Applied Foundation Testing

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Final Report of AFT-Cell
Bi-Directional Static Load Testing
Test Shaft
I-10 Mobile River Bridge
Mobile, Alabama
AFT Project No. 518009

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DN: c=US, o=APPLIED FOUNDATION TESTING, ou=APPLIED FOUNDATION TESTING, cn=Donald T Robertson, 0.9.2342.19200300.100.1.1=A01097C000001617C717FAC0000EEB3
Date: 2018.06.21 14:59:25 -04'00'

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REVISION: Removed typographical error on Page 1 - “Brief” is misspelled in the “Introduction and Brief Summary” Title

INTRODUCTION AND SUMMARY

This report is provided to summarize the results of bi-directional static load testing of a 72 inch diameter test drilled shaft as part of a pre-bid phase load test contract for the new Interstate 10 Mobile River Bridge Project in Mobile County, Alabama. The load test program consisted of installation and testing of one drilled shaft, and 11 driven piles. Foundation types include a 72” diameter drilled shaft, HP 14 x 89 piles, 18” PPC square piles, a 60” diameter steel open-ended pipe pile, 54” diameter PPC cylindrical piles, and a 30” PPC square pile.

The test shaft had a design diameter of 72-inches and was constructed with a total overall length of 180 feet. Please refer to the project source documents for a site plan of the actual location of the test shaft. This report only contains the analysis and results of the bi-directional load testing for the referenced test shaft. Results of all other testing (lateral Statnamic load testing, CSL, etc.) performed on the test shaft are provided under separate covers.

A.H. Beck was the drilled shaft contractor responsible for the installation of the test shaft and supplied field support to carry out the axial load testing. Applied Foundation Testing (AFT) was the specialty engineering firm performing the testing. Field instrumentation and set up of the bi-directional load test was led by AFT Technician Mr. Jason Frederick with assistance from other AFT staff. Data acquisition during testing was performed by Mr. Joseph Bailey, P.E, and Andrew Best. Katherine Shaw and Jordan Nelson performed the data reduction and reporting. Mr. Donald T. Robertson, P.E is the overall project manager and responsible engineer for the project and provided quality assurance oversight for the data analysis and reporting.

GENERALIZED SOIL CONDITIONS

A soil test boring (Boring No. MB-1) was performed at the shaft location and is included in Appendix B.

In general, the overburden soils at this location consisted of compacted gravel from original ground surface elevation to approximately +3.0 feet. From elevation +3.0 feet to -83.0 there were alternating layers of poorly graded sand/silt and very dense sandy silt. Following this was a layer of fat clay from approximately -83 feet to -98 feet. Below this elevation poorly graded sand sand/silt combinations were present to an approximate elevation of -123.0 feet. Another fat clay layer was present from elevation -128.0 feet to -132.0 feet. Poorly graded sand/silt was present until shaft termination at -170 feet.

These descriptions of soil conditions represent a summary of conditions as indicated in the provided materials and is included only to assist in evaluation of the load test data. For details regarding the soil conditions at the test site and elsewhere, the reader should reference the project source documents.

FOUNDATION DESCRIPTION

The test shaft had a design diameter of 72-inches and was constructed with a total overall length of 180 feet. The construction method can generally be described as follows. A permanent steel casing was used in the upper 57 feet with a 78-inch O.D. / 77-inch I.D., ½-inch wall thickness. The test shaft was excavated under polymer slurry drilling fluid using 72 inch diameter tools including a soil auger, digging bucket, and clean out bucket. Polymer slurry property tests consisting of viscosity, density, PH, and sand content were performed at various times during the construction process reported elsewhere. Once achieving the required tip elevation, the shaft bottom was cleaned using a clean out bucket and a complete fluid column exchange via a submersible pump at the shaft bottom. Subsequently it was checked for bottom firmness with a Mini-SID shaft bottom video inspection device. The bottom cleanliness met the specifications and was approved for concrete placement.

The reinforcement cage was constructed with two bi-directional load testing assemblies, the upper cell assembly was located at approximately elevation -118.2 feet and the lower cell assembly was located at approximately -161.6 feet in elevation. Both cell assemblies were exactly the same and consisted of four cells. Each cell assembly was capable of exerting a force of 4,000 kips.

Longitudinal shaft reinforcement for the test shaft consisted of eighteen (18) pairs of #11 bars (36 bars total) from the top of shaft to elevation -118.2 feet, which corresponds to the location of the upper cell assembly. A lighter cage was used for the portion of shaft between the two load cell assemblies consisting of eight (8) #11 bars from approximate elevation -118.2 feet to -161.6 feet, which is the location of the lower cell assembly. All longitudinal shaft reinforcement was surrounded by #7 spiral shear hoops. Details can be found in the plans and rebar shop drawings available from others.

The reinforcement cage also contained eight (8) steel CSL access tubes for integrity testing. Prior to the reinforcement cage being lowered into the excavation AFT tied four (4) levels of four embedded “sister bar” strain gages to the reinforcement cage at the locations shown in the attached schematic drawing.

The reinforcement cage was inserted into the excavation in two parts and the sections were joined over the excavation. Each section was temporarily supported from the permanent casing while splicing. A pump and 10-inch tremie pipe was used to place concrete. The tremie was installed to the bottom of shaft through the AFT-Cell assembly via funnels made of steel angle pieces. The tremie seal was obtained with a traveling foam plug. The total placed concrete volume is reported as 212 cubic yards, which is greater than the theoretical volume of 197 yds. The concrete was pumped until sound concrete was observed at the top of the drilled shaft (EL. $^{+}$10.2 feet).

AFT was not under contract to document the test shaft installation, but we have provided this summary based on our onsite observations and information as provided by the Contractor and the Owner’s representatives. For more information on the test shaft construction, the reader should reference the project source documents.

TEST SETUP AND INSTRUMENTATION

The bi-directional static load test method loads the shaft in two directions by hydraulically pressurizing an embedded jack (AFT-Cell) assembly within the shaft. Pressurizing the jack assembly simultaneously loads the shaft below the AFT-Cells that resists downward movement and loads the shaft above, which resists upward movement. The load is determined by relating the applied hydraulic pressure to the jack calibration. A description of the instrumentation used during the test is given below. Calibration data is provided in Appendix C. A summary of instrument locations and shaft properties is provided in Appendix A. Various key dates are summarized in Table 1.

Table 1. Load Testing Key Dates Summary

Test Location	Date Instrumented	Date Construction Completed	Load Test Date
Test Shaft	March 19 to 23, 2018	March 24, 2018	April 11, 2018

- AFT-Cell™ – The AFT-Cell is manufactured by Applied Foundation Testing in the USA. The load was determined using the NIST traceable jack calibrations attached in Appendix C to relate applied load and hydraulic pressure. Calibrations of the jacks meet the linearity and accuracy requirements given in ASTM D8169. Calibrated digital pressure gauges and an electronic pressure transducer monitored the applied pressure during testing. The pressure transducer was used for analysis and the digital gauge was used for visual reference and redundancy for the transducer.

- Expansion of AFT-Cell – was measured directly by four LVWDTs (Linear Vibrating Wire Displacement Transducers, Geokon Model 4450) attached to the jack assembly and spaced approximately equal around the circumference of the bearing plates. The LVWDT armature was fixed to the bottom bearing plate and the LVWDT body was rigidly fixed to the top bearing plate. The LVWDTs have a travel of 9 inches and were read to a 0.005-inch precision. The LVWDT assemblies functioned reliably.

- Shaft Elastic Compression – between the top of shaft and the top of the upper jack assembly was measured with two telltale assemblies consisting of a ½ inch pipe casing with an inner ¼ inch steel rod. The compression telltale assembly was monitored by a LVDT attached to the top of shaft. The LVDT indicator has a travel of at least 2 inches and is read to a 0.0001-inch precision. The stem of the indicator was axially aligned and fixed to the telltale rod.

- Upward Top of Shaft Movement – was measured using a pair of automated digital survey levels (Leica, Model DNA 03). Both survey levels monitored an INVAR barcode staff rigidly mounted to the top of shaft from a clear distance greater than 5D from the edge of the test shaft. The survey-level / INVAR rod reference system has a 0.001-inch precision.

- Strain Gages – Strain measurements were obtained using "sister bar" type strain gages manufactured by Applied Foundation Testing (Micro-Measurements gage type CEA-06-125UW-350). The sister bar gages have an accuracy of 1.0 με. The lead cabling was a multi-conductor with shielded wires with a highly robust extrusion molded casing. Four levels of gages with each level containing four gages spaced at 90 degrees around the rebar cage. Gage levels are shown in the drawing in Appendix A.

- Data Acquisition System – a National Instruments CompactDAQ™ was used to monitor all the instrumentation. A laptop computer controlled the data acquisition system. Instrumentation readings were taken at 5-second intervals during the test. The system provides two levels of backup for all recorded data. In addition, manual records were maintained during the test as a backup.

TEST PROCEDURES

The bi-directional static load test was conducted generally following ASTM D8169 “Standard Test Methods for Deep Foundations Under Static Axial Compressive Load”, “Procedure A – Quick Test”. Load increments of 5 percent of the maximum cell capacity were targeted for approximate 8-minute holds.

General: The loads applied by the embedded jack act simultaneously on the shaft above and below its location. The load acting upward is assumed to be zero until the buoyant weight of the shaft above is overcome; this is consistent with current industry analysis practice. The *net load* is therefore the *gross load* minus the buoyant weight of the shaft above the AFT-Cell. For Stage 1, the buoyant weight above the lower cell level was calculated as 451 kips. For Stages 2 and 3, the buoyant weight above the upper cell was calculated to be 347 kips.

Stage 1 as shown in Figure 1, the bottom level of jacks was pressurized to a maximum uni-directional applied load of 5,455 kips with 0.66 inches of upward cell displacement and 4.21 inches of downward cell displacement. The buoyant weight of the shaft for Stage 1 is comprised of the upper and middle sections, and is approximately 451 kips. The maximum upward load after correcting for buoyant weight was 5,004 kips. Stage 1 was concluded when downward displacement exceeded 5% of the shaft diameter. Individual plots of load and displacement vs time are given in Figures 2 and 3 for Stage 1.

Stage 2 involved pressurizing the upper level of cells with the bottom level of cells being open and vented so in theory there would be no resistance from the portion of shaft below the lower cells. However, the data indicated. The maximum load obtained during Stage 2 was 2,840 kips with a maximum downward cell displacement of 1.62 inches, and a maximum upward cell displacement of 0.28 inches. The maximum upward load after correcting for buoyant weight was 2,493 kips, as shown in Figure 4. It was desired to achieve greater shaft upward displacement so the lower cells were hydraulically locked off and jacking of the upper cells was continued in what is named as Stage 3.

Stage 3 involved pressurizing the upper level of cells with the bottom level of cells being hydraulically locked to provide additional reaction needed to carry the test load higher. This procedure was effective in achieving the additional desired upward movement of the shaft. The eventual maximum load was 3,865 kips, with a maximum upward cell displacement of 2.22 inches, and a maximum downward cell displacement of 2.14 inches. The maximum upward load after correcting for buoyant weight was 3,518 kips. Stage 3 was concluded when no further upward resistance could be gained.

For the purposes of presentation, Stage 2 and 3 are shown on the same plots. Load and displacement vs time are given in Figures 5 and 6 for Stage 2/3.

By summing the maximum loads from Stages 1 through 3 and subtracting the respective buoyant shaft weights, an equivalent shaft resistance of approximately 11,600 kips can be expected at a shaft head displacement of slightly above 3 inches.

TEST RESULTS AND ANALYSIS

Loads were applied and displacements were measured as discussed above. Strains in the shaft were also measured at each level during the loadings. The measured strains at each strain gage level were processed and then averaged and given in Figures 7, 9, and 10. Loads at each gage level were calculated by multiplying the average strain by the respective cross-sectional area and composite modulus of elasticity (stiffness). These plots are shown in Figures 8, 11, and 12. The load distribution is also plotted vs elevation in Figures 13 and 14. A composite shaft modulus was determined by weighting the individual modulus of the steel and concrete by their respective cross-sectional areas. In this way, the concrete modulus is calculated using ACI 318 formula: $E_c = 33Wc^{1.5} \times \sqrt{f'c}$ with an assumed concrete unit weight of W_c of 150 pcf and the closest average concrete strength at the time of testing. An f'^{c} of 6,468 psi was obtained from laboratory tests by others. Shaft stiffness values calculated in this way were used in the load transfer calculations.

Unit side shear values were then determined by subtracting the calculated loads at each strain gage level and dividing by the respective segment surface area. Segmental unit side shear values are presented in the form of a t-z curve or soil response curve. In the t-z curve, the displacement shown is at the midpoint of the segment. The midpoint displacement is calculated by subtracting the cumulative elastic shortening from the length of each foundation segment using the measured AFT-Cell displacement as the boundary value.

End Bearing: The intent of Stage 1 loading was to mobilize the base resistance by reacting against the full side resistance of the shaft above the bottom cells. Test data show a maximum load of 5,455 kips produced a total downward cell movement of 4.21 inches. After subtraction of the side resistance over the bottom 8 feet of the shaft, which was assumed to be 2.66 ksf, a load of 5,054 kips was transferred to the shaft base. This subsequent force acting on the cross-section end area of a 72 inch diameter shaft results in a maximum unit base resistance of 178.8 ksf. The displacement at the shaft base is calculated after accounting for the elastic shortening of the bottom 8 feet and together with the unit base resistance discussed above it is plotted in a Qz curve shown in Figure 18.

It is also noted that the end bearing response develops immediately, which is a testament to the good shaft bottom is cleaning techniques used by the contractor.

Stage 1 Upper Shear (shaft top to el -161.6’): The maximum load achieved during Stage 1 was 5,455 kips, measured at the cell with a total upward cell movement of 0.66 inches. After subtracting the buoyant shaft weight above the cells, the maximum upward load was 5,004 kips. Measured top of shaft movement was 0.59 inches. The difference between the shaft top displacement and the upward displacement at the cell location was due to the shaft elastic shortening. The amount of displacement measured at the shaft top is important as it indicates a large portion of the shaft side resistance was mobilized during Stage 1. The t-z curves for Stage 1 are shown in Figure 15.

Stage 2 and 3 Upper Shear (shaft top to el -118.2'): During Stage 2 the lower cell was left vented, therefore the closure of the lower cell assembly prevented significant load transfer below that depth. The maximum load reached during Stage 2 was 2,840 kips with a maximum downward cell displacement of 1.62 inches, and a maximum upward cell displacement of 0.28 inches. Observed top of shaft movement during this stage was 0.21 inches. With only minimal upward displacement, it was evident that the lower cells had to be hydraulically locked to engage more reaction for further jacking of the upper cells.

Stage 3 involved loading the upper cells with the lower cells locked off. Stage 3 indeed reached a higher load of 3,865 kips and the shaft segment above the cells displaced 2.22 inches upward. The observed top of shaft displacement was 2.14 inches. The t-z curves for Segments 1 through 4 are shown in Figure 16.

Stage 2 and 3 Lower Shear (between el -118.2' and el -161.6'): For the Stage 2 and Stage 3 loading, side shear analysis of the segment of shaft between the two cell levels is complex because the direction of loading was in reverse of Stage 1 loading. This segment of shaft was first displaced upward 0.66 inch during stage 1 then during stages 2 and 3, it was displaced downward 2.14 inches. In the course of all the loadings, this segment went through a reversal in loading directions. The effect of the load reversal can be seen in Figure 17.

We will also point out that although the bottom cells were open and vented during Stage 2, the rate of closure did not match the same rate of expansion of the upper cells. This suggests there was concrete rubble and or soil in the crack plane which prevented frictionless closure of the bottom cells. This must be considered when making interpretations of the Stage 2 data. For this reason we have only plotted the load at gage level 4, as shown in Figure 19.

Included in Table 2, is a summary of unit side shear and base resistance from the three loading cycles. The corresponding t-z curves for are presented in Figures 15, 16 and 17.

Table 2. Load Transfer Summary

Location	Segment Top / Segment Bottom Elevation (feet)	Soil Type	STAGE 1 Maximum Unit Side Shear Resistance (ksf)	STAGE 2/3 Maximum Unit Side Shear Resistance (ksf)
Segment 1	$^{+}9.88$ to $^{-}57.6$ Feet (Permanent Casing)	Sand w/ gravel	0.53 ↑	0.70 ↑
Segment 2	$^{-}57.6$ to $^{-}77.8$ Feet	Sand w/ gravel	2.42 ↑	2.69 ↑
Segment 3	$^{-}77.8$ to $^{-}99.1$ Feet	Fat Clay	1.52 ↑	1.81 ↑
Segment 4 and 5[1]	$^{-}99.1$ to $^{-}135.8$ Feet	Silty Sand w/ gravel	2.88 ↑	3.25 ↑ Seg 4 2.76 ↑ Seg 5
Upper AFT-Cell Elevation -120.0 Feet				
Segment 6	$^{-}135.8$ to $^{-}162.0$ Feet	Sand w/ gravel	2.66 ↑	N/A
Lower AFT-Cell Elevation -162.0 Feet				
End Bearing				
Base of Shaft	$^{-}170.0$ Feet	Sand w/ gravel	Stage 1 4,842 kips↓ @ 3.6”↓ 5,054 kips↓ @ 4.0”↓	171.3 ksf @ 3.6” (5% of Dia.) 178.8 ksf @ 4.0” Max Mobilized

Notes: 1) For Stage 1 the upper cell is modeled as being part of the adjacent segments. Therefore, values are reported based on a combined segment 4 and 5. Stage 2 has reported values for individual segments 4 and 5.

Equivalent Top Load versus Displacement: An equivalent top load versus displacement curve is presented in Figure 20 based on the AFT-Cell movement data. The method sums the upward and downward forces at equal displacements of each shaft section, therefore it is limited to the lower of the two observed displacements. This figure also shows the displacement corrected for elastic shortening that would occur if the shaft was loaded from the top. For a top loading of 11,600 kips, the corrected data indicates the shaft would have experienced 3 inches of displacement. As the shaft would be expected to develop additional side resistance for the given displacements shown, the overall displacement of the shaft provided in the elasticity corrected curve is an overestimation and can be considered conservative.

Creep Limit: Creep data for all sections of the shaft are shown in Figure 21.

CLOSURE

We want to thank you for the opportunity to be involved in this project. 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 AFT. 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. AFT 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.

REFERENCES

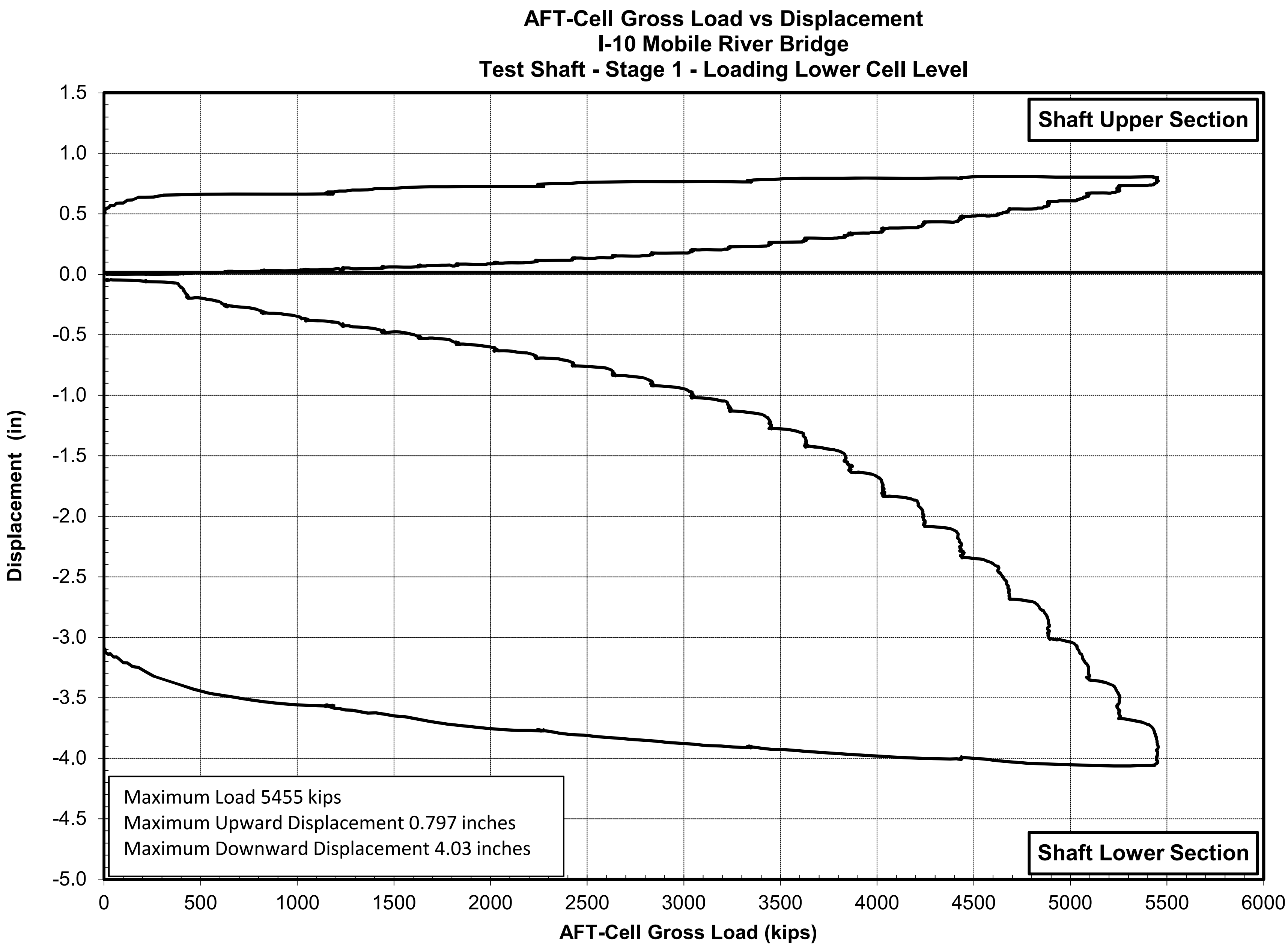
Lee, Jong-Sub. Park, Yung-Ho. “Equivalent pile load-head settlement curve using a bi-directional pile load test” Elsevier B.V. *Computers and Geotechnics*. Volume 35, Issue 2. March 2008. PP 124-133

Housel, William S. “Dynamic and Static Resistance of Cohesive Soil.” ASTM International. *Papers on Soils, 1959 Meetings.* PP 4-33.

Appendix A

Test Result Figures
Input/Analysis Parameters

Report of Bi-Directional Load Testing
I-10 Mobile River Bridge
AFT Project No. 518009
Mobile, Alabama



AFT-Cell Gross Load vs Displacement
I-10 Mobile River Bridge
Test Shaft - Stage 1 - Loading Lower Cell Level
Shaft Upper Section
Shaft Lower Section
Maximum Load 5455 kips
Maximum Upward Displacement 0.797 inches
Maximum Downward Displacement 4.03 inches
Displacement (in)
AFT-Cell Gross Load (kips)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

Figure 1

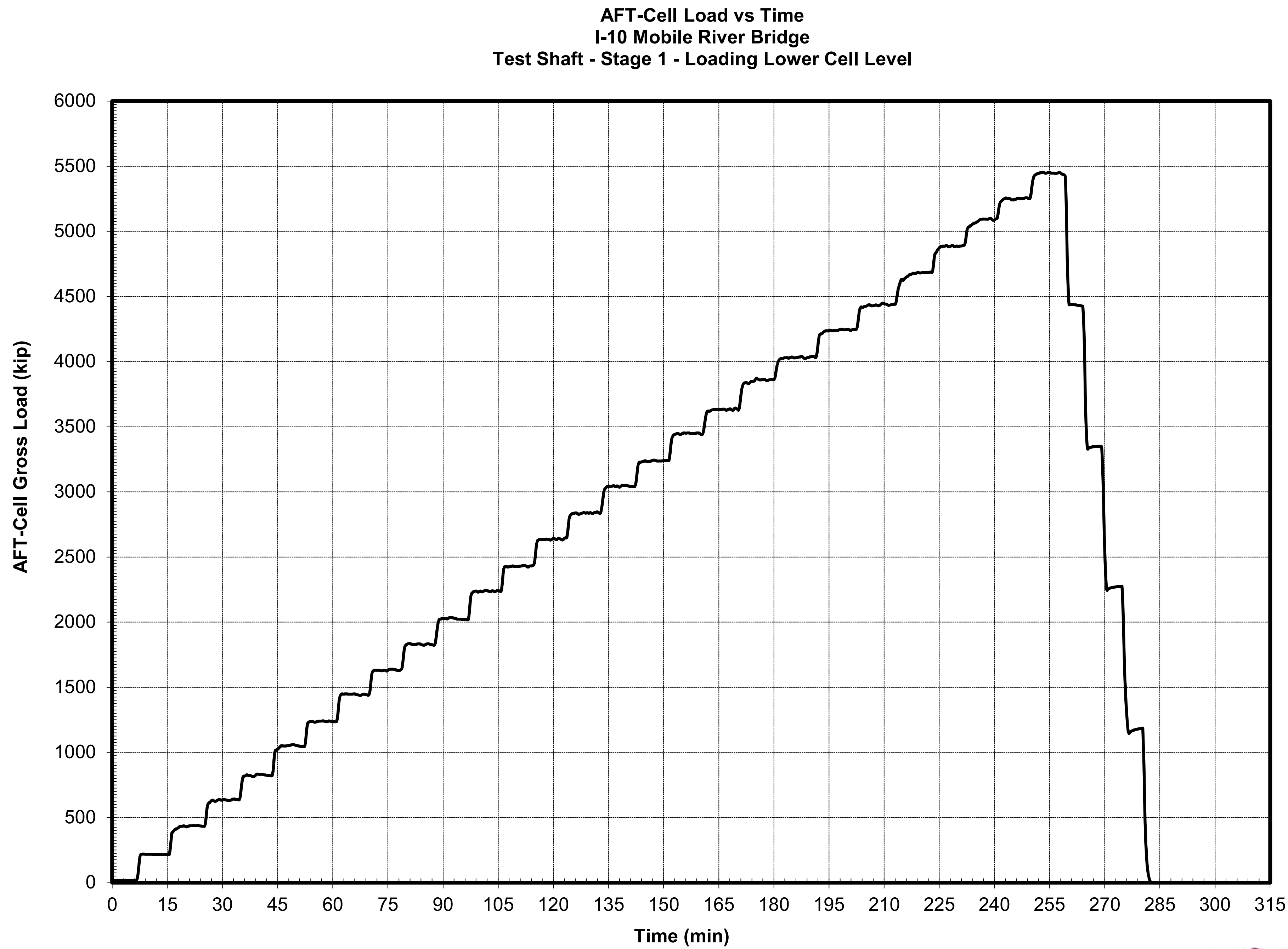

AFT-Cell Load vs Time
I-10 Mobile River Bridge
Test Shaft - Stage 1 - Loading Lower Cell Level
AFT-Cell Gross Load (kip)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Time (min)
0
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
300
315

Figure 2

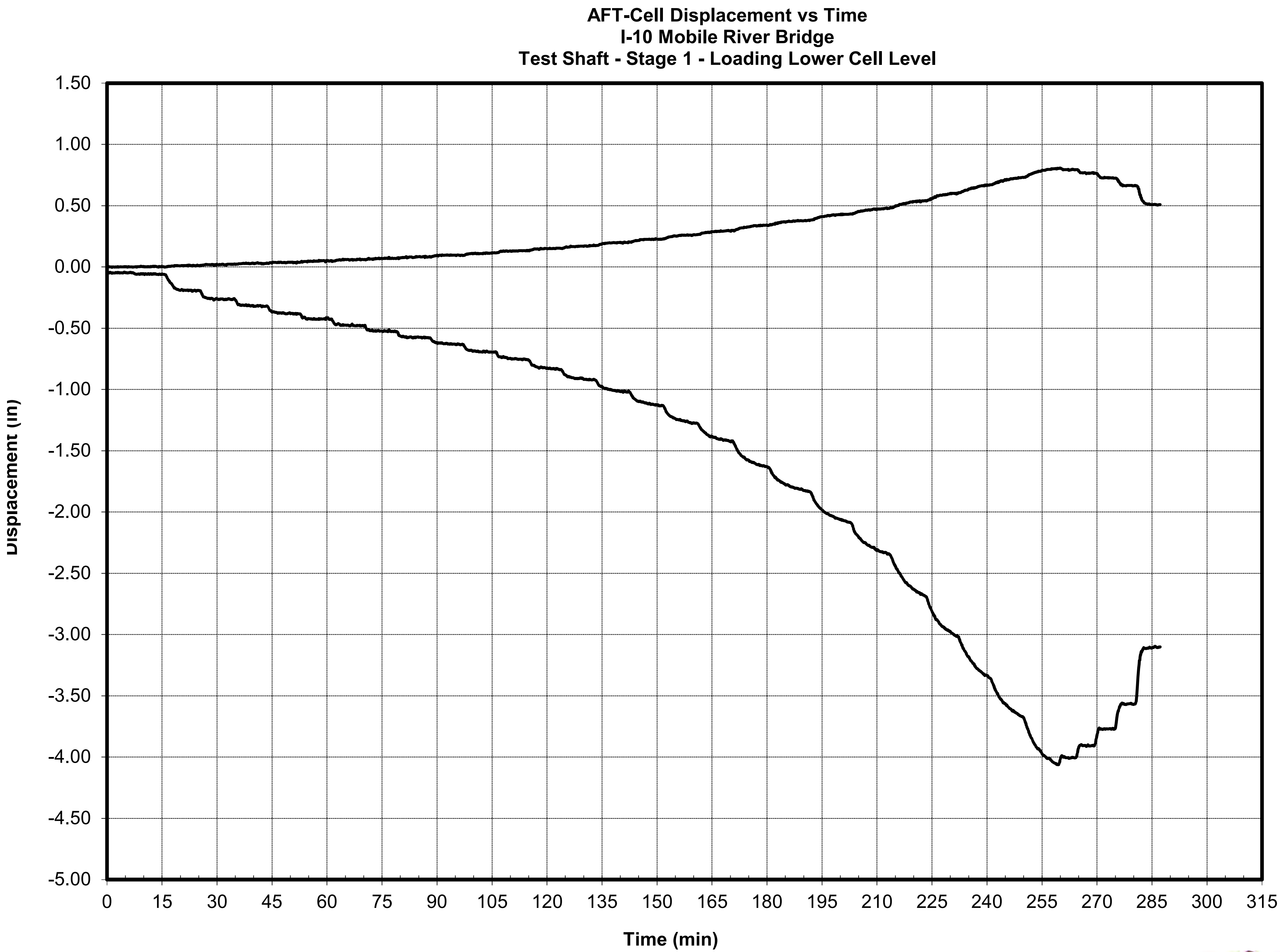

AFT-Cell Displacement vs Time
I-10 Mobile River Bridge
Test Shaft - Stage 1 - Loading Lower Cell Level
Displacement (in)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50
-4.00
-4.50
-5.00
0
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
300
315
Time (min)

Figure 3

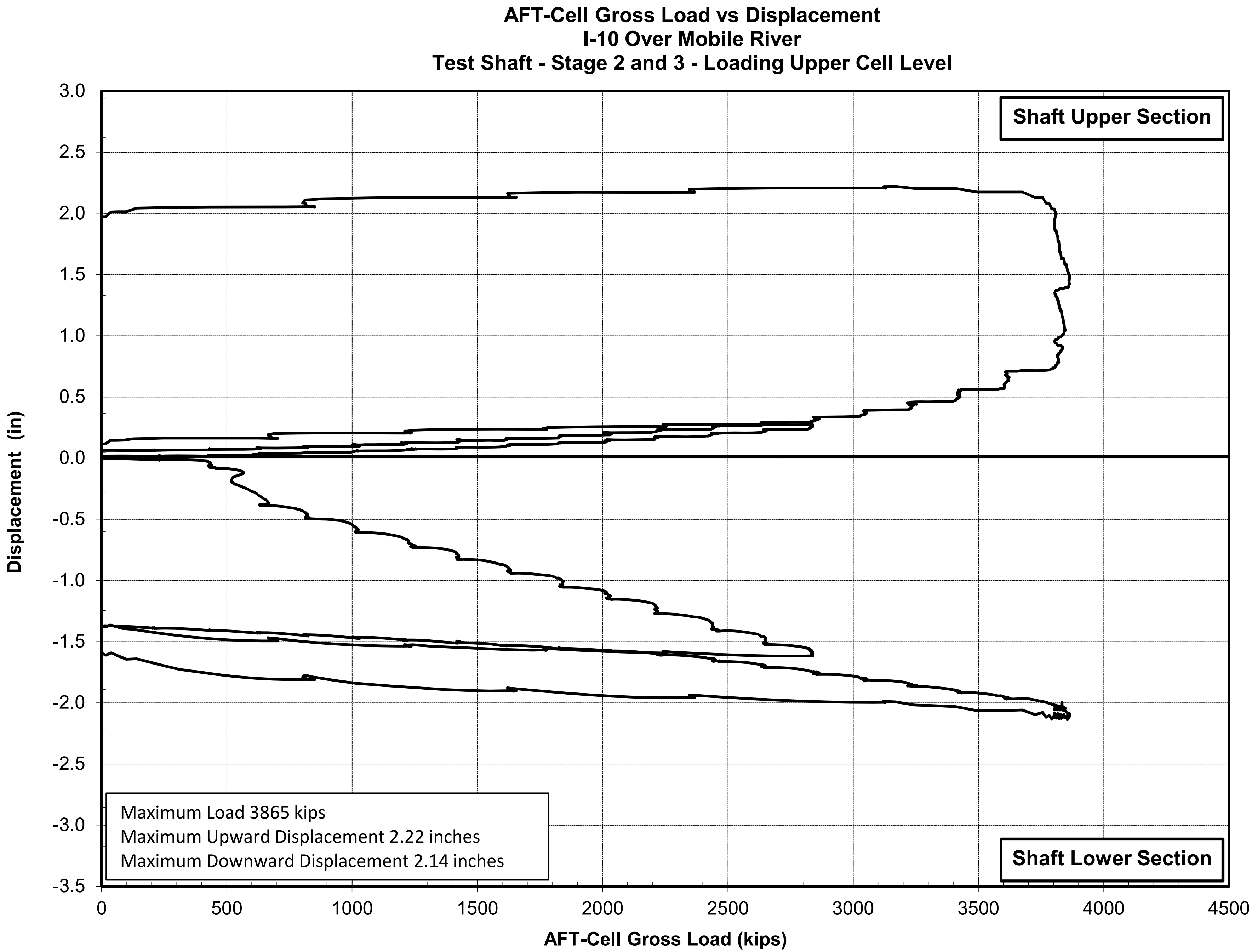

AFT-Cell Gross Load vs Displacement
I-10 Over Mobile River
Test Shaft - Stage 2 and 3 - Loading Upper Cell Level
Shaft Upper Section
Shaft Lower Section
Maximum Load 3865 kips
Maximum Upward Displacement 2.22 inches
Maximum Downward Displacement 2.14 inches
Displacement (in)
AFT-Cell Gross Load (kips)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
0
500
1000
1500
2000
2500
3000
3500
4000
4500

Figure 4

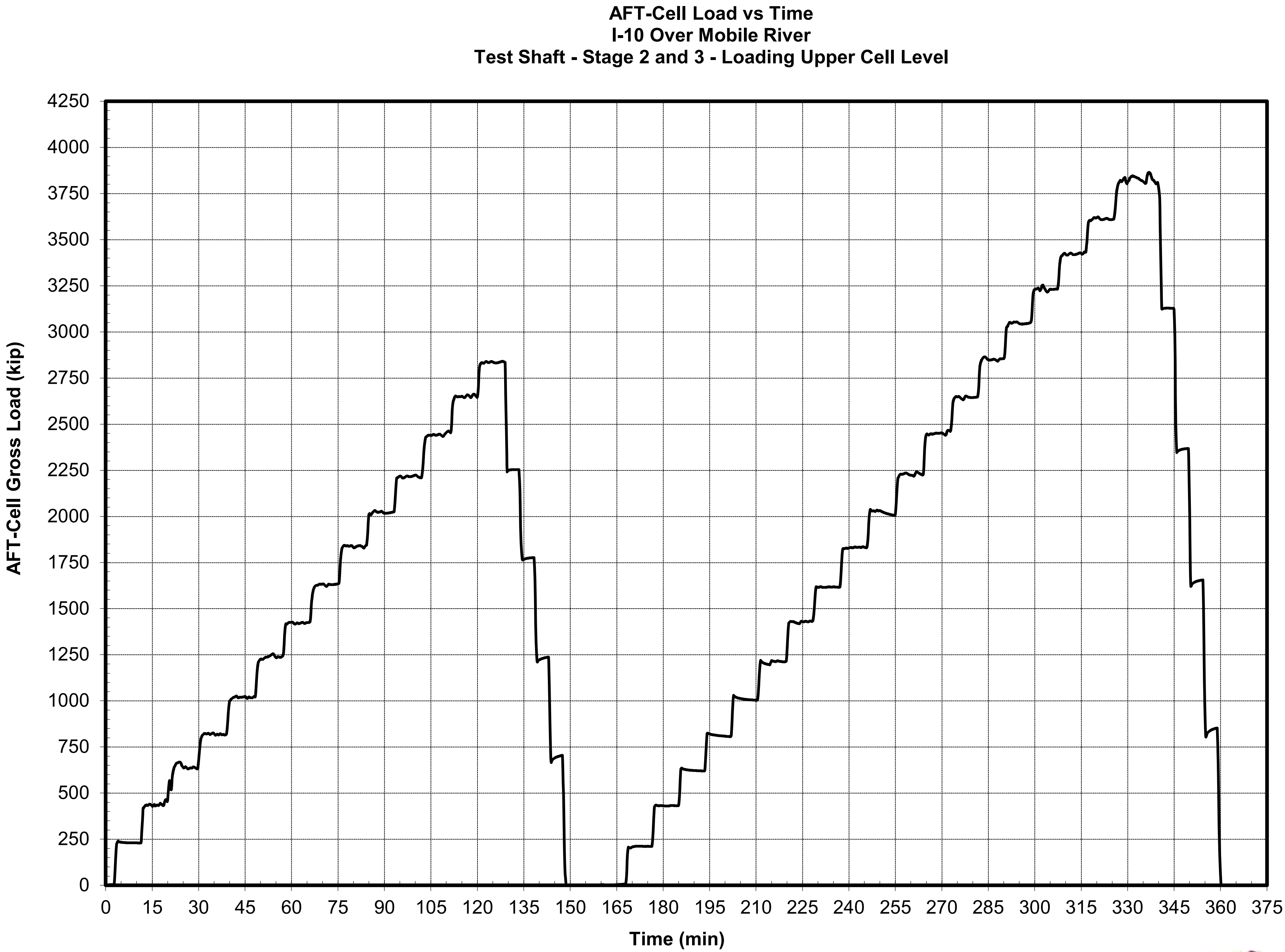

AFT-Cell Load vs Time
I-10 Over Mobile River
Test Shaft - Stage 2 and 3 - Loading Upper Cell Level
AFT-Cell Gross Load (kip)
Time (min)
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
2750
3000
3250
3500
3750
4000
4250
0
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
300
315
330
345
360
375

Figure 5

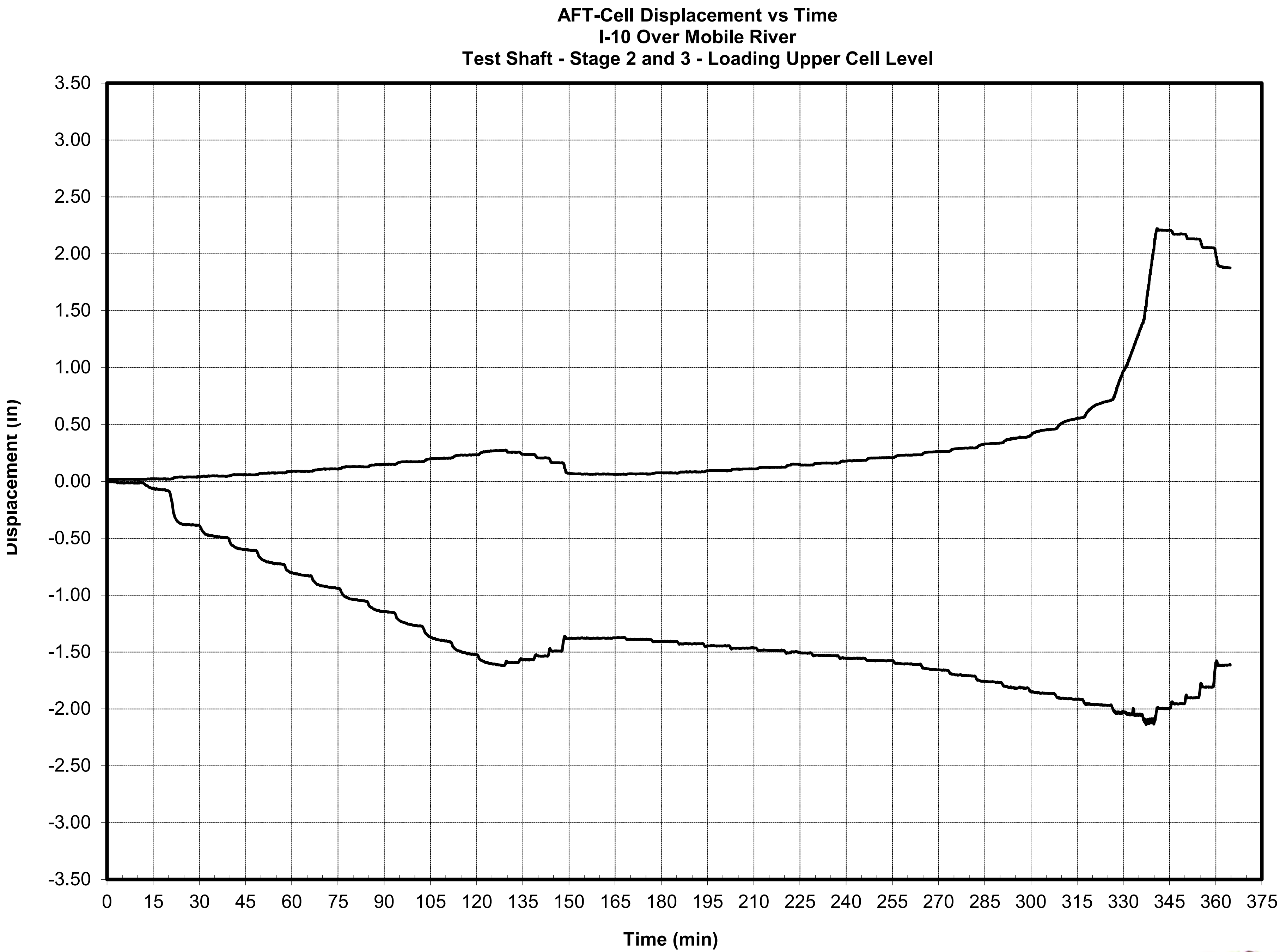
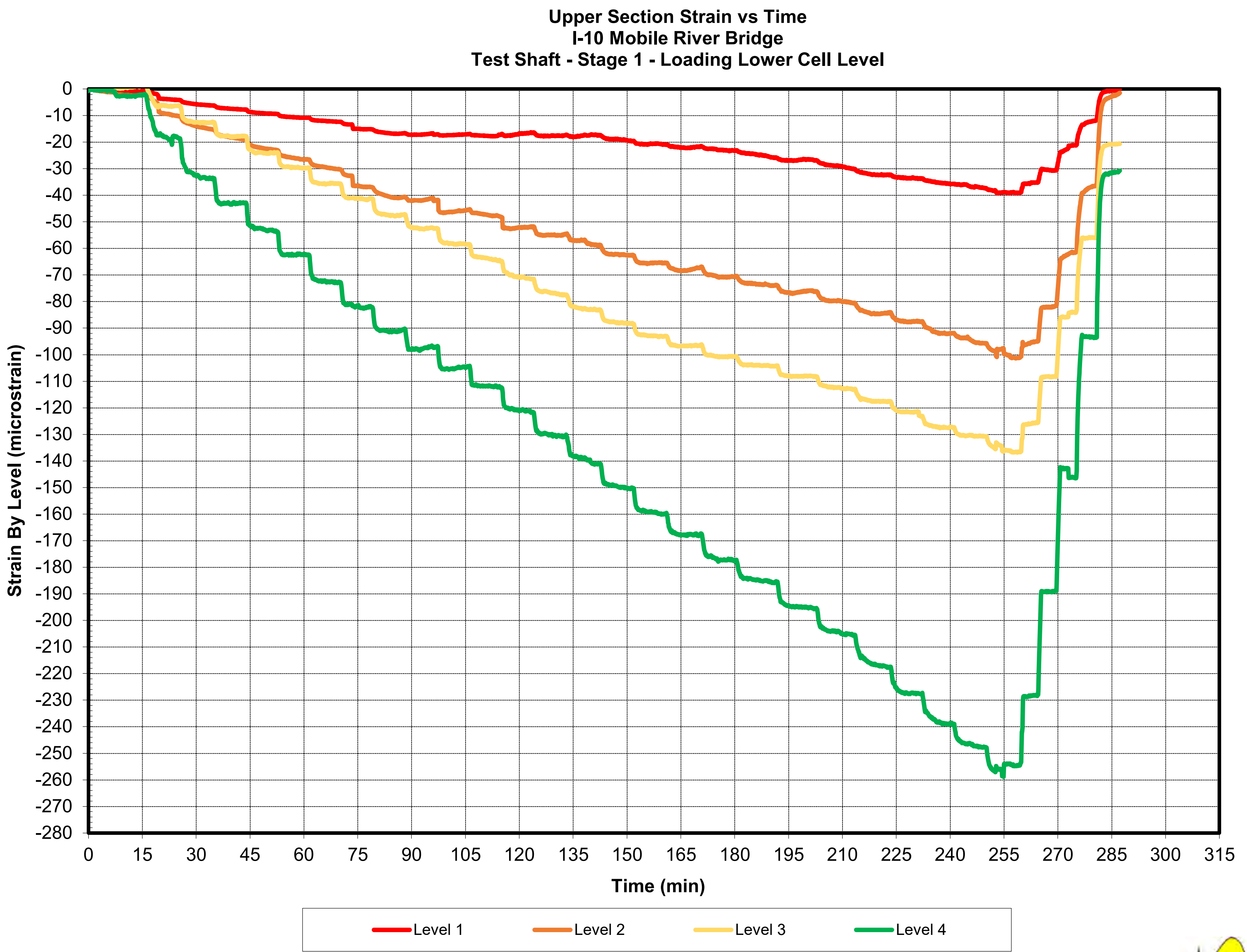
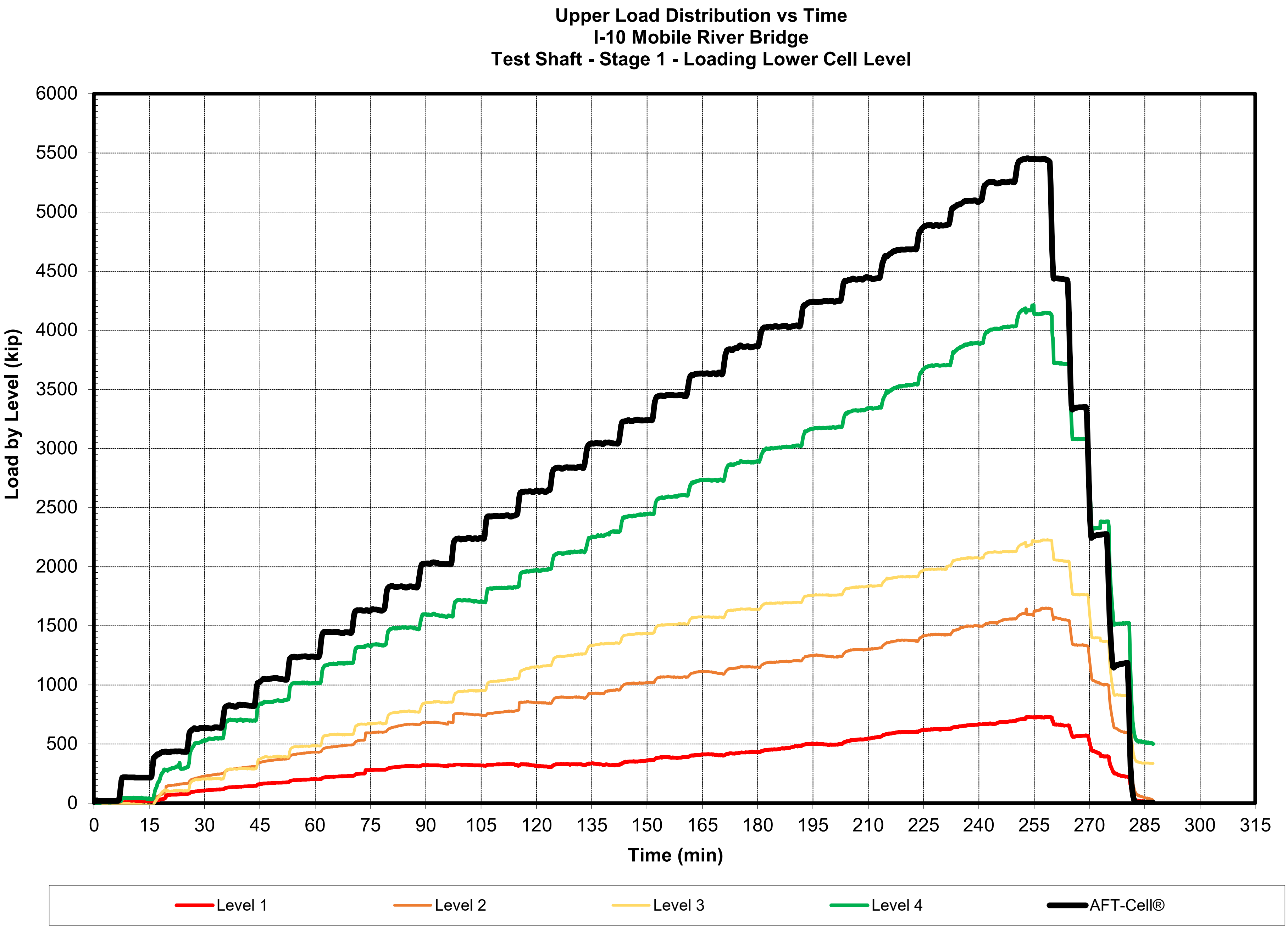

AFT-Cell Displacement vs Time
I-10 Over Mobile River
Test Shaft - Stage 2 and 3 - Loading Upper Cell Level
Displacement (in)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50
0
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
300
315
330
345
360
375
Time (min)

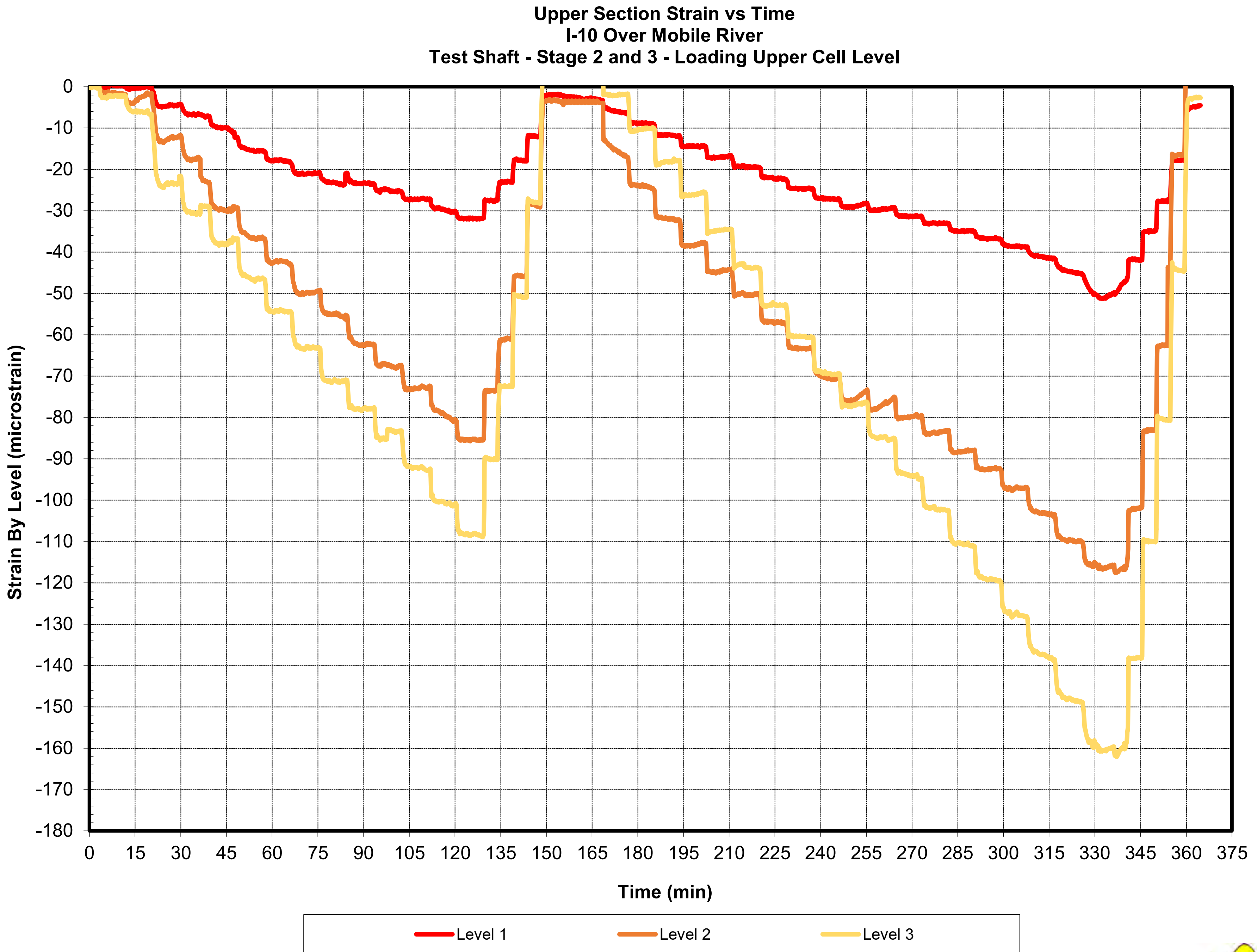
Figure 6


Upper Section Strain vs Time
I-10 Mobile River Bridge
Test Shaft - Stage 1 - Loading Lower Cell Level
Strain By Level (microstrain)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
-220
-230
-240
-250
-260
-270
-280
0
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
300
315
Time (min)
Level 1
Level 2
Level 3
Level 4



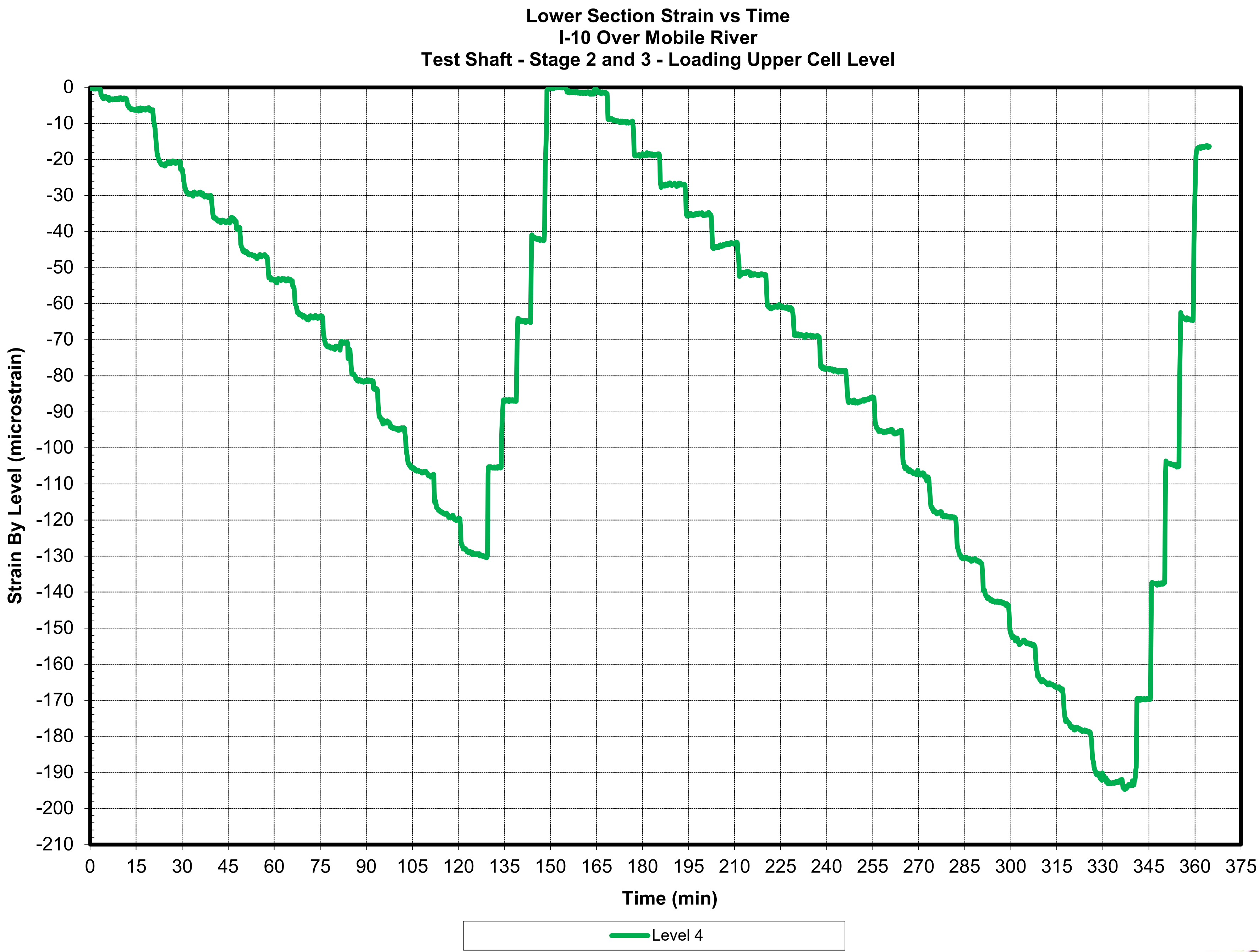
Upper Load Distribution vs Time
I-10 Mobile River Bridge
Test Shaft - Stage 1 - Loading Lower Cell Level
Load by Level (kip)
Time (min)
Level 1
Level 2
Level 3
Level 4
AFT-Cell®

Figure 8



Upper Section Strain vs Time
I-10 Over Mobile River
Test Shaft - Stage 2 and 3 - Loading Upper Cell Level
Strain By Level (microstrain)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
0
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
300
315
330
345
360
375
Time (min)
Level 1
Level 2
Level 3

Figure 9



Lower Section Strain vs Time
I-10 Over Mobile River
Test Shaft - Stage 2 and 3 - Loading Upper Cell Level
Strain By Level (microstrain)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345 360 375
Time (min)
Level 4

Figure 10

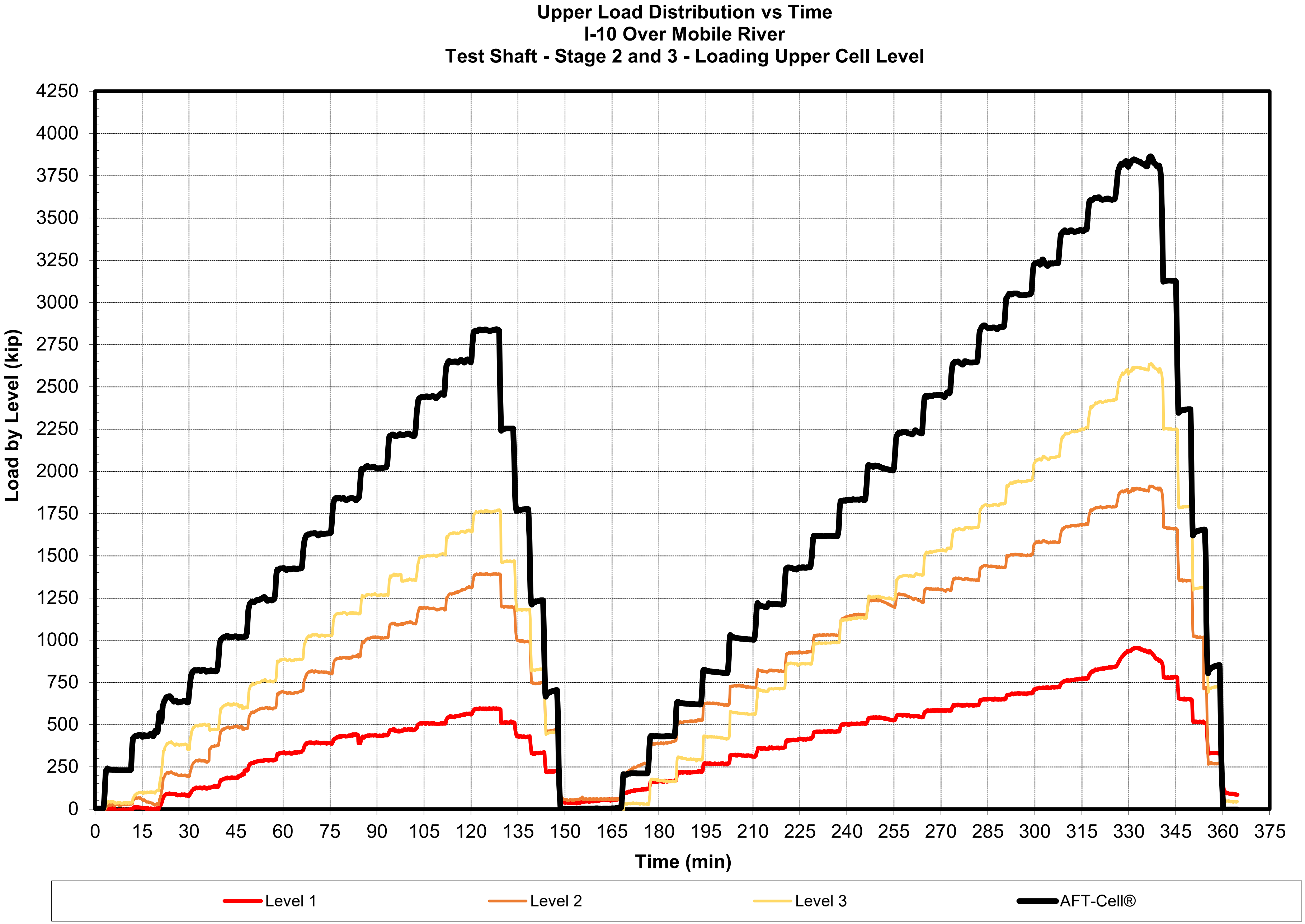

Upper Load Distribution vs Time
I-10 Over Mobile River
Test Shaft - Stage 2 and 3 - Loading Upper Cell Level
Load by Level (kip)
Time (min)
Level 1
Level 2
Level 3
AFT-Cell®

Figure 11

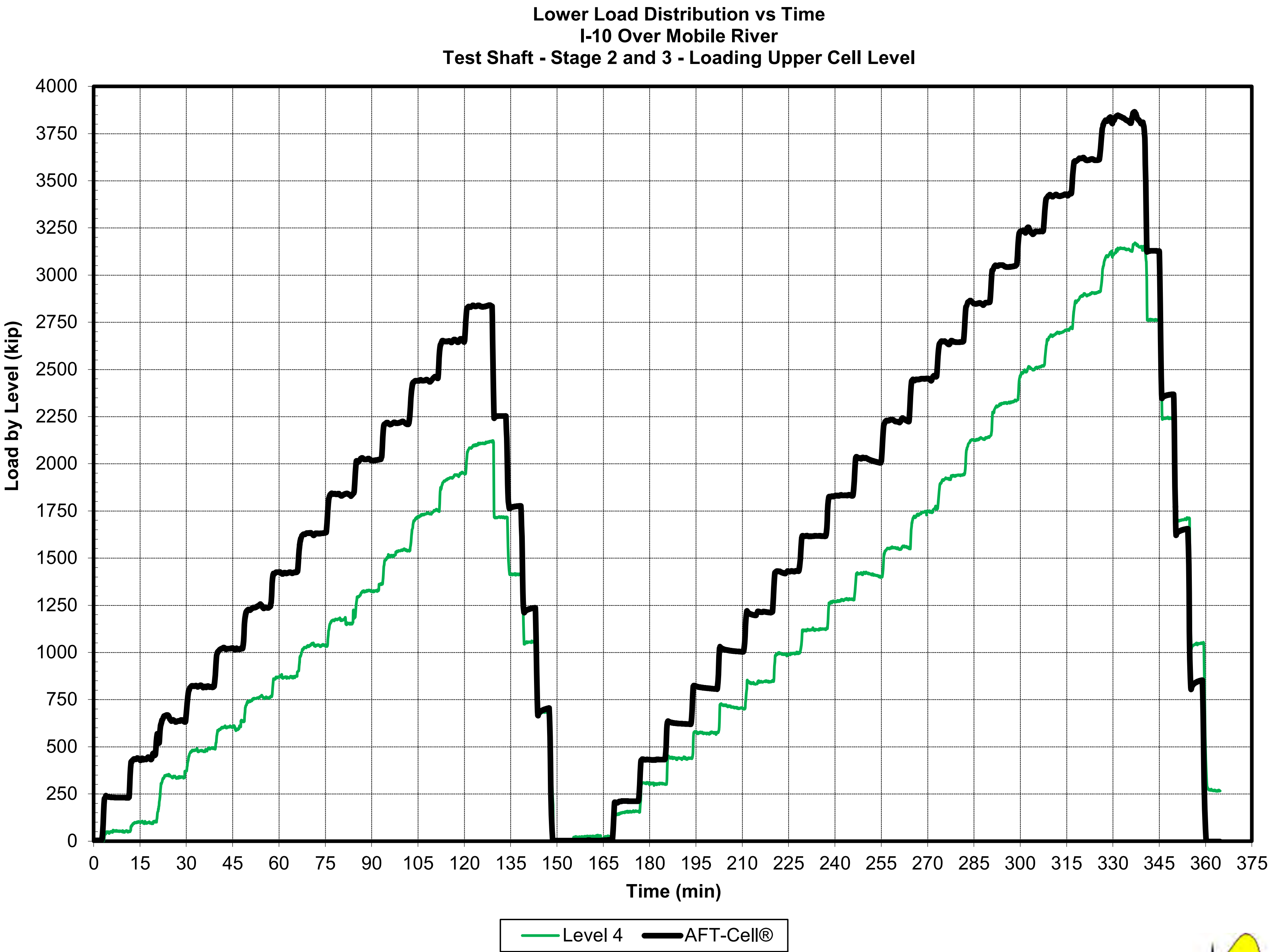
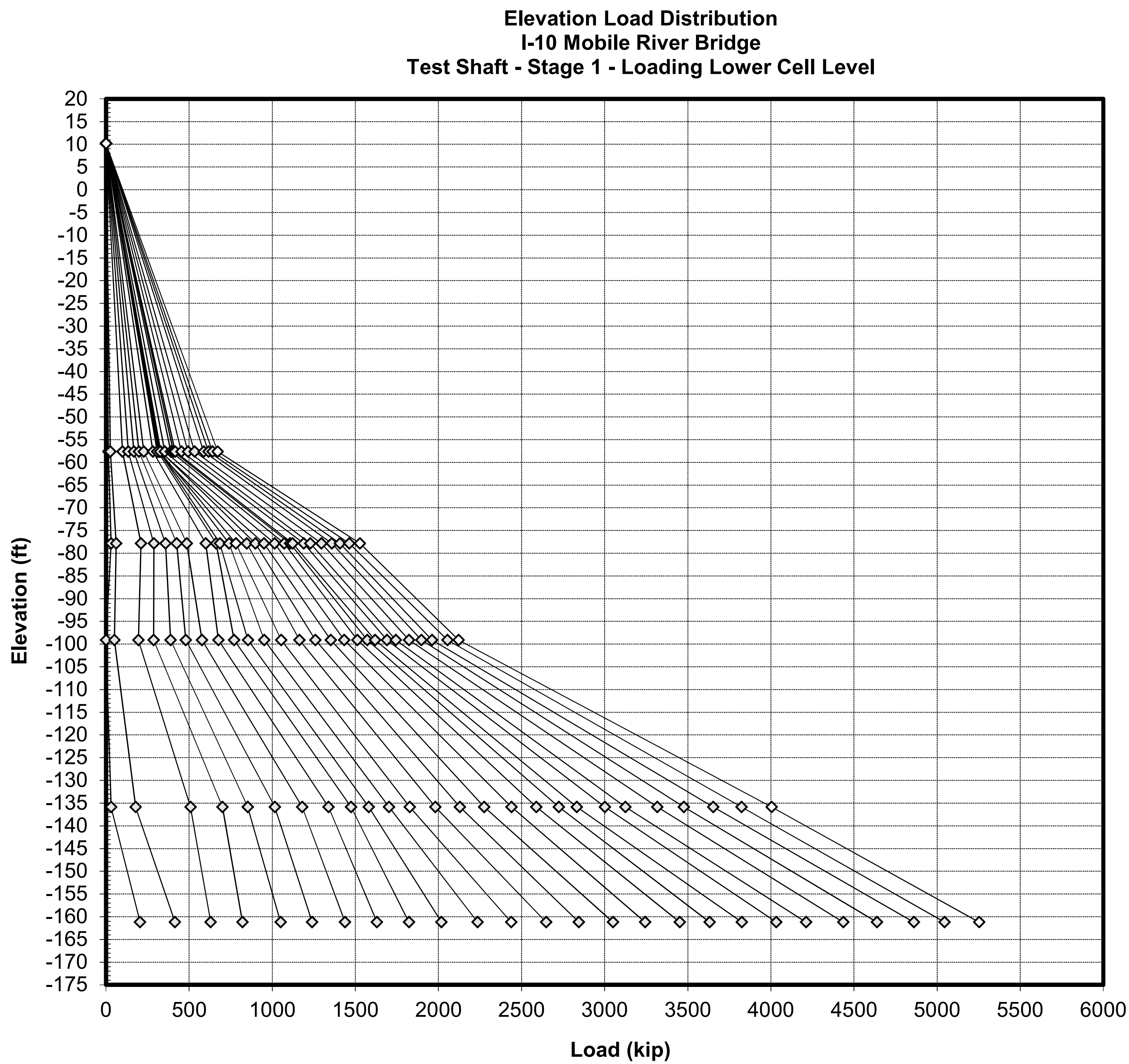
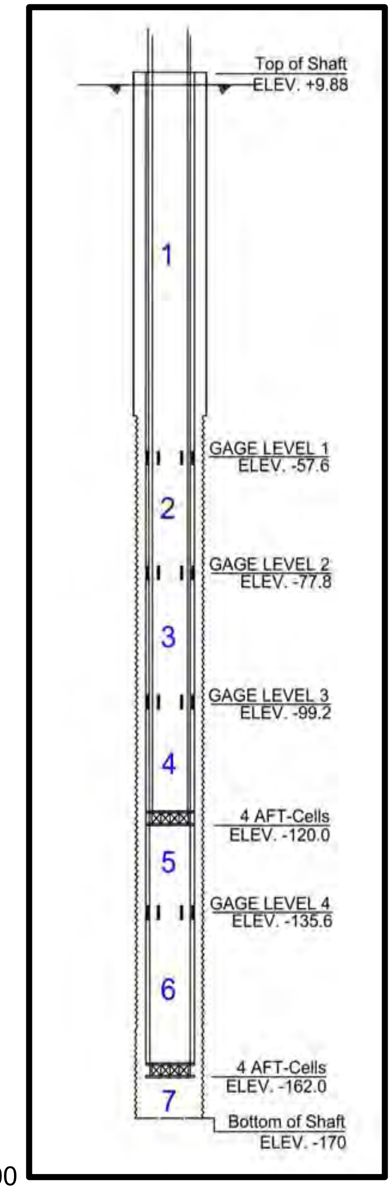

Lower Load Distribution vs Time
I-10 Over Mobile River
Test Shaft - Stage 2 and 3 - Loading Upper Cell Level
Load by Level (kip)
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
2750
3000
3250
3500
3750
4000
0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345 360 375
Time (min)
Level 4
AFT-Cell®

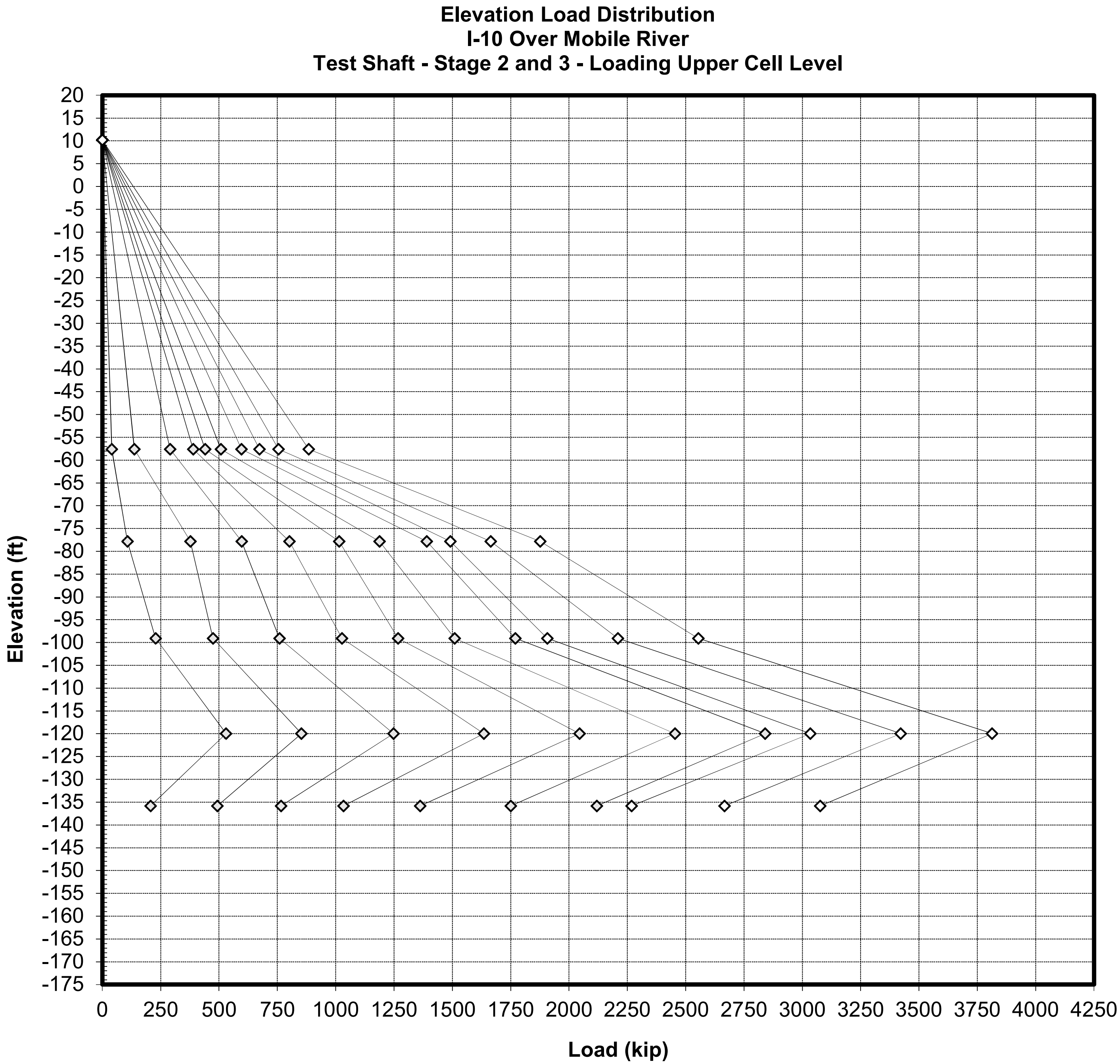
Figure 12



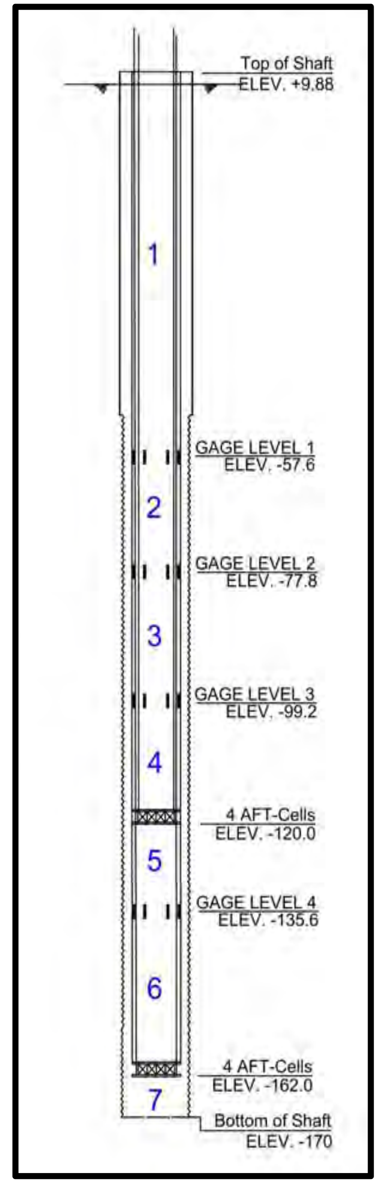
Elevation Load Distribution
I-10 Mobile River Bridge
Test Shaft - Stage 1 - Loading Lower Cell Level
Elevation (ft)
Load (kip)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
-85
-90
-95
-100
-105
-110
-115
-120
-125
-130
-135
-140
-145
-150
-155
-160
-165
-170
-175
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000



Top of Shaft
ELEV. +9.88
1
GAGE LEVEL 1
ELEV. -57.6
2
GAGE LEVEL 2
ELEV. -77.8
3
GAGE LEVEL 3
ELEV. -99.2
4
4 AFT-Cells
ELEV. -120.0
5
GAGE LEVEL 4
ELEV. -135.6
6
4 AFT-Cells
ELEV. -162.0
7
Bottom of Shaft
ELEV. -170



Elevation Load Distribution
I-10 Over Mobile River
Test Shaft - Stage 2 and 3 - Loading Upper Cell Level
Elevation (ft)
Load (kip)
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
-85
-90
-95
-100
-105
-110
-115
-120
-125
-130
-135
-140
-145
-150
-155
-160
-165
-170
-175
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
2750
3000
3250
3500
3750
4000
4250



Top of Shaft
ELEV. +9.88
1
GAGE LEVEL 1
ELEV. -57.6
2
GAGE LEVEL 2
ELEV. -77.8
3
GAGE LEVEL 3
ELEV. -99.2
4
4 AFT-Cells
ELEV. -120.0
5
GAGE LEVEL 4
ELEV. -135.6
6
4 AFT-Cells
ELEV. -162.0
7
Bottom of Shaft
ELEV. -170

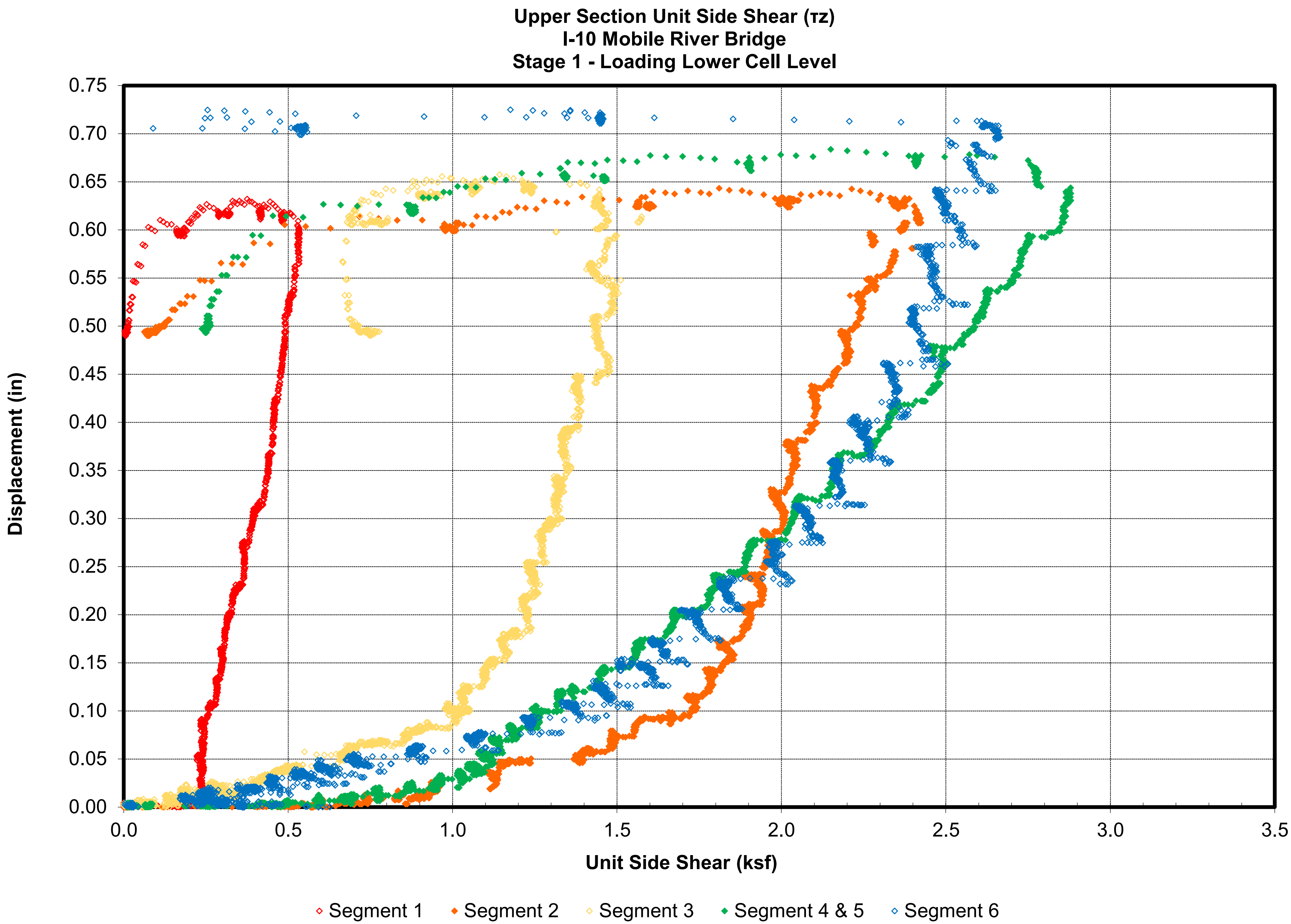
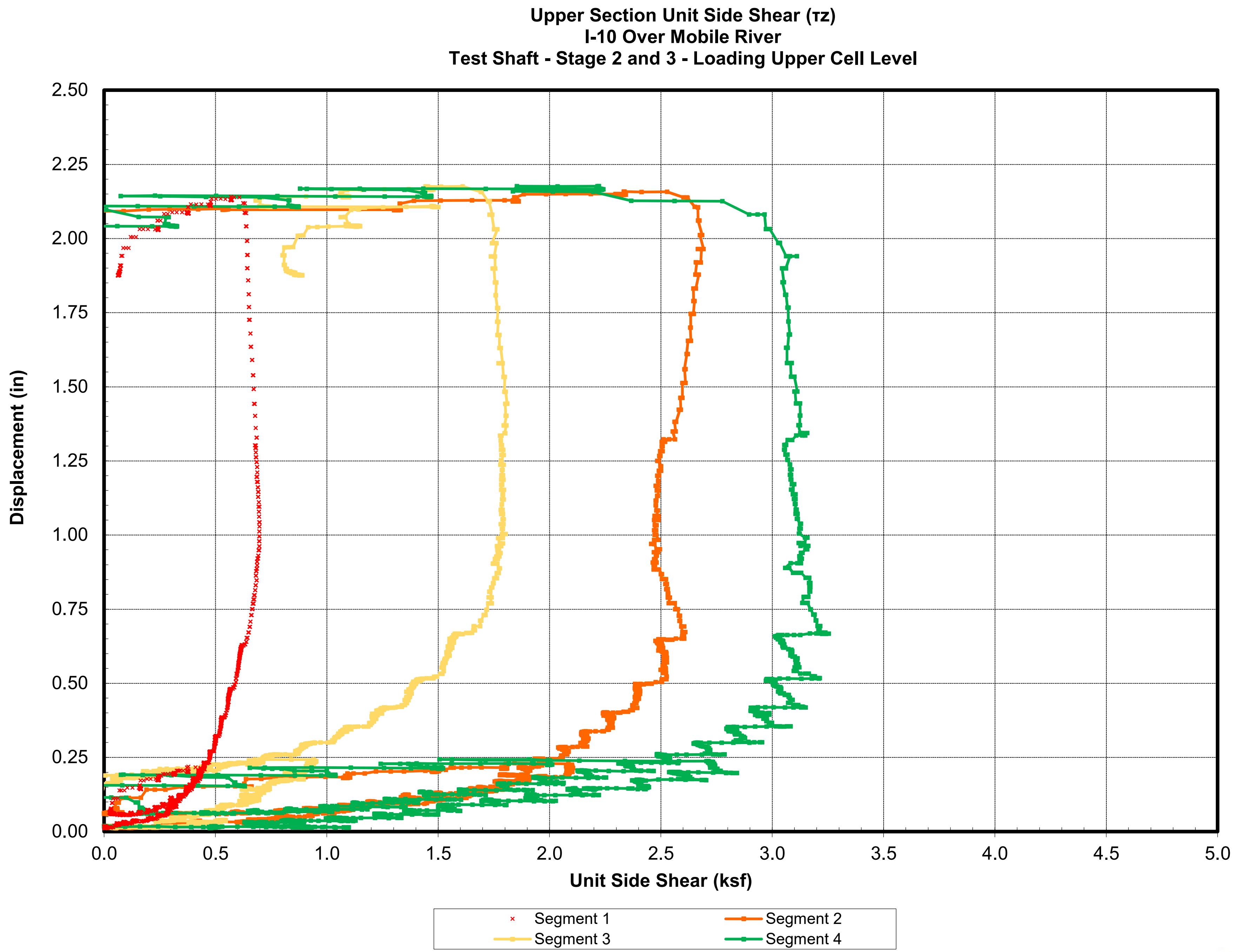
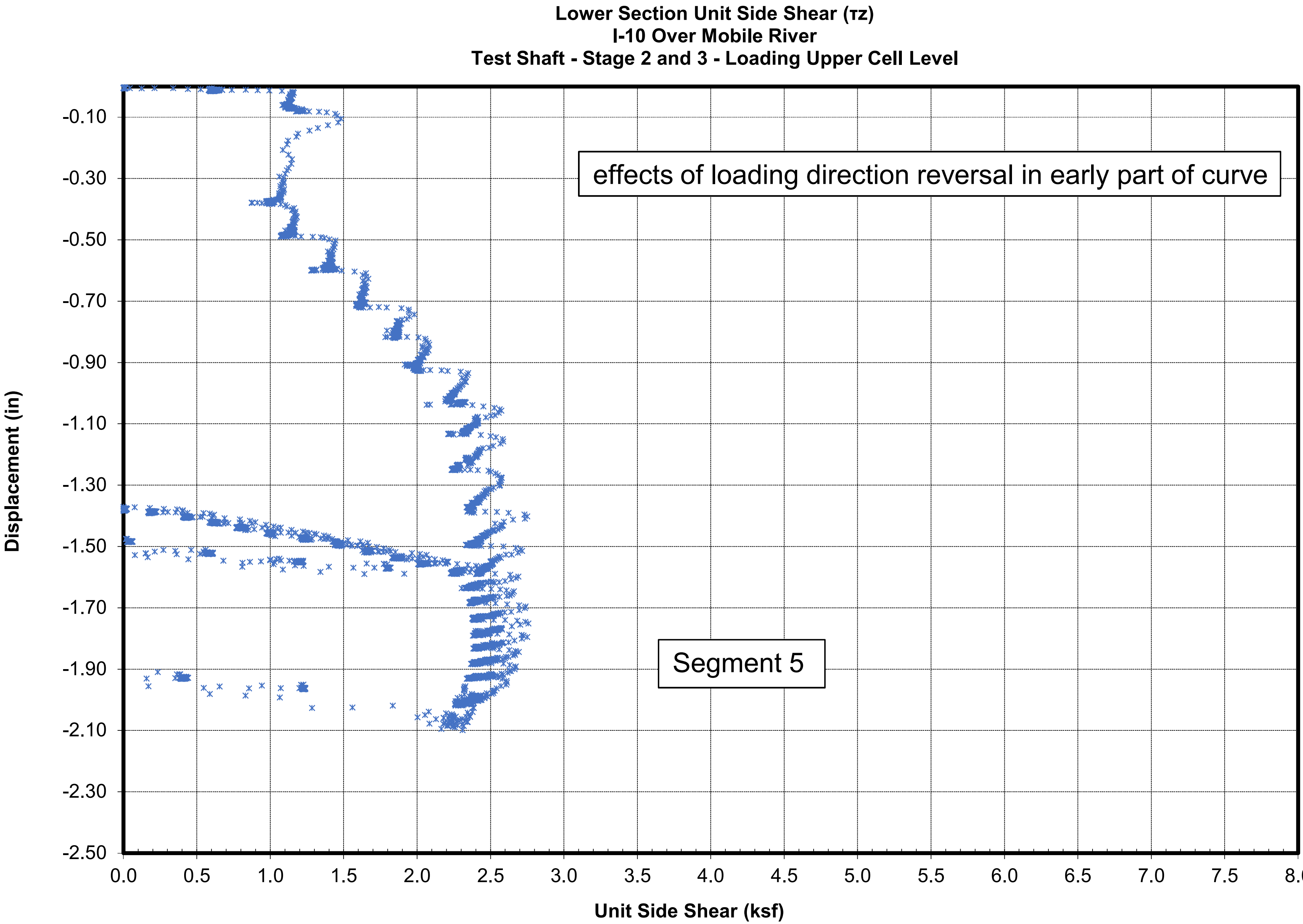
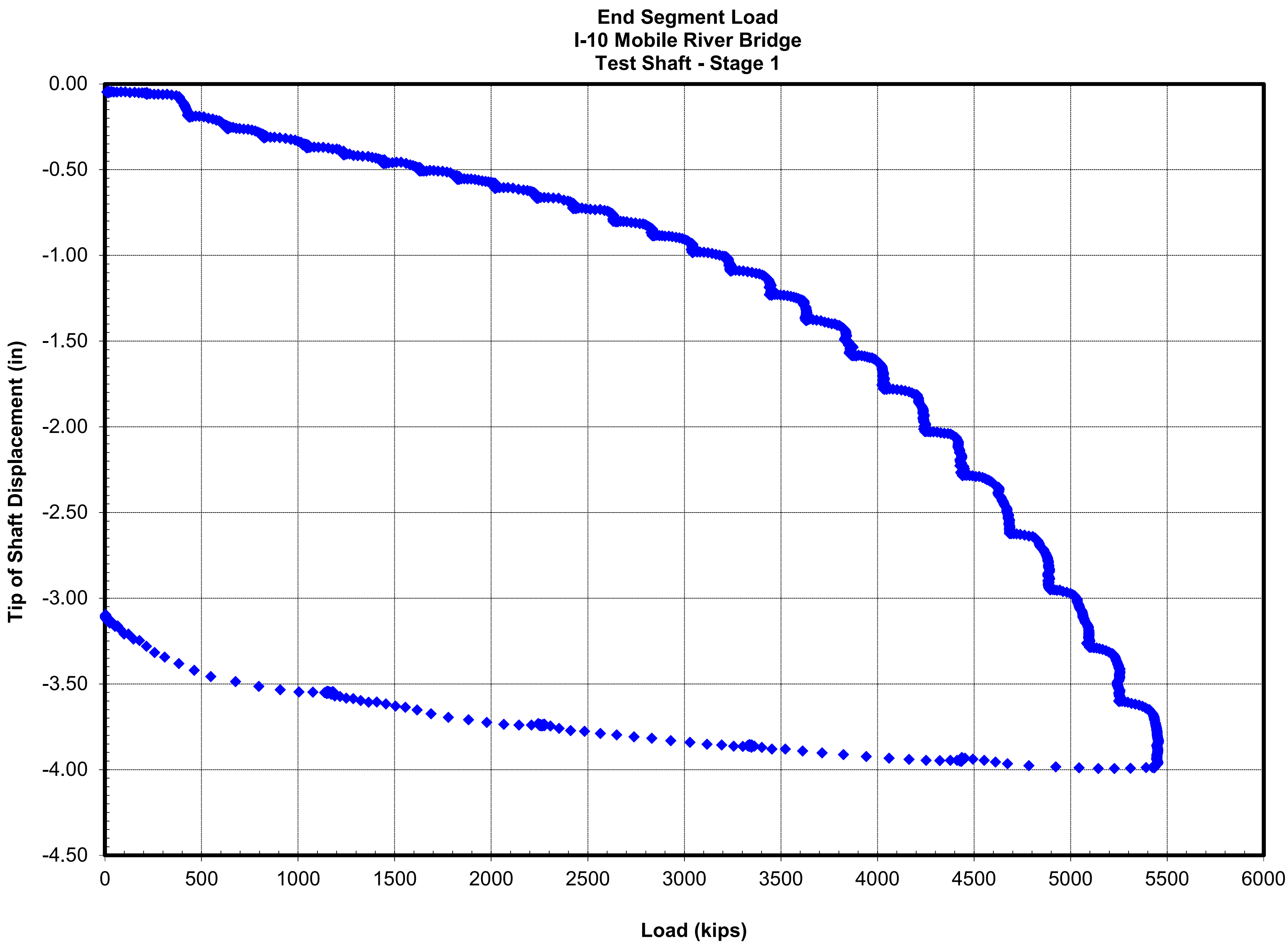

Upper Section Unit Side Shear (τz)
I-10 Mobile River Bridge
Stage 1 - Loading Lower Cell Level
Displacement (in)
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Unit Side Shear (ksf)
Segment 1
Segment 2
Segment 3
Segment 4 & 5
Segment 6

Figure 15


Upper Section Unit Side Shear (τz)
I-10 Over Mobile River
Test Shaft - Stage 2 and 3 - Loading Upper Cell Level
Displacement (in)
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Unit Side Shear (ksf)
Segment 1
Segment 2
Segment 3
Segment 4



Lower Section Unit Side Shear (τz)
I-10 Over Mobile River
Test Shaft - Stage 2 and 3 - Loading Upper Cell Level
effects of loading direction reversal in early part of curve
Segment 5
Displacement (in)
-0.10
-0.30
-0.50
-0.70
-0.90
-1.10
-1.30
-1.50
-1.70
-1.90
-2.10
-2.30
-2.50
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
Unit Side Shear (ksf)



End Segment Load
I-10 Mobile River Bridge
Test Shaft - Stage 1
Tip of Shaft Displacement (in)
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50
-4.00
-4.50
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Load (kips)

Figure 18

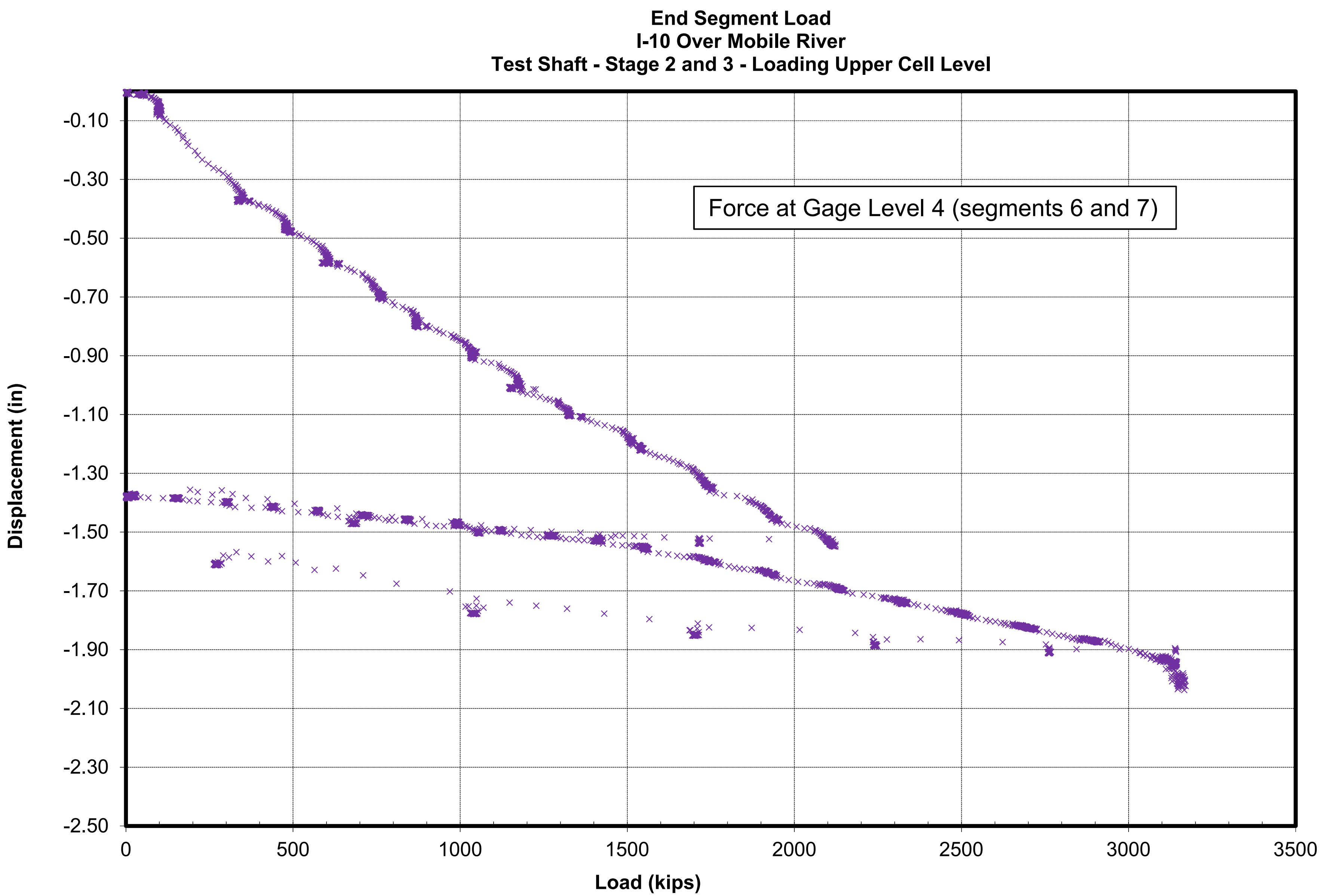

End Segment Load
I-10 Over Mobile River
Test Shaft - Stage 2 and 3 - Loading Upper Cell Level
Force at Gage Level 4 (segments 6 and 7)
Displacement (in)
-0.10
-0.30
-0.50
-0.70
-0.90
-1.10
-1.30
-1.50
-1.70
-1.90
-2.10
-2.30
-2.50
0
500
1000
1500
2000
2500
3000
3500
Load (kips)

Figure 19

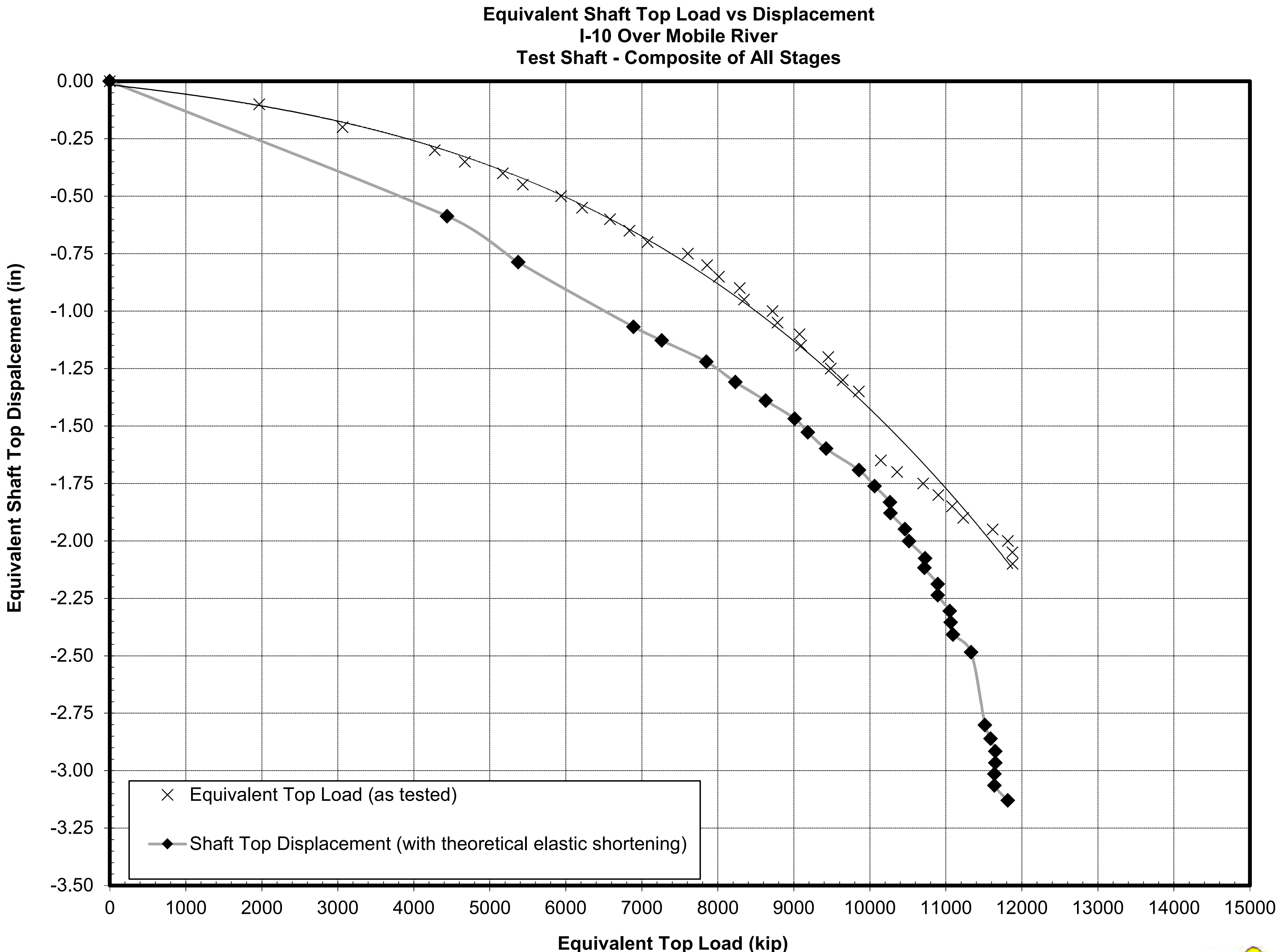

Equivalent Shaft Top Load vs Displacement
I-10 Over Mobile River
Test Shaft - Composite of All Stages
Equivalent Shaft Top Dispalcement (in)
0.00
-0.25
-0.50
-0.75
-1.00
-1.25
-1.50
-1.75
-2.00
-2.25
-2.50
-2.75
-3.00
-3.25
-3.50
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
Equivalent Top Load (kip)
Equivalent Top Load (as tested)
Shaft Top Displacement (with theoretical elastic shortening)

Figure 20

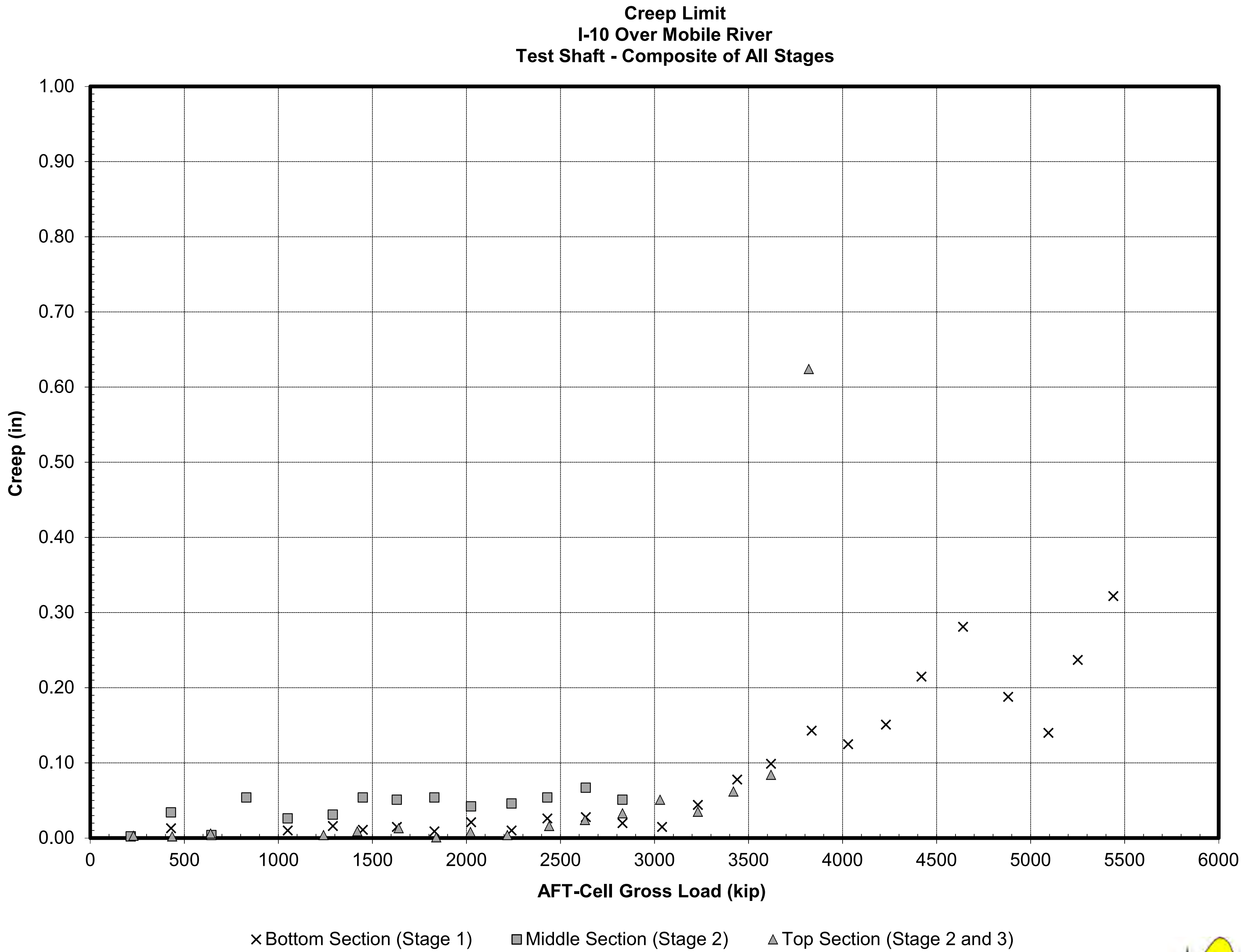

Creep Limit
I-10 Over Mobile River
Test Shaft - Composite of All Stages
Creep (in)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
AFT-Cell Gross Load (kip)
Bottom Section (Stage 1)
Middle Section (Stage 2)
Top Section (Stage 2 and 3)

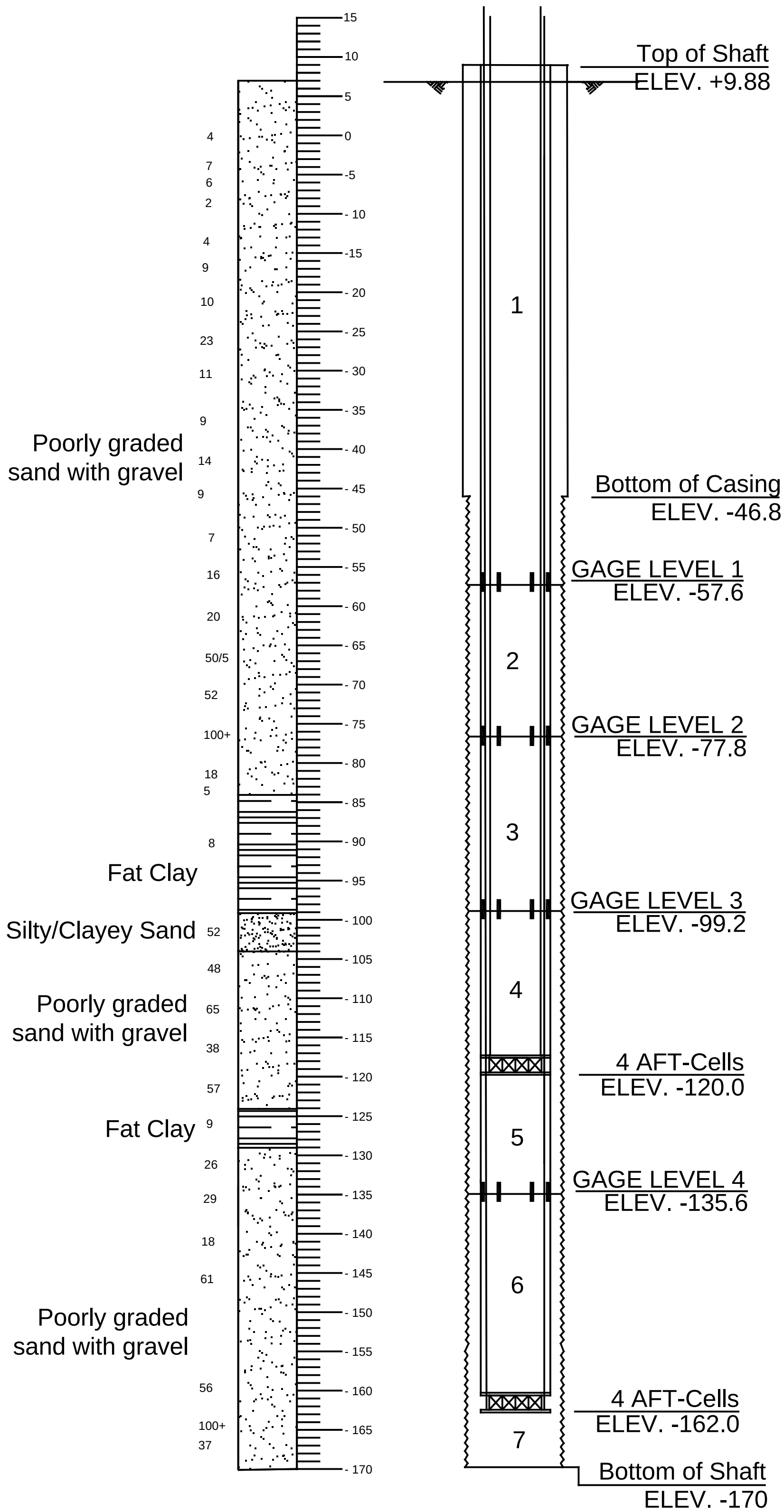
Figure 21

Appendix B

As-Built Test Shaft Schematic
Concrete Pour Log
Concrete Strength Report
Soil Boring Record

Report of Bi-Directional Load Testing
I-10 Mobile River Bridge
AFT Project No. 518009
Mobile, Alabama

TEST SHAFT - As Built
72" Ø DRILLED SHAFT - AFT-Cell Load Test



APPLIED FOUNDATION TESTING 4035 J Louis St Green Cove Springs, Fl 32043	72-INCH DIAMETER DRILLED SHAFT		
	I-10 MOBILE RIVER BRIDGE		
	DWN BY: KS Rev.:	05/04/18	FIGURE 21

FORM C-35 **ALABAMA DEPARTMENT OF TRANSPORTATION**

Revised 07-15-94

DRILLED SHAFT POURING RECORD

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

Bridge Station	To Station	Bridge Identification Number
Test Shaft		

Road Between	and

Contractor	Inspector
Jordan Pile Driving / A.H. Beck	Jay Davison

Date	Bent No. & Lane	Shaft No.	Kind of Soil
3/23/2018		TP-WPB	Silty Sand

Diameter of Shaft	Shaft Volume per Linear Foot (V_{LF})	Shaft Tip Elevation
72" / 77" in Casing (-46.8 EL)	1.047 CY / 1.198 CY in Casing	-170

Load Number	Quantity (Cu. Yds.)	Slump (In.)	Pouring Time		Concrete Elevation	Tremie Tip Elevation	Cylinder Number
			Start	Finish			
1	8	7.5	2:22 PM	2:28 PM	-165.3	-165	
2	8		2:28 PM	2:32 PM	-157.1	-165	
3	8		2:32 PM	2:51 PM	-150.6	-165	
4	8	9.5	2:52 PM	3:03 PM	-143.5	-160	
5	8		3:03 PM	3:09 PM	-138.6	-155	
6	8		3:10 PM	3:16 PM	-131.0	-150	
7	8		3:19 PM	3:35 PM	-124.2	-140	
8	8		3:35 PM	3:40 PM	-117.8	-135	
9	8	9.25	3:40 PM	3:45 PM	-109.7	-130	
10	8		3:45 PM	3:50 PM	-102.8	-120	
11	8		3:50 PM	3:55 PM	-93.8	-115	
12	8		3:55 PM	4:00 PM	-86.5	-110	
13	8	9.5	4:09 PM	4:13 PM	-79.3	-105	
14	8		4:13 PM	4:19 PM	-71.8	-90	
15	8		4:19 PM	4:28 PM	-63.1	-80	
16	8		4:25 PM	4:35 PM	-56.8	-70	
17	8		4:35 PM	4:39 PM	-48.8	-60	
18	8		4:39 PM	4:52 PM	-42.1	-55	
19	8		4:52 PM	4:56 PM	-35.7	-45	

V_Q = ______

1. Top of concrete elevation at completion of pour prior to trimming any excess : ____________
2. Shaft length before trimming : **L** = ______________ Ft.
3. Corresponding theoretical volume : $V_T = V_{LF} \times L$ = ______________ Cu. Yds.
4. Volume of excess in last truck : V_E = ______________ Cu. Yds.
5. Volume of overflow (if any) : V_O = ______________ Cu. Yds.
6. Actual shaft volume before trimming : $V_A = V_Q - V_E - V_O$ = ______________ Cu. Yds.
7. Overpour : $\frac{V_A - V_T}{V_T} \times 100$ = ______________ %

REMARKS

1. Record any problems with the operation of the mixing plant, supply irregularities (concrete delays), or possible setbacks (loss of priming in the tremie, movement of reinforcing steel, difficulties with extraction of temporary casing, caving of shaft wall, etc.) on the back of this sheet in the space provided for observations.
2. A theoretical volume versus elevation line should be plotted on the graph on the back of this sheet prior to concrete placement.
3. The actual concrete placement curve should be plotted during construction of the shaft. An elevation check should be taken as each truck pours out and the data recorded above and plotted on graph.
4. Any large variations of the actual concrete placement curve from the theoretical placement line should be investigated.
5. Draw sketch on back of this sheet showing location of shaft.

Correct______________________ **Approved**______________________

Project Manager **Area Operations Engineer**

FORM C-35 **ALABAMA DEPARTMENT OF TRANSPORTATION**

Revised 07-15-94

DRILLED SHAFT POURING RECORD

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

Bridge Station	To Station	Bridge Identification Number
Test Shaft		

Road Between	and

Contractor	Inspector
Jordan Pile Driving / A.H. Beck	Jay Davison

Date	Bent No. & Lane	Shaft No.	Kind of Soil
3/23/18		TP-WPB	Silty Sand

Diameter of Shaft	Shaft Volume per Linear Foot (V_{LF})	Shaft Tip Elevation
72" / 77" in Casing (-46.8 EL)	1.047 CY / 1.198 CY in Casing	-170

Load Number	Quantity (Cu. Yds.)	Slump (In.)	Pouring Time		Concrete Elevation	Tremie Tip Elevation	Cylinder Number
			Start	Finish			
20	8		4:56 PM	5:01 PM	-28.8	-40	
21	8	9.5	5:01 PM	5:05 PM	-24.3	-35	
22	8		5:05 PM	5:10 PM	-15.8	-30	
23	8		5:10 PM	5:14 PM	-9.5	-20	
24	8		5:14 PM	5:20 PM	-3.6	-15	
25	8		5:20 PM	5:24 PM	3.2	-10	
26	8	9	5:24 PM	5:30 PM	9.0	-5	
27	4		5:40 PM	5:50 PM	10.2	-5	

V_Q = 212

1. Top of concrete elevation at completion of pour prior to trimming any excess : 10.2
2. Shaft length before trimming : **L** = 180.2 Ft.
3. Corresponding theoretical volume : $V_T = V_{LF} \times L$ = 197.3 Cu. Yds.
4. Volume of excess in last truck : V_E = 2 Cu. Yds.
5. Volume of overflow (if any) : V_O = 2 Cu. Yds.
6. Actual shaft volume before trimming : $V_A = V_Q - V_E - V_O$ = 208 Cu. Yds.
7. Overpour : $\frac{V_A - V_T}{V_T} \times 100$ = 5.4 %

REMARKS

1. Record any problems with the operation of the mixing plant, supply irregularities (concrete delays), or possible setbacks (loss of priming in the tremie, movement of reinforcing steel, difficulties with extraction of temporary casing, caving of shaft wall, etc.) on the back of this sheet in the space provided for observations.
2. A theoretical volume versus elevation line should be plotted on the graph on the back of this sheet prior to concrete placement.
3. The actual concrete placement curve should be plotted during construction of the shaft. An elevation check should be taken as each truck pours out and the data recorded above and plotted on graph.
4. Any large variations of the actual concrete placement curve from the theoretical placement line should be investigated.
5. Draw sketch on back of this sheet showing location of shaft.

Correct ____________________ **Approved** ____________________

Project Manager **Area Operations Engineer**

Kay Ivey
Governor

Alabama Department of Transportation
Concrete Placement and Testing Report
BMT-174 Pending Tests

Report ID: 56081 **Pour Date:** 03/23/2018

John R. Cooper
Transportation Director

Project No: IM-I010(341)
Project Manager: Davison, Jay
Class/Type Concrete: DS-2A
Mix ID: DS2A-001-18
Method of Curing in Structure: Other Method
Cylinder Field Curing Method: Cylinder Curing Box
Time Placing Started/Completed: 02:00 PM / 06:05 PM
Supplied/Placed This Date: 212 CuYd / 212 CuYd

Area: Mobile
County: MOBILE
Prime Contractor: 11462 JORDAN PILE DRIVING, INC.
Ready Mix Supplier: Bayou Concrete, LLC - 10037 - Mobile, AL Plant 2(Canal)
Weather: Clear
Ambient Placement Temp Begin/End: 75 F / 70 F
Cylinder Field Curing Temp Low/High: 60 F / 80 F

Test Records

Ticket No: 20138293 **Test Start:** 02:10 PM **Test End:** 02:20 PM **Slump (in):** 9.25 **Air %:** 1.5 **Temp (F):** 82 **Cast Date:** 03/23/2018 **Inspector:** Burdett, Chris

Sample ID	Cylinder No	Cylinder Received Date	Test Date	Age	Average Diameter	Length	X-Section Area (sqin)	Total Applied Load	Req'd Strength (psi)	Actual Strength (psi)	Fracture Type	Lab Technician	Lab Remarks
786223	DS-1	03/26/2018	03/27/2018	4	5.98	12.0	28.04	131040	Varies	4670	Type 5	11907 Holland, Travis	N/A
786224	DS-2	03/26/2018	03/28/2018	5	5.97	12.0	27.95	140410	Varies	5020	Type 3	11907 Holland, Travis	N/A
786225	DS-3	03/26/2018	03/30/2018	7	5.98	12.0	28.09	154430	Varies	5500	Type 5	11907 Holland, Travis	N/A
786227	DS-5												
786226	DS-4												

Ticket No: 20138300 **Test Start:** 03:20 PM **Test End:** 03:30 PM **Slump (in):** 9.25 **Air %:** 1.2 **Temp (F):** 80 **Cast Date:** 03/23/2018 **Inspector:** Burdett, Chris

Sample ID	Cylinder No	Cylinder Received Date	Test Date	Age	Average Diameter	Length	X-Section Area (sqin)	Total Applied Load	Req'd Strength (psi)	Actual Strength (psi)	Fracture Type	Lab Technician	Lab Remarks
786228	DS-6	03/26/2018	03/27/2018	4	6.00	12.0	28.27	113310	Varies	4010	Type 2	11907 Holland, Travis	N/A
786229	DS-7	03/26/2018	03/28/2018	5	5.98	12.0	28.09	123940	Varies	4410	Type 3	11907 Holland, Travis	N/A
786230	DS-8	03/26/2018	03/30/2018	7	5.97	12.0	27.99	152990	Varies	5470	Type 5	11907 Holland, Travis	N/A
786232	DS-10												
786231	DS-9												

Ticket No: 20138308 **Test Start:** 03:50 PM **Test End:** 04:00 PM **Slump (in):** 9.50 **Air %:** 2 **Temp (F):** 79 **Cast Date:** 03/23/2018 **Inspector:** Burdett, Chris

Sample ID	Cylinder No	Cylinder Received Date	Test Date	Age	Average Diameter	Length	X-Section Area (sqin)	Total Applied Load	Req'd Strength (psi)	Actual Strength (psi)	Fracture Type	Lab Technician	Lab Remarks
786234	DS-11	03/26/2018	03/27/2018	4	5.99	12.0	28.13	129340	Varies	4600	Type 2	11907 Holland, Travis	N/A
786235	DS-12	03/26/2018	03/28/2018	5	5.98	12.0	28.09	140800	Varies	5010	Type 3	11907 Holland, Travis	N/A
786236	DS-13	03/26/2018	03/30/2018	7	6.00	12.0	28.27	153630	Varies	5430	Type 5	11907 Holland, Travis	N/A
786237	DS-14												
786238	DS-15												

Alabama Department of Transportation
Concrete Placement and Testing Report
BMT-174 Pending Tests

Kay Ivey
Governor

Report ID: 56081 **Pour Date:** 03/23/2018

John R. Cooper
Transportation Director

Ticket No: 20138314 **Test Start:** 04:45 PM **Test End:** 04:55 PM **Slump (in):** 9.50 **Air %:** 1.5 **Temp (F):** 80 **Cast Date:** 03/23/2018 **Inspector:** Burdett, Chris

Sample ID	Cylinder No	Cylinder Received Date	Test Date	Age	Average Diameter	Length	X-Section Area (sqin)	Total Applied Load	Req'd Strength (psi)	Actual Strength (psi)	Fracture Type	Lab Technician	Lab Remarks
786239	DS-16	03/26/2018	03/27/2018	4	5.98	12.0	28.09	109580	Varies	3900	Type 3	11907 Holland, Travis	N/A
786240	DS-17	03/26/2018	03/28/2018	5	5.97	12.0	27.95	126550	Varies	4530	Type 5	11907 Holland, Travis	N/A
786241	DS-18	03/26/2018	03/30/2018	7	5.99	12.0	28.18	164140	Varies	5830	Type 3	11907 Holland, Travis	N/A
786242	DS-19												
786243	DS-20												

Ticket No: 20138321 **Test Start:** 05:25 PM **Test End:** 05:35 PM **Slump (in):** 9.00 **Air %:** 1.5 **Temp (F):** 82 **Cast Date:** 03/23/2018 **Inspector:** Burdett, Chris

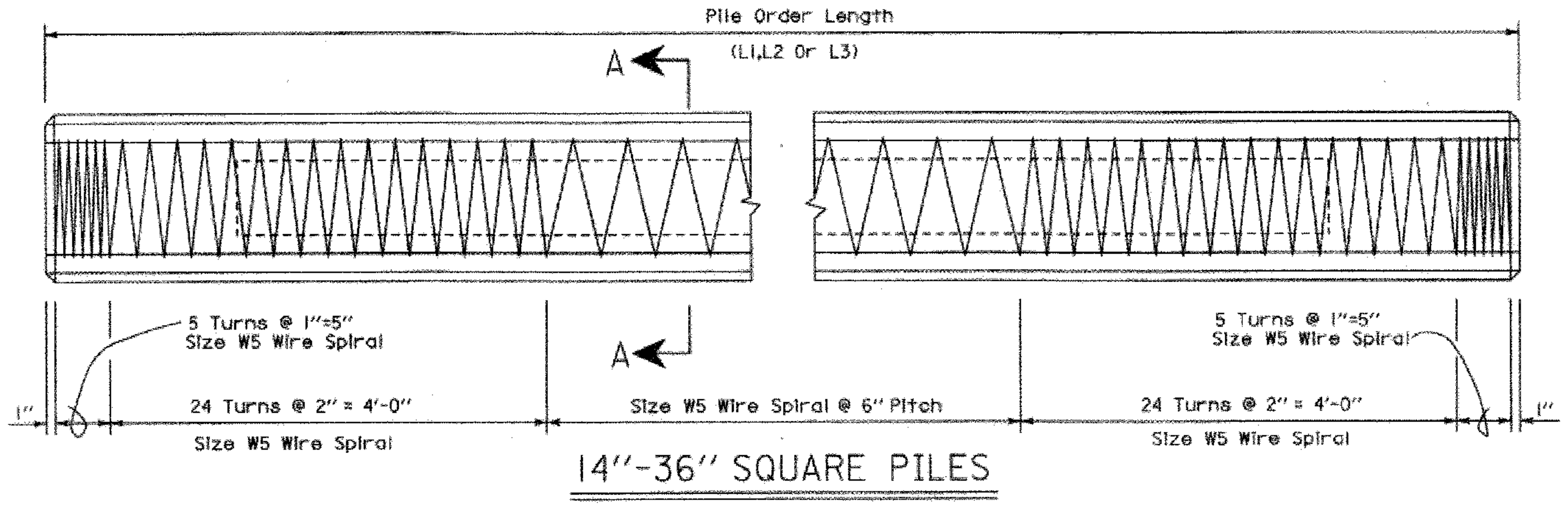
Sample ID	Cylinder No	Cylinder Received Date	Test Date	Age	Average Diameter	Length	X-Section Area (sqin)	Total Applied Load	Req'd Strength (psi)	Actual Strength (psi)	Fracture Type	Lab Technician	Lab Remarks
786244	DS-21	03/26/2018	03/27/2018	4	5.98	12.0	28.09	105880	Varies	3770	Type 3	11907 Holland, Travis	N/A
786245	DS-22	03/26/2018	03/28/2018	5	5.97	12.0	27.99	128670	Varies	4600	Type 5	11907 Holland, Travis	N/A
786246	DS-23	03/26/2018	03/30/2018	7	5.99	12.0	28.18	160430	Varies	5690	Type 5	11907 Holland, Travis	N/A
786247	DS-24												
786248	DS-25												

Pay Item(s): 0011 | 0190 | 506C087 | Drilled Shaft Construction, 6'-0" Diameter, Class DS2A Concrete

Reviewed by:

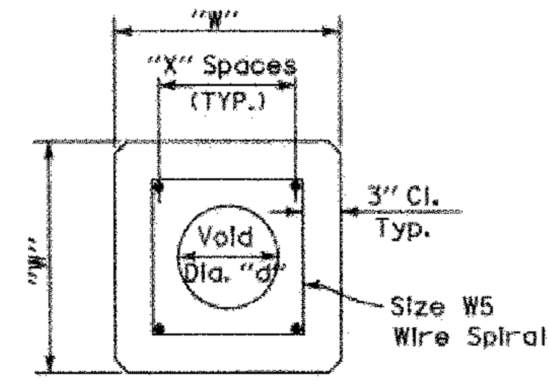
General Remarks: Rosalind Pettaway: Lab #99071-0001 Lab #99071-0002 Lab #99071-0003 Lab #99071-0004 Lab #99071-0005 Lab #99071-0006 Lab #99071-0007 Lab #99071-0008 Lab #99071-0009 Lab #99071-0010Lab #99071-0011 Lab #99071-0012 Lab #99071-0013 Lab #99071-0014 Lab #99071-0015

Disclaimer: All tests are in accordance with applicable AASHTO and ASTM specifications: C-31, C-39, C-143, C-172, C-231, C-1064, and C-1231.



14"-36" SQUARE PILES

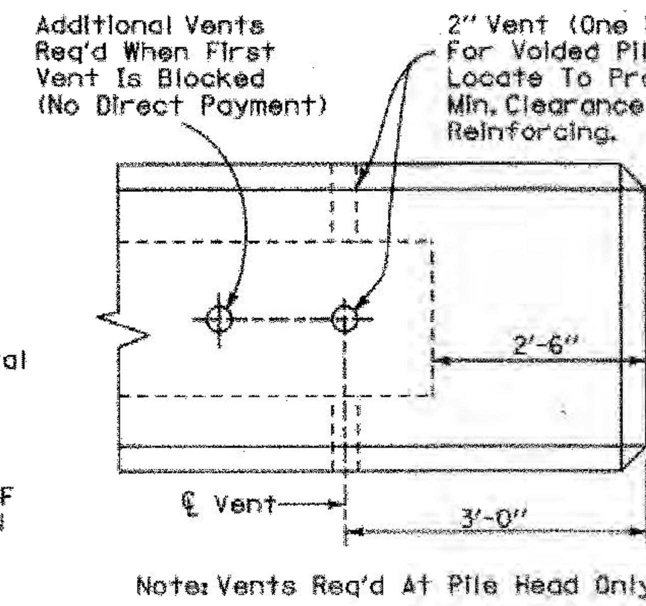
NO SCALE



NOTE:
STRAND PROTECTION: WHEN STRANDS ARE CUT FLUSH WITH END SURFACES OF PILE, THEY SHALL BE PAINTED WITH AN APPROVED EPOXY IMMEDIATELY AFTER CUTTING.

SECTION A-A

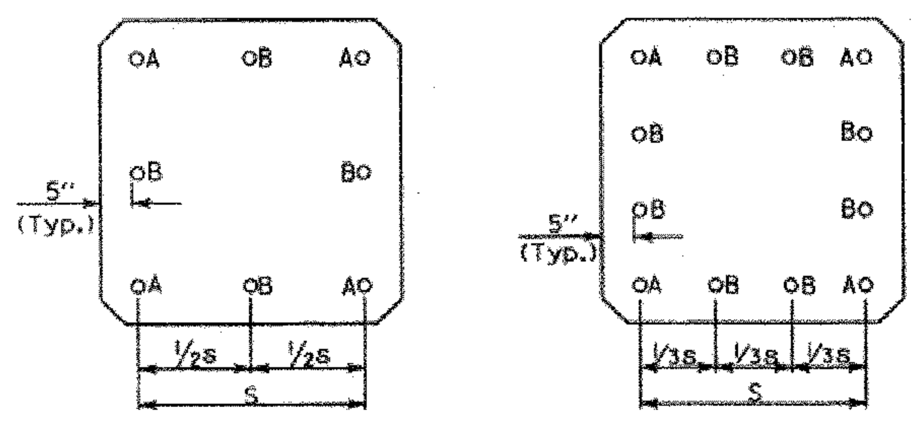
NO SCALE



Note: Vents Req'd At Pile Head Only.

PILE HEAD DETAIL

NO SCALE



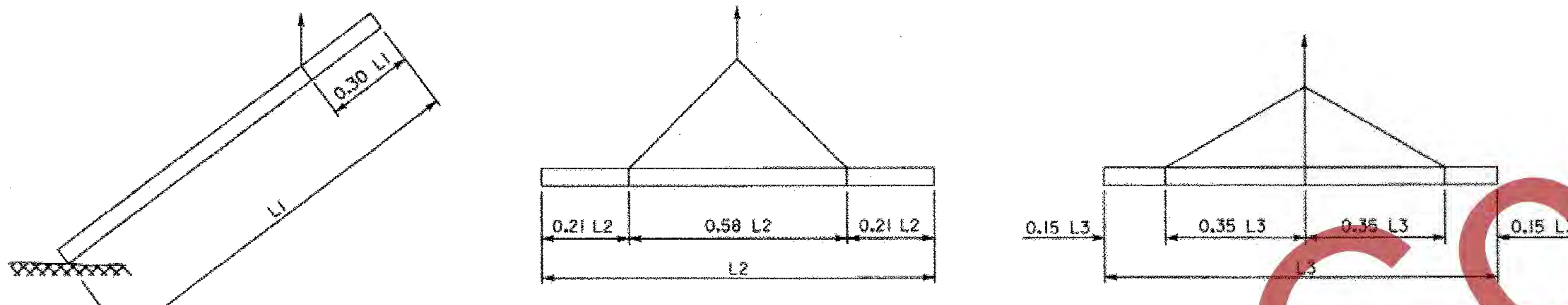
14" THRU 24" PILES

30" & 36" PILES

DOWEL HOLE PATTERN

DOWEL SIZE	D
#4,#6	1"
#7,#8	1 1/4"

PILE SIZE	DOWEL BAR SIZE LOCATION A	DOWEL BAR SIZE LOCATION B
14"	#7	—
16"	#8	—
18"	#8	#4
20"	#8	#6
24"	#8	#6
30"	#8	#7
36"	#8	#8



ONE POINT PICKUP

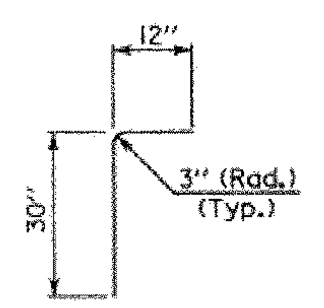
TWO POINT PICKUP

THREE POINT PICKUP

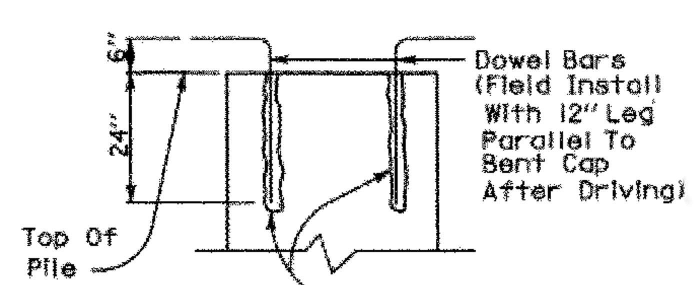
NOTE: Pick-Up Points To Be Plainly Marked On Piles

PICKUP DETAILS

NO SCALE



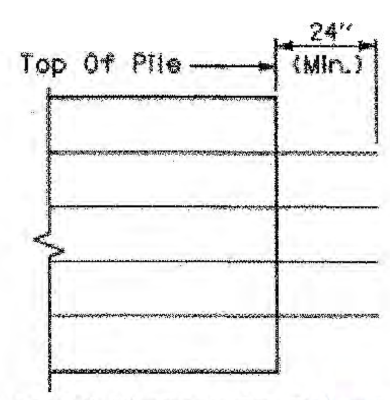
DOWEL BAR DETAIL
(TYP. #4 THRU #8)



NOTE:
Dowel Holes Shall Be Drilled After Driving Is Complete. Holes Shall Be Cleaned Prior To Setting Dowel Bars And Shall Be Free Of Dust, Oil, Water And Other Contaminents. Dowel Bars Shall Be Set Using An Approved Epoxy.

PILE HEAD ATTACHMENT

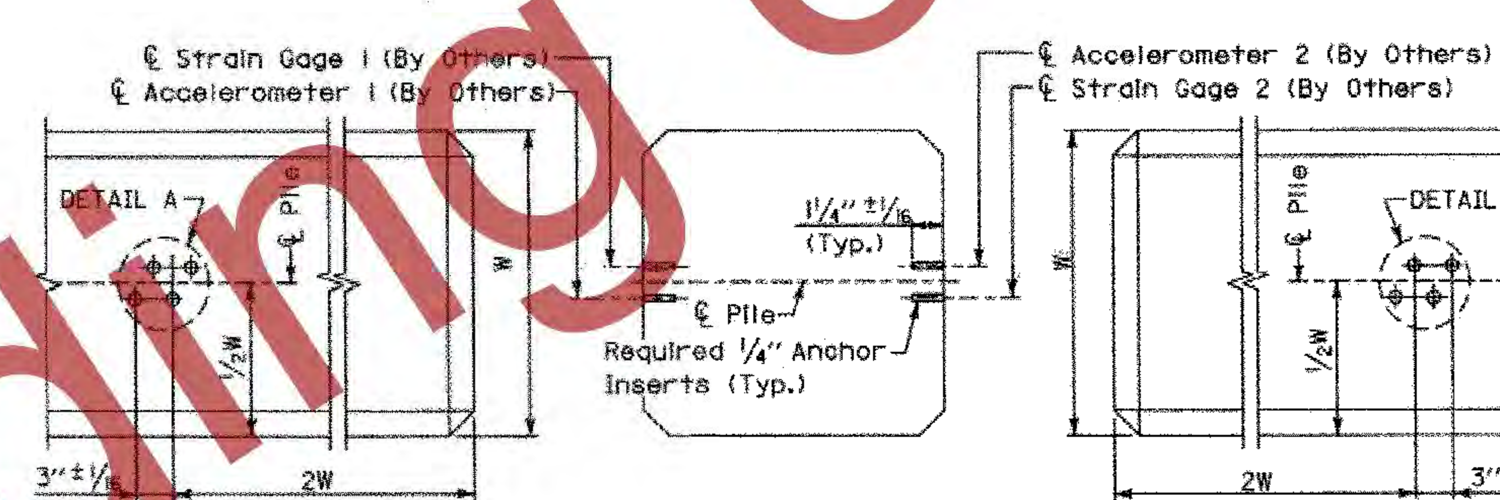
ALTERNATE 'B' (DOWEL BAR EXTENSION)



Prestressed Strands To Extend 24" Beyond Pile Cut-Off To Provide Attachment Of Pile To Bent And Abutment Caps (Typ. 14" Thru 36" Piles)

ALTERNATE 'A' (STRAND EXTENSION)

PILE HEAD ATTACHMENT



* LOCATION OF REQUIRED 1/4" INSERTS

NO SCALE

* 1/4" INSERTS: INSERTS FOR ALDOT MATERIALS & TEST BUREAU USE SHALL BE EITHER CAST INTO OR DRILLED INTO ALL PILING.

GENERAL NOTES

CONCRETE: THE CONTRACTOR SHALL DESIGN AND SUBMIT FOR APPROVAL A CONCRETE MIX WITH MINIMUM COMPRESSIVE CYLINDER STRENGTH OF 5,000 P.S.I. AT 28 DAYS UNLESS SHOWN OTHERWISE ON THE CONTRACT DRAWINGS. CONCRETE STRENGTH AT TIME OF TRANSFER OF PRESTRESSING FORCE SHALL BE 4,000 P.S.I. OR GREATER. CEMENT SHALL BE TYPE II EXCEPT WHEN OTHERWISE NOTED ON THE CONTRACT DRAWINGS, SPECIFICATIONS, OR SPECIAL PROVISIONS.

PRESTRESSING STEEL: STRESSING CABLE SHALL BE 1/2" DIA., SEVEN WIRE, UNCOATED, STRESS-RELIEVED OR LOW RELAXATION, GRADE 270, AND SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M 203. AN INITIAL TENSION OF 28,910 LBS. SHALL BE APPLIED TO EACH STRESS-RELIEVED TYPE STRAND, AND AN INITIAL TENSION OF 30,975 LBS. SHALL BE APPLIED TO EACH LOW-RELAXATION TYPE STRAND.

REINFORCING BARS: REINFORCING STEEL SHALL BE DEFORMED BILLET STEEL BARS, GRADE 60 AND SHALL MEET THE REQUIREMENTS OF AASHTO-M31.

SPIRAL REINFORCING STEEL: SPIRAL REINFORCEMENT SHALL BE SIZE W5(MIN.) COLD-DRAWN STEEL WIRE AND SHALL CONFORM TO AASHTO M-32.

FABRICATION TOLERANCES: MANUFACTURE OF THE PILING AND FABRICATION TOLERANCES SHALL BE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS. THE DETENSIONING PROCEDURE SHALL BE SUBMITTED TO THE BRIDGE ENGINEER FOR APPROVAL.

CHAMFERS AND CORNERS: ON PILES 18" OR SMALLER, ALL EXPOSED CONCRETE CORNERS ARE TO HAVE 3/4" CHAMFERS. ON PILES 20" OR LARGER, ALL EXPOSED CONCRETE CORNERS ARE TO HAVE 1 1/2" CHAMFER. A 1" RAD. CURVE WILL BE PERMITTED IN LIEU OF CHAMFERS SHOWN ABOVE. HOWEVER, ALL BENT PILES FURNISHED SHALL BE OF SAME CONFIGURATION.

PICK-UP AND HANDLING: MAXIMUM LENGTHS FOR PICK-UP HAVE BEEN DETERMINED USING THE FOLLOWING STRESS ASSUMPTIONS:

LOADING: 1 1/2 TIMES FULL DEAD LOAD. ALLOWABLE TENSILE STRESS EQUALS $5\sqrt{f'c}$ PSI. THIS STRESS AND LOADING CRITERIA ARE BASED ON CAREFUL HANDLING OF THE PILE. ROTATION OF PILE IN THE SLING IS TO BE PREVENTED UNTIL PILE IS IN VERTICAL POSITION. PICK-UP POINTS FOR ALL PILES TO BE CLEARLY MARKED ON PILE. PICK-UP POINTS SHOWN MAY BE MODIFIED FOR TRANSPORTATION PURPOSES PROVIDED THE TENSILE STRESS BASED ON ABOVE LOADING CRITERIA DOES NOT EXCEED $5\sqrt{f'c}$ PSI. THE MODIFIED PICK-UP POINTS SHALL BE SENT TO THE BRIDGE DESIGN ENGINEER FOR REVIEW.

PICK-UP DEVICES: CAST-IN-PLACE LOOPS MAY BE USED AS PICK-UP DEVICES FOR PRESTRESSED PILES. FOR PILE ABUTMENTS AND FOR PILE FOOTINGS THAT ARE TO BE CONSTRUCTED BELOW GROUNDLINE, THE FOLLOWING SHALL APPLY: THE LOOPS SHALL BE CUT OFF FLUSH WITH FACE OF THE PILE AND EXPOSED SURFACES OF THE LOOPS SHALL BE COATED WITH AN APPROVED EPOXY. FOR PILE BENTS AND FOR PILE FOOTINGS THAT ARE TO BE CONSTRUCTED ABOVE POOL (WATERLINE), THE FOLLOWING SHALL APPLY: A 3"x3" BY 1 1/2" DEEP RECESS (BLOCKOUT) SHALL BE PROVIDED AT EACH LOOP PROTRUSION. THE LOOPS SHALL BE CUT OFF FLUSH WITH THE RECESSED FACE OF THE PILE AND THE RECESS SHALL BE FILLED WITH AN APPROVED EPOXY. THE EPOXY SHALL OBTAIN THE 28-DAY STRENGTH SPECIFIED FOR THE PILE PRIOR TO DRIVING THE PILE. THE TYPE OF PICK-UP DEVICE TO BE USED BY THE CONTRACTOR SHALL BE CLEARLY SHOWN ON THE PRESTRESSED CONCRETE PILE SHOP DRAWINGS.

SHIPPING: PILING SHALL BE HELD AT THE PLANT FOR A MINIMUM OF 21 DAYS PRIOR TO SHIPPING. PILING SHALL NOT BE TRANSPORTED UNTIL THE MINIMUM 28 DAY COMPRESSIVE CONCRETE STRENGTH IS OBTAINED AND VERIFIED BY TEST CYLINDERS.

DRIVING: PILES SHALL BE DRIVEN TO AT LEAST THE MINIMUM TIP ELEVATION AS SHOWN ON CONTRACT PLANS UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

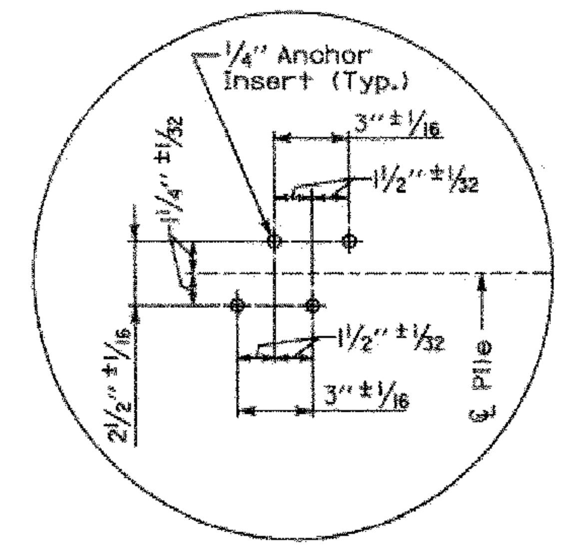
PILE HEAD ATTACHMENT: PROVISION SHALL BE MADE FOR PILE HEAD ATTACHMENT BY STRAND EXTENSION OR DOWEL BAR EXTENSION (SEE DETAIL, THIS SHEET) FOR BENT CAPS, ABUTMENT CAPS, AND FOR PILE FOOTINGS WHENEVER FOOTINGS ARE TO BE CONSTRUCTED ABOVE POOL (WATERLINE). THE CONTRACTOR'S PROPOSED METHOD OF PILE HEAD ATTACHMENT SHALL BE CLEARLY SHOWN ON THE PRESTRESSED CONCRETE PILE SHOP DRAWINGS. A PILE HEAD ATTACHMENT IS NOT REQUIRED FOR PILES IN FOOTINGS TO BE CONSTRUCTED BELOW GROUNDLINE.

BUILD-UP: THE USE OF A BUILD-UP (DRIVING OR NON-DRIVING) SHALL BE SUBJECT TO APPROVAL OF THE BRIDGE ENGINEER. SUBMIT DETAILS TO THE BRIDGE ENGINEER. CONCRETE SHALL BE THE SAME JOB MIX AS THE PRESTRESS CONCRETE.

JETTING OF PILES: JETTING OF PRESTRESSED CONCRETE PILES IS PERMISSIBLE SUBJECT TO SATISFYING THE CONDITIONS STATED IN ARTICLE 505.03(c)2 OF THE STANDARD SPECIFICATIONS. REFERENCE THIS ARTICLE OF THE SPECIFICATIONS FOR JET TUBE INSTALLATION REQUIREMENTS.

PILE PROPERTIES

PILE SIZE "W"	WEIGHT PER. LIN. FT. (Lbs./Ft.)	SECTION MODULUS OF CROSS SECTION (In.³)	AREA OF NORMAL CROSS SECTION (In.²)	VOID DIA. "d"	STRESS RELIEVED STRAND: NO. OF STRANDS	STRAND LAYOUT ("X" SPACES)	INITIAL PRESTRESS (PSI)	MAX. CASTING LENGTH: 1 POINT PICK-UP L1	2 POINT PICK-UP L2	3 POINT PICK-UP L3	LOW RELAXATION STRAND: NO. OF STRANDS	STRAND LAYOUT ("X" SPACES)	INITIAL PRESTRESS (PSI)	MAX. CASTING LENGTH: 1 POINT PICK-UP L1	2 POINT PICK-UP L2	3 POINT PICK-UP L3
14" Solid	204	457	196	0.00"	8	2	1180	60'-0"	85'-0"	121'-0"	8	2	1264	61'-0"	87'-0"	125'-0"
16" Solid	267	683	256	0.00"	8	2	903	58'-0"	83'-0"	118'-0"	8	2	968	60'-0"	84'-0"	121'-0"
18" Solid	338	972	324	0.00"	12	3	1071	66'-0"	93'-0"	133'-0"	12	3	1147	67'-0"	95'-0"	136'-0"
20" Solid	417	1,333	400	0.00"	16	4	1156	71'-0"	101'-0"	144'-0"	12	3	929	66'-0"	93'-0"	134'-0"
24" Voided	510	2,254	489	10.50"	16	4	946	78'-0"	110'-0"	158'-0"	16	4	1013	80'-0"	113'-0"	162'-0"
30" Voided	715	4,257	686	16.50"	24	6	1011	93'-0"	131'-0"	188'-0"	20	5	903	89'-0"	126'-0"	181'-0"
36" Voided	936	7,077	898	22.50"	32	8	1030	105'-0"	149'-0"	213'-0"	28	7	966	103'-0"	145'-0"	208'-0"



DETAIL A

ASSISTANT BRIDGE ENGINEER

BRIDGE ENGINEER

ALABAMA DEPARTMENT OF TRANSPORTATION

THIS SPECIAL PROJECT DRAWING TO BE USED WITH ANY OF THE FOLLOWING STANDARDS

REVISIONS

BRIDGE SPECIAL PROJECT DRAWING
PRECAST PRESTRESSED CONCRETE PILES
14-16-18-20-24-30 & 36 INCHES

ESTIMATED QUANTITIES
COMPUTED BY:
VERIFIED BY:
DESIGNED BY:
SCALE:
CHECKED BY:
DRAWN BY: K.R.T.
DATE CHECKED: 10-19-04
DATE DRAWN: 11-20-91

SPECIAL PROJ. DWG. NO.
PSCP-1
SHEET NO. 1 OF 1

(THIS SPECIAL PROJECT DRAWING FOR USE ON PROJECT NO. IM-I010(341), Mobile & Baldwin COUNTY ONLY)

thompson ENGINEERING — RECORD OF TEST BORING

Site Description:	I-10 Mobile River Bridge and Bayway
County:	Mobile
Boring No.:	TH-10
Boring Location:	470+55.32
Offset:	106.31' RT
Alignment:	I-10 Bayway
ALDOT PE No.:	DPI-0030(005)
TE Project No.:	15-1101-0228
Eng./Geo.:	C.Tisher
Elev.:	12.9 ft.
Northing:	245999.249
Easting:	1797615.33
Date Started:	9/7/2017
Total Depth:	180.0 ft.
Soil Depth:	180.0 ft.
Core Depth:	0.0 ft.
Date Completed:	9/8/2017
Bore Hole Diameter (in):	4-inch
AASHTO / ASTM Sampling Methods:	AASHTO T206 & T207
Drill Machine:	CME 45C
Drill Method:	MR
Hammer Type:	Automatic
Energy Ratio:	86%
Core Size:	N/A
Driller:	Thompson Eng
Groundwater: TOB	1.8 ft.
24 HR	20.0 ft.

Sheet panel 1 (Depth 0.0–30.0 ft)

Material Description	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
Loose, light blue and brown, fine grained, with trace gravel and wood, SILTY SAND (SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=17.8 %#200=18.3	0.0	SS-1	2	4	6	10
Medium dense, reddish brown, fine grained, POORLY GRADED SAND with SILT (SP-SM)	1.5	SS-2	4	8	7	15
Medium dense, pale brown, fine grained, POORLY GRADED SAND with SILT (SP-SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=21.1 %#200=10.9	3.0	SS-3	5	8	6	14
Medium dense, moist, gray	4.5	SS-4	5	6	6	12
Loose	6.0	SS-5	3	4	3	7
Very loose	8.5	SS-6	1	2	1	3
Very soft, moist, dark gray, with trace gravel, SANDY FAT CLAY (CH, A-7-6(14)), LL=55 PL=23 PI=31 NMC=51.7 %#200=54.0	13.5	SS-7	0	0	1	1
Undisturbed sample obtained from 18.0 to 20.0 feet. Approximately 24 inches of recovery. Moist, dark gray and reddish brown, LEAN CLAY with SAND (CL, A-6(15)), LL=39 PL=16 PI=22 NMC=48.7 %#200=73.8	18.0	ST-1				
Medium dense, moist, white, fine to medium grained, POORLY GRADED SAND with SILT (SP-SM, A-3(0)), LL=NP PL=NP PI=NP NMC=26.4 %#200=5.6	23.5	SS-8	9	14	15	29
Medium dense, moist, white and pale brown, fine grained, POORLY GRADED SAND with SILT	28.5	SS-9	8	10	13	23

Sheet panel 2 (Depth 30.0–60.0 ft)

Material Description	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
(SP-SM, A-3(0)), LL=NP PL=NP PI=NP NMC=23.7 %#200=6.9						
Dense, moist, reddish brown, fine grained, POORLY GRADED SILT WITH SAND (SP-SM)	33.5	SS-10	8	17	18	35
Dense, reddish brown and pale brown	38.5	SS-11	9	15	18	33
Dense, moist, red and pale brown, fine to medium grained, POORLY GRADED SAND with SILT (SP-SM, A-3(0)), LL=NP PL=NP PI=NP NMC=22.4 %#200=5.6	43.5	SS-12	9	16	15	31
Medium dense	48.5	SS-13	7	13	16	29
Medium dense, fine grained	53.5	SS-14	12	12	15	27
Medium dense, moist, red and pale brown, fine to medium grained, POORLY GRADED SAND with SILT	58.5	SS-15	6	6	5	11

Sheet panel 3 (Depth 60.0–90.0 ft)

Material Description	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
(SP-SM, A-3(0)), LL=NP PL=NP PI=NP NMC=22.8 %#200=5.2						
Dense, fine grained	63.5	SS-16	7	15	19	34
Medium dense	68.5	SS-17	4	8	8	16
Medium dense, moist, red and pale brown, fine to medium grained, POORLY GRADED SAND (SP, A-3(0)), LL=NP PL=NP PI=NP NMC=19.9 %#200=3.7	73.5	SS-18	10	10	14	24
Dense	78.5	SS-19	12	14	17	31
Medium dense, pale brown and reddish brown, with trace gravel	83.5	SS-20	6	7	10	17
Medium dense, moist, pale brown and reddish brown, fine to medium grained, POORLY GRADED SAND	88.5	SS-21	6	6	7	13

SPT N VALUE (blows/foot); PL — MC — LL; ▲ FINES CONTENT (%) 10 20 30 40 50 60 70 80 90

Elevations: 10.0, 5.0, 0.0, -5.0, -10.0, -15.0, -20.0, -25.0, -30.0, -35.0, -40.0, -45.0, -50.0, -55.0, -60.0, -65.0, -70.0, -75.0

LEGEND

SAMPLER TYPE
SS - Split Spoon; ST - Shelby Tube; DCP - Dynamic Cone Penetrometer; AC - Auger Cuttings; GB - Grab Bag; NQ - Rock Core

DRILLING METHOD
HSA - Hollow Stem Augers; SSA - Solid Stem Augers; HA - Hand Auger; MR - Mud Rotary Wash; RC - Rock Coring

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

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

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

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

APPROVED : SAM STERNBERG III, P.E.
GEOTECHNICAL ENGINEER
DATE :

Preliminary Project No:

TEST BORING RECORD
Sheet 1 of 12

thompson ENGINEERING

RECORD OF TEST BORING

Site Description:	I-10 Mobile River Bridge and Bayway					**County:**	Mobile
Boring No.:	TH-10	**Boring Location:**	470+55.32	**Offset:**	106.31' RT	**Alignment:**	I-10 Bayway
ALDOT PE No.:	DPI-0030(005)	**TE Project No.:**	15-1101-0228			**Eng./Geo.:**	C.Tisher
Elev.:	12.9 ft.	**Northing:**	245999.249	**Easting:**	1797615.33	**Date Started:**	9/7/2017
Total Depth:	180.0 ft.	**Soil Depth:**	180.0 ft.	**Core Depth:**	0.0 ft.	**Date Completed:**	9/8/2017
Bore Hole Diameter (in):	4-inch	**AASHTO / ASTM Sampling Methods:**	AASHTO T206 & T207				
Drill Machine:	CME 45C	**Drill Method:**	MR	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	TOB 1.8 ft.	**24 HR**	20.0 ft.

Depth (ft)	Elevation (ft)	Material Description	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
90.0		(SP, A-3(0)), LL=NP PL=NP PI=NP NMC=24.0 %#200=4.7						
95.0	-80.0	Dense	93.5	SS-22	8	16	21	37
100.0	-85.0	Dense	98.5	SS-23	16	22	24	46
105.0	-90.0	Firm, moist, dark gray, FAT CLAY (CH)	103.5	SS-24	2	3	4	7
110.0	-95.0	Undisturbed sample obtained from 108.0 to 110.0 feet. Approximately 24 inches of recovery. Moist, greenish gray, with trace sand, FAT CLAY (CH, A-7-6(66)), LL=85 PL=23 PI=62 NMC=39.5 %#200=93.7	108.0	ST-2				
115.0	-100.0	Stiff, moist, greenish gray, LEAN CLAY with SAND (CL)	113.5	SS-25	2	5	8	13
120.0	-105.0	Undisturbed sample obtained from 118.0 to 120.0 feet. Approximately 24 inches of recovery. Moist, greenish gray, LEAN CLAY with SAND (CL,	118.0	ST-3				

SPT N VALUE (blows/foot); PL — MC — LL; ▲ FINES CONTENT (%) ▲; 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE: SS - Split Spoon; ST - Shelby Tube; DCP - Dynamic Cone Penetrometer; AC - Auger Cuttings; GB - Grab Bag; NQ - Rock Core

DRILLING METHOD: HSA - Hollow Stem Augers; SSA - Solid Stem Augers; HA - Hand Auger; MR - Mud Rotary Wash; RC - Rock Coring

thompson ENGINEERING

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ALDOT PE No.:	DPI-0030(005)	**TE Project No.:**	15-1101-0228			**Eng./Geo.:**	C.Tisher
Elev.:	12.9 ft.	**Northing:**	245999.249	**Easting:**	1797615.33	**Date Started:**	9/7/2017
Total Depth:	180.0 ft.	**Soil Depth:**	180.0 ft.	**Core Depth:**	0.0 ft.	**Date Completed:**	9/8/2017
Bore Hole Diameter (in):	4-inch	**AASHTO / ASTM Sampling Methods:**	AASHTO T206 & T207				
Drill Machine:	CME 45C	**Drill Method:**	MR	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	TOB 1.8 ft.	**24 HR**	20.0 ft.

Depth (ft)	Elevation (ft)	Material Description	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
120.0		A-6(12)), LL=33 PL=17 PI=16 NMC=30.4 %#200=83.4						
125.0	-110.0	Dense, moist, pale brown, fine to medium grained, SAND (SP), with gravel	123.5	SS-26	9	16	15	31
130.0	-115.0	Dense, pale brown, medium to coarse grained	128.5	SS-27	9	19	18	37
135.0	-120.0	Very dense, moist, pale brown, fine to medium grained, with trace gravel, SILTY SAND (SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=16.9 %#200=13.5	133.5	SS-28	16	37	39	76X
140.0	-125.0	Dense	138.5	SS-29	13	20	22	42
145.0	-130.0	Very dense, with trace gravel	143.5	SS-30	16	28	31	59
150.0	-135.0	Very stiff, moist, bluish gray, SANDY LEAN CLAY (CL, A-6(8)), LL=32 PL=14 PI=17 NMC=22.8	148.5	SS-31	8	11	12	23

SPT N VALUE (blows/foot); PL — MC — LL; ▲ FINES CONTENT (%) ▲; 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE: SS - Split Spoon; ST - Shelby Tube; DCP - Dynamic Cone Penetrometer; AC - Auger Cuttings; GB - Grab Bag; NQ - Rock Core

DRILLING METHOD: HSA - Hollow Stem Augers; SSA - Solid Stem Augers; HA - Hand Auger; MR - Mud Rotary Wash; RC - Rock Coring

thompson ENGINEERING

RECORD OF TEST BORING

Site Description:	I-10 Mobile River Bridge and Bayway					**County:**	Mobile
Boring No.:	TH-10	**Boring Location:**	470+55.32	**Offset:**	106.31' RT	**Alignment:**	I-10 Bayway
ALDOT PE No.:	DPI-0030(005)	**TE Project No.:**	15-1101-0228			**Eng./Geo.:**	C.Tisher
Elev.:	12.9 ft.	**Northing:**	245999.249	**Easting:**	1797615.33	**Date Started:**	9/7/2017
Total Depth:	180.0 ft.	**Soil Depth:**	180.0 ft.	**Core Depth:**	0.0 ft.	**Date Completed:**	9/8/2017
Bore Hole Diameter (in):	4-inch	**AASHTO / ASTM Sampling Methods:**	AASHTO T206 & T207				
Drill Machine:	CME 45C	**Drill Method:**	MR	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	Thompson Eng	**Groundwater:**	TOB 1.8 ft.	**24 HR**	20.0 ft.

Depth (ft)	Elevation (ft)	Material Description	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
150.0		%#200=62.6						
155.0	-140.0							
160.0	-145.0	Hard, moist, bluish gray, FAT CLAY (CH, A-7-6(42)), LL=57 PL=14 PI=43 NMC=18.1 %#200=92.3	158.5	SS-32	9	17	22	39
165.0	-150.0							
170.0	-155.0	Dense, moist, grayish brown, fine to medium grained, with trace clay and trace gravel, SILTY SAND (SM, A-2-4(0)), LL=NP PL=NP NMC=15.1 %#200=19.5	168.5	SS-33	6	18	27	45X
175.0	-160.0							
180.0	-165.0	Very dense, wet, brownish gray, fine grained, POORLY GRADED SAND with SILT (SP-SM)	178.5	SS-34	30	50/6	X	50/6

SPT N VALUE (blows/foot); PL — MC — LL; ▲ FINES CONTENT (%) ▲; 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE: SS - Split Spoon; ST - Shelby Tube; DCP - Dynamic Cone Penetrometer; AC - Auger Cuttings; GB - Grab Bag; NQ - Rock Core

DRILLING METHOD: HSA - Hollow Stem Augers; SSA - Solid Stem Augers; HA - Hand Auger; MR - Mud Rotary Wash; RC - Rock Coring

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

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

APPROVED : SAM STERNBERG III, P.E.
GEOTECHNICAL ENGINEER

Preliminary Project No:

DATE :

TEST BORING RECORD
Sheet 2 of 12

REFERENCE PROJECT NUMBER	FISCAL YEAR	SHEET NUMBER
IM-I010(341)	2018	18

thompson ENGINEERING — RECORD OF TEST BORING

Site Description:	I-10 Mobile River Bridge and Bayway
County:	Mobile
Boring No.:	TH-10
Boring Location:	470+55.32
Offset:	106.31' RT
Alignment:	I-10 Bayway
ALDOT PE No.:	DPI-0030(005)
TE Project No.:	15-1101-0228
Eng./Geo.:	C.Tisher
Elev.:	12.9 ft.
Northing:	245999.249
Easting:	1797615.33
Date Started:	9/7/2017
Total Depth:	180.0 ft.
Soil Depth:	180.0 ft.
Core Depth:	0.0 ft.
Date Completed:	9/8/2017
Bore Hole Diameter (in):	4-inch
AASHTO / ASTM Sampling Methods:	AASHTO T206 & T207
Drill Machine:	CME 45C
Drill Method:	MR
Hammer Type:	Automatic
Energy Ratio:	86%
Core Size:	N/A
Driller:	Thompson Eng
Groundwater: TOB	1.8 ft.
24 HR	20.0 ft.

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		Boring Terminated at 180.0 feet.							
		*Groundwater depth TOB most likely influenced by drilling method.							

● SPT N VALUE (blows/foot); PL —MC— LL; ▲ FINES CONTENT (%); 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE: SS - Split Spoon; ST - Shelby Tube; DCP - Dynamic Cone Penetrometer; AC - Auger Cuttings; GB - Grab Bag; NQ - Rock Core

DRILLING METHOD: HSA - Hollow Stem Augers; SSA - Solid Stem Augers; HA - Hand Auger; MR - Mud Rotary Wash; RC - Rock Coring

thompson ENGINEERING — RECORD OF TEST BORING

Site Description:	I-10 Mobile River Bridge and Bayway
County:	Mobile
Boring No.:	MB-1
Boring Location:	514+25.88
Offset:	18.84' LT
Alignment:	I-10 Main Span
ALDOT PE No.:	DPI-0030(005)
TE Project No.:	15-1101-0228
Eng./Geo.:	B.Ellis/C.Tisher
Elev.:	2.9 ft.
Northing:	249675.65
Easting:	1799417.497
Date Started:	4/20/2016
Total Depth:	300.0 ft.
Soil Depth:	300.0 ft.
Core Depth:	0.0 ft.
Date Completed:	4/27/2016
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	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
0.0		Loose, moist, dark brown, fine to coarse grained, SILTY SAND with GRAVEL (SM)	0.0	SS-1	4	4	4	8
	0.0	Medium dense, wet, dark brown, fine to medium grained, with wood, SILTY SAND with GRAVEL (SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=57.0 %#200=17.6	1.5	SS-2	4	5	7	12
			3.0	SS-3	4	2	2	4
5.0		Very loose, wet, dark brown, fine to coarse grained, POORLY GRADED GRAVEL with SILT and SAND (GP-GM)	4.5	SS-4	2	2	5	7
		Loose, most likely fall in	6.0	SS-5	3	3	3	6
	-5.0	Loose, most likely fall in						
10.0		Very loose, most likely fall in	8.5	SS-6	2	1	1	2
	-10.0							
15.0		Very loose, wet, dark brown, fine to coarse grained, POORLY GRADED GRAVEL with SILT and SAND (GP-GM, A-1-a(0)), LL=NP PL=NP PI=NP NMC=18.9 %#200=10.9	13.5	SS-7	1	2	2	4
	-15.0							
20.0		Loose, wet, gray and brown, fine grained, POORLY GRADED SAND with GRAVEL (SP, A-1-b(0)), LL=NP PL=NP PI=NP NMC=16.9 %#200=4.7	18.5	SS-8	5	5	4	9
	-20.0							
25.0		Loose, dark brown and gray, fine to medium grained	23.5	SS-9	4	5	5	10
	-25.0							
30.0		Medium dense, gray and light gray	28.5	SS-10	8	12	11	23

● SPT N VALUE (blows/foot); PL —MC— LL; ▲ FINES CONTENT (%); 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE: SS - Split Spoon; ST - Shelby Tube; DCP - Dynamic Cone Penetrometer; AC - Auger Cuttings; GB - Grab Bag; NQ - Rock Core

DRILLING METHOD: HSA - Hollow Stem Augers; SSA - Solid Stem Augers; HA - Hand Auger; MR - Mud Rotary Wash; RC - Rock Coring

thompson ENGINEERING — RECORD OF TEST BORING

Site Description:	I-10 Mobile River Bridge and Bayway
County:	Mobile
Boring No.:	MB-1
Boring Location:	514+25.88
Offset:	18.84' LT
Alignment:	I-10 Main Span
ALDOT PE No.:	DPI-0030(005)
TE Project No.:	15-1101-0228
Eng./Geo.:	B.Ellis/C.Tisher
Elev.:	2.9 ft.
Northing:	249675.65
Easting:	1799417.497
Date Started:	4/20/2016
Total Depth:	300.0 ft.
Soil Depth:	300.0 ft.
Core Depth:	0.0 ft.
Date Completed:	4/27/2016
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	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
30.0								
	-30.0							
35.0		Medium dense, wet, yellowish brown and brown, fine grained, POORLY GRADED SAND with GRAVEL (SP, A-3(0)), LL=NP PL=NP PI=NP NMC=28.7 %#200=3.4	33.5	SS-11	6	5	6	11
	-35.0							
40.0		Loose, with trace shells	38.5	SS-12	5	4	5	9
	-40.0							
45.0		Medium dense, wet, pale brown, fine to medium grained, with trace gravel, POORLY GRADED SAND (SP, A-1-b(0)), LL=NP PL=NP PI=NP NMC=22.2 %#200=2.1	43.5	SS-13	4	6	8	14
	-45.0							
50.0		Loose, wet, pale brown, fine to medium grained, POORLY GRADED GRAVEL with SAND (GP, A-1-a(0)), LL=NP PL=NP PI=NP NMC=11.7 %#200=3.1	48.5	SS-14	6	5	4	9
	-50.0							
55.0		Loose, light brown	53.5	SS-15	4	3	4	7
	-55.0							
60.0		Medium dense, wet, pale brown, fine to medium grained, POORLY GRADED SAND with SILT	58.5	SS-16	8	10	6	16

● SPT N VALUE (blows/foot); PL —MC— LL; ▲ FINES CONTENT (%); 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE: SS - Split Spoon; ST - Shelby Tube; DCP - Dynamic Cone Penetrometer; AC - Auger Cuttings; GB - Grab Bag; NQ - Rock Core

DRILLING METHOD: HSA - Hollow Stem Augers; SSA - Solid Stem Augers; HA - Hand Auger; MR - Mud Rotary Wash; RC - Rock Coring

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
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NQ - Rock Core

Alabama Department of Transportation

Bridge Sheet of

thompson ENGINEERING
2970 COTTAGE HILL RD.
MOBILE, AL 36606

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

APPROVED : SAM STERNBERG III, P.E.
GEOTECHNICAL ENGINEER

Preliminary Project No:

DATE :

TEST BORING RECORD
Sheet 3 of 12

REFERENCE PROJECT NUMBER	FISCAL YEAR	SHEET NUMBER
IM-I010(341)	2018	19

thompson ENGINEERING — RECORD OF TEST BORING

Site Description:	I-10 Mobile River Bridge and Bayway
County:	Mobile
Boring No.:	MB-1
Boring Location:	514+25.88
Offset:	18.84' LT
Alignment:	I-10 Main Span
ALDOT PE No.:	DPI-0030(005)
TE Project No.:	15-1101-0228
Eng./Geo.:	B.Ellis/C.Tisher
Elev.:	2.9 ft.
Northing:	249675.65
Easting:	1799417.497
Date Started:	4/20/2016
Total Depth:	300.0 ft.
Soil Depth:	300.0 ft.
Core Depth:	0.0 ft.
Date Completed:	4/27/2016
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	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
60.0		(SP-SM)						
	-60.0	Medium dense, wet, reddish brown and brown, fine to medium grained, POORLY GRADED SAND with SILT (SP-SM, A-3(0)), LL=NP PL=NP PI=NP NMC=19.3 %#200=8.6	63.5	SS-17	6	8	12	20
65.0	-65.0	Very dense, No Recovery	68.5	SS-18	35	50/5	X	50/5
70.0	-70.0	Very dense, light brown	73.5	SS-19	12	28	24	52
75.0	-75.0	Very dense	78.5	SS-20	50	X	X	100+
80.0	-80.0	Medium dense, wet, medium to fine grained, with trace gravel	83.5	SS-21	7	8	7	15
85.0	-85.0	Firm, moist, dark gray, FAT CLAY (CH) NOTE: Sample rods slipped through hoisting ring and	88.5	SS-22	0	0	5	5
90.0								

SPT N VALUE (blows/foot); PL MC LL; ▲ FINES CONTENT (%) 10 20 30 40 50 60 70 80 90

thompson ENGINEERING — RECORD OF TEST BORING

Site Description: I-10 Mobile River Bridge and Bayway; County: Mobile; Boring No.: MB-1; Boring Location: 514+25.88; Offset: 18.84' LT; Alignment: I-10 Main Span; ALDOT PE No.: DPI-0030(005); TE Project No.: 15-1101-0228; Eng./Geo.: B.Ellis/C.Tisher; Elev.: 2.9 ft.; Northing: 249675.65; Easting: 1799417.497; Date Started: 4/20/2016; Total Depth: 300.0 ft.; Soil Depth: 300.0 ft.; Core Depth: 0.0 ft.; Date Completed: 4/27/2016; 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	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
90.0		penetrated the first 12 inches of the sample length. Undisturbed sample obtained from 90.5 to 92.5 feet. Approximately 24 inches of recovery.	90.5	ST-1				
	-90.0	Very stiff, moist, dark grayish brown, with trace sand, FAT CLAY (CH, A-7-6(29)), LL=52 PL=22 PI=31 NMC=40.1 %#200=75.7 Firm	93.5	SS-23	2	4	4	8
95.0	-95.0	Undisturbed sample obtained from 98.5 to 100.5 feet. Approximately 24 inches of recovery. Very stiff, moist, dark brown and light gray, FAT CLAY (CH, A-7-6(71)), LL=89 PL=28 PI=61 NMC=44.0 %#200=99.4	98.5	ST-2				
100.0	-100.0	Very dense, wet, gray and light gray, fine grained, SILTY CLAYEY SAND (SC-SM, A-2-4(0)), LL=21 PL=17 PI=4 NMC=23.9 %#200=26.7	103.5	SS-24	3	20	32	52
105.0	-105.0	Dense, wet, light gray, fine grained, POORLY GRADED SAND (SP)	108.5	SS-25	14	20	28	48
110.0	-110.0	Very dense, wet, light gray, fine to coarse grained, POORLY GRADED SAND (SP, A-1-b(0)), LL=NP PL=NP PI=NP NMC=19.5 %#200=3.3	113.5	SS-26	19	32	33	65
115.0	-115.0	Dense, fine grained, with trace gravel	118.5	SS-27	9	15	23	38
120.0								

thompson ENGINEERING — RECORD OF TEST BORING

Site Description: I-10 Mobile River Bridge and Bayway; County: Mobile; Boring No.: MB-1; Boring Location: 514+25.88; Offset: 18.84' LT; Alignment: I-10 Main Span; ALDOT PE No.: DPI-0030(005); TE Project No.: 15-1101-0228; Eng./Geo.: B.Ellis/C.Tisher; Elev.: 2.9 ft.; Northing: 249675.65; Easting: 1799417.497; Date Started: 4/20/2016; Total Depth: 300.0 ft.; Soil Depth: 300.0 ft.; Core Depth: 0.0 ft.; Date Completed: 4/27/2016; 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	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
120.0	-120.0	Very dense	123.5	SS-28	15	29	28	57
125.0	-125.0	Stiff, moist, gray, with trace sand, FAT CLAY (CH, A-7-6(34)), LL=53 PL=21 PI=32 NMC=23.7 %#200=95.0	128.5	SS-29	4	5	4	9
130.0	-130.0	Medium dense, wet, gray, fine grained, POORLY GRADED SAND with SILT (SP-SM)	133.5	SS-30	3	7	19	26
135.0	-135.0	Medium dense	138.5	SS-31	15	14	15	29
140.0	-140.0	Medium dense	143.5	SS-32	7	8	10	18
145.0	-145.0	Very dense, wet, gray, fine grained, POORLY GRADED SAND with SILT (SP-SM, A-2-4(0)), LL=NP	148.5	SS-33	28	34	27	61
150.0								

LEGEND

SAMPLER TYPE
SS - Split Spoon; ST - Shelby Tube; DCP - Dynamic Cone Penetrometer; AC - Auger Cuttings; GB - Grab Bag; NQ - Rock Core

DRILLING METHOD
HSA - Hollow Stem Augers; SSA - Solid Stem Augers; HA - Hand Auger; MR - Mud Rotary Wash; RC - Rock Coring

STRATA SYMBOLS

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

Bridge Sheet of

thompson ENGINEERING
2970 COTTAGE HILL RD.
MOBILE, AL 36606

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

APPROVED : SAM STERNBERG III, P.E.
GEOTECHNICAL ENGINEER

Preliminary Project No:

DATE :

TEST BORING RECORD
Sheet 4 of 12

thompson ENGINEERING — RECORD OF TEST BORING

Site Description: I-10 Mobile River Bridge and Bayway		County: Mobile	
Boring No.: MB-1	Boring Location: 514+25.88	Offset: 18.84' LT	Alignment: I-10 Main Span
ALDOT PE No.: DPI-0030(005)	TE Project No.: 15-1101-0228		Eng./Geo.: B.Ellis/C.Tisher
Elev.: 2.9 ft.	Northing: 249675.65	Easting: 1799417.497	Date Started: 4/20/2016
Total Depth: 300.0 ft.	Soil Depth: 300.0 ft.	Core Depth: 0.0 ft.	Date Completed: 4/27/2016
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	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
150.0		PL=NP PI=NP NMC=22.5 %#200=10.5						
155.0	-150.0	Undisturbed sample obtained from 153.5 to 155.5 feet. Approximately 24 inches of recovery. With trace clay	153.5	ST-3				
160.0	-155.0	Very dense	158.5	SS-34	26	24	32	56
165.0	-160.0	Very dense, wet, greenish gray, fine grained, with trace gravel, POORLY GRADED SAND with SILT (SP-SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=23.8 %#200=11.5	163.5	SS-35	23	47	50+	100
170.0	-165.0	Dense, wet, greenish gray, fine grained, CLAYEY SAND (SC, A-6(7)), LL=36 PL=13 PI=24 NMC=23.2 %#200=48.4	168.5	SS-36	11	19	18	37
175.0	-170.0	Dense, wet, gray, fine grained, POORLY GRADED SAND with SILT (SP-SM)	173.5	SS-37	11	18	25	43
180.0	-175.0	Dense	178.5	SS-38	16	19	20	39

SPT N VALUE (blows/foot) ● — PL MC LL — ▲ FINES CONTENT (%) 10 20 30 40 50 60 70 80 90

thompson ENGINEERING — RECORD OF TEST BORING

Site Description: I-10 Mobile River Bridge and Bayway		County: Mobile	
Boring No.: MB-1	Boring Location: 514+25.88	Offset: 18.84' LT	Alignment: I-10 Main Span
ALDOT PE No.: DPI-0030(005)	TE Project No.: 15-1101-0228		Eng./Geo.: B.Ellis/C.Tisher
Elev.: 2.9 ft.	Northing: 249675.65	Easting: 1799417.497	Date Started: 4/20/2016
Total Depth: 300.0 ft.	Soil Depth: 300.0 ft.	Core Depth: 0.0 ft.	Date Completed: 4/27/2016
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	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
180.0								
185.0	-180.0	Very dense, wet, gray, fine grained, POORLY GRADED SAND with SILT (SP-SM, A-3(0)), LL=NP PL=NP PI=NP NMC=26.5 %#200=9.7	183.5	SS-39	43	41	29	70
190.0	-185.0	Undisturbed sample obtained from 188.5 to 190.5 feet. Approximately 24 inches of recovery. Hard, wet, bluish gray, SANDY LEAN CLAY (CL, A-6(6)), LL=28 PL=14 PI=14 NMC=17.8 %#200=62.9	188.5	ST-4				
195.0	-190.0	Hard, wet, bluish gray, with trace sand, LEAN CLAY (CL, A-7-6(29)), LL=46 PL=16 PI=30 NMC=21.0 %#200=91.7	193.5	SS-40	12	14	21	35
200.0	-195.0	Hard	198.5	SS-41	22	18	20	38
205.0	-200.0							
210.0	-205.0	Hard, wet, bluish gray, with trace sand, LEAN CLAY (CL, A-6(21)), LL=39 PL=15 PI=24 NMC=17.0	208.5	SS-42	12	15	17	32

thompson ENGINEERING — RECORD OF TEST BORING

Site Description: I-10 Mobile River Bridge and Bayway		County: Mobile	
Boring No.: MB-1	Boring Location: 514+25.88	Offset: 18.84' LT	Alignment: I-10 Main Span
ALDOT PE No.: DPI-0030(005)	TE Project No.: 15-1101-0228		Eng./Geo.: B.Ellis/C.Tisher
Elev.: 2.9 ft.	Northing: 249675.65	Easting: 1799417.497	Date Started: 4/20/2016
Total Depth: 300.0 ft.	Soil Depth: 300.0 ft.	Core Depth: 0.0 ft.	Date Completed: 4/27/2016
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	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
210.0		%#200=88.7						
215.0	-210.0							
220.0	-215.0	Very dense, wet, bluish gray, fine grained, SILTY SAND (SM)	218.5	SS-43	23	33	48	81
225.0	-220.0							
230.0	-225.0	Dense, gray	228.5	SS-44	6	13	19	32
235.0	-230.0							
240.0	-235.0	Loose, wet, gray, fine grained, SILTY SAND (SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=25.3	238.5	SS-45	4	4	4	8

LEGEND

SAMPLER TYPE: SS - Split Spoon; ST - Shelby Tube; DCP - Dynamic Cone Penetrometer; AC - Auger Cuttings; GB - Grab Bag; NQ - Rock Core

DRILLING METHOD: HSA - Hollow Stem Augers; SSA - Solid Stem Augers; HA - Hand Auger; MR - Mud Rotary Wash; RC - Rock Coring

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

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

APPROVED : SAM STERNBERG III, P.E.
GEOTECHNICAL ENGINEER
DATE :

Preliminary Project No:

TEST BORING RECORD
Sheet 5 of 12

REFERENCE PROJECT NUMBER	FISCAL YEAR	SHEET NUMBER
IM-I010(341)	2018	21

thompson ENGINEERING

RECORD OF TEST BORING

Site Description:	I-10 Mobile River Bridge and Bayway					County:	Mobile
Boring No.:	MB-1	Boring Location:	514+25.88	Offset:	18.84' LT	Alignment:	I-10 Main Span
ALDOT PE No.:	DPI-0030(005)	TE Project No.:	15-1101-0228			Eng./Geo.:	B.Ellis/C.Tisher
Elev.:	2.9 ft.	Northing:	249675.65	Easting:	1799417.497	Date Started:	4/20/2016
Total Depth:	300.0 ft.	Soil Depth:	300.0 ft.	Core Depth:	0.0 ft.	Date Completed:	4/27/2016
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	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
240.0		%#200=28.0						
245.0	-240.0							
250.0	-245.0	Medium dense	248.5	SS-46	5	10	11	21
255.0	-250.0							
260.0	-255.0	Very dense, wet, gray, fine grained, POORLY GRADED SAND with SILT (SP-SM)	258.5	SS-47	30	50/0	X	50/0
265.0	-260.0							
270.0	-265.0	Very dense, with trace gravel	268.5	SS-48	43	50	X	50/6

● SPT N VALUE (blows/foot)
PL MC LL
▲ FINES CONTENT (%) ▲
10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
DCP - Dynamic Cone Penetrometer
AC - Auger Cuttings
GB - Grab Bag
NQ - Rock Core

DRILLING METHOD
HSA - Hollow Stem Augers
SSA - Solid Stem Augers
HA - Hand Auger
MR - Mud Rotary Wash
RC - Rock Coring

thompson ENGINEERING

RECORD OF TEST BORING

Site Description:	I-10 Mobile River Bridge and Bayway					County:	Mobile
Boring No.:	MB-1	Boring Location:	514+25.88	Offset:	18.84' LT	Alignment:	I-10 Main Span
ALDOT PE No.:	DPI-0030(005)	TE Project No.:	15-1101-0228			Eng./Geo.:	B.Ellis/C.Tisher
Elev.:	2.9 ft.	Northing:	249675.65	Easting:	1799417.497	Date Started:	4/20/2016
Total Depth:	300.0 ft.	Soil Depth:	300.0 ft.	Core Depth:	0.0 ft.	Date Completed:	4/27/2016
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	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
270.0								
275.0	-270.0							
280.0	-275.0	Very dense	278.5	SS-49	24	50/4	X	50/4
285.0	-280.0							
290.0	-285.0	Very dense, wet, light gray, fine grained, with trace gravel, POORLY GRADED SAND with SILT (SP-SM, A-2-4(0)), LL=NP PL=NP PI=NP NMC=21.1 %#200=10.9	288.5	SS-50	43	41	49	90
295.0	-290.0							
300.0	-295.0	Very dense, gray, with trace clay	298.5	SS-51	25	50	X	50/6

● SPT N VALUE (blows/foot)
PL MC LL
▲ FINES CONTENT (%) ▲
10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
DCP - Dynamic Cone Penetrometer
AC - Auger Cuttings
GB - Grab Bag
NQ - Rock Core

DRILLING METHOD
HSA - Hollow Stem Augers
SSA - Solid Stem Augers
HA - Hand Auger
MR - Mud Rotary Wash
RC - Rock Coring

thompson ENGINEERING

RECORD OF TEST BORING

Site Description:	I-10 Mobile River Bridge and Bayway					County:	Mobile
Boring No.:	MB-1	Boring Location:	514+25.88	Offset:	18.84' LT	Alignment:	I-10 Main Span
ALDOT PE No.:	DPI-0030(005)	TE Project No.:	15-1101-0228			Eng./Geo.:	B.Ellis/C.Tisher
Elev.:	2.9 ft.	Northing:	249675.65	Easting:	1799417.497	Date Started:	4/20/2016
Total Depth:	300.0 ft.	Soil Depth:	300.0 ft.	Core Depth:	0.0 ft.	Date Completed:	4/27/2016
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	Sample Depth (ft.)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		Boring Terminated at 300.0 feet.						

● SPT N VALUE (blows/foot)
PL MC LL
▲ FINES CONTENT (%) ▲
10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
DCP - Dynamic Cone Penetrometer
AC - Auger Cuttings
GB - Grab Bag
NQ - Rock Core

DRILLING METHOD
HSA - Hollow Stem Augers
SSA - Solid Stem Augers
HA - Hand Auger
MR - Mud Rotary Wash
RC - Rock Coring

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

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

APPROVED : SAM STERNBERG III, P.E.
GEOTECHNICAL ENGINEER
DATE :

Preliminary Project No:
TEST BORING RECORD
Sheet 6 of 12

Appendix C
Calibrations

Report of Bi-Directional Load Testing
I-10 Mobile River Bridge
AFT Project No. 518009
Mobile, Alabama

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 230 mm

Serial Number: 1744921

Calibration Instruction: CI-4400

Cable Length: N/A

Calibration Date: February 07, 2018

This calibration has been verified/validated as of 02/09/2018

Temperature: 21.3 °C

Technician: Kathy Rogers

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2621	2619	2620	-0.38	-0.17	-0.05	-0.02
46.0	3593	3592	3593	46.20	0.09	46.15	0.06
92.0	4549	4552	4551	92.09	0.04	91.85	-0.07
138.0	5515	5516	5516	138.31	0.14	138.08	0.03
184.0	6471	6468	6470	184.01	0.00	183.96	-0.02
230.0	7424	7422	7423	229.68	-0.14	230.01	0.01

(mm) Linear Gage Factor (G): 0.04790 **(mm/ digit)**

Regression Zero: 2628

Polynomial Gage Factors: **A:** 1.0301E-07 **B:** 0.04687 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001886 **(inches/digit)**

Polynomial Gage Factors: **A:** 4.0556E-09 **B:** 0.001845 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear, $D = G(R_1 - R_0)$**

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 230 mm

Serial Number: 1744922

Calibration Instruction: CI-4400

Cable Length: N/A

Calibration Date: February 07, 2018

This calibration has been verified/validated as of 02/09/2018

Temperature: 21.3 °C

Technician: [signature]

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2665	2664	2665	-0.50	-0.22	-0.06	-0.03
46.0	3652	3650	3651	46.21	0.09	46.12	0.05
92.0	4625	4625	4625	92.33	0.14	91.98	-0.01
138.0	5598	5595	5597	138.33	0.14	137.98	-0.01
184.0	6562	6561	6562	184.02	0.01	183.93	-0.03
230.0	7526	7523	7525	229.61	-0.17	230.05	0.02

(mm) Linear Gage Factor (G): 0.04735 **(mm/ digit)** **Regression Zero:** 2675

Polynomial Gage Factors: **A:** 1.3753E-07 **B:** 0.04595 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001864 **(inches/digit)**

Polynomial Gage Factors: **A:** 5.4145E-09 **B:** 0.001809 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear, $D = G(R_1 - R_0)$**

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 230 mm

Serial Number: 1741940

Calibration Instruction: CI-4400

Cable Length: N/A

Calibration Date: December 01, 2017

This calibration has been verified/validated as of 01/08/2018

Temperature: 22.6 °C

Technician: Kathy Rogers

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2617	2617	2617	-0.39	-0.17	-0.05	-0.02
46.0	3566	3565	3566	46.16	0.07	46.09	0.04
92.0	4506	4506	4506	92.33	0.14	92.04	0.02
138.0	5440	5439	5440	138.15	0.06	137.87	-0.06
184.0	6376	6376	6376	184.12	0.05	184.05	0.02
230.0	7305	7303	7304	229.67	-0.14	230.01	0.00

(mm) Linear Gage Factor (G): 0.04908 **(mm/ digit)**

Regression Zero: 2625

Polynomial Gage Factors: **A:** 1.1828E-07 **B:** 0.04791 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001932 **(inches/digit)**

Polynomial Gage Factors: **A:** 4.6565E-09 **B:** 0.001886 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear, $D = G(R_1 - R_0)$**

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 230 mm

Serial Number: 1741941

Calibration Instruction: CI-4400

Cable Length: N/A

Calibration Date: December 01, 2017

This calibration has been verified/validated as of 01/08/2018

Temperature: 22.6 °C

Technician: Kathy Rogers

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2747	2745	2746	-0.39	-0.17	-0.05	-0.02
46.0	3711	3709	3710	46.16	0.07	46.07	0.03
92.0	4667	4667	4667	92.36	0.16	92.06	0.03
138.0	5617	5616	5617	138.20	0.09	137.91	-0.04
184.0	6567	6566	6567	184.07	0.03	183.98	-0.01
230.0	7512	7511	7512	229.69	-0.13	230.03	0.01

(mm) Linear Gage Factor (G): 0.04828 **(mm/ digit)** **Regression Zero:** 2754

Polynomial Gage Factors: **A:** 1.1683E-07 **B:** 0.04708 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001901 **(inches/digit)**

Polynomial Gage Factors: **A:** 4.5996E-09 **B:** 0.001854 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear, $D = G(R_1 - R_0)$**

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 230 mm

Serial Number: 1741942

Calibration Instruction: CI-4400

Cable Length: N/A

Calibration Date: December 01, 2017

This calibration has been verified/validated as of 01/08/2018

Temperature: 22.6 °C

Technician: Kathy Rogers

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2743	2740	2742	-0.26	-0.11	0.01	0.00
46.0	3707	3706	3707	46.02	0.01	45.98	-0.01
92.0	4671	4668	4670	92.22	0.09	92.01	0.01
138.0	5629	5628	5629	138.21	0.09	138.01	0.01
184.0	6583	6584	6584	184.02	0.01	183.98	-0.01
230.0	7537	7536	7537	229.73	-0.12	230.01	0.00

(mm) Linear Gage Factor (G): 0.04797 **(mm/ digit)** **Regression Zero:** 2747

Polynomial Gage Factors: **A:** 8.5684E-08 **B:** 0.04709 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001888 **(inches/digit)**

Polynomial Gage Factors: **A:** 3.3734E-09 **B:** 0.001854 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear, $D = G(R_1 - R_0)$**

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 230 mm

Serial Number: 1741943

Calibration Instruction: CI-4400

Cable Length: N/A

Calibration Date: December 01, 2017

This calibration has been verified/validated as of 01/08/2018

Temperature: 22.6 °C

Technician: [signature]

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2774	2774	2774	-0.34	-0.15	0.02	0.01
46.0	3742	3740	3741	46.03	0.01	45.94	-0.03
92.0	4708	4707	4708	92.38	0.17	92.06	0.03
138.0	5665	5665	5665	138.29	0.13	137.98	-0.01
184.0	6620	6620	6620	184.09	0.04	184.00	0.00
230.0	7571	7569	7570	229.64	-0.15	230.00	0.00

(mm) Linear Gage Factor (G): 0.04795 **(mm/ digit)** **Regression Zero:** 2781

Polynomial Gage Factors: **A:** 1.2191E-07 **B:** 0.04669 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001888 **(inches/digit)**

Polynomial Gage Factors: **A:** 4.7997E-09 **B:** 0.001838 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear, $D = G(R_1 - R_0)$**

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 230 mm

Serial Number: 1739566

Calibration Instruction: CI-4400

Cable Length: N/A

Calibration Date: November 07, 2017

This calibration has been verified/validated as of 11/07/2017

Temperature: 21.8 °C

Technician: Kathy Rogers

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2736	2735	2736	-0.36	-0.16	-0.02	-0.01
46.0	3696	3699	3698	46.12	0.05	46.04	0.02
92.0	4654	4653	4654	92.32	0.14	92.03	0.01
138.0	5601	5605	5603	138.20	0.09	137.91	-0.04
184.0	6553	6554	6554	184.13	0.06	184.05	0.02
230.0	7495	7496	7496	229.65	-0.15	229.99	0.00

(mm) Linear Gage Factor (G): 0.04832 **(mm/ digit)** **Regression Zero:** 2743

Polynomial Gage Factors: **A:** 1.1617E-07 **B:** 0.04713 **C:** ________

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001902 **(inches/digit)**

Polynomial Gage Factors: **A:** 4.5735E-09 **B:** 0.001856 **C:** ________

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear,** $D = G(R_1 - R_0)$

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Displacement Transducer Calibration Report

Range: 230 mm

Serial Number: 1739567

Calibration Instruction: CI-4400

Cable Length: N/A

Calibration Date: November 07, 2017

This calibration has been verified/validated as of 11/07/2017

Temperature: 21.8 °C

Technician: *Kathy Rogers*

GK-401 Reading Position B

Actual Displacement (mm)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Displacement (Linear)	Error Linear (%FS)	Calculated Displacement (Polynomial)	Error Polynomial (%FS)
0.0	2416	2417	2417	-0.32	-0.14	0.03	0.01
46.0	3371	3370	3371	46.06	0.02	45.99	0.00
92.0	4319	4321	4320	92.21	0.09	91.94	-0.02
138.0	5266	5267	5267	138.22	0.09	137.95	-0.02
184.0	6212	6214	6213	184.23	0.10	184.17	0.07
230.0	7146	7146	7146	229.58	-0.18	229.92	-0.04

(mm) Linear Gage Factor (G): 0.04861 **(mm/ digit)** **Regression Zero:** 2423

Polynomial Gage Factors: **A:** 1.1333E-07 **B:** 0.04752 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

(inches) Linear Gage Factor (G): 0.001914 **(inches/digit)**

Polynomial Gage Factors: **A:** 4.4618E-09 **B:** 0.001871 **C:** ______

Calculate C by setting D = 0 and R_1 = initial field zero reading into the polynomial equation

Calculated Displacement: **Linear, $D = G(R_1 - R_0)$**

Polynomial, $D = AR_1^2 + BR_1 + C$

Refer to manual for temperature correction information.

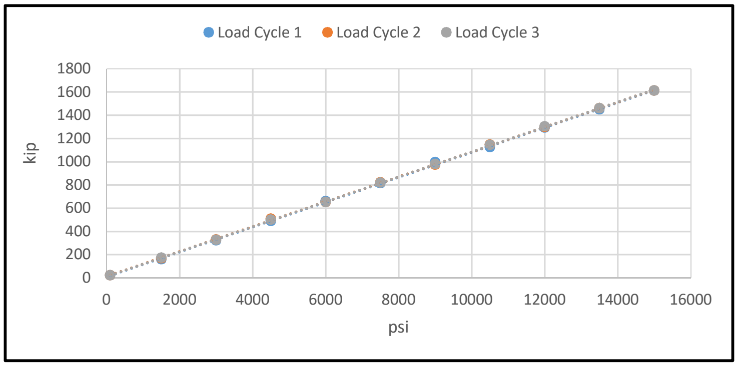
The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

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

AFT-Cell®
Calibration Report

Calibration Date	3/2/2018	**Description**	15 inch AFT-Cell
		Model	AFT-Cell® Model 15
Technician	Lee Johns	**Serial Number**	AFT15-016
Ambient	77.7	**Uni-Directional Range**	1695 kip
		Bi-Directional Equivalent Range	3390 kip

Held in Readiness prior to installation. Calibration interval is 6 months after release used as a reusable jack



Calibrating Equipment		
Item	**Description**	**Serial**
Pressure Reference	Ashcroft 20kpsi	1785041
Load Reference	22MN Load Cell	C3929-13
Data Acquisition	NI 9219	148B699
Load Frame	HULC 10000 kip	N/A

Load Cycle 1		Load Cycle 2		Load Cycle 3		
Stroke (in):	2.00	**Stroke (in):**	4.00	**Stroke (in):**	5.00	
Reference (kip)	**Pressure (psig)**	**Reference (kip)**	**Pressure (psig)**	**Reference (kip)**	**Pressure (psig)**	**Nonlinearity (%)**
22	100	21	100	21	100	-0.01%
160	1500	169	1500	173	1500	0.67%
323	3000	329	3000	326	3000	0.57%
488	4500	508	4500	501	4500	0.29%
661	6000	652	6000	651	6000	-0.38%
815	7500	822	7500	819	7500	-0.02%
997	9000	974	9000	979	9000	-1.23%
1125	10500	1146	10500	1143	10500	0.67%
1292	12000	1298	12000	1304	12000	0.30%
1450	13500	1460	13500	1460	13500	0.49%
1612	15000	1613	15000	1613	15000	0.44%

Comments:

Linear Jack Factor	**0.1072**	**kip/psig**
Regression Zero	**10.9649**	**kip**
Maximum Nonlinearity	**-1.23%**	

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

Technician:

Approved:

Applied Foundation Testing, Inc.
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Green Cove Springs, Fl 32043
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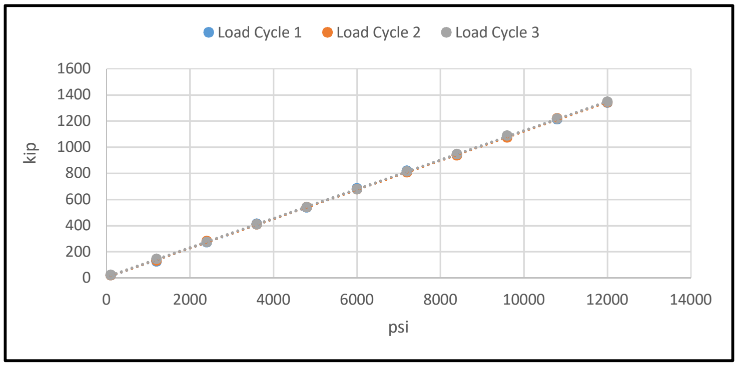
AFT-Cell®
Calibration Report

Calibration Date	2/2/2018	**Description**	Low Pressure 15" AFT-Cell
		Model	AFT-Cell® Model 15LP
Technician	Ryan Wendlandt	**Serial Number**	AFT15LP-008
Ambient	63.0° F	**Uni-Directional Range**	1300 kip
		Bi-Directional Equivalent Range	2600 kip



Calibrating Equipment		
Item	**Description**	**Serial**
Pressure Gauge	20000 PSIG	1785041
Load Reference	40MN	C4027-12
Data Acquisition	NI 9219	1A4225C
Load Frame	HULC 10000 kip	N/A

Load Cycle 1		**Load Cycle 2**		**Load Cycle 3**		
Stroke (in):	2.00	**Stroke (in):**	4.00	**Stroke (in):**	5.00	
Reference (kip)	**Pressure (psig)**	**Reference (kip)**	**Pressure (psig)**	**Reference (kip)**	**Pressure (psig)**	**Nonlinearity (%)**
19	100	19	100	22	100	-0.16%
125	1200	131	1200	144	1200	1.19%
272	2400	281	2400	275	2400	0.19%
412	3600	409	3600	409	3600	-0.32%
537	4800	540	4800	540	4800	0.41%
684	6000	678	6000	678	6000	-0.59%
819	7200	806	7200	815	7200	-0.60%
940	8400	937	8400	946	8400	0.37%
1081	9600	1074	9600	1087	9600	-0.15%
1212	10800	1221	10800	1218	10800	0.09%
1340	12000	1343	12000	1346	12000	0.56%

Comments:

Linear Jack Factor	**0.1118**	**kip/psig**
Regression Zero	**5.9917**	**kip**
Maximum Nonlinearity	**1.19%**	

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

Technician:

Approved:

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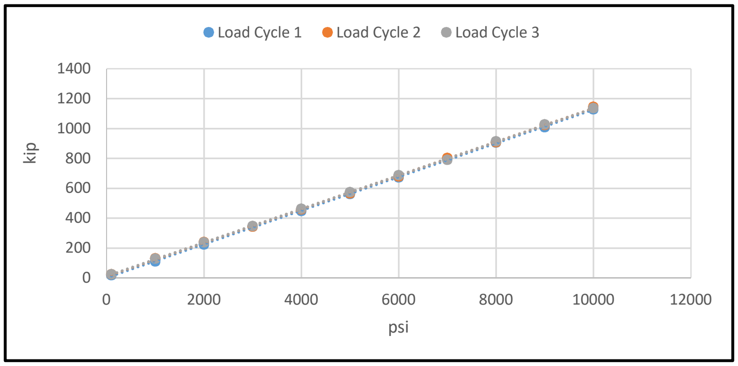
AFT-Cell®
Calibration Report

Calibration Date	2/15/2018	**Description**	Low Pressure 15" AFT-Cell
		Model	AFT-Cell® Model 15.0
Technician	Chan	**Serial Number**	AFT15LP-009
Ambient	63.3° F	**Uni-Directional Range**	1695 kip
		Bi-Directional Equivalent Range	3390 kip



Calibrating Equipment		
Item	**Description**	**Serial**
Pressure Gauge	20000 PSIG	1785041
Load Reference	40MN	C4027-12
Data Acquisition	NI 9219	1A4225C
Load Frame	HULC 10000 kip	N/A

Load Cycle 1		Load Cycle 2		Load Cycle 3		
Stroke (in):	2.00	**Stroke (in):**	4.00	**Stroke (in):**	5.00	
Reference (kip)	**Pressure (psig)**	**Reference (kip)**	**Pressure (psig)**	**Reference (kip)**	**Pressure (psig)**	**Nonlinearity (%)**
18	100	22	100	24	100	0.06%
110	1000	130	1000	128	1000	0.63%
221	2000	240	2000	238	2000	0.66%
342	3000	342	3000	347	3000	0.19%
447	4000	459	4000	461	4000	0.63%
561	5000	564	5000	573	5000	0.56%
673	6000	679	6000	688	6000	0.58%
798	7000	803	7000	789	7000	-0.18%
905	8000	907	8000	913	8000	0.12%
1008	9000	1023	9000	1027	9000	0.71%
1127	10000	1145	10000	1137	10000	0.33%

Comments:

Linear Jack Factor	**0.1125**	**kip/psig**
Regression Zero	**7.7244**	**kip**
Maximum Nonlinearity	**0.71%**	

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

Technician:

Approved:

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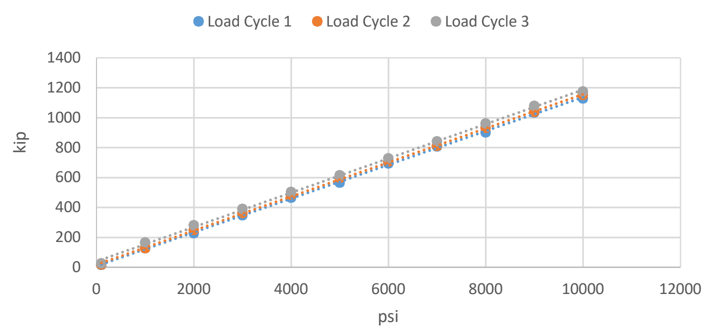
AFT-Cell®
Calibration Report

Calibration Date	2/14/2018	**Description**	Low Pressure 15" AFT-Cell
		Model	AFT-Cell® Model 15.0
Technician	Chan	**Serial Number**	AFT15LP-010
Ambient	63.3° F	**Uni-Directional Range**	1695 kip
		Bi-Directional Equivalent Range	3390 kip



Calibrating Equipment

Item	Description	Serial
Pressure Gauge	20000 PSIG	1785041
Load Reference	40MN	C4027-12
Data Acquisition	NI 9219	1A4225C
Load Frame	HULC 10000 kip	N/A

Load Cycle 1		Load Cycle 2		Load Cycle 3		
Stroke (in):	2.00	Stroke (in):	4.00	Stroke (in):	5.00	
Reference (kip)	**Pressure (psig)**	**Reference (kip)**	**Pressure (psig)**	**Reference (kip)**	**Pressure (psig)**	**Nonlinearity (%)**
15	100	18	100	25	100	1.04%
127	1000	127	1000	165	1000	0.52%
227	2000	248	2000	280	2000	1.29%
346	3000	362	3000	389	3000	0.99%
464	4000	484	4000	502	4000	0.79%
565	5000	596	5000	613	5000	1.55%
694	6000	705	6000	728	6000	0.64%
807	7000	812	7000	841	7000	0.67%
900	8000	930	8000	960	8000	1.91%
1034	9000	1037	9000	1078	9000	0.72%
1128	10000	1151	10000	1174	10000	1.89%

Comments:

Linear Jack Factor	0.1138	kip/psig
Regression Zero	21.6095	kip
Maximum Nonlinearity	1.91%	

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

Technician:

Approved:

MICRO-MEASUREMENTS

FOR COMPLETE TECHNICAL DATA, VISIT WWW.VISHAYPG.COM

GRID RESISTANCE IN OHMS	TC OF GAGE FACTOR, %/100°C
350.0±0.3%	(+1.2±0.2)

GRID	GAGE FACTOR @ 24°C	TRANSVERSE SENSITIVITY
1	2.175±0.5%	(+0.7±0.2)%
2		
3		
NOM		

THERMAL OUTPUT COEFFICIENTS FOR 1018 STEEL @ G.F. OF 2.00

ORDER	FAHRENHEIT	CELSIUS
0	-1.67E+2	-6.16E+1
1	+4.27E+0	+4.29E+0
2	-3.35E-2	-8.27E-2
3	+8.97E-5	+4.50E-4
4	-1.02E-7	-9.72E-7
5	+5.97E-11	+1.13E-9

FOIL LOT NUMBER

A86AD904

WORK ORDER NUMBER

03190043

30953042

ITEM CODE	QTY 1 PK	CODE	RoHS COMPLIANT
MMF003166	**(5 pcs)**	**201512US**	

COUNTRY OF ORIGIN USA

CEA-06-125UW-350

Appendix D

Analysis Method Supplement

Report of Bi-Directional Load Testing

I-10 Mobile River Bridge
AFT Project No. 518009
Mobile, Alabama

Guide to Calculations and Analysis

Applied Foundation Testing, Inc.

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www.testpile.com

Version	Authored	Approved	Release Date
1.1	JDN	MKM	12/3/2015

Contents

Introduction

This document is provided to describe the methodology by which results are obtained from an AFT-Cell® Bi-Directional Load Test. The AFT-Cell® is a proprietary test method that nevertheless conforms to industry-recognized approaches to geotechnical load testing and instrumentation to produce accurate, reliable results. Note that the AFT-Cell test method is in conformance with the soon to be released ASTM standard on Bi-Directional Static Load Testing.

In some cases, this document may be provided in support of a finalized report or as part of a submittal package. It is intended as a general explanation of the methodology used and not an exhaustive or specific guide to any individual test(s). Furthermore, for tests conducted in accordance with a third-party published test method, for any potential conflict between this document and the cited test method the cited test method is to take precedence.

For clarification or additional information, please contact Applied Foundation Testing.

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E: drobertson@testpile.com (Don Robertson)
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E: mmuchard@testpile.com (Mike Muchard)

Test Setup

Bi-Directional Jacks

For a given AFT-Cell test, one or more groups of one or more AFT-Cell embedded bi-directional jacks are installed in the reinforcement cage prior to installation in the foundation. The jack groups are installed at predetermined elevations commonly referred to as **cell levels** and are plumbed in a manifold arrangement to maintain equivalent pressure amongst all cells at each level. Provided all AFT-Cells at a given level share a common calibration (equivalent area) and are located equidistant from the shaft centerline, fluid statics in this arrangement guarantees that the load distribution will be centralized. Eccentric loading identified in neighboring strain gage levels will therefore be caused by other factors such as the geometry of the shaft and not by any inherent flaw in the test arrangement.

Each cell level is instrumented for pressure measurement at the surface at the supply pump. The cell level is also instrumented for expansion displacement using embedded displacement transducers and/or telltale rods.

An important concept for AFT-Cell testing—and indeed any bi-directional load testing—is that the load is reacted equally above and below the cell level into the shaft such that a reasonable balance of resistance is obtained. The AFT-Cell placement is therefore very important and requires input from the geotechnical engineer of record. Another concept is that the bi-directional loading stress is half that of a top down applied force from an anchored reaction frame or kentledge type top-down load test. In many cases, it may be desired to use the bi-directional results to estimate a would-be top down response of the foundation under test. This requires calculation of an **equivalent top load curve**, discussed in the following sections, which considers the additional stress imposed to the foundation in a top loading scenario.

Displacement Instruments

In addition to the embedded displacement transducer(s) used for cell opening (expansion) displacement, AFT-Cell tests are also commonly conducted with direct measurement of **segmental displacement** and **segmental compression** using cased rods commonly known as **Telltales** and reusable displacement transducers located above the surface. Depending on the test arrangement, Telltales may pass through or terminate above cell levels.

Top of shaft (TOS) displacement is measured directly using digital survey technology. Depending on the test arrangement, multiple digital surveys may be used for redundant measurements or to maintain measurement with respect to a fixed reference point commonly known as a **Backsight**. A traditional **reference beam** has been made obsolete with the advent of digital survey technology. Reference beams, which have always been susceptible to environmental side effects, are therefore not used.

Strain Instruments

Strain transducers in an AFT-Cell test are typically embedded instrumented rebar sections commonly known as **sister bars**. Sister Bars may be based on resistive foil or vibrating wire technology. Resistive gages are more economical, and as reliable as VW gages. Strain transducers are installed in the rebar cage prior to installation at predetermined elevations referred to as **strain levels.** Each strain level contains multiple strain transducers placed with even numbers of gauges per any given level depending on the test arrangement. Generally, **shaft segments** are bounded by strain levels and cell levels

Time Domain Calculations

The first step in conducting analysis of AFT-Cell test data is to calculate certain useful data in the time domain. Depending on the software application many of these calculations are typically done in real time during the test.

Segmental Displacements

For each Cell Level i the **cell level expansion** is defined in Equation 1.1

$$\Delta_{Cell,i} = \overline{\Delta_{Cell,i,j}} \qquad (1.1)$$

Where $\Delta_{Cell,i,j}$ is the individual reading of each cell opening displacement sensor at Cell Level i.

Segmental compression values for a given individual shaft Segment N may be determined from one or more instrumented Telltales (Equation 1.2) or alternatively from the average strain in the segment integrated over the section length (Equation 1.3).

$$\Delta_{Comp,n} = \Delta_{TTc,n} - \sum_{k=1}^{n-1} \Delta_{Comp,k} \qquad (1.2)$$

$$\Delta_{Comp,n} = \int \varepsilon \, dL_n \qquad (1.3)$$

Equation 1.3 assumes the strain distribution is uniform over the section length.

Segmental displacement values for a given individual shaft Segment N may then be determined using Equation 1.4 and the results from Equations 1.1, 1.2, and 1.3 or alternatively may be calculated from one or more instrumented Telltales (Equation 1.5).

$$d_n = \Delta_{Cell,n} - \Delta_{Comp,n} - d_{n-1} \qquad (1.4)$$

$$d_n = \Delta_{TTd,N} - d_{n-1} \qquad (1.5)$$

Note that in the previous equations, a special case arises for d_0 which is the **top of shaft displacement.** For this segment, we assume zero length and therefore zero compression. d_0 is then calculated from digital survey values as shown in Equation 1.6.

$$d_0 = \overline{\Delta_{TOS}} - \Delta_{Backsight} \qquad (1.6)$$

Cell Level Displacements

The **Top of Cell (TOC) displacement** for a given AFT-Cell level i is calculated as the measured top of shaft displacement plus the elastic compression for the portion of shaft above the AFT-Cell as shown in Equation 1.7 for the case of using segmental compression values. Equation 1.8 is for the case of using direct measurement of elastic compression via Compression Telltale.

$$\Delta_{TOC,i} = d_0 + \sum_{k=1}^{i} \Delta_{Comp,k} \qquad (1.7)$$

$$\Delta_{TOC,i} = d_0 + \Delta_{TTc,i} \qquad (1.8)$$

The **Bottom of Cell (BOC) displacement** at the AFT-Cell is obtained using Equation 1.9 and readings from multiple instruments: with embedded cell displacement transducers (where applicable), expansion telltales, or both. The basic calculation is the same in all instances and is simply the total cell expansion less the top of cell expansion determined in Equation 1.7 or 1.8.

$$\Delta_{BOC,i} = \Delta_{Cell,i} - \Delta_{TOC,i} \qquad (1.9)$$

The cell level displacement is then plotted versus the cell level gross load to obtain the plot shown in Figure 1. Note that an independent plot can be generated for any given cell level.

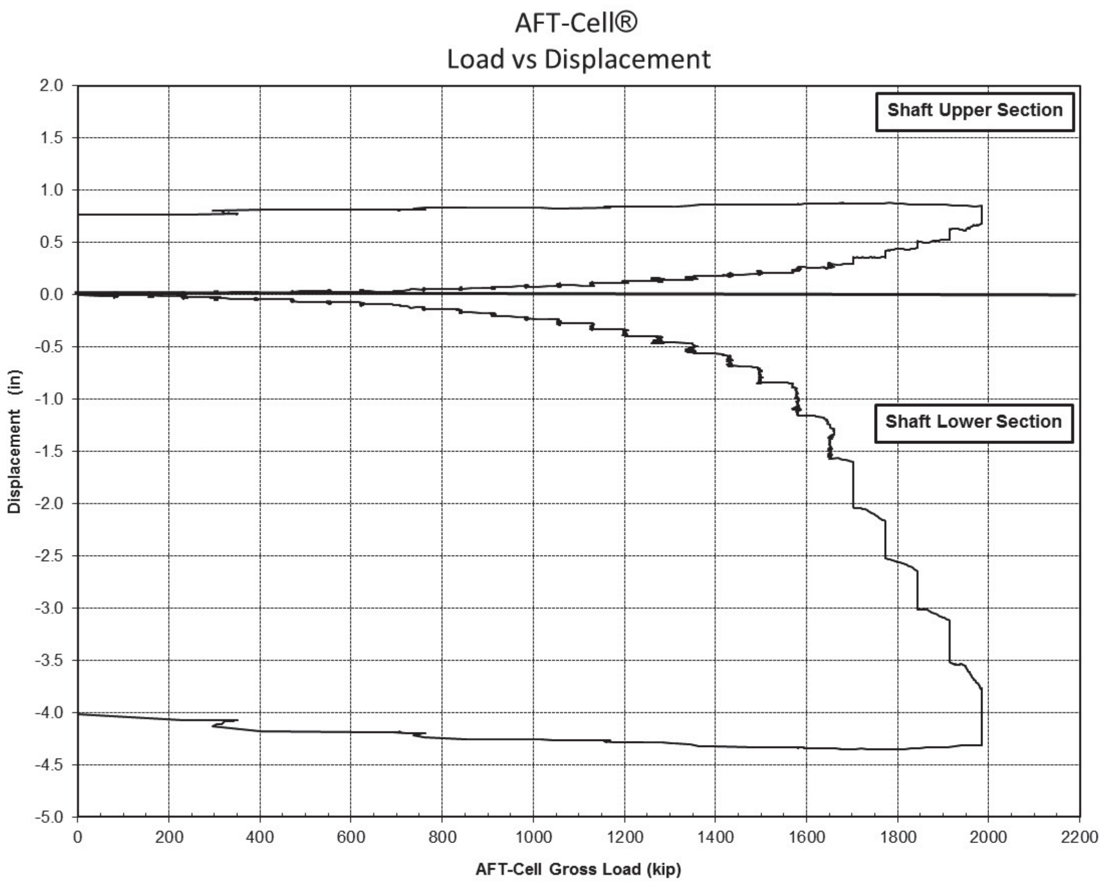

Figure 1: AFT-Cell® Load vs Displacement diagram. Continuous data acquisition.

Segmental Elasticity

For each Strain Level i, Equations 1.10, 1.11, and 1.12 are applied

$$\varepsilon_i = \overline{\varepsilon_{i,j}} \qquad (1.10)$$

$$\sigma_i = E_i \varepsilon_i \qquad (1.11)$$

$$F_i = A_i E_i \varepsilon_i \qquad (1.12)$$

Where E_i is the **composite modulus** and A_i is the **effective cross sectional area** at Level i.

AFT often uses **Thermal Integrity Profiling (TIP)** for shaft shape profiling to aid in determination of A_i. AFT may use other shape profiling methods such as mechanical or acoustic calipering (**SoniCaliper™**) if requested by the client, however TIP is the method preferred by AFT due to its ability to address a number of shortcomings in calipering methods.

Borehole calipering adds considerable effort and time during the shaft construction at a time sensitive portion of the construction process: when the shaft excavation is open. The wire method of TIP (ASTM D7949 Method B) minimally impacts the construction timeline and does so during reinforcement cage construction, which is a far less time sensitive phase in drilled shaft construction.

Borehole calipering is also limited in that it measures the shaft dimensions prior to concrete placement. These dimensions have the potential to change between calipering and completion of construction (e.g. sloughing, bulging of weak zones due to concrete forces, etc.). TIP provides an as-built shaft shape profile which enhances the accuracy of the calculation of A_i.

For each Cell Level i, load is calculated from the calibration of the AFT-Cell(s) and the recorded pressure as shown in Equation 1.13 and used as a boundary value for adjacent segments.

$$F_{Cell,i} = 2 * \sum_{j=1}^{k} C_{i,j} P_i \qquad (1.13)$$

Note the nominal force is doubled in order to represent the bi-directional nature of the applied force assuming that the length of Cell Level i is negligible. Each AFT-Cell is calibrated in-house with NIST traceable equipment.

Load Distribution

With the given calculations performed, a load distribution plot may now be generated as shown in Figure 2. For each load increment, the level force F_i is presented as a function of elevation. The resulting composite plot provides information about load shedding and the geotechnical nature of foundation under test.

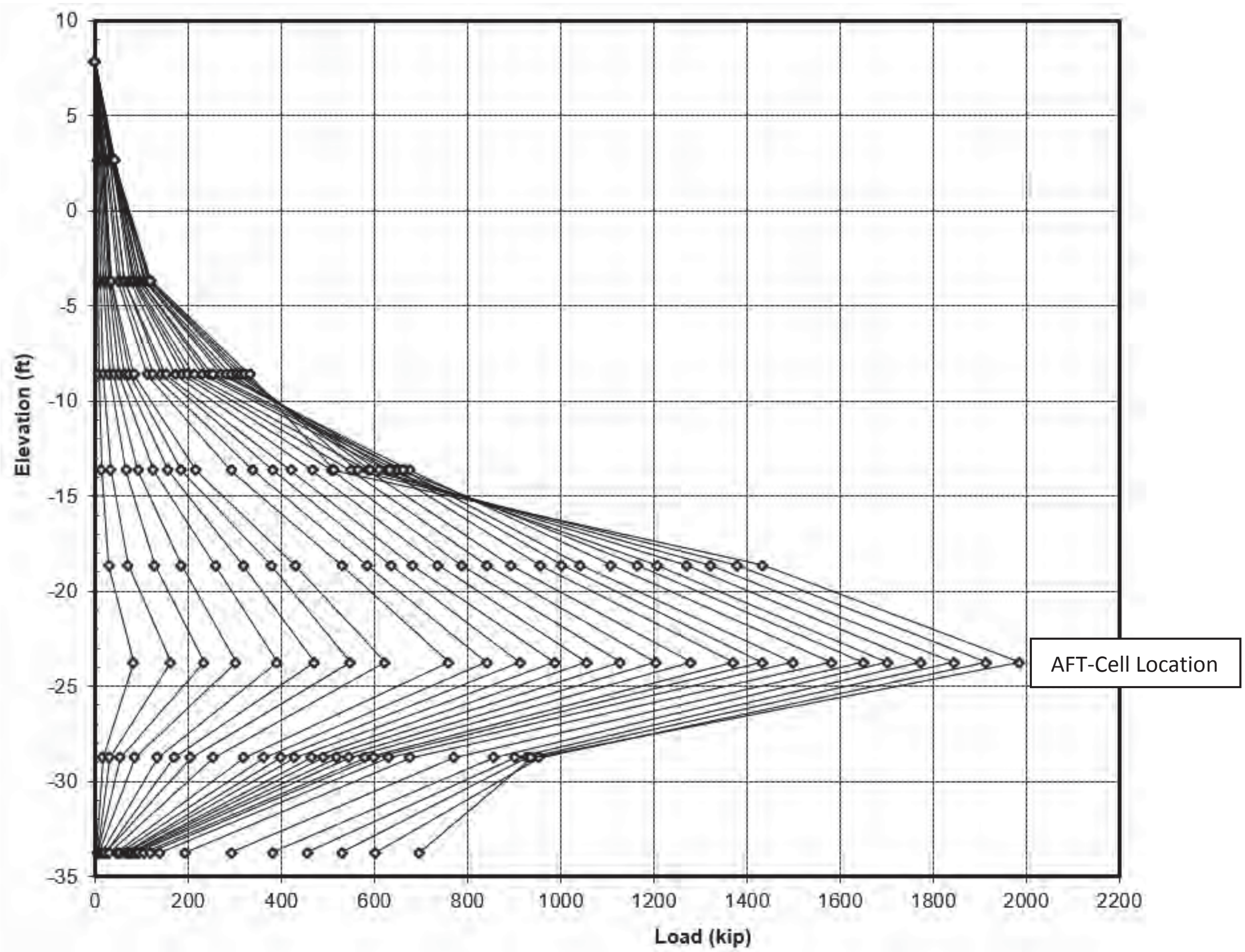

Figure 2: AFT-Cell® Load Distribution plot

Unit Side Shear

Side Shear Calculation

For each shaft Segment n, the **unit side shear** $\boldsymbol{\tau_Z}$ may be calculated from the load shed across the segment and the surface area of the segment. Note that Equation 2.1 is a general form; load directionality and **buoyant forces** change across cell level boundaries.

$$\tau_{Z,n} = \frac{(F_{i+1} - F_i) - F_{Buoyant,n}}{A_{S,n}} \qquad (2.1)$$

The buoyant force is taken as the equivalent force due to the submerged (below water table) self-weight of the shaft above the segment under investigation. To be consistent with current analysis practice, the load acting upward is assumed to be zero until the buoyant weight of the shaft above is overcome. Therefore, the *net load* is the *gross load* minus the buoyant weight of the shaft above the AFT-Cell.

Tz Plot

Following calculation of $\tau_{Z,n}$ in the time domain, a τ_Z plot is produced by plotting segmental displacement d_n as a function of $\tau_{Z,n}$. Multiple plots are usually produced to maintain a cohesive representation of displacement directionality across cell level boundaries as shown in Figures 3 and 4.

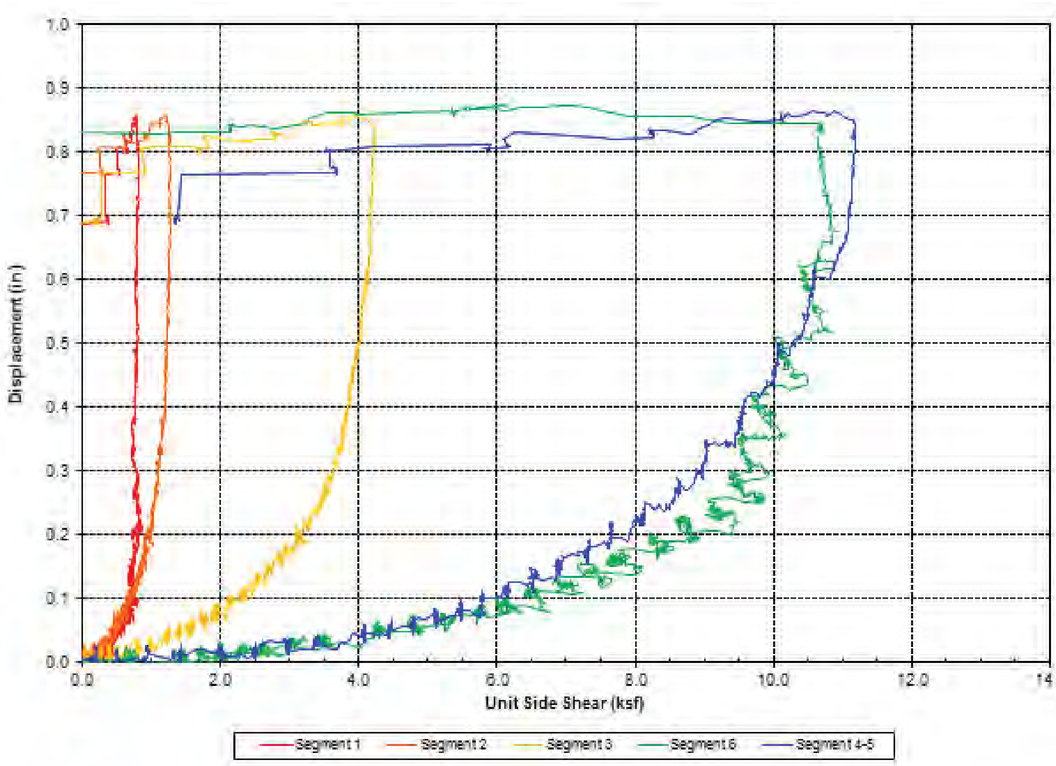

Figure 3: Example of a Tz plot with upward segmental displacements. Continuous data acquisition.

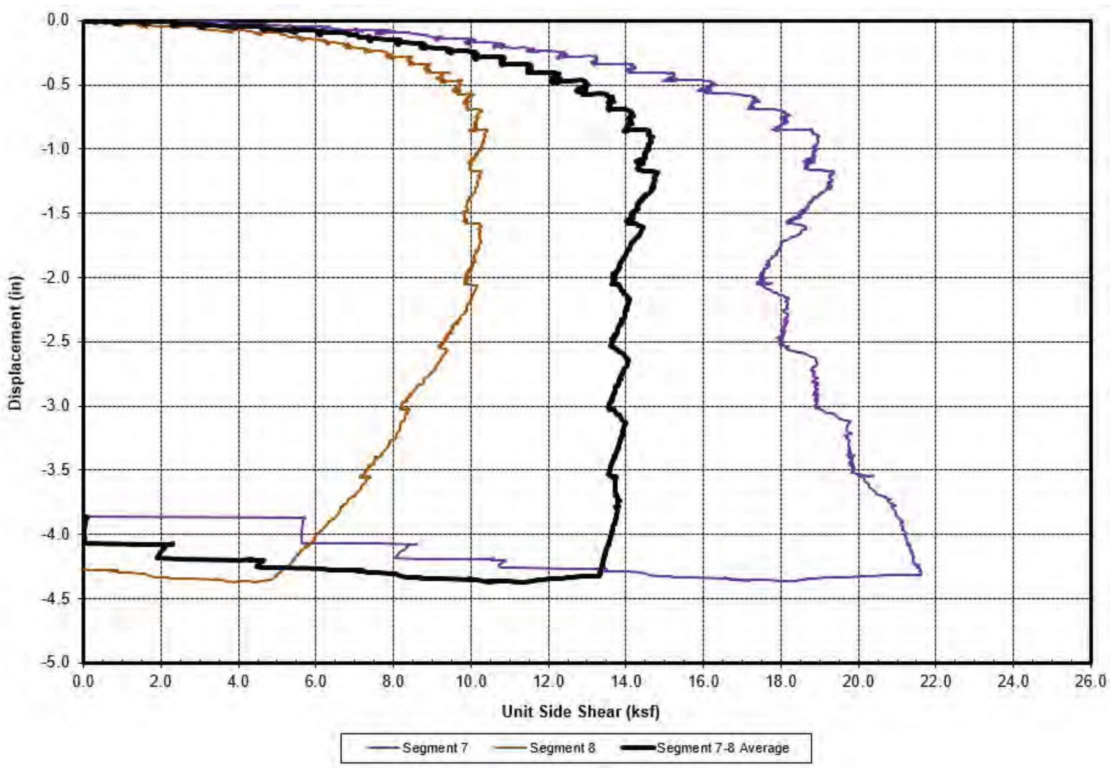

Figure 4: Example of Tz plot with downward segmental displacements. Continuous data acquisition.

End Bearing

End Bearing Calculation

For the lowest shaft Segment N, **end bearing q_z** may be calculated from the portion of the segmental force reacted through the tip divided by the area of the tip. The key assumption for this calculation is that the unit side shear for Segment N is equal to the unit side shear for Segment $N-1$, thereby allowing the portions of the segmental force reacted through shear and end bearing to be decoupled as shown in Equation 3.1.

$$q_z = \frac{F_N - (A_{S,N} * \tau_{Z,N-1})}{A_{C,N}} \qquad (3.1)$$

Qz Plot

Following calculation of q_z in the time domain, a q_Z plot is produced by plotting the displacement d_N as a function of q_z as shown in Figure 5.

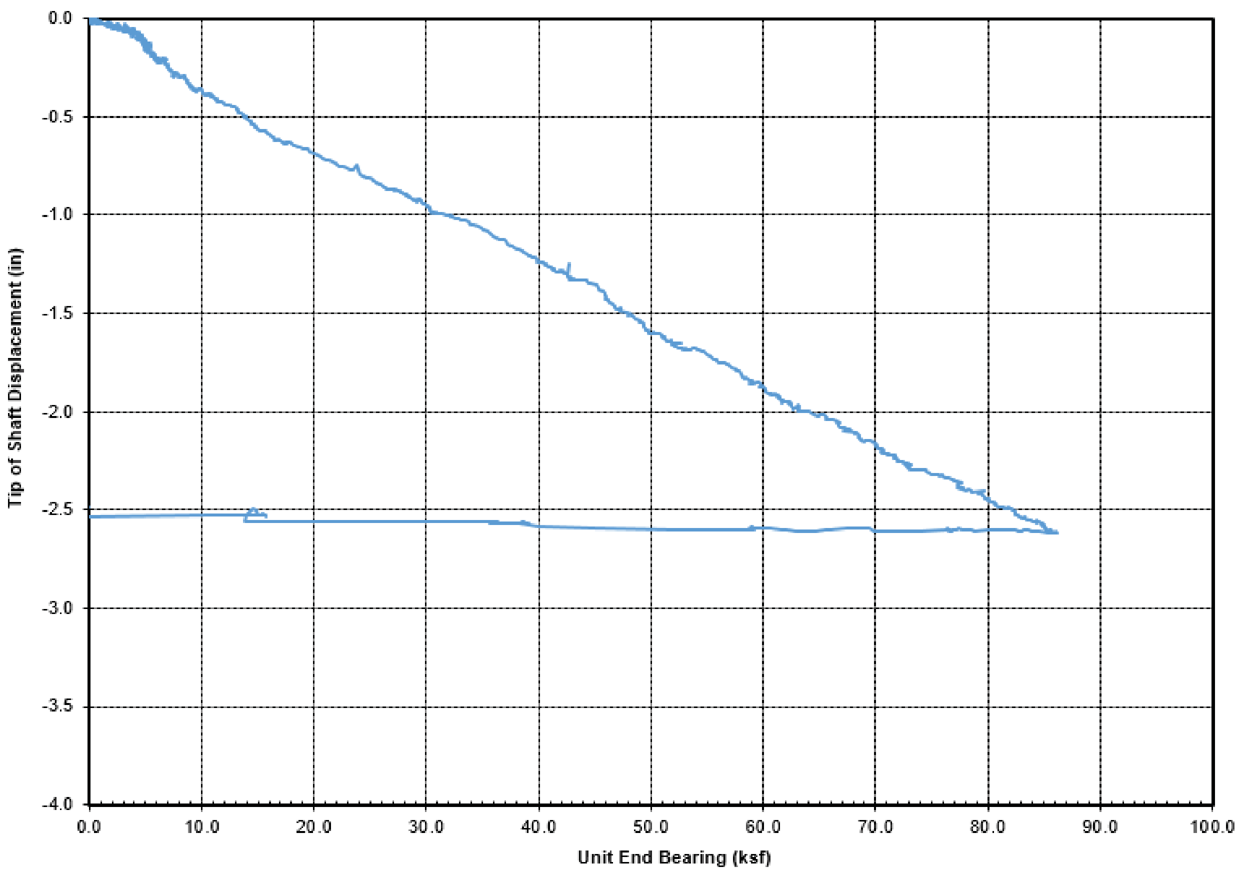

Figure 5: Example qz plot

Equivalent Top Load

The Equivalent Shaft Top Load vs Displacement plot is produced in order to model the shaft behavior as if it had undergone a traditional top-down static load test. Conceptually, the plot is a representation of the average load-displacement behavior of the shaft Segments between cell level and top-of-shaft and bottom-of-shaft boundaries. Each of these segmental groups can be conceived as a separate load test with their aggregate representing the overall performance of the shaft. For each Cell Level i, at each discrete load stabilized time interval t, Equation 4.1 is used to develop the Equivalent Top Load.

$$F_{Eq,i,t} = F_i\left(d_{i,UPPER}(t)\right) + F_i\left(d_{i,LOWER}(t)\right) \qquad (4.1)$$

The equivalent top of shaft displacement for this plot is defined in the time domain according to Equation 4.2.

$$d_{0,EQ,i} = -d_{i,UPPER}(t) \qquad (4.2)$$

A more precise calculation for equivalent top of shaft displacement accounts for additional elastic compression in the shaft at the given equivalent top of shaft load as shown in Equation 4.3.

$$d_{0,EQ,Corrected,i} = -\left[d_{i,UPPER}(t) + \sum_{k=1}^{N} \Delta_{Comp,k}\left(\frac{F_{Eq,i,t}}{2}\right)\right] \qquad (4.3)$$

The resultant data is plotted in the Equivalent Top Load domain as shown in Figure 6.

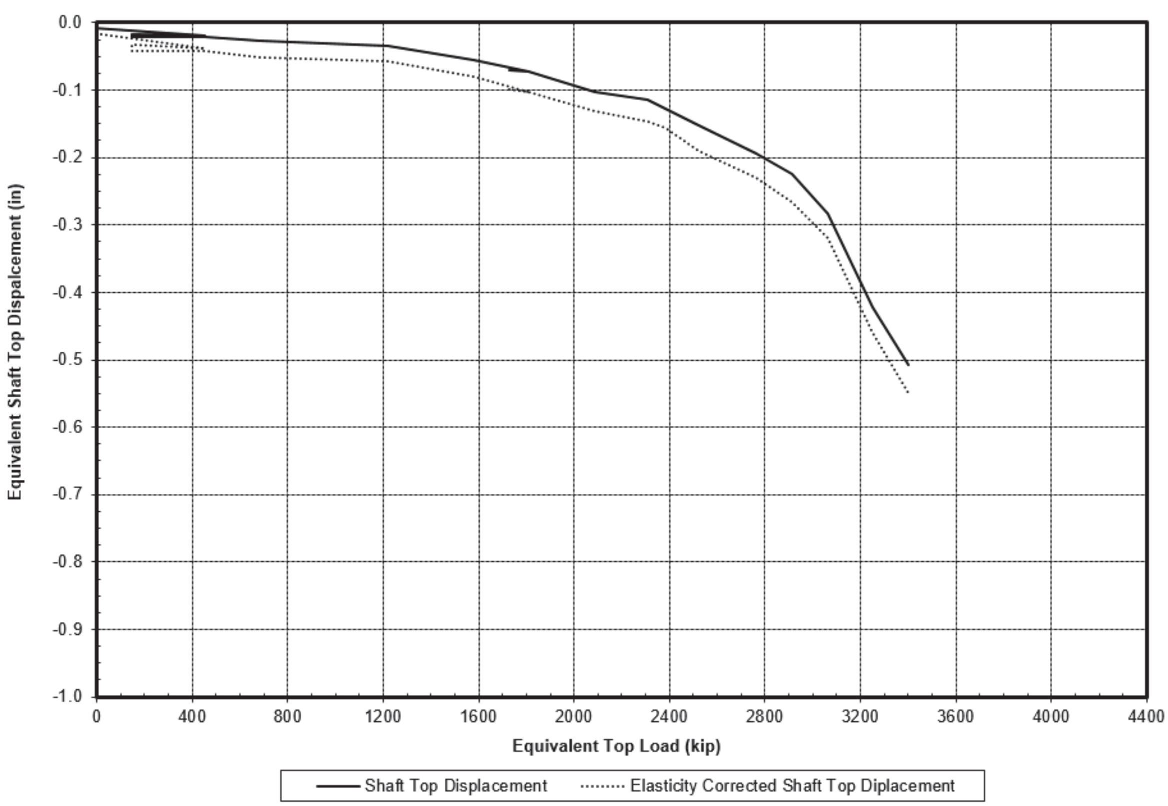

Figure 6: Example Equivalent Top Load vs. Displacement Plot with and without elasticity correction

Creep Limit

AFT-Cell tests can provide an evaluation for an equivalent top load on the foundation under investigation that could potentially create excessive creep behavior. This load value is frequently referred to as the **creep limit** or **yield limit.** AFT applies the methodology proposed by Housel (1959) to the AFT-Cell test by calculating individual values for creep for segmental groups surrounding the cell levels.

Creep is calculated for each group of shaft segments above and below each Cell Level i during each discrete load stabilized time interval t as shown in Equation 5.1. Generally the data for each segmental group is presented as upper section and lower section creep data, however for multiple cell levels this leads to redundancy and a numbering scheme may be employed.

$$\delta_i = d_i(t_2) - d_i(t_1) \qquad (5.1)$$

The creep limit plot is produced by plotting creep δ_i as a function of gross load as shown in Figure 7. The creep limit is then judged as the gross load at which significant creep is observed and is indicated by a linear fit. The final value reported for creep limit depends on the nature of the result

Case 1: For two distinct values of δ_i obtained at Cell Level i, the creep limit is defined by the load at which free motion of *both* segmental groups would be observed. Therefore, the greater of the two values is reported.

Case 2: For a case in which one value of δ_i is determined but the other segmental group does not exhibit creep behavior before reach maximum displacement, the creep limit is reported to be unknown, but greater than the maximum load applied to the segmental group that did not exhibit creep behavior.

Case 3: For a case in which δ_i cannot be determined for either segmental group, the creep limit is reported to be unknown, but greater than the maximum equivalent top load.

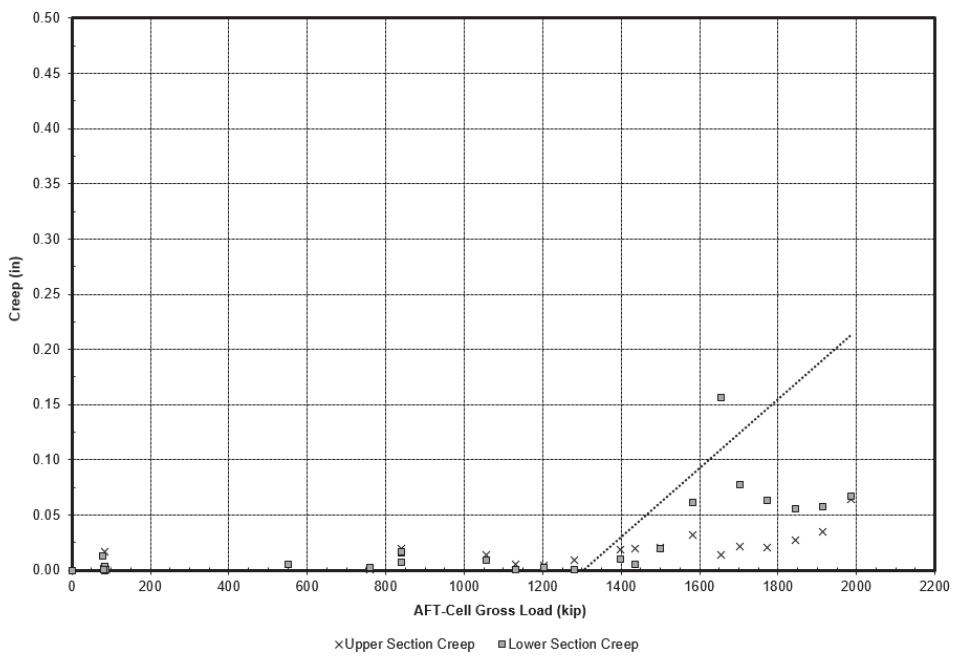

Figure 7: Example Creep Limit plot

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