GRL Engineers, Inc.

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TRANSMITTAL

To: Mr. Kevin Weber	From: Travis Coleman
Company: Lunda Construction Co.	No. of Sheets: 29
E-mail: kweber@lundaconstruction.com	Date: March 12, 2015

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

On March 10, 2015, East Abutment #3 and East Abutment #9 at the above structure were dynamically tested during initial driving. The piles were tested during restrike on March 11. Project plans indicated the piles have a required driving resistance, or ultimate capacity, of 480 kips (240 tons) and are oriented vertically and 1H:4V battered. The piles have a required minimum tip elevation of EL 700. The HP 14x73 H-piles were equipped with driving shoes and were driven with an APE D30-42 hammer (number PD 0234) reportedly operated on fuel setting 4.

East Abutment #3 was driven from a surface grade of EL 765.8 to a depth of 61.8 feet, which corresponds to a pile tip elevation of EL 704.0. The blow count over the final increment of driving was 10 blows for 2.125 inches of penetration at an average hammer stroke of 8.4 feet. The blow count at the beginning of restrike was 5 blows for 0.75 inches of penetration at an average hammer stroke of 8.9 feet.

East Abutment #9 was driven from a surface grade of EL 768.0 to a depth of 64.1 feet, which corresponds to a pile tip elevation of EL 703.9. The blow count over the final increment of driving was 37 blows per foot at an average hammer stroke of 8.7 feet. The blow count at the beginning of restrike was 5 blows for 0.875 inches of penetration at an average hammer stroke of 9.3 feet.

Our driving recommendations have been prepared on a blows-per-foot basis. For the 480 kip piles driven with an APE D30-42 hammer (PD 0234) in the East Abutment of the USH 10 bridge over Little Lake Butte des Morts we recommend using the following criteria:

Field Observed Hammer Stroke (feet)	Vertical Piles Recommended Minimum Blow Count (blows per foot)	1H:4V Batter Piles Recommended Minimum Blow Count (blows per foot)
7.5	46	48
8.0	44	43
8.5	36	38
9.0	33	34

We recommend the above blow counts at the required stroke be maintained for **two consecutive feet** of driving. We recommend immediately terminating driving **if the blow counts exceed 10** blows per inch or less at hammer strokes of 8.0 feet. We anticipate the production piles will terminate at depths similar to those of the test piles. Please note the tested piles had a tip elevation of approximately 4 feet above the minimum required pile tip elevation. Based upon the dynamic test results, we request the designer allow the minimum pile tip elevation to be revised to EL 705.

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.

Alex McCaskill, E.I.

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

Attachments:

Dynamic Test Results - (pages 3 – 15)
CAPWAP Analysis Results - (pages 16 – 29)

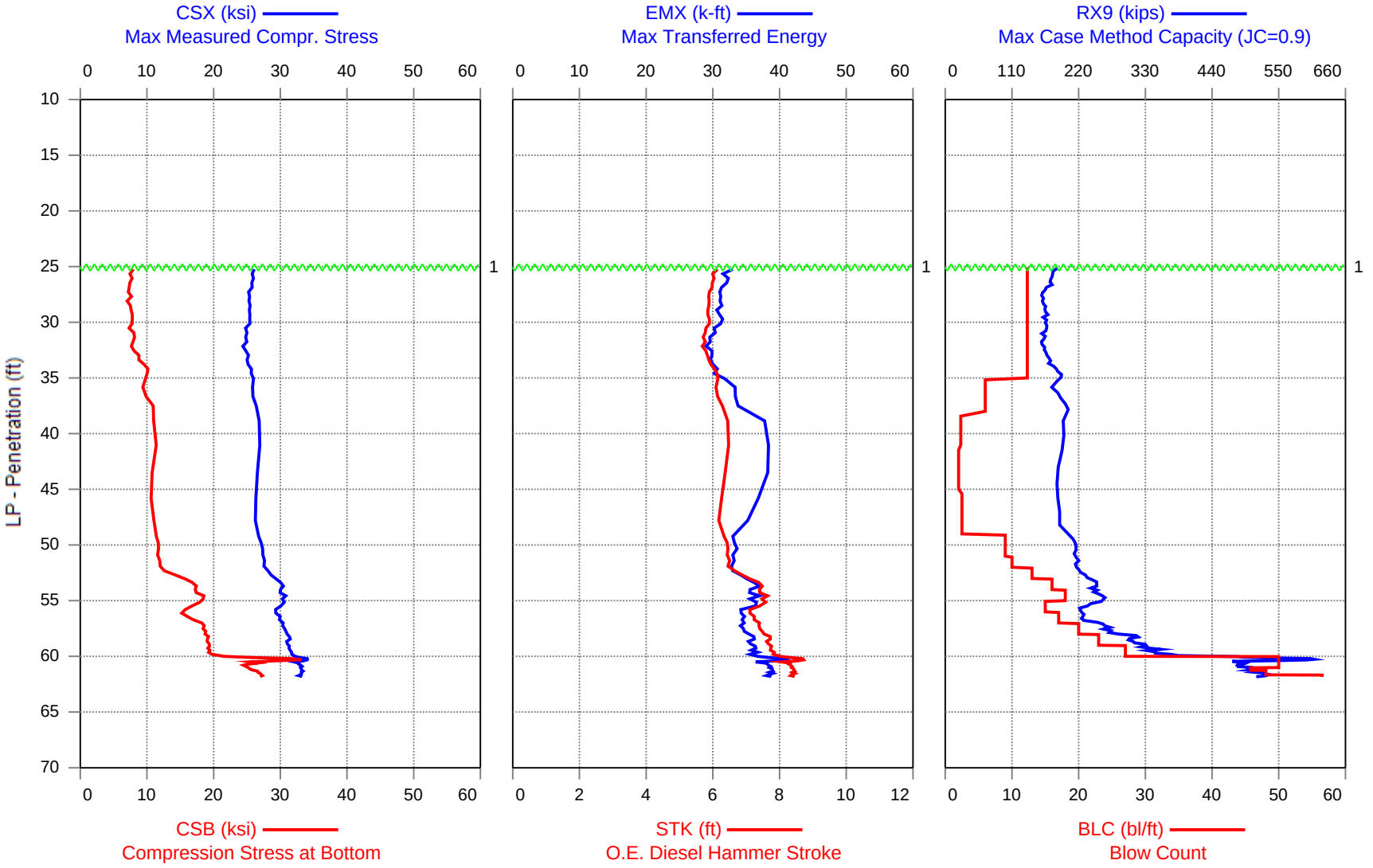
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 12-March-2015

Test started: 10-March-2015

USH 10 over Little Lake Butte des Morts - East Abutment #3

APE D30-42, HP 14 x 73



1 - Reported reference at El. 765.79

USH 10 over Little Lake Butte des Morts - East Abutment #3 APE D30-42, HP 14 x 73
OP: AM Date: 10-March-2015

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

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

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
123	35.00	12	AV123	25.3	8.1	31	5.9	48.3	169
			STD	0.6	1.0	1	0.2	0.6	10
			MAX	27.0	10.8	35	6.4	49.7	201
			MIN	24.0	6.8	28	5.6	46.6	154
129	36.00	6	AV6	25.8	9.5	33	6.1	47.6	180
			STD	0.6	0.3	2	0.2	0.6	6
			MAX	26.6	9.8	35	6.3	48.4	185
			MIN	24.9	9.1	31	5.9	47.0	167
135	37.00	6	AV6	25.9	9.8	33	6.2	47.4	188
			STD	0.7	0.6	2	0.2	0.7	4
			MAX	27.0	10.5	36	6.4	48.6	195
			MIN	24.7	9.1	30	5.8	46.4	182
141	38.00	6	AV6	26.4	11.0	34	6.3	46.9	200
			STD	0.5	0.5	1	0.1	0.4	4
			MAX	27.2	11.7	35	6.5	47.4	206
			MIN	25.7	10.1	33	6.1	46.1	195
148	41.00	2	AV7	27.0	11.2	39	6.5	46.2	195
			STD	0.4	0.4	1	0.1	0.4	4
			MAX	27.5	11.7	41	6.6	46.9	199
			MIN	26.4	10.4	37	6.3	45.7	188
156	45.00	2	AV8	26.6	10.9	38	6.4	46.6	187
			STD	0.4	0.4	1	0.1	0.4	4
			MAX	27.3	11.5	40	6.5	47.2	192
			MIN	25.9	10.4	37	6.2	46.1	180
166	49.00	3	AV10	26.3	10.9	36	6.2	47.2	189
			STD	0.7	0.4	2	0.2	0.7	6
			MAX	27.9	11.9	39	6.6	48.6	199
			MIN	25.1	10.2	33	5.8	45.8	177
175	50.00	9	AV9	26.9	11.6	33	6.4	46.5	212
			STD	0.6	0.4	1	0.1	0.4	5
			MAX	28.1	12.3	35	6.6	47.1	222
			MIN	26.1	10.7	31	6.2	45.7	206
184	51.00	9	AV9	27.4	11.6	33	6.4	46.3	214
			STD	0.6	0.3	1	0.2	0.6	5
			MAX	28.3	12.1	36	6.8	47.1	222
			MIN	26.5	11.2	31	6.2	45.3	207
194	52.00	10	AV10	27.6	12.0	33	6.5	46.2	217
			STD	0.5	0.3	1	0.1	0.5	5
			MAX	28.3	12.8	34	6.7	47.4	223
			MIN	26.4	11.6	31	6.1	45.6	207
207	53.00	13	AV13	28.4	13.6	34	6.8	45.3	226
			STD	0.8	1.3	2	0.3	0.8	7
			MAX	30.2	15.8	37	7.4	46.6	238
			MIN	27.4	11.9	31	6.4	43.4	216
223	54.00	16	AV16	30.0	16.9	36	7.4	43.5	246

USH 10 over Little Lake Butte des Morts - East Abutment #3 APE D30-42, HP 14 x 73
OP: AM Date: 10-March-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			STD	0.4	0.6	1	0.1	0.4	5
			MAX	30.9	17.8	38	7.6	44.3	252
			MIN	29.3	15.8	34	7.1	42.9	237
241	55.00	18	AV18	30.4	18.1	36	7.5	43.1	256
			STD	0.5	0.6	1	0.2	0.5	7
			MAX	31.3	19.0	38	7.8	44.0	265
			MIN	29.3	17.2	34	7.2	42.2	242
256	56.00	15	AV15	29.9	16.6	36	7.3	43.6	232
			STD	0.7	1.0	1	0.3	0.7	12
			MAX	30.9	18.6	37	7.7	44.8	259
			MIN	28.7	15.3	33	6.9	42.5	216
273	57.00	17	AV17	29.9	16.4	35	7.2	43.8	232
			STD	0.5	1.1	1	0.2	0.5	10
			MAX	30.7	19.1	36	7.5	44.9	256
			MIN	28.8	15.0	33	6.9	43.1	219
293	58.00	20	AV20	30.6	18.6	35	7.4	43.3	268
			STD	0.5	0.4	1	0.1	0.4	8
			MAX	31.2	19.3	36	7.6	44.1	287
			MIN	29.6	17.8	33	7.1	42.9	257
316	59.00	23	AV23	31.2	19.2	36	7.7	42.6	313
			STD	0.5	0.4	1	0.2	0.4	12
			MAX	32.3	20.0	37	7.9	44.0	351
			MIN	30.0	18.1	34	7.2	41.9	293
343	60.00	27	AV27	31.6	19.5	36	7.8	42.3	351
			STD	0.5	0.6	1	0.1	0.3	25
			MAX	32.6	20.6	38	7.9	42.9	429
			MIN	30.9	18.3	34	7.6	41.9	316
393	61.00	50	AV50	33.1	27.1	39	8.4	40.8	516
			STD	0.8	3.3	2	0.2	0.6	47
			MAX	35.1	33.9	42	9.0	41.8	626
			MIN	31.9	22.8	35	8.0	39.4	458
404	61.24	46	AV11	33.2	25.5	39	8.4	40.7	503
			STD	0.4	0.5	1	0.1	0.3	5
			MAX	34.0	26.3	41	8.7	41.0	512
			MIN	32.6	24.6	38	8.3	40.1	496
414	61.45	48	AV10	33.3	26.5	39	8.4	40.8	514
			STD	0.4	0.4	1	0.1	0.3	6
			MAX	33.9	27.1	40	8.6	41.4	521
			MIN	32.5	25.7	37	8.1	40.4	501
424	61.66	48	AV10	33.2	27.1	39	8.4	40.7	528
			STD	0.4	0.4	1	0.1	0.3	5
			MAX	33.6	27.5	40	8.6	41.2	534
			MIN	32.5	26.2	38	8.2	40.3	521
434	61.83	56	AV10	32.9	27.1	38	8.4	40.9	524
			STD	0.4	0.4	1	0.1	0.3	7
			MAX	33.7	27.8	39	8.6	41.4	535
			MIN	32.3	26.6	37	8.1	40.3	512
			Average	29.0	15.8	35	7.0	44.7	283
			Std. Dev.	3.1	7.1	3	1.0	3.0	132
			Maximum	35.1	33.9	42	9.0	49.7	626
			Minimum	24.0	6.8	28	5.6	39.4	154

Total number of blows analyzed: 434

BL#	Sensors
1-434	F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.03); A4: [K3550] 360.0 (1.03)

BL#	Comments
1	Reported reference at El. 765.79
430	CW

Time Summary

Drive 9 minutes 42 seconds 1:36 PM - 1:46 PM BN 1 - 434

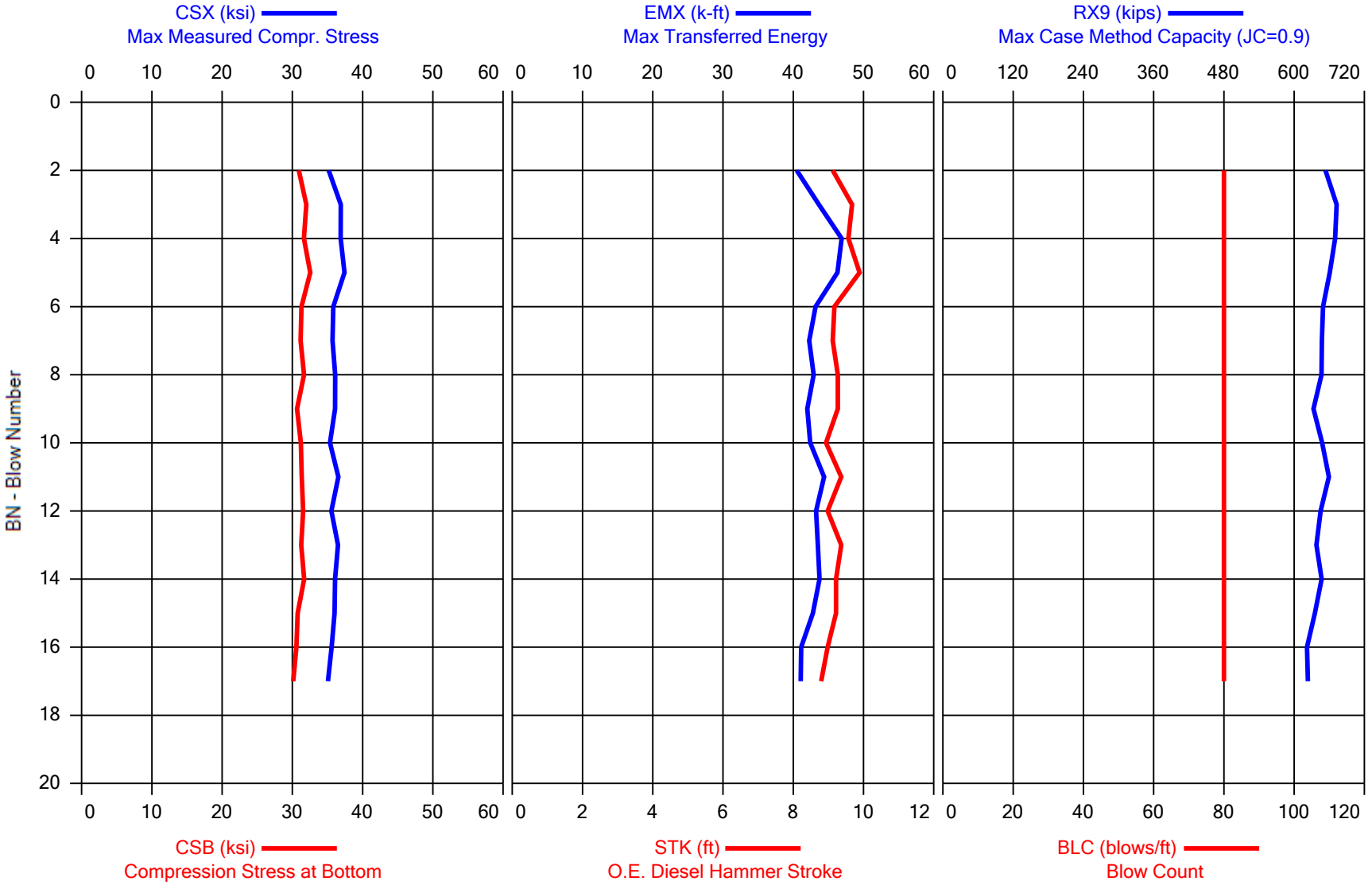
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 12-March-2015

Test started: 11-March-2015

USH 10 over Little Lake Butte des Morts - East Abutment #3 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - East Abutment #3 Restrike APE D30-42, HP 14 x 73
OP: AM Date: 11-March-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 67.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	blows/ft		ksi	ksi	k-ft	ft	bpm	kips
5	61.89	80	AV4	36.6	31.8	44	9.6	38.3	664
			STD	0.8	0.6	3	0.3	0.5	8
			MAX	37.4	32.6	47	9.9	39.2	673
			MIN	35.2	30.9	41	9.1	37.7	653
10	61.95	80	AV5	35.8	31.2	43	9.2	39.1	645
			STD	0.3	0.3	0	0.1	0.3	6
			MAX	36.1	31.7	43	9.3	39.6	649
			MIN	35.4	30.7	42	8.9	38.9	633
15	62.02	80	AV5	36.1	31.3	44	9.2	39.0	645
			STD	0.4	0.3	1	0.1	0.3	8
			MAX	36.5	31.7	44	9.4	39.5	659
			MIN	35.6	30.7	43	9.0	38.7	635
17	62.04	80	AV2	35.3	30.3	41	8.9	39.7	623
			STD	0.3	0.2	0	0.1	0.2	1
			MAX	35.6	30.6	41	9.0	39.9	623
			MIN	35.1	30.1	41	8.8	39.5	622
			Average	36.0	31.3	43	9.2	39.0	647
			Std. Dev.	0.6	0.6	2	0.3	0.6	14
			Maximum	37.4	32.6	47	9.9	39.9	673
			Minimum	35.1	30.1	41	8.8	37.7	622

Total number of blows analyzed: 16

BL# Sensors

1-17 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.08); A4: [K2524] 360.0 (1.08)

BL# Comments

4 CW

Time Summary

Drive 24 seconds 6:37 AM - 6:38 AM BN 1 - 17

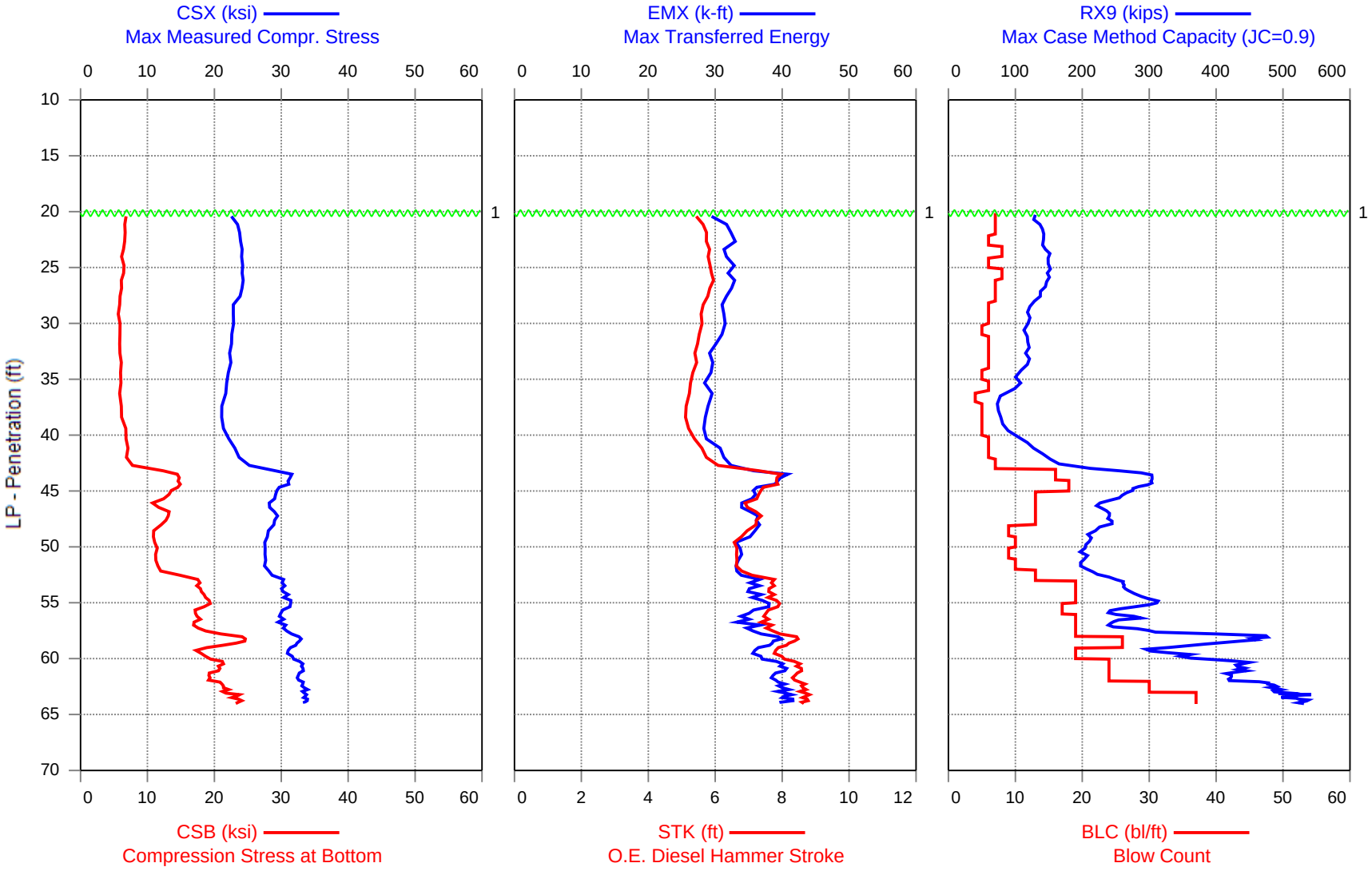
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 12-March-2015

Test started: 10-March-2015

USH 10 over Little Lake Butte des Morts - East Abutment #9

APE D30-42, HP 14 x 73



1 - Reported reference at El. 767.96

USH 10 over Little Lake Butte des Morts - East Abutment #9 APE D30-42, HP 14 x 73
OP: AM Date: 10-March-2015

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

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

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
7	21.00	7	AV7	22.8	6.8	30	5.5	50.0	130
			STD	0.8	0.2	2	0.2	0.8	5
			MAX	24.2	7.0	33	5.8	51.0	135
			MIN	21.9	6.5	28	5.3	48.6	121
14	22.00	7	AV7	23.5	6.6	32	5.7	49.3	140
			STD	0.5	0.2	1	0.1	0.5	2
			MAX	24.3	7.0	32	5.8	50.3	143
			MIN	22.8	6.4	30	5.4	48.7	136
20	23.00	6	AV6	24.1	6.6	33	5.8	48.8	141
			STD	0.5	0.2	1	0.2	0.6	4
			MAX	24.8	6.9	35	6.0	49.6	148
			MIN	23.5	6.4	32	5.6	47.9	137
28	24.00	8	AV8	24.1	6.3	31	5.8	48.7	148
			STD	0.3	0.2	1	0.1	0.3	4
			MAX	24.5	6.7	32	5.9	49.0	156
			MIN	23.7	5.9	30	5.7	48.2	143
34	25.00	6	AV6	24.2	6.4	33	5.8	48.7	148
			STD	0.2	0.3	1	0.1	0.2	2
			MAX	24.5	6.8	34	5.9	48.9	153
			MIN	23.9	5.7	32	5.8	48.2	147
42	26.00	8	AV8	24.3	6.4	32	5.9	48.3	151
			STD	0.4	0.5	1	0.1	0.3	5
			MAX	24.8	7.1	34	6.0	48.8	159
			MIN	23.8	5.4	31	5.8	47.9	141
49	27.00	7	AV7	24.3	6.1	33	5.9	48.3	145
			STD	0.4	0.2	0	0.1	0.3	3
			MAX	25.0	6.5	33	6.0	48.7	150
			MIN	23.8	5.7	33	5.8	47.9	142
56	28.00	7	AV7	23.5	6.0	31	5.7	49.1	135
			STD	0.7	0.4	1	0.1	0.5	4
			MAX	24.2	6.7	32	5.9	50.1	138
			MIN	22.1	5.6	29	5.5	48.4	127
62	29.00	6	AV6	22.9	5.7	31	5.6	49.4	121
			STD	0.2	0.4	0	0.1	0.4	4
			MAX	23.3	6.4	32	5.8	50.0	125
			MIN	22.5	5.4	31	5.5	48.8	114
68	30.00	6	AV6	22.9	5.7	31	5.6	49.5	122
			STD	0.6	0.1	1	0.1	0.6	3
			MAX	23.9	5.9	34	5.9	50.4	127
			MIN	22.2	5.5	30	5.4	48.5	117
73	31.00	5	AV5	22.7	5.9	32	5.5	49.9	113
			STD	0.8	0.4	2	0.2	0.7	6
			MAX	23.8	6.7	34	5.8	50.7	121
			MIN	21.9	5.6	29	5.3	48.9	102
79	32.00	6	AV6	22.5	5.9	30	5.5	50.0	119

USH 10 over Little Lake Butte des Morts - East Abutment #9 APE D30-42, HP 14 x 73
OP: AM Date: 10-March-2015

BL#	depth	BLC	TYPE	CSX	CSB	EMX	STK	BPM	RX9
	ft	bl/ft		ksi	ksi	k-ft	ft	bpm	kips
			STD	0.4	0.2	1	0.1	0.5	4
			MAX	23.3	6.2	32	5.7	50.5	124
			MIN	22.0	5.5	29	5.4	49.1	113
85	33.00	6	AV6	22.4	5.9	29	5.4	50.4	118
			STD	0.8	0.2	1	0.2	0.7	6
			MAX	22.9	6.1	31	5.5	51.8	123
			MIN	20.8	5.6	26	5.1	49.8	105
91	34.00	6	AV6	22.6	6.1	30	5.5	50.1	119
			STD	0.4	0.1	1	0.1	0.3	3
			MAX	23.0	6.2	31	5.6	50.6	122
			MIN	21.9	6.0	28	5.4	49.7	112
96	35.00	5	AV5	21.8	5.9	29	5.3	51.0	102
			STD	0.8	0.3	1	0.2	0.8	4
			MAX	22.8	6.3	31	5.5	52.2	107
			MIN	20.6	5.4	27	5.0	50.0	95
102	36.00	6	AV6	21.8	6.1	28	5.2	51.1	104
			STD	0.4	0.3	1	0.1	0.4	5
			MAX	22.5	6.4	29	5.4	51.7	108
			MIN	21.3	5.7	27	5.1	50.5	96
106	37.00	4	AV4	21.7	5.9	31	5.2	51.2	77
			STD	0.3	0.2	1	0.1	0.3	2
			MAX	21.9	6.3	31	5.3	51.6	79
			MIN	21.3	5.7	30	5.1	50.9	75
111	38.00	5	AV5	21.0	6.1	29	5.1	51.7	74
			STD	0.4	0.4	1	0.1	0.3	4
			MAX	21.6	6.5	29	5.2	52.1	78
			MIN	20.7	5.4	28	5.0	51.2	69
116	39.00	5	AV5	21.4	6.2	29	5.2	51.3	78
			STD	0.7	0.2	1	0.2	0.8	7
			MAX	22.6	6.5	30	5.5	52.4	88
			MIN	20.5	5.8	27	5.0	50.1	67
121	40.00	5	AV5	21.3	6.8	28	5.2	51.4	92
			STD	0.9	0.2	2	0.2	0.8	7
			MAX	22.3	7.2	29	5.4	52.9	101
			MIN	19.8	6.4	25	4.9	50.5	81
127	41.00	6	AV6	22.1	7.0	28	5.4	50.6	113
			STD	0.4	0.5	1	0.1	0.4	7
			MAX	22.5	7.9	30	5.5	51.1	126
			MIN	21.5	6.4	27	5.2	50.0	106
133	42.00	6	AV6	23.7	6.8	32	5.7	49.0	140
			STD	0.3	0.5	1	0.1	0.4	6
			MAX	24.2	7.6	33	5.9	49.5	151
			MIN	23.2	6.3	31	5.6	48.4	132
140	43.00	7	AV7	24.9	7.6	32	6.0	48.0	171
			STD	0.9	0.8	1	0.2	0.8	18
			MAX	26.3	9.4	34	6.4	49.3	202
			MIN	23.6	6.8	31	5.7	46.6	151
156	44.00	16	AV16	30.7	13.9	39	7.7	42.5	288
			STD	1.2	1.2	2	0.3	0.9	23
			MAX	31.9	15.1	42	8.1	45.2	308
			MIN	27.7	10.9	34	6.8	41.5	240

USH 10 over Little Lake Butte des Morts - East Abutment #9 APE D30-42, HP 14 x 73
OP: AM Date: 10-March-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
174	45.00	18	AV18	30.3	14.4	37	7.6	42.8	290
			STD	0.9	0.6	2	0.2	0.7	12
			MAX	31.6	15.4	40	8.0	43.8	307
			MIN	28.8	13.1	35	7.2	41.7	272
187	46.00	13	AV13	29.1	12.6	36	7.3	43.8	253
			STD	0.5	0.9	1	0.2	0.5	13
			MAX	30.1	13.7	39	7.7	44.3	270
			MIN	28.3	10.9	34	7.1	42.6	223
200	47.00	13	AV13	28.4	12.0	34	7.0	44.5	231
			STD	0.7	1.2	1	0.2	0.7	7
			MAX	29.4	13.8	36	7.3	46.0	244
			MIN	27.1	10.0	32	6.5	43.6	220
213	48.00	13	AV13	29.2	12.8	36	7.3	43.6	242
			STD	0.5	0.6	1	0.2	0.5	3
			MAX	30.1	13.7	38	7.6	44.3	247
			MIN	28.7	11.8	35	7.1	42.7	234
222	49.00	9	AV9	28.1	11.0	36	6.9	44.7	218
			STD	0.4	0.9	1	0.1	0.4	9
			MAX	28.6	12.5	37	7.1	45.5	230
			MIN	27.4	10.2	35	6.7	44.1	205
232	50.00	10	AV10	27.6	11.2	33	6.6	45.8	209
			STD	0.5	0.5	1	0.2	0.5	6
			MAX	28.2	11.9	36	6.8	46.6	217
			MIN	26.7	10.1	32	6.4	45.0	201
241	51.00	9	AV9	27.7	11.3	34	6.7	45.6	202
			STD	0.7	0.6	1	0.2	0.6	6
			MAX	28.8	12.2	36	6.9	46.7	210
			MIN	26.3	10.4	32	6.3	44.7	194
251	52.00	10	AV10	27.6	11.5	33	6.7	45.6	201
			STD	0.8	0.4	1	0.2	0.7	4
			MAX	28.9	12.2	36	7.0	46.6	209
			MIN	26.4	10.8	31	6.4	44.6	196
264	53.00	13	AV13	29.1	14.8	35	7.2	43.9	231
			STD	1.2	2.3	2	0.5	1.3	14
			MAX	32.0	17.8	41	8.2	45.9	253
			MIN	27.3	11.5	32	6.6	41.3	212
283	54.00	19	AV19	30.2	17.8	35	7.7	42.6	264
			STD	0.8	0.4	2	0.2	0.4	3
			MAX	31.7	18.5	38	7.9	43.4	271
			MIN	28.7	16.9	33	7.4	41.9	259
302	55.00	19	AV19	30.9	18.8	36	7.7	42.5	295
			STD	0.7	0.6	1	0.2	0.5	14
			MAX	32.3	20.0	39	8.1	43.2	317
			MIN	29.8	18.0	34	7.5	41.5	272
319	56.00	17	AV17	30.7	17.9	37	7.7	42.5	265
			STD	0.8	0.9	2	0.2	0.6	25
			MAX	31.9	19.4	39	8.1	43.5	306
			MIN	29.3	16.4	33	7.4	41.5	235
338	57.00	19	AV19	30.0	17.4	34	7.5	43.1	258
			STD	0.6	0.6	1	0.1	0.4	19

USH 10 over Little Lake Butte des Morts - East Abutment #9 APE D30-42, HP 14 x 73
OP: AM Date: 10-March-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
			MAX	31.0	18.8	37	7.9	43.7	303
			MIN	29.0	16.7	32	7.3	42.1	237
357	58.00	19	AV19	31.0	19.3	36	7.8	42.3	330
			STD	0.8	2.3	2	0.3	0.7	82
			MAX	32.6	24.2	39	8.4	43.3	481
			MIN	29.9	16.8	34	7.4	40.7	240
383	59.00	26	AV26	32.5	23.1	39	8.3	41.1	412
			STD	0.6	2.0	1	0.2	0.6	48
			MAX	33.8	26.4	41	8.7	42.4	488
			MIN	31.0	19.0	36	7.8	40.1	319
402	60.00	19	AV19	31.2	18.1	36	7.9	42.1	333
			STD	0.5	0.8	1	0.1	0.4	27
			MAX	32.6	19.6	39	8.3	42.9	366
			MIN	30.5	16.8	35	7.6	41.1	286
426	61.00	24	AV24	32.9	20.8	40	8.4	40.7	431
			STD	0.6	0.7	1	0.2	0.4	16
			MAX	34.2	22.2	42	8.8	41.6	462
			MIN	31.8	19.5	36	8.1	39.8	390
450	62.00	24	AV24	32.7	19.4	39	8.4	40.8	424
			STD	0.4	0.6	1	0.1	0.3	10
			MAX	33.9	20.8	41	8.7	41.2	449
			MIN	32.2	18.6	38	8.2	40.1	414
480	63.00	30	AV30	33.4	21.3	40	8.6	40.3	484
			STD	0.6	0.6	1	0.2	0.4	10
			MAX	34.5	22.6	43	8.9	41.4	500
			MIN	32.0	19.9	37	8.1	39.7	447
519	64.05	37	AV39	33.6	23.2	41	8.7	40.1	520
			STD	0.4	0.9	1	0.1	0.3	16
			MAX	34.3	25.0	43	8.9	40.7	549
			MIN	32.8	21.2	39	8.4	39.6	489
			Average	28.9	14.7	36	7.2	44.3	282
			Std. Dev.	4.0	6.2	4	1.2	3.7	133
			Maximum	34.5	26.4	43	8.9	52.9	549
			Minimum	19.8	5.4	25	4.9	39.6	67

Total number of blows analyzed: 519

BL# Sensors

1-519 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.04); A4: [K2524] 360.0 (1.04)

BL# Comments

1 Reported reference at El. 767.96
514 CW

Time Summary

Drive 11 minutes 46 seconds 2:19 PM - 2:31 PM BN 1 - 519

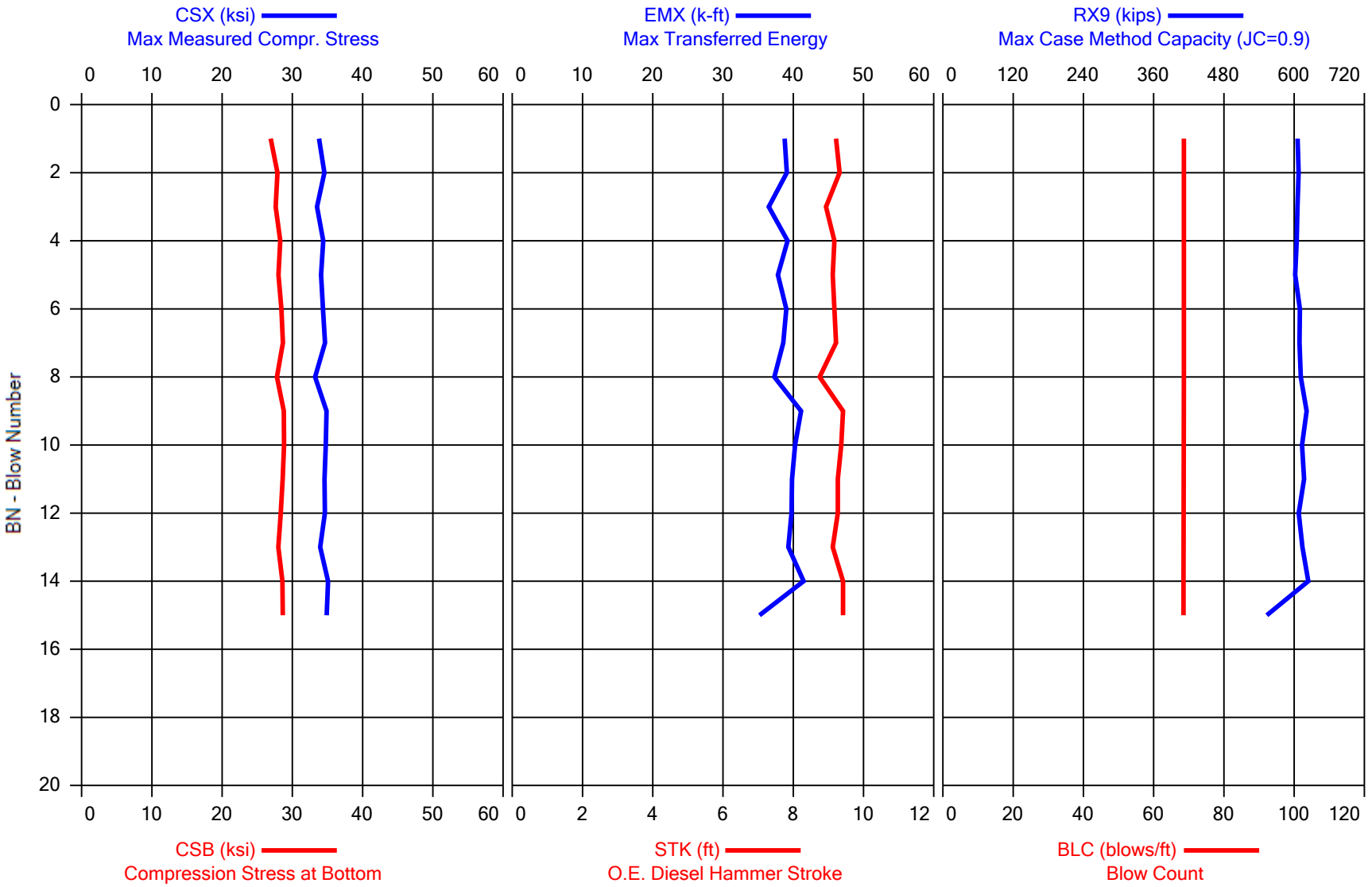
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 12-March-2015

Test started: 11-March-2015

USH 10 over Little Lake Butte des Morts - East Abutment #9 Restrike

APE D30-42, HP 14 x 73



USH 10 over Little Lake Butte des Morts - East Abutment #9 Restrike APE D30-42, HP 14 x 73
OP: AM Date: 11-March-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 69.00 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 ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	EMX k-ft	STK ft	BPM bpm	RX9 kips
5	64.11	69	AV5	34.1	27.7	38	9.2	39.1	605
			STD	0.4	0.5	1	0.1	0.3	2
			MAX	34.6	28.3	39	9.3	39.6	608
			MIN	33.5	26.9	37	8.9	38.8	602
10	64.19	69	AV5	34.4	28.5	39	9.2	39.1	613
			STD	0.6	0.4	1	0.2	0.5	4
			MAX	34.9	28.8	41	9.4	40.0	621
			MIN	33.2	27.8	37	8.7	38.6	609
15	64.26	68	AV5	34.6	28.4	39	9.3	38.8	603
			STD	0.4	0.2	2	0.1	0.2	25
			MAX	35.1	28.6	41	9.4	39.2	624
			MIN	34.0	28.0	35	9.1	38.6	553
			Average	34.4	28.2	39	9.2	39.0	607
			Std. Dev.	0.5	0.5	2	0.2	0.4	16
			Maximum	35.1	28.8	41	9.4	40.0	624
			Minimum	33.2	26.9	35	8.7	38.6	553

Total number of blows analyzed: 15

BL# Sensors

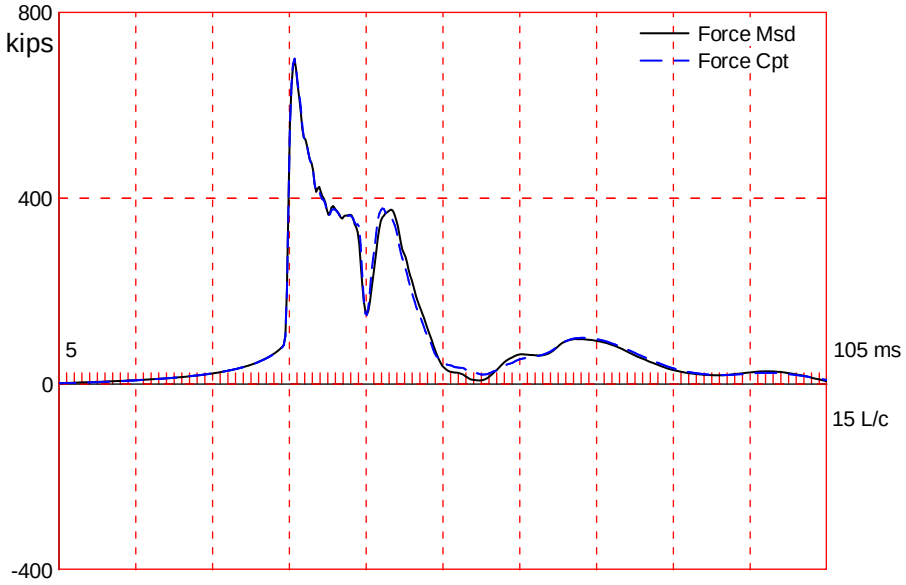
1-15 F3: [D815] 93.0 (1.00); F4: [F607] 93.6 (1.00); A3: [K3550] 360.0 (1.06); A4: [K2524] 360.0 (1.06)

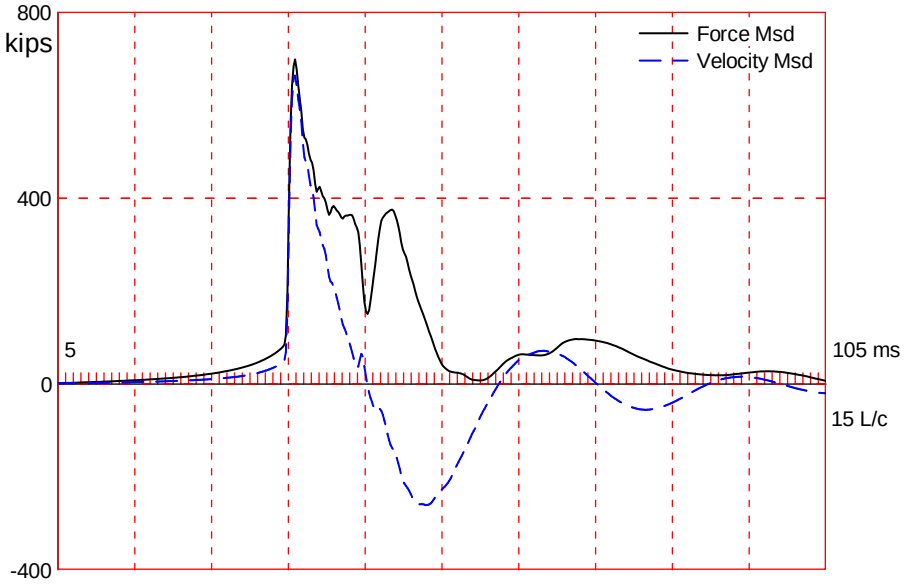
BL# Comments

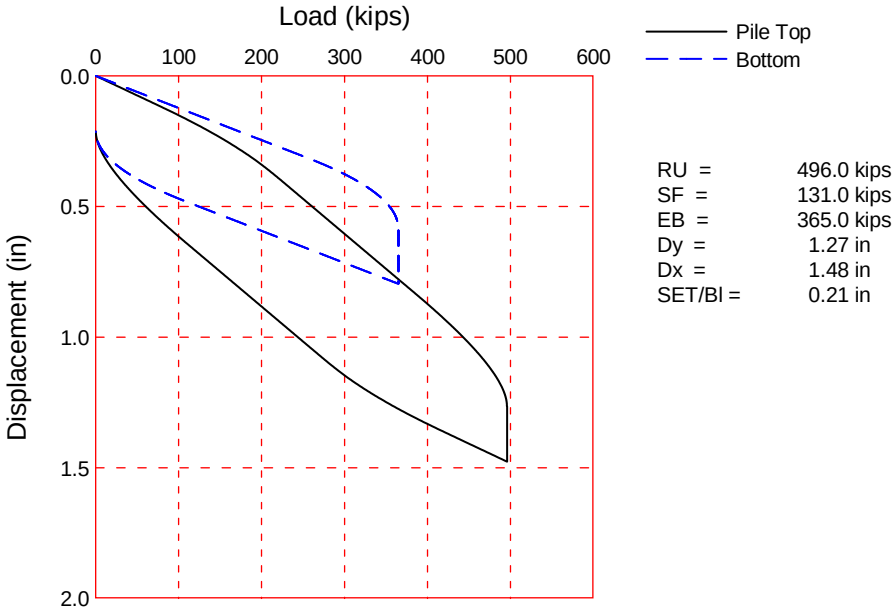
4 CW

Time Summary

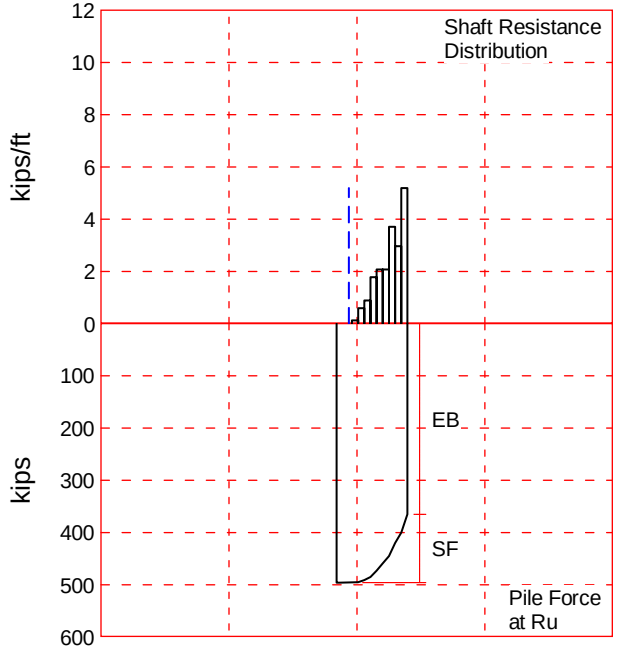
Drive 21 seconds 6:49 AM - 6:49 AM BN 1 - 15







RU =	496.0 kips
SF =	131.0 kips
EB =	365.0 kips
Dy =	1.27 in
Dx =	1.48 in
SET/Bl =	0.21 in



Length b. Sensors	77.5 ft
Embedment	61.8 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	2.46
Top Compr. Stress	32.8 ksi
Max Compr. Stress	33.7 ksi
Max Tension Stress	-1.87 ksi
Avg. Shaft Quake	0.09 in
Toe Quake	0.45 in
Avg. Shaft Smith Dpg.	0.26 s/ft
Toe Smith Damping	0.12 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: 496.0; along Shaft 131.0; at Toe 365.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf
				496.0			
1	23.6	7.8	1.0	495.0	1.0	0.13	0.03
2	30.3	14.6	4.0	491.0	5.0	0.59	0.13
3	37.1	21.3	6.0	485.0	11.0	0.89	0.19
4	43.8	28.1	12.0	473.0	23.0	1.78	0.38
5	50.5	34.8	14.0	459.0	37.0	2.08	0.44
6	57.3	41.5	14.0	445.0	51.0	2.08	0.44
7	64.0	48.3	25.0	420.0	76.0	3.71	0.79
8	70.8	55.0	20.0	400.0	96.0	2.97	0.63
9	77.5	61.8	35.0	365.0	131.0	5.19	1.11
Avg. Shaft			14.6			2.12	0.45
Toe			365.0				264.78

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.26	0.12
Quake	(in)	0.09	0.45
Case Damping Factor		0.89	1.15
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	94
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake)	(in)		0.06
Soil Plug Weight	(kips)		0.286

CAPWAP match quality = 2.46 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.21 in; Blow Count = 56 b/ft
Computed: Final Set = 0.22 in; Blow Count = 54 b/ft

max. Top Comp. Stress = 32.8 ksi (T= 36.1 ms, max= 1.029 x Top)
max. Comp. Stress = 33.7 ksi (Z= 30.3 ft, T= 37.7 ms)
max. Tens. Stress = -1.87 ksi (Z= 43.8 ft, T= 59.5 ms)
max. Energy (EMX) = 38.5 kip-ft; max. Measured Top Displ. (DMX)= 1.03 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.4	701.7	-12.6	32.8	-0.59	38.5	17.3	1.02
2	6.7	702.6	-13.2	32.8	-0.62	38.4	17.3	1.00
4	13.5	704.9	-14.4	32.9	-0.67	37.9	17.2	0.96
5	16.8	707.0	-15.0	33.0	-0.70	37.6	17.1	0.94
6	20.2	709.5	-19.3	33.1	-0.90	37.2	17.1	0.92
7	23.6	714.7	-25.4	33.4	-1.19	36.8	16.9	0.89
8	27.0	714.7	-30.0	33.4	-1.40	36.1	16.8	0.87
9	30.3	722.1	-35.7	33.7	-1.67	35.6	16.6	0.84
10	33.7	708.5	-34.9	33.1	-1.63	34.1	16.4	0.81
11	37.1	720.9	-39.6	33.7	-1.85	33.6	16.0	0.78
12	40.4	703.1	-35.2	32.8	-1.64	31.7	15.7	0.75
13	43.8	717.1	-40.1	33.5	-1.87	31.1	15.3	0.72
14	47.2	672.4	-27.7	31.4	-1.29	28.3	14.9	0.70
15	50.5	686.0	-32.7	32.0	-1.53	27.7	14.6	0.67
16	53.9	634.2	-16.5	29.6	-0.77	24.7	14.2	0.64
17	57.3	653.5	-21.1	30.5	-0.98	24.2	13.7	0.61
18	60.7	612.8	-5.6	28.6	-0.26	21.4	13.1	0.58
19	64.0	628.9	-10.3	29.4	-0.48	20.9	12.6	0.55
20	67.4	542.4	0.0	25.3	0.00	17.0	12.2	0.53
21	70.8	555.2	0.0	25.9	0.00	16.5	13.5	0.50
22	74.1	466.8	0.0	21.8	0.00	13.6	14.6	0.47
23	77.5	484.8	0.0	22.6	0.00	9.9	14.8	0.45
Absolute	30.3			33.7			(T =	37.7 ms)
	43.8				-1.87		(T =	59.5 ms)

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	753.6	691.8	629.9	568.1	506.3	444.5	382.6	320.8	259.0	197.1
RX	759.9	697.5	635.1	593.6	580.8	568.7	556.5	545.3	535.4	525.4
RU	753.6	691.8	629.9	568.1	506.3	444.5	382.6	320.8	259.0	197.1

RAU = 394.5 (kips); RA2 = 614.8 (kips)

Current CAPWAP Ru = 496.0 (kips); Corresponding J(RP)= 0.42;

RMX requires higher damping; see PDA-W

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS	KEB
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips	kips/in
17.6	35.89	672.5	699.4	711.7	1.03	0.21	0.21	38.9	752.7	938

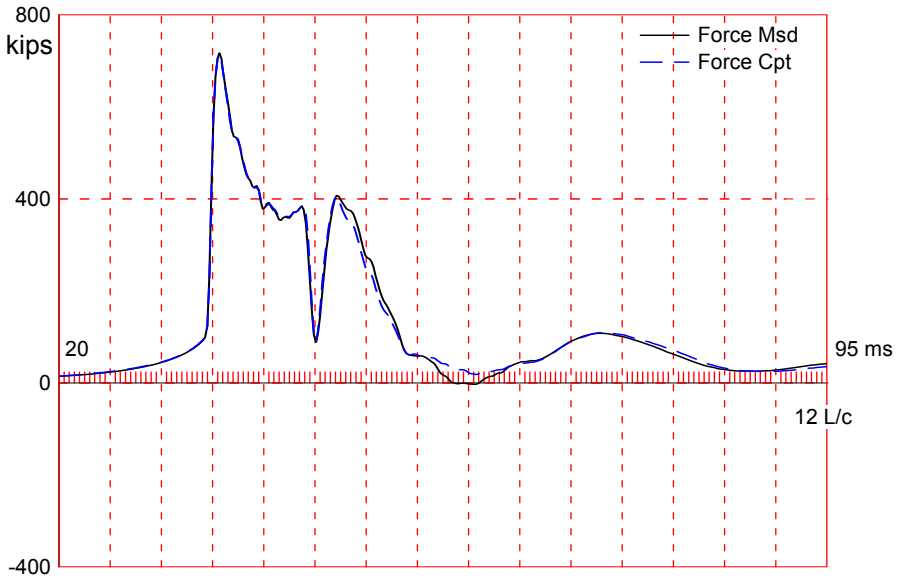
PILE PROFILE AND PILE MODEL

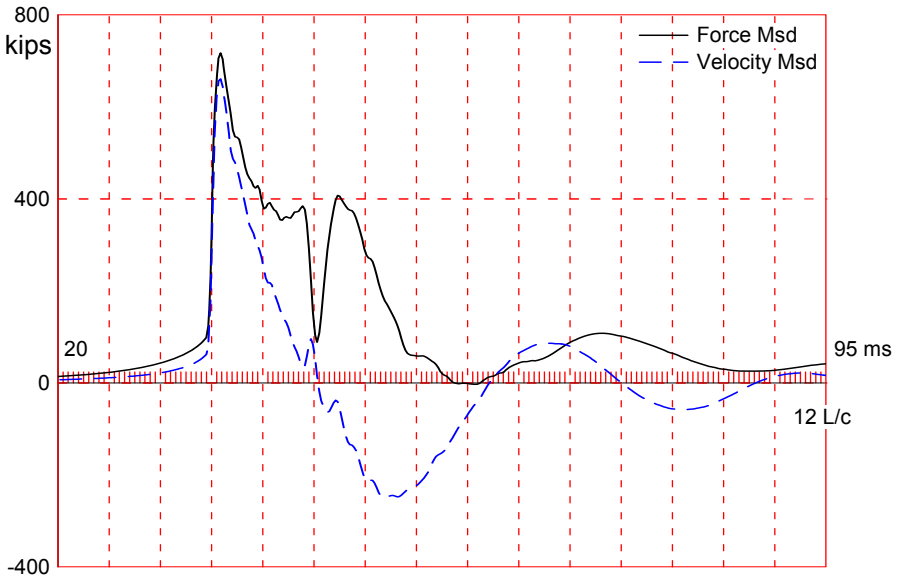
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.5	21.4	29992.2	492.000	4.70

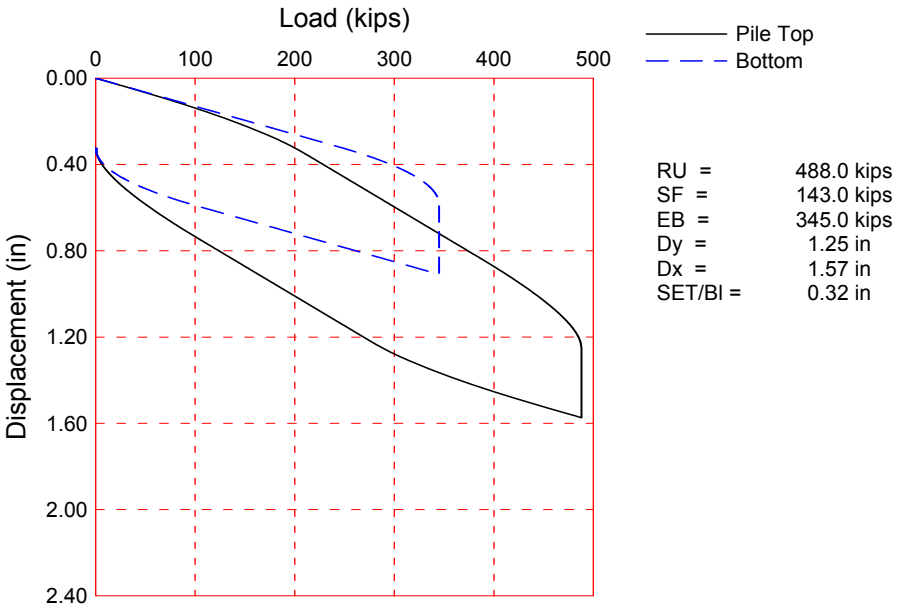
Toe Area 198.5 in^2

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

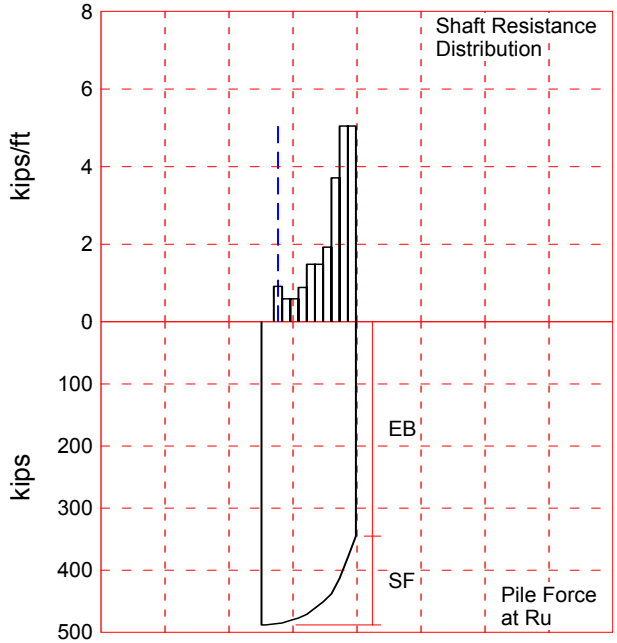
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 9.2 ms
Total volume: 11.517 ft^3; Volume ratio considering added impedance: 1.000







RU =	488.0 kips
SF =	143.0 kips
EB =	345.0 kips
Dy =	1.25 in
Dx =	1.57 in
SET/Bl =	0.32 in



Length b. Sensors	77.5 ft
Embedment	63.9 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	2.27
Top Compr. Stress	33.4 ksi
Max Compr. Stress	34.1 ksi
Max Tension Stress	-2.49 ksi
Avg. Shaft Quake	0.07 in
Toe Quake	0.45 in
Avg. Shaft Smith Dpg.	0.27 s/ft
Toe Smith Damping	0.10 s/ft

About the CAPWAP Results

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

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

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

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

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

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

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

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

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 488.0; along Shaft 143.0; at Toe 345.0 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
				488.0			
1	16.8	3.3	3.0	485.0	3.0	0.92	0.20
2	23.6	10.0	4.0	481.0	7.0	0.59	0.13
3	30.3	16.7	4.0	477.0	11.0	0.59	0.13
4	37.1	23.5	6.0	471.0	17.0	0.89	0.19
5	43.8	30.2	10.0	461.0	27.0	1.48	0.32
6	50.5	37.0	10.0	451.0	37.0	1.48	0.32
7	57.3	43.7	13.0	438.0	50.0	1.93	0.41
8	64.0	50.4	25.0	413.0	75.0	3.71	0.79
9	70.8	57.2	34.0	379.0	109.0	5.05	1.07
10	77.5	63.9	34.0	345.0	143.0	5.05	1.07
Avg. Shaft			14.3			2.24	0.48
Toe			345.0				250.27

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.27	0.10
Quake	(in)	0.07	0.45
Case Damping Factor		1.01	0.90
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	51
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	35	
Resistance Gap (included in Toe Quake)	(in)		0.12
Soil Plug Weight	(kips)		0.209

CAPWAP match quality = 2.27 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.32 in; Blow Count = 37 b/ft
Computed: Final Set = 0.30 in; Blow Count = 40 b/ft

max. Top Comp. Stress = 33.4 ksi (T= 36.1 ms, max= 1.022 x Top)
max. Comp. Stress = 34.1 ksi (Z= 16.8 ft, T= 36.9 ms)
max. Tens. Stress = -2.49 ksi (Z= 57.3 ft, T= 61.9 ms)
max. Energy (EMX) = 39.9 kip-ft; max. Measured Top Displ. (DMX)= 1.04 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.4	713.9	-15.2	33.4	-0.71	39.9	17.4	1.03
2	6.7	715.4	-15.2	33.4	-0.71	39.8	17.3	1.01
4	13.5	724.0	-16.6	33.8	-0.78	39.4	17.1	0.98
5	16.8	729.6	-17.6	34.1	-0.82	39.0	17.0	0.95
6	20.2	718.3	-19.8	33.6	-0.93	37.7	16.8	0.93
7	23.6	724.2	-25.9	33.8	-1.21	37.2	16.6	0.90
8	27.0	708.0	-29.1	33.1	-1.36	35.7	16.5	0.87
9	30.3	715.6	-35.6	33.4	-1.66	35.2	16.3	0.85
10	33.7	701.8	-38.2	32.8	-1.79	33.8	16.1	0.82
11	37.1	713.0	-43.4	33.3	-2.03	33.3	15.8	0.79
12	40.4	692.6	-43.5	32.4	-2.03	31.4	15.5	0.76
13	43.8	704.0	-48.8	32.9	-2.28	30.9	15.2	0.74
14	47.2	664.6	-46.9	31.0	-2.19	28.3	14.9	0.71
15	50.5	677.7	-51.3	31.7	-2.40	27.7	14.5	0.68
16	53.9	643.0	-49.4	30.0	-2.31	25.3	14.2	0.65
17	57.3	666.7	-53.4	31.1	-2.49	24.8	13.6	0.62
18	60.7	627.8	-49.2	29.3	-2.30	22.1	13.0	0.59
19	64.0	655.5	-52.8	30.6	-2.47	21.6	12.4	0.57
20	67.4	570.0	-43.9	26.6	-2.05	17.4	13.1	0.54
21	70.8	566.0	-45.5	26.4	-2.13	16.9	14.5	0.51
22	74.1	431.7	-31.9	20.2	-1.49	12.0	15.9	0.49
23	77.5	444.0	-33.6	20.7	-1.57	7.8	16.5	0.47
Absolute	16.8			34.1			(T =	36.9 ms)
	57.3				-2.49		(T =	61.9 ms)

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	721.4	654.8	588.1	521.5	454.9	388.2	321.6	254.9	188.3	121.7
RX	721.4	673.4	644.0	614.7	588.1	569.6	555.9	543.1	532.2	521.2
RU	721.4	654.8	588.1	521.5	454.9	388.2	321.6	254.9	188.3	121.7

RAU = 280.5 (kips); RA2 = 619.9 (kips)

Current CAPWAP Ru = 488.0 (kips); Corresponding J(RP)= 0.35;

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
17.5	35.89	669.6	718.1	718.1	1.04	0.32	0.32	40.3	706.8	1046

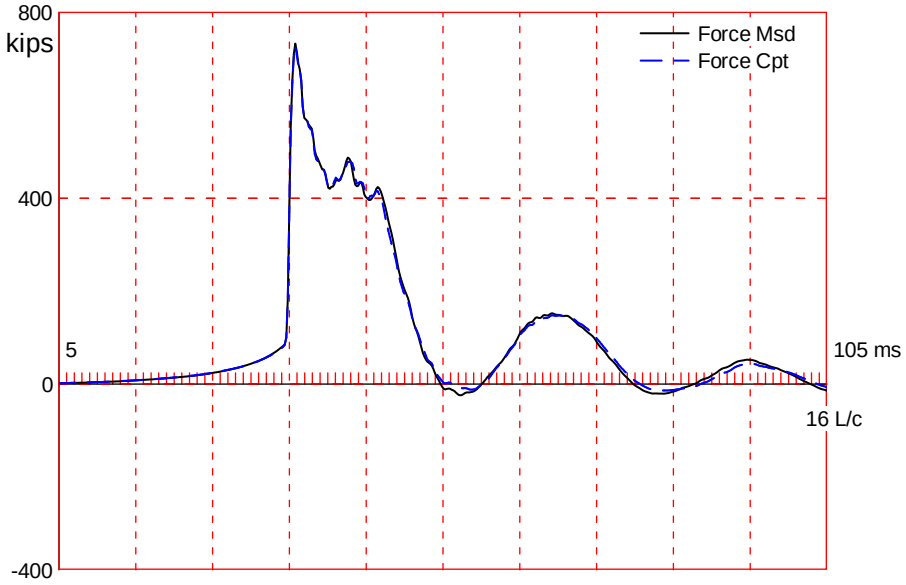
PILE PROFILE AND PILE MODEL

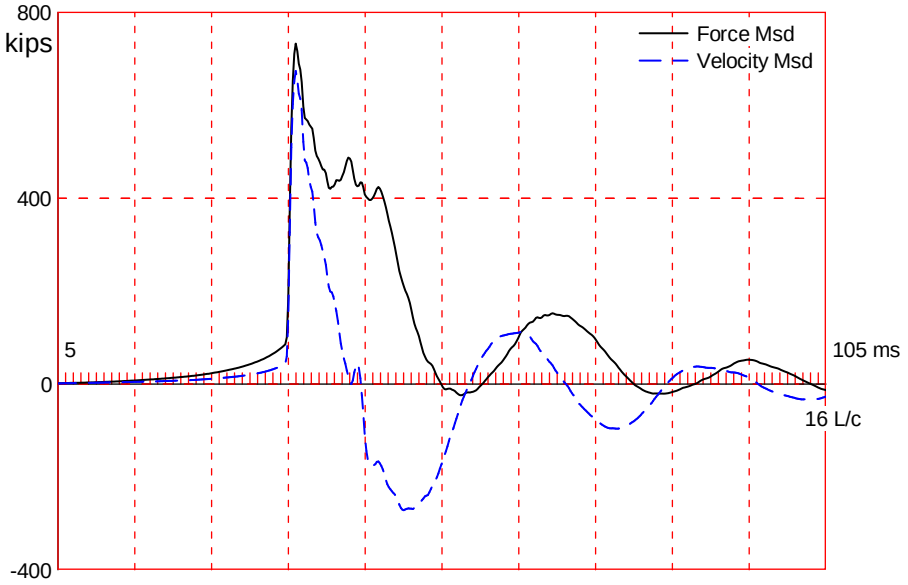
Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	21.4	29992.2	492.000	4.70
77.5	21.4	29992.2	492.000	4.70

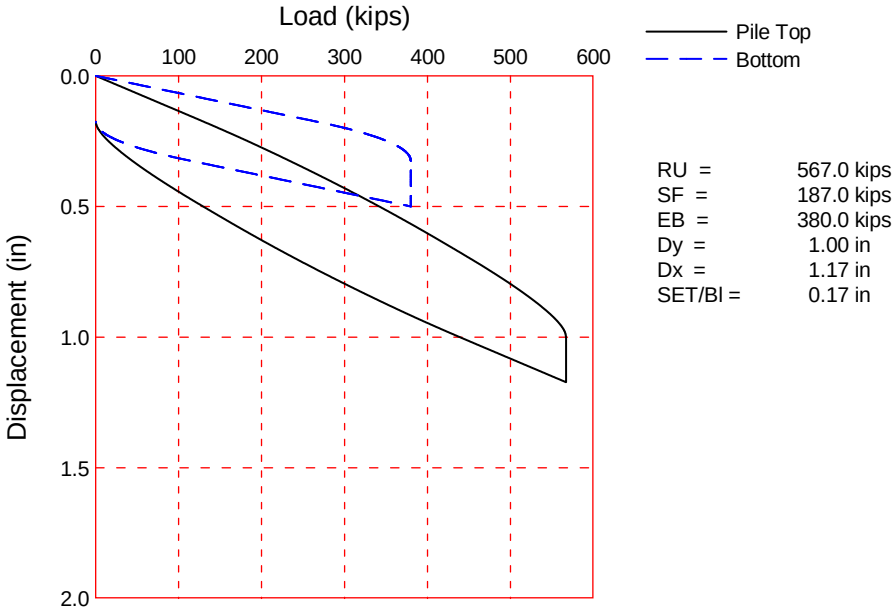
Toe Area 198.5 in^2

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

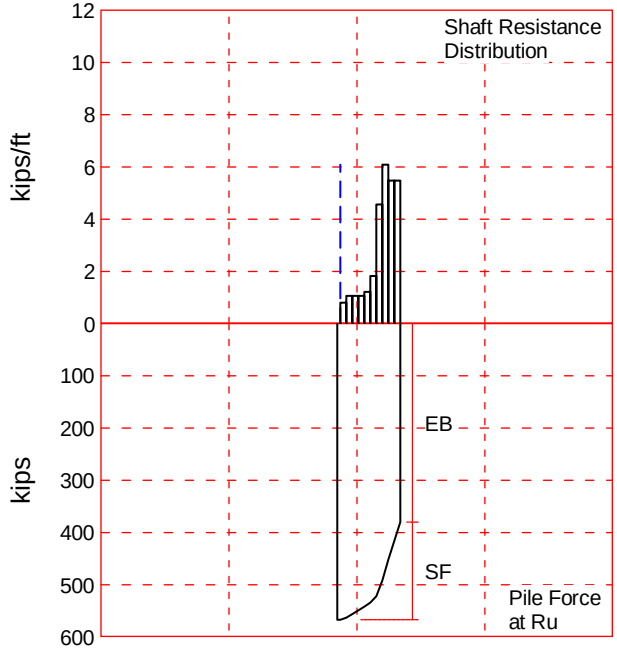
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.200 ms, 2L/c 9.2 ms
Total volume: 11.517 ft^3; Volume ratio considering added impedance: 1.000







RU =	567.0 kips
SF =	187.0 kips
EB =	380.0 kips
Dy =	1.00 in
Dx =	1.17 in
SET/Bl =	0.17 in



Length b. Sensors	69.0 ft
Embedment	64.1 ft
Top Area	21.4 in^2
End Bearing Area	198.5 in^2
Top Perimeter	4.70 ft
Top E-Modulus	29992 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	1.90
Top Compr. Stress	34.2 ksi
Max Compr. Stress	34.8 ksi
Max Tension Stress	-3.77 ksi
Avg. Shaft Quake	0.17 in
Toe Quake	0.25 in
Avg. Shaft Smith Dpg.	0.28 s/ft
Toe Smith Damping	0.15 s/ft

About the CAPWAP Results

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CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 567.0; along Shaft 187.0; at Toe 380.0 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
				567.0			
1	9.9	5.0	4.0	563.0	4.0	0.81	0.17
2	16.4	11.5	7.0	556.0	11.0	1.07	0.23
3	23.0	18.1	7.0	549.0	18.0	1.07	0.23
4	29.6	24.7	7.0	542.0	25.0	1.07	0.23
5	36.1	31.2	8.0	534.0	33.0	1.22	0.26
6	42.7	37.8	12.0	522.0	45.0	1.83	0.39
7	49.3	44.4	30.0	492.0	75.0	4.57	0.97
8	55.9	51.0	40.0	452.0	115.0	6.09	1.30
9	62.4	57.5	36.0	416.0	151.0	5.48	1.17
10	69.0	64.1	36.0	380.0	187.0	5.48	1.17
Avg. Shaft			18.7			2.92	0.62
Toe			380.0				275.66

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.28	0.15
Quake	(in)	0.17	0.25
Case Damping Factor		1.37	1.49
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	30
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	83	
Resistance Gap (included in Toe Quake)	(in)		0.03
Soil Plug Weight	(kips)	0.100	0.202

CAPWAP match quality = 1.90 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.17 in; Blow Count = 69 b/ft
Computed: Final Set = 0.18 in; Blow Count = 65 b/ft

max. Top Comp. Stress = 34.2 ksi (T= 36.2 ms, max= 1.020 x Top)
max. Comp. Stress = 34.8 ksi (Z= 9.9 ft, T= 36.6 ms)
max. Tens. Stress = -3.77 ksi (Z= 42.7 ft, T= 57.9 ms)
max. Energy (EMX) = 38.5 kip-ft; max. Measured Top Displ. (DMX)= 0.93 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	731.2	-22.3	34.2	-1.04	38.5	17.7	0.91
2	6.6	737.1	-29.0	34.4	-1.36	37.9	17.5	0.88
3	9.9	745.9	-38.3	34.8	-1.79	37.3	17.3	0.85
4	13.1	731.6	-43.4	34.2	-2.03	35.7	17.0	0.82
5	16.4	741.2	-51.9	34.6	-2.43	35.1	16.8	0.79
6	19.7	710.4	-52.7	33.2	-2.46	32.8	16.5	0.76
7	23.0	720.8	-59.2	33.7	-2.77	32.2	16.2	0.73
8	26.3	691.9	-59.2	32.3	-2.77	30.0	16.0	0.69
9	29.6	703.2	-68.1	32.9	-3.18	29.3	15.7	0.66
10	32.9	676.3	-68.4	31.6	-3.19	27.2	15.4	0.63
11	36.1	690.5	-75.8	32.3	-3.54	26.4	15.0	0.59
12	39.4	663.6	-73.6	31.0	-3.44	24.3	14.6	0.56
13	42.7	694.2	-80.7	32.4	-3.77	23.5	13.9	0.52
14	46.0	669.9	-73.0	31.3	-3.41	21.1	13.2	0.49
15	49.3	701.8	-75.2	32.8	-3.51	20.3	12.3	0.46
16	52.6	618.8	-53.3	28.9	-2.49	16.5	11.4	0.42
17	55.9	645.0	-54.3	30.1	-2.54	15.8	10.6	0.39
18	59.1	536.0	-39.5	25.0	-1.85	12.0	9.5	0.36
19	62.4	558.7	-40.2	26.1	-1.88	11.5	9.6	0.33
20	65.7	514.8	-38.2	24.0	-1.79	8.8	10.4	0.31
21	69.0	523.0	-38.7	24.4	-1.81	7.0	10.0	0.28
Absolute	9.9			34.8			(T =	36.6 ms)
	42.7				-3.77		(T =	57.9 ms)

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	902.6	851.3	800.0	748.7	697.4	646.1	594.8	543.4	492.1	440.8
RX	902.6	855.1	816.4	777.8	739.2	700.6	665.8	642.2	622.7	604.4
RU	916.6	866.6	816.7	766.8	716.9	667.0	617.1	567.2	517.2	467.3

RAU = 285.2 (kips); RA2 = 720.0 (kips)

Current CAPWAP Ru = 567.0 (kips); Corresponding J(RP)= 0.65;

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	35.97	679.5	736.2	736.2	0.93	0.17	0.17	39.2	849.0	1727

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
69.0	21.4	29992.2	492.000	4.70

Toe Area 198.5 in^2

Segmnt Number	Dist. B.G. ft	Impedance kips/ft/s	Imped. Change %	Tension Slack in	Tension Eff.	Compression Slack in	Compression Eff.	Perim. ft	Wave Speed ft/s	Soil Plug kips
1	3.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
20	65.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.050
21	69.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.050

Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.195 ms, 2L/c 8.2 ms
Total volume: 10.254 ft^3, Volume ratio considering added impedance: 1.000