



October 21, 2011

Mr. Joel Halterman
Walsh Construction Company
2301 Scranton Road
Cleveland, Ohio 44113

Re: ODOT 3000(10) I-90 Innerbelt Central Viaduct Unit 2
Foundation Pile Driving Criteria Analysis

Mr. Halterman:

As requested, GRL has performed analyses to evaluate the suitability of suggested criteria for Piers 6, 8, and 10 piling. The original suggested criteria was to drive the piles to refusal on bedrock, which was defined as 20 blows/inch in the plans (along with some further evaluation), with the hammer performance (stroke) equal to or greater than the performance observed during driving of the test piles. All of the test piles were driven well beyond 20 blows/inch in the piers of interest; therefore, GRL was requested to evaluate the estimated capacity of the piles, at 20 blows/inch, based on the data collected during initial driving with the production pile hammers and during restrike with the APPLE loading device.

In order to estimate the total capacity of piles driven to approximately 20 blows/inch with the available data, GRL suggested that the data collected during driving at a blow count of approximately 20 blows/inch be evaluated using CAPWAP analysis. The CAPWAP analysis provides a resistance distribution including the distribution of mobilized shaft resistance and mobilized end bearing. The analysis from data collected at approximately 20 blows/inch is then compared to the analysis performed on data collected near the end of driving. The mobilized shaft resistance of the two analyses are very similar as the difference in penetration depths were only 4 to 22 inches between the analyses. The mobilized end bearing from the analysis performed on data collected at approximately 20 blows/inch was compared to the mobilized end bearing from the analysis performed on data collected at the end of driving. This difference represents the additional mobilized end bearing from driving the piles beyond 20 blows/inch.

To evaluate the estimated total capacity of the piles at 20 blows/inch, the number calculated above was subtracted from the capacity determined from restrike testing with the APPLE loading device. Based on this method, the final capacity is the estimated total capacity of piles driven to approximately 20 blows/inch with similar hammer performance observed during driving of the test piles.

The results of these analyses have been summarized in Table 1. The complete results of the CAPWAP analyses are summarized in Table 2 and presented in Appendix B.

Pier 6 Analysis

Pile 2-57 was driven to a blow count of 45 blows for 0.5 inches of penetration and an average stroke of 9.6 ft at a depth of 160' – 0". The mobilized end bearing component from CAPWAP analysis was 901 kips. The drive log indicates that 20 blows/inch was first observed at a depth of 159' – 8". The average hammer stroke at this depth was 10.2 ft. The mobilized end bearing component from CAPWAP analysis was 830 kips. Therefore, the additional mobilized end bearing from driving the pile beyond 20 blows/inch was 71 kips.

The restrike test using the APPLE loading device indicated a total capacity of 2,687 kips, therefore, the estimated total capacity of the pile at 20 blows/inch and an average hammer stroke of 10.2 ft is 2,616 kips. The required capacity at Pier 6 was 2304 kips, which included a safety factor of 1.5. Therefore, the estimated safety factor at 20 blows/inch at an average hammer stroke of 10.2 ft is 1.70.

Pier 8 Analysis

Pile 2-127 was driven to a blow count of 30 blows/inch and an average stroke of 10.7 ft at a depth of 165' – 9". The mobilized end bearing component from CAPWAP analysis was 1054 kips. The drive log indicates that 20 blows/inch was first observed at a depth of 163' – 10". The average hammer stroke at this depth was 10.0 ft. The mobilized end bearing component from CAPWAP analysis was 857 kips. Therefore, the additional mobilized end bearing from driving the pile beyond 20 blows/inch was 197 kips.

The restrike test using the APPLE loading device was performed on pile 2-124. This pile was reportedly selected for testing because the crane could not safely reach pile 2-127 with the APPLE loading device. Pile 2-124 was reportedly driven to 56 blows/inch with an average hammer stroke of 10.7 ft at a depth of 165' – 9". The restrike using the APPLE loading device indicated a total capacity of 2696 kips. A direct estimate of the capacity of this pile at 20 blows/inch cannot be made because data was not collected during initial driving. However, reducing the ultimate capacity measured on 2-124 by the difference in mobilized end bearing on pile 2-127 would yield an estimated safety factor greater than 1.5 at 20 blows/inch.

Pier 10 Analysis

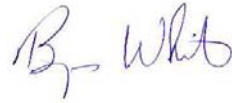
Pile 2-213 was driven to a blow count of 40 blows/inch and an average stroke of 9.6 ft at a depth of 145' – 0". The mobilized end bearing component from CAPWAP analysis was 1141 kips. The drive log indicates that 20 blows/inch was first observed at a depth of 144' – 1". The average hammer stroke at this depth was 9.8 ft. The mobilized end bearing component from CAPWAP analysis was 1066 kips. Therefore, the additional mobilized end bearing from driving the pile beyond 20 blows/inch was 75 kips.

The restrike test using the APPLE loading device indicated a total capacity of 2,487 kips, therefore, the estimated total capacity of the pile at 20 blows/inch is 2,412 kips. The required capacity at Pier 10 was 2034 kips, which included a safety factor of 1.5. Therefore, the estimated safety factor of this pile at 20 blows/inch is 1.78.

Based on this analysis procedure, piles driven to the suggested criteria of 20 blows/inch for 2 consecutive inches at the respective minimum suggested hammer strokes should provided safety factors in excess of 1.5.

If you have any questions on these analyses, or if we can be of assistance in any way, please contact us.

Sincerely,
GRL Engineers, Inc.

A handwritten signature in blue ink that reads "B. White". The signature is written in a cursive style with a large initial "B" and a stylized "White".

Benjamin White, P.E.

Table 1: Summary of Case Method Results

ODOT 3000(10) - I-90 Central Viaduct Unit 2

Substructure	Pile Number	End of Drive Penetration ¹ Depth (ft)	End of Drive Blow Count ² (bpi)	End of Drive Average Stroke (ft)	End of Drive Mobilized End Bearing ³ (kips)	Penetration Depth @ ~20 bpi ² (ft)	Blow Count Analyzed ² (bpi)	Average Stroke @ ~20 bpi (ft)	Mobilized End Bearing @~20 bpi ³ (kips)	Difference in Mobilized End Bearing (kips)	Ultimate Capacity from APPLE Test (kips)	Estimated Ultimate Capacity @ ~20 bpi (kips)	Required Capacity (SF = 1.5)	Estimated Safety Factor @ 20 bpi
Pier 6	2-57	160' - 0"	45 / 0.5"	9.6	901	159' - 8"	19 / 1"	10.2	830	71	2687	2616	2304	1.70
Pier 8	2-124	165' - 9"	56 / 1"	10.7	n/a	n/a	n/a	10.2	n/a	n/a	2696	n/a	2135	n/a
	2-127	165' - 8"	30 / 1"	10.5	1054	163' - 10"	22 / 1"	10.0	857	197	n/a	n/a	2135	n/a
Pier 10	2-213	145' - 0"	40 / 1"	9.6	1141	144' - 1"	21 / 1"	9.8	1066	75	2487*	2412	2034	1.78

Notes:

* - Because the set under impact was very small on Pier 10, all of the resistance was not mobilized, therefore, this is a lower bound estimate of ultimate capacity

1 - Depth below existing grade

2 - Blow counts and depths provided in pile driving logs or observed by GRL personnel

3 - Mobilized end bearing from CAPWAP analysis

Table 2: Summary of CAPWAP Results

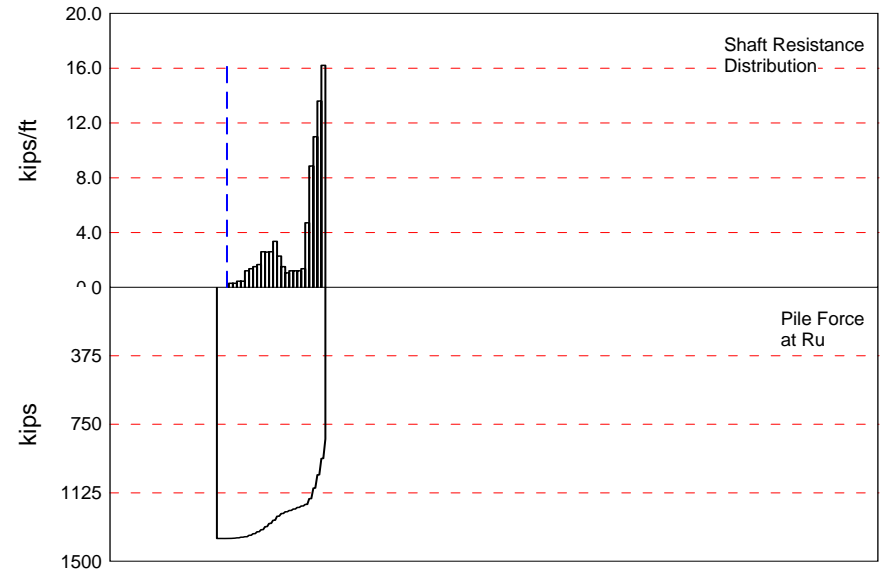
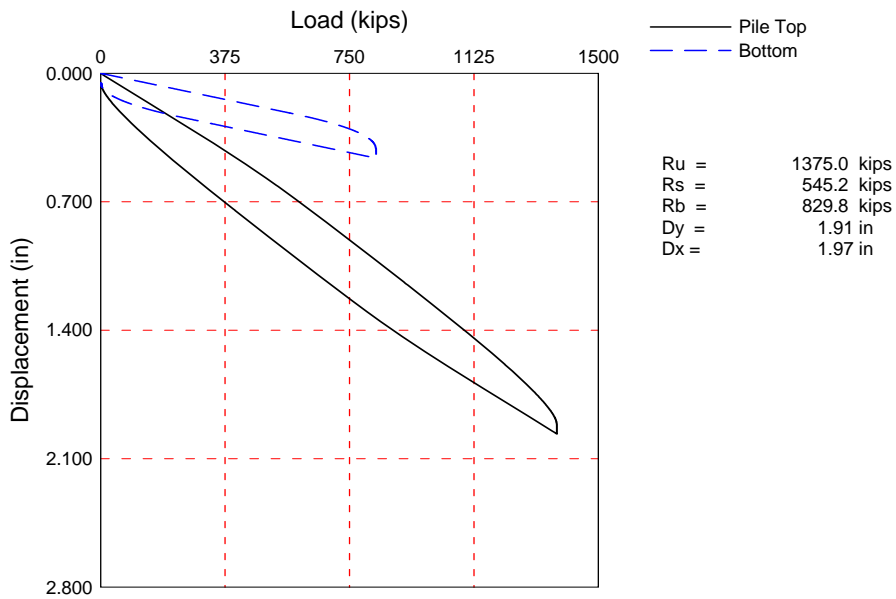
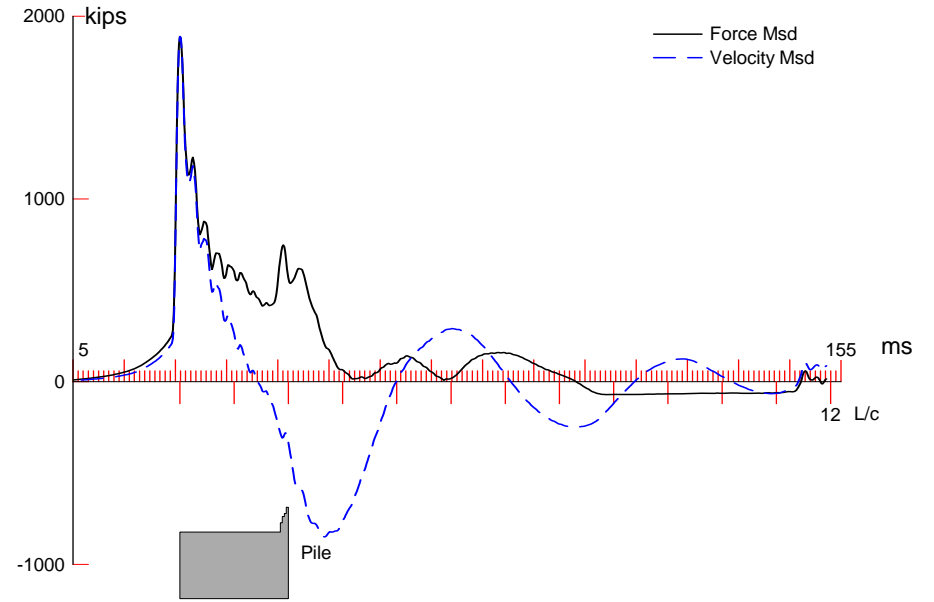
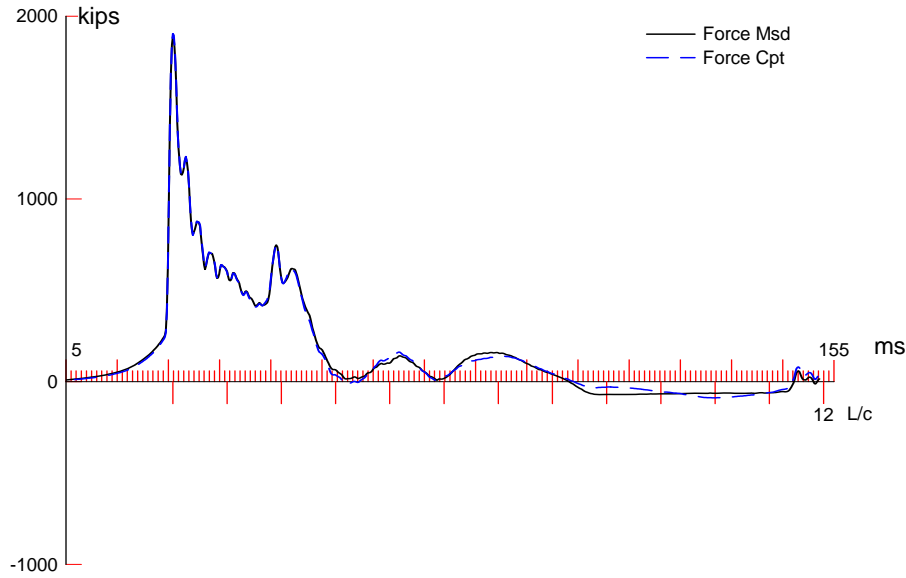
Substructure	Pile Number	Hammer	Blow Count (set)	Penetration Depth (ft)	Mobilized Capacity			Soil Damping		Soil Quake	
					Total (kips)	Shaft (kips)	Toe (kips)	Shaft (sec/ft)	Toe (sec/ft)	Shaft (in)	Toe (in)
Pier 6	2-57	D-80-23	19 / 1"	159' - 8"	1375	545	830	0.16	0.11	0.30	0.32
		D80-23	45 / 0.5"	160' - 0"	1451	549	901	0.15	0.11	0.30	0.33
		APPLE	(1/8")	160' - 0"	2687	1393	1294	0.19	0.19	0.20	0.17
Pier 8	2-127	D-80-23	22 / 1"	163' - 10"	1300	443	857	0.27	0.11	0.30	0.31
		D80-23	30 / 1"	165' - 8"	1503	449	1054	0.26	0.12	0.22	0.25
		APPLE	(1/8")	166' - 3" **	2696	1340	1356	0.11	0.18	0.16	0.13
Pier 10	2-213	D-80-23	21 / 1"	144' - 1"	1500	434	1066	0.19	0.08	0.27	0.34
		D80-23	40 / 1"	145' - 0"	1582	441	1141	0.17	0.08	0.30	0.31
		APPLE	(0")	145' - 0"	2487	1264	1223	0.17	0.11	0.17	0.17

** - Depth reference changed due to excavation or change in existing grade

Appendix A

Complete CAPWAP Analysis Results

Pier 6 Analyses



CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 1375.0; along Shaft 545.2; at Toe 829.8 kips

Soil Sgmt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				1375.0				
1	26.4	8.0	2.0	1373.0	2.0	0.25	0.04	0.159
2	33.0	14.6	2.0	1371.0	4.0	0.30	0.05	0.159
3	39.6	21.2	3.0	1368.0	7.0	0.46	0.08	0.159
4	46.1	27.8	3.0	1365.0	10.0	0.46	0.08	0.159
5	52.7	34.4	8.0	1357.0	18.0	1.21	0.20	0.159
6	59.3	41.0	9.0	1348.0	27.0	1.37	0.23	0.159
7	65.9	47.6	10.0	1338.0	37.0	1.52	0.25	0.159
8	72.5	54.2	11.0	1327.0	48.0	1.67	0.28	0.159
9	79.1	60.8	17.2	1309.8	65.2	2.61	0.43	0.159
10	85.7	67.4	17.0	1292.8	82.2	2.58	0.43	0.159
11	92.3	74.0	17.2	1275.6	99.4	2.61	0.43	0.159
12	98.9	80.6	22.2	1253.4	121.6	3.37	0.56	0.159
13	105.5	87.2	15.1	1238.3	136.7	2.29	0.38	0.159
14	112.1	93.7	10.0	1228.3	146.7	1.52	0.25	0.159
15	118.7	100.3	7.0	1221.3	153.7	1.06	0.18	0.159
16	125.3	106.9	8.0	1213.3	161.7	1.21	0.20	0.159
17	131.9	113.5	8.0	1205.3	169.7	1.21	0.20	0.159
18	138.4	120.1	8.0	1197.3	177.7	1.21	0.20	0.159
19	145.0	126.7	9.0	1188.3	186.7	1.37	0.23	0.159
20	151.6	133.3	31.1	1157.2	217.8	4.72	0.78	0.159
21	158.2	139.9	58.4	1098.8	276.2	8.86	1.46	0.159
22	164.8	146.5	72.5	1026.3	348.7	11.00	1.81	0.159
23	171.4	153.1	89.7	936.6	438.4	13.61	2.24	0.159
24	178.0	159.7	106.8	829.8	545.2	16.20	2.67	0.159
Avg. Shaft			22.7			3.41	0.56	0.159
Toe			829.8				361.24	0.113

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.295	0.316
Case Damping Factor		0.809	0.877
Unloading Quake	(% of loading quake)	100	89
Reloading Level	(% of Ru)	100	100

Soil Model Parameters/Extensions		Shaft	Toe
Soil Plug Weight	(kips)		0.05
CAPWAP match quality	= 1.22	(Wave Up Match) ; RSA = 0	
Observed: final set	= 0.053 in;	blow count	= 228 b/ft
Computed: final set	= 0.026 in;	blow count	= 464 b/ft
max. Top Comp. Stress	= 31.8 ksi	(T= 26.3 ms, max= 1.009 x Top)	
max. Comp. Stress	= 32.1 ksi	(Z= 52.7 ft, T= 29.4 ms)	
max. Tens. Stress	= -4.33 ksi	(Z= 145.0 ft, T= 68.4 ms)	
max. Energy (EMX)	= 107.5 kip-ft;	max. Measured Top Displ. (DMX)= 1.28 in	

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	1907.0	-85.4	31.8	-1.42	107.49	17.5	1.283
2	6.6	1907.9	-82.1	31.8	-1.37	107.29	17.5	1.273
5	16.5	1911.1	-82.6	31.8	-1.38	106.66	17.4	1.242
8	26.4	1918.6	-119.2	32.0	-1.99	105.92	17.3	1.208
11	36.3	1913.9	-146.9	31.9	-2.45	104.20	17.2	1.173
14	46.1	1918.6	-166.5	32.0	-2.77	102.58	17.0	1.133
17	56.0	1904.6	-169.9	31.7	-2.83	99.05	16.8	1.088
20	65.9	1902.5	-193.8	31.7	-3.23	95.78	16.5	1.039
23	75.8	1868.0	-178.2	31.1	-2.97	90.23	16.1	0.986
26	85.7	1852.3	-178.3	30.9	-2.97	85.11	15.7	0.927
29	95.6	1785.3	-171.4	29.7	-2.86	77.72	15.3	0.871
32	105.5	1749.4	-176.8	29.1	-2.95	72.12	14.9	0.811
35	115.4	1694.9	-186.3	28.2	-3.10	66.72	14.7	0.755
38	125.3	1699.3	-214.4	28.3	-3.57	63.14	14.4	0.690
41	135.1	1679.0	-235.4	28.0	-3.92	58.81	14.2	0.626
44	145.0	1700.9	-260.1	28.3	-4.33	54.82	13.8	0.555
47	154.9	1701.8	-231.0	28.4	-3.85	48.27	12.9	0.481
50	164.8	1797.7	-209.5	30.0	-3.49	41.22	10.7	0.408
51	168.1	1683.6	-182.3	28.1	-3.04	36.60	10.2	0.388
52	171.4	1671.5	-184.4	27.9	-3.07	35.81	10.3	0.370
53	174.7	1454.4	-155.4	24.2	-2.59	31.19	10.4	0.354
54	178.0	1515.2	-156.0	25.2	-2.60	27.30	10.3	0.339

EXTREMA TABLE

Pile Sgmt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
Absolute	52.7 145.0			32.1	-4.33		(T = 29.4 ms) (T = 68.4 ms)	

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	2350.8	2205.7	2060.6	1915.5	1770.5	1625.4	1480.3	1335.2	1190.2	1045.1
RX	2350.8	2205.7	2060.6	1915.5	1770.5	1625.4	1481.6	1390.8	1329.7	1268.6
RU	2410.8	2271.7	2132.7	1993.6	1854.5	1715.5	1576.4	1437.3	1298.3	1159.2

RAU = 1095.6 (kips); RA2 = 1218.5 (kips)

Current CAPWAP Ru = 1375.0 (kips); Corresponding J(RP)= 0.67; J(RX) = 0.73

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips
17.78	26.08	1904.5	1897.0	1897.0	1.281	0.053	0.053	107.8	1941.5

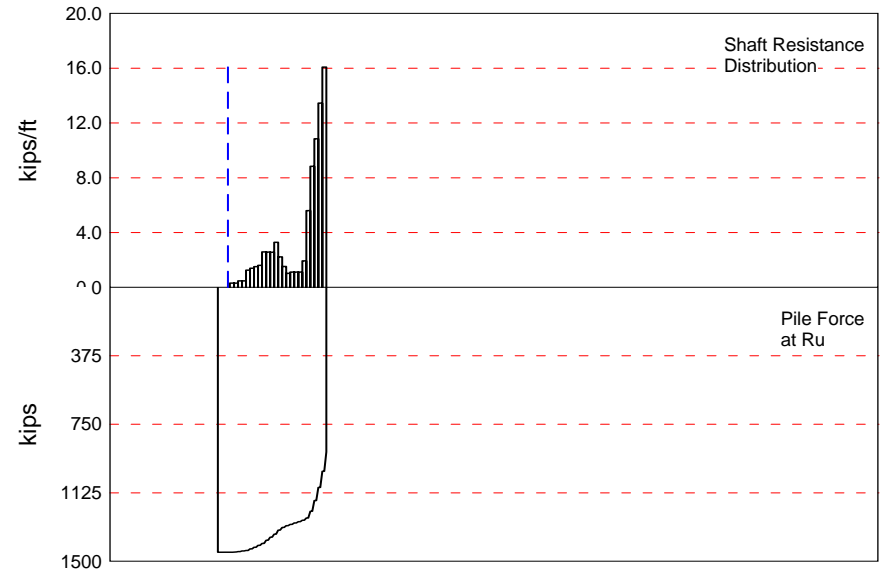
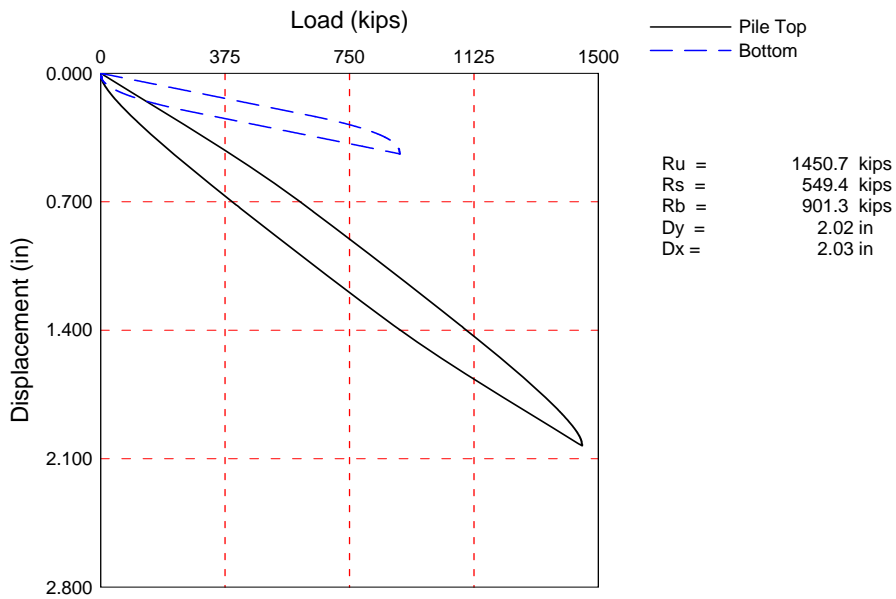
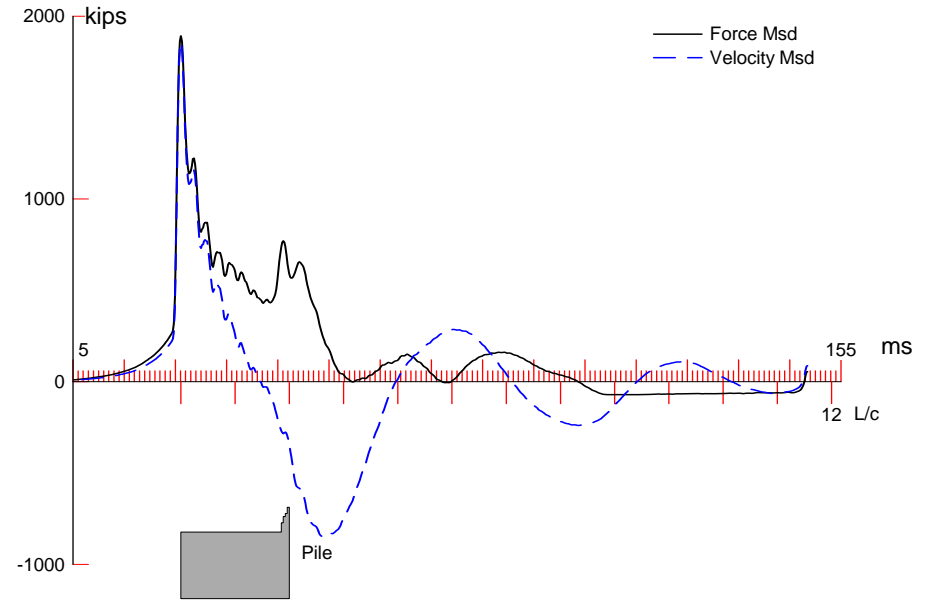
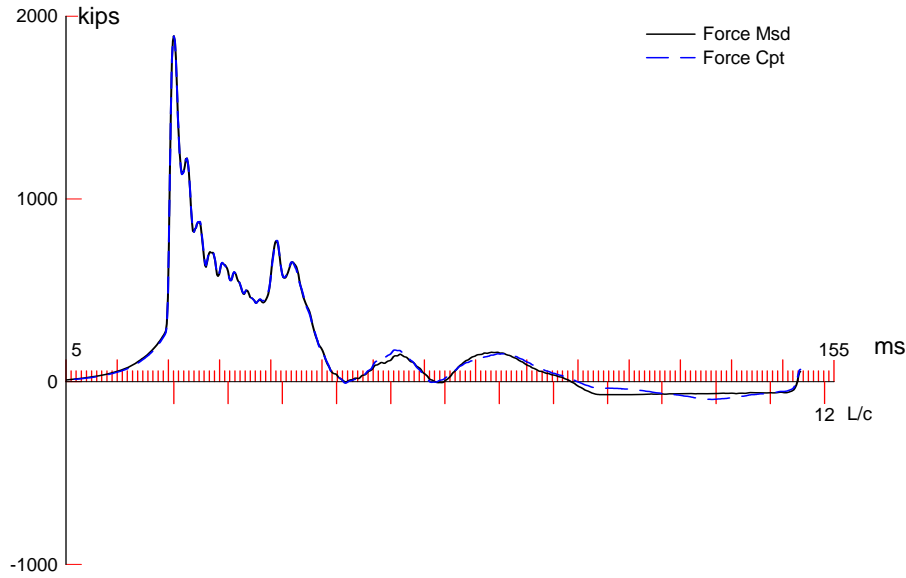
PILE PROFILE AND PILE MODEL

Depth ft	Area in ²	E-Modulus ksi	Spec. Weight lb/ft ³	Perim. ft
0.00	60.00	29992.2	492.000	6.063
178.00	60.00	29992.2	492.000	6.063

Toe Area 2.297 ft²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft
1	3.30	107.09	0.00	0.000	0.000	-0.000	0.000	6.063
51	168.11	122.09	14.01	0.000	0.000	-0.000	0.000	6.063
52	171.41	132.09	23.34	0.000	0.000	-0.000	0.000	6.063
53	174.70	137.09	28.01	0.000	0.000	-0.000	0.000	6.063
54	178.00	147.09	37.35	0.000	0.000	-0.000	0.000	6.063

Pile Damping 1.0 %, Time Incr 0.196 ms, Wave Speed 16807.9 ft/s, 2L/c 21.2 ms



CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 1450.7; along Shaft 549.4; at Toe 901.3 kips

Soil Sgmt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				1450.7				
1	26.4	8.4	2.1	1448.6	2.1	0.25	0.04	0.150
2	33.0	15.0	2.1	1446.5	4.2	0.32	0.05	0.150
3	39.6	21.6	3.2	1443.3	7.4	0.49	0.08	0.150
4	46.1	28.1	3.2	1440.1	10.6	0.49	0.08	0.150
5	52.7	34.7	8.3	1431.8	18.9	1.26	0.21	0.150
6	59.3	41.3	9.2	1422.6	28.1	1.40	0.23	0.150
7	65.9	47.9	10.0	1412.6	38.1	1.52	0.25	0.150
8	72.5	54.5	10.6	1402.0	48.7	1.61	0.27	0.150
9	79.1	61.1	17.1	1384.9	65.8	2.59	0.43	0.150
10	85.7	67.7	17.0	1367.9	82.8	2.58	0.43	0.150
11	92.3	74.3	16.9	1351.0	99.7	2.56	0.42	0.150
12	98.9	80.9	21.7	1329.3	121.4	3.29	0.54	0.150
13	105.5	87.5	14.7	1314.6	136.1	2.23	0.37	0.150
14	112.1	94.1	10.1	1304.5	146.2	1.53	0.25	0.150
15	118.7	100.7	6.8	1297.7	153.0	1.03	0.17	0.150
16	125.3	107.3	7.4	1290.3	160.4	1.12	0.19	0.150
17	131.9	113.9	7.4	1282.9	167.8	1.12	0.19	0.150
18	138.4	120.4	7.4	1275.5	175.2	1.12	0.19	0.150
19	145.0	127.0	12.8	1262.7	188.0	1.94	0.32	0.150
20	151.6	133.6	36.9	1225.8	224.9	5.60	0.92	0.150
21	158.2	140.2	58.3	1167.5	283.2	8.84	1.46	0.150
22	164.8	146.8	71.5	1096.0	354.7	10.85	1.79	0.150
23	171.4	153.4	88.7	1007.3	443.4	13.45	2.22	0.150
24	178.0	160.0	106.0	901.3	549.4	16.08	2.65	0.150
Avg. Shaft			22.9			3.43	0.57	0.150
Toe			901.3				392.37	0.109

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.295	0.329
Case Damping Factor		0.769	0.915
Unloading Quake	(% of loading quake)	100	77
Reloading Level	(% of Ru)	100	100

Soil Model Parameters/Extensions		Shaft	Toe
Soil Plug Weight	(kips)		0.03
CAPWAP match quality	= 0.91	(Wave Up Match) ; RSA = 0	
Observed: final set	= 0.011 in;	blow count	= 1080 b/ft
Computed: final set	= 0.018 in;	blow count	= 674 b/ft
max. Top Comp. Stress	= 31.6 ksi	(T= 26.5 ms, max= 1.011 x Top)	
max. Comp. Stress	= 31.9 ksi	(Z= 52.7 ft, T= 29.4 ms)	
max. Tens. Stress	= -4.52 ksi	(Z= 145.0 ft, T= 68.1 ms)	
max. Energy (EMX)	= 107.8 kip-ft;	max. Measured Top Displ. (DMX)= 1.30 in	

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	1894.1	-93.8	31.6	-1.56	107.80	17.3	1.301
2	6.6	1895.4	-91.2	31.6	-1.52	107.60	17.3	1.290
5	16.5	1899.8	-83.1	31.7	-1.39	106.94	17.2	1.259
8	26.4	1908.7	-114.9	31.8	-1.92	106.15	17.1	1.224
11	36.3	1905.1	-141.8	31.7	-2.36	104.36	17.0	1.187
14	46.1	1909.8	-160.6	31.8	-2.68	102.66	16.8	1.147
17	56.0	1894.4	-163.1	31.6	-2.72	99.08	16.6	1.101
20	65.9	1890.5	-183.8	31.5	-3.06	95.78	16.3	1.051
23	75.8	1857.0	-173.3	30.9	-2.89	90.38	16.0	0.998
26	85.7	1841.4	-170.4	30.7	-2.84	85.29	15.6	0.938
29	95.6	1777.4	-168.1	29.6	-2.80	78.02	15.2	0.881
32	105.5	1745.3	-177.4	29.1	-2.96	72.51	14.8	0.819
35	115.4	1694.8	-193.2	28.2	-3.22	67.11	14.6	0.761
38	125.3	1698.4	-226.5	28.3	-3.77	63.49	14.4	0.694
41	135.1	1682.3	-253.2	28.0	-4.22	59.27	14.1	0.630
44	145.0	1707.9	-271.2	28.5	-4.52	55.18	13.6	0.556
47	154.9	1693.4	-240.1	28.2	-4.00	47.84	12.7	0.480
50	164.8	1788.0	-218.4	29.8	-3.64	40.74	10.6	0.405
51	168.1	1678.6	-188.3	28.0	-3.14	36.24	10.1	0.384
52	171.4	1676.7	-190.1	27.9	-3.17	35.34	10.1	0.364
53	174.7	1478.2	-164.4	24.6	-2.74	30.89	10.3	0.347
54	178.0	1546.1	-165.5	25.8	-2.76	27.28	10.0	0.330

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
Absolute	52.7 145.0			31.9	-4.52		(T = 29.4 ms) (T = 68.1 ms)	

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	2348.2	2206.7	2065.2	1923.8	1782.3	1640.8	1499.3	1357.9	1216.4	1074.9
RX	2348.2	2206.7	2065.2	1923.8	1783.3	1643.0	1502.7	1417.0	1358.9	1300.9
RU	2380.4	2242.1	2103.9	1965.6	1827.3	1689.1	1550.8	1412.6	1274.3	1136.0

RAU = 1113.3 (kips); RA2 = 1244.1 (kips)

Current CAPWAP Ru = 1450.7 (kips); Corresponding J(RP)= 0.63; J(RX) = 0.66

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips
17.38	26.28	1861.6	1901.4	1901.4	1.302	0.018	0.011	108.3	1978.9

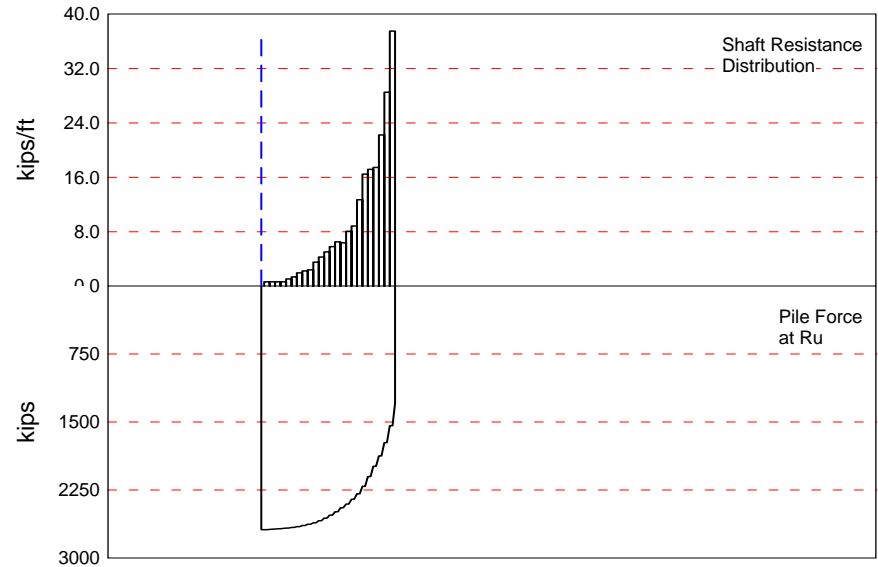
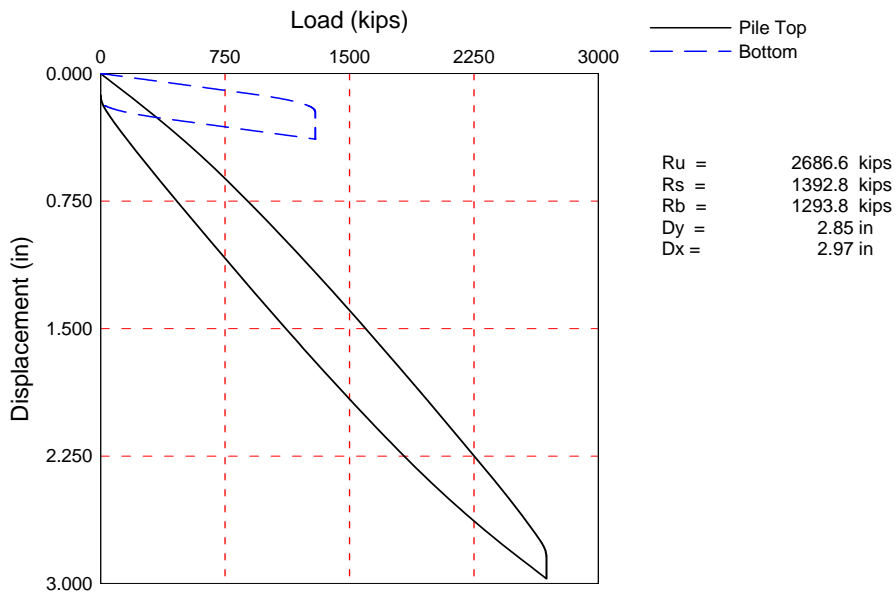
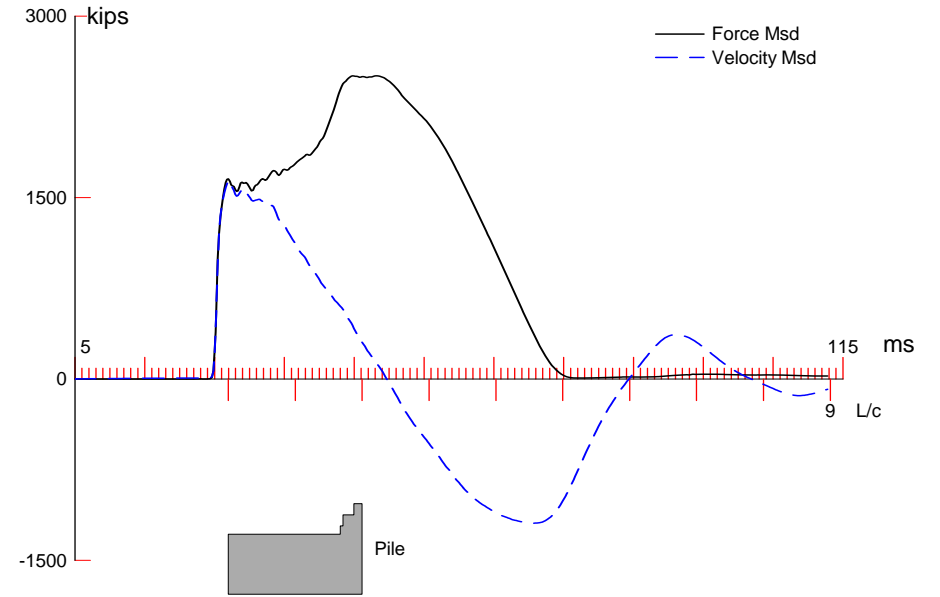
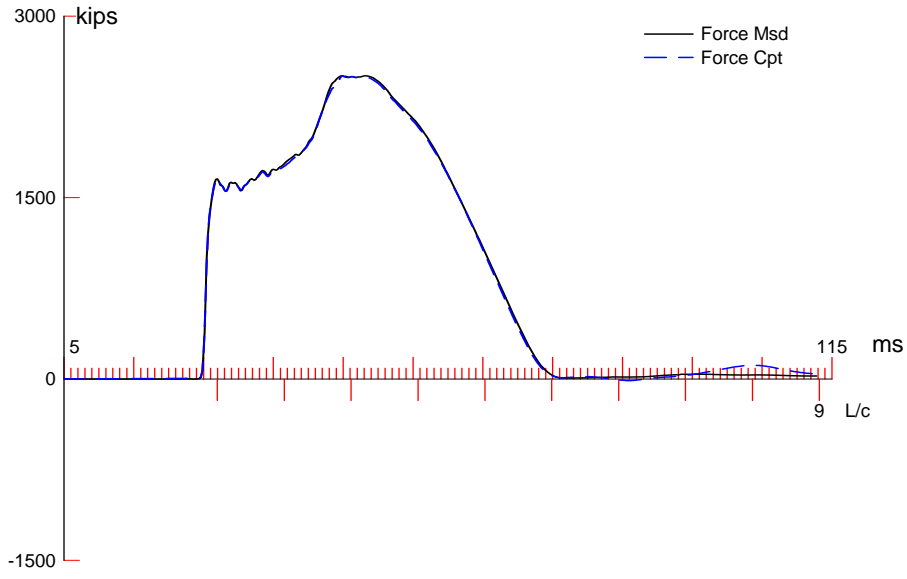
PILE PROFILE AND PILE MODEL

Depth ft	Area in ²	E-Modulus ksi	Spec. Weight lb/ft ³	Perim. ft
0.00	60.00	29992.2	492.000	6.063
178.00	60.00	29992.2	492.000	6.063

Toe Area 2.297 ft²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft
1	3.30	107.09	0.00	0.000	0.000	-0.000	0.000	6.063
51	168.11	122.09	14.01	0.000	0.000	-0.000	0.000	6.063
52	171.41	132.09	23.34	0.000	0.000	-0.000	0.000	6.063
53	174.70	137.09	28.01	0.000	0.000	-0.000	0.000	6.063
54	178.00	147.09	37.35	0.000	0.000	-0.000	0.000	6.063

Pile Damping 1.0 %, Time Incr 0.196 ms, Wave Speed 16807.9 ft/s, 2L/c 21.2 ms



CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 2686.6; along Shaft 1392.8; at Toe 1293.8 kips

Soil Sgmt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				2686.6				
1	9.9	8.9	4.1	2682.5	4.1	0.46	0.08	0.191
2	16.4	15.4	4.1	2678.4	8.2	0.62	0.10	0.191
3	23.0	22.0	4.1	2674.3	12.3	0.62	0.10	0.191
4	29.6	28.6	4.1	2670.2	16.4	0.62	0.10	0.191
5	36.1	35.1	6.9	2663.3	23.3	1.05	0.17	0.191
6	42.7	41.7	8.9	2654.4	32.2	1.35	0.23	0.191
7	49.3	48.3	12.8	2641.6	45.0	1.95	0.32	0.191
8	55.9	54.9	14.7	2626.9	59.7	2.24	0.37	0.191
9	62.4	61.4	15.7	2611.2	75.4	2.39	0.40	0.191
10	69.0	68.0	23.1	2588.1	98.5	3.52	0.59	0.191
11	75.6	74.6	28.2	2559.9	126.7	4.29	0.72	0.191
12	82.1	81.1	33.1	2526.8	159.8	5.04	0.84	0.191
13	88.7	87.7	38.1	2488.7	197.9	5.80	0.97	0.191
14	95.3	94.3	42.8	2445.9	240.7	6.51	1.09	0.191
15	101.9	100.9	41.9	2404.0	282.6	6.38	1.06	0.191
16	108.4	107.4	53.0	2351.0	335.6	8.07	1.34	0.191
17	115.0	114.0	58.1	2292.9	393.7	8.84	1.47	0.191
18	121.6	120.6	83.5	2209.4	477.2	12.71	2.12	0.191
19	128.1	127.1	108.1	2101.3	585.3	16.45	2.74	0.191
20	134.7	133.7	112.9	1988.4	698.2	17.18	2.86	0.191
21	141.3	140.3	114.7	1873.7	812.9	17.45	2.91	0.191
22	147.9	146.9	146.1	1727.6	959.0	22.23	3.71	0.191
23	154.4	153.4	187.4	1540.2	1146.4	28.52	4.75	0.191
24	161.0	160.0	246.4	1293.8	1392.8	37.50	6.25	0.191
Avg. Shaft			58.0			8.71	1.45	0.191
Toe			1293.8				3105.12	0.191

Soil Model Parameters/Extensions

		Shaft	Toe
Quake	(in)	0.201	0.172
Case Damping Factor		2.488	2.306
Reloading Level	(% of Ru)	-99	1
Unloading Level	(% of Ru)	76	

Soil Model Parameters/Extensions		Shaft	Toe
Soil Plug Weight	(kips)		1.25
CAPWAP match quality	= 1.03	(Wave Up Match)	; RSA = 0
Observed: final set	= 0.125 in;	blow count	= 96 b/ft
Computed: final set	= 0.085 in;	blow count	= 141 b/ft
max. Top Comp. Stress	= 42.1 ksi	(T= 45.0 ms, max= 1.061 x Top)	
max. Comp. Stress	= 44.7 ksi	(Z= 49.3 ft, T= 47.5 ms)	
max. Tens. Stress	= -5.78 ksi	(Z= 82.1 ft, T= 81.3 ms)	
max. Energy (EMX)	= 385.9 kip-ft;	max. Measured Top Displ. (DMX)=	2.66 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	2526.4	-27.6	42.1	-0.46	385.91	15.3	2.621
2	6.6	2540.5	-42.4	42.3	-0.71	380.25	15.2	2.566
5	16.4	2590.0	-100.8	43.2	-1.68	360.37	15.1	2.401
8	26.3	2628.2	-156.1	43.8	-2.60	337.92	14.9	2.233
11	36.1	2658.6	-217.5	44.3	-3.62	317.74	14.7	2.064
14	46.0	2671.6	-258.0	44.5	-4.30	292.07	14.4	1.894
17	55.9	2680.7	-302.6	44.7	-5.04	268.41	13.9	1.724
20	65.7	2664.2	-318.3	44.4	-5.30	239.07	13.3	1.554
23	75.6	2654.1	-346.3	44.2	-5.77	213.78	12.6	1.384
26	85.4	2594.1	-323.1	43.2	-5.38	180.06	11.8	1.217
29	95.3	2563.4	-330.4	42.7	-5.50	154.67	10.9	1.052
32	105.1	2478.0	-287.8	41.3	-4.80	123.62	10.0	0.890
35	115.0	2434.9	-278.4	40.6	-4.64	100.86	8.9	0.731
38	124.9	2297.7	-183.9	38.3	-3.06	73.15	7.6	0.579
41	134.7	2202.4	-121.1	36.7	-2.02	53.39	5.8	0.435
44	144.6	1983.7	-0.1	33.1	-0.00	35.93	4.7	0.331
45	147.9	1986.8	-0.1	33.1	-0.00	33.50	4.4	0.300
46	151.1	1843.6	-0.1	30.7	-0.00	27.89	4.0	0.271
47	154.4	1845.2	-0.1	30.7	-0.00	26.08	3.4	0.246
48	157.7	1661.2	-0.1	27.7	-0.00	21.51	2.9	0.223
49	161.0	1661.6	-0.1	27.7	-0.00	17.43	2.7	0.201
Absolute	49.3			44.7			(T =	47.5 ms)

EXTREMA TABLE

Pile Sgmt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
	82.1				-5.78		(T = 81.3 ms)	

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	2755.1	2700.8	2646.6	2592.3	2538.1	2483.8	2429.5	2375.3	2321.0	2266.8
RX	2871.4	2843.1	2814.8	2786.5	2758.2	2729.9	2702.1	2681.5	2665.9	2652.4
RU	2755.1	2700.8	2646.6	2592.3	2538.1	2483.8	2429.5	2375.3	2321.0	2266.8

RAU = 55.3 (kips); RA2 = 2871.3 (kips)

Current CAPWAP Ru = 2686.6 (kips); Corresponding J(RP)= 0.13; J(RX) = 0.68

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips
15.38	27.17	1647.4	1650.2	2507.9	2.656	0.117	0.125	388.8	3355.9

PILE PROFILE AND PILE MODEL

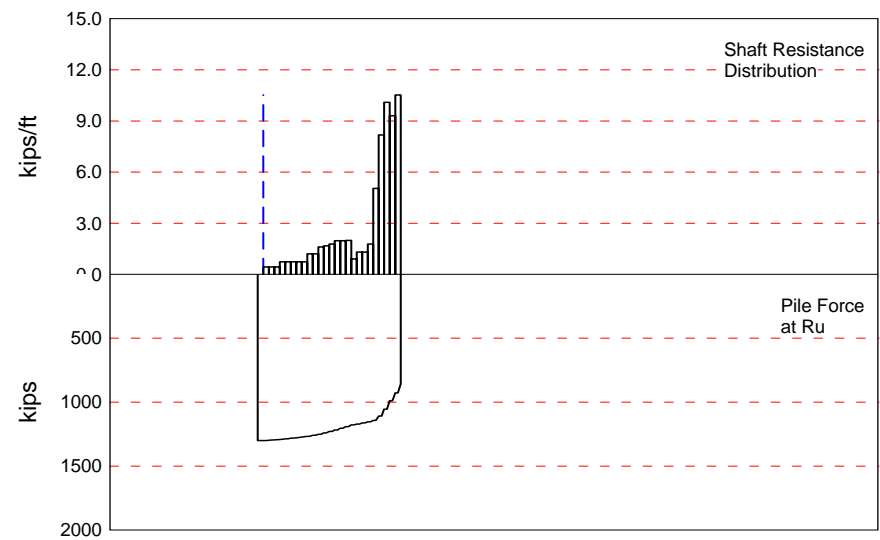
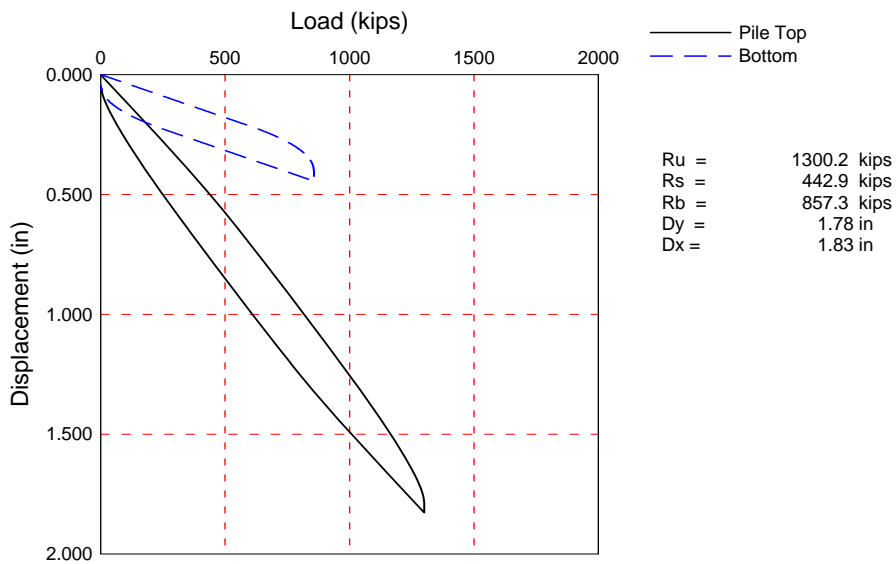
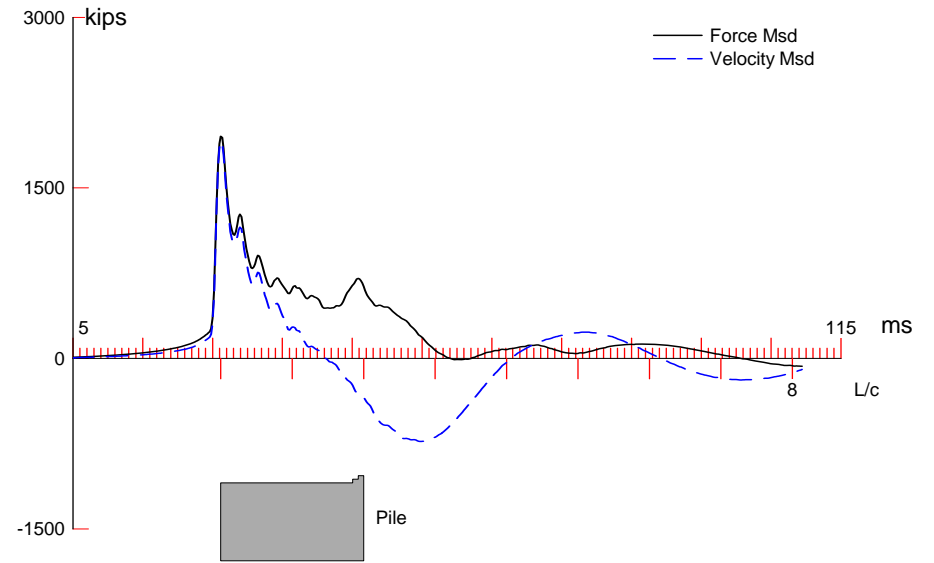
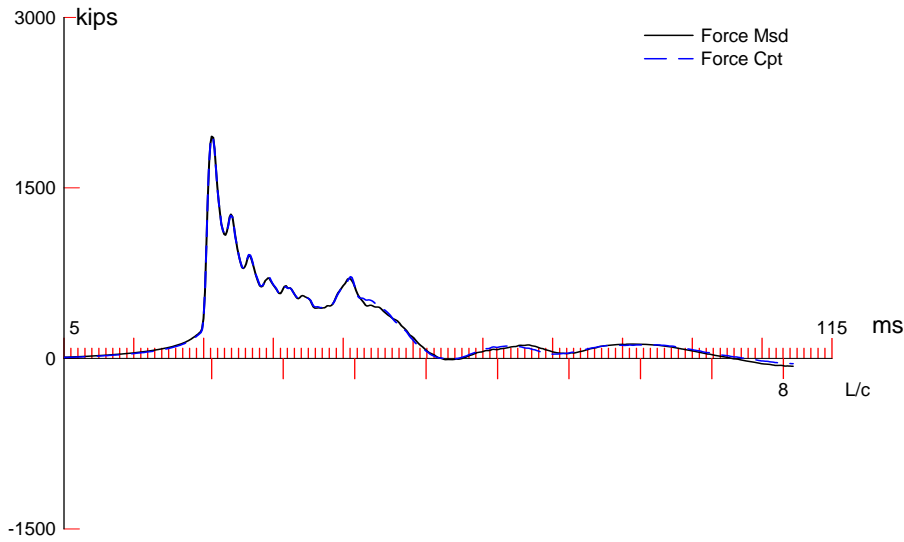
Depth ft	Area in ²	E-Modulus ksi	Spec. Weight lb/ft ³	Perim. ft
0.00	60.00	29992.2	492.000	6.000
161.00	60.00	29992.2	492.000	6.000

Toe Area 0.417 ft²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft
1	3.29	107.09	0.00	0.000	0.000	-0.000	0.000	6.000
42	138.00	122.09	14.01	0.000	0.000	-0.000	0.000	6.000
43	141.29	142.09	32.68	0.000	0.000	-0.000	0.000	6.000
47	154.43	162.09	51.36	0.000	0.000	-0.000	0.000	6.000
49	161.00	162.09	51.36	0.000	0.000	-0.000	0.000	6.000

Pile Damping 1.0 %, Time Incr 0.195 ms, Wave Speed 16807.9 ft/s, 2L/c 19.2 ms

Pier 8 Analyses



CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 1300.2; along Shaft 442.9; at Toe 857.3 kips

Soil Sgmt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				1300.2				
1	13.2	5.1	2.9	1297.3	2.9	0.57	0.09	0.272
2	19.8	11.7	2.9	1294.4	5.8	0.44	0.07	0.272
3	26.5	18.3	2.9	1291.5	8.7	0.44	0.07	0.272
4	33.1	24.9	4.9	1286.6	13.6	0.74	0.12	0.272
5	39.7	31.5	4.9	1281.7	18.5	0.74	0.12	0.272
6	46.3	38.1	4.9	1276.8	23.4	0.74	0.12	0.272
7	52.9	44.8	4.9	1271.9	28.3	0.74	0.12	0.272
8	59.5	51.4	4.9	1267.0	33.2	0.74	0.12	0.272
9	66.2	58.0	8.0	1259.0	41.2	1.21	0.20	0.272
10	72.8	64.6	8.0	1251.0	49.2	1.21	0.20	0.272
11	79.4	71.2	10.7	1240.3	59.9	1.62	0.27	0.272
12	86.0	77.8	11.1	1229.2	71.0	1.68	0.28	0.272
13	92.6	84.4	11.8	1217.4	82.8	1.78	0.29	0.272
14	99.2	91.1	13.1	1204.3	95.9	1.98	0.33	0.272
15	105.8	97.7	13.1	1191.2	109.0	1.98	0.33	0.272
16	112.5	104.3	13.2	1178.0	122.2	2.00	0.33	0.272
17	119.1	110.9	6.0	1172.0	128.2	0.91	0.15	0.272
18	125.7	117.5	8.7	1163.3	136.9	1.32	0.22	0.272
19	132.3	124.1	8.7	1154.6	145.6	1.32	0.22	0.272
20	138.9	130.8	11.8	1142.8	157.4	1.78	0.29	0.272
21	145.5	137.4	33.4	1109.4	190.8	5.05	0.83	0.272
22	152.2	144.0	54.1	1055.3	244.9	8.18	1.35	0.272
23	158.8	150.6	66.8	988.5	311.7	10.10	1.67	0.272
24	165.4	157.2	61.6	926.9	373.3	9.31	1.54	0.272
25	172.0	163.8	69.6	857.3	442.9	10.52	1.74	0.272
Avg. Shaft			17.7			2.70	0.45	0.272
Toe			857.3				373.21	0.114

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.295	0.307
Case Damping Factor		1.123	0.916
Unloading Quake	(% of loading quake)	96	47

Soil Model Parameters/Extensions		Shaft	Toe
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake) (in)			0.000
Soil Plug Weight	(kips)		0.67
<hr/>			
CAPWAP match quality	= 1.15	(Wave Up Match) ; RSA = 0	
Observed: final set	= 0.045 in;	blow count	= 264 b/ft
Computed: final set	= 0.044 in;	blow count	= 271 b/ft
max. Top Comp. Stress	= 32.5 ksi	(T= 26.6 ms, max= 1.006 x Top)	
max. Comp. Stress	= 32.7 ksi	(Z= 13.2 ft, T= 27.2 ms)	
max. Tens. Stress	= -3.54 ksi	(Z= 125.7 ft, T= 66.5 ms)	
max. Energy (EMX)	= 108.4 kip-ft;	max. Measured Top Displ. (DMX)= 1.24 in	

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	1949.6	-50.3	32.5	-0.84	108.37	17.8	1.244
2	6.6	1952.6	-54.3	32.5	-0.90	108.15	17.8	1.233
5	16.5	1949.3	-63.8	32.5	-1.06	106.51	17.6	1.201
8	26.5	1948.0	-88.1	32.5	-1.47	104.72	17.4	1.164
11	36.4	1925.2	-100.9	32.1	-1.68	101.30	17.2	1.123
14	46.3	1918.9	-119.7	32.0	-1.99	98.73	17.0	1.081
17	56.2	1889.5	-131.5	31.5	-2.19	94.61	16.8	1.034
20	66.2	1896.8	-156.1	31.6	-2.60	91.48	16.4	0.980
23	76.1	1852.3	-161.9	30.9	-2.70	85.71	16.1	0.926
26	86.0	1841.9	-184.0	30.7	-3.07	81.20	15.6	0.869
29	95.9	1774.8	-185.0	29.6	-3.08	73.79	15.2	0.805
32	105.8	1759.5	-201.2	29.3	-3.35	68.85	14.7	0.744
35	115.8	1670.4	-199.7	27.8	-3.33	61.59	14.4	0.679
38	125.7	1678.9	-212.2	28.0	-3.54	58.25	14.1	0.618
41	135.6	1650.7	-205.8	27.5	-3.43	52.96	13.6	0.550
44	145.5	1716.6	-204.2	28.6	-3.40	48.36	12.6	0.478
47	155.5	1566.6	-157.2	26.1	-2.62	37.75	11.0	0.410
48	158.8	1624.3	-159.2	27.1	-2.65	36.76	10.5	0.387
49	162.1	1503.8	-136.6	25.1	-2.28	31.46	9.9	0.366
50	165.4	1589.2	-138.1	26.5	-2.30	30.56	8.9	0.345
51	168.7	1409.4	-126.4	23.5	-2.11	26.53	9.0	0.326

EXTREMA TABLE

Pile Sgmt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
52	172.0	1350.1	-126.3	22.5	-2.10	23.26	9.3	0.308
Absolute	13.2 125.7			32.7			(T = 27.2 ms) (T = 66.5 ms)	

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	2418.8	2273.0	2127.2	1981.4	1835.6	1689.8	1544.0	1398.2	1252.4	1106.6
RX	2418.8	2273.0	2127.2	1981.4	1835.6	1689.8	1544.0	1398.2	1252.4	1109.0
RU	2471.2	2330.7	2190.1	2049.5	1908.9	1768.4	1627.8	1487.2	1346.7	1206.1

RAU = 63.3 (kips); RA2 = 1175.3 (kips)

Current CAPWAP Ru = 1300.2 (kips); Corresponding J(RP)= 0.77; J(RX) = 0.77

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips
17.87	26.37	1913.4	1963.6	1967.0	1.243	0.045	0.045	108.9	2029.0

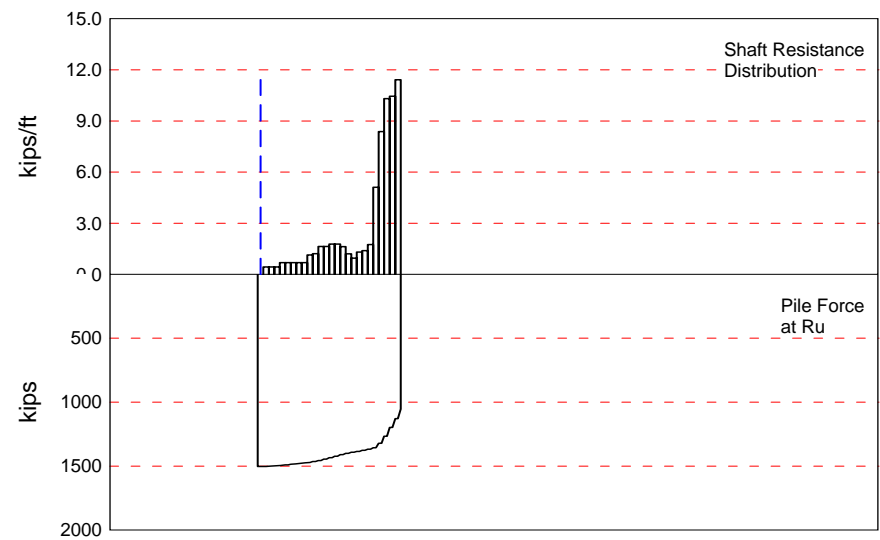
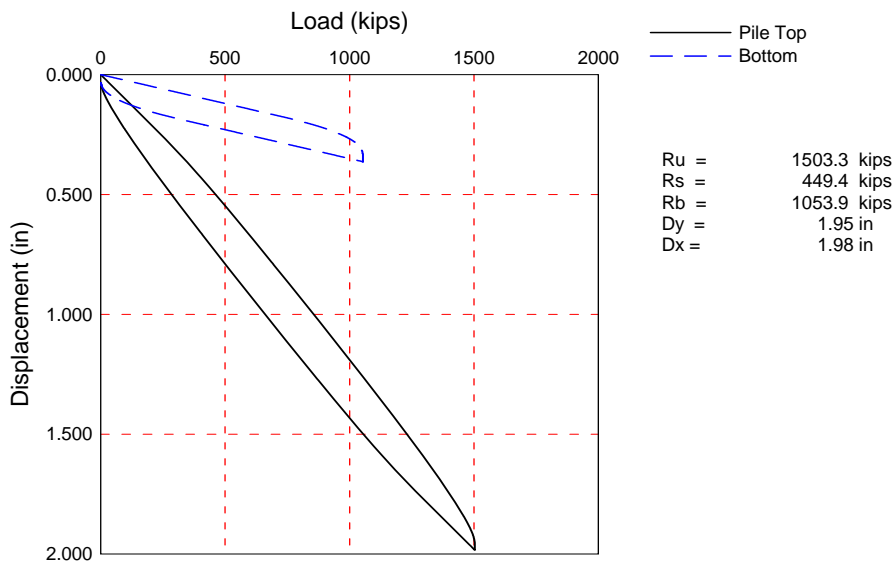
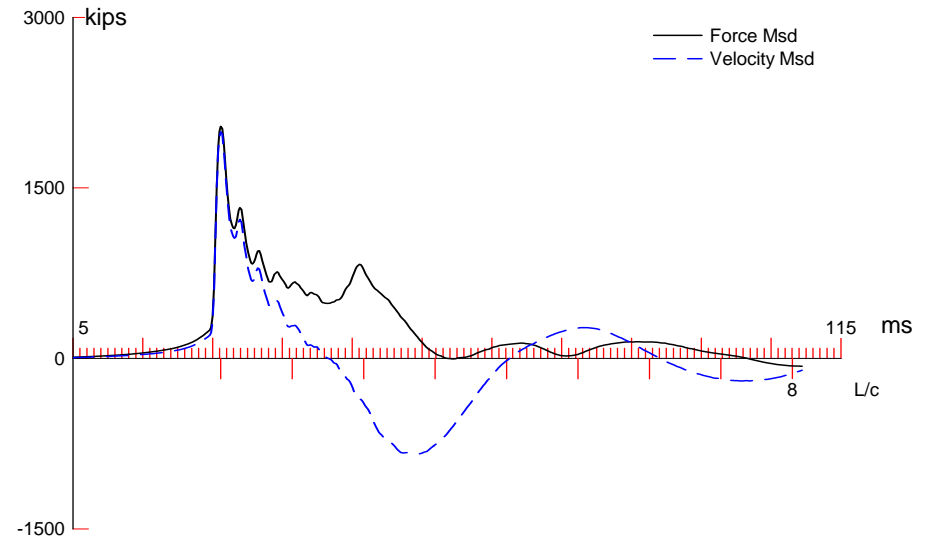
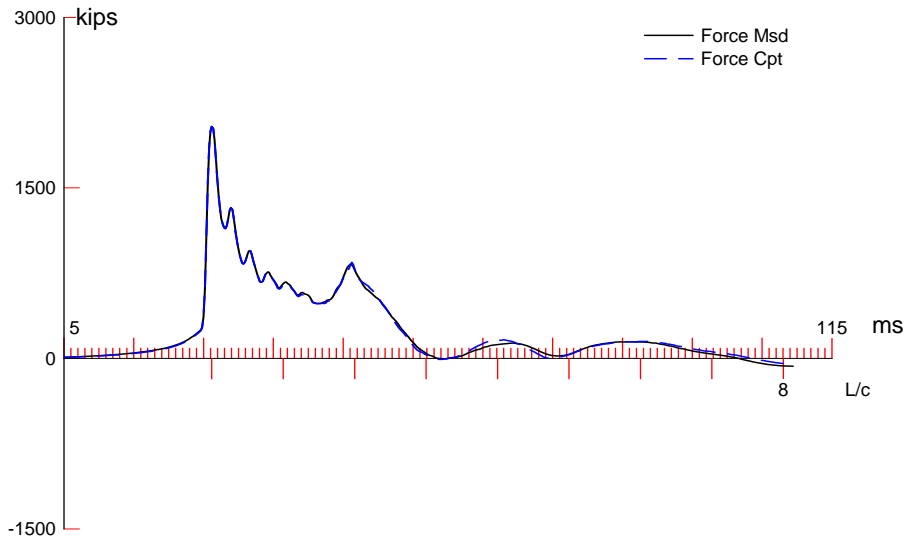
PILE PROFILE AND PILE MODEL

Depth ft	Area in ²	E-Modulus ksi	Spec. Weight lb/ft ³	Perim. ft
0.00	60.00	29992.2	492.000	6.063
172.00	60.00	29992.2	492.000	6.063

Toe Area 2.297 ft²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft
1	3.31	107.09	0.00	0.000	0.000	-0.000	0.000	6.063
49	162.08	112.09	4.67	0.000	0.000	-0.000	0.000	6.063
51	168.69	117.09	9.34	0.000	0.000	-0.000	0.000	6.063
52	172.00	117.09	9.34	0.000	0.000	-0.000	0.000	6.063

Pile Damping 1.0 %, Time Incr 0.197 ms, Wave Speed 16807.9 ft/s, 2L/c 20.5 ms



CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 1503.3; along Shaft 449.4; at Toe 1053.9 kips

Soil Sgmt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				1503.3				
1	13.2	6.9	2.9	1500.4	2.9	0.42	0.07	0.260
2	19.8	13.5	2.9	1497.5	5.8	0.44	0.07	0.260
3	26.5	20.1	2.9	1494.6	8.7	0.44	0.07	0.260
4	33.1	26.7	4.6	1490.0	13.3	0.70	0.11	0.260
5	39.7	33.4	4.6	1485.4	17.9	0.70	0.11	0.260
6	46.3	40.0	4.6	1480.8	22.5	0.70	0.11	0.260
7	52.9	46.6	4.6	1476.2	27.1	0.70	0.11	0.260
8	59.5	53.2	4.6	1471.6	31.7	0.70	0.11	0.260
9	66.2	59.8	7.6	1464.0	39.3	1.15	0.19	0.260
10	72.8	66.4	8.1	1455.9	47.4	1.22	0.20	0.260
11	79.4	73.1	10.9	1445.0	58.3	1.65	0.27	0.260
12	86.0	79.7	10.9	1434.1	69.2	1.65	0.27	0.260
13	92.6	86.3	11.8	1422.3	81.0	1.78	0.29	0.260
14	99.2	92.9	11.8	1410.5	92.8	1.78	0.29	0.260
15	105.8	99.5	10.8	1399.7	103.6	1.63	0.27	0.260
16	112.5	106.1	8.0	1391.7	111.6	1.21	0.20	0.260
17	119.1	112.7	6.3	1385.4	117.9	0.95	0.16	0.260
18	125.7	119.4	8.7	1376.7	126.6	1.32	0.22	0.260
19	132.3	126.0	9.2	1367.5	135.8	1.39	0.23	0.260
20	138.9	132.6	11.6	1355.9	147.4	1.75	0.29	0.260
21	145.5	139.2	33.8	1322.1	181.2	5.11	0.84	0.260
22	152.2	145.8	55.4	1266.7	236.6	8.37	1.38	0.260
23	158.8	152.4	68.2	1198.5	304.8	10.31	1.70	0.260
24	165.4	159.1	69.1	1129.4	373.9	10.45	1.72	0.260
25	172.0	165.7	75.5	1053.9	449.4	11.41	1.88	0.260
Avg. Shaft			18.0			2.71	0.45	0.260
Toe			1053.9				458.80	0.119

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.220	0.254
Case Damping Factor		1.091	1.171
Unloading Quake	(% of loading quake)	100	52

Soil Model Parameters/Extensions		Shaft	Toe
Reloading Level	(% of Ru)	100	1
Soil Plug Weight	(kips)		0.51
<hr/>			
CAPWAP match quality	= 1.29	(Wave Up Match) ; RSA = 0	
Observed: final set	= 0.033 in;	blow count	= 360 b/ft
Computed: final set	= 0.030 in;	blow count	= 399 b/ft
max. Top Comp. Stress	= 34.0 ksi	(T= 26.6 ms, max= 1.006 x Top)	
max. Comp. Stress	= 34.2 ksi	(Z= 13.2 ft, T= 27.2 ms)	
max. Tens. Stress	= -4.94 ksi	(Z= 132.3 ft, T= 66.5 ms)	
max. Energy (EMX)	= 120.2 kip-ft;	max. Measured Top Displ. (DMX)= 1.31 in	

EXTREMA TABLE

Pile Sgmt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	2041.4	-57.0	34.0	-0.95	120.23	18.6	1.320
2	6.6	2045.0	-61.8	34.1	-1.03	119.99	18.6	1.309
5	16.5	2042.1	-74.2	34.0	-1.24	118.22	18.4	1.275
8	26.5	2041.0	-96.7	34.0	-1.61	116.29	18.2	1.237
11	36.4	2018.6	-107.9	33.6	-1.80	112.64	18.0	1.194
14	46.3	2013.0	-122.5	33.5	-2.04	109.92	17.8	1.149
17	56.2	1983.0	-123.8	33.0	-2.06	105.59	17.6	1.099
20	66.2	1988.4	-141.0	33.1	-2.35	102.22	17.2	1.043
23	76.1	1944.1	-152.4	32.4	-2.54	95.87	16.9	0.984
26	86.0	1931.6	-188.8	32.2	-3.15	90.73	16.4	0.922
29	95.9	1858.9	-207.2	31.0	-3.45	82.41	16.0	0.853
32	105.8	1839.6	-240.5	30.7	-4.01	76.82	15.6	0.783
35	115.8	1777.9	-260.2	29.6	-4.34	69.71	15.3	0.709
38	125.7	1787.6	-288.7	29.8	-4.81	65.17	14.9	0.635
41	135.6	1756.6	-289.7	29.3	-4.83	58.40	14.4	0.554
44	145.5	1832.0	-286.5	30.5	-4.77	52.20	13.4	0.467
47	155.5	1680.1	-209.2	28.0	-3.49	39.78	11.6	0.384
48	158.8	1761.3	-211.8	29.3	-3.53	38.36	10.9	0.357
49	162.1	1618.3	-174.0	27.0	-2.90	32.67	10.1	0.330
50	165.4	1734.1	-174.3	28.9	-2.90	31.31	9.2	0.304
51	168.7	1583.3	-153.4	26.4	-2.56	26.84	8.5	0.280
52	172.0	1562.2	-153.8	26.0	-2.56	23.64	8.7	0.255

EXTREMA TABLE

Pile Sgmt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
Absolute	13.2 132.3			34.2	-4.94		(T = 27.2 ms) (T = 66.5 ms)	

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	2612.9	2468.4	2324.0	2179.5	2035.0	1890.6	1746.1	1601.7	1457.2	1312.8
RX	2612.9	2468.4	2324.0	2179.5	2035.0	1890.6	1746.1	1601.7	1457.2	1312.8
RU	2663.0	2523.5	2384.1	2244.6	2105.2	1965.8	1826.3	1686.9	1547.4	1408.0

RAU = 85.8 (kips); RA2 = 1357.0 (kips)

Current CAPWAP Ru = 1503.3 (kips); Corresponding J(RP)= 0.77; J(RX) = 0.77

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips
18.73	26.37	2006.1	2051.3	2051.3	1.314	0.033	0.033	120.6	2146.8

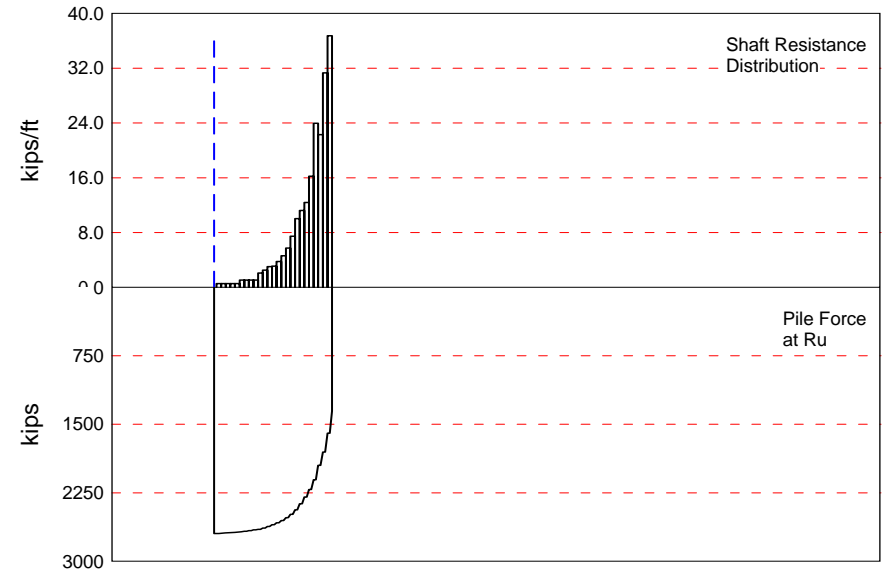
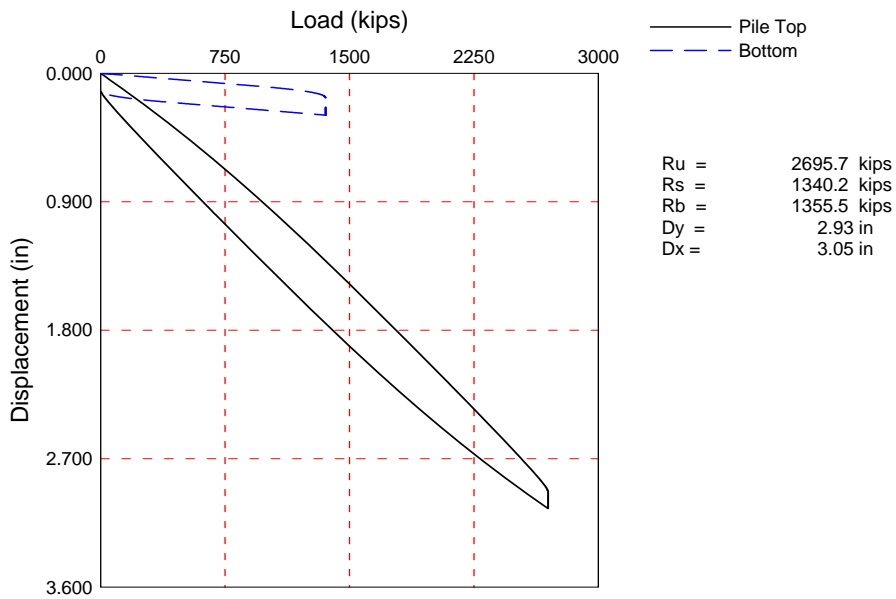
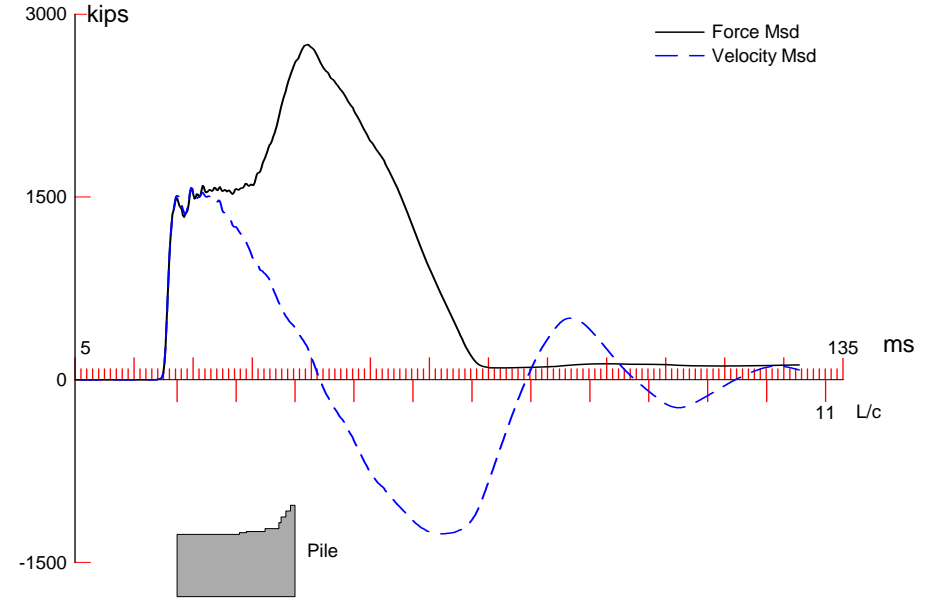
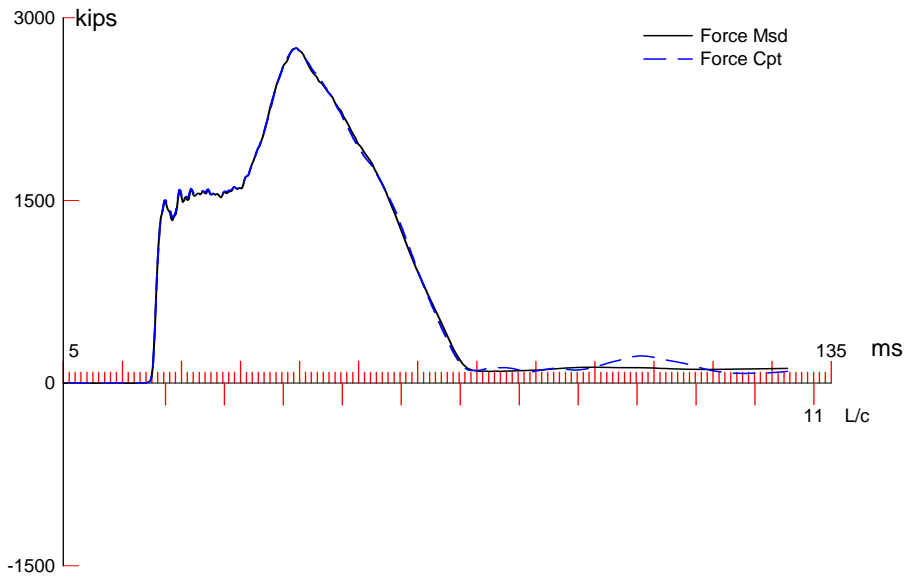
PILE PROFILE AND PILE MODEL

Depth ft	Area in ²	E-Modulus ksi	Spec. Weight lb/ft ³	Perim. ft
0.00	60.00	29992.2	492.000	6.063
172.00	60.00	29992.2	492.000	6.063

Toe Area 2.297 ft²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Eff.	Perim. ft	Soil Plug kips
1	3.31	107.09	0.00	0.000	0.000	-0.000	6.063	0.00
49	162.08	107.09	0.00	0.000	0.000	-0.000	6.063	0.03
50	165.38	107.09	0.00	0.000	0.000	-0.000	6.063	0.10
51	168.69	107.09	0.00	0.000	0.000	-0.000	6.063	0.15
52	172.00	107.09	0.00	0.000	0.000	-0.000	6.063	0.20

Pile Damping 1.0 %, Time Incr 0.197 ms, Wave Speed 16807.9 ft/s, 2L/c 20.5 ms



CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 2695.7; along Shaft 1340.2; at Toe 1355.5 kips

Soil Sgmt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft	Quake in
				2695.7					
1	9.9	8.4	3.7	2692.0	3.7	0.44	0.07	0.111	0.213
2	16.4	15.0	3.7	2688.3	7.4	0.56	0.09	0.111	0.213
3	23.0	21.6	3.7	2684.6	11.1	0.56	0.09	0.111	0.213
4	29.6	28.1	3.7	2680.9	14.8	0.56	0.09	0.111	0.213
5	36.2	34.7	3.7	2677.2	18.5	0.56	0.09	0.111	0.213
6	42.7	41.3	7.1	2670.1	25.6	1.08	0.18	0.111	0.213
7	49.3	47.9	7.1	2663.0	32.7	1.08	0.18	0.111	0.213
8	55.9	54.5	7.1	2655.9	39.8	1.08	0.18	0.111	0.213
9	62.5	61.0	7.1	2648.8	46.9	1.08	0.18	0.111	0.213
10	69.1	67.6	13.8	2635.0	60.7	2.10	0.35	0.111	0.213
11	75.6	74.2	16.6	2618.4	77.3	2.52	0.42	0.111	0.213
12	82.2	80.8	20.0	2598.4	97.3	3.04	0.50	0.111	0.213
13	88.8	87.3	20.4	2578.0	117.7	3.10	0.51	0.111	0.213
14	95.4	93.9	24.9	2553.1	142.6	3.79	0.62	0.111	0.213
15	101.9	100.5	30.4	2522.7	173.0	4.62	0.76	0.111	0.207
16	108.5	107.1	37.9	2484.8	210.9	5.76	0.95	0.111	0.199
17	115.1	113.6	49.2	2435.6	260.1	7.48	1.23	0.111	0.190
18	121.7	120.2	66.1	2369.5	326.2	10.05	1.66	0.111	0.182
19	128.2	126.8	73.9	2295.6	400.1	11.24	1.85	0.111	0.174
20	134.8	133.4	81.6	2214.0	481.7	12.41	2.05	0.111	0.166
21	141.4	139.9	106.7	2107.3	588.4	16.22	2.68	0.111	0.158
22	148.0	146.5	157.6	1949.7	746.0	23.96	3.95	0.111	0.151
23	154.5	153.1	146.6	1803.1	892.6	22.29	3.68	0.111	0.143
24	161.1	159.7	206.0	1597.1	1098.6	31.32	5.17	0.111	0.135
25	167.7	166.3	241.6	1355.5	1340.2	36.74	6.06	0.111	0.127
Avg. Shaft			53.6			8.06	1.33	0.111	0.158
Toe			1355.5				3253.20	0.184	0.130

Soil Model Parameters/Extensions		Shaft	Toe
Case Damping Factor		1.393	2.327
Unloading Quake	(% of loading quake)	97	30
Reloading Level	(% of Ru)	-94	1

Soil Model Parameters/Extensions		Shaft	Toe
Unloading Level	(% of Ru)	25	
Resistance Gap (included in Toe Quake) (in)			0.035
Soil Plug Weight	(kips)		0.44
<hr/>			
CAPWAP match quality	= 1.01	(Wave Up Match)	; RSA = 0
Observed: final set	= 0.125 in;	blow count	= 96 b/ft
Computed: final set	= 0.088 in;	blow count	= 137 b/ft
max. Top Comp. Stress	= 46.2 ksi	(T= 44.8 ms, max= 1.033 x Top)	
max. Comp. Stress	= 47.7 ksi	(Z= 39.5 ft, T= 46.4 ms)	
max. Tens. Stress	= -9.09 ksi	(Z= 115.1 ft, T= 80.6 ms)	
max. Energy (EMX)	= 390.6 kip-ft;	max. Measured Top Displ. (DMX)= 2.91 in	

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	2770.6	-0.5	46.2	-0.01	390.64	14.5	2.836
2	6.6	2784.2	-0.5	46.4	-0.01	384.09	14.5	2.777
5	16.4	2822.0	-12.7	47.0	-0.21	362.29	14.4	2.599
8	26.3	2845.7	-80.2	47.4	-1.34	338.70	14.3	2.419
11	36.2	2861.8	-155.9	47.7	-2.60	317.16	14.1	2.241
14	46.0	2850.3	-228.0	47.5	-3.80	293.40	13.8	2.064
17	55.9	2834.6	-303.7	47.2	-5.06	271.49	13.4	1.888
20	65.8	2813.3	-371.6	46.9	-6.19	247.77	13.2	1.712
23	75.6	2797.6	-434.1	46.6	-7.23	224.78	12.8	1.537
26	85.5	2760.8	-476.7	46.0	-7.94	197.21	12.4	1.363
29	95.4	2744.2	-511.0	45.7	-8.51	174.56	11.9	1.193
32	105.2	2691.7	-523.6	44.8	-8.73	147.50	11.3	1.027
35	115.1	2669.8	-545.8	44.5	-9.09	124.94	10.4	0.864
38	125.0	2556.9	-525.5	42.6	-8.76	96.52	9.5	0.705
41	134.8	2493.6	-525.9	41.5	-8.76	75.93	8.4	0.558
44	144.7	2310.0	-477.4	38.5	-7.95	52.76	6.9	0.419
47	154.5	2158.5	-440.6	36.0	-7.34	37.64	5.6	0.307
48	157.8	2007.7	-389.5	33.5	-6.49	31.58	5.1	0.277
49	161.1	2009.9	-393.5	33.5	-6.56	29.29	4.4	0.247
50	164.4	1803.7	-322.1	30.1	-5.37	23.92	4.0	0.223
51	167.7	1804.1	-325.4	30.1	-5.42	20.94	3.7	0.198

EXTREMA TABLE

Pile Sgmt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
Absolute	39.5 115.1			47.7			(T = 46.4 ms) (T = 80.6 ms)	
					-9.09			

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	2594.2	2551.5	2508.7	2466.0	2423.2	2380.5	2337.7	2295.0	2252.3	2209.5
RX	2879.1	2857.8	2839.1	2820.5	2801.9	2783.2	2764.6	2746.0	2728.7	2727.3
RU	2594.2	2551.5	2508.7	2466.0	2423.2	2380.5	2337.7	2295.0	2252.3	2209.5

RAU = 2712.5 (kips); RA2 = 2818.6 (kips)

Current CAPWAP Ru = 2695.7 (kips); Corresponding J(RP)= 0.00; matches RX9 within 5%

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips
14.77	22.50	1515.8	1505.9	2753.5	2.912	0.145	0.125	397.4	3140.1

PILE PROFILE AND PILE MODEL

Depth ft	Area in ²	E-Modulus ksi	Spec. Weight lb/ft ³	Perim. ft
0.00	60.00	29992.2	492.000	6.063
167.70	60.00	29992.2	492.000	6.063

Toe Area 0.417 ft²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft
1	3.29	107.09	0.00	0.000	0.000	-0.000	0.000	6.063
28	92.07	110.09	2.80	0.000	0.000	-0.000	0.000	6.063
31	101.94	112.09	4.67	0.000	0.000	-0.000	0.000	6.063
39	128.24	117.09	9.34	0.000	0.000	-0.000	0.000	6.063
45	147.97	127.09	18.68	0.000	0.000	-0.000	0.000	6.063
46	151.26	137.09	28.01	0.000	0.000	-0.000	0.000	6.063
48	157.84	147.09	37.35	0.000	0.000	-0.000	0.000	6.063

I-90 Innerbelt CV 2; Pile: Pier 8 Pile 2-124
HP 18X204; Blow: 3

Test: 09-Jun-2011 10:47:
CAPWAP(R) 2006-3

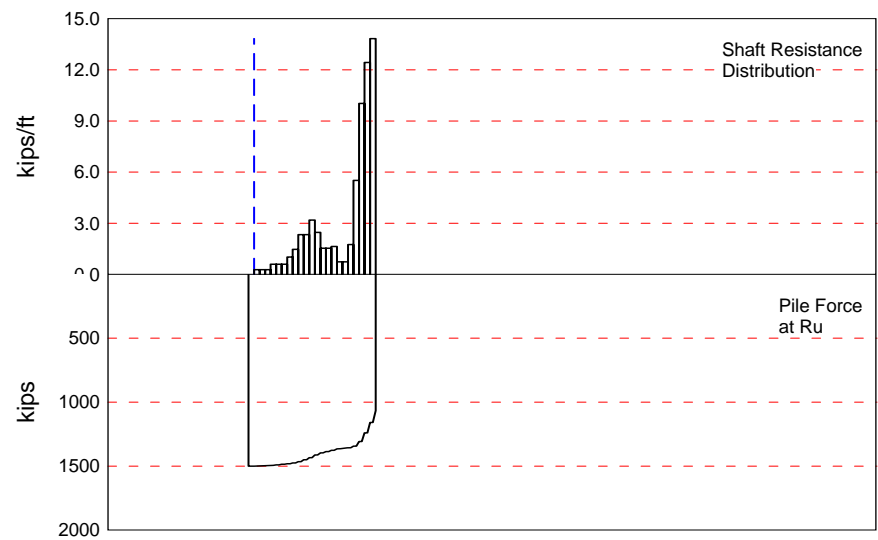
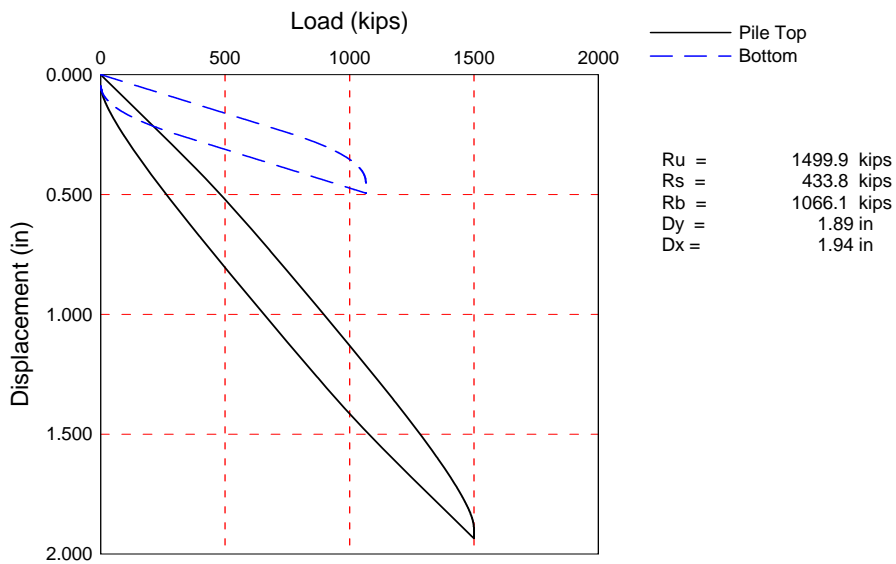
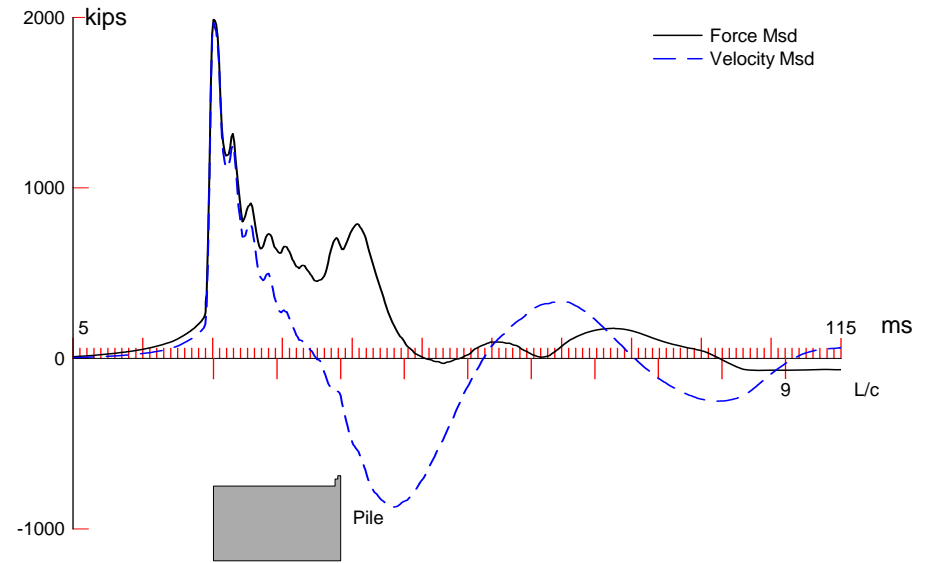
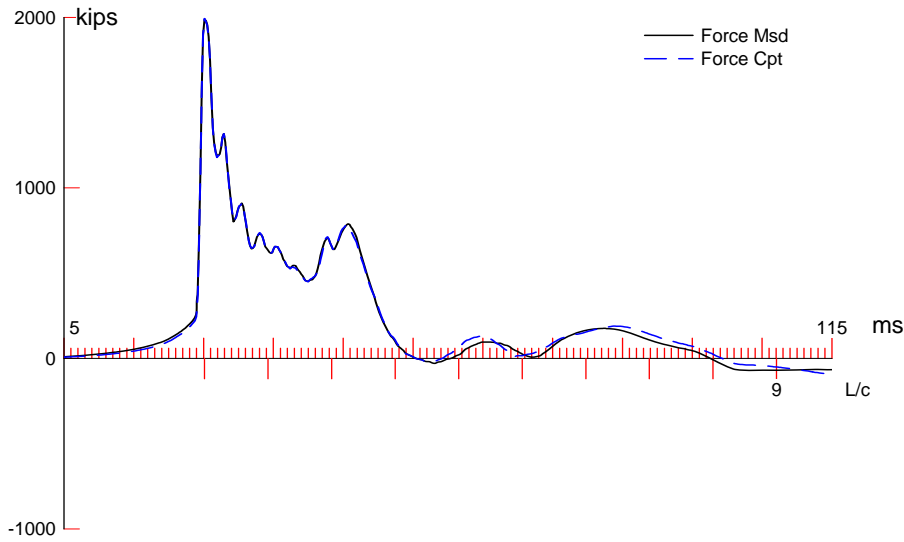
GRI Engineers, Inc.

OP RAW

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft
50	164.41	157.09	46.69	0.000	0.000	-0.000	0.000	6.063
51	167.70	157.09	46.69	0.000	0.000	-0.000	0.000	6.063

Pile Damping 1.0 %, Time Incr 0.196 ms, Wave Speed 16807.9 ft/s, 2L/c 20.0 ms

Pier 10 Analyses



CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 1499.9; along Shaft 433.8; at Toe 1066.1 kips

Soil Sgmt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				1499.9				
1	13.3	4.4	1.9	1498.0	1.9	0.43	0.07	0.193
2	20.0	11.1	1.9	1496.1	3.8	0.29	0.05	0.193
3	26.6	17.7	1.9	1494.2	5.7	0.29	0.05	0.193
4	33.3	24.4	4.0	1490.2	9.7	0.60	0.10	0.193
5	39.9	31.0	4.0	1486.2	13.7	0.60	0.10	0.193
6	46.6	37.7	4.0	1482.2	17.7	0.60	0.10	0.193
7	53.2	44.3	6.8	1475.4	24.5	1.02	0.17	0.193
8	59.9	51.0	9.8	1465.6	34.3	1.47	0.24	0.193
9	66.5	57.6	15.5	1450.1	49.8	2.33	0.38	0.193
10	73.2	64.3	15.5	1434.6	65.3	2.33	0.38	0.193
11	79.8	70.9	21.2	1413.4	86.5	3.19	0.53	0.193
12	86.5	77.6	16.4	1397.0	102.9	2.47	0.41	0.193
13	93.1	84.2	10.2	1386.8	113.1	1.53	0.25	0.193
14	99.8	90.9	10.2	1376.6	123.3	1.53	0.25	0.193
15	106.4	97.5	10.9	1365.7	134.2	1.64	0.27	0.193
16	113.1	104.2	4.9	1360.8	139.1	0.74	0.12	0.193
17	119.7	110.8	4.9	1355.9	144.0	0.74	0.12	0.193
18	126.4	117.5	11.7	1344.2	155.7	1.76	0.29	0.193
19	133.0	124.1	36.7	1307.5	192.4	5.52	0.91	0.193
20	139.7	130.8	66.7	1240.8	259.1	10.03	1.65	0.193
21	146.3	137.4	82.7	1158.1	341.8	12.43	2.05	0.193
22	153.0	144.1	92.0	1066.1	433.8	13.83	2.28	0.193
Avg. Shaft			19.7			3.01	0.50	0.193
Toe			1066.1				464.11	0.080

Soil Model Parameters/Extensions	Shaft	Toe
Quake (in)	0.274	0.344
Case Damping Factor	0.781	0.793
Unloading Quake (% of loading quake)	95	62
Reloading Level (% of Ru)	100	100
Resistance Gap (included in Toe Quake) (in)		0.009
Soil Plug Weight (kips)		0.04

I-90 Innerbelt CV-2; Pile: Pier 10 Pile 2-213
 HP 18X204; Blow: 2193

Test: 14-Jul-2011 10:53:
 CAPWAP(R) 2006-3

GRL Engineers, Inc.

OP: BAW

CAPWAP match quality	= 1.45	(Wave Up Match) ; RSA = 0
Observed: final set	= 0.048 in;	blow count = 252 b/ft
Computed: final set	= 0.065 in;	blow count = 185 b/ft
max. Top Comp. Stress	= 33.2 ksi	(T= 25.5 ms, max= 1.002 x Top)
max. Comp. Stress	= 33.3 ksi	(Z= 13.3 ft, T= 26.1 ms)
max. Tens. Stress	= -4.40 ksi	(Z= 126.4 ft, T= 61.9 ms)
max. Energy (EMX)	= 115.0 kip-ft;	max. Measured Top Displ. (DMX)= 1.25 in

EXTREMA TABLE

Pile Sgmt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	1994.4	-102.1	33.2	-1.70	115.00	18.3	1.263
2	6.7	1995.3	-100.1	33.2	-1.67	114.77	18.3	1.253
5	16.6	1993.2	-100.1	33.2	-1.67	113.46	18.2	1.218
8	26.6	1992.3	-122.8	33.2	-2.05	111.93	18.0	1.178
11	36.6	1979.8	-144.8	33.0	-2.41	109.26	17.9	1.136
14	46.6	1977.5	-169.5	32.9	-2.82	106.85	17.7	1.088
17	56.5	1963.4	-169.9	32.7	-2.83	102.41	17.4	1.033
20	66.5	1969.4	-185.2	32.8	-3.09	98.11	16.9	0.974
23	76.5	1899.5	-196.7	31.6	-3.28	89.79	16.4	0.917
26	86.5	1861.4	-221.4	31.0	-3.69	83.53	15.9	0.857
29	96.5	1793.3	-229.3	29.9	-3.82	75.90	15.6	0.788
32	106.4	1786.9	-247.5	29.8	-4.12	71.58	15.3	0.722
35	116.4	1753.4	-254.3	29.2	-4.24	65.77	15.1	0.648
38	126.4	1788.1	-264.0	29.8	-4.40	60.78	14.6	0.564
39	129.7	1781.6	-255.3	29.7	-4.25	58.05	14.3	0.536
40	133.0	1830.9	-258.4	30.5	-4.31	56.54	13.9	0.508
41	136.4	1768.7	-228.2	29.5	-3.80	51.59	13.5	0.479
42	139.7	1851.7	-231.3	30.9	-3.85	50.04	12.9	0.450
43	143.0	1714.6	-188.0	28.6	-3.13	43.49	12.1	0.423
44	146.3	1733.2	-190.0	28.9	-3.17	42.05	11.8	0.395
45	149.7	1499.8	-156.2	25.0	-2.60	35.82	11.9	0.372
46	153.0	1600.7	-157.0	26.7	-2.62	31.30	11.5	0.350
Absolute	13.3			33.3			(T = 26.1 ms)	
	126.4				-4.40		(T = 61.9 ms)	

I-90 Innerbelt CV-2; Pile: Pier 10 Pile 2-213
 HP 18X204; Blow: 2193
 GRL Engineers, Inc.

Test: 14-Jul-2011 10:53:
 CAPWAP(R) 2006-3
 OP: BAW

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	2421.3	2266.0	2110.8	1955.5	1800.2	1645.0	1489.7	1334.4	1179.1	1023.9
RX	2421.3	2269.2	2120.5	1971.8	1823.1	1676.6	1590.7	1528.5	1466.3	1404.5
RU	2445.4	2292.5	2139.7	1986.8	1834.0	1681.1	1528.2	1375.4	1222.5	1069.7

RAU = 1151.2 (kips); RA2 = 1424.1 (kips)

Current CAPWAP Ru = 1499.9 (kips); Corresponding J(RP)= 0.59; J(RX) = 0.75

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips
18.52	25.33	1982.9	1991.1	1992.1	1.248	0.046	0.048	115.4	2137.9

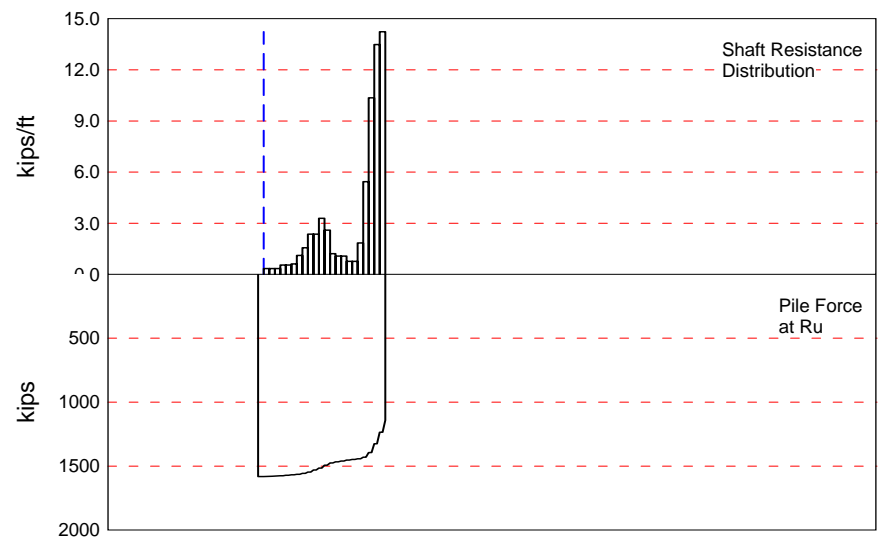
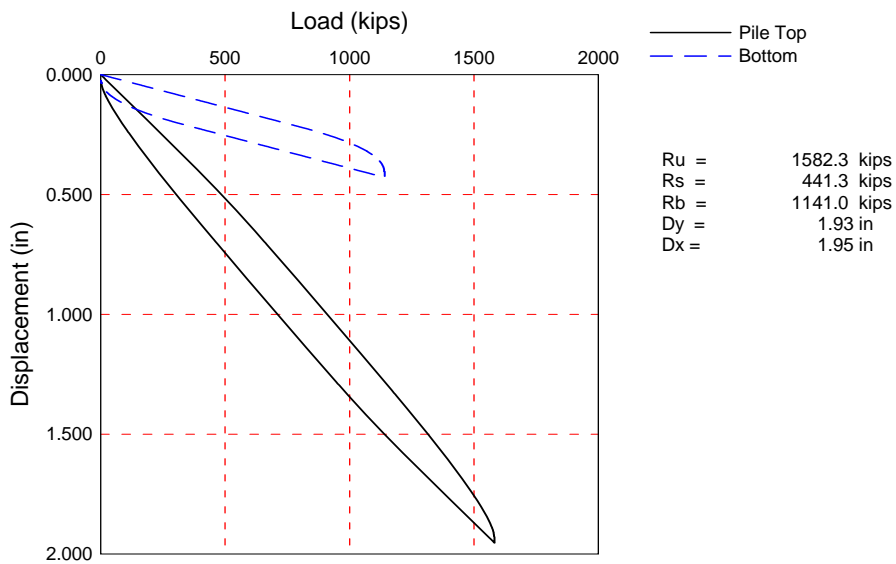
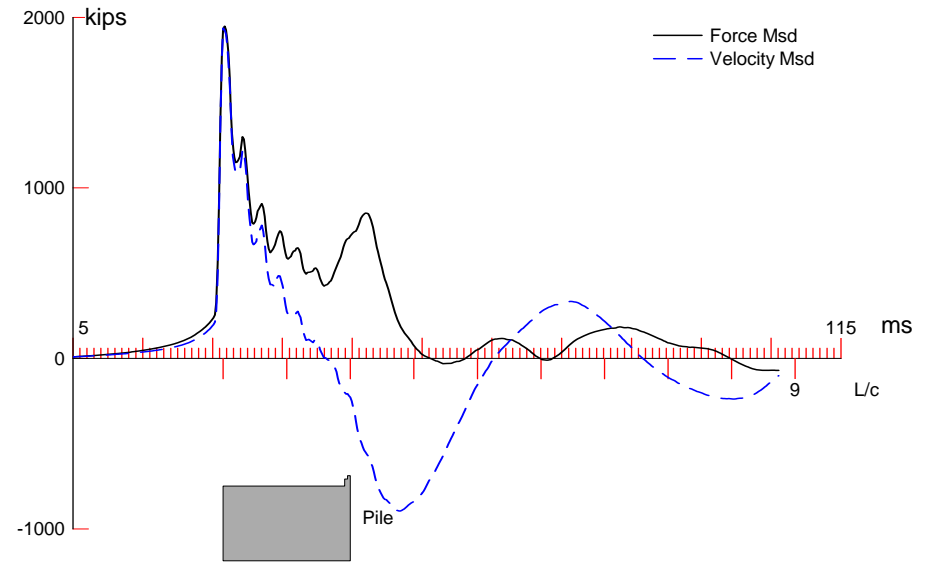
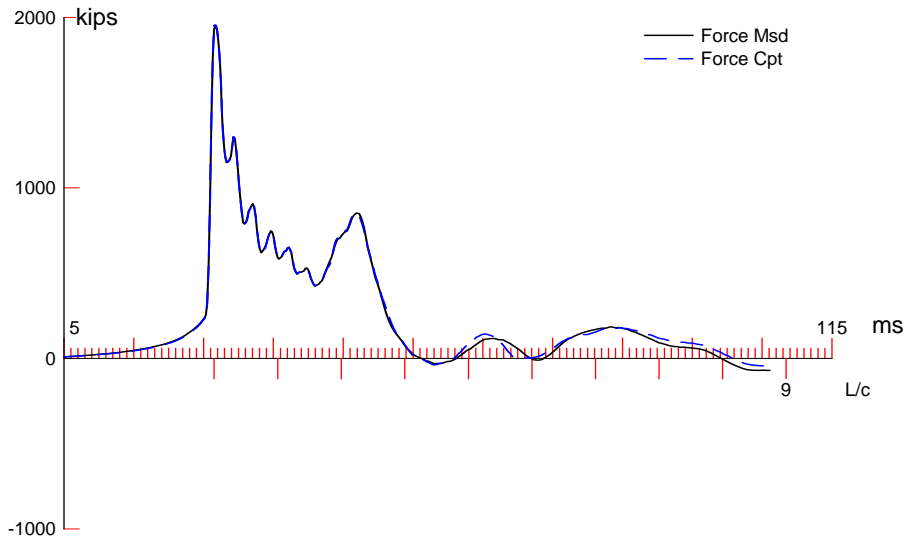
PILE PROFILE AND PILE MODEL

Depth	Area	E-Modulus	Spec. Weight	Perim.
ft	in ²	ksi	lb/ft ³	ft
0.00	60.00	29992.2	492.000	6.063
153.00	60.00	29992.2	492.000	6.063

Toe Area 2.297 ft²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft
1	3.33	107.09	0.00	0.000	0.000	-0.000	0.000	6.063
45	149.67	117.09	9.34	0.000	0.000	-0.000	0.000	6.063
46	153.00	122.09	14.01	0.000	0.000	-0.000	0.000	6.063

Pile Damping 1.0 %, Time Incr 0.198 ms, Wave Speed 16807.9 ft/s, 2L/c 18.2 ms



CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 1582.3; along Shaft 441.3; at Toe 1141.0 kips

Soil Sgmt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				1582.3				
1	13.3	5.3	2.3	1580.0	2.3	0.43	0.07	0.172
2	20.0	12.0	2.3	1577.7	4.6	0.35	0.06	0.172
3	26.6	18.6	2.3	1575.4	6.9	0.35	0.06	0.172
4	33.3	25.3	3.7	1571.7	10.6	0.56	0.09	0.172
5	39.9	31.9	3.7	1568.0	14.3	0.56	0.09	0.172
6	46.6	38.6	4.1	1563.9	18.4	0.62	0.10	0.172
7	53.2	45.2	7.4	1556.5	25.8	1.11	0.18	0.172
8	59.9	51.9	10.4	1546.1	36.2	1.56	0.26	0.172
9	66.5	58.5	15.7	1530.4	51.9	2.36	0.39	0.172
10	73.2	65.2	15.7	1514.7	67.6	2.36	0.39	0.172
11	79.8	71.8	21.9	1492.8	89.5	3.29	0.54	0.172
12	86.5	78.5	17.3	1475.5	106.8	2.60	0.43	0.172
13	93.1	85.1	8.1	1467.4	114.9	1.22	0.20	0.172
14	99.8	91.8	7.2	1460.2	122.1	1.08	0.18	0.172
15	106.4	98.4	7.2	1453.0	129.3	1.08	0.18	0.172
16	113.1	105.1	5.1	1447.9	134.4	0.77	0.13	0.172
17	119.7	111.7	5.1	1442.8	139.5	0.77	0.13	0.172
18	126.4	118.4	12.3	1430.5	151.8	1.85	0.30	0.172
19	133.0	125.0	36.2	1394.3	188.0	5.44	0.90	0.172
20	139.7	131.7	68.9	1325.4	256.9	10.36	1.71	0.172
21	146.3	138.3	89.7	1235.7	346.6	13.48	2.22	0.172
22	153.0	145.0	94.7	1141.0	441.3	14.24	2.35	0.172
Avg. Shaft			20.1			3.04	0.50	0.172
Toe			1141.0				496.71	0.082

Soil Model Parameters/Extensions	Shaft	Toe
Quake (in)	0.295	0.311
Case Damping Factor	0.710	0.873
Unloading Quake (% of loading quake)	89	54
Reloading Level (% of Ru)	-99	7
Resistance Gap (included in Toe Quake) (in)		0.006
Soil Plug Weight (kips)		0.02

GRL Engineers, Inc.

OP: BAW

CAPWAP match quality = 1.31 (Wave Up Match) ; RSA = 0
 Observed: final set = 0.025 in; blow count = 480 b/ft
 Computed: final set = 0.035 in; blow count = 340 b/ft
 max. Top Comp. Stress = 32.6 ksi (T= 27.1 ms, max= 1.005 x Top)
 max. Comp. Stress = 32.8 ksi (Z= 13.3 ft, T= 27.7 ms)
 max. Tens. Stress = -4.63 ksi (Z= 126.4 ft, T= 62.9 ms)
 max. Energy (EMX) = 110.0 kip-ft; max. Measured Top Displ. (DMX)= 1.25 in

EXTREMA TABLE

Pile Sgmt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	1957.7	-55.8	32.6	-0.93	109.95	17.9	1.244
2	6.7	1960.1	-67.0	32.7	-1.12	109.75	17.9	1.234
5	16.6	1961.4	-103.5	32.7	-1.73	108.48	17.8	1.201
8	26.6	1964.9	-136.1	32.7	-2.27	106.91	17.6	1.161
11	36.6	1957.1	-155.1	32.6	-2.59	104.49	17.5	1.121
14	46.6	1961.0	-179.5	32.7	-2.99	102.44	17.3	1.077
17	56.5	1946.3	-176.1	32.4	-2.93	98.11	17.0	1.021
20	66.5	1948.3	-209.8	32.5	-3.50	94.15	16.6	0.965
23	76.5	1884.1	-223.2	31.4	-3.72	86.40	16.2	0.908
26	86.5	1848.5	-240.9	30.8	-4.01	80.23	15.8	0.845
29	96.5	1785.9	-246.4	29.8	-4.11	73.33	15.5	0.777
32	106.4	1784.8	-263.9	29.7	-4.40	69.67	15.3	0.713
35	116.4	1767.2	-268.3	29.4	-4.47	64.08	15.1	0.633
38	126.4	1800.6	-277.7	30.0	-4.63	58.39	14.6	0.542
39	129.7	1795.2	-268.2	29.9	-4.47	55.75	14.3	0.514
40	133.0	1840.1	-272.6	30.7	-4.54	54.22	14.0	0.486
41	136.4	1787.8	-245.2	29.8	-4.09	49.71	13.5	0.457
42	139.7	1865.7	-249.0	31.1	-4.15	48.07	12.9	0.427
43	143.0	1753.2	-209.5	29.2	-3.49	42.05	12.1	0.399
44	146.3	1773.9	-211.7	29.6	-3.53	40.54	11.7	0.371
45	149.7	1586.7	-180.2	26.4	-3.00	34.63	11.6	0.346
46	153.0	1697.6	-181.7	28.3	-3.03	30.89	11.0	0.322
Absolute	13.3			32.8			(T = 27.7 ms)	
	126.4				-4.63		(T = 62.9 ms)	

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	2418.1	2270.5	2122.8	1975.2	1827.6	1680.0	1532.4	1384.7	1237.1	1089.5
RX	2432.9	2291.3	2149.7	2008.2	1868.5	1729.7	1652.8	1596.7	1540.7	1484.7
RU	2481.6	2340.4	2199.1	2057.8	1916.5	1775.3	1634.0	1492.7	1351.5	1210.2

RAU = 1141.6 (kips); RA2 = 1443.7 (kips)

Current CAPWAP Ru = 1582.3 (kips); Corresponding J(RP)= 0.57; J(RX) = 0.73

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips
18.26	26.72	1955.2	1939.1	1958.5	1.248	0.025	0.025	110.4	2081.2

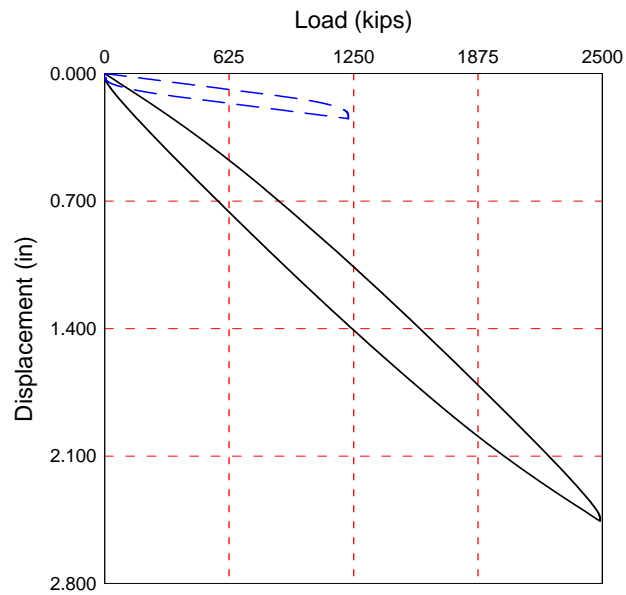
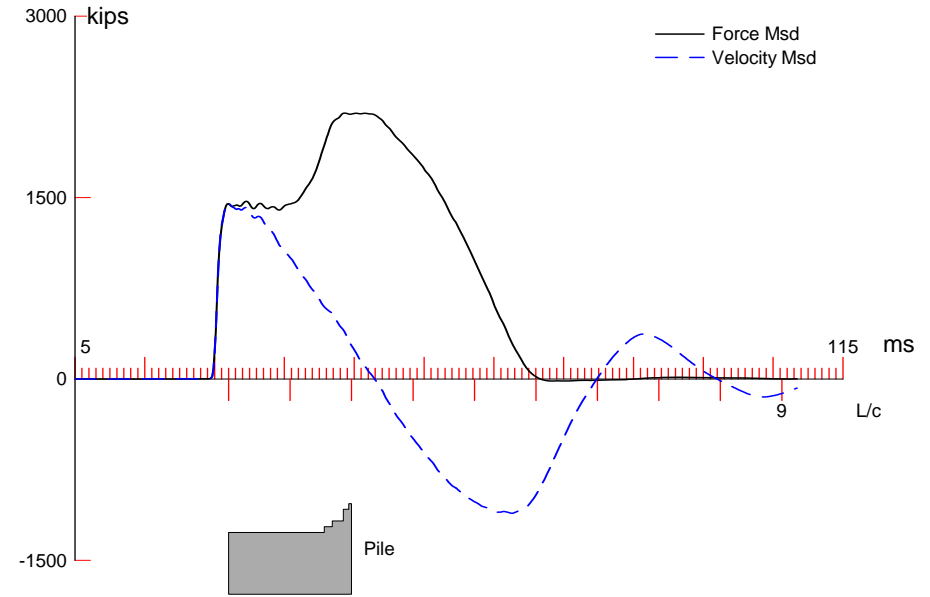
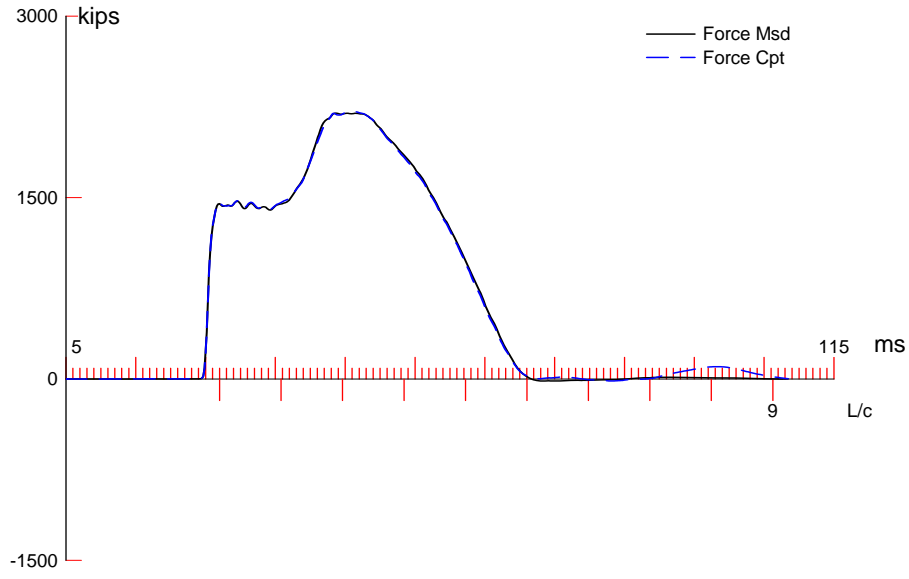
PILE PROFILE AND PILE MODEL

Depth ft	Area in ²	E-Modulus ksi	Spec. Weight lb/ft ³	Perim. ft
0.00	60.00	29992.2	492.000	6.063
153.00	60.00	29992.2	492.000	6.063

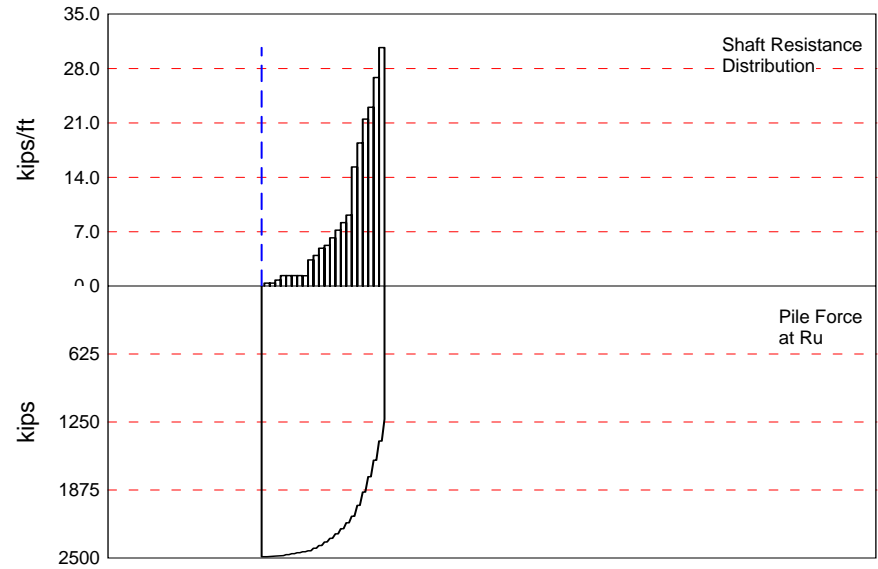
Toe Area 2.297 ft²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Eff.	Perim. ft
1	3.33	107.09	0.00	0.000	0.000	-0.000	0.000	6.063
45	149.67	117.09	9.34	0.000	0.000	-0.000	0.000	6.063
46	153.00	122.09	14.01	0.000	0.000	-0.000	0.000	6.063

Pile Damping 1.0 %, Time Incr 0.198 ms, Wave Speed 16807.9 ft/s, 2L/c 18.2 ms



Ru = 2487.7 kips
 Rs = 1264.3 kips
 Rb = 1223.4 kips
 Dy = 2.43 in
 Dx = 2.46 in



CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 2487.7; along Shaft 1264.3; at Toe 1223.4 kips

Soil Sgmt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				2487.7				
1	9.9	6.9	2.6	2485.1	2.6	0.38	0.06	0.169
2	16.4	13.4	2.6	2482.5	5.2	0.40	0.07	0.169
3	23.0	20.0	5.1	2477.4	10.3	0.78	0.13	0.169
4	29.6	26.6	8.9	2468.5	19.2	1.35	0.23	0.169
5	36.2	33.2	8.9	2459.6	28.1	1.35	0.23	0.169
6	42.8	39.8	8.9	2450.7	37.0	1.35	0.23	0.169
7	49.3	46.3	8.9	2441.8	45.9	1.35	0.23	0.169
8	55.9	52.9	8.8	2433.0	54.7	1.34	0.22	0.169
9	62.5	59.5	22.2	2410.8	76.9	3.38	0.56	0.169
10	69.1	66.1	26.0	2384.8	102.9	3.95	0.66	0.169
11	75.6	72.6	32.0	2352.8	134.9	4.86	0.81	0.169
12	82.2	79.2	34.5	2318.3	169.4	5.24	0.87	0.169
13	88.8	85.8	40.8	2277.5	210.2	6.20	1.03	0.169
14	95.4	92.4	47.3	2230.2	257.5	7.19	1.20	0.169
15	102.0	99.0	53.8	2176.4	311.3	8.18	1.36	0.169
16	108.5	105.5	60.1	2116.3	371.4	9.14	1.52	0.169
17	115.1	112.1	100.9	2015.4	472.3	15.34	2.56	0.169
18	121.7	118.7	121.1	1894.3	593.4	18.41	3.07	0.169
19	128.3	125.3	141.3	1753.0	734.7	21.48	3.58	0.169
20	134.8	131.8	151.3	1601.7	886.0	23.00	3.83	0.169
21	141.4	138.4	176.5	1425.2	1062.5	26.83	4.47	0.169
22	148.0	145.0	201.8	1223.4	1264.3	30.68	5.11	0.169
Avg. Shaft			57.5			8.72	1.45	0.169
Toe			1223.4				2936.16	0.108

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.172	0.172
Case Damping Factor		2.001	1.237
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	56	
Soil Plug Weight	(kips)		1.05

Innerbelt CV-2; Pile: Pier 10 Pile 213
 HP 18x204 APPLE; Blow: 3

Test: 29-Jul-2011 08:08:
 CAPWAP(R) 2006-3

GRL Engineers, Inc.

OP: BAW

CAPWAP match quality = 1.13 (Wave Up Match) ; RSA = 0
 Observed: final set = 0.024 in; blow count = 500 b/ft
 Computed: final set = 0.004 in; blow count = 3048 b/ft
 max. Top Comp. Stress = 37.2 ksi (T= 45.6 ms, max= 1.068 x Top)
 max. Comp. Stress = 39.7 ksi (Z= 55.9 ft, T= 45.6 ms)
 max. Tens. Stress = -6.55 ksi (Z= 88.8 ft, T= 78.1 ms)
 max. Energy (EMX) = 275.3 kip-ft; max. Measured Top Displ. (DMX)= 2.21 in

EXTREMA TABLE

Pile Sgmt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	2231.1	-28.7	37.2	-0.48	275.32	13.5	2.157
2	6.6	2249.8	-43.2	37.5	-0.72	270.83	13.5	2.108
5	16.4	2311.1	-109.3	38.5	-1.82	255.93	13.4	1.960
8	26.3	2348.3	-167.1	39.1	-2.78	238.84	13.2	1.811
11	36.2	2366.2	-224.8	39.4	-3.75	221.40	13.0	1.661
14	46.0	2372.1	-268.4	39.5	-4.47	201.30	12.8	1.511
17	55.9	2381.7	-324.0	39.7	-5.40	184.42	12.4	1.360
20	65.8	2359.2	-351.0	39.3	-5.85	162.56	11.8	1.210
23	75.6	2344.4	-381.8	39.1	-6.36	143.01	11.2	1.060
26	85.5	2278.4	-376.0	38.0	-6.27	117.74	10.4	0.913
29	95.4	2243.2	-389.2	37.4	-6.48	98.82	9.6	0.768
32	105.2	2146.5	-352.9	35.8	-5.88	75.60	8.6	0.627
35	115.1	2096.3	-346.2	34.9	-5.77	59.26	7.1	0.490
38	125.0	1883.6	-235.6	31.4	-3.92	38.76	5.9	0.374
39	128.3	1889.2	-245.7	31.5	-4.09	36.11	5.5	0.340
40	131.6	1753.8	-169.7	29.2	-2.83	29.21	5.1	0.308
41	134.8	1758.5	-178.1	29.3	-2.97	26.89	4.6	0.275
42	138.1	1614.8	-99.0	26.9	-1.65	21.44	4.2	0.246
43	141.4	1621.4	-106.8	27.0	-1.78	19.76	3.6	0.220
44	144.7	1462.3	-58.1	24.4	-0.97	15.60	3.7	0.197
45	148.0	1467.4	-63.3	24.4	-1.06	12.42	3.6	0.176
Absolute	55.9			39.7			(T = 45.6 ms)	
	88.8				-6.55		(T = 78.1 ms)	

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	2409.1	2358.5	2308.0	2257.5	2206.9	2156.4	2105.9	2055.3	2004.8	1954.2
RX	2516.4	2488.5	2460.8	2433.2	2405.8	2381.6	2366.9	2360.8	2355.6	2352.0
RU	2409.1	2358.5	2308.0	2257.5	2206.9	2156.4	2105.9	2055.3	2004.8	1954.2

RAU = 0.0 (kips); RA2 = 2466.1 (kips)

Current CAPWAP Ru = 2487.7 (kips); Corresponding J(RP)= 0.00; J(RX) = 0.10

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips
13.66	27.20	1462.7	1451.8	2199.0	2.207	0.026	0.024	279.5	3006.0

PILE PROFILE AND PILE MODEL

Depth ft	Area in ²	E-Modulus ksi	Spec. Weight lb/ft ³	Perim. ft
0.00	60.00	29992.2	492.000	6.000
148.00	60.00	29992.2	492.000	6.000

Toe Area 0.417 ft²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Eff.	Perim. ft
1	3.29	107.09	0.00	0.000	0.000	-0.000	0.000	6.000
36	118.40	117.09	9.34	0.000	0.000	-0.000	0.000	6.000
39	128.27	127.09	18.68	0.000	0.000	-0.000	0.000	6.000
43	141.42	147.09	37.35	0.000	0.000	-0.000	0.000	6.000
45	148.00	157.09	46.69	0.000	0.000	-0.000	0.000	6.000

Pile Damping 1.0 %, Time Incr 0.196 ms, Wave Speed 16807.9 ft/s, 2L/c 17.6 ms