GRL Engineers, Inc.

1540 E. Dundee Road, Suite 102 Palatine, IL 60074 USA
Phone: (847) 221-2750 Fax: (847) 221-2752

TRANSMITTAL

To: Mr. Kevin Weber	From: Alexander McCaskill
Company: Lunda Construction Co.	No. of Sheets: 51
E-mail: kweber@lundaconstruction.com	Date: June 11, 2015

RE: Dynamic Testing Results – USH 10 over Little Lake Butte des Morts
Structure B-70-403 - Pier 19
Winnebago County, Wisconsin

On June 10, 2015, Pier 19 #1, Pier 19 #36, and Pier 19 #44 at the above structure were dynamically tested during initial driving. The piles were tested during restrike on June 11. Project plans indicated that the exterior row piles have a required driving resistance, or ultimate capacity, of 480 kips (240 tons) and the interior row piles have a required driving resistance of 400 kips (200 tons). The piles have a required minimum tip elevation of EL 691. The HP 14x73 H-piles were equipped with driving shoes and were driven with an APE D30-42 hammer (number PD 0256) operated on fuel setting 4. The reference elevation for the piles was the top of the cofferdam at EL 739.7 to EL 740.6. The pier was excavated to an elevation of EL 718.2.

Pier 19 #1 was driven to a depth of 52.0 feet, which corresponds to a pile tip elevation of EL 687.7. The blow count over the final increment of driving was 10 blows for 2 inches of penetration at an average hammer stroke of 8.6 feet. The blow count at the beginning of restrike was 10 blows per for 2 ¼ inches of penetration at an average hammer stroke of 8.2 feet.

Pier 19 #36 was driven to a depth of 65.9 feet, which corresponds to a pile tip elevation of EL 674.7. The blow count over the final increment of driving was 10 blows for 1 ½ inches of penetration at an average hammer stroke of 9.4 feet. The blow count at the beginning of restrike was 10 blows for 1 ¼ inches of penetration at an average hammer stroke of 9.1 feet.

Pier 19 #44 was driven to a depth of 65.8 feet, which corresponds to a pile tip elevation of EL 673.9. The blow count over the final increment of driving was 10 blows for 1 inch of penetration at an average hammer stroke of 9.4 feet. The blow count at the beginning of restrike was 10 blows for 1 ½ inches of penetration at an average hammer stroke of 9.2 feet

We recommend that the production piles at Pier 19 of Structure B-70-403, driven with an APE D30-42 hammer PD 0256, obtain the minimum recommended blow count, noted below, based on the field observed hammer stroke. We recommend maintaining the minimum blow count for **three consecutive inches** of driving at the recommended average hammer stroke.

Field Observed Hammer Stroke (feet)	Exterior Piles (480 kips) Recommended Minimum Blow Count (blows per inch)	Interior Piles (400 kips) Recommended Minimum Blow Count (blows per inch)
7.0	6	3
7.5	5	3
8.0	4	3
8.5	4	3
9.0	4	3

We recommend immediately terminating driving **if the blow counts exceed 10** blows over an increment of one inch or less at hammer strokes of 8.0 feet, after satisfying the plan minimum tip requirements.

These criteria should not be used for acceptance of piles under restrike and/or re-drive conditions. After splicing or any other delays, we recommend not applying the criteria until two feet of driving has occurred beyond the termination depth associated with the delay, unless the blow count exceeds 10 blows per inch.

Please call if you have any questions on these recommendations.

GRL Engineers, Inc.

Alexander McCaskill

Travis Coleman, P.E.

cc: Jeff Horsfall – jeffrey.horsfall@dot.wi.gov

Attachments:

Dynamic Test Results - (pages 3 – 21)
CAPWAP Analysis Results - (pages 22 – 51)

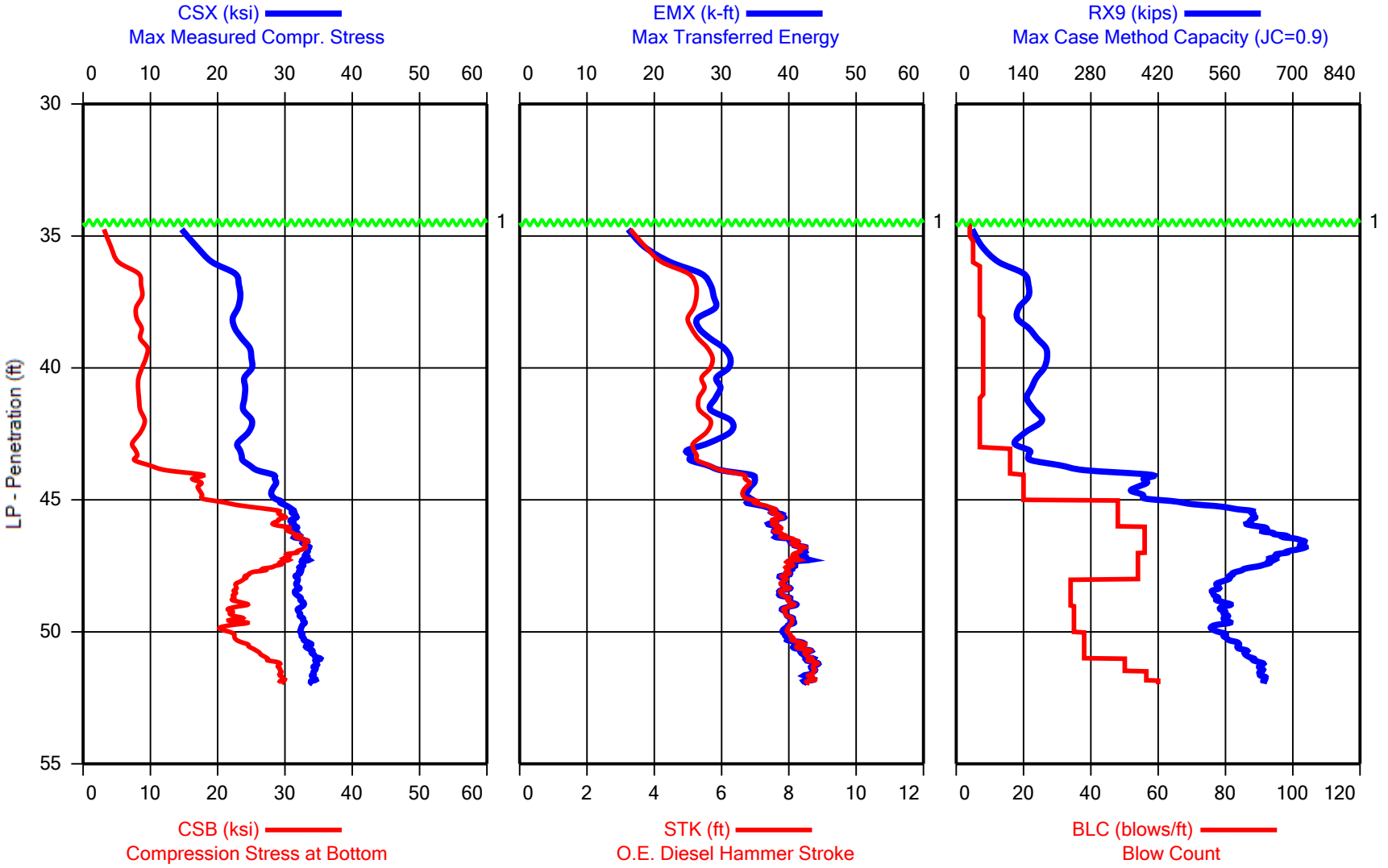
GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.50.1 - Case Method & iCAP® Results

Printed: 12-June-2015

Test started: 10-June-2015

USH 10 over Little Lake Butte des Morts - PIER 19 #1

APE D30-42, HP 14 x 73



1 - Reported reference at El. 739.7

USH 10 over Little Lake Butte des Morts - PIER 19 #1 APE D30-42, HP 14 x 73
OP: TC Date: 10-June-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

CSX: Max Measured Compr. Stress STK: O.E. Diesel Hammer Stroke
CSB: Compression Stress at Bottom BPM: Blows per Minute
EMX: Max Transferred Energy RX9: Max Case Method Capacity (JC=0.9)

BL#	Depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
8	35.00	4	AV3	14.6	3.1	16	3.3	63.5	33
			STD	0.7	0.2	1	0.1	0.8	10
			MAX	15.1	3.3	17	3.4	64.4	44
			MIN	13.7	2.9	15	3.2	62.4	21
13	36.00	5	AV5	17.6	4.4	20	3.9	58.9	61
			STD	1.1	0.4	2	0.2	1.7	11
			MAX	19.1	5.1	23	4.2	61.5	82
			MIN	15.9	3.9	17	3.5	56.8	51
20	37.00	7	AV7	22.4	8.1	27	5.0	52.2	141
			STD	1.2	0.9	2	0.3	1.5	12
			MAX	23.7	8.8	30	5.3	55.5	154
			MIN	19.9	6.0	23	4.4	50.7	116
27	38.00	7	AV7	23.0	8.2	29	5.2	51.5	138
			STD	0.6	0.5	1	0.1	0.6	12
			MAX	24.1	9.0	30	5.4	52.8	155
			MIN	21.9	7.7	26	4.9	50.6	124
35	39.00	8	AV8	22.9	8.5	27	5.2	51.5	152
			STD	0.7	0.5	1	0.1	0.7	17
			MAX	24.2	9.3	29	5.4	52.5	176
			MIN	21.7	7.7	26	5.0	50.4	125
43	40.00	8	AV8	24.9	9.3	31	5.7	49.3	188
			STD	0.2	0.4	1	0.1	0.4	3
			MAX	25.3	9.9	32	5.8	50.0	194
			MIN	24.6	8.7	30	5.5	48.6	184
51	41.00	8	AV8	24.3	8.2	30	5.5	50.0	163
			STD	0.7	0.4	1	0.1	0.5	7
			MAX	25.2	8.8	31	5.7	50.6	174
			MIN	23.1	7.8	28	5.4	49.3	156
58	42.00	7	AV7	24.1	8.6	29	5.4	50.5	162
			STD	0.9	0.3	2	0.2	1.0	18
			MAX	25.7	9.3	33	5.8	51.7	189
			MIN	22.8	8.2	27	5.1	48.7	137
65	43.00	7	AV7	23.9	8.1	30	5.4	50.4	139
			STD	1.0	0.9	2	0.2	1.0	19
			MAX	25.5	9.4	33	5.7	51.7	172
			MIN	22.7	7.0	27	5.1	49.0	116
81	44.00	16	AV16	24.4	9.6	27	5.5	50.0	201
			STD	1.2	2.7	2	0.4	1.6	73
			MAX	26.5	16.9	31	6.2	52.2	398
			MIN	22.8	7.1	24	5.0	47.2	144
101	45.00	20	AV20	28.4	17.4	34	6.7	45.4	387
			STD	0.7	0.8	1	0.2	0.6	17
			MAX	29.6	18.6	37	7.0	46.3	414
			MIN	27.3	14.9	32	6.5	44.5	354
149	46.00	48	AV48	30.8	26.9	37	7.5	43.2	578

USH 10 over Little Lake Butte des Morts - PIER 19 #1 APE D30-42, HP 14 x 73
OP: TC Date: 10-June-2015

BL#	Depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			STD	0.8	3.3	2	0.3	0.7	57
			MAX	32.3	30.4	40	7.9	45.1	631
			MIN	28.8	19.4	33	6.8	41.9	438
205	47.00	56	AV56	32.5	32.0	40	8.0	41.7	688
			STD	0.9	1.1	2	0.3	0.7	32
			MAX	33.9	34.0	43	8.6	43.2	736
			MIN	30.8	29.9	37	7.5	40.3	630
259	48.00	54	AV54	32.5	27.8	41	8.0	41.7	621
			STD	0.6	2.5	1	0.2	0.5	39
			MAX	33.9	31.3	44	8.4	43.2	678
			MIN	30.7	23.6	37	7.5	40.7	553
293	49.00	34	AV34	32.0	22.9	40	7.9	42.0	546
			STD	0.7	0.8	1	0.2	0.5	12
			MAX	33.3	25.2	42	8.4	43.0	582
			MIN	30.7	21.9	37	7.5	40.9	526
328	50.00	35	AV35	32.4	22.1	40	8.0	41.8	551
			STD	0.4	1.4	1	0.1	0.3	14
			MAX	33.1	24.6	42	8.3	42.4	577
			MIN	31.4	19.7	38	7.8	41.0	522
366	51.00	38	AV38	33.5	24.5	41	8.3	41.0	584
			STD	0.8	1.7	2	0.3	0.6	20
			MAX	35.6	27.5	45	8.9	42.4	619
			MIN	31.7	21.9	37	7.8	39.7	551
390	51.48	50	AV24	34.6	28.7	44	8.7	40.0	631
			STD	0.4	0.8	1	0.1	0.2	8
			MAX	35.4	29.7	45	8.9	40.5	647
			MIN	33.8	27.1	42	8.5	39.6	617
400	51.66	56	AV10	34.2	29.3	43	8.7	40.2	632
			STD	0.3	0.4	1	0.1	0.2	2
			MAX	34.8	30.1	44	8.8	40.4	636
			MIN	33.9	28.9	42	8.6	39.8	628
410	51.83	56	AV10	34.3	29.7	43	8.7	40.1	641
			STD	0.3	0.3	1	0.1	0.3	4
			MAX	34.6	30.4	44	8.8	40.6	648
			MIN	33.7	29.3	42	8.5	39.8	635
419	51.98	60	AV9	34.0	29.4	43	8.6	40.4	639
			STD	0.4	0.4	1	0.1	0.3	5
			MAX	34.7	30.1	44	8.8	41.0	650
			MIN	33.3	29.0	41	8.3	39.8	630
			Average	30.7	23.1	38	7.5	43.6	514
			Std. Dev.	4.0	8.1	6	1.2	4.2	186
			Maximum	35.6	34.0	45	8.9	64.4	736
			Minimum	13.7	2.9	15	3.2	39.6	21

Total number of blows analyzed: 414

BL# Sensors

1-419 F3: [K769] 91.9 (1.00); F4: [D815] 93.0 (1.00); A3: [K3658] 362.0 (1.00); A4: [K3550] 360.0 (1.00)

BL# Comments

6 Reported reference at El. 739.7
7 Mud line at El. 718.2

Time Summary

Drive 9 minutes 51 seconds 6:15 AM - 6:25 AM BN 1 - 419

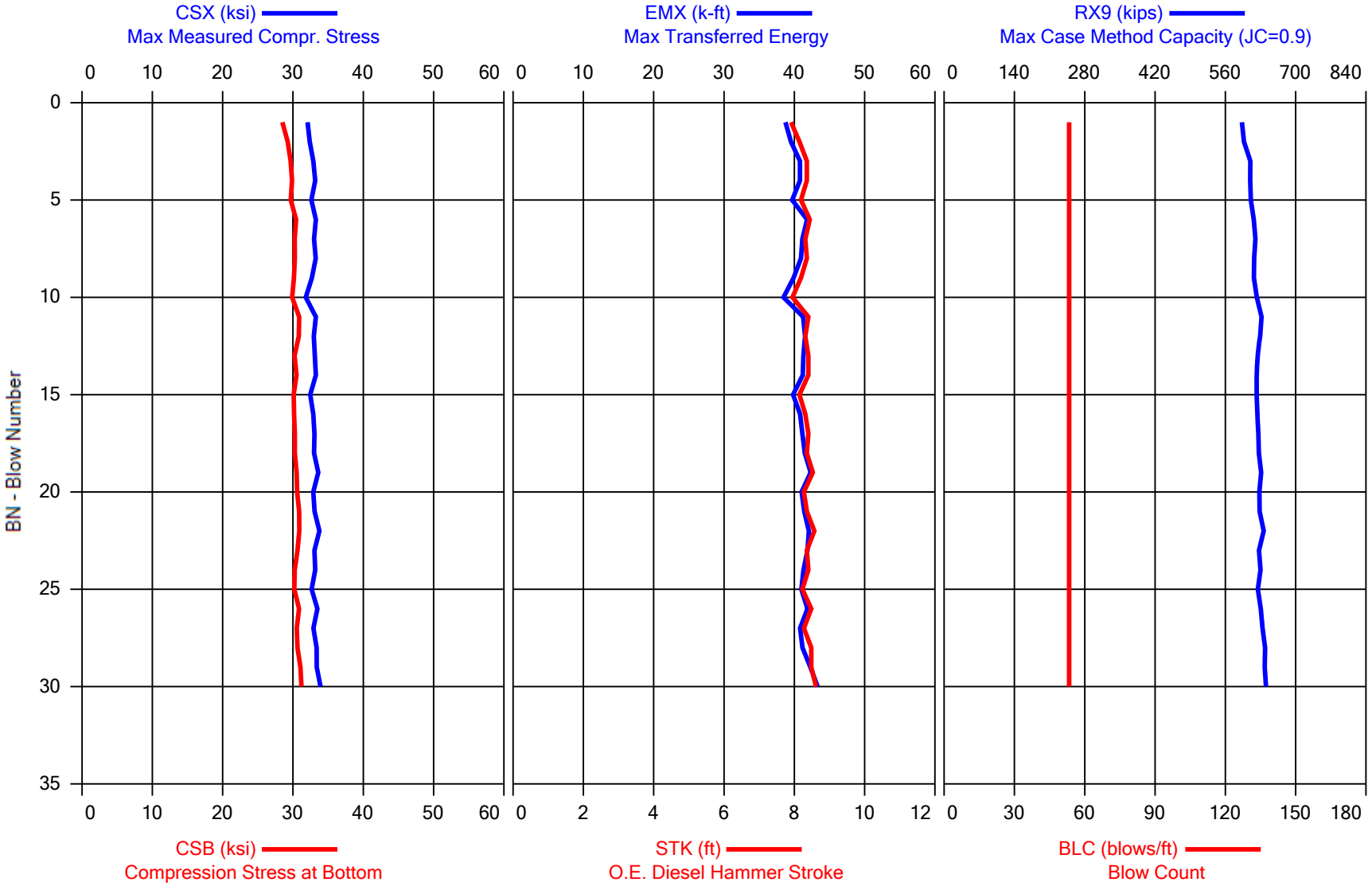
GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.50.1 - Case Method & iCAP® Results

Printed: 11-June-2015

Test started: 11-June-2015

USH 10 over Little Lake Butte des Morts - PIER 19 #1 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - PIER 19 #1 Restrike APE D30-42, HP 14 x 73
OP: AM Date: 11-June-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

CSX: Max Measured Compr. Stress
CSB: Compression Stress at Bottom
EMX: Max Transferred Energy
STK: O.E. Diesel Hammer Stroke
BPM: Blows per Minute
RX9: Max Case Method Capacity (JC=0.9)

BL#	Depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
10	52.19	53	AV10	32.7	29.8	40	8.2	41.2	611
			STD	0.5	0.5	1	0.2	0.4	9
			MAX	33.3	30.4	42	8.4	42.0	623
			MIN	31.8	28.5	38	7.9	40.7	593
20	52.38	53	AV10	33.0	30.4	41	8.4	40.9	627
			STD	0.3	0.3	1	0.1	0.2	3
			MAX	33.6	30.9	42	8.5	41.4	632
			MIN	32.5	30.1	40	8.1	40.5	622
30	52.56	53	AV10	33.3	30.7	42	8.4	40.7	633
			STD	0.4	0.3	1	0.1	0.3	5
			MAX	33.9	31.2	43	8.6	41.2	641
			MIN	32.6	30.2	41	8.2	40.3	625
			Average	33.0	30.3	41	8.3	41.0	624
			Std. Dev.	0.4	0.5	1	0.2	0.4	11
			Maximum	33.9	31.2	43	8.6	42.0	641
			Minimum	31.8	28.5	38	7.9	40.3	593

Total number of blows analyzed: 30

BL# Sensors

1-30 F3: [D815] 93.0 (1.00); F4: [K769] 91.9 (1.00); A3: [K3550] 360.0 (1.00); A4: [K3658] 362.0 (1.00)

BL# Comments

3 CW

Time Summary

Drive 42 seconds 6:55 AM - 6:56 AM BN 1 - 30

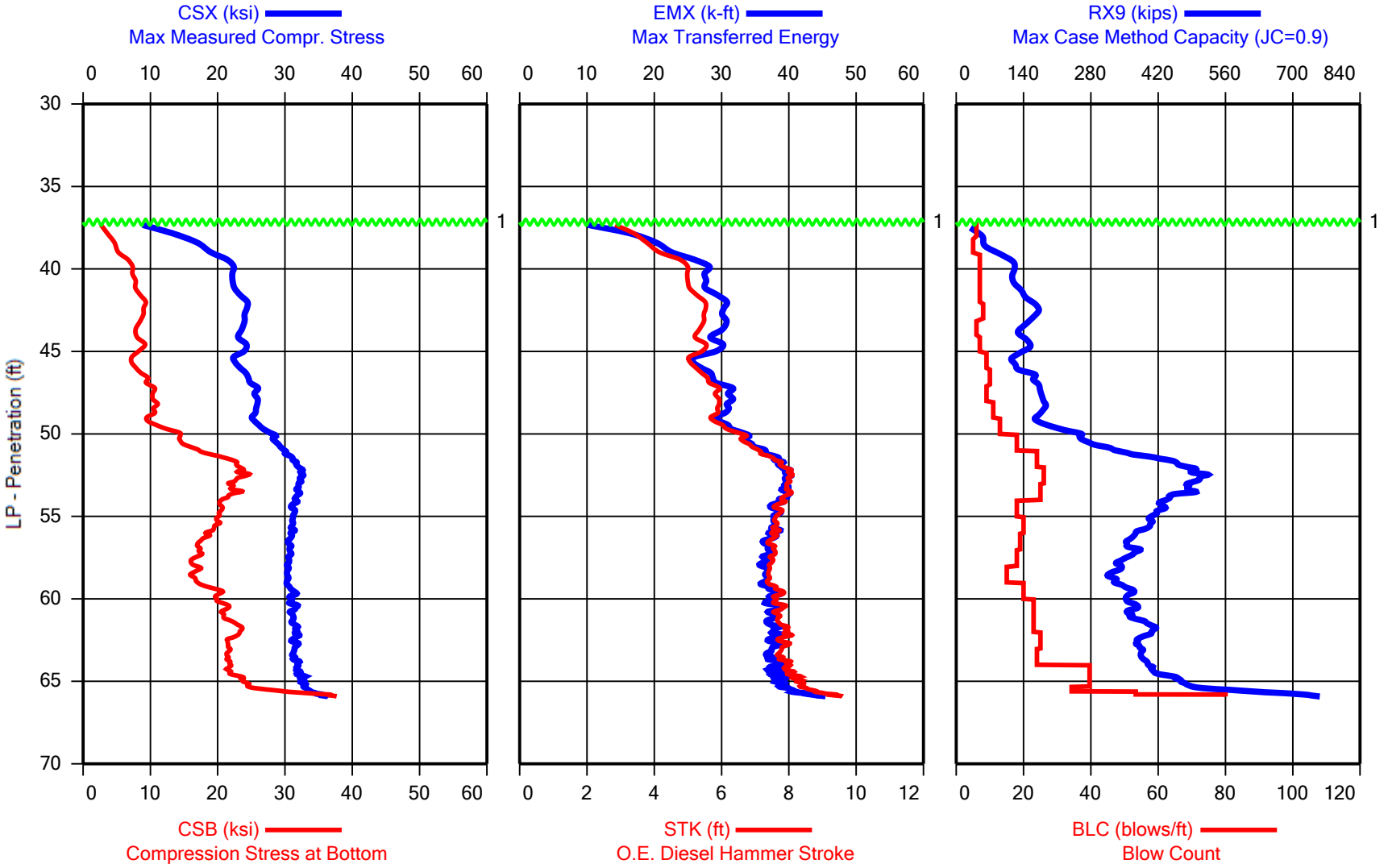
GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.50.1 - Case Method & iCAP® Results

Printed: 12-June-2015

Test started: 10-June-2015

USH 10 over Little Lake Butte des Morts - PIER 19 #36

APE D30-42, HP 14 x 73



1 - Reported reference at El. 740.57

USH 10 over Little Lake Butte des Morts - PIER 19 #36 APE D30-42, HP 14 x 73
OP: TC Date: 10-June-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.58 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

CSX: Max Measured Compr. Stress STK: O.E. Diesel Hammer Stroke
CSB: Compression Stress at Bottom BPM: Blows per Minute
EMX: Max Transferred Energy RX9: Max Case Method Capacity (JC=0.9)

BL#	Depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
12	38.00	6	AV6	11.0	3.1	13	3.1	65.4	33
			STD	3.5	0.6	4	0.4	3.4	19
			MAX	17.5	4.2	21	3.8	68.3	59
			MIN	7.7	2.5	9	2.8	59.1	0
17	39.00	5	AV5	17.6	4.8	21	3.9	58.8	63
			STD	0.9	0.5	2	0.2	1.4	10
			MAX	18.8	5.4	23	4.1	60.6	81
			MIN	16.3	4.3	19	3.6	57.3	55
24	40.00	7	AV7	21.6	6.8	26	4.8	53.4	115
			STD	1.1	0.7	2	0.3	1.5	10
			MAX	22.8	7.5	29	5.1	56.2	126
			MIN	19.7	5.4	22	4.3	51.8	95
31	41.00	7	AV7	22.4	7.5	28	5.0	52.2	118
			STD	0.6	0.4	1	0.1	0.7	4
			MAX	23.4	8.2	29	5.2	53.4	125
			MIN	21.3	7.2	26	4.8	51.1	110
38	42.00	7	AV7	23.3	8.6	29	5.2	51.2	143
			STD	1.1	0.6	2	0.3	1.2	10
			MAX	25.4	9.7	33	5.7	52.9	160
			MIN	21.9	7.6	26	4.9	49.1	132
46	43.00	8	AV8	24.2	9.0	30	5.5	50.0	167
			STD	0.5	0.2	1	0.1	0.4	6
			MAX	24.7	9.3	31	5.7	50.8	177
			MIN	23.3	8.6	29	5.3	49.3	158
52	44.00	6	AV6	23.7	8.0	30	5.4	50.5	137
			STD	0.3	0.3	1	0.1	0.4	9
			MAX	24.5	8.5	32	5.6	50.8	151
			MIN	23.5	7.7	30	5.3	49.6	126
59	45.00	7	AV7	23.8	8.7	30	5.4	50.3	149
			STD	0.7	0.5	2	0.2	0.8	10
			MAX	24.6	9.3	32	5.6	51.7	164
			MIN	22.8	7.8	27	5.1	49.4	135
68	46.00	9	AV9	22.7	7.4	26	5.1	51.8	122
			STD	0.4	0.3	1	0.1	0.4	7
			MAX	23.3	7.9	27	5.2	52.4	135
			MIN	22.1	6.9	25	5.0	51.1	112
78	47.00	10	AV10	24.5	9.1	29	5.5	49.8	155
			STD	0.6	0.7	1	0.2	0.7	16
			MAX	25.4	10.1	30	5.8	51.3	176
			MIN	23.3	7.9	27	5.2	48.7	128
87	48.00	9	AV9	25.8	10.5	31	5.9	48.4	176
			STD	0.4	0.4	1	0.1	0.4	6
			MAX	26.4	11.3	32	6.1	48.8	191
			MIN	25.4	10.0	30	5.8	47.7	166
98	49.00	11	AV11	25.7	10.5	31	5.9	48.5	180

USH 10 over Little Lake Butte des Morts - PIER 19 #36 APE D30-42, HP 14 x 73
OP: TC Date: 10-June-2015

BL#	Depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			STD	0.3	0.7	1	0.1	0.3	13
			MAX	26.3	11.8	32	6.0	49.1	204
			MIN	25.2	9.6	29	5.7	47.8	152
111	50.00	13	AV13	26.4	11.6	31	6.1	47.7	203
			STD	1.2	1.9	2	0.3	1.3	31
			MAX	29.0	15.1	36	6.9	49.8	260
			MIN	24.6	9.1	28	5.5	44.8	157
129	51.00	18	AV18	28.9	15.2	34	6.8	45.2	285
			STD	0.6	1.0	1	0.2	0.6	27
			MAX	30.1	17.4	37	7.2	46.5	337
			MIN	27.5	14.2	32	6.4	44.0	251
153	52.00	24	AV24	31.1	21.0	38	7.5	43.0	418
			STD	0.7	2.0	1	0.3	0.7	46
			MAX	32.1	23.2	40	7.9	44.5	483
			MIN	29.7	17.2	35	7.0	42.0	330
179	53.00	26	AV26	32.4	23.3	40	8.0	41.7	500
			STD	0.4	1.1	1	0.1	0.3	14
			MAX	33.3	26.7	41	8.3	42.3	531
			MIN	31.7	21.5	38	7.8	41.1	469
204	54.00	25	AV25	31.9	22.0	39	7.9	41.9	468
			STD	0.4	1.0	1	0.1	0.3	22
			MAX	32.7	24.7	41	8.2	42.5	510
			MIN	31.0	20.4	38	7.7	41.2	434
222	55.00	18	AV18	31.3	20.4	38	7.7	42.5	423
			STD	0.5	0.4	1	0.2	0.4	10
			MAX	32.4	21.5	40	8.1	43.4	443
			MIN	30.4	19.7	36	7.4	41.6	405
242	56.00	20	AV20	31.1	19.6	38	7.6	42.8	396
			STD	0.4	0.7	1	0.1	0.4	14
			MAX	32.2	20.6	41	8.0	43.5	416
			MIN	30.2	17.8	36	7.4	41.8	359
261	57.00	19	AV19	30.8	17.6	37	7.5	43.0	364
			STD	0.3	0.7	1	0.1	0.3	12
			MAX	31.4	19.6	39	7.8	43.6	389
			MIN	30.0	16.7	36	7.3	42.4	352
279	58.00	18	AV18	30.6	16.7	37	7.5	43.1	353
			STD	0.6	0.7	1	0.2	0.5	17
			MAX	31.9	18.0	38	7.9	44.1	381
			MIN	29.5	15.8	35	7.1	42.1	324
294	59.00	15	AV15	30.4	16.7	37	7.4	43.4	330
			STD	0.3	0.5	1	0.1	0.2	12
			MAX	31.1	17.6	38	7.6	43.6	356
			MIN	30.0	15.6	36	7.3	42.7	307
314	60.00	20	AV20	31.0	19.4	37	7.6	42.7	356
			STD	0.6	1.2	1	0.2	0.5	11
			MAX	32.3	20.9	40	8.0	44.1	372
			MIN	29.4	16.9	34	7.1	41.8	328
337	61.00	23	AV23	31.2	20.9	38	7.7	42.6	365
			STD	0.5	0.6	1	0.2	0.4	10
			MAX	32.1	22.0	40	8.0	43.4	380
			MIN	30.3	19.8	36	7.4	41.8	352

USH 10 over Little Lake Butte des Morts - PIER 19 #36 APE D30-42, HP 14 x 73
OP: TC Date: 10-June-2015

BL#	Depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
360	62.00	23	AV23	31.4	22.5	38	7.8	42.3	395
			STD	0.5	1.1	1	0.2	0.4	18
			MAX	32.4	23.8	40	8.1	43.1	420
			MIN	30.6	20.5	36	7.5	41.5	357
385	63.00	25	AV25	31.6	22.0	38	7.9	42.1	385
			STD	0.6	0.7	1	0.2	0.4	12
			MAX	32.9	23.4	40	8.3	43.1	409
			MIN	30.6	21.1	36	7.5	41.0	364
409	64.00	24	AV24	31.5	21.6	38	7.8	42.3	390
			STD	0.5	0.3	1	0.2	0.4	7
			MAX	32.8	22.0	41	8.2	42.9	400
			MIN	30.7	21.0	36	7.6	41.2	379
461	65.31	40	AV52	32.3	22.9	38	8.2	41.4	441
			STD	0.6	1.2	1	0.2	0.5	30
			MAX	33.5	25.8	41	8.7	42.3	493
			MIN	31.2	20.9	36	7.8	40.1	395
471	65.60	34	AV10	33.3	27.0	40	8.6	40.3	546
			STD	0.4	1.7	1	0.2	0.4	40
			MAX	34.0	29.5	41	8.9	40.9	604
			MIN	32.5	24.7	39	8.4	39.6	492
481	65.79	53	AV10	34.4	33.1	42	9.0	39.4	672
			STD	0.6	2.1	2	0.2	0.5	32
			MAX	35.4	36.7	45	9.5	40.1	724
			MIN	33.4	30.2	40	8.7	38.5	625
491	65.92	80	AV10	35.7	37.0	45	9.4	38.6	740
			STD	0.5	0.6	1	0.1	0.2	10
			MAX	36.9	38.1	46	9.7	38.9	756
			MIN	35.2	36.3	44	9.3	38.1	727
			Average	29.8	18.8	36	7.3	44.2	361
			Std. Dev.	4.0	6.6	5	1.2	4.4	140
			Maximum	36.9	38.1	46	9.7	68.3	756
			Minimum	7.7	2.5	9	2.8	38.1	0

Total number of blows analyzed: 485

BL# Sensors

1-491 F3: [K769] 91.9 (1.00); F4: [D815] 93.0 (1.00); A3: [K3658] 362.0 (1.00); A4: [K3550] 360.0 (1.00)

BL# Comments

7 Reported reference at El. 740.57
8 Mud line at El. 718.2

Time Summary

Drive 11 minutes 26 seconds 6:38 AM - 6:50 AM BN 1 - 491

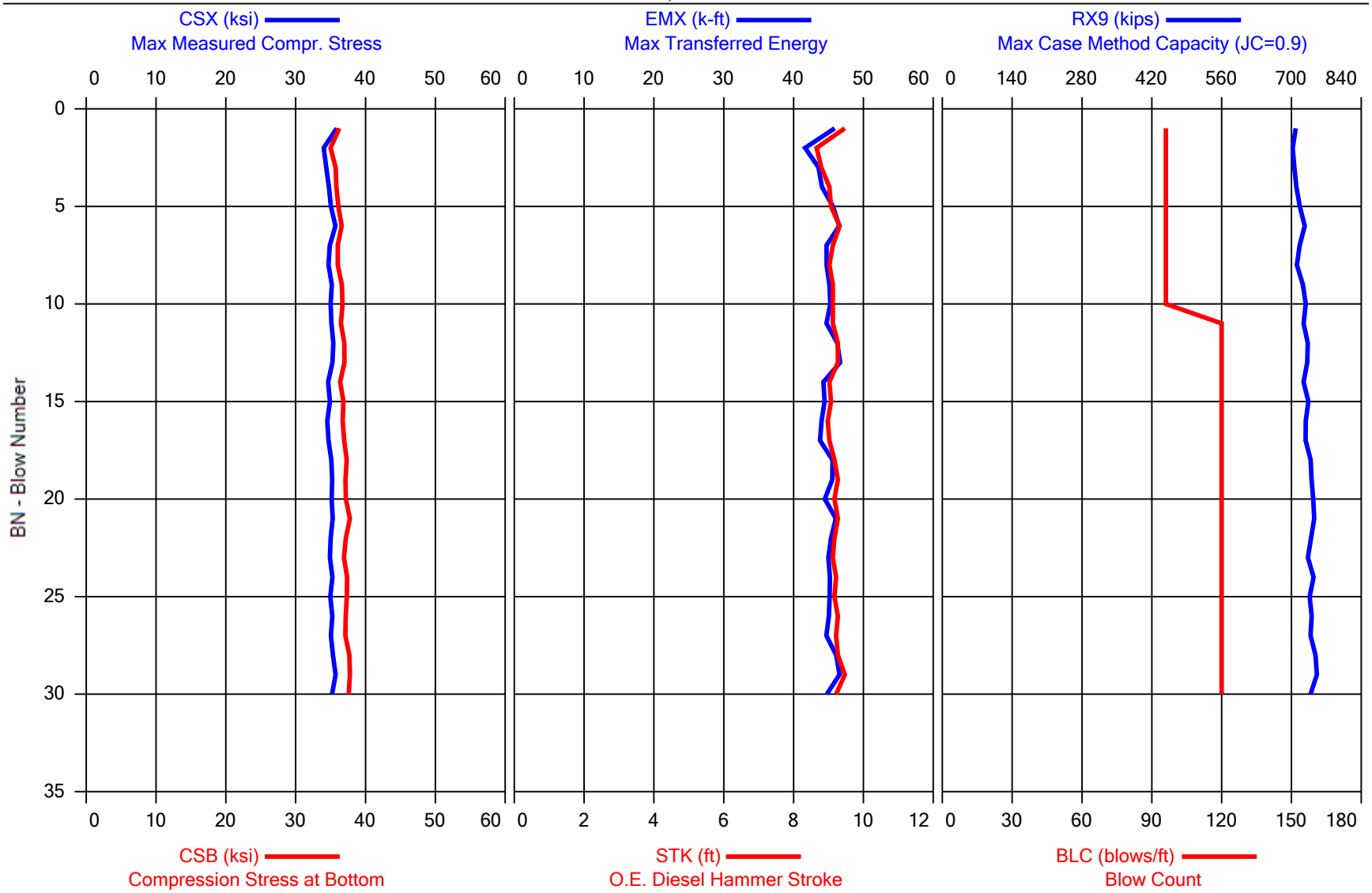
GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.50.1 - Case Method & iCAP® Results

Printed: 11-June-2015

Test started: 11-June-2015

USH 10 over Little Lake Butte des Morts - PIER 19 #36 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - PIER 19 #36 Restrike APE D30-42, HP 14 x 73
OP: AM Date: 11-June-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.60 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

CSX: Max Measured Compr. Stress STK: O.E. Diesel Hammer Stroke
CSB: Compression Stress at Bottom BPM: Blows per Minute
EMX: Max Transferred Energy RX9: Max Case Method Capacity (JC=0.9)

BL#	Depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
10	66.02	96	AV10	35.0	36.1	45	9.1	39.3	715
			STD	0.5	0.5	1	0.2	0.5	8
			MAX	35.9	36.7	47	9.5	40.2	729
			MIN	34.0	35.0	42	8.7	38.5	703
20	66.10	120	AV10	35.0	36.9	45	9.1	39.2	733
			STD	0.3	0.3	1	0.1	0.2	6
			MAX	35.4	37.3	47	9.3	39.5	744
			MIN	34.5	36.4	44	9.0	38.9	724
30	66.19	120	AV10	35.2	37.4	45	9.2	39.0	741
			STD	0.2	0.3	1	0.1	0.2	5
			MAX	35.7	37.8	47	9.5	39.2	751
			MIN	34.9	36.9	45	9.1	38.5	733
			Average	35.1	36.8	45	9.1	39.1	730
			Std. Dev.	0.4	0.6	1	0.2	0.3	13
			Maximum	35.9	37.8	47	9.5	40.2	751
			Minimum	34.0	35.0	42	8.7	38.5	703

Total number of blows analyzed: 30

BL# Sensors

1-30 F3: [D815] 93.0 (1.00); F4: [K769] 91.9 (1.00); A3: [K3550] 360.0 (1.00); A4: [K3658] 362.0 (1.00)

Time Summary

Drive 44 seconds 6:44 AM - 6:45 AM BN 1 - 30

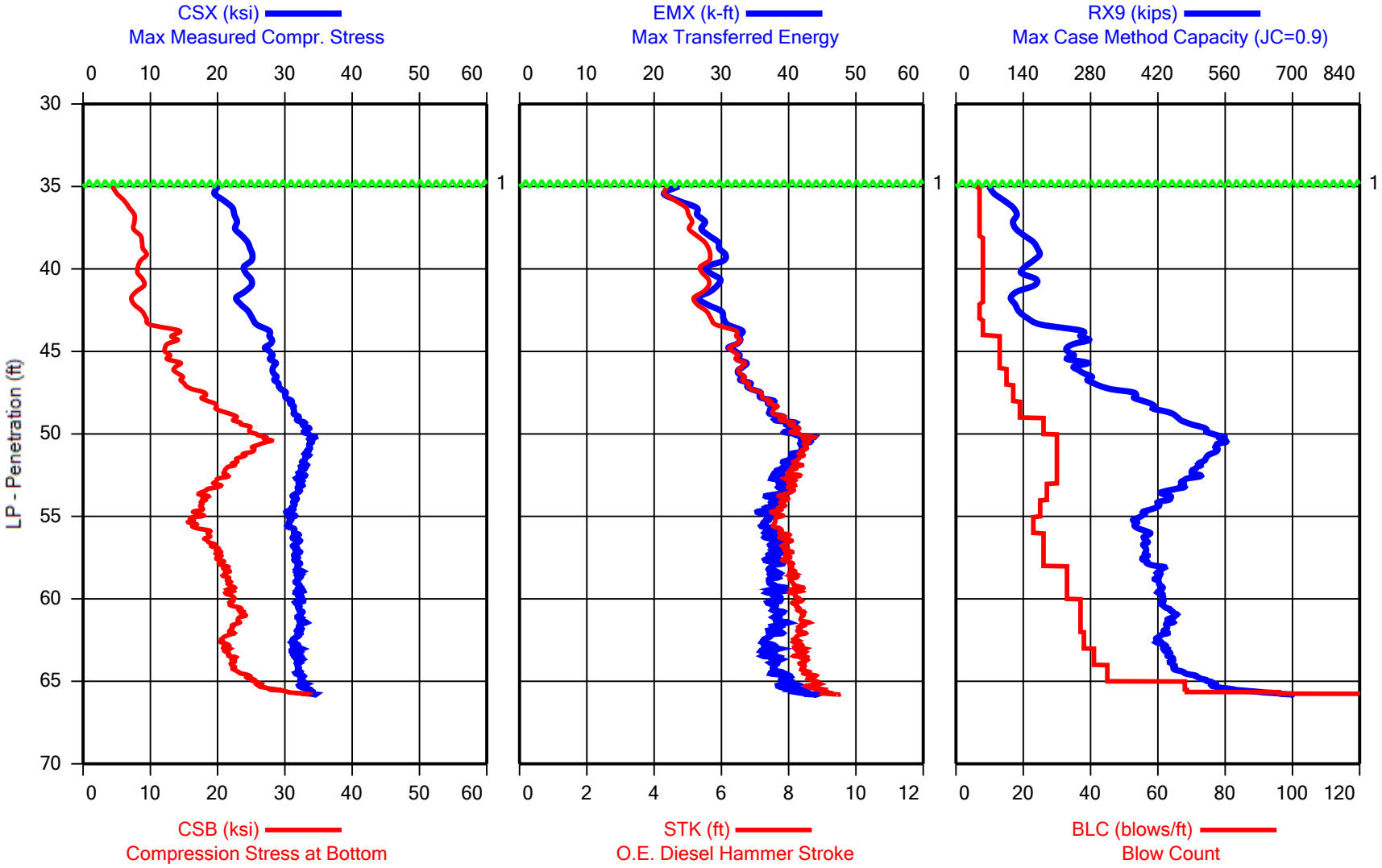
GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.50.1 - Case Method & iCAP® Results

Printed: 12-June-2015

Test started: 10-June-2015

USH 10 over Little Lake Butte des Morts - PIER 19 #44

APE D30-42, HP 14 x 73



1 - Reported reference at El. 739.7

USH 10 over Little Lake Butte des Morts - PIER 19 #44 APE D30-42, HP 14 x 73
OP: TC Date: 10-June-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

CSX: Max Measured Compr. Stress STK: O.E. Diesel Hammer Stroke
CSB: Compression Stress at Bottom BPM: Blows per Minute
EMX: Max Transferred Energy RX9: Max Case Method Capacity (JC=0.9)

BL#	Depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
6	35.00	6	AV2	21.4	4.4	26	4.6	54.5	68
			STD	2.5	0.2	6	0.4	2.5	7
			MAX	24.0	4.6	32	5.1	57.0	75
			MIN	18.9	4.2	20	4.2	52.0	61
13	36.00	7	AV7	19.8	5.4	22	4.4	55.6	87
			STD	1.2	0.7	2	0.3	1.5	13
			MAX	21.4	6.4	24	4.7	58.3	106
			MIN	17.5	4.3	19	4.0	53.7	70
20	37.00	7	AV7	22.4	7.3	27	5.0	52.2	122
			STD	0.5	0.4	1	0.1	0.6	8
			MAX	23.1	7.7	28	5.2	53.1	135
			MIN	21.7	6.7	26	4.8	51.4	112
27	38.00	7	AV7	22.9	7.8	27	5.1	51.8	128
			STD	0.5	0.5	1	0.1	0.5	11
			MAX	24.0	8.6	29	5.3	52.1	141
			MIN	22.4	7.3	27	5.0	50.7	112
35	39.00	8	AV8	24.7	8.9	30	5.6	49.7	165
			STD	0.4	0.3	1	0.1	0.4	9
			MAX	25.5	9.5	32	5.7	50.4	178
			MIN	24.0	8.3	28	5.4	49.1	149
43	40.00	8	AV8	24.6	8.6	29	5.5	49.8	157
			STD	0.7	0.5	1	0.2	0.7	12
			MAX	25.6	9.6	31	5.8	50.6	172
			MIN	23.8	8.0	27	5.4	48.8	137
51	41.00	8	AV8	24.7	8.7	29	5.6	49.7	156
			STD	0.7	0.6	1	0.1	0.6	16
			MAX	25.6	9.5	31	5.8	50.5	175
			MIN	23.8	7.9	28	5.4	48.9	135
59	42.00	8	AV8	23.5	7.6	27	5.3	50.8	124
			STD	1.0	0.6	2	0.2	1.0	12
			MAX	24.8	8.6	30	5.6	52.2	151
			MIN	22.1	7.0	25	5.0	49.4	113
66	43.00	7	AV7	24.4	8.6	30	5.5	49.8	133
			STD	0.5	0.7	1	0.1	0.6	9
			MAX	25.1	9.6	31	5.7	50.8	153
			MIN	23.5	7.3	28	5.3	49.0	124
74	44.00	8	AV8	26.7	11.9	32	6.1	47.6	215
			STD	1.1	2.2	2	0.4	1.4	44
			MAX	28.3	15.1	34	6.7	49.3	266
			MIN	25.1	9.4	30	5.7	45.6	158
87	45.00	13	AV13	27.7	12.9	32	6.4	46.5	250
			STD	0.5	0.8	1	0.2	0.5	20
			MAX	28.8	14.4	34	6.8	47.4	291
			MIN	26.8	11.6	31	6.1	45.3	217
100	46.00	13	AV13	28.2	13.3	33	6.5	46.0	248

USH 10 over Little Lake Butte des Morts - PIER 19 #44 APE D30-42, HP 14 x 73
OP: TC Date: 10-June-2015

BL#	Depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			STD	0.6	1.0	1	0.2	0.6	18
			MAX	29.1	15.2	35	6.8	47.1	292
			MIN	26.9	11.9	31	6.2	45.2	229
115	47.00	15	AV15	28.5	14.4	33	6.6	45.7	273
			STD	0.6	0.6	1	0.2	0.6	13
			MAX	30.0	15.6	36	7.1	46.5	299
			MIN	27.7	13.3	31	6.4	44.3	253
132	48.00	17	AV17	29.9	17.3	35	7.1	44.3	352
			STD	0.8	1.2	2	0.3	0.8	31
			MAX	31.2	18.7	38	7.5	45.4	388
			MIN	28.7	14.7	33	6.7	43.1	294
151	49.00	19	AV19	31.3	20.6	38	7.6	42.8	427
			STD	0.6	1.4	1	0.2	0.5	22
			MAX	32.7	23.2	40	8.1	43.5	460
			MIN	30.6	18.3	35	7.4	41.6	394
177	50.00	26	AV26	32.8	24.0	40	8.1	41.6	499
			STD	0.6	1.1	1	0.2	0.5	24
			MAX	34.0	25.7	42	8.4	42.6	530
			MIN	31.5	21.6	37	7.7	40.9	461
207	51.00	30	AV30	33.8	26.4	42	8.5	40.5	549
			STD	0.5	1.1	1	0.2	0.4	9
			MAX	35.0	28.2	45	8.9	41.2	569
			MIN	32.7	24.5	40	8.2	39.7	533
237	52.00	30	AV30	33.0	23.3	40	8.3	41.1	520
			STD	0.5	1.1	1	0.1	0.3	13
			MAX	33.7	25.9	43	8.5	41.8	551
			MIN	32.3	21.2	39	8.0	40.5	496
267	53.00	30	AV30	32.4	20.7	39	8.1	41.5	490
			STD	0.5	1.0	1	0.2	0.4	14
			MAX	33.3	22.9	41	8.4	42.3	514
			MIN	31.3	19.0	37	7.8	40.7	463
294	54.00	27	AV27	31.9	18.6	39	8.0	41.8	450
			STD	0.6	1.2	1	0.2	0.5	17
			MAX	33.1	20.9	42	8.4	42.7	480
			MIN	30.9	16.5	36	7.6	40.7	423
319	55.00	25	AV25	31.1	17.5	37	7.7	42.4	408
			STD	0.5	0.7	1	0.2	0.4	16
			MAX	31.9	18.5	39	7.9	43.5	440
			MIN	29.8	15.7	35	7.4	41.9	380
342	56.00	23	AV23	30.9	16.9	37	7.7	42.7	380
			STD	0.6	1.2	1	0.2	0.5	13
			MAX	31.9	20.5	39	8.0	43.6	414
			MIN	29.6	14.7	35	7.3	41.7	363
368	57.00	26	AV26	31.6	19.0	38	7.9	42.1	394
			STD	0.7	0.8	2	0.2	0.5	5
			MAX	32.8	20.4	41	8.3	43.3	404
			MIN	30.0	17.4	34	7.4	41.1	387
394	58.00	26	AV26	31.8	20.3	38	8.0	41.8	396
			STD	0.5	0.7	1	0.2	0.4	8
			MAX	32.7	21.5	41	8.3	42.8	411
			MIN	30.3	19.1	35	7.6	41.1	384

USH 10 over Little Lake Butte des Morts - PIER 19 #44 APE D30-42, HP 14 x 73
OP: TC Date: 10-June-2015

BL#	Depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
427	59.00	33	AV33	32.0	21.4	38	8.1	41.5	423
			STD	0.5	0.7	1	0.1	0.4	7
			MAX	33.1	22.5	39	8.4	42.2	443
			MIN	31.0	19.9	36	7.8	40.8	412
460	60.00	33	AV33	32.2	21.9	38	8.2	41.2	426
			STD	0.6	0.6	1	0.2	0.4	4
			MAX	33.7	23.3	41	8.6	42.1	434
			MIN	30.8	20.9	36	7.9	40.4	415
497	61.00	37	AV37	32.2	22.8	38	8.3	41.0	440
			STD	0.6	0.9	1	0.2	0.5	11
			MAX	33.6	24.6	41	8.7	42.3	462
			MIN	30.6	21.4	35	7.8	40.2	418
534	62.00	37	AV37	32.3	22.7	38	8.4	40.8	442
			STD	0.7	0.7	1	0.2	0.4	8
			MAX	34.0	24.2	41	8.8	41.7	464
			MIN	30.4	21.6	35	8.0	39.9	428
572	63.00	38	AV38	31.7	21.2	37	8.3	41.1	427
			STD	0.6	0.7	1	0.2	0.4	8
			MAX	33.0	23.3	40	8.6	42.1	446
			MIN	30.6	19.9	35	7.9	40.3	413
613	64.00	41	AV41	31.9	21.9	38	8.4	40.8	444
			STD	0.7	0.6	1	0.2	0.4	6
			MAX	33.0	23.3	40	8.7	41.9	455
			MIN	30.3	20.8	34	7.9	40.0	428
658	65.00	45	AV45	32.2	23.7	39	8.6	40.4	482
			STD	0.6	1.2	1	0.2	0.4	25
			MAX	33.9	26.7	43	9.0	41.4	526
			MIN	31.0	21.9	36	8.1	39.5	449
692	65.50	68	AV34	32.8	26.6	40	8.8	39.9	544
			STD	0.6	0.9	1	0.2	0.4	15
			MAX	34.5	29.7	43	9.2	40.7	579
			MIN	31.9	25.2	38	8.4	39.1	525
702	65.65	69	AV10	33.7	29.5	42	9.0	39.4	605
			STD	0.5	0.9	1	0.2	0.4	17
			MAX	34.4	30.9	43	9.4	40.1	635
			MIN	32.7	27.9	40	8.7	38.7	579
712	65.75	96	AV10	33.9	31.7	42	9.2	39.1	657
			STD	0.6	1.0	1	0.1	0.3	14
			MAX	34.8	33.4	44	9.4	39.5	675
			MIN	33.0	30.2	41	9.0	38.6	638
721	65.83	120	AV9	34.3	33.4	43	9.4	38.7	691
			STD	0.5	0.8	1	0.2	0.3	11
			MAX	35.0	34.8	45	9.6	39.2	711
			MIN	33.6	32.1	41	9.1	38.3	674
			Average	31.1	20.4	37	7.8	42.5	419
			Std. Dev.	2.8	5.5	4	1.0	3.2	120
			Maximum	35.0	34.8	45	9.6	58.3	711
			Minimum	17.5	4.2	19	4.0	38.3	61

Total number of blows analyzed: 717

BL#	Sensors
1-721	F3: [K769] 91.9 (1.00); F4: [D815] 93.0 (1.00); A3: [K3658] 362.0 (1.00); A4: [K3550] 360.0 (1.00)

BL#	Comments
5	Reported reference at El. 739.7
6	Mud line at El. 718.2

Time Summary

Drive	17 minutes 16 seconds	7:02 AM - 7:20 AM	BN 1 - 721

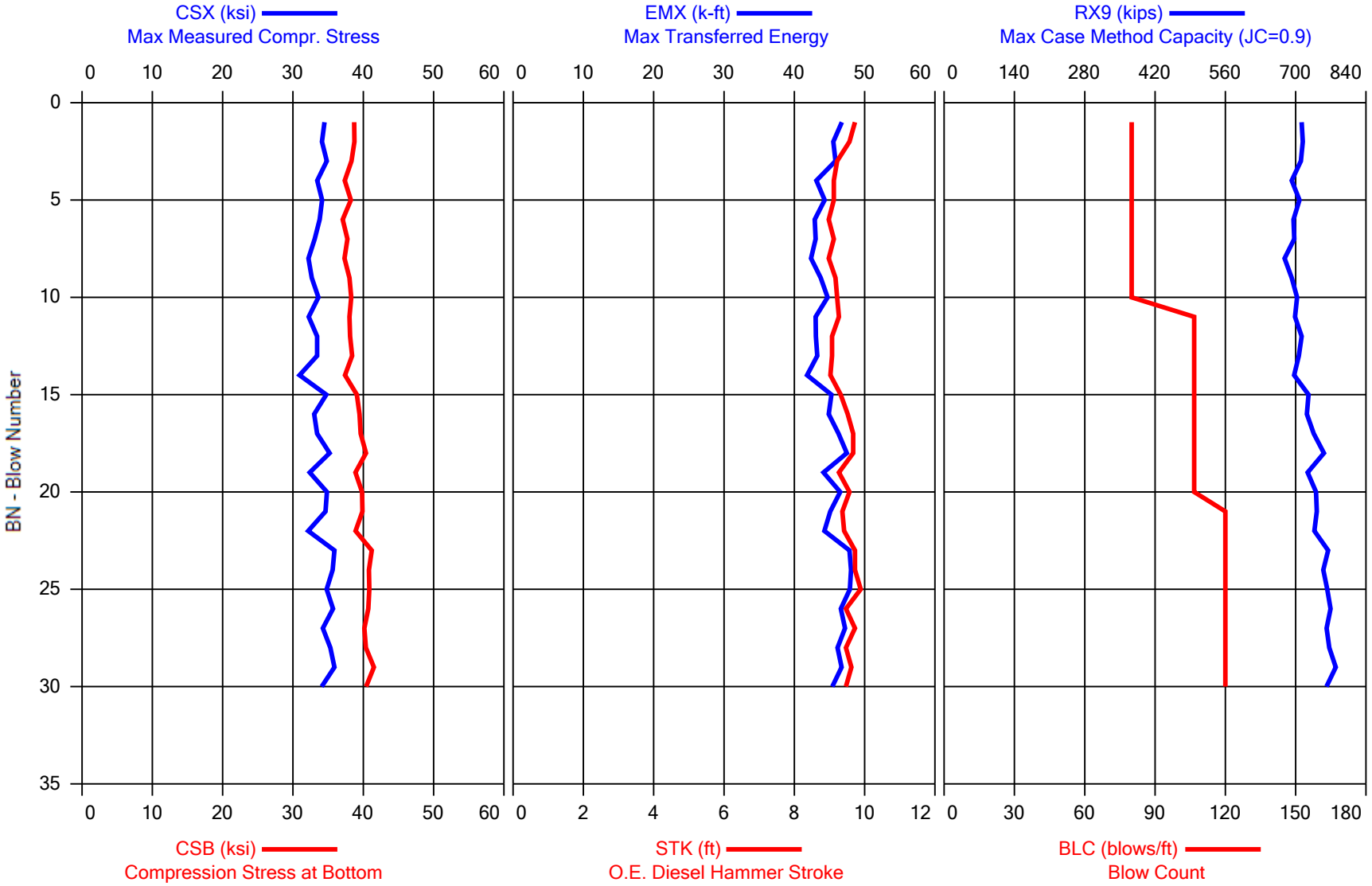
GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.50.1 - Case Method & iCAP® Results

Printed: 11-June-2015

Test started: 11-June-2015

USH 10 over Little Lake Butte des Morts - PIER 19 #44 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - PIER 19 #44 Restrike APE D30-42, HP 14 x 73
OP: AM Date: 11-June-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

CSX: Max Measured Compr. Stress STK: O.E. Diesel Hammer Stroke
CSB: Compression Stress at Bottom BPM: Blows per Minute
EMX: Max Transferred Energy RX9: Max Case Method Capacity (JC=0.9)

BL#	Depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
10	65.96	80	AV10	33.6	38.0	44	9.2	39.0	700
			STD	0.8	0.6	1	0.2	0.5	11
			MAX	34.8	38.7	47	9.7	39.5	714
			MIN	32.2	37.1	42	9.0	38.0	678
20	66.05	107	AV10	33.4	38.9	45	9.3	38.8	722
			STD	1.3	0.9	2	0.2	0.5	18
			MAX	35.2	40.4	47	9.7	39.4	756
			MIN	30.9	37.4	42	9.0	38.1	697
30	66.14	120	AV10	34.8	40.5	47	9.6	38.3	760
			STD	1.1	0.7	1	0.2	0.3	12
			MAX	35.9	41.5	48	9.9	38.7	780
			MIN	32.2	38.9	44	9.4	37.7	737
			Average	33.9	39.1	45	9.4	38.7	727
			Std. Dev.	1.2	1.3	2	0.3	0.5	28
			Maximum	35.9	41.5	48	9.9	39.5	780
			Minimum	30.9	37.1	42	9.0	37.7	678

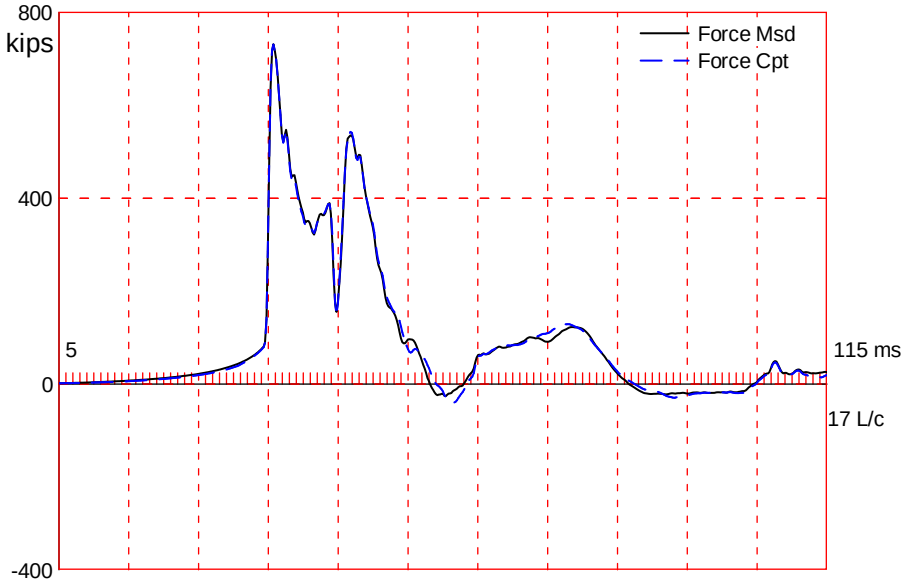
Total number of blows analyzed: 30

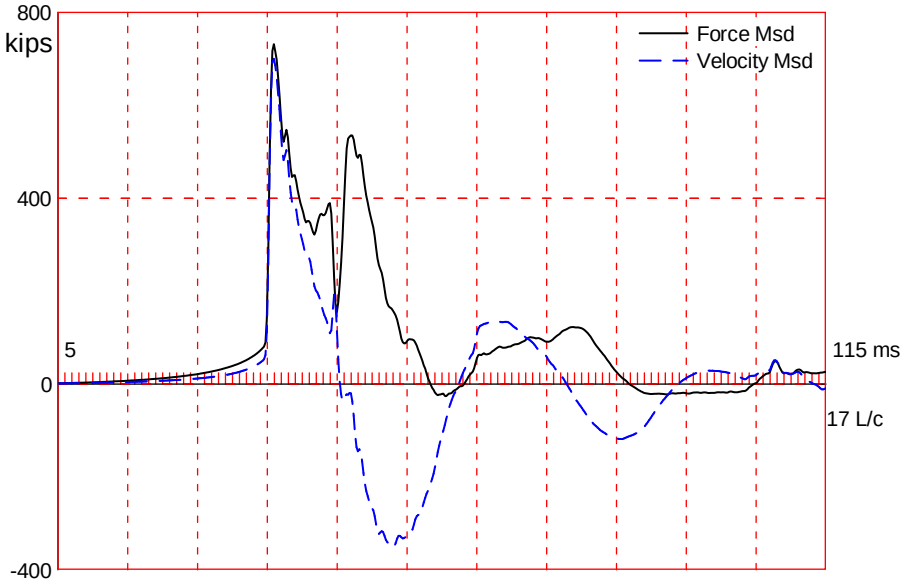
BL# Sensors

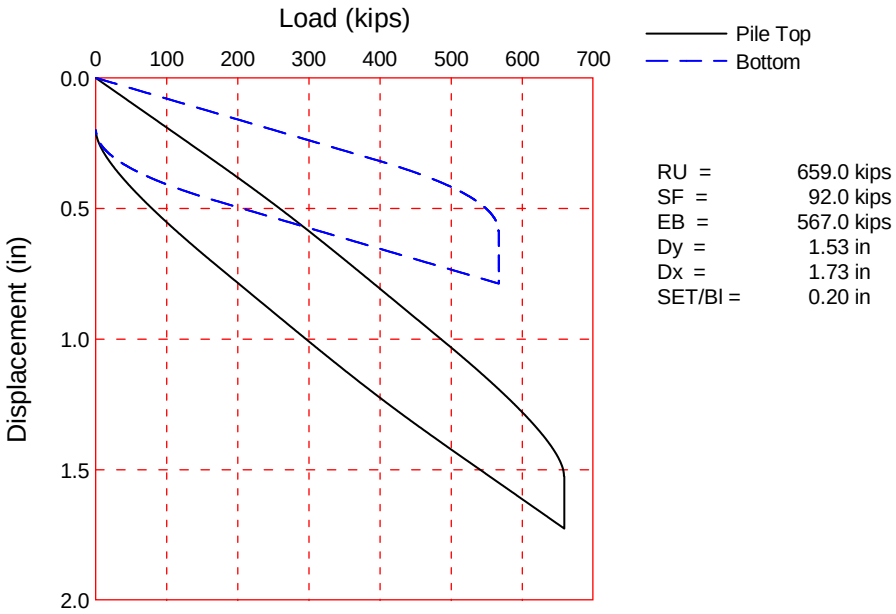
1-30 F3: [D815] 93.0 (1.00); F4: [K769] 91.9 (1.00); A3: [K3550] 360.0 (1.00); A4: [K3658] 362.0 (1.00)

Time Summary

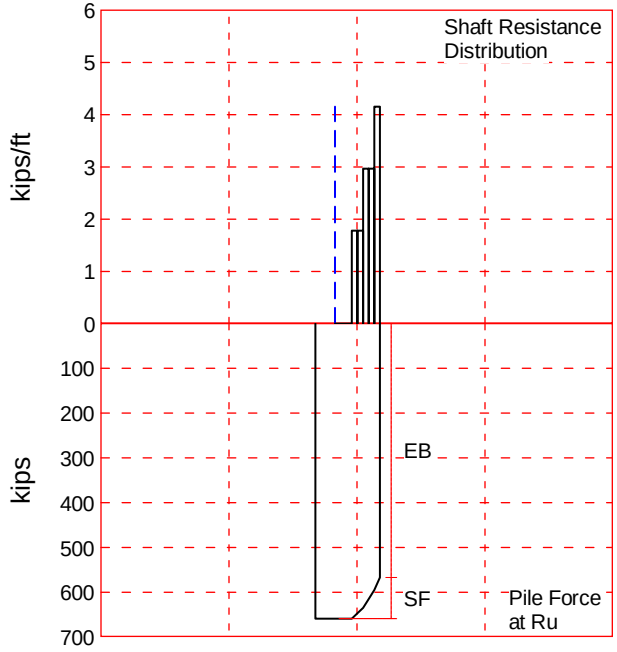
Drive 44 seconds 6:35 AM - 6:36 AM BN 1 - 30







RU =	659.0 kips
SF =	92.0 kips
EB =	567.0 kips
Dy =	1.53 in
Dx =	1.73 in
SET/Bl =	0.20 in



Length b. Sensors	77.5 ft
Embedment	52.0 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16790 ft/s
Match Quality	1.98
Top Compr. Stress	34.2 ksi
Max Compr. Stress	36.5 ksi
Max Tension Stress	-6.46 ksi
Avg. Shaft Quake	0.19 in
Toe Quake	0.45 in
Avg. Shaft Smith Dpg.	0.25 s/ft
Toe Smith Damping	0.05 s/ft

About the CAPWAP Results

The CAPWAP program performs a signal matching or reverse analysis based on measurements taken on a deep foundation under an impact load. The program is based on a one-dimensional mathematical model. Under certain conditions, the model only crudely approximates the often complex dynamic situations.

The CAPWAP analysis relies on the input of accurately measured dynamic data plus additional parameters describing pile and soil behavior. If the field measurements of force and velocity are incorrect or were taken under inappropriate conditions (e.g., at an inappropriate time or with too much or too little energy) or if the input pile model is incorrect, then the solution cannot represent the actual soil behavior.

Generally the CAPWAP analysis is used to estimate the axial compressive pile capacity and the soil resistance distribution. The long-term capacity is best evaluated with restrike tests since they incorporate soil strength changes (set-up gains or relaxation losses) that occur after installation. The calculated load settlement graph does not consider creep or long term consolidation settlements. When uplift is a controlling factor in the design, use of the CAPWAP results to assess uplift capacity should be made only after very careful analysis of only good measurement quality, and further used only with longer pile lengths and with nominally higher safety factors.

CAPWAP is also used to evaluate driving stresses along the length of the pile. However, it should be understood that the analysis is one dimensional and does not take into account bending effects or local contact stresses at the pile toe.

Furthermore, if the user of this software was not able to produce a solution with satisfactory signal “match quality” (MQ), then the associated CAPWAP results may be unreliable. There is no absolute scale for solution acceptability but solutions with MQ above 5 are generally considered less reliable than those with lower MQ values and every effort should be made to improve the analysis, for example, by getting help from other independent experts.

Considering the CAPWAP model limitations, the nature of the input parameters, the complexity of the analysis procedure, and the need for a responsible application of the results to actual construction projects, it is recommended that at least one static load test be performed on sites where little experience exists with dynamic behavior of the soil resistance or when the experience of the analyzing engineer with both program use and result application is limited.

Finally, the CAPWAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors. The CAPWAP results should be reviewed by the Engineer of Record with consideration of applicable geotechnical conditions including, but not limited to, group effects, potential settlement from underlying compressible layers, soil resistances provided from any layers unsuitable for long term support, as well as effective stress changes due to soil surcharges, excavation or change in water table elevation.

The CAPWAP analysis software is one of many means by which the capacity of a deep foundation can be assessed. The engineer performing the analysis is responsible for proper software application and the analysis results. Pile Dynamics accepts no liability whatsoever of any kind for the analysis solution and/or the application of the analysis result.

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 659.0; along Shaft 92.0; at Toe 567.0 kips

Soil Sgmnt 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
				659.0				
1	30.3	4.8	0.0	659.0	0.0	0.00	0.00	0.00
2	37.1	11.5	0.0	659.0	0.0	0.00	0.00	0.00
3	43.8	18.3	0.0	659.0	0.0	0.00	0.00	0.00
4	50.5	25.0	12.0	647.0	12.0	1.78	0.38	0.25
5	57.3	31.7	12.0	635.0	24.0	1.78	0.38	0.25
6	64.0	38.5	20.0	615.0	44.0	2.97	0.63	0.25
7	70.8	45.2	20.0	595.0	64.0	2.97	0.63	0.25
8	77.5	52.0	28.0	567.0	92.0	4.15	0.88	0.25
Avg. Shaft			11.5			1.77	0.38	0.25
Toe			567.0				411.32	0.05

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.19	0.45
Case Damping Factor		0.60	0.74
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	95	30
Reloading Level	(% of Ru)	100	0
Unloading Level	(% of Ru)	67	
Resistance Gap (included in Toe Quake)	(in)		0.02

CAPWAP match quality = 1.98 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.20 in; Blow Count = 60 b/ft
Computed: Final Set = 0.04 in; Blow Count = 319 b/ft
Transducer F3(K769) CAL: 91.9; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K3658) CAL: 362; RF: 1.00; A4(K3550) CAL: 360; RF: 1.00

max. Top Comp. Stress = 34.2 ksi (T= 36.1 ms, max= 1.067 x Top)
max. Comp. Stress = 36.5 ksi (Z= 50.5 ft, T= 38.9 ms)
max. Tens. Stress = -6.46 ksi (Z= 50.5 ft, T= 61.4 ms)
max. Energy (EMX) = 44.2 kip-ft; max. Measured Top Displ. (DMX)= 1.19 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	3.4	731.7	-50.1	34.2	-2.34	44.2	18.3	1.20
2	6.7	732.4	-61.3	34.2	-2.87	44.0	18.3	1.18
4	13.5	734.0	-84.5	34.3	-3.95	43.2	18.2	1.13
5	16.8	734.9	-96.3	34.3	-4.50	42.6	18.2	1.10
6	20.2	735.8	-111.3	34.4	-5.20	41.9	18.2	1.07
7	23.6	736.8	-122.6	34.4	-5.73	41.2	18.2	1.04
8	27.0	737.8	-129.9	34.5	-6.07	40.5	18.1	1.00
9	30.3	739.0	-132.8	34.5	-6.20	39.8	18.1	0.97
10	33.7	740.2	-133.9	34.6	-6.26	39.0	18.0	0.93
11	37.1	741.6	-135.3	34.6	-6.32	38.2	18.0	0.90
12	40.4	743.3	-136.1	34.7	-6.36	37.4	17.9	0.87
13	43.8	751.4	-136.6	35.1	-6.38	36.6	17.7	0.83
14	47.2	767.3	-137.2	35.8	-6.41	35.8	17.3	0.79
15	50.5	780.8	-138.4	36.5	-6.46	34.8	16.9	0.76
16	53.9	733.8	-125.7	34.3	-5.87	31.3	16.5	0.72
17	57.3	752.8	-127.2	35.2	-5.94	30.3	16.1	0.68
18	60.7	714.4	-115.0	33.4	-5.37	27.1	15.5	0.64
19	64.0	735.2	-116.4	34.3	-5.44	26.1	15.0	0.60
20	67.4	659.6	-94.4	30.8	-4.41	21.9	16.3	0.57
21	70.8	661.0	-95.2	30.9	-4.45	20.9	17.8	0.53
22	74.1	641.3	-77.7	30.0	-3.63	17.1	18.6	0.49
23	77.5	660.2	-78.5	30.8	-3.67	14.1	17.4	0.45
Absolute	50.5			36.5			(T =	38.9 ms)
	50.5				-6.46		(T =	61.4 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	764.2	694.6	625.1	555.5	485.9	416.4	346.8	277.3	207.7	138.1
RX	821.6	783.1	757.4	731.7	706.1	688.5	677.1	665.7	656.1	649.1
RU	764.2	694.6	625.1	555.5	485.9	416.4	346.8	277.3	207.7	138.1

RAU = 620.1 (kips); RA2 = 705.1 (kips)

Current CAPWAP Ru = 659.0 (kips); Corresponding J(RP)= 0.15; J(RX) = 0.77

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS	KEB
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips	kips/in
18.8	35.92	716.5	743.3	743.3	1.19	0.20	0.20	44.6	769.4	1319

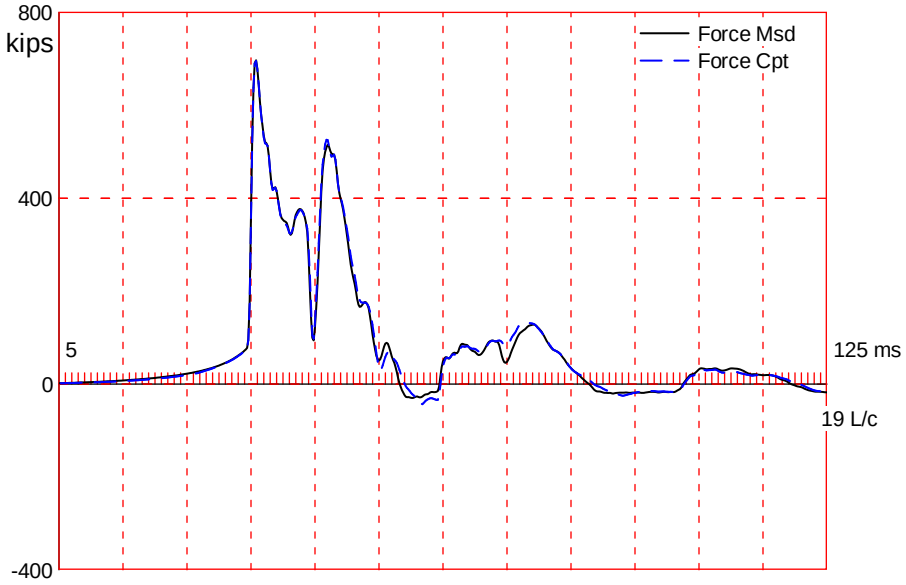
PILE PROFILE AND PILE MODEL

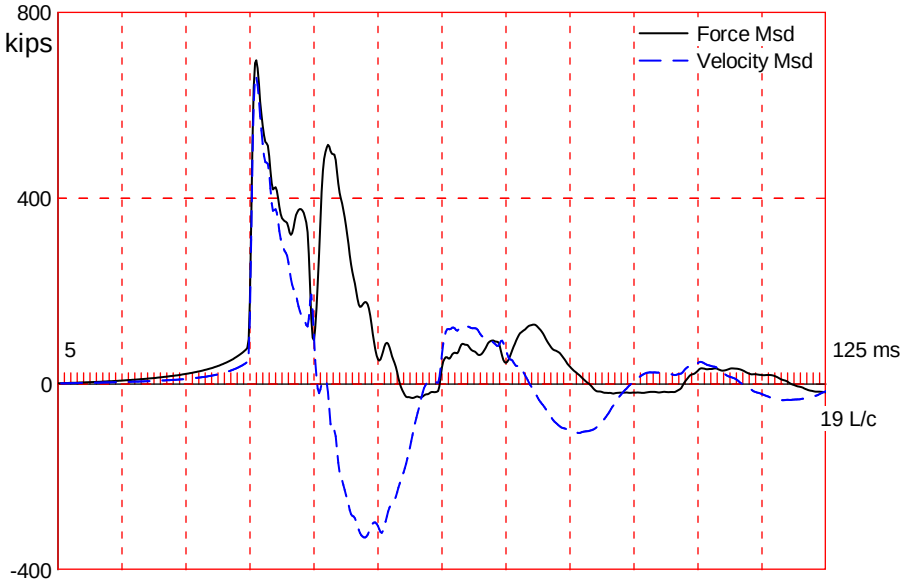
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.5	21.4	29992.2	492.000	4.70

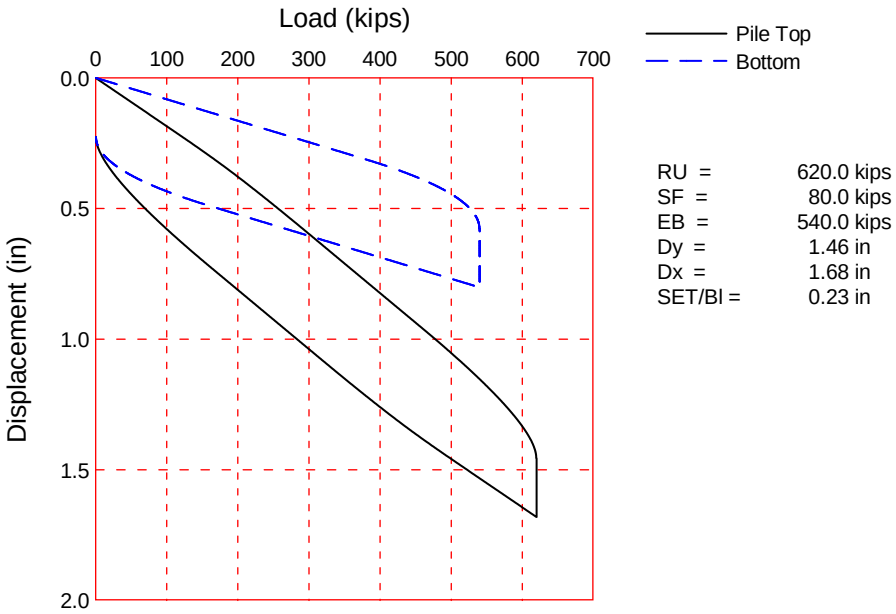
Toe Area 198.5 in^2

Top Segment Length 3.37 ft, Top Impedance 38 kips/ft/s

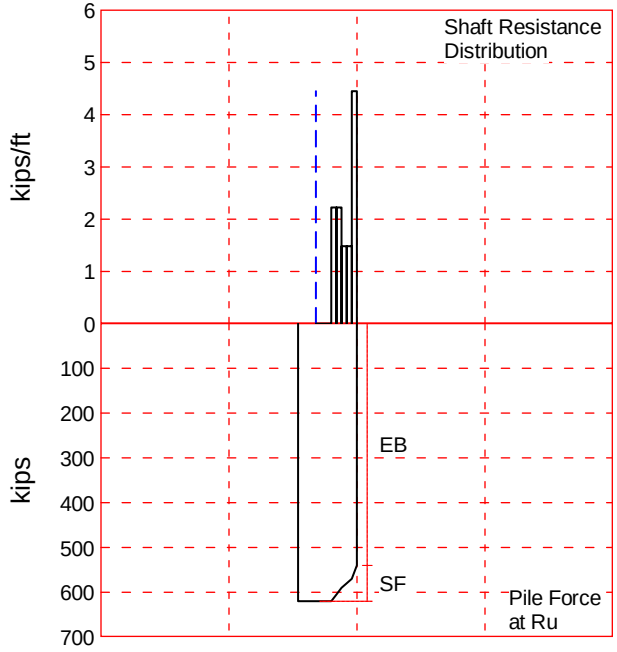
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16790.1 ft/s
Pile Damping 1.00 %, Time Incr 0.201 ms, 2L/c 9.2 ms
Total volume: 11.517 ft^3; Volume ratio considering added impedance: 1.000







RU =	620.0 kips
SF =	80.0 kips
EB =	540.0 kips
Dy =	1.46 in
Dx =	1.68 in
SET/Bl =	0.23 in



Length b. Sensors	77.5 ft
Embedment	52.1 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16848 ft/s
Match Quality	2.48
Top Compr. Stress	32.5 ksi
Max Compr. Stress	35.2 ksi
Max Tension Stress	-6.50 ksi
Avg. Shaft Quake	0.14 in
Toe Quake	0.44 in
Avg. Shaft Smith Dpg.	0.25 s/ft
Toe Smith Damping	0.06 s/ft

About the CAPWAP Results

The CAPWAP program performs a signal matching or reverse analysis based on measurements taken on a deep foundation under an impact load. The program is based on a one-dimensional mathematical model. Under certain conditions, the model only crudely approximates the often complex dynamic situations.

The CAPWAP analysis relies on the input of accurately measured dynamic data plus additional parameters describing pile and soil behavior. If the field measurements of force and velocity are incorrect or were taken under inappropriate conditions (e.g., at an inappropriate time or with too much or too little energy) or if the input pile model is incorrect, then the solution cannot represent the actual soil behavior.

Generally the CAPWAP analysis is used to estimate the axial compressive pile capacity and the soil resistance distribution. The long-term capacity is best evaluated with restrike tests since they incorporate soil strength changes (set-up gains or relaxation losses) that occur after installation. The calculated load settlement graph does not consider creep or long term consolidation settlements. When uplift is a controlling factor in the design, use of the CAPWAP results to assess uplift capacity should be made only after very careful analysis of only good measurement quality, and further used only with longer pile lengths and with nominally higher safety factors.

CAPWAP is also used to evaluate driving stresses along the length of the pile. However, it should be understood that the analysis is one dimensional and does not take into account bending effects or local contact stresses at the pile toe.

Furthermore, if the user of this software was not able to produce a solution with satisfactory signal “match quality” (MQ), then the associated CAPWAP results may be unreliable. There is no absolute scale for solution acceptability but solutions with MQ above 5 are generally considered less reliable than those with lower MQ values and every effort should be made to improve the analysis, for example, by getting help from other independent experts.

Considering the CAPWAP model limitations, the nature of the input parameters, the complexity of the analysis procedure, and the need for a responsible application of the results to actual construction projects, it is recommended that at least one static load test be performed on sites where little experience exists with dynamic behavior of the soil resistance or when the experience of the analyzing engineer with both program use and result application is limited.

Finally, the CAPWAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors. The CAPWAP results should be reviewed by the Engineer of Record with consideration of applicable geotechnical conditions including, but not limited to, group effects, potential settlement from underlying compressible layers, soil resistances provided from any layers unsuitable for long term support, as well as effective stress changes due to soil surcharges, excavation or change in water table elevation.

The CAPWAP analysis software is one of many means by which the capacity of a deep foundation can be assessed. The engineer performing the analysis is responsible for proper software application and the analysis results. Pile Dynamics accepts no liability whatsoever of any kind for the analysis solution and/or the application of the analysis result.

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 620.0; along Shaft 80.0; at Toe 540.0 kips

Soil Sgmnt 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
				620.0				
1	30.3	4.9	0.0	620.0	0.0	0.00	0.00	0.00
2	37.1	11.6	0.0	620.0	0.0	0.00	0.00	0.00
3	43.8	18.4	0.0	620.0	0.0	0.00	0.00	0.00
4	50.5	25.1	15.0	605.0	15.0	2.23	0.47	0.25
5	57.3	31.8	15.0	590.0	30.0	2.23	0.47	0.25
6	64.0	38.6	10.0	580.0	40.0	1.48	0.32	0.25
7	70.8	45.3	10.0	570.0	50.0	1.48	0.32	0.25
8	77.5	52.1	30.0	540.0	80.0	4.45	0.95	0.25
Avg. Shaft			10.0			1.54	0.33	0.25
Toe			540.0				391.74	0.06

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.14	0.44
Case Damping Factor		0.52	0.85
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	30
Unloading Level	(% of Ru)	53	
Resistance Gap (included in Toe Quake)	(in)		0.01
Soil Plug Weight	(kips)	0.030	

CAPWAP match quality = 2.48 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.23 in; Blow Count = 53 b/ft
Computed: Final Set = 0.20 in; Blow Count = 60 b/ft
Transducer F3(D815) CAL: 93.0; RF: 1.00; F4(K769) CAL: 91.9; RF: 1.00
A3(K3550) CAL: 360; RF: 1.00; A4(K3658) CAL: 362; RF: 1.00

max. Top Comp. Stress = 32.5 ksi (T= 36.2 ms, max= 1.082 x Top)
max. Comp. Stress = 35.2 ksi (Z= 50.5 ft, T= 39.0 ms)
max. Tens. Stress = -6.50 ksi (Z= 50.5 ft, T= 58.8 ms)
max. Energy (EMX) = 40.7 kip-ft; max. Measured Top Displ. (DMX)= 1.15 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	3.4	696.1	-55.9	32.5	-2.61	40.7	17.4	1.15
2	6.7	696.8	-65.8	32.6	-3.07	40.6	17.3	1.13
4	13.5	698.4	-91.5	32.6	-4.28	40.0	17.3	1.09
5	16.8	699.3	-104.3	32.7	-4.87	39.5	17.3	1.06
6	20.2	700.2	-116.4	32.7	-5.44	39.0	17.2	1.04
7	23.6	701.2	-124.3	32.8	-5.81	38.3	17.2	1.01
8	27.0	702.3	-128.5	32.8	-6.00	37.7	17.2	0.97
9	30.3	703.5	-130.3	32.9	-6.09	37.0	17.1	0.94
10	33.7	704.7	-131.1	32.9	-6.12	36.2	17.1	0.91
11	37.1	706.1	-131.5	33.0	-6.14	35.5	17.1	0.87
12	40.4	708.2	-131.8	33.1	-6.16	34.7	17.0	0.84
13	43.8	720.3	-132.5	33.6	-6.19	33.9	16.7	0.80
14	47.2	737.9	-133.9	34.5	-6.25	33.1	16.2	0.77
15	50.5	753.2	-139.1	35.2	-6.50	32.3	15.8	0.73
16	53.9	698.7	-134.6	32.6	-6.29	28.4	15.3	0.70
17	57.3	719.9	-138.4	33.6	-6.47	27.5	14.7	0.66
18	60.7	660.6	-122.1	30.9	-5.71	23.9	14.5	0.63
19	64.0	662.4	-123.3	30.9	-5.76	23.1	14.6	0.59
20	67.4	620.5	-112.8	29.0	-5.27	20.5	16.1	0.55
21	70.8	622.0	-114.1	29.1	-5.33	19.6	17.6	0.52
22	74.1	628.1	-103.9	29.3	-4.85	17.3	18.1	0.48
23	77.5	650.5	-105.2	30.4	-4.92	14.4	16.6	0.45
Absolute	50.5			35.2			(T =	39.0 ms)
	50.5				-6.50		(T =	58.8 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	660.6	591.6	522.7	453.7	384.8	315.8	246.8	177.9	108.9	40.0
RX	750.9	725.9	700.8	677.4	660.5	647.3	637.5	628.2	619.0	609.7
RU	690.5	622.0	553.5	485.0	416.5	348.0	279.5	211.0	142.5	74.0

RAU = 549.7 (kips); RA2 = 652.7 (kips)

Current CAPWAP Ru = 620.0 (kips); Corresponding J(RP)= 0.06; J(RX) = 0.79

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS	KEB
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips	kips/in
17.6	36.00	658.9	691.2	703.8	1.15	0.23	0.23	41.0	716.0	1256

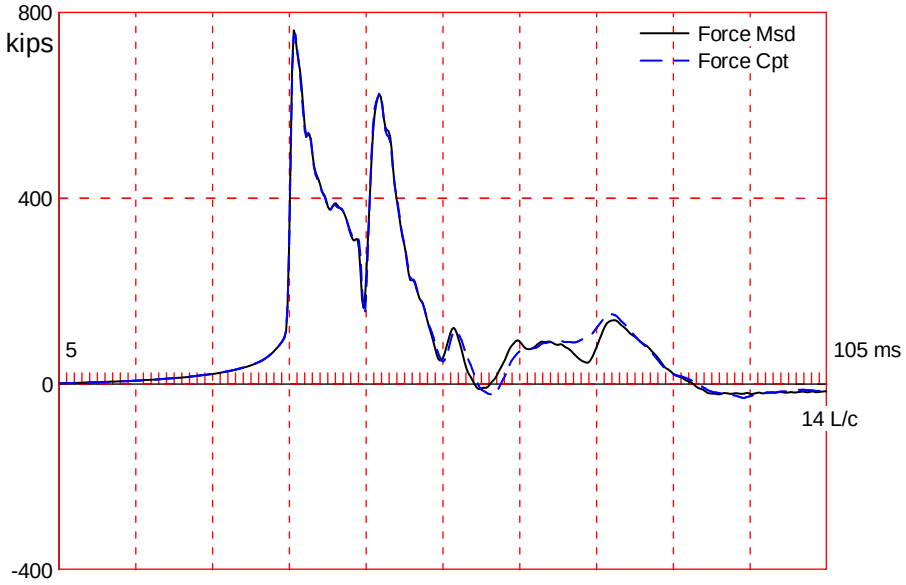
PILE PROFILE AND PILE MODEL

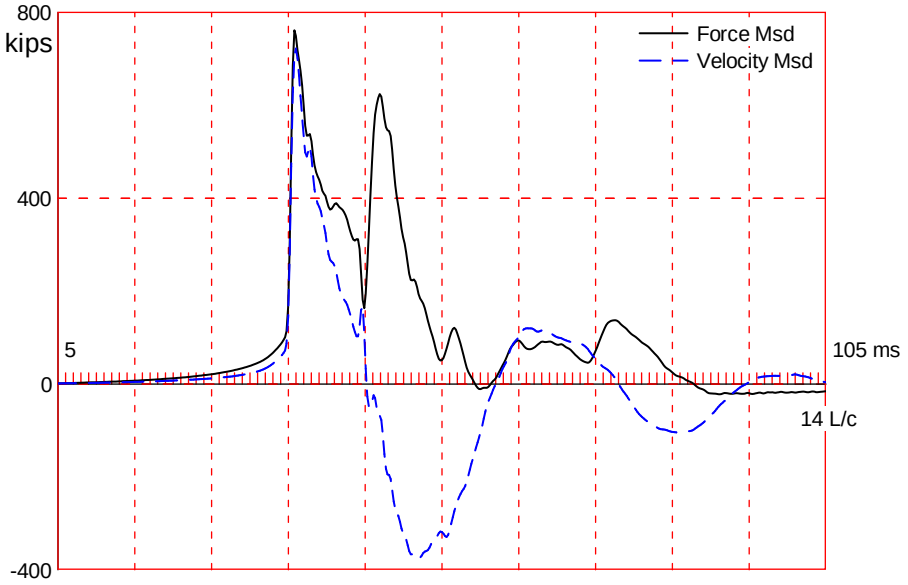
Depth ft	Area in²	E-Modulus ksi	Spec. Weight lb/ft³	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.5	21.4	29992.2	492.000	4.70

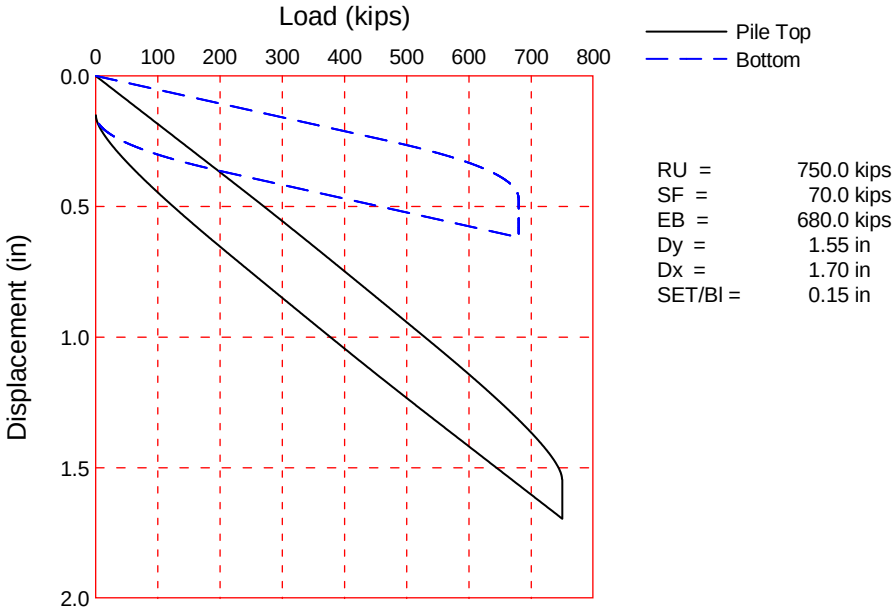
Toe Area 198.5 in²

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16847.8	0.000
19	64.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16847.8	0.020
20	67.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16847.8	0.010
21	70.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16847.8	0.000
23	77.5	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16847.8	0.000

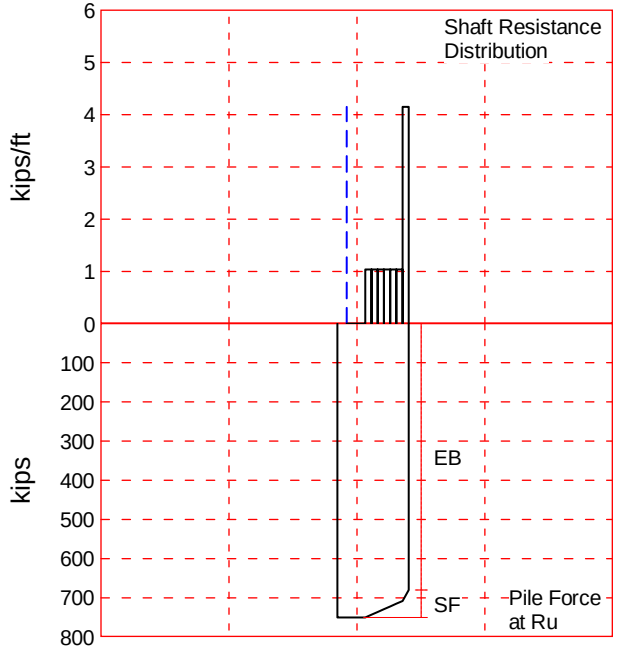
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16847.8 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 9.2 ms
Total volume: 11.517 ft³; Volume ratio considering added impedance: 1.000







RU =	750.0 kips
SF =	70.0 kips
EB =	680.0 kips
Dy =	1.55 in
Dx =	1.70 in
SET/Bl =	0.15 in



Length b. Sensors	77.6 ft
Embedment	65.9 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16684 ft/s
Match Quality	2.87
Top Compr. Stress	35.2 ksi
Max Compr. Stress	37.5 ksi
Max Tension Stress	-6.53 ksi
Avg. Shaft Quake	0.30 in
Toe Quake	0.36 in
Avg. Shaft Smith Dpg.	0.27 s/ft
Toe Smith Damping	0.06 s/ft

About the CAPWAP Results

The CAPWAP program performs a signal matching or reverse analysis based on measurements taken on a deep foundation under an impact load. The program is based on a one-dimensional mathematical model. Under certain conditions, the model only crudely approximates the often complex dynamic situations.

The CAPWAP analysis relies on the input of accurately measured dynamic data plus additional parameters describing pile and soil behavior. If the field measurements of force and velocity are incorrect or were taken under inappropriate conditions (e.g., at an inappropriate time or with too much or too little energy) or if the input pile model is incorrect, then the solution cannot represent the actual soil behavior.

Generally the CAPWAP analysis is used to estimate the axial compressive pile capacity and the soil resistance distribution. The long-term capacity is best evaluated with restrike tests since they incorporate soil strength changes (set-up gains or relaxation losses) that occur after installation. The calculated load settlement graph does not consider creep or long term consolidation settlements. When uplift is a controlling factor in the design, use of the CAPWAP results to assess uplift capacity should be made only after very careful analysis of only good measurement quality, and further used only with longer pile lengths and with nominally higher safety factors.

CAPWAP is also used to evaluate driving stresses along the length of the pile. However, it should be understood that the analysis is one dimensional and does not take into account bending effects or local contact stresses at the pile toe.

Furthermore, if the user of this software was not able to produce a solution with satisfactory signal “match quality” (MQ), then the associated CAPWAP results may be unreliable. There is no absolute scale for solution acceptability but solutions with MQ above 5 are generally considered less reliable than those with lower MQ values and every effort should be made to improve the analysis, for example, by getting help from other independent experts.

Considering the CAPWAP model limitations, the nature of the input parameters, the complexity of the analysis procedure, and the need for a responsible application of the results to actual construction projects, it is recommended that at least one static load test be performed on sites where little experience exists with dynamic behavior of the soil resistance or when the experience of the analyzing engineer with both program use and result application is limited.

Finally, the CAPWAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors. The CAPWAP results should be reviewed by the Engineer of Record with consideration of applicable geotechnical conditions including, but not limited to, group effects, potential settlement from underlying compressible layers, soil resistances provided from any layers unsuitable for long term support, as well as effective stress changes due to soil surcharges, excavation or change in water table elevation.

The CAPWAP analysis software is one of many means by which the capacity of a deep foundation can be assessed. The engineer performing the analysis is responsible for proper software application and the analysis results. Pile Dynamics accepts no liability whatsoever of any kind for the analysis solution and/or the application of the analysis result.

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 750.0; along Shaft 70.0; at Toe 680.0 kips

Soil Sgmnt 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
				750.0				
1	16.9	5.2	0.0	750.0	0.0	0.00	0.00	0.00
2	23.6	11.9	0.0	750.0	0.0	0.00	0.00	0.00
3	30.4	18.7	0.0	750.0	0.0	0.00	0.00	0.00
4	37.1	25.4	7.0	743.0	7.0	1.04	0.22	0.27
5	43.8	32.1	7.0	736.0	14.0	1.04	0.22	0.27
6	50.6	38.9	7.0	729.0	21.0	1.04	0.22	0.27
7	57.3	45.6	7.0	722.0	28.0	1.04	0.22	0.27
8	64.1	52.4	7.0	715.0	35.0	1.04	0.22	0.27
9	70.8	59.1	7.0	708.0	42.0	1.04	0.22	0.27
10	77.6	65.9	28.0	680.0	70.0	4.15	0.88	0.27
Avg. Shaft			7.0			1.06	0.23	0.27
Toe			680.0				493.30	0.06

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.30	0.36
Case Damping Factor		0.49	1.07
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	30	44
Unloading Level	(% of Ru)	37	
Soil Plug Weight	(kips)	0.030	

CAPWAP match quality = 2.87 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.15 in; Blow Count = 80 b/ft
Computed: Final Set = 0.01 in; Blow Count = 1538 b/ft
Transducer F3(K769) CAL: 91.9; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K3658) CAL: 362; RF: 1.00; A4(K3550) CAL: 360; RF: 1.00

max. Top Comp. Stress = 35.2 ksi (T= 36.2 ms, max= 1.066 x Top)
max. Comp. Stress = 37.5 ksi (Z= 77.6 ft, T= 41.4 ms)
max. Tens. Stress = -6.53 ksi (Z= 57.3 ft, T= 58.8 ms)
max. Energy (EMX) = 44.9 kip-ft; max. Measured Top Displ. (DMX)= 1.18 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	3.4	753.2	-35.5	35.2	-1.66	44.9	18.8	1.17
2	6.7	754.1	-48.4	35.2	-2.26	44.6	18.8	1.15
4	13.5	756.0	-77.4	35.3	-3.62	43.8	18.7	1.10
5	16.9	757.2	-89.2	35.4	-4.17	43.3	18.7	1.07
6	20.2	758.5	-96.9	35.4	-4.53	42.8	18.7	1.04
7	23.6	759.9	-102.4	35.5	-4.78	42.2	18.6	1.01
8	27.0	761.7	-108.9	35.6	-5.09	41.5	18.6	0.98
9	30.4	767.4	-114.8	35.9	-5.37	40.7	18.4	0.95
10	33.7	778.3	-117.0	36.4	-5.46	39.8	18.1	0.91
11	37.1	787.0	-117.6	36.8	-5.50	38.9	17.9	0.87
12	40.5	759.1	-113.0	35.5	-5.28	36.1	17.6	0.83
13	43.8	769.3	-114.2	35.9	-5.34	35.1	17.3	0.79
14	47.2	751.8	-118.3	35.1	-5.53	32.4	16.8	0.76
15	50.6	762.7	-132.5	35.6	-6.19	31.3	16.5	0.72
16	54.0	726.8	-135.1	34.0	-6.31	28.7	16.5	0.67
17	57.3	730.9	-139.7	34.1	-6.53	27.5	16.4	0.63
18	60.7	706.7	-134.3	33.0	-6.27	24.9	16.1	0.59
19	64.1	715.4	-135.5	33.4	-6.33	23.6	15.9	0.54
20	67.5	729.2	-129.4	34.1	-6.04	21.2	16.1	0.50
21	70.8	765.3	-130.6	35.8	-6.10	19.8	17.6	0.45
22	74.2	771.7	-124.1	36.1	-5.80	17.6	18.4	0.41
23	77.6	802.8	-124.3	37.5	-5.80	14.9	16.5	0.36
Absolute	77.6			37.5			(T =	41.4 ms)
	57.3				-6.53		(T =	58.8 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	876.9	816.1	755.2	694.4	633.6	572.8	512.0	451.1	390.3	329.5
RX	910.0	866.6	841.2	822.8	804.5	786.2	768.3	760.1	753.2	747.2
RU	876.9	816.1	755.2	694.4	633.6	572.8	512.0	451.1	390.3	329.5

RAU = 647.0 (kips); RA2 = 794.0 (kips)

Current CAPWAP Ru = 750.0 (kips); Corresponding J(RP)= 0.21; J(RX) = 0.85

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS	KEB
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips	kips/in
19.1	35.99	728.3	756.8	779.4	1.18	0.15	0.15	45.3	814.9	1889

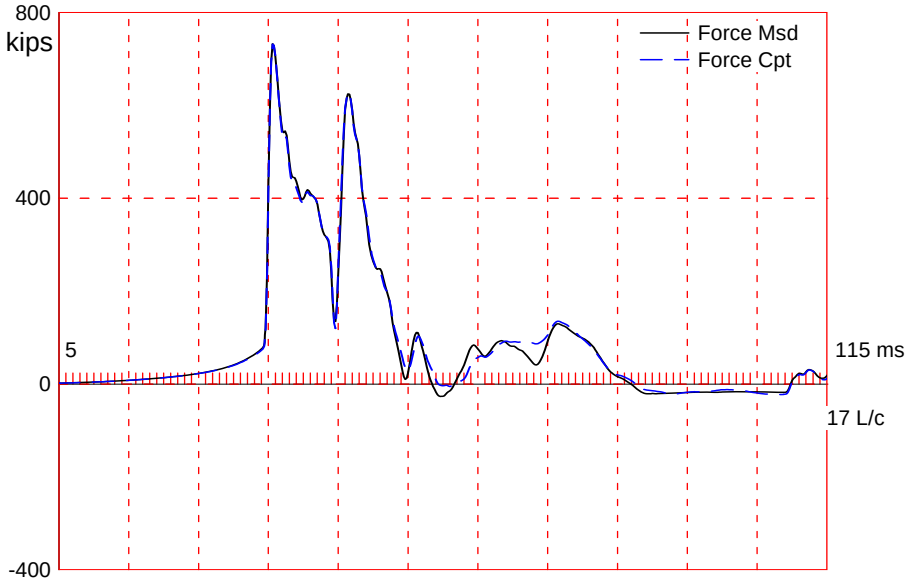
PILE PROFILE AND PILE MODEL

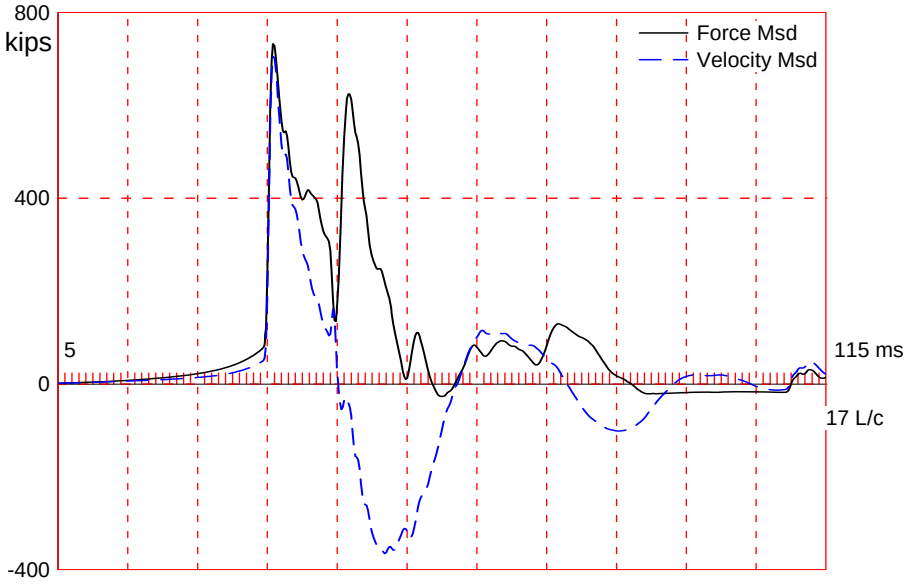
Depth	Area	E-Modulus	Spec. Weight	Perim.
ft	in^2	ksi	lb/ft^3	ft
0.0	21.4	29992.2	492.000	4.70
77.6	21.4	29992.2	492.000	4.70

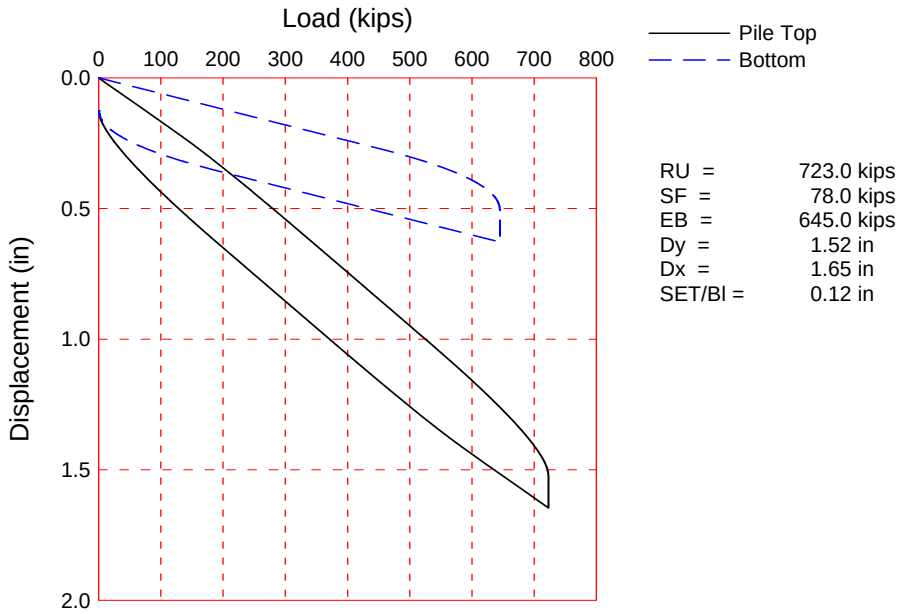
Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16683.9	0.000
16	54.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16683.9	0.020
17	57.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16683.9	0.010
18	60.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16683.9	0.000
23	77.6	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16683.9	0.000

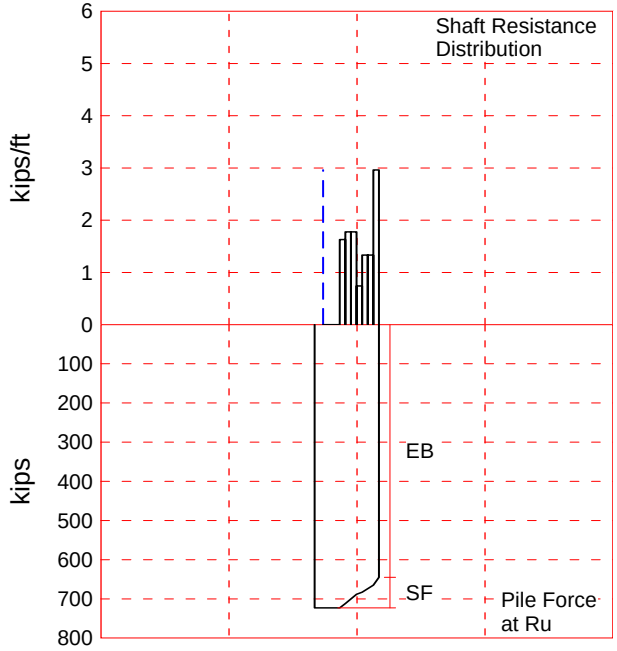
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16683.9 ft/s
Pile Damping 1.00 %, Time Incr 0.202 ms, 2L/c 9.3 ms
Total volume: 11.529 ft^3; Volume ratio considering added impedance: 1.000







RU =	723.0 kips
SF =	78.0 kips
EB =	645.0 kips
Dy =	1.52 in
Dx =	1.65 in
SET/Bl =	0.12 in



Length b. Sensors	77.6 ft
Embedment	66.0 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16870 ft/s
Match Quality	2.74
Top Compr. Stress	34.2 ksi
Max Compr. Stress	36.5 ksi
Max Tension Stress	-5.71 ksi
Avg. Shaft Quake	0.14 in
Toe Quake	0.39 in
Avg. Shaft Smith Dpg.	0.32 s/ft
Toe Smith Damping	0.06 s/ft

About the CAPWAP Results

The CAPWAP program performs a signal matching or reverse analysis based on measurements taken on a deep foundation under an impact load. The program is based on a one-dimensional mathematical model. Under certain conditions, the model only crudely approximates the often complex dynamic situations.

The CAPWAP analysis relies on the input of accurately measured dynamic data plus additional parameters describing pile and soil behavior. If the field measurements of force and velocity are incorrect or were taken under inappropriate conditions (e.g., at an inappropriate time or with too much or too little energy) or if the input pile model is incorrect, then the solution cannot represent the actual soil behavior.

Generally the CAPWAP analysis is used to estimate the axial compressive pile capacity and the soil resistance distribution. The long-term capacity is best evaluated with restrike tests since they incorporate soil strength changes (set-up gains or relaxation losses) that occur after installation. The calculated load settlement graph does not consider creep or long term consolidation settlements. When uplift is a controlling factor in the design, use of the CAPWAP results to assess uplift capacity should be made only after very careful analysis of only good measurement quality, and further used only with longer pile lengths and with nominally higher safety factors.

CAPWAP is also used to evaluate driving stresses along the length of the pile. However, it should be understood that the analysis is one dimensional and does not take into account bending effects or local contact stresses at the pile toe.

Furthermore, if the user of this software was not able to produce a solution with satisfactory signal "match quality" (MQ), then the associated CAPWAP results may be unreliable. There is no absolute scale for solution acceptability but solutions with MQ above 5 are generally considered less reliable than those with lower MQ values and every effort should be made to improve the analysis, for example, by getting help from other independent experts.

Considering the CAPWAP model limitations, the nature of the input parameters, the complexity of the analysis procedure, and the need for a responsible application of the results to actual construction projects, it is recommended that at least one static load test be performed on sites where little experience exists with dynamic behavior of the soil resistance or when the experience of the analyzing engineer with both program use and result application is limited.

Finally, the CAPWAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors. The CAPWAP results should be reviewed by the Engineer of Record with consideration of applicable geotechnical conditions including, but not limited to, group effects, potential settlement from underlying compressible layers, soil resistances provided from any layers unsuitable for long term support, as well as effective stress changes due to soil surcharges, excavation or change in water table elevation.

The CAPWAP analysis software is one of many means by which the capacity of a deep foundation can be assessed. The engineer performing the analysis is responsible for proper software application and the analysis results. Pile Dynamics accepts no liability whatsoever of any kind for the analysis solution and/or the application of the analysis result.

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 723.0; along Shaft 78.0; at Toe 645.0 kips

Soil Sgmnt 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
				723.0				
1	16.9	5.2	0.0	723.0	0.0	0.00	0.00	0.00
2	23.6	12.0	0.0	723.0	0.0	0.00	0.00	0.00
3	30.4	18.7	0.0	723.0	0.0	0.00	0.00	0.00
4	37.1	25.5	11.0	712.0	11.0	1.63	0.35	0.32
5	43.9	32.2	12.0	700.0	23.0	1.78	0.38	0.32
6	50.6	39.0	12.0	688.0	35.0	1.78	0.38	0.32
7	57.4	45.7	5.0	683.0	40.0	0.74	0.16	0.32
8	64.1	52.5	9.0	674.0	49.0	1.33	0.28	0.32
9	70.9	59.2	9.0	665.0	58.0	1.33	0.28	0.32
10	77.6	66.0	20.0	645.0	78.0	2.96	0.63	0.32
Avg. Shaft			7.8			1.18	0.25	0.32
Toe			645.0				467.91	0.06

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.14	0.39
Case Damping Factor		0.65	1.01
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	83
Reloading Level	(% of Ru)	100	0
Unloading Level	(% of Ru)	50	
Resistance Gap (included in Toe Quake)	(in)		0.11
Soil Plug Weight	(kips)	0.030	

CAPWAP match quality = 2.74 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.12 in; Blow Count = 96 b/ft
Computed: Final Set = 0.09 in; Blow Count = 137 b/ft
Transducer F3(D815) CAL: 93.0; RF: 1.00; F4(K769) CAL: 91.9; RF: 1.00
A3(K3550) CAL: 360; RF: 1.00; A4(K3658) CAL: 362; RF: 1.00

max. Top Comp. Stress = 34.2 ksi (T= 36.0 ms, max= 1.066 x Top)
max. Comp. Stress = 36.5 ksi (Z= 37.1 ft, T= 38.2 ms)
max. Tens. Stress = -5.71 ksi (Z= 37.1 ft, T= 61.4 ms)
max. Energy (EMX) = 43.8 kip-ft; max. Measured Top Displ. (DMX)= 1.16 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	3.4	732.4	-26.1	34.2	-1.22	43.8	18.5	1.16
2	6.7	732.7	-30.7	34.2	-1.43	43.6	18.4	1.15
4	13.5	733.4	-53.7	34.3	-2.51	42.8	18.4	1.10
5	16.9	733.8	-64.1	34.3	-3.00	42.4	18.3	1.07
6	20.2	734.3	-74.0	34.3	-3.46	41.8	18.3	1.04
7	23.6	734.8	-84.8	34.3	-3.96	41.3	18.3	1.02
8	27.0	737.0	-95.8	34.4	-4.48	40.6	18.2	0.98
9	30.4	750.3	-106.8	35.1	-4.99	39.8	18.0	0.95
10	33.7	766.0	-116.8	35.8	-5.46	38.9	17.6	0.91
11	37.1	780.8	-122.2	36.5	-5.71	37.9	17.2	0.87
12	40.5	726.5	-115.9	33.9	-5.42	33.7	16.7	0.84
13	43.9	744.0	-118.5	34.8	-5.54	32.7	16.4	0.80
14	47.2	692.4	-109.4	32.3	-5.11	28.5	15.7	0.76
15	50.6	694.8	-109.4	32.5	-5.11	27.4	15.5	0.72
16	54.0	647.7	-97.8	30.3	-4.57	23.6	15.4	0.68
17	57.4	652.6	-96.6	30.5	-4.51	22.5	15.3	0.64
18	60.7	650.4	-102.5	30.4	-4.79	20.3	15.1	0.60
19	64.1	666.1	-115.9	31.1	-5.42	19.2	14.9	0.56
20	67.5	670.5	-116.7	31.3	-5.45	16.3	16.6	0.52
21	70.9	705.2	-121.2	32.9	-5.66	15.2	18.0	0.47
22	74.2	710.1	-111.1	33.2	-5.19	12.6	18.1	0.43
23	77.6	724.8	-111.4	33.9	-5.21	10.6	15.7	0.39
Absolute	37.1			36.5			(T =	38.2 ms)
	37.1				-5.71		(T =	61.4 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	813.9	750.0	686.1	622.2	558.3	494.5	430.6	366.7	302.8	238.9
RX	872.6	840.8	822.1	804.0	785.9	767.8	750.1	735.1	722.4	711.5
RU	813.9	750.0	686.1	622.2	558.3	494.5	430.6	366.7	302.8	238.9

RAU = 595.4 (kips); RA2 = 740.6 (kips)

Current CAPWAP Ru = 723.0 (kips); Corresponding J(RP)= 0.14; J(RX) = 0.80

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS	KEB
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips	kips/in
18.7	35.80	712.8	739.9	739.9	1.16	0.13	0.12	44.0	821.0	2304

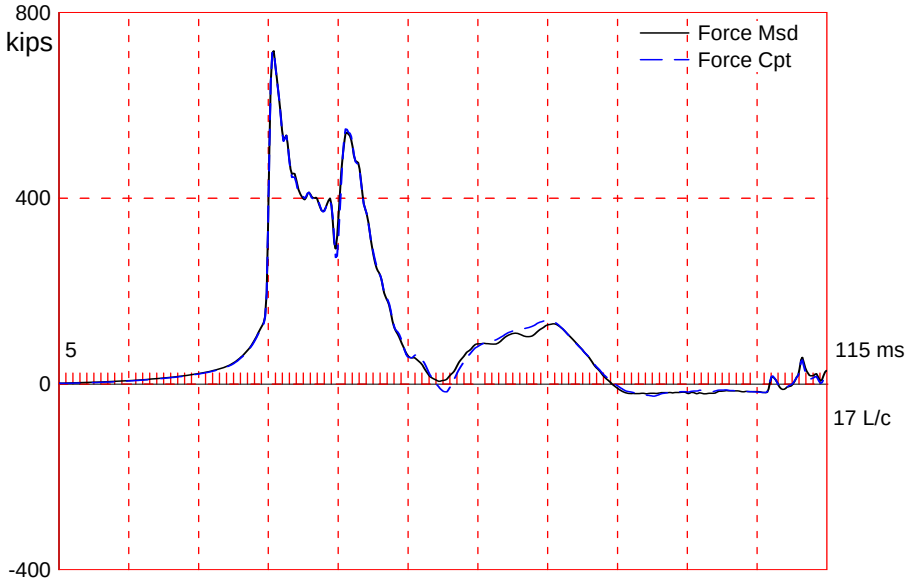
PILE PROFILE AND PILE MODEL

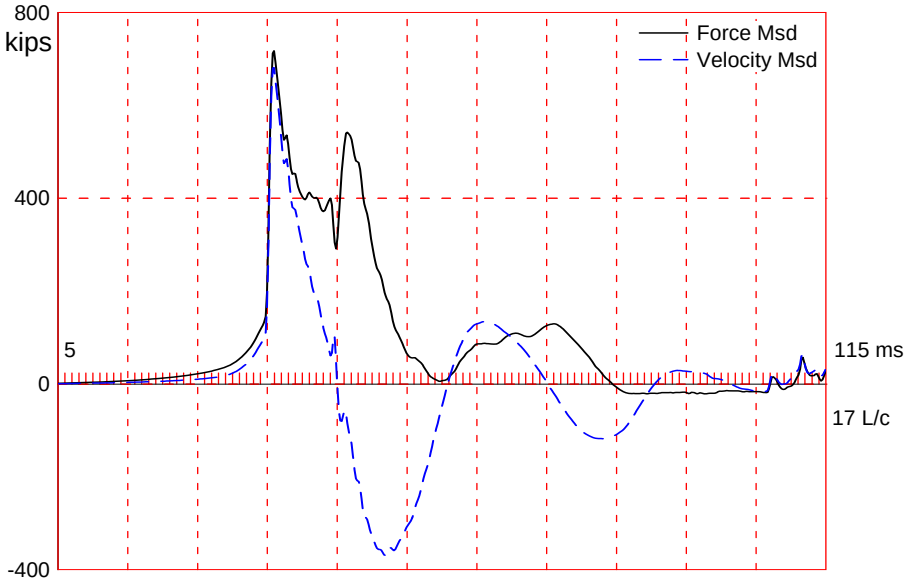
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.6	21.4	29992.2	492.000	4.70

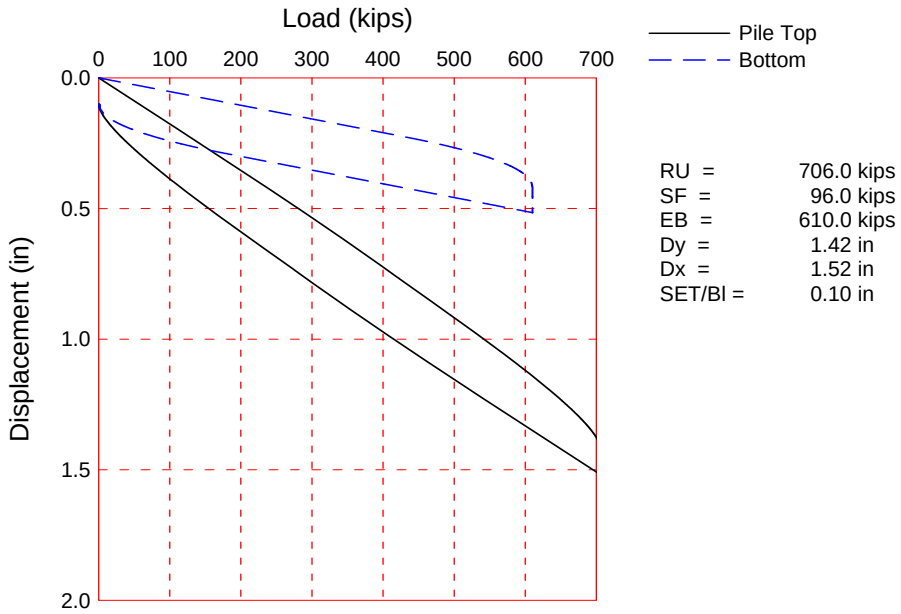
Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16869.6	0.000
16	54.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16869.6	0.020
17	57.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16869.6	0.000
18	60.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16869.6	0.010
19	64.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16869.6	0.000
23	77.6	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16869.6	0.000

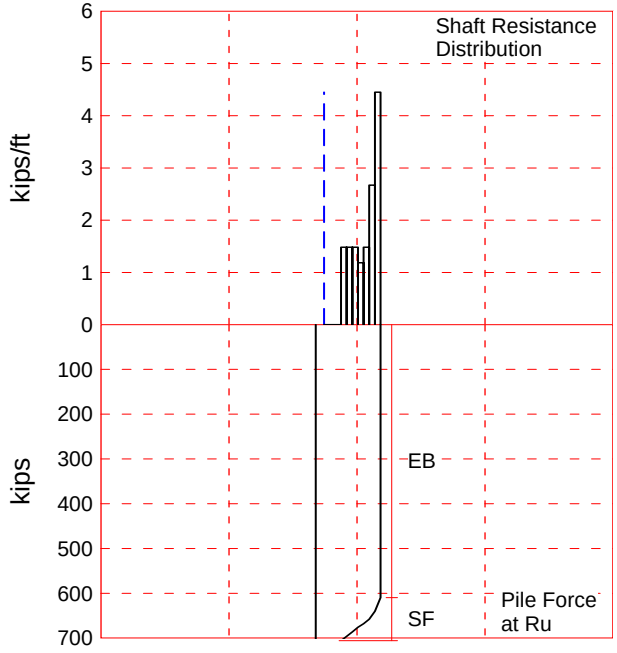
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16869.6 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 9.2 ms
Total volume: 11.532 ft^3; Volume ratio considering added impedance: 1.000







RU =	706.0 kips
SF =	96.0 kips
EB =	610.0 kips
Dy =	1.42 in
Dx =	1.52 in
SET/Bl =	0.10 in



Length b. Sensors	77.5 ft
Embedment	65.8 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16684 ft/s
Match Quality	1.74
Top Compr. Stress	33.6 ksi
Max Compr. Stress	35.8 ksi
Max Tension Stress	-6.00 ksi
Avg. Shaft Quake	0.26 in
Toe Quake	0.32 in
Avg. Shaft Smith Dpg.	0.28 s/ft
Toe Smith Damping	0.07 s/ft

About the CAPWAP Results

The CAPWAP program performs a signal matching or reverse analysis based on measurements taken on a deep foundation under an impact load. The program is based on a one-dimensional mathematical model. Under certain conditions, the model only crudely approximates the often complex dynamic situations.

The CAPWAP analysis relies on the input of accurately measured dynamic data plus additional parameters describing pile and soil behavior. If the field measurements of force and velocity are incorrect or were taken under inappropriate conditions (e.g., at an inappropriate time or with too much or too little energy) or if the input pile model is incorrect, then the solution cannot represent the actual soil behavior.

Generally the CAPWAP analysis is used to estimate the axial compressive pile capacity and the soil resistance distribution. The long-term capacity is best evaluated with restrike tests since they incorporate soil strength changes (set-up gains or relaxation losses) that occur after installation. The calculated load settlement graph does not consider creep or long term consolidation settlements. When uplift is a controlling factor in the design, use of the CAPWAP results to assess uplift capacity should be made only after very careful analysis of only good measurement quality, and further used only with longer pile lengths and with nominally higher safety factors.

CAPWAP is also used to evaluate driving stresses along the length of the pile. However, it should be understood that the analysis is one dimensional and does not take into account bending effects or local contact stresses at the pile toe.

Furthermore, if the user of this software was not able to produce a solution with satisfactory signal “match quality” (MQ), then the associated CAPWAP results may be unreliable. There is no absolute scale for solution acceptability but solutions with MQ above 5 are generally considered less reliable than those with lower MQ values and every effort should be made to improve the analysis, for example, by getting help from other independent experts.

Considering the CAPWAP model limitations, the nature of the input parameters, the complexity of the analysis procedure, and the need for a responsible application of the results to actual construction projects, it is recommended that at least one static load test be performed on sites where little experience exists with dynamic behavior of the soil resistance or when the experience of the analyzing engineer with both program use and result application is limited.

Finally, the CAPWAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors. The CAPWAP results should be reviewed by the Engineer of Record with consideration of applicable geotechnical conditions including, but not limited to, group effects, potential settlement from underlying compressible layers, soil resistances provided from any layers unsuitable for long term support, as well as effective stress changes due to soil surcharges, excavation or change in water table elevation.

The CAPWAP analysis software is one of many means by which the capacity of a deep foundation can be assessed. The engineer performing the analysis is responsible for proper software application and the analysis results. Pile Dynamics accepts no liability whatsoever of any kind for the analysis solution and/or the application of the analysis result.

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 706.0; along Shaft 96.0; at Toe 610.0 kips

Soil Sgmnt 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
				706.0				
1	16.8	5.2	0.0	706.0	0.0	0.00	0.00	0.00
2	23.6	11.9	0.0	706.0	0.0	0.00	0.00	0.00
3	30.3	18.6	0.0	706.0	0.0	0.00	0.00	0.00
4	37.1	25.4	10.0	696.0	10.0	1.48	0.32	0.28
5	43.8	32.1	10.0	686.0	20.0	1.48	0.32	0.28
6	50.5	38.9	10.0	676.0	30.0	1.48	0.32	0.28
7	57.3	45.6	8.0	668.0	38.0	1.19	0.25	0.28
8	64.0	52.3	10.0	658.0	48.0	1.48	0.32	0.28
9	70.8	59.1	18.0	640.0	66.0	2.67	0.57	0.28
10	77.5	65.8	30.0	610.0	96.0	4.45	0.95	0.28
Avg. Shaft			9.6			1.46	0.31	0.28
Toe			610.0				442.52	0.07

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.26	0.32
Case Damping Factor		0.70	1.12
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	30
Reloading Level	(% of Ru)	100	0
Unloading Level	(% of Ru)	59	
Soil Plug Weight	(kips)	0.040	

CAPWAP match quality = 1.74 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.10 in; Blow Count = 120 b/ft
Computed: Final Set = 0.01 in; Blow Count = 1047 b/ft
Transducer F3(K769) CAL: 91.9; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K3658) CAL: 362; RF: 1.00; A4(K3550) CAL: 360; RF: 1.00

max. Top Comp. Stress = 33.6 ksi (T= 36.2 ms, max= 1.066 x Top)
max. Comp. Stress = 35.8 ksi (Z= 37.1 ft, T= 38.2 ms)
max. Tens. Stress = -6.00 ksi (Z= 43.8 ft, T= 58.4 ms)
max. Energy (EMX) = 43.1 kip-ft; max. Measured Top Displ. (DMX)= 1.14 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	3.4	718.4	-29.9	33.6	-1.40	43.1	17.8	1.13
2	6.7	719.6	-42.2	33.6	-1.97	42.7	17.8	1.11
4	13.5	722.7	-65.3	33.8	-3.05	41.6	17.7	1.05
5	16.8	724.5	-76.1	33.8	-3.56	41.0	17.6	1.02
6	20.2	726.6	-88.4	33.9	-4.13	40.4	17.6	0.99
7	23.6	728.8	-96.6	34.0	-4.51	39.7	17.5	0.96
8	27.0	731.5	-102.4	34.2	-4.79	39.0	17.4	0.92
9	30.3	739.8	-108.8	34.6	-5.08	38.2	17.2	0.89
10	33.7	754.2	-117.8	35.2	-5.50	37.2	16.8	0.85
11	37.1	766.0	-124.0	35.8	-5.79	36.3	16.5	0.81
12	40.4	725.5	-120.7	33.9	-5.64	33.0	16.2	0.77
13	43.8	737.4	-128.5	34.4	-6.00	32.0	15.8	0.73
14	47.2	699.3	-120.7	32.7	-5.64	28.9	15.5	0.69
15	50.5	710.2	-123.1	33.2	-5.75	27.8	15.2	0.65
16	53.9	672.1	-112.3	31.4	-5.25	25.0	14.9	0.61
17	57.3	683.1	-115.3	31.9	-5.39	23.9	14.6	0.57
18	60.7	661.8	-107.8	30.9	-5.04	21.6	14.1	0.53
19	64.0	691.2	-109.0	32.3	-5.09	20.4	13.5	0.49
20	67.4	682.2	-101.0	31.9	-4.72	18.0	12.9	0.45
21	70.8	710.5	-101.9	33.2	-4.76	16.9	14.1	0.41
22	74.1	700.7	-92.7	32.7	-4.33	14.0	14.6	0.36
23	77.5	718.8	-93.2	33.6	-4.35	11.7	13.1	0.32
Absolute	37.1			35.8			(T =	38.2 ms)
	43.8				-6.00		(T =	58.4 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	908.1	856.0	803.9	751.8	699.7	647.5	595.4	543.3	491.2	439.1
RX	922.7	879.4	840.2	802.1	769.8	750.6	731.6	713.5	702.9	694.9
RU	908.9	856.9	804.9	752.9	700.8	648.8	596.8	544.8	492.7	440.7

RAU = 599.2 (kips); RA2 = 754.5 (kips)

Current CAPWAP Ru = 706.0 (kips); Corresponding J(RP)= 0.39; J(RX) = 0.77

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS	KEB
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips	kips/in
18.3	35.95	698.6	730.6	730.6	1.14	0.10	0.10	43.5	843.5	1906

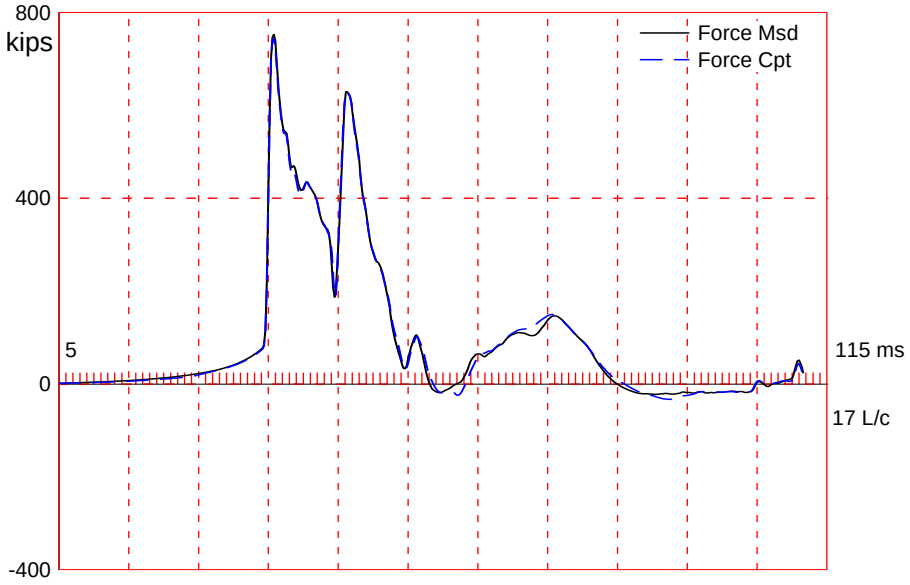
PILE PROFILE AND PILE MODEL

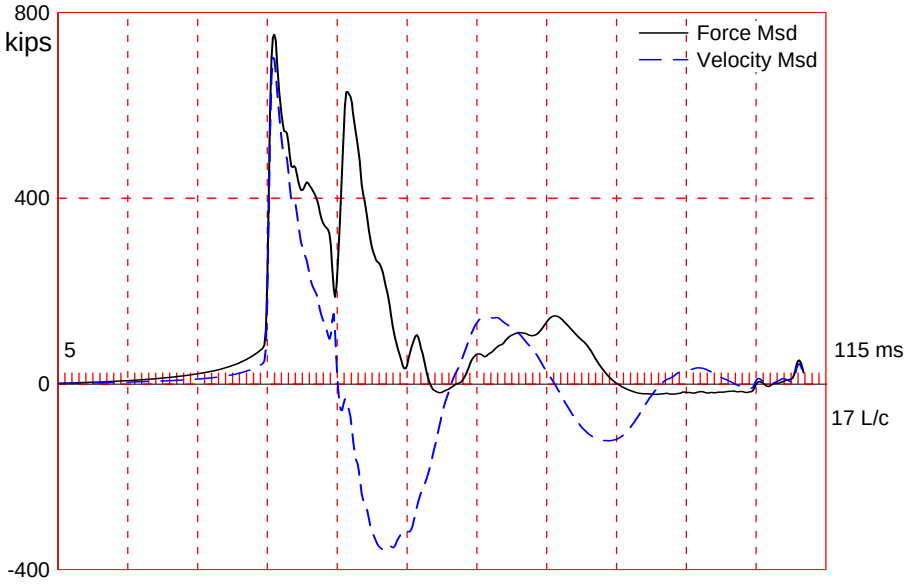
Depth	Area	E-Modulus	Spec. Weight	Perim.
ft	in^2	ksi	lb/ft^3	ft
0.0	21.4	29992.2	492.000	4.70
77.5	21.4	29992.2	492.000	4.70

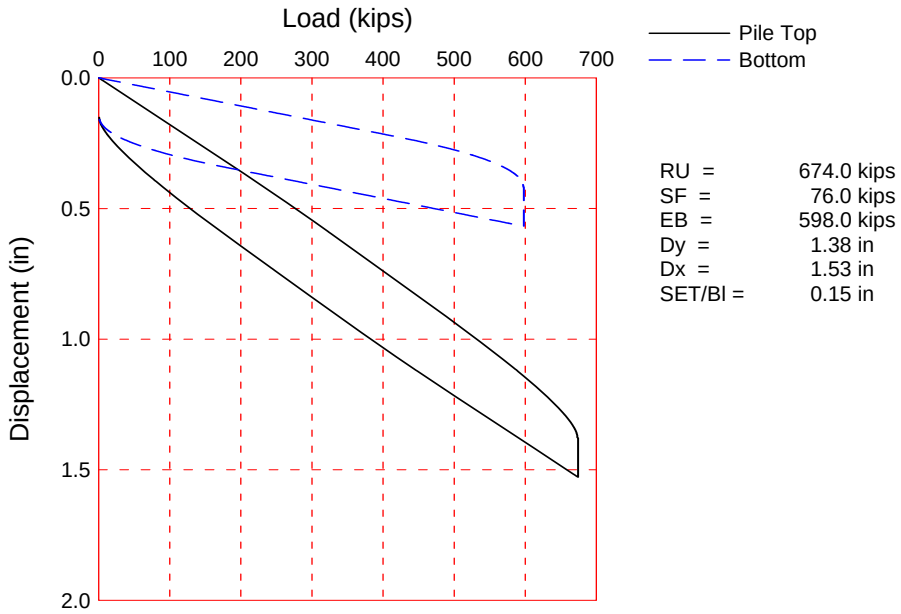
Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16683.9	0.000
21	70.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16683.9	0.040
22	74.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16683.9	0.000
23	77.5	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16683.9	0.000

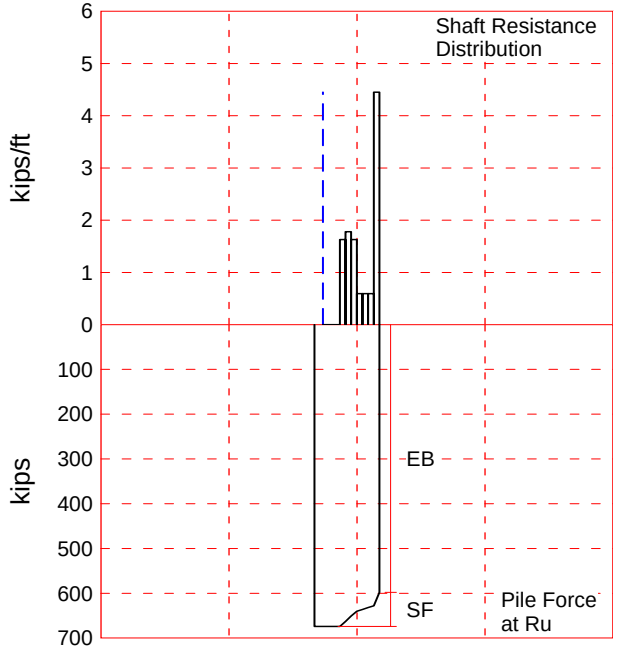
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16683.9 ft/s
Pile Damping 1.00 %, Time Incr 0.202 ms, 2L/c 9.3 ms
Total volume: 11.517 ft^3; Volume ratio considering added impedance: 1.000







RU =	674.0 kips
SF =	76.0 kips
EB =	598.0 kips
Dy =	1.38 in
Dx =	1.53 in
SET/Bl =	0.15 in



Length b. Sensors	77.5 ft
Embedment	65.9 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16667 ft/s
Match Quality	1.96
Top Compr. Stress	34.8 ksi
Max Compr. Stress	38.1 ksi
Max Tension Stress	-6.31 ksi
Avg. Shaft Quake	0.25 in
Toe Quake	0.32 in
Avg. Shaft Smith Dpg.	0.28 s/ft
Toe Smith Damping	0.10 s/ft

About the CAPWAP Results

The CAPWAP program performs a signal matching or reverse analysis based on measurements taken on a deep foundation under an impact load. The program is based on a one-dimensional mathematical model. Under certain conditions, the model only crudely approximates the often complex dynamic situations.

The CAPWAP analysis relies on the input of accurately measured dynamic data plus additional parameters describing pile and soil behavior. If the field measurements of force and velocity are incorrect or were taken under inappropriate conditions (e.g., at an inappropriate time or with too much or too little energy) or if the input pile model is incorrect, then the solution cannot represent the actual soil behavior.

Generally the CAPWAP analysis is used to estimate the axial compressive pile capacity and the soil resistance distribution. The long-term capacity is best evaluated with restrike tests since they incorporate soil strength changes (set-up gains or relaxation losses) that occur after installation. The calculated load settlement graph does not consider creep or long term consolidation settlements. When uplift is a controlling factor in the design, use of the CAPWAP results to assess uplift capacity should be made only after very careful analysis of only good measurement quality, and further used only with longer pile lengths and with nominally higher safety factors.

CAPWAP is also used to evaluate driving stresses along the length of the pile. However, it should be understood that the analysis is one dimensional and does not take into account bending effects or local contact stresses at the pile toe.

Furthermore, if the user of this software was not able to produce a solution with satisfactory signal "match quality" (MQ), then the associated CAPWAP results may be unreliable. There is no absolute scale for solution acceptability but solutions with MQ above 5 are generally considered less reliable than those with lower MQ values and every effort should be made to improve the analysis, for example, by getting help from other independent experts.

Considering the CAPWAP model limitations, the nature of the input parameters, the complexity of the analysis procedure, and the need for a responsible application of the results to actual construction projects, it is recommended that at least one static load test be performed on sites where little experience exists with dynamic behavior of the soil resistance or when the experience of the analyzing engineer with both program use and result application is limited.

Finally, the CAPWAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors. The CAPWAP results should be reviewed by the Engineer of Record with consideration of applicable geotechnical conditions including, but not limited to, group effects, potential settlement from underlying compressible layers, soil resistances provided from any layers unsuitable for long term support, as well as effective stress changes due to soil surcharges, excavation or change in water table elevation.

The CAPWAP analysis software is one of many means by which the capacity of a deep foundation can be assessed. The engineer performing the analysis is responsible for proper software application and the analysis results. Pile Dynamics accepts no liability whatsoever of any kind for the analysis solution and/or the application of the analysis result.

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 674.0; along Shaft 76.0; at Toe 598.0 kips

Soil Sgmnt 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
				674.0				
1	16.8	5.2	0.0	674.0	0.0	0.00	0.00	0.00
2	23.6	12.0	0.0	674.0	0.0	0.00	0.00	0.00
3	30.3	18.7	0.0	674.0	0.0	0.00	0.00	0.00
4	37.1	25.4	11.0	663.0	11.0	1.63	0.35	0.28
5	43.8	32.2	12.0	651.0	23.0	1.78	0.38	0.28
6	50.5	38.9	11.0	640.0	34.0	1.63	0.35	0.28
7	57.3	45.7	4.0	636.0	38.0	0.59	0.13	0.28
8	64.0	52.4	4.0	632.0	42.0	0.59	0.13	0.28
9	70.8	59.1	4.0	628.0	46.0	0.59	0.13	0.28
10	77.5	65.9	30.0	598.0	76.0	4.45	0.95	0.28
Avg. Shaft			7.6			1.15	0.25	0.28
Toe			598.0				433.81	0.10

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.25	0.32
Case Damping Factor		0.56	1.57
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	62	36
Reloading Level	(% of Ru)	100	0
Resistance Gap (included in Toe Quake)	(in)		0.01
Soil Plug Weight	(kips)	0.030	

CAPWAP match quality = 1.96 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.15 in; Blow Count = 80 b/ft
Computed: Final Set = 0.18 in; Blow Count = 68 b/ft
Transducer F3(D815) CAL: 93.0; RF: 1.02; F4(K769) CAL: 91.9; RF: 1.02
A3(K3550) CAL: 360; RF: 0.98; A4(K3658) CAL: 362; RF: 0.98

max. Top Comp. Stress = 34.8 ksi (T= 36.2 ms, max= 1.095 x Top)
max. Comp. Stress = 38.1 ksi (Z= 77.5 ft, T= 41.0 ms)
max. Tens. Stress = -6.31 ksi (Z= 37.1 ft, T= 60.5 ms)
max. Energy (EMX) = 45.3 kip-ft; max. Measured Top Displ. (DMX)= 1.14 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	3.4	744.3	-35.3	34.8	-1.65	45.3	18.5	1.15
2	6.7	745.2	-46.4	34.8	-2.17	45.0	18.5	1.13
4	13.5	747.2	-70.0	34.9	-3.27	44.1	18.5	1.08
5	16.8	748.3	-81.1	35.0	-3.79	43.6	18.4	1.05
6	20.2	749.4	-91.8	35.0	-4.29	43.0	18.4	1.02
7	23.6	750.7	-103.4	35.1	-4.83	42.3	18.4	0.99
8	27.0	753.2	-114.9	35.2	-5.37	41.6	18.3	0.96
9	30.3	764.9	-124.6	35.7	-5.82	40.7	18.0	0.92
10	33.7	782.0	-130.7	36.5	-6.11	39.7	17.6	0.88
11	37.1	803.0	-135.0	37.5	-6.31	38.7	17.1	0.84
12	40.4	759.4	-123.6	35.5	-5.78	34.9	16.6	0.80
13	43.8	771.0	-125.6	36.0	-5.87	33.7	16.2	0.76
14	47.2	715.3	-113.1	33.4	-5.28	29.9	16.0	0.72
15	50.5	720.7	-114.6	33.7	-5.35	28.7	15.9	0.68
16	53.9	670.6	-104.8	31.3	-4.90	25.3	15.7	0.64
17	57.3	676.6	-116.6	31.6	-5.45	24.2	15.6	0.59
18	60.7	686.6	-118.4	32.1	-5.53	22.3	15.4	0.55
19	64.0	698.9	-123.0	32.7	-5.75	21.0	15.2	0.51
20	67.4	721.7	-119.5	33.7	-5.58	19.2	15.7	0.46
21	70.8	748.2	-121.9	35.0	-5.70	18.0	16.9	0.42
22	74.1	753.8	-120.5	35.2	-5.63	16.4	17.0	0.38
23	77.5	815.2	-121.6	38.1	-5.68	14.2	14.4	0.34
Absolute	77.5			38.1			(T =	41.0 ms)
	37.1				-6.31		(T =	60.5 ms)

CASE METHOD

J =	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
RP	855.8	733.5	611.2	488.9	366.6					
RX	912.7	840.7	796.6	763.8	733.8	709.7	689.4	671.9	655.5	639.1
RU	855.8	733.5	611.2	488.9	366.6					

RAU = 610.5 (kips); RA2 = 754.3 (kips)

Current CAPWAP Ru = 674.0 (kips); Corresponding J(RP)= 0.30; J(RX) = 1.37

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS	KEB
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips	kips/in
18.7	35.78	713.5	753.9	754.0	1.14	0.15	0.15	45.6	847.1	1929

PILE PROFILE AND PILE MODEL

Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.5	21.4	29992.2	492.000	4.70

Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16666.7	0.000
13	43.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16666.7	0.010
16	53.9	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16666.7	0.000
23	77.5	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16666.7	0.000

Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16666.7 ft/s
Pile Damping 1.00 %, Time Incr 0.202 ms, 2L/c 9.3 ms
Total volume: 11.517 ft^3; Volume ratio considering added impedance: 1.000