Applied Foundation Testing

Alabama Certificate of Authorization CA3058-E

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Revision 1: June 26, 2018
Revision 2: July 2, 2018

Report of High-Strain Dynamic Pile Testing and Axial Statnamic Load Testing
TP-23A
I-10 over Mobile River and Bayway
Load Test Program
Mobile Country, Alabama
AFT Project No.: 118008

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ALABAMA LICENSED No. 22873 PROFESSIONAL ENGINEER DONALD T. ROBERTSON

Digitally signed by Donald T Robertson
DN: c=US, o=APPLIED FOUNDATION TESTING, ou=APPLIED FOUNDATION TESTING, cn=Donald T Robertson, 0.9.2342.19200300.100.1.1=A01097C000001617C717FAC0000EEB3
Date: 2018.07.02 17:22:21 -04'00'

REVISION 2: Revision 2 includes placement of the approved inspector's pile driving log in Appendix A. In Table 3, the Approximate Final Pile Tip Elevation was revised 123.5 feet to reflect the updated Approximate Final Pile Top Elevation described in Revision 1.

REVISION 1: Revision 1 dated June 26, 2018 to the original report dated June 8, 2018 included the following changes: The Generalized Soil Conditions section was changed to indicate that the groundwater depth, not elevation, noted in boring BW-23 was 0.0 feet. In the High-Strain Dynamic Pile Testing section, the pile tip elevation after jetting was changed so that it is based on the depth of the pile tip at start of impact driving. In Table 3, the Approximate Final Pile Top Elevation was revised to 12.5 feet. The Axial Statnamic Load Testing section and the figures in Appendix D were updated with a revised Statnamic analysis.

INTRODUCTION

The proposed I-10 Mobile River Bridge and Bayway project includes the construction of a new six-lane bridge across the Mobile River and a new eight-lane Bayway. A load test program has been conducted in advance of the construction contract to optimize the foundation design. Foundation types included in the load test program include two HP14x89 steel H-piles, two 18-inch square prestressed concrete piles, one 30-inch square prestressed concrete pile, five 54-inch diameter spun-cast concrete cylinder piles, one 60-inch diameter steel pipe pile, and one 72-inch diameter drilled shaft.

This report summarizes the installation and testing of the 54-inch diameter, 6-inch wall thickness, 136-feet long spun-cast concrete cylinder pile at location TP-23A. High-strain dynamic pile testing, also known as PDA, was performed during initial drive, 1 day restrike, and 17 day restrike. Axial Statnamic load testing was performed 14 days after the initial drive of TP-23A. A 17 day restrike was subsequently performed 3 days after axial Statnamic load testing. A summary of the test dates is included in Table 1 below.

Table 1: Summary of Test Dates

Test Pile	Test Description	Test Date
TP-23A	Initial Drive	4/24/2018
	1 Day Restrike	4/25/2018
	Statnamic Load Testing	5/8/2018
	17 Day Restrike	5/11/2018

The project plans indicate test pile TP-23A was located at station 629+57.00 offset left 150 feet, adjacent to the north of the existing I-10 Bayway. Please refer to the project source documents for a site plan of the actual location of the test piles.

Installation of test pile TP-23A was performed by Jordan Pile Driving, Inc. In addition, Jordan Pile Driving, Inc. provided the over-water support frame and necessary office and field support to carry out the axial Statnamic load testing. Applied Foundation Testing (AFT) was the specialty engineering firm performing the dynamic pile testing and monitoring the axial Statnamic load test. Dynamic pile testing was performed by Mr. Michael Worsham, P.E. Axial Statnamic load testing was performed by Mr. Donald Robertson, P.E., Mr. Michael Worsham, P.E., Mr. Jason Frederick, and Mr. Zack Cohens. Data analysis and reporting was performed by Mr. Donald Robertson, P.E. and Mr. Michael Worsham, P.E.

This report contains a compilation of the results for the dynamic pile testing and axial Statnamic load testing for TP-23A. This report includes an overview of the testing program, tabular and graphical representations of the data, discussion of the results, and instrumentation calibrations.

GENERALIZED SOIL CONDITIONS

Thompson Engineering performed the subsurface exploration as part of this project. The subsurface exploration consisted of drilling a single Standard Penetration Test (SPT) boring near each of the proposed foundation load test locations identified for the project. The nearest soil boring to TP-23A is boring BW-23 located at station 632+20.32 offset left 15.51 feet.

A copy of soil boring BW-23 is included in Appendix E. Detailed descriptions of the subsurface conditions encountered are presented in this attached soil boring. A summary of the soil conditions given in Table 2 below represents a summary of conditions as indicated in the provided materials and is included only to assist in evaluation of the load test data. For further details regarding the soil conditions at the test site and elsewhere, the reader should reference the project source documents.

The ground water depth noted in boring log BW-23 was 0.0 feet. Table 2 below provides a summary of the subsurface conditions.

Table 2: Description of Subsurface Soil Conditions(1)

Average Elevation From - To(2)	Material Description	Typical N-Value Range
-4.0 to -15.8	Silty Sand (SM)	0
-15.8 to -20.8	Sand (SP)	0
-20.8 to -35.8	Sandy Fat Clay (CH)	0
-35.8 to -40.8	Silty Sand (SM)	0
-40.8 to -45.8	Clayey Sand (SC)	3
-45.8 to -50.8	Fat Clay (CH)	0
-50.8 to -55.8	Sand (SP)	NA
-55.8 to -60.8	Sandy Lean Clay (CL)	3
-60.8 to -80.8	Silty Sand (SM)	11 to 24
-80.8 to -110.8	Sand; Sand with Gravel (SP)	24 to 57
-110.8 to -130.8	Lean Clay; Fat Clay (CL and CH)	24 to 39
-130.8 to -155.8	Sand with Silt (SP-SM)	60 to 70

Note 1: Table created from Thompson Engineering Test Boring Record BW-23 contained in the project plans.
Note 2: Elevations are referenced to North American Vertical Datum of 1988 (NAVD)

HIGH-STRAIN DYNAMIC PILE TESTING (PDA)

The test pile TP-23A was installed by Jordan Pile Driving, Inc. The test pile was prepared for high-strain dynamic testing by drilling holes and setting drop-in anchors for sensor attachment two pile diameters, or 108 inches, below the pile top.

Prior to driving pile TP-23A, the pile was jetted until the pile tip was at approximate elevation -56 feet. Pile TP-23A was then impact driven using a Pileco D180-32 open-ended diesel pile driving hammer. The Pileco D180-32 diesel hammer has a maximum rated energy of 443,500 foot-pounds (ram weight of 39,680 pounds at a stroke height of 11.18 feet). We understand the Pileco D180-32 hammer utilized a hammer cushion consisting of 12 inches of micarta and aluminum and a pile cushion consisting of 12 inches of pine plywood. A well compressed previously used pile cushion was utilized for the restrikes.

Applied Foundation Testing performed dynamic pile testing using a Pile Driving Analyzer Model PAX manufactured by Pile Dynamics, Inc. Dynamic testing was accomplished by externally attaching two piezo-electric accelerometers, two piezo-resistive accelerometers and four strain transducers and taking measurements during the initial drive and subsequent restrikes. Calibration information for the sensors utilized is included in Appendix F. The dynamic pile testing was performed in general accordance with the project plans and special provisions and ASTM D4945 *"Standard Test Method for High-Strain Dynamic Testing of Deep Foundations"*. During the initial drive, TP-23A was driven to where the sensor attachment points were approximately 1 foot above the waterline. At this point, the pile top was approximately 2 feet above the pile template/over-water support frame which is optimal for set-up of the Statnamic testing device.

Plots and tabular summaries of the dynamic testing results are included in Appendix B. In general, these summaries include blows per foot (BLC), penetration depth below reference, maximum Case method resistance, auto capacity method resistance for friction piles (RA2), maximum compressive stress (CSX), compressive stress at the bottom of pile (CSB), maximum tensile stress (TSX), stroke (STK), maximum transfer energy (EMX), and beta pile integrity factor (BTA). The top of the pile driving template was used as a reference for measuring penetration depth during the initial drive and restrikes. The top of the pile driving template was located at elevation 11.3 feet. The mudline elevation was measured as -13.4 feet. After driving the elevation of the top of soil inside the cylinder pile was measured as -28.5 feet. A summary of the test pile installation is provided in Tables 3 and 4 below.

Table 3: Summary of Pile Driving Information

Test Pile	Hammer Model	Approximate Reference Elevation (feet)	Approximate Ground Elevation (feet)	Approximate Final Pile Top Elevation (feet)	Approximate Final Tip Elevation[(1)] (feet)
TP-23A	Pileco D180-32	+11.3	-13.4	+12.5	-123.5

Note 1: Approximate reference elevation based on contractor survey measurement. Approximate final pile tip elevation based on depth below reference, pile movements during restrikes, and load test permanent displacement.

Table 4: Summary of Dynamic Pile Testing Results

Test Pile	EOD or BOR(1)	Blows per Foot at EOD or Blows per Inch for Restrike	Max. CSX Stress (ksi)	Avg. CSX Stress (ksi)	Max. TSX Stress (ksi)	Avg. TSX Stress (ksi)	Max. CSB Stress (ksi)	Avg. CSB Stress (ksi)	Avg. Transfer Energy (k-ft) / Approx. Stroke (ft.)
TP-23A	EOD	25 Blows/3"	4.35	2.99	1.31	0.44	3.29	2.01	92.4/7.83
	1 Day RS	11 Blows/1", 9 Blows/1", 7 Blows/1"	5.29	4.07	0.59	0.27	4.75	4.07	151.6/9.30
	17 Day RS	7 Blows/1", 7 Blows/1", 7 Blows/1"	6.61	5.67	0.60	0.27	4.77	4.17	174.2/10.46

Note 1: EOD – End of Initial Drive; RS – Restrike

Allowable maximum driving stresses for the spun-cast concrete cylinder piles are defined by the formulas located in the project special provisions. The maximum allowable compressive stress limit is defined as $0.85\sqrt{(f'_c)}$ – effective prestress. The maximum allowable tensile stress limit is defined as $3\sqrt{(f'_c)}$ + effective prestress.

In the above formula f'c is defined as the minimum concrete compressive strength for the piles, which is 10,000 psi per Plan Sheet 13. Per Plan Sheet 13, the strands shall be stressed to an initial tension of 30,900 lbs. Assuming a loss of 20 percent from initial tension provides an effective prestress value of 546 psi (0.55 ksi). The maximum allowable compressive stress is calculated as 7.95 ksi, and the maximum allowable tensile stress is calculated as 0.85 ksi.

The dynamic pile testing measurements indicate the maximum tensile stress (TSX) exceeded allowable stress limits for portions of the initial drive. In general, the high tensile stresses for some blows occurred early in the initial drive in softer driving conditions. In a production pile driving situation, additional pile cushion material or driving procedures to avoid these high tensile stresses would be needed. It is not recommended letting driving stresses reach levels exceeding allowable stress limits during production pile driving and restrikes.

The dynamic test data does not show any signs of integrity problems for TP-23A.

SIGNAL MATCHING ANALYSIS

Signal matching analyses were performed using the computer program CAPWAP (version 2014) to further evaluate the field measurements. Summaries of these analyses are presented in Table 5 below. The complete analyses are included in Appendix C. Signal matching analysis is considered a standard procedure to estimate the total ultimate resistance as well as estimate the resistance distribution (shaft and toe) from the dynamic pile testing data. The signal matching approach is used to back calculate various soil parameters. The program uses the data measured during a single blow as a boundary condition and the user performs many iterations on soil parameters to make a calculated wave-up match the measured one.

Table 5: Signal Matching Results Summary

Test Pile	EOD or Restrike	Blow No.	R_{ult} (kips)	R_{shaft} (kips)	R_{end} (kips)	Max. Case Method JC Damping Factor	EMX (k-ft)/Stroke (feet)	Qs (in)	Qt (in)	Ss (s/ft)	St (s/ft)	Match Quality
TP-23A	EOD	2014	1700	1366	334	0.70	133.9/ 9.32	0.21	0.42	0.29	0.30	1.73
	1 Day Restrike	3	2000	1640	360	1.01	211.6/ 11.59	0.17	0.38	0.40	0.23	1.39
	17 Day Restrike	2	2300	1926	374	1.05	173.1/ 12.30	0.05	0.10	0.40	0.35	1.99

The results of the CAPWAP signal matching analyses generally have the most confidence in the total resistance value, and to a lesser extent the resistance distribution in side resistance along the length of the pile and end bearing resistance at the pile bottom. This is generally attributed to intricacies in separating side resistance and end bearing resistance from the total resistance using signal matching techniques. The side resistance values from the analyses are the combined side resistance from the exterior and interior of the cylinder piles.

The signal matching analysis for TP-23A indicated a total ultimate resistance of 1,700 kips at end of initial drive, 2,000 kips during the 1 day restrike; and 2,300 kips during the 17 day restrike (3 days after axial Statnamic load testing). Based on the set measurements during EOD and restrikes for TP-23A, the resistance values presented in this report may be considered fully mobilized.

AXIAL STATNAMIC LOAD TESTING

Test pile TP-23A was subjected to axial Statnamic load testing (commonly referred to as Rapid load testing) on May 8, 2018, or 14 days after initial drive of the pile. Load testing was accomplished utilizing the 19MN Statnamic device in a single load cycle.

AXIAL STATNAMIC INSTRUMENTATION

The top of the pile was instrumented with a calibrated load cell and accelerometers (to measure acceleration and to calculate velocity and displacement). A brief description of the instrumentation used during the Statnamic test is given below. Calibration data is included in Appendix F.

Statnamic Device - The Statnamic load testing was accomplished with a device capable of applying a force of approximately 19 MN. This device uses a controlled burn of fuel to generate gas pressure inside a cylinder and ram (analogous to a gas actuated jack). As the pressure builds, it reacts against a heavy mass above the foundation. The pressure eventually builds high enough to propel the reaction mass upward; in turn a downward load is simultaneously applied to the foundation top which is many times greater than the weight of the reaction mass. The Statnamic device produces a time dependent load on the order of 1/2 second or less. The load produced is not an impact, which makes the Statnamic analysis very simplified and more reliable than dynamic techniques.

Load Cell - The load cell is calibrated full scale and manufactured by the George Kelk Corporation.
Accelerometers - Three accelerometers were arranged across the top of the shaft approximately 120 degrees apart during Statnamic testing. The accelerometers were manufactured by PCB Piezotronics, Inc. From the measured accelerations, shaft displacements at each accelerometer location were calculated. This provides very reliable and highly accurate displacement data.
Data Acquisition System - A National Instruments Data Acquisition System recorded the load cell and accelerometers at 5,000 samples per second for each sensor. This was more than ample to fully define the load and displacement response of the drilled shaft foundation during the load test.

AXIAL STATNAMIC TEST SET UP

Prior to the axial Statnamic load testing, Jordan Pile Driving set-up the over-water frame to support the test frame. This included driving pipe piles and constructing a work platform. This over-water frame was also used as the pile driving template. The top of pile concrete was in good condition after pile driving and required only a thin layer of quick set grout to achieve a level and smooth surface.

Additional preparations for the Statnamic load test included the following:

- Construct over-water support frame and mats to support the Statnamic device at the appropriate testing elevation and allow access to the pile.
- Prepare pile top with thin layer of quick set grout for a level and smooth testing surface.
- Assembly of the Statnamic load system as follows:
    - Placement of the load cell and Statnamic piston on the pile top.
    - Placement of the mechanical catch frame on support mats.
    - Placement of the Statnamic silencer and reaction masses on the pile top.
- Placement of accelerometers near the pile top.
- Connecting all instrumentation (load cell and accelerometers) to the data acquisition system and computer.

AXIAL STATNAMIC LOAD TEST RESULTS

The analysis of the Statnamic load test data was performed using the Unloading Point Method (UPM). Due to the rapid application of the load, it was also necessary to account for rate of loading effects. The analysis presented herein was performed using the UPM method in conjunction with rate effect factors (REF) in as suggested in the National Cooperative Highway Research Program (NCHRP) Project: NCHRP 21-08.

Test Pile TP-23A was loaded to a maximum derived static load of 2,705 kips. The maximum displacement during testing was 1.36 inches. The measured permanent displacement upon complete unloading was 0.47 inch. Table 6 presents a summary of the maximum derived static load, maximum displacement, and the permanent displacement upon unloading. The derived static load versus displacement response for TP-23A is shown in Figure 1 located in Appendix D. The derived static load versus displacement response for TP-23A exhibited primarily elastic behavior until the failure load of approximately 2,670 kips where pile to soil yielding behavior occurred.

Table 6: Summary of Load and Displacement for Test Pile TP-23A

Description	Data
Maximum Derived Static Load	2,705 kips
Maximum Displacement	1.36 inches
Permanent Displacement	0.47 inches

Additional commentary on the data reduction is described as follows. During the Statnamic test, the load cell and accelerometers were monitored with a high speed data acquisition system. This data is then analyzed to determine the overall static resistance. Before performing any static analysis of the data, the data must be "pre-processed", plotted and evaluated. Specifically, the load cell must be offset to account for the weight of the Statnamic reaction masses, which are supported by the pile prior to the load test. The applied Statnamic load versus time presented in Figure 2 in Appendix D depicts this initial static weight and shows approximately zero load on the pile after the load test. Additional plots of test measurements are included in the Appendix D consisting of: the pile top average acceleration versus time, integrated velocity at the pile top versus time, and pile top displacement versus time.

SUMMARY AND CONCLUSIONS

The load test program included the installation of a 54-inch diameter, 6-inch wall thickness, 136-feet long spun-cast concrete cylinder pile at location TP-23A. TP-23A was subjected to dynamic pile testing during initial drive and 1 and 17 day restrikes and axial Statnamic load testing 14 days after initial drive. A summary of the load test results is provided below:

TP-23A Load Testing Summary:

- The signal matching analysis of the dynamic testing data for TP-23A indicated a total ultimate resistance of 1,700 kips at end of initial drive, 2,000 kips for the 1 day restrike, and 2,300 kips for the 17 day restrike (3 days after axial Statnamic rapid load testing).
- TP-23A was subjected to axial Statnamic load testing 14 days after initial drive with a maximum derived static load of 2,705 kips with a maximum displacement of 1.36 inches and a permanent displacement of 0.47 inches.
- The failure load during axial Statnamic load testing based on the Davisson Failure Criterion was approximately 2,670 kips. The pile top displacement at the failure load was approximately 1.23 inch.

The purpose of this test pile program is to determine the pile bearing resistances (ultimate, side resistance, and end bearing) achievable for the pile type, size, and lengths installed. In addition, the designers may choose to use the results to optimize their foundation design and/or to minimize the risk of constructability issues. However, the design team would also need to consider the scope of the test pile program, the methods used for pile installation, and potential variability of soils along the bridge length when using the information gathered.

Some points to consider from the test pile program for the 54-inch diameter, 6-inch wall thickness, 136-feet long spun-cast concrete cylinder pile at location TP-23A are as follows:

- The dynamic pile testing results indicated slightly lower ultimate total resistances than measured during the axial Statnamic load test at TP-23A. Additionally, attempting to utilize higher resistances similar to those measured during axial Statnamic load testing in the dynamic test data signal matching analysis yielded poor match qualities so this approach was not utilized. The dynamic testing analyses included in this report are based on typical methods which produce good match qualities, and do not represent an attempt to match the axial Statnamic load test results. During production phase dynamic pile testing it may not be possible to verify the higher resistances achieved in this axial Statnamic load test. Additionally, during production phase testing when keeping driving stress values below allowable limits during initial drives and restrikes is of the upmost importance, due to possibly lower transfer energies, less resistance may be mobilized than shown in this report.
- Dynamic pile testing on production piles is recommended to determine bearing resistances, measure pile driving stresses, and determine hammer driving system suitability. Driving criteria may be developed based on this testing with recommendations provided to control tensile and compressive stresses at or below allowable levels.
- Signal matching analyses of the production pile dynamic test data is recommended to confirm and/or to provide a better estimate of the ultimate pile bearing resistance.

Below is a summary of the Appendix contents:

- Appendix A – Inspector's Pile Driving Records
- Appendix B – Dynamic Pile Testing Data Summaries
- Appendix C – CAPWAP Signal Matching Analysis Output
- Appendix D – Axial Compressive Statnamic Rapid
- Load Testing Graphical Results
    - Figure 1 – Derived Static Load versus Displacement Response from Statnamic Load Testing with Davisson Failure Criterion
    - Figure 2 – Applied Statnamic Load versus Elapsed Time
    - Figure 3 – Pile Top Acceleration and Velocity versus Elapsed Time
    - Figure 4 – Pile Top Displacement versus Elapsed Time
- Appendix E – Relevant Project Documents
- Appendix F – Instrument Calibrations

CLOSURE

We want to thank you for the opportunity to be involved in this project. We also want to thank you for all your support in setting up the test. Please do not hesitate to call us if you have any questions regarding the information in this report.

LIMITATIONS

This report presents test measurements made by Applied Foundation Testing, Inc. Interpretations were made based upon the measurements made by AFT with the latest techniques available and currently accepted standards of care recognized by Geotechnical Engineering professionals. Applied Foundation Testing is an independent agency and is not the Geotechnical Engineer of Record. The Geotechnical Engineer of Record should ultimately make final recommendations for foundation design and construction.

Appendix A

Inspector's Pile Driving Records
TP-23A

I-10 over Mobile River Bridge Load Test Program

ALDOT Project No.: IM-I010(341)
Mobile County, Alabama
AFT Project No.: 118008

FORM C-15A
REVISED 08-07-95

ALABAMA DEPARTMENT OF TRANSPORTATION
TEST PILE RECORD

Project Number	County	Division
IM-I010(341)	Mobile	Southwest Region

Bridge: Station	to Station	Bridge Identification Number
629+57	629+57	

Road Between	and	Lane (if applicable)
I-10	I-10	WB

Contractor	Inspector
Jordan Pile Driving	Donald Hector

Date	Bent No.& Lane	Pile No.	Kind of Soil
4/24/2018	TEST PILE	TP-23A	Soft, Wet, Black, Fat Clay

Kind of Pile	Size of Pile	Total Length (ft)
Spun Cast Cylinder	54"	136

Elev. Ground Line at Pile	Final Elev. At Top of Pile	Tip Elevation
-13.4	12.0	-124.0

Hammer Make	Hammer Model	Hammer Kind
PILECO	D180-32	Diesel

Hammer Type	Hammer Action	Rated Energy (ft.-lbs.)
Open	Single	443,500@11.1 Stroke

Weight of Hammer (lbs.)	Design Load (from plans) (tons)
39,680	

Hammer Cushion: Material	Thickness (in.)	Area (sq. in.)
Aluminum and Micarta Alternating	12	762

Pile Cushion (Before Driving): Material	Thickness (in.)	Area (sq. in.)
Plywood	12	904.32

Pile Cushion (After Driving): Material	Thickness (in.)	Area (sq. in.)
Plywood		

Pile Cap Weight (lbs.): 25,868

Height Of Fall (feet)	Energy Delivered To Pile (E) (ft.-lbs.)	Blows Per Foot Of Penetration (N)	Total Penetration (feet)	Bearing (Ru) (tons)
3.44	136,499	6	75	
3.38	134,118	4	76	
2.88	114,278	8	77	
2.9	115,072	9	78	

REMARKS

1. When using open type and gravity hammers, record weight of hammer and height of fall of hammer. Show rated energy when using closed type hammers.
2. Energy delivered to pile should be maintained practically constant once record keeping has begun unless specified otherwise by the Engineer.
3. Pile cushion is only required with concrete piling.
4. Pile cushion thickness after driving must be at least one-half the original thickness.
5. The bearing should be determined from the graph of Blows/Foot versus Bearing which is provided from the Wave Equation Analysis or Dynamic Formula of the driving system. If a graph is not provided, refer to Item 505.03(b)2 of the specifications to estimate the bearing capacity using the Dynamic Formula.
6. Driving should be continuous. Note any interruptions exceeding one hour.
7. Draw a sketch on back of this sheet showing location of test pile.
8. For continuation of test pile record, use Form C-15C-2.
9. Test pile (check one): Static Load Tested _____ Dynamic Load Test __x__ (If static load tested, load test report shall be attached to this report).

Correct _____
Project Manager

Approved _____
Area Operations Engineer

FORM C-15A-2
REVISED 08-07-95

ALABAMA DEPARTMENT OF TRANSPORTATION
CONTINUATION OF TEST PILE RECORD

Project Number	County	Division
IM-I010(341)	Mobile	Southwest Region

Bridge: Station	to Station	Bridge Identification Number
629+57	629+57	N/A

Date	Bent No.& Lane	Pile No.	Kind of Soil
4/24/2018	TEST PILE	TP-23A	Soft, Wet, Black, Fat Clay

Height Of Fall (feet)	Energy Delivered To Pile (E) (ft.-lbs.)	Blows Per Foot Of Penetration (N)	Total Penetration (feet)	Bearing (Ru) (tons)
3.51	139,277	11	79	
3.31	131,341	10	80	
4.57	181,338	8	81	
3.81	151,181	8	82	
3.34	132,531	9	83	
3.06	121,421	8	84	
2.96	117,453	10	85	
3.94	156,339	6	86	
5.05	200,384	8	87	
5.04	199,987	8	88	
5.05	200,384	6	89	
5.22	207,130	8	90	
5.25	208,320	7	91	
5.30	210,304	8	92	
5.21	206,733	7	93	
5.21	206,733	8	94	
5.31	210,701	9	95	
5.65	224,192	9	96	
5.76	228,557	14	97	
5.99	237,683	18	98	
6.12	242,842	22	99	
6.20	246,016	33	100	

FORM C-15A-2
REVISED 08-07-95

ALABAMA DEPARTMENT OF TRANSPORTATION
CONTINUATION OF TEST PILE RECORD

Project Number	County	Division
IM-I010(341)	Mobile	SW Region

Bridge: Station	to Station	Bridge Identification Number
629+57	629+57	N/A

Date	Bent No.& Lane	Pile No.	Kind of Soil
4/24/2018	TEST PILE	TP-23A	Soft, Wet, Black, Fat Clay

Height Of Fall (feet)	Energy Delivered To Pile (E) (ft.-lbs.)	Blows Per Foot Of Penetration (N)	Total Penetration (feet)	Bearing (Ru) (tons)
6.31	250,381	36	101	
6.39	253,555	46	102	
7.35	291,648	42	103	
7.33	290,854	37	104	
7.61	301,965	38	105	
7.62	302,362	38	106	
7.63	302,758	43	107	
7.79	309,107	54	108	
7.89	313,075	49	109	
8.35	331,328	46	110	
8.07	320,218	45	111	
8.63	342,438	41	112	
8.72	346,010	40	113	
6.53	259,110	40	114	
8.88	352,358	32	115	
8.08	320,614	43	116	
8.79	348,787	39	117	
8.75	347,200	43	118	
8.73	346,406	43	119	
8.75	347,200	46	120	
8.59	340,851	49	121	

FORM C-15A-2
REVISED 08-07-95

ALABAMA DEPARTMENT OF TRANSPORTATION
CONTINUATION OF TEST PILE RECORD

Project Number	County	Division
IM-I010(341)	Baldwin	SW Region

Bridge: Station	to Station	Bridge Identification Number
629+57	629+57	N/A

Date	Bent No.& Lane	Pile No.	Kind of Soil
4/24/2018	TEST PILE	TP-23A	Soft, Wet, Black, Fat Clay

Height Of Fall (feet)	Energy Delivered To Pile (E) (ft.-lbs.)	Blows Per Foot Of Penetration (N)	Total Penetration (feet)	Bearing (Ru) (tons)
8.94	354,739	50	122	
8.53	338,470	51	123	
7.77	308,314	50	124	

Appendix B

Dynamic Pile Testing Data Summaries
TP-23A

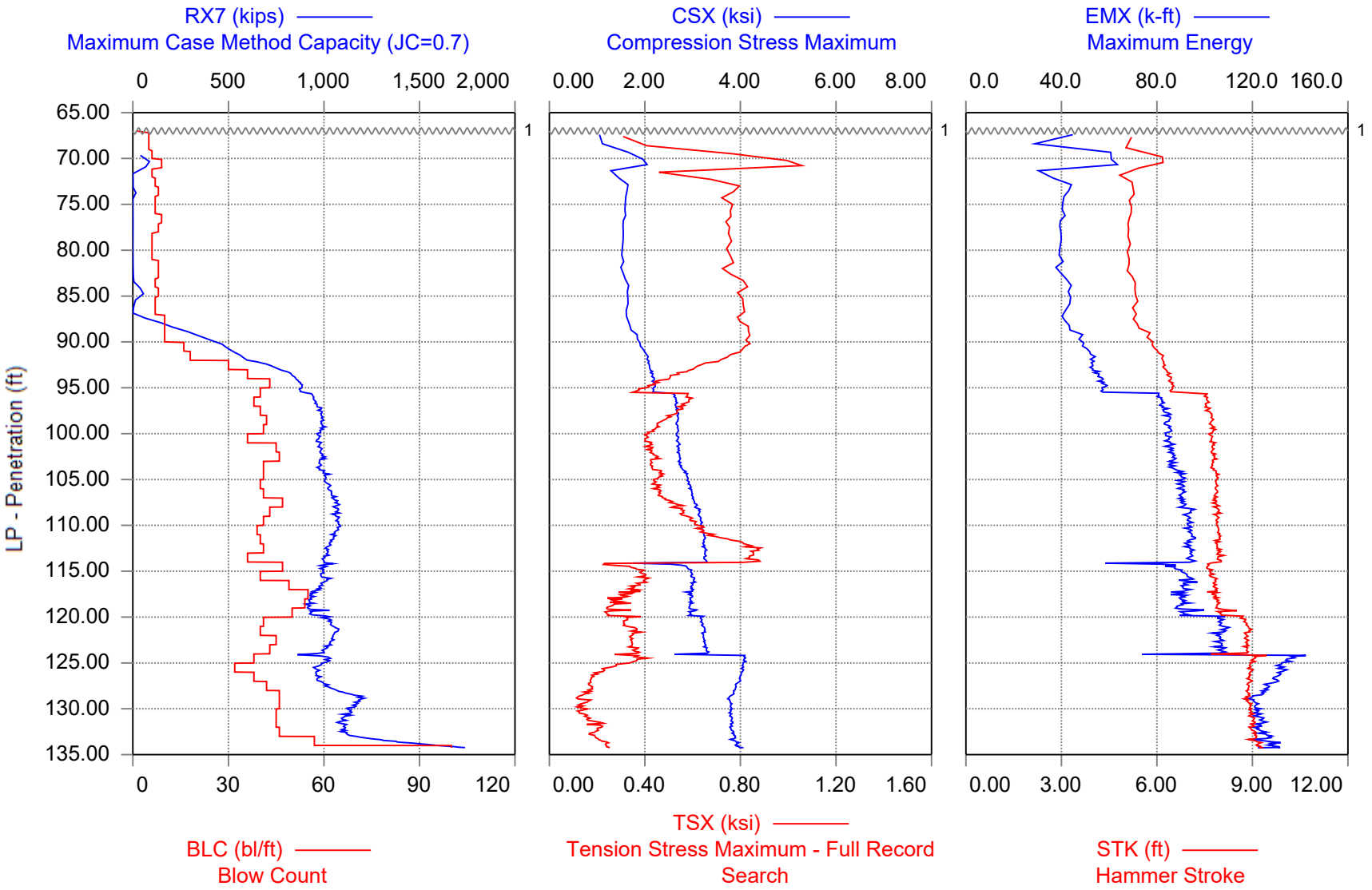
I-10 over Mobile River Bridge Load Test Program

ALDOT Project No.: IM-I010(341)
Mobile County, Alabama
AFT Project No.: 118008

Applied Foundation Testing, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 21-May-2018 Test started: 24-April-2018

I-10 MOBILE RIVER - TP-23A ID



1 - Template (Reference) El. = 11.25', Mudline El. = -13.4'

I-10 MOBILE RIVER - TP-23A ID 54" CYL, 6" WALL
OP: AFT Date: 24-April-2018

AR: 904.78 in² SP: 0.150 k/ft³
LE: 127.00 ft EM: 7,778.33 ksi
WS: 15,500.0 f/s JC: 0.70

RX7: Maximum Case Method Capacity (JC=0.7) TSX: Tension Stress Maximum - Full Record Search
RX8: Maximum Case Method Capacity (JC=0.8) EMX: Maximum Energy
RA2: Auto Capacity Friction Piles STK: Hammer Stroke
CSX: Compression Stress Maximum BTA: Integrity Factor (1)
CSB: Compression Stress at Bottom of Pile

BL#	Depth ft	BLC bl/ft	TYPE	RX7 kips	RX8 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
6	68.00	5	AV6	0	0	59	1.13	0.24	0.26	47.2	5.31	89
			STD	0	0	71	0.24	0.08	0.18	24.6	1.16	10
			MAX	0	0	184	1.53	0.34	0.51	85.6	6.91	100
			MIN	0	0	0	0.82	0.15	0.00	14.1	4.08	73
11	69.00	5	AV5	0	0	0	0.96	0.20	0.41	19.7	4.30	100
			STD	0	0	0	0.14	0.02	0.07	5.2	0.30	0
			MAX	0	0	0	1.17	0.23	0.50	28.1	4.76	100
			MIN	0	0	0	0.78	0.17	0.31	13.1	3.90	100
17	70.00	6	AV6	33	13	100	1.88	0.46	0.80	67.8	6.61	100
			STD	27	17	64	0.14	0.03	0.19	13.3	0.97	0
			MAX	78	42	198	2.05	0.50	0.98	93.5	8.40	100
			MIN	0	0	33	1.64	0.42	0.42	54.3	5.86	100
26	71.00	9	AV9	86	60	116	2.02	0.51	1.03	62.2	6.18	100
			STD	20	25	21	0.04	0.02	0.03	3.0	0.07	0
			MAX	109	93	144	2.08	0.53	1.08	65.8	6.28	100
			MIN	47	12	74	1.97	0.46	0.98	54.4	6.04	100
32	72.00	6	AV6	0	0	0	1.22	0.36	0.49	28.0	4.66	100
			STD	0	0	0	0.17	0.05	0.11	6.0	0.23	0
			MAX	0	0	0	1.45	0.42	0.64	36.5	4.99	100
			MIN	0	0	0	1.01	0.30	0.36	20.7	4.38	100
39	73.00	7	AV7	1	0	24	1.58	0.45	0.74	41.6	5.20	100
			STD	2	0	18	0.09	0.01	0.07	3.7	0.14	0
			MAX	6	0	48	1.70	0.46	0.82	45.4	5.40	100
			MIN	0	0	0	1.45	0.43	0.64	35.9	4.99	100
47	74.00	8	AV8	10	0	73	1.64	0.47	0.77	43.1	5.27	100
			STD	9	0	11	0.02	0.01	0.01	0.7	0.04	0
			MAX	28	0	88	1.68	0.49	0.80	44.3	5.35	100
			MIN	0	0	56	1.61	0.45	0.76	42.2	5.22	100
54	75.00	7	AV7	0	0	48	1.57	0.47	0.72	39.9	5.15	100
			STD	0	0	11	0.05	0.01	0.04	1.8	0.08	0
			MAX	0	0	63	1.62	0.48	0.76	42.8	5.22	100
			MIN	0	0	35	1.49	0.44	0.67	37.2	5.01	100
61	76.00	7	AV7	0	0	61	1.60	0.45	0.77	40.9	5.19	100
			STD	0	0	10	0.05	0.02	0.03	2.1	0.09	0
			MAX	0	0	77	1.66	0.46	0.81	43.0	5.29	100
			MIN	0	0	46	1.52	0.42	0.71	37.1	5.03	100

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BL#	Depth ft	BLC bl/ft	TYPE	RX7 kips	RX8 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
70	77.00	9	AV9	1	0	87	1.56	0.44	0.75	40.3	5.14	100
			STD	1	0	5	0.04	0.01	0.02	1.4	0.06	0
			MAX	5	0	96	1.64	0.46	0.80	42.9	5.27	100
			MIN	0	0	80	1.52	0.43	0.73	38.6	5.08	100
78	78.00	8	AV8	0	0	63	1.55	0.42	0.76	39.5	5.11	100
			STD	0	0	6	0.03	0.01	0.02	1.1	0.05	0
			MAX	0	0	72	1.61	0.44	0.80	42.1	5.20	100
			MIN	0	0	55	1.51	0.41	0.73	38.5	5.05	100
84	79.00	6	AV6	0	0	44	1.53	0.42	0.75	39.3	5.11	100
			STD	0	0	7	0.04	0.01	0.03	1.8	0.06	0
			MAX	0	0	56	1.59	0.44	0.78	42.1	5.20	100
			MIN	0	0	36	1.46	0.40	0.70	36.6	5.01	100
90	80.00	6	AV6	0	0	52	1.54	0.42	0.76	40.0	5.13	100
			STD	0	0	5	0.04	0.01	0.02	1.5	0.06	0
			MAX	0	0	59	1.61	0.44	0.81	43.0	5.27	100
			MIN	0	0	44	1.51	0.41	0.73	38.5	5.08	100
96	81.00	6	AV6	0	0	50	1.52	0.42	0.75	39.3	5.10	100
			STD	0	0	23	0.04	0.01	0.03	1.7	0.06	0
			MAX	0	0	66	1.57	0.43	0.78	40.8	5.16	100
			MIN	0	0	0	1.45	0.40	0.70	36.1	4.99	100
104	82.00	8	AV8	0	0	67	1.53	0.43	0.75	39.2	5.11	100
			STD	1	0	10	0.04	0.00	0.03	1.7	0.05	0
			MAX	2	0	76	1.58	0.44	0.80	41.4	5.18	100
			MIN	0	0	51	1.48	0.43	0.72	36.7	5.05	100
112	83.00	8	AV8	3	0	59	1.54	0.45	0.76	39.9	5.14	100
			STD	3	0	5	0.04	0.01	0.03	1.8	0.07	0
			MAX	8	0	68	1.59	0.47	0.80	42.3	5.22	100
			MIN	0	0	54	1.47	0.43	0.70	37.2	5.01	100
119	84.00	7	AV7	8	0	58	1.63	0.47	0.82	43.4	5.31	100
			STD	11	0	5	0.03	0.01	0.02	0.9	0.06	0
			MAX	25	0	67	1.68	0.48	0.86	44.6	5.40	100
			MIN	0	0	52	1.59	0.45	0.80	41.4	5.24	100
127	85.00	8	AV8	55	29	68	1.64	0.47	0.80	43.3	5.33	100
			STD	11	12	6	0.03	0.01	0.02	1.1	0.06	0
			MAX	74	50	80	1.68	0.49	0.83	44.7	5.40	100
			MIN	40	11	62	1.59	0.45	0.77	40.8	5.24	100
134	86.00	7	AV7	13	0	63	1.66	0.46	0.82	44.2	5.37	100
			STD	7	0	8	0.03	0.01	0.03	1.2	0.05	0
			MAX	23	0	75	1.71	0.48	0.87	46.0	5.47	100
			MIN	0	0	48	1.61	0.44	0.78	42.2	5.29	100
141	87.00	7	AV7	0	0	84	1.62	0.43	0.81	42.1	5.30	100
			STD	0	0	17	0.07	0.01	0.05	2.6	0.13	0
			MAX	0	0	110	1.72	0.44	0.89	46.3	5.49	100

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OP: AFT Date: 24-April-2018

BL#	Depth ft	BLC bl/ft	TYPE	RX7 kips	RX8 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
			MIN	0	0	64	1.54	0.42	0.74	39.2	5.14	100
151	88.00	10	AV10	90	77	111	1.61	0.44	0.79	40.2	5.28	100
			STD	60	57	10	0.05	0.02	0.04	2.0	0.09	0
			MAX	157	143	129	1.71	0.47	0.86	44.3	5.45	100
			MIN	0	0	98	1.55	0.41	0.72	37.7	5.16	100
161	89.00	10	AV10	230	223	253	1.73	0.51	0.83	44.6	5.52	100
			STD	47	51	88	0.08	0.03	0.05	3.9	0.18	0
			MAX	294	291	342	1.85	0.56	0.89	50.3	5.83	100
			MIN	145	130	112	1.57	0.46	0.73	37.2	5.22	100
171	90.00	10	AV10	372	371	305	1.84	0.60	0.83	48.1	5.76	100
			STD	33	34	21	0.06	0.03	0.05	3.0	0.12	0
			MAX	421	421	332	1.92	0.66	0.91	54.2	5.96	100
			MIN	325	323	264	1.69	0.55	0.73	41.8	5.47	100
187	91.00	16	AV16	487	487	387	1.93	0.70	0.82	50.0	5.93	100
			STD	19	19	31	0.04	0.04	0.03	1.9	0.09	0
			MAX	527	526	442	2.00	0.78	0.89	53.1	6.06	100
			MIN	463	463	350	1.85	0.64	0.79	46.5	5.78	100
205	92.00	18	AV18	563	563	497	2.04	0.87	0.75	52.6	6.14	100
			STD	22	22	38	0.04	0.04	0.03	2.0	0.09	0
			MAX	591	591	595	2.09	0.92	0.80	56.3	6.28	100
			MIN	530	530	447	1.97	0.77	0.68	47.8	5.98	100
235	93.00	30	AV30	704	704	622	2.09	1.03	0.64	52.9	6.22	100
			STD	44	44	36	0.03	0.05	0.04	1.8	0.07	0
			MAX	769	767	688	2.16	1.11	0.73	55.8	6.37	100
			MIN	613	613	536	2.04	0.92	0.57	49.1	6.09	100
271	94.00	36	AV36	823	822	723	2.15	1.19	0.54	55.2	6.36	100
			STD	24	24	24	0.05	0.05	0.04	2.3	0.11	0
			MAX	858	858	757	2.25	1.26	0.63	59.4	6.57	100
			MIN	769	767	658	2.06	1.09	0.44	50.6	6.12	100
314	95.00	43	AV43	875	871	796	2.20	1.32	0.44	57.5	6.46	100
			STD	14	12	27	0.04	0.04	0.04	2.2	0.10	0
			MAX	904	899	844	2.29	1.40	0.52	63.2	6.72	100
			MIN	850	848	750	2.11	1.25	0.36	53.5	6.28	100
354	96.00	40	AV40	907	904	874	2.38	1.47	0.46	68.2	6.96	100
			STD	36	34	34	0.23	0.08	0.11	12.3	0.58	0
			MAX	975	958	960	2.72	1.60	0.63	91.4	8.03	100
			MIN	850	849	811	2.09	1.35	0.32	52.6	6.28	100
392	97.00	38	AV38	954	943	927	2.66	1.59	0.58	82.3	7.58	100
			STD	13	10	19	0.05	0.02	0.03	2.5	0.12	0
			MAX	996	969	967	2.78	1.63	0.65	88.7	7.91	100
			MIN	933	921	880	2.56	1.56	0.50	78.4	7.35	100
432	98.00	40	AV40	982	962	970	2.67	1.64	0.54	83.4	7.63	100

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OP: AFT Date: 24-April-2018

BL#	Depth	BLC	TYPE	RX7	RX8	RA2	CSX	CSB	TSX	EMX	STK	BTA
	ft	bl/ft		kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
			STD	15	12	15	0.05	0.03	0.03	3.2	0.14	0
			MAX	1,009	983	1,001	2.78	1.70	0.61	90.8	7.91	100
			MIN	941	932	933	2.53	1.56	0.48	75.7	7.28	100
474	99.00	42	AV42	990	969	995	2.68	1.71	0.48	84.5	7.71	100
			STD	13	12	13	0.04	0.02	0.03	2.4	0.11	0
			MAX	1,023	999	1,028	2.76	1.75	0.55	88.9	7.99	100
			MIN	965	944	968	2.60	1.66	0.41	79.4	7.49	100
515	100.00	41	AV41	988	971	1,010	2.69	1.76	0.44	85.2	7.75	100
			STD	19	14	14	0.05	0.02	0.04	2.6	0.12	0
			MAX	1,022	999	1,046	2.80	1.79	0.50	91.4	8.03	100
			MIN	934	929	985	2.57	1.71	0.35	79.1	7.53	100
551	101.00	36	AV36	970	959	1,015	2.68	1.79	0.41	84.7	7.71	100
			STD	13	10	21	0.03	0.02	0.02	1.9	0.08	0
			MAX	1,002	983	1,062	2.76	1.82	0.46	89.2	7.95	100
			MIN	942	937	984	2.60	1.75	0.36	80.8	7.53	100
596	102.00	45	AV45	981	958	1,019	2.71	1.79	0.42	85.8	7.76	100
			STD	14	11	19	0.04	0.02	0.03	2.3	0.09	0
			MAX	1,009	986	1,060	2.80	1.83	0.49	91.7	8.03	100
			MIN	953	937	980	2.64	1.76	0.38	81.7	7.64	100
642	103.00	46	AV46	990	965	1,018	2.72	1.79	0.44	86.6	7.78	100
			STD	19	18	20	0.04	0.02	0.03	2.5	0.11	0
			MAX	1,034	1,010	1,066	2.80	1.84	0.51	91.5	7.99	100
			MIN	953	929	967	2.62	1.75	0.37	81.4	7.57	100
683	104.00	41	AV41	977	950	1,000	2.75	1.81	0.43	86.6	7.75	100
			STD	16	16	19	0.04	0.02	0.03	2.3	0.10	0
			MAX	1,029	999	1,040	2.84	1.84	0.49	92.5	7.99	100
			MIN	944	919	963	2.68	1.79	0.37	82.1	7.57	100
724	105.00	41	AV41	1,008	980	1,000	2.88	1.87	0.47	90.4	7.89	100
			STD	18	18	13	0.04	0.02	0.03	2.2	0.09	0
			MAX	1,057	1,027	1,028	2.95	1.92	0.52	94.2	8.07	100
			MIN	966	939	963	2.79	1.83	0.42	86.8	7.75	100
764	106.00	40	AV40	1,017	991	989	2.93	1.93	0.44	90.2	7.86	100
			STD	18	18	21	0.04	0.02	0.03	2.3	0.08	0
			MAX	1,048	1,020	1,040	3.00	1.96	0.49	94.0	7.99	100
			MIN	972	948	943	2.81	1.87	0.37	84.5	7.64	100
805	107.00	41	AV41	1,041	1,013	983	2.99	1.96	0.46	90.5	7.86	100
			STD	15	15	15	0.03	0.01	0.02	1.6	0.07	0
			MAX	1,075	1,046	1,016	3.06	1.99	0.52	93.8	8.03	100
			MIN	1,004	980	951	2.89	1.93	0.41	86.8	7.72	100
852	108.00	47	AV47	1,063	1,032	976	3.04	1.97	0.51	90.7	7.84	100
			STD	17	16	14	0.05	0.02	0.03	2.3	0.09	0
			MAX	1,112	1,078	1,011	3.14	2.01	0.58	95.2	8.07	100
			MIN	1,018	990	943	2.98	1.94	0.45	86.0	7.68	100

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OP: AFT Date: 24-April-2018

BL#	Depth ft	BLC bl/ft	TYPE	RX7 kips	RX8 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
895	109.00	43	AV43	1,065	1,031	1,001	3.13	2.01	0.55	93.2	7.90	100
			STD	18	17	17	0.05	0.02	0.03	2.5	0.10	0
			MAX	1,104	1,067	1,040	3.22	2.04	0.62	98.5	8.15	100
			MIN	1,018	985	969	3.03	1.96	0.50	88.5	7.75	100
936	110.00	41	AV41	1,074	1,037	1,032	3.17	2.01	0.60	93.4	7.89	100
			STD	10	10	13	0.03	0.01	0.02	1.6	0.06	0
			MAX	1,093	1,052	1,069	3.24	2.03	0.65	96.3	8.03	100
			MIN	1,047	1,010	995	3.12	1.98	0.55	90.2	7.75	100
975	111.00	39	AV39	1,067	1,026	1,071	3.21	2.02	0.64	93.8	7.93	100
			STD	18	18	19	0.04	0.02	0.03	2.2	0.08	0
			MAX	1,103	1,059	1,100	3.32	2.06	0.73	98.3	8.15	100
			MIN	1,032	989	1,021	3.11	1.97	0.58	88.2	7.75	100
1015	112.00	40	AV40	1,044	994	1,015	3.24	1.97	0.75	94.3	7.93	100
			STD	15	17	29	0.04	0.04	0.05	2.3	0.09	0
			MAX	1,072	1,028	1,069	3.31	2.05	0.87	97.5	8.11	100
			MIN	1,004	953	967	3.16	1.90	0.62	89.3	7.75	100
1056	113.00	41	AV41	1,021	991	979	3.25	1.92	0.85	93.8	7.92	100
			STD	12	13	14	0.05	0.01	0.04	2.1	0.09	0
			MAX	1,050	1,018	1,017	3.37	1.94	0.93	99.4	8.15	100
			MIN	998	960	953	3.14	1.89	0.76	89.0	7.72	100
1092	114.00	36	AV36	1,005	987	978	3.26	1.91	0.85	94.3	7.96	100
			STD	15	14	14	0.05	0.02	0.04	2.6	0.12	0
			MAX	1,043	1,025	1,004	3.40	1.95	0.95	101.1	8.27	100
			MIN	967	956	947	3.16	1.88	0.78	89.0	7.75	100
1139	115.00	47	AV47	1,002	984	1,139	2.76	1.96	0.36	84.3	7.64	100
			STD	64	60	91	0.41	0.14	0.19	10.7	0.19	0
			MAX	1,298	1,243	1,329	3.43	2.10	1.31	99.1	8.23	100
			MIN	788	784	829	1.14	1.22	0.20	41.1	7.08	100
1179	116.00	40	AV40	999	988	1,112	2.99	2.09	0.39	92.3	7.75	100
			STD	25	26	46	0.05	0.03	0.03	3.8	0.12	0
			MAX	1,053	1,038	1,223	3.12	2.16	0.45	102.3	8.07	100
			MIN	947	934	1,042	2.92	2.02	0.34	84.3	7.57	100
1228	117.00	49	AV49	987	978	1,134	3.00	2.09	0.37	92.1	7.82	100
			STD	20	19	30	0.05	0.03	0.04	4.1	0.10	0
			MAX	1,035	1,024	1,203	3.09	2.19	0.45	105.5	7.99	100
			MIN	953	949	1,038	2.88	2.01	0.29	81.6	7.60	100
1283	118.00	55	AV55	940	932	1,147	2.96	2.10	0.32	90.1	7.82	100
			STD	26	25	30	0.07	0.04	0.05	4.4	0.16	0
			MAX	1,004	993	1,239	3.12	2.16	0.49	99.3	8.27	100
			MIN	878	865	1,101	2.73	2.01	0.19	77.4	7.28	100
1337	119.00	54	AV54	923	919	1,127	2.95	2.13	0.27	90.4	7.90	100
			STD	19	18	32	0.04	0.02	0.04	3.4	0.11	0

I-10 MOBILE RIVER - TP-23A ID 54" CYL, 6" WALL
OP: AFT Date: 24-April-2018

BL#	Depth ft	BLC bl/ft	TYPE	RX7 kips	RX8 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
			MAX	965	959	1,201	3.08	2.19	0.40	100.0	8.15	100
			MIN	888	883	1,054	2.87	2.08	0.21	83.0	7.68	100
1387	120.00	50	AV50	957	952	1,078	3.01	2.18	0.27	94.7	8.16	100
			STD	53	51	40	0.12	0.05	0.07	8.2	0.38	0
			MAX	1,097	1,085	1,189	3.29	2.29	0.42	114.5	9.12	100
			MIN	897	893	1,014	2.85	2.10	0.16	83.2	7.75	100
1428	121.00	41	AV41	1,029	1,026	1,033	3.19	2.28	0.32	106.4	8.77	100
			STD	21	21	34	0.04	0.03	0.02	3.3	0.12	0
			MAX	1,064	1,064	1,128	3.26	2.32	0.36	114.4	9.03	100
			MIN	975	970	981	3.09	2.21	0.26	98.9	8.44	100
1468	122.00	40	AV40	1,062	1,062	989	3.24	2.30	0.36	107.2	8.87	100
			STD	19	19	28	0.04	0.02	0.03	2.9	0.11	0
			MAX	1,103	1,103	1,060	3.34	2.36	0.44	112.9	9.12	100
			MIN	1,023	1,023	941	3.16	2.25	0.31	100.8	8.61	100
1513	123.00	45	AV45	1,040	1,040	968	3.24	2.32	0.34	106.4	8.82	100
			STD	20	20	17	0.04	0.02	0.02	2.6	0.09	0
			MAX	1,078	1,077	1,007	3.34	2.38	0.40	112.5	9.03	100
			MIN	988	988	926	3.13	2.27	0.28	99.6	8.57	100
1556	124.00	43	AV43	1,005	1,004	1,013	3.29	2.32	0.36	106.9	8.82	100
			STD	25	25	23	0.04	0.02	0.03	3.1	0.11	0
			MAX	1,060	1,060	1,069	3.38	2.37	0.40	114.4	9.07	100
			MIN	934	934	955	3.18	2.25	0.29	98.1	8.57	100
1594	125.00	38	AV38	992	982	1,056	3.91	2.95	0.36	128.9	8.93	100
			STD	103	106	80	0.59	0.41	0.09	25.2	0.83	0
			MAX	1,112	1,044	1,120	4.35	3.25	0.58	156.7	10.16	100
			MIN	552	498	641	0.97	0.82	0.13	9.9	4.47	100
1626	126.00	32	AV32	968	966	1,129	4.05	3.18	0.25	132.2	8.94	100
			STD	27	29	29	0.05	0.05	0.06	3.2	0.13	0
			MAX	1,016	1,014	1,183	4.18	3.25	0.38	140.3	9.32	100
			MIN	911	898	1,076	3.93	3.10	0.15	123.0	8.70	100
1664	127.00	38	AV38	966	949	1,184	4.00	3.21	0.18	130.3	8.91	100
			STD	20	23	25	0.04	0.03	0.03	2.8	0.10	0
			MAX	1,016	994	1,245	4.10	3.29	0.27	136.3	9.12	100
			MIN	924	894	1,139	3.93	3.17	0.13	124.6	8.70	100
1706	128.00	42	AV42	1,022	933	1,196	3.91	3.14	0.17	126.7	8.87	100
			STD	35	27	25	0.04	0.03	0.03	2.8	0.09	0
			MAX	1,116	1,012	1,289	4.05	3.22	0.23	137.2	9.12	100
			MIN	966	873	1,154	3.79	3.06	0.12	120.3	8.66	100
1752	129.00	46	AV46	1,151	908	1,215	3.81	3.10	0.14	121.9	8.85	100
			STD	59	25	31	0.07	0.04	0.03	4.1	0.17	0
			MAX	1,250	977	1,291	3.99	3.17	0.22	131.0	9.22	100
			MIN	977	867	1,152	3.66	3.02	0.11	113.2	8.48	100

I-10 MOBILE RIVER - TP-23A ID 54" CYL, 6" WALL
OP: AFT Date: 24-April-2018

BL#	Depth	BLC	TYPE	RX7	RX8	RA2	CSX	CSB	TSX	EMX	STK	BTA
	ft	bl/ft		kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
1798	130.00	46	AV46	1,162	905	1,222	3.80	3.04	0.14	121.4	8.91	100
			STD	34	20	31	0.05	0.03	0.03	2.7	0.13	0
			MAX	1,234	946	1,308	3.90	3.12	0.25	127.7	9.17	100
			MIN	1,084	858	1,155	3.70	2.97	0.10	116.4	8.61	100
1843	131.00	45	AV45	1,126	927	1,262	3.80	2.97	0.14	122.3	8.96	100
			STD	31	22	32	0.05	0.04	0.03	2.8	0.14	0
			MAX	1,193	975	1,344	3.87	3.02	0.24	127.0	9.27	100
			MIN	1,073	887	1,184	3.66	2.86	0.10	114.0	8.61	100
1888	132.00	45	AV45	1,098	966	1,302	3.82	2.89	0.19	123.6	9.03	100
			STD	31	19	35	0.05	0.04	0.05	3.0	0.11	0
			MAX	1,152	1,030	1,376	3.92	2.97	0.30	129.8	9.27	100
			MIN	1,017	938	1,237	3.72	2.80	0.11	116.1	8.84	100
1934	133.00	46	AV46	1,115	1,054	1,411	3.84	2.83	0.19	124.1	9.04	100
			STD	28	43	53	0.05	0.03	0.04	3.2	0.11	0
			MAX	1,162	1,136	1,538	3.97	2.88	0.27	132.8	9.32	100
			MIN	1,030	983	1,313	3.73	2.74	0.13	118.1	8.79	100
1991	134.00	57	AV57	1,359	1,270	1,650	3.89	2.85	0.22	126.5	9.11	100
			STD	129	83	80	0.06	0.04	0.02	3.7	0.13	0
			MAX	1,605	1,423	1,828	4.00	2.95	0.25	134.2	9.32	100
			MIN	1,161	1,140	1,515	3.76	2.76	0.19	116.5	8.79	100
2016	134.25	100	AV25	1,676	1,485	1,836	3.97	3.00	0.24	129.9	9.25	100
			STD	44	32	52	0.04	0.05	0.02	2.9	0.08	0
			MAX	1,768	1,565	1,894	4.06	3.11	0.33	134.2	9.37	100
			MIN	1,594	1,428	1,621	3.84	2.90	0.23	122.3	8.98	100
			Average	935	895	985	2.99	2.01	0.44	92.4	7.83	100
			Std. Dev.	305	285	341	0.67	0.73	0.21	25.3	1.08	1
			Maximum	1,768	1,565	1,894	4.35	3.29	1.31	156.7	10.16	100
			Minimum	0	0	0	0.78	0.15	0.00	9.9	3.90	73

Total number of blows analyzed: 2016

BL# Sensors

1-2016 F1: [E655] 92.7 (1.00); F2: [J762] 93.9 (1.00); F3: [P454] 145.3 (1.00); F4: [P455] 145.8 (1.00); A1: [59379] 925.0 (1.00); A2: [59462] 1055.0 (1.00); A3: [K5647] 334.0 (1.00); A4: [K5943] 368.0 (1.00)

BL# Comments

1 Template (Reference) El. = 11.25', Mudline El. = -13.4'
1095 CHANGE PILE CUSHION

Time Summary

Drive 27 minutes 30 seconds 12:52 PM - 1:19 PM (4/24/2018) BN 1 - 1095
Stop 30 minutes 33 seconds 1:19 PM - 1:50 PM
Drive 11 minutes 11 seconds 1:50 PM - 2:01 PM BN 1096 - 1559
Stop 39 minutes 8 seconds 2:01 PM - 2:40 PM

Drive 11 minutes 31 seconds 2:40 PM - 2:52 PM BN 1560 - 2016

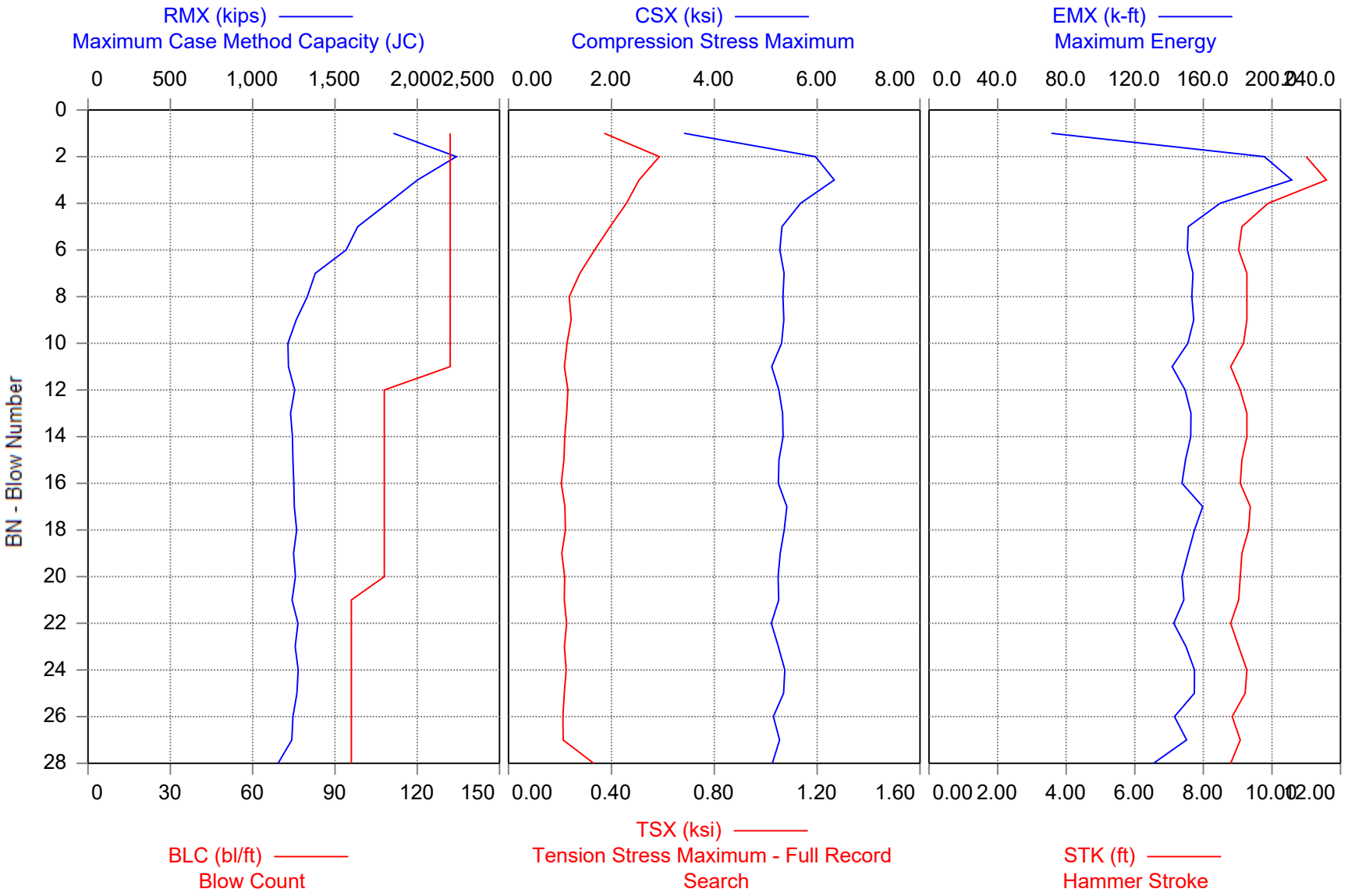
Total time [01:59:56] = (Driving [00:50:13] + Stop [01:09:42])

Applied Foundation Testing, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 25-May-2018

Test started: 25-April-2018

I-10 MOBILE RIVER - TP-23A 1DAY RS



I-10 MOBILE RIVER - TP-23A 1DAY RS 54" CYL, 6" WALL
OP: AFT Date: 25-April-2018

AR: 904.78 in² SP: 0.150 k/ft³
LE: 127.00 ft EM: 7,778.33 ksi
WS: 15,500.0 f/s JC: 1.01

RMX: Maximum Case Method Capacity (JC)
RX11: Maximum Case Method Capacity (JC=1.1)
RA2: Auto Capacity Friction Piles
CSX: Compression Stress Maximum
CSB: Compression Stress at Bottom of Pile
TSX: Tension Stress Maximum - Full Record Search
EMX: Maximum Energy
STK: Hammer Stroke
BTA: Integrity Factor (1)

BL#	BLC	RMX	RX11	RA2	CSX	CSB	TSX	EMX	STK	BTA
	bl/ft	kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
1	132	1,855	1,670	1,801	3.41	2.77	0.37	71.4	0.00	100
2	132	2,237	1,856	1,989	5.97	4.51	0.59	195.6	11.00	100
3	132	2,002	1,582	1,810	6.33	4.75	0.51	211.5	11.59	100
4	132	1,821	1,447	1,750	5.68	4.31	0.46	169.7	9.89	100
5	132	1,638	1,312	1,681	5.31	4.07	0.39	151.1	9.12	100
6	132	1,567	1,282	1,674	5.27	4.05	0.33	150.7	9.03	100
7	132	1,381	1,269	1,640	5.36	4.16	0.28	153.9	9.27	100
8	132	1,332	1,280	1,632	5.34	4.17	0.24	153.2	9.27	100
9	132	1,264	1,252	1,583	5.35	4.20	0.24	154.4	9.27	100
10	132	1,215	1,215	1,527	5.31	4.07	0.23	151.0	9.17	100
11	132	1,217	1,199	1,521	5.12	3.97	0.22	141.8	8.79	100
12	108	1,256	1,234	1,586	5.25	4.11	0.23	149.3	9.07	100
13	108	1,231	1,219	1,573	5.33	4.14	0.23	152.7	9.27	100
14	108	1,242	1,218	1,551	5.34	4.14	0.22	152.6	9.27	100
15	108	1,245	1,219	1,525	5.26	4.06	0.22	149.6	9.12	100
16	108	1,250	1,219	1,497	5.24	4.09	0.21	147.5	9.07	100
17	108	1,253	1,244	1,592	5.41	4.19	0.22	159.6	9.37	100
18	108	1,268	1,247	1,552	5.36	4.16	0.22	154.8	9.32	100
19	108	1,249	1,224	1,529	5.28	4.07	0.21	151.1	9.12	100
20	108	1,260	1,229	1,546	5.24	4.02	0.22	147.5	9.07	100
21	96	1,240	1,219	1,494	5.25	4.06	0.22	148.6	9.03	100
22	96	1,275	1,257	1,583	5.11	3.93	0.23	142.7	8.79	100
23	96	1,259	1,256	1,550	5.24	4.00	0.22	149.8	9.03	100
24	96	1,277	1,277	1,613	5.37	4.05	0.22	154.8	9.27	100
25	96	1,269	1,269	1,545	5.35	4.05	0.22	154.7	9.22	100
26	96	1,245	1,245	1,564	5.15	3.96	0.21	143.1	8.84	100
27	96	1,238	1,237	1,516	5.27	4.02	0.21	150.2	9.07	100
28	96	1,155	1,014	1,393	5.13	3.91	0.33	130.9	8.79	100
Average		1,384	1,292	1,601	5.29	4.07	0.27	151.6	9.30	100
Std. Dev.		269	160	117	0.44	0.30	0.10	21.7	0.61	0
Maximum		2,237	1,856	1,989	6.33	4.75	0.59	211.5	11.59	100
Minimum		1,155	1,014	1,393	3.41	2.77	0.21	71.4	8.79	100

Total number of blows analyzed: 28

BL# Sensors

1-28 F1: [E655] 92.7 (1.00); F2: [J762] 93.9 (1.00); F3: [P454] 145.3 (1.00); F4: [P455] 145.8 (1.00); A1: [59379] 925.0 (1.00); A2: [59462] 1055.0 (1.00); A3: [K5647] 334.0 (1.00); A4: [K5943] 368.0 (1.00)

BL# Comments

28 11BL/1", 9BL/1", 7BL/1"

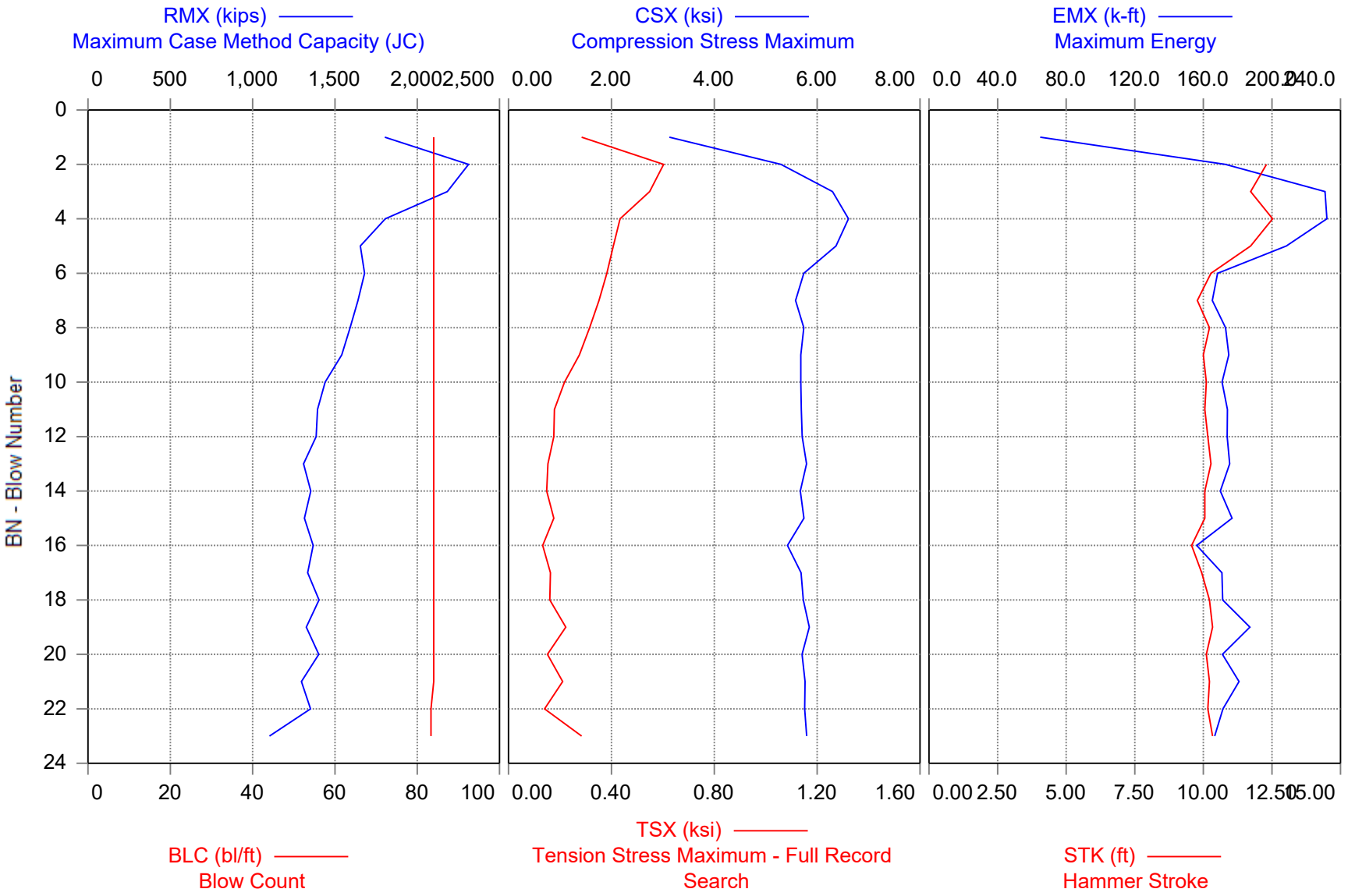
Time Summary

Drive 41 seconds 3:44 PM - 3:45 PM BN 1 - 28

Applied Foundation Testing, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 25-May-2018 Test started: 11-May-2018

I-10 MOBILE RIVER - TP-23A 17DAY RS



I-10 MOBILE RIVER - TP-23A 17DAY RS 54" CYL, 6" WALL
OP: AFT Date: 11-May-2018

AR: 904.78 in² SP: 0.150 k/ft³
LE: 127.00 ft EM: 7,778.33 ksi
WS: 15,500.0 f/s JC: 1.05

RMX: Maximum Case Method Capacity (JC)
RX11: Maximum Case Method Capacity (JC=1.1)
RA2: Auto Capacity Friction Piles
CSX: Compression Stress Maximum
CSB: Compression Stress at Bottom of Pile
TSX: Tension Stress Maximum - Full Record Search
EMX: Maximum Energy
STK: Hammer Stroke
BTA: Integrity Factor (1)

BL#	BLC	RMX	RX11	RA2	CSX	CSB	TSX	EMX	STK	BTA
	bl/ft	kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
1	84	1,803	1,714	1,808	3.13	2.50	0.28	64.9	0.00	100
2	84	2,312	2,137	2,175	5.30	4.19	0.60	172.9	12.30	100
3	84	2,183	1,962	2,088	6.30	4.66	0.55	231.0	11.72	100
4	84	1,806	1,592	1,931	6.61	4.77	0.43	232.1	12.52	100
5	84	1,655	1,521	1,850	6.37	4.46	0.41	208.4	11.72	100
6	84	1,680	1,576	1,797	5.74	4.13	0.38	168.2	10.28	100
7	84	1,640	1,528	1,763	5.58	4.01	0.35	165.2	9.78	100
8	84	1,592	1,481	1,803	5.74	4.12	0.32	172.9	10.22	100
9	84	1,541	1,429	1,892	5.68	4.19	0.28	174.8	10.00	100
10	84	1,441	1,332	1,843	5.68	4.17	0.22	170.9	10.11	100
11	84	1,394	1,345	1,882	5.69	4.21	0.18	174.0	10.05	100
12	84	1,386	1,346	1,892	5.71	4.18	0.18	173.9	10.16	100
13	84	1,310	1,301	1,794	5.79	4.21	0.15	175.4	10.28	100
14	84	1,353	1,307	1,775	5.67	4.17	0.15	169.8	10.05	100
15	84	1,314	1,306	1,870	5.74	4.29	0.18	176.7	10.05	100
16	84	1,368	1,266	1,752	5.42	4.06	0.13	156.1	9.57	100
17	84	1,334	1,286	1,793	5.69	4.17	0.16	170.8	9.94	100
18	84	1,403	1,296	1,810	5.73	4.19	0.16	171.2	10.22	100
19	84	1,326	1,307	1,840	5.85	4.32	0.22	187.1	10.33	100
20	84	1,402	1,304	1,873	5.71	4.21	0.15	171.1	10.11	100
21	84	1,297	1,277	1,825	5.77	4.20	0.21	180.8	10.22	100
22	83	1,352	1,294	1,760	5.76	4.22	0.14	171.4	10.16	100
23	83	1,102	999	1,485	5.80	4.20	0.28	166.6	10.33	100
Average		1,521	1,431	1,839	5.67	4.17	0.27	174.2	10.46	100
Std. Dev.		282	240	123	0.61	0.39	0.13	29.8	0.79	0
Maximum		2,312	2,137	2,175	6.61	4.77	0.60	232.1	12.52	100
Minimum		1,102	999	1,485	3.13	2.50	0.13	64.9	9.57	100

Total number of blows analyzed: 23

BL# Sensors

1-23 F1: [E655] 92.7 (1.00); F2: [J762] 93.9 (1.00); F3: [P454] 145.3 (1.00); F4: [P455] 145.8 (1.00); A1: [59379] 925.0 (1.00); A2: [59462] 1055.0 (1.00); A3: [K5647] 334.0 (1.00); A4: [K5943] 368.0 (1.00)

BL# Comments

23 7BL/1", 7BL/1", 7BL/1"

Time Summary

Drive 35 seconds 7:38 AM - 7:38 AM BN 1 - 23

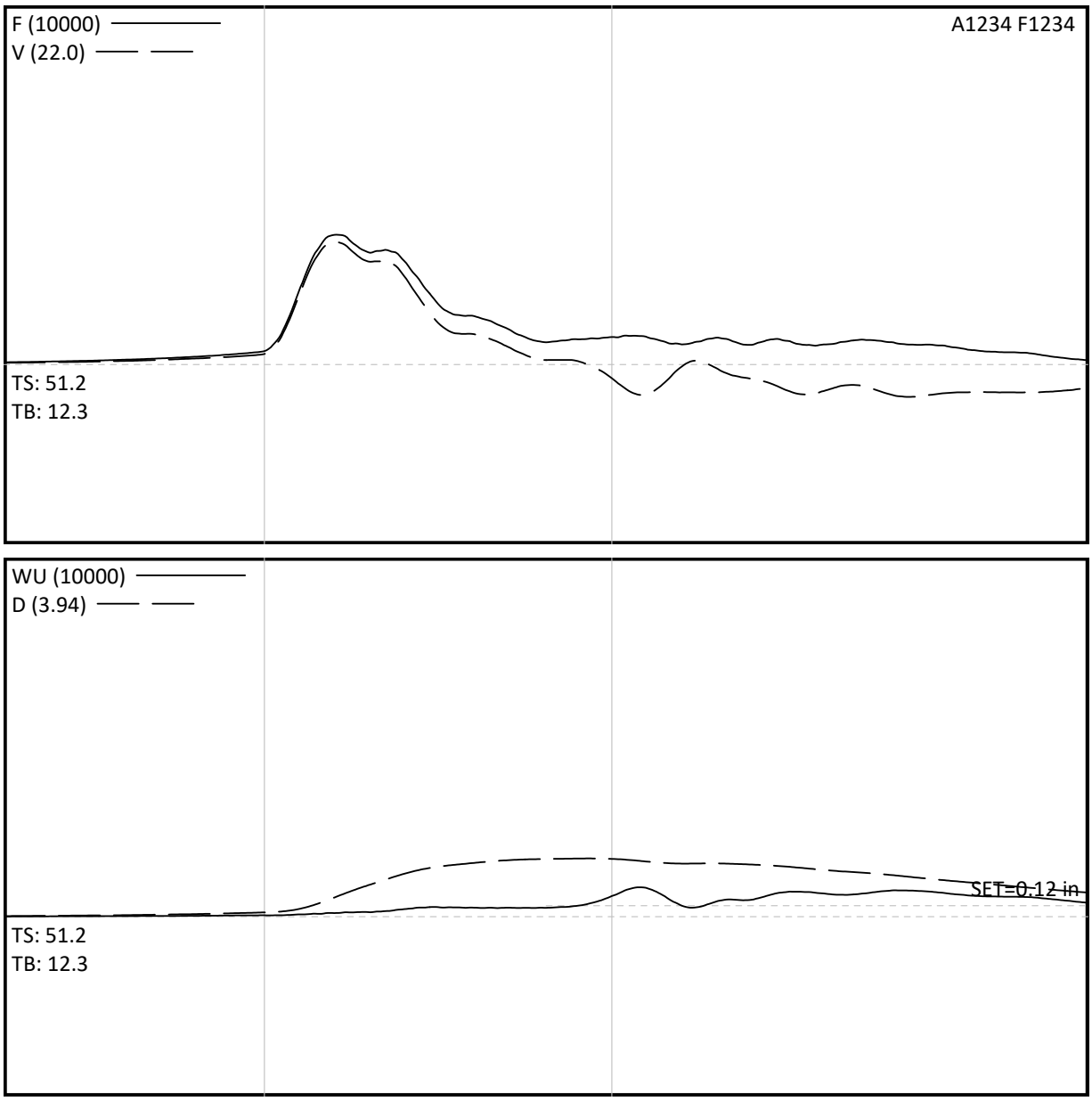
Appendix C

CAPWAP Signal Matching Analysis Output
TP-23A

I-10 over Mobile River Bridge Load Test Program

ALDOT Project No.: IM-I010(341)
Mobile County, Alabama
AFT Project No.: 118008

I-10 MOBILE RIVER TP-23A ID



Project Information

PROJECT: I-10 MOBILE RIVER
PILE NAME: TP-23A ID
DESCR: 54'' CYL, 6'' WALL
OPERATOR: AFT
FILE: TP-23A ID ana
4/24/2018 2:52:02 PM
Blow Number 2014

Pile Properties

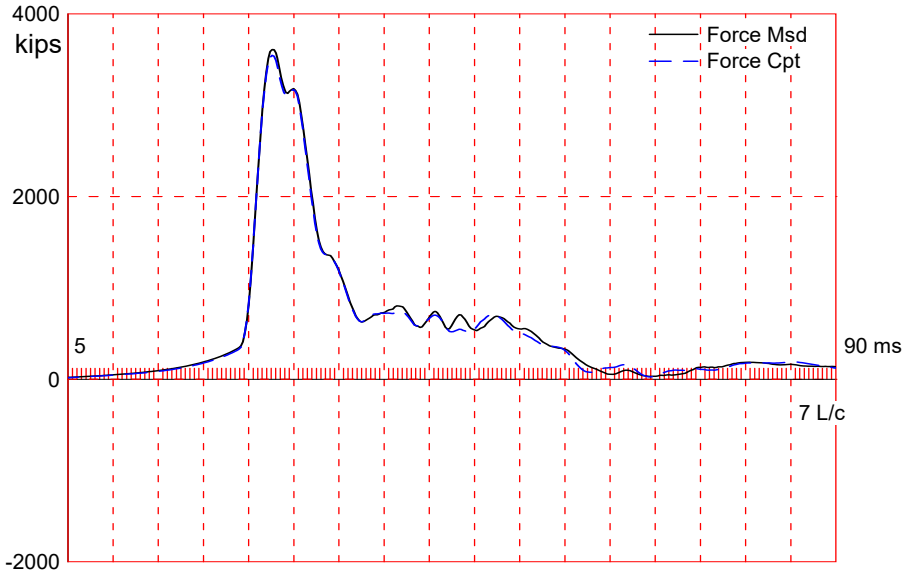
LE 127.00 ft
AR 904.78 in^2
EM 7778.33 ksi
SP 0.150 k/ft3
WS 15500.0 f/s
EA/C 454.0 ksec/ft
2L/C 16.40 ms
JC 0.70 []
LP 134.23 ft

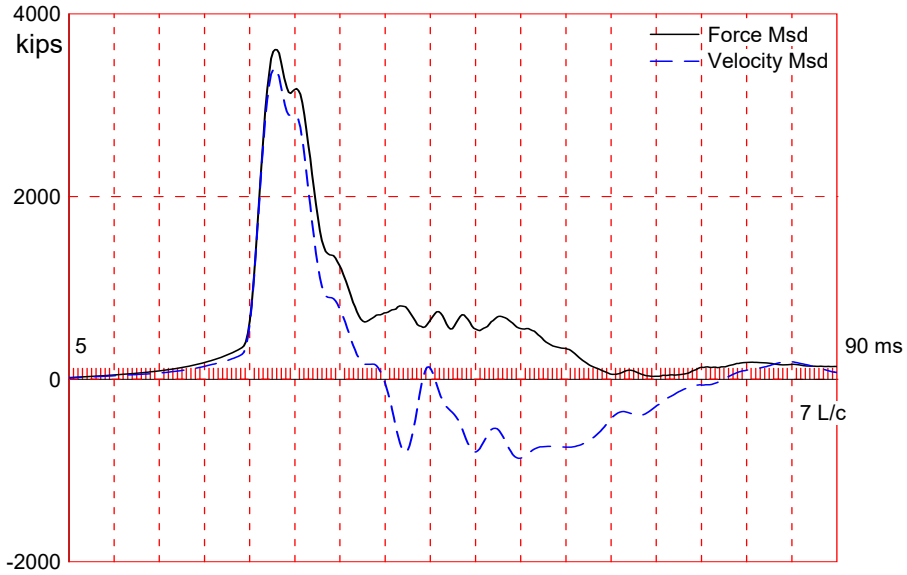
Quantity Results

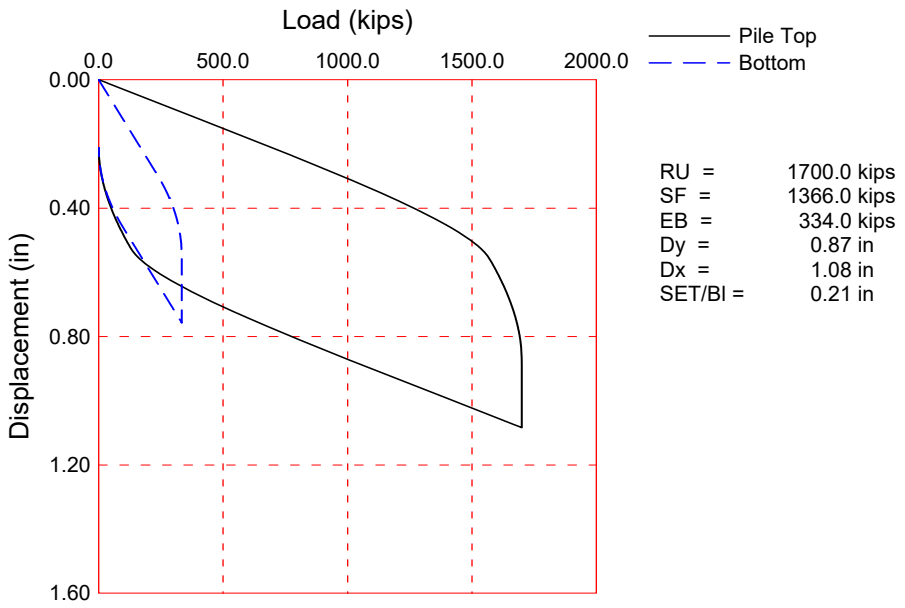
RX7 1725 kips
RX8 1526 kips
RA2 1894 kips
CSX 4.00 ksi
CSB 3.06 ksi
TSX 0.23 ksi
EMX 132.9 k-ft
STK 9.32 ft
BTA 100 (%)

Sensors

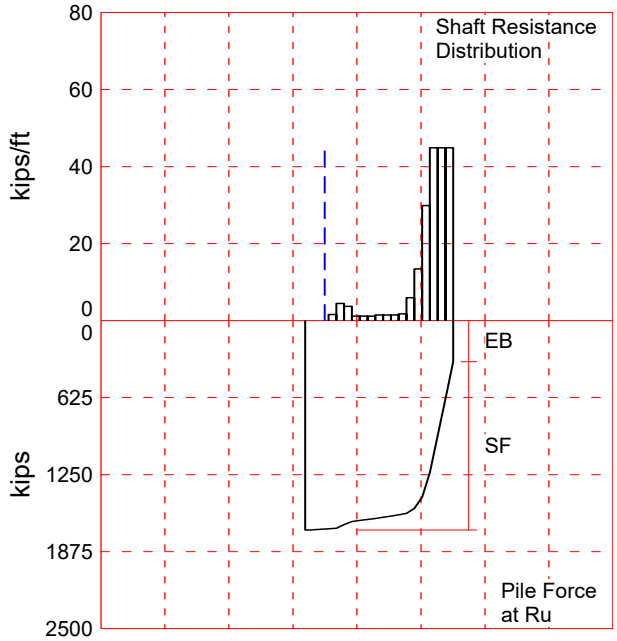
F1: [E655] 92.7 (1)
F2: [J762] 93.9 (1)
F3: [P454] 145.3 (1)
F4: [P455] 145.8 (1)
A1: [59379] 925 g's/v (1)
A2: [59462] 1055 g's/v (1)
A3: [K5647] 334 mv/5000g's (1)
A4: [K5943] 368 mv/5000g's (1)
CLIP: OK







RU =	1700.0 kips
SF =	1366.0 kips
EB =	334.0 kips
Dy =	0.87 in
Dx =	1.08 in
SET/Bl =	0.21 in



Length b. Sensors	127.0 ft
Embedment	109.5 ft
Top Area	6.28 ft^2
End Bearing Area	15.90 ft^2
Top Perimeter	14.14 ft
Top E-Modulus	7778 ksi
Top Spec. Weight	150.0 lb/ft^3
Top Wave Spd.	15500 ft/s
Overall W.S.	15488 ft/s
Match Quality	1.73
Top Compr. Stress	3.9 ksi
Max Compr. Stress	4.2 ksi
Max Tension Stress	-0.18 ksi
Avg. Shaft Quake	0.21 in
Toe Quake	0.42 in
Avg. Shaft Smith Dpg.	0.29 s/ft
Toe Smith Damping	0.30 s/ft

About the CAPWAP Results

The CAPWAP program performs a signal matching or reverse analysis based on measurements taken on a deep foundation under an impact load. The program is based on a one-dimensional mathematical model. Under certain conditions, the model only crudely approximates the often complex dynamic situations.

The CAPWAP analysis relies on the input of accurately measured dynamic data plus additional parameters describing pile and soil behavior. If the field measurements of force and velocity are incorrect or were taken under inappropriate conditions (e.g., at an inappropriate time or with too much or too little energy) or if the input pile model is incorrect, then the solution cannot represent the actual soil behavior.

Generally the CAPWAP analysis is used to estimate the axial compressive pile capacity and the soil resistance distribution. The long-term capacity is best evaluated with restrike tests since they incorporate soil strength changes (set-up gains or relaxation losses) that occur after installation. The calculated load settlement graph does not consider creep or long term consolidation settlements. When uplift is a controlling factor in the design, use of the CAPWAP results to assess uplift capacity should be made only after very careful analysis of only good measurement quality, and further used only with longer pile lengths and with nominally higher safety factors.

CAPWAP is also used to evaluate driving stresses along the length of the pile. However, it should be understood that the analysis is one dimensional and does not take into account bending effects or local contact stresses at the pile toe.

Furthermore, if the user of this software was not able to produce a solution with satisfactory signal “match quality” (MQ), then the associated CAPWAP results may be unreliable. There is no absolute scale for solution acceptability but solutions with MQ above 5 are generally considered less reliable than those with lower MQ values and every effort should be made to improve the analysis, for example, by getting help from other independent experts.

Considering the CAPWAP model limitations, the nature of the input parameters, the complexity of the analysis procedure, and the need for a responsible application of the results to actual construction projects, it is recommended that at least one static load test be performed on sites where little experience exists with dynamic behavior of the soil resistance or when the experience of the analyzing engineer with both program use and result application is limited.

Finally, the CAPWAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors. The CAPWAP results should be reviewed by the Engineer of Record with consideration of applicable geotechnical conditions including, but not limited to, group effects, potential settlement from underlying compressible layers, soil resistances provided from any layers unsuitable for long term support, as well as effective stress changes due to soil surcharges, excavation or change in water table elevation.

The CAPWAP analysis software is one of many means by which the capacity of a deep foundation can be assessed. The engineer performing the analysis is responsible for proper software application and the analysis results. Pile Dynamics accepts no liability whatsoever of any kind for the analysis solution and/or the application of the analysis result.

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 1700.0; along Shaft 1366.0; at Toe 334.0 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
				1700.0			
1	26.7	9.2	15.0	1685.0	15.0	1.62	0.11
2	33.4	15.9	30.0	1655.0	45.0	4.49	0.32
3	40.1	22.6	25.0	1630.0	70.0	3.74	0.26
4	46.8	29.3	8.0	1622.0	78.0	1.20	0.08
5	53.5	36.0	8.0	1614.0	86.0	1.20	0.08
6	60.2	42.7	8.0	1606.0	94.0	1.20	0.08
7	66.8	49.3	10.0	1596.0	104.0	1.50	0.11
8	73.5	56.0	10.0	1586.0	114.0	1.50	0.11
9	80.2	62.7	10.0	1576.0	124.0	1.50	0.11
10	86.9	69.4	12.0	1564.0	136.0	1.80	0.13
11	93.6	76.1	40.0	1524.0	176.0	5.98	0.42
12	100.3	82.8	90.0	1434.0	266.0	13.46	0.95
13	106.9	89.4	200.0	1234.0	466.0	29.92	2.12
14	113.6	96.1	300.0	934.0	766.0	44.88	3.17
15	120.3	102.8	300.0	634.0	1066.0	44.88	3.17
16	127.0	109.5	300.0	334.0	1366.0	44.88	3.17
Avg. Shaft			85.4			12.47	0.88
Toe			334.0				21.00

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.29	0.30
Quake	(in)	0.21	0.42
Case Damping Factor		0.87	0.22
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	76
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	6	
Resistance Gap (included in Toe Quake)	(in)		0.02
Soil Plug Weight	(kips)	4.650	2.000

CAPWAP match quality = 1.73 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.21 in; Blow Count = 57 b/ft
Computed: Final Set = 0.21 in; Blow Count = 57 b/ft

max. Top Comp. Stress = 3.9 ksi (T= 28.0 ms, max= 1.078 x Top)
max. Comp. Stress = 4.2 ksi (Z= 100.3 ft, T= 34.9 ms)
max. Tens. Stress = -0.18 ksi (Z= 100.3 ft, T= 70.1 ms)
max. Energy (EMX) = 133.9 kip-ft; max. Measured Top Displ. (DMX)= 0.65 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	3554.4	-10.1	3.9	-0.01	133.9	7.6	0.66
2	6.7	3567.3	-10.5	3.9	-0.01	133.7	7.6	0.65
4	13.4	3609.7	-14.0	4.0	-0.02	133.4	7.5	0.64
6	20.1	3657.0	-16.5	4.0	-0.02	133.0	7.4	0.63
8	26.7	3693.3	-24.6	4.1	-0.03	132.6	7.3	0.62
10	33.4	3675.6	-51.2	4.1	-0.06	130.4	7.2	0.61
12	40.1	3605.2	-68.7	4.0	-0.08	126.3	7.2	0.60
14	46.8	3546.7	-78.4	3.9	-0.09	122.6	7.1	0.58
16	53.5	3540.8	-91.4	3.9	-0.10	121.4	7.1	0.57
18	60.2	3535.8	-105.6	3.9	-0.12	120.3	7.1	0.57
20	66.8	3531.4	-118.6	3.9	-0.13	119.1	7.0	0.56
22	73.5	3525.3	-122.1	3.9	-0.13	117.7	7.0	0.55
24	80.2	3541.8	-126.6	3.9	-0.14	116.4	6.9	0.54
26	86.9	3603.1	-141.7	4.0	-0.16	115.1	6.7	0.53
28	93.6	3726.7	-153.4	4.1	-0.17	113.5	6.4	0.52
30	100.3	3833.0	-159.4	4.2	-0.18	109.5	6.0	0.51
32	106.9	3722.8	-155.4	4.1	-0.17	101.5	5.8	0.49
34	113.6	3148.1	-120.1	3.5	-0.13	85.1	6.2	0.48
35	117.0	2341.1	-65.4	2.6	-0.07	61.9	6.5	0.47
36	120.3	2148.4	-63.7	2.4	-0.07	61.8	6.7	0.47
37	123.7	1310.0	-15.4	1.4	-0.02	38.7	6.9	0.47
38	127.0	1337.1	-12.3	1.5	-0.01	15.3	6.9	0.46
Absolute	100.3			4.2			(T =	34.9 ms)
	100.3				-0.18		(T =	70.1 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	3789.8	3466.3	3142.9	2819.4	2495.9	2172.5	1849.0	1525.5	1202.1	878.6
RX	3789.8	3466.3	3142.9	2819.4	2495.9	2221.8	1965.4	1709.1	1510.4	1437.3
RU	3949.4	3641.9	3334.4	3026.9	2719.3	2411.8	2104.3	1796.8	1489.3	1181.8

RAU = 1260.4 (kips); RA2 = 1838.1 (kips)

Current CAPWAP Ru = 1700.0 (kips); Corresponding J(RP)= 0.65; J(RX) = 0.70

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
7.5	27.81	3411.7	3612.7	3616.6	0.65	0.21	0.21	134.0	3742.6	835

PILE PROFILE AND PILE MODEL

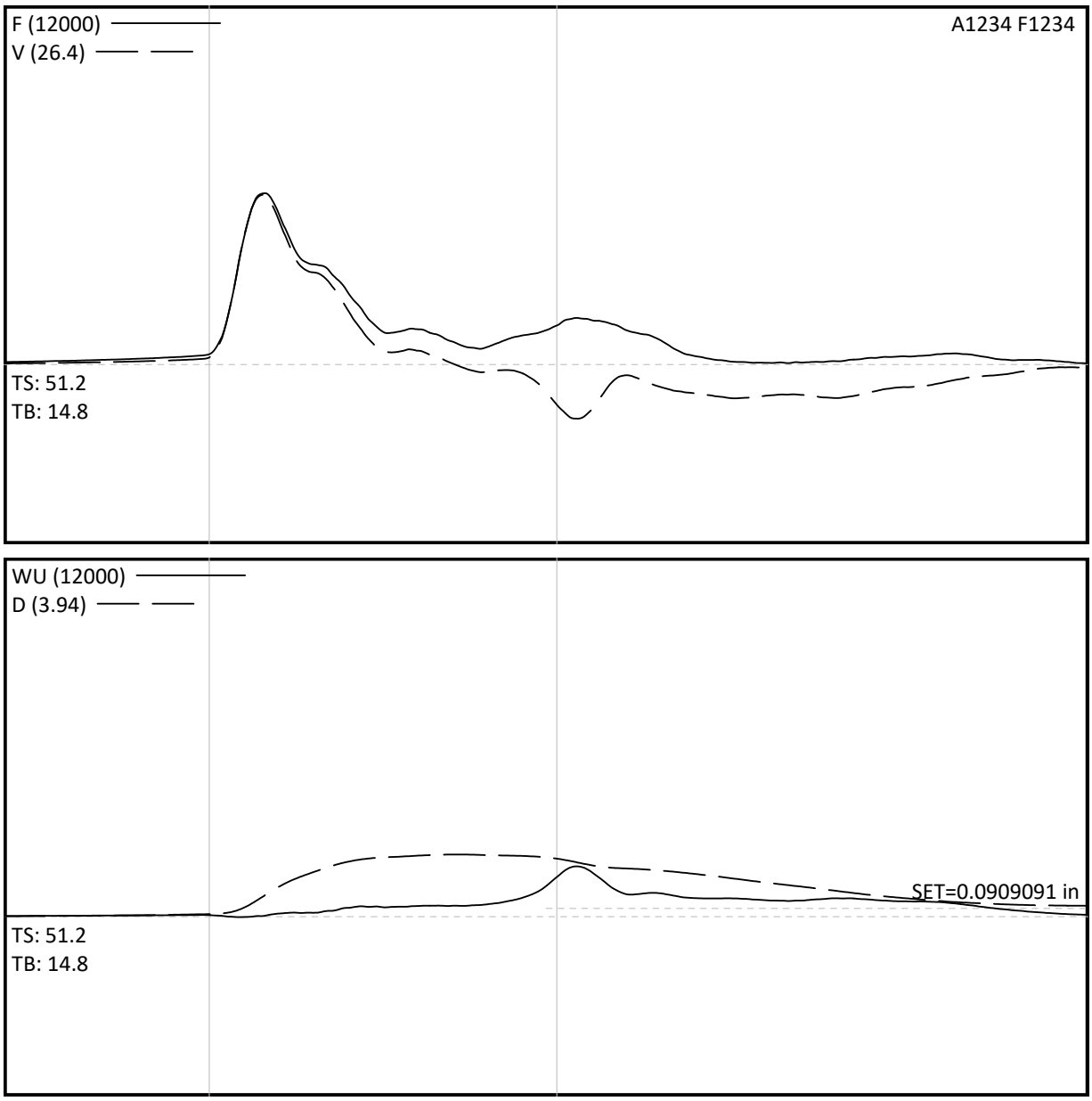
Depth	Area	E-Modulus	Spec. Weight	Perim.
ft	ft^2	ksi	lb/ft^3	ft
0.0	6.28	7778.3	150.000	14.14
127.0	6.28	7778.3	150.000	14.14

Toe Area 15.90 ft^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	Soil Plug kips
1	3.3	454.04	0.00	0.00	0.000	-0.00	0.000	14.14	15500.0	0.000
8	26.7	454.04	0.00	0.00	0.000	-0.00	0.000	14.14	15500.0	0.150
38	127.0	454.04	0.00	0.00	0.000	-0.00	0.000	14.14	15500.0	0.150

Wave Speed: Pile Top 15500.0, Elastic 15500.0, Overall 15487.8 ft/s
Pile Damping 2.00 %, Time Incr 0.216 ms, 2L/c 16.4 ms
Total volume: 797.965 ft^3; Volume ratio considering added impedance: 1.000

I-10 MOBILE RIVER TP-23A 1DAY RS



Project Information

PROJECT: I-10 MOBILE RIVER
PILE NAME: TP-23A 1DAY RS
DESCR: 54'' CYL, 6'' WALL
OPERATOR: AFT
FILE: TP-23A 1DAY RS ana
4/25/2018 3:44:49 PM
Blow Number 3

Pile Properties

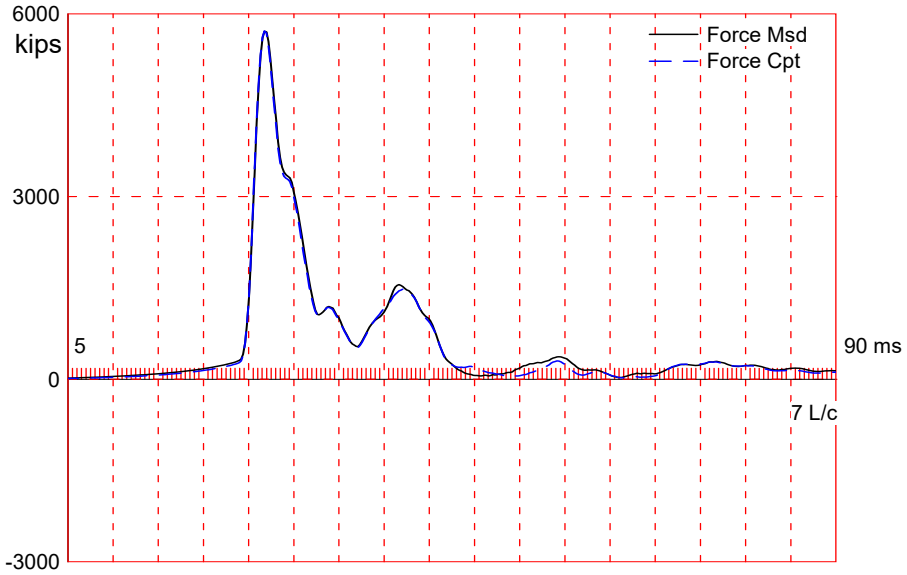
LE	127.00 ft
AR	904.78 in^2
EM	7778.33 ksi
SP	0.150 k/ft3
WS	15500.0 f/s
EA/C	454.0 ksec/ft
2L/C	16.40 ms
JC	1.01 []
LP	134.27 ft

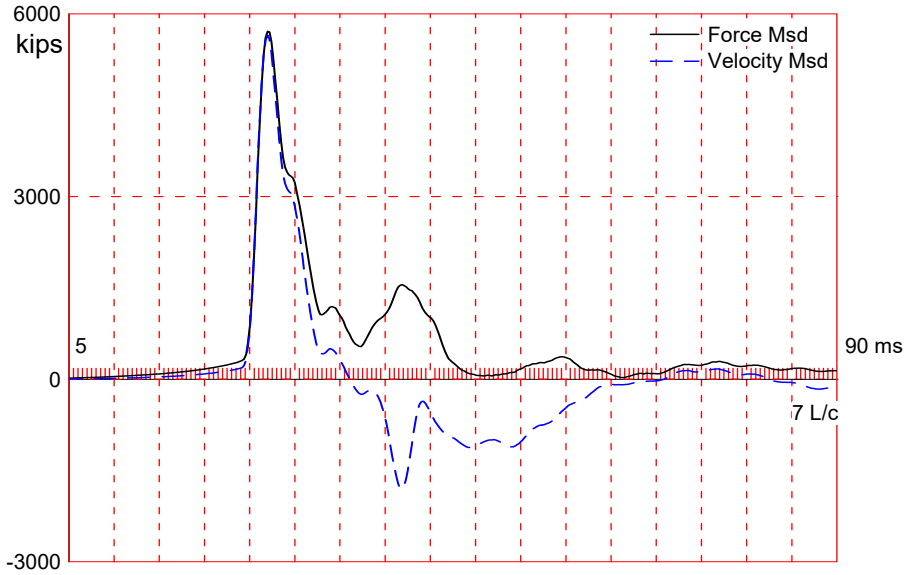
Quantity Results

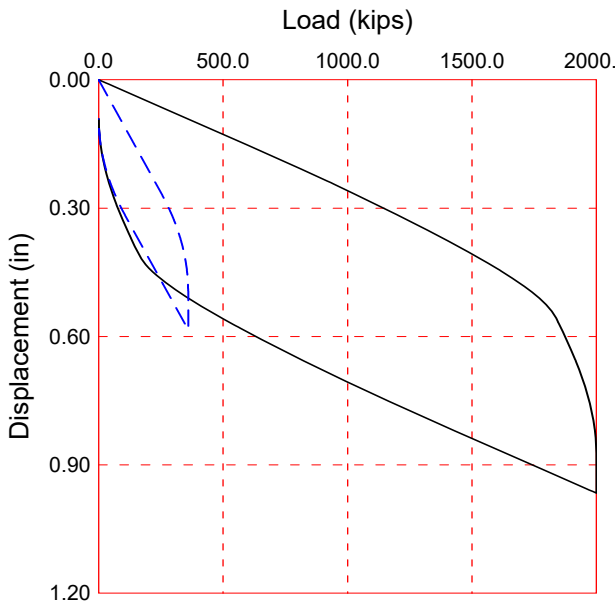
RMX	2002 kips
RX11	1582 kips
RA2	1810 kips
CSX	6.33 ksi
CSB	4.75 ksi
TSX	0.51 ksi
EMX	211.5 k-ft
STK	11.59 ft
BTA	100 (%)

Sensors

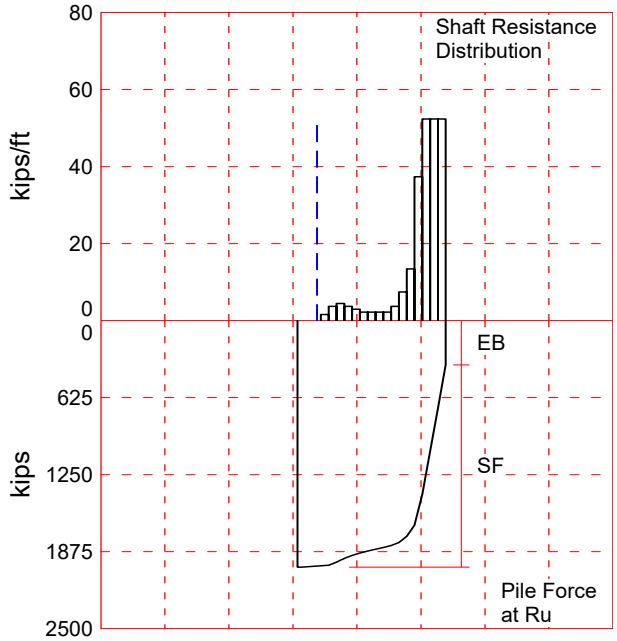
F1: [E655] 92.7 (1)
F2: [J762] 93.9 (1)
F3: [P454] 145.3 (1)
F4: [P455] 145.8 (1)
A1: [59379] 925 g's/v (1)
A2: [59462] 1055 g's/v (1)
A3: [K5647] 334 mv/5000g's (1)
A4: [K5943] 368 mv/5000g's (1)
CLIP: OK







RU =	2000.0 kips
SF =	1640.0 kips
EB =	360.0 kips
Dy =	0.88 in
Dx =	0.97 in
SET/Bl =	0.09 in



Length b. Sensors	127.0 ft
Embedment	109.5 ft
Top Area	6.28 ft^2
End Bearing Area	15.90 ft^2
Top Perimeter	14.14 ft
Top E-Modulus	7778 ksi
Top Spec. Weight	150.0 lb/ft^3
Top Wave Spd.	15500 ft/s
Overall W.S.	15488 ft/s
Match Quality	1.39
Top Compr. Stress	6.3 ksi
Max Compr. Stress	6.5 ksi
Max Tension Stress	-0.41 ksi
Avg. Shaft Quake	0.17 in
Toe Quake	0.38 in
Avg. Shaft Smith Dpg.	0.40 s/ft
Toe Smith Damping	0.23 s/ft

About the CAPWAP Results

The CAPWAP program performs a signal matching or reverse analysis based on measurements taken on a deep foundation under an impact load. The program is based on a one-dimensional mathematical model. Under certain conditions, the model only crudely approximates the often complex dynamic situations.

The CAPWAP analysis relies on the input of accurately measured dynamic data plus additional parameters describing pile and soil behavior. If the field measurements of force and velocity are incorrect or were taken under inappropriate conditions (e.g., at an inappropriate time or with too much or too little energy) or if the input pile model is incorrect, then the solution cannot represent the actual soil behavior.

Generally the CAPWAP analysis is used to estimate the axial compressive pile capacity and the soil resistance distribution. The long-term capacity is best evaluated with restrike tests since they incorporate soil strength changes (set-up gains or relaxation losses) that occur after installation. The calculated load settlement graph does not consider creep or long term consolidation settlements. When uplift is a controlling factor in the design, use of the CAPWAP results to assess uplift capacity should be made only after very careful analysis of only good measurement quality, and further used only with longer pile lengths and with nominally higher safety factors.

CAPWAP is also used to evaluate driving stresses along the length of the pile. However, it should be understood that the analysis is one dimensional and does not take into account bending effects or local contact stresses at the pile toe.

Furthermore, if the user of this software was not able to produce a solution with satisfactory signal “match quality” (MQ), then the associated CAPWAP results may be unreliable. There is no absolute scale for solution acceptability but solutions with MQ above 5 are generally considered less reliable than those with lower MQ values and every effort should be made to improve the analysis, for example, by getting help from other independent experts.

Considering the CAPWAP model limitations, the nature of the input parameters, the complexity of the analysis procedure, and the need for a responsible application of the results to actual construction projects, it is recommended that at least one static load test be performed on sites where little experience exists with dynamic behavior of the soil resistance or when the experience of the analyzing engineer with both program use and result application is limited.

Finally, the CAPWAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors. The CAPWAP results should be reviewed by the Engineer of Record with consideration of applicable geotechnical conditions including, but not limited to, group effects, potential settlement from underlying compressible layers, soil resistances provided from any layers unsuitable for long term support, as well as effective stress changes due to soil surcharges, excavation or change in water table elevation.

The CAPWAP analysis software is one of many means by which the capacity of a deep foundation can be assessed. The engineer performing the analysis is responsible for proper software application and the analysis results. Pile Dynamics accepts no liability whatsoever of any kind for the analysis solution and/or the application of the analysis result.

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 2000.0; along Shaft 1640.0; at Toe 360.0 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
				2000.0			
1	26.7	9.2	15.0	1985.0	15.0	1.62	0.11
2	33.4	15.9	25.0	1960.0	40.0	3.74	0.26
3	40.1	22.6	30.0	1930.0	70.0	4.49	0.32
4	46.8	29.3	25.0	1905.0	95.0	3.74	0.26
5	53.5	36.0	20.0	1885.0	115.0	2.99	0.21
6	60.2	42.7	15.0	1870.0	130.0	2.24	0.16
7	66.8	49.3	15.0	1855.0	145.0	2.24	0.16
8	73.5	56.0	15.0	1840.0	160.0	2.24	0.16
9	80.2	62.7	15.0	1825.0	175.0	2.24	0.16
10	86.9	69.4	25.0	1800.0	200.0	3.74	0.26
11	93.6	76.1	50.0	1750.0	250.0	7.48	0.53
12	100.3	82.8	90.0	1660.0	340.0	13.46	0.95
13	106.9	89.4	250.0	1410.0	590.0	37.40	2.65
14	113.6	96.1	350.0	1060.0	940.0	52.36	3.70
15	120.3	102.8	350.0	710.0	1290.0	52.36	3.70
16	127.0	109.5	350.0	360.0	1640.0	52.36	3.70
Avg. Shaft			102.5			14.98	1.06
Toe			360.0				22.64

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.40	0.23
Quake	(in)	0.17	0.38
Case Damping Factor		1.44	0.18
Damping Type		Viscous	Viscous
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	0	
Soil Plug Weight	(kips)		3.250

CAPWAP match quality = 1.39 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.09 in; Blow Count = 132 b/ft
Computed: Final Set = 0.09 in; Blow Count = 132 b/ft

max. Top Comp. Stress = 6.3 ksi (T= 27.2 ms, max= 1.033 x Top)
max. Comp. Stress = 6.5 ksi (Z= 106.9 ft, T= 34.3 ms)
max. Tens. Stress = -0.41 ksi (Z= 100.3 ft, T= 60.9 ms)
max. Energy (EMX) = 211.6 kip-ft; max. Measured Top Displ. (DMX)= 0.68 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	5722.0	-15.7	6.3	-0.02	211.6	12.4	0.70
2	6.7	5722.8	-26.7	6.3	-0.03	211.5	12.4	0.70
4	13.4	5731.0	-92.4	6.3	-0.10	211.1	12.4	0.69
6	20.1	5763.6	-116.4	6.4	-0.13	210.7	12.3	0.68
8	26.7	5824.5	-113.4	6.4	-0.13	210.1	12.1	0.66
10	33.4	5815.8	-80.0	6.4	-0.09	206.1	12.0	0.65
12	40.1	5743.2	-127.6	6.3	-0.14	199.8	11.8	0.63
14	46.8	5631.2	-201.0	6.2	-0.22	192.6	11.6	0.61
16	53.5	5539.3	-256.3	6.1	-0.28	186.7	11.5	0.60
18	60.2	5473.6	-286.5	6.0	-0.32	181.5	11.4	0.58
20	66.8	5437.0	-304.2	6.0	-0.34	176.6	11.3	0.55
22	73.5	5407.4	-310.9	6.0	-0.34	170.5	11.2	0.52
24	80.2	5404.7	-331.6	6.0	-0.37	163.5	11.0	0.49
26	86.9	5459.8	-348.7	6.0	-0.39	157.4	10.7	0.46
28	93.6	5582.3	-360.8	6.2	-0.40	153.0	10.2	0.44
30	100.3	5797.3	-368.8	6.4	-0.41	146.3	9.3	0.43
32	106.9	5912.4	-361.9	6.5	-0.40	136.0	8.2	0.41
34	113.6	5289.1	-285.5	5.8	-0.32	112.2	7.2	0.40
35	117.0	4074.8	-159.3	4.5	-0.18	82.0	7.1	0.40
36	120.3	3971.5	-159.7	4.4	-0.18	81.9	7.6	0.39
37	123.7	2563.5	-27.1	2.8	-0.03	51.7	8.1	0.39
38	127.0	2287.1	-26.4	2.5	-0.03	19.5	8.4	0.39
Absolute	106.9			6.5			(T =	34.3 ms)
	100.3				-0.41		(T =	60.9 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	6718.7	5785.3	4852.0	3918.7	2985.3					
RX	6718.7	5785.3	4852.0	3918.7	2985.3	2052.0	1194.4	1169.3	1144.1	1118.9
RU	7050.0	6183.0	5315.9	4448.9	3581.8					

RAU = 1039.4 (kips); RA2 = 1817.5 (kips)

Current CAPWAP Ru = 2000.0 (kips); Corresponding J(RP)= 0.00; J(RX) = 1.01

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
12.5	26.97	5670.8	5714.5	5744.9	0.68	0.10	0.09	212.0	6576.3	948

PILE PROFILE AND PILE MODEL

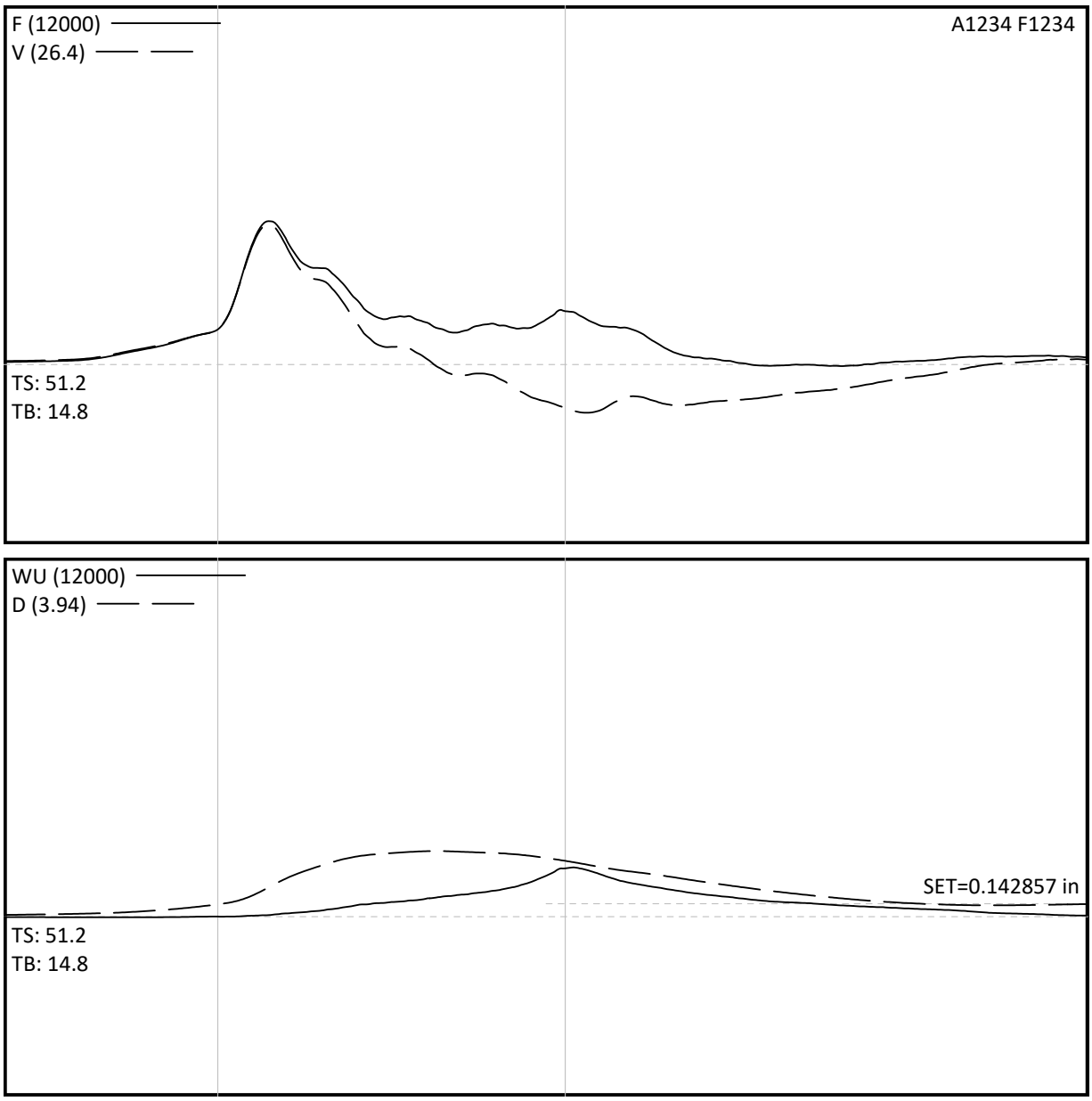
Depth ft	Area ft^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	6.28	7778.3	150.000	14.14
127.0	6.28	7778.3	150.000	14.14

Toe Area 15.90 ft^2

Top Segment Length 3.34 ft, Top Impedance 454 kips/ft/s

Wave Speed: Pile Top 15500.0, Elastic 15500.0, Overall 15487.8 ft/s
Pile Damping 2.00 %, Time Incr 0.216 ms, 2L/c 16.4 ms
Total volume: 797.965 ft^3; Volume ratio considering added impedance: 1.000

I-10 MOBILE RIVER TP-23A 17DAY RS



Project Information

PROJECT: I-10 MOBILE RIVER
PILE NAME: TP-23A 17DAY RS
DESCR: 54'' CYL, 6'' WALL
OPERATOR: AFT
FILE: TP-23A 17DAY RS ana
5/11/2018 7:38:16 AM
Blow Number 2

Pile Properties

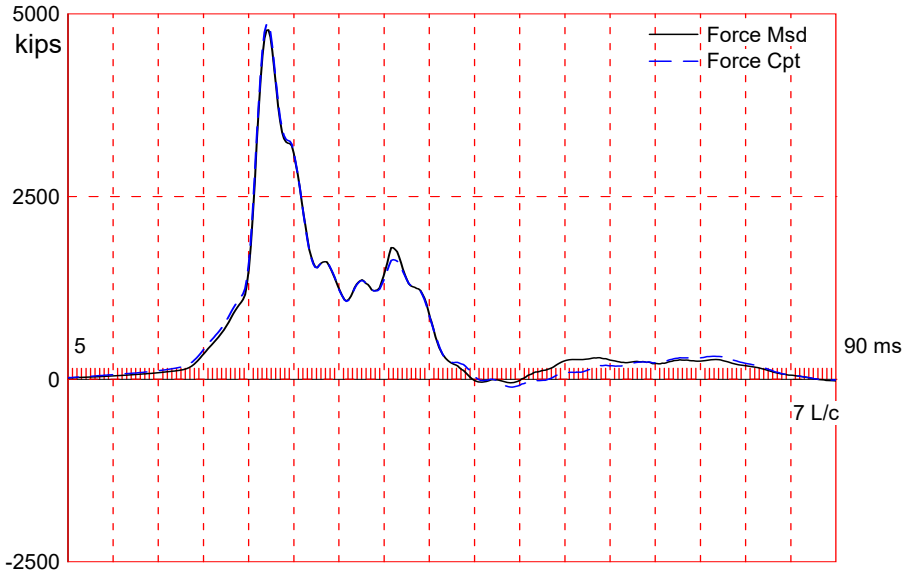
LE	127.00 ft
AR	904.78 in^2
EM	7778.33 ksi
SP	0.150 k/ft3
WS	15500.0 f/s
EA/C	454.0 ksec/ft
2L/C	16.40 ms
JC	1.05 []
LP	134.44 ft

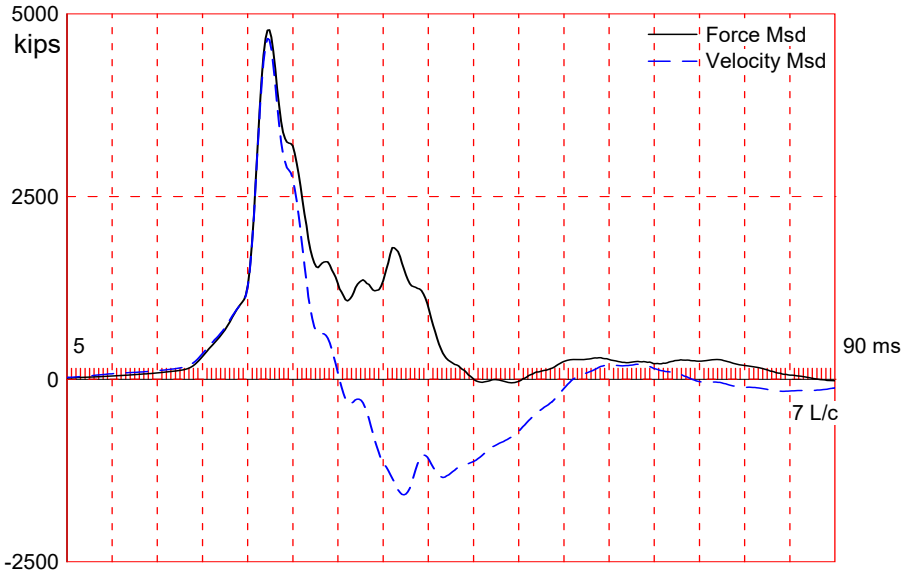
Quantity Results

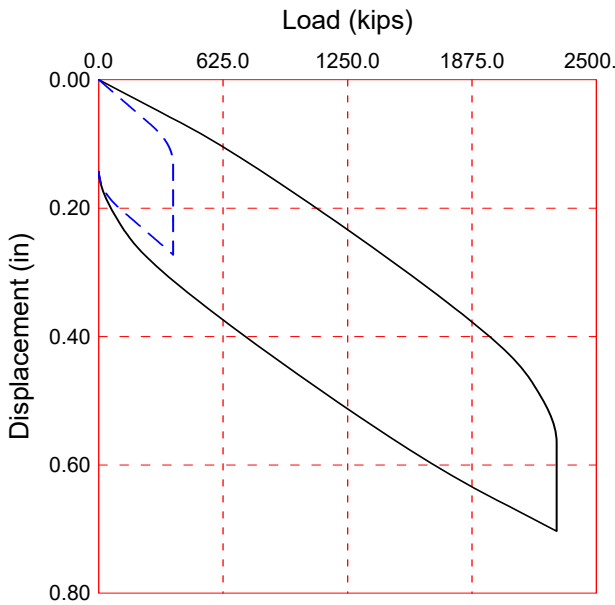
RMX	2312 kips
RX11	2137 kips
RA2	2175 kips
CSX	5.30 ksi
CSB	4.19 ksi
TSX	0.60 ksi
EMX	172.9 k-ft
STK	12.30 ft
BTA	100 (%)

Sensors

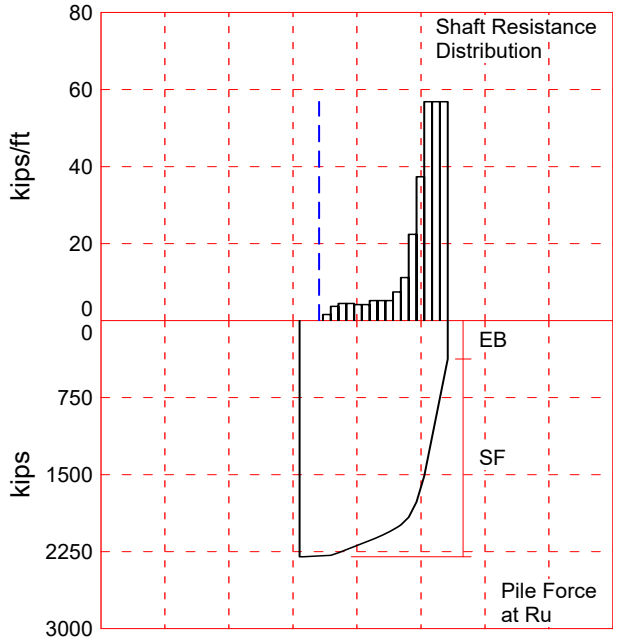
F1: [E655] 92.7 (1)
F2: [J762] 93.9 (1)
F3: [P454] 145.3 (1)
F4: [P455] 145.8 (1)
A1: [59379] 925 g's/v (1)
A2: [59462] 1055 g's/v (1)
A3: [K5647] 334 mv/5000g's (1)
A4: [K5943] 368 mv/5000g's (1)
CLIP: OK







RU =	2300.0 kips
SF =	1926.0 kips
EB =	374.0 kips
Dy =	0.56 in
Dx =	0.70 in
SET/BI =	0.14 in



Length b. Sensors	127.0 ft
Embedment	109.5 ft
Top Area	6.28 ft^2
End Bearing Area	15.90 ft^2
Top Perimeter	14.14 ft
Top E-Modulus	7778 ksi
Top Spec. Weight	150.0 lb/ft^3
Top Wave Spd.	15500 ft/s
Overall W.S.	15488 ft/s
Match Quality	1.99
Top Compr. Stress	5.4 ksi
Max Compr. Stress	5.6 ksi
Max Tension Stress	-0.57 ksi
Avg. Shaft Quake	0.05 in
Toe Quake	0.10 in
Avg. Shaft Smith Dpg.	0.40 s/ft
Toe Smith Damping	0.35 s/ft

About the CAPWAP Results

The CAPWAP program performs a signal matching or reverse analysis based on measurements taken on a deep foundation under an impact load. The program is based on a one-dimensional mathematical model. Under certain conditions, the model only crudely approximates the often complex dynamic situations.

The CAPWAP analysis relies on the input of accurately measured dynamic data plus additional parameters describing pile and soil behavior. If the field measurements of force and velocity are incorrect or were taken under inappropriate conditions (e.g., at an inappropriate time or with too much or too little energy) or if the input pile model is incorrect, then the solution cannot represent the actual soil behavior.

Generally the CAPWAP analysis is used to estimate the axial compressive pile capacity and the soil resistance distribution. The long-term capacity is best evaluated with restrike tests since they incorporate soil strength changes (set-up gains or relaxation losses) that occur after installation. The calculated load settlement graph does not consider creep or long term consolidation settlements. When uplift is a controlling factor in the design, use of the CAPWAP results to assess uplift capacity should be made only after very careful analysis of only good measurement quality, and further used only with longer pile lengths and with nominally higher safety factors.

CAPWAP is also used to evaluate driving stresses along the length of the pile. However, it should be understood that the analysis is one dimensional and does not take into account bending effects or local contact stresses at the pile toe.

Furthermore, if the user of this software was not able to produce a solution with satisfactory signal “match quality” (MQ), then the associated CAPWAP results may be unreliable. There is no absolute scale for solution acceptability but solutions with MQ above 5 are generally considered less reliable than those with lower MQ values and every effort should be made to improve the analysis, for example, by getting help from other independent experts.

Considering the CAPWAP model limitations, the nature of the input parameters, the complexity of the analysis procedure, and the need for a responsible application of the results to actual construction projects, it is recommended that at least one static load test be performed on sites where little experience exists with dynamic behavior of the soil resistance or when the experience of the analyzing engineer with both program use and result application is limited.

Finally, the CAPWAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors. The CAPWAP results should be reviewed by the Engineer of Record with consideration of applicable geotechnical conditions including, but not limited to, group effects, potential settlement from underlying compressible layers, soil resistances provided from any layers unsuitable for long term support, as well as effective stress changes due to soil surcharges, excavation or change in water table elevation.

The CAPWAP analysis software is one of many means by which the capacity of a deep foundation can be assessed. The engineer performing the analysis is responsible for proper software application and the analysis results. Pile Dynamics accepts no liability whatsoever of any kind for the analysis solution and/or the application of the analysis result.

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 2300.0; along Shaft 1926.0; at Toe 374.0 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
				2300.0			
1	26.7	9.2	15.0	2285.0	15.0	1.62	0.11
2	33.4	15.9	25.0	2260.0	40.0	3.74	0.26
3	40.1	22.6	30.0	2230.0	70.0	4.49	0.32
4	46.8	29.3	30.0	2200.0	100.0	4.49	0.32
5	53.5	36.0	28.0	2172.0	128.0	4.19	0.30
6	60.2	42.7	28.0	2144.0	156.0	4.19	0.30
7	66.8	49.3	35.0	2109.0	191.0	5.24	0.37
8	73.5	56.0	35.0	2074.0	226.0	5.24	0.37
9	80.2	62.7	35.0	2039.0	261.0	5.24	0.37
10	86.9	69.4	50.0	1989.0	311.0	7.48	0.53
11	93.6	76.1	75.0	1914.0	386.0	11.22	0.79
12	100.3	82.8	150.0	1764.0	536.0	22.44	1.59
13	106.9	89.4	250.0	1514.0	786.0	37.40	2.65
14	113.6	96.1	380.0	1134.0	1166.0	56.85	4.02
15	120.3	102.8	380.0	754.0	1546.0	56.85	4.02
16	127.0	109.5	380.0	374.0	1926.0	56.85	4.02
Avg. Shaft			120.4			17.59	1.24
Toe			374.0				23.52

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.40	0.35
Quake	(in)	0.05	0.10
Case Damping Factor		1.70	0.29
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	30	98
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	0	
Soil Plug Weight	(kips)		2.500

CAPWAP match quality = 1.99 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.14 in; Blow Count = 84 b/ft
Computed: Final Set = 0.14 in; Blow Count = 84 b/ft

max. Top Comp. Stress = 5.4 ksi (T= 27.4 ms, max= 1.031 x Top)
max. Comp. Stress = 5.6 ksi (Z= 26.7 ft, T= 29.1 ms)
max. Tens. Stress = -0.57 ksi (Z= 86.9 ft, T= 56.1 ms)
max. Energy (EMX) = 173.1 kip-ft; max. Measured Top Displ. (DMX)= 0.72 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	4872.1	-126.5	5.4	-0.14	173.1	10.1	0.69
2	6.7	4882.9	-145.4	5.4	-0.16	172.7	10.0	0.68
4	13.4	4914.3	-192.5	5.4	-0.21	171.6	10.0	0.66
6	20.1	4962.1	-248.5	5.5	-0.27	170.5	9.9	0.65
8	26.7	5024.4	-298.3	5.6	-0.33	169.1	9.7	0.63
10	33.4	5022.7	-318.9	5.6	-0.35	164.9	9.5	0.61
12	40.1	4979.0	-348.0	5.5	-0.38	159.0	9.4	0.58
14	46.8	4918.8	-400.8	5.4	-0.44	152.2	9.2	0.56
16	53.5	4870.9	-441.3	5.4	-0.49	145.7	9.0	0.53
18	60.2	4846.2	-458.0	5.4	-0.51	139.3	8.7	0.51
20	66.8	4829.2	-461.1	5.3	-0.51	132.7	8.5	0.48
22	73.5	4792.6	-477.6	5.3	-0.53	124.7	8.2	0.45
24	80.2	4783.0	-508.1	5.3	-0.56	116.3	7.9	0.41
26	86.9	4828.3	-518.6	5.3	-0.57	108.2	7.5	0.38
28	93.6	4900.2	-501.1	5.4	-0.55	100.7	7.0	0.35
30	100.3	4941.6	-464.2	5.5	-0.51	94.0	6.3	0.33
32	106.9	4786.3	-418.1	5.3	-0.46	84.1	5.5	0.31
34	113.6	4247.5	-342.9	4.7	-0.38	70.0	4.8	0.29
35	117.0	3210.1	-217.3	3.5	-0.24	51.0	4.8	0.29
36	120.3	3187.2	-223.8	3.5	-0.25	51.0	4.9	0.28
37	123.7	2075.2	-137.4	2.3	-0.15	33.0	5.0	0.28
38	127.0	2095.6	-144.8	2.3	-0.16	14.8	4.9	0.27
Absolute	26.7			5.6			(T =	29.1 ms)
	86.9				-0.57		(T =	56.1 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	5971.8	5269.7	4567.5	3865.4	3163.3					
RX	5971.8	5269.7	4567.5	3865.4	3163.3	2461.1	1759.0	1123.7	1028.9	939.3
RU	6589.9	6011.3	5432.8	4854.3	4275.7					

RAU = 910.6 (kips); RA2 = 2178.7 (kips)

Current CAPWAP Ru = 2300.0 (kips); Corresponding J(RP)= 0.00; J(RX) = 1.05

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
10.3	27.19	4683.9	4798.6	4798.6	0.72	0.14	0.14	174.0	4814.4	3740

PILE PROFILE AND PILE MODEL

Depth ft	Area ft^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	6.28	7778.3	150.000	14.14
127.0	6.28	7778.3	150.000	14.14

Toe Area 15.90 ft^2

Top Segment Length 3.34 ft, Top Impedance 454 kips/ft/s

Wave Speed: Pile Top 15500.0, Elastic 15500.0, Overall 15487.8 ft/s
Pile Damping 2.00 %, Time Incr 0.216 ms, 2L/c 16.4 ms
Total volume: 797.965 ft^3; Volume ratio considering added impedance: 1.000

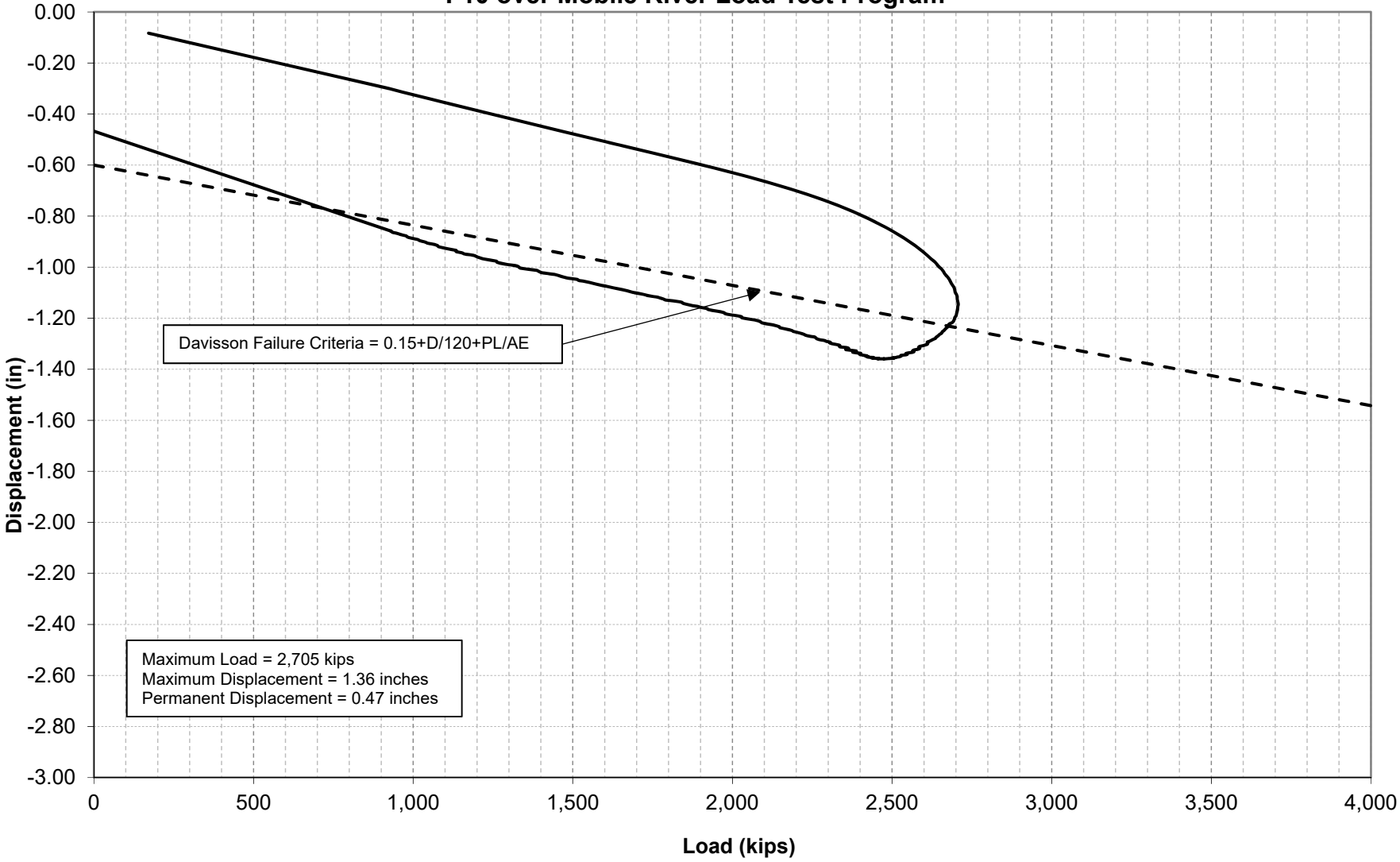
Appendix D

Axial Compressive Statnamic Rapid Load Testing Graphical Results
TP-23A

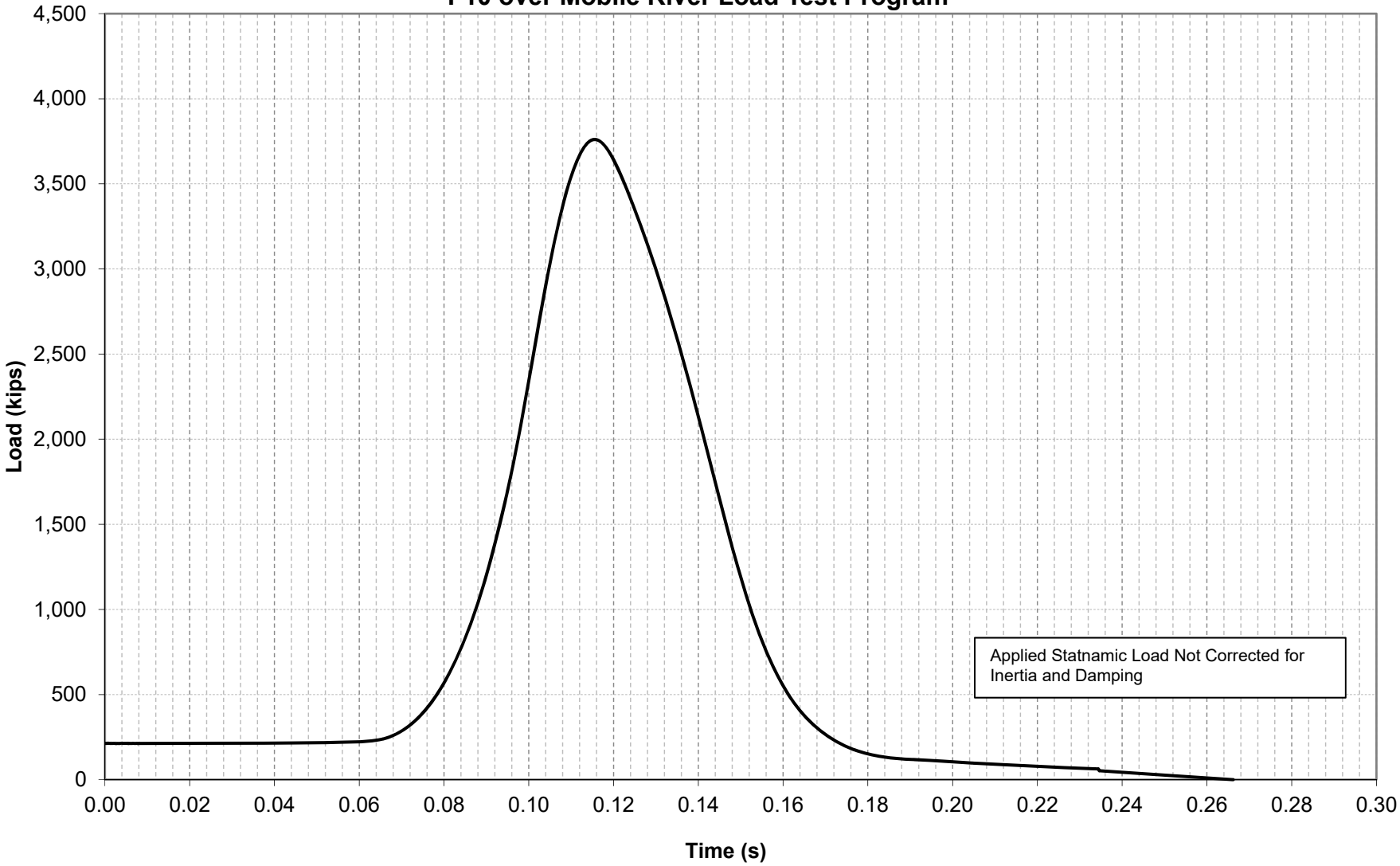
I-10 over Mobile River Bridge Load Test Program

ALDOT Project No.: IM-I010(341)
Mobile County, Alabama
AFT Project No.: 118008

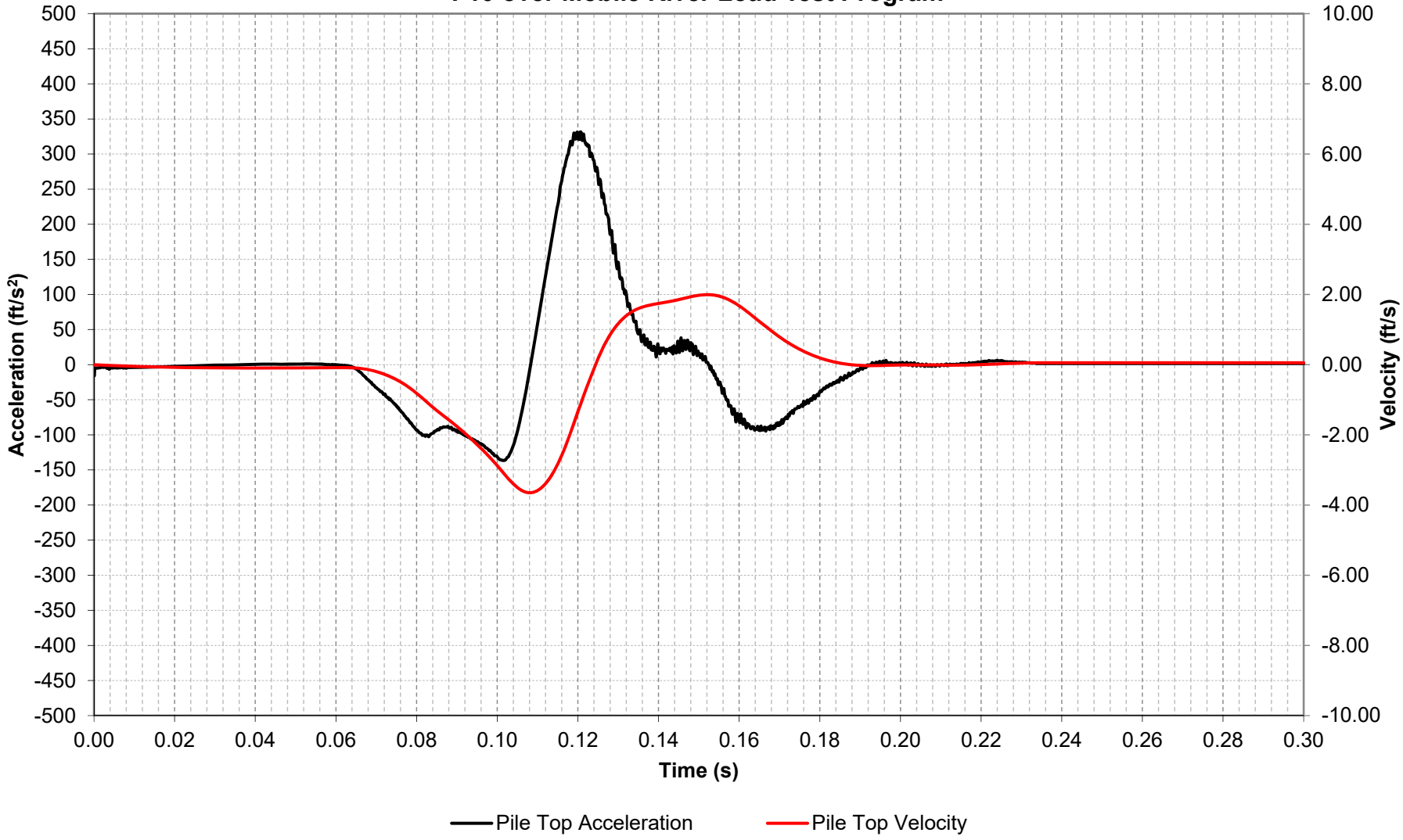
Derivated Static Load vs Displacement Response from Statnamic Load Test
TP-23A
I-10 over Mobile River Load Test Program



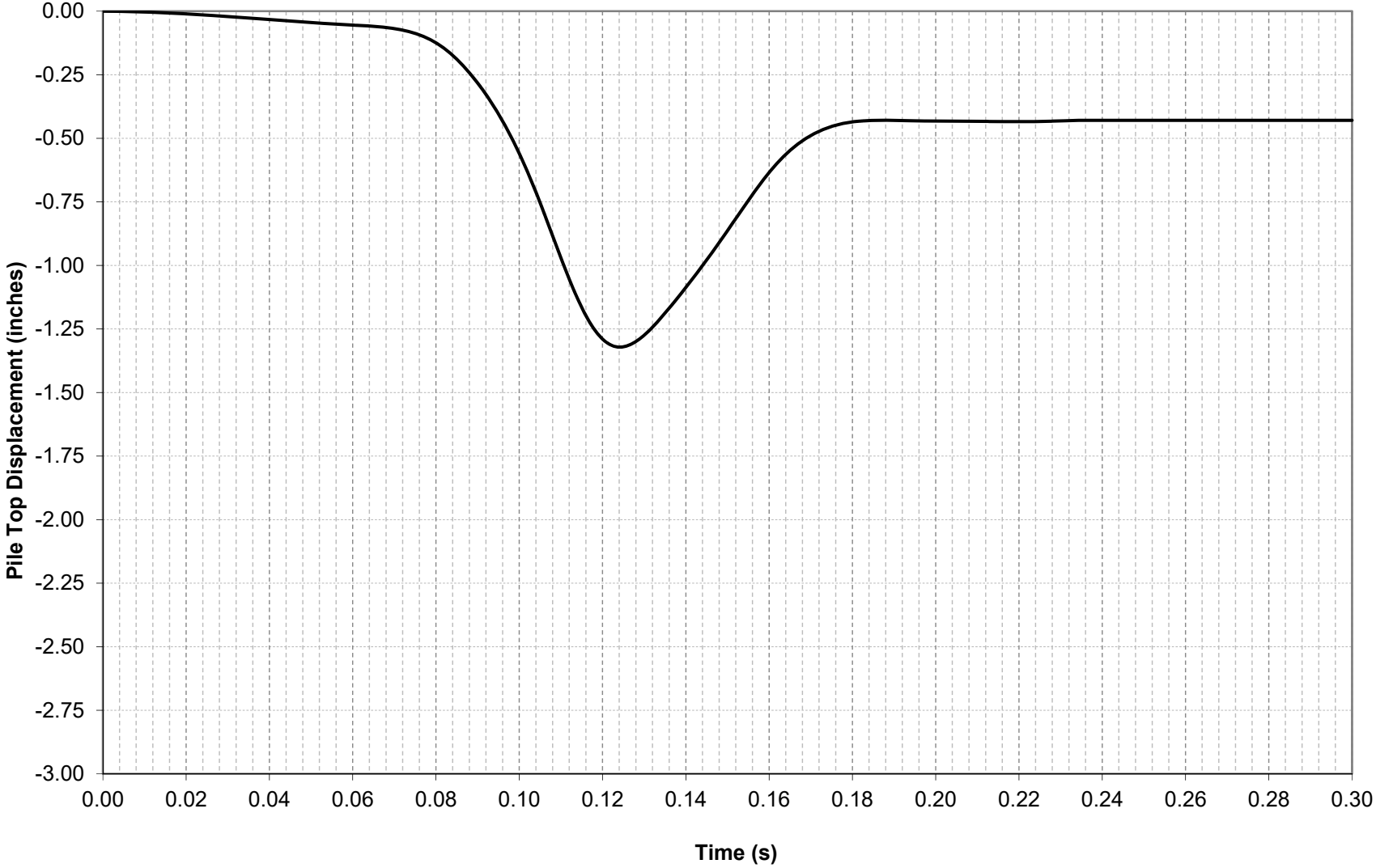
Applied Statnamic Load vs Time from Statnamic Load Test
TP-23A
I-10 over Mobile River Load Test Program



Pile Top Acceleration and Velocity vs Time from Statnamic Load Test
TP-23A
I-10 over Mobile River Load Test Program



Pile Top Displacement vs Time from Statnamic Load Test
TP-23A
I-10 over Mobile River Load Test Program



Appendix E

Relevant Project Documents
TP-23A

I-10 over Mobile River Bridge Load Test Program

ALDOT Project No.: IM-I010(341)
Mobile County, Alabama
AFT Project No.: 118008

REFERENCE PROJECT NO.	FISCAL YEAR	SHEET NO.
IM-1010(341)	2018	2

GENERAL PROJECT NOTES

200 THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS DIRECTLY TO THE MATERIALS AND TESTS ENGINEER OF ALL RAPID LOAD TESTS, SHAFT LOAD TESTS AND STATIC LOAD TESTS FOR APPROVAL.

201 THE CONTRACTOR SHALL PROVIDE REPORTS TO THE MATERIALS AND TESTS ENGINEER OF ALL STATIC LOAD TESTS, RAPID LOAD TESTS AND DYNAMIC TESTS, PREPARED BY SPECIALTY ENGINEERING FIRMS.

202 THE CONTRACTOR SHALL SUBMIT AN INSTALLATION PLAN FOR REVIEW AND APPROVAL FOR ALL TEST PILES IN THIS PROJECT.

301 LOCATION TP-10:

ALL FOUR TEST PILES SHALL BE IMPACT DRIVEN WITH PDA MONITORING TO PLANNED TIP ELEVATION OR TO REFUSAL, WHICHEVER COMES FIRST (NO JETTING).
CONTRACTOR SHALL PLAN TO RESTRIKE MEASUREMENT ON EACH PILE FOR DYNAMIC LOAD TESTING AND SIGNAL MATCHING ANALYSIS AT APPROXIMATELY 1 DAY AFTER INITIAL DRIVE.
CONTRACTOR SHALL PLAN FOR RESTRIKE MEASUREMENT ON PILES TP-10A-1 AND TP-10B-1 FOR DYNAMIC LOAD TESTING AND SIGNAL MATCHING ANALYSIS AT APPROXIMATELY 7 DAYS AFTER INITIAL DRIVE.
CONTRACTOR SHALL PERFORM STATIC LOAD TEST ON PILES TP-10A-2 AND TP-10B-2 IN ACCORDANCE WITH APPLICABLE SPECIAL PROVISIONS
CONTRACTOR SHALL PLAN FOR RESTRIKE MEASUREMENT ON PILES TP-10A-2 AND TP-10B-2 FOR DYNAMIC LOAD TESTING AND SIGNAL MATCHING ANALYSIS WITHIN 7 DAYS AFTER STATIC LOAD TEST.

302 LOCATION TP-WPA STEEL PIPE PILE:

PILE MAY BE INSTALLED WITH ONE SPLICE, AND FINAL PIECE SHALL NOT BE LESS THAN 75 FT IN LENGTH.

VIBRATORY HAMMER MAY BE USED TO INSTALL FIRST PIECE, AFTER SPLICING THE PILE SHALL BE DRIVEN TO THE TARGET TIP ELEVATION USING IMPACT HAMMER.

CONTRACTOR TO PROVIDE HAMMER SUFFICIENT TO DRIVE PILE TO TIP WITH WAVE EQUATION ANALYSIS PER ALDOT SPECS, WITH TARGETED DRIVING RESISTANCE AT END OF INITIAL DRIVE NOT MORE THAN 10 BLOWS PER INCH.

DYNAMIC MONITORING OF PILE USING PDA DURING INSTALLATION AFTER SPLICE, WITH SIGNAL MATCHING ANALYSIS ON SELECTED BLOWS NEAR END OF INITIAL DRIVE.

RAPID LOAD TEST OF PILE USING 19MN RAPID LOAD TEST DEVICE BETWEEN 10 AND 21 DAYS AFTER INITIAL DRIVE.

RESTRIKE BLOWS FOR DYNAMIC LOAD TESTING AND SIGNAL MATCHING ANALYSIS WITHIN ONE WEEK AFTER COMPLETION OF RAPID LOAD TEST (RLT).

303 LOCATION TP-WPB DRILLED SHAFT:

CONTRACTOR TO PERFORM LATERAL RAPID LOAD TESTS USING RAPD LOAD TEST DEVICE AFTER COMPLETION OF AXIAL LOAD TEST(S); LATERAL RLT SHALL BE CAPABLE TO APPLY A LATERAL FORCE OF AT LEAST 1000 KIPS. LATERAL RLT SHALL BE PERFORMED IN FOUR PROGRESSIVELY LARGER INCREMENTS UP TO MAXIMUM FORCE.

LATERAL RLT SHALL INCLUDE MEASUREMENTS OF FORCE AND TOP OF SHAFT DISPLACEMENT AND OF DISPLACEMENT AT NOT LESS THAN 6 ELEVATIONS BELOW TOP OF SHAFT.

TEST SHAFT SHALL BE CONSTRUCTED USING POLYMER BASED DRILLING FLUIDS, WITH ON-SITE SUPPORT FROM FLUID SUPPLIER.

304 LOCATION TP-04:

JETTING OF TP-04 ALLOWED (BUT NOT REQUIRED) TO ELEVATION -70FT
PILE SHALL BE IMPACT DRIVEN WITH PDA MONITORING TO TIP ELEVATION -110FT OR TO REFUSAL, WHICHEVER COMES FIRST
CONTRACTOR SHALL PLAN FOR UP TO TWO RESTRIKE MEASUREMENTS ON THIS PILE AT APPROXIMATELY 1 DAY AND 14 DAYS AFTER INITIAL DRIVE FOR DYNAMIC LOAD TESTING AND SIGNAL MATCHING ANALYSIS.

305 LOCATION TP-23:

JETTING OF TP-23A SHOULD BE PERFORMED TO ELEVATION -100FT
JETTING OF TP-23B AND TP-23C ALLOWED (BUT NOT REQUIRED) TO ELEVATION -70FT
PILE SHALL BE IMPACT DRIVEN WITH PDA MONITORING TO PLANNED TIP ELEVATION OR TO REFUSAL, WHICHEVER COMES FIRST. PLANNED TIP ELEVATION:
TP-23A: -130
TP-23B: -100
TP-23C: -100
CONTRACTOR SHALL PLAN FOR RESTRIKE MEASUREMENT ON EACH PILE FOR DYNAMIC LOAD TESTING AND SIGNAL MATCHING ANALYSIS AT ONE DAY AFTER INITIAL DRIVE AND WITHIN ONE WEEK AFTER COMPLETION OF RAPID LOAD TEST (RLT).
RAPID LOAD TEST OF EACH PILE USING 19MN RAPID LOAD TEST DEVICE NOT SOONER THAN 2 WEEKS AFTER INITIAL DRIVE.

306 LOCATION TP-111:

FOR TP-111A, JETTING IS ALLOWED (BUT NOT REQUIRED) TO ELEVATION -60FT
FOR TP-111B, JETTING SHALL BE PERFORMED TO ELEVATION -90FT
BOTH PILES SHALL BE IMPACT DRIVEN WITH PDA MONITORING TO TIP ELEVATION -120FT OR TO REFUSAL, WHICHEVER COMES FIRST
CONTRACTOR SHALL PLAN FOR UP TO TWO RESTRIKE MEASUREMENTS ON THESE PILES AT APPROXIMATELY 1 DAY AND 14 DAYS AFTER INITIAL DRIVE FOR DYNAMIC LOAD TESTING AND SIGNAL MATCHING ANALYSIS.

307 TEST PILES TP-WPA AND TP-WPB SHALL BE PLACED WITHIN THE LIMITS AN EXPLORATION TRENCH. IF REQUIRED SPACING IS NOT ADEQUATE IN ONE TRENCH, ONE OF THE PILES MAY BE PLACED IN AN ADJACENT EXPLORATION TRENCH.

308 THE CONTRACTOR SHALL CONTACT BILL TURNER (334-242-6144) WITH THE ENVIRONMENTAL TECHNICAL SECTION OF THE ALABAMA DEPARTMENT OF TRANSPORTATION NO LATER THAN TWO (2) WEEKS PRIOR TO STARTING WORK IN ORDER TO MAKE SURE THE EXPLORATION TRENCHES ARE MARKED AND VISIBLE.

800 IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO CONTACT THE VARIOUS UTILITY OWNERS AND DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES ON THIS PROJECT WHETHER SHOWN ON THE PLANS OR NOT. THE LOCATION OF ANY REQUIRED GUARDRAIL, SIGNS, FOOTINGS OF ANY NATURE AND/OR ELECTRICAL/COMMUNICATIONS CONDUITS MAY BE ADJUSTED AS DIRECTED BY THE ENGINEER TO PREVENT ANY CONFLICTS WITH THESE UTILITIES. UTILITY LINE LOCATE REQUESTS WILL BE LIMITED TO INCREMENTS NOT TO EXCEED 2000 LINEAR FEET PER WORKING DAY OPERATIONS. MULTIPLE REQUESTS WILL BE REQUIRED FOR PROJECTS GREATER THAN 2000 LINEAR FEET IN LENGTH.

900 NPDES PERMIT COVERAGE NOT REQUIRED FOR THIS PROJECT.

901 THERE SHALL BE NO FUEL TANKS STORED ON THE RIGHT OF WAY. IN ADDITION, FUEL TRUCKS OR VEHICLES TRANSPORTING CHEMICALS, FERTILIZER, ETC., NOT SHALL BE LEFT UNATTENDED ON THE RIGHT OF WAY.

902 THE CONTRACTOR SHALL FOLLOW ALL REQUIREMENTS CONTAINED WITHIN THE ARMY CORPS OF ENGINEERS PERMIT AND ANY REQUIREMENTS FROM U.S. FISH AND WILDLIFE SERVICE.

903 THE CONTRACTOR SHALL FOLLOW THE ALDOT STANDARD MANTEE CONSTRUCTION CONDITIONS LISTED BELOW:

A. THE LEAD PROJECT PROPONENT/CONTRACTOR SHALL INSTRUCT ALL PERSONNEL ASSOCIATED WITH THE PROJECT OF THE POTENTIAL PRESENCE OF MANATEES AND THE NEED TO AVOID COLLISIONS WITH MANATEES. ALL CONSTRUCTION PERSONNEL ARE RESPONSIBLE FOR OBSERVING WATER-RELATED ACTIVITIES FOR THE PRESENCE OF MANATEES. THE U.S. FISH AND WILDLIFE SERVICE WOULD RECOMMEND HIRING AN INDIVIDUAL FAMILIAR WITH THIS SPECIES TO ACT AS A SPOTTER FOR MANATEES DURING IN-WATER ACTIVITIES.

B. THE LEAD PROJECT PROPONENT/CONTRACTOR SHALL ADVISE ALL CONSTRUCTION PERSONNEL THAT THERE ARE CIVIL AND CRIMINAL PENALTIES FOR HARMING, HARASSING, OR KILLING MANATEES WHICH ARE PROTECTED UNDER THE MARINE MAMMAL PROTECTION ACT OF 1972 AND THE ENDANGERED SPECIES ACT OF 1973.

C. SILTATION BARRIERS SHALL BE MADE OF MATERIAL IN WHICH MANATEES CANNOT BECOME ENTANGLED, ARE PROPERLY SECURED, AND ARE REGULARLY MONITORED TO AVOID MANATEE ENTRAPMENT. BARRIERS MUST NOT BLOCK MANATEE ENTRY TO, OR EXIT FROM, ESSENTIAL HABITAT.

D. ALL VESSELS ASSOCIATED WITH THE CONSTRUCTION PROJECT SHALL OPERATE AT "NO WAKE/IDLE" SPEEDS AT ALL TIMES WHILE IN THE CONSTRUCTION AREA AND WHILE IN WATER WHERE THE DRAFT OF THE VESSEL PROVIDES LESS THAN A FOUR-FOOT CLEARANCE FROM THE BOTTOM. ALL VESSELS WILL FOLLOW ROUTES OF DEEP WATER WHENEVER POSSIBLE.

E. IF MANATEES ARE SEEN WITHIN 100 YARDS OF THE ACTIVE DAILY CONSTRUCTION/DREDGING OPERATION OR VESSEL MOVEMENT, ALL APPROPRIATE PRECAUTIONS SHALL BE IMPLEMENTED TO ENSURE THEIR PROTECTION. THESE PRECAUTIONS SHALL INCLUDE THE OPERATION OF ALL MOVING EQUIPMENT NO CLOSER THAN 50 FEET OF A MANATEE. OPERATION OF ANY EQUIPMENT CLOSER THAN 50 FEET TO A MANATEE SHALL NECESSITATE IMMEDIATE SHUTDOWN OF THAT EQUIPMENT. ACTIVITIES WILL NOT RESUME UNTIL THE MANATEE(S) HAS DEPARTED THE PROJECT AREA OF ITS OWN VOLITION.

F. ANY COLLISION WITH AND/OR INJURY TO A MANATEE SHALL BE REPORTED IMMEDIATELY TO THE U.S. FISH AND WILDLIFE SERVICE IN DAPHNE (251-441-5181).

G. TEMPORARY SIGNS CONCERNING THE MANATEES SHALL BE POSTED PRIOR TO AND DURING ALL CONSTRUCTION/DREDGING ACTIVITIES. ALL SIGNS ARE TO BE REMOVED BY THE LEAD PROJECT PROPONENT/CONTRACTOR UPON COMPLETION OF THE PROJECT. A SIGN MEASURING AT LEAST 3 FT. BY 4 FT. WHICH READS CAUTION: MANATEE AREA WILL BE POSTED IN A LOCATION PROMINENTLY VISIBLE TO WATER RELATED CONSTRUCTION CREWS. A SECOND SIGN SHOULD BE POSTED IF VESSELS ARE ASSOCIATED WITH THE CONSTRUCTION, AND SHOULD BE PLACED VISIBLE TO THE VESSEL OPERATOR. THE SECOND SIGN SHOULD BE AT LEAST 8" BY 11" WHICH READS CAUTION: MANATEE HABITAT. IDLE SPEED IS REQUIRED IF OPERATING A VESSEL IN THE CONSTRUCTION AREA. ALL EQUIPMENT MUST BE SHUTDOWN IF A MANATEE COMES WITHIN 50 FEET OF OPERATION. ANY COLLISION WITH AND/OR INJURY TO A MANATEE SHALL BE REPORTED IMMEDIATELY TO THE U.S. FISH AND WILDLIFE SERVICE IN DAPHNE (251-441-5181).

904-914 OMIT

915 BASIN BOOM SHALL BE REUSED AS NECESSARY AT EACH LOCATION (WATER).

CURRENT ALABAMA DEPARTMENT OF TRANSPORTATION

REVISIONS

ALABAMA DEPARTMENT OF TRANSPORTATION
1409 COLISEUM BOULEVARD
MONTGOMERY, AL 36130-3050

GENERAL PROJECT NOTES

DRAWN BY: _____
DATE DRAWN: _____

SPECIAL DRAWING NO.

INDEX NO.

PILE TIP ELEVATIONS

REFERENCE PROJECT NO	FISCAL YEAR	SHEET NO
IM-I010(341)	2018	2A

PILE TIP ELEVATIONS AND TARGETED NOMINAL RESISTANCE

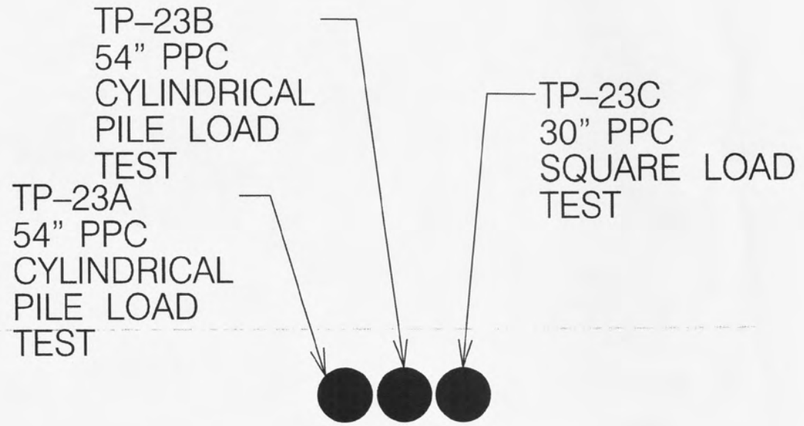
TEST PILE	PILE TYPE	STATION	SIDE	OFFSET	PILE LENGTH (FT)	TARGETED NOMINAL RESISTANCE (kips)	ESTIMATED TIP ELEVATION (FT)	MINIMUM TIP ELEVATION (FT)
TP-10A-1	HP 14X89	STATION 469+20.00	RT	110	82	300	-65	
TP-10A-2	HP 14X89	STATION 469+20.00	RT	111	82	300	-65	
TP-10B-1	18" PPC SQUARE	STATION 469+60.00	RT	110	77	650	-60	
TP-10B-2	18" PPC SQUARE	STATION 469+60.00	RT	110	77	650	-60	
TP-WPA	60" STEEL PIPE	STATION 513+33.00	LT	100	175	3100	-170	
TP-WPB	72" DRILLED SHAFT	STATION 513+53.00	LT	100	177	N/A	-170	
TP-04	54" PPC CYLINDRICAL	STATION 574+00.00	LT	150	120	3100	-110	-80
TP-23A	54" PPC CYLINDRICAL	STATION 629+57.00	LT	150	140	3100	-130	
TP-23B	54" PPC CYLINDRICAL	STATION 630+00.00	LT	150	110	3100	-100	
TP-23C	30" PPC SQUARE	STATION 630+43.00	LT	150	110	1500	-100	
TP-111A	54" PPC CYLINDRICAL	STATION 897+50.00	RT	150	130	3100	-120	
TP-111B	54" PPC CYLINDRICAL	STATION 898+00.00	RT	150	130	3100	-120	

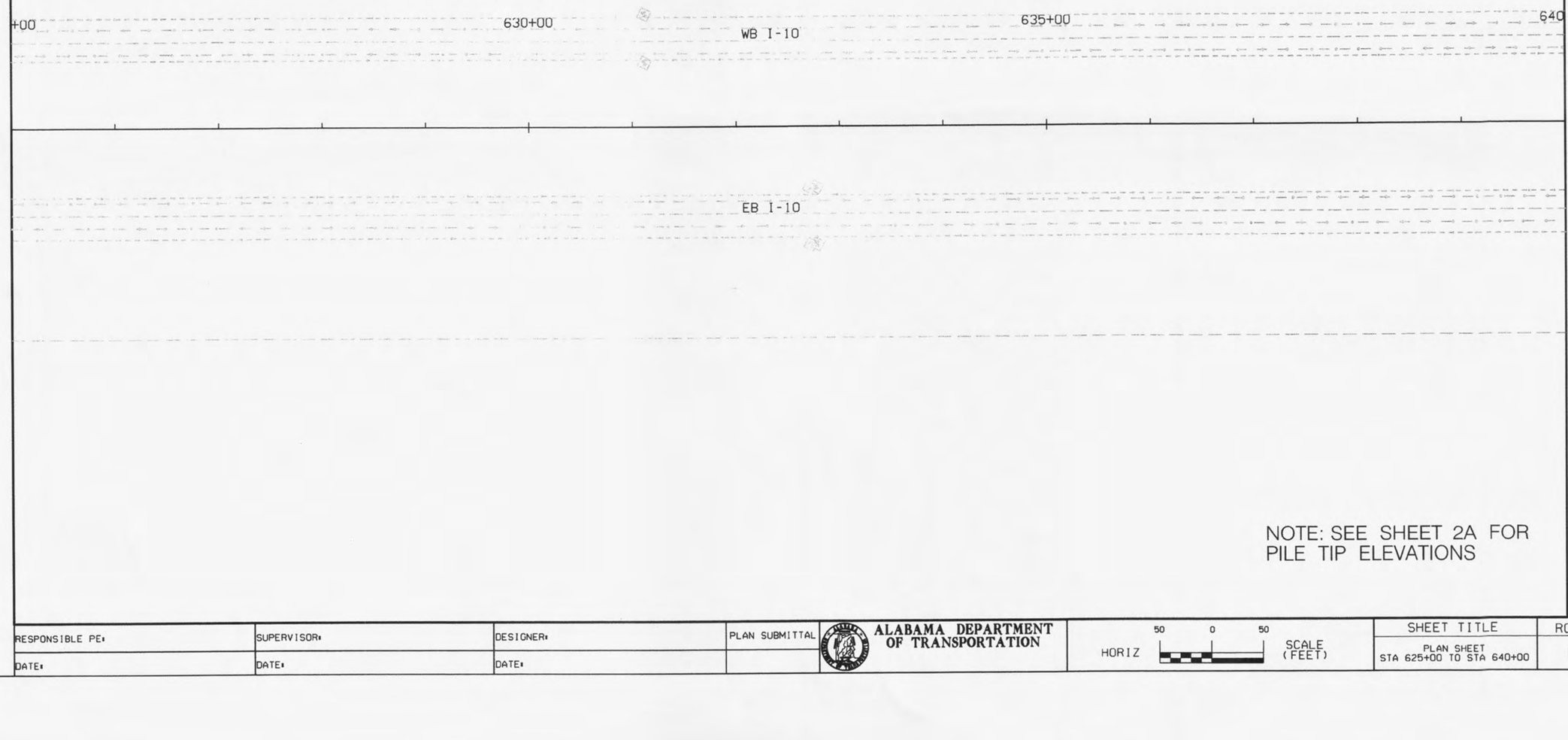
RESPONSIBLE PE:	SUPERVISOR:	DESIGNER:	PLAN SUBMITTAL	ALABAMA DEPARTMENT OF TRANSPORTATION		SHEET TITLE	ROUTE
DATE:	DATE:	DATE:				PILE TIP ELEVATIONS	I-10

PLAN SHEET

REFERENCE PROJECT NO	FISCAL YEAR	SHEET NO
IM-I010(341)	2018	7

PROJECT NOTES
200, 201, 202
304





NOTE: SEE SHEET 2A FOR
PILE TIP ELEVATIONS

RESPONSIBLE PE:	SUPERVISOR:	DESIGNER:	PLAN SUBMITTAL
DATE:	DATE:	DATE:	

ALABAMA DEPARTMENT OF TRANSPORTATION

HORIZ 50 0 50 SCALE (FEET)

SHEET TITLE	ROUTE
PLAN SHEET STA 625+00 TO STA 640+00	I-10

REFERENCE PROJECT NUMBER	FISCAL YEAR	SHEET NUMBER
IM-I010(341)	2018	24

RECORD OF TEST BORING

thompson ENGINEERING

Site Description:	I-10 Mobile River Bridge and Bayway					**County:**	Mobile
Boring No.:	BW-23	**Boring Location:**	632+20.32	**Offset:**	15.51 LT	**Alignment:**	I-10 Bayway
ALDOT PE No.:	DPI-0030(005)	**TE Project No.:**	15-1101-0228			**Eng./Geo.:**	Chris LaFroscia
Elev.:	-4.0 ft.	**Northing:**	249770.929	**Easting:**	1810248.834	**Date Started:**	11/18/2016
Total Depth:	180.0 ft.	**Soil Depth:**	180.0 ft.	**Core Depth:**	0.0 ft.	**Date Completed:**	11/28/2016
Bore Hole Diameter (in):	4-inch	**AASHTO / ASTM Sampling Methods:**	AASHTO T206 & T207				
Drill Machine:	CME 550X	**Drill Method:**	MR	**Hammer Type:**	Automatic	**Energy Ratio:**	88%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	**TOB** 0.0 ft.	**24 HR**	0.0 ft.

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE (blows/foot) PL MC LL; FINES CONTENT (%) 10 20 30 40 50 60 70 80 90
	-5.0	Very loose, wet, brown, fine grained, SILTY SAND (SM)		0.0	SS-1	0	0	0	0	
		Very loose, wet, brown, fine grained, SILTY SAND (SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=28.8 %#200=14.3		1.5	SS-2	0	0	0	0	
		Very loose, No Recovery		3.0	SS-3	0	0	0	0	
5.0		Very loose		4.5	SS-4	0	0	0	0	
	-10.0	Very loose		6.0	SS-5	0	0	0	0	
10.0		Very loose, wet, brown and black, fine grained, SILTY SAND (SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=51.4 %#200=29.8		8.5	SS-6	0	0	0	0	
	-15.0									
15.0		Very loose, wet, brown, fine grained, POORLY GRADED SAND (SP)		13.5	SS-7	0	0	0	0	
	-20.0									
20.0		Undisturbed sample obtained from 18.5 to 20.5 feet. Approximately 24 inches of recovery. Wet, dark gray, with trace organics and shells, SANDY FAT CLAY (CH)		18.5	ST-1					
	-25.0									
25.0		Very soft, wet, brown, SANDY FAT CLAY (CH, A-7-6(28)), LL=67 PL=14 PI=53 NMC=41.4 %#200=60.3		23.5	SS-8	0	0	0	0	
	-30.0									
30.0		Undisturbed sample obtained from 28.5 to 30.5 feet. Approximately 21 inches of recovery.		28.5	ST-2					

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	AC - Auger Cuttings	HSA - Hollow Stem Augers	MR - Mud Rotary Wash
ST - Shelby Tube	GB - Grab Bag	SSA - Solid Stem Augers	RC - Rock Coring
DCP - Dynamic Cone Penetrometer	NQ - Rock Core	HA - Hand Auger	

RECORD OF TEST BORING

thompson ENGINEERING

Site Description:	I-10 Mobile River Bridge and Bayway					**County:**	Mobile
Boring No.:	BW-23	**Boring Location:**	632+20.32	**Offset:**	15.51 LT	**Alignment:**	I-10 Bayway
ALDOT PE No.:	DPI-0030(005)	**TE Project No.:**	15-1101-0228			**Eng./Geo.:**	Chris LaFroscia
Elev.:	-4.0 ft.	**Northing:**	249770.929	**Easting:**	1810248.834	**Date Started:**	11/18/2016
Total Depth:	180.0 ft.	**Soil Depth:**	180.0 ft.	**Core Depth:**	0.0 ft.	**Date Completed:**	11/28/2016
Bore Hole Diameter (in):	4-inch	**AASHTO / ASTM Sampling Methods:**	AASHTO T206 & T207				
Drill Machine:	CME 550X	**Drill Method:**	MR	**Hammer Type:**	Automatic	**Energy Ratio:**	88%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	**TOB** 0.0 ft.	**24 HR**	0.0 ft.

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE (blows/foot) PL MC LL; FINES CONTENT (%) 10 20 30 40 50 60 70 80 90
30.0	-35.0	Dark gray, with shells								
		Very loose, wet, brown, fine grained, SILTY SAND (SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=28.4 %#200=31.3		33.5	SS-9	0	0	0	0	
35.0	-40.0									
40.0		Very loose, wet, brown, fine grained, with trace organics and gravel, CLAYEY SAND (SC, A-6(4)), LL=40 PL=17 PI=23 NMC=34.1 %#200=37.8		38.5	SS-10	0	0	3	3	
	-45.0									
45.0		Very soft, wet, brown, with trace sand, FAT CLAY (CH)		43.5	SS-11	0	0	0	0	
	-50.0									
50.0		Undisturbed sample obtained from 48.5 to 50.5 feet. Approximately 24 inches of recovery. Wet, gray, fine grained, with trace organics and trace clay, POORLY GRADED SAND (SP, A-3(0)), LL=NP PL=NP PI=NP NMC=25.7 %#200=2.0		48.5	ST-3					
	-55.0									
55.0		Soft, wet, brown, SANDY LEAN CLAY (CL, A-6(11)), LL=34 PL=14 PI=19 NMC=30.9 %#200=67.4		53.5	SS-12	0	0	3	3	
	-60.0									
60.0		Medium dense, wet, brown, fine to medium grained, SILTY SAND (SM, A-2-4(0)), LL=NP PL=NP PI=NP		58.5	SS-13	8	6	5	11	

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	AC - Auger Cuttings	HSA - Hollow Stem Augers	MR - Mud Rotary Wash
ST - Shelby Tube	GB - Grab Bag	SSA - Solid Stem Augers	RC - Rock Coring
DCP - Dynamic Cone Penetrometer	NQ - Rock Core	HA - Hand Auger	

RECORD OF TEST BORING

thompson ENGINEERING

Site Description:	I-10 Mobile River Bridge and Bayway					**County:**	Mobile
Boring No.:	BW-23	**Boring Location:**	632+20.32	**Offset:**	15.51 LT	**Alignment:**	I-10 Bayway
ALDOT PE No.:	DPI-0030(005)	**TE Project No.:**	15-1101-0228			**Eng./Geo.:**	Chris LaFroscia
Elev.:	-4.0 ft.	**Northing:**	249770.929	**Easting:**	1810248.834	**Date Started:**	11/18/2016
Total Depth:	180.0 ft.	**Soil Depth:**	180.0 ft.	**Core Depth:**	0.0 ft.	**Date Completed:**	11/28/2016
Bore Hole Diameter (in):	4-inch	**AASHTO / ASTM Sampling Methods:**	AASHTO T206 & T207				
Drill Machine:	CME 550X	**Drill Method:**	MR	**Hammer Type:**	Automatic	**Energy Ratio:**	88%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	**TOB** 0.0 ft.	**24 HR**	0.0 ft.

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE (blows/foot) PL MC LL; FINES CONTENT (%) 10 20 30 40 50 60 70 80 90
60.0	-65.0	NMC=31.1 %#200=23.0								
		Medium dense		63.5	SS-14	7	11	13	24	
65.0	-70.0									
70.0		Medium dense		68.5	SS-15	6	9	9	18	
	-75.0									
75.0		Medium dense		73.5	SS-16	9	9	11	20	
	-80.0									
80.0		Medium dense, wet, brown, fine to medium grained, with trace gravel, POORLY GRADED SAND with SILT (SP-SM, A-3(0)), LL=NP PL=NP PI=NP NMC=21.3 %#200=9.7		78.5	SS-17	14	15	10	25	
	-85.0									
85.0		Medium dense		83.5	SS-18	11	12	12	24	
	-90.0									
90.0		Dense, fine to coarse grained, with trace gravel		88.5	SS-19	20	22	21	43	

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	AC - Auger Cuttings	HSA - Hollow Stem Augers	MR - Mud Rotary Wash
ST - Shelby Tube	GB - Grab Bag	SSA - Solid Stem Augers	RC - Rock Coring
DCP - Dynamic Cone Penetrometer	NQ - Rock Core	HA - Hand Auger	

STRATA SYMBOLS

- SAND (SP)
- SILT (MH)
- FAT CLAY (CH)
- SILTY SAND (SM)
- POORLY GRADED SAND with SILT (SP-SM)
- ORGANIC SOILS (OL)
- Paving
- GRAVEL (GP)
- SANDY SILT (ML)
- LEAN CLAY (CL)
- TOPSOIL
- CLAYEY SAND (SC)
- CLAYEY SILTY SAND (SC-SM)
- WELL GRADED SAND with SILT and GRAVEL (SW-SM)
- SANDSTONE
- DOLOMITE
- CLAYEY GRAVEL (GC)
- POORLY GRADED GRAVEL with SILT and SAND (GP-GM)
- SILTY CLAY (CL-ML)
- Ground Water, ATD
- 24 Hr./Delayed Ground Water
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- MR - Mud Rotary

NO - Not Obtained

NE - Not Encountered

REC Recovery

RQD Rock Quality Designation

pp - Pocket Penetrometer

SS - Split Spoon

ST - Shelby Tube

DCP - Dynamic Cone Penetrometer

AC - Auger Cuttings

GB - Grab Bag

NQ - Rock Core

Alabama Department of Transportation

Bridge Sheet of

thompson ENGINEERING
2970 COTTAGE HILL RD.
MOBILE, AL 36606

APPROVED : SAM STERNBERG III, P.E.

GEOTECHNICAL ENGINEER

DATE :

PROJECT NO. 17-1101-0145
I-10 MOBILE RIVER BRIDGE
LOAD TEST PROGRAM
MOBILE COUNTY, ALABAMA

Preliminary Project No:

TEST BORING RECORD
Sheet 9 of 12

REFERENCE PROJECT NUMBER	FISCAL YEAR	SHEET NUMBER
IM-I010(341)	2018	25

RECORD OF TEST BORING

thompson ENGINEERING

Site Description:	I-10 Mobile River Bridge and Bayway					**County:**	Mobile
Boring No.:	BW-23	**Boring Location:**	632+20.32	**Offset:**	15.51 LT	**Alignment:**	I-10 Bayway
ALDOT PE No.:	DPI-0030(005)	**TE Project No.:**	15-1101-0228			**Eng./Geo.:**	Chris LaFroscia
Elev.:	-4.0 ft.	**Northing:**	249770.929	**Easting:**	1810248.834	**Date Started:**	11/18/2016
Total Depth:	180.0 ft.	**Soil Depth:**	180.0 ft.	**Core Depth:**	0.0 ft.	**Date Completed:**	11/28/2016
Bore Hole Diameter (in):	4-inch	**AASHTO / ASTM Sampling Methods:**	AASHTO T206 & T207				
Drill Machine:	CME 550X	**Drill Method:**	MR	**Hammer Type:**	Automatic	**Energy Ratio:**	88%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	**TOB** 0.0 ft.	**24 HR**	0.0 ft.

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE (blows/foot) PL MC LL; ▲ FINES CONTENT (%) ▲ 10 20 30 40 50 60 70 80 90
90.0										
	-95.0	Very dense		93.5	SS-20	19	25	29	54	
95.0										
	-100.0	Very dense, wet, brown, medium to fine grained, POORLY GRADED SAND with GRAVEL (SP, A-1-b(0)), LL=NP PL=NP PI=NP NMC=11.6 %#200=4.4		98.5	SS-21	19	26	31	57	
100.0										
	-105.0	Dense		103.5	SS-22	18	18	16	34	
105.0										
	-110.0	Hard, moist, brown and gray, LEAN CLAY (CL)		108.5	SS-23	13	16	21	37	
110.0										
	-115.0	Hard, moist, brown and gray, with trace sand, LEAN CLAY (CL, A-7-6(30)), LL=47 PL=14 PI=33 NMC=16.8 %#200=88.9		113.5	SS-24	14	15	19	34	
115.0										
	-120.0	Hard		118.5	SS-25	14	17	22	39	
120.0										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	AC - Auger Cuttings	HSA - Hollow Stem Augers	MR - Mud Rotary Wash
ST - Shelby Tube	GB - Grab Bag	SSA - Solid Stem Augers	RC - Rock Coring
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RECORD OF TEST BORING

thompson ENGINEERING

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Bore Hole Diameter (in):	4-inch	**AASHTO / ASTM Sampling Methods:**	AASHTO T206 & T207				
Drill Machine:	CME 550X	**Drill Method:**	MR	**Hammer Type:**	Automatic	**Energy Ratio:**	88%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	**TOB** 0.0 ft.	**24 HR**	0.0 ft.

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE (blows/foot) PL MC LL; ▲ FINES CONTENT (%) ▲ 10 20 30 40 50 60 70 80 90
120.0										
	-125.0	Very stiff, moist, brown and gray, with trace sand, FAT CLAY (CH, A-7-6(34)), LL=50 PL=14 PI=36 NMC=21.2 %#200=91.9		123.5	SS-26	8	11	13	24	
125.0										
	-130.0	Very dense, wet, brown, fine grained, POORLY GRADED SAND with SILT (SP-SM)		128.5	SS-27	20	28	42	70	
130.0										
	-135.0	Very dense, fine to medium grained		133.5	SS-28	25	36	44	80	
135.0										
	-140.0	Very dense, wet, brown, fine grained, POORLY GRADED SAND with SILT (SP-SM, A-3(0)), LL=NP PL=NP PI=NP NMC=26.2 %#200=8.7		138.5	SS-29	22	33	31	64	
140.0										
	-145.0	Very dense		143.5	SS-30	21	27	40	67	
145.0										
	-150.0	Very dense		148.5	SS-31	11	26	34	60	
150.0										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	AC - Auger Cuttings	HSA - Hollow Stem Augers	MR - Mud Rotary Wash
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thompson ENGINEERING

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Drill Machine:	CME 550X	**Drill Method:**	MR	**Hammer Type:**	Automatic	**Energy Ratio:**	88%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	**TOB** 0.0 ft.	**24 HR**	0.0 ft.

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE (blows/foot) PL MC LL; ▲ FINES CONTENT (%) ▲ 10 20 30 40 50 60 70 80 90
150.0										
	-155.0	Dense, wet, brown, fine grained, SILTY SAND (SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=19.2 %#200=31.0		153.5	SS-32	15	17	21	38	
155.0										
	-160.0	Medium dense		158.5	SS-33	6	9	12	21	
160.0										
	-165.0	Very stiff, moist, brown and black, SANDY LEAN CLAY (CL)		163.5	SS-34	5	9	13	22	
165.0										
	-170.0	Hard, moist, brown, SANDY LEAN CLAY (CL, A-6(5)), LL=28 PL=15 PI=13 NMC=15.5 %#200=62.1		168.5	SS-35	11	15	19	34	
170.0										
	-175.0	Hard		173.5	SS-36	12	15	17	32	
175.0										
	-180.0	Very stiff, moist, brown, SANDY LEAN CLAY (CL, A-6(8)), LL=33 PL=13 PI=20 NMC=18.2 %#200=59.4		178.5	SS-37	10	12	15	27	
180.0										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	AC - Auger Cuttings	HSA - Hollow Stem Augers	MR - Mud Rotary Wash
ST - Shelby Tube	GB - Grab Bag	SSA - Solid Stem Augers	RC - Rock Coring
DCP - Dynamic Cone Penetrometer	NQ - Rock Core	HA - Hand Auger	

STRATA SYMBOLS

- SAND (SP)
- SILT (MH)
- FAT CLAY (CH)
- SILTY SAND (SM)
- POORLY GRADED SAND with SILT (SP-SM)
- ORGANIC SOILS (OL)
- Paving
- GRAVEL (GP)
- SANDY SILT (ML)
- LEAN CLAY (CL)
- TOPSOIL
- CLAYEY SAND (SC)
- CLAYEY SILTY SAND (SC-SM)
- WELL GRADED SAND with SILT and GRAVEL (SW-SM)
- SANDSTONE
- DOLOMITE
- CLAYEY GRAVEL (GC)
- POORLY GRADED GRAVEL with SILT and SAND (GP-GM)
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REC Recovery

RQD Rock Quality Designation

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SS - Split Spoon

ST - Shelby Tube

DCP - Dynamic Cone Penetrometer

AC - Auger Cuttings

GB - Grab Bag

NQ - Rock Core

Alabama Department of Transportation

Bridge Sheet of

thompson ENGINEERING
2970 COTTAGE HILL RD.
MOBILE, AL 36606

APPROVED : SAM STERNBERG III, P.E.

GEOTECHNICAL ENGINEER

DATE :

PROJECT NO. 17-1101-0145
I-10 MOBILE RIVER BRIDGE
LOAD TEST PROGRAM
MOBILE COUNTY, ALABAMA

Preliminary Project No:

TEST BORING RECORD
Sheet 10 of 12

REFERENCE PROJECT NUMBER	FISCAL YEAR	SHEET NUMBER
IM-I010(341)	2018	26

RECORD OF TEST BORING

thompson ENGINEERING

Site Description:	I-10 Mobile River Bridge and Bayway					**County:**	Mobile
Boring No.:	BW-23	**Boring Location:**	632+20.32	**Offset:**	15.51 LT	**Alignment:**	I-10 Bayway
ALDOT PE No.:	DPI-0030(005)	**TE Project No.:**	15-1101-0228			**Eng./Geo.:**	Chris LaFroscia
Elev.:	-4.0 ft.	**Northing:**	249770.929	**Easting:**	1810248.834	**Date Started:**	11/18/2016
Total Depth:	180.0 ft.	**Soil Depth:**	180.0 ft.	**Core Depth:**	0.0 ft.	**Date Completed:**	11/28/2016
Bore Hole Diameter (in):	4-inch	**AASHTO / ASTM Sampling Methods:**		AASHTO T206 & T207			
Drill Machine:	CME 550X	**Drill Method:**	MR	**Hammer Type:**	Automatic	**Energy Ratio:**	88%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	**TOB** 0.0 ft.	**24 HR**	0.0 ft.

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE (blows/foot) PL MC LL ▲ FINES CONTENT (%) ▲ 10 20 30 40 50 60 70 80 90
		Boring Terminated at 180.0 feet.								

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	AC - Auger Cuttings	HSA - Hollow Stem Augers	MR - Mud Rotary Wash
ST - Shelby Tube	GB - Grab Bag	SSA - Solid Stem Augers	RC - Rock Coring
DCP - Dynamic Cone Penetrometer	NQ - Rock Core	HA - Hand Auger	

RECORD OF TEST BORING

thompson ENGINEERING

Site Description:	I-10 Mobile River Bridge and Bayway					**County:**	Mobile
Boring No.:	BW-110	**Boring Location:**	894+44.18	**Offset:**	19.23 RT	**Alignment:**	I-10 Bayway
ALDOT PE No.:	DPI-0030(005)	**TE Project No.:**	15-1101-0228			**Eng./Geo.:**	Justin Fancher
Elev.:	-1.5 ft.	**Northing:**	238883.4863	**Easting:**	1833753.01	**Date Started:**	12/14/2015
Total Depth:	120.0 ft.	**Soil Depth:**	120.0 ft.	**Core Depth:**	0.0 ft.	**Date Completed:**	12/15/2015
Bore Hole Diameter (in):	4-inch	**AASHTO / ASTM Sampling Methods:**		AASHTO T206 & T207			
Drill Machine:	CME 45C	**Drill Method:**	MR	**Hammer Type:**	Manual	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	**TOB** 0.0 ft.	**24 HR**	0.0 ft.

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE (blows/foot) PL MC LL ▲ FINES CONTENT (%) ▲ 10 20 30 40 50 60 70 80 90
	0.0	Very soft, wet, dark gray, LEAN CLAY with SAND (CL)		0.0	SS-1	0	0	0	0	●
	-5.0	Very soft		1.5	SS-2	0	0	0	0	●
5.0		Very soft		3.0	SS-3	0	0	0	0	●
		Very soft, wet, dark gray, LEAN CLAY with SAND (CL, A-7-6(16)), LL=49 PL=26 PI=23 NMC=26.5 %#200=72.3		4.5	SS-4	0	0	0	0	● ▲
	-10.0	Very soft, No Recovery		6.0	SS-5	0	0	1	1	●
10.0		Very soft		8.5	SS-6	0	0	0	0	●
	-15.0	Very loose, wet, gray, fine grained, POORLY GRADED SAND (SP)		13.5	SS-7	0	0	1	1	●
15.0										
	-20.0	Very loose, wet, gray, fine to medium grained, SILTY SAND (SM)		18.5	SS-8	0	0	0	0	●
20.0										
	-25.0	Very loose, wet, gray, fine to medium grained, SILTY SAND (SM, A-4(0)), LL=NP PL=NP PI=NP NMC=27.9 %#200=39.1		23.5	SS-9	0	0	0	0	■ ○ ▲
25.0										
	-30.0	Very loose		28.5	SS-10	0	0	0	0	●
30.0										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	AC - Auger Cuttings	HSA - Hollow Stem Augers	MR - Mud Rotary Wash
ST - Shelby Tube	GB - Grab Bag	SSA - Solid Stem Augers	RC - Rock Coring
DCP - Dynamic Cone Penetrometer	NQ - Rock Core	HA - Hand Auger	

RECORD OF TEST BORING

thompson ENGINEERING

Site Description:	I-10 Mobile River Bridge and Bayway					**County:**	Mobile
Boring No.:	BW-110	**Boring Location:**	894+44.18	**Offset:**	19.23 RT	**Alignment:**	I-10 Bayway
ALDOT PE No.:	DPI-0030(005)	**TE Project No.:**	15-1101-0228			**Eng./Geo.:**	Justin Fancher
Elev.:	-1.5 ft.	**Northing:**	238883.4863	**Easting:**	1833753.01	**Date Started:**	12/14/2015
Total Depth:	120.0 ft.	**Soil Depth:**	120.0 ft.	**Core Depth:**	0.0 ft.	**Date Completed:**	12/15/2015
Bore Hole Diameter (in):	4-inch	**AASHTO / ASTM Sampling Methods:**		AASHTO T206 & T207			
Drill Machine:	CME 45C	**Drill Method:**	MR	**Hammer Type:**	Manual	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	**TOB** 0.0 ft.	**24 HR**	0.0 ft.

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE (blows/foot) PL MC LL ▲ FINES CONTENT (%) ▲ 10 20 30 40 50 60 70 80 90
30.0										
	-35.0	Very loose, wet, gray, fine to medium grained, POORLY GRADED SAND with SILT (SP-SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=27.3 %#200=11.7		33.5	SS-11	1	1	1	2	● ▲ ○
35.0										
	-40.0	Loose		38.5	SS-12	2	3	2	5	●
40.0										
	-45.0	Loose, light gray		43.5	SS-13	4	4	5	9	●
45.0										
	-50.0	Medium dense		48.5	SS-14	7	9	13	22	●
50.0										
	-55.0	Medium dense, wet, light gray, fine to medium grained, POORLY GRADED SAND with SILT (SP-SM, A-3(0)), LL=NP PL=NP PI=NP NMC=20.9 %#200=5.9		53.5	SS-15	10	11	10	21	X ▲ ●
55.0										
	-60.0	Loose		58.5	SS-16	5	4	4	8	●
60.0										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	AC - Auger Cuttings	HSA - Hollow Stem Augers	MR - Mud Rotary Wash
ST - Shelby Tube	GB - Grab Bag	SSA - Solid Stem Augers	RC - Rock Coring
DCP - Dynamic Cone Penetrometer	NQ - Rock Core	HA - Hand Auger	

STRATA SYMBOLS

- SAND (SP)
- SILT (MH)
- FAT CLAY (CH)
- SILTY SAND (SM)
- POORLY GRADED SAND with SILT (SP-SM)
- ORGANIC SOILS (OL)
- Paving
- GRAVEL (GP)
- SANDY SILT (ML)
- LEAN CLAY (CL)
- TOPSOIL
- CLAYEY SAND (SC)
- CLAYEY SILTY SAND (SC-SM)
- WELL GRADED SAND with SILT and GRAVEL (SW-SM)
- SANDSTONE
- DOLOMITE
- CLAYEY GRAVEL (GC)
- POORLY GRADED GRAVEL with SILT and SAND (GP-GM)
- SILTY CLAY (CL-ML)
- Ground Water, ATD
- 24 Hr./Delayed Ground Water
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- MR - Mud Rotary

NO - Not Obtained

NE - Not Encountered

REC Recovery

RQD Rock Quality Designation

pp - Pocket Penetrometer

SS - Split Spoon

ST - Shelby Tube

DCP - Dynamic Cone Penetrometer

AC - Auger Cuttings

GB - Grab Bag

NQ - Rock Core

Alabama Department of Transportation

Bridge Sheet of

thompson ENGINEERING
2970 COTTAGE HILL RD.
MOBILE, AL 36606

APPROVED : SAM STERNBERG III, P.E.

GEOTECHNICAL ENGINEER

DATE :

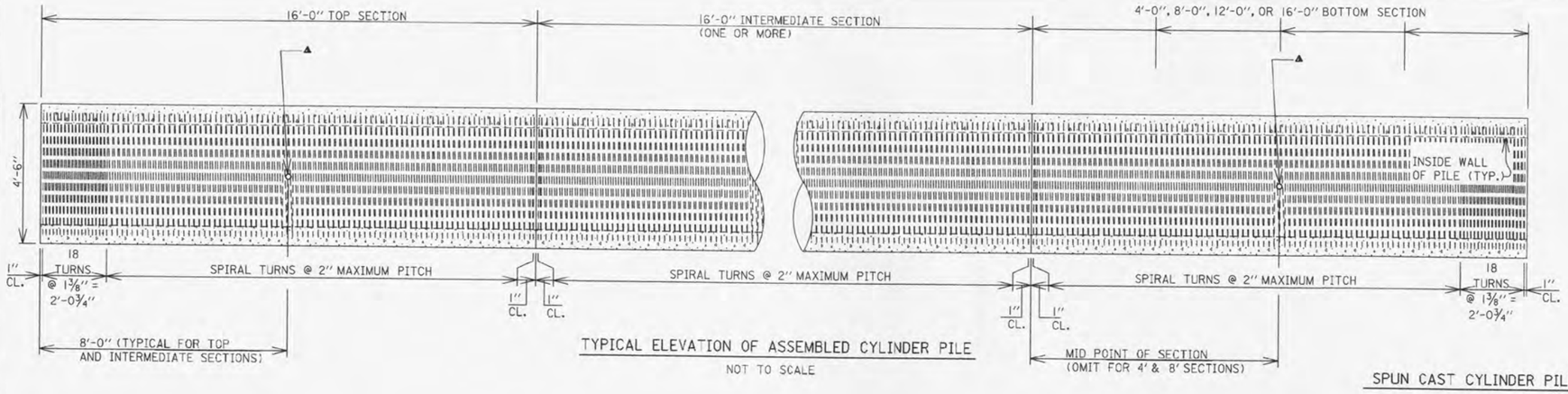
PROJECT NO. 17-1101-0145
I-10 MOBILE RIVER BRIDGE
LOAD TEST PROGRAM
MOBILE COUNTY, ALABAMA

Preliminary Project No:

TEST BORING RECORD

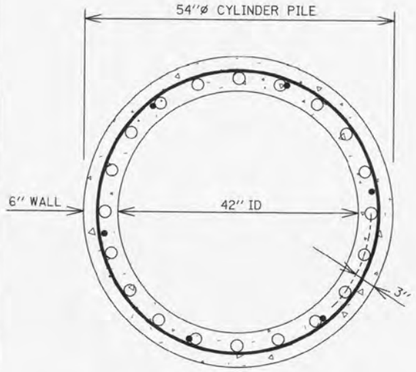
SPUN CYLINDER CONCRETE PILE DETAILS

REFERENCE PROJECT NO	FISCAL YEAR	SHEET NO
IM-I010(341)	2018	13



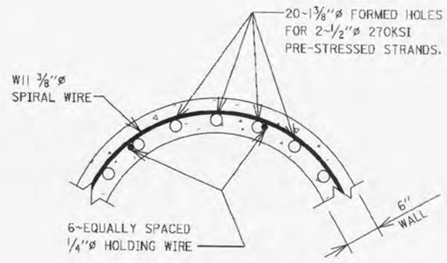
TYPICAL ELEVATION OF ASSEMBLED CYLINDER PILE

NOT TO SCALE



54" DIAMETER SECTION (20 CABLES)

NOT TO SCALE



TYPICAL REINFORCING DETAIL

NOT TO SCALE

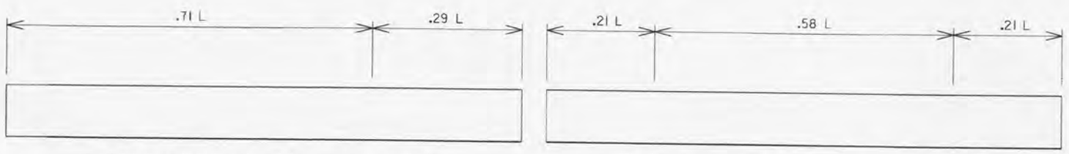
PRESTRESSED PILE SCHEDULE

QUANTITY	LENGTH	COMMENTS
1	120'-0"	TP-04
1	140'-0"	TP-23A
1	110'-0"	TP-23B
1	130'-0"	TP-111A
1	130'-0"	TP-111B
NO PILE SHALL BE PRODUCED WITHOUT WRITTEN APPROVAL OF THIS DRAWING		

SPUN CAST CYLINDER PILE GENERAL NOTES

1. STEEL FORMS FOR EACH SPUN CAST CYLINDER PILE SECTION SHALL NOT BE REMOVED UNTIL THE COMPRESSIVE STRENGTH OF THE CONCRETE HAS REACHED A MINIMUM OF 7,000 PSI.
2. THE CONCRETE IN THE SPUN CAST CYLINDER CONCRETE PILE SECTIONS SHALL HAVE A COMPRESSIVE STRENGTH OF 7,000 PSI PRIOR TO BEING ASSEMBLED INTO A SPUN CAST CYLINDER CONCRETE PILE UNIT AND RECEIVING THE PRESTRESSING FORCE.
3. SPUN CAST CYLINDER CONCRETE PILES SHALL NOT BE SHIPPED AND DRIVEN UNTIL THE MINIMUM 28-DAY COMPRESSIVE STRENGTH OF THE CONCRETE IS 10,000 PSI.
4. GROUT SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI PRIOR TO RELEASE OF STRANDS. REFER TO ALDOT-451 FOR GROUT TESTING.
5. THE ABUTTING JOINING SURFACES OF EACH SECTION SHALL BE COVERED BY A JOINT SEALING MATERIAL AND THE SPUN CAST CYLINDER CONCRETE PILES STRESSED TO 100 PSI AS DIRECTED IN ALDOT-451.
6. THE SPUN CAST CYLINDER CONCRETE PILES SHALL HAVE CABLES PLACED AS SHOWN IN THE SECTIONS ON THIS SHEET. EACH CABLE IS COMPOSED OF 2-1/2" ø, 270 KSI LOW RELAXATION STRANDS CONFORMING TO AASHTO M 203. THE STRANDS SHALL BE STRESSED TO AN INITAL TENSION OF 30,900 LBS IN THE SEQUENCE DESCRIBED IN ALDOT-451.
7. SPIRAL AND SPACER REINFORCING SHALL BE WII COLD DRAWN STEEL WIRE CONFORMING TO AASHTO DESIGNATION M 32. THE SPIRAL REINFORCING STEEL MAY BE WELDED TO THE WII LONGITUDINAL WIRE.

▲8. PROVIDE ONE(1) 2"ø VENT HOLE (@ ℄ PILE) ON TWO(2) OPPOSITE FACES OF PILES (TYPICAL EACH PILE SECTION.



1-POINT LIFT DETAIL(MAX. LEN. 124'-0")

2-POINT LIFT DETAIL(MAX. LEN. 173'-0")

RESPONSIBLE PE:	SUPERVISOR:	DESIGNER:	PLAN SUBMITTAL	ALABAMA DEPARTMENT OF TRANSPORTATION	NOT TO SCALE	SHEET TITLE	ROUTE
DATE:	DATE:	DATE:				SPUN CYLINDER CONCRETE PILE DETAILS	I-10

Appendix F

Instrument Calibrations
TP-23A

I-10 over Mobile River Bridge Load Test Program

ALDOT Project No.: IM-I010(341)
Mobile County, Alabama
AFT Project No.: 118008

Pile Dynamics, Inc.

Certificate of Calibration

Transducer Model: BDI ST350

Serial Number: E655

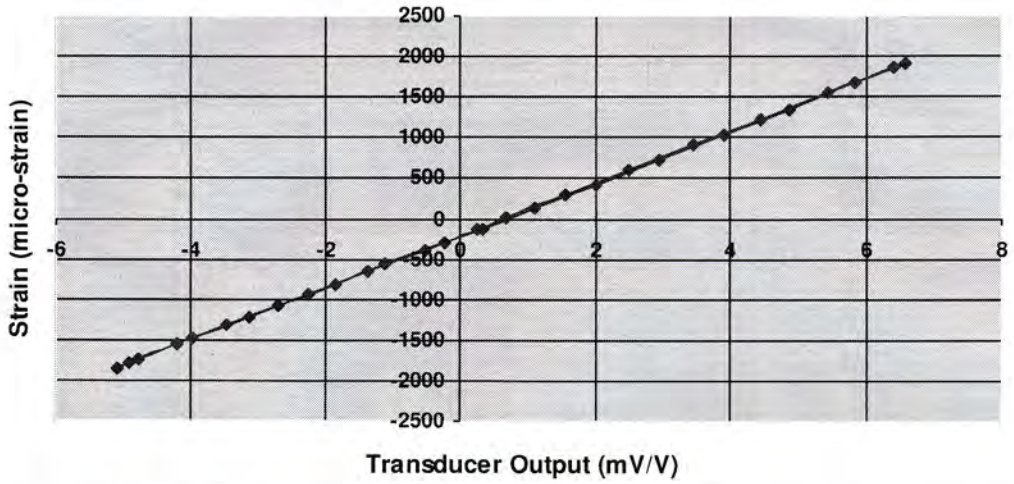
PDI Gage Factor: 92.7 με/V

General Gage Factor: 321.8 $\mu\varepsilon/mV/V_{ext}$
Initial Offset Voltage: 0.149 mV/V_{ext}

Table 1 – Representative Calibration Data

Applied Strain (με)	Transducer Output (mV/V_{ext})	Applied Strain (με)	Transducer Output (mV/V_{ext})
-132	0.253	133	1.110
-286	-0.238	423	2.009
-565	-1.103	726	2.949
-808	-1.866	1035	3.901
-1075	-2.707	1349	4.878
-1324	-3.476	1671	5.850
-1558	-4.208	1915	6.567
-1790	-4.911	1868	6.416
-1856	-5.099	1549	5.441
-1741	-4.789	1226	4.447
-1486	-3.993	912	3.460
-1209	-3.125	599	2.486
-935	-2.243	301	1.568
-662	-1.365	9	0.670
-390	-0.510	-131	0.244
-125	0.319	-132	0.240

Calibration Curve



Mean Linear Correlation Coefficient (LCC): 9.999728E-1

LCC Standard Deviation: 2.690308E-6

Calibrated By: Kay Tol

Signature: Kay Tol

Date/Time: 2/28/2018 8:04 AM

Temperature (°C): 25.3

Specifications

PDI Automated Strain Transducer Calibration System (PDI-ASTCS)

ASTCS Calibration Information	
ASTCS Serial Number:	ASTCS-0005
ASTCS Software Version:	2.310
ASTCS Independent Verification Date:	11/5/2014 11:54 AM
Strain Transducer Gage Length:	3.0 inches (76.2 mm)
Applied Full Scale Displacement Range:	±7.500000E-3 inches
Method for Applying Displacement:	Precision Step Motor Coupled to Linear Stage
Excitation Voltage for Calibration:	2.5 VDC
Displacement Measurements:	Dual Precision AC LVDT's, Output Averaged
Displacement Certification:	NIST 274437-07
Linearity Verification Technique:	Linear Correlation Coefficient > 0.9999
Repeatability Verification Technique:	Standard Deviation < 0.5 % (of mean)
ASTCS System Check	
Reference Strain Transducer:	4367T
Reference General Gage Factor:	293.000 με/mV/V
LVDT #1 Sensitivity (inches/volt):	7.916500E-3
LVDT #2 Sensitivity (inches/volt):	8.042000E-3
Date/Time of Last System Check:	2/27/2018 3:17 PM
PDI Strain Transducer Connections	
Black:	+ Excitation
Green:	- Excitation
Red:	+ Signal
White:	- Signal
Grey:/BARE	Shield

NIST Reference:

PDI certifies the above PDI-ASTCS instrument meets or exceeds published specifications and has been verified using standards and instruments whose accuracies are traceable to the National Institute of Standards and Technology (NIST), an accepted value of a natural physical constant or a ratio calibration technique. The calibration of this instrument was performed in accordance with the PDI Quality Assurance program. Measurements and information provided on this report are valid at the time of calibration only.

Pile Dynamics, Inc.

Certificate of Calibration

Transducer Model: BDI ST350

Serial Number: J762

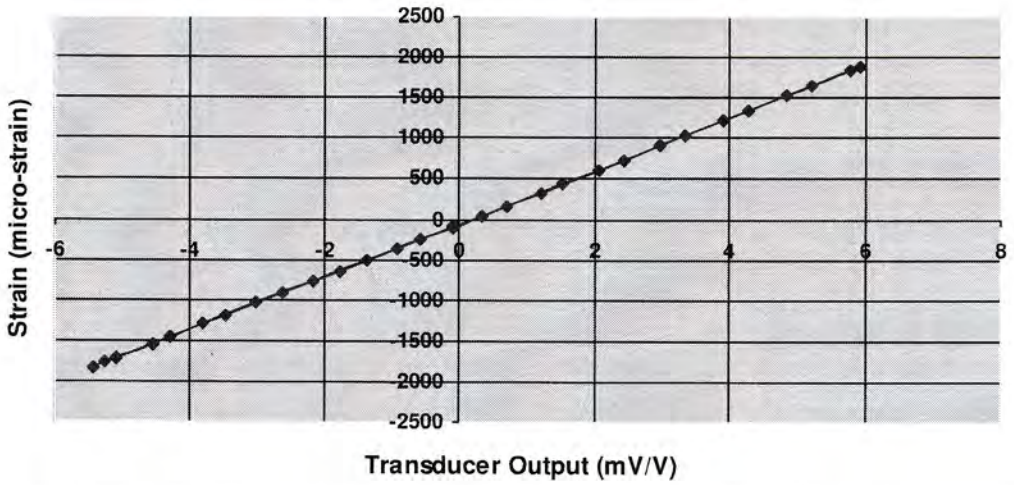
PDI Gage Factor: 93.9 με/V

General Gage Factor: 326.1 $\mu\varepsilon/mV/V_{ext}$
Initial Offset Voltage: -0.006 mV/V_{ext}

Table 1 – Representative Calibration Data

Applied Strain (με)	Transducer Output (mV/V_{ext})	Applied Strain (με)	Transducer Output (mV/V_{ext})
-95	-0.099	158	0.710
-244	-0.569	430	1.538
-507	-1.370	723	2.430
-765	-2.165	1021	3.335
-1036	-3.005	1327	4.269
-1302	-3.817	1642	5.216
-1546	-4.563	1883	5.918
-1769	-5.256	1841	5.789
-1829	-5.427	1531	4.856
-1714	-5.105	1218	3.908
-1455	-4.308	914	2.976
-1190	-3.475	616	2.064
-920	-2.631	332	1.201
-648	-1.772	47	0.328
-369	-0.905	-95	-0.086
-94	-0.057	-93	-0.090

Calibration Curve



Mean Linear Correlation Coefficient (LCC): 9.999784E-1

LCC Standard Deviation: 1.747861E-6

Calibrated By: Kay Tol

Signature: Kay Tol

Date/Time: 2/28/2018 8:02 AM

Temperature (°C): 25.3

Specifications

PDI Automated Strain Transducer Calibration System (PDI-ASTCS)

ASTCS Calibration Information	
ASTCS Serial Number:	ASTCS-0005
ASTCS Software Version:	2.310
ASTCS Independent Verification Date:	11/5/2014 11:54 AM
Strain Transducer Gage Length:	3.0 inches (76.2 mm)
Applied Full Scale Displacement Range:	±7.500000E-3 inches
Method for Applying Displacement:	Precision Step Motor Coupled to Linear Stage
Excitation Voltage for Calibration:	2.5 VDC
Displacement Measurements:	Dual Precision AC LVDT's, Output Averaged
Displacement Certification:	NIST 274437-07
Linearity Verification Technique:	Linear Correlation Coefficient > 0.9999
Repeatability Verification Technique:	Standard Deviation < 0.5 % (of mean)
ASTCS System Check	
Reference Strain Transducer:	4367T
Reference General Gage Factor:	293.000 με/mV/V
LVDT #1 Sensitivity (inches/volt):	7.916500E-3
LVDT #2 Sensitivity (inches/volt):	8.042000E-3
Date/Time of Last System Check:	2/27/2018 3:17 PM
PDI Strain Transducer Connections	
Black:	+ Excitation
Green:	- Excitation
Red:	+ Signal
White:	- Signal
Grey:/BARE	Shield

NIST Reference:

PDI certifies the above PDI-ASTCS instrument meets or exceeds published specifications and has been verified using standards and instruments whose accuracies are traceable to the National Institute of Standards and Technology (NIST), an accepted value of a natural physical constant or a ratio calibration technique. The calibration of this instrument was performed in accordance with the PDI Quality Assurance program. Measurements and information provided on this report are valid at the time of calibration only.

Pile Dynamics, Inc.

Certificate of Calibration

Transducer Model: BDI ST350

Serial Number: P454

PDI Gage Factor: 145.3 με/V

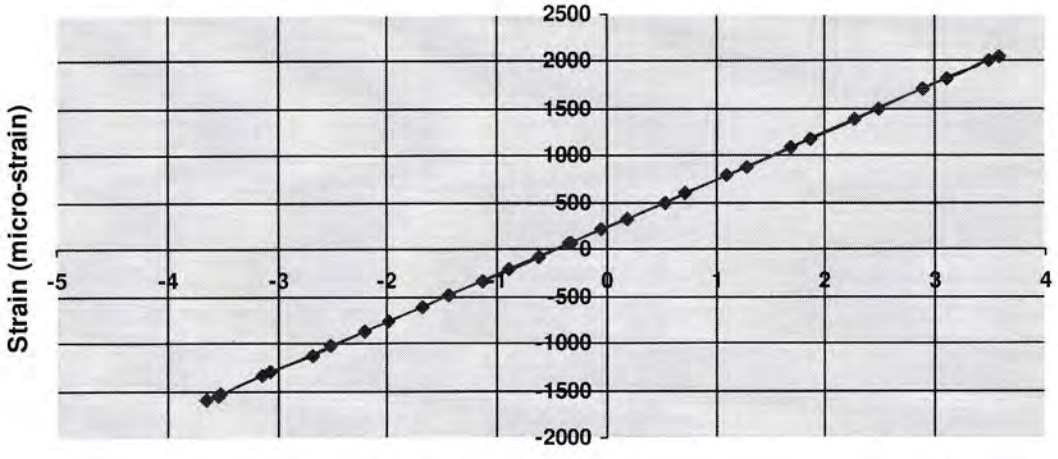
General Gage Factor: 504.7 $\mu\varepsilon/mV/V_{ext}$

Initial Offset Voltage: -0.113 mV/V_{ext}

Table 1 – Representative Calibration Data

Applied Strain (με)	Transducer Output (mV/V_{ext})	Applied Strain (με)	Transducer Output (mV/V_{ext})
65	-0.330	335	0.184
-83	-0.628	598	0.709
-331	-1.125	889	1.284
-607	-1.670	1188	1.872
-876	-2.202	1497	2.487
-1115	-2.687	1814	3.109
-1344	-3.136	2058	3.573
-1543	-3.541	2013	3.492
-1597	-3.646	1700	2.888
-1525	-3.515	1387	2.272
-1288	-3.058	1088	1.683
-1023	-2.521	794	1.100
-753	-1.982	502	0.529
-483	-1.439	210	-0.047
-210	-0.893	71	-0.319
70	-0.337	70	-0.321

Calibration Curve



Mean Linear Correlation Coefficient (LCC): 9.999805E-1

LCC Standard Deviation: 1.224288E-6

Calibrated By: Vanna Thach

Signature: Thach

Date/Time: 1/26/2018 8:12 AM

Temperature (°C): 24.3

Specifications

PDI Automated Strain Transducer Calibration System (PDI-ASTCS)

ASTCS Calibration Information	
ASTCS Serial Number:	ASTCS-0005
ASTCS Software Version:	2.310
ASTCS Independent Verification Date:	11/5/2014 11:54 AM
Strain Transducer Gage Length:	3.0 inches (76.2 mm)
Applied Full Scale Displacement Range:	±7.500000E-3 inches
Method for Applying Displacement:	Precision Step Motor Coupled to Linear Stage
Excitation Voltage for Calibration:	2.5 VDC
Displacement Measurements:	Dual Precision AC LVDT's, Output Averaged
Displacement Certification:	NIST 274437-07
Linearity Verification Technique:	Linear Correlation Coefficient > 0.9999
Repeatability Verification Technique:	Standard Deviation < 0.5 % (of mean)
ASTCS System Check	
Reference Strain Transducer:	4367T
Reference General Gage Factor:	293.000 με/mV/V
LVDT #1 Sensitivity (inches/volt):	7.916500E-3
LVDT #2 Sensitivity (inches/volt):	8.042000E-3
Date/Time of Last System Check:	1/26/2018 7:12 AM
PDI Strain Transducer Connections	
Black:	+ Excitation
Green:	- Excitation
Red:	+ Signal
White:	- Signal
Grey:/BARE	Shield

NIST Reference:

PDI certifies the above PDI-ASTCS instrument meets or exceeds published specifications and has been verified using standards and instruments whose accuracies are traceable to the National Institute of Standards and Technology (NIST), an accepted value of a natural physical constant or a ratio calibration technique. The calibration of this instrument was performed in accordance with the PDI Quality Assurance program. Measurements and information provided on this report are valid at the time of calibration only.

Pile Dynamics, Inc.

Certificate of Calibration

Transducer Model: BDI ST350

Serial Number: P455

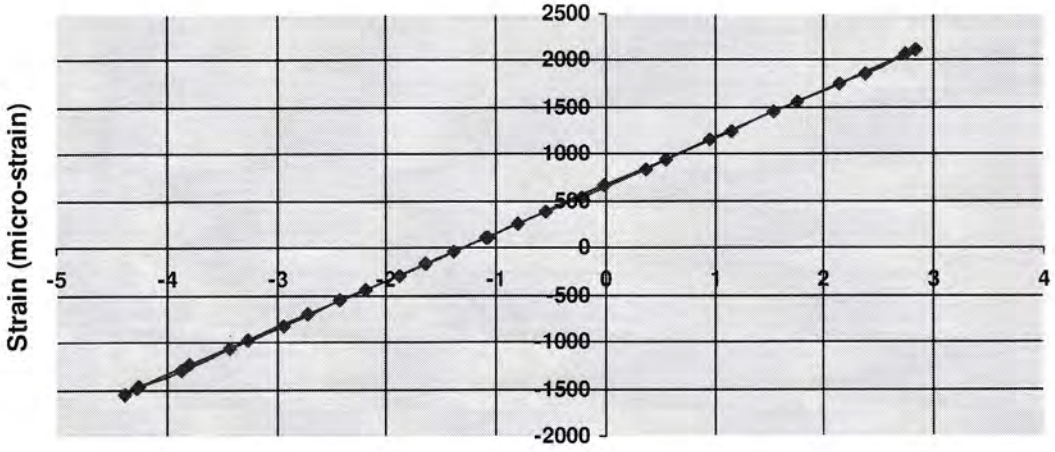
PDI Gage Factor: 145.8 με/V

General Gage Factor: 506.2 $\mu\varepsilon/mV/V_{ext}$
Initial Offset Voltage: -0.434 mV/V_{ext}

Table 1 – Representative Calibration Data

Applied Strain (με)	Transducer Output (mV/V_{ext})	Applied Strain (με)	Transducer Output (mV/V_{ext})
110	-1.082	389	-0.551
-42	-1.386	657	-0.021
-288	-1.881	947	0.552
-560	-2.418	1246	1.143
-828	-2.945	1556	1.751
-1070	-3.431	1869	2.371
-1290	-3.866	2115	2.834
-1489	-4.264	2069	2.749
-1547	-4.375	1752	2.143
-1473	-4.243	1446	1.542
-1238	-3.788	1147	0.958
-976	-3.260	845	0.360
-707	-2.726	548	-0.218
-440	-2.191	255	-0.796
-163	-1.641	114	-1.075
118	-1.086	114	-1.076

Calibration Curve



Mean Linear Correlation Coefficient (LCC): 9.999817E-1

LCC Standard Deviation: 3.891526E-7

Calibrated By: Vanna Thach

Signature: Thach

Date/Time: 1/26/2018 7:26 AM

Temperature (°C): 23.6

Specifications

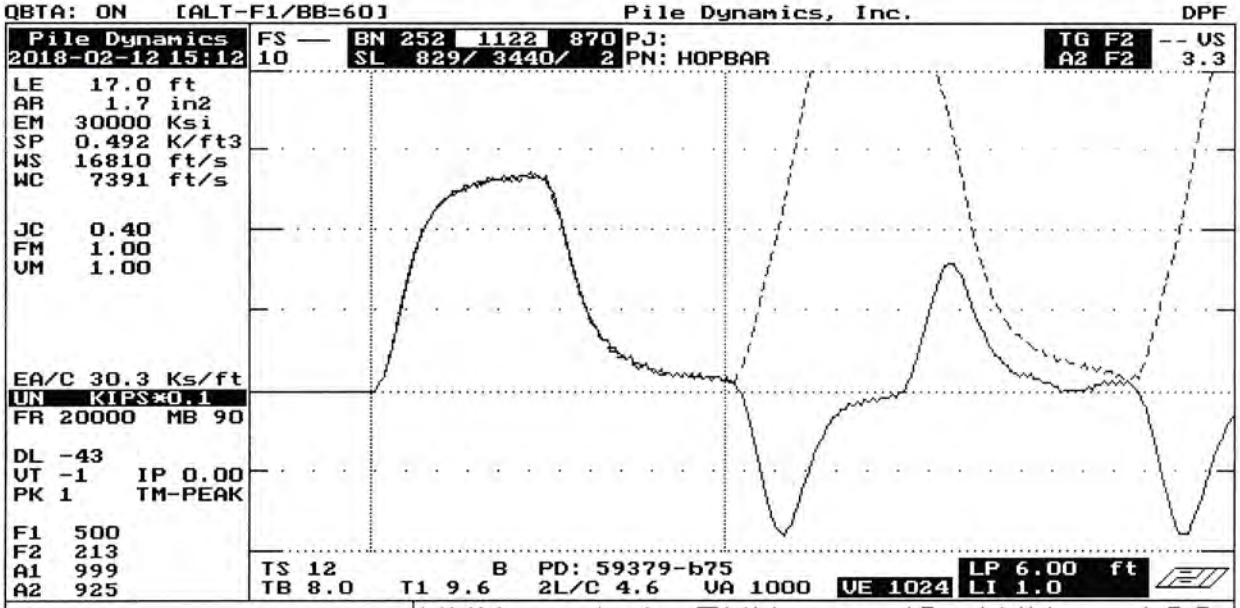
PDI Automated Strain Transducer Calibration System (PDI-ASTCS)

ASTCS Calibration Information	
ASTCS Serial Number:	ASTCS-0005
ASTCS Software Version:	2.310
ASTCS Independent Verification Date:	11/5/2014 11:54 AM
Strain Transducer Gage Length:	3.0 inches (76.2 mm)
Applied Full Scale Displacement Range:	±7.500000E-3 inches
Method for Applying Displacement:	Precision Step Motor Coupled to Linear Stage
Excitation Voltage for Calibration:	2.5 VDC
Displacement Measurements:	Dual Precision AC LVDT's, Output Averaged
Displacement Certification:	NIST 274437-07
Linearity Verification Technique:	Linear Correlation Coefficient > 0.9999
Repeatability Verification Technique:	Standard Deviation < 0.5 % (of mean)
ASTCS System Check	
Reference Strain Transducer:	4367T
Reference General Gage Factor:	293.000 με/mV/V
LVDT #1 Sensitivity (inches/volt):	7.916500E-3
LVDT #2 Sensitivity (inches/volt):	8.042000E-3
Date/Time of Last System Check:	1/26/2018 7:12 AM
PDI Strain Transducer Connections	
Black:	+ Excitation
Green:	- Excitation
Red:	+ Signal
White:	- Signal
Grey:/BARE	Shield

NIST Reference:

PDI certifies the above PDI-ASTCS instrument meets or exceeds published specifications and has been verified using standards and instruments whose accuracies are traceable to the National Institute of Standards and Technology (NIST), an accepted value of a natural physical constant or a ratio calibration technique. The calibration of this instrument was performed in accordance with the PDI Quality Assurance program. Measurements and information provided on this report are valid at the time of calibration only.

QBTA: ON [ALT-F1/BB=60] Pile Dynamics, Inc. DPF



VMX= 4.4 FMX= 68 AMX= 139
EMX= 0.3 MEX= 133 FVP= 1.00

ACCEPT SQ-OFF FL-OFF PR-OFF

ACCEPT

ACCELEROMETER CALIBRATION N.I.S.T. Traceable

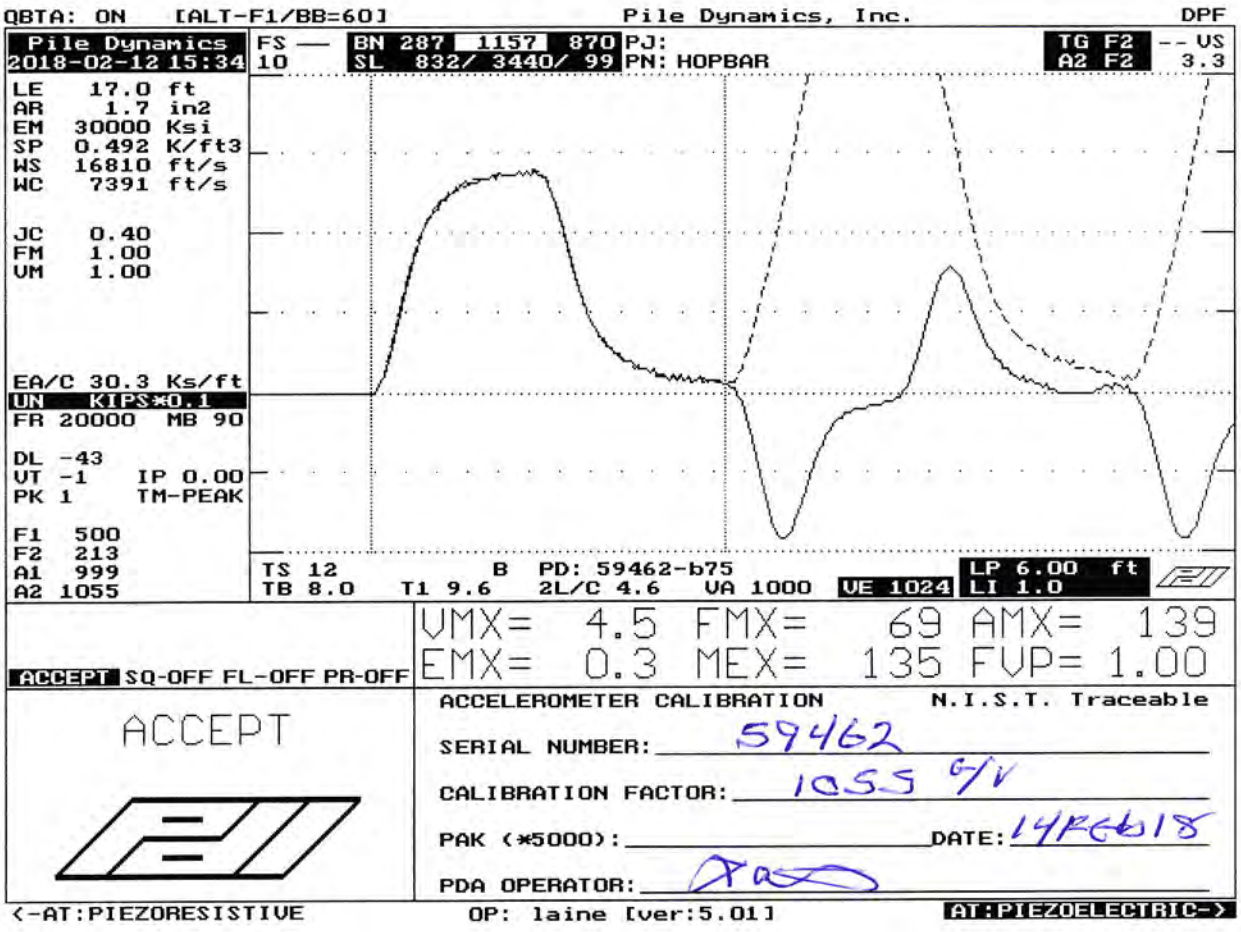
SERIAL NUMBER: 59379

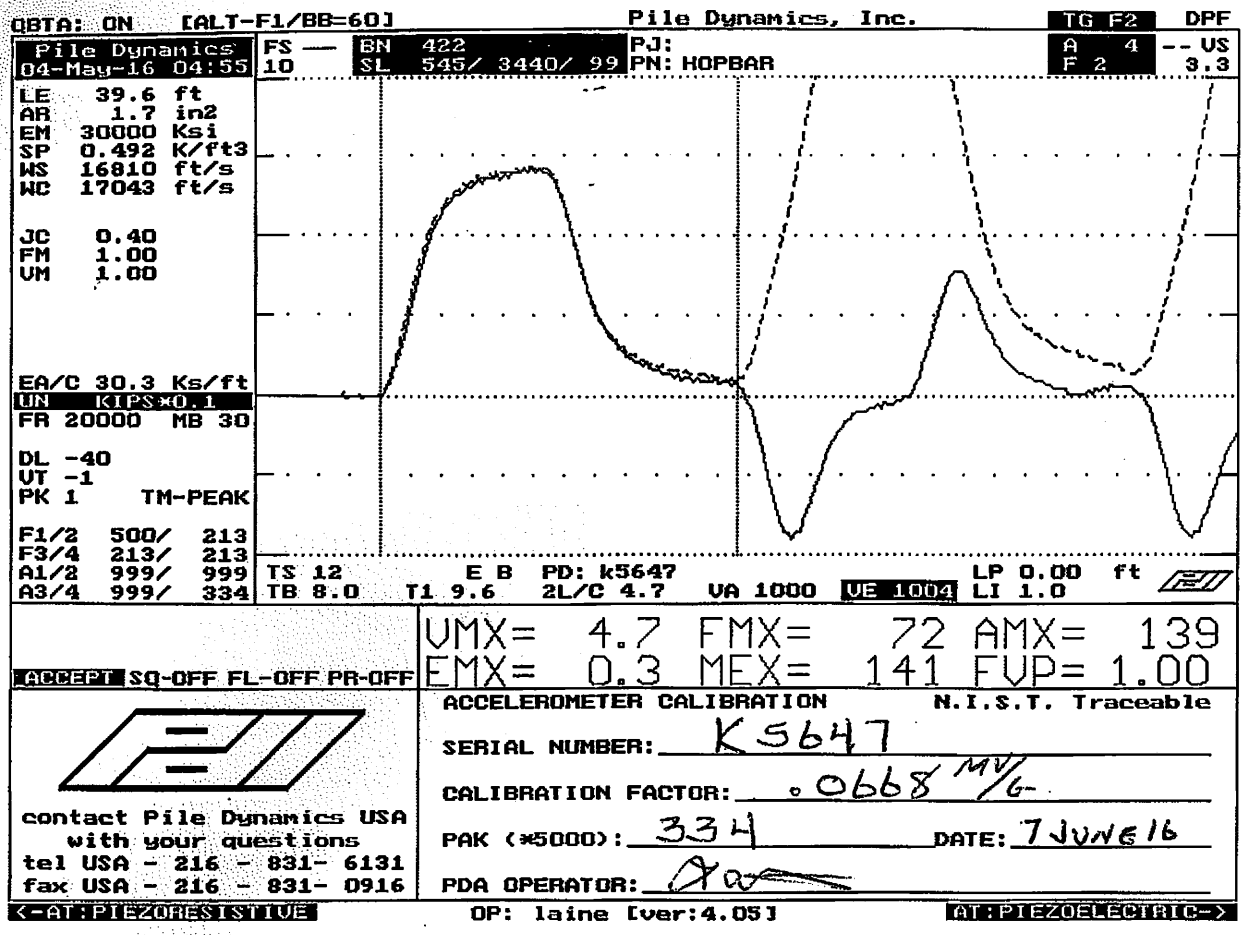
CALIBRATION FACTOR: 925 e/v

PAK (*5000): _____ DATE: 14Feb18

PDA OPERATOR: [signature]

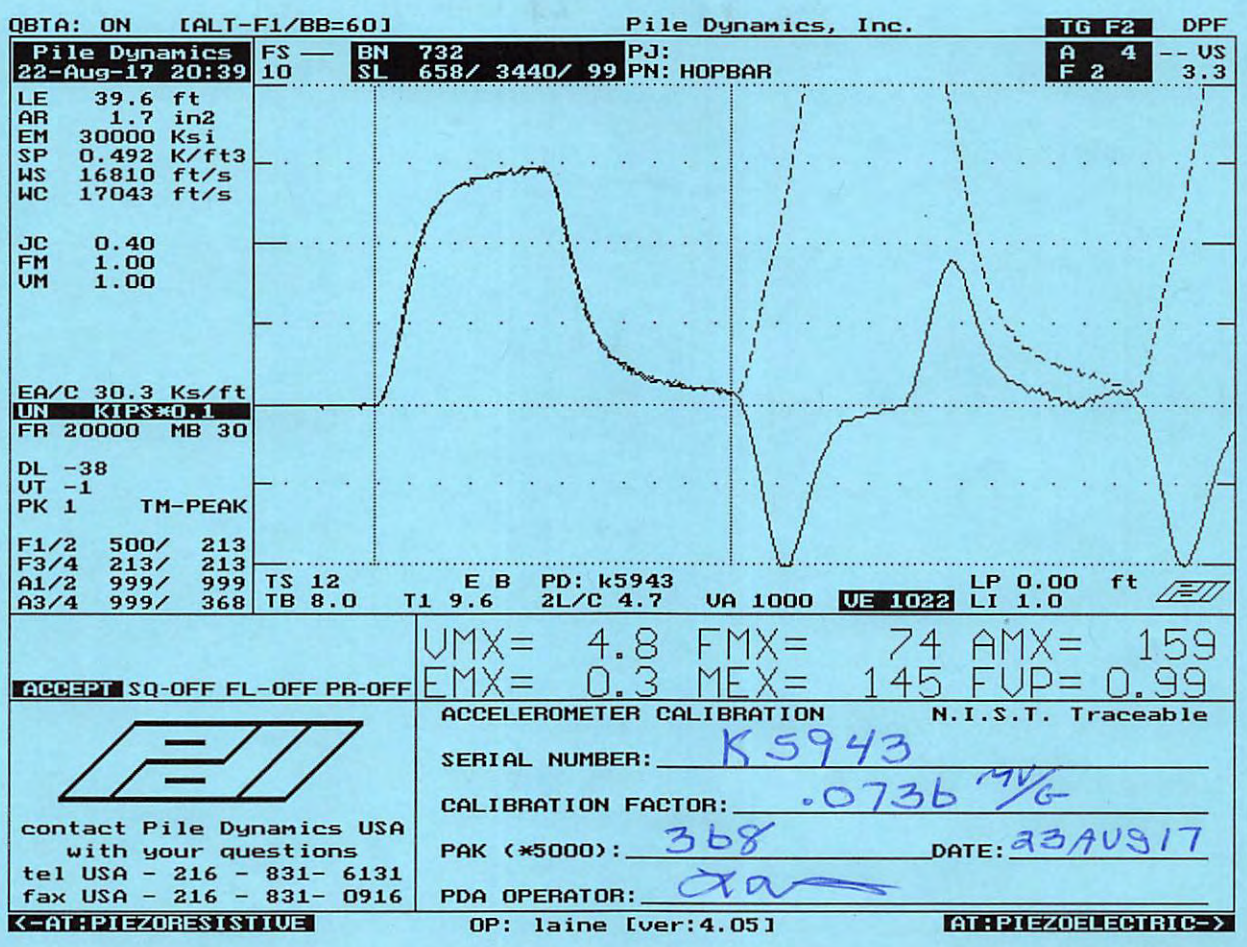
<-AT:PIEZORESISTIVE OP: laine [ver:5.01] AT:PIEZOELECTRIC->


QBTA: ON [ALT-F1/BB=60]
Pile Dynamics, Inc.
DPF
Pile Dynamics
2018-02-12 15:34
FS —
10
BN 287 1157 870
SL 832/ 3440/ 99
PJ:
PN: HOPBAR
TG F2
A2 F2
-- VS
3.3
LE 17.0 ft
AR 1.7 in2
EM 30000 Ksi
SP 0.492 K/ft3
WS 16810 ft/s
WC 7391 ft/s
JC 0.40
FM 1.00
VM 1.00
EA/C 30.3 Ks/ft
UN KIPS*0.1
FR 20000 MB 90
DL -43
VT -1 IP 0.00
PK 1 TM-PEAK
F1 500
F2 213
A1 999
A2 1055
TS 12
TB 8.0
T1 9.6
B
PD: 59462-b75
2L/C 4.6
VA 1000
VE 1024
LP 6.00 ft
LI 1.0
VMX= 4.5 FMX= 69 AMX= 139
EMX= 0.3 MEX= 135 FVP= 1.00
ACCEPT SQ-OFF FL-OFF PR-OFF
ACCEPT
ACCELEROMETER CALIBRATION
N.I.S.T. Traceable
SERIAL NUMBER: 59462
CALIBRATION FACTOR: 1055 G/V
PAK (*5000):
DATE: 14Feb18
PDA OPERATOR:
<-AT:PIEZORESISTIVE
OP: laine [ver:5.01]
AT:PIEZOELECTRIC->



Smart Sensor

Smart Chip Programmed By M.W. **on** 7JUN16 **CRC Value** 34B5



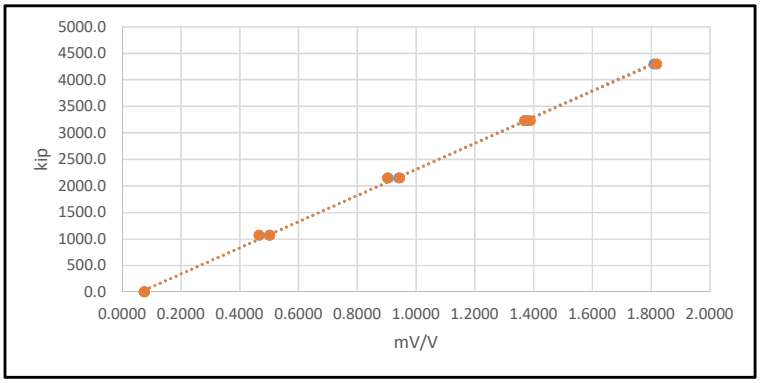
Smart Sensor

Smart Chip Programmed By T.M.N. **on** 23AUG17 **CRC Value** BADD

Applied Foundation Testing, Inc.
4035 J. Louis Street
Green Cove Springs, Fl 32043
P: (904) 284-1337
F: (904) 284-1339

Force Transducer Calibration Report

Calibration Date	2/28/2017	**Description**	19MN Kelk Load Cell
Calibration Due	2/28/2018	**Model**	C3929-1
Technician	Justin Eason	**Serial Number**	15
Ambient	81.2	**Range**	4300 kip



Calibrating Equipment		
Item	**Description**	**Serial**
Pressure Gauge	20000 PSIG	1659929
Load Reference	40MN	C027-12
Data Acquisition	NI 9219	1A4225C

Load Cycle 1			Load Cycle 2			Average
Load Reference (kip)	**Found As (mV/V)**	**Left As (mV/V)**	**Load Reference (kip)**	**Found As (mV/V)**	**Left As (mV/V)**	**Nonlinearity (%)**
0.0	0.0751	0.0751	0.0	0.0750	0.0750	0.78%
1070.0	0.5013	0.5013	1070.0	0.5035	0.5035	0.38%
2150.0	0.9404	0.9404	2150.0	0.9448	0.9448	0.48%
3230.0	1.3800	1.3800	3230.0	1.3900	1.3900	0.71%
4300.0	1.8100	1.8100	4300.0	1.8200	1.8200	0.46%
3230.0	1.3700	1.3700	3230.0	1.3700	1.3700	-0.15%
2150.0	0.9045	0.9045	2150.0	0.9029	0.9029	-1.75%
1070.0	0.4655	0.4655	1070.0	0.4658	0.4658	-1.72%
0.0	0.0750	0.0750	0.0	0.0756	0.0756	0.80%

Comments:

Linear Gage Factor	**2463.2948**	**kip/mV/V**
Regression Zero	**-151.1177**	**kip**
Maximum Nonlinearity	**-1.75%**	
Sensitivity	**1.7456**	**mV/V**

Applied Foundation Testing, Inc. hereby certifies that this instrument meets or exceeds all requirements for its intended use and the reported calibration factors are accurate to within the limits of the calibrating procedure. Reference standards and calibrations are traceable to the National Institute of Standards and Technology (NIST) where applicable.

Technician:

Approved:

~ Calibration Certificate ~

Per ISO 16063-21

Model Number: 3701G2FA50G

Serial Number: 3795

Description: DC Accelerometer

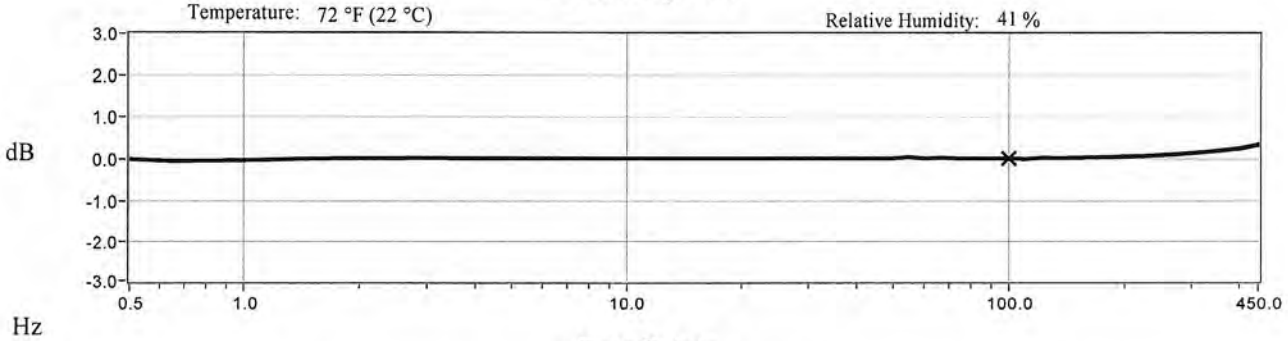
Manufacturer: PCB

Method: Back-to-Back Comparison AT401-12

Calibration Data

Sensitivity @ 100 Hz	**59.9 mV/g**	Offset Voltage (@ 0 g)	9.6 mVDC
	(6.10 mV/m/s²)	Resonant Frequency	1.59 kHz

Sensitivity Plot



Data Points

Frequency (Hz)	Dev. (%)	Frequency (Hz)	Dev. (%)	Frequency (Hz)	Dev. (%)
0.5	-0.3	10	0.1	70	0.1
1	-0.6	15	0.1	REF. FREQ.	0.0
2	0.0	20	0.0	200	0.5
5	0.0	30	0.1	450	3.9
7	0.0	50	0.1		

Mounting Surface: Calibration Fixture w/Silicone Grease Fastener: Stud Fixture Orientation: Vertical
Acceleration Level (pk)[1]: 1.00 g (9.81 m/s²)
[1]The acceleration level may be limited by shaker displacement at low frequencies. If the listed level cannot be obtained, the calibration system uses the following formula to set the vibration amplitude; Acceleration Level (g) = 0.207 x (freq)². [2]The gravitational constant used for calculations by the calibration system is; 1 g = 9.80665 m/s².

Condition of Unit

As Found: In Tolerance

As Left: In Tolerance

Notes

1. Calibration is traceable to one or more of the following; PTB 10065, PTB 10066 and NIST 683/283498.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 10012-1, ANSI Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Due to state of art limitations, the test uncertainty ratio is 3:1. Measurement uncertainty (95% confidence level with coverage factor of 2) for frequency ranges tested during calibration are as follows: 0.5-0.99 Hz; +/- 1.8%, 1-30 Hz; +/- 1.0%, 30.01-199 Hz; +/- 1.5%, 200-1 kHz; +/- 3.0%.

Technician: Ronald Stevens RS 4270 Date: 1/25/2018

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VIBRATION DIVISION
3425 Walden Avenue · Depew, NY 14043
TEL: 888-684-0013 · FAX: 716-685-3886 · www.pcb.com

~ Calibration Certificate ~

Per ISO 16063-21

Model Number: 3701G2FA50G

Serial Number: 3795

Description: DC Accelerometer

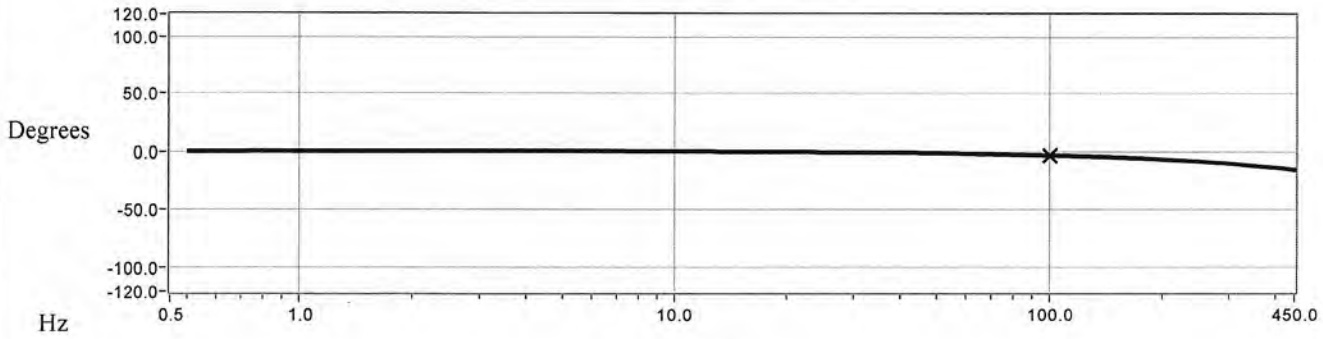
Manufacturer: PCB

Method: Back-to-Back Comparison AT401-12

Calibration Data

Sensitivity @ 100 Hz **59.9 mV/g** **(6.10 mV/m/s²)**

Phase Plot



Data Points

Frequency (Hz)	Phase (°)	Frequency (Hz)	Phase (°)
0.5	-0.6	30	-1.3
1	-0.2	50	-2.0
2	-0.2	70	-2.8
5	-0.3	REF. FREQ.	-4.0
7	-0.3	200	-7.3
10	-0.5	450	-16.4
15	-0.7		
20	-0.9		

Notes

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Technician: Ronald Stevens RS 4270 Date: 1/25/2018

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CAL96-3599767065.696+1

ACS-11

~ Calibration Certificate ~

Per ISO 16063-21

Model Number: 3701G2FA50G

Serial Number: 7984

Description: DC Accelerometer

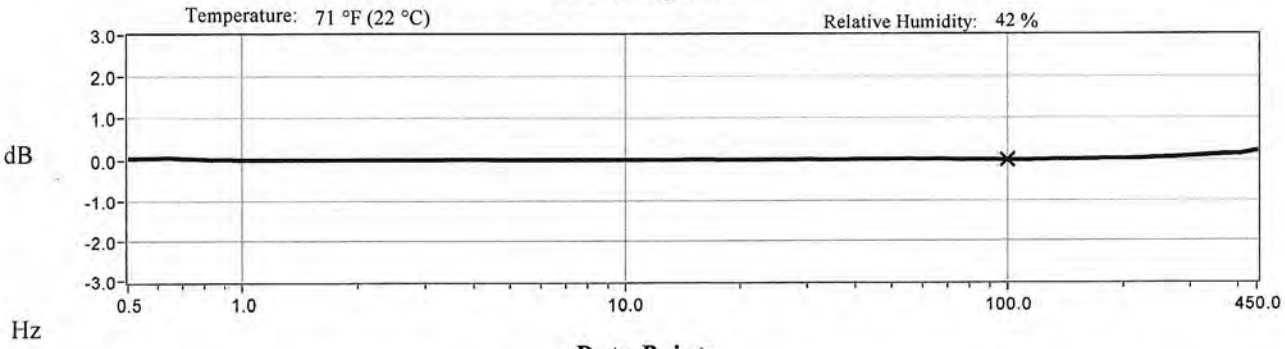
Manufacturer: PCB

Method: Back-to-Back Comparison AT401-12

Calibration Data

Sensitivity @ 100 Hz	**60.9 mV/g**	Offset Voltage (@ 0 g)	3.3 mVDC
	(6.21 mV/m/s²)	Resonant Frequency	1.53 kHz

Sensitivity Plot



Data Points

Frequency (Hz)	Dev. (%)	Frequency (Hz)	Dev. (%)	Frequency (Hz)	Dev. (%)
0.5	0.5	10	0.0	70	0.1
1	0.1	15	0.1	REF. FREQ.	0.0
2	0.0	20	0.1	200	0.2
5	0.1	30	0.1	450	2.5
7	0.1	50	0.1		

Mounting Surface: Calibration Fixture w/Silicone Grease Fastener: Stud Fixture Orientation: Vertical
Acceleration Level (pk)[1]: 1.00 g (9.81 m/s²)
[1]The acceleration level may be limited by shaker displacement at low frequencies. If the listed level cannot be obtained, the calibration system uses the following formula to set the vibration amplitude; Acceleration Level (g) = 0.207 x (freq)². [2]The gravitational constant used for calculations by the calibration system is; 1 g = 9.80665 m/s².

Condition of Unit

As Found: In Tolerance

As Left: In Tolerance

Notes

1. Calibration is traceable to one or more of the following; PTB 10065, PTB 10066 and NIST 683/283498.
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3. Calibration is performed in compliance with ISO 10012-1, ANSI Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Due to state of art limitations, the test uncertainty ratio is 3:1. Measurement uncertainty (95% confidence level with coverage factor of 2) for frequency ranges tested during calibration are as follows: 0.5-0.99 Hz; +/- 1.8%, 1-30 Hz; +/- 1.0%, 30.01-199 Hz; +/- 1.5%, 200-1 kHz; +/- 3.0%.

Technician: Ronald Stevens RS 4270 Date: 1/25/2018

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~ Calibration Certificate ~

Per ISO 16063-21

Model Number: 3701G2FA50G

Serial Number: 7984

Description: DC Accelerometer

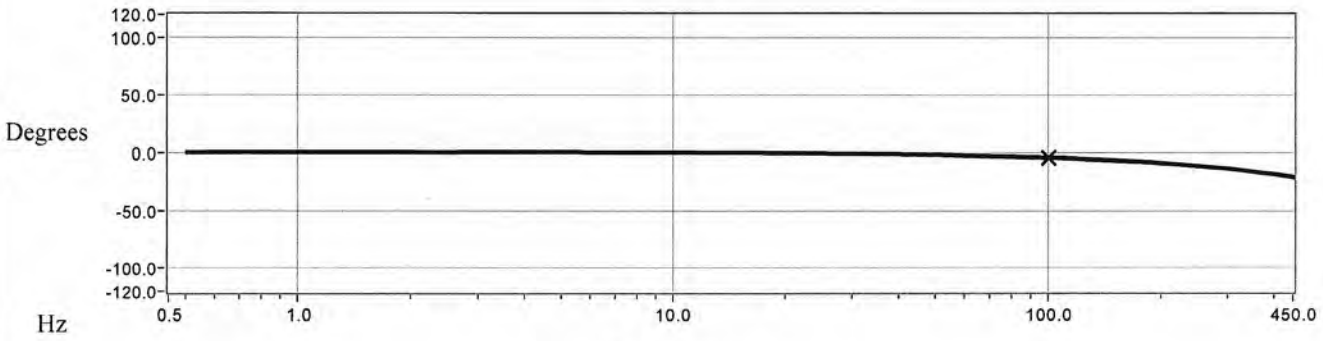
Manufacturer: PCB

Method: Back-to-Back Comparison AT401-12

Calibration Data

Sensitivity @ 100 Hz **60.9 mV/g** **(6.21 mV/m/s²)**

Phase Plot



Data Points

Frequency (Hz)	Phase (°)	Frequency (Hz)	Phase (°)
0.5	-0.3	30	-1.6
1	-0.1	50	-2.5
2	-0.2	70	-3.6
5	-0.3	REF. FREQ.	-5.0
7	-0.4	200	-9.5
10	-0.6	450	-21.4
15	-0.8		
20	-1.0		

Notes

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Technician: Ronald Stevens RS 4270 Date: 1/25/2018

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CAL96-3599769893.715+1

ACS-11

~ Calibration Certificate ~

Per ISO 16063-21

Model Number: 3711E1150G

Serial Number: 8860

Description: DC Accelerometer

Manufacturer: PCB

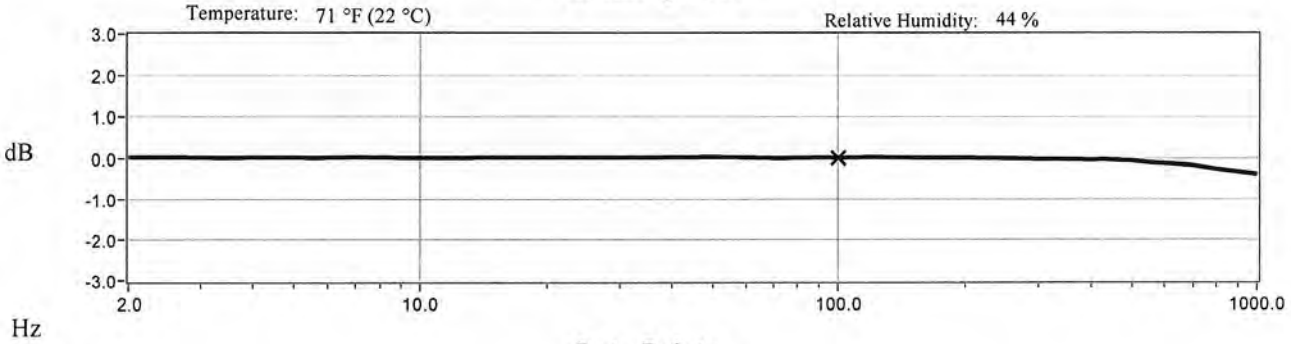
Method: Back-to-Back Comparison AT401-12

Calibration Data

Sensitivity @ 100 Hz **40.2 mV/g** **(4.10 mV/m/s²)**

Offset Voltage (@ 0 g) 9.3 mVDC

Sensitivity Plot



Data Points

Frequency (Hz)	Dev. (%)	Frequency (Hz)	Dev. (%)	Frequency (Hz)	Dev. (%)
2	0.1	20	0.1	200	-0.0
5	0.1	30	0.1	500	-0.8
7	0.1	50	0.3	1000	-4.5
10	0.0	70	-0.0		
15	0.1	REF. FREQ.	0.0		

Mounting Surface: Calibration Fixture w/Silicone Grease Fastener: Stud Fixture Orientation: Vertical
Acceleration Level (pk)[1]: 1.00 g (9.81 m/s²)
[1]The acceleration level may be limited by shaker displacement at low frequencies. If the listed level cannot be obtained, the calibration system uses the following formula to set the vibration amplitude; Acceleration Level (g) = 0.207 x (freq)². [2]The gravitational constant used for calculations by the calibration system is; 1 g = 9.80665 m/s².

Condition of Unit

As Found: In Tolerance

As Left: In Tolerance

Notes

1. Calibration is traceable to one or more of the following; PTB 10065, PTB 10066 and NIST 683/283498.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
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4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
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Technician: Ronald Stevens RS 4270 Date: 1/25/2018

ACCREDITED
CALIBRATION CERT #1862.01

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~ Calibration Certificate ~

Per ISO 16063-21

Model Number: 3711E1150G

Serial Number: 8860

Description: DC Accelerometer

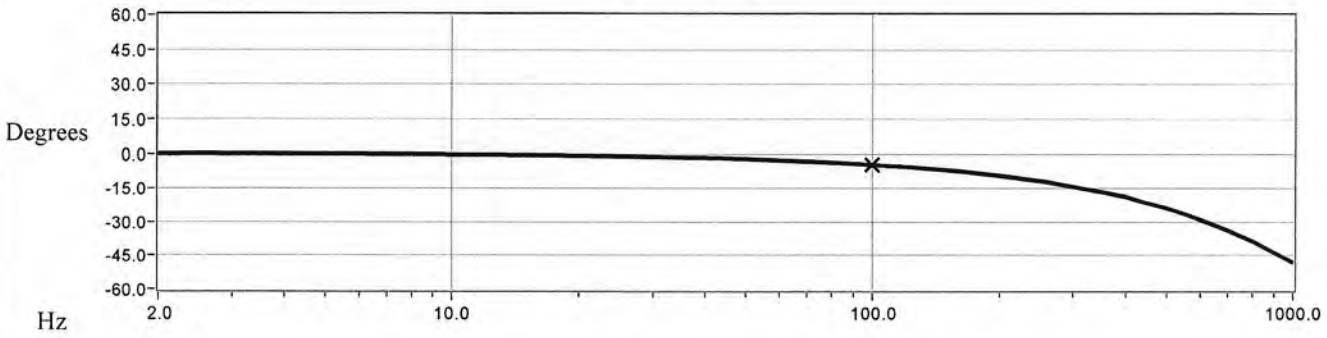
Manufacturer: PCB

Method: Back-to-Back Comparison AT401-12

Calibration Data

Sensitivity @ 100 Hz **40.2 mV/g** **(4.10 mV/m/s²)**

Phase Plot



Data Points

Frequency (Hz)	Phase (°)	Frequency (Hz)	Phase (°)
2	-0.2	70	-3.5
5	-0.3	REF. FREQ.	-4.9
7	-0.3	200	-9.5
10	-0.6	500	-23.9
15	-0.8	1000	-48.2
20	-1.0		
30	-1.5		
50	-2.4		

Notes

1. Calibration is traceable to one or more of the following; PTB 10065, PTB 10066 and NIST 683/283498.
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Technician: Ronald Stevens RS 4270 Date: 1/25/2018

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