GRL Engineers, Inc.

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TRANSMITTAL

To: Mr. Kevin Weber	From: Rory Flynn
Company: Lunda Construction Co.	No. of Sheets: 42
E-mail: kweber@lundaconstruction.com	Date: April 20, 2015

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

On April 16, 2015, West Abutment Pile #3 and #8 at the above structure were dynamically tested during initial driving. Restrike testing was performed on April 17. Project plans indicate the HP 14 x 73 H-piles at the abutment have a required driving resistance, or ultimate capacity, of 400 kips (200 tons). The abutment consists of both vertical and 1H:4V battered piles with a minimum tip elevation of EL 707.0. The piles were equipped with driving shoes and were driven with an APE D30-42 hammer (number PD 0234) operated on fuel setting 4.

West Abutment #3 was driven to a depth of 81.5 feet which corresponds to a pile tip elevation of EL 696.0. The reported pile set over the final ten blows of driving was $2^{1}/_{4}$ inches. The average hammer stroke over this increment was 8.4 feet. During the beginning of restrike the pile was driven $1^{3}/_{4}$ inches over ten blows at an average stroke of 8.5 feet.

West Abutment #8 was driven to a depth of 83.0 feet which corresponds to a pile tip elevation of El. 694.5. The reported pile set over the final ten blows of driving was $1^{1}/_{4}$ inches. The average hammer stroke over this increment was 8.3 feet. During the beginning of restrike the pile was driven $1^{1}/_{8}$ inches over ten blows at an average stroke of 8.6 feet.

We recommend the production piles at the West Abutment of Structure B-70-403, driven with the APE D30-42 hammer PD0234, obtain the minimum recommended blow count, noted below, based on the field observed hammer stroke. We recommend maintaining the minimum blow count for **three consecutive inches** of driving at the recommended average hammer stroke. Additionally, all production piles should achieve the minimum pile tip elevation of EL 707.0 for uplift, as indicated on the plans. The criteria is applicable to both the vertical and the 1H:4V batter piles.

Field Observed Hammer Stroke (feet)	Recommended Minimum Blow Count (blows per inch)
7.0	5
7.5	4
8.0	4
8.5	4
9.0	4
9.5	3

Driving should be halted if a blow count of 10 blows per inch at a 8.5 foot stroke or higher is achieved prior to attaining the criteria. We anticipate the production piles will terminate at depths similar to those of the test pile.

Please call if you have any questions on these recommendations.

GRL Engineers, Inc.

Rory Flynn, E.I.

Travis Coleman, P.E.

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

Attachments:

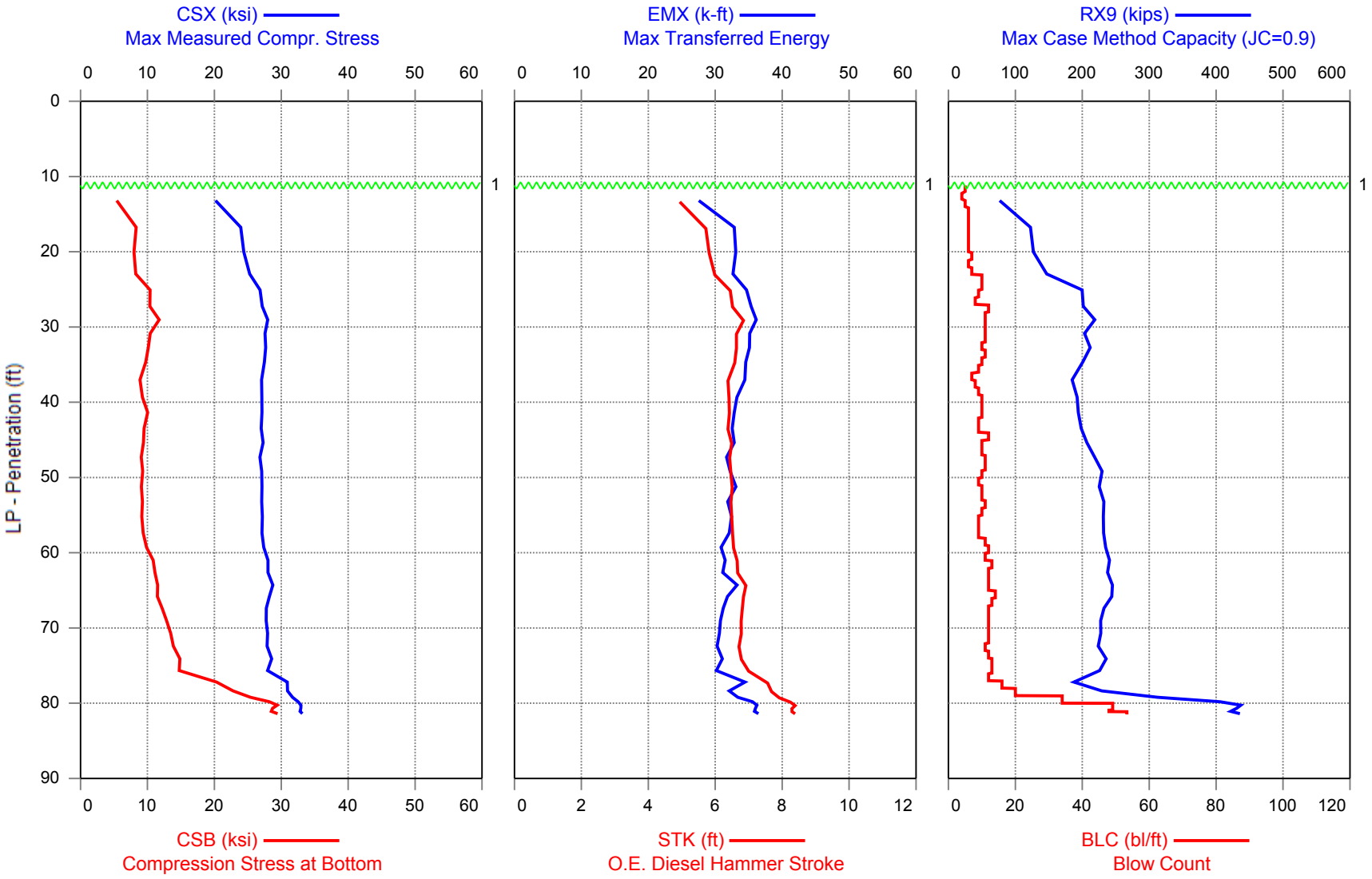
Dynamic Test Results - (pages 3 - 22)
CAPWAP Analysis Results - (pages 23 - 42)

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

Printed: 17-April-2015

Test started: 16-April-2015

USH 10 over LLBDM - WEST ABUTMENT #3
APE D30-42, HP 14 x 73



1 - Reported Reference EL 777.46

USH 10 over LLBDM - WEST ABUTMENT #3 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

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

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

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
3	11.20	5	AV1	20.9	3.0	4.8	30	53.2	43
			MAX	20.9	3.0	4.8	30	53.2	43
			MIN	20.9	3.0	4.8	30	53.2	43
7	12.00	5	AV3	18.9	4.4	4.7	25	55.1	65
			MAX	25.7	5.1	6.1	39	64.0	84
			MIN	11.2	3.0	3.2	12	47.7	36
11	13.00	4	AV4	19.0	5.1	4.7	26	54.0	64
			MAX	19.6	5.5	4.8	27	55.1	69
			MIN	18.0	4.8	4.5	24	53.2	57
16	14.00	5	AV5	18.9	5.2	4.7	24	54.0	76
			MAX	20.1	5.4	4.9	26	56.8	84
			MIN	16.3	4.9	4.2	21	52.6	68
22	15.00	6	AV6	21.9	6.9	5.3	29	51.0	108
			MAX	24.7	8.9	6.0	36	53.8	125
			MIN	19.1	5.6	4.7	24	48.0	84
28	16.00	6	AV6	24.8	9.4	6.0	34	47.8	126
			MAX	25.3	9.8	6.1	37	49.0	133
			MIN	23.7	9.0	5.7	32	47.4	119
34	17.00	6	AV6	23.8	8.4	5.7	33	49.1	122
			MAX	24.9	9.0	5.9	34	49.7	127
			MIN	23.1	7.3	5.6	32	48.3	119
40	18.00	6	AV6	23.2	7.4	5.5	31	50.1	120
			MAX	24.0	7.9	5.6	33	51.1	126
			MIN	22.2	7.0	5.2	29	49.4	113
46	19.00	6	AV6	23.6	7.6	5.7	33	49.3	125
			MAX	24.2	8.5	5.8	35	49.9	133
			MIN	23.0	7.2	5.5	31	48.8	117
52	20.00	6	AV6	24.3	7.8	5.8	33	48.6	123
			MAX	24.9	8.3	6.0	34	49.2	125
			MIN	23.5	7.2	5.7	32	47.9	121
59	21.00	7	AV7	24.8	8.1	5.9	33	48.3	129
			MAX	25.4	8.7	6.0	35	49.0	137
			MIN	24.1	7.4	5.7	31	47.8	121
65	22.00	6	AV6	24.8	8.4	5.8	33	48.6	130
			MAX	25.3	9.0	5.9	34	49.3	134
			MIN	24.0	8.1	5.7	33	48.2	126

USH 10 over LLBDM - WEST ABUTMENT #3 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
72	23.00	7	AV7	24.8	7.7	5.8	33	48.7	134
			MAX	25.5	8.1	6.0	34	49.2	142
			MIN	24.2	7.3	5.7	31	48.1	129
82	24.00	10	AV10	25.8	8.6	6.1	32	47.6	161
			MAX	27.1	10.0	6.3	34	48.7	181
			MIN	24.5	7.2	5.8	31	46.7	138
92	25.00	10	AV10	26.6	10.1	6.3	34	46.7	197
			MAX	27.4	11.3	6.5	35	47.4	208
			MIN	25.8	9.5	6.1	32	46.1	182
101	26.00	9	AV9	27.0	10.7	6.5	35	46.1	203
			MAX	27.6	11.6	6.7	37	46.9	208
			MIN	26.4	9.8	6.3	34	45.5	196
109	27.00	8	AV8	27.3	10.6	6.6	36	45.9	206
			MAX	28.0	11.3	6.8	38	46.9	212
			MIN	26.2	10.0	6.3	34	45.1	201
121	28.00	12	AV12	27.0	10.3	6.5	35	46.1	200
			MAX	27.5	11.1	6.7	37	46.7	216
			MIN	26.3	9.6	6.3	33	45.5	186
132	29.00	11	AV11	27.3	10.6	6.6	35	45.8	206
			MAX	28.9	12.6	7.0	38	47.2	236
			MIN	26.1	8.1	6.2	32	44.4	182
143	30.00	11	AV11	28.6	12.7	7.0	37	44.6	229
			MAX	29.2	13.6	7.1	38	45.1	235
			MIN	27.9	12.2	6.8	36	44.1	215
154	31.00	11	AV11	27.7	11.0	6.7	35	45.6	208
			MAX	28.7	12.8	7.1	38	46.7	219
			MIN	26.1	9.8	6.3	33	44.3	183
165	32.00	11	AV11	27.5	9.6	6.6	35	45.8	201
			MAX	28.4	10.5	6.8	36	46.6	221
			MIN	26.5	8.7	6.4	33	45.2	188
175	33.00	10	AV10	27.9	10.9	6.8	36	45.3	222
			MAX	28.4	11.8	6.9	37	45.9	228
			MIN	27.4	9.8	6.6	35	44.9	209
186	34.00	11	AV11	27.2	9.2	6.5	34	46.2	195
			MAX	27.6	9.9	6.6	35	47.3	206
			MIN	25.8	8.3	6.2	31	45.7	187
196	35.00	10	AV10	27.5	9.9	6.6	35	45.7	204
			MAX	28.6	10.7	6.8	37	46.3	213
			MIN	26.7	8.9	6.5	33	45.0	196

USH 10 over LLBDM - WEST ABUTMENT #3 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
205	36.00	9	AV9	27.3	9.4	6.5	34	46.2	196
			MAX	27.9	10.6	6.7	35	46.6	216
			MIN	26.7	8.3	6.4	33	45.6	184
212	37.00	7	AV7	27.4	9.3	6.5	35	46.3	187
			MAX	27.6	9.9	6.5	37	46.7	196
			MIN	26.9	8.4	6.3	33	46.0	175
220	38.00	8	AV8	26.8	8.6	6.3	34	46.8	182
			MAX	27.7	9.5	6.5	35	47.5	187
			MIN	26.0	7.9	6.1	32	46.3	178
229	39.00	9	AV9	26.9	8.8	6.3	33	46.7	188
			MAX	27.9	9.6	6.6	35	47.5	195
			MIN	25.9	8.0	6.1	31	45.9	171
239	40.00	10	AV10	27.3	9.6	6.5	34	46.2	194
			MAX	28.0	10.7	6.6	34	47.0	204
			MIN	26.3	8.7	6.3	32	45.7	180
249	41.00	10	AV10	27.0	9.9	6.4	33	46.4	197
			MAX	27.6	11.6	6.5	34	47.0	204
			MIN	26.2	8.5	6.3	31	46.0	193
259	42.00	10	AV10	27.1	9.9	6.4	32	46.5	192
			MAX	28.2	11.2	6.6	34	47.4	201
			MIN	26.3	8.9	6.1	31	45.7	183
268	43.00	9	AV9	27.2	9.9	6.4	34	46.3	192
			MAX	28.0	10.7	6.7	35	47.2	198
			MIN	26.2	9.1	6.2	31	45.6	186
277	44.00	9	AV9	27.0	9.1	6.4	33	46.6	198
			MAX	28.1	9.8	6.6	34	47.7	204
			MIN	26.0	8.6	6.1	30	45.9	187
289	45.00	12	AV12	27.3	9.7	6.5	32	46.3	208
			MAX	28.2	10.7	6.7	34	47.3	220
			MIN	26.3	8.7	6.2	30	45.5	195
299	46.00	10	AV10	27.1	9.3	6.4	33	46.3	206
			MAX	27.8	9.9	6.6	34	47.1	218
			MIN	26.5	8.6	6.2	31	45.8	197
309	47.00	10	AV10	26.7	9.0	6.4	32	46.5	211
			MAX	27.5	9.7	6.6	34	47.2	217
			MIN	26.0	8.4	6.2	31	45.8	204
320	48.00	11	AV11	26.8	9.1	6.4	31	46.4	220
			MAX	27.3	9.7	6.5	32	46.9	228
			MIN	26.3	8.5	6.3	31	46.0	210
331	49.00	11	AV11	27.4	9.6	6.6	33	45.9	232

USH 10 over LLBDM - WEST ABUTMENT #3 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			MAX	28.1	10.0	6.8	35	47.2	240
			MIN	26.0	9.1	6.2	30	45.2	223
341	50.00	10	AV10	26.9	9.1	6.4	32	46.4	229
			MAX	27.6	9.8	6.7	33	47.1	234
			MIN	26.1	8.7	6.2	30	45.6	225
350	51.00	9	AV9	27.2	9.1	6.5	34	46.0	226
			MAX	28.3	10.1	6.9	37	46.9	239
			MIN	26.5	8.8	6.3	31	44.8	218
360	52.00	10	AV10	27.0	9.1	6.5	33	46.2	224
			MAX	27.5	9.6	6.7	33	46.7	231
			MIN	26.5	8.9	6.3	31	45.4	220
370	53.00	10	AV10	27.1	9.0	6.4	32	46.4	230
			MAX	27.9	9.4	6.7	34	47.2	243
			MIN	26.4	8.8	6.2	31	45.4	222
381	54.00	11	AV11	27.1	9.4	6.5	32	46.3	233
			MAX	28.1	10.6	6.7	33	47.0	239
			MIN	26.3	8.9	6.3	30	45.6	229
391	55.00	10	AV10	27.2	9.2	6.5	32	46.1	230
			MAX	27.8	9.6	6.8	34	46.8	240
			MIN	26.7	8.8	6.3	31	45.3	226
400	56.00	9	AV9	27.1	9.1	6.5	32	46.2	231
			MAX	27.7	9.5	6.6	34	46.9	239
			MIN	26.4	8.9	6.3	31	45.7	227
409	57.00	9	AV9	27.1	9.4	6.5	33	46.1	231
			MAX	28.1	10.4	6.8	35	46.8	241
			MIN	26.3	9.0	6.3	31	45.3	223
418	58.00	9	AV9	27.1	9.3	6.5	32	46.2	231
			MAX	27.6	10.3	6.6	34	46.7	238
			MIN	26.6	9.0	6.3	31	45.7	227
429	59.00	11	AV11	27.4	9.6	6.5	32	46.0	236
			MAX	28.3	9.9	6.9	34	47.2	246
			MIN	26.4	9.2	6.2	30	44.9	229
441	60.00	12	AV12	27.3	10.0	6.5	30	46.2	235
			MAX	28.2	10.4	6.7	31	46.8	240
			MIN	26.5	9.6	6.3	29	45.6	230
452	61.00	11	AV11	28.1	10.6	6.7	32	45.6	239
			MAX	29.7	11.3	7.1	35	46.5	248
			MIN	27.5	10.1	6.4	30	44.3	233
465	62.00	13	AV13	27.9	11.0	6.7	31	45.6	242
			MAX	29.1	11.8	6.9	33	46.4	246

USH 10 over LLBDM - WEST ABUTMENT #3 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			MIN	27.2	10.3	6.4	28	44.7	233
477	63.00	12	AV12	28.1	11.3	6.7	31	45.5	238
			MAX	29.9	12.0	7.1	35	46.3	248
			MIN	27.3	10.3	6.5	29	44.1	233
489	64.00	12	AV12	28.3	11.3	6.8	32	45.3	241
			MAX	29.2	12.2	7.0	34	45.9	253
			MIN	27.3	10.9	6.6	30	44.4	234
501	65.00	12	AV12	28.8	11.6	7.0	34	44.6	246
			MAX	29.1	12.2	7.1	35	45.2	252
			MIN	28.4	10.9	6.8	33	44.2	241
515	66.00	14	AV14	28.2	11.4	6.8	32	45.1	244
			MAX	28.8	12.0	7.0	33	46.0	251
			MIN	27.4	11.0	6.5	30	44.4	238
528	67.00	13	AV13	28.1	11.7	6.8	32	45.1	240
			MAX	28.9	12.2	7.1	33	45.8	251
			MIN	27.1	11.2	6.6	30	44.2	230
540	68.00	12	AV12	27.6	12.3	6.8	31	45.2	230
			MAX	28.5	13.0	7.1	33	46.1	240
			MIN	26.7	11.3	6.5	29	44.2	222
552	69.00	12	AV12	27.8	13.0	6.8	31	45.1	229
			MAX	28.7	13.5	7.1	33	45.9	236
			MIN	26.9	12.1	6.6	29	44.2	218
564	70.00	12	AV12	27.8	12.8	6.8	31	45.2	227
			MAX	28.6	13.3	7.0	32	45.8	233
			MIN	26.7	12.2	6.6	29	44.5	217
576	71.00	12	AV12	28.0	13.5	6.8	31	45.1	228
			MAX	28.9	14.1	7.1	32	45.7	236
			MIN	27.4	12.4	6.6	30	44.2	223
588	72.00	12	AV12	27.7	13.8	6.7	30	45.5	224
			MAX	29.6	14.5	7.2	33	46.2	235
			MIN	27.1	13.1	6.5	28	43.8	217
599	73.00	11	AV11	27.8	13.8	6.7	30	45.5	224
			MAX	28.6	14.5	6.8	31	46.1	229
			MIN	26.9	13.4	6.5	28	45.0	219
611	74.00	12	AV12	28.6	14.6	6.7	31	45.3	230
			MAX	29.5	15.2	6.9	32	46.0	237
			MIN	27.9	13.8	6.5	29	44.7	220
624	75.00	13	AV13	28.4	14.9	6.8	31	45.2	238
			MAX	29.6	15.4	7.2	33	46.1	253
			MIN	27.4	14.6	6.5	29	43.9	232

USH 10 over LLBDM - WEST ABUTMENT #3 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
637	76.00	13	AV13	28.4	15.0	6.8	31	45.2	231
			MAX	29.2	15.8	7.0	33	46.1	238
			MIN	27.4	14.3	6.5	29	44.4	226
649	77.00	12	AV11	30.4	17.8	7.6	35	43.1	214
			MAX	33.1	20.1	9.1	42	45.3	229
			MIN	28.0	14.9	6.8	30	39.3	193
665	78.00	16	AV16	30.5	20.9	7.5	33	43.0	179
			MAX	31.8	22.2	7.9	35	43.7	196
			MIN	29.8	18.9	7.3	30	41.9	165
685	79.00	20	AV20	31.2	23.3	7.7	33	42.5	245
			MAX	32.1	25.6	7.9	35	43.2	306
			MIN	30.3	22.0	7.5	31	41.9	208
719	80.00	34	AV34	32.0	26.8	8.0	34	41.7	359
			MAX	33.5	30.2	8.6	38	42.9	440
			MIN	30.7	24.5	7.6	31	40.4	283
764	80.92	49	AV45	32.9	29.0	8.3	36	40.9	432
			MAX	33.8	30.3	8.6	38	41.6	459
			MIN	32.3	27.7	8.1	35	40.3	408
774	81.13	48	AV10	32.7	28.2	8.2	36	41.2	416
			MAX	33.1	29.1	8.4	36	41.9	430
			MIN	31.9	27.6	7.9	34	40.8	406
784	81.31	53	AV10	33.0	29.0	8.4	36	40.9	431
			MAX	33.5	29.6	8.5	37	41.3	437
			MIN	32.5	28.4	8.2	35	40.5	422
794	81.50	53	AV9	33.3	29.5	8.4	37	40.8	438
			MAX	33.7	30.0	8.6	38	41.3	442
			MIN	32.5	28.7	8.2	36	40.3	433
			Average	28.0	13.5	6.8	33	45.4	235
			Maximum	33.8	30.3	9.1	42	64.0	459
			Minimum	11.2	3.0	3.2	12	39.3	36

Total number of blows analyzed: 789

BL# Sensors

1-794 F3: [F607] 93.6 (0.98); F4: [D815] 93.0 (0.98); A3: [K2524] 360.0 (1.03); A4: [K3550] 360.0 (1.03)

BL# Comments

3 Reported Reference EL 777.46
642 LE = 90.00 ft; WC = 16,822.4 f/s

Time Summary

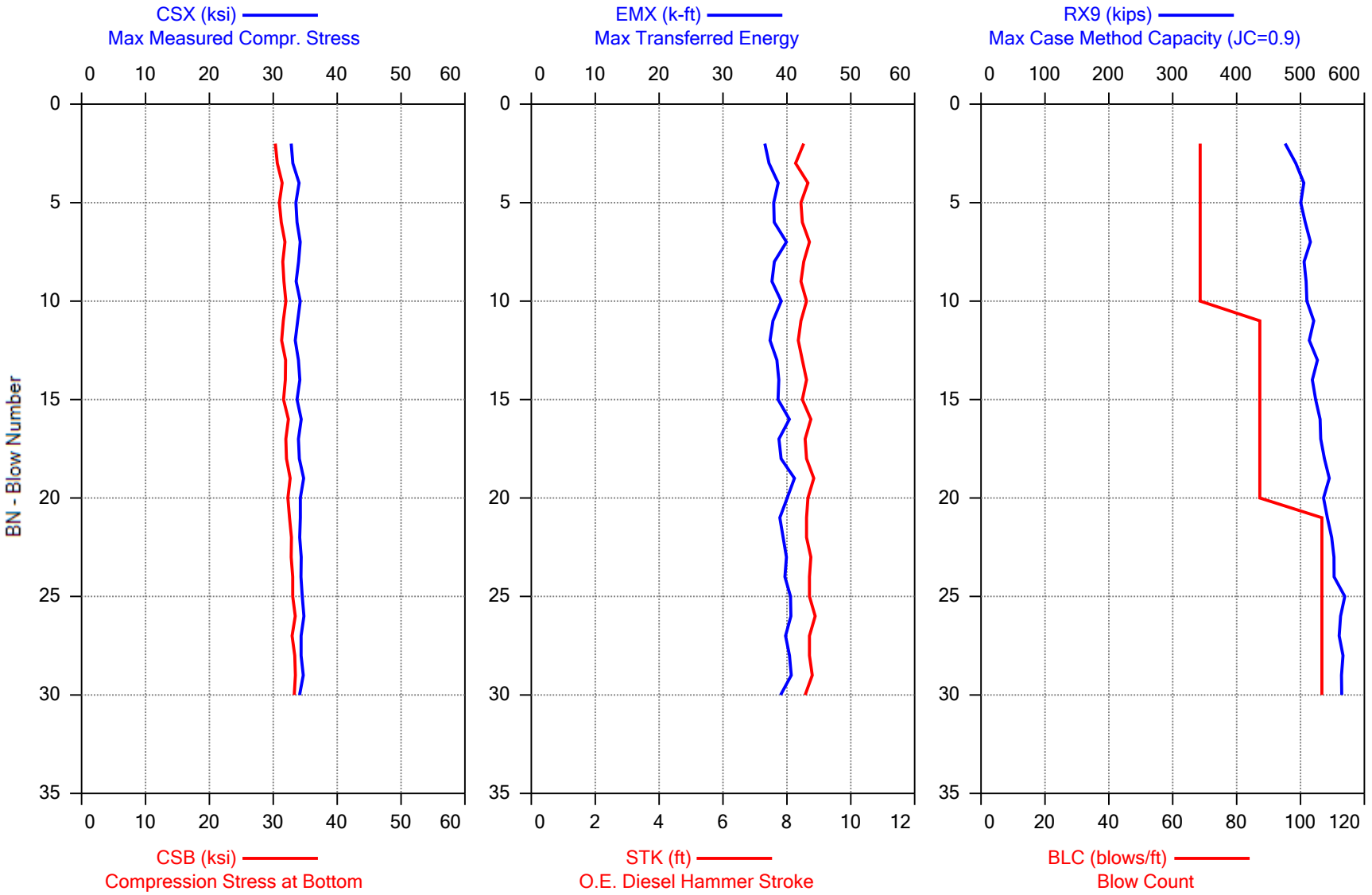
Drive	14 minutes 22 seconds	7:16 AM - 7:31 AM (4/16/2015) BN 1 - 641
Stop	2 hours 18 minutes 40 seconds	7:31 AM - 9:49 AM
Drive	3 minutes 39 seconds	9:49 AM - 9:53 AM BN 642 - 794

Total time [02:36:42] = (Driving [00:18:01] + Stop [02:18:40])

Printed: 17-April-2015

Test started: 17-April-2015

USH 10 over LLBDM - WEST ABUTMENT #3-BOR
APE D30-42, HP 14 x 73



USH 10 over LLBDM - WEST ABUTMENT #3-BOR APE D30-42, HP 14 x 73
OP: RF Date: 17-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 90.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
10	81.65	69	AV9	33.7	31.3	8.5	38	40.5	502
			MAX	34.2	32.0	8.7	40	41.1	516
			MIN	32.8	30.3	8.3	37	40.1	476
20	81.76	87	AV10	34.0	32.0	8.6	39	40.4	528
			MAX	34.7	32.6	8.8	41	40.9	545
			MIN	33.4	31.3	8.4	37	39.8	514
30	81.85	107	AV10	34.4	33.1	8.7	40	40.1	558
			MAX	34.8	33.5	8.9	41	40.4	569
			MIN	34.1	32.5	8.6	39	39.7	542
			Average	34.0	32.1	8.6	39	40.3	531
			Maximum	34.8	33.5	8.9	41	41.1	569
			Minimum	32.8	30.3	8.3	37	39.7	476

Total number of blows analyzed: 29

BL# Sensors

1-30 F3: [F607] 93.6 (0.97); F4: [D815] 93.0 (0.97); A3: [K2524] 360.0 (1.03); A4: [K3550] 360.0 (1.03)

Time Summary

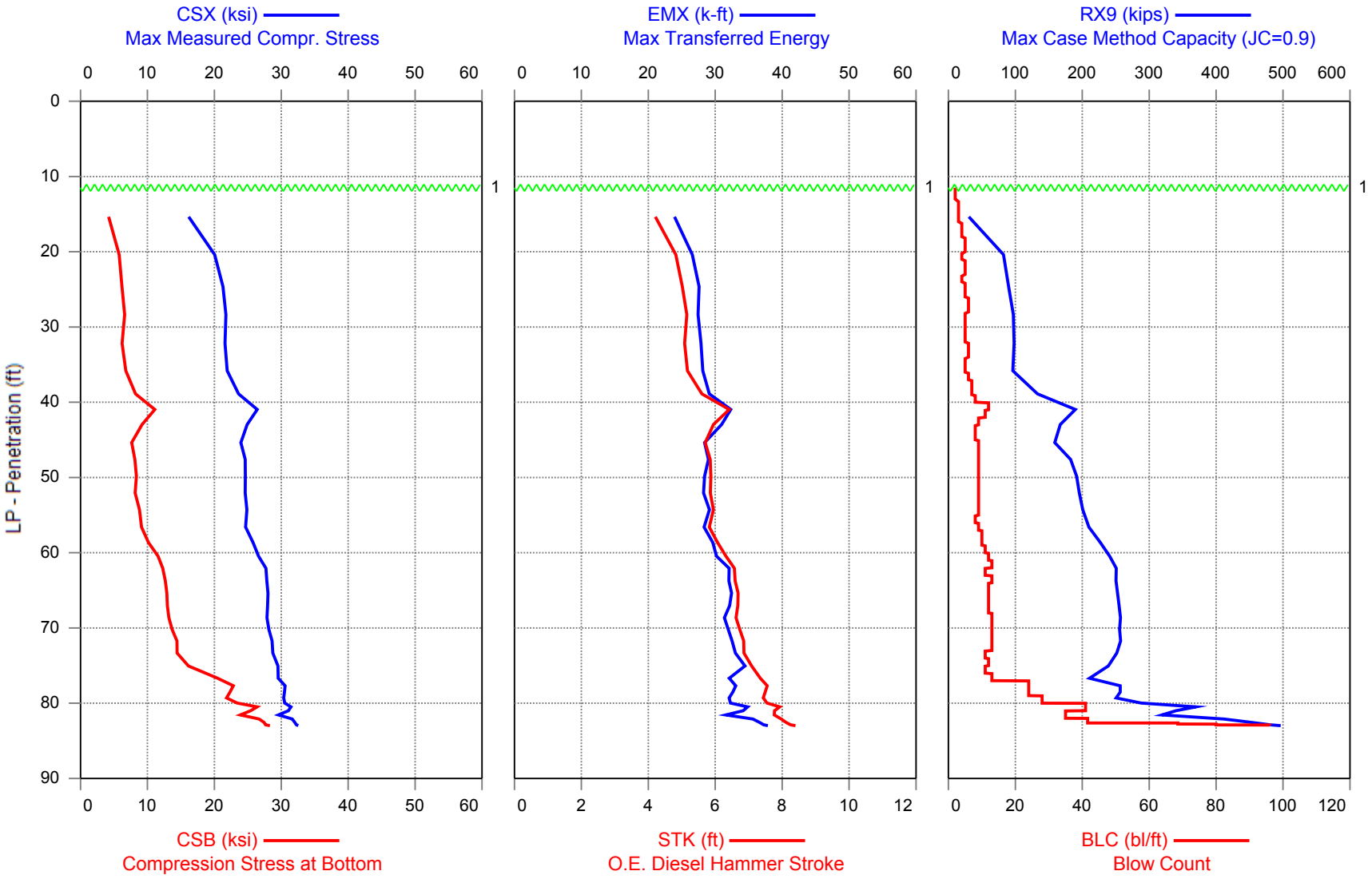
Drive 43 seconds 7:07 AM - 7:08 AM BN 1 - 30

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

Printed: 17-April-2015

Test started: 16-April-2015

USH 10 over LLBDM - WEST ABUTMENT #8
APE D30-42, HP 14 x 73



1 - Reported Reference EL 777.46

USH 10 over LLBDM - WEST ABUTMENT #8 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

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

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

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
3	11.50	2	AV1	22.9	3.7	5.4	40	50.6	1
			MAX	22.9	3.7	5.4	40	50.6	1
			MIN	22.9	3.7	5.4	40	50.6	1
4	12.00	2	AV1	15.3	3.2	3.9	23	58.9	0
			MAX	15.3	3.2	3.9	23	58.9	0
			MIN	15.3	3.2	3.9	23	58.9	0
6	13.00	2	AV2	8.6	2.3	3.2	13	64.8	0
			MAX	10.6	2.6	3.3	16	66.6	0
			MIN	6.5	2.0	3.0	11	63.0	0
9	14.00	3	AV2	11.9	2.4	4.0	21	59.9	0
			MAX	22.5	4.3	5.2	42	68.2	0
			MIN	1.4	0.5	2.8	1	51.5	0
12	15.00	3	AV3	14.4	3.3	3.7	21	60.2	0
			MAX	16.4	3.7	3.9	27	61.9	0
			MIN	12.7	3.0	3.5	16	58.4	0
15	16.00	3	AV2	20.8	4.8	4.8	33	53.3	31
			MAX	23.0	5.3	5.3	37	55.8	62
			MIN	18.5	4.3	4.3	29	50.8	0
19	17.00	4	AV4	17.6	5.6	4.4	24	55.4	59
			MAX	18.7	6.0	4.6	26	56.2	63
			MIN	16.9	5.2	4.3	22	54.6	54
23	18.00	4	AV4	17.7	5.2	4.4	24	55.3	60
			MAX	19.2	5.3	4.7	26	56.6	74
			MIN	16.5	4.9	4.2	22	53.7	52
28	19.00	5	AV5	19.1	5.5	4.7	25	54.0	78
			MAX	20.3	5.6	4.9	27	54.8	85
			MIN	18.1	5.3	4.5	23	52.9	70
33	20.00	5	AV5	20.6	6.4	5.0	28	52.4	91
			MAX	21.2	7.0	5.1	29	53.1	96
			MIN	20.0	5.7	4.8	26	51.7	80
37	21.00	4	AV4	20.3	5.9	4.9	28	52.8	77
			MAX	20.9	6.7	5.1	30	54.4	83
			MIN	18.9	5.1	4.6	24	51.8	73
42	22.00	5	AV5	19.7	5.6	4.7	25	53.9	81
			MAX	21.1	6.0	5.0	27	54.7	83
			MIN	18.8	5.3	4.5	24	52.1	79

USH 10 over LLBDM - WEST ABUTMENT #8 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
47	23.00	5	AV5	20.5	5.5	4.8	27	53.3	85
			MAX	21.3	6.0	4.9	28	54.7	89
			MIN	19.5	5.2	4.5	25	52.7	78
51	24.00	4	AV4	21.2	6.3	5.0	28	52.5	84
			MAX	21.9	6.4	5.1	29	53.0	88
			MIN	20.7	6.2	4.9	27	51.7	81
56	25.00	5	AV5	21.1	6.5	5.0	27	52.3	91
			MAX	21.7	6.7	5.1	29	52.7	94
			MIN	20.7	6.3	4.9	26	51.9	87
61	26.00	5	AV5	21.5	6.2	5.1	28	51.8	90
			MAX	22.0	6.7	5.2	29	53.2	95
			MIN	20.3	5.8	4.8	26	51.1	84
67	27.00	6	AV6	22.1	6.3	5.2	28	51.2	98
			MAX	22.4	6.8	5.3	28	51.8	101
			MIN	21.6	6.1	5.1	27	50.7	96
73	28.00	6	AV6	22.0	6.8	5.2	27	51.2	105
			MAX	22.7	7.0	5.4	29	51.7	107
			MIN	21.6	6.5	5.1	26	50.6	102
78	29.00	5	AV5	21.8	6.4	5.2	28	51.5	99
			MAX	22.3	6.9	5.3	29	52.6	102
			MIN	20.7	6.0	4.9	26	50.8	93
83	30.00	5	AV5	21.4	6.7	5.1	28	51.8	90
			MAX	22.1	6.9	5.2	29	52.8	94
			MIN	20.5	6.3	4.9	26	51.2	81
88	31.00	5	AV5	20.8	5.7	4.9	27	52.8	86
			MAX	21.6	6.1	5.1	28	53.4	97
			MIN	20.2	5.5	4.8	26	51.8	72
93	32.00	5	AV5	22.3	6.2	5.2	30	51.2	103
			MAX	23.5	6.5	5.5	33	53.3	108
			MIN	20.3	5.9	4.8	26	50.1	92
99	33.00	6	AV6	21.8	6.1	5.2	28	51.5	101
			MAX	22.7	6.5	5.4	30	52.4	105
			MIN	21.0	5.8	5.0	26	50.5	96
105	34.00	6	AV6	21.3	7.0	5.0	27	52.3	98
			MAX	22.6	8.5	5.3	29	54.4	105
			MIN	19.6	5.9	4.6	24	50.7	92
110	35.00	5	AV5	22.3	7.9	5.3	29	51.0	99
			MAX	23.4	8.7	5.5	32	51.6	104
			MIN	21.7	7.0	5.1	27	49.9	96

USH 10 over LLBDM - WEST ABUTMENT #8 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

BL#	depth	BLC	TYPE	CSX	CSB	STK	EMX	BPM	RX9
	ft	bl/ft		ksi	ksi	ft	k-ft	bpm	kips
115	36.00	5	AV5	22.0	6.3	5.2	29	51.3	92
			MAX	23.2	6.7	5.5	32	52.7	99
			MIN	20.8	6.0	4.9	27	50.0	89
121	37.00	6	AV6	21.8	6.2	5.1	28	51.7	96
			MAX	22.2	6.3	5.2	29	52.5	101
			MIN	21.0	6.1	5.0	27	51.4	93
128	38.00	7	AV7	22.2	6.9	5.2	27	51.2	112
			MAX	23.4	8.1	5.6	30	52.2	133
			MIN	21.3	6.2	5.0	25	49.7	96
135	39.00	7	AV7	23.0	7.6	5.4	28	50.3	123
			MAX	24.4	8.8	5.8	31	52.2	143
			MIN	21.0	7.0	5.0	25	48.9	113
143	40.00	8	AV8	24.4	9.0	5.8	30	48.7	144
			MAX	24.9	10.3	5.9	32	49.3	169
			MIN	24.0	8.5	5.7	29	48.2	132
155	41.00	12	AV12	25.9	10.4	6.3	31	47.1	183
			MAX	27.6	12.4	6.8	34	49.9	208
			MIN	23.5	8.0	5.5	26	45.2	137
166	42.00	11	AV11	26.9	11.7	6.6	34	45.9	195
			MAX	28.5	12.8	7.1	37	47.1	201
			MIN	25.6	10.5	6.2	32	44.1	188
175	43.00	9	AV9	25.8	10.4	6.2	33	47.3	181
			MAX	26.8	11.9	6.6	35	48.2	191
			MIN	25.1	9.6	5.9	31	45.8	168
183	44.00	8	AV8	23.7	7.7	5.6	29	49.5	148
			MAX	25.8	9.2	6.1	32	51.3	166
			MIN	22.4	7.0	5.2	25	47.6	134
191	45.00	8	AV8	23.6	7.3	5.6	28	49.6	146
			MAX	24.4	7.7	5.8	29	50.1	156
			MIN	23.0	7.1	5.5	27	48.7	139
200	46.00	9	AV9	24.3	7.8	5.8	29	48.7	163
			MAX	25.1	8.2	6.0	31	50.4	169
			MIN	22.7	7.6	5.4	26	47.9	155
209	47.00	9	AV9	24.3	8.0	5.8	29	48.8	173
			MAX	25.1	8.4	6.0	30	50.0	185
			MIN	23.1	7.5	5.5	27	48.1	163
218	48.00	9	AV9	24.7	8.1	5.9	29	48.5	184
			MAX	26.2	8.8	6.2	33	50.1	194
			MIN	23.2	7.7	5.5	26	47.1	175
227	49.00	9	AV9	24.6	8.2	5.9	29	48.4	186

USH 10 over LLBDM - WEST ABUTMENT #8 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			MAX	25.3	8.7	6.0	30	49.5	190
			MIN	23.6	7.9	5.6	27	47.9	182
236	50.00	9	AV9	24.4	8.3	5.8	28	48.7	188
			MAX	25.6	8.9	6.1	30	49.5	196
			MIN	23.6	7.8	5.6	26	47.7	182
245	51.00	9	AV9	24.7	8.4	5.9	28	48.3	196
			MAX	25.6	9.0	6.1	31	48.9	205
			MIN	23.9	7.8	5.8	27	47.4	187
254	52.00	9	AV9	24.2	8.1	5.8	27	48.8	194
			MAX	24.7	8.7	5.9	28	49.4	199
			MIN	23.8	7.9	5.6	26	48.2	189
263	53.00	9	AV9	25.1	8.2	5.9	29	48.2	198
			MAX	26.2	8.4	6.2	31	49.7	203
			MIN	23.5	7.7	5.6	27	47.1	189
272	54.00	9	AV9	24.6	8.5	5.9	28	48.3	198
			MAX	25.6	9.5	6.2	30	49.4	207
			MIN	23.6	8.2	5.6	27	47.2	191
281	55.00	9	AV9	24.9	8.9	5.9	29	48.1	202
			MAX	25.7	9.5	6.1	32	48.8	207
			MIN	24.4	8.5	5.8	28	47.5	197
289	56.00	8	AV8	24.9	8.8	5.9	29	48.5	202
			MAX	26.5	9.9	6.4	32	49.3	209
			MIN	24.1	8.2	5.7	28	46.6	197
298	57.00	9	AV9	24.8	9.2	5.9	29	48.5	211
			MAX	26.1	9.6	6.2	31	49.5	219
			MIN	23.8	8.8	5.6	27	47.1	203
308	58.00	10	AV10	25.1	9.6	5.9	29	48.2	219
			MAX	26.7	10.7	6.3	31	49.2	231
			MIN	24.2	9.0	5.7	26	46.9	208
318	59.00	10	AV10	25.5	9.8	6.0	29	48.0	224
			MAX	26.5	10.5	6.3	31	48.9	234
			MIN	24.6	9.0	5.8	28	46.9	217
329	60.00	11	AV11	26.1	11.1	6.2	30	47.3	233
			MAX	26.8	11.7	6.4	32	47.9	240
			MIN	25.5	10.4	6.0	29	46.6	227
341	61.00	12	AV12	26.8	11.6	6.4	30	46.6	243
			MAX	27.6	12.6	6.7	33	47.2	252
			MIN	26.3	11.0	6.2	29	45.5	238
354	62.00	13	AV13	27.4	12.2	6.5	31	46.2	250
			MAX	28.2	12.8	6.8	33	47.1	263

USH 10 over LLBDM - WEST ABUTMENT #8 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
			MIN	26.7	11.7	6.2	29	45.2	243
365	63.00	11	AV11	27.8	12.4	6.6	32	45.9	249
			MAX	28.7	12.8	6.8	34	46.9	257
			MIN	26.5	12.1	6.3	30	45.0	242
378	64.00	13	AV13	28.0	12.6	6.6	32	45.8	252
			MAX	29.2	13.2	6.9	35	46.6	260
			MIN	26.9	12.1	6.4	31	44.7	247
390	65.00	12	AV12	27.7	12.8	6.6	32	45.8	249
			MAX	28.8	13.4	7.0	34	46.4	257
			MIN	27.0	12.3	6.4	31	44.6	243
402	66.00	12	AV12	28.1	13.1	6.7	33	45.4	255
			MAX	29.1	13.7	7.0	35	46.5	263
			MIN	27.0	12.5	6.4	30	44.6	247
414	67.00	12	AV12	28.0	12.9	6.7	32	45.5	254
			MAX	29.0	14.1	6.9	34	46.2	262
			MIN	27.1	12.2	6.5	31	44.8	246
426	68.00	12	AV12	28.0	13.0	6.7	32	45.6	256
			MAX	28.9	14.1	6.8	34	46.4	261
			MIN	27.0	12.4	6.4	31	45.0	249
439	69.00	13	AV13	28.0	13.1	6.6	32	45.7	259
			MAX	28.7	14.1	6.8	33	46.2	265
			MIN	27.5	12.5	6.5	31	45.0	254
452	70.00	13	AV13	27.7	13.4	6.6	31	45.7	254
			MAX	28.7	14.1	6.8	32	46.4	264
			MIN	26.8	12.7	6.4	30	45.1	247
465	71.00	13	AV13	28.3	13.8	6.8	32	45.3	256
			MAX	28.9	14.6	6.9	33	46.0	260
			MIN	27.5	13.4	6.5	31	44.8	249
478	72.00	13	AV13	28.6	14.4	6.8	32	45.0	257
			MAX	29.1	15.1	7.0	34	45.6	263
			MIN	28.0	13.5	6.7	31	44.4	250
491	73.00	13	AV13	28.7	14.4	6.9	33	45.0	258
			MAX	29.8	15.0	7.1	35	45.5	262
			MIN	28.1	14.0	6.7	31	44.1	252
502	74.00	11	AV11	28.8	14.4	6.9	33	45.0	248
			MAX	29.8	14.8	7.1	36	45.8	255
			MIN	27.7	13.9	6.6	31	44.1	239
514	75.00	12	AV12	28.8	14.7	6.9	33	44.9	246
			MAX	29.7	15.4	7.1	35	45.4	252
			MIN	28.1	14.3	6.7	32	44.1	240

USH 10 over LLBDM - WEST ABUTMENT #8 APE D30-42, HP 14 x 73
OP: RF Date: 16-April-2015

BL#	depth ft	BLC bl/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
525	76.00	11	AV11	30.1	17.5	7.3	36	43.7	232
			MAX	31.0	19.1	7.6	38	44.1	243
			MIN	29.4	15.2	7.1	34	42.8	223
538	77.00	13	AV13	29.4	20.1	7.3	32	43.6	195
			MAX	31.4	21.9	7.9	36	44.6	226
			MIN	27.5	18.0	7.0	30	42.1	155
562	78.00	24	AV24	30.4	22.7	7.5	33	43.0	254
			MAX	31.4	23.9	7.8	35	43.9	275
			MIN	29.4	21.7	7.2	30	42.2	232
586	79.00	24	AV24	30.5	22.2	7.5	33	43.1	254
			MAX	31.5	22.9	7.8	35	44.2	269
			MIN	29.3	21.3	7.1	30	42.2	233
614	80.00	28	AV28	30.3	22.1	7.4	32	43.3	255
			MAX	31.8	23.5	7.9	34	44.3	283
			MIN	29.3	20.8	7.1	30	42.1	236
655	81.00	41	AV41	31.2	25.8	7.8	34	42.2	353
			MAX	32.2	27.0	8.2	37	43.2	380
			MIN	30.3	23.3	7.5	32	41.2	289
690	82.00	35	AV35	30.2	24.5	7.8	33	42.4	331
			MAX	32.1	26.8	8.1	37	43.2	407
			MIN	15.4	12.7	7.5	9	41.5	187
716	82.63	42	AV26	31.9	27.1	8.1	36	41.6	433
			MAX	33.0	28.1	8.4	40	42.7	459
			MIN	30.6	26.1	7.6	33	40.7	411
726	82.77	69	AV10	32.1	27.5	8.1	37	41.4	465
			MAX	33.4	28.5	8.6	39	42.2	472
			MIN	31.2	26.7	7.8	35	40.4	455
736	82.90	80	AV10	32.3	27.7	8.3	37	41.1	477
			MAX	33.1	28.3	8.6	39	41.7	487
			MIN	31.6	27.1	8.0	36	40.4	470
746	83.00	96	AV10	32.3	27.8	8.3	37	41.1	488
			MAX	32.8	28.5	8.5	38	41.5	499
			MIN	31.9	27.3	8.1	36	40.6	478
			Average	26.8	14.3	6.5	31	46.5	230
			Maximum	33.4	28.5	8.6	42	68.2	499
			Minimum	1.4	0.5	2.8	1	40.4	0

Total number of blows analyzed: 742

BL# Sensors

1-746 F3: [D815] 93.0 (0.99); F4: [F607] 93.6 (0.99); A3: [K3550] 360.0 (1.01); A4: [K2524] 360.0 (1.01)

BL# Comments

3 Reported Reference EL 777.46
526 LE = 90.00 ft

Time Summary

Drive	11 minutes 47 seconds	8:54 AM - 9:06 AM (4/16/2015) BN 1 - 525
Stop	1 hour 9 minutes 25 seconds	9:06 AM - 10:16 AM
Drive	5 minutes 11 seconds	10:16 AM - 10:21 AM BN 526 - 746

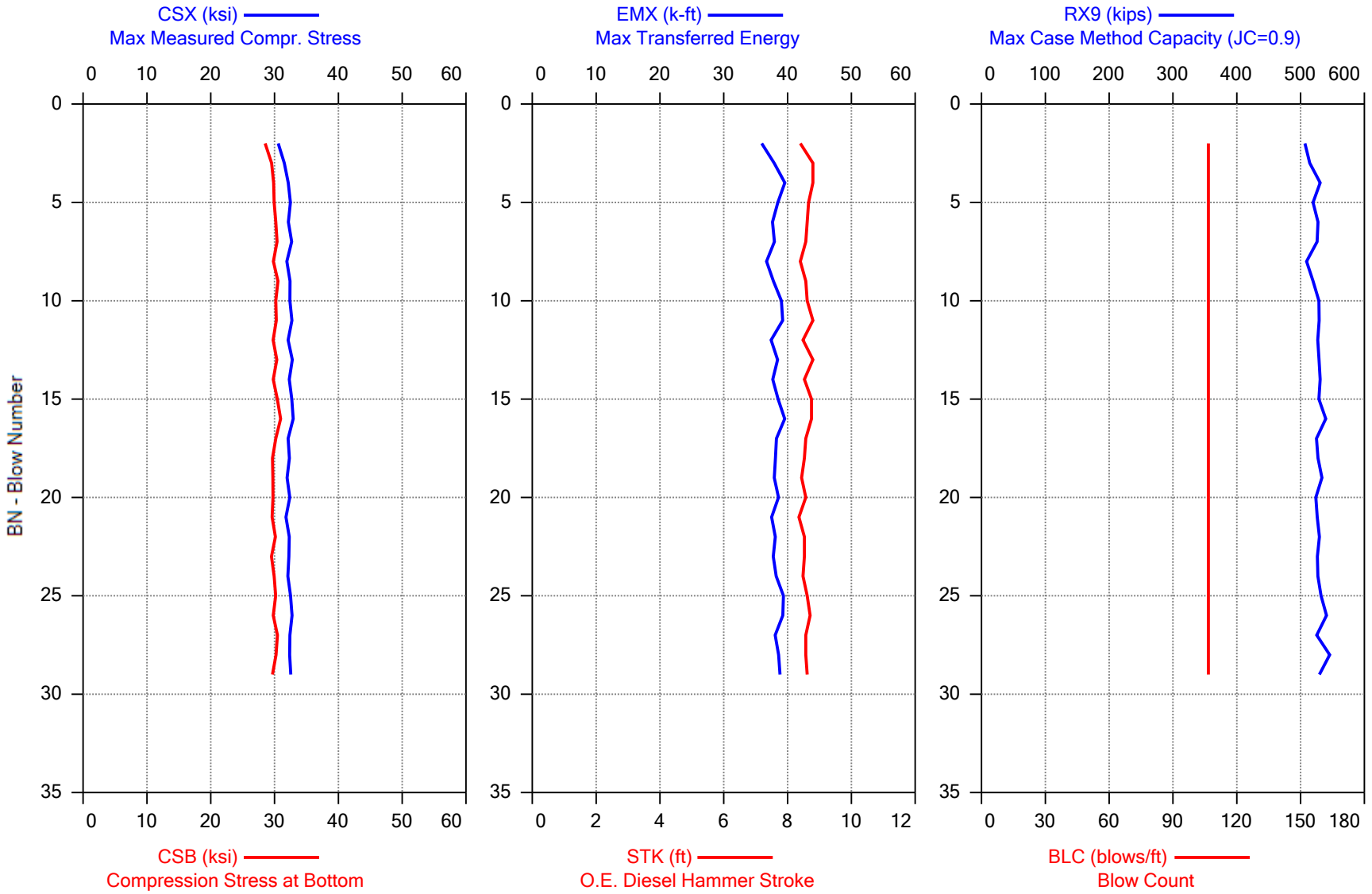
Total time [01:26:23] = (Driving [00:16:58] + Stop [01:09:25])

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

Printed: 17-April-2015

Test started: 17-April-2015

USH 10 over LLBDM - WEST ABUTMENT #8-BOR
APE D30-42, HP 14 x 73



USH 10 over LLBDM - WEST ABUTMENT #8-BOR APE D30-42, HP 14 x 73
OP: RF Date: 17-April-2015

AR: 21.40 in² SP: 0.492 k/ft³
LE: 90.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 1.00 []

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

BL#	depth ft	BLC blows/ft	TYPE	CSX ksi	CSB ksi	STK ft	EMX k-ft	BPM bpm	RX9 kips
10	83.09	107	AV9	32.0	29.9	8.6	38	40.3	520
			MAX	32.7	30.5	8.8	40	40.8	531
			MIN	30.6	28.5	8.4	36	39.9	507
20	83.19	107	AV10	32.4	30.1	8.6	38	40.3	529
			MAX	32.9	31.0	8.8	40	40.7	539
			MIN	32.0	29.7	8.4	37	39.9	524
30	83.28	107	AV9	32.3	29.9	8.6	38	40.4	531
			MAX	32.7	30.5	8.7	39	40.9	545
			MIN	31.8	29.5	8.4	37	40.1	525
			Average	32.3	30.0	8.6	38	40.4	527
			Maximum	32.9	31.0	8.8	40	40.9	545
			Minimum	30.6	28.5	8.4	36	39.9	507

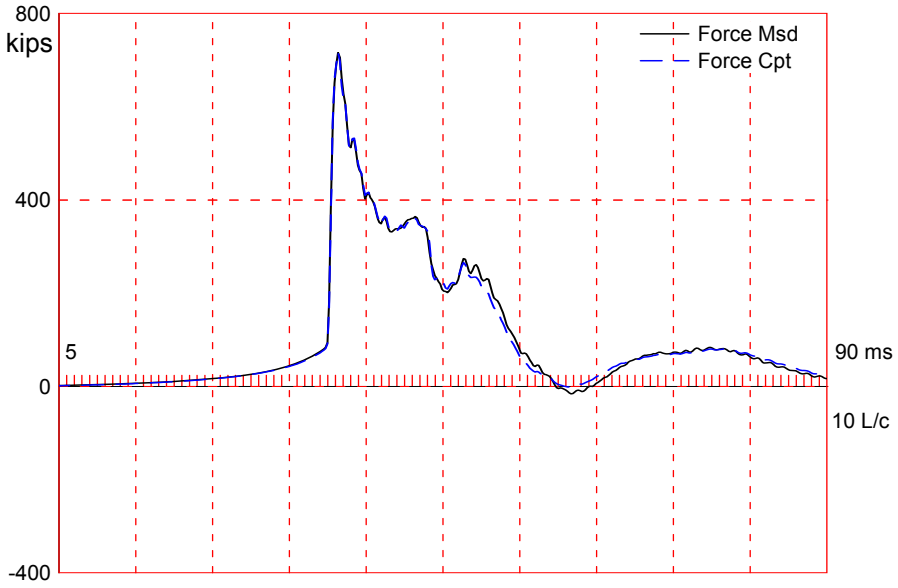
Total number of blows analyzed: 28

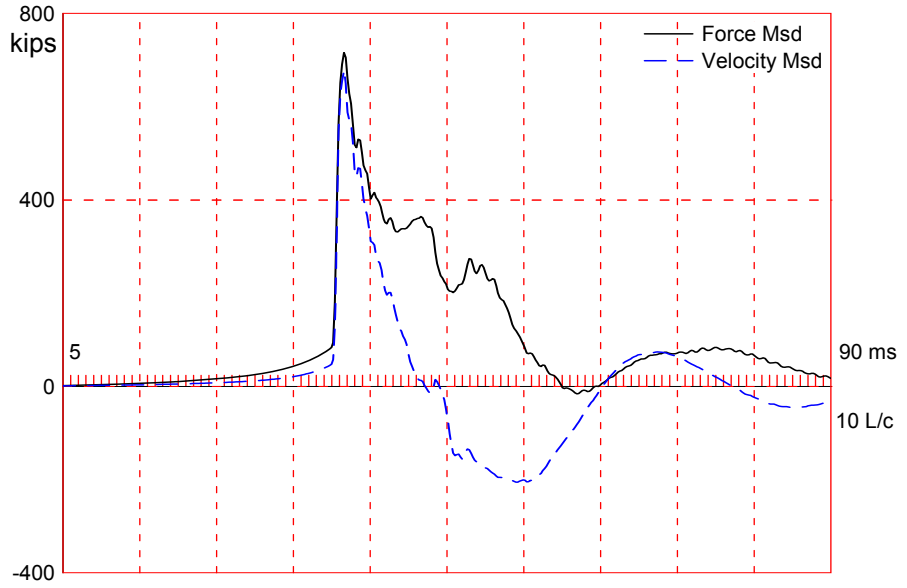
BL# Sensors

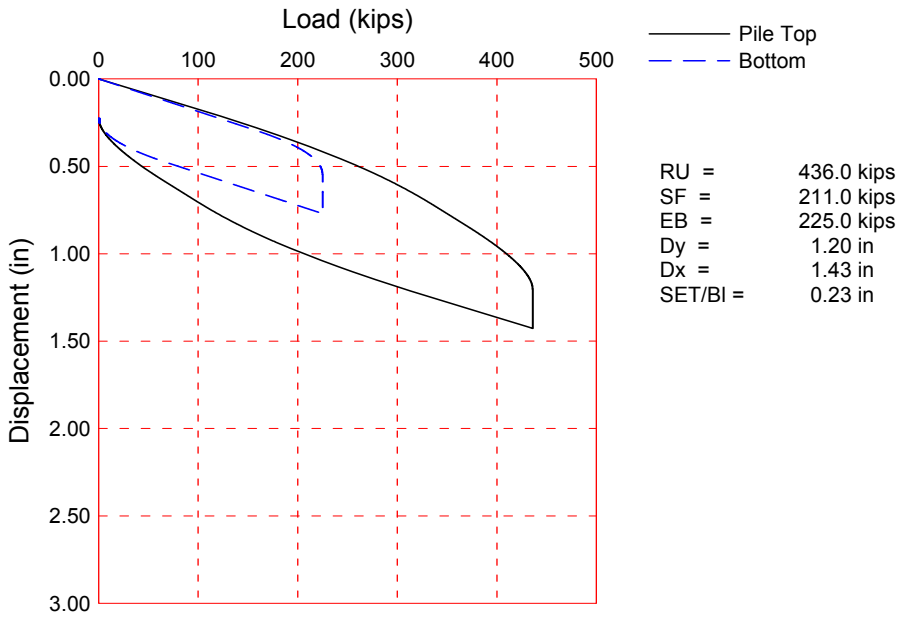
1-30 F3: [D815] 93.0 (0.97); F4: [F607] 93.6 (0.97); A3: [K3550] 360.0 (1.03); A4: [K2524] 360.0 (1.03)

Time Summary

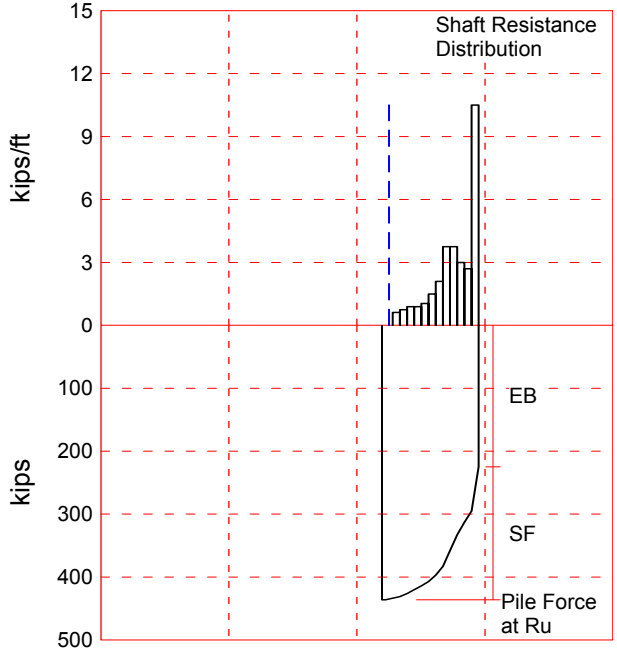
Drive 43 seconds 6:57 AM - 6:57 AM BN 1 - 30







RU =	436.0 kips
SF =	211.0 kips
EB =	225.0 kips
Dy =	1.20 in
Dx =	1.43 in
SET/Bl =	0.23 in



Length b. Sensors	90.0 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.	16808 ft/s
Match Quality	1.98
Top Compr. Stress	33.5 ksi
Max Compr. Stress	34.3 ksi
Max Tension Stress	-1.23 ksi
Avg. Shaft Quake	0.18 in
Toe Quake	0.42 in
Avg. Shaft Smith Dpg.	0.24 s/ft
Toe Smith Damping	0.07 s/ft

About the CAPWAP Results

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

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

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

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

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

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

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

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

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 436.0; along Shaft 211.0; at Toe 225.0 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
				436.0			
1	16.7	8.1	5.0	431.0	5.0	0.62	0.13
2	23.3	14.8	5.0	426.0	10.0	0.75	0.16
3	30.0	21.5	6.0	420.0	16.0	0.90	0.19
4	36.7	28.1	6.0	414.0	22.0	0.90	0.19
5	43.3	34.8	7.0	407.0	29.0	1.05	0.22
6	50.0	41.5	10.0	397.0	39.0	1.50	0.32
7	56.7	48.1	14.0	383.0	53.0	2.10	0.45
8	63.3	54.8	25.0	358.0	78.0	3.75	0.80
9	70.0	61.5	25.0	333.0	103.0	3.75	0.80
10	76.7	68.1	20.0	313.0	123.0	3.00	0.64
11	83.3	74.8	18.0	295.0	141.0	2.70	0.57
12	90.0	81.5	70.0	225.0	211.0	10.50	2.23
Avg. Shaft			17.6			2.59	0.55
Toe			225.0				163.22

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.24	0.07
Quake	(in)	0.18	0.42
Case Damping Factor		1.33	0.41
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	76	115
Unloading Level	(% of Ru)	78	
Resistance Gap (included in Toe Quake)	(in)		0.03
Soil Plug Weight	(kips)		0.121

CAPWAP match quality = 1.98 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.23 in; Blow Count = 53 b/ft
Computed: Final Set = 0.26 in; Blow Count = 46 b/ft

Transducer F3(F607) CAL: 93.6; RF: 0.97; F4(D815) CAL: 93.0; RF: 0.97
A3(K2524) CAL: 360; RF: 1.02; A4(K3550) CAL: 360; RF: 1.02

max. Top Comp. Stress = 33.5 ksi (T= 36.3 ms, max= 1.026 x Top)
max. Comp. Stress = 34.3 ksi (Z= 16.7 ft, T= 37.1 ms)
max. Tens. Stress = -1.23 ksi (Z= 30.0 ft, T= 63.7 ms)
max. Energy (EMX) = 37.5 kip-ft; max. Measured Top Displ. (DMX)= 0.98 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	716.3	-10.8	33.5	-0.51	37.5	17.7	0.97
2	6.7	717.3	-11.8	33.5	-0.55	37.3	17.7	0.96
4	13.3	728.3	-19.6	34.0	-0.92	36.8	17.4	0.92
6	20.0	715.0	-22.1	33.4	-1.03	35.1	17.0	0.88
8	26.7	703.9	-23.0	32.9	-1.08	33.3	16.6	0.84
10	33.3	688.6	-22.8	32.2	-1.06	31.4	16.2	0.79
12	40.0	675.4	-22.1	31.6	-1.03	29.6	15.8	0.75
13	43.3	685.7	-25.2	32.0	-1.18	29.3	15.5	0.72
14	46.7	663.2	-20.0	31.0	-0.93	27.7	15.2	0.70
15	50.0	676.6	-23.1	31.6	-1.08	27.3	14.9	0.68
16	53.3	645.6	-15.9	30.2	-0.74	25.4	14.5	0.66
17	56.7	668.0	-17.9	31.2	-0.84	25.1	14.0	0.63
18	60.0	628.5	-6.0	29.4	-0.28	22.8	13.4	0.61
19	63.3	652.1	-9.1	30.5	-0.43	22.4	12.8	0.59
20	66.7	573.3	0.0	26.8	0.00	19.0	12.3	0.57
21	70.0	590.2	0.0	27.6	0.00	18.7	11.8	0.55
22	73.3	516.5	0.0	24.1	0.00	15.7	11.4	0.52
23	76.7	530.2	0.0	24.8	0.00	15.4	11.1	0.50
24	80.0	476.4	0.0	22.3	0.00	13.1	10.7	0.48
25	83.3	478.0	0.0	22.3	0.00	12.9	11.3	0.47
26	86.7	383.4	0.0	17.9	0.00	11.0	12.5	0.45
27	90.0	383.4	0.0	17.9	0.00	5.2	12.5	0.43
Absolute	16.7			34.3			(T =	37.1 ms)
	30.0				-1.23		(T =	63.7 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	801.9	749.2	696.5	643.8	591.1	538.4	485.7	433.0	380.3	327.6
RX	801.9	749.2	696.5	643.8	591.1	538.4	493.6	466.9	452.5	442.0
RU	834.4	730.2	626.1	521.9	417.7	313.6	209.4	105.2	1.1	0.0

RAU = 253.4 (kips); RA2 = 530.7 (kips)

Current CAPWAP Ru = 436.0 (kips); Corresponding J(RP)= 1.39; matches RX20 within 5%

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
17.7	36.29	649.7	705.5	715.7	0.98	0.23	0.23	37.6	747.6	577

PILE PROFILE AND PILE MODEL

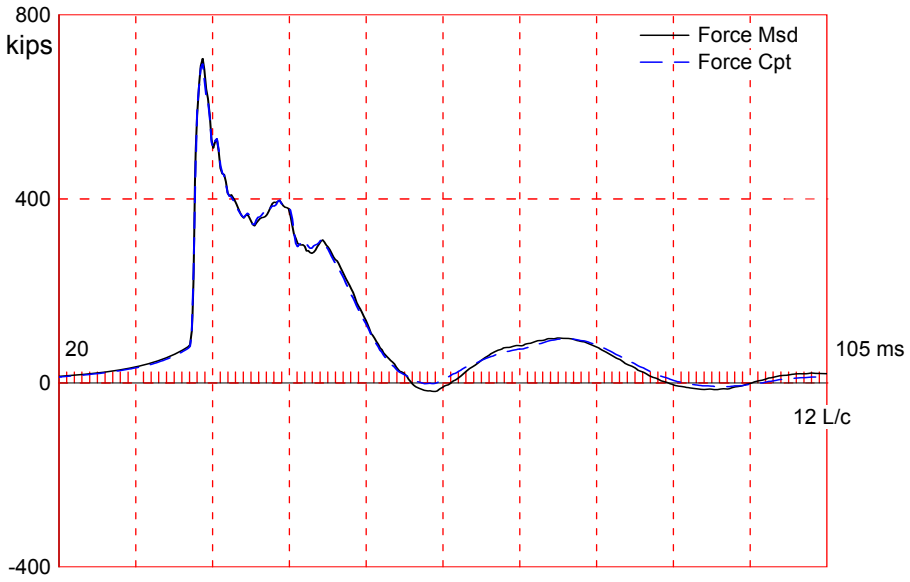
Depth ft	Area in²	E-Modulus ksi	Spec. Weight lb/ft³	Perim. ft
0.0	21.4	29992.2	492.000	4.70
90.0	21.4	29992.2	492.000	4.70

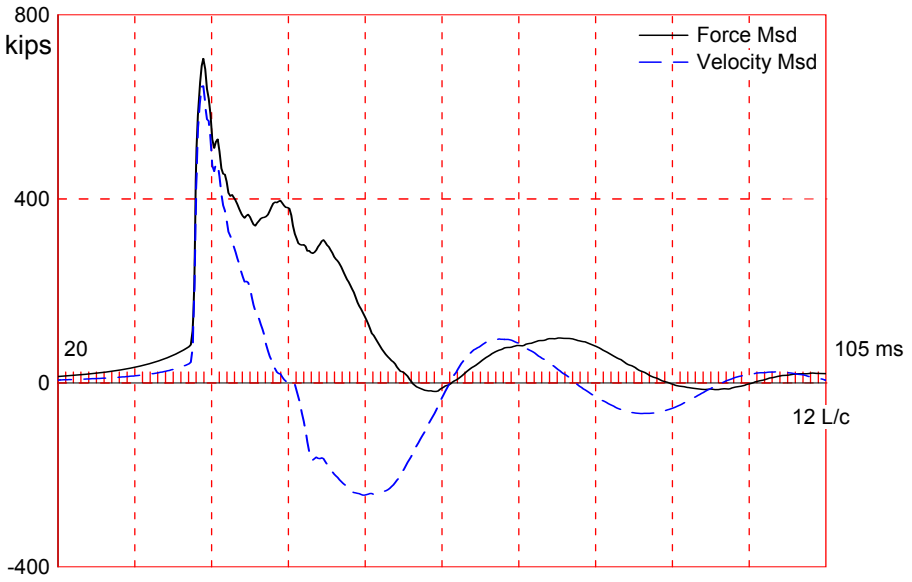
Toe Area 198.5 in²

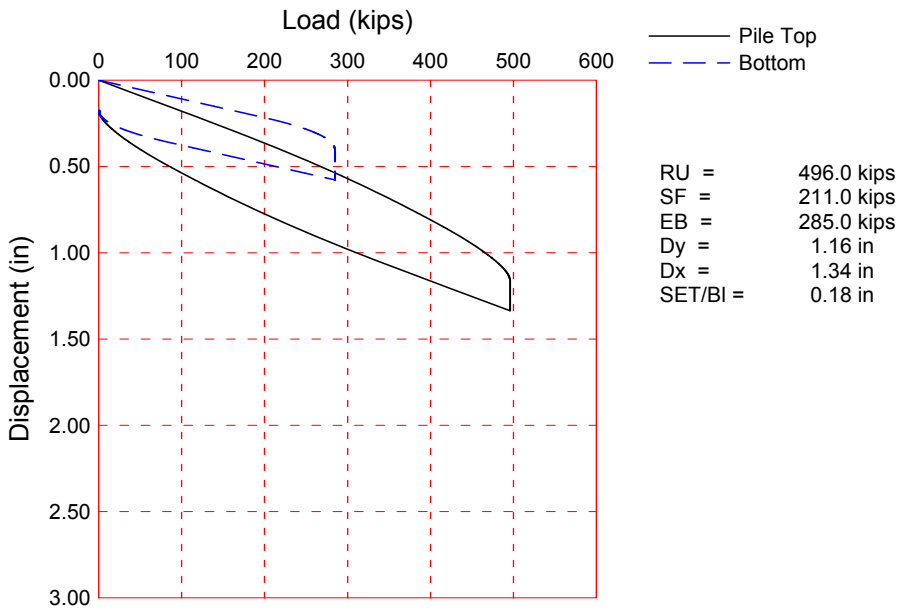
Top Segment Length 3.33 ft, Top Impedance 38 kips/ft/s

Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.198 ms, 2L/c 10.7 ms

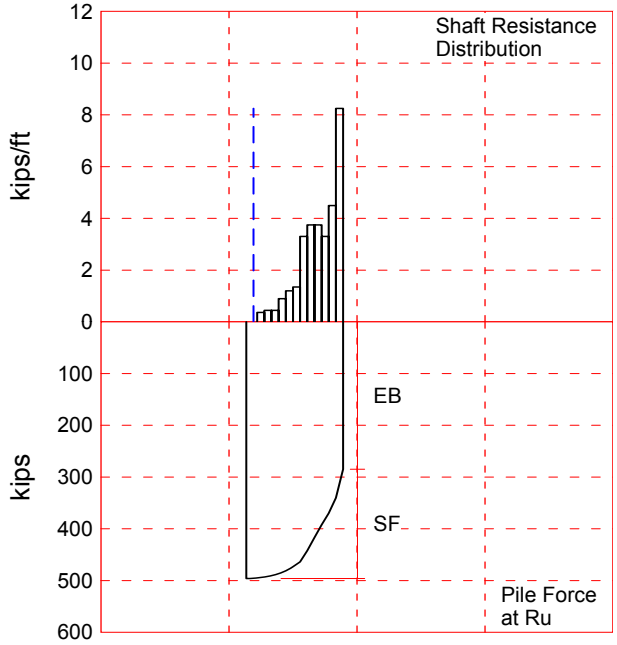
Total volume: 13.375 ft^3; Volume ratio considering added impedance: 1.000







RU =	496.0 kips
SF =	211.0 kips
EB =	285.0 kips
Dy =	1.16 in
Dx =	1.34 in
SET/Bl =	0.18 in



Length b. Sensors	90.0 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.	16808 ft/s
Match Quality	1.96
Top Compr. Stress	32.4 ksi
Max Compr. Stress	33.1 ksi
Max Tension Stress	-2.57 ksi
Avg. Shaft Quake	0.22 in
Toe Quake	0.31 in
Avg. Shaft Smith Dpg.	0.26 s/ft
Toe Smith Damping	0.13 s/ft

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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.

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

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 496.0; along Shaft 211.0; at Toe 285.0 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	16.7	8.2	3.0	493.0	3.0	0.37	0.08
2	23.3	14.9	3.0	490.0	6.0	0.45	0.10
3	30.0	21.5	3.0	487.0	9.0	0.45	0.10
4	36.7	28.2	6.0	481.0	15.0	0.90	0.19
5	43.3	34.9	8.0	473.0	23.0	1.20	0.26
6	50.0	41.5	9.0	464.0	32.0	1.35	0.29
7	56.7	48.2	22.0	442.0	54.0	3.30	0.70
8	63.3	54.9	25.0	417.0	79.0	3.75	0.80
9	70.0	61.5	25.0	392.0	104.0	3.75	0.80
10	76.7	68.2	22.0	370.0	126.0	3.30	0.70
11	83.3	74.9	30.0	340.0	156.0	4.50	0.96
12	90.0	81.5	55.0	285.0	211.0	8.25	1.76
Avg. Shaft			17.6			2.59	0.55
Toe			285.0				206.75

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.26	0.13
Quake	(in)	0.22	0.31
Case Damping Factor		1.44	0.97
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	73	107
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	97	
Resistance Gap (included in Toe Quake)	(in)		0.01
Soil Plug Weight	(kips)	0.025	0.081

CAPWAP match quality = 1.96 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.18 in; Blow Count = 69 b/ft
Computed: Final Set = 0.14 in; Blow Count = 85 b/ft
Transducer F1(F607) CAL: 93.6; RF: 0.97; F2(D815) CAL: 93.0; RF: 0.97
A1(K2524) CAL: 360; RF: 1.03; A2(K3550) CAL: 360; RF: 1.03

max. Top Comp. Stress = 32.4 ksi (T= 36.3 ms, max= 1.021 x Top)
max. Comp. Stress = 33.1 ksi (Z= 16.7 ft, T= 37.1 ms)
max. Tens. Stress = -2.57 ksi (Z= 43.3 ft, T= 62.1 ms)
max. Energy (EMX) = 36.8 kip-ft; max. Measured Top Displ. (DMX)= 0.98 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	694.4	-11.4	32.4	-0.53	36.8	17.2	0.98
2	6.7	695.6	-15.4	32.5	-0.72	36.5	17.1	0.96
4	13.3	703.6	-28.9	32.9	-1.35	35.8	16.9	0.91
6	20.0	696.5	-36.3	32.5	-1.69	34.2	16.7	0.86
8	26.7	690.0	-43.0	32.2	-2.01	32.7	16.4	0.81
10	33.3	689.4	-49.1	32.2	-2.29	31.1	16.0	0.76
12	40.0	678.5	-50.2	31.7	-2.34	29.0	15.5	0.70
13	43.3	690.9	-55.0	32.3	-2.57	28.5	15.2	0.67
14	46.7	661.9	-48.0	30.9	-2.24	26.6	14.9	0.65
15	50.0	685.0	-52.3	32.0	-2.44	26.0	14.4	0.62
16	53.3	661.7	-44.0	30.9	-2.05	24.2	13.8	0.59
17	56.7	687.8	-47.7	32.1	-2.23	23.6	13.3	0.56
18	60.0	614.9	-24.0	28.7	-1.12	20.4	12.7	0.53
19	63.3	639.2	-27.4	29.9	-1.28	19.9	12.2	0.51
20	66.7	563.8	-1.1	26.3	-0.05	16.8	11.6	0.48
21	70.0	588.6	-4.1	27.5	-0.19	16.3	11.0	0.45
22	73.3	515.2	0.0	24.1	0.00	13.7	10.6	0.43
23	76.7	531.7	0.0	24.8	0.00	13.3	10.2	0.40
24	80.0	477.9	-0.0	22.3	-0.00	11.2	9.8	0.38
25	83.3	468.7	-0.0	21.9	-0.00	10.8	10.4	0.36
26	86.7	418.3	-0.0	19.5	-0.00	8.6	11.1	0.34
27	90.0	431.4	-0.0	20.2	-0.00	5.7	10.3	0.31
Absolute	16.7			33.1			(T =	37.1 ms)
	43.3				-2.57		(T =	62.1 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	825.8	781.9	738.0	694.1	650.2	606.3	562.4	518.5	474.6	430.7
RX	825.8	781.9	738.0	694.1	650.2	606.7	569.3	541.2	514.8	498.0
RU	853.6	767.0	680.4	593.7	507.1	420.5	333.9	247.2	160.6	74.0

RAU = 235.4 (kips); RA2 = 578.2 (kips)

Current CAPWAP Ru = 496.0 (kips); Corresponding J(RP)= 1.50; J(RX) = 1.83

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
16.9	36.29	604.7	682.0	704.7	0.98	0.18	0.18	37.1	768.8	950

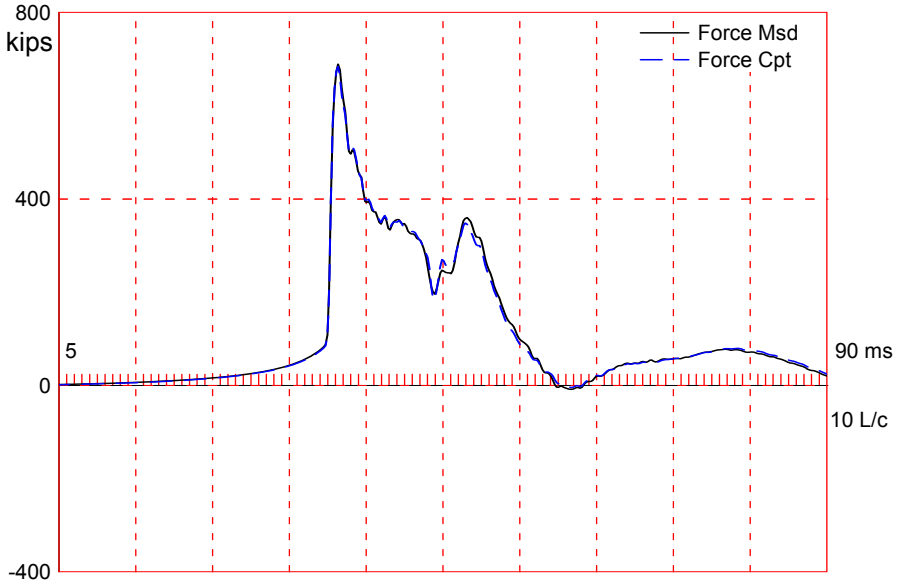
PILE PROFILE AND PILE MODEL

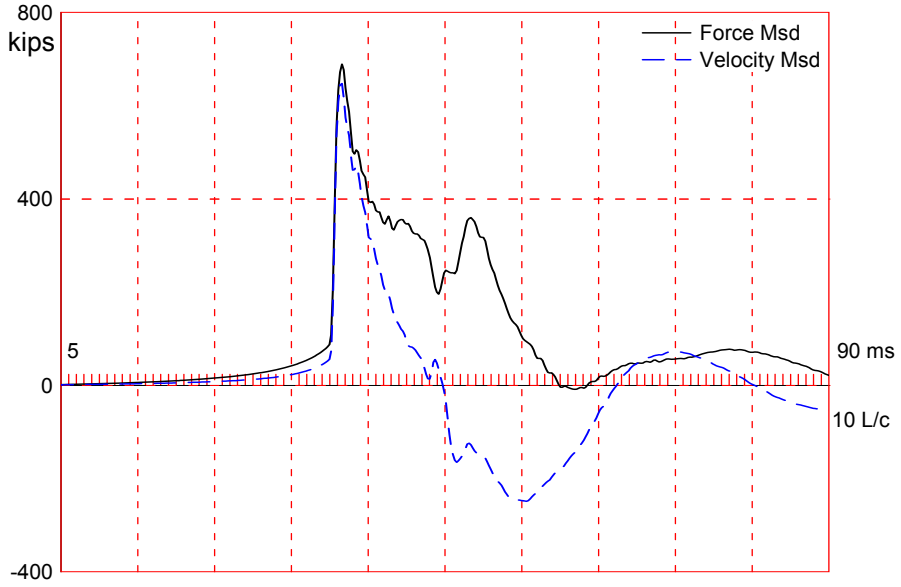
Depth ft	Area in²	E-Modulus ksi	Spec. Weight lb/ft³	Perim. ft
0.0	21.4	29992.2	492.000	4.70
90.0	21.4	29992.2	492.000	4.70

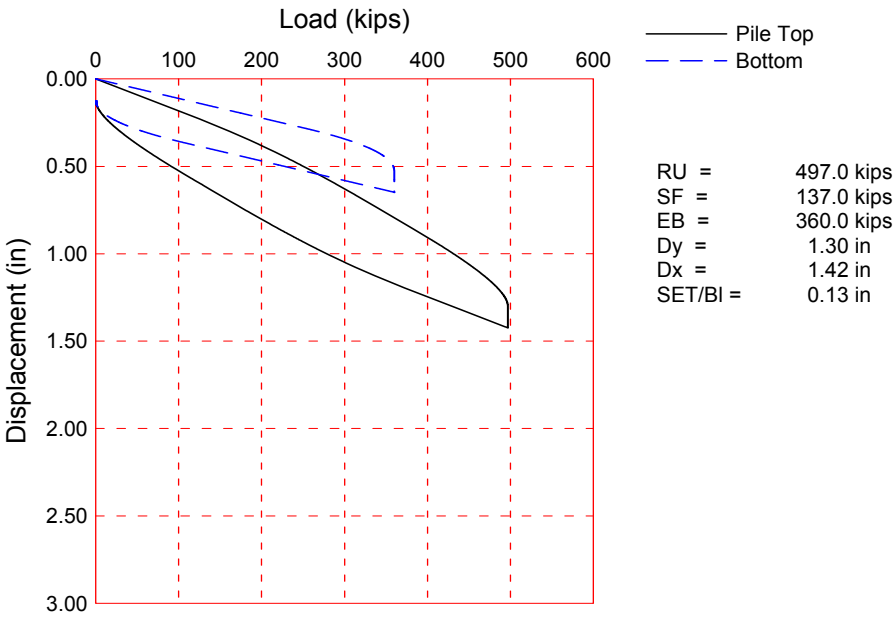
Toe Area 198.5 in²

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
23	76.7	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.015
24	80.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.010
25	83.3	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000
27	90.0	38.20	0.00	0.00	0.000	-0.00	0.000	4.70	16807.9	0.000

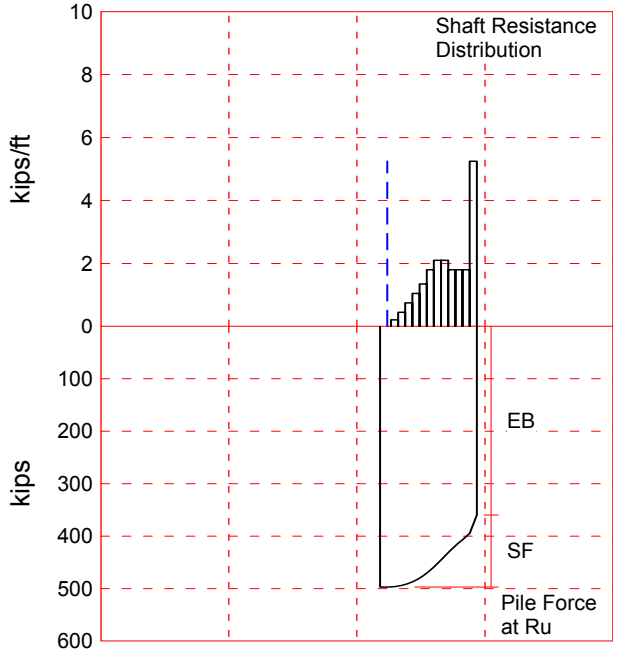
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.198 ms, 2L/c 10.7 ms
Total volume: 13.375 ft^3; Volume ratio considering added impedance: 1.000







RU =	497.0 kips
SF =	137.0 kips
EB =	360.0 kips
Dy =	1.30 in
Dx =	1.42 in
SET/Bl =	0.13 in



Length b. Sensors	90.0 ft
Embedment	83.0 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	1.59
Top Compr. Stress	32.0 ksi
Max Compr. Stress	32.5 ksi
Max Tension Stress	-1.89 ksi
Avg. Shaft Quake	0.18 in
Toe Quake	0.40 in
Avg. Shaft Smith Dpg.	0.28 s/ft
Toe Smith Damping	0.08 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: 497.0; along Shaft 137.0; at Toe 360.0 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
				497.0			
1	16.7	9.7	2.0	495.0	2.0	0.21	0.04
2	23.3	16.3	3.0	492.0	5.0	0.45	0.10
3	30.0	23.0	5.0	487.0	10.0	0.75	0.16
4	36.7	29.7	7.0	480.0	17.0	1.05	0.22
5	43.3	36.3	9.0	471.0	26.0	1.35	0.29
6	50.0	43.0	12.0	459.0	38.0	1.80	0.38
7	56.7	49.7	14.0	445.0	52.0	2.10	0.45
8	63.3	56.3	14.0	431.0	66.0	2.10	0.45
9	70.0	63.0	12.0	419.0	78.0	1.80	0.38
10	76.7	69.7	12.0	407.0	90.0	1.80	0.38
11	83.3	76.3	12.0	395.0	102.0	1.80	0.38
12	90.0	83.0	35.0	360.0	137.0	5.25	1.12
Avg. Shaft			11.4			1.65	0.35
Toe			360.0				261.16

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.28	0.08
Quake	(in)	0.18	0.40
Case Damping Factor		0.99	0.75
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	122
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	99	
Resistance Gap (included in Toe Quake)	(in)		0.07
Soil Plug Weight	(kips)		0.185

CAPWAP match quality = 1.59 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.13 in; Blow Count = 96 b/ft
Computed: Final Set = 0.14 in; Blow Count = 86 b/ft

Transducer F3(D815) CAL: 93.0; RF: 0.99; F4(F607) CAL: 93.6; RF: 0.99
A3(K3550) CAL: 360; RF: 1.01; A4(K2524) CAL: 360; RF: 1.01

max. Top Comp. Stress = 32.0 ksi (T= 36.3 ms, max= 1.017 x Top)
max. Comp. Stress = 32.5 ksi (Z= 16.7 ft, T= 37.1 ms)
max. Tens. Stress = -1.89 ksi (Z= 36.7 ft, T= 64.3 ms)
max. Energy (EMX) = 37.4 kip-ft; max. Measured Top Displ. (DMX)= 1.04 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	685.2	-11.0	32.0	-0.51	37.4	17.1	1.03
2	6.7	686.1	-14.1	32.1	-0.66	37.3	17.0	1.02
4	13.3	692.2	-24.0	32.3	-1.12	36.8	16.8	0.98
6	20.0	689.7	-29.6	32.2	-1.38	35.8	16.6	0.94
8	26.7	686.0	-34.8	32.0	-1.62	34.3	16.3	0.90
10	33.3	676.0	-35.0	31.6	-1.63	32.4	15.8	0.85
12	40.0	659.9	-34.1	30.8	-1.59	30.0	15.2	0.80
13	43.3	673.2	-38.3	31.5	-1.79	29.6	14.9	0.77
14	46.7	639.6	-28.2	29.9	-1.32	27.3	14.6	0.75
15	50.0	654.5	-32.7	30.6	-1.53	26.8	14.2	0.72
16	53.3	609.0	-19.6	28.5	-0.92	24.2	13.8	0.70
17	56.7	623.7	-22.7	29.1	-1.06	23.7	13.4	0.67
18	60.0	570.5	-7.6	26.7	-0.36	21.0	13.1	0.64
19	63.3	582.8	-11.4	27.2	-0.53	20.5	12.8	0.62
20	66.7	530.4	0.0	24.8	0.00	18.0	12.5	0.59
21	70.0	541.1	0.0	25.3	0.00	17.5	12.2	0.57
22	73.3	498.8	0.0	23.3	0.00	15.4	12.0	0.54
23	76.7	509.4	0.0	23.8	0.00	15.0	11.7	0.51
24	80.0	471.9	0.0	22.0	0.00	13.1	11.7	0.49
25	83.3	469.4	0.0	21.9	0.00	12.6	12.6	0.46
26	86.7	453.6	0.0	21.2	0.00	10.9	13.6	0.44
27	90.0	470.1	0.0	22.0	0.00	7.8	13.6	0.41
Absolute	16.7			32.5			(T =	37.1 ms)
	36.7				-1.89		(T =	64.3 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	745.6	626.8	507.9	389.1	270.2					
RX	749.7	634.0	569.7	531.5	507.9	492.1	478.4	464.7	451.0	441.7
RU	745.6	626.8	507.9	389.1	270.2					

RAU = 368.6 (kips); RA2 = 583.1 (kips)

Current CAPWAP Ru = 497.0 (kips); Corresponding J(RP)= 0.42; J(RX) = 0.93

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
17.1	36.09	654.1	685.8	691.5	1.04	0.13	0.13	37.7	774.2	1075

PILE PROFILE AND PILE MODEL

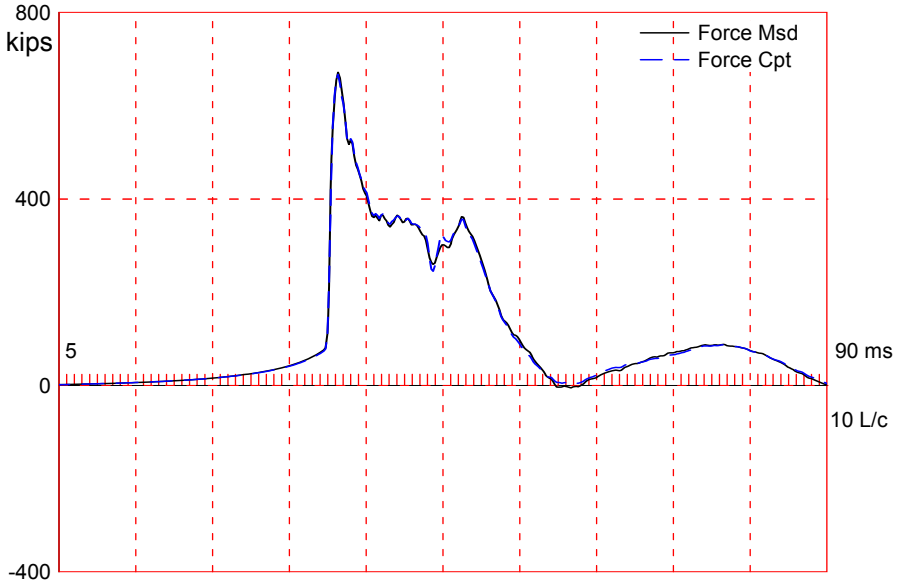
Depth ft	Area in²	E-Modulus ksi	Spec. Weight lb/ft³	Perim. ft
0.0	21.4	29992.2	492.000	4.70
90.0	21.4	29992.2	492.000	4.70

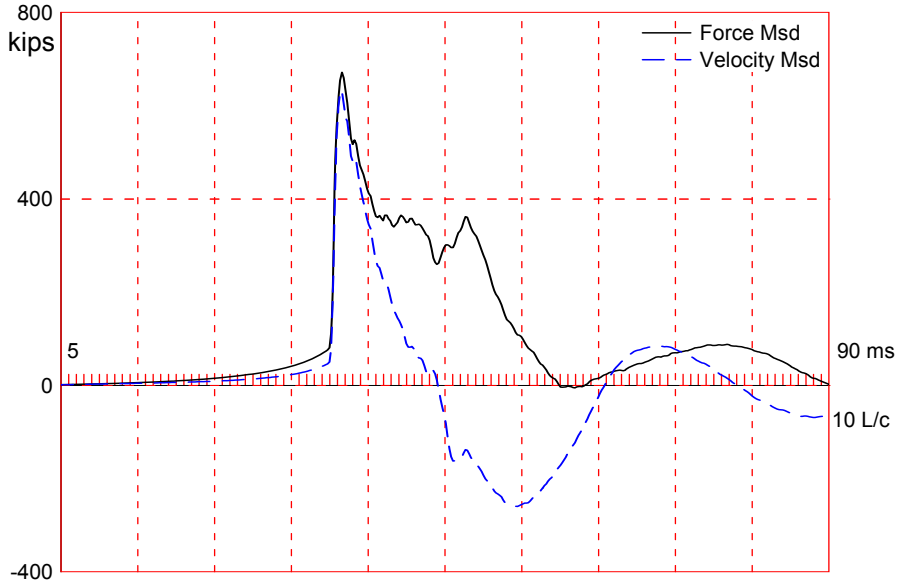
Toe Area 198.5 in²

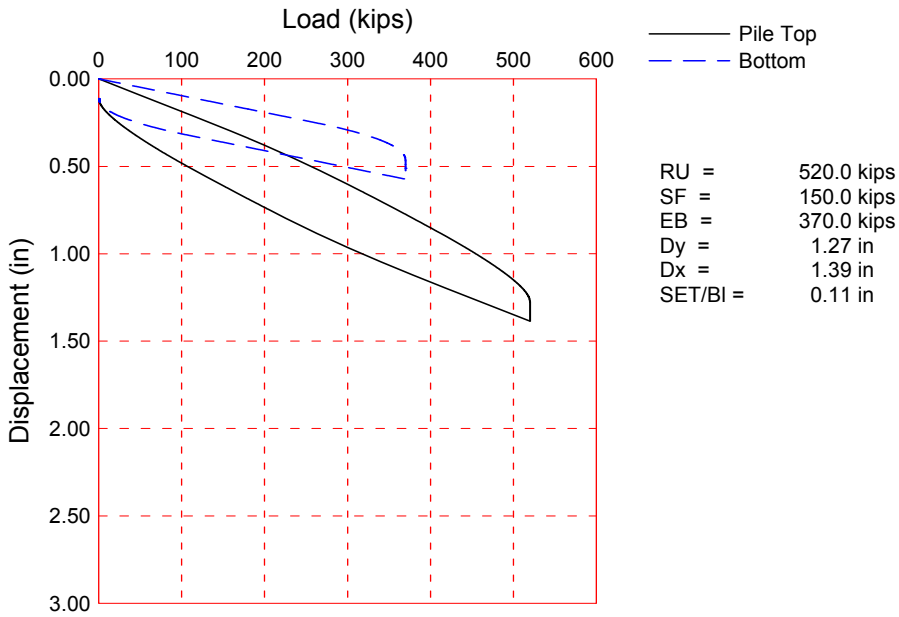
Top Segment Length 3.33 ft, Top Impedance 38 kips/ft/s

Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.198 ms, 2L/c 10.7 ms

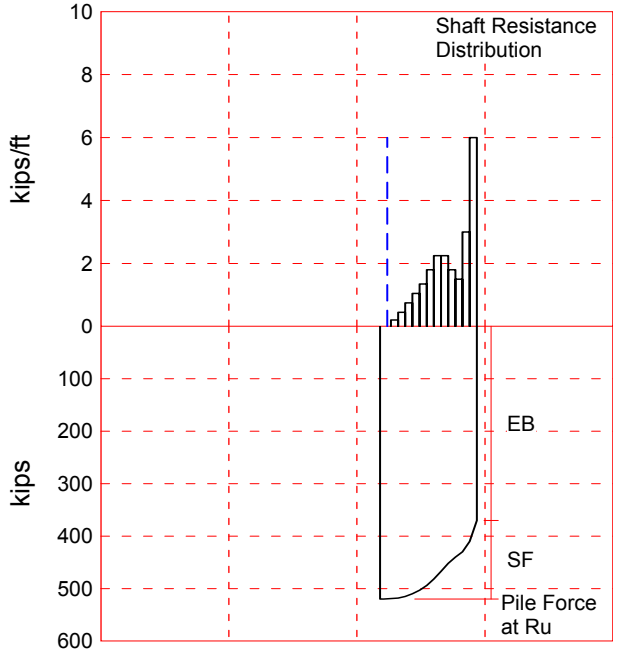
Total volume: 13.375 ft^3; Volume ratio considering added impedance: 1.000







RU =	520.0 kips
SF =	150.0 kips
EB =	370.0 kips
Dy =	1.27 in
Dx =	1.39 in
SET/Bl =	0.11 in



Length b. Sensors	90.0 ft
Embedment	83.0 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	1.33
Top Compr. Stress	31.2 ksi
Max Compr. Stress	31.7 ksi
Max Tension Stress	-2.28 ksi
Avg. Shaft Quake	0.22 in
Toe Quake	0.36 in
Avg. Shaft Smith Dpg.	0.27 s/ft
Toe Smith Damping	0.12 s/ft

About the CAPWAP Results

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

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 520.0; along Shaft 150.0; at Toe 370.0 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
				520.0			
1	16.7	9.7	2.0	518.0	2.0	0.21	0.04
2	23.3	16.4	3.0	515.0	5.0	0.45	0.10
3	30.0	23.0	5.0	510.0	10.0	0.75	0.16
4	36.7	29.7	7.0	503.0	17.0	1.05	0.22
5	43.3	36.4	9.0	494.0	26.0	1.35	0.29
6	50.0	43.0	12.0	482.0	38.0	1.80	0.38
7	56.7	49.7	15.0	467.0	53.0	2.25	0.48
8	63.3	56.4	15.0	452.0	68.0	2.25	0.48
9	70.0	63.0	12.0	440.0	80.0	1.80	0.38
10	76.7	69.7	10.0	430.0	90.0	1.50	0.32
11	83.3	76.4	20.0	410.0	110.0	3.00	0.64
12	90.0	83.0	40.0	370.0	150.0	6.00	1.28
Avg. Shaft			12.5			1.81	0.38
Toe			370.0				268.41

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.27	0.12
Quake	(in)	0.22	0.36
Case Damping Factor		1.06	1.16
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	90	109
Reloading Level	(% of Ru)	100	100
Resistance Gap (included in Toe Quake)	(in)		0.05
Soil Plug Weight	(kips)		0.131

CAPWAP match quality = 1.33 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.11 in; Blow Count = 107 b/ft
Computed: Final Set = 0.12 in; Blow Count = 101 b/ft
Transducer F1(D815) CAL: 93.0; RF: 0.97; F2(F607) CAL: 93.6; RF: 0.97
A1(K3550) CAL: 360; RF: 1.03; A2(K2524) CAL: 360; RF: 1.03

max. Top Comp. Stress = 31.2 ksi (T= 36.3 ms, max= 1.017 x Top)
max. Comp. Stress = 31.7 ksi (Z= 16.7 ft, T= 37.1 ms)
max. Tens. Stress = -2.28 ksi (Z= 36.7 ft, T= 62.7 ms)
max. Energy (EMX) = 37.5 kip-ft; max. Measured Top Displ. (DMX)= 1.05 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	667.7	-23.6	31.2	-1.10	37.5	16.6	1.03
2	6.7	668.6	-25.5	31.2	-1.19	37.3	16.6	1.01
4	13.3	674.3	-29.2	31.5	-1.37	36.7	16.5	0.97
6	20.0	671.8	-32.7	31.4	-1.53	35.5	16.2	0.93
8	26.7	668.2	-39.9	31.2	-1.86	33.9	15.9	0.88
10	33.3	658.7	-42.9	30.8	-2.01	31.8	15.4	0.82
12	40.0	643.5	-42.2	30.1	-1.97	29.4	14.9	0.77
13	43.3	657.1	-47.6	30.7	-2.22	28.9	14.5	0.74
14	46.7	624.7	-38.7	29.2	-1.81	26.7	14.3	0.71
15	50.0	641.5	-42.9	30.0	-2.00	26.2	13.8	0.69
16	53.3	600.6	-29.7	28.1	-1.39	23.6	13.4	0.66
17	56.7	617.5	-34.3	28.8	-1.60	23.1	13.0	0.63
18	60.0	565.8	-16.8	26.4	-0.78	20.3	12.7	0.60
19	63.3	579.5	-21.1	27.1	-0.99	19.8	12.3	0.57
20	66.7	528.6	-4.9	24.7	-0.23	17.3	12.0	0.55
21	70.0	539.7	-8.3	25.2	-0.39	16.8	11.7	0.52
22	73.3	502.0	0.0	23.5	0.00	14.9	11.5	0.49
23	76.7	518.0	0.0	24.2	0.00	14.4	11.1	0.46
24	80.0	494.6	0.0	23.1	0.00	12.9	10.7	0.43
25	83.3	503.9	0.0	23.5	0.00	12.4	11.6	0.41
26	86.7	487.2	0.0	22.8	0.00	10.3	12.4	0.38
27	90.0	506.0	0.0	23.6	0.00	7.6	11.7	0.36
Absolute	16.7			31.7			(T =	37.1 ms)
	36.7				-2.28		(T =	62.7 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	787.2	738.0	688.8	639.6	590.4	541.3	492.1	442.9	393.7	344.6
RX	787.2	738.0	692.2	650.8	625.0	599.3	573.5	547.8	531.7	518.1
RU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

RAU = 353.2 (kips); RA2 = 577.8 (kips)

Current CAPWAP Ru = 520.0 (kips); Corresponding J(RP)= 1.09; J(RX) = 1.77

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
16.5	36.09	631.9	671.6	671.6	1.05	0.11	0.11	37.8	778.6	1194

PILE PROFILE AND PILE MODEL

Depth ft	Area in²	E-Modulus ksi	Spec. Weight lb/ft³	Perim. ft
0.0	21.4	29992.2	492.000	4.70
90.0	21.4	29992.2	492.000	4.70

Toe Area 198.5 in²

Top Segment Length 3.33 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 0.198 ms, 2L/c 10.7 ms

Total volume: 13.375 ft^3; Volume ratio considering added impedance: 1.000