GRL Engineers, Inc.

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TRANSMITTAL

To: Mr. Kevin Weber	From: Travis Coleman
Company: Lunda Construction Co.	No. of Sheets: 64
E-mail: kweber@lundaconstruction.com	Date: April 23, 2015

RE: Dynamic Testing Results – USH 10 over Little Lake Butte des Morts
Structure B-70-403 - Pier 12
Winnebago County, Wisconsin

On April 21, 2015, Pier 12 #1, Pier 12 #16, Pier 12 #23, and Pier 12 #56 at the above structure were dynamically tested during initial driving. The piles were tested during restrike on April 22. Project plans indicated the exterior row piles have a required driving resistance, or ultimate capacity, of 400 kips (200 tons) and the interior row piles have a required driving resistance of 350 kips (175 tons). The reference elevation for the piles was the top of the ring at EL 740.3 to EL 739.4. We understand the pier was excavated to an elevation of EL 717.2. The piles have a required minimum tip elevation of EL 658.8. 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 12 #1 was driven to a depth of 88.4 feet, which corresponds to a pile tip elevation of EL 651.8. The blow count over the final increment of driving was 10 blows for 2 ½ inches of penetration at an average hammer stroke of 8.6 feet. The blow count at the beginning of restrike was 10 blows for 1 ½ inches of penetration at an average hammer stroke of 8.8 feet.

Pier 12 #16 was driven to a depth of 88.0 feet, which corresponds to a pile tip elevation of EL 652.3. The blow count over the final increment of driving was 10 blows for 4 inches of penetration at an average hammer stroke of 7.7 feet. The blow count at the beginning of restrike was 10 blows for 3 inches of penetration at an average hammer stroke of 8.2 feet.

Pier 12 #23 was driven to a depth of 88.0 feet, which corresponds to a pile tip elevation of EL 652.3. The blow count over the final increment of driving was 10 blows for 2 ½ inches of penetration at an average hammer stroke of 8.9 feet. The blow count at the beginning of restrike was 10 blows for 1 ½ inches of penetration at an average hammer stroke of 8.5 feet.

Pier 12 #56 was driven to a depth of 81.6 feet, which corresponds to a pile tip elevation of EL 657.8. The blow count over the final increment of driving was 10 blows for 3 inches of penetration at an average hammer stroke of 9.0 feet. The blow count at the beginning of restrike was 10 blows for 2 ½ inches of penetration at an average hammer stroke of 8.3 feet.

We recommend the production piles at Pier 12 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 **two consecutive inches** of driving at the recommended average hammer stroke. Additionally, all production piles should achieve the minimum pile tip elevation of EL 658.8 for uplift, as indicated on the plans.

Field Observed Hammer Stroke (feet)	Exterior Piles (400 kips) Recommended Minimum Blow Count (blows per inch)	Interior Piles (350 kips) Recommended Minimum Blow Count (blows per inch)
6.5	4	3
7.0	4	3
7.5	4	3
8.0	3	3
8.5	3	3
9.0	3	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.

Please call if you have any questions on these recommendations.

GRL Engineers, Inc.

Travis Coleman, P.E.

Rory Flynn, E.I.

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

Attachments:

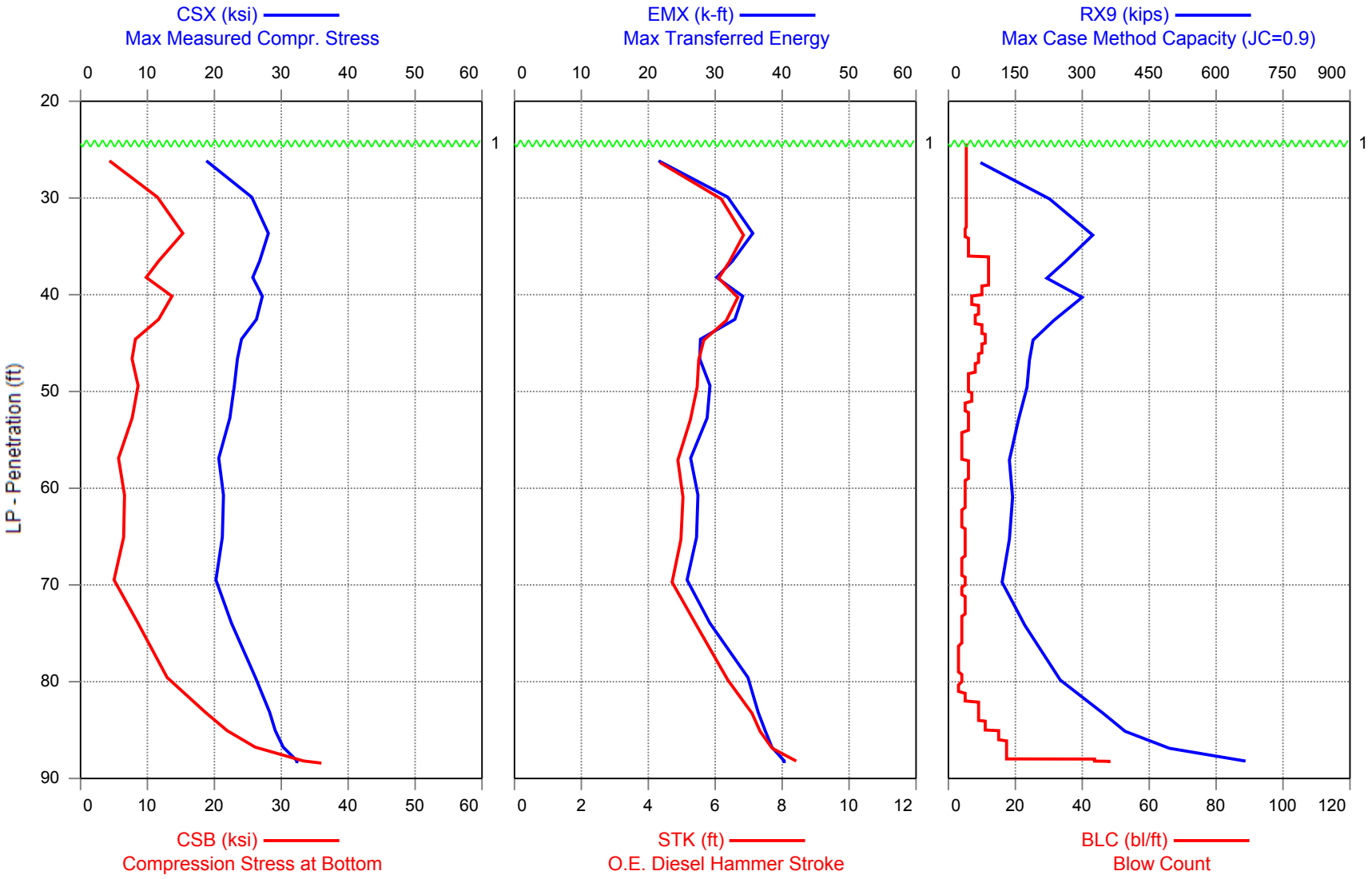
Dynamic Test Results - (pages 3 – 36)
CAPWAP Analysis Results - (pages 37 – 64)

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

Printed: 21-April-2015

Test started: 21-April-2015

USH 10 over LLBDM - PIER 12 #1
APE D30-42, HP 14 x 73



1 - Reported Reference EL 740.25

USH 10 over LLBDM - PIER 12 #1 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.66 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
48	33.00	5	AV47	23.1	9.1	5.5	28	51.1	169
			MAX	28.8	17.3	7.0	37	68.4	334
			MIN	10.9	2.1	2.8	10	44.4	0
53	34.00	5	AV5	28.1	15.8	6.9	36	44.8	330
			MAX	28.8	16.6	7.1	38	45.3	332
			MIN	27.6	14.9	6.8	35	44.1	326
59	35.00	6	AV6	27.9	14.6	6.8	36	45.2	322
			MAX	28.9	15.3	7.1	38	46.0	333
			MIN	26.7	13.7	6.5	33	44.3	311
65	36.00	6	AV6	27.7	14.0	6.7	35	45.6	298
			MAX	29.1	14.8	7.1	38	46.4	319
			MIN	26.8	13.0	6.4	32	44.2	281
77	37.00	12	AV12	26.7	11.3	6.4	32	46.4	259
			MAX	27.6	12.7	6.7	35	47.0	293
			MIN	26.0	10.0	6.3	31	45.4	237
89	38.00	12	AV12	26.4	11.0	6.3	32	46.8	253
			MAX	27.2	11.4	6.5	33	47.5	265
			MIN	25.6	10.2	6.1	30	46.1	238
101	39.00	12	AV12	25.3	9.1	6.0	29	47.9	201
			MAX	26.6	10.9	6.4	31	48.5	231
			MIN	24.8	8.3	5.9	28	46.6	178
111	40.00	10	AV10	26.6	12.5	6.4	33	46.4	272
			MAX	28.1	14.9	6.9	35	48.3	326
			MIN	25.0	9.3	5.9	31	44.8	211
118	41.00	7	AV7	27.7	15.1	6.9	35	44.9	324
			MAX	28.2	15.6	7.1	37	45.8	336
			MIN	26.8	14.3	6.6	34	44.3	306
127	42.00	9	AV9	26.9	13.7	6.6	34	45.9	287
			MAX	28.1	14.5	6.9	37	46.7	313
			MIN	25.8	12.8	6.3	32	44.7	258
135	43.00	8	AV8	26.5	11.8	6.4	34	46.5	238
			MAX	27.0	13.0	6.5	36	47.7	254
			MIN	25.6	10.7	6.1	32	46.0	224
145	44.00	10	AV10	25.4	9.3	6.0	31	47.8	201
			MAX	26.7	10.5	6.4	33	50.0	227
			MIN	23.3	8.4	5.5	27	46.4	180

USH 10 over LLBDM - PIER 12 #1 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
156	45.00	11	AV11	23.9	8.0	5.6	27	49.4	189
			MAX	24.4	8.9	5.8	28	49.8	200
			MIN	23.4	7.2	5.5	26	48.9	178
166	46.00	10	AV10	23.8	8.2	5.6	27	49.5	190
			MAX	24.3	8.6	5.7	28	49.7	203
			MIN	23.4	7.7	5.6	26	49.0	179
175	47.00	9	AV9	23.6	7.7	5.5	28	49.8	186
			MAX	24.6	8.2	5.8	30	51.0	194
			MIN	22.5	7.2	5.3	25	48.8	178
183	48.00	8	AV8	22.9	7.8	5.4	27	50.4	177
			MAX	23.7	8.4	5.6	29	51.8	190
			MIN	21.8	7.3	5.1	25	49.4	168
189	49.00	6	AV6	22.8	8.8	5.4	29	50.4	174
			MAX	23.3	9.0	5.5	30	50.9	196
			MIN	22.2	8.3	5.3	28	49.8	161
195	50.00	6	AV6	23.1	8.5	5.5	30	50.2	175
			MAX	24.2	8.8	5.7	32	51.0	185
			MIN	22.2	8.2	5.3	27	49.1	169
202	51.00	7	AV7	23.2	8.6	5.5	29	50.0	178
			MAX	24.1	9.4	5.8	30	50.8	186
			MIN	22.4	8.0	5.3	27	48.9	170
207	52.00	5	AV5	23.0	8.7	5.4	30	50.2	172
			MAX	23.7	9.2	5.6	32	51.2	196
			MIN	22.0	8.3	5.2	28	49.7	157
213	53.00	6	AV6	22.6	8.3	5.4	29	50.6	162
			MAX	23.2	8.8	5.5	30	51.0	169
			MIN	22.2	7.3	5.3	28	49.8	152
219	54.00	6	AV6	21.7	6.7	5.1	28	51.6	153
			MAX	22.4	7.4	5.4	29	52.9	162
			MIN	20.7	6.2	4.9	26	50.6	147
223	55.00	4	AV4	20.8	6.2	4.9	28	52.7	128
			MAX	21.8	6.6	5.1	29	53.6	136
			MIN	20.0	5.6	4.7	26	51.7	116
227	56.00	4	AV4	20.6	5.9	4.9	28	53.0	126
			MAX	21.3	6.0	5.0	29	53.3	129
			MIN	20.3	5.8	4.8	27	52.2	121
231	57.00	4	AV4	20.2	5.4	4.8	28	53.5	122
			MAX	20.6	5.5	4.9	29	54.4	128
			MIN	19.3	5.3	4.6	25	53.0	119

USH 10 over LLBDM - PIER 12 #1 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth	BLC	TYPE	CSX	CSB	STK	EMX	BPM	RX9
	ft	bl/ft		ksi	ksi	ft	k-ft	bpm	kips
237	58.00	6	AV6	20.6	5.2	4.8	25	53.1	143
			MAX	21.6	6.2	5.1	26	53.8	152
			MIN	19.9	4.7	4.7	23	51.8	136
243	59.00	6	AV6	21.4	6.4	5.1	26	52.0	153
			MAX	21.9	6.9	5.1	28	52.6	158
			MIN	20.9	5.9	4.9	25	51.7	148
248	60.00	5	AV5	21.2	6.6	5.0	27	52.4	142
			MAX	21.8	6.9	5.1	28	53.4	146
			MIN	20.3	6.3	4.8	25	51.8	138
253	61.00	5	AV5	21.2	6.7	5.0	27	52.5	140
			MAX	21.6	7.0	5.1	28	53.1	147
			MIN	20.8	6.5	4.8	26	51.9	136
258	62.00	5	AV5	21.8	6.3	5.1	28	51.6	145
			MAX	22.4	6.6	5.3	30	52.2	150
			MIN	21.3	5.9	5.0	27	50.9	138
262	63.00	4	AV4	21.6	6.7	5.1	29	52.0	146
			MAX	22.0	7.2	5.1	30	52.1	155
			MIN	21.4	6.2	5.0	28	51.7	141
266	64.00	4	AV4	21.7	7.1	5.1	29	51.9	139
			MAX	22.2	7.4	5.2	29	52.2	144
			MIN	21.4	6.8	5.0	28	51.5	134
271	65.00	5	AV5	21.1	6.6	5.0	27	52.5	138
			MAX	21.5	7.4	5.1	28	53.7	145
			MIN	20.1	5.7	4.7	25	51.9	132
276	66.00	5	AV5	21.3	6.4	5.0	27	52.1	140
			MAX	21.7	7.0	5.1	28	53.0	147
			MIN	20.5	5.9	4.9	26	51.6	125
281	67.00	5	AV5	20.6	5.7	4.9	26	53.0	131
			MAX	21.3	6.3	5.0	27	53.6	144
			MIN	20.1	5.4	4.7	24	52.2	121
285	68.00	4	AV4	21.1	6.0	5.0	29	52.5	127
			MAX	21.4	6.4	5.1	30	53.1	136
			MIN	20.6	5.7	4.8	27	52.0	120
289	69.00	4	AV4	20.6	5.5	4.8	28	53.2	116
			MAX	21.1	5.7	4.9	28	53.6	121
			MIN	20.2	5.1	4.7	27	52.7	109
294	70.00	5	AV5	20.1	4.6	4.7	24	53.9	124
			MAX	21.3	4.9	4.9	26	55.7	139
			MIN	18.3	4.1	4.4	23	52.7	113
298	71.00	4	AV4	20.1	4.6	4.7	26	54.0	116

USH 10 over LLBDM - PIER 12 #1 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth	BLC	TYPE	CSX	CSB	STK	EMX	BPM	RX9
	ft	bl/ft		ksi	ksi	ft	k-ft	bpm	kips
			MAX	20.6	5.3	4.8	27	54.5	122
			MIN	19.7	4.3	4.6	25	53.4	111
303	72.00	5	AV5	19.7	5.8	4.6	24	54.4	127
			MAX	21.6	8.8	5.1	28	55.9	147
			MIN	18.6	3.9	4.3	21	51.8	112
308	73.00	5	AV5	22.1	7.9	5.2	29	51.1	141
			MAX	22.7	8.8	5.4	30	52.3	149
			MIN	21.0	6.2	5.0	27	50.6	129
312	74.00	4	AV4	21.4	6.2	5.0	28	52.2	120
			MAX	22.0	6.5	5.1	29	53.1	135
			MIN	20.8	5.7	4.8	28	51.6	107
316	75.00	4	AV4	22.6	8.2	5.4	29	50.7	160
			MAX	23.6	9.6	5.6	31	52.7	189
			MIN	21.0	6.4	4.9	27	49.4	131
320	76.00	4	AV4	24.4	11.3	5.9	31	48.5	223
			MAX	25.4	13.5	6.2	33	49.3	259
			MIN	23.8	9.5	5.7	29	47.3	187
323	77.00	3	AV3	26.2	13.7	6.4	35	46.5	276
			MAX	26.9	14.3	6.6	37	47.4	292
			MIN	25.2	13.0	6.1	33	45.8	266
326	78.00	3	AV3	26.3	13.8	6.4	35	46.5	264
			MAX	26.8	14.1	6.5	37	46.9	272
			MIN	25.9	13.5	6.3	34	46.0	257
329	79.00	3	AV3	26.3	12.7	6.4	36	46.4	244
			MAX	26.9	13.4	6.5	39	47.0	264
			MIN	25.5	11.7	6.3	34	46.0	218
333	80.00	4	AV4	25.1	10.0	6.0	33	48.0	192
			MAX	26.5	10.7	6.4	35	49.2	212
			MIN	23.9	9.4	5.7	31	46.6	179
336	81.00	3	AV3	24.9	10.3	5.9	33	48.2	200
			MAX	26.2	11.6	6.3	36	49.1	231
			MIN	24.2	9.2	5.7	32	46.7	175
341	82.00	5	AV5	27.3	16.1	6.7	35	45.4	304
			MAX	28.5	17.9	7.1	37	47.0	339
			MIN	25.8	13.2	6.3	33	44.2	262
350	83.00	9	AV9	27.8	17.3	6.9	36	44.8	325
			MAX	28.4	18.2	7.1	37	45.4	342
			MIN	27.1	16.4	6.7	34	44.2	310
359	84.00	9	AV9	28.5	19.4	7.1	37	44.2	353
			MAX	29.6	21.5	7.5	39	45.7	402

USH 10 over LLBDM - PIER 12 #1 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			MIN	26.9	16.5	6.6	34	43.1	312
370	85.00	11	AV11	29.3	22.0	7.4	38	43.3	399
			MAX	29.7	23.3	7.6	39	43.6	424
			MIN	28.9	21.1	7.3	37	42.9	378
385	86.00	15	AV15	29.1	21.9	7.3	37	43.6	394
			MAX	29.7	22.8	7.6	39	44.8	417
			MIN	27.7	20.9	6.9	35	42.9	374
402	87.98	17	AV17	30.6	27.2	7.7	39	42.4	512
			MAX	34.0	31.5	8.1	41	43.5	599
			MIN	29.0	24.5	7.4	37	41.6	435
412	88.21	44	AV10	31.7	32.1	8.2	39	41.3	627
			MAX	32.7	33.4	8.6	41	41.9	666
			MIN	30.6	30.6	7.9	37	40.4	582
422	88.42	48	AV10	33.2	35.1	8.6	41	40.3	705
			MAX	34.7	37.2	9.1	45	40.9	729
			MIN	32.0	33.8	8.4	33	39.3	680
			Average	24.9	12.2	6.0	31	48.3	247
			Maximum	34.7	37.2	9.1	45	68.4	729
			Minimum	10.9	2.1	2.8	10	39.3	0

Total number of blows analyzed: 421

BL# Sensors

1-422 F3: [D815] 93.0 (0.97); F4: [F607] 93.6 (0.97); A3: [K3550] 360.0 (1.04); A4: [K2524] 360.0 (1.04)

BL# Comments

2 Reported Reference EL 740.25

Time Summary

Drive 9 minutes 3 seconds 9:14 AM - 9:23 AM BN 1 - 422

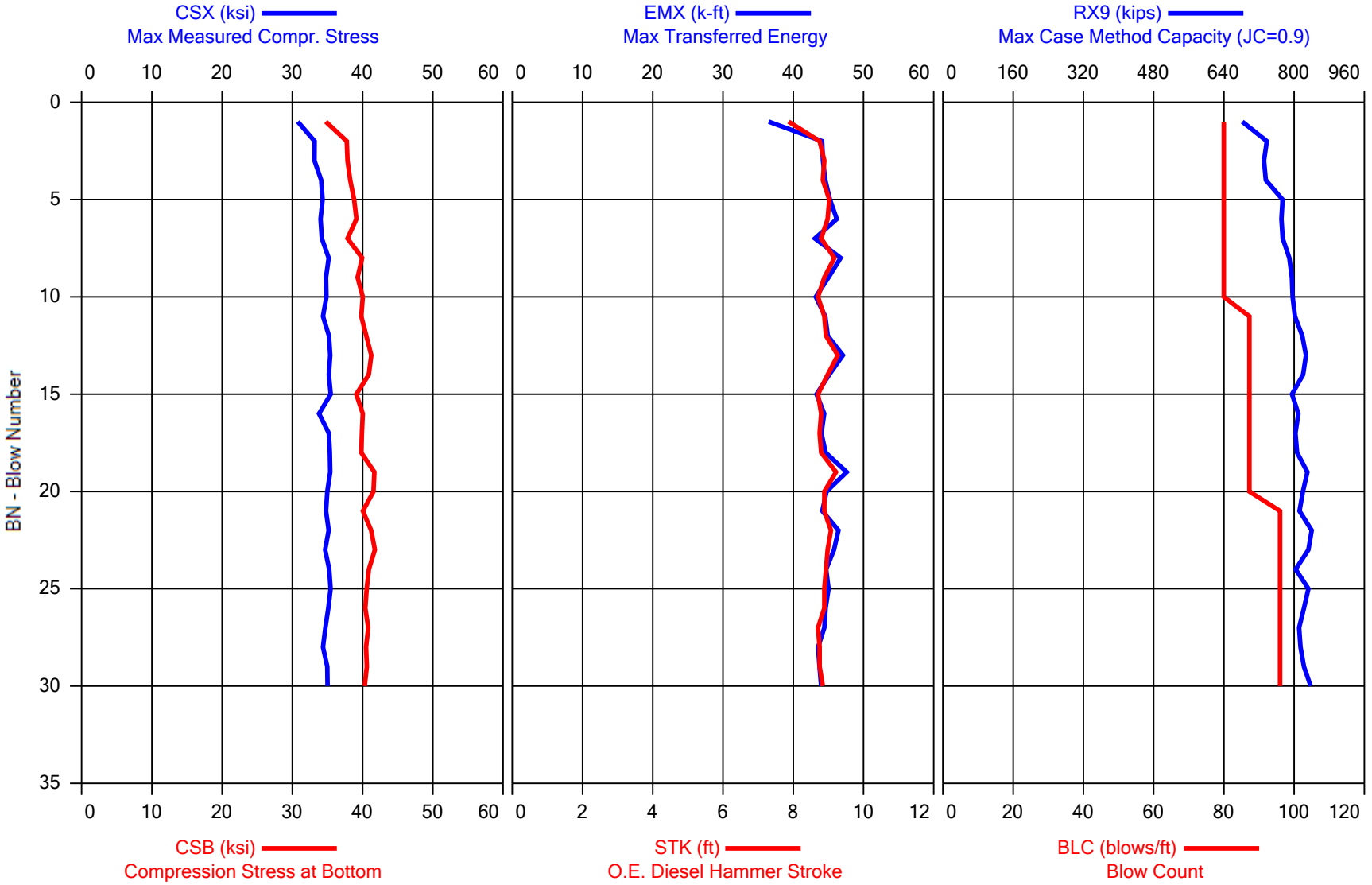
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 22-April-2015

Test started: 22-April-2015

USH 10 over Little Lake Butte des Morts - Pier 12 #1 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - Pier 12 #1 Restrike APE D30-42, HP 14 x 73
OP: TC Date: 22-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.66 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
10	88.54	80	AV10	33.8	38.4	44	8.8	39.9	759
			STD	1.2	1.4	3	0.3	0.8	35
			MAX	35.2	40.0	47	9.2	42.1	797
			MIN	30.8	34.8	37	7.9	39.1	682
20	88.66	87	AV10	35.0	40.5	45	8.9	39.6	813
			STD	0.5	0.8	1	0.2	0.4	11
			MAX	35.5	41.7	48	9.3	40.1	830
			MIN	33.8	39.1	43	8.7	38.9	795
30	88.76	96	AV10	34.9	40.7	45	8.9	39.7	823
			STD	0.3	0.5	1	0.1	0.2	12
			MAX	35.4	41.7	46	9.1	40.1	840
			MIN	34.4	40.0	44	8.7	39.3	803
			Average	34.6	39.8	45	8.9	39.8	798
			Std. Dev.	0.9	1.4	2	0.2	0.5	36
			Maximum	35.5	41.7	48	9.3	42.1	840
			Minimum	30.8	34.8	37	7.9	38.9	682

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 (1.05); A4: [K3550] 360.0 (1.05)

Time Summary

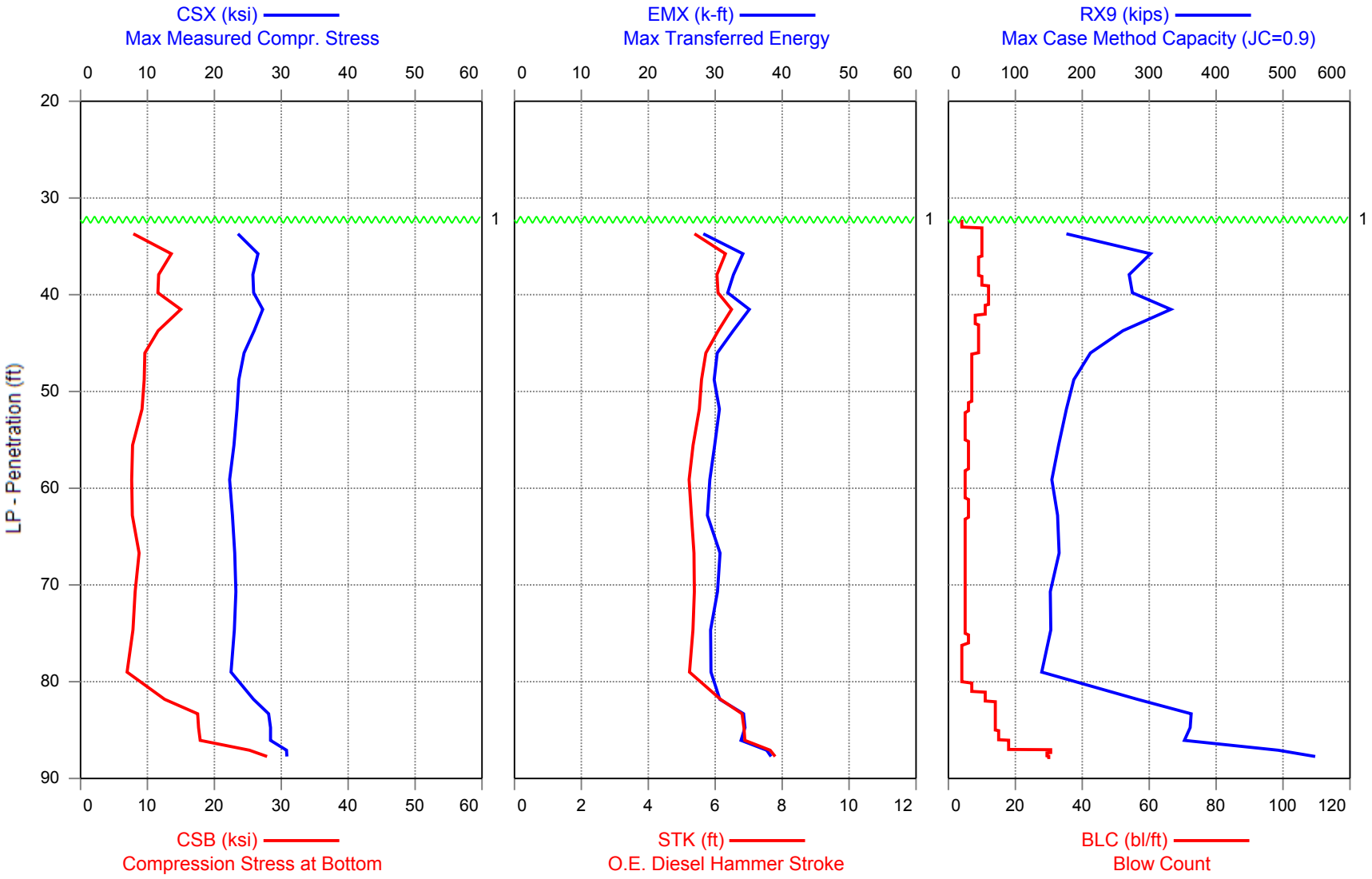
Drive 43 seconds 6:26 AM - 6:27 AM BN 1 - 30

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

Printed: 21-April-2015

Test started: 21-April-2015

USH 10 over LLBDM - PIER 12 #16
APE D30-42, HP 14 x 73



1 - Reported Reference EL 740.25

USH 10 over LLBDM - PIER 12 #16 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

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

CSX: Max Measured Compr. Stress
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
3	32.25	4	AV1	24.9	3.5	4.9	35	53.0	33
			MAX	24.9	3.5	4.9	35	53.0	33
			MIN	24.9	3.5	4.9	35	53.0	33
4	32.50	4	AV1	17.5	3.0	3.6	13	61.3	42
			MAX	17.5	3.0	3.6	13	61.3	42
			MIN	17.5	3.0	3.6	13	61.3	42
6	33.00	4	AV1	22.3	6.8	4.9	32	52.8	105
			MAX	22.3	6.8	4.9	32	52.8	105
			MIN	22.3	6.8	4.9	32	52.8	105
7	33.10	10	AV1	20.8	4.3	4.8	23	53.4	125
			MAX	20.8	4.3	4.8	23	53.4	125
			MIN	20.8	4.3	4.8	23	53.4	125
8	33.20	10	AV1	20.6	4.4	4.8	23	53.1	113
			MAX	20.6	4.4	4.8	23	53.1	113
			MIN	20.6	4.4	4.8	23	53.1	113
9	33.30	10	AV1	21.3	4.3	5.0	24	52.5	102
			MAX	21.3	4.3	5.0	24	52.5	102
			MIN	21.3	4.3	5.0	24	52.5	102
10	33.40	10	AV1	22.4	4.4	5.0	25	52.4	100
			MAX	22.4	4.4	5.0	25	52.4	100
			MIN	22.4	4.4	5.0	25	52.4	100
11	33.50	10	AV1	21.4	4.1	4.7	22	53.7	105
			MAX	21.4	4.1	4.7	22	53.7	105
			MIN	21.4	4.1	4.7	22	53.7	105
16	34.00	10	AV5	22.7	6.8	5.2	26	51.4	160
			MAX	23.4	10.9	5.4	27	52.4	240
			MIN	22.1	4.5	5.0	25	50.4	109
26	35.00	10	AV10	26.4	13.0	6.3	34	46.9	291
			MAX	27.1	13.9	6.4	35	48.2	309
			MIN	25.5	11.3	5.9	31	46.4	257
36	36.00	10	AV10	26.7	13.8	6.4	34	46.7	308
			MAX	28.0	14.4	6.7	37	48.5	323
			MIN	24.9	13.1	5.9	31	45.4	293
45	37.00	9	AV9	26.3	12.9	6.2	34	47.1	288
			MAX	27.0	13.9	6.4	35	48.1	299
			MIN	25.4	12.1	6.0	32	46.6	274

USH 10 over LLBDM - PIER 12 #16 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
54	38.00	9	AV9	25.7	11.2	6.0	33	47.9	262
			MAX	26.4	12.3	6.2	35	48.7	284
			MIN	24.9	10.5	5.8	31	47.2	250
64	39.00	10	AV10	25.8	11.9	6.1	32	47.7	275
			MAX	26.6	12.5	6.3	33	48.8	289
			MIN	24.6	11.2	5.8	30	46.9	260
76	40.00	12	AV12	25.3	10.3	5.9	31	48.3	249
			MAX	26.3	11.4	6.2	32	49.4	271
			MIN	24.3	9.3	5.6	29	47.1	233
88	41.00	12	AV12	27.2	14.4	6.5	34	46.3	333
			MAX	28.1	15.5	6.7	36	47.3	354
			MIN	26.3	12.2	6.2	33	45.5	285
99	42.00	11	AV11	27.4	15.1	6.5	35	46.1	337
			MAX	28.1	15.8	6.8	37	46.9	347
			MIN	26.5	14.5	6.3	34	45.3	318
107	43.00	8	AV8	26.4	14.0	6.3	34	47.0	293
			MAX	27.4	14.8	6.5	36	47.7	307
			MIN	25.7	13.0	6.1	33	46.1	277
116	44.00	9	AV9	26.1	11.7	6.1	33	47.5	263
			MAX	27.3	12.4	6.5	35	48.7	275
			MIN	25.0	11.0	5.8	31	46.2	247
125	45.00	9	AV9	25.3	10.3	5.9	31	48.2	237
			MAX	26.9	11.0	6.3	34	49.3	254
			MIN	24.3	9.7	5.7	30	46.9	220
134	46.00	9	AV9	24.3	9.2	5.7	29	49.3	213
			MAX	25.2	9.7	5.9	31	50.4	220
			MIN	23.3	8.9	5.4	28	48.3	201
141	47.00	7	AV7	24.3	9.8	5.7	31	49.1	207
			MAX	25.1	10.4	5.9	33	49.9	215
			MIN	23.6	9.4	5.5	29	48.2	196
148	48.00	7	AV7	24.8	10.1	5.8	32	48.6	201
			MAX	25.5	10.6	6.0	33	49.0	225
			MIN	24.4	9.5	5.7	31	48.1	187
155	49.00	7	AV7	23.2	9.3	5.5	29	50.2	180
			MAX	24.0	9.7	5.7	31	50.9	186
			MIN	22.4	8.5	5.3	28	49.2	170
162	50.00	7	AV7	23.3	9.5	5.5	30	49.8	189
			MAX	24.1	9.7	5.7	30	50.8	198
			MIN	22.5	9.1	5.3	28	49.0	175

USH 10 over LLBDM - PIER 12 #16 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
169	51.00	7	AV7	23.5	9.5	5.6	30	49.6	188
			MAX	24.1	10.0	5.7	31	50.3	200
			MIN	22.9	9.0	5.4	29	49.0	176
175	52.00	6	AV6	23.7	9.5	5.6	31	49.4	183
			MAX	24.4	10.4	5.8	32	50.2	202
			MIN	23.2	8.9	5.4	29	48.9	170
180	53.00	5	AV5	23.3	8.7	5.5	31	50.2	167
			MAX	24.0	9.1	5.6	33	51.0	170
			MIN	22.6	8.5	5.3	29	49.4	165
185	54.00	5	AV5	22.8	8.9	5.4	30	50.6	160
			MAX	23.4	9.4	5.5	32	51.3	163
			MIN	22.3	8.6	5.2	29	50.0	153
190	55.00	5	AV5	22.9	7.6	5.3	31	50.7	162
			MAX	23.4	8.8	5.5	32	52.6	175
			MIN	21.3	6.3	4.9	28	50.1	146
196	56.00	6	AV6	22.6	6.8	5.2	28	51.3	158
			MAX	23.8	7.8	5.5	30	53.1	174
			MIN	21.0	5.9	4.8	25	50.1	145
202	57.00	6	AV6	23.3	8.4	5.4	30	50.3	173
			MAX	24.5	8.7	5.7	32	51.4	180
			MIN	22.4	7.7	5.2	28	49.1	163
208	58.00	6	AV6	22.9	7.7	5.4	29	50.6	169
			MAX	24.1	8.2	5.7	31	52.3	181
			MIN	21.3	6.9	5.0	27	49.2	155
213	59.00	5	AV5	22.4	7.7	5.2	30	51.2	152
			MAX	23.2	8.4	5.4	31	51.9	169
			MIN	21.7	7.2	5.1	28	50.2	145
218	60.00	5	AV5	22.1	7.3	5.2	29	51.5	145
			MAX	22.7	7.6	5.3	30	52.0	148
			MIN	21.7	7.0	5.1	28	50.7	143
223	61.00	5	AV5	21.8	7.9	5.1	29	51.6	152
			MAX	22.4	8.1	5.3	30	52.1	155
			MIN	21.4	7.6	5.0	28	50.9	148
229	62.00	6	AV6	22.1	6.5	5.1	27	51.6	150
			MAX	22.6	7.7	5.2	28	52.2	161
			MIN	21.6	5.7	5.0	27	51.1	140
235	63.00	6	AV6	22.7	7.8	5.3	28	50.9	165
			MAX	23.7	8.2	5.6	31	52.0	173
			MIN	21.7	7.0	5.1	26	49.7	154
240	64.00	5	AV5	23.1	8.7	5.4	31	50.4	173

USH 10 over LLBDM - PIER 12 #16 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			MAX	24.0	9.0	5.6	32	50.9	181
			MIN	22.4	8.3	5.3	29	49.5	168
245	65.00	5	AV5	23.2	8.6	5.4	31	50.4	170
			MAX	23.8	8.8	5.6	33	50.6	175
			MIN	23.0	8.4	5.4	30	49.7	166
250	66.00	5	AV5	23.1	9.0	5.4	31	50.5	166
			MAX	23.7	10.5	5.5	32	50.8	184
			MIN	22.8	7.9	5.3	29	49.8	152
255	67.00	5	AV5	22.9	9.0	5.3	30	50.7	163
			MAX	23.4	9.5	5.4	31	51.1	171
			MIN	22.6	8.4	5.2	29	50.4	156
260	68.00	5	AV5	23.0	8.4	5.4	31	50.6	165
			MAX	23.4	8.8	5.4	31	51.2	168
			MIN	22.4	7.6	5.2	30	50.2	162
265	69.00	5	AV5	23.3	8.8	5.4	32	50.3	161
			MAX	24.3	9.7	5.7	33	50.9	165
			MIN	22.9	8.2	5.3	30	49.3	157
270	70.00	5	AV5	23.1	7.7	5.4	30	50.6	149
			MAX	23.4	8.1	5.4	30	50.9	155
			MIN	22.8	7.3	5.3	28	50.2	144
275	71.00	5	AV5	22.6	7.7	5.2	29	51.2	152
			MAX	23.3	8.3	5.4	31	52.2	162
			MIN	21.7	7.4	5.0	27	50.5	140
280	72.00	5	AV5	23.8	8.7	5.5	32	49.9	154
			MAX	24.1	9.4	5.6	33	50.5	163
			MIN	23.2	8.0	5.4	31	49.5	142
285	73.00	5	AV5	23.1	7.9	5.4	30	50.6	152
			MAX	23.7	8.8	5.5	31	51.5	158
			MIN	22.4	7.1	5.2	29	50.1	147
290	74.00	5	AV5	22.6	7.5	5.2	29	51.2	142
			MAX	23.2	7.7	5.4	30	52.0	149
			MIN	22.1	7.3	5.1	28	50.6	135
295	75.00	5	AV5	22.7	7.6	5.3	29	51.1	142
			MAX	23.2	7.9	5.3	29	51.3	148
			MIN	22.4	7.3	5.2	29	50.8	135
301	76.00	6	AV6	23.4	7.9	5.4	29	50.3	167
			MAX	24.2	8.8	5.6	31	51.7	188
			MIN	22.1	6.5	5.1	27	49.4	150
305	77.00	4	AV4	23.4	9.8	5.5	32	50.0	164
			MAX	23.8	10.2	5.6	33	50.5	177

USH 10 over LLBDM - PIER 12 #16 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			MIN	23.1	9.2	5.4	31	49.5	152
309	78.00	4	AV4	23.2	8.4	5.4	32	50.2	151
			MAX	23.8	9.4	5.6	33	50.9	157
			MIN	22.6	7.1	5.3	31	49.5	144
313	79.00	4	AV4	22.7	7.7	5.3	31	51.1	141
			MAX	23.4	8.9	5.4	33	51.6	151
			MIN	22.2	7.1	5.1	30	50.3	128
317	80.00	4	AV4	22.3	6.9	5.2	31	51.4	128
			MAX	23.3	7.1	5.4	33	52.2	143
			MIN	21.7	6.5	5.0	29	50.5	109
324	81.00	7	AV7	21.6	4.5	5.0	24	52.3	130
			MAX	22.3	5.1	5.2	26	53.5	149
			MIN	20.7	4.1	4.8	23	51.5	119
335	82.00	11	AV11	25.1	10.7	5.9	30	48.3	255
			MAX	27.2	14.9	6.5	34	52.5	314
			MIN	21.5	5.0	5.0	22	46.0	151
349	83.00	14	AV14	27.7	16.6	6.7	34	45.5	346
			MAX	28.3	18.7	6.8	35	47.0	387
			MIN	26.1	14.8	6.3	31	45.0	322
363	84.00	14	AV14	28.1	17.7	6.8	34	45.2	366
			MAX	29.3	19.9	7.1	36	46.9	432
			MIN	26.6	14.3	6.3	31	44.1	329
377	85.00	14	AV14	28.5	18.4	6.9	35	44.9	375
			MAX	29.2	20.0	7.1	36	46.1	410
			MIN	27.3	16.1	6.5	32	44.1	341
392	86.00	15	AV15	28.0	16.1	6.7	33	45.3	326
			MAX	28.9	17.9	6.9	34	46.2	348
			MIN	27.2	15.1	6.5	32	44.7	314
410	87.00	18	AV18	29.3	20.7	7.2	35	44.0	400
			MAX	31.3	24.5	7.8	40	45.2	463
			MIN	27.9	16.2	6.8	33	42.3	333
420	87.33	31	AV10	31.2	26.3	7.7	38	42.4	526
			MAX	33.0	28.1	8.0	40	43.0	606
			MIN	30.3	24.3	7.5	36	41.7	466
430	87.67	29	AV10	30.6	26.4	7.8	38	42.2	518
			MAX	32.8	29.3	8.4	42	43.0	567
			MIN	26.0	24.1	7.5	29	40.8	487
440	88.00	30	AV10	31.1	29.1	7.7	39	42.4	567
			MAX	31.9	31.6	7.9	40	43.4	616
			MIN	30.0	27.6	7.4	37	41.9	531

USH 10 over LLBDM - PIER 12 #16 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			Average	25.3	12.3	6.0	32	48.2	256
			Maximum	33.0	31.6	8.4	42	61.3	616
			Minimum	17.5	3.0	3.6	13	40.8	33

Total number of blows analyzed: 437

BL# Sensors

1-440 F3: [D815] 93.0 (0.97); F4: [F607] 93.6 (0.97); A3: [K3550] 360.0 (1.05); A4: [K2524] 360.0 (1.05)

BL# Comments

3 Reported Reference EL 740.25

Time Summary

Drive 13 minutes 30 seconds 9:38 AM - 9:52 AM BN 1 - 440

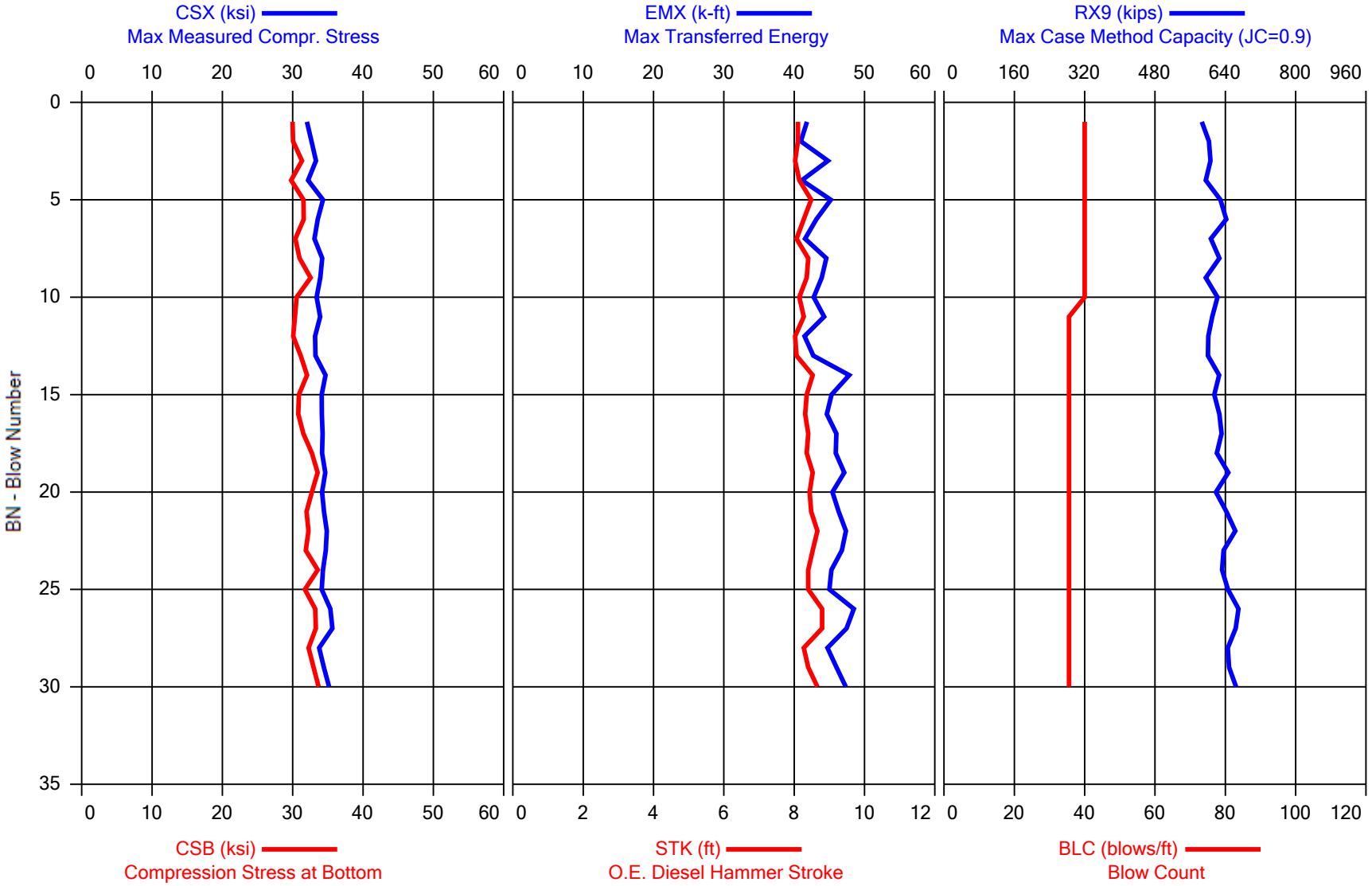
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 22-April-2015

Test started: 22-April-2015

USH 10 over Little Lake Butte des Morts - Pier 12 #16 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - Pier 12 #16 Restrike APE D30-42, HP 14 x 73
OP: TC Date: 22-April-2015

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

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

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
10	88.25	40	AV10	33.3	30.9	43	8.2	41.3	611
			STD	0.7	0.8	2	0.1	0.4	17
			MAX	34.3	32.5	45	8.5	41.7	642
			MIN	32.0	29.8	41	8.0	40.6	586
20	88.53	36	AV10	34.0	31.6	45	8.3	41.0	620
			STD	0.5	1.1	2	0.2	0.4	13
			MAX	34.7	33.5	48	8.5	41.7	647
			MIN	33.2	30.1	41	8.0	40.5	600
30	88.81	36	AV10	34.7	32.7	46	8.5	40.5	651
			STD	0.6	0.7	1	0.2	0.4	12
			MAX	35.6	33.7	48	8.8	41.1	670
			MIN	33.8	31.7	45	8.3	39.9	632
			Average	34.0	31.7	45	8.4	40.9	627
			Std. Dev.	0.8	1.2	2	0.2	0.5	22
			Maximum	35.6	33.7	48	8.8	41.7	670
			Minimum	32.0	29.8	41	8.0	39.9	586

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 (1.10); A4: [K2524] 360.0 (1.10)

Time Summary

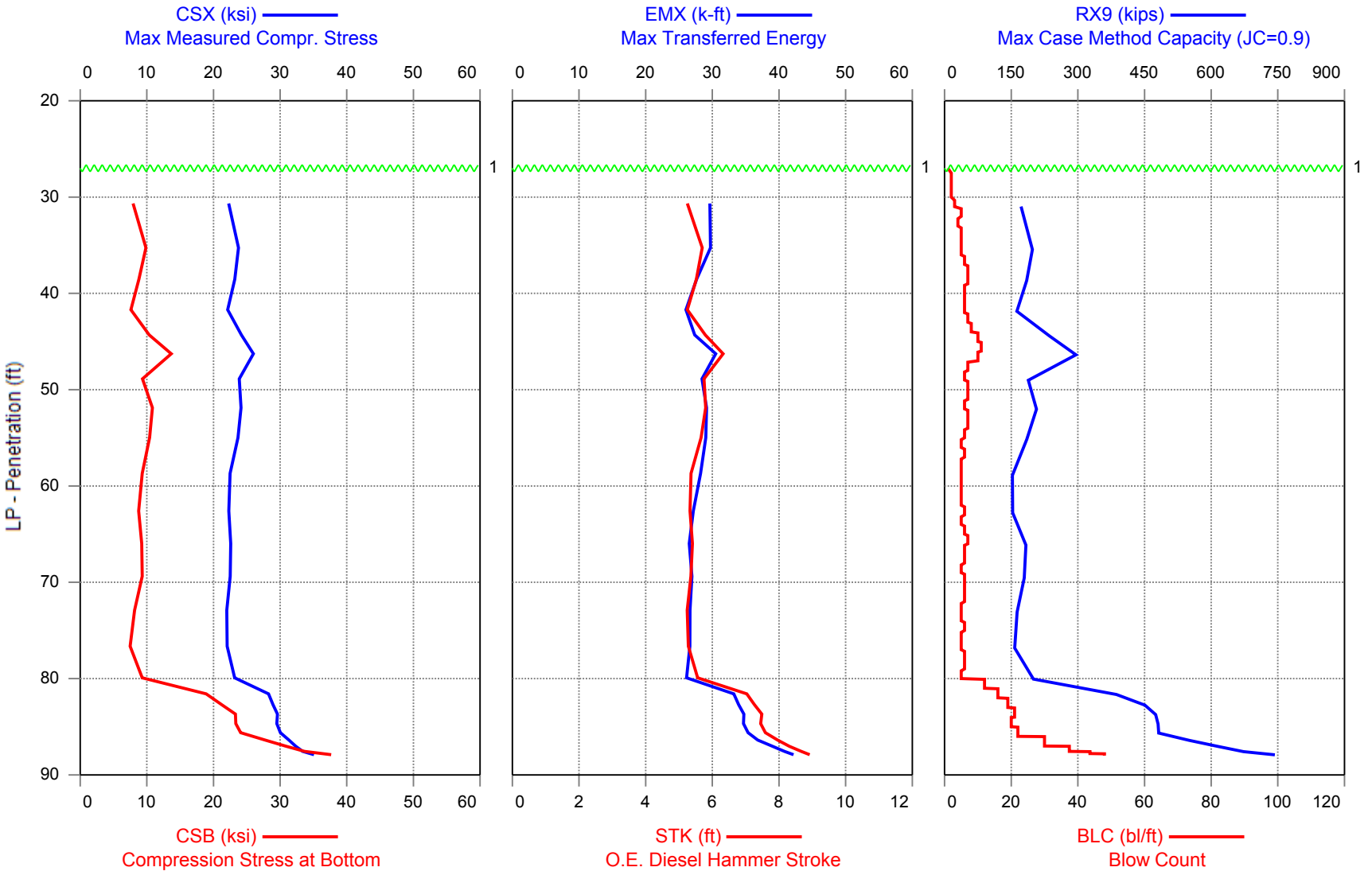
Drive 42 seconds 6:32 AM - 6:33 AM BN 1 - 30

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

Printed: 21-April-2015

Test started: 21-April-2015

USH 10 over LLBDM - PIER 12 #23
APE D30-42, HP 14 x 73



1 - Reported Reference EL 740.25

USH 10 over LLBDM - PIER 12 #23 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

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

CSX: Max Measured Compr. Stress
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
3	27.00	1	AV1	19.8	2.0	4.2	29	56.9	0
			MAX	19.8	2.0	4.2	29	56.9	0
			MIN	19.8	2.0	4.2	29	56.9	0
4	27.50	2	AV1	15.9	5.4	3.5	20	61.5	102
			MAX	15.9	5.4	3.5	20	61.5	102
			MIN	15.9	5.4	3.5	20	61.5	102
5	28.00	2	AV1	19.2	7.4	4.5	27	54.8	161
			MAX	19.2	7.4	4.5	27	54.8	161
			MIN	19.2	7.4	4.5	27	54.8	161
7	29.00	2	AV2	22.6	8.6	5.4	32	50.6	172
			MAX	22.6	8.7	5.4	32	50.7	182
			MIN	22.6	8.6	5.3	31	50.5	162
9	30.00	2	AV2	24.0	9.0	5.7	34	49.1	181
			MAX	24.3	9.1	5.8	35	49.4	185
			MIN	23.6	8.9	5.6	33	48.8	177
12	31.00	3	AV3	23.7	9.1	5.6	32	49.4	187
			MAX	24.0	9.2	5.7	33	49.5	198
			MIN	23.5	9.0	5.6	30	49.1	181
17	32.00	5	AV5	22.8	7.8	5.4	30	50.3	165
			MAX	24.3	8.7	5.9	33	51.7	182
			MIN	21.4	7.2	5.1	27	48.4	150
21	33.00	4	AV4	22.3	8.3	5.3	28	51.0	175
			MAX	22.7	9.0	5.4	30	51.2	204
			MIN	22.0	7.8	5.2	27	50.3	162
26	34.00	5	AV5	23.5	9.7	5.6	30	49.5	196
			MAX	23.9	10.3	5.7	30	49.8	200
			MIN	23.3	9.4	5.5	29	49.1	191
31	35.00	5	AV5	23.7	9.8	5.7	30	49.2	197
			MAX	24.0	10.1	5.8	31	49.7	207
			MIN	23.4	9.4	5.6	29	48.7	188
36	36.00	5	AV5	23.9	10.2	5.8	30	48.9	208
			MAX	24.8	10.5	5.9	31	49.3	213
			MIN	23.1	10.0	5.7	28	48.2	202
42	37.00	6	AV6	23.8	9.7	5.7	29	49.1	193
			MAX	24.7	10.2	6.0	32	49.7	205
			MIN	23.0	8.6	5.6	27	48.1	180

USH 10 over LLBDM - PIER 12 #23 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
49	38.00	7	AV7	22.6	7.8	5.3	26	50.7	177
			MAX	23.4	8.4	5.5	28	52.6	184
			MIN	20.8	7.1	4.9	23	49.8	166
56	39.00	7	AV7	23.5	9.7	5.6	28	49.5	198
			MAX	24.3	10.3	5.8	30	50.3	204
			MIN	22.8	8.9	5.4	27	48.6	190
62	40.00	6	AV6	23.6	9.0	5.6	29	49.5	181
			MAX	24.2	10.1	5.9	31	50.2	192
			MIN	23.0	8.4	5.4	27	48.5	174
68	41.00	6	AV6	22.6	8.0	5.4	27	50.5	167
			MAX	23.1	8.6	5.4	28	51.2	176
			MIN	22.1	7.2	5.2	26	50.2	149
74	42.00	6	AV6	21.7	7.1	5.1	26	51.6	155
			MAX	22.2	7.2	5.2	27	52.4	160
			MIN	21.1	6.9	5.0	25	51.1	148
81	43.00	7	AV7	22.0	7.6	5.2	25	51.2	164
			MAX	22.3	8.0	5.3	26	51.7	169
			MIN	21.6	7.2	5.1	24	50.8	158
89	44.00	8	AV8	22.5	7.8	5.4	25	50.6	168
			MAX	23.1	8.2	5.5	26	51.3	178
			MIN	21.8	7.4	5.2	24	49.9	161
99	45.00	10	AV10	24.8	11.2	5.9	28	48.3	247
			MAX	26.3	14.0	6.4	31	50.4	300
			MIN	23.0	7.7	5.4	24	46.5	176
110	46.00	11	AV11	26.3	14.4	6.4	31	46.5	323
			MAX	27.1	15.6	6.6	32	47.1	348
			MIN	25.8	13.2	6.2	30	45.7	297
120	47.00	10	AV10	25.9	13.2	6.3	30	46.9	290
			MAX	26.3	14.4	6.5	31	47.6	303
			MIN	25.0	12.2	6.1	29	46.3	269
127	48.00	7	AV7	25.0	11.3	6.1	30	47.6	226
			MAX	25.7	12.1	6.3	32	48.5	247
			MIN	24.1	10.2	5.9	29	46.8	199
133	49.00	6	AV6	24.2	9.3	5.8	30	48.6	179
			MAX	24.8	10.0	6.1	31	49.5	193
			MIN	23.3	7.8	5.6	27	47.7	161
140	50.00	7	AV7	22.8	8.1	5.5	26	50.2	178
			MAX	23.5	9.1	5.6	27	51.3	191
			MIN	21.6	7.2	5.2	25	49.4	169

USH 10 over LLBDM - PIER 12 #23 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
147	51.00	7	AV7	24.3	10.3	5.8	29	48.6	203
			MAX	24.7	11.5	5.9	31	49.2	226
			MIN	23.8	9.4	5.7	28	48.2	191
153	52.00	6	AV6	24.0	10.8	5.8	29	48.8	196
			MAX	24.6	11.4	5.9	31	49.4	216
			MIN	23.5	10.2	5.6	28	48.3	186
160	53.00	7	AV7	24.1	11.0	5.8	29	48.7	215
			MAX	24.4	11.8	5.9	30	49.2	223
			MIN	23.6	10.6	5.7	28	48.5	207
167	54.00	7	AV7	23.9	10.8	5.7	28	49.0	206
			MAX	24.3	11.4	5.9	29	49.4	214
			MIN	23.7	10.3	5.6	28	48.5	199
173	55.00	6	AV6	23.7	10.0	5.7	29	49.2	183
			MAX	24.7	10.8	5.9	31	49.8	197
			MIN	23.1	8.8	5.5	27	48.3	163
178	56.00	5	AV5	23.6	10.4	5.6	30	49.4	179
			MAX	24.1	10.9	5.7	31	49.7	183
			MIN	22.9	9.8	5.6	28	49.0	174
184	57.00	6	AV6	23.3	10.2	5.6	29	49.7	176
			MAX	23.7	11.7	5.7	30	50.1	211
			MIN	22.9	8.9	5.5	28	49.2	158
189	58.00	5	AV5	22.1	9.3	5.3	28	51.0	150
			MAX	22.4	9.6	5.4	28	51.3	159
			MIN	21.8	8.6	5.2	27	50.6	140
194	59.00	5	AV5	22.7	9.6	5.4	29	50.4	159
			MAX	23.7	10.6	5.7	31	51.0	168
			MIN	22.0	9.1	5.3	27	49.2	143
199	60.00	5	AV5	22.5	9.2	5.4	28	50.5	149
			MAX	23.0	9.6	5.5	29	50.9	153
			MIN	22.3	8.9	5.3	28	49.9	145
204	61.00	5	AV5	22.4	9.0	5.3	28	50.7	151
			MAX	23.1	9.6	5.5	29	51.2	155
			MIN	22.0	8.6	5.2	26	50.1	146
209	62.00	5	AV5	22.3	8.6	5.3	28	50.8	148
			MAX	23.1	9.3	5.4	29	51.9	150
			MIN	21.1	8.3	5.1	26	50.2	143
215	63.00	6	AV6	22.0	8.1	5.2	26	51.1	151
			MAX	22.5	8.6	5.4	27	53.0	164
			MIN	20.2	7.3	4.9	23	50.4	142
220	64.00	5	AV5	22.3	9.4	5.4	27	50.6	159

USH 10 over LLBDM - PIER 12 #23 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			MAX	23.6	10.8	5.7	30	52.1	183
			MIN	20.9	8.3	5.0	24	49.0	142
226	65.00	6	AV6	22.3	8.7	5.4	27	50.6	155
			MAX	23.1	9.6	5.6	28	51.6	166
			MIN	21.4	7.8	5.1	25	49.6	147
233	66.00	7	AV7	21.5	7.7	5.1	24	51.7	157
			MAX	23.4	10.6	5.7	27	52.8	201
			MIN	20.7	5.5	4.9	22	49.3	119
239	67.00	6	AV6	23.6	10.9	5.7	29	49.2	211
			MAX	23.9	11.7	5.8	30	49.7	247
			MIN	23.1	10.2	5.6	28	48.8	186
245	68.00	6	AV6	23.3	10.3	5.5	28	49.9	211
			MAX	23.9	11.2	5.7	29	51.0	226
			MIN	22.0	9.2	5.3	26	49.2	199
250	69.00	5	AV5	22.3	10.0	5.3	27	50.7	187
			MAX	23.2	10.8	5.6	29	51.3	227
			MIN	21.5	9.2	5.2	26	49.7	162
256	70.00	6	AV6	22.7	9.2	5.4	27	50.3	177
			MAX	24.0	10.5	5.7	29	51.4	206
			MIN	21.8	8.2	5.2	25	49.1	154
262	71.00	6	AV6	22.3	8.6	5.3	27	50.9	170
			MAX	23.5	10.3	5.6	28	52.3	228
			MIN	21.0	7.5	5.0	24	49.7	147
268	72.00	6	AV6	22.5	9.7	5.3	27	50.6	200
			MAX	23.4	10.7	5.6	29	51.1	251
			MIN	22.0	8.6	5.2	27	49.5	154
273	73.00	5	AV5	22.1	8.2	5.3	27	50.9	145
			MAX	22.6	8.6	5.3	28	51.4	153
			MIN	21.4	7.2	5.2	26	50.7	138
278	74.00	5	AV5	21.2	7.5	5.1	26	51.9	153
			MAX	21.9	8.6	5.2	26	52.8	174
			MIN	20.4	6.5	4.9	25	51.3	135
284	75.00	6	AV6	22.3	7.0	5.3	26	50.8	148
			MAX	23.1	7.5	5.5	28	51.9	158
			MIN	21.3	6.2	5.1	25	49.8	137
289	76.00	5	AV5	21.7	7.8	5.2	26	51.3	152
			MAX	22.8	8.6	5.4	28	52.3	176
			MIN	20.9	6.8	5.0	25	50.3	129
294	77.00	5	AV5	22.1	7.4	5.3	27	50.9	145
			MAX	22.4	7.9	5.4	28	51.3	167

USH 10 over LLBDM - PIER 12 #23 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			MIN	21.8	6.8	5.2	26	50.6	127
300	78.00	6	AV6	21.9	7.0	5.3	26	51.0	163
			MAX	22.2	9.1	5.3	26	51.6	208
			MIN	21.5	5.8	5.1	25	50.7	145
306	79.00	6	AV6	22.9	9.1	5.5	28	49.9	187
			MAX	24.2	10.0	5.9	30	50.9	211
			MIN	22.3	7.9	5.3	26	48.5	161
311	80.00	5	AV5	22.7	10.0	5.3	28	50.7	196
			MAX	25.2	11.1	5.5	29	51.6	242
			MIN	21.7	8.5	5.1	26	50.0	136
323	81.00	12	AV12	23.5	9.1	5.7	25	49.4	203
			MAX	26.1	11.2	6.3	29	52.5	236
			MIN	20.3	5.1	5.0	20	46.7	141
339	82.00	16	AV16	28.4	19.2	7.1	33	44.4	383
			MAX	31.0	24.1	7.8	38	48.0	463
			MIN	24.6	13.7	6.0	26	42.3	308
358	83.00	19	AV19	28.9	20.7	7.3	34	43.8	433
			MAX	30.0	24.2	7.6	37	44.8	551
			MIN	27.9	17.7	6.9	31	42.7	353
379	84.00	21	AV21	29.6	23.2	7.5	35	43.1	478
			MAX	30.7	24.5	7.9	37	43.9	533
			MIN	28.6	21.4	7.2	33	42.1	425
399	85.00	20	AV20	29.3	23.1	7.4	34	43.4	469
			MAX	30.1	24.5	7.7	37	44.6	531
			MIN	27.9	21.7	7.0	32	42.6	429
421	86.00	22	AV22	30.0	24.0	7.6	35	42.8	478
			MAX	31.3	25.3	8.0	38	43.7	568
			MIN	29.0	22.3	7.3	33	41.8	430
451	87.00	30	AV30	31.5	28.5	8.0	37	41.7	568
			MAX	32.7	31.9	8.5	40	43.4	704
			MIN	29.2	25.2	7.4	33	40.6	496
472	87.56	37	AV21	32.6	32.0	8.4	39	40.8	635
			MAX	33.6	34.3	8.8	42	41.8	678
			MIN	31.6	29.1	8.0	37	39.9	574
482	87.79	44	AV10	34.0	34.7	8.9	42	39.8	688
			MAX	34.8	36.7	9.1	44	40.4	710
			MIN	33.0	33.6	8.6	40	39.2	658
492	88.00	48	AV10	35.1	37.7	8.9	42	39.6	742
			MAX	37.7	40.2	9.1	44	40.3	775
			MIN	33.1	35.9	8.6	40	39.2	711

USH 10 over LLBDM - PIER 12 #23 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			Average	25.8	15.2	6.3	31	47.3	305
			Maximum	37.7	40.2	9.1	44	61.5	775
			Minimum	15.9	2.0	3.5	20	39.2	0

Total number of blows analyzed: 490

BL# Sensors

1-492 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

3 Reported Reference EL 740.25

Time Summary

Drive 10 minutes 48 seconds 10:08 AM - 10:18 AM BN 1 - 492

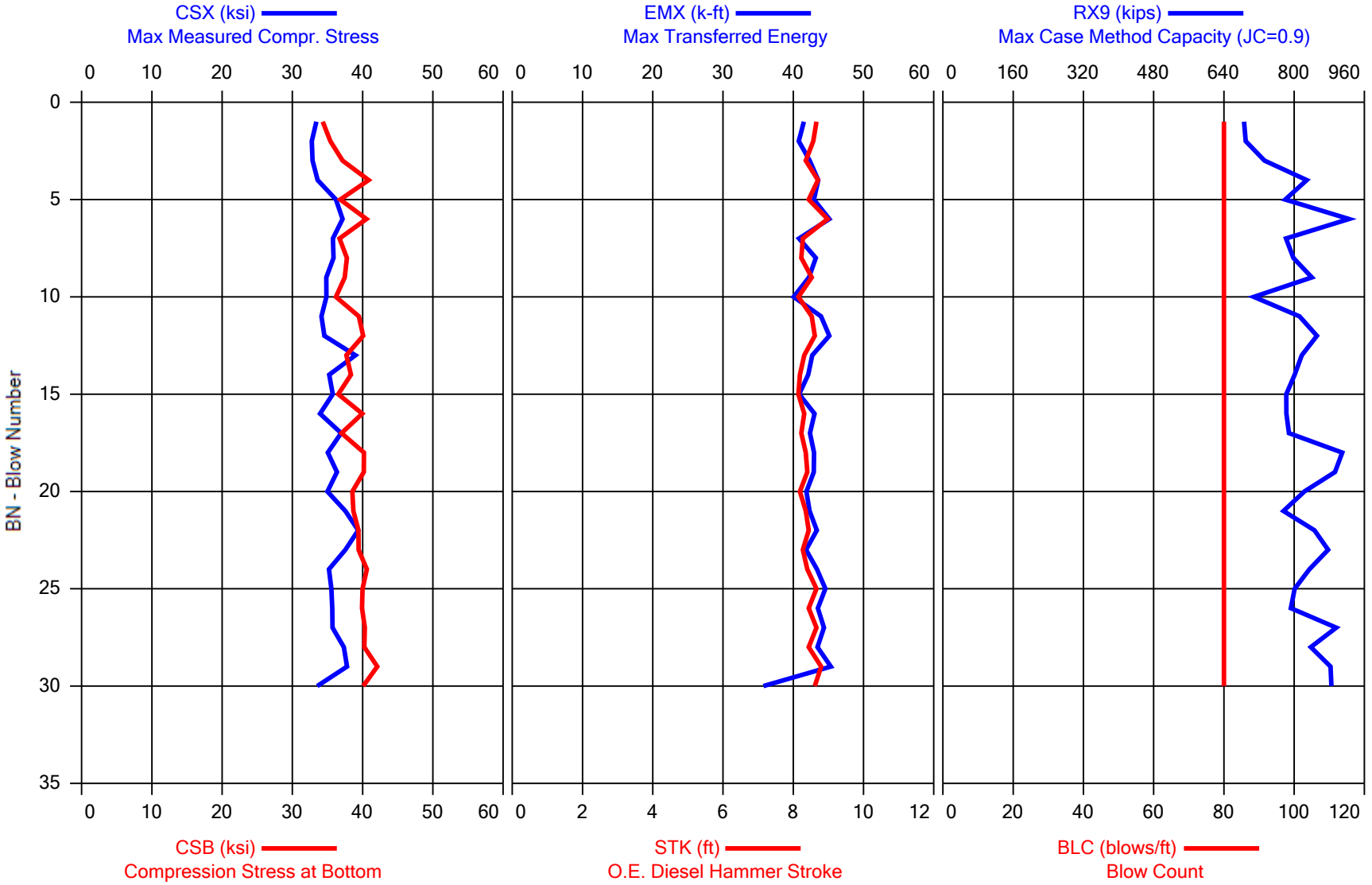
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 22-April-2015

Test started: 22-April-2015

USH 10 over Little Lake Butte des Morts - Pier 12 #23 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - Pier 12 #23 Restrike APE D30-42, HP 14 x 73
OP: TC Date: 22-April-2015

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

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

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
10	88.13	80	AV10	34.7	37.3	42	8.5	40.6	777
			STD	1.4	1.9	1	0.2	0.5	72
			MAX	37.2	40.9	45	9.0	41.4	925
			MIN	32.8	34.3	40	8.1	39.5	686
20	88.25	80	AV10	35.6	38.8	43	8.3	41.0	826
			STD	1.4	1.3	1	0.1	0.3	43
			MAX	39.0	40.2	45	8.6	41.4	910
			MIN	33.9	36.5	41	8.1	40.3	782
30	88.38	80	AV10	36.5	40.1	43	8.5	40.6	843
			STD	1.6	0.8	3	0.2	0.4	40
			MAX	39.4	42.1	45	8.8	41.1	896
			MIN	33.5	38.7	36	8.3	39.9	776
			Average	35.6	38.7	43	8.4	40.7	815
			Std. Dev.	1.7	1.8	2	0.2	0.5	60
			Maximum	39.4	42.1	45	9.0	41.4	925
			Minimum	32.8	34.3	36	8.1	39.5	686

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 (1.05); A4: [K3550] 360.0 (1.05)

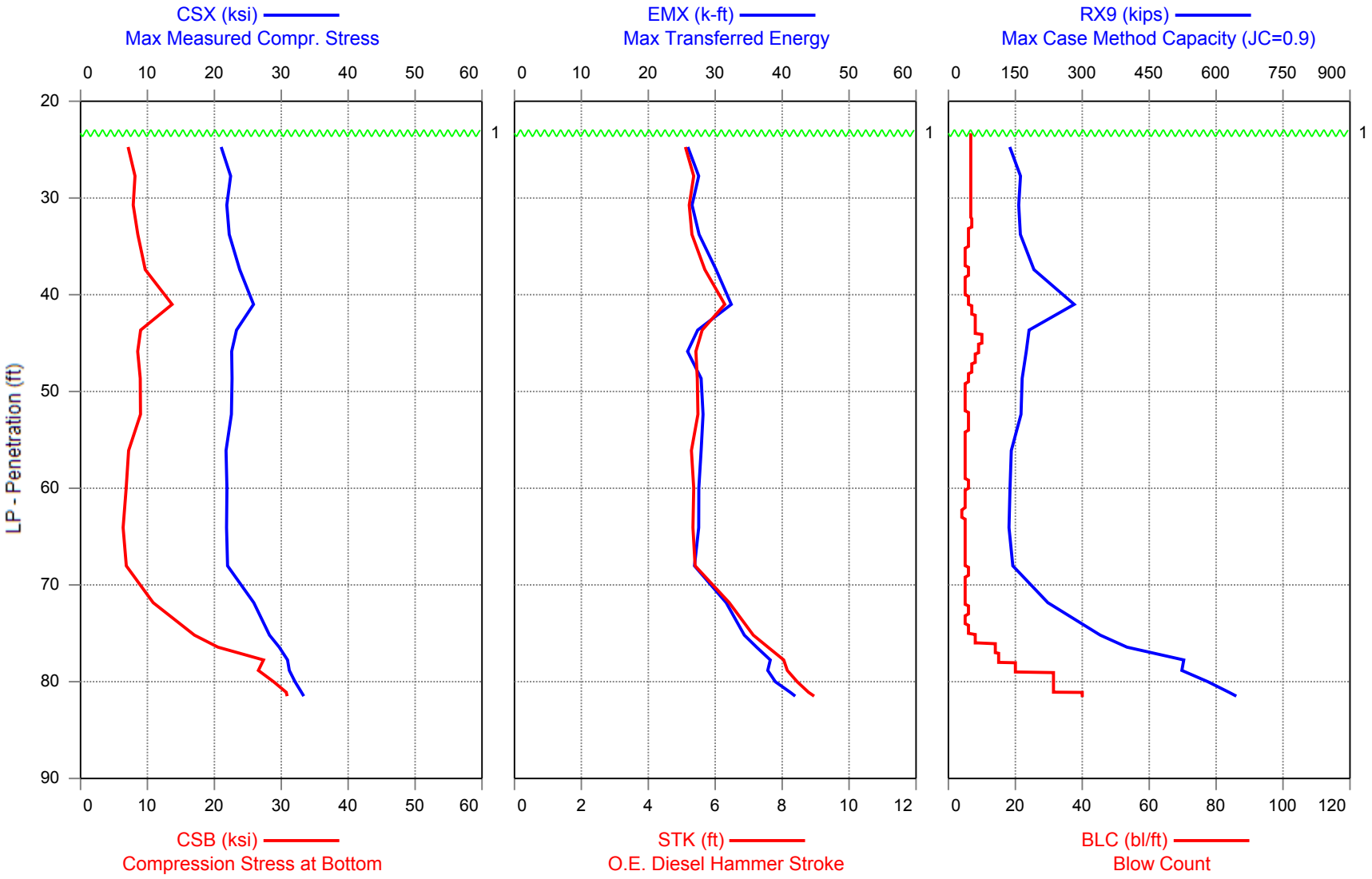
Time Summary

Drive 42 seconds 6:39 AM - 6:40 AM BN 1 - 30

Printed: 21-April-2015

Test started: 21-April-2015

USH 10 over LLBDM - PIER 12 #56
APE D30-42, HP 14 x 73



1 - Reported Reference EL 739.42

USH 10 over LLBDM - PIER 12 #56 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.58 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 ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
3	23.30	7	AV1	21.1	4.2	4.9	28	52.6	55
			MAX	21.1	4.2	4.9	28	52.6	55
			MIN	21.1	4.2	4.9	28	52.6	55
61	32.00	7	AV58	21.8	7.7	5.2	27	51.3	154
			MAX	24.6	10.6	6.1	32	59.3	225
			MIN	15.9	2.7	3.8	17	47.7	31
68	33.00	7	AV7	21.9	8.7	5.3	26	51.0	167
			MAX	22.6	9.5	5.4	27	51.7	191
			MIN	21.5	7.8	5.1	25	50.4	154
74	34.00	6	AV6	22.2	8.3	5.3	28	50.9	154
			MAX	22.5	9.5	5.4	28	51.3	162
			MIN	21.8	7.1	5.2	27	50.5	143
80	35.00	6	AV6	22.3	8.4	5.3	28	50.9	160
			MAX	22.9	9.9	5.4	29	52.2	177
			MIN	21.1	7.2	5.0	25	50.4	149
85	36.00	5	AV5	22.9	9.2	5.5	30	50.0	172
			MAX	23.7	10.6	5.7	32	50.8	193
			MIN	22.1	8.5	5.3	28	49.2	154
90	37.00	5	AV5	22.5	7.7	5.3	29	50.6	148
			MAX	22.9	8.4	5.4	31	51.1	156
			MIN	22.1	7.3	5.2	28	50.2	143
96	38.00	6	AV6	23.6	9.1	5.6	30	49.5	177
			MAX	24.0	10.4	5.7	32	50.1	201
			MIN	23.1	7.4	5.5	29	49.1	162
101	39.00	5	AV5	25.3	12.2	6.1	32	47.6	246
			MAX	26.1	12.7	6.3	33	48.0	274
			MIN	24.8	11.3	6.0	30	46.7	217
106	40.00	5	AV5	26.0	14.6	6.3	32	46.7	302
			MAX	26.3	16.0	6.5	33	47.2	318
			MIN	25.7	13.6	6.2	32	46.3	284
112	41.00	6	AV6	26.3	14.3	6.4	33	46.5	302
			MAX	26.7	15.9	6.5	34	47.1	317
			MIN	25.6	13.5	6.2	32	46.0	291
119	42.00	7	AV7	25.8	13.2	6.3	33	46.9	269
			MAX	26.5	15.0	6.4	34	47.4	292
			MIN	25.3	12.2	6.1	31	46.4	252

USH 10 over LLBDM - PIER 12 #56 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
127	43.00	8	AV8	25.0	11.5	6.0	31	47.8	226
			MAX	25.8	12.9	6.3	32	48.8	244
			MIN	24.1	10.1	5.8	28	47.0	202
135	44.00	8	AV8	23.5	9.3	5.6	28	49.4	179
			MAX	24.8	11.8	6.0	30	50.6	214
			MIN	22.5	6.8	5.4	26	48.1	155
145	45.00	10	AV10	21.9	7.2	5.3	24	51.0	157
			MAX	22.6	8.0	5.4	25	52.0	171
			MIN	21.1	6.2	5.1	23	50.2	151
154	46.00	9	AV9	22.7	8.6	5.4	26	50.2	182
			MAX	23.2	10.0	5.6	27	51.1	210
			MIN	21.9	7.1	5.2	25	49.7	164
162	47.00	8	AV8	22.7	8.9	5.5	27	50.2	171
			MAX	24.4	9.3	5.9	29	50.9	186
			MIN	22.0	7.6	5.3	26	48.5	165
169	48.00	7	AV7	22.8	9.0	5.5	27	50.0	172
			MAX	23.8	9.5	5.7	28	50.5	197
			MIN	22.3	8.8	5.4	27	49.2	164
175	49.00	6	AV6	22.2	8.3	5.4	27	50.6	160
			MAX	23.5	9.9	5.6	29	51.5	181
			MIN	21.3	7.5	5.2	25	49.4	148
180	50.00	5	AV5	22.8	9.2	5.5	29	49.9	163
			MAX	23.3	9.8	5.6	30	50.9	169
			MIN	22.0	8.1	5.3	27	49.4	151
185	51.00	5	AV5	23.1	9.6	5.6	30	49.4	169
			MAX	23.8	9.9	5.8	31	49.8	173
			MIN	22.7	9.4	5.5	29	48.8	164
190	52.00	5	AV5	22.8	9.2	5.5	28	49.8	164
			MAX	23.3	9.4	5.7	29	50.1	166
			MIN	22.4	9.1	5.5	28	49.2	162
196	53.00	6	AV6	22.4	9.0	5.4	28	50.3	161
			MAX	22.9	9.9	5.6	29	51.3	173
			MIN	21.3	8.5	5.2	26	49.6	151
202	54.00	6	AV6	22.2	8.4	5.4	27	50.5	158
			MAX	23.9	9.0	5.8	31	52.1	164
			MIN	20.5	8.0	5.0	25	48.7	148
207	55.00	5	AV5	23.2	9.0	5.6	30	49.4	166
			MAX	24.0	9.8	5.8	32	49.9	176
			MIN	22.7	8.4	5.5	28	48.7	157

USH 10 over LLBDM - PIER 12 #56 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth	BLC	TYPE	CSX	CSB	STK	EMX	BPM	RX9
	ft	bl/ft		ksi	ksi	ft	k-ft	bpm	kips
212	56.00	5	AV5	22.2	7.5	5.4	29	50.5	142
			MAX	23.3	8.2	5.7	31	51.9	157
			MIN	20.9	7.0	5.1	27	49.3	133
217	57.00	5	AV5	20.9	6.4	5.1	26	51.8	135
			MAX	21.9	6.8	5.3	28	52.7	138
			MIN	20.1	6.1	4.9	25	50.8	130
222	58.00	5	AV5	20.7	5.7	5.0	26	52.1	121
			MAX	21.0	6.7	5.1	27	52.4	134
			MIN	20.2	5.0	5.0	26	51.7	112
227	59.00	5	AV5	22.0	7.3	5.4	28	50.5	138
			MAX	23.8	8.0	5.8	31	52.8	146
			MIN	20.0	5.7	4.9	25	48.7	120
233	60.00	6	AV6	22.0	7.4	5.4	27	50.5	140
			MAX	22.9	8.1	5.5	28	51.0	146
			MIN	21.4	6.8	5.3	25	49.9	133
238	61.00	5	AV5	22.0	6.5	5.4	28	50.5	135
			MAX	22.9	6.8	5.6	29	51.1	144
			MIN	21.3	6.1	5.2	27	49.6	126
243	62.00	5	AV5	21.6	6.1	5.3	28	51.0	140
			MAX	22.3	7.0	5.4	29	51.8	153
			MIN	20.8	5.6	5.1	25	50.4	132
247	63.00	4	AV4	22.7	7.5	5.5	30	49.8	141
			MAX	23.2	7.7	5.7	31	50.4	148
			MIN	22.2	7.3	5.4	29	49.1	135
252	64.00	5	AV5	22.0	7.0	5.4	28	50.5	138
			MAX	22.6	7.5	5.5	29	50.9	144
			MIN	21.5	6.7	5.3	27	50.0	135
257	65.00	5	AV5	21.5	5.7	5.3	27	51.0	133
			MAX	22.3	6.2	5.4	28	51.7	146
			MIN	20.7	5.0	5.1	26	50.2	125
262	66.00	5	AV5	21.2	5.4	5.2	26	51.4	131
			MAX	21.7	5.8	5.2	27	51.8	134
			MIN	20.9	4.8	5.1	25	51.1	129
267	67.00	5	AV5	21.4	6.6	5.3	27	51.0	135
			MAX	21.7	6.9	5.4	28	51.3	143
			MIN	21.0	6.3	5.2	25	50.5	127
272	68.00	5	AV5	22.1	7.2	5.4	28	50.3	142
			MAX	22.8	7.7	5.6	30	51.0	147
			MIN	21.3	6.8	5.3	27	49.4	139
278	69.00	6	AV6	21.6	6.3	5.3	25	50.9	149

USH 10 over LLBDM - PIER 12 #56 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			MAX	21.9	7.0	5.4	26	51.6	155
			MIN	21.0	6.0	5.1	24	50.5	146
283	70.00	5	AV5	23.5	7.6	5.8	29	48.9	156
			MAX	24.8	8.2	6.1	31	50.4	170
			MIN	22.0	7.0	5.4	27	47.4	140
288	71.00	5	AV5	24.8	8.3	6.1	31	47.5	172
			MAX	25.7	8.4	6.3	33	49.1	187
			MIN	23.4	8.2	5.7	28	46.7	166
293	72.00	5	AV5	25.5	9.3	6.3	31	46.9	201
			MAX	26.2	9.4	6.5	32	47.4	213
			MIN	24.9	9.1	6.1	30	46.2	193
299	73.00	6	AV6	26.6	12.3	6.6	32	45.9	251
			MAX	27.1	13.7	6.7	33	46.8	275
			MIN	25.8	10.7	6.3	30	45.4	226
304	74.00	5	AV5	28.0	17.0	7.1	34	44.2	330
			MAX	29.0	20.5	7.5	36	45.3	399
			MIN	26.9	14.2	6.8	32	43.2	277
310	75.00	6	AV6	28.6	17.7	7.3	36	43.8	353
			MAX	29.6	19.3	7.6	38	44.2	387
			MIN	28.0	16.7	7.1	34	42.8	333
318	76.00	8	AV8	27.7	15.6	6.9	33	44.7	318
			MAX	28.2	16.7	7.1	34	45.7	336
			MIN	26.8	14.9	6.6	31	44.3	305
319	76.00	9	AV1	28.7	17.5	7.2	35	43.8	343
			MAX	28.7	17.5	7.2	35	43.8	343
			MIN	28.7	17.5	7.2	35	43.8	343
341	77.00	14	AV22	29.4	20.1	7.5	36	43.1	391
			MAX	31.2	25.0	8.1	39	44.5	471
			MIN	27.9	17.8	7.0	32	41.4	349
356	78.00	15	AV15	30.9	26.5	8.0	38	41.7	510
			MAX	31.8	28.3	8.3	40	42.7	538
			MIN	30.0	23.9	7.6	36	41.0	471
376	79.00	20	AV20	31.1	27.1	8.1	38	41.5	530
			MAX	31.9	30.1	8.4	39	42.0	593
			MIN	30.3	24.6	7.9	37	40.9	501
410	81.08	31	AV34	32.1	28.9	8.5	39	40.6	583
			MAX	33.8	31.9	9.1	43	41.7	645
			MIN	30.6	25.8	8.0	36	39.3	527
420	81.33	40	AV10	33.0	30.8	8.8	41	40.0	634
			MAX	33.6	31.8	9.0	42	40.7	642

USH 10 over LLBDM - PIER 12 #56 APE D30-42, HP 14 x 73
OP: RF Date: 21-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			MIN	32.0	29.7	8.4	39	39.5	627
430	81.58	40	AV10	33.4	30.9	9.0	42	39.6	645
			MAX	34.2	31.8	9.2	44	39.9	655
			MIN	32.8	30.3	8.8	41	39.0	632
			Average	25.2	13.6	6.3	31	47.5	272
			Maximum	34.2	31.9	9.2	44	59.3	655
			Minimum	15.9	2.7	3.8	17	39.0	31

Total number of blows analyzed: 428

BL# Sensors

1-430 F3: [F607] 93.6 (0.98); F4: [D815] 93.0 (0.98); A3: [K2524] 360.0 (1.02); A4: [K3550] 360.0 (1.02)

BL# Comments

3 Reported Reference EL 739.42

Time Summary

Drive 11 minutes 5 seconds 10:34 AM - 10:46 AM BN 1 - 430

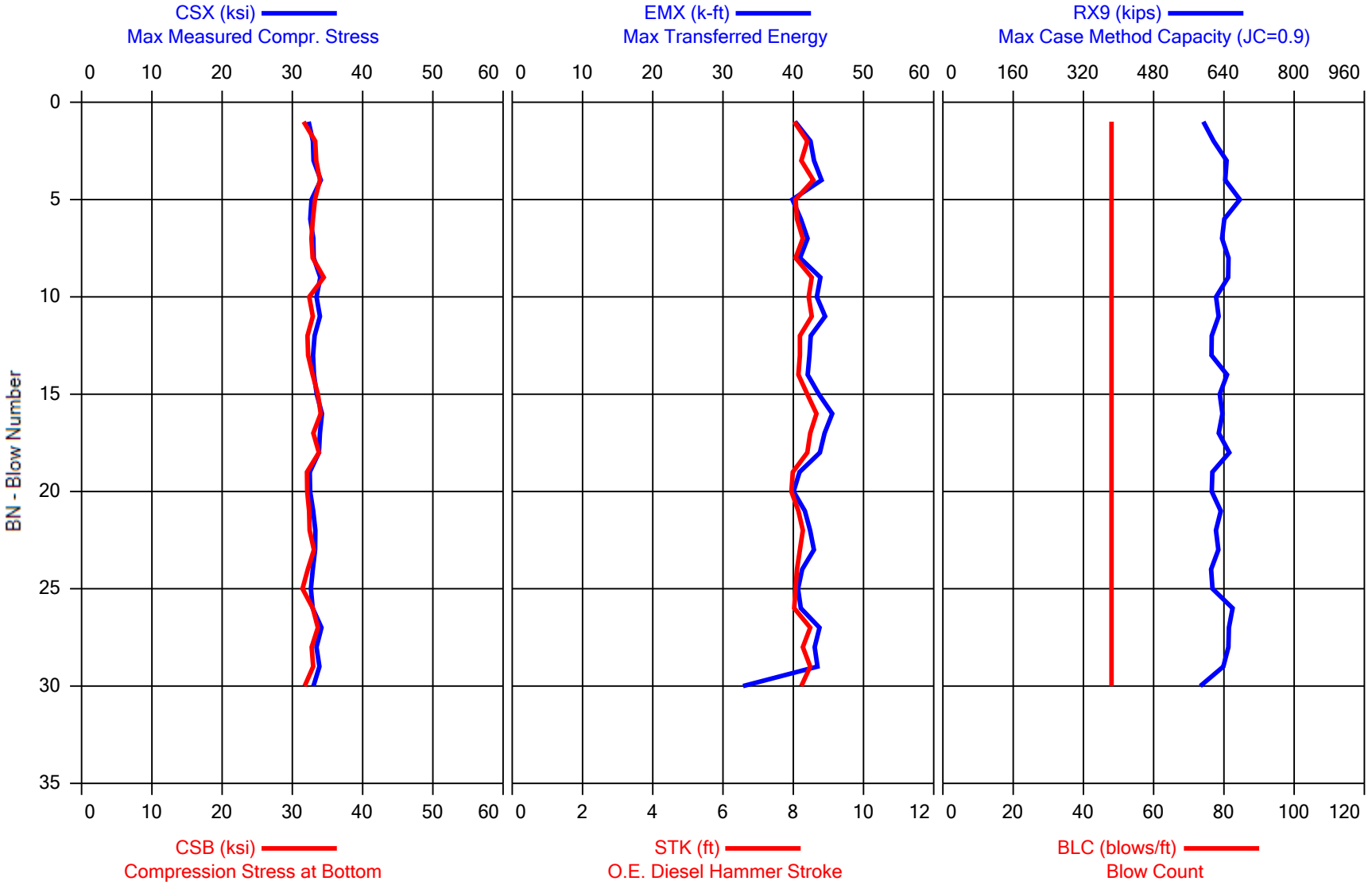
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 22-April-2015

Test started: 22-April-2015

USH 10 over Little Lake Butte des Morts - Pier 12 #56 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - Pier 12 #56 Restrike APE D30-42, HP 14 x 73
OP: TC Date: 22-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 92.58 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
10	81.79	48	AV10	33.1	33.1	42	8.3	41.1	637
			STD	0.5	0.8	1	0.2	0.5	21
			MAX	34.1	34.5	44	8.6	41.7	676
			MIN	32.3	31.6	40	8.0	40.4	593
20	82.00	48	AV10	33.3	32.9	43	8.3	41.1	627
			STD	0.6	0.7	2	0.2	0.5	14
			MAX	34.2	34.0	46	8.7	41.9	652
			MIN	32.5	32.1	40	7.9	40.2	612
30	82.21	48	AV10	33.2	32.6	41	8.2	41.2	629
			STD	0.4	0.6	3	0.1	0.4	21
			MAX	34.1	33.6	44	8.5	41.7	660
			MIN	32.6	31.4	33	8.0	40.6	586
			Average	33.2	32.8	42	8.3	41.1	631
			Std. Dev.	0.5	0.7	2	0.2	0.5	20
			Maximum	34.2	34.5	46	8.7	41.9	676
			Minimum	32.3	31.4	33	7.9	40.2	586

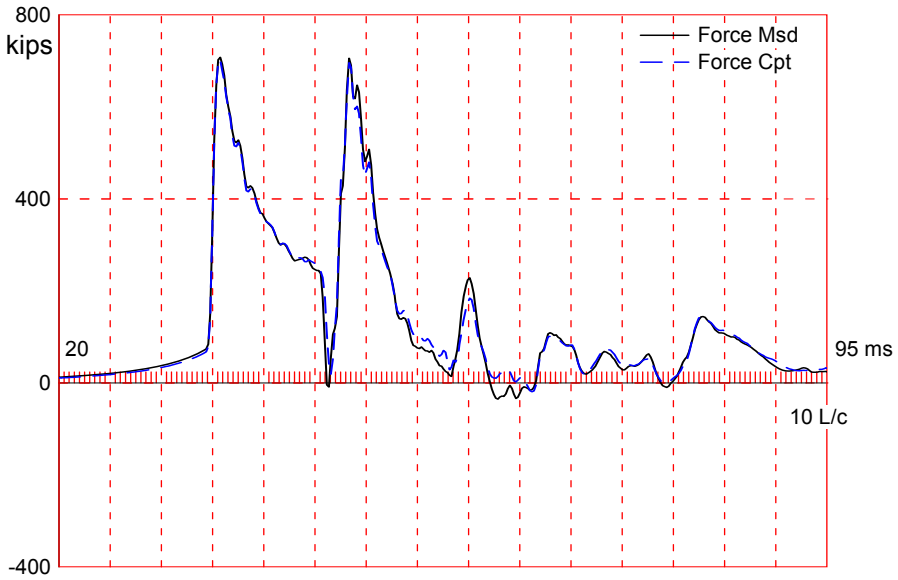
Total number of blows analyzed: 30

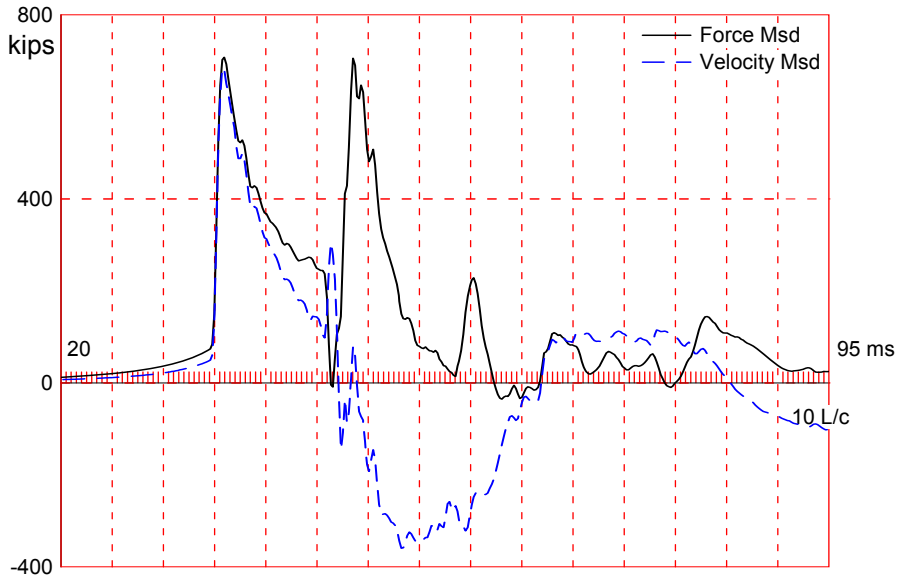
BL# Sensors

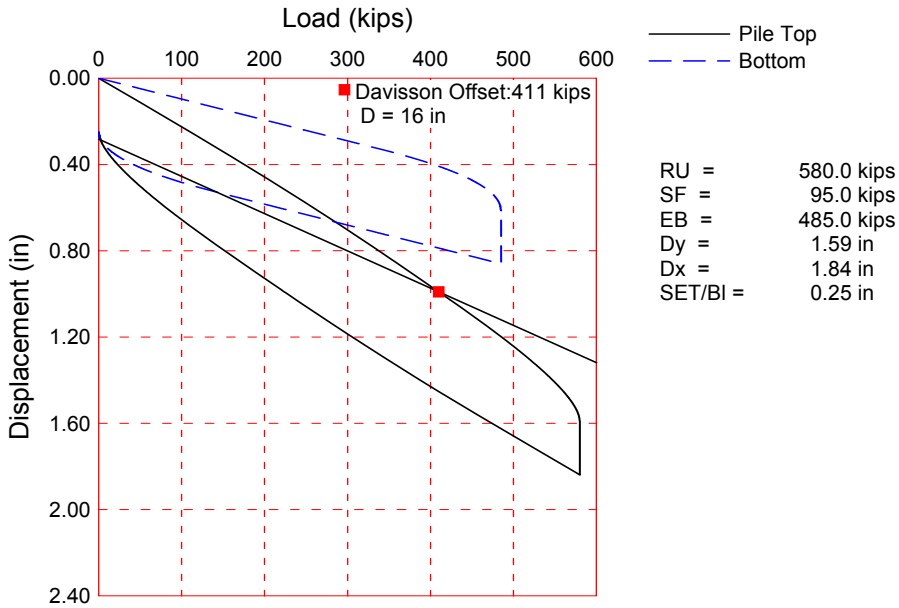
1-30 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.05); A4: [K3550] 360.0 (1.05)

Time Summary

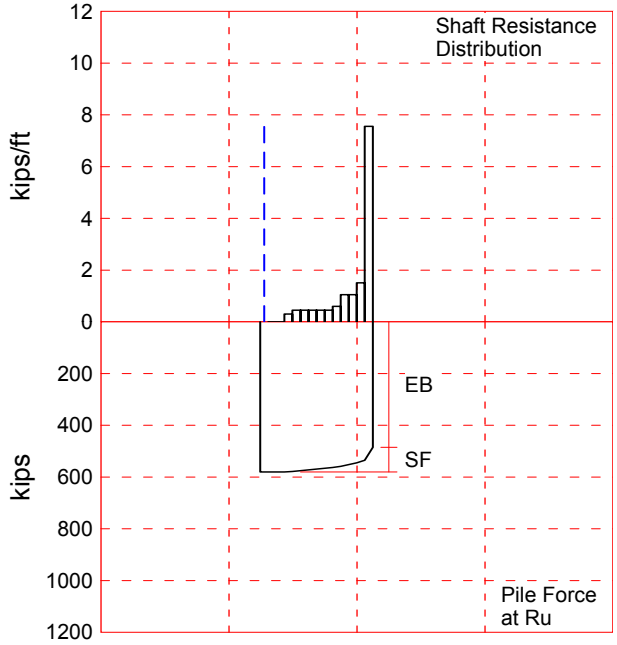
Drive 42 seconds 6:49 AM - 6:50 AM BN 1 - 30







RU =	580.0 kips
SF =	95.0 kips
EB =	485.0 kips
Dy =	1.59 in
Dx =	1.84 in
SET/BI =	0.25 in



Length b. Sensors	92.7 ft
Embedment	88.3 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.	16847 ft/s
Match Quality	3.89
Top Compr. Stress	33.1 ksi
Max Compr. Stress	33.8 ksi
Max Tension Stress	-5.63 ksi
Avg. Shaft Quake	0.25 in
Toe Quake	0.47 in
Avg. Shaft Smith Dpg.	0.27 s/ft
Toe Smith Damping	0.14 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: 580.0; along Shaft 95.0; at Toe 485.0 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
				580.0				
1	13.2	8.9	0.0	580.0	0.0	0.00	0.00	0.00
2	19.9	15.5	0.0	580.0	0.0	0.00	0.00	0.00
3	26.5	22.1	2.0	578.0	2.0	0.30	0.06	0.27
4	33.1	28.8	3.0	575.0	5.0	0.45	0.10	0.27
5	39.7	35.4	3.0	572.0	8.0	0.45	0.10	0.27
6	46.3	42.0	3.0	569.0	11.0	0.45	0.10	0.27
7	52.9	48.6	3.0	566.0	14.0	0.45	0.10	0.27
8	59.6	55.2	3.0	563.0	17.0	0.45	0.10	0.27
9	66.2	61.9	4.0	559.0	21.0	0.60	0.13	0.27
10	72.8	68.5	7.0	552.0	28.0	1.06	0.23	0.27
11	79.4	75.1	7.0	545.0	35.0	1.06	0.23	0.27
12	86.0	81.7	10.0	535.0	45.0	1.51	0.32	0.27
13	92.7	88.3	50.0	485.0	95.0	7.55	1.61	0.27
Avg. Shaft			7.3			1.08	0.23	0.27
Toe			485.0				351.84	0.14

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.25	0.47
Case Damping Factor		0.67	1.78
Damping Type		Viscous	Smith
Unloading Quake	(% of loading quake)	100	90
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake) (in)			0.22

CAPWAP match quality = 3.89 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.25 in; Blow Count = 48 b/ft
Computed: Final Set = 0.22 in; Blow Count = 55 b/ft
Transducer F3(D815) CAL: 93.0; RF: 0.96; F4(F607) CAL: 93.6; RF: 0.96
A3(K3550) CAL: 360; RF: 1.03; A4(K2524) CAL: 360; RF: 1.03

max. Top Comp. Stress = 33.1 ksi (T= 48.7 ms, max= 1.021 x Top)
max. Comp. Stress = 33.8 ksi (Z= 92.7 ft, T= 42.4 ms)
max. Tens. Stress = -5.63 ksi (Z= 72.8 ft, T= 67.0 ms)
max. Energy (EMX) = 43.8 kip-ft; max. Measured Top Displ. (DMX)= 1.31 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	708.3	-34.6	33.1	-1.62	43.8	18.0	1.31
2	6.6	705.6	-34.0	33.0	-1.59	43.6	18.0	1.30
4	13.2	703.2	-38.0	32.9	-1.78	43.0	18.0	1.26
6	19.9	705.7	-57.5	33.0	-2.68	42.3	17.9	1.21
8	26.5	712.1	-75.4	33.3	-3.52	41.5	17.7	1.16
10	33.1	708.5	-90.3	33.1	-4.22	39.8	17.5	1.11
12	39.7	699.2	-93.7	32.7	-4.38	37.8	17.3	1.05
14	46.3	689.9	-90.4	32.2	-4.22	35.6	17.1	0.99
15	49.6	677.2	-84.3	31.6	-3.94	34.1	17.0	0.96
16	52.9	680.7	-90.7	31.8	-4.24	33.4	16.9	0.93
17	56.3	668.1	-87.1	31.2	-4.07	31.8	16.8	0.90
18	59.6	672.1	-85.5	31.4	-3.99	30.9	16.7	0.86
19	62.9	660.8	-84.3	30.9	-3.94	29.3	16.6	0.82
20	66.2	666.9	-99.5	31.2	-4.65	28.4	16.4	0.79
21	69.5	653.6	-110.2	30.5	-5.15	26.4	16.2	0.75
22	72.8	660.5	-120.5	30.9	-5.63	25.5	16.0	0.71
23	76.1	638.9	-114.5	29.8	-5.35	22.9	16.7	0.67
24	79.4	655.7	-110.0	30.6	-5.14	21.9	16.8	0.64
25	82.7	672.7	-91.2	31.4	-4.26	19.6	18.3	0.60
26	86.0	706.2	-79.2	33.0	-3.70	18.7	19.6	0.56
27	89.4	703.6	-61.0	32.9	-2.85	16.2	20.8	0.53
28	92.7	723.4	-59.1	33.8	-2.76	9.8	21.0	0.49
Absolute	92.7			33.8			(T =	42.4 ms)
	72.8				-5.63		(T =	67.0 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	634.8	479.7	324.5	169.3	14.2					
RX	838.5	795.8	776.6	757.3	738.0	723.2	708.5	695.2	684.2	675.7
RU	634.8	479.7	324.5	169.3	14.2					

RAU = 540.2 (kips); RA2 = 752.6 (kips)

Current CAPWAP Ru = 580.0 (kips); Corresponding J(RP)= 0.07;

RMX requires higher damping; see PDA-W

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
18.3	35.75	697.6	713.1	742.3	1.31	0.25	0.25	43.9	673.0	1940

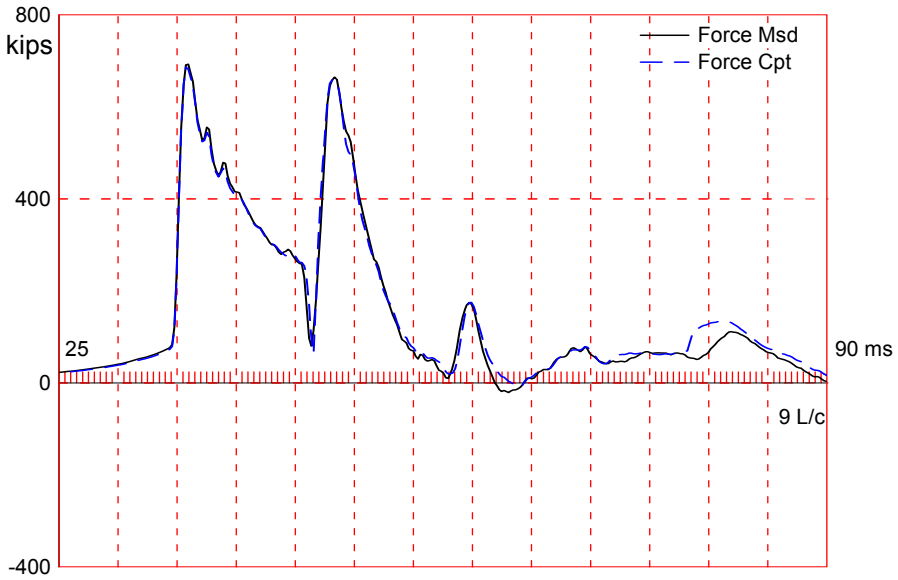
PILE PROFILE AND PILE MODEL

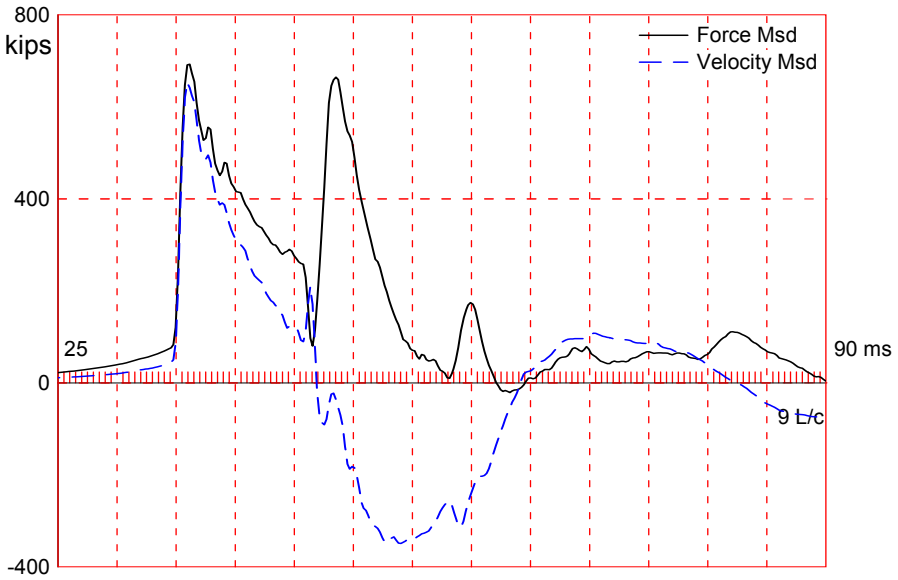
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.7	21.4	29992.2	492.000	4.70

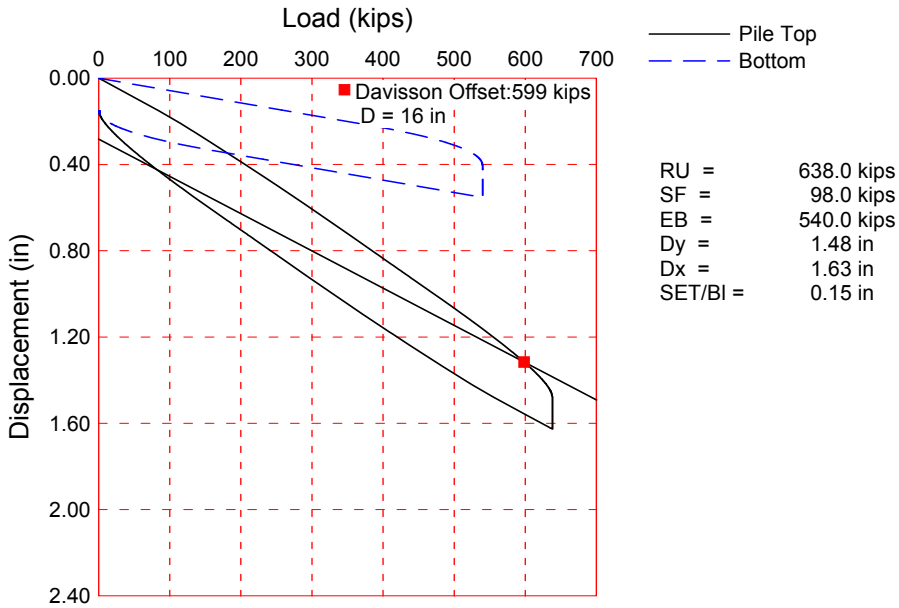
Toe Area 198.5 in^2

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

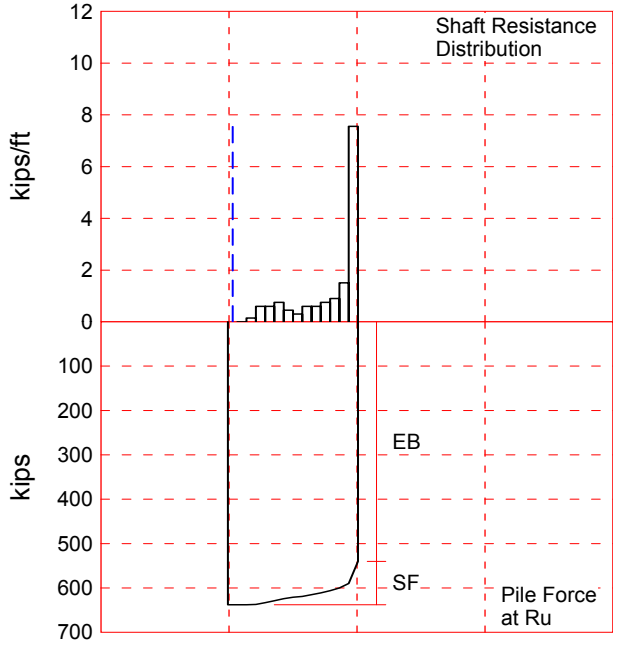
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16847.3 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 11.0 ms
Total volume: 13.770 ft^3; Volume ratio considering added impedance: 1.000







RU =	638.0 kips
SF =	98.0 kips
EB =	540.0 kips
Dy =	1.48 in
Dx =	1.63 in
SET/Bl =	0.15 in



Length b. Sensors	92.7 ft
Embedment	88.5 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.	16847 ft/s
Match Quality	3.82
Top Compr. Stress	32.1 ksi
Max Compr. Stress	37.6 ksi
Max Tension Stress	-5.06 ksi
Avg. Shaft Quake	0.11 in
Toe Quake	0.31 in
Avg. Shaft Smith Dpg.	0.29 s/ft
Toe Smith Damping	0.18 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: 638.0; along Shaft 98.0; 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
				638.0				
1	13.2	9.0	0.0	638.0	0.0	0.00	0.00	0.00
2	19.9	15.6	1.0	637.0	1.0	0.15	0.03	0.29
3	26.5	22.3	4.0	633.0	5.0	0.60	0.13	0.29
4	33.1	28.9	4.0	629.0	9.0	0.60	0.13	0.29
5	39.7	35.5	5.0	624.0	14.0	0.76	0.16	0.29
6	46.3	42.1	3.0	621.0	17.0	0.45	0.10	0.29
7	52.9	48.7	2.0	619.0	19.0	0.30	0.06	0.29
8	59.6	55.4	4.0	615.0	23.0	0.60	0.13	0.29
9	66.2	62.0	4.0	611.0	27.0	0.60	0.13	0.29
10	72.8	68.6	5.0	606.0	32.0	0.76	0.16	0.29
11	79.4	75.2	6.0	600.0	38.0	0.91	0.19	0.29
12	86.0	81.8	10.0	590.0	48.0	1.51	0.32	0.29
13	92.7	88.5	50.0	540.0	98.0	7.55	1.61	0.29
Avg. Shaft			7.5			1.11	0.24	0.29
Toe			540.0				391.73	0.18

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.11	0.31
Case Damping Factor		0.74	2.54
Damping Type		Viscous	Smith
Unloading Quake	(% of loading quake)	79	41
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	75	
Resistance Gap (included in Toe Quake)	(in)		0.12

CAPWAP match quality = 3.82 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.15 in; Blow Count = 80 b/ft
Computed: Final Set = 0.11 in; Blow Count = 109 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 = 32.1 ksi (T= 36.1 ms, max= 1.171 x Top)
max. Comp. Stress = 37.6 ksi (Z= 92.7 ft, T= 42.0 ms)
max. Tens. Stress = -5.06 ksi (Z= 46.3 ft, T= 61.5 ms)
max. Energy (EMX) = 43.6 kip-ft; max. Measured Top Displ. (DMX)= 1.23 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	687.0	-29.4	32.1	-1.37	43.6	17.2	1.23
2	6.6	687.4	-38.2	32.1	-1.79	43.4	17.2	1.21
4	13.2	688.7	-64.8	32.2	-3.03	42.8	17.1	1.17
6	19.9	693.7	-79.2	32.4	-3.70	42.0	16.9	1.12
8	26.5	698.4	-83.9	32.6	-3.92	40.7	16.6	1.07
10	33.1	686.8	-75.4	32.1	-3.52	38.4	16.3	1.02
12	39.7	674.2	-77.1	31.5	-3.60	35.9	16.0	0.96
14	46.3	653.0	-108.3	30.5	-5.06	33.0	15.8	0.89
15	49.6	639.2	-108.1	29.9	-5.05	31.4	15.7	0.86
16	52.9	643.8	-106.8	30.1	-4.99	30.5	15.6	0.82
17	56.3	637.7	-101.4	29.8	-4.74	29.0	15.4	0.78
18	59.6	652.6	-103.5	30.5	-4.83	28.0	15.3	0.75
19	62.9	662.6	-97.7	31.0	-4.57	25.9	15.2	0.70
20	66.2	669.4	-101.5	31.3	-4.74	24.7	15.0	0.66
21	69.5	688.9	-100.8	32.2	-4.71	22.7	14.9	0.62
22	72.8	713.3	-101.2	33.3	-4.73	21.5	14.7	0.58
23	76.1	714.7	-94.3	33.4	-4.40	19.3	14.5	0.54
24	79.4	728.5	-95.9	34.0	-4.48	18.0	14.6	0.49
25	82.7	760.9	-87.2	35.5	-4.07	15.8	16.3	0.45
26	86.0	771.6	-88.1	36.0	-4.11	14.7	17.5	0.41
27	89.4	764.3	-75.8	35.7	-3.54	12.4	17.7	0.37
28	92.7	804.3	-74.3	37.6	-3.47	8.5	16.3	0.33
Absolute	92.7			37.6			(T =	42.0 ms)
	46.3				-5.06		(T =	61.5 ms)

CASE METHOD

J =	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
RP	754.1	636.0	517.8	399.6	281.5					
RX	896.8	854.7	820.9	787.0	753.2	729.2	718.9	708.6	698.3	688.1
RU	754.1	636.0	517.8	399.6	281.5					

RAU = 360.4 (kips); RA2 = 785.8 (kips)

Current CAPWAP Ru = 638.0 (kips); Corresponding J(RP)= 0.20;

RMX requires higher damping; see PDA-W

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
17.2	35.95	658.2	686.7	706.0	1.23	0.15	0.15	43.8	762.0	2842

PILE PROFILE AND PILE MODEL

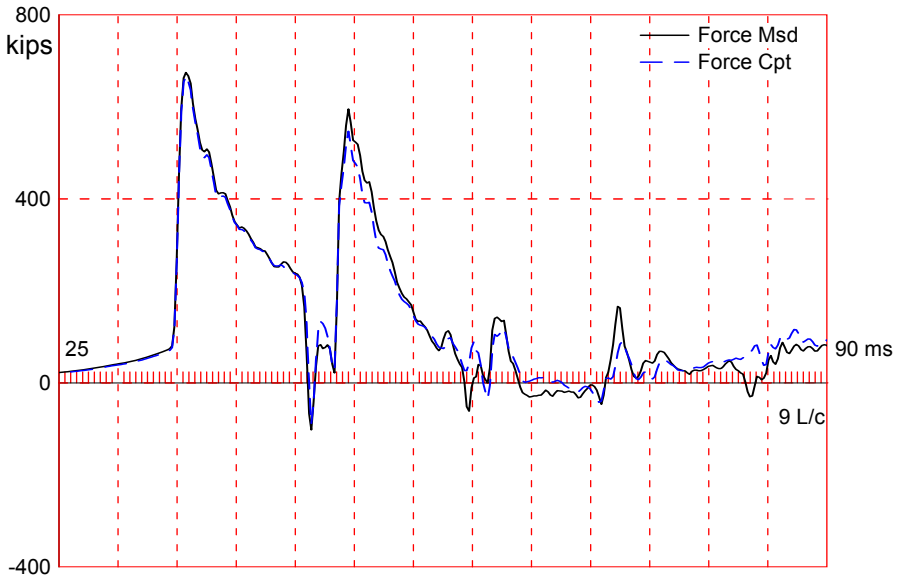
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.7	21.4	29992.2	492.000	4.70

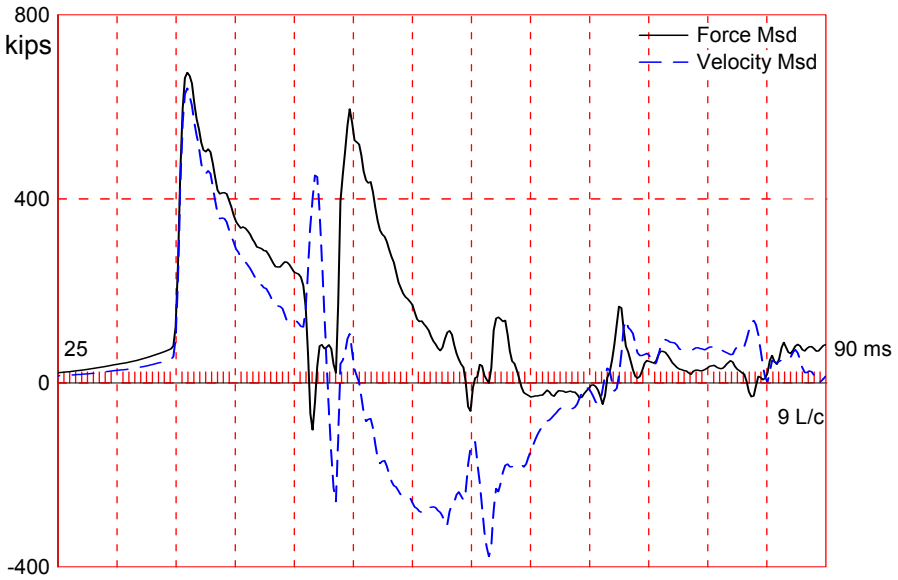
Toe Area 198.5 in^2

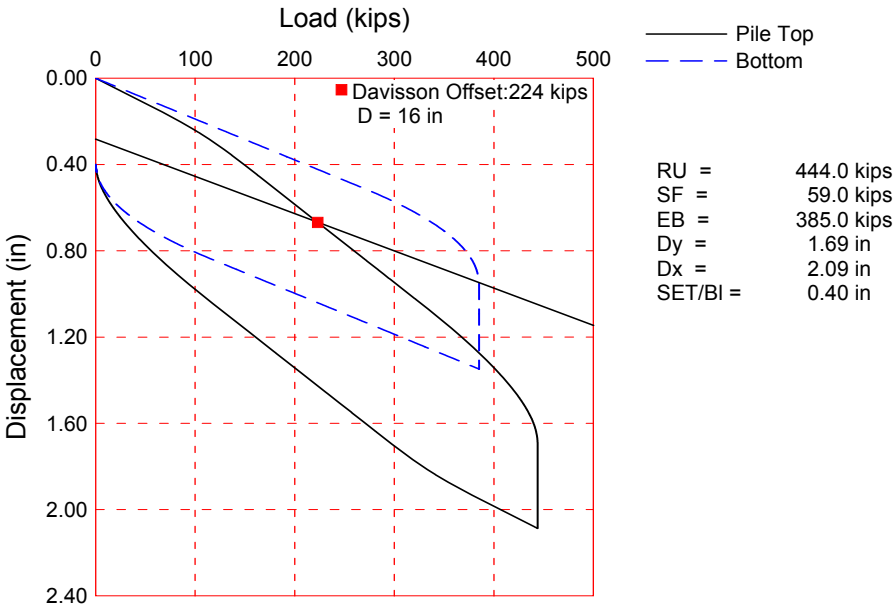
Top Segment Length 3.31 ft, Top Impedance 38 kips/ft/s

Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16847.3 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 11.0 ms
Total volume: 13.770 ft^3; Volume ratio considering added impedance: 1.000

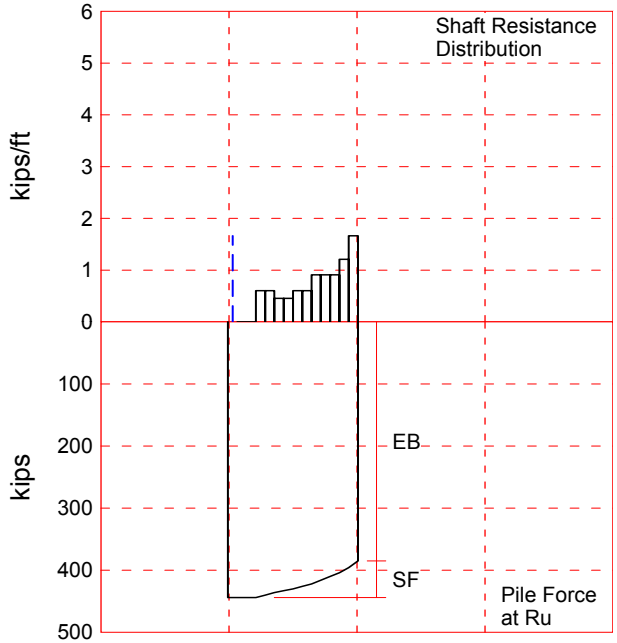
Match Quality Poor - Results May Be Unreliable!!!







RU =	444.0 kips
SF =	59.0 kips
EB =	385.0 kips
Dy =	1.69 in
Dx =	2.09 in
SET/Bl =	0.40 in



Length b. Sensors	92.5 ft
Embedment	87.9 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16818 ft/s
Match Quality	6.12
Top Compr. Stress	31.2 ksi
Max Compr. Stress	31.7 ksi
Max Tension Stress	-6.29 ksi
Avg. Shaft Quake	0.14 in
Toe Quake	0.73 in
Avg. Shaft Smith Dpg.	0.22 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.

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Match Quality Poor - Results May Be Unreliable!!!

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 444.0; along Shaft 59.0; at Toe 385.0 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
				444.0				
1	13.2	8.6	0.0	444.0	0.0	0.00	0.00	0.00
2	19.8	15.2	0.0	444.0	0.0	0.00	0.00	0.00
3	26.4	21.8	4.0	440.0	4.0	0.61	0.13	0.22
4	33.0	28.4	4.0	436.0	8.0	0.61	0.13	0.22
5	39.6	35.0	3.0	433.0	11.0	0.45	0.10	0.22
6	46.3	41.7	3.0	430.0	14.0	0.45	0.10	0.22
7	52.9	48.3	4.0	426.0	18.0	0.61	0.13	0.22
8	59.5	54.9	4.0	422.0	22.0	0.61	0.13	0.22
9	66.1	61.5	6.0	416.0	28.0	0.91	0.19	0.22
10	72.7	68.1	6.0	410.0	34.0	0.91	0.19	0.22
11	79.3	74.7	6.0	404.0	40.0	0.91	0.19	0.22
12	85.9	81.3	8.0	396.0	48.0	1.21	0.26	0.22
13	92.5	87.9	11.0	385.0	59.0	1.66	0.35	0.22
Avg. Shaft			4.5			0.67	0.14	0.22
Toe			385.0				279.29	0.11

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.14	0.73
Case Damping Factor		0.34	1.11
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	68
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake) (in)			0.19

CAPWAP match quality = 6.12 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.40 in; Blow Count = 30 b/ft
Computed: Final Set = 0.36 in; Blow Count = 33 b/ft
Transducer F3(D815) CAL: 93.0; RF: 0.97; F4(F607) CAL: 93.6; RF: 0.97
A3(K3550) CAL: 360; RF: 1.05; A4(K2524) CAL: 360; RF: 1.05

max. Top Comp. Stress = 31.2 ksi (T= 36.1 ms, max= 1.016 x Top)
max. Comp. Stress = 31.7 ksi (Z= 26.4 ft, T= 37.5 ms)
max. Tens. Stress = -6.29 ksi (Z= 79.3 ft, T= 66.2 ms)
max. Energy (EMX) = 41.2 kip-ft; max. Measured Top Displ. (DMX)= 1.37 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	667.1	-113.5	31.2	-5.30	41.2	17.0	1.37
2	6.6	667.4	-90.1	31.2	-4.21	40.7	17.0	1.35
4	13.2	668.0	-65.1	31.2	-3.04	39.7	16.9	1.32
6	19.8	670.6	-67.7	31.3	-3.16	38.8	16.8	1.27
8	26.4	677.7	-86.3	31.7	-4.03	37.8	16.6	1.23
10	33.0	665.4	-95.5	31.1	-4.46	35.9	16.5	1.18
12	39.6	651.8	-103.2	30.5	-4.82	34.0	16.3	1.14
14	46.3	643.8	-113.5	30.1	-5.30	32.3	16.1	1.09
15	49.6	634.1	-114.7	29.6	-5.36	31.1	16.0	1.07
16	52.9	636.8	-122.8	29.7	-5.74	30.7	15.9	1.04
17	56.2	622.3	-121.9	29.1	-5.69	29.2	15.8	1.02
18	59.5	625.4	-129.6	29.2	-6.05	28.8	16.6	0.99
19	62.8	612.6	-128.2	28.6	-5.99	27.3	17.1	0.97
20	66.1	615.7	-134.1	28.8	-6.26	26.9	17.2	0.94
21	69.4	593.8	-128.0	27.7	-5.98	24.9	18.3	0.92
22	72.7	596.7	-134.5	27.9	-6.28	24.5	19.7	0.89
23	76.0	574.7	-128.8	26.8	-6.02	22.6	19.8	0.87
24	79.3	577.8	-134.6	27.0	-6.29	22.3	20.5	0.84
25	82.6	554.6	-126.2	25.9	-5.90	20.5	22.0	0.81
26	85.9	509.6	-131.5	23.8	-6.14	20.2	23.6	0.79
27	89.2	500.3	-124.5	23.4	-5.82	18.0	24.3	0.76
28	92.5	525.0	-133.4	24.5	-6.23	16.5	23.2	0.74
Absolute	26.4			31.7			(T =	37.5 ms)
	79.3				-6.29		(T =	66.2 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	439.2	260.7	82.3	0.0	0.0					
RX	658.7	611.3	585.2	562.0	544.5	529.9	518.4	507.0	495.5	489.2
RU	439.2	260.7	82.3	0.0	0.0					

RAU = 440.7 (kips); RA2 = 587.1 (kips)

Current CAPWAP Ru = 444.0 (kips); Corresponding J(RP)= 0.00;

RMX requires higher damping; see PDA-W

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
17.0	35.95	648.6	682.8	682.8	1.37	0.40	0.40	40.7	551.3	713

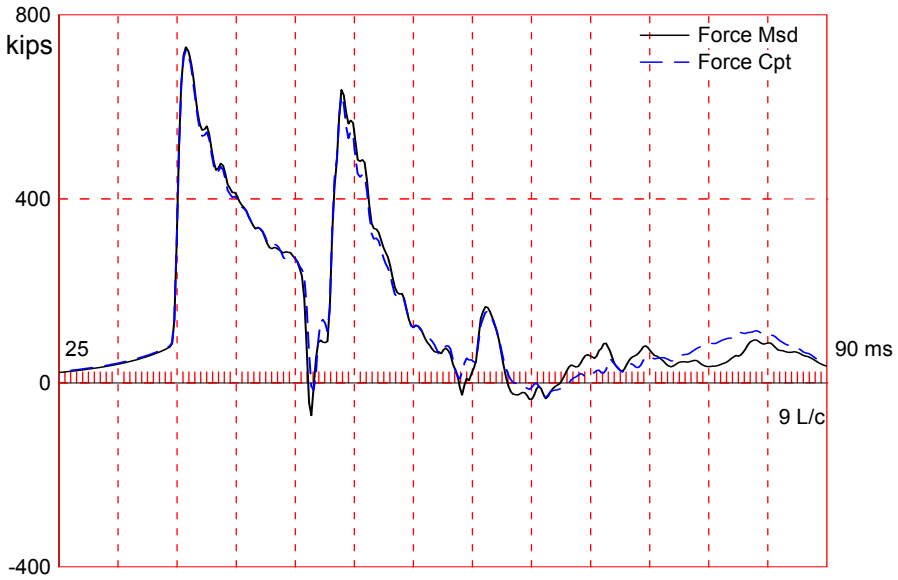
PILE PROFILE AND PILE MODEL

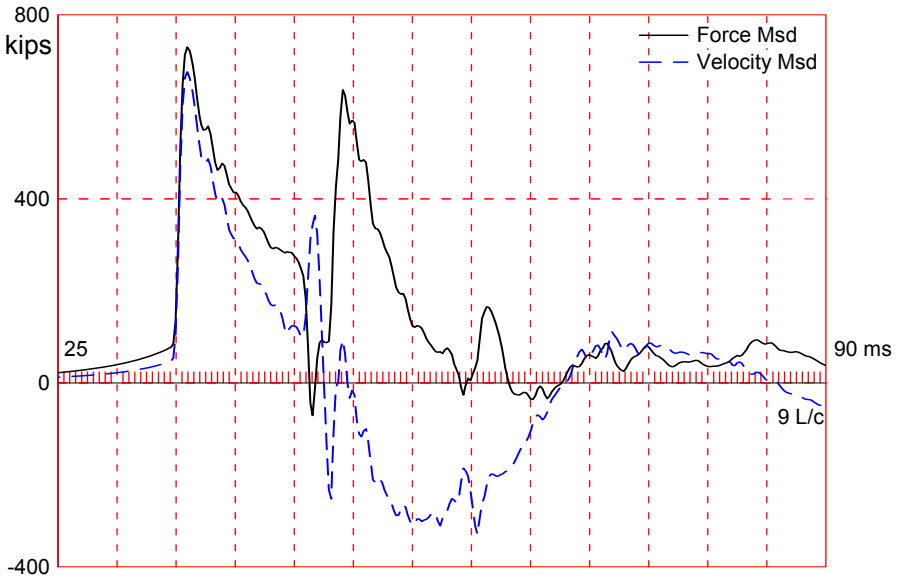
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.5	21.4	29992.2	492.000	4.70

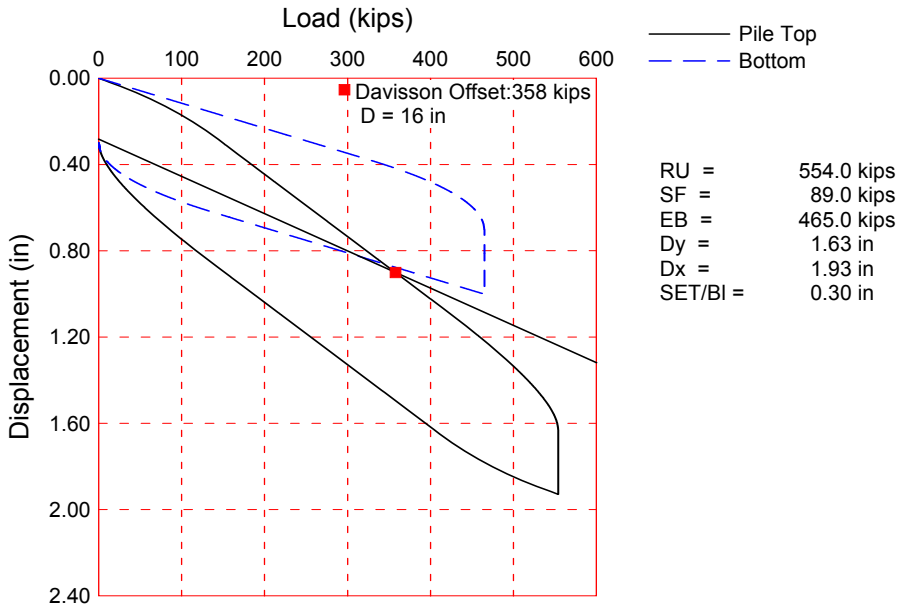
Toe Area 198.5 in^2

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

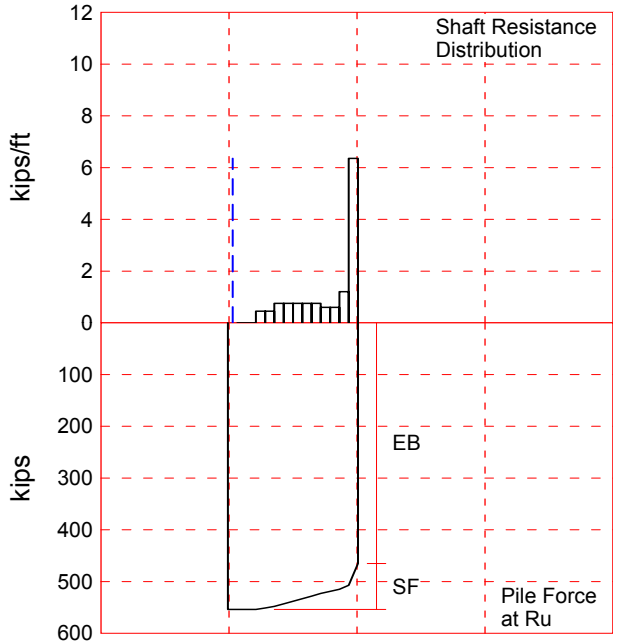
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16818.2 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 11.0 ms
Total volume: 13.747 ft^3; Volume ratio considering added impedance: 1.000







RU =	554.0 kips
SF =	89.0 kips
EB =	465.0 kips
Dy =	1.63 in
Dx =	1.93 in
SET/Bl =	0.30 in



Length b. Sensors	92.5 ft
Embedment	88.1 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.	16818 ft/s
Match Quality	4.85
Top Compr. Stress	33.8 ksi
Max Compr. Stress	34.3 ksi
Max Tension Stress	-6.89 ksi
Avg. Shaft Quake	0.04 in
Toe Quake	0.54 in
Avg. Shaft Smith Dpg.	0.22 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: 554.0; along Shaft 89.0; at Toe 465.0 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
				554.0				
1	13.2	8.8	0.0	554.0	0.0	0.00	0.00	0.00
2	19.8	15.4	0.0	554.0	0.0	0.00	0.00	0.00
3	26.4	22.1	3.0	551.0	3.0	0.45	0.10	0.22
4	33.0	28.7	3.0	548.0	6.0	0.45	0.10	0.22
5	39.6	35.3	5.0	543.0	11.0	0.76	0.16	0.22
6	46.3	41.9	5.0	538.0	16.0	0.76	0.16	0.22
7	52.9	48.5	5.0	533.0	21.0	0.76	0.16	0.22
8	59.5	55.1	5.0	528.0	26.0	0.76	0.16	0.22
9	66.1	61.7	5.0	523.0	31.0	0.76	0.16	0.22
10	72.7	68.3	4.0	519.0	35.0	0.61	0.13	0.22
11	79.3	74.9	4.0	515.0	39.0	0.61	0.13	0.22
12	85.9	81.5	8.0	507.0	47.0	1.21	0.26	0.22
13	92.5	88.1	42.0	465.0	89.0	6.36	1.35	0.22
Avg. Shaft			6.8			1.01	0.21	0.22
Toe			465.0				337.33	0.11

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.04	0.54
Case Damping Factor		0.51	1.34
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	53
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	65	
Resistance Gap (included in Toe Quake)	(in)		0.15

CAPWAP match quality = 4.85 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.30 in; Blow Count = 40 b/ft
Computed: Final Set = 0.26 in; Blow Count = 46 b/ft
Transducer F3(D815) CAL: 93.0; RF: 1.00; F4(F607) CAL: 93.6; RF: 1.00
A3(K3550) CAL: 360; RF: 1.10; A4(K2524) CAL: 360; RF: 1.10

max. Top Comp. Stress = 33.8 ksi (T= 36.1 ms, max= 1.016 x Top)
max. Comp. Stress = 34.3 ksi (Z= 26.4 ft, T= 37.5 ms)
max. Tens. Stress = -6.89 ksi (Z= 79.3 ft, T= 65.2 ms)
max. Energy (EMX) = 45.3 kip-ft; max. Measured Top Displ. (DMX)= 1.33 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	723.5	-57.6	33.8	-2.69	45.3	17.9	1.30
2	6.6	724.0	-49.4	33.8	-2.31	45.0	17.8	1.28
4	13.2	725.2	-65.9	33.9	-3.08	44.5	17.8	1.24
6	19.8	728.1	-79.9	34.0	-3.73	43.9	17.7	1.20
8	26.4	734.7	-91.5	34.3	-4.28	43.1	17.5	1.15
10	33.0	727.8	-104.2	34.0	-4.87	41.4	17.3	1.10
12	39.6	723.3	-118.3	33.8	-5.53	39.5	17.0	1.05
14	46.3	709.4	-122.9	33.1	-5.74	37.1	16.7	1.00
15	49.6	691.3	-123.7	32.3	-5.78	35.1	16.6	0.97
16	52.9	695.5	-130.4	32.5	-6.09	34.5	16.5	0.94
17	56.2	677.6	-126.6	31.7	-5.91	32.6	16.3	0.91
18	59.5	681.7	-124.8	31.8	-5.83	31.9	16.2	0.87
19	62.8	664.0	-124.3	31.0	-5.81	30.0	16.3	0.84
20	66.1	667.6	-134.3	31.2	-6.27	29.3	17.0	0.81
21	69.4	649.2	-133.9	30.3	-6.26	27.4	16.9	0.78
22	72.7	652.4	-138.8	30.5	-6.48	26.6	18.1	0.75
23	76.0	638.7	-140.5	29.8	-6.57	25.0	19.1	0.71
24	79.3	643.4	-147.5	30.1	-6.89	24.2	19.1	0.68
25	82.6	630.6	-142.4	29.5	-6.65	22.6	20.3	0.65
26	85.9	622.5	-140.9	29.1	-6.58	21.9	22.2	0.61
27	89.2	635.5	-137.4	29.7	-6.42	19.6	23.4	0.58
28	92.5	659.6	-140.8	30.8	-6.58	13.2	22.9	0.55
Absolute	26.4			34.3			(T =	37.5 ms)
	79.3				-6.89		(T =	65.2 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	550.8	377.0	203.3	29.6	0.0					
RX	772.8	717.2	679.6	652.7	631.0	610.8	590.5	572.1	557.5	543.0
RU	550.8	377.0	203.3	29.6	0.0					

RAU = 486.2 (kips); RA2 = 685.3 (kips)

Current CAPWAP Ru = 554.0 (kips); Corresponding J(RP)= 0.00; J(RX) = 1.65

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
17.9	35.95	685.3	734.1	734.1	1.33	0.30	0.30	45.4	669.2	1192

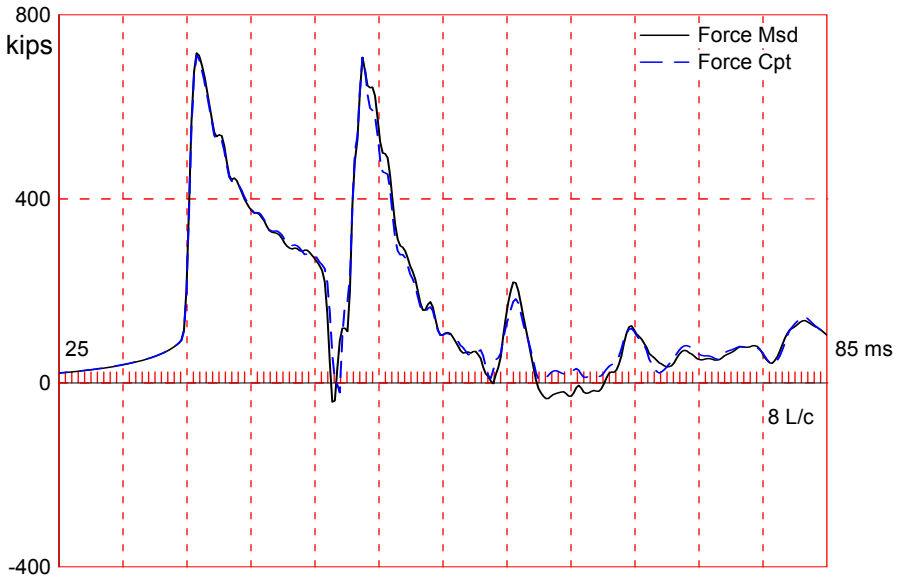
PILE PROFILE AND PILE MODEL

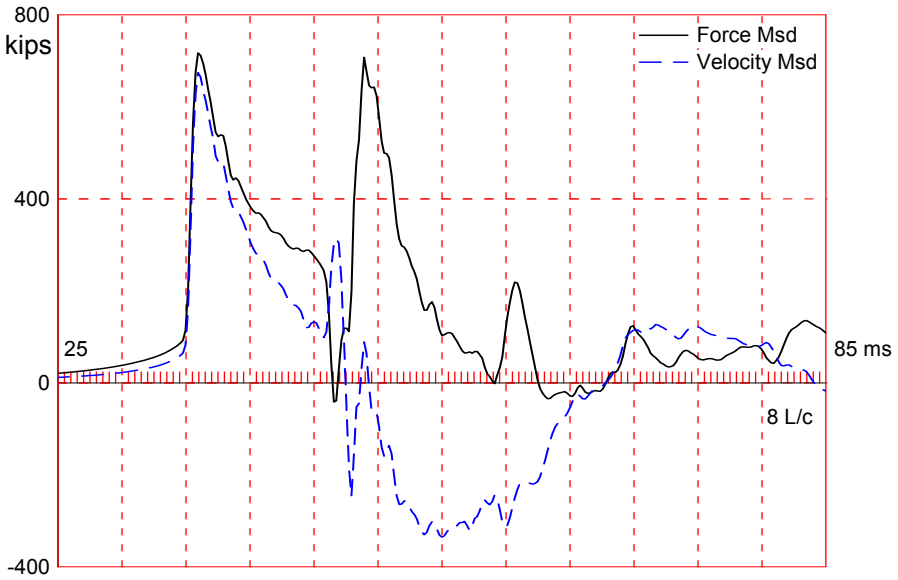
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.5	21.4	29992.2	492.000	4.70

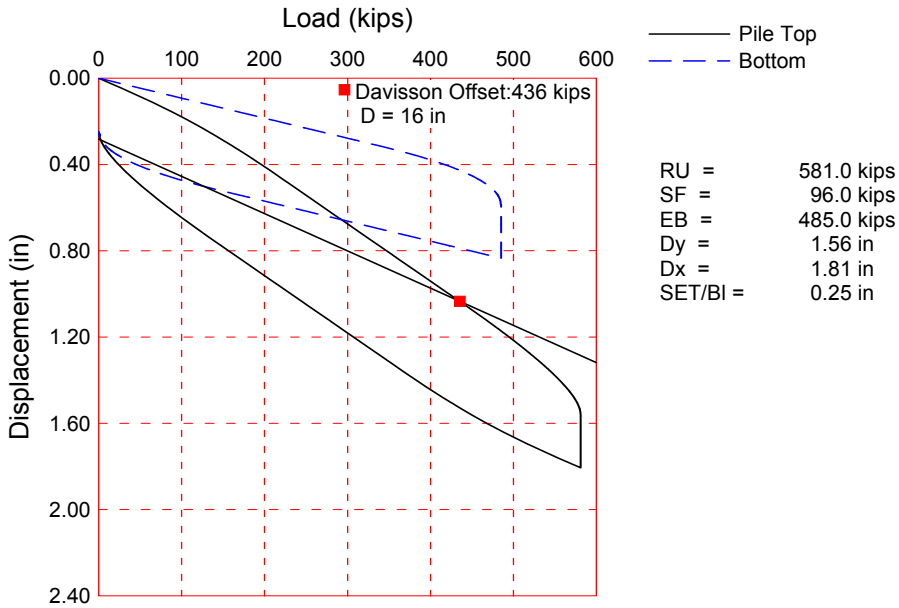
Toe Area 198.5 in^2

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

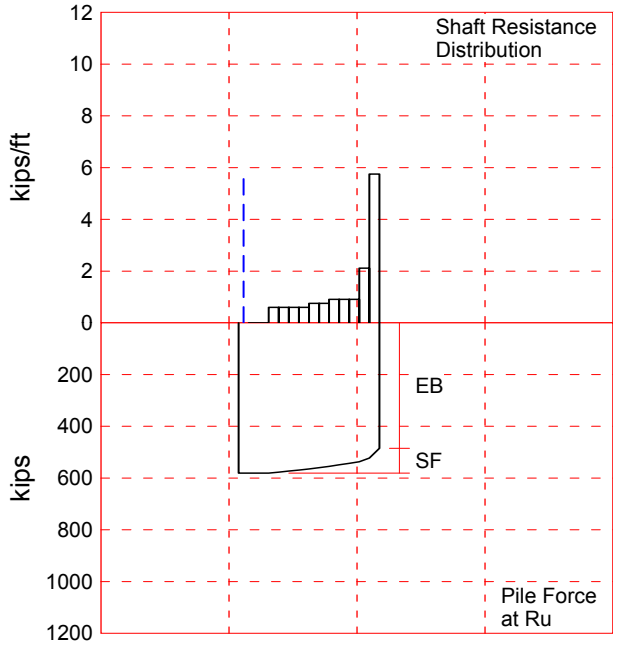
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16818.2 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 11.0 ms
Total volume: 13.747 ft^3; Volume ratio considering added impedance: 1.000







RU =	581.0 kips
SF =	96.0 kips
EB =	485.0 kips
Dy =	1.56 in
Dx =	1.81 in
SET/Bl =	0.25 in



Length b. Sensors	92.5 ft
Embedment	87.9 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16818 ft/s
Match Quality	4.30
Top Compr. Stress	33.3 ksi
Max Compr. Stress	33.8 ksi
Max Tension Stress	-5.87 ksi
Avg. Shaft Quake	0.08 in
Toe Quake	0.45 in
Avg. Shaft Smith Dpg.	0.23 s/ft
Toe Smith Damping	0.15 s/ft

About the CAPWAP Results

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CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 581.0; along Shaft 96.0; at Toe 485.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				581.0				
1	13.2	8.6	0.0	581.0	0.0	0.00	0.00	0.00
2	19.8	15.2	0.0	581.0	0.0	0.00	0.00	0.00
3	26.4	21.8	4.0	577.0	4.0	0.61	0.13	0.23
4	33.0	28.5	4.0	573.0	8.0	0.61	0.13	0.23
5	39.6	35.1	4.0	569.0	12.0	0.61	0.13	0.23
6	46.3	41.7	4.0	565.0	16.0	0.61	0.13	0.23
7	52.9	48.3	5.0	560.0	21.0	0.76	0.16	0.23
8	59.5	54.9	5.0	555.0	26.0	0.76	0.16	0.23
9	66.1	61.5	6.0	549.0	32.0	0.91	0.19	0.23
10	72.7	68.1	6.0	543.0	38.0	0.91	0.19	0.23
11	79.3	74.7	6.0	537.0	44.0	0.91	0.19	0.23
12	85.9	81.3	14.0	523.0	58.0	2.12	0.45	0.23
13	92.5	87.9	38.0	485.0	96.0	5.75	1.22	0.23
Avg. Shaft			7.4			1.09	0.23	0.23
Toe			485.0				351.84	0.15

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.08	0.45
Case Damping Factor		0.58	1.90
Damping Type		Viscous	Smith
Unloading Quake	(% of loading quake)	91	152
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	98	
Resistance Gap (included in Toe Quake)	(in)		0.22

CAPWAP match quality = 4.30 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.25 in; Blow Count = 48 b/ft
Computed: Final Set = 0.22 in; Blow Count = 55 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 = 33.3 ksi (T= 36.1 ms, max= 1.016 x Top)
max. Comp. Stress = 33.8 ksi (Z= 26.4 ft, T= 37.5 ms)
max. Tens. Stress = -5.87 ksi (Z= 79.3 ft, T= 67.4 ms)
max. Energy (EMX) = 43.3 kip-ft; max. Measured Top Displ. (DMX)= 1.30 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	712.6	-43.0	33.3	-2.01	43.3	17.8	1.28
2	6.6	713.0	-32.3	33.3	-1.51	43.1	17.7	1.26
4	13.2	713.9	-35.9	33.4	-1.68	42.6	17.7	1.22
6	19.8	716.0	-49.7	33.5	-2.32	41.9	17.6	1.18
8	26.4	724.2	-63.0	33.8	-2.94	41.0	17.3	1.13
10	33.0	712.4	-65.1	33.3	-3.04	38.9	17.0	1.08
12	39.6	701.3	-72.0	32.8	-3.37	36.7	16.8	1.02
14	46.3	691.5	-80.4	32.3	-3.76	34.4	16.5	0.96
15	49.6	677.9	-77.4	31.7	-3.61	32.7	16.3	0.93
16	52.9	682.7	-77.5	31.9	-3.62	32.0	16.2	0.90
17	56.2	664.6	-82.1	31.0	-3.84	30.0	16.1	0.87
18	59.5	670.0	-89.2	31.3	-4.17	29.2	15.9	0.83
19	62.8	652.7	-89.4	30.5	-4.17	27.2	15.7	0.80
20	66.1	658.0	-95.8	30.7	-4.47	26.3	15.6	0.76
21	69.4	636.1	-108.1	29.7	-5.05	24.1	15.8	0.72
22	72.7	640.7	-123.2	29.9	-5.76	23.2	16.9	0.69
23	76.0	618.9	-125.5	28.9	-5.86	21.0	18.1	0.65
24	79.3	632.9	-125.8	29.6	-5.87	20.0	18.3	0.61
25	82.6	645.0	-107.1	30.1	-5.01	17.9	19.4	0.57
26	85.9	684.1	-90.4	32.0	-4.22	17.0	20.9	0.54
27	89.2	681.4	-59.5	31.8	-2.78	13.9	22.1	0.50
28	92.5	702.2	-52.3	32.8	-2.44	8.8	22.7	0.47
Absolute	26.4			33.8			(T =	37.5 ms)
	79.3				-5.87		(T =	67.4 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	578.6	412.9	247.1	81.4	0.0					
RX	847.6	792.9	746.4	730.8	719.7	708.7	697.7	686.7	675.7	664.7
RU	578.6	412.9	247.1	81.4	0.0					

RAU = 478.7 (kips); RA2 = 765.0 (kips)

Current CAPWAP Ru = 581.0 (kips); Corresponding J(RP)= 0.00;

RMX requires higher damping; see PDA-W

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
17.9	35.95	683.3	724.0	724.0	1.30	0.25	0.25	43.6	673.3	2109

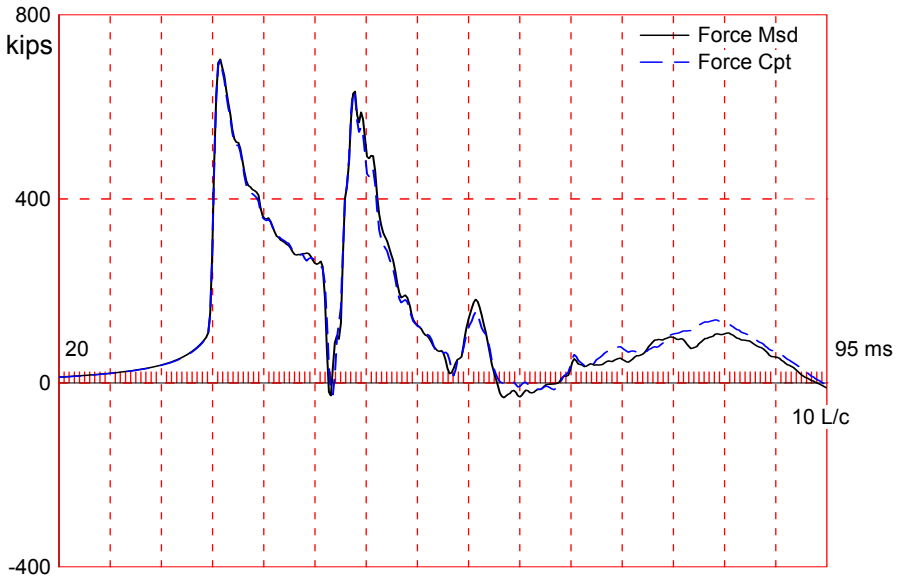
PILE PROFILE AND PILE MODEL

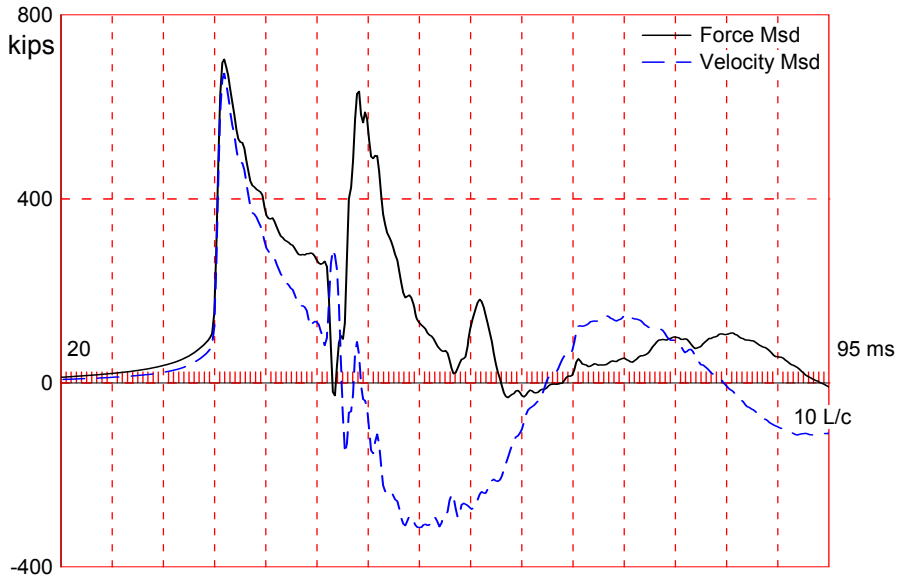
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.5	21.4	29992.2	492.000	4.70

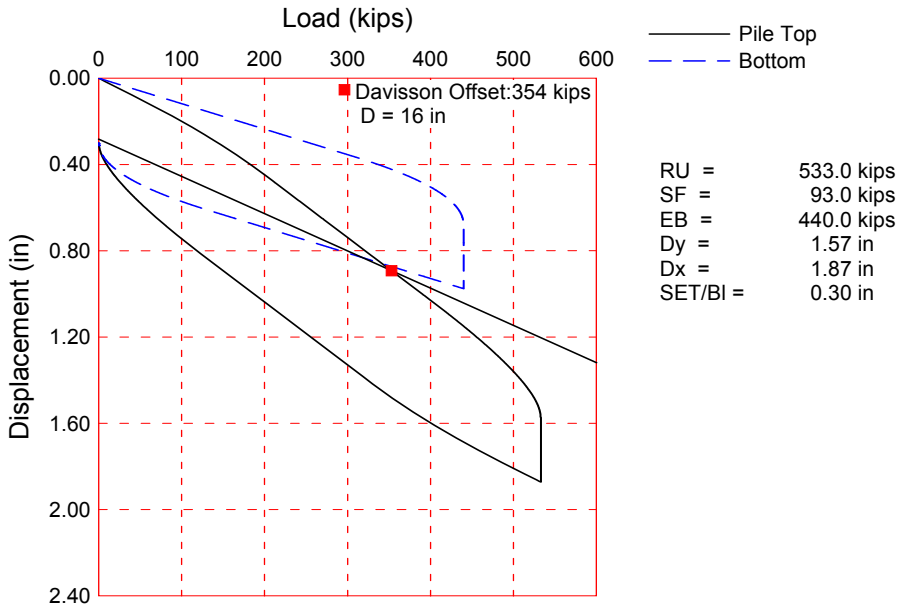
Toe Area 198.5 in^2

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

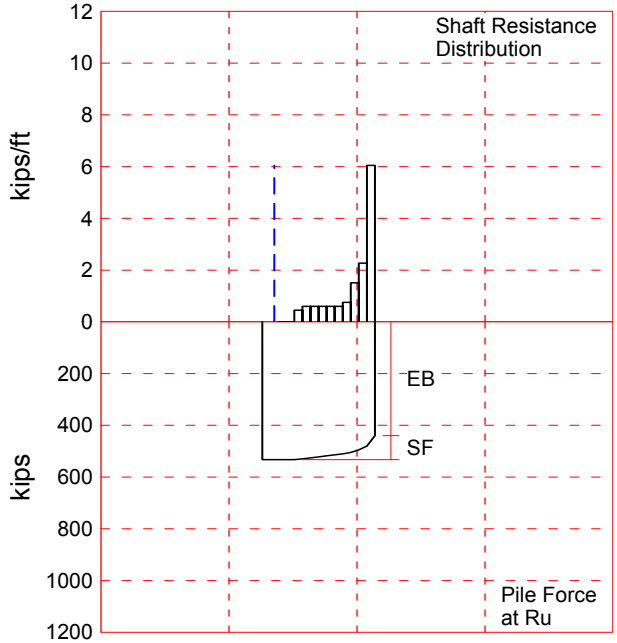
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16818.2 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 11.0 ms
Total volume: 13.747 ft^3; Volume ratio considering added impedance: 1.000







RU =	533.0 kips
SF =	93.0 kips
EB =	440.0 kips
Dy =	1.57 in
Dx =	1.87 in
SET/BI =	0.30 in



Length b. Sensors	92.6 ft
Embedment	81.5 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.	16833 ft/s
Match Quality	4.19
Top Compr. Stress	32.8 ksi
Max Compr. Stress	33.4 ksi
Max Tension Stress	-6.16 ksi
Avg. Shaft Quake	0.10 in
Toe Quake	0.52 in
Avg. Shaft Smith Dpg.	0.24 s/ft
Toe Smith Damping	0.14 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: 533.0; along Shaft 93.0; at Toe 440.0 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
				533.0				
1	19.8	8.7	0.0	533.0	0.0	0.00	0.00	0.00
2	26.5	15.4	0.0	533.0	0.0	0.00	0.00	0.00
3	33.1	22.0	3.0	530.0	3.0	0.45	0.10	0.24
4	39.7	28.6	4.0	526.0	7.0	0.60	0.13	0.24
5	46.3	35.2	4.0	522.0	11.0	0.60	0.13	0.24
6	52.9	41.8	4.0	518.0	15.0	0.60	0.13	0.24
7	59.5	48.4	4.0	514.0	19.0	0.60	0.13	0.24
8	66.1	55.0	4.0	510.0	23.0	0.60	0.13	0.24
9	72.7	61.6	5.0	505.0	28.0	0.76	0.16	0.24
10	79.4	68.3	10.0	495.0	38.0	1.51	0.32	0.24
11	86.0	74.9	15.0	480.0	53.0	2.27	0.48	0.24
12	92.6	81.5	40.0	440.0	93.0	6.05	1.29	0.24
Avg. Shaft			7.8			1.14	0.24	0.24
Toe			440.0				319.19	0.14

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.10	0.52
Case Damping Factor		0.58	1.61
Damping Type		Viscous	Smith
Unloading Quake	(% of loading quake)	92	76
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake) (in)			0.24

CAPWAP match quality = 4.19 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.30 in; Blow Count = 40 b/ft
Computed: Final Set = 0.26 in; Blow Count = 46 b/ft
Transducer F3(F607) CAL: 93.6; RF: 0.98; F4(D815) CAL: 93.0; RF: 0.98
A3(K2524) CAL: 360; RF: 1.02; A4(K3550) CAL: 360; RF: 1.02

max. Top Comp. Stress = 32.8 ksi (T= 36.1 ms, max= 1.020 x Top)
max. Comp. Stress = 33.4 ksi (Z= 33.1 ft, T= 37.9 ms)
max. Tens. Stress = -6.16 ksi (Z= 72.7 ft, T= 67.6 ms)
max. Energy (EMX) = 42.6 kip-ft; max. Measured Top Displ. (DMX)= 1.30 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	701.4	-39.5	32.8	-1.85	42.6	17.7	1.31
2	6.6	702.0	-42.1	32.8	-1.97	42.4	17.6	1.29
4	13.2	703.3	-48.8	32.9	-2.28	41.9	17.6	1.25
6	19.8	704.9	-71.0	32.9	-3.32	41.3	17.5	1.21
8	26.5	708.1	-87.4	33.1	-4.08	40.4	17.4	1.16
10	33.1	715.8	-109.6	33.4	-5.12	39.5	17.2	1.11
12	39.7	709.2	-117.3	33.1	-5.48	37.6	17.0	1.05
14	46.3	697.6	-126.6	32.6	-5.91	35.3	16.7	1.00
15	49.6	682.5	-121.7	31.9	-5.68	33.6	16.6	0.97
16	52.9	686.2	-116.2	32.1	-5.43	33.0	16.5	0.94
17	56.2	671.1	-106.5	31.4	-4.98	31.3	16.3	0.90
18	59.5	674.5	-111.0	31.5	-5.19	30.6	16.2	0.87
19	62.8	659.4	-112.0	30.8	-5.23	28.9	16.1	0.84
20	66.1	663.0	-120.8	31.0	-5.64	28.1	16.0	0.81
21	69.4	648.8	-125.8	30.3	-5.88	26.4	15.9	0.77
22	72.7	654.1	-131.9	30.6	-6.16	25.6	16.4	0.74
23	76.0	639.7	-123.4	29.9	-5.76	23.7	17.4	0.70
24	79.4	646.9	-114.0	30.2	-5.33	22.9	17.8	0.67
25	82.7	610.6	-97.2	28.5	-4.54	20.1	19.0	0.64
26	86.0	628.8	-100.8	29.4	-4.71	19.4	20.4	0.60
27	89.3	625.6	-73.6	29.2	-3.44	15.9	21.7	0.57
28	92.6	647.6	-64.3	30.3	-3.00	9.8	22.3	0.54
Absolute	33.1			33.4			(T =	37.9 ms)
	72.7				-6.16		(T =	67.6 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	572.4	408.3	244.1	79.9	0.0					
RX	777.8	714.8	680.1	668.9	657.7	646.5	635.3	624.1	612.9	601.7
RU	572.4	408.3	244.1	79.9	0.0					

RAU = 488.4 (kips); RA2 = 703.9 (kips)

Current CAPWAP Ru = 533.0 (kips); Corresponding J(RP)= 0.05;

RMX requires higher damping; see PDA-W

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
17.8	35.95	680.6	712.7	712.7	1.30	0.30	0.30	42.8	642.0	1571

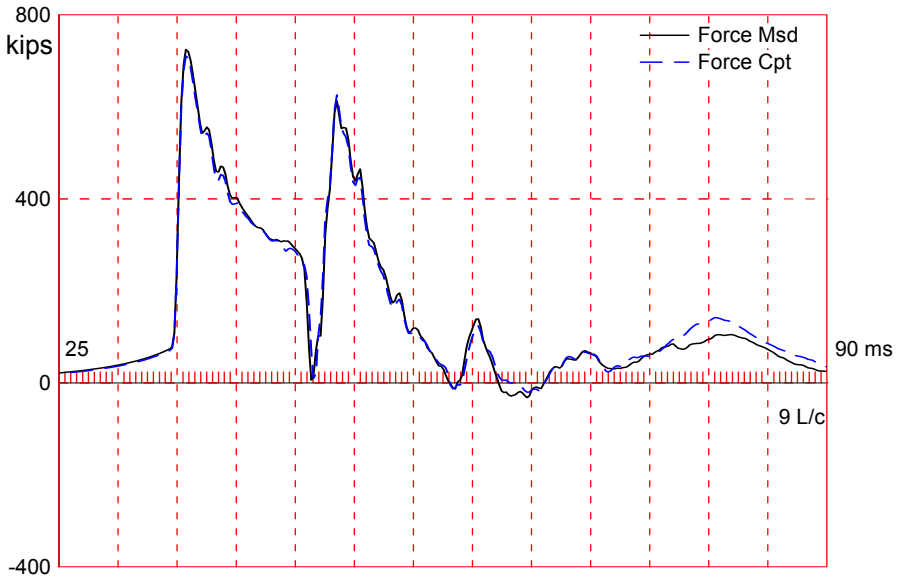
PILE PROFILE AND PILE MODEL

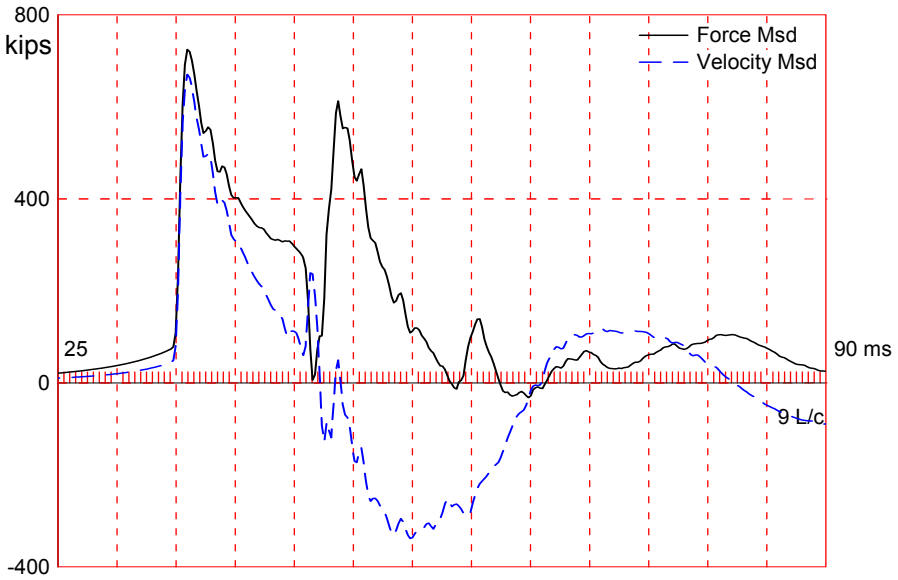
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.6	21.4	29992.2	492.000	4.70

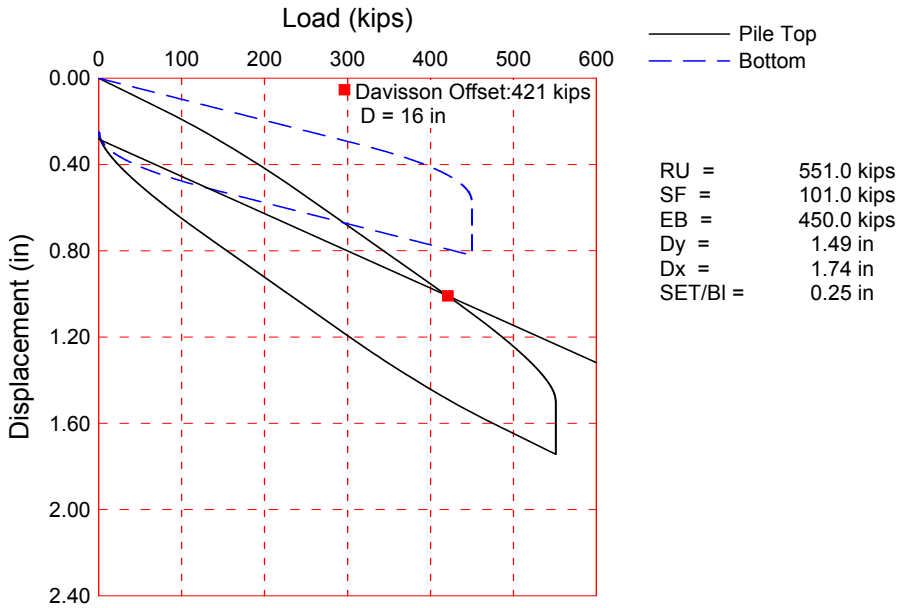
Toe Area 198.5 in^2

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

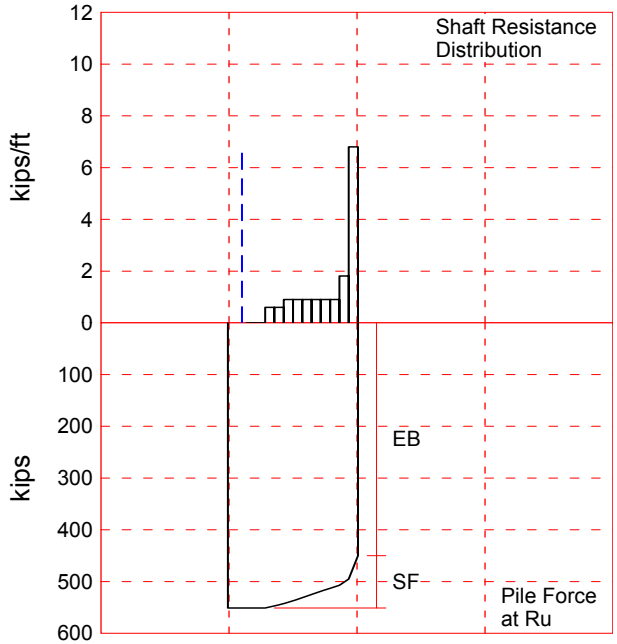
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16832.7 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 11.0 ms
Total volume: 13.758 ft^3; Volume ratio considering added impedance: 1.000







RU =	551.0 kips
SF =	101.0 kips
EB =	450.0 kips
Dy =	1.49 in
Dx =	1.74 in
SET/Bl =	0.25 in



Length b. Sensors	92.6 ft
Embedment	81.7 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.	16833 ft/s
Match Quality	3.78
Top Compr. Stress	33.2 ksi
Max Compr. Stress	33.9 ksi
Max Tension Stress	-5.67 ksi
Avg. Shaft Quake	0.11 in
Toe Quake	0.44 in
Avg. Shaft Smith Dpg.	0.26 s/ft
Toe Smith Damping	0.17 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.

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

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

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 551.0; along Shaft 101.0; 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	Smith Damping Factor s/ft
				551.0				
1	19.8	8.9	0.0	551.0	0.0	0.00	0.00	0.00
2	26.5	15.5	0.0	551.0	0.0	0.00	0.00	0.00
3	33.1	22.2	4.0	547.0	4.0	0.60	0.13	0.26
4	39.7	28.8	4.0	543.0	8.0	0.60	0.13	0.26
5	46.3	35.4	6.0	537.0	14.0	0.91	0.19	0.26
6	52.9	42.0	6.0	531.0	20.0	0.91	0.19	0.26
7	59.5	48.6	6.0	525.0	26.0	0.91	0.19	0.26
8	66.1	55.2	6.0	519.0	32.0	0.91	0.19	0.26
9	72.7	61.8	6.0	513.0	38.0	0.91	0.19	0.26
10	79.4	68.4	6.0	507.0	44.0	0.91	0.19	0.26
11	86.0	75.1	12.0	495.0	56.0	1.81	0.39	0.26
12	92.6	81.7	45.0	450.0	101.0	6.80	1.45	0.26
Avg. Shaft			8.4			1.24	0.26	0.26
Toe			450.0				326.45	0.17

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.11	0.44
Case Damping Factor		0.69	2.00
Damping Type		Viscous	Smith
Unloading Quake	(% of loading quake)	100	40
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake) (in)			0.16

CAPWAP match quality = 3.78 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.25 in; Blow Count = 48 b/ft
Computed: Final Set = 0.21 in; Blow Count = 56 b/ft
Transducer F3(F607) CAL: 93.6; RF: 1.00; F4(D815) CAL: 93.0; RF: 1.00
A3(K2524) CAL: 360; RF: 1.06; A4(K3550) CAL: 360; RF: 1.06

max. Top Comp. Stress = 33.2 ksi (T= 36.1 ms, max= 1.021 x Top)
max. Comp. Stress = 33.9 ksi (Z= 33.1 ft, T= 38.1 ms)
max. Tens. Stress = -5.67 ksi (Z= 59.5 ft, T= 62.9 ms)
max. Energy (EMX) = 44.9 kip-ft; max. Measured Top Displ. (DMX)= 1.24 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	711.1	-36.2	33.2	-1.69	44.9	17.9	1.26
2	6.6	711.4	-44.5	33.2	-2.08	44.7	17.9	1.25
4	13.2	712.2	-60.5	33.3	-2.82	44.2	17.8	1.21
6	19.8	713.2	-82.2	33.3	-3.84	43.5	17.8	1.16
8	26.5	716.3	-92.1	33.5	-4.30	42.6	17.7	1.11
10	33.1	726.2	-105.1	33.9	-4.91	41.6	17.4	1.06
12	39.7	716.7	-100.1	33.5	-4.68	39.2	17.1	1.00
14	46.3	709.2	-108.4	33.1	-5.06	36.7	16.7	0.94
15	49.6	684.2	-113.6	32.0	-5.31	34.3	16.4	0.91
16	52.9	691.2	-115.7	32.3	-5.41	33.6	16.3	0.87
17	56.2	666.7	-114.0	31.1	-5.32	31.3	16.1	0.84
18	59.5	673.5	-121.3	31.5	-5.67	30.5	15.9	0.81
19	62.8	649.4	-112.8	30.3	-5.27	28.2	15.7	0.77
20	66.1	655.8	-115.6	30.6	-5.40	27.3	15.5	0.74
21	69.4	632.0	-105.2	29.5	-4.91	25.1	15.3	0.70
22	72.7	638.2	-105.7	29.8	-4.94	24.2	15.7	0.66
23	76.0	622.4	-95.0	29.1	-4.44	22.1	16.5	0.63
24	79.4	641.1	-100.0	30.0	-4.67	21.2	16.5	0.59
25	82.7	648.6	-91.3	30.3	-4.26	19.3	17.9	0.56
26	86.0	684.1	-93.8	32.0	-4.38	18.5	19.4	0.52
27	89.3	678.2	-72.1	31.7	-3.37	15.9	20.4	0.49
28	92.6	698.3	-73.6	32.6	-3.44	10.4	19.5	0.46
Absolute	33.1			33.9			(T =	38.1 ms)
	59.5				-5.67		(T =	62.9 ms)

CASE METHOD

J =	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
RP	656.3	506.9	357.6	208.2	58.9					
RX	828.6	767.8	717.3	680.0	654.9	631.2	608.2	586.7	573.0	561.5
RU	656.3	506.9	357.6	208.2	58.9					

RAU = 493.8 (kips); RA2 = 672.0 (kips)

Current CAPWAP Ru = 551.0 (kips); Corresponding J(RP)= 0.14; J(RX) = 1.98

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
17.7	35.95	675.7	727.4	728.8	1.24	0.25	0.25	44.8	721.5	1607

PILE PROFILE AND PILE MODEL

Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
92.6	21.4	29992.2	492.000	4.70

Toe Area 198.5 in^2

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

Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16832.7 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 11.0 ms
Total volume: 13.758 ft^3; Volume ratio considering added impedance: 1.000