ARNOLD AND O'SHERIDAN INC
CONSULTING ENGINEERS
1111 DEMING WAY, MADISON, WI 53717-1953
TEL: 608.821.8500 FAX: 608.821.8501

JOB NAME: CAMROCK BRIDGE.
JOB NO: 060285A DATE: 1-9-07
ENGINEER: _____ SHEET NO.: _____

FROM PREV. 'L' PILE ANALYSIS

TAKE LENGTH AS IS BUT REFINE SPACING.

- IF SPACING IS 4'-0" MAX.

→ REDUCE ASSOC. LOADS BY 4/5.5 = 0.73

$M_{max} = 470640(0.73) = 343567$ "-# $V = 5808(0.73) = 4239$#

IF USING DF PILES (14"ϕ) $F_b' = 1670$ psi $F_v = 80$ psi

$f_b = 343567/169.6 = 2026$ psi > 1670 NG.

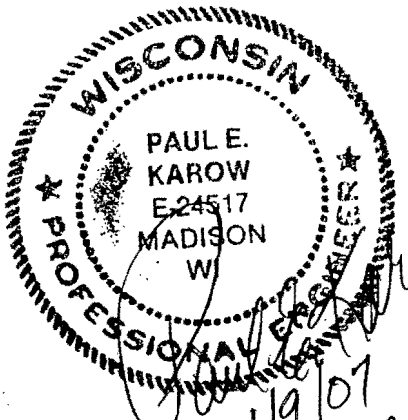
∴ 3'-0" ± OC TRY

IF 3'-0" oc $M_{max} = 470640(3/5.5) = 256713$ "-# $V = 5808(3/5.5) = 3168$# (a TOR.)

IF RED PINE (14"ϕ) $F_b' = 1317$ psi $V_{max} = 10100(3/5.5) = 5510$#

$f_b = 256713/169.6 = 1514$ psi (12") (EVALUATE PILE @ 12.5" (TAPER FROM 14"ϕ) $S = 192$"^{3} → $f_b = 1337$ psi ∴ OK)

∴ USE 14"ϕ TREATED (0.80%) RED PINE TIMBER PILES @ 3'-0" oc.

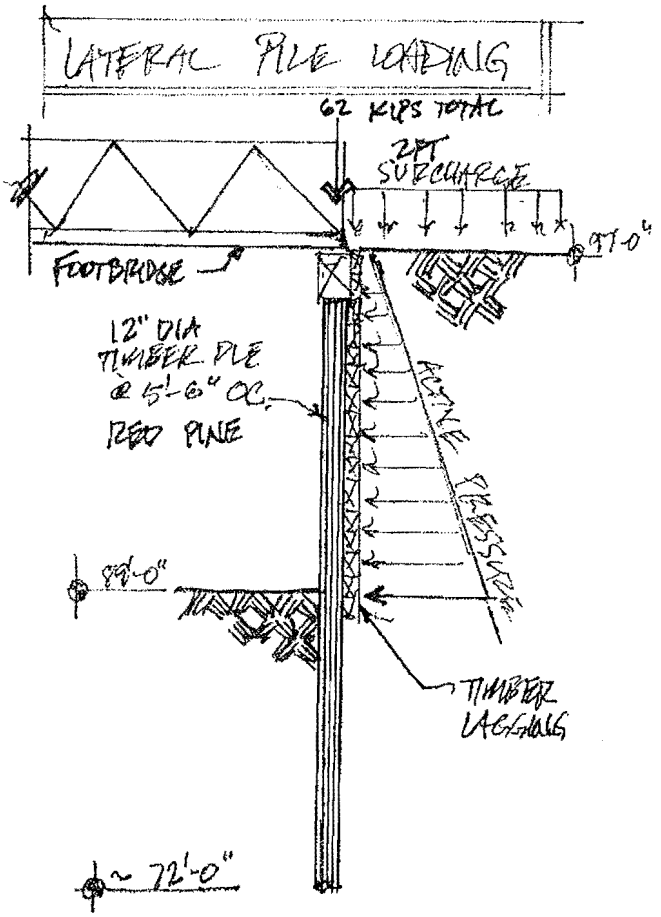


1/9/07

Calls - pp. 1-24

ARNOLD AND O'SHERIDAN INC
CONSULTING ENGINEERS
4125 N. 124TH ST., BROOKFIELD, WI 53005-1837
TEL: 262.783.6130 FAX: 262.783.5121

JOB NAME: CAM ROCK BRIDGE
JOB NO.: 06028SA DATE: 1.8.07
ENGINEER: SJZ SHEET NO.:



DESIGN ASSUMPTIONS:

- HORIZONTAL LOAD FROM BRIDGE NEGLIGIBLE
- VERTICAL BRIDGE REACTION 62 K TOTAL (½ AT EACH STRINGER)
- ACTIVE PRESSURE = 33 pcf (RESISTED BY PILES, NOT BRIDGE)
- 2FT SURCHARGE PRESSURE
- PILE DESIGN (SEE ATTACHED SHEETS)
- 12" DIA RED PINE TIMBER PILE

DESIGN LOADING:

VERTICAL: $DL = \frac{1}{2} TL = 15.5$ KIPS
$LL = \frac{1}{2} TL = 15.5$ KIPS

HORZ: $33 pcf (8')^2/2 (5.5') = 5808$ LBS

MOMENT: $5808 LBS (8'/3) = 15.5$ K-FT

FROM SOIL BORING 1 ANALYSIS:

$M_{MAX} = 470640$ lbs·in
$S_x = 169.6$ in³
$f_b = 2775$ psi
$F_b' = 1900 \times (0.9/C_D) \times (0.77_{LSP}) = 1317$ psi ∴ NG

SPACE PILES @ 5'-6" / (2775/1317) = 2'-7" o.c. CONTROLS

$V_{MAX} = 10102$ lbs
$A = 113.1$ in²
$f_v = 89.3$ psi
$F_v' = 85 psi \times (0.9/C_D) = 76.5$ psi ∴ NG
SPACE PILES @ 5'-6" / (89.3/76.5) = 4'-8" o.c.

Specify 14" piles to be 12" @ critical moment

FROM SOIL BORING 2 ANALYSIS:

$M_{MAX} = 289610$ lbs·in
$S_x = 169.6$ in³
$f_b = 1708$ psi
$F_b = 1317$ psi ∴ NG
SPACE PILES @ 5'-6" / (1708/1317) = 4'-3" o.c.

$V_{MAX} = 6798$ lbs
$A = 113.1$ in²
$f_v = 60.1$ psi
$F_v = 76.5$ psi ∴ OK

Soil Boring 1.lpo

LPILE Plus for Windows, Version 4.0 (4.0.10)

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

This program is licensed to:

Scott Luckiesh, P.E.,S.E.
Arnold and O'Sheridan Inc

Path to file locations:
I:\2006\060285\Engineering\Design\Structural\Calcs\LPile Design\
Name of input data file: Soil Boring 1.lpd
Name of output file: Soil Boring 1.lpo
Name of plot output file: Soil Boring 1.lpp
Name of runtime file: Soil Boring 1.lpr

Time and Date of Analysis

Date: January 9, 2007 Time: 8:17:28

Problem Title

Abutment Pile Design

Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100

Soil Boring 1.lpo

- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 204.00 in
Depth of ground surface below top of pile = .00 in
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	12.000	1018.0000	113.1000	1280000.000
2	204.0000	12.000	1018.0000	113.1000	1280000.000

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 72.000 in

Layer 2 is stiff clay with water-induced erosion
Distance from top of pile to top of layer = 72.000 in
Distance from top of pile to bottom of layer = 132.000 in
p-y subgrade modulus k for top of soil layer = 100.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 100.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 132.000 in
Distance from top of pile to bottom of layer = 300.000 in
p-y subgrade modulus k for top of soil layer = 440.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1000.000 lbs/in**3

(Depth of lowest layer extends 96.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 6 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3

1	.00	.06370
2	72.00	.06370
3	72.00	.06940
4	132.00	.06940
5	132.00	.07520
6	300.00	.07520

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 6 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	1.73610	.00	.02000	.0
2	72.000	1.73610	.00	.02000	.0
3	72.000	6.94400	.00	.01000	.0
4	132.000	6.94400	.00	.01000	.0
5	132.000	.00000	30.00	------	------
6	300.000	.00000	30.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 5808.000 lbs
Bending moment at pile head = 186000.000 in-lbs
Axial load at pile head = 15500.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 5808.000 lbs
Specified bending moment at pile head = 186000.000 in-lbs
Specified axial load at pile head = 15500.000 lbs

Non-zero moment for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	2.045	186000.0000	5808.0000	-.033378	1233.3141	-47.0324
2.040	1.978	198801.2677	5710.0623	-.033077	1308.7636	-48.9850
4.080	1.911	211388.8383	5608.2064	-.032756	1382.9536	-50.8738
6.120	1.844	223754.2283	5502.5637	-.032415	1455.8341	-52.6976
8.160	1.778	235889.2354	5393.2677	-.032055	1527.3567	-54.4553
10.200	1.713	247785.9440	5280.4548	-.031677	1597.4748	-56.1457
12.240	1.649	259436.7307	5164.2633	-.031280	1666.1435	-57.7675
14.280	1.586	270834.2690	5044.8344	-.030865	1733.3196	-59.3197
16.320	1.523	281971.5355	4922.3115	-.030432	1798.9616	-60.8008
18.360	1.461	292841.8147	4796.8406	-.029982	1863.0301	-62.2098
20.400	1.401	303438.7047	4668.5703	-.029515	1925.4872	-63.5454
22.440	1.341	313756.1231	4537.6518	-.029032	1986.2971	-64.8061
24.480	1.282	323788.3124	4404.2388	-.028533	2045.4259	-65.9909
26.520	1.225	333529.8454	4268.4879	-.028018	2102.8416	-67.0982
28.560	1.168	342975.6316	4130.5584	-.027489	2158.5142	-68.1268
30.600	1.112	352120.9230	3990.6124	-.026945	2212.4158	-69.0752
32.640	1.058	360961.3199	3848.8148	-.026387	2264.5203	-69.9420
34.680	1.005	369492.7773	3705.3337	-.025815	2314.8039	-70.7258
36.720	.952760	377711.6112	3560.3400	-.025230	2363.2450	-71.4249
38.760	.901894	385614.5051	3414.0078	-.024632	2409.8239	-72.0380
40.800	.852260	393198.5166	3266.5146	-.024023	2454.5234	-72.5632
42.840	.803881	400461.0845	3118.0411	-.023402	2497.3283	-72.9990
44.880	.756782	407400.0355	2968.7717	-.022769	2538.2259	-73.3436
46.920	.710983	414013.5920	2818.8940	-.022126	2577.2056	-73.5952
48.960	.666507	420300.3796	2668.5999	-.021473	2614.2593	-73.7520
51.000	.623373	426259.4347	2518.0848	-.020810	2649.3814	-73.8118
53.040	.581601	431890.2132	2367.5485	-.020139	2682.5687	-73.7728
55.080	.541208	437192.5990	2217.1950	-.019458	2713.8205	-73.6326
57.120	.502211	442166.9129	2067.2330	-.018770	2743.1387	-73.3890
59.160	.464626	446813.9222	1917.8757	-.018074	2770.5277	-73.0397
61.200	.428468	451134.8508	1769.3416	-.017371	2795.9949	-72.5820
63.240	.393752	455131.3898	1621.8546	-.016662	2819.5501	-72.0132
65.280	.360488	458805.7082	1475.6441	-.015946	2841.2062	-71.3304
67.320	.328691	462160.4654	1330.9457	-.015225	2860.9789	-70.5307
69.360	.298369	465198.8235	1188.0014	-.014500	2878.8867	-69.6108
71.400	.269533	467924.4605	1047.0599	-.013769	2894.9513	-68.5671
73.440	.242191	470341.5848	463.7175	-.013035	2909.1977	-503.3373
75.480	.216351	470640.7372	-554.7021	-.012298	2910.9608	-495.1133
77.520	.192015	468856.1278	-1553.6603	-.011563	2900.4425	-484.2575
79.560	.169176	465033.0225	-2527.8527	-.010832	2877.9095	-470.8330
81.600	.147822	459227.4779	-3472.0894	-.010108	2843.6921	-454.8893
83.640	.127935	451506.1328	-4381.2540	-.009395	2798.1832	-436.4486
85.680	.109490	441946.1120	-5250.2206	-.008696	2741.8373	-415.4794
87.720	.092456	430635.1544	-6073.6751	-.008013	2675.1715	-391.8290
89.760	.076798	417672.2435	-6845.5741	-.007349	2598.7693	-364.9348

91.800	.062473	403169.9440	-7555.1064	-.006706	2513.2941	-330.6851
93.840	.049437	387271.5070	-8192.4544	-.006087	2419.5901	-294.1659
95.880	.037637	370129.6982	-8754.3068	-.005495	2318.5579	-256.6698
97.920	.027019	351901.4097	-9237.9320	-.004929	2211.1220	-217.4726
99.960	.017525	332750.6670	-9638.4040	-.004393	2098.2492	-175.1470
102.000	.009094	312854.5603	-9945.7470	-.003888	1980.9834	-126.1697
104.040	.001662	292417.8986	-10101.7437	-.003414	1860.5315	-26.7683
106.080	-.004836	271855.3623	-10048.5787	-.002973	1739.3378	78.8909
108.120	-.010466	251607.6803	-9830.0576	-.002563	1619.9998	135.3455
110.160	-.015292	231910.7967	-9525.1295	-.002184	1503.9081	163.6037
112.200	-.019378	212883.2861	-9170.4031	-.001836	1391.7617	184.1671
114.240	-.022784	194611.6670	-8778.8619	-.001517	1284.0704	199.6968
116.280	-.025568	177161.4722	-8359.3931	-.001226	1181.2206	211.5471
118.320	-.027786	160582.8818	-7918.6706	-9.617E-04	1083.5079	220.5338
120.360	-.029492	144914.1153	-7461.9809	-7.226E-04	991.1576	227.2013
122.400	-.030734	130183.6960	-6993.6580	-5.072E-04	904.3378	231.9388
124.440	-.031561	116412.0685	-6517.3414	-3.142E-04	823.1691	235.0383
126.480	-.032016	103612.8137	-6036.1408	-1.420E-04	747.7314	236.7269
128.520	-.032140	91793.5925	-5552.7500	1.098E-05	678.0700	237.1857
130.560	-.031972	80956.8992	-5069.5279	1.462E-04	614.1995	236.5614
132.600	-.031544	71100.6723	-4722.9624	2.652E-04	556.1078	103.2087
134.640	-.030889	61670.4391	-4507.4040	3.692E-04	500.5269	108.1230
136.680	-.030038	52687.1176	-4282.2644	4.587E-04	447.5800	112.6022
138.720	-.029018	44169.7932	-4048.4645	5.345E-04	397.3796	116.6133
140.760	-.027857	36135.5801	-3806.9902	5.974E-04	350.0267	120.1263
142.800	-.026581	28599.4957	-3558.8851	6.480E-04	305.6097	123.1140
144.840	-.025213	21574.3466	-3305.2451	6.873E-04	264.2041	125.5528
146.880	-.023776	15070.6299	-3047.2104	7.160E-04	225.8718	127.4225
148.920	-.022292	9096.4484	-2785.9589	7.349E-04	190.6605	128.7065
150.960	-.020778	3657.4415	-2522.6987	7.449E-04	158.6035	129.3918
153.000	-.019252	-1243.2697	-2258.6606	7.468E-04	144.3746	129.4690
155.040	-.017731	-5605.1210	-1995.0915	7.414E-04	170.0829	128.9321
157.080	-.016227	-9430.1311	-1733.2471	7.297E-04	192.6272	127.7781
159.120	-.014754	-12722.9131	-1474.3866	7.123E-04	212.0346	126.0067
161.160	-.013321	-15490.6758	-1219.7678	6.902E-04	228.3475	123.6197
163.200	-.011938	-17743.2161	-970.6435	6.642E-04	241.6238	120.6199
165.240	-.010611	-19492.9064	-728.2609	6.351E-04	251.9363	117.0101
167.280	-.009347	-20754.6825	-493.8633	6.036E-04	259.3731	112.7915
169.320	-.008149	-21546.0382	-268.6959	5.705E-04	264.0373	107.9609
171.360	-.007019	-21887.0374	-54.0178	5.365E-04	266.0471	102.5079
173.400	-.005960	-21800.3565	148.8782	5.023E-04	265.5362	96.4098
175.440	-.004970	-21311.3773	338.6332	4.685E-04	262.6542	89.6245
177.480	-.004048	-20448.3617	513.7703	4.358E-04	257.5677	82.0785
179.520	-.003192	-19242.7560	672.6095	4.048E-04	250.4619	73.6463
181.560	-.002397	-17729.7115	813.1213	3.758E-04	241.5442	64.1104
183.600	-.001659	-15948.9875	932.6446	3.494E-04	231.0488	53.0693
185.640	-9.71E-04	-13946.6206	1027.2340	3.260E-04	219.2470	39.6654
187.680	-3.28E-04	-11778.4920	1089.3344	3.059E-04	206.4682	21.2174
189.720	2.77E-04	-9521.4819	1090.8062	2.892E-04	193.1656	-19.7745
191.760	8.52E-04	-7346.2940	1029.3728	2.760E-04	180.3453	-40.4543
193.800	.001403	-5339.0970	930.3909	2.661E-04	168.5150	-56.5868
195.840	.001937	-3567.1274	800.1880	2.591E-04	158.0712	-71.0631
197.880	.002460	-2090.7173	641.2359	2.547E-04	149.3694	-84.7723
199.920	.002977	-966.9924	454.6616	2.523E-04	142.7462	-98.1436
201.960	.003490	-251.6541	240.9039	2.514E-04	138.5301	-111.4227
204.000	.004002	0.0000	0.0000	2.512E-04	137.0469	-124.7576

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Soil Boring 1.lpo

Pile-head deflection	=	2.04548883	in
Computed slope at pile head	=	-.03337813	
Maximum bending moment	=	470640.737	lbs-in
Maximum shear force	=	-10101.744	lbs
Depth of maximum bending moment	=	75.480	in
Depth of maximum shear force	=	104.040	in
Number of iterations	=	22	
Number of zero deflection points	=	2	

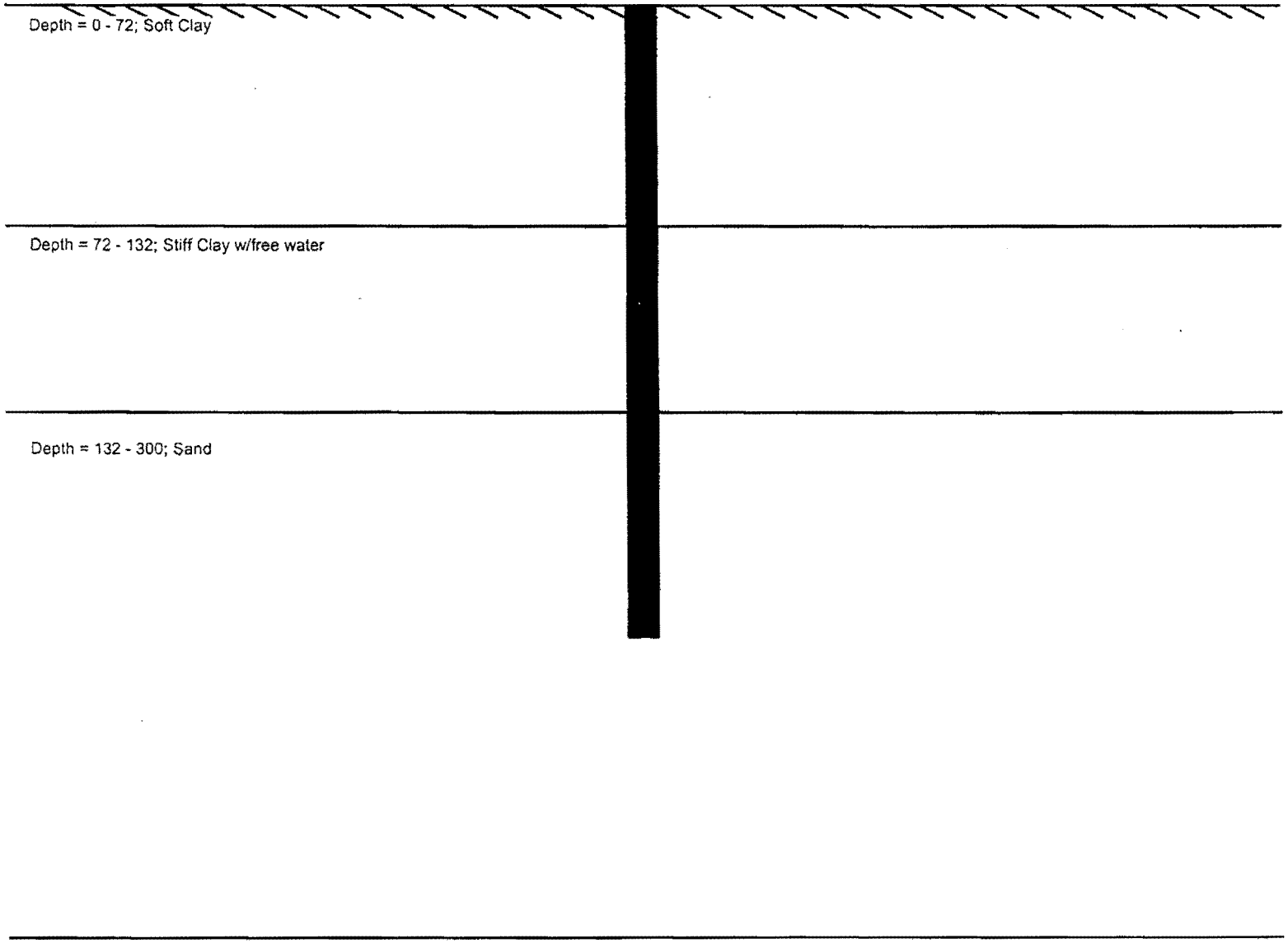
Summary of Pile-head Response

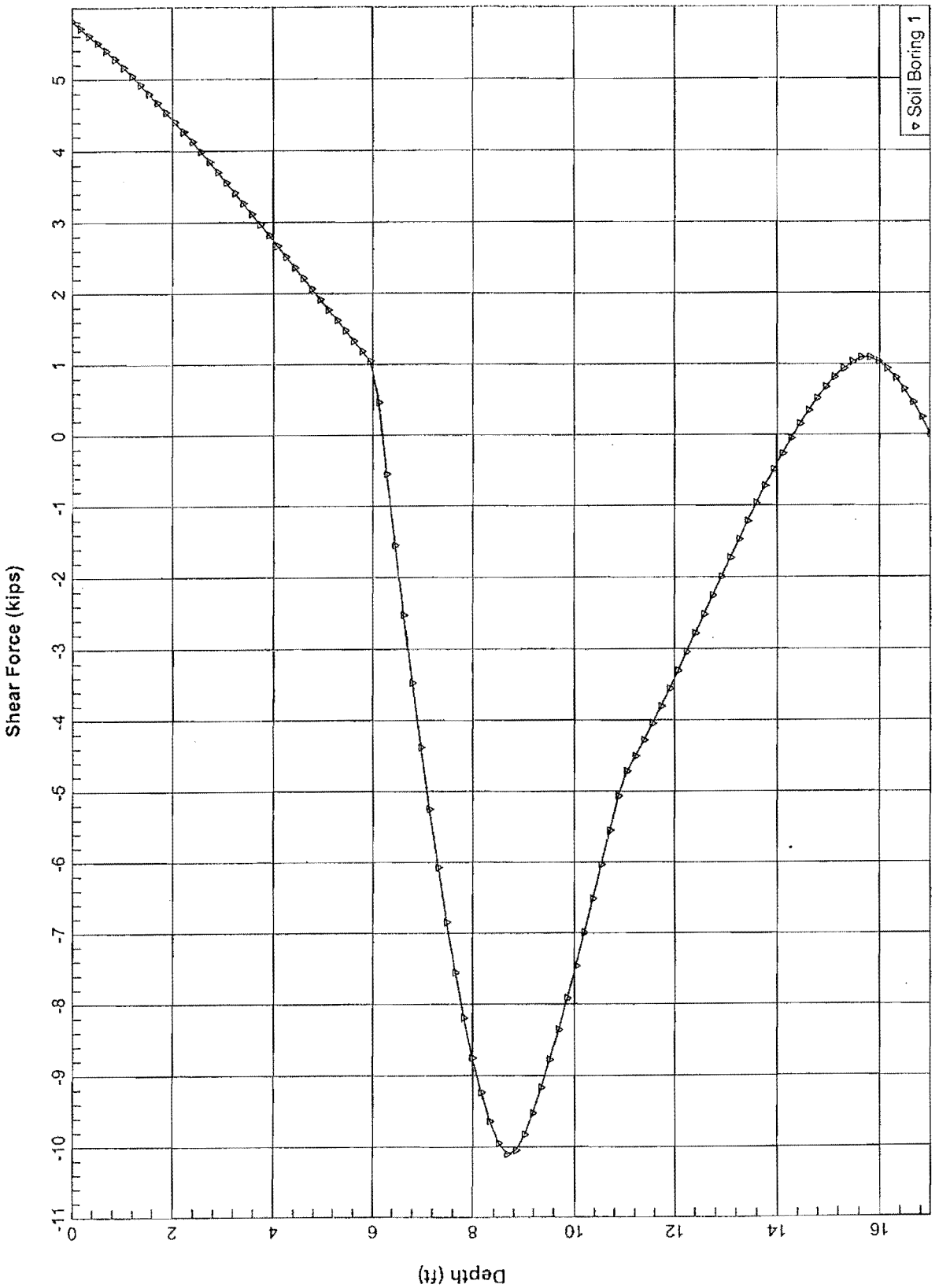
Definition of symbols for pile-head boundary conditions:

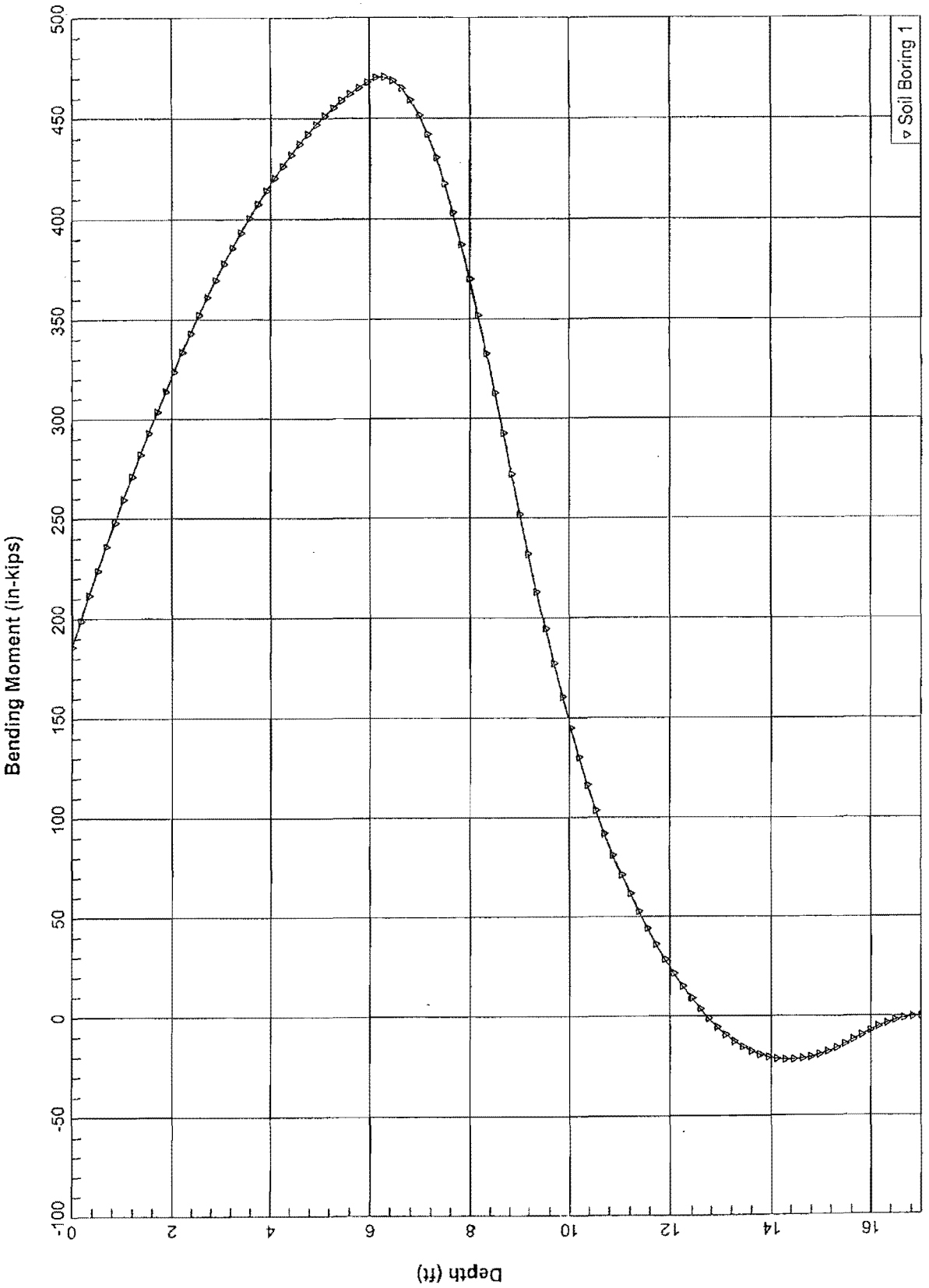
y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

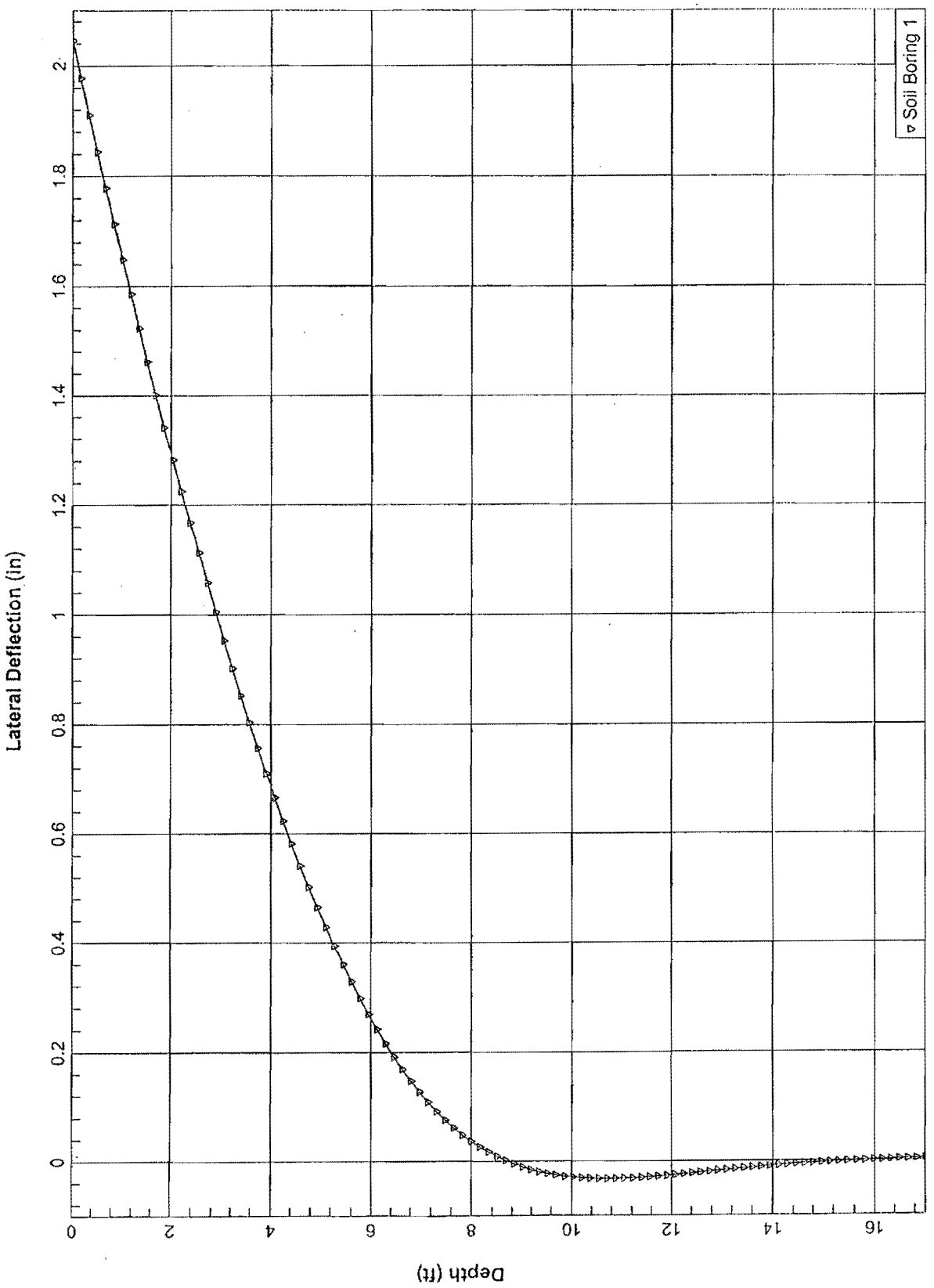
BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 5808.000	M= 1.86E+05	15500.0000	2.0455	470640.7372	-10101.7437

The analysis ended normally.


Depth = 0 - 72; Soft Clay
Depth = 72 - 132; Stiff Clay w/free water
Depth = 132 - 300; Sand


Soil Boring 1
Shear Force (kips)
Depth (ft)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
0
2
4
6
8
10
12
14
16


Bending Moment (in-kips)
Depth (ft)
Soil Boring 1
500
450
400
350
300
250
200
150
100
50
0
-50
-100
0
2
4
6
8
10
12
14
16


Soil Boring 1
Lateral Deflection (in)
Depth (ft)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
2
4
6
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10
12
14
16

LPILE Plus for Windows, Version 4.0 (4.0.10)

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

This program is licensed to:

Scott Luckiesh, P.E.,S.E.
Arnold and O'Sheridan Inc

Path to file locations:
I:\2006\060285\Engineering\Design\Structural\Calcs\LPile Design\
Name of input data file: Soil Boring 2.lpd
Name of output file: Soil Boring 2.lpo
Name of plot output file: Soil Boring 2.lpp
Name of runtime file: Soil Boring 2.lpr

Time and Date of Analysis

Date: January 9, 2007 Time: 8:24:23

Problem Title

Abutment Pile Design

Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100

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- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 180.00 in
Depth of ground surface below top of pile = .00 in
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	12.000	1018.0000	113.1000	1280000.000
2	180.0000	12.000	1018.0000	113.1000	1280000.000

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is stiff clay with water-induced erosion
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 96.000 in
p-y subgrade modulus k for top of soil layer = 200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 200.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 96.000 in
Distance from top of pile to bottom of layer = 180.000 in
p-y subgrade modulus k for top of soil layer = 160.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 300.000 lbs/in**3

(Depth of lowest layer extends .00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 4 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	.00	.07230
2	96.00	.07230
3	96.00	.07520

4	180.00	.07520

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 4 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	10.41670	.00	.00500	.0
2	96.000	10.41670	.00	.00500	.0
3	96.000	.00000	30.00	------	------
4	180.000	.00000	30.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 5808.000 lbs
Bending moment at pile head = 186000.000 in-lbs
Axial load at pile head = 15500.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Computed Values of Load Distribution and Deflection for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 5808.000 lbs

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Specified bending moment at pile head = 186000.000 in-lbs
Specified axial load at pile head = 15500.000 lbs

Non-zero moment for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.325091	186000.0000	5808.0000	-.011269	1233.3141	0.0000
1.800	.305038	196765.2198	5803.1079	-.011005	1296.7633	-5.4357
3.600	.285474	207505.2445	5776.8377	-.010725	1360.0640	-23.7533
5.400	.266427	218160.3110	5703.9480	-.010431	1422.8640	-57.2352
7.200	.247921	228621.5272	5564.7980	-.010123	1484.5215	-97.3758
9.000	.229985	238758.4346	5347.6629	-.009800	1544.2675	-143.8855
10.800	.212642	248419.9511	5041.3190	-.009463	1601.2116	-196.4965
12.600	.195916	257435.2446	4640.3233	-.009114	1654.3469	-249.0543
14.400	.179831	265633.6804	4151.7268	-.008753	1702.6678	-293.8308
16.200	.164406	272869.8670	3580.4612	-.008381	1745.3172	-340.9088
18.000	.149660	278990.9924	2926.4710	-.008000	1781.3946	-385.7469
19.800	.135607	283851.5452	2195.1823	-.007611	1810.0422	-426.7960
21.600	.122260	287318.3390	1393.9344	-.007216	1830.4752	-463.4794
23.400	.109628	289272.3861	531.0181	-.006818	1841.9922	-495.3165
25.200	.097715	289610.4590	-358.0017	-.006418	1843.9847	-492.4833
27.000	.086522	288341.7244	-1221.7333	-.006019	1836.5069	-467.2185
28.800	.076046	285548.0889	-2036.4520	-.005623	1820.0415	-438.0245
30.600	.066280	281324.2489	-2795.7437	-.005231	1795.1466	-405.6330
32.400	.057213	275775.3155	-3494.4820	-.004846	1762.4416	-370.7428
34.200	.048833	269014.5468	-4128.7641	-.004470	1722.5943	-334.0151
36.000	.041121	261161.2013	-4695.8399	-.004104	1676.3074	-296.0692
37.800	.034058	252338.5262	-5194.0343	-.003749	1624.3073	-257.4801
39.600	.027623	242671.8903	-5622.6641	-.003407	1567.3331	-218.7753
41.400	.021791	232287.0698	-5981.9519	-.003079	1506.1259	-180.4334
43.200	.016537	221308.6927	-6272.9366	-.002766	1441.4203	-142.8829
45.000	.011834	209858.8456	-6497.3831	-.002468	1373.9359	-106.5021
46.800	.007652	198055.8434	-6657.6919	-.002187	1304.3701	-71.6187
48.600	.003962	186013.1634	-6756.8087	-.001921	1233.3916	-38.5110
50.400	7.35E-04	173838.5385	-6798.1368	-.001673	1161.6355	-7.4091
52.200	-.002060	161633.2083	-6785.4518	-.001441	1089.6984	21.5036
54.000	-.004453	149491.3203	-6722.8193	-.001226	1018.1352	48.0880
55.800	-.006474	137499.4761	-6614.5178	-.001028	947.4563	72.2470
57.600	-.008153	125736.4129	-6464.9650	-8.461E-04	878.1259	93.9227
59.400	-.009520	114272.8132	-6278.6507	-6.803E-04	810.5605	113.0932
61.200	-.010602	103171.2314	-6060.0740	-5.301E-04	745.1288	129.7698
63.000	-.011428	92486.1276	-5813.6869	-3.950E-04	682.1517	143.9935
64.800	-.012024	82263.9983	-5543.8444	-2.743E-04	621.9034	155.8315
66.600	-.012415	72543.5927	-5254.7594	-1.674E-04	564.6122	165.3740
68.400	-.012627	63356.2031	-4950.4650	-7.349E-05	510.4626	172.7308
70.200	-.012680	54726.0195	-4634.7823	8.067E-06	459.5971	178.0277
72.000	-.012597	46670.5367	-4311.2940	7.810E-05	412.1188	181.4037
73.800	-.012399	39201.0032	-3983.3240	1.374E-04	368.0940	183.0074
75.600	-.012103	32322.9029	-3653.9224	1.868E-04	327.5551	182.9943
77.400	-.011726	26036.4584	-3325.8560	2.271E-04	290.5034	181.5239
79.200	-.011285	20337.1479	-3001.6032	2.592E-04	256.9122	178.7570
81.000	-.010793	15216.2262	-2683.3541	2.837E-04	226.7299	174.8532
82.800	-.010264	10661.2424	-2373.0143	3.016E-04	199.8833	169.9688
84.600	-.009708	6656.5467	-2072.2132	3.135E-04	176.2799	164.2546
86.400	-.009135	3183.7791	-1782.3156	3.203E-04	155.8118	157.8539
88.200	-.008554	222.3356	-1504.4359	3.227E-04	138.3573	150.9013
90.000	-.007973	-2250.1962	-1239.4560	3.213E-04	150.3093	143.5208
91.800	-.007398	-4257.6339	-988.0452	3.168E-04	162.1410	135.8245
93.600	-.006833	-5824.8360	-750.6822	3.098E-04	171.3779	127.9121

95.400	-.006282	-6977.3784	-527.6789	3.010E-04	178.1709	119.8693
97.200	-.005749	-7741.2754	-389.8582	2.908E-04	182.6732	33.2649
99.000	-.005235	-8397.0959	-330.8053	2.797E-04	186.5386	32.3495
100.800	-.004743	-8947.7803	-273.5703	2.677E-04	189.7843	31.2449
102.600	-.004272	-9396.8864	-218.4827	2.550E-04	192.4313	29.9636
104.400	-.003824	-9748.5484	-165.8470	2.418E-04	194.5039	28.5205
106.200	-.003401	-10007.4281	-115.6141	2.282E-04	196.0297	27.2937
108.000	-.003003	-10177.4904	-67.0396	2.142E-04	197.0321	26.6780
109.800	-.002630	-10260.7239	-19.7078	2.001E-04	197.5226	25.9129
111.600	-.002283	-10259.6040	26.1128	1.859E-04	197.5160	24.9988
113.400	-.001961	-10177.0925	70.1543	1.718E-04	197.0297	23.9362
115.200	-.001664	-10016.6354	111.7067	1.579E-04	196.0840	22.2330
117.000	-.001392	-9783.7573	149.1607	1.442E-04	194.7114	19.3826
118.800	-.001145	-9487.7025	181.5384	1.309E-04	192.9665	16.5926
120.600	-9.21E-04	-9137.5218	208.9689	1.180E-04	190.9026	13.8856
122.400	-7.20E-04	-8741.9995	231.6197	1.057E-04	188.5714	11.2819
124.200	-5.41E-04	-8309.5870	249.6926	9.389E-05	186.0228	8.7992
126.000	-3.82E-04	-7848.3450	263.4195	8.273E-05	183.3043	6.4529
127.800	-2.43E-04	-7365.8929	273.0574	7.222E-05	180.4608	4.2559
129.600	-1.22E-04	-6869.3679	278.8844	6.238E-05	177.5343	2.2185
131.400	-1.85E-05	-6365.3902	281.1946	5.324E-05	174.5639	.3484
133.200	6.94E-05	-5860.0384	280.2940	4.480E-05	171.5854	-1.3490
135.000	1.43E-04	-5358.8314	276.4965	3.705E-05	168.6313	-2.8705
136.800	2.03E-04	-4866.7183	270.1193	2.999E-05	165.7309	-4.2153
138.600	2.51E-04	-4388.0753	261.4795	2.360E-05	162.9098	-5.3845
140.400	2.88E-04	-3926.7089	250.8905	1.785E-05	160.1905	-6.3810
142.200	3.15E-04	-3485.8657	238.6591	1.273E-05	157.5922	-7.2094
144.000	3.34E-04	-3068.2466	225.0827	8.206E-06	155.1308	-7.8755
145.800	3.45E-04	-2676.0261	210.4467	4.238E-06	152.8191	-8.3866
147.600	3.49E-04	-2310.8749	195.0232	7.940E-07	150.6669	-8.7506
149.400	3.47E-04	-1973.9867	179.0690	-2.165E-06	148.6814	-8.9764
151.200	3.41E-04	-1666.1058	162.8245	-4.680E-06	146.8667	-9.0731
153.000	3.31E-04	-1387.5574	146.5135	-6.789E-06	145.2250	-9.0502
154.800	3.17E-04	-1138.2782	130.3427	-8.533E-06	143.7558	-8.9174
156.600	3.00E-04	-917.8475	114.5016	-9.954E-06	142.4566	-8.6839
158.400	2.81E-04	-725.5171	99.1633	-1.109E-05	141.3230	-8.3587
160.200	2.60E-04	-560.2410	84.4851	-1.198E-05	140.3489	-7.9504
162.000	2.38E-04	-420.7026	70.6096	-1.265E-05	139.5264	-7.4667
163.800	2.14E-04	-305.3402	57.6664	-1.316E-05	138.8465	-6.9147
165.600	1.90E-04	-212.3696	45.7728	-1.351E-05	138.2985	-6.3004
167.400	1.66E-04	-139.8042	35.0363	-1.376E-05	137.8709	-5.6290
169.200	1.41E-04	-85.4714	25.5560	-1.391E-05	137.5506	-4.9046
171.000	1.16E-04	-47.0263	17.4245	-1.400E-05	137.3240	-4.1304
172.800	9.03E-05	-21.9617	10.7297	-1.405E-05	137.1763	-3.3084
174.600	6.50E-05	-7.6154	5.5563	-1.407E-05	137.0917	-2.4398
176.400	3.97E-05	-1.1737	1.9880	-1.408E-05	137.0538	-1.5251
178.200	1.43E-05	.3268	.1078	-1.408E-05	137.0488	-.5640
180.000	-1.10E-05	0.0000	0.0000	-1.408E-05	137.0469	.4442

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.32509080	in
Computed slope at pile head	=	-.01126896	
Maximum bending moment	=	289610.459	lbs-in
Maximum shear force	=	-6798.137	lbs
Depth of maximum bending moment	=	25.200	in
Depth of maximum shear force	=	50.400	in
Number of iterations	=	15	

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Number of zero deflection points = 3

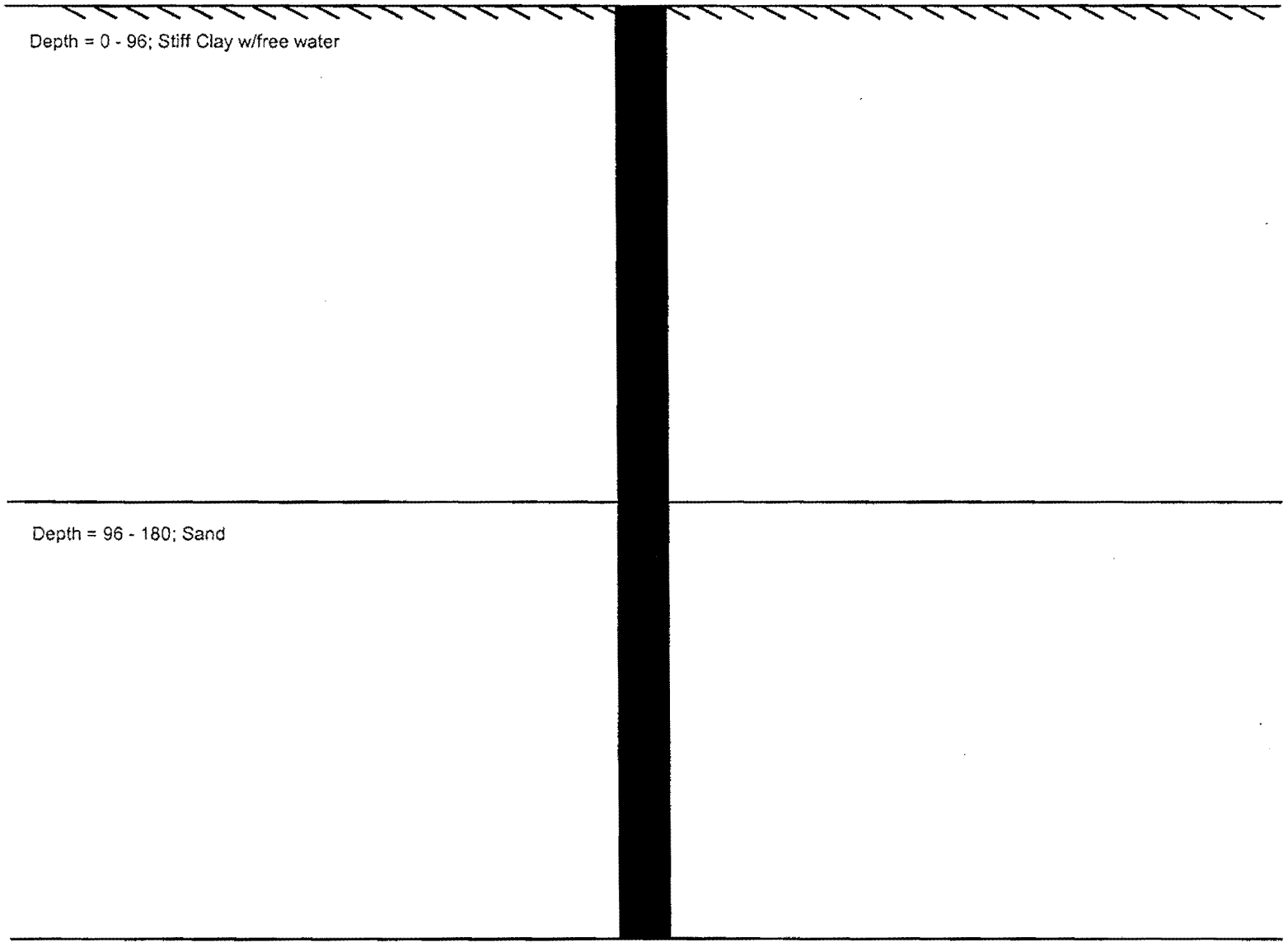
Summary of Pile-head Response

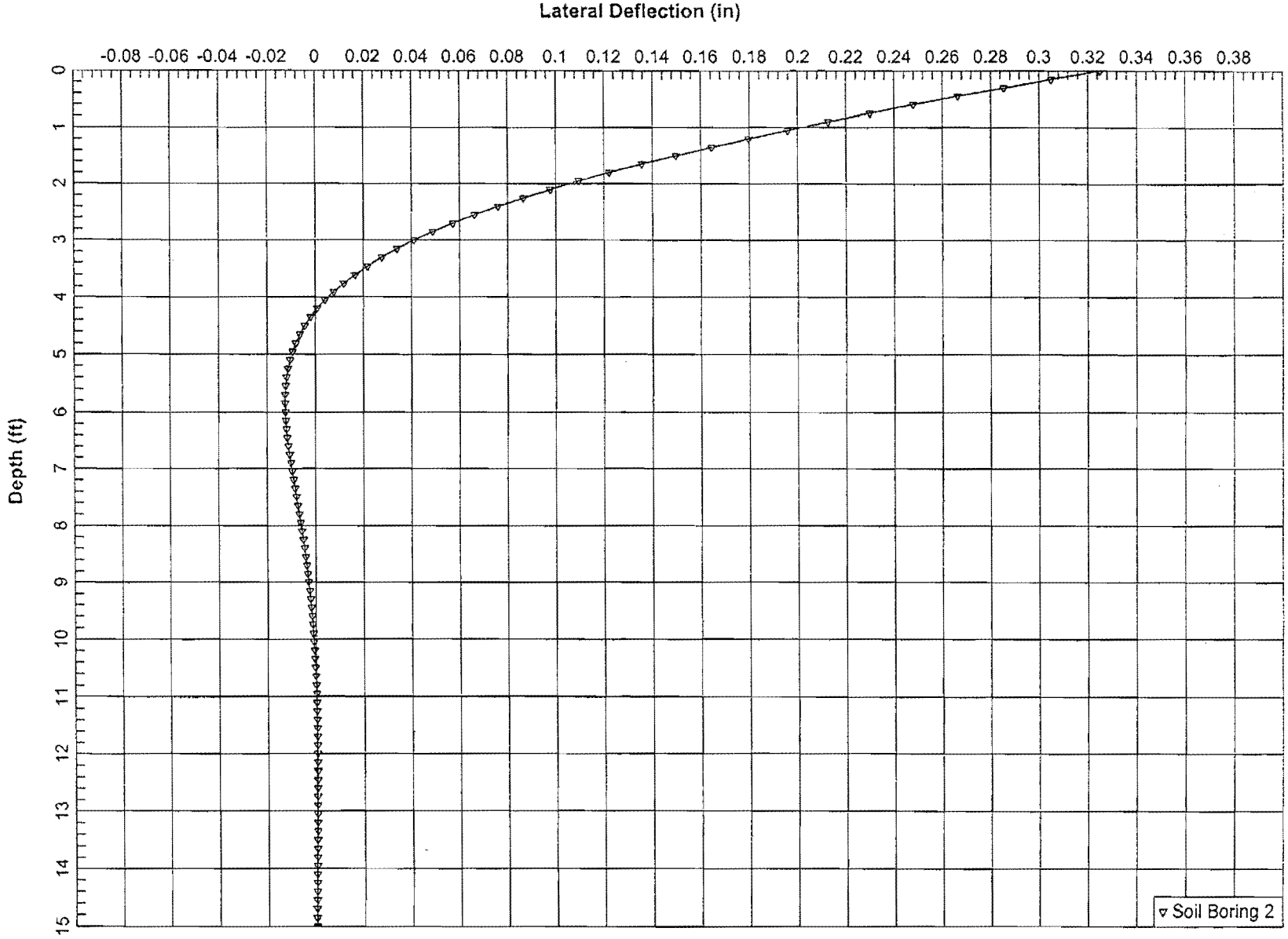
Definition of symbols for pile-head boundary conditions:

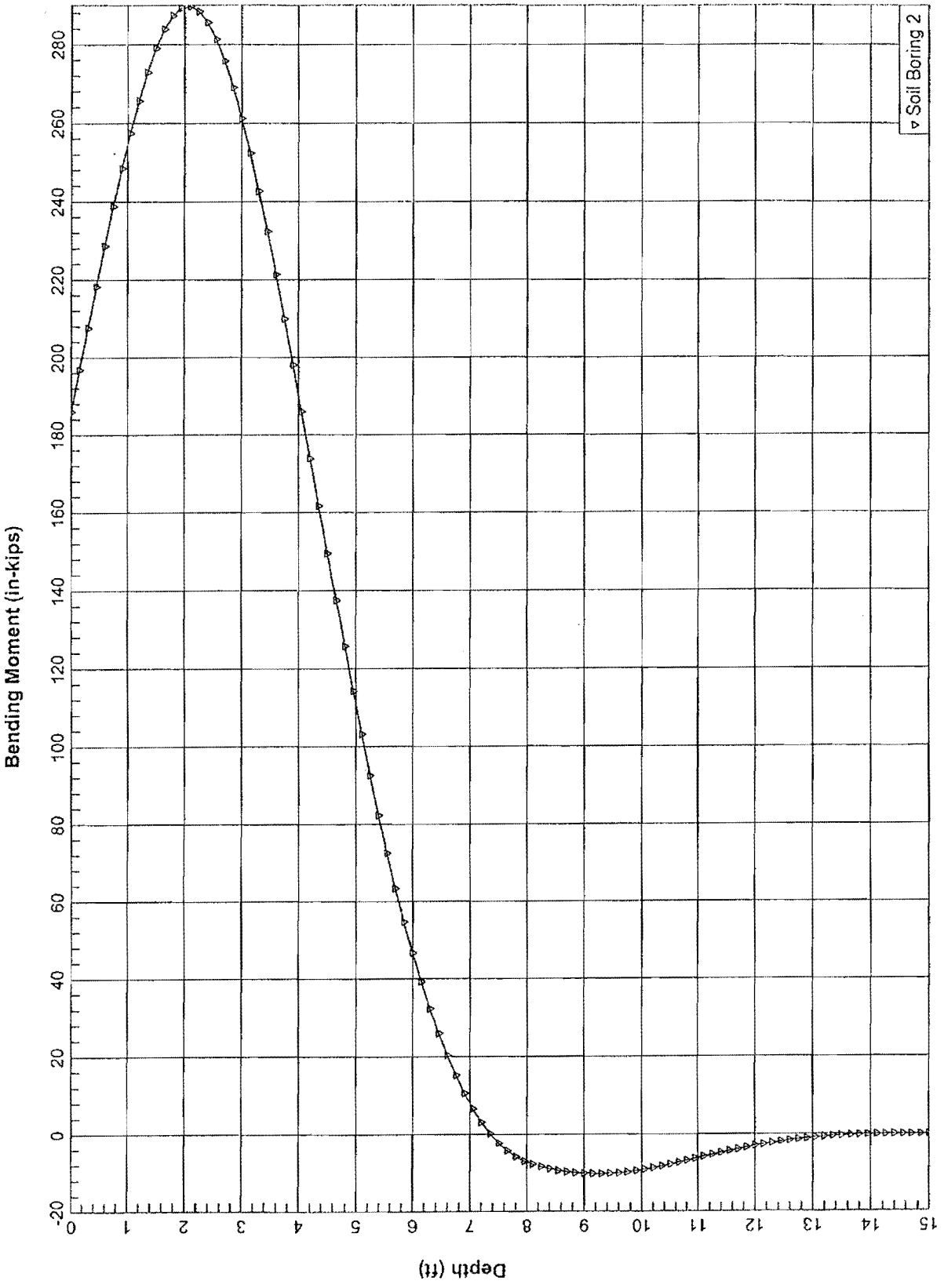
y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 5808.000	M= 1.86E+05	15500.0000	.3251	289610.4590	-6798.1368

The analysis ended normally.


Depth = 0 - 96; Stiff Clay w/free water
Depth = 96 - 180; Sand


Lateral Deflection (in)
-0.08 -0.06 -0.04 -0.02 0 0.02 0.04 0.06 0.08 0.1 0.12 0.14 0.16 0.18 0.2 0.22 0.24 0.26 0.28 0.3 0.32 0.34 0.36 0.38
Depth (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Soil Boring 2


Bending Moment (in-kips)
Depth (ft)
Soil Boring 2
-20
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

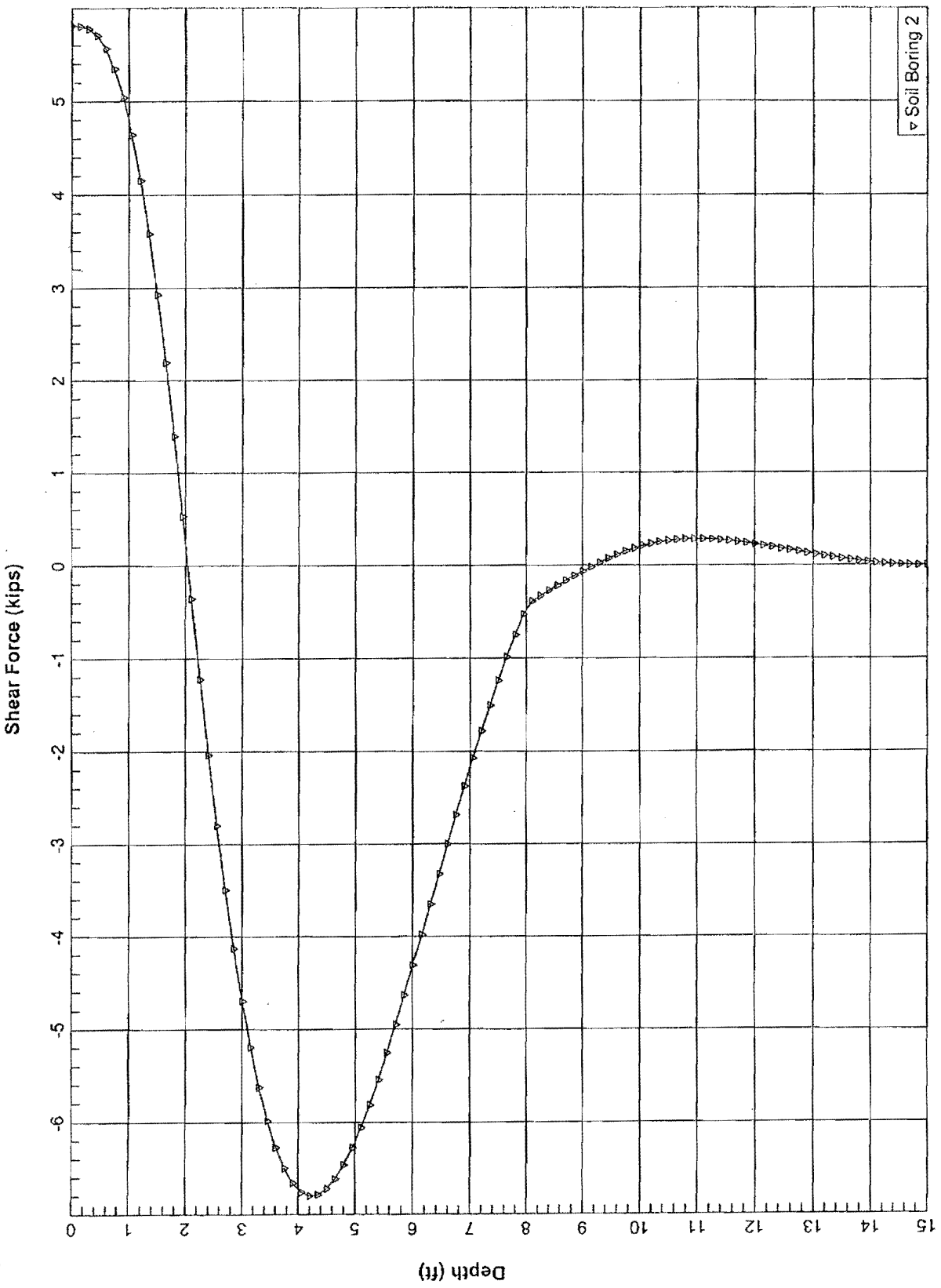

Soil Boring 2
Shear Force (kips)
Depth (ft)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

Table 1A - Boring 1
Soil Parameters for Lateral Deflection Analysis of Driven Piles
Cam Rock Park Pedestrian Bridge, Dane County, Wisconsin

Soil Layer	Fill: Very Loose F-M Sand	Clayey SILT to PEAT	Med. Stiff Lean CLAY	Loose to Med. Dense SAND
Approximate Depth (1)	**0 to 7 ft**	**7 to 14 ft**	**7 to 19 ft**	**19 to 25 ft**
Estimated Soil Parameters				
Angle of internal friction, ϕ	27 degrees	0 degrees	0 degrees	30 degrees
Cohesion	0 lb/sq ft	250 lb/sq ft	1000 lb/sq ft	0 lb/sq ft
Moist unit weight	115 lb/cu ft	110 lb/cu ft	120 lb/cu ft	130 lb/cu ft
Submerged unit weight	53 lb/cu ft	48 lb/cu ft	58 lb/cu ft	68 lb/cu ft
Earth pressure coefficients (2)				
Active, Ka	0.38	1.00	1.00	0.33
Passive, Kp	2.66	1.00	1.00	3.00
Sand Strata				
Constant of subgrade reaction, n_h (3)	20 lb/cu in.	N.A. (4)	N.A.	40 lb/cu in.
Clay/Silt: (Cyclic Loading Conditions)				
Coefficient of horizontal subgrade reaction, k_h	N.A.	20 lb/cu in.	100 lb/cu in.	N.A.
Additional *L-Pile* Parameters				
Soil type - code	4	1	2	4
Soil type - description	Sand	Submerged Soft Clay	Stiff Clay with Free Water	Sand
Strain at 50% of max stress	N.A.	0.020	0.010	N.A.
Driven Displacement Piles (5)				
Allowable Side Friction (FS=2)	not recommended	not recommended	0.35 kips/sq ft	0.25 kips/sq ft
Allowable End Bearing (FS=2)	not recommended	not recommended	not recommended	60 kips/sq ft

Notes:

(1) Depths have been generalized to some extent. Refer to boring logs for detailed description at each location.
(2) Values do not include a factor of safety (i.e., FS = 1.0)
(3) Where $k_h = (n_h)(x)$ and x is the depth below ground surface.
(4) N.A. = not applicable
(5) Values include a factor of safety of 2.0.

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Table 1B - Boring 2
Soil Parameters for Lateral Deflection Analysis of Driven Piles
Cam Rock Park Pedestrian Bridge, Dane County, Wisconsin

Soil Layer	Topsoil and Stiff Lean CLAY	Loose Fine to Medium SAND	Stiff to Hard Lean CLAY	Very Loose to Very Dense SAND
Approximate Depth (1)	**0 to 4 ft**	**4 to 6.5 ft**	**6.5 to 17 ft**	**17 to 24 ft**
Estimated Soil Parameters				
Angle of internal friction, ϕ	**0** degrees	**28** degrees	**0** degrees	**30** degrees
Cohesion	**1500** lb/sq ft	**0** lb/sq ft	**1500** lb/sq ft	**0** lb/sq ft
Moist unit weight	**120** lb/cu ft	**120** lb/cu ft	**125** lb/cu ft	**130** lb/cu ft
Submerged unit weight	**58** lb/cu ft	**58** lb/cu ft	**63** lb/cu ft	**68** lb/cu ft
Earth pressure coefficients (2)				
Active, Ka	**1.00**	**0.36**	**1.00**	**0.33**
Passive, Kp	**1.00**	**2.77**	**1.00**	**3.00**
Sand Strata				
Constant of subgrade reaction, n_h (3)	**N.A.** (4)	**20** lb/cu in.	**N.A.**	**20** lb/cu in.
Clay/Silt: (Cyclic Loading Conditions)				
Coefficient of horizontal subgrade reaction, k_h	**100** lb/cu in.	**N.A.**	**200** lb/cu in.	**N.A.**
Additional *L-Pile* Parameters				
Soil type - code	**3**	**4**	**2**	**4**
Soil type - description	**Stiff Clay w/o Free Water**	**Sand**	**Stiff Clay with Free Water**	**Sand**
Strain at 50% of max stress	**0.010**	**N.A.**	**0.005**	**N.A.**
Driven Displacement Piles (5)				
Allowable Side Friction (FS=2)	not recommended	not recommended	**0.30** kips/sq ft	**0.10** kips/sq ft
Allowable End Bearing (FS=2)	not recommended	not recommended	not recommended	(NOTE 6) kips/sq ft

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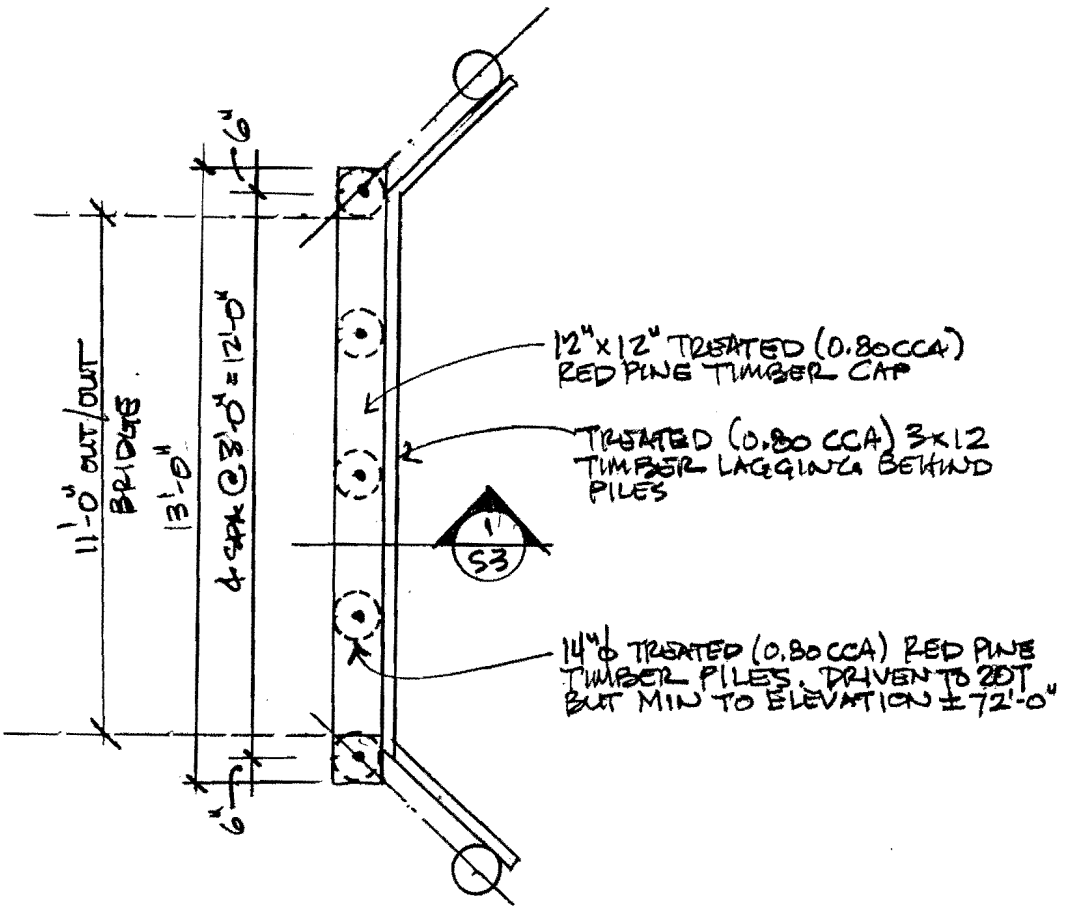
Notes:

(1) Depths have been generalized to some extent. Refer to boring logs for detailed description at each location.
(2) Values do not include a factor of safety (i.e., FS = 1.0)
(3) Where $k_h = (n_h)(x)$ and x is the depth below ground surface.
(4) N.A. = not applicable
(5) Values include a factor of safety of 2.0.
(6) Drive to refusal on weathered bedrock.

ARNOLD AND O'SHERIDAN INC
CONSULTING ENGINEERS
1111 DEMING WAY, MADISON, WI 53717-1953
TEL: 608.821.8500 FAX: 608.821.8501

JOB NAME: CAM - ROCK PARK BRIDGE ABUTS
JOB NO.: _____ DATE: 01-11-07
ENGINEER: _____ SHEET NO.: S2



1/S2 PLAN VIEW - NORTH & SOUTH ABUTMENTS SIM

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CONSULTING ENGINEERS
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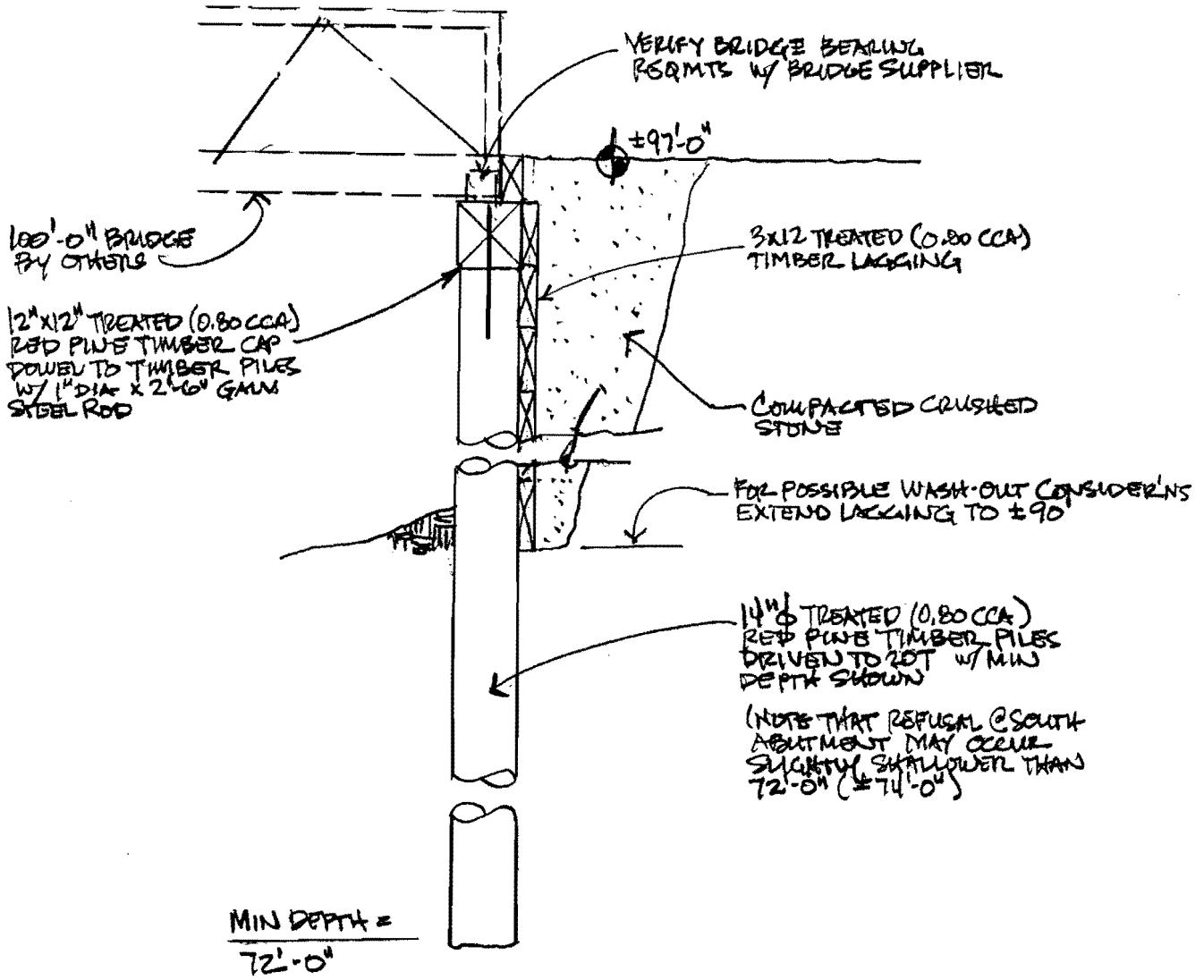
JOB NAME: CAM-ROCK PARK BRIDGE ABUT'S
JOB NO.: DATE: 01-11-07
ENGINEER: SHEET NO.: S3



1/S3 TIMBER PILE ABUTMENT SECTION