Andreyev Engineering, Inc.

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Groundwater ▼ Environmental ▼ Geotechnical ▼ Construction Materials Testing

February 21, 2022
Project No: GPGT-21-152

To: **Halff Associates, Inc.**
902 North Sinclair Avenue
Tavares, Florida 32778

Attention: **Mr. Duane Booth, PE**

Subject: **Report, Geotechnical Investigation, Proposed Ferndale Preserve-Observation Tower/Fishing Pier and Canoe/Kayak Launch, Lake Apopka, Lake County, Florida**

Dear Mr. Booth:

Andreyev Engineering, Inc. (AEI) has completed a geotechnical investigation for the above referenced project. The purpose of this study was to obtain geotechnical data to assist in the foundation design of the proposed Ferndale Preserve-Observation Tower/Fishing Pier and Canoe/Kayak Launch, Lake Apopka, Lake County, Florida. This report presents the results of our geotechnical investigation along with an evaluation of the soil and groundwater conditions encountered and analyses of pile foundation alternatives.

SITE LOCATION AND PROJECT DESCRIPTION

The subject site is located at the western shore of Lake Apopka in Section 27, Township 26 South, and Range 26 East in Ferndale, Lake County, Florida. The site vicinity is shown on the U.S.G.S. Topographic Map on the attached **Figure 1**. The proposed observation tower/fishing pier will be located at the eastern end of the 200-acre nature preserve. Ferndale Preserve has a 2.1-mile-long hiking trail, and the observation tower/fishing pier will be located at Marker D of the hiking trail. The proposed fishing pier will extend about 60 feet into Lake Apopka from the lake shoreline and there will be a 24 feet high observation tower at the end of the pier. We understand the proposed fishing pier/observation tower will be supported on steel H Piles or precast concrete piles. The vertical and lateral loading on each bridge pile is expected to be 30,000 lbs and 6,000 lbs, respectively. Structural design loading information was provided by Mr. David Viele, Jr. P.E. of TLC Engineering Solutions. An aerial view of the site is shown on **Figure 2**. The NRCS web soil survey map of the site was reviewed, and a copy of the soil survey map is shown on **Figure 3**.

PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to explore subsurface soil and groundwater conditions at this site for foundation design of the proposed observation tower/fishing pier.

The scope of this investigation included:

- Drilled three (3) Standard Penetration Test (SPT) borings, designated as TB-1 thru TB-3, to a depth of 30 feet below ground surface, at the beginning, middle and end of the proposed of the 60 feet long pier.

- Analyzed Steel H Piles of 8", 10" and 12" size and 12'x12" precast concrete pile for the observation tower/pier construction.

The approximate locations of the borings TB-1 thru TB-3 are shown on **Figure 4.** At boring TB-1 and TB-2, the depths of water were 6 feet and 3 feet, respectively**.** The borings TB-1 and TB-2 were performed from a barge. Standard Penetration Tests (SPTs) were carried out in general accordance with ASTM Standard D-1586. Closely spaced SPT tests with split barrel sampling were performed in the upper 10 feet, with successive tests carried out at 5-foot intervals thereafter. Samples recovered from the boring were returned to AEI's laboratory for visual classification and stratification. Upon completion of drilling, the SPT boreholes were backfilled with additional bentonite and soil materials.

NATURAL RESOURCES CONSERVATION SERVICE SOIL SURVEY

The Web Soil Survey Map published by the U.S. Department of Agriculture; Natural Resources Conservation Service (NRCS) was reviewed. The portion of the NRCS Soil Map covering the subject site is shown on the attached **Figure 3**. The soil map units for the subject project site are identified as *Soil Map Unit #9:* ***Candler Sand, 5 to 12% Slopes,*** *#44* ***Everglades Muck, Depressional*** *and #34* ***Orlando Fine Sand, 0 to 5% slopes.***

SOIL AND GROUNDWATER CONDITIONS

Soil samples recovered from the borings were visually and tactually classified and stratified in the laboratory using the Unified Soil Classification System (USCS) and the interpretation of the field logs by a geotechnical engineer. Results of the Standard Penetration Test (SPT) boring, in profile form, are presented on **Figure 5**. On the profiles, horizontal lines designating the interface between differing materials represent approximate boundaries. The actual transition between layers is typically gradual.

In general, the borings encountered the following soil Strata:

- Dark brown to black highly organic soil/muck.

- Gray slightly fine sand to silty fine sand with trace organics.

- Gray slightly silty fine sand.

- Gray to red clayey fine sand.

- Brown to yellow silty to slightly clayey fine sand.

The SPT blow counts, or "N-Values" are shown adjacent to the boring profiles on **Figure 5**. The "N" values have been empirically correlated with various soil properties and are considered to be indicative of the relative density of cohesionless soils and the consistency of cohesive soil.

Highly organic soil (muck) with SPT N-value of weight-of-rod (WR) penetration of SPT drilling tool to 1 blow/foot was encountered at borings TB-1 and TB-2. The thickness of the highly organic soil (muck) at TB-1 was 5.5 feet and it indicated a moisture content of 1,058.5% and organic content of 67.9%. The mucky soil at TB-1 is considered to be highly compressible. The thickness of the mucky soil at TB-2 location was 1.5 feet thick and it indicated weight-of-rod (WR) penetration of drilling tool over a depth of 1-foot.

Below the mucky sand, fine sand to slightly silty fine sand (Stratum 2 and Stratum 3) extended to a depth of 18.5 feet to 23.5 feet below the ground surface. The SPT N-values in the silty sand ranged between 3 blows/foot to 16 blows/foot indicating very loose to medium relative density.

Clayey fine sand to silty to slightly clayey fine sand (Stratum 4 and Stratum 5) extended to the maximum explored of 35 feet. The SPT "N" values in these two strata ranged between 7 blows/foot to 25 blows/foot indication loose to medium relative density.

Correlation of the SPT-N values with relative density, unconfined compressive strength and consistency are provided in the following table:

Coarse-Grained Soils		**Fine Grained Soils**		
Penetration Resistance N (blows/ft)	Relative Density of Sand	Penetration Resistance N (blows/ft)	Unconfined Compressive Strength of Clay (tons/ft^2)	Consistency of Clay
0-4	Very Loose	<2	<0.25	Very Soft
4-10	Loose	2-4	0.25-0.50	Soft
10-30	Medium-Dense	4-8	0.50-1.00	Medium
30-50	Dense	8-15	1.00-2.00	Stiff
>50	Very Dense	15-30	2.00-4.00	Very Stiff
		>30	>4.00	Hard

Laboratory Tests

Laboratory tests were performed on three (3) selected samples for moisture content (ASTM D2216) and fines content (passing sieve No. 200) (ASTM D2419). Organic content tests (ASTM D2974) were performed on four (4) selected samples. The laboratory results are shown on the soil profiles on **Figure 5.**

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this investigation and our evaluation of the encountered subsurface conditions, it is our opinion that the encountered foundation soils at the site of the fishing pier and observation tower are suitable for supporting the proposed structures on pile foundation.

Pile Foundation Analyses

The vertical and lateral capacity of 8”, 10” and 12” Steel H Piles and 12” X 12” Precast Concrete Piles for the Observation Tower were analyzed using the AllPile Pile Analysis Software developed by Civiltech Software Company. The depth of water at SPT boring TB-1 at the proposed observation tower location is about 6 feet and the pile top was assumed to be 8 feet above the lakebed. The soil profile at boring TB-1 shown on **Figure 5** was used for the analyses of the piles.

The outputs of the pile analyses for the Steel H Piles are shown on **Attachment A** and the outputs for the pile analyses for the 12" X 12" precast concrete pile are shown in **Attachment B.**. The results of our analyses are summarized in the tables below:

Table 1: Steel H Piles for the Proposed Observation Tower

Pile Designation	Total Pile Length Required for Allowable Vertical Load of 30 kips	Pile Penetration into Ground for Allowable Vertical Load of 30 kips	Lateral Deflection of Pile Under Lateral Load of 6 kips
HP8X36	140 ft	132 ft	1.77 in
HP10X57	92 ft	84 ft	0.84 in
HP12X63	47 ft	39	0.58 in

Table 2: Precast Concrete Pile for the Proposed Observation Tower

Pile Size	Total Pile Length Required for Allowable Vertical Load of 30 kips	Pile Penetration into Ground for Allowable Vertical Load of 30 kips	Lateral Deflection of Pile Under Lateral Load of 6 kips
12"x12"	45 ft	37	1.29 in

Based on the results of the analyses, to develop allowable vertical load capacity of 30 kips, the total lengths of 8", 10" and 12" H Piles for the Observation Tower will be 140, 92 and 47 feet respectively, with about 132, 84 and 39 feet of penetration below the lakebed (mudline), respectively. The lateral deflection of the 8", 10" and 12" H Piles under a lateral load of 6 kips will be about 1.77", 0.84" and 0.58", respectively. The project structural engineer will have to decide on the H Pile size to be used depending on the tolerable lateral deflection of the structure.

Alternatively, 12"x12" precast concrete piles can be used. The calculated total length of 12"x12" precast concrete pile to develop allowable vertical load capacity of 30 kips is 45 feet with about 37 feet of penetration below the lakebed (mud line). The calculated lateral deflection of the 12"x12" precast concrete pile under lateral load of 6 kips will be 1.29 inches. The project structural engineer will decide on the most suitable pile type depending on cost, availability and preference.

AllPile pile analysis software performs static analysis based on soil mechanics principles. The pile capacity will need to be verified in the field by static load test (ASTM D1143) or dynamic tests during pile driving using Pile Driving Analyzer (PDA) and CAPWAP analyses.

CLOSURE

This report has been prepared for the exclusive use of Halff Associates, Inc. and its designers, based on our understanding of the project as stated in this report. Any modifications in design concepts from the description stated in this report should be made known to AEI for possible modification of recommendations presented in this report. This exploration was performed in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made as to the professional advice presented herein. The geotechnical

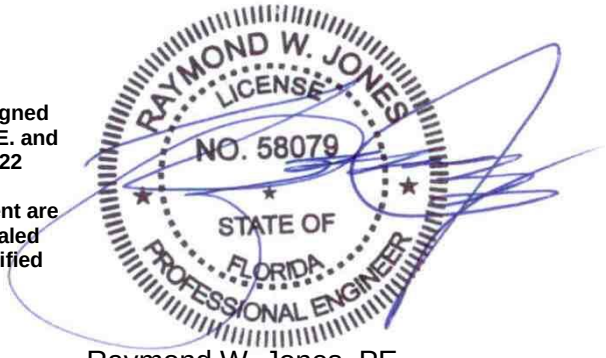
exploration and recommendations submitted herein are based on the data obtained from the soil boring presented on **Figure 5**. The report does not reflect any variations which may occur adjacent to or away from the boring. The nature and extent of the variations may not become evident until during construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented in this report. An on-site visit may be required by a geotechnical engineer to note the characteristics of the variations during the construction period. This geotechnical study investigated the soil conditions within the project area to the drilled depth of 35 feet below ground surface and was not intended to investigate deeper soil conditions with regard to the presence or absence of Karst activity.

AEI appreciates the opportunity to participate in this project, and we trust that the information herein is sufficient for your immediate needs. If you have any questions or comments concerning the contents of this report, please do not hesitate to contact the undersigned.

Sincerely,
ANDREYEV ENGINEERING, INC.

This item has been digitally signed and sealed by Shawkat Ali, P.E. and Raymond Jones, P.E. on 2/21/22

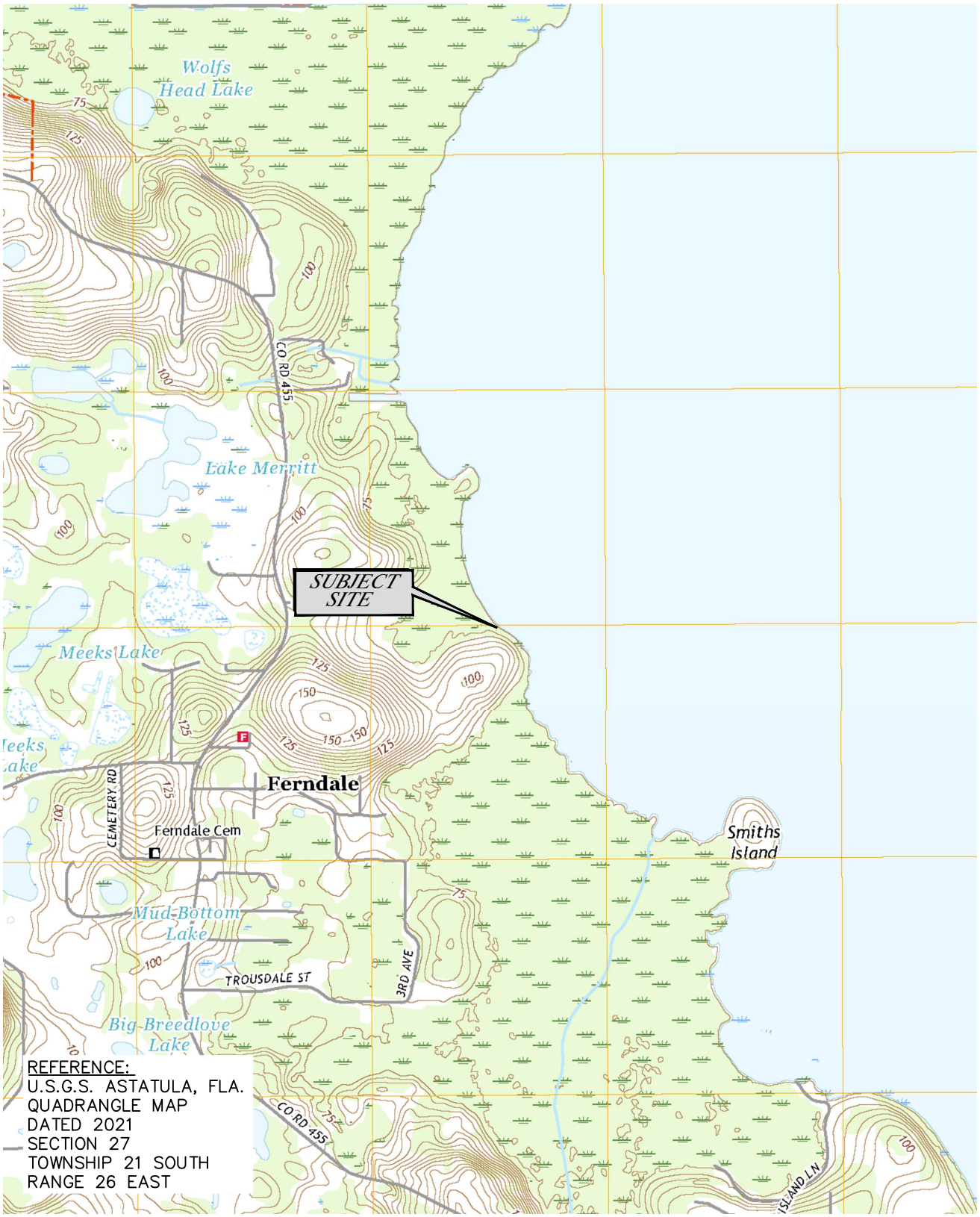
Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies



Shawkat Ali, Ph. D., P.E.
Senior Project Engineer
Florida License No. 52568

Raymond W. Jones, PE.
Vice President
Florida License No. 58079

FIGURES



0 1000 2000 4000

GRAPHIC SCALE: 1"=2000'

Andreyev Engineering, Inc.

APPROXIMATE SCALE: 1"=2000'	DATE: 12/13/21	ENGINEER: SA
	PN: GPGT-21-152	DRAWN BY: DLS

GEOTECHNICAL INVESTIGATION

PROPOSED FERNDALE PRESERVE OBSERVATION TOWER/FISHING PIER & CANOE/KAYAK LAUNCH

FERNDALE, LAKE COUNTY, FL

U.S.G.S. TOPOGRAPHIC MAP

FIGURE 1

0 25 50 100

GRAPHIC SCALE: 1"=50'

Andreyev Engineering, Inc.

APPROXIMATE SCALE: 1"=50'	DATE: 12/13/21	ENGINEER: SA
	PN: GPGT-21-152	DRAWN BY: DLS

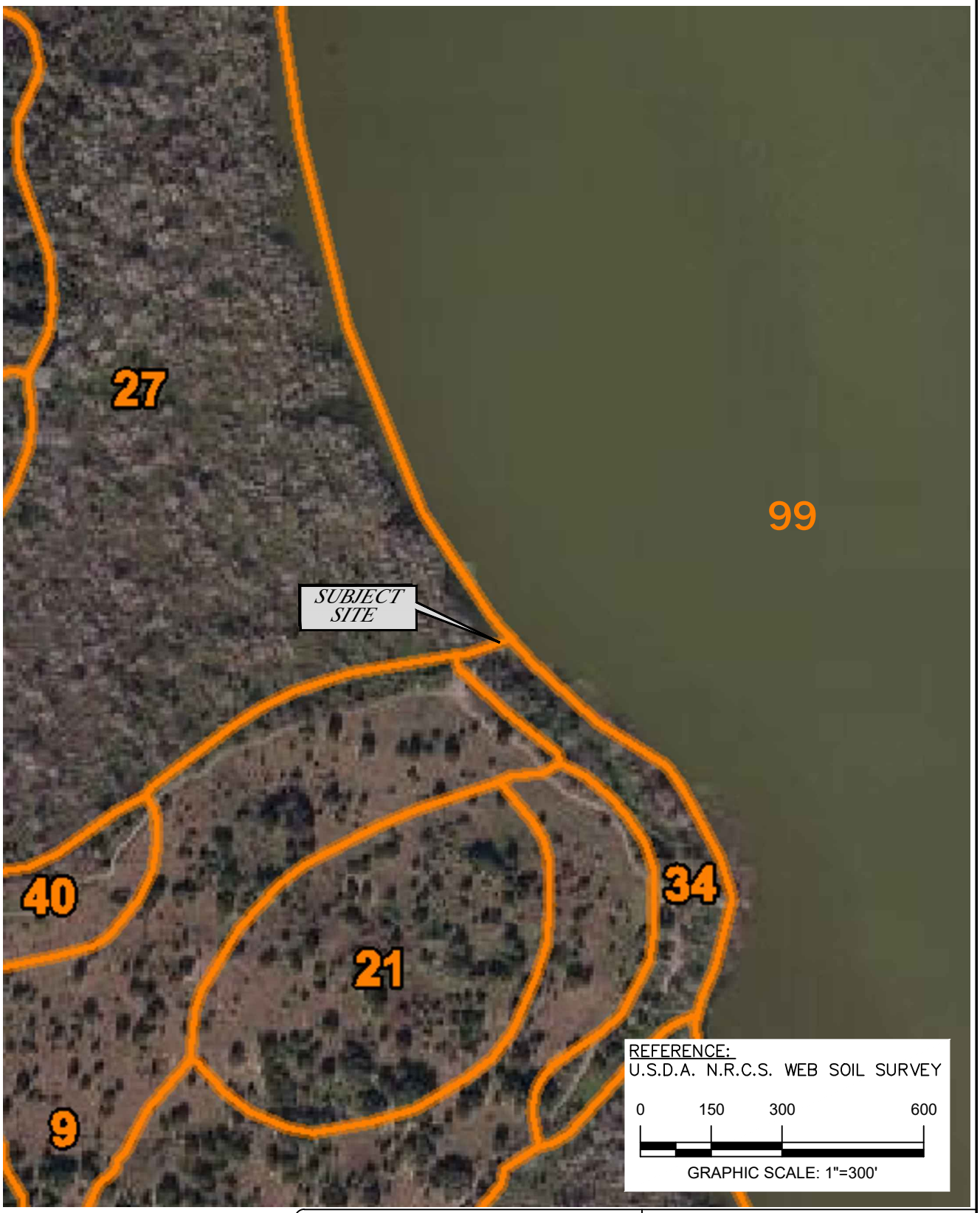
GEOTECHNICAL INVESTIGATION

PROPOSED FERNDALE PRESERVE OBSERVATION TOWER/FISHING PIER & CANOE/KAYAK LAUNCH

FERNDALE, LAKE COUNTY, FL

AERIAL VIEW OF SITE

FIGURE 2



LEGEND:

9	CANDLER SAND, 5 TO 12% SLOPES
27	EVERGLADES MUCK, DEPRESSIONAL
34	ORLANDO FINE SAND, 0 TO 5% SLOPES
99	WATER

Andreyev Engineering, Inc.

APPROXIMATE SCALE: 1"=300'	DATE: 12/13/21	ENGINEER: SA
	PN: GPGT-21-152	DRAWN BY: DLS

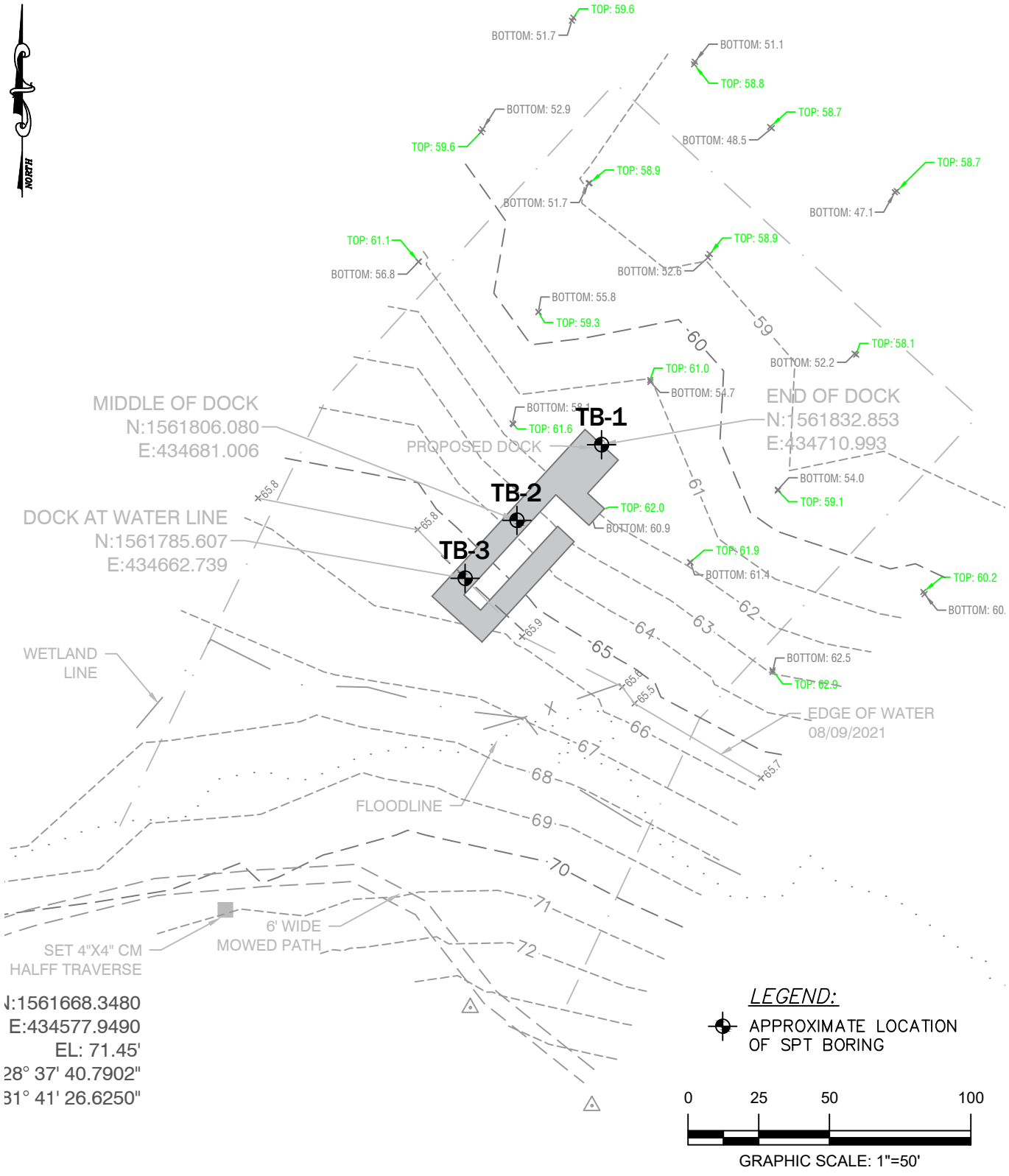
GEOTECHNICAL INVESTIGATION

PROPOSED FERNDALE PRESERVE OBSERVATION TOWER/FISHING PIER & CANOE/KAYAK LAUNCH

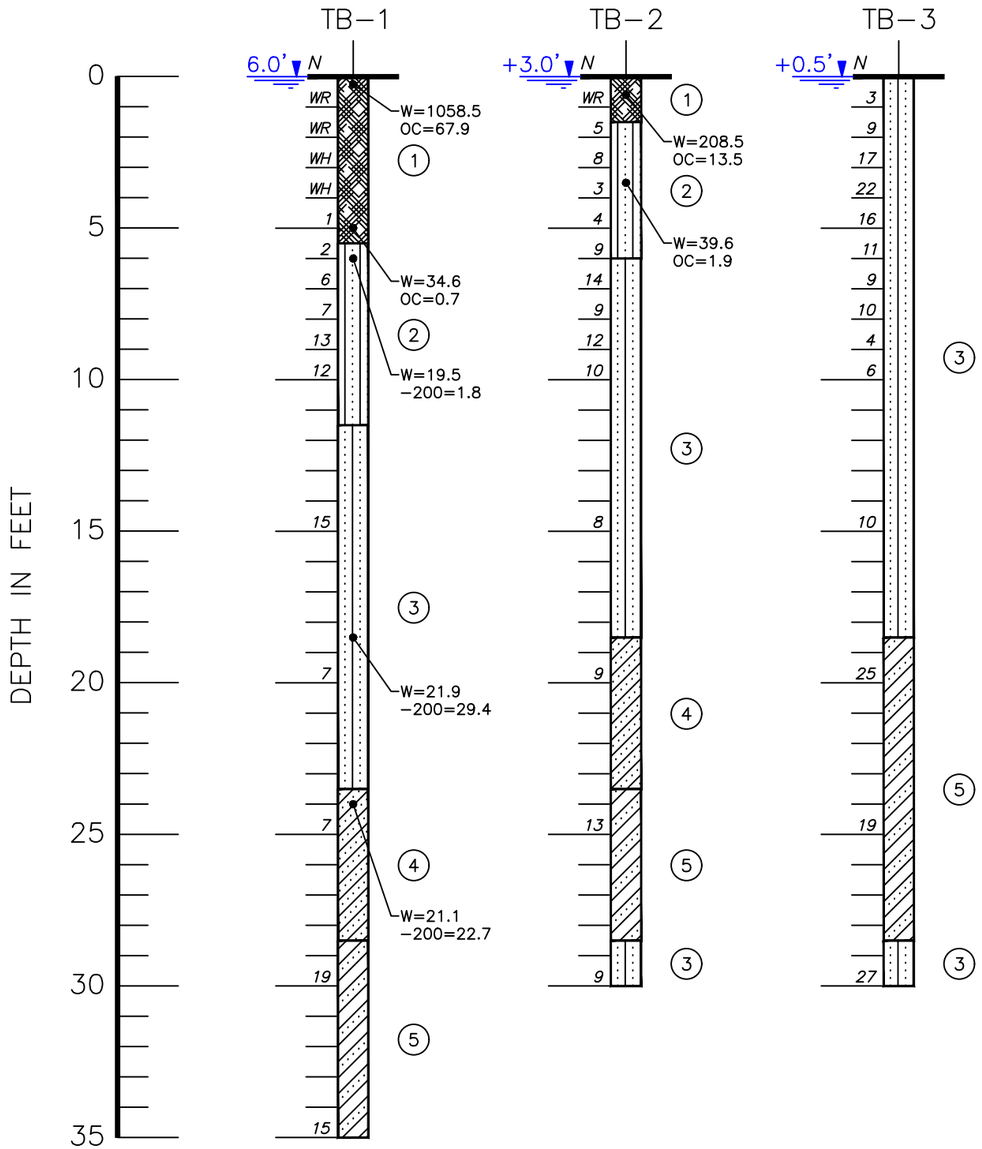
FERNDALE, LAKE COUNTY, FL

N.R.C.S. SOIL SURVEY MAP

FIGURE 3



Andreyev Engineering, Inc.			GEOTECHNICAL INVESTIGATION **PROPOSED FERNDALE PRESERVE OBSERVATION TOWER/FISHING PIER & CANOE/KAYAK LAUNCH** FERNDALE, LAKE COUNTY, FL
APPROXIMATE SCALE: 1"=50'	DATE: 12/13/21 PN: GPGT-21-152	ENGINEER: SA DRAWN BY: DLS	BORING LOCATION PLAN FIGURE 4



LEGEND:

1. DARK BROWN TO BLACK HIGHLY ORGANIC SOIL/MUCK (PT)
2. GRAY FINE SAND TO SLIGHTLY SILTY FINE SAND WITH TRACE ORGANICS (SP)(SP–SM)
3. GRAY SLIGHTLY SILTY FINE SAND (SP)(SP–SM)
4. GRAY TO RED CLAYEY FINE SAND (SC)
5. BROWN TO YELLOW SILTY TO SLIGHTLY CLAYEY FINE SAND (SM)(SC)

(SP) UNIFIED SOIL CLASSIFICATION SYSTEM GROUP SYMBOL

1.0' DEPTH TO GROUNDWATER, DECEMBER 2 & 3, 2021

N STANDARD PENETRATION RESISTANCE, IN BLOWS PER FOOT

WR BORING ADVANCED UNDER STATIC WEIGHT OF DRILL ROD

WH BORING ADVANCED UNDER STATIC WEIGHT OF DRILL HAMMER & ROD

W MOISTURE CONTENT, IN PERCENT

–200 PERCENT OF FINES PASSING THE U.S. No. 200 SIEVE

OC ORGANIC CONTENT, IN PERCENT

Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION
PROPOSED FERNDALE PRESERVE OBSERVATION TOWER/FISHING PIER & CANOE/KAYAK LAUNCH
FERNDALE, LAKE COUNTY, FL

SOIL PROFILES

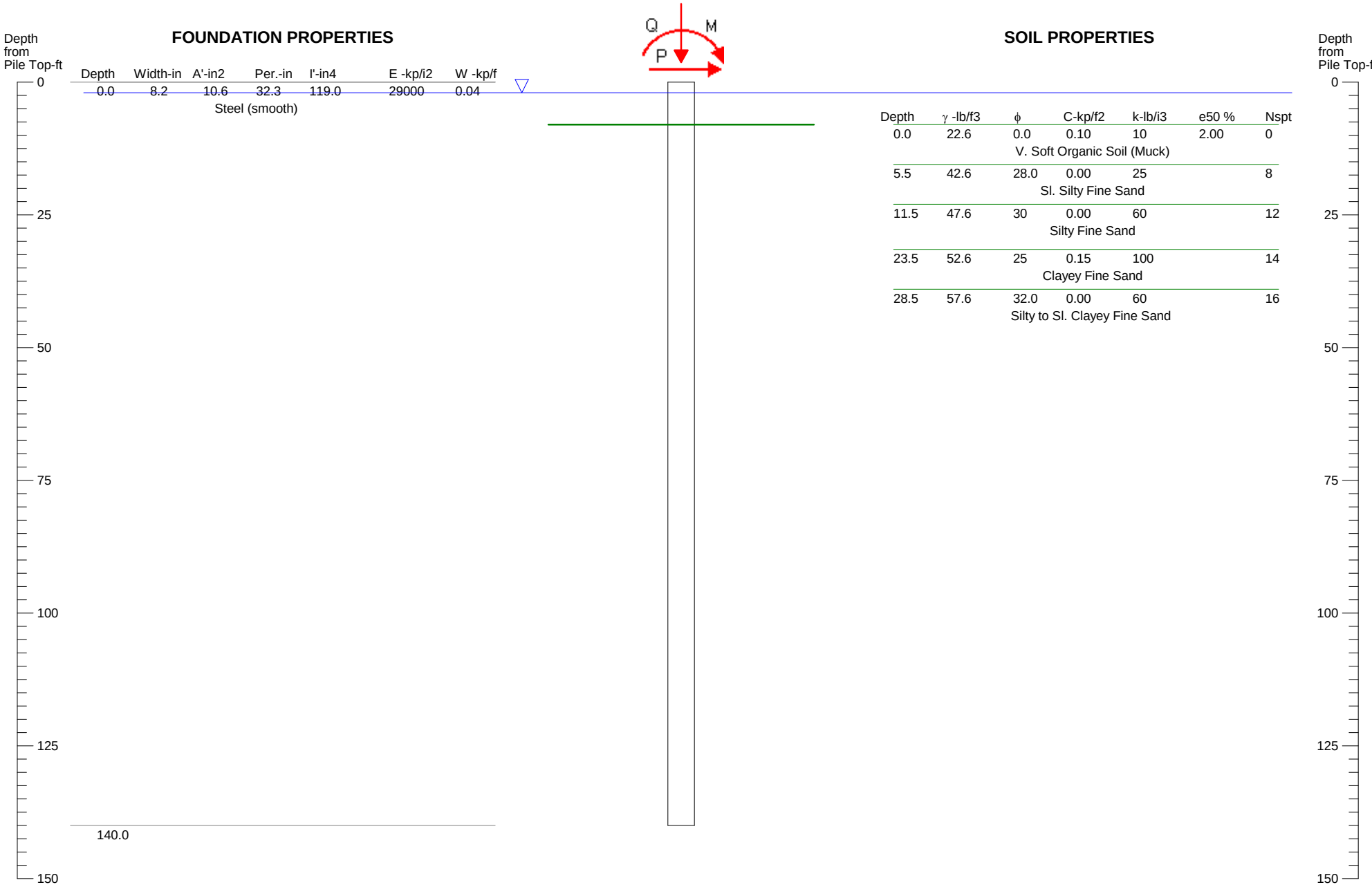
APPROXIMATE SCALE:	DATE: 12/16/21	ENGINEER: SA
1"=5'	PN: GPGT–21–152	DRAWN BY: DLS

FIGURE 5

ATTACHMENT A

ALLPILE PILE ANALYSES OUTPUTS
FERNDALE PRESERVE OBSERVATION TOWER
STEEL HP8x36 PILE @ TB-1

FOUNDATION PROFILE & SOIL CONDITIONS

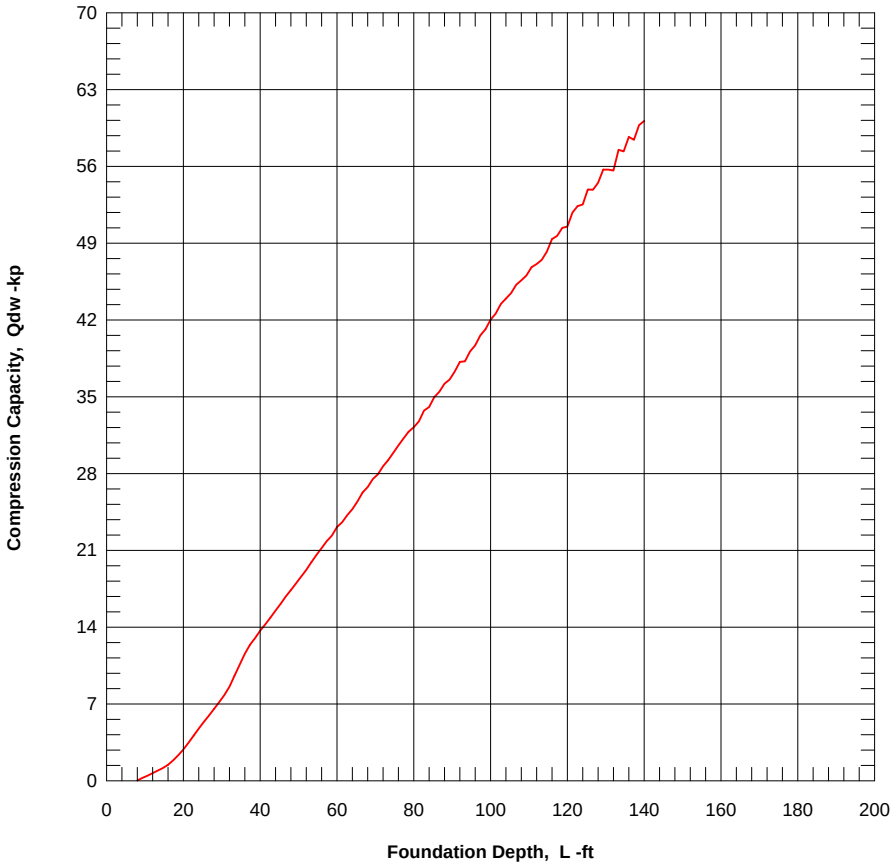


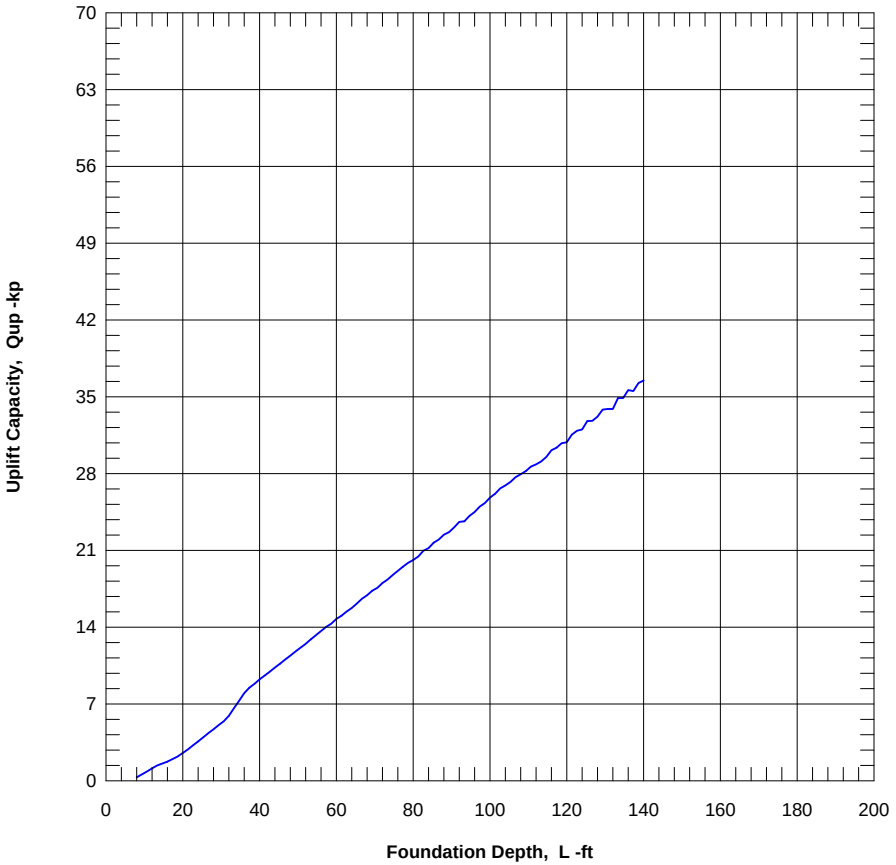
Andreyev Engineering, Inc.
AllPile Civiltech Software

Ferndale Preserve Observation Tower/Pier, Lake Apopka
HP8X36 Steel Pile @ SPT Boring TB-1

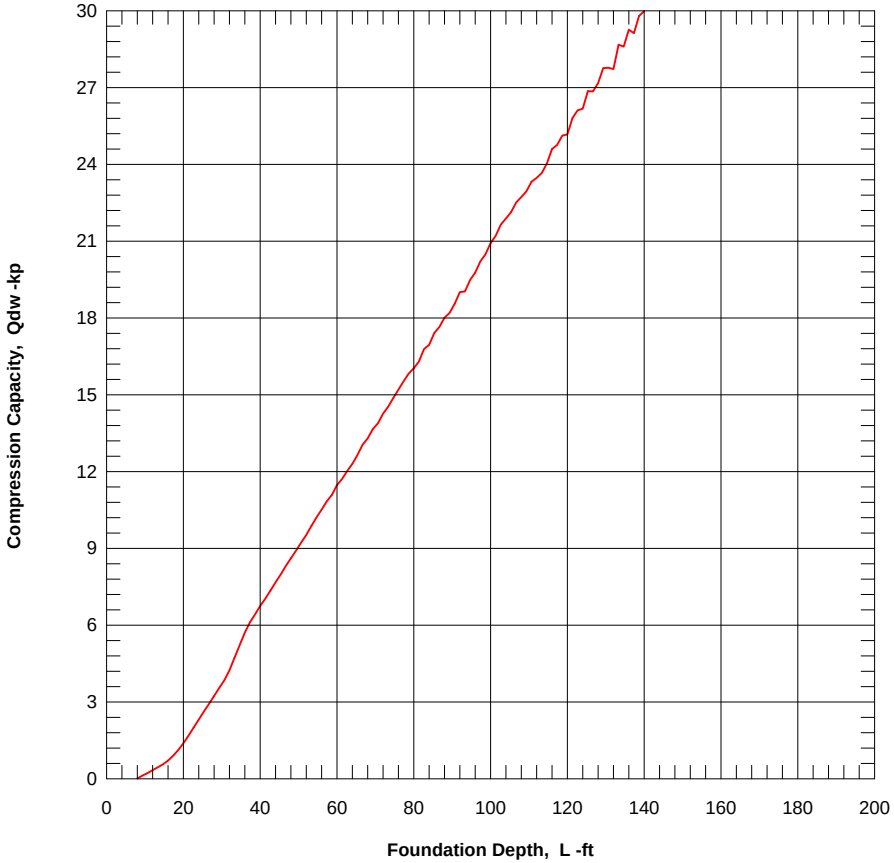
Figure 1

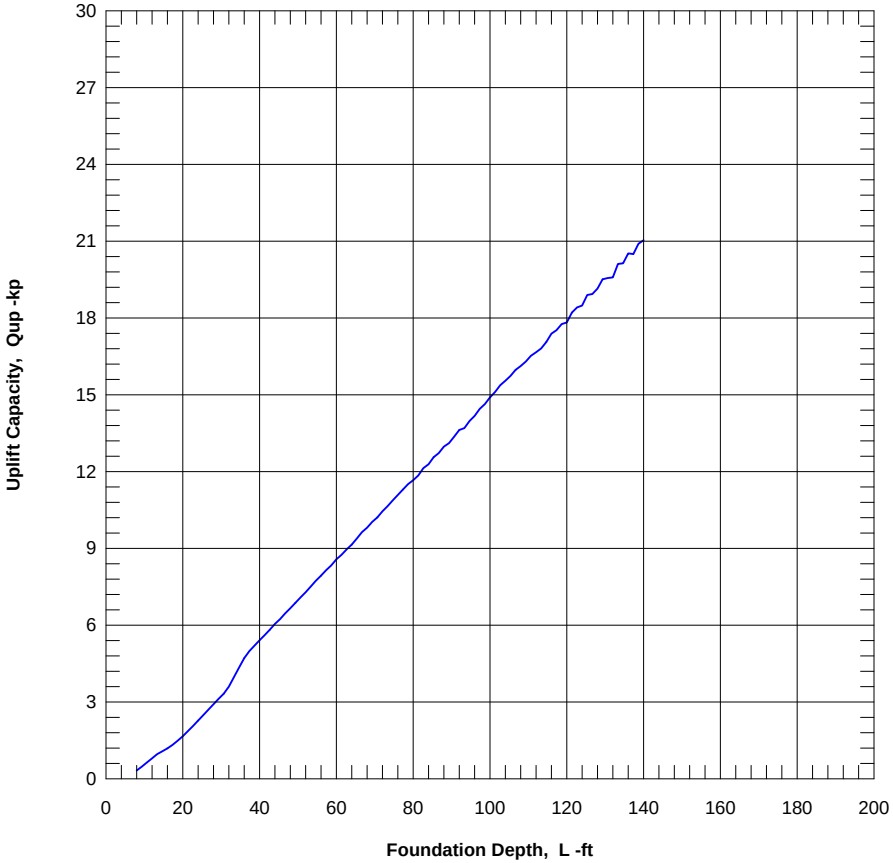
ULTIMATE CAPACITY vs FOUNDATION DEPTH



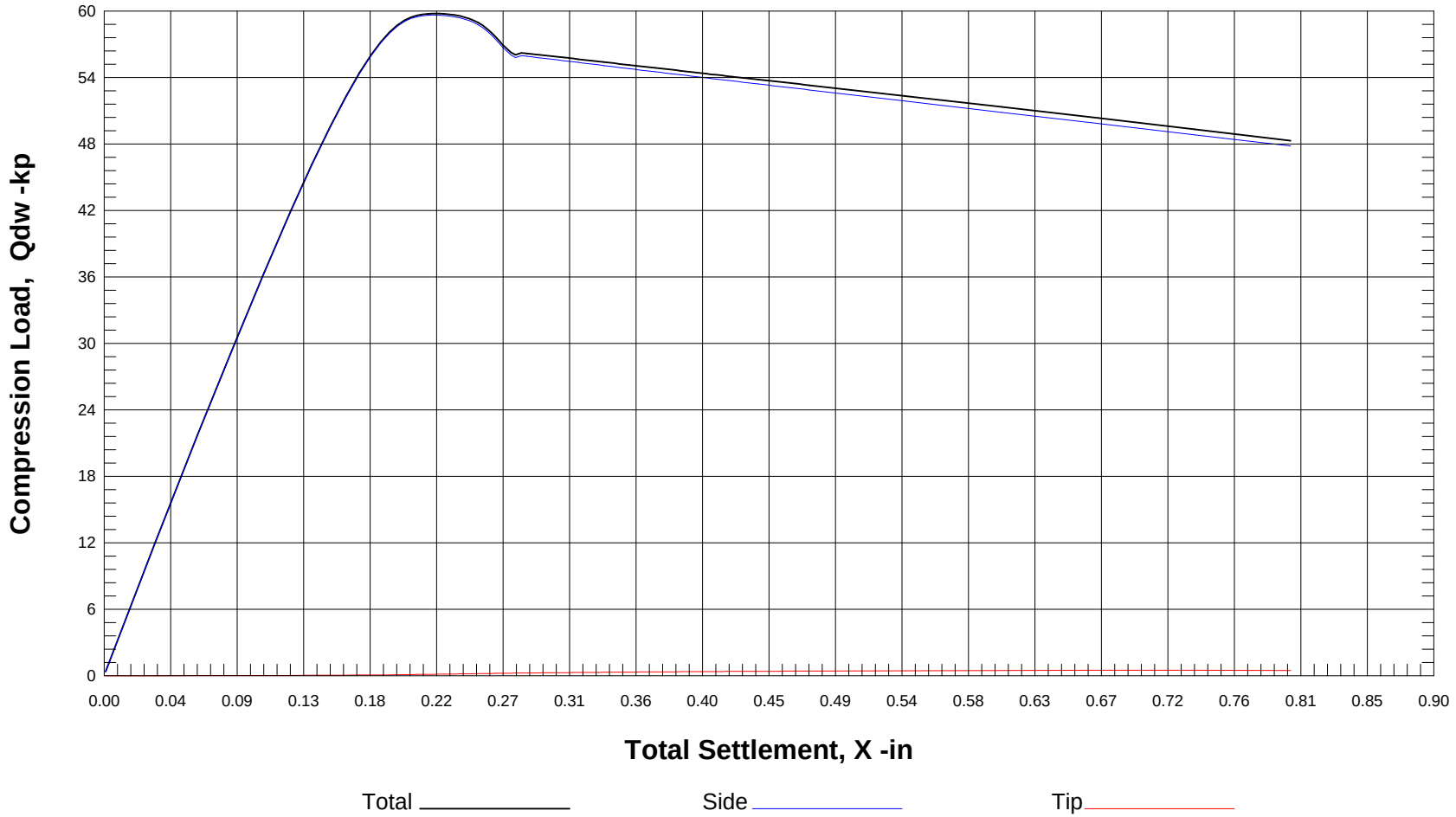


ALLOWABLE CAPACITY vs FOUNDATION DEPTH

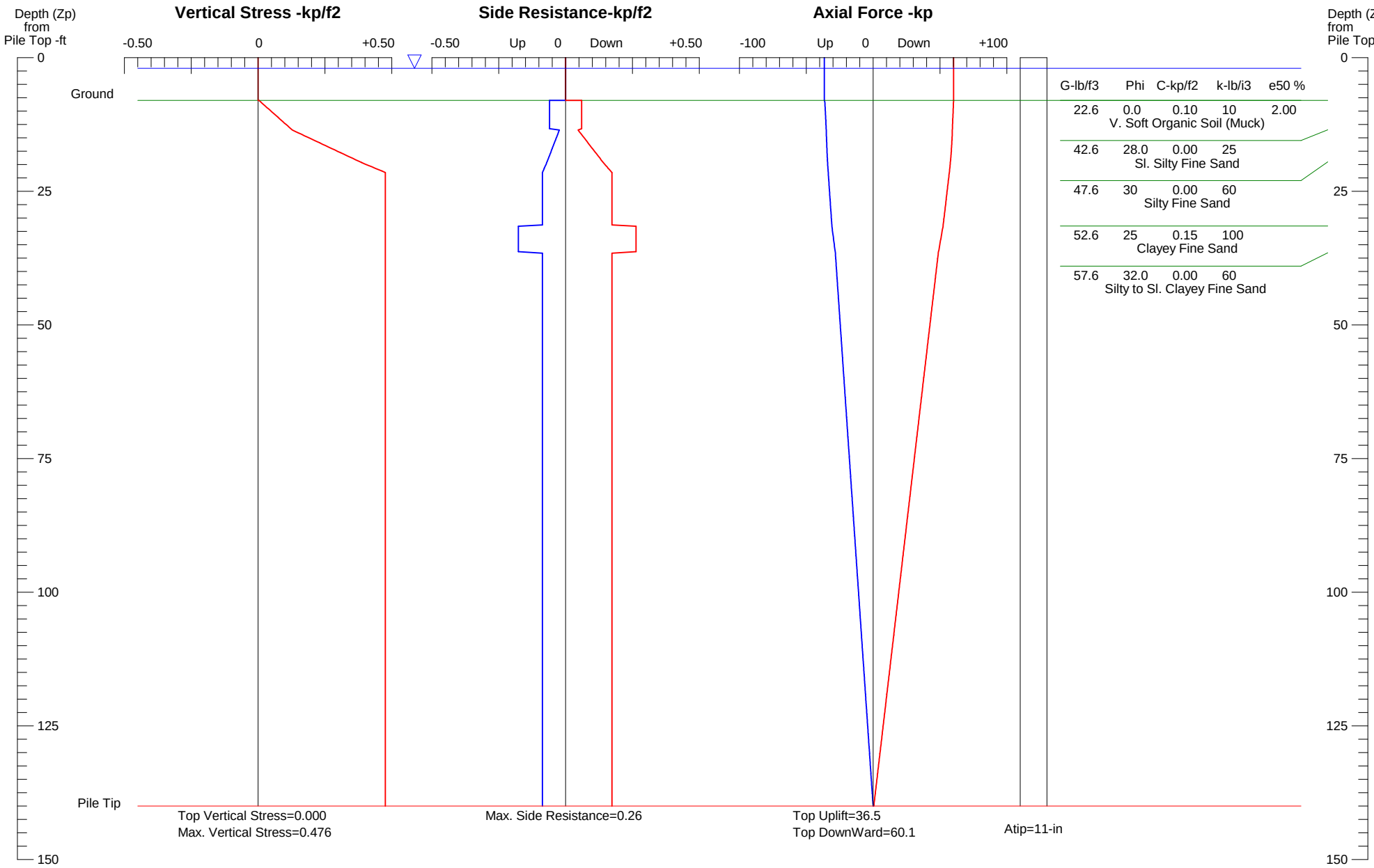




Vertical Load vs. Total Settlement



SOIL STRESS, SIDE RESISTANCE, & AXIAL FORCE vs DEPTH
Based on Ultimate Load Condition



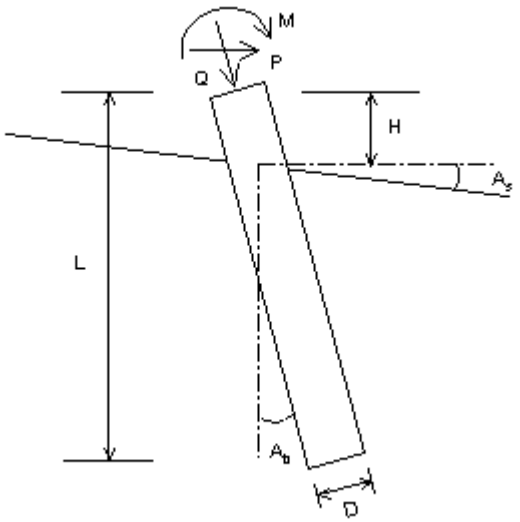
Andreyev Engineering, Inc.
AllPile Civiltech Software

Ferndale Preserve Observation Tower/Pier, Lake Apopka
HP8X36 Steel Pile @ SPT Boring TB-1

Figure 5

VERTICAL ANALYSIS

Figure 6



Driving Steel Pile (Open end)

Loads:
Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 30.0 -kp

Profile:
Pile Length, L= 140.0 -ft
Top Height, H= 8.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0
Fixed Head Condition

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	22.6	0.0	0.10	10	2.00	0
5.5	42.6	28.0	0.00	25	35	8
11.5	47.6	30	0.00	60	40	12
23.5	52.6	25	0.15	100	50	14
28.5	57.6	32.0	0.00	60	47.20	16

Pile Data:

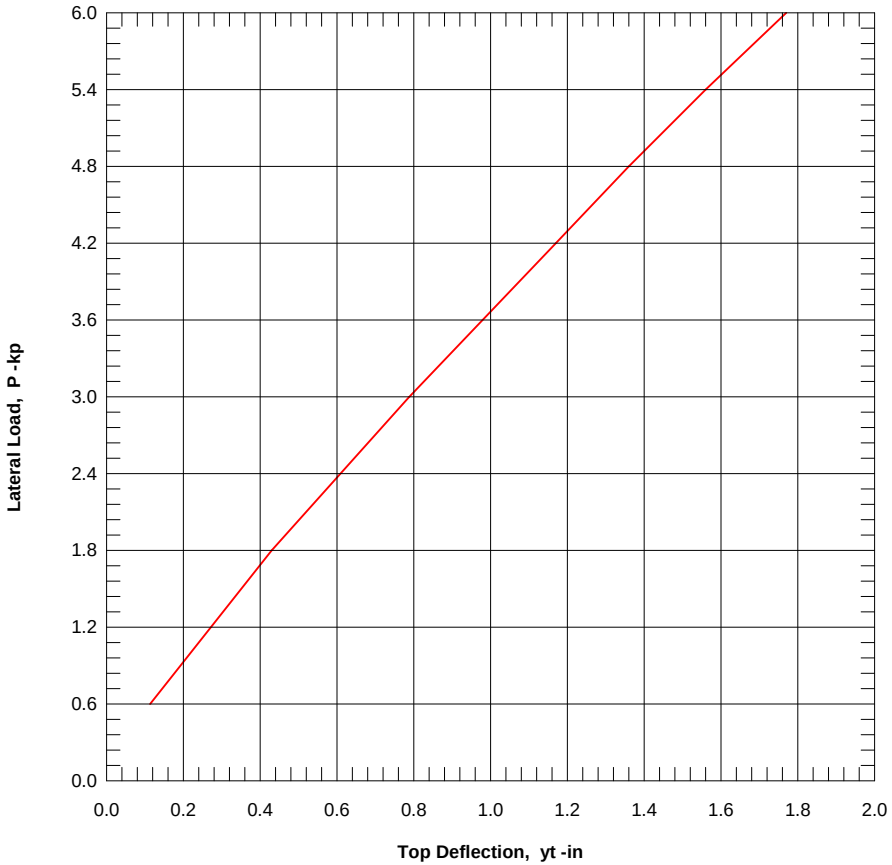
Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	8.2	10.6	32.3	119.0	29000	0.04
140.0						

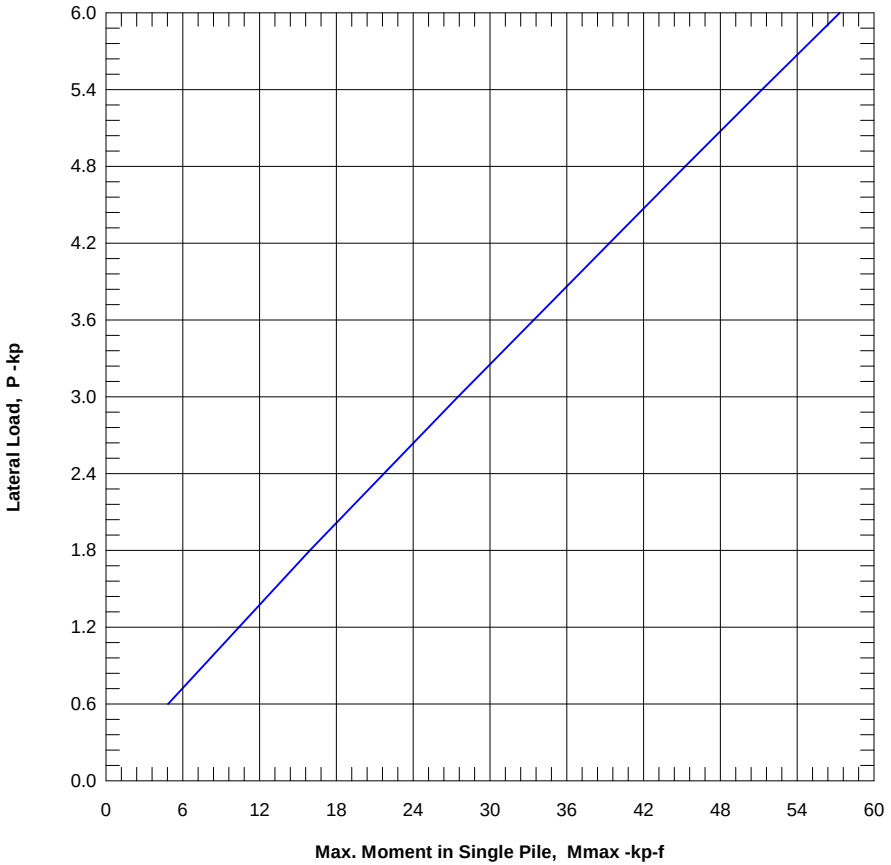
Vertical Capacity:
Weight above Ground= 0.32 Total Weight= 5.60-kp *Soil Weight is not included
Side Resistance (Down)= 59.640-kp Side Resistance (Up)= 30.877-kp
Tip Resistance (Down)= 0.498-kp Tip Resistance (Up)= 0.000-kp
Total Ultimate Capacity (Down) Qult= 60.138-kp Total Ultimate Capacity (Up)= 36.477-kp
Total Allowable Capacity (Down) Qallow= 29.986-kp Total Allowable Capacity (Up) Qallow= 21.039-kp
N/G! Qallow < Q

Settlement Calculation:
At Q= 30.00-kp Settlement= 0.08827-in
At Xallow= 1.00-in Q= 99999.00000-kp

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

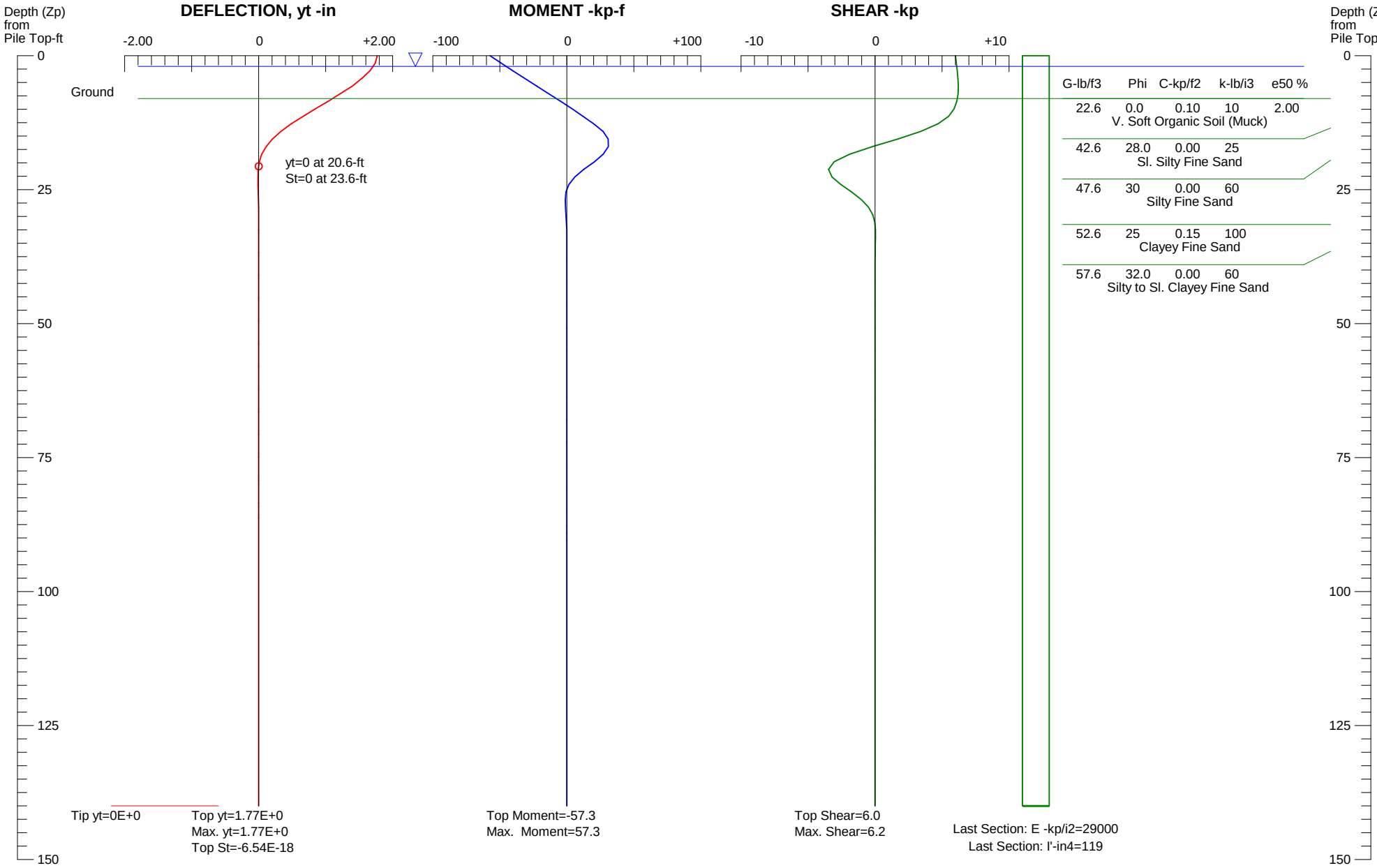
LATERAL LOAD vs DEFLECTION & MAX. MOMENT





PILE DEFLECTION & FORCE vs DEPTH

Single Pile, Khead=5, Kbc=2



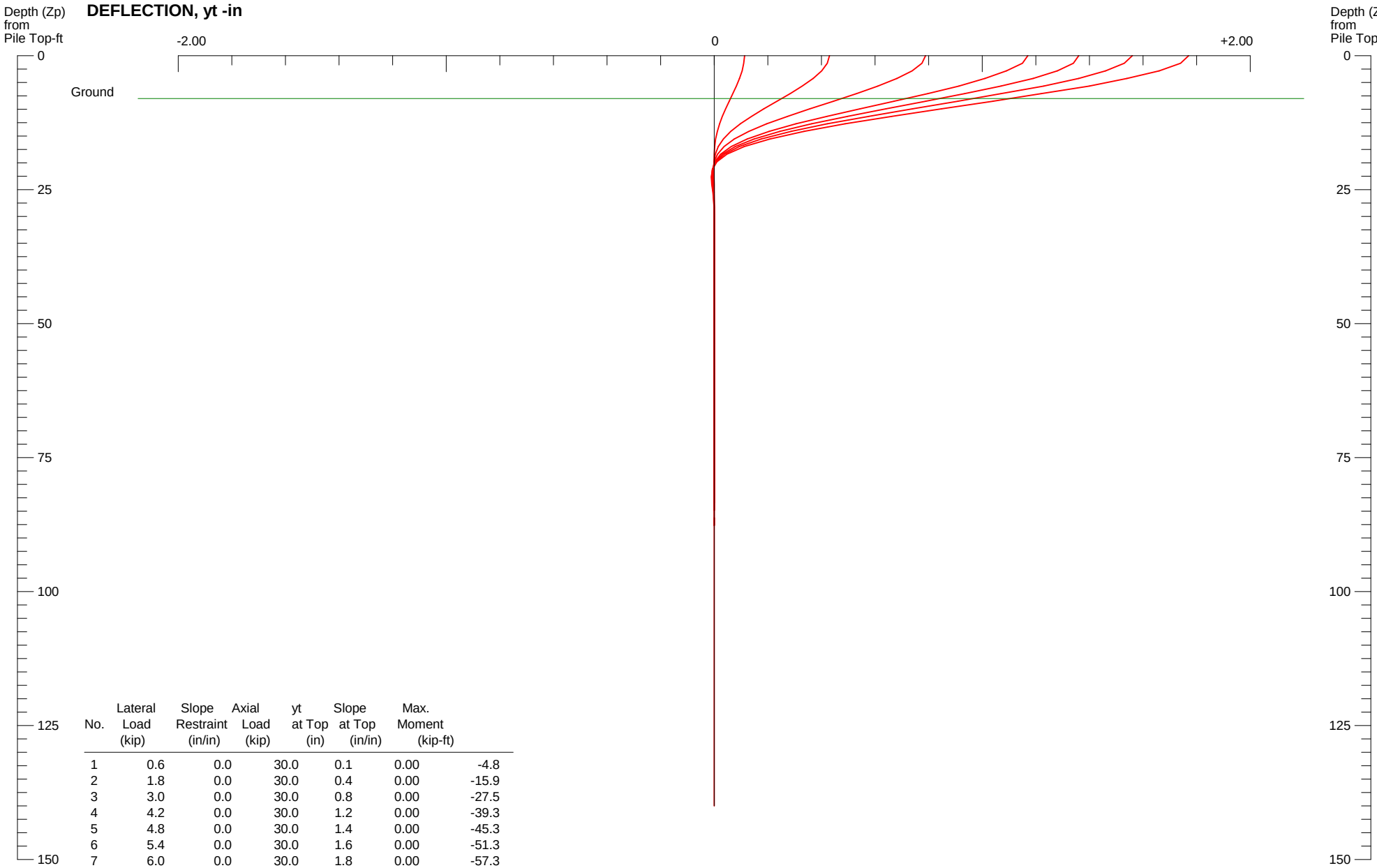
Andreyev Engineering, Inc.
AllPile Civiltech Software

Ferndale Preserve Observation Tower/Pier, Lake Apopka
HP8X36 Steel Pile @ SPT Boring TB-1

Figure 8

PILE DEFLECTION vs LOADING

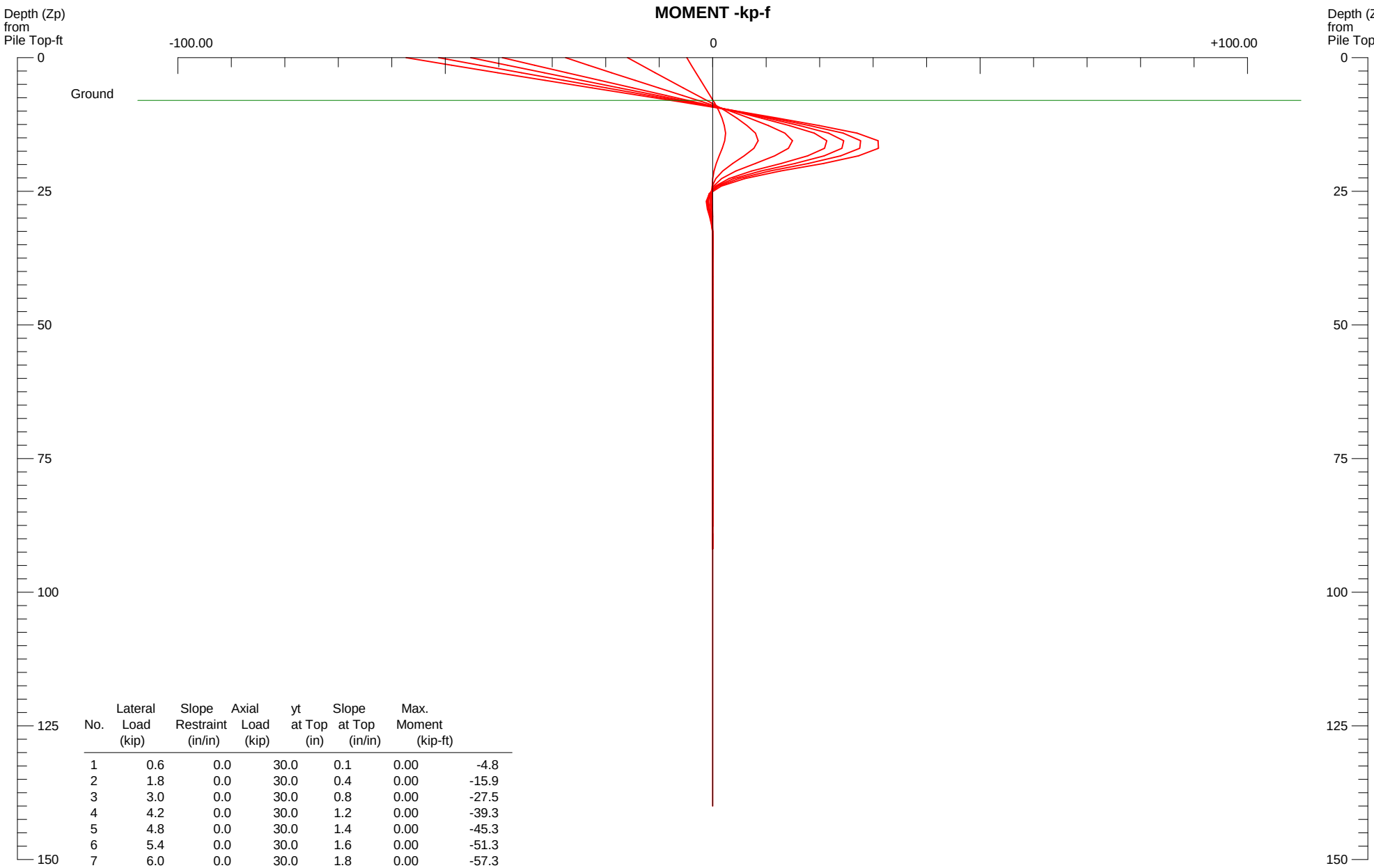
Single Pile, Khead=5, Kbc=2



No.	Lateral Load (kip)	Slope Restraint (in/in)	Axial Load (kip)	yt at Top (in)	Slope at Top (in/in)	Max. Moment (kip-ft)
1	0.6	0.0	30.0	0.1	0.00	-4.8
2	1.8	0.0	30.0	0.4	0.00	-15.9
3	3.0	0.0	30.0	0.8	0.00	-27.5
4	4.2	0.0	30.0	1.2	0.00	-39.3
5	4.8	0.0	30.0	1.4	0.00	-45.3
6	5.4	0.0	30.0	1.6	0.00	-51.3
7	6.0	0.0	30.0	1.8	0.00	-57.3

PILE MOMENT vs LOADING

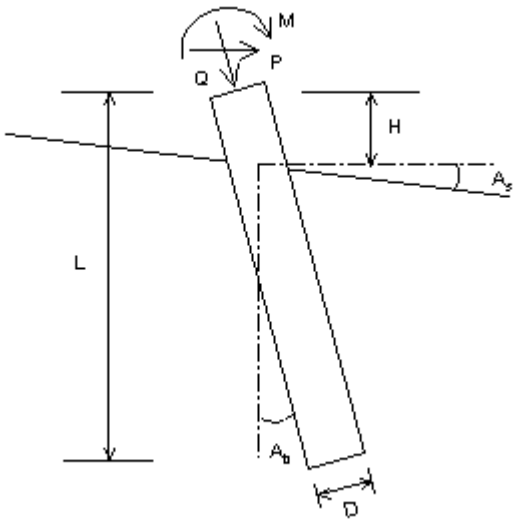
Single Pile, Khead=5, Kbc=2



No.	Lateral Load (kip)	Slope Restraint (in/in)	Axial Load (kip)	yt at Top (in)	Slope at Top (in/in)	Max. Moment (kip-ft)	
1	0.6	0.0	30.0	0.1	0.00	-4.8	
2	1.8	0.0	30.0	0.4	0.00	-15.9	
3	3.0	0.0	30.0	0.8	0.00	-27.5	
4	4.2	0.0	30.0	1.2	0.00	-39.3	
5	4.8	0.0	30.0	1.4	0.00	-45.3	
6	5.4	0.0	30.0	1.6	0.00	-51.3	
7	6.0	0.0	30.0	1.8	0.00	-57.3	

LATERAL ANALYSIS

Figure 11



Driving Steel Pile (Open end)

Loads:
Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 30.0 -kp
Shear Load, P= 6.0 -kp
Slope Restrain St= 0.00000 -in/-in

Profile:
Pile Length, L= 140.0 -ft
Top Height, H= 8.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0
Fixed Head Condition

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	22.6	0.0	0.10	10	2.00	0
5.5	42.6	28.0	0.00	25	35	8
11.5	47.6	30	0.00	60	40	12
23.5	52.6	25	0.15	100	50	14
28.5	57.6	32.0	0.00	60	47.20	16

Pile Data:

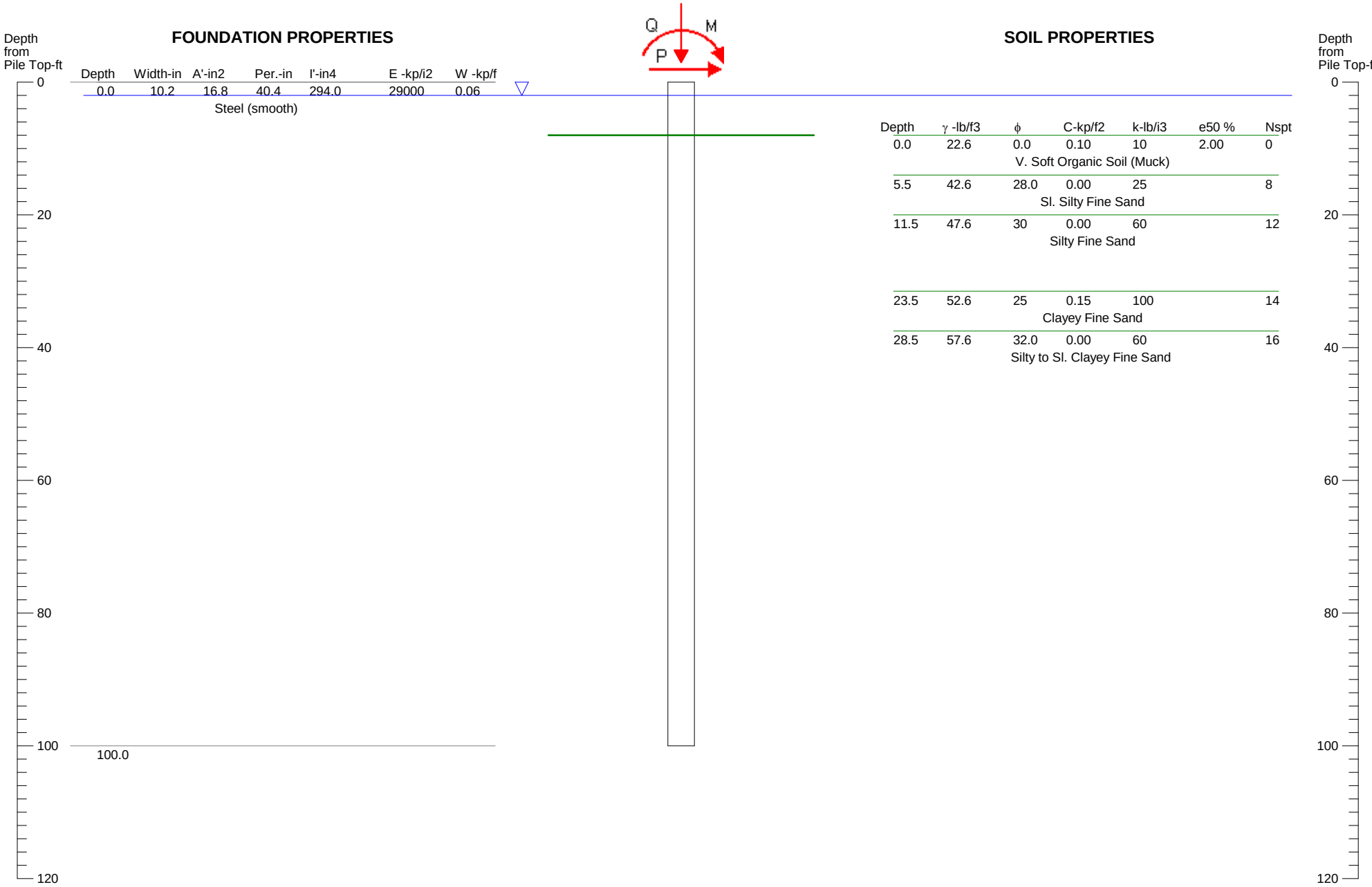
Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	8.2	10.6	32.3	119.0	29000	0.04
140.0						

Single Pile Lateral Analysis:
Top Deflection, yt= 1.77000-in
Max. Moment, M= -57.33-kp-f
Top Deflection Slope, St= 0.00000
OK! Top Deflection, 1.7700-in is less than the Allowable Deflection= 2.00-in

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.
The Max. Moment calculated by program is an internal force from the applied load conditions. Structural engineer has to check whether the pile has enough capacity to resist the moment with adequate factor of safety. If not, the pile may fail under the load conditions.

ALLPILE PILE ANALYSES OUTPUTS
FERNDALE PRESERVE OBSERVATION TOWER
STEEL HP10x57 PILE @ TB-1

FOUNDATION PROFILE & SOIL CONDITIONS



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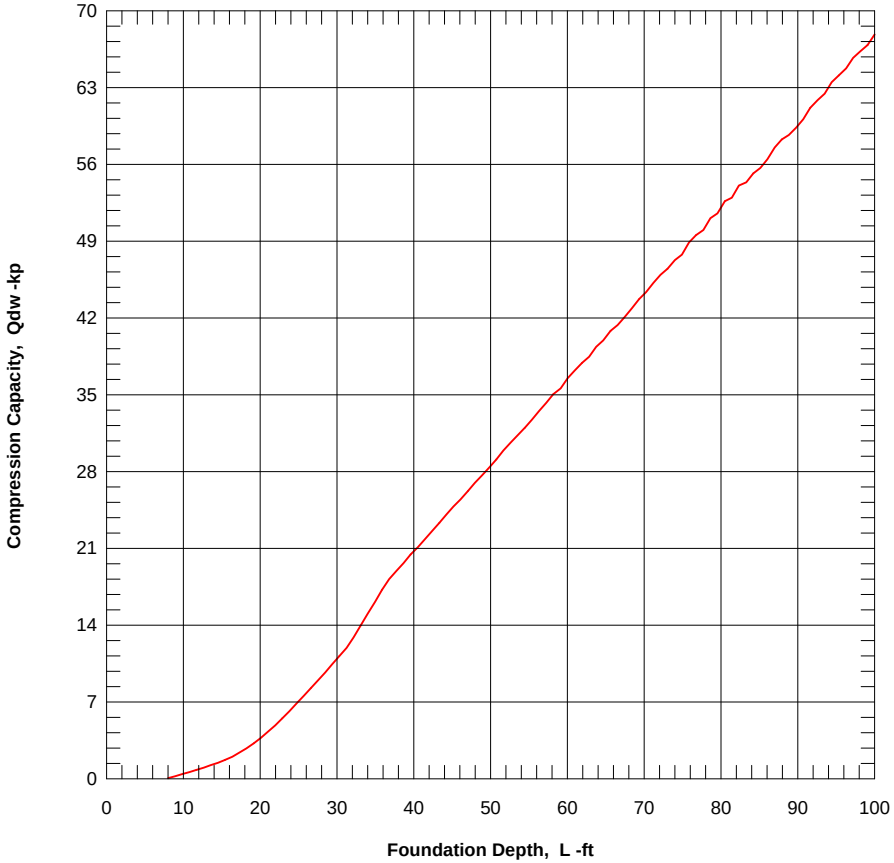
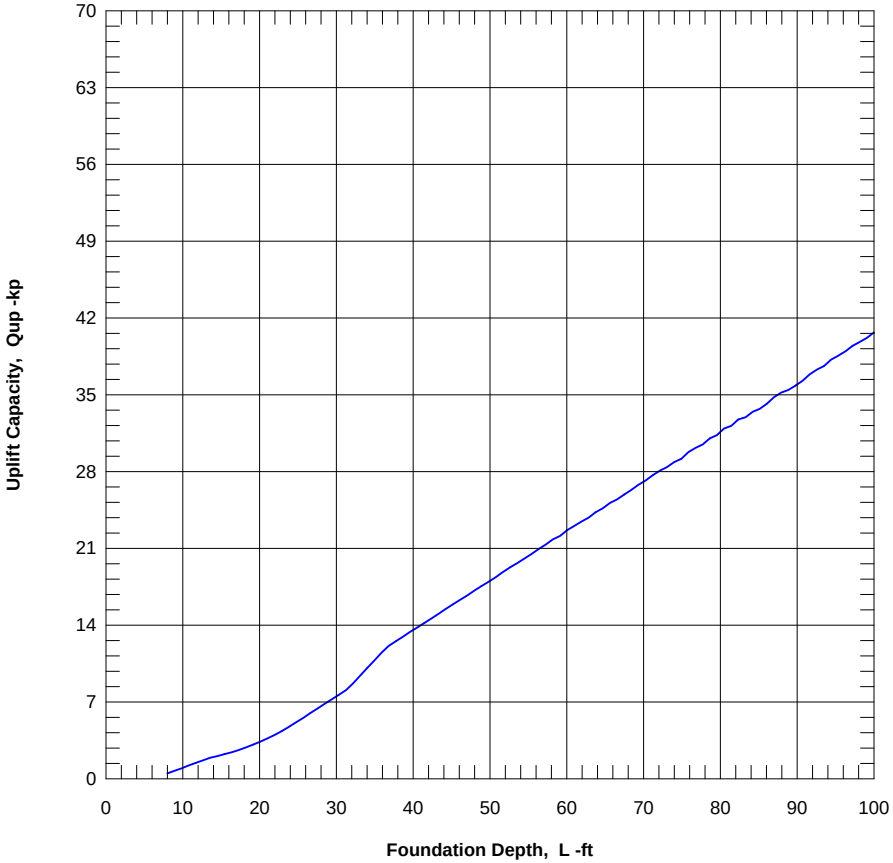
AllPile Civiltech Software

Ferndale Preserve Observation Tower/Pier, Lake Apopka
HP10X57 Steel Pile @ SPT Boring TB-1

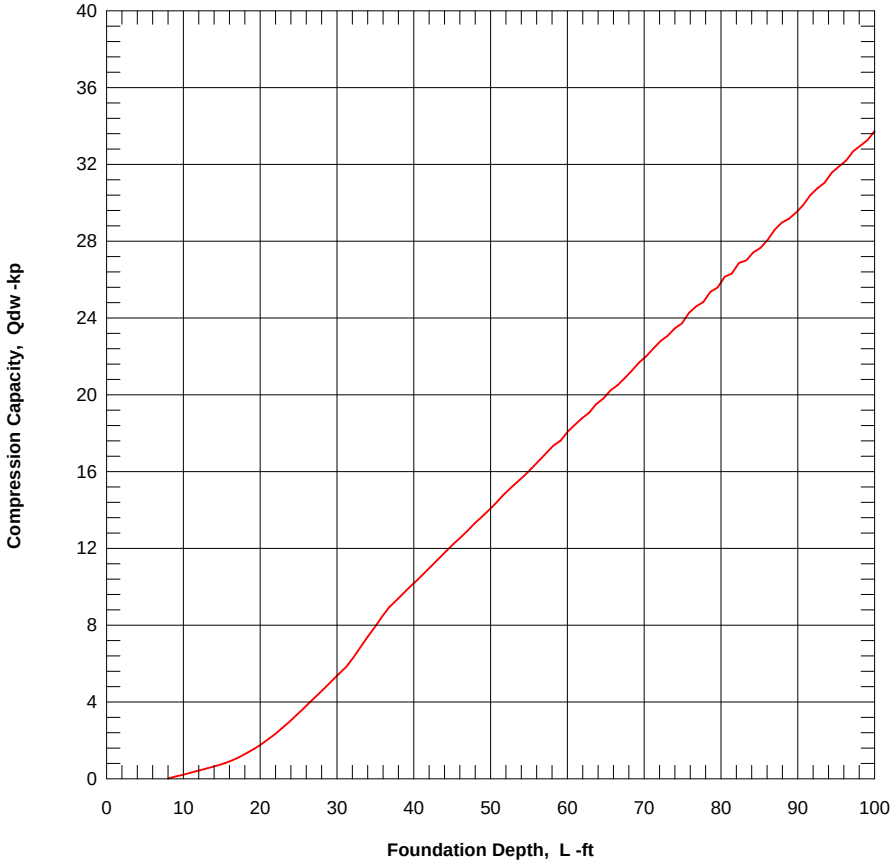
Figure 1

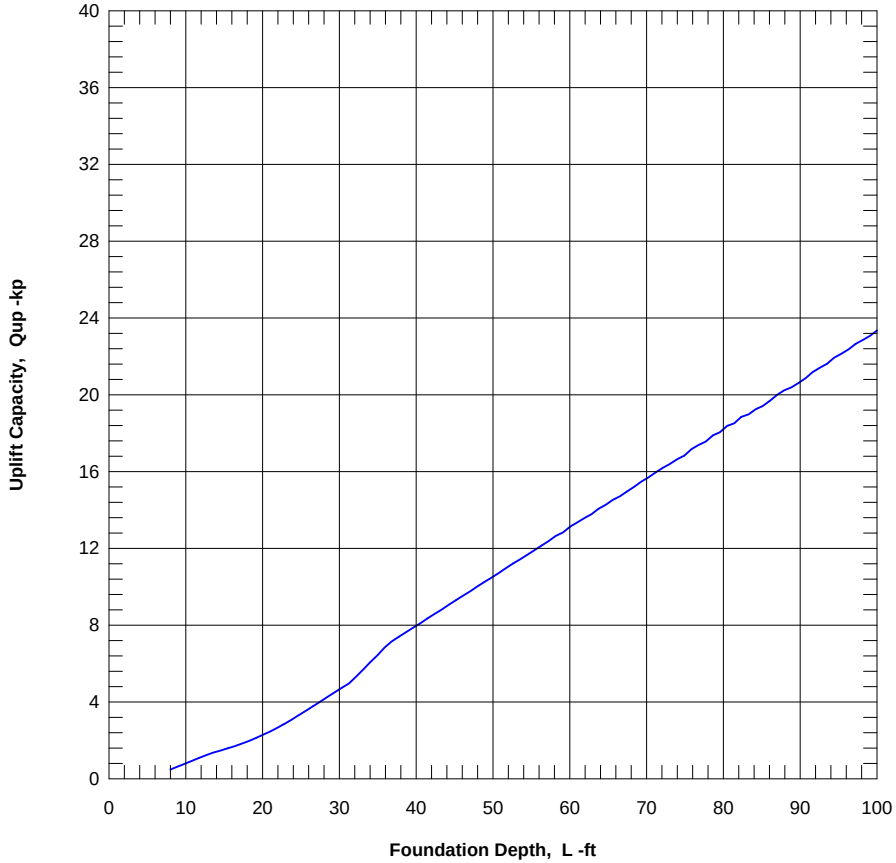
ULTIMATE CAPACITY vs FOUNDATION DEPTH



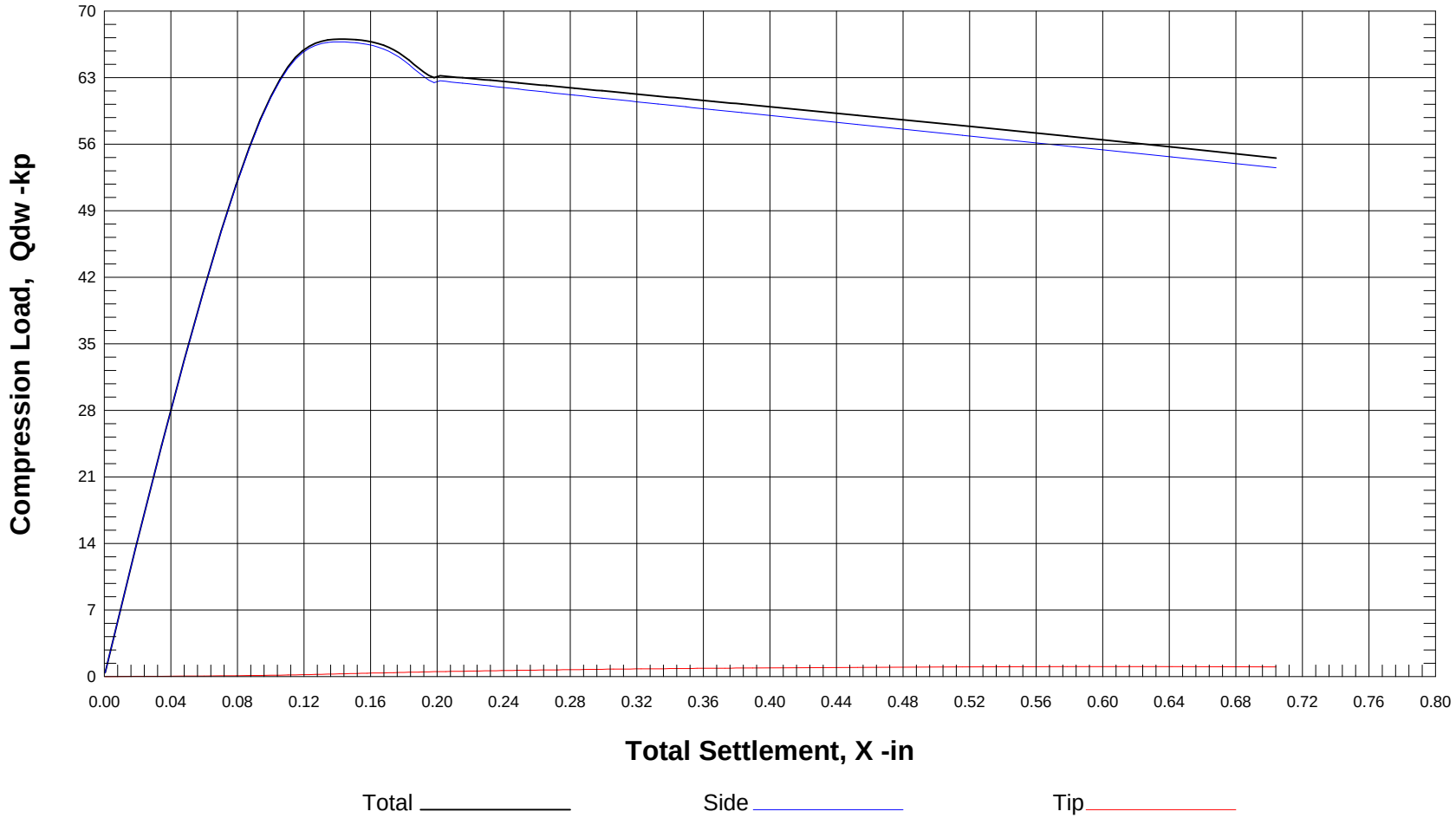


ALLOWABLE CAPACITY vs FOUNDATION DEPTH



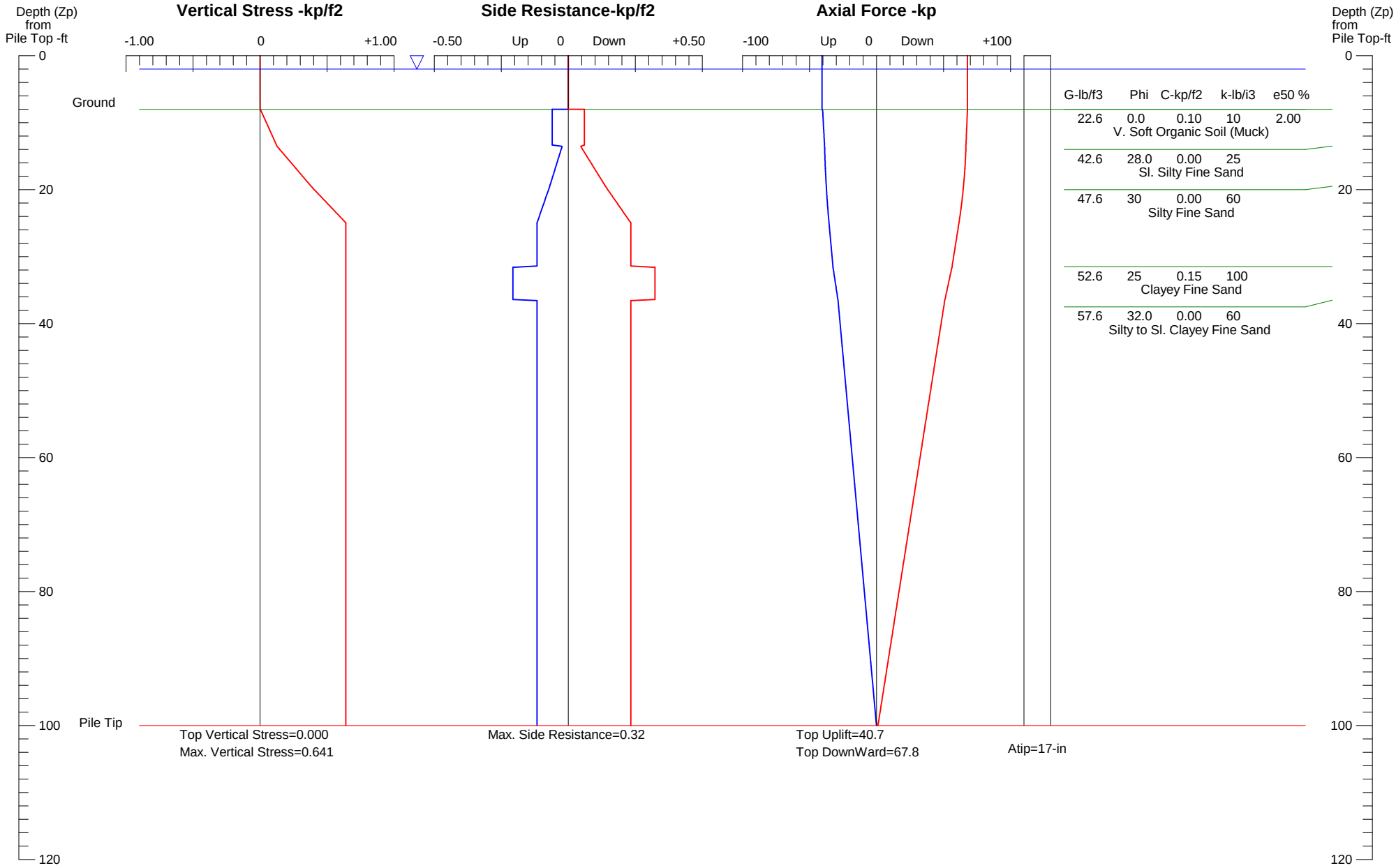


Vertical Load vs. Total Settlement



SOIL STRESS, SIDE RESISTANCE, & AXIAL FORCE vs DEPTH

Based on Ultimate Load Condition



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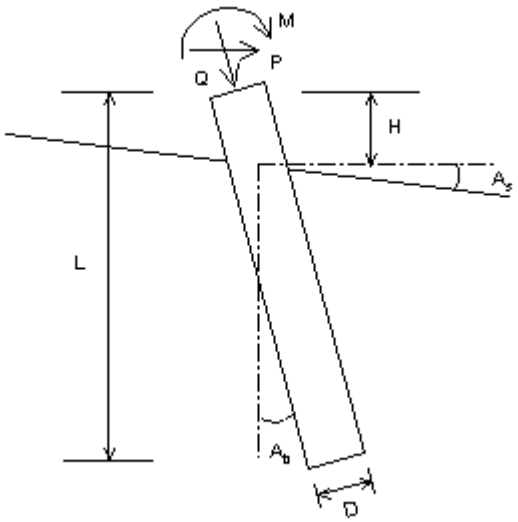
Ferndale Preserve Observation Tower/Pier, Lake Apopka
HP10X57 Steel Pile @ SPT Boring TB-1

Figure 5

VERTICAL ANALYSIS

Figure 6



Driving Steel Pile (Open end)

Loads:
Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 30.0 -kp

Profile:
Pile Length, L= 100.0 -ft
Top Height, H= 8.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0
Fixed Head Condition

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	22.6	0.0	0.10	10	2.00	0
5.5	42.6	28.0	0.00	25	35	8
11.5	47.6	30	0.00	60	40	12
23.5	52.6	25	0.15	100	50	14
28.5	57.6	32.0	0.00	60	47.20	16

Pile Data:

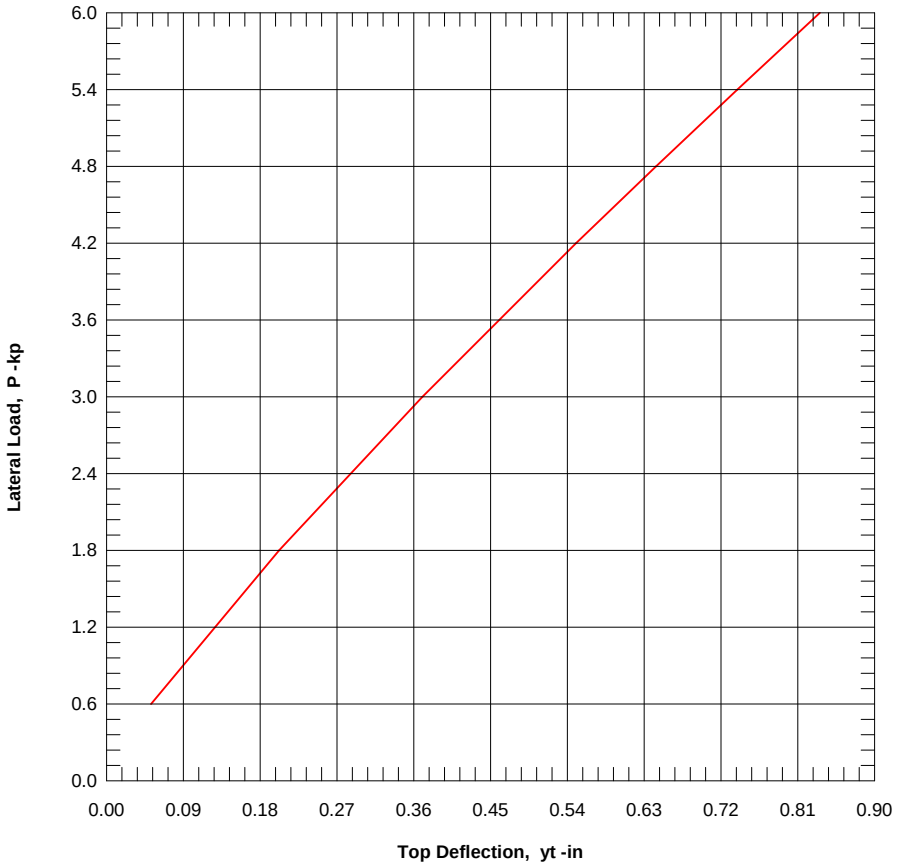
Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	10.2	16.8	40.4	294.0	29000	0.06
100.0						

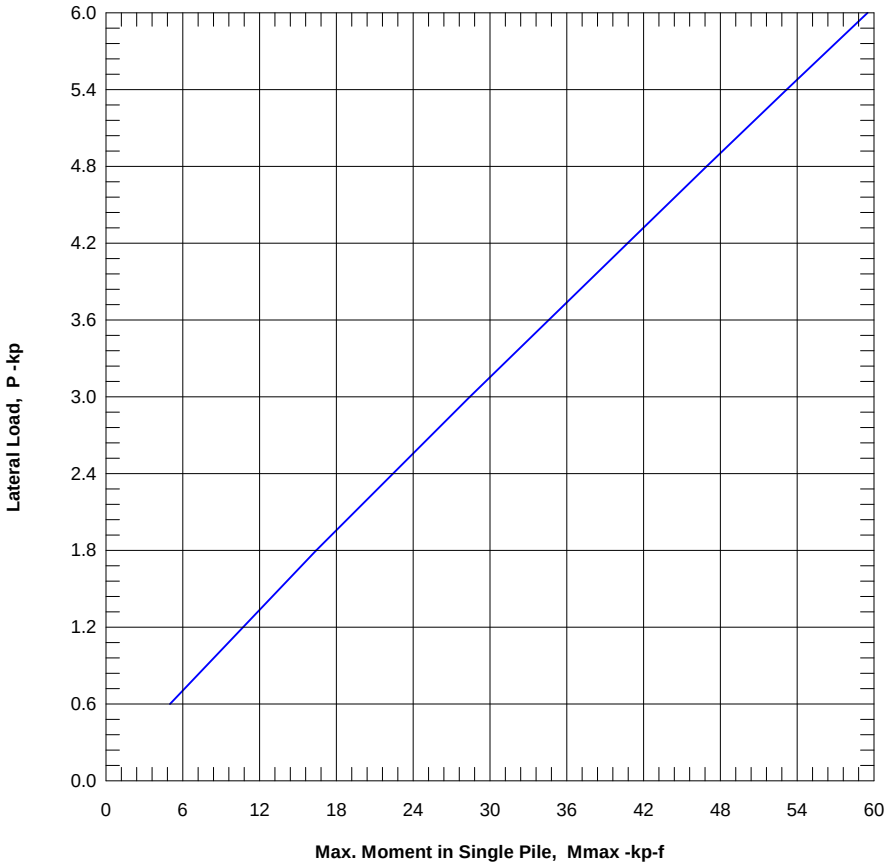
Vertical Capacity:
Weight above Ground= 0.48 Total Weight= 6.00-kp *Soil Weight is not included
Side Resistance (Down)= 66.764-kp Side Resistance (Up)= 34.695-kp
Tip Resistance (Down)= 1.064-kp Tip Resistance (Up)= 0.000-kp
Total Ultimate Capacity (Down) Qult= 67.828-kp Total Ultimate Capacity (Up)= 40.695-kp
Total Allowable Capacity (Down) Qallow= 33.737-kp Total Allowable Capacity (Up) Qallow= 23.348-kp
OK! Qallow > Q

Settlement Calculation:
At Q= 30.00-kp Settlement= 0.04299-in
At Xallow= 1.00-in Q= 99999.00000-kp

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

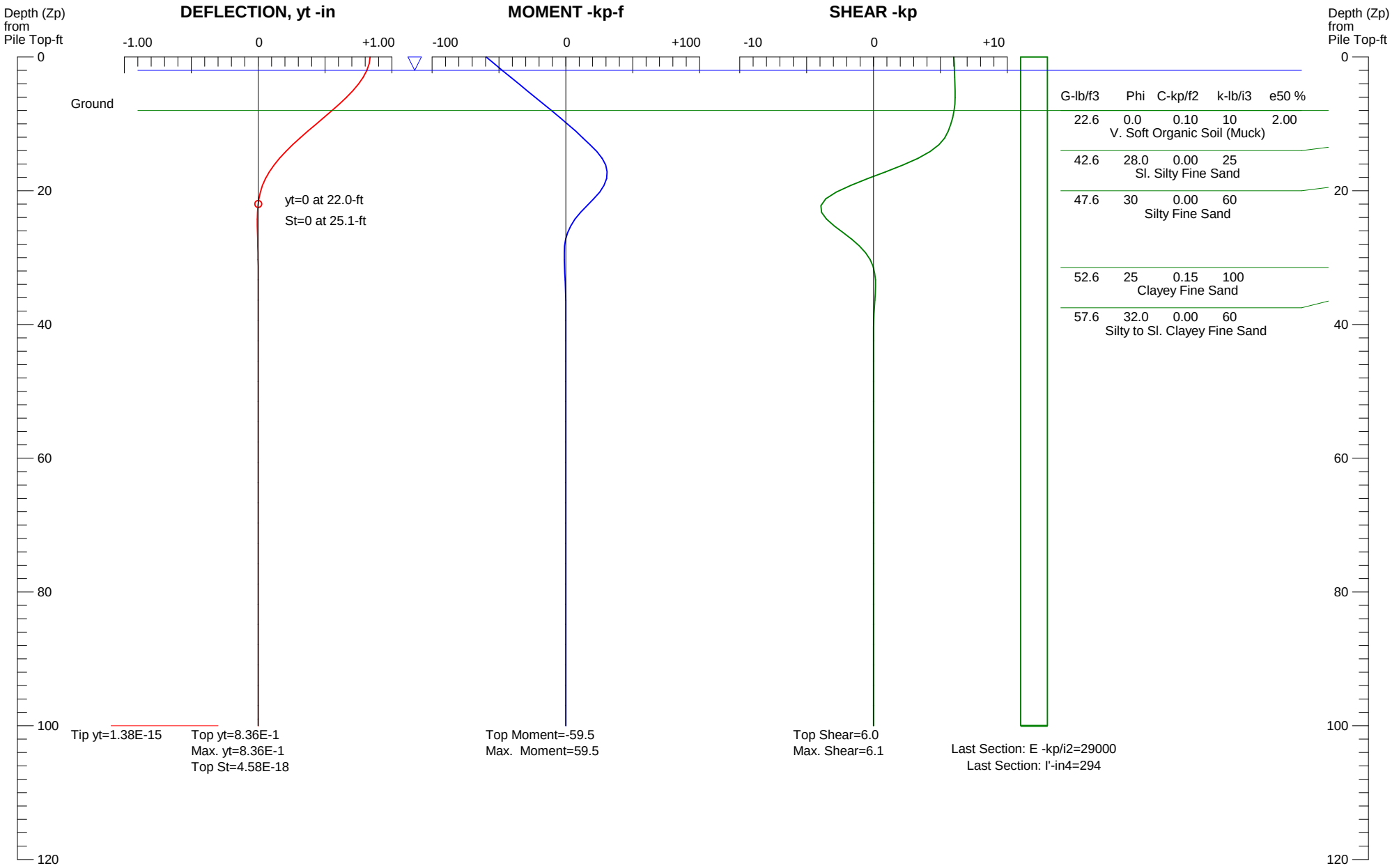
LATERAL LOAD vs DEFLECTION & MAX. MOMENT





PILE DEFLECTION & FORCE vs DEPTH

Single Pile, Khead=5, Kbc=2



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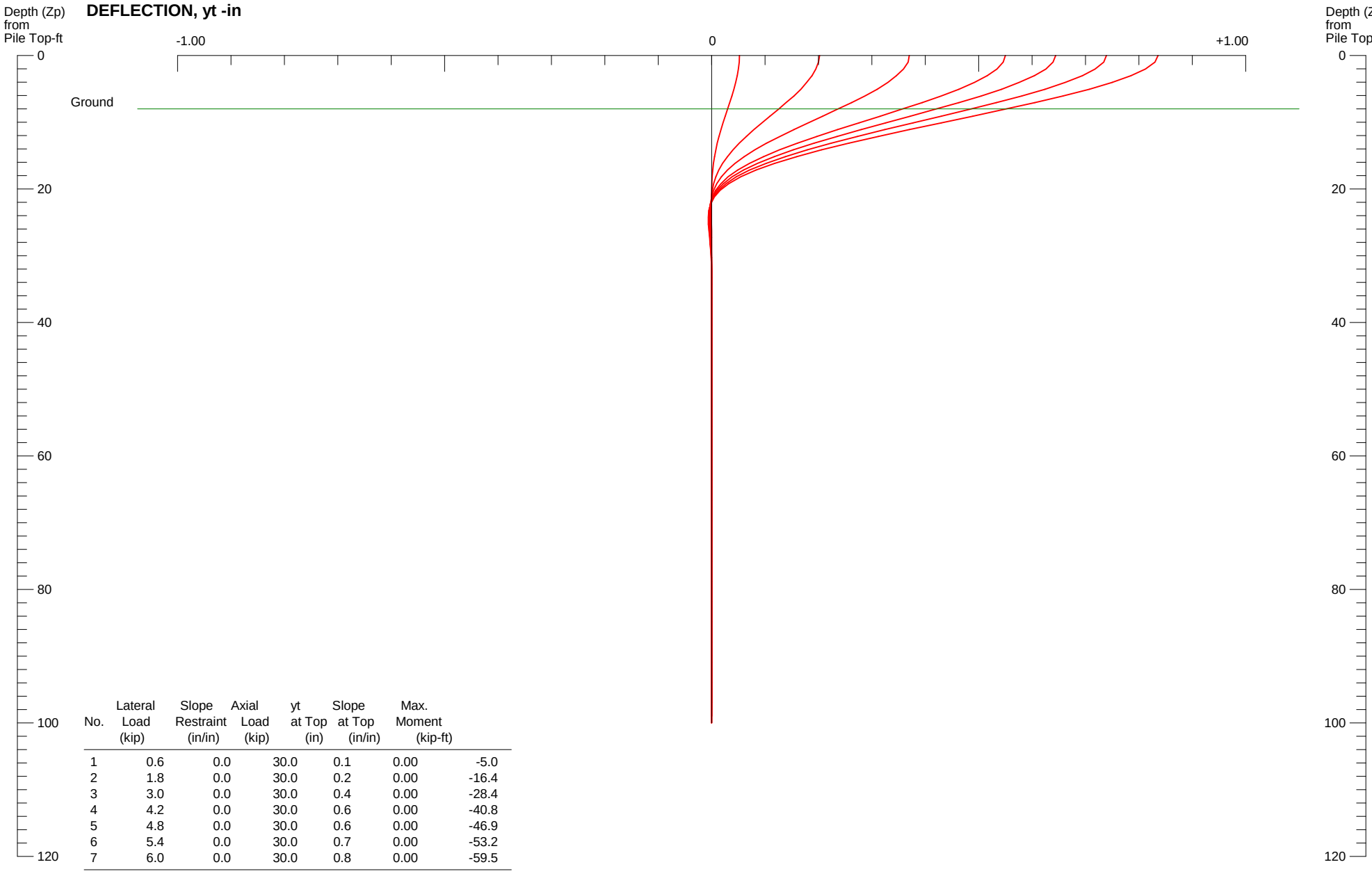
Ferndale Preserve Observation Tower/Pier, Lake Apopka
HP10X57 Steel Pile @ SPT Boring TB-1

Figure 8

PILE DEFLECTION vs LOADING

Single Pile, Khead=5, Kbc=2



No.	Lateral Load (kip)	Slope Restraint (in/in)	Axial Load (kip)	yt at Top (in)	Slope at Top (in/in)	Max. Moment (kip-ft)	
1	0.6	0.0	30.0	0.1	0.00	-5.0	
2	1.8	0.0	30.0	0.2	0.00	-16.4	
3	3.0	0.0	30.0	0.4	0.00	-28.4	
4	4.2	0.0	30.0	0.6	0.00	-40.8	
5	4.8	0.0	30.0	0.6	0.00	-46.9	
6	5.4	0.0	30.0	0.7	0.00	-53.2	
7	6.0	0.0	30.0	0.8	0.00	-59.5	

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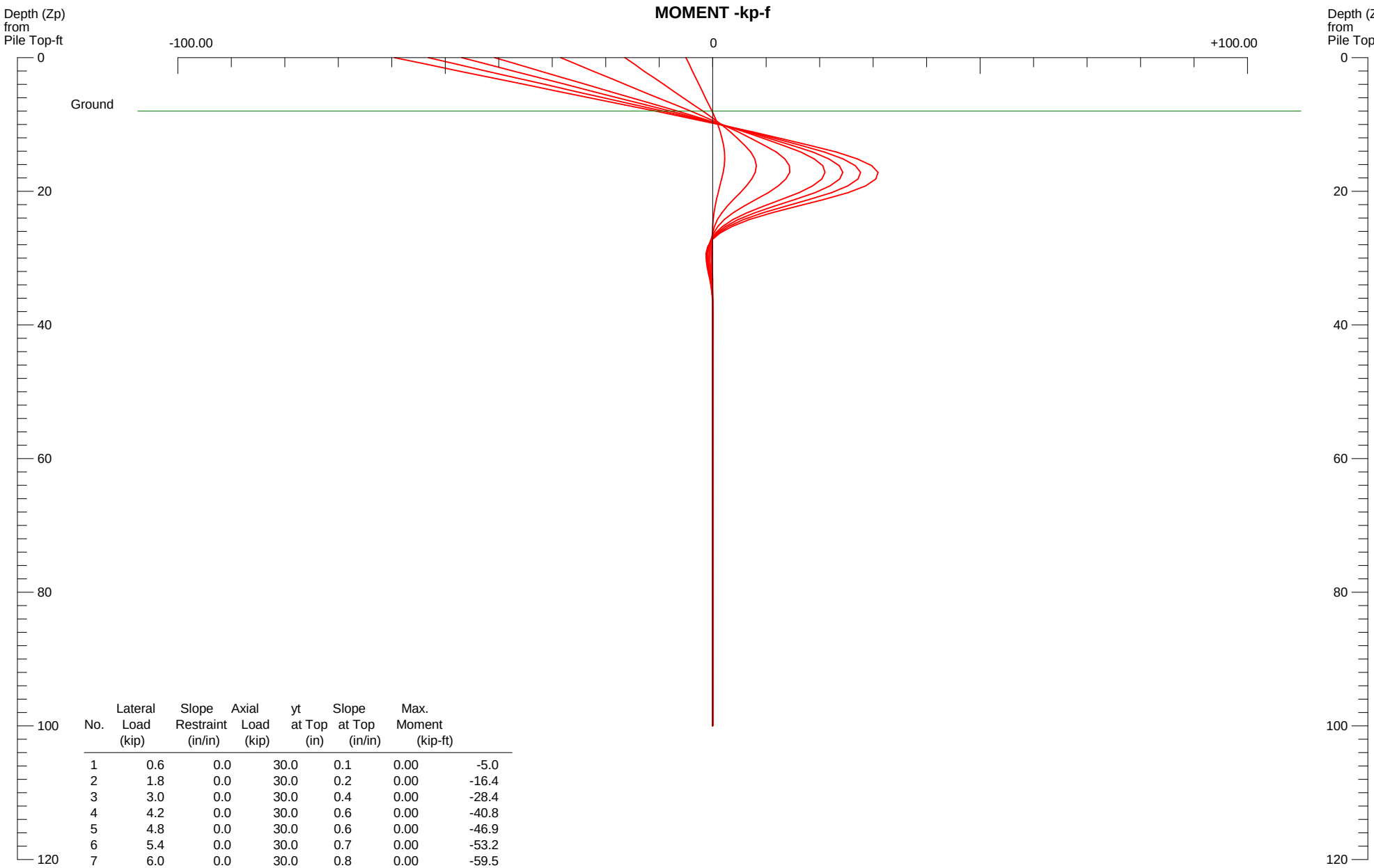
Ferndale Preserve Observation Tower/Pier, Lake Apopka
HP10X57 Steel Pile @ SPT Boring TB-1

Figure 9

PILE MOMENT vs LOADING

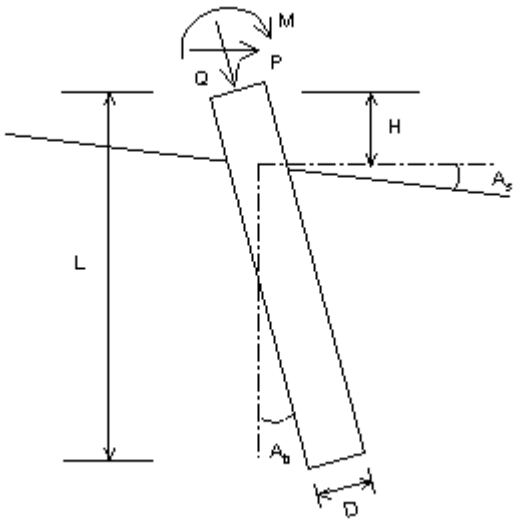
Single Pile, Khead=5, Kbc=2



No.	Lateral Load (kip)	Slope Restraint (in/in)	Axial Load (kip)	yt at Top (in)	Slope at Top (in/in)	Max. Moment (kip-ft)	
1	0.6	0.0	30.0	0.1	0.00	-5.0	
2	1.8	0.0	30.0	0.2	0.00	-16.4	
3	3.0	0.0	30.0	0.4	0.00	-28.4	
4	4.2	0.0	30.0	0.6	0.00	-40.8	
5	4.8	0.0	30.0	0.6	0.00	-46.9	
6	5.4	0.0	30.0	0.7	0.00	-53.2	
7	6.0	0.0	30.0	0.8	0.00	-59.5	

LATERAL ANALYSIS

Figure 11



Driving Steel Pile (Open end)

Loads:
Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 30.0 -kp
Shear Load, P= 6.0 -kp
Slope Restrain St= 0.00000 -in/-in

Profile:
Pile Length, L= 100.0 -ft
Top Height, H= 8.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0
Fixed Head Condition

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	22.6	0.0	0.10	10	2.00	0
5.5	42.6	28.0	0.00	25	35	8
11.5	47.6	30	0.00	60	40	12
23.5	52.6	25	0.15	100	50	14
28.5	57.6	32.0	0.00	60	47.20	16

Pile Data:

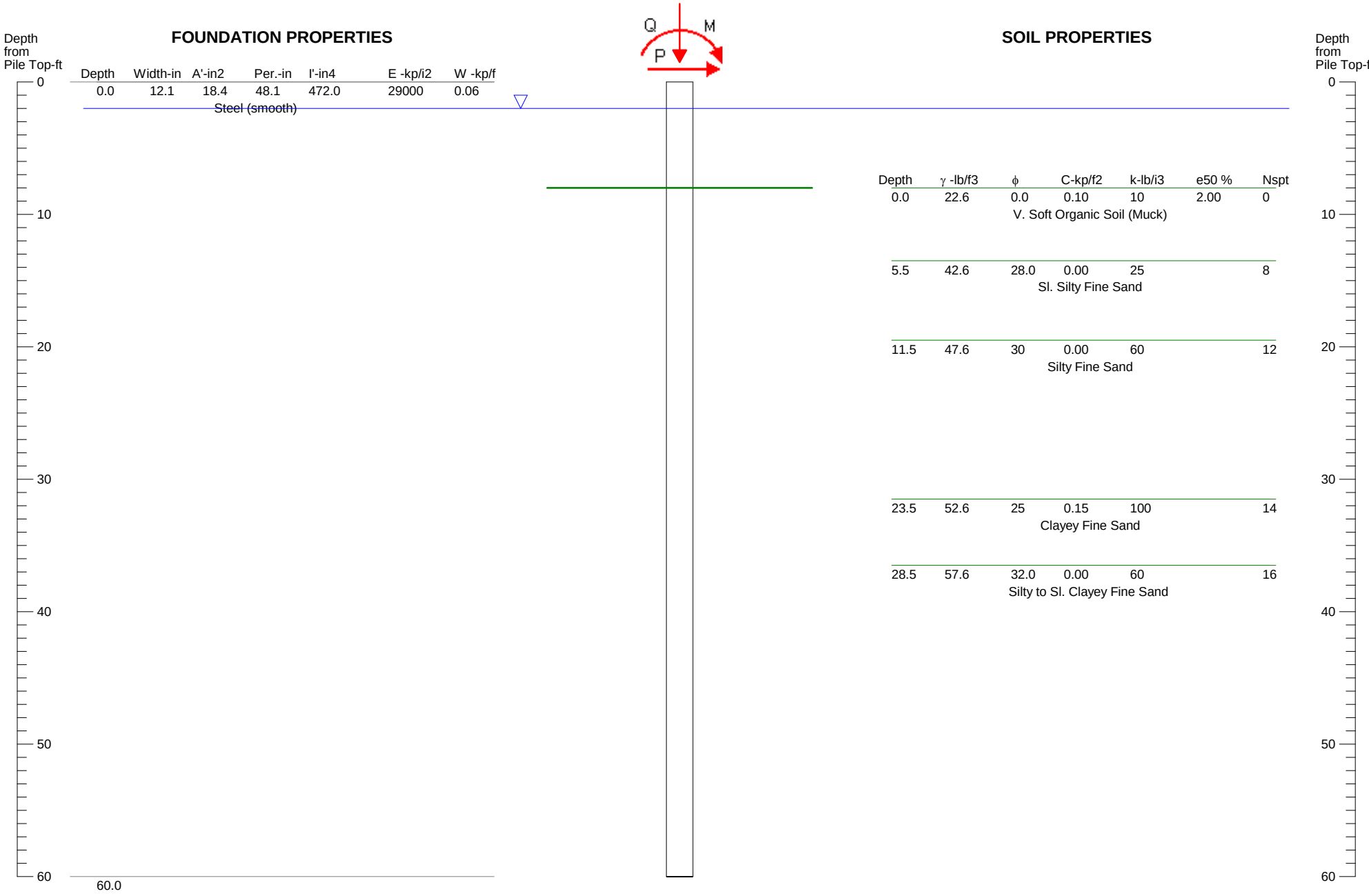
Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	10.2	16.8	40.4	294.0	29000	0.06
100.0						

Single Pile Lateral Analysis:
Top Deflection, yt= 0.83600-in
Max. Moment, M= -59.50-kp-f
Top Deflection Slope, St= 0.00000
OK! Top Deflection, 0.8360-in is less than the Allowable Deflection= 2.00-in

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.
The Max. Moment calculated by program is an internal force from the applied load conditions. Structural engineer has to check whether the pile has enough capacity to resist the moment with adequate factor of safety. If not, the pile may fail under the load conditions.

ALLPILE PILE ANALYSES OUTPUTS
FERNDALE PRESERVE OBSERVATION TOWER
STEEL HP12x63 PILE @ TB-1

FOUNDATION PROFILE & SOIL CONDITIONS



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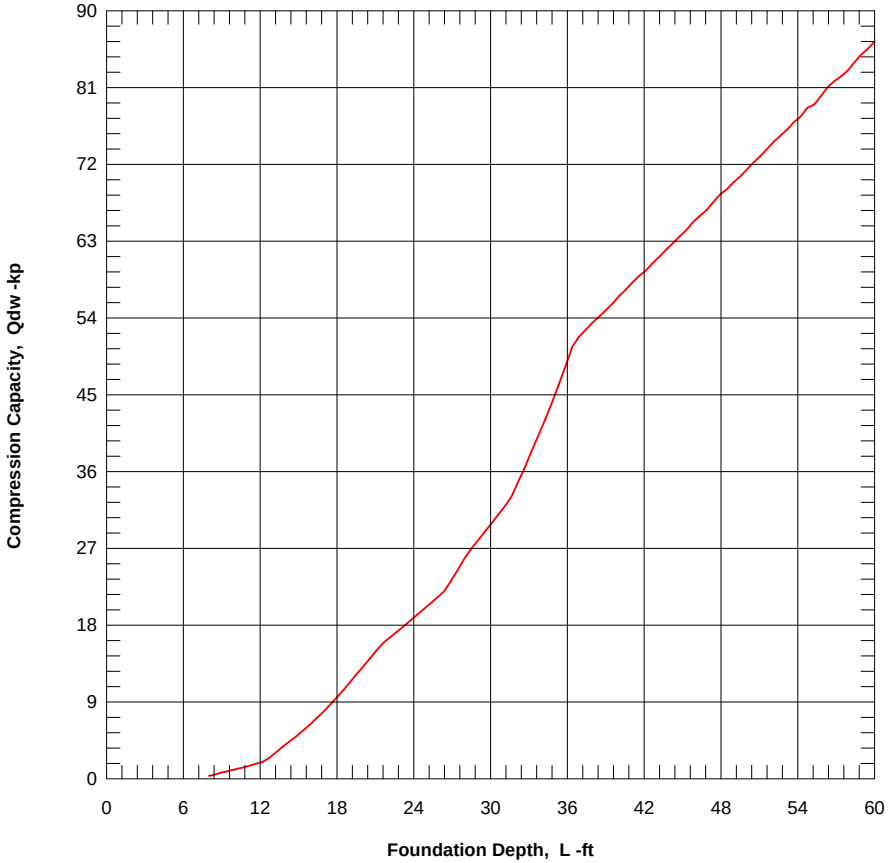
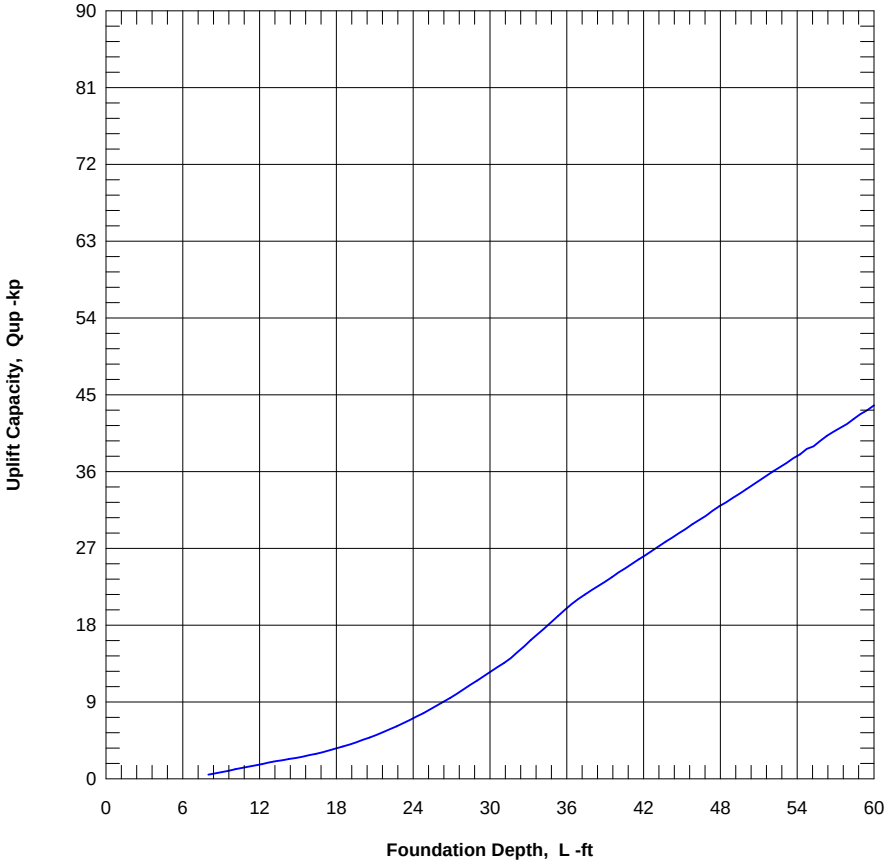
Ferndale Preserve Observation Tower/Pier, Lake Apopka
HP12X63 Steel Pile @ SPT Boring TB-1

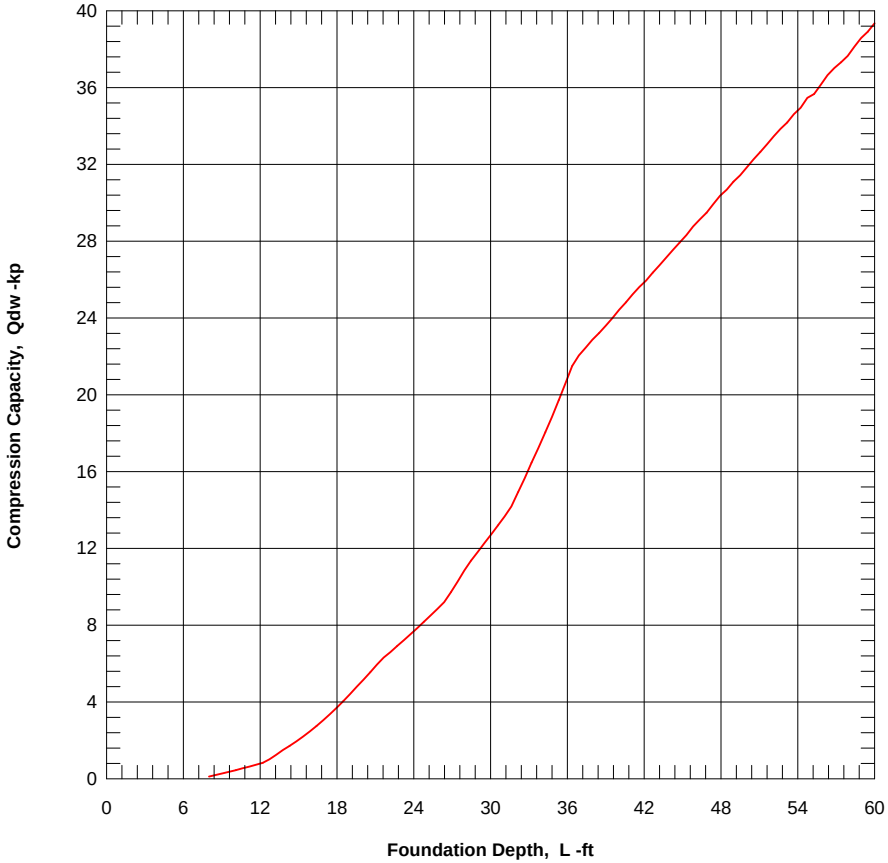
Figure 1

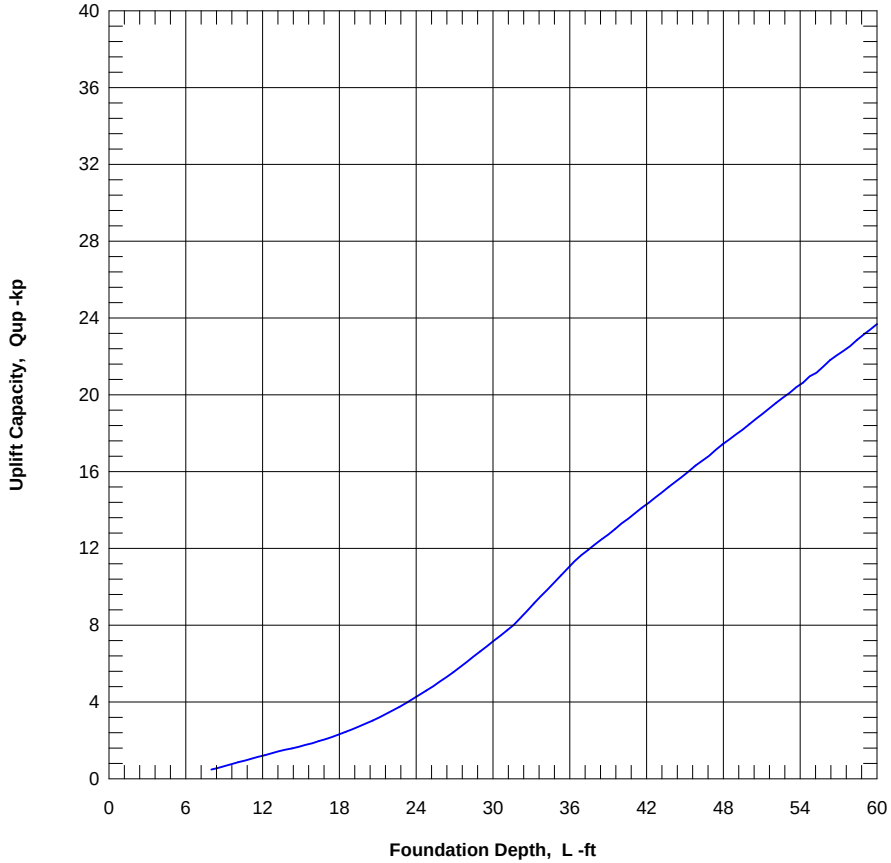
ULTIMATE CAPACITY vs FOUNDATION DEPTH



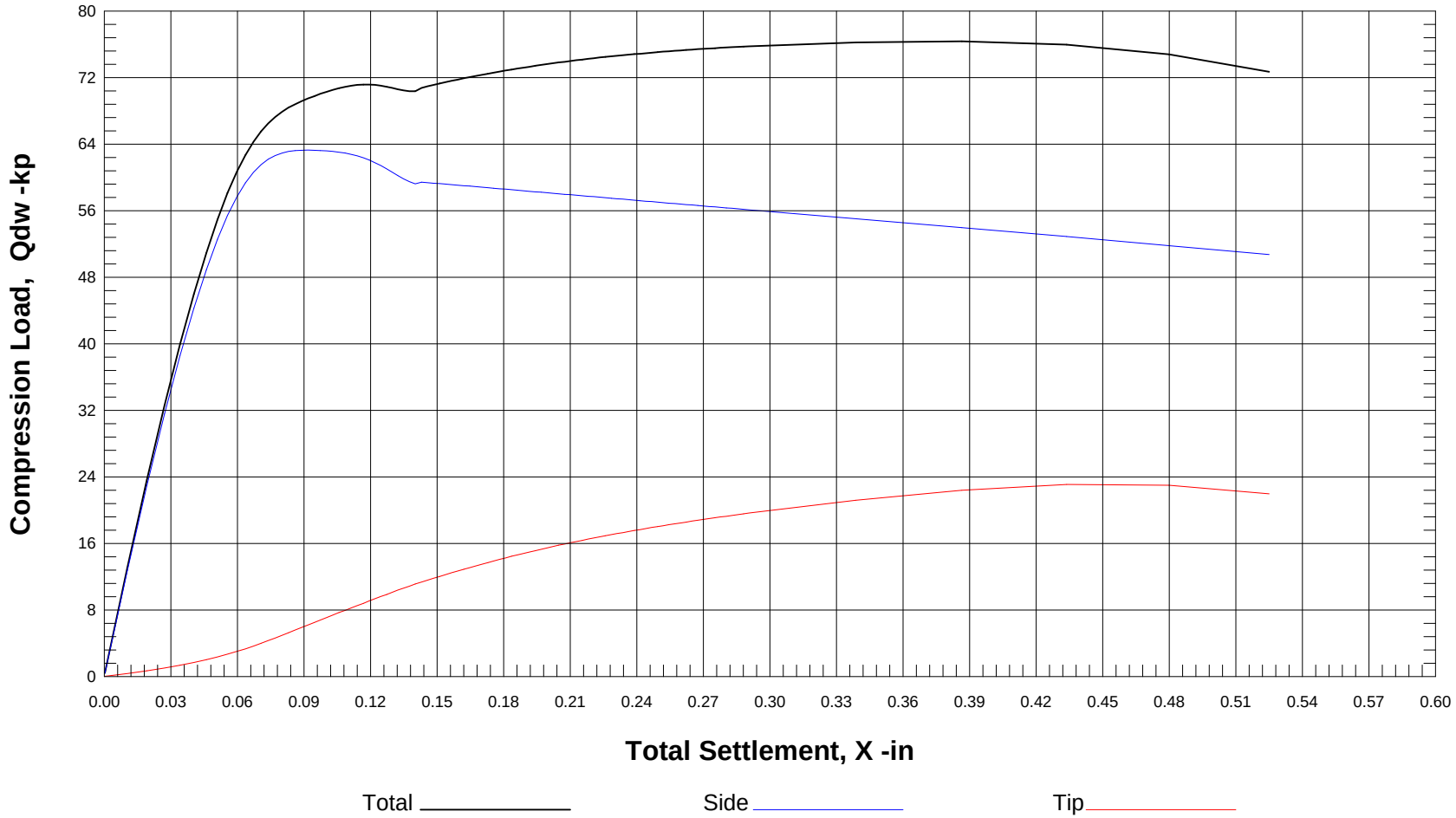


ALLOWABLE CAPACITY vs FOUNDATION DEPTH



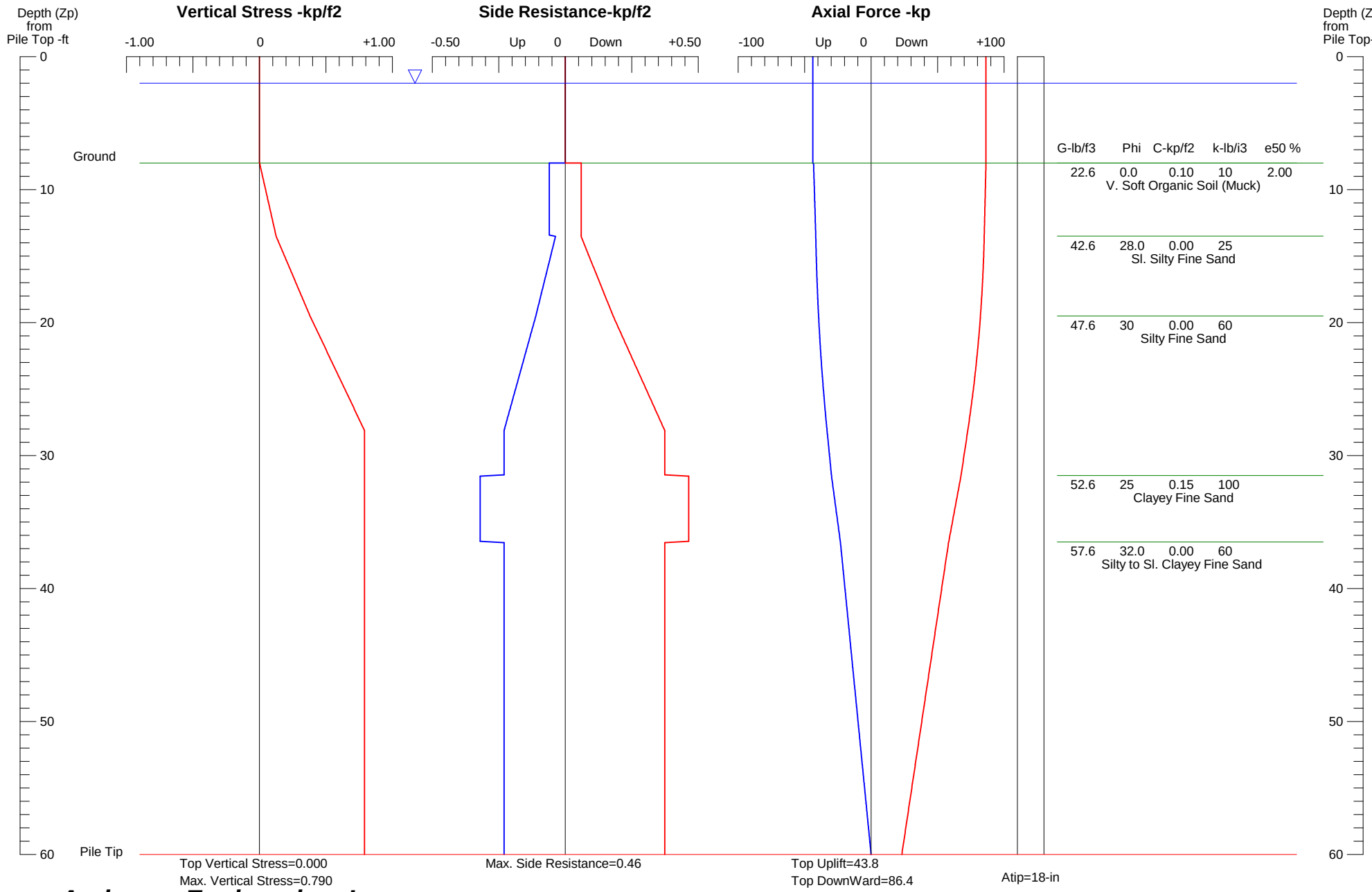


Vertical Load vs. Total Settlement



SOIL STRESS, SIDE RESISTANCE, & AXIAL FORCE vs DEPTH

Based on Ultimate Load Condition



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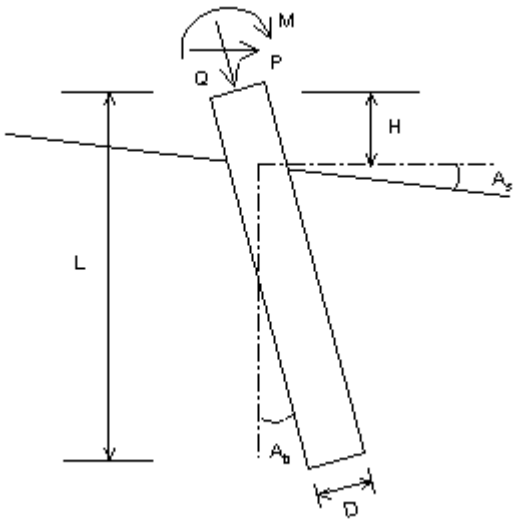
Ferndale Preserve Observation Tower/Pier, Lake Apopka
HP12X63 Steel Pile @ SPT Boring TB-1

Figure 5

VERTICAL ANALYSIS

Figure 6



Driving Concrete Pile

Loads:
Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 30.0 -kp

Profile:
Pile Length, L= 60.0 -ft
Top Height, H= 8.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0
Fixed Head Condition

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	22.6	0.0	0.10	10	2.00	0
5.5	42.6	28.0	0.00	25	35	8
11.5	47.6	30	0.00	60	40	12
23.5	52.6	25	0.15	100	50	14
28.5	57.6	32.0	0.00	60	47.20	16

Pile Data:

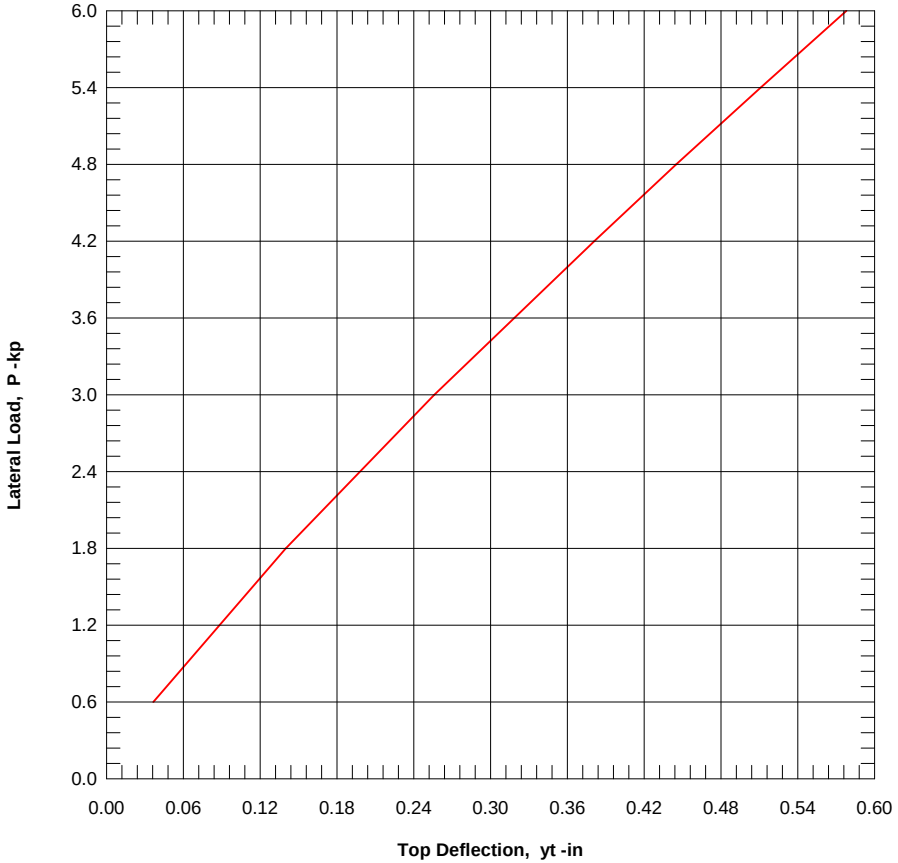
Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	12.1	18.4	48.1	472.0	29000	0.06
60.0						

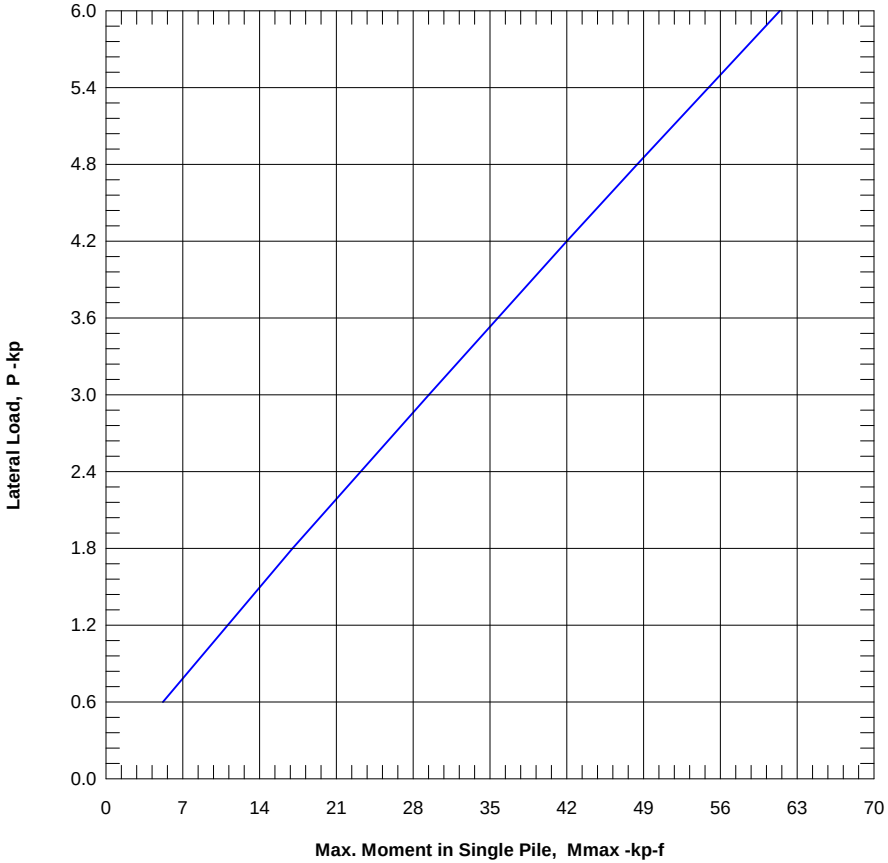
Vertical Capacity:
Weight above Ground= 0.48 Total Weight= 3.60-kp *Soil Weight is not included
Side Resistance (Down)= 63.289-kp Side Resistance (Up)= 40.152-kp
Tip Resistance (Down)= 23.094-kp Tip Resistance (Up)= 0.000-kp
Total Ultimate Capacity (Down) Qult= 86.383-kp Total Ultimate Capacity (Up)= 43.752-kp
Total Allowable Capacity (Down) Qallow= 39.343-kp Total Allowable Capacity (Up) Qallow= 23.676-kp
OK! Qallow > Q

Settlement Calculation:
At Q= 30.00-kp Settlement= 0.02485-in
At Xallow= 1.00-in Q= 99999.00000-kp

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

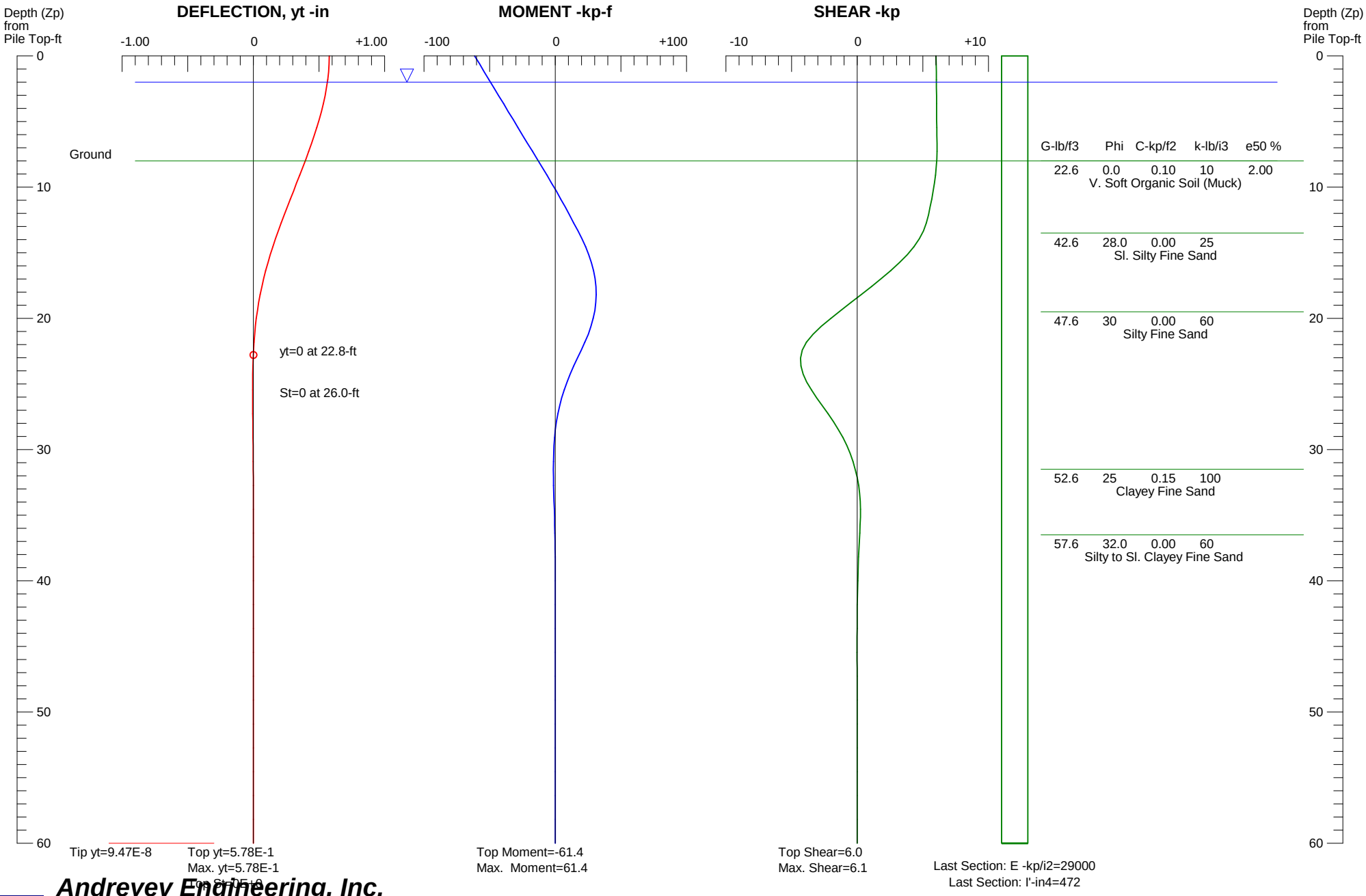
LATERAL LOAD vs DEFLECTION & MAX. MOMENT





PILE DEFLECTION & FORCE vs DEPTH

Single Pile, Khead=5, Kbc=2



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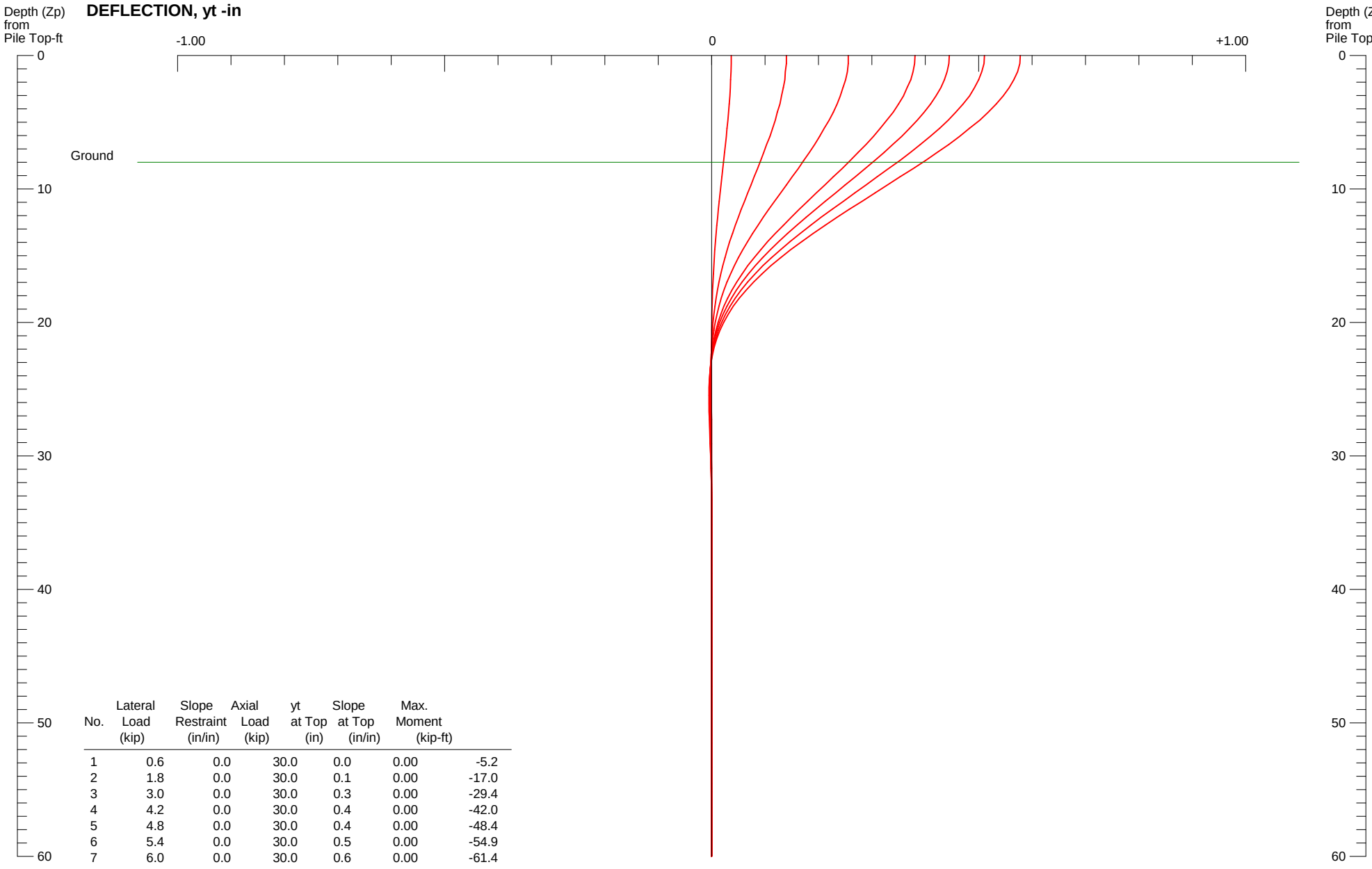
Ferndale Preserve Observation Tower/Pier, Lake Apopka
HP12X63 Steel Pile @ SPT Boring TB-1

Figure 8

PILE DEFLECTION vs LOADING

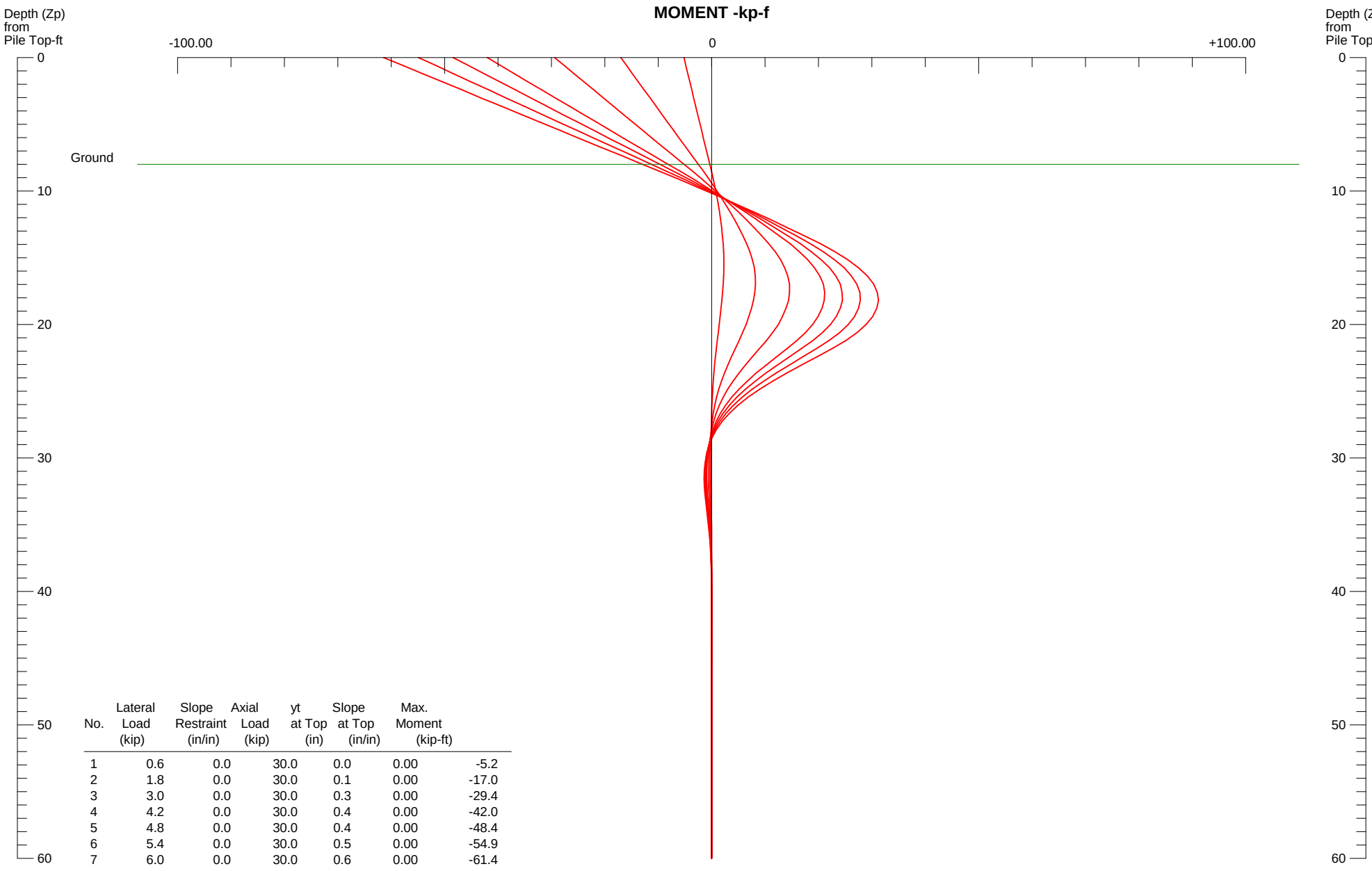
Single Pile, Khead=5, Kbc=2



No.	Lateral Load (kip)	Slope Restraint (in/in)	Axial Load (kip)	yt at Top (in)	Slope at Top (in/in)	Max. Moment (kip-ft)	
1	0.6	0.0	30.0	0.0	0.00	-5.2	
2	1.8	0.0	30.0	0.1	0.00	-17.0	
3	3.0	0.0	30.0	0.3	0.00	-29.4	
4	4.2	0.0	30.0	0.4	0.00	-42.0	
5	4.8	0.0	30.0	0.4	0.00	-48.4	
6	5.4	0.0	30.0	0.5	0.00	-54.9	
7	6.0	0.0	30.0	0.6	0.00	-61.4	

PILE MOMENT vs LOADING

Single Pile, Khead=5, Kbc=2



No.	Lateral Load (kip)	Slope Restraint (in/in)	Axial Load (kip)	yt at Top (in)	Slope at Top (in/in)	Max. Moment (kip-ft)
1	0.6	0.0	30.0	0.0	0.00	-5.2
2	1.8	0.0	30.0	0.1	0.00	-17.0
3	3.0	0.0	30.0	0.3	0.00	-29.4
4	4.2	0.0	30.0	0.4	0.00	-42.0
5	4.8	0.0	30.0	0.4	0.00	-48.4
6	5.4	0.0	30.0	0.5	0.00	-54.9
7	6.0	0.0	30.0	0.6	0.00	-61.4

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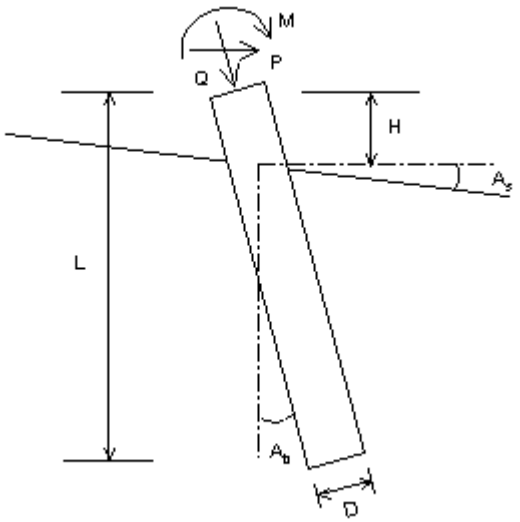
Ferndale Preserve Observation Tower/Pier, Lake Apopka
HP12X63 Steel Pile @ SPT Boring TB-1

Figure 10

LATERAL ANALYSIS

Figure 11



Driving Concrete Pile

Loads:
Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 30.0 -kp
Shear Load, P= 6.0 -kp
Slope Restrain St= 0.00000 -in/-in

Profile:
Pile Length, L= 60.0 -ft
Top Height, H= 8.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0
Fixed Head Condition

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	22.6	0.0	0.10	10	2.00	0
5.5	42.6	28.0	0.00	25	35	8
11.5	47.6	30	0.00	60	40	12
23.5	52.6	25	0.15	100	50	14
28.5	57.6	32.0	0.00	60	47.20	16

Pile Data:

Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	12.1	18.4	48.1	472.0	29000	0.06
60.0						

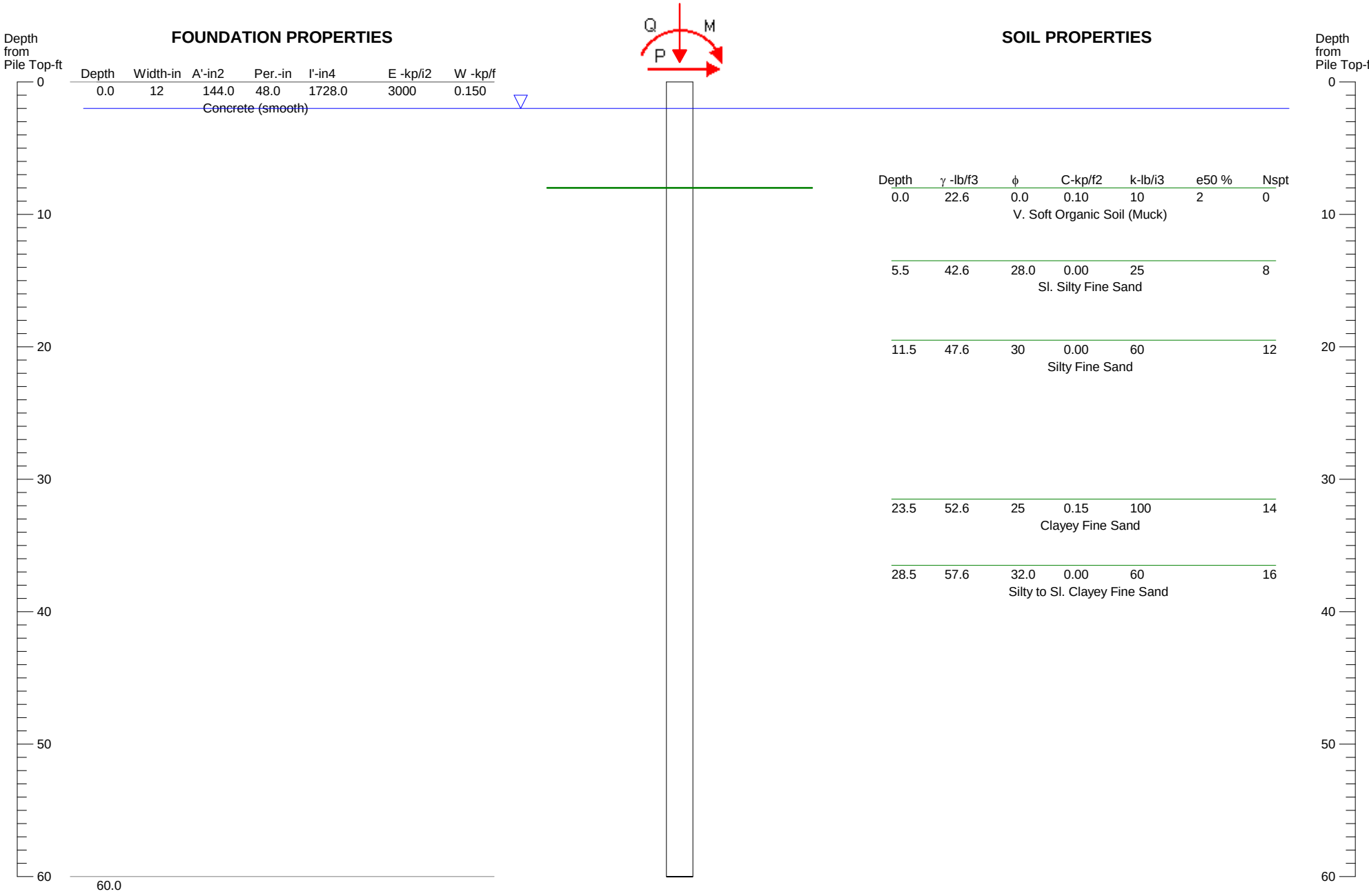
Single Pile Lateral Analysis:
Top Deflection, yt= 0.57800-in
Max. Moment, M= -61.42-kp-f
Top Deflection Slope, St= 0.00000
OK! Top Deflection, 0.5780-in is less than the Allowable Deflection= 2.00-in

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.
The Max. Moment calculated by program is an internal force from the applied load conditions. Structural engineer has to check whether the pile has enough capacity to resist the moment with adequate factor of safety. If not, the pile may fail under the load conditions.

ATTACHMENT B

ALLPILE PILE ANALYSES OUTPUTS
FERNDALE PRESERVE OBSERVATION TOWER
12”X12” PRECAST CONCRETE PILE @ TB-1

FOUNDATION PROFILE & SOIL CONDITIONS



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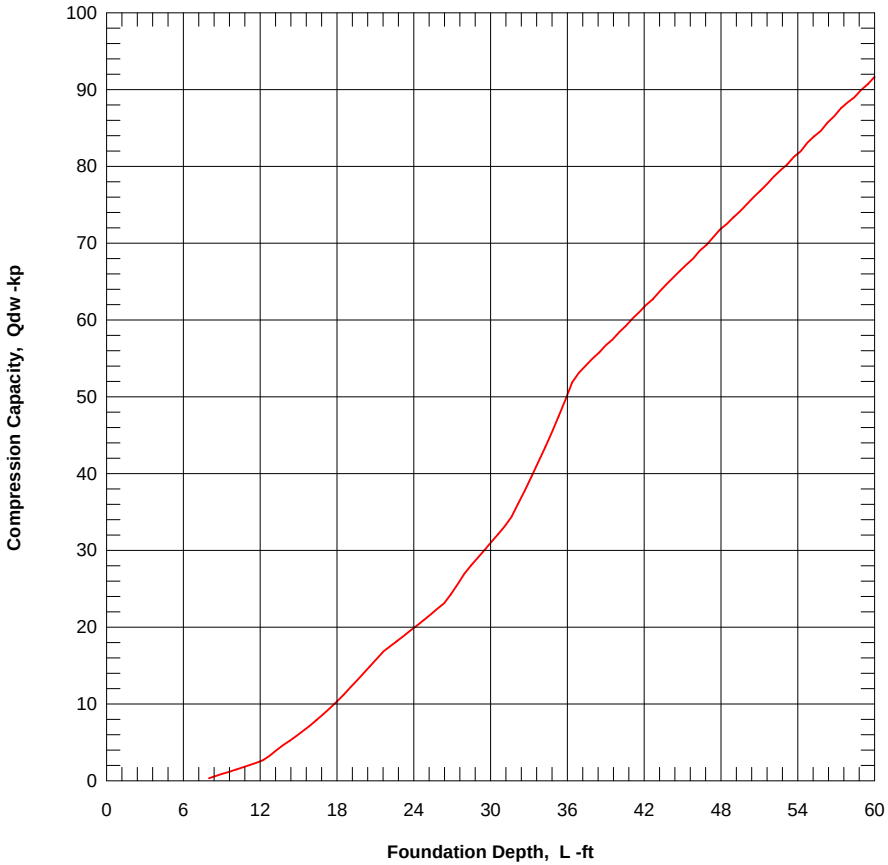
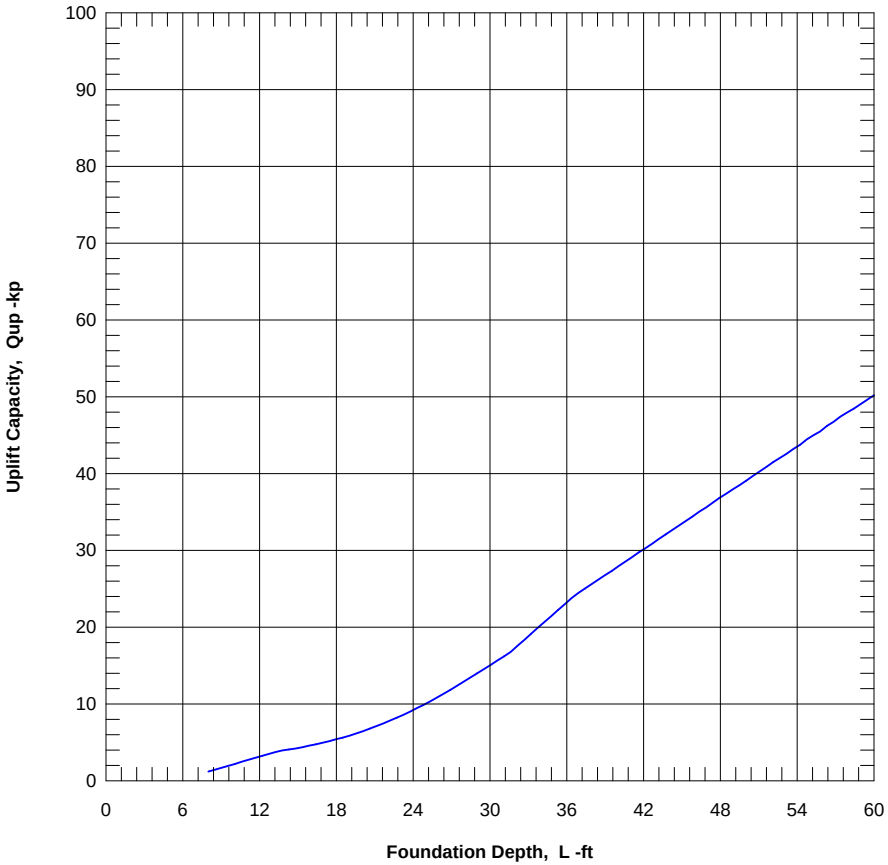
Ferndale Preserve Observation Tower/Pier, Lake Apopka
12" X 12" Precast Concrete Pile @ SPT Boring TB-1

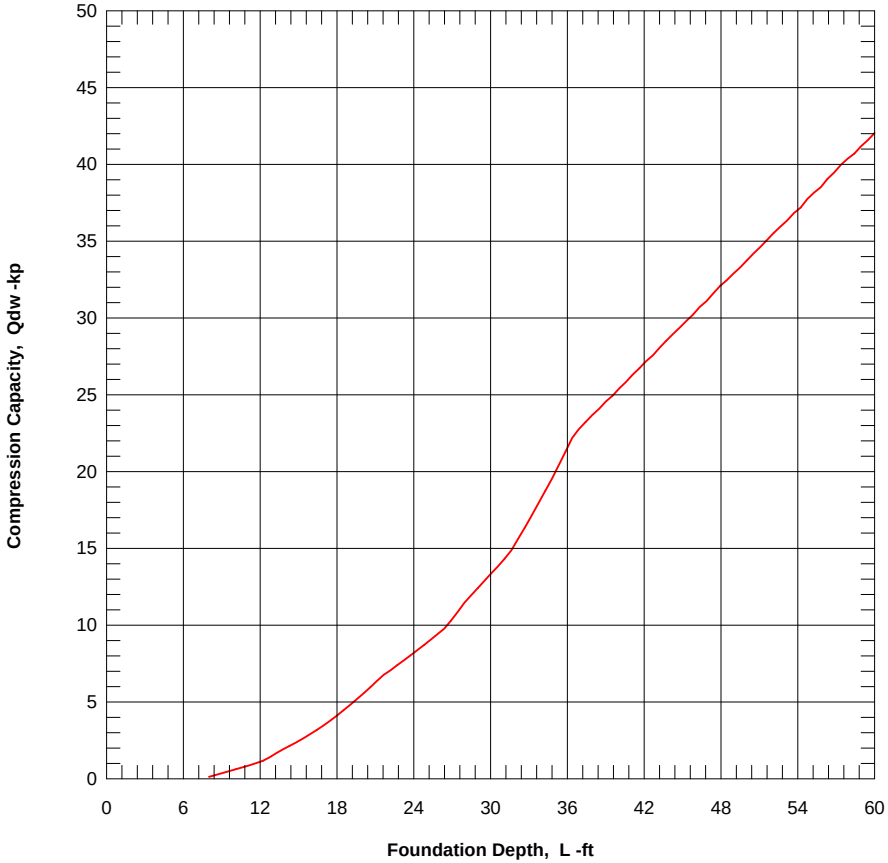
Figure 1

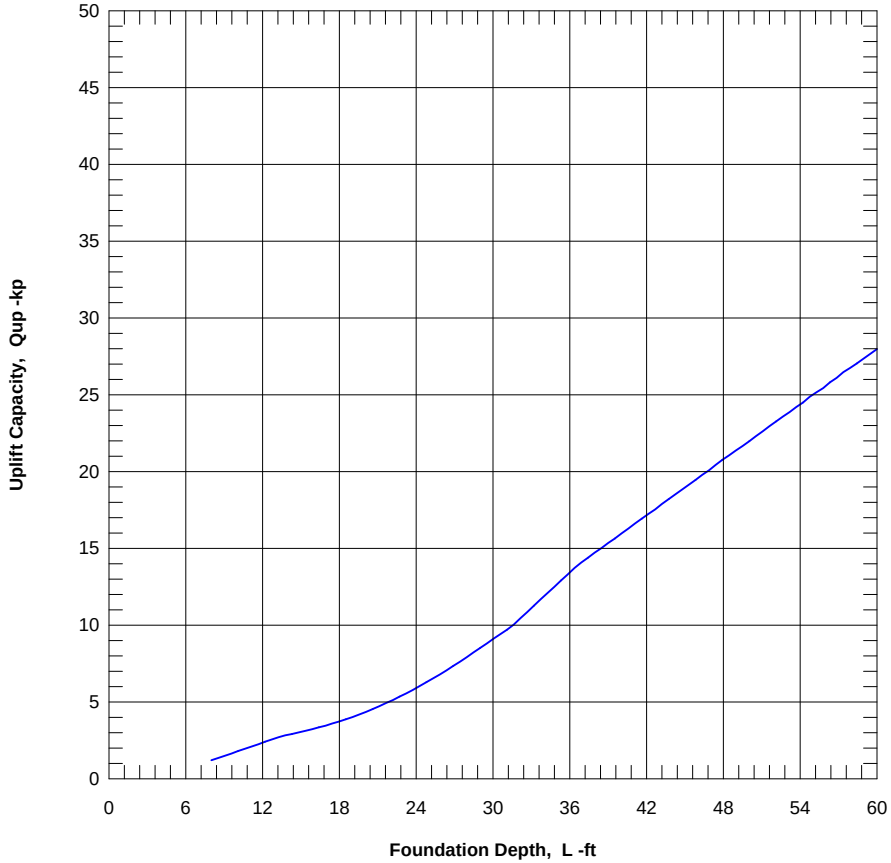
ULTIMATE CAPACITY vs FOUNDATION DEPTH



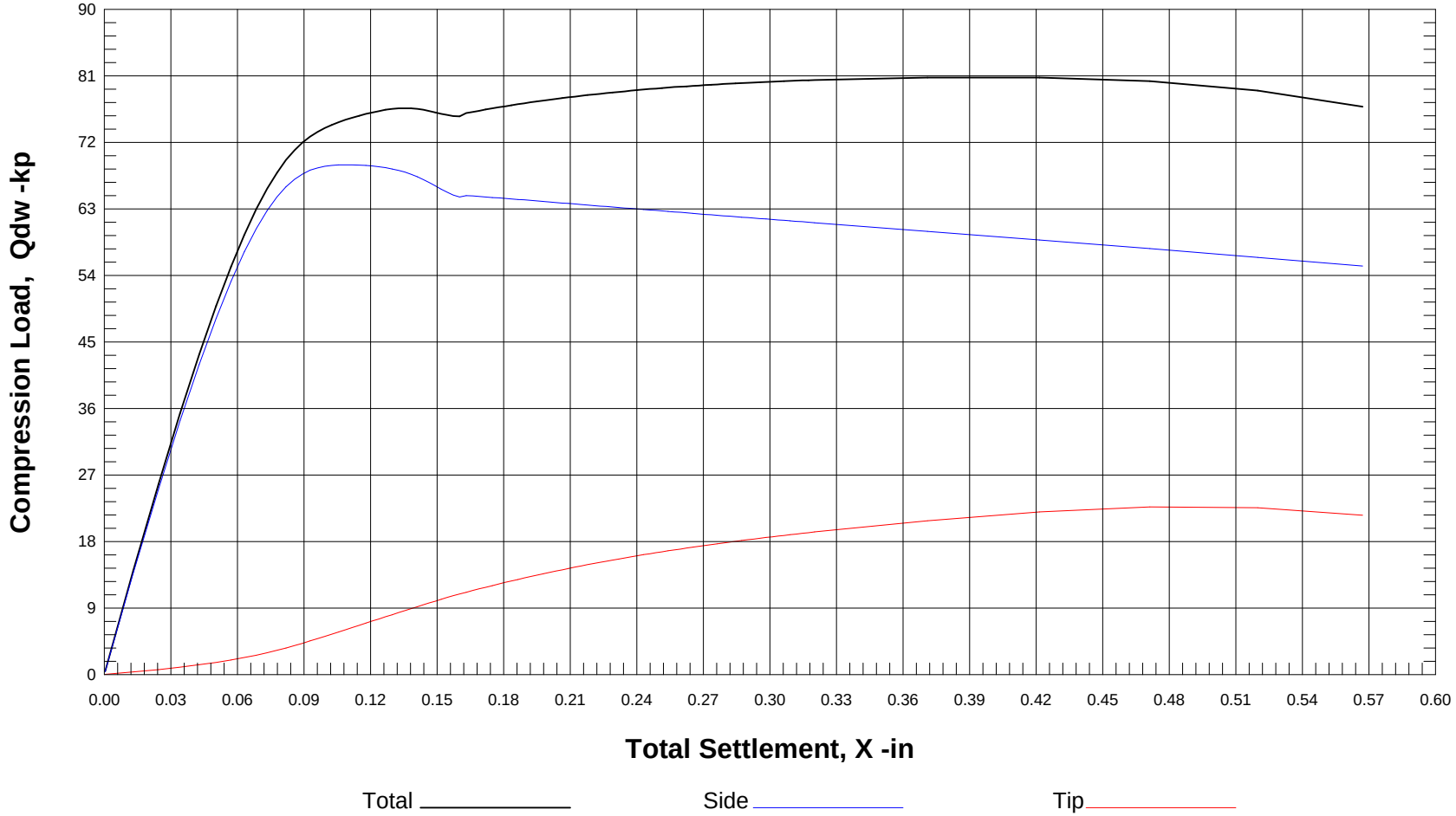


ALLOWABLE CAPACITY vs FOUNDATION DEPTH



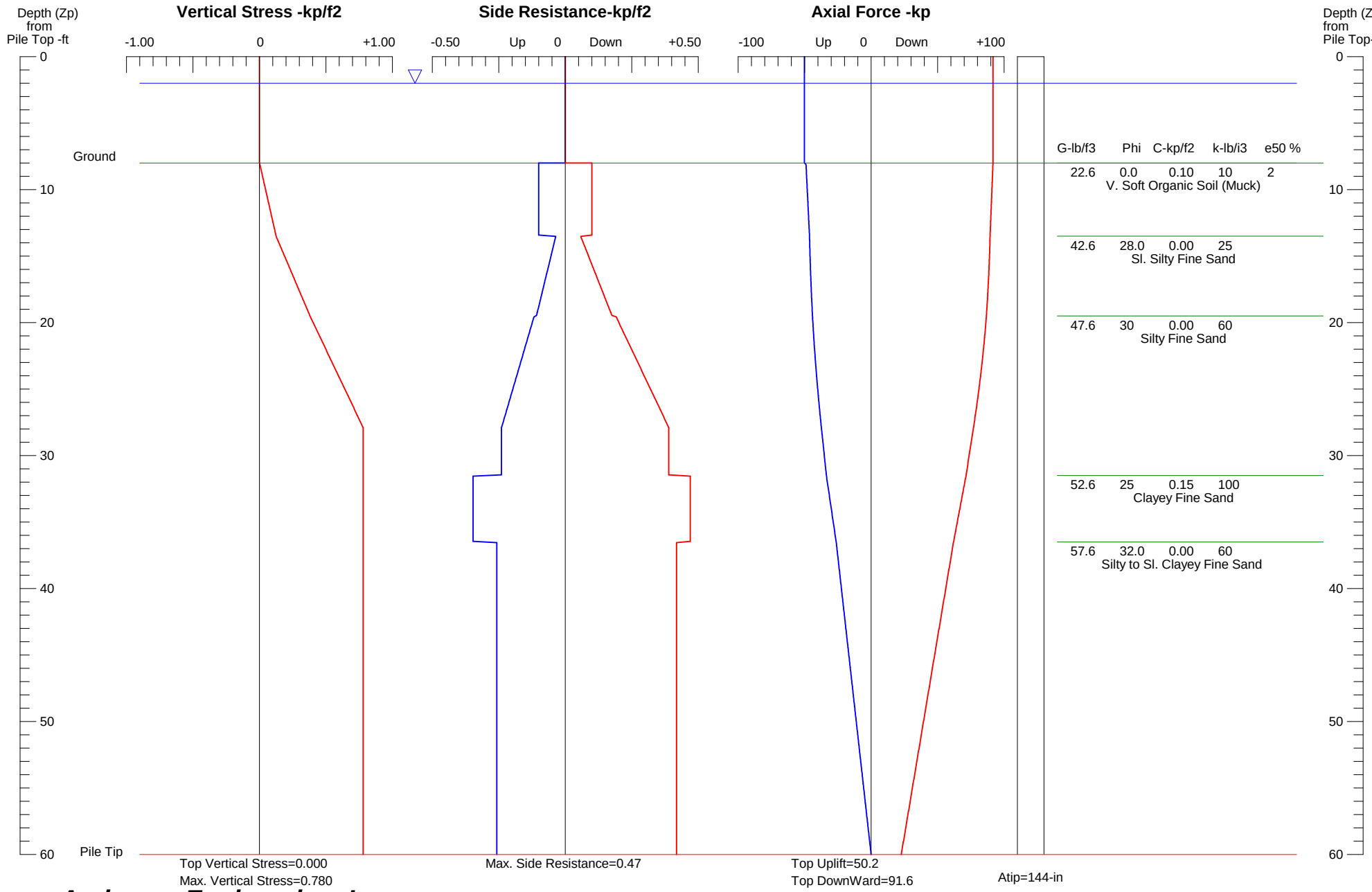


Vertical Load vs. Total Settlement



SOIL STRESS, SIDE RESISTANCE, & AXIAL FORCE vs DEPTH

Based on Ultimate Load Condition



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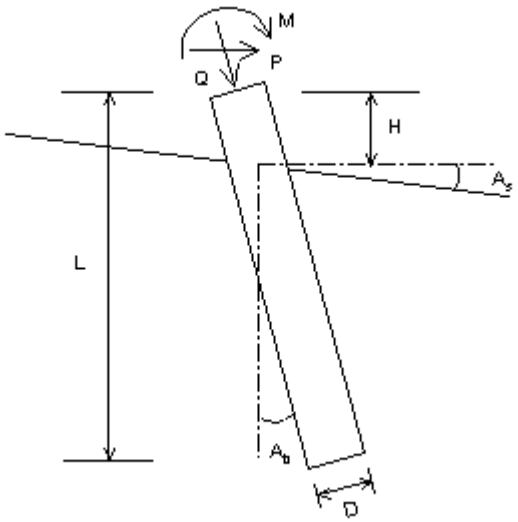
Ferndale Preserve Observation Tower/Pier, Lake Apopka
12" X 12" Precast Concrete Pile @ SPT Boring TB-1

Figure 5

VERTICAL ANALYSIS

Figure 6



Driving Concrete Pile

Loads:
Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 30.0 -kp

Profile:
Pile Length, L= 60.0 -ft
Top Height, H= 8.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0
Fixed Head Condition

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	22.6	0.0	0.10	10	2	0
5.5	42.6	28.0	0.00	25	35	8
11.5	47.6	30	0.00	60	40	12
23.5	52.6	25	0.15	100	50	14
28.5	57.6	32.0	0.00	60	47.20	16

Pile Data:

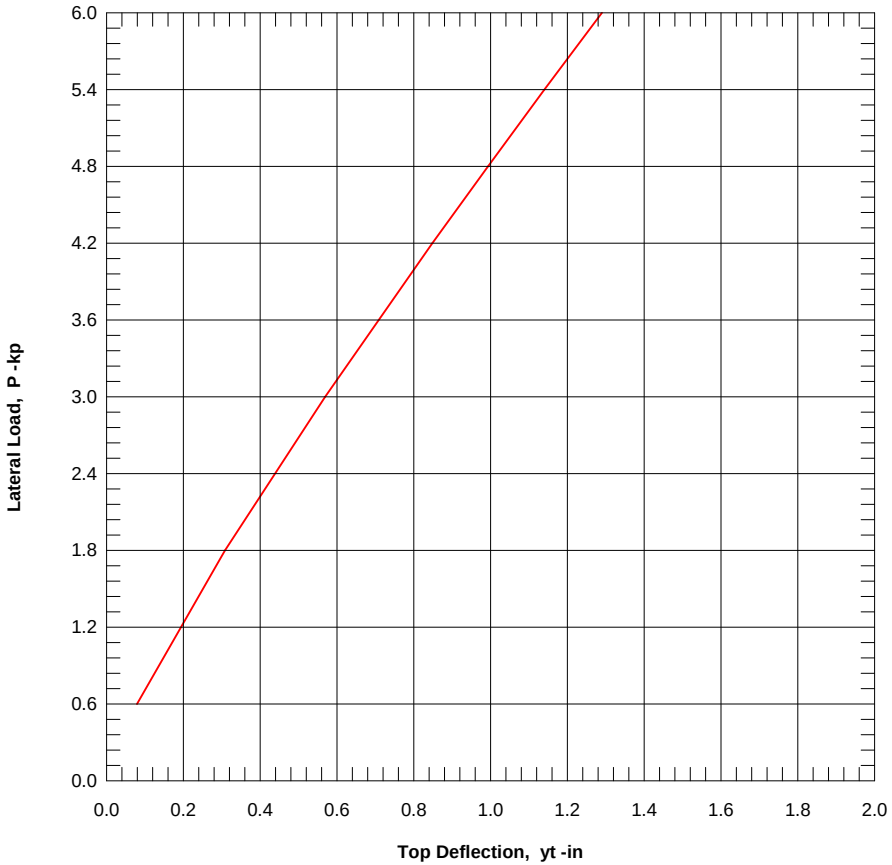
Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	12	144.0	48.0	1728.0	3000	0.150
60.0						

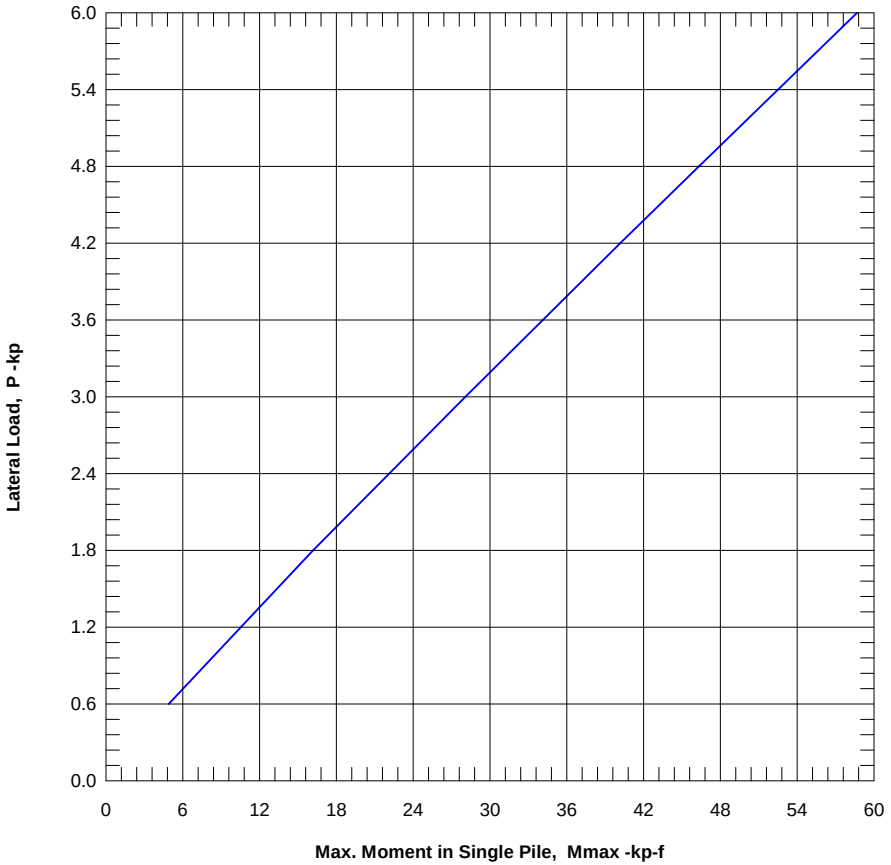
Vertical Capacity:
Weight above Ground= 1.20 Total Weight= 5.76-kp *Soil Weight is not included
Side Resistance (Down)= 68.971-kp Side Resistance (Up)= 44.448-kp
Tip Resistance (Down)= 22.678-kp Tip Resistance (Up)= 0.000-kp
Total Ultimate Capacity (Down) Qult= 91.650-kp Total Ultimate Capacity (Up)= 50.203-kp
Total Allowable Capacity (Down) Qallow= 42.045-kp Total Allowable Capacity (Up) Qallow= 27.979-kp
OK! Qallow > Q

Settlement Calculation:
At Q= 30.00-kp Settlement= 0.02872-in
At Xallow= 1.00-in Q= 99999.00000-kp

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

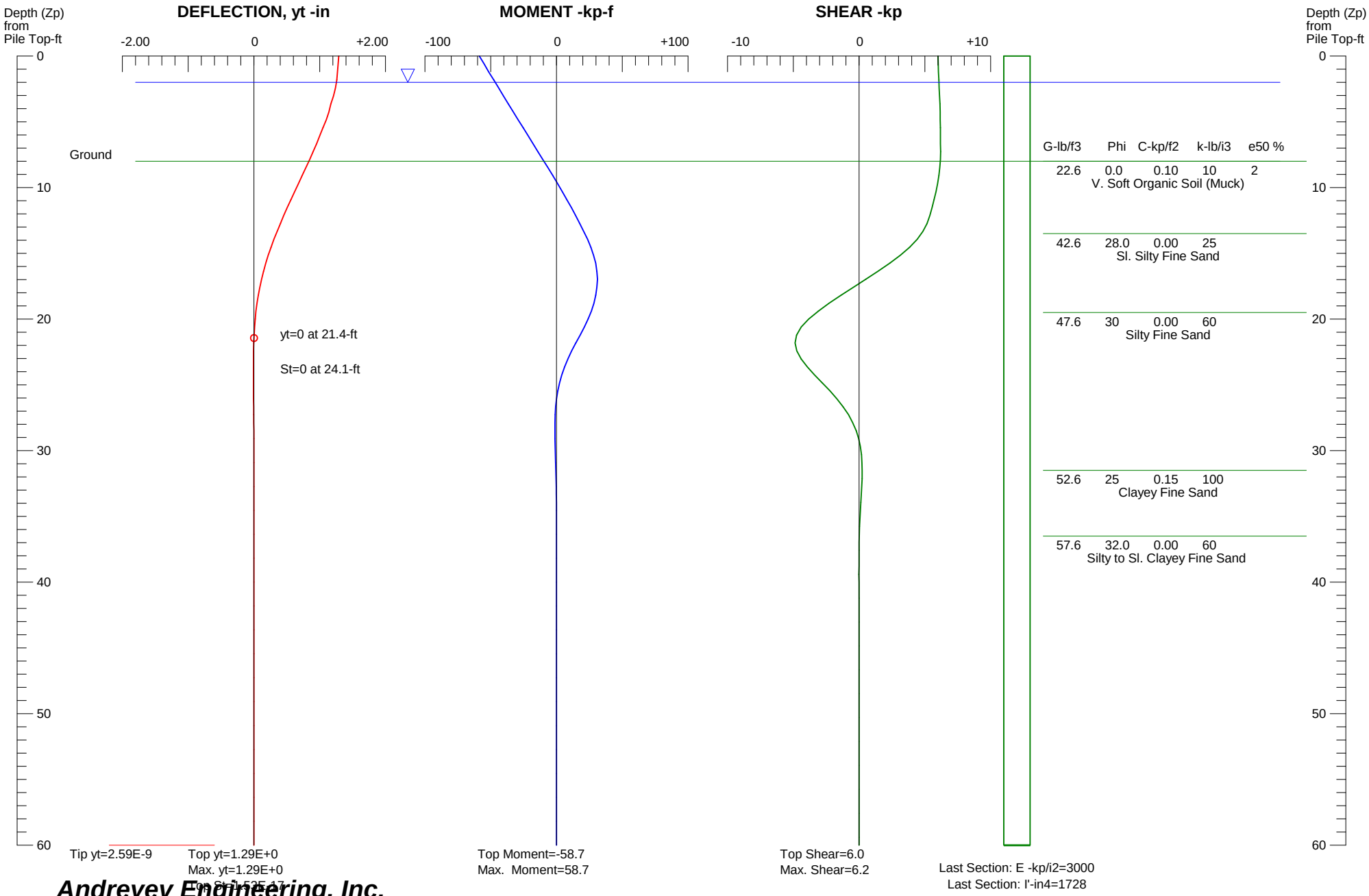
LATERAL LOAD vs DEFLECTION & MAX. MOMENT





PILE DEFLECTION & FORCE vs DEPTH

Single Pile, Khead=5, Kbc=2



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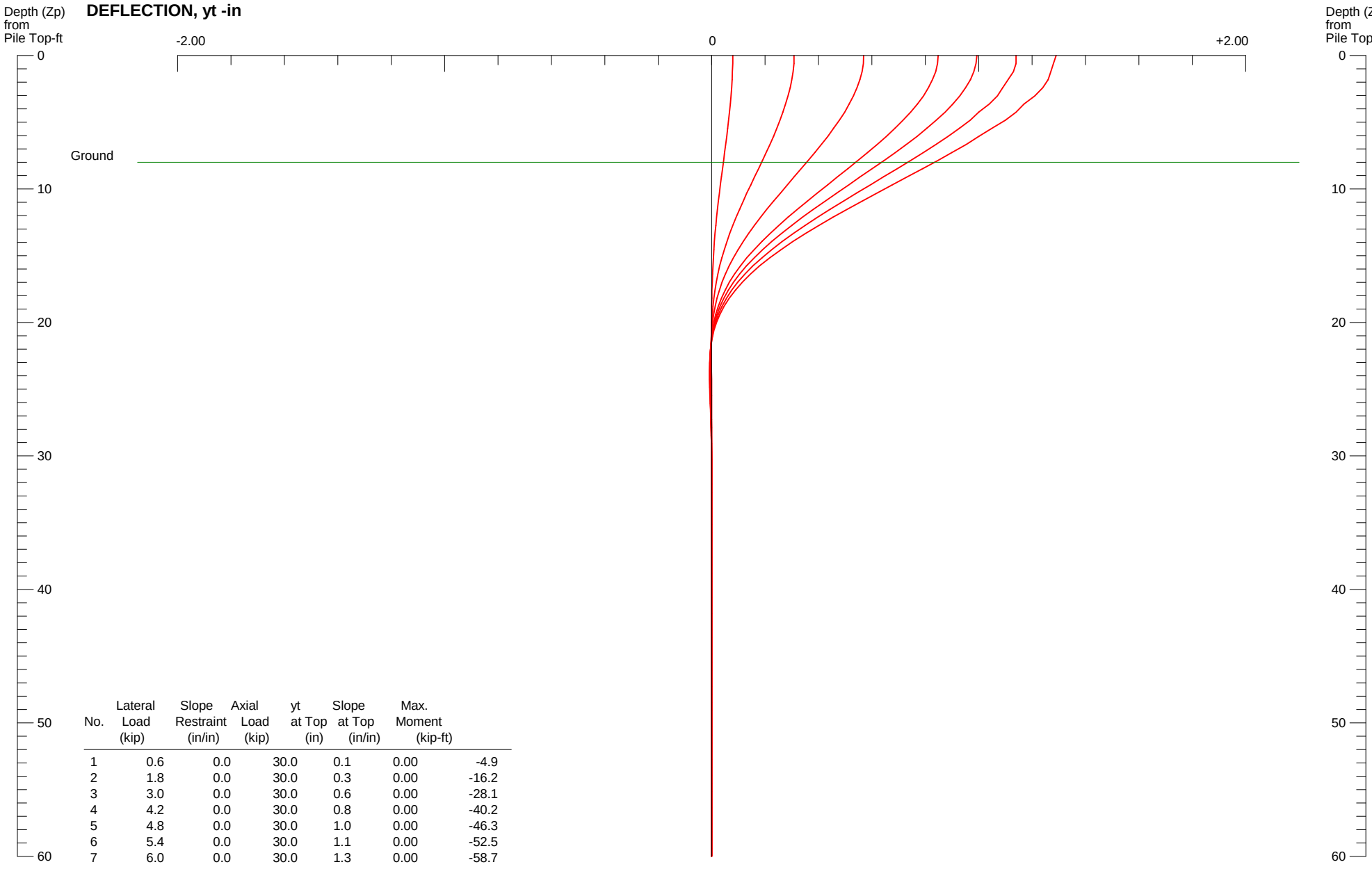
Ferndale Preserve Observation Tower/Pier, Lake Apopka
12" X 12" Precast Concrete Pile @ SPT Boring TB-1

Figure 8

PILE DEFLECTION vs LOADING

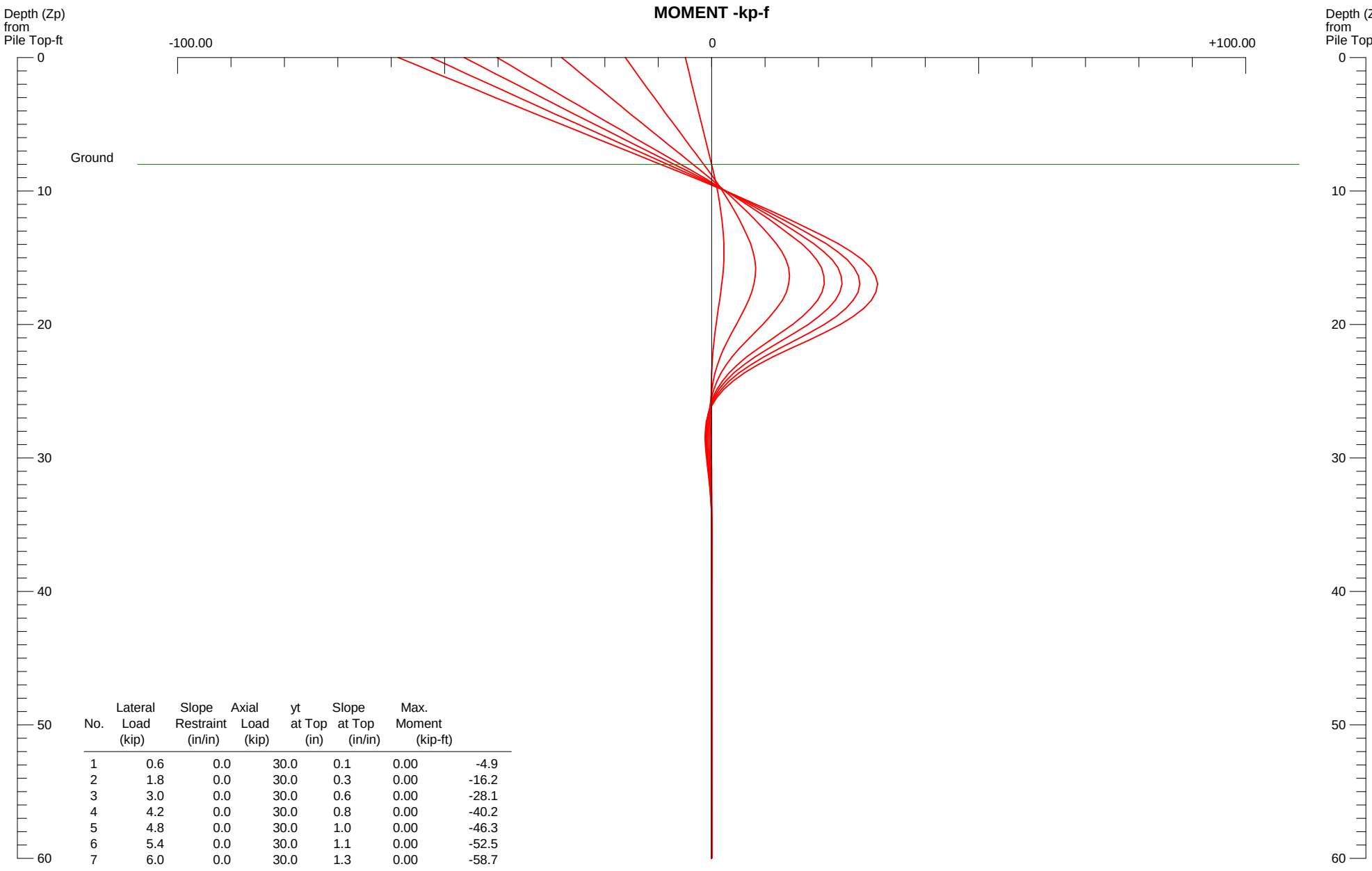
Single Pile, Khead=5, Kbc=2



No.	Lateral Load (kip)	Slope Restraint (in/in)	Axial Load (kip)	yt at Top (in)	Slope at Top (in/in)	Max. Moment (kip-ft)	
1	0.6	0.0	30.0	0.1	0.00	-4.9	
2	1.8	0.0	30.0	0.3	0.00	-16.2	
3	3.0	0.0	30.0	0.6	0.00	-28.1	
4	4.2	0.0	30.0	0.8	0.00	-40.2	
5	4.8	0.0	30.0	1.0	0.00	-46.3	
6	5.4	0.0	30.0	1.1	0.00	-52.5	
7	6.0	0.0	30.0	1.3	0.00	-58.7	

PILE MOMENT vs LOADING

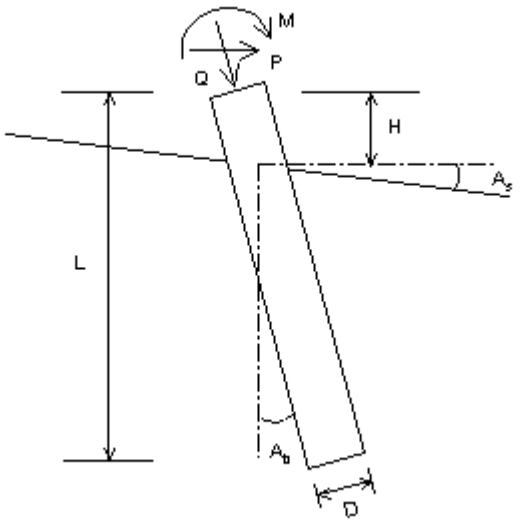
Single Pile, Khead=5, Kbc=2



No.	Lateral Load (kip)	Slope Restraint (in/in)	Axial Load (kip)	yt at Top (in)	Slope at Top (in/in)	Max. Moment (kip-ft)	
1	0.6	0.0	30.0	0.1	0.00	-4.9	
2	1.8	0.0	30.0	0.3	0.00	-16.2	
3	3.0	0.0	30.0	0.6	0.00	-28.1	
4	4.2	0.0	30.0	0.8	0.00	-40.2	
5	4.8	0.0	30.0	1.0	0.00	-46.3	
6	5.4	0.0	30.0	1.1	0.00	-52.5	
7	6.0	0.0	30.0	1.3	0.00	-58.7	

LATERAL ANALYSIS

Figure 11



Driving Concrete Pile

Loads:
Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 30.0 -kp
Shear Load, P= 6.0 -kp
Slope Restrain St= 0.00000 -in/-in

Profile:
Pile Length, L= 60.0 -ft
Top Height, H= 8.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0
Fixed Head Condition

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	22.6	0.0	0.10	10	2	0
5.5	42.6	28.0	0.00	25	35	8
11.5	47.6	30	0.00	60	40	12
23.5	52.6	25	0.15	100	50	14
28.5	57.6	32.0	0.00	60	47.20	16

Pile Data:

Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	12	144.0	48.0	1728.0	3000	0.150
60.0						

Single Pile Lateral Analysis:
Top Deflection, yt= 1.29000-in
Max. Moment, M= -58.67-kp-f
Top Deflection Slope, St= 0.00000
OK! Top Deflection, 1.2900-in is less than the Allowable Deflection= 2.00-in

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.
The Max. Moment calculated by program is an internal force from the applied load conditions. Structural engineer has to check whether the pile has enough capacity to resist the moment with adequate factor of safety. If not, the pile may fail under the load conditions.