Applied Foundation Testing

Alabama Certificate of Authorization CA3058-E

June 8, 2018
Revision 1: June 26, 2018
Revision 2: July 2, 2018

Report of High-Strain Dynamic Pile Testing and Axial Statnamic Load Testing
TP-23B
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 17:24:00 -04'00'

REVISION 2: Revision 2 includes placement of the approved inspector's pile driving log in Appendix A.

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.

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, 112-feet long spun-cast concrete cylinder pile at location TP-23B. 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 15 days after the initial drive of TP-23B. A 17 day restrike was subsequently performed 2 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-23B	Initial Drive	4/24/2018
	1 Day Restrike	4/25/2018
	Statnamic Load Testing	5/9/2018
	17 Day Restrike	5/11/2018

The project plans indicate test pile TP-23B was located at station 630+00.00 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-23B 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-23B. 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-23B 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-23B 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-23B, the pile was jetted until the pile tip was at approximate elevation -50 feet. Pile TP-23B 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-23B 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 -12.3 feet. After driving the elevation of the top of soil inside the cylinder pile was measured as -19.3 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-23B	Pileco D180-32	+11.3	-12.3	+12.4	-99.6

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-23B	EOD	13 Blows/3"	3.17	2.20	1.29	0.49	1.81	1.22	60.0/6.51

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.)
	1 Day RS	7 Blows/1", 5 Blows/1", 3 Blows/1"	5.10	4.51	1.60	0.95	3.26	3.07	115.9/8.28
	17 Day RS	4 Blows/1", 3 Blows/1", 3 Blows/1"	6.07	5.24	1.46	1.01	4.08	3.55	152.6/9.98

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 and restrikes. In general, the high tensile stresses for some blows occurred early in the initial drive in softer driving conditions. During restrikes, maximum tensile stress (TSX) values exceeding the allowable stress limits were measured. These high tensile stresses during restrikes were due to the use of a previously used conditioned pile cushion and the hammer at the highest fuel setting of 4 in order to transfer maximum energies to the pile to attempt to fully mobilize resistance. Given the purposes of the load test program, it is important to attempt to fully mobilize resistance during testing. 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-23B.

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-23B	EOD	853	1050	379	671	0.85	86.7/ 7.72	0.04	0.68	0.15	0.13	3.31
	1 Day Restrike	14	1050	549	501	0.70	144.0/ 9.07	0.04	0.40	0.30	0.15	2.45
	17 Day Restrike	3	1080	663	417	0.70	196.7/ 11.59	0.04	0.48	0.40	0.19	2.89

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 shown in the analyses are the combined side resistance from the exterior and interior of the cylinder piles. It is worth noting that the signal matching analyses indicated only a small increase in total resistance over time tested, with increasing side resistance values and deceasing end bearing resistance values over time. These changes may be due to a loss in end bearing resistance with an offsetting increase in side resistance, or it could be due to difficulties with the analysis program correctly separating side resistance and end bearing resistance.

The signal matching analysis for TP-23B indicated a total ultimate resistance of 1,050 kips at end of initial drive, 1,050 kips during the 1 day restrike; and 1,080 kips during the 17 day restrike (2 days after axial Statnamic load testing). Based on the set measurements during initial drive and restrikes for TP-23B, the resistance values presented in this report may be considered fully mobilized.

AXIAL STATNAMIC LOAD TESTING

Test pile TP-23B was subjected to axial Statnamic load testing (commonly referred to as Rapid load testing) on May 9, 2018, or 15 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-23B was loaded to a maximum derived static load of 1,917 kips. The maximum displacement during testing was 1.48 inches. The measured permanent displacement upon complete unloading was 1.25 inches. 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-23B is shown in Figure 1 located in Appendix D. The derived static load versus displacement response for TP-23B exhibited

primarily elastic behavior until the failure load of approximately 1,880 kips where pile to soil yielding behavior occurred.

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

Description	Data
Maximum Derived Static Load	1,917 kips
Maximum Displacement	1.48 inches
Permanent Displacement	1.25 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, 112-feet long spun-cast concrete cylinder pile at location TP-23B. TP-23B was subjected to dynamic pile testing during initial drive and 1 and 17 day restrikes and axial Statnamic load testing 15 days after initial drive. A summary of the load test results is provided below:

TP-23B Load Testing Summary:

- The signal matching analysis of the dynamic testing data for TP-23B indicated a total ultimate resistance of 1,050 kips at end of initial drive, 1,050 kips for the 1 day restrike, and 1,080 kips for the 17 day restrike (2 days after axial Statnamic rapid load testing).
- TP-23B was subjected to axial Statnamic load testing 15 days after initial drive with a maximum derived static load of 1,917 kips with a maximum displacement of 1.48 inches and a permanent displacement of 1.25 inches.
- The failure load during axial Statnamic load testing based on the Davisson Failure Criterion was approximately 1,800 kips. The pile top displacement at the failure load was approximately 0.94 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, 112-feet long spun-cast concrete cylinder pile at location TP-23B are as follows:

- The dynamic pile testing results indicated lower ultimate total resistances than measured during the axial Statnamic load test at TP-23B. 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.
- The signal matching analyses indicated only a small increase in total resistance over the time tested for TP-23B. Additionally, the signal matching analyses indicate increasing side resistance values and deceasing end bearing resistance values over time. These changes may be due to a loss in end bearing resistance with an offsetting increase in side resistance, or it could be due to difficulties with the CAPWAP signal matching analysis program correctly separating side resistance and end bearing resistance.
- 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-23B

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: IM-I010(341)	County: Mobile	Division: Southwest Region
Bridge: Station 630+00 to Station 630+00		Bridge Identification Number:
Road Between: I-10 and I-10		Lane (if applicable): WB
Contractor: Jordan Pile Driving	Inspector: Donald Hector	
Date: 4/24/2018	Bent No.& Lane: TEST PILE	Pile No.: TP-23B
Kind of Soil: Soft, Wet, Black, Fat Clay		
Kind of Pile: Spun Cast Cylinder	Size of Pile: 54"	Total Length (ft): 112
Elev. Ground Line at Pile: -12.3	Final Elev. At Top of Pile: 12.4	Tip Elevation: -99.6
Hammer Make: PILECO	Hammer Model: D180-32	Hammer Kind: Diesel
Hammer Type: Open	Hammer Action: Single	Rated Energy (ft.-lbs.): 443,500@11.1 Stroke
Weight of Hammer (lbs.): 39,680	Design Load (from plans) (tons):	
Hammer Cushion: Material: Aluminum and Micarta Alternating	Thickness (in.): 12	Area (sq. in.): 762
Pile Cushion (Before Driving): Material: Plywood	Thickness (in.): 12	Area (sq. in.): 904.32
Pile Cushion (After Driving): Material: Plywood	Thickness (in.):	Area (sq. in.):
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	80	
5.66	224,589	15	81	
6.09	241,651	26	82	
6.24	247,603	30	83	

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
630+00	630+00	N/A

Date	Bent No.& Lane	Pile No.	Kind of Soil
4/24/2018	TEST PILE	TP-23B	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)
6.30	249,984	31	84	
6.37	252,762	32	85	
6.41	254,349	37	86	
6.49	257,523	45	87	
6.43	255,142	48	88	
6.44	255,539	45	89	
6.49	257,523	43	90	
6.45	255,936	40	91	
5.44	215,859	55	92	
6.41	254,349	47	93	
6.39	253,555	47	94	
6.36	252,365	44	95	
6.36	252,365	55	96	
7.56	299,981	37	97	
7.47	296,410	37	98	
7.48	296,806	42	99	

Appendix B

Dynamic Pile Testing Data Summaries
TP-23B

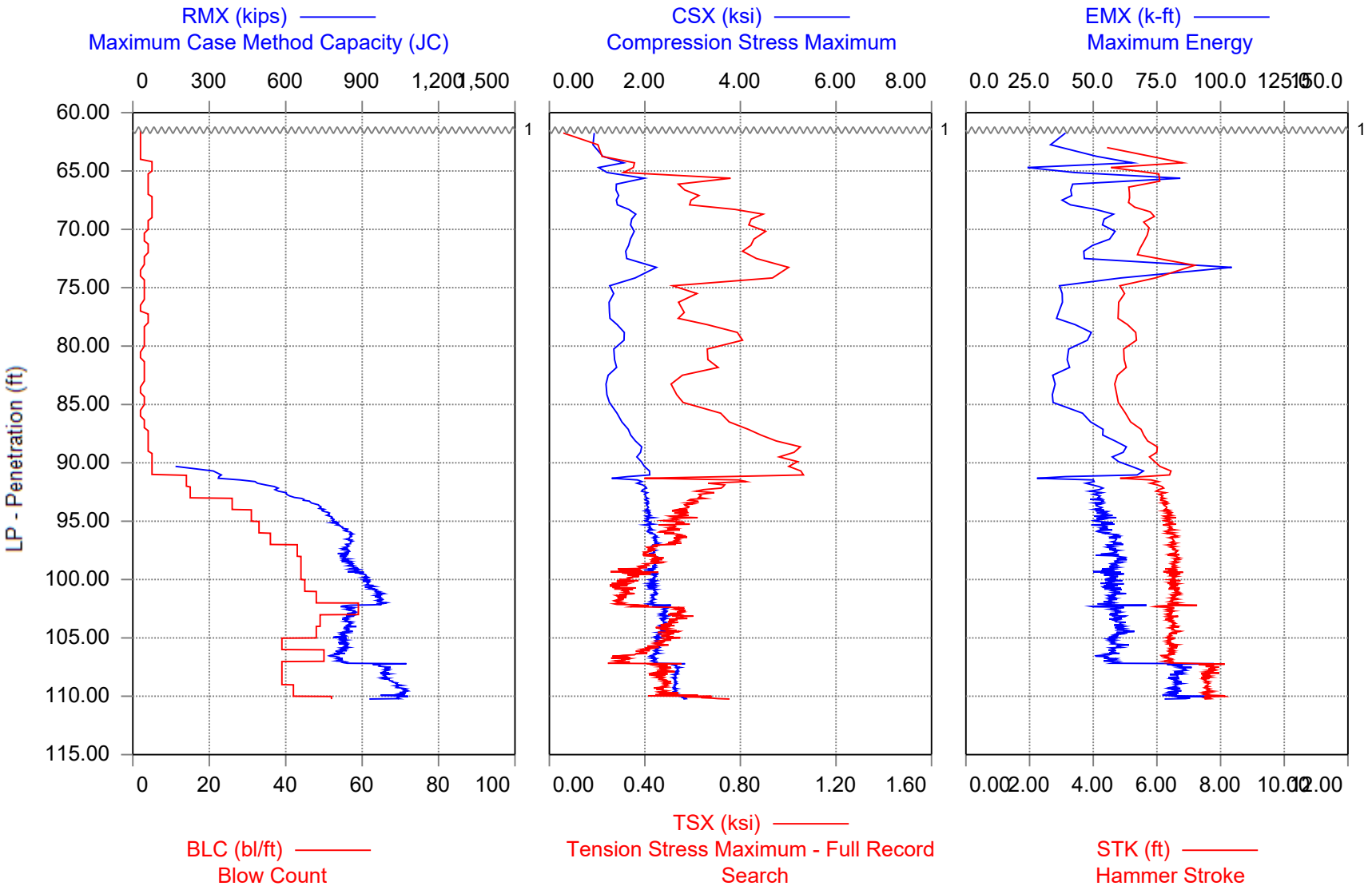
I-10 over Mobile River Bridge Load Test Program

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: 30-May-2018 Test started: 24-April-2018

I-10 MOBILE RIVER - TP-23B ID



1 - Template (Reference) El. = 11.25', Mudline El. = -12.3'

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

AR: 904.78 in² SP: 0.150 k/ft³
LE: 103.00 ft EM: 7,778.33 ksi
WS: 15,500.0 f/s JC: 0.85

RMX: Maximum Case Method Capacity (JC)
RX9: Maximum Case Method Capacity (JC=0.9)
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#	Depth ft	BLC bl/ft	TYPE	RMX kips	RX9 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
2	62.00	2	AV2	0	0	0	0.94	0.14	0.06	39.1	**	85
			STD	0	0	0	0.07	0.01	0.04	2.1	**	5
			MAX	0	0	0	1.01	0.15	0.10	41.3	**	89
			MIN	0	0	0	0.87	0.14	0.01	37.0	**	80
4	63.00	2	AV2	0	0	0	0.91	0.10	0.20	33.2	4.20	88
			STD	0	0	0	0.23	0.08	0.08	21.3	0.00	12
			MAX	0	0	0	1.14	0.18	0.28	54.5	4.20	100
			MIN	0	0	0	0.69	0.01	0.13	11.9	4.20	76
6	64.00	2	AV2	0	0	0	1.12	0.17	0.22	51.4	4.67	88
			STD	0	0	0	0.15	0.10	0.17	28.0	0.00	12
			MAX	0	0	0	1.27	0.27	0.39	79.4	4.67	100
			MIN	0	0	0	0.98	0.07	0.05	23.4	4.67	76
11	65.00	5	AV5	0	0	64	1.19	0.23	0.33	38.7	5.34	100
			STD	0	0	81	0.32	0.08	0.16	24.5	1.33	0
			MAX	0	0	195	1.57	0.34	0.58	81.9	7.64	100
			MIN	0	0	0	0.76	0.15	0.13	14.5	3.97	100
15	66.00	4	AV4	0	0	85	1.78	0.38	0.63	71.1	6.77	100
			STD	0	0	56	0.22	0.05	0.18	18.2	1.14	0
			MAX	0	0	158	1.99	0.44	0.91	97.1	8.15	100
			MIN	0	0	0	1.48	0.30	0.40	45.6	5.35	100
19	67.00	4	AV4	0	0	0	1.39	0.29	0.56	40.7	5.13	100
			STD	0	0	0	0.05	0.01	0.06	1.5	0.06	0
			MAX	0	0	0	1.45	0.31	0.63	42.4	5.20	100
			MIN	0	0	0	1.32	0.28	0.48	38.2	5.05	100
24	68.00	5	AV5	0	0	9	1.42	0.30	0.60	39.7	5.13	100
			STD	0	0	17	0.04	0.01	0.03	2.1	0.07	0
			MAX	0	0	43	1.45	0.32	0.63	42.9	5.22	100
			MIN	0	0	0	1.36	0.29	0.55	36.6	5.05	100
29	69.00	5	AV5	0	0	43	1.75	0.37	0.85	54.8	5.77	100
			STD	0	0	9	0.08	0.02	0.07	3.6	0.20	0
			MAX	0	0	51	1.84	0.39	0.91	58.7	6.01	100
			MIN	0	0	29	1.59	0.33	0.72	48.5	5.42	100
33	70.00	4	AV4	0	0	37	1.71	0.34	0.84	54.1	5.67	100
			STD	0	0	8	0.05	0.01	0.04	2.3	0.09	0
			MAX	0	0	44	1.78	0.35	0.90	57.1	5.80	100
			MIN	0	0	27	1.66	0.34	0.80	51.7	5.56	100

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

BL#	Depth ft	BLC bl/ft	TYPE	RMX kips	RX9 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
36	71.00	3	AV3	0	0	0	1.72	0.33	0.88	57.7	5.67	100
			STD	0	0	0	0.04	0.01	0.03	1.7	0.10	0
			MAX	0	0	0	1.77	0.34	0.91	60.1	5.80	100
			MIN	0	0	0	1.68	0.32	0.83	56.2	5.59	100
40	72.00	4	AV4	0	0	25	1.63	0.32	0.83	48.0	5.45	100
			STD	0	0	3	0.04	0.01	0.03	1.9	0.09	0
			MAX	0	0	28	1.68	0.33	0.86	50.6	5.54	100
			MIN	0	0	20	1.57	0.30	0.78	45.3	5.31	100
43	73.00	3	AV3	0	0	7	1.75	0.33	0.82	58.6	5.43	100
			STD	0	0	10	0.18	0.05	0.06	17.6	0.03	0
			MAX	0	0	21	2.01	0.40	0.88	82.8	5.47	100
			MIN	0	0	0	1.60	0.29	0.74	41.7	5.40	100
45	74.00	2	AV2	0	0	27	2.36	0.41	1.28	104.2	7.96	100
			STD	0	0	27	0.11	0.04	0.01	21.7	1.02	0
			MAX	0	0	53	2.47	0.46	1.29	125.8	8.98	100
			MIN	0	0	0	2.24	0.37	1.27	82.5	6.95	100
48	75.00	3	AV3	0	0	0	1.29	0.22	0.54	37.5	4.88	100
			STD	0	0	0	0.09	0.02	0.08	3.8	0.14	0
			MAX	0	0	0	1.36	0.23	0.60	41.2	4.99	100
			MIN	0	0	0	1.16	0.20	0.43	32.2	4.68	100
51	76.00	3	AV3	0	0	0	1.30	0.22	0.57	36.9	4.88	100
			STD	0	0	0	0.09	0.02	0.08	2.2	0.16	0
			MAX	0	0	0	1.41	0.24	0.67	40.0	5.08	100
			MIN	0	0	0	1.20	0.20	0.47	35.1	4.68	100
53	77.00	2	AV2	0	0	0	1.28	0.16	0.59	40.5	4.85	90
			STD	0	0	0	0.02	0.01	0.02	0.2	0.07	1
			MAX	0	0	0	1.30	0.17	0.61	40.7	4.91	90
			MIN	0	0	0	1.26	0.16	0.57	40.3	4.78	89
57	78.00	4	AV4	0	0	24	1.29	0.22	0.56	35.7	4.83	100
			STD	0	0	14	0.04	0.01	0.03	2.4	0.07	0
			MAX	0	0	36	1.36	0.24	0.60	39.3	4.95	100
			MIN	0	0	0	1.24	0.21	0.51	32.5	4.76	100
60	79.00	3	AV3	0	0	0	1.54	0.26	0.76	48.3	5.29	100
			STD	0	0	0	0.05	0.01	0.04	1.7	0.07	0
			MAX	0	0	0	1.61	0.26	0.82	50.6	5.38	100
			MIN	0	0	0	1.48	0.25	0.72	46.5	5.20	100
63	80.00	3	AV3	0	0	0	1.50	0.24	0.77	44.6	5.25	100
			STD	0	0	0	0.09	0.02	0.06	4.6	0.17	0
			MAX	0	0	0	1.61	0.27	0.84	49.7	5.45	100
			MIN	0	0	0	1.39	0.21	0.70	38.6	5.03	100
65	81.00	2	AV2	0	0	0	1.34	0.16	0.66	42.1	4.95	95
			STD	0	0	0	0.03	0.00	0.03	0.1	0.08	5
			MAX	0	0	0	1.37	0.16	0.69	42.2	5.03	100

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

BL#	Depth ft	BLC bl/ft	TYPE	RMX kips	RX9 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
			MIN	0	0	0	1.31	0.16	0.63	42.0	4.87	90
68	82.00	3	AV3	0	0	0	1.39	0.19	0.68	39.6	4.99	100
			STD	0	0	0	0.03	0.01	0.03	1.5	0.07	0
			MAX	0	0	0	1.43	0.20	0.72	41.1	5.08	100
			MIN	0	0	0	1.35	0.19	0.64	37.5	4.91	100
71	83.00	3	AV3	0	0	0	1.22	0.17	0.54	33.7	4.73	100
			STD	0	0	0	0.05	0.01	0.04	1.7	0.06	0
			MAX	0	0	0	1.29	0.17	0.61	36.0	4.82	100
			MIN	0	0	0	1.18	0.16	0.51	32.1	4.67	100
73	84.00	2	AV2	0	0	0	1.21	0.13	0.55	36.6	4.75	100
			STD	0	0	0	0.03	0.00	0.04	0.6	0.07	0
			MAX	0	0	0	1.24	0.14	0.59	37.2	4.82	100
			MIN	0	0	0	1.18	0.13	0.51	36.0	4.68	100
76	85.00	3	AV3	0	0	7	1.23	0.16	0.53	33.4	4.75	96
			STD	0	0	7	0.04	0.01	0.04	1.2	0.07	6
			MAX	0	0	16	1.28	0.17	0.57	34.5	4.83	100
			MIN	0	0	0	1.17	0.15	0.48	31.8	4.67	88
78	86.00	2	AV2	0	0	0	1.41	0.16	0.72	45.8	5.01	95
			STD	0	0	0	0.00	0.00	0.00	1.6	0.00	5
			MAX	0	0	0	1.42	0.17	0.72	47.4	5.01	100
			MIN	0	0	0	1.41	0.16	0.71	44.2	5.01	90
81	87.00	3	AV3	0	0	4	1.56	0.27	0.78	51.5	5.29	100
			STD	0	0	6	0.08	0.03	0.05	5.0	0.19	0
			MAX	0	0	12	1.65	0.31	0.84	56.7	5.51	100
			MIN	0	0	0	1.47	0.23	0.73	44.8	5.05	100
85	88.00	4	AV4	0	0	103	1.70	0.31	0.88	53.2	5.57	100
			STD	0	0	23	0.04	0.01	0.04	1.4	0.05	0
			MAX	0	0	125	1.76	0.32	0.94	54.5	5.63	100
			MIN	0	0	65	1.65	0.30	0.82	51.0	5.49	100
89	89.00	4	AV4	0	0	158	1.91	0.37	1.03	63.6	5.97	100
			STD	0	0	17	0.04	0.02	0.04	1.4	0.11	0
			MAX	0	0	170	1.94	0.40	1.06	66.0	6.06	100
			MIN	0	0	129	1.85	0.34	0.96	62.5	5.78	100
94	90.00	5	AV5	0	0	162	1.88	0.37	1.00	58.5	5.87	100
			STD	0	0	23	0.04	0.02	0.04	2.1	0.08	0
			MAX	0	0	207	1.93	0.40	1.05	61.7	5.96	100
			MIN	0	0	142	1.83	0.35	0.96	55.4	5.75	100
99	91.00	5	AV5	255	252	211	2.05	0.55	1.03	67.5	6.29	100
			STD	79	82	39	0.06	0.04	0.03	2.7	0.18	0
			MAX	334	334	265	2.12	0.59	1.07	69.8	6.51	100
			MIN	118	109	167	1.94	0.47	0.98	62.5	5.98	100
113	92.00	14	AV14	436	435	382	1.79	0.59	0.72	46.0	5.76	100

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

BL#	Depth ft	BLC bl/ft	TYPE	RMX kips	RX9 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
			STD	77	77	52	0.29	0.14	0.22	11.6	0.56	0
			MAX	543	543	463	2.12	0.77	1.11	66.1	6.45	100
			MIN	296	296	259	1.17	0.37	0.30	22.7	4.61	100
128	93.00	15	AV15	592	591	491	2.01	0.88	0.66	52.1	6.14	100
			STD	26	26	29	0.05	0.03	0.05	2.1	0.12	0
			MAX	645	644	544	2.07	0.93	0.77	55.3	6.34	100
			MIN	552	552	449	1.91	0.83	0.60	47.3	5.93	100
154	94.00	26	AV26	710	709	632	2.05	0.97	0.59	52.2	6.24	100
			STD	29	29	46	0.03	0.02	0.03	1.9	0.09	0
			MAX	759	759	770	2.10	1.01	0.66	55.6	6.42	100
			MIN	662	661	556	1.97	0.90	0.52	48.8	6.04	100
185	95.00	31	AV31	771	770	719	2.07	1.01	0.54	53.5	6.35	100
			STD	15	15	40	0.05	0.03	0.04	3.1	0.13	0
			MAX	797	797	837	2.18	1.09	0.63	62.0	6.63	100
			MIN	737	737	671	1.98	0.96	0.47	48.9	6.14	100
218	96.00	33	AV33	821	820	847	2.10	1.05	0.52	54.1	6.41	100
			STD	23	23	53	0.06	0.03	0.05	3.1	0.14	0
			MAX	874	874	925	2.21	1.11	0.60	59.1	6.76	100
			MIN	772	772	715	1.97	0.99	0.41	48.4	6.12	100
254	97.00	36	AV36	853	852	897	2.22	1.16	0.53	58.6	6.51	100
			STD	9	9	32	0.06	0.04	0.06	3.2	0.15	0
			MAX	871	871	943	2.33	1.26	0.63	65.1	6.79	100
			MIN	822	821	783	2.03	1.10	0.42	50.5	6.14	100
297	98.00	43	AV43	838	837	935	2.16	1.22	0.42	57.2	6.53	100
			STD	15	15	34	0.09	0.03	0.06	4.2	0.21	0
			MAX	859	858	996	2.36	1.30	0.57	67.9	7.08	100
			MIN	787	787	777	1.80	1.14	0.23	39.7	5.73	100
341	99.00	44	AV44	846	836	926	2.23	1.27	0.43	59.3	6.57	100
			STD	20	17	21	0.06	0.02	0.04	2.5	0.11	0
			MAX	880	868	978	2.35	1.31	0.53	64.9	6.85	100
			MIN	782	781	881	2.07	1.23	0.34	53.7	6.25	100
385	100.00	44	AV44	895	884	920	2.17	1.29	0.35	56.8	6.50	100
			STD	25	25	21	0.08	0.03	0.06	3.5	0.18	0
			MAX	933	921	965	2.38	1.35	0.53	67.0	7.01	100
			MIN	839	830	863	1.96	1.23	0.20	48.9	6.09	100
430	101.00	45	AV45	931	922	935	2.16	1.32	0.31	57.3	6.54	100
			STD	19	19	22	0.06	0.02	0.04	3.3	0.15	0
			MAX	966	959	975	2.27	1.36	0.42	64.6	6.91	100
			MIN	875	864	863	2.00	1.26	0.24	50.6	6.20	100
478	102.00	48	AV48	968	965	964	2.18	1.32	0.31	57.9	6.56	100
			STD	13	14	19	0.05	0.02	0.03	2.3	0.11	0
			MAX	1,010	1,010	1,010	2.27	1.35	0.37	63.6	6.76	100
			MIN	935	931	916	2.07	1.28	0.26	52.1	6.31	100

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

BL#	Depth ft	BLC bl/ft	TYPE	RMX kips	RX9 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
537	103.00	59	AV59	872	872	971	2.35	1.41	0.47	58.2	6.42	100
			STD	52	52	36	0.14	0.06	0.11	5.0	0.24	0
			MAX	1,019	1,017	1,123	2.81	1.66	0.63	84.8	7.64	100
			MIN	771	771	833	2.01	1.29	0.13	48.4	5.91	100
586	104.00	49	AV49	846	839	971	2.39	1.43	0.52	59.7	6.47	100
			STD	14	14	16	0.05	0.02	0.04	2.2	0.10	0
			MAX	892	891	1,003	2.57	1.47	0.67	66.4	6.82	100
			MIN	814	811	935	2.30	1.38	0.43	54.4	6.25	100
634	105.00	48	AV48	835	826	1,011	2.33	1.47	0.50	60.5	6.49	100
			STD	19	17	21	0.06	0.02	0.04	2.7	0.12	0
			MAX	889	873	1,053	2.49	1.51	0.62	68.0	6.85	100
			MIN	774	774	953	2.21	1.43	0.44	55.5	6.28	100
673	106.00	39	AV39	828	824	1,037	2.27	1.46	0.46	58.5	6.45	100
			STD	16	16	19	0.05	0.02	0.05	2.5	0.12	0
			MAX	859	854	1,072	2.40	1.52	0.55	66.8	6.76	100
			MIN	796	794	988	2.18	1.42	0.34	54.1	6.25	100
723	107.00	50	AV50	806	799	1,004	2.20	1.50	0.34	56.2	6.38	100
			STD	19	19	28	0.06	0.02	0.05	2.6	0.12	0
			MAX	840	837	1,063	2.39	1.55	0.49	63.9	6.76	100
			MIN	765	757	951	2.08	1.45	0.23	49.6	6.09	100
762	108.00	39	AV39	963	952	1,056	2.59	1.65	0.44	80.4	7.48	100
			STD	66	66	38	0.19	0.06	0.09	11.1	0.52	0
			MAX	1,081	1,066	1,122	2.90	1.74	0.66	101.8	8.61	100
			MIN	812	802	958	2.19	1.51	0.19	56.6	6.37	100
801	109.00	39	AV39	1,006	990	1,050	2.64	1.66	0.48	82.7	7.58	100
			STD	24	23	17	0.10	0.02	0.10	5.2	0.27	0
			MAX	1,048	1,031	1,085	2.90	1.73	0.71	95.9	8.36	100
			MIN	936	925	1,019	2.42	1.61	0.24	70.9	6.98	100
843	110.00	42	AV42	1,053	1,038	1,023	2.64	1.61	0.49	81.9	7.62	100
			STD	45	43	45	0.15	0.05	0.12	7.4	0.26	0
			MAX	1,172	1,153	1,121	3.17	1.81	0.79	105.7	8.57	100
			MIN	877	859	775	2.27	1.54	0.15	61.1	7.11	100
856	110.25	52	AV13	1,024	1,005	962	2.83	1.61	0.66	84.2	7.58	100
			STD	55	55	78	0.03	0.04	0.07	3.9	0.09	0
			MAX	1,049	1,033	1,001	2.88	1.74	0.85	89.8	7.72	100
			MIN	837	817	694	2.77	1.57	0.55	73.2	7.46	100
			Average	768	762	826	2.20	1.22	0.49	60.0	6.51	100
			Std. Dev.	293	290	313	0.34	0.40	0.16	12.3	0.65	2
			Maximum	1,172	1,153	1,123	3.17	1.81	1.29	125.8	8.98	100
			Minimum	0	0	0	0.69	0.01	0.01	11.9	3.97	76

Total number of blows analyzed: 856

BL# Sensors

1-856 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. = -12.3'

Time Summary

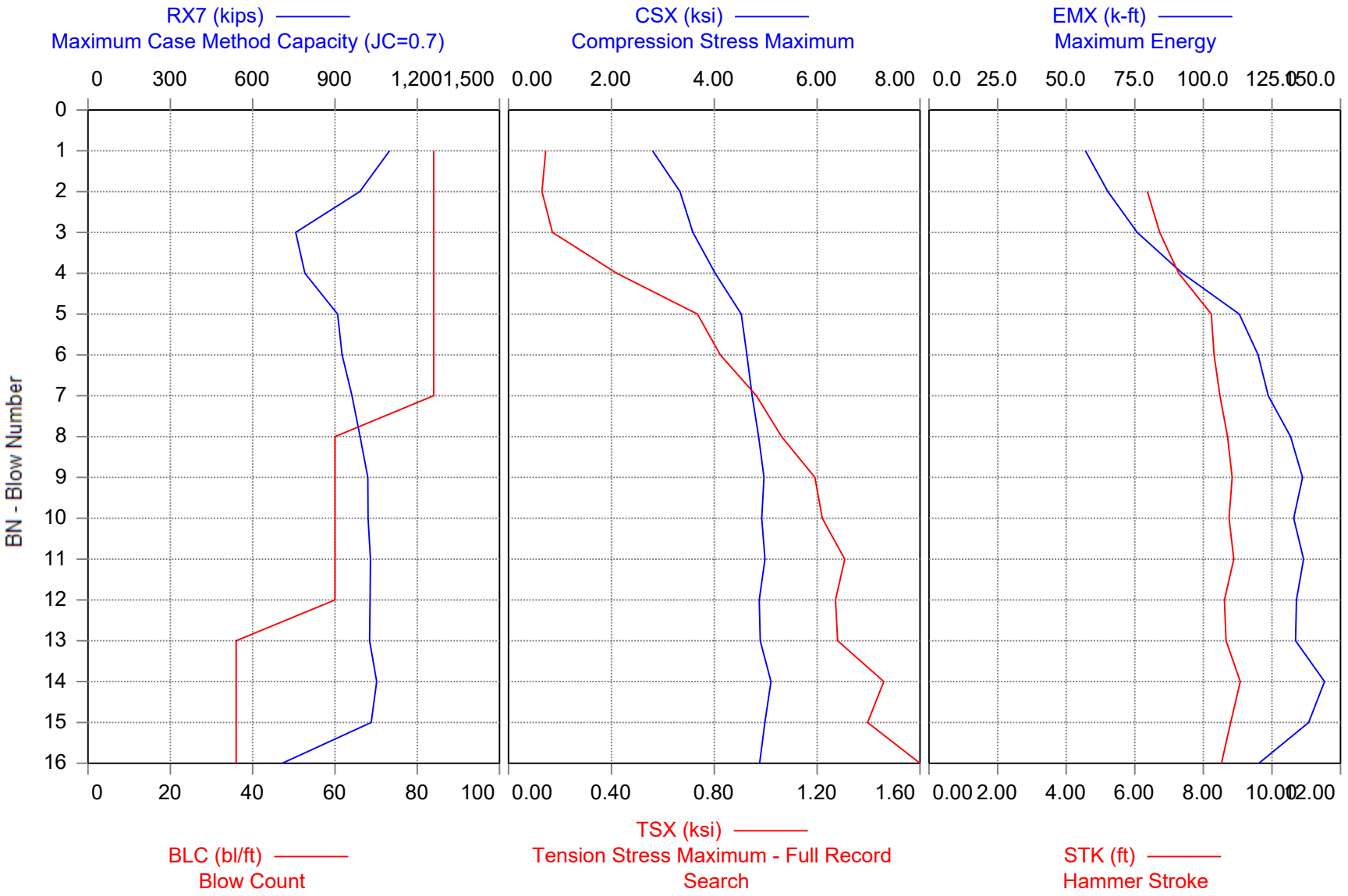
Drive	17 minutes 50 seconds	10:35 AM - 10:53 AM (4/24/2018) BN 1 - 488
Stop	53 minutes 6 seconds	10:53 AM - 11:46 AM
Drive	10 minutes 2 seconds	11:46 AM - 11:56 AM BN 489 - 856

Total time [01:20:59] = (Driving [00:27:53] + Stop [00:53:06])

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

Printed: 30-May-2018 Test started: 25-April-2018

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



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

AR: 904.78 in² SP: 0.150 k/ft³
LE: 103.00 ft EM: 7,778.33 ksi
WS: 15,500.0 f/s JC: 0.70

RX7: Maximum Case Method Capacity (JC=0.7)
RX8: Maximum Case Method Capacity (JC=0.8)
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	RX7	RX8	RA2	CSX	CSB	TSX	EMX	STK	BTA
	bl/ft	kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
1	84	1,099	864	857	2.80	2.41	0.14	57.0	0.00	100
2	84	991	696	960	3.33	2.71	0.13	65.2	6.37	100
3	84	757	666	913	3.58	2.84	0.17	75.9	6.72	100
4	84	791	781	980	4.02	2.98	0.42	92.3	7.28	100
5	84	910	882	1,016	4.52	3.24	0.73	113.1	8.23	100
6	84	926	888	1,040	4.63	3.26	0.82	120.0	8.31	100
7	84	962	914	995	4.74	3.26	0.96	123.6	8.48	100
8	60	992	933	1,016	4.86	3.26	1.06	131.8	8.70	100
9	60	1,020	954	1,014	4.97	3.23	1.19	136.1	8.84	100
10	60	1,021	959	1,005	4.92	3.18	1.22	132.9	8.75	100
11	60	1,029	964	999	4.99	3.13	1.31	136.5	8.89	100
12	60	1,028	973	1,009	4.87	3.20	1.27	133.9	8.61	100
13	36	1,026	965	957	4.89	3.10	1.28	133.6	8.66	100
14	36	1,052	976	948	5.10	3.15	1.46	144.2	9.07	100
15	36	1,032	962	938	4.98	3.10	1.40	138.4	8.79	100
16	36	708	632	766	4.88	3.04	1.60	120.2	8.53	100
Average		959	875	963	4.51	3.07	0.95	115.9	8.28	100
Std. Dev.		110	113	68	0.67	0.23	0.48	27.0	0.79	0
Maximum		1,099	976	1,040	5.10	3.26	1.60	144.2	9.07	100
Minimum		708	632	766	2.80	2.41	0.13	57.0	6.37	100

Total number of blows analyzed: 16

BL# Sensors

1-16 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

16 7BL/1", 5BL/1", 3BL/1"

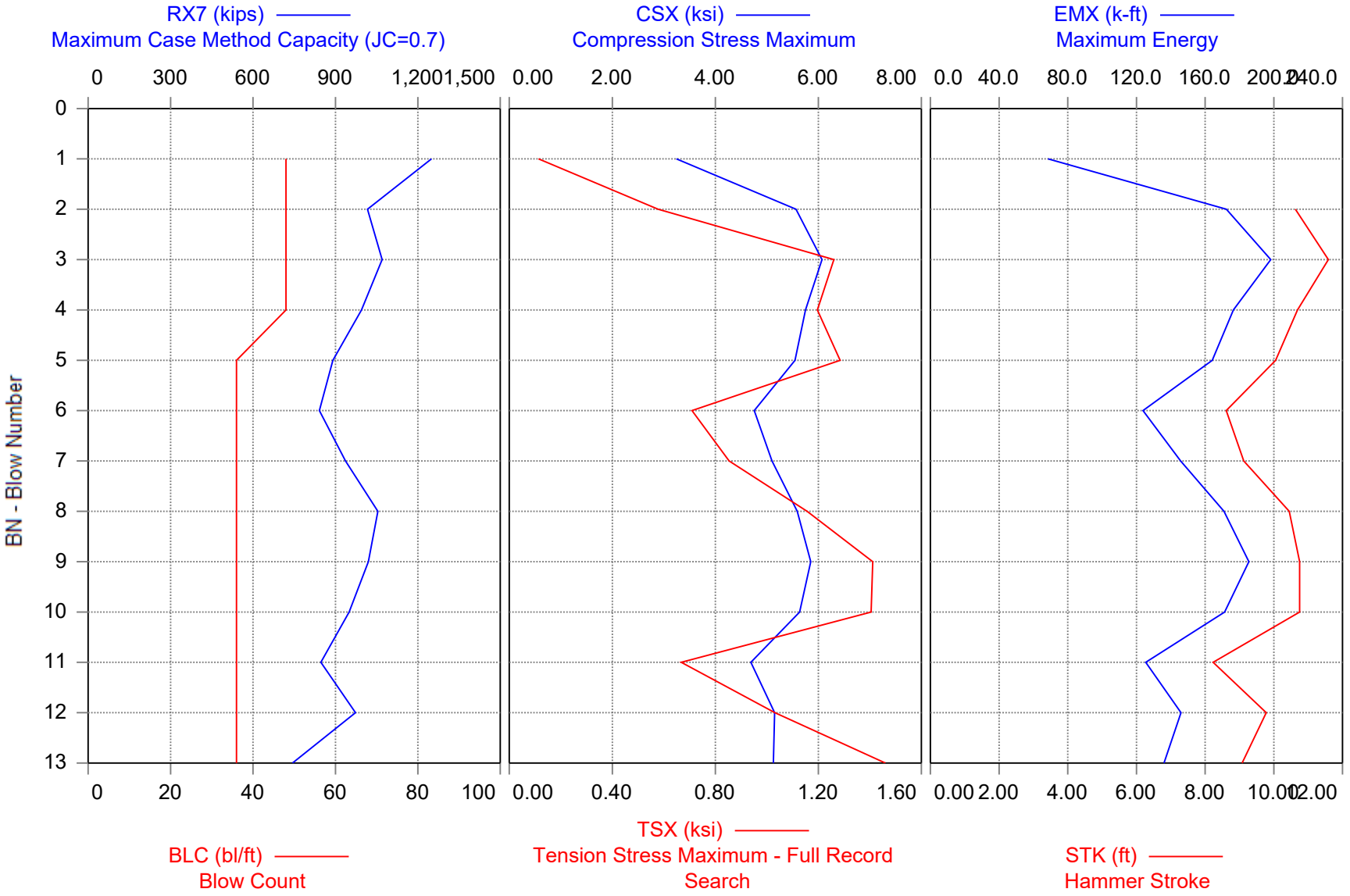
Time Summary

Drive 21 seconds 3:05 PM - 3:05 PM BN 1 - 16

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

Printed: 30-May-2018 Test started: 11-May-2018

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



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

AR: 904.78 in² SP: 0.150 k/ft³
LE: 103.00 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#	BLC	RX7	RX8	RA2	CSX	CSB	TSX	EMX	STK	BTA
	bl/ft	kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
1	48	1,250	980	961	3.24	2.80	0.11	68.5	0.00	100
2	48	1,017	983	1,101	5.57	4.08	0.58	172.3	10.63	100
3	48	1,070	1,002	1,121	6.07	4.04	1.26	198.2	11.59	100
4	48	995	947	1,037	5.75	3.84	1.20	176.4	10.69	100
5	36	891	854	935	5.55	3.65	1.28	164.1	10.05	100
6	36	841	799	954	4.75	3.32	0.71	123.8	8.61	100
7	36	937	895	1,040	5.10	3.45	0.85	145.7	9.12	100
8	36	1,054	989	1,107	5.59	3.62	1.16	171.0	10.45	100
9	36	1,020	964	1,121	5.85	3.74	1.41	185.4	10.75	100
10	36	950	890	1,010	5.64	3.67	1.40	171.3	10.75	100
11	36	847	812	1,004	4.69	3.24	0.67	125.4	8.23	100
12	36	973	916	1,079	5.15	3.36	1.03	145.9	9.78	100
13	36	744	673	832	5.12	3.36	1.46	136.0	9.07	100
Average		968	900	1,023	5.24	3.55	1.01	152.6	9.98	100
Std. Dev.		121	92	83	0.70	0.34	0.39	32.8	0.98	0
Maximum		1,250	1,002	1,121	6.07	4.08	1.46	198.2	11.59	100
Minimum		744	673	832	3.24	2.80	0.11	68.5	8.23	100

Total number of blows analyzed: 13

BL# Sensors

1-13 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

13 4BL/1", 3BL/1", 3BL/1"

Time Summary

Drive 19 seconds 8:16 AM - 8:16 AM BN 1 - 13

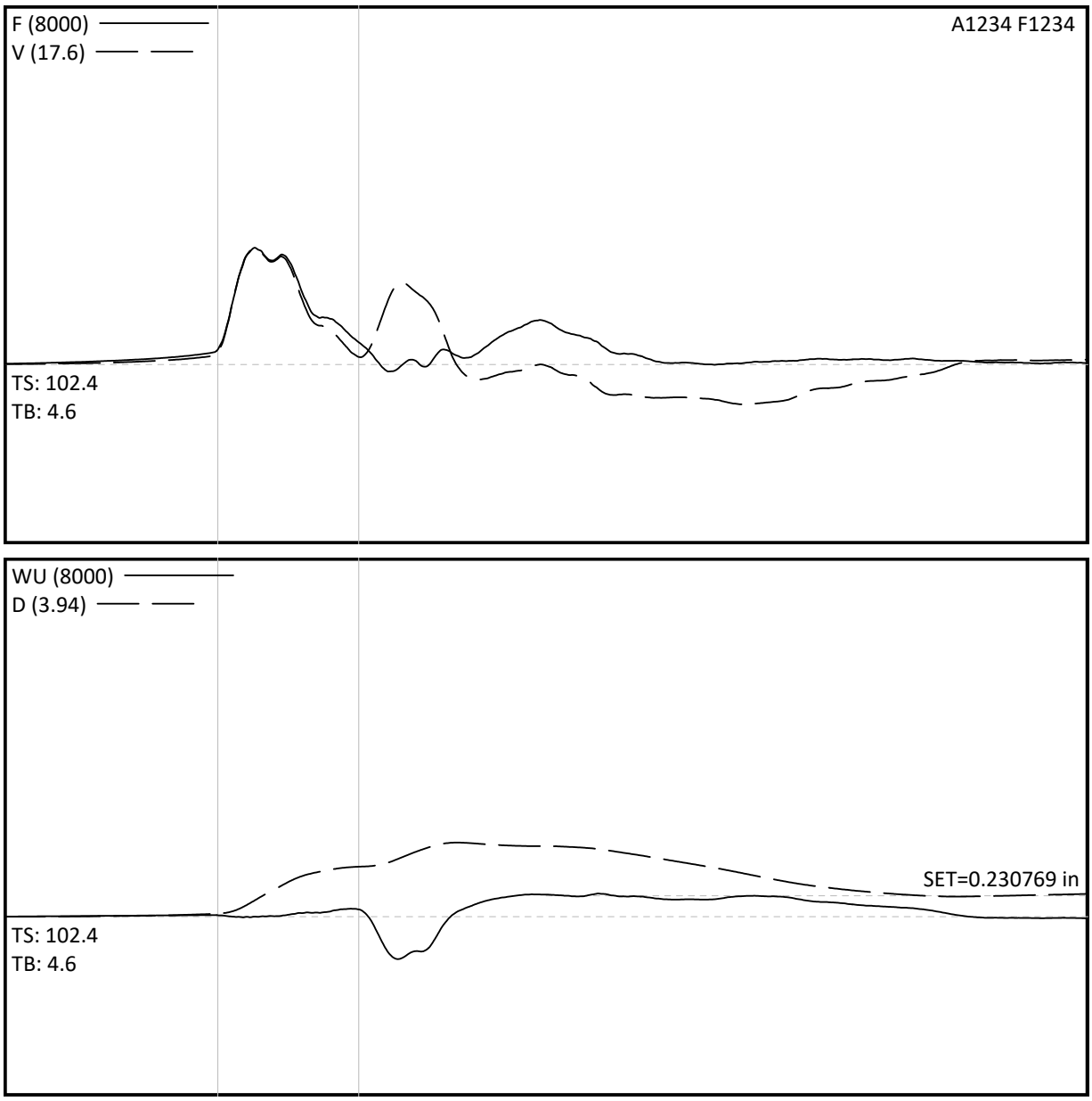
Appendix C

CAPWAP Signal Matching Analysis Output
TP-23B

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-23B ID



Project Information

PROJECT: I-10 MOBILE RIVER
PILE NAME: TP-23B ID
DESCR: 54'' CYL, 6'' WALL
OPERATOR: AFT
FILE: TP-23B ID ana
4/24/2018 11:56:24 AM
Blow Number 853

Pile Properties

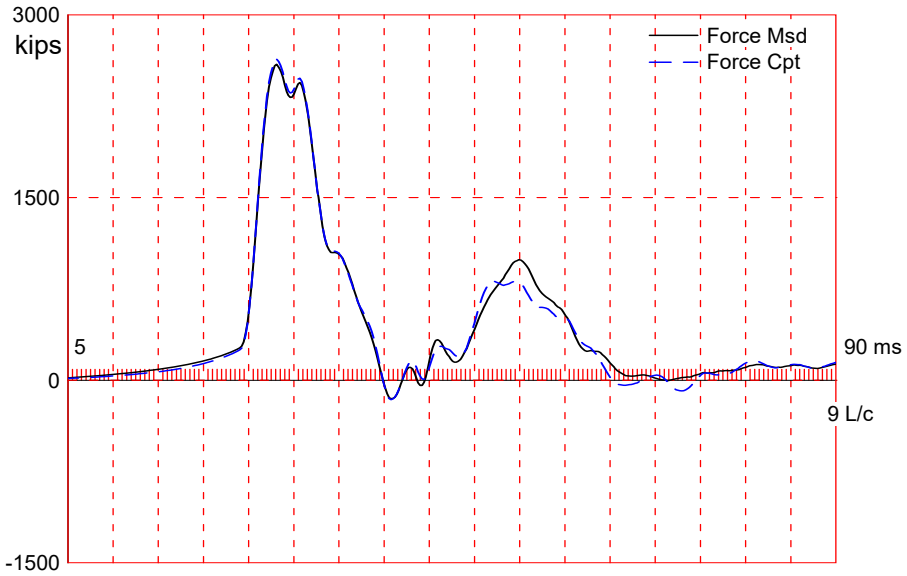
LE 103.00 ft
AR 904.78 in^2
EM 7778.33 ksi
SP 0.150 k/ft3
WS 15500.0 f/s
EA/C 454.0 ksec/ft
2L/C 13.30 ms
JC 0.85 []
LP 110.19 ft

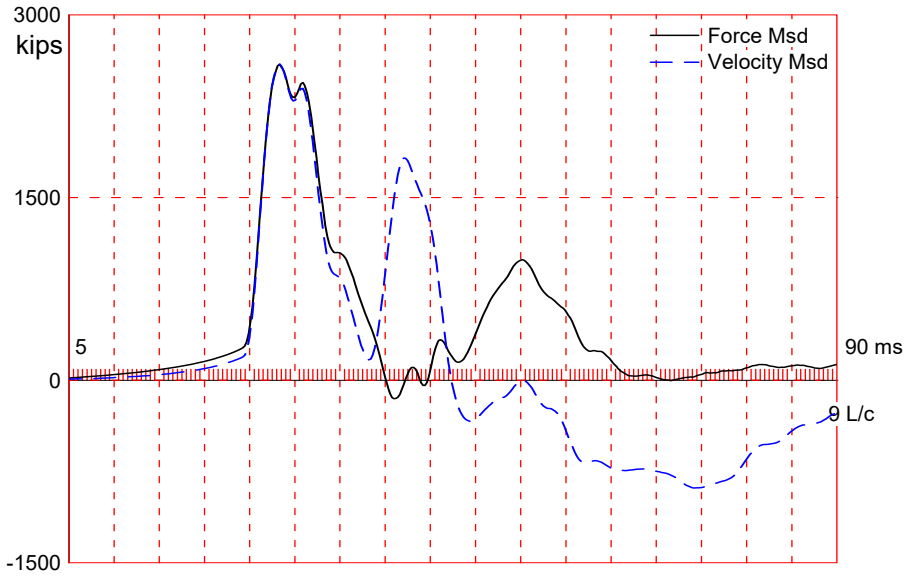
Quantity Results

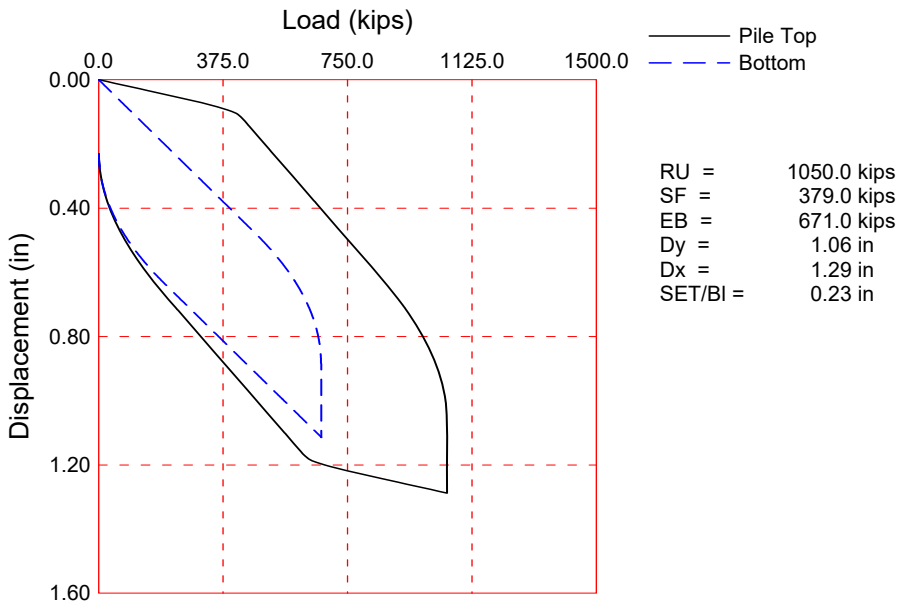
RMX 1049 kips
RX9 1029 kips
RA2 994 kips
CSX 2.88 ksi
CSB 1.58 ksi
TSX 0.71 ksi
EMX 86.6 k-ft
STK 7.72 ft
BTA 100 (%)

Sensors

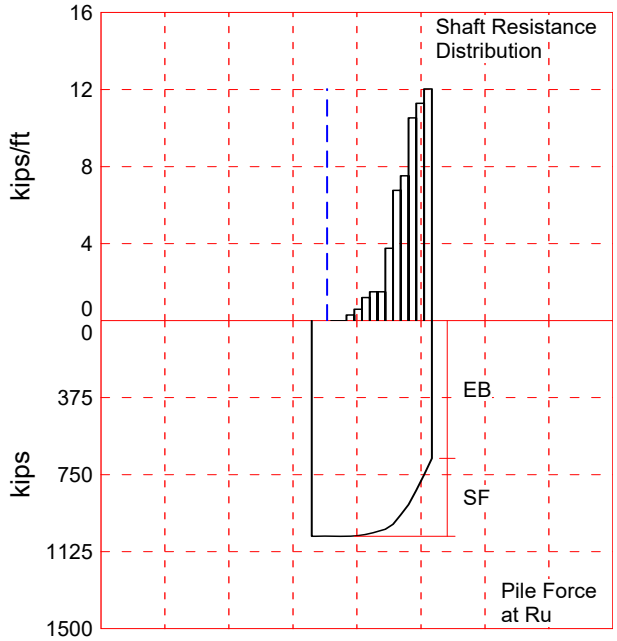
F1: [E655] 92.7 (1)
F2: [J762] 93.9 (1)
F3: [P454] 145.3 (1)
F4: [P455] 145.8 (1)
A1: [59379] 925 g's/v (1)
A2: [59462] 1055 g's/v (1)
A3: [K5647] 334 mv/5000g's (1)
A4: [K5943] 368 mv/5000g's (1)
CLIP: OK







RU =	1050.0 kips
SF =	379.0 kips
EB =	671.0 kips
Dy =	1.06 in
Dx =	1.29 in
SET/BI =	0.23 in



Length b. Sensors	103.0 ft
Embedment	86.5 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.	15489 ft/s
Match Quality	3.31
Top Compr. Stress	2.9 ksi
Max Compr. Stress	3.0 ksi
Max Tension Stress	-0.70 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.68 in
Avg. Shaft Smith Dpg.	0.15 s/ft
Toe Smith Damping	0.13 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: 1050.0; along Shaft 379.0; at Toe 671.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				1050.0				
1	23.3	6.8	0.0	1050.0	0.0	0.00	0.00	0.00
2	29.9	13.4	0.0	1050.0	0.0	0.00	0.00	0.00
3	36.5	20.0	2.0	1048.0	2.0	0.30	0.02	0.15
4	43.2	26.7	4.0	1044.0	6.0	0.60	0.04	0.15
5	49.8	33.3	8.0	1036.0	14.0	1.20	0.09	0.15
6	56.5	40.0	10.0	1026.0	24.0	1.50	0.11	0.15
7	63.1	46.6	10.0	1016.0	34.0	1.50	0.11	0.15
8	69.8	53.3	25.0	991.0	59.0	3.76	0.27	0.15
9	76.4	59.9	45.0	946.0	104.0	6.77	0.48	0.15
10	83.1	66.6	50.0	896.0	154.0	7.52	0.53	0.15
11	89.7	73.2	70.0	826.0	224.0	10.53	0.75	0.15
12	96.4	79.9	75.0	751.0	299.0	11.29	0.80	0.15
13	103.0	86.5	80.0	671.0	379.0	12.04	0.85	0.15
Avg. Shaft			29.2			4.38	0.31	0.15
Toe			671.0				42.19	0.13

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.04	0.68
Case Damping Factor		0.13	0.19
Damping Type		Viscous	Viscous
Unloading Quake	(% of loading quake)	30	44
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	0	
Soil Plug Weight	(kips)		1.016

CAPWAP match quality = 3.31 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.23 in; Blow Count = 52 b/ft
Computed: Final Set = 0.23 in; Blow Count = 52 b/ft

max. Top Comp. Stress = 2.9 ksi (T= 28.5 ms, max= 1.025 x Top)
max. Comp. Stress = 3.0 ksi (Z= 69.8 ft, T= 32.8 ms)
max. Tens. Stress = -0.70 ksi (Z= 23.3 ft, T= 40.3 ms)
max. Energy (EMX) = 86.7 kip-ft; max. Measured Top Displ. (DMX)= 0.81 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	2639.7	-267.2	2.9	-0.30	86.7	5.6	0.81
2	6.6	2642.2	-365.3	2.9	-0.40	86.7	5.6	0.81
4	13.3	2647.5	-522.5	2.9	-0.58	86.6	5.6	0.80
6	19.9	2653.8	-619.5	2.9	-0.68	86.4	5.6	0.80
8	26.6	2661.5	-630.0	2.9	-0.70	86.1	5.6	0.79
10	33.2	2670.5	-544.2	3.0	-0.60	85.8	5.5	0.78
12	39.9	2677.4	-391.6	3.0	-0.43	85.1	5.5	0.77
14	46.5	2682.1	-390.6	3.0	-0.43	84.1	5.5	0.75
16	53.2	2683.3	-302.9	3.0	-0.33	82.9	5.4	0.74
18	59.8	2686.2	-145.3	3.0	-0.16	81.6	5.4	0.73
20	66.5	2693.4	-119.0	3.0	-0.13	80.5	6.2	0.73
21	69.8	2706.8	-127.6	3.0	-0.14	80.4	6.6	0.72
22	73.1	2676.7	-130.8	3.0	-0.14	77.9	6.9	0.72
23	76.4	2672.1	-138.3	3.0	-0.15	77.8	7.2	0.72
24	79.7	2546.7	-136.9	2.8	-0.15	73.4	7.3	0.71
25	83.1	2457.1	-145.6	2.7	-0.16	73.3	7.4	0.71
26	86.4	2240.4	-141.4	2.5	-0.16	68.2	7.3	0.71
27	89.7	2071.3	-146.0	2.3	-0.16	68.1	7.2	0.70
28	93.0	1739.8	-137.6	1.9	-0.15	61.0	7.5	0.70
29	96.4	1497.3	-146.3	1.7	-0.16	60.9	7.6	0.70
30	99.7	1172.9	-135.4	1.3	-0.15	53.2	7.8	0.69
31	103.0	1164.0	-140.0	1.3	-0.15	45.7	7.8	0.69
Absolute	69.8			3.0			(T =	32.8 ms)
	23.3				-0.70		(T =	40.3 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	1669.4	1315.6	961.8	608.0	254.2	0.0	0.0	0.0	0.0	0.0
RX	1669.4	1378.1	1334.1	1290.0	1246.0	1201.9	1157.9	1113.8	1069.8	1029.0
RU	1669.4	1315.6	961.8	608.0	254.2	0.0	0.0	0.0	0.0	0.0

RAU = 789.0 (kips); RA2 = 996.7 (kips)

Current CAPWAP Ru = 1050.0 (kips); Corresponding J(RP)= 0.18; J(RX) = 0.85

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
5.7	28.53	2602.8	2604.8	2604.8	0.81	0.23	0.23	86.6	1992.0	987

PILE PROFILE AND PILE MODEL

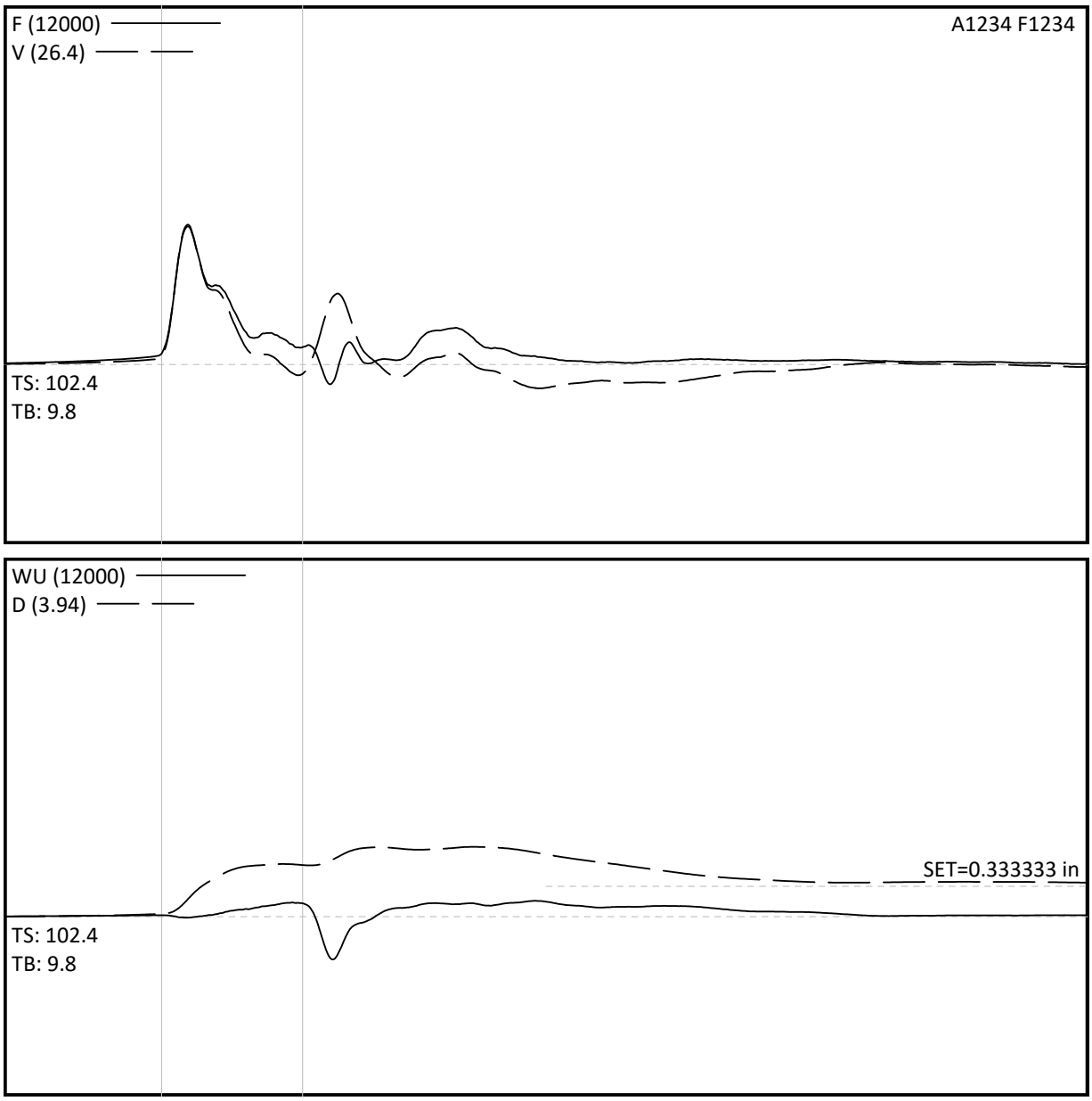
Depth ft	Area ft^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	6.28	7778.3	150.000	14.14
103.0	6.28	7778.3	150.000	14.14

Toe Area 15.90 ft^2

Top Segment Length 3.32 ft, Top Impedance 454 kips/ft/s

Wave Speed: Pile Top 15500.0, Elastic 15500.0, Overall 15488.7 ft/s
Pile Damping 2.00 %, Time Incr 0.215 ms, 2L/c 13.3 ms
Total volume: 647.168 ft^3; Volume ratio considering added impedance: 1.000

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



Project Information

PROJECT: I-10 MOBILE RIVER
PILE NAME: TP-23B 1DAY RS
DESCR: 54" CYL, 6" WALL
OPERATOR: AFT
FILE: TP-23B 1DAY RS ana
4/25/2018 3:05:19 PM
Blow Number 14

Pile Properties

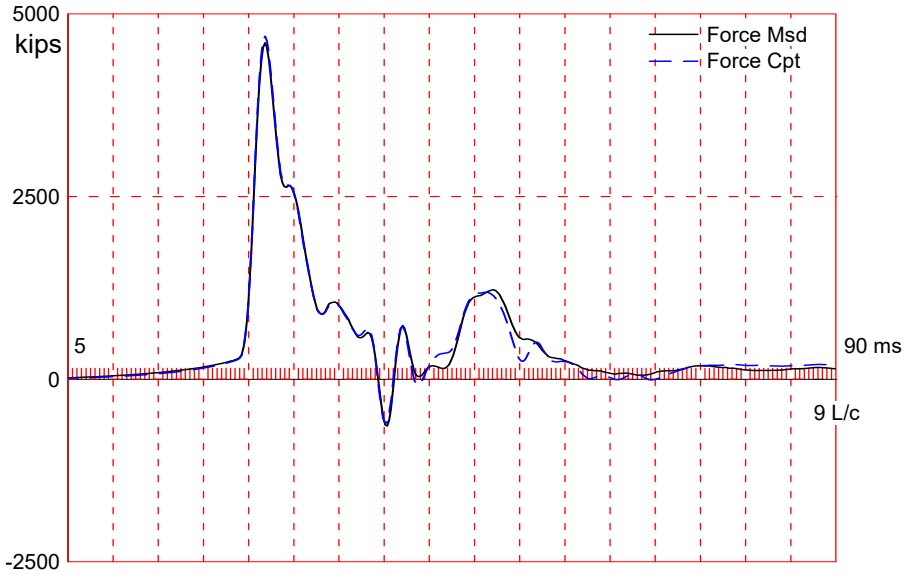
LE 103.00 ft
AR 904.78 in^2
EM 7778.33 ksi
SP 0.150 k/ft3
WS 15500.0 f/s
EA/C 454.0 ksec/ft
2L/C 13.30 ms
JC 0.70 []
LP 110.47 ft

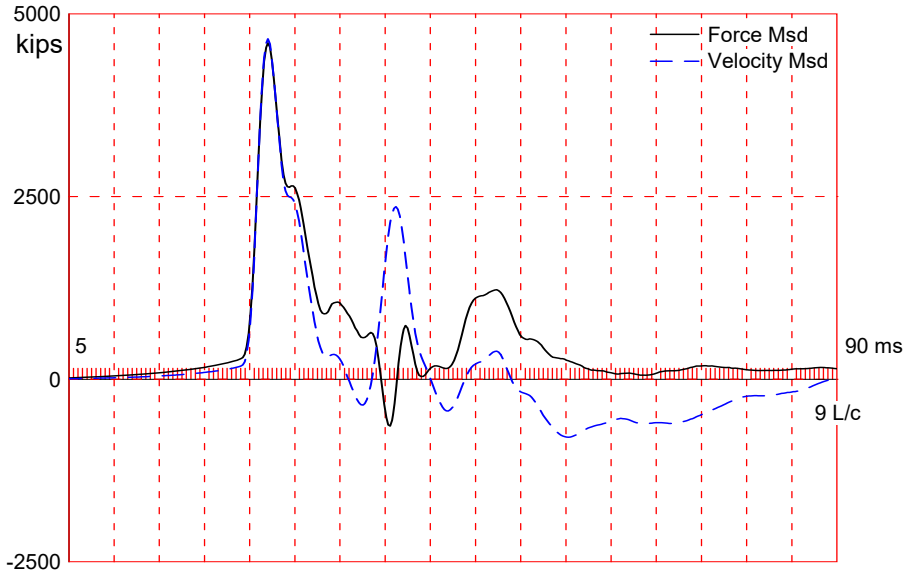
Quantity Results

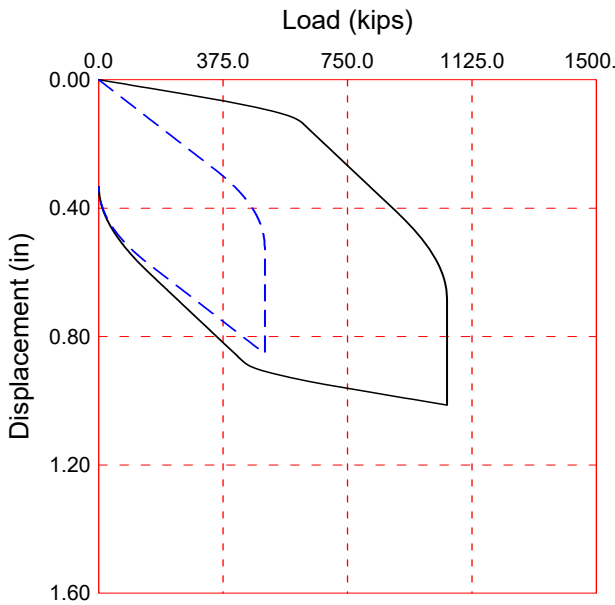
RX7 1052 kips
RX8 976 kips
RA2 948 kips
CSX 5.10 ksi
CSB 3.15 ksi
TSX 1.46 ksi
EMX 144.2 k-ft
STK 9.07 ft
BTA 100 (%)

Sensors

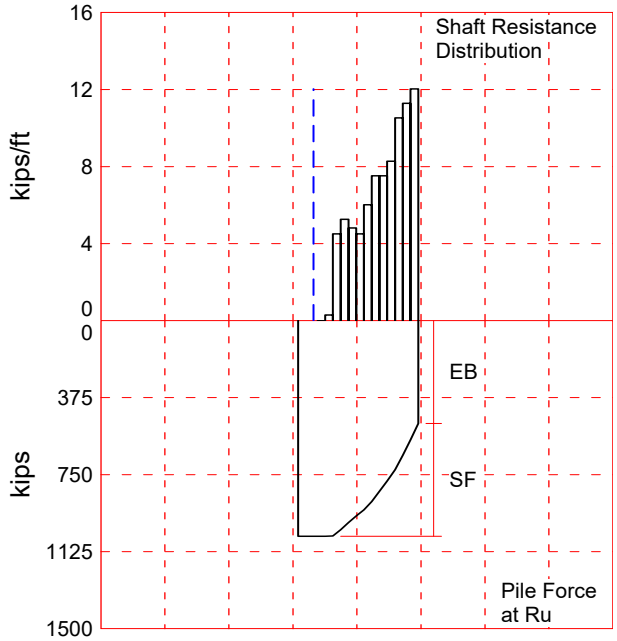
F1: [E655] 92.7 (1)
F2: [J762] 93.9 (1)
F3: [P454] 145.3 (1)
F4: [P455] 145.8 (1)
A1: [59379] 925 g's/v (1)
A2: [59462] 1055 g's/v (1)
A3: [K5647] 334 mv/5000g's (1)
A4: [K5943] 368 mv/5000g's (1)
CLIP: OK







RU =	1050.0 kips
SF =	549.0 kips
EB =	501.0 kips
Dy =	0.68 in
Dx =	1.01 in
SET/Bl =	0.33 in



Length b. Sensors	103.0 ft
Embedment	86.5 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.	15489 ft/s
Match Quality	2.45
Top Compr. Stress	5.2 ksi
Max Compr. Stress	5.3 ksi
Max Tension Stress	-1.36 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.40 in
Avg. Shaft Smith Dpg.	0.30 s/ft
Toe Smith Damping	0.15 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: 1050.0; along Shaft 549.0; at Toe 501.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				1050.0				
1	23.3	6.8	0.0	1050.0	0.0	0.00	0.00	0.00
2	29.9	13.4	2.0	1048.0	2.0	0.30	0.02	0.30
3	36.5	20.0	30.0	1018.0	32.0	4.51	0.32	0.30
4	43.2	26.7	35.0	983.0	67.0	5.27	0.37	0.30
5	49.8	33.3	32.0	951.0	99.0	4.82	0.34	0.30
6	56.5	40.0	30.0	921.0	129.0	4.51	0.32	0.30
7	63.1	46.6	40.0	881.0	169.0	6.02	0.43	0.30
8	69.8	53.3	50.0	831.0	219.0	7.52	0.53	0.30
9	76.4	59.9	50.0	781.0	269.0	7.52	0.53	0.30
10	83.1	66.6	55.0	726.0	324.0	8.28	0.59	0.30
11	89.7	73.2	70.0	656.0	394.0	10.53	0.75	0.30
12	96.4	79.9	75.0	581.0	469.0	11.29	0.80	0.30
13	103.0	86.5	80.0	501.0	549.0	12.04	0.85	0.30
Avg. Shaft			42.2			6.35	0.45	0.30
Toe			501.0				31.50	0.15

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.04	0.40
Case Damping Factor		0.36	0.17
Damping Type		Viscous	Viscous
Unloading Quake	(% of loading quake)	30	85
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	0	
Resistance Gap (included in Toe Quake)	(in)		0.00
Soil Plug Weight	(kips)		0.700

CAPWAP match quality = 2.45 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.33 in; Blow Count = 36 b/ft
Computed: Final Set = 0.34 in; Blow Count = 36 b/ft

max. Top Comp. Stress = 5.2 ksi (T= 27.2 ms, max= 1.025 x Top)
max. Comp. Stress = 5.3 ksi (Z= 36.5 ft, T= 29.4 ms)
max. Tens. Stress = -1.36 ksi (Z= 23.3 ft, T= 39.0 ms)
max. Energy (EMX) = 144.0 kip-ft; max. Measured Top Displ. (DMX)= 0.77 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	4698.4	-725.1	5.2	-0.80	144.0	10.1	0.77
2	6.6	4701.0	-794.5	5.2	-0.88	143.9	10.0	0.76
4	13.3	4707.1	-937.1	5.2	-1.04	143.7	10.0	0.76
6	19.9	4717.9	-1184.1	5.2	-1.31	143.4	10.0	0.75
8	26.6	4747.9	-1211.2	5.2	-1.34	143.0	9.9	0.74
10	33.2	4791.2	-1022.7	5.3	-1.13	142.1	9.8	0.73
12	39.9	4728.8	-859.6	5.2	-0.95	137.1	9.6	0.72
14	46.5	4645.8	-794.2	5.1	-0.88	131.4	9.5	0.71
16	53.2	4580.7	-933.5	5.1	-1.03	126.1	9.4	0.70
18	59.8	4535.9	-915.9	5.0	-1.01	121.4	9.2	0.69
20	66.5	4467.7	-634.1	4.9	-0.70	115.4	9.0	0.68
21	69.8	4505.6	-362.0	5.0	-0.40	115.3	8.9	0.68
22	73.1	4368.2	-184.8	4.8	-0.20	107.7	8.8	0.68
23	76.4	4409.3	-65.7	4.9	-0.07	107.6	8.7	0.67
24	79.7	4279.0	-111.7	4.7	-0.12	99.8	8.6	0.67
25	83.1	4296.0	-39.9	4.7	-0.04	99.7	8.6	0.67
26	86.4	4073.4	-12.6	4.5	-0.01	90.8	8.8	0.66
27	89.7	3897.2	0.0	4.3	0.00	90.7	9.9	0.66
28	93.0	3343.9	0.0	3.7	0.00	78.8	11.0	0.66
29	96.4	2871.2	0.0	3.2	0.00	78.8	11.9	0.66
30	99.7	2000.4	0.0	2.2	0.00	65.2	12.5	0.66
31	103.0	1585.9	0.0	1.8	0.00	51.2	12.7	0.66
Absolute	36.5			5.3			(T =	29.4 ms)
	23.3				-1.36		(T =	39.0 ms)

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	3325.7	2728.1	2130.5	1532.9	935.3	337.7	0.0	0.0	0.0	0.0
RX	3325.7	2728.1	2130.5	1532.9	1328.0	1232.5	1139.1	1052.9	977.4	935.3
RU	3569.2	2995.9	2422.7	1849.4	1276.2	703.0	129.7	0.0	0.0	0.0

RAU = 840.2 (kips); RA2 = 949.0 (kips)

Current CAPWAP Ru = 1050.0 (kips); Corresponding J(RP)= 0.38; 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
10.3	27.03	4678.2	4623.4	4623.4	0.77	0.33	0.33	144.4	3152.0	1253

PILE PROFILE AND PILE MODEL

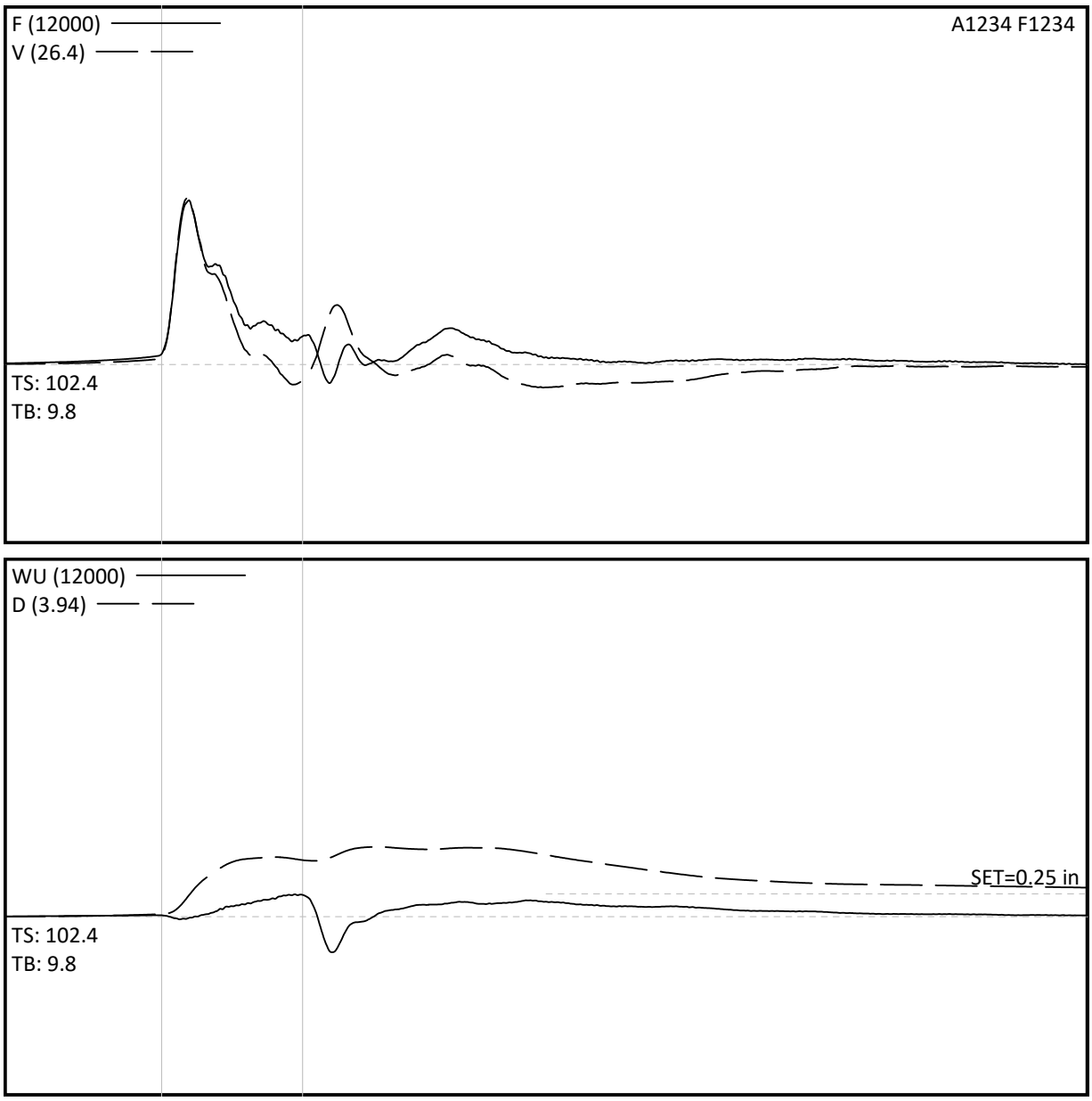
Depth ft	Area ft^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	6.28	7778.3	150.000	14.14
103.0	6.28	7778.3	150.000	14.14

Toe Area 15.90 ft^2

Top Segment Length 3.32 ft, Top Impedance 454 kips/ft/s

Wave Speed: Pile Top 15500.0, Elastic 15500.0, Overall 15488.7 ft/s
Pile Damping 2.00 %, Time Incr 0.215 ms, 2L/c 13.3 ms
Total volume: 647.168 ft^3; Volume ratio considering added impedance: 1.000

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



Project Information

PROJECT: I-10 MOBILE RIVER
PILE NAME: TP-23B 17DAY RS
DESCR: 54'' CYL, 6'' WALL
OPERATOR: AFT
FILE: TP-23B 17DAY RS ana
5/11/2018 8:16:05 AM
Blow Number 3

Pile Properties

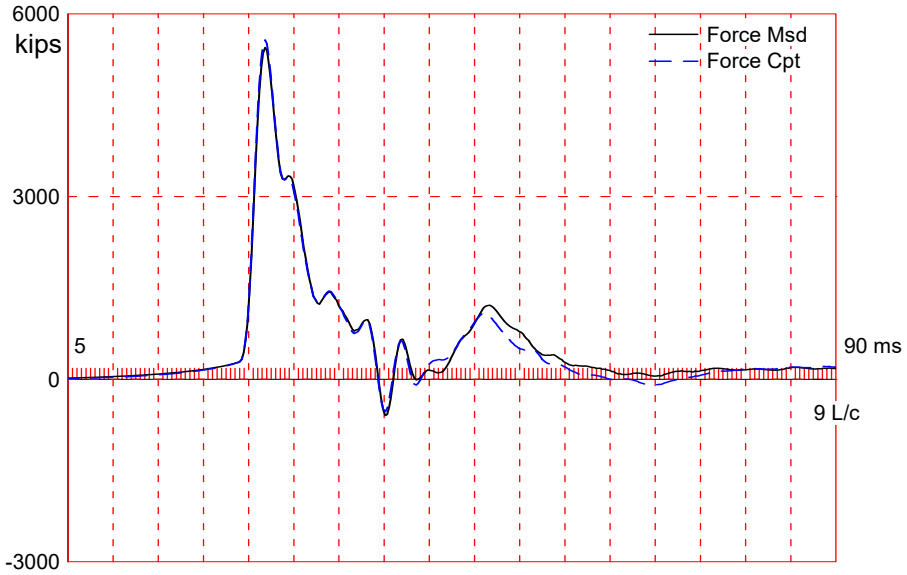
LE 103.00 ft
AR 904.78 in^2
EM 7778.33 ksi
SP 0.150 k/ft3
WS 15500.0 f/s
EA/C 454.0 ksec/ft
2L/C 13.30 ms
JC 0.70 []
LP 110.56 ft

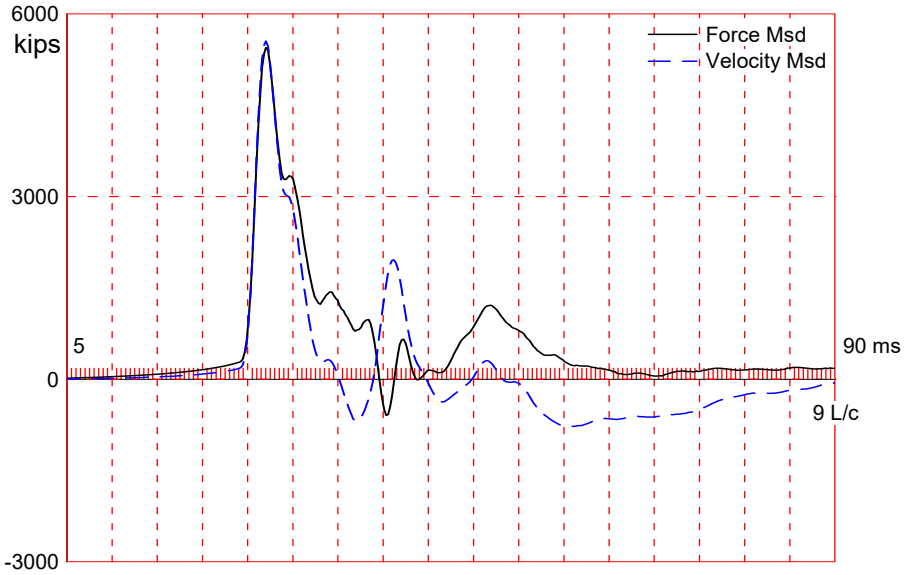
Quantity Results

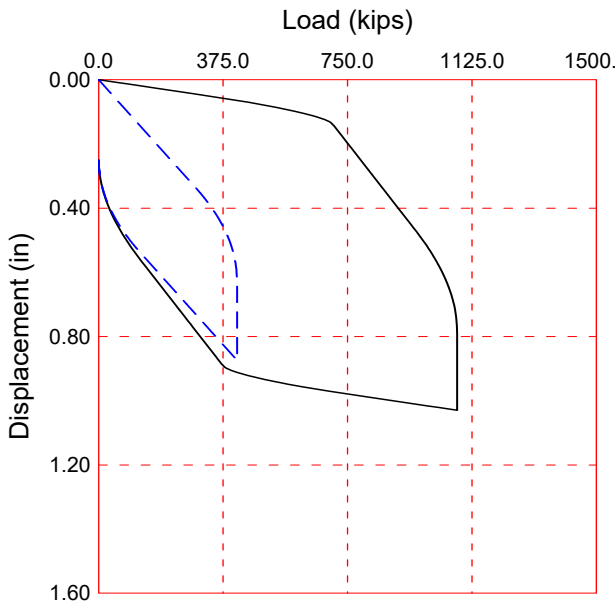
RX7 1070 kips
RX8 1002 kips
RA2 1121 kips
CSX 6.07 ksi
CSB 4.04 ksi
TSX 1.26 ksi
EMX 198.2 k-ft
STK 11.59 ft
BTA 100 (%)

Sensors

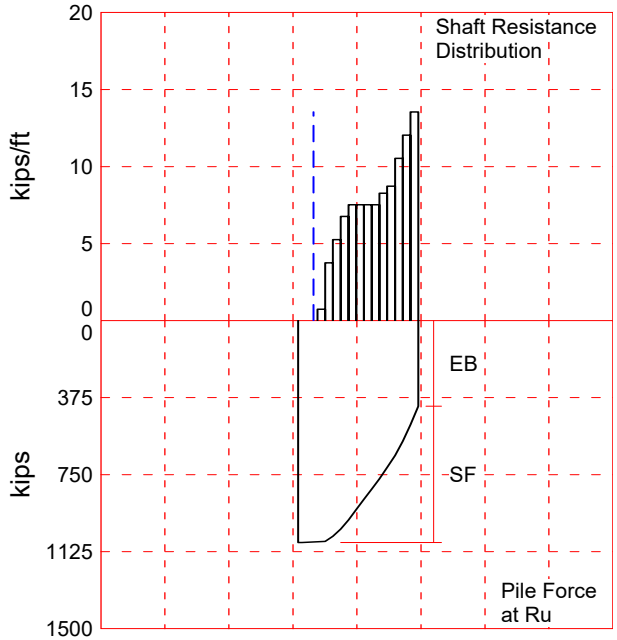
F1: [E655] 92.7 (1)
F2: [J762] 93.9 (1)
F3: [P454] 145.3 (1)
F4: [P455] 145.8 (1)
A1: [59379] 925 g's/v (1)
A2: [59462] 1055 g's/v (1)
A3: [K5647] 334 mv/5000g's (1)
A4: [K5943] 368 mv/5000g's (1)
CLIP: OK







RU =	1080.0 kips
SF =	663.0 kips
EB =	417.0 kips
Dy =	0.78 in
Dx =	1.03 in
SET/Bl =	0.25 in



Length b. Sensors	103.0 ft
Embedment	86.5 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.	15489 ft/s
Match Quality	2.89
Top Compr. Stress	6.2 ksi
Max Compr. Stress	6.3 ksi
Max Tension Stress	-1.13 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.48 in
Avg. Shaft Smith Dpg.	0.40 s/ft
Toe Smith Damping	0.19 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: 1080.0; along Shaft 663.0; at Toe 417.0 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
				1080.0			
1	23.3	6.8	5.0	1075.0	5.0	0.74	0.05
2	29.9	13.4	25.0	1050.0	30.0	3.76	0.27
3	36.5	20.0	35.0	1015.0	65.0	5.27	0.37
4	43.2	26.7	45.0	970.0	110.0	6.77	0.48
5	49.8	33.3	50.0	920.0	160.0	7.52	0.53
6	56.5	40.0	50.0	870.0	210.0	7.52	0.53
7	63.1	46.6	50.0	820.0	260.0	7.52	0.53
8	69.8	53.3	50.0	770.0	310.0	7.52	0.53
9	76.4	59.9	55.0	715.0	365.0	8.28	0.59
10	83.1	66.6	58.0	657.0	423.0	8.73	0.62
11	89.7	73.2	70.0	587.0	493.0	10.53	0.75
12	96.4	79.9	80.0	507.0	573.0	12.04	0.85
13	103.0	86.5	90.0	417.0	663.0	13.54	0.96
Avg. Shaft			51.0			7.66	0.54
Toe			417.0				26.22

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.40	0.19
Quake	(in)	0.04	0.48
Case Damping Factor		0.58	0.17
Damping Type		Viscous	Viscous
Unloading Quake	(% of loading quake)	30	99
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	0	

CAPWAP match quality = 2.89 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.25 in; Blow Count = 48 b/ft
Computed: Final Set = 0.25 in; Blow Count = 47 b/ft

max. Top Comp. Stress = 6.2 ksi (T= 27.2 ms, max= 1.027 x Top)
max. Comp. Stress = 6.3 ksi (Z= 29.9 ft, T= 29.0 ms)
max. Tens. Stress = -1.13 ksi (Z= 26.6 ft, T= 38.8 ms)
max. Energy (EMX) = 196.7 kip-ft; max. Measured Top Displ. (DMX)= 0.76 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	5578.6	-644.6	6.2	-0.71	196.7	11.9	0.76
2	6.6	5582.5	-691.6	6.2	-0.76	196.3	11.9	0.76
4	13.3	5597.9	-709.8	6.2	-0.78	196.0	11.9	0.76
6	19.9	5640.2	-860.7	6.2	-0.95	195.6	11.8	0.75
8	26.6	5686.5	-1019.2	6.3	-1.13	194.0	11.6	0.74
10	33.2	5643.9	-941.7	6.2	-1.04	188.3	11.4	0.73
12	39.9	5563.4	-726.7	6.1	-0.80	180.8	11.1	0.72
14	46.5	5442.9	-528.0	6.0	-0.58	171.4	10.8	0.71
16	53.2	5299.3	-582.4	5.9	-0.64	161.9	10.5	0.70
18	59.8	5159.0	-707.2	5.7	-0.78	152.5	10.3	0.69
20	66.5	5026.5	-532.1	5.6	-0.59	141.9	10.0	0.68
21	69.8	5082.8	-259.5	5.6	-0.29	141.7	9.9	0.68
22	73.1	4904.1	-94.6	5.4	-0.10	131.8	9.7	0.68
23	76.4	4963.5	-37.4	5.5	-0.04	131.7	9.6	0.67
24	79.7	4770.8	-124.0	5.3	-0.14	120.4	9.4	0.67
25	83.1	4803.3	-45.2	5.3	-0.05	120.3	9.3	0.67
26	86.4	4491.2	-27.8	5.0	-0.03	107.9	9.5	0.67
27	89.7	4295.7	0.0	4.7	0.00	107.9	10.6	0.67
28	93.0	3620.9	0.0	4.0	0.00	92.1	11.8	0.66
29	96.4	3102.8	0.0	3.4	0.00	92.0	12.8	0.66
30	99.7	2094.1	0.0	2.3	0.00	73.0	13.3	0.66
31	103.0	1818.2	0.0	2.0	0.00	52.0	13.5	0.66
Absolute	29.9			6.3			(T =	29.0 ms)
	26.6				-1.13		(T =	38.8 ms)

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	4412.3	3748.5	3084.6	2420.8	1757.0	1093.2	429.4	0.0	0.0	0.0
RX	4412.3	3748.5	3084.6	2420.8	1757.0	1329.0	1149.2	1080.4	1014.5	969.9
RU	4888.7	4272.5	3656.4	3040.2	2424.0	1807.9	1191.7	575.5	0.0	0.0

RAU = 776.2 (kips); RA2 = 1190.8 (kips)

Current CAPWAP Ru = 1080.0 (kips); Corresponding J(RP)= 0.50; 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
12.3	27.03	5574.7	5475.6	5491.0	0.76	0.25	0.25	197.6	4710.9	869

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
103.0	6.28	7778.3	150.000	14.14

Toe Area 15.90 ft^2

Top Segment Length 3.32 ft, Top Impedance 454 kips/ft/s

Wave Speed: Pile Top 15500.0, Elastic 15500.0, Overall 15488.7 ft/s
Pile Damping 2.00 %, Time Incr 0.215 ms, 2L/c 13.3 ms
Total volume: 647.168 ft^3; Volume ratio considering added impedance: 1.000

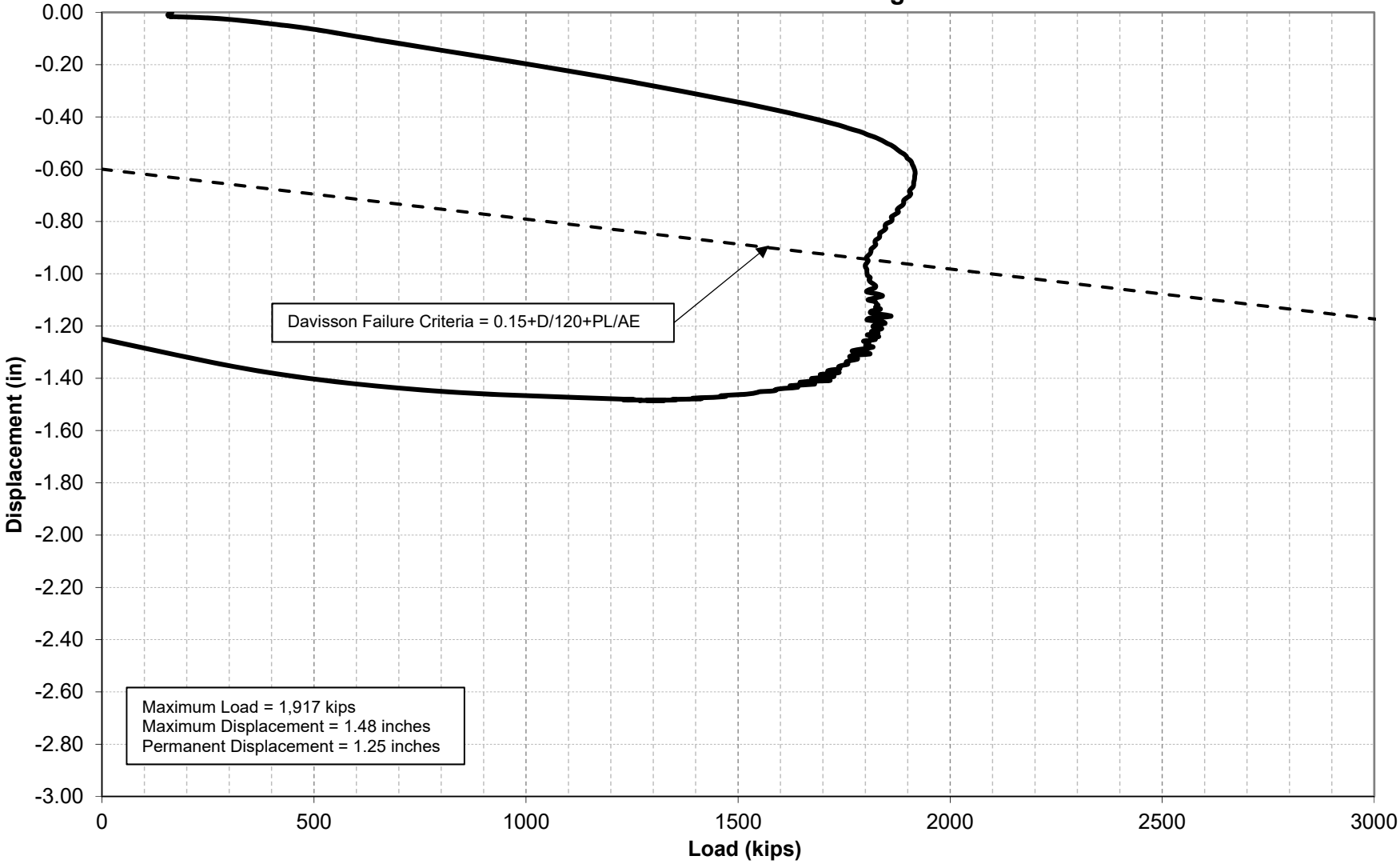
Appendix D

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

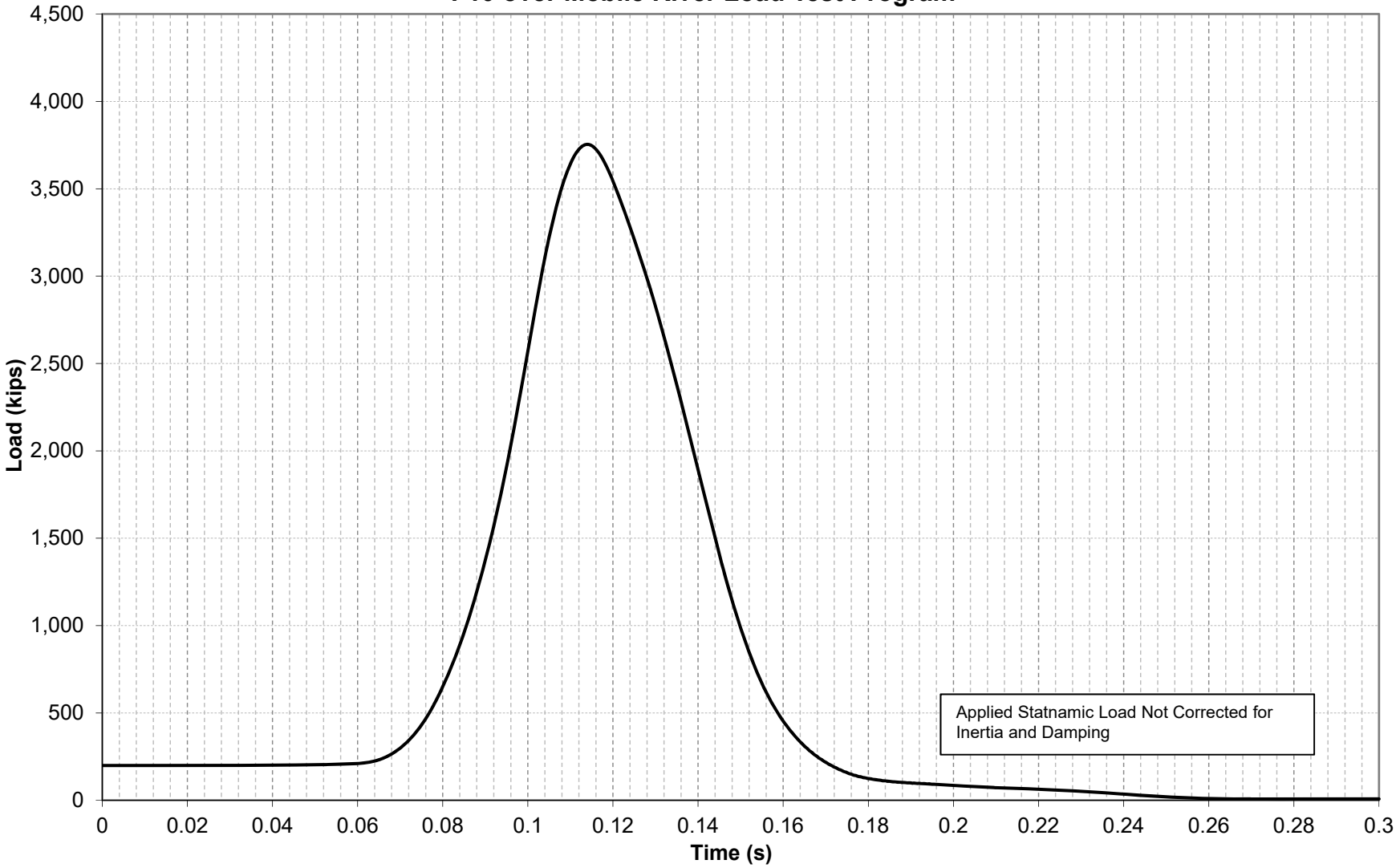
I-10 over Mobile River Bridge Load Test Program

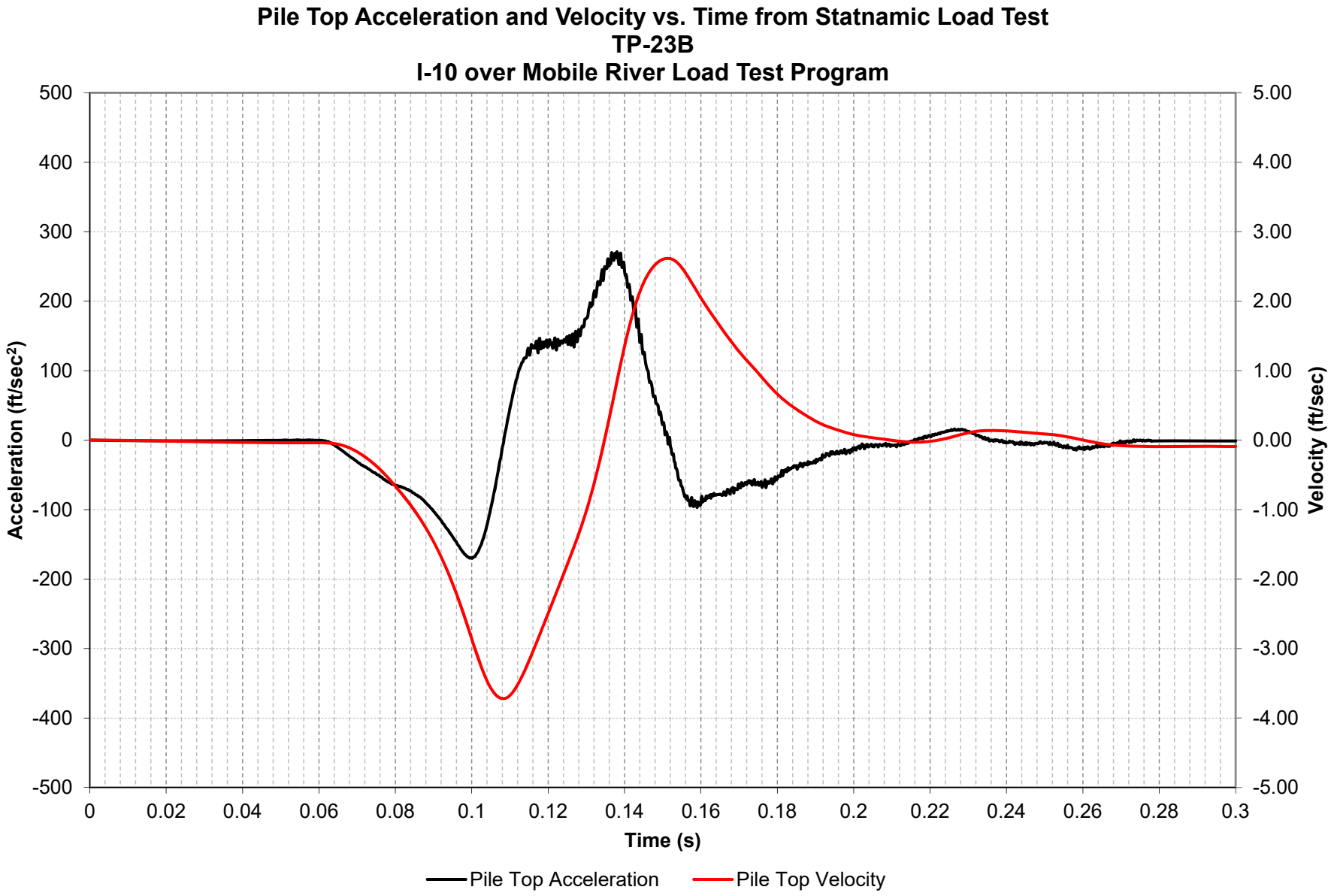
ALDOT Project No.: IM-I010(341)
Mobile County, Alabama
AFT Project No.: 118008

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

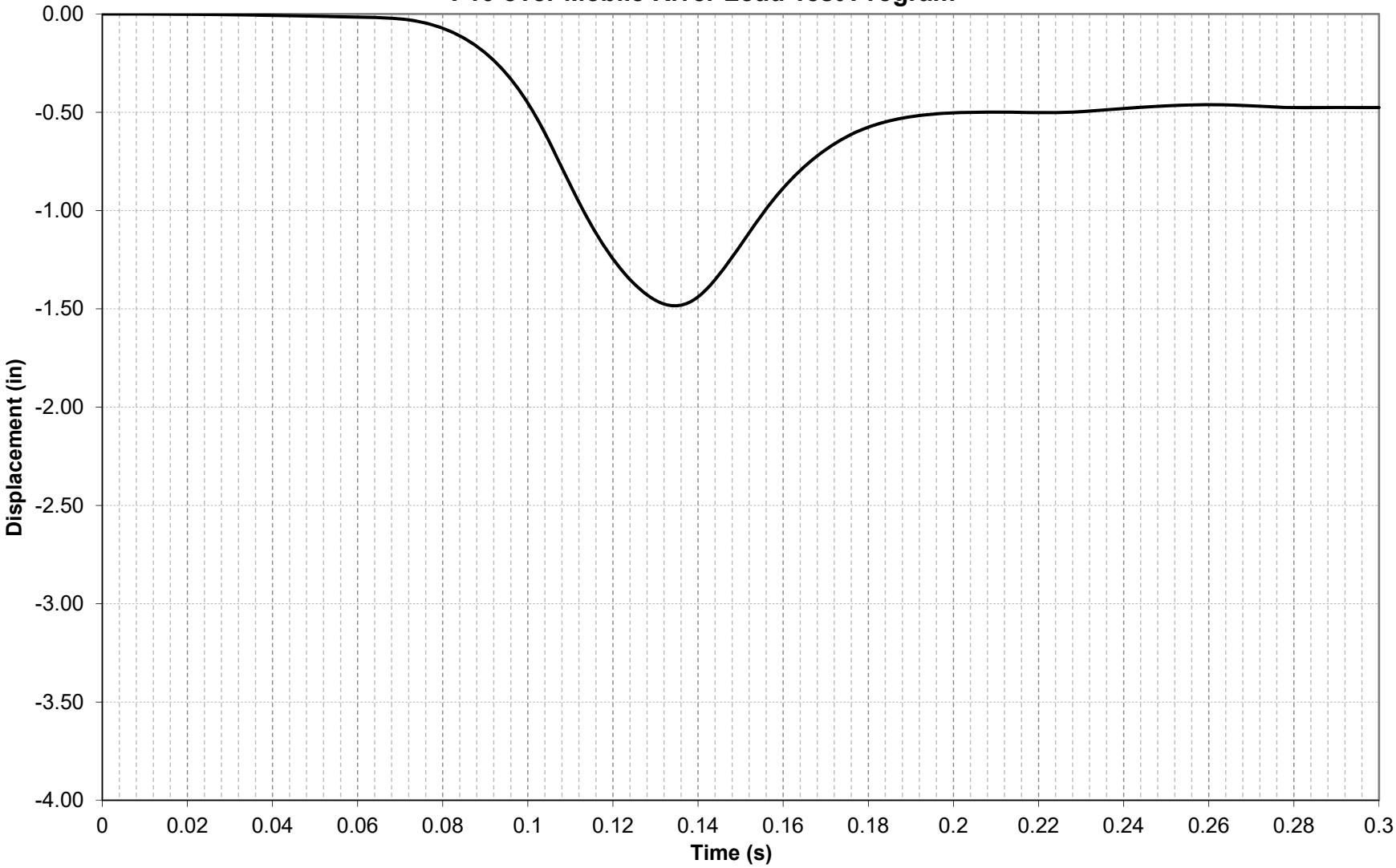


Applied Statnamic Load vs. Time from Statnamic Load Test
TP-23B
I-10 over Mobile River Load Test Program




Pile Top Acceleration and Velocity vs. Time from Statnamic Load Test
TP-23B
I-10 over Mobile River Load Test Program
Acceleration (ft/sec²)
Velocity (ft/sec)
Time (s)
500
400
300
200
100
0
-100
-200
-300
-400
-500
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.22
0.24
0.26
0.28
0.3
Pile Top Acceleration
Pile Top Velocity

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



Appendix E

Relevant Project Documents
TP-23B

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

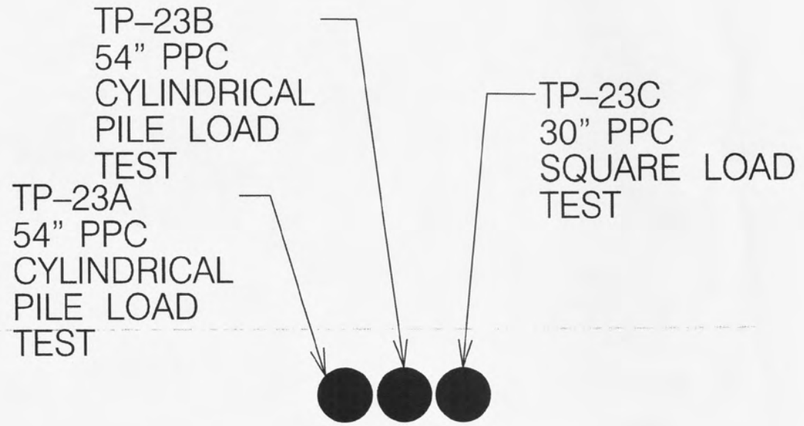
TEST PILE	PILE TYPE	STATION	SIDE	OFFSET	PILE LENGTH (FT)	TARGETED NOMINAL RESISTANCE (kips)	ESTIMATED TIP ELEVATION (FT)	MINIMUM TIP ELEVATION (FT)
TP-10A-1	HP 14X89	STATION 469+20.00	RT	110	82	300	-65	
TP-10A-2	HP 14X89	STATION 469+20.00	RT	111	82	300	-65	
TP-10B-1	18" PPC SQUARE	STATION 469+60.00	RT	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	

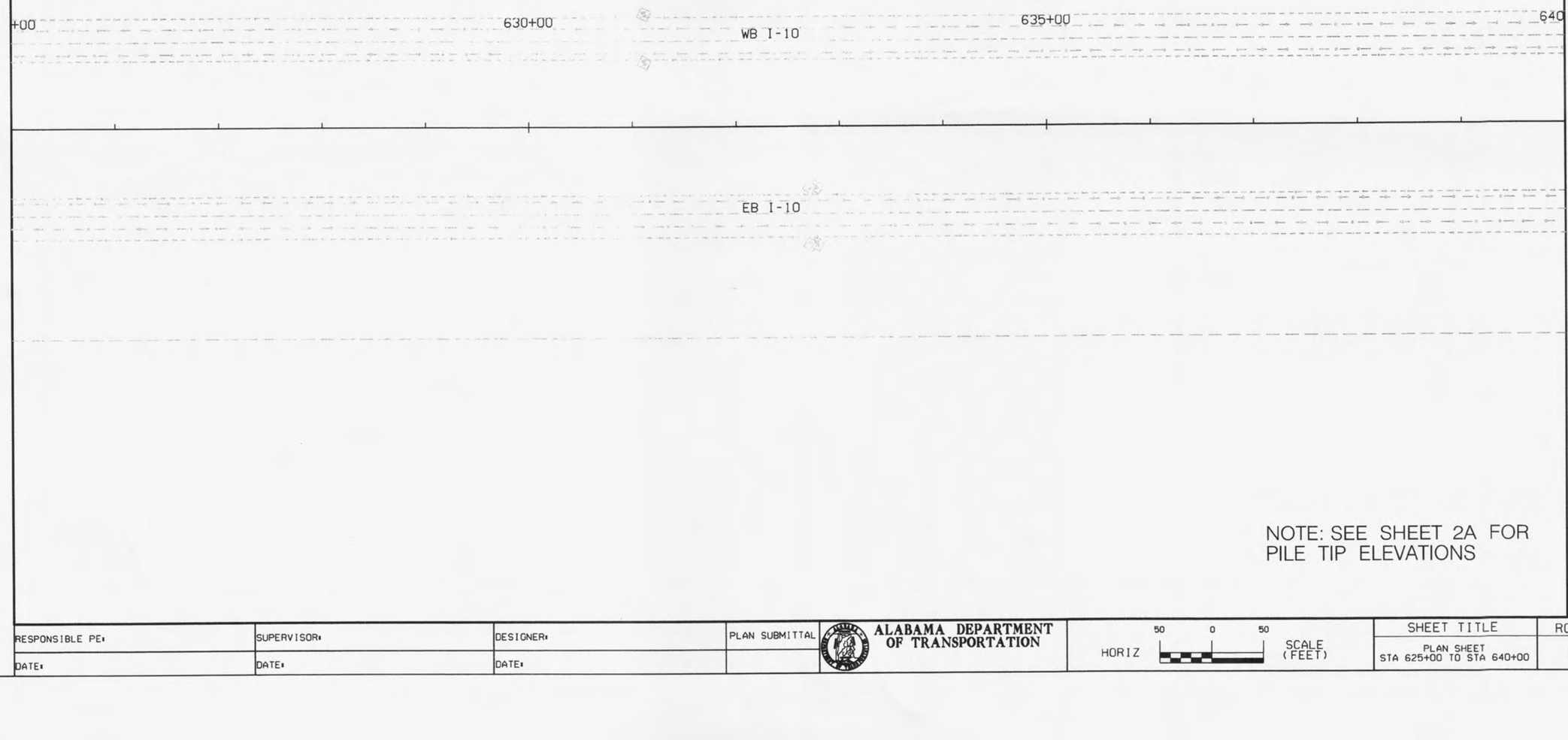
RESPONSIBLE PE:	SUPERVISOR:	DESIGNER:	PLAN SUBMITTAL	ALABAMA DEPARTMENT OF TRANSPORTATION		SHEET TITLE	ROUTE
DATE:	DATE:	DATE:				PILE TIP ELEVATIONS	I-10

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
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
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
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
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)
- 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 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
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STRATA SYMBOLS

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- 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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- HSA - Hollow Stem Auger
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NO - Not Obtained

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REC Recovery

RQD Rock Quality Designation

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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 :

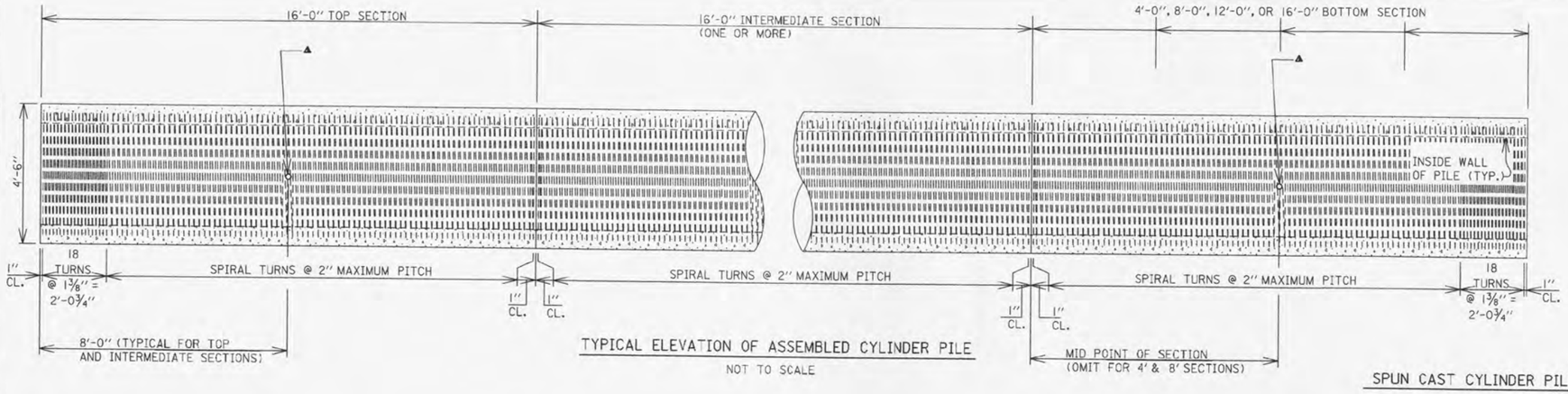
PROJECT NO. 17-1101-0145
I-10 MOBILE RIVER BRIDGE
LOAD TEST PROGRAM
MOBILE COUNTY, ALABAMA

Preliminary Project No:

TEST BORING RECORD

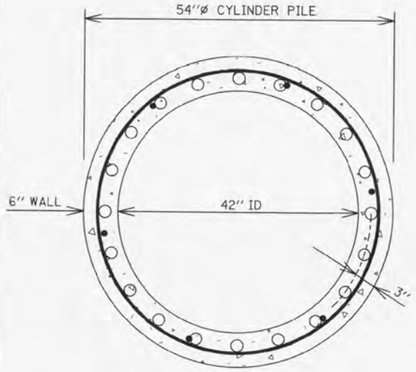
SPUN CYLINDER CONCRETE PILE DETAILS

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



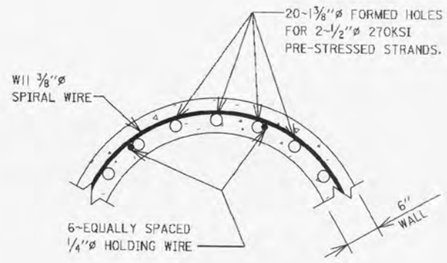
TYPICAL ELEVATION OF ASSEMBLED CYLINDER PILE

NOT TO SCALE



54" DIAMETER SECTION (20 CABLES)

NOT TO SCALE



TYPICAL REINFORCING DETAIL

NOT TO SCALE

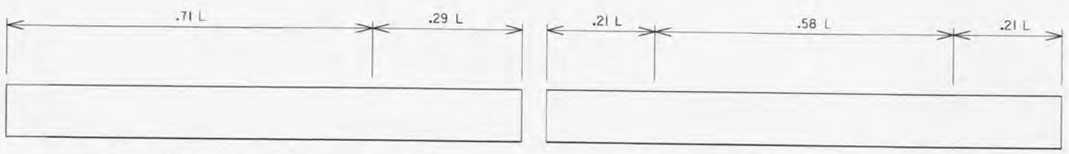
PRESTRESSED PILE SCHEDULE

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-23B

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

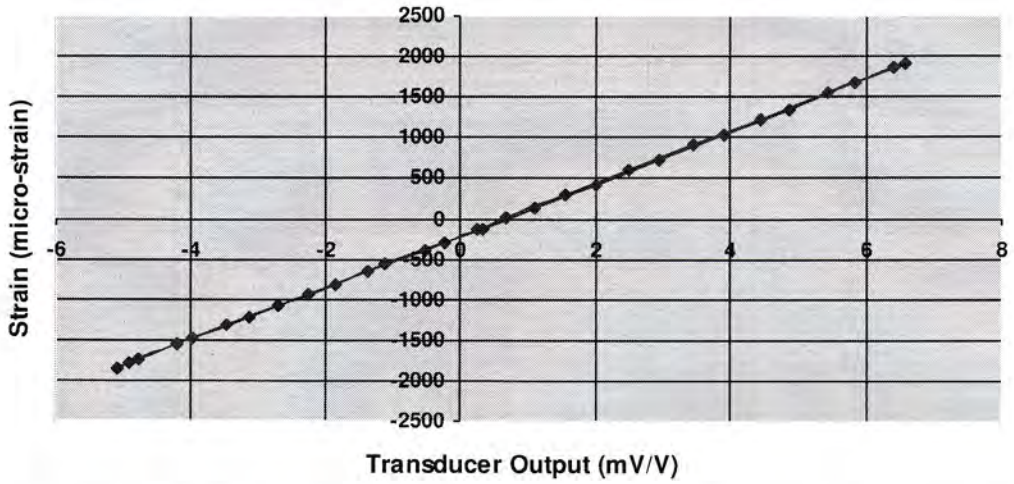
PDI Gage Factor: 92.7 με/V

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

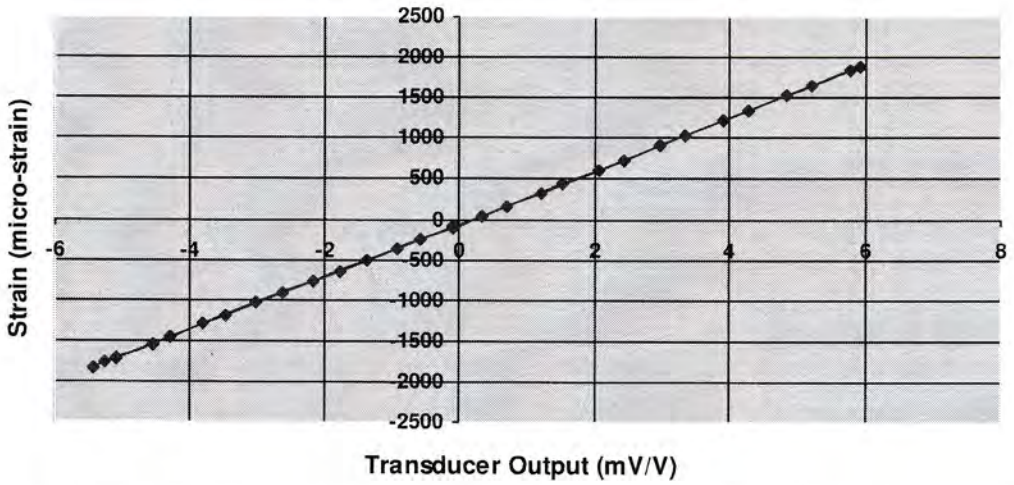
PDI Gage Factor: 93.9 με/V

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

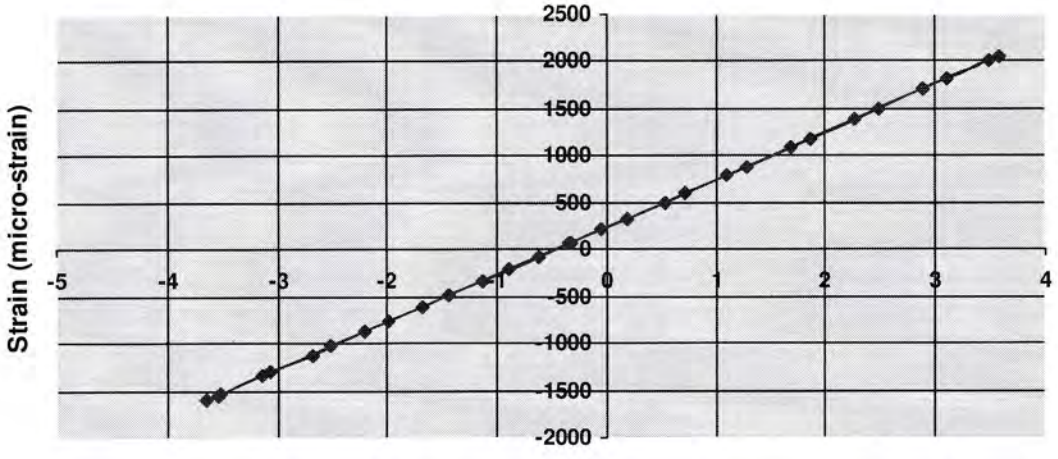
General Gage Factor: 504.7 $\mu\varepsilon/mV/V_{ext}$

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

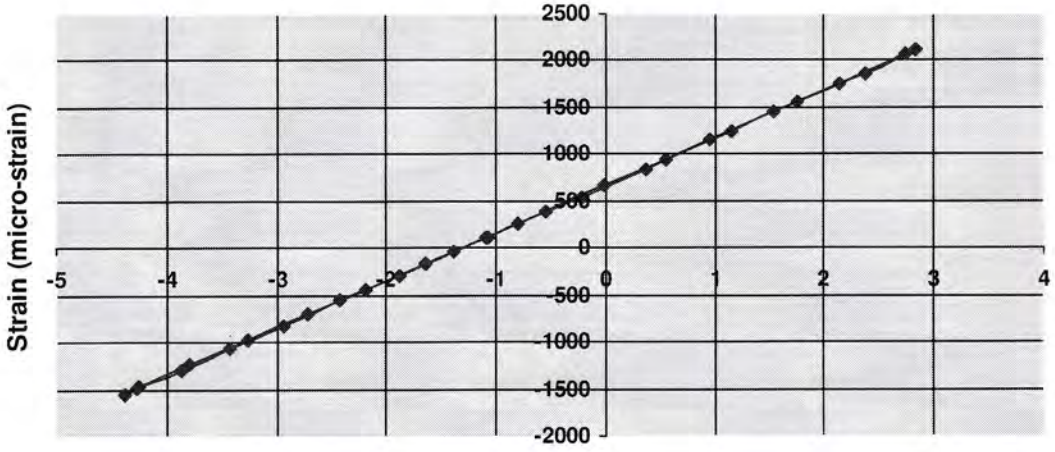
PDI Gage Factor: 145.8 με/V

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

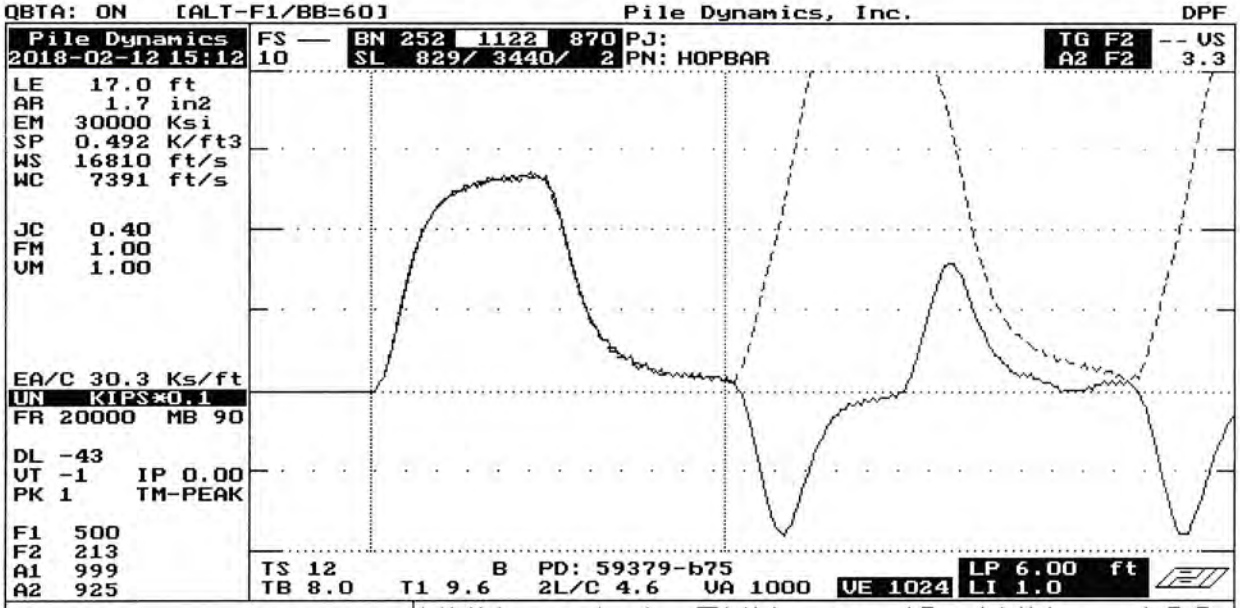
PDI Automated Strain Transducer Calibration System (PDI-ASTCS)

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

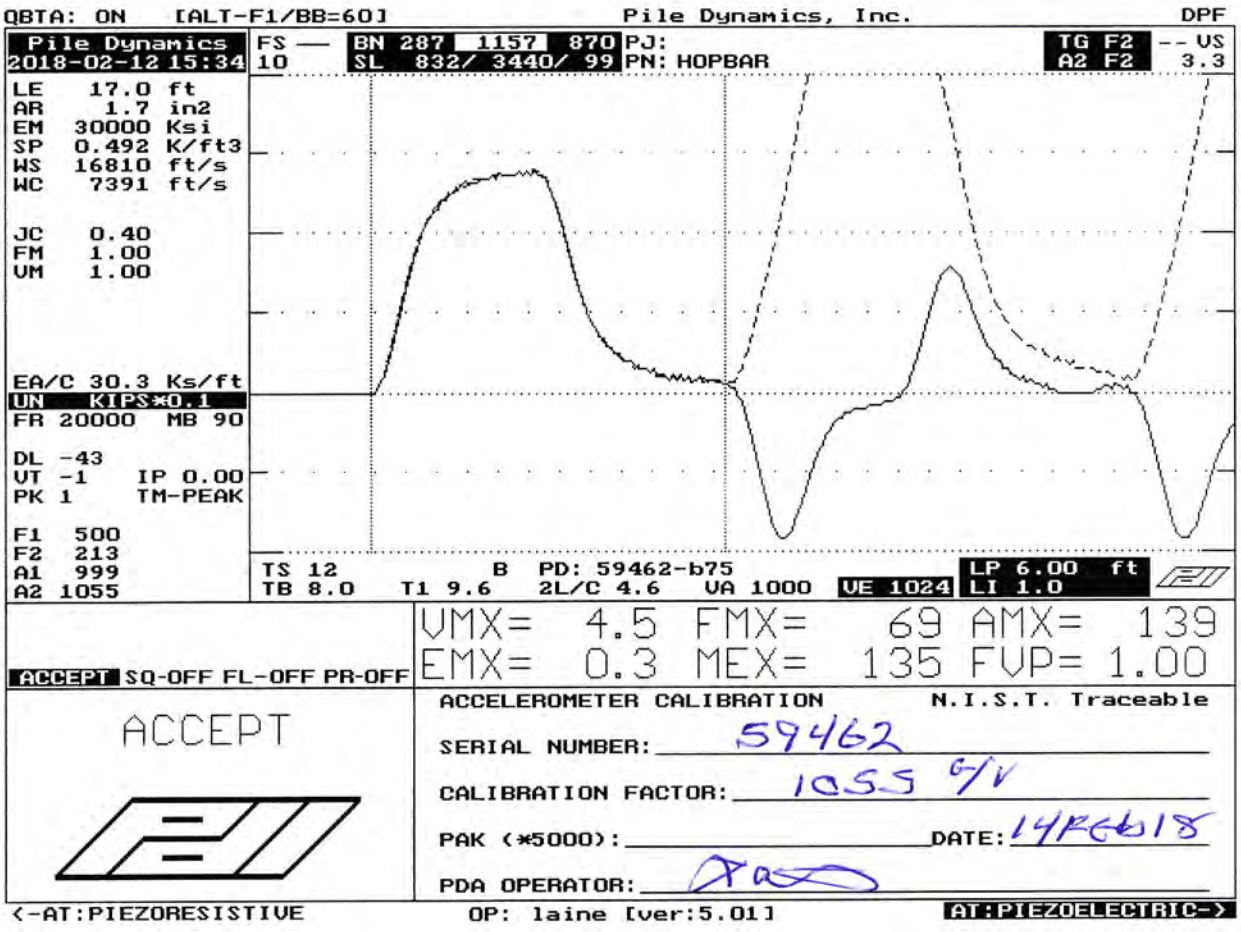
SERIAL NUMBER: 59379

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
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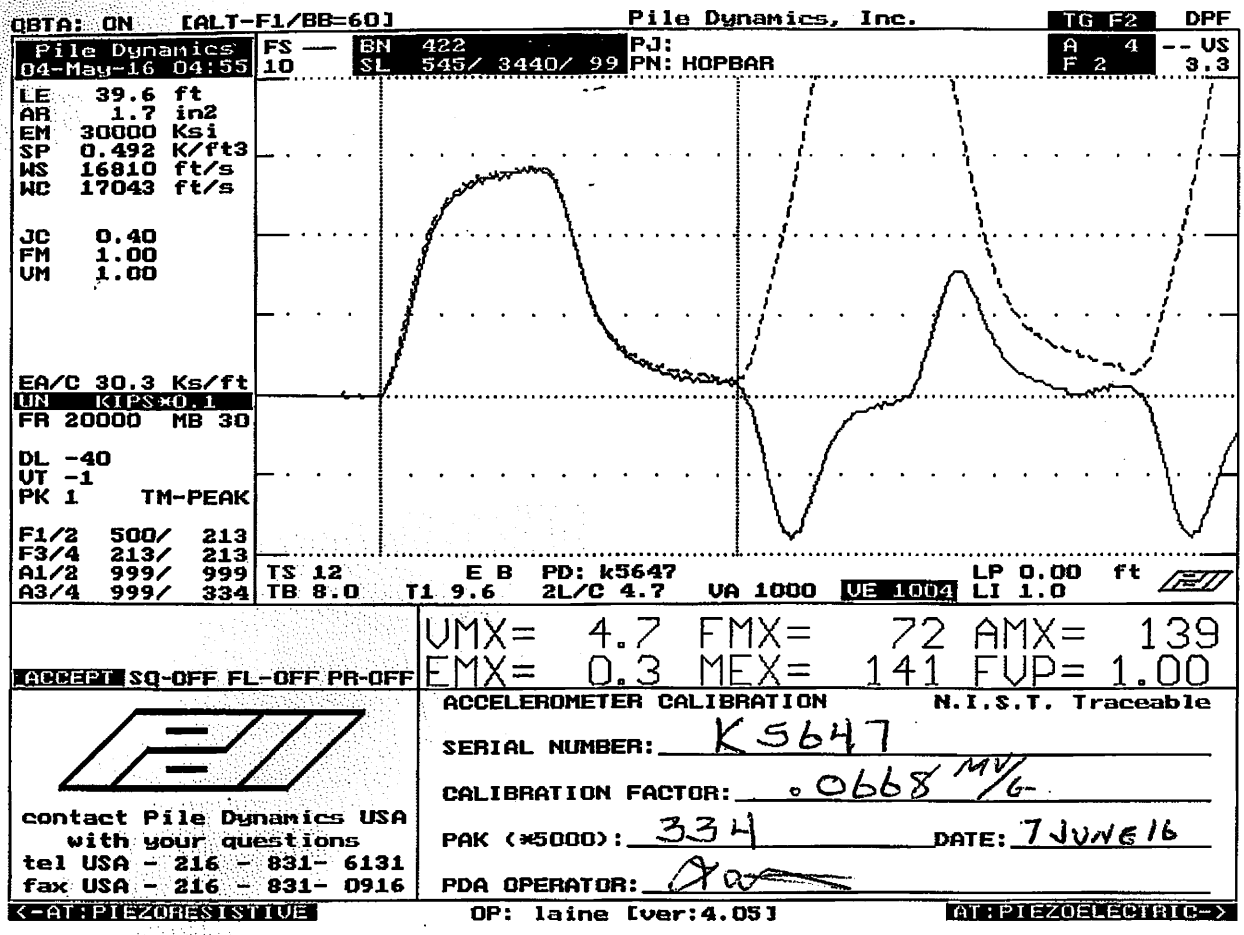
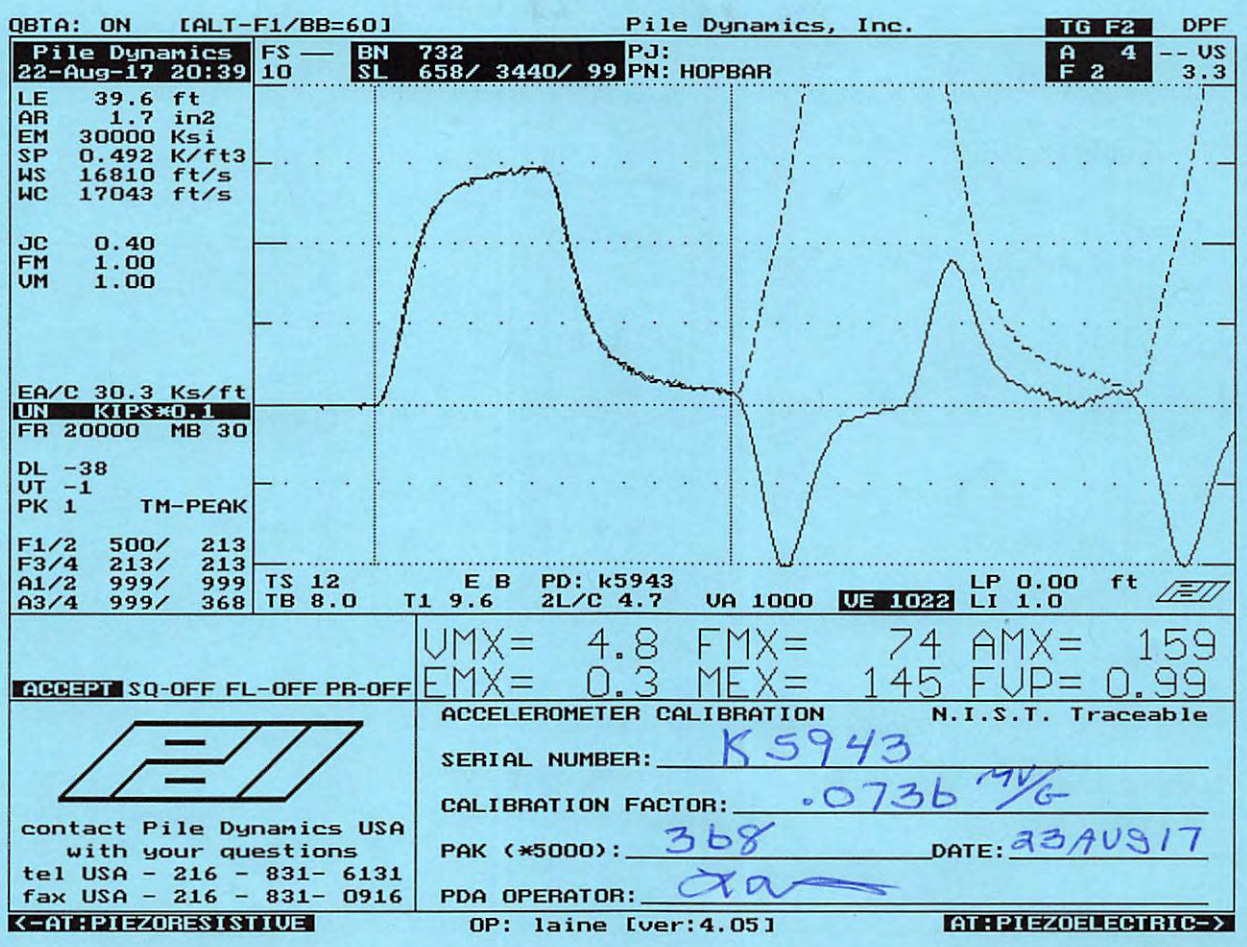
SL 832/ 3440/ 99
PJ:
PN: HOPBAR
TG F2
A2 F2
-- VS
3.3
LE 17.0 ft
AR 1.7 in2
EM 30000 Ksi
SP 0.492 K/ft3
WS 16810 ft/s
WC 7391 ft/s
JC 0.40
FM 1.00
VM 1.00
EA/C 30.3 Ks/ft
UN KIPS*0.1
FR 20000 MB 90
DL -43
VT -1 IP 0.00
PK 1 TM-PEAK
F1 500
F2 213
A1 999
A2 1055
TS 12
TB 8.0
T1 9.6
B
PD: 59462-b75
2L/C 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



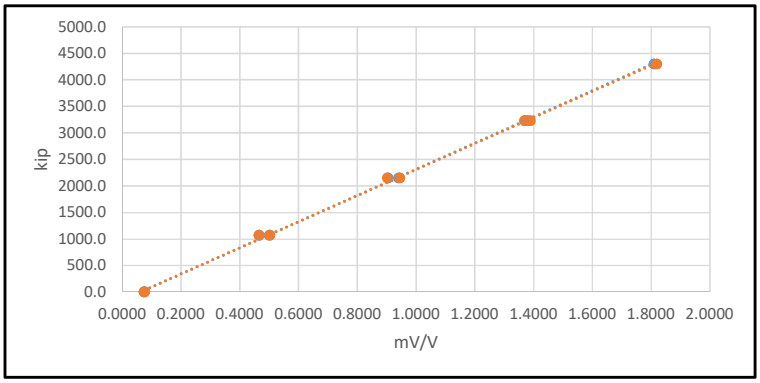
Smart Sensor

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

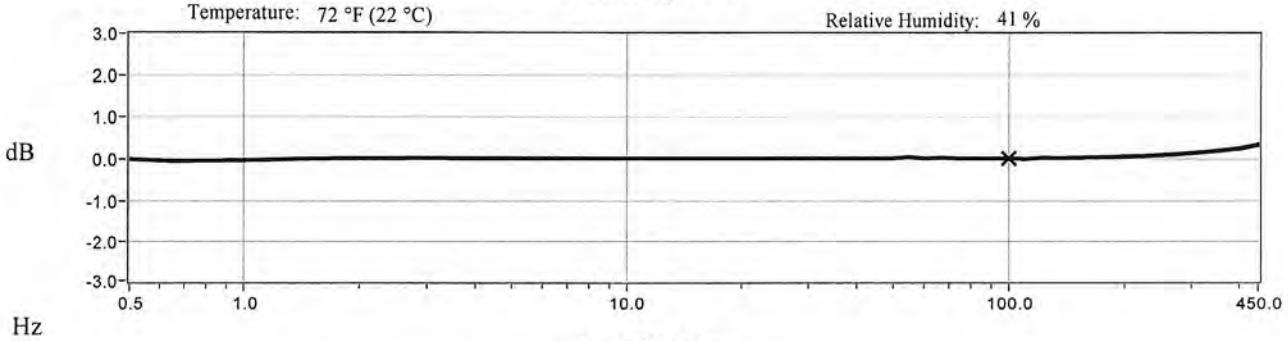
Manufacturer: PCB

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

PCB PIEZOTRONICS INC.
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

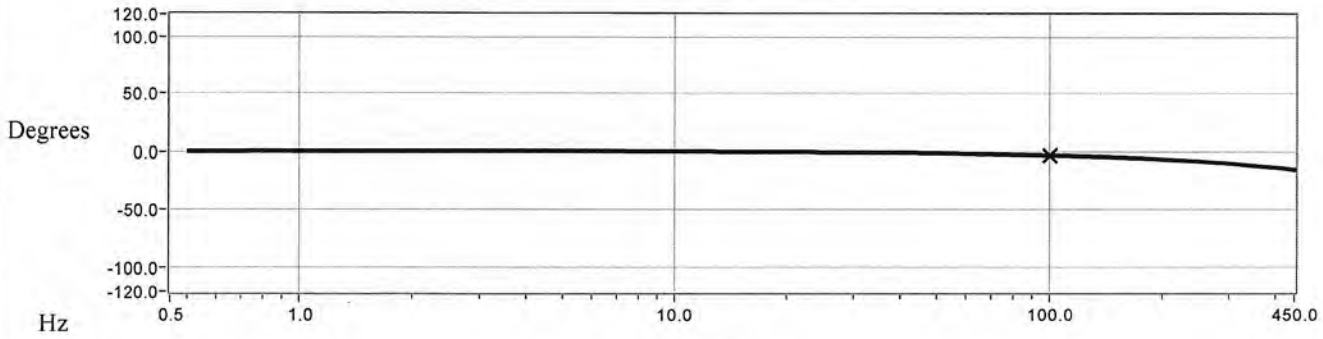
Manufacturer: PCB

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

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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CAL96-3599767065.696+1

ACS-11

~ Calibration Certificate ~

Per ISO 16063-21

Model Number: 3701G2FA50G

Serial Number: 7984

Description: DC Accelerometer

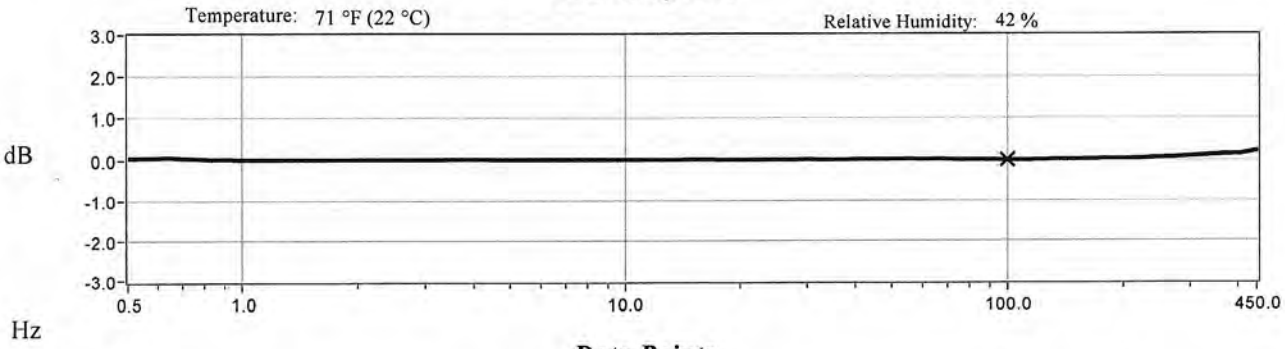
Manufacturer: PCB

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.
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

PCB PIEZOTRONICS INC.
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: 7984

Description: DC Accelerometer

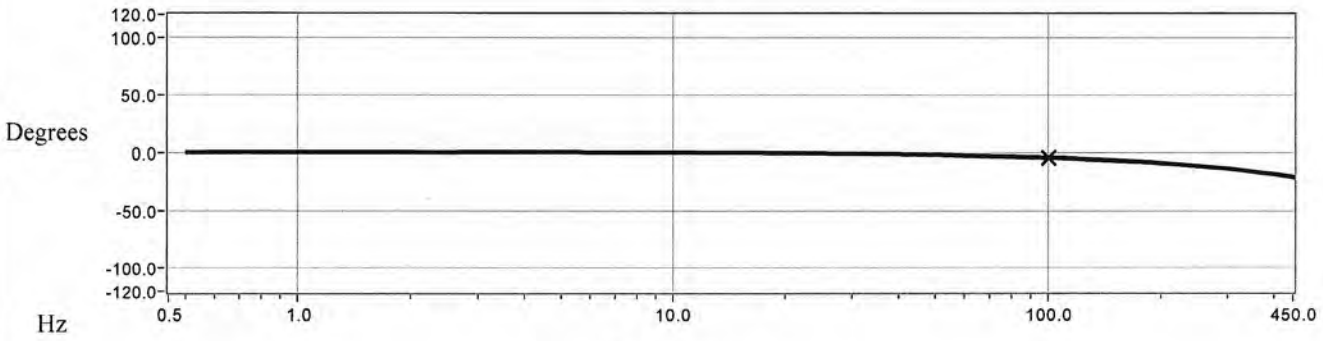
Manufacturer: PCB

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

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. 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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CAL96-3599769893.715+1

ACS-11

~ Calibration Certificate ~

Per ISO 16063-21

Model Number: 3711E1150G

Serial Number: 8860

Description: DC Accelerometer

Manufacturer: PCB

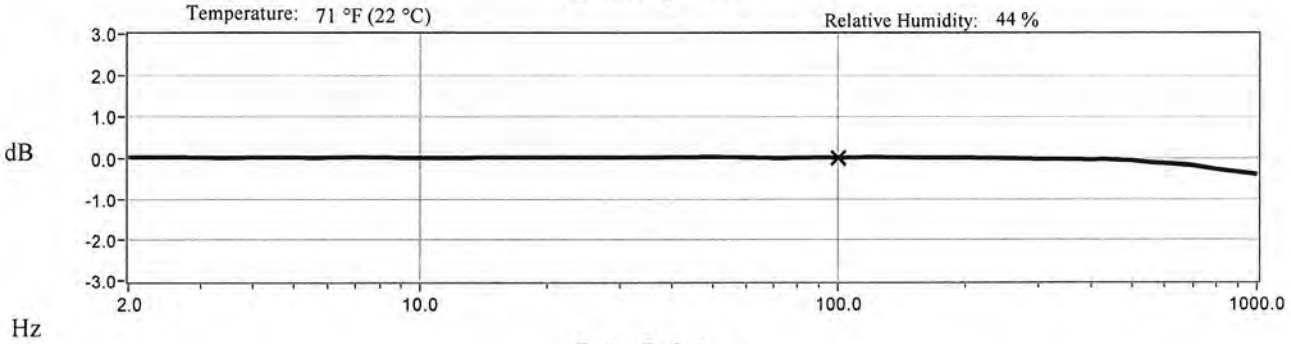
Method: Back-to-Back Comparison AT401-12

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

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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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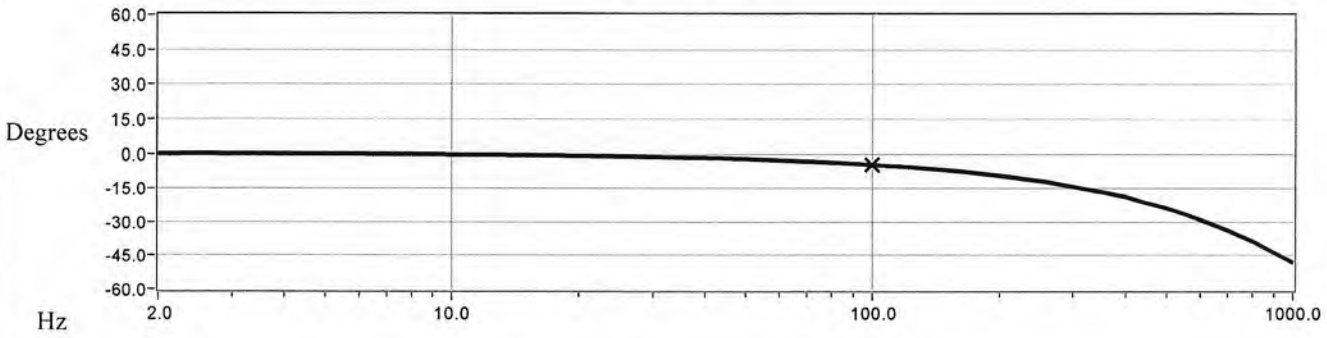
Method: Back-to-Back Comparison AT401-12

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

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