GRL Engineers, Inc.

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TRANSMITTAL

To: Mr. Kevin Weber	From: Alexander McCaskill
Company: Lunda Construction Co.	No. of Sheets: 53
E-mail: kweber@lundaconstruction.com	Date: April 5, 2015

RE: Dynamic Testing Results – USH 10 over Little Lake Butte des Morts
Structure B-70-403 - Pier 15
Winnebago County, Wisconsin

On April 2, 2015, Pier 15 #1, Pier 15 #36, and Pier 15 #44 at the above structure were dynamically tested during initial driving. The piles were tested during restrike on April 3. Project plans indicated 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 reference elevation for the piles was the top of the ring at EL 740.8. We understand the pier was excavated to an elevation of EL 717.3. The piles have a required minimum tip elevation of EL 678.0. The HP 14x73 H-piles were equipped with driving shoes and were driven with an APE D30-42 hammer (number PD 0256) reportedly operated on fuel setting 4.

Pier 15 #1 was driven to a depth of 68.4 feet, which corresponds to a pile tip elevation of EL 672.4. The blow count over the final increment of driving was 10 blows for 1 ¼ inches of penetration at an average hammer stroke of 7.2 feet. The blow count at the beginning of restrike was 10 blows for ⅞ inches of penetration at an average hammer stroke of 6.8 feet.

Pier 15 #36 was driven to a depth of 68.1 feet, which corresponds to a pile tip elevation of EL 672.7. The blow count over the final increment of driving was 10 blows for 2 ⅜ inches of penetration at an average hammer stroke of 7.0 feet. The blow count at the beginning of restrike was 10 blows for 1 ¾ inches of penetration at an average hammer stroke of 6.5 feet.

Pier 15 #44 was driven to a depth of 70.1 feet, which corresponds to a pile tip elevation of EL 670.7. The blow count over the final increment of driving was 10 blows for 2 inches of penetration at an average hammer stroke of 7.3 feet. The blow count at the beginning of restrike was 10 blows for 1 ½ inches of penetration at an average hammer stroke of 6.7 feet

We recommend the production piles at Pier 15 of Structure B-70-403, driven with the APE D30-42 hammer PD0256, 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. Additionally, all production piles should achieve the minimum pile tip elevation of EL 678.0 for uplift, as indicated on the plans.

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)
6.5	7	5
7.0	6	4
7.5	5	4
8.0	4	3
8.5	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 any minimum tip requirements. We anticipate the production piles will terminate at depths similar to those of the test piles.

These criteria should not be used for acceptance of piles under restrike and/or redrive conditions. After splicing or any other delays, we recommend not applying the criteria until a full foot 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, E.I.

Travis Coleman, P.E.

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

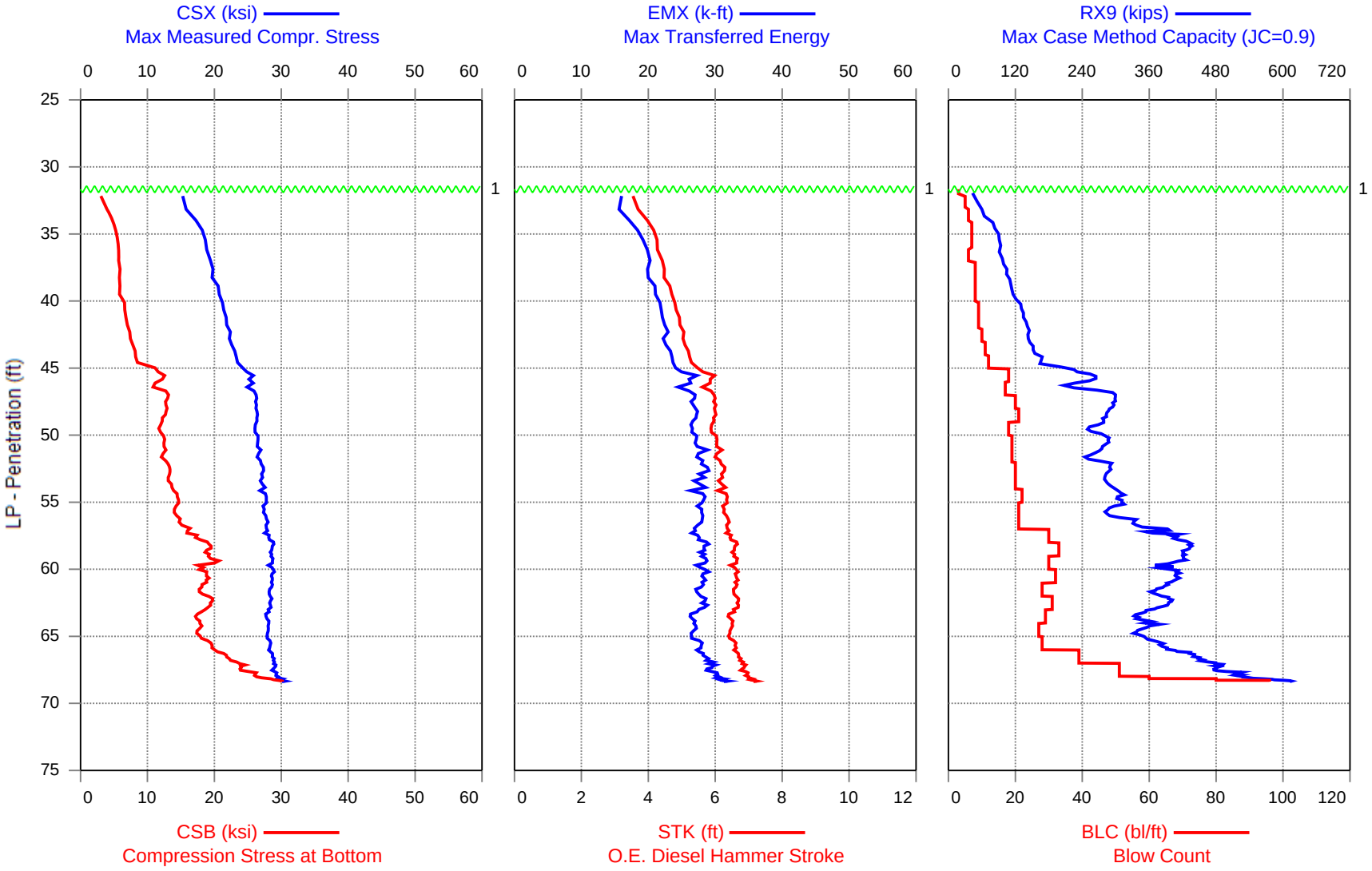
Attachments:

Dynamic Test Results - (pages 3 – 23)
CAPWAP Analysis Results - (pages 24 – 53)

Printed: 02-April-2015

Test started: 02-April-2015

USH 10 over Little Lake Butte des Morts - Pier 15 #1
APE D30-42, HP 14 x 73



1 - Reported reference at El. 740.79

USH 10 over Little Lake Butte des Morts - Pier 15 #1 APE D30-42, HP 14 x 73
OP: AM Date: 02-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.40 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	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
9	31.67	3	AV1	22.4	3.6	28	4.8	53.5	61
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	22.4	3.6	28	4.8	53.5	61
			MIN	22.4	3.6	28	4.8	53.5	61
10	32.00	3	AV1	15.7	2.9	16	3.5	61.9	31
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	15.7	2.9	16	3.5	61.9	31
			MIN	15.7	2.9	16	3.5	61.9	31
15	33.00	5	AV5	13.9	3.3	14	3.4	63.0	50
			STD	1.5	0.5	2	0.3	2.3	9
			MAX	16.0	3.9	16	3.7	66.2	62
			MIN	11.8	2.7	10	3.0	60.4	38
21	34.00	6	AV6	16.3	4.3	16	3.8	59.5	66
			STD	0.7	0.3	1	0.1	1.0	8
			MAX	17.9	4.8	18	4.1	60.4	79
			MIN	15.7	3.9	15	3.7	57.5	56
28	35.00	7	AV7	18.1	5.2	18	4.1	57.1	84
			STD	0.6	0.2	1	0.1	0.9	6
			MAX	19.1	5.5	20	4.4	58.3	92
			MIN	17.2	4.8	17	4.0	55.7	78
35	36.00	7	AV7	18.6	5.5	19	4.2	56.5	92
			STD	0.5	0.1	0	0.1	0.6	3
			MAX	19.6	5.8	20	4.4	57.3	96
			MIN	18.0	5.3	19	4.1	55.3	88
41	37.00	6	AV6	19.2	5.6	21	4.4	55.7	94
			STD	0.3	0.3	0	0.1	0.5	3
			MAX	19.5	5.9	21	4.5	56.6	98
			MIN	18.5	5.2	20	4.2	54.9	90
49	38.00	8	AV8	19.5	5.9	20	4.4	55.4	102
			STD	0.9	0.2	1	0.2	1.0	4
			MAX	20.8	6.3	21	4.7	57.0	110
			MIN	18.2	5.6	18	4.2	53.9	95
57	39.00	8	AV8	20.3	5.8	21	4.6	54.4	111
			STD	1.0	0.4	2	0.2	1.2	3
			MAX	21.8	6.4	23	4.9	56.1	116
			MIN	18.7	5.5	19	4.3	52.6	105
65	40.00	8	AV8	20.7	6.1	21	4.7	53.9	117
			STD	0.5	0.4	1	0.1	0.7	4
			MAX	21.5	6.7	22	4.9	55.1	122
			MIN	19.9	5.3	20	4.5	52.7	111
74	41.00	9	AV9	21.5	6.6	22	4.9	53.0	132
			STD	0.6	0.3	1	0.1	0.7	5
			MAX	22.4	7.2	24	5.0	54.4	139
			MIN	20.4	6.1	20	4.6	52.2	124
83	42.00	9	AV9	21.8	6.9	22	4.9	52.6	139

USH 10 over Little Lake Butte des Morts - Pier 15 #1 APE D30-42, HP 14 x 73
OP: AM Date: 02-April-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			STD	0.5	0.5	1	0.1	0.5	6
			MAX	22.4	8.1	23	5.1	53.4	147
			MIN	20.9	6.3	21	4.8	51.8	130
93	43.00	10	AV10	22.3	7.4	23	5.0	52.0	144
			STD	0.8	0.2	1	0.2	0.7	5
			MAX	23.4	7.6	24	5.3	53.3	151
			MIN	21.1	7.1	20	4.8	51.0	136
104	44.00	11	AV11	22.8	8.0	23	5.1	51.6	152
			STD	0.6	0.3	1	0.1	0.7	4
			MAX	23.6	8.6	24	5.4	52.7	158
			MIN	21.8	7.5	20	4.9	50.5	146
116	45.00	12	AV12	23.6	9.0	24	5.3	50.8	175
			STD	0.2	1.1	0	0.1	0.2	17
			MAX	24.1	11.3	25	5.4	51.2	218
			MIN	23.2	8.1	23	5.2	50.2	157
134	46.00	18	AV18	25.3	12.1	26	5.8	48.7	249
			STD	0.7	0.5	1	0.2	0.8	16
			MAX	26.4	13.2	28	6.1	50.0	268
			MIN	24.1	11.3	24	5.5	47.7	222
151	47.00	17	AV17	25.6	11.9	26	5.8	48.7	251
			STD	0.7	1.1	1	0.2	0.7	36
			MAX	26.8	13.6	29	6.1	50.2	307
			MIN	24.2	10.3	24	5.4	47.5	205
171	48.00	20	AV20	26.3	12.9	27	6.0	47.9	297
			STD	0.3	0.5	1	0.1	0.4	5
			MAX	27.1	13.7	29	6.3	48.4	307
			MIN	25.8	12.1	25	5.9	47.0	287
192	49.00	21	AV21	26.3	12.5	27	6.0	48.1	283
			STD	0.5	0.4	1	0.1	0.4	5
			MAX	27.0	13.2	28	6.1	48.9	292
			MIN	25.3	11.8	25	5.8	47.5	274
210	50.00	18	AV18	26.2	12.0	27	5.9	48.3	263
			STD	0.5	0.4	1	0.2	0.6	12
			MAX	27.0	12.7	28	6.2	49.6	280
			MIN	25.2	11.4	25	5.6	47.3	244
229	51.00	19	AV19	26.5	12.5	27	6.0	47.8	283
			STD	0.4	0.3	1	0.1	0.4	5
			MAX	27.0	13.2	29	6.2	48.4	291
			MIN	25.7	11.8	25	5.9	47.1	273
248	52.00	19	AV19	26.7	12.5	28	6.1	47.6	261
			STD	0.4	0.5	1	0.1	0.5	12
			MAX	27.3	13.4	30	6.3	48.4	278
			MIN	26.0	11.6	26	5.9	46.8	235
268	53.00	20	AV20	27.2	13.3	28	6.2	47.1	288
			STD	0.4	0.3	1	0.1	0.4	5
			MAX	27.8	13.9	30	6.4	48.0	296
			MIN	26.2	13.0	26	6.0	46.5	280
288	54.00	20	AV20	27.2	13.4	28	6.2	47.2	286
			STD	0.3	0.3	1	0.1	0.4	7
			MAX	27.8	14.0	29	6.4	47.9	298
			MIN	26.6	12.9	26	6.0	46.5	275

USH 10 over Little Lake Butte des Morts - Pier 15 #1
OP: AM

APE D30-42, HP 14 x 73
Date: 02-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
310	55.00	22	AV22	27.5	14.4	28	6.3	46.9	307
			STD	0.5	0.4	1	0.1	0.5	6
			MAX	28.2	15.1	30	6.5	48.0	321
			MIN	26.3	13.8	25	6.0	46.3	296
331	56.00	21	AV21	27.4	14.2	28	6.3	46.9	293
			STD	0.4	0.4	1	0.1	0.4	13
			MAX	28.2	15.0	30	6.5	47.5	322
			MIN	26.9	13.6	26	6.1	46.3	277
352	57.00	21	AV21	27.8	15.1	28	6.4	46.6	335
			STD	0.3	0.6	1	0.1	0.3	21
			MAX	28.2	16.5	29	6.5	47.3	389
			MIN	27.2	14.1	26	6.2	46.1	294
382	58.00	30	AV30	28.1	17.2	27	6.5	46.3	401
			STD	0.5	1.3	1	0.1	0.5	23
			MAX	29.5	19.3	30	6.8	47.4	431
			MIN	27.0	14.9	25	6.1	45.1	346
415	59.00	33	AV33	28.6	19.1	28	6.6	45.9	428
			STD	0.4	0.4	1	0.1	0.4	7
			MAX	29.7	20.3	30	6.8	46.8	441
			MIN	27.9	18.3	27	6.3	45.0	416
445	60.00	30	AV30	28.5	19.1	28	6.6	45.9	403
			STD	0.4	1.5	1	0.1	0.4	20
			MAX	29.3	20.9	30	6.8	46.6	434
			MIN	27.8	16.2	26	6.4	45.2	356
477	61.00	32	AV32	28.7	18.8	28	6.6	45.7	408
			STD	0.4	0.3	1	0.1	0.4	6
			MAX	29.4	19.4	30	6.8	46.7	420
			MIN	27.8	17.8	27	6.3	45.1	394
505	62.00	28	AV28	28.4	18.1	28	6.6	45.9	378
			STD	0.4	0.4	1	0.1	0.3	11
			MAX	29.4	18.9	29	6.8	46.5	398
			MIN	27.5	17.4	26	6.4	45.0	359
536	63.00	31	AV31	28.4	19.4	28	6.7	45.6	390
			STD	0.3	0.4	1	0.1	0.2	11
			MAX	28.9	20.0	30	6.8	46.1	409
			MIN	27.8	18.6	27	6.5	45.1	367
565	64.00	29	AV29	27.9	17.6	27	6.5	46.3	347
			STD	0.4	0.4	1	0.1	0.4	10
			MAX	28.6	18.4	28	6.7	47.0	366
			MIN	27.2	17.0	25	6.3	45.5	330
592	65.00	27	AV27	28.0	17.7	27	6.5	46.3	349
			STD	0.5	0.4	1	0.2	0.5	14
			MAX	29.3	19.1	29	6.8	47.3	380
			MIN	26.9	17.1	25	6.2	45.1	330
620	66.00	28	AV28	28.2	19.2	28	6.6	46.0	375
			STD	0.4	0.7	1	0.1	0.4	15
			MAX	29.0	20.2	29	6.8	46.6	400
			MIN	27.3	17.7	26	6.4	45.1	348
659	67.00	39	AV39	28.7	21.8	29	6.7	45.4	443
			STD	0.5	1.1	1	0.1	0.4	20

USH 10 over Little Lake Butte des Morts - Pier 15 #1 APE D30-42, HP 14 x 73
OP: AM Date: 02-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			MAX	29.7	24.3	30	6.9	46.4	486
			MIN	27.7	19.7	27	6.4	44.7	402
709	67.98	51	AV50	29.0	24.8	30	6.9	44.9	496
			STD	0.5	1.0	1	0.1	0.4	20
			MAX	30.3	27.0	32	7.2	45.7	542
			MIN	28.1	23.3	28	6.6	43.8	467
719	68.15	60	AV10	29.7	26.9	31	7.0	44.5	536
			STD	0.5	0.6	1	0.1	0.3	11
			MAX	30.5	28.1	32	7.2	45.0	556
			MIN	29.0	26.2	29	6.8	43.9	523
729	68.27	80	AV10	29.9	28.8	31	7.1	44.4	579
			STD	0.3	0.5	0	0.1	0.2	12
			MAX	30.7	29.7	32	7.2	44.6	602
			MIN	29.6	27.9	30	7.0	43.9	557
739	68.38	96	AV10	30.4	30.0	32	7.2	43.9	611
			STD	0.4	0.3	1	0.1	0.3	6
			MAX	31.0	30.5	32	7.4	44.4	619
			MIN	29.8	29.3	30	7.0	43.5	602
			Average	26.8	16.0	27	6.2	47.6	333
			Std. Dev.	3.0	5.8	3	0.7	3.3	120
			Maximum	31.0	30.5	32	7.4	66.2	619
			Minimum	11.8	2.7	10	3.0	43.5	31

Total number of blows analyzed: 731

BL# Sensors

1-739 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.00); A4: [K2524] 360.0 (1.00)

BL# Comments

9 Reported reference at El. 740.79
10 Mud line at El. 717.29

Time Summary

Drive 16 minutes 6 seconds 8:21 AM - 8:37 AM BN 1 - 739

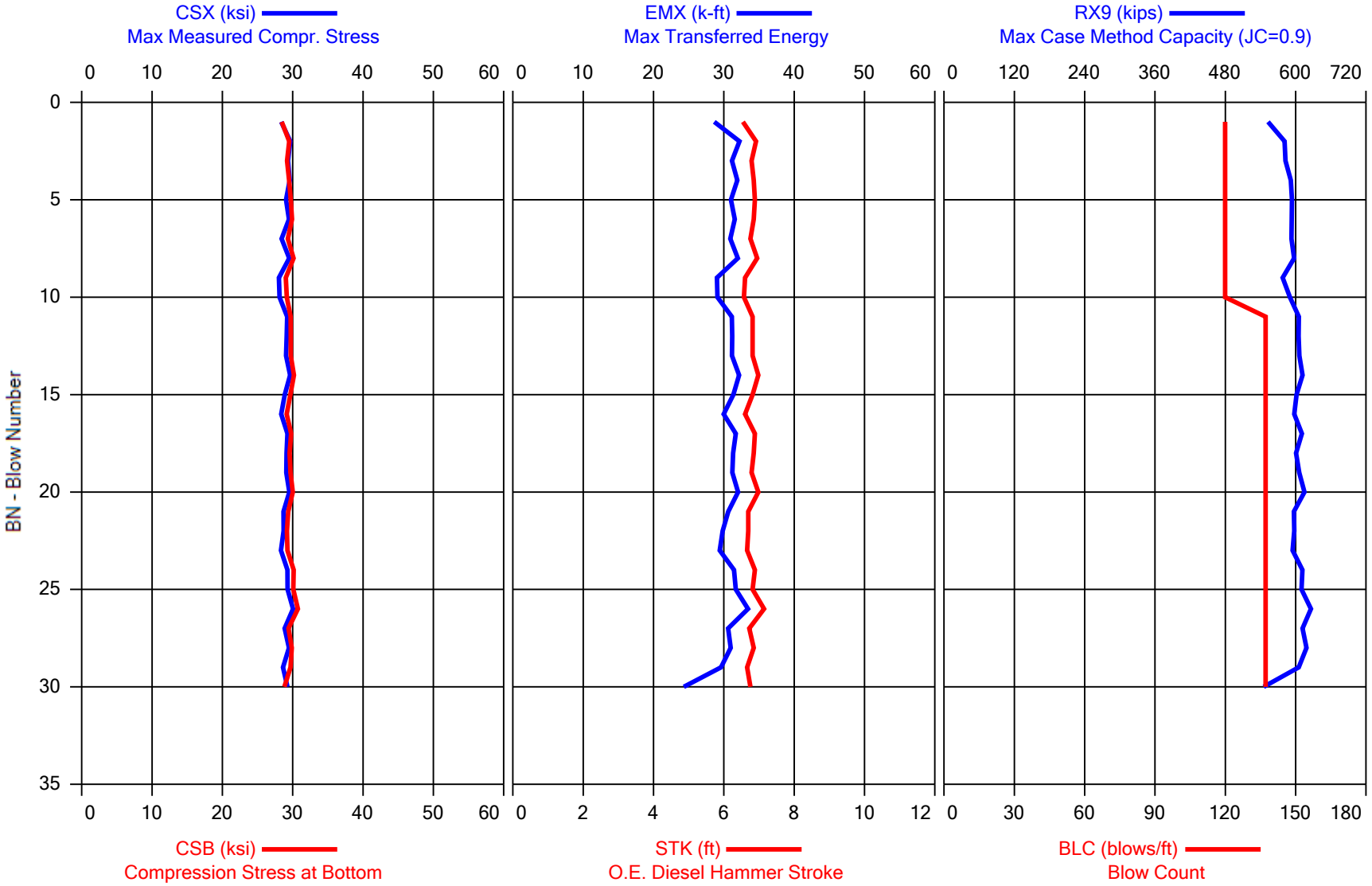
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 03-April-2015

Test started: 03-April-2015

USH 10 over Little Lake Butte des Morts - Pier 15 #1 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - Pier 15 #1 Restrike APE D30-42, HP 14 x 73
OP: AM Date: 03-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 73.00 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	68.46	137	AV10	29.0	29.4	31	6.8	45.3	585
			STD	0.6	0.5	1	0.1	0.5	12
			MAX	29.7	30.1	32	6.9	46.0	597
			MIN	28.0	28.4	29	6.5	44.7	553
20	68.53	137	AV10	29.1	29.7	31	6.8	45.1	606
			STD	0.3	0.3	1	0.1	0.3	5
			MAX	29.6	30.2	32	7.0	45.8	615
			MIN	28.4	29.1	30	6.6	44.6	598
30	68.60	137	AV10	29.0	29.7	30	6.8	45.2	602
			STD	0.5	0.5	2	0.1	0.4	21
			MAX	30.1	30.7	33	7.1	45.6	626
			MIN	28.3	28.8	24	6.7	44.1	545
			Average	29.0	29.6	31	6.8	45.2	598
			Std. Dev.	0.5	0.5	2	0.1	0.4	17
			Maximum	30.1	30.7	33	7.1	46.0	626
			Minimum	28.0	28.4	24	6.5	44.1	545

Total number of blows analyzed: 30

BL# Sensors

1-30 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.10); A4: [K3550] 360.0 (1.10)

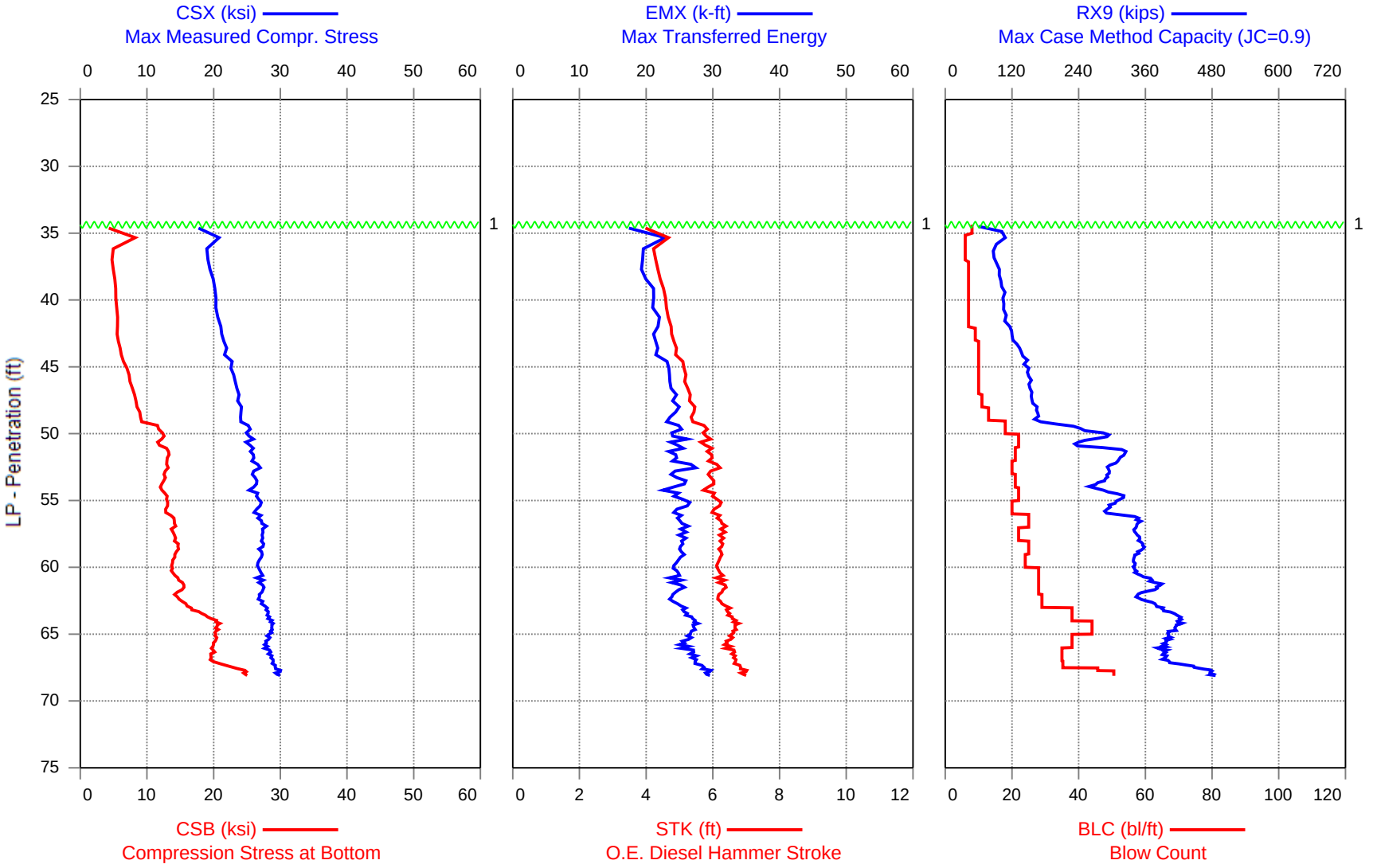
Time Summary

Drive 38 seconds 9:02 AM - 9:03 AM BN 1 - 30

Printed: 02-April-2015

Test started: 02-April-2015

USH 10 over Little Lake Butte des Morts - Pier 15 #36
APE D30-42, HP 14 x 73



1 - Reported Reference at El. 740.79

USH 10 over Little Lake Butte des Morts - Pier 15 #36 APE D30-42, HP 14 x 73
OP: AM Date: 02-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.40 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	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
9	34.38	8	AV1	24.7	3.8	30	5.3	50.7	65
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	24.7	3.8	30	5.3	50.7	65
			MIN	24.7	3.8	30	5.3	50.7	65
14	35.00	8	AV5	16.6	5.1	15	3.8	59.8	84
			STD	1.6	2.0	2	0.3	2.0	31
			MAX	19.0	8.0	19	4.3	62.3	129
			MIN	14.3	3.4	12	3.4	56.3	56
20	36.00	6	AV6	20.6	7.4	23	4.6	54.4	100
			STD	1.1	1.7	2	0.3	1.5	10
			MAX	22.2	9.2	26	5.0	56.6	110
			MIN	18.8	5.0	19	4.2	52.4	83
26	37.00	6	AV6	18.8	4.7	19	4.2	56.6	87
			STD	0.2	0.1	1	0.1	0.4	3
			MAX	19.1	4.8	20	4.3	57.4	91
			MIN	18.4	4.5	18	4.1	56.2	83
33	38.00	7	AV7	19.4	4.9	19	4.3	55.8	95
			STD	0.3	0.1	0	0.1	0.3	3
			MAX	20.0	5.0	20	4.5	56.1	100
			MIN	19.1	4.7	19	4.3	55.1	90
40	39.00	7	AV7	20.0	5.2	20	4.5	55.2	100
			STD	0.3	0.1	1	0.1	0.5	3
			MAX	20.6	5.4	21	4.6	55.8	105
			MIN	19.5	5.0	20	4.3	54.6	96
47	40.00	7	AV7	20.2	5.3	21	4.5	54.7	105
			STD	0.5	0.2	1	0.1	0.6	4
			MAX	21.0	5.6	22	4.7	55.4	111
			MIN	19.6	5.0	20	4.4	53.9	99
54	41.00	7	AV7	20.3	5.5	21	4.6	54.4	106
			STD	0.6	0.3	1	0.1	0.7	3
			MAX	21.1	5.8	23	4.8	55.3	109
			MIN	19.5	4.9	19	4.4	53.2	100
61	42.00	7	AV7	20.9	5.7	22	4.7	53.7	110
			STD	0.6	0.1	1	0.1	0.5	4
			MAX	22.0	5.8	24	4.9	54.2	117
			MIN	20.3	5.5	21	4.6	52.7	105
70	43.00	9	AV9	21.3	5.5	21	4.8	53.4	119
			STD	0.4	0.3	1	0.1	0.4	3
			MAX	22.1	6.1	22	5.0	53.9	124
			MIN	20.8	5.0	20	4.7	52.5	115
80	44.00	10	AV10	21.7	6.0	22	4.9	52.9	132
			STD	0.4	0.5	1	0.1	0.4	5
			MAX	22.5	6.7	22	5.0	53.6	138
			MIN	21.2	5.2	21	4.7	52.3	122
90	45.00	10	AV10	22.4	6.5	23	5.0	52.1	144

USH 10 over Little Lake Butte des Morts - Pier 15 #36 APE D30-42, HP 14 x 73
OP: AM Date: 02-April-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			STD	0.8	0.5	1	0.2	0.8	5
			MAX	23.5	7.3	25	5.2	54.0	151
			MIN	20.7	5.7	21	4.7	51.1	135
100	46.00	10	AV10	22.8	7.1	23	5.2	51.5	151
			STD	0.4	0.4	1	0.1	0.5	4
			MAX	23.7	7.6	25	5.4	52.3	156
			MIN	22.3	6.4	22	5.0	50.6	146
110	47.00	10	AV10	23.6	7.9	24	5.2	51.1	153
			STD	0.5	0.4	1	0.1	0.5	3
			MAX	24.5	8.7	25	5.4	51.9	158
			MIN	22.8	7.1	23	5.1	50.5	147
121	48.00	11	AV11	23.8	8.3	24	5.4	50.6	158
			STD	0.5	0.4	1	0.1	0.5	4
			MAX	24.4	8.9	26	5.5	51.4	164
			MIN	23.1	7.6	23	5.2	49.8	152
134	49.00	13	AV13	24.1	8.9	24	5.4	50.4	165
			STD	0.6	0.4	1	0.2	0.7	5
			MAX	25.1	9.5	26	5.6	51.9	176
			MIN	22.8	7.9	22	5.1	49.4	157
152	50.00	18	AV18	25.0	11.2	24	5.7	49.2	230
			STD	0.9	1.2	2	0.3	1.0	37
			MAX	26.7	12.7	28	6.1	51.7	292
			MIN	23.0	9.1	21	5.1	47.4	167
174	51.00	22	AV22	25.4	12.1	25	5.8	48.8	260
			STD	0.8	0.6	1	0.2	0.8	24
			MAX	27.1	13.1	27	6.1	50.5	298
			MIN	23.8	11.1	22	5.4	47.4	232
195	52.00	21	AV21	25.8	13.1	24	5.9	48.2	316
			STD	0.4	0.2	1	0.1	0.5	9
			MAX	26.8	13.5	27	6.2	49.2	327
			MIN	25.1	12.7	23	5.7	47.3	289
215	53.00	20	AV20	26.3	12.9	26	6.0	47.8	298
			STD	0.7	0.4	2	0.2	0.7	6
			MAX	27.9	13.6	29	6.4	48.9	313
			MIN	25.3	12.3	23	5.8	46.4	290
236	54.00	21	AV21	26.3	12.5	25	6.0	48.0	280
			STD	0.6	0.5	1	0.1	0.6	13
			MAX	27.9	13.4	29	6.3	48.8	298
			MIN	25.3	11.5	23	5.8	46.8	254
258	55.00	22	AV22	26.2	12.7	24	5.9	48.2	302
			STD	0.8	0.5	2	0.2	0.8	19
			MAX	28.0	13.3	28	6.4	49.8	325
			MIN	24.9	11.7	21	5.5	46.5	265
278	56.00	20	AV20	26.7	13.0	25	6.1	47.5	296
			STD	0.6	0.3	1	0.2	0.6	8
			MAX	27.7	13.6	27	6.4	48.6	310
			MIN	25.3	12.4	23	5.8	46.5	282
303	57.00	25	AV25	27.2	14.0	25	6.2	47.0	342
			STD	0.8	0.4	1	0.2	0.7	11
			MAX	28.7	15.1	28	6.6	48.2	355
			MIN	25.9	12.9	23	5.9	45.8	308

USH 10 over Little Lake Butte des Morts - Pier 15 #36
OP: AM
APE D30-42, HP 14 x 73
Date: 02-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
325	58.00	22	AV22	27.3	14.0	26	6.3	46.9	345
			STD	0.4	0.4	1	0.1	0.4	5
			MAX	28.2	14.6	27	6.5	47.8	352
			MIN	26.7	13.2	24	6.0	46.1	338
350	59.00	25	AV25	27.3	14.5	25	6.3	47.0	353
			STD	0.6	0.3	1	0.2	0.5	5
			MAX	29.2	15.2	29	6.8	47.7	362
			MIN	26.3	13.9	24	6.1	45.2	345
374	60.00	24	AV24	26.8	13.9	25	6.2	47.3	340
			STD	0.6	0.3	1	0.1	0.5	4
			MAX	28.2	14.7	26	6.5	48.2	352
			MIN	25.6	13.3	23	5.9	46.3	335
402	61.00	28	AV28	27.0	14.1	25	6.2	47.2	352
			STD	0.7	0.5	1	0.2	0.6	12
			MAX	28.3	15.0	26	6.5	48.9	376
			MIN	25.2	13.4	21	5.8	46.2	339
430	62.00	28	AV28	27.2	15.2	25	6.3	46.8	374
			STD	0.7	0.5	1	0.2	0.7	14
			MAX	28.2	16.0	28	6.7	48.7	395
			MIN	25.6	14.1	22	5.8	45.6	345
459	63.00	29	AV29	27.1	15.2	24	6.2	47.1	363
			STD	0.7	0.7	1	0.2	0.6	15
			MAX	28.7	16.4	27	6.6	48.4	385
			MIN	25.7	13.8	22	5.9	45.7	339
497	64.00	38	AV38	28.2	18.4	26	6.5	46.1	410
			STD	0.7	1.2	1	0.2	0.7	13
			MAX	29.4	20.7	29	6.9	47.6	430
			MIN	26.9	16.3	24	6.1	44.8	388
541	65.00	44	AV44	28.7	20.5	27	6.7	45.6	413
			STD	0.5	0.4	1	0.1	0.4	8
			MAX	29.9	21.7	29	7.1	46.5	432
			MIN	27.7	19.8	26	6.4	44.3	396
579	66.00	38	AV38	28.0	20.2	26	6.5	46.2	398
			STD	0.6	0.3	1	0.2	0.6	6
			MAX	29.3	21.1	28	6.8	47.2	411
			MIN	27.0	19.4	24	6.2	45.1	381
614	67.00	35	AV35	28.5	19.7	27	6.6	45.8	394
			STD	0.6	0.3	1	0.1	0.5	7
			MAX	29.7	20.3	29	6.9	47.1	404
			MIN	27.0	19.2	25	6.2	44.9	374
632	67.51	35	AV18	29.0	21.4	28	6.7	45.4	426
			STD	0.6	1.2	1	0.2	0.5	19
			MAX	30.3	23.4	30	7.1	46.1	452
			MIN	27.9	19.7	26	6.5	44.3	400
642	67.73	46	AV10	29.6	24.0	29	6.9	44.9	468
			STD	0.8	0.8	1	0.2	0.6	11
			MAX	30.7	25.1	31	7.2	46.0	483
			MIN	28.0	22.8	26	6.5	43.9	453
652	67.93	51	AV10	29.6	24.6	29	6.9	44.8	477
			STD	0.8	0.4	1	0.2	0.6	4

USH 10 over Little Lake Butte des Morts - Pier 15 #36 APE D30-42, HP 14 x 73
OP: AM Date: 02-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			MAX	30.7	25.3	30	7.2	45.7	482
			MIN	28.4	24.0	28	6.6	43.9	468
662	68.13	51	AV10	29.8	24.9	29	7.0	44.7	481
			STD	0.7	0.4	1	0.2	0.5	6
			MAX	30.6	25.5	31	7.2	45.4	492
			MIN	28.8	24.4	28	6.7	43.9	472
			Average	26.3	14.4	25	6.0	48.1	314
			Std. Dev.	2.7	5.2	2	0.7	2.9	107
			Maximum	30.7	25.5	31	7.2	62.3	492
			Minimum	14.3	3.4	12	3.4	43.9	56

Total number of blows analyzed: 654

BL# Sensors

1-662 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.00); A4: [K2524] 360.0 (1.00)

BL# Comments

9 Reported Reference at El. 740.79
10 Mud line at El. 717.29

Time Summary

Drive 14 minutes 20 seconds 8:53 AM - 9:07 AM BN 1 - 662

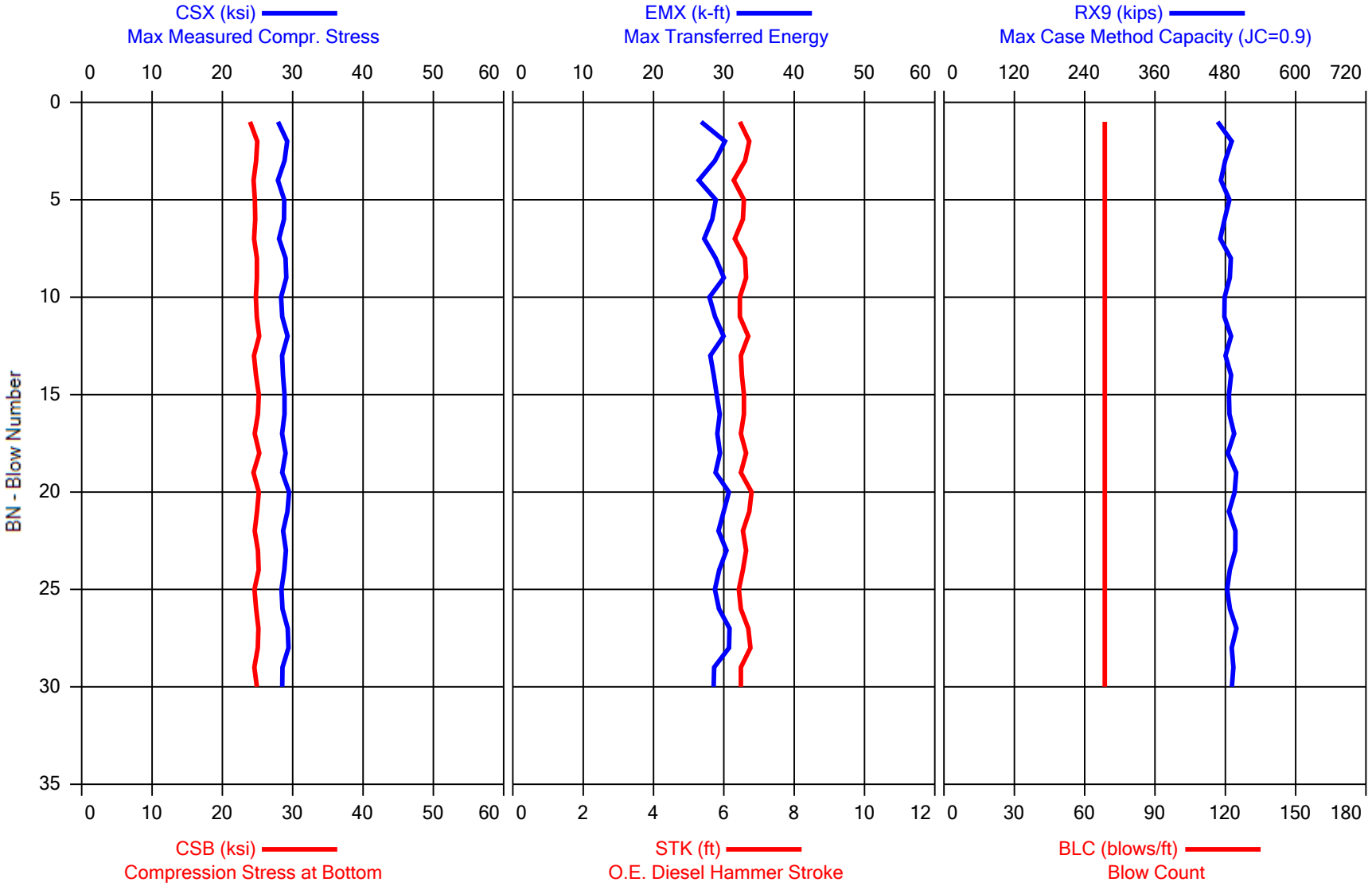
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 03-April-2015

Test started: 03-April-2015

USH 10 over Little Lake Butte des Morts - Pier 15 #36 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - Pier 15 #36 Restrike APE D30-42, HP 14 x 73
OP: AM Date: 03-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 73.00 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	68.27	69	AV10	28.6	24.6	28	6.5	46.1	480
			STD	0.5	0.3	1	0.1	0.5	8
			MAX	29.2	25.0	30	6.7	46.9	491
			MIN	27.9	23.9	26	6.3	45.4	467
20	68.42	69	AV10	28.8	24.9	29	6.6	45.9	489
			STD	0.3	0.3	1	0.1	0.3	6
			MAX	29.5	25.3	31	6.8	46.3	498
			MIN	28.5	24.4	28	6.5	45.2	478
30	68.56	69	AV10	28.8	24.9	30	6.6	45.9	491
			STD	0.4	0.2	1	0.1	0.4	5
			MAX	29.4	25.2	31	6.8	46.4	499
			MIN	28.4	24.5	29	6.4	45.3	483
			Average	28.7	24.8	29	6.6	46.0	487
			Std. Dev.	0.4	0.3	1	0.1	0.4	8
			Maximum	29.5	25.3	31	6.8	46.9	499
			Minimum	27.9	23.9	26	6.3	45.2	467

Total number of blows analyzed: 30

BL# Sensors

1-30 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.10); A4: [K2524] 360.0 (1.10)

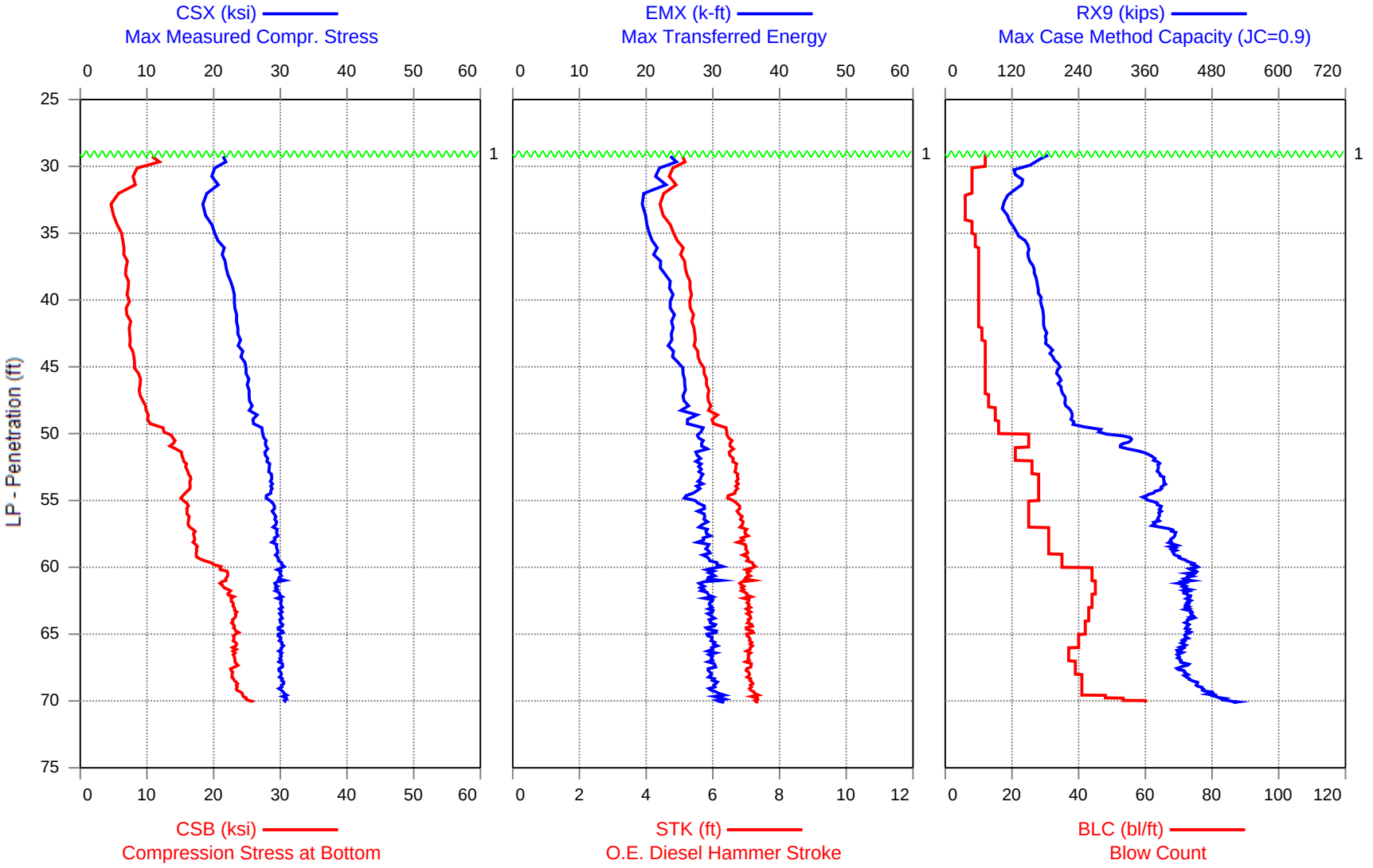
Time Summary

Drive 37 seconds 9:10 AM - 9:11 AM BN 1 - 30

Printed: 02-April-2015

Test started: 02-April-2015

USH 10 over Little Lake Butte des Morts - Pier 15 #44
APE D30-42, HP 14 x 73



1 - Reported reference at El. 740.79

USH 10 over Little Lake Butte des Morts - Pier 15 #44 APE D30-42, HP 14 x 73
OP: AM Date: 02-April-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
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	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
8	29.08	12	AV1	20.2	11.0	21	4.9	52.9	186
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	20.2	11.0	21	4.9	52.9	186
			MIN	20.2	11.0	21	4.9	52.9	186
19	30.00	12	AV11	21.8	11.1	24	5.1	51.6	166
			STD	0.5	1.4	1	0.1	0.6	14
			MAX	22.6	12.8	25	5.3	52.8	187
			MIN	20.7	7.5	23	4.9	50.7	143
27	31.00	8	AV8	19.5	7.8	21	4.7	54.1	129
			STD	0.9	0.6	2	0.2	1.0	10
			MAX	21.4	8.9	24	5.0	55.6	143
			MIN	18.1	7.1	19	4.4	52.1	115
35	32.00	8	AV8	20.4	7.5	22	4.8	53.2	131
			STD	0.7	1.1	2	0.2	0.9	9
			MAX	21.3	9.0	24	5.0	54.6	142
			MIN	18.9	5.2	20	4.6	52.2	117
41	33.00	6	AV6	18.2	4.8	19	4.4	55.7	106
			STD	0.5	0.2	1	0.1	0.6	6
			MAX	19.1	5.0	21	4.5	56.4	116
			MIN	17.5	4.6	18	4.3	54.7	97
47	34.00	6	AV6	18.7	4.9	20	4.5	55.0	109
			STD	0.4	0.3	1	0.1	0.5	5
			MAX	19.1	5.2	21	4.6	55.8	117
			MIN	18.0	4.3	19	4.3	54.3	102
55	35.00	8	AV8	19.9	5.8	20	4.8	53.5	123
			STD	0.7	0.3	1	0.1	0.7	5
			MAX	20.6	6.3	22	4.9	55.2	131
			MIN	18.4	5.4	18	4.5	52.8	115
64	36.00	9	AV9	20.8	6.4	21	5.0	52.5	141
			STD	0.8	0.3	1	0.2	0.8	8
			MAX	22.4	6.8	23	5.3	53.6	154
			MIN	19.9	5.8	19	4.7	51.0	130
74	37.00	10	AV10	21.5	6.6	21	5.1	51.9	150
			STD	0.7	0.3	1	0.2	0.9	4
			MAX	22.8	7.0	23	5.4	53.4	155
			MIN	20.3	6.1	19	4.8	50.4	141
84	38.00	10	AV10	21.9	7.0	22	5.2	51.4	157
			STD	0.6	0.3	1	0.2	0.7	4
			MAX	23.0	7.5	24	5.5	52.3	163
			MIN	21.1	6.5	21	5.0	50.1	147
94	39.00	10	AV10	22.5	7.1	23	5.3	50.9	164
			STD	0.5	0.4	1	0.1	0.5	2
			MAX	23.1	7.6	25	5.4	52.1	167
			MIN	21.3	6.5	21	5.0	50.2	160
104	40.00	10	AV10	23.0	7.2	24	5.3	50.7	169

USH 10 over Little Lake Butte des Morts - Pier 15 #44 APE D30-42, HP 14 x 73
OP: AM Date: 02-April-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			STD	0.5	0.4	1	0.1	0.4	4
			MAX	23.7	8.0	26	5.6	51.2	177
			MIN	22.2	6.6	23	5.2	49.7	163
114	41.00	10	AV10	23.2	7.0	24	5.3	50.7	174
			STD	0.7	0.3	1	0.1	0.7	4
			MAX	24.5	7.5	26	5.6	51.8	183
			MIN	22.3	6.4	22	5.1	49.7	170
124	42.00	10	AV10	23.4	7.3	24	5.4	50.5	176
			STD	0.6	0.4	1	0.1	0.4	4
			MAX	24.3	7.9	26	5.6	51.1	182
			MIN	22.6	6.6	23	5.2	49.5	168
135	43.00	11	AV11	23.7	7.4	24	5.5	50.1	180
			STD	0.5	0.3	1	0.1	0.5	3
			MAX	24.7	7.9	25	5.6	51.1	187
			MIN	22.7	6.9	22	5.2	49.4	175
147	44.00	12	AV12	24.1	7.7	24	5.5	50.0	187
			STD	0.6	0.4	1	0.1	0.5	6
			MAX	25.4	8.5	25	5.7	51.0	196
			MIN	22.9	7.2	22	5.3	49.1	177
159	45.00	12	AV12	24.5	8.1	25	5.6	49.5	198
			STD	0.6	0.4	1	0.1	0.5	5
			MAX	25.9	8.8	26	5.9	50.1	207
			MIN	23.6	7.4	23	5.5	48.4	190
171	46.00	12	AV12	25.0	8.6	26	5.8	48.9	204
			STD	0.6	0.5	1	0.1	0.5	5
			MAX	25.9	9.2	27	6.0	49.7	213
			MIN	23.8	7.9	24	5.6	48.1	197
183	47.00	12	AV12	25.1	8.9	26	5.8	48.7	207
			STD	0.7	0.4	1	0.2	0.7	3
			MAX	26.6	9.4	27	6.2	50.0	211
			MIN	23.9	8.2	23	5.5	47.2	200
196	48.00	13	AV13	25.6	9.5	26	5.9	48.3	216
			STD	0.4	0.5	1	0.1	0.3	3
			MAX	26.3	10.3	28	6.1	48.9	219
			MIN	24.9	8.8	25	5.8	47.6	210
211	49.00	15	AV15	25.9	10.0	26	6.0	48.0	226
			STD	0.6	0.5	1	0.2	0.6	2
			MAX	26.9	10.8	28	6.3	49.0	230
			MIN	24.8	8.9	24	5.7	46.9	222
227	50.00	16	AV16	26.8	11.7	28	6.3	47.0	255
			STD	0.7	1.1	1	0.2	0.8	22
			MAX	27.7	12.9	29	6.6	48.5	284
			MIN	25.3	9.8	25	5.9	45.9	224
252	51.00	25	AV25	27.7	13.8	28	6.5	46.1	323
			STD	0.5	0.5	1	0.2	0.5	12
			MAX	29.0	14.9	31	6.8	47.4	339
			MIN	26.4	13.1	25	6.1	45.0	294
273	52.00	21	AV21	27.9	15.1	28	6.5	46.0	358
			STD	0.5	0.5	1	0.1	0.5	19
			MAX	28.7	15.8	31	6.8	46.8	379
			MIN	27.0	13.8	26	6.3	45.1	316

USH 10 over Little Lake Butte des Morts - Pier 15 #44 APE D30-42, HP 14 x 73
OP: AM Date: 02-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
299	53.00	26	AV26	28.3	15.9	28	6.7	45.5	383
			STD	0.4	0.3	1	0.1	0.5	3
			MAX	29.4	16.4	30	7.0	46.6	390
			MIN	27.3	15.0	26	6.4	44.6	378
327	54.00	28	AV28	28.7	16.5	28	6.7	45.4	392
			STD	0.5	0.3	1	0.2	0.5	4
			MAX	29.7	16.8	30	7.0	46.7	399
			MIN	27.4	15.6	25	6.3	44.5	383
355	55.00	28	AV28	28.3	15.7	27	6.6	45.9	371
			STD	0.6	0.5	1	0.2	0.6	12
			MAX	29.3	16.8	29	6.9	46.9	393
			MIN	27.1	14.9	24	6.3	44.9	352
380	56.00	25	AV25	28.9	16.0	28	6.8	45.3	384
			STD	0.6	0.2	1	0.2	0.5	5
			MAX	29.9	16.3	31	7.1	46.3	392
			MIN	27.9	15.5	26	6.5	44.3	370
405	57.00	25	AV25	29.3	16.2	29	6.9	44.9	381
			STD	0.7	0.3	1	0.2	0.6	6
			MAX	30.4	16.8	31	7.2	46.2	388
			MIN	27.5	15.4	26	6.5	44.0	371
436	58.00	31	AV31	29.3	17.0	29	6.9	44.7	409
			STD	0.6	0.3	1	0.2	0.5	6
			MAX	30.4	17.6	31	7.2	46.1	419
			MIN	28.0	16.5	27	6.5	43.8	392
467	59.00	31	AV31	29.4	17.4	29	7.0	44.6	410
			STD	0.6	0.3	1	0.2	0.5	6
			MAX	30.4	17.8	31	7.3	45.7	420
			MIN	28.3	16.7	27	6.6	43.7	398
502	60.00	35	AV35	29.9	18.9	30	7.1	44.3	434
			STD	0.6	1.3	1	0.2	0.6	14
			MAX	31.1	21.7	33	7.5	45.6	459
			MIN	28.3	17.1	27	6.7	43.2	407
546	61.00	44	AV44	30.0	21.8	30	7.1	44.4	442
			STD	0.4	0.5	1	0.1	0.4	7
			MAX	31.0	22.9	32	7.4	45.2	455
			MIN	29.2	20.4	28	6.8	43.5	426
591	62.00	45	AV45	29.5	21.7	29	6.9	44.8	431
			STD	0.5	0.6	1	0.1	0.5	6
			MAX	31.3	23.0	32	7.5	45.6	446
			MIN	28.7	20.6	27	6.7	43.2	418
635	63.00	44	AV44	30.1	22.8	30	7.1	44.4	437
			STD	0.4	0.4	1	0.1	0.4	5
			MAX	31.1	23.8	32	7.4	45.1	450
			MIN	29.2	21.7	28	6.8	43.5	430
678	64.00	43	AV43	30.1	23.2	30	7.1	44.3	441
			STD	0.3	0.3	1	0.1	0.4	6
			MAX	30.7	23.7	31	7.3	45.2	450
			MIN	29.3	22.5	28	6.8	43.6	427
720	65.00	42	AV42	30.0	23.1	30	7.1	44.2	436
			STD	0.5	0.4	1	0.2	0.5	5

USH 10 over Little Lake Butte des Morts - Pier 15 #44 APE D30-42, HP 14 x 73
OP: AM Date: 02-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			MAX	31.2	24.3	32	7.4	45.0	456
			MIN	29.0	22.4	28	6.8	43.3	427
760	66.00	40	AV40	30.1	23.1	30	7.1	44.2	430
			STD	0.5	0.4	1	0.1	0.4	4
			MAX	31.0	23.9	32	7.5	45.1	438
			MIN	29.2	22.5	28	6.8	43.2	419
797	67.00	37	AV37	30.1	23.1	30	7.1	44.3	422
			STD	0.4	0.3	1	0.1	0.4	5
			MAX	31.3	23.7	32	7.4	45.2	430
			MIN	29.0	22.6	28	6.8	43.3	413
836	68.00	39	AV39	30.1	23.0	30	7.1	44.3	428
			STD	0.4	0.4	1	0.1	0.4	7
			MAX	30.9	24.1	31	7.3	45.4	441
			MIN	28.9	22.2	28	6.7	43.7	413
900	69.56	41	AV64	30.3	23.4	30	7.2	44.1	455
			STD	0.4	0.5	1	0.1	0.4	16
			MAX	31.3	24.9	32	7.5	44.8	487
			MIN	29.2	22.4	28	6.9	43.1	429
910	69.77	48	AV10	30.7	24.5	31	7.3	43.8	487
			STD	0.4	0.3	1	0.1	0.3	5
			MAX	31.3	24.9	33	7.5	44.2	496
			MIN	30.0	24.0	29	7.1	43.2	479
920	69.96	53	AV10	30.9	25.0	31	7.3	43.6	500
			STD	0.4	0.2	1	0.1	0.4	3
			MAX	31.5	25.3	33	7.5	44.1	506
			MIN	30.4	24.7	30	7.1	43.0	496
930	70.13	60	AV10	30.7	25.8	31	7.3	43.7	518
			STD	0.3	0.2	1	0.1	0.3	6
			MAX	31.0	26.3	32	7.4	44.3	529
			MIN	30.1	25.4	30	7.1	43.3	509
			Average	28.1	17.5	28	6.6	46.0	363
			Std. Dev.	3.1	6.1	3	0.7	2.8	109
			Maximum	31.5	26.3	33	7.5	56.4	529
			Minimum	17.5	4.3	18	4.3	43.0	97

Total number of blows analyzed: 923

BL# Sensors

1-930 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.00); A4: [K2524] 360.0 (1.00)

BL# Comments

8 Reported reference at El. 740.79

Time Summary

Drive 20 minutes 26 seconds 9:19 AM - 9:39 AM BN 1 - 930

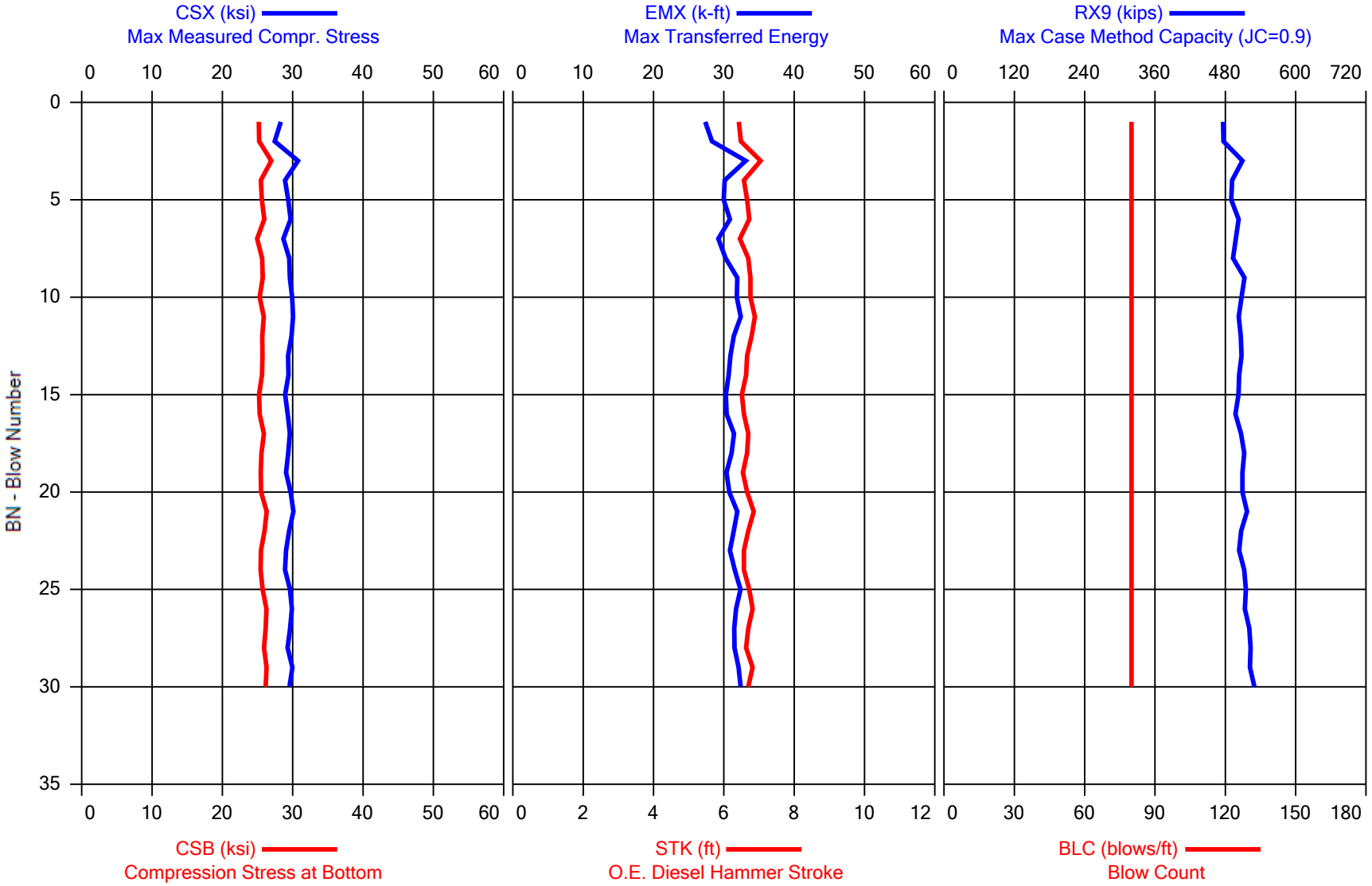
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 03-April-2015

Test started: 03-April-2015

USH 10 over Little Lake Butte des Morts - Pier 15 #44 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - Pier 15 #44 Restrike APE D30-42, HP 14 x 73
OP: AM Date: 03-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 75.00 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	70.25	80	AV10	29.2	25.6	30	6.7	45.6	496
			STD	0.9	0.5	2	0.2	0.6	12
			MAX	30.7	27.0	33	7.0	46.4	513
			MIN	27.4	24.9	27	6.4	44.4	476
20	70.38	80	AV10	29.5	25.6	31	6.7	45.6	506
			STD	0.3	0.2	1	0.1	0.3	4
			MAX	30.1	25.9	32	6.9	46.1	512
			MIN	28.9	25.2	30	6.5	44.9	497
30	70.50	80	AV10	29.5	26.0	32	6.7	45.5	516
			STD	0.4	0.3	0	0.1	0.3	7
			MAX	30.1	26.3	32	6.8	45.9	530
			MIN	28.9	25.4	31	6.6	45.0	503
			Average	29.4	25.7	31	6.7	45.6	506
			Std. Dev.	0.6	0.4	1	0.1	0.4	12
			Maximum	30.7	27.0	33	7.0	46.4	530
			Minimum	27.4	24.9	27	6.4	44.4	476

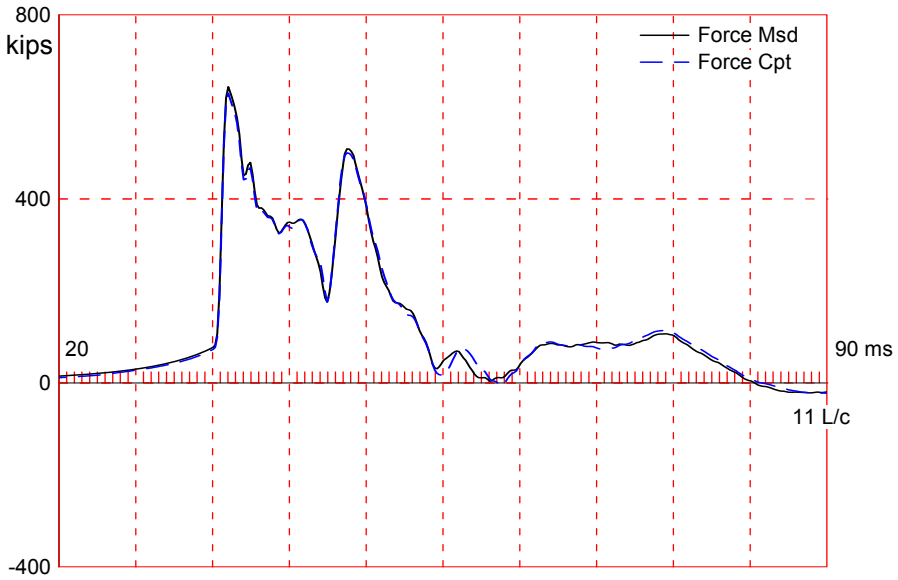
Total number of blows analyzed: 30

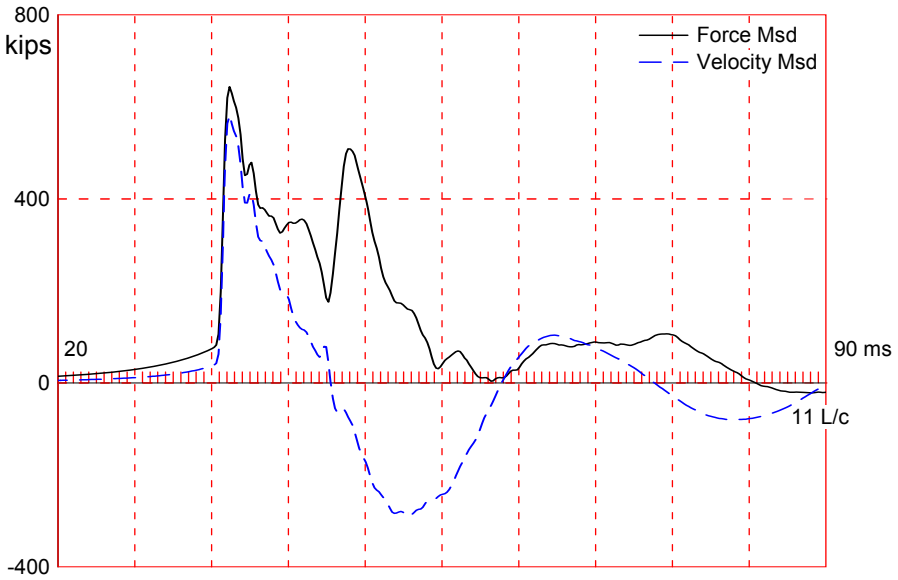
BL# Sensors

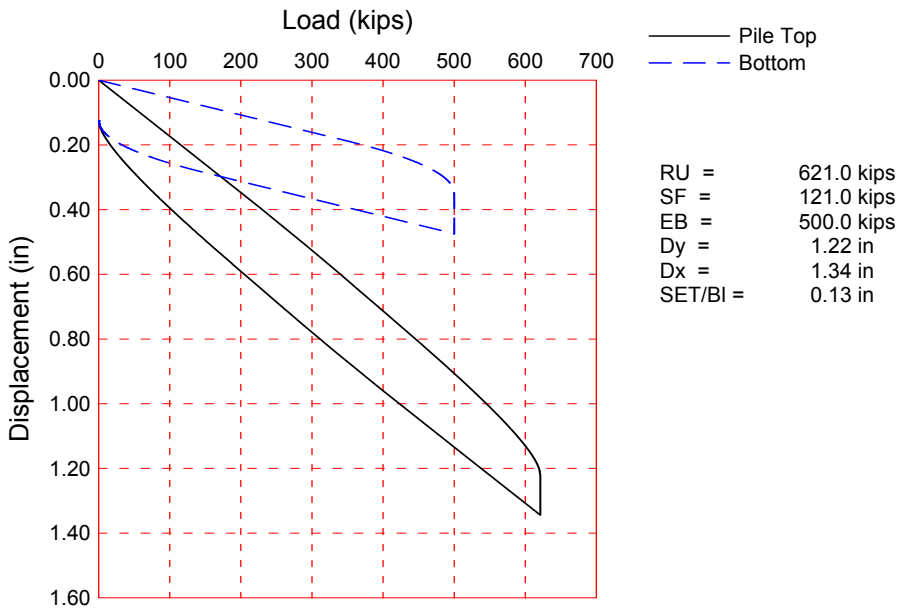
1-30 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.10); A4: [K2524] 360.0 (1.10)

Time Summary

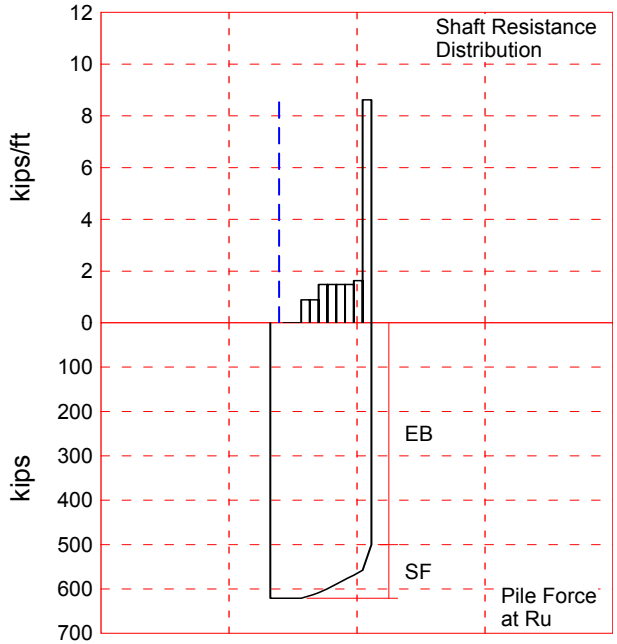
Drive 38 seconds 9:16 AM - 9:17 AM BN 1 - 30







RU =	621.0 kips
SF =	121.0 kips
EB =	500.0 kips
Dy =	1.22 in
Dx =	1.34 in
SET/Bl =	0.13 in



Length b. Sensors	77.4 ft
Embedment	68.4 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.	16808 ft/s
Match Quality	2.16
Top Compr. Stress	29.5 ksi
Max Compr. Stress	30.4 ksi
Max Tension Stress	-4.70 ksi
Avg. Shaft Quake	0.25 in
Toe Quake	0.27 in
Avg. Shaft Smith Dpg.	0.26 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: 621.0; along Shaft 121.0; at Toe 500.0 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
				621.0				
1	16.8	7.8	0.0	621.0	0.0	0.00	0.00	0.00
2	23.6	14.5	0.0	621.0	0.0	0.00	0.00	0.00
3	30.3	21.2	6.0	615.0	6.0	0.89	0.19	0.26
4	37.0	28.0	6.0	609.0	12.0	0.89	0.19	0.26
5	43.7	34.7	10.0	599.0	22.0	1.49	0.32	0.26
6	50.5	41.4	10.0	589.0	32.0	1.49	0.32	0.26
7	57.2	48.2	10.0	579.0	42.0	1.49	0.32	0.26
8	63.9	54.9	10.0	569.0	52.0	1.49	0.32	0.26
9	70.7	61.6	11.0	558.0	63.0	1.63	0.35	0.26
10	77.4	68.4	58.0	500.0	121.0	8.62	1.83	0.26
Avg. Shaft			12.1			1.77	0.38	0.26
Toe			500.0				362.72	0.06

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.25	0.27
Case Damping Factor		0.82	0.79
Damping Type		Viscous	Smith
Unloading Quake	(% of loading quake)	36	33
Unloading Level	(% of Ru)	38	
Resistance Gap (included in Toe Quake)	(in)		0.01
Soil Plug Weight	(kips)	0.080	

CAPWAP match quality = 2.16 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.13 in; Blow Count = 96 b/ft
Computed: Final Set = 0.01 in; Blow Count = 1857 b/ft
Transducer F3(D815) CAL: 93.0; RF: 1.00; F4(F607) CAL: 93.6; RF: 1.00
A3(K3550) CAL: 360; RF: 1.00; A4(K2524) CAL: 360; RF: 1.00

max. Top Comp. Stress = 29.5 ksi (T= 35.8 ms, max= 1.033 x Top)
max. Comp. Stress = 30.4 ksi (Z= 30.3 ft, T= 37.4 ms)
max. Tens. Stress = -4.70 ksi (Z= 50.5 ft, T= 57.7 ms)
max. Energy (EMX) = 31.0 kip-ft; max. Measured Top Displ. (DMX)= 0.90 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	630.5	-26.8	29.5	-1.25	31.0	15.6	0.93
2	6.7	631.2	-29.5	29.5	-1.38	30.8	15.5	0.91
4	13.5	632.8	-44.5	29.6	-2.08	30.3	15.5	0.87
5	16.8	633.6	-57.3	29.6	-2.68	29.9	15.4	0.85
6	20.2	634.6	-66.0	29.6	-3.08	29.5	15.4	0.83
7	23.6	637.5	-68.3	29.8	-3.19	29.0	15.3	0.80
8	26.9	645.2	-68.2	30.1	-3.19	28.5	15.1	0.77
9	30.3	651.2	-70.6	30.4	-3.30	27.9	14.9	0.74
10	33.7	631.8	-69.8	29.5	-3.26	26.2	14.7	0.71
11	37.0	638.9	-83.0	29.8	-3.88	25.6	14.5	0.68
12	40.4	624.2	-89.8	29.2	-4.20	23.9	14.2	0.65
13	43.7	633.1	-97.8	29.6	-4.57	23.2	13.9	0.62
14	47.1	603.4	-95.2	28.2	-4.45	21.1	13.6	0.58
15	50.5	624.4	-100.7	29.2	-4.70	20.4	13.1	0.55
16	53.8	605.6	-91.6	28.3	-4.28	18.4	12.5	0.52
17	57.2	610.6	-91.0	28.5	-4.25	17.7	12.4	0.49
18	60.6	572.8	-82.5	26.8	-3.86	15.7	12.3	0.45
19	63.9	569.8	-80.8	26.6	-3.78	14.9	12.3	0.42
20	67.3	591.3	-71.9	27.6	-3.36	13.1	12.4	0.38
21	70.7	618.9	-73.3	28.9	-3.43	12.2	13.1	0.34
22	74.0	615.2	-60.7	28.7	-2.84	10.5	13.6	0.31
23	77.4	634.7	-57.4	29.6	-2.68	7.5	12.2	0.27
Absolute	30.3			30.4			(T =	37.4 ms)
	50.5				-4.70		(T =	57.7 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	698.4	644.0	589.5	535.1	480.6	426.2	371.7	317.3	262.8	208.4
RX	766.0	734.3	718.4	702.6	686.8	670.9	655.3	641.3	629.5	617.7
RU	698.4	644.0	589.5	535.1	480.6	426.2	371.7	317.3	262.8	208.4

RAU = 449.3 (kips); RA2 = 657.8 (kips)

Current CAPWAP Ru = 621.0 (kips); Corresponding J(RP)= 0.14; J(RX) = 0.87

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
15.5	35.64	591.0	652.0	652.0	0.90	0.13	0.13	31.2	726.9	1923

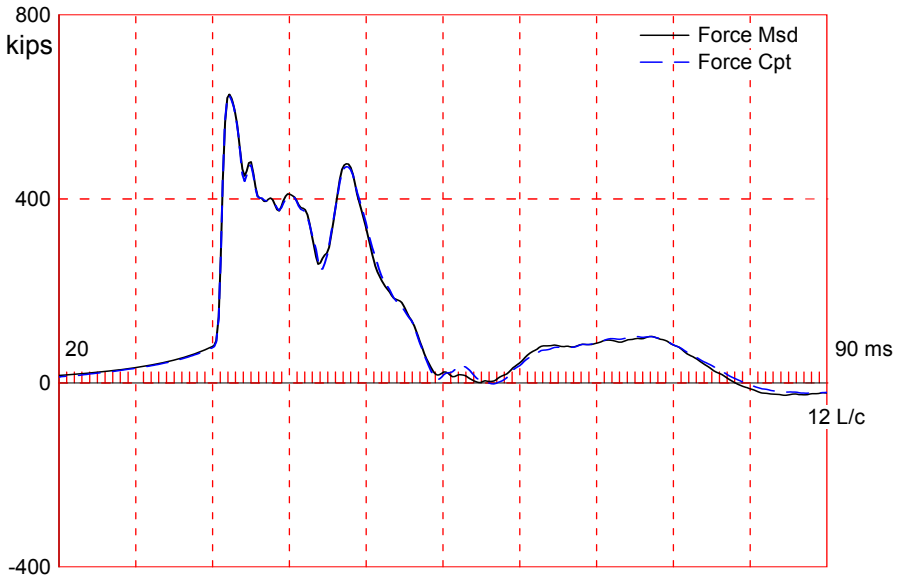
PILE PROFILE AND PILE MODEL

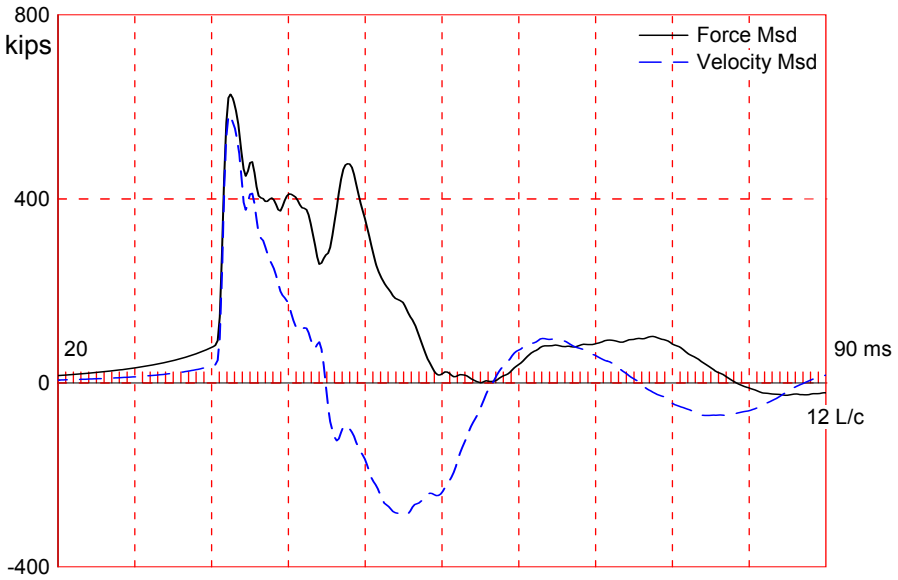
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.4	21.4	29992.2	492.000	4.70

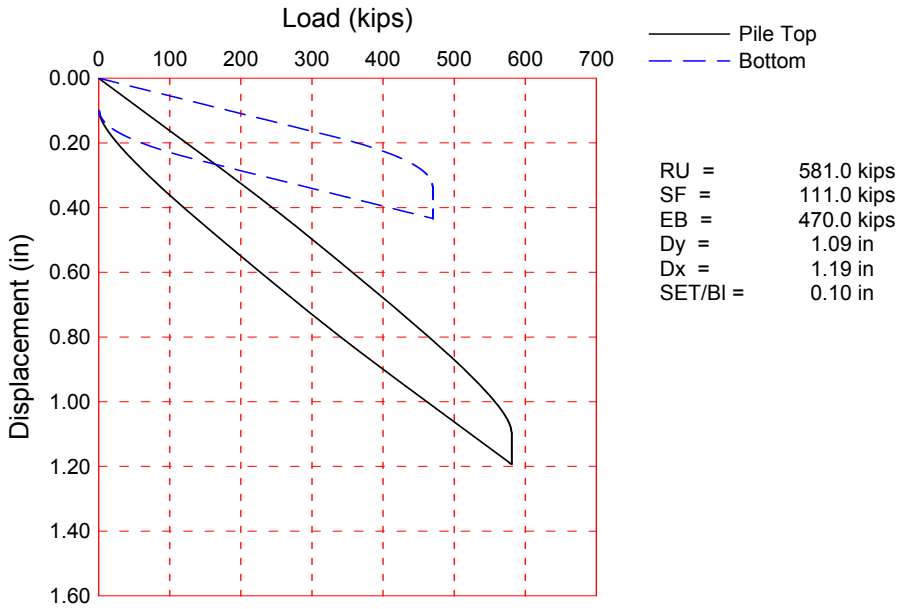
Toe Area 198.5 in^2

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	16807.9	0.000
17	57.2	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.030
19	63.9	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.020
20	67.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
23	77.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

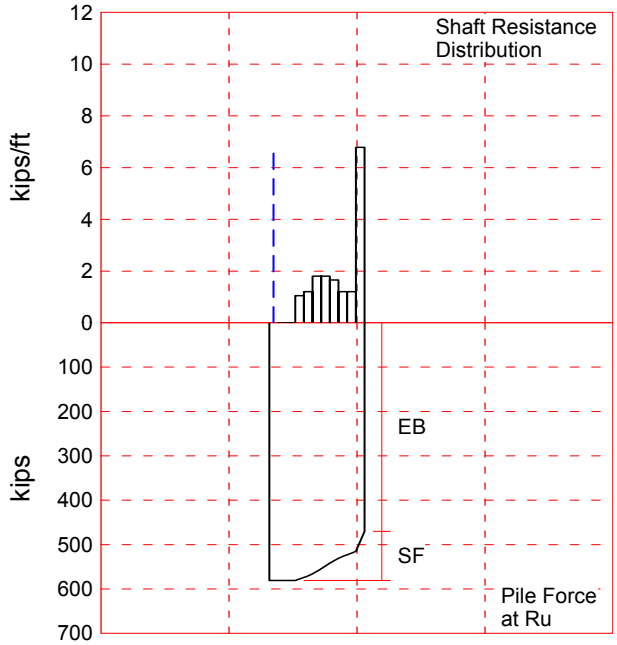
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 9.2 ms
Total volume: 11.503 ft^3; Volume ratio considering added impedance: 1.000







RU =	581.0 kips
SF =	111.0 kips
EB =	470.0 kips
Dy =	1.09 in
Dx =	1.19 in
SET/Bl =	0.10 in



Length b. Sensors	73.0 ft
Embedment	68.4 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.	16808 ft/s
Match Quality	1.75
Top Compr. Stress	29.2 ksi
Max Compr. Stress	30.6 ksi
Max Tension Stress	-4.87 ksi
Avg. Shaft Quake	0.23 in
Toe Quake	0.26 in
Avg. Shaft Smith Dpg.	0.31 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: 581.0; along Shaft 111.0; at Toe 470.0 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
				581.0				
1	13.3	8.7	0.0	581.0	0.0	0.00	0.00	0.00
2	19.9	15.3	0.0	581.0	0.0	0.00	0.00	0.00
3	26.5	22.0	7.0	574.0	7.0	1.05	0.22	0.31
4	33.2	28.6	8.0	566.0	15.0	1.21	0.26	0.31
5	39.8	35.2	12.0	554.0	27.0	1.81	0.38	0.31
6	46.5	41.9	12.0	542.0	39.0	1.81	0.38	0.31
7	53.1	48.5	11.0	531.0	50.0	1.66	0.35	0.31
8	59.7	55.1	8.0	523.0	58.0	1.21	0.26	0.31
9	66.4	61.8	8.0	515.0	66.0	1.21	0.26	0.31
10	73.0	68.4	45.0	470.0	111.0	6.78	1.44	0.31
Avg. Shaft			11.1			1.62	0.35	0.31
Toe			470.0				340.95	0.07

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.23	0.26
Case Damping Factor		0.90	0.86
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	52	31
Unloading Level	(% of Ru)	31	
Resistance Gap (included in Toe Quake)	(in)		0.01
Soil Plug Weight	(kips)	0.070	

CAPWAP match quality = 1.75 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.10 in; Blow Count = 120 b/ft
Computed: Final Set = 0.02 in; Blow Count = 666 b/ft
Transducer F3(F607) CAL: 93.6; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K2524) CAL: 360; RF: 1.10; A4(K3550) CAL: 360; RF: 1.10

max. Top Comp. Stress = 29.2 ksi (T= 35.9 ms, max= 1.047 x Top)
max. Comp. Stress = 30.6 ksi (Z= 26.5 ft, T= 37.3 ms)
max. Tens. Stress = -4.87 ksi (Z= 46.5 ft, T= 57.6 ms)
max. Energy (EMX) = 31.6 kip-ft; max. Measured Top Displ. (DMX)= 0.90 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	625.7	-24.6	29.2	-1.15	31.6	15.2	0.91
2	6.6	626.7	-26.8	29.3	-1.25	31.3	15.2	0.89
3	10.0	627.8	-33.1	29.3	-1.54	31.0	15.2	0.87
4	13.3	629.0	-42.3	29.4	-1.97	30.6	15.1	0.84
5	16.6	630.5	-50.1	29.5	-2.34	30.2	15.1	0.82
6	19.9	636.4	-57.0	29.7	-2.66	29.6	14.9	0.79
7	23.2	646.5	-70.2	30.2	-3.28	29.0	14.7	0.76
8	26.5	655.4	-83.4	30.6	-3.90	28.3	14.4	0.73
9	29.9	630.0	-87.9	29.4	-4.11	26.3	14.1	0.70
10	33.2	641.1	-97.7	30.0	-4.57	25.6	13.8	0.67
11	36.5	616.4	-98.9	28.8	-4.62	23.5	13.4	0.63
12	39.8	628.3	-103.4	29.4	-4.83	22.7	13.1	0.60
13	43.1	590.2	-97.0	27.6	-4.53	20.1	12.7	0.57
14	46.5	616.5	-104.3	28.8	-4.87	19.4	12.2	0.53
15	49.8	582.0	-95.5	27.2	-4.46	17.0	11.5	0.50
16	53.1	578.1	-96.4	27.0	-4.50	16.3	11.6	0.47
17	56.4	536.1	-87.7	25.0	-4.10	14.3	11.7	0.43
18	59.7	545.7	-90.3	25.5	-4.22	13.5	11.5	0.40
19	63.0	566.0	-85.0	26.4	-3.97	11.9	11.8	0.37
20	66.4	585.8	-87.0	27.4	-4.06	11.2	12.5	0.33
21	69.7	583.9	-82.1	27.3	-3.83	9.9	12.8	0.30
22	73.0	597.7	-83.8	27.9	-3.92	7.3	11.5	0.27
Absolute	26.5			30.6			(T =	37.3 ms)
	46.5				-4.87		(T =	57.6 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	734.7	638.3	542.0	445.6	349.3					
RX	770.7	701.5	668.2	635.3	604.2	577.7	554.9	537.1	521.1	505.2
RU	734.7	638.3	542.0	445.6	349.3					

RAU = 451.1 (kips); RA2 = 648.6 (kips)

Current CAPWAP Ru = 581.0 (kips); Corresponding J(RP)= 0.32; J(RX) = 0.97

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
15.4	35.54	586.9	629.5	629.9	0.90	0.12	0.10	31.8	761.5	1880

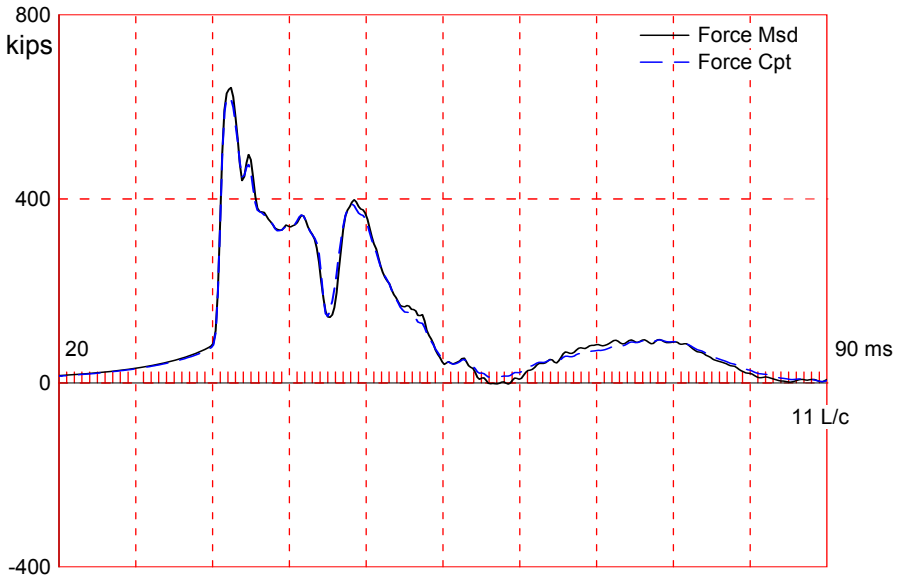
PILE PROFILE AND PILE MODEL

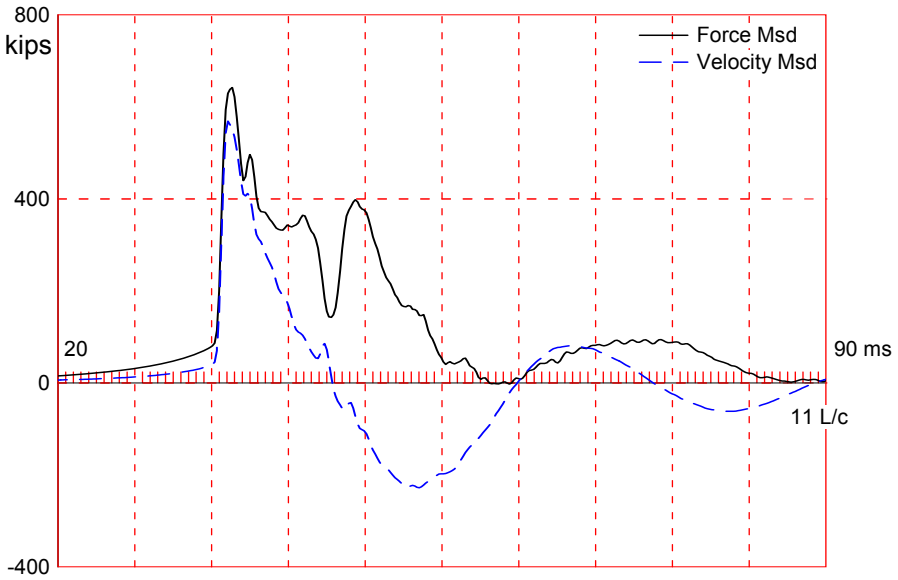
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
73.0	21.4	29992.2	492.000	4.70

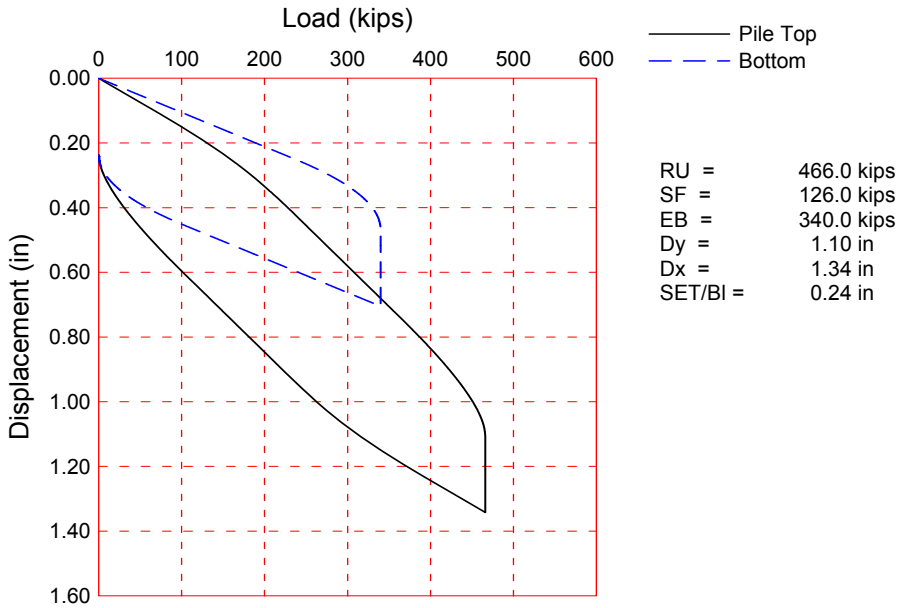
Toe Area 198.5 in^2

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	3.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
16	53.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.030
17	56.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.040
18	59.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
22	73.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

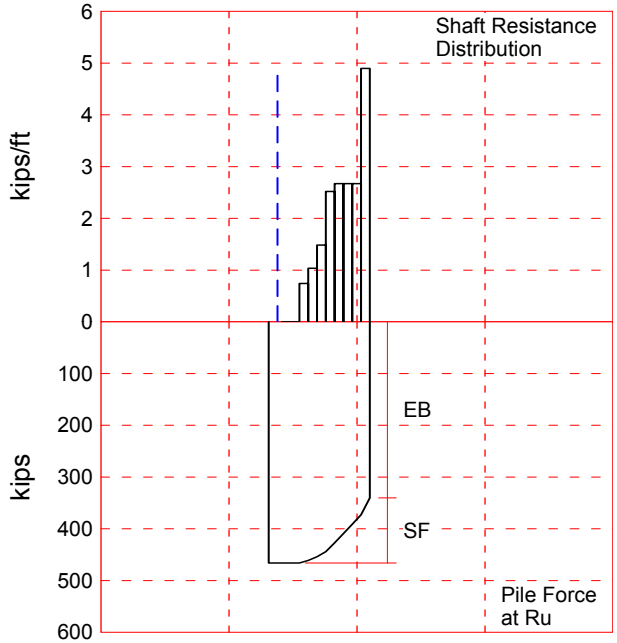
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.197 ms, 2L/c 8.7 ms
Total volume: 10.849 ft^3; Volume ratio considering added impedance: 1.000







RU =	466.0 kips
SF =	126.0 kips
EB =	340.0 kips
Dy =	1.10 in
Dx =	1.34 in
SET/Bl =	0.24 in



Length b. Sensors	77.5 ft
Embedment	68.1 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.	16808 ft/s
Match Quality	2.23
Top Compr. Stress	29.0 ksi
Max Compr. Stress	30.2 ksi
Max Tension Stress	-1.90 ksi
Avg. Shaft Quake	0.09 in
Toe Quake	0.36 in
Avg. Shaft Smith Dpg.	0.27 s/ft
Toe Smith Damping	0.11 s/ft

About the CAPWAP Results

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CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 466.0; along Shaft 126.0; at Toe 340.0 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
				466.0				
1	16.8	7.4	0.0	466.0	0.0	0.00	0.00	0.00
2	23.6	14.2	0.0	466.0	0.0	0.00	0.00	0.00
3	30.3	20.9	5.0	461.0	5.0	0.74	0.16	0.27
4	37.1	27.7	7.0	454.0	12.0	1.04	0.22	0.27
5	43.8	34.4	10.0	444.0	22.0	1.48	0.32	0.27
6	50.5	41.1	17.0	427.0	39.0	2.52	0.54	0.27
7	57.3	47.9	18.0	409.0	57.0	2.67	0.57	0.27
8	64.0	54.6	18.0	391.0	75.0	2.67	0.57	0.27
9	70.8	61.3	18.0	373.0	93.0	2.67	0.57	0.27
10	77.5	68.1	33.0	340.0	126.0	4.90	1.04	0.27
Avg. Shaft			12.6			1.85	0.39	0.27
Toe			340.0				246.65	0.11

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.09	0.36
Case Damping Factor		0.89	0.98
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	91	81
Resistance Gap (included in Toe Quake)	(in)		0.06
Soil Plug Weight	(kips)	0.060	0.005

CAPWAP match quality = 2.23 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.24 in; Blow Count = 51 b/ft
Computed: Final Set = 0.09 in; Blow Count = 138 b/ft

Transducer F3(D815) CAL: 93.0; RF: 1.00; F4(F607) CAL: 93.6; RF: 1.00
A3(K3550) CAL: 360; RF: 1.03; A4(K2524) CAL: 360; RF: 1.03

max. Top Comp. Stress = 29.0 ksi (T= 35.9 ms, max= 1.043 x Top)
max. Comp. Stress = 30.2 ksi (Z= 30.3 ft, T= 37.7 ms)
max. Tens. Stress = -1.90 ksi (Z= 37.1 ft, T= 60.7 ms)
max. Energy (EMX) = 30.8 kip-ft; max. Measured Top Displ. (DMX)= 0.91 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	3.4	620.2	-12.3	29.0	-0.57	30.8	15.2	0.92
2	6.7	621.3	-13.2	29.0	-0.62	30.6	15.1	0.90
4	13.5	623.5	-16.0	29.1	-0.75	30.2	15.1	0.87
5	16.8	624.8	-22.2	29.2	-1.04	29.9	15.0	0.85
6	20.2	626.6	-27.0	29.3	-1.26	29.5	15.0	0.82
7	23.6	632.2	-32.1	29.5	-1.50	29.1	14.9	0.80
8	27.0	638.4	-36.0	29.8	-1.68	28.7	14.7	0.77
9	30.3	647.1	-40.2	30.2	-1.88	28.2	14.5	0.75
10	33.7	630.7	-36.7	29.5	-1.71	26.8	14.3	0.72
11	37.1	642.2	-40.6	30.0	-1.90	26.2	14.1	0.69
12	40.4	620.4	-35.3	29.0	-1.65	24.5	13.7	0.66
13	43.8	638.0	-39.8	29.8	-1.86	24.0	13.4	0.63
14	47.2	613.2	-31.4	28.6	-1.47	21.9	13.0	0.61
15	50.5	635.3	-35.0	29.7	-1.63	21.3	12.4	0.58
16	53.9	578.2	-18.0	27.0	-0.84	18.5	11.8	0.55
17	57.3	586.1	-21.1	27.4	-0.98	18.0	11.5	0.52
18	60.7	520.4	-3.1	24.3	-0.15	15.2	11.3	0.50
19	64.0	532.2	-5.5	24.9	-0.25	14.7	11.2	0.47
20	67.4	463.2	-0.0	21.6	-0.00	12.3	13.0	0.45
21	70.8	476.5	-0.0	22.3	-0.00	11.9	13.8	0.42
22	74.1	455.4	-0.0	21.3	-0.00	9.7	13.9	0.40
23	77.5	469.4	-0.0	21.9	-0.00	7.1	12.7	0.37
Absolute	30.3			30.2			(T =	37.7 ms)
	37.1				-1.90		(T =	60.7 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	648.7	536.4	424.1	311.8	199.5					
RX	682.1	617.8	572.1	535.5	508.5	485.1	464.2	447.1	431.9	421.7
RU	648.7	536.4	424.1	311.8	199.5					

RAU = 384.1 (kips); RA2 = 569.3 (kips)

Current CAPWAP Ru = 466.0 (kips); Corresponding J(RP)= 0.33; J(RX) = 1.18

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
15.1	35.48	576.1	634.1	648.1	0.91	0.24	0.24	31.0	649.6	1133

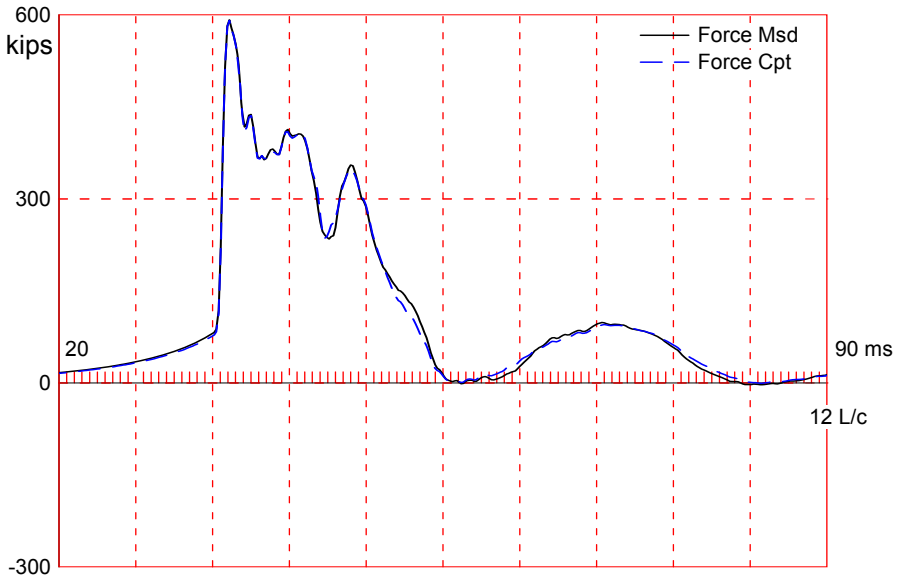
PILE PROFILE AND PILE MODEL

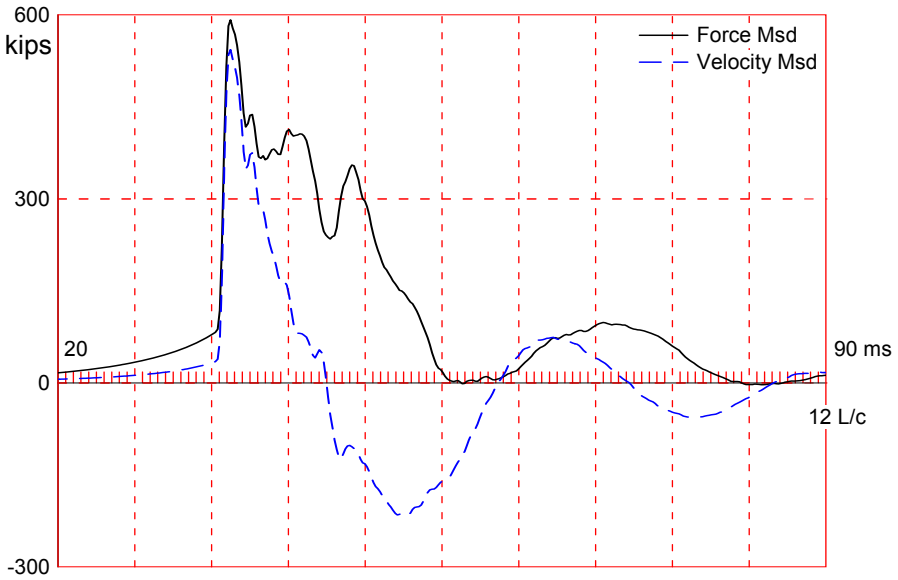
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.5	21.4	29992.2	492.000	4.70

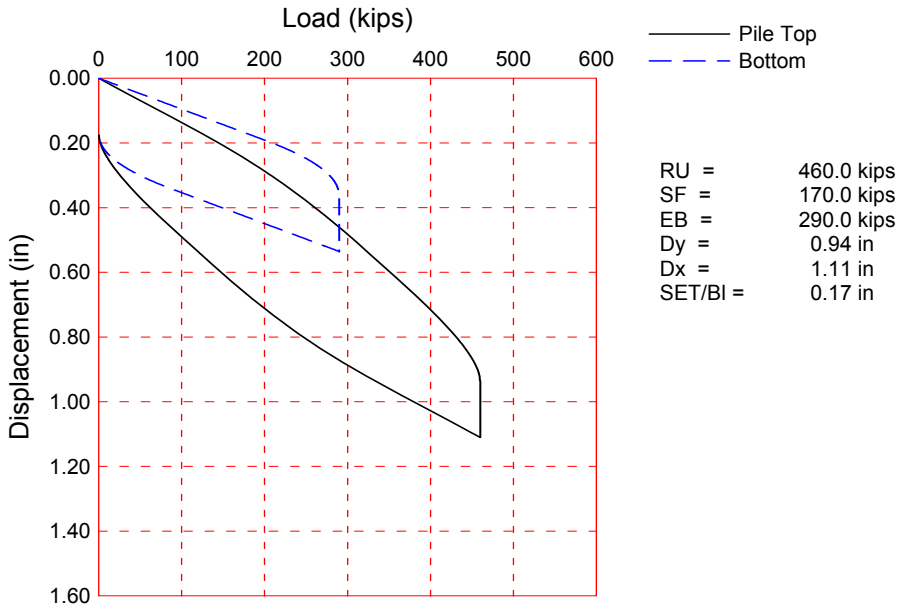
Toe Area 198.5 in^2

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	16807.9	0.000
17	57.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.020
20	67.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
23	77.5	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

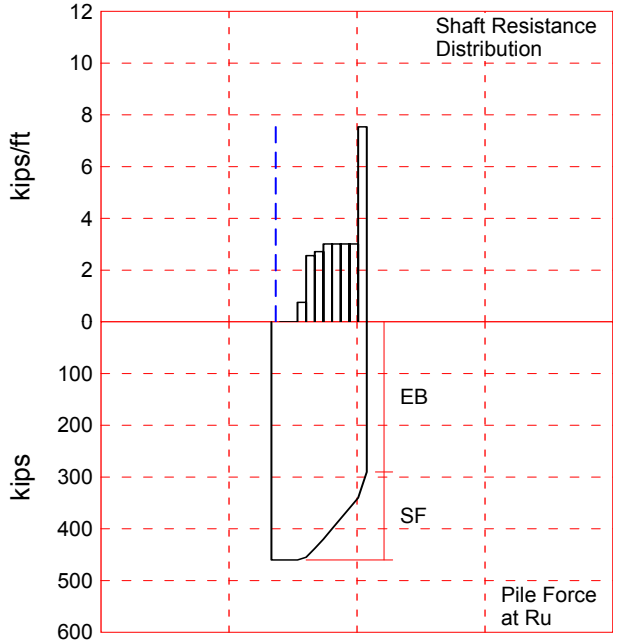
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 9.2 ms
Total volume: 11.517 ft^3; Volume ratio considering added impedance: 1.000







RU =	460.0 kips
SF =	170.0 kips
EB =	290.0 kips
Dy =	0.94 in
Dx =	1.11 in
SET/BI =	0.17 in



Length b. Sensors	73.0 ft
Embedment	68.2 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.	16808 ft/s
Match Quality	1.67
Top Compr. Stress	27.6 ksi
Max Compr. Stress	29.3 ksi
Max Tension Stress	-2.35 ksi
Avg. Shaft Quake	0.11 in
Toe Quake	0.28 in
Avg. Shaft Smith Dpg.	0.29 s/ft
Toe Smith Damping	0.16 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: 460.0; along Shaft 170.0; at Toe 290.0 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
				460.0				
1	13.3	8.5	0.0	460.0	0.0	0.00	0.00	0.00
2	19.9	15.1	0.0	460.0	0.0	0.00	0.00	0.00
3	26.5	21.7	5.0	455.0	5.0	0.75	0.16	0.29
4	33.2	28.4	17.0	438.0	22.0	2.56	0.55	0.29
5	39.8	35.0	18.0	420.0	40.0	2.71	0.58	0.29
6	46.5	41.6	20.0	400.0	60.0	3.01	0.64	0.29
7	53.1	48.3	20.0	380.0	80.0	3.01	0.64	0.29
8	59.7	54.9	20.0	360.0	100.0	3.01	0.64	0.29
9	66.4	61.5	20.0	340.0	120.0	3.01	0.64	0.29
10	73.0	68.2	50.0	290.0	170.0	7.53	1.60	0.29
Avg. Shaft			17.0			2.49	0.53	0.29
Toe			290.0				210.38	0.16

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.11	0.28
Case Damping Factor		1.29	1.21
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	62	119
Unloading Level	(% of Ru)	91	
Resistance Gap (included in Toe Quake)	(in)		0.05
Soil Plug Weight	(kips)	0.180	0.033

CAPWAP match quality = 1.67 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.17 in; Blow Count = 69 b/ft
Computed: Final Set = 0.06 in; Blow Count = 190 b/ft
Transducer F3(D815) CAL: 93.0; RF: 1.00; F4(F607) CAL: 93.6; RF: 1.00
A3(K3550) CAL: 360; RF: 1.10; A4(K2524) CAL: 360; RF: 1.10

max. Top Comp. Stress = 27.6 ksi (T= 35.9 ms, max= 1.061 x Top)
max. Comp. Stress = 29.3 ksi (Z= 33.2 ft, T= 37.7 ms)
max. Tens. Stress = -2.35 ksi (Z= 33.2 ft, T= 57.8 ms)
max. Energy (EMX) = 26.2 kip-ft; max. Measured Top Displ. (DMX)= 0.79 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	591.8	-6.1	27.6	-0.28	26.2	14.2	0.79
2	6.6	592.8	-13.1	27.7	-0.61	25.9	14.2	0.77
3	10.0	594.0	-19.2	27.7	-0.89	25.7	14.2	0.75
4	13.3	595.2	-25.4	27.8	-1.19	25.3	14.1	0.73
5	16.6	596.6	-31.2	27.9	-1.46	25.0	14.1	0.70
6	19.9	600.2	-37.2	28.0	-1.74	24.6	14.0	0.68
7	23.2	607.6	-42.7	28.4	-1.99	24.1	13.8	0.65
8	26.5	617.9	-47.2	28.9	-2.21	23.6	13.5	0.63
9	29.9	613.4	-45.1	28.7	-2.10	22.4	13.0	0.60
10	33.2	627.9	-50.3	29.3	-2.35	21.9	12.6	0.57
11	36.5	569.5	-29.6	26.6	-1.38	19.1	12.1	0.55
12	39.8	586.0	-34.2	27.4	-1.60	18.7	11.7	0.52
13	43.1	538.0	-13.0	25.1	-0.61	16.2	11.0	0.49
14	46.5	561.5	-17.0	26.2	-0.80	15.7	10.4	0.47
15	49.8	505.3	0.0	23.6	0.00	13.3	9.7	0.44
16	53.1	519.0	-0.0	24.2	-0.00	12.9	9.3	0.42
17	56.4	460.2	-0.0	21.5	-0.00	10.9	9.0	0.39
18	59.7	460.4	-0.0	21.5	-0.00	10.4	8.9	0.37
19	63.0	398.7	-0.0	18.6	-0.00	8.6	9.4	0.35
20	66.4	421.2	-0.0	19.7	-0.00	8.3	9.9	0.32
21	69.7	399.0	-0.0	18.6	-0.00	6.7	10.3	0.30
22	73.0	407.5	-0.0	19.0	-0.00	4.3	9.5	0.28
Absolute	33.2			29.3			(T =	37.7 ms)
	33.2				-2.35		(T =	57.8 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	673.9	630.0	586.0	542.1	498.2	454.2	410.3	366.4	322.4	278.5
RX	673.9	632.9	594.3	570.2	552.3	534.3	516.3	498.6	483.3	474.4
RU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

RAU = 318.9 (kips); RA2 = 538.3 (kips)

Current CAPWAP Ru = 460.0 (kips); Corresponding J(RP)= 0.97; matches RX20 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	KEB kips/in
14.2	35.73	543.4	591.8	591.8	0.79	0.17	0.17	26.4	656.6	1261

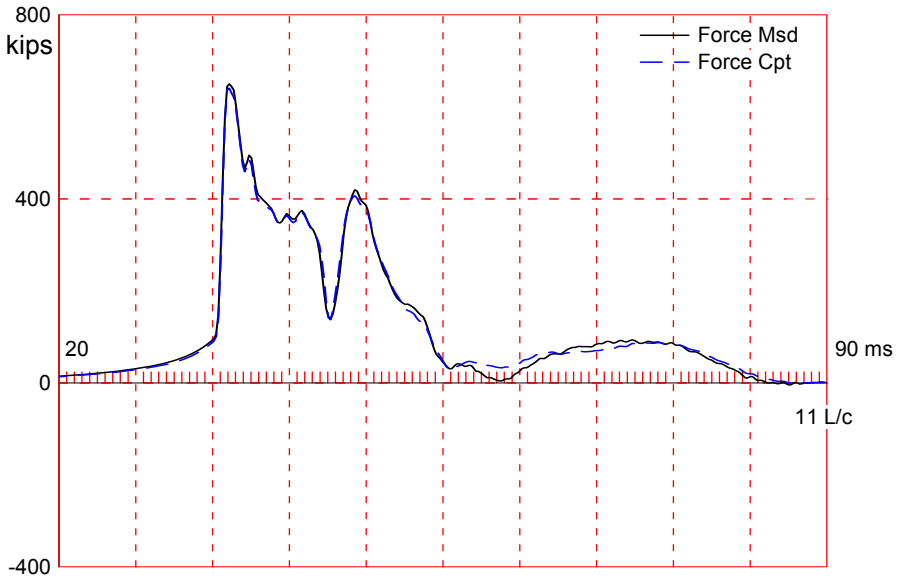
PILE PROFILE AND PILE MODEL

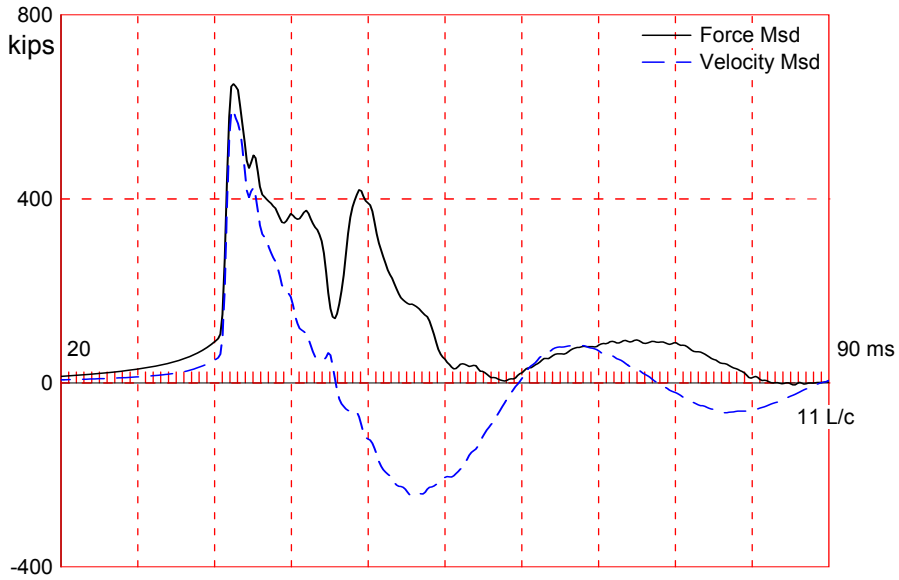
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
73.0	21.4	29992.2	492.000	4.70

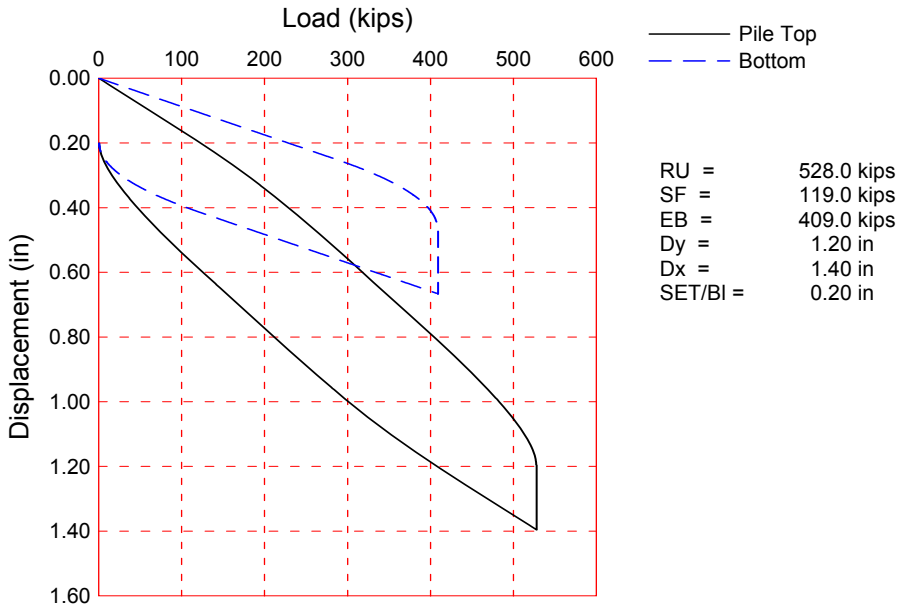
Toe Area 198.5 in^2

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	3.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
15	49.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
16	53.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.030
17	56.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.050
19	63.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.040
20	66.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
22	73.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

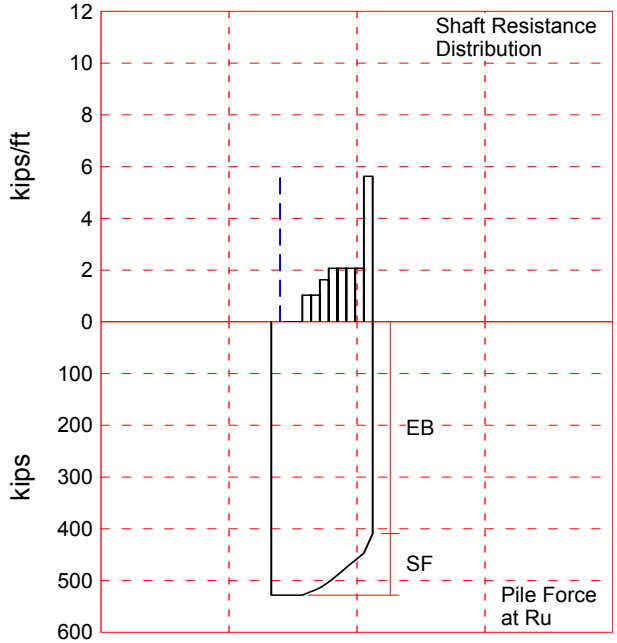
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.197 ms, 2L/c 8.7 ms
Total volume: 10.849 $ft^{3;}$ Volume ratio considering added impedance: 1.000







RU =	528.0 kips
SF =	119.0 kips
EB =	409.0 kips
Dy =	1.20 in
Dx =	1.40 in
SET/BI =	0.20 in



Length b. Sensors	77.6 ft
Embedment	70.1 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.	16808 ft/s
Match Quality	2.51
Top Compr. Stress	30.0 ksi
Max Compr. Stress	31.4 ksi
Max Tension Stress	-1.15 ksi
Avg. Shaft Quake	0.13 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.

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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.

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CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 528.0; along Shaft 119.0; at Toe 409.0 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
				528.0				
1	16.9	9.4	0.0	528.0	0.0	0.00	0.00	0.00
2	23.6	16.1	0.0	528.0	0.0	0.00	0.00	0.00
3	30.4	22.9	7.0	521.0	7.0	1.04	0.22	0.27
4	37.1	29.6	7.0	514.0	14.0	1.04	0.22	0.27
5	43.9	36.4	11.0	503.0	25.0	1.63	0.35	0.27
6	50.6	43.1	14.0	489.0	39.0	2.07	0.44	0.27
7	57.4	49.9	14.0	475.0	53.0	2.07	0.44	0.27
8	64.1	56.6	14.0	461.0	67.0	2.07	0.44	0.27
9	70.9	63.4	14.0	447.0	81.0	2.07	0.44	0.27
10	77.6	70.1	38.0	409.0	119.0	5.63	1.20	0.27
Avg. Shaft			11.9			1.70	0.36	0.27
Toe			409.0				296.70	0.06

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.13	0.36
Case Damping Factor		0.84	0.64
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	55	82
Resistance Gap (included in Toe Quake)	(in)		0.02
Soil Plug Weight	(kips)	0.080	0.031

CAPWAP match quality = 2.51 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.20 in; Blow Count = 60 b/ft
Computed: Final Set = 0.06 in; Blow Count = 198 b/ft
Transducer F3(D815) CAL: 93.0; RF: 1.00; F4(F607) CAL: 93.6; RF: 1.00
A3(K3550) CAL: 360; RF: 1.03; A4(K2524) CAL: 360; RF: 1.03

max. Top Comp. Stress = 30.0 ksi (T= 35.9 ms, max= 1.046 x Top)
max. Comp. Stress = 31.4 ksi (Z= 30.4 ft, T= 37.5 ms)
max. Tens. Stress = -1.15 ksi (Z= 30.4 ft, T= 60.0 ms)
max. Energy (EMX) = 32.4 kip-ft; max. Measured Top Displ. (DMX)= 0.93 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	641.7	-3.1	30.0	-0.15	32.4	15.7	0.94
2	6.7	642.9	-5.9	30.0	-0.28	32.3	15.7	0.93
4	13.5	645.6	-10.7	30.2	-0.50	31.9	15.6	0.89
5	16.9	647.1	-12.9	30.2	-0.60	31.6	15.6	0.87
6	20.2	648.9	-15.0	30.3	-0.70	31.3	15.5	0.85
7	23.6	654.1	-16.9	30.6	-0.79	30.9	15.4	0.83
8	27.0	664.1	-20.2	31.0	-0.95	30.4	15.1	0.80
9	30.4	671.2	-24.6	31.4	-1.15	30.0	14.9	0.77
10	33.7	646.1	-19.8	30.2	-0.93	28.1	14.7	0.75
11	37.1	655.0	-23.8	30.6	-1.11	27.5	14.4	0.72
12	40.5	634.7	-17.6	29.6	-0.82	25.7	14.1	0.69
13	43.9	645.9	-21.1	30.2	-0.99	25.1	13.8	0.66
14	47.2	615.3	-10.2	28.7	-0.47	22.8	13.3	0.63
15	50.6	634.4	-16.5	29.6	-0.77	22.2	12.8	0.60
16	54.0	589.9	-2.3	27.6	-0.11	19.6	12.2	0.57
17	57.4	600.6	-6.5	28.1	-0.30	19.0	12.0	0.54
18	60.7	554.9	-0.0	25.9	-0.00	16.6	11.6	0.51
19	64.1	559.6	-0.0	26.1	-0.00	16.0	11.5	0.48
20	67.5	508.9	-0.0	23.8	-0.00	13.8	12.3	0.45
21	70.9	507.6	-0.0	23.7	-0.00	13.2	13.4	0.42
22	74.2	503.8	-0.0	23.5	-0.00	11.3	13.7	0.40
23	77.6	515.9	-0.0	24.1	-0.00	8.2	13.3	0.37
Absolute	30.4			31.4			(T =	37.5 ms)
	30.4				-1.15		(T =	60.0 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	683.1	624.7	566.3	507.9	449.5	391.1	332.7	274.3	215.9	157.4
RX	707.8	669.8	645.9	622.0	598.3	577.0	561.4	547.6	535.2	524.8
RU	683.1	624.7	566.3	507.9	449.5	391.1	332.7	274.3	215.9	157.4

RAU = 402.1 (kips); RA2 = 603.2 (kips)

Current CAPWAP Ru = 528.0 (kips); Corresponding J(RP)= 0.27; J(RX) = 0.87

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
15.9	35.73	605.6	661.5	661.5	0.93	0.20	0.20	32.6	695.6	1203

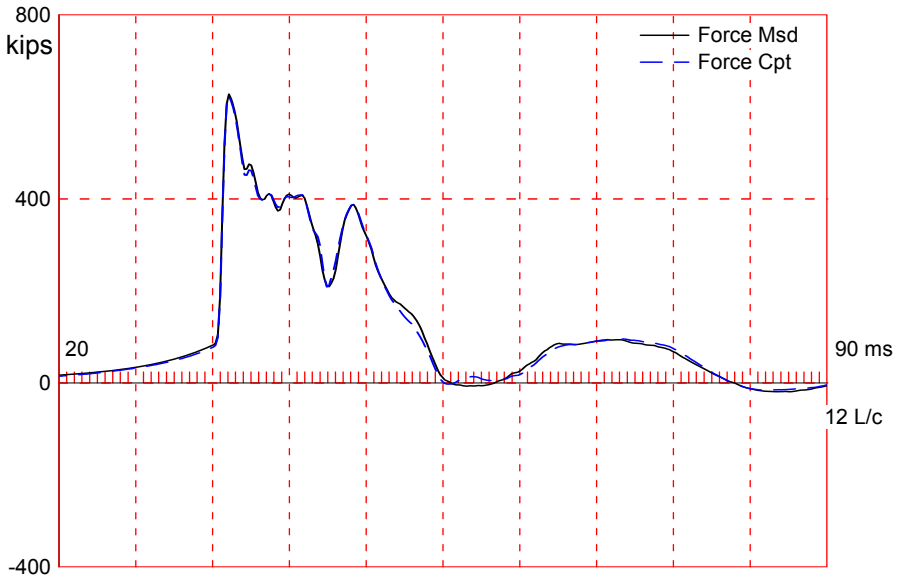
PILE PROFILE AND PILE MODEL

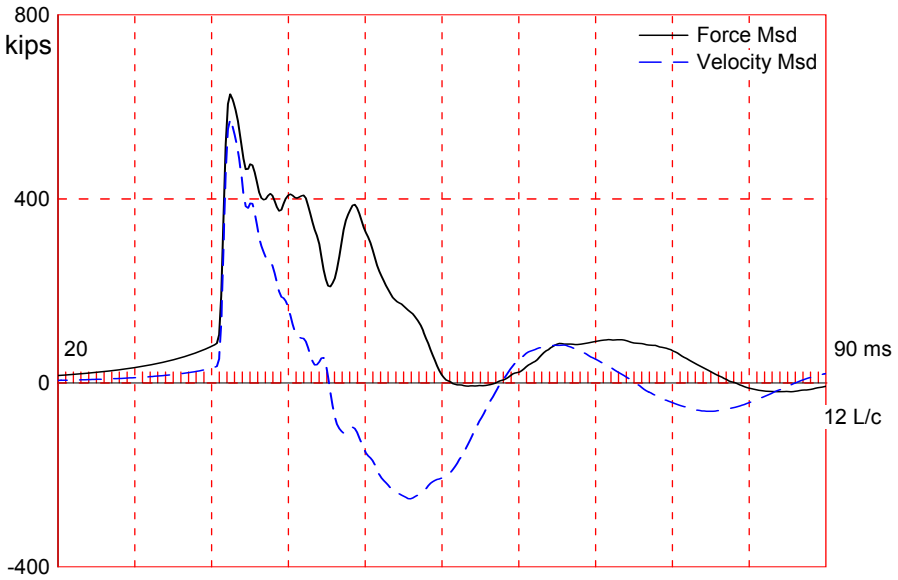
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.6	21.4	29992.2	492.000	4.70

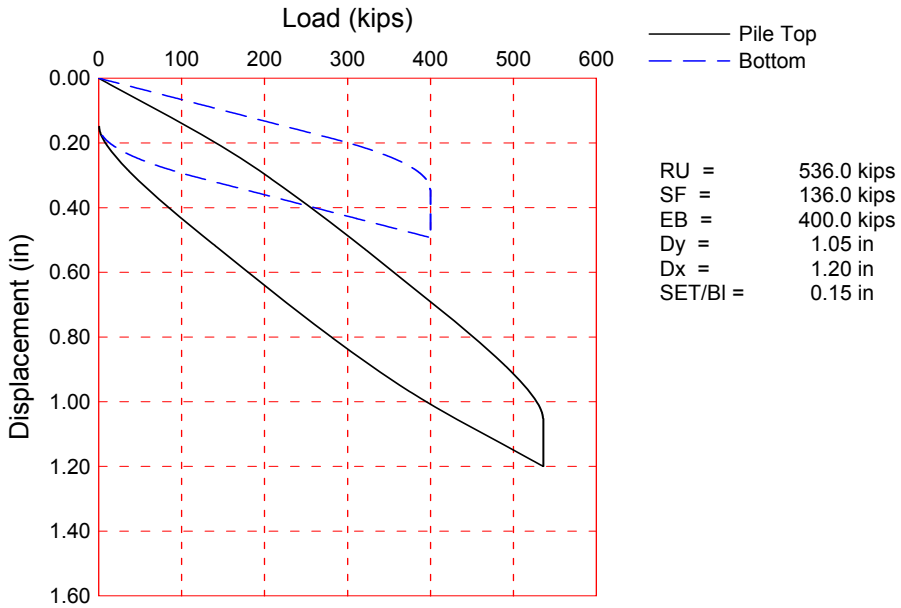
Toe Area 198.5 in^2

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	16807.9	0.000
17	57.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.020
21	70.9	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
23	77.6	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

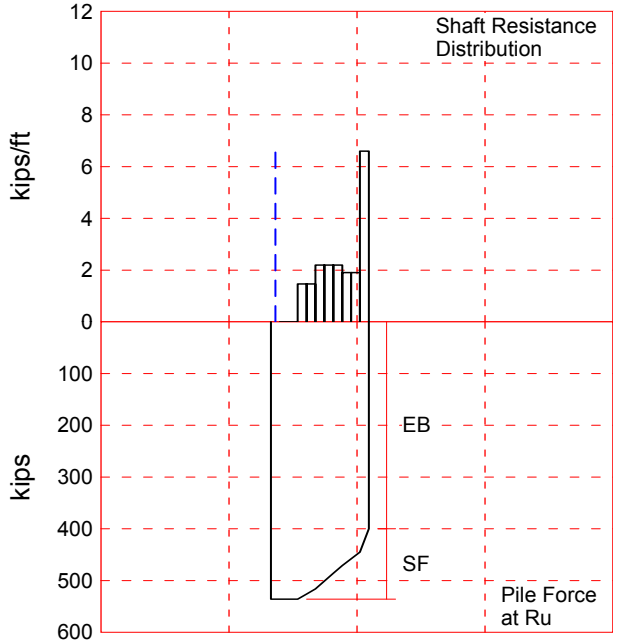
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.201 ms, 2L/c 9.2 ms
Total volume: 11.532 ft^3; Volume ratio considering added impedance: 1.000







RU =	536.0 kips
SF =	136.0 kips
EB =	400.0 kips
Dy =	1.05 in
Dx =	1.20 in
SET/Bl =	0.15 in



Length b. Sensors	75.0 ft
Embedment	70.2 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.	16808 ft/s
Match Quality	1.81
Top Compr. Stress	29.2 ksi
Max Compr. Stress	30.8 ksi
Max Tension Stress	-4.09 ksi
Avg. Shaft Quake	0.11 in
Toe Quake	0.27 in
Avg. Shaft Smith Dpg.	0.31 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: 536.0; along Shaft 136.0; at Toe 400.0 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
				536.0				
1	13.6	8.8	0.0	536.0	0.0	0.00	0.00	0.00
2	20.5	15.7	0.0	536.0	0.0	0.00	0.00	0.00
3	27.3	22.5	10.0	526.0	10.0	1.47	0.31	0.31
4	34.1	29.3	10.0	516.0	20.0	1.47	0.31	0.31
5	40.9	36.1	15.0	501.0	35.0	2.20	0.47	0.31
6	47.7	42.9	15.0	486.0	50.0	2.20	0.47	0.31
7	54.5	49.7	15.0	471.0	65.0	2.20	0.47	0.31
8	61.4	56.6	13.0	458.0	78.0	1.91	0.41	0.31
9	68.2	63.4	13.0	445.0	91.0	1.91	0.41	0.31
10	75.0	70.2	45.0	400.0	136.0	6.60	1.40	0.31
Avg. Shaft			13.6			1.94	0.41	0.31
Toe			400.0				290.17	0.06

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.11	0.27
Case Damping Factor		1.10	0.63
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	38	30
Unloading Level	(% of Ru)	15	
Resistance Gap (included in Toe Quake)	(in)		0.01
Soil Plug Weight	(kips)	0.130	0.027

CAPWAP match quality = 1.81 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.15 in; Blow Count = 80 b/ft
Computed: Final Set = 0.05 in; Blow Count = 263 b/ft

Transducer F3(D815) CAL: 93.0; RF: 1.00; F4(F607) CAL: 93.6; RF: 1.00
A3(K3550) CAL: 360; RF: 1.08; A4(K2524) CAL: 360; RF: 1.08

max. Top Comp. Stress = 29.2 ksi (T= 35.9 ms, max= 1.054 x Top)
max. Comp. Stress = 30.8 ksi (Z= 27.3 ft, T= 37.3 ms)
max. Tens. Stress = -4.09 ksi (Z= 47.7 ft, T= 59.2 ms)
max. Energy (EMX) = 30.0 kip-ft; max. Measured Top Displ. (DMX)= 0.84 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	625.1	-17.5	29.2	-0.82	30.0	15.1	0.85
2	6.8	626.1	-19.3	29.2	-0.90	29.8	15.0	0.83
3	10.2	627.2	-24.3	29.3	-1.13	29.5	15.0	0.81
4	13.6	628.4	-33.3	29.4	-1.56	29.2	14.9	0.79
5	17.0	629.8	-43.7	29.4	-2.04	28.8	14.9	0.77
6	20.5	634.6	-53.6	29.6	-2.50	28.4	14.8	0.74
7	23.9	649.2	-62.9	30.3	-2.94	27.9	14.4	0.71
8	27.3	659.1	-71.5	30.8	-3.34	27.4	14.1	0.69
9	30.7	619.8	-72.0	29.0	-3.36	25.0	13.7	0.66
10	34.1	631.1	-79.4	29.5	-3.71	24.4	13.4	0.63
11	37.5	599.0	-79.5	28.0	-3.71	22.1	12.9	0.60
12	40.9	613.1	-85.8	28.6	-4.01	21.5	12.5	0.57
13	44.3	565.6	-82.1	26.4	-3.83	18.8	12.0	0.54
14	47.7	592.8	-87.6	27.7	-4.09	18.2	11.3	0.51
15	51.1	547.6	-83.8	25.6	-3.92	15.8	10.6	0.48
16	54.5	554.5	-86.9	25.9	-4.06	15.2	10.3	0.45
17	58.0	499.3	-79.4	23.3	-3.71	13.0	10.2	0.42
18	61.4	501.4	-79.6	23.4	-3.72	12.3	10.1	0.39
19	64.8	470.0	-71.9	22.0	-3.36	10.6	10.3	0.36
20	68.2	488.4	-71.8	22.8	-3.35	10.0	11.1	0.33
21	71.6	481.4	-63.8	22.5	-2.98	8.4	11.7	0.30
22	75.0	491.8	-63.8	23.0	-2.98	5.8	11.0	0.27
Absolute	27.3			30.8			(T =	37.3 ms)
	47.7				-4.09		(T =	59.2 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	702.5	651.0	599.5	548.1	496.6	445.2	393.7	342.2	290.8	239.3
RX	706.1	662.7	634.0	613.6	593.2	572.9	552.5	534.7	517.8	502.4
RU	702.5	651.0	599.5	548.1	496.6	445.2	393.7	342.2	290.8	239.3

RAU = 404.5 (kips); RA2 = 592.9 (kips)

Current CAPWAP Ru = 536.0 (kips); Corresponding J(RP)= 0.32; J(RX) = 0.69

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
15.2	35.70	581.3	635.8	635.8	0.84	0.15	0.15	30.3	731.9	1538

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
75.0	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	16807.9	0.000
16	54.5	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.040
18	61.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.030
19	64.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.020
20	68.2	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
22	75.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.203 ms, 2L/c 8.9 ms
Total volume: 11.146 $ft^{3;}$ Volume ratio considering added impedance: 1.000