# GRL Engineers, Inc.

1540 E. Dundee Road, Suite 102 Palatine, IL 60074 USA
Phone: (847) 221-2750 Fax: (847) 221-2752

## TRANSMITTAL

| | |
|---|---|
| To: Mr. Kevin Weber | From: Rory Flynn |
| Company: Lunda Construction Co. | No. of Sheets: 54 |
| E-mail: kweber@lundaconstruction.com | Date: January 29, 2015 |

RE: Dynamic Testing Results – USH 10 over Little Lake Butte des Morts
Structure B-70-403 - Pier 7
Winnebago County, Wisconsin

On January 27, 2015, Pier 7 #1, Pier 7 #36, and Pier 7 #44 at the above structure were dynamically tested during initial driving. The piles were tested during restrike on January 28. Project plans indicated the exterior row piles have a required driving resistance, or ultimate capacity, of 480 kips (240 tons) and the interior row piles have a required driving resistance of 400 kips (200 tons). The piles have a required minimum tip elevation of EL 664. The HP 14x73 H-piles were equipped with driving shoes and were driven with an APE D30-42 hammer (number PD 0256) reportedly operated on fuel setting 4. The reference elevations for the piles were the top of the template at EL 740.5 to EL 740.6. We understand the pier was excavated to an elevation of EL 718.3 to EL 719.3.

Pier 7 #1 was driven to a depth of 90.5 feet, which corresponds to a pile tip elevation of EL 650.1. The blow count over the final increment of driving was 28 blows for 6 inches of penetration at an average hammer stroke of 7.4 feet. The blow count at the beginning of restrike was 5 blows for $^3/_8$ inch of penetration at an average hammer stroke of 7.1 feet.

Pier 7 #36 was driven to a depth of 81.8 feet, which corresponds to a pile tip elevation of EL 658.6. The blow count over the final increment of driving was 42 blows for 10 inches of penetration at an average hammer stroke of 6.6 feet. The blow count at the beginning of restrike was 5 blows for ½ inch of penetration at an average hammer stroke of 7.4 feet

Pier 7 #44 was driven to a depth of 89.8 feet, which corresponds to a pile tip elevation of EL 650.6. The blow count over the final increment of driving was 58 blows for 10 inches of penetration at an average hammer stroke of 6.8 feet. The blow count at the beginning of restrike was 5 blows for $^3/_8$ inch of penetration at an average hammer stroke of 6.9 feet.

Our driving recommendations have been prepared on a blows-per-inch basis. The criteria should be applied only after the minimum pile tip elevation is achieved. For the 480 and 400 kips piles driven with an APE D30-42 hammer (PD 0256) in Pier 7 of the USH 10 bridge over Little Lake Butte des Morts we recommend using the following criteria:

| Field Observed Hammer Stroke (feet) | Exterior Piles (480 kips) Recommended Minimum Blow Count (blows per inch) | Interior Piles (400 kips) Recommended Minimum Blow Count (blows per inch) |
|---|---|---|
| 6.0 | 8 | 5 |
| 6.5 | 6 | 4 |
| 7.0 | 5 | 3 |
| 7.5 | 4 | 3 |
| 8.0 | 4 | 3 |
| 8.5 | 4 | 3 |

We recommend the above blow counts at the required stroke be maintained for **three consecutive inches** of driving. We recommend immediately terminating driving **if the blow counts exceed 10** blows over an increment of one inch or less at hammer strokes of 8.0 feet or greater, after satisfying the plan minimum tip requirements. We anticipate the production piles will terminate at depths similar to those of the test piles.

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

Please call if you have any questions on these recommendations.

GRL Engineers, Inc.

Rory Flynn, E.I.

Travis Coleman, P.E.

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

Attachments:

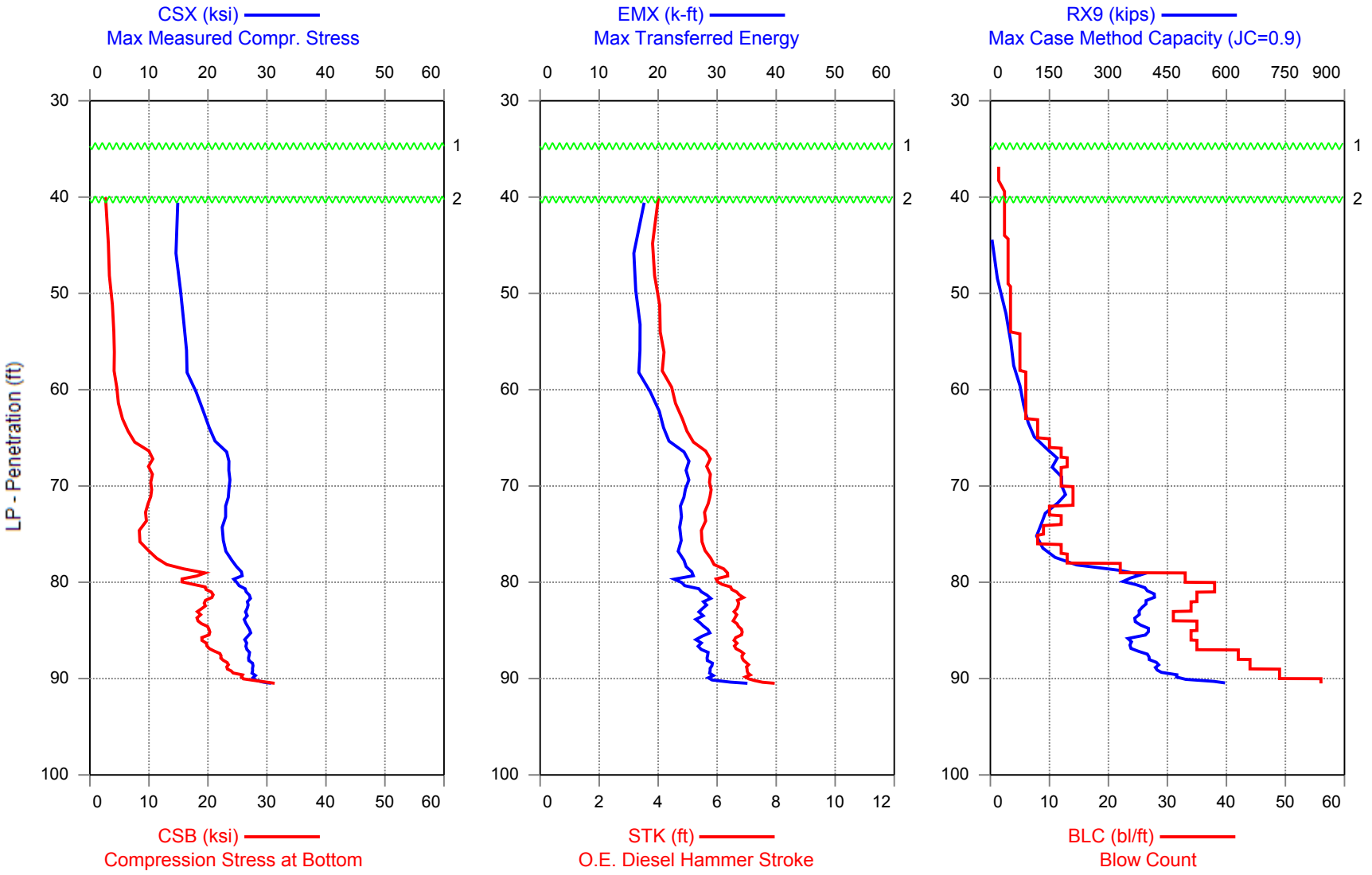
Dynamic Test Results - (pages 3 – 24)
CAPWAP Analysis Results - (pages 25 – 54)

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

Printed: 28-January-2015

Test started: 27-January-2015

# USH 10 - B-70-403 - PIER 7 #1 EOID
## APE D30-42, HP 14 x 73




1 - Reported Reference EL 740.56

2 - Bottom of Excavation EL 718.31

USH 10 - B-70-403 - PIER 7 #1 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

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 | 39.00 | 1 | AV3 | 13.6 | 2.0 | 17 | 3.7 | 60.8 | 0 |
| | | | MAX | 21.5 | 3.1 | 29 | 4.9 | 67.6 | 0 |
| | | | MIN | 5.9 | 0.9 | 6 | 2.9 | 52.9 | 0 |
| 19 | 44.00 | 2 | AV10 | 15.1 | 2.9 | 18 | 3.9 | 59.1 | 1 |
| | | | MAX | 25.2 | 4.5 | 36 | 5.9 | 64.9 | 14 |
| | | | MIN | 8.4 | 1.9 | 8 | 3.1 | 48.4 | 0 |
| 34 | 49.00 | 3 | AV15 | 14.8 | 3.3 | 16 | 3.9 | 58.8 | 9 |
| | | | MAX | 17.1 | 3.8 | 20 | 4.3 | 62.0 | 25 |
| | | | MIN | 11.5 | 2.7 | 11 | 3.5 | 56.3 | 0 |
| 51 | 54.00 | 3 | AV17 | 15.7 | 3.9 | 17 | 4.0 | 57.8 | 37 |
| | | | MAX | 17.0 | 4.3 | 19 | 4.3 | 60.3 | 55 |
| | | | MIN | 13.5 | 3.2 | 13 | 3.7 | 56.1 | 23 |
| 56 | 55.00 | 5 | AV5 | 15.8 | 4.0 | 16 | 4.1 | 57.6 | 47 |
| | | | MAX | 16.7 | 4.1 | 17 | 4.2 | 59.3 | 55 |
| | | | MIN | 14.1 | 3.9 | 13 | 3.8 | 56.8 | 39 |
| 61 | 56.00 | 5 | AV5 | 16.5 | 4.1 | 17 | 4.2 | 56.8 | 58 |
| | | | MAX | 17.5 | 4.4 | 19 | 4.3 | 57.9 | 62 |
| | | | MIN | 15.5 | 3.9 | 16 | 4.0 | 55.8 | 53 |
| 66 | 57.00 | 5 | AV5 | 16.7 | 4.1 | 17 | 4.2 | 56.7 | 58 |
| | | | MAX | 17.5 | 4.3 | 19 | 4.3 | 57.4 | 63 |
| | | | MIN | 15.9 | 4.1 | 16 | 4.1 | 55.9 | 53 |
| 71 | 58.00 | 5 | AV5 | 16.3 | 4.1 | 17 | 4.2 | 57.0 | 61 |
| | | | MAX | 18.2 | 4.2 | 20 | 4.5 | 58.0 | 65 |
| | | | MIN | 15.4 | 4.0 | 15 | 4.0 | 55.0 | 52 |
| 77 | 59.00 | 6 | AV6 | 16.2 | 4.2 | 16 | 4.2 | 57.0 | 64 |
| | | | MAX | 17.3 | 4.3 | 19 | 4.3 | 57.8 | 76 |
| | | | MIN | 15.4 | 4.0 | 15 | 4.0 | 55.8 | 51 |
| 83 | 60.00 | 6 | AV6 | 18.1 | 4.6 | 19 | 4.5 | 54.9 | 77 |
| | | | MAX | 19.1 | 4.9 | 20 | 4.7 | 56.3 | 79 |
| | | | MIN | 17.0 | 4.4 | 17 | 4.3 | 53.7 | 75 |
| 89 | 61.00 | 6 | AV6 | 17.8 | 4.6 | 18 | 4.5 | 55.2 | 78 |
| | | | MAX | 19.3 | 4.9 | 21 | 4.8 | 56.9 | 85 |
| | | | MIN | 16.3 | 4.3 | 16 | 4.2 | 53.5 | 73 |
| 95 | 62.00 | 6 | AV6 | 18.7 | 4.8 | 19 | 4.6 | 54.5 | 83 |
| | | | MAX | 19.3 | 5.2 | 21 | 4.7 | 55.1 | 88 |
| | | | MIN | 18.2 | 4.4 | 18 | 4.5 | 53.8 | 81 |
| 101 | 63.00 | 6 | AV6 | 19.8 | 5.4 | 21 | 4.8 | 53.2 | 92 |
| | | | MAX | 20.0 | 5.7 | 22 | 4.9 | 53.5 | 95 |

USH 10 - B-70-403 - PIER 7 #1 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

| BL# | depth ft | BLC bl/ft | TYPE | CSX ksi | CSB ksi | EMX k-ft | STK ft | BPM bpm | RX9 kips |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | 19.5 | 5.1 | 21 | 4.8 | 53.0 | 89 |
| 109 | 64.00 | 8 | AV8 | 19.8 | 5.8 | 20 | 4.9 | 53.0 | 97 |
| | | | MAX | 20.4 | 6.1 | 21 | 5.0 | 54.2 | 101 |
| | | | MIN | 19.0 | 5.4 | 19 | 4.6 | 52.4 | 92 |
| 117 | 65.00 | 8 | AV8 | 20.6 | 6.7 | 21 | 5.0 | 52.2 | 106 |
| | | | MAX | 21.6 | 7.0 | 23 | 5.2 | 53.3 | 115 |
| | | | MIN | 19.6 | 6.1 | 19 | 4.8 | 51.2 | 100 |
| 127 | 66.00 | 10 | AV10 | 21.4 | 7.7 | 22 | 5.2 | 51.3 | 120 |
| | | | MAX | 22.2 | 8.3 | 23 | 5.4 | 52.0 | 125 |
| | | | MIN | 20.8 | 6.9 | 20 | 5.1 | 50.6 | 111 |
| 139 | 67.00 | 12 | AV12 | 23.4 | 10.4 | 25 | 5.7 | 49.2 | 164 |
| | | | MAX | 24.7 | 11.2 | 27 | 6.1 | 51.2 | 183 |
| | | | MIN | 21.5 | 8.3 | 22 | 5.2 | 47.5 | 128 |
| 152 | 68.00 | 13 | AV13 | 23.5 | 10.2 | 25 | 5.7 | 49.2 | 159 |
| | | | MAX | 24.3 | 10.9 | 27 | 6.0 | 49.9 | 176 |
| | | | MIN | 22.8 | 9.5 | 24 | 5.5 | 48.1 | 140 |
| 164 | 69.00 | 12 | AV12 | 23.7 | 10.5 | 25 | 5.7 | 48.9 | 173 |
| | | | MAX | 24.3 | 10.8 | 26 | 5.9 | 50.1 | 184 |
| | | | MIN | 22.4 | 10.1 | 22 | 5.5 | 48.3 | 152 |
| 176 | 70.00 | 12 | AV12 | 23.6 | 10.3 | 25 | 5.8 | 48.9 | 178 |
| | | | MAX | 24.2 | 10.7 | 27 | 5.9 | 49.9 | 187 |
| | | | MIN | 22.6 | 10.1 | 23 | 5.5 | 48.2 | 167 |
| 190 | 71.00 | 14 | AV14 | 23.6 | 10.5 | 25 | 5.8 | 48.8 | 190 |
| | | | MAX | 24.2 | 10.7 | 26 | 5.9 | 49.5 | 198 |
| | | | MIN | 23.0 | 10.2 | 24 | 5.6 | 48.2 | 184 |
| 204 | 72.00 | 14 | AV14 | 23.3 | 10.0 | 24 | 5.7 | 49.0 | 179 |
| | | | MAX | 23.9 | 10.4 | 25 | 5.9 | 49.8 | 190 |
| | | | MIN | 22.5 | 9.6 | 22 | 5.5 | 48.5 | 162 |
| 214 | 73.00 | 10 | AV10 | 22.8 | 9.5 | 24 | 5.6 | 49.6 | 140 |
| | | | MAX | 23.5 | 9.8 | 25 | 5.7 | 50.4 | 159 |
| | | | MIN | 22.1 | 9.1 | 23 | 5.4 | 49.0 | 131 |
| 226 | 74.00 | 12 | AV12 | 22.9 | 9.6 | 24 | 5.6 | 49.5 | 140 |
| | | | MAX | 23.5 | 10.4 | 25 | 5.8 | 50.6 | 156 |
| | | | MIN | 21.9 | 8.7 | 22 | 5.4 | 48.9 | 128 |
| 235 | 75.00 | 9 | AV9 | 22.4 | 8.3 | 24 | 5.5 | 50.1 | 115 |
| | | | MAX | 22.7 | 8.8 | 25 | 5.5 | 50.5 | 122 |
| | | | MIN | 21.9 | 8.0 | 23 | 5.4 | 49.8 | 111 |
| 243 | 76.00 | 8 | AV8 | 22.5 | 8.4 | 24 | 5.5 | 50.2 | 118 |
| | | | MAX | 22.9 | 8.7 | 25 | 5.6 | 50.8 | 120 |
| | | | MIN | 21.9 | 8.2 | 23 | 5.3 | 49.7 | 115 |

USH 10 - B-70-403 - PIER 7 #1 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

| BL# | depth ft | BLC bl/ft | TYPE | CSX ksi | CSB ksi | EMX k-ft | STK ft | BPM bpm | RX9 kips |
|---|---|---|---|---|---|---|---|---|---|
| 255 | 77.00 | 12 | AV12 | 23.0 | 9.6 | 23 | 5.6 | 49.7 | 135 |
| | | | MAX | 24.0 | 10.8 | 25 | 5.8 | 50.7 | 156 |
| | | | MIN | 22.1 | 8.6 | 22 | 5.3 | 48.7 | 122 |
| 268 | 78.00 | 13 | AV13 | 23.8 | 11.4 | 24 | 5.8 | 48.9 | 171 |
| | | | MAX | 24.6 | 12.9 | 26 | 6.0 | 49.9 | 201 |
| | | | MIN | 22.9 | 10.3 | 23 | 5.5 | 48.0 | 145 |
| 290 | 79.00 | 22 | AV22 | 25.3 | 15.5 | 25 | 6.2 | 47.3 | 280 |
| | | | MAX | 26.9 | 20.3 | 28 | 6.6 | 48.6 | 400 |
| | | | MIN | 23.8 | 12.7 | 23 | 5.8 | 45.7 | 192 |
| 323 | 80.00 | 33 | AV33 | 24.9 | 17.1 | 24 | 6.1 | 47.5 | 361 |
| | | | MAX | 27.0 | 20.3 | 28 | 6.6 | 49.6 | 401 |
| | | | MIN | 22.9 | 14.7 | 20 | 5.6 | 45.7 | 323 |
| 361 | 81.00 | 38 | AV38 | 25.8 | 18.8 | 26 | 6.4 | 46.6 | 383 |
| | | | MAX | 27.2 | 20.7 | 28 | 6.8 | 49.2 | 412 |
| | | | MIN | 23.3 | 15.1 | 21 | 5.7 | 45.3 | 332 |
| 396 | 82.00 | 35 | AV35 | 27.0 | 20.4 | 28 | 6.8 | 45.3 | 411 |
| | | | MAX | 28.0 | 21.5 | 30 | 7.0 | 46.4 | 425 |
| | | | MIN | 25.8 | 19.1 | 26 | 6.4 | 44.4 | 389 |
| 430 | 83.00 | 34 | AV34 | 26.7 | 19.2 | 28 | 6.7 | 45.5 | 388 |
| | | | MAX | 27.4 | 20.5 | 29 | 6.9 | 46.2 | 402 |
| | | | MIN | 25.9 | 18.0 | 26 | 6.5 | 44.7 | 364 |
| 461 | 84.00 | 31 | AV31 | 26.4 | 18.3 | 27 | 6.6 | 45.9 | 371 |
| | | | MAX | 27.2 | 19.2 | 29 | 6.8 | 46.7 | 387 |
| | | | MIN | 25.6 | 17.5 | 25 | 6.3 | 45.0 | 352 |
| 496 | 85.00 | 35 | AV35 | 26.7 | 19.5 | 28 | 6.7 | 45.4 | 387 |
| | | | MAX | 27.9 | 20.7 | 30 | 7.1 | 46.1 | 412 |
| | | | MIN | 25.9 | 18.1 | 26 | 6.5 | 44.3 | 367 |
| 530 | 86.00 | 34 | AV34 | 26.8 | 19.7 | 28 | 6.7 | 45.4 | 381 |
| | | | MAX | 27.8 | 20.8 | 30 | 7.0 | 46.7 | 408 |
| | | | MIN | 25.5 | 18.0 | 25 | 6.3 | 44.5 | 337 |
| 565 | 87.00 | 35 | AV35 | 26.5 | 19.8 | 27 | 6.6 | 45.7 | 357 |
| | | | MAX | 27.2 | 20.5 | 29 | 6.8 | 47.3 | 368 |
| | | | MIN | 24.8 | 18.5 | 24 | 6.2 | 45.0 | 346 |
| 607 | 88.00 | 42 | AV42 | 26.9 | 21.9 | 28 | 6.8 | 45.0 | 393 |
| | | | MAX | 27.9 | 22.5 | 30 | 7.1 | 45.8 | 405 |
| | | | MIN | 26.1 | 20.6 | 27 | 6.6 | 44.3 | 358 |
| 651 | 89.00 | 44 | AV44 | 27.4 | 23.2 | 29 | 7.0 | 44.6 | 421 |
| | | | MAX | 28.7 | 24.0 | 31 | 7.3 | 45.2 | 433 |
| | | | MIN | 26.7 | 22.2 | 28 | 6.8 | 43.6 | 397 |

USH 10 - B-70-403 - PIER 7 #1 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

| BL# | depth | BLC | TYPE | CSX | CSB | EMX | STK | BPM | RX9 |
|---|---|---|---|---|---|---|---|---|---|
| | ft | bl/ft | | ksi | ksi | k-ft | ft | bpm | kips |
| 700 | 90.00 | 49 | AV49 | 27.7 | 24.9 | 29 | 7.0 | 44.4 | 453 |
| | | | MAX | 29.1 | 27.1 | 32 | 7.5 | 46.6 | 511 |
| | | | MIN | 25.4 | 23.2 | 25 | 6.4 | 43.1 | 419 |
| 728 | 90.50 | 56 | AV28 | 28.8 | 28.6 | 31 | 7.4 | 43.5 | 550 |
| | | | MAX | 31.0 | 31.4 | 35 | 7.9 | 45.3 | 613 |
| | | | MIN | 26.6 | 25.4 | 26 | 6.8 | 41.9 | 484 |
| | | | Average | 24.5 | 16.0 | 25 | 6.1 | 48.0 | 295 |
| | | | Maximum | 31.0 | 31.4 | 36 | 7.9 | 67.6 | 613 |
| | | | Minimum | 5.9 | 0.9 | 6 | 2.9 | 41.9 | 0 |

Total number of blows analyzed: 722

BL# Sensors

1-728 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.07); A4: [K3550] 360.0 (1.07)

BL# Comments

1 Reported Reference EL 740.56
10 Bottom of Excavation EL 718.31

Time Summary

Drive 16 minutes 38 seconds 1:28 PM - 1:45 PM BN 1 - 728

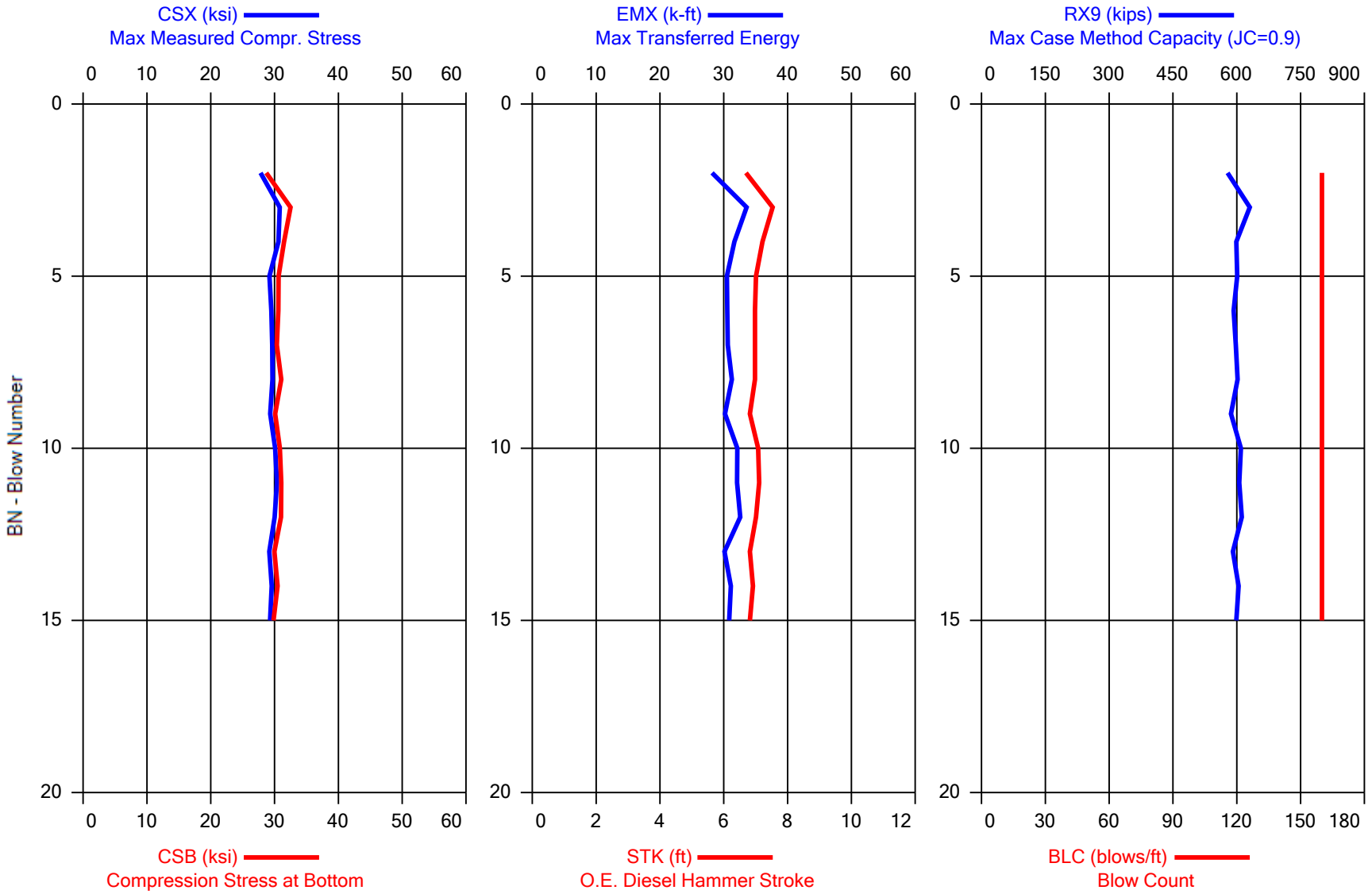
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 29-January-2015

Test started: 28-January-2015

USH 10 - B-70-403 - PIER 7 #1 BOR

APE D30-42, HP 14 x 73



USH 10 - B-70-403 - PIER 7 #1 BOR APE D30-42, HP 14 x 73
OP: RF Date: 28-January-2015

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 ft | BLC blows/ft | TYPE | CSX ksi | CSB ksi | EMX k-ft | STK ft | BPM bpm | RX9 kips |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 90.53 | 160 | AV4 | 29.6 | 30.8 | 31 | 7.1 | 44.2 | 602 |
| | | | MAX | 30.8 | 32.5 | 34 | 7.5 | 45.5 | 631 |
| | | | MIN | 27.8 | 28.7 | 28 | 6.7 | 43.0 | 578 |
| 10 | 90.56 | 160 | AV5 | 29.6 | 30.6 | 31 | 7.0 | 44.6 | 598 |
| | | | MAX | 30.1 | 31.0 | 32 | 7.1 | 45.1 | 610 |
| | | | MIN | 29.3 | 30.1 | 30 | 6.8 | 44.3 | 586 |
| 15 | 90.59 | 160 | AV5 | 29.7 | 30.5 | 31 | 6.9 | 44.7 | 602 |
| | | | MAX | 30.4 | 31.0 | 33 | 7.1 | 45.1 | 612 |
| | | | MIN | 29.2 | 29.8 | 30 | 6.8 | 44.2 | 591 |
| | | | Average | 29.6 | 30.6 | 31 | 7.0 | 44.6 | 601 |
| | | | Maximum | 30.8 | 32.5 | 34 | 7.5 | 45.5 | 631 |
| | | | Minimum | 27.8 | 28.7 | 28 | 6.7 | 43.0 | 578 |

Total number of blows analyzed: 14

BL# Sensors

1-15 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.09); A4: [K3550] 360.0 (1.09)

Time Summary

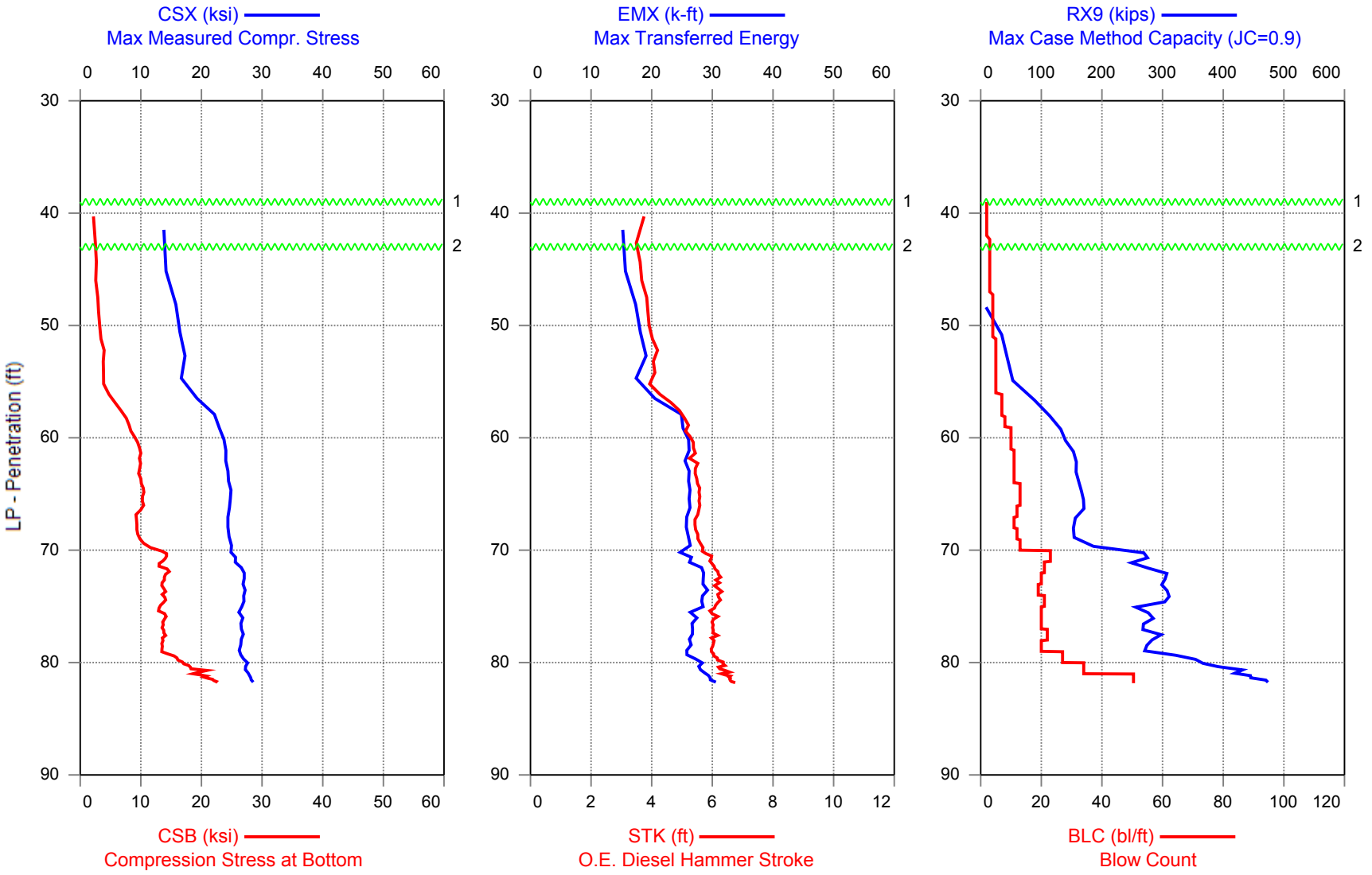
Drive 18 seconds 8:01 AM - 8:02 AM BN 1 - 15

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

Printed: 27-January-2015

Test started: 27-January-2015

# USH 10 - B-70-403 - PIER 7 #36 EOID
## APE D30-42, HP 14 x 73




1 - Reported Reference EL 740.47

2 - Bottom of Excavation EL 719.31

USH 10 - B-70-403 - PIER 7 #36 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

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 |
| 3 | 39.00 | 2 | AV1 | 14.4 | 2.4 | 15 | 3.5 | 61.6 | 0 |
| | | | MAX | 14.4 | 2.4 | 15 | 3.5 | 61.6 | 0 |
| | | | MIN | 14.4 | 2.4 | 15 | 3.5 | 61.6 | 0 |
| 4 | 39.50 | 2 | AV1 | 8.6 | 1.3 | 7 | 3.1 | 65.4 | 0 |
| | | | MAX | 8.6 | 1.3 | 7 | 3.1 | 65.4 | 0 |
| | | | MIN | 8.6 | 1.3 | 7 | 3.1 | 65.4 | 0 |
| 6 | 40.50 | 2 | AV1 | 25.0 | 2.2 | 33 | 5.4 | 50.4 | 0 |
| | | | MAX | 25.0 | 2.2 | 33 | 5.4 | 50.4 | 0 |
| | | | MIN | 25.0 | 2.2 | 33 | 5.4 | 50.4 | 0 |
| 7 | 41.00 | 2 | AV1 | 14.9 | 2.9 | 18 | 3.5 | 61.4 | 0 |
| | | | MAX | 14.9 | 2.9 | 18 | 3.5 | 61.4 | 0 |
| | | | MIN | 14.9 | 2.9 | 18 | 3.5 | 61.4 | 0 |
| 9 | 42.00 | 2 | AV2 | 10.6 | 2.0 | 11 | 3.2 | 64.3 | 0 |
| | | | MAX | 11.1 | 2.1 | 11 | 3.2 | 64.4 | 0 |
| | | | MIN | 10.1 | 1.9 | 11 | 3.2 | 64.1 | 0 |
| 12 | 43.00 | 3 | AV3 | 13.4 | 2.9 | 15 | 3.6 | 61.3 | 0 |
| | | | MAX | 16.3 | 3.1 | 18 | 3.9 | 63.8 | 0 |
| | | | MIN | 10.4 | 2.7 | 12 | 3.3 | 58.5 | 0 |
| 15 | 44.00 | 3 | AV3 | 12.9 | 2.3 | 13 | 3.5 | 62.1 | 0 |
| | | | MAX | 13.9 | 2.6 | 14 | 3.5 | 62.8 | 0 |
| | | | MIN | 12.1 | 2.0 | 12 | 3.4 | 61.5 | 0 |
| 18 | 45.00 | 3 | AV3 | 15.0 | 2.8 | 17 | 3.7 | 59.8 | 0 |
| | | | MAX | 16.6 | 2.9 | 18 | 3.9 | 61.2 | 0 |
| | | | MIN | 13.6 | 2.6 | 15 | 3.6 | 58.4 | 0 |
| 21 | 46.00 | 3 | AV3 | 13.9 | 2.6 | 16 | 3.6 | 60.8 | 0 |
| | | | MAX | 14.3 | 2.8 | 17 | 3.7 | 61.4 | 0 |
| | | | MIN | 13.2 | 2.4 | 15 | 3.5 | 60.2 | 0 |
| 24 | 47.00 | 3 | AV3 | 15.2 | 2.8 | 17 | 3.8 | 59.5 | 0 |
| | | | MAX | 15.5 | 3.3 | 18 | 3.9 | 60.3 | 0 |
| | | | MIN | 14.7 | 2.5 | 17 | 3.7 | 59.0 | 0 |
| 28 | 48.00 | 4 | AV4 | 15.7 | 2.8 | 17 | 3.8 | 59.2 | 5 |
| | | | MAX | 16.1 | 3.0 | 18 | 3.9 | 60.4 | 13 |
| | | | MIN | 14.6 | 2.7 | 16 | 3.7 | 58.8 | 0 |
| 32 | 49.00 | 4 | AV4 | 16.0 | 3.0 | 18 | 3.9 | 58.8 | 8 |
| | | | MAX | 16.2 | 3.1 | 18 | 3.9 | 59.4 | 13 |
| | | | MIN | 15.6 | 3.0 | 17 | 3.8 | 58.4 | 5 |
| 36 | 50.00 | 4 | AV4 | 16.1 | 3.1 | 18 | 3.9 | 58.7 | 21 |
| | | | MAX | 16.6 | 3.3 | 18 | 3.9 | 59.2 | 29 |

USH 10 - B-70-403 - PIER 7 #36 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

| BL# | depth ft | BLC bl/ft | TYPE | CSX ksi | CSB ksi | EMX k-ft | STK ft | BPM bpm | RX9 kips |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | 15.6 | 3.0 | 16 | 3.8 | 58.4 | 15 |
| 40 | 51.00 | 4 | AV4 | 16.4 | 3.3 | 18 | 4.0 | 58.2 | 29 |
| | | | MAX | 17.0 | 3.5 | 20 | 4.1 | 59.0 | 46 |
| | | | MIN | 15.7 | 3.0 | 16 | 3.9 | 57.5 | 19 |
| 45 | 52.00 | 5 | AV5 | 17.0 | 3.7 | 19 | 4.1 | 57.5 | 48 |
| | | | MAX | 17.8 | 4.2 | 20 | 4.2 | 58.3 | 57 |
| | | | MIN | 16.2 | 3.5 | 17 | 4.0 | 56.6 | 37 |
| 50 | 53.00 | 5 | AV5 | 17.2 | 3.8 | 19 | 4.1 | 57.3 | 40 |
| | | | MAX | 18.0 | 4.0 | 21 | 4.3 | 58.1 | 54 |
| | | | MIN | 16.5 | 3.7 | 18 | 4.0 | 56.3 | 29 |
| 55 | 54.00 | 5 | AV5 | 17.1 | 3.9 | 18 | 4.1 | 57.4 | 46 |
| | | | MAX | 17.4 | 4.1 | 19 | 4.1 | 57.7 | 52 |
| | | | MIN | 16.9 | 3.8 | 18 | 4.0 | 57.1 | 37 |
| 60 | 55.00 | 5 | AV5 | 16.8 | 3.7 | 18 | 4.0 | 57.8 | 49 |
| | | | MAX | 17.6 | 3.9 | 19 | 4.2 | 58.8 | 58 |
| | | | MIN | 15.9 | 3.6 | 16 | 3.9 | 57.0 | 42 |
| 65 | 56.00 | 5 | AV5 | 16.9 | 4.2 | 18 | 4.1 | 57.7 | 63 |
| | | | MAX | 18.1 | 4.5 | 20 | 4.2 | 59.2 | 73 |
| | | | MIN | 15.5 | 3.7 | 15 | 3.8 | 56.5 | 51 |
| 72 | 57.00 | 7 | AV7 | 19.4 | 5.4 | 20 | 4.5 | 55.1 | 88 |
| | | | MAX | 20.7 | 5.9 | 23 | 4.7 | 56.1 | 96 |
| | | | MIN | 18.3 | 4.8 | 19 | 4.3 | 53.9 | 77 |
| 79 | 58.00 | 7 | AV7 | 21.7 | 6.7 | 25 | 4.9 | 52.7 | 104 |
| | | | MAX | 22.4 | 7.5 | 26 | 5.1 | 53.4 | 108 |
| | | | MIN | 21.0 | 6.1 | 23 | 4.8 | 51.9 | 97 |
| 87 | 59.00 | 8 | AV8 | 22.9 | 7.8 | 26 | 5.1 | 51.6 | 124 |
| | | | MAX | 23.3 | 8.1 | 27 | 5.2 | 52.2 | 132 |
| | | | MIN | 22.3 | 7.5 | 24 | 5.0 | 51.1 | 117 |
| 97 | 60.00 | 10 | AV10 | 23.1 | 8.6 | 25 | 5.2 | 51.3 | 135 |
| | | | MAX | 24.0 | 9.1 | 27 | 5.4 | 52.1 | 138 |
| | | | MIN | 22.3 | 8.2 | 23 | 5.0 | 50.6 | 130 |
| 107 | 61.00 | 10 | AV10 | 23.8 | 9.5 | 26 | 5.3 | 50.7 | 143 |
| | | | MAX | 24.6 | 9.8 | 27 | 5.5 | 51.6 | 151 |
| | | | MIN | 23.0 | 9.1 | 24 | 5.1 | 50.0 | 136 |
| 118 | 62.00 | 11 | AV11 | 23.9 | 9.9 | 25 | 5.4 | 50.6 | 155 |
| | | | MAX | 24.6 | 10.2 | 28 | 5.5 | 51.5 | 160 |
| | | | MIN | 23.1 | 9.4 | 23 | 5.2 | 49.9 | 149 |
| 129 | 63.00 | 11 | AV11 | 24.4 | 9.9 | 27 | 5.5 | 50.1 | 158 |
| | | | MAX | 24.9 | 10.3 | 28 | 5.6 | 50.7 | 169 |
| | | | MIN | 23.9 | 9.5 | 25 | 5.3 | 49.6 | 152 |

USH 10 - B-70-403 - PIER 7 #36 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

| BL# | depth ft | BLC bl/ft | TYPE | CSX ksi | CSB ksi | EMX k-ft | STK ft | BPM bpm | RX9 kips |
|---|---|---|---|---|---|---|---|---|---|
| 140 | 64.00 | 11 | AV11 | 24.5 | 9.9 | 26 | 5.5 | 50.1 | 158 |
| | | | MAX | 24.9 | 10.3 | 28 | 5.6 | 50.6 | 165 |
| | | | MIN | 23.9 | 9.2 | 24 | 5.4 | 49.5 | 149 |
| 153 | 65.00 | 13 | AV13 | 24.8 | 10.4 | 26 | 5.6 | 49.7 | 167 |
| | | | MAX | 25.6 | 11.0 | 28 | 5.7 | 50.4 | 171 |
| | | | MIN | 23.9 | 9.9 | 25 | 5.4 | 49.0 | 161 |
| 166 | 66.00 | 13 | AV13 | 24.7 | 10.3 | 26 | 5.6 | 49.6 | 171 |
| | | | MAX | 25.4 | 10.8 | 27 | 5.7 | 50.2 | 182 |
| | | | MIN | 24.2 | 9.9 | 25 | 5.4 | 49.2 | 161 |
| 178 | 67.00 | 12 | AV12 | 24.6 | 9.7 | 26 | 5.5 | 49.8 | 166 |
| | | | MAX | 25.3 | 11.0 | 28 | 5.7 | 50.7 | 177 |
| | | | MIN | 23.7 | 8.7 | 25 | 5.3 | 49.1 | 155 |
| 189 | 68.00 | 11 | AV11 | 24.3 | 9.3 | 26 | 5.4 | 50.3 | 153 |
| | | | MAX | 24.5 | 9.7 | 26 | 5.5 | 51.2 | 159 |
| | | | MIN | 23.4 | 8.9 | 24 | 5.2 | 50.0 | 147 |
| 201 | 69.00 | 12 | AV12 | 24.5 | 9.5 | 26 | 5.5 | 50.0 | 154 |
| | | | MAX | 25.3 | 10.1 | 27 | 5.7 | 50.5 | 158 |
| | | | MIN | 23.8 | 9.2 | 25 | 5.4 | 49.1 | 148 |
| 214 | 70.00 | 13 | AV13 | 24.9 | 11.0 | 26 | 5.6 | 49.4 | 179 |
| | | | MAX | 26.2 | 12.8 | 28 | 5.9 | 49.9 | 236 |
| | | | MIN | 24.3 | 10.0 | 25 | 5.5 | 48.4 | 153 |
| 237 | 71.00 | 23 | AV23 | 25.3 | 14.0 | 26 | 5.9 | 48.5 | 271 |
| | | | MAX | 26.2 | 14.5 | 28 | 6.1 | 50.8 | 284 |
| | | | MIN | 23.1 | 13.4 | 21 | 5.3 | 47.7 | 251 |
| 258 | 72.00 | 21 | AV21 | 26.4 | 13.7 | 28 | 6.1 | 47.7 | 271 |
| | | | MAX | 27.3 | 15.3 | 29 | 6.2 | 48.8 | 309 |
| | | | MIN | 25.0 | 12.5 | 25 | 5.8 | 47.1 | 228 |
| 278 | 73.00 | 20 | AV20 | 27.1 | 13.8 | 29 | 6.2 | 47.2 | 304 |
| | | | MAX | 27.8 | 14.5 | 31 | 6.4 | 47.9 | 311 |
| | | | MIN | 26.2 | 13.3 | 27 | 6.0 | 46.5 | 294 |
| 297 | 74.00 | 19 | AV19 | 27.0 | 13.8 | 29 | 6.2 | 47.2 | 304 |
| | | | MAX | 27.9 | 14.3 | 31 | 6.5 | 47.9 | 316 |
| | | | MIN | 26.3 | 13.2 | 27 | 6.0 | 46.3 | 295 |
| 318 | 75.00 | 21 | AV21 | 26.9 | 13.7 | 28 | 6.2 | 47.3 | 301 |
| | | | MAX | 27.7 | 14.8 | 30 | 6.4 | 48.1 | 318 |
| | | | MIN | 26.1 | 12.8 | 27 | 6.0 | 46.5 | 264 |
| 338 | 76.00 | 20 | AV20 | 26.5 | 13.5 | 27 | 6.0 | 47.8 | 270 |
| | | | MAX | 27.7 | 14.4 | 29 | 6.3 | 48.5 | 303 |
| | | | MIN | 25.7 | 12.4 | 25 | 5.9 | 46.8 | 236 |

USH 10 - B-70-403 - PIER 7 #36 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

| BL# | depth ft | BLC bl/ft | TYPE | CSX ksi | CSB ksi | EMX k-ft | STK ft | BPM bpm | RX9 kips |
|---|---|---|---|---|---|---|---|---|---|
| 358 | 77.00 | 20 | AV20 | 26.5 | 13.7 | 27 | 6.0 | 47.9 | 269 |
| | | | MAX | 27.3 | 14.2 | 29 | 6.2 | 49.1 | 284 |
| | | | MIN | 25.4 | 13.2 | 24 | 5.7 | 47.1 | 253 |
| 380 | 78.00 | 22 | AV22 | 26.7 | 13.8 | 26 | 6.0 | 47.8 | 288 |
| | | | MAX | 27.4 | 14.4 | 28 | 6.3 | 48.7 | 312 |
| | | | MIN | 25.7 | 13.3 | 24 | 5.8 | 47.0 | 267 |
| 400 | 79.00 | 20 | AV20 | 26.5 | 13.5 | 27 | 6.0 | 47.9 | 272 |
| | | | MAX | 27.5 | 14.0 | 29 | 6.3 | 48.5 | 278 |
| | | | MIN | 25.7 | 13.1 | 25 | 5.9 | 46.9 | 262 |
| 427 | 80.00 | 27 | AV27 | 26.8 | 15.5 | 27 | 6.1 | 47.5 | 332 |
| | | | MAX | 27.7 | 17.0 | 29 | 6.4 | 48.4 | 367 |
| | | | MIN | 25.8 | 13.4 | 25 | 5.9 | 46.5 | 272 |
| 461 | 81.00 | 34 | AV34 | 27.4 | 18.6 | 28 | 6.4 | 46.6 | 404 |
| | | | MAX | 28.4 | 22.8 | 31 | 6.7 | 48.2 | 476 |
| | | | MIN | 25.7 | 16.7 | 25 | 5.9 | 45.6 | 362 |
| 503 | 81.83 | 50 | AV42 | 28.2 | 21.2 | 30 | 6.6 | 45.9 | 455 |
| | | | MAX | 29.2 | 23.1 | 32 | 6.8 | 47.6 | 486 |
| | | | MIN | 26.2 | 18.9 | 26 | 6.1 | 45.0 | 416 |
| | | | Average | 24.6 | 12.2 | 26 | 5.7 | 49.7 | 237 |
| | | | Maximum | 29.2 | 23.1 | 33 | 6.8 | 65.4 | 486 |
| | | | Minimum | 8.6 | 1.3 | 7 | 3.1 | 45.0 | 0 |

Total number of blows analyzed: 500

BL# Sensors

1-503 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.09); A4: [K3550] 360.0 (1.09)

BL# Comments

3 Reported Reference EL 740.47
12 Bottom of Excavation EL 719.31

Time Summary

Drive 10 minutes 45 seconds 1:01 PM - 1:12 PM BN 1 - 503

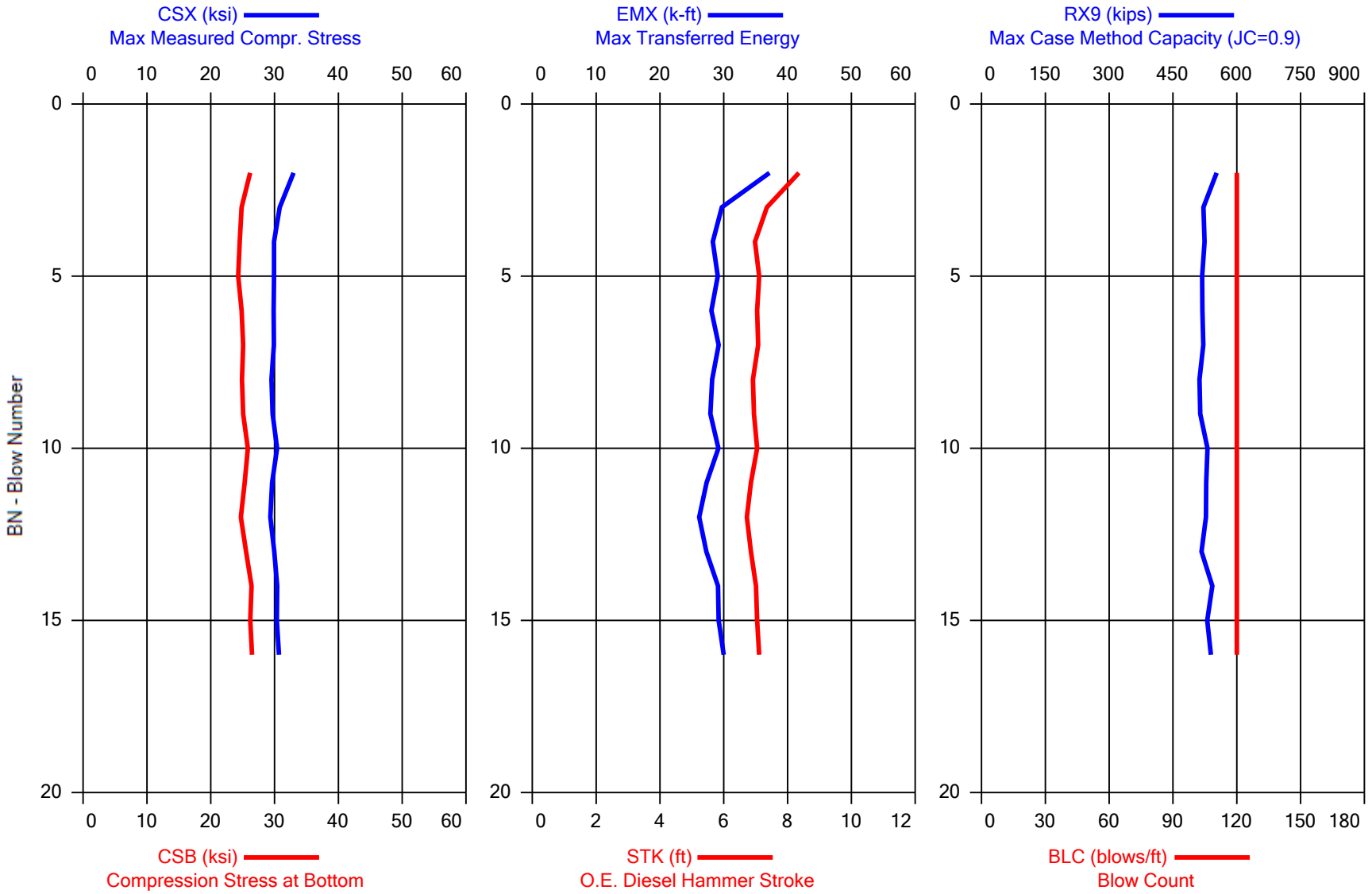
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 29-January-2015

Test started: 28-January-2015

USH 10 - B-70-403 - PIER 7 #36 BOR

APE D30-42, HP 14 x 73



USH 10 - B-70-403 - PIER 7 #36 BOR APE D30-42, HP 14 x 73
OP: RF Date: 28-January-2015

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 ft | BLC blows/ft | TYPE | CSX ksi | CSB ksi | EMX k-ft | STK ft | BPM bpm | RX9 kips |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 81.87 | 120 | AV4 | 30.9 | 25.0 | 31 | 7.4 | 43.3 | 529 |
| | | | MAX | 33.0 | 26.2 | 37 | 8.4 | 44.6 | 553 |
| | | | MIN | 29.9 | 24.3 | 28 | 7.0 | 40.9 | 519 |
| 10 | 81.91 | 120 | AV5 | 29.9 | 25.1 | 28 | 7.0 | 44.5 | 520 |
| | | | MAX | 30.4 | 25.8 | 29 | 7.1 | 44.8 | 531 |
| | | | MIN | 29.5 | 24.8 | 28 | 6.9 | 44.3 | 512 |
| 16 | 81.96 | 120 | AV6 | 30.1 | 25.8 | 28 | 6.9 | 44.8 | 531 |
| | | | MAX | 30.7 | 26.5 | 30 | 7.1 | 45.4 | 542 |
| | | | MIN | 29.3 | 24.7 | 26 | 6.7 | 44.2 | 517 |
| | | | Average | 30.2 | 25.3 | 29 | 7.1 | 44.3 | 527 |
| | | | Maximum | 33.0 | 26.5 | 37 | 8.4 | 45.4 | 553 |
| | | | Minimum | 29.3 | 24.3 | 26 | 6.7 | 40.9 | 512 |

Total number of blows analyzed: 15

BL# Sensors

1-16 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.09); A4: [K3550] 360.0 (1.09)

Time Summary

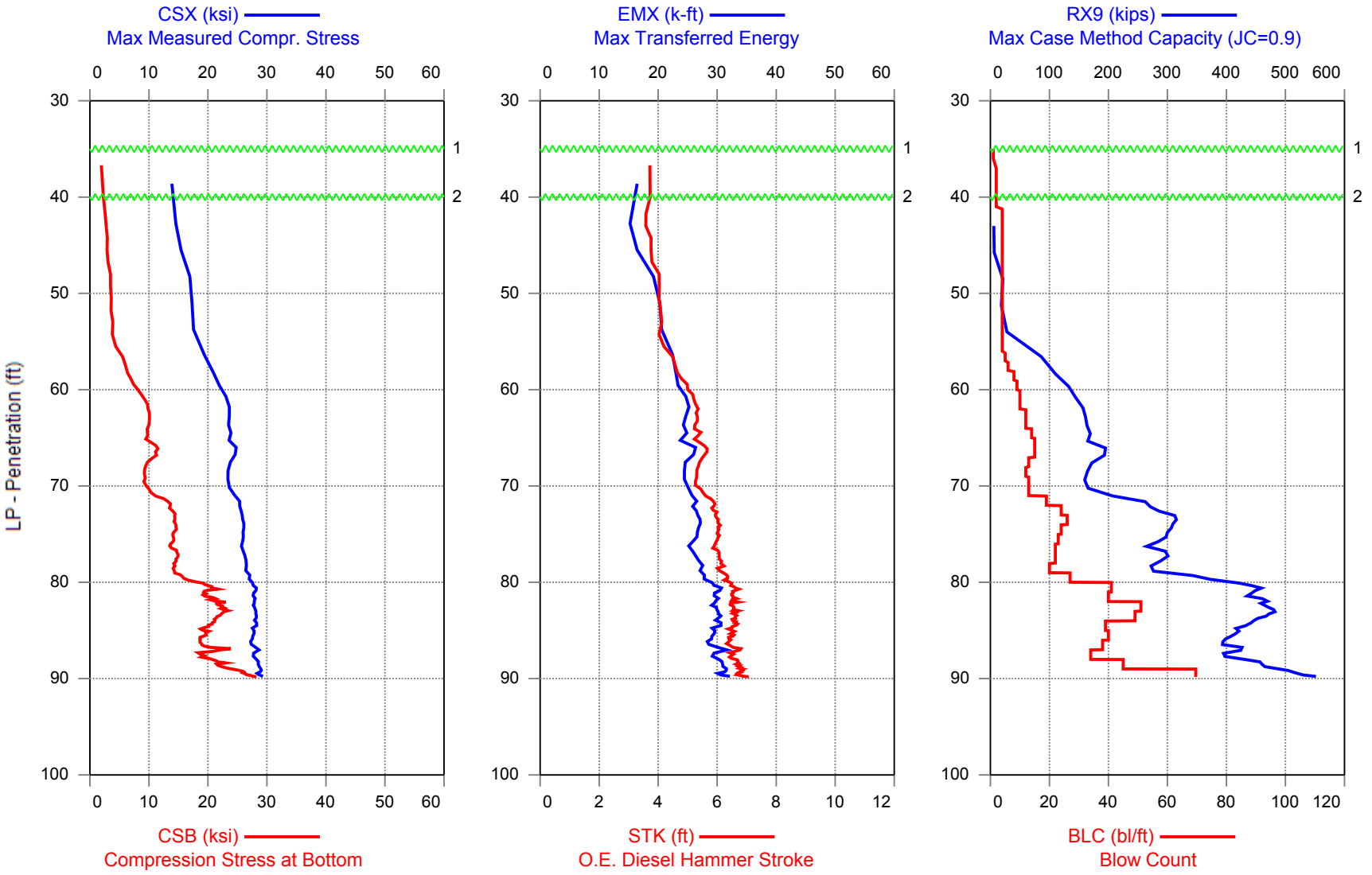
Drive 20 seconds 7:51 AM - 7:51 AM BN 1 - 16

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

Printed: 29-January-2015

Test started: 27-January-2015

# USH 10 - B-70-403 - PIER 7 #44 EOID
## APE D30-42, HP 14 x 73




1 - Reported Reference EL 740.47

2 - Bottom of Excavation EL 719.31

USH 10 - B-70-403 - PIER 7 #44 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

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 |
| 3 | 35.00 | 1 | AV1 | 9.2 | 1.2 | 10 | 3.0 | 66.5 | 0 |
| | | | MAX | 9.2 | 1.2 | 10 | 3.0 | 66.5 | 0 |
| | | | MIN | 9.2 | 1.2 | 10 | 3.0 | 66.5 | 0 |
| 4 | 36.00 | 1 | AV1 | 5.7 | 0.9 | 7 | 2.7 | 69.6 | 0 |
| | | | MAX | 5.7 | 0.9 | 7 | 2.7 | 69.6 | 0 |
| | | | MIN | 5.7 | 0.9 | 7 | 2.7 | 69.6 | 0 |
| 6 | 37.00 | 2 | AV1 | 26.0 | 2.9 | 34 | 5.9 | 48.4 | 0 |
| | | | MAX | 26.0 | 2.9 | 34 | 5.9 | 48.4 | 0 |
| | | | MIN | 26.0 | 2.9 | 34 | 5.9 | 48.4 | 0 |
| 7 | 37.50 | 2 | AV1 | 16.1 | 2.6 | 21 | 3.7 | 60.4 | 0 |
| | | | MAX | 16.1 | 2.6 | 21 | 3.7 | 60.4 | 0 |
| | | | MIN | 16.1 | 2.6 | 21 | 3.7 | 60.4 | 0 |
| 8 | 38.00 | 2 | AV1 | 13.3 | 2.1 | 12 | 3.4 | 62.7 | 0 |
| | | | MAX | 13.3 | 2.1 | 12 | 3.4 | 62.7 | 0 |
| | | | MIN | 13.3 | 2.1 | 12 | 3.4 | 62.7 | 0 |
| 10 | 39.00 | 2 | AV1 | 26.1 | 2.9 | 38 | 5.8 | 48.6 | 0 |
| | | | MAX | 26.1 | 2.9 | 38 | 5.8 | 48.6 | 0 |
| | | | MIN | 26.1 | 2.9 | 38 | 5.8 | 48.6 | 0 |
| 11 | 39.50 | 2 | AV1 | 13.8 | 2.3 | 16 | 3.3 | 63.1 | 0 |
| | | | MAX | 13.8 | 2.3 | 16 | 3.3 | 63.1 | 0 |
| | | | MIN | 13.8 | 2.3 | 16 | 3.3 | 63.1 | 0 |
| 12 | 40.00 | 2 | AV1 | 14.2 | 2.4 | 15 | 3.6 | 61.2 | 0 |
| | | | MAX | 14.2 | 2.4 | 15 | 3.6 | 61.2 | 0 |
| | | | MIN | 14.2 | 2.4 | 15 | 3.6 | 61.2 | 0 |
| 14 | 41.00 | 2 | AV2 | 8.8 | 2.0 | 8 | 3.0 | 66.8 | 0 |
| | | | MAX | 9.7 | 2.0 | 9 | 3.0 | 67.6 | 0 |
| | | | MIN | 8.0 | 1.9 | 8 | 2.9 | 65.9 | 0 |
| 18 | 42.00 | 4 | AV4 | 14.9 | 2.7 | 16 | 3.7 | 60.2 | 9 |
| | | | MAX | 19.4 | 3.2 | 21 | 4.4 | 64.2 | 23 |
| | | | MIN | 10.8 | 2.1 | 11 | 3.2 | 55.6 | 0 |
| 22 | 43.00 | 4 | AV4 | 12.9 | 2.7 | 13 | 3.4 | 62.4 | 2 |
| | | | MAX | 16.9 | 3.0 | 18 | 4.0 | 66.2 | 7 |
| | | | MIN | 9.4 | 2.2 | 8 | 3.0 | 58.2 | 0 |
| 26 | 44.00 | 4 | AV4 | 14.9 | 2.8 | 16 | 3.7 | 60.4 | 5 |
| | | | MAX | 17.3 | 3.3 | 18 | 4.0 | 63.3 | 10 |
| | | | MIN | 12.0 | 2.4 | 11 | 3.3 | 57.9 | 0 |
| 30 | 45.00 | 4 | AV4 | 15.8 | 3.0 | 17 | 3.8 | 59.5 | 3 |
| | | | MAX | 16.8 | 3.1 | 19 | 3.9 | 60.7 | 6 |

USH 10 - B-70-403 - PIER 7 #44 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

| BL# | depth ft | BLC bl/ft | TYPE | CSX ksi | CSB ksi | EMX k-ft | STK ft | BPM bpm | RX9 kips |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | 15.0 | 2.7 | 16 | 3.6 | 58.4 | 0 |
| 34 | 46.00 | 4 | AV4 | 15.2 | 2.9 | 16 | 3.7 | 60.1 | 11 |
| | | | MAX | 16.0 | 3.0 | 17 | 3.8 | 61.7 | 16 |
| | | | MIN | 13.8 | 2.7 | 14 | 3.5 | 59.2 | 7 |
| 38 | 47.00 | 4 | AV4 | 15.6 | 3.1 | 17 | 3.8 | 59.7 | 5 |
| | | | MAX | 16.6 | 3.6 | 19 | 3.9 | 60.7 | 7 |
| | | | MIN | 14.5 | 2.8 | 15 | 3.6 | 58.6 | 1 |
| 42 | 48.00 | 4 | AV4 | 16.5 | 3.2 | 18 | 3.9 | 58.5 | 19 |
| | | | MAX | 17.3 | 3.3 | 20 | 4.1 | 59.6 | 23 |
| | | | MIN | 15.3 | 3.0 | 16 | 3.8 | 57.5 | 14 |
| 46 | 49.00 | 4 | AV4 | 17.4 | 3.6 | 20 | 4.1 | 57.6 | 20 |
| | | | MAX | 18.4 | 3.9 | 21 | 4.2 | 58.6 | 28 |
| | | | MIN | 16.5 | 3.2 | 18 | 3.9 | 56.5 | 14 |
| 50 | 50.00 | 4 | AV4 | 17.2 | 3.6 | 20 | 4.0 | 57.8 | 24 |
| | | | MAX | 18.1 | 3.7 | 21 | 4.2 | 58.4 | 26 |
| | | | MIN | 16.7 | 3.5 | 18 | 3.9 | 56.9 | 22 |
| 54 | 51.00 | 4 | AV4 | 17.2 | 3.6 | 20 | 4.1 | 57.7 | 17 |
| | | | MAX | 18.4 | 3.9 | 22 | 4.3 | 58.7 | 24 |
| | | | MIN | 16.4 | 3.3 | 19 | 3.9 | 56.3 | 10 |
| 58 | 52.00 | 4 | AV4 | 17.1 | 3.5 | 20 | 4.1 | 57.7 | 18 |
| | | | MAX | 17.9 | 3.6 | 21 | 4.2 | 58.4 | 24 |
| | | | MIN | 16.5 | 3.3 | 19 | 3.9 | 56.9 | 10 |
| 62 | 53.00 | 4 | AV4 | 18.3 | 4.0 | 22 | 4.2 | 56.6 | 28 |
| | | | MAX | 19.0 | 4.2 | 24 | 4.4 | 57.7 | 38 |
| | | | MIN | 17.4 | 3.9 | 19 | 4.0 | 55.7 | 17 |
| 66 | 54.00 | 4 | AV4 | 16.7 | 3.7 | 19 | 4.0 | 58.4 | 32 |
| | | | MAX | 17.5 | 3.8 | 20 | 4.1 | 59.3 | 38 |
| | | | MIN | 15.7 | 3.6 | 18 | 3.8 | 57.5 | 25 |
| 70 | 55.00 | 4 | AV4 | 17.8 | 3.9 | 21 | 4.1 | 57.4 | 21 |
| | | | MAX | 18.3 | 4.1 | 22 | 4.2 | 58.1 | 41 |
| | | | MIN | 17.1 | 3.7 | 20 | 4.0 | 56.8 | 7 |
| 74 | 56.00 | 4 | AV4 | 18.3 | 4.5 | 22 | 4.2 | 56.7 | 50 |
| | | | MAX | 18.9 | 5.2 | 22 | 4.3 | 57.2 | 72 |
| | | | MIN | 17.9 | 4.0 | 21 | 4.1 | 55.9 | 28 |
| 79 | 57.00 | 5 | AV5 | 19.9 | 5.6 | 23 | 4.5 | 54.9 | 95 |
| | | | MAX | 20.3 | 6.0 | 24 | 4.6 | 55.8 | 100 |
| | | | MIN | 19.3 | 5.2 | 22 | 4.3 | 54.4 | 90 |
| 85 | 58.00 | 6 | AV6 | 20.6 | 6.1 | 23 | 4.6 | 54.2 | 104 |
| | | | MAX | 21.8 | 6.5 | 25 | 4.9 | 55.0 | 113 |
| | | | MIN | 19.8 | 5.7 | 22 | 4.5 | 52.9 | 99 |

USH 10 - B-70-403 - PIER 7 #44 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

| BL# | depth ft | BLC bl/ft | TYPE | CSX ksi | CSB ksi | EMX k-ft | STK ft | BPM bpm | RX9 kips |
|---|---|---|---|---|---|---|---|---|---|
| 93 | 59.00 | 8 | AV8 | 21.0 | 6.6 | 22 | 4.7 | 53.8 | 111 |
| | | | MAX | 22.3 | 7.0 | 24 | 5.0 | 55.1 | 119 |
| | | | MIN | 19.7 | 6.0 | 20 | 4.5 | 52.3 | 100 |
| 102 | 60.00 | 9 | AV9 | 22.0 | 7.6 | 24 | 4.9 | 52.6 | 130 |
| | | | MAX | 23.1 | 8.3 | 25 | 5.2 | 53.9 | 141 |
| | | | MIN | 20.8 | 7.2 | 21 | 4.7 | 51.4 | 118 |
| 112 | 61.00 | 10 | AV10 | 23.0 | 8.7 | 25 | 5.2 | 51.5 | 144 |
| | | | MAX | 23.8 | 9.4 | 26 | 5.3 | 52.3 | 153 |
| | | | MIN | 22.3 | 8.1 | 23 | 5.0 | 50.7 | 132 |
| 122 | 62.00 | 10 | AV10 | 23.4 | 9.8 | 25 | 5.3 | 51.0 | 152 |
| | | | MAX | 23.9 | 10.4 | 26 | 5.4 | 51.6 | 164 |
| | | | MIN | 23.0 | 9.3 | 23 | 5.1 | 50.5 | 145 |
| 134 | 63.00 | 12 | AV12 | 23.7 | 10.0 | 25 | 5.3 | 50.7 | 161 |
| | | | MAX | 24.4 | 10.4 | 26 | 5.5 | 51.0 | 166 |
| | | | MIN | 23.3 | 9.5 | 24 | 5.3 | 50.0 | 157 |
| 146 | 64.00 | 12 | AV12 | 23.5 | 10.0 | 24 | 5.3 | 50.9 | 163 |
| | | | MAX | 24.2 | 10.6 | 26 | 5.4 | 51.7 | 174 |
| | | | MIN | 22.8 | 9.7 | 22 | 5.1 | 50.3 | 154 |
| 160 | 65.00 | 14 | AV14 | 23.7 | 9.7 | 24 | 5.3 | 50.7 | 168 |
| | | | MAX | 24.5 | 10.2 | 27 | 5.5 | 51.5 | 176 |
| | | | MIN | 22.7 | 9.2 | 22 | 5.2 | 49.9 | 155 |
| 175 | 66.00 | 15 | AV15 | 24.0 | 10.5 | 25 | 5.4 | 50.3 | 174 |
| | | | MAX | 25.0 | 11.6 | 27 | 5.6 | 51.7 | 194 |
| | | | MIN | 22.6 | 9.1 | 23 | 5.1 | 49.4 | 157 |
| 190 | 67.00 | 15 | AV15 | 24.8 | 11.2 | 26 | 5.6 | 49.4 | 197 |
| | | | MAX | 25.4 | 11.6 | 28 | 5.8 | 49.9 | 203 |
| | | | MIN | 24.4 | 10.4 | 25 | 5.5 | 48.8 | 191 |
| 203 | 68.00 | 13 | AV13 | 23.8 | 9.9 | 25 | 5.4 | 50.4 | 173 |
| | | | MAX | 24.2 | 11.1 | 26 | 5.5 | 50.8 | 187 |
| | | | MIN | 23.3 | 9.0 | 23 | 5.3 | 49.9 | 163 |
| 215 | 69.00 | 12 | AV12 | 23.4 | 9.3 | 25 | 5.3 | 50.8 | 165 |
| | | | MAX | 23.9 | 9.8 | 25 | 5.4 | 51.1 | 173 |
| | | | MIN | 23.1 | 8.9 | 24 | 5.2 | 50.4 | 153 |
| 228 | 70.00 | 13 | AV13 | 23.3 | 9.3 | 24 | 5.3 | 51.0 | 158 |
| | | | MAX | 23.6 | 9.6 | 25 | 5.3 | 51.3 | 166 |
| | | | MIN | 22.9 | 8.8 | 23 | 5.2 | 50.8 | 150 |
| 241 | 71.00 | 13 | AV13 | 24.0 | 10.2 | 26 | 5.5 | 50.1 | 175 |
| | | | MAX | 24.7 | 11.1 | 27 | 5.7 | 51.0 | 193 |
| | | | MIN | 23.2 | 9.4 | 24 | 5.3 | 49.2 | 159 |

USH 10 - B-70-403 - PIER 7 #44 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

| BL# | depth | BLC | TYPE | CSX | CSB | EMX | STK | BPM | RX9 |
|---|---|---|---|---|---|---|---|---|---|
| | ft | bl/ft | | ksi | ksi | k-ft | ft | bpm | kips |
| 260 | 72.00 | 19 | AV19 | 25.3 | 12.9 | 26 | 5.8 | 48.6 | 252 |
| | | | MAX | 26.0 | 14.0 | 28 | 6.0 | 49.7 | 279 |
| | | | MIN | 24.3 | 11.1 | 25 | 5.6 | 47.9 | 212 |
| 284 | 73.00 | 24 | AV24 | 25.5 | 13.9 | 26 | 5.9 | 48.3 | 284 |
| | | | MAX | 26.5 | 14.7 | 28 | 6.1 | 49.2 | 314 |
| | | | MIN | 24.5 | 13.2 | 24 | 5.7 | 47.6 | 266 |
| 310 | 74.00 | 26 | AV26 | 25.9 | 14.4 | 27 | 6.0 | 47.9 | 314 |
| | | | MAX | 26.6 | 14.9 | 29 | 6.2 | 48.4 | 320 |
| | | | MIN | 25.5 | 14.0 | 26 | 5.9 | 47.2 | 307 |
| 334 | 75.00 | 24 | AV24 | 26.0 | 14.4 | 27 | 6.0 | 47.8 | 304 |
| | | | MAX | 26.5 | 15.1 | 28 | 6.2 | 48.1 | 309 |
| | | | MIN | 25.5 | 13.8 | 26 | 6.0 | 47.3 | 295 |
| 357 | 76.00 | 23 | AV23 | 25.9 | 14.1 | 26 | 6.0 | 47.9 | 292 |
| | | | MAX | 26.4 | 14.8 | 28 | 6.1 | 48.6 | 306 |
| | | | MIN | 25.4 | 13.6 | 24 | 5.8 | 47.5 | 274 |
| 379 | 77.00 | 22 | AV22 | 25.8 | 14.1 | 26 | 6.0 | 48.1 | 280 |
| | | | MAX | 26.7 | 15.1 | 27 | 6.2 | 48.8 | 309 |
| | | | MIN | 25.3 | 13.3 | 24 | 5.8 | 47.3 | 255 |
| 401 | 78.00 | 22 | AV22 | 26.4 | 14.7 | 27 | 6.1 | 47.6 | 295 |
| | | | MAX | 27.0 | 15.4 | 29 | 6.3 | 48.0 | 311 |
| | | | MIN | 25.9 | 14.2 | 25 | 6.0 | 47.0 | 281 |
| 421 | 79.00 | 20 | AV20 | 26.5 | 14.3 | 27 | 6.1 | 47.5 | 274 |
| | | | MAX | 27.5 | 15.1 | 30 | 6.3 | 48.2 | 302 |
| | | | MIN | 25.7 | 13.9 | 25 | 5.9 | 46.7 | 256 |
| 448 | 80.00 | 27 | AV27 | 27.1 | 16.0 | 28 | 6.3 | 46.8 | 357 |
| | | | MAX | 27.9 | 18.2 | 30 | 6.5 | 47.3 | 405 |
| | | | MIN | 26.5 | 14.2 | 27 | 6.2 | 46.2 | 272 |
| 489 | 81.00 | 41 | AV41 | 27.9 | 20.1 | 30 | 6.6 | 45.9 | 445 |
| | | | MAX | 29.0 | 22.7 | 32 | 6.9 | 46.7 | 481 |
| | | | MIN | 27.2 | 18.5 | 28 | 6.3 | 44.9 | 410 |
| 529 | 82.00 | 40 | AV40 | 27.8 | 20.2 | 30 | 6.5 | 46.0 | 448 |
| | | | MAX | 28.8 | 22.9 | 32 | 6.8 | 47.0 | 491 |
| | | | MIN | 26.7 | 18.9 | 28 | 6.3 | 45.1 | 429 |
| 580 | 83.00 | 51 | AV51 | 27.9 | 22.4 | 30 | 6.6 | 45.9 | 472 |
| | | | MAX | 28.7 | 24.1 | 31 | 6.8 | 46.7 | 503 |
| | | | MIN | 27.2 | 20.8 | 28 | 6.3 | 45.3 | 448 |
| 629 | 84.00 | 49 | AV49 | 28.1 | 21.8 | 30 | 6.6 | 45.9 | 464 |
| | | | MAX | 28.7 | 23.2 | 31 | 6.7 | 46.8 | 485 |
| | | | MIN | 27.1 | 20.7 | 28 | 6.3 | 45.4 | 443 |
| 668 | 85.00 | 39 | AV39 | 28.0 | 20.0 | 30 | 6.6 | 46.0 | 430 |

USH 10 - B-70-403 - PIER 7 #44 EOID APE D30-42, HP 14 x 73
OP: RF Date: 27-January-2015

| BL# | depth ft | BLC bl/ft | TYPE | CSX ksi | CSB ksi | EMX k-ft | STK ft | BPM bpm | RX9 kips |
|---|---|---|---|---|---|---|---|---|---|
| | | | MAX | 28.7 | 21.5 | 32 | 6.8 | 47.0 | 449 |
| | | | MIN | 27.0 | 18.6 | 28 | 6.3 | 45.3 | 401 |
| 708 | 86.00 | 40 | AV40 | 27.7 | 19.3 | 29 | 6.5 | 46.2 | 410 |
| | | | MAX | 28.7 | 20.2 | 31 | 6.7 | 47.3 | 428 |
| | | | MIN | 26.5 | 18.3 | 28 | 6.2 | 45.4 | 393 |
| 746 | 87.00 | 38 | AV38 | 27.7 | 19.9 | 29 | 6.5 | 46.2 | 408 |
| | | | MAX | 29.1 | 24.9 | 32 | 6.9 | 47.7 | 472 |
| | | | MIN | 26.0 | 18.3 | 26 | 6.1 | 44.9 | 382 |
| 780 | 88.00 | 34 | AV34 | 27.9 | 19.7 | 30 | 6.5 | 46.1 | 404 |
| | | | MAX | 28.9 | 22.0 | 33 | 6.8 | 47.3 | 431 |
| | | | MIN | 26.7 | 18.0 | 27 | 6.2 | 45.2 | 376 |
| 825 | 89.00 | 45 | AV45 | 28.6 | 22.1 | 31 | 6.7 | 45.4 | 460 |
| | | | MAX | 29.3 | 24.1 | 32 | 6.9 | 46.3 | 491 |
| | | | MIN | 27.6 | 20.3 | 29 | 6.5 | 44.8 | 426 |
| 883 | 89.83 | 70 | AV58 | 28.9 | 26.2 | 31 | 6.8 | 45.2 | 521 |
| | | | MAX | 30.2 | 28.4 | 34 | 7.1 | 46.3 | 563 |
| | | | MIN | 27.5 | 24.3 | 29 | 6.5 | 44.1 | 493 |
| | | | Average | 25.7 | 16.0 | 27 | 6.0 | 48.4 | 325 |
| | | | Maximum | 30.2 | 28.4 | 38 | 7.1 | 69.6 | 563 |
| | | | Minimum | 5.7 | 0.9 | 7 | 2.7 | 44.1 | 0 |

Total number of blows analyzed: 879

BL# Sensors

1-883 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.09); A4: [K3550] 360.0 (1.09)

BL# Comments

3 Reported Reference EL 740.47
12 Bottom of Excavation EL 719.31

Time Summary

Drive 19 minutes 7 seconds 12:28 PM - 12:47 PM BN 1 - 883

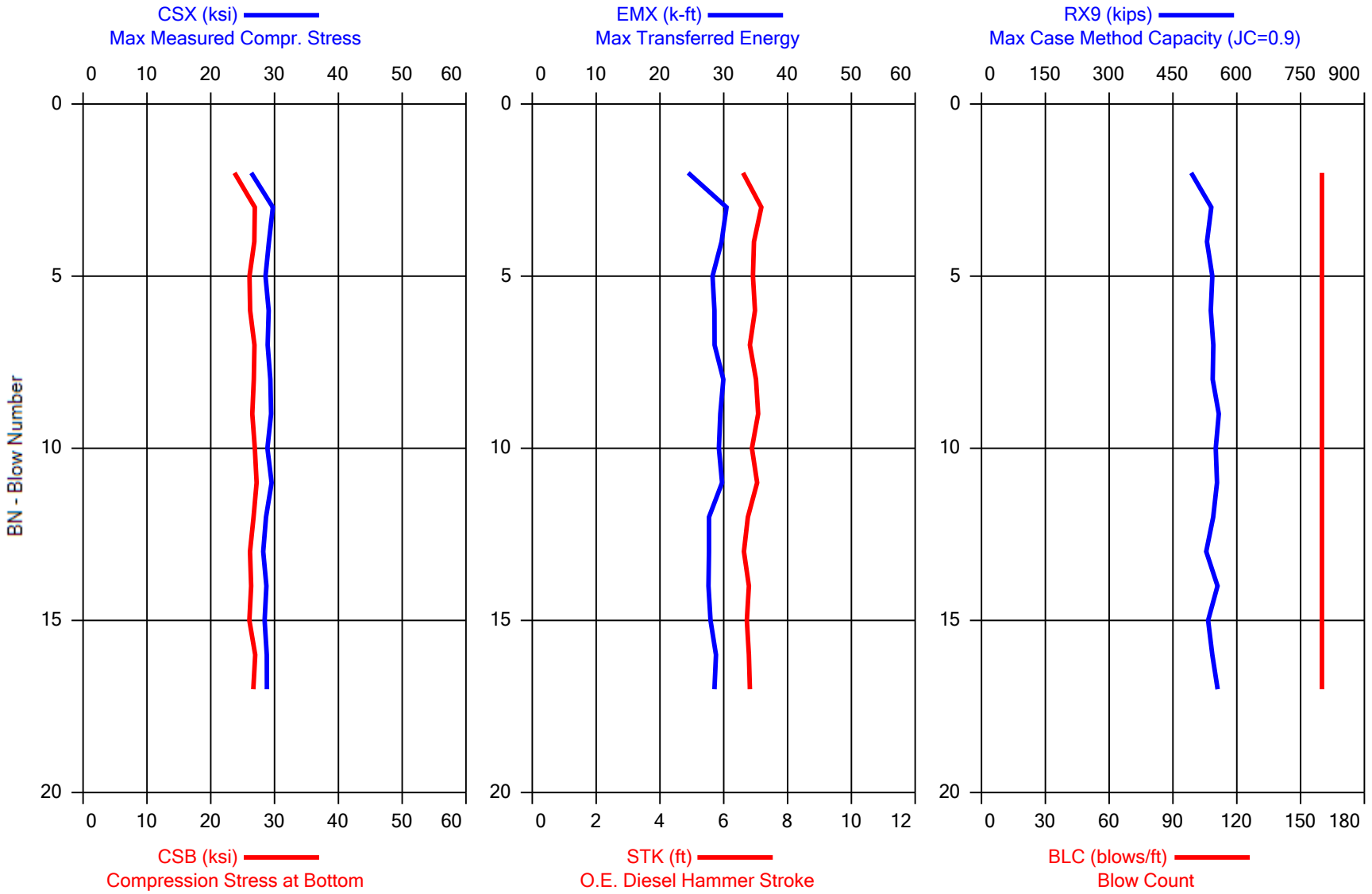
GRL Engineers, Inc. - PDIPLOT2 Ver 2014.2.48.1 - Case Method & iCAP® Results

Printed: 29-January-2015

Test started: 28-January-2015

USH 10 - B-70-403 - PIER 7 #44 BOR

APE D30-42, HP 14 x 73



USH 10 - B-70-403 - PIER 7 #44 BOR APE D30-42, HP 14 x 73
OP: RF Date: 28-January-2015

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 ft | BLC blows/ft | TYPE | CSX ksi | CSB ksi | EMX k-ft | STK ft | BPM bpm | RX9 kips |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 89.86 | 160 | AV4 | 28.4 | 25.9 | 28 | 6.9 | 44.8 | 526 |
| | | | MAX | 29.7 | 26.9 | 30 | 7.2 | 45.8 | 543 |
| | | | MIN | 26.3 | 23.7 | 24 | 6.6 | 44.0 | 493 |
| 10 | 89.90 | 160 | AV5 | 29.1 | 26.6 | 29 | 7.0 | 44.7 | 547 |
| | | | MAX | 29.4 | 26.9 | 30 | 7.1 | 45.1 | 558 |
| | | | MIN | 28.9 | 26.2 | 29 | 6.8 | 44.3 | 539 |
| 17 | 89.94 | 160 | AV7 | 28.7 | 26.6 | 28 | 6.8 | 45.2 | 544 |
| | | | MAX | 29.5 | 27.2 | 30 | 7.0 | 45.7 | 555 |
| | | | MIN | 28.2 | 26.1 | 28 | 6.6 | 44.4 | 528 |
| | | | Average | 28.8 | 26.4 | 29 | 6.9 | 44.9 | 541 |
| | | | Maximum | 29.7 | 27.2 | 30 | 7.2 | 45.8 | 558 |
| | | | Minimum | 26.3 | 23.7 | 24 | 6.6 | 44.0 | 493 |

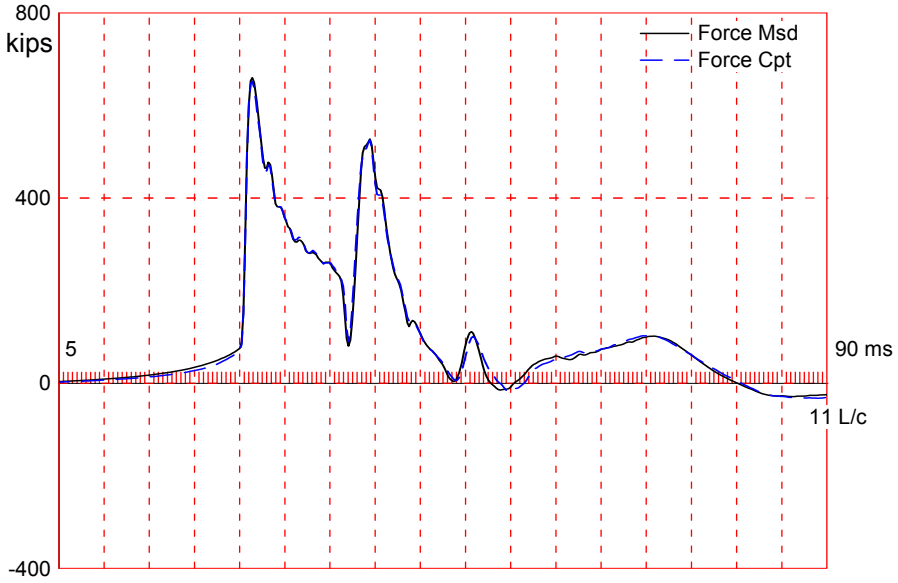
Total number of blows analyzed: 16

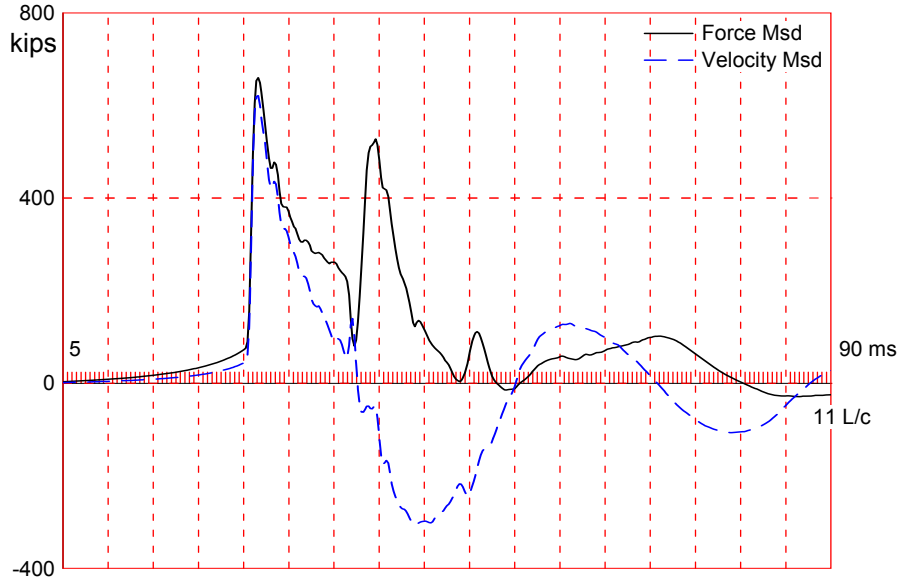
BL# Sensors

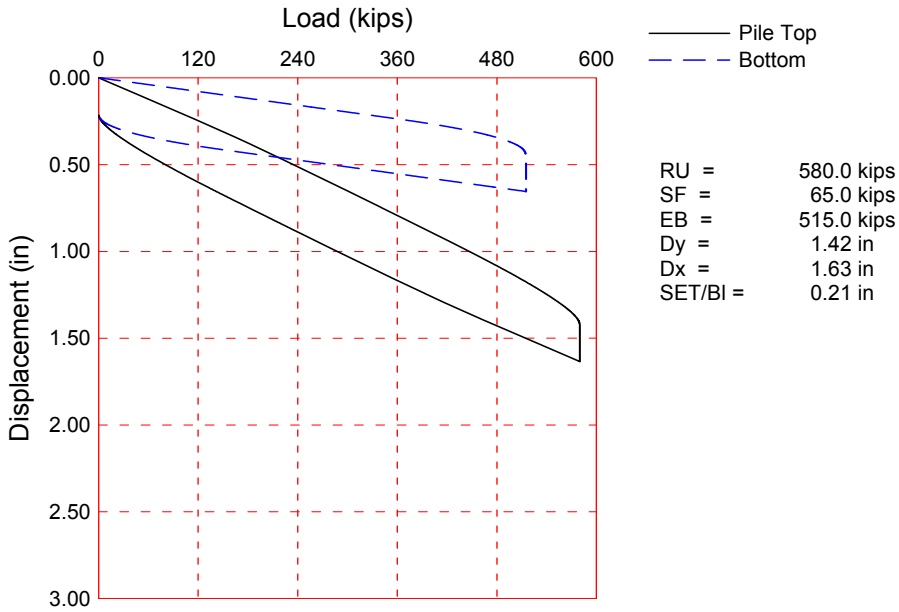
1-17 F3: [F607] 93.6 (1.00); F4: [D815] 93.0 (1.00); A3: [K2524] 360.0 (1.09); A4: [K3550] 360.0 (1.09)

Time Summary

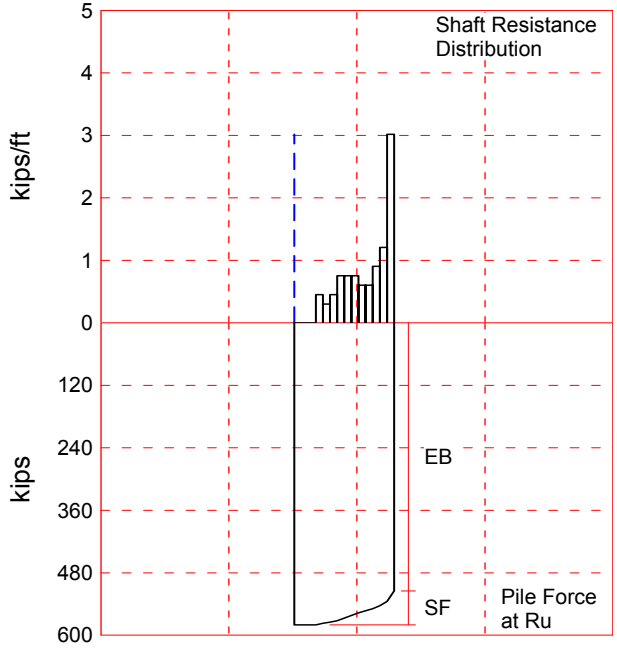
Drive 21 seconds 7:41 AM - 7:41 AM BN 1 - 17




| | |
|---|---|
| RU = | 580.0 kips |
| SF = | 65.0 kips |
| EB = | 515.0 kips |
| Dy = | 1.42 in |
| Dx = | 1.63 in |
| SET/BI = | 0.21 in |




| | |
|---|---|
| Length b. Sensors | 92.8 ft |
| Embedment | 90.5 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 | 2.11 |
| Top Compr. Stress | 30.5 ksi |
| Max Compr. Stress | 31.9 ksi |
| Max Tension Stress | -5.72 ksi |
| Avg. Shaft Quake | 0.19 in |
| Toe Quake | 0.34 in |
| Avg. Shaft Smith Dpg. | 0.25 s/ft |
| Toe Smith Damping | 0.11 s/ft |

## About the CAPWAP Results

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

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

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

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

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

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

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

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

## CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 580.0; along Shaft 65.0; at Toe 515.0 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Smith Damping Factor s/ft |
|---|---|---|---|---|---|---|---|---|
| | | | | 580.0 | | | | |
| 1 | 6.6 | 4.4 | 0.0 | 580.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| 2 | 13.3 | 11.0 | 0.0 | 580.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| 3 | 19.9 | 17.6 | 0.0 | 580.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| 4 | 26.5 | 24.3 | 3.0 | 577.0 | 3.0 | 0.45 | 0.10 | 0.25 |
| 5 | 33.1 | 30.9 | 2.0 | 575.0 | 5.0 | 0.30 | 0.06 | 0.25 |
| 6 | 39.8 | 37.5 | 3.0 | 572.0 | 8.0 | 0.45 | 0.10 | 0.25 |
| 7 | 46.4 | 44.1 | 5.0 | 567.0 | 13.0 | 0.75 | 0.16 | 0.25 |
| 8 | 53.0 | 50.8 | 5.0 | 562.0 | 18.0 | 0.75 | 0.16 | 0.25 |
| 9 | 59.6 | 57.4 | 5.0 | 557.0 | 23.0 | 0.75 | 0.16 | 0.25 |
| 10 | 66.3 | 64.0 | 4.0 | 553.0 | 27.0 | 0.60 | 0.13 | 0.25 |
| 11 | 72.9 | 70.6 | 4.0 | 549.0 | 31.0 | 0.60 | 0.13 | 0.25 |
| 12 | 79.5 | 77.3 | 6.0 | 543.0 | 37.0 | 0.91 | 0.19 | 0.25 |
| 13 | 86.1 | 83.9 | 8.0 | 535.0 | 45.0 | 1.21 | 0.26 | 0.25 |
| 14 | 92.8 | 90.5 | 20.0 | 515.0 | 65.0 | 3.02 | 0.64 | 0.25 |
| Avg. Shaft | | | 4.6 | | | 0.72 | 0.15 | 0.25 |
| Toe | | | 515.0 | | | | 373.60 | 0.11 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Quake | (in) | 0.19 | 0.34 |
| Case Damping Factor | | 0.43 | 1.48 |
| Damping Type | | Viscous | Sm+Visc |
| Unloading Quake | (% of loading quake) | 56 | 34 |
| Unloading Level | (% of Ru) | 91 | |
| Resistance Gap (included in Toe Quake) | (in) | | 0.01 |
| Soil Plug Weight | (kips) | 0.020 | |

CAPWAP match quality = 2.11 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.21 in; Blow Count = 56 b/ft
Computed: Final Set = 0.25 in; Blow Count = 48 b/ft

max. Top Comp. Stress = 30.5 ksi (T= 26.8 ms, max= 1.046 x Top)
max. Comp. Stress = 31.9 ksi (Z= 92.8 ft, T= 32.7 ms)
max. Tens. Stress = -5.72 ksi (Z= 53.0 ft, T= 52.8 ms)
max. Energy (EMX) = 35.3 kip-ft; max. Measured Top Displ. (DMX)= 1.08 in

**EXTREMA TABLE**

| Pile Sgmnt No. | Dist. Below Gages ft | max. Force kips | min. Force kips | max. Comp. Stress ksi | max. Tens. Stress ksi | max. Trnsfd. Energy kip-ft | max. Veloc. ft/s | max. Displ. in |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 653.0 | -35.1 | 30.5 | -1.64 | 35.3 | 16.4 | 1.09 |
| 2 | 6.6 | 653.7 | -42.3 | 30.5 | -1.98 | 35.1 | 16.4 | 1.08 |
| 4 | 13.3 | 655.3 | -58.3 | 30.6 | -2.72 | 34.7 | 16.4 | 1.05 |
| 6 | 19.9 | 659.3 | -74.8 | 30.8 | -3.49 | 34.2 | 16.3 | 1.01 |
| 8 | 26.5 | 666.5 | -88.5 | 31.1 | -4.13 | 33.5 | 16.1 | 0.96 |
| 10 | 33.1 | 658.1 | -90.9 | 30.7 | -4.24 | 32.0 | 15.9 | 0.91 |
| 12 | 39.8 | 657.7 | -91.1 | 30.7 | -4.26 | 30.7 | 15.6 | 0.86 |
| 14 | 46.4 | 655.1 | -109.1 | 30.6 | -5.10 | 29.0 | 15.3 | 0.81 |
| 15 | 49.7 | 637.2 | -113.4 | 29.8 | -5.30 | 27.4 | 15.1 | 0.78 |
| 16 | 53.0 | 643.0 | -122.5 | 30.0 | -5.72 | 26.8 | 15.0 | 0.75 |
| 17 | 56.3 | 625.7 | -119.6 | 29.2 | -5.59 | 25.2 | 14.8 | 0.72 |
| 18 | 59.6 | 630.9 | -122.3 | 29.5 | -5.71 | 24.6 | 14.7 | 0.69 |
| 19 | 62.9 | 613.2 | -118.1 | 28.6 | -5.52 | 23.0 | 14.5 | 0.66 |
| 20 | 66.3 | 620.2 | -118.6 | 29.0 | -5.54 | 22.3 | 14.4 | 0.62 |
| 21 | 69.6 | 616.6 | -114.7 | 28.8 | -5.36 | 20.9 | 14.0 | 0.59 |
| 22 | 72.9 | 617.6 | -116.4 | 28.9 | -5.44 | 20.1 | 13.9 | 0.56 |
| 23 | 76.2 | 600.9 | -111.7 | 28.1 | -5.22 | 18.7 | 13.9 | 0.52 |
| 24 | 79.5 | 608.4 | -112.4 | 28.4 | -5.25 | 17.9 | 13.7 | 0.49 |
| 25 | 82.8 | 627.6 | -105.9 | 29.3 | -4.95 | 16.3 | 14.8 | 0.45 |
| 26 | 86.1 | 650.7 | -106.7 | 30.4 | -4.99 | 15.5 | 16.2 | 0.42 |
| 27 | 89.4 | 649.1 | -97.7 | 30.3 | -4.57 | 13.8 | 16.1 | 0.38 |
| 28 | 92.8 | 683.0 | -98.7 | 31.9 | -4.61 | 13.0 | 14.3 | 0.35 |
| Absolute | 92.8 | | | 31.9 | | | (T = | 32.7 ms) |
| | 53.0 | | | | -5.72 | | (T = | 52.8 ms) |

**CASE METHOD**

| J = | 0.0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 713.3 | 659.2 | 605.1 | 551.0 | 497.0 | 442.9 | 388.8 | 334.7 | 280.6 | 226.5 |
| RX | 762.0 | 732.6 | 709.4 | 694.0 | 678.5 | 663.0 | 647.5 | 633.6 | 621.0 | 611.6 |
| RU | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

RAU = 415.4 (kips); RA2 = 614.0 (kips)

Current CAPWAP Ru = 580.0 (kips); Corresponding J(RP)= 0.49; 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| 16.3 | 26.61 | 621.3 | 659.9 | 659.9 | 1.08 | 0.21 | 0.21 | 35.4 | 656.4 | 1580 |

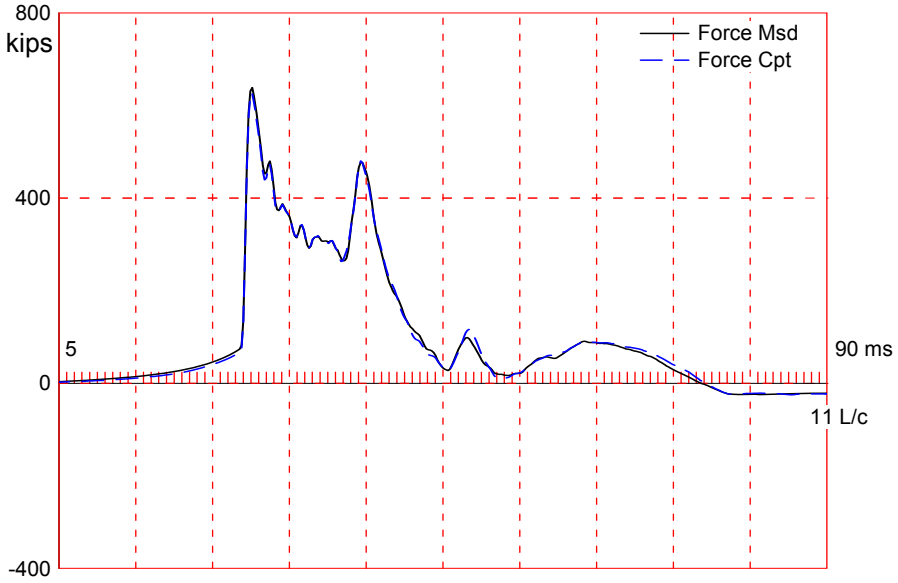
**PILE PROFILE AND PILE MODEL**

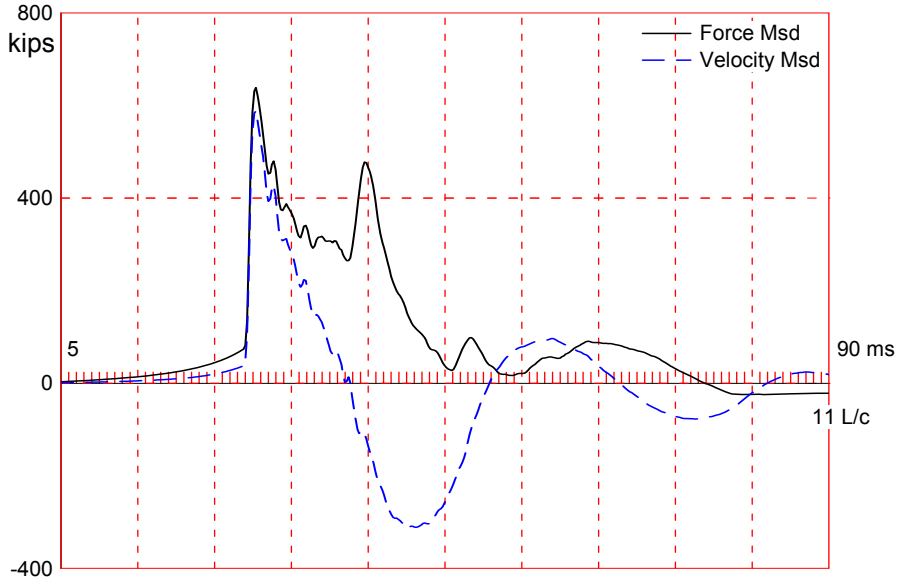
| Depth ft | Area $in^2$ | E-Modulus ksi | Spec. Weight $lb/ft^3$ | Perim. ft |
|---|---|---|---|---|
| 0.0 | 21.4 | 29992.2 | 492.000 | 4.70 |
| 92.8 | 21.4 | 29992.2 | 492.000 | 4.70 |

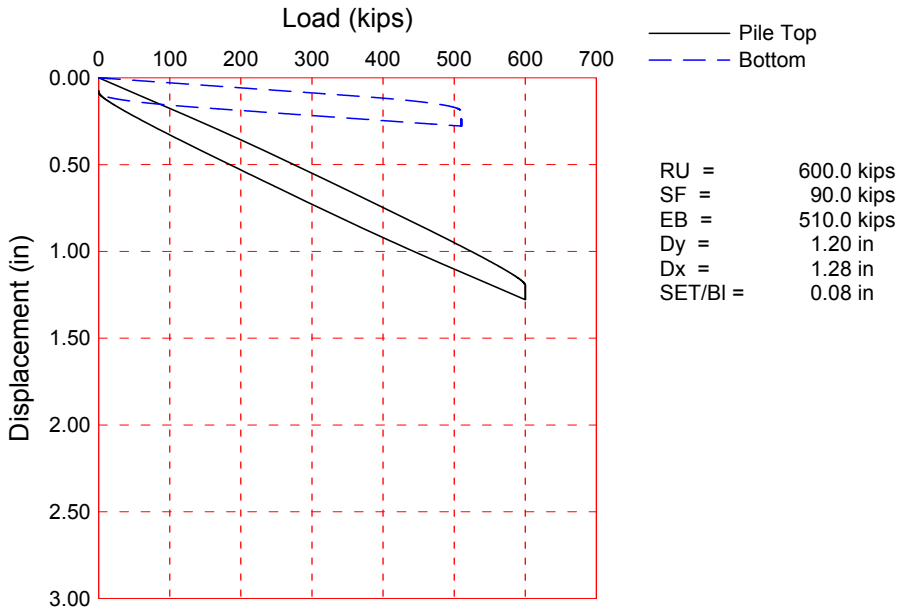
Toe Area 198.5 $in^2$

| Segmnt Number | Dist. B.G. ft | Impedance kips/ft/s | Imped. Change % | Slack in | Tension Eff. | Slack in | Compression Eff. | Perim. ft | Wave Speed ft/s | Soil Plug kips |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 23 | 76.2 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.020 |
| 24 | 79.5 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 28 | 92.8 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |

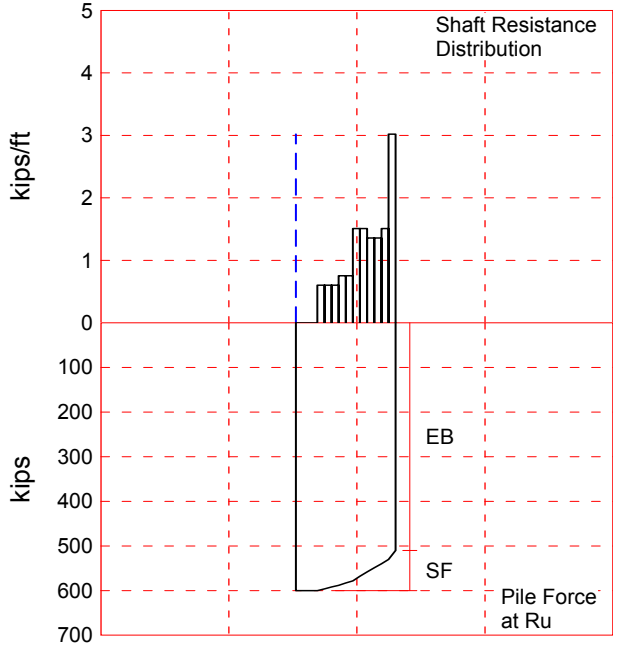
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.197 ms, 2L/c 11.0 ms
Total volume: 13.784 $ft^3$; Volume ratio considering added impedance: 1.000




| | |
|---|---|
| RU = | 600.0 kips |
| SF = | 90.0 kips |
| EB = | 510.0 kips |
| Dy = | 1.20 in |
| Dx = | 1.28 in |
| SET/Bl = | 0.08 in |




| | |
|---|---|
| Length b. Sensors | 92.7 ft |
| Embedment | 90.5 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 | 1.51 |
| Top Compr. Stress | 29.3 ksi |
| Max Compr. Stress | 30.4 ksi |
| Max Tension Stress | -5.35 ksi |
| Avg. Shaft Quake | 0.18 in |
| Toe Quake | 0.15 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: 600.0; along Shaft 90.0; at Toe 510.0 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Smith Damping Factor s/ft | Quake in |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 600.0 | | | | | |
| 1 | 6.6 | 4.5 | 0.0 | 600.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.19 |
| 2 | 13.2 | 11.1 | 0.0 | 600.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.19 |
| 3 | 19.9 | 17.7 | 0.0 | 600.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.19 |
| 4 | 26.5 | 24.3 | 4.0 | 596.0 | 4.0 | 0.60 | 0.13 | 0.28 | 0.19 |
| 5 | 33.1 | 30.9 | 4.0 | 592.0 | 8.0 | 0.60 | 0.13 | 0.28 | 0.19 |
| 6 | 39.7 | 37.6 | 4.0 | 588.0 | 12.0 | 0.60 | 0.13 | 0.28 | 0.19 |
| 7 | 46.3 | 44.2 | 5.0 | 583.0 | 17.0 | 0.76 | 0.16 | 0.28 | 0.19 |
| 8 | 53.0 | 50.8 | 5.0 | 578.0 | 22.0 | 0.76 | 0.16 | 0.28 | 0.19 |
| 9 | 59.6 | 57.4 | 10.0 | 568.0 | 32.0 | 1.51 | 0.32 | 0.28 | 0.19 |
| 10 | 66.2 | 64.0 | 10.0 | 558.0 | 42.0 | 1.51 | 0.32 | 0.28 | 0.19 |
| 11 | 72.8 | 70.7 | 9.0 | 549.0 | 51.0 | 1.36 | 0.29 | 0.28 | 0.19 |
| 12 | 79.4 | 77.3 | 9.0 | 540.0 | 60.0 | 1.36 | 0.29 | 0.28 | 0.19 |
| 13 | 86.1 | 83.9 | 10.0 | 530.0 | 70.0 | 1.51 | 0.32 | 0.28 | 0.19 |
| 14 | 92.7 | 90.5 | 20.0 | 510.0 | 90.0 | 3.02 | 0.64 | 0.28 | 0.16 |
| Avg. Shaft | | | 6.4 | | | 0.99 | 0.21 | 0.28 | 0.18 |
| Toe | | | 510.0 | | | | 369.97 | 0.08 | 0.15 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Case Damping Factor | | 0.66 | 1.07 |
| Damping Type | | Viscous | Viscous |
| Unloading Quake | (% of loading quake) | 46 | 30 |
| Unloading Level | (% of Ru) | 51 | |
| Resistance Gap (included in Toe Quake) | (in) | | 0.00 |
| Soil Plug Weight | (kips) | 0.020 | |

CAPWAP match quality = 1.51 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.08 in; Blow Count = 160 b/ft
Computed: Final Set = 0.09 in; Blow Count = 137 b/ft
Transducer F3(F607) CAL: 93.6; RF: 0.98; F4(D815) CAL: 93.0; RF: 0.98
A3(K2524) CAL: 360; RF: 1.09; A4(K3550) CAL: 360; RF: 1.09

max. Top Comp. Stress = 29.3 ksi (T= 26.8 ms, max= 1.037 x Top)
max. Comp. Stress = 30.4 ksi (Z= 92.7 ft, T= 32.7 ms)
max. Tens. Stress = -5.35 ksi (Z= 59.6 ft, T= 51.0 ms)
max. Energy (EMX) = 32.9 kip-ft; max. Measured Top Displ. (DMX)= 0.96 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 | 627.6 | -26.1 | 29.3 | -1.22 | 32.9 | 15.7 | 0.98 |
| 2 | 6.6 | 628.4 | -28.8 | 29.4 | -1.35 | 32.6 | 15.6 | 0.97 |
| 4 | 13.2 | 630.1 | -34.2 | 29.4 | -1.60 | 32.1 | 15.6 | 0.92 |
| 6 | 19.9 | 635.0 | -39.4 | 29.7 | -1.84 | 31.3 | 15.5 | 0.88 |
| 8 | 26.5 | 645.9 | -43.9 | 30.2 | -2.05 | 30.6 | 15.2 | 0.83 |
| 10 | 33.1 | 636.0 | -62.4 | 29.7 | -2.92 | 28.7 | 14.9 | 0.78 |
| 12 | 39.7 | 627.3 | -89.8 | 29.3 | -4.20 | 26.8 | 14.6 | 0.72 |
| 14 | 46.3 | 620.5 | -107.7 | 29.0 | -5.03 | 25.0 | 14.2 | 0.66 |
| 15 | 49.6 | 603.4 | -109.7 | 28.2 | -5.12 | 23.4 | 14.0 | 0.63 |
| 16 | 53.0 | 612.3 | -114.0 | 28.6 | -5.33 | 22.7 | 13.8 | 0.60 |
| 17 | 56.3 | 601.0 | -112.1 | 28.1 | -5.24 | 21.3 | 13.5 | 0.57 |
| 18 | 59.6 | 611.3 | -114.5 | 28.6 | -5.35 | 20.6 | 13.2 | 0.54 |
| 19 | 62.9 | 578.8 | -105.9 | 27.0 | -4.95 | 18.5 | 12.9 | 0.50 |
| 20 | 66.2 | 589.7 | -107.4 | 27.6 | -5.02 | 17.7 | 12.6 | 0.47 |
| 21 | 69.5 | 576.0 | -98.9 | 26.9 | -4.62 | 15.7 | 12.1 | 0.43 |
| 22 | 72.8 | 586.2 | -100.2 | 27.4 | -4.68 | 14.8 | 12.0 | 0.40 |
| 23 | 76.1 | 577.7 | -92.5 | 27.0 | -4.32 | 13.1 | 11.9 | 0.36 |
| 24 | 79.4 | 613.8 | -94.2 | 28.7 | -4.40 | 12.2 | 11.6 | 0.33 |
| 25 | 82.7 | 629.2 | -86.5 | 29.4 | -4.04 | 10.8 | 11.3 | 0.29 |
| 26 | 86.1 | 639.8 | -87.3 | 29.9 | -4.08 | 10.0 | 10.8 | 0.26 |
| 27 | 89.4 | 622.8 | -79.0 | 29.1 | -3.69 | 8.8 | 10.0 | 0.22 |
| 28 | 92.7 | 650.6 | -80.1 | 30.4 | -3.74 | 8.0 | 8.4 | 0.19 |
| Absolute | 92.7 | | | 30.4 | | | (T = | 32.7 ms) |
| | 59.6 | | | | -5.35 | | (T = | 51.0 ms) |

**CASE METHOD**

| J = | 0.0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 817.5 | 733.8 | 650.0 | 566.3 | 482.6 | | | | | |
| RX | 830.0 | 764.4 | 706.2 | 663.5 | 632.8 | 606.1 | 581.4 | 557.4 | 534.0 | 510.6 |
| RU | 816.6 | 732.7 | 648.8 | 564.8 | 480.9 | | | | | |

RAU = 373.6 (kips); RA2 = 606.1 (kips)

Current CAPWAP Ru = 600.0 (kips); Corresponding J(RP)= 0.52; J(RX) = 1.05

| VMX ft/s | TVP ms | VT1*Z kips | FT1 kips | FMX kips | DMX in | DFN in | SET in | EMX kip-ft | QUS kips | KEB kips/in |
|---|---|---|---|---|---|---|---|---|---|---|
| 15.5 | 26.78 | 593.5 | 642.7 | 642.7 | 0.96 | 0.07 | 0.08 | 33.1 | 764.8 | 3495 |

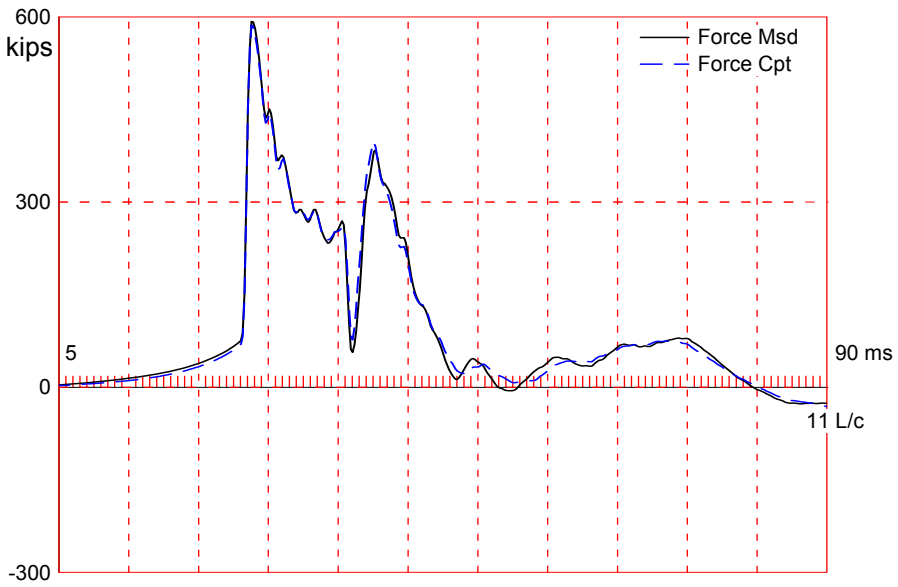
**PILE PROFILE AND PILE MODEL**

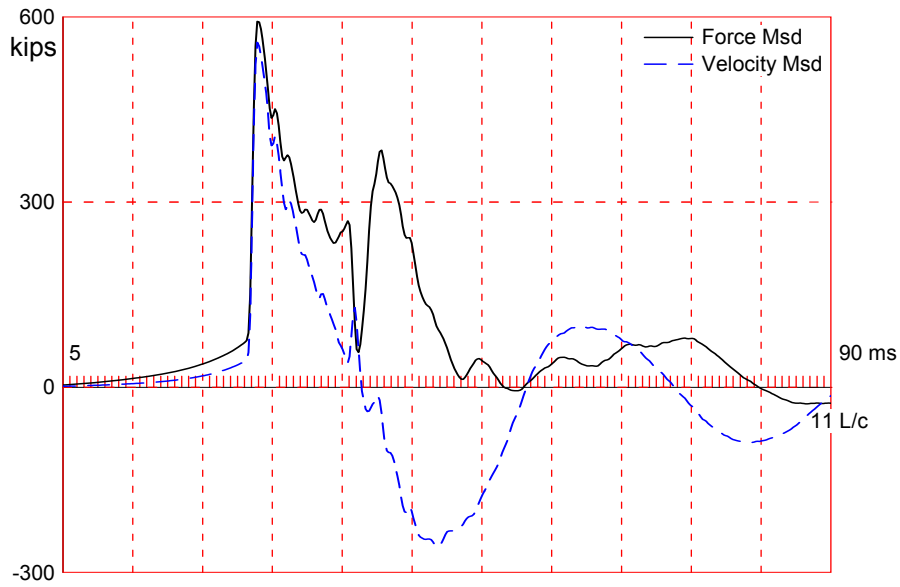
| Depth ft | Area $in^2$ | E-Modulus ksi | Spec. Weight $lb/ft^3$ | Perim. ft |
|---|---|---|---|---|
| 0.0 | 21.4 | 29992.2 | 492.000 | 4.70 |
| 92.7 | 21.4 | 29992.2 | 492.000 | 4.70 |

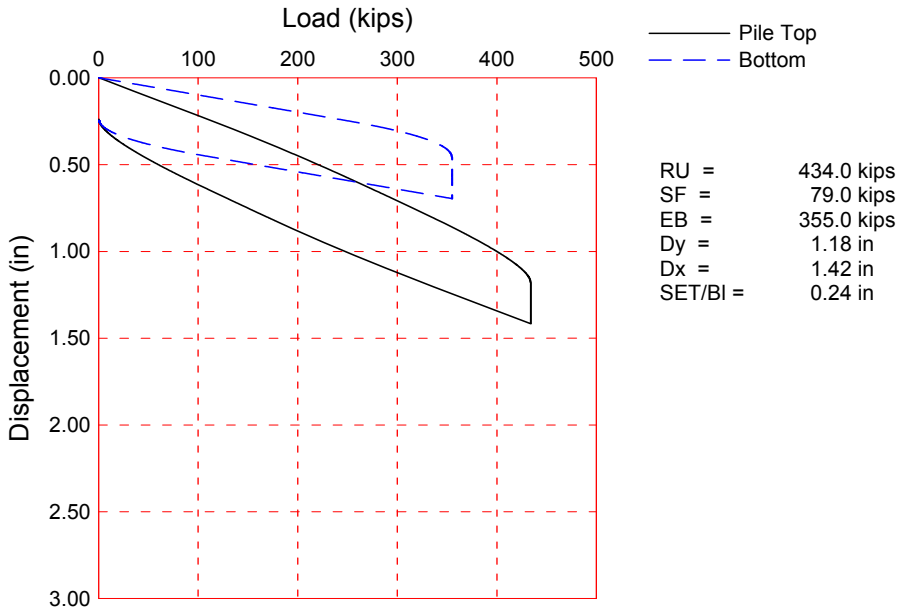
Toe Area 198.5 $in^2$

| Segmnt Number | Dist. B.G. ft | Impedance kips/ft/s | Imped. Change % | Slack in | Tension Eff. | Slack in | Compression Eff. | Perim. ft | Wave Speed ft/s | Soil Plug kips |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 23 | 76.1 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.020 |
| 24 | 79.4 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 28 | 92.7 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |

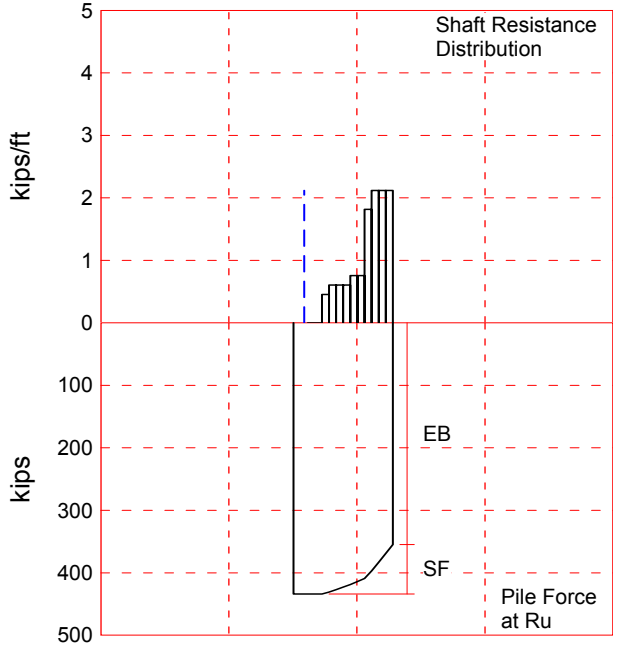
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.197 ms, 2L/c 11.0 ms
Total volume: 13.772 $ft^3$; Volume ratio considering added impedance: 1.000




| | |
|---|---|
| RU = | 434.0 kips |
| SF = | 79.0 kips |
| EB = | 355.0 kips |
| Dy = | 1.18 in |
| Dx = | 1.42 in |
| SET/BI = | 0.24 in |




| | |
|---|---|
| Length b. Sensors | 92.4 ft |
| Embedment | 81.8 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 | 2.97 |
| Top Compr. Stress | 27.5 ksi |
| Max Compr. Stress | 28.3 ksi |
| Max Tension Stress | -4.52 ksi |
| Avg. Shaft Quake | 0.19 in |
| Toe Quake | 0.35 in |
| Avg. Shaft Smith Dpg. | 0.25 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: 434.0; along Shaft 79.0; at Toe 355.0 kips**

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Smith Damping Factor s/ft |
|---|---|---|---|---|---|---|---|---|
| | | | | 434.0 | | | | |
| 1 | 19.8 | 9.2 | 0.0 | 434.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| 2 | 26.4 | 15.8 | 0.0 | 434.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| 3 | 33.0 | 22.4 | 3.0 | 431.0 | 3.0 | 0.45 | 0.10 | 0.25 |
| 4 | 39.6 | 29.0 | 4.0 | 427.0 | 7.0 | 0.61 | 0.13 | 0.25 |
| 5 | 46.2 | 35.6 | 4.0 | 423.0 | 11.0 | 0.61 | 0.13 | 0.25 |
| 6 | 52.8 | 42.2 | 4.0 | 419.0 | 15.0 | 0.61 | 0.13 | 0.25 |
| 7 | 59.4 | 48.8 | 5.0 | 414.0 | 20.0 | 0.76 | 0.16 | 0.25 |
| 8 | 66.0 | 55.4 | 5.0 | 409.0 | 25.0 | 0.76 | 0.16 | 0.25 |
| 9 | 72.6 | 62.0 | 12.0 | 397.0 | 37.0 | 1.82 | 0.39 | 0.25 |
| 10 | 79.2 | 68.6 | 14.0 | 383.0 | 51.0 | 2.12 | 0.45 | 0.25 |
| 11 | 85.8 | 75.2 | 14.0 | 369.0 | 65.0 | 2.12 | 0.45 | 0.25 |
| 12 | 92.4 | 81.8 | 14.0 | 355.0 | 79.0 | 2.12 | 0.45 | 0.25 |
| Avg. Shaft | | | 6.6 | | | 0.97 | 0.21 | 0.25 |
| Toe | | | 355.0 | | | | 257.53 | 0.10 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Quake | (in) | 0.19 | 0.35 |
| Case Damping Factor | | 0.52 | 0.93 |
| Damping Type | | Viscous | Sm+Visc |
| Unloading Quake | (% of loading quake) | 89 | 39 |
| Soil Plug Weight | (kips) | 0.060 | 0.065 |

CAPWAP match quality = 2.97 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.24 in; Blow Count = 50 b/ft
Computed: Final Set = 0.28 in; Blow Count = 43 b/ft

max. Top Comp. Stress = 27.5 ksi (T= 26.7 ms, max= 1.030 x Top)
max. Comp. Stress = 28.3 ksi (Z= 29.7 ft, T= 28.3 ms)
max. Tens. Stress = -4.52 ksi (Z= 72.6 ft, T= 53.6 ms)
max. Energy (EMX) = 30.5 kip-ft; max. Measured Top Displ. (DMX)= 1.00 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 | 587.6 | -36.8 | 27.5 | -1.72 | 30.5 | 14.8 | 1.02 |
| 2 | 6.6 | 587.9 | -39.1 | 27.5 | -1.83 | 30.4 | 14.7 | 1.01 |
| 4 | 13.2 | 588.6 | -43.2 | 27.5 | -2.02 | 30.1 | 14.7 | 0.98 |
| 6 | 19.8 | 589.5 | -47.3 | 27.5 | -2.21 | 29.6 | 14.6 | 0.94 |
| 8 | 26.4 | 604.1 | -60.9 | 28.2 | -2.84 | 29.0 | 14.3 | 0.90 |
| 10 | 33.0 | 599.7 | -74.9 | 28.0 | -3.50 | 28.5 | 14.3 | 0.86 |
| 12 | 39.6 | 596.4 | -80.5 | 27.9 | -3.76 | 27.2 | 14.0 | 0.82 |
| 14 | 46.2 | 588.0 | -80.1 | 27.5 | -3.74 | 25.6 | 13.8 | 0.77 |
| 15 | 49.5 | 577.3 | -76.8 | 27.0 | -3.59 | 24.4 | 13.6 | 0.74 |
| 16 | 52.8 | 592.4 | -78.8 | 27.7 | -3.68 | 23.9 | 13.3 | 0.72 |
| 17 | 56.1 | 585.3 | -76.9 | 27.3 | -3.59 | 22.8 | 12.9 | 0.69 |
| 18 | 59.4 | 580.2 | -83.6 | 27.1 | -3.91 | 22.4 | 13.1 | 0.67 |
| 19 | 62.7 | 559.1 | -85.6 | 26.1 | -4.00 | 21.1 | 13.1 | 0.64 |
| 20 | 66.0 | 567.2 | -91.5 | 26.5 | -4.27 | 20.7 | 12.9 | 0.61 |
| 21 | 69.3 | 558.8 | -90.8 | 26.1 | -4.24 | 19.5 | 12.6 | 0.59 |
| 22 | 72.6 | 569.2 | -96.8 | 26.6 | -4.52 | 19.0 | 12.3 | 0.56 |
| 23 | 75.9 | 536.5 | -84.1 | 25.1 | -3.93 | 17.1 | 12.0 | 0.54 |
| 24 | 79.2 | 546.9 | -85.6 | 25.6 | -4.00 | 16.6 | 11.7 | 0.51 |
| 25 | 82.5 | 508.3 | -73.2 | 23.7 | -3.42 | 14.6 | 13.0 | 0.49 |
| 26 | 85.8 | 493.6 | -73.7 | 23.1 | -3.44 | 14.3 | 14.0 | 0.47 |
| 27 | 89.1 | 485.0 | -64.6 | 22.7 | -3.02 | 12.5 | 14.7 | 0.44 |
| 28 | 92.4 | 498.4 | -65.0 | 23.3 | -3.04 | 11.4 | 14.4 | 0.42 |
| Absolute | 29.7 | | | 28.3 | | | (T = | 28.3 ms) |
| | 72.6 | | | | -4.52 | | (T = | 53.6 ms) |

## CASE METHOD

| J = | 0.0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 555.7 | 434.9 | 314.0 | 193.2 | 72.4 | | | | | |
| RX | 609.3 | 557.9 | 511.2 | 489.2 | 468.0 | 455.9 | 451.7 | 447.4 | 443.3 | 439.3 |
| RU | 555.7 | 434.9 | 314.0 | 193.2 | 72.4 | | | | | |

RAU = 378.2 (kips); RA2 = 498.4 (kips)

Current CAPWAP Ru = 434.0 (kips); Corresponding J(RP)= 0.20; 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| 14.8 | 26.51 | 564.1 | 595.9 | 599.2 | 1.00 | 0.24 | 0.24 | 30.6 | 591.2 | 1009 |

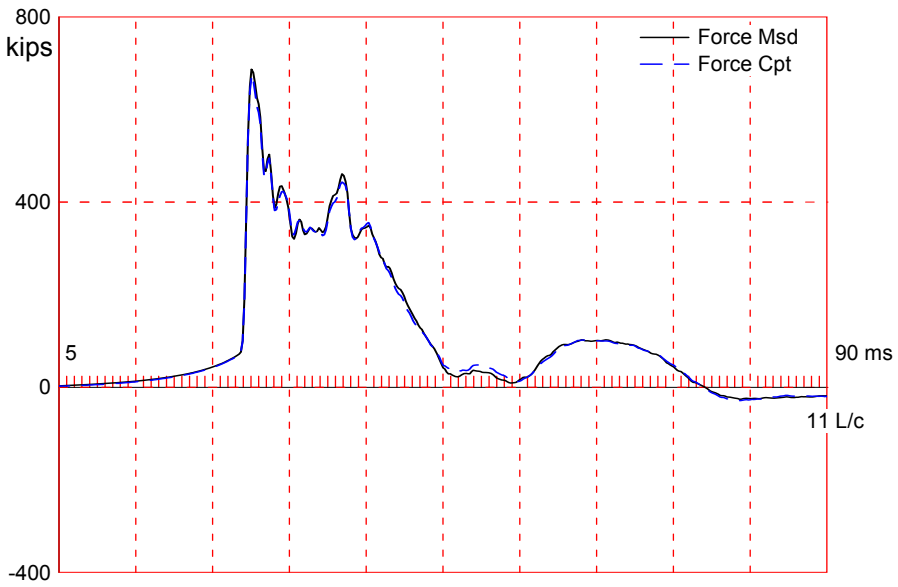
## PILE PROFILE AND PILE MODEL

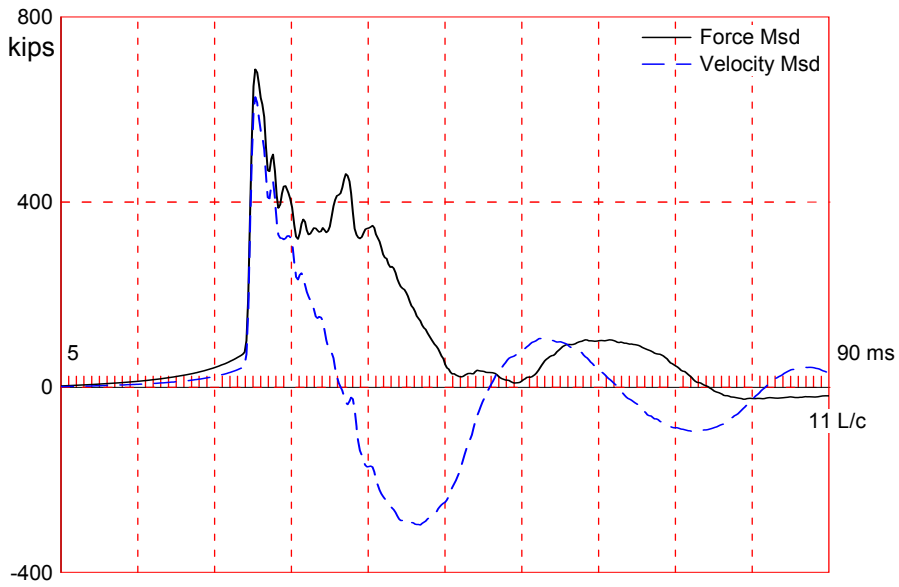
| Depth ft | Area $in^2$ | E-Modulus ksi | Spec. Weight $lb/ft^3$ | Perim. ft |
|---|---|---|---|---|
| 0.0 | 21.4 | 29992.2 | 492.000 | 4.70 |
| 92.4 | 21.4 | 29992.2 | 492.000 | 4.70 |

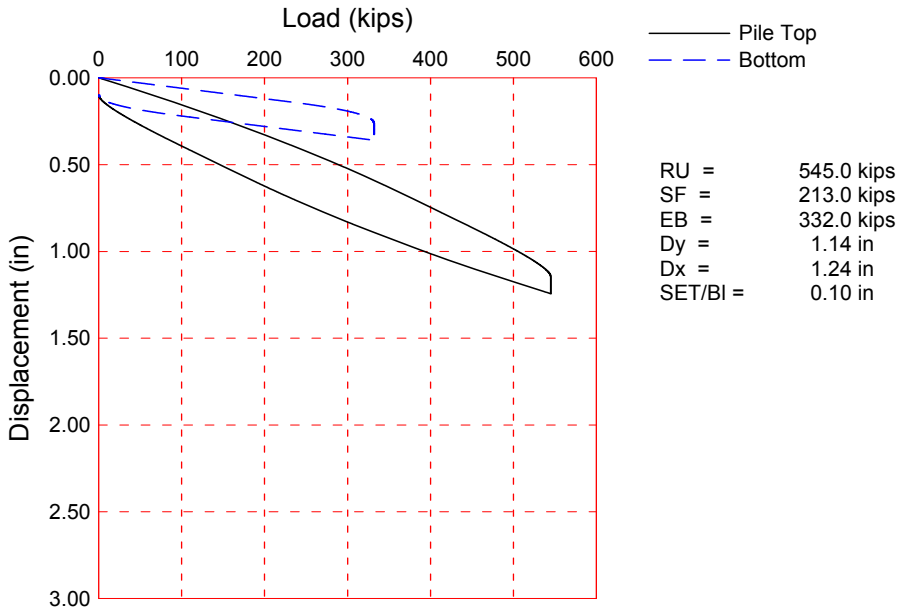
Toe Area 198.5 $in^2$

| Segmnt Number | Dist. B.G. ft | Impedance kips/ft/s | Imped. Change % | Slack in | Tension Eff. | Slack in | Compression Eff. | Perim. ft | Wave Speed ft/s | Soil Plug kips |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 10 | 33.0 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.020 |
| 11 | 36.3 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 18 | 59.4 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.020 |
| 20 | 66.0 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 28 | 92.4 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |

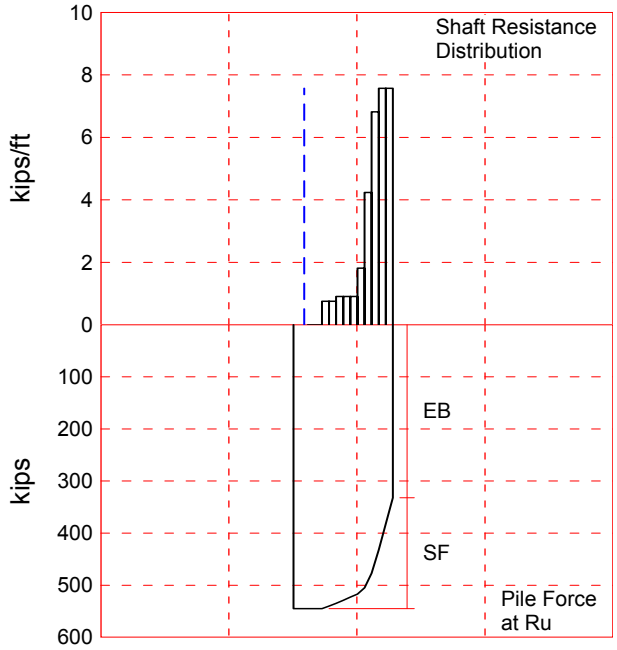
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 11.0 ms
Total volume: 13.735 $ft^3$; Volume ratio considering added impedance: 1.000




| | |
|---|---|
| RU = | 545.0 kips |
| SF = | 213.0 kips |
| EB = | 332.0 kips |
| Dy = | 1.14 in |
| Dx = | 1.24 in |
| SET/Bl = | 0.10 in |




| | |
|---|---|
| Length b. Sensors | 92.4 ft |
| Embedment | 81.8 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 | 1.43 |
| Top Compr. Stress | 31.5 ksi |
| Max Compr. Stress | 32.8 ksi |
| Max Tension Stress | -5.33 ksi |
| Avg. Shaft Quake | 0.08 in |
| Toe Quake | 0.20 in |
| Avg. Shaft Smith Dpg. | 0.30 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: 545.0; along Shaft 213.0; at Toe 332.0 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Smith Damping Factor s/ft |
|---|---|---|---|---|---|---|---|---|
| | | | | 545.0 | | | | |
| 1 | 19.8 | 9.2 | 0.0 | 545.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| 2 | 26.4 | 15.8 | 0.0 | 545.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| 3 | 33.0 | 22.4 | 5.0 | 540.0 | 5.0 | 0.76 | 0.16 | 0.30 |
| 4 | 39.6 | 29.0 | 5.0 | 535.0 | 10.0 | 0.76 | 0.16 | 0.30 |
| 5 | 46.2 | 35.6 | 6.0 | 529.0 | 16.0 | 0.91 | 0.19 | 0.30 |
| 6 | 52.8 | 42.2 | 6.0 | 523.0 | 22.0 | 0.91 | 0.19 | 0.30 |
| 7 | 59.4 | 48.8 | 6.0 | 517.0 | 28.0 | 0.91 | 0.19 | 0.30 |
| 8 | 66.0 | 55.4 | 12.0 | 505.0 | 40.0 | 1.82 | 0.39 | 0.30 |
| 9 | 72.6 | 62.0 | 28.0 | 477.0 | 68.0 | 4.24 | 0.90 | 0.30 |
| 10 | 79.2 | 68.6 | 45.0 | 432.0 | 113.0 | 6.82 | 1.45 | 0.30 |
| 11 | 85.8 | 75.2 | 50.0 | 382.0 | 163.0 | 7.57 | 1.61 | 0.30 |
| 12 | 92.4 | 81.8 | 50.0 | 332.0 | 213.0 | 7.57 | 1.61 | 0.30 |
| Avg. Shaft | | | 17.8 | | | 2.60 | 0.55 | 0.30 |
| Toe | | | 332.0 | | | | 240.84 | 0.10 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Quake | (in) | 0.08 | 0.20 |
| Case Damping Factor | | 1.67 | 0.87 |
| Damping Type | | Viscous | Sm+Visc |
| Unloading Quake | (% of loading quake) | 100 | 30 |
| Unloading Level | (% of Ru) | 31 | |
| Soil Plug Weight | (kips) | 0.135 | 0.051 |

CAPWAP match quality = 1.43 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.10 in; Blow Count = 120 b/ft
Computed: Final Set = 0.11 in; Blow Count = 106 b/ft

max. Top Comp. Stress = 31.5 ksi (T= 26.7 ms, max= 1.040 x Top)
max. Comp. Stress = 32.8 ksi (Z= 29.7 ft, T= 28.3 ms)
max. Tens. Stress = -5.33 ksi (Z= 66.0 ft, T= 52.2 ms)
max. Energy (EMX) = 35.9 kip-ft; max. Measured Top Displ. (DMX)= 1.00 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 | 674.1 | -32.3 | 31.5 | -1.51 | 35.9 | 16.8 | 1.00 |
| 2 | 6.6 | 674.8 | -35.7 | 31.5 | -1.67 | 35.4 | 16.7 | 0.97 |
| 4 | 13.2 | 676.3 | -42.4 | 31.6 | -1.98 | 34.4 | 16.6 | 0.92 |
| 6 | 19.8 | 678.1 | -48.3 | 31.7 | -2.26 | 33.4 | 16.6 | 0.87 |
| 8 | 26.4 | 692.6 | -54.1 | 32.4 | -2.53 | 32.4 | 16.2 | 0.81 |
| 10 | 33.0 | 697.1 | -65.9 | 32.6 | -3.08 | 31.4 | 16.0 | 0.76 |
| 12 | 39.6 | 682.0 | -78.0 | 31.9 | -3.64 | 29.0 | 15.6 | 0.70 |
| 14 | 46.2 | 670.8 | -89.6 | 31.3 | -4.19 | 26.7 | 15.1 | 0.64 |
| 15 | 49.5 | 650.2 | -91.3 | 30.4 | -4.26 | 25.0 | 14.8 | 0.61 |
| 16 | 52.8 | 665.8 | -98.3 | 31.1 | -4.59 | 24.3 | 14.4 | 0.57 |
| 17 | 56.1 | 638.3 | -100.6 | 29.8 | -4.70 | 22.6 | 14.1 | 0.54 |
| 18 | 59.4 | 642.8 | -106.4 | 30.0 | -4.97 | 22.0 | 14.1 | 0.51 |
| 19 | 62.7 | 630.5 | -108.7 | 29.5 | -5.08 | 20.4 | 13.7 | 0.48 |
| 20 | 66.0 | 652.9 | -114.0 | 30.5 | -5.33 | 19.7 | 13.2 | 0.45 |
| 21 | 69.3 | 625.7 | -109.2 | 29.2 | -5.10 | 17.6 | 12.4 | 0.41 |
| 22 | 72.6 | 657.9 | -111.1 | 30.7 | -5.19 | 16.9 | 11.6 | 0.38 |
| 23 | 75.9 | 590.3 | -95.5 | 27.6 | -4.46 | 13.8 | 10.6 | 0.35 |
| 24 | 79.2 | 620.1 | -97.0 | 29.0 | -4.53 | 13.3 | 9.5 | 0.32 |
| 25 | 82.5 | 492.6 | -72.5 | 23.0 | -3.39 | 9.8 | 8.5 | 0.30 |
| 26 | 85.8 | 497.5 | -73.6 | 23.2 | -3.44 | 9.4 | 8.4 | 0.27 |
| 27 | 89.1 | 439.6 | -47.7 | 20.5 | -2.23 | 6.5 | 9.0 | 0.25 |
| 28 | 92.4 | 446.2 | -48.8 | 20.8 | -2.28 | 4.4 | 8.7 | 0.22 |
| Absolute | 29.7 | | | 32.8 | | | (T = | 28.3 ms) |
| | 66.0 | | | | -5.33 | | (T = | 52.2 ms) |

**CASE METHOD**

| J = | 0.0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 853.1 | 759.4 | 665.7 | 572.0 | 478.4 | | | | | |
| RX | 857.2 | 768.5 | 682.4 | 614.2 | 566.8 | 538.0 | 521.0 | 510.5 | 506.1 | 502.0 |
| RU | 853.5 | 759.9 | 666.3 | 572.7 | 479.1 | | | | | |

RAU = 222.5 (kips); RA2 = 639.4 (kips)

Current CAPWAP Ru = 545.0 (kips); Corresponding J(RP)= 0.66; J(RX) = 0.92

| 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 | 26.51 | 631.1 | 690.3 | 690.3 | 1.00 | 0.10 | 0.10 | 36.2 | 791.2 | 1660 |

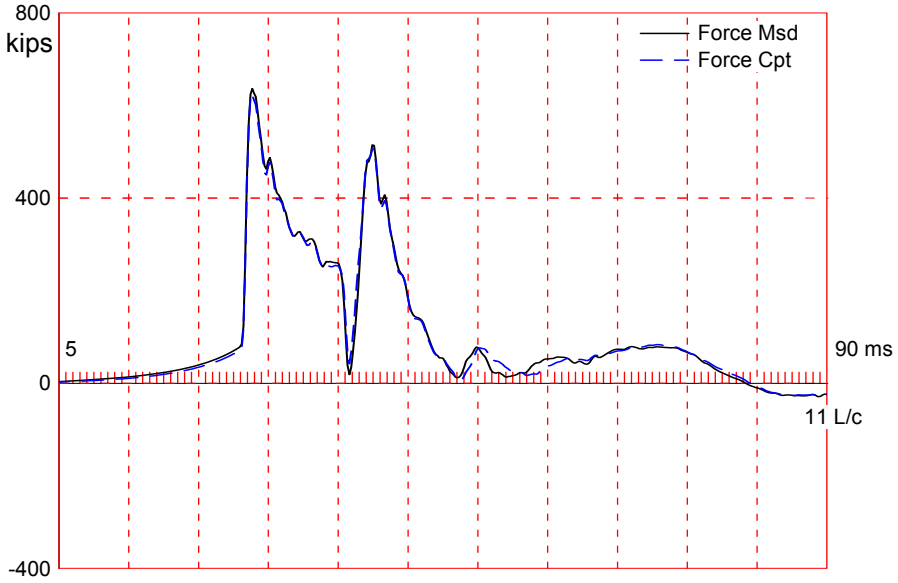
**PILE PROFILE AND PILE MODEL**

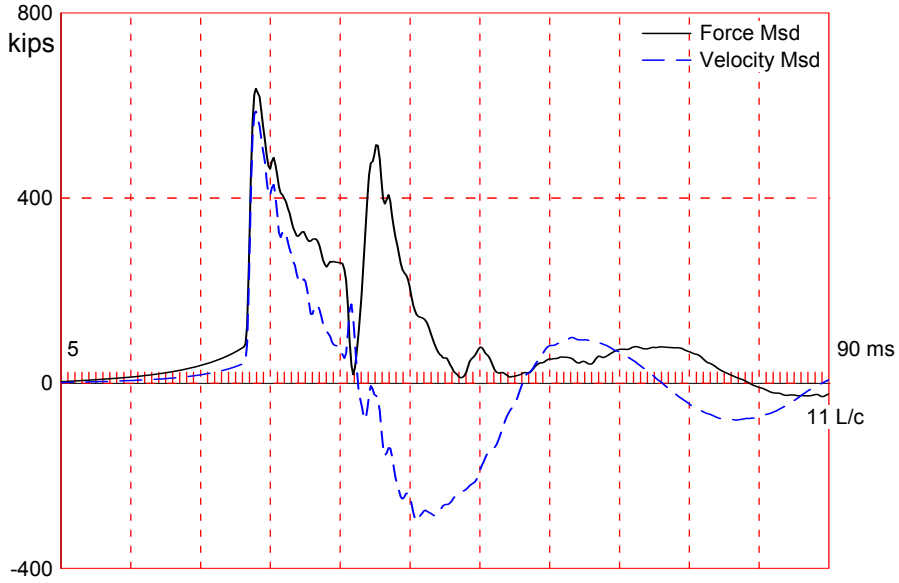
| Depth ft | Area in² | E-Modulus ksi | Spec. Weight lb/ft³ | Perim. ft |
|---|---|---|---|---|
| 0.0 | 21.4 | 29992.2 | 492.000 | 4.70 |
| 92.4 | 21.4 | 29992.2 | 492.000 | 4.70 |

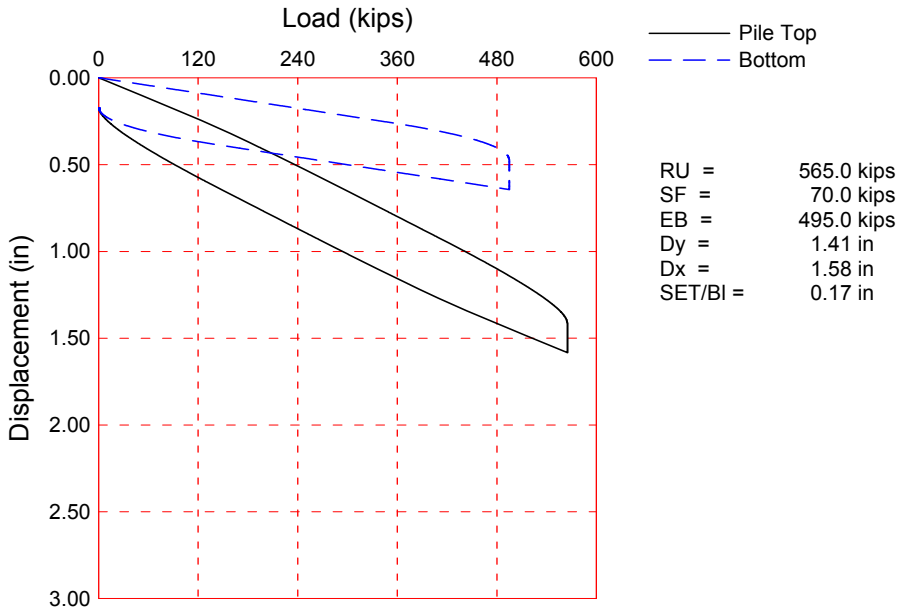
Toe Area 198.5 in²

| Segmnt Number | Dist. B.G. ft | Impedance kips/ft/s | Imped. Change % | 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 |
| 10 | 33.0 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.020 |
| 11 | 36.3 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 18 | 59.4 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.020 |
| 19 | 62.7 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 26 | 85.8 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.020 |
| 27 | 89.1 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.025 |
| 28 | 92.4 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.050 |

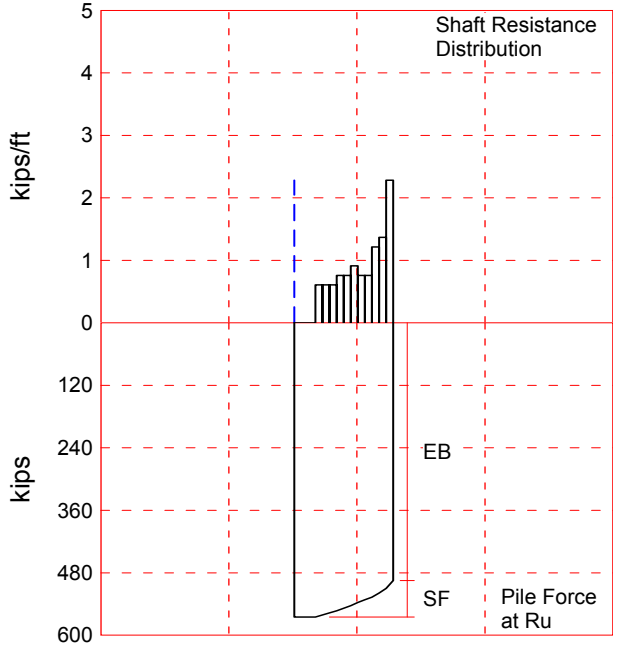
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.196 ms, 2L/c 11.0 ms
Total volume: 13.735 $ft^3$; Volume ratio considering added impedance: 1.000




| | |
|---|---|
| RU = | 565.0 kips |
| SF = | 70.0 kips |
| EB = | 495.0 kips |
| Dy = | 1.41 in |
| Dx = | 1.58 in |
| SET/BI = | 0.17 in |




| | |
|---|---|
| Length b. Sensors | 92.0 ft |
| Embedment | 89.8 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 | 2.60 |
| Top Compr. Stress | 29.2 ksi |
| Max Compr. Stress | 30.1 ksi |
| Max Tension Stress | -4.73 ksi |
| Avg. Shaft Quake | 0.16 in |
| Toe Quake | 0.36 in |
| Avg. Shaft Smith Dpg. | 0.23 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: 565.0; along Shaft 70.0; at Toe 495.0 kips

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Smith Damping Factor s/ft |
|---|---|---|---|---|---|---|---|---|
| | | | | 565.0 | | | | |
| 1 | 6.6 | 4.4 | 0.0 | 565.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| 2 | 13.1 | 11.0 | 0.0 | 565.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| 3 | 19.7 | 17.5 | 0.0 | 565.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| 4 | 26.3 | 24.1 | 4.0 | 561.0 | 4.0 | 0.61 | 0.13 | 0.23 |
| 5 | 32.9 | 30.7 | 4.0 | 557.0 | 8.0 | 0.61 | 0.13 | 0.23 |
| 6 | 39.4 | 37.3 | 4.0 | 553.0 | 12.0 | 0.61 | 0.13 | 0.23 |
| 7 | 46.0 | 43.8 | 5.0 | 548.0 | 17.0 | 0.76 | 0.16 | 0.23 |
| 8 | 52.6 | 50.4 | 5.0 | 543.0 | 22.0 | 0.76 | 0.16 | 0.23 |
| 9 | 59.1 | 57.0 | 6.0 | 537.0 | 28.0 | 0.91 | 0.19 | 0.23 |
| 10 | 65.7 | 63.5 | 5.0 | 532.0 | 33.0 | 0.76 | 0.16 | 0.23 |
| 11 | 72.3 | 70.1 | 5.0 | 527.0 | 38.0 | 0.76 | 0.16 | 0.23 |
| 12 | 78.9 | 76.7 | 8.0 | 519.0 | 46.0 | 1.22 | 0.26 | 0.23 |
| 13 | 85.4 | 83.3 | 9.0 | 510.0 | 55.0 | 1.37 | 0.29 | 0.23 |
| 14 | 92.0 | 89.8 | 15.0 | 495.0 | 70.0 | 2.28 | 0.49 | 0.23 |
| Avg. Shaft | | | 5.0 | | | 0.78 | 0.17 | 0.23 |
| Toe | | | 495.0 | | | | 359.09 | 0.07 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Quake | (in) | 0.16 | 0.36 |
| Case Damping Factor | | 0.42 | 0.91 |
| Damping Type | | Viscous | Sm+Visc |
| Unloading Quake | (% of loading quake) | 51 | 51 |
| Unloading Level | (% of Ru) | 75 | |
| Soil Plug Weight | (kips) | 0.040 | |

CAPWAP match quality = 2.60 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.17 in; Blow Count = 70 b/ft
Computed: Final Set = 0.19 in; Blow Count = 62 b/ft

max. Top Comp. Stress = 29.2 ksi (T= 26.8 ms, max= 1.030 x Top)
max. Comp. Stress = 30.1 ksi (Z= 23.0 ft, T= 28.0 ms)
max. Tens. Stress = -4.73 ksi (Z= 72.3 ft, T= 53.8 ms)
max. Energy (EMX) = 34.1 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 | 626.0 | -29.5 | 29.2 | -1.38 | 34.1 | 15.7 | 1.07 |
| 2 | 6.6 | 626.7 | -31.2 | 29.3 | -1.46 | 34.1 | 15.6 | 1.06 |
| 4 | 13.1 | 628.3 | -36.1 | 29.4 | -1.69 | 33.7 | 15.6 | 1.03 |
| 6 | 19.7 | 643.8 | -40.6 | 30.1 | -1.90 | 33.2 | 15.2 | 0.99 |
| 8 | 26.3 | 640.5 | -50.0 | 29.9 | -2.33 | 32.6 | 15.2 | 0.95 |
| 10 | 32.9 | 631.3 | -63.6 | 29.5 | -2.97 | 31.0 | 15.0 | 0.90 |
| 12 | 39.4 | 622.9 | -75.9 | 29.1 | -3.54 | 29.4 | 14.7 | 0.86 |
| 14 | 46.0 | 617.1 | -75.8 | 28.8 | -3.54 | 27.6 | 14.4 | 0.81 |
| 15 | 49.3 | 610.7 | -71.3 | 28.5 | -3.33 | 26.1 | 14.0 | 0.78 |
| 16 | 52.6 | 613.4 | -71.2 | 28.7 | -3.33 | 25.7 | 13.9 | 0.75 |
| 17 | 55.9 | 591.5 | -72.3 | 27.6 | -3.38 | 24.2 | 13.9 | 0.72 |
| 18 | 59.1 | 595.8 | -82.6 | 27.8 | -3.86 | 23.6 | 13.8 | 0.69 |
| 19 | 62.4 | 576.9 | -84.3 | 27.0 | -3.94 | 22.0 | 13.6 | 0.66 |
| 20 | 65.7 | 581.6 | -94.0 | 27.2 | -4.39 | 21.4 | 13.5 | 0.63 |
| 21 | 69.0 | 567.3 | -96.6 | 26.5 | -4.51 | 20.0 | 13.4 | 0.60 |
| 22 | 72.3 | 572.9 | -101.2 | 26.8 | -4.73 | 19.4 | 13.2 | 0.57 |
| 23 | 75.6 | 561.7 | -95.8 | 26.2 | -4.48 | 18.0 | 13.0 | 0.54 |
| 24 | 78.9 | 568.8 | -95.9 | 26.6 | -4.48 | 17.3 | 13.8 | 0.51 |
| 25 | 82.1 | 550.3 | -86.9 | 25.7 | -4.06 | 15.6 | 15.2 | 0.48 |
| 26 | 85.4 | 586.6 | -86.9 | 27.4 | -4.06 | 14.9 | 16.5 | 0.44 |
| 27 | 88.7 | 587.9 | -76.8 | 27.5 | -3.59 | 13.2 | 16.9 | 0.41 |
| 28 | 92.0 | 603.0 | -76.8 | 28.2 | -3.59 | 12.1 | 15.6 | 0.38 |
| Absolute | 23.0 | | | 30.1 | | | (T = | 28.0 ms) |
| | 72.3 | | | | -4.73 | | (T = | 53.8 ms) |

## CASE METHOD

| J = | 0.0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 583.7 | 522.7 | 461.8 | 400.8 | 339.8 | 278.8 | 217.8 | 156.9 | 95.9 | 34.9 |
| RX | 704.3 | 684.1 | 663.8 | 646.3 | 629.2 | 613.9 | 600.7 | 587.6 | 574.4 | 561.3 |
| RU | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

RAU = 426.9 (kips); RA2 = 634.9 (kips)

Current CAPWAP Ru = 565.0 (kips); Corresponding J(RP)= 0.06; J(RX) = 1.74

| VMX ft/s | TVP ms | VT1*Z kips | FT1 kips | FMX kips | DMX in | DFN in | SET in | EMX kip-ft | QUS kips | KEB kips/in |
|---|---|---|---|---|---|---|---|---|---|---|
| 15.4 | 26.59 | 587.6 | 636.4 | 636.4 | 1.05 | 0.17 | 0.17 | 34.0 | 670.1 | 1364 |

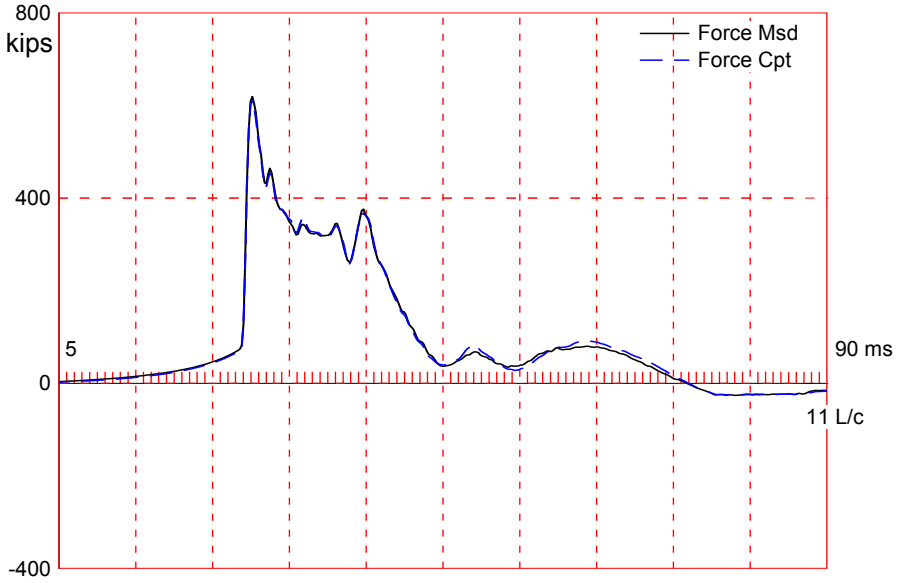
## PILE PROFILE AND PILE MODEL

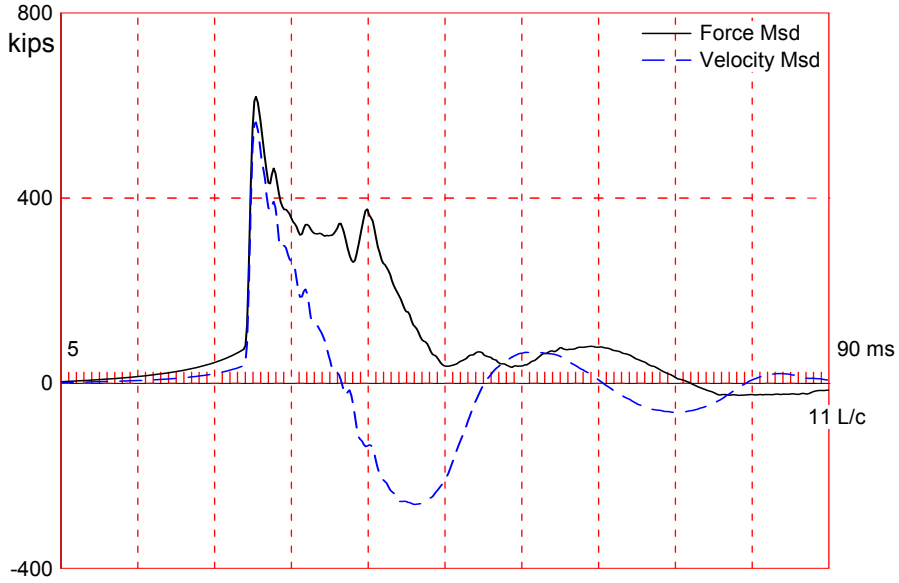
| Depth ft | Area in² | E-Modulus ksi | Spec. Weight lb/ft³ | Perim. ft |
|---|---|---|---|---|
| 0.0 | 21.4 | 29992.2 | 492.000 | 4.70 |
| 92.0 | 21.4 | 29992.2 | 492.000 | 4.70 |

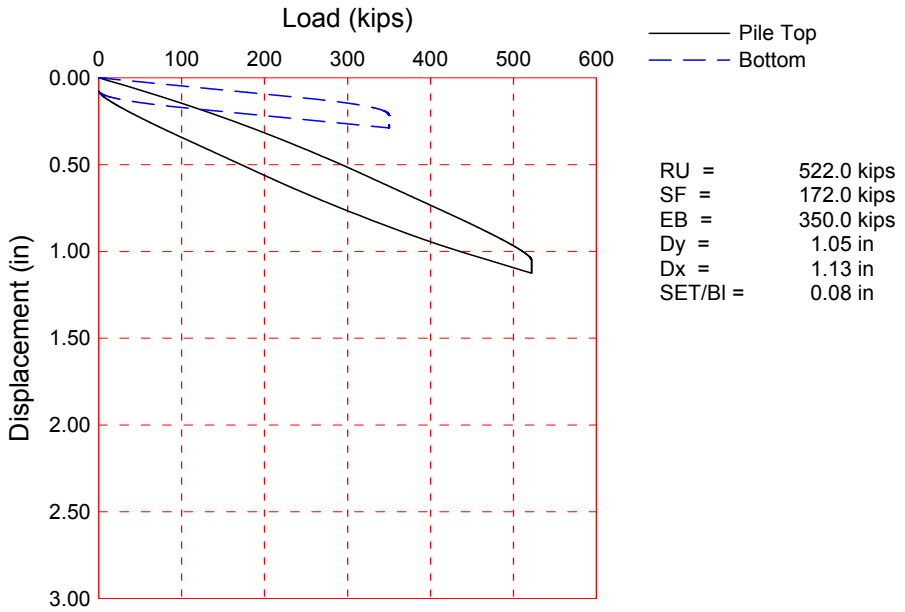
Toe Area 198.5 in²

| Segmnt Number | Dist. B.G. ft | Impedance kips/ft/s | Imped. Change % | 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 |
| 8 | 26.3 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.020 |
| 9 | 29.6 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 17 | 55.9 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.020 |
| 18 | 59.1 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 28 | 92.0 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |

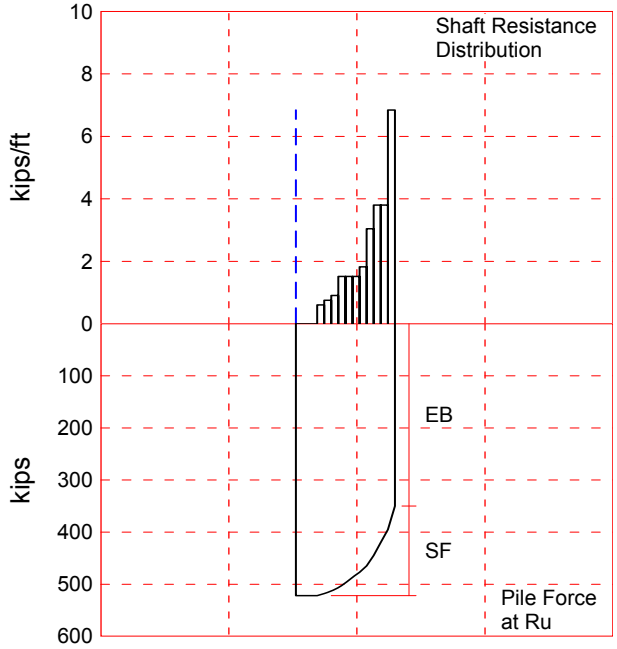
Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.195 ms, 2L/c 10.9 ms
Total volume: 13.672 $ft^3$; Volume ratio considering added impedance: 1.000




| | |
|---|---|
| RU = | 522.0 kips |
| SF = | 172.0 kips |
| EB = | 350.0 kips |
| Dy = | 1.05 in |
| Dx = | 1.13 in |
| SET/BI = | 0.08 in |




| | |
|---|---|
| Length b. Sensors | 92.0 ft |
| Embedment | 89.9 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 | 1.56 |
| Top Compr. Stress | 28.5 ksi |
| Max Compr. Stress | 29.6 ksi |
| Max Tension Stress | -3.84 ksi |
| Avg. Shaft Quake | 0.07 in |
| Toe Quake | 0.16 in |
| Avg. Shaft Smith Dpg. | 0.30 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: 522.0; along Shaft 172.0; at Toe 350.0 kips**

| Soil Sgmnt No. | Dist. Below Gages ft | Depth Below Grade ft | Ru kips | Force in Pile kips | Sum of Ru kips | Unit Resist. (Depth) kips/ft | Unit Resist. (Area) ksf | Smith Damping Factor s/ft | Quake in |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 522.0 | | | | | |
| 1 | 6.6 | 4.4 | 0.0 | 522.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.08 |
| 2 | 13.1 | 11.0 | 0.0 | 522.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.08 |
| 3 | 19.7 | 17.6 | 0.0 | 522.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.08 |
| 4 | 26.3 | 24.1 | 4.0 | 518.0 | 4.0 | 0.61 | 0.13 | 0.30 | 0.08 |
| 5 | 32.9 | 30.7 | 5.0 | 513.0 | 9.0 | 0.76 | 0.16 | 0.30 | 0.08 |
| 6 | 39.4 | 37.3 | 6.0 | 507.0 | 15.0 | 0.91 | 0.19 | 0.30 | 0.08 |
| 7 | 46.0 | 43.9 | 10.0 | 497.0 | 25.0 | 1.52 | 0.32 | 0.30 | 0.08 |
| 8 | 52.6 | 50.4 | 10.0 | 487.0 | 35.0 | 1.52 | 0.32 | 0.30 | 0.08 |
| 9 | 59.1 | 57.0 | 10.0 | 477.0 | 45.0 | 1.52 | 0.32 | 0.30 | 0.08 |
| 10 | 65.7 | 63.6 | 12.0 | 465.0 | 57.0 | 1.83 | 0.39 | 0.30 | 0.08 |
| 11 | 72.3 | 70.1 | 20.0 | 445.0 | 77.0 | 3.04 | 0.65 | 0.30 | 0.08 |
| 12 | 78.9 | 76.7 | 25.0 | 420.0 | 102.0 | 3.80 | 0.81 | 0.30 | 0.08 |
| 13 | 85.4 | 83.3 | 25.0 | 395.0 | 127.0 | 3.80 | 0.81 | 0.30 | 0.07 |
| 14 | 92.0 | 89.9 | 45.0 | 350.0 | 172.0 | 6.85 | 1.46 | 0.30 | 0.05 |
| Avg. Shaft | | | 12.3 | | | 1.91 | 0.41 | 0.30 | 0.07 |
| Toe | | | 350.0 | | | | 253.90 | 0.08 | 0.16 |

| Soil Model Parameters/Extensions | | Shaft | Toe |
|---|---|---|---|
| Case Damping Factor | | 1.35 | 0.77 |
| Damping Type | | Viscous | Sm+Visc |
| Unloading Quake | (% of loading quake) | 96 | 30 |
| Reloading Level | (% of Ru) | -100 | 100 |
| Unloading Level | (% of Ru) | 25 | |
| Resistance Gap (included in Toe Quake) | (in) | | 0.00 |
| Soil Plug Weight | (kips) | 0.040 | 0.005 |

**CAPWAP match quality = 1.56 (Wave Up Match) ; RSA = 0**
**Observed: Final Set = 0.08 in; Blow Count = 160 b/ft**
**Computed: Final Set = 0.08 in; Blow Count = 151 b/ft**

Transducer F3(F607) CAL: 93.6; RF: 0.98; F4(D815) CAL: 93.0; RF: 0.98
A3(K2524) CAL: 360; RF: 1.09; A4(K3550) CAL: 360; RF: 1.09

**max. Top Comp. Stress = 28.5 ksi (T= 26.8 ms, max= 1.036 x Top)**
**max. Comp. Stress = 29.6 ksi (Z= 23.0 ft, T= 28.0 ms)**
**max. Tens. Stress = -3.84 ksi (Z= 65.7 ft, T= 51.6 ms)**
**max. Energy (EMX) = 29.5 kip-ft; max. Measured Top Displ. (DMX)= 0.88 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 | 611.0 | -27.4 | 28.5 | -1.28 | 29.5 | 15.0 | 0.88 |
| 2 | 6.6 | 612.0 | -29.9 | 28.6 | -1.40 | 29.2 | 15.0 | 0.86 |
| 4 | 13.1 | 614.3 | -34.7 | 28.7 | -1.62 | 28.7 | 14.9 | 0.82 |
| 6 | 19.7 | 630.7 | -39.5 | 29.5 | -1.84 | 28.0 | 14.4 | 0.78 |
| 8 | 26.3 | 630.4 | -43.5 | 29.5 | -2.03 | 27.3 | 14.4 | 0.73 |
| 10 | 32.9 | 623.0 | -45.8 | 29.1 | -2.14 | 25.7 | 14.1 | 0.68 |
| 12 | 39.4 | 614.0 | -47.6 | 28.7 | -2.22 | 23.8 | 13.6 | 0.63 |
| 14 | 46.0 | 607.4 | -59.2 | 28.4 | -2.77 | 21.8 | 13.0 | 0.58 |
| 15 | 49.3 | 579.1 | -59.4 | 27.1 | -2.77 | 19.8 | 12.4 | 0.55 |
| 16 | 52.6 | 586.2 | -67.8 | 27.4 | -3.17 | 19.2 | 12.2 | 0.52 |
| 17 | 55.9 | 544.9 | -67.8 | 25.5 | -3.17 | 17.3 | 12.1 | 0.49 |
| 18 | 59.1 | 555.6 | -75.3 | 26.0 | -3.52 | 16.7 | 11.8 | 0.46 |
| 19 | 62.4 | 524.4 | -76.1 | 24.5 | -3.56 | 15.0 | 11.5 | 0.43 |
| 20 | 65.7 | 541.8 | -82.1 | 25.3 | -3.84 | 14.5 | 11.1 | 0.40 |
| 21 | 69.0 | 510.0 | -79.4 | 23.8 | -3.71 | 12.8 | 10.6 | 0.38 |
| 22 | 72.3 | 530.3 | -81.1 | 24.8 | -3.79 | 12.2 | 10.1 | 0.35 |
| 23 | 75.6 | 473.3 | -71.8 | 22.1 | -3.36 | 10.1 | 9.5 | 0.32 |
| 24 | 78.9 | 493.5 | -73.4 | 23.1 | -3.43 | 9.6 | 9.0 | 0.29 |
| 25 | 82.1 | 465.5 | -62.1 | 21.7 | -2.90 | 7.6 | 8.5 | 0.26 |
| 26 | 85.4 | 482.2 | -62.6 | 22.5 | -2.92 | 7.1 | 9.3 | 0.24 |
| 27 | 88.7 | 453.7 | -50.1 | 21.2 | -2.34 | 5.5 | 9.5 | 0.21 |
| 28 | 92.0 | 462.4 | -50.2 | 21.6 | -2.35 | 3.9 | 8.3 | 0.19 |
| Absolute | 23.0 | | | 29.6 | | | (T = | 28.0 ms) |
| | 65.7 | | | | -3.84 | | (T = | 51.6 ms) |

## CASE METHOD

| J = | 0.0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 |
|---|---|---|---|---|---|---|---|---|---|---|
| RP | 765.4 | 728.4 | 691.3 | 654.3 | 617.3 | 580.3 | 543.3 | 506.3 | 469.3 | 432.3 |
| RX | 765.4 | 728.4 | 693.8 | 660.9 | 627.9 | 604.7 | 585.1 | 568.3 | 551.5 | 534.6 |
| RU | 798.8 | 727.7 | 656.7 | 585.6 | 514.6 | 443.5 | 372.5 | 301.5 | 230.4 | 159.4 |

RAU = 198.2 (kips); RA2 = 557.5 (kips)

Current CAPWAP Ru = 522.0 (kips); Corresponding J(RP)= 1.32; J(RX) = 1.96

| VMX ft/s | TVP ms | VT1*Z kips | FT1 kips | FMX kips | DMX in | DFN in | SET in | EMX kip-ft | QUS kips | KEB kips/in |
|---|---|---|---|---|---|---|---|---|---|---|
| 14.8 | 26.78 | 547.4 | 606.5 | 619.3 | 0.88 | 0.08 | 0.08 | 29.8 | 745.0 | 2146 |

## PILE PROFILE AND PILE MODEL

| Depth ft | Area $in^2$ | E-Modulus ksi | Spec. Weight $lb/ft^3$ | Perim. ft |
|---|---|---|---|---|
| 0.0 | 21.4 | 29992.2 | 492.000 | 4.70 |
| 92.0 | 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 % | Slack in | Tension Eff. | 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 |
| 8 | 26.3 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.020 |
| 9 | 29.6 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 17 | 55.9 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.020 |
| 18 | 59.1 | 38.20 | 0.00 | 0.00 | 0.000 | -0.00 | 0.000 | 4.70 | 16807.9 | 0.000 |
| 28 | 92.0 | 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 0.195 ms, 2L/c 10.9 ms
Total volume: 13.672 $ft^3$; Volume ratio considering added impedance: 1.000