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
TP-111A
I-10 over Mobile River and Bayway
Load Test Program
Mobile Country, Alabama
AFT Project No.: 118008

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Digitally signed by Donald T Robertson
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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-110 was 0.0 feet. Also, a typographical error was corrected in High-Strain Dynamic Pile Testing section, where F3 sensor was included twice, the second entry was corrected to F4.

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, 128-feet long spun-cast concrete cylinder pile at location TP-111A. High-strain dynamic pile testing, also known as PDA, was performed during initial drive, 1 day restrike, and 14 day restrike. 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-111A	Initial Drive	5/17/2018
	1 Day Restrike	5/18/2018
	14 Day Restrike	5/31/2018

The project plans indicate test pile TP-111A was located at station 897+50.00 offset right 150 feet, adjacent to the south 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-111A was performed by Jordan Pile Driving, Inc. Applied Foundation Testing (AFT) was the specialty engineering firm performing the dynamic pile testing. Dynamic pile testing was performed by Mr. Michael Worsham, P.E. 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 for TP-111A. This report includes an overview of the testing program, tabular and graphical representations of the data and analysis, 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-111A is boring BW-110 located at station 894+44.18 offset right 19.23 feet.

A copy of soil boring BW-110 is included in Appendix D. 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-110 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
-1.5 to -13.2	Lean Clay with Sand (CL)	0 to 1
-13.2 to -18.2	Sand (SP)	1
-18.2 to -33.2	Silty Sand (SM)	0
-33.2 to -83.2	Sand with Silt (SP-SM)	2 to 37
-83.2 to -121.5	Lean Clay with Sand (CH)	18 to 61

Note 1: Table created from Thompson Engineering Test Boring Record BW-110 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-111A 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-111A, the pile was jetted until the pile tip was at approximate elevation -38 feet. Pile TP-111A 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. During a portion of the initial drive, the F1 strain transducer did not function properly, therefore only the average from the F3, A3, F4, and A4 sensors, located 180 degrees apart, were used in the data output and analysis for this this portion of initial drive until the F1 sensor was driven down far enough to be replaced. This portion of data collected utilizing the average of the F3, A3, F4, and A4 sensors was of high quality with good proportionality and should be considered highly reliable. Calibration information for the sensors utilized is included in Appendix E. 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-111A was driven to where the sensor attachment points were approximately 1 foot above the waterline.

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 most of initial drive. The top of the pile driving template was located at elevation 12.7 feet. After the template was removed the reference elevation was moved to elevation 12.9 feet; however, the penetration depths shown in the plots and tabular summaries of the dynamic testing results are based on the original top of pile driving template reference elevation of 12.7 feet. The mudline elevation was measured as -16.9 feet. After driving the elevation of the top of soil inside the cylinder pile was measured as -57.0 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-111A	Pileco D180-32	+12.7[2], +12.9[3]	-16.9	+12.6	-115.4

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.
Note 2: Top of template elevation
Note 3: Reference elevation after removal of template.

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-111A	EOD	59 Blows/1'	6.11	3.24	1.15	0.39	3.48	1.95	96.1/8.25

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	4 Blows/1", 9 Blows/1", 9 Blows/1"	5.51	4.99	0.40	0.31	4.26	3.71	145.4/9.57
	14 Day RS	11 Blows/0.55"[2]	2.75	1.33	0.50	0.21	2.09	0.81	17.9/NA[3]

Note 1: EOD – End of Initial Drive; RS – Restrike
Note 2: Due to lack of options for fixed reference in over water construction, the inspector used the helmet movement through the stationary hammer leads to determine blows per inch during restrikes. Due to pile top concrete crushing during the 14 day restrike it was not possible to accurately determine pile top movement (blows per inch) during restrike. The dynamic testing accelerometer measurements indicate pile top movements of less than or equal to 0.05 inch per blow, so this was used in data and analysis presented in this report.
Note 3: Due to pile top concrete crushing during 14 day restrike, many false triggers were recorded. Due to these false triggers, some stroke heights during the 14 day restrike were not accurately determined by the software.

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

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

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

During the initial drive of TP-111A, hammer alignment issues caused a portion of the pile top concrete to spall near the end of drive. During the 1 day restrike this concrete spalling became more severe due to the high energy blows imparted to the pile in the attempt to fully mobilize resistance. During the 14 day restrike the pile top concrete began to crush, with most blows only transferring a small amount of energy into the pile due to the pile top concrete crushing. One higher energy blow was recorded during dynamic testing and a signal matching analysis was performed on this blow. The results of this signal matching analysis better represents the 14 day resistance than other blows recorded. The remainder of the blows during this 14 day restrike were of very low energy due to the pile top concrete crushing. The dynamic test data does not show any signs of integrity problems below the sensor location for TP-111A.

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-111A	EOD	2763	1410	1139	271	0.62	92.9/ 9.07	0.20	0.15	0.36	0.15	2.36
	1 Day Restrike	3	1900	1584	316	0.83	166.6/ 10.22	0.04	0.13	0.32	0.30	2.76
	14 Day Restrike	2	1950	1634	316	1.05	124.8/ NA(1)	0.15	0.04	0.40	0.39	2.40

Note 1: Due to pile top concrete crushing during 14 day restrike, many false triggers were recorded. Due to these false triggers, some stroke heights during the 14 day restrike were not accurately determined by the software.

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

The signal matching analysis for TP-111A indicated a total ultimate resistance of 1,410 kips at end of initial drive, 1,900 kips during the 1 day restrike; and 1,950 kips during the 14 day restrike. Based on the set measurements during end of initial drive and 1 day restrike for TP-111A, the resistance values presented in this report may be considered fully mobilized for end of initial drive and 1 day restrike. Due to small set measurement during 14 day restrike the resistance value may not be fully mobilized; however, the increase in resistance from the signal matching analysis between the 1 and 14 day restrikes seems proportionate to other testing performed at the site.

SUMMARY AND CONCLUSIONS

The load test program included the installation of a 54-inch diameter, 6-inch wall thickness, 128-feet long spun-cast concrete cylinder pile at location TP-111A. TP-111A was subjected to dynamic pile testing during initial drive and 1 and 14 day restrikes. A summary of the test results is provided below:

TP-111A Testing Summary:

- The signal matching analysis of the dynamic testing data for TP-111A indicated a total ultimate resistance of 1,410 kips at end of initial drive, 1,900 kips for the 1 day restrike, and 1,950 kips for the 14 day restrike.

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, 128-feet long spun-cast concrete cylinder pile at location TP-111A are as follows:

- During production phase testing when keeping driving stress values below allowable limits during initial drives and restrikes is of the upmost importance, due to possibly lower transfer energies, less resistance may be mobilized than shown in this report.
- Dynamic pile testing on production piles is recommended to determine bearing resistances, measure pile driving stresses, and determine hammer driving system suitability. Driving criteria may be developed based on this testing with recommendations provided to control tensile and compressive stresses at or below allowable levels.
- Signal matching analyses of the production pile dynamic test data is recommended to confirm and/or to provide a better estimate of the ultimate pile bearing resistance.

Below is a summary of the Appendix contents:

- Appendix A – Inspector's Pile Driving Records
- Appendix B – Dynamic Pile Testing Data Summaries
- Appendix C – CAPWAP Signal Matching Analysis Output
- Appendix D – Relevant Project Documents
- Appendix E – 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-111A

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 897+50 to Station 897+50		Bridge Identification Number:
Road Between: I-10 and I-10		Lane (if applicable): EB
Contractor: Jordan Pile Driving	Inspector: Donald Hector	
Date: 5/16/2018	Bent No.& Lane: TEST PILE	Pile No.: TP-111A
Kind of Soil: Soft, Wet, Black, Fat Clay		
Kind of Pile: Spun Cast Cylinder	Size of Pile: 54"	Total Length (ft): 128
Elev. Ground Line at Pile: -14.9	Final Elev. At Top of Pile: 12.9	Tip Elevation: -115.1
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)
4.24	168,243	7	43	
3.71	147,213	10	44	
5.91	234,509	12	45	
5.62	223,002	17	46	

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
897+50	897+50	N/A

Date	Bent No.& Lane	Pile No.	Kind of Soil
5/16/2018	TEST PILE	TP-111A	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)
5.59	221,811	18	47	
5.92	234,906	26	48	
5.84	231,731	27	49	
5.84	231,731	32	50	
6.00	238,080	35	51	
5.99	237,683	39	52	
6.04	239,667	52	53	
6.79	269,427	40	54	
7.04	279,347	33	55	
7.15	283,712	37	56	
7.09	281,331	43	57	
7.25	287,680	49	58	
6.82	270,618	46	59	
7.38	292,838	49	60	
7.81	309,901	40	61	
8.02	318,234	30	62	
8.07	320,218	39	63	
7.39	293,235	34	64	
8.04	319,027	34	65	
8.05	319,424	31	66	
8.23	326,566	35	67	
7.50	297,600	40	68	

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

ALABAM)EPARTMENT OF TRANSPORTATI(
CONTINUATION OF TEST PILE RECORD

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

Bridge: Station	to Station	Bridge Identification Number
897+50	897+50	N/A

Date	Bent No.& Lane	Pile No.	Kind of Soil
5/16/2018	TEST PILE	TP-111A	Soft, Wet, Black, Fat Clay

Height Of Fall (feet)	Energy Delivered To Pile (E) (ft-lbs.)	Blows Per Foot Of Penetration (N)	Total Penetration (feet)	Bearing (Ru) (tons)
8.39	332,915	33	69	
8.32	330,138	40	70	
8.27	328,154	37	71	
7.61	301,965	39	72	
7.64	303,155	43	73	
8.24	326,963	43	74	
8.16	323,789	39	75	
8.23	326,566	36	76	
8.73	346,406	39	77	
8.13	322,598	43	78	
6.52	258,714	39	79	
8.25	327,360	37	80	
7.79	309,107	32	81	
7.78	308,710	36	82	
7.28	288,870	45	83	
7.52	298,394	38	84	
8.90	353,152	38	85	
8.94	354,739	35	86	
7.58	300,774	36	87	
8.93	354,342	37	88	
8.22	326,170	32	89	
9.08	360,294	36	90	
9.02	357,914	30	91	

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

ALABAMA DEPARTMENT OF TRANSPORTATION
CONTINUATION OF TEST PILE RECORD

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

Bridge: Station	to Station	Bridge Identification Number
897+50	897+50	N/A

Date	Bent No.& Lane	Pile No.	Kind of Soil
5/16/2018	TEST PILE	TP-111A	Soft, Wet, Black, Fat Clay

Height Of Fall (feet)	Energy Delivered To Pile (E) (ft. lbs.)	Blows Per Foot Of Penetration (N)	Total Penetration (feet)	Bearing (Ru) (tons)
8.90	353,152	33	92	
8.36	331,725	45	93	
8.38	332,518	40	94	
8.09	321,011	44	95	
7.90	313,472	43	96	
9.06	359,501	39	97	
8.95	355,136	38	98	
8.40	333,312	40	99	
9.01	357,517	39	100	
6.03	239,270	42	101	
4.59	182,131	46	102	
6.62	262,682	56	103	
7.08	280,934	60	104	
5.61	222,605	53	105	
8.70	345,216	50	106	
8.60	341,248	47	107	
8.50	337,280	50	108	
7.68	304,742	35	109	
6.17	244,826	51	110	
8.60	341,248	54	111	
8.72	346,010	51	112	
9.25	367,040	53	113	
9.51	377,357	47	114	
9.00	357,120	58	115	

Appendix B

Dynamic Pile Testing Data Summaries
TP-111A

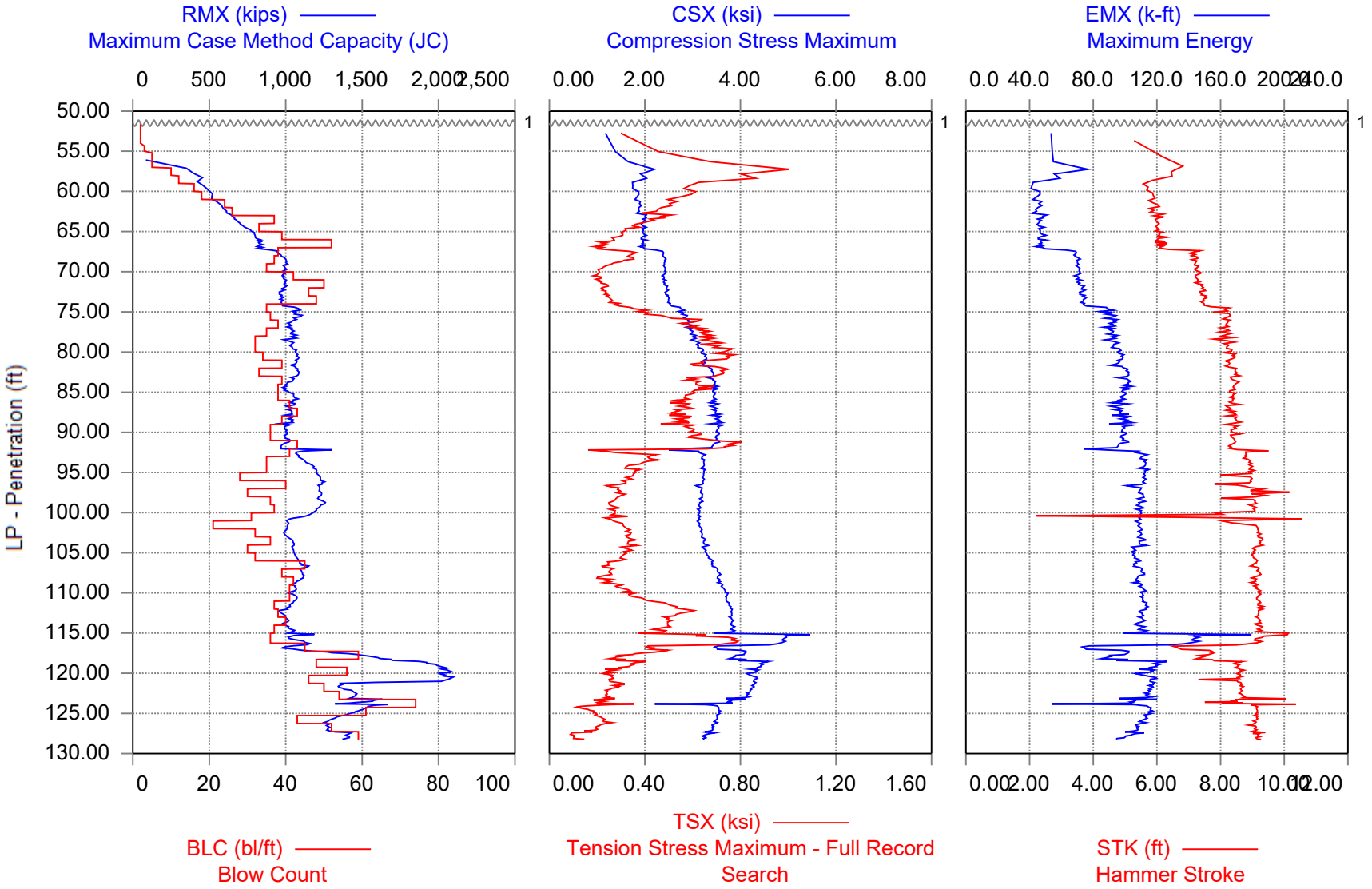
I-10 over Mobile River Bridge Load Test Program

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: 09-June-2018 Test started: 17-May-2018

I-10 MOBILE RIVER - TP-111A ID



1 - Template (Reference) El. = 12.68', Mudline El. = -16.9'

I-10 MOBILE RIVER - TP-111A ID 54" CYL, 6" WALL
OP: AFT Date: 17-May-2018

AR: 904.78 in² SP: 0.150 k/ft³
LE: 119.00 ft EM: 7,778.33 ksi
WS: 15,500.0 f/s JC: 0.62

RMX: Maximum Case Method Capacity (JC)
RX7: Maximum Case Method Capacity (JC=0.7)
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	RX7 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
2	52.00	2	AV2	0	0	0	1.01	0.14	0.06	55.5	**	77
			STD	0	0	0	0.10	0.05	0.04	17.9	**	1
			MAX	0	0	0	1.11	0.19	0.10	73.4	**	78
			MIN	0	0	0	0.92	0.08	0.03	37.7	**	76
4	53.00	2	AV2	0	0	10	1.34	0.17	0.30	65.5	6.41	81
			STD	0	0	10	0.01	0.02	0.20	7.9	0.73	1
			MAX	0	0	21	1.36	0.18	0.50	73.4	7.14	82
			MIN	0	0	0	1.33	0.15	0.11	57.7	5.68	80
6	54.00	2	AV2	0	0	0	1.17	0.10	0.53	39.8	5.00	88
			STD	0	0	0	0.15	0.03	0.08	9.1	0.29	12
			MAX	0	0	0	1.32	0.13	0.61	48.9	5.29	100
			MIN	0	0	0	1.02	0.07	0.45	30.6	4.70	76
9	55.00	3	AV3	0	0	0	0.97	0.18	0.24	35.2	4.45	72
			STD	0	0	0	0.35	0.15	0.04	28.5	0.00	3
			MAX	0	0	0	1.46	0.39	0.29	75.4	4.45	75
			MIN	0	0	0	0.66	0.06	0.20	12.8	4.45	67
14	56.00	5	AV5	31	17	250	1.65	0.41	0.65	60.2	6.35	95
			STD	32	24	90	0.19	0.05	0.17	20.3	1.08	6
			MAX	82	60	390	1.87	0.50	0.83	93.3	8.19	100
			MIN	0	0	139	1.42	0.36	0.36	40.4	5.33	86
19	57.00	5	AV5	167	142	241	1.83	0.50	0.75	66.5	6.39	93
			STD	68	71	78	0.27	0.06	0.13	16.6	0.71	5
			MAX	254	235	319	2.13	0.56	0.90	83.5	7.18	100
			MIN	71	43	108	1.39	0.39	0.53	39.5	5.31	88
29	58.00	10	AV10	400	399	453	2.03	0.55	0.90	64.0	6.49	95
			STD	13	14	55	0.22	0.02	0.16	12.6	0.56	5
			MAX	423	423	499	2.25	0.58	1.11	79.0	7.18	100
			MIN	385	381	352	1.61	0.50	0.59	43.0	5.54	90
41	59.00	12	AV12	439	437	376	1.92	0.59	0.77	52.9	6.06	100
			STD	31	29	27	0.27	0.02	0.21	14.2	0.57	0
			MAX	484	481	419	2.29	0.64	1.05	72.6	6.85	100
			MIN	396	396	336	1.53	0.55	0.48	32.9	5.29	100
57	60.00	16	AV16	474	474	368	1.77	0.68	0.59	42.4	5.70	100
			STD	26	26	15	0.16	0.04	0.11	6.8	0.29	0
			MAX	512	512	392	2.00	0.77	0.76	53.0	6.20	100
			MIN	423	423	339	1.46	0.60	0.36	28.9	5.12	100

I-10 MOBILE RIVER - TP-111A ID 54" CYL, 6" WALL
OP: AFT Date: 17-May-2018

BL#	Depth ft	BLC bl/ft	TYPE	RMX kips	RX7 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
75	61.00	18	AV18	520	519	400	1.87	0.78	0.58	46.2	5.90	100
			STD	8	8	12	0.06	0.03	0.04	3.0	0.14	0
			MAX	533	531	424	1.98	0.84	0.66	51.9	6.14	100
			MIN	505	504	381	1.78	0.73	0.50	42.1	5.68	100
99	62.00	24	AV24	562	559	436	1.88	0.87	0.51	46.1	5.92	100
			STD	27	26	25	0.13	0.05	0.08	6.1	0.28	0
			MAX	602	599	493	2.08	0.95	0.66	57.0	6.40	100
			MIN	491	488	373	1.59	0.75	0.36	32.0	5.29	100
125	63.00	26	AV26	612	604	490	1.89	0.94	0.45	45.0	5.93	100
			STD	21	19	25	0.14	0.05	0.08	6.8	0.30	0
			MAX	657	643	575	2.25	1.05	0.63	63.6	6.72	100
			MIN	571	567	441	1.60	0.86	0.26	31.7	5.38	100
162	64.00	37	AV37	674	663	559	1.98	1.04	0.43	46.5	6.00	100
			STD	20	19	38	0.12	0.04	0.07	5.0	0.23	0
			MAX	714	701	622	2.12	1.12	0.55	52.5	6.31	100
			MIN	611	603	499	1.63	0.90	0.23	32.5	5.38	100
195	65.00	33	AV33	739	721	646	1.95	1.12	0.34	46.0	6.01	100
			STD	26	24	17	0.12	0.04	0.07	5.1	0.24	0
			MAX	779	765	670	2.13	1.18	0.46	53.9	6.37	100
			MIN	693	676	596	1.65	0.99	0.21	33.4	5.42	100
234	66.00	39	AV39	799	783	675	1.97	1.19	0.29	47.5	6.09	100
			STD	38	35	13	0.14	0.05	0.05	6.4	0.30	0
			MAX	848	831	708	2.15	1.26	0.37	56.1	6.51	100
			MIN	699	692	646	1.63	1.08	0.20	33.0	5.45	100
286	67.00	52	AV52	832	821	699	1.97	1.26	0.23	47.6	6.12	100
			STD	43	41	8	0.11	0.04	0.04	5.3	0.25	0
			MAX	892	878	717	2.13	1.34	0.32	55.8	6.48	100
			MIN	717	710	685	1.66	1.13	0.18	34.1	5.49	100
324	68.00	38	AV38	919	903	715	2.27	1.41	0.31	63.4	6.89	100
			STD	69	65	17	0.21	0.07	0.08	10.7	0.51	0
			MAX	978	961	761	2.49	1.48	0.44	76.0	7.57	100
			MIN	679	676	666	1.59	1.15	0.18	31.2	5.42	100
361	69.00	37	AV37	997	983	714	2.41	1.50	0.32	70.0	7.21	100
			STD	21	20	10	0.07	0.03	0.06	3.9	0.20	0
			MAX	1,034	1,019	745	2.62	1.55	0.49	82.8	7.87	100
			MIN	949	938	698	2.27	1.44	0.20	63.1	6.82	100
396	70.00	35	AV35	997	984	711	2.42	1.56	0.23	70.9	7.25	100
			STD	33	32	9	0.07	0.03	0.04	4.0	0.18	0
			MAX	1,049	1,034	729	2.53	1.62	0.33	77.4	7.57	100
			MIN	921	912	690	2.21	1.50	0.17	60.0	6.72	100
438	71.00	42	AV42	988	977	748	2.40	1.58	0.20	70.5	7.27	100
			STD	26	24	17	0.06	0.03	0.03	3.5	0.17	0
			MAX	1,034	1,022	780	2.51	1.64	0.27	77.6	7.60	100

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OP: AFT Date: 17-May-2018

BL#	Depth	BLC	TYPE	RMX	RX7	RA2	CSX	CSB	TSX	EMX	STK	BTA
	ft	bl/ft		kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
			MIN	930	922	708	2.27	1.52	0.16	62.6	6.88	100
488	72.00	50	AV50	998	987	786	2.43	1.60	0.23	71.9	7.35	100
			STD	25	24	19	0.06	0.03	0.03	3.2	0.16	0
			MAX	1,044	1,032	819	2.52	1.65	0.29	77.1	7.57	100
			MIN	947	939	749	2.28	1.53	0.17	63.5	6.95	100
534	73.00	46	AV46	972	961	830	2.45	1.63	0.23	72.9	7.43	100
			STD	18	17	10	0.04	0.02	0.03	2.4	0.11	0
			MAX	1,015	1,002	850	2.56	1.67	0.32	79.1	7.68	100
			MIN	933	924	808	2.37	1.59	0.19	68.3	7.21	100
582	74.00	48	AV48	974	963	831	2.50	1.63	0.26	74.0	7.47	100
			STD	20	18	9	0.05	0.02	0.04	2.7	0.12	0
			MAX	1,037	1,021	849	2.61	1.69	0.36	80.7	7.79	100
			MIN	938	929	812	2.40	1.58	0.19	68.0	7.25	100
617	75.00	35	AV35	1,040	1,023	840	2.69	1.71	0.34	84.1	7.91	100
			STD	58	54	16	0.13	0.06	0.08	8.1	0.36	0
			MAX	1,129	1,105	875	2.92	1.80	0.49	97.3	8.48	100
			MIN	956	943	812	2.48	1.61	0.21	71.5	7.39	100
653	76.00	36	AV36	1,074	1,051	905	2.83	1.80	0.48	90.8	8.17	100
			STD	47	43	34	0.12	0.04	0.10	6.6	0.29	0
			MAX	1,186	1,154	974	3.09	1.86	0.67	107.6	8.89	100
			MIN	959	944	853	2.53	1.68	0.26	75.4	7.49	100
691	77.00	38	AV38	1,027	1,000	992	2.92	1.85	0.60	91.7	8.18	100
			STD	22	20	15	0.07	0.03	0.06	4.1	0.17	0
			MAX	1,075	1,041	1,013	3.03	1.91	0.72	99.4	8.48	100
			MIN	953	933	953	2.69	1.76	0.47	77.3	7.60	100
726	78.00	35	AV35	1,047	1,019	968	2.99	1.83	0.65	92.2	8.19	100
			STD	32	29	16	0.10	0.03	0.07	5.6	0.24	0
			MAX	1,091	1,061	1,001	3.17	1.87	0.78	101.3	8.61	100
			MIN	984	962	927	2.79	1.76	0.53	80.6	7.68	100
758	79.00	32	AV32	1,034	1,008	940	3.05	1.84	0.67	92.0	8.16	100
			STD	50	45	19	0.15	0.05	0.11	8.3	0.34	0
			MAX	1,109	1,077	969	3.33	1.91	0.89	106.0	8.79	100
			MIN	911	896	894	2.70	1.72	0.46	73.0	7.39	100
790	80.00	32	AV32	1,050	1,023	942	3.16	1.88	0.72	94.9	8.26	100
			STD	29	26	12	0.10	0.02	0.07	4.9	0.21	0
			MAX	1,091	1,061	966	3.31	1.92	0.83	102.6	8.61	100
			MIN	975	957	917	2.90	1.81	0.51	82.2	7.75	100
824	81.00	34	AV34	1,076	1,048	934	3.25	1.90	0.74	97.6	8.35	100
			STD	28	26	13	0.10	0.03	0.08	4.9	0.21	0
			MAX	1,130	1,099	976	3.43	1.97	0.87	106.3	8.70	100
			MIN	1,034	1,010	911	3.06	1.84	0.60	89.8	7.95	100
863	82.00	39	AV39	1,062	1,030	936	3.26	1.94	0.65	95.6	8.24	100

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OP: AFT Date: 17-May-2018

BL#	Depth	BLC	TYPE	RMX	RX7	RA2	CSX	CSB	TSX	EMX	STK	BTA
	ft	bl/ft		kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
			STD	36	34	12	0.11	0.04	0.08	5.5	0.23	0
			MAX	1,135	1,095	964	3.50	2.03	0.85	107.2	8.75	100
			MIN	954	931	909	3.01	1.86	0.47	81.4	7.68	100
896	83.00	33	AV33	1,082	1,045	923	3.42	2.02	0.73	102.0	8.50	100
			STD	16	14	9	0.05	0.03	0.04	2.8	0.12	0
			MAX	1,125	1,083	944	3.57	2.11	0.81	109.5	8.84	100
			MIN	1,057	1,023	905	3.33	1.98	0.64	97.4	8.27	100
935	84.00	39	AV39	1,035	1,002	928	3.42	2.11	0.61	100.8	8.43	100
			STD	24	23	13	0.08	0.05	0.06	4.0	0.15	0
			MAX	1,089	1,053	959	3.61	2.19	0.75	110.2	8.79	100
			MIN	985	955	905	3.25	2.01	0.50	92.3	8.11	100
973	85.00	38	AV38	997	966	925	3.46	2.14	0.64	100.1	8.39	100
			STD	25	22	15	0.09	0.04	0.07	4.7	0.19	0
			MAX	1,047	1,013	953	3.62	2.20	0.81	108.2	8.70	100
			MIN	947	921	894	3.26	2.06	0.47	89.2	7.99	100
1011	86.00	38	AV38	1,055	1,021	920	3.45	2.08	0.58	98.8	8.39	100
			STD	18	17	11	0.06	0.02	0.05	3.2	0.13	0
			MAX	1,093	1,058	941	3.59	2.13	0.69	105.8	8.66	100
			MIN	1,021	992	895	3.33	2.04	0.49	92.6	8.15	100
1052	87.00	41	AV41	1,039	1,011	896	3.45	2.06	0.56	96.0	8.32	100
			STD	47	42	23	0.15	0.05	0.09	7.8	0.33	0
			MAX	1,169	1,129	940	3.83	2.20	0.79	117.5	9.22	100
			MIN	940	922	843	3.13	1.96	0.36	79.4	7.57	100
1095	88.00	43	AV43	1,031	1,003	894	3.48	2.10	0.54	97.0	8.34	100
			STD	33	30	19	0.11	0.04	0.07	5.9	0.23	0
			MAX	1,079	1,047	928	3.75	2.20	0.74	109.9	8.93	100
			MIN	929	911	828	3.21	2.01	0.37	82.3	7.75	100
1134	89.00	39	AV39	1,028	1,000	895	3.52	2.13	0.55	99.4	8.45	100
			STD	41	37	25	0.13	0.04	0.08	6.9	0.29	0
			MAX	1,083	1,050	926	3.80	2.22	0.73	113.6	9.07	100
			MIN	895	880	818	3.11	2.01	0.32	77.3	7.49	100
1170	90.00	36	AV36	1,003	976	867	3.54	2.17	0.59	99.5	8.42	100
			STD	31	28	18	0.11	0.03	0.07	5.9	0.24	0
			MAX	1,075	1,041	907	3.77	2.25	0.70	112.7	8.98	100
			MIN	939	920	835	3.26	2.10	0.35	86.0	7.87	100
1206	91.00	36	AV36	1,005	978	888	3.51	2.17	0.62	98.9	8.41	100
			STD	22	19	23	0.08	0.03	0.06	4.1	0.17	0
			MAX	1,044	1,013	926	3.68	2.23	0.73	107.3	8.79	100
			MIN	959	937	834	3.33	2.12	0.49	90.1	8.11	100
1249	92.00	43	AV43	989	960	918	3.46	2.09	0.75	97.5	8.37	100
			STD	28	29	17	0.09	0.04	0.06	4.3	0.17	0
			MAX	1,051	1,021	968	3.67	2.20	0.90	107.9	8.79	100
			MIN	951	918	884	3.35	2.02	0.61	91.5	8.11	100

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OP: AFT Date: 17-May-2018

BL#	Depth ft	BLC bl/ft	TYPE	RMX kips	RX7 kips	RA2 kips	CSX ksi	CSB ksi	TSX ksi	EMX k-ft	STK ft	BTA (%)
1290	93.00	41	AV41	1,106	1,033	1,068	3.01	2.12	0.36	102.1	8.84	100
			STD	99	101	113	0.51	0.20	0.18	18.8	0.60	0
			MAX	1,433	1,371	1,399	3.66	2.26	1.15	121.1	11.52	100
			MIN	908	775	754	1.07	1.06	0.13	21.8	7.64	100
1325	94.00	35	AV35	1,120	1,041	1,060	3.22	2.15	0.41	111.9	8.85	100
			STD	24	22	23	0.08	0.04	0.06	4.7	0.21	0
			MAX	1,163	1,082	1,110	3.39	2.24	0.53	122.4	9.32	100
			MIN	1,077	994	1,014	3.07	2.09	0.26	102.9	8.44	100
1360	95.00	35	AV35	1,189	1,108	1,095	3.22	2.24	0.34	111.9	8.95	100
			STD	15	14	16	0.12	0.04	0.09	6.7	0.27	0
			MAX	1,216	1,134	1,134	3.47	2.34	0.54	126.9	9.57	100
			MIN	1,166	1,083	1,067	2.96	2.15	0.17	95.9	8.31	100
1388	96.00	28	AV28	1,219	1,134	1,065	3.23	2.27	0.34	112.5	8.75	100
			STD	15	14	16	0.07	0.02	0.06	4.1	1.07	0
			MAX	1,247	1,156	1,092	3.37	2.32	0.50	121.4	9.32	100
			MIN	1,189	1,105	1,029	3.10	2.21	0.25	103.8	3.27	100
1428	97.00	40	AV40	1,231	1,139	1,043	3.17	2.29	0.29	108.7	8.67	100
			STD	25	26	45	0.10	0.04	0.06	6.9	1.05	0
			MAX	1,352	1,265	1,275	3.33	2.36	0.38	119.2	10.05	100
			MIN	1,198	1,104	992	2.85	2.17	0.14	87.3	2.51	100
1458	98.00	30	AV30	1,228	1,132	1,017	3.19	2.29	0.30	110.0	9.36	100
			STD	11	12	14	0.04	0.02	0.04	3.2	2.20	0
			MAX	1,254	1,160	1,059	3.27	2.33	0.37	115.4	16.68	100
			MIN	1,203	1,106	995	3.12	2.26	0.23	104.5	3.52	100
1494	99.00	36	AV36	1,235	1,140	1,021	3.17	2.29	0.27	110.2	8.89	100
			STD	21	21	18	0.06	0.02	0.03	4.2	1.07	0
			MAX	1,268	1,173	1,063	3.26	2.33	0.35	116.8	9.32	100
			MIN	1,194	1,098	985	3.03	2.22	0.20	100.4	2.65	100
1531	100.00	37	AV37	1,207	1,123	1,044	3.14	2.23	0.27	109.3	8.85	100
			STD	18	15	14	0.04	0.03	0.02	2.6	1.18	0
			MAX	1,239	1,148	1,071	3.25	2.28	0.34	116.7	9.37	100
			MIN	1,169	1,088	1,013	3.08	2.18	0.23	105.2	1.82	100
1562	101.00	31	AV31	1,099	1,019	1,025	3.14	2.15	0.27	109.8	7.24	100
			STD	60	57	24	0.08	0.04	0.08	6.1	3.86	0
			MAX	1,183	1,100	1,118	3.32	2.21	0.44	122.5	16.34	100
			MIN	994	914	990	3.01	2.05	0.16	100.6	1.49	100
1583	102.00	21	AV21	1,010	944	1,025	3.14	2.01	0.31	108.5	8.91	100
			STD	19	18	26	0.13	0.04	0.09	8.5	0.98	0
			MAX	1,038	984	1,064	3.35	2.16	0.46	123.0	9.89	100
			MIN	959	917	959	2.79	1.95	0.15	87.3	4.97	100
1615	103.00	32	AV32	997	939	1,066	3.19	1.98	0.33	109.8	9.20	100
			STD	14	22	20	0.09	0.02	0.07	6.0	0.27	0

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BL#	Depth	BLC	TYPE	RMX	RX7	RA2	CSX	CSB	TSX	EMX	STK	BTA
	ft	bl/ft		kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
			MAX	1,024	986	1,111	3.32	2.02	0.46	118.9	9.62	100
			MIN	969	905	1,006	2.97	1.91	0.16	94.8	8.53	100
1651	104.00	36	AV36	1,042	962	1,099	3.23	1.97	0.33	109.7	9.24	100
			STD	17	16	16	0.06	0.02	0.05	4.0	0.19	0
			MAX	1,079	995	1,135	3.38	2.01	0.47	121.0	9.73	100
			MIN	1,008	932	1,071	3.11	1.91	0.21	101.8	8.84	100
1681	105.00	30	AV30	1,047	965	1,069	3.26	1.87	0.33	106.6	9.10	100
			STD	12	13	21	0.11	0.05	0.08	7.0	0.30	0
			MAX	1,076	992	1,128	3.54	2.00	0.50	125.9	10.00	100
			MIN	1,019	934	1,039	2.97	1.80	0.13	92.3	8.57	100
1713	106.00	32	AV32	1,069	977	1,056	3.34	1.79	0.31	106.6	9.05	100
			STD	10	8	14	0.07	0.01	0.04	3.3	0.13	0
			MAX	1,093	1,002	1,080	3.44	1.82	0.37	112.1	9.22	100
			MIN	1,045	960	1,023	3.18	1.76	0.23	98.5	8.75	100
1758	107.00	45	AV45	1,112	984	1,099	3.43	1.79	0.25	107.3	9.09	100
			STD	25	16	15	0.06	0.03	0.04	3.1	0.13	0
			MAX	1,166	1,017	1,131	3.59	1.86	0.32	114.5	9.37	100
			MIN	1,076	949	1,061	3.31	1.74	0.19	102.4	8.89	100
1797	108.00	39	AV39	1,108	940	1,053	3.54	1.88	0.25	110.5	9.19	100
			STD	20	17	21	0.06	0.04	0.04	3.3	0.14	0
			MAX	1,162	973	1,085	3.71	1.94	0.34	118.9	9.57	100
			MIN	1,069	899	1,002	3.43	1.81	0.17	103.7	8.93	100
1839	109.00	42	AV42	1,080	938	999	3.56	1.92	0.24	107.9	9.07	100
			STD	29	29	18	0.06	0.01	0.04	3.0	0.13	0
			MAX	1,143	985	1,051	3.68	1.96	0.33	112.4	9.37	100
			MIN	1,031	881	962	3.40	1.89	0.11	102.0	8.70	100
1880	110.00	41	AV41	1,056	1,001	986	3.65	1.96	0.31	110.8	9.15	100
			STD	19	21	29	0.06	0.03	0.05	3.1	0.13	0
			MAX	1,082	1,038	1,024	3.76	2.01	0.40	116.7	9.47	100
			MIN	996	945	907	3.50	1.90	0.20	103.9	8.84	100
1921	111.00	41	AV41	1,062	1,054	962	3.71	1.95	0.37	111.2	9.20	100
			STD	19	17	24	0.06	0.04	0.06	3.1	0.14	0
			MAX	1,100	1,086	1,016	3.84	2.02	0.47	116.9	9.52	100
			MIN	1,009	1,003	919	3.59	1.87	0.23	104.7	8.98	100
1958	112.00	37	AV37	1,030	1,017	997	3.76	1.86	0.50	112.9	9.22	100
			STD	20	22	20	0.09	0.02	0.07	4.4	0.19	0
			MAX	1,079	1,065	1,035	3.96	1.93	0.67	123.0	9.67	100
			MIN	995	978	958	3.58	1.82	0.36	103.8	8.84	100
1996	113.00	38	AV38	979	969	969	3.81	1.84	0.56	110.6	9.19	100
			STD	22	26	21	0.06	0.02	0.06	3.6	0.14	0
			MAX	1,045	1,042	1,057	3.95	1.88	0.70	120.3	9.57	100
			MIN	935	918	934	3.68	1.80	0.44	102.3	8.93	100

I-10 MOBILE RIVER - TP-111A ID 54" CYL, 6" WALL
OP: AFT Date: 17-May-2018

BL#	Depth	BLC	TYPE	RMX	RX7	RA2	CSX	CSB	TSX	EMX	STK	BTA
	ft	bl/ft		kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
2036	114.00	40	AV40	1,001	987	958	3.82	1.84	0.50	109.7	9.19	100
			STD	20	21	37	0.06	0.02	0.04	3.5	0.13	0
			MAX	1,035	1,022	1,020	3.92	1.88	0.57	115.8	9.37	100
			MIN	951	940	874	3.65	1.77	0.39	98.7	8.84	100
2073	115.00	37	AV37	1,033	1,018	938	3.83	1.84	0.47	110.6	9.22	100
			STD	22	25	20	0.07	0.02	0.06	3.6	0.14	0
			MAX	1,083	1,070	976	3.98	1.89	0.60	118.9	9.52	100
			MIN	983	967	903	3.68	1.79	0.34	103.2	8.93	100
2118	116.25	36	AV45	1,079	1,023	903	4.87	2.48	0.70	145.0	9.46	100
			STD	90	89	126	0.66	0.28	0.16	27.2	0.76	0
			MAX	1,524	1,191	1,274	6.11	3.21	0.90	229.8	13.16	100
			MIN	861	802	605	1.09	1.20	0.00	16.1	8.70	100
2163	117.25	45	AV45	1,073	990	650	3.93	2.10	0.51	95.3	7.43	100
			STD	69	102	81	0.57	0.30	0.15	26.9	0.97	0
			MAX	1,178	1,176	788	4.97	2.58	0.84	147.4	9.32	100
			MIN	950	823	546	2.86	1.51	0.22	50.7	5.80	100
2222	118.25	59	AV59	1,476	1,210	785	3.98	2.81	0.33	95.2	7.53	100
			STD	137	150	38	0.22	0.15	0.08	9.9	0.33	0
			MAX	1,762	1,481	853	4.30	3.15	0.48	110.4	8.15	100
			MIN	1,186	921	694	3.20	2.38	0.16	62.5	6.45	100
2270	119.25	48	AV48	1,907	1,627	814	4.37	3.23	0.34	115.8	8.35	100
			STD	116	108	41	0.22	0.20	0.05	11.4	0.43	0
			MAX	2,074	1,795	868	4.66	3.48	0.44	130.6	8.93	100
			MIN	1,676	1,407	712	3.77	2.68	0.24	85.6	7.28	100
2326	120.25	56	AV56	2,045	1,781	880	4.27	3.19	0.26	113.4	8.60	100
			STD	38	32	32	0.13	0.12	0.04	6.8	0.17	0
			MAX	2,132	1,852	957	4.50	3.38	0.40	125.6	8.98	100
			MIN	1,959	1,720	792	3.95	2.90	0.20	97.9	8.15	100
2372	121.25	46	AV46	1,952	1,681	894	4.30	3.13	0.26	116.8	8.42	100
			STD	232	244	47	0.10	0.13	0.03	5.6	1.03	0
			MAX	2,119	1,847	1,029	4.47	3.33	0.36	126.3	8.93	100
			MIN	1,356	1,051	837	4.00	2.82	0.23	100.3	1.59	100
2422	122.25	50	AV50	1,377	1,082	1,035	4.25	2.77	0.27	116.3	8.66	100
			STD	35	41	13	0.07	0.05	0.04	3.3	0.13	0
			MAX	1,451	1,168	1,065	4.39	2.91	0.36	122.7	8.89	100
			MIN	1,328	1,021	1,005	4.04	2.64	0.22	106.8	8.27	100
2476	123.25	54	AV54	1,464	1,186	1,079	4.11	2.66	0.24	113.3	8.85	100
			STD	59	67	72	0.27	0.20	0.07	11.7	1.41	0
			MAX	1,638	1,385	1,267	4.55	2.99	0.72	144.0	18.71	100
			MIN	1,309	1,004	730	2.63	1.55	0.12	54.7	6.98	100
2550	124.25	74	AV74	1,533	1,321	1,270	3.53	2.03	0.20	103.4	8.74	100
			STD	122	127	189	0.52	0.41	0.07	18.7	1.20	0
			MAX	1,700	1,606	1,841	4.07	2.59	0.52	119.4	12.76	100

I-10 MOBILE RIVER - TP-111A ID 54" CYL, 6" WALL
OP: AFT Date: 17-May-2018

BL#	Depth	BLC	TYPE	RMX	RX7	RA2	CSX	CSB	TSX	EMX	STK	BTA
	ft	bl/ft		kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
			MIN	948	874	824	1.04	0.60	0.11	10.4	1.80	100
2611	125.25	61	AV61	1,460	1,251	1,331	3.55	1.84	0.18	115.5	9.13	100
			STD	47	49	25	0.03	0.03	0.02	2.3	0.11	0
			MAX	1,552	1,345	1,387	3.65	1.92	0.21	121.7	9.42	100
			MIN	1,362	1,145	1,283	3.45	1.79	0.12	108.5	8.89	100
2654	126.25	43	AV43	1,299	1,086	1,248	3.49	1.71	0.23	111.9	9.11	100
			STD	38	41	24	0.05	0.05	0.03	3.3	0.14	0
			MAX	1,394	1,187	1,298	3.65	1.81	0.35	123.6	9.62	100
			MIN	1,214	979	1,210	3.39	1.63	0.18	105.1	8.79	100
2706	127.25	52	AV52	1,278	1,068	1,248	3.41	1.62	0.20	107.5	9.06	100
			STD	14	16	15	0.05	0.03	0.03	2.8	0.13	0
			MAX	1,306	1,105	1,281	3.52	1.70	0.26	113.3	9.32	100
			MIN	1,254	1,039	1,212	3.30	1.56	0.13	100.4	8.66	100
2765	128.25	59	AV59	1,399	1,195	1,337	3.28	1.65	0.11	101.8	9.17	100
			STD	46	45	75	0.17	0.08	0.05	10.3	0.22	0
			MAX	1,447	1,248	1,396	3.67	1.78	0.46	125.9	9.89	100
			MIN	1,189	967	913	2.27	1.14	0.08	45.0	8.44	100
			Average	1,122	1,035	929	3.24	1.95	0.39	96.1	8.25	100
			Std. Dev.	306	239	211	0.71	0.53	0.19	23.1	1.19	1
			Maximum	2,132	1,852	1,841	6.11	3.48	1.15	229.8	18.71	100
			Minimum	0	0	0	0.66	0.06	0.00	10.4	1.49	67

Total number of blows analyzed: 2765

BL#	Sensors
1-1261	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)
1262-2074	F1: off; ; F2: off; ; F3: [P454] 145.3 (1.00); F4: [P455] 145.8 (1.00); A1: off; A2: off; A3: [K5647] 334.0 (1.00); A4: [K5943] 368.0 (1.00)
2075-2765	F1: [H829] 92.2 (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. = 12.68', Mudline El. = -16.9'
1252	CHANGE CUSHION
2074	REMOVE TEMPLATE, CHANGE F1
2075	New Reference El. = 12.93'
2517	SPALLED PILE DUE TO MISALIGNMENT, CHANGE CUSHION

Time Summary

Drive	31 minutes 38 seconds	10:37 AM - 11:08 AM (5/17/2018) BN 1 - 1252
Stop	27 minutes 56 seconds	11:08 AM - 11:36 AM
Drive	21 minutes 37 seconds	11:36 AM - 11:58 AM BN 1253 - 2074
Stop	46 minutes 51 seconds	11:58 AM - 12:45 PM

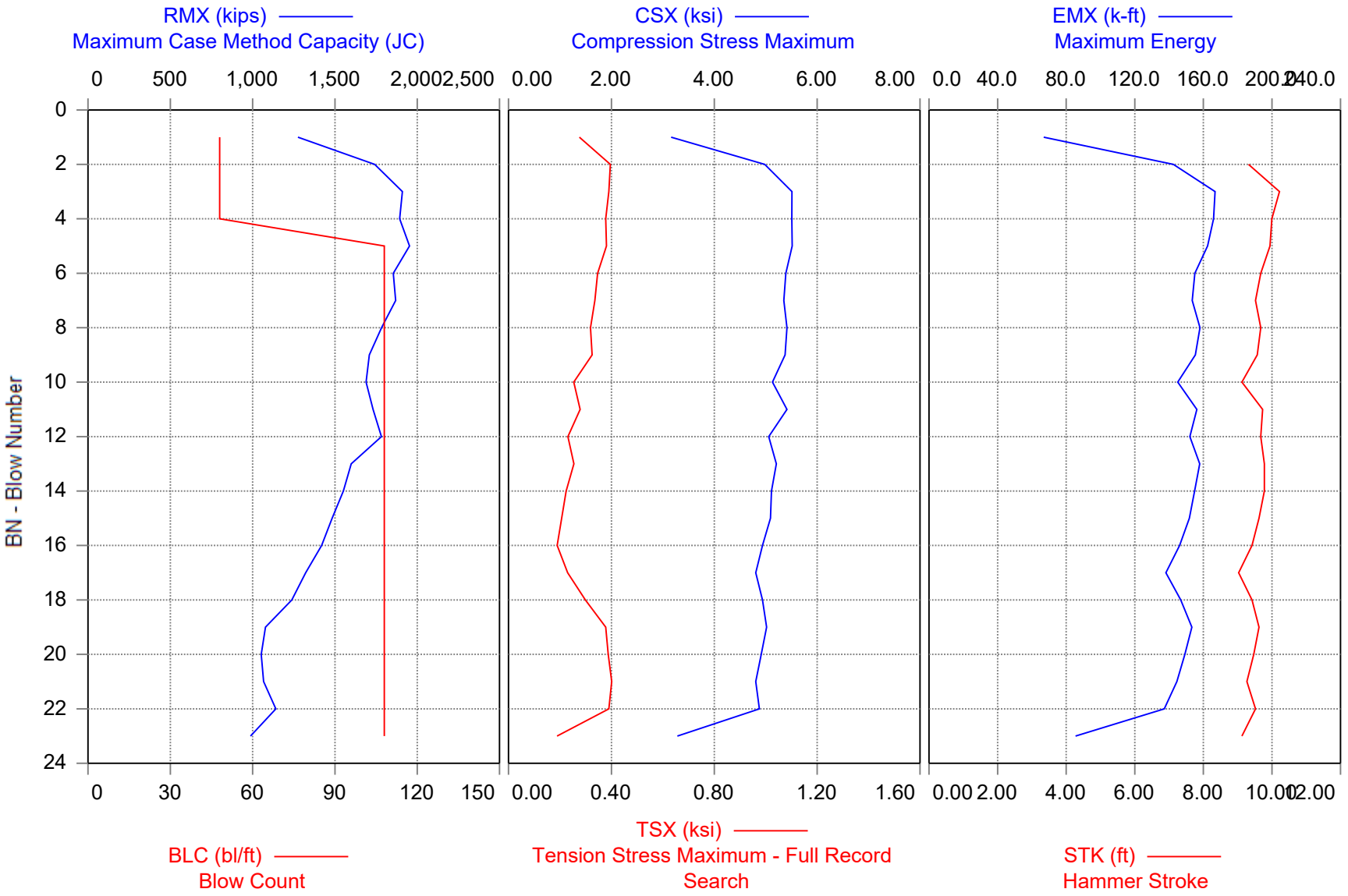
Drive 15 minutes 55 seconds 12:45 PM - 1:01 PM BN 2075 - 2516
Stop 25 minutes 2 seconds 1:01 PM - 1:26 PM
Drive 10 minutes 58 seconds 1:26 PM - 1:37 PM BN 2517 - 2765

Total time [02:59:58] = (Driving [01:20:09] + Stop [01:39:49])

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

Printed: 07-June-2018 Test started: 18-May-2018

I-10 MOBILE RIVER - TP-111A 1 DAY RS



I-10 MOBILE RIVER - TP-111A 1 DAY RS 54" CYL, 6" WALL
OP: AFT Date: 18-May-2018

AR: 904.78 in² SP: 0.150 k/ft³
LE: 119.00 ft EM: 7,778.33 ksi
WS: 15,500.0 f/s JC: 0.83

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#	BLC	RMX	RX9	RA2	CSX	CSB	TSX	EMX	STK	BTA
	bl/ft	kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
1	48	1,275	1,115	877	3.16	2.38	0.28	66.9	0.00	74
2	48	1,742	1,470	888	4.98	3.86	0.40	142.5	9.32	72
3	48	1,910	1,610	961	5.51	4.26	0.39	166.8	10.22	71
4	48	1,893	1,593	943	5.51	4.23	0.38	165.9	10.00	72
5	108	1,953	1,656	1,097	5.51	4.21	0.38	162.5	9.94	68
6	108	1,854	1,562	1,066	5.39	4.09	0.35	155.0	9.67	72
7	108	1,868	1,580	1,106	5.35	4.06	0.34	153.5	9.52	71
8	108	1,783	1,487	1,094	5.41	4.06	0.32	158.0	9.67	70
9	108	1,709	1,412	1,068	5.38	4.01	0.32	155.3	9.57	70
10	108	1,689	1,409	1,067	5.13	3.85	0.25	145.1	9.12	71
11	108	1,731	1,432	1,095	5.41	4.10	0.28	156.2	9.73	73
12	108	1,782	1,510	1,156	5.06	3.85	0.23	152.1	9.67	76
13	108	1,599	1,309	1,112	5.21	3.88	0.25	157.9	9.78	76
14	108	1,551	1,266	1,131	5.11	3.80	0.22	154.9	9.78	77
15	108	1,483	1,197	1,099	5.09	3.79	0.21	151.8	9.62	80
16	108	1,419	1,141	1,115	4.94	3.68	0.19	146.1	9.42	81
17	108	1,322	1,050	1,130	4.81	3.52	0.23	138.2	9.03	81
18	108	1,238	1,073	1,129	4.94	3.58	0.30	146.8	9.42	82
19	108	1,078	1,060	1,127	5.02	3.60	0.38	153.3	9.62	83
20	108	1,052	1,052	1,108	4.91	3.50	0.39	149.2	9.47	83
21	108	1,067	1,066	1,116	4.80	3.38	0.40	144.5	9.27	84
22	108	1,141	1,141	1,346	4.87	3.38	0.39	137.2	9.52	86
23	108	987	899	1,272	3.28	2.35	0.19	85.4	9.12	82
Average		1,527	1,308	1,091	4.99	3.71	0.31	145.4	9.57	76
Std. Dev.		313	224	102	0.59	0.49	0.07	22.8	0.29	5
Maximum		1,953	1,656	1,346	5.51	4.26	0.40	166.8	10.22	86
Minimum		987	899	877	3.16	2.35	0.19	66.9	9.03	68

Total number of blows analyzed: 23

BL# Sensors

1-23 F1: [H829] 92.2 (1.00); F2: [J762] 93.9 (1.00); F3: [P454] 145.3 (1.00); F4: [P455] 145.8 (1.00); A1: [59379] 925.0 (1.00); A2: [59462] 1055.0 (1.00); A3: [K5647] 334.0 (1.00); A4: [K5943] 368.0 (1.00)

BL# Comments

23 4BL/1", 9BL/1", 9BL/1"

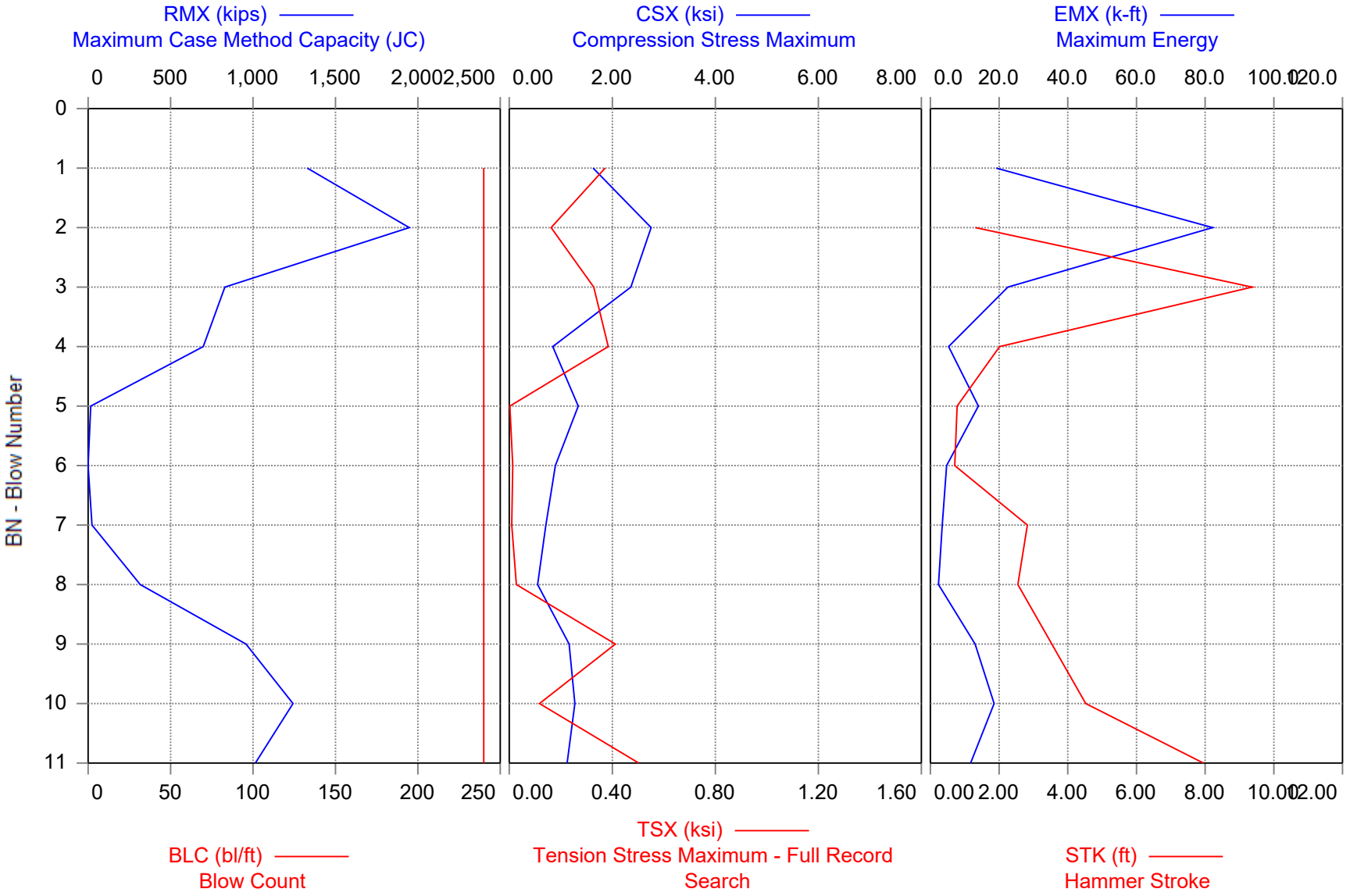
Time Summary

Drive 34 seconds 12:53 PM - 12:53 PM BN 1 - 23

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

Printed: 07-June-2018 Test started: 31-May-2018

I-10 MOBILE RIVER - TP-111A 14 DAY RS



I-10 MOBILE RIVER - TP-111A 14 DAY RS 54" CYL, 6" WALL
OP: AFT Date: 31-May-2018

AR: 904.78 in² SP: 0.150 k/ft³
LE: 119.00 ft EM: 7,778.33 ksi
WS: 15,500.0 f/s JC: 1.03

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

BL#	BLC	RMX	RX11	RA2	CSX	CSB	TSX	EMX	STK	BTA
	bl/ft	kips	kips	kips	ksi	ksi	ksi	k-ft	ft	(%)
1	240	1,329	1,329	1,029	1.63	1.24	0.37	19.2	0.00	87
2	240	1,947	1,859	1,689	2.75	2.09	0.16	82.2	1.31	100
3	240	829	828	993	2.36	1.88	0.33	22.5	9.37	64
4	240	698	698	738	0.84	0.50	0.38	5.3	2.01	51
5	240	16	16	10	1.34	0.01	0.00	14.0	0.78	13
6	240	0	0	47	0.89	0.03	0.01	4.7	0.71	0
7	240	23	22	62	0.71	0.05	0.01	3.4	2.82	59
8	240	316	298	334	0.55	0.32	0.03	2.3	2.55	100
9	240	957	951	1,195	1.16	0.90	0.41	13.0	0.00	63
10	240	1,243	1,213	1,411	1.27	1.11	0.12	18.5	4.52	83
11	240	1,014	1,003	1,144	1.12	0.78	0.50	11.7	7.95	78
Average		761	747	787	1.33	0.81	0.21	17.9	3.56	63
Std. Dev.		599	582	563	0.65	0.69	0.18	21.4	2.96	31
Maximum		1,947	1,859	1,689	2.75	2.09	0.50	82.2	9.37	100
Minimum		0	0	10	0.55	0.01	0.00	2.3	0.71	0

Total number of blows analyzed: 11

BL# Sensors

1-11 F1: [A788] 95.1 (1.00); F2: [I840] 94.9 (1.00); F3: [P454] 145.3 (1.00); F4: [P455] 145.8 (1.00); A1: [59379] 925.0 (-1.00); A2: [42301A] 930.0 (1.00); A3: [K5647] 334.0 (1.00); A4: [K5943] 368.0 (1.00)

BL# Comments

1 INSPECTOR USED HELMET MOVEMENT THROUGH STATIONARY HAMMER LEADS TO COUNT BLOWS PER INCH BECAUSE NOT ABLE TO SET-UP STRING LINE OR OTHER TYPE FIXED REFERENCE

9 INSPECTOR MEASURED 3BL/1", 2BL/1", 1BL/1", HOWEVER PILE MOVEMENT NOT ABLE TO BE MEASURED ACCURATELY DUE TO CRUSHING PILE TOP CONCRETE

11 2BL, PILE MOVEMENT NOT ABLE TO BE MEASURED DUE TO CRUSHING PILE TOP CONCRETE

Time Summary

Drive 5 minutes 25 seconds 9:34 AM - 9:40 AM BN 1 - 11

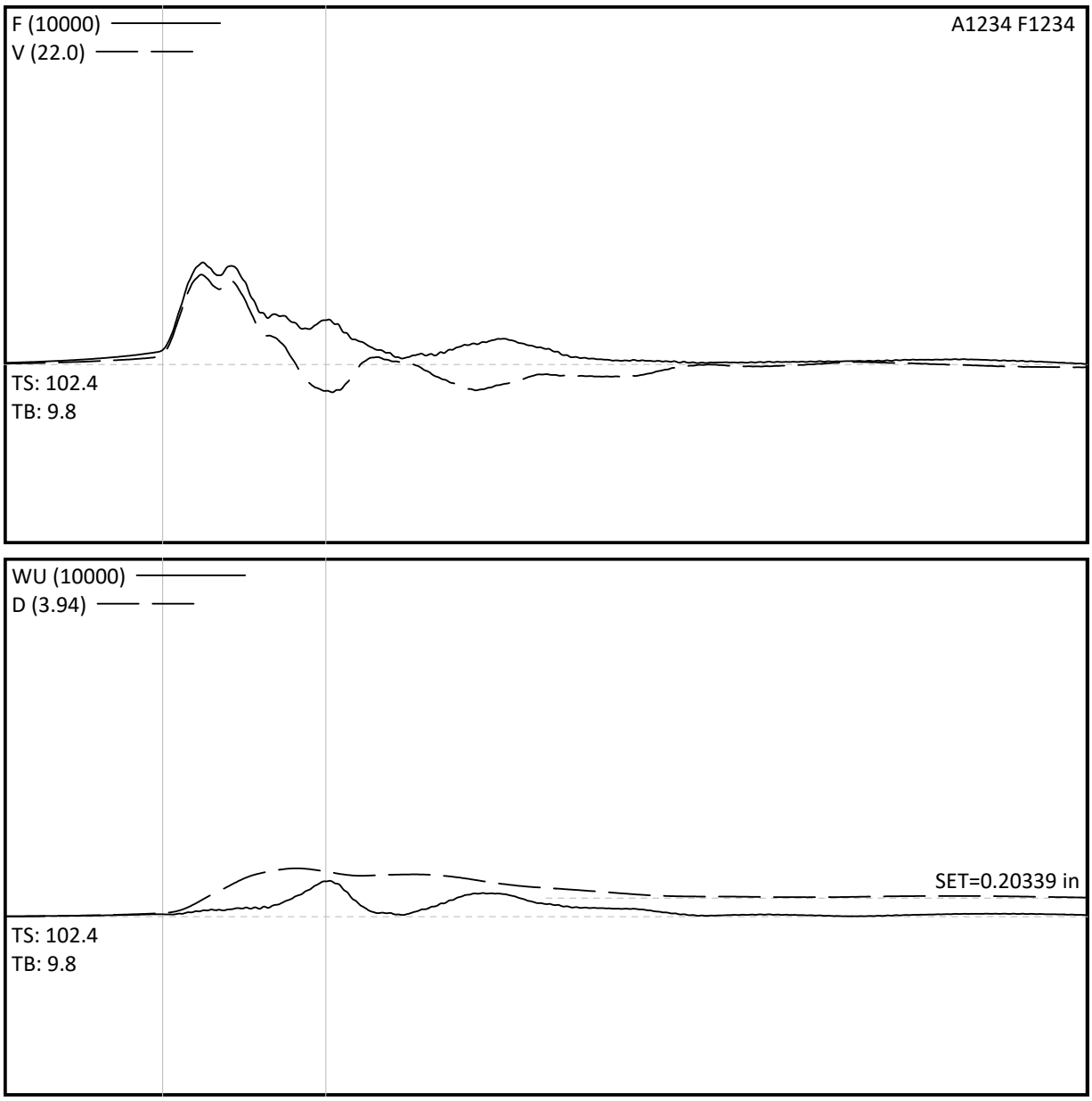
Appendix C

CAPWAP Signal Matching Analysis Output
TP-111A

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-111A ID



Project Information

PROJECT: I-10 MOBILE RIVER
PILE NAME: TP-111A ID
DESCR: 54'' CYL, 6'' WALL
OPERATOR: AFT
FILE: TP-111A ID ana
5/17/2018 1:37:09 PM
Blow Number 2763

Pile Properties

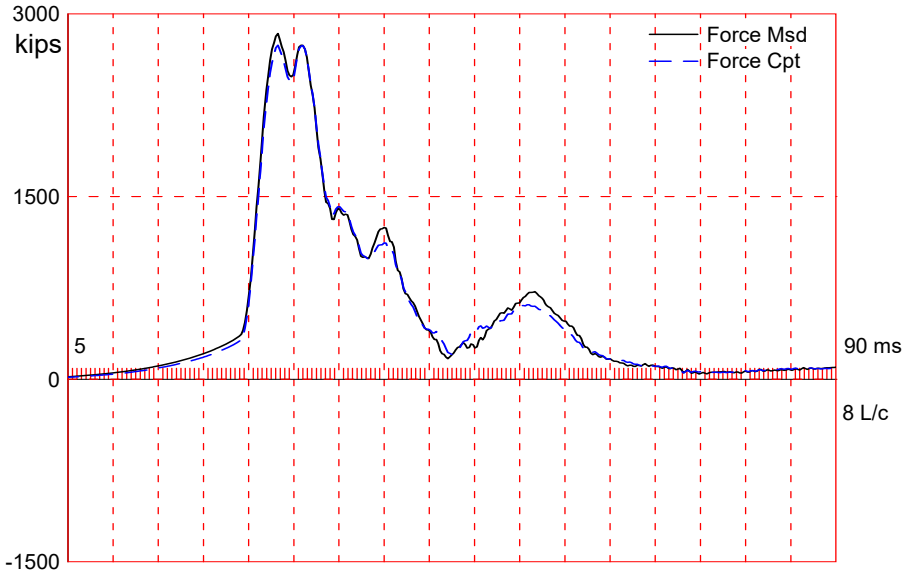
LE 119.00 ft
AR 904.78 in^2
EM 7778.33 ksi
SP 0.150 k/ft3
WS 15500.0 f/s
EA/C 454.0 ksec/ft
2L/C 15.40 ms
JC 0.62 []
LP 128.22 ft

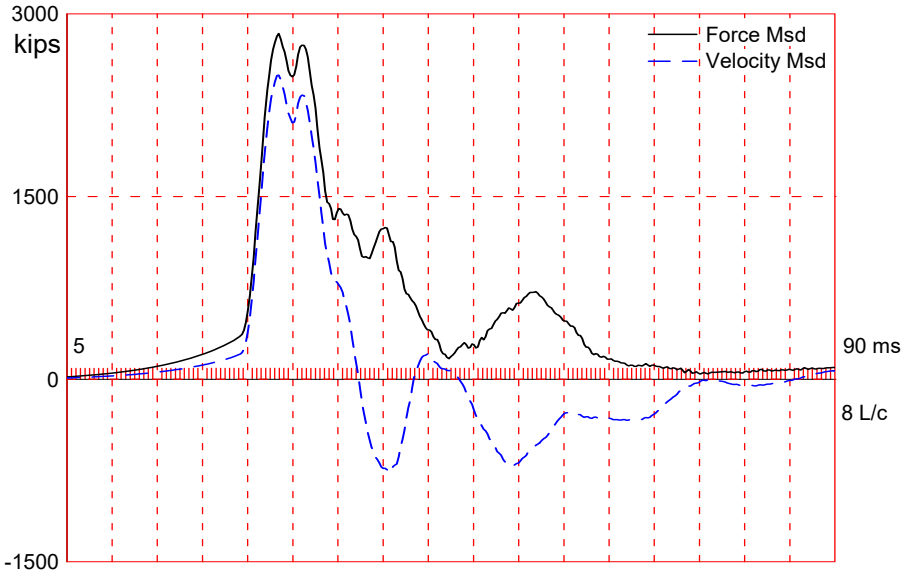
Quantity Results

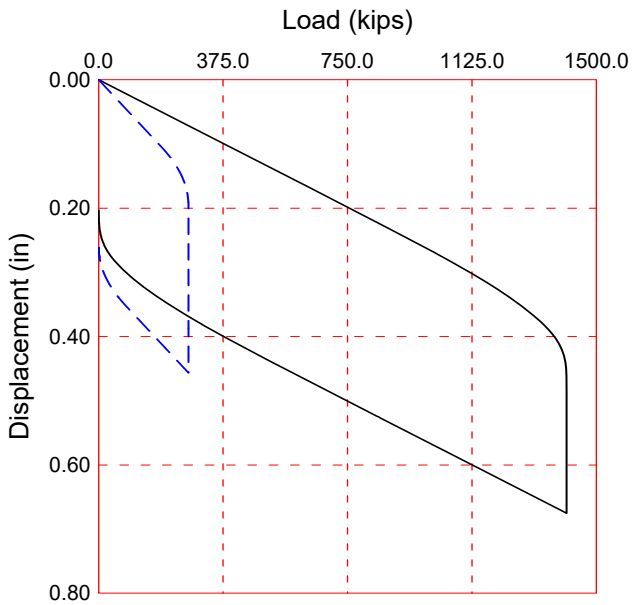
RMX 1439 kips
RX7 1248 kips
RA2 1395 kips
CSX 3.15 ksi
CSB 1.62 ksi
TSX 0.10 ksi
EMX 93.0 k-ft
STK 9.07 ft
BTA 100 (%)

Sensors

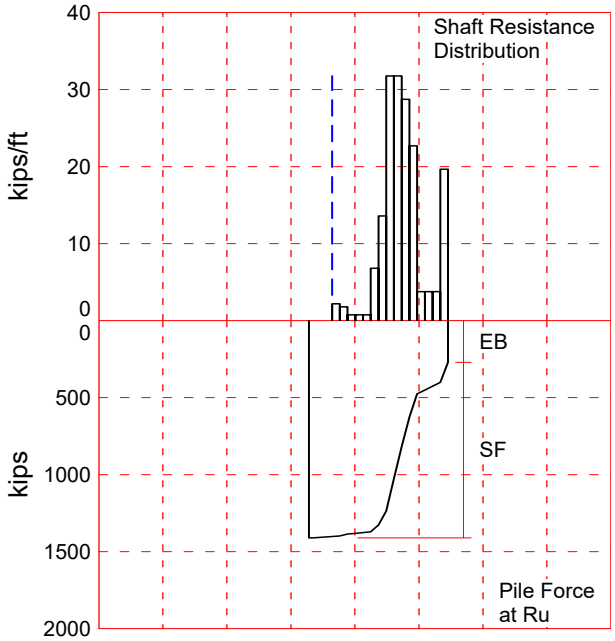
F1: [H829] 92.2 (1)
F2: [J762] 93.9 (1)
F3: [P454] 145.3 (1)
F4: [P455] 145.8 (1)
A1: [59379] 925 g's/v (1)
A2: [59462] 1055 g's/v (1)
A3: [K5647] 334 mv/5000g's (1)
A4: [K5943] 368 mv/5000g's (1)
CLIP: OK







RU =	1410.0 kips
SF =	1139.0 kips
EB =	271.0 kips
Dy =	0.47 in
Dx =	0.68 in
SET/Bl =	0.20 in



Length b. Sensors	119.0 ft
Embedment	98.0 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.	15455 ft/s
Match Quality	2.36
Top Compr. Stress	3.1 ksi
Max Compr. Stress	3.7 ksi
Max Tension Stress	-0.24 ksi
Avg. Shaft Quake	0.20 in
Toe Quake	0.15 in
Avg. Shaft Smith Dpg.	0.36 s/ft
Toe Smith Damping	0.15 s/ft

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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: 1410.0; along Shaft 1139.0; at Toe 271.0 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
				1410.0			
1	26.4	5.4	12.0	1398.0	12.0	2.20	0.16
2	33.1	12.1	12.0	1386.0	24.0	1.82	0.13
3	39.7	18.7	5.0	1381.0	29.0	0.76	0.05
4	46.3	25.3	5.0	1376.0	34.0	0.76	0.05
5	52.9	31.9	5.0	1371.0	39.0	0.76	0.05
6	59.5	38.5	45.0	1326.0	84.0	6.81	0.48
7	66.1	45.1	90.0	1236.0	174.0	13.61	0.96
8	72.7	51.7	210.0	1026.0	384.0	31.76	2.25
9	79.3	58.3	210.0	816.0	594.0	31.76	2.25
10	85.9	64.9	190.0	626.0	784.0	28.74	2.03
11	92.6	71.6	150.0	476.0	934.0	22.69	1.60
12	99.2	78.2	25.0	451.0	959.0	3.78	0.27
13	105.8	84.8	25.0	426.0	984.0	3.78	0.27
14	112.4	91.4	25.0	401.0	1009.0	3.78	0.27
15	119.0	98.0	130.0	271.0	1139.0	19.66	1.39
Avg. Shaft			75.9			11.62	0.82
Toe			271.0				17.04

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.36	0.15
Quake	(in)	0.20	0.15
Case Damping Factor		0.90	0.09
Damping Type		Viscous	Sm+Visc
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	0	
Soil Plug Weight	(kips)	8.700	

CAPWAP match quality = 2.36 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.20 in; Blow Count = 59 b/ft
Computed: Final Set = 0.20 in; Blow Count = 59 b/ft

max. Top Comp. Stress = 3.1 ksi (T= 28.7 ms, max= 1.218 x Top)
max. Comp. Stress = 3.7 ksi (Z= 59.5 ft, T= 35.3 ms)
max. Tens. Stress = -0.24 ksi (Z= 95.9 ft, T= 41.3 ms)
max. Energy (EMX) = 92.9 kip-ft; max. Measured Top Displ. (DMX)= 0.53 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	2759.8	-30.2	3.1	-0.03	92.9	5.7	0.54
2	6.6	2781.6	-30.3	3.1	-0.03	92.5	5.6	0.53
4	13.2	2828.5	-31.6	3.1	-0.03	91.6	5.5	0.52
6	19.8	2866.3	-33.3	3.2	-0.04	90.4	5.4	0.50
8	26.4	2886.9	-34.8	3.2	-0.04	89.1	5.4	0.48
10	33.1	2891.0	-42.9	3.2	-0.05	86.5	5.3	0.47
12	39.7	2999.3	-52.2	3.3	-0.06	84.7	5.3	0.46
14	46.3	3140.9	-64.4	3.5	-0.07	84.0	5.2	0.45
16	52.9	3269.2	-75.0	3.6	-0.08	83.5	5.0	0.45
18	59.5	3360.2	-83.8	3.7	-0.09	83.0	4.8	0.44
20	66.1	3323.8	-83.2	3.7	-0.09	79.9	4.4	0.44
22	72.7	3157.9	-79.3	3.5	-0.09	74.1	4.1	0.44
24	79.3	2737.5	-70.2	3.0	-0.08	61.5	3.8	0.44
26	85.9	2387.6	-67.0	2.6	-0.07	48.7	4.4	0.44
28	92.6	2048.9	-65.1	2.3	-0.07	36.7	4.7	0.43
30	99.2	1644.4	-165.2	1.8	-0.18	27.0	4.7	0.43
31	102.5	1482.0	-111.8	1.6	-0.12	25.2	4.7	0.43
32	105.8	1336.8	-52.3	1.5	-0.06	25.2	4.9	0.43
33	109.1	1116.1	-42.8	1.2	-0.05	23.4	5.1	0.43
34	112.4	941.2	-26.1	1.0	-0.03	23.4	5.2	0.43
35	115.7	828.2	-18.1	0.9	-0.02	21.6	5.3	0.42
36	119.0	834.1	-18.2	0.9	-0.02	12.4	5.2	0.42
Absolute	59.5			3.7			(T =	35.3 ms)
	95.9				-0.24		(T =	41.3 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	2928.5	2684.6	2440.8	2197.0	1953.1	1709.3	1465.4	1221.6	977.8	733.9
RX	2928.5	2684.6	2440.8	2197.0	1953.1	1709.3	1465.4	1221.6	1099.2	1095.6
RU	3024.8	2790.6	2556.4	2322.1	2087.9	1853.7	1619.5	1385.3	1151.1	916.9

RAU = 1090.1 (kips); RA2 = 1371.4 (kips)

Current CAPWAP Ru = 1410.0 (kips); Corresponding J(RP)= 0.62; J(RX) = 0.62

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS	KEB
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips	kips/in
5.5	28.45	2513.1	2853.7	2856.3	0.53	0.20	0.20	93.3	3049.5	1807

PILE PROFILE AND PILE MODEL

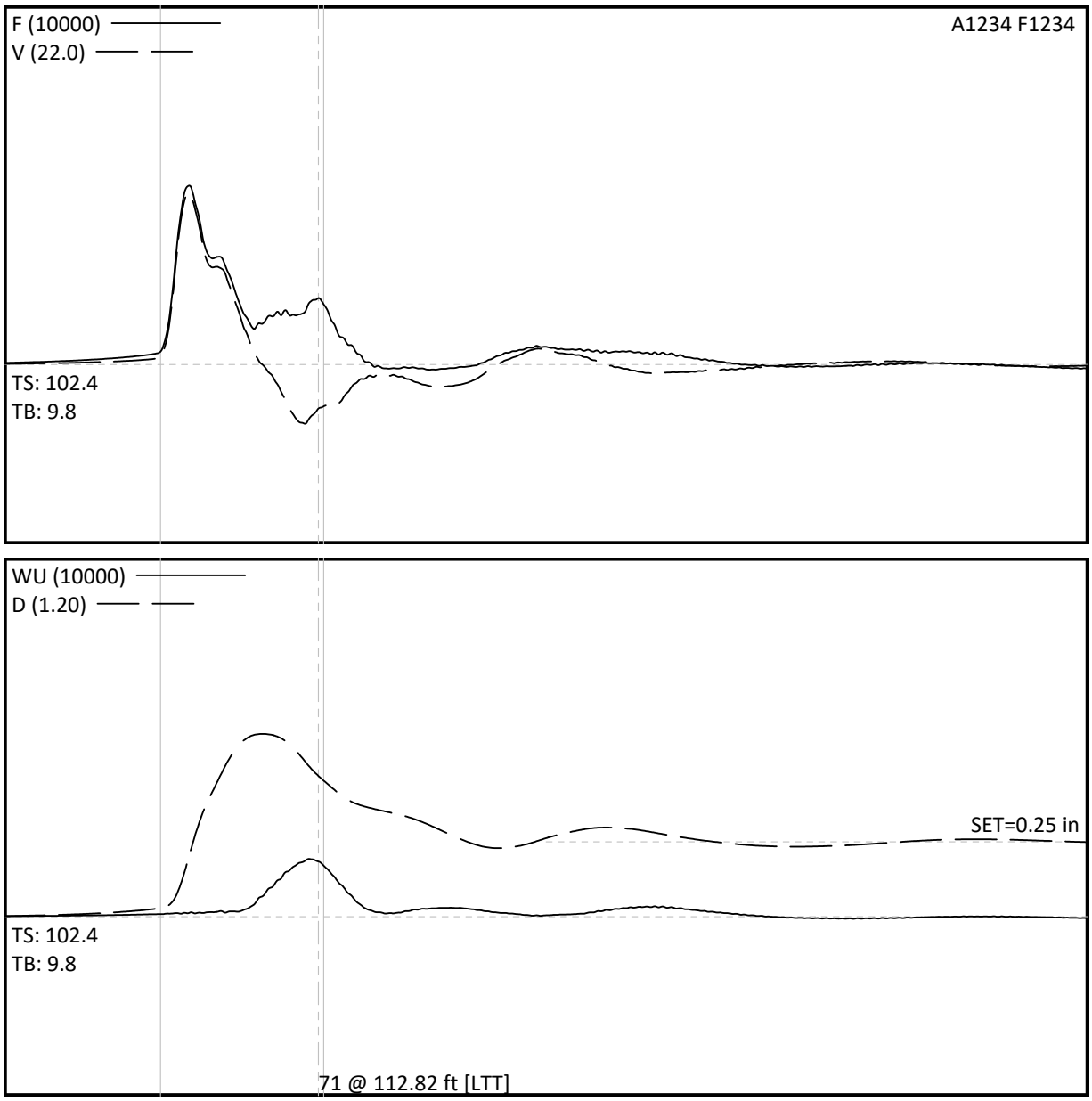
Depth ft	Area ft²	E-Modulus ksi	Spec. Weight lb/ft³	Perim. ft
0.0	6.28	7778.3	150.000	14.14
119.0	6.28	7778.3	150.000	14.14

Toe Area 15.90 ft²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.3	454.04	0.00	0.00	0.000	-0.00	0.000	14.14	15454.5	0.000
8	26.4	454.04	0.00	0.00	0.000	-0.00	0.000	14.14	15454.5	0.300
36	119.0	454.04	0.00	0.00	0.000	-0.00	0.000	14.14	15454.5	0.300

Wave Speed: Pile Top 15500.0, Elastic 15500.0, Overall 15454.5 ft/s
Pile Damping 2.00 %, Time Incr 0.214 ms, 2L/c 15.4 ms
Total volume: 747.699 ft³; Volume ratio considering added impedance: 1.000

I-10 MOBILE RIVER TP-111A 1 DAY RS



Project Information

PROJECT: I-10 MOBILE RIVER
PILE NAME: TP-111A 1 DAY RS
DESCR: 54'' CYL, 6'' WALL
OPERATOR: AFT
FILE: TP-111A 1 DAY RS ana
5/18/2018 12:53:06 PM
Blow Number 3

Pile Properties

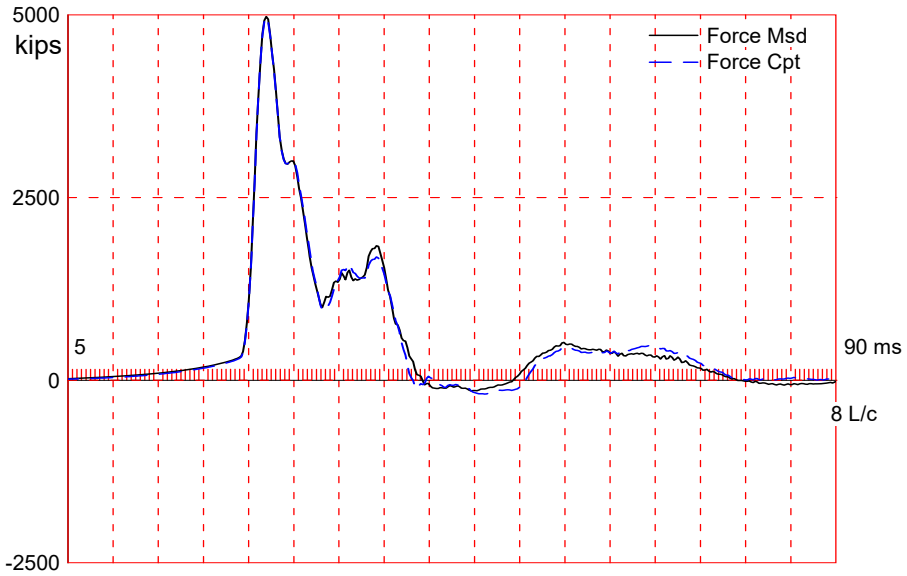
LE 119.00 ft
AR 904.78 in^2
EM 7778.33 ksi
SP 0.150 k/ft3
WS 15500.0 f/s
EA/C 454.0 ksec/ft
2L/C 15.40 ms
JC 0.83 []
LP 128.31 ft

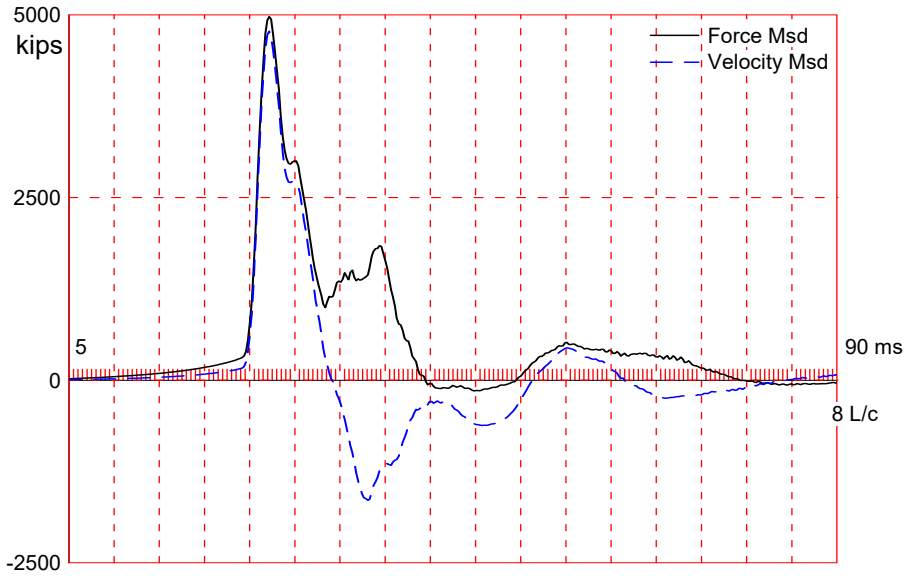
Quantity Results

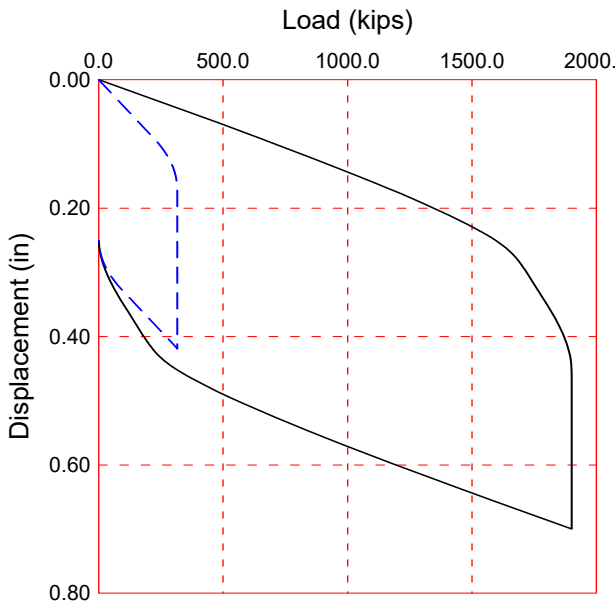
RMX 1910 kips
RX9 1610 kips
RA2 961 kips
CSX 5.51 ksi
CSB 4.26 ksi
TSX 0.39 ksi
EMX 166.9 k-ft
STK 10.22 ft
BTA 71 (%)

Sensors

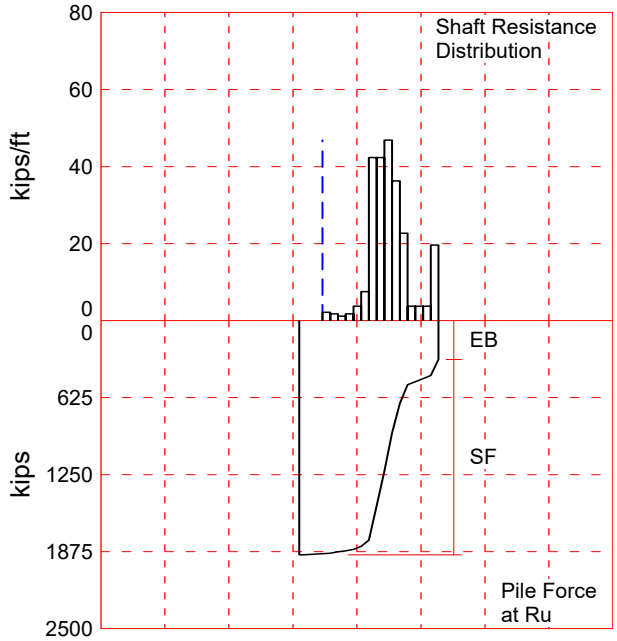
F1: [H829] 92.2 (1)
F2: [J762] 93.9 (1)
F3: [P454] 145.3 (1)
F4: [P455] 145.8 (1)
A1: [59379] 925 g's/v (1)
A2: [59462] 1055 g's/v (1)
A3: [K5647] 334 mv/5000g's (1)
A4: [K5943] 368 mv/5000g's (1)
CLIP: OK







RU =	1900.0 kips
SF =	1584.0 kips
EB =	316.0 kips
Dy =	0.45 in
Dx =	0.70 in
SET/Bl =	0.25 in



Length b. Sensors	119.0 ft
Embedment	98.0 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.	15455 ft/s
Match Quality	2.76
Top Compr. Stress	5.5 ksi
Max Compr. Stress	6.3 ksi
Max Tension Stress	-0.57 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.13 in
Avg. Shaft Smith Dpg.	0.32 s/ft
Toe Smith Damping	0.30 s/ft

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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.

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CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 1900.0; along Shaft 1584.0; at Toe 316.0 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
				1900.0			
1	26.4	5.4	12.0	1888.0	12.0	2.20	0.16
2	33.1	12.1	12.0	1876.0	24.0	1.82	0.13
3	39.7	18.7	8.0	1868.0	32.0	1.21	0.09
4	46.3	25.3	12.0	1856.0	44.0	1.82	0.13
5	52.9	31.9	25.0	1831.0	69.0	3.78	0.27
6	59.5	38.5	50.0	1781.0	119.0	7.56	0.53
7	66.1	45.1	280.0	1501.0	399.0	42.35	3.00
8	72.7	51.7	280.0	1221.0	679.0	42.35	3.00
9	79.3	58.3	310.0	911.0	989.0	46.89	3.32
10	85.9	64.9	240.0	671.0	1229.0	36.30	2.57
11	92.6	71.6	150.0	521.0	1379.0	22.69	1.60
12	99.2	78.2	25.0	496.0	1404.0	3.78	0.27
13	105.8	84.8	25.0	471.0	1429.0	3.78	0.27
14	112.4	91.4	25.0	446.0	1454.0	3.78	0.27
15	119.0	98.0	130.0	316.0	1584.0	19.66	1.39
Avg. Shaft			105.6			16.16	1.14
Toe			316.0				19.87

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.32	0.30
Quake	(in)	0.04	0.13
Case Damping Factor		1.12	0.21
Damping Type		Viscous	Viscous
Unloading Quake	(% of loading quake)	30	100
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	0	
Soil Plug Weight	(kips)		5.000

CAPWAP match quality = 2.76 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.25 in; Blow Count = 48 b/ft
Computed: Final Set = 0.25 in; Blow Count = 48 b/ft

max. Top Comp. Stress = 5.5 ksi (T= 27.4 ms, max= 1.146 x Top)
max. Comp. Stress = 6.3 ksi (Z= 66.1 ft, T= 31.7 ms)
max. Tens. Stress = -0.57 ksi (Z= 95.9 ft, T= 40.2 ms)
max. Energy (EMX) = 166.6 kip-ft; max. Measured Top Displ. (DMX)= 0.61 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	4967.2	-194.9	5.5	-0.22	166.6	10.5	0.61
2	6.6	4971.4	-234.7	5.5	-0.26	166.3	10.5	0.61
4	13.2	4985.6	-306.7	5.5	-0.34	165.3	10.5	0.59
6	19.8	5010.4	-349.2	5.5	-0.39	163.8	10.4	0.57
8	26.4	5039.3	-388.4	5.6	-0.43	161.4	10.3	0.54
10	33.1	5016.2	-408.8	5.5	-0.45	156.5	10.3	0.51
12	39.7	5002.8	-416.3	5.5	-0.46	150.8	10.2	0.48
14	46.3	5036.0	-401.2	5.6	-0.44	145.5	10.0	0.45
16	52.9	5200.4	-366.1	5.7	-0.40	139.9	9.6	0.41
18	59.5	5486.3	-383.0	6.1	-0.42	134.6	8.8	0.38
20	66.1	5692.7	-385.3	6.3	-0.43	129.9	7.9	0.38
22	72.7	5112.2	-319.3	5.7	-0.35	108.4	7.1	0.38
24	79.3	4515.4	-246.8	5.0	-0.27	89.1	6.4	0.38
26	85.9	3776.7	-223.7	4.2	-0.25	68.8	6.0	0.38
28	92.6	3159.0	-379.2	3.5	-0.42	53.2	5.8	0.38
30	99.2	2785.4	-473.7	3.1	-0.52	42.6	5.7	0.39
31	102.5	2737.2	-438.2	3.0	-0.48	40.6	5.6	0.39
32	105.8	2709.1	-342.6	3.0	-0.38	40.5	5.7	0.39
33	109.1	2552.9	-241.8	2.8	-0.27	38.4	6.2	0.39
34	112.4	2347.7	-101.3	2.6	-0.11	38.2	6.9	0.39
35	115.7	2028.0	-60.4	2.2	-0.07	36.2	7.4	0.39
36	119.0	1752.0	-65.9	1.9	-0.07	24.8	7.8	0.39
Absolute	66.1			6.3			(T =	31.7 ms)
	95.9				-0.57		(T =	40.2 ms)

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	5471.9	5041.0	4610.1	4179.3	3748.4	3317.5	2886.6	2455.8	2024.9	1594.0
RX	5471.9	5041.0	4610.1	4179.3	3748.4	3317.5	2886.6	2455.8	2024.9	1594.0
RU	6415.4	6078.9	5742.4	5405.9	5069.4	4732.9	4396.4	4059.8	3723.3	3386.8

RAU = 475.3 (kips); RA2 = 924.3 (kips)

Current CAPWAP Ru = 1900.0 (kips); Corresponding J(RP)= 0.83; J(RX) = 0.83

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS	KEB
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips	kips/in
10.6	27.16	4800.8	4979.7	5008.4	0.61	0.25	0.25	167.3	4663.9	2431

PILE PROFILE AND PILE MODEL

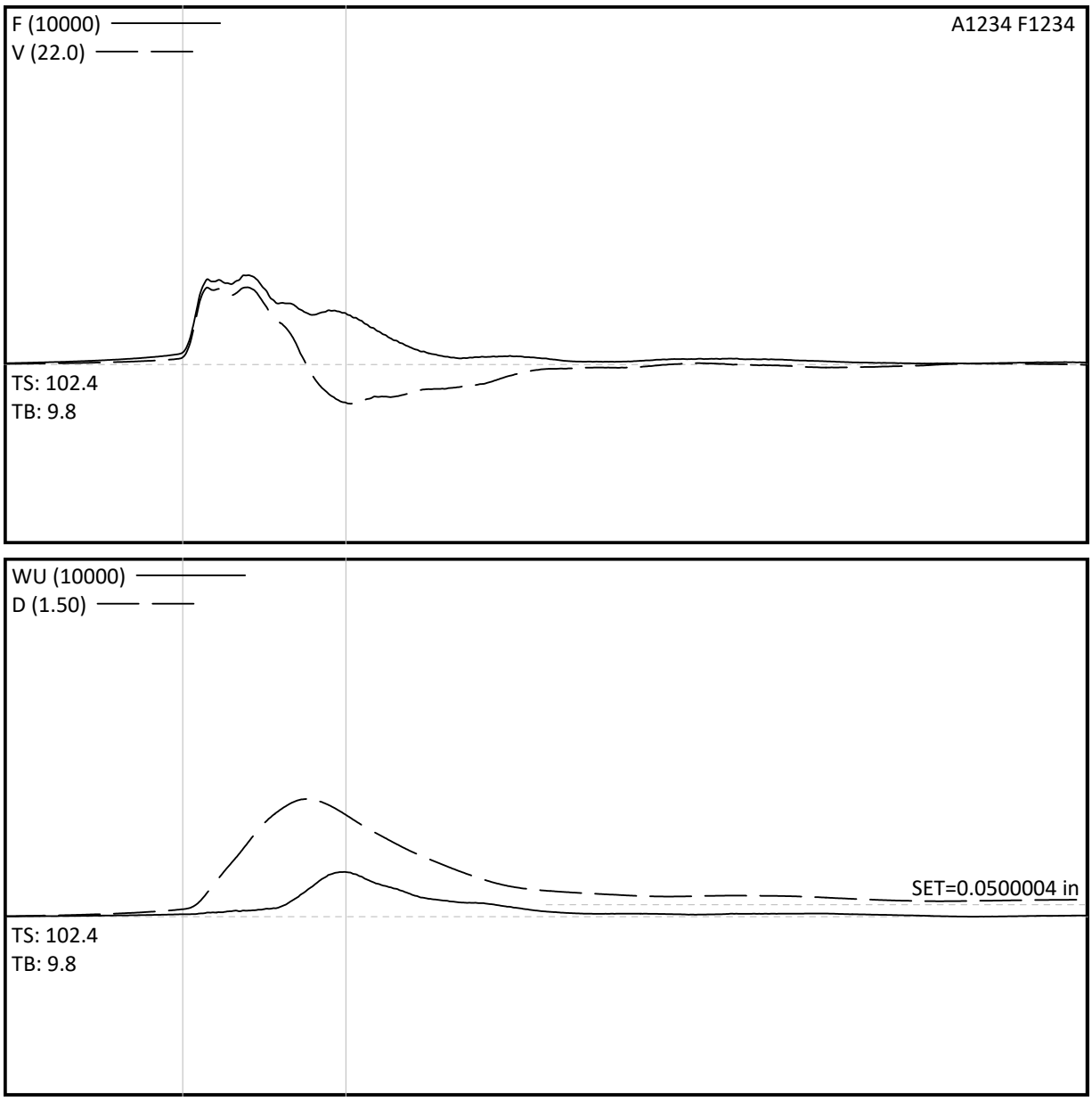
Depth ft	Area ft^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	6.28	7778.3	150.000	14.14
119.0	6.28	7778.3	150.000	14.14

Toe Area 15.90 ft^2

Top Segment Length 3.31 ft, Top Impedance 454 kips/ft/s

Wave Speed: Pile Top 15500.0, Elastic 15500.0, Overall 15454.5 ft/s
Pile Damping 2.00 %, Time Incr 0.214 ms, 2L/c 15.4 ms
Total volume: 747.699 ft^3; Volume ratio considering added impedance: 1.000

I-10 MOBILE RIVER TP-111A 14DAY RS



Project Information

PROJECT: I-10 MOBILE RIVER
PILE NAME: TP-111A 14DAY RS
DESCR: 54'' CYL, 6'' WALL
OPERATOR: AFT
FILE: TP-111A 14DAY RS ana
5/31/2018 9:34:57 AM
Blow Number 2

Pile Properties

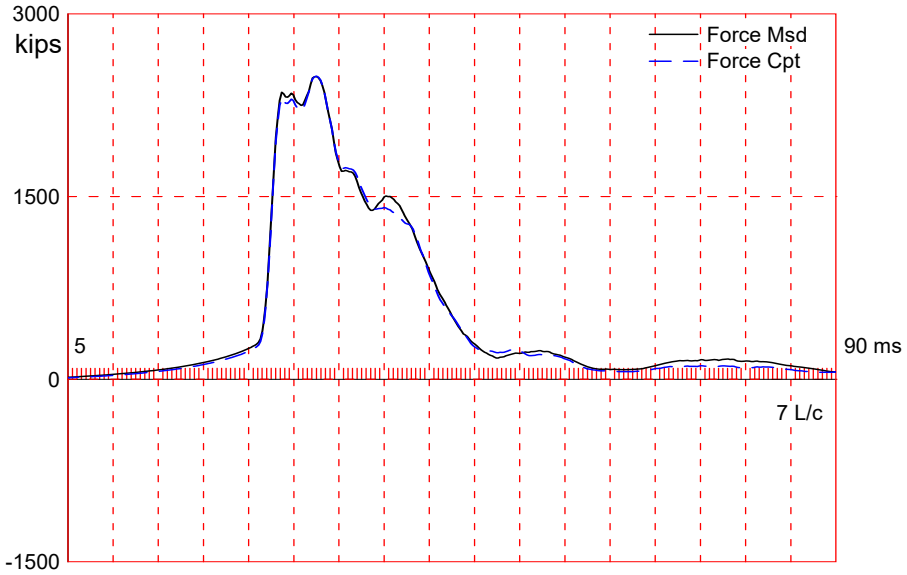
LE 119.00 ft
AR 904.78 in^2
EM 7778.33 ksi
SP 0.150 k/ft3
WS 15500.0 f/s
EA/C 454.0 ksec/ft
2L/C 15.40 ms
JC 1.03 []
LP 128.52 ft

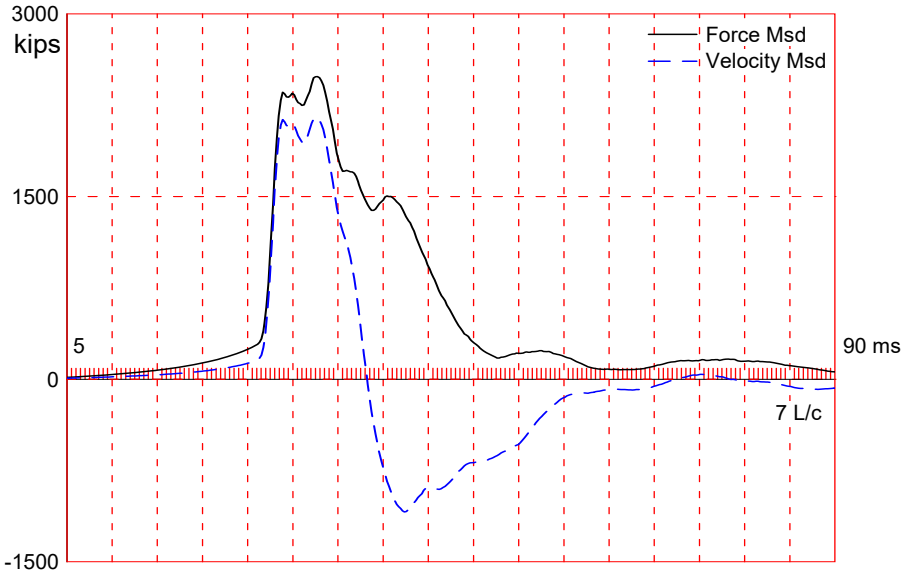
Quantity Results

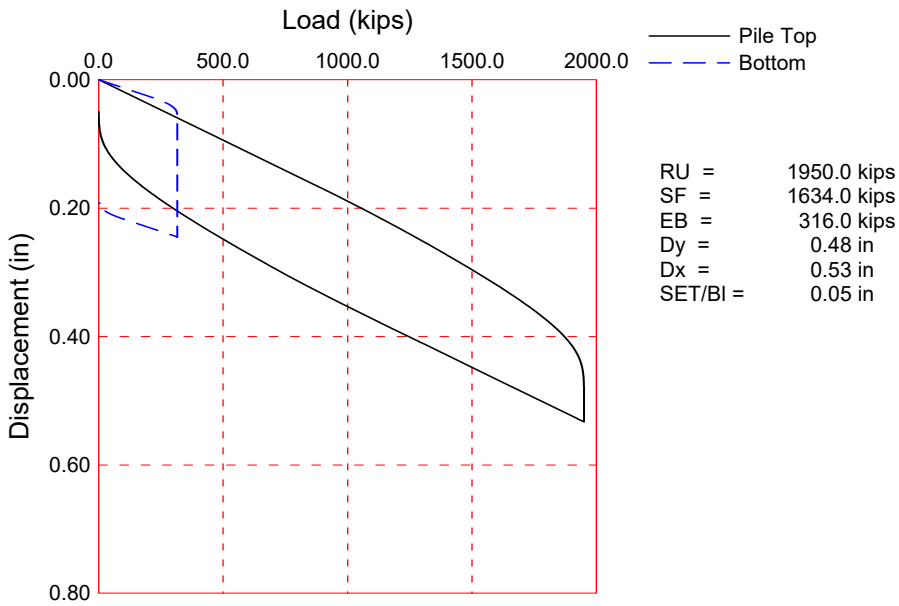
RMX 1947 kips
RX9 2112 kips
RA2 1689 kips
CSX 2.75 ksi
CSB 2.09 ksi
TSX 0.16 ksi
EMX 82.2 k-ft
STK 1.31 ft
BTA 100 (%)

Sensors

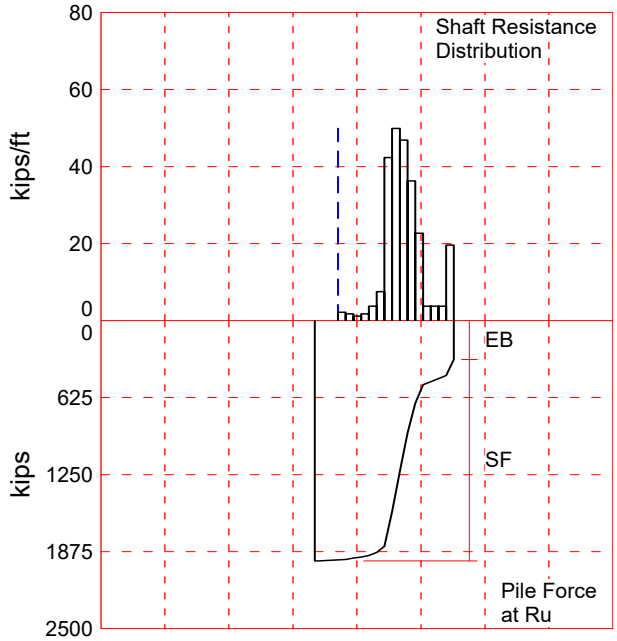
F1: [A788] 95.1 (1)
F2: [I840] 94.9 (1)
F3: [P454] 145.3 (1)
F4: [P455] 145.8 (1)
A1: [59379] 925 g's/v (-1)
A2: [42301A] 930 g's/v (1)
A3: [K5647] 334 mv/5000g's (1)
A4: [K5943] 368 mv/5000g's (1)
CLIP: OK







RU =	1950.0 kips
SF =	1634.0 kips
EB =	316.0 kips
Dy =	0.48 in
Dx =	0.53 in
SET/Bl =	0.05 in



Length b. Sensors	119.0 ft
Embedment	98.0 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.	15455 ft/s
Match Quality	2.40
Top Compr. Stress	2.8 ksi
Max Compr. Stress	3.7 ksi
Max Tension Stress	-0.10 ksi
Avg. Shaft Quake	0.15 in
Toe Quake	0.04 in
Avg. Shaft Smith Dpg.	0.40 s/ft
Toe Smith Damping	0.39 s/ft

CAPWAP(R) 2014-2 Licensed to Applied Foundation Testing, Inc.

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: 1950.0; along Shaft 1634.0; at Toe 316.0 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
				1950.0			
1	26.4	5.4	12.0	1938.0	12.0	2.20	0.16
2	33.1	12.1	12.0	1926.0	24.0	1.82	0.13
3	39.7	18.7	8.0	1918.0	32.0	1.21	0.09
4	46.3	25.3	12.0	1906.0	44.0	1.82	0.13
5	52.9	31.9	25.0	1881.0	69.0	3.78	0.27
6	59.5	38.5	50.0	1831.0	119.0	7.56	0.53
7	66.1	45.1	280.0	1551.0	399.0	42.35	3.00
8	72.7	51.7	330.0	1221.0	729.0	49.92	3.53
9	79.3	58.3	310.0	911.0	1039.0	46.89	3.32
10	85.9	64.9	240.0	671.0	1279.0	36.30	2.57
11	92.6	71.6	150.0	521.0	1429.0	22.69	1.60
12	99.2	78.2	25.0	496.0	1454.0	3.78	0.27
13	105.8	84.8	25.0	471.0	1479.0	3.78	0.27
14	112.4	91.4	25.0	446.0	1504.0	3.78	0.27
15	119.0	98.0	130.0	316.0	1634.0	19.66	1.39
Avg. Shaft			108.9			16.67	1.18
Toe			316.0				19.87

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.40	0.39
Quake	(in)	0.15	0.04
Case Damping Factor		1.45	0.27
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	30
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	0	
Resistance Gap (included in Toe Quake)	(in)		0.00
Soil Plug Weight	(kips)	4.932	4.820

CAPWAP match quality = 2.40 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.05 in; Blow Count = 240 b/ft
Computed: Final Set = 0.06 in; Blow Count = 198 b/ft

max. Top Comp. Stress = 2.8 ksi (T= 32.9 ms, max= 1.330 x Top)
max. Comp. Stress = 3.7 ksi (Z= 59.5 ft, T= 37.0 ms)
max. Tens. Stress = -0.10 ksi (Z= 66.1 ft, T= 57.1 ms)
max. Energy (EMX) = 81.4 kip-ft; max. Measured Top Displ. (DMX)= 0.49 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	2500.2	-74.4	2.8	-0.08	81.4	4.8	0.49
2	6.6	2509.9	-74.7	2.8	-0.08	80.7	4.8	0.48
4	13.2	2533.4	-75.2	2.8	-0.08	79.2	4.7	0.46
6	19.8	2580.3	-75.8	2.9	-0.08	77.2	4.6	0.44
8	26.4	2702.7	-76.3	3.0	-0.08	75.0	4.6	0.41
10	33.1	2886.0	-76.2	3.2	-0.08	71.6	4.5	0.39
12	39.7	3053.6	-76.0	3.4	-0.08	68.2	4.5	0.36
14	46.3	3190.6	-76.1	3.5	-0.08	65.0	4.4	0.33
16	52.9	3287.1	-76.0	3.6	-0.08	62.0	4.2	0.31
18	59.5	3324.3	-80.5	3.7	-0.09	59.4	3.9	0.29
20	66.1	3295.2	-91.2	3.6	-0.10	56.2	3.4	0.27
22	72.7	2842.1	-62.6	3.1	-0.07	46.2	3.0	0.26
24	79.3	2297.8	-49.8	2.5	-0.06	36.1	2.7	0.25
26	85.9	1709.2	-37.7	1.9	-0.04	27.4	2.5	0.25
28	92.6	1397.5	-31.1	1.5	-0.03	20.7	2.6	0.25
30	99.2	1225.7	-58.0	1.4	-0.06	16.5	2.6	0.25
31	102.5	1206.2	-65.6	1.3	-0.07	15.8	2.5	0.25
32	105.8	1209.6	-66.9	1.3	-0.07	15.8	2.5	0.24
33	109.1	1156.8	-72.1	1.3	-0.08	15.1	2.7	0.24
34	112.4	1096.2	-72.3	1.2	-0.08	15.1	2.7	0.24
35	115.7	963.9	-76.3	1.1	-0.08	14.5	2.8	0.24
36	119.0	901.6	-72.3	1.0	-0.08	11.2	2.9	0.24
Absolute	59.5			3.7			(T =	37.0 ms)
	66.1				-0.10		(T =	57.1 ms)

CASE METHOD

J =	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
RP	3254.2	3000.5	2746.7	2493.0	2239.2					
RX	3254.2	3000.5	2746.7	2493.0	2239.2	1985.5	1731.8	1478.0	1224.3	970.5
RU	3360.9	3128.4	2896.0	2663.6	2431.2					

RAU = 691.1 (kips); RA2 = 1689.0 (kips)

Current CAPWAP Ru = 1950.0 (kips); Corresponding J(RP)= 0.00; J(RX) = 1.03

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
4.7	28.87	2146.4	2376.5	2489.9	0.49	0.05	0.05	82.2	3641.2	8026

PILE PROFILE AND PILE MODEL

Depth	Area	E-Modulus	Spec. Weight	Perim.
ft	ft²	ksi	lb/ft³	ft
0.0	6.28	7778.3	150.000	14.14
119.0	6.28	7778.3	150.000	14.14

Toe Area 15.90 ft²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.3	454.04	0.00	0.00	0.000	-0.00	0.000	14.14	15454.5	0.000
8	26.4	454.04	0.00	0.00	0.000	-0.00	0.000	14.14	15454.5	0.170
36	119.0	454.04	0.00	0.00	0.000	-0.00	0.000	14.14	15454.5	0.170

Wave Speed: Pile Top 15500.0, Elastic 15500.0, Overall 15454.5 ft/s
Pile Damping 2.00 %, Time Incr 0.214 ms, 2L/c 15.4 ms
Total volume: 747.699 ft³; Volume ratio considering added impedance: 1.000

Appendix D

Relevant Project Documents
TP-111A

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-11:

FOR TP-11A, JETTING IS ALLOWED (BUT NOT REQUIRED) TO ELEVATION -60FT
FOR TP-11B, 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

THIS DRAWING REPRESENTS DESIGNS PREPARED FOR USE BY THE ALABAMA DEPARTMENT OF TRANSPORTATION AND IS NOT TO BE COPIED, REPRODUCED, ALTERED, OR USED BY ANYONE, OR ANY ORGANIZATION, WITHOUT THE EXPRESSED WRITTEN CONSENT OF THE ALABAMA DEPARTMENT OF TRANSPORTATION REPRESENTATIVE AUTHORIZED TO APPROVE THIS USE. ANYONE MAKING UNAUTHORIZED USE OF THIS DRAWING MAY BE PROSECUTED TO THE FULLEST EXTENT OF THE LAW.

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

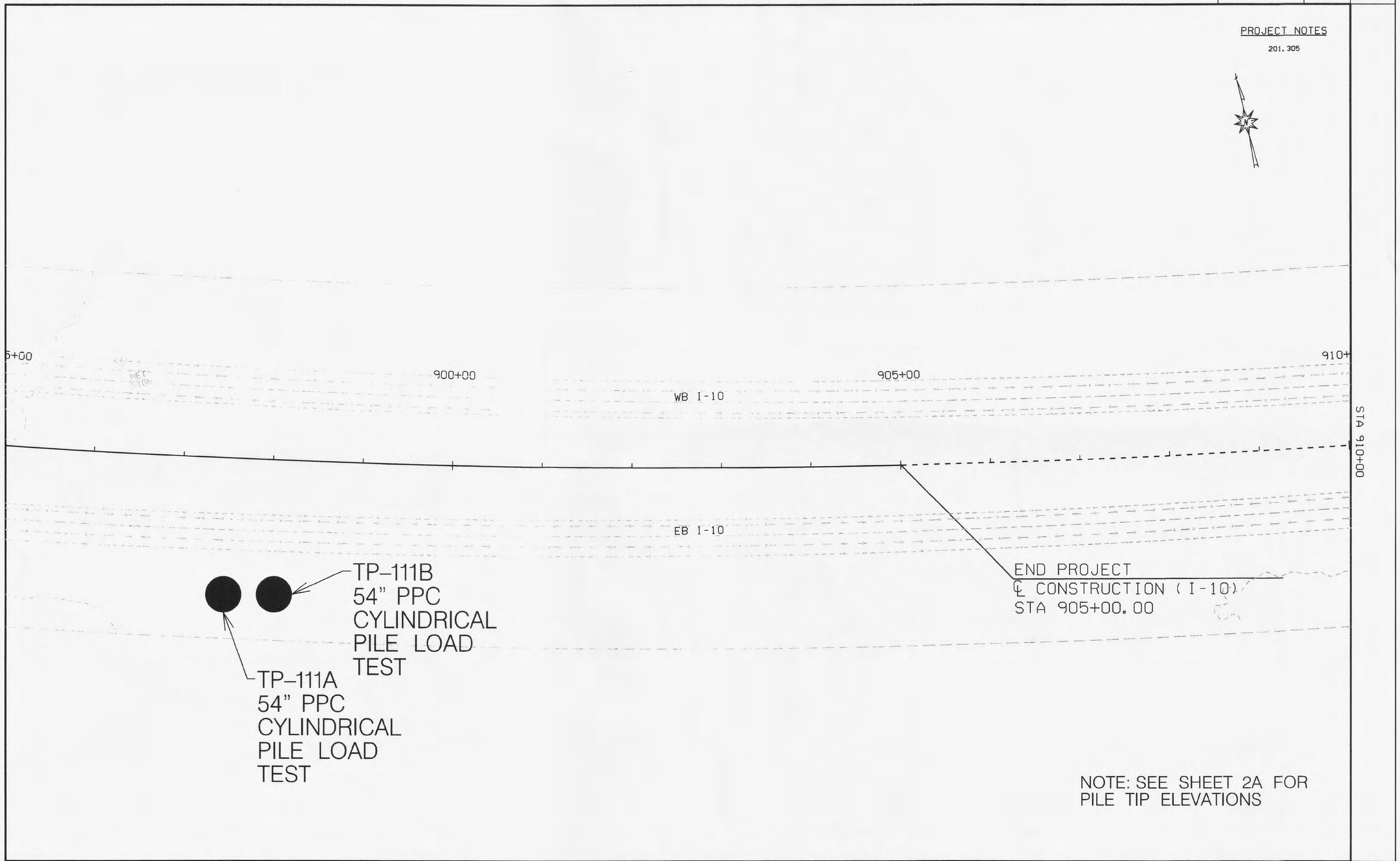
PILE TIP ELEVATIONS AND TARGETED NOMINAL RESISTANCE

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	8



RESPONSIBLE PE:	SUPERVISOR:	DESIGNER:	PLAN SUBMITTAL	ALABAMA DEPARTMENT OF TRANSPORTATION	HORIZ 50 0 50 SCALE (FEET)	SHEET TITLE	ROUTE
DATE:	DATE:	DATE:				PLAN SHEET STA 895+00 TO STA 910+00	I-10

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	-5.0	Very soft, wet, dark gray, LEAN CLAY with SAND (CL)		0.0	SS-1	0	0	0	0	●
		Very soft		1.5	SS-2	0	0	0	0	●
5.0		Very soft		3.0	SS-3	0	0	0	0	●
		Very soft, wet, dark gray, LEAN CLAY with SAND (CL, A-7-6(16)), LL=49 PL=26 PI=23 NMC=26.5 %#200=72.3		4.5	SS-4	0	0	0	0	● ▲
	-10.0	Very soft, No Recovery		6.0	SS-5	0	0	1	1	●
10.0		Very soft		8.5	SS-6	0	0	0	0	●
	-15.0	Very loose, wet, gray, fine grained, POORLY GRADED SAND (SP)		13.5	SS-7	0	0	1	1	●
15.0										
	-20.0	Very loose, wet, gray, fine to medium grained, SILTY SAND (SM)		18.5	SS-8	0	0	0	0	●
20.0										
	-25.0	Very loose, wet, gray, fine to medium grained, SILTY SAND (SM, A-4(0)), LL=NP PL=NP PI=NP NMC=27.9 %#200=39.1		23.5	SS-9	0	0	0	0	■ ○ ▲
25.0										
	-30.0	Very loose		28.5	SS-10	0	0	0	0	●
30.0										

LEGEND

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

RECORD OF TEST BORING

thompson ENGINEERING

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

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

LEGEND

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

STRATA SYMBOLS

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

NO - Not Obtained

NE - Not Encountered

REC Recovery

RQD Rock Quality Designation

pp - Pocket Penetrometer

SS - Split Spoon

ST - Shelby Tube

DCP - Dynamic Cone Penetrometer

AC - Auger Cuttings

GB - Grab Bag

NQ - Rock Core

Alabama Department of Transportation

Bridge Sheet of

thompson ENGINEERING
2970 COTTAGE HILL RD.
MOBILE, AL 36606

APPROVED : SAM STERNBERG III, P.E.

GEOTECHNICAL ENGINEER

DATE :

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

Preliminary Project No:

TEST BORING RECORD

REFERENCE PROJECT NUMBER	FISCAL YEAR	SHEET NUMBER
IM-I010(341)	2018	27

thompson ENGINEERING

RECORD OF TEST BORING

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
60.0										
65.0	-65.0	Medium dense, gray		63.5	SS-17	8	6	7	13	●
70.0	-70.0	Medium dense		68.5	SS-18	9	9	9	18	●
75.0	-75.0	Dense, light gray		73.5	SS-19	13	25	25	50	●
80.0	-80.0	Dense		78.5	SS-20	10	14	23	37	●
85.0	-85.0	Medium dense, with trace clay		83.5	SS-21	6	11	13	24	●
90.0	-90.0	Medium dense		88.5	SS-22	7	8	9	17	●

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	

thompson ENGINEERING

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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
90.0										
95.0	-95.0	Very stiff, moist, greenish gray, LEAN CLAY with SAND (CL)		93.5	SS-23	9	9	9	18	●
		Undisturbed sample obtained from 95.5 to 97.5 feet. Approximately 24 inches of recovery. Very soft, moist, greenish gray, with trace gravel, LEAN CLAY with SAND (CL, A-7-6(18)), LL=42 PL=14 PI=27 NMC=50.4 %#200=72.8		95.5	ST-1					×—× O ▲
100.0	-100.0	Very stiff		98.5	SS-24	11	11	13	24	●
105.0	-105.0	Very stiff		103.5	SS-25	10	11	15	26	●
110.0	-110.0	Hard, gray		108.5	SS-26	14	17	31	48	●
115.0	-115.0	Hard, greenish gray		113.5	SS-27	22	22	19	41	●
120.0	-120.0	Hard, gray		118.5	SS-28	19	27	34	61	●

LEGEND

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

RECORD OF TEST BORING

Site Description:	I-10 Mobile River Bridge and Bayway			**County:**	Mobile
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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
		Boring Terminated at 120.0 ft.								

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

- 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
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NO - Not Obtained

NE - Not Encountered

REC Recovery

RQD Rock Quality Designation

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SS - Split Spoon

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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 :

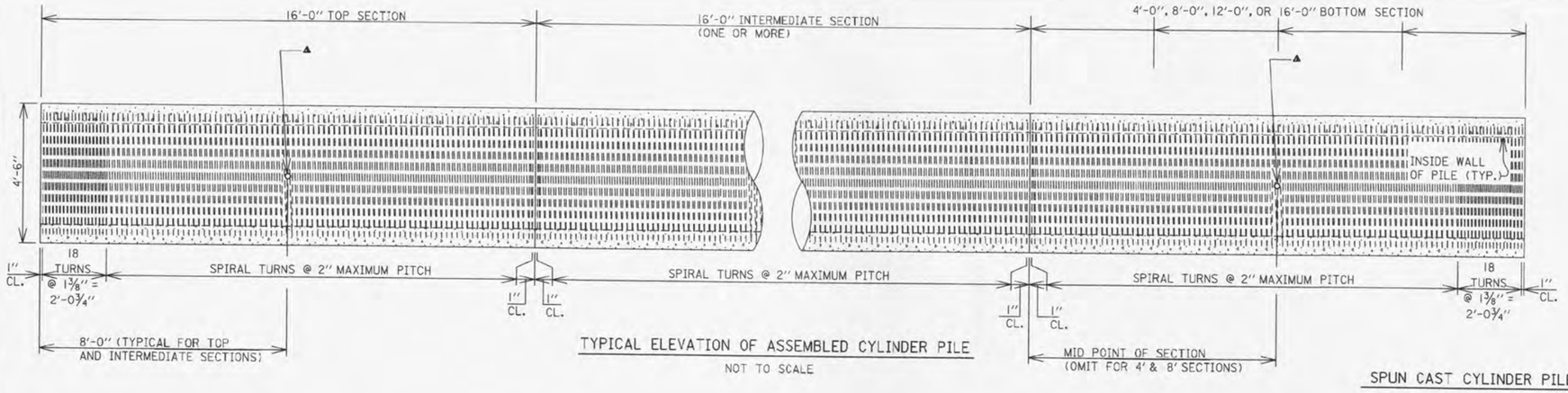
PROJECT NO. 17-1101-0145
I-10 MOBILE RIVER BRIDGE
LOAD TEST PROGRAM
MOBILE COUNTY, ALABAMA

Preliminary Project No:

TEST BORING RECORD
Sheet 12 of 12

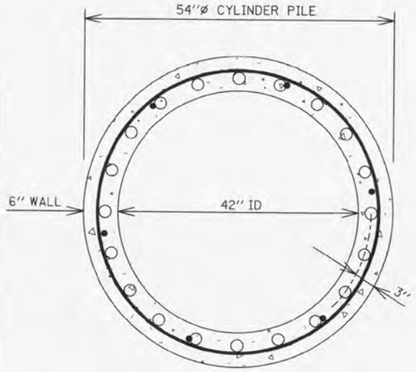
SPUN CYLINDER CONCRETE PILE DETAILS

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



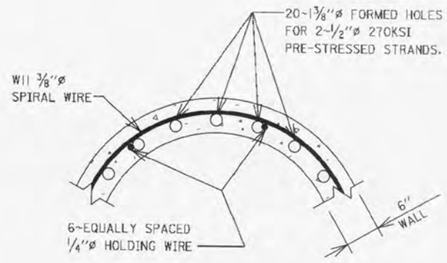
TYPICAL ELEVATION OF ASSEMBLED CYLINDER PILE

NOT TO SCALE



54" DIAMETER SECTION (20 CABLES)

NOT TO SCALE



TYPICAL REINFORCING DETAIL

NOT TO SCALE

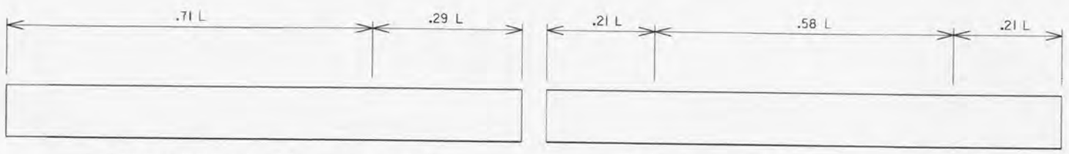
PRESTRESSED PILE SCHEDULE

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 E

Instrument Calibrations
TP-111A

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

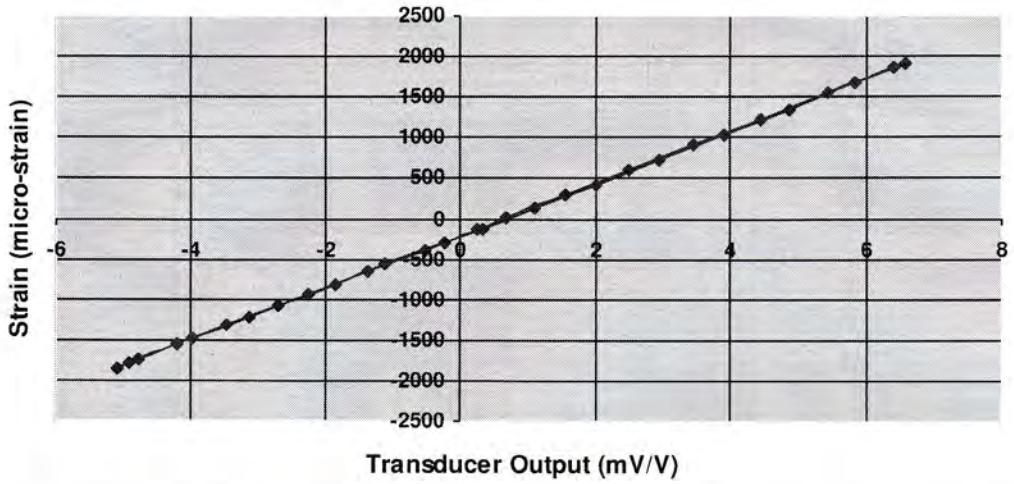
PDI Gage Factor: 92.7 με/V

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: H829

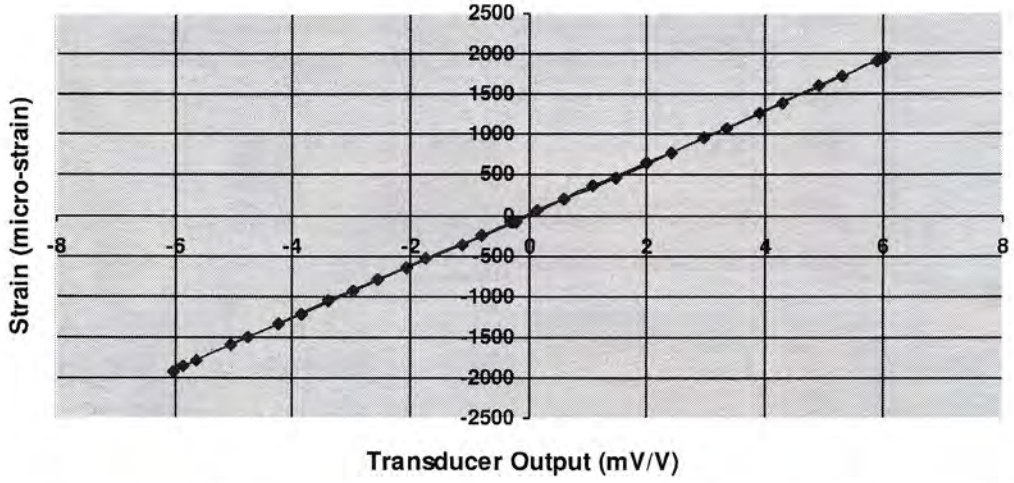
PDI Gage Factor: 92.2 με/V

General Gage Factor: 320.3 $\mu\varepsilon/mV/V_{ext}$
Initial Offset Voltage: -0.162 mV/V_{ext}

Table 1 – Representative Calibration Data

Applied Strain (με)	Transducer Output (mV/V_{ext})	Applied Strain (με)	Transducer Output (mV/V_{ext})
-83	-0.299	192	0.604
-240	-0.811	472	1.479
-536	-1.746	768	2.403
-793	-2.548	1074	3.347
-1060	-3.377	1386	4.315
-1337	-4.236	1708	5.293
-1598	-5.047	1952	6.012
-1855	-5.842	1907	5.875
-1924	-6.035	1589	4.905
-1785	-5.632	1271	3.927
-1508	-4.749	965	2.963
-1225	-3.859	657	2.007
-942	-2.962	363	1.087
-654	-2.051	62	0.147
-365	-1.133	-84	-0.291
-74	-0.218	-83	-0.292

Calibration Curve



Mean Linear Correlation Coefficient (LCC): 9.999766E-1

LCC Standard Deviation: 2.876815E-6

Calibrated By: Kay Tol

Signature: Kay Tol

Date/Time: 2/28/2018 7:59 AM

Temperature (°C): 25.4

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: A788

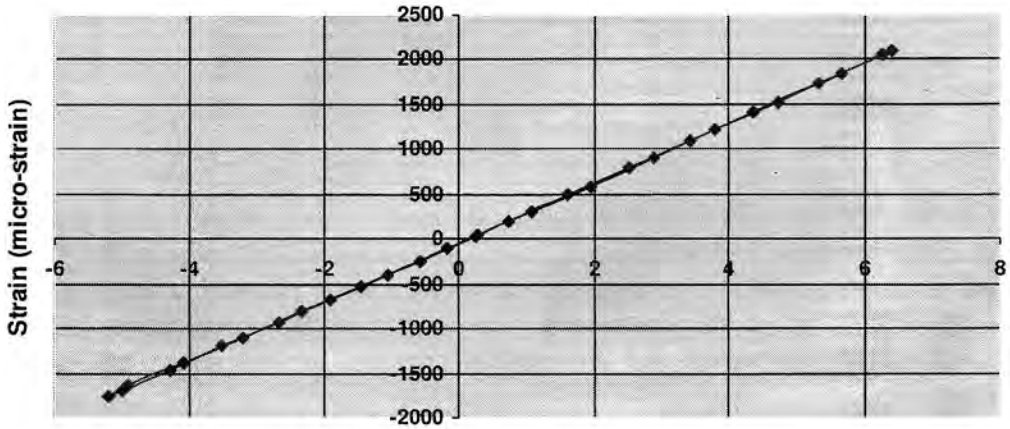
PDI Gage Factor: 95.1 με/V

General Gage Factor: 330.2 με/mV/V_{ext}
Initial Offset Voltage: 0.069 mV/V_{ext}

Table 1 – Representative Calibration Data

Applied Strain (με)	Transducer Output (mV/V_{ext})	Applied Strain (με)	Transducer Output (mV/V_{ext})
37	0.271	302	1.075
-111	-0.191	591	1.958
-401	-1.068	899	2.875
-672	-1.903	1213	3.811
-924	-2.687	1526	4.745
-1196	-3.519	1842	5.670
-1457	-4.307	2095	6.411
-1691	-5.011	2049	6.266
-1755	-5.201	1723	5.323
-1645	-4.908	1405	4.368
-1379	-4.094	1091	3.432
-1098	-3.226	786	2.520
-813	-2.338	488	1.618
-523	-1.449	190	0.721
-244	-0.586	39	0.272
32	0.257	39	0.271

Calibration Curve



Mean Linear Correlation Coefficient (LCC): 9.999596E-1

LCC Standard Deviation: 1.506151E-6

Calibrated By: ES

Signature:

Date/Time: 7/18/2017 1:34 PM

Temperature (°C): 26.1

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: I840

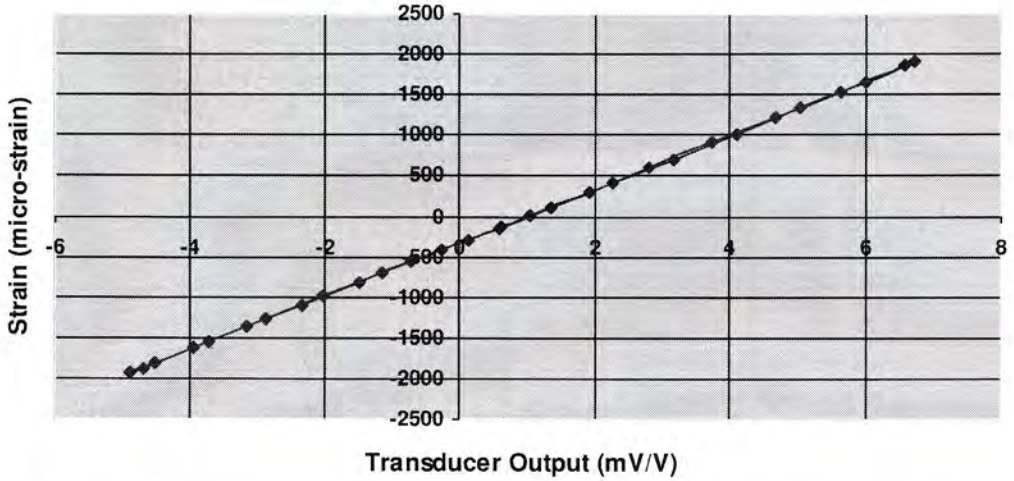
PDI Gage Factor: 94.9 με/V

General Gage Factor: 329.4 $\mu\varepsilon/mV/V_{ext}$
Initial Offset Voltage: 0.287 mV/V_{ext}

Table 1 – Representative Calibration Data

Applied Strain (με)	Transducer Output (mV/V_{ext})	Applied Strain (με)	Transducer Output (mV/V_{ext})
-133	0.623	114	1.365
-287	0.136	404	2.259
-568	-0.717	706	3.165
-818	-1.484	1012	4.097
-1095	-2.326	1329	5.050
-1367	-3.158	1652	6.009
-1626	-3.942	1899	6.725
-1874	-4.690	1857	6.592
-1941	-4.887	1533	5.646
-1816	-4.532	1216	4.687
-1551	-3.730	901	3.740
-1275	-2.888	593	2.811
-995	-2.024	299	1.919
-708	-1.149	10	1.046
-426	-0.272	-131	0.619
-147	0.577	-132	0.616

Calibration Curve



Mean Linear Correlation Coefficient (LCC): 9.999856E-1

LCC Standard Deviation: 3.104323E-7

Calibrated By: Kay Tol

Signature: Kay Tol

Date/Time: 2/28/2018 8:06 AM

Temperature (°C): 25.4

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

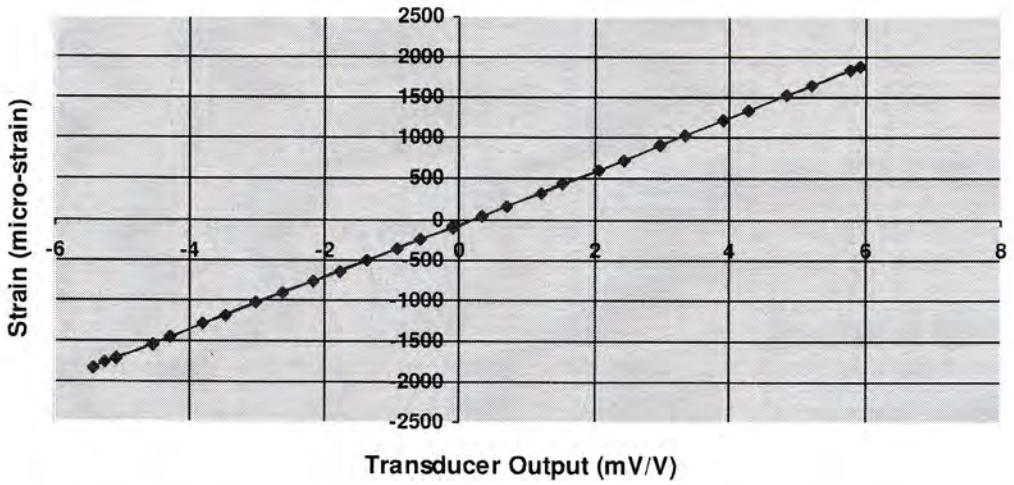
PDI Gage Factor: 93.9 με/V

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

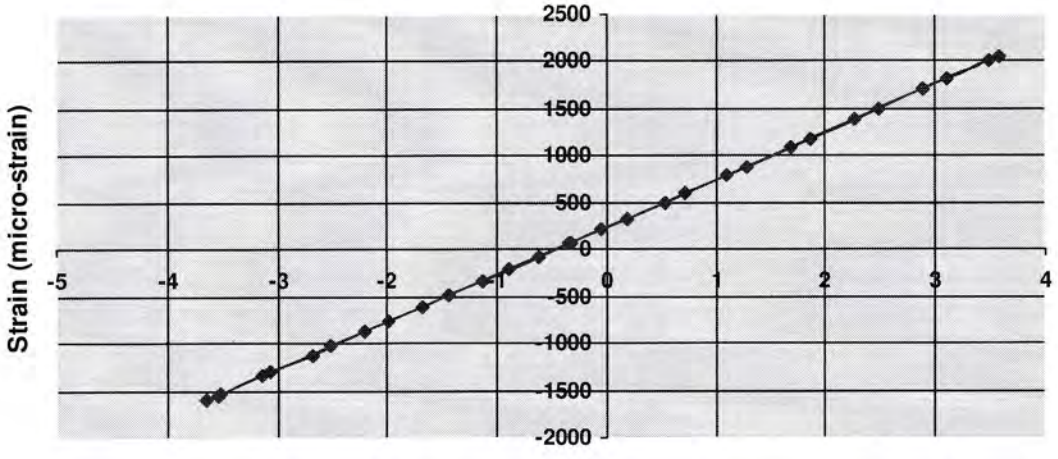
General Gage Factor: 504.7 $\mu\varepsilon/mV/V_{ext}$

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

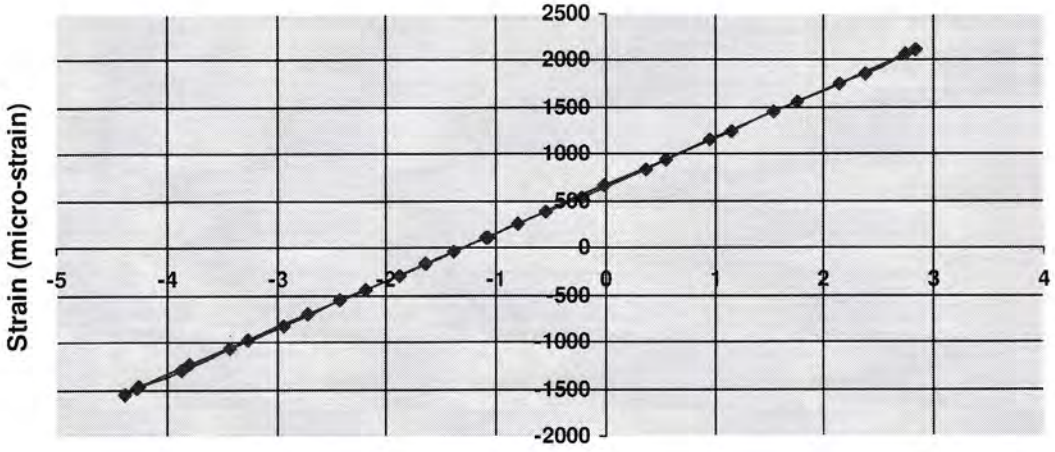
PDI Gage Factor: 145.8 με/V

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

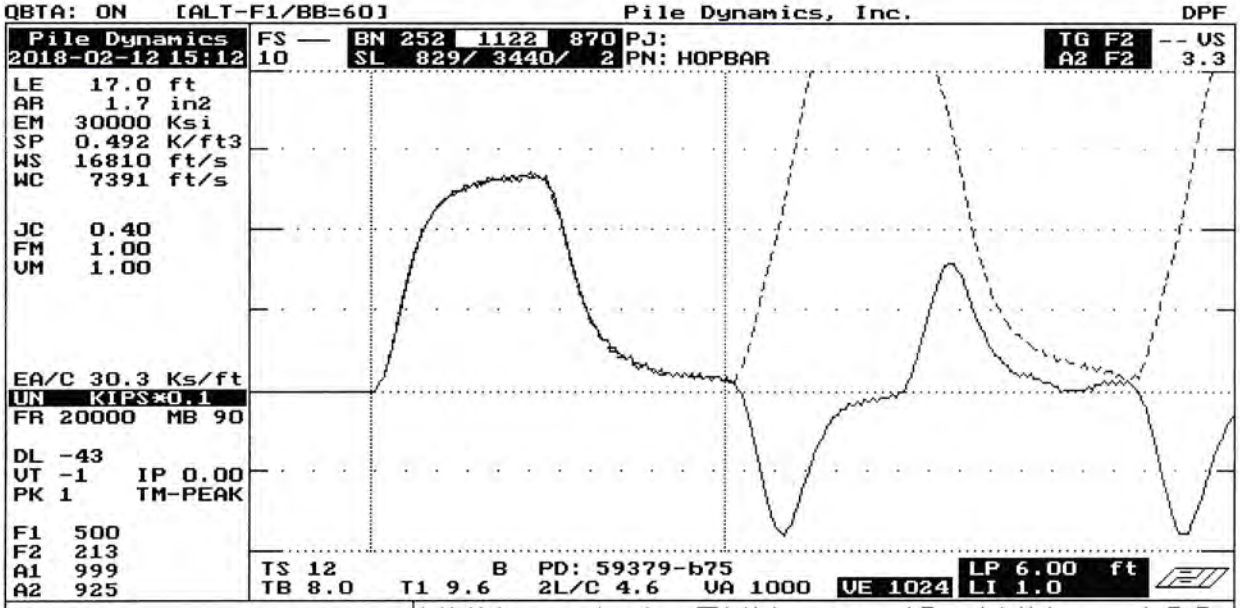
PDI Automated Strain Transducer Calibration System (PDI-ASTCS)

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



ACCEPT SQ-OFF FL-OFF PR-OFF

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

ACCEPT

ACCELEROMETER CALIBRATION N.I.S.T. Traceable

SERIAL NUMBER: 59379

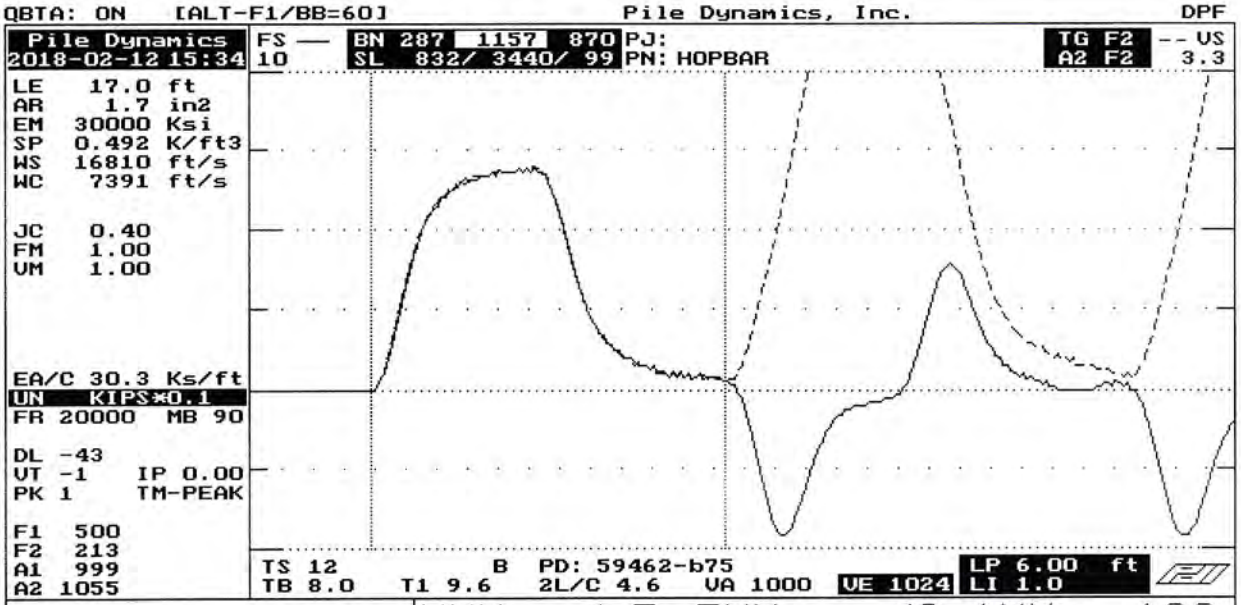
CALIBRATION FACTOR: 925 e/v

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



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

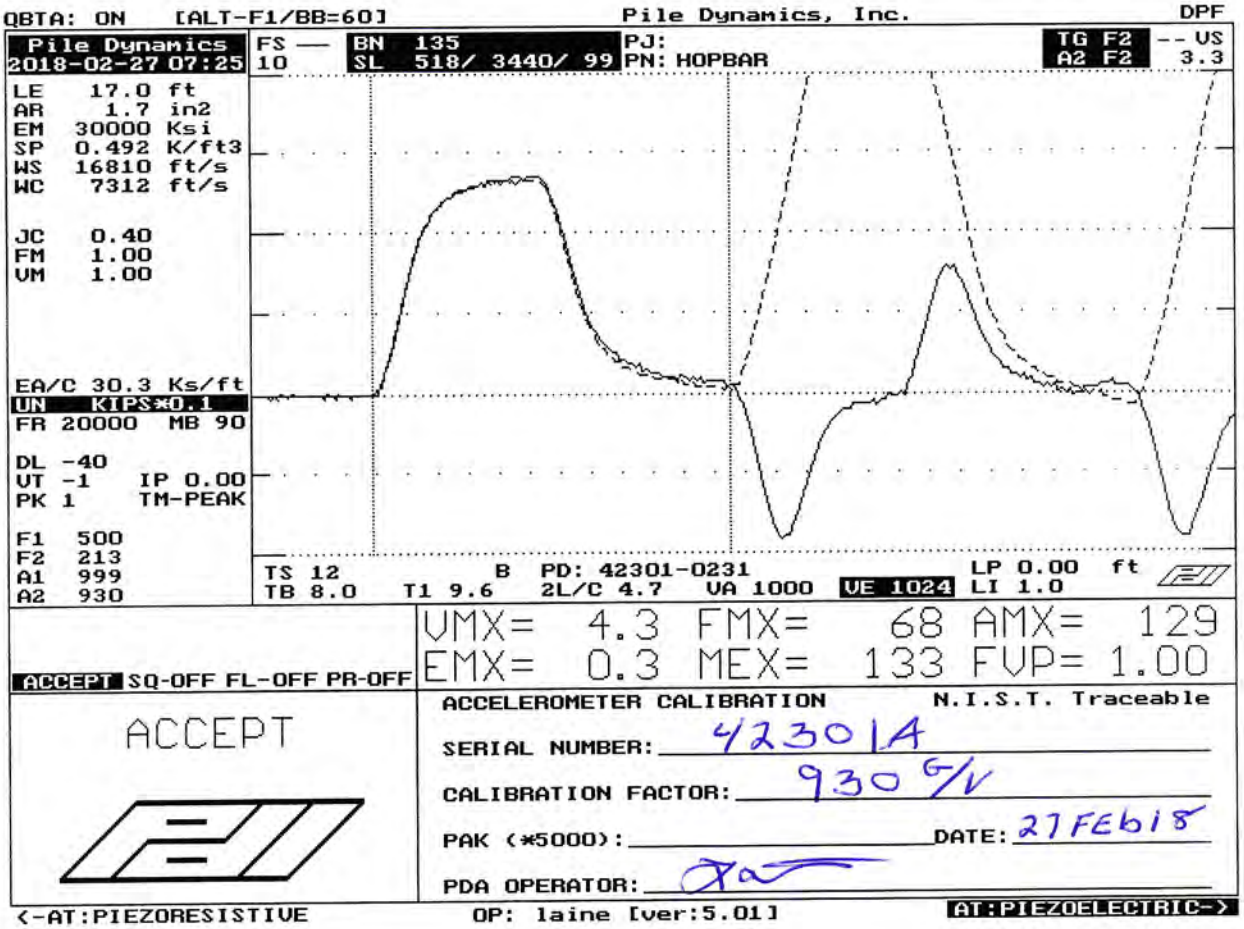
CALIBRATION FACTOR: 1055 G/V

PAK (*5000): DATE: 14Feb18

PDA OPERATOR:

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

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



VMX= 4.3 FMX= 68 AMX= 129
EMX= 0.3 MEX= 133 FVP= 1.00

ACCEPT SQ-OFF FL-OFF PR-OFF

ACCEPT

ACCELEROMETER CALIBRATION N.I.S.T. Traceable

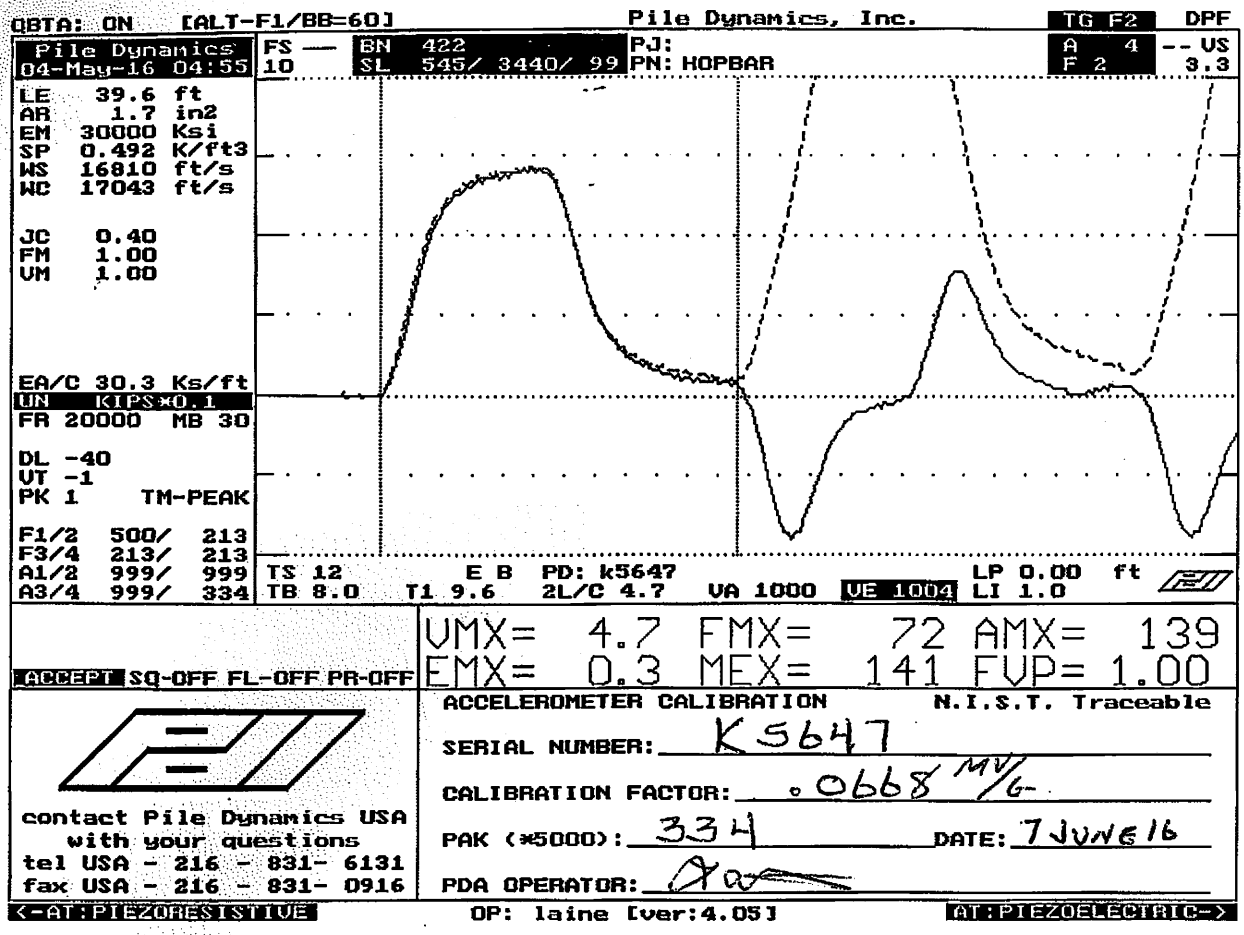
SERIAL NUMBER: 42301A

CALIBRATION FACTOR: 930 G/V

PAK (*5000): _____ DATE: 27 Feb 18

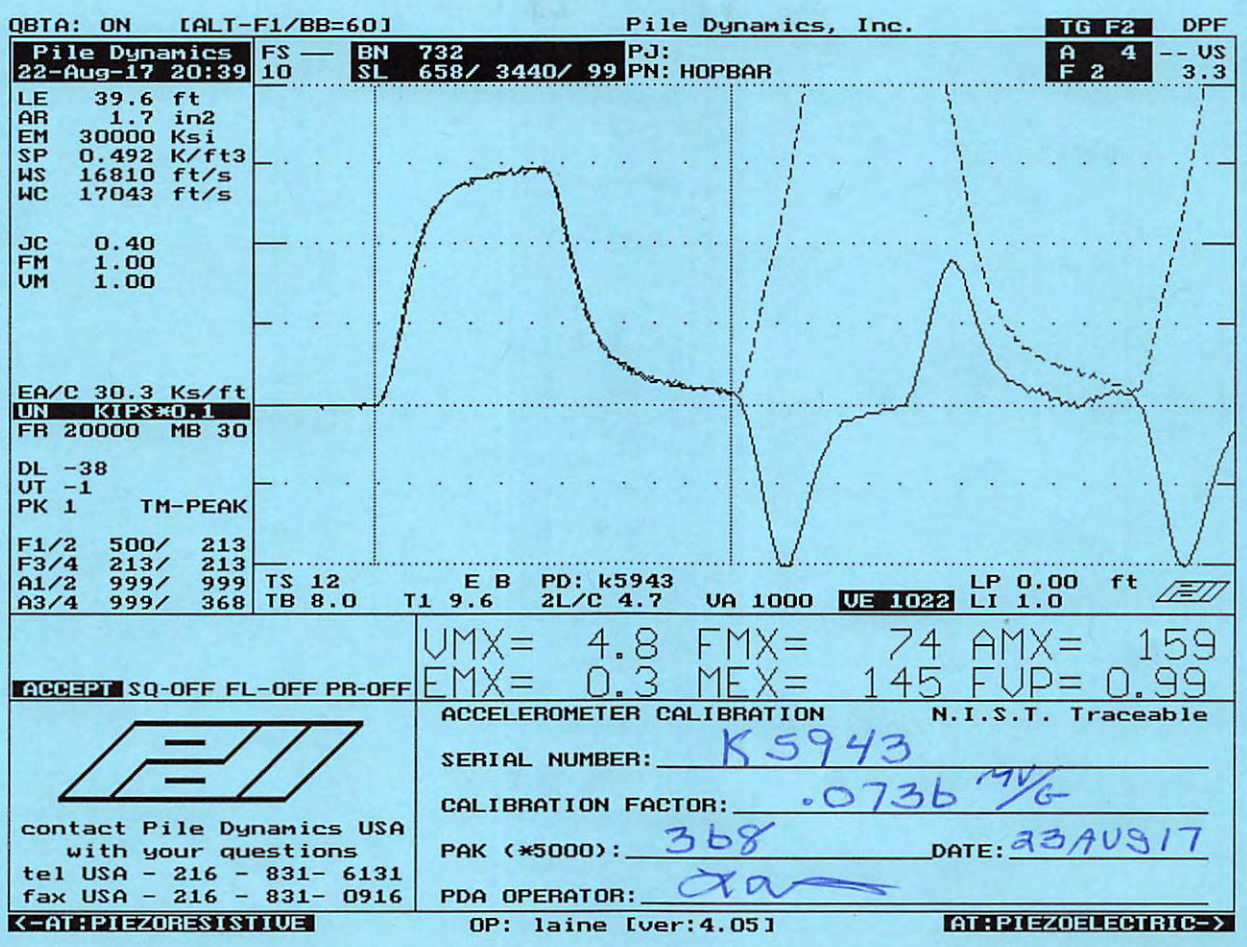
PDA OPERATOR: [signature]

<-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