GRL Engineers, Inc.

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TRANSMITTAL

To: Mr. Kevin Weber	From: Travis Coleman
Company: Lunda Construction Co.	No. of Sheets: 47
E-mail: kweber@lundaconstruction.com	Date: February 26, 2015

RE: Dynamic Testing Results – USH 10 over Little Lake Butte des Morts
Structure B-70-403 - Pier 4
Winnebago County, Wisconsin

On February 24, 2015, Pier 4 #1, Pier 4 #36, and Pier 4 #44 at the above structure were dynamically tested during initial driving. The piles were tested during restrike on February 25. 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 cofferdam reference grade was reported to be EL 741.1 for Pier 4 #1 and EL 741.2 for Pier 4 #36 and Pier 4 #44. It was reported to GRL that the mud line was at EL 718.1. The piles have a required minimum tip elevation of EL 660. The HP 14x73 H-piles were equipped with driving shoes and were driven with an APE D30-42 hammer (number PD 0256) that was reported to be operated on fuel setting 4.

Pier 4 #1 was driven to a depth of 86.2 feet, which corresponds to a pile tip elevation of EL 654.9. The blow count over the final increment of driving was 10 blows for 1⅜ inches of penetration at an average hammer stroke of 6.9 feet. The blow count at the beginning of restrike was 10 blows for ⅝ inch of penetration at an average hammer stroke of 7.2 feet.

Pier 4 #36 was driven to a depth of 83.8 feet, which corresponds to a pile tip elevation of EL 657.4. The blow count over the final increment of driving was 10 blows for 2⅞ inches of penetration at an average hammer stroke of 6.2 feet. The blow count at the beginning of restrike was 10 blows for 1⅝ inch of penetration at an average hammer stroke of 6.8 feet.

Pier 4 #44 was driven to a depth of 87.9 feet, which corresponds to a pile tip elevation of EL 653.3. The blow count over the final increment of driving was 10 blows for 1⅜ inches of penetration at an average hammer stroke of 7.4 feet. The blow count at the beginning of restrike was 10 blows for ⅞ inch of penetration at an average hammer stroke of 7.8 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 4 of the USH 10 bridge over Little Lake Butte des Morts we recommend using the following criteria:

February 26, 2015

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	9	4
6.5	7	4
7.0	6	4
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 any minimum tip requirements. We anticipate the production piles will terminate at depths similar to those of the test piles.

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

Please call if you have any questions on these recommendations.

GRL Engineers, Inc.

Travis Coleman, P.E.

Mark Rawlings

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

Attachments:

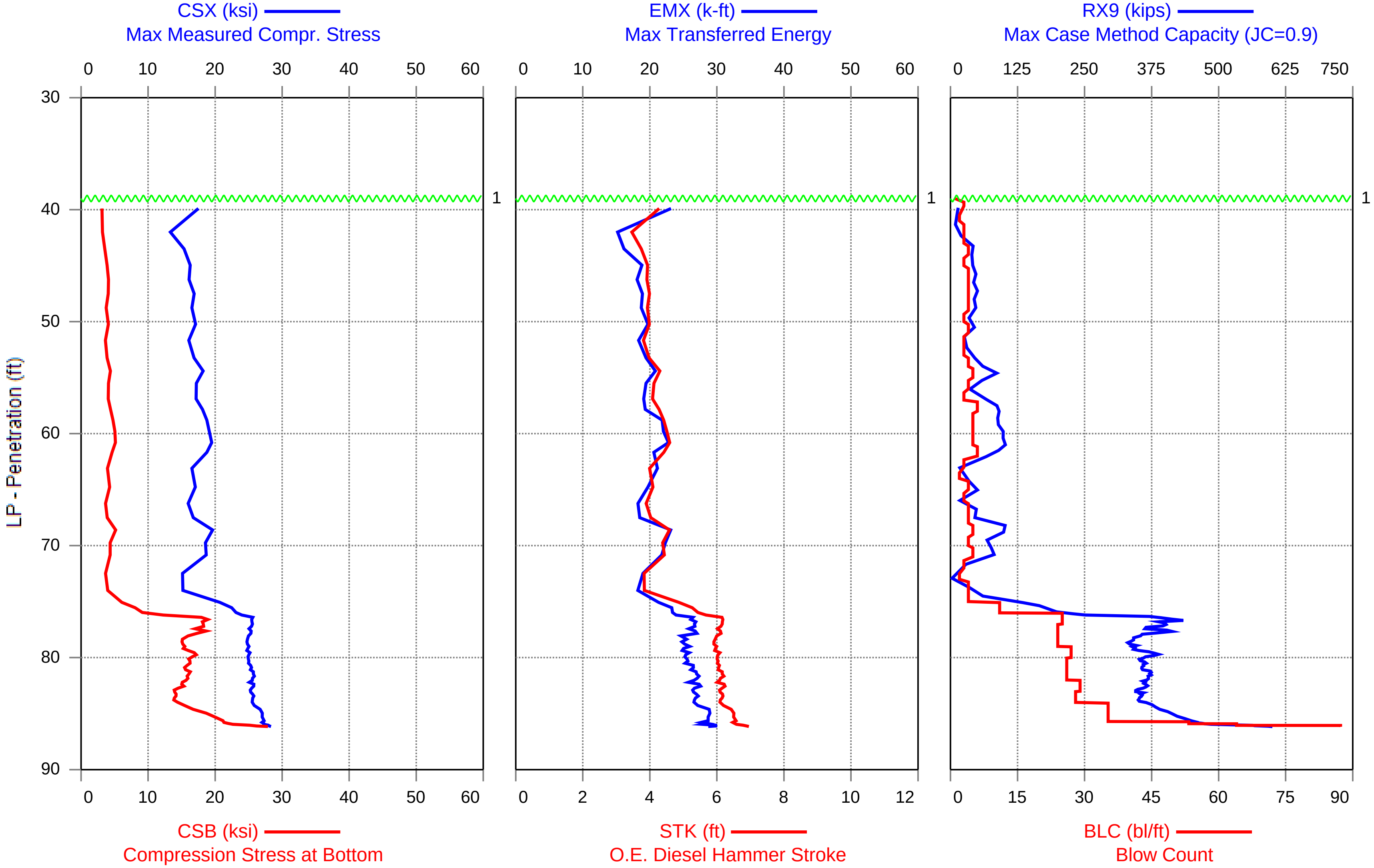
Dynamic Test Results - (pages 3 – 26)
CAPWAP Analysis Results - (pages 27 – 47)

Printed: 25-February-2015

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

Test started: 24-February-2015

USH 10 over Little Lake Butte des Morts - PIER 4 #1
APE D30-42, HP 14 x 73



1 - Reported reference at El. 741.1

2 - Mud line at El. 718.1

USH 10 over Little Lake Butte des Morts - PIER 4 #1
OP: TC

APE D30-42, HP 14 x 73
Date: 24-February-2015

AR: 21.40 in²
LE: 92.50 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
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
5	39.00	1	AV1	24.4	4.0	41	5.7	49.3	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	24.4	4.0	41	5.7	49.3	0
			MIN	24.4	4.0	41	5.7	49.3	0
6	39.33	3	AV1	18.0	3.5	20	4.2	57.0	29
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	18.0	3.5	20	4.2	57.0	29
			MIN	18.0	3.5	20	4.2	57.0	29
7	39.67	3	AV1	7.7	1.6	5	2.7	69.3	4
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	7.7	1.6	5	2.7	69.3	4
			MIN	7.7	1.6	5	2.7	69.3	4
9	40.50	2	AV1	22.0	3.7	32	5.2	51.5	10
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	22.0	3.7	32	5.2	51.5	10
			MIN	22.0	3.7	32	5.2	51.5	10
10	41.00	2	AV1	15.4	2.8	17	3.7	60.1	16
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	15.4	2.8	17	3.7	60.1	16
			MIN	15.4	2.8	17	3.7	60.1	16
13	42.00	3	AV3	12.3	3.0	14	3.3	63.6	5
			STD	1.0	0.2	2	0.1	1.2	1
			MAX	13.7	3.3	16	3.5	64.6	6
			MIN	11.6	2.8	13	3.2	61.9	3
16	43.00	3	AV3	14.3	3.4	16	3.6	60.7	30
			STD	0.8	0.1	1	0.1	1.1	4
			MAX	15.1	3.5	18	3.8	62.2	33
			MIN	13.3	3.2	15	3.4	59.7	23
20	44.00	4	AV4	15.9	3.6	17	3.8	59.4	44
			STD	1.6	0.2	1	0.2	1.7	4
			MAX	18.1	4.0	18	4.2	61.8	50
			MIN	13.6	3.4	14	3.5	56.9	40
23	45.00	3	AV3	15.7	3.7	19	3.8	59.6	38
			STD	0.6	0.1	1	0.1	0.5	5
			MAX	16.4	3.8	20	3.9	59.9	44
			MIN	15.0	3.7	17	3.7	58.9	32
27	46.00	4	AV4	16.9	4.1	19	4.0	57.9	48
			STD	0.8	0.1	1	0.2	1.2	2
			MAX	17.7	4.3	20	4.3	59.7	49
			MIN	15.7	4.0	18	3.8	56.3	44
31	47.00	4	AV4	16.1	4.2	18	3.9	58.4	45
			STD	0.8	0.3	1	0.0	0.3	4
			MAX	17.0	4.5	20	4.0	58.9	50
			MIN	14.9	3.6	16	3.9	58.0	40
35	48.00	4	AV4	16.9	4.0	19	4.0	58.2	47

USH 10 over Little Lake Butte des Morts - PIER 4 #1 APE D30-42, HP 14 x 73
OP: TC Date: 24-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	0.3	1	0.1	0.8	4
			MAX	17.8	4.5	20	4.1	59.3	51
			MIN	15.8	3.7	17	3.8	57.3	43
39	49.00	4	AV4	16.9	3.8	19	4.0	58.1	47
			STD	0.3	0.1	1	0.1	0.6	2
			MAX	17.3	4.0	20	4.1	58.9	50
			MIN	16.5	3.6	18	3.9	57.2	45
42	50.00	3	AV3	16.8	3.8	20	3.9	58.5	35
			STD	1.2	0.3	2	0.2	1.3	2
			MAX	17.8	4.2	22	4.1	60.3	36
			MIN	15.2	3.4	18	3.7	57.3	31
46	51.00	4	AV4	16.6	4.0	18	3.9	58.7	43
			STD	0.3	0.2	1	0.1	0.4	3
			MAX	16.9	4.3	19	4.0	59.2	46
			MIN	16.1	3.7	18	3.8	58.2	40
49	52.00	3	AV3	16.1	3.7	19	3.8	59.3	24
			STD	0.4	0.1	0	0.1	0.8	10
			MAX	16.7	3.8	19	4.0	60.0	33
			MIN	15.8	3.5	18	3.7	58.2	9
52	53.00	3	AV3	16.7	3.7	20	3.9	58.4	33
			STD	0.7	0.2	2	0.1	1.0	6
			MAX	17.6	4.1	22	4.1	59.7	39
			MIN	15.9	3.5	18	3.8	57.4	24
56	54.00	4	AV4	16.7	4.0	18	3.9	58.4	51
			STD	0.6	0.1	1	0.1	0.6	3
			MAX	17.7	4.1	19	4.1	59.0	54
			MIN	16.1	3.8	18	3.9	57.5	47
61	55.00	5	AV5	18.8	4.6	21	4.4	55.5	81
			STD	0.5	0.3	1	0.1	0.8	6
			MAX	19.2	5.1	22	4.5	57.0	88
			MIN	18.0	4.1	20	4.2	54.9	73
65	56.00	4	AV4	16.7	3.8	19	4.0	57.9	47
			STD	0.9	0.3	2	0.2	1.2	6
			MAX	17.9	4.2	22	4.3	59.3	53
			MIN	15.9	3.5	17	3.8	56.3	37
68	57.00	3	AV3	16.0	3.9	19	3.8	59.1	46
			STD	0.5	0.1	1	0.1	0.4	16
			MAX	16.6	4.0	20	3.9	59.4	58
			MIN	15.5	3.9	17	3.8	58.5	24
74	58.00	6	AV6	18.5	4.3	20	4.3	55.8	88
			STD	0.8	0.1	1	0.2	1.0	4
			MAX	19.6	4.4	21	4.5	57.3	96
			MIN	17.3	4.0	18	4.1	54.7	86
79	59.00	5	AV5	18.4	4.7	21	4.3	55.8	87
			STD	0.6	0.2	1	0.1	0.7	3
			MAX	18.9	4.9	22	4.5	57.0	89
			MIN	17.4	4.5	19	4.2	55.1	82
84	60.00	5	AV5	19.2	5.0	22	4.5	54.8	96
			STD	0.3	0.2	0	0.1	0.4	4
			MAX	19.7	5.2	23	4.6	55.4	102
			MIN	18.7	4.7	21	4.4	54.3	93

USH 10 over Little Lake Butte des Morts - PIER 4 #1 APE D30-42, HP 14 x 73
OP: TC Date: 24-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
89	61.00	5	AV5	19.5	5.2	23	4.6	54.4	101
			STD	0.7	0.2	1	0.1	0.7	4
			MAX	20.5	5.6	25	4.8	55.1	106
			MIN	18.7	5.1	22	4.5	53.3	96
95	62.00	6	AV6	18.8	4.6	21	4.4	55.4	87
			STD	0.5	0.3	1	0.1	0.6	9
			MAX	19.8	5.1	22	4.6	56.0	97
			MIN	18.1	4.2	20	4.3	54.2	70
98	63.00	3	AV3	16.9	4.1	21	4.1	57.4	32
			STD	0.5	0.2	1	0.1	0.6	11
			MAX	17.6	4.4	22	4.2	57.9	44
			MIN	16.6	3.9	21	4.0	56.5	17
100	64.00	2	AV2	15.9	3.7	21	3.8	59.2	0
			STD	0.6	0.1	1	0.1	0.9	0
			MAX	16.6	3.8	22	4.0	60.1	0
			MIN	15.3	3.6	20	3.7	58.3	0
104	65.00	4	AV4	16.9	4.3	19	4.1	57.7	54
			STD	1.8	0.4	3	0.4	2.5	3
			MAX	19.1	4.8	23	4.6	60.5	56
			MIN	15.1	3.7	16	3.7	54.4	49
107	66.00	3	AV3	16.9	4.0	20	4.0	57.8	20
			STD	0.7	0.3	1	0.1	0.7	16
			MAX	17.8	4.3	21	4.2	58.5	40
			MIN	16.3	3.7	20	3.9	56.8	0
111	67.00	4	AV4	16.1	3.7	18	3.9	58.7	44
			STD	0.8	0.2	1	0.2	1.1	7
			MAX	17.2	3.9	19	4.1	60.0	52
			MIN	15.0	3.5	16	3.7	57.3	33
115	68.00	4	AV4	16.6	3.9	18	4.0	58.0	57
			STD	0.7	0.3	1	0.2	1.1	21
			MAX	17.7	4.4	20	4.2	59.7	89
			MIN	15.9	3.7	17	3.8	56.7	33
120	69.00	5	AV5	19.6	5.2	23	4.6	54.5	103
			STD	0.6	0.3	1	0.1	0.7	6
			MAX	20.4	5.5	24	4.7	55.4	110
			MIN	18.7	4.6	22	4.4	53.6	93
124	70.00	4	AV4	18.6	4.3	22	4.4	55.6	67
			STD	0.2	0.2	0	0.1	0.5	4
			MAX	18.9	4.5	23	4.5	56.3	73
			MIN	18.3	4.1	22	4.3	55.1	63
129	71.00	5	AV5	18.7	4.4	22	4.4	55.3	82
			STD	0.5	0.2	0	0.1	0.5	3
			MAX	19.4	4.6	22	4.5	55.9	86
			MIN	18.1	4.1	21	4.3	54.7	77
132	72.00	3	AV3	16.5	3.8	20	4.0	57.8	29
			STD	1.5	0.2	2	0.3	1.7	16
			MAX	18.4	4.0	22	4.4	59.9	51
			MIN	14.7	3.6	18	3.7	55.7	15
134	73.00	2	AV2	15.4	3.7	20	3.9	58.9	0
			STD	0.4	0.1	0	0.1	0.4	0

USH 10 over Little Lake Butte des Morts - PIER 4 #1 APE D30-42, HP 14 x 73
OP: TC Date: 24-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			MAX	15.8	3.7	21	3.9	59.3	0
			MIN	15.0	3.6	20	3.8	58.5	0
138	74.00	4	AV4	14.5	3.6	17	3.8	59.8	29
			STD	0.8	0.0	1	0.1	0.9	14
			MAX	15.7	3.6	18	3.9	60.7	43
			MIN	13.7	3.6	16	3.6	58.8	9
142	75.00	4	AV4	17.4	4.9	20	4.2	57.0	76
			STD	2.2	0.6	3	0.5	2.8	47
			MAX	21.2	5.4	25	5.0	59.0	122
			MIN	15.5	3.8	16	3.9	52.2	0
153	76.00	11	AV11	22.5	7.9	23	5.3	51.0	174
			STD	0.6	1.0	1	0.1	0.7	21
			MAX	23.3	8.9	24	5.5	52.0	200
			MIN	21.7	5.9	21	5.1	50.0	133
178	77.00	25	AV25	25.0	16.4	26	6.0	48.0	361
			STD	0.9	3.4	2	0.3	1.1	71
			MAX	26.2	20.3	28	6.3	50.3	450
			MIN	23.1	9.0	22	5.4	46.7	221
226	79.00	24	AV45	25.1	16.6	26	6.0	47.8	364
			STD	0.4	1.6	1	0.1	0.4	29
			MAX	26.0	21.3	28	6.2	48.5	418
			MIN	24.4	14.4	19	5.9	47.1	325
253	80.00	27	AV27	24.9	16.3	25	6.0	47.9	363
			STD	0.3	0.8	1	0.1	0.3	18
			MAX	25.4	17.9	27	6.1	48.5	393
			MIN	24.3	15.0	24	5.9	47.4	336
279	81.00	26	AV26	25.1	15.9	26	6.0	47.8	358
			STD	0.3	0.4	1	0.1	0.3	5
			MAX	26.0	16.5	27	6.2	48.5	370
			MIN	24.4	15.3	25	5.9	47.2	348
305	82.00	26	AV26	25.6	16.0	27	6.1	47.4	370
			STD	0.3	0.3	1	0.1	0.3	7
			MAX	26.2	16.8	28	6.3	48.0	385
			MIN	25.1	15.5	26	6.0	46.9	355
334	83.00	29	AV29	25.4	14.8	27	6.1	47.5	359
			STD	0.4	0.6	1	0.1	0.4	8
			MAX	26.2	15.7	29	6.4	48.6	372
			MIN	24.4	13.6	24	5.8	46.5	340
362	84.00	28	AV28	25.6	14.1	27	6.1	47.4	354
			STD	0.3	0.3	0	0.1	0.3	5
			MAX	26.1	14.7	28	6.3	48.1	367
			MIN	25.0	13.4	26	6.0	46.9	343
387	85.71	35	AV25	26.7	18.1	28	6.4	46.4	408
			STD	0.6	2.2	1	0.1	0.5	26
			MAX	27.4	21.3	29	6.6	47.5	456
			MIN	25.6	14.6	27	6.1	45.7	366
397	85.90	53	AV10	27.1	21.6	28	6.5	46.1	462
			STD	0.2	0.4	1	0.1	0.2	7
			MAX	27.5	22.4	29	6.6	46.5	479
			MIN	26.7	21.0	27	6.4	45.8	455

USH 10 over Little Lake Butte des Morts - PIER 4 #1
OP: TC

APE D30-42, HP 14 x 73
Date: 24-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
407	86.05	64	AV10	27.5	23.6	29	6.7	45.6	510
			STD	0.5	1.4	1	0.1	0.5	33
			MAX	28.4	26.2	31	7.0	46.2	564
			MIN	26.9	22.1	27	6.5	44.6	470
417	86.17	87	AV10	28.2	26.8	29	6.9	44.8	585
			STD	0.3	1.0	2	0.1	0.2	18
			MAX	28.8	28.0	30	7.0	45.2	608
			MIN	27.8	25.5	24	6.8	44.4	554
			Average	22.7	12.4	24	5.5	50.8	268
			Std. Dev.	4.2	6.6	4	1.0	5.0	163
			Maximum	28.8	28.0	41	7.0	69.3	608
			Minimum	7.7	1.6	5	2.7	44.4	0

Total number of blows analyzed: 409

BL# Sensors

1-417 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.07); A4: [K2524] 360.0 (1.07)

BL# Comments

5 Reported reference at El. 741.1

Time Summary

Drive 10 minutes 38 seconds 11:43 AM - 11:54 AM BN 1 - 417

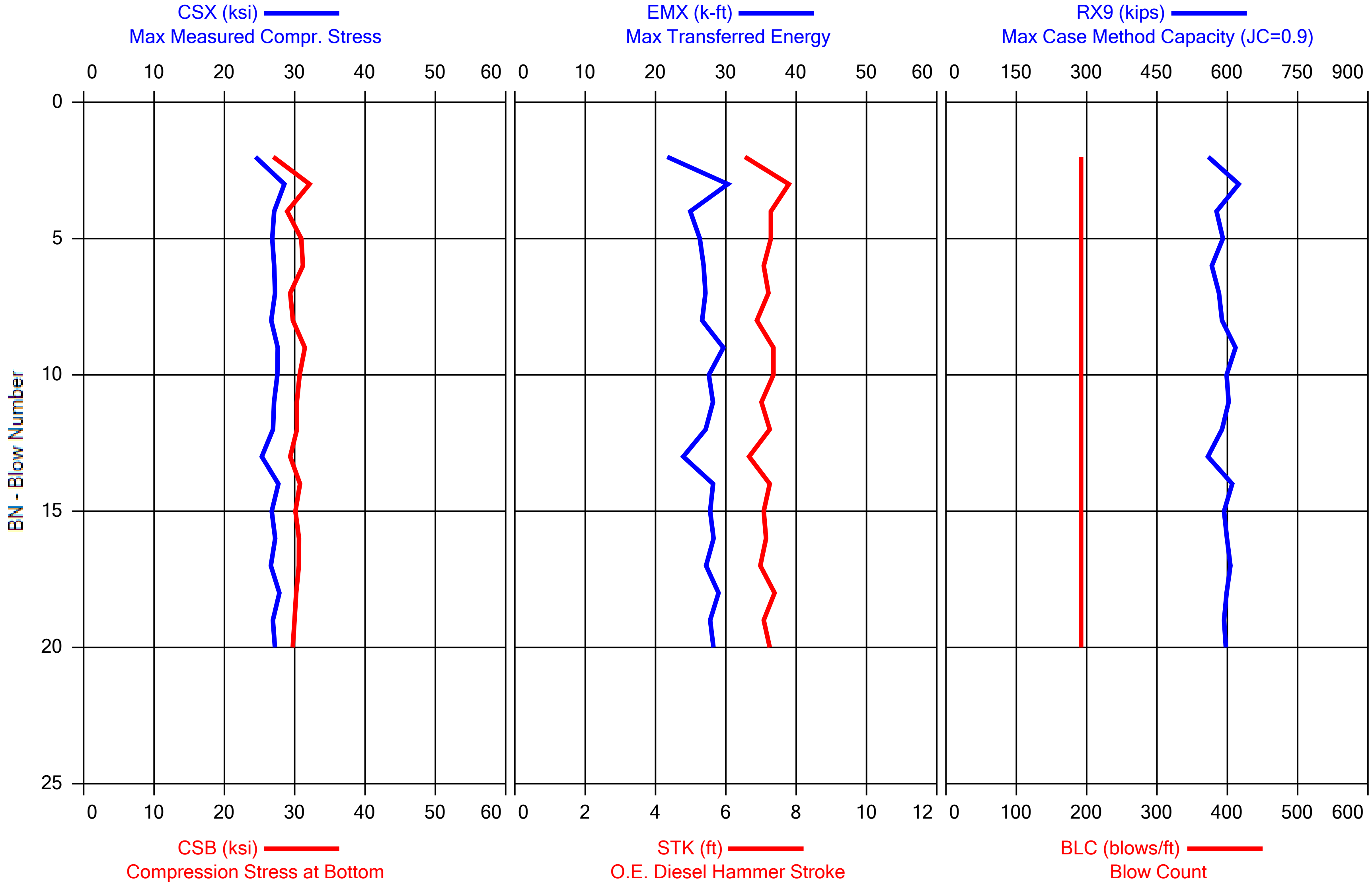
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 26-February-2015

Test started: 25-February-2015

USH 10 over Little Lake Butte des Morts - PIER 4 #1 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - PIER 4 #1 Restrike APE D30-42, HP 14 x 73
OP: TC Date: 25-February-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
10	86.22	192	AV9	27.0	30.1	27	7.2	44.0	589
			STD	1.0	1.5	2	0.3	1.0	20
			MAX	28.5	32.1	30	7.8	46.0	624
			MIN	24.4	27.0	22	6.5	42.3	559
20	86.27	192	AV10	26.9	30.2	28	7.1	44.2	595
			STD	0.6	0.4	1	0.2	0.6	14
			MAX	27.8	30.8	29	7.4	45.6	610
			MIN	25.3	29.4	24	6.7	43.4	558
			Average	27.0	30.2	27	7.2	44.1	592
			Std. Dev.	0.9	1.1	2	0.3	0.8	17
			Maximum	28.5	32.1	30	7.8	46.0	624
			Minimum	24.4	27.0	22	6.5	42.3	558

Total number of blows analyzed: 19

BL# Sensors

1-20 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.09); A4: [K3550] 360.0 (1.09)

Time Summary

Drive 25 seconds 8:22 AM - 8:23 AM BN 1 - 20

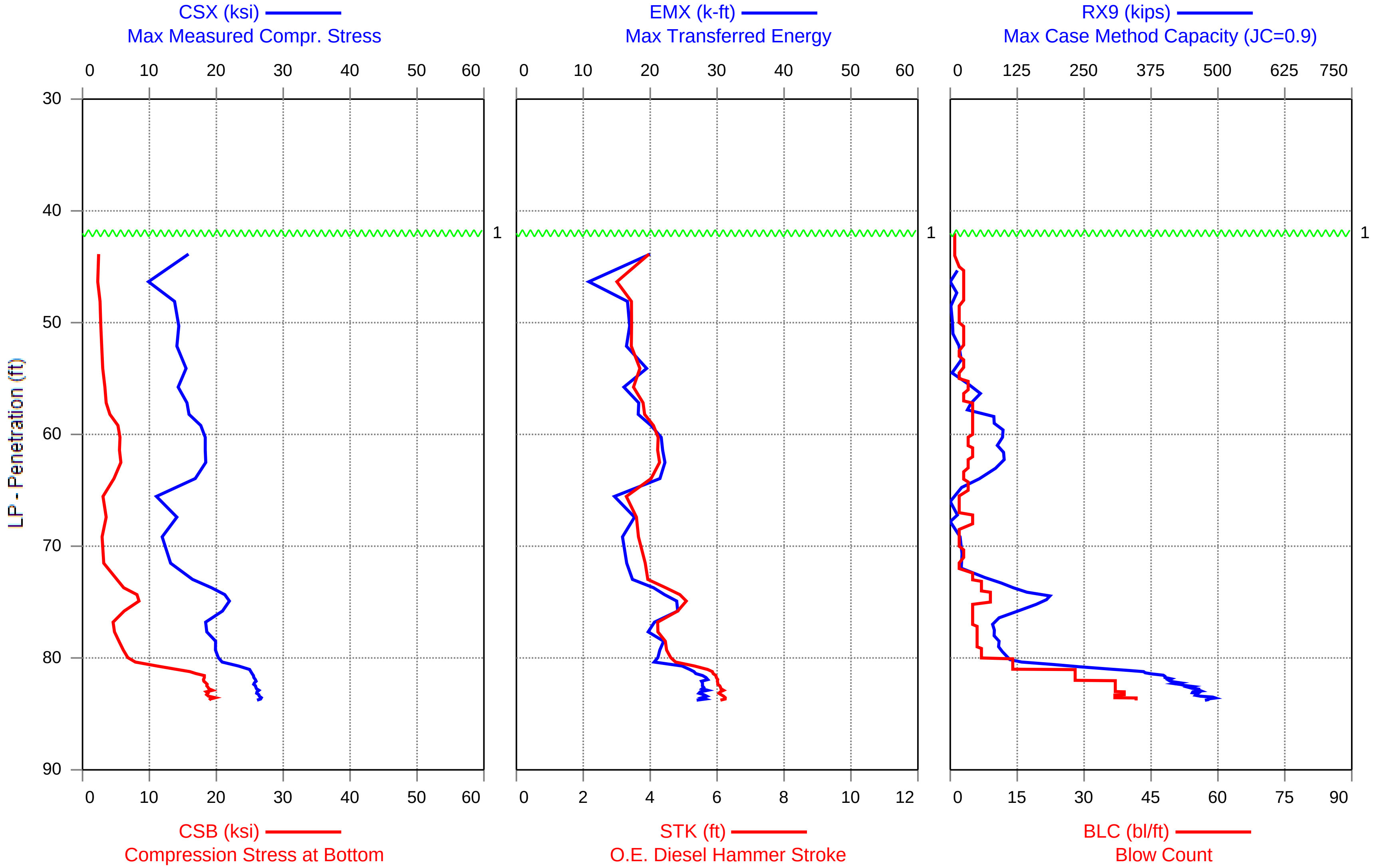
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 25-February-2015

Test started: 24-February-2015

USH 10 over Little Lake Butte des Morts - PIER 4 #36

APE D30-42, HP 14 x 73



1 - Reported reference at El. 741.2

2 - Mud line at El. 718.1

USH 10 over Little Lake Butte des Morts - PIER 4 #36 APE D30-42, HP 14 x 73
OP: TC Date: 24-February-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 93.67 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	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
6	42.00	1	AV1	25.0	3.3	35	5.3	50.7	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	25.0	3.3	35	5.3	50.7	0
			MIN	25.0	3.3	35	5.3	50.7	0
7	43.00	1	AV1	12.9	2.2	17	3.0	66.1	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	12.9	2.2	17	3.0	66.1	0
			MIN	12.9	2.2	17	3.0	66.1	0
8	44.00	1	AV1	1.7	0.0	1	2.7	68.9	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	1.7	0.0	1	2.7	68.9	0
			MIN	1.7	0.0	1	2.7	68.9	0
10	45.00	2	AV1	26.0	3.9	32	5.6	49.6	40
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	26.0	3.9	32	5.6	49.6	40
			MIN	26.0	3.9	32	5.6	49.6	40
11	45.33	3	AV1	13.6	2.7	15	3.2	64.7	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	13.6	2.7	15	3.2	64.7	0
			MIN	13.6	2.7	15	3.2	64.7	0
12	45.67	3	AV1	9.5	2.1	9	2.9	66.9	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	9.5	2.1	9	2.9	66.9	0
			MIN	9.5	2.1	9	2.9	66.9	0
13	46.00	3	AV1	7.2	1.9	7	2.8	68.4	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	7.2	1.9	7	2.8	68.4	0
			MIN	7.2	1.9	7	2.8	68.4	0
16	47.00	3	AV3	10.9	2.5	13	3.1	65.4	0
			STD	2.4	0.5	3	0.2	2.3	1
			MAX	13.8	3.2	16	3.4	68.4	1
			MIN	7.8	1.9	8	2.8	62.8	0
19	48.00	3	AV3	13.4	2.7	15	3.4	62.8	13
			STD	1.5	0.2	2	0.2	1.7	7
			MAX	15.6	2.9	17	3.7	64.1	19
			MIN	12.4	2.4	13	3.2	60.4	4
21	49.00	2	AV2	14.3	2.6	19	3.5	61.6	0
			STD	0.1	0.0	1	0.0	0.1	0
			MAX	14.3	2.6	20	3.5	61.6	0
			MIN	14.2	2.6	18	3.5	61.5	0
23	50.00	2	AV2	15.8	2.7	20	3.6	60.7	0
			STD	0.6	0.1	1	0.1	1.0	0
			MAX	16.4	2.8	22	3.8	61.7	0
			MIN	15.2	2.5	19	3.5	59.7	0
26	51.00	3	AV3	13.4	2.8	15	3.3	63.3	7

USH 10 over Little Lake Butte des Morts - PIER 4 #36 APE D30-42, HP 14 x 73
OP: TC Date: 24-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			STD	0.4	0.1	0	0.1	0.6	5
			MAX	13.9	3.0	15	3.4	64.1	12
			MIN	13.0	2.7	14	3.2	62.6	0
29	52.00	3	AV3	14.6	3.0	16	3.5	61.8	11
			STD	0.6	0.1	0	0.1	0.5	6
			MAX	15.4	3.0	16	3.6	62.3	19
			MIN	14.1	2.8	16	3.4	61.1	7
31	53.00	2	AV2	13.4	2.7	17	3.3	63.2	24
			STD	1.7	0.3	3	0.3	2.4	2
			MAX	15.1	3.0	21	3.6	65.6	25
			MIN	11.6	2.4	14	3.1	60.8	22
34	54.00	3	AV3	14.9	3.0	18	3.6	61.0	12
			STD	2.6	0.5	3	0.4	3.2	17
			MAX	18.2	3.6	21	4.1	65.0	36
			MIN	11.7	2.5	14	3.1	57.2	0
36	55.00	2	AV2	16.3	3.1	22	3.8	59.5	5
			STD	0.8	0.1	0	0.1	0.5	5
			MAX	17.1	3.1	22	3.9	60.0	10
			MIN	15.5	3.0	22	3.7	59.0	0
40	56.00	4	AV4	14.0	3.2	15	3.4	62.2	38
			STD	0.5	0.1	1	0.0	0.4	7
			MAX	14.7	3.3	16	3.5	62.7	48
			MIN	13.4	3.0	14	3.4	61.6	31
43	57.00	3	AV3	17.8	4.3	23	4.1	57.5	58
			STD	1.7	0.3	2	0.3	2.0	6
			MAX	19.7	4.7	25	4.4	60.1	66
			MIN	15.7	3.9	21	3.7	55.4	53
48	58.00	5	AV5	12.7	3.2	14	3.3	63.5	32
			STD	2.7	0.7	3	0.4	3.1	21
			MAX	16.6	4.1	17	3.9	67.4	60
			MIN	9.1	2.3	9	2.9	58.5	0
53	59.00	5	AV5	18.1	4.7	21	4.2	57.1	79
			STD	1.3	0.3	2	0.3	1.7	13
			MAX	19.8	5.1	23	4.6	59.0	94
			MIN	16.4	4.2	19	3.9	54.6	62
58	60.00	5	AV5	18.0	5.6	21	4.2	56.9	97
			STD	0.3	0.3	1	0.0	0.2	2
			MAX	18.5	5.9	21	4.2	57.1	101
			MIN	17.7	5.2	20	4.1	56.5	93
62	61.00	4	AV4	18.3	5.5	22	4.2	56.6	94
			STD	0.8	0.4	1	0.2	1.0	7
			MAX	19.2	6.1	24	4.4	58.1	105
			MIN	17.1	5.0	20	4.0	55.7	85
67	62.00	5	AV5	18.7	5.8	22	4.3	56.1	97
			STD	0.5	0.3	1	0.1	0.6	7
			MAX	19.1	6.1	23	4.4	57.4	106
			MIN	17.8	5.3	21	4.1	55.7	86
71	63.00	4	AV4	18.3	5.7	22	4.3	56.3	96
			STD	0.2	0.3	0	0.0	0.1	6
			MAX	18.5	6.1	23	4.3	56.4	100
			MIN	18.1	5.2	22	4.3	56.2	86

USH 10 over Little Lake Butte des Morts - PIER 4 #36 APE D30-42, HP 14 x 73
OP: TC Date: 24-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
74	64.00	3	AV3	17.7	4.9	23	4.1	57.2	61
			STD	0.5	0.1	1	0.1	0.5	6
			MAX	18.2	5.0	24	4.2	57.8	69
			MIN	17.1	4.8	22	4.0	56.5	55
78	65.00	4	AV4	14.6	4.0	18	3.7	59.9	28
			STD	1.2	0.4	1	0.1	1.0	18
			MAX	16.3	4.6	20	3.9	61.2	48
			MIN	13.2	3.6	17	3.6	58.4	0
80	66.00	2	AV2	9.5	2.7	13	3.1	65.3	0
			STD	1.6	0.3	2	0.2	1.7	0
			MAX	11.1	3.0	15	3.3	67.0	0
			MIN	7.9	2.4	11	2.9	63.6	0
82	67.00	2	AV2	12.1	3.2	17	3.3	63.4	0
			STD	2.8	0.5	5	0.3	3.0	0
			MAX	14.9	3.7	22	3.7	66.4	0
			MIN	9.3	2.6	13	3.0	60.4	0
87	68.00	5	AV5	13.0	3.4	15	3.4	62.4	8
			STD	3.0	0.6	4	0.4	3.1	16
			MAX	17.2	4.4	20	3.9	66.8	40
			MIN	9.4	2.8	10	2.9	58.7	0
89	69.00	2	AV2	4.3	1.3	5	2.8	68.2	0
			STD	2.1	0.6	3	0.0	0.0	0
			MAX	6.4	1.9	9	2.8	68.2	0
			MIN	2.2	0.7	2	2.8	68.1	0
91	70.00	2	AV1	26.7	5.1	41	6.2	47.3	55
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	26.7	5.1	41	6.2	47.3	55
			MIN	26.7	5.1	41	6.2	47.3	55
94	71.00	3	AV3	14.3	3.8	17	3.6	61.2	22
			STD	0.7	0.1	1	0.1	0.9	17
			MAX	14.8	4.0	18	3.7	62.0	43
			MIN	13.3	3.6	16	3.5	59.9	0
96	72.00	2	AV2	6.3	1.6	8	3.1	65.7	0
			STD	3.8	1.0	5	0.3	2.5	0
			MAX	10.1	2.6	13	3.3	68.1	0
			MIN	2.5	0.6	3	2.8	63.2	0
101	73.00	5	AV4	17.5	4.6	20	4.2	57.6	64
			STD	4.8	0.7	7	1.0	5.8	10
			MAX	25.2	5.3	31	5.9	62.8	80
			MIN	13.4	3.9	14	3.4	48.3	54
108	74.00	7	AV7	19.1	6.2	20	4.4	55.4	111
			STD	1.2	0.9	2	0.3	1.4	19
			MAX	21.3	7.8	24	4.9	57.4	139
			MIN	17.6	4.9	18	4.1	52.8	82
117	75.00	9	AV9	21.6	8.3	23	5.0	52.4	173
			STD	0.8	1.0	1	0.2	0.9	19
			MAX	22.7	9.7	24	5.2	53.8	199
			MIN	20.1	6.2	21	4.7	51.1	132
122	76.00	5	AV5	21.4	6.9	25	4.9	52.7	138
			STD	0.6	1.2	1	0.1	0.7	18

USH 10 over Little Lake Butte des Morts - PIER 4 #36
OP: TC
APE D30-42, HP 14 x 73
Date: 24-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			MAX	22.0	8.4	26	5.0	54.1	159
			MIN	20.3	5.3	23	4.6	52.1	110
127	77.00	5	AV5	18.6	4.6	21	4.3	56.3	85
			STD	1.0	0.3	2	0.2	1.4	11
			MAX	19.8	5.2	22	4.6	58.2	105
			MIN	17.2	4.4	18	4.0	54.6	74
133	78.00	6	AV6	18.6	4.8	20	4.2	56.5	81
			STD	0.4	0.1	1	0.1	0.6	5
			MAX	19.3	5.0	21	4.4	57.3	89
			MIN	18.0	4.6	19	4.1	55.7	76
139	79.00	6	AV6	19.9	5.5	22	4.5	55.2	90
			STD	0.2	0.2	0	0.0	0.2	1
			MAX	20.1	5.9	23	4.5	55.6	92
			MIN	19.4	5.1	21	4.4	55.0	88
146	80.00	7	AV7	20.1	6.4	22	4.6	54.6	100
			STD	0.4	0.4	1	0.1	0.6	5
			MAX	20.6	6.9	23	4.7	55.6	106
			MIN	19.4	5.9	21	4.4	54.0	93
160	81.00	14	AV14	22.2	9.8	23	5.1	52.0	186
			STD	1.8	2.5	3	0.4	2.0	66
			MAX	25.1	14.0	27	5.7	54.6	297
			MIN	20.0	6.8	19	4.6	49.0	110
188	82.00	28	AV28	25.4	17.2	27	5.9	48.3	381
			STD	0.4	1.4	1	0.1	0.5	31
			MAX	26.3	18.9	30	6.1	49.3	417
			MIN	24.7	13.7	25	5.7	47.5	308
225	83.00	37	AV37	25.9	18.7	28	6.1	47.6	441
			STD	0.5	0.5	1	0.1	0.4	19
			MAX	27.4	20.2	30	6.4	48.3	472
			MIN	25.2	17.6	27	5.9	46.4	406
236	83.28	39	AV11	26.0	18.6	27	6.1	47.7	457
			STD	0.2	0.3	1	0.0	0.2	9
			MAX	26.4	19.0	28	6.1	48.0	469
			MIN	25.7	18.0	26	6.0	47.4	445
246	83.55	37	AV10	26.5	19.2	28	6.2	47.2	475
			STD	0.4	0.7	1	0.1	0.4	17
			MAX	27.2	20.5	29	6.4	47.9	506
			MIN	25.7	18.4	27	6.0	46.6	455
256	83.79	42	AV10	26.5	19.1	28	6.2	47.2	483
			STD	0.4	0.5	1	0.1	0.4	8
			MAX	27.3	20.2	30	6.5	47.9	496
			MIN	25.7	18.7	26	6.0	46.3	471
			Average	20.5	10.2	23	4.9	54.0	213
			Std. Dev.	5.6	6.8	6	1.1	6.3	184
			Maximum	27.4	20.5	41	6.5	68.9	506
			Minimum	1.7	0.0	1	2.7	46.3	0

Total number of blows analyzed: 248

BL# Sensors

1-256 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.08); A4: [K3550] 360.0 (1.08)

BL#	Comments
6	Reported reference at El. 741.2

Time Summary

Drive 7 minutes 4 seconds 12:15 PM - 12:22 PM BN 1 - 256

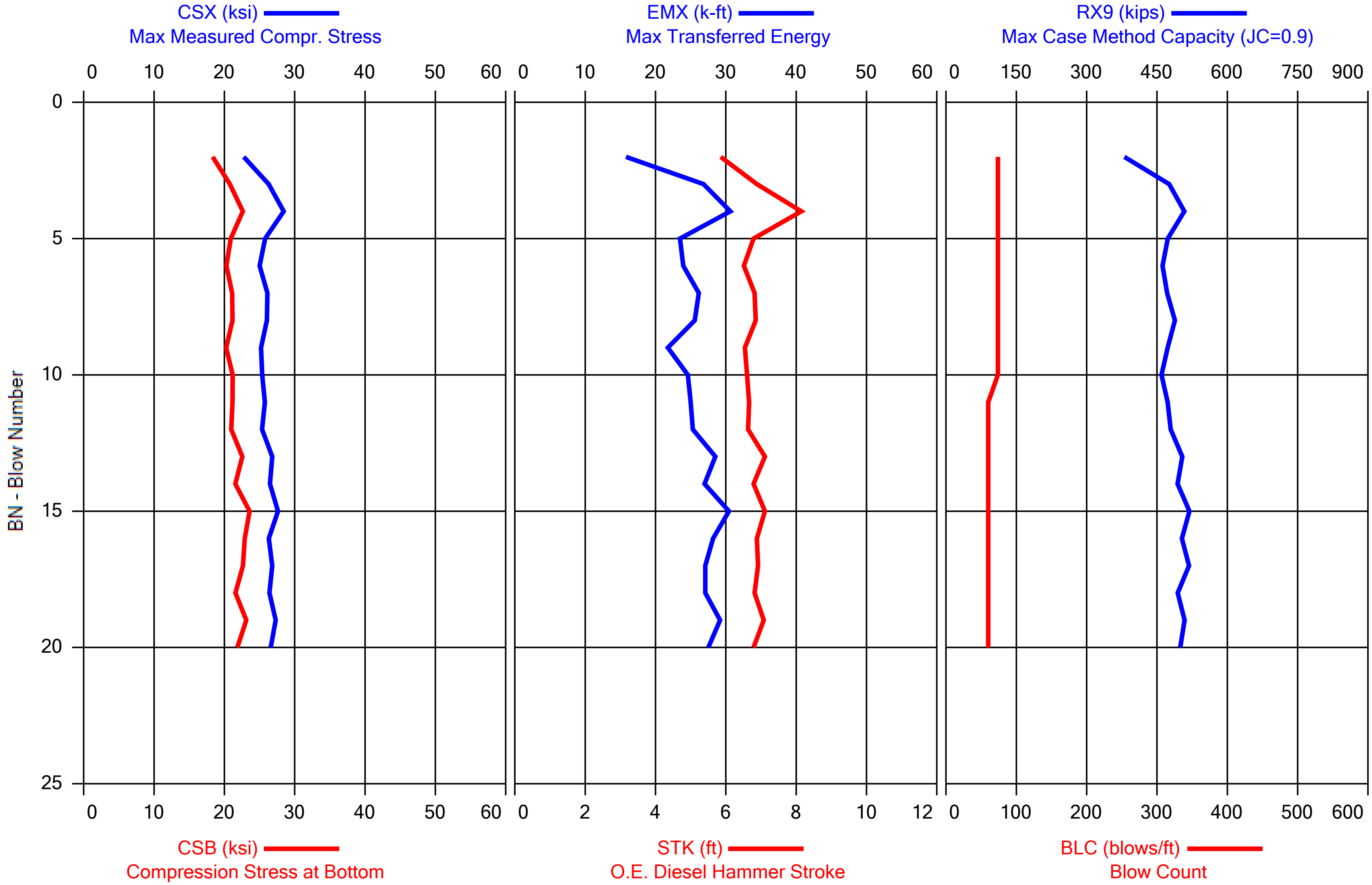
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 26-February-2015

Test started: 25-February-2015

USH 10 over Little Lake Butte des Morts - PIER 4 #36 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - PIER 4 #36 Restrike APE D30-42, HP 14 x 73
OP: TC Date: 25-February-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 93.67 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	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
10	83.93	74	AV9	25.7	20.7	24	6.8	45.3	466
			STD	1.4	1.1	4	0.6	1.7	33
			MAX	28.4	22.6	31	8.1	48.5	508
			MIN	22.7	18.3	16	5.9	41.4	380
20	84.09	60	AV10	26.5	22.2	28	6.9	44.9	499
			STD	0.6	0.8	2	0.2	0.5	14
			MAX	27.6	23.6	30	7.1	45.7	519
			MIN	25.4	21.0	25	6.6	44.2	473
			Average	26.1	21.5	26	6.8	45.1	483
			Std. Dev.	1.2	1.2	3	0.4	1.3	30
			Maximum	28.4	23.6	31	8.1	48.5	519
			Minimum	22.7	18.3	16	5.9	41.4	380

Total number of blows analyzed: 19

BL# Sensors

1-20 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.09); A4: [K3550] 360.0 (1.09)

Time Summary

Drive 25 seconds 8:14 AM - 8:14 AM BN 1 - 20

GRL engineers, inc.

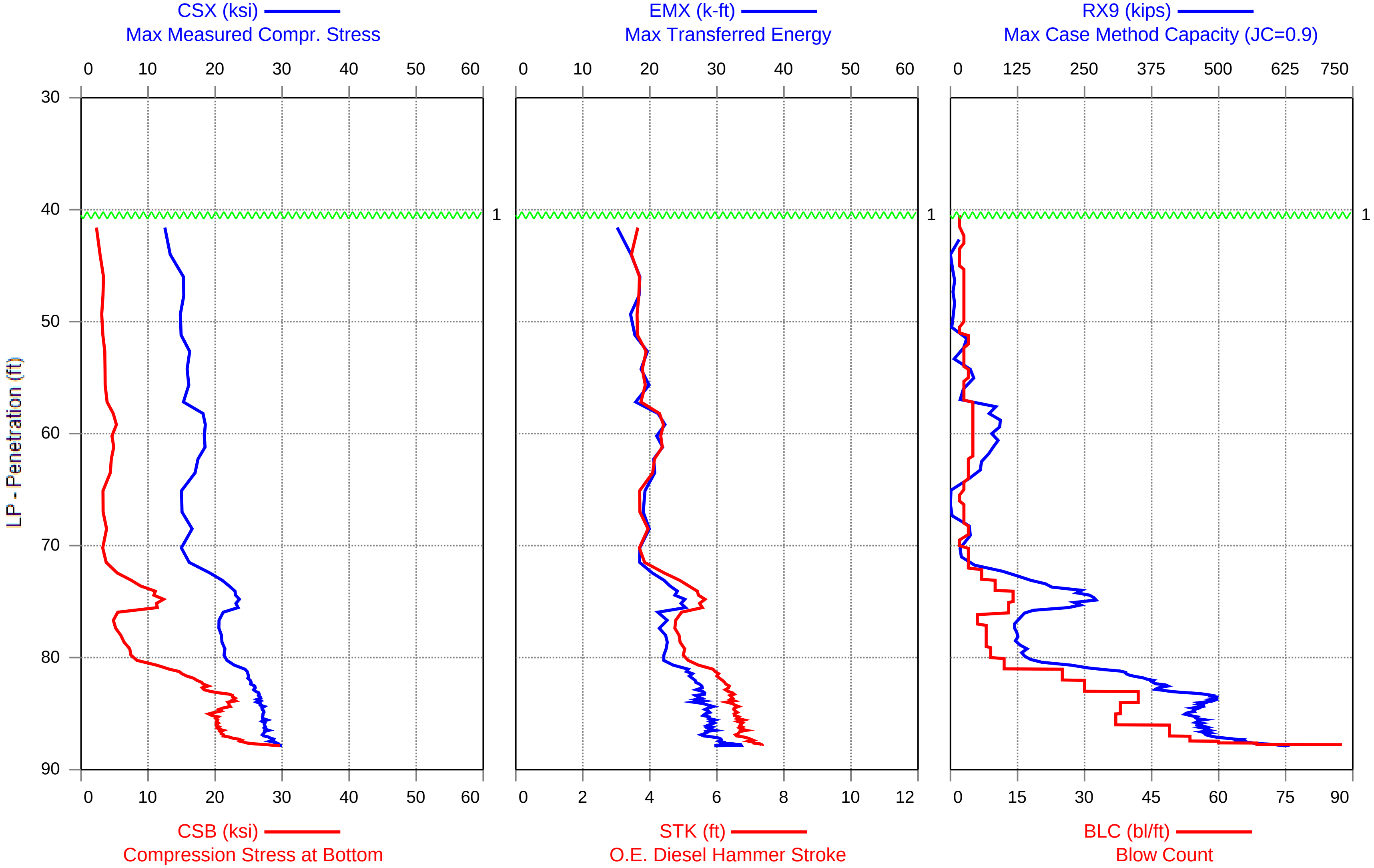
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 25-February-2015

Test started: 24-February-2015

USH 10 over Little Lake Butte des Morts - PIER 4 #44

APE D30-42, HP 14 x 73



1 - Reported reference at El. 741.2

2 - Mud line at El. 741.2

USH 10 over Little Lake Butte des Morts - PIER 4 #44 APE D30-42, HP 14 x 73
OP: TC Date: 24-February-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.42 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	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
3	40.50	2	AV1	13.4	2.7	17	3.4	62.7	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	13.4	2.7	17	3.4	62.7	0
			MIN	13.4	2.7	17	3.4	62.7	0
4	41.00	2	AV1	8.6	2.0	11	3.0	66.5	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	8.6	2.0	11	3.0	66.5	0
			MIN	8.6	2.0	11	3.0	66.5	0
6	42.00	2	AV1	0.8	0.0	0	2.7	69.4	0
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	0.8	0.0	0	2.7	69.4	0
			MIN	0.8	0.0	0	2.7	69.4	0
9	43.00	3	AV3	17.0	3.2	20	4.1	58.5	16
			STD	5.8	0.5	8	1.1	6.8	23
			MAX	24.9	3.9	31	5.7	64.1	49
			MIN	11.3	2.8	13	3.2	49.0	0
11	44.00	2	AV2	11.5	2.5	15	3.2	64.2	0
			STD	1.0	0.0	2	0.1	1.0	0
			MAX	12.5	2.5	17	3.3	65.2	0
			MIN	10.4	2.4	13	3.1	63.1	0
13	45.00	2	AV2	16.2	3.2	22	3.8	59.5	0
			STD	0.3	0.0	1	0.0	0.2	0
			MAX	16.4	3.2	23	3.8	59.7	0
			MIN	15.9	3.1	21	3.8	59.2	0
16	46.00	3	AV3	14.9	3.3	18	3.6	60.6	6
			STD	0.5	0.0	1	0.1	0.7	2
			MAX	15.6	3.3	19	3.7	61.6	8
			MIN	14.2	3.2	17	3.5	59.8	4
19	47.00	3	AV3	15.7	3.4	19	3.7	59.9	8
			STD	0.3	0.2	0	0.1	0.4	4
			MAX	16.0	3.6	19	3.8	60.4	14
			MIN	15.3	3.3	19	3.7	59.4	4
22	48.00	3	AV3	15.3	3.3	18	3.7	60.4	4
			STD	0.7	0.1	1	0.1	0.7	3
			MAX	16.2	3.5	19	3.8	61.1	7
			MIN	14.7	3.1	17	3.6	59.5	0
25	49.00	3	AV3	15.5	3.1	18	3.7	60.2	7
			STD	0.9	0.3	2	0.2	1.2	8
			MAX	16.6	3.4	19	3.9	61.7	19
			MIN	14.4	2.7	16	3.5	58.8	0
28	50.00	3	AV3	14.4	3.1	17	3.6	61.3	7
			STD	2.0	0.4	3	0.3	2.3	5
			MAX	17.0	3.6	21	4.0	63.9	13
			MIN	12.3	2.7	13	3.2	58.3	0
30	51.00	2	AV2	14.5	2.7	18	3.5	61.6	0

USH 10 over Little Lake Butte des Morts - PIER 4 #44
APE D30-42, HP 14 x 73
OP: TC
Date: 24-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			STD	1.4	0.2	2	0.2	1.9	0
			MAX	15.9	2.9	20	3.8	63.5	0
			MIN	13.0	2.5	16	3.3	59.7	0
34	52.00	4	AV4	15.9	3.8	19	3.8	59.3	36
			STD	1.3	0.4	2	0.2	1.6	20
			MAX	17.8	4.1	22	4.2	61.0	54
			MIN	14.4	3.1	16	3.6	56.8	1
37	53.00	3	AV3	16.1	3.5	19	3.9	59.1	7
			STD	1.7	0.4	2	0.3	2.1	10
			MAX	18.2	4.1	22	4.3	61.5	20
			MIN	14.1	3.0	17	3.5	56.3	0
40	54.00	3	AV3	14.4	3.1	17	3.5	61.4	10
			STD	0.4	0.0	1	0.1	0.8	6
			MAX	15.0	3.1	18	3.7	62.2	17
			MIN	14.1	3.1	16	3.4	60.3	4
44	55.00	4	AV4	16.6	3.7	19	3.9	58.7	50
			STD	0.8	0.3	1	0.1	0.8	4
			MAX	17.3	4.1	20	4.0	60.1	56
			MIN	15.2	3.3	18	3.7	57.9	46
47	56.00	3	AV3	16.7	3.8	21	4.0	58.3	33
			STD	0.8	0.3	2	0.1	0.9	2
			MAX	17.6	4.2	23	4.1	59.5	34
			MIN	15.6	3.6	19	3.8	57.4	30
50	57.00	3	AV3	14.0	3.0	17	3.5	61.5	3
			STD	0.9	0.2	0	0.1	0.9	4
			MAX	15.1	3.2	17	3.7	62.4	8
			MIN	13.1	2.9	16	3.4	60.2	0
55	58.00	5	AV5	17.4	4.6	20	4.1	57.4	78
			STD	1.9	0.6	3	0.4	2.7	15
			MAX	19.6	5.2	23	4.6	61.7	95
			MIN	14.6	3.6	16	3.5	54.3	54
60	59.00	5	AV5	18.1	5.0	21	4.3	56.2	83
			STD	0.5	0.3	1	0.1	0.7	13
			MAX	18.7	5.2	23	4.5	57.2	96
			MIN	17.3	4.4	20	4.1	55.1	62
65	60.00	5	AV5	18.5	5.1	22	4.4	55.7	88
			STD	0.7	0.4	1	0.1	0.8	9
			MAX	19.5	5.5	23	4.5	57.0	98
			MIN	17.4	4.4	21	4.2	54.7	73
70	61.00	5	AV5	18.5	4.7	22	4.4	55.7	83
			STD	0.3	0.2	1	0.1	0.5	9
			MAX	19.1	4.9	23	4.5	56.4	92
			MIN	18.2	4.4	20	4.3	54.8	66
75	62.00	5	AV5	18.1	4.7	21	4.3	56.3	74
			STD	0.4	0.2	1	0.1	0.6	8
			MAX	18.6	5.1	22	4.4	57.3	82
			MIN	17.4	4.4	20	4.1	55.6	61
79	63.00	4	AV4	17.6	4.6	21	4.2	57.0	58
			STD	0.6	0.2	1	0.1	0.8	4
			MAX	18.5	4.9	23	4.4	57.7	65
			MIN	17.0	4.2	20	4.0	55.7	53

USH 10 over Little Lake Butte des Morts - PIER 4 #44 APE D30-42, HP 14 x 73
OP: TC Date: 24-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
83	64.00	4	AV4	16.6	4.3	20	4.0	58.0	51
			STD	1.1	0.3	2	0.2	1.4	4
			MAX	17.9	4.8	23	4.3	59.9	56
			MIN	15.1	4.0	18	3.7	56.1	48
86	65.00	3	AV3	14.6	3.3	18	3.7	60.5	3
			STD	0.3	0.1	0	0.1	0.5	3
			MAX	15.0	3.3	18	3.7	60.8	7
			MIN	14.2	3.2	18	3.6	59.8	0
88	66.00	2	AV2	15.5	3.3	21	3.7	59.9	0
			STD	0.5	0.1	0	0.1	0.5	0
			MAX	16.0	3.4	21	3.8	60.3	0
			MIN	15.0	3.2	21	3.7	59.4	0
91	67.00	3	AV3	14.7	3.2	18	3.6	60.7	1
			STD	0.3	0.1	0	0.0	0.3	1
			MAX	15.0	3.4	19	3.7	61.1	2
			MIN	14.3	3.1	18	3.6	60.3	0
94	68.00	3	AV3	15.3	3.4	20	3.8	59.7	2
			STD	0.7	0.1	1	0.1	0.7	3
			MAX	16.3	3.4	21	3.9	60.3	6
			MIN	14.6	3.2	19	3.7	58.7	0
98	69.00	4	AV4	17.1	3.9	20	4.0	58.1	54
			STD	1.6	0.3	2	0.3	2.3	5
			MAX	18.2	4.2	22	4.3	62.0	61
			MIN	14.4	3.4	17	3.5	56.2	49
100	70.00	2	AV2	15.2	3.1	21	3.8	59.8	0
			STD	0.2	0.1	0	0.0	0.2	0
			MAX	15.4	3.2	21	3.8	59.9	0
			MIN	15.0	3.0	20	3.7	59.6	0
104	71.00	4	AV4	15.2	3.4	17	3.7	60.2	22
			STD	1.4	0.1	1	0.2	1.8	11
			MAX	16.8	3.6	19	4.0	62.2	40
			MIN	13.7	3.3	16	3.4	58.1	14
108	72.00	4	AV4	16.1	3.8	19	3.8	59.2	40
			STD	0.6	0.2	1	0.1	1.0	9
			MAX	17.1	4.1	21	4.0	60.1	50
			MIN	15.6	3.4	17	3.7	57.7	26
115	73.00	7	AV7	19.6	5.8	21	4.5	54.9	115
			STD	1.7	1.1	2	0.4	2.1	19
			MAX	21.4	7.2	23	4.9	58.5	138
			MIN	16.5	4.2	17	3.9	52.7	78
125	74.00	10	AV10	22.0	9.0	23	5.1	51.6	189
			STD	0.6	1.2	1	0.2	0.7	30
			MAX	23.1	11.4	24	5.4	52.7	255
			MIN	21.0	6.7	22	4.9	50.3	146
139	75.00	14	AV14	23.2	11.5	24	5.5	49.9	256
			STD	0.4	0.7	1	0.1	0.5	18
			MAX	23.9	12.7	27	5.8	50.6	283
			MIN	22.8	10.1	23	5.4	48.9	222
152	76.00	13	AV13	22.7	9.5	24	5.4	50.6	199
			STD	1.1	2.8	2	0.3	1.4	42

USH 10 over Little Lake Butte des Morts - PIER 4 #44
OP: TC
APE D30-42, HP 14 x 73
Date: 24-February-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			MAX	24.0	12.9	26	5.7	53.1	258
			MIN	20.7	4.8	20	4.8	49.0	138
158	77.00	6	AV6	20.6	5.0	23	4.8	53.4	126
			STD	0.3	0.3	1	0.1	0.5	6
			MAX	21.0	5.6	23	4.9	54.0	135
			MIN	20.3	4.6	21	4.7	52.7	118
166	78.00	8	AV8	20.7	5.4	22	4.8	53.4	122
			STD	0.3	0.4	1	0.1	0.5	5
			MAX	21.3	5.9	23	4.9	53.9	129
			MIN	20.2	5.0	21	4.7	52.6	113
174	79.00	8	AV8	21.1	6.4	23	4.9	52.7	125
			STD	0.3	0.3	0	0.1	0.3	5
			MAX	21.4	7.0	23	5.0	53.5	136
			MIN	20.5	6.0	22	4.8	52.3	117
183	80.00	9	AV9	21.4	7.4	22	5.0	52.1	138
			STD	0.3	0.1	1	0.1	0.4	5
			MAX	22.2	7.7	23	5.2	52.6	144
			MIN	21.1	7.2	22	4.9	51.3	130
195	81.00	12	AV12	22.7	10.4	24	5.4	50.4	201
			STD	1.1	2.0	2	0.3	1.3	44
			MAX	25.2	13.5	28	6.0	52.1	265
			MIN	21.3	7.8	21	5.0	47.8	148
220	82.00	25	AV25	24.8	15.4	26	6.0	47.9	334
			STD	0.4	1.2	1	0.1	0.5	24
			MAX	25.5	17.4	27	6.2	49.5	377
			MIN	23.4	12.8	23	5.6	47.2	283
250	83.00	30	AV30	25.7	18.3	27	6.3	46.9	389
			STD	0.5	0.6	1	0.1	0.4	13
			MAX	26.6	19.7	29	6.5	47.8	422
			MIN	24.6	17.2	26	6.0	46.0	370
292	84.00	42	AV42	26.5	22.1	27	6.4	46.4	476
			STD	0.5	1.2	1	0.1	0.4	24
			MAX	27.6	23.5	29	6.7	47.2	515
			MIN	25.6	19.3	26	6.2	45.5	413
330	85.00	38	AV38	27.0	21.2	29	6.5	46.0	458
			STD	0.5	1.0	1	0.1	0.4	11
			MAX	27.9	22.9	30	6.8	47.4	479
			MIN	25.7	19.0	26	6.1	45.3	436
367	86.00	37	AV37	27.2	20.1	29	6.7	45.6	457
			STD	0.5	0.5	1	0.1	0.5	10
			MAX	28.3	20.9	31	7.0	46.7	476
			MIN	25.9	18.9	26	6.3	44.5	431
416	87.00	49	AV49	27.4	20.8	29	6.7	45.5	476
			STD	0.5	0.5	1	0.1	0.5	6
			MAX	28.6	22.1	31	7.1	46.6	491
			MIN	26.6	19.9	27	6.4	44.3	464
440	87.45	54	AV24	28.2	22.9	30	6.9	44.8	519
			STD	0.6	0.9	1	0.2	0.6	22
			MAX	29.6	24.4	32	7.2	46.0	553
			MIN	27.0	21.1	28	6.5	43.9	484

USH 10 over Little Lake Butte des Morts - PIER 4 #44 APE D30-42, HP 14 x 73
OP: TC Date: 24-February-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
450	87.62	60	AV10	28.9	24.3	31	7.1	44.3	553
			STD	0.3	0.4	1	0.1	0.2	8
			MAX	29.2	24.9	32	7.2	44.6	562
			MIN	28.3	23.5	30	7.0	43.8	538
460	87.76	69	AV10	29.2	25.8	32	7.2	43.9	581
			STD	0.5	0.8	1	0.2	0.5	13
			MAX	30.3	27.1	34	7.5	45.1	602
			MIN	28.2	24.2	30	6.8	43.0	556
470	87.88	87	AV10	29.7	28.9	33	7.4	43.5	619
			STD	0.5	0.8	3	0.2	0.4	14
			MAX	30.2	29.9	35	7.6	44.4	640
			MIN	28.6	27.4	25	7.0	42.9	598
			Average	23.6	14.8	25	5.7	49.9	314
			Std. Dev.	4.9	8.0	5	1.2	5.7	195
			Maximum	30.3	29.9	35	7.6	69.4	640
			Minimum	0.8	0.0	0	2.7	42.9	0

Total number of blows analyzed: 467

BL# Sensors

1-470 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

3 Reported reference at El. 741.2

Time Summary

Drive 10 minutes 0 second 12:40 PM - 12:50 PM BN 1 - 470

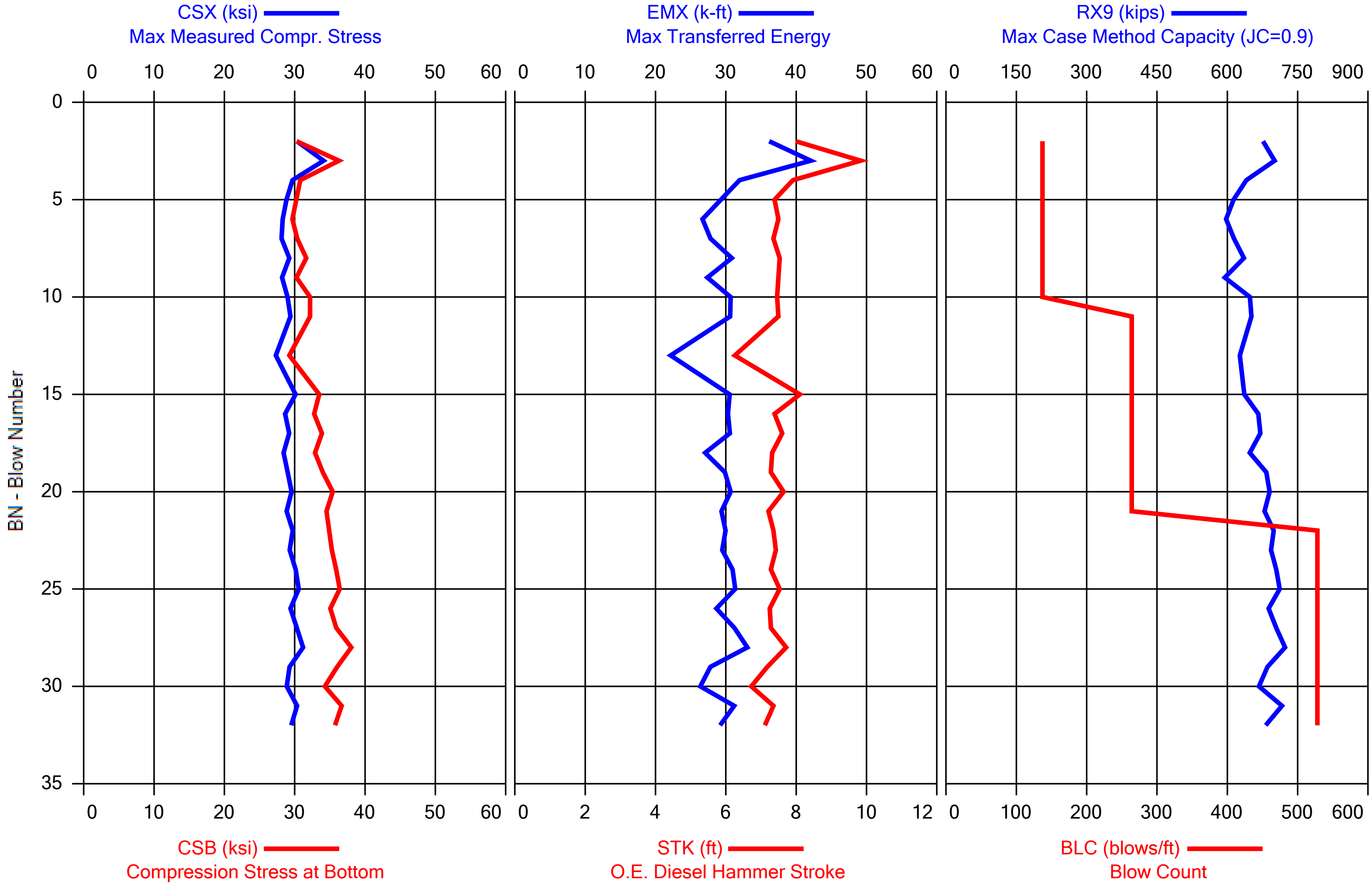
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 25-February-2015

Test started: 25-February-2015

USH 10 over Little Lake Butte des Morts - PIER 4 #44 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - PIER 4 #44 Restrike APE D30-42, HP 14 x 73
OP: TC Date: 25-February-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.42 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
10	87.95	137	AV9	29.5	31.3	31	7.8	42.3	636
			STD	1.8	1.9	5	0.7	1.7	34
			MAX	34.1	36.3	42	9.8	43.5	701
			MIN	28.1	29.7	27	7.4	37.8	595
21	87.99	264	AV9	28.9	33.2	29	7.4	43.5	661
			STD	0.8	1.7	3	0.5	1.4	21
			MAX	30.1	35.4	31	8.1	47.0	690
			MIN	27.3	29.2	22	6.3	41.5	627
32	88.01	528	AV11	29.9	35.8	30	7.3	43.7	698
			STD	0.7	1.0	2	0.2	0.7	16
			MAX	31.2	38.1	33	7.7	45.4	723
			MIN	28.9	34.3	26	6.7	42.5	667
			Average	29.5	33.6	30	7.5	43.2	667
			Std. Dev.	1.2	2.4	3	0.6	1.4	35
			Maximum	34.1	38.1	42	9.8	47.0	723
			Minimum	27.3	29.2	22	6.3	37.8	595

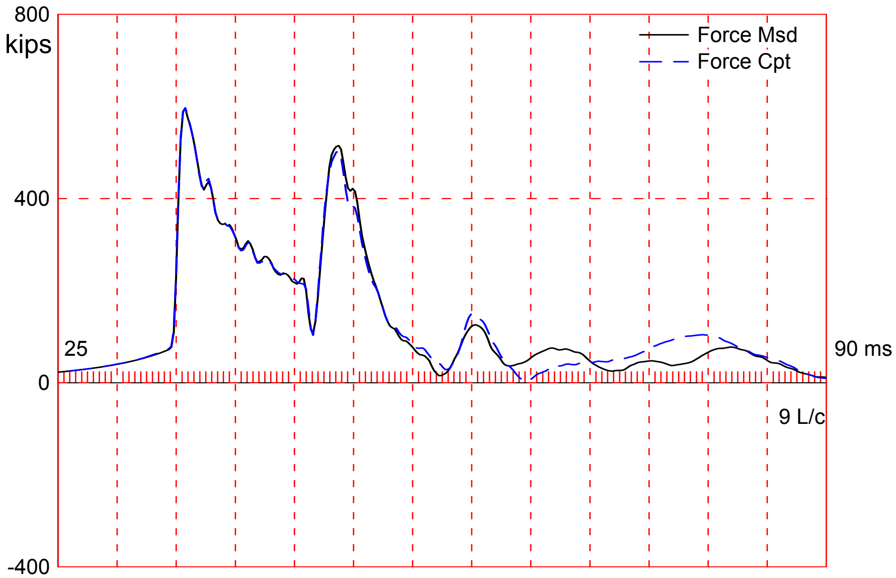
Total number of blows analyzed: 29

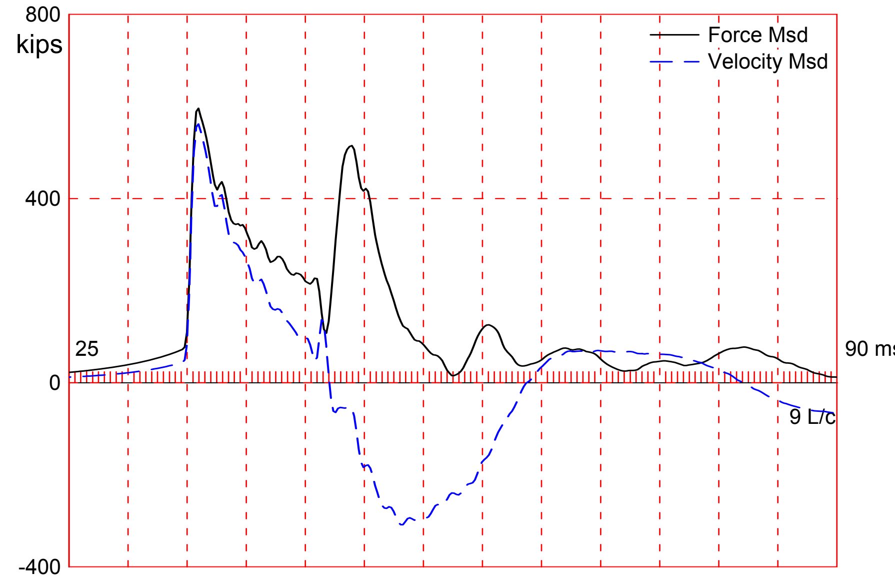
BL# Sensors

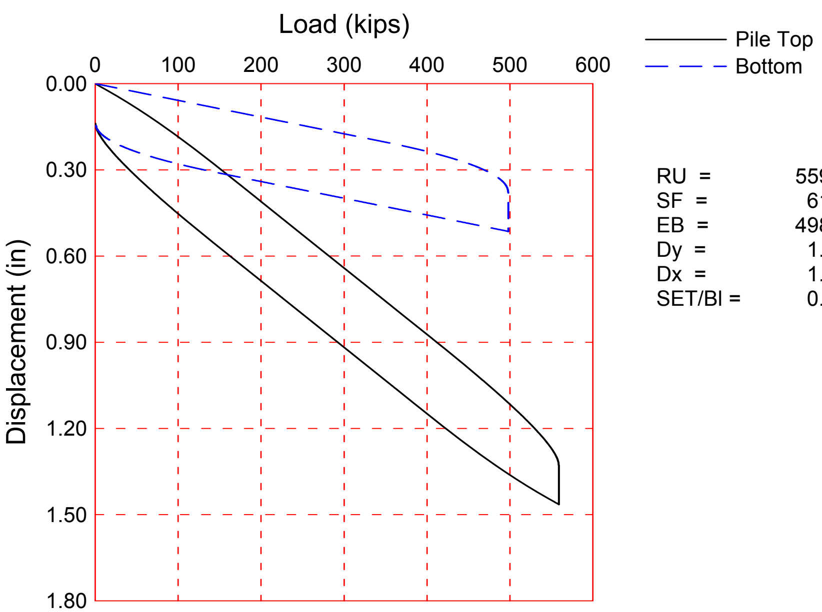
1-32 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.09); A4: [K3550] 360.0 (1.09)

Time Summary

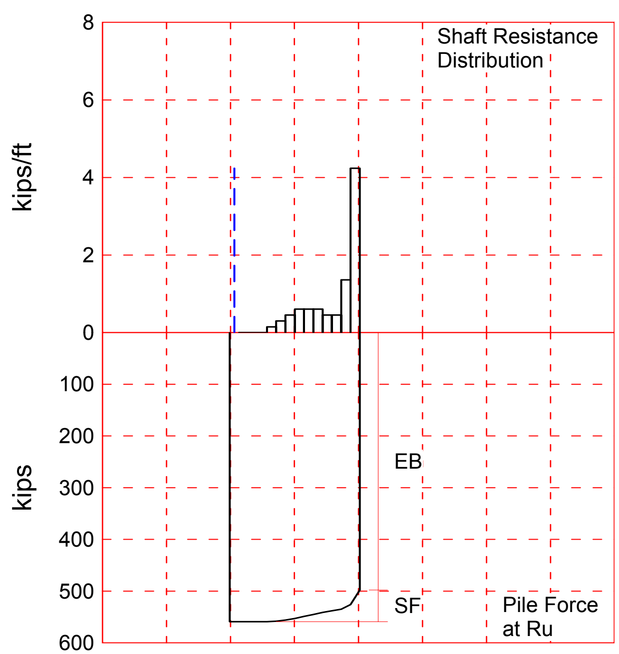
Drive 1 minute 19 seconds 8:03 AM - 8:05 AM BN 1 - 32







RU =	559.0 kips
SF =	61.0 kips
EB =	498.0 kips
Dy =	1.33 in
Dx =	1.46 in
SET/Bl =	0.14 in



Length b. Sensors	92.5 ft
Embedment	86.1 ft
Top Area	21.4 in²
End Bearing Area	198.5 in²
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft³
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	4.92
Top Compr. Stress	27.9 ksi
Max Compr. Stress	29.9 ksi
Max Tension Stress	-6.48 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.29 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: 559.0; along Shaft 61.0; at Toe 498.0 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
				559.0				
1	13.2	6.8	0.0	559.0	0.0	0.00	0.00	0.00
2	19.8	13.5	0.0	559.0	0.0	0.00	0.00	0.00
3	26.4	20.1	0.0	559.0	0.0	0.00	0.00	0.00
4	33.0	26.7	1.0	558.0	1.0	0.15	0.03	0.28
5	39.6	33.3	2.0	556.0	3.0	0.30	0.06	0.28
6	46.3	39.9	3.0	553.0	6.0	0.45	0.10	0.28
7	52.9	46.5	4.0	549.0	10.0	0.61	0.13	0.28
8	59.5	53.1	4.0	545.0	14.0	0.61	0.13	0.28
9	66.1	59.7	4.0	541.0	18.0	0.61	0.13	0.28
10	72.7	66.3	3.0	538.0	21.0	0.45	0.10	0.28
11	79.3	72.9	3.0	535.0	24.0	0.45	0.10	0.28
12	85.9	79.5	9.0	526.0	33.0	1.36	0.29	0.28
13	92.5	86.1	28.0	498.0	61.0	4.24	0.90	0.28
Avg. Shaft			4.7			0.71	0.15	0.28
Toe			498.0				361.27	0.10

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.04	0.29
Case Damping Factor		0.45	1.30
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	32	31
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	77	
Resistance Gap (included in Toe Quake) (in)			0.01
Soil Plug Weight	(kips)		0.038

CAPWAP match quality = 4.92 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.14 in; Blow Count = 87 b/ft
Computed: Final Set = 0.10 in; Blow Count = 122 b/ft
Transducer F3(D815) CAL: 93.0; RF: 1.00; F4(F607) CAL: 93.6; RF: 1.00
A3(K3550) CAL: 360; RF: 1.07; A4(K2524) CAL: 360; RF: 1.07

max. Top Comp. Stress = 27.9 ksi (T= 36.2 ms, max= 1.072 x Top)
max. Comp. Stress = 29.9 ksi (Z= 92.5 ft, T= 42.3 ms)
max. Tens. Stress = -6.48 ksi (Z= 59.5 ft, T= 61.5 ms)
max. Energy (EMX) = 30.1 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	597.4	-34.9	27.9	-1.63	30.1	14.7	1.03
2	6.6	598.0	-36.1	27.9	-1.69	30.0	14.7	1.01
4	13.2	599.2	-37.9	28.0	-1.77	29.5	14.6	0.98
6	19.8	600.5	-41.5	28.1	-1.94	29.0	14.6	0.94
8	26.4	602.4	-44.8	28.1	-2.09	28.5	14.5	0.90
10	33.0	606.2	-48.1	28.3	-2.25	27.8	14.4	0.85
12	39.6	607.0	-71.2	28.4	-3.33	26.7	14.2	0.80
14	46.3	604.6	-100.9	28.2	-4.71	25.3	14.0	0.75
15	49.6	595.1	-110.6	27.8	-5.17	24.2	13.9	0.72
16	52.9	598.9	-125.4	28.0	-5.86	23.6	13.8	0.69
17	56.2	584.7	-132.9	27.3	-6.21	22.3	13.6	0.66
18	59.5	588.6	-138.8	27.5	-6.48	21.6	13.5	0.63
19	62.8	574.8	-134.7	26.9	-6.29	20.3	13.4	0.60
20	66.1	578.4	-135.3	27.0	-6.32	19.6	13.3	0.57
21	69.4	563.9	-131.5	26.3	-6.14	18.3	13.1	0.54
22	72.7	567.4	-132.1	26.5	-6.17	17.5	13.0	0.50
23	76.0	558.1	-128.1	26.1	-5.98	16.3	12.9	0.47
24	79.3	565.0	-128.6	26.4	-6.01	15.5	12.7	0.44
25	82.6	599.4	-126.1	28.0	-5.89	14.4	13.2	0.40
26	85.9	622.7	-126.3	29.1	-5.90	13.6	14.3	0.37
27	89.2	622.4	-115.6	29.1	-5.40	11.9	15.0	0.33
28	92.5	640.6	-115.8	29.9	-5.41	9.8	13.7	0.30
Absolute	92.5			29.9			(T =	42.3 ms)
	59.5				-6.48		(T =	61.5 ms)

CASE METHOD

J =	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
RP	623.8	514.0	404.1	294.2	184.3					
RX	711.8	683.1	654.4	626.8	606.7	602.4	598.2	594.0	589.7	585.5
RU	623.8	514.0	404.1	294.2	184.3					

RAU = 519.1 (kips); RA2 = 632.0 (kips)

Current CAPWAP Ru = 559.0 (kips); Corresponding J(RP)= 0.12; matches RX20 within 5%

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
14.9	35.97	568.9	604.3	604.3	1.04	0.14	0.14	30.3	619.0	1779

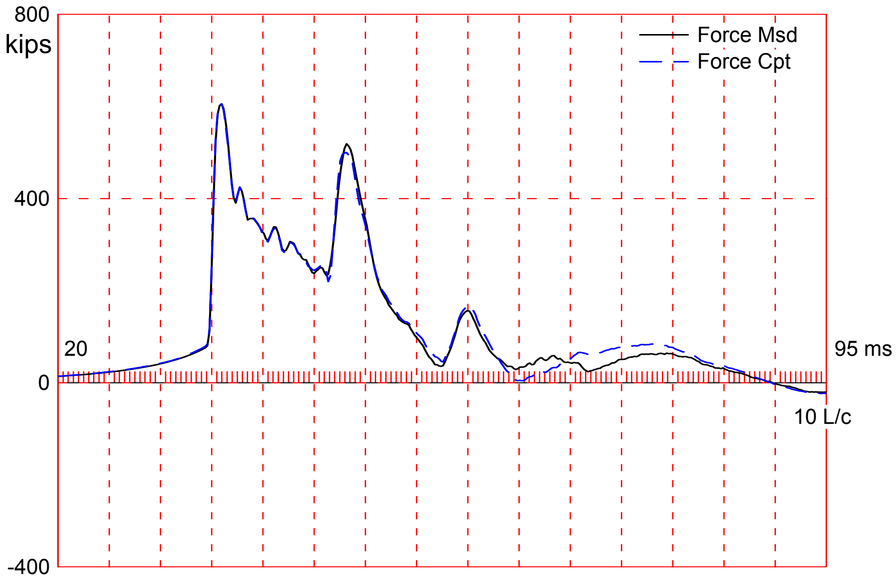
PILE PROFILE AND PILE MODEL

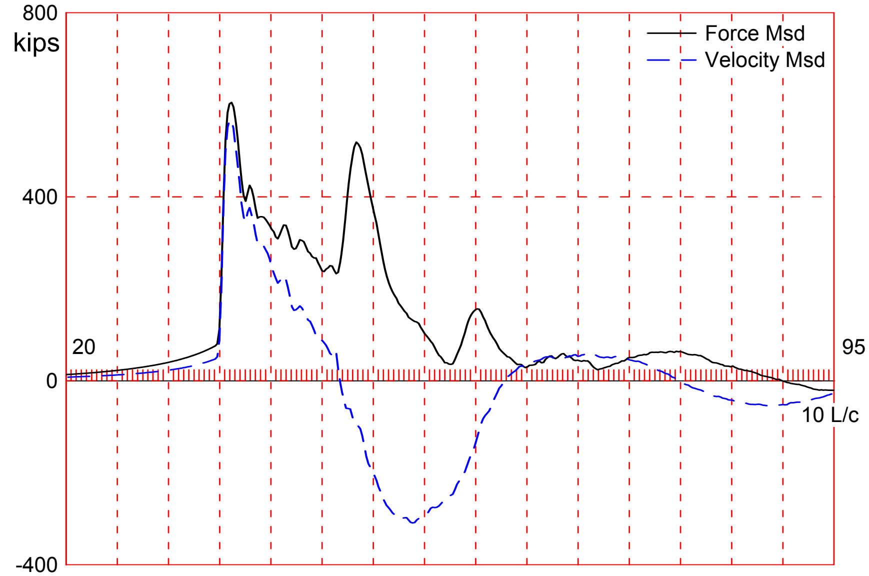
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.5	21.4	29992.2	492.000	4.70

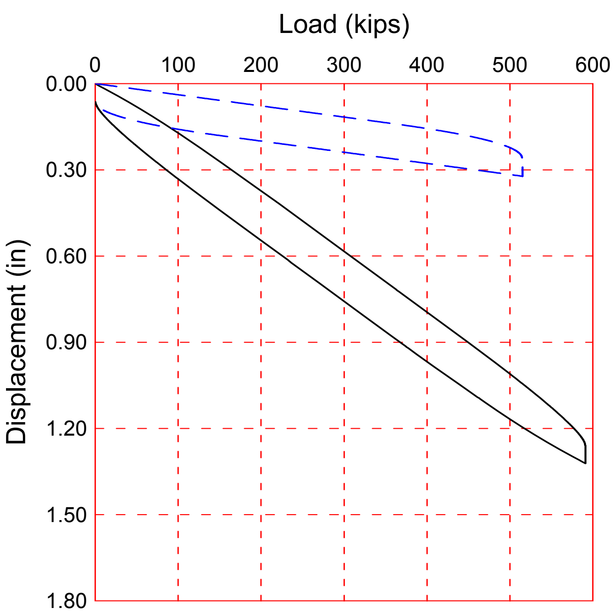
Toe Area 198.5 in^2

Top Segment Length 3.30 ft, Top Impedance 38 kips/ft/s

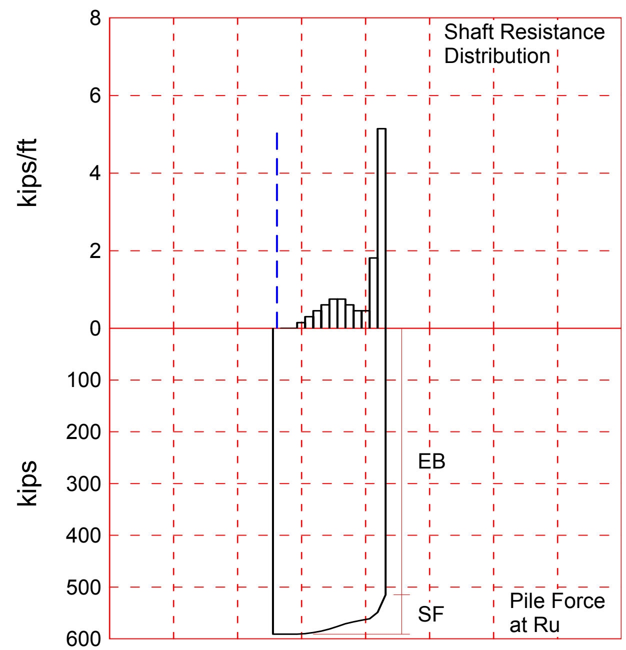
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.197 ms, 2L/c 11.0 ms
Total volume: 13.747 ft^3; Volume ratio considering added impedance: 1.000







RU = 591.0 kips
SF = 76.0 kips
EB = 515.0 kips
Dy = 1.26 in
Dx = 1.32 in
SET/Bl = 0.06 in



Length b. Sensors	92.5 ft
Embedment	86.2 ft
Top Area	21.4 in²
End Bearing Area	198.5 in²
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft³
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	3.83
Top Compr. Stress	28.3 ksi
Max Compr. Stress	32.5 ksi
Max Tension Stress	-5.82 ksi
Avg. Shaft Quake	0.05 in
Toe Quake	0.20 in
Avg. Shaft Smith Dpg.	0.34 s/ft
Toe Smith Damping	0.13 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: 591.0; along Shaft 76.0; 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
				591.0				
1	13.2	6.9	0.0	591.0	0.0	0.00	0.00	0.00
2	19.8	13.5	0.0	591.0	0.0	0.00	0.00	0.00
3	26.4	20.1	1.0	590.0	1.0	0.15	0.03	0.34
4	33.0	26.7	2.0	588.0	3.0	0.30	0.06	0.34
5	39.6	33.3	3.0	585.0	6.0	0.45	0.10	0.34
6	46.3	39.9	4.0	581.0	10.0	0.61	0.13	0.34
7	52.9	46.5	5.0	576.0	15.0	0.76	0.16	0.34
8	59.5	53.1	5.0	571.0	20.0	0.76	0.16	0.34
9	66.1	59.8	4.0	567.0	24.0	0.61	0.13	0.34
10	72.7	66.4	3.0	564.0	27.0	0.45	0.10	0.34
11	79.3	73.0	3.0	561.0	30.0	0.45	0.10	0.34
12	85.9	79.6	12.0	549.0	42.0	1.82	0.39	0.34
13	92.5	86.2	34.0	515.0	76.0	5.15	1.10	0.34
Avg. Shaft			5.8			0.88	0.19	0.34
Toe			515.0				373.60	0.13

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.05	0.20
Case Damping Factor		0.68	1.75
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	41	51
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	44	
Resistance Gap (included in Toe Quake) (in)			0.01
Soil Plug Weight	(kips)		0.100

CAPWAP match quality = 3.83 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.06 in; Blow Count = 192 b/ft
Computed: Final Set = 0.02 in; Blow Count = 514 b/ft
Transducer F3(F607) CAL: 93.6; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K2524) CAL: 360; RF: 1.09; A4(K3550) CAL: 360; RF: 1.09

max. Top Comp. Stress = 28.3 ksi (T= 36.4 ms, max= 1.146 x Top)
max. Comp. Stress = 32.5 ksi (Z= 92.5 ft, T= 42.1 ms)
max. Tens. Stress = -5.82 ksi (Z= 79.3 ft, T= 62.5 ms)
max. Energy (EMX) = 30.3 kip-ft; max. Measured Top Displ. (DMX)= 1.01 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	606.4	-27.7	28.3	-1.29	30.3	14.8	0.99
2	6.6	607.2	-29.1	28.4	-1.36	30.0	14.8	0.97
4	13.2	609.0	-31.5	28.4	-1.47	29.5	14.7	0.93
6	19.8	612.2	-34.0	28.6	-1.59	29.0	14.6	0.89
8	26.4	617.9	-36.8	28.9	-1.72	28.3	14.5	0.85
10	33.0	619.8	-38.6	29.0	-1.81	27.1	14.3	0.80
12	39.6	618.2	-51.9	28.9	-2.42	25.5	14.0	0.74
14	46.3	613.0	-79.7	28.6	-3.72	23.8	13.7	0.68
15	49.6	596.4	-87.9	27.9	-4.11	22.3	13.5	0.65
16	52.9	603.5	-100.4	28.2	-4.69	21.6	13.3	0.62
17	56.2	581.6	-106.0	27.2	-4.95	20.0	13.2	0.59
18	59.5	587.7	-116.1	27.5	-5.43	19.3	13.0	0.56
19	62.8	565.6	-118.8	26.4	-5.55	17.7	12.9	0.52
20	66.1	570.7	-124.1	26.7	-5.80	17.0	12.7	0.49
21	69.4	567.6	-122.0	26.5	-5.70	15.6	12.6	0.46
22	72.7	577.9	-123.6	27.0	-5.78	14.7	12.5	0.42
23	76.0	575.8	-121.5	26.9	-5.68	13.5	12.3	0.38
24	79.3	606.5	-124.6	28.3	-5.82	12.6	12.0	0.35
25	82.6	622.4	-123.6	29.1	-5.77	11.4	11.7	0.31
26	85.9	627.5	-124.0	29.3	-5.79	10.5	11.9	0.28
27	89.2	638.2	-114.6	29.8	-5.35	8.7	11.9	0.24
28	92.5	695.2	-114.5	32.5	-5.35	6.9	10.4	0.21
Absolute	92.5			32.5			(T =	42.1 ms)
	79.3				-5.82		(T =	62.5 ms)

CASE METHOD

J =	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
RP	762.3	679.6	596.8	514.1	431.3					
RX	789.6	720.4	674.2	651.5	631.8	616.7	603.4	592.0	580.6	570.6
RU	767.8	686.1	604.5	522.8	441.2					

RAU = 444.6 (kips); RA2 = 654.4 (kips)

Current CAPWAP Ru = 591.0 (kips); Corresponding J(RP)= 0.41; J(RX) = 1.42

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	36.17	569.2	606.8	610.6	1.01	0.06	0.06	30.5	682.9	2711

PILE PROFILE AND PILE MODEL

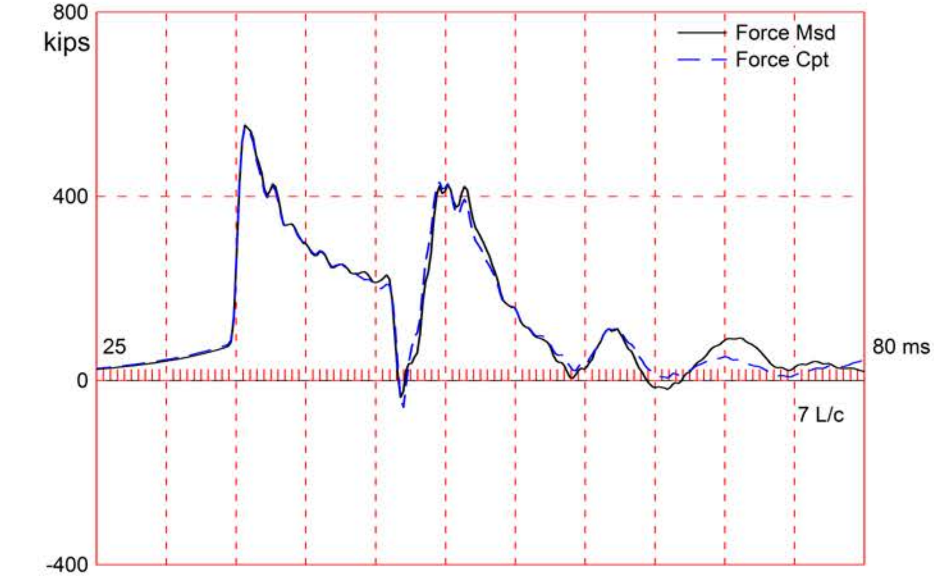
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.5	21.4	29992.2	492.000	4.70

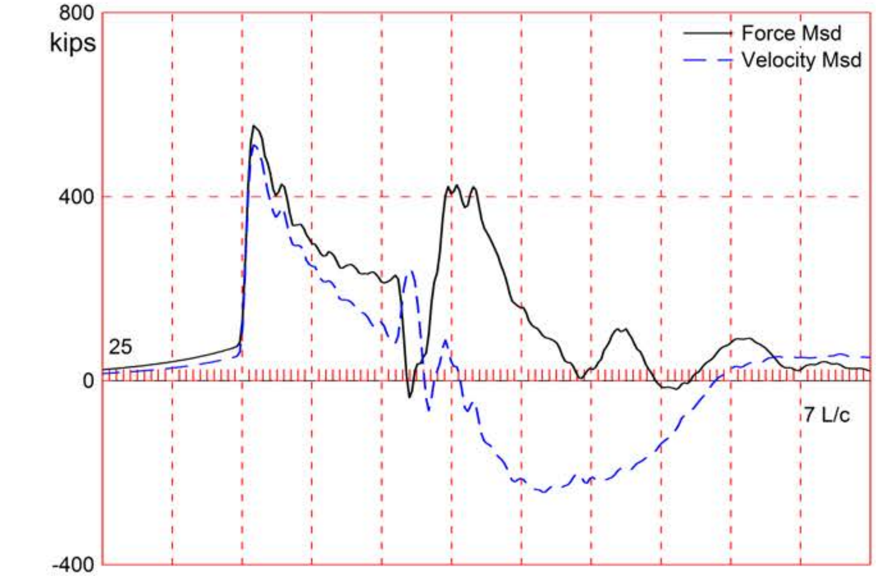
Toe Area 198.5 in^2

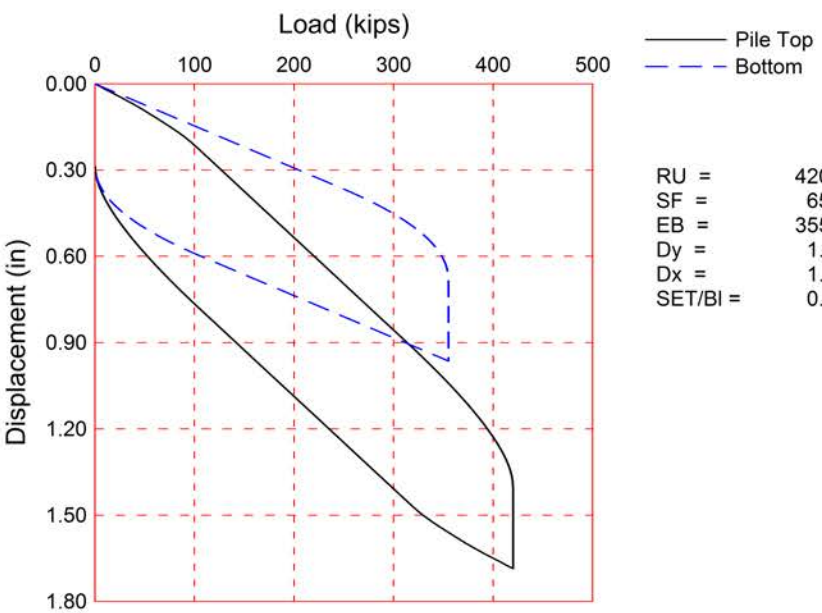
Top Segment Length 3.30 ft, Top Impedance 38 kips/ft/s

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: 13.747 ft^3; Volume ratio considering added impedance: 1.000

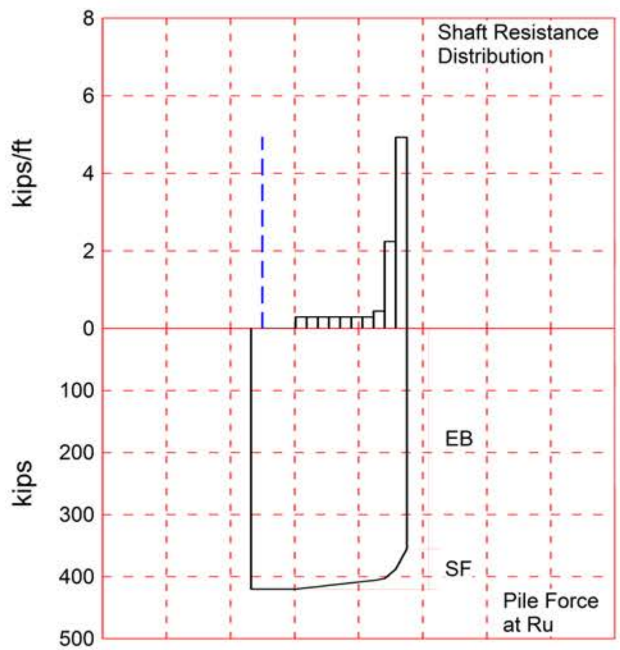
Match Quality Poor - Results May Be Unreliable!!!



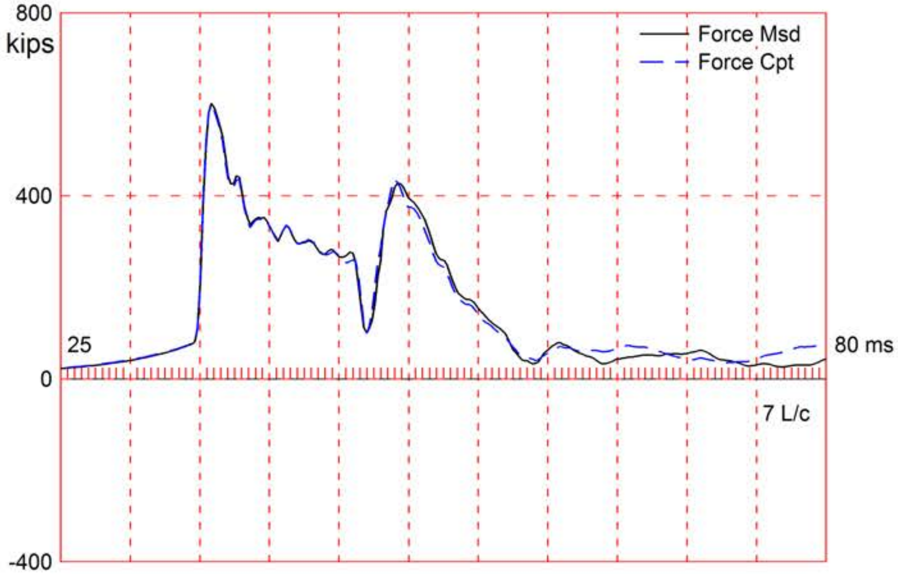


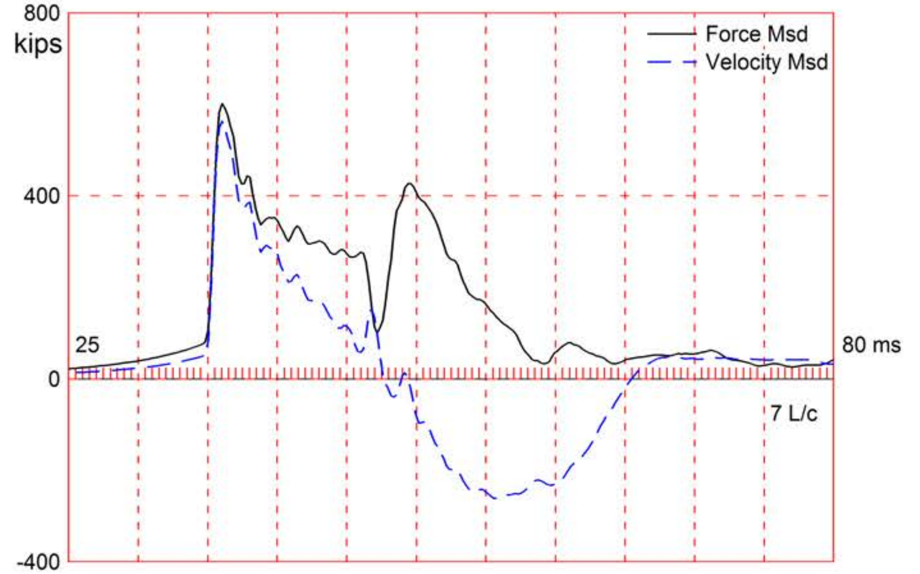


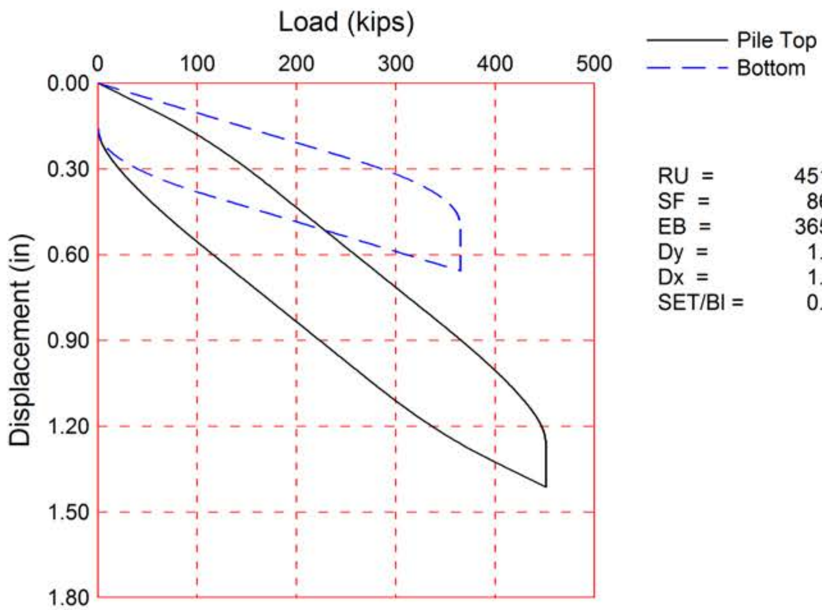
RU =	420.0 kips
SF =	65.0 kips
EB =	355.0 kips
Dy =	1.40 in
Dx =	1.69 in
SET/Bl =	0.29 in



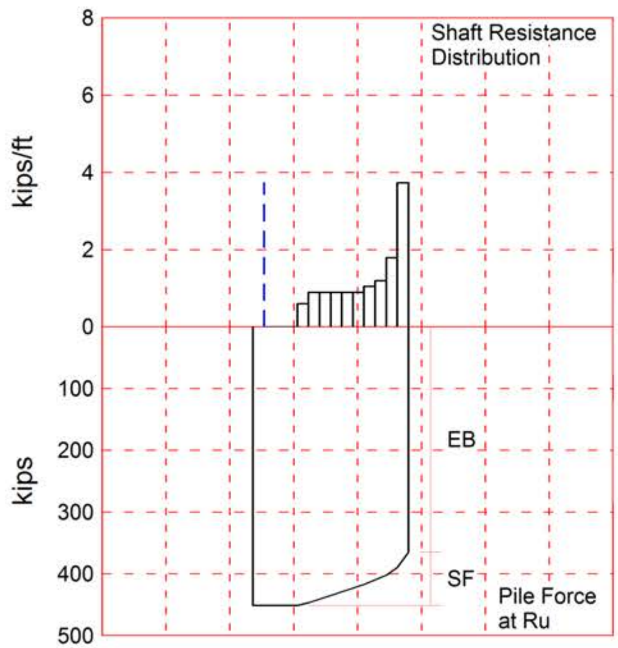
Length b. Sensors	93.7 ft
Embedment	83.7 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	6.37
Top Compr. Stress	25.7 ksi
Max Compr. Stress	26.0 ksi
Max Tension Stress	-4.37 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.52 in
Avg. Shaft Smith Dpg.	0.28 s/ft
Toe Smith Damping	0.11 s/ft







RU	=	451.0 kips
SF	=	86.0 kips
EB	=	365.0 kips
Dy	=	1.25 in
Dx	=	1.41 in
SET/Bl	=	0.16 in



Length b. Sensors	93.7 ft
Embedment	83.8 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	3.68
Top Compr. Stress	28.1 ksi
Max Compr. Stress	28.8 ksi
Max Tension Stress	-1.77 ksi
Avg. Shaft Quake	0.07 in
Toe Quake	0.38 in
Avg. Shaft Smith Dpg.	0.28 s/ft
Toe Smith Damping	0.14 s/ft

About the CAPWAP Results

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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.

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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: 451.0; along Shaft 86.0; at Toe 365.0 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
				451.0				
1	13.4	3.6	0.0	451.0	0.0	0.00	0.00	0.00
2	20.1	10.2	0.0	451.0	0.0	0.00	0.00	0.00
3	26.8	16.9	0.0	451.0	0.0	0.00	0.00	0.00
4	33.5	23.6	4.0	447.0	4.0	0.60	0.13	0.28
5	40.1	30.3	6.0	441.0	10.0	0.90	0.19	0.28
6	46.8	37.0	6.0	435.0	16.0	0.90	0.19	0.28
7	53.5	43.7	6.0	429.0	22.0	0.90	0.19	0.28
8	60.2	50.4	6.0	423.0	28.0	0.90	0.19	0.28
9	66.9	57.1	6.0	417.0	34.0	0.90	0.19	0.28
10	73.6	63.8	7.0	410.0	41.0	1.05	0.22	0.28
11	80.3	70.5	8.0	402.0	49.0	1.20	0.25	0.28
12	87.0	77.2	12.0	390.0	61.0	1.79	0.38	0.28
13	93.7	83.8	25.0	365.0	86.0	3.74	0.80	0.28
Avg. Shaft			6.6			1.03	0.22	0.28
Toe			365.0				264.78	0.14

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.07	0.38
Case Damping Factor		0.63	1.34
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	93
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake) (in)			0.07
Soil Plug Weight	(kips)		0.146

CAPWAP match quality = 3.68 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.16 in; Blow Count = 74 b/ft
Computed: Final Set = 0.13 in; Blow Count = 89 b/ft
Transducer F3(F607) CAL: 93.6; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K2524) CAL: 360; RF: 1.10; A4(K3550) CAL: 360; RF: 1.10

max. Top Comp. Stress = 28.1 ksi (T= 36.2 ms, max= 1.027 x Top)
max. Comp. Stress = 28.8 ksi (Z= 33.5 ft, T= 38.0 ms)
max. Tens. Stress = -1.77 ksi (Z= 33.5 ft, T= 99.5 ms)
max. Energy (EMX) = 31.2 kip-ft; max. Measured Top Displ. (DMX)= 1.06 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	600.9	-27.6	28.1	-1.29	31.2	14.8	1.06
2	6.7	601.6	-28.1	28.1	-1.31	31.1	14.8	1.04
4	13.4	603.0	-29.8	28.2	-1.39	30.6	14.7	1.00
6	20.1	604.5	-32.5	28.2	-1.52	29.9	14.6	0.96
8	26.8	607.8	-35.0	28.4	-1.63	29.3	14.5	0.92
10	33.5	617.4	-37.9	28.8	-1.77	28.5	14.2	0.87
12	40.1	609.6	-35.8	28.5	-1.67	26.8	13.9	0.82
14	46.8	592.1	-31.2	27.7	-1.46	24.6	13.6	0.76
15	50.2	569.9	-25.1	26.6	-1.17	22.9	13.4	0.74
16	53.5	574.7	-25.6	26.9	-1.20	22.5	13.3	0.71
17	56.9	552.9	-22.2	25.8	-1.04	20.9	13.1	0.68
18	60.2	557.6	-28.9	26.1	-1.35	20.4	12.9	0.66
19	63.6	536.0	-23.9	25.0	-1.12	18.9	12.8	0.63
20	66.9	540.9	-30.7	25.3	-1.43	18.4	12.6	0.60
21	70.3	520.5	-26.2	24.3	-1.22	17.0	12.4	0.58
22	73.6	525.8	-31.7	24.6	-1.48	16.5	12.3	0.55
23	76.9	502.0	-26.5	23.5	-1.24	15.0	12.1	0.52
24	80.3	509.4	-30.7	23.8	-1.44	14.6	11.9	0.50
25	83.6	483.4	-23.1	22.6	-1.08	13.1	12.6	0.47
26	87.0	482.5	-28.1	22.5	-1.31	12.6	13.7	0.44
27	90.3	486.6	-15.7	22.7	-0.73	10.9	14.6	0.42
28	93.7	501.0	-19.4	23.4	-0.91	8.7	14.1	0.39
Absolute	33.5			28.8			(T =	38.0 ms)
	33.5				-1.77		(T =	99.5 ms)

CASE METHOD

J =	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
RP	581.7	462.5	343.4	224.3	105.2					
RX	629.7	587.0	544.3	527.8	514.2	500.7	487.2	479.0	471.9	464.7
RU	581.7	462.5	343.4	224.3	105.2					

RAU = 408.9 (kips); RA2 = 548.8 (kips)

Current CAPWAP Ru = 451.0 (kips); Corresponding J(RP)= 0.22; matches RX20 within 5%

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
14.9	36.03	568.6	608.6	608.6	1.06	0.17	0.16	31.3	612.2	1177

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
93.7	21.4	29992.2	492.000	4.70

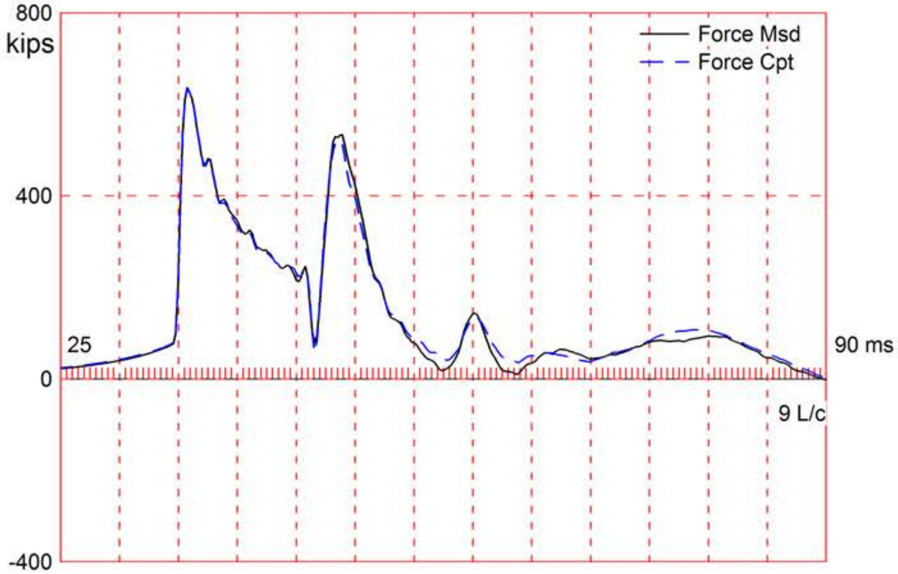
Toe Area 198.5 in^2

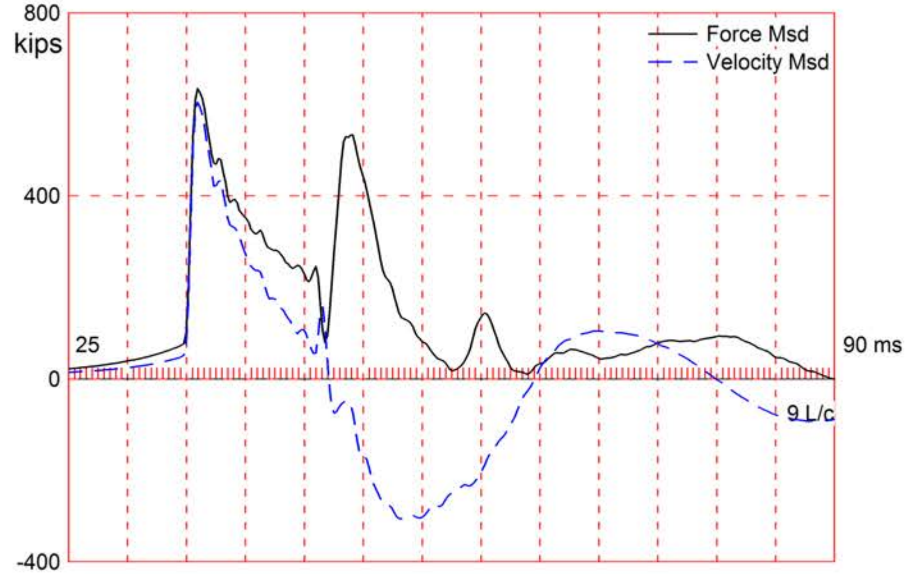
Top Segment Length 3.35 ft, Top Impedance 38 kips/ft/s

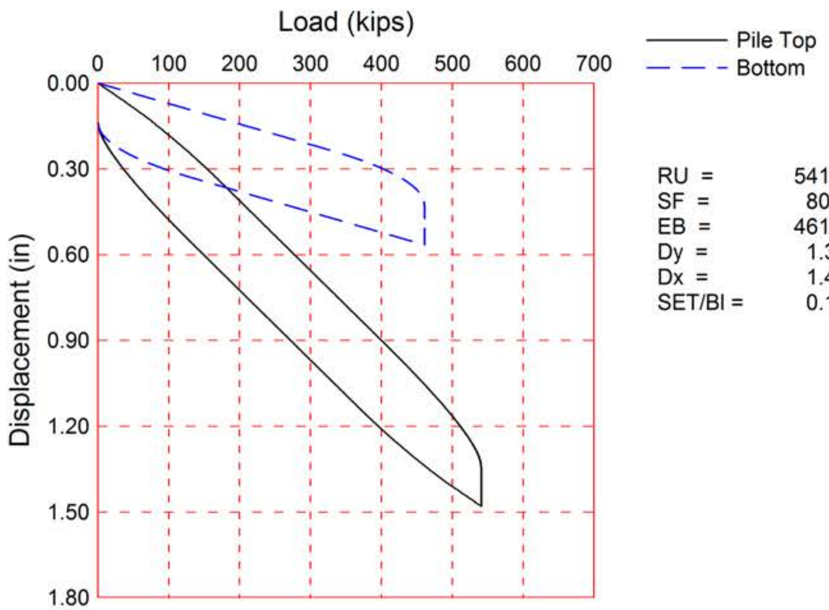
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.199 ms, 2L/c 11.1 ms
Total volume: 13.920 ft^3; Volume ratio considering added impedance: 1.000

USH10 OVER LLBDM; Pile: PIER 4 #44 EOID; APE D30-42, HP 14 x 73; Blow: 466 (Test: 24-Feb-2015 12:50:)
GRL Engineers, Inc.

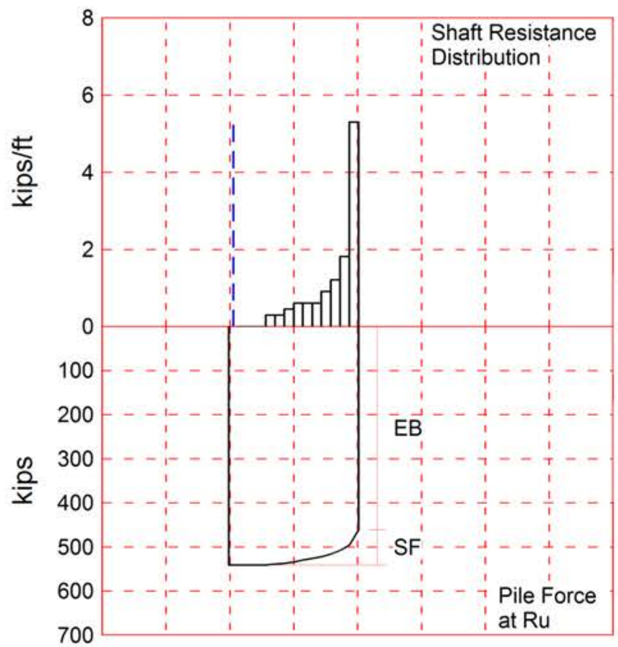
26-Feb-2015
CAPWAP(R) 2014-1







RU =	541.0 kips
SF =	80.0 kips
EB =	461.0 kips
Dy =	1.34 in
Dx =	1.48 in
SET/Bl =	0.14 in



Length b. Sensors	92.4 ft
Embedment	87.8 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	3.16
Top Compr. Stress	29.8 ksi
Max Compr. Stress	30.3 ksi
Max Tension Stress	-4.35 ksi
Avg. Shaft Quake	0.05 in
Toe Quake	0.33 in
Avg. Shaft Smith Dpg.	0.28 s/ft
Toe Smith Damping	0.11 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: 541.0; along Shaft 80.0; at Toe 461.0 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
				541.0				
1	13.2	8.6	0.0	541.0	0.0	0.00	0.00	0.00
2	19.8	15.2	0.0	541.0	0.0	0.00	0.00	0.00
3	26.4	21.8	0.0	541.0	0.0	0.00	0.00	0.00
4	33.0	28.4	2.0	539.0	2.0	0.30	0.06	0.28
5	39.6	35.0	2.0	537.0	4.0	0.30	0.06	0.28
6	46.2	41.6	3.0	534.0	7.0	0.45	0.10	0.28
7	52.8	48.2	4.0	530.0	11.0	0.61	0.13	0.28
8	59.4	54.8	4.0	526.0	15.0	0.61	0.13	0.28
9	66.0	61.4	4.0	522.0	19.0	0.61	0.13	0.28
10	72.6	68.0	6.0	516.0	25.0	0.91	0.19	0.28
11	79.2	74.6	8.0	508.0	33.0	1.21	0.26	0.28
12	85.8	81.2	12.0	496.0	45.0	1.82	0.39	0.28
13	92.4	87.8	35.0	461.0	80.0	5.30	1.13	0.28
Avg. Shaft			6.2			0.91	0.19	0.28
Toe			461.0				334.42	0.11

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.05	0.33
Case Damping Factor		0.59	1.33
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	104
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake) (in)			0.07
Soil Plug Weight	(kips)		0.063

CAPWAP match quality = 3.16 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.14 in; Blow Count = 87 b/ft
Computed: Final Set = 0.10 in; Blow Count = 122 b/ft
Transducer F3(F607) CAL: 93.6; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K2524) CAL: 360; RF: 1.07; A4(K3550) CAL: 360; RF: 1.07

max. Top Comp. Stress = 29.8 ksi (T= 36.1 ms, max= 1.016 x Top)
max. Comp. Stress = 30.3 ksi (Z= 92.4 ft, T= 43.4 ms)
max. Tens. Stress = -4.35 ksi (Z= 79.2 ft, T= 62.8 ms)
max. Energy (EMX) = 34.4 kip-ft; max. Measured Top Displ. (DMX)= 1.11 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	637.5	-25.2	29.8	-1.18	34.4	15.8	1.10
2	6.6	638.0	-27.2	29.8	-1.27	34.3	15.7	1.09
4	13.2	638.9	-32.8	29.8	-1.53	33.8	15.7	1.05
6	19.8	639.9	-38.4	29.9	-1.80	33.3	15.6	1.01
8	26.4	641.7	-44.7	30.0	-2.09	32.7	15.6	0.97
10	33.0	646.8	-50.4	30.2	-2.35	32.0	15.4	0.92
12	39.6	641.6	-55.1	30.0	-2.57	30.6	15.2	0.87
14	46.2	638.4	-62.4	29.8	-2.91	29.1	15.0	0.82
15	49.5	628.0	-63.6	29.3	-2.97	27.8	14.9	0.79
16	52.8	631.6	-66.3	29.5	-3.10	27.2	14.7	0.76
17	56.1	616.1	-64.7	28.8	-3.02	25.7	14.6	0.73
18	59.4	619.6	-72.2	28.9	-3.37	25.0	14.5	0.70
19	62.7	604.4	-73.5	28.2	-3.43	23.4	14.3	0.66
20	66.0	608.9	-81.2	28.4	-3.79	22.7	14.2	0.63
21	69.3	595.4	-81.8	27.8	-3.82	21.2	14.0	0.60
22	72.6	602.7	-88.8	28.2	-4.15	20.4	13.9	0.56
23	75.9	581.3	-86.8	27.2	-4.06	18.6	13.6	0.53
24	79.2	595.6	-93.0	27.8	-4.35	17.8	13.6	0.49
25	82.5	605.0	-86.8	28.3	-4.05	15.8	15.2	0.46
26	85.8	634.6	-92.7	29.6	-4.33	15.1	16.5	0.43
27	89.1	632.2	-80.3	29.5	-3.75	12.9	16.9	0.40
28	92.4	647.8	-84.7	30.3	-3.96	9.8	15.7	0.36
Absolute	92.4			30.3			(T =	43.4 ms)
	79.2				-4.35		(T =	62.8 ms)

CASE METHOD

J =	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
RP	637.5	515.1	392.7	270.3	147.8					
RX	756.7	722.3	688.8	658.1	640.5	631.1	622.0	613.4	604.7	596.0
RU	637.5	515.1	392.7	270.3	147.8					

RAU = 406.6 (kips); RA2 = 674.1 (kips)

Current CAPWAP Ru = 541.0 (kips); Corresponding J(RP)= 0.16;

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
16.0	35.94	609.3	640.2	640.2	1.11	0.14	0.14	34.6	663.8	1773

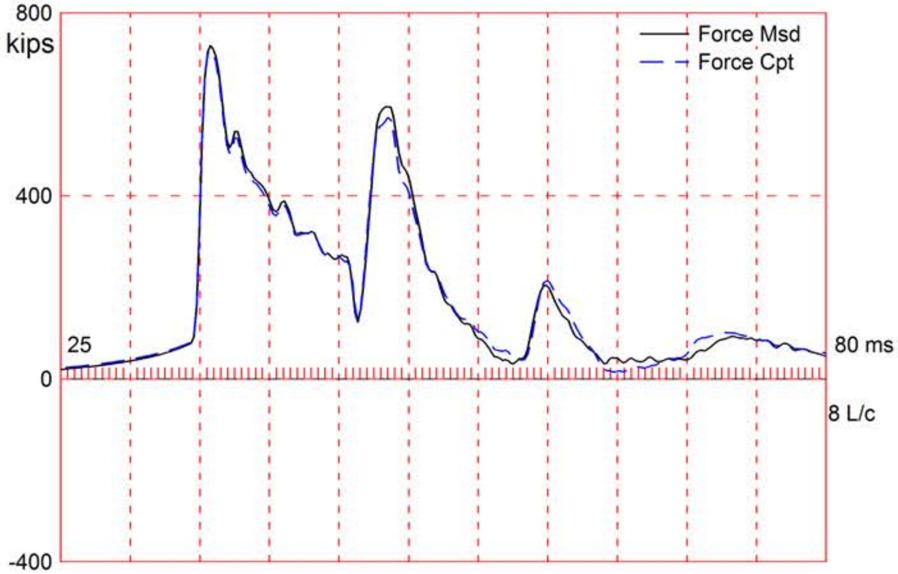
PILE PROFILE AND PILE MODEL

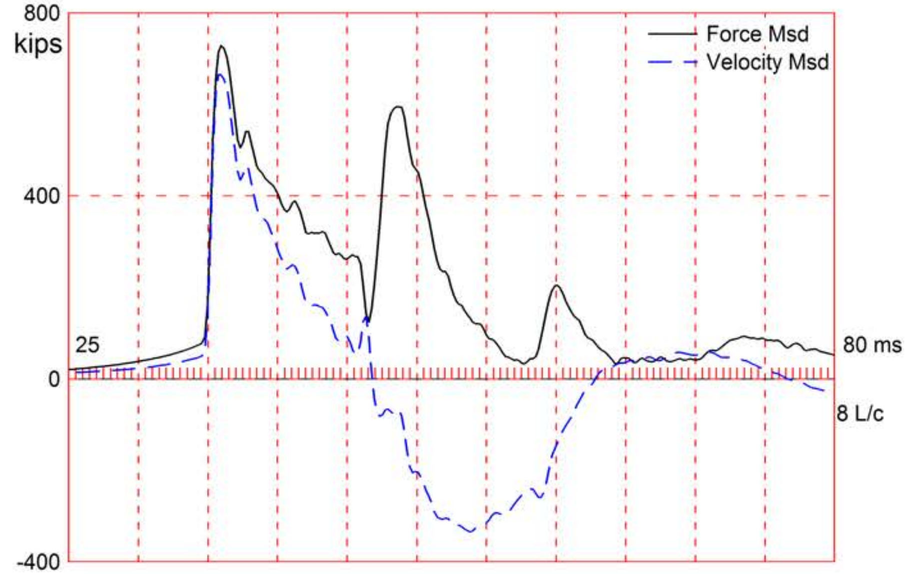
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.4	21.4	29992.2	492.000	4.70

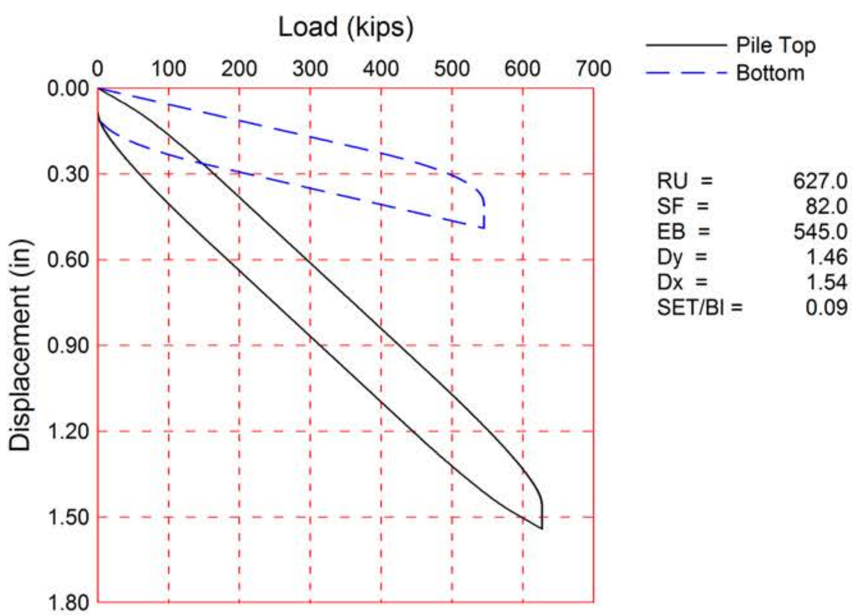
Toe Area 198.5 in^2

Top Segment Length 3.30 ft, Top Impedance 38 kips/ft/s

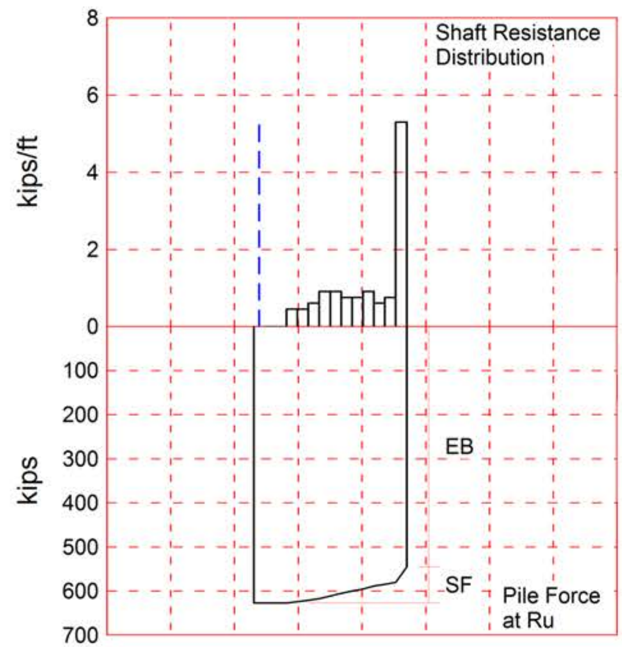
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 11.0 ms
Total volume: 13.735 ft^3; Volume ratio considering added impedance: 1.000







RU =	627.0 kips
SF =	82.0 kips
EB =	545.0 kips
Dy =	1.46 in
Dx =	1.54 in
SET/Bl =	0.09 in



Length b. Sensors	92.4 ft
Embedment	87.9 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	2.86
Top Compr. Stress	33.5 ksi
Max Compr. Stress	36.2 ksi
Max Tension Stress	-5.80 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.31 in
Avg. Shaft Smith Dpg.	0.27 s/ft
Toe Smith Damping	0.11 s/ft

About the CAPWAP Results

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CAPWAP 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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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: 627.0; along Shaft 82.0; at Toe 545.0 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
				627.0					
1	13.2	8.7	0.0	627.0	0.0	0.00	0.00	0.00	0.04
2	19.8	15.3	0.0	627.0	0.0	0.00	0.00	0.00	0.04
3	26.4	21.9	3.0	624.0	3.0	0.45	0.10	0.27	0.04
4	33.0	28.5	3.0	621.0	6.0	0.45	0.10	0.27	0.04
5	39.6	35.1	4.0	617.0	10.0	0.61	0.13	0.27	0.04
6	46.2	41.7	6.0	611.0	16.0	0.91	0.19	0.27	0.04
7	52.8	48.3	6.0	605.0	22.0	0.91	0.19	0.27	0.04
8	59.4	54.9	5.0	600.0	27.0	0.76	0.16	0.27	0.04
9	66.0	61.5	5.0	595.0	32.0	0.76	0.16	0.27	0.04
10	72.6	68.1	6.0	589.0	38.0	0.91	0.19	0.27	0.04
11	79.2	74.7	4.0	585.0	42.0	0.61	0.13	0.27	0.04
12	85.8	81.3	5.0	580.0	47.0	0.76	0.16	0.27	0.04
13	92.4	87.9	35.0	545.0	82.0	5.30	1.13	0.27	0.04
Avg. Shaft			6.3			0.93	0.20	0.27	0.04
Toe			545.0				395.36	0.11	0.31

Soil Model Parameters/Extensions		Shaft	Toe
Case Damping Factor		0.58	1.57
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	68	30
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	14	
Resistance Gap (included in Toe Quake) (in)			0.01
Soil Plug Weight	(kips)		0.004

CAPWAP match quality = 2.86 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.09 in; Blow Count = 137 b/ft
Computed: Final Set = 0.06 in; Blow Count = 215 b/ft
Transducer F3(F607) CAL: 93.6; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K2524) CAL: 360; RF: 1.10; A4(K3550) CAL: 360; RF: 1.10

max. Top Comp. Stress = 33.5 ksi (T= 36.1 ms, max= 1.080 x Top)
max. Comp. Stress = 36.2 ksi (Z= 92.4 ft, T= 42.0 ms)
max. Tens. Stress = -5.80 ksi (Z= 72.6 ft, T= 60.9 ms)
max. Energy (EMX) = 42.6 kip-ft; max. Measured Top Displ. (DMX)= 1.16 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	717.6	-20.7	33.5	-0.97	42.6	17.7	1.15
2	6.6	718.5	-21.4	33.6	-1.00	42.4	17.6	1.13
4	13.2	720.3	-24.4	33.6	-1.14	41.8	17.6	1.09
6	19.8	724.3	-27.8	33.8	-1.30	41.1	17.5	1.05
8	26.4	732.6	-30.4	34.2	-1.42	40.4	17.2	1.01
10	33.0	724.5	-41.9	33.8	-1.96	38.6	17.0	0.95
12	39.6	719.5	-74.1	33.6	-3.46	36.6	16.7	0.89
14	46.2	711.7	-102.5	33.2	-4.79	34.4	16.3	0.84
15	49.5	687.1	-112.5	32.1	-5.26	32.1	16.1	0.80
16	52.8	692.8	-119.5	32.4	-5.58	31.3	15.9	0.77
17	56.1	667.6	-117.9	31.2	-5.51	29.0	15.8	0.73
18	59.4	673.1	-119.4	31.4	-5.58	28.2	15.6	0.70
19	62.7	653.7	-119.6	30.5	-5.59	26.3	15.4	0.66
20	66.0	659.9	-122.7	30.8	-5.73	25.4	15.3	0.63
21	69.3	641.7	-122.4	30.0	-5.72	23.5	15.1	0.59
22	72.6	647.1	-124.2	30.2	-5.80	22.6	14.9	0.55
23	75.9	629.6	-120.6	29.4	-5.63	20.5	14.8	0.51
24	79.2	659.1	-123.0	30.8	-5.75	19.5	14.6	0.48
25	82.5	688.4	-120.8	32.2	-5.64	17.9	16.0	0.44
26	85.8	705.5	-122.2	33.0	-5.71	16.9	16.9	0.40
27	89.1	708.0	-121.8	33.1	-5.69	15.3	16.6	0.36
28	92.4	775.1	-123.2	36.2	-5.76	12.4	14.5	0.32
Absolute	92.4			36.2			(T =	42.0 ms)
	72.6				-5.80		(T =	60.9 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	785.7	663.3	541.0	418.6	296.3					
RX	894.1	816.2	774.1	743.7	714.4	691.8	675.0	660.4	645.9	631.3
RU	785.7	663.3	541.0	418.6	296.3					

RAU = 478.8 (kips); RA2 = 775.9 (kips)

Current CAPWAP Ru = 627.0 (kips); Corresponding J(RP)= 0.26; J(RX) = 1.86

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
17.6	35.74	671.4	726.0	729.7	1.16	0.09	0.09	42.6	819.2	1817

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
92.4	21.4	29992.2	492.000	4.70

Toe Area 198.5 in^2

Top Segment Length 3.30 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 0.196 ms, 2L/c 11.0 ms
Total volume: 13.735 ft^3; Volume ratio considering added impedance: 1.000