GRL Engineers, Inc.

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TRANSMITTAL

To: Mr. Kevin Weber	From: Al Ziai
Company: Lunda Construction Co.	No. of Sheets: 47
E-mail: kweber@lundaconstruction.com	Date: April 30, 2015

RE: Dynamic Testing Results – USH 10 over Little Lake Butte des Morts
Structure B-70-403 - Pier 17
Winnebago County, Wisconsin

On April 28, 2015, Pier 17 #1, Pier 17 #36, and Pier 17 #44 at the above structure were dynamically tested during initial driving. The piles were tested during restrike on April 29. Project plans indicated the exterior row piles have a required driving resistance, or ultimate capacity, of 480 kips (240 tons) and the interior row piles have a required driving resistance of 400 kips (200 tons). The piles have a required minimum tip elevation of EL 685. 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. The reference elevation for the piles was the top of the ring at EL 740.9. We understand the pier was excavated to an elevation of EL 721.4.

Pier 17 #1 was driven to a depth of 65.4 feet, which corresponds to a pile tip elevation of EL 675.5. The blow count over the final increment of driving was 10 blows for 2 inches of penetration at an average hammer stroke of 9.0 feet. The blow count at the beginning of restrike was 10 blows per for 2 inches of penetration at an average hammer stroke of 7.9 feet.

Pier 17 #36 was driven to a depth of 55.5 feet, which corresponds to a pile tip elevation of EL 685.4. The blow count over the final increment of driving was 10 blows for 2 inches of penetration at an average hammer stroke of 9.2 feet. The blow count at the beginning of restrike was 10 blows for 1 ½ inches of penetration at an average hammer stroke of 8.1 feet.

Pier 16 #44 was driven to a depth of 61.1 feet, which corresponds to a pile tip elevation of EL 679.8. The blow count over the final increment of driving was 10 blows for 1 ¾ inches of penetration at an average hammer stroke of 9.3 feet. The blow count at the beginning of restrike was 10 blows for 1 ¼ inch of penetration at an average hammer stroke of 8.0 feet

We recommend the production piles at Pier 17 of Structure B-70-403, driven with an 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.

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)
7.0	10	7
7.5	8	6
8.0	6	5
8.5	5	4
9.0	4	4
9.5	4	3

Additionally, all production piles should achieve the minimum pile tip elevation of EL 685.0 for uplift, as indicated on the plans. Please note that Pier 17 #36 terminated five inches above this minimum pile tip elevation. 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. If the piles terminate above the minimum pile tip elevation please notify the engineer of record.

These criteria should not be used for acceptance of piles under restrike and/or re-drive conditions. After splicing or any other delays, we recommend not applying the criteria until two feet 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.

Al Ziai

Travis Coleman, P.E.

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

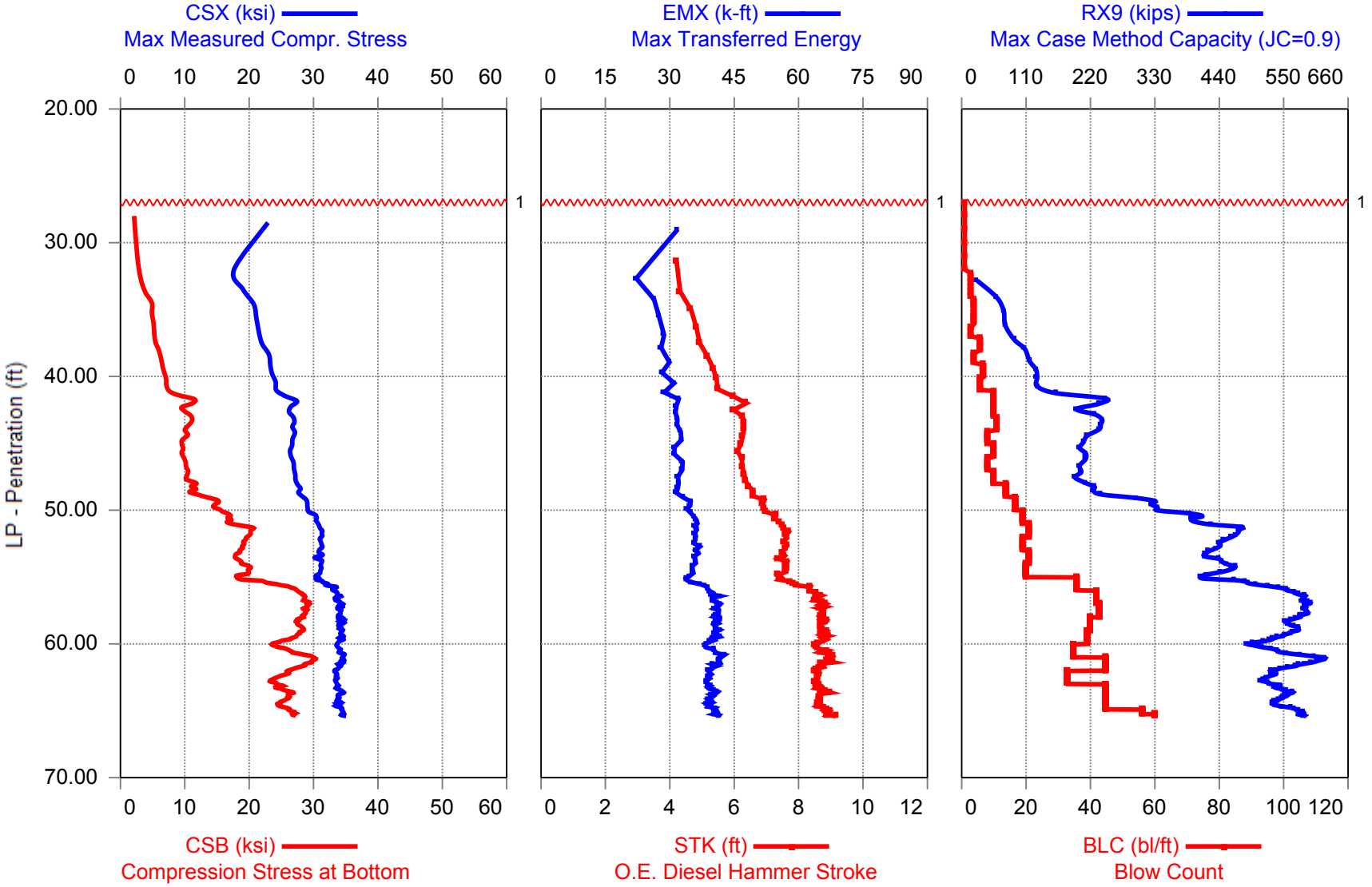
Attachments:

Dynamic Test Results - (pages 3 – 21)
CAPWAP Analysis Results - (pages 22 – 47)

GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.49.5 - Case Method & iCAP® Results

Printed: 29-April-2015 Test started: 28-April-2015

USH 10 over LLBDM - PIER 17 #1 EOID - APE D30-42, HP 14 x 73



1 - Reference elevation EL 740.9. Mud line EL 721.4

USH 10 over LLBDM - PIER 17 #1 EOID APE D30-42, HP 14 x 73
OP: TC Date: 28-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.58 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	BLC	TYPE	CSX	CSB	STK	EMX	BPM	RX9
	ft	bl/ft		ksi	ksi	ft	k-ft	bpm	kips
6	32.00	1	AV6	21.9	2.4	4.6	31	55.2	0
			MAX	24.1	3.4	5.2	42	61.8	0
			MIN	15.8	1.6	3.5	18	51.2	0
9	33.00	3	AV3	16.5	3.2	3.8	20	59.2	19
			MAX	18.2	3.4	4.2	23	61.8	34
			MIN	14.8	3.0	3.5	17	57.0	4
12	34.00	3	AV3	19.3	3.8	4.3	25	55.9	51
			MAX	19.8	4.0	4.4	26	56.9	55
			MIN	18.4	3.7	4.2	25	55.3	49
16	35.00	4	AV4	20.7	4.8	4.6	27	54.1	69
			MAX	21.2	5.2	4.7	28	55.3	73
			MIN	19.7	4.5	4.4	26	53.7	63
20	36.00	4	AV4	21.1	5.1	4.7	28	53.7	75
			MAX	21.9	5.3	4.9	30	54.9	81
			MIN	20.3	4.9	4.5	25	52.8	71
23	37.00	3	AV3	21.5	5.3	4.8	31	53.3	73
			MAX	21.9	5.3	4.9	31	53.8	77
			MIN	21.0	5.1	4.7	30	53.0	65
29	38.00	6	AV6	22.1	5.6	5.0	27	52.4	101
			MAX	23.0	5.9	5.2	29	53.6	111
			MIN	21.1	5.2	4.7	25	51.3	90
33	39.00	4	AV4	22.9	6.3	5.2	31	51.5	112
			MAX	23.6	6.6	5.3	31	52.3	116
			MIN	22.2	6.1	5.0	29	50.9	107
40	40.00	7	AV7	23.6	6.8	5.4	28	50.6	127
			MAX	24.1	7.1	5.5	29	51.2	130
			MIN	23.1	6.5	5.2	28	49.9	125
46	41.00	6	AV6	24.2	7.3	5.5	31	50.0	129
			MAX	24.6	7.9	5.6	32	50.5	135
			MIN	23.7	6.9	5.4	30	49.5	121
56	42.00	10	AV10	26.0	9.9	6.0	30	48.0	212
			MAX	27.7	12.0	6.5	33	50.1	256
			MIN	24.0	7.3	5.5	27	46.1	141
66	43.00	10	AV10	26.4	10.2	6.1	31	47.5	214
			MAX	27.3	11.4	6.4	33	48.3	242
			MIN	25.6	9.1	5.9	30	46.5	192

USH 10 over LLBDM - PIER 17 #1 EOID APE D30-42, HP 14 x 73
OP: TC Date: 28-April-2015

BL#	Depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
77	44.00	11	AV11	26.9	10.6	6.3	32	46.9	239
			MAX	27.7	11.4	6.5	34	47.4	244
			MIN	26.4	9.5	6.1	30	46.1	231
85	45.00	8	AV8	26.8	10.1	6.2	33	47.0	212
			MAX	27.4	10.8	6.4	34	47.6	226
			MIN	26.3	9.1	6.1	32	46.5	200
95	46.00	10	AV10	26.5	9.6	6.1	31	47.4	208
			MAX	27.3	10.1	6.5	34	48.5	217
			MIN	25.4	9.0	5.9	28	46.3	193
103	47.00	8	AV8	27.0	10.2	6.3	33	46.9	205
			MAX	27.2	10.7	6.4	34	47.7	215
			MIN	26.4	9.6	6.1	32	46.4	194
113	48.00	10	AV10	27.2	10.7	6.3	32	46.7	202
			MAX	27.8	12.3	6.6	34	47.2	217
			MIN	26.7	9.7	6.2	31	45.9	192
127	49.00	14	AV14	27.8	11.5	6.5	32	46.1	233
			MAX	28.6	13.6	6.8	34	46.8	283
			MIN	27.0	10.2	6.3	29	45.1	204
144	50.00	17	AV17	29.0	14.8	6.9	34	44.8	325
			MAX	29.8	16.2	7.1	36	45.5	354
			MIN	28.3	13.7	6.7	32	44.1	284
163	51.00	19	AV19	30.1	16.7	7.2	36	43.8	391
			MAX	31.0	18.4	7.5	38	44.9	429
			MIN	29.1	14.9	6.9	33	43.1	333
184	52.00	21	AV21	31.2	19.8	7.6	36	42.8	467
			MAX	32.1	21.0	7.9	38	43.8	486
			MIN	30.2	17.2	7.2	34	41.9	419
203	53.00	19	AV19	31.1	19.1	7.6	36	42.9	442
			MAX	31.7	19.8	7.8	38	43.7	461
			MIN	30.3	18.2	7.3	34	42.3	427
224	54.00	21	AV21	31.0	18.3	7.5	36	43.0	429
			MAX	31.7	19.0	7.7	38	44.2	452
			MIN	29.7	17.1	7.1	34	42.5	402
244	55.00	20	AV20	30.9	19.5	7.5	35	43.0	444
			MAX	31.6	21.0	7.8	36	44.2	472
			MIN	29.5	17.9	7.1	34	42.4	399
280	56.00	36	AV36	32.0	23.5	7.9	36	42.0	496
			MAX	34.0	27.6	8.6	41	44.0	559
			MIN	30.0	17.8	7.2	32	40.3	401

USH 10 over LLBDM - PIER 17 #1 EOID APE D30-42, HP 14 x 73
OP: TC Date: 28-April-2015

BL#	Depth	BLC	TYPE	CSX	CSB	STK	EMX	BPM	RX9
	ft	bl/ft		ksi	ksi	ft	k-ft	bpm	kips
322	57.00	42	AV42	33.8	28.5	8.6	40	40.4	581
			MAX	35.2	29.6	9.1	43	41.1	598
			MIN	33.2	27.4	8.3	38	39.2	558
365	58.00	43	AV43	34.1	28.7	8.7	41	40.0	585
			MAX	35.3	29.7	9.1	44	40.7	606
			MIN	33.3	28.0	8.4	39	39.2	573
405	59.00	40	AV40	34.3	27.9	8.8	41	39.9	566
			MAX	35.4	28.7	9.2	44	40.7	589
			MIN	33.3	27.1	8.4	39	39.1	547
444	60.00	39	AV39	34.2	26.4	8.8	40	40.0	536
			MAX	35.1	28.3	9.1	43	40.6	571
			MIN	33.5	23.5	8.5	38	39.3	490
479	61.00	35	AV35	34.1	26.5	8.8	40	40.0	543
			MAX	35.7	30.0	9.3	45	41.0	615
			MIN	32.9	23.1	8.3	37	38.8	484
524	62.00	45	AV45	34.2	28.6	8.8	41	39.9	581
			MAX	35.8	30.7	9.4	44	41.2	627
			MIN	32.7	25.9	8.2	38	38.6	528
557	63.00	33	AV33	33.5	24.6	8.6	39	40.4	524
			MAX	34.1	26.7	8.9	41	40.9	547
			MIN	32.8	23.1	8.4	37	39.7	507
602	64.00	45	AV45	34.0	25.6	8.7	40	40.1	550
			MAX	35.3	27.0	9.2	42	40.9	574
			MIN	33.0	23.8	8.4	38	39.1	527
642	64.90	45	AV40	33.9	25.3	8.7	40	40.2	544
			MAX	34.5	26.5	8.9	41	40.9	571
			MIN	32.9	24.2	8.4	37	39.7	526
652	65.07	56	AV10	34.4	26.4	8.9	41	39.7	575
			MAX	35.1	27.2	9.2	42	40.3	585
			MIN	33.7	25.7	8.6	39	39.0	564
662	65.25	56	AV10	34.6	27.0	8.9	41	39.6	582
			MAX	35.1	27.4	9.1	42	39.9	586
			MIN	34.1	26.7	8.8	40	39.2	572
672	65.42	60	AV10	34.6	27.0	9.0	41	39.5	582
			MAX	35.2	27.5	9.2	42	40.0	594
			MIN	33.9	26.5	8.7	40	39.0	573
			Average	31.6	21.8	7.9	37	42.4	458
			Maximum	35.8	30.7	9.4	45	61.8	627
			Minimum	14.8	1.6	3.5	17	38.6	0

Total number of blows analyzed: 672

BL#	Sensors
1-672	F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.00); A4: [K3550] 360.0 (1.00)

BL#	Comments
1	Reference elevation EL 740.9. Mud line EL 721.4
670	CW

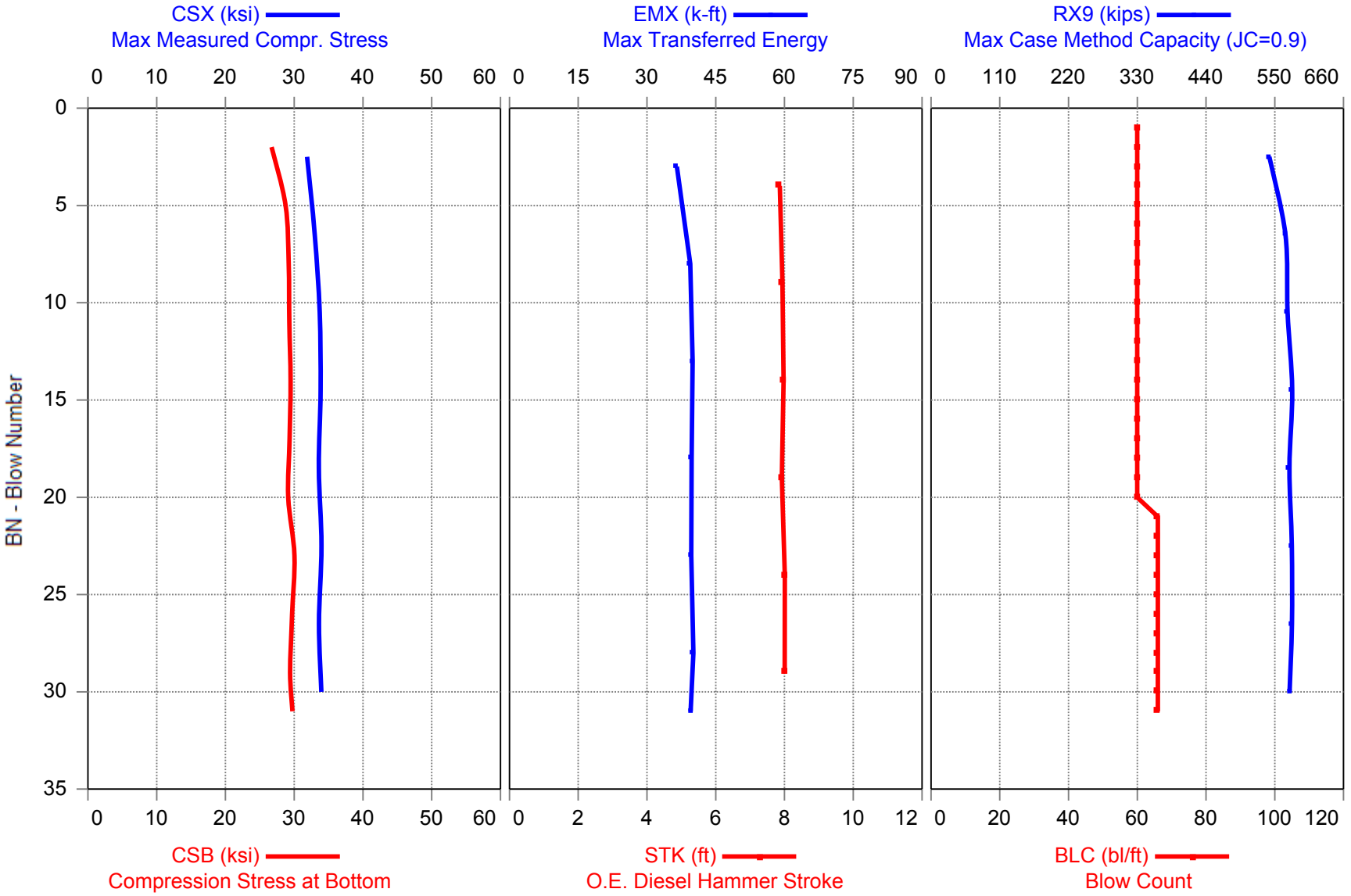
Time Summary

Drive	16 minutes 29 seconds	6:38 AM - 6:54 AM BN 1 - 672

GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.49.5 - Case Method & iCAP® Results

Printed: 29-April-2015 Test started: 29-April-2015

USH 10 over LLBDM - PIER 17 #1 BOR - APE D30-42, HP 14 x 73



USH 10 over LLBDM - PIER 17 #1 BOR APE D30-42, HP 14 x 73
OP: TC Date: 29-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.60 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

CSX: Max Measured Compr. Stress
CSB: Compression Stress at Bottom
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 bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
10	64.58	60	AV10	32.7	28.3	7.9	38	42.0	557
			MAX	33.9	29.4	8.2	42	42.6	575
			MIN	27.3	23.5	7.7	27	41.3	478
20	64.75	60	AV10	33.7	29.4	8.0	40	41.9	575
			MAX	34.5	29.8	8.3	42	42.3	586
			MIN	33.0	28.9	7.8	38	41.1	567
31	64.92	66	AV11	33.8	29.6	8.0	40	41.8	576
			MAX	34.4	30.3	8.2	41	42.4	585
			MIN	33.1	28.7	7.8	39	41.3	570
			Average	33.4	29.1	8.0	39	41.9	570
			Maximum	34.5	30.3	8.3	42	42.6	586
			Minimum	27.3	23.5	7.7	27	41.1	478

Total number of blows analyzed: 31

BL# Sensors

1-31 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.03); A4: [K3550] 360.0 (1.03)

BL# Comments

3 CW

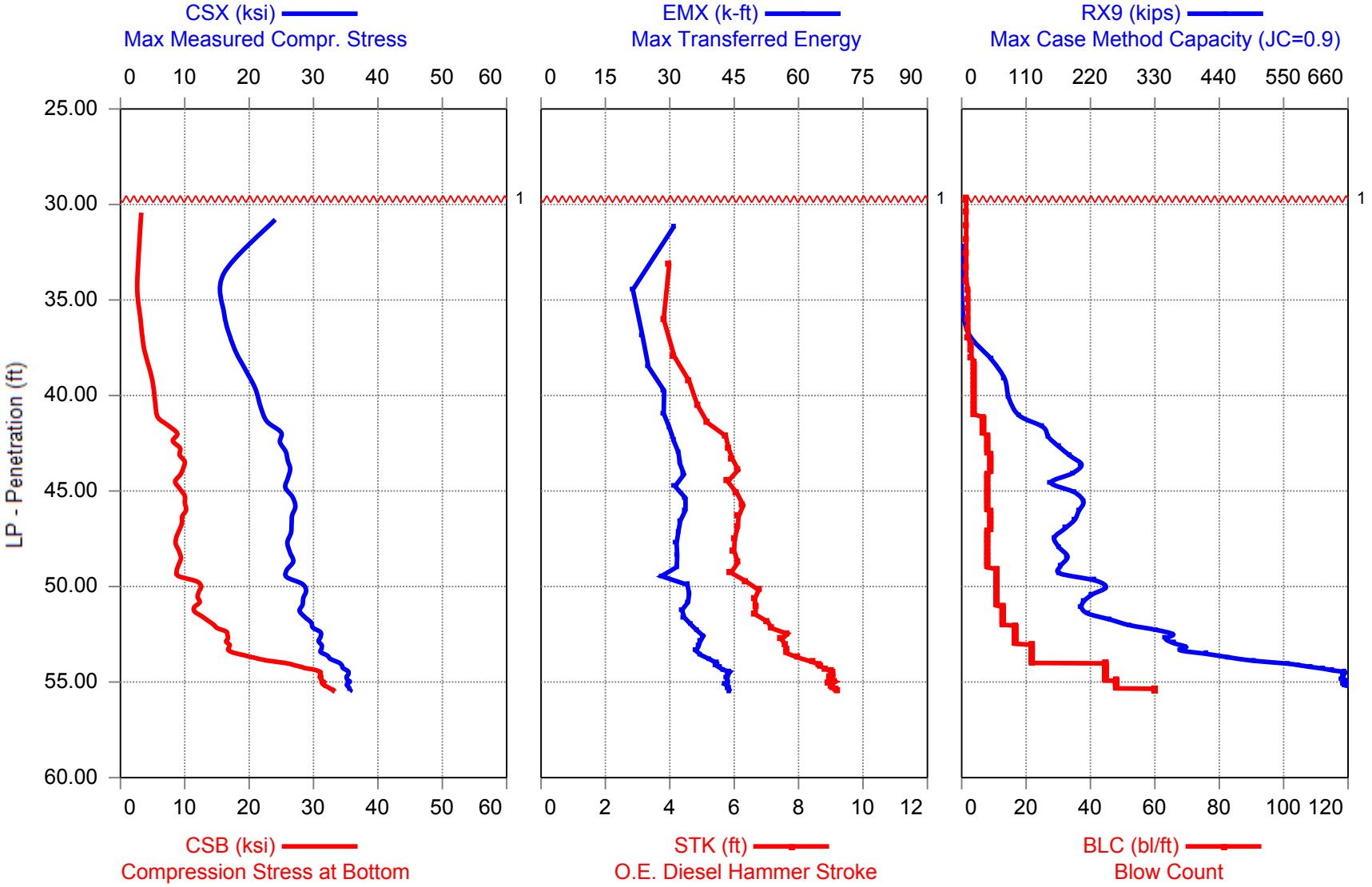
Time Summary

Drive 42 seconds 6:57 AM - 6:57 AM BN 1 - 31

GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.49.5 - Case Method & iCAP® Results

Printed: 29-April-2015 Test started: 28-April-2015

USH 10 over LLBDM - PIER 17 #36 EOID - APE D30-42, HP 14 x 73



1 - Reference elevation EL 740.9. Mud line EL 721.4

USH 10 over LLBDM - PIER 17 #36 EOID APE D30-42, HP 14 x 73
OP: TC Date: 28-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

CSX: Max Measured Compr. Stress
CSB: Compression Stress at Bottom
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 bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
7	34.00	1	AV7	21.0	3.0	4.1	28	57.7	3
			MAX	26.0	4.1	5.2	38	62.8	18
			MIN	14.0	2.3	3.4	20	51.4	0
9	35.00	2	AV2	14.2	2.6	3.4	21	62.2	0
			MAX	14.9	2.7	3.6	22	63.1	0
			MIN	13.4	2.4	3.3	19	61.3	0
11	36.00	2	AV2	16.3	3.3	3.8	24	59.5	0
			MAX	16.8	3.3	3.9	24	60.2	0
			MIN	15.9	3.2	3.7	23	58.7	0
13	37.00	2	AV2	17.2	3.2	3.9	26	58.4	0
			MAX	17.5	3.6	4.0	26	58.8	0
			MIN	16.9	2.9	3.9	25	58.0	0
16	38.00	3	AV3	17.7	3.6	4.0	22	57.8	44
			MAX	18.0	3.8	4.1	23	58.1	46
			MIN	17.6	3.4	4.0	21	57.6	40
20	39.00	4	AV4	19.4	4.6	4.4	26	55.7	63
			MAX	20.7	5.0	4.6	28	56.4	69
			MIN	18.8	4.0	4.3	22	54.1	57
24	40.00	4	AV4	20.9	5.2	4.7	28	53.9	78
			MAX	21.4	5.3	4.8	29	54.2	85
			MIN	20.7	5.1	4.6	28	53.4	73
28	41.00	4	AV4	21.8	5.5	4.9	30	52.7	87
			MAX	22.2	5.8	5.0	32	53.2	95
			MIN	21.5	5.3	4.8	30	52.1	76
35	42.00	7	AV7	23.6	7.4	5.3	29	50.8	131
			MAX	25.0	8.9	5.8	32	53.3	155
			MIN	21.6	5.6	4.8	25	48.8	103
43	43.00	8	AV8	25.3	8.8	5.8	31	48.8	159
			MAX	26.3	9.6	6.0	33	50.0	181
			MIN	24.1	7.7	5.5	29	47.8	133
52	44.00	9	AV9	26.1	9.7	6.0	32	47.9	198
			MAX	26.6	10.1	6.1	34	48.8	207
			MIN	25.3	8.8	5.8	31	47.4	191
60	45.00	8	AV8	25.8	9.0	5.9	32	48.3	167
			MAX	27.0	9.8	6.3	35	49.3	190
			MIN	24.8	8.3	5.7	30	46.9	144

USH 10 over LLBDM - PIER 17 #36 EOID APE D30-42, HP 14 x 73
OP: TC Date: 28-April-2015

BL#	Depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
68	46.00	8	AV8	27.0	10.0	6.2	34	47.1	205
			MAX	27.8	10.4	6.5	36	47.7	212
			MIN	26.2	9.8	6.1	33	46.3	193
77	47.00	9	AV9	26.6	9.6	6.1	32	47.5	191
			MAX	27.1	10.2	6.3	34	48.4	204
			MIN	25.7	9.0	5.9	31	47.0	177
85	48.00	8	AV8	26.2	8.8	6.0	32	47.9	161
			MAX	26.6	9.2	6.1	33	48.6	178
			MIN	25.6	8.5	5.8	30	47.5	145
93	49.00	8	AV8	26.5	9.2	6.1	32	47.7	175
			MAX	27.5	10.0	6.3	34	48.5	185
			MIN	25.6	8.8	5.9	30	46.8	158
104	50.00	11	AV11	26.7	10.3	6.2	31	47.3	205
			MAX	28.6	12.8	6.7	35	49.4	254
			MIN	24.6	8.2	5.6	27	45.5	162
115	51.00	11	AV11	28.6	12.2	6.7	34	45.5	220
			MAX	29.4	13.5	7.0	36	46.4	253
			MIN	27.6	11.6	6.4	32	44.5	205
128	52.00	13	AV13	28.6	12.6	6.8	34	45.2	235
			MAX	30.4	14.8	7.4	36	46.2	288
			MIN	27.3	11.1	6.5	32	43.5	200
145	53.00	17	AV17	30.8	16.2	7.4	37	43.3	343
			MAX	32.3	17.2	8.0	40	44.3	379
			MIN	29.7	14.6	7.1	34	41.7	290
167	54.00	22	AV22	32.0	19.3	7.9	38	42.2	428
			MAX	34.3	25.3	8.7	42	43.3	533
			MIN	30.6	16.5	7.4	35	40.2	370
208	54.92	45	AV41	35.0	29.8	8.9	43	39.7	628
			MAX	36.1	31.9	9.3	45	40.5	666
			MIN	33.9	26.2	8.5	40	38.8	552
218	55.13	48	AV10	35.5	31.5	9.0	44	39.4	656
			MAX	36.4	32.3	9.4	46	39.8	666
			MIN	34.9	31.2	8.8	43	38.7	651
228	55.33	48	AV10	35.4	32.1	9.0	44	39.4	665
			MAX	35.8	32.9	9.2	45	39.7	678
			MIN	34.8	31.4	8.9	43	39.1	647
238	55.50	60	AV10	35.6	33.0	9.2	44	39.1	689
			MAX	36.0	33.6	9.3	45	39.4	700
			MIN	35.1	32.4	9.0	43	38.8	679
			Average	29.1	16.8	7.1	36	45.2	341

USH 10 over LLBDM - PIER 17 #36 EOID APE D30-42, HP 14 x 73
OP: TC Date: 28-April-2015

BL#	Depth	BLC	TYPE	CSX	CSB	STK	EMX	BPM	RX9
	ft	bl/ft		ksi	ksi	ft	k-ft	bpm	kips
			Maximum	36.4	33.6	9.4	46	63.1	700
			Minimum	13.4	2.3	3.3	19	38.7	0

Total number of blows analyzed: 238

BL# Sensors

1-238 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.00); A4: [K3550] 360.0 (1.00)

BL# Comments

1 Reference elevation EL 740.9. Mud line EL 721.4
232 CW

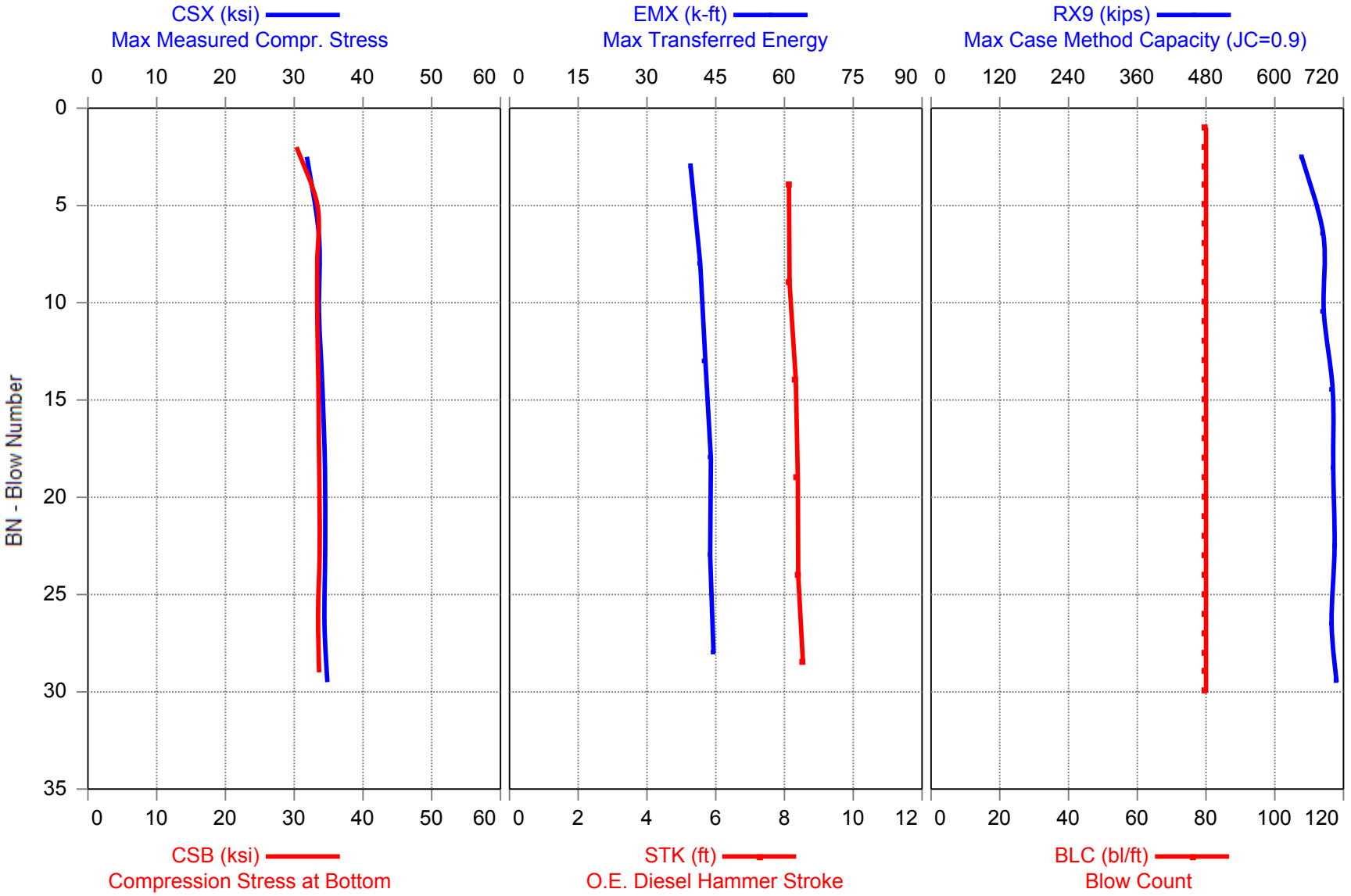
Time Summary

Drive 5 minutes 55 seconds 7:09 AM - 7:15 AM BN 1 - 238

GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.49.5 - Case Method & iCAP® Results

Printed: 29-April-2015 Test started: 29-April-2015

USH 10 over LLBDM - PIER 17 #36 BOR - APE D30-42, HP 14 x 73



USH 10 over LLBDM - PIER 17 #36 BOR APE D30-42, HP 14 x 73
OP: TC Date: 29-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

CSX: Max Measured Compr. Stress
CSB: Compression Stress at Bottom
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 bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
10	55.63	80	AV10	32.9	32.5	8.1	41	41.4	668
			MAX	34.1	33.5	8.2	43	41.6	689
			MIN	26.6	25.7	8.1	27	41.2	555
20	55.75	80	AV10	34.2	33.5	8.3	43	40.9	700
			MAX	34.9	34.1	8.5	45	41.4	707
			MIN	33.5	33.1	8.1	42	40.5	688
30	55.88	80	AV10	34.5	33.6	8.5	44	40.7	703
			MAX	35.1	34.1	8.7	46	41.0	715
			MIN	34.1	33.2	8.3	43	40.2	692
			Average	33.9	33.2	8.3	43	41.0	690
			Maximum	35.1	34.1	8.7	46	41.6	715
			Minimum	26.6	25.7	8.1	27	40.2	555

Total number of blows analyzed: 30

BL# Sensors

1-30 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.04); A4: [K3550] 360.0 (1.04)

BL# Comments

4 CW

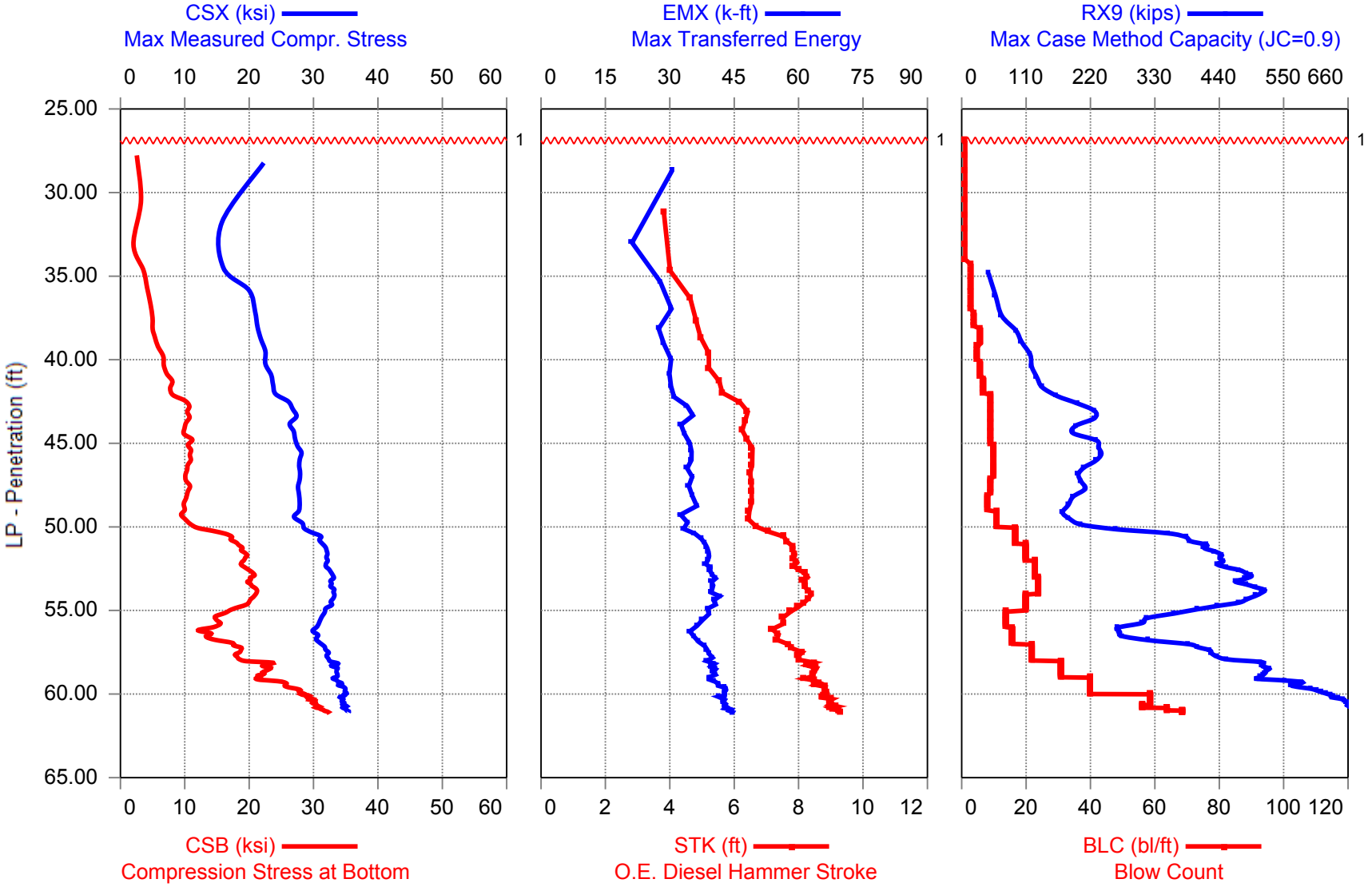
Time Summary

Drive 42 seconds 7:06 AM - 7:07 AM BN 1 - 30

GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.49.5 - Case Method & iCAP® Results

Printed: 29-April-2015 Test started: 28-April-2015

USH 10 over LLBDM - PIER 17 #44 EOID - APE D30-42, HP 14 x 73



1 - Reference elevation EL 740.9. Mud line EL 721.4

USH 10 over LLBDM - PIER 17 #44 EOID APE D30-42, HP 14 x 73
OP: TC Date: 28-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.60 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

CSX: Max Measured Compr. Stress
CSB: Compression Stress at Bottom
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 bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
9	34.00	1	AV9	18.2	2.6	3.7	27	60.3	0
			MAX	24.7	4.7	4.5	40	65.4	0
			MIN	11.5	1.9	3.1	19	55.0	0
12	35.00	3	AV3	17.3	3.6	4.1	24	57.7	40
			MAX	19.5	4.0	4.4	28	60.2	57
			MIN	15.0	3.3	3.7	20	55.3	17
15	36.00	3	AV3	19.8	4.1	4.5	29	55.1	59
			MAX	20.3	4.3	4.6	30	56.1	64
			MIN	19.0	4.0	4.3	28	54.5	53
18	37.00	3	AV3	21.1	4.7	4.8	32	53.5	58
			MAX	21.7	4.8	4.9	33	53.9	59
			MIN	20.6	4.6	4.7	31	52.7	57
22	38.00	4	AV4	20.9	5.0	4.8	29	53.4	74
			MAX	21.8	5.3	5.1	30	54.2	80
			MIN	20.4	4.7	4.6	28	52.0	69
28	39.00	6	AV6	21.7	5.3	5.0	27	52.5	99
			MAX	22.2	5.6	5.1	28	53.7	105
			MIN	20.9	5.0	4.7	25	51.7	94
33	40.00	5	AV5	22.5	6.4	5.2	31	51.3	114
			MAX	22.8	6.8	5.3	32	51.8	135
			MIN	21.8	5.7	5.1	30	50.9	104
39	41.00	6	AV6	22.8	7.0	5.2	29	51.1	121
			MAX	23.2	7.3	5.4	31	51.7	128
			MIN	22.2	6.5	5.1	28	50.5	116
46	42.00	7	AV7	23.9	7.8	5.6	31	49.6	136
			MAX	24.8	8.3	5.8	32	50.5	143
			MIN	23.1	7.1	5.4	29	48.8	132
55	43.00	9	AV9	25.9	9.9	6.1	33	47.6	194
			MAX	27.2	11.0	6.5	35	49.4	228
			MIN	24.0	8.3	5.6	30	46.3	150
64	44.00	9	AV9	26.9	10.4	6.4	34	46.6	218
			MAX	27.5	11.1	6.5	36	47.9	232
			MIN	25.5	9.2	6.0	31	46.0	187
73	45.00	9	AV9	27.1	10.4	6.3	34	46.7	208
			MAX	27.7	11.7	6.6	36	47.4	237
			MIN	26.1	9.8	6.1	32	45.9	178

USH 10 over LLBDM - PIER 17 #44 EOID APE D30-42, HP 14 x 73
OP: TC Date: 28-April-2015

BL#	Depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
83	46.00	10	AV10	27.8	10.9	6.6	35	45.9	235
			MAX	28.9	11.7	6.8	36	46.8	243
			MIN	26.9	10.2	6.3	34	45.1	221
93	47.00	10	AV10	27.8	10.3	6.5	35	46.1	208
			MAX	28.5	10.9	6.8	36	47.1	225
			MIN	27.1	9.5	6.2	33	45.3	197
102	48.00	9	AV9	27.9	10.5	6.6	35	46.0	207
			MAX	28.6	11.0	6.8	36	47.0	218
			MIN	26.9	9.9	6.3	34	45.2	199
110	49.00	8	AV8	27.7	10.1	6.5	36	46.0	182
			MAX	28.5	10.7	6.8	37	46.5	189
			MIN	27.2	9.4	6.4	34	45.3	173
121	50.00	11	AV11	27.5	10.1	6.5	33	46.3	188
			MAX	28.6	11.4	6.8	35	47.2	212
			MIN	26.6	9.2	6.2	32	45.2	161
138	51.00	17	AV17	30.4	16.1	7.4	36	43.5	352
			MAX	32.5	19.2	8.0	40	45.2	412
			MIN	28.7	12.1	6.8	33	41.7	224
158	52.00	20	AV20	31.9	19.1	7.8	39	42.2	432
			MAX	33.0	20.3	8.1	40	42.9	452
			MIN	30.9	17.9	7.6	37	41.4	407
181	53.00	23	AV23	32.5	19.8	8.0	39	41.7	466
			MAX	33.6	21.1	8.4	42	42.6	501
			MIN	31.2	17.9	7.7	37	40.7	431
205	54.00	24	AV24	32.9	20.5	8.2	40	41.2	495
			MAX	33.9	21.4	8.6	43	41.9	521
			MIN	31.8	19.5	7.9	37	40.3	462
225	55.00	20	AV20	32.7	19.5	8.1	40	41.4	461
			MAX	33.6	21.0	8.6	43	42.7	506
			MIN	31.3	16.8	7.6	38	40.4	400
239	56.00	14	AV14	31.1	15.3	7.6	38	42.9	322
			MAX	32.2	16.7	7.9	41	44.0	391
			MIN	30.1	13.7	7.2	36	41.9	262
255	57.00	16	AV16	30.5	14.2	7.3	36	43.5	296
			MAX	31.5	17.7	7.8	39	44.8	387
			MIN	29.3	11.6	6.9	33	42.3	237
277	58.00	22	AV22	32.0	18.3	7.9	39	41.9	425
			MAX	33.4	19.4	8.4	42	42.9	468
			MIN	30.8	17.3	7.6	36	40.7	387

USH 10 over LLBDM - PIER 17 #44 EOID APE D30-42, HP 14 x 73
OP: TC Date: 28-April-2015

BL#	Depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
308	59.00	31	AV31	33.5	22.3	8.4	40	40.7	517
			MAX	34.3	24.0	8.7	42	42.1	532
			MIN	31.7	19.0	7.9	37	40.0	463
348	60.00	40	AV40	34.3	25.6	8.7	42	40.2	576
			MAX	35.5	28.6	9.1	44	41.5	630
			MIN	32.8	20.4	8.1	37	39.3	490
386	60.65	59	AV38	34.5	29.6	8.9	42	39.6	647
			MAX	35.9	31.1	9.3	45	40.4	674
			MIN	33.4	28.0	8.6	40	38.9	622
396	60.82	56	AV10	34.7	30.5	9.0	43	39.4	666
			MAX	35.4	31.2	9.4	44	39.8	676
			MIN	34.2	30.1	8.8	42	38.7	659
406	60.98	64	AV10	35.0	31.3	9.2	44	39.1	683
			MAX	35.6	32.0	9.4	46	39.4	695
			MIN	34.3	30.6	9.0	42	38.7	672
416	61.13	69	AV10	35.3	32.0	9.3	44	38.9	695
			MAX	35.9	32.4	9.4	46	39.6	708
			MIN	34.3	31.2	8.9	43	38.6	680
			Average	30.7	18.4	7.6	38	43.4	404
			Maximum	35.9	32.4	9.4	46	65.4	708
			Minimum	11.5	1.9	3.1	19	38.6	0

Total number of blows analyzed: 416

BL# Sensors

1-416 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.02); A4: [K3550] 360.0 (1.02)

BL# Comments

1 Reference elevation EL 740.9. Mud line EL 721.4
414 CW

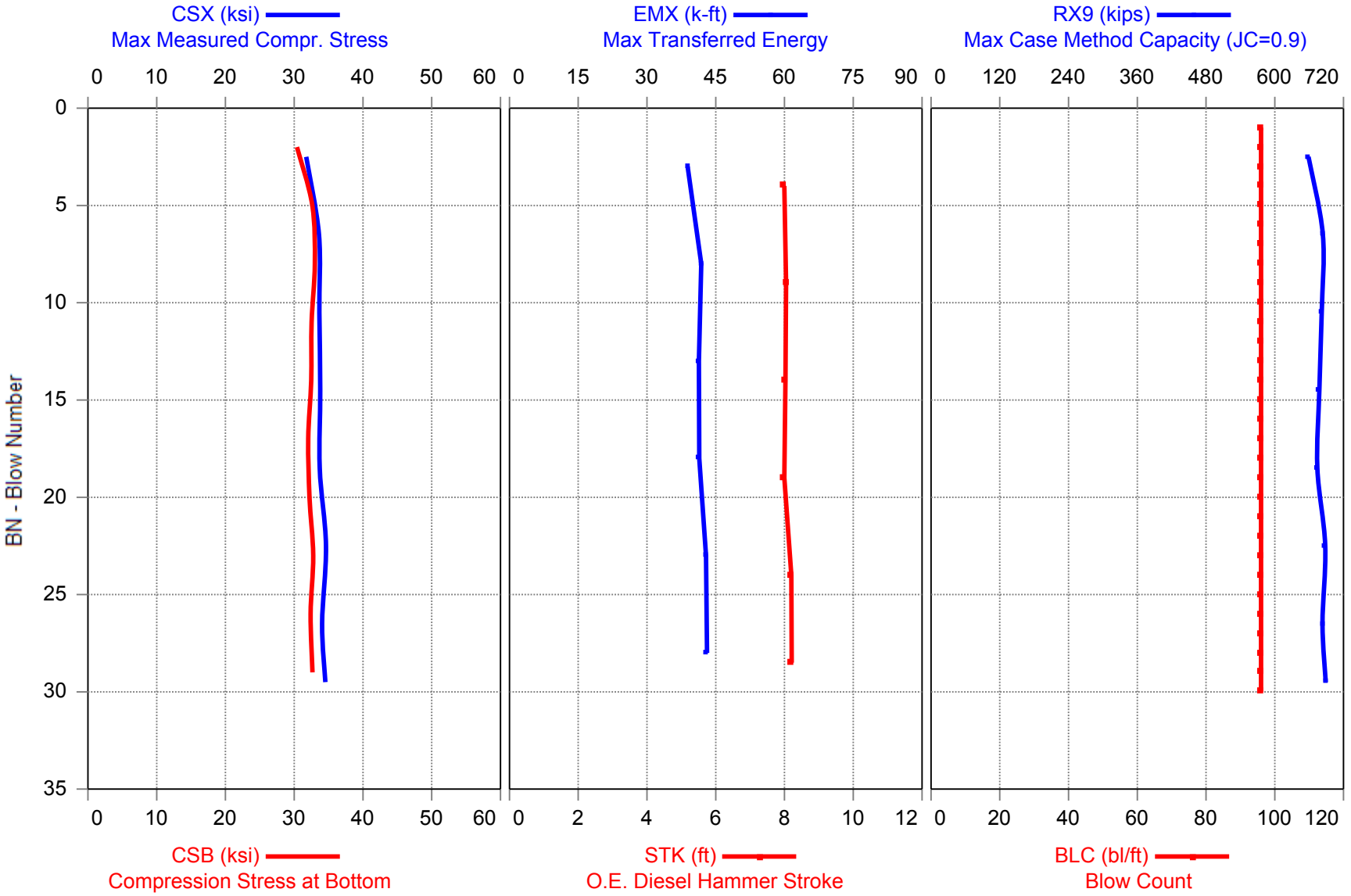
Time Summary

Drive 10 minutes 11 seconds 7:26 AM - 7:36 AM BN 1 - 416

GRL Engineers, Inc. - PDIPLOT2 Ver 2015.1.49.5 - Case Method & iCAP® Results

Printed: 29-April-2015 Test started: 29-April-2015

USH 10 over LLBDM - PIER 17 #44 BOR - APE D30-42, HP 14 x 73



USH 10 over LLBDM - PIER 17 #44 BOR APE D30-42, HP 14 x 73
OP: TC Date: 29-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 77.60 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

CSX: Max Measured Compr. Stress
CSB: Compression Stress at Bottom
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 bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
10	61.23	96	AV10	32.9	32.1	8.0	40	41.7	674
			MAX	34.3	33.2	8.3	43	42.0	692
			MIN	26.3	25.2	7.9	27	41.1	578
20	61.33	96	AV10	33.7	32.2	8.0	41	41.8	676
			MAX	34.2	32.7	8.1	43	42.2	684
			MIN	33.0	31.7	7.8	40	41.4	670
30	61.44	96	AV10	34.4	32.6	8.2	43	41.3	686
			MAX	35.0	33.1	8.5	44	41.7	697
			MIN	33.8	32.2	8.0	41	40.6	678
			Average	33.7	32.3	8.1	42	41.6	679
			Maximum	35.0	33.2	8.5	44	42.2	697
			Minimum	26.3	25.2	7.8	27	40.6	578

Total number of blows analyzed: 30

BL# Sensors

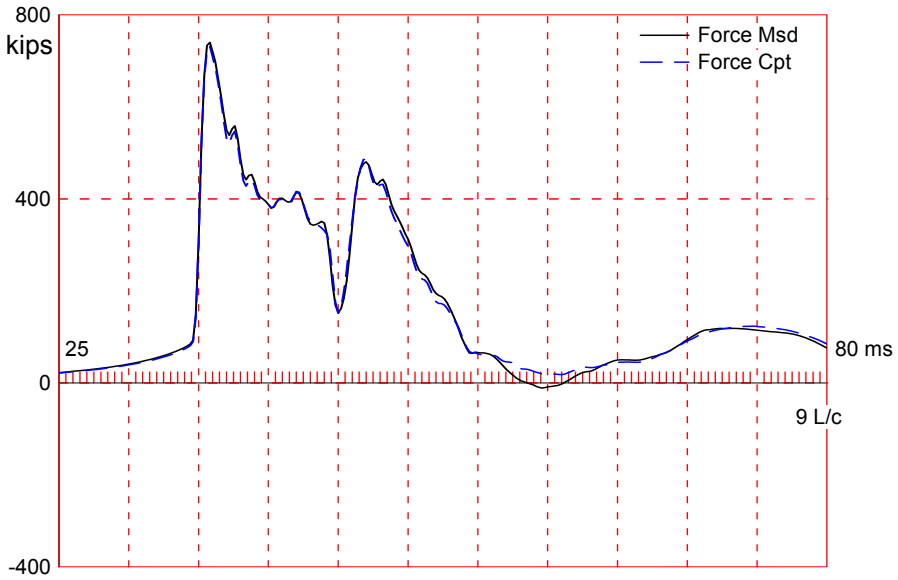
1-30 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.04); A4: [K3550] 360.0 (1.04)

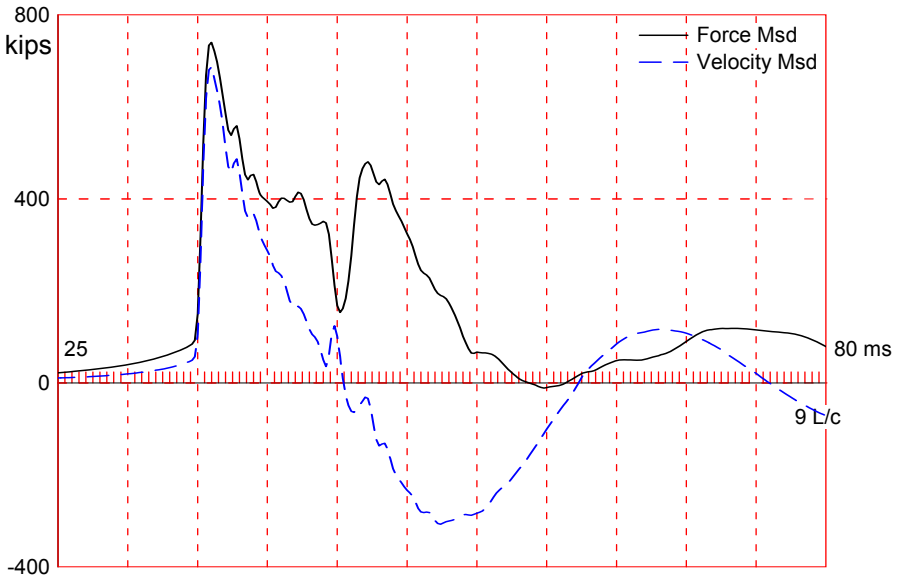
BL# Comments

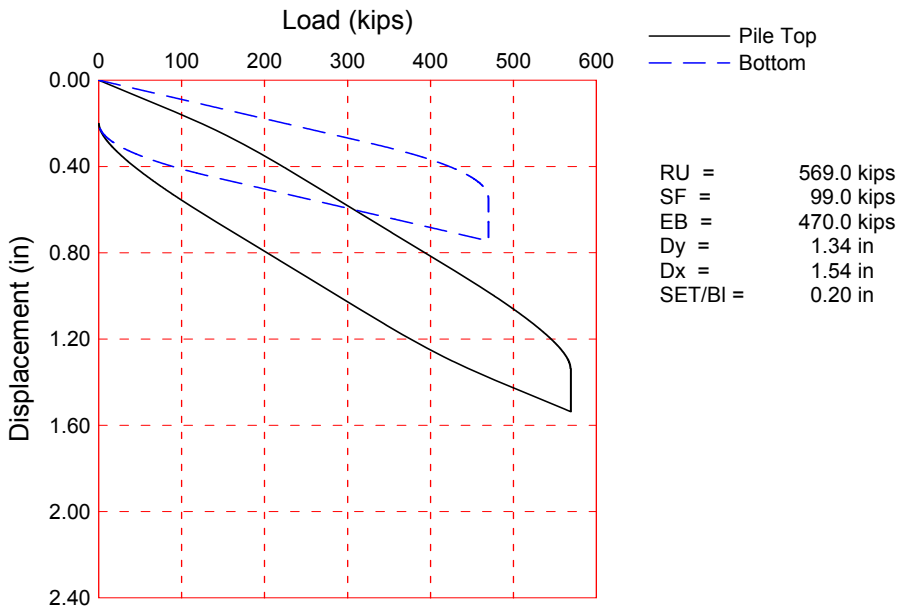
3 CW

Time Summary

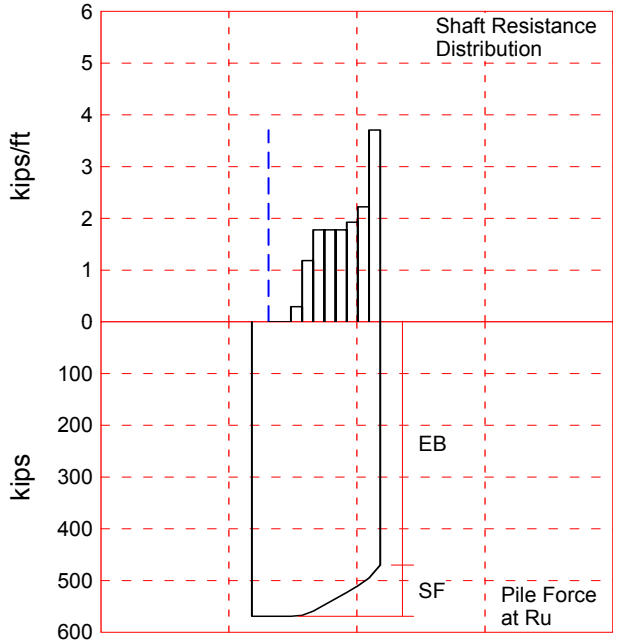
Drive 41 seconds 7:13 AM - 7:14 AM BN 1 - 30







RU =	569.0 kips
SF =	99.0 kips
EB =	470.0 kips
Dy =	1.34 in
Dx =	1.54 in
SET/Bl =	0.20 in



Length b. Sensors	77.6 ft
Embedment	65.4 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16866 ft/s
Match Quality	2.36
Top Compr. Stress	34.2 ksi
Max Compr. Stress	35.8 ksi
Max Tension Stress	-3.66 ksi
Avg. Shaft Quake	0.10 in
Toe Quake	0.42 in
Avg. Shaft Smith Dpg.	0.27 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: 569.0; along Shaft 99.0; at Toe 470.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				569.0				
1	16.9	4.7	0.0	569.0	0.0	0.00	0.00	0.00
2	23.6	11.4	0.0	569.0	0.0	0.00	0.00	0.00
3	30.4	18.2	2.0	567.0	2.0	0.30	0.06	0.27
4	37.1	24.9	8.0	559.0	10.0	1.19	0.25	0.27
5	43.9	31.7	12.0	547.0	22.0	1.78	0.38	0.27
6	50.6	38.4	12.0	535.0	34.0	1.78	0.38	0.27
7	57.3	45.1	12.0	523.0	46.0	1.78	0.38	0.27
8	64.1	51.9	13.0	510.0	59.0	1.93	0.41	0.27
9	70.8	58.6	15.0	495.0	74.0	2.22	0.47	0.27
10	77.6	65.4	25.0	470.0	99.0	3.71	0.79	0.27
Avg. Shaft			9.9			1.51	0.32	0.27
Toe			470.0				340.95	0.09

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.10	0.42
Case Damping Factor		0.70	1.11
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	61
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	74	
Resistance Gap (included in Toe Quake)	(in)		0.02
Soil Plug Weight	(kips)	0.045	0.130

CAPWAP match quality = 2.36 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.20 in; Blow Count = 60 b/ft
Computed: Final Set = 0.06 in; Blow Count = 194 b/ft

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

max. Top Comp. Stress = 34.2 ksi (T= 36.2 ms, max= 1.045 x Top)
max. Comp. Stress = 35.8 ksi (Z= 37.1 ft, T= 38.2 ms)
max. Tens. Stress = -3.66 ksi (Z= 43.9 ft, T= 61.2 ms)
max. Energy (EMX) = 41.9 kip-ft; max. Measured Top Displ. (DMX)= 1.07 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	732.7	-17.1	34.2	-0.80	41.9	18.2	1.08
2	6.7	733.8	-17.9	34.3	-0.84	41.7	18.1	1.07
4	13.5	736.3	-24.8	34.4	-1.16	41.0	18.1	1.02
5	16.9	737.6	-29.3	34.5	-1.37	40.6	18.0	1.00
6	20.2	739.0	-37.5	34.5	-1.75	40.1	18.0	0.97
7	23.6	741.9	-46.4	34.7	-2.17	39.6	17.9	0.95
8	27.0	746.2	-54.4	34.9	-2.54	39.1	17.8	0.92
9	30.4	753.6	-62.8	35.2	-2.93	38.5	17.6	0.89
10	33.7	754.2	-67.8	35.2	-3.17	37.3	17.3	0.86
11	37.1	765.4	-74.7	35.8	-3.49	36.6	17.0	0.82
12	40.5	737.9	-71.5	34.5	-3.34	34.0	16.5	0.79
13	43.9	750.3	-78.3	35.1	-3.66	33.2	16.2	0.76
14	47.2	709.1	-70.0	33.1	-3.27	29.9	15.6	0.72
15	50.6	728.2	-76.2	34.0	-3.56	29.1	15.1	0.69
16	54.0	682.4	-68.4	31.9	-3.20	26.0	14.7	0.65
17	57.3	684.2	-73.7	32.0	-3.44	25.3	14.6	0.62
18	60.7	635.2	-67.0	29.7	-3.13	22.4	14.4	0.59
19	64.1	647.2	-72.1	30.2	-3.37	21.7	14.0	0.55
20	67.5	602.3	-63.3	28.1	-2.96	19.0	13.9	0.52
21	70.8	597.7	-66.9	27.9	-3.13	18.3	15.3	0.49
22	74.2	586.6	-56.4	27.4	-2.64	15.6	16.3	0.46
23	77.6	607.0	-58.5	28.4	-2.73	12.8	16.0	0.43
Absolute	37.1			35.8			(T =	38.2 ms)
	43.9				-3.66		(T =	61.2 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	762.8	626.1	489.4	352.7	216.1					
RX	787.0	730.5	674.0	623.4	597.5	577.1	566.8	558.2	553.0	547.9
RU	762.8	626.1	489.4	352.7	216.1					

RAU = 498.6 (kips); RA2 = 653.8 (kips)

Current CAPWAP Ru = 569.0 (kips); Corresponding J(RP)= 0.28; J(RX) = 1.16

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
18.3	36.00	700.6	745.5	754.3	1.07	0.20	0.20	42.1	794.2	1175

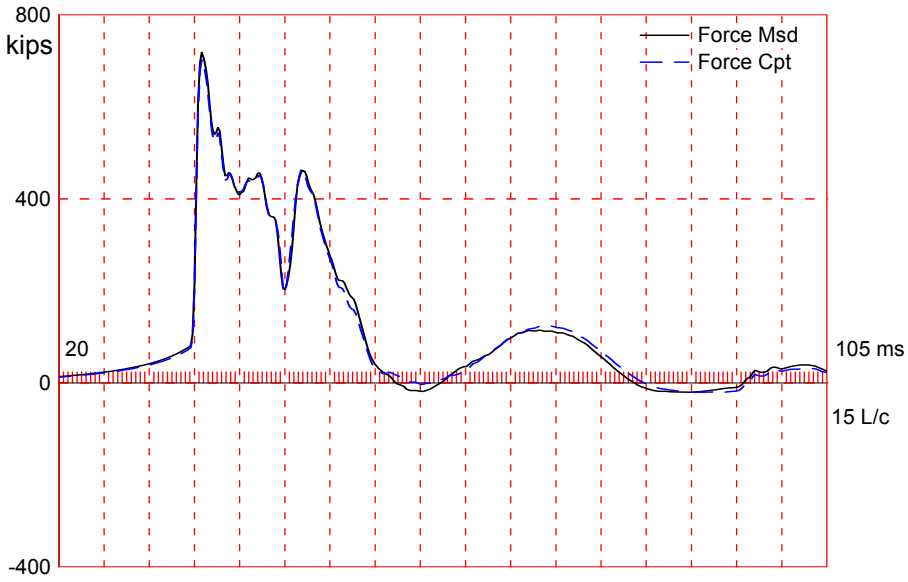
PILE PROFILE AND PILE MODEL

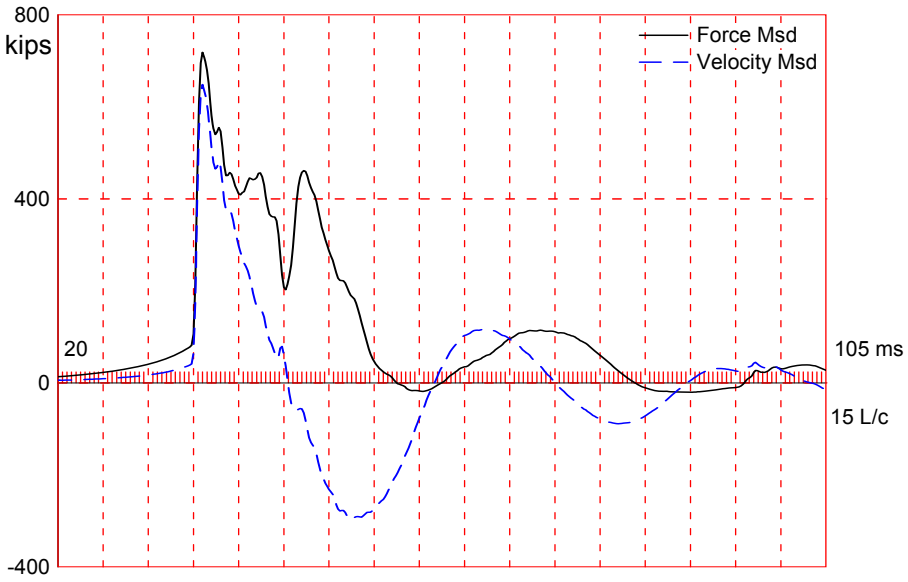
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.6	21.4	29992.2	492.000	4.70

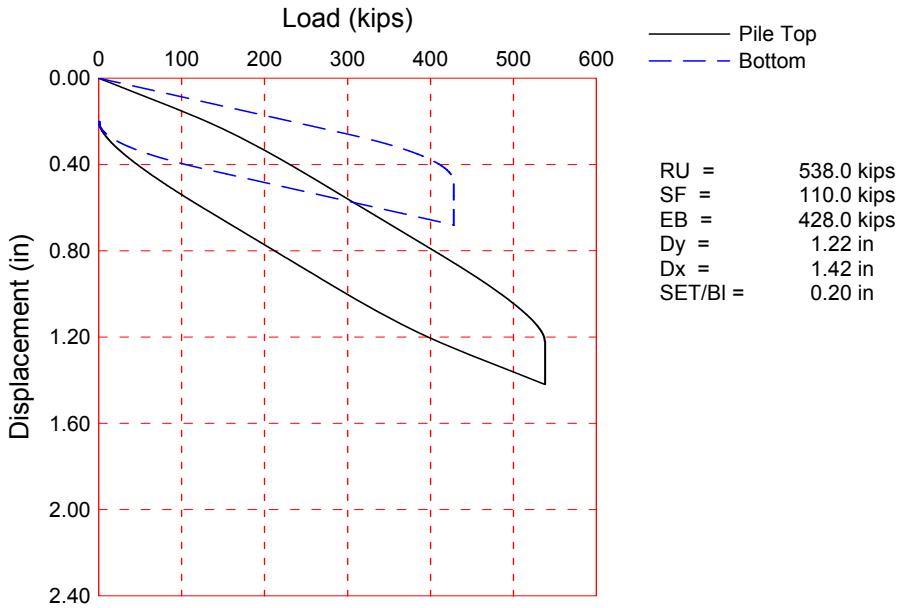
Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	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	16865.9	0.000
16	54.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16865.9	0.010
17	57.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16865.9	0.020
18	60.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16865.9	0.015
19	64.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16865.9	0.000
23	77.6	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16865.9	0.000

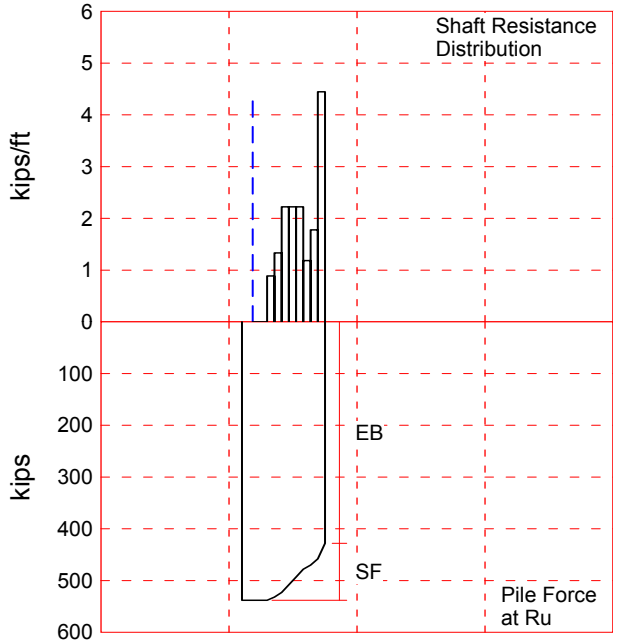
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16865.9 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 9.2 ms
Total volume: 11.530 $ft^{3;}$ Volume ratio considering added impedance: 1.000







RU =	538.0 kips
SF =	110.0 kips
EB =	428.0 kips
Dy =	1.22 in
Dx =	1.42 in
SET/BI =	0.20 in



Length b. Sensors	77.6 ft
Embedment	64.5 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16870 ft/s
Match Quality	2.35
Top Compr. Stress	32.9 ksi
Max Compr. Stress	34.2 ksi
Max Tension Stress	-4.78 ksi
Avg. Shaft Quake	0.10 in
Toe Quake	0.37 in
Avg. Shaft Smith Dpg.	0.29 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: 538.0; along Shaft 110.0; at Toe 428.0 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
				538.0				
1	16.9	3.7	0.0	538.0	0.0	0.00	0.00	0.00
2	23.6	10.5	0.0	538.0	0.0	0.00	0.00	0.00
3	30.4	17.2	6.0	532.0	6.0	0.89	0.19	0.29
4	37.1	24.0	9.0	523.0	15.0	1.33	0.28	0.29
5	43.9	30.7	15.0	508.0	30.0	2.22	0.47	0.29
6	50.6	37.5	15.0	493.0	45.0	2.22	0.47	0.29
7	57.4	44.2	15.0	478.0	60.0	2.22	0.47	0.29
8	64.1	51.0	8.0	470.0	68.0	1.19	0.25	0.29
9	70.9	57.7	12.0	458.0	80.0	1.78	0.38	0.29
10	77.6	64.5	30.0	428.0	110.0	4.45	0.95	0.29
Avg. Shaft			11.0			1.71	0.36	0.29
Toe			428.0				310.49	0.11

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.10	0.37
Case Damping Factor		0.84	1.23
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	37
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	60	
Resistance Gap (included in Toe Quake)	(in)		0.02
Soil Plug Weight	(kips)	0.035	0.109

CAPWAP match quality = 2.35 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.20 in; Blow Count = 60 b/ft
Computed: Final Set = 0.09 in; Blow Count = 136 b/ft
Transducer F3(F607) CAL: 93.6; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K2524) CAL: 360; RF: 1.02; A4(K3550) CAL: 360; RF: 1.02

max. Top Comp. Stress = 32.9 ksi (T= 36.2 ms, max= 1.040 x Top)
max. Comp. Stress = 34.2 ksi (Z= 30.4 ft, T= 37.8 ms)
max. Tens. Stress = -4.78 ksi (Z= 43.9 ft, T= 61.4 ms)
max. Energy (EMX) = 41.4 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	703.2	-23.5	32.9	-1.10	41.4	17.4	1.06
2	6.7	704.4	-26.3	32.9	-1.23	41.2	17.3	1.04
4	13.5	706.8	-43.5	33.0	-2.03	40.5	17.2	0.99
5	16.9	708.1	-53.8	33.1	-2.52	40.1	17.2	0.97
6	20.2	709.4	-63.7	33.1	-2.98	39.6	17.2	0.94
7	23.6	713.5	-71.9	33.3	-3.36	39.1	17.0	0.91
8	27.0	723.7	-78.9	33.8	-3.69	38.5	16.7	0.88
9	30.4	731.5	-87.3	34.2	-4.08	37.8	16.5	0.85
10	33.7	711.1	-88.5	33.2	-4.13	35.6	16.1	0.82
11	37.1	724.1	-95.5	33.8	-4.46	34.9	15.8	0.79
12	40.5	693.6	-95.0	32.4	-4.44	32.1	15.3	0.75
13	43.9	711.0	-102.2	33.2	-4.78	31.3	14.9	0.72
14	47.2	657.1	-96.5	30.7	-4.51	27.5	14.2	0.69
15	50.6	673.5	-102.0	31.5	-4.76	26.8	13.8	0.65
16	54.0	616.9	-93.9	28.8	-4.38	23.4	13.3	0.62
17	57.4	622.3	-99.3	29.1	-4.64	22.7	13.0	0.59
18	60.7	555.5	-89.7	26.0	-4.19	19.6	12.9	0.55
19	64.1	567.6	-90.8	26.5	-4.24	18.9	12.7	0.52
20	67.5	542.8	-84.2	25.4	-3.93	17.2	12.6	0.49
21	70.9	567.6	-87.0	26.5	-4.07	16.5	13.9	0.46
22	74.2	567.6	-76.9	26.5	-3.59	14.5	14.7	0.43
23	77.6	582.9	-77.5	27.2	-3.62	11.6	14.1	0.40
Absolute	30.4			34.2			(T =	37.8 ms)
	43.9				-4.78		(T =	61.4 ms)

CASE METHOD

J =	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
RP	765.9	643.6	521.2	398.8	276.4					
RX	789.3	734.6	679.9	625.4	583.6	555.6	530.2	509.5	495.3	486.7
RU	765.9	643.6	521.2	398.8	276.4					

RAU = 480.1 (kips); RA2 = 640.7 (kips)

Current CAPWAP Ru = 538.0 (kips); Corresponding J(RP)= 0.37; J(RX) = 1.14

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
17.2	35.80	656.8	721.0	723.6	1.04	0.20	0.20	41.7	804.6	1223

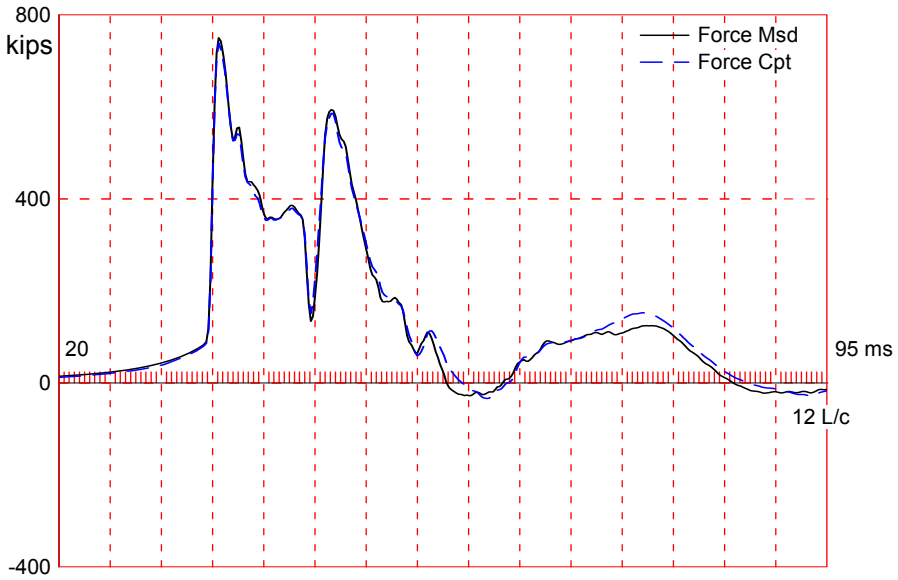
PILE PROFILE AND PILE MODEL

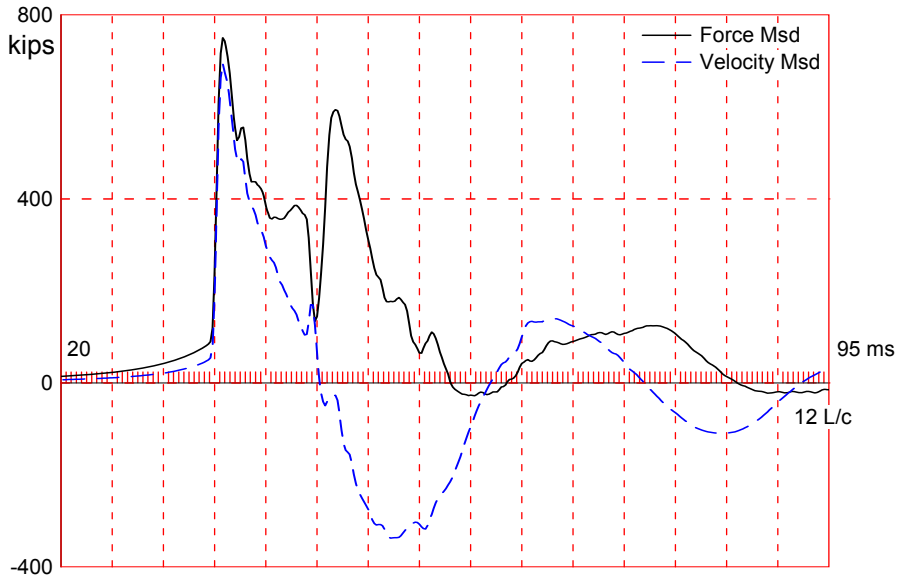
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.6	21.4	29992.2	492.000	4.70

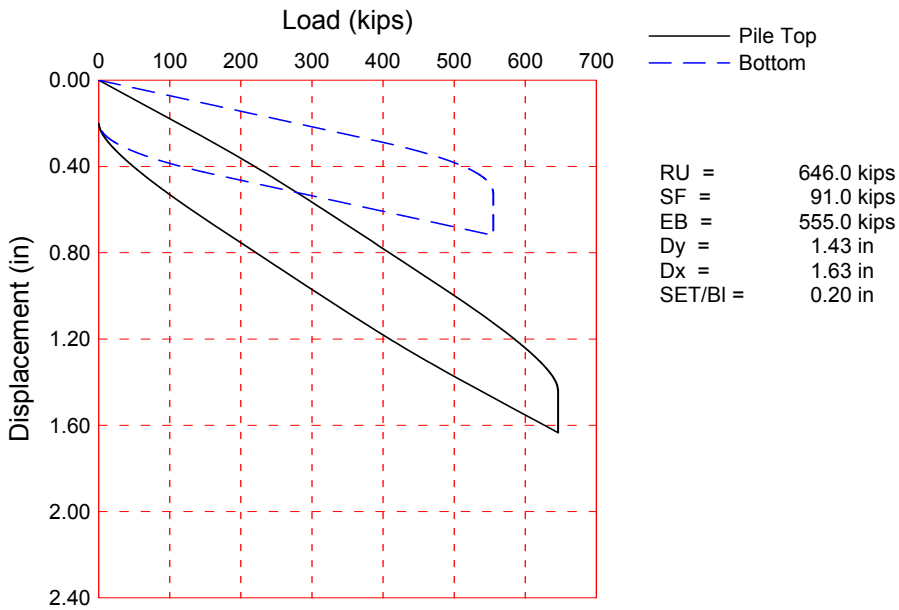
Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16869.6	0.000
16	54.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16869.6	0.010
18	60.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16869.6	0.015
19	64.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16869.6	0.000
23	77.6	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16869.6	0.000

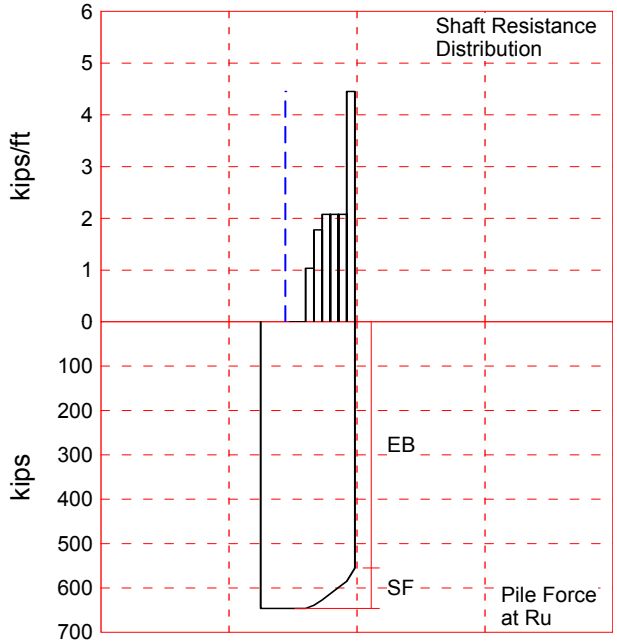
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16869.6 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 9.2 ms
Total volume: 11.532 ft^3; Volume ratio considering added impedance: 1.000







RU =	646.0 kips
SF =	91.0 kips
EB =	555.0 kips
Dy =	1.43 in
Dx =	1.63 in
SET/Bl =	0.20 in



Length b. Sensors	77.5 ft
Embedment	55.4 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16848 ft/s
Match Quality	3.34
Top Compr. Stress	34.6 ksi
Max Compr. Stress	36.0 ksi
Max Tension Stress	-6.54 ksi
Avg. Shaft Quake	0.15 in
Toe Quake	0.40 in
Avg. Shaft Smith Dpg.	0.24 s/ft
Toe Smith Damping	0.07 s/ft

About the CAPWAP Results

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

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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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CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 646.0; along Shaft 91.0; at Toe 555.0 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
				646.0				
1	30.3	8.2	0.0	646.0	0.0	0.00	0.00	0.00
2	37.1	15.0	0.0	646.0	0.0	0.00	0.00	0.00
3	43.8	21.7	7.0	639.0	7.0	1.04	0.22	0.24
4	50.5	28.4	12.0	627.0	19.0	1.78	0.38	0.24
5	57.3	35.2	14.0	613.0	33.0	2.08	0.44	0.24
6	64.0	41.9	14.0	599.0	47.0	2.08	0.44	0.24
7	70.8	48.7	14.0	585.0	61.0	2.08	0.44	0.24
8	77.5	55.4	30.0	555.0	91.0	4.45	0.95	0.24
Avg. Shaft			11.4			1.64	0.35	0.24
Toe			555.0				402.62	0.07

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.15	0.40
Case Damping Factor		0.57	1.02
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	35
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	50	
Resistance Gap (included in Toe Quake)	(in)		0.02

CAPWAP match quality = 3.34 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.20 in; Blow Count = 60 b/ft
Computed: Final Set = 0.05 in; Blow Count = 243 b/ft
Transducer F3(F607) CAL: 93.6; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K2524) CAL: 360; RF: 1.00; A4(K3550) CAL: 360; RF: 1.00

max. Top Comp. Stress = 34.6 ksi (T= 36.0 ms, max= 1.041 x Top)
max. Comp. Stress = 36.0 ksi (Z= 43.8 ft, T= 38.4 ms)
max. Tens. Stress = -6.54 ksi (Z= 43.8 ft, T= 60.8 ms)
max. Energy (EMX) = 43.9 kip-ft; max. Measured Top Displ. (DMX)= 1.15 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	739.8	-43.5	34.6	-2.03	43.9	18.4	1.17
2	6.7	740.4	-51.7	34.6	-2.42	43.6	18.4	1.15
4	13.5	741.7	-74.3	34.6	-3.47	42.7	18.3	1.10
5	16.8	742.4	-86.0	34.7	-4.02	42.1	18.3	1.07
6	20.2	743.2	-98.2	34.7	-4.59	41.5	18.3	1.04
7	23.6	744.1	-110.4	34.8	-5.16	40.8	18.2	1.01
8	27.0	745.1	-120.2	34.8	-5.62	40.1	18.2	0.97
9	30.3	746.2	-128.9	34.9	-6.02	39.3	18.1	0.94
10	33.7	747.5	-135.1	34.9	-6.31	38.5	18.1	0.90
11	37.1	751.3	-137.1	35.1	-6.40	37.7	17.9	0.87
12	40.4	761.0	-137.9	35.6	-6.44	36.8	17.7	0.83
13	43.8	770.4	-139.9	36.0	-6.54	35.9	17.4	0.80
14	47.2	749.5	-134.5	35.0	-6.28	33.4	17.0	0.76
15	50.5	763.9	-135.9	35.7	-6.35	32.5	16.6	0.72
16	53.9	721.6	-125.6	33.7	-5.87	29.1	16.2	0.68
17	57.3	735.9	-129.6	34.4	-6.05	28.2	15.8	0.64
18	60.7	685.7	-118.0	32.0	-5.51	24.7	15.4	0.60
19	64.0	699.6	-119.9	32.7	-5.60	23.7	15.0	0.57
20	67.4	646.8	-107.4	30.2	-5.02	20.6	16.1	0.53
21	70.8	684.0	-109.9	32.0	-5.13	19.7	17.6	0.49
22	74.1	678.2	-97.4	31.7	-4.55	16.9	18.1	0.45
23	77.5	696.1	-99.1	32.5	-4.63	14.1	16.5	0.41
Absolute	43.8			36.0			(T =	38.4 ms)
	43.8				-6.54		(T =	60.8 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	758.2	616.2	474.2	332.2	190.1					
RX	842.5	798.7	755.0	713.9	693.2	679.6	666.0	652.3	638.7	628.4
RU	758.2	616.2	474.2	332.2	190.1					

RAU = 508.5 (kips); RA2 = 739.5 (kips)

Current CAPWAP Ru = 646.0 (kips); Corresponding J(RP)= 0.16; J(RX) = 1.49

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
18.5	35.80	707.9	760.4	760.4	1.15	0.20	0.20	44.1	785.0	1461

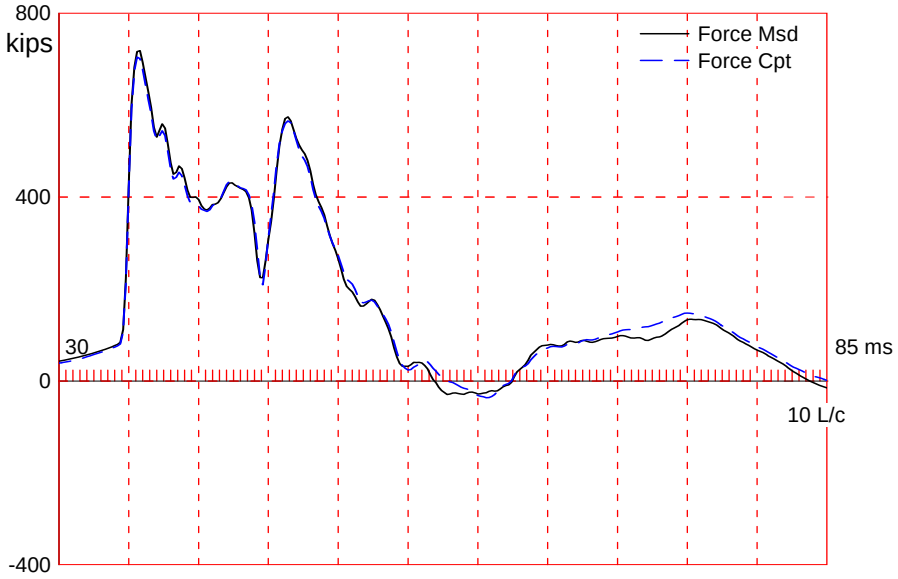
PILE PROFILE AND PILE MODEL

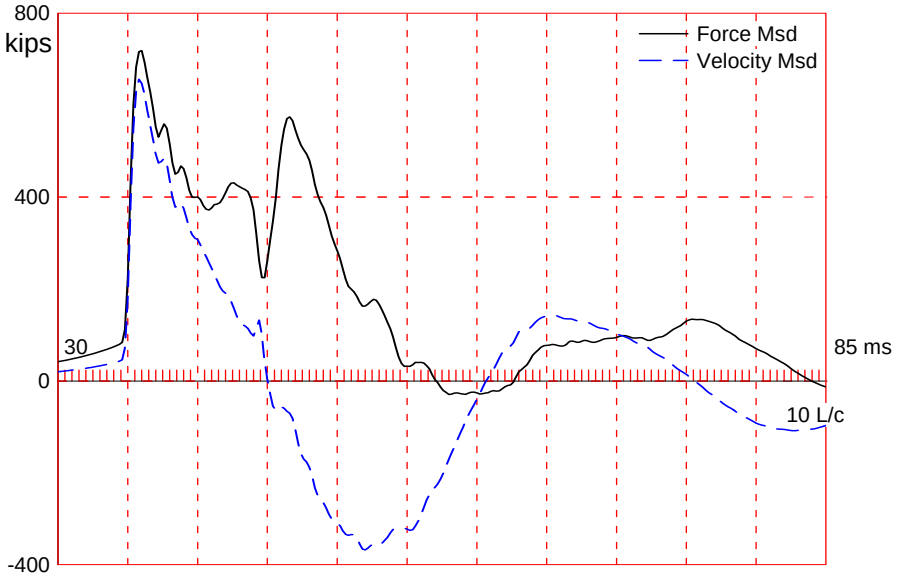
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.5	21.4	29992.2	492.000	4.70

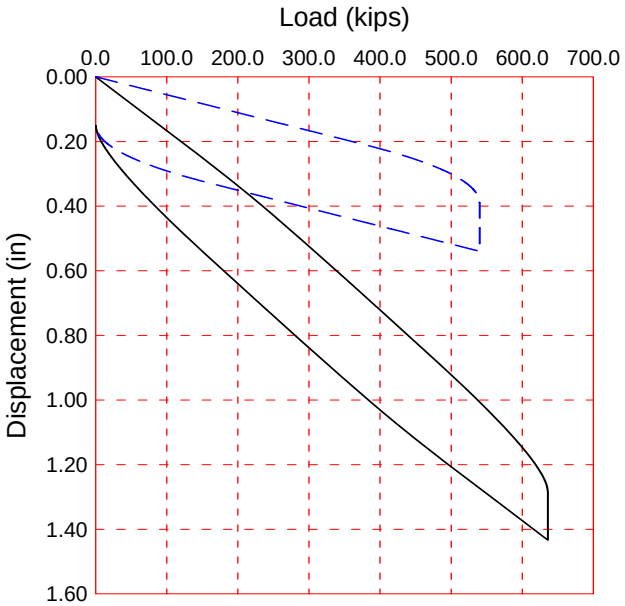
Toe Area 198.5 in^2

Top Segment Length 3.37 ft, Top Impedance 38 kips/ft/s

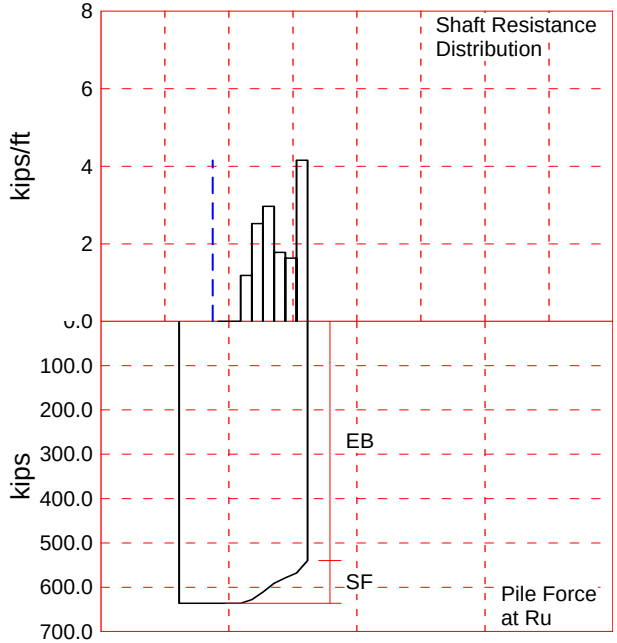
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16847.8 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 9.2 ms
Total volume: 11.517 ft^3; Volume ratio considering added impedance: 1.000







RU =	636.0 kips
SF =	96.0 kips
EB =	540.0 kips
Dy =	1.28 in
Dx =	1.43 in
SET/Bl =	0.15 in



Length b. Sensors	77.5 ft
Embedment	55.6 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.	16848 ft/s
Match Quality	2.71
Top Compr. Stress	33.0 ksi
Max Compr. Stress	35.4 ksi
Max Tension Stress	-8.06 ksi
Avg. Shaft Quake	0.14 in
Toe Quake	0.30 in
Avg. Shaft Smith Dpg.	0.29 s/ft
Toe Smith Damping	0.08 s/ft

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 636.0; along Shaft 96.0; at Toe 540.0 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
				636.0				
1	30.3	8.4	0.0	636.0	0.0	0.00	0.00	0.00
2	37.1	15.1	0.0	636.0	0.0	0.00	0.00	0.00
3	43.8	21.9	8.0	628.0	8.0	1.19	0.25	0.29
4	50.5	28.6	17.0	611.0	25.0	2.52	0.54	0.29
5	57.3	35.3	20.0	591.0	45.0	2.97	0.63	0.29
6	64.0	42.1	12.0	579.0	57.0	1.78	0.38	0.29
7	70.8	48.8	11.0	568.0	68.0	1.63	0.35	0.29
8	77.5	55.6	28.0	540.0	96.0	4.15	0.88	0.29
Avg. Shaft			12.0			1.73	0.37	0.29
Toe			540.0				391.74	0.08

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.14	0.30
Case Damping Factor		0.73	1.13
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	30
Reloading Level	(% of Ru)	100	0
Unloading Level	(% of Ru)	39	
Resistance Gap (included in Toe Quake)	(in)		0.02
Soil Plug Weight	(kips)	0.040	

CAPWAP match quality = 2.71 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.15 in; Blow Count = 80 b/ft
Computed: Final Set = 0.06 in; Blow Count = 202 b/ft

Transducer F3(F607) CAL: 93.6; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K2524) CAL: 360; RF: 1.04; A4(K3550) CAL: 360; RF: 1.04

max. Top Comp. Stress = 33.0 ksi (T= 36.0 ms, max= 1.073 x Top)
max. Comp. Stress = 35.4 ksi (Z= 43.8 ft, T= 38.6 ms)
max. Tens. Stress = -8.06 ksi (Z= 50.5 ft, T= 58.2 ms)
max. Energy (EMX) = 42.5 kip-ft; max. Measured Top Displ. (DMX)= 1.10 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.4	705.5	-48.4	33.0	-2.26	42.5	17.5	1.12
2	6.7	706.2	-61.1	33.0	-2.86	42.2	17.4	1.10
4	13.5	707.7	-85.2	33.1	-3.98	41.2	17.4	1.04
5	16.8	708.6	-98.3	33.1	-4.59	40.5	17.3	1.01
6	20.2	709.6	-112.4	33.1	-5.25	39.8	17.3	0.98
7	23.6	710.6	-127.5	33.2	-5.96	39.0	17.2	0.94
8	27.0	711.7	-138.6	33.2	-6.48	38.1	17.2	0.91
9	30.3	713.0	-146.6	33.3	-6.85	37.2	17.1	0.87
10	33.7	715.2	-150.3	33.4	-7.02	36.2	17.1	0.83
11	37.1	725.6	-151.0	33.9	-7.05	35.3	16.9	0.80
12	40.4	737.7	-154.0	34.5	-7.20	34.3	16.6	0.76
13	43.8	757.2	-166.4	35.4	-7.78	33.3	16.2	0.72
14	47.2	733.3	-168.1	34.3	-7.85	30.6	15.6	0.68
15	50.5	757.1	-172.5	35.4	-8.06	29.6	15.1	0.64
16	53.9	695.4	-154.5	32.5	-7.22	25.4	14.3	0.60
17	57.3	712.2	-156.3	33.3	-7.30	24.3	13.7	0.56
18	60.7	635.4	-135.7	29.7	-6.34	20.1	13.3	0.52
19	64.0	654.5	-138.3	30.6	-6.46	19.1	13.0	0.48
20	67.4	653.3	-127.1	30.5	-5.94	16.5	14.0	0.45
21	70.8	676.6	-130.2	31.6	-6.08	15.6	15.3	0.41
22	74.1	676.0	-120.5	31.6	-5.63	13.5	15.6	0.37
23	77.5	692.5	-121.7	32.4	-5.69	11.9	13.7	0.34
Absolute	43.8			35.4			(T =	38.6 ms)
	50.5				-8.06		(T =	58.2 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	807.4	693.6	579.9	466.2	352.5					
RX	861.5	809.7	769.3	728.8	694.7	674.8	659.1	644.1	631.0	623.9
RU	807.4	693.6	579.9	466.2	352.5					

RAU = 532.0 (kips); RA2 = 745.7 (kips)

Current CAPWAP Ru = 636.0 (kips); Corresponding J(RP)= 0.30; J(RX) = 1.52

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
17.3	35.80	661.7	714.2	725.2	1.10	0.15	0.15	42.8	821.2	1929

PILE PROFILE AND PILE MODEL

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

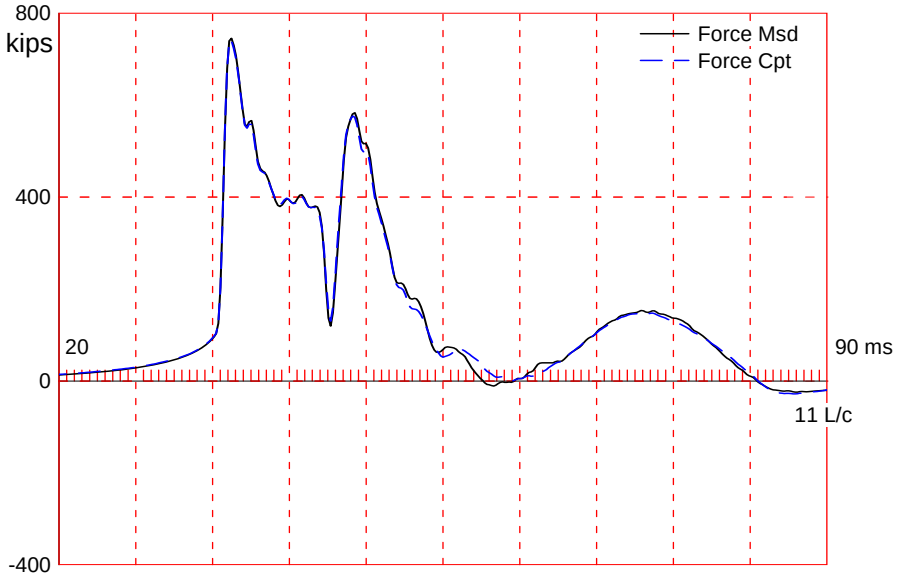
Toe Area 198.5 in^2

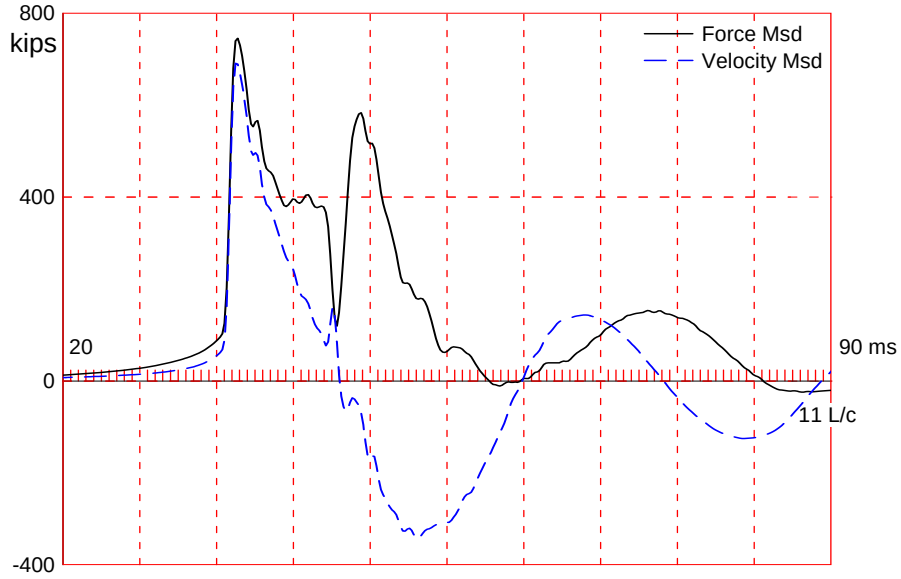
Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Slack in	Tension Eff.	Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16847.8	0.000
18	60.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16847.8	0.010
22	74.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16847.8	0.000
23	77.5	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16847.8	0.000

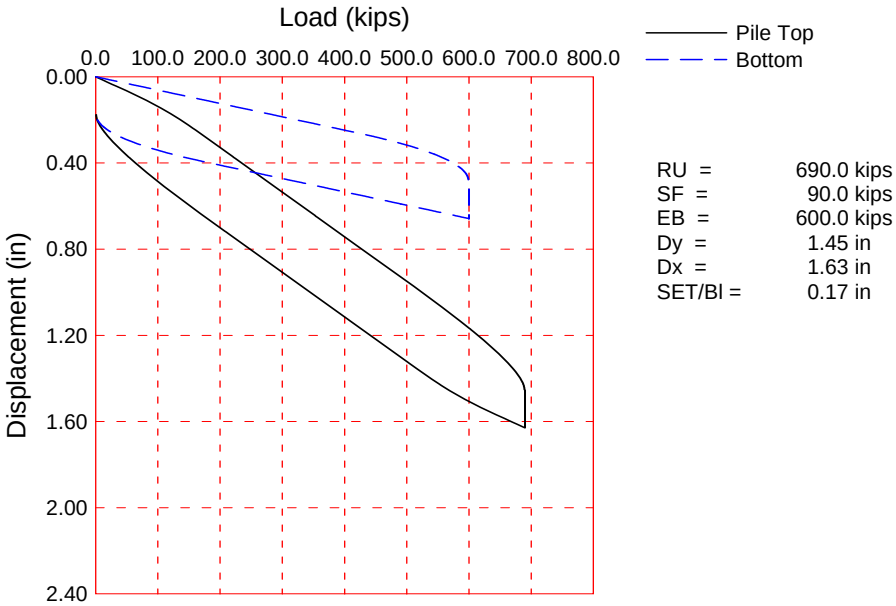
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16847.8 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 9.2 ms
Total volume: 11.517 ft^3; Volume ratio considering added impedance: 1.000

DYNAMIC RESISTANCE TABLE

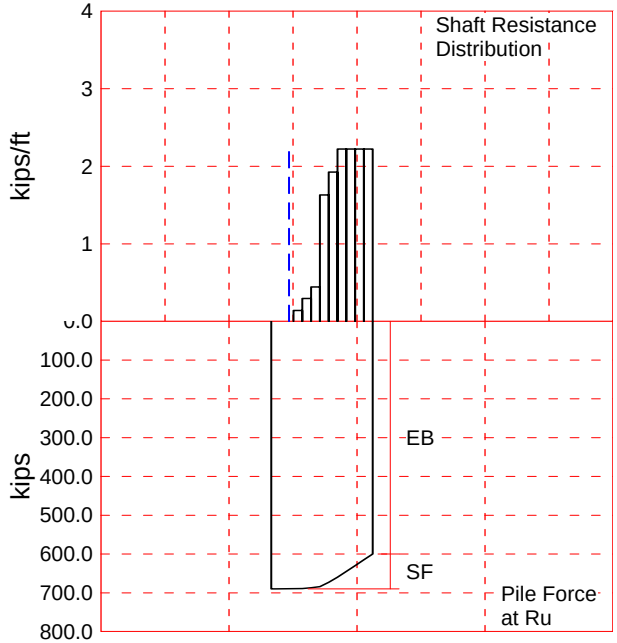
Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Damping Rd at Max. Rt kips	Max Rt (Ru+Rd) kips	Total Unit Rt W. Resp. to Depth kips/ft	Area ksf	Smith Damping Factor s/ft
1	30.3	8.4	0.0	0.0	0.0	0.00	0.00	0.00
2	37.1	15.1	0.0	0.0	0.0	0.00	0.00	0.00
3	43.8	21.9	8.0	37.4	45.4	6.74	1.43	0.29
4	50.5	28.6	17.0	73.3	90.3	13.39	2.85	0.29
5	57.3	35.3	20.0	77.8	97.8	14.51	3.09	0.29
6	64.0	42.1	12.0	44.5	56.5	8.39	1.79	0.29
7	70.8	48.8	11.0	48.3	59.3	8.80	1.87	0.29
8	77.5	55.6	28.0	101.5	129.5	19.22	4.09	0.29
Avg. Shaft			12.0	47.9	59.9	8.62	1.83	0.29
Toe			540.0	101.8	641.8		465.61	0.08
Total					1120.7			







RU =	690.0 kips
SF =	90.0 kips
EB =	600.0 kips
Dy =	1.45 in
Dx =	1.63 in
SET/Bl =	0.17 in



Length b. Sensors	77.6 ft
Embedment	61.1 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	1.91
Top Compr. Stress	34.7 ksi
Max Compr. Stress	36.1 ksi
Max Tension Stress	-5.78 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.37 in
Avg. Shaft Smith Dpg.	0.25 s/ft
Toe Smith Damping	0.06 s/ft

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 690.0; along Shaft 90.0; at Toe 600.0 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
				690.0			
1	23.6	7.1	1.0	689.0	1.0	0.14	0.03
2	30.4	13.9	2.0	687.0	3.0	0.30	0.06
3	37.1	20.6	3.0	684.0	6.0	0.44	0.09
4	43.9	27.4	11.0	673.0	17.0	1.63	0.35
5	50.6	34.1	13.0	660.0	30.0	1.93	0.41
6	57.4	40.9	15.0	645.0	45.0	2.22	0.47
7	64.1	47.6	15.0	630.0	60.0	2.22	0.47
8	70.9	54.3	15.0	615.0	75.0	2.22	0.47
9	77.6	61.1	15.0	600.0	90.0	2.22	0.47
Avg. Shaft			10.0			1.47	0.31
Toe			600.0				435.26

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.25	0.06
Quake	(in)	0.04	0.37
Case Damping Factor		0.59	0.94
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	51
Reloading Level	(% of Ru)	100	0
Unloading Level	(% of Ru)	99	
Resistance Gap (included in Toe Quake)	(in)		0.01
Soil Plug Weight	(kips)		0.039

CAPWAP match quality = 1.91 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.17 in; Blow Count = 69 b/ft
Computed: Final Set = 0.19 in; Blow Count = 64 b/ft
Transducer F3(F607) CAL: 93.6; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K2524) CAL: 360; RF: 1.02; A4(K3550) CAL: 360; RF: 1.02

max. Top Comp. Stress = 34.7 ksi (T= 36.1 ms, max= 1.041 x Top)
max. Comp. Stress = 36.1 ksi (Z= 43.9 ft, T= 38.5 ms)
max. Tens. Stress = -5.78 ksi (Z= 43.9 ft, T= 61.6 ms)
max. Energy (EMX) = 44.7 kip-ft; max. Measured Top Displ. (DMX)= 1.15 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	741.9	-33.1	34.7	-1.55	44.7	18.1	1.13
2	6.7	743.2	-38.3	34.7	-1.79	44.5	18.1	1.11
4	13.5	745.9	-48.2	34.8	-2.25	43.6	18.0	1.06
5	16.9	748.2	-59.7	35.0	-2.79	43.1	18.0	1.03
6	20.2	750.9	-70.8	35.1	-3.31	42.5	17.9	1.00
7	23.6	754.1	-80.4	35.2	-3.76	41.9	17.8	0.97
8	27.0	752.7	-88.8	35.2	-4.15	40.9	17.7	0.94
9	30.4	757.2	-97.3	35.4	-4.54	40.1	17.6	0.91
10	33.7	752.2	-102.9	35.1	-4.81	38.7	17.4	0.87
11	37.1	762.0	-111.5	35.6	-5.21	37.9	17.2	0.83
12	40.5	759.7	-116.5	35.5	-5.44	36.3	16.8	0.80
13	43.9	772.2	-123.8	36.1	-5.78	35.3	16.5	0.76
14	47.2	731.2	-114.4	34.2	-5.34	32.0	16.1	0.72
15	50.6	744.3	-117.7	34.8	-5.50	31.0	15.7	0.68
16	54.0	696.8	-104.9	32.5	-4.90	27.4	15.3	0.64
17	57.4	709.6	-107.1	33.1	-5.01	26.4	15.0	0.61
18	60.7	654.1	-89.8	30.6	-4.20	22.8	14.6	0.57
19	64.1	666.5	-89.8	31.1	-4.19	21.8	14.2	0.53
20	67.5	627.9	-72.2	29.3	-3.37	18.5	16.0	0.49
21	70.9	660.8	-76.8	30.9	-3.59	17.4	17.2	0.45
22	74.2	660.3	-61.4	30.8	-2.87	14.4	17.9	0.41
23	77.6	678.4	-64.0	31.7	-2.99	13.0	16.6	0.37
Absolute	43.9			36.1			(T =	38.5 ms)
	43.9				-5.78		(T =	61.6 ms)

CASE METHOD

J =	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
RP	736.7	593.0	449.3	305.5	161.8					
RX	849.4	806.0	762.7	722.2	703.9	689.1	674.3	659.5	644.8	630.0
RU	736.7	593.0	449.3	305.5	161.8					

RAU = 523.2 (kips); RA2 = 762.2 (kips)

Current CAPWAP Ru = 690.0 (kips); Corresponding J(RP)= 0.07; J(RX) = 0.99

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
18.4	35.73	702.5	752.8	752.8	1.15	0.18	0.17	44.9	815.5	1667

PILE PROFILE AND PILE MODEL

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

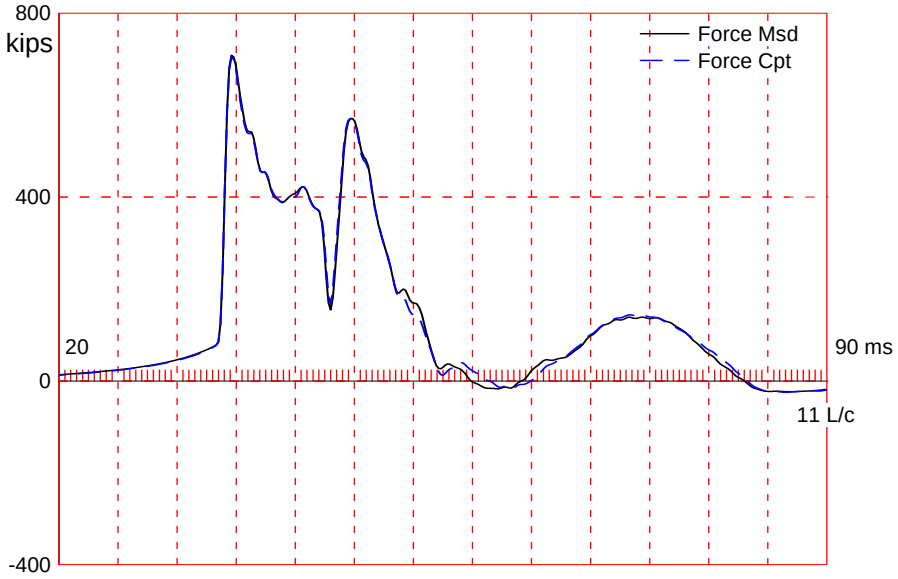
Toe Area 198.5 in^2

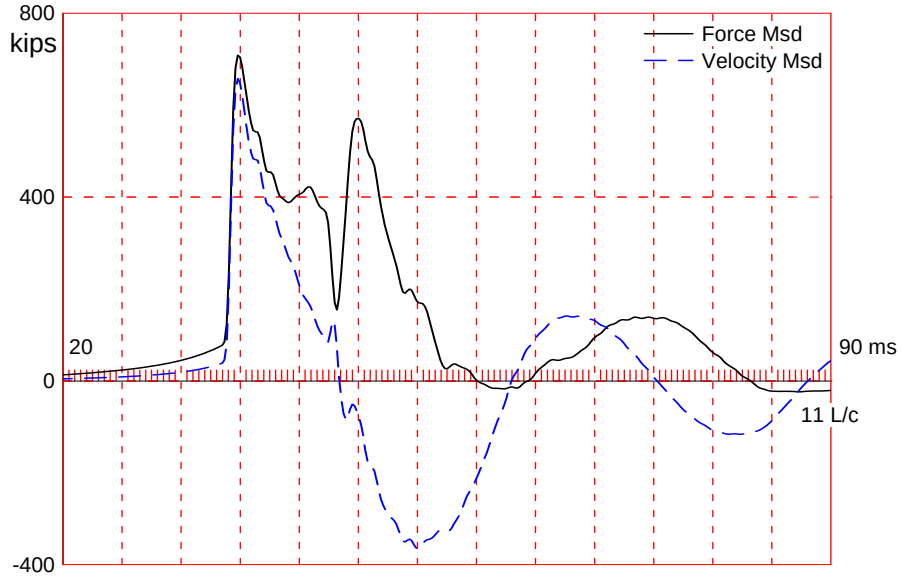
Top Segment Length 3.37 ft, Top Impedance 38 kips/ft/s

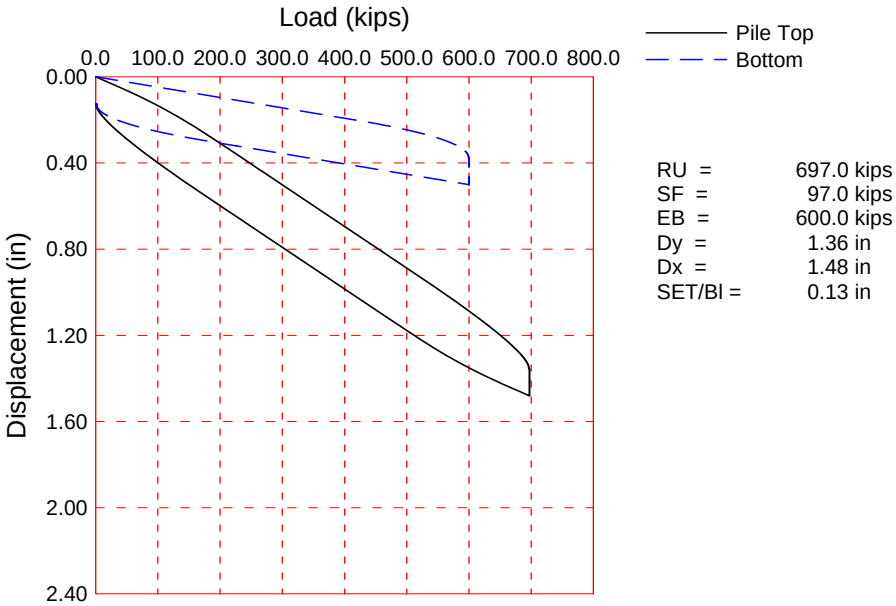
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.201 ms, 2L/c 9.2 ms
Total volume: 11.532 ft^3; Volume ratio considering added impedance: 1.000

DYNAMIC RESISTANCE TABLE

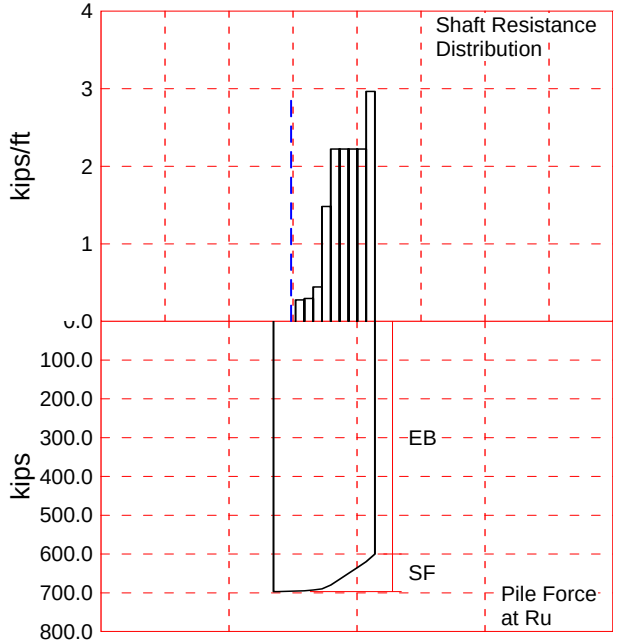
Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Damping Rd at Max. Rt kips	Max Rt (Ru+Rd) kips	Total Unit Rt W. Resp. to Depth kips/ft	Area ksf
1	23.6	7.1	1.0	4.4	5.4	0.77	0.16
2	30.4	13.9	2.0	8.8	10.8	1.60	0.34
3	37.1	20.6	3.0	12.8	15.8	2.35	0.50
4	43.9	27.4	11.0	44.9	55.9	8.29	1.76
5	50.6	34.1	13.0	50.6	63.6	9.42	2.00
6	57.4	40.9	15.0	55.4	70.4	10.43	2.22
7	64.1	47.6	15.0	52.7	67.7	10.03	2.13
8	70.9	54.3	15.0	63.7	78.7	11.67	2.48
9	77.6	61.1	15.0	60.4	75.4	11.18	2.38
Avg. Shaft			10.0	39.3	49.3	7.26	1.55
Toe			600.0	51.7	651.7		472.77
Total					1095.4		







RU =	697.0 kips
SF =	97.0 kips
EB =	600.0 kips
Dy =	1.36 in
Dx =	1.48 in
SET/Bl =	0.13 in



Length b. Sensors	77.6 ft
Embedment	61.2 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	1.85
Top Compr. Stress	33.0 ksi
Max Compr. Stress	34.1 ksi
Max Tension Stress	-7.05 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.29 in
Avg. Shaft Smith Dpg.	0.27 s/ft
Toe Smith Damping	0.07 s/ft

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 697.0; along Shaft 97.0; at Toe 600.0 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
				697.0			
1	23.6	7.2	2.0	695.0	2.0	0.28	0.06
2	30.4	13.9	2.0	693.0	4.0	0.30	0.06
3	37.1	20.7	3.0	690.0	7.0	0.44	0.09
4	43.9	27.4	10.0	680.0	17.0	1.48	0.32
5	50.6	34.2	15.0	665.0	32.0	2.22	0.47
6	57.4	40.9	15.0	650.0	47.0	2.22	0.47
7	64.1	47.7	15.0	635.0	62.0	2.22	0.47
8	70.9	54.4	15.0	620.0	77.0	2.22	0.47
9	77.6	61.2	20.0	600.0	97.0	2.96	0.63
Avg. Shaft			10.8			1.59	0.34
Toe			600.0				435.26

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.27	0.07
Quake	(in)	0.04	0.29
Case Damping Factor		0.69	1.10
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	48
Reloading Level	(% of Ru)	100	0
Unloading Level	(% of Ru)	93	
Resistance Gap (included in Toe Quake)	(in)		0.01
Soil Plug Weight	(kips)	0.030	

CAPWAP match quality = 1.85 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.13 in; Blow Count = 96 b/ft
Computed: Final Set = 0.04 in; Blow Count = 325 b/ft
Transducer F3(F607) CAL: 93.6; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K2524) CAL: 360; RF: 1.05; A4(K3550) CAL: 360; RF: 1.05

max. Top Comp. Stress = 33.0 ksi (T= 36.1 ms, max= 1.035 x Top)
max. Comp. Stress = 34.1 ksi (Z= 43.9 ft, T= 38.7 ms)
max. Tens. Stress = -7.05 ksi (Z= 43.9 ft, T= 60.6 ms)
max. Energy (EMX) = 41.8 kip-ft; max. Measured Top Displ. (DMX)= 1.08 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.4	706.1	-30.2	33.0	-1.41	41.8	17.3	1.07
2	6.7	707.0	-43.7	33.0	-2.04	41.6	17.2	1.05
4	13.5	708.9	-68.2	33.1	-3.19	40.7	17.2	1.00
5	16.9	710.9	-81.7	33.2	-3.82	40.2	17.1	0.97
6	20.2	714.4	-93.8	33.4	-4.38	39.5	17.0	0.94
7	23.6	717.4	-104.9	33.5	-4.90	38.8	16.9	0.91
8	27.0	710.1	-112.9	33.2	-5.27	37.5	16.8	0.88
9	30.4	713.8	-122.8	33.3	-5.74	36.6	16.7	0.84
10	33.7	707.8	-129.9	33.1	-6.07	35.2	16.5	0.80
11	37.1	718.7	-138.4	33.6	-6.47	34.3	16.3	0.76
12	40.5	715.0	-142.4	33.4	-6.65	32.6	16.0	0.73
13	43.9	730.7	-150.9	34.1	-7.05	31.6	15.6	0.69
14	47.2	697.5	-146.0	32.6	-6.82	28.6	15.1	0.65
15	50.6	720.0	-148.9	33.6	-6.96	27.6	14.6	0.61
16	54.0	665.8	-133.0	31.1	-6.21	23.9	14.0	0.57
17	57.4	671.5	-141.3	31.4	-6.60	22.8	13.7	0.53
18	60.7	632.1	-127.4	29.5	-5.95	19.4	13.5	0.49
19	64.1	651.7	-131.9	30.4	-6.16	18.3	13.1	0.45
20	67.5	645.7	-117.6	30.2	-5.49	15.3	14.6	0.41
21	70.9	667.2	-119.9	31.2	-5.60	14.2	15.8	0.37
22	74.2	661.6	-100.8	30.9	-4.71	11.6	16.1	0.33
23	77.6	677.1	-101.2	31.6	-4.73	10.1	14.1	0.29
Absolute	43.9			34.1			(T =	38.7 ms)
	43.9				-7.05		(T =	60.6 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	771.3	710.5	649.8	589.0	528.2	467.4	406.7	345.9	285.1	224.3
RX	843.7	818.2	799.7	781.5	763.2	745.0	727.0	710.1	695.0	686.4
RU	771.3	710.5	649.8	589.0	528.2	467.4	406.7	345.9	285.1	224.3

RAU = 539.5 (kips); RA2 = 734.9 (kips)

Current CAPWAP Ru = 697.0 (kips); Corresponding J(RP)= 0.12; J(RX) = 0.79

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
17.4	35.93	664.7	714.5	714.5	1.08	0.11	0.13	42.2	841.8	2143

PILE PROFILE AND PILE MODEL

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

Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
17	57.4	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
18	60.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.020
19	64.1	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
23	77.6	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

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

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	23.6	7.2	2.0	9.1	11.1	1.54	0.33
2	30.4	13.9	2.0	9.0	11.0	1.63	0.35
3	37.1	20.7	3.0	13.2	16.2	2.40	0.51
4	43.9	27.4	10.0	41.8	51.8	7.68	1.63
5	50.6	34.2	15.0	58.4	73.4	10.89	2.32
6	57.4	40.9	15.0	54.4	69.4	10.29	2.19
7	64.1	47.7	15.0	52.4	67.4	9.99	2.13
8	70.9	54.4	15.0	63.2	78.2	11.59	2.47
9	77.6	61.2	20.0	76.2	96.2	14.26	3.03
Avg. Shaft			10.8	42.0	52.8	7.76	1.65
Toe			600.0	44.9	644.9		467.81
Total					1119.7		