GRL Engineers, Inc.

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TRANSMITTAL

To: Mr. Kevin Weber	From: Travis Coleman
Company: Lunda Construction Co.	No. of Sheets: 57
E-mail: kweber@lundaconstruction.com	Date: December 30, 2014

RE: Dynamic Testing Results – USH 10 over Little Lake Butte des Morts
Structure B-70-403 - Pier 6
Winnebago County, Wisconsin

On December 24, 2014, Pier 6 #1, Pier 6 #36, and Pier 6 #44 at the above structure were dynamically tested during initial driving. The piles were tested during restrike on December 29. 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 elevations for the piles were the top of the template at EL 740.4 to EL 740.8. We understand the pier was excavated to approximately two to three feet below the bottom of footing elevation of EL 720.5. The piles have a required minimum tip elevation of EL 663. 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 6 #1 was driven to a depth of 87.0 feet, which corresponds to a pile tip elevation of EL 653.4. The blow count over the final increment of driving was 10 blows for 2 inches of penetration at an average hammer stroke of 7.7 feet. The blow count at the beginning of restrike was 5 blows for ½ inch of penetration at an average hammer stroke of 7.3 feet.

Pier 6 #36 was driven to a depth of 83.0 feet, which corresponds to a pile tip elevation of EL 657.8. The blow count over the final increment of driving was 10 blows for 3 ¾ inch of penetration at an average hammer stroke of 6.6 feet. The blow count at the beginning of restrike was 5 blows for 1 ⅛ inch of penetration at an average hammer stroke of 6.8 feet

Pier 6 #44 was driven to a depth of 88.0 feet, which corresponds to a pile tip elevation of EL 652.8. The blow count over the final increment of driving was 60 blows for one foot of penetration at an average hammer stroke of 7.3 feet. The blow count at the beginning of restrike was 5 blows for ⅝ inch of penetration at an average hammer stroke of 8.7 feet.

Our driving recommendations have been prepared on a blows-per-inch basis. The criteria should be applied only after the minimum pile tip elevation is achieved. For the 480 and 400 kips piles driven with an APE D30-42 hammer (PD 0256) in Pier 6 of the USH 10 bridge over Little Lake Butte des Morts we recommend using the following criteria:

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	4
7.0	5	3
7.5	5	3
8.0	4	3
8.5	4	3
9.0	4	3

We recommend the above blow counts at the required stroke be maintained for **three consecutive inches** of driving. 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. 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.

Travis Coleman, P.E.

Rory Flynn, E.I.

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

Attachments:

Dynamic Test Results - (pages 3 – 27)
CAPWAP Analysis Results - (pages 28 – 57)

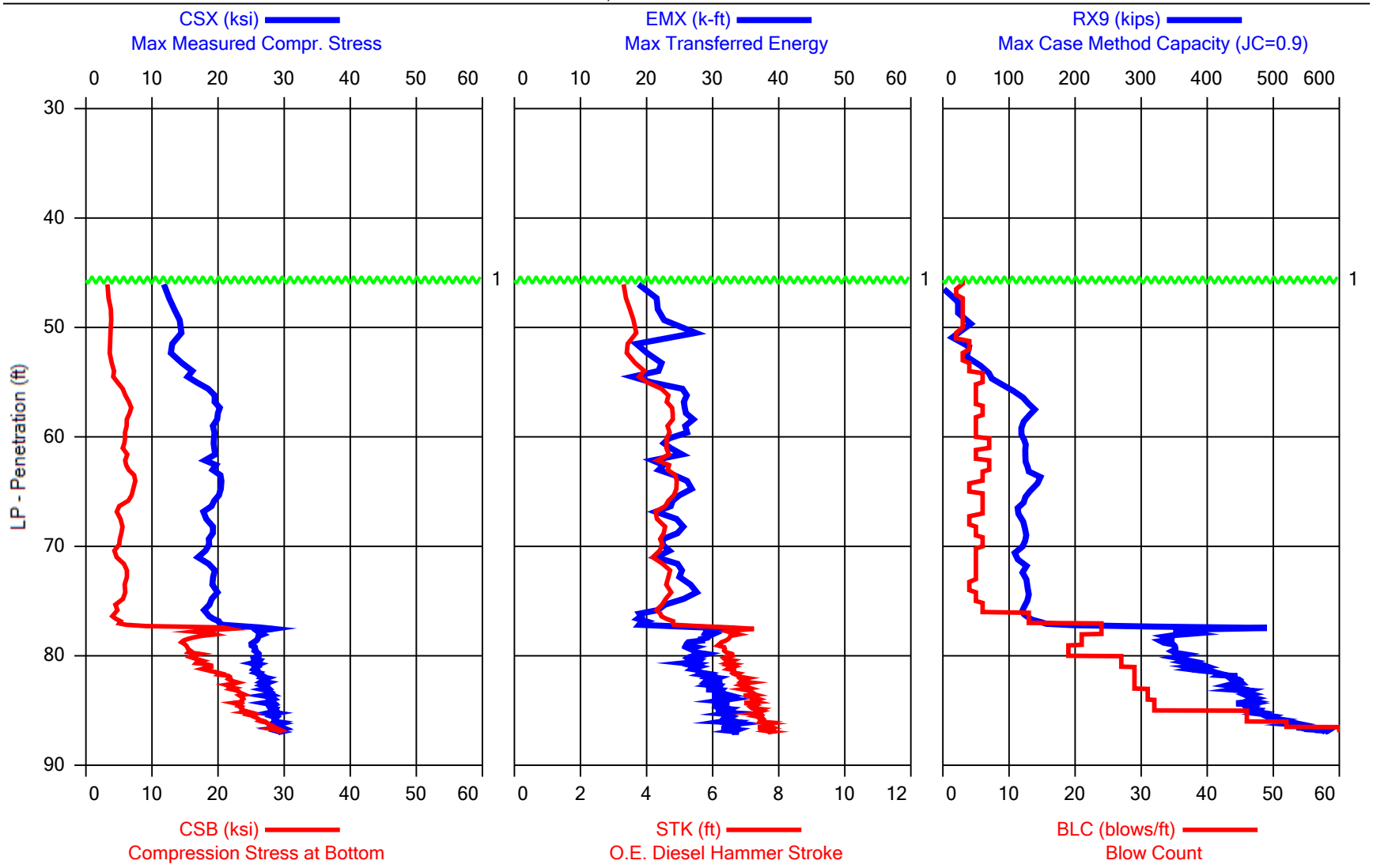
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.0 - Case Method & iCAP® Results

Printed: 30-December-2014

Test started: 24-December-2014

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #1 - EOID

APE D30-42, HP 14 x 73



1 - Top of Template EL 740.38

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #1 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.67 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 ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
8	45.67	3	AV1	12.8	3.5	18	3.4	62.8	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	12.8	3.5	18	3.4	62.8	0
			MIN	12.8	3.5	18	3.4	62.8	0
9	46.00	3	AV1	11.8	3.2	18	3.3	63.2	5
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	11.8	3.2	18	3.3	63.2	5
			MIN	11.8	3.2	18	3.3	63.2	5
10	46.50	2	AV1	10.9	3.1	21	3.2	64.2	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	10.9	3.1	21	3.2	64.2	0
			MIN	10.9	3.1	21	3.2	64.2	0
11	47.00	2	AV1	12.8	3.5	24	3.4	62.4	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	12.8	3.5	24	3.4	62.4	0
			MIN	12.8	3.5	24	3.4	62.4	0
12	47.33	3	AV1	12.6	3.3	20	3.4	62.8	14
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	12.6	3.3	20	3.4	62.8	14
			MIN	12.6	3.3	20	3.4	62.8	14
13	47.67	3	AV1	12.4	3.5	21	3.3	63.0	26
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	12.4	3.5	21	3.3	63.0	26
			MIN	12.4	3.5	21	3.3	63.0	26
14	48.00	3	AV1	13.4	3.7	21	3.5	61.5	29
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	13.4	3.7	21	3.5	61.5	29
			MIN	13.4	3.7	21	3.5	61.5	29
15	48.33	3	AV1	13.9	3.8	22	3.5	61.4	26
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	13.9	3.8	22	3.5	61.4	26
			MIN	13.9	3.8	22	3.5	61.4	26
17	49.00	3	AV2	13.6	3.9	23	3.5	61.6	21
			STD	0.7	0.0	1	0.1	0.8	1
			MAX	14.3	3.9	23	3.6	62.4	22
			MIN	12.8	3.9	22	3.4	60.7	21
20	50.00	3	AV3	13.8	3.7	22	3.5	61.4	42
			STD	0.6	0.2	0	0.1	0.6	6

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #1 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			MAX	14.4	3.9	22	3.6	62.2	50
			MIN	13.0	3.5	22	3.4	60.8	36
22	51.00	2	AV2	15.2	3.8	30	3.8	59.4	0
			STD	0.1	0.0	0	0.0	0.1	0
			MAX	15.3	3.9	30	3.8	59.4	0
			MIN	15.1	3.8	30	3.8	59.3	0
26	52.00	4	AV4	13.3	3.7	19	3.5	62.1	40
			STD	0.9	0.2	1	0.1	1.3	4
			MAX	13.9	3.9	19	3.6	64.2	45
			MIN	11.8	3.4	17	3.2	61.1	36
29	53.00	3	AV3	13.1	3.5	22	3.4	62.3	36
			STD	1.4	0.2	2	0.2	1.6	9
			MAX	14.8	3.7	25	3.7	64.3	48
			MIN	11.4	3.3	19	3.2	60.4	29
33	54.00	4	AV4	15.2	4.1	22	3.8	59.6	59
			STD	0.8	0.2	1	0.1	1.0	6
			MAX	16.1	4.5	23	3.9	61.0	64
			MIN	14.1	4.0	21	3.6	58.4	49
39	55.00	6	AV6	15.9	4.3	18	3.9	59.1	75
			STD	0.5	0.2	1	0.1	0.6	6
			MAX	16.5	4.6	20	4.0	59.9	83
			MIN	15.2	4.1	18	3.7	58.2	68
44	56.00	5	AV5	18.5	5.5	25	4.4	55.2	101
			STD	0.7	0.2	1	0.2	1.0	11
			MAX	19.4	5.8	27	4.7	56.5	117
			MIN	17.6	5.2	24	4.2	54.0	87
49	57.00	5	AV5	19.5	6.3	26	4.6	54.2	123
			STD	0.2	0.3	1	0.1	0.3	3
			MAX	19.8	6.7	27	4.7	54.7	128
			MIN	19.2	6.0	25	4.5	53.7	120
55	58.00	6	AV6	20.1	6.7	26	4.8	53.4	136
			STD	0.4	0.3	1	0.1	0.5	3
			MAX	20.7	7.1	27	4.9	54.1	140
			MIN	19.4	6.3	25	4.6	52.8	131
60	59.00	5	AV5	19.7	6.2	27	4.7	53.6	122
			STD	0.3	0.2	1	0.1	0.4	4
			MAX	20.0	6.5	27	4.8	54.4	129
			MIN	19.2	6.0	26	4.6	53.2	117
65	60.00	5	AV5	19.3	5.9	26	4.7	54.1	119
			STD	0.4	0.1	1	0.1	0.6	1
			MAX	20.0	6.0	28	4.9	54.6	121
			MIN	18.9	5.8	25	4.6	53.0	117

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #1 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
72	61.00	7	AV7	19.4	5.8	23	4.6	54.4	124
			STD	0.4	0.1	0	0.1	0.4	3
			MAX	20.0	6.0	23	4.7	54.8	130
			MIN	18.9	5.6	22	4.5	53.7	122
77	62.00	5	AV5	19.4	6.1	25	4.6	54.2	125
			STD	0.5	0.3	2	0.1	0.7	2
			MAX	19.8	6.4	27	4.7	55.5	129
			MIN	18.4	5.4	21	4.4	53.7	121
84	63.00	7	AV7	19.1	6.1	22	4.5	54.7	127
			STD	1.1	0.2	1	0.2	1.3	6
			MAX	20.7	6.4	24	4.9	56.6	135
			MIN	17.3	5.8	20	4.2	52.6	115
90	64.00	6	AV6	20.2	7.3	24	4.9	53.0	142
			STD	0.9	0.4	2	0.1	0.7	13
			MAX	21.4	7.7	26	5.1	53.9	152
			MIN	18.6	6.6	20	4.7	51.9	116
94	65.00	4	AV4	20.4	7.2	27	4.9	52.8	136
			STD	0.3	0.2	0	0.1	0.4	5
			MAX	20.9	7.4	27	5.0	53.3	142
			MIN	20.0	7.0	27	4.8	52.2	129
100	66.00	6	AV6	19.8	6.7	24	4.7	53.6	126
			STD	0.6	0.3	1	0.1	0.7	5
			MAX	20.7	7.2	26	5.0	54.6	133
			MIN	18.9	6.2	22	4.6	52.5	120
106	67.00	6	AV6	18.4	4.9	23	4.4	55.4	114
			STD	0.7	0.3	1	0.2	1.0	3
			MAX	19.3	5.3	24	4.7	56.8	118
			MIN	17.3	4.6	21	4.2	54.0	110
110	68.00	4	AV4	18.3	5.5	25	4.3	55.9	119
			STD	0.6	0.7	1	0.1	0.8	4
			MAX	18.9	6.3	26	4.5	57.1	125
			MIN	17.3	4.6	23	4.1	55.0	113
115	69.00	5	AV5	19.3	5.3	25	4.6	54.6	127
			STD	0.8	0.2	2	0.2	0.9	4
			MAX	20.5	5.6	28	4.8	55.5	134
			MIN	18.6	5.0	23	4.4	53.2	123
121	70.00	6	AV6	18.6	5.1	22	4.4	55.2	122
			STD	0.5	0.4	1	0.1	0.5	3
			MAX	19.3	5.6	24	4.6	56.0	127
			MIN	18.0	4.6	21	4.3	54.6	117
126	71.00	5	AV5	17.6	4.5	23	4.3	56.1	112
			STD	0.8	0.2	1	0.1	0.9	5
			MAX	18.4	4.8	24	4.4	57.7	120

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #1 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			MIN	16.2	4.3	20	4.0	55.3	106
131	72.00	5	AV5	18.5	5.5	24	4.5	55.1	122
			STD	0.9	0.7	1	0.2	1.1	6
			MAX	19.9	6.4	26	4.8	56.8	129
			MIN	16.9	4.5	22	4.2	53.5	112
136	73.00	5	AV5	19.3	6.2	25	4.7	54.0	122
			STD	0.3	0.3	0	0.0	0.2	5
			MAX	19.6	6.7	26	4.7	54.2	131
			MIN	18.9	6.0	25	4.6	53.7	115
140	74.00	4	AV4	19.3	5.8	27	4.6	54.2	128
			STD	0.8	0.2	1	0.1	0.7	2
			MAX	20.4	6.2	28	4.8	55.0	130
			MIN	18.4	5.6	25	4.5	53.3	125
145	75.00	5	AV5	19.4	5.8	26	4.7	54.1	129
			STD	0.5	0.3	1	0.1	0.5	2
			MAX	20.2	6.4	28	4.8	54.6	131
			MIN	18.9	5.5	25	4.6	53.5	124
151	76.00	6	AV6	18.3	4.6	22	4.4	55.6	122
			STD	0.6	0.2	1	0.1	0.7	5
			MAX	19.1	4.8	23	4.6	56.8	129
			MIN	17.3	4.4	21	4.2	54.6	115
164	77.00	13	AV13	19.1	4.6	19	4.6	54.5	133
			STD	0.8	0.6	1	0.2	1.0	10
			MAX	20.5	5.8	21	4.9	56.2	154
			MIN	17.8	3.9	18	4.3	52.8	120
188	78.00	24	AV24	25.1	15.0	27	6.2	47.6	331
			STD	2.7	6.3	5	0.8	3.3	107
			MAX	28.8	25.6	35	7.4	53.4	523
			MIN	20.3	4.3	18	4.8	43.3	149
209	79.00	21	AV21	25.8	15.9	28	6.4	46.4	342
			STD	0.6	1.6	2	0.2	0.7	12
			MAX	26.7	19.8	30	6.8	47.8	365
			MIN	24.5	14.2	25	6.0	45.3	319
228	80.00	19	AV19	25.7	15.8	27	6.4	46.5	354
			STD	0.4	0.8	1	0.2	0.6	11
			MAX	26.5	18.2	30	6.7	47.4	381
			MIN	25.0	14.8	25	6.1	45.4	340
255	81.00	27	AV27	25.7	17.3	27	6.5	46.2	371
			STD	0.5	1.2	1	0.2	0.6	16
			MAX	26.5	19.8	29	6.8	47.3	409
			MIN	24.8	15.6	25	6.2	45.3	345
284	82.00	29	AV29	26.1	19.7	28	6.7	45.6	408

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #1 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			STD	0.6	1.5	1	0.2	0.6	23
			MAX	27.3	22.2	31	7.1	46.8	454
			MIN	25.1	17.2	25	6.3	44.3	368
313	83.00	29	AV29	27.1	22.0	30	7.0	44.6	444
			STD	0.5	0.6	1	0.2	0.5	10
			MAX	28.1	23.5	32	7.3	46.1	461
			MIN	25.7	20.8	28	6.5	43.7	424
344	84.00	31	AV31	27.7	23.3	31	7.2	44.0	461
			STD	0.6	0.6	1	0.2	0.6	10
			MAX	28.9	24.5	34	7.5	45.5	485
			MIN	26.3	21.6	27	6.7	43.0	430
376	85.00	32	AV32	28.0	23.3	31	7.3	43.8	462
			STD	0.5	0.5	1	0.2	0.5	9
			MAX	28.9	24.1	33	7.6	45.2	476
			MIN	26.7	22.0	29	6.8	42.9	438
422	86.00	46	AV46	28.6	25.3	32	7.4	43.3	494
			STD	0.4	0.9	1	0.1	0.4	13
			MAX	29.4	27.0	34	7.7	44.4	516
			MIN	27.6	23.7	30	7.0	42.6	467
448	86.50	52	AV26	29.0	27.7	33	7.6	42.7	536
			STD	0.3	0.5	1	0.1	0.3	10
			MAX	29.9	28.7	35	7.9	43.3	551
			MIN	28.5	26.6	31	7.4	41.9	514
458	86.67	60	AV10	28.8	28.2	33	7.6	43.0	543
			STD	0.5	0.5	1	0.2	0.5	7
			MAX	29.5	29.0	35	7.8	43.7	551
			MIN	28.0	27.4	31	7.3	42.3	527
468	86.83	60	AV10	29.0	28.9	33	7.6	42.9	561
			STD	0.4	0.6	1	0.2	0.5	10
			MAX	29.9	30.1	35	7.9	43.5	577
			MIN	28.5	27.9	31	7.4	41.9	545
478	87.00	60	AV10	29.3	29.5	33	7.7	42.5	581
			STD	0.3	0.4	1	0.1	0.3	9
			MAX	29.7	30.3	35	7.9	42.8	599
			MIN	28.6	29.1	32	7.6	42.0	568
			Average	24.2	16.4	28	6.1	48.4	331
			Std. Dev.	4.7	8.8	4	1.3	5.7	172
			Maximum	29.9	30.3	35	7.9	64.3	599
			Minimum	10.9	3.1	17	3.2	41.9	0

Total number of blows analyzed: 471

BL# Sensors

1-478 F3: [F590] 95.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K2253] 325.0 (1.03); A4: [K2524] 360.0 (1.03)

BL#	Comments
8	Top of Template EL 740.38
476	W

Time Summary

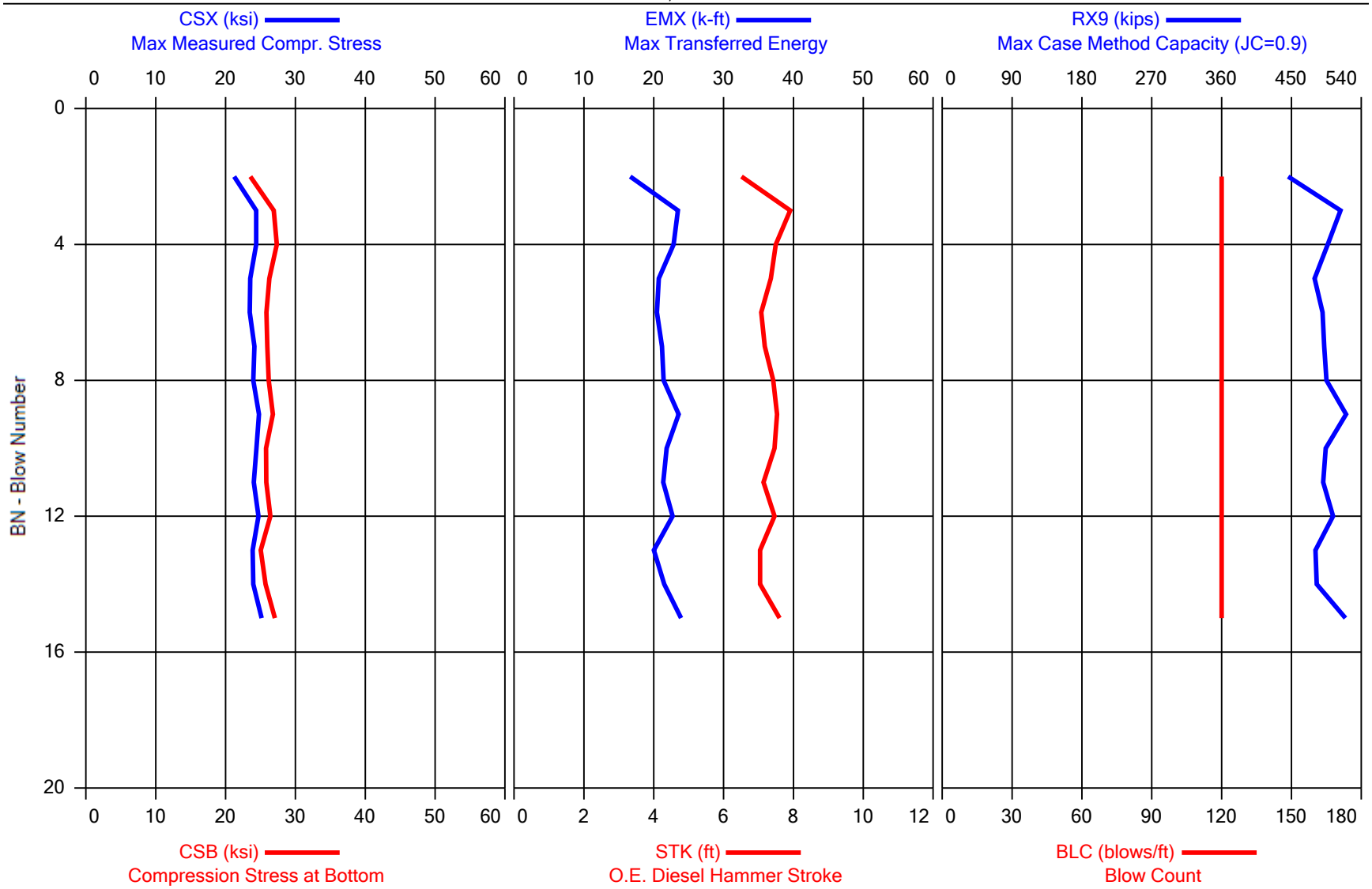
Drive 10 minutes 16 seconds 10:24 AM - 10:34 AM BN 1 - 478

GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.0 - Case Method & iCAP® Results

Printed: 29-December-2014 Test started: 29-December-2014

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #1 - BOR

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #1 - BOR APE D30-42, HP 14 x 73
OP: TC Date: 29-December-2014

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.67 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 ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
5	87.04	120	AV4	23.4	26.0	21	7.3	43.7	484
			MAX	24.4	27.3	23	7.9	46.1	513
			MIN	21.2	23.5	17	6.5	42.0	446
10	87.08	120	AV5	24.1	26.1	22	7.3	43.6	498
			MAX	24.8	26.8	24	7.5	44.3	520
			MIN	23.5	25.8	20	7.1	43.0	490
15	87.13	120	AV5	24.4	26.0	22	7.3	43.8	496
			MAX	25.2	27.1	24	7.6	44.4	520
			MIN	23.9	25.0	20	7.0	42.8	481
			Average	24.0	26.0	22	7.3	43.7	493
			Maximum	25.2	27.3	24	7.9	46.1	520
			Minimum	21.2	23.5	17	6.5	42.0	446

Total number of blows analyzed: 14

BL# Sensors

1-15 F3: [F590] 95.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K2253] 325.0 (1.00); A4: [K2524] 360.0 (1.00)

Time Summary

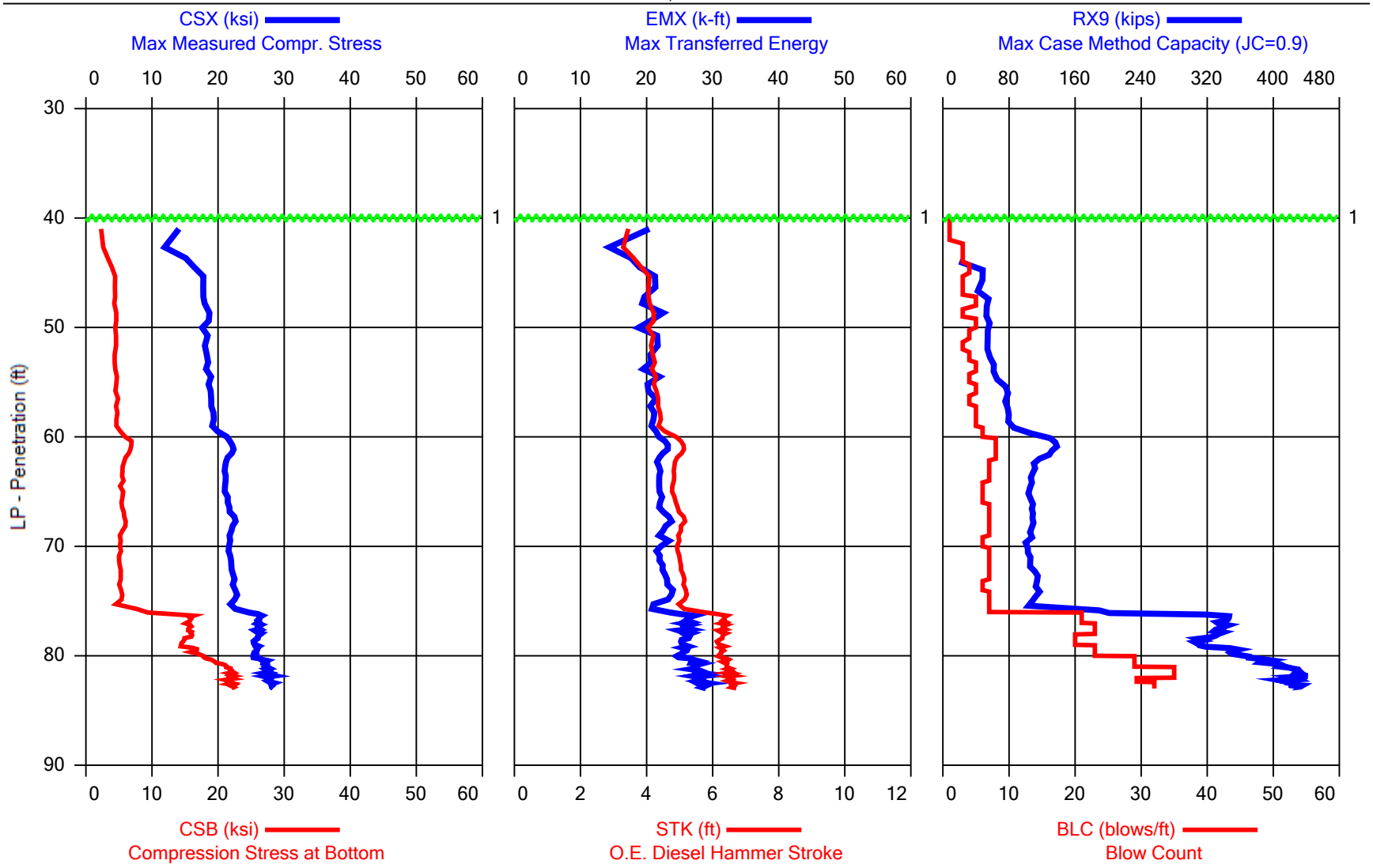
Drive 19 seconds 8:17 AM - 8:18 AM BN 1 - 15

GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.0 - Case Method & iCAP® Results

Printed: 29-December-2014 Test started: 24-December-2014

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #36 - EOID

APE D30-42, HP 14 x 73



1 - Top of Template EL740.78

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #36 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.67 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 ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
11	40.00	1	AV1	15.4	2.1	21	3.5	61.6	0
			MAX	15.4	2.1	21	3.5	61.6	0
			MIN	15.4	2.1	21	3.5	61.6	0
12	41.00	1	AV1	14.3	2.5	22	3.5	61.5	0
			MAX	14.3	2.5	22	3.5	61.5	0
			MIN	14.3	2.5	22	3.5	61.5	0
13	42.00	1	AV1	12.5	2.2	19	3.3	63.5	0
			MAX	12.5	2.2	19	3.3	63.5	0
			MIN	12.5	2.2	19	3.3	63.5	0
14	42.33	3	AV1	9.3	2.1	11	3.0	66.1	0
			MAX	9.3	2.1	11	3.0	66.1	0
			MIN	9.3	2.1	11	3.0	66.1	0
15	42.67	3	AV1	12.7	2.7	15	3.4	62.7	0
			MAX	12.7	2.7	15	3.4	62.7	0
			MIN	12.7	2.7	15	3.4	62.7	0
16	43.00	3	AV1	13.8	3.0	17	3.5	61.9	0
			MAX	13.8	3.0	17	3.5	61.9	0
			MIN	13.8	3.0	17	3.5	61.9	0
17	43.33	3	AV1	14.8	3.2	17	3.6	61.3	0
			MAX	14.8	3.2	17	3.6	61.3	0
			MIN	14.8	3.2	17	3.6	61.3	0
18	43.67	3	AV1	15.4	3.3	17	3.7	60.4	1
			MAX	15.4	3.3	17	3.7	60.4	1
			MIN	15.4	3.3	17	3.7	60.4	1
19	44.00	3	AV1	15.2	3.5	19	3.6	60.8	19
			MAX	15.2	3.5	19	3.6	60.8	19
			MIN	15.2	3.5	19	3.6	60.8	19
20	44.25	4	AV1	16.4	4.2	19	3.8	59.2	39
			MAX	16.4	4.2	19	3.8	59.2	39
			MIN	16.4	4.2	19	3.8	59.2	39
21	44.50	4	AV1	16.7	3.6	18	3.9	58.8	43
			MAX	16.7	3.6	18	3.9	58.8	43
			MIN	16.7	3.6	18	3.9	58.8	43
23	45.00	4	AV2	17.2	4.5	21	4.0	58.2	51
			MAX	18.2	5.1	22	4.2	59.5	51
			MIN	16.1	3.9	20	3.8	56.8	51

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #36 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
26	46.00	3	AV3	17.8	4.3	21	4.1	57.6	48
			MAX	18.3	4.7	21	4.1	58.0	50
			MIN	17.4	3.8	21	4.0	57.1	46
29	47.00	3	AV3	17.7	4.4	21	4.1	57.6	42
			MAX	18.2	4.7	22	4.1	58.0	45
			MIN	17.3	4.2	21	4.0	57.1	40
34	48.00	5	AV5	17.8	4.3	19	4.1	57.6	56
			MAX	18.2	4.3	20	4.1	58.5	57
			MIN	17.1	4.2	18	3.9	57.1	54
37	49.00	3	AV3	18.7	4.6	23	4.2	56.6	50
			MAX	18.8	5.1	23	4.2	56.8	52
			MIN	18.6	4.3	22	4.2	56.5	47
42	50.00	5	AV5	18.1	4.5	20	4.1	57.2	55
			MAX	18.9	4.8	21	4.3	58.4	57
			MIN	17.1	4.1	18	3.9	56.3	51
46	51.00	4	AV4	18.3	4.6	21	4.2	56.8	56
			MAX	18.7	4.9	22	4.2	57.2	58
			MIN	18.1	4.3	20	4.1	56.6	54
49	52.00	3	AV3	18.0	4.5	22	4.1	57.1	53
			MAX	18.8	4.6	23	4.2	57.5	55
			MIN	17.6	4.4	20	4.1	56.5	51
53	53.00	4	AV4	18.1	4.3	20	4.2	57.0	57
			MAX	18.6	4.4	22	4.3	57.6	64
			MIN	17.4	4.2	19	4.1	56.3	52
58	54.00	5	AV5	18.5	4.4	20	4.2	56.5	63
			MAX	19.0	4.5	22	4.3	57.9	65
			MIN	17.4	4.4	19	4.0	55.8	60
62	55.00	4	AV4	18.9	4.7	22	4.3	56.2	63
			MAX	19.0	5.1	22	4.3	56.4	72
			MIN	18.7	4.5	21	4.3	56.0	57
67	56.00	5	AV5	18.7	4.5	20	4.3	56.4	77
			MAX	19.2	4.6	20	4.3	56.8	79
			MIN	18.4	4.4	20	4.2	55.8	76
71	57.00	4	AV4	19.0	4.8	21	4.4	55.8	76
			MAX	19.3	5.2	22	4.4	56.0	79
			MIN	18.8	4.5	21	4.3	55.5	74
76	58.00	5	AV5	19.1	4.7	21	4.4	55.7	79
			MAX	19.6	5.0	21	4.5	56.4	83
			MIN	18.4	4.5	20	4.3	55.0	76

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #36 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
81	59.00	5	AV5	19.2	4.6	21	4.4	55.6	80
			MAX	19.7	4.8	21	4.5	56.2	83
			MIN	18.6	4.4	21	4.3	54.9	72
87	60.00	6	AV6	20.2	5.3	21	4.6	54.3	102
			MAX	21.1	5.9	22	4.9	55.4	121
			MIN	19.4	4.5	20	4.4	53.0	85
95	61.00	8	AV8	22.1	6.8	23	5.1	51.8	136
			MAX	23.0	7.1	24	5.3	52.4	141
			MIN	21.5	6.2	22	5.0	50.9	131
103	62.00	8	AV8	21.8	6.4	22	5.0	52.2	128
			MAX	23.0	6.8	24	5.2	53.0	134
			MIN	21.2	5.9	21	4.9	51.1	119
110	63.00	7	AV7	21.1	5.6	22	4.8	53.0	111
			MAX	21.7	6.1	23	5.0	53.3	114
			MIN	20.9	5.4	21	4.8	52.5	107
117	64.00	7	AV7	21.0	5.5	22	4.8	53.3	108
			MAX	22.0	5.9	23	5.1	54.3	114
			MIN	20.1	5.2	21	4.6	52.0	103
123	65.00	6	AV6	21.2	5.4	22	4.8	53.2	105
			MAX	22.1	5.9	24	5.0	54.3	109
			MIN	20.2	5.0	21	4.6	52.1	101
129	66.00	6	AV6	21.3	5.5	22	4.8	53.1	106
			MAX	21.9	5.8	24	5.0	53.9	111
			MIN	20.8	5.2	21	4.7	52.4	98
136	67.00	7	AV7	21.7	5.6	22	5.0	52.5	108
			MAX	22.3	5.8	23	5.1	53.4	113
			MIN	21.0	5.3	21	4.8	51.7	103
143	68.00	7	AV7	22.5	5.9	23	5.1	51.7	109
			MAX	22.8	6.2	24	5.2	52.2	112
			MIN	22.1	5.8	23	5.0	51.3	106
150	69.00	7	AV7	21.9	5.5	22	5.0	52.2	107
			MAX	22.6	6.0	24	5.2	53.1	112
			MIN	21.2	5.2	21	4.8	51.5	103
156	70.00	6	AV6	21.8	5.2	23	5.0	52.5	103
			MAX	22.6	5.5	24	5.2	53.0	114
			MIN	21.4	5.0	22	4.9	51.5	93
163	71.00	7	AV7	21.7	5.1	22	5.0	52.4	104
			MAX	22.6	5.5	23	5.2	53.2	108
			MIN	21.0	4.9	21	4.8	51.4	99
170	72.00	7	AV7	22.0	5.0	22	5.0	52.2	106

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #36 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			MAX	22.6	5.4	23	5.2	52.8	109
			MIN	21.6	4.8	21	4.9	51.4	102
177	73.00	7	AV7	22.3	5.3	23	5.1	51.8	113
			MAX	23.3	5.6	24	5.3	52.6	116
			MIN	21.4	4.9	21	4.9	50.7	110
183	74.00	6	AV6	22.5	5.2	24	5.2	51.4	114
			MAX	23.3	5.4	25	5.4	52.1	123
			MIN	21.9	5.0	23	5.0	50.5	105
190	75.00	7	AV7	22.6	5.4	23	5.2	51.5	113
			MAX	23.3	5.9	25	5.4	52.2	119
			MIN	21.9	5.0	22	5.0	50.6	107
197	76.00	7	AV7	22.6	6.7	22	5.2	51.5	141
			MAX	24.9	10.4	25	5.9	53.2	207
			MIN	21.3	4.3	19	4.8	48.4	98
218	77.00	21	AV21	26.1	14.7	26	6.3	46.9	319
			MAX	27.1	16.7	28	6.5	48.9	362
			MIN	24.6	8.5	23	5.8	46.0	163
241	78.00	23	AV23	26.1	15.7	26	6.3	46.8	337
			MAX	27.3	16.6	28	6.6	47.7	352
			MIN	25.2	14.8	24	6.1	45.8	326
261	79.00	20	AV20	25.8	15.1	26	6.2	47.1	316
			MAX	26.6	16.3	27	6.4	48.1	337
			MIN	24.6	14.3	24	6.0	46.4	300
284	80.00	23	AV23	25.7	16.2	26	6.3	47.0	345
			MAX	26.9	17.5	27	6.5	47.7	365
			MIN	24.8	14.3	24	6.1	46.2	307
313	81.00	29	AV29	26.7	19.5	27	6.4	46.6	391
			MAX	28.0	21.4	29	6.6	47.7	416
			MIN	24.9	17.7	24	6.1	45.7	362
348	82.00	35	AV35	27.7	21.9	28	6.5	46.0	428
			MAX	28.6	22.7	30	6.8	46.8	451
			MIN	26.8	20.9	26	6.3	45.3	407
359	82.38	29	AV11	27.8	21.6	28	6.5	46.0	420
			MAX	28.6	22.8	29	6.7	46.9	444
			MIN	27.2	20.0	26	6.3	45.6	402
369	82.69	32	AV10	28.1	21.8	28	6.6	45.8	423
			MAX	28.8	22.5	30	6.8	46.2	453
			MIN	27.7	20.8	27	6.5	45.1	407
379	83.00	32	AV10	28.2	22.2	29	6.6	45.7	428
			MAX	28.7	23.2	29	6.8	46.5	442

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #36 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			MIN	27.5	21.3	28	6.4	45.3	409
			Average	23.5	11.7	24	5.5	50.5	231
			Maximum	28.8	23.2	30	6.8	66.1	453
			Minimum	9.3	2.1	11	3.0	45.1	0

Total number of blows analyzed: 369

BL# Sensors

1-379 F3: [F590] 95.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K2253] 325.0 (1.04); A4: [K2524] 360.0 (1.04)

BL# Comments

11 Top of Template EL740.78
376 CW

Time Summary

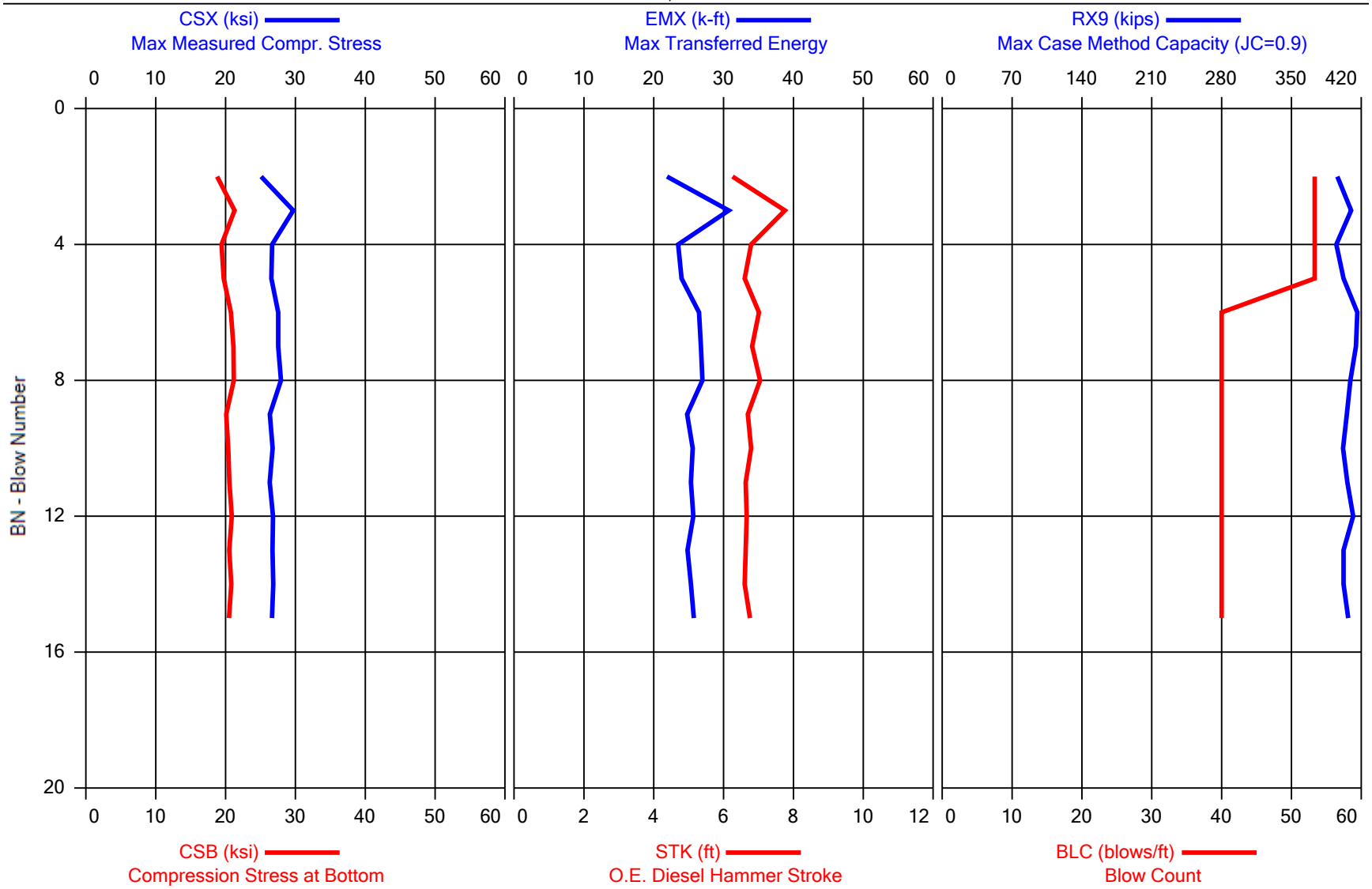
Drive 9 minutes 59 seconds 9:52 AM - 10:02 AM BN 1 - 379

GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.0 - Case Method & iCAP® Results

Printed: 29-December-2014 Test started: 29-December-2014

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #36 - BOR

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #36 - BOR APE D30-42, HP 14 x 73
OP: TC Date: 29-December-2014

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.67 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 ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
5	83.09	53	AV4	27.0	19.8	25	6.8	45.1	401
			MAX	29.7	21.3	31	7.8	47.0	410
			MIN	25.1	18.8	22	6.3	42.4	395
10	83.22	40	AV5	27.2	20.7	26	6.9	44.9	409
			MAX	27.9	21.2	27	7.0	45.5	416
			MIN	26.3	20.1	25	6.7	44.4	402
15	83.34	40	AV5	26.7	20.6	25	6.7	45.6	406
			MAX	26.8	20.9	26	6.8	45.8	412
			MIN	26.3	20.5	25	6.6	45.3	402
			Average	27.0	20.4	26	6.8	45.2	406
			Maximum	29.7	21.3	31	7.8	47.0	416
			Minimum	25.1	18.8	22	6.3	42.4	395

Total number of blows analyzed: 14

BL# Sensors

1-15 F3: [F607] 93.6 (1.00); F4: [F590] 95.0 (1.00); A3: [K2524] 360.0 (1.06); A4: [K2253] 325.0 (1.06)

BL# Comments

4 CW

Time Summary

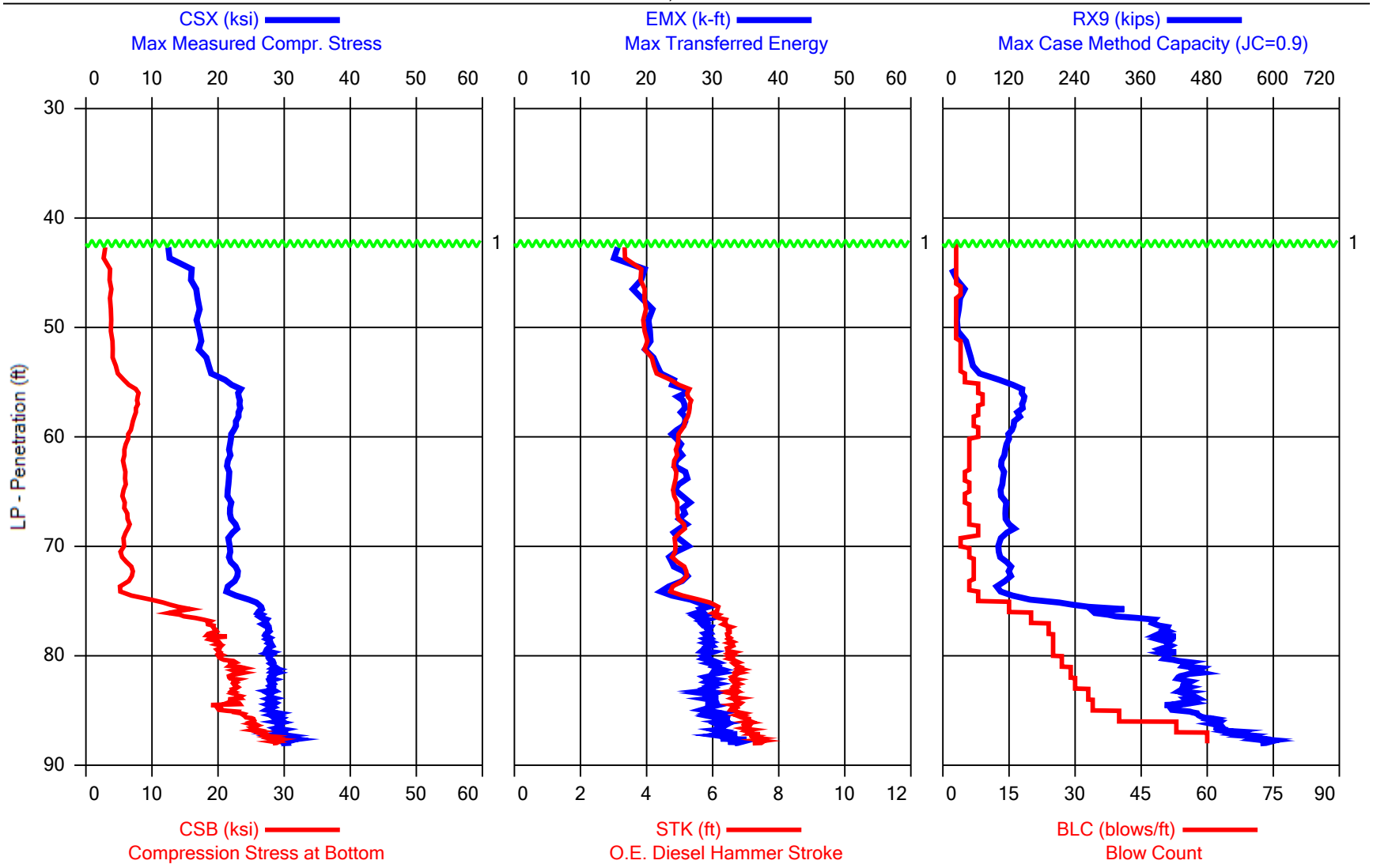
Drive 18 seconds 8:09 AM - 8:10 AM BN 1 - 15

GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.0 - Case Method & iCAP® Results

Printed: 29-December-2014 Test started: 24-December-2014

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #44 - EOID

APE D30-42, HP 14 x 73



1 - Top of Template EL 740.78

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #44 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.67 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 ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
4	42.33	3	AV1	11.3	2.8	15	3.1	64.9	0
			MAX	11.3	2.8	15	3.1	64.9	0
			MIN	11.3	2.8	15	3.1	64.9	0
5	42.67	3	AV1	13.0	3.0	17	3.4	62.6	0
			MAX	13.0	3.0	17	3.4	62.6	0
			MIN	13.0	3.0	17	3.4	62.6	0
6	43.00	3	AV1	13.0	2.9	15	3.5	61.9	0
			MAX	13.0	2.9	15	3.5	61.9	0
			MIN	13.0	2.9	15	3.5	61.9	0
9	44.00	3	AV3	12.7	2.7	15	3.3	63.0	0
			MAX	12.9	2.7	16	3.4	63.1	0
			MIN	12.3	2.6	15	3.3	62.9	0
12	45.00	3	AV3	16.0	3.6	20	3.8	59.1	16
			MAX	16.5	4.2	20	3.9	59.4	19
			MIN	15.5	3.4	19	3.8	58.9	12
15	46.00	3	AV3	15.9	3.6	19	3.8	59.3	26
			MAX	16.5	4.3	21	3.9	59.7	32
			MIN	15.4	3.1	18	3.8	58.7	23
19	47.00	4	AV4	16.9	3.8	18	4.0	58.4	38
			MAX	17.9	4.2	19	4.1	59.8	44
			MIN	15.5	3.5	18	3.7	57.4	34
22	48.00	3	AV3	16.3	3.5	19	3.8	59.1	29
			MAX	16.7	3.8	20	3.9	60.0	37
			MIN	15.6	3.4	19	3.7	58.6	22
25	49.00	3	AV3	17.3	3.9	21	4.0	58.2	31
			MAX	18.6	4.2	22	4.2	59.9	42
			MIN	15.8	3.7	19	3.7	56.8	17
28	50.00	3	AV3	17.3	3.7	21	4.0	58.2	23
			MAX	17.6	3.9	21	4.0	58.6	25
			MIN	17.0	3.6	21	3.9	57.7	20
31	51.00	3	AV3	17.1	3.9	21	4.0	58.3	30
			MAX	17.4	4.1	21	4.0	58.7	33
			MIN	16.5	3.6	20	3.9	57.9	27
35	52.00	4	AV4	17.4	4.0	20	4.0	58.2	46
			MAX	17.7	4.2	20	4.1	58.7	48
			MIN	16.9	3.9	19	3.9	57.6	44

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #44 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
39	53.00	4	AV4	17.8	4.1	21	4.1	57.4	50
			MAX	18.9	4.2	22	4.3	58.5	52
			MIN	16.7	3.9	20	3.9	56.3	46
43	54.00	4	AV4	18.4	4.5	22	4.2	56.8	54
			MAX	18.8	5.0	22	4.3	57.3	55
			MIN	17.9	4.2	21	4.1	56.4	52
48	55.00	5	AV5	20.4	5.4	23	4.6	54.4	91
			MAX	21.9	6.1	25	4.9	56.0	107
			MIN	19.0	4.6	21	4.3	52.8	62
56	56.00	8	AV8	22.8	7.2	25	5.2	51.5	138
			MAX	25.1	8.1	28	5.7	52.8	155
			MIN	21.8	6.3	24	4.9	49.3	119
65	57.00	9	AV9	23.1	7.8	25	5.3	50.9	146
			MAX	23.7	8.0	26	5.4	51.3	150
			MIN	22.8	7.5	24	5.2	50.3	142
73	58.00	8	AV8	23.3	7.6	26	5.3	50.8	140
			MAX	24.1	8.0	27	5.4	52.0	148
			MIN	22.0	7.2	23	5.1	50.2	131
80	59.00	7	AV7	22.8	7.1	26	5.2	51.4	133
			MAX	23.4	7.2	26	5.3	52.1	145
			MIN	22.0	6.7	25	5.0	50.9	127
88	60.00	8	AV8	22.3	6.6	24	5.0	52.1	123
			MAX	22.9	7.1	25	5.1	52.8	127
			MIN	21.6	6.2	23	4.9	51.6	118
94	61.00	6	AV6	21.8	6.1	25	4.9	52.7	117
			MAX	22.2	6.4	26	5.0	52.9	121
			MIN	21.5	5.8	24	4.9	52.1	115
100	62.00	6	AV6	21.6	5.7	25	4.9	52.9	111
			MAX	22.3	6.0	26	5.0	53.8	120
			MIN	20.8	5.3	23	4.7	52.1	104
106	63.00	6	AV6	21.5	5.8	25	4.9	53.0	108
			MAX	22.1	6.1	26	4.9	53.5	117
			MIN	21.0	5.5	24	4.8	52.6	102
111	64.00	5	AV5	21.7	6.0	26	4.9	52.8	109
			MAX	22.7	6.3	27	5.1	53.6	117
			MIN	20.8	5.8	25	4.7	51.7	98
117	65.00	6	AV6	21.5	5.9	25	4.8	53.2	106
			MAX	21.8	6.3	25	4.9	53.5	109
			MIN	21.3	5.5	24	4.8	52.8	101

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #44 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
122	66.00	5	AV5	21.7	5.7	26	4.9	52.8	109
			MAX	22.3	6.2	28	5.0	53.3	113
			MIN	21.2	5.5	25	4.8	52.1	98
128	67.00	6	AV6	21.8	5.9	26	4.9	52.7	115
			MAX	22.4	6.3	27	5.0	53.2	120
			MIN	21.6	5.6	25	4.8	52.1	109
134	68.00	6	AV6	22.0	6.4	25	5.0	52.3	115
			MAX	23.1	7.0	27	5.2	53.0	118
			MIN	21.2	5.9	24	4.9	51.5	111
142	69.00	8	AV8	22.6	6.2	25	5.1	51.9	122
			MAX	23.3	6.7	26	5.2	52.8	134
			MIN	21.8	5.7	23	4.9	51.1	114
146	70.00	4	AV4	21.6	5.8	26	4.9	52.9	101
			MAX	22.3	6.2	28	5.0	53.4	104
			MIN	21.1	5.6	25	4.8	52.2	98
152	71.00	6	AV6	21.6	5.3	24	4.8	53.3	102
			MAX	22.2	5.5	25	5.0	53.9	107
			MIN	21.2	5.0	23	4.7	52.5	99
159	72.00	7	AV7	22.3	6.4	24	5.0	52.2	118
			MAX	22.9	7.2	24	5.2	52.9	128
			MIN	21.6	5.6	23	4.9	51.3	105
166	73.00	7	AV7	23.0	7.0	26	5.2	51.2	121
			MAX	23.8	7.5	27	5.4	52.1	130
			MIN	22.3	6.3	25	5.0	50.5	111
172	74.00	6	AV6	21.6	5.5	24	4.8	53.1	103
			MAX	22.3	6.5	25	5.0	53.9	111
			MIN	21.0	5.0	23	4.7	52.1	96
180	75.00	8	AV8	23.1	7.6	24	5.2	51.4	133
			MAX	25.1	10.7	28	5.7	53.8	175
			MIN	21.1	5.3	21	4.7	49.1	101
195	76.00	15	AV15	26.3	13.6	28	6.1	47.6	262
			MAX	26.9	16.9	30	6.4	48.7	352
			MIN	25.1	11.3	26	5.8	46.6	198
215	77.00	20	AV20	26.7	16.0	28	6.2	47.2	339
			MAX	27.5	19.2	30	6.5	48.3	387
			MIN	25.6	11.2	26	5.9	46.2	248
239	78.00	24	AV24	27.5	19.2	29	6.5	46.3	400
			MAX	28.5	20.7	31	6.8	47.3	414
			MIN	26.2	17.8	28	6.2	45.3	384
264	79.00	25	AV25	27.6	19.5	29	6.5	46.1	402

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #44 - EOID APE D30-42, HP 14 x 73
OP: TC Date: 24-December-2014

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			MAX	28.3	21.8	31	6.8	46.9	428
			MIN	26.6	17.6	28	6.3	45.3	383
289	80.00	25	AV25	27.7	20.2	29	6.5	46.1	405
			MAX	28.7	21.0	30	6.8	46.9	449
			MIN	26.7	18.7	27	6.3	45.3	387
316	81.00	27	AV27	28.1	21.4	30	6.6	45.7	426
			MAX	29.1	23.9	32	7.0	46.4	469
			MIN	27.3	19.5	28	6.4	44.5	395
345	82.00	29	AV29	28.4	22.8	30	6.7	45.4	452
			MAX	29.4	25.4	32	7.1	46.1	492
			MIN	27.6	21.0	29	6.5	44.3	418
375	83.00	30	AV30	28.1	22.5	30	6.7	45.6	439
			MAX	29.1	24.2	31	6.8	46.7	481
			MIN	26.9	21.3	28	6.3	45.0	417
408	84.00	33	AV33	27.9	22.6	29	6.7	45.6	445
			MAX	29.0	24.1	31	6.9	46.2	474
			MIN	27.2	21.3	28	6.5	44.7	421
442	85.00	34	AV34	28.0	21.1	30	6.7	45.5	430
			MAX	29.3	24.0	32	7.1	46.4	456
			MIN	26.9	18.1	28	6.4	44.3	389
482	86.00	40	AV40	28.7	24.1	31	6.9	44.8	471
			MAX	30.3	25.8	33	7.2	45.9	500
			MIN	27.5	21.3	28	6.6	43.8	432
535	87.00	53	AV53	29.2	25.5	31	7.0	44.4	504
			MAX	30.0	26.6	33	7.3	45.6	534
			MIN	27.9	24.4	29	6.7	43.7	483
595	88.00	60	AV60	30.2	27.9	33	7.3	43.6	565
			MAX	31.5	29.5	37	7.8	44.6	599
			MIN	29.0	25.7	30	7.0	42.4	522
			Average	26.1	17.5	28	6.2	47.8	346
			Maximum	31.5	29.5	37	7.8	64.9	599
			Minimum	11.3	2.6	15	3.1	42.4	0

Total number of blows analyzed: 592

BL# Sensors

1-595 F3: [F607] 93.6 (1.00); F4: [F590] 95.0 (1.00); A3: [K2524] 360.0 (1.04); A4: [K2253] 325.0 (1.04)

BL# Comments

4 Top of Template EL 740.78
592 CW

Time Summary

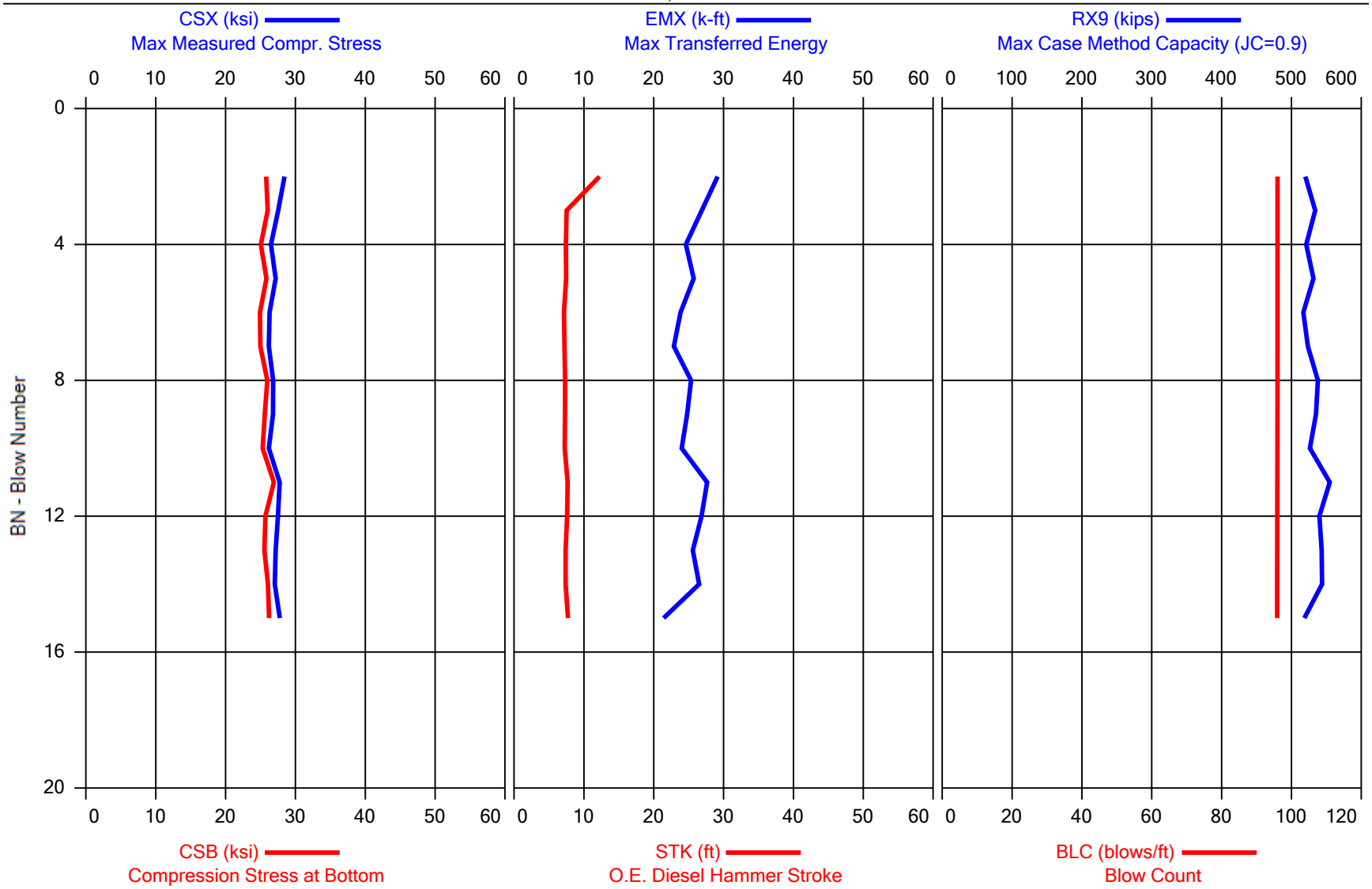
Drive 12 minutes 50 seconds 9:17 AM - 9:30 AM BN 1 - 595

GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.0 - Case Method & iCAP® Results

Printed: 29-December-2014 Test started: 29-December-2014

USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #44 - BOR

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - B-70-403 - Pier 6 #44 - BOR APE D30-42, HP 14 x 73
OP: TC Date: 29-December-2014

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.67 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 ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
5	88.05	96	AV4	27.4	25.7	27	8.7	40.9	527
			MAX	28.4	26.0	29	12.2	43.3	534
			MIN	26.5	25.0	25	7.4	34.0	520
10	88.10	96	AV5	26.5	25.4	24	7.2	43.8	528
			MAX	26.8	26.0	25	7.3	44.1	538
			MIN	26.2	24.9	23	7.1	43.6	517
15	88.16	96	AV5	27.4	26.1	26	7.6	42.9	540
			MAX	27.8	26.9	28	7.7	43.4	555
			MIN	27.0	25.6	21	7.4	42.5	518
			Average	27.1	25.7	25	7.8	42.7	532
			Maximum	28.4	26.9	29	12.2	44.1	555
			Minimum	26.2	24.9	21	7.1	34.0	517

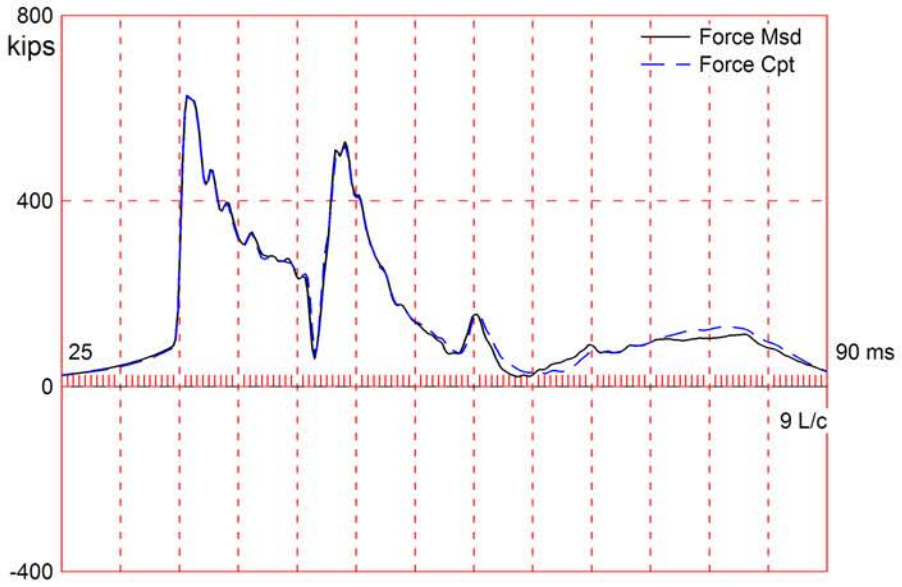
Total number of blows analyzed: 14

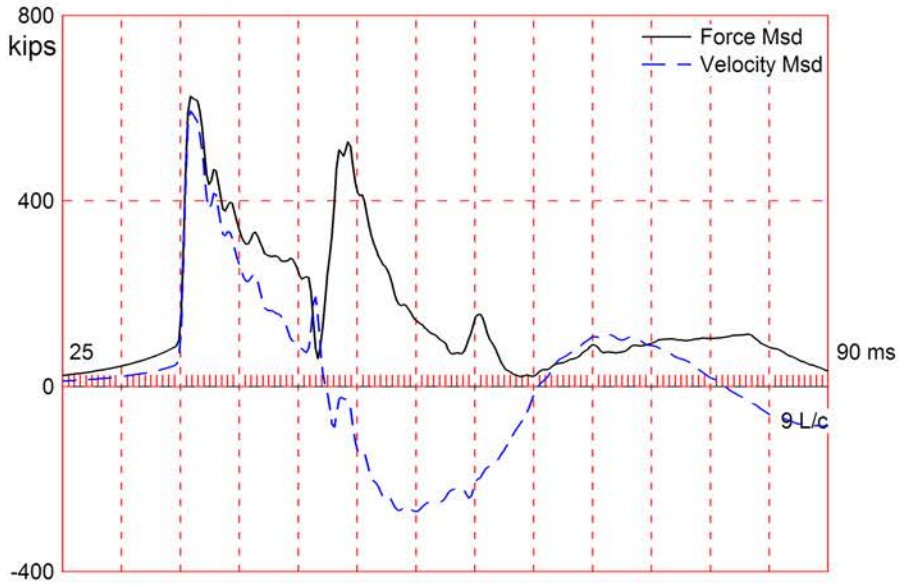
BL# Sensors

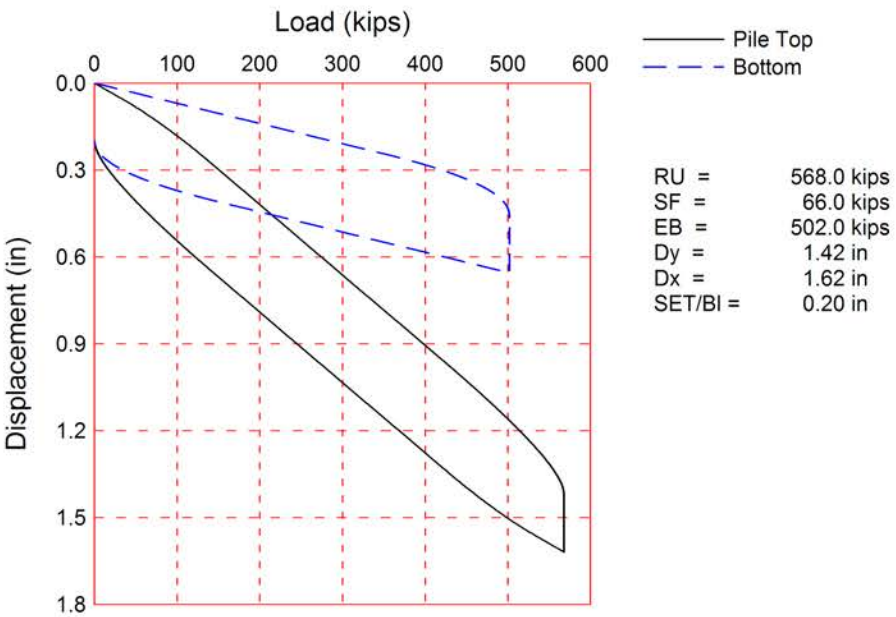
1-15 F3: [F590] 95.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K2253] 325.0 (1.00); A4: [K2524] 360.0 (1.00)

Time Summary

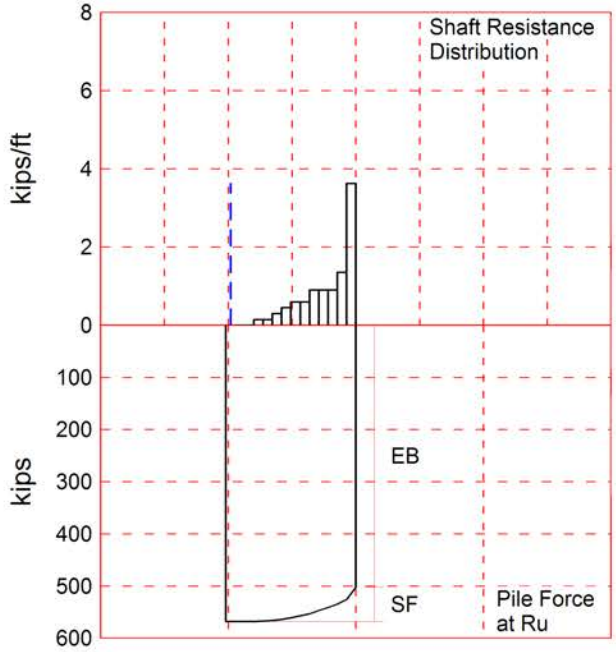
Drive 20 seconds 8:00 AM - 8:01 AM BN 1 - 15







RU =	568.0 kips
SF =	66.0 kips
EB =	502.0 kips
Dy =	1.42 in
Dx =	1.62 in
SET/Bl =	0.20 in



Length b. Sensors	92.7 ft
Embedment	86.7 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	2.77
Top Compr. Stress	29.4 ksi
Max Compr. Stress	30.3 ksi
Max Tension Stress	-3.87 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.35 in
Avg. Shaft Smith Dpg.	0.25 s/ft
Toe Smith Damping	0.09 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: 568.0; along Shaft 66.0; at Toe 502.0 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
				568.0				
1	13.2	7.2	0.0	568.0	0.0	0.00	0.00	0.00
2	19.9	13.8	0.0	568.0	0.0	0.00	0.00	0.00
3	26.5	20.5	1.0	567.0	1.0	0.15	0.03	0.25
4	33.1	27.1	1.0	566.0	2.0	0.15	0.03	0.25
5	39.7	33.7	2.0	564.0	4.0	0.30	0.06	0.25
6	46.3	40.3	3.0	561.0	7.0	0.45	0.10	0.25
7	53.0	46.9	4.0	557.0	11.0	0.60	0.13	0.25
8	59.6	53.6	4.0	553.0	15.0	0.60	0.13	0.25
9	66.2	60.2	6.0	547.0	21.0	0.91	0.19	0.25
10	72.8	66.8	6.0	541.0	27.0	0.91	0.19	0.25
11	79.4	73.4	6.0	535.0	33.0	0.91	0.19	0.25
12	86.1	80.0	9.0	526.0	42.0	1.36	0.29	0.25
13	92.7	86.7	24.0	502.0	66.0	3.63	0.77	0.25
Avg. Shaft			5.1			0.76	0.16	0.25
Toe			502.0				364.17	0.09

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.04	0.35
Case Damping Factor		0.43	1.18
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	59	42
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	64	
Resistance Gap (included in Toe Quake)	(in)		0.01
Soil Plug Weight	(kips)	0.020	

CAPWAP match quality = 2.77 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.20 in; Blow Count = 60 b/ft
Computed: Final Set = 0.16 in; Blow Count = 73 b/ft

max. Top Comp. Stress = 29.4 ksi (T= 36.0 ms, max= 1.030 x Top)
max. Comp. Stress = 30.3 ksi (Z= 92.7 ft, T= 42.3 ms)
max. Tens. Stress = -3.87 ksi (Z= 72.8 ft, T= 63.6 ms)
max. Energy (EMX) = 34.4 kip-ft; max. Measured Top Displ. (DMX)= 1.10 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	629.0	-12.8	29.4	-0.60	34.4	15.5	1.10
2	6.6	629.4	-14.2	29.4	-0.67	34.2	15.4	1.09
4	13.2	630.2	-17.4	29.4	-0.81	33.7	15.4	1.05
6	19.9	631.3	-32.4	29.5	-1.52	33.2	15.3	1.01
8	26.5	634.2	-46.8	29.6	-2.19	32.5	15.2	0.96
10	33.1	632.5	-58.7	29.5	-2.74	31.5	15.1	0.92
12	39.7	633.9	-69.0	29.6	-3.22	30.3	14.9	0.86
14	46.3	632.5	-74.0	29.5	-3.46	28.9	14.7	0.81
15	49.6	623.5	-72.1	29.1	-3.37	27.7	14.5	0.78
16	53.0	627.5	-71.4	29.3	-3.33	27.1	14.4	0.75
17	56.3	614.2	-68.3	28.7	-3.19	25.7	14.3	0.72
18	59.6	619.4	-68.4	28.9	-3.20	25.0	14.1	0.69
19	62.9	608.1	-72.0	28.4	-3.36	23.6	14.0	0.66
20	66.2	616.6	-78.7	28.8	-3.68	22.8	13.8	0.62
21	69.5	600.3	-79.3	28.0	-3.70	21.1	13.5	0.59
22	72.8	607.4	-82.9	28.4	-3.87	20.4	13.3	0.56
23	76.1	583.1	-78.5	27.2	-3.67	18.8	13.2	0.53
24	79.4	587.6	-78.7	27.5	-3.68	18.0	13.7	0.49
25	82.7	586.2	-73.8	27.4	-3.45	16.4	15.7	0.46
26	86.1	617.7	-73.9	28.9	-3.45	15.7	16.3	0.43
27	89.4	616.5	-66.0	28.8	-3.08	13.8	16.4	0.39
28	92.7	648.1	-66.2	30.3	-3.09	11.8	14.9	0.36
Absolute	92.7			30.3			(T =	42.3 ms)
	72.8				-3.87		(T =	63.6 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	620.7	499.0	377.4	255.8	134.1					
RX	734.2	676.2	641.8	612.8	588.0	566.2	548.0	534.7	521.5	508.3
RU	620.7	499.0	377.4	255.8	134.1					

RAU = 460.0 (kips); RA2 = 623.0 (kips)

Current CAPWAP Ru = 568.0 (kips); Corresponding J(RP)= 0.09; J(RX) = 0.98

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
15.7	35.84	598.4	630.5	630.5	1.10	0.20	0.20	34.5	636.8	1476

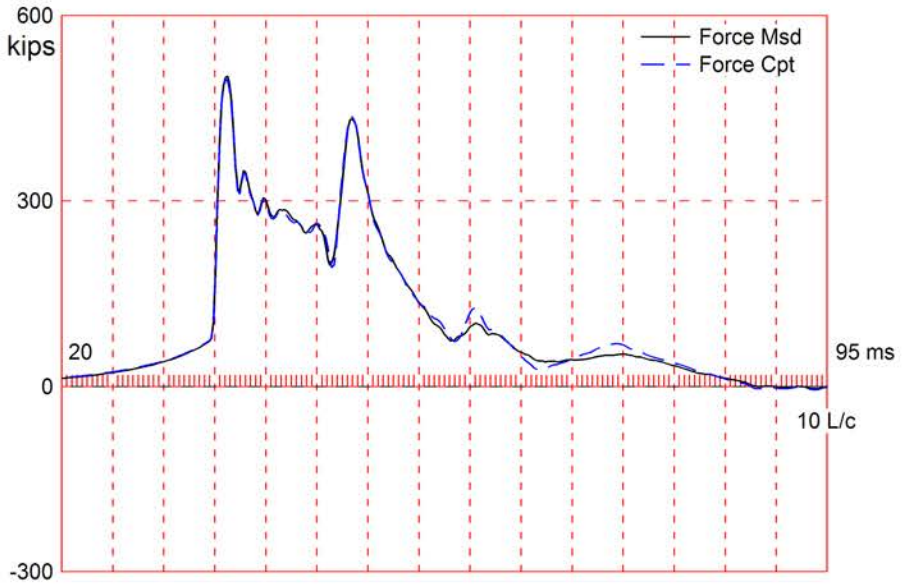
PILE PROFILE AND PILE MODEL

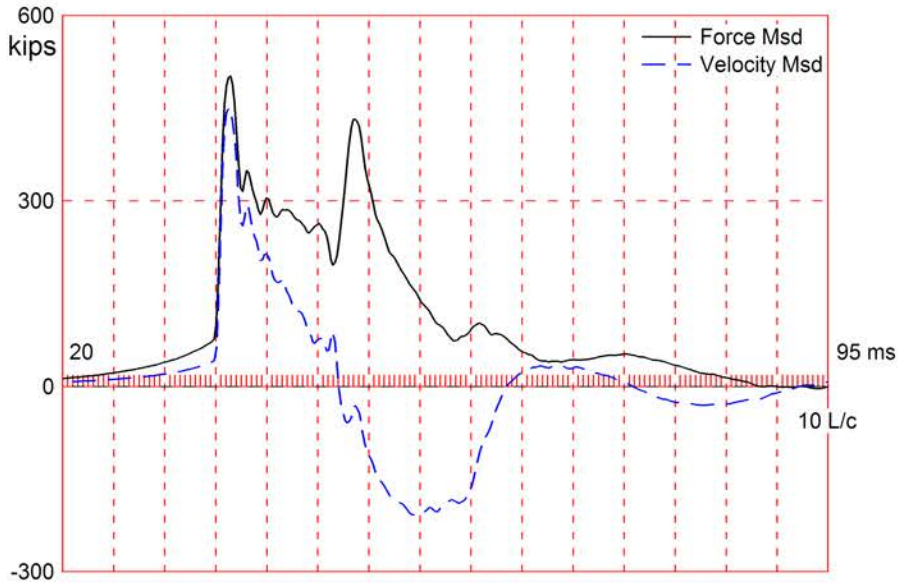
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.7	21.4	29992.2	492.000	4.70

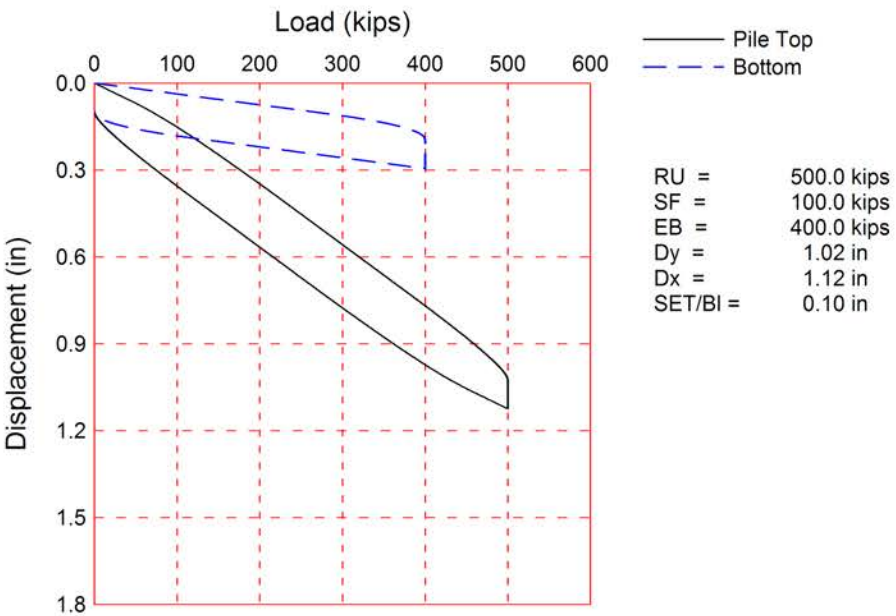
Toe Area 198.5 in^2

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	3.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
23	76.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
25	82.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
28	92.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

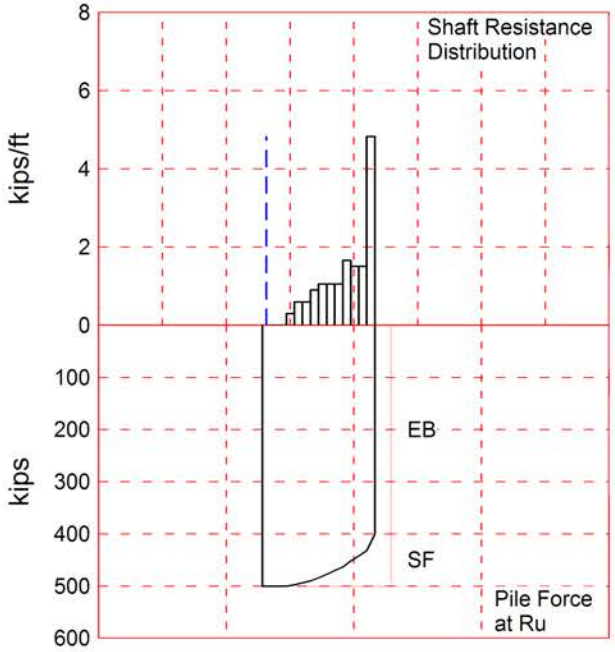
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.197 ms, 2L/c 11.0 ms
Total volume: 13.772 ft^3; Volume ratio considering added impedance: 1.000







RU =	500.0 kips
SF =	100.0 kips
EB =	400.0 kips
Dy =	1.02 in
Dx =	1.12 in
SET/Bl =	0.10 in



Length b. Sensors	92.7 ft
Embedment	87.0 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.	16808 ft/s
Match Quality	2.12
Top Compr. Stress	23.2 ksi
Max Compr. Stress	23.9 ksi
Max Tension Stress	-2.55 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.15 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: 500.0; along Shaft 100.0; 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
				500.0				
1	13.2	7.6	0.0	500.0	0.0	0.00	0.00	0.00
2	19.9	14.2	0.0	500.0	0.0	0.00	0.00	0.00
3	26.5	20.8	2.0	498.0	2.0	0.30	0.06	0.28
4	33.1	27.4	4.0	494.0	6.0	0.60	0.13	0.28
5	39.7	34.0	4.0	490.0	10.0	0.60	0.13	0.28
6	46.3	40.7	6.0	484.0	16.0	0.91	0.19	0.28
7	53.0	47.3	7.0	477.0	23.0	1.06	0.23	0.28
8	59.6	53.9	7.0	470.0	30.0	1.06	0.23	0.28
9	66.2	60.5	7.0	463.0	37.0	1.06	0.23	0.28
10	72.8	67.1	11.0	452.0	48.0	1.66	0.35	0.28
11	79.4	73.8	10.0	442.0	58.0	1.51	0.32	0.28
12	86.1	80.4	10.0	432.0	68.0	1.51	0.32	0.28
13	92.7	87.0	32.0	400.0	100.0	4.83	1.03	0.28
Avg. Shaft			7.7			1.15	0.24	0.28
Toe			400.0				290.17	0.10

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.04	0.15
Case Damping Factor		0.73	1.05
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	55	30
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	15	
Resistance Gap (included in Toe Quake)	(in)		0.01

CAPWAP match quality = 2.12 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.10 in; Blow Count = 120 b/ft
Computed: Final Set = 0.06 in; Blow Count = 191 b/ft

max. Top Comp. Stress = 23.2 ksi (T= 36.6 ms, max= 1.032 x Top)
max. Comp. Stress = 23.9 ksi (Z= 92.7 ft, T= 42.3 ms)
max. Tens. Stress = -2.55 ksi (Z= 66.2 ft, T= 62.8 ms)
max. Energy (EMX) = 20.4 kip-ft; max. Measured Top Displ. (DMX)= 0.81 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	496.6	-16.3	23.2	-0.76	20.4	11.8	0.80
2	6.6	497.5	-16.4	23.2	-0.76	20.2	11.8	0.79
4	13.2	499.4	-16.6	23.3	-0.78	19.8	11.8	0.75
6	19.9	504.6	-16.7	23.6	-0.78	19.2	11.7	0.71
8	26.5	512.1	-16.8	23.9	-0.78	18.6	11.5	0.67
10	33.1	511.7	-16.6	23.9	-0.77	17.7	11.3	0.62
12	39.7	505.0	-19.2	23.6	-0.90	16.4	11.0	0.58
14	46.3	500.4	-31.4	23.4	-1.47	15.1	10.7	0.53
15	49.6	482.0	-35.7	22.5	-1.67	13.9	10.5	0.50
16	53.0	488.3	-42.6	22.8	-1.99	13.5	10.4	0.47
17	56.3	466.7	-45.7	21.8	-2.13	12.3	10.2	0.45
18	59.6	473.1	-51.3	22.1	-2.40	11.9	10.1	0.42
19	62.9	452.9	-52.8	21.2	-2.46	10.7	9.9	0.40
20	66.2	462.3	-54.5	21.6	-2.55	10.2	9.7	0.37
21	69.5	449.2	-52.7	21.0	-2.46	9.2	9.5	0.34
22	72.8	452.8	-53.7	21.2	-2.51	8.7	9.3	0.32
23	76.1	443.7	-50.3	20.7	-2.35	7.5	9.0	0.29
24	79.4	448.1	-50.6	20.9	-2.36	7.0	8.8	0.26
25	82.7	455.8	-47.1	21.3	-2.20	5.9	9.8	0.24
26	86.1	465.4	-47.5	21.7	-2.22	5.4	10.0	0.21
27	89.4	460.7	-44.1	21.5	-2.06	4.4	9.7	0.18
28	92.7	512.6	-44.4	23.9	-2.07	3.4	8.0	0.15
Absolute	92.7			23.9			(T =	42.3 ms)
	66.2				-2.55		(T =	62.8 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	627.2	594.6	561.9	529.2	496.5	463.8	431.1	398.4	365.8	333.1
RX	647.8	620.5	594.9	572.7	551.7	530.7	511.9	498.4	488.9	481.9
RU	629.0	596.5	564.0	531.5	499.0	466.5	434.0	401.5	369.0	336.5

RAU = 347.8 (kips); RA2 = 528.4 (kips)

Current CAPWAP Ru = 500.0 (kips); Corresponding J(RP)= 0.39; 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
11.8	36.23	450.5	503.5	503.5	0.81	0.10	0.10	20.6	540.1	2857

PILE PROFILE AND PILE MODEL

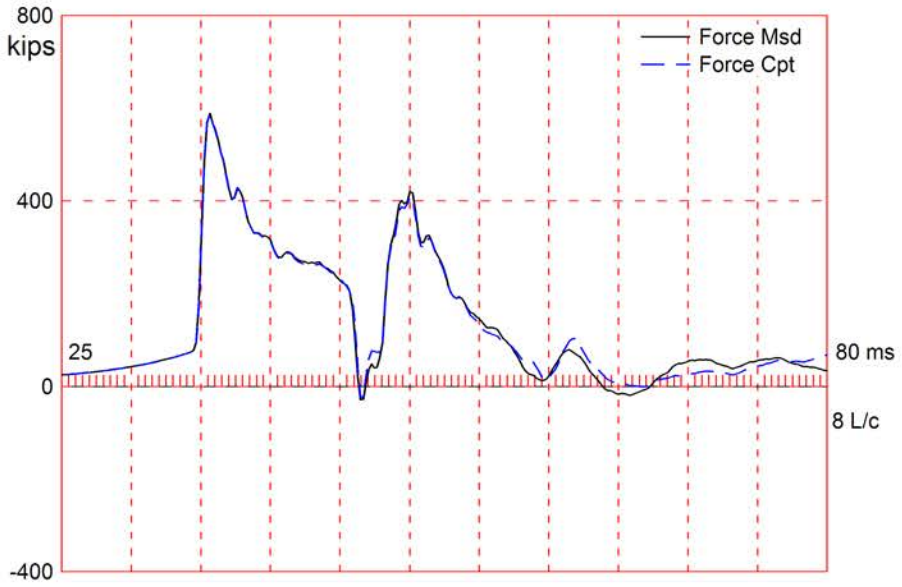
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.7	21.4	29992.2	492.000	4.70

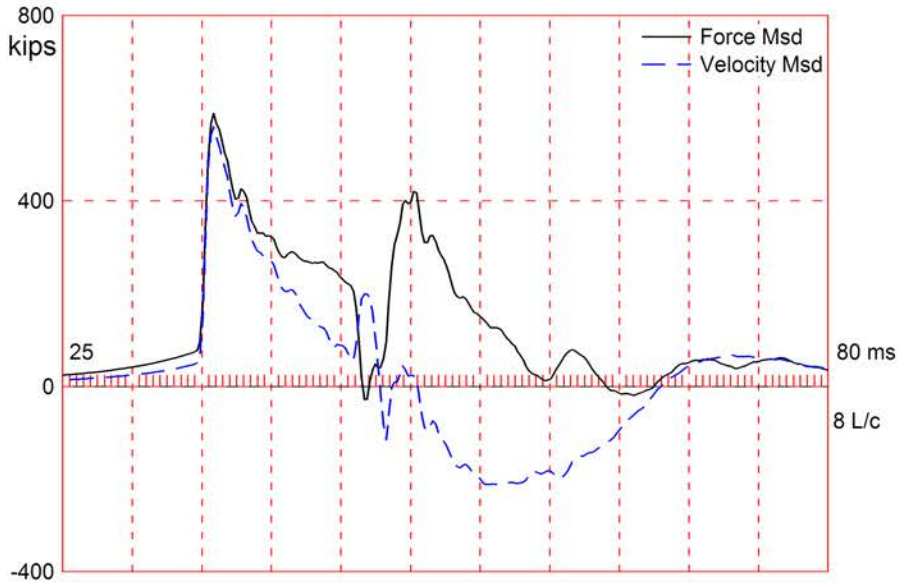
Toe Area 198.5 in^2

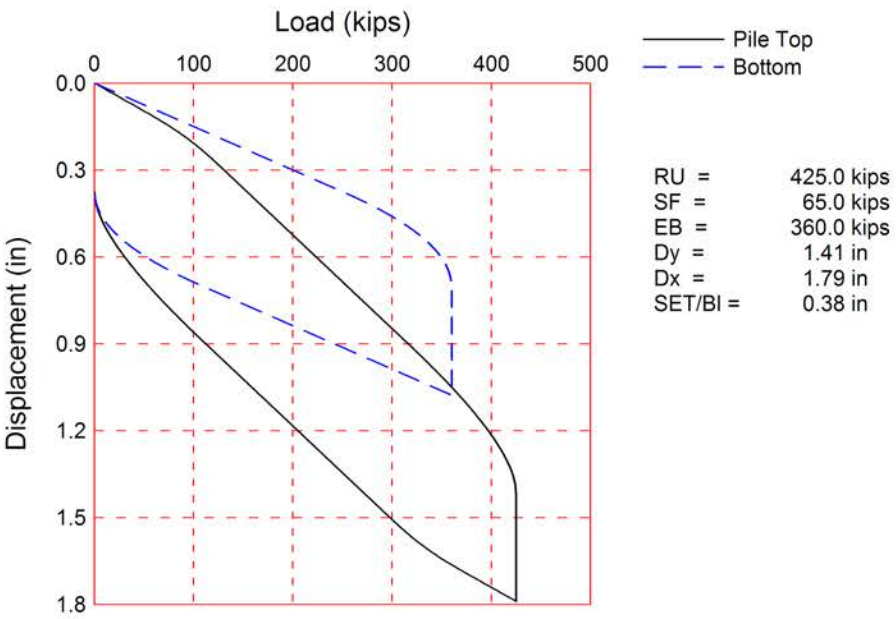
Top Segment Length 3.31 ft, Top Impedance 38 kips/ft/s

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 11.0 ms

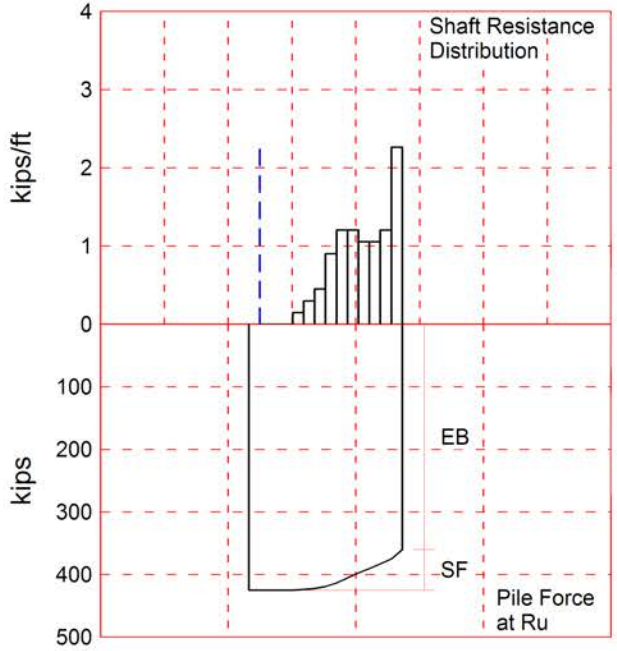
Total volume: 13.772 ft^3; Volume ratio considering added impedance: 1.000







RU =	425.0 kips
SF =	65.0 kips
EB =	360.0 kips
Dy =	1.41 in
Dx =	1.79 in
SET/Bl =	0.38 in



Length b. Sensors	92.7 ft
Embedment	82.9 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.	16808 ft/s
Match Quality	4.44
Top Compr. Stress	27.6 ksi
Max Compr. Stress	27.9 ksi
Max Tension Stress	-3.92 ksi
Avg. Shaft Quake	0.07 in
Toe Quake	0.54 in
Avg. Shaft Smith Dpg.	0.24 s/ft
Toe Smith Damping	0.07 s/ft

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CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 425.0; along Shaft 65.0; at Toe 360.0 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
				425.0				
1	13.2	3.5	0.0	425.0	0.0	0.00	0.00	0.00
2	19.9	10.1	0.0	425.0	0.0	0.00	0.00	0.00
3	26.5	16.7	0.0	425.0	0.0	0.00	0.00	0.00
4	33.1	23.3	1.0	424.0	1.0	0.15	0.03	0.24
5	39.7	30.0	2.0	422.0	3.0	0.30	0.06	0.24
6	46.3	36.6	3.0	419.0	6.0	0.45	0.10	0.24
7	53.0	43.2	6.0	413.0	12.0	0.91	0.19	0.24
8	59.6	49.8	8.0	405.0	20.0	1.21	0.26	0.24
9	66.2	56.4	8.0	397.0	28.0	1.21	0.26	0.24
10	72.8	63.0	7.0	390.0	35.0	1.06	0.23	0.24
11	79.4	69.7	7.0	383.0	42.0	1.06	0.23	0.24
12	86.1	76.3	8.0	375.0	50.0	1.21	0.26	0.24
13	92.7	82.9	15.0	360.0	65.0	2.27	0.48	0.24
Avg. Shaft			5.0			0.78	0.17	0.24
Toe			360.0				261.16	0.07

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.07	0.54
Case Damping Factor		0.41	0.66
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	32	30
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	87	
Resistance Gap (included in Toe Quake)	(in)		0.04
Soil Plug Weight	(kips)	0.020	0.025

CAPWAP match quality = 4.44 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.38 in; Blow Count = 32 b/ft
Computed: Final Set = 0.34 in; Blow Count = 36 b/ft

max. Top Comp. Stress = 27.6 ksi (T= 36.0 ms, max= 1.012 x Top)
max. Comp. Stress = 27.9 ksi (Z= 39.7 ft, T= 38.2 ms)
max. Tens. Stress = -3.92 ksi (Z= 46.3 ft, T= 67.1 ms)
max. Energy (EMX) = 29.3 kip-ft; max. Measured Top Displ. (DMX)= 1.09 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	590.0	-11.8	27.6	-0.55	29.3	14.6	1.08
2	6.6	590.4	-16.8	27.6	-0.78	29.2	14.6	1.07
4	13.2	591.3	-30.6	27.6	-1.43	29.0	14.6	1.05
6	19.9	592.3	-42.6	27.7	-1.99	28.7	14.5	1.02
8	26.5	593.5	-53.8	27.7	-2.51	28.3	14.5	0.99
10	33.1	596.2	-66.3	27.9	-3.10	27.8	14.4	0.95
12	39.7	597.2	-76.2	27.9	-3.56	27.1	14.2	0.91
14	46.3	596.2	-83.9	27.9	-3.92	26.0	14.0	0.87
15	49.6	589.7	-81.9	27.5	-3.83	25.1	13.8	0.85
16	53.0	594.6	-81.2	27.8	-3.79	24.8	13.6	0.82
17	56.3	577.1	-75.1	27.0	-3.51	23.2	13.4	0.80
18	59.6	582.5	-75.3	27.2	-3.52	22.9	13.3	0.78
19	62.9	556.9	-67.3	26.0	-3.14	21.0	13.0	0.75
20	66.2	562.2	-68.7	26.3	-3.21	20.7	12.9	0.73
21	69.5	543.0	-62.1	25.4	-2.90	18.9	12.8	0.71
22	72.8	548.3	-63.2	25.6	-2.95	18.5	13.8	0.68
23	76.1	518.5	-57.6	24.2	-2.69	17.0	13.6	0.66
24	79.4	520.9	-63.8	24.3	-2.98	16.6	14.1	0.64
25	82.7	499.4	-58.5	23.3	-2.73	15.1	15.7	0.61
26	86.1	468.2	-60.4	21.9	-2.82	14.7	16.8	0.59
27	89.4	422.4	-51.4	19.7	-2.40	13.1	17.7	0.57
28	92.7	434.2	-50.5	20.3	-2.36	11.3	17.5	0.54
Absolute	39.7			27.9			(T =	38.2 ms)
	46.3				-3.92		(T =	67.1 ms)

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	465.0	394.1	323.2	252.3	181.3	110.4	39.5	0.0	0.0	0.0
RX	571.7	548.2	524.7	501.1	477.6	460.1	449.3	439.0	428.8	418.6
RU	465.0	394.1	323.2	252.3	181.3	110.4	39.5	0.0	0.0	0.0

RAU = 355.1 (kips); RA2 = 462.8 (kips)

Current CAPWAP Ru = 425.0 (kips); Corresponding J(RP)= 0.06; J(RX) = 0.84

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
14.9	35.84	569.3	604.9	604.9	1.09	0.39	0.38	29.5	484.8	720

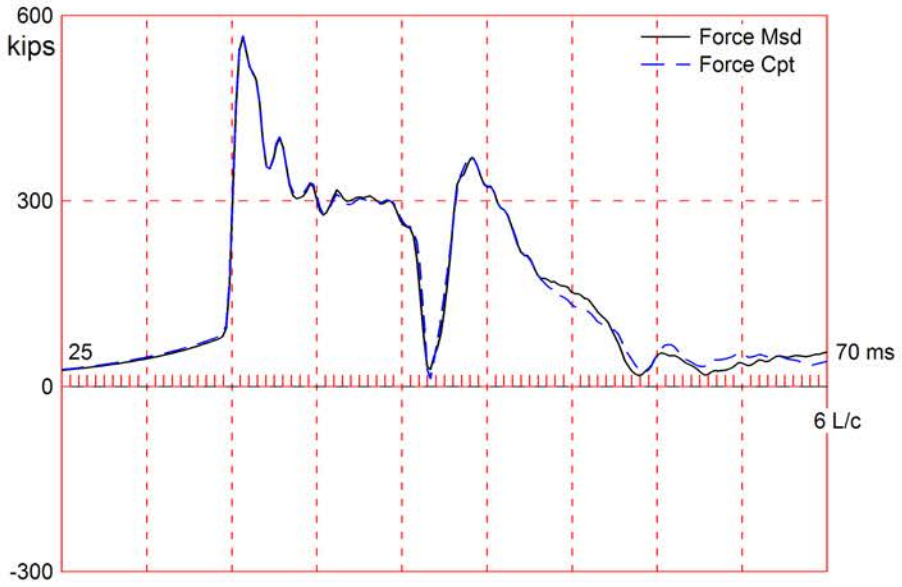
PILE PROFILE AND PILE MODEL

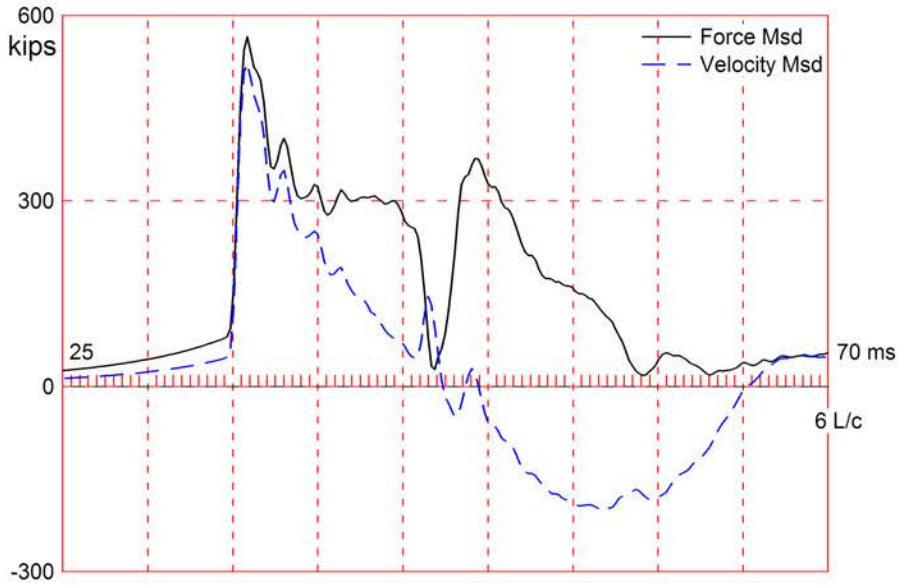
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.7	21.4	29992.2	492.000	4.70

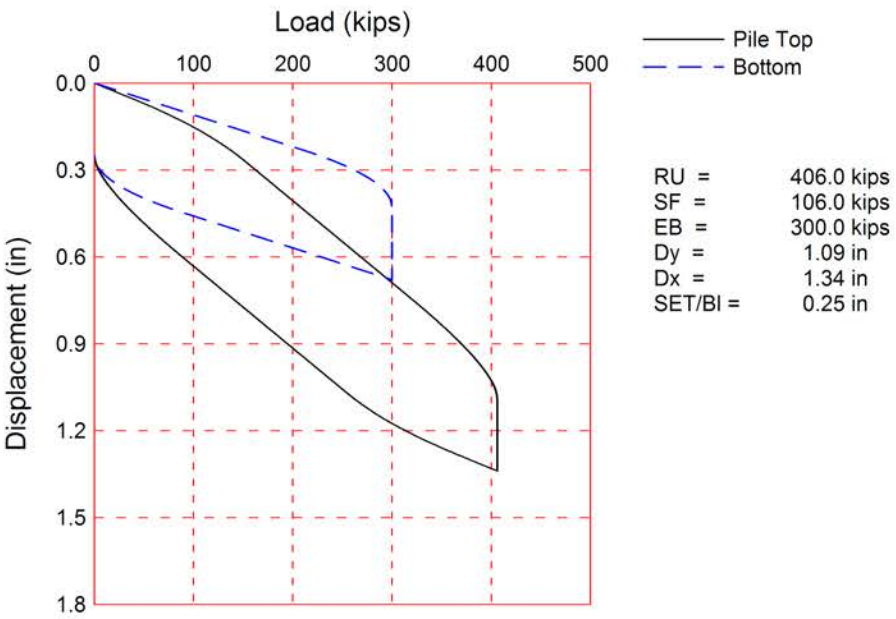
Toe Area 198.5 in^2

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	3.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
23	76.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.020
24	79.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
28	92.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

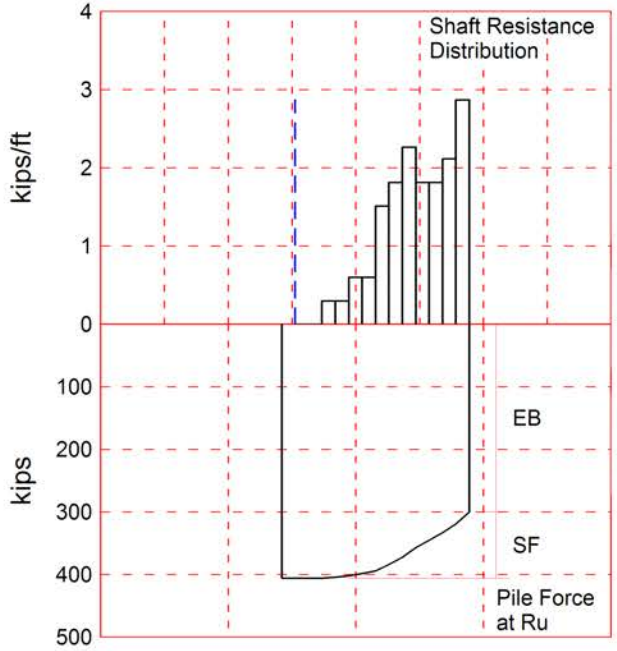
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.197 ms, 2L/c 11.0 ms
Total volume: 13.772 ft^3; Volume ratio considering added impedance: 1.000







RU =	406.0 kips
SF =	106.0 kips
EB =	300.0 kips
Dy =	1.09 in
Dx =	1.34 in
SET/Bl =	0.25 in



Length b. Sensors	92.7 ft
Embedment	83.1 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	3.19
Top Compr. Stress	26.5 ksi
Max Compr. Stress	27.0 ksi
Max Tension Stress	-2.66 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.33 in
Avg. Shaft Smith Dpg.	0.27 s/ft
Toe Smith Damping	0.08 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: 406.0; along Shaft 106.0; at Toe 300.0 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	Quake in
				406.0					
1	13.2	3.7	0.0	406.0	0.0	0.00	0.00	0.00	0.04
2	19.9	10.3	0.0	406.0	0.0	0.00	0.00	0.00	0.04
3	26.5	16.9	2.0	404.0	2.0	0.30	0.06	0.27	0.04
4	33.1	23.5	2.0	402.0	4.0	0.30	0.06	0.27	0.04
5	39.7	30.1	4.0	398.0	8.0	0.60	0.13	0.27	0.04
6	46.3	36.7	4.0	394.0	12.0	0.60	0.13	0.27	0.04
7	53.0	43.4	10.0	384.0	22.0	1.51	0.32	0.27	0.04
8	59.6	50.0	12.0	372.0	34.0	1.81	0.39	0.27	0.04
9	66.2	56.6	15.0	357.0	49.0	2.27	0.48	0.27	0.04
10	72.8	63.2	12.0	345.0	61.0	1.81	0.39	0.27	0.04
11	79.4	69.8	12.0	333.0	73.0	1.81	0.39	0.27	0.04
12	86.1	76.5	14.0	319.0	87.0	2.12	0.45	0.27	0.04
13	92.7	83.1	19.0	300.0	106.0	2.87	0.61	0.27	0.04
Avg. Shaft			8.2			1.28	0.27	0.27	0.04
Toe			300.0				217.63	0.08	0.33

Soil Model Parameters/Extensions		Shaft	Toe
Case Damping Factor		0.75	0.63
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	30	30
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	25	
Resistance Gap (included in Toe Quake)	(in)		0.07
Soil Plug Weight	(kips)	0.040	

CAPWAP match quality = 3.19 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.25 in; Blow Count = 48 b/ft
Computed: Final Set = 0.21 in; Blow Count = 57 b/ft

Transducer F1(F607) CAL: 93.6; RF: 1.00; F2(F590) CAL: 95.0; RF: 1.00
A1(K2524) CAL: 360; RF: 1.06; A2(K2253) CAL: 325; RF: 1.06

max. Top Comp. Stress = 26.5 ksi (T= 36.0 ms, max= 1.017 x Top)
max. Comp. Stress = 27.0 ksi (Z= 26.5 ft, T= 37.4 ms)
max. Tens. Stress = -2.66 ksi (Z= 79.4 ft, T= 64.4 ms)
max. Energy (EMX) = 25.0 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	3.3	567.6	-17.5	26.5	-0.82	25.0	13.6	0.91
2	6.6	568.3	-18.6	26.5	-0.87	25.0	13.6	0.90
4	13.2	569.9	-20.8	26.6	-0.97	24.8	13.5	0.87
6	19.9	572.2	-22.6	26.7	-1.06	24.3	13.4	0.84
8	26.5	577.4	-24.2	27.0	-1.13	23.8	13.3	0.80
10	33.1	574.0	-33.0	26.8	-1.54	22.8	13.1	0.76
12	39.7	573.3	-40.3	26.8	-1.88	21.8	12.9	0.71
14	46.3	565.3	-47.3	26.4	-2.21	20.5	12.6	0.67
15	49.6	557.8	-49.7	26.1	-2.32	19.5	12.3	0.64
16	53.0	565.3	-53.4	26.4	-2.49	19.1	12.1	0.62
17	56.3	534.5	-50.8	25.0	-2.38	17.3	11.8	0.59
18	59.6	542.9	-51.2	25.4	-2.39	16.9	11.5	0.57
19	62.9	507.2	-48.8	23.7	-2.28	15.0	11.2	0.55
20	66.2	518.7	-52.4	24.2	-2.45	14.6	10.9	0.53
21	69.5	476.6	-47.4	22.3	-2.21	12.5	10.7	0.50
22	72.8	484.1	-53.2	22.6	-2.49	12.2	11.7	0.48
23	76.1	442.5	-51.7	20.7	-2.42	10.5	11.1	0.46
24	79.4	444.0	-57.0	20.7	-2.66	10.2	11.4	0.44
25	82.7	409.5	-52.0	19.1	-2.43	8.6	13.7	0.42
26	86.1	388.3	-51.5	18.1	-2.41	8.4	14.6	0.40
27	89.4	362.7	-42.5	16.9	-1.99	6.7	15.5	0.38
28	92.7	372.0	-42.0	17.4	-1.96	5.3	14.8	0.36
Absolute	26.5			27.0			(T =	37.4 ms)
	79.4				-2.66		(T =	64.4 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	505.3	446.1	386.9	327.6	268.4	209.2	150.0	90.7	31.5	0.0
RX	540.5	520.0	499.5	478.9	458.4	437.9	424.0	414.7	405.7	397.6
RU	505.3	446.1	386.9	327.6	268.4	209.2	150.0	90.7	31.5	0.0

RAU = 332.8 (kips); RA2 = 449.3 (kips)

Current CAPWAP Ru = 406.0 (kips); Corresponding J(RP)= 0.17; J(RX) = 0.80

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
13.8	35.84	528.8	568.7	570.7	0.93	0.27	0.25	25.2	514.4	1154

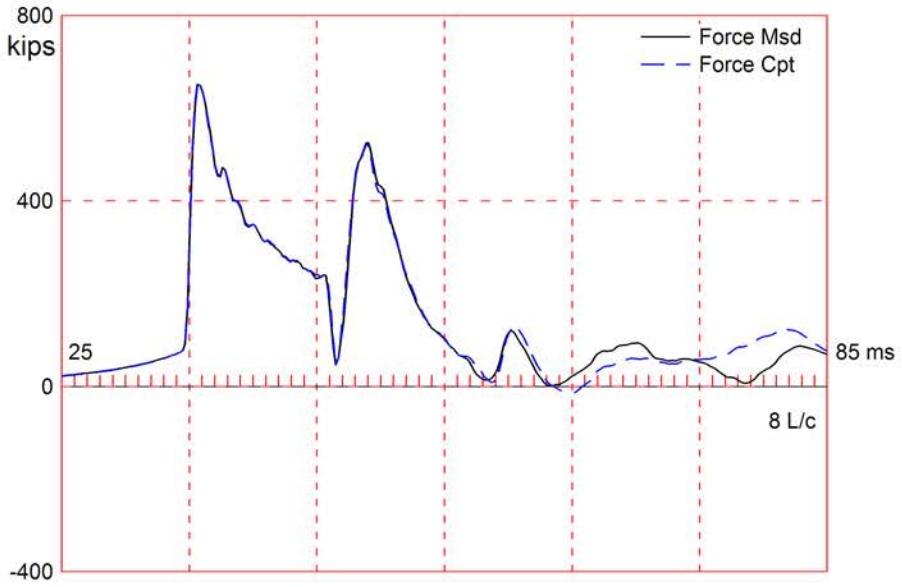
PILE PROFILE AND PILE MODEL

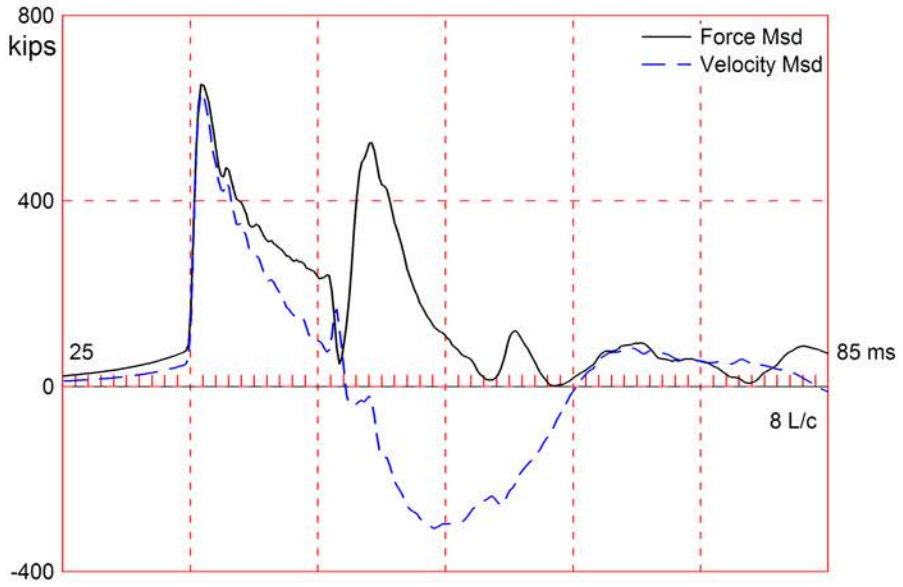
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.7	21.4	29992.2	492.000	4.70

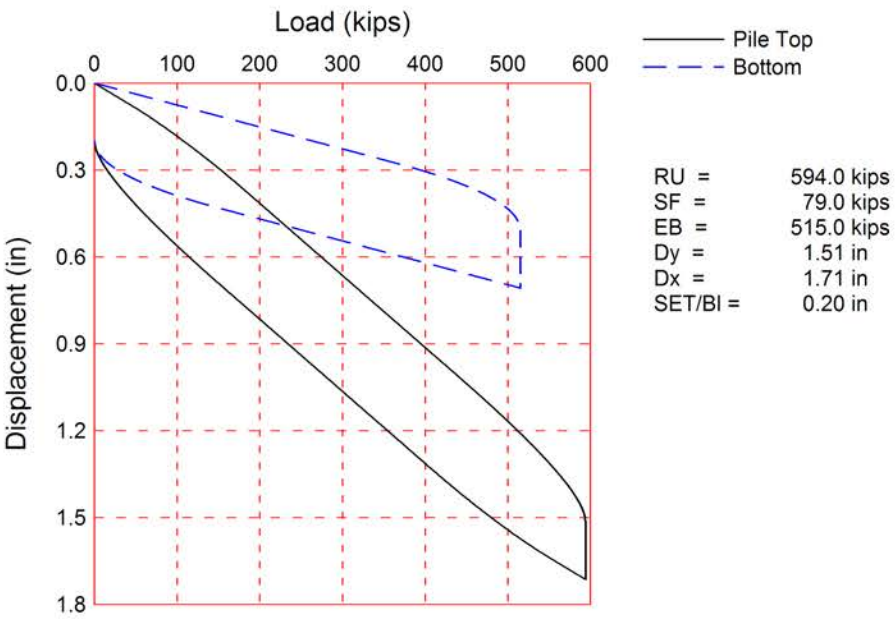
Toe Area 198.5 in^2

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	3.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
22	72.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
23	76.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.020
24	79.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
25	82.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
28	92.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

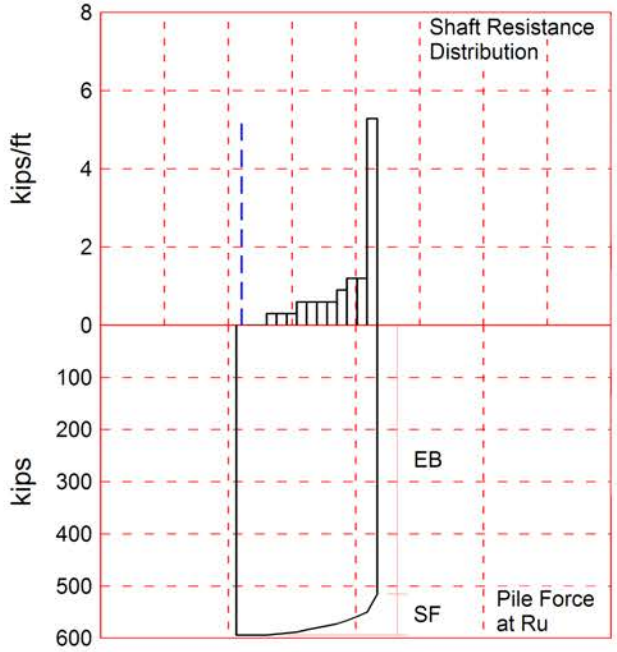
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.197 ms, 2L/c 11.0 ms
Total volume: 13.772 ft^3; Volume ratio considering added impedance: 1.000







RU =	594.0 kips
SF =	79.0 kips
EB =	515.0 kips
Dy =	1.51 in
Dx =	1.71 in
SET/Bl =	0.20 in



Length b. Sensors	92.7 ft
Embedment	88.0 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.	16808 ft/s
Match Quality	4.59
Top Compr. Stress	30.8 ksi
Max Compr. Stress	31.1 ksi
Max Tension Stress	-6.14 ksi
Avg. Shaft Quake	0.06 in
Toe Quake	0.39 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.

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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.

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CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 594.0; along Shaft 79.0; at Toe 515.0 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
				594.0				
1	13.2	8.5	0.0	594.0	0.0	0.00	0.00	0.00
2	19.9	15.1	0.0	594.0	0.0	0.00	0.00	0.00
3	26.5	21.8	2.0	592.0	2.0	0.30	0.06	0.28
4	33.1	28.4	2.0	590.0	4.0	0.30	0.06	0.28
5	39.7	35.0	2.0	588.0	6.0	0.30	0.06	0.28
6	46.3	41.6	4.0	584.0	10.0	0.60	0.13	0.28
7	53.0	48.2	4.0	580.0	14.0	0.60	0.13	0.28
8	59.6	54.9	4.0	576.0	18.0	0.60	0.13	0.28
9	66.2	61.5	4.0	572.0	22.0	0.60	0.13	0.28
10	72.8	68.1	6.0	566.0	28.0	0.91	0.19	0.28
11	79.4	74.7	8.0	558.0	36.0	1.21	0.26	0.28
12	86.1	81.3	8.0	550.0	44.0	1.21	0.26	0.28
13	92.7	88.0	35.0	515.0	79.0	5.29	1.13	0.28
Avg. Shaft			6.1			0.90	0.19	0.28
Toe			515.0				373.60	0.07

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.06	0.39
Case Damping Factor		0.58	0.94
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	70	30
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	47	
Resistance Gap (included in Toe Quake)	(in)		0.06
Soil Plug Weight	(kips)	0.010	0.019

CAPWAP match quality = 4.59 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.20 in; Blow Count = 60 b/ft
Computed: Final Set = 0.16 in; Blow Count = 75 b/ft
Transducer F1(F607) CAL: 93.6; RF: 1.00; F2(F590) CAL: 95.0; RF: 1.00
A1(K2524) CAL: 360; RF: 1.04; A2(K2253) CAL: 325; RF: 1.04

max. Top Comp. Stress = 30.8 ksi (T= 36.0 ms, max= 1.011 x Top)
max. Comp. Stress = 31.1 ksi (Z= 26.5 ft, T= 37.6 ms)
max. Tens. Stress = -6.14 ksi (Z= 53.0 ft, T= 62.4 ms)
max. Energy (EMX) = 36.3 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	3.3	658.4	-33.1	30.8	-1.55	36.3	16.4	1.13
2	6.6	658.6	-38.2	30.8	-1.79	36.2	16.4	1.12
4	13.2	659.0	-61.3	30.8	-2.86	35.7	16.3	1.08
6	19.9	660.2	-80.7	30.8	-3.77	35.2	16.2	1.04
8	26.5	665.8	-84.0	31.1	-3.93	34.5	16.0	1.00
10	33.1	660.5	-83.8	30.9	-3.92	33.2	15.9	0.95
12	39.7	656.9	-84.1	30.7	-3.93	31.8	15.7	0.90
14	46.3	655.6	-113.1	30.6	-5.28	30.3	15.4	0.85
15	49.6	639.2	-122.4	29.9	-5.72	28.7	15.3	0.82
16	53.0	643.7	-131.4	30.1	-6.14	28.1	15.1	0.79
17	56.3	627.6	-129.7	29.3	-6.06	26.6	15.0	0.76
18	59.6	632.0	-130.6	29.5	-6.10	25.9	14.9	0.73
19	62.9	616.0	-127.4	28.8	-5.95	24.4	14.8	0.70
20	66.2	622.9	-127.9	29.1	-5.98	23.7	14.6	0.67
21	69.5	613.5	-124.3	28.7	-5.81	22.2	14.3	0.63
22	72.8	617.5	-124.5	28.8	-5.81	21.4	14.2	0.60
23	76.1	592.2	-118.4	27.7	-5.53	19.5	14.1	0.56
24	79.4	599.5	-119.1	28.0	-5.56	18.7	14.1	0.53
25	82.7	578.6	-111.3	27.0	-5.20	16.6	15.6	0.50
26	86.1	610.1	-111.5	28.5	-5.21	15.8	16.9	0.46
27	89.4	615.1	-103.5	28.7	-4.84	13.9	17.3	0.43
28	92.7	629.6	-103.7	29.4	-4.84	10.3	15.7	0.39
Absolute	26.5			31.1			(T =	37.6 ms)
	53.0				-6.14		(T =	62.4 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	645.2	513.3	381.5	249.6	117.7					
RX	732.8	693.7	654.5	620.8	603.3	586.6	571.9	558.8	551.6	545.3
RU	645.2	513.3	381.5	249.6	117.7					

RAU = 438.5 (kips); RA2 = 619.1 (kips)

Current CAPWAP Ru = 594.0 (kips); Corresponding J(RP)= 0.08; J(RX) = 0.91

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
16.8	35.84	641.8	662.7	662.7	1.14	0.21	0.20	36.4	651.9	1561

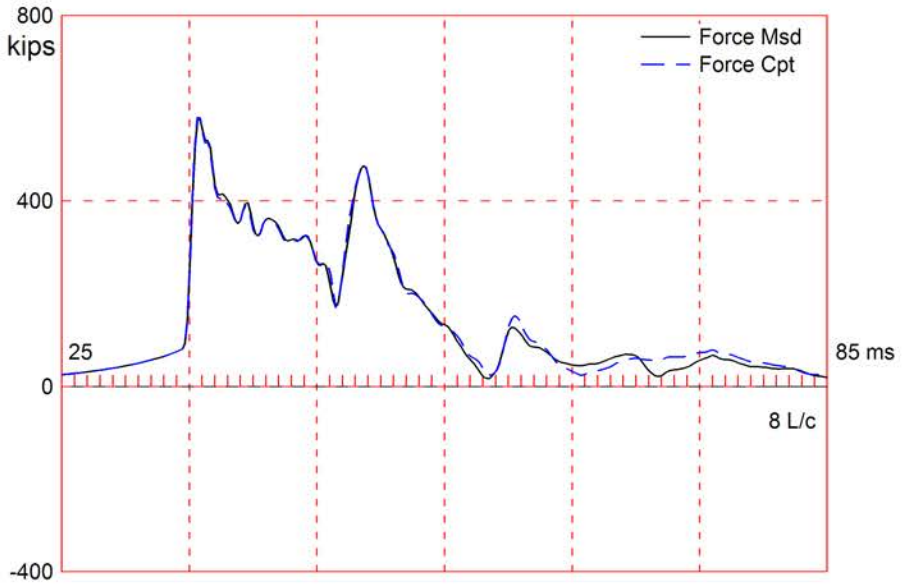
PILE PROFILE AND PILE MODEL

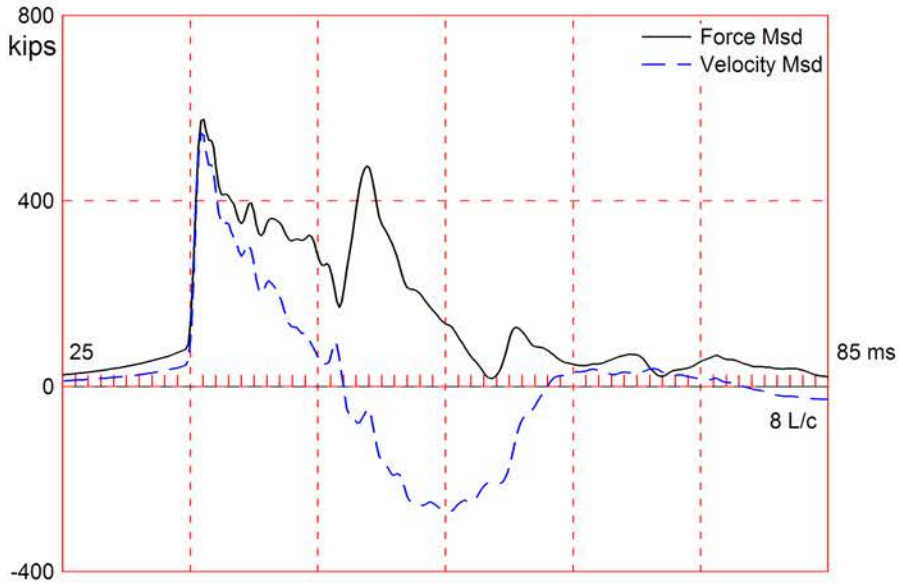
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.7	21.4	29992.2	492.000	4.70

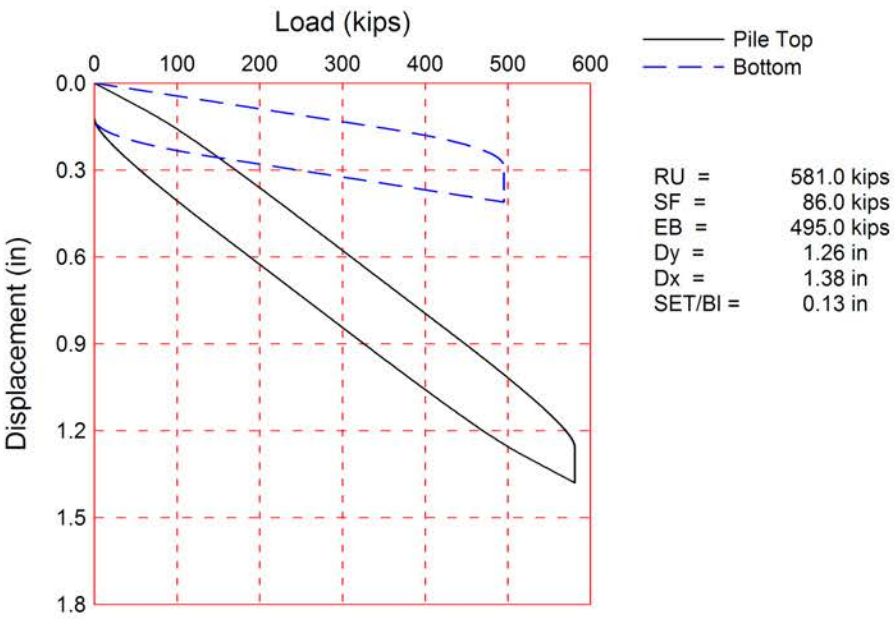
Toe Area 198.5 in^2

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	3.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
23	76.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
24	79.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
28	92.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

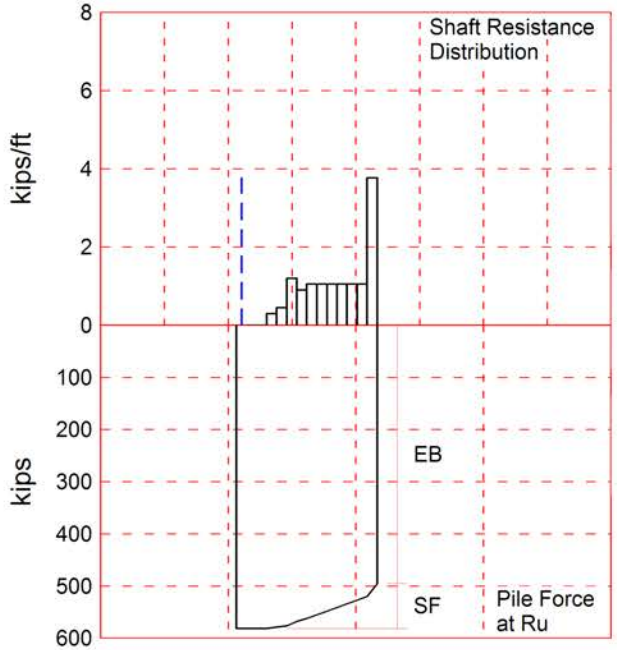
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.197 ms, 2L/c 11.0 ms
Total volume: 13.772 ft^3; Volume ratio considering added impedance: 1.000







RU =	581.0 kips
SF =	86.0 kips
EB =	495.0 kips
Dy =	1.26 in
Dx =	1.38 in
SET/Bl =	0.13 in



Length b. Sensors	92.7 ft
Embedment	88.0 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.	16808 ft/s
Match Quality	2.82
Top Compr. Stress	27.1 ksi
Max Compr. Stress	27.8 ksi
Max Tension Stress	-4.44 ksi
Avg. Shaft Quake	0.06 in
Toe Quake	0.22 in
Avg. Shaft Smith Dpg.	0.35 s/ft
Toe Smith Damping	0.08 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 86.0; at Toe 495.0 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	13.2	8.6	0.0	581.0	0.0	0.00	0.00	0.00
2	19.9	15.2	0.0	581.0	0.0	0.00	0.00	0.00
3	26.5	21.8	2.0	579.0	2.0	0.30	0.06	0.35
4	33.1	28.4	3.0	576.0	5.0	0.45	0.10	0.35
5	39.7	35.0	8.0	568.0	13.0	1.21	0.26	0.35
6	46.3	41.7	6.0	562.0	19.0	0.91	0.19	0.35
7	53.0	48.3	7.0	555.0	26.0	1.06	0.23	0.35
8	59.6	54.9	7.0	548.0	33.0	1.06	0.23	0.35
9	66.2	61.5	7.0	541.0	40.0	1.06	0.23	0.35
10	72.8	68.1	7.0	534.0	47.0	1.06	0.23	0.35
11	79.4	74.8	7.0	527.0	54.0	1.06	0.23	0.35
12	86.1	81.4	7.0	520.0	61.0	1.06	0.23	0.35
13	92.7	88.0	25.0	495.0	86.0	3.78	0.80	0.35
Avg. Shaft			6.6			0.98	0.21	0.35
Toe			495.0				359.09	0.08

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.06	0.22
Case Damping Factor		0.79	1.04
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	30	30
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	25	
Resistance Gap (included in Toe Quake)	(in)		0.03
Soil Plug Weight	(kips)	0.040	0.019

CAPWAP match quality = 2.82 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.13 in; Blow Count = 96 b/ft
Computed: Final Set = 0.09 in; Blow Count = 138 b/ft

max. Top Comp. Stress = 27.1 ksi (T= 36.0 ms, max= 1.024 x Top)
max. Comp. Stress = 27.8 ksi (Z= 39.7 ft, T= 38.4 ms)
max. Tens. Stress = -4.44 ksi (Z= 59.6 ft, T= 62.4 ms)
max. Energy (EMX) = 29.6 kip-ft; max. Measured Top Displ. (DMX)= 0.97 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	580.5	-17.8	27.1	-0.83	29.6	14.1	0.97
2	6.6	581.2	-17.9	27.2	-0.83	29.4	14.1	0.95
4	13.2	583.2	-18.0	27.2	-0.84	28.9	14.0	0.91
6	19.9	586.7	-18.1	27.4	-0.85	28.4	13.9	0.87
8	26.5	593.8	-23.7	27.7	-1.11	27.6	13.7	0.83
10	33.1	594.1	-49.2	27.8	-2.30	26.1	13.4	0.77
12	39.7	594.1	-71.6	27.8	-3.34	24.5	13.0	0.72
14	46.3	564.5	-79.4	26.4	-3.71	21.8	12.6	0.66
15	49.6	540.9	-81.1	25.3	-3.79	20.0	12.3	0.63
16	53.0	549.9	-88.5	25.7	-4.13	19.4	12.1	0.60
17	56.3	523.5	-90.5	24.5	-4.23	17.5	11.8	0.57
18	59.6	531.7	-95.0	24.8	-4.44	16.8	11.6	0.54
19	62.9	519.4	-91.0	24.3	-4.25	15.1	11.4	0.51
20	66.2	521.8	-91.8	24.4	-4.29	14.6	11.1	0.48
21	69.5	521.7	-87.2	24.4	-4.08	13.0	10.7	0.45
22	72.8	539.9	-88.1	25.2	-4.12	12.3	10.6	0.41
23	76.1	539.8	-84.0	25.2	-3.92	10.8	10.5	0.38
24	79.4	544.4	-84.7	25.4	-3.96	10.1	10.4	0.35
25	82.7	539.9	-79.7	25.2	-3.72	8.7	10.9	0.32
26	86.1	540.1	-80.1	25.2	-3.74	8.0	11.6	0.28
27	89.4	534.4	-75.1	25.0	-3.51	6.7	12.0	0.25
28	92.7	569.2	-75.2	26.6	-3.51	5.4	10.5	0.22
Absolute	39.7			27.8			(T =	38.4 ms)
	59.6				-4.44		(T =	62.4 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	652.9	604.0	555.0	506.1	457.2	408.3	359.4	310.5	261.6	212.7
RX	703.9	674.5	645.0	617.7	600.1	588.2	576.6	565.0	553.4	541.8
RU	652.9	604.0	555.0	506.1	457.2	408.3	359.4	310.5	261.6	212.7

RAU = 364.0 (kips); RA2 = 582.0 (kips)

Current CAPWAP Ru = 581.0 (kips); Corresponding J(RP)= 0.15; J(RX) = 0.56

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
14.6	35.84	556.3	585.6	585.6	0.97	0.13	0.13	29.8	650.9	2605

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
92.7	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	3.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
22	72.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
23	76.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.020
24	79.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
25	82.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
28	92.7	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 11.0 ms
Total volume: 13.772 ft^3; Volume ratio considering added impedance: 1.000