GRL Engineers, Inc.

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TRANSMITTAL

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

RE: Dynamic Testing Results – USH 10 over Little Lake Butte des Morts
Structure B-70-403 - Pier 8
Winnebago County, Wisconsin

On February 3, 2014, Pier 8 #1, Pier 8 #36, and Pier 8 #44 at the above structure were dynamically tested during initial driving. The piles were tested during restrike on February 4. 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 740.7. We understand the pier was excavated to approximately EL 718. The piles have a required minimum tip elevation of EL 664.0. 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 8 #1 was driven to a depth of 83.5 feet, which corresponds to a pile tip elevation of EL 657.3. The blow count over the final increment of driving was 10 blows for 1⅞ inches of penetration at an average hammer stroke of 7.7 feet. The blow count at the beginning of restrike was 5 blows for ⅝ inch of penetration at an average hammer stroke of 7.5 feet.

Pier 8 #36 was driven to a depth of 81.3 feet, which corresponds to a pile tip elevation of EL 659.5. The blow count over the final increment of driving was 10 blows for 2 inches of penetration at an average hammer stroke of 7.0 feet. The blow count at the beginning of restrike was 5 blows for ⅝ inches of penetration at an average hammer stroke of 6.8 feet

Pier 8 #44 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 1⅛ inches of penetration at an average hammer stroke of 7.7 feet. The blow count at the beginning of restrike was 5 blows per ¼ inch of penetration at an average hammer stroke of 7.2 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 8 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)
6.0	16	8
6.5	12	6
7.0	9	6
7.5	8	5
8.0	7	4
8.5	6	4

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 or greater, 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:

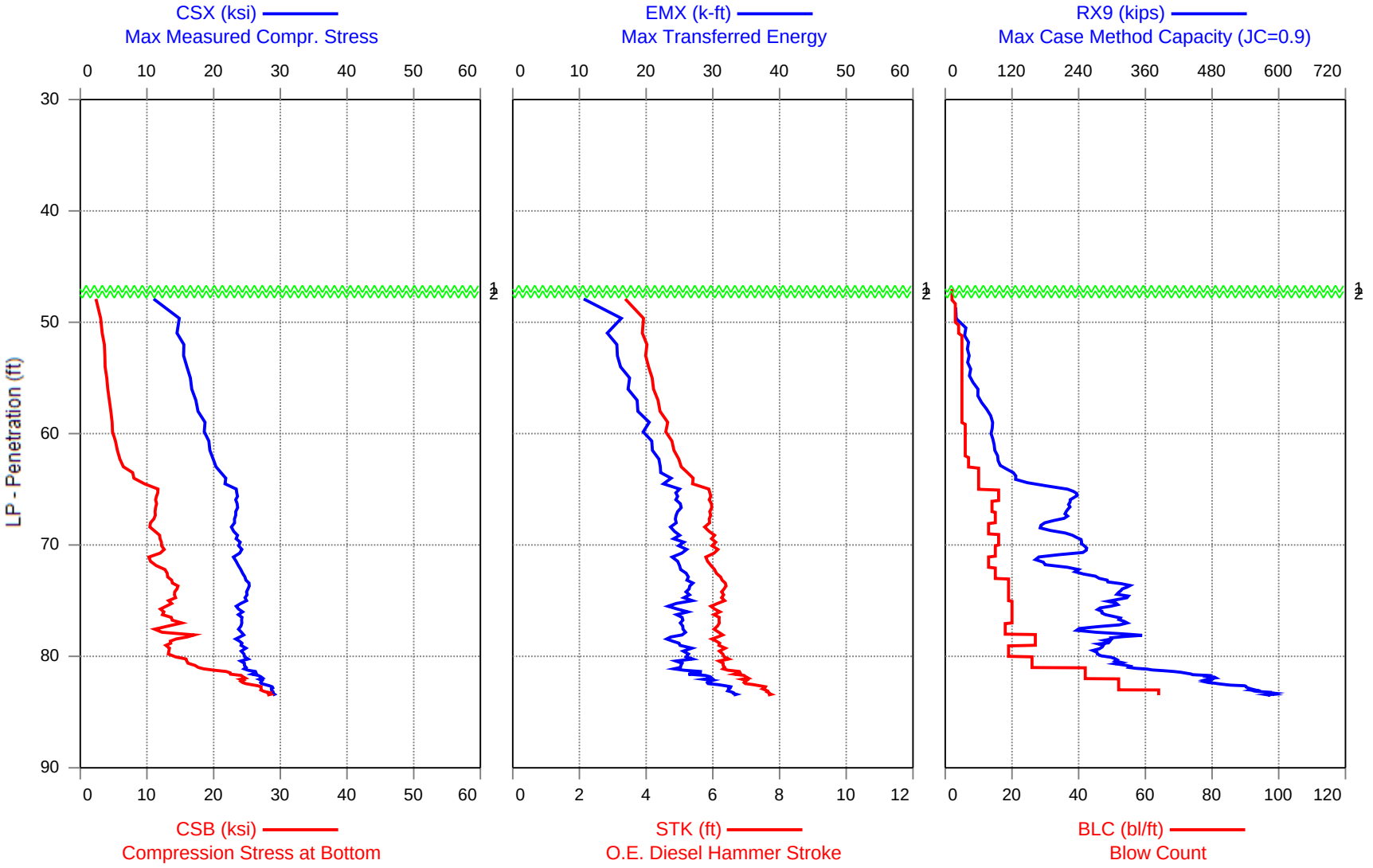
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 03-February-2015

Test started: 03-February-2015

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #1

APE D30-42, HP 14 x 73



1 - Reported Reference EL 740.8

2 - Mud Line at EL 718.2

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #1 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 94.16 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
22	47.00	2	AV1	10.0	2.3	9	3.2	64.0	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	10.0	2.3	9	3.2	64.0	0
			MIN	10.0	2.3	9	3.2	64.0	0
23	47.50	2	AV1	9.0	1.9	8	3.1	65.1	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	9.0	1.9	8	3.1	65.1	0
			MIN	9.0	1.9	8	3.1	65.1	0
24	48.00	2	AV1	11.3	2.3	11	3.4	62.7	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	11.3	2.3	11	3.4	62.7	0
			MIN	11.3	2.3	11	3.4	62.7	0
25	48.33	3	AV1	13.5	2.8	14	3.7	60.4	22
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	13.5	2.8	14	3.7	60.4	22
			MIN	13.5	2.8	14	3.7	60.4	22
26	48.67	3	AV1	11.2	2.5	11	3.5	62.0	9
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	11.2	2.5	11	3.5	62.0	9
			MIN	11.2	2.5	11	3.5	62.0	9
27	49.00	3	AV1	13.2	2.5	14	3.8	59.2	25
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	13.2	2.5	14	3.8	59.2	25
			MIN	13.2	2.5	14	3.8	59.2	25
28	49.33	3	AV1	14.4	3.1	17	3.9	58.6	13
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	14.4	3.1	17	3.9	58.6	13
			MIN	14.4	3.1	17	3.9	58.6	13
29	49.67	3	AV1	15.7	3.2	18	4.0	58.2	12
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	15.7	3.2	18	4.0	58.2	12
			MIN	15.7	3.2	18	4.0	58.2	12
30	50.00	3	AV1	15.2	3.1	17	3.9	58.8	34
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	15.2	3.1	17	3.9	58.8	34
			MIN	15.2	3.1	17	3.9	58.8	34
31	50.25	4	AV1	15.7	3.5	17	4.0	58.1	39
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	15.7	3.5	17	4.0	58.1	39
			MIN	15.7	3.5	17	4.0	58.1	39
32	50.50	4	AV1	15.4	3.4	16	3.9	58.4	38
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	15.4	3.4	16	3.9	58.4	38
			MIN	15.4	3.4	16	3.9	58.4	38
33	50.75	4	AV1	14.9	3.3	15	4.0	57.9	34

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #1 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	14.9	3.3	15	4.0	57.9	34
			MIN	14.9	3.3	15	4.0	57.9	34
34	51.00	4	AV1	14.7	3.3	14	4.0	58.2	37
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	14.7	3.3	14	4.0	58.2	37
			MIN	14.7	3.3	14	4.0	58.2	37
35	51.20	5	AV1	13.6	3.2	12	3.7	60.1	34
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	13.6	3.2	12	3.7	60.1	34
			MIN	13.6	3.2	12	3.7	60.1	34
36	51.40	5	AV1	13.9	3.2	13	3.8	59.6	34
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	13.9	3.2	13	3.8	59.6	34
			MIN	13.9	3.2	13	3.8	59.6	34
39	52.00	5	AV3	15.8	3.7	16	4.1	57.5	42
			STD	0.7	0.2	1	0.2	1.2	3
			MAX	16.6	3.9	17	4.3	59.1	45
			MIN	14.8	3.4	15	3.8	56.3	38
44	53.00	5	AV5	15.5	3.7	16	4.0	58.2	42
			STD	0.6	0.2	1	0.1	0.8	4
			MAX	16.3	3.9	17	4.1	59.3	49
			MIN	14.7	3.3	14	3.8	57.2	38
49	54.00	5	AV5	15.7	3.7	16	4.0	57.9	40
			STD	0.5	0.1	1	0.1	0.5	2
			MAX	16.3	3.8	16	4.1	58.9	41
			MIN	14.9	3.6	15	3.9	57.3	38
54	55.00	5	AV5	16.2	3.9	17	4.1	57.2	45
			STD	0.4	0.1	1	0.1	0.4	4
			MAX	16.7	4.0	18	4.2	57.8	52
			MIN	15.6	3.8	16	4.0	56.6	41
59	56.00	5	AV5	16.8	4.1	18	4.2	56.5	54
			STD	0.6	0.1	1	0.1	0.6	5
			MAX	17.7	4.3	18	4.4	57.6	63
			MIN	15.9	4.0	16	4.1	55.6	48
64	57.00	5	AV5	17.0	4.2	18	4.3	56.2	59
			STD	0.4	0.1	1	0.1	0.5	5
			MAX	17.6	4.4	19	4.4	56.8	66
			MIN	16.5	4.1	17	4.2	55.3	52
69	58.00	5	AV5	17.5	4.5	18	4.4	55.6	72
			STD	0.5	0.1	1	0.1	0.6	5
			MAX	18.2	4.7	19	4.5	56.4	82
			MIN	16.8	4.4	17	4.3	54.9	68
74	59.00	5	AV5	18.2	4.7	20	4.5	54.7	83
			STD	0.4	0.2	1	0.1	0.5	2
			MAX	18.7	4.9	20	4.6	55.4	85
			MIN	17.9	4.4	19	4.4	54.1	78
80	60.00	6	AV6	18.7	4.8	20	4.6	54.2	84
			STD	0.5	0.2	1	0.1	0.6	2
			MAX	19.4	5.2	21	4.8	55.1	87
			MIN	18.0	4.6	19	4.5	53.5	82

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #1 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
86	61.00	6	AV6	19.2	5.2	21	4.7	53.6	86
			STD	0.4	0.1	1	0.1	0.5	3
			MAX	19.8	5.4	22	4.9	54.3	90
			MIN	18.6	4.9	19	4.6	52.9	83
92	62.00	6	AV6	19.4	5.6	21	4.8	53.2	90
			STD	0.5	0.2	1	0.1	0.6	3
			MAX	20.1	5.9	23	5.0	54.1	93
			MIN	18.5	5.3	19	4.6	52.1	85
99	63.00	7	AV7	20.2	6.2	22	5.0	52.1	97
			STD	0.3	0.2	1	0.1	0.3	4
			MAX	20.6	6.5	23	5.1	52.7	102
			MIN	19.6	5.9	21	4.9	51.7	89
109	64.00	10	AV10	21.2	7.7	23	5.3	51.0	121
			STD	0.7	0.8	1	0.2	0.9	8
			MAX	22.4	8.8	25	5.6	52.4	130
			MIN	20.2	6.5	21	5.0	49.6	103
119	65.00	10	AV10	22.2	9.8	23	5.5	49.9	168
			STD	1.0	1.5	2	0.3	1.2	34
			MAX	23.7	11.8	26	6.0	51.6	226
			MIN	20.7	7.8	20	5.1	48.0	124
135	66.00	16	AV16	23.4	11.5	25	5.9	48.3	231
			STD	0.3	0.2	1	0.1	0.3	6
			MAX	24.3	11.9	26	6.1	49.1	240
			MIN	22.7	10.9	23	5.7	47.7	223
149	67.00	14	AV14	23.5	11.4	25	6.0	48.1	222
			STD	0.2	0.2	1	0.1	0.2	4
			MAX	23.9	11.6	26	6.1	48.6	229
			MIN	23.1	11.1	24	5.8	47.7	213
164	68.00	15	AV15	23.2	11.0	24	5.9	48.3	207
			STD	0.5	0.3	1	0.1	0.5	16
			MAX	24.2	11.4	26	6.1	49.2	222
			MIN	22.4	10.3	23	5.7	47.4	176
177	69.00	13	AV13	23.0	10.8	24	5.9	48.5	187
			STD	0.5	0.5	1	0.1	0.6	18
			MAX	23.8	11.7	25	6.1	49.4	218
			MIN	22.0	10.3	23	5.6	47.6	166
193	70.00	16	AV16	23.7	12.1	25	6.0	47.9	241
			STD	0.4	0.2	1	0.1	0.4	7
			MAX	24.5	12.5	27	6.2	49.0	253
			MIN	22.6	11.7	23	5.7	47.1	226
208	71.00	15	AV15	23.9	12.1	25	6.0	47.8	237
			STD	0.5	0.7	1	0.1	0.5	26
			MAX	24.7	12.8	27	6.3	48.9	261
			MIN	22.7	10.5	24	5.8	46.9	173
221	72.00	13	AV13	23.4	10.7	25	5.9	48.5	178
			STD	0.6	0.7	1	0.2	0.7	19
			MAX	24.2	12.1	26	6.1	49.7	228
			MIN	22.2	9.9	23	5.6	47.6	158
236	73.00	15	AV15	24.4	12.9	26	6.1	47.5	250
			STD	0.4	0.4	1	0.1	0.4	18

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #1 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			MAX	25.2	14.0	28	6.4	48.0	282
			MIN	23.9	12.3	24	6.0	46.6	220
255	74.00	19	AV19	25.1	14.2	26	6.3	46.7	311
			STD	0.3	0.6	1	0.1	0.3	19
			MAX	25.5	14.9	27	6.5	47.4	340
			MIN	24.4	12.9	25	6.1	46.3	283
274	75.00	19	AV19	24.9	14.1	26	6.3	46.8	316
			STD	0.4	0.5	1	0.1	0.5	10
			MAX	26.1	14.8	29	6.7	47.7	331
			MIN	24.2	13.1	25	6.1	45.6	293
294	76.00	20	AV20	23.9	12.8	25	6.1	47.6	292
			STD	0.6	0.7	2	0.2	0.6	15
			MAX	25.0	14.4	28	6.4	48.5	320
			MIN	22.8	11.5	22	5.9	46.5	268
314	77.00	20	AV20	24.1	13.5	25	6.1	47.4	306
			STD	0.5	1.2	1	0.1	0.5	17
			MAX	25.2	15.9	27	6.5	48.4	329
			MIN	23.1	11.5	23	5.9	46.2	275
332	78.00	18	AV18	24.1	12.6	26	6.1	47.4	275
			STD	0.5	1.4	1	0.1	0.5	32
			MAX	24.6	15.3	28	6.3	48.3	325
			MIN	23.2	11.0	24	5.9	46.8	227
359	79.00	27	AV27	23.9	14.6	24	6.1	47.5	303
			STD	0.7	1.8	1	0.2	0.7	26
			MAX	25.6	18.2	28	6.6	48.9	358
			MIN	22.6	11.7	21	5.8	45.9	271
378	80.00	19	AV19	24.5	13.3	26	6.3	46.9	276
			STD	0.5	0.2	1	0.1	0.5	6
			MAX	25.2	13.9	28	6.5	48.2	284
			MIN	23.2	12.9	24	5.9	46.2	259
404	81.00	26	AV26	24.6	16.2	26	6.3	46.8	313
			STD	0.9	0.9	2	0.2	0.9	11
			MAX	26.0	18.2	28	6.7	48.9	337
			MIN	22.5	14.3	22	5.8	45.5	293
446	82.00	42	AV42	26.1	22.1	28	6.7	45.4	427
			STD	1.1	2.3	2	0.3	1.0	47
			MAX	27.8	25.2	31	7.4	48.1	492
			MIN	23.3	17.5	22	6.0	43.5	341
498	83.00	52	AV52	27.8	25.6	31	7.2	43.9	508
			STD	0.9	1.4	2	0.3	0.9	34
			MAX	29.8	28.0	35	7.9	45.7	564
			MIN	26.0	23.3	27	6.6	42.1	458
520	83.34	64	AV22	28.9	27.8	33	7.6	42.7	572
			STD	0.4	0.7	1	0.2	0.4	15
			MAX	29.3	28.9	34	7.9	43.7	598
			MIN	27.7	26.4	30	7.3	42.1	544
530	83.50	64	AV9	28.9	28.3	33	7.7	42.6	586
			STD	0.4	0.4	1	0.1	0.4	7
			MAX	29.5	28.8	34	7.9	43.1	598
			MIN	28.3	27.7	32	7.5	41.9	577
			Average	23.7	14.5	25	6.1	48.1	287

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #1 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			Std. Dev.	3.6	7.0	4	0.9	4.1	149
			Maximum	29.8	28.9	35	7.9	65.1	598
			Minimum	9.0	1.9	8	3.1	41.9	0

Total number of blows analyzed: 508

BL# Sensors

1-530 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.10); A4: [K2524] 360.0 (1.10)

BL# Comments

22 Reported Reference EL 740.8
23 Mud Line at EL 718.2

Time Summary

Drive 12 minutes 14 seconds 12:31 PM - 12:43 PM BN 1 - 530

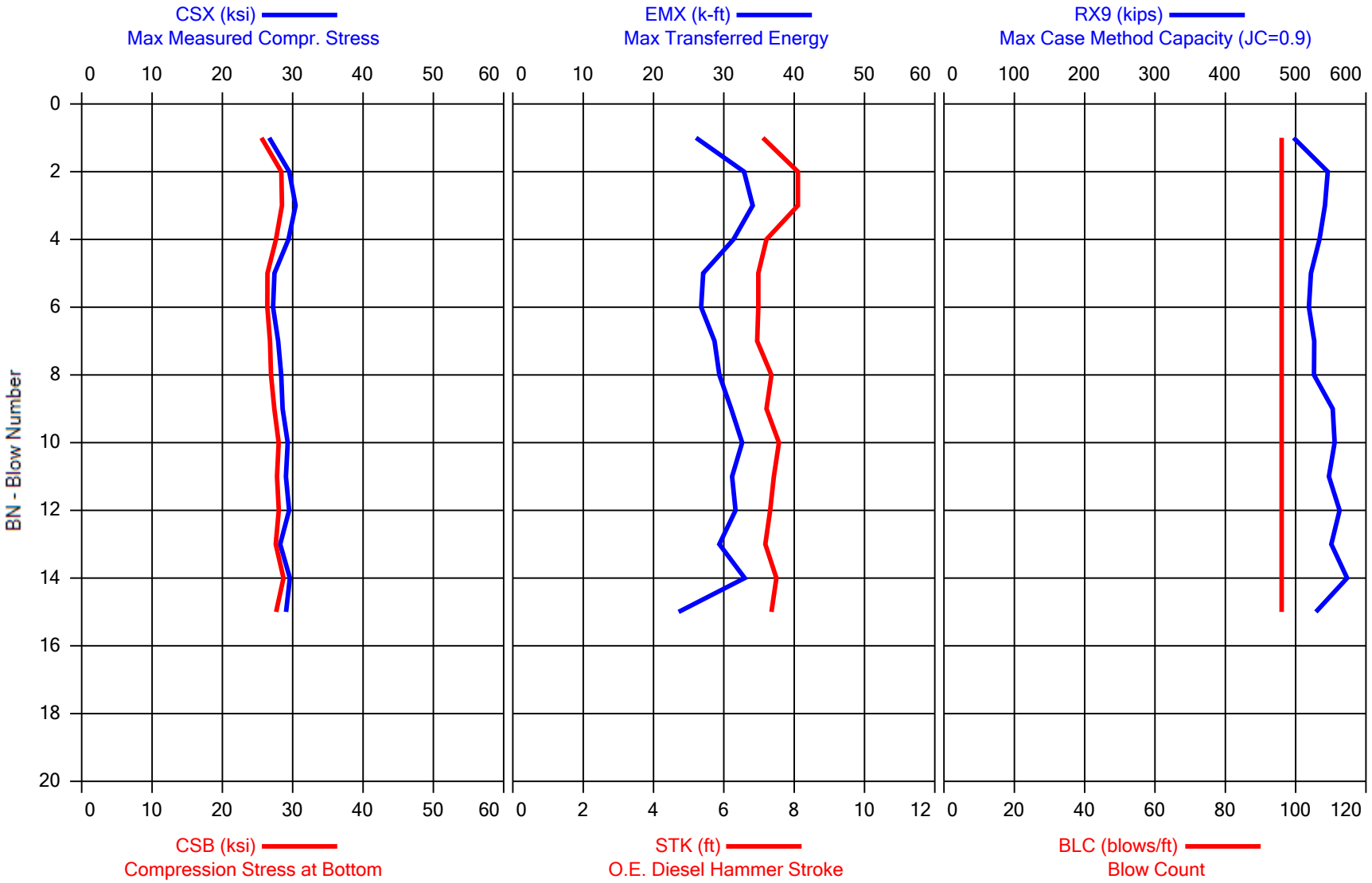
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 04-February-2015

Test started: 04-February-2015

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #1 BOR

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #1 BOR APE D30-42, HP 14 x 73
OP: AM Date: 04-February-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 94.17 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
5	83.55	96	AV5	28.7	27.3	30	7.5	43.1	528
			STD	1.4	1.1	3	0.5	1.4	17
			MAX	30.4	28.5	34	8.1	44.6	546
			MIN	26.7	25.6	26	7.0	41.5	497
10	83.60	96	AV5	28.3	27.1	30	7.2	43.9	536
			STD	0.7	0.6	2	0.2	0.7	15
			MAX	29.3	28.0	33	7.6	44.7	555
			MIN	27.2	26.4	27	6.9	42.9	519
15	83.66	96	AV5	29.1	27.9	30	7.4	43.5	552
			STD	0.5	0.4	3	0.1	0.3	15
			MAX	29.6	28.7	33	7.5	44.0	573
			MIN	28.2	27.6	24	7.2	43.1	529
			Average	28.7	27.4	30	7.4	43.5	539
			Std. Dev.	1.0	0.8	3	0.3	0.9	19
			Maximum	30.4	28.7	34	8.1	44.7	573
			Minimum	26.7	25.6	24	6.9	41.5	497

Total number of blows analyzed: 15

BL# Sensors

1-15 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 19 seconds 7:59 AM - 7:59 AM BN 1 - 15

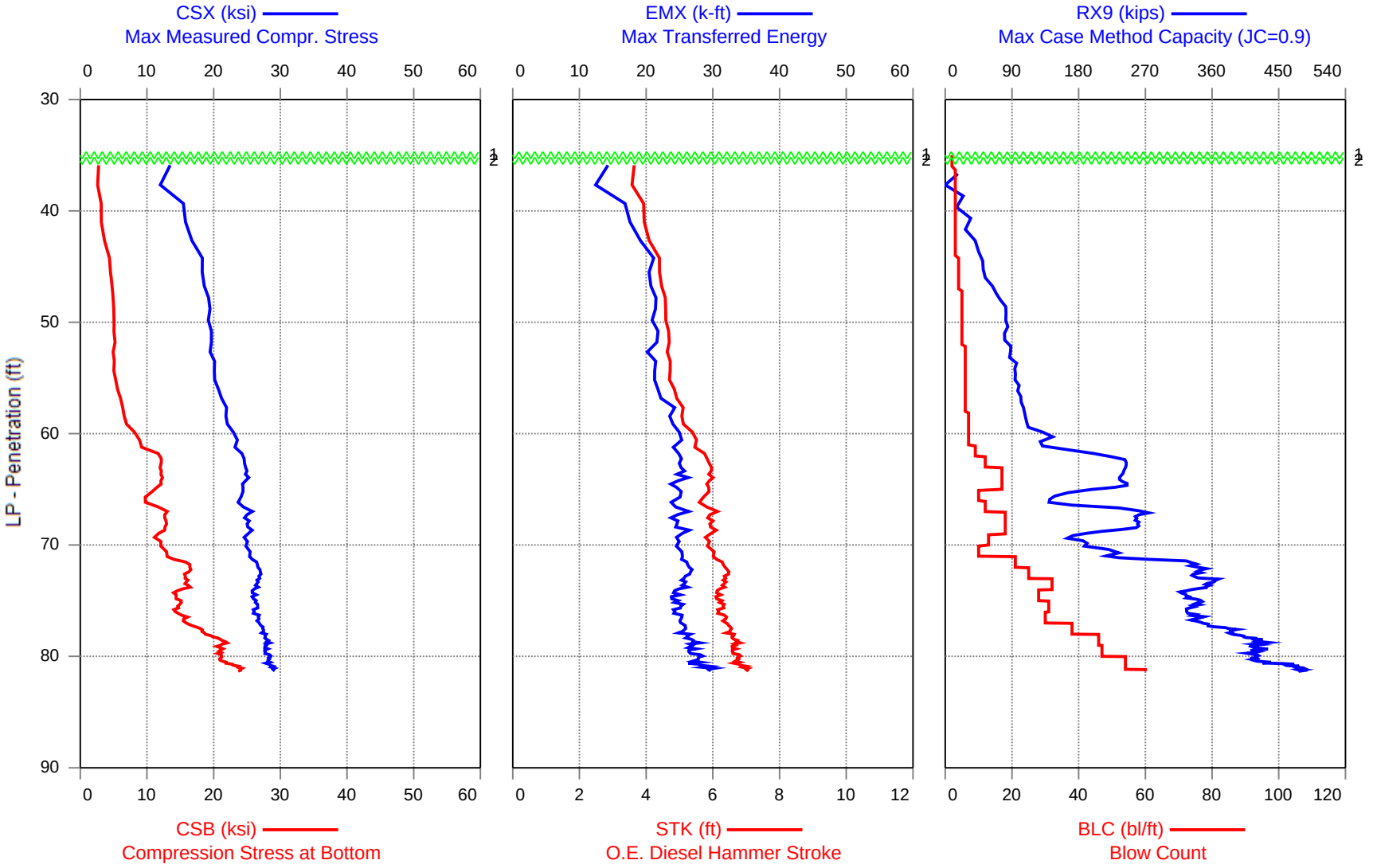
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 04-February-2015

Test started: 03-February-2015

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #36

APE D30-42, HP 14 x 73



1 - Reported Reference EL 740.9

2 - Mud Line at EL 717.5

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #36 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 94.75 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	35.00	2	AV1	13.7	2.5	15	3.5	62.0	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	13.7	2.5	15	3.5	62.0	0
			MIN	13.7	2.5	15	3.5	62.0	0
9	35.50	2	AV1	11.1	2.3	11	3.4	62.8	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	11.1	2.3	11	3.4	62.8	0
			MIN	11.1	2.3	11	3.4	62.8	0
10	36.00	2	AV1	11.2	2.3	12	3.4	62.6	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	11.2	2.3	12	3.4	62.6	0
			MIN	11.2	2.3	12	3.4	62.6	0
11	36.33	3	AV1	15.0	3.3	17	3.9	58.5	22
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	15.0	3.3	17	3.9	58.5	22
			MIN	15.0	3.3	17	3.9	58.5	22
12	36.67	3	AV1	16.4	3.4	17	4.0	57.7	4
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	16.4	3.4	17	4.0	57.7	4
			MIN	16.4	3.4	17	4.0	57.7	4
13	37.00	3	AV1	13.3	2.8	12	3.6	60.8	25
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	13.3	2.8	12	3.6	60.8	25
			MIN	13.3	2.8	12	3.6	60.8	25
16	38.00	3	AV3	9.4	2.1	10	3.3	63.8	0
			STD	2.7	0.5	4	0.3	2.4	0
			MAX	13.2	2.9	16	3.7	65.8	0
			MIN	7.1	1.6	7	3.0	60.4	0
19	39.00	3	AV3	16.3	3.4	18	4.1	57.7	24
			STD	1.7	0.4	3	0.3	2.0	16
			MAX	18.4	3.8	21	4.5	60.0	40
			MIN	14.2	2.8	14	3.7	55.2	3
22	40.00	3	AV3	15.6	3.1	17	4.0	58.4	15
			STD	1.9	0.4	2	0.3	1.8	4
			MAX	17.2	3.5	19	4.2	60.9	19
			MIN	13.0	2.7	14	3.6	57.0	10
25	41.00	3	AV3	15.3	3.1	17	3.9	58.9	34
			STD	0.3	0.1	1	0.1	0.4	1
			MAX	15.6	3.2	18	3.9	59.5	35
			MIN	14.8	3.1	16	3.8	58.6	34
28	42.00	3	AV3	16.5	3.3	19	4.1	57.6	27
			STD	0.3	0.1	0	0.1	0.4	15
			MAX	16.8	3.4	19	4.1	58.1	42
			MIN	16.2	3.1	18	4.0	57.2	7
31	43.00	3	AV3	16.4	3.5	18	4.0	57.8	40

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #36 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			STD	0.2	0.1	1	0.0	0.2	1
			MAX	16.7	3.7	19	4.1	58.0	41
			MIN	16.1	3.4	18	4.0	57.6	40
34	44.00	3	AV3	18.4	4.3	22	4.4	55.5	45
			STD	0.5	0.1	1	0.1	0.5	2
			MAX	18.9	4.4	24	4.5	56.0	47
			MIN	17.8	4.2	21	4.3	54.8	43
38	45.00	4	AV4	18.1	4.4	21	4.4	55.7	51
			STD	0.7	0.2	1	0.1	0.8	3
			MAX	18.9	4.8	22	4.5	57.0	54
			MIN	16.9	4.2	18	4.2	54.9	46
42	46.00	4	AV4	18.3	4.6	20	4.4	55.5	53
			STD	0.7	0.1	1	0.1	0.7	4
			MAX	19.1	4.7	22	4.5	56.4	60
			MIN	17.6	4.4	18	4.3	54.7	51
46	47.00	4	AV4	18.4	4.7	21	4.4	55.3	61
			STD	0.7	0.1	1	0.1	0.8	8
			MAX	19.0	4.9	22	4.5	56.7	69
			MIN	17.2	4.6	18	4.2	54.7	51
51	48.00	5	AV5	19.1	4.8	21	4.6	54.6	70
			STD	0.3	0.1	0	0.1	0.3	3
			MAX	19.5	5.0	22	4.6	55.1	74
			MIN	18.6	4.7	21	4.5	54.2	65
56	49.00	5	AV5	19.6	5.1	22	4.6	54.3	80
			STD	0.5	0.1	1	0.1	0.6	3
			MAX	20.0	5.3	23	4.7	55.3	85
			MIN	18.7	4.9	20	4.4	53.6	76
61	50.00	5	AV5	19.3	5.1	21	4.6	54.4	83
			STD	0.1	0.2	0	0.0	0.1	4
			MAX	19.4	5.4	22	4.6	54.6	88
			MIN	19.2	4.9	21	4.6	54.2	78
66	51.00	5	AV5	19.6	5.0	22	4.7	54.1	81
			STD	0.4	0.2	1	0.1	0.4	5
			MAX	20.0	5.5	23	4.8	54.7	89
			MIN	19.0	4.8	20	4.5	53.4	76
71	52.00	5	AV5	19.6	5.2	22	4.7	54.0	82
			STD	0.3	0.2	1	0.1	0.4	4
			MAX	20.1	5.5	23	4.8	54.3	87
			MIN	19.3	5.0	21	4.6	53.3	77
77	53.00	6	AV6	19.5	5.0	20	4.6	54.1	88
			STD	0.4	0.1	1	0.1	0.5	3
			MAX	20.1	5.2	22	4.8	55.0	91
			MIN	18.8	4.8	19	4.5	53.4	83
83	54.00	6	AV6	20.2	5.1	21	4.7	53.7	94
			STD	0.5	0.2	1	0.1	0.4	5
			MAX	20.6	5.5	22	4.8	54.2	99
			MIN	19.4	4.9	20	4.6	53.3	85
89	55.00	6	AV6	20.1	5.2	21	4.7	53.8	94
			STD	0.2	0.3	0	0.1	0.3	2
			MAX	20.5	5.8	22	4.8	54.1	95
			MIN	19.9	4.9	21	4.6	53.3	91

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #36 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
95	56.00	6	AV6	20.5	5.4	22	4.8	53.4	98
			STD	0.5	0.2	1	0.1	0.5	2
			MAX	21.2	5.8	22	4.9	54.2	100
			MIN	19.9	5.0	21	4.6	52.8	93
101	57.00	6	AV6	21.0	5.9	22	4.9	52.9	100
			STD	0.4	0.3	1	0.1	0.5	3
			MAX	21.5	6.3	23	5.0	53.8	105
			MIN	20.3	5.3	21	4.7	52.5	94
107	58.00	6	AV6	21.8	6.3	24	5.1	51.9	106
			STD	0.5	0.1	1	0.1	0.4	5
			MAX	22.5	6.5	25	5.2	52.6	110
			MIN	21.1	6.2	22	4.9	51.4	98
114	59.00	7	AV7	21.9	6.7	24	5.1	51.9	108
			STD	0.3	0.2	1	0.1	0.3	2
			MAX	22.3	7.2	25	5.2	52.3	112
			MIN	21.2	6.4	23	5.0	51.4	104
121	60.00	7	AV7	22.4	7.5	25	5.2	51.1	120
			STD	0.5	0.7	1	0.1	0.6	10
			MAX	23.4	8.9	26	5.5	52.1	136
			MIN	21.6	6.8	22	5.0	50.1	109
128	61.00	7	AV7	23.5	8.9	25	5.5	49.9	135
			STD	0.3	0.4	0	0.1	0.3	10
			MAX	24.0	9.5	26	5.6	50.3	150
			MIN	23.1	8.3	25	5.4	49.4	123
137	62.00	9	AV9	23.8	10.7	24	5.6	49.5	176
			STD	0.7	1.3	1	0.2	0.9	30
			MAX	24.8	12.0	26	5.9	51.4	221
			MIN	22.3	8.0	23	5.2	48.5	128
149	63.00	12	AV12	24.6	12.1	25	5.9	48.4	241
			STD	0.5	0.2	1	0.1	0.4	7
			MAX	25.5	12.4	27	6.0	49.5	248
			MIN	23.8	11.9	24	5.6	47.8	220
166	64.00	17	AV17	25.0	12.1	25	5.9	48.2	239
			STD	0.3	0.1	1	0.1	0.3	5
			MAX	25.7	12.3	27	6.1	48.8	247
			MIN	24.5	11.8	24	5.8	47.6	228
183	65.00	17	AV17	24.6	11.9	25	5.9	48.4	235
			STD	0.5	0.4	1	0.1	0.4	13
			MAX	25.7	12.5	27	6.1	48.8	249
			MIN	23.9	11.1	23	5.8	47.4	202
193	66.00	10	AV10	24.1	10.1	25	5.7	49.0	155
			STD	0.5	0.6	1	0.1	0.6	15
			MAX	24.7	10.9	27	6.0	50.2	181
			MIN	23.1	9.4	23	5.4	48.1	138
205	67.00	12	AV12	24.6	11.4	25	5.8	48.6	201
			STD	0.9	1.3	1	0.2	0.9	49
			MAX	26.0	13.2	27	6.2	49.7	267
			MIN	23.4	9.4	23	5.6	47.3	137
223	68.00	18	AV18	25.1	12.8	25	5.9	48.2	261
			STD	0.6	0.2	1	0.1	0.6	7

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #36 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			MAX	26.0	13.2	26	6.2	49.0	276
			MIN	24.2	12.3	22	5.7	47.2	250
241	69.00	18	AV18	25.3	12.5	25	6.0	48.0	236
			STD	0.4	0.4	1	0.1	0.4	28
			MAX	26.2	13.2	28	6.2	48.7	267
			MIN	24.7	11.5	24	5.8	47.1	187
254	70.00	13	AV13	24.8	11.6	25	5.8	48.6	179
			STD	0.5	0.5	1	0.1	0.6	12
			MAX	25.5	12.6	26	6.0	49.5	201
			MIN	24.0	10.8	23	5.6	47.9	161
264	71.00	10	AV10	25.3	12.7	25	6.0	47.9	217
			STD	0.3	0.4	1	0.1	0.3	18
			MAX	25.8	13.2	26	6.1	48.4	240
			MIN	24.9	12.0	24	5.9	47.4	183
285	72.00	21	AV21	26.2	15.2	26	6.2	47.1	305
			STD	0.5	1.3	1	0.1	0.5	42
			MAX	27.0	17.0	27	6.4	48.0	345
			MIN	25.3	12.8	24	6.0	46.5	219
310	73.00	25	AV25	26.9	16.0	26	6.4	46.4	341
			STD	0.4	0.6	1	0.1	0.4	6
			MAX	27.6	16.8	28	6.7	47.4	355
			MIN	26.0	14.7	25	6.1	45.6	329
342	74.00	32	AV32	26.5	16.0	26	6.3	46.8	355
			STD	0.3	0.5	1	0.1	0.4	10
			MAX	27.3	17.0	27	6.5	47.4	378
			MIN	25.8	15.1	24	6.1	46.0	333
370	75.00	28	AV28	26.0	14.5	24	6.2	47.3	328
			STD	0.5	0.5	1	0.1	0.5	9
			MAX	27.0	15.8	26	6.4	48.5	346
			MIN	25.1	13.4	22	5.9	46.5	315
401	76.00	31	AV31	26.3	14.6	25	6.2	47.1	334
			STD	0.6	0.5	1	0.2	0.6	8
			MAX	27.4	15.8	27	6.5	48.3	350
			MIN	25.3	13.7	23	5.9	46.1	317
431	77.00	30	AV30	26.6	15.4	25	6.3	46.8	338
			STD	0.6	0.6	1	0.2	0.6	8
			MAX	27.6	16.7	27	6.7	48.2	354
			MIN	24.9	14.3	22	5.9	45.5	322
469	78.00	38	AV38	27.3	17.6	26	6.5	46.2	374
			STD	0.5	1.0	1	0.1	0.5	15
			MAX	28.2	19.4	27	6.7	47.6	402
			MIN	26.3	15.7	23	6.1	45.4	348
515	79.00	46	AV46	28.0	20.8	27	6.7	45.6	415
			STD	0.5	0.9	1	0.2	0.5	13
			MAX	29.3	22.6	30	7.0	46.7	442
			MIN	27.0	18.8	25	6.3	44.4	382
562	80.00	47	AV47	27.9	21.0	27	6.6	45.7	418
			STD	0.6	0.4	1	0.2	0.6	8
			MAX	29.0	22.0	29	7.0	46.9	442
			MIN	26.7	19.9	24	6.3	44.5	403

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #36 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
625	81.17	54	AV63	28.5	22.3	28	6.8	45.1	446
			STD	0.6	1.3	1	0.2	0.6	27
			MAX	29.6	24.7	31	7.2	46.4	493
			MIN	27.1	20.0	25	6.4	44.0	405
635	81.33	60	AV10	28.8	23.8	29	7.0	44.6	480
			STD	0.3	0.3	1	0.1	0.3	7
			MAX	29.6	24.2	31	7.1	44.9	494
			MIN	28.3	23.0	28	6.9	44.1	471
			Average	25.2	14.4	25	6.0	48.3	288
			Std. Dev.	3.5	5.8	3	0.8	3.6	130
			Maximum	29.6	24.7	31	7.2	65.8	494
			Minimum	7.1	1.6	7	3.0	44.0	0

Total number of blows analyzed: 628

BL# Sensors

1-635 F3: [D815] 93.0 (0.97); F4: [F607] 93.6 (0.97); A3: [K3550] 360.0 (1.10); A4: [K2524] 360.0 (1.10)

BL# Comments

8 Reported Reference EL 740.9
9 Mud Line at EL 717.5

Time Summary

Drive 14 minutes 13 seconds 11:59 AM - 12:13 PM BN 1 - 635

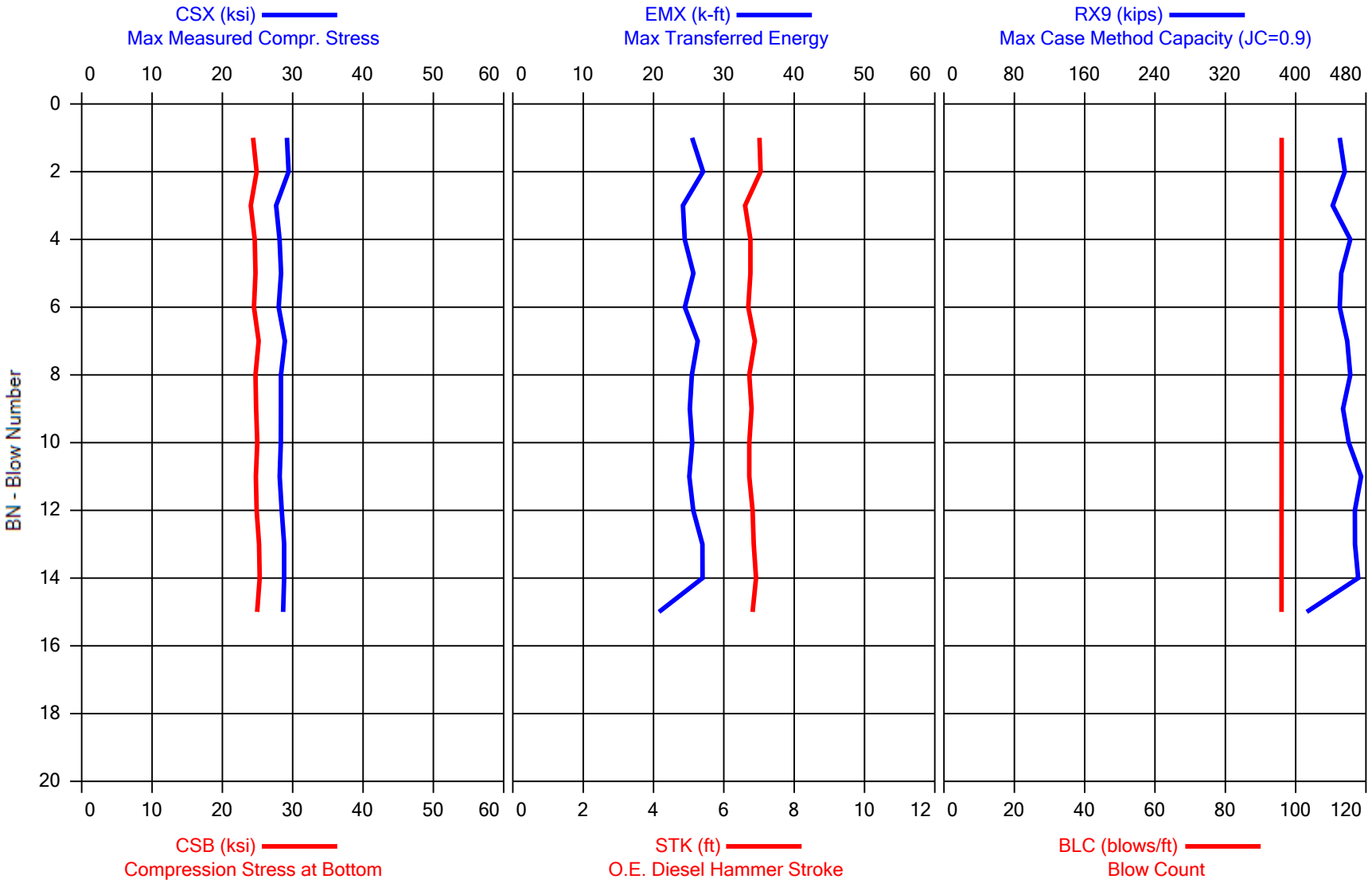
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 04-February-2015

Test started: 04-February-2015

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #36 BOR

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #36 BOR APE D30-42, HP 14 x 73
OP: AM Date: 04-February-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 94.75 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
5	81.39	96	AV5	28.5	24.5	25	6.8	45.1	452
			STD	0.7	0.3	1	0.2	0.5	7
			MAX	29.4	24.9	27	7.0	45.8	462
			MIN	27.6	24.0	24	6.6	44.4	442
10	81.44	96	AV5	28.4	24.8	25	6.8	45.3	457
			STD	0.3	0.2	1	0.1	0.2	4
			MAX	28.9	25.2	26	6.9	45.5	462
			MIN	28.0	24.5	24	6.7	44.9	450
15	81.49	96	AV5	28.6	25.0	25	6.8	45.1	459
			STD	0.2	0.2	2	0.1	0.2	23
			MAX	28.8	25.3	27	6.9	45.4	474
			MIN	28.2	24.8	21	6.7	44.8	413
			Average	28.5	24.8	25	6.8	45.1	456
			Std. Dev.	0.4	0.3	1	0.1	0.4	14
			Maximum	29.4	25.3	27	7.0	45.8	474
			Minimum	27.6	24.0	21	6.6	44.4	413

Total number of blows analyzed: 15

BL# Sensors

1-15 F3: [F607] 93.6 (0.97); F4: [D815] 93.0 (0.97); A3: [K2524] 360.0 (1.10); A4: [K3550] 360.0 (1.10)

Time Summary

Drive 18 seconds 7:48 AM - 7:49 AM BN 1 - 15

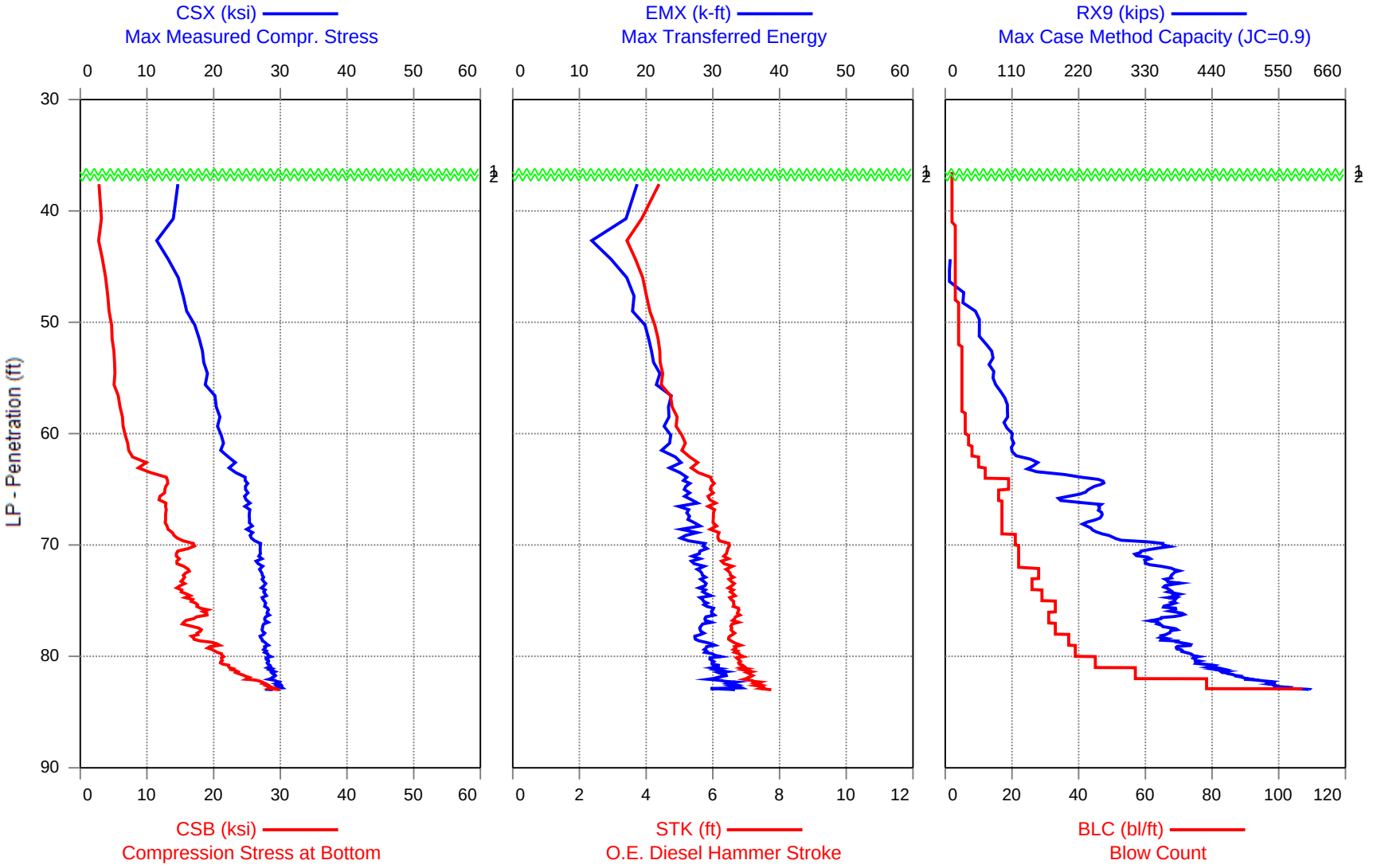
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 03-February-2015

Test started: 03-February-2015

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #44

APE D30-42, HP 14 x 73



1 - Reported Reference EL 740.8

2 - Mud Line at EL 717.5

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #44 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 93.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
6	36.50	2	AV1	21.9	4.0	33	5.8	48.9	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	21.9	4.0	33	5.8	48.9	0
			MIN	21.9	4.0	33	5.8	48.9	0
7	37.00	2	AV1	17.1	3.7	21	4.3	55.8	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	17.1	3.7	21	4.3	55.8	0
			MIN	17.1	3.7	21	4.3	55.8	0
8	37.50	2	AV1	9.4	1.8	9	3.1	64.8	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	9.4	1.8	9	3.1	64.8	0
			MIN	9.4	1.8	9	3.1	64.8	0
9	38.00	2	AV1	1.7	0.2	0	2.8	67.8	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	1.7	0.2	0	2.8	67.8	0
			MIN	1.7	0.2	0	2.8	67.8	0
11	39.00	2	AV1	23.2	4.4	30	5.8	48.6	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	23.2	4.4	30	5.8	48.6	0
			MIN	23.2	4.4	30	5.8	48.6	0
12	39.50	2	AV1	16.3	4.1	22	4.1	57.4	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	16.3	4.1	22	4.1	57.4	0
			MIN	16.3	4.1	22	4.1	57.4	0
13	40.00	2	AV1	5.9	1.3	5	2.8	68.2	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	5.9	1.3	5	2.8	68.2	0
			MIN	5.9	1.3	5	2.8	68.2	0
15	41.00	2	AV1	17.8	3.7	25	4.6	54.5	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	17.8	3.7	25	4.6	54.5	0
			MIN	17.8	3.7	25	4.6	54.5	0
18	42.00	3	AV3	13.5	3.1	14	3.7	60.1	0
			STD	2.7	0.5	3	0.4	3.1	0
			MAX	17.2	3.8	19	4.3	63.0	0
			MIN	10.8	2.5	10	3.3	55.9	0
21	43.00	3	AV3	11.7	2.8	12	3.4	62.2	0
			STD	0.6	0.1	1	0.1	0.8	0
			MAX	12.4	2.9	13	3.6	63.1	0
			MIN	10.8	2.7	12	3.3	61.2	0
24	44.00	3	AV3	12.5	3.2	13	3.6	61.3	3
			STD	1.1	0.3	2	0.2	1.3	5
			MAX	14.0	3.5	16	3.8	62.4	10
			MIN	11.5	2.9	12	3.4	59.4	0
27	45.00	3	AV3	13.3	3.4	15	3.7	60.1	5

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #44 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			STD	0.9	0.2	2	0.1	1.0	6
			MAX	14.3	3.7	18	3.9	61.4	14
			MIN	12.2	3.1	13	3.5	59.0	0
30	46.00	3	AV3	14.5	3.7	16	3.9	59.1	10
			STD	1.7	0.3	3	0.3	2.0	8
			MAX	16.2	4.0	20	4.1	61.8	21
			MIN	12.1	3.3	13	3.5	57.1	0
33	47.00	3	AV3	15.3	4.0	19	4.0	58.0	13
			STD	1.1	0.2	1	0.2	1.3	11
			MAX	16.2	4.2	20	4.2	59.8	26
			MIN	13.9	3.8	17	3.7	57.0	0
36	48.00	3	AV3	15.1	4.1	17	3.9	58.4	31
			STD	0.3	0.1	1	0.1	0.5	3
			MAX	15.6	4.3	19	4.0	58.9	35
			MIN	14.9	4.0	17	3.9	57.8	28
40	49.00	4	AV4	16.0	4.3	19	4.1	57.1	40
			STD	0.3	0.1	1	0.1	0.3	11
			MAX	16.5	4.4	20	4.2	57.5	51
			MIN	15.8	4.3	18	4.1	56.6	24
44	50.00	4	AV4	16.2	4.4	18	4.1	57.3	55
			STD	0.6	0.1	1	0.1	0.7	3
			MAX	17.3	4.6	19	4.3	57.8	59
			MIN	15.7	4.2	17	4.0	56.2	50
48	51.00	4	AV4	17.6	4.8	20	4.3	55.9	56
			STD	0.8	0.2	2	0.2	0.9	5
			MAX	18.3	5.0	23	4.5	57.5	62
			MIN	16.3	4.5	18	4.1	55.0	49
52	52.00	4	AV4	17.9	4.8	20	4.4	55.8	61
			STD	0.3	0.1	0	0.1	0.3	6
			MAX	18.1	5.0	21	4.4	56.2	71
			MIN	17.5	4.8	20	4.3	55.3	56
57	53.00	5	AV5	18.3	5.1	21	4.4	55.5	75
			STD	0.3	0.1	1	0.1	0.5	2
			MAX	18.8	5.1	22	4.5	56.1	78
			MIN	17.9	5.0	20	4.3	54.8	72
62	54.00	5	AV5	18.5	5.1	21	4.4	55.4	76
			STD	0.8	0.1	1	0.2	1.0	7
			MAX	19.5	5.3	23	4.6	56.8	82
			MIN	17.3	5.0	20	4.2	54.3	66
67	55.00	5	AV5	19.1	5.2	22	4.5	54.9	82
			STD	0.5	0.2	1	0.1	0.6	4
			MAX	19.7	5.4	23	4.6	55.9	86
			MIN	18.3	5.0	21	4.3	54.2	75
72	56.00	5	AV5	18.8	5.1	22	4.5	55.2	81
			STD	0.6	0.1	1	0.1	0.7	8
			MAX	19.3	5.2	22	4.6	56.4	88
			MIN	17.6	4.9	20	4.3	54.6	66
77	57.00	5	AV5	20.2	5.7	24	4.7	53.7	96
			STD	0.3	0.1	1	0.1	0.4	3
			MAX	20.7	5.8	25	4.8	54.1	99
			MIN	19.8	5.5	23	4.6	53.1	92

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #44 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
82	58.00	5	AV5	20.4	6.0	23	4.8	53.4	103
			STD	0.2	0.2	1	0.1	0.4	1
			MAX	20.7	6.3	24	4.9	54.0	104
			MIN	20.0	5.7	23	4.7	53.0	101
88	59.00	6	AV6	20.9	6.3	23	4.9	52.7	100
			STD	0.4	0.1	1	0.1	0.5	3
			MAX	21.6	6.5	25	5.1	53.1	105
			MIN	20.4	6.2	22	4.8	51.7	95
94	60.00	6	AV6	20.7	6.5	23	4.9	52.5	104
			STD	0.4	0.2	1	0.1	0.5	5
			MAX	21.4	6.8	26	5.1	53.2	113
			MIN	20.1	6.3	22	4.8	51.7	97
101	61.00	7	AV7	21.4	7.0	24	5.1	51.6	111
			STD	0.6	0.2	1	0.1	0.7	3
			MAX	22.2	7.2	26	5.4	52.6	117
			MIN	20.4	6.7	22	4.9	50.6	105
109	62.00	8	AV8	21.2	7.3	22	5.1	51.8	110
			STD	0.4	0.1	1	0.1	0.4	2
			MAX	21.9	7.6	24	5.2	52.4	113
			MIN	20.7	7.0	21	5.0	51.2	106
119	63.00	10	AV10	22.9	9.2	25	5.5	50.1	144
			STD	0.7	0.8	1	0.1	0.6	8
			MAX	23.7	10.2	27	5.6	50.9	155
			MIN	21.9	7.5	23	5.3	49.4	128
131	64.00	12	AV12	23.5	10.8	25	5.6	49.4	177
			STD	1.1	1.8	2	0.3	1.2	37
			MAX	25.1	13.0	27	6.0	51.2	233
			MIN	21.8	8.3	23	5.2	47.8	131
150	65.00	19	AV19	24.8	13.0	26	6.0	48.1	252
			STD	0.3	0.2	1	0.1	0.3	8
			MAX	25.4	13.3	28	6.1	48.6	265
			MIN	24.4	12.5	25	5.8	47.5	236
166	66.00	16	AV16	24.9	12.2	26	5.9	48.2	211
			STD	0.3	0.4	1	0.1	0.3	19
			MAX	25.5	13.0	29	6.1	48.9	235
			MIN	24.3	11.6	25	5.8	47.5	182
183	67.00	17	AV17	25.2	12.8	26	6.0	48.0	245
			STD	0.5	0.3	1	0.1	0.6	19
			MAX	25.7	13.2	28	6.2	49.7	262
			MIN	23.6	12.1	23	5.6	47.1	196
200	68.00	17	AV17	25.3	12.8	26	6.0	47.9	251
			STD	0.3	0.1	1	0.1	0.3	9
			MAX	25.8	13.0	28	6.1	48.5	261
			MIN	24.9	12.6	25	5.9	47.4	232
217	69.00	17	AV17	25.5	13.3	27	6.1	47.7	240
			STD	0.6	0.4	2	0.1	0.5	10
			MAX	26.5	14.2	29	6.3	48.6	260
			MIN	24.6	12.6	24	5.8	46.7	221
238	70.00	21	AV21	26.1	15.3	27	6.3	47.0	304
			STD	0.7	1.1	2	0.2	0.6	35

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #44 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			MAX	27.7	17.5	30	6.7	47.8	362
			MIN	25.2	13.9	24	6.0	45.6	264
260	71.00	22	AV22	27.0	15.4	28	6.4	46.4	335
			STD	0.3	1.3	1	0.1	0.3	24
			MAX	27.5	18.6	29	6.6	47.0	387
			MIN	26.5	13.9	26	6.3	45.9	303
282	72.00	22	AV22	26.9	14.8	28	6.4	46.5	339
			STD	0.5	0.7	1	0.2	0.6	16
			MAX	27.9	17.1	30	6.8	47.2	388
			MIN	26.1	13.6	26	6.2	45.2	312
310	73.00	28	AV26	27.2	15.9	28	6.5	46.1	375
			STD	0.3	0.5	1	0.1	0.4	7
			MAX	27.8	16.9	29	6.7	46.9	387
			MIN	26.4	14.8	27	6.3	45.4	364
336	74.00	26	AV26	27.5	15.1	29	6.5	46.0	368
			STD	0.3	0.6	1	0.1	0.3	9
			MAX	28.2	16.2	30	6.8	46.7	393
			MIN	26.8	13.9	27	6.3	45.3	357
365	75.00	29	AV29	27.6	15.9	29	6.6	45.9	377
			STD	0.4	0.8	1	0.1	0.3	6
			MAX	28.5	17.6	31	6.8	46.8	387
			MIN	26.6	14.3	27	6.3	45.1	364
398	76.00	33	AV33	27.9	17.8	29	6.7	45.5	373
			STD	0.3	1.0	1	0.1	0.3	8
			MAX	28.4	20.0	31	6.8	46.2	387
			MIN	27.2	16.0	27	6.5	45.0	358
429	77.00	31	AV31	27.9	17.3	29	6.7	45.5	367
			STD	0.3	1.5	1	0.1	0.3	20
			MAX	28.7	19.8	31	6.9	46.1	397
			MIN	27.3	14.9	28	6.5	44.8	331
462	78.00	33	AV31	27.4	17.3	28	6.6	45.9	367
			STD	0.4	1.1	1	0.1	0.4	10
			MAX	28.2	19.1	30	6.8	46.6	384
			MIN	26.5	14.6	27	6.4	45.1	344
499	79.00	37	AV37	27.4	18.3	28	6.6	45.9	373
			STD	0.5	1.6	1	0.1	0.5	19
			MAX	28.6	21.3	31	6.9	46.5	408
			MIN	26.6	16.0	26	6.4	44.7	349
538	80.00	39	AV39	27.9	20.3	29	6.7	45.4	394
			STD	0.4	0.9	1	0.1	0.4	12
			MAX	29.0	22.0	32	7.0	46.5	420
			MIN	26.7	18.8	28	6.4	44.4	374
583	81.00	45	AV45	28.2	21.5	30	6.8	45.1	421
			STD	0.4	0.6	1	0.1	0.4	13
			MAX	29.2	23.3	32	7.1	45.8	448
			MIN	27.3	20.2	29	6.6	44.2	407
640	82.00	57	AV57	28.8	23.9	31	7.1	44.4	468
			STD	0.4	0.9	1	0.1	0.4	16
			MAX	30.3	25.8	34	7.5	45.2	501
			MIN	27.9	22.0	29	6.8	43.2	440

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #44 APE D30-42, HP 14 x 73
OP: AM Date: 03-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
711	82.91	78	AV69	29.5	27.4	32	7.3	43.6	536
			STD	0.8	1.1	2	0.2	0.6	19
			MAX	30.9	29.3	36	7.7	45.0	568
			MIN	25.8	24.5	26	6.8	42.6	492
721	83.00	107	AV10	28.2	29.5	32	7.7	42.7	595
			STD	1.0	0.7	1	0.1	0.3	12
			MAX	29.4	30.4	34	7.8	43.1	612
			MIN	26.3	28.2	29	7.5	42.3	568
			Average	26.0	16.6	28	6.3	47.2	332
			Std. Dev.	3.9	6.7	4	0.9	4.0	143
			Maximum	30.9	30.4	36	7.8	68.2	612
			Minimum	1.7	0.2	0	2.8	42.3	0

Total number of blows analyzed: 708

BL# Sensors

1-721 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.07); A4: [K3550] 360.0 (1.07)

BL# Comments

6 Reported Reference EL 740.8
7 Mud Line at EL 717.5

Time Summary

Drive 18 minutes 12 seconds 11:23 AM - 11:41 AM BN 1 - 721

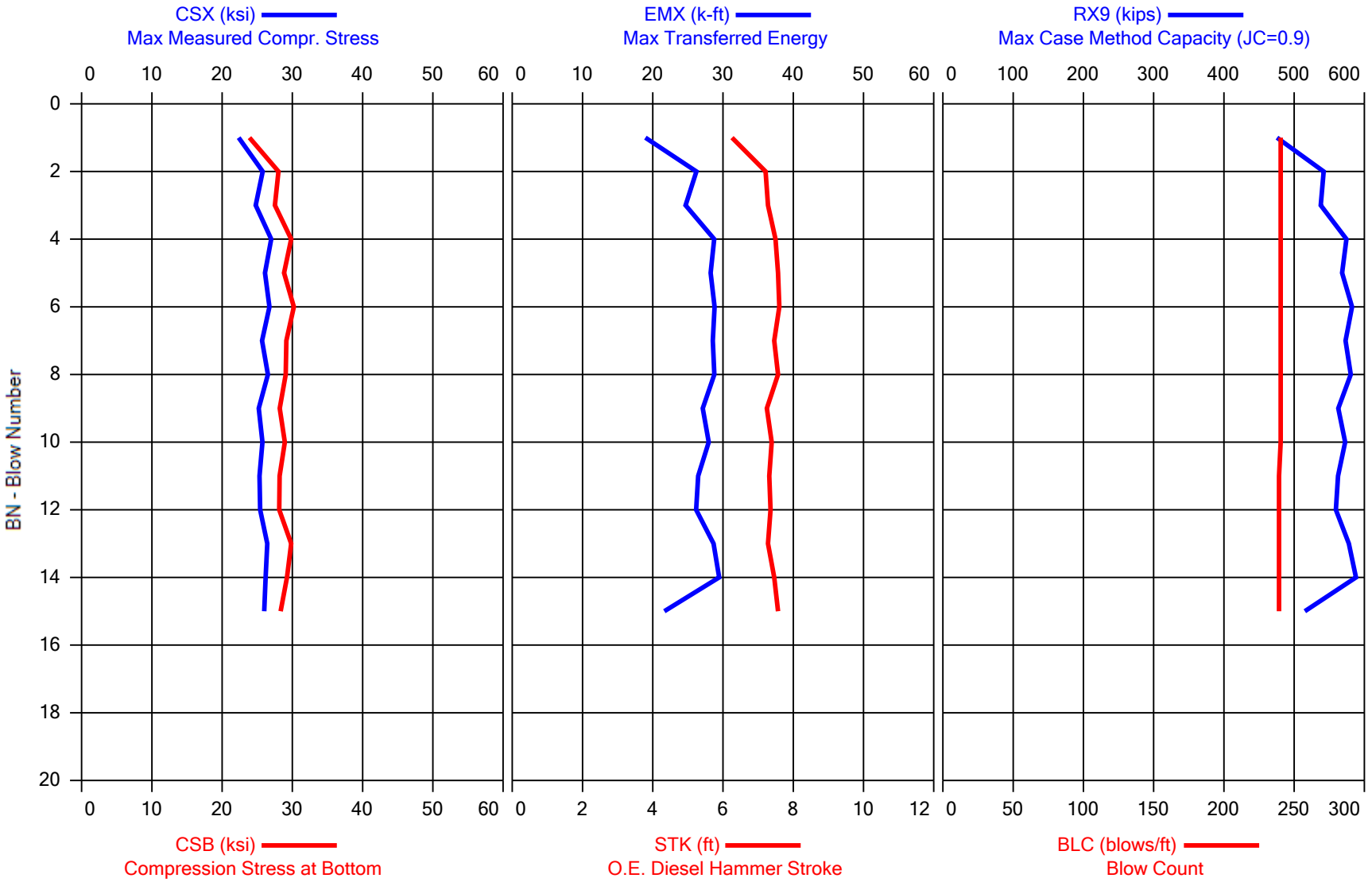
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 04-February-2015

Test started: 04-February-2015

USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #44 BOR

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - B-70-403 - PIER 8 #44 BOR APE D30-42, HP 14 x 73
OP: AM Date: 04-February-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 93.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
5	83.02	240	AV5	25.2	27.6	25	7.2	44.1	540
			STD	1.6	2.0	4	0.5	1.5	35
			MAX	27.0	29.8	29	7.6	47.0	574
			MIN	22.4	23.9	19	6.3	42.9	475
10	83.04	240	AV5	26.0	29.1	28	7.5	43.2	574
			STD	0.6	0.6	1	0.1	0.4	7
			MAX	26.7	30.2	29	7.6	43.8	582
			MIN	25.2	28.2	27	7.2	42.8	563
15	83.06	239	AV5	25.9	28.7	26	7.4	43.4	561
			STD	0.4	0.7	3	0.1	0.3	25
			MAX	26.4	29.8	29	7.6	43.7	588
			MIN	25.3	28.1	22	7.3	42.9	515
			Average	25.7	28.5	27	7.3	43.6	558
			Std. Dev.	1.1	1.4	3	0.3	1.0	29
			Maximum	27.0	30.2	29	7.6	47.0	588
			Minimum	22.4	23.9	19	6.3	42.8	475

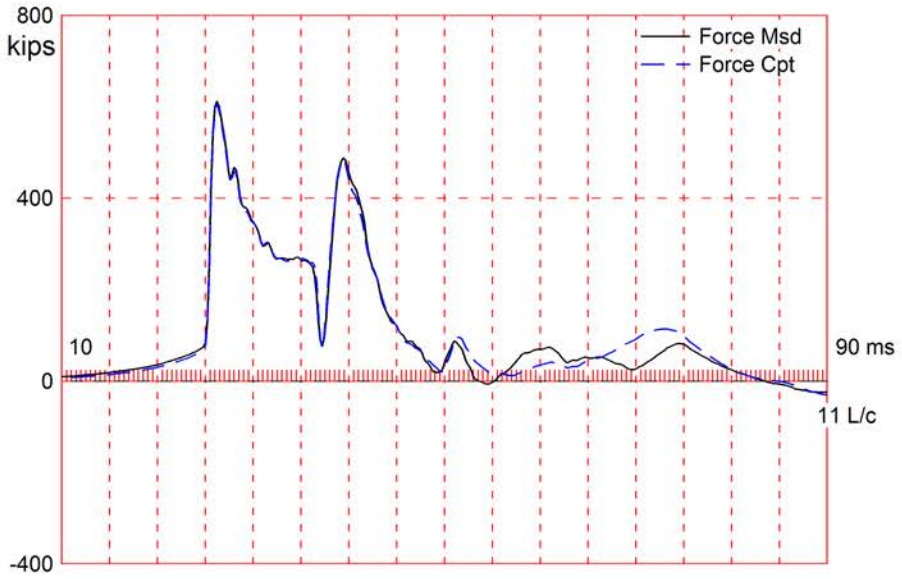
Total number of blows analyzed: 15

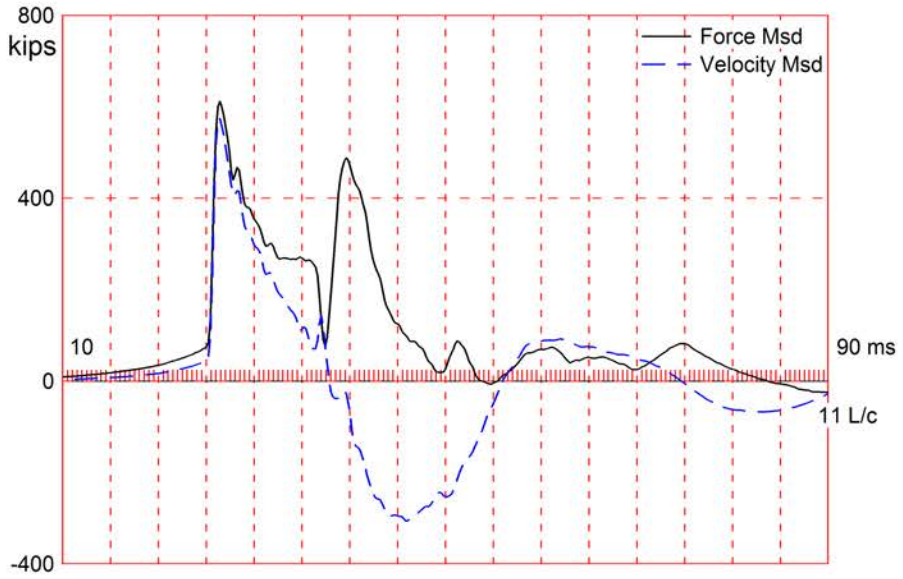
BL# Sensors

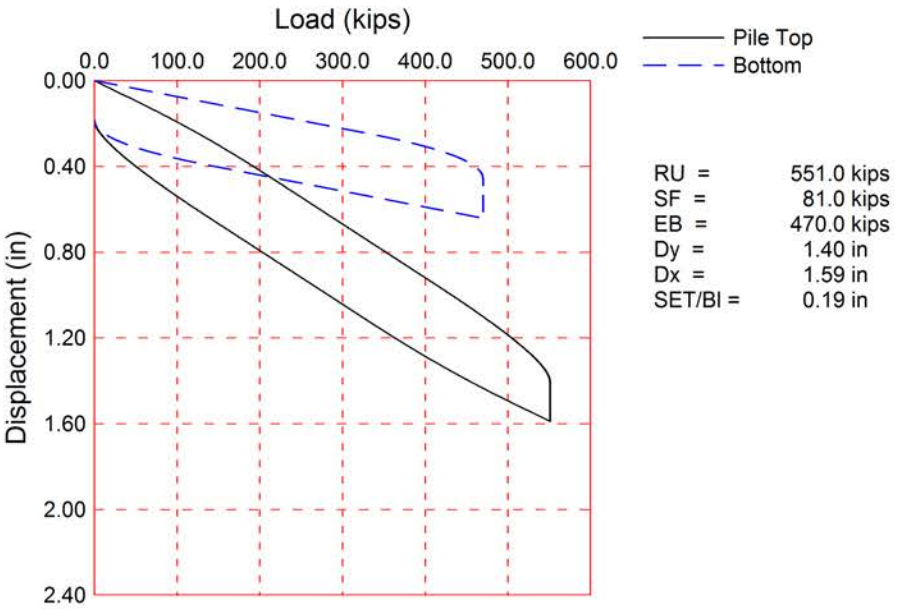
1-15 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.10); A4: [K3550] 360.0 (1.10)

Time Summary

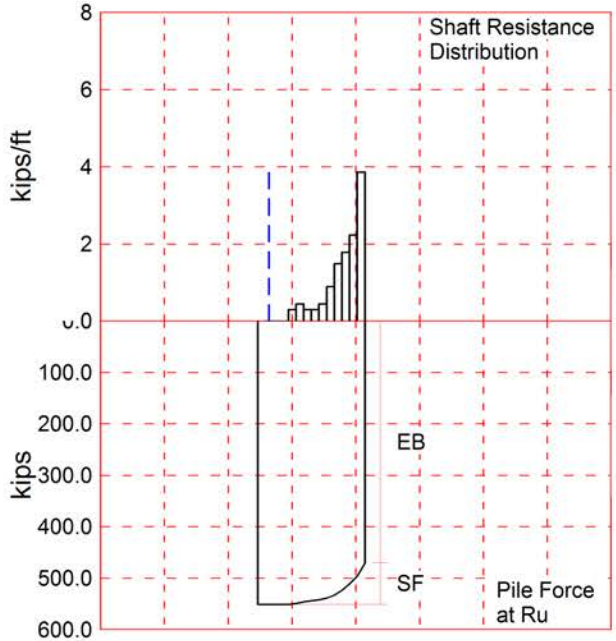
Drive 19 seconds 7:39 AM - 7:39 AM BN 1 - 15







RU =	551.0 kips
SF =	81.0 kips
EB =	470.0 kips
Dy =	1.40 in
Dx =	1.59 in
SET/Bl =	0.19 in



Length b. Sensors	94.2 ft
Embedment	83.5 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	4.96
Top Compr. Stress	28.3 ksi
Max Compr. Stress	28.9 ksi
Max Tension Stress	-6.43 ksi
Avg. Shaft Quake	0.08 in
Toe Quake	0.35 in
Avg. Shaft Smith Dpg.	0.23 s/ft
Toe Smith Damping	0.07 s/ft

CAPWAP(R) 2014-1 Licensed to GRL Engineers, Inc.

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: 551.0; along Shaft 81.0; 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
				551.0				
1	13.5	2.8	0.0	551.0	0.0	0.00	0.00	0.00
2	20.2	9.5	0.0	551.0	0.0	0.00	0.00	0.00
3	26.9	16.2	0.0	551.0	0.0	0.00	0.00	0.00
4	33.6	22.9	2.0	549.0	2.0	0.30	0.06	0.23
5	40.4	29.7	3.0	546.0	5.0	0.45	0.09	0.23
6	47.1	36.4	2.0	544.0	7.0	0.30	0.06	0.23
7	53.8	43.1	2.0	542.0	9.0	0.30	0.06	0.23
8	60.5	49.8	3.0	539.0	12.0	0.45	0.09	0.23
9	67.3	56.6	6.0	533.0	18.0	0.89	0.19	0.23
10	74.0	63.3	10.0	523.0	28.0	1.49	0.32	0.23
11	80.7	70.0	12.0	511.0	40.0	1.78	0.38	0.23
12	87.4	76.7	15.0	496.0	55.0	2.23	0.47	0.23
13	94.2	83.5	26.0	470.0	81.0	3.87	0.82	0.23
Avg. Shaft			6.2			0.97	0.21	0.23
Toe			470.0				340.95	0.07

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.08	0.35
Case Damping Factor		0.49	0.86
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	60	51
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake)	(in)		0.01
Soil Plug Weight	(kips)		0.017

CAPWAP match quality = 4.96 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.19 in; Blow Count = 64 b/ft
Computed: Final Set = 0.15 in; Blow Count = 82 b/ft

max. Top Comp. Stress = 28.3 ksi (T= 26.6 ms, max= 1.021 x Top)
max. Comp. Stress = 28.9 ksi (Z= 33.6 ft, T= 28.4 ms)
max. Tens. Stress = -6.43 ksi (Z= 67.3 ft, T= 54.0 ms)
max. Energy (EMX) = 33.4 kip-ft; max. Measured Top Displ. (DMX)= 1.08 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	606.4	-36.3	28.3	-1.70	33.4	15.2	1.10
2	6.7	607.2	-37.2	28.4	-1.74	33.3	15.2	1.09
4	13.5	608.7	-40.9	28.4	-1.91	32.8	15.1	1.05
6	20.2	610.5	-54.9	28.5	-2.56	32.3	15.0	1.01
8	26.9	613.4	-72.9	28.7	-3.41	31.5	15.0	0.96
10	33.6	619.0	-92.0	28.9	-4.30	30.7	14.8	0.92
12	40.4	616.5	-104.6	28.8	-4.89	29.4	14.6	0.86
14	47.1	608.6	-105.0	28.4	-4.91	27.8	14.5	0.81
15	50.4	602.8	-102.5	28.2	-4.79	26.9	14.4	0.78
16	53.8	605.9	-104.7	28.3	-4.89	26.4	14.3	0.75
17	57.2	601.6	-112.6	28.1	-5.26	25.4	14.2	0.72
18	60.5	606.3	-123.0	28.3	-5.75	24.8	14.0	0.69
19	63.9	600.8	-128.6	28.1	-6.01	23.6	13.9	0.66
20	67.3	607.7	-137.7	28.4	-6.43	23.0	13.7	0.63
21	70.6	593.6	-135.7	27.7	-6.34	21.4	13.4	0.60
22	74.0	601.8	-137.3	28.1	-6.42	20.7	13.2	0.57
23	77.3	573.9	-124.0	26.8	-5.79	18.6	12.8	0.53
24	80.7	584.3	-124.2	27.3	-5.80	17.9	12.6	0.50
25	84.1	548.9	-108.0	25.6	-5.05	15.7	13.9	0.47
26	87.4	575.8	-108.1	26.9	-5.05	15.0	15.1	0.43
27	90.8	570.8	-88.3	26.7	-4.12	12.8	15.7	0.40
28	94.2	585.8	-88.4	27.4	-4.13	10.8	14.6	0.37
Absolute	33.6			28.9			(T =	28.4 ms)
	67.3				-6.43		(T =	54.0 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	595.3	535.6	475.9	416.2	356.5	296.8	237.0	177.3	117.6	57.9
RX	702.1	682.8	663.7	644.5	625.3	608.9	602.1	595.4	588.7	582.0
RU	595.3	535.6	475.9	416.2	356.5	296.8	237.0	177.3	117.6	57.9

RAU = 420.9 (kips); RA2 = 616.4 (kips)

Current CAPWAP Ru = 551.0 (kips); Corresponding J(RP)= 0.07;

RMX requires higher damping; see PDA-W

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	26.61	581.9	610.4	616.0	1.08	0.19	0.19	33.5	636.0	1382

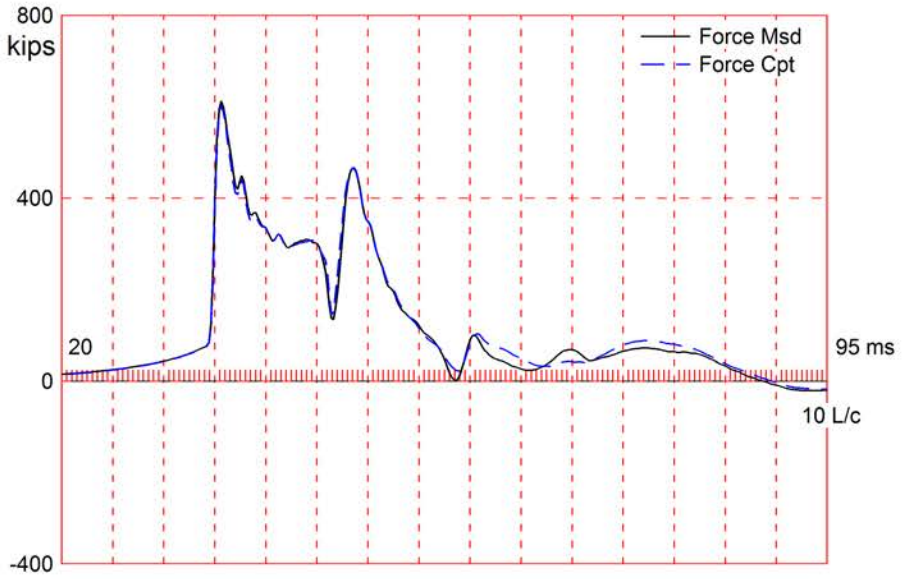
PILE PROFILE AND PILE MODEL

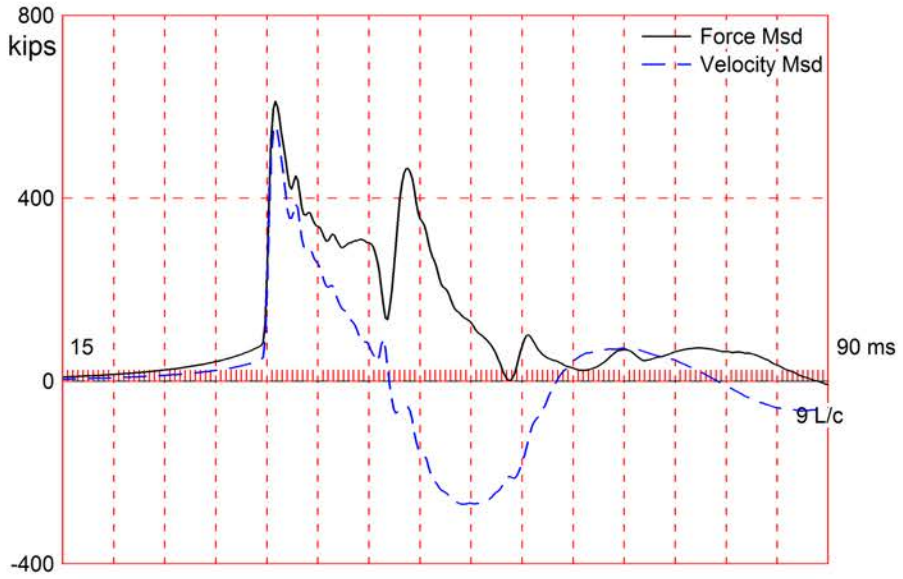
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
94.2	21.4	29992.2	492.000	4.70

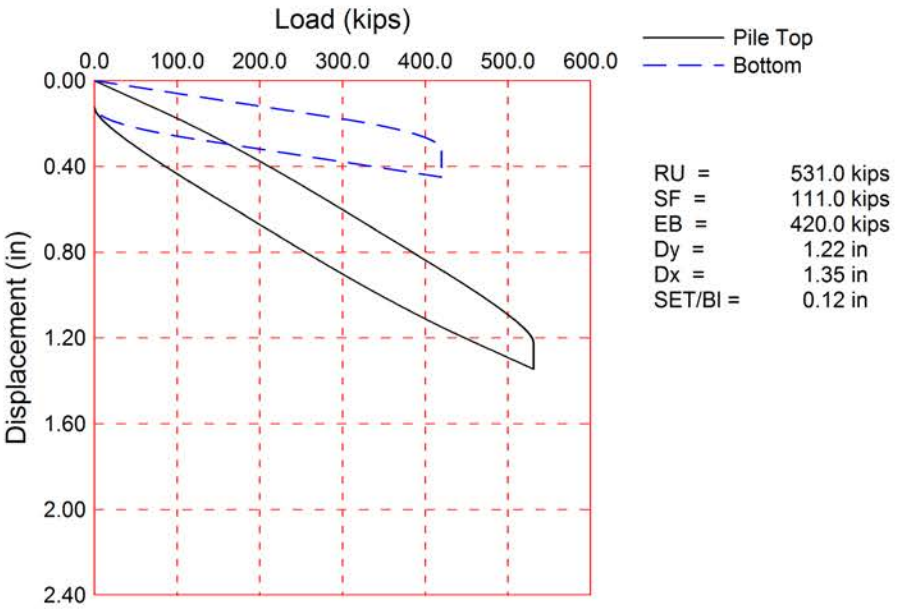
Toe Area 198.5 in^2

Top Segment Length 3.36 ft, Top Impedance 38 kips/ft/s

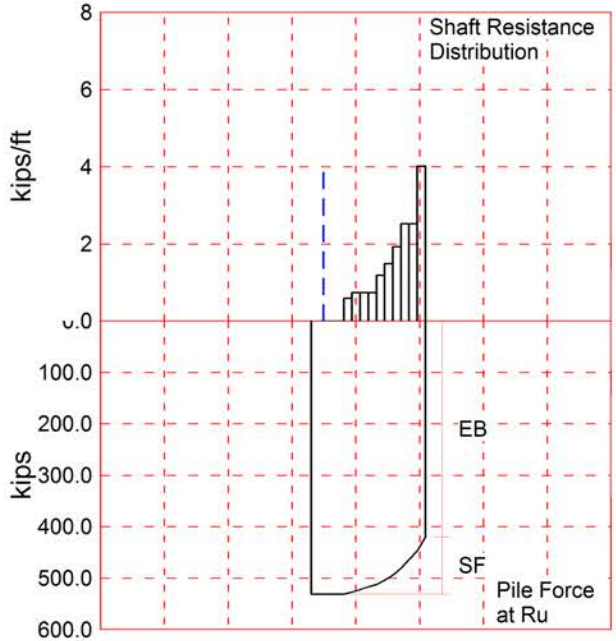
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 11.2 ms
Total volume: 13.993 ft^3; Volume ratio considering added impedance: 1.000







RU =	531.0 kips
SF =	111.0 kips
EB =	420.0 kips
Dy =	1.22 in
Dx =	1.35 in
SET/Bl =	0.12 in



Length b. Sensors	94.2 ft
Embedment	83.5 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	3.25
Top Compr. Stress	28.2 ksi
Max Compr. Stress	29.0 ksi
Max Tension Stress	-3.64 ksi
Avg. Shaft Quake	0.10 in
Toe Quake	0.25 in
Avg. Shaft Smith Dpg.	0.30 s/ft
Toe Smith Damping	0.10 s/ft

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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.

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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: 531.0; along Shaft 111.0; at Toe 420.0 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
				531.0					
1	13.5	2.8	0.0	531.0	0.0	0.00	0.00	0.00	0.10
2	20.2	9.6	0.0	531.0	0.0	0.00	0.00	0.00	0.10
3	26.9	16.3	0.0	531.0	0.0	0.00	0.00	0.00	0.10
4	33.6	23.0	4.0	527.0	4.0	0.59	0.13	0.30	0.10
5	40.4	29.7	5.0	522.0	9.0	0.74	0.16	0.30	0.10
6	47.1	36.5	5.0	517.0	14.0	0.74	0.16	0.30	0.10
7	53.8	43.2	5.0	512.0	19.0	0.74	0.16	0.30	0.10
8	60.5	49.9	8.0	504.0	27.0	1.19	0.25	0.30	0.10
9	67.3	56.6	10.0	494.0	37.0	1.49	0.32	0.30	0.10
10	74.0	63.4	13.0	481.0	50.0	1.93	0.41	0.30	0.10
11	80.7	70.1	17.0	464.0	67.0	2.53	0.54	0.30	0.10
12	87.4	76.8	17.0	447.0	84.0	2.53	0.54	0.30	0.10
13	94.2	83.5	27.0	420.0	111.0	4.01	0.85	0.30	0.09
Avg. Shaft			8.5			1.33	0.28	0.30	0.10
Toe			420.0				304.68	0.10	0.25

Soil Model Parameters/Extensions		Shaft	Toe
Case Damping Factor		0.87	1.10
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	84	106
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake)	(in)		0.07
Soil Plug Weight	(kips)	0.040	

CAPWAP match quality = 3.25 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.12 in; Blow Count = 96 b/ft
Computed: Final Set = 0.11 in; Blow Count = 105 b/ft

max. Top Comp. Stress = 28.2 ksi (T= 36.0 ms, max= 1.030 x Top)
max. Comp. Stress = 29.0 ksi (Z= 33.6 ft, T= 37.8 ms)
max. Tens. Stress = -3.64 ksi (Z= 67.3 ft, T= 63.2 ms)
max. Energy (EMX) = 30.7 kip-ft; max. Measured Top Displ. (DMX)= 1.00 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	602.7	-25.4	28.2	-1.19	30.7	14.9	1.01
2	6.7	603.4	-24.9	28.2	-1.16	30.6	14.8	1.00
4	13.5	604.9	-27.9	28.3	-1.30	30.1	14.8	0.96
6	20.2	606.6	-32.5	28.3	-1.52	29.4	14.7	0.91
8	26.9	610.7	-37.2	28.5	-1.74	28.6	14.6	0.86
10	33.6	621.0	-47.3	29.0	-2.21	27.7	14.3	0.81
12	40.4	611.5	-57.5	28.6	-2.69	25.8	14.0	0.76
14	47.1	597.1	-65.5	27.9	-3.06	23.8	13.7	0.70
15	50.4	578.3	-64.8	27.0	-3.02	22.3	13.5	0.67
16	53.8	584.5	-72.7	27.3	-3.40	21.7	13.3	0.64
17	57.2	569.3	-71.2	26.6	-3.32	20.2	13.0	0.61
18	60.5	577.1	-77.9	27.0	-3.64	19.6	12.8	0.58
19	63.9	551.0	-71.8	25.7	-3.35	17.7	12.5	0.55
20	67.3	568.2	-78.0	26.5	-3.64	17.1	12.1	0.52
21	70.6	539.0	-69.0	25.2	-3.22	15.1	11.6	0.49
22	74.0	546.9	-74.5	25.5	-3.48	14.4	11.4	0.45
23	77.4	510.7	-62.0	23.9	-2.90	12.3	11.1	0.42
24	80.7	524.0	-67.8	24.5	-3.17	11.6	10.9	0.39
25	84.1	526.8	-51.0	24.6	-2.38	9.4	12.0	0.36
26	87.4	542.6	-55.7	25.3	-2.60	8.8	13.0	0.33
27	90.8	525.4	-39.4	24.5	-1.84	7.0	13.1	0.30
28	94.2	534.1	-43.6	25.0	-2.03	5.6	11.0	0.27
Absolute	33.6			29.0			(T =	37.8 ms)
	67.3				-3.64		(T =	63.2 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	660.3	608.2	556.1	504.0	451.9	399.7	347.6	295.5	243.4	191.3
RX	706.3	670.2	653.8	637.4	621.0	604.6	588.9	573.3	558.4	544.1
RU	660.3	608.2	556.1	504.0	451.9	399.7	347.6	295.5	243.4	191.3

RAU = 340.9 (kips); RA2 = 582.2 (kips)

Current CAPWAP Ru = 531.0 (kips); Corresponding J(RP)= 0.25; matches RX9 within 5%

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
14.7	35.82	562.8	618.7	618.7	1.00	0.16	0.12	30.9	657.6	2333

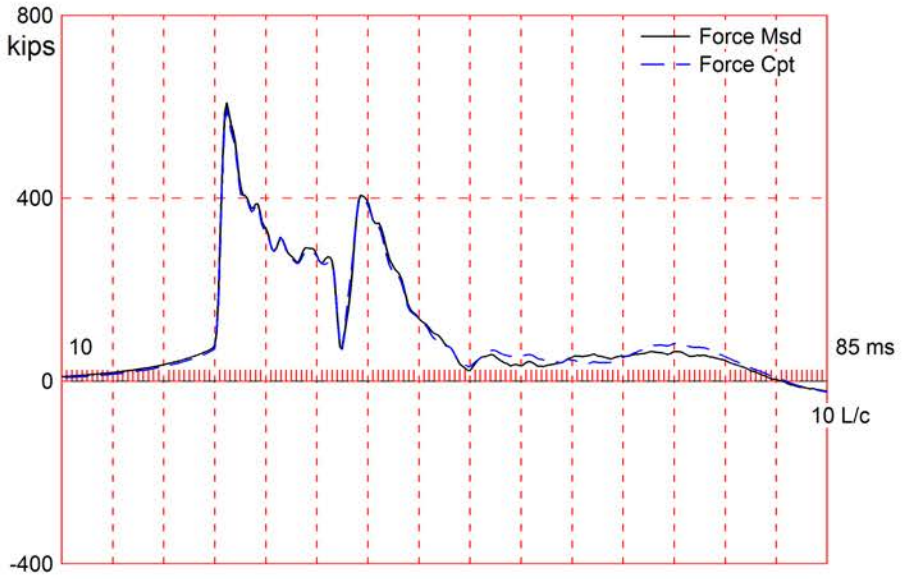
PILE PROFILE AND PILE MODEL

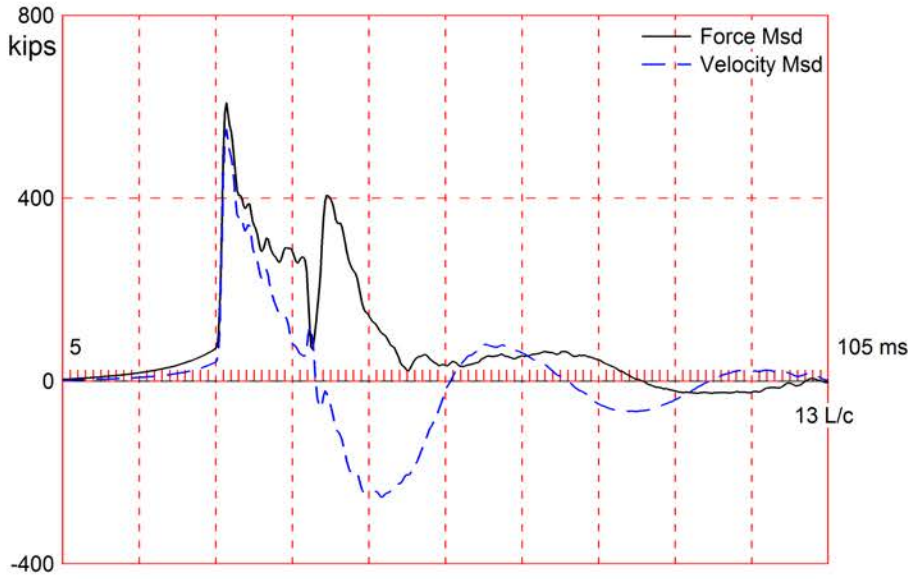
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
94.2	21.4	29992.2	492.000	4.70

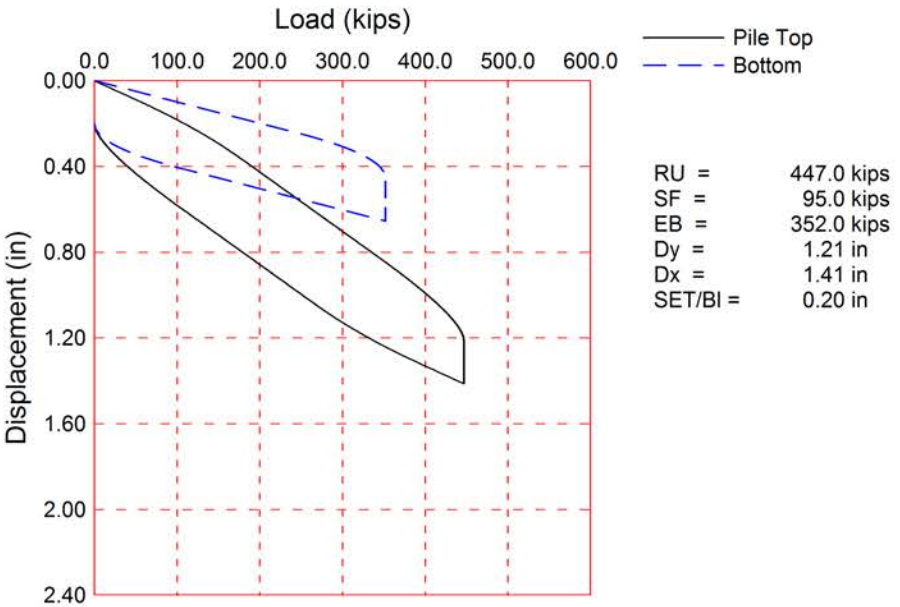
Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
22	74.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
23	77.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.020
24	80.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
25	84.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
28	94.2	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

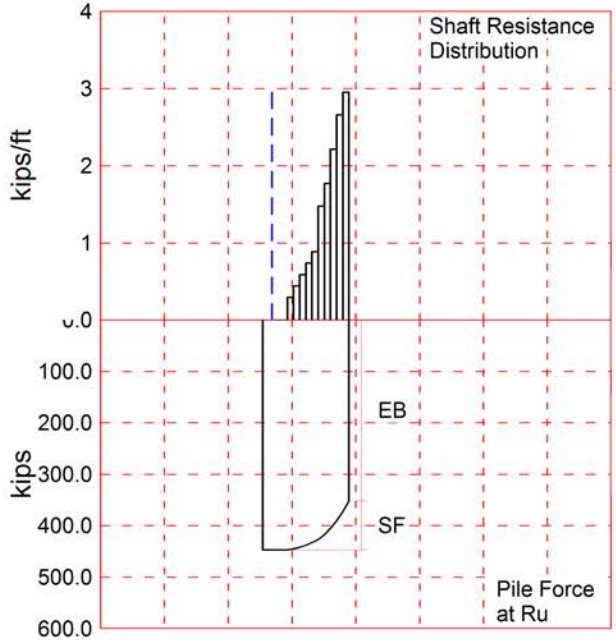
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 11.2 ms
Total volume: 13.994 ft^3; Volume ratio considering added impedance: 1.000







RU =	447.0 kips
SF =	95.0 kips
EB =	352.0 kips
Dy =	1.21 in
Dx =	1.41 in
SET/Bl =	0.20 in



Length b. Sensors	94.8 ft
Embedment	81.3 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	2.70
Top Compr. Stress	27.7 ksi
Max Compr. Stress	28.2 ksi
Max Tension Stress	-3.04 ksi
Avg. Shaft Quake	0.07 in
Toe Quake	0.35 in
Avg. Shaft Smith Dpg.	0.25 s/ft
Toe Smith Damping	0.12 s/ft

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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: 447.0; along Shaft 95.0; at Toe 352.0 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
				447.0				
1	20.3	6.9	0.0	447.0	0.0	0.00	0.00	0.00
2	27.1	13.6	0.0	447.0	0.0	0.00	0.00	0.00
3	33.8	20.4	2.0	445.0	2.0	0.30	0.06	0.25
4	40.6	27.2	3.0	442.0	5.0	0.44	0.09	0.25
5	47.4	33.9	4.0	438.0	9.0	0.59	0.13	0.25
6	54.1	40.7	5.0	433.0	14.0	0.74	0.16	0.25
7	60.9	47.5	6.0	427.0	20.0	0.89	0.19	0.25
8	67.7	54.2	10.0	417.0	30.0	1.48	0.31	0.25
9	74.4	61.0	12.0	405.0	42.0	1.77	0.38	0.25
10	81.2	67.8	15.0	390.0	57.0	2.22	0.47	0.25
11	88.0	74.5	18.0	372.0	75.0	2.66	0.57	0.25
12	94.8	81.3	20.0	352.0	95.0	2.96	0.63	0.25
Avg. Shaft			7.9			1.17	0.25	0.25
Toe			352.0				255.35	0.12

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.07	0.35
Case Damping Factor		0.62	1.11
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	75
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake)	(in)		0.06
Soil Plug Weight	(kips)	0.055	0.056

CAPWAP match quality = 2.70 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.20 in; Blow Count = 60 b/ft
Computed: Final Set = 0.21 in; Blow Count = 56 b/ft

max. Top Comp. Stress = 27.7 ksi (T= 26.6 ms, max= 1.018 x Top)
max. Comp. Stress = 28.2 ksi (Z= 33.8 ft, T= 28.4 ms)
max. Tens. Stress = -3.04 ksi (Z= 67.7 ft, T= 54.4 ms)
max. Energy (EMX) = 29.9 kip-ft; max. Measured Top Displ. (DMX)= 1.00 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	592.9	-33.4	27.7	-1.56	29.9	14.8	1.03
2	6.8	593.5	-34.9	27.7	-1.63	29.8	14.8	1.02
4	13.5	594.8	-38.8	27.8	-1.81	29.4	14.7	0.98
6	20.3	596.2	-42.6	27.9	-1.99	28.8	14.7	0.94
8	27.1	598.4	-46.0	28.0	-2.15	28.2	14.6	0.90
10	33.8	603.7	-49.4	28.2	-2.31	27.6	14.4	0.86
12	40.6	601.4	-50.6	28.1	-2.36	26.3	14.2	0.81
14	47.4	596.2	-50.2	27.9	-2.34	24.8	14.0	0.75
15	50.8	583.6	-50.3	27.3	-2.35	23.6	13.8	0.73
16	54.1	588.3	-57.1	27.5	-2.67	23.2	13.7	0.70
17	57.5	572.6	-55.6	26.7	-2.60	21.9	13.5	0.67
18	60.9	578.5	-62.4	27.0	-2.92	21.4	13.3	0.65
19	64.3	563.1	-59.7	26.3	-2.79	20.0	13.0	0.62
20	67.7	577.4	-65.1	27.0	-3.04	19.5	12.6	0.59
21	71.1	555.4	-55.8	25.9	-2.61	17.6	12.1	0.57
22	74.4	561.0	-60.4	26.2	-2.82	17.1	12.0	0.54
23	77.8	516.2	-48.7	24.1	-2.27	15.1	11.9	0.51
24	81.2	519.8	-54.2	24.3	-2.53	14.6	11.7	0.48
25	84.6	473.7	-39.5	22.1	-1.85	12.5	13.2	0.46
26	88.0	482.1	-43.5	22.5	-2.03	12.0	14.1	0.43
27	91.4	463.3	-25.5	21.6	-1.19	9.8	15.0	0.41
28	94.8	471.8	-29.4	22.0	-1.37	8.3	14.2	0.39
Absolute	33.8			28.2			(T =	28.4 ms)
	67.7				-3.04		(T =	54.4 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	574.4	514.2	453.9	393.6	333.3	273.1	212.8	152.5	92.2	32.0
RX	627.3	589.1	572.8	556.6	541.4	527.6	513.7	499.8	486.4	476.2
RU	574.4	514.2	453.9	393.6	333.3	273.1	212.8	152.5	92.2	32.0

RAU = 358.5 (kips); RA2 = 511.0 (kips)

Current CAPWAP Ru = 447.0 (kips); Corresponding J(RP)= 0.21;

RMX requires higher damping; see PDA-W

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	26.37	558.7	618.4	618.4	1.00	0.20	0.20	29.9	599.0	1214

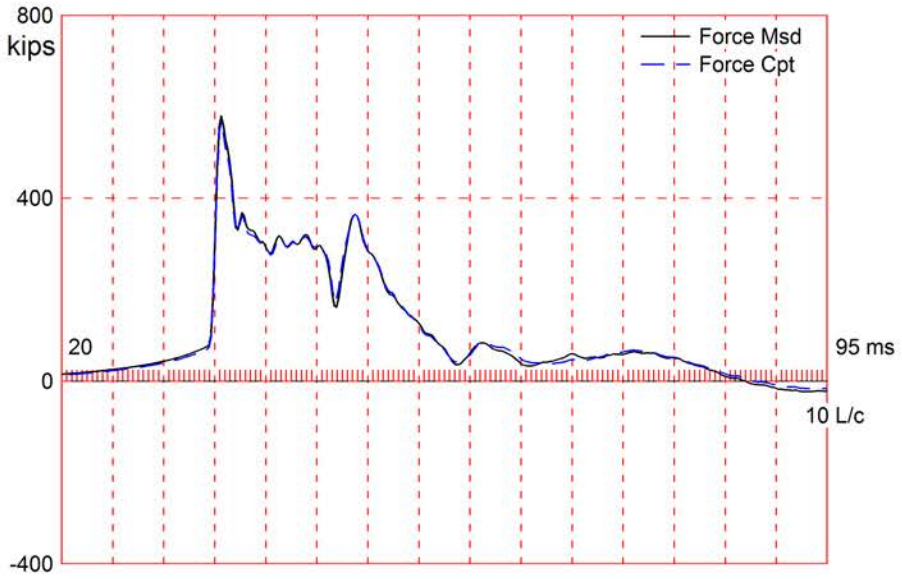
PILE PROFILE AND PILE MODEL

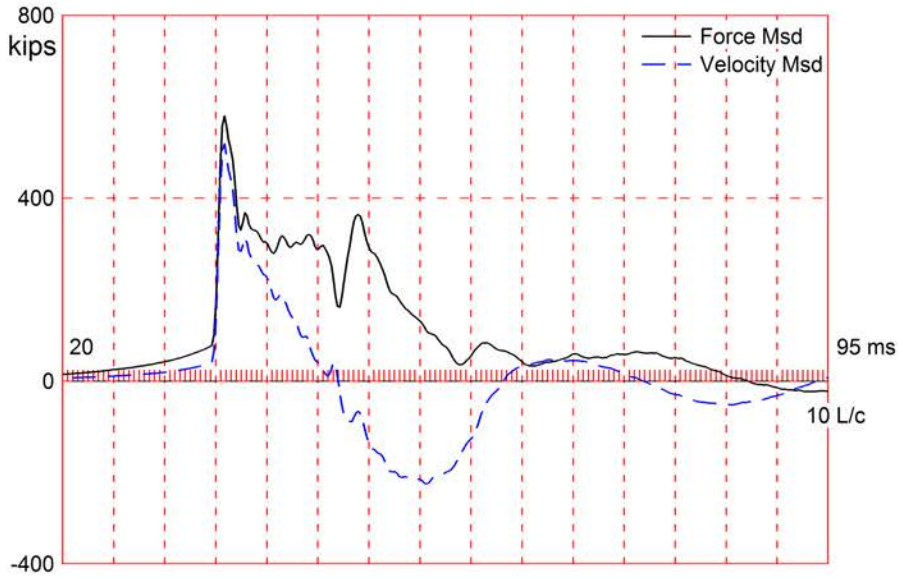
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
94.8	21.4	29992.2	492.000	4.70

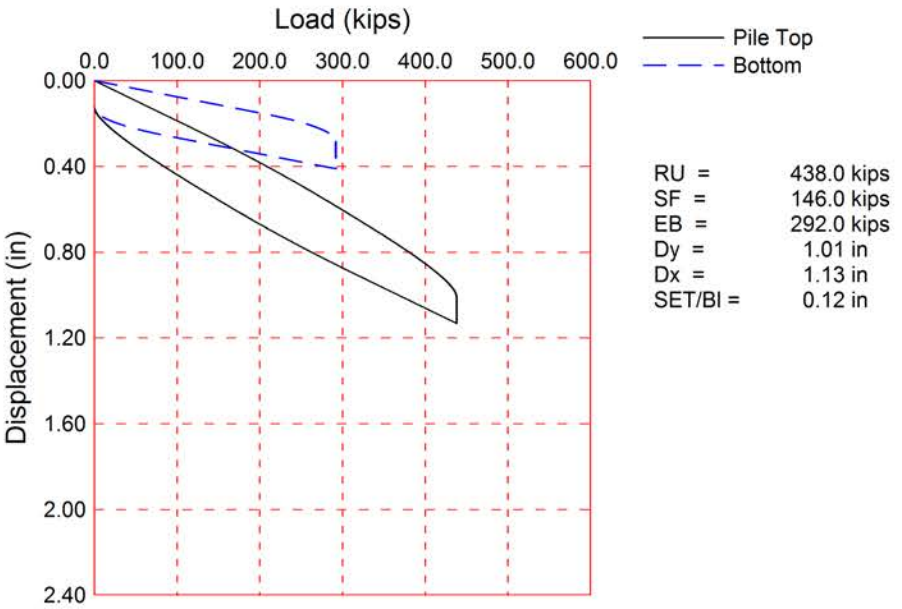
Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
22	74.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.020
23	77.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.025
24	81.2	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
25	84.6	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
28	94.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

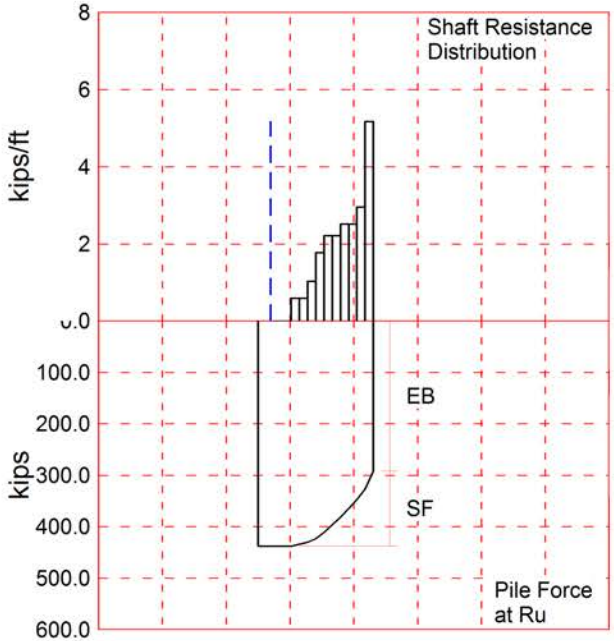
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.201 ms, 2L/c 11.3 ms
Total volume: 14.081 ft^3; Volume ratio considering added impedance: 1.000







RU =	438.0 kips
SF =	146.0 kips
EB =	292.0 kips
Dy =	1.01 in
Dx =	1.13 in
SET/Bl =	0.12 in



Length b. Sensors	94.8 ft
Embedment	81.4 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	1.80
Top Compr. Stress	26.5 ksi
Max Compr. Stress	27.3 ksi
Max Tension Stress	-1.48 ksi
Avg. Shaft Quake	0.17 in
Toe Quake	0.22 in
Avg. Shaft Smith Dpg.	0.26 s/ft
Toe Smith Damping	0.12 s/ft

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CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 438.0; along Shaft 146.0; at Toe 292.0 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
				438.0				
1	20.3	6.9	0.0	438.0	0.0	0.00	0.00	0.00
2	27.1	13.7	0.0	438.0	0.0	0.00	0.00	0.00
3	33.8	20.5	4.0	434.0	4.0	0.59	0.13	0.26
4	40.6	27.2	4.0	430.0	8.0	0.59	0.13	0.26
5	47.4	34.0	7.0	423.0	15.0	1.03	0.22	0.26
6	54.1	40.8	12.0	411.0	27.0	1.77	0.38	0.26
7	60.9	47.5	15.0	396.0	42.0	2.22	0.47	0.26
8	67.7	54.3	15.0	381.0	57.0	2.22	0.47	0.26
9	74.4	61.1	17.0	364.0	74.0	2.51	0.53	0.26
10	81.2	67.8	17.0	347.0	91.0	2.51	0.53	0.26
11	88.0	74.6	20.0	327.0	111.0	2.96	0.63	0.26
12	94.8	81.4	35.0	292.0	146.0	5.17	1.10	0.26
Avg. Shaft			12.2			1.79	0.38	0.26
Toe			292.0				211.83	0.12

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.17	0.22
Case Damping Factor		0.99	0.92
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	64	102
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake)	(in)		0.02
Soil Plug Weight	(kips)	0.030	

CAPWAP match quality = 1.80 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.12 in; Blow Count = 96 b/ft
Computed: Final Set = 0.13 in; Blow Count = 95 b/ft

max. Top Comp. Stress = 26.5 ksi (T= 36.0 ms, max= 1.030 x Top)
max. Comp. Stress = 27.3 ksi (Z= 33.8 ft, T= 37.9 ms)
max. Tens. Stress = -1.48 ksi (Z= 54.1 ft, T= 62.0 ms)
max. Energy (EMX) = 24.0 kip-ft; max. Measured Top Displ. (DMX)= 0.85 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	566.4	-18.0	26.5	-0.84	24.0	14.0	0.87
2	6.8	567.4	-19.9	26.5	-0.93	23.8	13.9	0.86
4	13.5	569.2	-23.2	26.6	-1.08	23.4	13.8	0.82
6	20.3	571.1	-26.0	26.7	-1.21	22.8	13.8	0.78
8	27.1	574.4	-28.5	26.8	-1.33	22.2	13.7	0.74
10	33.8	583.6	-31.0	27.3	-1.45	21.4	13.4	0.69
12	40.6	576.0	-29.4	26.9	-1.37	19.9	13.1	0.64
14	47.4	574.3	-31.5	26.8	-1.47	18.5	12.7	0.58
15	50.8	557.1	-26.5	26.0	-1.24	17.2	12.4	0.56
16	54.1	567.7	-31.8	26.5	-1.48	16.8	12.1	0.53
17	57.5	534.4	-19.3	25.0	-0.90	15.1	11.7	0.50
18	60.9	545.8	-24.3	25.5	-1.14	14.6	11.4	0.48
19	64.3	503.6	-8.1	23.5	-0.38	12.8	11.0	0.45
20	67.7	515.3	-12.6	24.1	-0.59	12.4	10.7	0.43
21	71.1	482.5	0.0	22.5	0.00	10.8	10.2	0.40
22	74.4	496.9	-1.8	23.2	-0.09	10.4	9.8	0.38
23	77.8	449.5	0.0	21.0	0.00	8.9	9.6	0.35
24	81.2	457.1	-0.0	21.4	-0.00	8.5	9.4	0.33
25	84.6	419.6	-0.0	19.6	-0.00	7.2	9.1	0.31
26	88.0	407.4	-0.0	19.0	-0.00	6.9	9.9	0.29
27	91.4	374.5	-0.0	17.5	-0.00	5.7	10.8	0.27
28	94.8	410.4	-0.0	19.2	-0.00	4.4	9.9	0.24
Absolute	33.8			27.3			(T =	37.9 ms)
	54.1				-1.48		(T =	62.0 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	642.0	594.5	546.9	499.4	451.9	404.4	356.9	309.4	261.9	214.3
RX	651.2	610.8	579.4	549.8	524.3	499.6	483.9	470.8	457.7	444.6
RU	642.0	594.5	546.9	499.4	451.9	404.4	356.9	309.4	261.9	214.3

RAU = 262.4 (kips); RA2 = 498.0 (kips)

Current CAPWAP Ru = 438.0 (kips); Corresponding J(RP)= 0.43; matches RX9 within 5%

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
13.9	35.84	530.8	586.3	591.5	0.85	0.12	0.12	24.1	593.9	1460

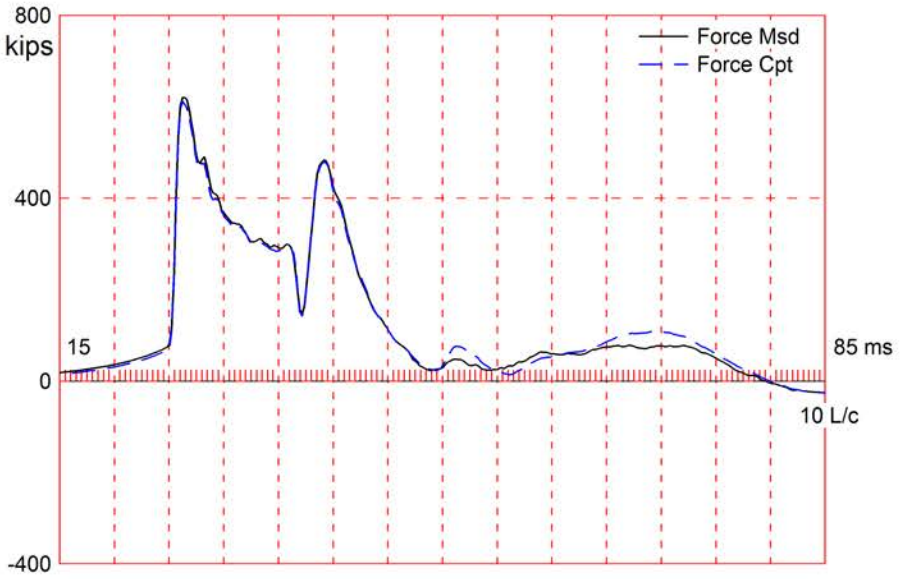
PILE PROFILE AND PILE MODEL

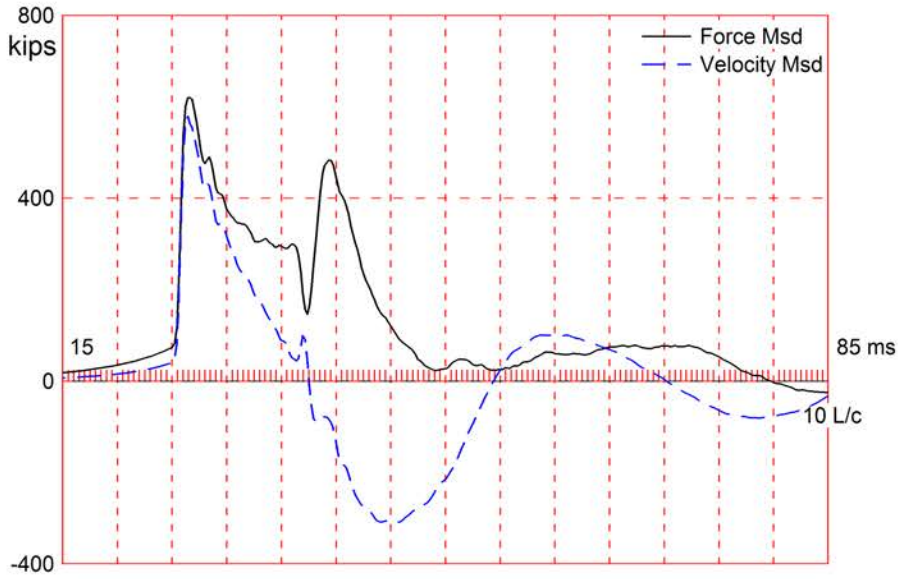
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
94.8	21.4	29992.2	492.000	4.70

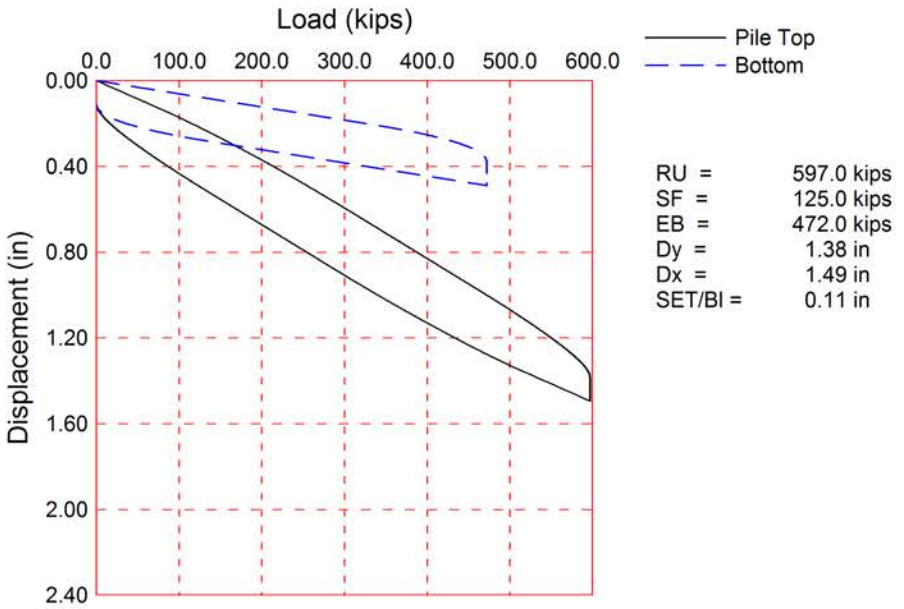
Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
23	77.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.020
24	81.2	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
25	84.6	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
28	94.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

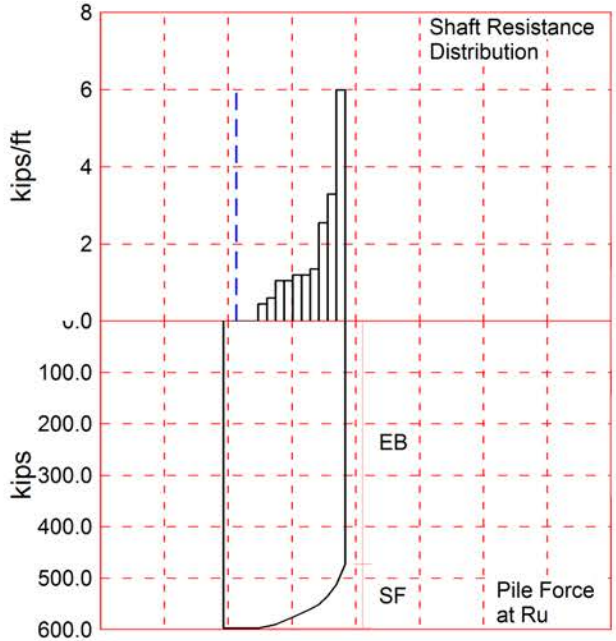
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.201 ms, 2L/c 11.3 ms
Total volume: 14.081 ft^3; Volume ratio considering added impedance: 1.000







RU =	597.0 kips
SF =	125.0 kips
EB =	472.0 kips
Dy =	1.38 in
Dx =	1.49 in
SET/Bl =	0.11 in



Length b. Sensors	93.5 ft
Embedment	83.0 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	3.01
Top Compr. Stress	28.6 ksi
Max Compr. Stress	29.3 ksi
Max Tension Stress	-5.81 ksi
Avg. Shaft Quake	0.09 in
Toe Quake	0.29 in
Avg. Shaft Smith Dpg.	0.25 s/ft
Toe Smith Damping	0.06 s/ft

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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: 597.0; along Shaft 125.0; at Toe 472.0 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
				597.0				
1	13.4	2.8	0.0	597.0	0.0	0.00	0.00	0.00
2	20.0	9.5	0.0	597.0	0.0	0.00	0.00	0.00
3	26.7	16.2	0.0	597.0	0.0	0.00	0.00	0.00
4	33.4	22.9	3.0	594.0	3.0	0.45	0.10	0.25
5	40.1	29.5	4.0	590.0	7.0	0.60	0.13	0.25
6	46.8	36.2	7.0	583.0	14.0	1.05	0.22	0.25
7	53.4	42.9	7.0	576.0	21.0	1.05	0.22	0.25
8	60.1	49.6	8.0	568.0	29.0	1.20	0.25	0.25
9	66.8	56.3	8.0	560.0	37.0	1.20	0.25	0.25
10	73.5	62.9	9.0	551.0	46.0	1.35	0.29	0.25
11	80.1	69.6	17.0	534.0	63.0	2.55	0.54	0.25
12	86.8	76.3	22.0	512.0	85.0	3.29	0.70	0.25
13	93.5	83.0	40.0	472.0	125.0	5.99	1.27	0.25
Avg. Shaft			9.6			1.51	0.32	0.25
Toe			472.0				342.40	0.06

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.09	0.29
Case Damping Factor		0.82	0.74
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	47
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	42	
Resistance Gap (included in Toe Quake)	(in)		0.06

CAPWAP match quality = 3.01 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.11 in; Blow Count = 107 b/ft
Computed: Final Set = 0.11 in; Blow Count = 114 b/ft

max. Top Comp. Stress = 28.6 ksi (T= 26.6 ms, max= 1.024 x Top)
max. Comp. Stress = 29.3 ksi (Z= 33.4 ft, T= 28.4 ms)
max. Tens. Stress = -5.81 ksi (Z= 66.8 ft, T= 52.4 ms)
max. Energy (EMX) = 35.5 kip-ft; max. Measured Top Displ. (DMX)= 1.04 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	613.1	-33.1	28.6	-1.55	35.5	15.3	1.08
2	6.7	613.8	-35.2	28.7	-1.64	35.3	15.3	1.07
4	13.4	615.2	-40.4	28.7	-1.89	34.8	15.3	1.03
6	20.0	616.8	-45.4	28.8	-2.12	34.1	15.2	0.98
8	26.7	620.1	-51.2	29.0	-2.39	33.4	15.1	0.94
10	33.4	627.8	-66.0	29.3	-3.08	32.5	14.9	0.88
12	40.1	624.0	-88.2	29.1	-4.12	30.8	14.6	0.83
14	46.8	619.4	-108.4	28.9	-5.06	28.8	14.2	0.77
15	50.1	595.9	-112.6	27.8	-5.26	26.9	14.0	0.74
16	53.4	602.7	-118.9	28.2	-5.55	26.2	13.8	0.71
17	56.8	579.9	-117.0	27.1	-5.47	24.3	13.5	0.68
18	60.1	587.3	-123.4	27.4	-5.77	23.6	13.4	0.65
19	63.4	561.0	-121.6	26.2	-5.68	21.5	13.1	0.61
20	66.8	568.8	-124.4	26.6	-5.81	20.8	13.0	0.58
21	70.1	544.5	-118.8	25.4	-5.55	18.9	12.7	0.55
22	73.5	559.0	-120.3	26.1	-5.62	18.1	12.4	0.51
23	76.8	558.3	-114.3	26.1	-5.34	16.2	12.0	0.48
24	80.1	573.9	-114.8	26.8	-5.36	15.4	12.2	0.44
25	83.5	563.4	-100.9	26.3	-4.71	12.8	13.4	0.41
26	86.8	588.8	-101.0	27.5	-4.72	12.0	14.1	0.38
27	90.2	570.1	-82.9	26.6	-3.87	9.4	14.3	0.34
28	93.5	584.6	-82.9	27.3	-3.87	6.9	12.6	0.31
Absolute	33.4			29.3			(T =	28.4 ms)
	66.8				-5.81		(T =	52.4 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	701.0	650.6	600.1	549.7	499.2	448.8	398.3	347.9	297.4	247.0
RX	776.4	746.8	720.4	697.5	679.9	662.6	645.2	627.9	610.6	598.0
RU	701.0	650.6	600.1	549.7	499.2	448.8	398.3	347.9	297.4	247.0

RAU = 387.4 (kips); RA2 = 620.3 (kips)

Current CAPWAP Ru = 597.0 (kips); Corresponding J(RP)= 0.21; matches RX9 within 5%

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
15.3	26.42	584.4	621.2	622.1	1.04	0.11	0.11	35.5	736.2	2052

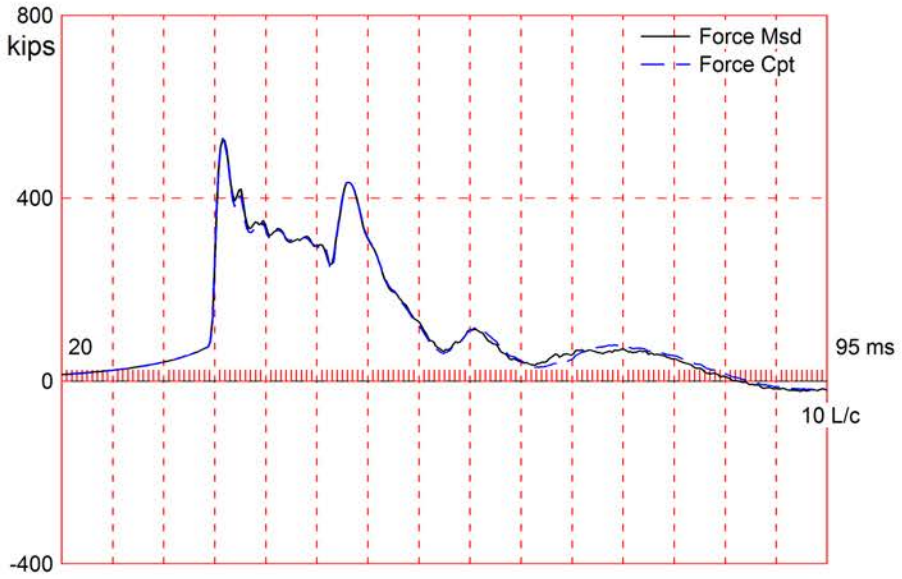
PILE PROFILE AND PILE MODEL

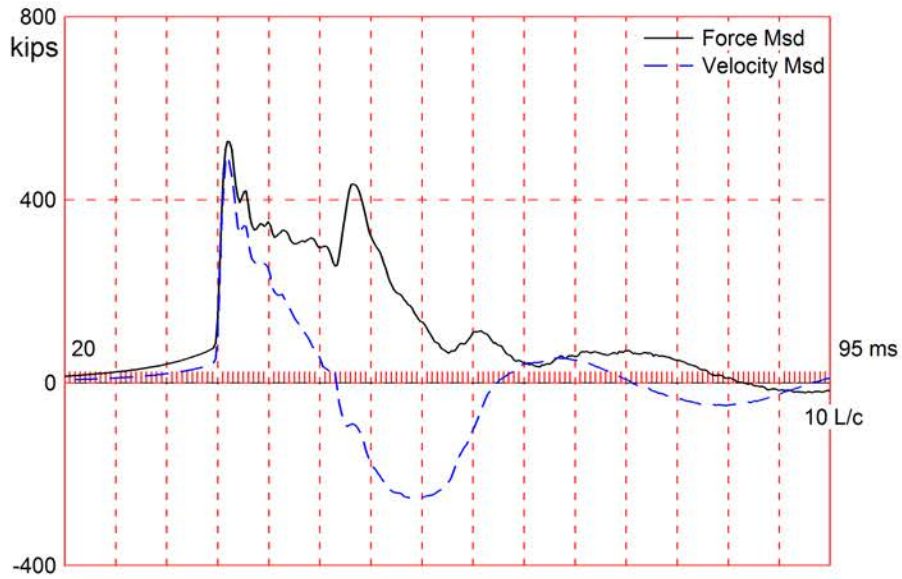
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
93.5	21.4	29992.2	492.000	4.70

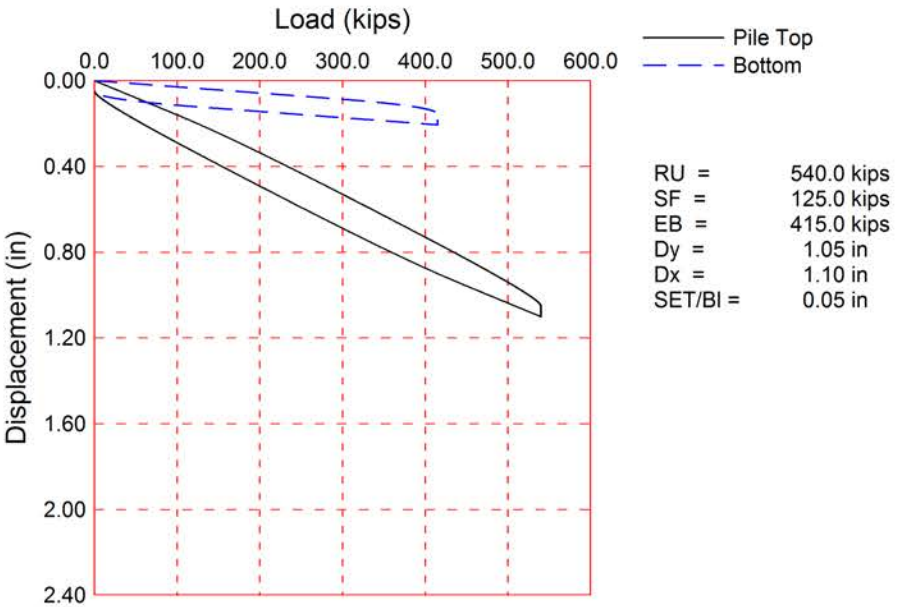
Toe Area 198.5 in^2

Top Segment Length 3.34 ft, Top Impedance 38 kips/ft/s

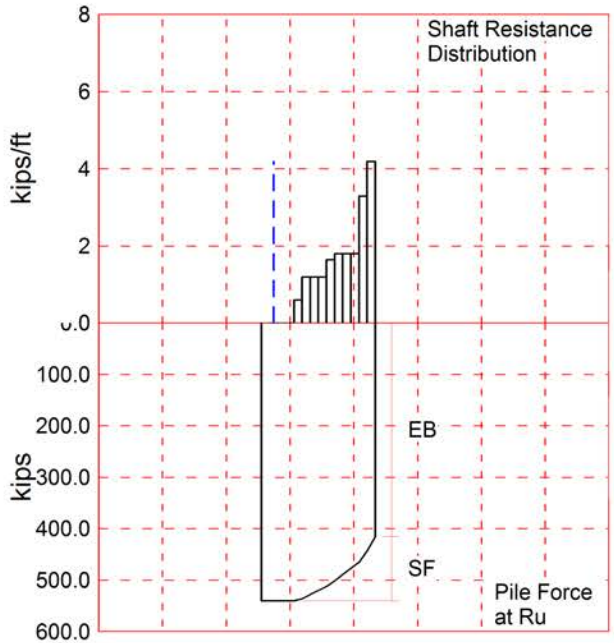
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.199 ms, 2L/c 11.1 ms
Total volume: 13.895 ft^3; Volume ratio considering added impedance: 1.000







RU =	540.0 kips
SF =	125.0 kips
EB =	415.0 kips
Dy =	1.05 in
Dx =	1.10 in
SET/Bl =	0.05 in



Length b. Sensors	93.5 ft
Embedment	83.0 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	24.9 ksi
Max Compr. Stress	25.9 ksi
Max Tension Stress	-1.52 ksi
Avg. Shaft Quake	0.09 in
Toe Quake	0.12 in
Avg. Shaft Smith Dpg.	0.29 s/ft
Toe Smith Damping	0.10 s/ft

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CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 540.0; along Shaft 125.0; at Toe 415.0 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
				540.0					
1	13.4	2.9	0.0	540.0	0.0	0.00	0.00	0.00	0.10
2	20.0	9.5	0.0	540.0	0.0	0.00	0.00	0.00	0.10
3	26.7	16.2	0.0	540.0	0.0	0.00	0.00	0.00	0.10
4	33.4	22.9	4.0	536.0	4.0	0.60	0.13	0.29	0.10
5	40.1	29.6	8.0	528.0	12.0	1.20	0.25	0.29	0.10
6	46.8	36.3	8.0	520.0	20.0	1.20	0.25	0.29	0.10
7	53.4	42.9	8.0	512.0	28.0	1.20	0.25	0.29	0.10
8	60.1	49.6	11.0	501.0	39.0	1.65	0.35	0.29	0.10
9	66.8	56.3	12.0	489.0	51.0	1.80	0.38	0.29	0.10
10	73.5	63.0	12.0	477.0	63.0	1.80	0.38	0.29	0.10
11	80.1	69.7	12.0	465.0	75.0	1.80	0.38	0.29	0.10
12	86.8	76.3	22.0	443.0	97.0	3.29	0.70	0.29	0.10
13	93.5	83.0	28.0	415.0	125.0	4.19	0.89	0.29	0.06
Avg. Shaft			9.6			1.51	0.32	0.29	0.09
Toe			415.0				301.06	0.10	0.12

Soil Model Parameters/Extensions		Shaft	Toe
Case Damping Factor		0.95	1.09
Damping Type		Viscous	Sm+Visc
Reloading Level	(% of Ru)	100	100

CAPWAP match quality = 2.12 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.05 in; Blow Count = 240 b/ft
Computed: Final Set = 0.04 in; Blow Count = 270 b/ft

max. Top Comp. Stress = 24.9 ksi (T= 36.2 ms, max= 1.040 x Top)
max. Comp. Stress = 25.9 ksi (Z= 33.4 ft, T= 37.9 ms)
max. Tens. Stress = -1.52 ksi (Z= 33.4 ft, T= 93.4 ms)
max. Energy (EMX) = 24.6 kip-ft; max. Measured Top Displ. (DMX)= 0.86 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	532.1	-21.0	24.9	-0.98	24.6	12.9	0.86
2	6.7	532.9	-22.2	24.9	-1.04	24.4	12.8	0.85
4	13.4	534.8	-24.6	25.0	-1.15	23.8	12.8	0.80
6	20.0	536.9	-27.5	25.1	-1.28	23.2	12.7	0.76
8	26.7	541.7	-30.2	25.3	-1.41	22.4	12.6	0.71
10	33.4	553.5	-32.5	25.9	-1.52	21.5	12.2	0.66
12	40.1	551.6	-31.0	25.8	-1.45	19.9	11.8	0.61
14	46.8	532.6	-25.7	24.9	-1.20	17.7	11.3	0.55
15	50.1	506.8	-19.5	23.7	-0.91	16.1	11.1	0.52
16	53.4	516.1	-25.8	24.1	-1.21	15.5	10.9	0.49
17	56.8	494.0	-20.5	23.1	-0.96	14.0	10.6	0.46
18	60.1	504.9	-27.9	23.6	-1.30	13.5	10.3	0.43
19	63.4	487.7	-18.4	22.8	-0.86	11.8	10.0	0.40
20	66.8	504.4	-25.2	23.6	-1.18	11.2	9.7	0.37
21	70.1	499.7	-15.2	23.3	-0.71	9.6	9.5	0.34
22	73.5	501.4	-21.4	23.4	-1.00	9.0	9.2	0.31
23	76.8	488.4	-11.8	22.8	-0.55	7.6	8.9	0.28
24	80.1	487.0	-17.7	22.7	-0.83	7.0	8.5	0.25
25	83.5	492.7	-9.0	23.0	-0.42	5.9	8.4	0.22
26	86.8	510.1	-14.2	23.8	-0.66	5.3	9.0	0.19
27	90.2	488.9	-2.2	22.8	-0.10	4.0	8.8	0.16
28	93.5	495.1	-6.3	23.1	-0.29	3.3	7.2	0.13
Absolute	33.4			25.9			(T =	37.9 ms)
	33.4				-1.52		(T =	93.4 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	692.0	658.4	624.7	591.1	557.4	523.8	490.2	456.5	422.9	389.2
RX	716.1	687.3	658.6	635.7	613.8	591.9	574.5	563.0	551.5	539.9
RU	705.5	673.2	640.9	608.6	576.3	544.0	511.7	479.4	447.1	414.8

RAU = 289.3 (kips); RA2 = 576.1 (kips)

Current CAPWAP Ru = 540.0 (kips); Corresponding J(RP)= 0.45; J(RX) = 0.90

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
13.1	36.16	499.3	529.1	530.3	0.86	0.05	0.05	24.8	650.5	3458

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
93.5	21.4	29992.2	492.000	4.70

Toe Area 198.5 in^2

Top Segment Length 3.34 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 0.199 ms, 2L/c 11.1 ms
Total volume: 13.895 ft^3; Volume ratio considering added impedance: 1.000