

From: [Olk, John](#)
To: [Green, Frank](#);
cc: [Daly, Keith](#); [Peppers, Nicki](#);
Subject: RE: Contract 8078 - Wave Equation Analysis (WEAP) submittal
Date: Tuesday, February 01, 2011 11:26:31 AM
Attachments: [8078 - Pile Driving WEAP Analysis.pdf](#)

This is Approved.

John Olk P.E.
WSDOT Bridge Construction Support Engineer
360-705-7395

Check Submittal Status Online: <http://www.wsdot.wa.gov/eesc/bridge/conlog/>

From: Green, Frank [mailto:greenf@columbiarivercrossing.com]
Sent: Wednesday, January 26, 2011 8:39 AM
To: Olk, John
Cc: Daly, Keith
Subject: FW: Contract 8078 - Wave Equation Analysis (WEAP) submittal

Attached is the WEAP analysis for C8078.

Thank you

From: Green, Frank
Sent: Tuesday, January 25, 2011 3:49 PM
To: Deml, Matt; Turton, Rob; Peterson, Laura; Degenhart, Mark
Subject: FW: Contract 8078 - Wave Equation Analysis (WEAP) submittal

FYI

From: Vernon Uy [mailto:vernonu@americanconstco.com]
Sent: Tuesday, January 25, 2011 3:43 PM
To: Green, Frank
Cc: Daly, Keith; Peppers, Nicki
Subject: Contract 8078 - Wave Equation Analysis (WEAP) submittal

Hi Frank.

Attached you'll find the Wave Equation Analysis submittal for the above project. This is to satisfy Section 6-05.3 (9) A and the Special Provisions (page 104).

Hard copies are in the mail. Thanks.

Vernon Uy
American Construction Company, Inc.
(425) 870-3217

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8078

Robert Miner Dynamic Testing, Inc.

Dynamic Measurements and Analyses for Deep Foundations

January 25, 2011

Mr. Kevin Culbert
American Construction Company
1501 Taylor Way
Tacoma, Washington 98421

APPROVED

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
BRIDGE AND STRUCTURES OFFICE
BY: CONSTRUCTION SUPPORT ENGINEER

Re: Wave Equation Analysis
PP24x0.50", APE D19-42 Hammer
PP48x1.00", APE D80-42 Hammer
Columbia River Crossing Temporary Pile Test Program
Clark County, WA

DATE

FEB - 1 2011

RMDT Job 11F03

Dear Sir,

At your request, we performed wave equation analyses for the project referenced above. The objectives of the analyses were prediction of axial pile stresses and penetration resistances during pile driving for specific soil resistance values. The following sections summarize data submitted to Robert Miner Dynamic Testing, Inc. (RMDT), program input, analyses made, results, and conclusions regarding certain aspects of pile driveability.

ANALYSIS DETAILS

Our analyses are primarily based on general project information provided by American Construction. Additional information used in our analyses was taken from GRLWEAP™ program data files or was based on our judgment.

Program: GRLWEAP™, Version 2005

Pile Details: We understand that the pile steel will be ASTM A252 Grade 3 (Fy=45 ksi) in all cases. The piles will be driven open-end and three will be 24"OD and three will be 48" OD. Selected pile details used in our analyses are tabulated below.

Pile	Pile Size OD x Wall	Scheduled Length ft	Scheduled Tip Elevation ft	Analysis Soil Penetration ft	Scheduled Ultimate Resistance kips
A1 & A2	PP24x0.50"	81	-60	35	180
A3 & A4	PP48x1.00"	131	-110	85	2000
B1	PP24x0.50"	91	-70	45	180
B2	PP48x1.00"	96	-75	50	2000

Mailing Address: P.O. Box 340, Manchester, WA, 98353, USA **Phone:** 360-871-5480
Location: 2288 Colchester Dr. E., Ste A, Manchester, WA, 98353 **Fax:** 360-871-5483

Soil and Foundation Design: Subsurface information provided to RMDT indicates that the piles will encounter non-cohesive granular soils, with sand predominating. At location B the specified tip elevations correspond with relatively high SPT N-values and the soils are thus potentially dense to very dense.

For the 24 and 48" OD piles the Scheduled Ultimate Bearing Capacity is 180 kips and 2000 kips, respectively. RMDT did not perform soil resistance calculations to compute any relation between soil resistance and length of pile penetration. Such static soil analyses were beyond the scope of this report. For further information on the soils and foundation design please refer to appropriate project documents. The soil parameters values used in our wave equation analyses are given below:

Soil Quake (skin)	0.10 inches
Soil Quake (toe)	0.20 inches (open-end)
Soil Damping (skin)	0.10 sec/ft
Soil Damping (toe)	0.15 sec/ft
% Shaft Friction	80 percent at Location A 50 percent for Pile B1 & 60 percent for Pile B2

Hammers: The proposed hammers are an APE D19-42 and APE D80-42 for the 24" and 48" OD piles, respectively. These hammers are open end diesel hammers with variable fuel supply. A summary of the hammer and driving system details is given below.

Hammer	Maximum Rated Energy kip-ft	Ram Weight kips	Maximum Ram Stroke ft	Helmet Weight kips	Hammer Cushion Stiffness kip/inch
APE D19-42	47	4.2	12.5	5.0	42,875
APE D80-42	198	17.6	13.1	5.0	42,875

The analysis details for the helmet and cushion are approximate, and reflect use of leads sized to handle both pile sizes. For analysis of the D80-42 we adjusted the GRLWEAP hammer combustion pressure (fuel setting) so as to obtain a ram stroke of approximately 10 ft during hard driving. For the D19-42 relatively easy driving is expected and we reduced the combustion pressure to reflect a reduced fuel setting in the field.

Analysis Type: The WSDOT Standard Specifications require that GRLWEAP results for the required ultimate resistances yield penetration resistances below 100 BPF (blows per ft) and that computed axial stresses remain below 0.9 times the nominal material yield strength. Analyses for penetration resistance and driving stress are to be completed with a GRLWEAP

hammer efficiency of 0.72 and 0.84, respectively.

We completed Bearing Graph format analyses with a range of soil resistance values and the two required hammer efficiencies, 0.72 and 0.84 percent. Results for analyses with the lower and higher efficiencies are identified by "LO" and "HI" in the analysis title block. For each assigned axial soil resistance the GRLWEAP Bearing Graph results include the predicted penetration resistance in BPF, and the peak axial compressive stresses.

GRLWEAP RESULTS

The results of all analyses are summarized on attached pages in both graphical and tabular formats, including a summary of key program input. Appendix A contains further input and results which may be used for more detailed review of our analyses.

SUMMARY

The following results and opinions are based on the information provided to us, the results of our analyses, and our engineering judgement:

1) Piles A1, A2 and B1, PP24"x0.50", APE D19-42

- a) Bearing Graph analyses with a hammer efficiency of 0.72 yielded a penetration resistance of 20 BPF at Location A and 21 BPF at Location B for a 180 kip ultimate resistance with a ram stroke of approximately 6.5 to 7.0 ft.
- b) Bearing Graph analyses with a hammer efficiency of 0.84 yielded peak axial driving stresses below 20 ksi for all resistances up to 420 kips

2) Piles A3, A4 and B2, PP48"x1.00", APE D80-42

- a) Bearing Graph analyses for an ultimate resistance of 2000 kips and a hammer efficiency of 0.72 yielded a penetration resistance of 85 and 97 BPF for Locations A and B, respectively.
- b) Bearing Graph analyses with a hammer efficiency of 0.84 yielded peak axial driving stresses below 30 ksi for all resistances up to 2700 kips and strokes up to 10 ft
- c) It is our opinion that the slightly higher penetration resistance computed for Location B reflects our assumption that Location B will have relatively more end bearing. The damping parameter value assigned to end bearing is slightly larger than the value assigned to friction. However, we also consider it likely that the shaft damping will be less than the 0.10 inch/second value used in our analyses and we expect that field driveability will be easier than predicted here for the assumed axial resistances.

3. The WSDOT Standard Specifications require that GRLWEAP results for the required ultimate resistances yield penetration resistances below 100 BPF and that computed axial stresses remain below 0.9 times the nominal material yield strength. All GRLWEAP analysis for the proposed APE D19-42 and D80-42 satisfy these dual requirements. In our

opinion, these proposed hammers are suitable for the anticipated conditions and scheduled ultimate resistances. Our analyses and opinions reflect our expectation that the D80-42 will achieve a ram stroke height of approximately 10 ft during hard driving.

4. The GRLWEAP computed driving stresses do not include any stresses that result from local contact forces, eccentric loading or bending. Thus, total stresses may be higher than the GRLWEAP computed values. We recommend careful attention to preparation of the pile for driving and proper alignment of the hammer, striker plate, and pile during all driving.

ADDITIONAL CONSIDERATIONS

The analyses presented and discussed herein were completed for purposes of driveability analysis in the context of preconstruction hammer evaluation. Please note that the results calculated by the wave equation analysis program depend on a variety of hammer, pile and soil input parameters. Please also review the information that is given on the cover page for Appendix A. We attempted to base our analyses on our best interpretation of information provided to us for this work. However, actual field conditions, project requirements and hammer performance may vary from what we assumed and therefore driving stresses and blow counts may differ from these predictions. Soil setup during interruptions to driving, or soil conditions that cause actual resistances to exceed the stated resistances may cause harder driving than is predicted in these analyses. RMDT did not evaluate or predict any relation between tip elevation and soil resistance or tip elevation and driving resistance. Soil resistances assigned in wave equation analyses are ultimate resistance values and they must be reduced by an appropriate resistance factor or safety factor to compute a factored resistance or allowable load.

We enjoyed performing these analyses for you. If you or your client have any questions or if we can provide further assistance, please contact us.

Very truly yours,



Expires 02/27/ 11

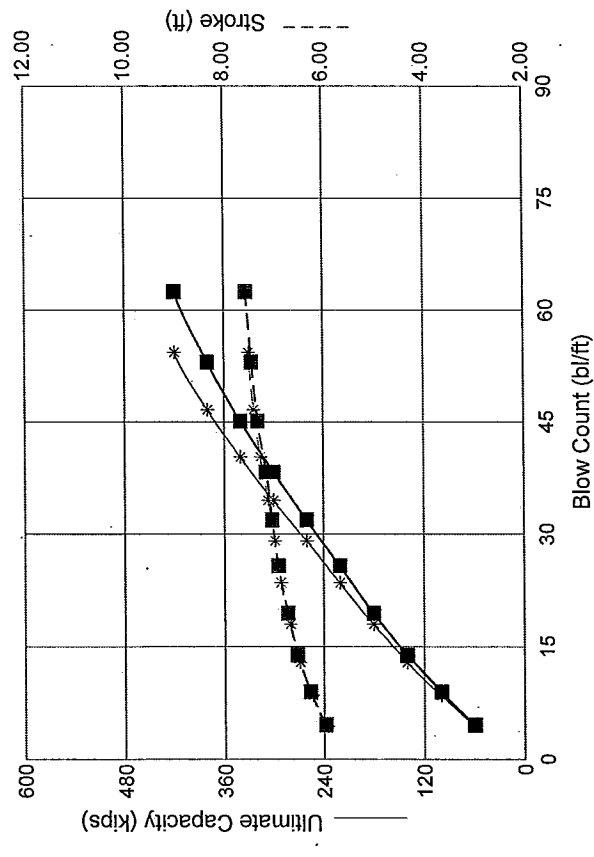
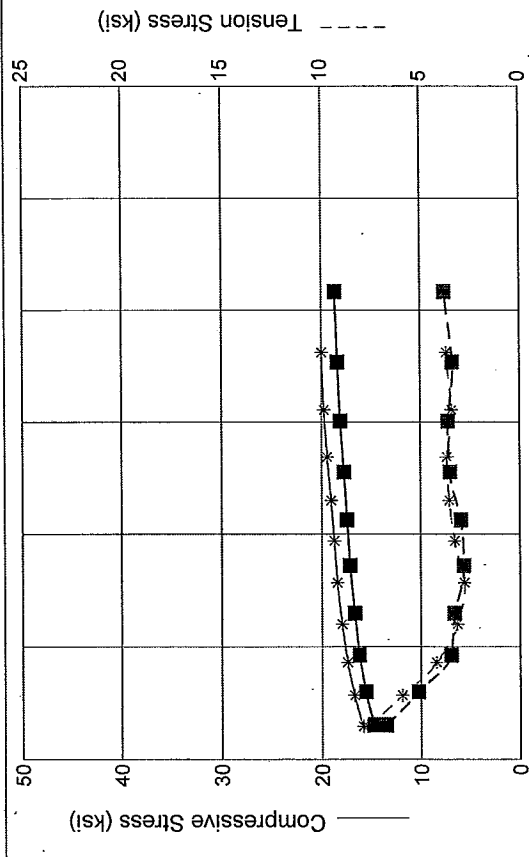
Andrew Banas, Staff Engineer
Robert Miner Dynamic Testing, Inc.

Robert Miner, P. E.
Robert Miner Dynamic Testing, Inc.

Robert Miner Dynamic Testing, Inc.

■ American, CRC Pile A1&A2, APE D19-42 LO

* American, CRC Pile A1&A2, APE D19-42 HI



	■ APE D 19-42	* APE D 19-42
Efficiency	0.720	0.840
Helmet	5.00	5.00 kips
Hammer Cushion	42875	42875 kips/in
Skin Quake	0.100 in	0.100 in
Toe Quake	0.200 in	0.200 in
Skin Damping	0.100 sec/ft	0.100 sec/ft
Toe Damping	0.150 sec/ft	0.150 sec/ft
Pile Length	81.00	81.00 ft
Pile Penetration	35.00	35.00 ft
Pile Top Area	36.91	36.91 in ²

Skin Friction Distribution

Pile Model

Skin Friction Distribution

Pile Model

Res. Shaft = 80 % (Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
60.0	14.70	6.78	4.6	5.96	19.60
100.0	15.59	5.13	9.0	6.27	18.05
140.0	16.23	3.46	13.9	6.53	17.43
180.0	16.71	3.28	19.5	6.72	17.20
220.0	17.17	2.81	25.8	6.91	17.00
260.0	17.45	2.96	31.9	7.03	16.81
300.0	17.75	3.50	38.3	7.15	16.78
340.0	18.10	3.60	45.1	7.32	17.15
380.0	18.37	3.37	53.0	7.44	17.39
420.0	18.62	3.77	62.5	7.55	17.58

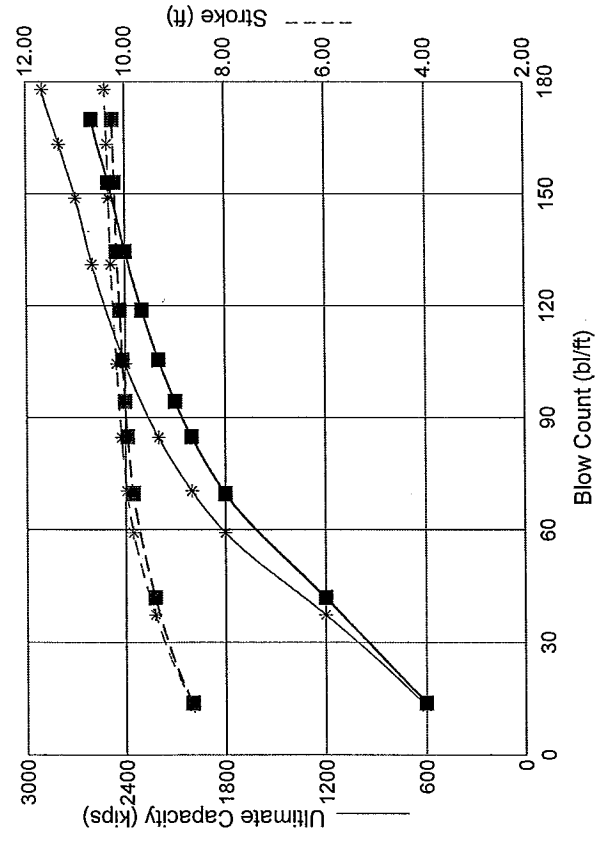
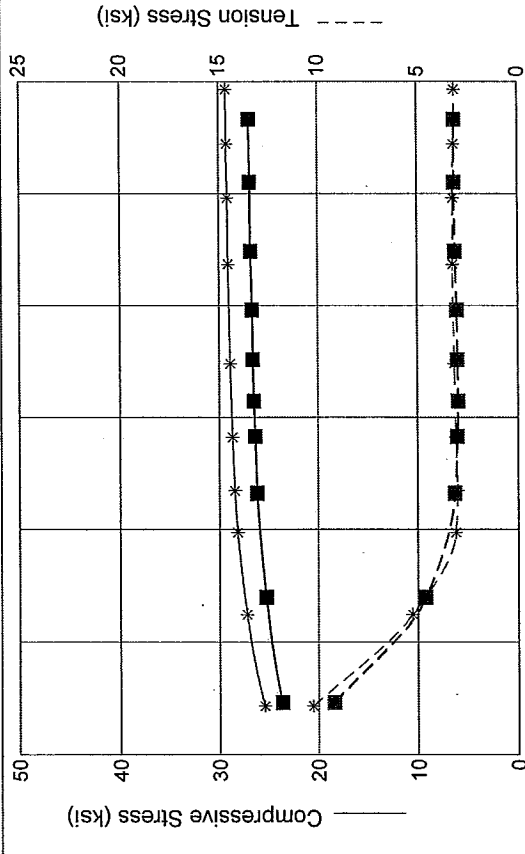
American, CRC Pile A1&A2, APE D19-42 HI

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
60.0	15.86	7.73	4.4	5.92	21.35
100.0	16.75	5.96	8.5	6.23	19.79
140.0	17.44	4.21	12.9	6.48	19.28
180.0	17.96	3.15	18.0	6.67	19.09
220.0	18.43	2.79	23.5	6.86	18.94
260.0	18.74	3.27	29.1	6.98	18.76
300.0	19.05	3.54	34.5	7.11	18.77
340.0	19.43	3.65	40.3	7.26	19.17
380.0	19.75	3.41	46.6	7.40	19.51
420.0	19.97	3.67	54.3	7.50	19.68

Robert Miner Dynamic Testing, Inc.

■ American, CRC Pile A3&A4, APE D80-42 LO

* American, CRC Pile A3&A4, APE D80-42 HI



	■ APE	D 80-42	* APE	D 80-42
Efficiency	0.720	0.840		
Helmet	5.00	5.00 kips		
Hammer Cushion	42875	42875 kips/in		
Skin Quake	0.100 in	0.100 in		
Toe Quake	0.200 in	0.200 in		
Skin Damping	0.100 sec/ft	0.100 sec/ft		
Toe Damping	0.150 sec/ft	0.150 sec/ft		
Pile Length	131.00	131.00 ft		
Pile Penetration	85.00	85.00 ft		
Pile Top Area	147.66	147.66 in ²		

	■ APE	D 80-42	* APE	D 80-42
Pile Model	[Diagram]	[Diagram]	[Diagram]	[Diagram]
Skin Friction Distribution	[Diagram]	[Diagram]	[Diagram]	[Diagram]

Res. Shaft = 80 % (Proportional)

Res. Shaft = 80 % (Proportional)

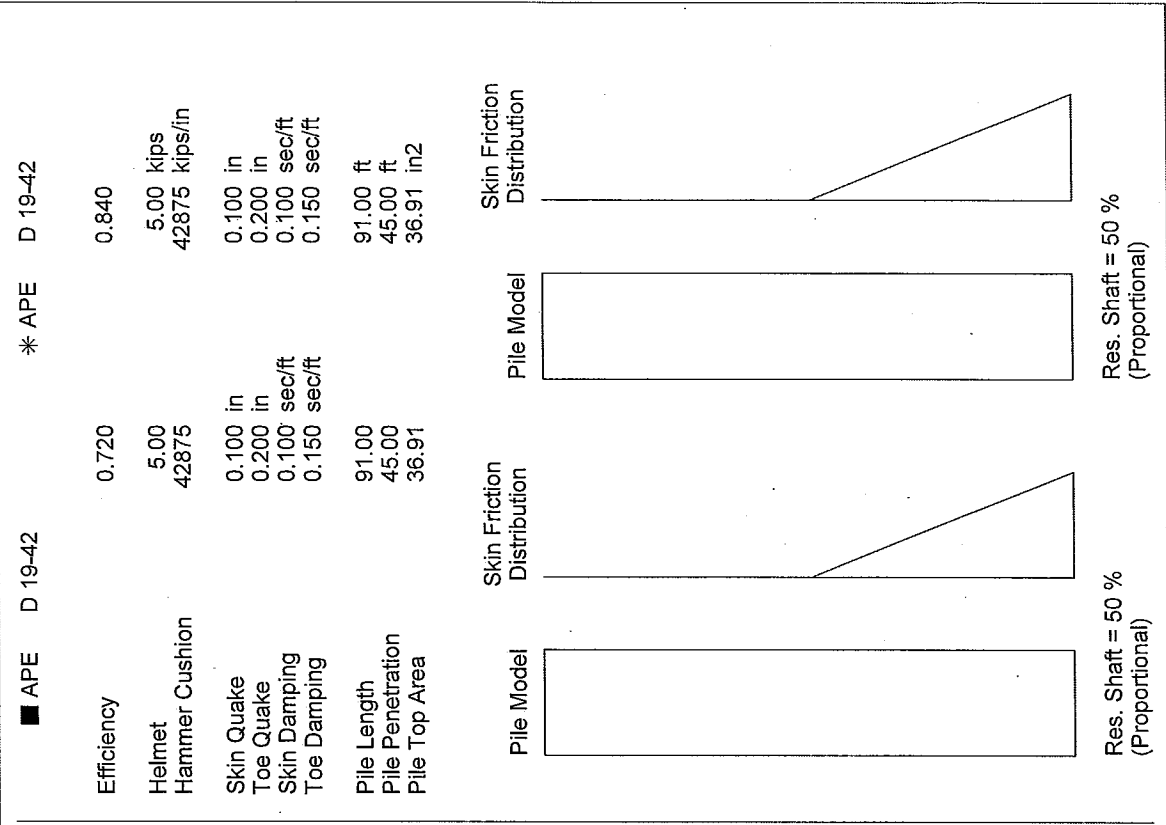
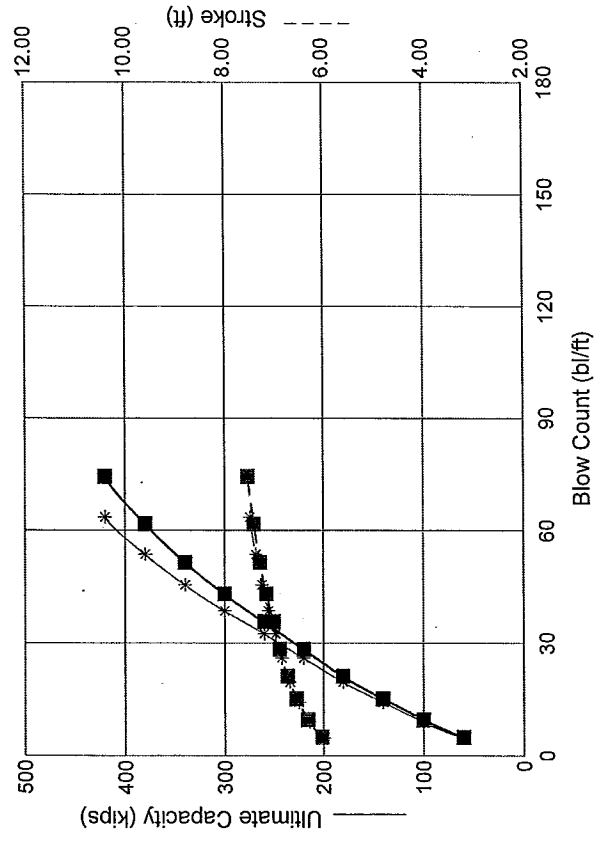
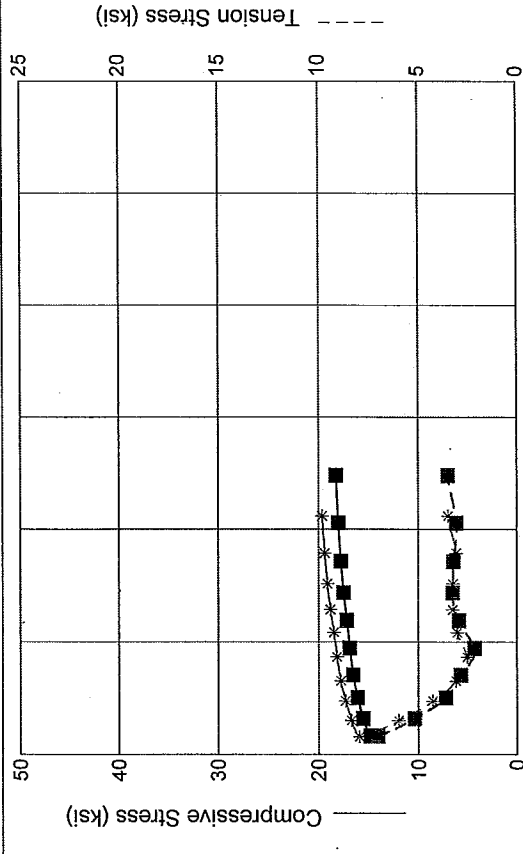
Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
600.0	23.66	9.20	13.9	8.66	79.36
1200.0	25.27	4.61	41.9	9.41	75.47
1800.0	26.16	3.14	69.7	9.85	78.73
2000.0	26.36	3.02	84.8	9.96	79.55
2100.0	26.47	2.98	94.3	10.01	79.96
2200.0	26.58	3.01	105.4	10.06	80.38
2300.0	26.64	3.03	118.8	10.11	80.67
2400.0	26.78	3.12	134.5	10.17	81.24
2500.0	26.85	3.15	153.1	10.21	81.56
2600.0	26.92	3.14	169.9	10.25	81.85

American, CRC Pile A3&A4, APE D80-42 HI

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
600.0	25.44	10.27	12.9	8.63	88.75
1200.0	27.21	5.28	37.3	9.41	85.73
1800.0	28.15	3.11	59.2	9.85	89.63
2000.0	28.42	3.01	70.3	9.98	90.85
2200.0	28.63	3.09	84.6	10.08	91.87
2400.0	28.85	3.15	104.3	10.18	92.78
2600.0	29.05	3.23	131.0	10.29	93.79
2700.0	29.12	3.22	148.8	10.33	94.15
2800.0	29.20	3.18	163.3	10.36	94.46
2900.0	29.25	3.13	177.9	10.40	94.77

Robert Miner Dynamic Testing, Inc.
 ■ American, CRC Pile B1, APE D19-42 LO
 * American, CRC Pile B1, APE D19-42 HI

GRLWEAP (TM) Version 2005

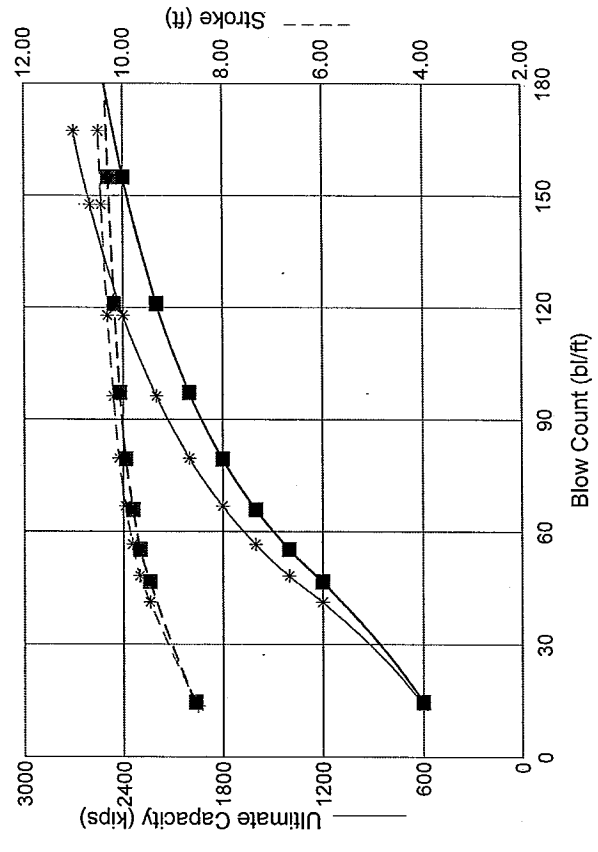
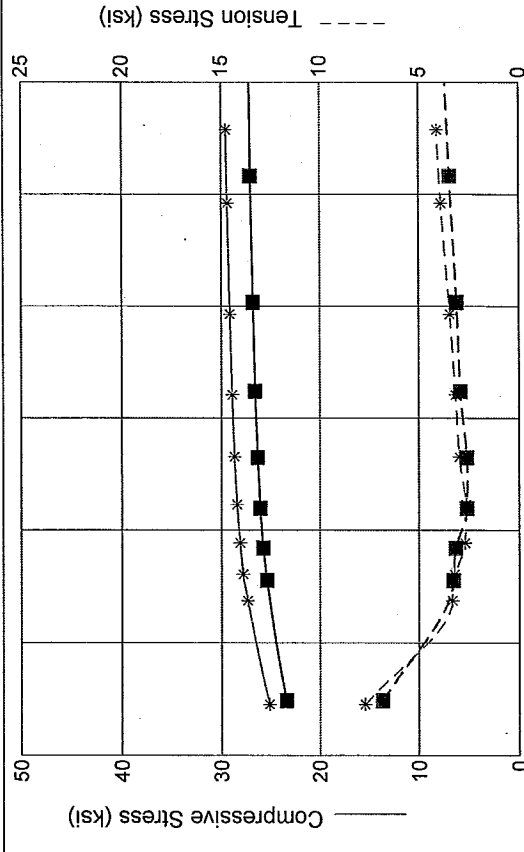


Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
60.0	14.79	7.02	4.9	6.03	19.42
100.0	15.55	5.19	9.6	6.32	17.92
140.0	16.10	3.60	15.2	6.55	17.38
180.0	16.55	2.84	21.2	6.73	17.17
220.0	16.92	2.13	28.4	6.89	16.99
260.0	17.20	2.92	35.7	7.01	16.90
300.0	17.51	3.25	43.1	7.16	16.98
340.0	17.79	3.21	51.5	7.29	17.28
380.0	18.04	3.05	61.7	7.41	17.55
420.0	18.26	3.49	74.4	7.53	17.78

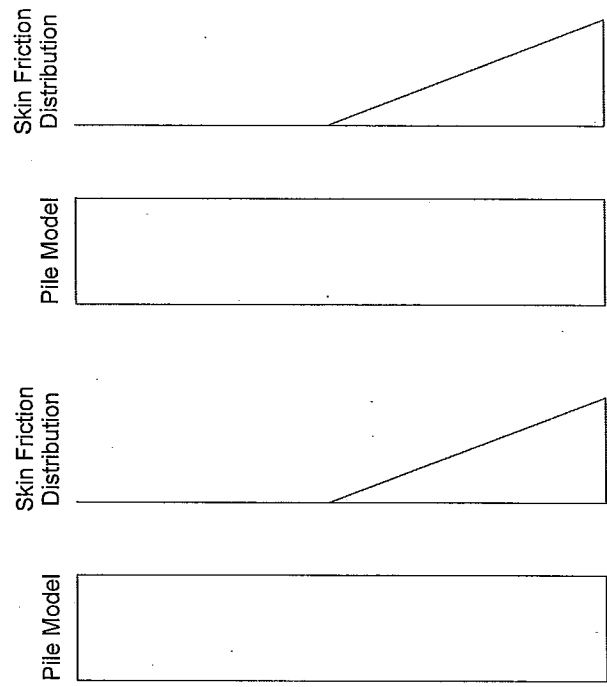
American, CRC Pile B1, APE D19-42 HI

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
60.0	15.94	7.95	4.7	5.99	21.11
100.0	16.75	6.00	9.0	6.28	19.71
140.0	17.33	4.28	14.2	6.50	19.20
180.0	17.81	3.08	19.6	6.68	19.08
220.0	18.19	2.50	26.0	6.85	18.90
260.0	18.48	3.01	32.5	6.97	18.84
300.0	18.83	3.24	38.6	7.12	19.00
340.0	19.12	3.24	45.5	7.25	19.33
380.0	19.39	3.07	53.6	7.37	19.65
420.0	19.64	3.48	63.5	7.49	19.91

Robert Miner Dynamic Testing, Inc.
 ■ American, CRC Pile B2, APE D80-42 LO
 * American, CRC Pile B2, APE D80-42 HI



	■ APE	D 80-42	* APE	D 80-42
Efficiency	0.720		0.840	
Helmet Hammer Cushion	5.00		5.00 kips	
	42875		42875 kips/in	
Skin Quake	0.100 in		0.100 in	
Toe Quake	0.200 in		0.200 in	
Skin Damping	0.100 sec/ft		0.100 sec/ft	
Toe Damping	0.150 sec/ft		0.150 sec/ft	
Pile Length	96.00		96.00 ft	
Pile Penetration	50.00		50.00 ft	
Pile Top Area	147.66		147.66 in2	



Res. Shaft = 60 % (Proportional)
 Res. Shaft = 60 % (Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
600.0	23.40	6.83	14.6	8.55	80.01
1200.0	25.39	3.28	46.7	9.47	76.09
1400.0	25.77	3.17	55.3	9.67	76.80
1600.0	26.08	2.60	65.9	9.81	77.69
1800.0	26.33	2.60	79.4	9.95	78.21
2000.0	26.58	2.92	97.1	10.07	79.12
2200.0	26.79	3.11	121.0	10.18	80.03
2400.0	27.04	3.46	154.9	10.30	81.05
2600.0	27.23	3.85	201.4	10.41	81.89
2700.0	27.31	4.00	230.5	10.45	82.23

American, CRC Pile B2, APE D80-42 HI

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
600.0	25.14	7.72	13.6	8.50	89.23
1200.0	27.35	3.33	41.2	9.47	86.83
1400.0	27.81	3.23	48.2	9.68	87.63
1600.0	28.11	2.71	56.6	9.82	88.55
1800.0	28.41	2.64	66.8	9.96	89.39
2000.0	28.68	2.98	79.6	10.09	90.59
2200.0	28.89	3.17	96.2	10.20	91.63
2400.0	29.12	3.45	117.8	10.32	92.84
2600.0	29.37	3.89	147.6	10.44	94.07
2700.0	29.51	4.09	167.3	10.50	94.72

Appendix A

INFORMATION ON USE OF GRLWEAP RESULTS AND GRLWEAP PROGRAM OUTPUT

The GRLWEAP wave equation program uses mathematical models that describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate complex, dynamic behavior. Input parameter values are partially or completely intended to model normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. Thus, in some cases the data supplied with the program and data selected by RMDT may reflect conditions that differ significantly from actual field conditions. The GRLWEAP program authors and RMDT recommend prudent and informed use of the GRLWEAP results. Generally, aspects of the soil response and hammer performance should be verified by dynamic measurements and CAPWAP analyses, static load testing, or other suitable methods of analysis and inspection.

Driving stresses computed by the GRLWEAP program do not include bending or other local non-axial stresses, prestresses or residual fabrication stresses. Thus, inspection based on GRLWEAP results must account for those and any other sources of additional stress.

All GRLWEAP results, including those from Bearing Graph or Inspector's Graph analyses should be used in conjunction with observed blow counts and observed strokes. However, time dependent soil strength changes, such as "setup" or "relaxation" may alter the soil resistance and produce long term ultimate bearing capacity values that differ substantially from those expected based on observed blow counts and wave equation analysis. Also, hammer strokes, transfer energy and soil resistance may vary over the interval that the blows are counted, especially for restrikes or piles driven to rock. Inspection procedures should account for these sources of variation or uncertainty.

The GRLWEAP soil resistance values are ultimate values. They MUST be reduced by an appropriate factor of safety or resistance factor. The selection of such a factor is the responsibility of either the foundation engineer or the engineer directing field inspection. RMDT recommends that the factor reflect the quality of construction control, the variability of the site conditions, uncertainties in the loads, the nature of the structure, applicable codes, and other relevant factors.

Input File: C:\PJ\AMERICAN, CRC\A1&A2 LO.GWI
 Hammer File: C:\Program Files\PDI\GRLWEAP 2005\HAMMER2003.GW
 Hammer File Version: 2003 (8/28/2009)

Input File Contents

American, CRC Pile A1&A2, APE D19-42 LO
 OUT OSG HAM STR FUL PEL N SPL N-U P-D %SK ISM 0 PHI RSA ITR H-D MXT DEx
 6 0 571 0 1 0 0 0 0 0 80 0 0 0 0 0 0 0.000
 Pile g Hammer g Toe Area Pile Size Pile Type
 32.170 32.170 452.390 24.000 Pipe
 W Cp A Cp E Cp T Cp CoR ROut StCp
 5.000 490.000 175.0 2.000 0.920 0.010 0.0
 A Cu E Cu T Cu CoR ROut StCu
 0.000 0.0 0.000 0.000 0.000 0.0
 LPle APle EPle WPlle Peri Strg CoR ROut
 81.000 36.910 30000.000 492.000 6.283 36.000 0.850 0.010
 Manufac Hmr Name HmrType No Seg-s
 APE D 19-42 1 5
 Ram Wt Ram L Ram Dia MaxStrk RtdStrk Effic
 4.19 128.00 12.60 12.50 11.25 0.80
 IB. Wt IB. L IB.Dia IB CoR IB RO
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 CompStrk A Chamber V Chamber C Delay C Duratn Exp Coeff VolCStart Vol CEnd
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 P atm P1 P2 P3 P4 P5
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 Stroke Effic. Pressure R-Weight T-Delay Exp-Coeff Eps-Str Total-AW
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 Qs Qt Js Jt Qx Jx Rati Dept
 0.100 0.200 0.100 0.150 0.000 0.000 0.000 0.000
 Research Soil Model: Atoe, Plug, Gap, Q-fac
 0.000 0.000 0.000 0.000
 Research Soil Model: RD-skn: m, d, toe: m, d
 0.000 0.000 0.000 0.000
 Res. Distribution
 Dpth Rskn Dpth Dpth
 0.00 0.00 35.00 35.00 0.00 0.00 0.00 0.00 0.00 0.00
 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 35.00 1.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 81.00 2.31 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 Rult
 60.0 100.0 140.0 180.0 220.0 260.0 300.0 340.0 380.0 420.0
 Diameter COGHammer WHammer ABatter Depth Sup Flag
 0.000 0.000 0.000 0.000 0.000 0

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2005
English Units

American, CRC Pile A1&A2, APE D19-42 LO

Hammer Model:	D 19-42		Made by:	APE	
No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.838				
2	0.838	141250.2	1.000	0.0100	
3	0.838	141250.2	1.000	0.0100	
4	0.838	141250.2	1.000	0.0100	
5	0.838	141250.2	1.000	0.0100	
Imp Block	0.754	71041.4	0.900	0.0100	
Helmet	5.000	42875.0	0.920	0.0100	6.0
Combined Pile Top		27340.7			

HAMMER OPTIONS:

Hammer File ID No.	571	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.19	Ram Length	(inch)	128.00
Maximum Stroke	(ft)	12.50			
Rated Stroke	(ft)	11.25	Efficiency		0.720
Maximum Pressure	(psi)	1710.00	Actual Pressure	(psi)	1539.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00100	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION

Cross Sect. Area	(in2)	490.00
Elastic-Modulus	(ksi)	175.0
Thickness	(inch)	2.00
Coeff of Restitution		0.9
RoundOut	(ft)	0.0
Stiffness	(kips/in)	42875.0

PILE CUSHION

Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	0.00
Coeff of Restitution		0.0
RoundOut	(ft)	0.0
Stiffness	(kips/in)	0.0

PILE PROFILE:

Toe Area (in2) 452.390 Pipe Type Pipe
 Pile Size (inch) 24.000

L b Top	Area	E-Mod	Spec Wt	Perim	Strength	Wave Sp	EA/c
ft	in2	ksi	lb/ft3	ft	ksi	ft/s	k/ft/s
0.0	36.91	30000.	492.0	6.3	36.000	16807.	65.9
81.0	36.91	30000.	492.0	6.3	36.000	16807.	65.9

Wave Travel Time 2L/c (ms) 9.639

Pile and Soil Model						Total Capacity			Rut (kips)			60.0		
No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area	ft	ft	in2
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2			
1	0.426	27341.	0.010	0.000	0.85	0.0	0.100	0.100	3.38	6.3	36.9			
2	0.426	27341.	0.000	0.000	1.00	0.0	0.100	0.100	6.75	6.3	36.9			
14	0.426	27341.	0.000	0.000	1.00	0.1	0.100	0.100	47.25	6.3	36.9			
15	0.426	27341.	0.000	0.000	1.00	0.8	0.100	0.100	50.62	6.3	36.9			
16	0.426	27341.	0.000	0.000	1.00	1.7	0.100	0.100	54.00	6.3	36.9			
17	0.426	27341.	0.000	0.000	1.00	2.6	0.100	0.100	57.38	6.3	36.9			
18	0.426	27341.	0.000	0.000	1.00	3.5	0.100	0.100	60.75	6.3	36.9			
19	0.426	27341.	0.000	0.000	1.00	4.3	0.100	0.100	64.12	6.3	36.9			
20	0.426	27341.	0.000	0.000	1.00	5.2	0.100	0.100	67.50	6.3	36.9			
21	0.426	27341.	0.000	0.000	1.00	6.1	0.100	0.100	70.88	6.3	36.9			
22	0.426	27341.	0.000	0.000	1.00	7.0	0.100	0.100	74.25	6.3	36.9			
23	0.426	27341.	0.000	0.000	1.00	7.9	0.100	0.100	77.62	6.3	36.9			
24	0.426	27341.	0.000	0.000	1.00	8.8	0.100	0.100	81.00	6.3	36.9			
Toe						12.0	0.150	0.200						

10.215 kips total unreduced pile weight (g= 32.17 ft/s2)
 10.215 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		File Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
Pile Penetration (ft)	35.00	Pile Damping Fact. (k/ft/s)	1.318
% Shaft Resistance	80		
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0
Output Level: Variable vs Time			
Gravity Mass, Pile, Hammer:	32.170	32.170	32.170
Output Segment Generation:	Automatic		

Rut= 60.0, Rtoe = 12.0 kips, Time Inc. =0.077 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	535.8	2	0.00	0	14.52	2	12.14	12	2.736	76	19.60
2	-121.6	12	536.3	3	-3.29	12	14.53	3	11.61	12	2.735	76	19.66
3	-200.0	12	537.2	3	-5.42	12	14.55	3	10.84	12	2.734	76	19.74
4	-235.0	11	537.7	3	-6.37	11	14.57	3	10.18	13	2.733	76	19.82
5	-247.5	11	537.9	3	-6.71	11	14.57	3	9.77	13	2.732	76	19.90
6	-250.2	11	538.6	3	-6.78	11	14.59	3	9.51	13	2.731	76	19.98
7	-249.6	11	539.0	4	-6.76	11	14.60	4	9.28	13	2.729	76	20.05
8	-246.0	11	539.2	4	-6.66	11	14.61	4	8.99	14	2.728	75	20.13
9	-239.2	11	539.9	4	-6.48	11	14.63	4	8.64	14	2.727	75	20.21
10	-228.5	10	540.0	4	-6.19	10	14.63	4	8.84	10	2.725	75	20.29
11	-214.3	10	540.5	4	-5.81	10	14.64	4	9.06	10	2.724	75	20.37
12	-200.2	10	540.9	5	-5.42	10	14.66	5	9.23	10	2.722	75	20.45
13	-191.4	36	541.0	5	-5.19	36	14.66	5	9.36	10	2.723	71	20.53
14	-182.3	36	542.0	5	-4.94	36	14.68	5	9.50	9	2.723	72	20.60
15	-170.0	9	542.7	5	-4.61	9	14.70	5	9.74	9	2.725	72	20.55
16	-155.0	9	542.2	6	-4.20	9	14.69	6	10.11	9	2.726	72	20.23
17	-134.8	9	540.7	6	-3.65	9	14.65	6	10.53	9	2.727	72	19.62
18	-111.9	9	537.3	6	-3.03	9	14.56	6	10.90	9	2.727	72	18.71
19	-93.3	9	531.8	6	-2.53	9	14.41	6	11.19	8	2.727	72	17.49
20	-83.5	18	519.4	6	-2.26	18	14.07	6	11.50	8	2.726	72	15.96
21	-74.8	18	489.8	6	-2.03	18	13.27	6	12.04	8	2.726	72	14.11
22	-62.6	18	429.4	7	-1.70	18	11.63	7	12.81	8	2.725	73	11.91
23	-44.1	28	329.0	7	-1.19	28	8.91	7	13.65	7	2.725	73	9.37
24	-15.5	28	186.6	7	-0.42	28	5.06	7	14.22	7	2.724	73	8.01

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 5.66 5.96 5.94

Max. Combustion Pressure 1539.0 psi

Rut= 100.0, Rtoe = 20.0 kips, Time Inc. =0.077 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et.
	kips	ms	kips	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	562.9	2	0.00	0	15.25	2	10.24	12	1.497	38	18.05
2	-102.6	12	563.7	3	-2.78	12	15.27	3	9.75	12	1.497	38	18.10
3	-160.5	12	564.5	3	-4.35	12	15.29	3	8.99	12	1.496	38	18.14
4	-182.6	12	565.4	3	-4.95	12	15.32	3	8.36	13	1.495	38	18.19
5	-188.6	11	565.9	3	-5.11	11	15.33	3	8.32	3	1.494	38	18.23
6	-189.2	11	566.6	3	-5.13	11	15.35	3	8.31	4	1.492	38	18.27
7	-187.9	11	567.4	4	-5.09	11	15.37	4	8.32	4	1.489	38	18.31
8	-184.0	11	567.7	4	-4.98	11	15.38	4	8.32	4	1.487	38	18.35
9	-177.3	11	568.5	4	-4.80	11	15.40	4	8.31	4	1.484	38	18.39
10	-166.3	10	569.1	4	-4.50	10	15.42	4	8.31	4	1.480	38	18.42
11	-151.8	10	569.5	4	-4.11	10	15.43	4	8.31	5	1.477	39	18.45
12	-137.0	10	570.5	5	-3.71	10	15.46	5	8.31	5	1.473	39	18.48
13	-124.9	10	571.3	5	-3.38	10	15.48	5	8.45	10	1.470	39	18.52
14	-115.4	10	572.8	5	-3.13	10	15.52	5	8.61	9	1.467	39	18.54
15	-103.8	9	575.0	5	-2.81	9	15.58	5	8.87	9	1.464	41	18.45
16	-88.4	9	575.3	6	-2.40	9	15.59	6	9.27	9	1.464	41	18.14
17	-69.0	9	573.9	6	-1.87	9	15.55	6	9.71	9	1.464	41	17.57
18	-49.9	19	570.4	6	-1.35	19	15.45	6	10.11	9	1.463	41	16.73
19	-46.7	50	563.4	6	-1.27	50	15.27	6	10.43	8	1.463	41	15.62
20	-39.7	50	549.5	6	-1.07	50	14.89	6	10.80	8	1.462	41	14.22
21	-30.5	18	517.9	6	-0.83	18	14.03	6	11.39	8	1.461	41	12.54
22	-24.1	18	452.7	7	-0.65	18	12.27	7	12.23	8	1.460	41	10.56
23	-11.7	49	344.2	7	-0.32	49	9.33	7	13.13	7	1.460	41	8.28
24	-2.3	49	196.1	7	-0.06	49	5.31	7	13.67	7	1.459	41	7.06

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 5.95 6.27 6.24

Max. Combustion Pressure 1539.0 psi

Rut= 140.0, Rtoe = 28.0 kips, Time Inc. =0.077 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	582.8	2	0.00	0	15.79	2	8.57	2	1.041	31	17.43
2	-78.9	12	583.6	3	-2.14	12	15.81	3	8.57	3	1.041	31	17.41
3	-116.0	12	584.6	3	-3.14	12	15.84	3	8.57	3	1.039	31	17.39
4	-126.2	11	585.6	3	-3.42	11	15.87	3	8.57	3	1.037	31	17.37
5	-127.8	11	586.1	3	-3.46	11	15.88	3	8.57	3	1.034	31	17.38
6	-127.6	11	586.9	3	-3.46	11	15.90	3	8.56	4	1.030	31	17.39
7	-125.9	11	587.8	4	-3.41	11	15.92	4	8.56	4	1.025	31	17.39
8	-122.5	11	588.2	4	-3.32	11	15.94	4	8.56	4	1.022	30	17.41
9	-115.1	11	589.3	4	-3.12	11	15.97	4	8.55	4	1.019	30	17.43
10	-103.6	10	590.1	4	-2.81	10	15.99	4	8.55	4	1.017	30	17.45
11	-91.7	47	590.7	4	-2.48	47	16.00	4	8.54	5	1.015	30	17.48
12	-92.2	47	592.0	5	-2.50	47	16.04	5	8.53	5	1.012	30	17.49
13	-87.8	47	593.0	5	-2.38	47	16.07	5	8.52	5	1.008	30	17.51
14	-79.3	46	595.0	5	-2.15	46	16.12	5	8.49	5	1.004	33	17.51
15	-69.2	46	598.1	5	-1.88	46	16.20	5	8.45	5	1.000	33	17.41
16	-63.4	46	599.1	6	-1.72	46	16.23	6	8.45	9	0.996	33	17.08
17	-65.2	45	597.5	6	-1.77	45	16.19	6	8.91	9	0.993	31	16.52
18	-65.7	45	593.6	6	-1.78	45	16.08	6	9.32	8	0.991	31	15.72
19	-61.6	45	585.5	6	-1.67	45	15.86	6	9.65	8	0.989	31	14.66
20	-57.5	45	569.7	6	-1.56	45	15.44	6	10.07	8	0.987	31	13.34
21	-53.6	45	533.7	6	-1.45	45	14.46	6	10.73	8	0.985	32	11.75
22	-44.4	45	463.8	6	-1.20	45	12.57	6	11.64	7	0.983	32	9.88
23	-29.6	45	352.3	7	-0.80	45	9.55	7	12.56	7	0.982	32	7.72
24	-10.5	45	202.6	7	-0.28	45	5.49	7	13.04	7	0.980	32	6.57

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 6.18 6.53 6.50

Max. Combustion Pressure 1539.0 psi

Rut= 180.0, Rtoe = 36.0 kips, Time Inc. =0.077 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	597.3	2	0.00	0	16.18	2	8.76	2	0.832	22	17.20
2	-52.9	12	598.2	3	-1.43	12	16.21	3	8.75	3	0.829	22	17.21
3	-70.3	12	599.5	3	-1.91	12	16.24	3	8.75	3	0.825	22	17.21
4	-74.9	43	600.2	3	-2.03	43	16.26	3	8.76	3	0.819	22	17.20
5	-87.8	42	600.9	3	-2.38	42	16.28	3	8.75	3	0.814	22	17.19
6	-96.3	42	602.0	3	-2.61	42	16.31	3	8.75	3	0.807	22	17.16
7	-101.9	42	602.5	4	-2.76	42	16.32	4	8.74	4	0.801	23	17.14
8	-107.6	42	603.4	4	-2.92	42	16.35	4	8.73	4	0.794	23	17.10
9	-112.2	42	604.5	4	-3.04	42	16.38	4	8.73	4	0.786	23	17.07
10	-115.0	42	605.1	4	-3.12	42	16.39	4	8.72	4	0.779	23	17.03
11	-119.1	41	606.4	4	-3.23	41	16.43	4	8.71	4	0.771	23	16.98
12	-121.2	41	607.6	5	-3.28	41	16.46	5	8.71	5	0.765	27	16.92
13	-118.2	41	608.8	5	-3.20	41	16.49	5	8.68	5	0.762	27	16.86
14	-111.1	41	611.6	5	-3.01	41	16.57	5	8.65	5	0.759	27	16.85
15	-103.8	41	615.4	5	-2.81	41	16.67	5	8.58	5	0.756	26	16.75
16	-99.1	40	616.6	6	-2.69	40	16.71	6	8.50	6	0.755	26	16.45
17	-94.7	40	615.2	6	-2.56	40	16.67	6	8.39	6	0.753	26	15.91
18	-88.3	40	610.2	6	-2.39	40	16.53	6	8.59	8	0.751	26	15.12
19	-79.8	40	600.6	6	-2.16	40	16.27	6	8.93	8	0.748	26	14.09
20	-70.1	40	582.4	6	-1.90	40	15.78	6	9.40	8	0.746	26	12.80
21	-58.8	39	543.1	6	-1.59	39	14.71	6	10.13	8	0.743	26	11.26
22	-45.4	39	470.5	6	-1.23	39	12.75	6	11.10	7	0.741	26	9.44
23	-30.2	39	357.9	6	-0.82	39	9.70	6	11.99	7	0.739	26	7.35
24	-11.8	39	207.8	7	-0.32	39	5.63	7	12.34	7	0.737	26	6.23

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 6.39 6.72 6.69

Max. Combustion Pressure 1539.0 psi

Rut= 220.0, Rtoe = 44.0 kips, Time Inc. =0.077 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	611.4	2	0.00	0	16.56	2	8.95	2	0.710	20	17.00
2	-25.1	12	612.3	3	-0.68	12	16.59	3	8.95	3	0.704	20	16.98
3	-34.8	40	613.5	3	-0.94	40	16.62	3	8.94	3	0.698	20	16.96
4	-49.3	40	614.6	3	-1.33	40	16.65	3	8.94	3	0.693	21	16.94
5	-60.9	40	615.2	3	-1.65	40	16.67	3	8.94	3	0.687	21	16.93
6	-69.9	40	616.2	3	-1.89	40	16.69	3	8.93	4	0.682	21	16.91
7	-78.2	39	617.1	4	-2.12	39	16.72	4	8.93	4	0.676	21	16.89
8	-86.1	39	617.6	4	-2.33	39	16.73	4	8.92	4	0.669	21	16.86
9	-90.7	39	619.0	4	-2.46	39	16.77	4	8.91	4	0.662	21	16.82
10	-91.5	39	620.0	4	-2.48	39	16.80	4	8.91	4	0.654	21	16.76
11	-89.0	39	620.9	4	-2.41	39	16.82	4	8.90	5	0.645	21	16.69
12	-84.3	39	622.5	5	-2.28	39	16.87	5	8.89	5	0.637	15	16.61
13	-83.9	38	624.2	5	-2.27	38	16.91	5	8.86	5	0.632	16	16.53
14	-90.8	38	626.9	5	-2.46	38	16.99	5	8.81	5	0.626	16	16.44
15	-99.2	38	631.8	5	-2.69	38	17.12	5	8.74	5	0.620	16	16.29
16	-103.8	38	633.8	6	-2.81	38	17.17	6	8.62	6	0.613	16	15.98
17	-102.1	38	631.6	6	-2.77	38	17.11	6	8.48	6	0.608	24	15.42
18	-94.4	38	625.5	6	-2.56	38	16.95	6	8.30	6	0.605	24	14.64
19	-82.0	38	614.8	6	-2.22	38	16.66	6	8.32	8	0.601	24	13.61
20	-66.8	37	593.7	6	-1.81	37	16.08	6	8.85	8	0.597	24	12.34
21	-54.6	37	551.3	6	-1.48	37	14.94	6	9.63	7	0.594	24	10.82
22	-41.6	37	477.1	6	-1.13	37	12.93	6	10.66	7	0.591	24	9.05
23	-26.0	37	363.9	7	-0.70	37	9.86	7	11.47	7	0.588	24	7.02
24	-7.9	37	212.2	7	-0.21	37	5.75	7	11.73	7	0.586	24	5.94

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 6.57 6.91 6.88

Max. Combustion Pressure 1539.0 psi

Rut= 260.0, Rtoe = 52.0 kips, Time Inc. =0.077 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	619.2	2	0.00	0	16.78	2	9.06	2	0.632	18	16.81
2	-17.0	33	620.9	3	-0.46	33	16.82	3	9.05	3	0.624	18	16.76
3	-30.5	33	622.0	3	-0.83	33	16.85	3	9.06	3	0.616	18	16.70
4	-40.0	33	622.6	3	-1.08	33	16.87	3	9.05	3	0.610	14	16.65
5	-46.1	33	623.9	3	-1.25	33	16.90	3	9.05	3	0.608	14	16.58
6	-50.1	33	624.7	3	-1.36	33	16.93	3	9.04	3	0.605	14	16.53
7	-53.2	33	625.4	4	-1.44	33	16.94	4	9.03	4	0.601	14	16.51
8	-55.9	33	626.7	4	-1.52	33	16.98	4	9.03	4	0.596	14	16.50
9	-59.7	32	627.6	4	-1.62	32	17.00	4	9.02	4	0.591	14	16.48
10	-68.8	32	628.7	4	-1.87	32	17.03	4	9.00	4	0.585	14	16.46
11	-80.1	31	630.2	4	-2.17	31	17.07	4	9.00	4	0.579	14	16.43
12	-90.5	31	631.3	5	-2.45	31	17.10	5	8.98	5	0.572	15	16.40
13	-99.2	31	633.5	5	-2.69	31	17.16	5	8.96	5	0.565	15	16.36
14	-105.4	31	636.9	5	-2.86	31	17.26	5	8.90	5	0.558	15	16.31
15	-109.2	31	642.1	5	-2.96	31	17.40	5	8.81	5	0.550	15	16.14
16	-108.7	31	644.1	5	-2.95	31	17.45	5	8.68	6	0.542	15	15.76
17	-103.7	32	642.1	6	-2.81	32	17.40	6	8.49	6	0.534	15	15.13
18	-95.1	32	635.2	6	-2.58	32	17.21	6	8.29	6	0.527	15	14.28
19	-84.2	32	622.4	6	-2.28	32	16.86	6	8.06	6	0.519	16	13.20
20	-71.1	32	599.0	6	-1.93	32	16.23	6	8.30	8	0.513	16	11.91
21	-56.4	32	553.9	6	-1.53	32	15.01	6	9.13	7	0.507	16	10.39
22	-39.9	32	478.6	6	-1.08	32	12.97	6	10.20	7	0.503	16	8.64
23	-22.2	31	365.5	6	-0.60	31	9.90	6	10.90	7	0.499	16	6.66
24	-3.6	31	214.7	7	-0.10	31	5.82	7	11.09	7	0.496	16	5.60

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 6.74 7.03 7.01

Max. Combustion Pressure 1539.0 psi

Rut= 300.0, Rtoe = 60.0 kips, Time Inc. =0.077 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	628.0	2	0.00	0	17.01	2	9.18	2	0.582	13	16.78
2	-15.4	32	628.9	3	-0.42	32	17.04	3	9.18	3	0.581	13	16.77
3	-30.2	32	630.4	3	-0.82	32	17.08	3	9.17	3	0.579	13	16.78
4	-44.3	32	631.5	3	-1.20	32	17.11	3	9.17	3	0.576	13	16.78
5	-57.4	32	632.0	3	-1.55	32	17.12	3	9.16	3	0.572	13	16.78
6	-69.0	32	633.4	3	-1.87	32	17.16	3	9.15	3	0.567	13	16.77
7	-79.1	32	634.4	4	-2.14	32	17.19	4	9.15	4	0.562	13	16.75
8	-87.9	32	635.1	4	-2.38	32	17.21	4	9.14	4	0.556	13	16.73
9	-95.4	32	636.6	4	-2.58	32	17.25	4	9.13	4	0.550	14	16.70
10	-102.0	31	637.7	4	-2.76	31	17.28	4	9.12	4	0.542	14	16.66
11	-108.1	31	639.0	4	-2.93	31	17.31	4	9.10	5	0.535	14	16.60
12	-114.2	31	640.8	5	-3.09	31	17.36	5	9.09	5	0.527	14	16.54
13	-120.3	31	642.7	5	-3.26	31	17.41	5	9.06	5	0.518	14	16.47
14	-125.7	31	646.4	5	-3.41	31	17.51	5	9.00	5	0.509	14	16.39
15	-129.3	31	652.7	5	-3.50	31	17.68	5	8.89	5	0.500	14	16.19
16	-127.3	31	655.3	6	-3.45	31	17.75	6	8.73	6	0.491	14	15.77
17	-119.1	31	652.4	6	-3.23	31	17.68	6	8.53	6	0.482	15	15.10
18	-107.3	31	644.1	6	-2.91	31	17.45	6	8.28	6	0.473	15	14.20
19	-92.9	31	629.8	6	-2.52	31	17.06	6	8.01	6	0.464	15	13.08
20	-76.1	31	603.7	6	-2.06	31	16.36	6	7.84	6	0.456	15	11.74
21	-57.7	31	556.3	6	-1.56	31	15.07	6	8.72	7	0.448	15	10.20
22	-37.9	31	481.0	6	-1.03	31	13.03	6	9.78	7	0.442	15	8.44
23	-18.0	31	366.9	7	-0.49	31	9.94	7	10.39	7	0.437	15	6.46
24	-0.1	31	216.6	7	0.00	31	5.87	7	10.56	7	0.434	16	5.42

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 6.90 7.15 7.13

Max. Combustion Pressure 1539.0 psi

Rut= 340.0, Rtoe = 68.0 kips, Time Inc. =0.077 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	638.8	2	0.00	0	17.31	2	9.34	2	0.566	12	17.15
2	-11.4	32	640.6	3	-0.31	32	17.36	3	9.34	3	0.564	12	17.15
3	-22.5	32	641.6	3	-0.61	32	17.38	3	9.34	3	0.560	12	17.15
4	-32.8	32	642.5	3	-0.89	32	17.41	3	9.33	3	0.555	13	17.14
5	-42.7	32	643.9	3	-1.16	32	17.44	3	9.32	3	0.549	13	17.12
6	-53.5	31	644.7	3	-1.45	31	17.47	3	9.32	3	0.543	13	17.08
7	-64.5	31	645.7	4	-1.75	31	17.49	4	9.30	4	0.536	13	17.04
8	-74.6	31	647.1	4	-2.02	31	17.53	4	9.30	4	0.528	13	16.99
9	-83.6	31	648.0	4	-2.27	31	17.56	4	9.29	4	0.520	13	16.93
10	-92.3	31	649.4	4	-2.50	31	17.59	4	9.27	4	0.512	13	16.86
11	-101.6	30	650.9	4	-2.75	30	17.64	4	9.27	4	0.502	13	16.78
12	-111.3	30	652.1	5	-3.01	30	17.67	5	9.24	5	0.493	13	16.68
13	-120.2	30	654.8	5	-3.26	30	17.74	5	9.21	5	0.482	14	16.57
14	-127.7	30	658.9	5	-3.46	30	17.85	5	9.14	5	0.472	14	16.45
15	-132.8	30	665.6	5	-3.60	30	18.03	5	9.02	5	0.461	14	16.21
16	-131.8	30	668.2	6	-3.57	30	18.10	6	8.84	6	0.450	14	15.73
17	-123.6	30	665.0	6	-3.35	30	18.02	6	8.61	6	0.440	14	15.01
18	-109.3	30	656.0	6	-2.96	30	17.77	6	8.32	6	0.429	14	14.06
19	-92.2	30	640.1	6	-2.50	30	17.34	6	8.02	6	0.419	14	12.91
20	-73.8	30	611.7	6	-2.00	30	16.57	6	7.79	6	0.410	14	11.55
21	-54.6	30	562.3	6	-1.48	30	15.23	6	8.42	7	0.402	13	9.99
22	-35.2	30	484.6	6	-0.95	30	13.13	6	9.43	7	0.395	13	8.23
23	-16.2	30	370.5	6	-0.44	30	10.04	6	9.99	7	0.390	13	6.27
24	0.0	0	219.7	7	0.00	0	5.95	7	10.19	7	0.386	13	5.23

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 7.05 7.32 7.30

Max. Combustion Pressure 1539.0 psi

Rut= 380.0, Rtoe = 76.0 kips, Time Inc. =0.077 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kips	ms	kips	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	647.2	2	0.00	0	17.53	2	9.45	2	0.554	12	17.39
2	-13.9	23	648.7	3	-0.38	23	17.58	3	9.46	3	0.551	12	17.39
3	-28.1	23	649.6	3	-0.76	23	17.60	3	9.46	3	0.546	12	17.38
4	-42.8	23	650.8	3	-1.16	23	17.63	3	9.45	3	0.539	12	17.34
5	-53.0	23	652.1	3	-1.44	23	17.67	3	9.44	3	0.531	12	17.29
6	-57.8	23	652.9	3	-1.57	23	17.69	3	9.43	3	0.523	12	17.22
7	-65.5	28	654.2	4	-1.77	28	17.72	4	9.42	4	0.514	13	17.14
8	-73.9	28	655.5	4	-2.00	28	17.76	4	9.41	4	0.504	13	17.05
9	-81.7	29	656.3	4	-2.21	29	17.78	4	9.40	4	0.494	13	16.96
10	-88.7	29	658.1	4	-2.40	29	17.83	4	9.39	4	0.484	13	16.85
11	-94.8	29	659.5	4	-2.57	29	17.87	4	9.38	4	0.473	13	16.73
12	-100.4	29	661.0	5	-2.72	29	17.91	5	9.35	5	0.462	13	16.60
13	-107.8	30	663.7	5	-2.92	30	17.98	5	9.32	5	0.451	13	16.46
14	-116.3	30	668.0	5	-3.15	30	18.10	5	9.24	5	0.439	13	16.30
15	-123.1	30	675.3	5	-3.33	30	18.30	5	9.11	5	0.427	13	16.02
16	-124.4	30	678.1	6	-3.37	30	18.37	6	8.90	6	0.415	12	15.51
17	-119.3	30	674.6	6	-3.23	30	18.28	6	8.64	6	0.404	12	14.76
18	-107.9	29	664.5	6	-2.92	29	18.00	6	8.33	6	0.393	12	13.79
19	-92.1	29	646.9	6	-2.49	29	17.53	6	7.99	6	0.383	12	12.61
20	-73.8	29	616.0	6	-2.00	29	16.69	6	7.72	6	0.373	12	11.24
21	-54.2	29	564.6	6	-1.47	29	15.30	6	8.15	7	0.364	13	9.69
22	-34.4	29	486.0	6	-0.93	29	13.17	6	9.06	7	0.357	13	7.94
23	-14.1	29	371.7	6	-0.38	29	10.07	6	9.59	7	0.351	13	6.01
24	0.0	0	221.4	7	0.00	0	6.00	7	9.84	7	0.347	13	4.99

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 7.20 7.44 7.43

Max. Combustion Pressure 1539.0 psi

Rut= 420.0, Rtoe = 84.0 kips, Time Inc. =0.077 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	653.9	2	0.00	0	17.71	2	9.56	2	0.545	12	17.58
2	-25.7	23	655.7	3	-0.70	23	17.77	3	9.56	3	0.540	12	17.57
3	-47.1	23	656.9	3	-1.28	23	17.80	3	9.56	3	0.534	12	17.53
4	-63.7	23	657.6	3	-1.73	23	17.82	3	9.55	3	0.526	12	17.47
5	-73.7	23	659.2	3	-2.00	23	17.86	3	9.54	3	0.516	12	17.39
6	-78.0	23	660.3	3	-2.11	23	17.89	3	9.53	3	0.506	12	17.28
7	-78.9	23	661.2	4	-2.14	23	17.91	4	9.52	4	0.495	12	17.16
8	-78.9	23	662.9	4	-2.14	23	17.96	4	9.51	4	0.484	12	17.03
9	-84.4	28	664.0	4	-2.29	28	17.99	4	9.50	4	0.473	12	16.89
10	-91.2	28	665.4	4	-2.47	28	18.03	4	9.48	4	0.461	12	16.74
11	-97.3	28	667.1	4	-2.64	28	18.07	4	9.47	4	0.449	12	16.59
12	-102.6	28	668.5	5	-2.78	28	18.11	5	9.45	5	0.437	12	16.43
13	-107.2	28	671.3	5	-2.90	28	18.19	5	9.41	5	0.425	12	16.28
14	-118.7	25	676.0	5	-3.22	25	18.32	5	9.33	5	0.413	12	16.12
15	-132.3	25	684.1	5	-3.58	25	18.53	5	9.18	5	0.401	12	15.83
16	-139.2	25	687.3	6	-3.77	25	18.62	6	8.96	6	0.388	12	15.29
17	-137.1	25	683.2	6	-3.71	25	18.51	6	8.67	6	0.376	12	14.50
18	-126.9	25	671.9	6	-3.44	25	18.20	6	8.33	6	0.364	12	13.49
19	-109.6	26	652.2	6	-2.97	26	17.67	6	7.96	6	0.353	12	12.28
20	-89.5	26	619.0	6	-2.43	26	16.77	6	7.65	6	0.342	12	10.89
21	-68.0	26	566.0	6	-1.84	26	15.34	6	7.89	7	0.332	12	9.33
22	-45.7	26	486.6	6	-1.24	26	13.18	6	8.70	7	0.324	12	7.60
23	-23.1	26	371.7	6	-0.62	26	10.07	6	9.25	7	0.317	12	5.71
24	-0.1	26	222.3	7	0.00	26	6.02	7	9.54	7	0.312	12	4.71

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 7.33 7.55 7.54

Max. Combustion Pressure 1539.0 psi

Rut	Bl Ct	Stroke (ft)	Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt	
kip	b/ft	down	up	ksi		ksi			kip-ft	b/min	
60.0	4.6	5.96	5.94	-6.78	6	11	14.70	15	5	19.6	48.8
100.0	9.0	6.27	6.24	-5.13	6	11	15.59	16	6	18.1	47.5
140.0	13.9	6.53	6.50	-3.46	5	11	16.23	16	6	17.4	46.4
180.0	19.5	6.72	6.69	-3.28	12	41	16.71	16	6	17.2	45.8
220.0	25.8	6.91	6.88	-2.81	16	38	17.17	16	6	17.0	45.1
260.0	31.9	7.03	7.01	-2.96	15	31	17.45	16	5	16.8	44.7
300.0	38.3	7.15	7.13	-3.50	15	31	17.75	16	6	16.8	44.3
340.0	45.1	7.32	7.30	-3.60	15	30	18.10	16	6	17.1	43.8
380.0	53.0	7.44	7.43	-3.37	16	30	18.37	16	6	17.4	43.4
420.0	62.5	7.55	7.54	-3.77	16	25	18.62	16	6	17.6	43.1

Input File: C:\PJ\AMERICAN, CRC\B2 LO.GWI
 Hammer File: C:\Program Files\PDI\GRLWEAP 2005\HAMMER2003.GW
 Hammer File Version: 2003 (8/28/2009)

Input File Contents

American, CRC Pile B2, APE D80-42 LO
 OUT OSG HAM STR FUL PEL N SPL N-U P-D %SK ISM 0 PHI RSA ITR H-D MXT DEx
 6 0 576 0 1 0 0 0 0 0 0 60 0 0 0 0 0 0 0 0 0 0 0 0.000
 Pile g Hammer g Toe Area Pile Size Pile Type
 32.170 32.170 1809.560 48.000 Pipe
 W Cp A Cp E Cp T Cp CoR ROut StCp
 5.000 490.000 175.0 2.000 0.920 0.010 0.0
 A Cu E Cu T Cu CoR ROut StCu
 0.000 0.0 0.000 0.000 0.000 0.0
 LPlE APlE EPlE WPlE Peri Strg CoR ROut
 96.000 147.660 30000.000 492.000 12.566 36.000 0.850 0.010
 Manufac Hmr Name HmrType No Seg-s
 APE D 80-42 1 5
 Ram Wt Ram L Ram Dia MaxStrk RtdStrk Efficy
 17.64 147.20 24.80 13.08 11.25 0.80
 IB. Wt IB. L IB.Dia IB CoR IB RO
 5.00 42.10 24.80 0.900 0.010
 CompStrk A Chamber V Chamber C Delay C Duratn Exp Coeff VolCStart Vol CEnd
 22.91 483.00 863.80 0.001 0.002 1.250 0.00 0.00
 P atm P1 P2 P3 P4 P5
 14.70 1410.00 1269.00 1142.00 1028.00 0.00
 Stroke Effic. Pressure R-Weight T-Delay Exp-Coeff Eps-Str Total-AW
 11.2500 0.7200 1481.0000 0.0000 0.0000 0.0000 0.0100 0.0000
 Qs Qt Js Jt Qx Jx Rati Dept
 0.100 0.200 0.100 0.150 0.000 0.000 0.000 0.000
 Research Soil Model: Atoe, Plug, Gap, Q-fac
 0.000 0.000 0.000 0.000
 Research Soil Model: RD-skn: m, d, toe: m, d
 0.000 0.000 0.000 0.000
 Res. Distribution
 Dpth Rskn Dpth Dpth
 0.00 0.00 50.00 50.00 0.00 0.00 0.00 0.00 0.00 0.00
 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 50.00 1.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 96.00 1.92 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 Rult
 600.0 1200.0 1400.0 1600.0 1800.0 2000.0 2200.0 2400.0 2600.0 2700.0
 Diameter COGHammer WHammer ABatter Depth Sup Flag
 0.000 0.000 0.000 0.000 0.000 0

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
 Version 2005
 English Units

American, CRC Pile B2, APE D80-42 LO

Hammer Model: D 80-42		Made by: APE			
No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	3.528				
2	3.528	475831.8	1.000	0.0100	
3	3.528	475831.8	1.000	0.0100	
4	3.528	475831.8	1.000	0.0100	
5	3.528	475831.8	1.000	0.0100	
Imp Block	5.000	195813.4	0.900	0.0100	
Helmet	5.000	42875.0	0.920	0.0100	20.3
Combined Pile Top		111513.9			

HAMMER OPTIONS:

Hammer File ID No.	576	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	17.64	Ram Length	(inch)	147.20
Maximum Stroke	(ft)	13.08			
Rated Stroke	(ft)	11.25	Efficiency		0.720
Maximum Pressure	(psi)	1410.00	Actual Pressure	(psi)	1481.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	24.80			
Combustion Delay	(s)	0.00100	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION

Cross Sect. Area	(in2)	490.00
Elastic-Modulus	(ksi)	175.0
Thickness	(inch)	2.00
Coeff of Restitution		0.9
RoundOut	(ft)	0.0
Stiffness	(kips/in)	42875.0

PILE CUSHION

Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	0.00
Coeff of Restitution		0.0
RoundOut	(ft)	0.0
Stiffness	(kips/in)	0.0

PILE PROFILE:

Toe Area (in2) 1809.560 Pile Type Pipe
 Pile Size (inch) 48.000

L b Top	Area	E-Mod	Spec Wt	Perim	Strength	Wave Sp	EA/c
ft	in2	ksi	lb/ft3	ft	ksi	ft/s	k/ft/s
0.0	147.66	30000.	492.0	12.6	36.000	16807.	263.6
96.0	147.66	30000.	492.0	12.6	36.000	16807.	263.6

Wave Travel Time 2L/c (ms) 11.424

Pile and Soil Model							Total Capacity Rut (kips)			600.0	
No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	1.670	111514.	0.010	0.000	0.85	0.0	0.100	0.100	3.31	12.6	147.7
2	1.670	111514.	0.000	0.000	1.00	0.0	0.100	0.100	6.62	12.6	147.7
14	1.670	111514.	0.000	0.000	1.00	0.0	0.100	0.100	46.34	12.6	147.7
15	1.670	111514.	0.000	0.000	1.00	1.9	0.100	0.100	49.66	12.6	147.7
16	1.670	111514.	0.000	0.000	1.00	5.1	0.100	0.100	52.97	12.6	147.7
17	1.670	111514.	0.000	0.000	1.00	8.2	0.100	0.100	56.28	12.6	147.7
18	1.670	111514.	0.000	0.000	1.00	11.4	0.100	0.100	59.59	12.6	147.7
19	1.670	111514.	0.000	0.000	1.00	14.5	0.100	0.100	62.90	12.6	147.7
20	1.670	111514.	0.000	0.000	1.00	17.7	0.100	0.100	66.21	12.6	147.7
21	1.670	111514.	0.000	0.000	1.00	20.8	0.100	0.100	69.52	12.6	147.7
22	1.670	111514.	0.000	0.000	1.00	24.0	0.100	0.100	72.83	12.6	147.7
23	1.670	111514.	0.000	0.000	1.00	27.2	0.100	0.100	76.14	12.6	147.7
24	1.670	111514.	0.000	0.000	1.00	30.3	0.100	0.100	79.45	12.6	147.7
25	1.670	111514.	0.000	0.000	1.00	33.5	0.100	0.100	82.76	12.6	147.7
26	1.670	111514.	0.000	0.000	1.00	36.6	0.100	0.100	86.07	12.6	147.7
27	1.670	111514.	0.000	0.000	1.00	39.8	0.100	0.100	89.38	12.6	147.7
28	1.670	111514.	0.000	0.000	1.00	42.9	0.100	0.100	92.69	12.6	147.7
29	1.670	111515.	0.000	0.000	1.00	46.1	0.100	0.100	96.00	12.6	147.7
Toe						240.0	0.150	0.200			

48.432 kips total unreduced pile weight (g= 32.17 ft/s2)
 48.432 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		File Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
Pile Penetration (ft)	50.00	Pile Damping Fact. (k/ft/s)	5.271
% Shaft Resistance	60		
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0
Output Level: Variable vs Time			
Gravity Mass, Pile, Hammer:	32.170	32.170	
Output Segment Generation: Automatic			

Rut= 600.0, Rtoe = 240.0 kips, Time Inc. =0.087 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	3441.5	2	0.00	0	23.31	2	12.77	2	1.033	32	80.01
2	-504.1	13	3449.1	2	-3.41	13	23.36	2	12.81	2	1.031	31	79.96
3	-790.7	13	3455.8	2	-5.35	13	23.40	2	12.79	3	1.028	31	79.87
4	-923.7	13	3444.6	3	-6.26	13	23.33	3	12.76	3	1.026	31	79.87
5	-973.4	13	3455.0	3	-6.59	13	23.40	3	12.76	3	1.024	31	79.86
6	-976.8	13	3449.3	3	-6.62	13	23.36	3	12.70	3	1.020	31	79.84
7	-957.6	12	3444.6	3	-6.48	12	23.33	3	12.70	3	1.015	31	79.85
8	-935.0	12	3446.3	3	-6.33	12	23.34	3	12.67	4	1.009	31	79.85
9	-921.6	12	3434.3	4	-6.24	12	23.26	4	12.61	4	1.003	31	79.84
10	-913.8	12	3435.4	4	-6.19	12	23.27	4	12.61	4	1.000	30	79.80
11	-913.9	12	3432.2	4	-6.19	12	23.24	4	12.56	4	0.998	30	79.72
12	-912.5	11	3417.2	4	-6.18	11	23.14	4	12.51	4	0.994	30	79.56
13	-899.1	11	3422.7	5	-6.09	11	23.18	5	12.49	5	0.992	29	79.53
14	-874.0	11	3417.7	5	-5.92	11	23.15	5	12.43	5	0.993	29	79.47
15	-855.5	11	3409.6	5	-5.79	11	23.09	5	12.38	5	0.992	29	79.23
16	-859.9	11	3412.8	5	-5.82	11	23.11	5	12.33	5	0.990	29	78.65
17	-903.4	10	3401.0	5	-6.12	10	23.03	5	12.24	5	0.986	29	77.77
18	-965.0	10	3384.8	6	-6.54	10	22.92	6	12.17	6	0.981	29	76.58
19	-1008.8	10	3372.1	6	-6.83	10	22.84	6	12.10	6	0.975	29	75.02
20	-1005.5	10	3345.2	6	-6.81	10	22.65	6	11.98	6	0.970	28	73.20
21	-932.5	10	3316.9	6	-6.31	10	22.46	6	11.88	6	0.967	28	71.02
22	-774.5	10	3288.7	6	-5.25	10	22.27	6	11.79	6	0.965	27	68.42
23	-539.2	9	3247.0	6	-3.65	9	21.99	6	11.66	7	0.964	27	65.36
24	-375.1	9	3203.2	7	-2.54	9	21.69	7	11.56	7	0.964	27	61.91
25	-493.9	9	3146.5	7	-3.34	9	21.31	7	11.56	7	0.964	27	58.17
26	-627.8	9	3027.2	7	-4.25	9	20.50	7	12.04	7	0.964	27	54.00
27	-676.7	8	2743.4	7	-4.58	8	18.58	7	13.99	8	0.964	27	49.34
28	-541.1	8	2207.4	7	-3.66	8	14.95	7	16.64	8	0.963	26	44.15
29	-72.8	8	1403.4	7	-0.49	8	9.50	7	17.95	8	0.962	26	41.38

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 8.37 8.55 8.53

Max. Combustion Pressure 1481.0 psi

Rut= 1200.0, Rtoe = 480.0 kips, Time Inc. =0.087 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kips	ms	kips	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	3737.8	2	0.00	0	25.31	2	13.84	2	0.617	18	76.09
2	-120.7	13	3736.6	2	-0.82	13	25.31	2	13.81	2	0.613	14	75.56
3	-202.0	13	3748.0	2	-1.37	13	25.38	2	13.84	3	0.607	14	75.30
4	-235.7	13	3749.2	3	-1.60	13	25.39	3	13.79	3	0.601	15	75.08
5	-232.7	13	3742.0	3	-1.58	13	25.34	3	13.78	3	0.596	15	74.95
6	-205.1	12	3749.0	3	-1.39	12	25.39	3	13.76	3	0.591	15	74.81
7	-239.4	34	3738.7	3	-1.62	34	25.32	3	13.68	3	0.585	15	74.63
8	-274.6	34	3739.6	3	-1.86	34	25.33	3	13.68	4	0.577	15	74.34
9	-303.8	34	3738.1	4	-2.06	34	25.32	4	13.63	4	0.568	15	73.92
10	-327.2	34	3722.1	4	-2.22	34	25.21	4	13.58	4	0.558	16	73.40
11	-343.1	34	3729.6	4	-2.32	34	25.26	4	13.56	4	0.547	16	72.82
12	-378.4	32	3723.8	4	-2.56	32	25.22	4	13.49	4	0.538	14	72.49
13	-424.9	32	3714.1	5	-2.88	32	25.15	5	13.45	5	0.530	14	72.17
14	-459.1	33	3719.7	5	-3.11	33	25.19	5	13.40	5	0.522	14	71.82
15	-480.2	33	3716.7	5	-3.25	33	25.17	5	13.29	5	0.513	14	71.31
16	-483.9	33	3714.8	5	-3.28	33	25.16	5	13.20	5	0.504	14	70.46
17	-467.7	33	3708.9	5	-3.17	33	25.12	5	13.09	5	0.494	14	69.20
18	-434.8	33	3682.0	5	-2.94	33	24.94	5	12.92	6	0.484	14	67.59
19	-393.5	33	3658.2	6	-2.66	33	24.77	6	12.76	6	0.474	14	65.64
20	-376.9	34	3622.5	6	-2.55	34	24.53	6	12.58	6	0.465	13	63.37
21	-381.2	34	3567.5	6	-2.58	34	24.16	6	12.35	6	0.455	13	60.79
22	-360.9	34	3521.3	6	-2.44	34	23.85	6	12.12	6	0.446	13	57.89
23	-303.1	34	3457.7	6	-2.05	34	23.42	6	11.89	7	0.437	13	54.68
24	-214.0	34	3377.4	7	-1.45	34	22.87	7	11.63	7	0.428	15	51.22
25	-144.0	31	3291.2	7	-0.98	31	22.29	7	11.46	7	0.421	15	47.57
26	-135.7	35	3136.7	7	-0.92	35	21.24	7	11.73	7	0.414	15	43.66
27	-113.5	35	2823.0	7	-0.77	35	19.12	7	13.21	8	0.408	15	39.40
28	-57.7	35	2266.2	7	-0.39	35	15.35	7	15.04	8	0.402	15	34.71
29	0.0	0	1533.8	8	0.00	0	10.39	8	15.46	8	0.397	15	32.20

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 9.47 9.49

Max. Combustion Pressure 1481.0 psi

Rut= 1400.0, Rtoe = 560.0 kips, Time Inc. =0.087 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kips	ms	kips	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	3783.3	2	0.00	0	25.62	2	13.99	2	0.582	14	76.80
2	-34.4	28	3796.4	2	-0.23	28	25.71	2	14.04	2	0.578	14	76.70
3	-105.5	28	3803.3	2	-0.71	28	25.76	2	14.01	2	0.571	14	76.47
4	-111.7	28	3795.4	3	-0.76	28	25.70	3	13.99	3	0.563	14	76.14
5	-120.7	33	3805.7	3	-0.82	33	25.77	3	13.98	3	0.555	14	75.79
6	-168.9	31	3797.1	3	-1.14	31	25.72	3	13.90	3	0.547	13	75.50
7	-221.5	31	3797.5	3	-1.50	31	25.72	3	13.91	3	0.540	13	75.23
8	-265.1	31	3797.3	3	-1.80	31	25.72	3	13.86	3	0.532	13	74.92
9	-304.7	31	3781.3	4	-2.06	31	25.61	4	13.80	4	0.524	13	74.58
10	-344.2	32	3789.2	4	-2.33	32	25.66	4	13.79	4	0.515	13	74.19
11	-382.8	32	3783.4	4	-2.59	32	25.62	4	13.72	4	0.506	14	73.79
12	-418.0	32	3773.6	4	-2.83	32	25.56	4	13.68	4	0.498	14	73.48
13	-446.4	32	3778.1	4	-3.02	32	25.59	4	13.64	5	0.490	14	73.13
14	-463.7	32	3771.2	5	-3.14	32	25.54	5	13.54	5	0.481	14	72.75
15	-467.6	32	3773.9	5	-3.17	32	25.56	5	13.48	5	0.472	14	72.19
16	-454.7	33	3777.6	5	-3.08	33	25.58	5	13.37	5	0.462	13	71.26
17	-426.1	33	3758.0	5	-2.89	33	25.45	5	13.20	5	0.452	13	69.92
18	-390.0	31	3742.2	5	-2.64	31	25.34	5	13.05	6	0.442	13	68.21
19	-385.6	31	3710.8	6	-2.61	31	25.13	6	12.86	6	0.432	13	66.16
20	-362.2	31	3659.2	6	-2.45	31	24.78	6	12.62	6	0.423	13	63.77
21	-319.9	32	3616.1	6	-2.17	32	24.49	6	12.38	6	0.413	13	61.04
22	-276.8	34	3552.7	6	-1.87	34	24.06	6	12.13	6	0.404	12	57.98
23	-219.3	34	3475.7	6	-1.49	34	23.54	6	11.83	6	0.394	12	54.61
24	-186.2	30	3399.9	7	-1.26	30	23.03	7	11.52	7	0.385	12	51.00
25	-148.0	30	3296.5	7	-1.00	30	22.32	7	11.32	7	0.378	12	47.23
26	-100.5	30	3131.3	7	-0.68	30	21.21	7	11.52	7	0.372	11	43.27
27	-44.4	30	2811.3	7	-0.30	30	19.04	7	12.83	7	0.367	11	38.97
28	0.0	0	2266.9	7	0.00	0	15.35	7	14.45	8	0.362	11	34.21
29	0.0	0	1558.4	8	0.00	0	10.55	8	14.67	8	0.357	11	31.66

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 9.67 9.68

Max. Combustion Pressure 1481.0 psi

Rut= 1600.0, Rtoe = 640.0 kips, Time Inc. =0.087 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	3831.0	2	0.00	0	25.94	2	14.20	2	0.555	14	77.69
2	-51.3	28	3846.8	2	-0.35	28	26.05	2	14.20	2	0.551	14	77.59
3	-119.1	28	3842.5	2	-0.81	28	26.02	2	14.16	3	0.545	14	77.38
4	-127.2	28	3851.5	3	-0.86	28	26.08	3	14.18	3	0.538	13	77.13
5	-188.9	30	3850.9	3	-1.28	30	26.08	3	14.12	3	0.531	13	76.89
6	-244.4	31	3842.5	3	-1.65	31	26.02	3	14.10	3	0.525	13	76.64
7	-285.0	31	3849.0	3	-1.93	31	26.07	3	14.08	3	0.517	13	76.36
8	-312.1	31	3838.4	3	-2.11	31	26.00	3	13.99	4	0.509	13	76.04
9	-330.5	31	3838.4	4	-2.24	31	26.00	4	13.99	4	0.501	13	75.66
10	-345.4	31	3837.5	4	-2.34	31	25.99	4	13.94	4	0.491	12	75.24
11	-360.1	32	3822.1	4	-2.44	32	25.88	4	13.87	4	0.482	12	74.77
12	-373.2	32	3828.8	4	-2.53	32	25.93	4	13.85	4	0.472	12	74.27
13	-381.9	32	3824.4	4	-2.59	32	25.90	4	13.78	5	0.462	12	73.76
14	-384.4	32	3815.5	5	-2.60	32	25.84	5	13.71	5	0.451	12	73.24
15	-379.7	32	3828.3	5	-2.57	32	25.93	5	13.63	5	0.441	12	72.55
16	-362.5	32	3823.4	5	-2.46	32	25.89	5	13.49	5	0.430	11	71.47
17	-346.8	31	3810.9	5	-2.35	31	25.81	5	13.33	5	0.419	11	69.93
18	-339.1	31	3791.1	5	-2.30	31	25.67	5	13.16	6	0.407	11	67.99
19	-320.1	31	3747.6	6	-2.17	31	25.38	6	12.92	6	0.397	12	65.79
20	-291.8	29	3705.5	6	-1.98	29	25.09	6	12.66	6	0.387	12	63.27
21	-264.3	29	3648.1	6	-1.79	29	24.71	6	12.40	6	0.378	10	60.50
22	-229.8	30	3569.6	6	-1.56	30	24.17	6	12.09	6	0.370	10	57.41
23	-188.2	30	3497.7	6	-1.27	30	23.69	6	11.74	6	0.361	10	53.97
24	-143.4	30	3405.7	7	-0.97	30	23.06	7	11.43	7	0.352	10	50.22
25	-120.5	24	3288.0	7	-0.82	24	22.27	7	11.17	7	0.345	11	46.36
26	-108.3	23	3114.8	7	-0.73	23	21.09	7	11.29	7	0.339	11	42.33
27	-58.2	23	2797.3	7	-0.39	23	18.94	7	12.46	7	0.333	11	37.94
28	0.0	0	2258.1	7	0.00	0	15.29	7	13.88	8	0.328	11	33.11
29	0.0	0	1582.1	8	0.00	0	10.71	8	13.96	8	0.322	11	30.51

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 9.81 9.82

Max. Combustion Pressure 1481.0 psi

Rut= 1800.0, Rtoe = 720.0 kips, Time Inc. =0.087 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kips	ms	kips	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	3872.8	2	0.00	0	26.23	2	14.32	2	0.535	14	78.21
2	-63.6	28	3870.1	2	-0.43	28	26.21	2	14.30	2	0.531	13	78.11
3	-123.6	28	3886.3	2	-0.84	28	26.32	2	14.32	2	0.525	13	77.94
4	-135.0	30	3885.4	3	-0.91	30	26.31	3	14.26	3	0.519	13	77.74
5	-195.3	30	3882.3	3	-1.32	30	26.29	3	14.27	3	0.513	13	77.53
6	-238.9	30	3887.4	3	-1.62	30	26.33	3	14.23	3	0.506	13	77.29
7	-266.2	31	3874.2	3	-1.80	31	26.24	3	14.17	3	0.499	13	77.01
8	-278.5	31	3880.0	3	-1.89	31	26.28	3	14.16	3	0.491	12	76.67
9	-280.3	31	3876.2	4	-1.90	31	26.25	4	14.09	4	0.482	12	76.27
10	-276.5	31	3864.3	4	-1.87	31	26.17	4	14.05	4	0.472	12	75.82
11	-271.7	31	3870.2	4	-1.84	31	26.21	4	14.02	4	0.463	12	75.34
12	-271.5	29	3862.0	4	-1.84	29	26.15	4	13.93	4	0.453	12	74.84
13	-287.4	30	3857.3	4	-1.95	30	26.12	4	13.90	5	0.442	12	74.33
14	-319.3	25	3861.8	5	-2.16	25	26.15	5	13.84	5	0.432	11	73.79
15	-359.0	25	3858.9	5	-2.43	25	26.13	5	13.70	5	0.421	11	73.06
16	-382.9	25	3864.3	5	-2.59	25	26.17	5	13.59	5	0.410	11	71.90
17	-383.9	25	3852.5	5	-2.60	25	26.09	5	13.42	5	0.399	11	70.26
18	-362.2	25	3816.3	5	-2.45	25	25.85	5	13.18	5	0.387	11	68.23
19	-320.5	25	3786.3	6	-2.17	25	25.64	6	12.96	6	0.377	10	65.93
20	-277.2	29	3731.9	6	-1.88	29	25.27	6	12.69	6	0.368	10	63.35
21	-230.4	29	3662.7	6	-1.56	29	24.81	6	12.36	6	0.360	10	60.45
22	-188.6	27	3592.2	6	-1.28	27	24.33	6	12.02	6	0.351	10	57.15
23	-156.6	24	3499.4	6	-1.06	24	23.70	6	11.67	6	0.341	10	53.47
24	-144.0	23	3397.2	7	-0.97	23	23.01	7	11.30	7	0.330	10	49.45
25	-127.8	23	3277.7	7	-0.87	23	22.20	7	10.97	7	0.320	10	45.24
26	-96.6	23	3094.3	7	-0.65	23	20.96	7	11.03	7	0.311	10	40.94
27	-35.2	23	2772.4	7	-0.24	23	18.78	7	12.09	7	0.304	11	36.44
28	0.0	0	2237.6	7	0.00	0	15.15	7	13.31	8	0.298	11	31.58
29	0.0	0	1601.3	8	0.00	0	10.84	8	13.27	8	0.291	11	28.95

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 9.95 9.94

Max. Combustion Pressure 1481.0 psi

Rut= 2000.0, Rtoe = 800.0 kips, Time Inc. =0.087 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kips	ms	kips	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	3904.2	2	0.00	0	26.44	2	14.42	2	0.521	11	79.12
2	-64.0	28	3912.3	2	-0.43	28	26.50	2	14.46	2	0.514	13	78.72
3	-115.3	28	3924.0	2	-0.78	28	26.57	2	14.44	2	0.509	13	78.36
4	-120.6	28	3912.2	3	-0.82	28	26.49	3	14.40	3	0.503	13	78.18
5	-164.1	30	3925.2	3	-1.11	30	26.58	3	14.40	3	0.498	13	77.98
6	-197.1	30	3920.2	3	-1.33	30	26.55	3	14.33	3	0.491	13	77.75
7	-216.2	30	3915.5	3	-1.46	30	26.52	3	14.32	3	0.484	12	77.45
8	-221.0	30	3918.9	3	-1.50	30	26.54	3	14.28	3	0.475	12	77.10
9	-232.1	27	3905.6	4	-1.57	27	26.45	4	14.20	4	0.466	12	76.69
10	-232.9	26	3909.3	4	-1.58	26	26.47	4	14.20	4	0.457	12	76.23
11	-274.3	24	3906.4	4	-1.86	24	26.46	4	14.13	4	0.447	12	75.74
12	-306.2	24	3892.1	4	-2.07	24	26.36	4	14.07	4	0.437	12	75.24
13	-326.3	24	3900.1	4	-2.21	24	26.41	4	14.04	5	0.427	11	74.72
14	-366.1	25	3896.5	5	-2.48	25	26.39	5	13.94	5	0.416	11	74.17
15	-406.9	25	3898.7	5	-2.76	25	26.40	5	13.83	5	0.405	11	73.40
16	-430.0	25	3906.2	5	-2.91	25	26.45	5	13.70	5	0.394	11	72.17
17	-431.1	25	3885.1	5	-2.92	25	26.31	5	13.49	5	0.382	11	70.46
18	-410.9	25	3860.0	5	-2.78	25	26.14	5	13.26	6	0.372	10	68.37
19	-373.7	25	3818.6	6	-2.53	25	25.86	6	13.01	6	0.362	10	65.99
20	-328.4	24	3750.7	6	-2.22	24	25.40	6	12.69	6	0.353	10	63.28
21	-281.4	24	3689.1	6	-1.91	24	24.98	6	12.32	6	0.344	10	60.20
22	-234.5	24	3603.4	6	-1.59	24	24.40	6	11.98	6	0.335	10	56.68
23	-195.5	24	3500.5	6	-1.32	24	23.71	6	11.59	6	0.324	10	52.75
24	-159.6	23	3396.4	7	-1.08	23	23.00	7	11.17	7	0.312	10	48.47
25	-122.4	23	3265.1	7	-0.83	23	22.11	7	10.81	7	0.299	10	43.96
26	-71.0	23	3074.3	7	-0.48	23	20.82	7	10.81	7	0.288	10	39.41
27	0.0	0	2747.5	7	0.00	0	18.61	7	11.73	7	0.279	11	34.73
28	0.0	0	2220.7	7	0.00	0	15.04	7	12.81	8	0.271	11	29.83
29	0.0	0	1624.2	8	0.00	0	11.00	8	12.71	8	0.264	11	27.18

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 10.07 10.06

Max. Combustion Pressure 1481.0 psi

Rut= 2200.0, Rtoe = 880.0 kips, Time Inc. =0.087 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kips	ms	kips	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	3940.0	2	0.00	0	26.68	2	14.57	2	0.519	11	80.03
2	-56.2	27	3943.4	2	-0.38	27	26.71	2	14.52	2	0.510	11	79.61
3	-100.3	27	3950.9	2	-0.68	27	26.76	2	14.56	2	0.501	10	79.16
4	-114.8	50	3956.5	3	-0.78	50	26.79	3	14.52	3	0.491	10	78.68
5	-148.6	50	3944.3	3	-1.01	50	26.71	3	14.49	3	0.485	13	78.25
6	-177.8	50	3955.6	3	-1.20	50	26.79	3	14.48	3	0.478	12	78.01
7	-202.4	50	3947.9	3	-1.37	50	26.74	3	14.40	3	0.470	12	77.71
8	-224.1	50	3945.0	3	-1.52	50	26.72	3	14.39	3	0.462	12	77.34
9	-244.6	50	3946.7	4	-1.66	50	26.73	4	14.34	4	0.453	12	76.92
10	-266.4	24	3932.5	4	-1.80	24	26.63	4	14.27	4	0.443	12	76.45
11	-310.0	24	3937.5	4	-2.10	24	26.67	4	14.25	4	0.434	12	75.97
12	-342.8	24	3934.2	4	-2.32	24	26.64	4	14.18	4	0.424	11	75.47
13	-365.5	24	3921.5	4	-2.48	24	26.56	4	14.12	5	0.413	11	74.94
14	-391.2	25	3931.5	5	-2.65	25	26.63	5	14.06	5	0.403	11	74.38
15	-432.2	25	3935.0	5	-2.93	25	26.65	5	13.93	5	0.392	11	73.58
16	-456.6	25	3934.5	5	-3.09	25	26.65	5	13.76	5	0.380	11	72.29
17	-459.0	25	3924.8	5	-3.11	25	26.58	5	13.58	5	0.369	10	70.52
18	-442.6	25	3885.1	5	-3.00	25	26.31	5	13.31	5	0.358	10	68.36
19	-418.3	23	3843.8	6	-2.83	23	26.03	6	13.00	6	0.349	10	65.89
20	-382.5	24	3781.8	6	-2.59	24	25.61	6	12.69	6	0.340	10	63.04
21	-345.9	24	3695.4	6	-2.34	24	25.03	6	12.32	6	0.331	10	59.77
22	-296.7	24	3612.2	6	-2.01	24	24.46	6	11.90	6	0.321	10	56.06
23	-235.1	23	3505.8	6	-1.59	23	23.74	6	11.47	6	0.309	10	51.88
24	-175.3	23	3380.9	7	-1.19	23	22.90	7	11.04	7	0.295	10	47.33
25	-113.7	23	3243.3	7	-0.77	23	21.96	7	10.67	7	0.281	10	42.57
26	-42.1	23	3042.6	7	-0.29	23	20.61	7	10.59	7	0.268	10	37.76
27	0.0	0	2724.6	7	0.00	0	18.45	7	11.38	7	0.257	10	32.92
28	0.0	0	2207.7	7	0.00	0	14.95	7	12.33	7	0.248	10	27.97
29	0.0	0	1648.0	8	0.00	0	11.16	8	12.16	8	0.239	11	25.29

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 10.18 10.18

Max. Combustion Pressure 1481.0 psi

Rut= 2400.0, Rtoe = 960.0 kips, Time Inc. =0.087 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	3968.6	2	0.00	0	26.88	2	14.70	2	0.518	10	81.05
2	-46.4	50	3986.8	2	-0.31	50	27.00	2	14.71	2	0.509	10	80.62
3	-91.7	50	3983.6	2	-0.62	50	26.98	2	14.66	3	0.499	10	80.16
4	-134.7	50	3992.5	3	-0.91	50	27.04	3	14.68	3	0.489	10	79.68
5	-175.3	50	3992.8	3	-1.19	50	27.04	3	14.62	3	0.479	10	79.19
6	-213.1	50	3983.7	3	-1.44	50	26.98	3	14.60	3	0.469	10	78.68
7	-248.0	50	3991.2	3	-1.68	50	27.03	3	14.57	3	0.459	12	78.13
8	-282.1	50	3980.7	3	-1.91	50	26.96	3	14.48	4	0.451	12	77.62
9	-316.2	50	3980.8	4	-2.14	50	26.96	4	14.48	4	0.442	12	77.19
10	-349.0	50	3980.4	4	-2.36	50	26.96	4	14.42	4	0.432	12	76.72
11	-379.4	50	3964.7	4	-2.57	50	26.85	4	14.35	4	0.422	12	76.23
12	-406.7	50	3972.4	4	-2.75	50	26.90	4	14.33	4	0.412	11	75.73
13	-430.7	50	3968.5	4	-2.92	50	26.88	4	14.25	5	0.402	11	75.20
14	-451.0	50	3961.0	5	-3.05	50	26.83	5	14.17	5	0.391	11	74.61
15	-467.7	50	3978.2	5	-3.17	50	26.94	5	14.07	5	0.380	11	73.78
16	-482.3	23	3974.4	5	-3.27	23	26.92	5	13.87	5	0.368	11	72.45
17	-505.6	23	3959.9	5	-3.42	23	26.82	5	13.64	5	0.357	10	70.61
18	-510.6	23	3929.2	5	-3.46	23	26.61	5	13.39	6	0.347	10	68.39
19	-495.1	23	3867.6	6	-3.35	23	26.19	6	13.07	6	0.338	10	65.80
20	-456.1	23	3809.0	6	-3.09	23	25.80	6	12.68	6	0.329	10	62.80
21	-399.9	24	3723.4	6	-2.71	24	25.22	6	12.30	6	0.319	10	59.35
22	-347.1	24	3618.6	6	-2.35	24	24.51	6	11.87	6	0.308	10	55.41
23	-273.6	23	3510.8	6	-1.85	23	23.78	6	11.41	6	0.295	10	51.02
24	-191.0	23	3382.9	7	-1.29	23	22.91	7	10.94	7	0.281	10	46.25
25	-109.1	23	3231.2	7	-0.74	23	21.88	7	10.51	7	0.266	10	41.24
26	-20.1	23	3029.5	7	-0.14	23	20.52	7	10.40	7	0.251	10	36.19
27	0.0	0	2696.6	7	0.00	0	18.26	7	11.06	7	0.238	10	31.17
28	0.0	0	2191.9	7	0.00	0	14.84	7	11.91	8	0.227	10	26.15
29	0.0	0	1674.4	8	0.00	0	11.34	8	11.75	8	0.217	11	23.44

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 10.30 10.27

Max. Combustion Pressure 1481.0 psi

Rut= 2600.0, Rtoe = 1040.0 kips, Time Inc. =0.087 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kip	ms	kip	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	4002.6	2	0.00	0	27.11	2	14.80	2	0.517	10	81.89
2	-48.3	50	4002.9	2	-0.33	50	27.11	2	14.76	2	0.507	10	81.45
3	-95.7	50	4016.6	2	-0.65	50	27.20	2	14.80	2	0.498	10	80.99
4	-141.7	50	4018.5	3	-0.96	50	27.21	3	14.74	3	0.488	10	80.51
5	-185.8	50	4012.2	3	-1.26	50	27.17	3	14.73	3	0.478	10	80.01
6	-228.0	50	4020.0	3	-1.54	50	27.22	3	14.70	3	0.468	10	79.48
7	-268.6	49	4008.4	3	-1.82	49	27.15	3	14.62	3	0.457	10	78.92
8	-308.7	49	4011.7	3	-2.09	49	27.17	3	14.62	3	0.446	10	78.30
9	-349.2	49	4009.9	4	-2.36	49	27.16	4	14.56	4	0.435	9	77.65
10	-385.5	49	3995.1	4	-2.61	49	27.06	4	14.50	4	0.423	9	76.98
11	-417.9	49	4003.3	4	-2.83	49	27.11	4	14.47	4	0.412	11	76.41
12	-448.4	49	3996.8	4	-3.04	49	27.07	4	14.39	4	0.402	11	75.90
13	-477.8	50	3990.1	4	-3.24	50	27.02	4	14.34	5	0.392	11	75.35
14	-504.3	50	3997.5	5	-3.42	50	27.07	5	14.27	5	0.381	11	74.71
15	-526.9	50	3999.3	5	-3.57	50	27.08	5	14.11	5	0.370	11	73.78
16	-544.8	23	4005.8	5	-3.69	23	27.13	5	13.95	5	0.358	10	72.40
17	-567.8	23	3990.4	5	-3.85	23	27.02	5	13.72	5	0.347	10	70.51
18	-568.3	23	3944.3	5	-3.85	23	26.71	5	13.41	5	0.337	10	68.21
19	-548.0	23	3899.2	6	-3.71	23	26.41	6	13.06	6	0.328	10	65.51
20	-504.7	22	3822.3	6	-3.42	22	25.89	6	12.69	6	0.319	10	62.35
21	-441.2	24	3730.2	6	-2.99	24	25.26	6	12.26	6	0.309	10	58.71
22	-380.2	23	3627.6	6	-2.57	23	24.57	6	11.79	6	0.297	10	54.59
23	-298.3	23	3503.5	6	-2.02	23	23.73	6	11.28	6	0.283	10	49.99
24	-199.3	23	3362.7	7	-1.35	23	22.77	7	10.80	7	0.268	10	45.03
25	-99.9	23	3207.9	7	-0.68	23	21.72	7	10.37	7	0.252	10	39.86
26	0.0	0	2996.6	7	0.00	0	20.29	7	10.19	7	0.236	10	34.65
27	0.0	0	2675.0	7	0.00	0	18.12	7	10.75	7	0.222	10	29.52
28	0.0	0	2172.6	7	0.00	0	14.71	7	11.54	7	0.210	10	24.46
29	0.0	0	1690.8	8	0.00	0	11.45	8	11.32	7	0.200	10	21.72

(Eq) Strokes Analyzed and Last Return (ft):
 11.25 10.41 10.38

Max. Combustion Pressure 1481.0 psi

Rut= 2700.0, Rtoe = 1080.0 kips, Time Inc. =0.087 ms

No	mxTForce	t	mxCForce	t	mxTStrss	t	mxCStrss	t	max V	t	max D	t	max Et
	kips	ms	kips	ms	ksi	ms	ksi	ms	ft/s	ms	inch	ms	kip-ft
1	0.0	0	4012.1	2	0.00	0	27.17	2	14.84	2	0.516	10	82.23
2	-48.6	50	4020.5	2	-0.33	50	27.23	2	14.81	2	0.507	10	81.79
3	-96.6	50	4021.4	2	-0.65	50	27.23	2	14.82	2	0.497	10	81.32
4	-143.5	49	4032.0	3	-0.97	49	27.31	3	14.80	3	0.487	10	80.84
5	-189.2	49	4020.5	3	-1.28	49	27.23	3	14.75	3	0.477	10	80.34
6	-233.6	49	4029.2	3	-1.58	49	27.29	3	14.75	3	0.467	10	79.80
7	-277.5	49	4025.8	3	-1.88	49	27.26	3	14.68	3	0.456	10	79.23
8	-322.2	49	4016.4	3	-2.18	49	27.20	3	14.65	3	0.445	9	78.60
9	-366.5	49	4022.2	4	-2.48	49	27.24	4	14.61	4	0.434	9	77.94
10	-406.4	49	4011.6	4	-2.75	49	27.17	4	14.51	4	0.422	9	77.28
11	-441.2	49	4010.7	4	-2.99	49	27.16	4	14.51	4	0.412	8	76.74
12	-471.6	49	4011.2	4	-3.19	49	27.16	4	14.45	4	0.402	8	76.23
13	-499.5	49	3997.9	4	-3.38	49	27.08	4	14.35	5	0.391	8	75.65
14	-526.1	49	4007.1	5	-3.56	49	27.14	5	14.31	5	0.380	8	74.99
15	-550.4	49	4016.2	5	-3.73	49	27.20	5	14.17	5	0.367	8	74.03
16	-568.0	23	4012.3	5	-3.85	23	27.17	5	13.95	5	0.354	9	72.45
17	-590.5	23	4002.9	5	-4.00	23	27.11	5	13.74	5	0.343	10	70.38
18	-589.5	23	3958.7	5	-3.99	23	26.81	5	13.43	5	0.333	10	68.04
19	-567.9	23	3904.7	6	-3.85	23	26.44	6	13.05	6	0.324	10	65.28
20	-524.2	22	3831.0	6	-3.55	22	25.94	6	12.67	6	0.314	10	62.04
21	-456.1	24	3729.2	6	-3.09	24	25.26	6	12.23	6	0.304	9	58.32
22	-391.3	23	3625.5	6	-2.65	23	24.55	6	11.76	6	0.292	9	54.08
23	-305.9	23	3500.8	6	-2.07	23	23.71	6	11.25	6	0.278	9	49.39
24	-203.2	23	3356.7	7	-1.38	23	22.73	7	10.74	7	0.262	10	44.37
25	-100.5	23	3193.6	7	-0.68	23	21.63	7	10.28	7	0.246	10	39.13
26	0.0	0	2985.1	7	0.00	0	20.22	7	10.11	7	0.229	10	33.87
27	0.0	0	2656.0	7	0.00	0	17.99	7	10.62	7	0.215	10	28.72
28	0.0	0	2161.6	7	0.00	0	14.64	7	11.35	7	0.203	10	23.67
29	0.0	0	1695.7	8	0.00	0	11.48	8	11.11	7	0.192	10	20.95

Activated Capacity 2657.1 k
 (Eq) Strokes Analyzed and Last Return (ft):
 11.25 10.45 10.41

Max. Combustion Pressure 1481.0 psi

Rut	Bl Ct	Stroke (ft)	Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt	
kips	b/ft	down	up			ksi			kip-ft	b/min	
600.0	14.6	8.55	8.53	-6.83	19	10	23.40	3	2	80.0	40.4
1200.0	46.7	9.47	9.49	-3.28	16	33	25.39	4	3	76.1	38.3
1400.0	55.3	9.67	9.68	-3.17	15	32	25.77	5	3	76.8	37.9
1600.0	65.9	9.81	9.82	-2.60	14	32	26.08	4	3	77.7	37.7
1800.0	79.4	9.95	9.94	-2.60	17	25	26.33	6	3	78.2	37.4
2000.0	97.1	10.07	10.06	-2.92	17	25	26.58	5	3	79.1	37.2
2200.0	121.0	10.18	10.18	-3.11	17	25	26.79	4	3	80.0	37.0
2400.0	154.9	10.30	10.27	-3.46	18	23	27.04	5	3	81.1	36.8
2600.0	201.4	10.41	10.38	-3.85	18	23	27.22	6	3	81.9	36.6
2700.0	230.5	10.45	10.41	-4.00	17	23	27.31	4	3	82.2	36.6