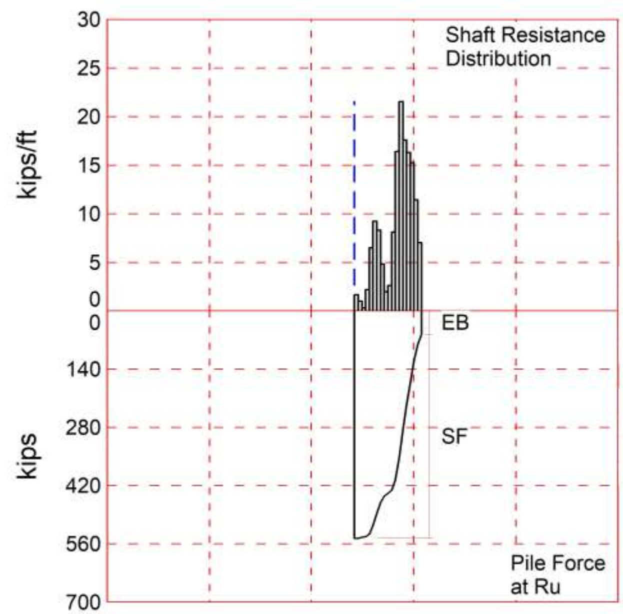
Wave Speed: Pile Top 16807.8, Elastic 14493.9, Overall 14165.8 ft/s
Pile Damping 2.00 %, Time Incr 0.232 ms, 2L/c 8.3 ms
Total volume: 50.447 $ft^3$; Volume ratio considering added impedance: 0.753




RU = 550.8 kips
SF = 494.6 kips
EB = 56.2 kips
Dy = 0.53 in
Dx = 0.73 in
SET/Bl = 0.20 in




| | |
|---|---|
| Length b. Sensors | 58.7 ft |
| Embedment | 57.0 ft |
| Top Area | 20.8 $in^2$ |
| End Bearing Area | 254.2 $in^2$ |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 $lb/ft^3$ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 13451 ft/s |
| Match Quality | 1.73 |
| Top Compr. Stress | 38.7 ksi |
| Max Compr. Stress | 38.7 ksi |
| Max Tension Stress | -3.47 ksi |
| Avg. Shaft Quake | 0.05 in |
| Toe Quake | 0.25 in |
| Avg. Shaft Smith Dpg. | 0.05 s/ft |
| Toe Smith Damping | 0.34 s/ft |

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 550.8; along Shaft 494.6; at Toe 56.2 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Quake in |
|---|---|---|---|---|---|---|---|---|
| | | | | 550.8 | | | | |
| 1 | 4.0 | 2.3 | 3.9 | 546.9 | 3.9 | 1.68 | 0.36 | 0.04 |
| 2 | 7.1 | 5.5 | 3.2 | 543.8 | 7.1 | 1.01 | 0.21 | 0.04 |
| 3 | 10.3 | 8.6 | 0.9 | 542.8 | 8.0 | 0.30 | 0.06 | 0.04 |
| 4 | 13.4 | 11.8 | 6.9 | 535.9 | 14.9 | 2.19 | 0.46 | 0.04 |
| 5 | 16.5 | 14.9 | 20.5 | 515.5 | 35.4 | 6.51 | 1.38 | 0.04 |
| 6 | 19.7 | 18.0 | 29.0 | 486.4 | 64.4 | 9.24 | 1.96 | 0.04 |
| 7 | 22.8 | 21.2 | 26.1 | 460.3 | 90.5 | 8.31 | 1.76 | 0.04 |
| 8 | 26.0 | 24.3 | 15.2 | 445.1 | 105.7 | 4.84 | 1.03 | 0.04 |
| 9 | 29.1 | 27.5 | 6.2 | 439.0 | 111.9 | 1.96 | 0.42 | 0.04 |
| 10 | 32.3 | 30.6 | 8.2 | 430.8 | 120.1 | 2.60 | 0.55 | 0.04 |
| 11 | 35.4 | 33.8 | 25.6 | 405.2 | 145.7 | 8.12 | 1.75 | 0.04 |
| 12 | 38.6 | 37.0 | 52.4 | 352.7 | 198.1 | 16.43 | 3.81 | 0.05 |
| 13 | 41.8 | 40.2 | 69.7 | 283.0 | 267.8 | 21.54 | 5.42 | 0.05 |
| 14 | 45.1 | 43.5 | 57.7 | 225.3 | 325.6 | 17.60 | 4.85 | 0.05 |
| 15 | 48.4 | 46.8 | 54.2 | 171.0 | 379.8 | 16.32 | 4.96 | 0.05 |
| 16 | 51.8 | 50.2 | 51.4 | 119.6 | 431.3 | 15.27 | 5.18 | 0.05 |
| 17 | 55.2 | 53.6 | 39.1 | 80.5 | 470.3 | 11.45 | 4.40 | 0.05 |
| 18 | 58.7 | 57.0 | 24.3 | 56.2 | 494.6 | 7.04 | 3.11 | 0.05 |
| Avg. Shaft | | | 27.5 | | | 8.67 | 2.11 | 0.05 |
| Toe | | | 56.2 | | | | 31.83 | 0.25 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Smith Damping Factor | | 0.05 | 0.34 |
| Case Damping Factor | | 0.73 | 0.51 |
| Damping Type | | Viscous | Viscous |
| Unloading Quake | (% of loading quake) | 25 | 50 |
| Reloading Level | (% of Ru) | 100 | 100 |
| Unloading Level | (% of Ru) | 10 | |
| Resistance Gap (included in Toe Quake) (in) | | | 0.01 |
| Soil Plug Weight | (kips) | 1.259 | 1.012 |
| Soil Support Dashpot | | 2.100 | 0.000 |
| Soil Support Weight | (kips) | 1.60 | 0.00 |

CAPWAP match quality = 1.73 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.20 in; Blow Count = 61 b/ft
Computed: Final Set = 0.16 in; Blow Count = 73 b/ft
Transducer F1 (W064) CAL: 92.1; RF: 1.00; F2 (Z051) CAL: 89.4; RF: 1.00
A3 (K14584) CAL: 416; RF: 1.00; A4 (K11820) CAL: 434; RF: 1.00

max. Top Comp. Stress = 38.7 ksi (T= 36.8 ms, max= 1.000 x Top)
max. Comp. Stress = 38.7 ksi (Z= 4.0 ft, T= 36.8 ms)
max. Tens. Stress = -3.47 ksi (Z= 4.0 ft, T= 46.0 ms)
max. Energy (EMX) = 14.2 kip-ft; max. Measured Top Displ. (DMX)= 0.29 in

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 4.0 | 802.3 | -72.1 | 38.7 | -3.47 | 14.2 | 7.8 | 0.29 |
| 2 | 7.1 | 813.0 | -109.2 | 3.2 | -0.43 | 13.9 | 7.6 | 0.28 |
| 3 | 10.3 | 829.7 | -151.3 | 3.3 | -0.60 | 13.7 | 7.4 | 0.27 |
| 4 | 13.4 | 848.2 | -163.8 | 3.3 | -0.64 | 13.6 | 7.1 | 0.26 |
| 5 | 16.5 | 862.9 | -150.8 | 3.4 | -0.59 | 13.4 | 6.9 | 0.26 |
| 6 | 19.7 | 879.7 | -135.5 | 3.5 | -0.53 | 12.9 | 6.6 | 0.25 |
| 7 | 22.8 | 870.3 | -108.9 | 3.4 | -0.43 | 12.2 | 6.2 | 0.25 |
| 8 | 26.0 | 862.3 | -78.6 | 3.4 | -0.31 | 11.6 | 5.9 | 0.25 |
| 9 | 29.1 | 855.9 | -63.1 | 3.4 | -0.25 | 11.2 | 5.8 | 0.25 |
| 10 | 32.3 | 840.7 | -87.2 | 3.3 | -0.34 | 11.1 | 5.8 | 0.25 |
| 11 | 35.4 | 815.1 | -86.9 | 3.3 | -0.35 | 10.9 | 6.0 | 0.25 |
| 12 | 38.6 | 781.1 | -82.4 | 3.5 | -0.37 | 10.3 | 6.0 | 0.25 |
| 13 | 41.8 | 714.0 | -75.4 | 3.6 | -0.38 | 9.2 | 6.0 | 0.25 |
| 14 | 45.1 | 622.6 | -49.4 | 3.7 | -0.29 | 7.8 | 6.0 | 0.25 |
| 15 | 48.4 | 533.2 | -25.5 | 3.7 | -0.18 | 6.6 | 6.2 | 0.25 |
| 16 | 51.8 | 513.5 | -41.1 | 4.4 | -0.35 | 5.5 | 6.1 | 0.25 |
| 17 | 55.2 | 473.4 | -40.7 | 5.2 | -0.45 | 4.4 | 6.9 | 0.25 |
| 18 | 58.7 | 383.8 | -28.0 | 6.0 | -0.44 | 2.7 | 8.3 | 0.25 |
| Absolute | 4.0 | | | 38.7 | | | (T = | 36.8 ms) |
| | 4.0 | | | | -3.47 | | (T = | 46.0 ms) |

## CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 588.9 | 541.0 | 493.1 | 445.3 | 397.4 | 349.5 | 301.7 | 253.8 | 205.9 | 158.0 |
| RX | 598.3 | 547.5 | 496.8 | 446.1 | 397.4 | 349.5 | 301.7 | 253.8 | 205.9 | 158.0 |
| RU | 598.7 | 551.9 | 505.0 | 458.1 | 411.2 | 364.3 | 317.4 | 270.5 | 223.7 | 176.8 |

RAU = 39.6 (kips); RA2 = 559.3 (kips)

Current CAPWAP Ru = 550.8 (kips); Corresponding J(RP)= 0.08; J(RX) = 0.09

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 9.4 | 37.55 | 349.8 | 717.8 | 774.6 | 0.29 | 0.20 | 0.20 | 14.8 | 729.1 | 238 |

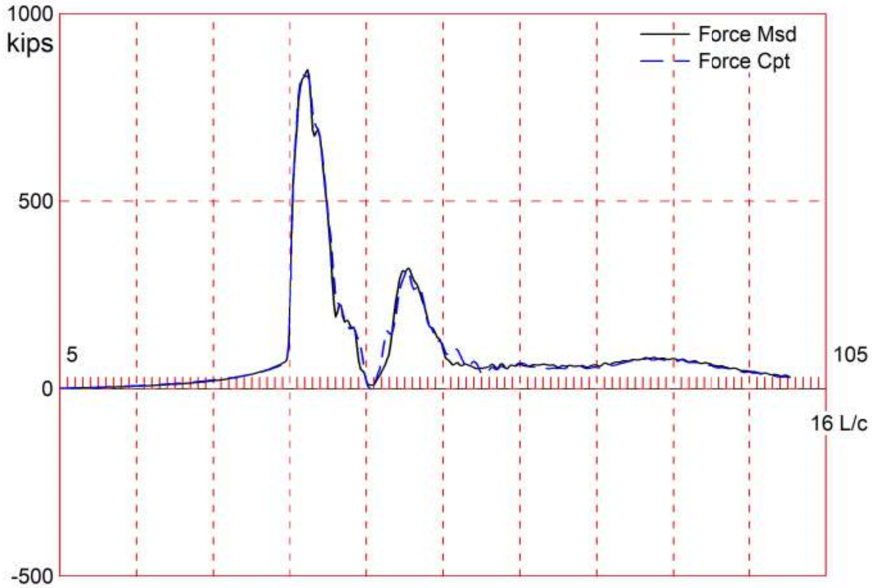
## PILE PROFILE AND PILE MODEL

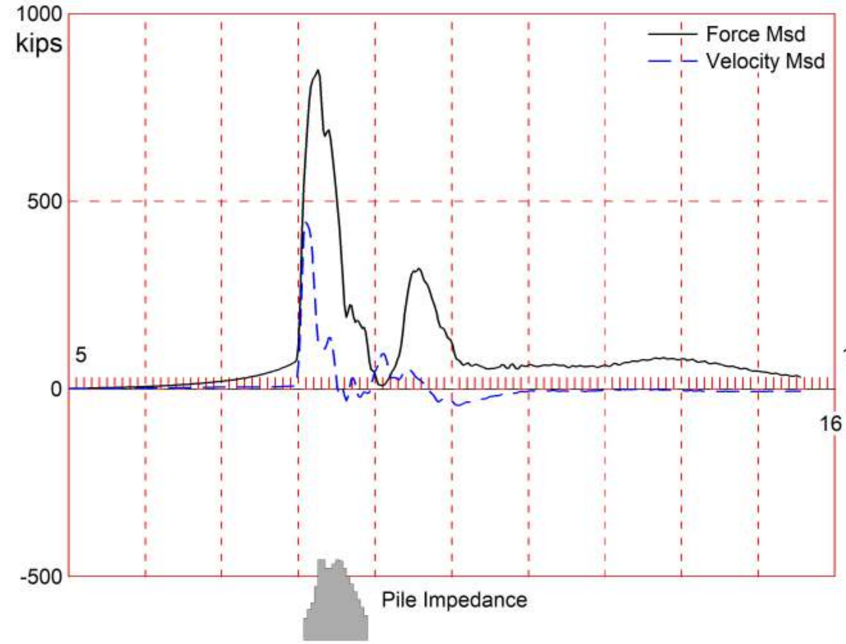
| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.8 | 30000.1 | 492.000 | 4.71 |
| 3.9 | 20.8 | 30000.1 | 492.000 | 4.71 |
| 3.9 | 254.2 | 7015.8 | 183.783 | 4.71 |
| 33.3 | 254.2 | 7015.8 | 183.783 | 4.71 |
| 58.7 | 50.3 | 10135.3 | 216.822 | 2.09 |

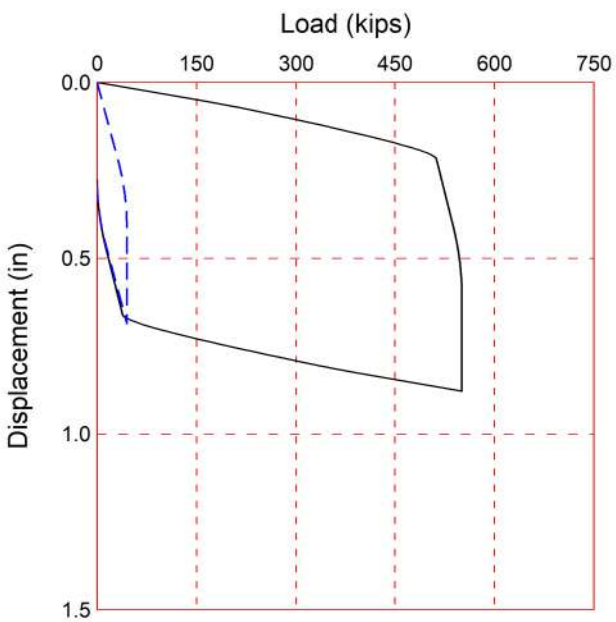
Toe Area 254.2 $in^2$

| Segmnt Number | Dist. B.G. | Impedance | Imped. Change | Slack | Tension Eff. | Compression Slack | Compression Eff. | Perim. | Wave Speed | Soil Plug |
|---|---|---|---|---|---|---|---|---|---|---|
| | ft | kips/ft/s | % | in | | in | | ft | ft/s | kips |
| 1 | 4.0 | 37.04 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 16390.5 | 0.000 |
| 2 | 7.1 | 95.05 | -29.13 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12968.8 | 0.000 |
| 3 | 10.3 | 89.08 | -33.59 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12968.8 | 0.000 |
| 4 | 13.4 | 99.53 | -25.80 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12968.8 | 0.000 |
| 6 | 19.7 | 106.38 | -20.69 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12968.8 | 0.000 |
| 9 | 29.1 | 126.94 | -5.36 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12968.8 | 0.000 |
| 10 | 32.3 | 129.68 | -3.32 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 12968.8 | 0.000 |
| 11 | 35.4 | 131.27 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.64 | 13008.5 | 0.157 |
| 12 | 38.6 | 119.02 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.31 | 13178.6 | 0.157 |
| 13 | 41.8 | 106.03 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.97 | 13359.0 | 0.157 |
| 14 | 45.1 | 93.05 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.63 | 13539.3 | 0.157 |
| 15 | 48.4 | 80.06 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.29 | 13719.7 | 0.157 |
| 16 | 51.8 | 67.08 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.95 | 13900.0 | 0.157 |
| 17 | 55.2 | 54.10 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.61 | 14080.4 | 0.157 |
| 18 | 58.7 | 41.11 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.26 | 14260.7 | 0.157 |

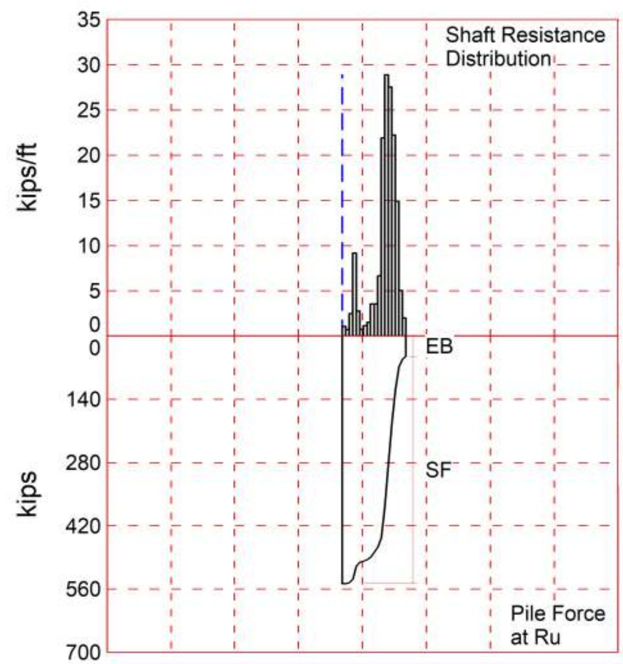
Wave Speed: Pile Top 16807.8, Elastic 13794.0, Overall 13451.4 ft/s
Pile Damping 2.00 %, Time Incr 0.242 ms, 2L/c 8.7 ms
Total volume: 68.624 $ft^3$; Volume ratio considering added impedance: 0.870




RU = 550.8 kips
SF = 505.9 kips
EB = 45.0 kips
Dy = 0.60 in
Dx = 0.88 in
SET/Bl = 0.28 in




| | |
|---|---|
| Length b. Sensors | 58.5 ft |
| Embedment | 57.0 ft |
| Top Area | 20.8 $in^2$ |
| End Bearing Area | 254.2 $in^2$ |
| Top Perimeter | 4.71 ft |
| Top E-Modulus | 30000 ksi |
| Top Spec. Weight | 492.0 $lb/ft^3$ |
| Top Wave Spd. | 16808 ft/s |
| Overall W.S. | 14108 ft/s |
| Match Quality | 2.79 |
| Top Compr. Stress | 43.8 ksi |
| Max Compr. Stress | 43.8 ksi |
| Max Tension Stress | -1.09 ksi |
| Avg. Shaft Quake | 0.04 in |
| Toe Quake | 0.31 in |
| Avg. Shaft Smith Dpg. | 0.05 s/ft |
| Toe Smith Damping | 0.21 s/ft |

## CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 550.8; along Shaft 505.9; at Toe 45.0 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf |
|---|---|---|---|---|---|---|---|
| | | | | 550.8 | | | |
| 1 | 4.0 | 2.5 | 2.7 | 548.2 | 2.7 | 1.08 | 0.23 |
| 2 | 7.1 | 5.6 | 2.2 | 545.9 | 4.9 | 0.72 | 0.15 |
| 3 | 10.2 | 8.8 | 7.8 | 538.1 | 12.7 | 2.49 | 0.53 |
| 4 | 13.4 | 11.9 | 28.9 | 509.2 | 41.6 | 9.19 | 1.95 |
| 5 | 16.5 | 15.0 | 8.7 | 500.6 | 50.3 | 2.76 | 0.59 |
| 6 | 19.7 | 18.2 | 2.4 | 498.2 | 52.7 | 0.76 | 0.16 |
| 7 | 22.8 | 21.3 | 3.6 | 494.6 | 56.2 | 1.14 | 0.24 |
| 8 | 25.9 | 24.5 | 4.9 | 489.8 | 61.1 | 1.55 | 0.33 |
| 9 | 29.1 | 27.6 | 11.2 | 478.6 | 72.2 | 3.55 | 0.75 |
| 10 | 32.2 | 30.7 | 11.2 | 467.5 | 83.4 | 3.55 | 0.75 |
| 11 | 35.4 | 33.9 | 21.0 | 446.4 | 104.4 | 6.68 | 1.44 |
| 12 | 38.6 | 37.1 | 69.9 | 376.6 | 174.3 | 21.91 | 5.07 |
| 13 | 41.8 | 40.3 | 93.4 | 283.2 | 267.7 | 28.88 | 7.25 |
| 14 | 45.1 | 43.6 | 90.3 | 192.9 | 357.9 | 27.54 | 7.57 |
| 15 | 48.4 | 46.9 | 73.8 | 119.1 | 431.7 | 22.22 | 6.74 |
| 16 | 51.8 | 50.3 | 50.1 | 69.0 | 481.9 | 14.90 | 5.05 |
| 17 | 55.2 | 53.7 | 17.2 | 51.8 | 499.0 | 5.03 | 1.93 |
| 18 | 58.6 | 57.1 | 6.9 | 45.0 | 505.9 | 1.99 | 0.88 |
| Avg. Shaft | | | 28.1 | | | 8.87 | 2.15 |
| Toe | | | 45.0 | | | | 25.47 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Smith Damping Factor | | 0.05 | 0.21 |
| Quake | (in) | 0.04 | 0.31 |
| Case Damping Factor | | 0.71 | 0.26 |
| Damping Type | | Viscous | Viscous |
| Unloading Quake | (% of loading quake) | 25 | 140 |
| Reloading Level | (% of Ru) | 100 | 100 |
| Unloading Level | (% of Ru) | 0 | |
| Resistance Gap (included in Toe Quake) (in) | | | 0.24 |
| Soil Plug Weight | (kips) | 1.529 | 0.674 |
| Soil Support Dashpot | | 5.000 | 0.000 |
| Soil Support Weight | (kips) | 1.60 | 0.00 |

CAPWAP match quality = 2.79 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.28 in; Blow Count = 44 b/ft
Computed: Final Set = 0.30 in; Blow Count = 41 b/ft
Transducer F1 (W064) CAL: 92.1; RF: 1.00; F2 (Z051) CAL: 89.4; RF: 1.00
*Not Active A3*(K14584) CAL: 416; RF: 1.00; A4 (K11820) CAL: 434; RF: 1.00

max. Top Comp. Stress = 43.8 ksi (T= 37.1 ms, max= 1.000 x Top)
max. Comp. Stress = 43.8 ksi (Z= 4.0 ft, T= 37.1 ms)
max. Tens. Stress = -1.09 ksi (Z= 58.6 ft, T= 42.9 ms)
max. Energy (EMX) = 19.2 kip-ft; max. Measured Top Displ. (DMX)= 0.48 in

EXTREMA TABLE

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 4.0 | 908.3 | -13.5 | 43.8 | -0.65 | 19.2 | 9.6 | 0.40 |
| 2 | 7.1 | 964.9 | -19.0 | 3.8 | -0.07 | 19.0 | 8.2 | 0.39 |
| 3 | 10.2 | 1005.5 | -53.2 | 4.0 | -0.21 | 18.8 | 6.6 | 0.38 |
| 4 | 13.4 | 993.7 | -75.6 | 3.9 | -0.30 | 18.4 | 6.7 | 0.38 |
| 5 | 16.5 | 947.5 | -94.1 | 3.7 | -0.37 | 17.4 | 6.7 | 0.37 |
| 6 | 19.7 | 949.5 | -135.5 | 3.7 | -0.53 | 17.0 | 6.6 | 0.37 |
| 7 | 22.8 | 967.7 | -135.7 | 3.8 | -0.53 | 16.9 | 6.4 | 0.37 |
| 8 | 25.9 | 972.1 | -104.9 | 3.8 | -0.41 | 16.7 | 6.4 | 0.36 |
| 9 | 29.1 | 952.7 | -135.4 | 3.7 | -0.53 | 16.5 | 6.5 | 0.36 |
| 10 | 32.2 | 917.6 | -159.6 | 3.6 | -0.63 | 16.1 | 6.6 | 0.35 |
| 11 | 35.4 | 898.1 | -111.0 | 3.6 | -0.45 | 15.6 | 6.6 | 0.34 |
| 12 | 38.6 | 882.3 | -41.9 | 3.9 | -0.19 | 14.9 | 6.5 | 0.34 |
| 13 | 41.8 | 805.3 | -17.2 | 4.1 | -0.09 | 12.7 | 6.4 | 0.33 |
| 14 | 45.1 | 680.5 | -19.2 | 4.0 | -0.11 | 9.8 | 6.5 | 0.33 |
| 15 | 48.4 | 548.1 | -47.0 | 3.8 | -0.33 | 7.1 | 6.7 | 0.33 |
| 16 | 51.8 | 493.4 | -97.1 | 4.2 | -0.83 | 5.1 | 7.5 | 0.33 |
| 17 | 55.2 | 386.3 | -97.6 | 4.3 | -1.08 | 3.6 | 9.2 | 0.33 |
| 18 | 58.6 | 318.2 | -69.4 | 5.0 | -1.09 | 2.1 | 10.6 | 0.33 |
| Absolute | 4.0 | | | 43.8 | | | (T = | 37.1 ms) |
| | 58.6 | | | | -1.09 | | (T = | 42.9 ms) |

CASE METHOD

| J = | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 623.5 | 580.4 | 537.3 | 494.2 | 451.1 | 408.0 | 364.9 | 321.8 | 278.7 | 235.6 |
| RX | 713.5 | 660.7 | 607.9 | 555.1 | 502.3 | 452.6 | 409.0 | 365.3 | 321.7 | 278.0 |
| RU | 835.7 | 813.8 | 792.0 | 770.1 | 748.2 | 726.3 | 704.4 | 682.5 | 660.7 | 638.8 |

RAU = 180.3 (kips); RA2 = 672.4 (kips)

Current CAPWAP Ru = 550.8 (kips); Corresponding J(RP)= 0.17; J(RX) = 0.31

| VMX | TVP | VT1*Z | FT1 | FMX | DMX | DFN | SET | EMX | QUS | KEB |
|---|---|---|---|---|---|---|---|---|---|---|
| ft/s | ms | kips | kips | kips | in | in | in | kip-ft | kips | kips/in |
| 12.2 | 35.95 | 451.2 | 603.4 | 876.2 | 0.48 | 0.28 | 0.28 | 20.8 | 660.2 | 571 |

PILE PROFILE AND PILE MODEL

| Depth | Area | E-Modulus | Spec. Weight | Perim. |
|---|---|---|---|---|
| ft | $in^2$ | ksi | $lb/ft^3$ | ft |
| 0.0 | 20.8 | 30000.1 | 492.000 | 4.71 |
| 3.3 | 20.8 | 30000.1 | 492.000 | 4.71 |
| 3.6 | 254.2 | 7015.8 | 183.974 | 4.71 |
| 33.3 | 254.2 | 7015.8 | 183.974 | 4.71 |
| 58.5 | 50.3 | 10135.3 | 216.822 | 2.09 |

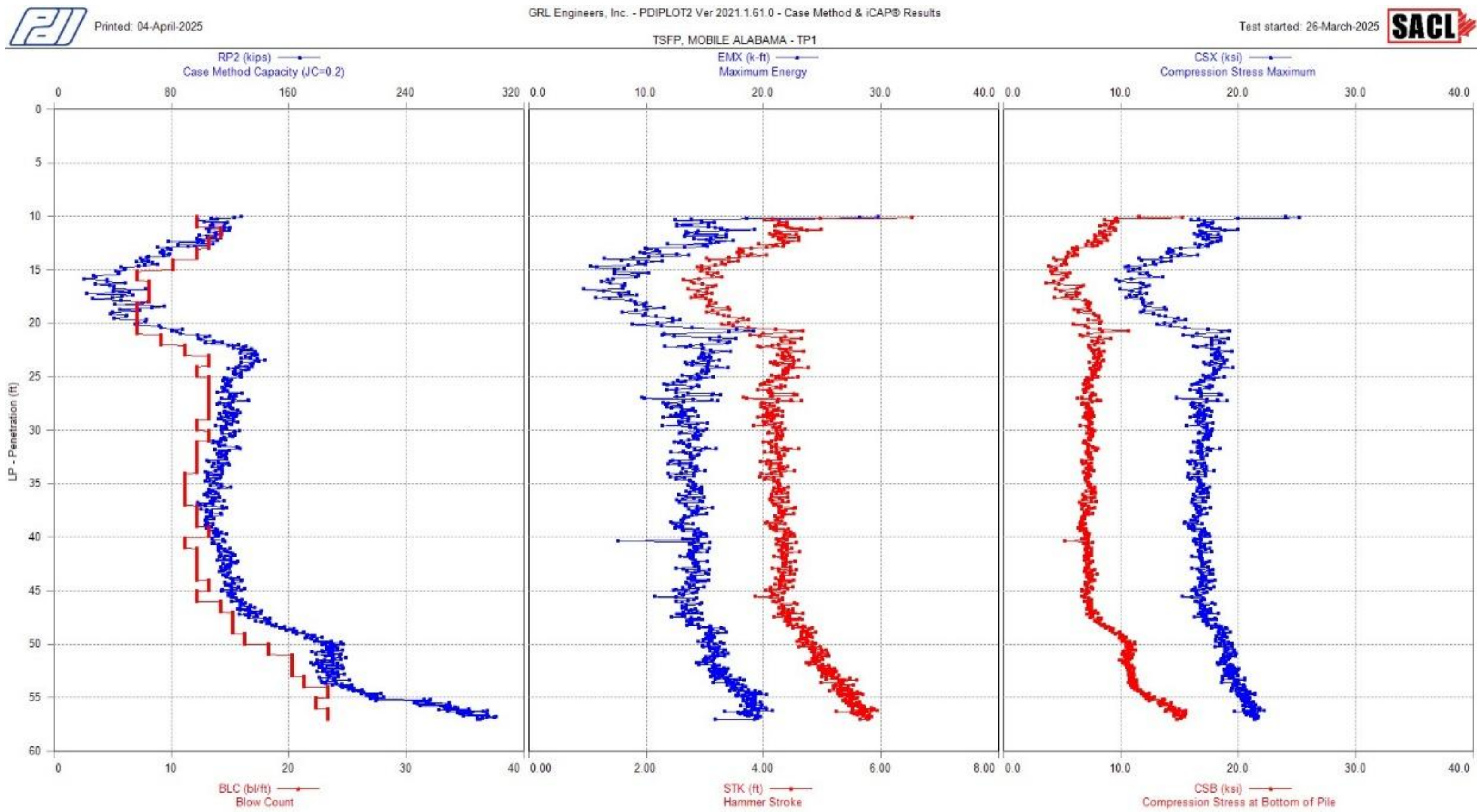
Toe Area 254.2 $in^2$

| Segmnt Number | Dist. B.G. | Impedance | Imped. Change | Slack | Tension Eff. | Compression Slack | Eff. | Perim. | Wave Speed | Soil Plug |
|---|---|---|---|---|---|---|---|---|---|---|
| | ft | kips/ft/s | % | in | | in | | ft | ft/s | kips |
| 1 | 4.0 | 37.04 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 17227.3 | 0.000 |
| 2 | 7.1 | 51.39 | -61.70 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13623.8 | 0.090 |
| 3 | 10.2 | 61.67 | -54.04 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13623.8 | 0.090 |
| 4 | 13.4 | 89.08 | -33.62 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13623.8 | 0.090 |
| 5 | 16.5 | 134.19 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13623.8 | 0.090 |
| 7 | 22.8 | 119.91 | -10.64 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13623.8 | 0.090 |
| 9 | 29.1 | 126.77 | -5.54 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13623.8 | 0.090 |
| 10 | 32.2 | 134.19 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.71 | 13623.8 | 0.090 |
| 11 | 35.4 | 131.66 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.64 | 13661.0 | 0.090 |
| 12 | 38.6 | 119.52 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.33 | 13838.9 | 0.090 |
| 13 | 41.8 | 106.46 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.98 | 14030.4 | 0.090 |
| 14 | 45.1 | 93.40 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.64 | 14221.9 | 0.090 |
| 15 | 48.4 | 80.33 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 3.30 | 14413.4 | 0.090 |
| 16 | 51.8 | 67.27 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.95 | 14604.8 | 0.090 |
| 17 | 55.2 | 54.21 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.61 | 14796.3 | 0.090 |
| 18 | 58.6 | 41.15 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 2.26 | 14987.8 | 0.090 |

Wave Speed: Pile Top 16807.8, Elastic 13764.1, Overall 14107.6 ft/s
Pile Damping 1.00 %, Time Incr 0.230 ms, 2L/c 8.3 ms
Total volume: 69.141 $ft^3$; Volume ratio considering added impedance: 0.876

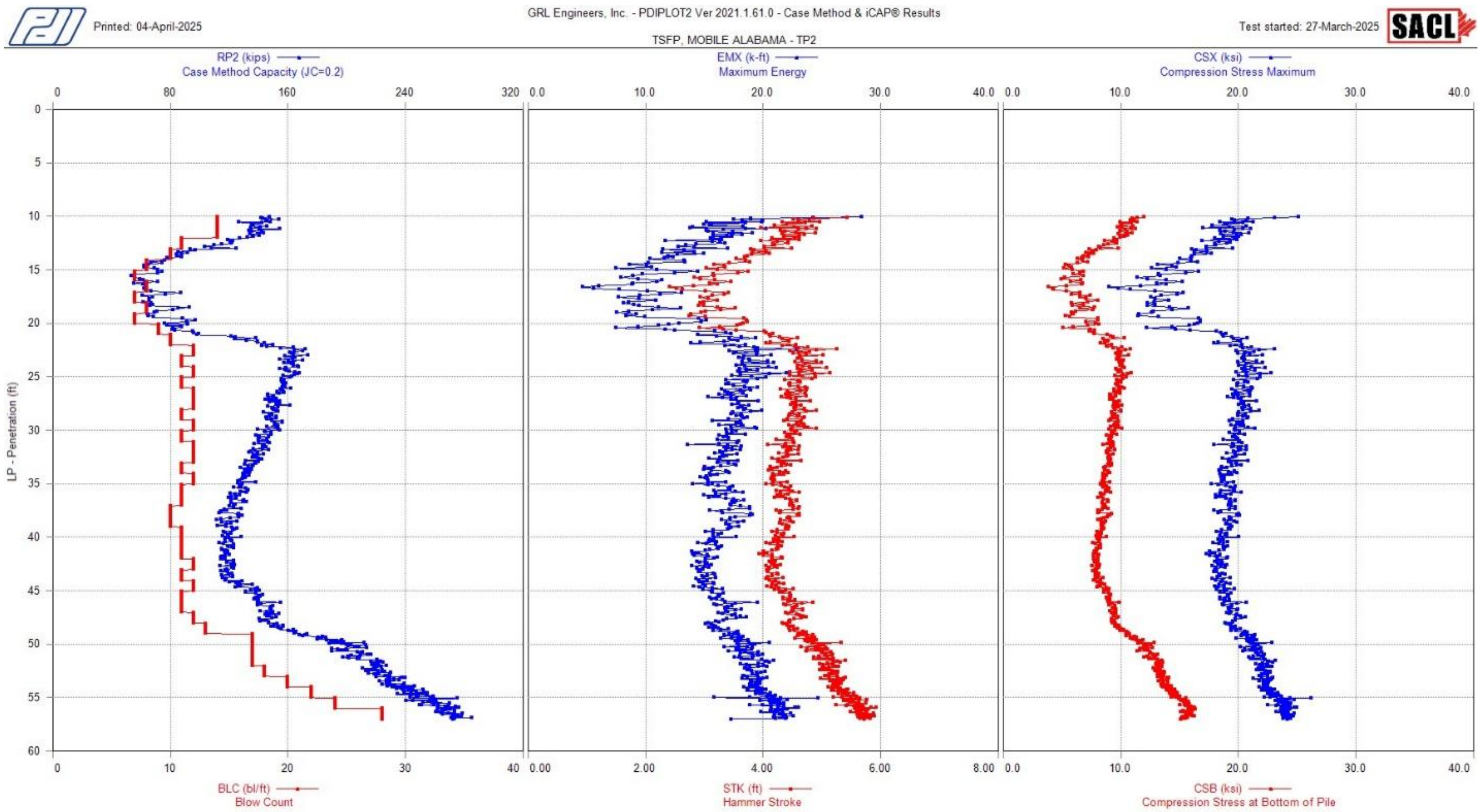
# Appendix 5

# Pile driving records and PDA Plots



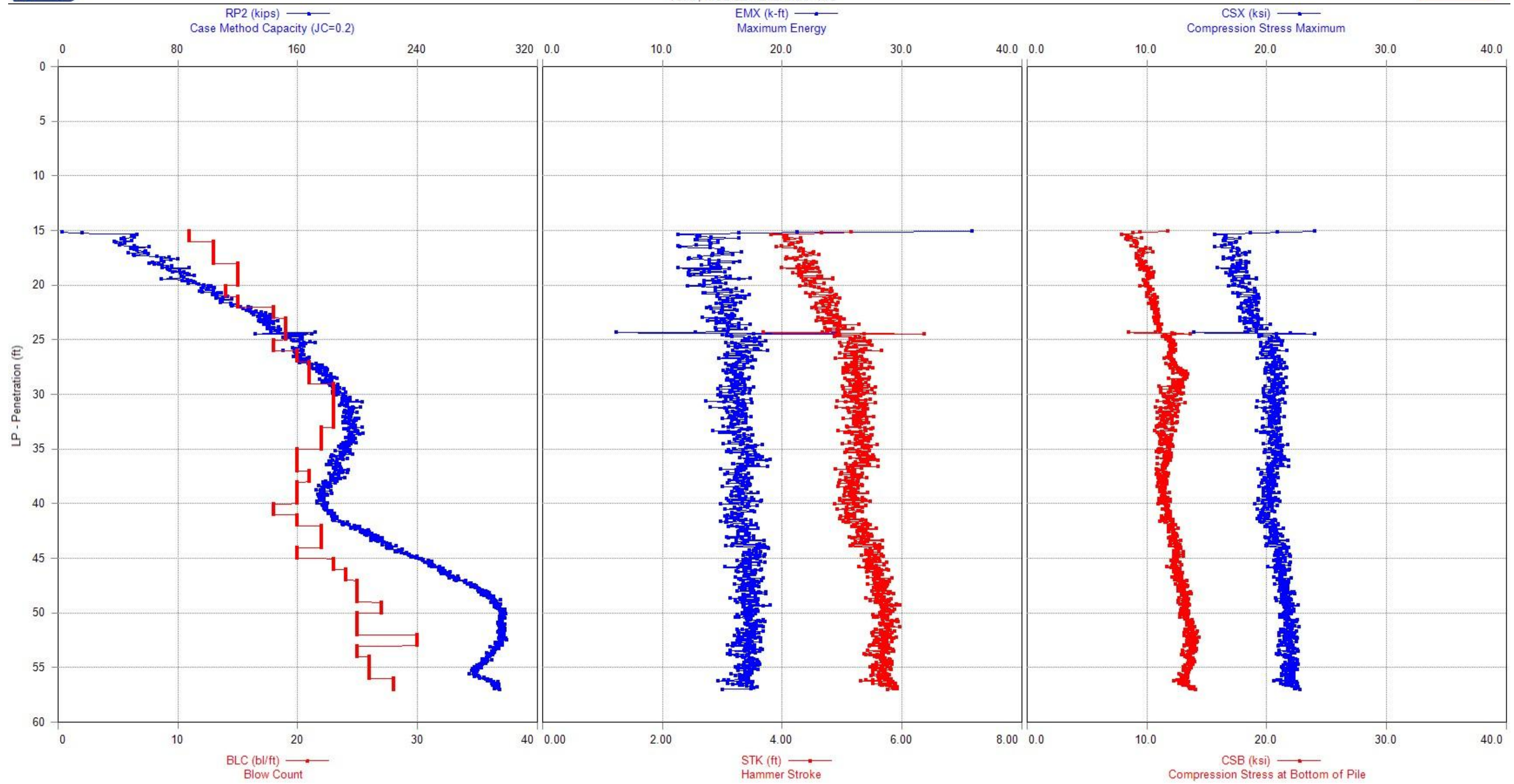
Printed: 04-April-2025
GRL Engineers, Inc. - PDIPLOT2 Ver 2021.1.61.0 - Case Method & iCAP® Results
TSFP, MOBILE ALABAMA - TP1
Test started: 26-March-2025
SACL
RP2 (kips)
Case Method Capacity (JC=0.2)
EMX (k-ft)
Maximum Energy
CSX (ksi)
Compression Stress Maximum
LP - Penetration (ft)
BLC (bl/ft)
Blow Count
STK (ft)
Hammer Stroke
CSB (ksi)
Compression Stress at Bottom of Pile

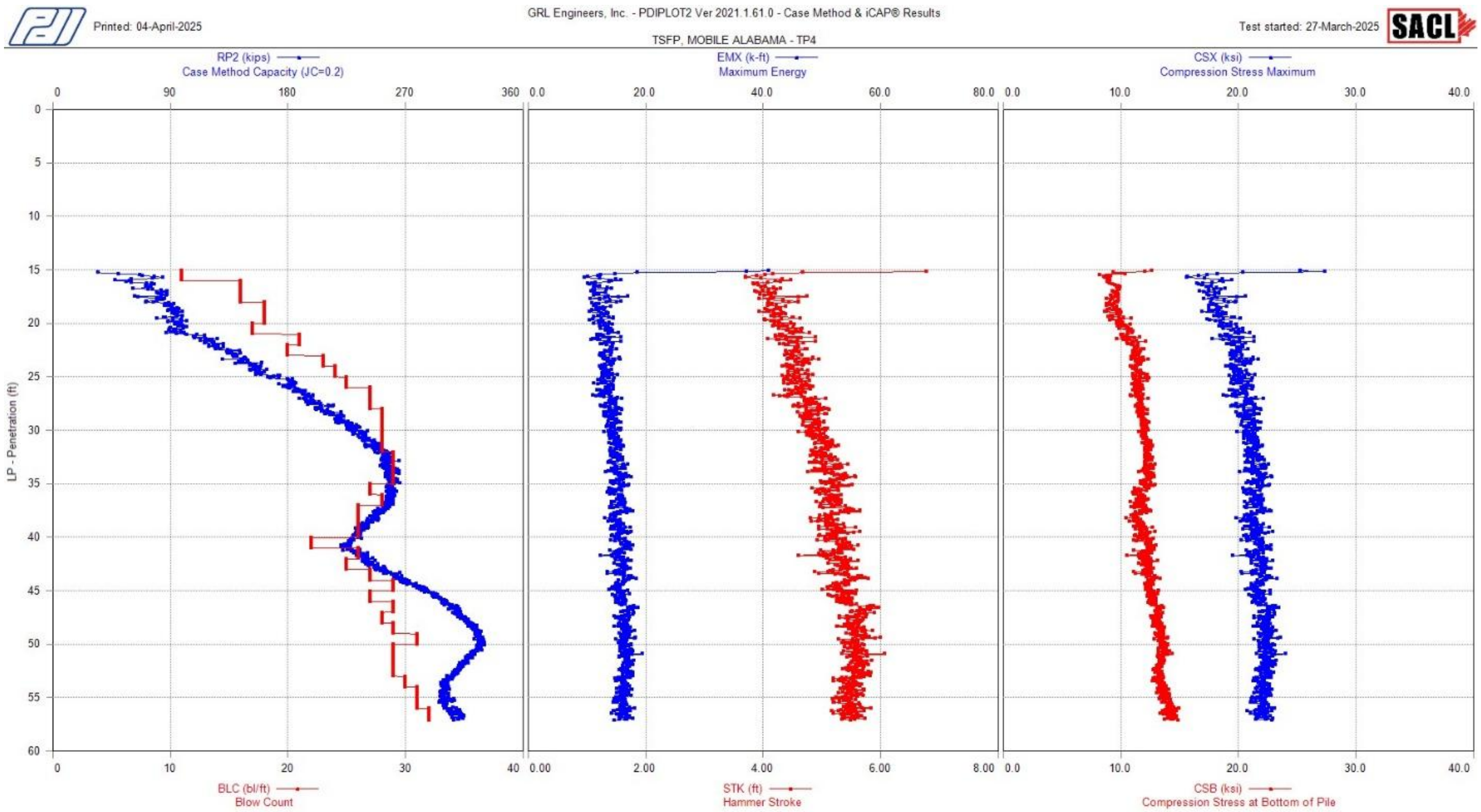

SACL



Printed: 04-April-2025
GRL Engineers, Inc. - PDIPLOT2 Ver 2021.1.61.0 - Case Method & iCAP® Results
TSFP, MOBILE ALABAMA - TP2
Test started: 27-March-2025
SACL
RP2 (kips)
Case Method Capacity (JC=0.2)
EMX (k-ft)
Maximum Energy
CSX (ksi)
Compression Stress Maximum
LP - Penetration (ft)
BLC (bl/ft)
Blow Count
STK (ft)
Hammer Stroke
CSB (ksi)
Compression Stress at Bottom of Pile

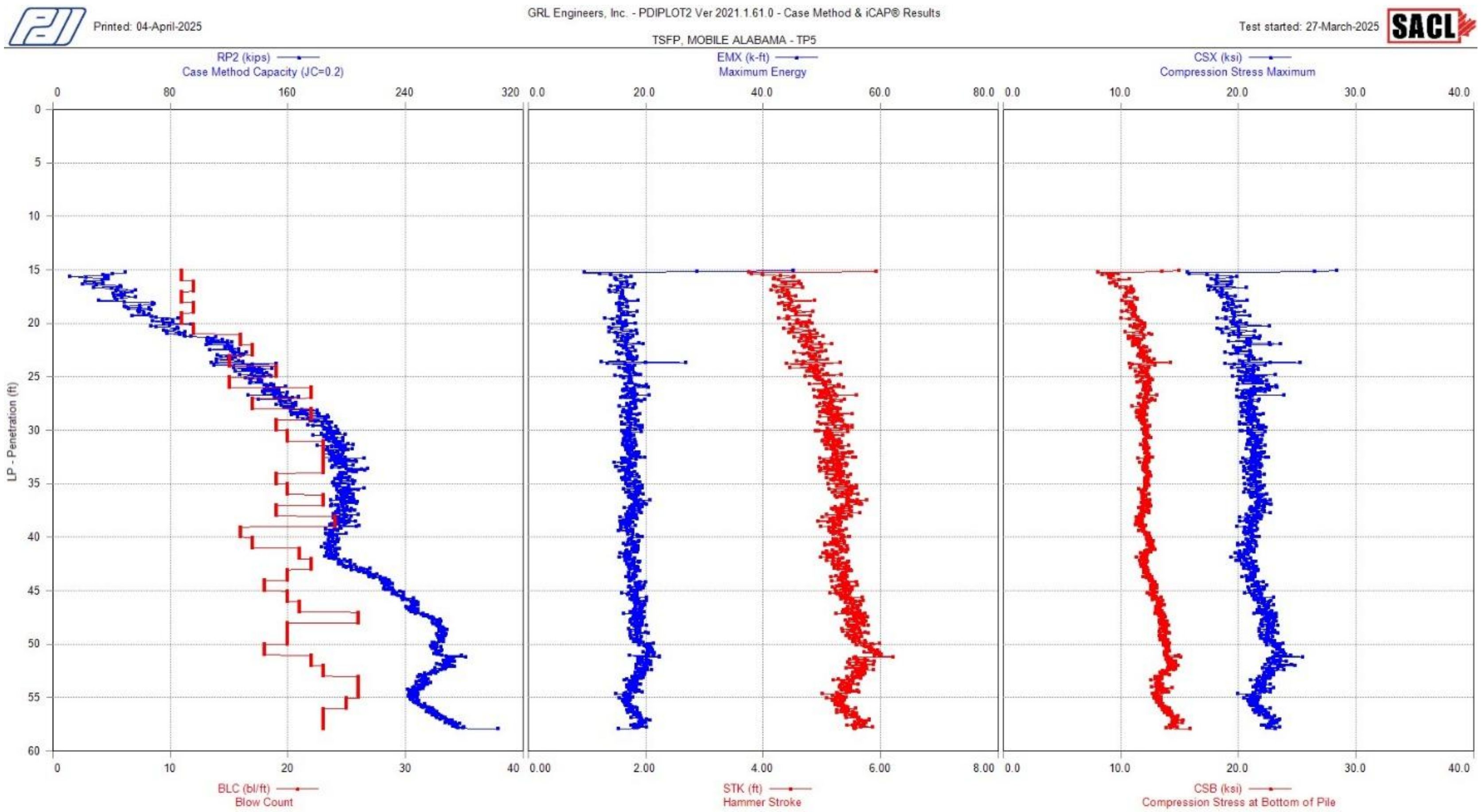

SACL


RP2 (kips)
Case Method Capacity (JC=0.2)
EMX (k-ft)
Maximum Energy
CSX (ksi)
Compression Stress Maximum
LP - Penetration (ft)
BLC (bl/ft)
Blow Count
STK (ft)
Hammer Stroke
CSB (ksi)
Compression Stress at Bottom of Pile



Printed: 04-April-2025
GRL Engineers, Inc. - PDIPLOT2 Ver 2021.1.61.0 - Case Method & iCAP® Results
TSFP, MOBILE ALABAMA - TP4
Test started: 27-March-2025
SACL
RP2 (kips)
Case Method Capacity (JC=0.2)
EMX (k-ft)
Maximum Energy
CSX (ksi)
Compression Stress Maximum
LP - Penetration (ft)
BLC (bl/ft)
Blow Count
STK (ft)
Hammer Stroke
CSB (ksi)
Compression Stress at Bottom of Pile


SACL

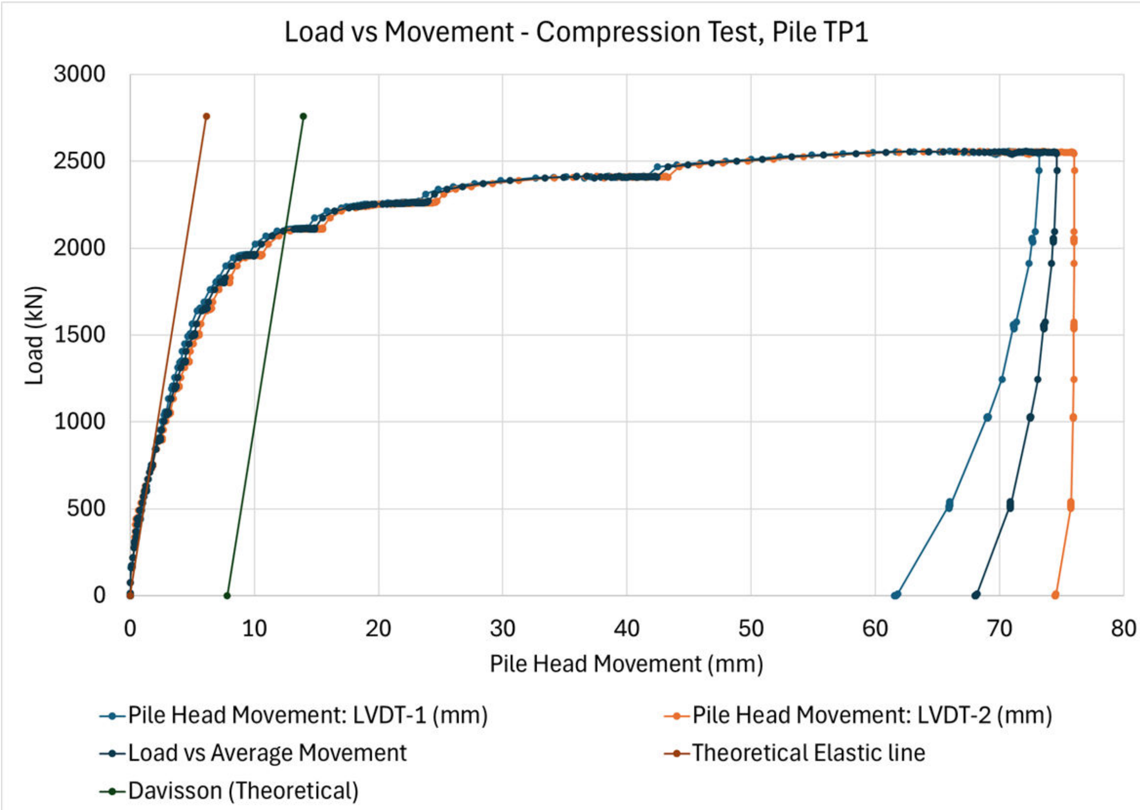


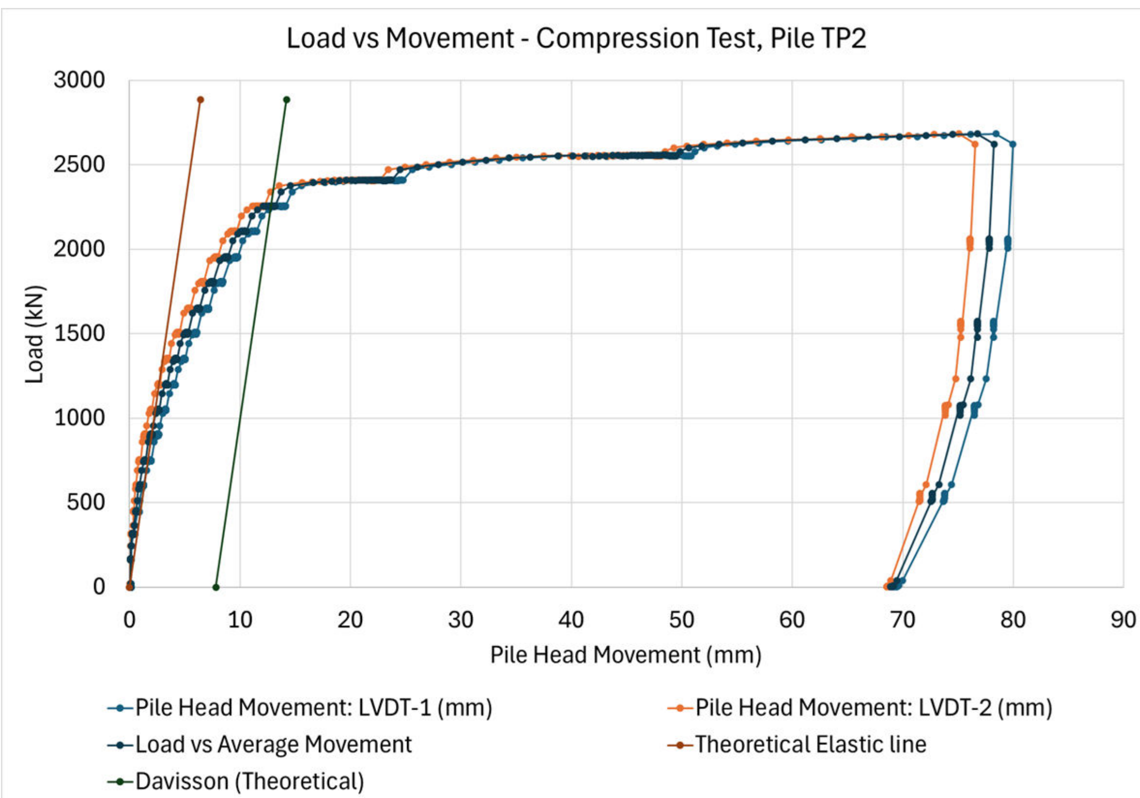
Printed: 04-April-2025
GRL Engineers, Inc. - PDIPLOT2 Ver 2021.1.61.0 - Case Method & iCAP® Results
TSFP, MOBILE ALABAMA - TP5
Test started: 27-March-2025
SACL
RP2 (kips)
Case Method Capacity (JC=0.2)
EMX (k-ft)
Maximum Energy
CSX (ksi)
Compression Stress Maximum
LP - Penetration (ft)
BLC (bl/ft)
Blow Count
STK (ft)
Hammer Stroke
CSB (ksi)
Compression Stress at Bottom of Pile


SACL

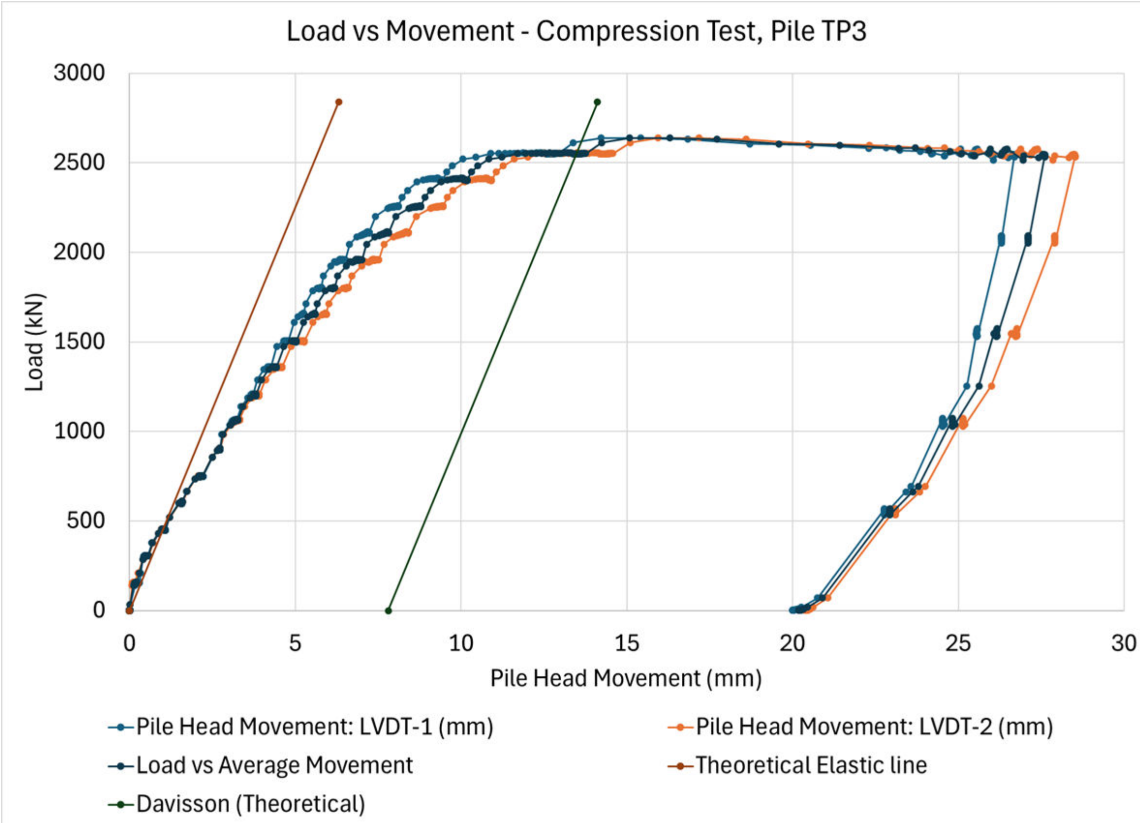
# Appendix 6

## Static test data – Load v. pile head movement

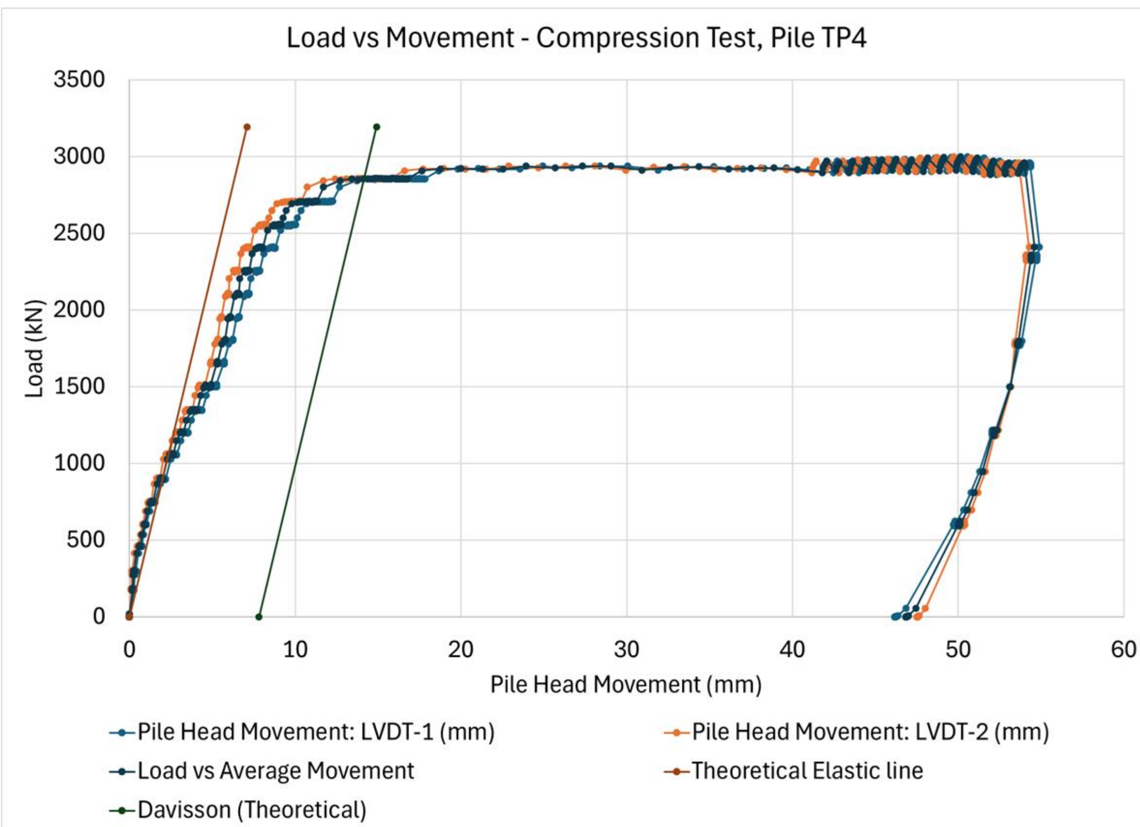

Load vs Movement - Compression Test, Pile TP1
3000
2500
2000
1500
1000
500
0
Load (kN)
0
10
20
30
40
50
60
70
80
Pile Head Movement (mm)
Pile Head Movement: LVDT-1 (mm)
Pile Head Movement: LVDT-2 (mm)
Load vs Average Movement
Theoretical Elastic line
Davisson (Theoretical)


Load vs Movement - Compression Test, Pile TP2
3000
2500
2000
1500
1000
500
0
Load (kN)
0
10
20
30
40
50
60
70
80
90
Pile Head Movement (mm)
Pile Head Movement: LVDT-1 (mm)
Pile Head Movement: LVDT-2 (mm)
Load vs Average Movement
Theoretical Elastic line
Davisson (Theoretical)

SACL

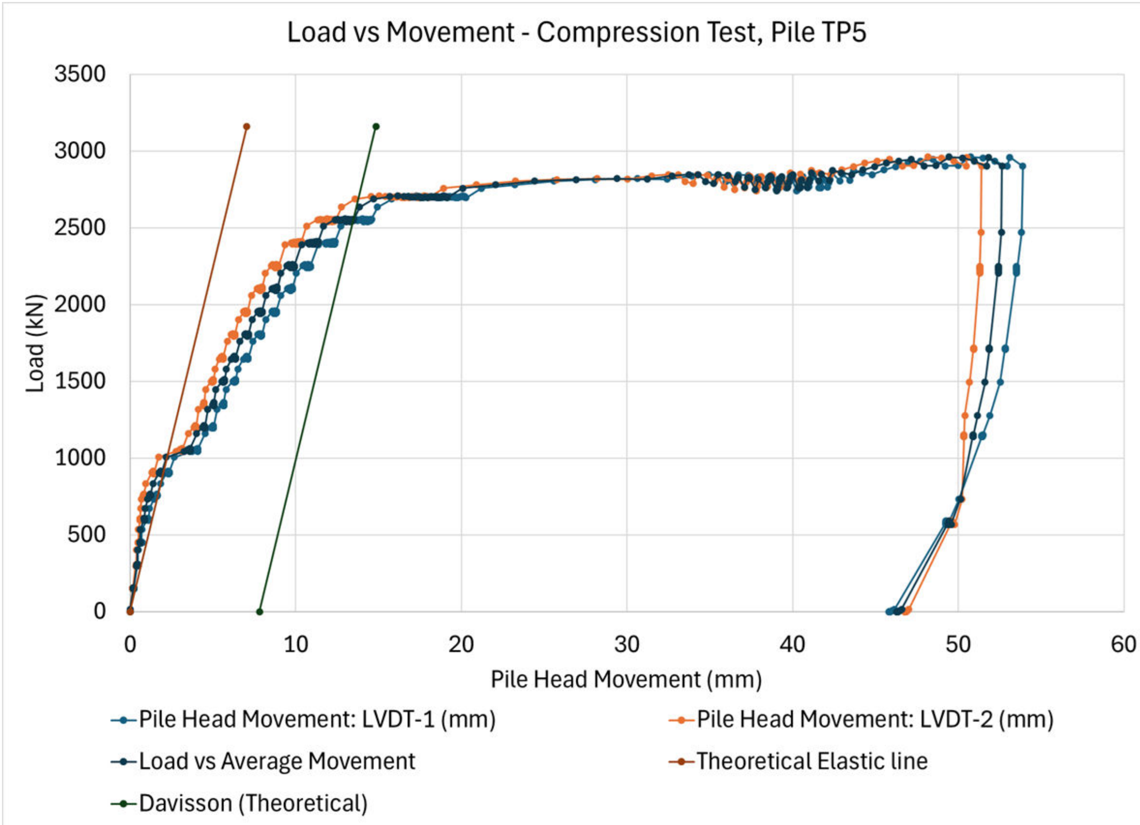


Load vs Movement - Compression Test, Pile TP3
Load (kN)
Pile Head Movement (mm)
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
Pile Head Movement: LVDT-1 (mm)
Pile Head Movement: LVDT-2 (mm)
Load vs Average Movement
Theoretical Elastic line
Davisson (Theoretical)

Load vs Movement - Compression Test, Pile TP4
Load (kN)
Pile Head Movement (mm)
3500
3000
2500
2000
1500
1000
500
0
0
10
20
30
40
50
60
Pile Head Movement: LVDT-1 (mm)
Pile Head Movement: LVDT-2 (mm)
Load vs Average Movement
Theoretical Elastic line
Davisson (Theoretical)


SACL

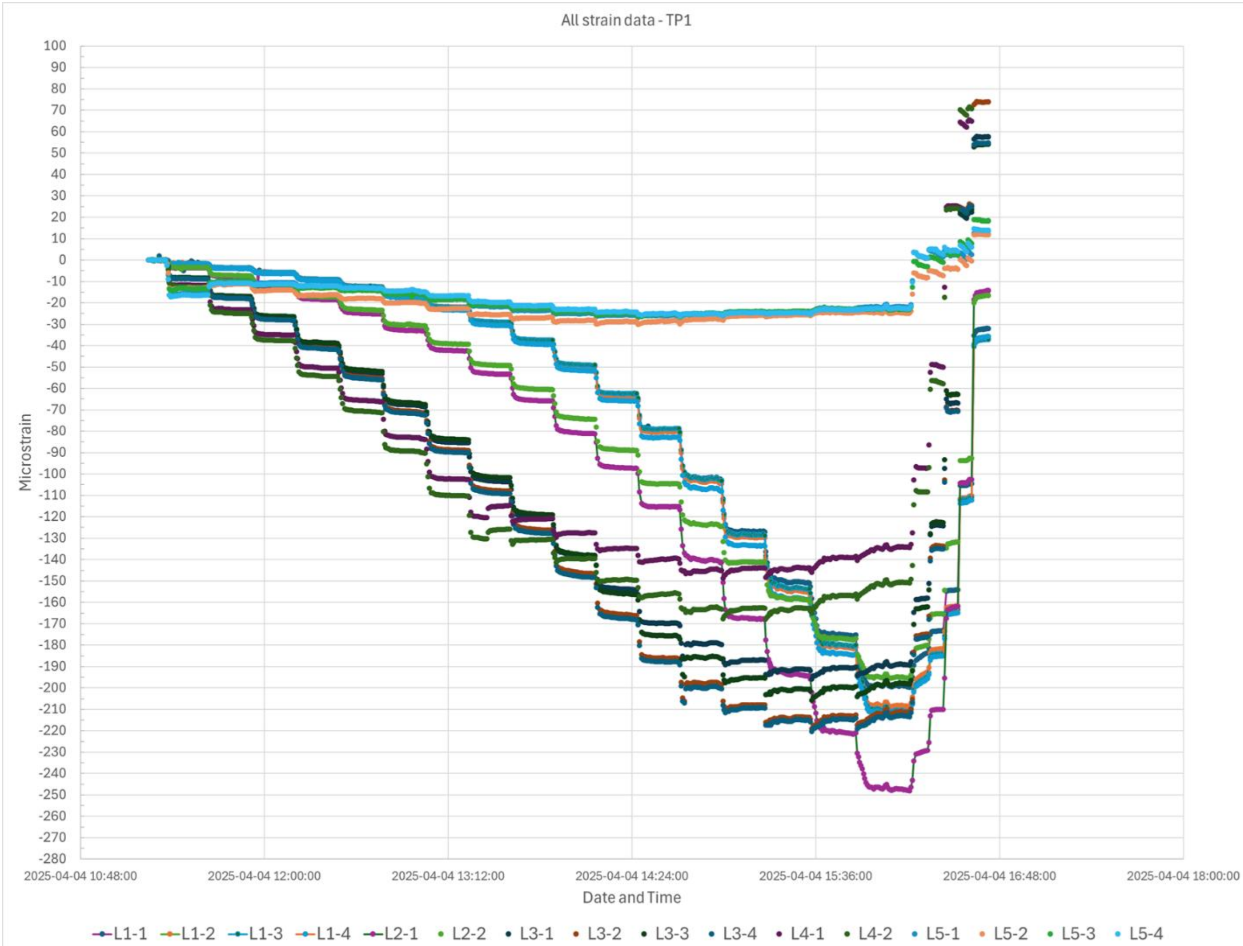


Load vs Movement - Compression Test, Pile TP5
3500
3000
2500
2000
1500
1000
500
0
Load (kN)
0
10
20
30
40
50
60
Pile Head Movement (mm)
Pile Head Movement: LVDT-1 (mm)
Pile Head Movement: LVDT-2 (mm)
Load vs Average Movement
Theoretical Elastic line
Davisson (Theoretical)


SACL

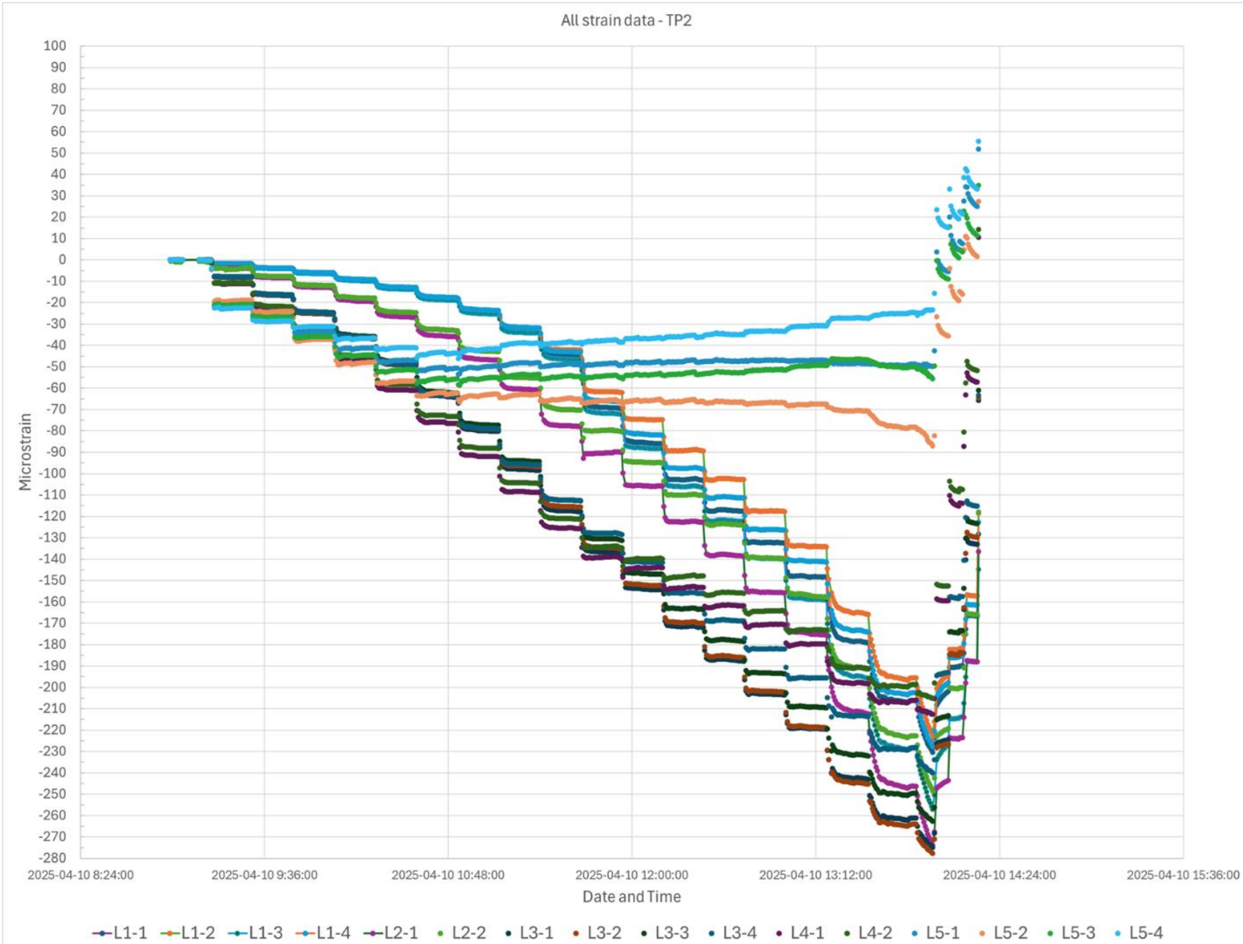
# Appendix 7

# Strain data



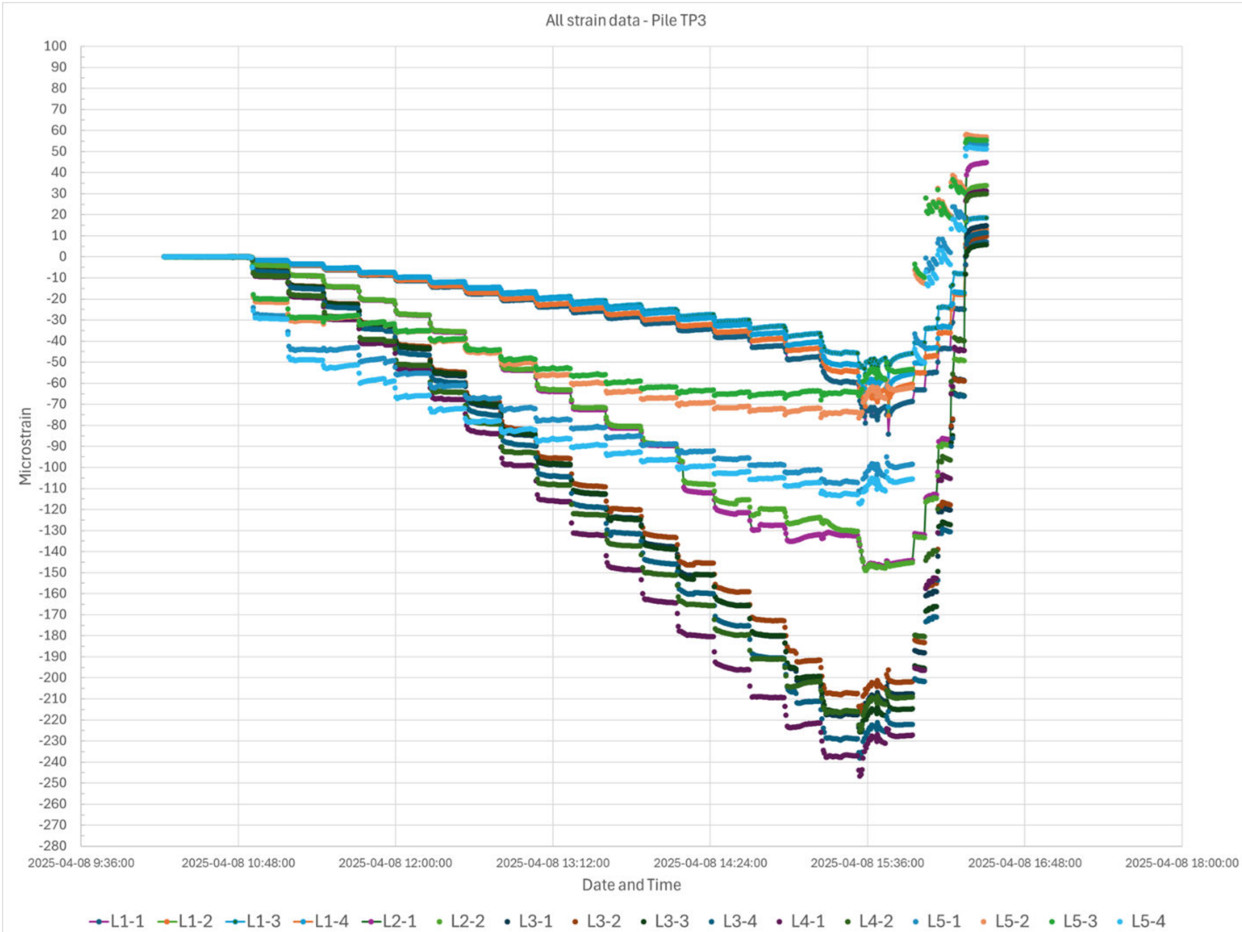
All strain data - TP1
Microstrain
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
-220
-230
-240
-250
-260
-270
-280
2025-04-04 10:48:00
2025-04-04 12:00:00
2025-04-04 13:12:00
2025-04-04 14:24:00
2025-04-04 15:36:00
2025-04-04 16:48:00
2025-04-04 18:00:00
Date and Time
L1-1 L1-2 L1-3 L1-4 L2-1 L2-2 L3-1 L3-2 L3-3 L3-4 L4-1 L4-2 L5-1 L5-2 L5-3 L5-4


SACL

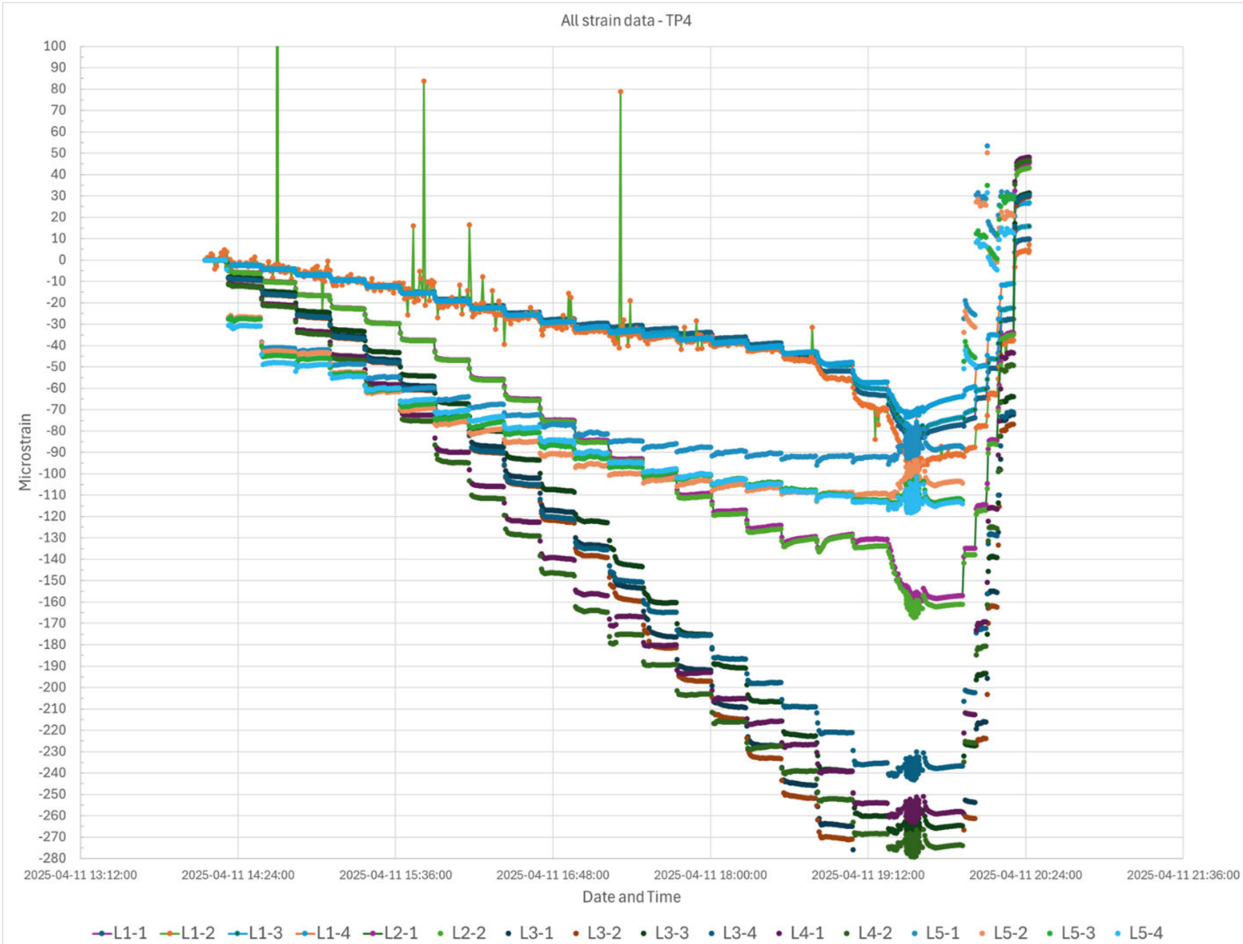


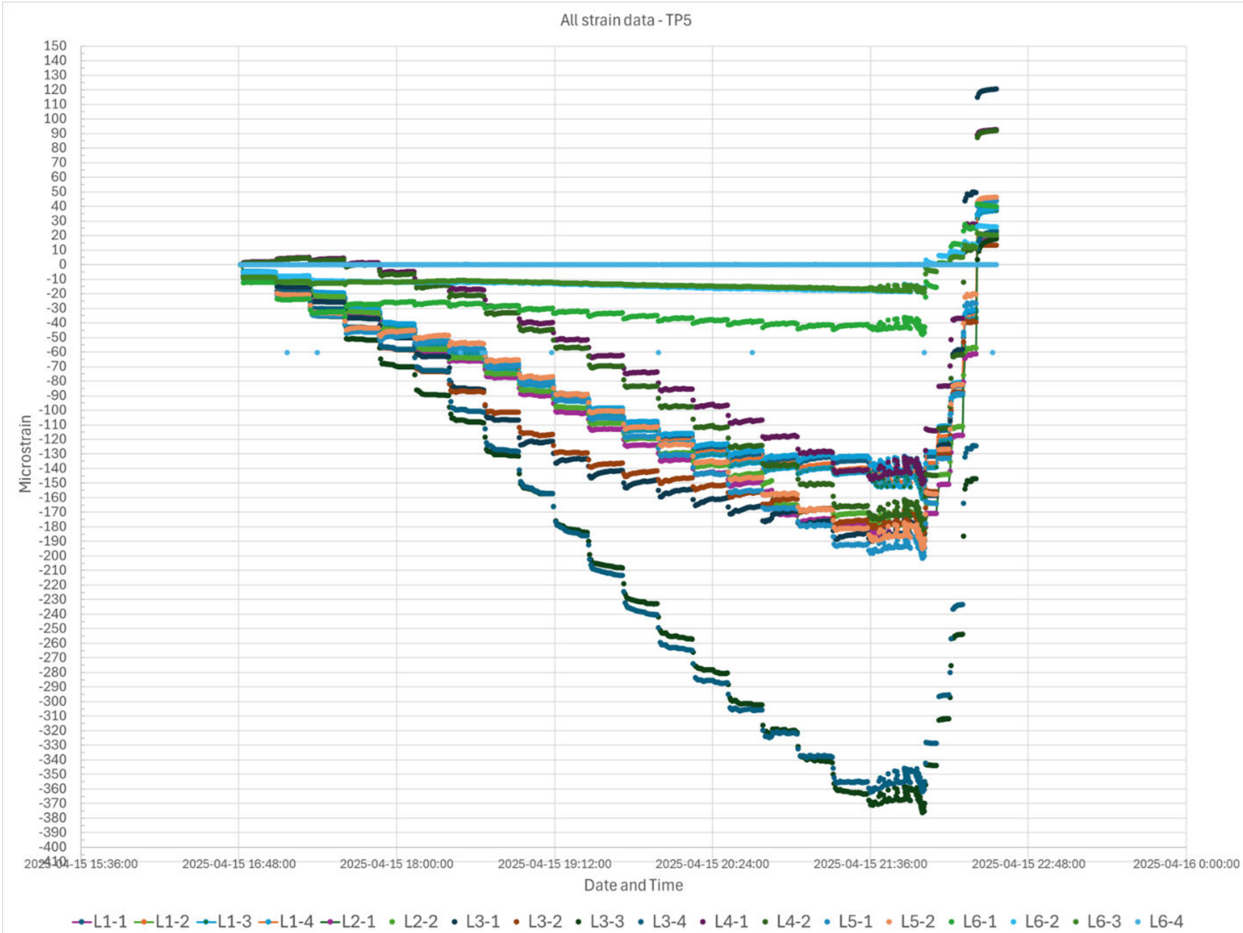
All strain data - TP2
Microstrain
Date and Time
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
-220
-230
-240
-250
-260
-270
-280
2025-04-10 8:24:00
2025-04-10 9:36:00
2025-04-10 10:48:00
2025-04-10 12:00:00
2025-04-10 13:12:00
2025-04-10 14:24:00
2025-04-10 15:36:00
L1-1
L1-2
L1-3
L1-4
L2-1
L2-2
L3-1
L3-2
L3-3
L3-4
L4-1
L4-2
L5-1
L5-2
L5-3
L5-4


SACL



All strain data - Pile TP3
Microstrain
Date and Time
2025-04-08 9:36:00
2025-04-08 10:48:00
2025-04-08 12:00:00
2025-04-08 13:12:00
2025-04-08 14:24:00
2025-04-08 15:36:00
2025-04-08 16:48:00
2025-04-08 18:00:00
L1-1 L1-2 L1-3 L1-4 L2-1 L2-2 L3-1 L3-2 L3-3 L3-4 L4-1 L4-2 L5-1 L5-2 L5-3 L5-4


All strain data - TP4
Microstrain
Date and Time
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
-220
-230
-240
-250
-260
-270
-280
2025-04-11 13:12:00
2025-04-11 14:24:00
2025-04-11 15:36:00
2025-04-11 16:48:00
2025-04-11 18:00:00
2025-04-11 19:12:00
2025-04-11 20:24:00
2025-04-11 21:36:00
L1-1
L1-2
L1-3
L1-4
L2-1
L2-2
L3-1
L3-2
L3-3
L3-4
L4-1
L4-2
L5-1
L5-2
L5-3
L5-4



All strain data - TP5
Microstrain
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
-220
-230
-240
-250
-260
-270
-280
-290
-300
-310
-320
-330
-340
-350
-360
-370
-380
-390
-400
-410
2025-04-15 15:36:00
2025-04-15 16:48:00
2025-04-15 18:00:00
2025-04-15 19:12:00
2025-04-15 20:24:00
2025-04-15 21:36:00
2025-04-15 22:48:00
2025-04-16 0:00:00
Date and Time
L1-1 L1-2 L1-3 L1-4 L2-1 L2-2 L3-1 L3-2 L3-3 L3-4 L4-1 L4-2 L5-1 L5-2 L6-1 L6-2 L6-3 L6-4


SACL