Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

May 4, 2015
File No.: 14-55-9544
Doc. #2

American Piledriving Equipment, Inc.
1345 Industrial Park Road
Mullberry, FL 33860

Attention: Mr. Paul Suver
Mr. Jim Casavant

Subject: Pile Load Test Program
APE Helical Piles

Gentlemen:

As authorized by your return of our Proposal Project Acceptance Sheet regarding our proposal 14-p144 dated June 17, 2014, Ardaman & Associates, Inc. observed the installation of helical steel pipe piles at the American Piledriving Equipment, Inc. (APE) facility in Mulberry, Florida. This letter presents a brief summary of our site observations and the results of the load tests.

Background

APE installed four helical piles in their yard in Mulberry, Florida. The approximate locations of the test piles are shown in the attached Figure 1. Each test pile is steel pipe with an outside diameter of 7 inches and an inside diameter of 6 inches. Each pipe tip section has an 18-inches nominal diameter single flight auger at the tip of the pile. The auger plate was approximately 3/4 inch thick and was located about three inches to 9 inches above the pile tip.

Photo 1 – Helical Pile Tip

Each pile has a threaded coupling on the top of a 20 feet long segment. Extension sections have threaded couplings to allow extension of the pile. The top threaded coupling also has a hex-head to allow for handling and coupling of the segments.

Photo 2 - Threaded Coupling at the Top of the Pipe Section

The piles may be installed grouted or un-grouted depending on the pile design and capacity requirements. If the piles are grouted, holes are burned into the tip of the pile below the bottom helical flight to allow injection of grout at the level of the helical plate as shown in Photo 3.

Photo 3 – Helical Pile Tip with Grout Holes

The pipe segments were picked up with a hydraulic rotary head mounted on a Caterpillar 349E Hydraulic Excavator. Photo 4 shows the excavator with the rotary head mounted to the machine. Photo 5 shows the rotary head used to drive the piles.

Photo 4 – Caterpillar 349E with the Rotery Pile Driving Head.

Photo 5 - APE Rotary Drive Head for Helical Piles

The load frame for the load test was developed by APE to mate to the helical piles that were driven as anchor piles. Each anchor pile has two or three levels of helical plates to provide additional uplift resistance to the anchor piles. See Photos 6 through 8 for photos of the test pile setup. The anchor piles were only 20 feet long, and they were not grouted.

Photo 6 – Attachment of the Load Frame to the Anchor Piles

Photo 7 – Load Frame Setup for the Vertical Load Test

Photo 8 – Load Frame Setup for the Lateral Load Test

Site Soil Conditions

The firm of Madrid Engineering Group, Inc. (MEG) of Bartow, Florida was engaged by APE to perform a Standard Penetration Test Boring (SPT, ASTM D-1586) at the APE yard in Mulberry, and install an observation well. A copy of the Madrid report is attached in Appendix A of this letter for reference. The performance of the boring was not observed by Ardaman & Associates, Inc. The boring encountered a stratum of medium to very loose sand from 0 to 12 feet below grade underlain by very loose silty sand with SPT N =2 bpf to 17 feet. The very loose silty sand was underlain by very soft clay with Weight of Hammer (WOH) resistance to 22 feet. The sequence was repeated with five feet of very loose sand underlain again by five feet of very soft clay to 32 feet below grade. The soil from 32 feet to 68 feet below grade was described as loose to medium calcareous clayey sand with a stiff calcareous clay layer from 47 to 52 feet below grade. The boring was terminated at 70 feet below grade in very dense calcareous clayey sand with limestone fragments. The SPT penetration resistance was 18-19-50/3” at 70 feet below grade.

The water table at the boring and at the observation well installed by MEG was recorded at 5 feet below grade.

The site area is known to have been subjected to strip mining for phosphate, and was reclaimed by bulldozing the overburden stripped from above the phosphate matrix to fill the mine pit. Based on evaluation of the boring data, the soil below a depth of 32 feet may not have been disturbed by mining.

Load Tests

As described above, the piles are installed by a rotary drill so inspection of the installation was limited to installation time. As a production system, tracking of torque and crowd might be possible; however, those systems were not available at the time the piles were installed. Some piles were installed by APE without observation by an Ardaman & Associates, Inc. engineer at the site.

Load Test Results

A vertical load test was run on each of four (4) test piles. The locations of the test piles are shown in Figure 1. A lateral load test was run on each of three of the piles after the vertical load on the pile was completed. Each load test was numbered in the order the test was run, with the pile number and Load Test number recorded. The load tests were run by applying the load in increments, and allowing the pile to relax without increasing the load to the initial load. Otherwise, the load tests were run in general accordance with the Quick method as shown in ASTM D-1143.

Interpretation of vertical load tests in Florida is typically done using the Davisson Offset Method. In this method, an elastic deflection line for the pile is drawn on the load test graph assuming that the pile is a column loaded for its length. An offset line is drawn at 0.15+D/120 parallel to the elastic deflection line where D is the diameter of the pipe. The intersection of the offset line with the load-deflection curve for the load test is used to define the pile capacity. There are other methods used to interpret pile capacity from load test data, but this method is typically used in Florida, and is presented in this letter as the pile capacity for each load test.

The results of the lateral load tests will be described separately, following the presentation of the results of the vertical load tests.

<u>Pile #1, LT-1</u>

The pile was installed to about 70 feet below grade where it encountered high resistance to advancement. Grouting of the pile was inconsistent, so we believe that the grout was not continuous along the pile. Figure 3 shows the results of the load test. The load was brought to the target level, but it relaxed due to slippage of the anchor piles. Readings were taken until the load stabilized, and a “Best Fit” set of data were used to construct the load deflection relationship. The maximum load reached during the test was 73 tons at a displacement of 1.53 inches. The net displacement of the pile was 1.4 inches after unloading.

<u>Pile #2, LT-3</u>

The test pile was installed to about 70 feet below grade. In this case, the grouting was more consistent, and was probably continuous along the pile length. Figure 4 shows the results of the test. The pile could not be loaded to its ultimate capacity because the reaction piles were slipping, resulting in a maximum load of 191 tons applied to the top of the pile. The pile did not cross the Davisson Offset Line. The displacement at the maximum load was 0.77 inch. The net displacement after unloading was about ¼ inch.

<u>Pile #3, LT-5</u>

The test pile was installed to about 20 feet below grade. Based on the boring data available for review, the tip of the pile would be in a very soft clay with a Standard Penetration Test Resistance, N, described as Weight of Hammer. That is, the sampler punched into the ground under the static weight of the drill rods and the 140 lb test hammer. The pile was not grouted. The results of the load test are shown on Figure 5. The sample reached and ultimate load and Davisson Capacity of 12.7 tons at a deflection of

0.22 inches. The pile then plunged to 0.85 inch displacement at a reduced load of 12.5 tons. The pile was re-loaded to confirm the test results. The second load plunged at 12 tons at about 1.39 inches displacement. The pile had a net displacement of 1.3 inches when the load was removed.

Pile #4, LT-7

This pile was installed to refusal at about 70 feet below grade. The pile was not grouted, so the stiffness of the pile was lower than for the grouted piles installed earlier. Figure 6 shows the results of the load test. The pile had a Davisson Offset Capacity of 112 tons at a deflection of 0.74 inch. The pile did not reach ultimate because APE directed that Ardaman terminate the loading at about 1 inch displacement. The capacity was 140 tons at 1 inch displacement, and about 151 tons at the end of primary loading with 1.093 inch displacement. The net displacement of the pile after unloading was less than 0.2 inch.

Lateral Load Tests

The lateral load test results for the three piles are shown in Figure 7 through 10 as horizontal displacement of the pile with increasing lateral load. Two dial gages were set in the primary jack direction, and one dial gage was set perpendicular to the jack to record the effect of off-center loading. The displacements recorded by the dials are shown on the figure.

Pile #1, LL-2

The pile was installed to 70 feet below grade. The pile was loaded laterally with the results shown in Figure 7. The load test was terminated at about 11 tons. The pile rebound data were lost when the jack suddenly depressurized when the valve was opened. The load at a displacement of ½ inch was 9.1 tons.

Pile #2, LL-4

The pile was installed to a depth of 70 feet and grouted full length. The pile was loaded laterally, with the results of the load test shown in Figure 8. The loading was stopped when the pile exceeded 1 inch lateral displacement. The lateral load at a displacement of ½ inch was 6.2 tons. The net pile displacement after the load was released was about 0.27 inch.

Pile #3, LL-6

Pile 3 was installed to a depth of 20 feet without grout. The results of the lateral load test are shown in Figure 10. The pile loading was stopped at about 1.2 inches total lateral deflection at a load of about 9.3 tons. The lateral load at ½ inch deflection was 4.7 tons. The net deflection of the pile after the load was released was 0.4 inch.

Load Test Results Summary

The results of the load tests are summarized in Table 1, below. The data from the load tests are attached in Appendix B for reference.

TABLE 1 – SUMMARY OF PILE LOAD TEST RESULTS

Pile Number	Load Test Number	Pile Length (ft)	Davisson Capacity (tons)	Deflection (inches)	End of Test Capacity (tons)	Deflection (inches)	Remarks
Pile 1	LT-1	70	56	0.45	73	1.53	Partially Grouted
Pile 2	LT-3	70	NA	NA	191	0.77	Grouted/Reactions Slipping, did not reach ultimate
Pile 3	LT-5	20	12.7	0.22	12.0	1.39	Not Grouted
Pile 4	LT-7	70	111	0.74	151	1.093	Not Grouted, Load was not taken to ultimate
			L Force (tons)	ΔH (inches)	L Force (tons)	ΔH (inches)	
Pile 1	LL-2	70	9.1	0.50	10.6	1.00	Partially Grouted
Pile 2	LL-4	70	6.2	0.50	10.9	1.00	Grouted
Pile 3	LL-6	20	4.7	0.50	8.1	1.00	Not Grouted

Analyses of Pile Capacity

Vertical Load

It is important that the capacity of the helical piles can be predicted by typical analyses for pile capacity. The analyses for piles in Florida are typically performed using SPT-97 (FDOT Research Bulletin 121) or FB-Deep (Bridge Software Institute, University of Florida), computer programs developed for the Florida Department of Transportation to evaluate pile capacity using soil classification and SPT Penetration Resistance, N, in blows per foot. Figure 2 shows the results of SPT-97 analyses conducted by Ardaman & Associates, Inc. using the Madrid boring. The graphic log of the boring is shown adjacent to the results of the SPT-97 analyses for reference. The Figure shows the results of the analyses for the 7-inches diameter pipe coupled with the analyses for the 18-inches diameter plate tip bearing. Separate analyses were run for the shaft of the pile and for the tip plate bearing to analyze the total pile capacity. The figure shows good correlation of pile capacity for both grouted and un-grouted piles. The analyses for the shallow pile, Pile 3 at 20 feet depth, under predicts the capacity of the pile. However, it should be realized that the soil conditions are highly variable in mined, reclaimed land, so the actual soil conditions at the shallow depth may not be as represented in the boring. The deeper soil strata that were not disturbed by mining are more reliably predicted, and as noted above, the analyses correlated very well with the predicted capacity.

Analyses performed for bearing of the helical tip using the β Method and the Madrid boring indicate that piles terminated at 20 feet below grade would be in very soft clay soil with an undrained strength, Su, less than 150 psf. The β Method bearing for the 18 inch diameter auger plate in very soft clay would be less than 1 ton. However, the ultimate bearing at 70 feet below grade could be as high as 227 tons. As noted above, the analyses of plate bearing capacity can be predicted by the β method. In general, the deep piles were not loaded to their capacity, so the predicted capacity maybe above the actual measured maximum load.

Lateral Load Performance

The computer program LPILE 2013 was used to analyze the performance of the 20 foot deep pile. The results of the analyses are shown in Figure 10 as lateral load plotted against lateral displacement. The analyses using just the diameter and stiffness of the pipe over-predicted displacement significantly. However, when the system is assumed to have a diameter equal to the auger plate, and the stiffness is weighted as $E = Es*As/A_{Plate}$, the prediction of displacement versus load is very good as can be seen in Figure 10. The detailed output from LPILE is shown as displacement versus depth and moment versus depth in Figures 11 and 12.

Conclusions

In general, the single flight helical piles provided excellent capacity, and they were installed with no vibration. The capacity and lateral load performance of the piles can be predicted using typical analytical models.

We appreciate the opportunity to work with you on this project. If you have any questions on the data presented in this letter, please feel free to contact us at any time.

Very Truly Yours,
Ardaman & Associates, Inc.
Florida Certificate of Authorization No. 00005950

ROSS T. MCGILLIVRAY LICENSE No. 17920 STATE OF FLORIDA PROFESSIONAL ENGINEER

Digitally signed by Ross T. McGillivray, PE
DN: cn=Ross T. McGillivray, PE, o=Ardaman and Associates, Inc., ou=Tampa Branch, email=rmcgillivray@ardaman.com, c=US
Date: 2015.05.04 11:25:14 -04'00'

Ross T. McGillivray, P.E
Senior Consultant
Florida License No. 17920

Whitney A. Stevens, P.E.
Senior Geotechnical Engineer
Florida License No. 70821

Test Pile Locations (typ)

Pile #1 - 70 feet Deep - Ungrouted
Pile #2 - 70 feet Deep - Grouted
Pile #3 - 20 feet Deep - Ungrouted
Pile #4 - 70 feet Deep - Grouted

Scale: 1 inch = 60 feet

RTM \ Ardaman \ 14-9544 \DCAD\ FIG-01.dcd

DRAWN BY: RTM	CHECKED BY:	DATE: 02-22-2015	Helical Pile Load Test Project American Pile Driving Equipment, Inc. - Mulberry, Florida	**Test Pile Locations**	FIGURE NO.
FILE NO. 14-55-9544	APPROVED BY:	FL Registration: 17920		Ardaman & Associates, Inc. Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing FL Firm Registration: 5950	1

American Pile Equipment, Inc. - Mulberry, FL
SPT 97 Analyses of Piles - 7" Shaft Pipe w/ 18" Plate Tip
Boring MEG SPT-1

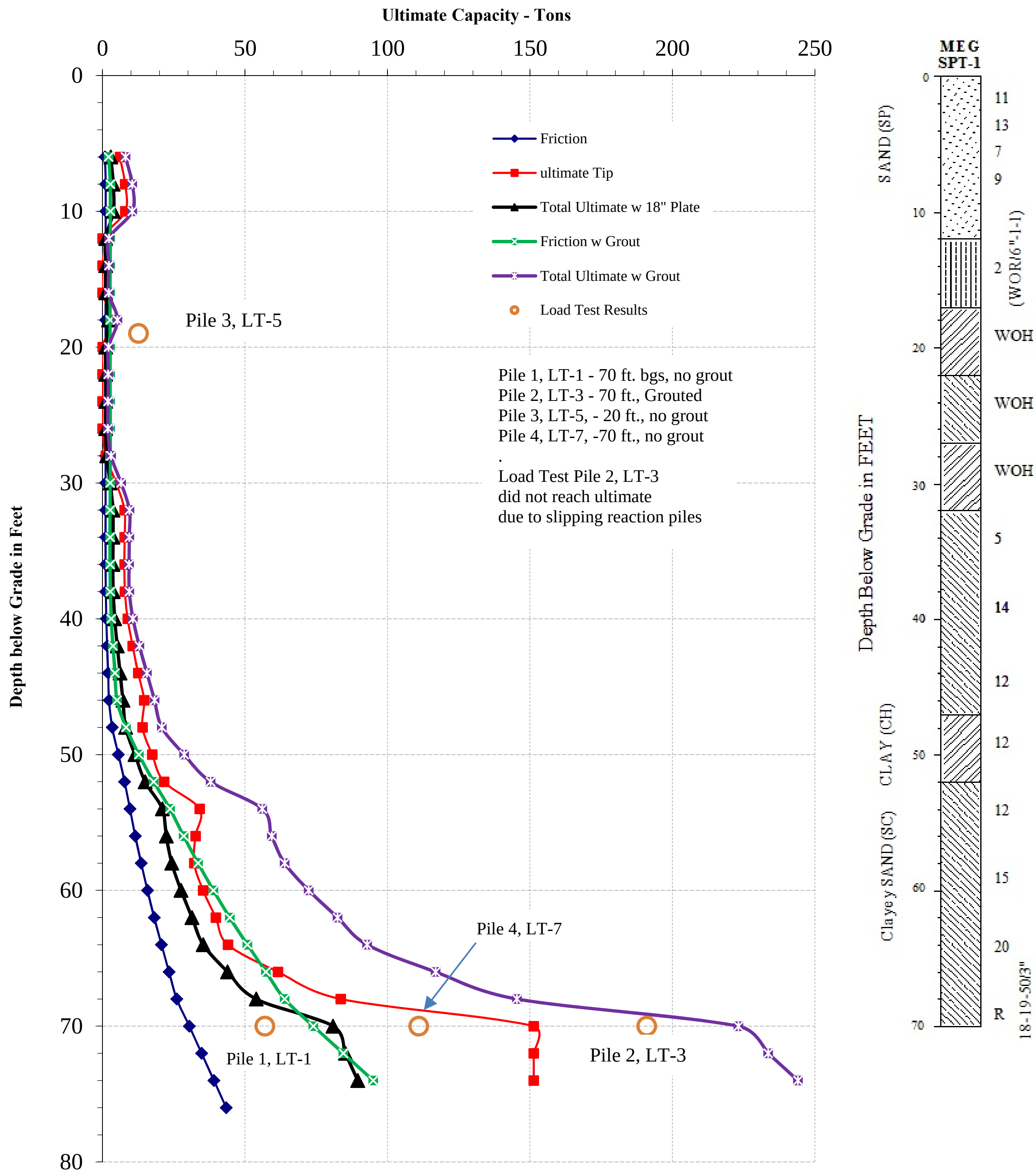

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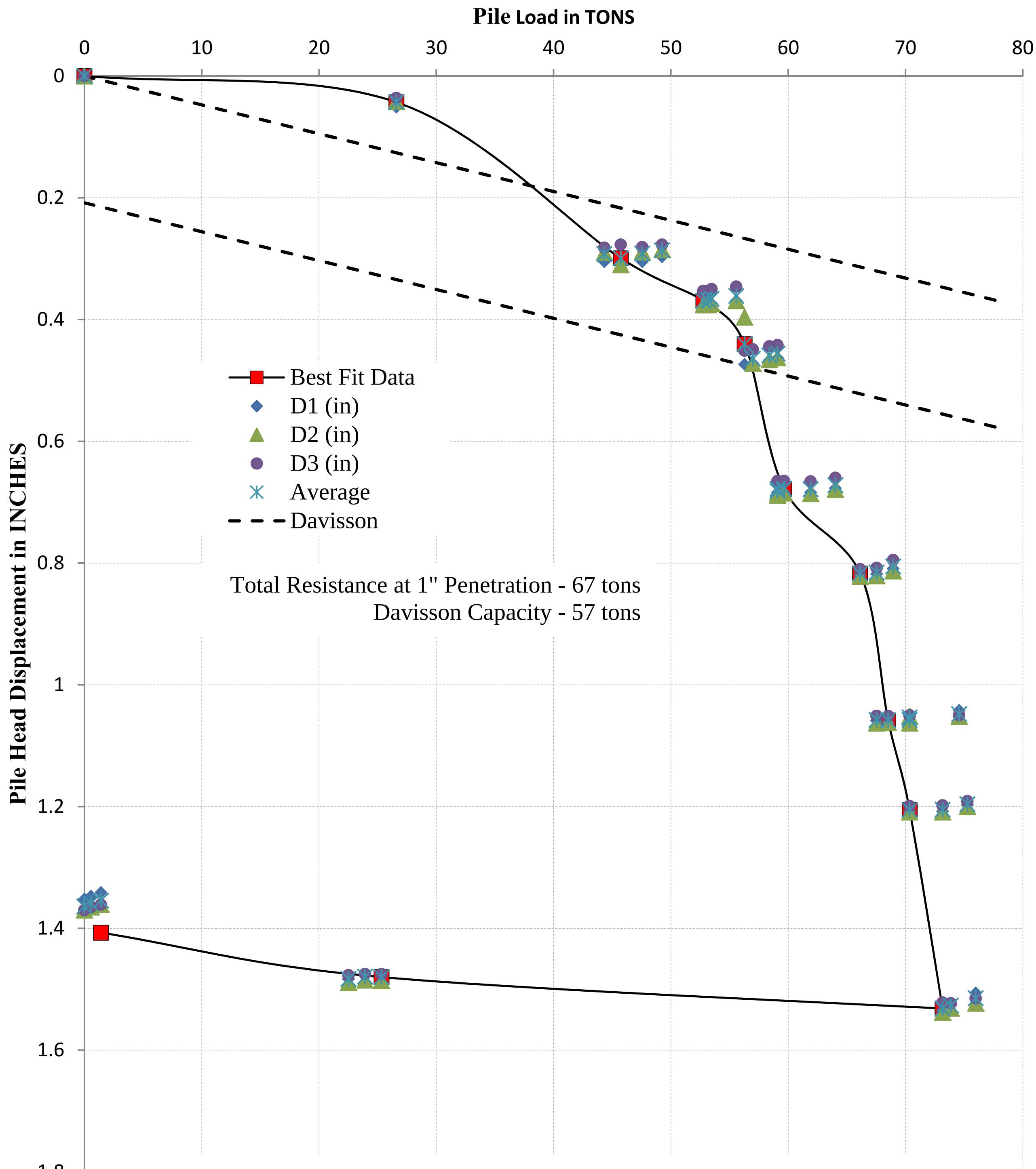
Figure 2

American Pile Equipment, Inc. - 7-In. Dia. Single Flight Helical Steel Pipe Pile 3/8" Wall, Grout Filled - Pile 1, LT-1



Note:

1. The pile is grouted , but grouting problems resulted in non-continuous grout
2. The reaction piles were slipping, so the load relaxed significantly at each load stage
   Therefore, the Load-Displecement Curve is non-uniform
3. Total pile length recorded during installation was 70 feet.

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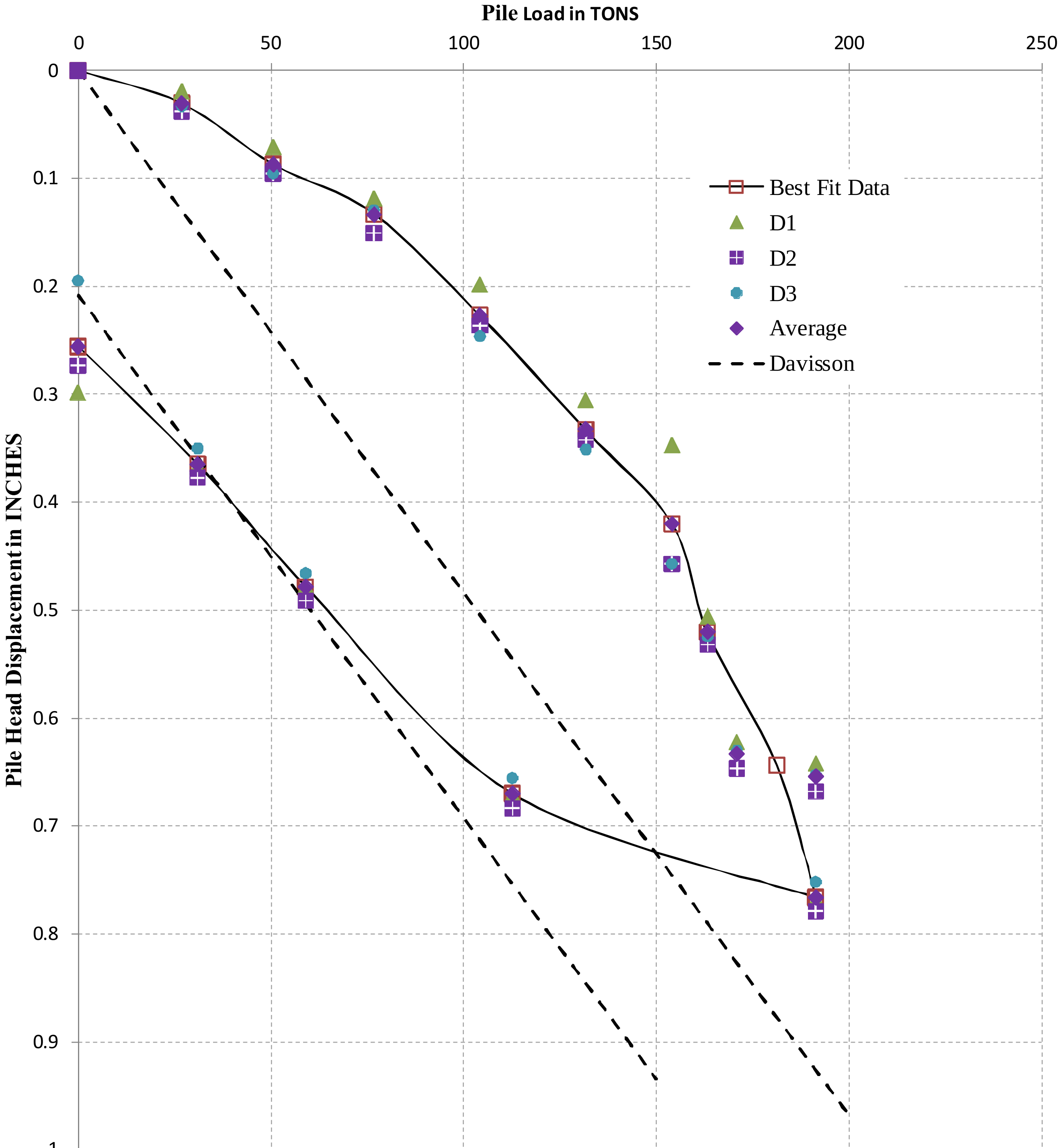
Figure 3

American Pile Equipment, Inc. - 7-In. Dia. with 18-In. Dia. Single Flight Helical Steel Pipe Pile 3/8" Wall, Grout Filled Pile 2, LT-3



Note:

1. The pile is grouted , Length 72 ft. below grade
2. The reaction piles were slipping, so the load relaxed significantly at each load stage
   Therefore, the Load-Displecement Curve is non-uniform

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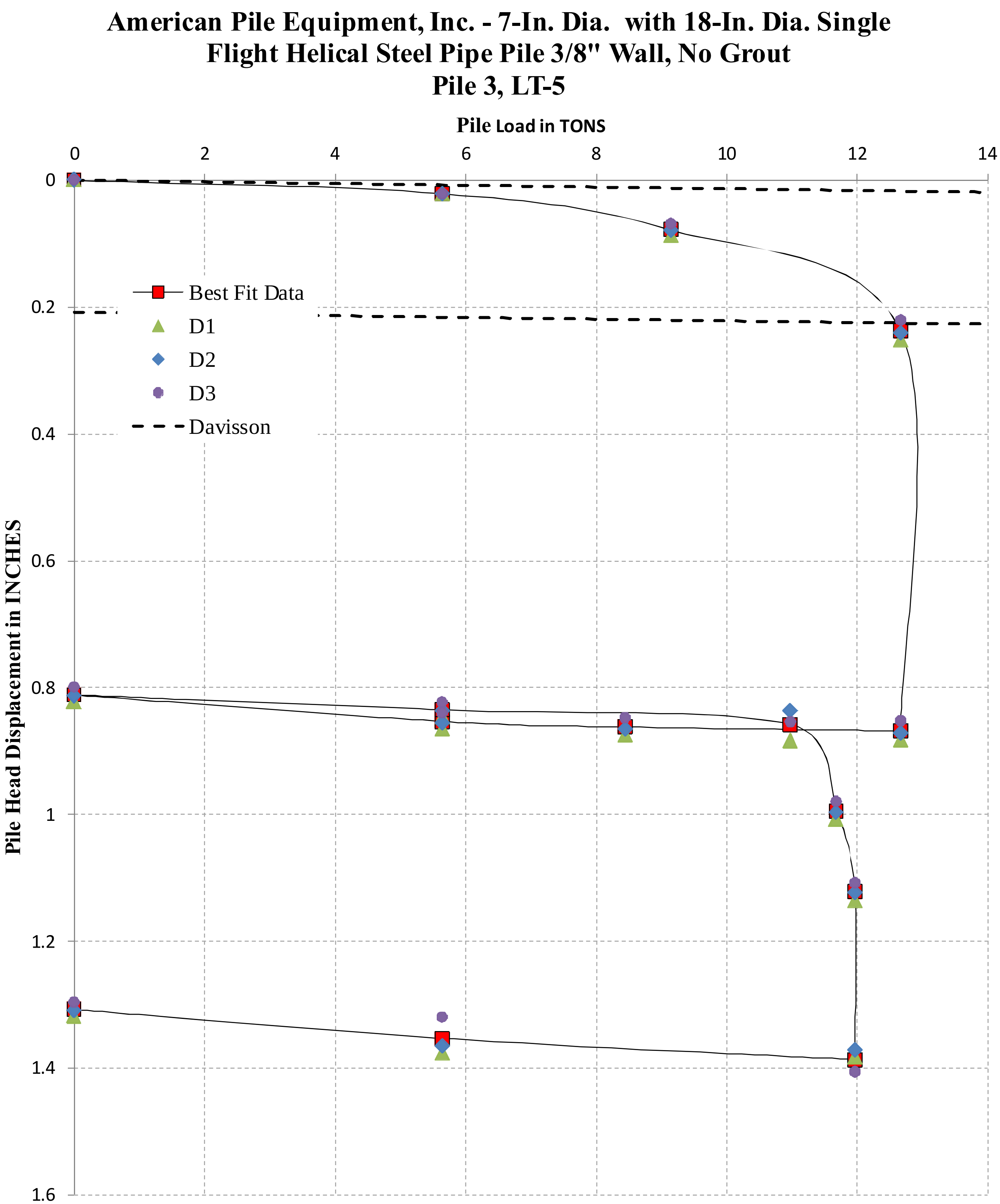
Figure 4



Notes:

1. The pile is not grouted , Length 20 ft. below grade
2. Pile loaded, unloaded and reloaded to confirm measurements

Figure 5

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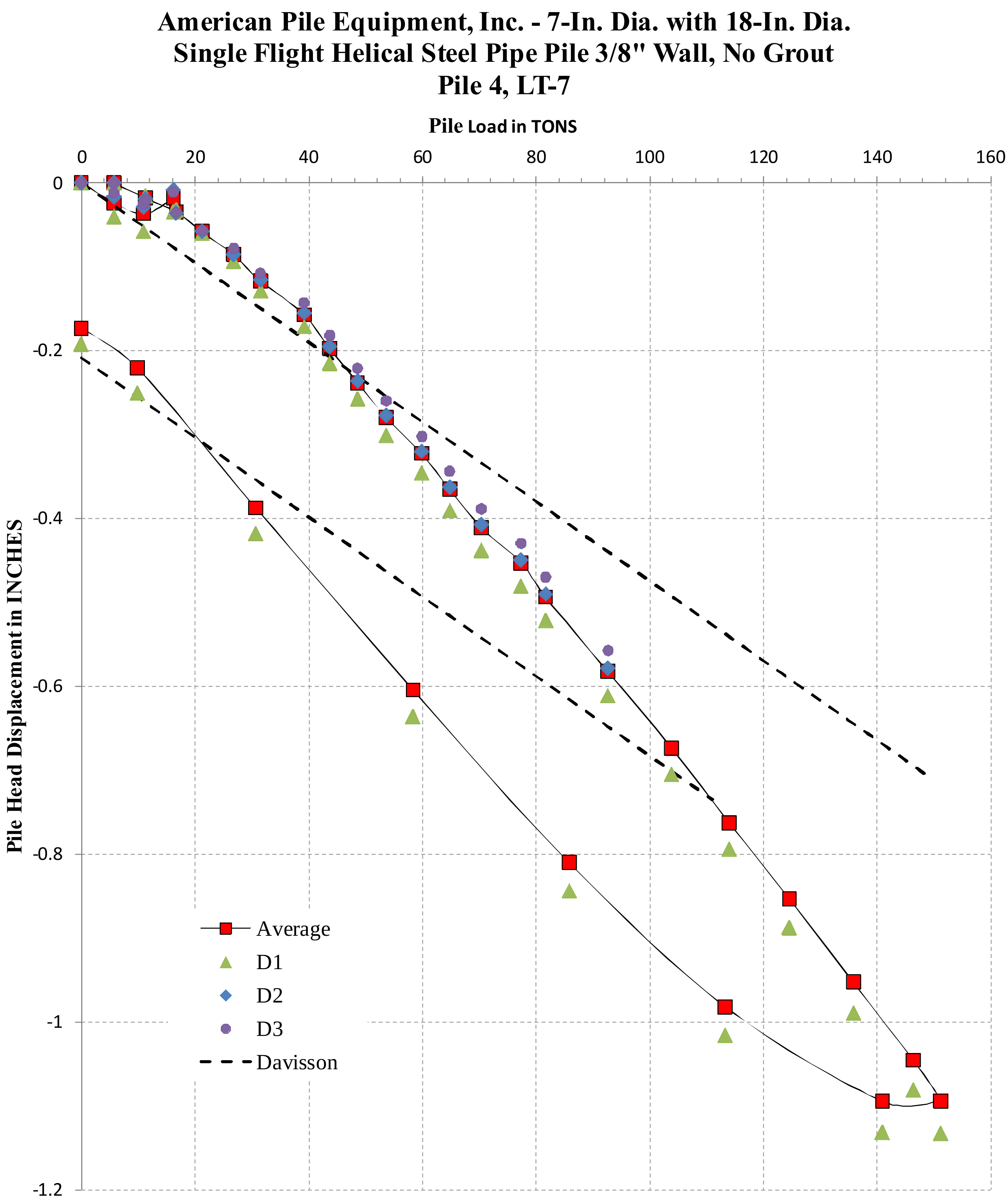

Notes:

1. The pile is not grouted , Length 70 ft. below grade
2. Pile did not reach ultimate. Loading was terminated at Client's request

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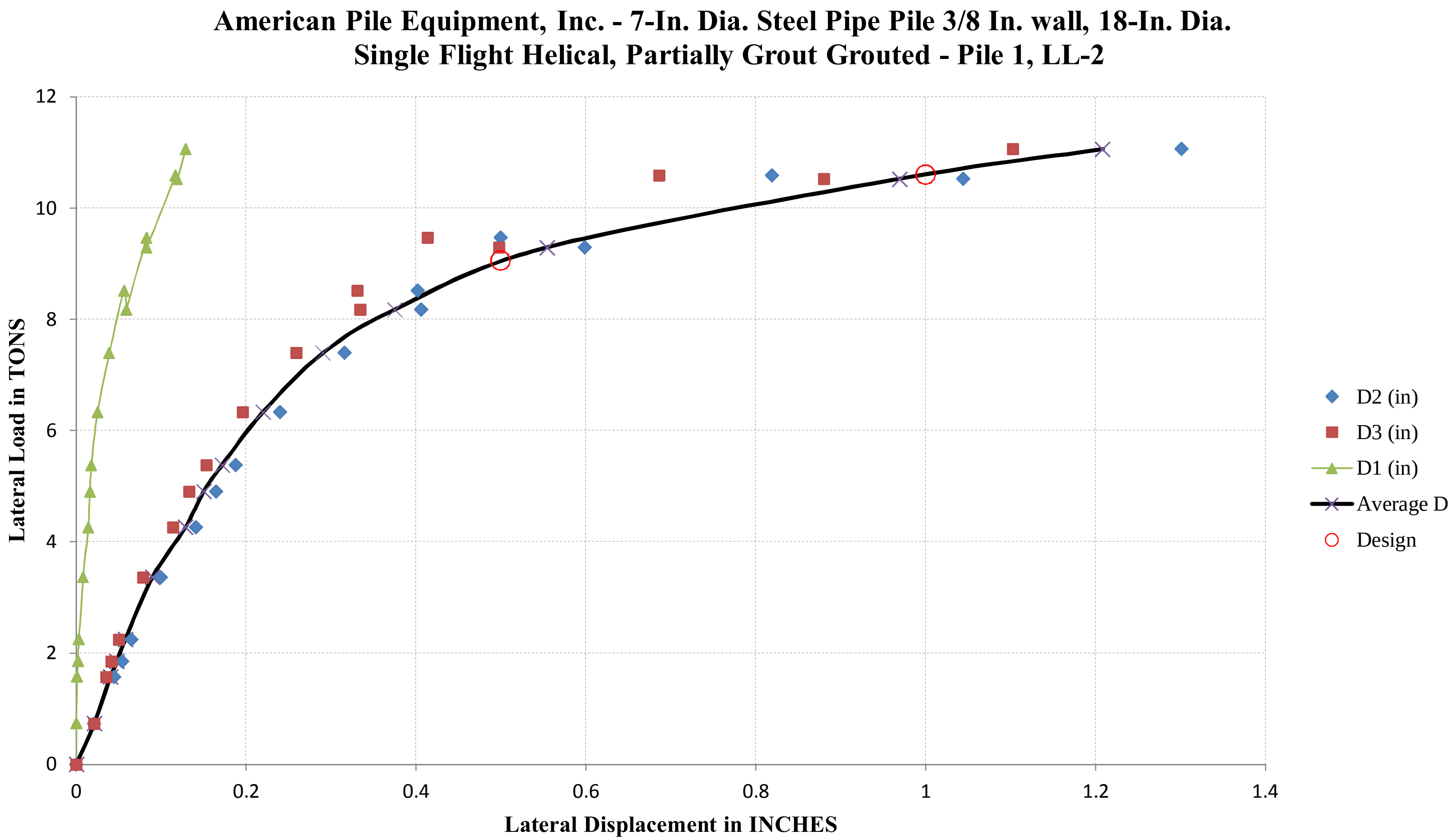
Figure 6



Note: 1. Pile Length approximately70 feet below grade
2. Grouting was inconsistent due to injection problems during installation
3. D1 is perpendicular to the loading direction. D2 is below the jack level, D3 is above the jack level
4. Pile rebounded suddenly due to lack of valve at the pump. No unload data are available

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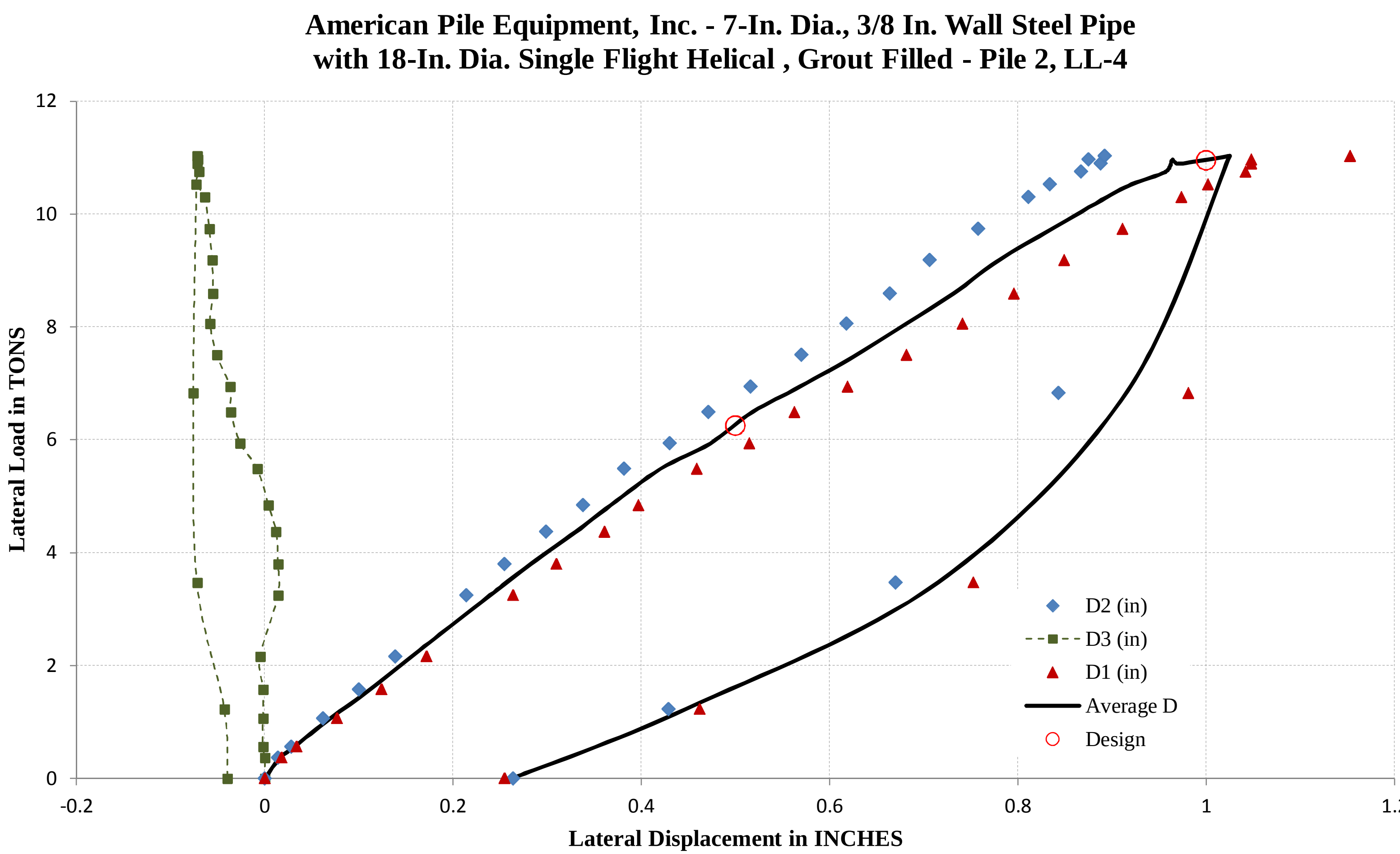
Figure 7



Note: 1. Pile Length approximately 59 feet below grade
2. Grouting was inconsistent due to injection problems during installation
3. D3 is perpendicular to the loading direction. D2 is below the jack level, D1 is above the jack level
4. Jack is 8 inches above grade

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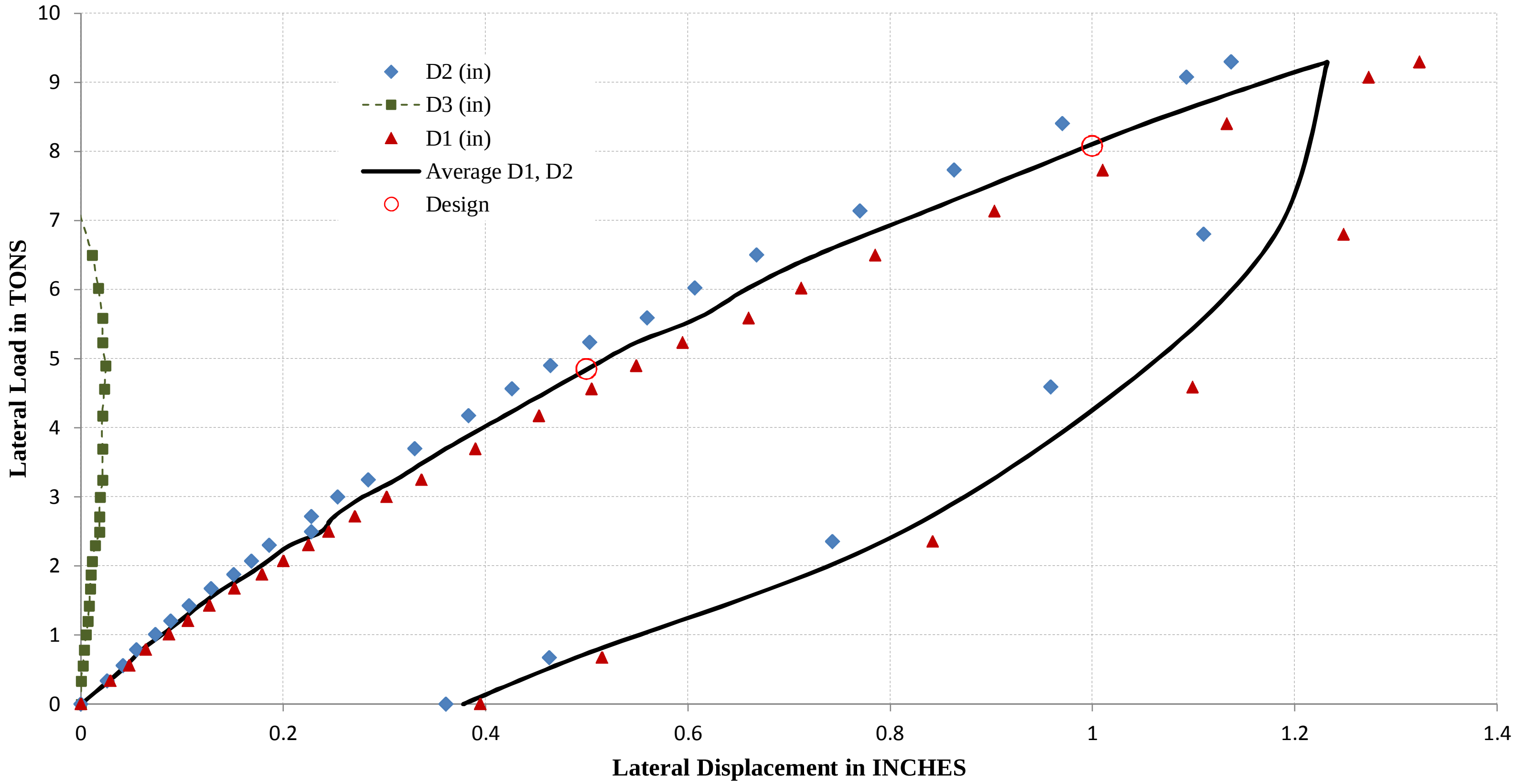
Figure 8

American Pile Equipment, Inc. - 7-In. Dia. 3/8 In. Wall Steel Pipe with 18-In. Dia. Single Flight Helical, No Grout - Pile 3, LL-6



Note:
1. Pile Length approximately 20 feet below grade
2. Pile was not grouted
3. D3 is perpendicular to the loading direction. D2 is below the jack level, D1 is above the jack level
4. Jack is 6.5 inches above grade

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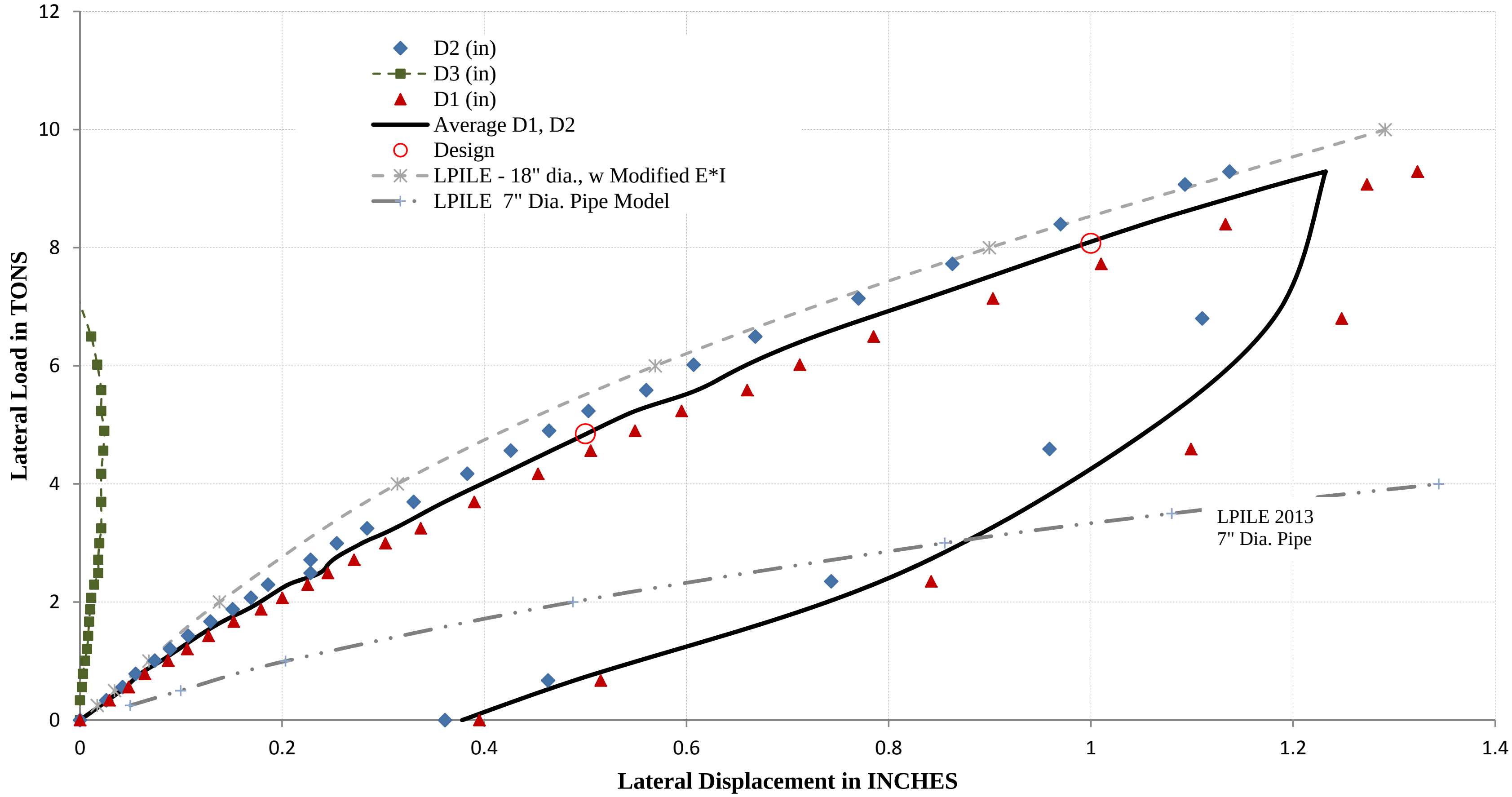
Figure 9

American Pile Equipment, Inc. - 7-In. Dia., Steel Pipe Pile 3/8" Wall, 18-inches Dia. Single Flight Helical , No Grout - with LPILE Model Results Pile 3, LL-6



Note: LPILE Model, I = I of Plate Dia., E = Es*As/A_{Plate}
Model Dia. = 18 inches

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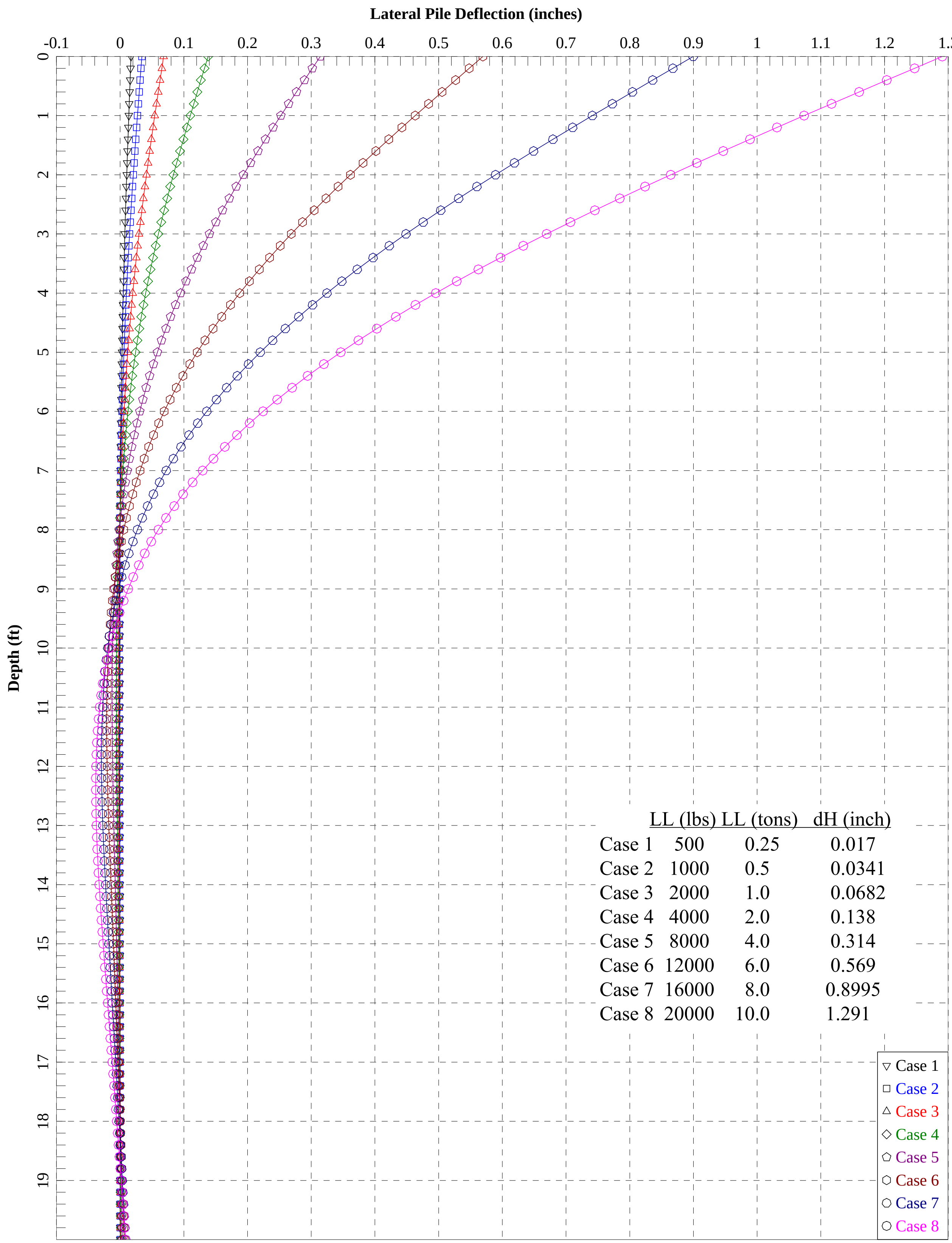
Figure 10



Ardaman & Associates, Inc. File: 14-55-9544 - APE Pile 3, LL-6 LPILE Model, Modified EI

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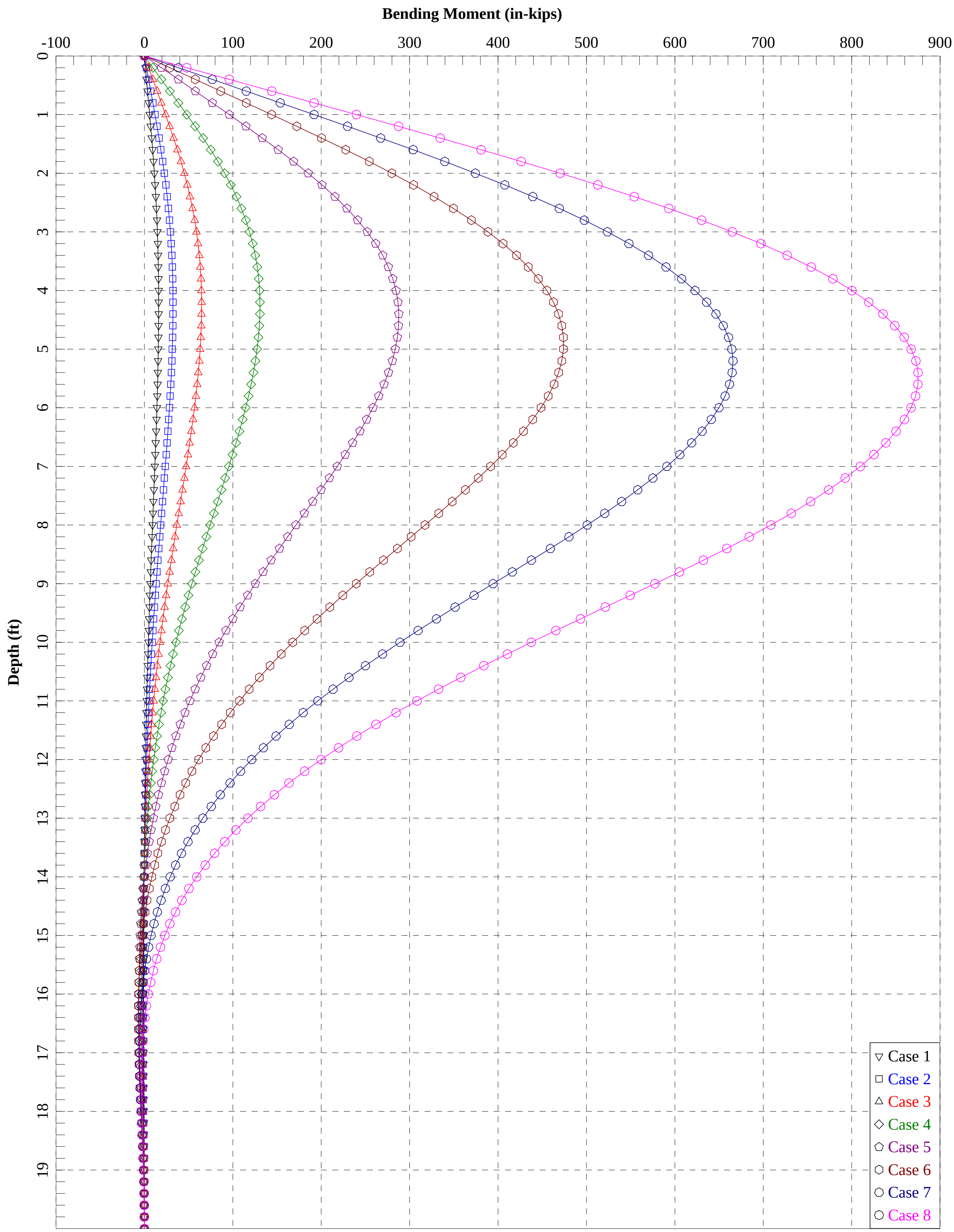
Figure 11



Ardaman & Associates, Inc. File: 14-55-9544 - APE Pile 3, LL-6 LPILE Model, Modified EI

Figure 12

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Appendix A

Madrid Engineering Group Letter
Standard Penetration Test Boring
Well Installation Log

American Piledriving Equipment, Inc.
14-55-9544

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

MADRID ENGINEERING GROUP, INC.
2030 State Road 60 E
Bartow, FL 33830
Ph: (863) 533-9007
Fax: (863) 533-8997
The Earth is Our Business

April 24, 2014

Mr. Matthew DeRextro
American Piledriving Equipment
1345 Industrial Park Road
Mulberry, FL 33860

Subject: Piezometer Installation and Soil Testing
MEG Project No. 11347

Dear Mr. DeRextro:

At your request Madrid Engineering Group, Inc. (MEG) completed one SPT boring and a piezometer installation at the subject property located at 1345 Industrial Park Road in Mulberry, Florida. It is known that the property lies on reclaimed land formerly strip-mined for phosphate. It should be noted that this type of mined land typcially includes mixed sand and clayey sand soils with possible layers of very soft waste phosphatic clay to depths of up to 30 to 40 feet below ground surface (bgs).

NRCS Soil Survey Review

Soils data from the United States Department of Agriculture – Natural Resources Conservation Service (NRCS; formerly the Soil Conservation Service, or SCS) were reviewed as part of the investigation. Based on a review of the available information, the mapped soil unit in the vicinity of the property was identified as **Pomona fine sand** (map unit 7) and **Neilhurst sand, 1 to 5 percent slopes** (map unit 12).

According to the NRCS, *this Pomona soil is poorly drained on broad areas on flatwoods. Areas of this soil range from 5 to several hundred acres. Slopes are smooth to concave and are 0 to 2 percent. Typically, this soil has a very dark gray fine sand surface layer about 6 inches thick. The subsurface layer to a depth of about 21 inches is sand. It is light brownish gray in the upper part and light gray in the lower part. The subsoil to a depth of about 26 inches is dark reddish brown loamy fine sand. Below that is very pale brown and light gray fine sand to a depth of about 48 inches, light gray fine sandy loam to a depth of about 60 inches, and light gray sandy clay loam to a depth of about 73 inches. The underlying material is light gray loamy sand to a depth of at least 80 inches. This Pomona soil is reported to have a seasonal high water table within 12 inches of the surface for 1 to 4 months during most years. The available water capacity is low. This soil is severely limited as a site for urban development because of wetness. The absorption fields can be elevated* *by adding fill material. The high water table interferes with proper functioning of septic tank absorption fields. To overcome the problems caused by wetness on sites used for buildings or local roads and streets, a drainage system can be installed to lower the high water table or fill material can be added to increase the effective depth to the high water table.*

According to the NRCS, *this excessively drained Neilhurst soil is on broad uplands and low knolls. It is formed in homogenous sandy material from phosphate and silica mining operations. Areas of this soil range from about 100 to 600 acres. Slopes are mainly smooth to concave. Typically, this soil has a grayish brown sand surface layer about 3 inches thick. The underlying material to a depth of at least 80 inches is light gray sand that is mixed with reddish brown and brown sand. Some areas have coarse sand or fragments of rock. This Neilhurst soil generally does not have a high water table within a depth of 80 inches; however, the water table can be within a depth of 30 inches for brief periods during the summer following heavy rainfall. The available water capacity is low.*

SPT Boring and Piezometer Installation

One standard penetration test (SPT) soil boring, designated SPT-1, was completed on April 21, 2014, using the mud-rotary drilling method. Soil samples were collected from the boreholes in general accordance with ASTM D1586 using a 1.4-inch I.D. split-spoon sampler driven with a 140-pound slide safety hammer falling a distance of 30 inches.

Boring SPT-1 was located in a grassy area along the south side of the property. In general, the SPT boring encountered medium dense to very loose fine sand from the ground surface to a depth of approximately 12 feet bgs followed by very loose silty sand to a depth of 17 feet bgs. This unit was underlain by very soft waste phosphatic clay and very loose clayey sand to a depth of 32 feet bgs followed by loose to medium dense clayey sand with phosphate to a depth of 47 feet bgs, stiff clay with phosphate to a depth of 52 feet bgs and medium dense to very dense clayey sand with phosphate to the boring termination depth at 70 feet bgs. The boring log is attached to this letter.

The water table was estimated by soil saturation at a depth of approximately 5 feet bgs. No loss of drilling fluid circulation was noted during the boring. Based on the data obtained, the surficial (approximate) 32 feet of soil has been affected by the strip-mining and reclamation process. Natural, un-altered soil exists below a depth of 32 feet bgs.

One Piezometer well was installed to a depth of 25 feet bgs approximately 2 to 3 feet from the location of boring SPT-1. The permit number for this well is 835799 as filed with the State of Florida Southwest Water Management District. Similar soil conditions were encountered during the piezometer installation as those encountered in the SPT boring. The Piezometer consists of a 2-inch diameter PVC casing (25 feet length plus riser pipe) with the bottom 10 feet slotted PVC. A filter pack and a cement grout seal were installed near the surface as shown on the attached diagram. A 2-foot square concrete pad and 3-

foot riser pipe are included. The water table was recorded at a depth of 5 feet bgs. The well was developed for approximately 30 minutes until clear after installation.

Limitations

The findings herein are based on the field investigation program conducted at the referenced site, research and review of previous data collected at the site, and our professional judgment. The conditions described within this report are accurate with respect to the location and extent described. Because conditions vary from place to place, conditions different from those encountered in our investigation may exist. The information in this report is intended for the sole use of the addressees and may not be relied upon, used by, or referenced by any third party. In the event conclusions and/or recommendations based on our data are made by others, such conclusions and/or recommendations are not our responsibility unless we have been given an opportunity to review and concur with them. MEG reserves the right to revise or update any of the observations, assessments, and/or recommendations as additional information becomes available or conditions change. No warranty regarding this investigation or the effectiveness of the stabilization measures is intended, nor should any be inferred.

Sincerely,
Madrid Engineering Group, Inc.

Robert L. Stach, P.G.
Chief Geologist
Florida P.E. No. 1732

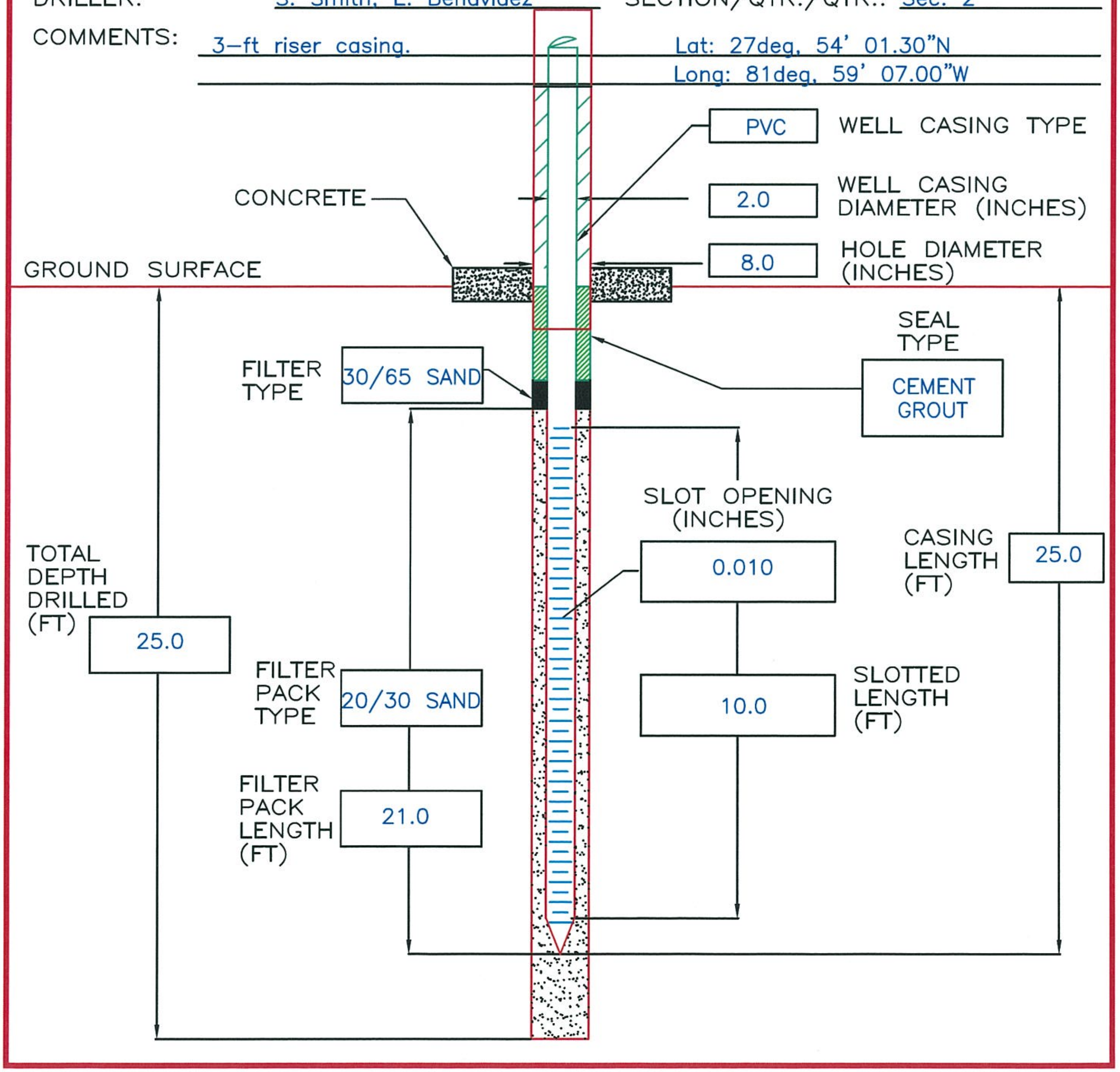
Attachments: SPT Boring Log
Piezometer Diagram

MADRID ENGINEERING GROUP, INC.

PIEZOMETER DIAGRAM

PROJECT NAME:	Piezometer Installation	PROJECT NO.:	11347
CLIENT:	A.P.E.	TOP OF CASING EL.:	
WELL NUMBER:		SURFACE EL.:	
DATE INSTALLED:	April 21, 2014	GROUNDWATER:	5 ft. depth
DRILLING METHOD:	Auger	INSPECTOR:	N/A
WELL DIAMETER:	2-inch	CITY/COUNTY:	Mulberry/Polk
PERMIT NUMBER:	835799	TOWNSHIP/RANGE:	T30S, R23E
DRILLER:	S. Smith, E. Benavidez	SECTION/QTR./QTR.:	Sec. 2

COMMENTS: 3-ft riser casing. Lat: 27deg, 54' 01.30"N Long: 81deg, 59' 07.00"W



Depth (ft)	DESCRIPTION	Elev. (ft)	Blows	N-Value
0	Medium dense, very pale brown, sand. (SP)		2-5-6-9	11
			7-6-7-8	13
	Loose, light gray.	▽ (5 ft)	3-3-4-3	7
	Very pale brown.		4-3-6-6	9
	Very loose.		1/12"-3-2	3
12	Very loose, gray, silty sand. (SM)		WOR/6"-1-1	2
17	Very soft, greenish gray, clay. (CH)		WOH/18" FAST	WOH
22	Very loose, pale brown, clayey sand. (SC)		WOH/18" FAST	WOH
27	Very soft, gray, clay. (CH)		WOH/18" FAST	WOH
32	Loose, greenish gray, calcareous clayey sand with abundant phosphate. (SC)		6-2-3	5
	Medium dense, pale yellow.		6-6-8	14
	Yellow.		4-5-7	12
47	Stiff, yellow, calcareous clay with phosphate. (CH)		5-4-8	12
52	Medium dense, yellow, calcareous clayey sand with phosphate. (SC)		4-5-7	12
	Greenish gray.		4-7-8	15
	Gray.		5-9-11	20
	Very dense, gray, calcareous clayey sand with phosphate and indurated fragments.		18-19-50/3"	Refusal

● STANDARD PENETRATION TEST (0, 10, 20, 30, 40, 60, 80, 100)

BORING LOCATION:

BORING NUMBER SPT-1
DATE DRILLED 4/21/2014
PROJECT NUMBER 11347
PROJECT American Piledriving Equipment

TEST BORING RECORD
MEG

REMARKS: No loss of circulation occurred. A surficial water table was encountered at 5 ft. bgs.

MEG — The Earth is Our Business

Appendix B

Load Test Jack Calibrations
Load Test Field Log Data
LPILE Output File

American Piledriving Equipment, Inc.
14-55-9544

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

Jaxx LLC

1920 Occidental AVE S Ste. E
Seattle, WA 98134
Ph. (206) 624-5299
Fax (206) 624-5298

American Piledriving Equipment
7032 S. 196th
Kent, WA 98032

Date: 10/7/2014

Report #	11039C

RE: Certification One (1) hydraulic ram, one (1) pump, one (1) gauge

Equipment:	Cylinder	Elect/Hyd Pump	PSI Gauge
Capacity:	10 TONS	10,000 PSI	0-10,000 PSI
Make:	BVA	Power Team	Wika
Model:	H1004	PE554	
Serial # (unit #):	H1405000125 (#3)	359104	

Calibration conforms to ANSI/NCSI. Z540-1
Test equiptment traceable to NIST
Certification valid until: 10/7/2015

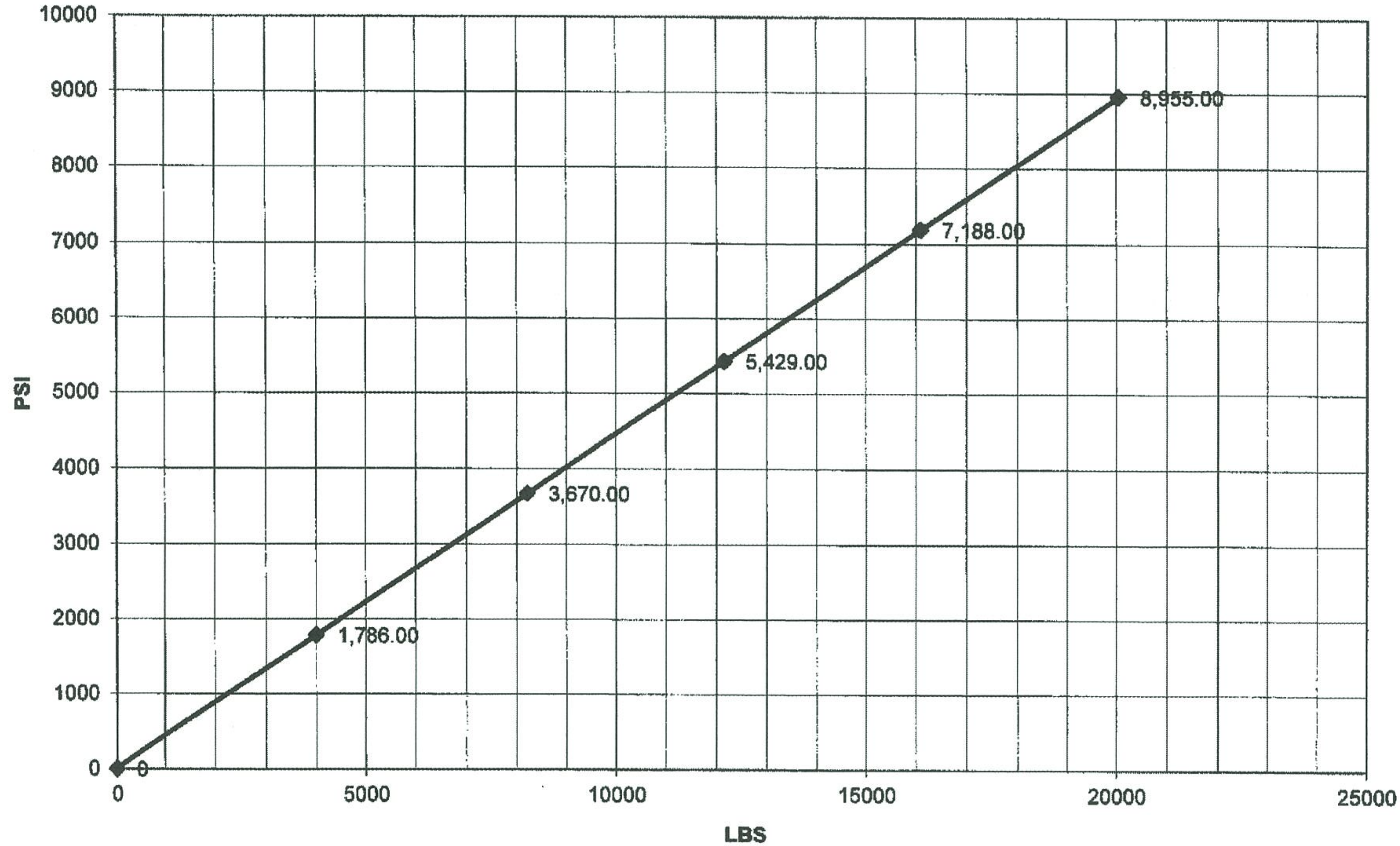
Average Reading (PSI)	Certified Readings (lbs)
0	0
1,786.00	4,000.00
3,670.00	8,220.00
5,429.00	12,160.00
7,188.00	16,100.00
8,955.00	20,060.00

Test Equiptment	S/N	Test Date	Recall Date	Test No.
CLC-400K	213351	12/10/2013	12/10/2014	97811

Patrick Marks
Service Technician

American Piledriving Equipment, Inc.
CALIBRATION CHART
#11039C

Power Team PE554 pump (s/n 3359104), BVA H1004 ram #3 (s/n H1405000125), Gauge



JAXX LLC
206-624-5299

10/7/2014

Jaxx LLC

1920 Occidental AVE S Ste. E
Seattle, WA 98134
Ph. (206) 624-5299
Fax (206) 624-5298

American Piledriving Equipment
7032 S. 196th
Kent, WA 98032

Date: 10/7/2014

Report #	11039B

RE: Certification One (1) hydraulic ram, one (1) pump, one (1) gauge

Equipment:	Cylinder	Elect/Hyd Pump	PSI Gauge
Capacity:	250 TONS	10,000 PSI	0-10,000 PSI
Make:	EAGLE PRO	Power Team	Wika
Model:	EDX-2506	PE554	
Serial # (unit #):	13052203-002 (#2)	359104	

Calibration conforms to ANSI/NCSI. Z540-1
Test equiptment traceable to NIST
Certification valid until: 10/7/2015

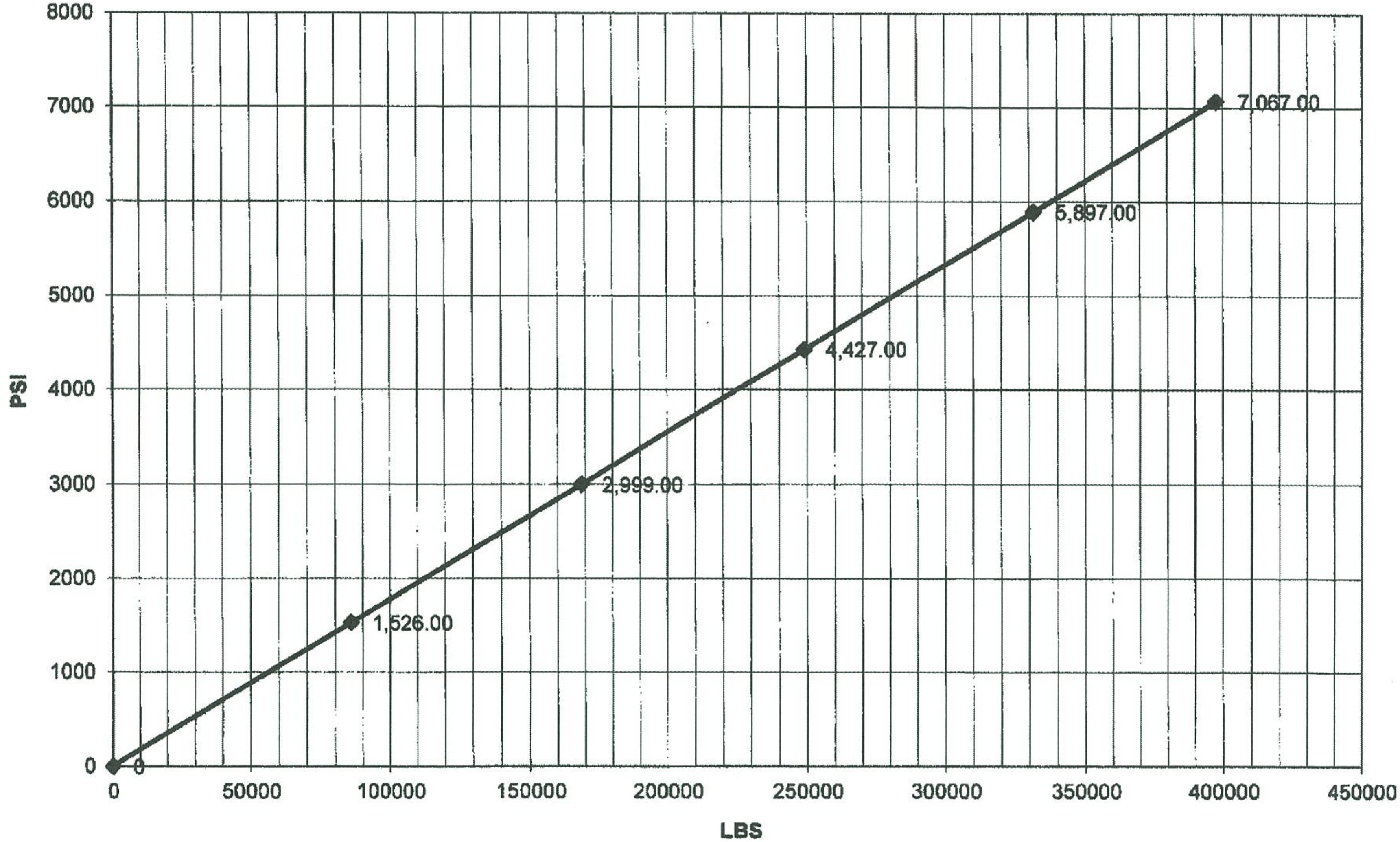
Average Reading (PSI)	Certified Readings (lbs)
0	0
1,526.00	85,880.00
2,999.00	168,760.00
4,427.00	249,160.00
5,897.00	331,880.00
7,067.00	397,740.00

Test Equiptment	S/N	Test Date	Recall Date	Test No.
CLC-400K	213351	12/10/2013	12/10/2014	97811

Patrick Marks
Service Technician

American Piledriving Equipment, Inc.
CALIBRATION CHART
#11039B

Power Team PE554 pump (s/n 359104), Eagle Pro EDX EDX-2506 ram #2 (s/n 13052203-002), Gauge



JAXX LLC
206-624-5299

10/7/2014

Ardaman & Associates, Inc.

Florida Certificate of Authorization No. 00005950

ARDAMAN & ASSOCIATES, INC.
3925 COCONUT PALM DRIVE, SUITE 115
TAMPA, FLORIDA 33619
Phone (813) 620-3389
FAX (813) 628-4008

COMPRESSIVE STRENGTH OF CONCRETE CYLINDERS

Project Name:	**Helical Pile Monitoring**	**Report Date:**	**11/6/2014**
Project Location:	**1345 Industrial Park Rd, Mulberry, Florida**	**File Number:**	**14-55-9544**
Project Client:	**American Piledriving Equipment**		
Project Contractor:	**Unknown**	**Concrete Supplier:**	**Unknown**

DESIGN DATA

Specified Compressive Strength: **Unknown** psi @ **28** days	Slump (inches): **Unknown**	Air Content (percent): **N/A**	Product Code: **Unknown**

Mix Type: [X] Normal Wt. [ ] Lightweight [ ] Mortar Mix [ ] Grout [ ] Other

[X] Transit Mixed [ ] Pump Mixed [ ] Other

FIELD AND LAB DATA

Date: **6/25/2014**	Time Concrete Batched: **Unknown**	Time Concrete Sampled[1]: **Unknown**	Sampled By: **AM**
Concrete Truck No: **Unknown**	Ticket Number: **Unknown**	Size of Load (C.Y.): **Unknown**	Weather Conditions: **Unknown**
Water Added at Job Site: [ ] Yes [X] No If Yes: Gal. To C.Y.			Extra Water Authorized By: **N/A**
Slump (inches)[2]: **Unknown**	Air Temperature (° F): **Unknown**	Concrete Temperature (° F)[3]: **Unknown**	Wet Weight (P.C.F.): **N/A**
Air Content (% by Vol)[4]: **N/A**	Molded and Cured[5] to general accordance with ASTM C-31: [X] Yes [ ] No [ ] Unknown		Tested to ASTM C-39: [X] Yes [ ] No

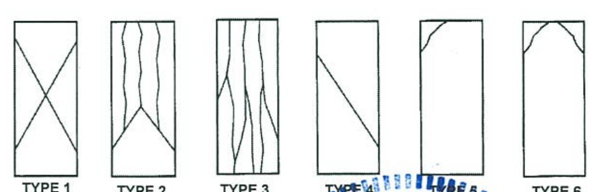
Location of Concrete Placement: **Unknown**

Set No. 1	Date Received In Lab	Date Tested	Age (days)	Test Specimen Size Diameter (in.)	Test Specimen Size Area (sq. in.)	Total Load Applied (lbs)	Test Strength (psi)	Type of Fracture	Specimen Weight (Air Dry-lbs)
a	11/5/2014	11/5/14	133	4.00	12.57	126,950	10,100	5	
b		11/5/14	133	3.97	12.38	105,781	8,550	5	
c		11/5/14	133	4.01	12.63	125,151	9,910	5	

REMARKS:

1 - Representative sample of concrete collected in accordance with ASTM C-172.
2 - Slump measurement performed in accordance with ASTM C-143.
3 - Temperature of representative sample determined in accordance with ASTM C-1064.
4 - Air content of representative sample of concrete determined in accordance with ASTM C-231.
5 - Concrete specimen cured in accordance with ASTM C-31 after being received in laboratory.

Type of Fractures



CMEC Accreditation No. 1001527
AASHTO R18
ASTM E329, C1077 and D3740

By: 11/7/14

Philip P. Schlossnagle, P.E.
Florida License No. 60922

APE Helical Pipe Piles
14-55-9544 - APE, Mulberry, FL
Ardaman & Associates, Inc. - Tampa, FL
LT-1 W Pile - Pile 1
Jack Load Calculation

Pile Flight	17	in dia.
Pipe:	7	in dia.
Pipe Wall	0.375	inch

Tip 'aT =	1.57625	sq. ft.
As =	7.804894	Sq. inches
Ag =	30.67962	sq. inches
Qb =	53.90777	Tons
Qf =	153.1526	Tons

Ram Area: 56.28 in^2

Pump Pressure (psi)	Jack Load (tons)	Pump Pressure (psi)	Test Load (tons)
-------------	-------------		
1000	28.14	500	14.07
2000	56.28	1000	28.14
3000	84.42	1500	42.21
4000	112.56	2000	56.28
5000	140.7	3000	84.42
6000	168.84	4000	112.56
7000	196.98	5000	140.7
8000	225.12	6000	168.84
8750	246.225	7000	196.98

Calibration			Load Test		D1 (in)	D2 (in)	D3 (in)		Δ1 (in)	Δ2 (in)	Δ3 (in)	Average Δ	Best Fit Data load	dZ
0	0		0	0	0.762	0.78	0.822		0	0	0	0	0	0
1526	42.94		945	26.5923	0.711	0.738	0.786	10:22:36	0.051	0.042	0.036	0.043	26.5923	0.043
2999	84.38		1750	49.245	0.465	0.495	0.545	10:25	0.297	0.285	0.277	0.286333	45.7275	0.299333
4427	124.58		1690	47.5566	0.457	0.491	0.541	10:27	0.305	0.289	0.281	0.291667	52.7625	0.369
5897	165.94		1575	44.3205	0.457	0.49	0.54	10:29	0.305	0.29	0.282	0.292333	56.28	0.440167
7067	198.87		1625	45.7275	0.451	0.47	0.545	10:31	0.311	0.31	0.277	0.299333	59.6568	0.678
			1975	55.5765	0.393	0.411	0.476	10:33	0.369	0.369	0.346	0.361333	66.129	0.817
			1900	53.466	0.388	0.406	0.472	10:34	0.374	0.374	0.35	0.366	68.5209	1.058333
			1890	53.1846	0.386	0.404	0.469	10:35	0.376	0.376	0.353	0.368333	70.35	1.205333
			1875	52.7625	0.384	0.404	0.469	10:36:36	0.378	0.376	0.353	0.369	73.164	1.531667
			2100	59.094	0.299	0.317	0.38		0.463	0.463	0.442	0.456		
			2075	58.3905	0.295	0.314	0.378	10:39	0.467	0.466	0.444	0.459	73.164	1.531667
			2025	56.9835	0.29	0.308	0.373	10:42	0.472	0.472	0.449	0.464333	25.326	1.48
			2000	56.28	0.2885	0.384	0.371	10:47	0.4735	0.396	0.451	0.440167	1.407	1.407
			2275	64.0185	0.085	0.101	0.162	10:48	0.677	0.679	0.66	0.672		
			2200	61.908	0.078	0.094	0.156	10:57	0.684	0.686	0.666	0.678667		
			2100	59.094	0.075	0.091	0.153	11:02	0.687	0.689	0.669	0.681667		
		R1	2100	59.094	0.078	0.095	0.157	11:08	0.684	0.685	0.665	0.678		
		R1	2120	59.6568	0.813	0.642	0.842	11:14	0.684	0.685	0.665	0.678		
			2450	68.943	0.688	0.514	0.712	11:15	0.809	0.813	0.795	0.805667		
			2400	67.536	0.679	0.506	0.699	11:20	0.818	0.821	0.808	0.815667		
			2350	66.129	0.678	0.505	0.697	11:24	0.819	0.822	0.81	0.817		
			2650	74.571	0.455	0.275	0.457	11:25	1.042	1.052	1.05	1.048		
			2500	70.35	0.438	0.275	0.457	11:30	1.059	1.052	1.05	1.053667		
		R2	2500	70.35	0.438	0.264	0.456	11:34	1.059	1.063	1.051	1.057667		
		R2	2400	67.536	0.797	0.908	0.884	11:38	1.059	1.063	1.051	1.057667		
			2400	67.536	0.797	0.908	0.884	11:40	1.059	1.063	1.051	1.057667		
			2435	68.5209	0.8	0.909	0.884	11:41	1.062	1.062	1.051	1.058333		
			2675	75.2745	0.665	0.771	0.744	11:44	1.197	1.2	1.191	1.196		
			2600	73.164	0.654	0.762	0.737	11:48	1.208	1.209	1.198	1.205		
			2500	70.35	0.654	0.762	0.736	11:54	1.208	1.209	1.199	1.205333		
			2700	75.978	0.356	0.448	0.42	11:57	1.506	1.523	1.515	1.514667		
			2625	73.8675	0.336	0.44	0.412	12:01	1.526	1.531	1.523	1.526667		
			2600	73.164	0.327	0.433	0.413	2:09	1.535	1.538	1.522	1.531667		
			2600	73.164	0.327	0.433	0.413	2:09	1.535	1.538	1.522	1.531667		
			800	22.512	0.379	0.482	0.458	12:11	1.483	1.489	1.477	1.483		
			800	22.512	0.379	0.482	0.458	12:11	1.483	1.489	1.477	1.483		
			850	23.919	0.384	0.486	0.46	12:14	1.478	1.485	1.475	1.479333		
			900	25.326	0.383	0.485	0.46	12:22	1.479	1.486	1.475	1.48		
			0	0	0.51	0.601	0.565	12:23	1.352	1.37	1.37	1.364		
			20	0.5628	0.515	0.606	0.57	12:27	1.347	1.365	1.365	1.359		
			50	1.407	0.521	0.61	0.574	12:33	1.341	1.361	1.361	1.354333		

APE Helical Pipe Piles
14-55-9544 - APE, Mulberry, FL
Ardaman & Associates, Inc. - Tampa, FL
Lateral Load Test LL-2
Jack Load Calculation

Pile Flight	17	in dia.
Pipe:	7	in dia.
Pipe Wall	0.375	inch

Tip 'aT =	1.57625	sq. ft.
As =	7.804894	Sq. inches
Ag =	30.67962	sq. inches
Qb =	53.90777	Tons
Qf =	153.1526	Tons

Ram Area: 56.28 in^2

Pump Pressure (psi)	Jack Load (tons)		Pump Pressure (psi)	Test Load (tons)	D1 (in)	D2 (in)	D3 (in)	Δ1 (in)	Δ2 (in)	Δ3 (in)	Average Δ		
-------------	-------------												
			250	0.28							SQRT(((Δ2+Δ3)/2)^2+Δ1^2)		
			500	0.56									
			750	0.84									
			1000	1.12									
			1250	1.4									
			1500	1.68									
			1750	1.96									
			2000	2.24									
			2125	2.38									
												P (tons)	Best Fit Δ
Calibration			Load Test										
0	0	0.00112	0	0	0.358	-0.026	0.169	0	0	0	0	0	0
1786	2		650	0.728	0.358	-0.005	0.19	0	0.021	0.021	0.021	0.728	0.021
3670	4.11		1400	1.568	0.357	0.019	0.204	0.001	0.045	0.035	0.040012	1.568	0.040012
5429	6.08		1650	1.848	0.356	0.028	0.2105	0.002	0.054	0.0415	0.047792	1.848	0.047792
7188	8.05		2000	2.24	0.355	0.039	0.219	0.003	0.065	0.05	0.057578	2.24	0.057578
8955	10.03		3000	3.36	0.35	0.074	0.2475	0.008	0.1	0.0785	0.089608	3.36	0.089608
			3800	4.256	0.344	0.115	0.283	0.014	0.141	0.114	0.128266	4.256	0.128266
			4375	4.9	0.342	0.139	0.302	0.016	0.165	0.133	0.149857	4.9	0.149857
			4800	5.376	0.34	0.162	0.322	0.018	0.188	0.153	0.171448	5.376	0.171448
			5650	6.328	0.333	0.214	0.365	0.025	0.24	0.196	0.219429	6.328	0.219429
			6600	7.392	0.319	0.29	0.428	0.039	0.316	0.259	0.290133	7.392	0.290133
			7600	8.512	0.302	0.376	0.5	0.056	0.402	0.331	0.370754	8.176	0.374921
		R	7300	8.176	0.299	0.38	0.5035	0.059	0.406	0.3345	0.374921	9.296	0.554497
		R	7300	8.176	0.712	0.338	0.5	0.059	0.406	0.3345	0.374921	10.528	0.96958
			8450	9.464	0.688	0.432	0.579	0.083	0.5	0.4135	0.46423	11.06	1.208654
			8300	9.296	0.688	0.437	0.584	0.083	0.599	0.4975	0.554497		
			9450	10.584	0.654	0.558	0.689	0.117	0.819	0.6865	0.761788		
			9400	10.528	0.652	0.563	0.694	0.119	1.044	0.8805	0.96958		
			9875	11.06	0.642	0.595	0.722	0.129	1.301	1.1025	1.208654		
			0	0	0.762	0.035	0.255						

APE Helical Pipe Piles
14-55-9544 - APE, Mulberry, FL
Ardaman & Associates, Inc. - Tampa, FL
LT-3W Pile
Jack Load Calculation

Pile Flight	18	in dia.
Pipe:	7	in dia.
Pipe Wall	0.375	inch

Tip 'aT =	1.767146	sq. ft.
As =	7.804894	Sq. inches
Ag =	30.67962	sq. inches
Qb =	60.43639	Tons
Qf =	153.1526	Tons

Ram Area: 56.28 in^2

Pump Pressure (psi)	Jack Load (tons)
1000	28.14
2000	56.28
3000	84.42
4000	112.56
5000	140.7
6000	168.84
7000	196.98
8000	225.12
8750	246.225

Pump Pressure (psi)	Test Load (tons)
500	14.07
1000	28.14
1500	42.21
2000	56.28
3000	84.42
4000	112.56
5000	140.7
6000	168.84
7000	196.98

Calibration

0	0
1526	42.94
2999	84.38
4427	124.58
5897	165.94
7067	198.87

Load Test

Pump Pressure (psi)	Test Load (tons)	D1 (in)	D2 (in)	D3 (in)		Δ1 (in)	Δ2 (in)	Δ3 (in)	Avg
0	0	0.668	0.357	0.34		0	0	0	0
950	26.733	0.688	0.395	0.373		0.02	0.038	0.033	0.030333
1800	50.652	0.739	0.452	0.435	14:33	0.071	0.095	0.095	0.087
2725	76.6815	0.787	0.508	0.469	14:38	0.119	0.151	0.129	0.133
3700	104.118	0.8665	0.593	0.586	14:42	0.1985	0.236	0.246	0.226833
4675	131.5545	0.973	0.6995	0.691		0.305	0.3425	0.351	0.332833
5475	154.0665	1.015	0.814	0.797		0.347	0.457	0.457	0.420333
5800	163.212	1.174	0.889	0.864		0.506	0.532	0.524	0.520667
6075	170.9505	1.29	1.004	0.97		0.622	0.647	0.63	0.633
6800	191.352	1.31	1.025	0.993		0.642	0.668	0.653	0.654333
6800	191.352	1.436	1.136	1.092		0.768	0.779	0.752	0.766333
6800	191.352	1.436	1.136	1.092		0.768	0.779	0.752	0.766333
4000	112.56	1.339	1.041	0.995		0.671	0.684	0.655	0.67
2100	59.094	1.146	0.848	0.806		0.478	0.491	0.466	0.478333
1100	30.954	1.035	0.734	0.69		0.367	0.377	0.35	0.364667
0	0	0.967	0.63	0.535		0.299	0.273	0.195	0.255667

APE Helical Pipe Piles
14-55-9544 - APE, Mulberry, FL
Ardaman & Associates, Inc. - Tampa, FL
Lateral Load Test LL-4
Jack Load Calculation

Pile Flight	18	in dia.	
Pipe:	7	in dia.	
Pipe Wall	0.375	inch	
Tip 'aT =	1.767146	sq. ft.	
As =	7.804894	Sq. inches	
Ag =	30.67962	sq. inches	
Qb =	60.43639	Tons	
Qf =	153.1526	Tons	

Ram Area: 56.28 in^2

Pump Pressure (psi)	Jack Load (tons)
-------------	-------------

Pump Pressure (psi)	Test Load (tons)
250	0.28
500	0.56
750	0.84
1000	1.12
1250	1.4
1500	1.68
1750	1.96
2000	2.24
2125	2.38

Average Δ = SQRT(((Δ1+Δ2)/2)^2+Δ3^2)

Calibration			Load Test		D1 (in)	D2 (in)	D3 (in)	Δ1 (in)	Δ2 (in)	Δ3 (in)	Average Δ
0	0	0.00112	0	0	0.3	0.3	0.6	0	0	0	0
1786	2		325	0.364	0.318	0.314	0.6	0.018	0.014	0	0.016
3670	4.11		500	0.56	0.334	0.328	0.598	0.034	0.028	-0.002	0.031064
5429	6.08		950	1.064	0.377	0.362	0.598	0.077	0.062	-0.002	0.069529
7188	8.05		1410	1.5792	0.424	0.4	0.598	0.124	0.1	-0.002	0.112018
8955	10.03		1925	2.156	0.472	0.439	0.595	0.172	0.139	-0.005	0.15558
			2900	3.248	0.564	0.514	0.614	0.264	0.214	0.014	0.23941
			3395	3.8024	0.61	0.555	0.614	0.31	0.255	0.014	0.282847
			3900	4.368	0.661	0.599	0.612	0.361	0.299	0.012	0.330218
			4325	4.844	0.697	0.638	0.604	0.397	0.338	0.004	0.367522
			4900	5.488	0.759	0.682	0.592	0.459	0.382	-0.008	0.420576
			5300	5.936	0.815	0.73	0.574	0.515	0.43	-0.026	0.473215
			5800	6.496	0.863	0.771	0.564	0.563	0.471	-0.036	0.518252
			6200	6.944	0.919	0.816	0.563	0.619	0.516	-0.037	0.568705
			6700	7.504	0.982	0.87	0.549	0.682	0.57	-0.051	0.628074
			7200	8.064	1.041	0.918	0.542	0.741	0.618	-0.058	0.681971
			7675	8.596	1.096	0.964	0.545	0.796	0.664	-0.055	0.732069
			8200	9.184	1.149	1.006	0.544	0.849	0.706	-0.056	0.779514
			8700	9.744	1.211	1.058	0.541	0.911	0.758	-0.059	0.836583
			9200	10.304	1.274	1.111	0.536	0.974	0.811	-0.064	0.894792
			9400	10.528	1.302	1.134	0.527	1.002	0.834	-0.073	0.920898
			9600	10.752	1.342	1.167	0.53	1.042	0.867	-0.07	0.957063
			9790	10.9648	1.348	1.175	0.529	1.048	0.875	-0.071	0.964118
		R D1	9725	10.892	1.09	1.188	0.528	1.048	0.888	-0.072	0.970674
			9850	11.032	1.195	1.192	0.528	1.153	0.892	-0.072	1.025032
			9850	11.032	1.195	1.192	0.528	1.153	0.892	-0.072	1.025032
			6100	6.832	1.023	1.143	0.524	0.981	0.843	-0.076	0.915161
			3100	3.472	0.795	0.97	0.528	0.753	0.67	-0.072	0.715134
			1100	1.232	0.504	0.729	0.557	0.462	0.429	-0.043	0.44757
			0	0	0.297	0.564	0.56	0.255	0.264	-0.04	0.262565

APE Helical Pipe Piles
14-55-9544 - APE, Mulberry, FL
Ardaman & Associates, Inc. - Tampa, FL
Pile 3, LT-5 Pile
Jack Load Calculation

Pile Flight	18	in dia.	
Pipe:	7	in dia.	
Pipe Wall	0.375	inch	
Tip 'aT =	1.767146	sq. ft.	
As =	7.804894	Sq. inches	
Ag =	30.67962	sq. inches	
Qb =	60.43639	Tons	
Qf =	153.1526	Tons	

Ram Area: 56.28 in^2

Pump Pressure (psi)	Jack Load (tons)	Pump Pressure (psi)	Test Load (tons)	D1 (in)	D2 (in)	D3 (in)	Δ1 (in)	Δ2 (in)	Δ3 (in)	Avg Δ1:Δ3 (in)
-------------	-------------									
1000	28.14	500	14.07							
2000	56.28	1000	28.14							
3000	84.42	1500	42.21							
4000	112.56	2000	56.28							
5000	140.7	3000	84.42							
6000	168.84	4000	112.56							
7000	196.98	5000	140.7							
8000	225.12	6000	168.84							
8750	246.225	7000	196.98							
Calibration		Load Test								
0	0	0	0	0.196	0.195	0.195	0	0	0	0
1526	42.94	200	5.628	0.218	0.216	0.216	0.022	0.021	0.021	0.021333
2999	84.38	325	9.1455	0.283	0.274	0.264	0.087	0.079	0.069	0.078333
4427	124.58	450	12.663	0.448	0.436	0.416	0.252	0.241	0.221	0.238
5897	165.94	450	12.663	1.077	1.066	1.047	0.881	0.871	0.852	0.868
7067	198.87									
		450	12.663	1.077	1.066	1.047	0.881	0.871	0.852	0.868
		300	8.442	1.07	1.059	1.043	0.874	0.864	0.848	0.862
		200	5.628	1.06	1.05	1.035	0.864	0.855	0.84	0.853
		0	0	1.018	1.008	0.994	0.822	0.813	0.799	0.811333
		0	0	1.018	1.008	0.994	0.822	0.813	0.799	0.811333
		200	5.628	1.042	1.032	1.017	0.846	0.837	0.822	0.835
		390	10.9746	1.079	1.032	1.049	0.883	0.837	0.854	0.858
		415	11.6781	1.203	1.191	1.174	1.007	0.996	0.979	0.994
		425	11.9595	1.331	1.318	1.302	1.135	1.123	1.107	1.121667
		425	11.9595	1.578	1.566	1.6	1.382	1.371	1.405	1.386
		425	11.9595	1.578	1.566	1.6	1.382	1.371	1.405	1.386
		200	5.628	1.571	1.559	1.514	1.375	1.364	1.319	1.352667
		0	0	1.513	1.503	1.49	1.317	1.308	1.295	1.306667

APE Helical Pipe Piles
14-55-9544 - APE, Mulberry, FL
Ardaman & Associates, Inc. - Tampa, FL
Lateral Load Test Pile 3, LL-6
Jack Load Calculation

Pile Flight	18	in dia.
Pipe:	7	in dia.
Pipe Wall	0.375	inch

Tip 'aT =	1.767146	sq. ft.
As =	7.804894	Sq. inches
Ag =	30.67962	sq. inches
Qb =	60.43639	Tons
Qf =	153.1526	Tons

Ram Area: 56.28 in^2

Pump Pressure (psi)	Jack Load (tons)		Pump Pressure (psi)	Test Load (tons)	D1 (in)	D2 (in)	D3 (in)	Δ1 (in)	Δ2 (in)	Δ3 (in)	Average Δ1, Δ2
-------------	-------------										
			250	0.28						SQRT(((Δ1+Δ2)/2)^2+Δ3^2)	
			500	0.56							
			750	0.84							
			1000	1.12							
			1250	1.4							
			1500	1.68							
			1750	1.96							
			2000	2.24							
			2125	2.38							
Calibration			Load Test								
0	0	0.00112	0	0	0.602	0.701	1.099	0	0	0	0
1786	2		300	0.336	0.631	0.727	1.2	0.029	0.026	0	0.0275
3670	4.11		500	0.56	0.65	0.743	1.202	0.048	0.042	0.002	0.045044
5429	6.08		700	0.784	0.666	0.756	1.203	0.064	0.055	0.003	0.059576
7188	8.05		900	1.008	0.689	0.775	1.205	0.087	0.074	0.005	0.080655
8955	10.03		1075	1.204	0.708	0.79	1.207	0.106	0.089	0.007	0.097751
			1275	1.428	0.729	0.808	1.208	0.127	0.107	0.008	0.117273
			1490	1.6688	0.754	0.83	1.209	0.152	0.129	0.009	0.140788
			1675	1.876	0.781	0.852	1.21	0.179	0.151	0.01	0.165303
			1850	2.072	0.802	0.87	1.211	0.2	0.169	0.011	0.184828
			2050	2.296	0.827	0.887	1.214	0.225	0.186	0.014	0.205976
			2225	2.492	0.847	0.929	1.218	0.245	0.228	0.018	0.237184
			2425	2.716	0.873	0.929	1.218	0.271	0.228	0.018	0.250148
			2675	2.996	0.904	0.955	1.219	0.302	0.254	0.019	0.278649
			2900	3.248	0.939	0.985	1.221	0.337	0.284	0.021	0.311209
			3300	3.696	0.992	1.031	1.221	0.39	0.33	0.021	0.360612
			3725	4.172	1.055	1.084	1.221	0.453	0.383	0.021	0.418527
			4075	4.564	1.107	1.127	1.223	0.505	0.426	0.023	0.466068
			4375	4.9	1.151	1.165	1.224	0.549	0.464	0.024	0.507068
			4675	5.236	1.197	1.204	1.221	0.595	0.503	0.021	0.549401
			4990	5.5888	1.262	1.261	1.221	0.66	0.56	0.021	0.610361
			5375	6.02	1.314	1.308	1.217	0.712	0.607	0.017	0.659719
			5800	6.496	1.387	1.369	1.211	0.785	0.668	0.011	0.726583
			6375	7.14	1.505	1.471	1.198	0.903	0.77	-0.002	0.836502
			6900	7.728	1.612	1.564	1.186	1.01	0.863	-0.014	0.936605
			7500	8.4	1.735	1.671	1.167	1.133	0.97	-0.033	1.052018
			8100	9.072	1.875	1.794	1.139	1.273	1.093	-0.061	1.184572
			8295	9.2904	1.925	1.838	1.127	1.323	1.137	-0.073	1.232164
			8295	9.2904	1.925	1.838	1.127	1.323	1.137	-0.073	1.232164
			6075	6.804	1.85	1.811	1.131	1.248	1.11	-0.069	1.181017
			4100	4.592	1.701	1.66	1.156	1.099	0.959	-0.044	1.02994
			2100	2.352	1.444	1.444	1.181	0.842	0.743	-0.019	0.792728
			600	0.672	1.117	1.164	1.195	0.515	0.463	-0.005	0.489026
			0	0	0.997	1.062	1.197	0.395	0.361	-0.003	0.378012

Pile 4, LT-7, Vertical Load Test

APE Helical Pipe Piles
14-55-9544 - APE, Mulberry, FL
Ardaman & Associates, Inc. - Tampa, FL
Pile 4, LT-7 Pile
Jack Load Calculation

Pile Flight	17	in dia.
Pipe:	7	in dia.
Pipe Wall	0.375	inch

Tip 'aT =	1.57625	sq. ft.
As =	7.804894	Sq. inches
Ag =	30.67962	sq. inches
Qb =	53.90777	Tons
Qf =	153.1526	Tons

Qs =	195.1224	Tons
Qg =	76.69904	
QT =	271.8214	

Ram Area: 56.28 in^2

Pump Pressure (psi)	Jack Load (tons)	Pump Pressure (psi)	Test Load (tons)
-------------	-------------		
1000	28.14	500	14.07
2000	56.28	1000	28.14
3000	84.42	1500	42.21
4000	112.56	2000	56.28
5000	140.7	3000	84.42
6000	168.84	4000	112.56
7000	196.98	5000	140.7
8000	225.12	6000	168.84
8750	246.225	7000	196.98

Calibration

0	0
1526	42.94
2999	84.38
4427	124.58
5897	165.94
7067	198.87

Load Test

Pump Pressure (psi)	Test Load (tons)	D1 (in)	D2 (in)	D3 (in)			D1 (in)	D2 (in)	D3 (in)		Average
0	0	1.814	1.889	1.85			0	0	0		0
200	5.628	1.774	1.872	1.838			-0.04	-0.017	-0.012		-0.023
390	10.9746	1.756	1.861	1.825			-0.058	-0.028	-0.025		-0.037
575	16.1805	1.78	1.881	1.839			-0.034	-0.008	-0.011		-0.01767
200	5.628	0.291	0.108	0.128			0	0	0		0
400	11.256	0.306	0.127	0.148			-0.015	-0.019	-0.02		-0.018
590	16.6026	0.323	0.143	0.163			-0.032	-0.035	-0.035		-0.034
750	21.105	0.351	0.166	0.184			-0.06	-0.058	-0.056		-0.058
950	26.733	0.384	0.193	0.206			-0.093	-0.085	-0.078		-0.08533
1120	31.5168	0.419	0.224	0.235			-0.128	-0.116	-0.107		-0.117
1390	39.1146	0.462	0.263	0.271			-0.171	-0.155	-0.143		-0.15633
1550	43.617	0.506	0.303	0.31			-0.215	-0.195	-0.182		-0.19733
1725	48.5415	0.5485	0.344	0.349			-0.2575	-0.236	-0.221		-0.23817
1905	53.6067	0.592	0.385	0.388			-0.301	-0.277	-0.26		-0.27933
2125	59.7975	0.636	0.427	0.43			-0.345	-0.319	-0.302		-0.322
2300	64.722	0.681	0.4695	0.471			-0.39	-0.3615	-0.343		-0.36483
2500	70.35	0.729	0.515	0.516			-0.438	-0.407	-0.388		-0.411
2750	77.385	0.771	0.557	0.557			-0.48	-0.449	-0.429		-0.45267
2900	81.606	0.812	0.5975	0.597			-0.521	-0.4895	-0.469		-0.49317
3290	92.5806	0.902	0.686	0.685			-0.611	-0.578	-0.557		-0.582
3690	103.8366	0.995	0.777	0.775			-0.704	-0.669	-0.647		-0.67333
4050	113.967	1.085	0.866	0.863			-0.794	-0.758	-0.735		-0.76233
4425	124.5195	1.178	0.955	0.951			-0.887	-0.847	-0.823		-0.85233
4825	135.7755	1.279	1.055	1.05			-0.988	-0.947	-0.922		-0.95233
5200	146.328	1.372	1.147	1.142			-1.081	-1.039	-1.014		-1.04467
5375	151.2525	1.423	1.191	1.192			-1.132	-1.083	-1.064		-1.093
5375	151.2525	1.423	1.191	1.192	0	0	-1.132	-1.083	-1.064	0	-1.093
5010	140.9814	1.422	1.196	1.191			-1.131	-1.088	-1.063		-1.094
4025	113.2635	1.307	1.084	1.08			-1.016	-0.976	-0.952		-0.98133
3050	85.827	1.134	0.913	0.909			-0.843	-0.805	-0.781		-0.80967
2075	58.3905	0.927	0.708	0.704			-0.636	-0.6	-0.576		-0.604
1090	30.6726	0.708	0.491	0.489			-0.417	-0.383	-0.361		-0.387
350	9.849	0.541	0.324	0.324			-0.25	-0.216	-0.196		-0.22067
0	0	0.483	0.278	0.285			-0.192	-0.17	-0.157		-0.173

LPILE 2013 Lateral Load Analyses

7” Dia., 3/8” Wall Steel Pipe Pile with 18” Dia. Single Flight Helical Tip – 20 feet Deep

```
                LPile Plus for Windows, Version 2013-07.007

              Analysis of Individual Piles and Drilled Shafts
             Subjected to Lateral Loading Using the p-y Method

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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:        G:\Projects\2014\14-9544 APE Helical Piles\LPile\
Name of input data file:       Case 2 Load Range.lp7d
Name of output report file:    Case 2 Load Range.lp7o
Name of plot output file:      Case 2 Load Range.lp7p
Name of runtime messeage file: Case 2 Load Range.lp7r

--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  May 4, 2015     Time:   9:46:36

--------------------------------------------------------------------------------
                                 Problem Title
--------------------------------------------------------------------------------

Project Name: APE Helical Pile Analyses
Job Number: 14-55-9544
Client: American Pile Equipment Company
Engineer: Ross T. McGillivray, PE
Description: 7-inches Dia. Steel pipe with 18" Helical Auger Tip
             D – Analyses = Diameter of the Plate, I = I based on Plate Diameter

--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Engineering Units of Input Data and Computations:
 - Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed                 =          500
- Deflection tolerance for convergence                 =   1.0000E-05 in
- Maximum allowable deflection                         =     100.0000 in
- Number of pile increments                            =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
 - Compute pile response under loading and nonlinear bending properties of pile
   (only if nonlinear pile properties are input)
 - Use of p-y modification factors for p-y curves not selected
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - No p-y curves to be computed and reported for user-specified depths
 - Report only summary tables of pile-head deflection, maximum bending moment,
   and maximum shear force in output report file.

--------------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Total number of pile sections                          =          1

Total length of pile                                   =      20.00 ft

Depth of ground surface below top of pile              =       0.67 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile.

Point         Depth              Pile
                X              Diameter
               ft                 in
-----       ---------        -----------
  1           0.00000         18.0000000
  2         20.000000         18.0000000


Input Structural Properties:
----------------------------

Pile Section No. 1:

   Section Type                                        =    Elastic Pile
   Cross-sectional Shape                               =        Circular
   Section Length                                      =     20.00000 ft
   Top Width                                           =     18.00000 in
   Bottom Width                                        =     18.00000 in
   Top Area                                            =    254.50000 Sq. in
   Bottom Area                                         =    254.50000 Sq. in
   Moment of Inertia at Top                            =   5153.00000 in^4
   Moment of Inertia at Bottom                         =   5153.00000 in^4
   Elastic Modulus                                     =      889468. lbs/in^2
                                                     E =   Es*As/A-Plate

--------------------------------------------------------------------------------
                     Ground Slope and Pile Batter Angles
--------------------------------------------------------------------------------

Ground Slope Angle                                     =        0.000 degrees
                                                       =        0.000 radians

Pile Batter Angle                                      =        0.000 degrees
                                                       =        0.000 radians
```

LPILE 2013 Lateral Load Analyses

7" Dia., 3/8" Wall Steel Pipe Pile with 18" Dia. Single Flight Helical Tip – 20 feet Deep

Soil and Rock Layering Information

The soil profile is modelled using 8 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

```
   Distance from top of pile to top of layer          =      0.67000 ft
   Distance from top of pile to bottom of layer       =      4.90000 ft
   Effective unit weight at top of layer              =    115.00000 pcf
   Effective unit weight at bottom of layer           =    115.00000 pcf
   Friction angle at top of layer                     =     36.00000 deg.
   Friction angle at bottom of layer                  =     32.00000 deg.
   Subgrade k at top of layer                         =     92.00000 pci
   Subgrade k at bottom of layer                      =     54.00000 pci
```

Layer 2 is sand, p-y criteria by Reese et al., 1974

```
   Distance from top of pile to top of layer          =      4.90000 ft
   Distance from top of pile to bottom of layer       =     17.00000 ft
   Effective unit weight at top of layer              =     60.00000 pcf
   Effective unit weight at bottom of layer           =     60.00000 pcf
   Friction angle at top of layer                     =     32.00000 deg.
   Friction angle at bottom of layer                  =     27.00000 deg.
   Subgrade k at top of layer                         =     54.00000 pci
   Subgrade k at bottom of layer                      =     20.00000 pci
```

Layer 3 is soft clay, p-y criteria by Matlock, 1970

```
   Distance from top of pile to top of layer          =     17.00000 ft
   Distance from top of pile to bottom of layer       =     22.00000 ft
   Effective unit weight at top of layer              =     57.00000 pcf
   Effective unit weight at bottom of layer           =     57.00000 pcf
   Undrained cohesion at top of layer                 =    125.00000 psf
   Undrained cohesion at bottom of layer              =    125.00000 psf
   Epsilon-50 at top of layer                         =      0.00270
   Epsilon-50 at bottom of layer                      =      0.02700
```

Layer 4 is sand, p-y criteria by Reese et al., 1974

```
   Distance from top of pile to top of layer          =     22.00000 ft
   Distance from top of pile to bottom of layer       =     27.00000 ft
   Effective unit weight at top of layer              =     60.00000 pcf
   Effective unit weight at bottom of layer           =     60.00000 pcf
   Friction angle at top of layer                     =     27.00000 deg.
   Friction angle at bottom of layer                  =     27.00000 deg.
   Subgrade k at top of layer                         =     20.00000 pci
   Subgrade k at bottom of layer                      =     20.00000 pci
```

Layer 5 is soft clay, p-y criteria by Matlock, 1970

```
   Distance from top of pile to top of layer          =     27.00000 ft
   Distance from top of pile to bottom of layer       =     32.00000 ft
   Effective unit weight at top of layer              =     27.00000 pcf
   Effective unit weight at bottom of layer           =     57.00000 pcf
   Undrained cohesion at top of layer                 =    125.00000 psf
   Undrained cohesion at bottom of layer              =    125.00000 psf
   Epsilon-50 at top of layer                         =      0.02680
   Epsilon-50 at bottom of layer                      =      0.02680
```

Layer 6 is sand, p-y criteria by Reese et al., 1974

```
   Distance from top of pile to top of layer          =     32.00000 ft
   Distance from top of pile to bottom of layer       =     47.00000 ft
   Effective unit weight at top of layer              =     60.00000 pcf
   Effective unit weight at bottom of layer           =     60.00000 pcf
   Friction angle at top of layer                     =     29.00000 deg.
   Friction angle at bottom of layer                  =     31.80000 deg.
   Subgrade k at top of layer                         =     22.00000 pci
   Subgrade k at bottom of layer                      =     48.00000 pci
```

Layer 7 is stiff clay with water-induced erosion

```
   Distance from top of pile to top of layer          =     47.00000 ft
   Distance from top of pile to bottom of layer       =     68.00000 ft
   Effective unit weight at top of layer              =     58.00000 pcf
   Effective unit weight at bottom of layer           =     58.00000 pcf
   Undrained cohesion at top of layer                 =   1500.00000 psf
   Undrained cohesion at bottom of layer              =   1875.00000 psf
   Epsilon-50 at top of layer                         =      0.00640
   Epsilon-50 at bottom of layer                      =      0.00560
   Subgrade k at top of layer                         =    694.00000 pci
   Subgrade k at bottom of layer                      =    905.00000 pci
```

Layer 8 is stiff clay with water-induced erosion

```
   Distance from top of pile to top of layer          =     68.00000 ft
   Distance from top of pile to bottom of layer       =     72.00000 ft
   Effective unit weight at top of layer              =     58.00000 pcf
   Effective unit weight at bottom of layer           =     58.00000 pcf
   Undrained cohesion at top of layer                 =   7500.00000 psf
   Undrained cohesion at bottom of layer              =   7500.00000 psf
   Epsilon-50 at top of layer                         =      0.00230
   Epsilon-50 at bottom of layer                      =      0.00230
   Subgrade k at top of layer                         =   2000.00000 pci
   Subgrade k at bottom of layer                      =   2000.00000 pci
```

(Depth of lowest soil layer extends   52.00 ft below pile tip)

Summary of Soil Properties

Layer Num.	Layer Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.	Strain Factor Epsilon 50	kpy pci
1	Sand (Reese, et al.)	0.670	115.000	--	36.000	--	92.000
		4.900	115.000	--	32.000	--	54.000
2	Sand (Reese, et al.)	4.900	60.000	--	32.000	--	54.000
		17.000	60.000	--	27.000	--	20.000
3	Soft Clay	17.000	57.000	125.000	--	0.00270	--
		22.000	57.000	125.000	--	0.02700	--
4	Sand (Reese, et al.)	22.000	60.000	--	27.000	--	20.000
		27.000	60.000	--	27.000	--	20.000
5	Soft Clay	27.000	27.000	125.000	--	0.02680	--
		32.000	57.000	125.000	--	0.02680	--
6	Sand (Reese, et al.)	32.000	60.000	--	29.000	--	22.000
		47.000	60.000	--	31.800	--	48.000
7	Stiff Clay with Free Water	47.000	58.000	1500.000	--	0.00640	694.000
		68.000	58.000	1875.000	--	0.00560	905.000
8	Stiff Clay with Free Water	68.000	58.000	7500.000	--	0.00230	2000.000
		72.000	58.000	7500.000	--	0.00230	2000.000

LPILE 2013 Lateral Load Analyses

7” Dia., 3/8” Wall Steel Pipe Pile with 18” Dia. Single Flight Helical Tip – 20 feet Deep

Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 8

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 500.00000 lbs	M = 0.0000 in-lbs	0.0000000	No
2	1	V = 1000.00000 lbs	M = 0.0000 in-lbs	0.0000000	No
3	1	V = 2000.00000 lbs	M = 0.0000 in-lbs	0.0000000	No
4	1	V = 4000.00000 lbs	M = 0.0000 in-lbs	0.0000000	No
5	1	V = 8000.00000 lbs	M = 0.0000 in-lbs	0.0000000	No
6	1	V = 12000. lbs	M = 0.0000 in-lbs	0.0000000	No
7	1	V = 16000. lbs	M = 0.0000 in-lbs	0.0000000	No
8	1	V = 20000. lbs	M = 0.0000 in-lbs	0.0000000	No

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

Summary of Pile Response(s)

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Shear in Pile lbs	Pile-head Rotation radians
1	1	V = 500.0000	M = 0.000	0.0000000	0.01704185	16187.	500.0000	-0.00029039
2	1	V = 1000.0000	M = 0.000	0.0000000	0.03409267	32368.	1000.0000	-0.00058086
3	1	V = 2000.0000	M = 0.000	0.0000000	0.06820041	64725.	2000.0000	-0.00116187
4	1	V = 4000.0000	M = 0.000	0.0000000	0.13800807	130759.	4000.0000	-0.00234760
5	1	V = 8000.0000	M = 0.000	0.0000000	0.31419740	287764.	8000.0000	-0.00519969
6	1	V = 12000.	M = 0.000	0.0000000	0.56941025	473952.	12000.	-0.00890941
7	1	V = 16000.	M = 0.000	0.0000000	0.89957783	665692.	16000.	-0.01325965
8	1	V = 20000.	M = 0.000	0.0000000	1.29076116	875009.	20000.	-0.01818241

The analysis ended normally.