GRL Engineers, Inc.

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TRANSMITTAL

To: Mr. Kevin Weber	From: Travis Coleman
Company: Lunda Construction Co.	No. of Sheets: 46
E-mail: kweber@lundaconstruction.com	Date: March 24, 2015

RE: Dynamic Testing Results – USH 10 over Little Lake Butte des Morts
Structure B-70-403 - Pier 13
Winnebago County, Wisconsin

On March 20, 2015, Pier 13 #1, Pier 13 #36, and Pier 13 #44 at the above structure were dynamically tested during initial driving. The piles were tested during restrike on March 23. 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 740.2 to EL 740.4. We understand the pier was excavated to elevation of EL 717.2. The piles have a required minimum tip elevation of EL 670.5. 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 13 #1 was driven to a depth of 78.6 feet, which corresponds to a pile tip elevation of EL 661.8. The blow count over the final increment of driving was 10 blows for 4 inches of penetration at an average hammer stroke of 7.4 feet. The blow count at the beginning of restrike was 10 blows for 2.¾ inch of penetration at an average hammer stroke of 6.7 feet.

Pier 13 #36 was driven to a depth of 82.1 feet, which corresponds to a pile tip elevation of EL 658.1. The blow count over the final increment of driving was 10 blows for 1½ inches of penetration at an average hammer stroke of 7.7 feet. The blow count at the beginning of restrike was 10 blows for ¾ inch of penetration at an average hammer stroke of 6.7 feet.

Pier 13 #44 was driven to a depth of 83.3 feet, which corresponds to a pile tip elevation of EL 657.0. The blow count over the final increment of driving was 10 blows for 1¼ inches of penetration at an average hammer stroke of 7.0 feet. The blow count at the beginning of restrike was 10 blows for ¾ inch of penetration at an average hammer stroke of 6.6 feet

We recommend the production piles at Pier 13 of Structure B-70-403 driven with the APE D30-42 hammer PD0256 obtain the minimum recommended blow count, noted below, based on the field observed hammer stroke. We recommend maintaining the minimum blow count for **three consecutive inches** of driving at the recommended average hammer stroke. Additionally, all production piles should achieve the minimum pile tip elevation of EL 670.5 for uplift, as indicated on the plans.

Field Observed Hammer Stroke (feet)	Exterior Piles (480 kips) Recommended Minimum Blow Count (blows per inch)	Interior Piles (400 kips) Recommended Minimum Blow Count (blows per inch)
6.5	5	3
7.0	5	3
7.5	4	3
8.0	4	3
8.5	4	3

We recommend immediately terminating driving **if the blow counts exceed 10** blows over an increment of one inch or less at hammer strokes of 8.0 feet, after satisfying any minimum tip requirements. We anticipate the production piles will terminate at depths similar to those of the test piles.

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

The dynamic test records for Pier 13 #36 indicated damage began to occur at the pile toe at approximately 76 feet of penetration. The restrike record required impedance reductions over the lower portion of the shaft, with a maximum impedance reduction of 24 percent at the pile toe. GRL recommends that only the shaft resistance above the damage be considered as the pile capacity, which is 130 kips. We recommend this analysis be reviewed by the structural engineer of record.

Please call if you have any questions on these recommendations.

GRL Engineers, Inc.

Travis Coleman, P.E.

Al Ziai

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

Attachments:

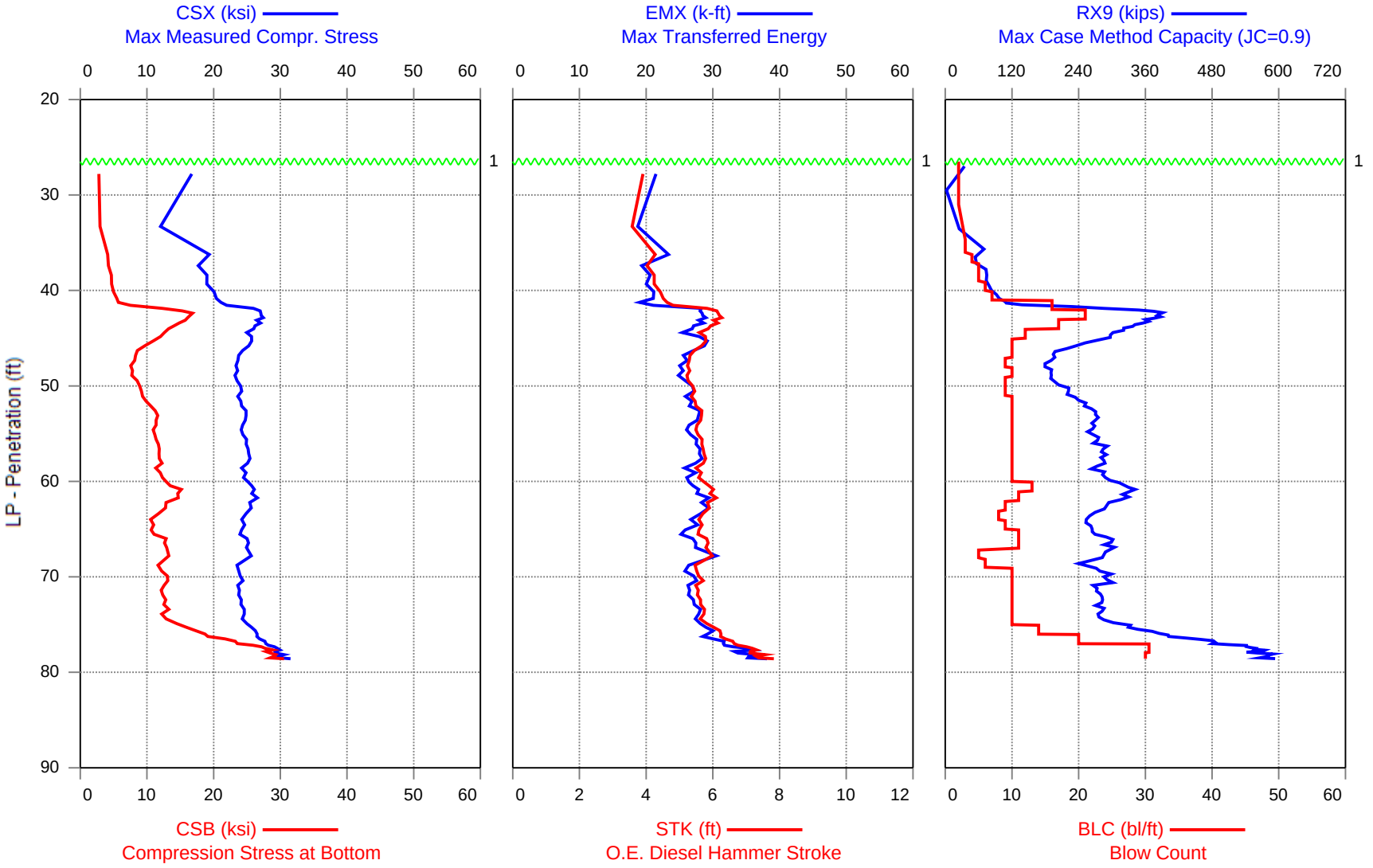
Dynamic Test Results - (pages 4 – 27)
CAPWAP Analysis Results - (pages 28 – 46)

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

Printed: 20-March-2015

Test started: 20-March-2015

USH 10 over Little Lake Butte des Morts - PIER 13 #1
APE D30-42, HP 14 x 73



1 - Reported Reference at El. 740.35

USH 10 over Little Lake Butte des Morts - PIER 13 #1 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 71.83 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
14	32.00	2	AV7	14.9	2.6	19	3.6	61.1	16
			STD	4.4	0.5	5	0.6	4.3	18
			MAX	22.9	3.4	28	4.8	68.1	47
			MIN	6.8	2.0	10	2.8	53.5	0
20	34.67	3	AV1	4.9	3.0	12	3.2	64.5	26
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	4.9	3.0	12	3.2	64.5	26
			MIN	4.9	3.0	12	3.2	64.5	26
21	35.00	3	AV1	13.3	3.4	23	4.0	58.3	50
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	13.3	3.4	23	4.0	58.3	50
			MIN	13.3	3.4	23	4.0	58.3	50
22	35.33	3	AV1	21.7	4.0	31	4.8	53.2	67
			STD	0.0	0.0	0	0.0	0.0	0
			MAX	21.7	4.0	31	4.8	53.2	67
			MIN	21.7	4.0	31	4.8	53.2	67
24	36.00	3	AV2	22.1	4.1	29	4.7	53.6	71
			STD	0.1	0.1	2	0.0	0.0	4
			MAX	22.1	4.2	30	4.7	53.6	75
			MIN	22.0	4.1	27	4.7	53.6	67
28	37.00	4	AV4	17.1	4.1	19	3.9	58.8	52
			STD	1.2	0.2	2	0.2	1.1	4
			MAX	19.0	4.4	22	4.2	60.1	58
			MIN	15.8	3.8	18	3.7	57.0	46
33	38.00	5	AV5	18.4	4.4	20	4.1	57.1	68
			STD	1.1	0.3	2	0.2	1.3	7
			MAX	19.7	4.7	22	4.4	59.0	76
			MIN	16.6	4.1	18	3.9	55.6	55
38	39.00	5	AV5	19.0	4.7	21	4.2	56.5	74
			STD	0.4	0.1	0	0.1	0.6	1
			MAX	19.7	4.8	21	4.4	57.1	76
			MIN	18.5	4.5	20	4.1	55.5	73
44	40.00	6	AV6	19.4	4.8	20	4.3	56.1	79
			STD	0.8	0.1	1	0.1	0.8	5
			MAX	20.7	5.0	22	4.5	57.3	85
			MIN	18.5	4.6	19	4.1	54.7	74
51	41.00	7	AV7	20.0	5.3	21	4.4	55.3	93
			STD	1.0	0.3	1	0.2	1.1	4
			MAX	21.6	5.6	23	4.7	56.9	98
			MIN	18.6	4.8	19	4.2	53.7	86
67	42.00	16	AV16	22.9	8.3	23	5.1	52.2	183
			STD	2.3	3.0	4	0.6	2.6	80
			MAX	27.0	13.8	30	6.1	55.6	329
			MIN	19.9	5.6	17	4.4	47.5	103
88	43.00	21	AV21	27.1	16.2	28	6.2	47.3	379

USH 10 over Little Lake Butte des Morts - PIER 13 #1 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			STD	0.7	0.7	1	0.2	0.7	12
			MAX	28.1	17.2	31	6.5	48.4	400
			MIN	25.9	14.4	26	5.9	46.3	347
105	44.00	17	AV17	26.5	14.5	28	6.0	47.9	346
			STD	0.7	0.9	1	0.2	0.6	17
			MAX	27.6	16.0	30	6.3	49.2	378
			MIN	24.9	13.1	25	5.7	46.9	319
117	45.00	12	AV12	25.5	12.5	27	5.7	49.0	304
			STD	0.7	0.5	2	0.2	0.7	13
			MAX	26.6	13.5	30	6.0	50.2	340
			MIN	24.2	11.5	24	5.4	47.8	290
127	46.00	10	AV10	25.5	10.3	29	5.7	49.0	251
			STD	0.7	0.7	1	0.2	0.7	19
			MAX	26.2	11.4	31	5.9	50.2	278
			MIN	24.4	9.3	27	5.4	48.3	223
137	47.00	10	AV10	24.0	8.4	26	5.4	50.5	200
			STD	1.0	0.3	2	0.2	1.0	9
			MAX	26.1	9.0	30	5.9	51.9	216
			MIN	22.7	8.0	24	5.1	48.3	190
146	48.00	9	AV9	23.7	7.9	26	5.3	50.8	185
			STD	0.5	0.3	1	0.1	0.4	6
			MAX	24.2	8.3	27	5.4	51.4	193
			MIN	23.0	7.5	24	5.2	50.4	176
156	49.00	10	AV10	23.3	7.7	25	5.2	51.1	189
			STD	0.9	0.3	1	0.2	0.8	8
			MAX	25.0	8.4	27	5.6	52.5	207
			MIN	22.0	7.4	23	5.0	49.7	172
165	50.00	9	AV9	23.5	8.6	26	5.3	51.1	197
			STD	0.6	0.3	1	0.1	0.6	9
			MAX	24.6	8.9	28	5.5	51.9	213
			MIN	22.6	8.1	24	5.1	50.0	177
174	51.00	9	AV9	24.1	9.1	27	5.4	50.2	221
			STD	0.7	0.2	1	0.1	0.6	7
			MAX	24.8	9.4	28	5.6	51.3	229
			MIN	22.8	8.8	25	5.2	49.6	209
184	52.00	10	AV10	23.9	9.8	26	5.4	50.3	242
			STD	0.5	0.3	1	0.1	0.5	9
			MAX	24.6	10.3	27	5.6	51.4	263
			MIN	22.9	9.3	24	5.2	49.6	231
194	53.00	10	AV10	24.7	11.2	28	5.6	49.4	266
			STD	0.4	0.4	1	0.1	0.4	7
			MAX	25.4	11.9	29	5.8	50.2	274
			MIN	24.0	10.4	27	5.4	48.7	251
204	54.00	10	AV10	24.7	11.4	28	5.6	49.4	269
			STD	0.5	0.2	1	0.1	0.5	7
			MAX	25.7	11.7	29	5.9	50.1	281
			MIN	24.1	10.9	25	5.5	48.5	261
214	55.00	10	AV10	24.3	11.1	26	5.5	49.9	264
			STD	0.5	0.4	1	0.1	0.5	8
			MAX	25.0	11.7	28	5.7	50.7	280
			MIN	23.4	10.5	25	5.3	49.3	251

USH 10 over Little Lake Butte des Morts - PIER 13 #1 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
224	56.00	10	AV10	24.6	11.4	27	5.6	49.5	271
			STD	0.4	0.2	1	0.1	0.4	7
			MAX	25.4	11.7	29	5.8	50.0	283
			MIN	24.0	11.0	26	5.5	48.8	260
234	57.00	10	AV10	25.1	11.9	28	5.7	49.2	284
			STD	0.5	0.3	1	0.1	0.5	9
			MAX	26.2	12.3	30	6.0	49.8	303
			MIN	24.4	11.4	27	5.5	48.1	273
244	58.00	10	AV10	25.4	12.0	28	5.8	48.8	285
			STD	0.6	0.5	1	0.1	0.6	7
			MAX	26.6	13.0	30	6.0	49.7	298
			MIN	24.4	11.1	26	5.6	47.8	275
254	59.00	10	AV10	24.7	11.7	27	5.6	49.5	276
			STD	0.9	0.6	2	0.2	0.9	11
			MAX	26.1	13.1	30	6.0	51.0	292
			MIN	23.4	10.9	24	5.3	48.1	255
264	60.00	10	AV10	24.7	12.3	27	5.6	49.4	289
			STD	0.4	0.3	1	0.1	0.5	7
			MAX	25.4	12.7	28	5.8	50.1	300
			MIN	24.2	11.7	25	5.5	48.7	275
277	61.00	13	AV13	25.7	14.1	27	5.9	48.3	328
			STD	0.6	1.0	1	0.2	0.6	14
			MAX	26.7	16.2	29	6.2	49.5	351
			MIN	24.6	13.0	25	5.6	47.3	309
288	62.00	11	AV11	26.1	14.5	28	6.0	48.0	322
			STD	0.9	0.9	2	0.3	0.9	14
			MAX	27.7	15.8	32	6.4	49.2	341
			MIN	24.7	13.0	26	5.7	46.4	297
297	63.00	9	AV9	25.6	12.8	29	5.9	48.4	290
			STD	0.8	0.3	1	0.2	0.8	7
			MAX	26.4	13.4	31	6.1	49.8	300
			MIN	24.2	12.3	27	5.5	47.7	277
305	64.00	8	AV8	24.7	11.3	28	5.7	49.3	261
			STD	0.6	0.7	1	0.1	0.6	9
			MAX	26.0	12.4	30	6.0	50.0	283
			MIN	23.9	9.9	27	5.5	48.1	252
314	65.00	9	AV9	24.3	10.8	27	5.6	49.5	258
			STD	0.7	0.4	1	0.2	0.6	9
			MAX	25.8	11.6	29	6.0	50.4	273
			MIN	23.4	10.4	25	5.4	48.1	242
325	66.00	11	AV11	24.3	11.4	26	5.6	49.4	276
			STD	0.6	0.9	1	0.1	0.6	13
			MAX	25.6	12.8	27	5.9	50.2	299
			MIN	23.4	10.2	25	5.4	48.3	261
336	67.00	11	AV11	25.2	12.9	27	5.9	48.5	298
			STD	0.5	0.6	1	0.1	0.5	10
			MAX	26.0	13.8	29	6.1	49.4	315
			MIN	24.2	11.8	26	5.6	47.7	280
341	68.00	5	AV5	25.4	13.2	30	5.9	48.3	286
			STD	0.7	0.4	1	0.2	0.8	7

USH 10 over Little Lake Butte des Morts - PIER 13 #1 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			MAX	26.1	13.7	32	6.1	49.8	296
			MIN	23.9	12.8	28	5.5	47.7	276
347	69.00	6	AV5	23.8	12.0	27	5.6	49.8	254
			STD	1.4	1.1	2	0.3	1.4	24
			MAX	25.2	13.0	30	5.9	52.3	281
			MIN	21.5	10.5	24	5.0	48.4	216
357	70.00	10	AV10	23.9	12.4	26	5.5	49.8	284
			STD	0.5	0.7	1	0.1	0.5	17
			MAX	24.9	13.2	28	5.8	50.6	311
			MIN	23.1	11.1	24	5.4	48.9	260
367	71.00	10	AV10	23.9	12.9	27	5.6	49.6	287
			STD	1.0	0.5	2	0.2	1.1	19
			MAX	25.6	13.5	29	6.0	52.5	309
			MIN	21.3	11.9	23	5.0	48.1	244
377	72.00	10	AV10	23.9	12.3	27	5.6	49.7	275
			STD	0.5	0.5	1	0.1	0.4	8
			MAX	24.6	13.0	28	5.7	50.5	286
			MIN	23.2	11.7	25	5.4	49.1	265
387	73.00	10	AV10	24.1	12.7	27	5.6	49.5	280
			STD	0.6	0.3	1	0.1	0.6	10
			MAX	24.8	13.4	28	5.8	50.6	293
			MIN	22.9	12.3	26	5.4	48.7	265
397	74.00	10	AV10	24.6	12.8	28	5.7	48.9	280
			STD	0.4	0.7	1	0.1	0.4	8
			MAX	25.3	13.7	30	5.9	49.4	293
			MIN	24.1	11.6	27	5.6	48.3	264
407	75.00	10	AV10	24.5	13.4	28	5.7	49.2	290
			STD	0.6	0.9	1	0.2	0.6	12
			MAX	25.3	14.9	30	5.9	50.5	307
			MIN	23.4	12.0	26	5.4	48.2	272
421	76.00	14	AV14	26.1	16.9	30	6.2	47.4	357
			STD	0.9	1.3	2	0.2	0.9	24
			MAX	28.1	19.1	35	6.7	48.4	397
			MIN	25.2	15.2	27	5.9	45.6	322
441	77.00	20	AV20	27.1	21.4	30	6.4	46.4	447
			STD	0.8	2.0	2	0.2	0.8	35
			MAX	28.5	24.1	33	6.8	47.8	490
			MIN	25.7	17.9	27	6.0	45.0	389
469	77.92	31	AV28	29.1	27.3	34	7.0	44.4	547
			STD	1.1	1.6	3	0.3	1.0	25
			MAX	30.7	30.0	38	7.7	46.8	596
			MIN	26.6	23.4	29	6.3	42.6	486
479	78.25	30	AV10	29.8	28.9	35	7.3	43.7	575
			STD	0.9	0.9	2	0.3	0.9	13
			MAX	31.2	30.9	38	7.8	44.9	594
			MIN	28.4	27.5	32	6.9	42.4	558
489	78.58	30	AV10	30.1	29.0	36	7.4	43.4	580
			STD	0.9	0.8	1	0.3	0.8	16
			MAX	31.5	30.6	38	7.8	45.0	605
			MIN	28.2	27.9	33	6.8	42.2	550
			Average	24.8	13.4	27	5.7	49.3	296

USH 10 over Little Lake Butte des Morts - PIER 13 #1 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			Std. Dev.	3.0	6.1	4	0.7	3.3	123
			Maximum	31.5	30.9	38	7.8	68.1	605
			Minimum	4.9	2.0	10	2.8	42.2	0

Total number of blows analyzed: 476

BL# Sensors

1-489 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

3 Reported Reference at El. 740.35
4 Mudline at El. 717.23
336 Stopped to move gages up to pile head
344 LE = 93.83 ft; WC = 16,755.4 f/s

Time Summary

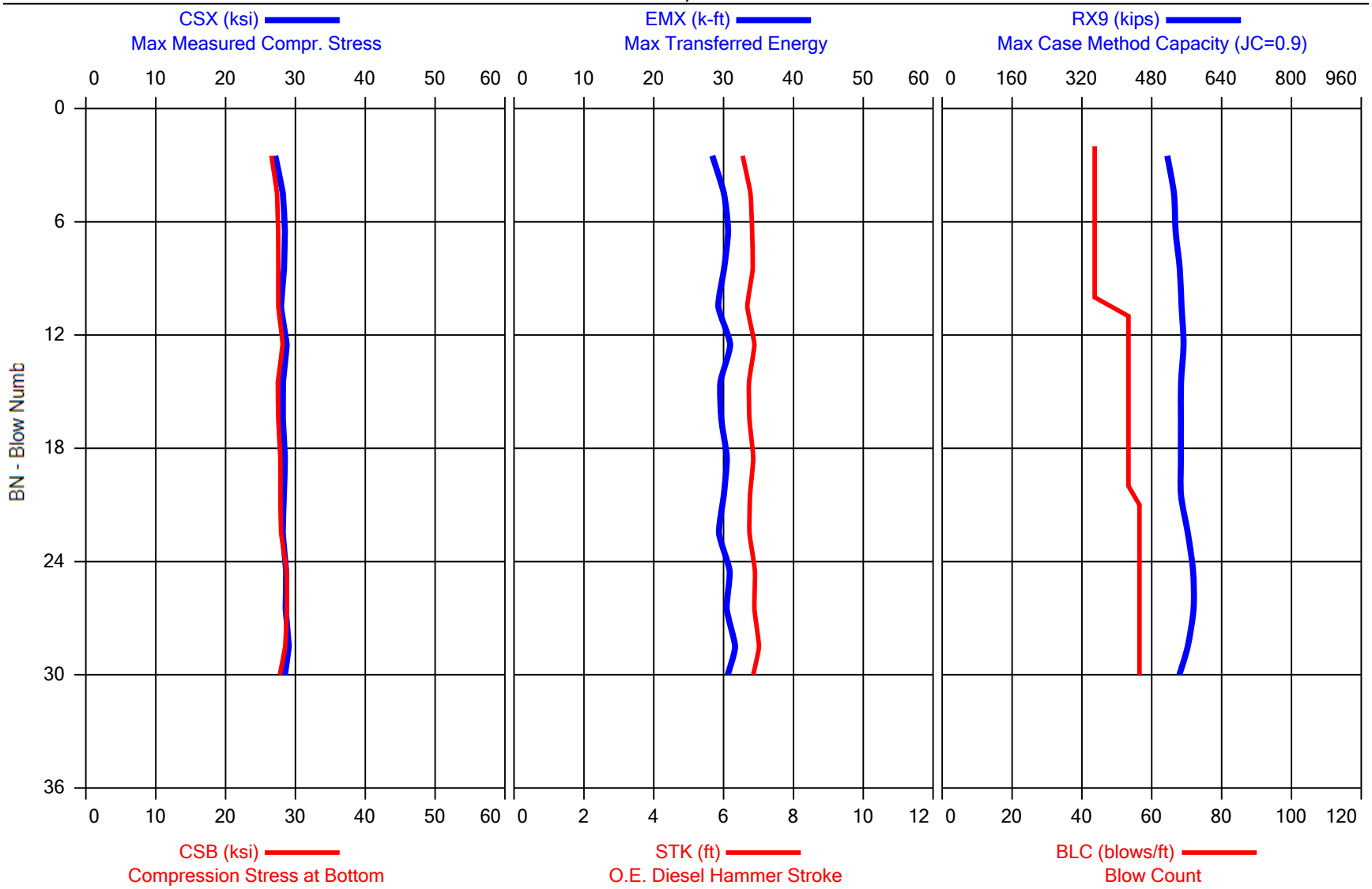
Drive 20 minutes 17 seconds 8:02 AM - 8:22 AM BN 1 - 489

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

Printed: 23-March-2015 Test started: 23-March-2015

USH10 OVER LLBDM - PIER 13 #1 - BOR

APE D30-42, HP 14 x 73



USH10 OVER LLBDM - PIER 13 #1 - BOR APE D30-42, HP 14 x 73
OP: AZ Date: 23-March-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 84.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
10	78.81	44	AV9	28.1	27.3	6.7	30	45.4	534
			STD	0.6	0.5	0.1	1	0.4	15
			MAX	28.5	27.8	6.8	31	46.5	556
			MIN	26.5	26.0	6.4	28	45.0	500
20	79.00	53	AV10	28.4	27.7	6.8	30	45.2	547
			STD	0.3	0.3	0.1	1	0.3	4
			MAX	29.0	28.3	6.9	31	45.6	555
			MIN	27.7	27.4	6.7	29	44.7	540
30	79.17	56	AV10	28.6	28.4	6.9	31	45.0	564
			STD	0.4	0.5	0.1	1	0.4	12
			MAX	29.5	29.2	7.2	33	45.6	579
			MIN	27.9	27.4	6.7	28	44.0	543
			Average	28.3	27.8	6.8	30	45.2	549
			Std. Dev.	0.5	0.6	0.1	1	0.4	17
			Maximum	29.5	29.2	7.2	33	46.5	579
			Minimum	26.5	26.0	6.4	28	44.0	500

Total number of blows analyzed: 29

BL# Sensors

1-30 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.09); A4: [K3550] 360.0 (1.09)

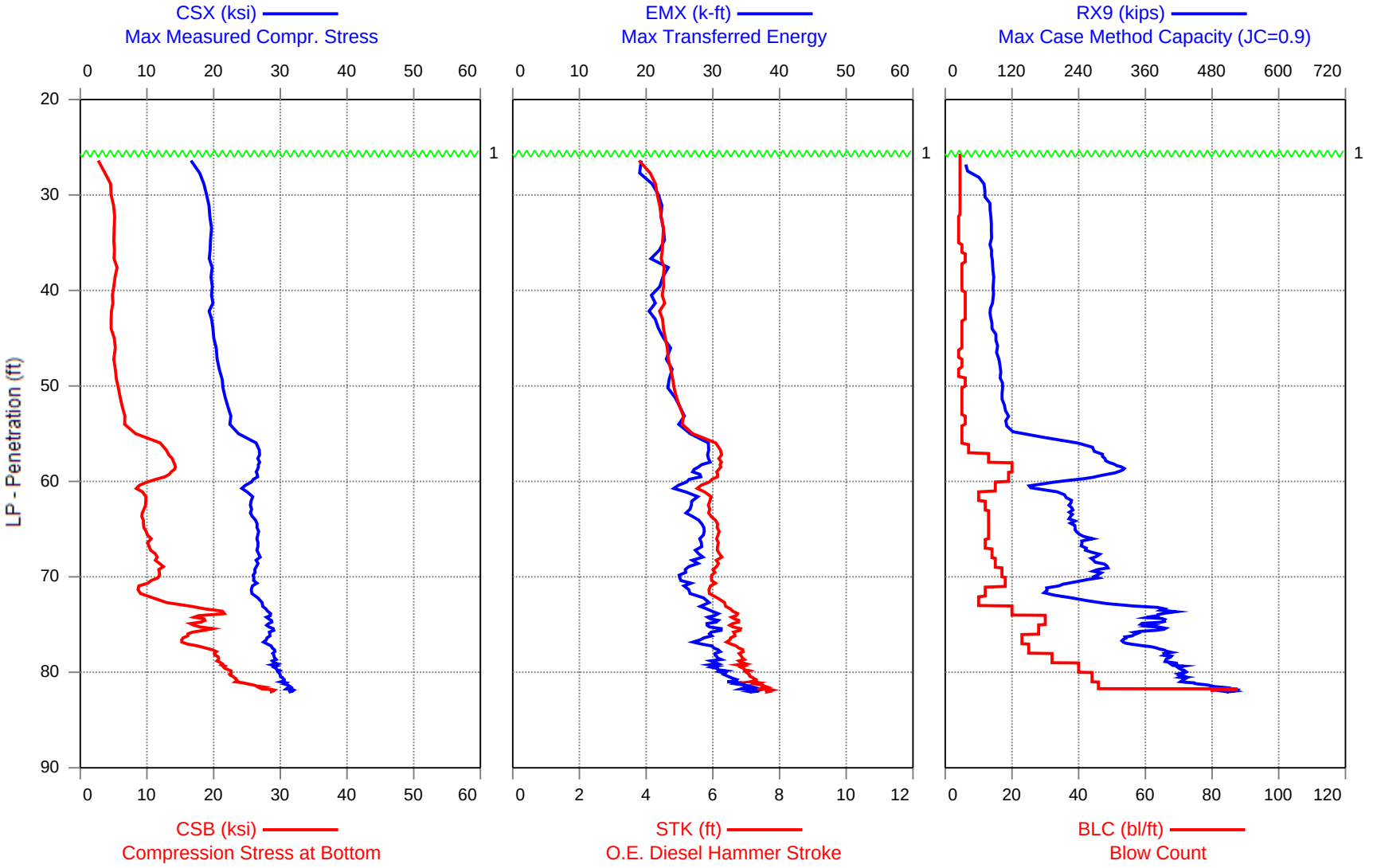
Time Summary

Drive 38 seconds 6:54 AM - 6:54 AM BN 1 - 30

Printed: 20-March-2015

Test started: 20-March-2015

USH 10 over Little Lake Butte des Morts - PIER 13 #36
APE D30-42, HP 14 x 73



1 - Reported reference at El. 740.23

USH 10 over Little Lake Butte des Morts - PIER 13 #36 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-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
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
31	32.00	4	AV27	18.4	4.2	21	4.2	56.9	60
			STD	2.4	0.9	3	0.5	3.1	24
			MAX	25.8	5.7	32	5.6	64.7	84
			MIN	12.4	1.9	12	3.2	49.5	0
35	33.00	4	AV4	19.5	5.1	22	4.5	55.0	83
			STD	0.5	0.2	1	0.1	0.5	3
			MAX	20.1	5.5	24	4.6	55.8	87
			MIN	18.7	5.0	21	4.3	54.4	78
39	34.00	4	AV4	19.6	5.0	22	4.5	54.9	84
			STD	0.4	0.4	2	0.1	0.4	4
			MAX	20.2	5.7	26	4.6	55.3	88
			MIN	19.1	4.5	20	4.4	54.3	78
43	35.00	4	AV4	19.4	5.1	23	4.5	55.2	81
			STD	0.4	0.1	1	0.1	0.4	4
			MAX	20.0	5.3	24	4.6	55.7	84
			MIN	18.8	5.0	21	4.4	54.6	75
48	36.00	5	AV5	19.5	5.1	22	4.5	54.9	83
			STD	0.4	0.3	1	0.1	0.5	1
			MAX	20.2	5.6	23	4.7	55.5	84
			MIN	19.0	4.7	21	4.4	54.0	81
54	37.00	6	AV6	19.5	5.1	21	4.5	55.1	84
			STD	0.4	0.2	1	0.1	0.5	2
			MAX	20.1	5.3	22	4.6	55.8	86
			MIN	18.8	4.8	20	4.3	54.4	82
59	38.00	5	AV5	19.8	5.5	23	4.5	54.7	85
			STD	0.4	0.1	1	0.1	0.4	1
			MAX	20.3	5.7	24	4.6	55.3	87
			MIN	19.2	5.3	22	4.4	54.1	84
64	39.00	5	AV5	19.6	5.2	23	4.5	54.9	87
			STD	0.3	0.1	1	0.1	0.4	1
			MAX	19.8	5.5	23	4.6	55.5	89
			MIN	19.1	5.1	22	4.4	54.4	86
69	40.00	5	AV5	19.8	5.0	22	4.5	54.8	86
			STD	0.8	0.2	2	0.2	0.9	3
			MAX	21.3	5.3	24	4.8	55.6	90
			MIN	19.0	4.6	20	4.4	53.3	81
75	41.00	6	AV6	19.7	5.0	21	4.5	54.9	86
			STD	0.4	0.5	1	0.1	0.5	2
			MAX	20.2	5.7	21	4.6	55.8	90
			MIN	19.1	4.3	20	4.3	54.5	84
81	42.00	6	AV6	19.6	4.6	21	4.5	55.1	83
			STD	0.8	0.3	1	0.2	1.0	2
			MAX	20.9	5.2	22	4.8	56.1	86
			MIN	18.8	4.3	19	4.3	53.4	80
87	43.00	6	AV6	19.6	4.7	21	4.5	55.1	81

USH 10 over Little Lake Butte des Morts - PIER 13 #36 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			STD	0.2	0.2	0	0.1	0.3	1
			MAX	19.9	5.0	22	4.5	55.7	83
			MIN	19.3	4.5	20	4.4	54.8	80
92	44.00	5	AV5	19.7	4.6	22	4.5	55.0	84
			STD	0.6	0.2	1	0.1	0.7	2
			MAX	20.6	4.8	23	4.6	56.1	86
			MIN	18.8	4.3	21	4.3	54.2	82
97	45.00	5	AV5	20.0	5.0	22	4.6	54.5	90
			STD	0.9	0.3	2	0.2	1.1	4
			MAX	21.1	5.3	25	4.8	56.1	95
			MIN	18.7	4.7	20	4.3	53.1	84
102	46.00	5	AV5	20.0	5.1	22	4.5	54.7	93
			STD	0.2	0.1	0	0.0	0.2	2
			MAX	20.3	5.2	22	4.6	54.9	95
			MIN	19.6	4.9	22	4.5	54.5	89
106	47.00	4	AV4	20.7	5.3	25	4.7	53.9	93
			STD	0.5	0.3	1	0.1	0.6	2
			MAX	21.2	5.8	26	4.8	54.8	97
			MIN	19.9	5.0	23	4.5	53.3	92
111	48.00	5	AV5	20.7	5.0	23	4.7	53.7	98
			STD	0.4	0.2	1	0.1	0.5	3
			MAX	21.5	5.3	24	4.9	54.3	104
			MIN	20.2	4.7	21	4.6	52.9	94
115	49.00	4	AV4	20.9	5.4	24	4.7	53.6	99
			STD	0.7	0.1	1	0.2	0.8	2
			MAX	21.8	5.5	26	5.0	54.7	102
			MIN	19.9	5.3	23	4.5	52.4	96
121	50.00	6	AV6	21.3	5.5	23	4.8	53.2	102
			STD	0.3	0.1	1	0.1	0.3	5
			MAX	21.6	5.6	24	4.9	53.8	108
			MIN	20.7	5.4	22	4.7	52.9	92
126	51.00	5	AV5	21.5	5.8	24	4.9	53.0	103
			STD	0.2	0.3	1	0.1	0.3	3
			MAX	21.7	6.2	25	4.9	53.3	107
			MIN	21.2	5.4	23	4.8	52.6	98
131	52.00	5	AV5	21.9	6.1	25	5.0	52.4	103
			STD	0.1	0.0	0	0.0	0.1	3
			MAX	22.1	6.2	25	5.0	52.7	106
			MIN	21.8	6.0	24	4.9	52.3	98
136	53.00	5	AV5	22.3	6.5	25	5.0	52.1	109
			STD	0.1	0.2	1	0.0	0.1	4
			MAX	22.4	6.7	26	5.1	52.2	114
			MIN	22.2	6.3	25	5.0	52.0	102
142	54.00	6	AV6	22.6	6.7	26	5.1	51.7	111
			STD	0.3	0.2	1	0.1	0.3	3
			MAX	23.2	7.1	28	5.3	52.0	116
			MIN	22.3	6.5	23	5.1	51.0	106
147	55.00	5	AV5	22.6	7.1	25	5.1	51.7	117
			STD	0.2	0.4	0	0.0	0.2	9
			MAX	22.8	7.8	26	5.2	51.9	132
			MIN	22.3	6.7	24	5.1	51.4	107

USH 10 over Little Lake Butte des Morts - PIER 13 #36 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
152	56.00	5	AV5	25.9	11.0	29	5.9	48.2	200
			STD	0.8	1.1	1	0.2	0.9	32
			MAX	27.1	12.3	30	6.3	49.5	241
			MIN	24.6	9.1	28	5.6	46.9	152
159	57.00	7	AV7	26.7	12.8	29	6.2	47.2	264
			STD	0.3	0.4	1	0.1	0.3	10
			MAX	27.1	13.5	32	6.3	47.7	282
			MIN	26.2	12.4	28	6.1	46.8	249
172	58.00	13	AV13	26.8	13.6	29	6.2	47.1	286
			STD	0.3	0.4	1	0.1	0.3	5
			MAX	27.3	14.1	31	6.4	47.6	293
			MIN	26.2	12.9	28	6.1	46.6	277
192	59.00	20	AV20	26.6	14.1	28	6.2	47.2	313
			STD	0.5	0.3	1	0.1	0.5	8
			MAX	27.4	14.5	30	6.4	48.1	329
			MIN	25.8	13.6	25	6.0	46.5	296
211	60.00	19	AV19	26.3	12.4	27	6.1	47.6	265
			STD	0.5	1.1	1	0.1	0.5	30
			MAX	27.2	13.9	29	6.3	48.4	310
			MIN	25.5	10.2	26	5.9	46.8	211
226	61.00	15	AV15	24.8	8.9	25	5.7	49.3	170
			STD	0.6	0.6	1	0.1	0.6	18
			MAX	25.7	10.0	27	5.9	50.1	206
			MIN	24.0	8.2	24	5.5	48.3	145
236	62.00	10	AV10	25.5	9.8	27	5.9	48.4	215
			STD	0.5	0.2	1	0.1	0.5	11
			MAX	26.2	10.4	28	6.1	49.5	234
			MIN	24.4	9.5	26	5.6	47.7	191
248	63.00	12	AV12	25.6	9.7	27	5.9	48.3	226
			STD	0.4	0.2	1	0.1	0.4	4
			MAX	26.3	9.9	28	6.1	48.9	232
			MIN	25.1	9.3	26	5.8	47.7	218
261	64.00	13	AV13	25.8	9.3	27	5.9	48.2	226
			STD	0.4	0.3	1	0.1	0.4	7
			MAX	26.6	9.8	28	6.1	49.0	241
			MIN	25.0	8.8	25	5.7	47.4	215
274	65.00	13	AV13	26.5	9.5	28	6.1	47.5	231
			STD	0.3	0.2	1	0.1	0.4	7
			MAX	27.0	9.8	29	6.3	48.1	240
			MIN	25.8	9.2	27	6.0	47.0	222
287	66.00	13	AV13	26.6	10.1	29	6.2	47.4	244
			STD	0.3	0.3	1	0.1	0.3	11
			MAX	27.0	10.7	29	6.3	48.0	268
			MIN	26.0	9.6	27	6.0	47.0	227
299	67.00	12	AV12	26.6	10.3	28	6.1	47.4	249
			STD	0.4	0.3	1	0.1	0.4	10
			MAX	27.3	11.1	29	6.3	47.9	276
			MIN	26.0	9.9	27	6.0	46.8	231
313	68.00	14	AV14	26.7	11.1	28	6.2	47.2	266
			STD	0.5	0.6	1	0.1	0.5	11

USH 10 over Little Lake Butte des Morts - PIER 13 #36 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			MAX	27.7	11.9	30	6.5	48.0	291
			MIN	26.1	10.2	26	6.0	46.2	249
328	69.00	15	AV15	26.5	11.8	27	6.1	47.5	277
			STD	0.4	0.6	1	0.1	0.4	12
			MAX	27.0	12.7	28	6.3	48.3	294
			MIN	25.7	10.7	24	5.9	46.9	260
345	70.00	17	AV17	26.1	11.9	26	6.0	47.9	276
			STD	0.5	0.3	1	0.1	0.5	12
			MAX	27.1	12.7	28	6.3	48.6	300
			MIN	25.3	11.3	23	5.8	46.9	256
363	71.00	18	AV18	26.1	10.3	26	6.0	48.0	236
			STD	0.4	1.0	1	0.1	0.3	26
			MAX	26.9	12.3	27	6.2	48.5	278
			MIN	25.5	8.8	24	5.9	47.2	197
375	72.00	12	AV12	25.7	8.9	26	5.9	48.4	185
			STD	0.4	0.4	1	0.1	0.5	9
			MAX	26.5	9.8	28	6.1	49.0	197
			MIN	25.0	8.5	25	5.7	47.6	171
385	73.00	10	AV10	27.1	12.4	29	6.3	46.9	263
			STD	0.6	1.2	1	0.2	0.6	31
			MAX	27.9	14.2	31	6.5	48.0	310
			MIN	26.0	10.3	26	6.0	46.0	214
405	74.00	20	AV20	28.0	19.8	30	6.6	45.9	389
			STD	0.7	2.5	1	0.2	0.6	19
			MAX	29.1	25.6	32	6.9	47.0	424
			MIN	27.0	15.2	27	6.3	44.8	337
435	75.00	30	AV30	28.3	17.7	30	6.7	45.6	378
			STD	0.5	0.9	1	0.2	0.5	17
			MAX	29.3	19.7	32	7.0	46.8	413
			MIN	27.2	16.2	27	6.3	44.6	344
463	76.00	28	AV28	28.5	17.8	30	6.7	45.5	369
			STD	0.4	1.4	1	0.1	0.5	21
			MAX	29.2	21.7	32	6.9	46.6	403
			MIN	27.5	15.9	28	6.4	44.8	336
486	77.00	23	AV23	28.0	15.5	28	6.5	46.0	325
			STD	0.6	0.4	1	0.2	0.6	7
			MAX	28.9	16.6	31	6.8	47.1	342
			MIN	26.7	14.9	26	6.2	45.1	316
511	78.00	25	AV25	28.8	18.9	30	6.8	45.2	379
			STD	0.5	1.4	1	0.2	0.5	22
			MAX	29.9	21.0	33	7.1	46.5	418
			MIN	27.6	16.2	28	6.4	44.1	332
543	79.00	32	AV32	29.0	20.5	30	6.8	45.0	400
			STD	0.4	0.4	1	0.1	0.4	7
			MAX	29.8	21.3	32	7.1	46.0	413
			MIN	28.1	19.5	28	6.5	44.3	386
583	80.00	40	AV40	29.4	21.8	31	6.9	44.8	422
			STD	0.6	0.6	1	0.2	0.5	9
			MAX	30.5	23.1	33	7.3	46.1	438
			MIN	27.9	20.8	28	6.5	43.7	405

USH 10 over Little Lake Butte des Morts - PIER 13 #36 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
627	81.00	44	AV44	30.2	23.0	32	7.2	44.1	427
			STD	0.4	0.5	1	0.1	0.4	5
			MAX	31.3	24.0	35	7.5	44.9	439
			MIN	29.4	22.0	31	6.9	43.1	417
660	81.72	46	AV33	31.0	26.0	35	7.4	43.3	470
			STD	0.6	1.3	1	0.2	0.6	21
			MAX	32.1	28.0	37	7.9	44.6	505
			MIN	29.6	23.3	31	7.0	42.1	426
670	81.83	87	AV10	31.4	28.1	36	7.6	42.8	509
			STD	0.5	0.7	1	0.2	0.4	12
			MAX	32.2	29.3	37	7.8	43.5	522
			MIN	30.5	27.1	33	7.4	42.3	487
680	81.96	80	AV10	32.0	29.1	37	7.8	42.3	523
			STD	0.2	0.3	1	0.1	0.2	6
			MAX	32.5	29.4	38	7.9	42.7	529
			MIN	31.6	28.4	36	7.6	41.9	513
690	82.08	80	AV10	31.5	28.6	36	7.7	42.7	512
			STD	0.7	0.5	2	0.2	0.6	9
			MAX	32.4	29.3	38	7.9	43.7	523
			MIN	30.1	27.8	33	7.3	41.9	492
			Average	26.4	14.4	28	6.2	47.8	287
			Std. Dev.	3.7	7.1	4	1.0	4.0	133
			Maximum	32.5	29.4	38	7.9	64.7	529
			Minimum	12.4	1.9	12	3.2	41.9	0

Total number of blows analyzed: 686

BL# Sensors

1-690 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

3 Reported reference at El. 740.23
4 Mudline at El. 717.23

Time Summary

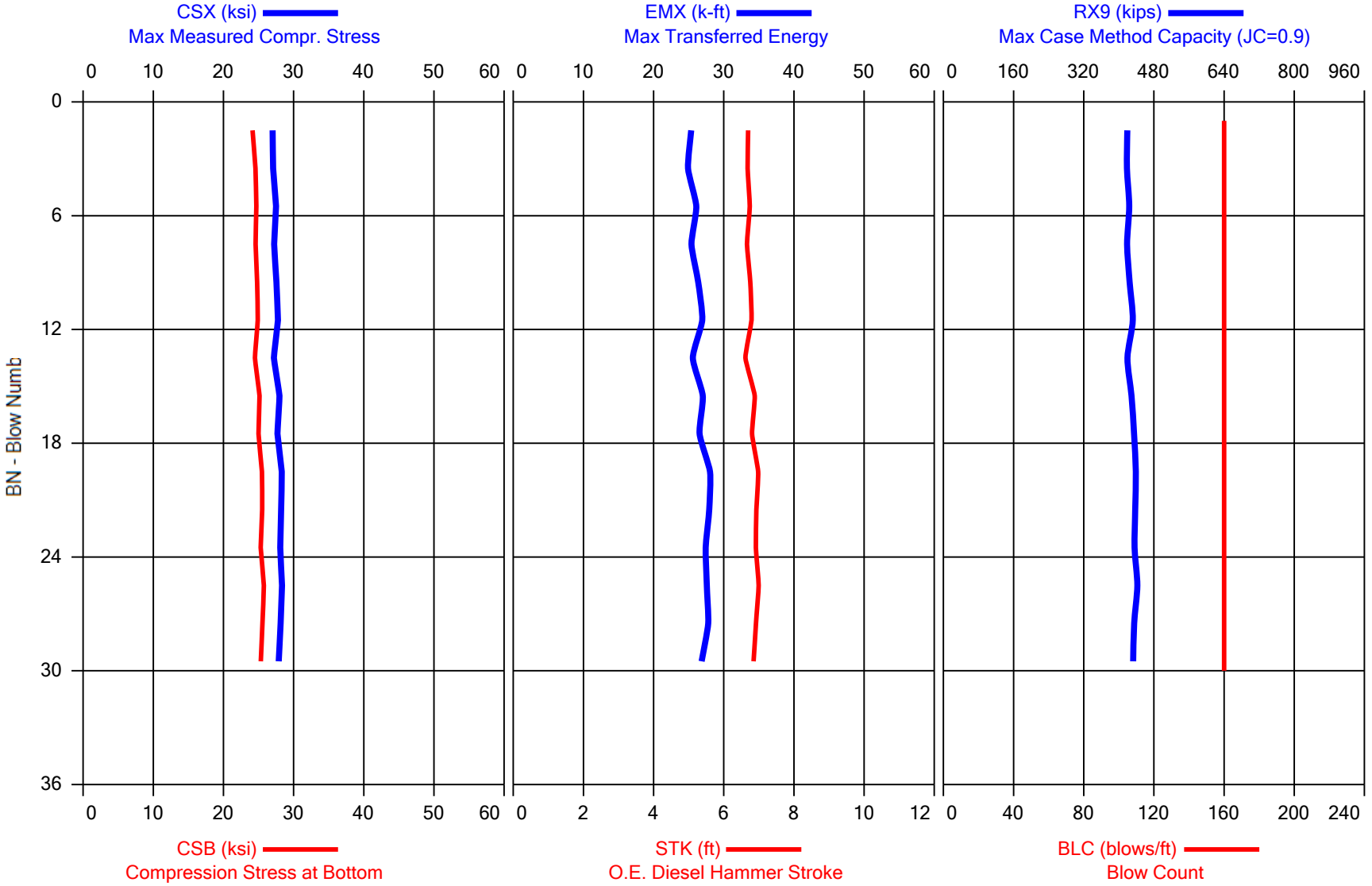
Drive 15 minutes 38 seconds 7:32 AM - 7:47 AM BN 1 - 690

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

Printed: 23-March-2015 Test started: 23-March-2015

USH10 OVER LLBDM - PIER 13 #36 - BOR

APE D30-42, HP 14 x 73



USH10 OVER LLBDM - PIER 13 #36 - BOR APE D30-42, HP 14 x 73
OP: AZ Date: 23-March-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 87.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth	BLC	TYPE	CSX	CSB	STK	EMX	BPM	RX9
	ft	blows/ft		ksi	ksi	ft	k-ft	bpm	kips
10	82	160	AV10	27.3	24.6	6.7	26	45.5	421
			STD	0.4	0.3	0.1	1	0.3	5
			MAX	27.8	25.0	6.8	27	46.0	428
			MIN	26.6	23.7	6.5	25	45.0	410
20	82	160	AV10	27.8	25.0	6.8	27	45.1	431
			STD	0.5	0.5	0.2	1	0.6	8
			MAX	28.8	25.9	7.1	29	45.9	443
			MIN	27.1	24.4	6.6	25	44.1	417
30	82	160	AV10	28.1	25.5	6.9	28	44.8	437
			STD	0.4	0.3	0.1	1	0.4	4
			MAX	28.7	26.0	7.1	29	45.4	445
			MIN	27.6	25.1	6.7	26	44.2	429
			Average	27.7	25.0	6.8	27	45.1	429
			Std. Dev.	0.6	0.5	0.2	1	0.5	9
			Maximum	28.8	26.0	7.1	29	46.0	445
			Minimum	26.6	23.7	6.5	25	44.1	410

Total number of blows analyzed: 30

BL# Sensors

1-30 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.09); A4: [K2524] 360.0 (1.09)

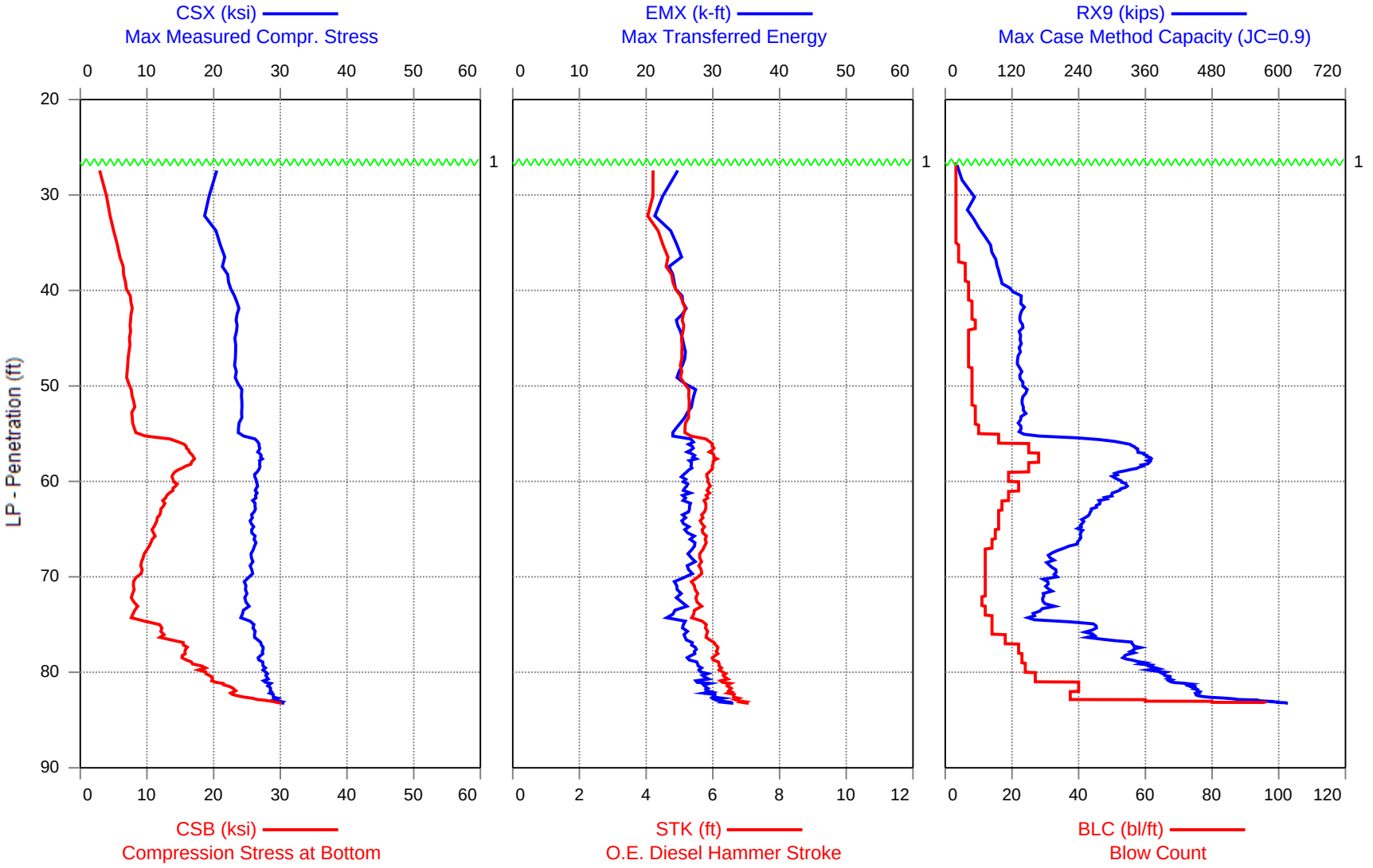
Time Summary

Drive 38 seconds 7:04 AM - 7:05 AM BN 1 - 30

Printed: 20-March-2015

Test started: 20-March-2015

USH 10 over Little Lake Butte des Morts - PIER 13 #44
APE D30-42, HP 14 x 73



1 - Reported reference at El. 740.23

USH 10 over Little Lake Butte des Morts - PIER 13 #44 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 93.92 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
32	35.00	3	AV22	19.8	4.2	23	4.2	57.1	48
			STD	3.8	1.0	7	0.7	4.6	20
			MAX	29.7	5.5	43	6.5	67.9	79
			MIN	12.0	2.1	10	2.8	46.2	7
36	36.00	4	AV4	21.2	5.6	25	4.5	54.7	83
			STD	0.4	0.1	0	0.1	0.5	2
			MAX	21.9	5.7	25	4.7	55.2	87
			MIN	20.8	5.5	24	4.5	54.0	81
40	37.00	4	AV4	21.8	6.0	25	4.7	54.0	89
			STD	0.6	0.1	1	0.1	0.6	3
			MAX	22.3	6.2	27	4.8	54.8	94
			MIN	20.9	5.8	24	4.5	53.2	84
46	38.00	6	AV6	21.5	6.5	24	4.6	54.1	94
			STD	0.8	0.2	1	0.2	0.9	5
			MAX	22.6	6.7	25	4.9	55.8	100
			MIN	20.1	6.2	22	4.3	52.9	85
52	39.00	6	AV6	21.8	6.5	23	4.7	53.8	99
			STD	0.6	0.2	1	0.1	0.5	2
			MAX	22.4	6.8	25	4.8	54.7	102
			MIN	20.7	6.3	22	4.5	53.1	95
59	40.00	7	AV7	22.6	6.9	25	4.9	52.8	110
			STD	0.4	0.1	1	0.1	0.4	7
			MAX	23.3	7.2	26	5.0	53.3	117
			MIN	22.1	6.7	23	4.8	52.1	100
66	41.00	7	AV7	23.1	7.5	25	5.0	52.2	133
			STD	0.4	0.2	1	0.1	0.4	6
			MAX	23.8	7.8	27	5.2	52.8	145
			MIN	22.6	7.1	24	4.9	51.5	125
74	42.00	8	AV8	23.7	7.7	26	5.1	51.6	139
			STD	0.2	0.2	0	0.1	0.3	3
			MAX	24.1	7.9	27	5.2	52.0	144
			MIN	23.4	7.4	25	5.1	51.2	135
82	43.00	8	AV8	23.5	7.7	25	5.1	51.7	136
			STD	0.3	0.2	1	0.1	0.4	3
			MAX	23.9	7.9	26	5.2	52.3	139
			MIN	23.0	7.5	24	5.0	51.3	128
91	44.00	9	AV9	23.5	7.5	25	5.1	51.7	138
			STD	0.4	0.1	1	0.1	0.4	3
			MAX	24.1	7.6	26	5.2	52.4	141
			MIN	22.9	7.3	23	5.0	51.1	130
98	45.00	7	AV7	23.3	7.5	25	5.1	51.9	134
			STD	0.2	0.1	0	0.1	0.2	4
			MAX	23.6	7.7	26	5.2	52.2	140
			MIN	22.9	7.3	25	5.0	51.5	129
105	46.00	7	AV7	23.3	7.4	26	5.1	51.9	136

USH 10 over Little Lake Butte des Morts - PIER 13 #44 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			STD	0.5	0.2	1	0.1	0.5	3
			MAX	23.9	7.7	27	5.2	52.9	142
			MIN	22.4	7.2	24	4.9	51.2	134
112	47.00	7	AV7	23.2	7.3	26	5.1	52.0	133
			STD	0.3	0.1	0	0.1	0.2	3
			MAX	23.7	7.5	27	5.1	52.3	138
			MIN	22.8	7.2	25	5.0	51.6	128
119	48.00	7	AV7	23.3	7.1	26	5.1	51.9	130
			STD	0.4	0.2	1	0.1	0.4	4
			MAX	23.8	7.3	27	5.2	52.7	134
			MIN	22.5	6.8	24	4.9	51.4	124
127	49.00	8	AV8	23.3	7.0	25	5.0	52.1	136
			STD	0.3	0.1	0	0.1	0.4	3
			MAX	23.6	7.2	25	5.1	52.7	143
			MIN	22.6	6.9	24	4.9	51.7	133
135	50.00	8	AV8	23.5	7.1	25	5.1	51.8	138
			STD	0.2	0.2	1	0.1	0.4	3
			MAX	23.9	7.4	26	5.2	52.3	142
			MIN	23.2	6.8	24	5.0	51.2	134
143	51.00	8	AV8	24.3	7.7	27	5.3	50.9	145
			STD	0.3	0.2	1	0.1	0.3	4
			MAX	24.7	7.9	28	5.4	51.4	154
			MIN	23.8	7.4	27	5.2	50.5	140
151	52.00	8	AV8	24.2	7.9	27	5.3	50.9	139
			STD	0.2	0.2	0	0.1	0.3	3
			MAX	24.4	8.3	28	5.3	51.5	142
			MIN	23.6	7.6	26	5.2	50.7	133
160	53.00	9	AV9	24.2	7.9	26	5.3	50.9	142
			STD	0.3	0.2	1	0.1	0.4	4
			MAX	24.6	8.3	28	5.4	51.7	151
			MIN	23.4	7.6	25	5.1	50.5	137
169	54.00	9	AV9	24.0	7.8	25	5.2	51.2	134
			STD	0.5	0.2	1	0.1	0.5	5
			MAX	24.6	8.2	26	5.3	52.2	144
			MIN	23.0	7.6	24	5.0	50.7	127
179	55.00	10	AV10	23.8	8.2	25	5.2	51.4	135
			STD	0.5	0.3	1	0.1	0.6	2
			MAX	24.6	8.7	26	5.4	52.5	138
			MIN	22.8	7.8	22	5.0	50.3	131
195	56.00	16	AV16	25.6	12.4	26	5.6	49.4	243
			STD	1.1	2.4	2	0.3	1.3	63
			MAX	27.3	15.1	28	6.0	51.9	319
			MIN	23.4	8.4	23	5.1	47.8	144
220	57.00	25	AV25	26.8	16.0	27	6.0	48.0	341
			STD	0.3	0.5	1	0.1	0.3	6
			MAX	27.3	17.0	27	6.1	48.6	352
			MIN	26.3	15.1	25	5.8	47.5	330
248	58.00	28	AV28	27.1	16.9	27	6.0	47.8	365
			STD	0.4	0.3	1	0.1	0.4	6
			MAX	27.8	17.5	29	6.3	48.7	379
			MIN	26.1	16.1	25	5.8	46.9	353

USH 10 over Little Lake Butte des Morts - PIER 13 #44
OP: AM
APE D30-42, HP 14 x 73
Date: 20-March-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
273	59.00	25	AV25	26.8	15.5	27	6.0	48.1	345
			STD	0.3	0.9	0	0.1	0.3	16
			MAX	27.6	17.0	28	6.1	48.5	369
			MIN	26.3	14.1	26	5.9	47.4	312
292	60.00	19	AV19	26.3	13.9	26	5.8	48.6	308
			STD	0.4	0.2	1	0.1	0.4	6
			MAX	26.8	14.3	27	6.0	49.6	320
			MIN	25.3	13.5	24	5.6	48.0	295
314	61.00	22	AV22	26.4	14.1	26	5.9	48.4	321
			STD	0.3	0.4	1	0.1	0.3	6
			MAX	27.0	15.0	27	6.0	48.9	331
			MIN	25.8	13.3	24	5.8	47.9	308
333	62.00	19	AV19	26.3	12.9	26	5.8	48.6	295
			STD	0.5	0.5	1	0.1	0.4	10
			MAX	27.0	13.9	29	6.0	49.5	310
			MIN	25.4	12.1	24	5.6	47.9	275
350	63.00	17	AV17	26.3	12.4	27	5.8	48.7	273
			STD	0.3	0.3	1	0.1	0.3	6
			MAX	26.9	13.1	28	5.9	49.2	281
			MIN	25.6	11.9	26	5.7	48.3	258
366	64.00	16	AV16	25.8	11.9	26	5.7	49.1	256
			STD	0.4	0.4	1	0.1	0.4	6
			MAX	26.6	12.8	27	5.9	49.7	265
			MIN	25.1	11.2	25	5.6	48.4	245
382	65.00	16	AV16	25.6	11.1	26	5.7	49.3	245
			STD	0.5	0.3	1	0.1	0.4	4
			MAX	26.7	11.5	28	5.9	50.0	251
			MIN	24.8	10.5	24	5.5	48.2	234
397	66.00	15	AV15	26.0	11.0	27	5.7	48.9	244
			STD	0.5	0.2	1	0.1	0.4	4
			MAX	27.1	11.4	28	6.0	49.5	252
			MIN	25.3	10.5	25	5.6	47.9	235
411	67.00	14	AV14	26.2	10.5	27	5.8	48.8	232
			STD	0.3	0.3	1	0.1	0.4	11
			MAX	26.6	11.1	28	5.9	49.4	245
			MIN	25.7	9.9	26	5.6	48.2	213
423	68.00	12	AV12	25.7	9.7	27	5.6	49.4	194
			STD	0.4	0.3	1	0.1	0.4	10
			MAX	26.5	10.4	28	5.8	50.1	212
			MIN	25.1	9.1	25	5.5	48.6	177
435	69.00	12	AV12	25.7	9.1	27	5.6	49.4	188
			STD	0.4	0.1	1	0.1	0.3	7
			MAX	26.2	9.3	28	5.8	50.3	202
			MIN	24.8	8.9	25	5.4	48.9	176
447	70.00	12	AV12	25.8	9.1	27	5.7	49.3	198
			STD	0.2	0.3	0	0.0	0.2	6
			MAX	26.1	9.7	27	5.7	49.7	207
			MIN	25.5	8.6	26	5.6	49.0	187
459	71.00	12	AV12	24.8	8.0	24	5.4	50.4	185
			STD	0.7	0.2	1	0.2	0.7	9

USH 10 over Little Lake Butte des Morts - PIER 13 #44 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			MAX	25.8	8.5	26	5.6	51.5	206
			MIN	23.6	7.6	22	5.2	49.4	171
471	72.00	12	AV12	24.8	8.0	25	5.5	50.0	182
			STD	0.4	0.3	1	0.1	0.4	11
			MAX	25.6	8.5	26	5.7	50.5	200
			MIN	24.3	7.4	23	5.4	49.2	161
482	73.00	11	AV11	24.8	8.0	25	5.5	49.9	178
			STD	0.4	0.4	1	0.1	0.4	8
			MAX	25.5	8.8	26	5.7	50.6	189
			MIN	24.1	7.4	24	5.4	49.2	169
494	74.00	12	AV12	24.7	8.2	25	5.5	49.9	172
			STD	0.8	0.4	2	0.2	0.9	16
			MAX	26.2	9.0	27	5.9	51.3	201
			MIN	23.4	7.7	22	5.2	48.4	155
508	75.00	14	AV14	25.0	9.3	25	5.6	49.6	194
			STD	1.0	1.7	2	0.2	1.0	47
			MAX	26.4	11.8	27	5.9	51.7	277
			MIN	23.1	7.5	21	5.1	48.3	146
522	76.00	14	AV14	26.0	12.2	26	5.8	48.8	265
			STD	0.6	0.3	1	0.1	0.6	9
			MAX	27.1	13.0	28	6.1	50.0	277
			MIN	24.7	11.8	23	5.5	47.6	240
540	77.00	18	AV18	26.6	13.5	26	5.9	48.3	292
			STD	0.5	1.4	1	0.1	0.5	31
			MAX	27.3	16.2	29	6.1	49.6	341
			MIN	25.2	11.7	24	5.6	47.6	254
562	78.00	22	AV22	27.3	15.8	27	6.1	47.5	340
			STD	0.5	0.4	1	0.1	0.4	9
			MAX	28.2	16.8	28	6.3	48.2	372
			MIN	26.4	15.0	26	5.9	46.8	327
585	79.00	23	AV23	27.0	15.7	27	6.1	47.7	332
			STD	0.4	0.6	1	0.1	0.4	14
			MAX	28.0	17.0	29	6.3	48.3	366
			MIN	26.4	14.9	25	5.9	46.7	313
609	80.00	24	AV24	27.5	18.0	28	6.2	47.2	372
			STD	0.4	0.9	1	0.1	0.4	13
			MAX	28.2	19.8	29	6.4	48.1	395
			MIN	26.6	16.4	26	6.0	46.5	342
636	81.00	27	AV27	27.9	19.5	29	6.3	46.7	400
			STD	0.5	0.6	1	0.1	0.4	8
			MAX	28.6	20.5	31	6.6	47.8	423
			MIN	26.9	18.5	26	6.0	45.8	386
676	82.00	40	AV40	28.4	22.2	29	6.5	46.3	442
			STD	0.5	1.0	1	0.1	0.5	15
			MAX	29.5	23.7	31	6.8	47.0	463
			MIN	27.5	19.8	27	6.3	45.3	406
708	82.85	37	AV32	28.9	24.0	30	6.6	45.8	471
			STD	0.6	1.3	1	0.2	0.5	25
			MAX	30.2	26.2	32	6.9	46.5	526
			MIN	28.1	22.3	28	6.4	44.8	441

USH 10 over Little Lake Butte des Morts - PIER 13 #44 APE D30-42, HP 14 x 73
OP: AM Date: 20-March-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
718	83.02	60	AV10	29.5	27.8	31	6.8	45.3	561
			STD	0.4	0.5	1	0.1	0.4	11
			MAX	30.3	28.7	32	6.9	45.8	578
			MIN	28.8	26.8	30	6.6	44.7	538
728	83.15	80	AV10	30.0	29.1	32	6.9	44.8	591
			STD	0.3	0.4	1	0.1	0.3	8
			MAX	30.7	29.8	33	7.1	45.2	603
			MIN	29.5	28.4	31	6.8	44.1	578
738	83.25	96	AV10	30.2	29.9	32	7.0	44.6	611
			STD	0.4	0.4	1	0.1	0.3	10
			MAX	30.8	30.6	34	7.1	45.1	634
			MIN	29.8	29.4	31	6.8	44.1	598
			Average	25.9	13.5	27	5.8	49.1	277
			Std. Dev.	2.3	6.0	2	0.6	2.7	128
			Maximum	30.8	30.6	43	7.1	67.9	634
			Minimum	12.0	2.1	10	2.8	44.1	7

Total number of blows analyzed: 728

BL# Sensors

1-738 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.10); A4: [K3550] 360.0 (1.10)

BL# Comments

5 Reported reference at El. 740.23
6 Mudline at El. 717.23

Time Summary

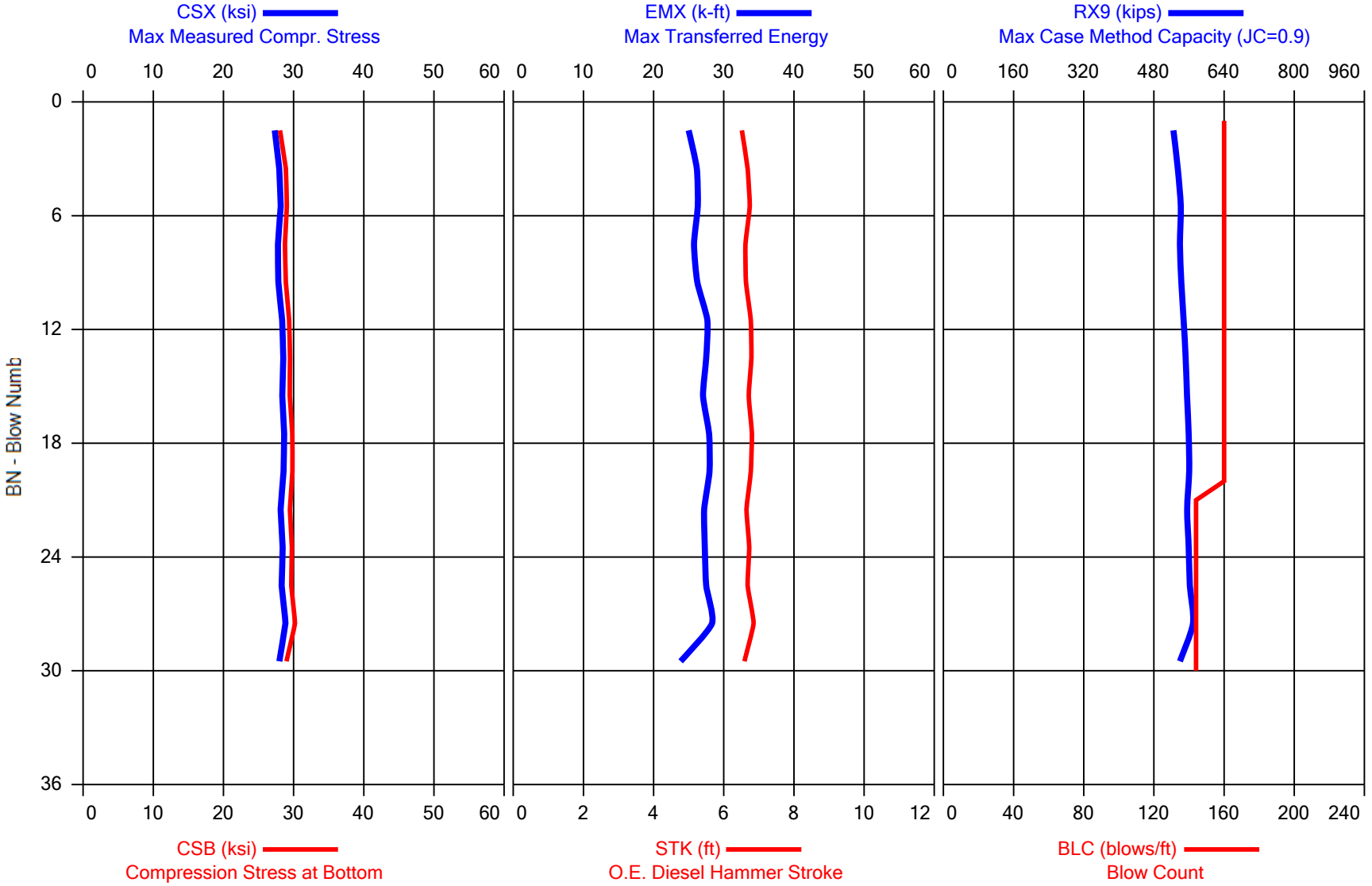
Drive 16 minutes 9 seconds 7:01 AM - 7:17 AM BN 1 - 738

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

Printed: 23-March-2015 Test started: 23-March-2015

USH10 OVER LLBDM - PIER 13 #44 - BOR

APE D30-42, HP 14 x 73



USH10 OVER LLBDM - PIER 13 #44 - BOR APE D30-42, HP 14 x 73
OP: AZ Date: 23-March-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 88.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth	BLC	TYPE	CSX	CSB	STK	EMX	BPM	RX9
	ft	blows/ft		ksi	ksi	ft	k-ft	bpm	kips
10	83	160	AV10	27.8	28.7	6.6	26	45.7	536
			STD	0.4	0.5	0.1	1	0.4	9
			MAX	28.3	29.3	6.8	27	46.6	546
			MIN	27.0	27.5	6.4	24	45.1	516
20	83	160	AV10	28.5	29.6	6.8	28	45.3	555
			STD	0.2	0.3	0.1	1	0.2	5
			MAX	28.9	30.0	6.8	29	45.8	563
			MIN	28.1	29.1	6.6	26	45.0	547
29	83	144	AV9	28.4	29.7	6.7	27	45.5	561
			STD	0.4	0.3	0.1	1	0.4	6
			MAX	29.0	30.2	6.9	29	46.0	569
			MIN	27.9	29.3	6.5	27	44.9	552
30	83	144	AV1	28.1	28.6	6.6	21	45.7	519
			STD	0.0	0.0	0.0	0	0.0	0
			MAX	28.1	28.6	6.6	21	45.7	519
			MIN	28.1	28.6	6.6	21	45.7	519
			Average	28.2	29.3	6.7	27	45.5	549
			Std. Dev.	0.4	0.6	0.1	1	0.4	14
			Maximum	29.0	30.2	6.9	29	46.6	569
			Minimum	27.0	27.5	6.4	21	44.9	516

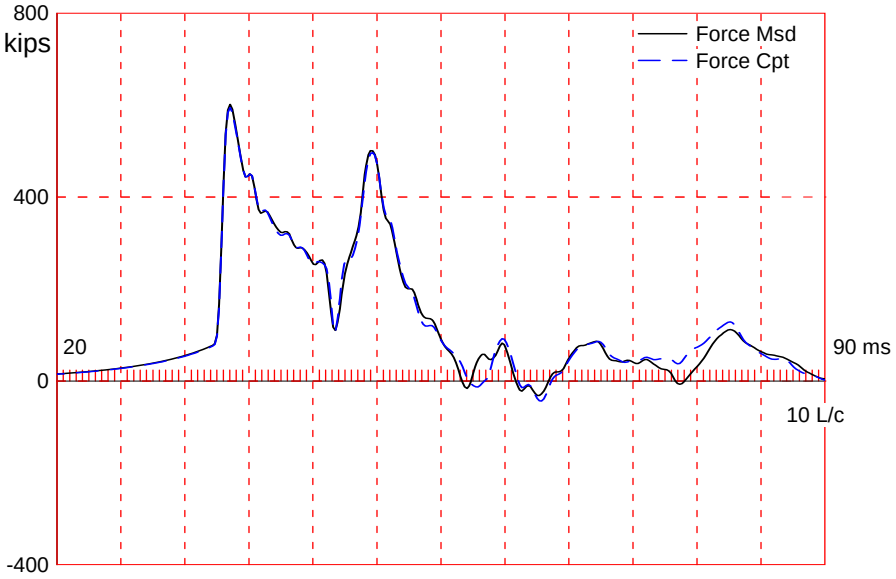
Total number of blows analyzed: 30

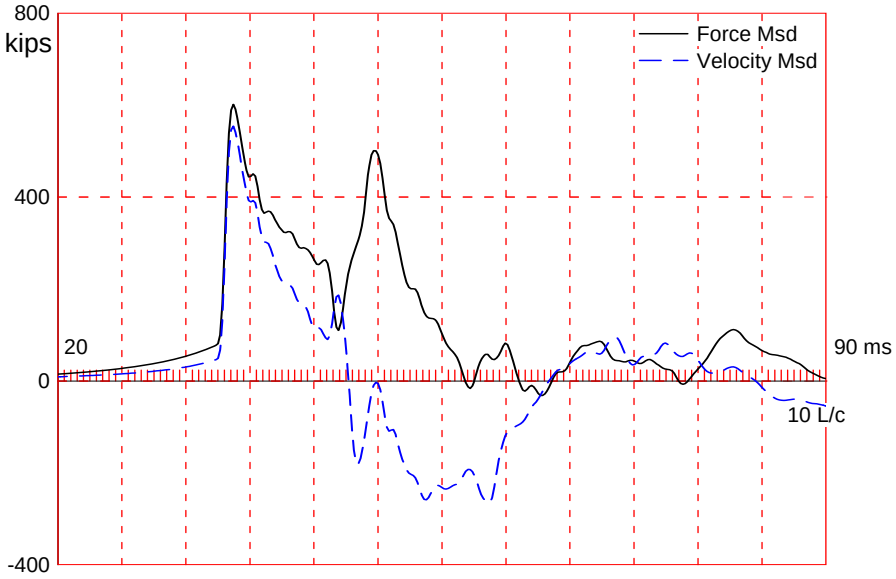
BL# Sensors

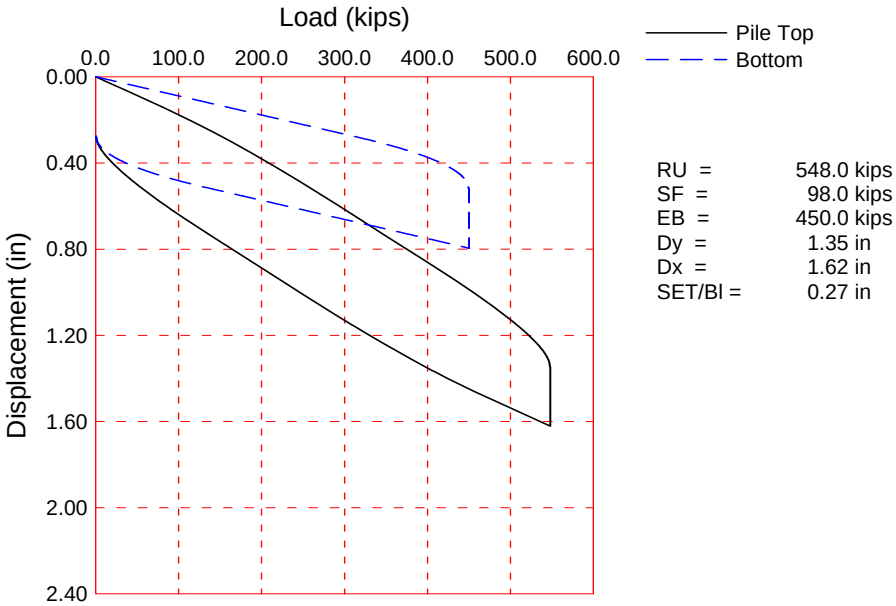
1-30 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.08); A4: [K2524] 360.0 (1.08)

Time Summary

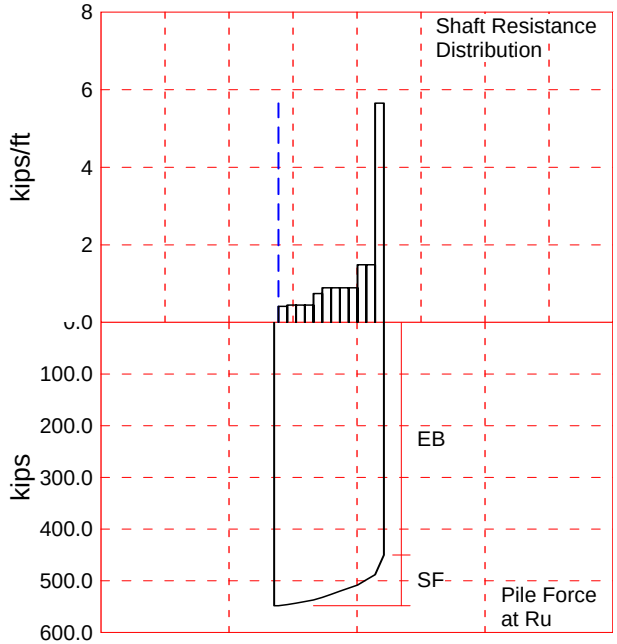
Drive 38 seconds 7:11 AM - 7:12 AM BN 1 - 30







RU =	548.0 kips
SF =	98.0 kips
EB =	450.0 kips
Dy =	1.35 in
Dx =	1.62 in
SET/Bl =	0.27 in



Length b. Sensors	84.0 ft
Embedment	78.7 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	3.63
Top Compr. Stress	27.9 ksi
Max Compr. Stress	28.1 ksi
Max Tension Stress	-5.42 ksi
Avg. Shaft Quake	0.14 in
Toe Quake	0.40 in
Avg. Shaft Smith Dpg.	0.24 s/ft
Toe Smith Damping	0.07 s/ft

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 548.0; along Shaft 98.0; at Toe 450.0 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
				548.0			
1	10.1	4.8	2.0	546.0	2.0	0.42	0.09
2	16.8	11.5	3.0	543.0	5.0	0.45	0.10
3	23.5	18.2	3.0	540.0	8.0	0.45	0.10
4	30.2	25.0	3.0	537.0	11.0	0.45	0.10
5	37.0	31.7	5.0	532.0	16.0	0.74	0.16
6	43.7	38.4	6.0	526.0	22.0	0.89	0.19
7	50.4	45.1	6.0	520.0	28.0	0.89	0.19
8	57.1	51.8	6.0	514.0	34.0	0.89	0.19
9	63.8	58.6	6.0	508.0	40.0	0.89	0.19
10	70.6	65.3	10.0	498.0	50.0	1.49	0.32
11	77.3	72.0	10.0	488.0	60.0	1.49	0.32
12	84.0	78.7	38.0	450.0	98.0	5.65	1.20
Avg. Shaft			8.2			1.24	0.26
Toe			450.0				326.45

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.24	0.07
Quake	(in)	0.14	0.40
Case Damping Factor		0.62	0.82
Damping Type		Viscous	Smith
Unloading Quake	(% of loading quake)	30	30
Unloading Level	(% of Ru)	43	
Resistance Gap (included in Toe Quake)	(in)		0.11

CAPWAP match quality = 3.63 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.27 in; Blow Count = 44 b/ft
Computed: Final Set = 0.27 in; Blow Count = 45 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 = 27.9 ksi (T= 36.2 ms, max= 1.009 x Top)
max. Comp. Stress = 28.1 ksi (Z= 10.1 ft, T= 36.6 ms)
max. Tens. Stress = -5.42 ksi (Z= 43.7 ft, T= 62.0 ms)
max. Energy (EMX) = 30.5 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	3.4	596.7	-53.9	27.9	-2.52	30.5	14.6	1.03
2	6.7	599.2	-58.2	28.0	-2.72	30.3	14.6	1.01
4	13.4	596.2	-68.1	27.9	-3.18	29.3	14.4	0.97
6	20.2	589.0	-74.5	27.5	-3.48	28.0	14.2	0.93
8	26.9	582.0	-61.6	27.2	-2.88	26.7	14.1	0.89
9	30.2	585.9	-68.5	27.4	-3.20	26.4	13.9	0.86
10	33.6	577.9	-78.6	27.0	-3.67	25.4	13.8	0.84
11	37.0	582.5	-99.8	27.2	-4.66	24.9	13.7	0.81
12	40.3	566.8	-111.8	26.5	-5.22	23.5	13.5	0.79
13	43.7	571.4	-115.9	26.7	-5.42	23.0	13.4	0.76
14	47.0	551.7	-105.7	25.8	-4.94	21.5	13.2	0.73
15	50.4	556.3	-103.4	26.0	-4.83	21.0	13.1	0.70
16	53.8	536.7	-97.4	25.1	-4.55	19.4	13.0	0.67
17	57.1	541.1	-99.9	25.3	-4.67	18.8	12.9	0.64
18	60.5	521.7	-92.2	24.4	-4.31	17.3	12.7	0.61
19	63.8	527.7	-86.8	24.7	-4.05	16.8	12.5	0.58
20	67.2	511.4	-75.5	23.9	-3.53	15.3	12.3	0.55
21	70.6	517.8	-72.0	24.2	-3.36	14.7	13.1	0.52
22	73.9	504.1	-59.9	23.5	-2.80	12.9	14.4	0.49
23	77.3	530.8	-55.9	24.8	-2.61	12.2	15.5	0.46
24	80.6	533.6	-43.6	24.9	-2.04	10.5	15.6	0.43
25	84.0	548.8	-41.1	25.6	-1.92	7.9	14.0	0.41
Absolute	10.1			28.1			(T =	36.6 ms)
	43.7				-5.42		(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	575.6	517.3	459.0	400.7	342.4	284.1	225.7	167.4	109.1	50.8
RX	675.5	654.7	637.4	620.8	604.3	587.8	572.6	558.6	545.3	533.1
RU	575.6	517.3	459.0	400.7	342.4	284.1	225.7	167.4	109.1	50.8

RAU = 412.7 (kips); RA2 = 567.4 (kips)

Current CAPWAP Ru = 548.0 (kips); Corresponding J(RP)= 0.05; J(RX) = 0.78

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
14.6	35.98	556.8	602.0	603.7	1.04	0.26	0.27	30.8	560.2	1552

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
84.0	21.4	29992.2	492.000	4.70

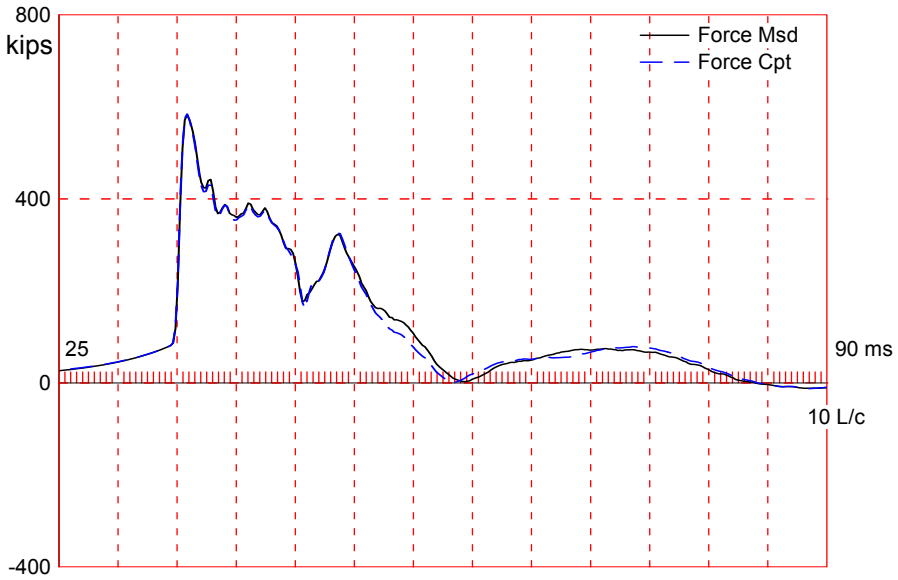
Toe Area 198.5 in^2

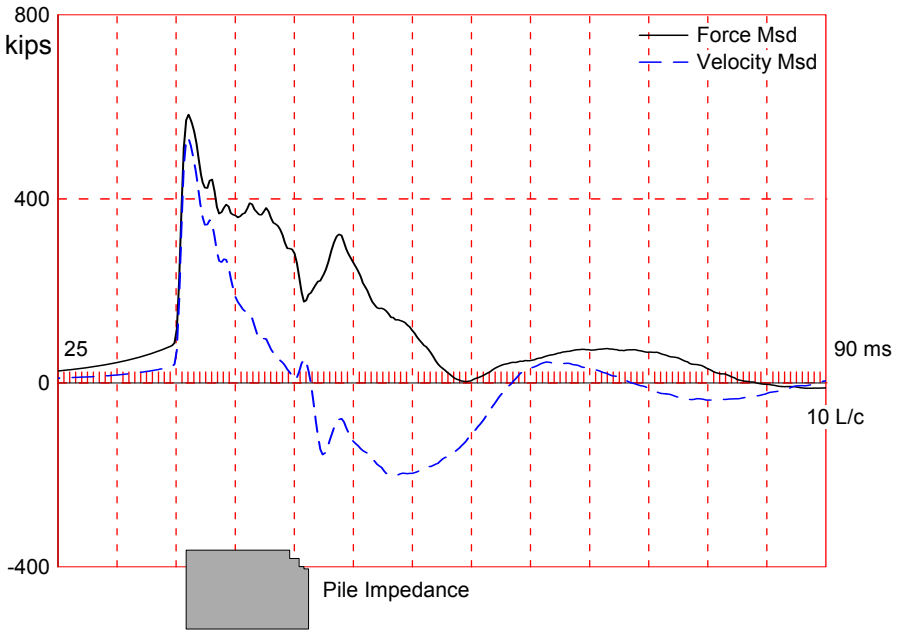
Top Segment Length 3.36 ft, Top Impedance 38 kips/ft/s

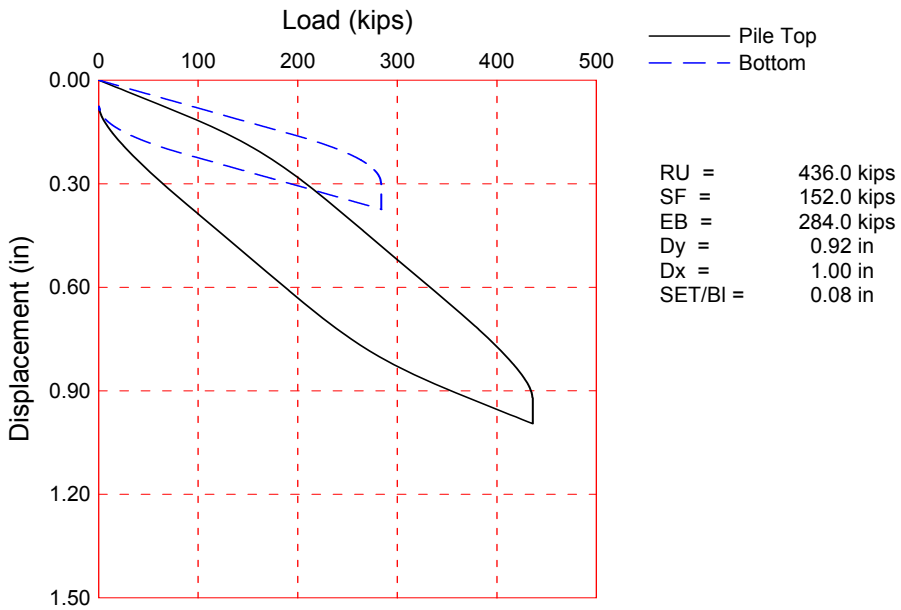
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 10.0 ms
Total volume: 12.483 ft^3; Volume ratio considering added impedance: 1.000

DYNAMIC RESISTANCE TABLE

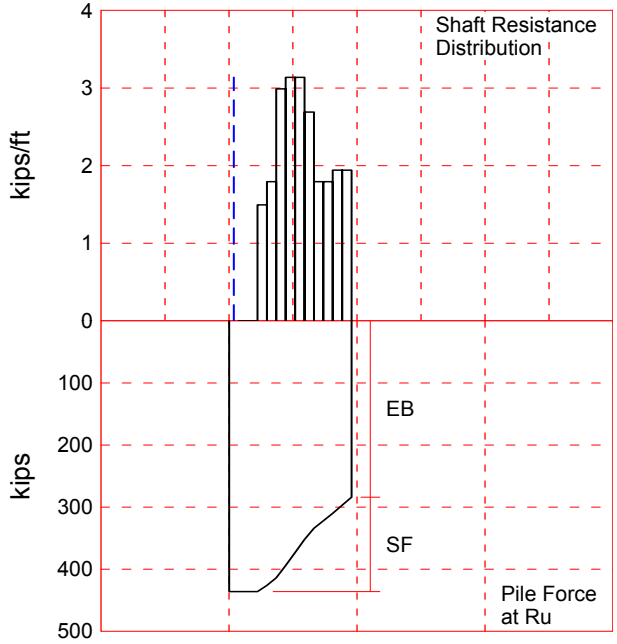
Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Damping Rd at Max. Rt kips	Max Rt (Ru+Rd) kips	Total Unit Rt W. Resp. to Depth kips/ft	Area ksf
1	10.1	4.8	2.0	6.9	8.9	1.86	0.40
2	16.8	11.5	3.0	10.3	13.3	1.98	0.42
3	23.5	18.2	3.0	10.2	13.2	1.96	0.42
4	30.2	25.0	3.0	10.0	13.0	1.94	0.41
5	37.0	31.7	5.0	16.3	21.3	3.17	0.68
6	43.7	38.4	6.0	19.2	25.2	3.75	0.80
7	50.4	45.1	6.0	18.8	24.8	3.69	0.78
8	57.1	51.8	6.0	18.4	24.4	3.63	0.77
9	63.8	58.6	6.0	18.0	24.0	3.56	0.76
10	70.6	65.3	10.0	31.1	41.1	6.12	1.30
11	77.3	72.0	10.0	36.9	46.9	6.98	1.49
12	84.0	78.7	38.0	127.5	165.5	24.63	5.24
Avg. Shaft			8.2	27.0	35.1	5.36	1.14
Toe			450.0	34.3	484.3		351.36
Total					905.9		







RU =	436.0 kips
SF =	152.0 kips
EB =	284.0 kips
Dy =	0.92 in
Dx =	1.00 in
SET/BI =	0.08 in



Length b. Sensors	87.0 ft
Embedment	82.1 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16800 ft/s
Match Quality	2.29
Top Compr. Stress	27.4 ksi
Max Compr. Stress	28.8 ksi
Max Tension Stress	-1.75 ksi
Avg. Shaft Quake	0.06 in
Toe Quake	0.23 in
Avg. Shaft Smith Dpg.	0.25 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: 436.0; along Shaft 152.0; at Toe 284.0 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
				436.0				
1	13.4	8.5	0.0	436.0	0.0	0.00	0.00	0.00
2	20.1	15.2	0.0	436.0	0.0	0.00	0.00	0.00
3	26.8	21.8	10.0	426.0	10.0	1.49	0.32	0.25
4	33.5	28.5	12.0	414.0	22.0	1.79	0.38	0.25
5	40.2	35.2	20.0	394.0	42.0	2.99	0.64	0.25
6	46.8	41.9	21.0	373.0	63.0	3.14	0.67	0.25
7	53.5	48.6	21.0	352.0	84.0	3.14	0.67	0.25
8	60.2	55.3	18.0	334.0	102.0	2.69	0.57	0.25
9	66.9	62.0	12.0	322.0	114.0	1.79	0.38	0.25
10	73.6	68.7	12.0	310.0	126.0	1.79	0.38	0.25
11	80.3	75.4	13.0	297.0	139.0	1.94	0.41	0.25
12	87.0	82.1	13.0	284.0	152.0	1.94	0.41	0.25
Avg. Shaft			12.7			1.85	0.39	0.25
Toe			284.0				206.02	0.13

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.06	0.23
Case Damping Factor		0.99	0.97
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	90	50
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	7	
Resistance Gap (included in Toe Quake)	(in)		0.03

CAPWAP match quality = 2.29 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.08 in; Blow Count = 160 b/ft
Computed: Final Set = 0.11 in; Blow Count = 105 b/ft
Transducer F1(D815) CAL: 93.0; RF: 1.00; F2(F607) CAL: 93.6; RF: 1.00
A1(K3550) CAL: 360; RF: 1.10; A2(K2524) CAL: 360; RF: 1.10

max. Top Comp. Stress = 27.4 ksi (T= 36.3 ms, max= 1.052 x Top)
max. Comp. Stress = 28.8 ksi (Z= 26.8 ft, T= 37.6 ms)
max. Tens. Stress = -1.75 ksi (Z= 73.6 ft, T= 63.9 ms)
max. Energy (EMX) = 25.5 kip-ft; max. Measured Top Displ. (DMX)= 0.79 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	585.7	-13.8	27.4	-0.64	25.5	13.9	0.79
2	6.7	587.0	-14.7	27.4	-0.68	25.4	13.8	0.77
4	13.4	589.9	-15.6	27.6	-0.73	25.0	13.7	0.74
6	20.1	597.1	-17.2	27.9	-0.80	24.5	13.5	0.70
8	26.8	616.2	-27.7	28.8	-1.29	23.9	13.0	0.66
10	33.5	597.5	-32.5	27.9	-1.52	21.7	12.4	0.61
11	36.8	568.1	-30.4	26.5	-1.42	19.8	11.9	0.59
12	40.2	580.3	-34.9	27.1	-1.63	19.4	11.6	0.56
13	43.5	523.1	-28.1	24.4	-1.31	16.7	11.0	0.54
14	46.8	534.9	-32.2	25.0	-1.50	16.3	10.7	0.52
15	50.2	476.4	-26.0	22.3	-1.22	13.7	10.3	0.49
16	53.5	487.4	-30.3	22.8	-1.41	13.4	10.0	0.47
17	56.9	429.4	-25.4	20.1	-1.19	11.1	9.6	0.45
18	60.2	438.0	-29.6	20.5	-1.38	10.7	9.4	0.42
19	63.6	387.5	-27.9	18.1	-1.30	8.9	9.1	0.40
20	66.9	390.5	-32.2	18.2	-1.50	8.6	9.0	0.38
21	70.3	350.4	-33.2	16.4	-1.55	7.4	9.1	0.36
22	73.6	350.2	-37.5	16.4	-1.75	7.1	9.5	0.34
23	77.0	340.5	-35.2	15.9	-1.65	6.0	10.9	0.32
24	80.3	352.2	-35.8	16.5	-1.67	5.7	11.7	0.30
25	83.7	340.6	-32.6	15.9	-1.52	4.6	12.1	0.27
26	87.0	349.8	-32.6	16.3	-1.52	4.1	10.6	0.25
Absolute	26.8			28.8			(T =	37.6 ms)
	73.6				-1.75		(T =	63.9 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	658.0	611.5	564.9	518.3	471.8	425.2	378.6	332.1	285.5	239.0
RX	677.6	642.1	608.6	575.2	541.8	514.9	489.3	469.4	449.5	429.6
RU	658.0	611.5	564.9	518.3	471.8	425.2	378.6	332.1	285.5	239.0

RAU = 295.1 (kips); RA2 = 504.6 (kips)

Current CAPWAP Ru = 436.0 (kips); Corresponding J(RP)= 0.48; J(RX) = 0.87

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
14.1	36.05	536.8	586.8	586.8	0.79	0.08	0.08	25.6	707.9	1420

Possible Pile Damage at 1.0 L Below Gages?

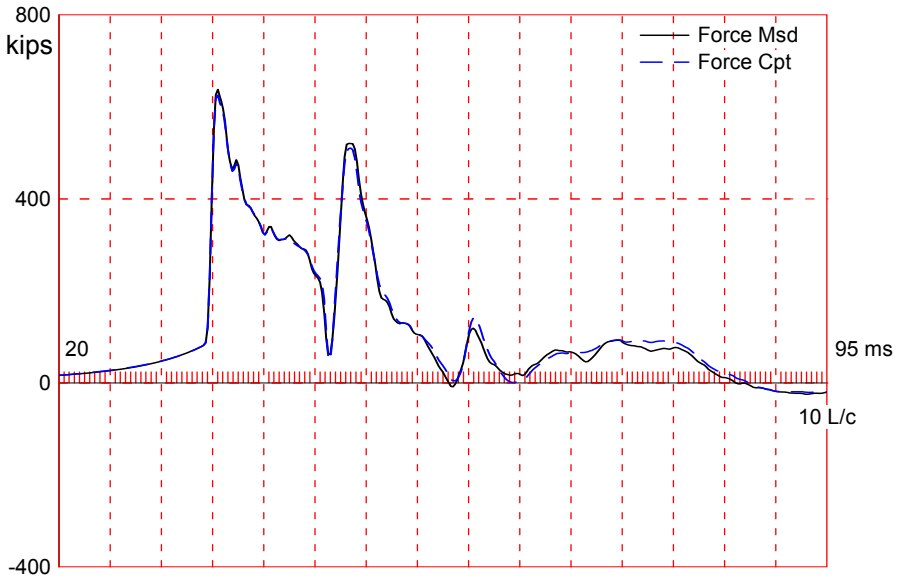
PILE PROFILE AND PILE MODEL

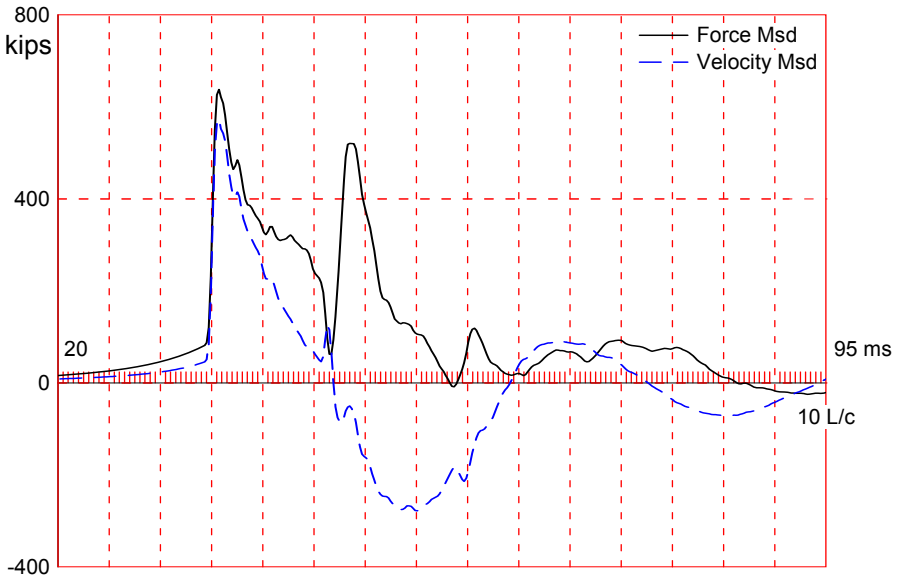
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
87.0	21.4	29992.2	492.000	4.70

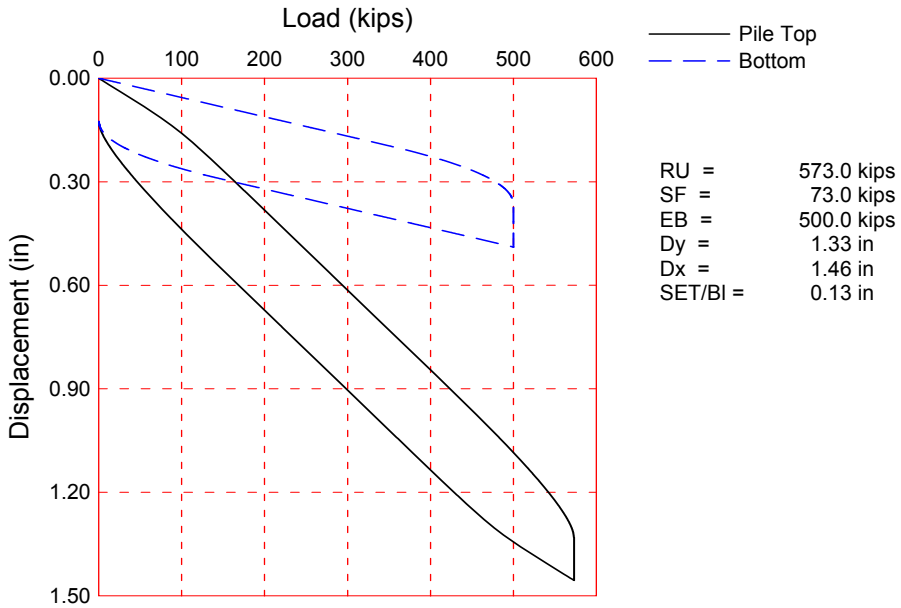
Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s
1	3.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16800.0
23	77.0	34.20	-10.47	0.00	0.000	-0.00	0.000	4.70	16800.0
25	83.7	30.20	-20.94	0.00	0.000	-0.00	0.000	4.70	16800.0
26	87.0	29.20	-23.56	0.00	0.000	-0.00	0.000	4.70	16800.0

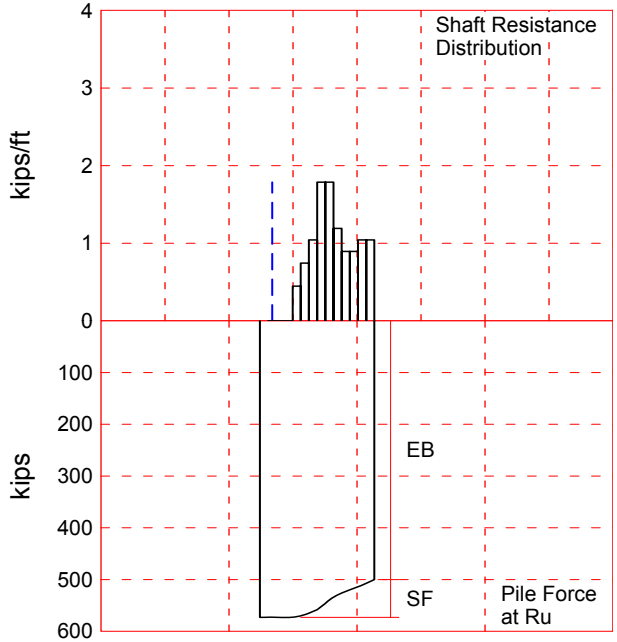
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16800.0 ft/s
Pile Damping 1.00 %, Time Incr 0.199 ms, 2L/c 10.4 ms
Total volume: 12.604 ft^3; Volume ratio considering added impedance: 0.975







RU =	573.0 kips
SF =	73.0 kips
EB =	500.0 kips
Dy =	1.33 in
Dx =	1.46 in
SET/Bl =	0.13 in



Length b. Sensors	93.9 ft
Embedment	83.2 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	2.59
Top Compr. Stress	29.3 ksi
Max Compr. Stress	30.1 ksi
Max Tension Stress	-5.25 ksi
Avg. Shaft Quake	0.05 in
Toe Quake	0.28 in
Avg. Shaft Smith Dpg.	0.22 s/ft
Toe Smith Damping	0.09 s/ft

About the CAPWAP Results

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

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

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

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

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

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

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

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

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 573.0; along Shaft 73.0; at Toe 500.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				573.0				
1	13.4	2.7	0.0	573.0	0.0	0.00	0.00	0.00
2	20.1	9.4	0.0	573.0	0.0	0.00	0.00	0.00
3	26.8	16.1	0.0	573.0	0.0	0.00	0.00	0.00
4	33.5	22.8	3.0	570.0	3.0	0.45	0.10	0.22
5	40.3	29.5	5.0	565.0	8.0	0.75	0.16	0.22
6	47.0	36.2	7.0	558.0	15.0	1.04	0.22	0.22
7	53.7	43.0	12.0	546.0	27.0	1.79	0.38	0.22
8	60.4	49.7	12.0	534.0	39.0	1.79	0.38	0.22
9	67.1	56.4	8.0	526.0	47.0	1.19	0.25	0.22
10	73.8	63.1	6.0	520.0	53.0	0.89	0.19	0.22
11	80.5	69.8	6.0	514.0	59.0	0.89	0.19	0.22
12	87.2	76.5	7.0	507.0	66.0	1.04	0.22	0.22
13	93.9	83.2	7.0	500.0	73.0	1.04	0.22	0.22
Avg. Shaft			5.6			0.88	0.19	0.22
Toe			500.0				362.72	0.09

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.05	0.28
Case Damping Factor		0.42	1.18
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	80	30
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	44	
Resistance Gap (included in Toe Quake)	(in)		0.02
Soil Plug Weight	(kips)	0.030	

CAPWAP match quality = 2.59 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.13 in; Blow Count = 96 b/ft
Computed: Final Set = 0.12 in; Blow Count = 99 b/ft

max. Top Comp. Stress = 29.3 ksi (T= 35.9 ms, max= 1.029 x Top)
max. Comp. Stress = 30.1 ksi (Z= 33.5 ft, T= 37.7 ms)
max. Tens. Stress = -5.25 ksi (Z= 47.0 ft, T= 62.3 ms)
max. Energy (EMX) = 33.1 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	3.4	626.4	-23.8	29.3	-1.11	33.1	15.3	1.04
2	6.7	627.1	-26.3	29.3	-1.23	32.9	15.3	1.03
4	13.4	630.6	-31.4	29.5	-1.47	32.6	15.1	0.99
6	20.1	633.4	-42.2	29.6	-1.97	32.1	15.1	0.96
8	26.8	637.0	-46.6	29.8	-2.18	31.5	15.0	0.91
10	33.5	644.3	-75.5	30.1	-3.53	30.7	14.8	0.86
12	40.3	641.6	-98.8	30.0	-4.61	29.1	14.5	0.81
14	47.0	634.3	-112.3	29.6	-5.25	27.1	14.1	0.75
15	50.3	616.5	-109.0	28.8	-5.09	25.3	13.8	0.72
16	53.7	624.2	-111.3	29.2	-5.20	24.7	13.6	0.69
17	57.0	587.1	-104.0	27.4	-4.86	22.2	13.3	0.66
18	60.4	593.3	-104.6	27.7	-4.89	21.5	13.2	0.63
19	63.7	554.7	-96.0	25.9	-4.49	19.1	12.9	0.60
20	67.1	565.5	-96.6	26.4	-4.51	18.5	12.7	0.57
21	70.4	545.8	-90.3	25.5	-4.22	16.8	12.4	0.54
22	73.8	544.2	-90.8	25.4	-4.24	16.1	12.6	0.51
23	77.1	532.1	-86.8	24.9	-4.05	14.6	12.5	0.47
24	80.5	546.1	-87.5	25.5	-4.09	13.8	13.1	0.44
25	83.9	567.4	-83.4	26.5	-3.89	12.4	14.7	0.41
26	87.2	596.8	-83.5	27.9	-3.90	11.7	15.8	0.37
27	90.6	602.7	-78.0	28.2	-3.64	10.4	16.3	0.34
28	93.9	615.6	-78.1	28.8	-3.65	10.1	14.4	0.31
Absolute	33.5			30.1			(T =	37.7 ms)
	47.0				-5.25		(T =	62.3 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	631.5	572.0	512.5	453.0	393.4	333.9	274.4	214.9	155.3	95.8
RX	744.6	726.3	710.2	694.1	678.0	662.7	647.7	632.7	618.5	606.6
RU	631.5	572.0	512.5	453.0	393.4	333.9	274.4	214.9	155.3	95.8

RAU = 380.1 (kips); RA2 = 588.1 (kips)

Current CAPWAP Ru = 573.0 (kips); RMX requires J > 0.9;

Check with PDA-W; RA2 may be a better Case Method

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	35.72	583.5	643.3	643.3	1.04	0.13	0.13	33.2	681.3	1923

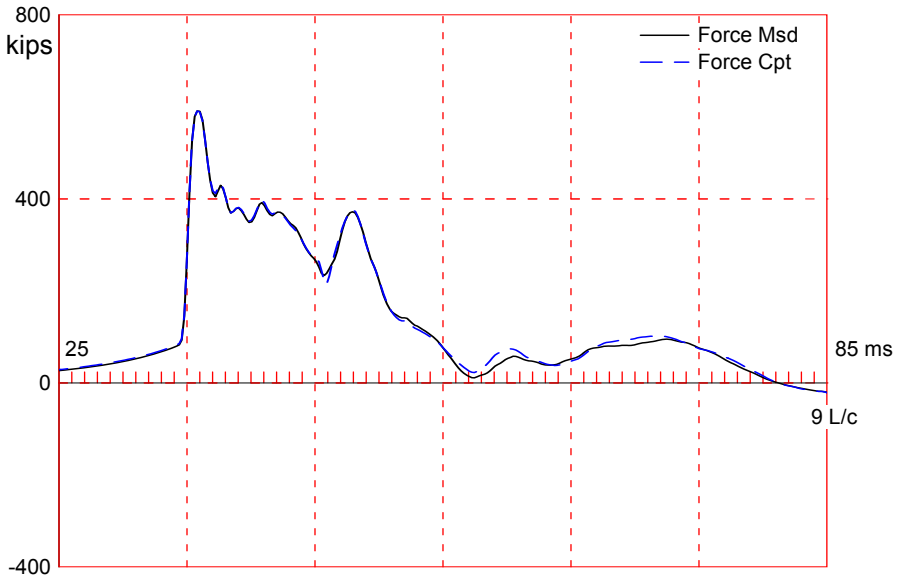
PILE PROFILE AND PILE MODEL

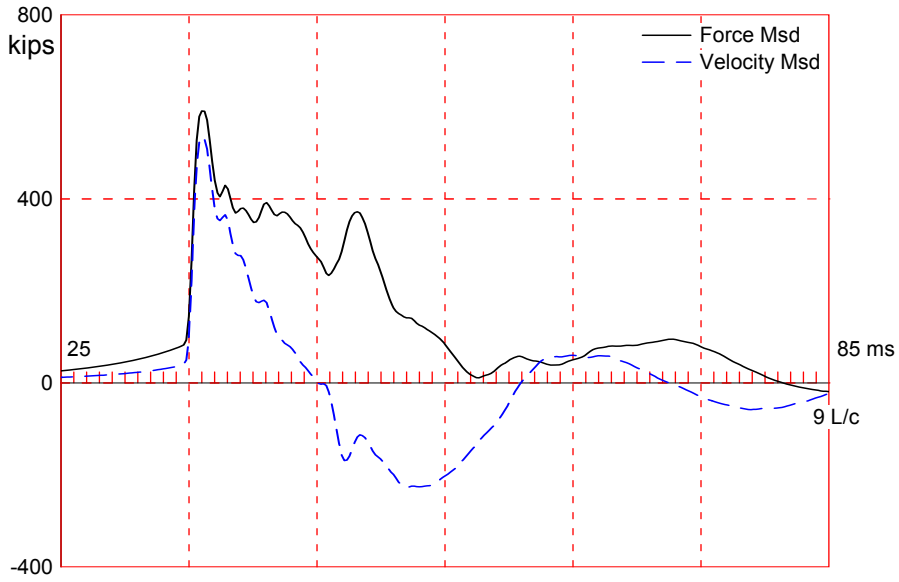
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
93.9	21.4	29992.2	492.000	4.70

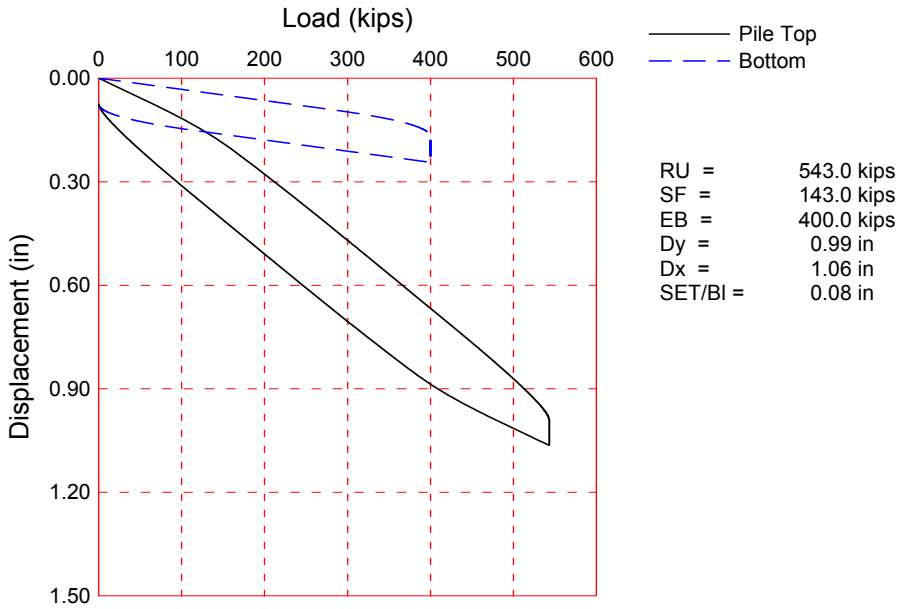
Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
22	73.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.015
24	80.5	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
28	93.9	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

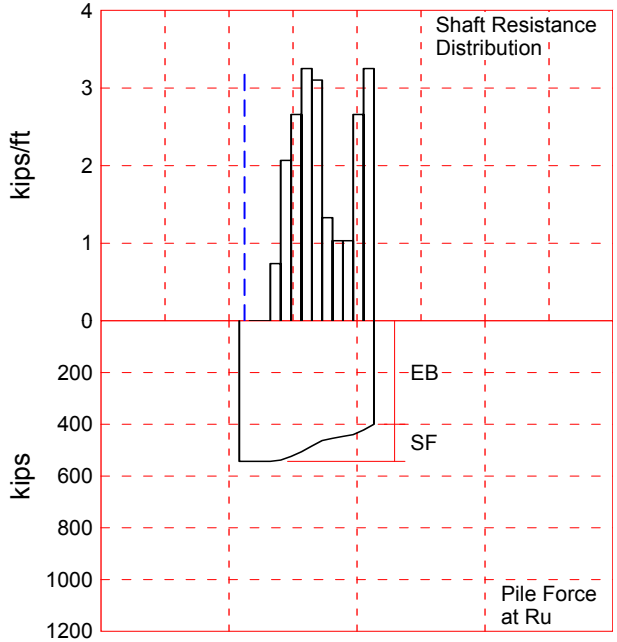
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 11.2 ms
Total volume: 13.958 ft^3; Volume ratio considering added impedance: 1.000







RU =	543.0 kips
SF =	143.0 kips
EB =	400.0 kips
Dy =	0.99 in
Dx =	1.06 in
SET/Bl =	0.08 in



Length b. Sensors	88.0 ft
Embedment	83.3 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.	16731 ft/s
Match Quality	1.61
Top Compr. Stress	27.7 ksi
Max Compr. Stress	29.5 ksi
Max Tension Stress	-2.28 ksi
Avg. Shaft Quake	0.05 in
Toe Quake	0.13 in
Avg. Shaft Smith Dpg.	0.27 s/ft
Toe Smith Damping	0.16 s/ft

About the CAPWAP Results

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CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 543.0; along Shaft 143.0; at Toe 400.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				543.0				
1	13.5	8.8	0.0	543.0	0.0	0.00	0.00	0.00
2	20.3	15.6	0.0	543.0	0.0	0.00	0.00	0.00
3	27.1	22.3	5.0	538.0	5.0	0.74	0.16	0.27
4	33.8	29.1	14.0	524.0	19.0	2.07	0.44	0.27
5	40.6	35.9	18.0	506.0	37.0	2.66	0.57	0.27
6	47.4	42.6	22.0	484.0	59.0	3.25	0.69	0.27
7	54.2	49.4	21.0	463.0	80.0	3.10	0.66	0.27
8	60.9	56.2	9.0	454.0	89.0	1.33	0.28	0.27
9	67.7	62.9	7.0	447.0	96.0	1.03	0.22	0.27
10	74.5	69.7	7.0	440.0	103.0	1.03	0.22	0.27
11	81.2	76.5	18.0	422.0	121.0	2.66	0.57	0.27
12	88.0	83.3	22.0	400.0	143.0	3.25	0.69	0.27
Avg. Shaft			11.9			1.72	0.37	0.27
Toe			400.0				290.17	0.16

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.05	0.13
Case Damping Factor		1.01	1.68
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	63	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)	0.025	0.060

CAPWAP match quality = 1.61 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.08 in; Blow Count = 160 b/ft
Computed: Final Set = 0.05 in; Blow Count = 246 b/ft
Transducer F1(D815) CAL: 93.0; RF: 1.00; F2(F607) CAL: 93.6; RF: 1.00
A1(K3550) CAL: 360; RF: 1.08; A2(K2524) CAL: 360; RF: 1.08

max. Top Comp. Stress = 27.7 ksi (T= 36.2 ms, max= 1.066 x Top)
max. Comp. Stress = 29.5 ksi (Z= 33.8 ft, T= 38.2 ms)
max. Tens. Stress = -2.28 ksi (Z= 74.5 ft, T= 61.9 ms)
max. Energy (EMX) = 25.8 kip-ft; max. Measured Top Displ. (DMX)= 0.81 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.4	592.7	-24.5	27.7	-1.15	25.8	14.0	0.78
2	6.8	594.0	-26.5	27.7	-1.24	25.6	13.9	0.77
4	13.5	596.7	-29.8	27.9	-1.39	25.2	13.8	0.73
6	20.3	604.9	-32.5	28.3	-1.52	24.7	13.6	0.69
8	27.1	625.6	-34.6	29.2	-1.61	23.9	13.2	0.64
10	33.8	632.0	-38.4	29.5	-1.79	22.2	12.5	0.59
11	37.2	586.7	-38.7	27.4	-1.81	19.8	12.0	0.56
12	40.6	605.3	-45.8	28.3	-2.14	19.3	11.6	0.53
13	44.0	548.7	-43.2	25.6	-2.02	16.7	11.1	0.50
14	47.4	565.0	-48.7	26.4	-2.27	16.1	10.7	0.47
15	50.8	495.7	-43.6	23.2	-2.03	13.3	10.3	0.45
16	54.2	503.7	-48.0	23.5	-2.24	12.8	10.0	0.42
17	57.5	458.3	-44.3	21.4	-2.07	10.5	9.8	0.39
18	60.9	460.8	-47.8	21.5	-2.23	10.0	9.6	0.37
19	64.3	450.3	-46.7	21.0	-2.18	8.8	9.3	0.34
20	67.7	452.8	-48.0	21.2	-2.24	8.3	9.2	0.31
21	71.1	452.5	-47.2	21.1	-2.20	7.3	9.1	0.28
22	74.5	465.5	-48.8	21.7	-2.28	6.7	8.9	0.25
23	77.8	479.8	-47.7	22.4	-2.23	5.8	8.9	0.22
24	81.2	486.1	-48.6	22.7	-2.27	5.3	9.6	0.19
25	84.6	471.4	-43.7	22.0	-2.04	4.0	9.2	0.17
26	88.0	509.6	-43.8	23.8	-2.05	3.4	7.6	0.14
Absolute	33.8			29.5			(T =	38.2 ms)
	74.5				-2.28		(T =	61.9 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	737.4	698.4	659.3	620.3	581.3	542.2	503.2	464.1	425.1	386.1
RX	765.9	731.2	699.6	668.2	636.7	607.0	581.4	559.9	542.3	526.2
RU	737.0	698.0	658.9	619.8	580.7	541.7	502.6	463.5	424.4	385.3

RAU = 168.5 (kips); RA2 = 526.1 (kips)

Current CAPWAP Ru = 543.0 (kips); Corresponding J(RP)= 0.50; J(RX) = 0.80

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
14.1	36.01	537.4	590.4	597.1	0.81	0.08	0.08	26.1	705.8	3333

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
88.0	21.4	29992.2	492.000	4.70

Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16730.8	0.000
21	71.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16730.8	0.015
22	74.5	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16730.8	0.010
23	77.8	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16730.8	0.000
26	88.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16730.8	0.000

Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16730.8 ft/s
Pile Damping 1.00 %, Time Incr 0.202 ms, 2L/c 10.5 ms
Total volume: 13.078 ft^3; Volume ratio considering added impedance: 1.000