



DETERMINATION OF PILE DRIVEABILITY AND CAPACITY FROM PENETRATION TESTS. VOLUME 2 APPENDIXES

GOBLE, RAUSCHE, LIKINS AND ASSOCIATES, INC., CLEVELAND, OH

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FOREWORD

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This report, Determination of Pile Driveability and Capacity from Penetration Tests, is comprised of three volumes. Volume II (FHWA-RD-96-180), contained here, describes the data bank that has been assembled as part of the study and contains dynamic and static load test data. Volume I (FHWA-RD-96-179) summarizes the design and experimental use of a method that extracts dynamic soil resistance parameters as the Standard Penetration Test is being performed. Extensive correlations with full scale load tests were made based on these results. Volume III (FHWA-RD-96-181) documents the results oa literature study and summarizes available information on dynamic soil models and their parameters.

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Charles J. Nemmers, P.E. Office of Engineering Research and Development

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16. Abstract		
in situ soil testing techniques. As a her	ne potential improvement of dynamic v	wave equation analysis methodology using

in-situ soil testing techniques. As a basis for this investigation, the literature was reviewed and a summary was compiled of efforts made to date on the development of models and associated parameters for pile driving analysis. Furthermore a data base was developed containing more than 150 cases of test piles with static load tests, dynamic restrike tests, soil information, driving system data and installation records. One hundred data base cases were subjected to correlation studies using both wave equation and CAPWAP. This work yielded dynamic soil model parameters which did not indicate a specific relationship with soil grain size.

The in-situ soil testing device utilized was a Modified SPT which yielded data from both static and dynamic measurements. Either static uplift or torque tests yielded static ultimate shaft resistance, and uplift tests also indicated a shaft resistance quake. Static compressive tests on a special tip indicated ultimate end bearing and associated toe quake. Indirectly, by signal matching, soil damping parameters were calculated. These quantities were then used for the prediction of full-scale pile behavior. Data from the Modified SPT were gathered and analyzed on six sites with previous full-scale static pile tests and on three sites where static load tests were to be performed at a later date.

Recommendations derived from these tests pertain to the current soil model and to proposals for future changes. In general, the current approach was found to yield, on the average, very reasonable results for end of installation situations. For restrike tests, standard parameters may be misleading. Any necessary modifications to the current approach, for example, the use of particularly large toe quakes or low toe damping factors should be based on Modified SPT measurements. Differences between prediction and full-scale pile field behavior were attributed to soil strength changes over relatively small distances which cannot be detected with standard SPT spacings of 5 ft (1.5 m).

This volume is the first in a series.	Other volumes in the series are:
FHWA-RD-96-179	Volume I: Final Report
FHWA-RD-96-181	Volume III: Literature Review, Data Base and Appendixes

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* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

(Revised September 1993)

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LIST OF SYMBOLS

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А	-	cross section area or setup parameter
A3	-	average of the three highest shaft resistance per unit length
A _s	-	pile soil contact area
A _{toe}	-	toe area
В	-	pile width
CI	-	circumference of the pile
с	-	velocity of wave propagation
E	-	modulus of elasticity
F1	-	loading toe quake multiplier (hyperbolic model)
F2	-	unloading toe quake multiplier (hyperbolic model)
F _m (t)	-	force measured near the top of drill string
F [∔] (t)	-	downward traveling force wave
F [†] (t)	-	upward traveling force wave
\overline{f}_{s}	-	average unit sleeve friction
J or J _c	-	Smith damping constant
J _s	-	shaft damping
J _t	-	Toe damping
L	-	pile length below gauges
MS	-	shaft support soil mass
NFac	-	ratio of number of pile segments to soil segments
К	-	ratio of unit pile friction to unit sleeve friction
k	-	cushion stiffness
m	-	mass constant
Ν	-	SPT N-value
N ₆₀	-	SPT N-value corrected to 60 percent transfer efficiency
n	-	damping exponent
q	-	quake
Q _p	-	pile toe resistance
Q _s	-	pile shaft resistance or shaft quake
Q _t	-	toe quake
q _{c1} , q _{c2} , q _{c3}	-	average cone tip resistance
R	-	total measured toe resistance
R(t)	-	toe resistance force
R _a	-	inertia or acceleration dependent resistance
R _{cī}	-	total calculated toe resistance
R _d	-	dynamic or velocity dependent resistance

LIST OF SYMBOLS (continued)

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R _s	-	static or displacement dependent resistance
R _u	-	ultimate static capacity
SK	-	shaft radiation damping parameter
u(t)	-	displacement at the toe
ú(t)	-	velocity of soil
ü(t)	-	acceleration
ů _m	-	measured velocity
V _{impact}	-	SPT hammer impact velocity
Z1	-	impedance of the very top pile segment
ϕ_{a}	-	toe radiation damping constant
$ au_{o}$	-	soil shear strength at time t_o
τ(t)	-	soil shear strength at time t
Δ_{i}	-	final displacement

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А	-	setup factor
C ₁	-	frequency dependent parameter for toe soil stiffness (Mitwally and Novak, 1988)
C ₂	-	frequency dependence parameter for toe soil damping (Mitwally and Novak, 1988)
с _н	-	damping factor at toe (Holeyman, 1988)
Cs	-	frequency dependent shaft damping (Mitwally and Novak, 1988)
C _t	-	frequency dependent toe damping (Mitwally and Novak, 1988)
Cu	-	undrained shear strength
E	-	elastic modulus
E'	-	modulus of viscosity (Holeyman, 1988)
E,	-	initial tangent modulus (Holeyman, 1988)
f _s	-	cone shaft friction or unit shaft resistance
G	-	soil's shear modulus
G₅	-	toe soil shear modulus (Mitwally and Novak, 1988)
۱ _p	-	influence coefficient (Hussein, 1992)
Ĵ	-	Smith damping factor
J _c	-	Coyle-Gibson exponent damping factor
J _G	-	toe damping prior to failure (Lee et al., 1988)
J _G '	-	toe damping during failure (Lee et al., 1988)

LIST OF SYMBOLS (continued)

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JĽ,	-	shaft damping prior to failure (Lee et al., 1988)		
J _M	-	purely viscous damping factor (Middendorp and Brederode, 1984)		
J _{R.toe}	-	toe damping value (Randolph and Simons, 1986)		
J _s	-	shaft damping		
J _t	-	toe damping		
k	-	soil stiffness		
k _н	-	soil stiffness at toe (Holeyman, 1988)		
k _s	-	shaft soil stiffness		
k _t	-	soil stiffness (Randolph and Simons, 1986)		
m _s	-	soil mass		
n	-	Coyle-Gibson damping exponent		
p _c	-	cone tip pressure		
p _y	-	yield pressure (Liang and Sheng, 1992)		
q	-	quake		
q,	-	ultimate strength at the base (Holeyman, 1988)		
qs	-	shaft quake		
q _t	-	toe quake		
q _{ut}	-	unit toe resistance		
r _o	-	pile radius		
r _H	-	cone bottom radius (Holeyman, 1988)		
r _m	-	radius of zone of soil deformation (Nguyen et al., 1988)		
R _d	-	total dynamic soil resistance		
R _f	-	failure load (Lee et al., 1988)		
R _t	-	total shaft resistance (Middendorp and Brederode, 1984)		
R _s	-	total static soil resistance		
R _u	-	ultimate resistance		
R _{t1}	-	failure load at time t ₁		
R _{t2}	-	failure load at time t ₂		
S ₁	-	frequency dependent parameter for shaft soil stiffness (Mitwally and		
		Novak, 1988)		
S ₂	-	frequency dependent parameter for shaft soil damping (Mitwally and		
		Novak, 1988)		
t _i	-	time to failure		
u	-	displacement of pile segment		
ù	-	velocity of pile segment		
ü	-	acceleration of pile segment		

LIST OF SYMBOLS (continued)

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u _o	-	pore water pressure
V ₁	-	pile velocity (Briaud and Garland, 1984)
V ₂	-	pile static reference velocity (Briaud and Garland, 1984)
V _s	-	shear wave velocity
σ	-	stress
ε	-	strain
ε _ι	-	average volumetric locking strain (Liang and Hussein, 1992)
ρ	-	soil mass density
$ au_{max}$	-	maximum shear strain (Nguyen et al., 1988)
τ	-	soil shear strength (Liang and Hussein, 1992)
$\tau_{\rm u}$	-	ultimate shear stress
ν	-	Poisson's ratio
ϕ	-	friction angle of soil
ω	-	frequency

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APPENDIX A

WAVE EQUATION ANALYSIS RESULTS

A.1 INTRODUCTION

The wave equation analyses were performed with GRLWEAP[™], Version 1.993-1. Two types of analysis were performed: bearing graph analysis and driveability analysis. This appendix presents the GRLWEAP summary results for six correlation study sites and three verification sites which are discussed in chapters 6 and 7, respectively. For each site, several analyses were performed with different distributions and magnitudes of soil resistance, and with a number of different dynamic soil parameters. These analyses were identified as summarized in the following (see chapter 6.3 for detail discussion).

STD-ST:	soil resistance from "Modified SPT STATIC" analysis and standard GRLWEAP
	soil parameters.
MDF-ST:	soil resistance from "Modified SPT STATIC" analysis, standard shaft GRLWEAP
	soil parameters; toe damping (J _t) as per SPT-ST (except Portland: $J_t = .01$ s/ft).
SPT-ST:	soil resistance from "Modified SPT STATIC" analysis; soil parameters from the
	"static" analysis of the Modified SPT data.
SPT-DYN:	soil resistance from "Modified SPT DYNAMIC" analysis; soil parameters from
	the "dynamic" analysis of the Modified SPT data.
MDF-Cap-STD:	modified shaft resistance (see chapter 6.3), toe resistance from "Modified SPT
	STATIC" analysis; standard GRLWEAP soil parameters.
MDF-Cap-SPT:	modified shaft resistance (see chapter 6.3), toe resistance from "Modified SPT
	STATIC" analysis; soil parameters from the "static analysis" of the Modified SPT
	data.
STD (FHWA):	soil resistance from the FHWA method (see chapter 6.1); standard GRLWEAP
	soil parameters.

A.2 Bearing Graph Analysis

The bearing graph analysis results for nine sites are presented in figures A.1 through A.52 and are summarized in table A.1.

A.3 Driveability Analysis

The driveability analysis results for nine sites are presented in figures A.53 through A.104 and are summarized in table A.2.

Table A.1: Summary of Bearing Graph Analysis Results			
Sites	Parameters Type	Figure	
St. Mary, OH	STD-ST	A.1	
	SPT-ST	A.2	
	SPT-DYN	A.3	
	MDF-ST	A.4	
Portland, ME	STD-ST	A.5	
	SPT-ST	A.6	
	SPT-DYN	A.7	
	MDF-ST	A.8	
	MDF-Cap-STD	A.9	
	MDF-Cap-SPT	A.10	
C&D Canal, Pier 17, DE	STD-ST	A.11	
	SPT-ST	A.12	
	SPT-DYN	A.13	
	MDF-ST	A.14	
	MDF-Cap-STD	A.15	
	MDF-Cap-SPT	A.16	
C&D Canal, Pier 21, DE	STD-ST	A.17	
	SPT-ST	A.18	
	SPT-DYN	A.19	
	MDF-ST	A.20	
	MDF-Cap-STD	A.21	
	MDF-Cap-SPT	A.22	
White City Bridge, FL	STD-ST	A.23	
	SPT-ST	A.24	
	SPT-DYN	A.25	
Apalachicola, FL	STD-ST	A.26	

Table A.1: Summary of Bearing Graph Analysis Results (continued)			
Sites	Parameters Type	Figure	
Apalachicola, FL	SPT-ST	A.27	
(continued)	SPT-DYN	A.28	
	MDF-ST	A.29	
	MDF-Cap-STD	A.30	
	MDF-Cap-SPT	A.31	
Aucilla, FL	STD-ST	A.32	
	STD-DYN	A.33	
	SPT-ST	A.34	
	SPT-DYN	A.35	
	MDF-ST	Á.36	
	MDF-DYN	A.37	
	STD (FHWA)	A.38	
Vilano - East, FL	STD-ST	A.39	
	STD-DYN	A.40	
	SPT-ST	A.41	
	SPT-DYN	A.42	
	MDF-ST	A.43	
	MDF-DYN	A.44	
	STD (FHWA)	A.45	
Vilano - West, FL	STD-ST	A.46	
	STD-DYN	A.47	
	SPT-ST	A.48	
	SPT-DYN	A.49	
	MDF-ST	A.50	
	MDF-DYN	A.51	
	STD (FHWA)	A.52	

Table A.2: Summary of Driveability Analysis Results		
Sites	Parameters Type	Figure
St. Mary, OH	STD-ST	A.53
	SPT-ST	A.54
	SPT-DYN	A.55
	MDF-ST	A.56
Portland, ME	STD-ST	A.57
	SPT-ST	A.58
	SPT-DYN	A.59
	MDF-ST	A.60
	MDF-Cap-STD	A.61
	MDF-Cap-SPT	A.62
C&D Canal, Pier 17, DE	STD-ST	A.63
	SPT-ST	A.64
	SPT-DYN	A.65
	MDF-ST	A.66
	MDF-Cap-STD	A.67
	MDF-Cap-SPT	A.68
C&D Canal, Pier 21, DE	STD-ST	A.69
	SPT-ST	A.70
	SPT-DYN	A.71
	MDF-ST	A.72
	MDF-Cap-STD	A.73
	MDF-Cap-SPT	A.74
White City Bridge, FL	STD-ST	A.75
	SPT-ST	A.76
	SPT-DYN	A.77
Apalachicola, FL	STD-ST	A.78

Table A.2: Summary of Driveability Analysis Results (continued)			
Sites	Parameters Type	Figure	
Apalachicola, FL	SPT-ST	A.79	
(continued)	SPT-DYN	A.80	
	MDF-ST	A.81	
	MDF-Cap-STD	A.82	
	MDF-Cap-SPT	A.83	
Aucilla, FL	STD-ST	A.84	
	STD-DYN	A.85	
	SPT-ST	A.86	
	SPT-DYN	A.87	
	MDF-ST	A.88	
	MDF-DYN	A.80	
	STD (FHWA)	A.90	
Vilano - East, FL	STD-ST	A.91	
	STD-DYN	A.92	
	SPT-ST	A.93	
	SPT-DYN	A.94	
	MDF-ST	A.95	
	MDF-DYN	A.96	
	STD (FHWA)	A.97	
Vilano - West, FL	STD-ST	A.98	
	STD-DYN	A.99	
	SPT-ST	A.100	
	SPT-DYN	A.101	
	MDF-ST	A.102	
	MDF-DYN	A.103	
	STD (FHWA)	A.104	

St.Mary, Bearing Graph, STD Parm. Static

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	50.0	25.472	6.904	6.7	5.00	20.63
2	100.0	25.489	1.072	12.7	5.00	20.64
3	150.0	25.506	2.168	18.7	5.00	20.31
4	200.0	25.523	3.573	28.2	5.00	19.78
5	250.0	25.540	1.898	45.7	5.00	19.51
6	275.0	25.548	2.084	61.5	5.00	19.38
7	300.0	25.555	1.750	88.7	5.00	19.27
8	325.0	25.578	1.842	146.6	5.00	19.15
9	350.0	25.599	1.994	347.3	5.00	19.05
10	375.0	25.607	2.051	6925.8	5.00	18.95



Figure A.1: Bearing Graph STD-ST Analysis for St. Mary, OH

St.Marv.	Bearing	Graph,	SPT	Parm.	Static
----------	---------	--------	-----	-------	--------

Stroke Energy No. Ultimate Max C. Max T. Blow Capacity Stress Stress Count ksi BPF ft k-ft kips ksi 50.0 25.481 11.686 4.7 5.00 20.64 1 25.508 6.009 8.8 5.00 20.62 2 100.0 3 150.0 25.538 4.083 13.2 5.00 20.49 2.253 18.1 5.00 20.17 4 200.0 25.568 5 2.353 25.9 5.00 19.69 250.0 25.598 6 275.0 25.613 2.337 30.5 5.00 19.57 7 300.0 25.628 2.419 38.0 5.00 19.44 2.779 8 325.0 25.642 50.5 5.00 19.32 9 350.0 25.657 2.433 73.6 5.00 19.21 10 375.0 25.672 2.637 113.0 5.00 19.09



Figure A.2: Bearing Graph SPT-ST Analysis for St. Mary, OH

St.Mary, Bearing (Graph,SPT	Parm,	Dynamic
--------------------	-----------	-------	---------

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	50.0	24.953	8.163	6.9	5.00	19.76
2	100.0	24.962	2.817	13.3	5.00	19.58
3	150.0	24.970	1.463	20.0	5.00	19.16
4	200.0	24.978	2.072	31.3	5.00	18.92
5	250.0	24.989	1.942	54.1	5.00	18.70
6	275.0	24.995	2.143	77.3	5.00	18.60
7	300.0	25.000	2.290	124.2	5.00	18.50
8	325.0	25.006	2.414	265.5	5.00	18.40
9	350.0	25.011	2.494	1289.8	5.00	18.31
10	375.0	25.016	2.508	9999.0	5.00	18.23



Figure A.3: Bearing Graph SPT-DYN Analysis for St. Mary, OH

St.Mary, Bearing Graph, MDF Parm. Static

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	Capacity	Stress	Stress	Count		
	kips	ksi	ksi	BPF	ft	k-ft
1	50.0	25.472	9.718	5.7	5.00	20.58
2	100.0	25.489	4.548	10.8	5.00	20.62
3	150.0	25.506	2.291	16.0	5.00	20.38
4	200.0	25.523	2.882	23.3	5.00	19.88
5	250.0	25.540	3.706	36.3	5.00	19.51
6	275.0	25.548	2.532	47.8	5.00	19.38
7	300.0	25.557	2.740	67.1	5.00	19.27
8	325.0	25.565	2.586	106.3	5.00	19.15
9	350.0	25.573	2.297	211.3	5.00	19.05
10	375.0	25.582	2.036	494.8	5.00	18.95



Figure A.4: Bearing Graph MDF-ST Analysis for St. Mary, OH

Portland, Bearing Graph, STD, Static

No. Ultimate Max C. Max T. Blow Stroke Energy Capacity Stress Stress Count kips ksi ksi BPF ft k-ft 1 50.0 .000 .000 -1.0 .00 .00 42.00 2 100.0 15.298 .000 4.5 4.56 3 5.00 37.31 150.0 17.719 .132 7.5 5.21 33.89 4 200.0 18.824 .718 11.0 32.86 5 250.0 20.700 14.8 5.65 .866 6 300.0 21.926 .954 18.8 5.87 31.75 7 325.0 22.935 .989 21.0 5.98 31.40 30.98 8 350.0 23.650 1.103 23.5 6.04 31.16 9 375.0 24.791 1.206 26.0 6.21 10 400.0 25.574 1.347 28.7 6.30 31.20



Figure A.5: Bearing Graph STD-ST Analysis for Portland, ME

No.	Ultimate Corrective	Max C.	Max T.	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	50.0	10.981	.000	2.9	3.93	44.99
2	100.0	15.593	.000	6.7	4.72	37.38
3	150.0	18.352	.000	11.0	5.30	34.34
4	200.0	21.405	.000	15.9	5.59	32.00
5	250.0	24.140	.000	20.9	5.95	31.56
6	300.0	25.718	.000	26.8	6.12	31.03
7	325.0	26.477	.210	30.2	6.21	30.86
8	350.0	27.557	.550	33.5	6.40	31.27
9	375.0	28.263	.694	37.6	6.50	31.52
10	400.0	28.728	.699	42.3	6.54	31.56



Figure A.6: Bearing Graph SPT-ST Analysis for Portland, ME

Portland, Bearing Graph, SPT, Dynamic

No.	Ultimate Consoity	Max C.	Max T.	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	50.0	10.910	.000	2.9	3.93	44.96
2	100.0	15.534	.000	6.7	4.72	37.25
3	150.0	18.375	.000	11.1	5.30	34.30
4	200.0	21.345	.000	16.1	5.60	31.95
5	250.0	23.850	.000	21.2	5.94	31.55
6	300.0	25.461	.000	27.2	6.11	31.12
7	325.0	26.186	.208	30.7	6.20	30.99
8	350.0	27.371	.463	34.1	6.40	31.55
9	375.0	28.085	.590	38.3	6.51	31.67
10	400.0	28.607	.558	43.2	6.56	31.75



Figure A.7: Bearing Graph SPT-DYN Analysis for Portland, ME

Portland, Bearing Graph, MDF, Static

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	50.0	.000	.000	-1.0	.00	.00
2	100.0	.000	.000	-1.0	.00	.00
3	150.0	14.687	.000	4.0	4.19	41.53
4	200.0	15.991	.399	5.9	4.51	38.34
5	250.0	17.512	2.580	8.0	4.89	36.97
6	300.0	19.089	1.717	10.1	5.26	35.97
7	325.0	19,421	2.542	11.5	5.31	34.76
8	350.0	20.279	1.934	12.6	5.53	34.62
9	375.0	20.737	1.343	14.2	5.65	34.12
10	400.0	21.023	2.407	16.2	5.70	33.45



Figure A.8: Bearing Graph MDF-ST Analysis for Portland, ME

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	Capacity kips	Stress ksi	Stress ksi	BPF	ft	k-ft
1	50.0	.000	.000	-1.0	.00	.00
2	100.0	15.463	.000	4.6	4.58	41.71
3	150.0	18.003	.212	7.7	5.02	37,15
4	200.0	19.123	.499	11.3	5.24	33.68
5	250.0	21.039	.635	15.1	5.69	32.85
6	300.0	23.497	.690	19.2	5.91	31.73
7	325.0	24.662	.770	21.4	6.03	31.60
8	350.0	25.504	.886	23.9	6.08	31.26
9	375.0	26.737	1.013	26.3	6.27	31.46
10	400.0	27.554	1.221	29.1	6.36	31.40



Figure A.9: Bearing Graph MDF-Cap-STD Analysis for Portland, ME

Portland, Bearing Graph, MDF-Cap-SPT, ST

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	Capacity	Stress	Stress	Count		
	kips	ksi	ksi	BPF	ft	k-ft
1	50.0	11.001	.000	3.0	3.93	44.23
2	100.0	16.034	.000	7.0	4.72	36.44
3	150.0	19.546	.000	11.5	5.40	33.69
4	200.0	23.516	.000	16.6	5.74	31.83
5	250.0	25.544	.000	22.2	5.91	30.88
6	300.0	28.015	.195	28.1	6.26	31.32
7	325.0	29.176	.265	31.3	6.43	31.68
8	350.0	29.948	.175	35.3	6.52	31.79
9	375.0	30.434	.201	39.9	6.57	31.83
10	400.0	31.584	.294	44.2	6.75	32.51



Figure A.10: Bearing Graph MDF-Cap-SPT Analysis for Portland, ME

C&D P17, Bearing Graph, STD Parm, ST

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.607	1.753	4.1	7.15	43.53
2	200.0	2.672	1.477	9.8	7.34	37.24
3	300.0	2.813	1.295	17.3	7.81	34.53
4	400.0	2.894	1.108	25.1	8.04	32.86
5	500.0	2.924	.923	36.2	8.15	31.87
6	600.0	2.985	.772	50.9	8.42	31.70
7	700.0	3.018	.617	67.8	8.55	32.18
8	800.0	3.031	.500	78.3	8.62	32.21
9	900.0	3.036	.349	89.7	8.65	31.92
10	1000.0	3.096	.244	100.4	8.86	32.42



Figure A.11: Bearing Graph STD-ST C&D Canal, Pier 17, DE

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No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.713	1.809	5.0	7.15	41.20
2	200.0	2.866	1.585	11.7	7.63	36.40
3	300.0	2.927	1.314	19.9	7.87	33.98
4	400.0	3.037	1.118	27.8	8.25	33.10
5	500.0	3.098	.907	39.7	8.44	32.34
6	600.0	3.131	.691	53.0	8.54	31.49
7	700.0	3.199	.509	59.6	8.78	31.86
8	800.0	3.236	.325	67.8	8.90	31.70
9	900.0	3.252	.245	77.9	8.96	31.63
10	1000.0	3.270	.173	90.0	8.99	31.63



Figure A.12: Bearing Graph SPT-ST C&D Canal, Pier 17, DE

C&D P17	7,	Bearing	Graph,	SPT	Parm,	DYN

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.734	1.887	4.5	7.15	41.74
2	200.0	2.837	1.642	10.3	7.56	37.07
3	300.0	2.964	1.455	17.4	7.96	34.60
4	400.0	3.036	1.241	24.5	8.17	32.98
5	500.0	3.067	1.020	33.6	8.27	32.04
6	600.0	3.136	.842	43.5	8.53	32.15
7	700.0	3.173	.658	51.7	8.66	32.02
8	800.0	3.195	.475	57.8	8.73	31.67
9	900.0	3.204	.301	65.1	8.76	31.09
10	1000.0	3.208	.199	73.5	8.78	30.85



Figure A.13: Bearing Graph SPT-DYN C&D Canal, Pier 17, DE

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Ultimate	Max C.	Max T.	Blow	Stroke	Energy
Capacity	Stress	Stress	Count		
kips	ksi	ksi	BPF	ft	k-ft
100.0	2.567	1.811	3.6	6.83	43.79
200.0	2.709	1.689	8.2	7.28	38.58
300.0	2.851	1.581	14.4	7.73	35.46
400.0	2.924	1.425	21.6	7.95	33.65
500.0	2.953	1.238	29.5	8.07	32.48
600.0	3.024	1.098	40.0	8.33	32.29
700.0	3.053	.939	52.6	8.46	32.62
800.0	3.075	.787	64.6	8.52	32.81
900.0	3.078	.642	72.6	8.55	32.62
1000.0	3.082	.512	82.1	8.57	32.27
	Ultimate Capacity kips 100.0 200.0 300.0 400.0 500.0 600.0 700.0 800.0 900.0 1000.0	Ultimate Max C. Capacity Stress kips ksi 100.0 2.567 200.0 2.709 300.0 2.851 400.0 2.924 500.0 2.953 600.0 3.024 700.0 3.053 800.0 3.075 900.0 3.078 1000.0 3.082	UltimateMax C.Max T.CapacityStressStresskipsksiksi100.02.5671.811200.02.7091.689300.02.8511.581400.02.9241.425500.02.9531.238600.03.0241.098700.03.053.939800.03.075.787900.03.082.512	UltimateMax C.Max T.BlowCapacityStressStressCountkipsksiksiBPF100.02.5671.8113.6200.02.7091.6898.2300.02.8511.58114.4400.02.9241.42521.6500.02.9531.23829.5600.03.0241.09840.0700.03.053.93952.6800.03.075.78764.6900.03.078.64272.61000.03.082.51282.1	Ultimate Max C. Max T. Blow Stroke Capacity Stress Stress Count Ksi BPF ft 100.0 2.567 1.811 3.6 6.83 200.0 2.709 1.689 8.2 7.28 300.0 2.851 1.581 14.4 7.73 400.0 2.924 1.425 21.6 7.95 500.0 2.953 1.238 29.5 8.07 600.0 3.024 1.098 40.0 8.33 700.0 3.053 .939 52.6 8.46 800.0 3.075 .787 64.6 8.52 900.0 3.078 .642 72.6 8.55 1000.0 3.082 .512 82.1 8.57



Figure A.14: Bearing Graph MDF-ST C&D Canal, Pier 17, DE

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	Capacity kips	Stress ksi	Stress ksi	Count BPF	ft	k-ft
1	100.0	2.447	1.623	4.3	7.15	40.50
2	200.0	2.529	1.406	10.4	7.41	34.17
3	300.0	2.664	1.266	18.5	7.87	31.35
4	400.0	2.728	1.085	26.8	8.10	29.58
5	500.0	2.753	.900	39.3	8.21	28.58
6	600.0	2.808	.750	55.0	8.44	28.48
7	700.0	2.837	.599	70.0	8.56	28.73
8	800.0	2.848	.452	79.8	8.61	28.45
. 9	900.0	2.857	.326	91.9	8.64	27.96
10	1000.0	2.930	.288	102.4	8.91	28.40



Figure A.15: Bearing Graph MDF-Cap-STD C&D Canal, Pier 17, DE

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No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.480	1.553	6.0	7.15	35.86
2	200.0	2.637	1.345	14.0	7.74	31.73
3	300.0	2.714	1.114	23.8	8.03	29.29
4	400.0	2.804	.918	35.5	8.35	28.04
5	500.0	2.851	.715	52.3	8.51	26.77
6	600.0	2.879	.524	64.0	8.58	26.24
7	700.0	2.948	.379	73.1	8.85	26.41
8	800.0	2.976	.227	85.2	8.99	26.46
9	900.0	3.003	.087	99.8	9.05	26.61
10	1000.0	3.011	.038	119.3	9.09	26.56



Figure A.16: Bearing Graph MDF-Cap-SPT C&D Canal, Pier 17, DE

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	capacity kips	stress ksi	stress ksi	BPF	ft	k-ft
-	100.0	0 593	1 920	4 0	7 15	13 65
1	100.0	2.503	1.020	4.0	7.15	43.05
2	250.0	2.753	1.594	13.1	7.59	34.84
3	400.0	2.893	1.370	24.6	8.06	32.26
4	550.0	2.966	1.125	42.1	8.30	31.02
5	700.0	2.999	.912	59.8	8.41	30.76
6	850.0	3.104	.765	69.3	8.75	31.31
7	1000.0	3.167	.632	82.6	8.92	30.98
8	1150.0	3.211	.514	100.2	9.00	31.14
9	1300.0	3.229	.408	124.8	9.04	31.05
10	1500.0	3.307	.292	163.7	9.27	31.95



Figure A.17: Bearing Graph STD-ST, C&D Canal, Pier 21, DE

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.616	1.968	3.3	7.15	42.97
2	250.0	2.738	1.819	9.7	7.47	35.12
3	400.0	2.906	1.733	18.2	8.01	31.94
4	550.0	2.983	1.577	26.6	8.27	30.75
5	700.0	3.026	1.395	36.0	8.41	30.11
6	850.0	3.057	1.215	45.7	8.48	29.85
7	1000.0	3.072	1.033	51.6	8.51	29.38
8	1150.0	3.137	.897	57.2	8.77	29.63
9	1300.0	3.167	.754	64.3	8.90	30.13
10	1500.0	3.193	.602	77.4	8.96	30.12



Figure A.18: Bearing Graph SPT-ST, C&D Canal, Pier 21, DE

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy	
	Capacity kips	Stress ksi	Stress ksi	BPF	ft	k-ft	
1	100.0	2.629	2.004	3.2	7.15	42.65	
2	250.0	2.760	1.892	9.8	7.53	34.37	
3	400.0	2.910	1.822	17.9	8.03	31.59	
4	550.0	2.986	1.691	25.6	8.29	30.66	
5	700.0	3.030	1.528	35.0	8.41	29.82	
6	850.0	3.053	1.363	44.2	8.48	29.14	
7	1000.0	3.113	1.237	48.8	8.69	29.39	
8	1150.0	3.174	1.098	54.3	8.80	29.89	
9	1300.0	3.197	.955	61.2	8.85	30.14	
10	1500.0	3,206	.745	74.5	8,88	30.06	



Figure A.19: Bearing Graph SPT-DYN, C&D Canal, Pier 21, DE

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No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	Capacity	Stress	Stress	Count		
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.504	1.777	3.9	6.86	42.51
2	250.0	2.753	1.674	12.4	7.58	34.98
3	400.0	2.863	1.463	23.8	7.94	31.66
4	550.0	2.969	1.263	38.9	8.32	31.05
5	700.0	3.023	1.051	56.2	8.51	31.11
6	850.0	3.065	.877	66.6	8.60	30.60
7	1000.0	3.163	.757	77.2	8.90	30.95
8	1150.0	3.216	.638	92.0	9.05	31.26
9	1300.0	3.250	.526	112.1	9.13	31.43
10	1500.0	3.279	.398	151.1	9.17	31.48



Figure A.20: Bearing Graph MDF-ST, C&D Canal, Pier 21, DE

C&D P21, B.G, STD Parm, MDF Capacity

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No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.582	1.846	4.0	7.15	43.46
2	250.0	2.770	1.671	13.1	7.63	34.55
3	400.0	2.901	1.470	24.4	8.09	32.00
4	550.0	2.981	1.248	41.0	8.32	30.75
5	700.0	3.016	1.027	56.6	8.43	30.27
6	850.0	3.131	.887	65.1	8.79	30.78
7	1000.0	3.202	.742	76.7	8.97	31.06
8	1150.0	3.241	.616	92.2	9.06	31.24
9	1300.0	3.264	.509	113.0	9.10	31.26
10	1500.0	3.288	.377	152.6	9.13	31.17





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C&D P21, B.G, SPT Parm, MDF Capacity

No. Ultimate Max C. Max T. Blow Stroke Energy Capacity Stress Stress Count ksi BPF ft k-ft kips ksi 100.0 2.628 1.996 3.3 7.15 42.72 1 34.74 2 250.0 2.751 1.876 9.7 7.49 31.68 3 400.0 2.919 1.821 18.1 8.03 4 550.0 2.998 1.691 26.2 8.29 30.53 5 700.0 3.038 1.532 35.0 8.43 29.79 8.49 29.47 6 850.0 3.075 1.378 44.1 7 1000.0 3.087 1.214 50.1 8.53 28.80 55.6 8.78 29.52 8 1150.0 3.142 1.100 9 1300.0 3.197 .982 61.7 8.90 30.21 10 1500.0 3.212 .801 74.5 8.97 30.27



Figure A.22: Bearing Graph MDF-Cap-SPT, C&D Canal, Pier 21, DE

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No.	Ultimate	Max C. Stress	Max T.	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	50.0	1.504	.750	2.4	5.96	36.57
2	100.0	1,566	.663	5.1	6.18	30.80
3	200.0	1.779	.574	13.9	6.94	23.54
4	300.0	1.881	.454	28.0	7.32	19.87
5	400.0	1.921	.383	44.8	7.50	18.42
6	500.0	1.930	.286	77.1	7.60	17.11
7	550.0	1.974	.264	103.2	7.84	16.96
8	600.0	1.998	.233	127.9	7.96	16.58
9	650.0	2.010	.205	157.1	8.02	16.38
10	700.0	2.019	.226	181.5	8.05	16.46



Figure A.23: Bearing Graph STD-ST, White City Bridge, FL

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WHITE CITY, Bearing Graph, SPT Parm, ST

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	Capacity	Stress	Stress	Count		
	kips	ksi	ksi	BPF	ft	k-ft
1	50.0	1.458	.770	2.0	5.79	36.89
2	100.0	1.509	.750	3.1	5.94	33.99
3	200.0	1.754	.829	8.8	6.71	25.59
4	300.0	1.840	.736	16.4	7.10	22.15
5	400.0	1.869	.587	25.8	7.29	19.89
6	500.0	1.897	.494	37.7	7.39	18.34
7	550.0	1.945	.467	45.2	7.64	18.05
8	600.0	1.970	.502	56.7	7.76	17.33
9	650.0	1.985	.654	71.0	7.82	16.50
10	700.0	2.001	.793	83.8	7.85	15.76



Figure A.24: Bearing Graph SPT-ST, White City Bridge, FL

WHITE CITY, Bearing Graph, SPT Parm, DYN

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	50.0	1.473	.753	2.2	5.86	37.33
2	100.0	1.532	.689	4.1	6.07	32.78
3	200.0	1.706	.643	11.2	6.72	25.54
4	300.0	1.810	.611	23.3	7.04	20.95
5	400.0	1.907	.612	38.8	7.44	19.18
6	500.0	1.943	.560	63.9	7.64	18.18
7	550.0	1.963	.533	85.6	7.74	17.80
8	600.0	1.966	.492	126.2	7.79	17.18
9	650.0	1.973	.453	167.7	7.81	16.62
10	700.0	2.002	.436	223.4	7.99	16.32



Figure A.25: Bearing Graph SPT-DYN, White City Bridge, FL
APALACHICOLA, STD, STATIC, BEARING GRAPH

No.	Ultimate Capacity	Max C. Stress	Max T.	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.001	1.179	7.4	3.00	22.84
2	200.0	2.007	.892	15.2	3.00	22.41
3	300.0	2.014	.653	23.5	3.00	22.03
4	400.0	2.020	.453	33.0	3.00	21.89
5	500.0	2.026	.299	41.0	3.00	21.52
6	600.0	2.031	.429	51.6	3.00	21.03
7	700.0	2.037	.419	67.0	3.00	20.34
8	800.0	2.042	.367	89.9	3.00	19.76
9	900.0	2.048	.374	123.6	3.00	19.43
10	1000.0	2.054	.362	178.6	3.00	19.13



Figure A.26: Bearing Graph STD-ST, Apalachicola, FL

APALACHICOLA, SPT, STATIC, BEARING GRAPH

No.	Ultimate Capacitv	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.999	1.236	7.1	3.00	22.99
2	200.0	2.005	.977	13.8	3.00	22.51
3	300.0	2.010	.738	21.2	3.00	22.16
4	400.0	2.014	.513	29.7	3.00	21.91
5	500.0	2.018	.378	36.7	3.00	21.88
6	600.0	2.023	.418	45.5	3.00	21.42
7	700.0	2.028	.446	58.1	3.00	20.76
8	800.0	2.032	.445	77.8	3.00	20.15
9	900.0	2.036	.451	113.1	3.00	19.87
10	1000.0	2.040	. 460	186.3	3.00	19.58



Figure A.27: Bearing Graph SPT-ST, Apalachicola, FL

APALACHICOLA, SPT, DYN, BEARING GRAPH

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	Capacity kips	Stress ksi	Stress ksi	Count BPF	ft	k-ft
1	100.0	1.999	1.246	6.6	3.00	23.74
2	200.0	2.005	.995	13.4	3.00	22.54
3	300.0	2.010	.760	20.6	3.00	22.22
4	400.0	2.014	.535	29.1	3.00	22.00
5	500.0	2.018	.351	36.6	3.00	21.80
6	600.0	2.023	.444	45.3	3.00	21.46
7	700.0	2.028	.419	58.1	3.00	21.07
8	800.0	2.032	.396	78.5	3.00	20.42
9	900.0	2.036	.384	115.9	3.00	20.06
10	1000.0	2.040	.384	198.5	3.00	19.79



Figure A.28: Bearing Graph SPT-DYN, Apalachicola, FL

APALACHICOLA, MDF, STATIC, BEARING GRAPH

Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
kips	ksi	ksi	BPF	ft	k-ft
100.0	2.001	1.249	6.9	3.00	22.81
200.0	2.007	1.008	13.6	3.00	22.37
300.0	2.013	.786	21.0	3.00	21.98
400.0	2.020	.587	29.8	3.00	21.89
500.0	2.026	.408	37.5	3.00	21.32
600.0	2.032	.469	46.7	3.00	21.02
700.0	2.037	.534	59.9	3.00	20.42
800.0	2.043	.521	80.4	3.00	19.78
900.0	2.048	.537	111.5	3.00	19.45
1000.0	2.054	.517	160.6	3.00	19.13
	Ultimate Capacity kips 100.0 200.0 300.0 400.0 500.0 600.0 700.0 800.0 900.0 1000.0	Ultimate Max C. Capacity Stress kips ksi 100.0 2.001 200.0 2.007 300.0 2.013 400.0 2.020 500.0 2.026 600.0 2.032 700.0 2.037 800.0 2.043 900.0 2.048 1000.0 2.054	Ultimate Max C. Max T. Capacity Stress ksi ksi 100.0 2.001 1.249 200.0 2.007 1.008 300.0 2.013 .786 400.0 2.020 .587 500.0 2.026 .408 600.0 2.032 .469 700.0 2.037 .534 800.0 2.043 .521 900.0 2.048 .537 1000.0 2.054 .517	Ultimate Capacity kipsMax C. Stress ksiMax T. Stress Stress BPF100.02.0011.2496.9200.02.0071.00813.6300.02.013.78621.0400.02.020.58729.8500.02.032.46946.7700.02.037.53459.9800.02.043.52180.4900.02.054.517160.6	Ultimate Capacity kipsMax C. Stress ksiMax T. Stress ksiBlow Count BPFStroke ft100.02.0011.2496.93.00200.02.0071.00813.63.00300.02.013.78621.03.00400.02.020.58729.83.00500.02.026.40837.53.00600.02.032.46946.73.00700.02.037.53459.93.00800.02.043.52180.43.00900.02.054.517160.63.00



Figure A.29: Bearing Graph MDF-ST, Apalachicola, FL

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APALACHICOLA, MODIFIED CAPACITY, STD, BG

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	Capacity	Stress	Stress	Count	f+	k-ft
	KTD2	KƏT	KOT	0.1	10	K-1C
1	100.0	2.009	1.212	7.4	3.00	22.88
2	200.0	2.013	.915	15.5	3.00	22.54
3	300.0	2.018	.675	24.3	3.00	22.19
4	400.0	2.022	.483	34.5	3.00	21.97
5	500.0	2.026	.432	43.7	3.00	21.92
6	600.0	2.031	.439	55.6	3.00	21.49
7	700.0	2.036	.418	73.4	3.00	20.87
8	800.0	2.040	.439	102.6	3.00	20.29
9	900.0	2.044	.442	152.8	3.00	20.02
10	1000.0	2.048	.446	247.4	3.00	19.75



Figure A.30: Bearing Graph MDF-Cap-STD, Apalachicola, FL

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APALACHICOLA, MODIFIED CAPACITY, SPT, BG

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.009	1.286	6.9	3.00	22.88
2	200.0	2.013	1.037	13.3	3.00	22.49
3	300.0	2.018	.801	20.4	3.00	22.16
4	400.0	2.022	.580	28.6	3.00	21.91
5	500.0	2.026	.413	35.8	3.00	21.86
6	600.0	2.031	. 449	44.1	3.00	21.45
7	700.0	2.036	.482	55.8	3.00	20.97
8	800.0	2.040	.490	74.0	3.00	20.25
9	900.0	2.044	.489	105.8	3.00	19.98
10	1000.0	2.048	.497	169.5	3.00	19.71



Figure A.31: Bearing Graph MDF-Cap-SPT, Apalachicola, FL

Aucilla, Bearing Graph, STD, Static

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.642	.589	13.0	3.00	12.49
2	300.0	1.695	.298	45.8	3.00	11.45
3	400.0	1.719	. 226	70.5	3.00	10.73
4	500.0	1.741	.167	123.5	3.00	9.81
5	600.0	1.763	.090	290.0	3.00	9.01
6	700.0	1.784	.100	1214.6	3.00	8.33
7	800.0	1.804	.155	9999.0	3.00	7.77



Figure A.32: Bearing Graph STD-ST Analysis for Aucilla, FL

Aucilla, Bearing Graph, STD, Dynamic

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.644	.607	12.9	3.00	12.46
2	300.0	1.701	.304	45.6	3.00	11.36
3	400.0	1.726	.255	70.1	3.00	10.58
4	500.0	1.750	.205	122.7	3.00	9.61
5	600.0	1.772	.125	286.1	3.00	8.76
6	700.0	1.794	.133	1182.9	3.00	8.09
7	800.0	1.815	.175	9999.0	3.00	7.52



Figure A.33: Bearing Graph STD-DYN Analysis for Aucilla, FL

Aucilla, Bearing Graph, SPT, Static

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.639	.687	10.8	3.00	12.55
2	300.0	1.685	.360	36.0	3.00	11.60
3	400.0	1.707	.306	51.1	3.00	11.05
4	500.0	1.727	.196	80.1	3.00	10.17
5	600.0	1.747	.161	158.5	3.00	9.45
6	700.0	1.765	.256	583.5	3.00	8.84
7	800.0	1.784	.301	9999.0	3.00	8.33



Figure A.34: Bearing Graph SPT-ST Analysis for Aucilla, FL

Aucilla, Bearing Graph, SPT, Dynamic

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.645	.639	12.3	3.00	12.45
2	300.0	1.702	.329	40.8	3.00	11.27
3	400.0	1.728	.262	60.7	3.00	10.27
4	500.0	1.752	.245	101.9	3.00	9.31
5	600.0	1.774	.283	230.7	3.00	8.66
6	700.0	1.796	.292	1929.1	3.00	8.05
7	800.0	1.817	.278	9999.0	3.00	7.47





Aucilla, Bearing Graph, MDF, Static

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.639	.681	11.0	3.00	12.55
2	300.0	1.684	.334	38.9	3.00	11.62
3	400.0	1.706	.287	57.1	3.00	11.05
4	500.0	1.726	.189	93.0	3.00	10.39
5	600.0	1.746	.067	194.3	3.00	9.66
6	700.0	1.764	.058	564.9	3.00	8.96
7	800.0	1.782	.109	9999.0	3.00	8.37



Figure A.36: Bearing Graph MDF-ST Analysis for Aucilla, FL

Aucilla, Bearing Graph, MDF, Dynamic

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count BPF	Stroke ft	Energy k-ft
	KTh2	K91	KST	DIT		K-1C
1	100.0	1.644	.706	11.4	3.00	12.45
2	300.0	1.701	.346	40.4	3.00	11.29
3	400.0	1.726	.303	59.5	3.00	10.61
4	500.0	1.750	.211	98.9	3.00	9.68
5	600.0	1.772	.139	211.5	3.00	8.82
6	700.0	1.794	.168	635.8	3.00	8.09
7	800.0	1.815	.191	9999.0	3.00	7.52





Aucilla, Bearing Graph, STD Method

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.621	.387	13.2	3.00	12.94
2	300.0	1.636	.205	45.0	3.00	12.75
3	400.0	1.642	.204	69.5	3.00	12.57
4	500.0	1.800	.300	113.5	3.00	12.37
5	600.0	1.923	.278	223.4	3.00	12.15
6	700.0	1.959	.252	688.8	3.00	11.93
7	800.0	1.965	.233	9999.0	3.00	11.70



Figure A.38: Bearing Graph STD (FHWA) Analysis for Aucilla, FL

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No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.707	.093	4.7	4.48	36.33
2	200.0	1.934	.000	11.8	5.20	28.79
3	300.0	2.113	.032	21.3	5.69	26.04
4	400.0	2.369	.000	28.9	5.93	25.24
5	500.0	2.617	.055	39.2	6.18	24.03
6	550.0	2.743	.096	45.7	6.31	23.43
7	600.0	2.847	.105	54.0	6.37	22.70
8	650.0	2.980	.084	61.9	6.62	22.63
9	700.0	3.089	.060	73.1	6.74	22.25
10	750.0	3.183	.047	87.3	6.80	21.92



Figure A.39: Bearing Graph STD-ST Analysis for Vilano - East, FL

Vilano-East, Bearing Graph, STD, Dynamic

No.	Ultimate Capacity	Max C.	Max T. Stress	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.706	.097	4.6	4.48	36.39
2	200.0	1.933	.000	11.7	5.20	28.85
3	300.0	2.106	.049	21.1	5.68	26.02
4	400.0	2.361	.000	28.7	5.92	25.24
5	500.0	2.611	.069	38.8	6.17	24.02
6	550.0	2.736	.125	45.1	6.29	23.41
7	600.0	2.841	.158	53.4	6.35	22.68
8	650.0	2.975	.150	61.3	6.58	22.56
9	700.0	3.083	.134	72.5	6.70	22.16
10	750.0	3.178	.126	87.1	6.75	21.76



Figure A.40: Bearing Graph STD-DYN Analysis for Vilano - East, FL

Vilano-East, Bearing Graph, SPT, Static

No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.710	.091	4.7	4.49	36.24
2	200.0	1.938	.000	11.9	5.21	28.70
3	300.0	2.118	.031	21.5	5.70	26.02
4	400.0	2.371	.000	29.3	5.94	25.13
5	500.0	2.618	.051	39.8	6.20	23.90
6	550.0	2.744	.093	46.4	6.32	23.33
7	600.0	2.847	.102	54.9	6.39	22.60
8	650.0	2.979	.083	63.2	6.62	22.50
9	700.0	3.084	.061	75.0	6.74	22.10
10	750.0	3.178	.050	89.8	6.80	21.79



Figure A.41: Bearing Graph SPT-ST Analysis for Vilano - East, FL

Vilano-East, Bearing Graph, SPT, Dynamic

No. Ultimate Max C. Max T. Blow Stroke Energy Capacity Stress Stress Count BPF ft k-ft kips ksi ksi 100.0 1.706 .097 4.6 4.48 36.39 1 200.0 1,933 .000 11.7 5.20 28.85 2 21.1 26.02 3 300.0 2.106 .049 5.68 4 400.0 2.361 .000 28.7 5.92 25.24 5 500.0 2.611 .069 38.8 6.17 24.02 6.29 23.41 6 550.0 2.736 .125 45.1 7 600.0 2.841 .158 53.4 6.35 22.68 8 650.0 2.975 .150 61.3 6.58 22.56 9 700.0 3.083 .134 72.5 6.70 22.16 10 750.0 3.178 .126 87.1 6.75 21.76



Figure A.42: Bearing Graph SPT-DYN Analysis for Vilano - East, FL

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Vilano-East, Bearing Graph, MDF, Static

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.649	.297	2.5	4.35	43.13
2	200.0	1.790	.146	6.9	4.64	31.71
3	300.0	1.932	.050	12.4	5.21	27.62
4	400.0	2.006	.320	18.7	5.49	25.63
5	500.0	2.191	.161	24.3	5.64	25.44
6	550.0	2.288	.144	27.5	5.71	25.15
7	600.0	2.422	.195	30.6	5.93	25.29
8	650.0	2.529	.223	34.7	6.04	24.91
9	700.0	2.631	.289	40.0	6.09	24.23
10	750.0	2.760	.319	44.8	6.32	24.13



Figure A.43: Bearing Graph MDF-ST Analysis for Vilano - East, FL

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Vilano-East, Bearing Graph, MDF, Dynamic

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	Capacity kips	Stress ksi	Stress ksi	Count BPF	ft	k-ft
1	100.0	1.651	.294	2.5	4.35	43.01
2	200.0	1.793	.143	7.0	4.65	31.66
3	300.0	1.934	.073	12.5	5.21	27.56
4	400.0	2.007	.336	18.8	5.49	25.58
5	500.0	2.195	.158	24.5	5.64	25.39
6	550.0	2.292	.180	27.7	5.71	25.09
7	600.0	2.426	.234	30.8	5.93	25.21
8	650.0	2.533	.239	34.9	6.04	24.82
9	700.0	2.640	.316	40.2	6.09	24.15
10	750.0	2.769	.358	45.4	6.30	23.95



Figure A.44: Bearing Graph MDF-DYN Analysis for Vilano - East, FL

Vilano-East, Bearing Graph, STD Method

No.	Ultimate Capacity	Max C.	Max T.	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	1.707	.091	4.7	4.48	36.34
2	200.0	1.935	.000	11.8	5.20	28.81
3	300.0	2.118	.034	21.3	5.69	26.06
4	400.0	2.373	.000	28.9	5.93	25.26
5	500.0	2.622	.061	39.1	6.18	24.06
6	550.0	2.746	.101	45.6	6.31	23.43
7	600.0	2.852	.106	53.9	6.37	22.74
8	650.0	2.984	.085	61.8	6.62	22.66
9	700.0	3.093	.061	73.0	6.74	22.27
10	750.0	3.183	.047	87.2	6.80	21.94



Figure A.45: Bearing Graph STD (FHWA) Analysis for Vilano - East, FL

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Vilano-West,	Bearing	Graph,	STD,	Stati	LC
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No. Ultimate Max C. Max T. Blow Stroke Energy Stress Stress Count Capacity BPF ft kips ksi ksi k-ft 2.073 .544 5.44 38.80 100.0 4.6 1 2.233 .399 5.89 29.62 2 200.0 12.1 250.0 2.297 .329 17.7 6.12 27.36 3 2.337 .249 22.1 6.23 26.23 4 300.0 5 350.0 2.392 .178 25.2 6.45 26.06 .130 6 400.0 2.427 29.1 6.56 25.41 7 450.0 .076 33.9 24.92 2.451 6.61 8 500.0 2.468 .000 39.9 6.64 24.40 9 550.0 2.514 .000 46.1 6.84 24.45 10 600.0 54.6 24.18 2.543 .009 6.94



Figure A.46: Bearing Graph STD-ST Analysis for Vilano - West, FL

Vilano-West,	Bearing	Graph,	STD,	Dynami	LC
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No.	Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.072	.553	4.6	5.44	38.81
2	200.0	2.236	.417	12.0	5.89	29.58
3	250.0	2.301	.351	17.7	6.12	27.31
4	300.0	2.342	.274	22.1	6.23	26.12
5	350.0	2.396	.206	25.3	6.45	25.90
6	400.0	2.431	.139	29.2	6.55	25.22
7	450.0	2.455	.082	34.0	6.61	24.70
8	500.0	2.475	.000	40.0	6.63	24.21
9	550.0	2.522	.000	46.3	6.84	24.23
10	600.0	2.553	.010	54.8	6.94	23.96



Figure A.47: Bearing Graph STD-DYN Analysis for Vilano - West, FL

No.	Ultimate Capacity	Max C.	Max T. Stress	Blow	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.034	.569	3.6	5.32	41.27
2	200.0	2.179	.448	9.4	5.70	31.51
3	250.0	2.256	.395	12.8	6.05	29.74
4	300.0	2.302	.330	17.9	6.22	27.69
5	350.0	2.335	.285	20.9	6.31	27.14
6	400.0	2.354	.264	23.7	6.35	26.65
7	450.0	2.370	.204	26.9	6.38	26.06
8	500.0	2.410	.170	30.0	6.57	26.03
9	550.0	2.436	.083	33.9	6.67	25.90
10	600.0	2.453	.032	38.8	6.72	25.58



Figure A.48: Bearing Graph SPT-ST Analysis for Vilano - West, FL

Vilano-West, Bearing Graph, SPT, Dynamic

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	Capacity	Stress	Stress	Count		
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.072	.553	4.6	5.44	38.81
2	200.0	2.236	.417	12.0	5.89	29.58
3	250.0	2.301	.351	17.7	6.12	27.31
4	300.0	2.342	.274	22.1	6.23	26.12
5	350.0	2.396	.206	25.3	6.45	25.90
6	400.0	2.431	.139	29.2	6.55	25.22
7	450.0	2.455	.082	34.0	6.61	24.70
8	500.0	2.475	.000	40.0	6.63	24.21
9	550.0	2.522	.000	46.3	6.84	24.23
10	600.0	2.553	.010	54.8	6.94	23.96



Figure A.49: Bearing Graph SPT-DYN Analysis for Vilano - West, FL

Vilano-West,	Bearing	Graph,	MDF,	Stati	LC
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Ultimate Capacity	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
kips	ksi	ksi	BPF	ft	k-ft
100.0	2.050	.641	3.7	5.35	40.59
200.0	2.211	.562	9.7	5.77	30.85
250.0	2.290	.526	13.3	6.11	29.01
300.0	2.340	.467	18.5	6.28	26.93
350.0	2.374	.396	21.6	6.36	26.07
400.0	2.398	.352	24.7	6.40	25.49
450.0	2.414	.267	28.4	6.42	24.77
500.0	2.456	.230	32.1	6.60	24.64
550.0	2.483	.143	37.0	6.68	24.34
600.0	2.501	.164	43.4	6.72	23.91
	Ultimate Capacity kips 100.0 200.0 250.0 300.0 350.0 400.0 450.0 500.0 550.0 600.0	Ultimate Capacity kips Max C. Stress ksi 100.0 2.050 2.211 250.0 2.290 300.0 2.340 350.0 2.374 400.0 2.398 450.0 2.414 500.0 2.456 550.0 2.483 600.0 2.501	Ultimate Max C. Max T. Capacity Stress Stress kips ksi ksi ksi 100.0 2.050 .641 200.0 2.211 .562 250.0 2.290 .526 300.0 2.340 .467 350.0 2.374 .396 400.0 2.398 .352 450.0 2.414 .267 500.0 2.414 .267 500.0 2.483 .143 600.0 2.501 .164	Ultimate Capacity kipsMax C. Stress ksiMax T. Stress ksiBlow Count BPF100.02.050.6413.7200.02.211.5629.7250.02.290.52613.3300.02.340.46718.5350.02.374.39621.6400.02.398.35224.7450.02.414.26728.4500.02.483.14337.0600.02.501.16443.4	Ultimate Capacity kips Max C. Stress ksi Max T. Stress ksi Blow Count BPF Stroke ft 100.0 2.050 .641 3.7 5.35 200.0 2.211 .562 9.7 5.77 250.0 2.290 .526 13.3 6.11 300.0 2.340 .467 18.5 6.28 350.0 2.374 .396 21.6 6.36 400.0 2.398 .352 24.7 6.40 450.0 2.414 .267 28.4 6.42 500.0 2.483 .143 37.0 6.68 600.0 2.501 .164 43.4 6.72



Figure A.50: Bearing Graph MDF-ST Analysis for Vilano - West, FL

ATTAID-MESC, Deal the allaphy moly bynami	Vilano-West,	Bearing	Graph,	MDF,	Dynamic
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10/10/94

No.	Ultimate	Max C.	Max T.	Blow	Stroke	Energy
	Capacity	Stress	Stress	Count		
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.055	.662	3.8	5.36	40.37
2	200.0	2.220	.598	9.8	5.79	30.53
3	250.0	2.285	.559	13.9	6.00	28.07
4	300.0	2.350	.511	18.9	6.26	26.53
5	350.0	2.390	.449	21.8	6.39	25.73
6	400.0	2.420	.378	24.9	6.46	25.19
7	450.0	2.441	.298	28.6	6.49	24.48
8	500.0	2.458	.234	33.1	6.50	23.85
9	550.0	2.502	.157	37.8	6.69	23.79
10	600.0	2.531	.181	44.1	6.79	23.47





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Vilano-West, Bearing Graph, STD Method

No.	Ultimate Capacitv	Max C. Stress	Max T. Stress	Blow Count	Stroke	Energy
	kips	ksi	ksi	BPF	ft	k-ft
1	100.0	2.077	.596	4.6	5.45	38.72
2	200.0	2.241	.478	12.1	5.90	29.43
3	250.0	2.303	.416	17.8	6.13	27.09
4	300.0	2.343	.342	22.2	6.24	25.88
5	350.0	2.395	.276	25.5	6.45	25,60
6	400.0	2.427	.199	29.6	6.55	24.83
7	450.0	2.451	.117	34.5	6.60	24.30
8	500.0	2.469	.030	40.7	6.63	23.73
9	550.0	2.516	.000	47.4	6.84	23.69
10	600.0	2.547	.000	56.3	6.95	23.40



Figure A.52: Bearing Graph STD (FHWA) Analysis for Vilano - West, FL

St.Mary, Driveability, STD Parm. Static

10/07/94

	Ultimate		End	Blow	Max C.	Max T.	Blow	
feet	kips	Friction kips	Bearing kips	bl/ft	ksi	ksi	bpm	kip-ft
15.0	.0	.0	.0	.0	.000	.000	.0	.0
25.0 30.0	7.0 16.3	4.4 11.1	2.6 5.2	2.4 3.1	24.578 24.578	17.254 14.414	60.0 60.0	18.7 18.8
35.0 40.0	25.7 28.1	18.8 24.3	6.8 3.9	4.1 4.5	24.609 24.648	11.865 11.369	60.0 60.0	18.8 18.8
45.0 50.0	64.4 93.4	41.2 65.7	23.3 27.7	9.4 13.4	24.772 24.824	3.275 1.846	60.0 60.0	19.0 19.1
55.0 60.0	108.3	87.9 115.0	20.4 35.5	15.4 22.6	24.835 24.850	1.707 4.278	60.0 60.0	19.1 18.8
70.0	188.2	160.8	27.3	32.5 33.1	24.840 24.816 24.777	5.431	60.0 60.0	18.4
80.0 85.0	209.3 208.9	174.9 182.3	34.4 26.5	38.9 37.5	24.756 24.748	5.397 5.141	60.0 60.0	18.2 18.1
90.0 95.0	196.0 198.4	186.1 188.5	9.8	31.4 31.3	24.732 24.720	3.858 2.991	60.0 60.0	18.0 17.9
100.0	237.5 308.6	195.8 208.3	41.7 100.3	48.6 186.7	24.700 24.688	3.331 3.642	60.0	17.8
Total D	riving Time	37.38	min. for	60.0 bl/r	min			
Blow Tota	/ Rate: 11 Driving T	ime:	50 bl/ 44.86 min	min 56.0	40 bl/min 07 min	30 74.76	bl/min min	
St.Mary, D	riveability, STI	D Parm. Stat	ie					10/07/94
Goble Raus	che Likins & Ass	sociates, In	c. Fri	etion Factor=	- 1.000	GRLWEAP	TM) Version	1.993-1



Figure A.53: Driveability Graph STD-ST Analysis for St. Mary, OH

St.Mary, Driveability, SPT Param. Static

10/07/94

	epte 10.00 150.0	Ultimate Capacity kips .0 .0 .0 .0 .0 .0 .0 .0 .0 .0 .0 .0 .0	Skin Friction kips .0 .0 4.2 10.9 18.8 24.0 41.1 65.6 87.9 114.9 144.3 160.7 167.0 175.0 185.9 195.7 208.2	End Bearing kips .0 .0 2.4 5.1 6.5 22.9 27.9 35.2 27.5 29.5 29.5 29.5 29.5 29.5 29.5 29.5 29	Blow cbl/ft .00 2.6253211 3.53211 15.71 21.81 21.81 21.70	Max C. Stress ksi .000 25.160 25.162 25.164 25.375 25.443 25.545 25.545 25.545 25.553 25.524 25.553 25.524 25.553 25.524 25.355 25.351 25.3555 25.3555 25.3555 25.35555 25.35555555555	Max T. Stress ksi .000 .000 18.600 16.780 14.895 14.143 9.443 4.966 2.912 3.348 3.592 4.448 4.386 2.935	Blowe Ratem 000000000000000000000000000000000000	ENTHRU kip-ft .0 19.3 19.4 19.4 19.7 19.7 19.7 19.5 19.3 19.2 18.6 18.5 18.5
Tot	tal Dr	riving Time Bate:	9 21.95	min.for 6	30.0 bl/n in 4	nin 10 bl/min	30	bl/min	
	Tota]	L Driving	Fime:	26.34 min	32.9	93 min	43.90	min	
st.M	ary, Dr	iveability, SF	°T Param. Sta	rtic					10/07/94
Goble	e Rausch	he Likins & A⊴	sociates, In	e. Frict	ion Factor=	1.000	GRLWEAP(1	M) Version	1.993-1
		– <u>–</u> Capacit	y (kips)	— Com.Str	ess (Ksi)	E	NTHRU (K-ft) Fri	etion (%)
	_	62 124 186	248 310	6.0 12.0 18.0	24.0 30.0	4.0 8.0	12.0 16.0	20.0	50 100
	22						╼╪╼╼╞		
2	4	b		y marked	6 6				°, °,
₹ -	66				k				
Dep					4			7* 7*	
	88	$+ \langle - $	$\left(\left \right \right)$					╶╁┫┠╾╴	
			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		4			/ T +	6
	110	12 24 36	48 60	4.0 8.0 12.0	16.0 20.0	12 24	36 48	] [ 60	
									1

Figure A.54: Driveability Graph SPT-ST Analysis for St. Mary, OH

# St.Mary, Driveability, SPT Parm, Dynamic

10/07/94

Ultimate Depth Capacity F feet kips 10.0 .0 15.0 .0 20.0 .0 25.0 6.7 30.0 16.0 35.0 25.6 40.0 27.6 45.0 63.9 50.0 93.3 55.0 108.8 60.0 150.3 65.0 173.5 70.0 179.5 75.0 190.9 80.0 213.0 85.0 221.3 90.0 219.9 95.0 224.7 100.0 256.8 105.0 316.3	Skin riction kips .0 4.2 10.9 18.8 24.1 41.0 65.7 87.9 114.9 144.3 163.4 175.7 191.0 206.0 214.1 218.9 231.6 255.9 27.60	End Bearing kips .0 2.4 5.1 6.5 22.7 205.2 16.1 22.0 155.2 25.2 15.8 25.2 16.1 15.2 25.4 55.2 60.4	Blow Count bl/ft .0 22.855 7.69 127.54 224.24 30.0 117.54 224.24 30.0 117.54 224.24 30.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 117.54 200.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 1	Max C. Stress .000 .000 25.024 25.103 25.103 25.110 25.287 25.341 25.341 25.341 25.438 25.440 25.432 25.376 25.378 25.3283 25.225 25.224	Max T. Stress .000 .000 18.978 13.646 13.879 13.646 1.6174 2.670 3.754 4.537 4.923 5.262 4.754 4.537 3.677	Blow Rate bpm 0.0 60.0 60.0 60.0 60.0 60.0 60.0 60.0	ENTHRU kip-ft .00 19.4 19.4 19.4 19.7 19.6 19.3 19.3 19.3 19.3 19.3 18.8 18.5 18.5 18.4 18.4
Blow Rate: Total Driving Ti	27.60 m	50 bl/mi 33.12 min	in 41.4	111 10 bl/min 10 min	30 55.20	bl/min min	



Figure A.55: Driveability Graph SPT-DYN Analysis for St. Mary, OH

#### St.Mary, Driviability, MDF Param. Static

10/07/94



Figure A.56: Driveability Graph MDF-ST Analysis for St. Mary, OH

# Portland, Driveability, STD Parm, Static

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	.0	.0	.0	.0	.000	.000	.0	.0
10.0	.6	.0	.6	-1.0	.000	.000	95.9	.0
15.0	4.1	.1	4.0	-1.0	.000	.000	95.4	.0
20.0	8.4	.4	8.0	-1.0	.000	.000	94.6	.0
25.0	12.8	1.1	11.7	-1.0	.000	.000	93.5	.0
30.0	18.0	2.4	15.7	-1.0	.000	.000	83.3	.0
35.0	112.4	5.2	107.2	5.4	15.586	.000	55.1	39.2
40.0	207.5	7.8	199.7	11.9	19.876	.478	50.6	33.7
42.0	208.6	8.9	199.8	12.0	19.860	.503	50.6	33.7
45.0	193.7	10.6	183.2	10.7	19.700	.518	50.9	34.8
51.0	162.5	14.5	148.0	8.6	17.841	.542	52.6	35.8
53.0	147.0	15.8	131.2	7.4	17.666	.000	53.1	37.4

#### Friction Loss/Gain Factor 1.000

Total Driving Time 3.65 min. only if hammer runs continuously



Figure A.57: Driveability Graph STD-ST Analysis for Portland, ME

# Portland, Driveability, SPT Parm, Static

10/07/94

Friction	loss/Gain	Factor	1,000
TITOLIOU	LUSS/Gain	1 40 101	1.000

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	.0	.0	.0	.0	.000	.000	.0	.0
10.0	.6	.0	.6	-1.0	.000	.000	95.9	.0
15.0	4.1	.1	4.0	-1.0	.000	.000	95.4	.0
20.0	8.4	.4	8.0	-1.0	.000	.000	94.6	.0
25.0	12.8	1.1	11.7	-1.0	.000	.000	93.5	.0
30.0	18.0	2.4	15.7	-1.0	.000	.000	81.9	.0
35.0	112.4	5.2	107.2	5.4	15.222	.000	55.2	39.3
40.0	207.5	7.8	199.7	11.9	19.394	.414	50.8	34.0
42.0	208.6	8.9	199.8	11.9	19.353	.420	50.8	33.9
45.0	193.7	10.6	183.2	10.6	19.108	.396	51.1	35.2
51.0	162.5	14.5	148.0	9.8	17.745	.336	51.9	34.9
53.0	147.0	15.8	131.2	10.9	18.584	.000	51.1	34.2

Total Driving Time 3.80 min. only if hammer runs continuously



Figure A.58: Driveability Graph SPT-ST Analysis for Portland, ME

# Portland, Driveability, SPT Parm, Dynamic

10/07/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	.0	.0	.0	.0	.000	.000	.0	.0
10.0	2.6	.0	2.6	-1.0	.000	.000	95.7	.0
15.0	11.1	.1	11.0	-1.0	.000	.000	78.9	.0
20.0	35.4	.7	34.7	-1.0	.000	.000	78.7	.0
25.0	58.8	1.7	57.1	2.4	11.335	.000	59.9	47.5
30.0	83.0	3.2	79.8	3.7	14.027	.000	57.1	43.7
35.0	166.4	5.3	161.1	8.9	18.350	.346	52.3	35.4
40.0	251.5	7.8	243.7	15.2	21.456	.524	49.4	32.5
42.0	234.6	8.9	225.7	13.6	21.013	.530	49.7	33.6
45.0	220.7	10.6	210.1	14.7	21.583	.364	49.5	32.3
51.0	179.5	14.5	164.9	14.3	21.590	.000	49.7	32.9
53.0	157.0	15.9	141.1	12.0	18.819	.000	50.8	33.4
Total D	riving Tim	ie 5.87	min. only	if hammer	runs con	tinuousl	.y	

#### Friction Loss/Gain Factor 1.000



Figure A.59: Driveability Graph SPT-DYN Analysis for Portland, ME

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# Portland, Driveability, MDF Parm, Static

10/07/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	.0	.0	.0	.0	.000	.000	.0	.0
10.0	.6	.0	.6	-1.0	.000	.000	96.1	.0
15.0	4.1	.1	4.0	-1.0	.000	.000	96.3	.0
20.0	8.4	.4	8.0	-1.0	.000	.000	96.6	.0
25.0	12.8	1.1	11.7	-1.0	.000	.000	96.9	.0
30.0	18.0	2.4	15.7	-1.0	.000	.000	76.8	.0
35.0	112.4	5.2	107.2	2.7	13.129	.000	59.3	45.5
40.0	207.5	7.8	199.7	5.8	16.640	.320	54.7	39.7
42.0	208.6	8.9	199.8	5.9	16.640	.328	54.6	39.5
45.0	193.7	10.6	183.2	5.3	16.446	.222	55.1	41.0
51.0	162.5	14.5	148.0	4.5	15.128	.000	56.7	40.5
53.0	147.0	15.8	131.2	3.8	14.825	.429	57.2	42.6

#### Friction Loss/Gain Factor 1.000

Total Driving Time 1.68 min. only if hammer runs continuously



Figure A.60: Driveability Graph STD-ST Analysis for Portland, ME

#### Portland, Drvblty, MDF-Cap-STD, Static

10/07/94

#### Friction Loss/Gain Factor 1.000

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	8.9	.0	8.9	-1.0	.000	.000	94.4	.0
10.0	17.6	.0	17.6	-1.0	.000	.000	87.5	.0
15.0	25.1	.2	25.0	-1.0	.000	.000	84.4	.0
20.0	33.4	.7	32.7	-1.0	.000	.000	79.1	.0
25.0	41.8	1.6	40.2	-1.0	.000	.000	80.4	.0
30.0	51.0	3.0	48.0	-1.0	.000	.000	65.7	.0
35.0	273.4	5.4	267.9	17.3	22.929	.511	48.9	31.9
40.0	495.5	8.0	487.5	41.4	32.971	1.698	44.5	33.3
42.0	496.6	9.1	487.5	41.7	32.911	1.725	44.5	33.3
45.0	457.7	10.8	446.9	36.4	30.943	1.558	45.3	32.4
51.0	377.5	14.8	362.6	26.7	27.235	1.028	46.9	31.5
53.0	338.0	16.3	321.7	22.6	25.516	.835	47.6	31.5

Total Driving Time 13.70 min. only if hammer runs continuously



Figure A.61: Driveability Graph MDF-Cap-STD Analysis for Portland, ME
# Portland, Drvblty, MDF-Cap-SPT, Static

10/07/94

# Friction Loss/Gain Factor 1.000

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	8.9	.0	8.9	-1.0	.000	.000	94.4	.0
10.0	17.6	.0	17.6	-1.0	.000	.000	87.5	.0
15.0	25.1	.2	25.0	-1.0	.000	.000	84.4	.0
20.0	33.4	.7	32.7	-1.0	.000	.000	78.9	.0
25.0	41.8	1.6	40.2	-1.0	.000	.000	80.8	.0
30.0	51.0	3.0	48.0	2.1	9.701	.000	61.4	47.6
35.0	273.4	5.4	267.9	17.3	22.720	.485	49.0	31.9
40.0	495.5	8.0	487.5	41.6	32.245	1.480	44.6	33.6
42.0	496.6	9.1	487.5	41.8	32.198	1.500	44.6	33.6
45.0	457.7	10.8	446.9	36.5	30.146	1.351	45.5	32.6
51.0	377.5	14.8	362.6	31.3	28.195	.581	46.5	31.8
53.0	338.0	16.3	321.7	34.0	29.569	.189	46.4	31.3

Total Driving Time 14.55 min. only if hammer runs continuously



Figure A.62: Driveability Graph MDF-Cap-SPT Analysis for Portland, ME

.

# C&D P17, Driveability, STD Parm, ST

10/07/94

# Friction Loss/Gain Factor 1.000

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kins	kins	kins	b1/ft	ksi	ksi	bom	kip-ft
5.0	80.8	6.8	74.0	3.4	2,498	1.657	45.5	44.1
10.0	33.0	11.3	21.7	2.3	2.431	1.794	46.3	46.9
15.0	26.6	13.2	13.4	2.2	2.389	1.783	46.6	46.6
20.0	26.8	16.3	10.5	2.2	2.393	1.788	46.5	46.3
25.0	6.1	6.1	.0	2.2	2.381	1.840	46.8	45.7
30.0	108.1	36.8	71.4	4.6	2.474	1.567	45.4	41.0
35.0	95.6	44.4	51.3	4.0	2.475	1.657	45.5	41.8
40.0	168.9	60.2	108.7	7.8	2.640	1.544	43.9	39.3
45.0	198.2	78.4	119.8	9.6	2.686	1.494	43.5	38.1
50.0	657.9	114.1	543.9	62.3	3.036	.685	40.4	33.4
55.0	634.6	179.2	455.4	57.7	3.013	.686	40.5	32.9
60.0	633.8	265.8	368.1	56.2	3.021	.645	40.5	32.8
65.0	630.8	335.3	295.5	55.0	3.015	.662	40.6	32.5
66.0	627.8	348.2	279.7	54.3	3.021	.675	40.6	32.5

Total Driving Time 30.76 min. only if hammer runs continuously



Figure A.63: Driveability Graph STD-ST Analysis for C&D Canal, Pier 17, DE

# C&D P17, Driveability, SPT Parm, ST

10/07/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bom	kip-ft
5.0	80.8	6.8	74.0	2.8	2.633	1.946	45.4	43.7
10.0	33.0	11.3	21.7	2.2	2,540	1.948	46.2	47.9
15.0	26.6	13.2	13.4	2.1	2,495	1.916	46.5	48.1
20.0	26.8	16.3	10.5	2.1	2.496	1.916	46.5	47.9
25.0	6.1	6.1	.0	2.0	2.363	1.824	47.3	47.9
30.0	108.1	36.8	71.4	3.8	2.735	1.963	44.6	42.7
35.0	95.6	44.4	51.3	3.6	2.711	1.991	44.8	43.1
40.0	168.9	60.2	108.7	6.5	2.876	1.965	43.5	38.9
45.0	198.2	78.4	119.8	8.0	2.887	1.885	43.1	38.1
50.0	657.9	114.1	543.9	36.5	3.133	.909	40.8	33.5
55.0	634.6	179.2	455.4	41.5	3.164	.646	40.6	33.1
60.0	633.8	265.8	368.1	47.3	3.218	.461	40.2	33.5
65.0	630.8	335.3	295.5	51.5	3.227	.419	40.1	33.0
66.0	627.8	348.2	279.7	53.9	3.226	.423	40.1	33.0

Friction Loss/Gain Factor 1.000

Total Driving Time 23.71 min. only if hammer runs continuously



Figure A.64: Driveability Graph SPT-ST Analysis for C&D Canal, Pier 17, DE

# C&D P17, Driveability, SPT Parm, DYN

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10/07/94

# Friction Loss/Gain Factor 1.000

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	65.0	6.4	58.7	2.6	2.608	1.959	45.6	44.9
10.0	26.6	10.2	16.4	2.1	2.536	1.964	46.3	48.4
15.0	22.4	12.1	10.2	2.1	2.503	1.939	46.6	48.2
20.0	24.8	16.0	8.8	2.1	2.505	1.933	46.5	47.8
25.0	7.1	7.1	.0	2.0	2.350	1.809	47.4	48.0
30.0	96.1	36.5	59.6	3.4	2.685	1.958	44.9	43.4
35.0	87.6	44.1	43.5	3.4	2.677	1.975	44.9	43.3
40.0	154.2	61.5	92.7	6.1	2.870	1.960	43.6	39.6
45.0	183.0	81.0	101.9	8.1	2.920	1.903	43.0	37.7
50.0	477.7	116.5	361.2	24.4	3.097	1.220	41.4	33.3
55.0	553.4	182.2	371.2	33.4	3.134	.860	40.9	33.2
60.0	585.6	269.0	316.6	39.0	3.164	.711	40.6	33.1
65.0	592.6	338.6	254.0	41.8	3.178	.707	40.5	32.8
66.0	592.6	351.6	241.0	42.8	3.180	.717	40.5	32.7

Total Driving Time 19.04 min. only if hammer runs continuously



Figure A.65: Driveability Graph SPT-DYN Analysis for C&D Canal, Pier 17, DE

C&D P17, Driveability, MDF Parm, ST

10/07/94

Friction	Loss/Gain	Factor	1.000
11 10 11011	Looo, duith	1 40 501	

Total Driving Time 22.03 min. only if hammer runs continuously



Figure A.66: Driveability Graph MDF-ST Analysis for C&D Canal, Pier 17, DE

## C&D P17, Drvblty, STD Parm, MDF Capacity

10/07/94

# Friction Loss/Gain Factor 1.000

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	90.4	13.4	77.0	3.7	2.603	1.713	45.5	45.2
10.0	56.3	28.0	28.4	2.7	2.603	1.870	45.8	47.1
15.0	56.8	37.0	19.7	2.7	2.605	1.881	45.7	46.8
20.0	61.9	46.2	15.6	2.8	2.604	1.874	45.7	46.7
25.0	43.2	43.2	.0	2.6	2.554	1.878	45.9	48.2
30.0	154.1	77.6	76.5	6.7	2.733	1.700	44.2	41.6
35.0	157.0	100.5	56.5	6.9	2.747	1.756	44.1	41.0
40.0	242.9	129.7	113.2	12.0	2.901	1.577	42.9	38.1
45.0	288.7	164.8	123.9	15.6	2.964	1.513	42.4	36.7
50.0	775.3	229.0	546.2	79.9	3.214	.632	40.1	35.6
55.0	812.1	354.0	458.1	78.5	3.210	.563	40.1	35.5
60.0	889.8	519.5	370.3	81.1	3.217	.397	40.0	35.0
65.0	949.8	652.5	297.3	80.4	3.272	.274	39.7	35.2
66.0	957.8	676.7	281.1	80.3	3.278	.268	39.7	35.0

Total Driving Time 43.31 min. only if hammer runs continuously



Figure A.67: Driveability Graph MDF-Cap-STD Analysis for C&D Canal, Pier 17, DE

# C&D P17, Drvblty, SPT Parm, MDF Capacity

10/07/94

# Friction Loss/Gain Factor 1.000

Depth feet 5.0 10.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0 60.0	Ultimate Capacity 90.4 56.3 56.8 61.9 43.2 154.1 157.0 242.9 288.7 775.3 812.1 889.8	Skin Friction kips 13.4 28.0 37.1 46.2 43.2 77.6 100.5 129.7 164.8 229.0 354.0 519.5	End Bearing kips 77.0 28.4 19.7 15.6 .0 76.5 56.5 113.2 123.9 546.2 458.1 370.3	Blow Count bl/ft 3.0 2.6 2.8 2.7 6.2 6.9 10.9 14.3 51.1 62.1 77.3	Max C. Stress ksi 2.683 2.651 2.656 2.661 2.645 2.915 3.027 3.023 3.281 3.374 3.386	Max T. Stress ksi 1.964 1.980 1.973 1.966 1.982 1.973 1.971 1.892 1.743 .632 .238 .181	Blow Rate bpm 45.3 45.5 45.5 45.4 45.5 43.6 43.5 42.5 42.3 40.3 39.6 39.5	ENTHRU kip-ft 44.0 45.7 45.5 44.7 45.5 39.9 38.6 36.1 34.4 33.9 34.2 32.7
55.0	812.1	354.0	458.1	62.1	3.374	.238	39.6	34.2
60.0	889.8	519.5	370.3	77.3	3.386	.181	39.5	32.7
65.0	949.9	652.5	297.3	87.7	3.427	.136	39.2	33.3
66.0	957.8	676.7	281.1	89.7	3.432	.108	39.2	33.1

Total Driving Time 37.80 min. only if hammer runs continuously



Figure A.68: Driveability Graph MDF-Cap-SPT Analysis for C&D Canal, Pier 17, DE

## C&D P21, Driveability, STD Parm, ST

137.4

192.9

282.7

356.6

417.1

481.0

558.3

595.4

40.0

45.0

50.0

55.0

60.0

65.0

70.0

72.0

304.4

372.6

514.9

483.0

564.6

609.5

727.5

785.0

Total Driving Time

10/10/94

ENTHRU

kip-ft

.0

43.8

43.4

39.7

40.6

35.4

33.9

32.8

32.5

31.6

31.4

31.3

32.2

42.5

42.0

41.2

41.3

40.9

40.7

40.4

40.0

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm
15.0	.0	.0	.0	.0	.000	.000	.0
20.0	75.5	15.2	60.3	3.2	2.420	1.611	45.9
25.0	78.4	37.0	41.4	3.3	2.425	1.612	45.9
30.0	168.3	74.6	93.6	7.7	2.598	1.421	44.1
35.0	142.1	100.7	41.4	6.2	2.576	1.535	44.4

17.3

22.5

36.6

32.4

43.2

48.9

60.8

63.3

33.31 min. only if hammer runs continuously

2.780

2.858

2.952

2.944

2.974

2.996

3.036

3.113

1.113

.991

.753

.923

.845

.925

.833

.795

167.1

179.7

232.2

126.4

147.4

128.5

169.2

189.6



Figure A.69: Driveability Graph STD-ST Analysis for C&D Canal, Pier 21, DE

Friction	Loss/Gain	Factor	1.000
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	OTCTURCO	OKTH	Ellu	BIOM	Max C.	max I.	BTOM	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
15.0	.0	.0	.0	.0	.000	.000	.0	.0
20.0	75.5	15.2	60.3	2.9	2.464	1.791	45.8	41.7
25.0	78.4	37.0	41.4	2.8	2.464	1.808	45.8	41.6
30.0	168.3	74.6	93.6	5.6	2.650	1.768	44.2	39.5
35.0	142.1	100.7	41.4	4.3	2.609	1.841	44.6	40.8
40.0	304.4	137.4	167.1	11.8	2.842	1.588	42.6	35.0
45.0	372.6	192.9	179.7	15.7	2.888	1.439	42.1	34.1
50.0	514.9	282.7	232.2	25.9	2.974	1.093	41.4	32.1
55.0	483.0	356.6	126.4	25.5	2.991	1.211	41.4	32.0
60.0	564.6	417.1	147.4	33.5	3.023	1.103	41.0	30.9
65.0	609.5	481.0	128.5	36.5	3.050	1.186	40.8	30.4
70.0	727.5	558.3	169.2	44.1	3.079	1.175	40.5	30.1
72.0	785.0	595.4	189.6	47.6	3.086	1.128	40.4	30.1

Total Driving Time 24.58 min. only if hammer runs continuously



Figure A.70: Driveability Graph SPT-ST Analysis for C&D Canal, Pier 21, DE

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
15.0	.0	.0	.0	.0	.000	.000	.0	.0
20.0	59.6	14.6	45.0	2.5	2.441	1.811	46.1	43.3
25.0	69.8	37.3	32.6	2.6	2.461	1.830	45.9	42.3
30.0	151.4	76.8	74.6	4.8	2.624	1.817	44.5	40.3
35.0	138.8	105.0	33.9	4.1	2.604	1.860	44.7	41.0
40.0	298.3	162.8	135.5	10.9	2.842	1.657	42.7	35.2
45.0	388.0	241.8	146.2	16.3	2.899	1.448	42.1	33.5
50.0	525.6	336.6	189.0	26.2	2.987	1.122	41.4	32.0
55.0	517.3	414.8	102.5	27.8	3.011	1.187	41.2	31.5
60.0	597.6	478.3	119.3	35.4	3.042	1.136	40.9	30.5
65.0	646.5	542.4	104.1	38.8	3.066	1.268	40.6	29.9
70.0	754.0	616.4	137.6	45.2	3.084	1.279	40.4	29.6
72.0	805.8	651.9	153.9	47.4	3.098	1.247	40.3	29.7

### Friction Loss/Gain Factor 1.000

Total Driving Time 25.37 min. only if hammer runs continuously



Figure A.71: Driveability Graph SPT-DYN Analysis for C&D Canal, Pier 21, DE

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
15.0	.0	.0	.0	.0	.000	.000	.0	.0
20.0	75.5	15.2	60.3	2.9	2.419	1.697	46.1	44.5
25.0	78.4	37.0	41.4	3.1	2.425	1.670	46.0	43.9
30.0	168.3	74.6	93.6	6.7	2,582	1.533	44.3	40.2
35.0	142.1	100.7	41.4	5.8	2.562	1.583	44.5	40.8
40.0	304.4	137.4	167.1	15.1	2.773	1.306	42.6	35.5
45.0	372.6	192.9	179.7	20.3	2.859	1.197	42.0	34.2
50.0	514.9	282.7	232.2	32.6	2.921	.926	41.4	32.5
55.0	483.0	356.6	126.4	30.3	2.941	1.053	41.4	32.4
60.0	564.6	417.1	147.4	40.0	2.969	.970	41.0	31.5
65.0	609.5	481.0	128.5	45.5	3.000	1.058	40.8	31.4
70.0	727.5	558.3	169.2	57.8	3.036	.991	40.5	31.2
72.0	785.0	595.4	189.6	61.1	3.071	.925	40.3	31.3

# Friction Loss/Gain Factor 1.000

Total Driving Time 30.67 min. only if hammer runs continuously



Figure A.72: Driveability Graph MDF-ST Analysis for C&D Canal, Pier 21, DE

# C&D P21, Drvblty, STD Parm, MDF Capacity

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
15.0	.0	.0	.0	.0	.000	.000	.0	.0
20.0	95.9	31.1	64.9	4.0	2.424	1.534	45.7	42.2
25.0	126.6	79.6	46.9	5.4	2.547	1.536	44.8	41.6
30.0	247.9	149.4	98.6	12.6	2.712	1.240	43.0	37.0
35.0	251.4	206.7	44.8	12.9	2.772	1.306	42.8	36.3
40.0	438.4	267.3	171.1	27.8	2.921	.847	41.6	33.2
45.0	557.1	373.8	183.3	41.9	3.018	.677	41.0	32.4
50.0	779.1	544.0	235.1	68.6	3.111	.610	40.3	33.1
55.0	815.7	687.4	128.2	65.5	3.155	.443	40.1	32.7
60.0	949.1	800.2	148.9	75.0	3.198	.419	39.7	31.8
65.0	1050.7	921.1	129.6	81.6	3.235	.596	39.4	31.3
70.0	1235.4	1065.5	169.9	102.7	3.269	.496	39.1	31.5
72.0	1324.9	1134.8	190.2	116.1	3.296	.425	39.0	31.7

# Friction Loss/Gain Factor 1.000

Total Driving Time 60.88 min. only if hammer runs continuously



Figure A.73: Driveability Graph MDF-Cap-STD Analysis for C&D Canal, Pier 21, DE

# C&D P21, Drvblty, SPT Parm, MDF Capacity

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
15.0	.0	.0	.0	.0	.000	.000	.0	.0
20.0	95.9	31.1	64.9	3.2	2.563	1.855	45.1	42.3
25.0	126.6	79.6	46.9	3.8	2.592	1.849	44.8	41.4
30.0	247.9	149.4	98.6	8.6	2.783	1.716	43.2	37.1
35.0	251.4	206.7	44.8	8.4	2.798	1.774	43.2	36.9
40.0	438.4	267.3	171.1	18.1	2.964	1.428	41.8	32.4
45.0	557.1	373.8	183.3	25.6	3.020	1.212	41.4	31.6
50.0	779.1	544.0	235.1	45.6	3.138	.723	40.5	31.7
55.0	815.7	687.4	128.2	49.5	3.179	.697	40.3	31.2
60.0	949.1	800.2	148.9	56.9	3.215	.622	39.9	30.4
65.0	1050.7	921.1	129.6	60.8	3.244	.821	39.7	30.5
70.0	1235.4	1065.5	169.9	69.7	3.234	.763	39.5	30.5
72.0	1324.9	1134.8	190.2	77.7	3.206	.667	39.7	29.8





Figure A.74: Driveability Graph MDF-Cap-SPT Analysis for C&D Canal, Pier 21, DE

## WHITE CITY, Driveability, STD Parm, ST

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
3.0	122.2	.0	122.2	6.7	1.652	.674	46.3	29.2
6.0	108.2	.0	108.2	5.6	1.647	.711	46.5	30.9
9.0	94.2	.0	94.2	4.7	1.567	.676	47.4	31.5
12.0	128.3	.0	128.3	7.2	1.644	.649	46.3	28.4
15.0	146.3	.0	146.3	8.8	1.655	.608	46.0	26.4
18.0	37.3	.0	37.3	2.1	1.443	.720	49.3	37.1
21.0	23.3	.0	23.3	1.7	1.367	.678	50.0	39.1
24.0	168.3	.0	168.3	10.8	1.732	.614	45.2	25.5
27.0	90.3	.0	90.3	4.5	1.558	.680	47.5	31.9
30.0	107.1	.6	106.5	5.7	1.563	.636	47.2	29.7
33.0	495.0	4.4	490.5	72.4	1.981	.324	42.1	17.8
35.0	533.2	8.5	524.6	92.1	1.980	.286	42.0	17.3
37.2	620.2	13.5	606.7	143.8	1.982	.201	41.8	16.1

# Friction Loss/Gain Factor 1.000

Total Driving Time 16.40 min. only if hammer runs continuously



Figure A.75: Driveability Graph STD-ST Analysis for White City Bridge, FL

# WHITE CITY, Driveability, SPT Parm, ST

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
3.0	122.2	.0	122.2	4.0	1.625	.838	47.3	32.6
6.0	108.2	.0	108.2	3.4	1.549	.781	48.0	33.5
9.0	94.2	.0	94.2	2.8	1.536	.791	48.2	35.7
12.0	128.3	.0	128.3	4.5	1.570	.769	47.5	30.5
15.0	146.3	.0	146.3	5.3	1.654	.827	46.7	29.6
18.0	37.3	.0	37.3	1.8	1.416	.745	49.8	36.0
21.0	23.3	.0	23.3	1.6	1.337	.681	50.4	37.3
24.0	168.3	.0	168.3	6.5	1.710	.844	46.1	28.1
27.0	90.3	.0	90.3	2.7	1.491	.750	48.6	35.4
30.0	107.1	.6	106.5	3.5	1.515	.745	48.3	32.9
33.0	495.0	4.4	490.5	35.9	1.907	.493	43.0	18.7
35.0	533.2	8.5	524.6	42.9	1.911	.462	42.8	17.9
37.2	620.2	13.5	606.7	61.3	1.982	.540	42.1	17.2

Friction Loss/Gain Factor 1.000

Total Driving Time 8.08 min. only if hammer runs continuously



Figure A.76: Driveability Graph SPT-ST Analysis for White City Bridge, FL

# WHITE CITY, Driveability, SPT Parm, DYN

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
3.0	101.2	.0	101.2	4.2	1.564	.719	47.6	33.0
6.0	89.2	.0	89.2	3.5	1.563	.747	47.8	34.4
9.0	78.2	.0	78.2	3.0	1.567	.780	48.0	35.8
12.0	107.3	.0	107.3	4.5	1.557	.696	47.5	32.3
15.0	123.3	.0	123.3	5.5	1.558	.660	47.3	30.6
18.0	28.3	.0	28.3	1.7	1.309	.623	50.4	37.9
21.0	16.3	.0	16.3	1.5	1.204	.535	51.2	39.7
24.0	143.3	.0	143.3	6.7	1.623	.676	46.5	29.6
27.0	76.3	.0	76.3	2.9	1.511	.726	48.4	35.3
30.0	91.1	.6	90.5	3.7	1.508	.687	48.2	33.5
33.0	456.1	4.6	451.6	50.6	1.935	.588	42.7	18.7
35.0	471.9	8.8	463.0	54.8	1.939	.579	42.6	18.5
37.2	538.8	14.0	524.8	82.4	1.937	.527	42.4	17.6





Figure A.77: Driveability Graph SPT-DYN Analysis for White City Bridge, FL

# APALACHICOLA, STD, STATIC, DRIVEABILITY

10/10/94

Blow Rate: Total Driving Time: $50 \text{ bl/min}$ $40 \text{ bl/min}$ $30 \text{ bl/min}$ APRLACHICOLA, STD, STATIC, DRIVEABILITY 10/10/94 Goble Rausche Likins & Associates, Inc. Friction Factor= 1.000 GRLHEAP(TH) Version 1.993-1 Capacity (Kips) Com.Stress (Ks1) ENTHRU (K-ft) Friction (2) $140 \ 280 \ 420 \ 560 \ 700$ $0.60 \ 1.60 \ 2.40 \ 3.20 \ 4.00$ $6.0 \ 12.0 \ 19.0 \ 24.0 \ 30.0 \ 50 \ 100$ $10 \ 10 \ 10 \ 10 \ 10 \ 10 \ 10 \ 10 \$	De 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	epth feet 10.0 25.0 35.0 40.0 55.0 40.0 55.0 55.0 55.0 35.0 35.0 35.0 35.0 3	Ultimate Capacity kips 235.2 169.4 92.3 102.0 134.5 82.7 76.3 95.8 164.1 215.5 268.3 339.5 474.1 428.9 450.7 560.1 655.2	Skin Friction kips 20.0 31.2 34.0 39.5 50.9 47.0 49.2 57.2 71.3 90.0 115.1 143.6 180.1 209.2 229.3 266.0 295.0 e 32.96	End Bearing kips 215.2 138.2 58.4 62.5 83.7 35.7 27.1 38.6 92.7 125.5 153.2 195.9 294.0 219.7 221.4 294.1 360.2 min. for 60	Blow Count bl/ft 20.9 14.4 7.4 8.2 11.0 6.5 6.3 7.6 13.6 13.6 13.4 48.5 41.8 43.4 57.3 76.0	Max C. Stress ksi 1.890 1.891 1.891 1.891 1.891 1.891 1.891 1.892 1.904 1.919 1.930 1.938 1.946 1.951 1.951 1.948 1.943 1.932 in	Max T. Stress ksi .639 .785 1.043 1.019 .919 1.113 1.144 1.074 .843 .686 .538 .375 .354 .330 .341 .335 .353	Blow Rate bpm 60.0 60.0 60.0 60.0 60.0 60.0 60.0 60.	ENTHRU kip-ft 20.8 22.1 20.8 20.9 21.9 20.7 20.8 20.6 20.5 20.2 20.2 20.1 19.8 19.5
APALACHICOLA, STD, STATIC, DRIVEABILITY  10/10/94    Gobie Rausche Likins & Associates, Inc.  Friction Factor= 1.000  CRLHEAPCTH) Version 1.993-1    Image: Compact of the second seco		Blow Tota	Rate: 1 Driving 1	Time:	50 bl/mir 39.55 min	4 49.4	0 bl/min 4 min	30 65.92	bl/min min	
Goble Rausche Likins & Associates, Inc.  Friction Factor= 1.000  GRLHERP(TH) Version 1.993-1 $$ Capacity (kips) $$ Com.Stress (ksi) $$ ENTHRU (k-ft)  Friction (%)    140  280  420  560  700  0.80  1.60  2.40  3.20  4.00  6.0  12.0  18.0  24.0  30.0  50  100    140  280  420  560  700  0.80  1.60  2.40  3.20  4.00  6.0  12.0  18.0  24.0  30.0  50  100    140  280  420  560  700  0.80  1.60  2.40  3.20  4.00  6.0  12.0  18.0  24.0  30.0  50  100    140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140  140	APALA	ACHICOL	A, STD, STATIC	, DRIVEABILI	ТҮ	·		··		10/10/94
Capacity (kips) Com.Stress (ksi) ENTHRU (k-ft)  Friction (2)    140  280  420  560  700  0.880  1.60  2.40  3.20  4.00  6.0  12.0  18.0  24.0  30.0  50  100    20	Gobie	e Rauso	the Likins & As	sociates, Ir	ne. Frietie	n Factor=	1.000	GRLWEAPK T	1) Version	1.993-1
$(\frac{1}{4})$			— — — Capacit	ty (Kips)	Com.Stres	s (Ksi)	E	NTHRU (K-ft)	· Frid	tion (%)
	Depth (ft)	20 40 50 80 100		60 75		20 4.90				

Figure A.78: Driveability Graph STD-ST Analysis for Apalachicola, FL

# Friction Loss/Gain Factor 1.000

Dep 10 11 20 30 40 40 50 60 70 78 88	U1 ⁻ bet 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0	timate bacity kips 235.2 169.4 92.3 102.0 134.5 82.7 76.3 95.8 164.1 215.5 268.3 339.5 474.1 428.9 450.1 550.2	Skin Friction 20.0 31.2 34.0 39.5 50.9 47.0 49.2 57.2 57.2 57.2 57.2 57.2 57.2 57.2 57	End Bearing kips 215.2 138.2 58.4 62.5 83.7 27.1 35.7 27.1 38.6 92.7 125.5 153.2 195.9 294.0 219.7 221.4 294.1 360.2	Blow Count bl/ft 13.1 10.0 6.1 6.4 8.9 6.1 6.5 10.6 13.8 17.6 23.9 31.0 32.4 40.5 50.6	Max C. Stress ksi 1.891 1.891 1.891 1.891 1.891 1.906 1.912 1.923 1.940 1.948 1.955 1.963 1.966 1.959 1.949 1.936	Max T. Stress ksi .883 1.011 1.181 1.162 1.087 1.209 1.217 1.172 1.017 .871 .717 .530 .491 .436 .464 .558 .614	Blow Rate bpm 60.0 60.0 60.0 60.0 60.0 60.0 60.0 60.	ENTHRU kip-ft 20.8 20.6 21.7 20.6 20.5 20.5 20.5 20.5 20.4 20.2 20.2 20.2 20.1 19.9 19.6 19.2
Tot	al Driv	ing Time	23.99	) min. for	60.0 bl/m	in 			
	Blow Ra Total D	te: riving 1	Time:	50 bl/i 28.79 min	11n 4 35.9	0 bl/min 9 min	30 47.98	bl/min min	
APALA	CHICOLA, S	PT, STATIC	, DRIVEABIL	.ITY					10/10/94
Goble	Rausche L	ikins & As	sociates, I	ine. Fri	tion Factor=	1.000	GRLWERP( T	M) Version	1.993-1
		— Capacit	y (Kips)	Com.S	tress (Ksi)	E	NTHRU (K-ft)	) Frid	tion (%)
	140	280 420	560 700	0.80 1.60 2.4	0 3.20 4.00	6.0 12.0	18.0 24.0	30.0	50 100
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Figure A.79: Driveability Graph SPT-ST Analysis for Apalachicola, FL

____ Ten.Stress (ksi)

0.80 1.60 2.40 3.20 4.00

12

-----

24

36

48

Bl. Rte. (8/min)

60

60

48

Blow Count (BPF)

12

24

36

# APALACHICOLA, SPT, DYNAMIC, DRIVEABILITY

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	'Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
10.0	215.7	26.0	189.6	12.6	1.890	.890	60.0	20.8
15.0	163.8	41.2	122.6	10.2	1.890	.983	60.0	20.9
20.0	102.2	47.1	55.2	6.7	1.891	1.120	60.0	22.1
25.0	112.0	54.4	57.6	7.5	1.891	1.103	60.0	20.9
30.0	146.1	69.4	76.6	9.9	1.896	1.023	60.0	20.8
35.0	102.0	67.9	34.2	7.2	1.914	1.130	60.0	21.0
40.0	99.1	72.4	26.7	7.2	1.927	1.132	60.0	21.0
45.0	119.0	81.8	37.2	9.0	1.940	1.083	60.0	20.5
50.0	181.8	97.2	84.6	12.3	1.955	.938	60.0	20.4
55.0	229.9	116.0	113.9	15.7	1.965	.800	60.0	20.3
60.0	277.7	139.3	138.4	19.2	1.974	.656	60.0	20.1
65.0	339.8	165.3	174.5	24.5	1.984	.560	60.0	20.3
70.0	463.1	200.1	263.1	34.9	1.991	.455	60.0	19.9
75.0	424.3	227.8	196.5	32.8	1.992	.410	60.0	19.8
80.0	445.2	247.2	198.0	34.2	1.984	.428	60.0	19.5
85.0	545.4	282.3	263.1	42.7	1.971	.487	60.0	19.3
89.0	632.6	310.2	322.4	53.9	1.953	.463	60.0	18.9
Total D	riving Tim	e 25.85 r	nin. for	60.0 bl/m	in			
Blow	Rate:		50 bl/m	nin 4	0 bl/min	30	bl/min	
Tota	l Driving '	Time:	31.02 min	38.7	8 min	51.70	min	







Figure A.80: Driveability Graph SPT-DYN Analysis for Apalachicola, FL

# APALACHICOLA, MDF, STATIC, DRIVEABILITY

Ultimate Depth Capacity feet kips 10.0 235.2 15.0 169.4 20.0 92.3 25.0 102.0 30.0 134.5 35.0 82.7 40.0 76.3 45.0 95.8 50.0 164.1 55.0 215.5 60.0 268.3 65.0 339.5 70.0 474.1 75.0 428.9 80.0 450.7 85.0 560.1 89.0 655.2 Total Driving Ti Blow Rate: Total Driving Ti	Skin Friction kips 20.0 31.2 34.0 39.5 50.9 47.0 49.2 57.2 71.3 90.0 115.1 143.6 180.1 209.2 229.3 266.0 295.0 me 27.27	End Bearing kips 215.2 138.2 58.4 62.5 83.7 35.7 27.1 38.6 92.7 125.5 153.2 195.9 294.0 219.7 221.4 294.1 360.2 min. for ( 50 bl/min	Blow Count bl/ft 14.4 10.7 6.5 6.7 9.4 6.3 6.7 11.2 15.0 19.3 25.8 40.3 35.6 38.0 48.2 61.3 60.0 bl/mi in 40	Max C. Stress ksi 1.891 1.891 1.891 1.891 1.891 1.891 1.891 1.892 1.904 1.919 1.930 1.937 1.945 1.951 1.952 1.943 1.933 in bl/min	Max T. Stress ksi .903 1.003 1.161 1.143 1.067 1.187 1.202 1.153 .998 .866 .727 .567 .454 .448 .486 .432 .451 30 b 54 54 m	Blow Rate ENTHRU bpm kip-ft 60.0 20.8 60.0 20.9 60.0 20.7 60.0 21.2 60.0 20.6 60.0 20.6 60.0 20.6 60.0 20.6 60.0 20.6 60.0 20.6 60.0 20.6 60.0 20.5 60.0 20.5 60.0 20.2 60.0 20.1 60.0 20.1 60.0 20.1 60.0 20.1 60.0 20.1 60.0 20.1 60.0 20.1 60.0 20.5 60.0 19.8 60.0 19.5
	TIME.		40.90		J4.J4 III	±11
APALACHICOLA, MDF, STA	TIC, DRIVEABILI	ΤY				10/10/94
Goble Rausche Likins &	Associates, Ind	e. Friet	ion Factor=	1.000	GRLWEAP( TM)	Version 1.993-1
Capa	sity (Kips) −	_ — — — Com.Str	ress (Ksi)	El	NTHRU (K-ft)	Friction (%)
135 278 4 28 40 40 40 40 40 40 40 40 40 40 40 40 40	2 56 70	0.80 1.60 2.40	3.20 4.00			
Blow	Count (BPF)	Ten.Sti	ress (Ksi)	В	l. Rte. (B/mil	n)

Figure A.81: Driveability Graph MDF-ST Analysis for Apalachicola, FL

# APALACHICOLA, Drvblty, MDF CAPACITY, STD

10/10/94

Depth feet 10.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0 60.0 65.0 70.0 75.0 80.0 85.0 89.0 Total D	Ultimate Capacity kips 249.5 194.9 126.0 139.9 177.1 129.6 125.8 148.5 218.4 280.7 348.1 436.3 590.0 565.5 600.4 713.7 827.9 riving Tim	Skin Friction kips 32.2 51.7 60.7 70.3 87.3 87.9 93.6 104.4 120.5 150.0 190.0 235.5 292.1 341.7 375.3 416.1 464.1 e 48.07	End Bearing kips 217.3 143.2 65.2 69.6 89.8 41.7 32.3 44.1 97.9 130.7 158.0 200.8 298.0 223.8 225.1 297.6 363.8 min. for	Blow Count bl/ft 22.4 16.9 10.4 11.6 15.0 10.8 10.5 12.2 18.6 25.1 32.2 44.1 66.7 59.8 64.9 93.7 150.1 60.0 bl/m	Max C. Stress ksi 1.899 1.899 1.899 1.899 1.906 1.923 1.934 1.945 1.952 1.960 1.965 1.970 1.968 1.968 1.968 1.961 1.949 in	Max T. Stress ksi .614 .721 .939 .908 .806 .986 1.015 .939 .727 .561 .397 .342 .400 .492 .486 .447 .419	Blow Rate bpm 60.0 60.0 60.0 60.0 60.0 60.0 60.0 60.	ENTHRU kip-ft 20.8 20.8 20.8 20.8 20.8 20.8 20.8 20.5 20.3 20.2 20.0 19.8 19.7 19.5 19.1 18.7
Blow Tota	Rate: 1 Driving	Time:	50 bl/1 57.68 min	nin 4 72.1	0 bl/min 0 min	30   96.14	bl/min min	
Goble Rauso	H, Urvbity, H	550ciates, In ty (Kips) 680 850	SIJ Com.S 0.80 1.60 2.4 Com.S 0.80 1.60 2.4 	etion Factor= tress (Ksi) 0 3.20 4.00	1.000	GRLWEAP(T) NTHRU (K-ft) 18.0 24.0 3 1 7 7 7 9 4 1 1 7 7 9 4 4 4 4 4 4 4 4 4 4 4 4	1) Version Frid	1.993-1 :tion (%) 50 100
100	32 64 96	128 160	0.80 1.60 2.40	3.20 4.00	12 24	36 48	60 60	
······								

Figure A.82: Driveability Graph MDF-Cap-STD Analysis for Apalachicola, FL

# APALACHICOLA, Drvblty, MDF CAPACITY, SPT

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	, kipš	kips	kipš	bl/ft	ksi	ksi	bpm	kip-ft
10.0	249.5	32.2	217.3	14.3	1.899	.858	60.0	20.7
15.0	194.9	51.7	143.2	11.8	1.899	.950	60.0	20.7
20.0	126.0	60.7	65.2	8.3	1.899	1.097	60.0	20.7
25.0	139.9	70.3	69.6	9.6	1.908	1.076	60.0	20.7
30.0	177.1	87.3	89.8	11.7	1.940	.991	60.0	20.6
35.0	129.6	87.9	41.7	9.5	1.963	1.100	60.0	20.6
40.0	125.8	93.6	32.3	9.5	1.975	1.104	60.0	20.6
45.0	148.5	104.4	44.1	10.7	1.983	1.048	60.0	20.5
50.0	218.4	120.5	97.9	14.8	1.996	.888	60.0	20.3
55.0	280.7	150.0	130.7	19.1	2.006	.706	60.0	20.0
60.0	348.1	190.0	158.0	24.7	2.018	.504	60.0	20.3
65.0	436.3	235.5	200.8	32.2	2.026	.443	60.0	19.8
70.0	590.0	292.1	298.0	44.1	2.031	.583	60.0	19.5
75.0	565.5	341.7	223.8	43.0	2.029	.563	60.0	19.2
80.0	600.4	375.3	225.1	46.8	2.018	.555	60.0	18.8
85.0	713.7	416.1	297.6	62.6	1.994	.550	60.0	18.3
89.0	827.9	464.1	363.8	92.2	1.972	.515	60.0	17.9
				00 0 61 (				
lotal D	riving (im	e 34.20	min. for	60.0 DI/M	in			
Blow	Bate:		50 bl/m	nin 4	0 bl/min	30	bl/min	
Tota	l Drivina	Time:	41.04 min	51.3	0 min	68.40	min	
		·						



Figure A.83: Driveability Graph MDF-Cap-SPT Analysis for Apalachicola, FL

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	221.0	19.0	201.9	32.3	1.615	.216	60.0	13.1
10.0	89.3	49.1	40.2	11.7	1.615	.384	60.0	13.0
15.0	170.2	89.6	80.6	22.8	1.616	.332	60.0	13.1
20.0	237.8	120.2	117.6	33.7	1.639	.444	60.0	13.0
25.0	263.8	144.2	119.6	37.4	1.695	.483	60.0	13.0
30.0	287.7	166.8	120.9	41.3	1.765	.418	60.0	12.9
35.0	384.4	197.8	186.6	61.5	1.835	.609	60.0	12.6
40.0	490.2	238.6	251.6	101.0	1.888	.620	60.0	12.2
45.0	394.2	269.3	124.9	63.9	1.888	.510	60.0	12.1
50.0	311.3	279.8	31.5	45.0	1.844	.298	60.0	12.0
55.0	709.4	290.9	418.5	769.7	1.823	.255	60.0	10.9
60.0	599.5	290.5	309.1	256.8	1.774	.159	60.0	10.5
63.0	667.7	291.5	376.1	573.9	1.763	.113	60.0	10.2
Total D	riving Tim	e 133.15	min. for	60.0 bl/n	nin			
Blow Tota	Rate: 1 Driving	Time:	50 bl/m 159.78 min	nin 2 199.7	40 bl/min 72 min	30 266.30	bl/min min	



Figure A.84: Driveability Graph STD-ST Analysis for Aucilla, FL

Aucilla, Driveability, STD, Dynamic

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	, kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	221.0	19.0	201.9	32.3	1.615	.216	60.0	13.1
10.0	89.3	49.1	40.2	11.7	1.615	.384	60.0	13.0
15.0	167.5	87.1	80.4	22.4	1.616	.333	60.0	13.1
20.0	182.6	115.8	66.8	24.7	1.635	.242	60.0	13.0
25.0	216.4	147.6	68.7	30.5	1.690	.447	60.0	13.0
30.0	245.8	175.9	69.8	34.6	1.760	.533	60.0	12.9
35.0	312.8	205.5	107.3	45.8	1.831	.373	60.0	12.8
40.0	383.4	239.3	144.1	61.0	1.887	.574	60.0	12.4
45.0	339.9	267.3	72.6	50.7	1.892	.414	60.0	12.3
50.0	301.8	283.7	18.1	43.2	1.853	.265	60.0	12.0
55.0	580.7	298.8	281.9	202.0	1.829	.253	60.0	11.0
60.0	506.8	298.6	208.3	122.7	1.782	.156	60.0	10.6
63.0	553.0	299.7	253.2	176.6	1.769	.112	60.0	10.2
Total D	riving Tim	e 59.16	min. for	60.0 bl/m	in			
Blow Tota	Rate: 1 Driving	Time:	50 bl/m 70.99 min	nin 4 88.7	0 bl/min 4 min	30 118.32	bl/min min	



Figure A.85: Driveability Graph STD-DYN Analysis for Aucilla, FL

# Aucilla, Driveability, SPT, Static

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kipš	bl/ft	ksi	ksi	bpm	kip-ft
5.0	221.0	19.0	201.9	19.9	1.616	.461	60.0	13.0
10.0	89.3	49.1	40.2	10.6	1.617	.474	60.0	13.0
15.0	170.2	89.6	80.6	20.2	1.688	.320	60.0	13.1
20.0	237.8	120.2	117.6	29.9	1.784	.360	60.0	12.9
25.0	263.8	144.2	119.6	33.5	1.855	.338	60.0	12.7
30.0	287.7	166.8	120.9	36.7	1.906	.479	60.0	12.3
35.0	384.4	197.8	186.6	49.1	1.953	.524	60.0	11.7
40.0	490.2	238.6	251.6	73.3	1.972	.513	60.0	11.1
45.0	394.2	269.3	124.9	54.9	1.933	.341	60.0	10.7
50.0	311.3	279.8	31.5	43.4	1.871	.332	60.0	10.3
55.0	709.4	290.9	418.5	434.1	1.859	.241	60.0	9.6
60.0	599.5	290.5	309.1	209.5	1.846	.166	60.0	9.1
63.0	667.7	291.5	376.1	369.4	1.848	.114	60.0	8.7
「otal D	riving Time	e 90.32	min. for	60.0 bl/m	in			
Blow	Rate:		50 bl/m	min 4	0 bl/min	30	bl/min	
Tota	l Driving ⁻	Time:	108.38 min	135.4	l8 min	180.64	min	



Figure A.86: Driveability Graph SPT-ST Analysis for Aucilla, FL

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kipš	bl/ft	ksi	ksi	bpm	kip-ft
5.0	221.0	19.0	201.9	26.5	1.619	.190	60.0	13.0
10.0	89.3	49.1	40.2	11.0	1.615	.434	60.0	13.0
15.0	167.5	87.1	80.4	21.3	1.635	.333	60.0	13.2
20.0	182.6	115.8	66.8	24.5	1.716	.441	60.0	13.1
25.0	216.4	147.6	68.7	29.7	1.796	.427	60.0	13.0
30.0	245.8	175.9	69.8	33.0	1.858	.351	60.0	12.7
35.0	312.8	205.5	107.3	41.1	1.922	.565	60.0	12.2
40.0	383.4	239.3	144.1	52.5	1.964	.603	60.0	11.5
45.0	339.9	267.3	72.6	46.0	1.945	.504	60.0	11.4
50.0	301.8	283.7	18.1	41.1	1.877	.507	60.0	11.2
55.0	580.7	298.8	281.9	149.7	1.854	.302	60.0	10.0
60.0	506.8	298.6	208.3	98.9	1.822	.183	60.0	9.7
63.0	553.0	299.7	253.2	191.4	1.818	.074	60.0	9.2
Total D	riving Tim	e 51.10	min. for	60.0 bl/m	nin			
Blow Tota	Rate: 1 Driving	Time:	50 bl/m 61.32 min	in 2 76.6	40 bl/min 35 min	30 102.20	bl/min min	



Figure A.87: Driveability Graph STD-DYN Analysis for Aucilla, FL

# Aucilla, Driveability, MDF, Static

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	221.0	19.0	201.9	21.0	1.615	.240	60.0	13.0
10.0	89.3	49.1	40.2	9.8	1.615	.486	60.0	13.1
15.0	170.2	89.6	80.6	19.1	1.616	.392	60.0	13.1
20.0	237.8	120.2	117.6	28.4	1.639	.496	60.0	13.0
25.0	263.8	144.2	119.6	32.8	1.695	.596	60.0	13.0
30.0	287.7	166.8	120.9	36.3	1.764	.558	60.0	12.9
35.0	384.4	197.8	186.6	51.0	1.834	.579	60.0	12.6
40.0	490.2	238.6	251.6	77.9	1.888	.684	60.0	12.3
45.0	394.2	269.3	124.9	56.5	1.888	.552	60.0	12.2
50.0	311.3	279.8	31.5	43.6	1.844	.291	60.0	12.0
55.0	709.4	290.9	418.5	388.1	1.823	.324	60.0	11.0
60.0	599.5	290.5	309.1	171.9	1.774	.245	60.0	10.6
63.0	667.7	291.5	376.1	320.5	1.763	.184	60.0	10.3
ſotal D	riving Tim	e 83.18 r	in. for	60.0 bl/m	iin			
Blow	Rate:		50 bl/m	in 4	0 bl/min	30	bl/min	
Tota	l Driving	Time:	99.82 min	124.7	7 min	166.36	min	



Figure A.88: Driveability Graph MDF-ST Analysis for Aucilla, FL

Aucilla, Driveability, MDF, Dynamic

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	, kips	kips	kipš	bl/ft	ksi	ksi	bpm	kip-ft
5.0	221.0	19.0	201.9	21.0	1.615	.240	60.0	13.0
10.0	89.3	49.1	40.2	9.8	1.615	.486	60.0	13.1
15.0	167.5	87.1	80.4	18.8	1.616	.390	60.0	13.1
20.0	182.6	115.8	66.8	21.4	1.635	.377	60.0	13.0
25.0	216.4	147.6	68.7	26.8	1.689	.447	60.0	13.0
30.0	245.8	175.9	69.8	32.0	1.759	.598	60.0	13.0
35.0	312.8	205.5	107.3	41.1	1.830	.420	60.0	12.7
40.0	383.4	239.3	144.1	52.9	1.887	.566	60.0	12.5
45.0	339.9	267.3	72.6	47.2	1.892	.377	60.0	12.2
50.0	301.8	283.7	18.1	42.5	1.853	.261	60.0	11.9
55.0	580.7	298.8	281.9	143.9	1.829	.317	60.0	11.0
60.0	506.8	298.6	208.3	97.0	1.782	.204	60.0	10.7
63.0	553.0	299.7	253.2	129.8	1.769	.170	60.0	10.3
Total D	riving Tim	e 47.83	min. for	60.0 bl/m	nin			
Blow Tota	Rate: 1 Driving	Time:	50 bl/ 57.40 min	min 2 71.7	40 bl/min 75 min	30 95.66	bl/min min	



Figure A.89: Driveability Graph MDF-DYN Analysis for Aucilla, FL

# Aucilla, Driveability, STD Method

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	12.7	1.3	11.4	4.8	1.614	.816	60.0	12.9
10.0	5.1	1.9	3.2	4.4	1.614	.865	60.0	12.9
15.0	12.9	7.9	4.9	4.7	1.614	.817	60.0	12.9
20.0	25.8	20.8	5.1	5.4	1.614	.743	60.0	13.0
25.0	45.0	38.3	6.6	6.3	1.615	.642	60.0	13.0
30.0	61.1	53.7	7.4	7.8	1.624	.567	60.0	13.0
35.0	83.9	72.5	11.4	10.8	1.652	.475	60.0	13.0
40.0	105.9	93.1	12.8	13.6	1.684	.412	60.0	12.9
45.0	120.6	113.6	7.1	15.7	1.702	.404	60.0	12.9
50.0	132.3	127.8	4.5	17.3	1.706	.433	60.0	12.8
55.0	750.4	144.6	605.8	1193.5	1.950	.322	60.0	12.2
60.0	556.5	144.1	412.5	159.5	1.695	.284	60.0	12.1
63.0	839.7	145.3	694.4	9999.0	1.972	.258	60.0	11.8
rotal D	riving Time	e 113.68	min. for	60.0 bl/r	nin			
Blow	Rate:	Cimo:	50 bl/r	nin 4	40 bl/min 52 min	30	bl/min min	
ιστα	т рітатій і	TUIC .	100.42 1111	170.0	74 MILII	221.00		



Figure A.90: Driveability Graph STD (FHWA) Analysis for Aucilla, FL

Friction	Loss/Gain	Factor	1.000
11 70 67011	Looo, auti	1 40 201	11000

Depth feet 5.0 10.0 15.0 20.0 25.0	Ultimate Capacity kips 43.5 34.2 22.8 45.0 108.6	Skin Friction kips 1.4 3.8 4.8 8.6 13.2	End Bearing kips 42.1 30.4 18.0 36.4 95.5	Blow Count bl/ft 2.0 1.7 1.5 1.9 4.9	Max C. Stress ksi 1.194 1.188 1.102 1.260 1.789	Max T. Stress ksi .034 .083 .089 .087 .113	Blow Rate bpm 62.0 62.6 63.8 61.6 54.5	ENTHRU kip-ft 41.4 42.9 40.5 42.5 36.8
25.0 30.0	108.6	13.2	95.5 269.0	4.9 18.3	1.789	.113	54.5 47.3	36.8 30.1
35.0	506.6	32.7	473.9	39.7	2.634	.067	47.3	23.8
Total D	riving Tim	ie 5.06	min. only	if hammer	runs cor	ntinuously	,	





	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	26.8	.8	26.0	-1.0	.000	.000	85.6	.0
10.0	20.4	2.1	18.3	1.5	1.066	.074	64.1	40.6
15.0	12.1	2.4	9.7	-1.0	.000	.000	94.3	.0
20.0	1.3	.7	.6	-1.0	.000	.000	100.1	.0
25.0	97.7	8.6	89.1	4.4	1.743	.120	55.2	38.2
30.0	246.4	24.2	222.2	14.1	2.145	.024	48.2	31.4
35.0	426.9	38.8	388.1	31.4	2.421	.000	48.2	24.6
Total D	riving Tim	e 3.57	min. only	if hammer	runs con	tinuousl	y	





		,	
Friction	Loss/Gain	Factor	1.000

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	43.5	1.4	42.1	1.7	1.238	.172	62.6	38.1
10.0	34.2	3.8	30.4	1.5	1.170	.148	63.3	39.3
15.0	22.8	4.8	18.0	-1.0	.000	.000	86.6	.0
20.0	45.0	8.6	36.4	1.6	1.180	.129	62.9	41.1
25.0	108.6	13.2	95.5	5.2	1.816	.106	54.2	36.0
30.0	292.9	23.9	269.0	17.3	2.160	.024	47.5	31.4
35.0	506.6	32.7	473.9	42.3	2.538	.053	47.0	27.1

Total Driving Time 4.94 min. only if hammer runs continuously





## Friction Loss/Gain Factor 1.000

Depth feet 5.0 10.0 15.0 20.0 25.0	Ultimate Capacity kips 26.8 20.4 12.1 1.3 97.7	Skin Friction kips 2.1 2.4 .7 8.6 24.2	End Bearing 26.0 18.3 9.7 .6 89.1	Blow Count bl/ft -1.0 -1.0 -1.0 4.3	Max C. Stress ksi .000 .000 .000 1.714	Max T. Stress ksi .000 .000 .000 .104	Blow Rate bpm 89.1 88.1 97.3 100.3 55.4	ENTHRU kip-ft .0 .0 .0 .0 38.7
25.0	97.7	8.6	89.1	4.3	1.714	.104	55.4	38.7
30.0	246.4	24.2	222.2	19.1	2.180	.021	47.3	33.2
35.0	426.9	38.8	388.1	31.4	2.300	.115	48.1	27.2

Total Driving Time 4.01 min. only if hammer runs continuously





# Friction Loss/Gain Factor 1.000

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	43.5	1.4	42.1	-1.0	.000	.000	84.8	.0
10.0	34.2	3.8	30.4	1.5	1.099	.117	63.9	38.5
15.0	22.8	4.8	18.0	1.4	1.050	.115	64.6	37.2
20.0	45.0	8.6	36.4	1.6	1.176	.137	63.0	40.5
25.0	108.6	13.2	95.5	2.9	1.654	.276	57.0	40.1
30.0	292.9	23.9	269.0	10.1	2.065	.096	49.7	32.6
35.0	506.6	32.7	473.9	24.5	2.222	.159	49.1	25.8

Total Driving Time 2.83 min. only if hammer runs continuously





Friction Loss/Gain Factor 1.000

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
5.0	26.8	.8	26.0	-1.0	.000	.000	90.2	.0
10.0	20.4	2.1	18.3	-1.0	.000	.000	87.7	.0
15.0	12.1	2.4	9.7	-1.0	.000	.000	98.2	.0
20.0	1.3	.7	.6	-1.0	.000	.000	100.3	.0
25.0	97.7	8.6	89.1	2.4	1.627	.281	57.4	42.9
30.0	246.4	24.2	222.2	7.8	2.018	.152	50.8	35.3
35.0	426.9	38.8	388.1	20.1	2.061	.364	49.8	25.8

Total Driving Time 1.96 min. only if hammer runs continuously



Figure A.96: Driveability Graph MDF-DYN Analysis for Vilano - East, FL

#### Ultimate End Blow Max C. Max T. Blow Skin **ENTHRU** Depth Capacity Friction Bearing Count Stress Stress Rate kip-ft feet kips kips kips bl/ft ksi ksi bpm 12.9 5.0 12.7 1.3 11.4 4.8 1.614 .816 60.0 1.9 12.9 10.0 5.1 3.2 4.4 1.614 .865 60.0 12.9 7.9 4.9 4.7 1.614 .817 60.0 15.0 12.9 20.0 25.8 20.8 5.1 5.4 1.614 .743 60.0 13.0 25.0 45.0 38.3 6.6 6.3 1.615 .642 60.0 13.0 60.0 13.0 30.0 61.1 53.7 7.4 7.8 1.624 .567 60.0 13.0 35.0 83.9 72.5 11.4 10.8 1.652 .475 60.0 12.9 93.1 40.0 105.9 12.8 13.6 1.684 .412 120.6 7.1 15.7 1.702 .404 60.0 12.9 45.0 113.6 60.0 12.8 50.0 132.3 127.8 4.5 17.3 1.706 .433 1193.5 60.0 12.2 55.0 750.4 144.6 605.8 1.950 .322 60.0 12.1 60.0 556.5 144.1 412.5 159.5 1.695 .284 63.0 839.7 145.3 694.4 9999.0 1.972 .258 60.0 11.8

# Friction Loss/Gain Factor 1.000

Total Driving Time 113.68 min. for 60.0 bl/min

Blow Rate: Total Driving Time: 50 bl/min 40 bl/min 136.42 min 170.52 min

30 bl/min 227.36 min



Figure A.97: Driveability Graph STD (FHWA) Analysis for Vilano - East, FL
Vilano-West, Driveability, STD, Static

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
30.0	42.9	35.9	7.0	2.3	1.932	.556	53.0	44.4
35.0	62.2	54.4	7.8	2.9	1.951	.465	52.5	42.6
40.0	78.8	70.5	8.4	3.7	2.033	.447	51.5	41.1
45.0	86.8	78.2	8.6	4.1	2.046	.461	51.3	39.4
50.0	127.8	91.2	36.6	6.6	2.170	.424	49.7	35.3
55.0	139.6	102.5	37.1	7.5	2.190	.471	49.5	33.6
60.0	183.9	117.4	66.5	10.6	2.269	.454	48.1	30.9
62.0	255.3	130.5	124.8	18.0	2.331	.282	47.1	27.9

Friction Loss/Gain Factor 1.000

Total Driving Time 4.36 min. only if hammer runs continuously



Figure A.98: Driveability Graph STD-ST Analysis for Vilano - West, FL

Vilano-West, Driveability, STD, Dynamic

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	· kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
30.0	42.9	35.9	7.0	2.3	1.932	.556	53.0	44.4
35.0	62.2	54.4	7.8	2.9	1.951	.465	52.5	42.6
40.0	80.1	71.7	8.4	3.7	2.036	.443	51.5	40.9
45.0	90.2	81.6	8.6	4.4	2.055	.449	51.2	38.8
50.0	105.6	93.1	12.6	5.4	2.084	.464	50.7	35.8
55.0	118.2	105.4	12.8	6.2	2.169	.542	49.7	35.4
60.0	178.4	121.2	57.2	10.3	2.268	.470	48.2	31.2
62.0	276.7	129.3	147.4	20.1	2.351	.227	46.8	27.5

Friction Loss/Gain Factor 1.000

Total Driving Time 4.14 min. only if hammer runs continuously



Figure A.99: Driveability Graph STD-DYN Analysis for Vilano - West, FL

Vilano-West, Driveability, SPT, Static

10/10/94

							_	
	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
30.0	42.9	35.9	7.0	2.0	1.910	.603	53.3	44.6
35.0	62.2	54.4	7.8	2.5	1.961	.562	52.7	41.9
40.0	78.8	70.5	8.4	2.9	2.073	. 593	51.5	40.9
45.0	86.8	78.2	8.6	3.5	2.096	.593	51.2	38.7
50.0	127.8	91.2	36.6	5.8	2.218	.547	49.7	34.1
55.0	139.6	102.5	37.1	7.3	2.248	.550	49.4	31.8
60.0	183.9	117.4	66.5	11.1	2.320	.509	47.9	29.1
62.0	255.3	130.5	124.8	20.4	2.373	.200	46.9	26.6

### Friction Loss/Gain Factor 1.000

Total Driving Time 4.10 min. only if hammer runs continuously



Figure A.100: Driveability Graph SPT-ST Analysis for Vilano - West, FL

Vilano-West, Driveability, SPT, Dynamic

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
30.0	42.9	35.9	7.0	2.2	1.926	.563	53.0	44.6
35.0	62.2	54.4	7.8	2.8	1.973	.517	52.4	41.6
40.0	80.1	71.7	8.4	3.9	2.102	.488	50.9	38.9
45.0	90.2	81.6	8.6	5.1	2.131	.451	50.5	35.7
50.0	105.6	93.1	12.6	6.7	2.216	.449	49.4	33.6
55.0	118.2	105.4	12.8	7.9	2.239	.480	49.2	31.8
60.0	178.4	121.2	57.2	14.1	2.349	.324	47.5	28.0
62.0	276.7	129.3	147.4	21.0	2.368	.219	46.9	26.6

#### Friction Loss/Gain Factor 1.000

Total Driving Time 4.85 min. only if hammer runs continuously





10/10/94

Friction	Loss/Gain	Factor	1.000
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	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
30.0	42.9	35.9	7.0	2.2	1.928	.572	53.1	44.4
35.0	62.2	54.4	7.8	2.8	1.947	.480	52.6	42.8
40.0	78.8	70.5	8.4	3.5	2.027	.461	51.6	41.4
45.0	86.8	78.2	8.6	4.0	2.040	.477	51.4	39.6
50.0	127.8	91.2	36.6	5.9	2.158	.491	49.9	36.0
55.0	139.6	102.5	37.1	6.7	2.178	.540	49.7	34.2
60.0	183.9	117.4	66.5	9.2	2.254	.573	48.5	31.8
62.0	255.3	130.5	124.8	13.8	2.314	.483	47.4	29.0

Total Driving Time 3.95 min. only if hammer runs continuously



Figure A.102: Driveability Graph MDF-ST Analysis for Vilano - West, FL

#### Vilano-West, Driveability, MDF, Dynamic

10/10/94

Friction	Loss/Gain	Factor	1.000

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
30.0	42.9	35.9	7.0	2.2	1.928	.572	53.1	44.4
35.0	62.2	54.4	7.8	2.8	1.947	. 480	52.6	42.8
40.0	80.1	71.7	8.4	3.6	2.032	.457	51.6	41.2
45.0	90.2	81.6	8.6	4.2	2.049	. 465	51.3	39.1
50.0	105.6	93.1	12.6	5.1	2.078	.488	50.8	36.2
55.0	118.2	105.4	12.8	5.9	2.167	.569	49.9	35.7
60.0	178.4	121.2	57.2	9.0	2.253	.571	48.6	31.9
62.0	276.7	129.3	147.4	15.4	2.329	.455	47.2	28.3

Total Driving Time 3.83 min. only if hammer runs continuously





#### Vilano-West, Driveability, MDF, Static

10/10/94

	Ultimate	Skin	End	Blow	Max C.	Max T.	Blow	
Depth	Capacity	Friction	Bearing	Count	Stress	Stress	Rate	ENTHRU
feet	kips	kips	kips	bl/ft	ksi	ksi	bpm	kip-ft
30.0	42.9	35.9	7.0	2.2	1.928	.572	53.1	44.4
35.0	62.2	54.4	7.8	2.8	1.947	.480	52.6	42.8
40.0	78.8	70.5	8.4	3.5	2.027	.461	51.6	41.4
45.0	86.8	78.2	8.6	4.0	2.040	.477	51.4	39.6
50.0	127.8	91.2	36.6	5.9	2.158	.491	49.9	36.0
55.0	139.6	102.5	37.1	6.7	2.178	.540	49.7	34.2
60.0	183.9	117.4	66.5	9.2	2.254	.573	48.5	31.8
62.0	255.3	130.5	124.8	13.8	2.314	.483	47.4	29.0
02.0	200.0	130,5	124.0	13.0	2.314	.403	4/.4	29.

### Friction Loss/Gain Factor 1.000

Total Driving Time 3.95 min. only if hammer runs continuously





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## APPENDIX B

## SPT STATIC LOAD TEST RESULTS

## B.1 LOAD VERSUS DISPLACEMENT PLOTS

The sampler load vs displacement plots presented in this appendix were calculated from top measured load and displacement values, taking into account the weight of the drill rod, and the elastic compression or elongation of the drill rod. For uplift tests, the weight of the rod and the elastic elongation were subtracted from the measured top loads and displacements, respectively. For compression tests, the weight of the rod was added to the measured top loads and the elastic compression was subtracted from the measured top displacements.

The static load tests were often repeated several times at different displacement rates. The loading followed by unloading is indicated on the load-displacement plots as *cycle* and the displacement rate is given in inches per minute for the cycle indicated. Some of the load tests were repeated after a waiting period as indicated on the plot whenever applicable. Also presented on the plots is the soil type based on the Unified Soil Classification System (USCS), the SPT N-value corrected to 60 percent maximum transferred energy (N₆₀), and Davisson's failure criterion line. When an oversized tip was used in a compression test, N₆₀ was obtained from the nearest measurement depth. N-values marked * were taken from existing soil borings and therefore uncorrected.

Table B.1 summarizes the static load tests results performed for this study including the test locations, test type (*i.e.*, uplift or compression), the maximum load measured (Ru), and the corresponding figure number. For uplift load tests with very low resistance values, only the load maxima are given in table B.1 and no load-displacement plots.

	Table B.1:	Summary of SPT	Static Load Test	Results	
	Location of Test Site	Test Depth	Test type	Ru	Figure
		[ft-wait time]		[kips]	
1.	St. Mary,	40	Uplift	1.50	B.1
	Cleveland, OH	65	Uplift	2.10	B.2
		100	Uplift	0.90	B.3
		100-15hours	Uplift	1.40	B.4
		103.5	Uplift	1.30	B.5
		105	Compression	4.00	B.6
2.	Fore River Bridge,	20	Uplift	0.10	
	Portland, ME	30	Uplift	0.18	
		40	Uplift	0.24	
		42	Compression	6.50	B.7
		54	Compression	5.50	B.8
		56	Compression	2.10	B.9
3.	C&D Canal,	14	Uplift	0.42	B.10
	Pier 17, DE	40	Uplift	0.05	
		50	Uplift	0.48	B.11
		55	Uplift	0.54	B.12
		55-1hour	Uplift	0.55	B.13
		55-14hours	Uplift	0.80	B.14
		60	Uplift	0.80	B.15
		60-1hour	Uplift	0.70	B.16
		65	Uplift	2.30	B.17
		65-2hours	Uplift	2.70	B.18
		70	Compression	3.50	B.19
4.	C&D Canal,	40	Uplift	0.65	B.20
	Pier 21, DE	40-1hour	Uplift	0.60	B.21

	Table B.1: Sum	mary of SPT Station	c Load Test Result	s (continued)	
	Location of Test Site	Test Depth	Test Type	Ru	Figure
		[ft-wait time]		[kips]	
4.	C&D Canal,	55	Uplift	1.00	B.22
	Pier 21, DE	55-1hour	Uplift	0.90	B.23
	(continued)	65	Uplift	1.35	B.24
		70	Compression	1.75	B.25
		71	Compression	2.60	B.26
5.	White City Bridge,	31	Uplift	0.10	
	TP3, FL	32	Compression	5.00	B.27
		35	Compression	6.00	B.28
6.	White City Bridge,	15.5	Uplift	0.04	
	TP6, FL	33	Compression	8.00	
7.	Apalachicola River	20	Uplift	0.10	
	Bridge, FL	25	Uplift	0.15	
		25-14hours	Uplift	0.22	
		55	Uplift	0.75	B.29
		55-1hour	Uplift	0.65	B.30
		75	Uplift	0.58	B.31
		75-1hour	Uplift	0.42	B.32
		89	Compression	5.60	B.33
8.	Sunshine Skyway	27.5	Uplift	0.14	
	Bridge, FL	27.5-15hours	Uplift	0.14	
		40	Uplift	0.03	
		45	Compression	11.50	B.34
		45.5	Uplift	1.25	B.35
		50	Uplift	0.68	B.36
		53	Compression	9.00	B.37

	Table B.1: Sum	mary of SPT Statio	c Load Test Result	s (continued)	
	Location of Test Site	Test Depth	Test Type	Ru	Figure
		[ft-wait time]		[kips]	
9.	Aucilla River Bridge,	· 10	Uplift	1.13	B.38
	FL	20	Uplift	0.92	B.39
		30	Uplift	0.82	B.40
		30-1hour	Uplift	0.90	B.40
		30-11hours	Uplift	1.05	B.40
		42	Compression	2.55	B.41
		45	Uplift	0.54	B.42
		45-15mins	Uplift	0.61	B.42
		63	Compression	8.10	B.43
		67.5	Compression	6.75	B.44
10.	Vilano Bridge - East,	15	Compression	0.96	B.45
	FL	20	Compression	1.23	B.46
		25	Compression	3.21	B.47
		30	Compression	7.60	B.48
		30	Uplift	0.45	B.49
		30-15mins	Uplift	0.32	B.49
		30-1hour	Uplift	0.17	B.49
		35	Compression	9.90	B.50
		40	Compression	11.60	B.51
11.	Vilano Bridge - West,	30	Uplift	0.60	B.52
	FL	35	Uplift	0.50	B.53
		35-15mins	Uplift	0.43	B.53
		35-1hour	Uplift	0.50	B.53
		45	Uplift	0.16	B.54
		45-15mins	Uplift	0.24	B.54

Table B.1: Summary of SPT Static Load Test Results (continued)						
	Location of Test Site	Test Depth	Test Type	Ru	Figure	
		[ft-wait time]		[kips]		
11.	Vilano Bridge - West,	45-1hour	Uplift	0.31	B.54	
	FL (continued)	50	Uplift	0.30	B.55	
		50-1hour	Uplift	0.51	B.55	
		50-14hours	Uplift	0.88	B.55	
		52	Compression	0.60	B.56	
		55	Uplift	0.28	B.57	
		55-15mins	Uplift	0.41	B.57	
		55-1hour	Uplift	0.57	B.57	
		59	Uplift	0.48	B.58	
		59-15mins	Uplift	0.41	B.58	
		59-1hour	Uplift	0.49	B.58	
		62	Compression	3.25	B.59	
		67	Compression	2.70	B.60	







Figure B.2: Load versus Displacement for St. Mary, Cleveland, OH at depth of 65 ft



Figure B.3: Load versus Displacement for St. Mary, Cleveland, OH at depth of 100 ft



Figure B.4: Load versus Displacement for St. Mary, Cleveland, OH at depth of 100 ft (15 h)



Figure B.5: Load versus Displacement for St. Mary, Cleveland, OH at depth of 103.5 ft



Figure B.6: Load versus Displacement for St. Mary, Cleveland, OH at depth of 105 ft



Figure B.7: Load versus Displacement for Fore River Bridge, Portland, ME at depth of 42 ft



Figure B.8: Load versus Displacement for Fore River Bridge, Portland, ME at depth of 54 ft



Figure B.9: Load versus Displacement for Fore River Bridge, Portland, ME at depth of 56 ft



Figure B.10: Load versus Displacement for C&D Canal, Pier 17, DE at depth of 14 ft



Figure B.11: Load versus Displacement for C&D Canal, Pier 17, DE at depth of 50 ft



Figure B.12: Load versus Displacement for C&D Canal, Pier 17, DE at depth of 55 ft



Figure B.13: Load versus Displacement for C&D Canal, Pier 17, DE at depth of 55 ft (1 h)



Figure B.14: Load versus Displacement for C&D Canal, Pier 17, DE at depth of 55 ft (14 h)



Figure B.15: Load versus Displacement for C&D Canal, Pier 17, DE at depth of 60 ft



Figure B.16: Load versus Displacement for C&D Canal, Pier 17, DE at depth of 60 ft (1 h)



Figure B.17: Load versus Displacement for C&D Canal, Pier 17, DE at depth of 65 ft



Figure B.18: Load versus Displacement for C&D Canal, Pier 17, DE at depth of 65 ft (2 h)



Figure B.19: Load versus Displacement for C&D Canal, Pier 17, DE at depth of 70 ft



Figure B.20: Load versus Displacement for C&D Canal, Pier 21, DE at depth of 40 ft



Figure B.21: Load versus Displacement for C&D Canal, Pier 21, DE at depth of 40 ft (1 h)



Figure B.22: Load versus Displacement for C&D Canal, Pier 21, DE at depth of 55 ft



Figure B.23: Load versus Displacement for C&D Canal, Pier 21, DE at depth of 55 ft (1 h)



Figure B.24: Load versus Displacement for C&D Canal, Pier 21, DE at depth of 65 ft



Figure B.25: Load versus Displacement for C&D Canal, Pier 21, DE at depth of 70 ft



Figure B.26: Load versus Displacement for C&D Canal, Pier 21, DE at depth of 71 ft



Figure B.27: Load versus Displacement for White City Bridge, TP3, FL at depth of 32 ft



Figure B.28: Load versus Displacement for White City Bridge, TP3, FL at depth of 35 ft



Figure B.29: Load versus Displacement for Apalachicola River Bridge, FL at depth of 55 ft



Figure B.30: Load versus Displacement for Apalachicola, FL at depth of 55 ft (15 min & 1h)



Figure B.31: Load versus Displacement for Apalachicola River Bridge, FL at depth of 75 ft



Figure B.32: Load versus Displacement for Apalachicola, FL at depth of 75 ft (15 min & 1 h)



Figure B.33: Load versus Displacement for Apalachicola River Bridge, FL at depth of 89 ft



Figure B.34: Load versus Displacement for Sunshine Skyway Bridge, FL at depth of 45 ft



Figure B.35: Load versus Displacement for Sunshine Skyway Bridge, FL at depth of 45.5 ft



Figure B.36: Load versus Displacement for Sunshine Skyway Bridge, FL at depth of 50 ft



Figure B.37: Load versus Displacement for Sunshine Skyway Bridge, FL at depth of 53 ft



Figure B.38: Load versus Displacement for Aucilla River Bridge, FL at depth of 10 ft



Figure B.39: Load versus Displacement for Aucilla River Bridge, FL at depth of 20 ft



Figure B.40: Load versus Displacement for Aucilla River Bridge, FL at depth of 30 ft



Figure B.41: Load versus Displacement for Aucilla River Bridge, FL at depth of 42 ft



Figure B.42: Load versus Displacement for Aucilla River Bridge, FL at depth of 45 ft



Figure B.43: Load versus Displacement for Aucilla River Bridge, FL at depth of 63 ft



Figure B.44: Load versus Displacement for Aucilla River Bridge, FL at depth of 67.5 ft



Figure B.45: Load versus Displacement for Vilano Bridge - East, FL at depth of 15 ft



Figure B.46: Load versus Displacement for Vilano Bridge - East, FL at depth of 20 ft



Figure B.47: Load versus Displacement for Vilano Bridge - East, FL at depth of 25 ft



Figure B.48: Load versus Displacement for Vilano - East, FL at depth of 30 ft (Compression)



Figure B.49: Load versus Displacement for Vilano -East, FL at depth of 30 ft (Uplift)



Figure B.50: Load versus Displacement for Vilano Bridge - East, FL at depth of 35 ft



Figure B.51: Load versus Displacement for Vilano Bridge - East, FL at depth of 40 ft



Figure B.52: Load versus Displacement for Vilano Bridge - West, FL at depth of 30 ft



Figure B.53: Load versus Displacement for Vilano Bridge - West, FL at depth of 35 ft



Figure B.54: Load versus Displacement for Vilano Bridge - West, FL at depth of 45 ft



Figure B.55: Load versus Displacement for Vilano Bridge - West, FL at depth of 50 ft



Figure B.56: Load versus Displacement for Vilano Bridge - West, FL at depth of 52 ft



Figure B.57: Load versus Displacement for Vilano Bridge - West, FL at depth of 55 ft



Figure B.58: Load versus Displacement for Vilano Bridge - West, FL at depth of 59 ft



Figure B.59: Load versus Displacement for Vilano Bridge - West, FL at depth of 62 ft



Figure B.60: Load versus Displacement for Vilano Bridge - West, FL at depth of 67 ft

# APPENDIX C

## TORQUE TEST RESULTS

The torque test results were plotted as torque vs angle of rotation measured near the top of the SPT drill string. The results are summarized in table C.1 including peak torque and residual torque. The torque tests were performed with two different types of device, (a) torque wrench and (b) instrumented torque rod. Details about each instrument are discussed in chapter 4. With the torque wrench, only peak and residual values could be recorded. However, both torque and angle of rotation were recorded continuously with the instrumented torque rod, and therefore the torque vs angle of rotation plots are presented in figures C.1 to C.15.

The plots of torque vs angle of rotation include a shear resistance scale on the right y-axis. Furthermore, for comparison, the uplift resistance of the soil and other shear resistance results (whenever available) are also shown on the plot. For example, for Apalachicola River Bridge, FL, figure C.1 shows both the uplift resistance and the unconfined compressive strength of the soil.

Table C.1: Summary of Torque Test Results						
	Location of Test Site	Test	Peak	Residual	Figure	
	(Test Device)	Depth	Torque	Torque		
		[ft]	[lbs-ft]	[lbs-ft]		
1.	C&D Canal, Pier 17, DE	60	70	70		
	(Torque Wrench)	65	220	220		
2.	C&D Canal, Pier 21, DE	40	15	15		
	(Torque Wrench)	55	130	130		
		65	150	150		
3.	Apalachicola River Brg, FL	55	77	54	C.1	
	(Instrumented Torque Rod)	75	60	60	C.2	
4.	Sunshine Skyway Brg, FL	45.5	125	64	C.3	
	(Instrumented Torque Rod)	50	88	55	C.4	
5.	Aucilla River Bridge, FL	10	70	22	C.5	
	(Instrumented Torque Rod)	20	100	40	C.6	
		30	90	45	C.7	
		45	62	58	C.8	
6.	Vilano Bridge - East, FL	30	. 30	30	C.9	
	(Instrumented Torque Rod)			·		
7.	Vilano Bridge - West, FL	30	58	30	C.10	
	(Instrumented Torque Rod)	35	65	42	C.11	
		45	57	35	C.12	
		50	59	27	C.13	
		55	73	32	C.14	
		59	60	36	C.15	

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Figure C.1: Torque versus Rotation for Apalachicola RiverBridge, FL at depth of 55 ft



Figure C.2: Torque versus Rotation for Apalachicola River Bridge, FL at depth of 75 ft



Figure C.3: Torque versus Rotation for Sunshine Skyway Bridge, FL at depth of 45.5 ft



Figure C.4: Torque versus Rotation for Sunshine Skyway Bridge, FL at depth of 50 ft



Figure C.5: Torque versus Rotation for Aucilla River Bridge, FL at depth of 10 ft



Figure C.6: Torque versus Rotation for Aucilla River Bridge, FL at depth of 20 ft



Figure C.7: Torque versus Rotation for Aucilla River Bridge, FL at depth of 30 ft



Figure C.8: Torque versus Rotation for Aucilla River Bridge, FL at depth of 45 ft







Figure C.10: Torque versus Rotation for Vilano Bridge - West, FL at depth of 30 ft



Figure C.11: Torque versus Rotation for Vilano Bridge - West, FL at depth of 35 ft



Figure C.12: Torque versus Rotation for Vilano Bridge -West, FL at depth of 45 ft



Figure C.13: Torque versus Rotation for Vilano Bridge - West, FL at depth of 50 ft



Figure C.14: Torque versus Rotation for Vilano Bridge - West, FL at depth of 55 ft



Figure C.15: Torque versus Rotation for Vilano Bridge - West, FL at depth of 59 ft

### APPENDIX D

### DYNAMIC TEST RESULTS

### D.1 FORCE AND VELOCITY TIME HISTORY

The force and velocity (F-V) time histories, measured near the top of the SPT drive rod are presented in this appendix. The calculated F-V time histories at the bottom end of the drill string (when an oversized tip was used) or at the sampler location (when split spoon sampler was used) are also presented here. Both the top and bottom F-V time histories are presented on the same figure, with the top F-V presented in (a) and the bottom F-V in (b). The velocity scales are always calculated from the force scale by dividing with the drive rod impedance. The bottom F-V time histories were determined from the top F-V according to the method discussed in chapter 5. The bottom measured and computed force histories are presented in (c) and (d) when available for statically and dynamically calculated parameters, respectively. Table D.1 summarizes the location (site and depth) of the F-V time histories as well as the corresponding figure number. Note that the "test depth" column in table D.1 also includes the waiting time, whether split spoon sampler or oversized tip was used, and the hammer drop height if different from 30 in. When an oversized tip was used, a letter "C" is indicated on the table. When "C2" is indicated, the test was performed with an oversized tip and after the static load test was conducted. In figures D.96 and D.99, ASLT stands for after static load test.

Table D.1: Summary of Dynamic Test Results						
	Location of Test Site	Test Depth	Figure			
		[ft-wait time]				
1.	St. Mary, Cleveland, OH	40	D.1			
		65	D.2			
		65-25mins	D.3			
		65-2hours	D.4			
		100	D.5			
		100-15hours	D.6			
		103.5	D.7			
		105 C	D.8			
2.	Fore River Bridge, Portland, ME	20	D.9			
		30	D.10			
		40	D.11			
		42 C	D.12			
		54 C	D.13			
		56 C	D.14			
3.	C&D Canal, Pier 17, DE	14	D.15			
		40	D.16			
		50	D.17			
		55	D.18			
		55-1hour	D.19			
		55-14hours	D.20			
		60	D.21			
		60-1hour	D.22			
		65	D.23			
		65-2hours	D.24			
		70 C	D.25			
Table D.1: Summary of Dynamic Test Results (continued)						
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	Location of Test Site	Test Depth	Figure			
		[ft-wait time]				
4.	C&D Canal, Pier 21, DE	40	D.26			
		40-1hour	D.27			
		55	D.28			
		55-1hour	D.29			
		65	D.30			
		70 C	D.31			
		71 C	D.32			
5.	White City Bridge, TP3, FL	20	D.33			
		29	D.34			
		31	D.35			
		32 C	D.36			
		35 C	D.37			
6.	White City Bridge, TP6, FL	16	D.38			
		32	D.39			
		33 C	D.40			
7.	Apalachicola River Bridge, FL	20	D.41			
		25	D.42			
		25-14hours	D.43			
		55	D.44			
		55-1hour	D.45			
		75	D.46			
		75-1hour	D.47			
		89 C	D.48			
8.	Aucilla River Bridge, FL	5	D.49			
		10	D.50			

Table D.1: Summary of Dynamic Test Results (continued)					
	Location of Test Site	Test Depth	Figure		
		[ft-wait time]			
8.	Aucilla River Bridge, FL	15	D.51		
	(continued)	20	D.52		
		20-15mins	D.53		
		25	D.54		
		30	D.55		
		30-11hours	D.56		
		35	D.57		
		40	D.58		
		42 C	D.59		
		45	D.60		
		50	D.61		
		55	D.62		
		60	, D.63		
		63 C	D.64		
		65	D.65		
		67.5 C	D.66		
9.	Vilano Bridge - East, FL	10	D.67		
		15 C	D.68		
		15	D.69		
		20 C	`D.70		
		25 C	D.71		
		25	D.72		
		30 C	D.73		
		30	D.74		
		35 C	D.75		

Table D.1: Summary of Dynamic Test Results (continued)					
	Location of Test Site	Test Depth	Figure		
		[ft-wait time]			
9.	Vilano Bridge - East, FL	35	D.76		
	(continued)	40 C	D.77		
10.	Vilano Bridge - West, FL	30	D.78		
		35	D.79		
		35-1hour	D.80		
		40	D.81		
		42	D.82		
		45	D.83		
		45-1hour	D.84		
		50	D.85		
		50-14hours-4"	D.86		
		50-14hours-8"	D.87		
		52 C	D.88		
		55	D.89		
		55-1hour-4"	D.90		
		55-1hour-20"	D.91		
		59	D.92		
		59-1hour-5"	D.93		
		59-1hour-30"	D.94		
		62-C	D.95		
		62-C2	D.96		
		64	D.97		
		67-C	D.98		
		67-C2	D.99		
		68	D.100		



Figure D.1a: Top F-V Time History for St. Mary, Cleveland, OH at depth of 40 ft



Figure D.1b: Bottom F-V Time History for St. Mary, Cleveland, OH at depth of 40 ft



Figure D.1c: Bottom Force Time History (Static) for St. Mary, Cleveland, OH at depth of 40 ft



Figure D.1d: Bottom Force Time History (Dynamic) for St. Mary, Cleveland at depth of 40 ft



Figure D.2a: Top F-V Time History for St. Mary, Cleveland, OH at depth of 65 ft



Figure D.2b: Bottom F-V Time History for St. Mary, Cleveland, OH at depth of 65 ft



Figure D.2c: Bottom Force Time History (Static) for St. Mary, Cleveland, OH at depth of 65 ft



Figure D.2d: Bottom Force Time (Dynamic) History for St. Mary, Cleveland at depth of 65 ft



Figure D.3a: Top F-V Time History for St. Mary, Cleveland, OH at depth of 65 ft (25 min)



Figure D.3b: Bottom F-V Time History for St. Mary, Cleveland, OH at depth of 65 ft (25 min)



Figure D.4a: Top F-V Time History for St. Mary, Cleveland, OH at depth of 65 ft (2 h)



Figure D.4b: Bottom F-V Time History for St. Mary, Cleveland, OH at depth of 65 ft (2 h)



Figure D.4c: Bottom Force Time History (Static) for St. Mary, OH at depth of 65 ft (2 h)



Figure D.4d: Bottom Force Time History (Dynamic) for St. Mary, OH at depth of 65 ft (2 h)



Figure D.5a: Top F-V Time History for St. Mary, Cleveland, OH at depth of 100 ft



Figure D.5b: Bottom F-V Time History for St. Mary, Cleveland, OH at depth of 100 ft



Figure D.5c: Bottom Force Time History (Static) for St. Mary, Cleveland at depth of 100 ft



Figure D.5d: Bottom Force Time History (Dynamic) for St. Mary, Cleveland at depth of 100 ft



Figure D.6a: Top F-V Time History for St. Mary, Cleveland, OH at depth of 100 ft (15 h)



Figure D.6b: Bottom F-V Time History for St. Mary, Cleveland, OH at depth of 100 ft (15 h)



Figure D.6c: Bottom Force Time History (Static) for St. Mary, OH at depth of 100 ft (15 h)



Figure D.6d: Bottom Force Time History (Dynamic) for St. Mary, OH at depth of 100 ft (15 h)



Figure D.7a: Top F-V Time History for St. Mary, Cleveland, OH at depth of 103.5 ft



Figure D.7b: Bottom F-V Time History for St. Mary, Cleveland, OH at depth of 103.5 ft



Figure D.7c: Bottom Force Time History (Static) for St. Mary, OH at depth of 103.5 ft



Figure D.7d: Bottom Force Time History (Dynamic) for St. Mary, OH at depth of 103.5 ft



Figure D.8a: Top F-V Time History for St. Mary, Cleveland, OH at depth of 105 ft



Figure D.8b: Bottom F-V Time History for St. Mary, Cleveland, OH at depth of 105 ft



Figure D.8c: Bottom Force Time History (Static) for St. Mary, Cleveland at depth of 105 ft



Figure D.8d: Bottom Force Time History (Dynamic) for St. Mary, Cleveland at depth of 105 ft



Figure D.9a: Top F-V Time History for Fore River Bridge, Portland, ME at depth of 20 ft



Figure D.9b: Bottom F-V Time History for Fore River Bridge, Portland, ME at depth of 20 ft



Figure D.9c: Bottom Force Time History (Dynamic) for Fore River Bridge at depth of 20 ft



Figure D.10a: Top F-V Time History for Fore River Bridge, Portland, ME at depth of 30 ft



Figure D.10b: Bottom F-V Time History for Fore River Bridge, Portland, ME at depth of 30 ft



Figure D.10c: Bottom Force Time History (Dynamic) for Fore River Bridge at depth of 30 ft



Figure D.11a: Top F-V Time History for Fore River Bridge, Portland, ME at depth of 40 ft



Figure D.11b: Bottom F-V Time History for Fore River Bridge, Portland, ME at depth of 40 ft



Figure D.11c: Bottom Force Time History (Dynamic) for Fore River Bridge at depth of 40 ft



Figure D.12a: Top F-V Time History for Fore River Bridge, Portland, ME at depth of 42 ft



Figure D.12b: Bottom F-V Time History for Fore River Bridge, Portland, ME at depth of 42 ft



Figure D.12c: Bottom Force Time (Static) History for Fore River Bridge at depth of 42 ft



Figure D.12d: Bottom Force Time History (Dynamic) for Fore River Bridge at depth of 42 ft



Figure D.13a: Top F-V Time History for Fore River Bridge, Portland, ME at depth of 54 ft



Figure D.13b: Bottom F-V Time History for Fore River Bridge, Portland, ME at depth of 54 ft



Figure D.13c: Bottom Force Time History (Static) for Fore River Bridge at depth of 54 ft



Figure D.13d: Bottom Force Time History (Dynamic) for Fore River Bridge at depth of 54 ft



Figure D.14a: Top F-V Time History for Fore River Bridge, Portland, ME at depth of 56 ft



Figure D.14b: Bottom F-V Time History for Fore River Bridge, Portland, ME at depth of 56 ft



Figure D.14c: Bottom Force Time History (Static) for Fore River Bridge at depth of 56 ft



Figure D.14d: Bottom Force Time History (Dynamic) for Fore River Bridge at depth of 56 ft



Figure D.15a: Top F-V Time History for C&D Canal, Pier 17, DE at depth of 14 ft



Figure D.15b: Bottom F-V Time History for C&D Canal, Pier 17, DE at depth of 14 ft



Figure D.15c: Bottom Force Time History (Static) for C&D Canal, Pier 17 at depth of 14 ft



Figure D.15d: Bottom Force Time History (Dynamic) for C&D Canal, Pier 17 at depth of 14 ft



Figure D.16a: Top F-V Time History for C&D Canal, Pier 17, DE at depth of 40 ft



Figure D.16b: Bottom F-V Time History for C&D Canal, Pier 17, DE at depth of 40 ft



Figure D.17a: Top F-V Time History for C&D Canal, Pier 17, DE at depth of 50 ft



Figure D.17b: Bottom F-V Time History for C&D Canal, Pier 17, DE at depth of 50 ft



Figure D.18a: Top F-V Time History for C&D Canal, Pier 17, DE at depth of 55 ft



Figure D.18b: Bottom F-V Time History for C&D Canal, Pier 17, DE at depth of 55 ft



Figure D.18c: Bottom Force Time History (Static) for C&D Canal, Pier 17 at depth of 55 ft



Figure D.18d: Bottom Force Time History (Dynamic) for C&D Canal, Pier 17 at depth of 55 ft



Figure D.19a: Top F-V Time History for C&D Canal, Pier 17, DE at depth of 55 ft (1 h)



Figure D.19b: Bottom F-V Time History for C&D Canal, Pier 17, DE at depth of 55 ft (1 h)



Figure D.20a: Top F-V Time History for C&D Canal, Pier 17, DE at depth of 55 ft (14 h)



Figure D.20b: Bottom F-V Time History for C&D Canal, Pier 17, DE at depth of 55 ft (14 h)



Figure D.20c: Bottom Force Time History (Static) for C&D, Pier 17 at depth of 55 ft (14 h)



Figure D.20d: Bottom Force Time History (Dynamic) for C&D, Pier 17 at depth of 55 ft (14 h)



Figure D.21a: Top F-V Time History for C&D Canal, Pier 17, DE at depth of 60 ft



Figure D.21b: Bottom F-V Time History for C&D Canal, Pier 17, DE at depth of 60 ft



Figure D.21c: Bottom Force Time History (Static) for C&D Canal, Pier 17 at depth of 60 ft



Figure D.21d: Bottom Force Time History (Dynamic) for C&D Canal, Pier 17 at depth of 60 ft



Figure D.22a: Top F-V Time History for C&D Canal, Pier 17, DE at depth of 60 ft (1 h)



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Figure D.22b: Bottom F-V Time History for C&D Canal, Pier 17, DE at depth of 60 ft (1 h)



Figure D.22c: Bottom Force Time History (Static) for C&D, Pier 17 at depth of 60 ft (1 h)



Figure D.22d: Bottom Force Time History (Dynamic) for C&D, Pier 17 at depth of 60 ft (1 h)



Figure D.23a: Top F-V Time History for C&D Canal, Pier 17, DE at depth of 65 ft



Figure D.23b: Bottom F-V Time History for C&D Canal, Pier 17, DE at depth of 65 ft



Figure D.23c: Bottom Force Time History (Static) for C&D Canal, Pier 17 at depth of 65 ft



Figure D.23d: Bottom Force Time History (Dynamic) for C&D Canal, Pier 17 at depth of 65 ft



Figure D.24a: Top F-V Time History for C&D Canal, Pier 17, DE at depth of 65 ft (2 h)



Figure D.24b: Bottom F-V Time History for C&D Canal, Pier 17, DE at depth of 65 ft (2 h)



Figure D.24c: Bottom Force Time History (Static) for C&D, Pier 17 at depth of 65 ft (2 h)



Figure D.24d: Bottom Force Time History (Dynamic) for C&D, Pier 17 at depth of 65 ft (2 h)







Figure D.25b: Bottom F-V Time History for C&D Canal, Pier 17, DE at depth of 70 ft







Figure D.25d: Bottom Force Time History (Dynamic) for C&D Canal, Pier 17 at depth of 70 ft



Figure D.26a: Top F-V Time History for C&D Canal, Pier 21, DE at depth of 40 ft



Figure D.26b: Bottom F-V Time History for C&D Canal, Pier 21, DE at depth of 40 ft



Figure D.26c: Bottom Force Time History (Static) for C&D Canal, Pier 21 at depth of 40 ft



Figure D.27a: Top F-V Time History for C&D Canal, Pier 21, DE at depth of 40 ft (1 h)



Figure D.27b: Bottom F-V Time History for C&D Canal, Pier 21, DE at depth of 40 ft (1 h)



Figure D.28a: Top F-V Time History for C&D Canal, Pier 21, DE at depth of 55 ft



Figure D.28b: Bottom F-V Time History for C&D Canal, Pier 21, DE at depth of 55 ft



Figure D.28c: Bottom Force Time History (Static) for C&D Canal, Pier 21 at depth of 55 ft



Figure D.28d: Bottom Force Time History (Dynamic) for C&D Canal, Pier 21 at depth of 55 ft



Figure D.29a: Top F-V Time History for C&D Canal, Pier 21, DE at depth of 55 ft (1 h)



Figure D.29b: Bottom F-V Time History for C&D Canal, Pier 21, DE at depth of 55 ft (1 h)



Figure D.29c: Bottom Force Time History (Static) for C&D, Pier 21 at depth of 55 ft (1 h)



Figure D.29d: Bottom Force Time History (Dynamic) for C&D, Pier 21 at depth of 55 ft (1 h)



Figure D.30a: Top F-V Time History for C&D Canal, Pier 21, DE at depth of 65 ft



Figure D.30b: Bottom F-V Time History for C&D Canal, Pier 21, DE at depth of 65 ft



Figure D.30c: Bottom Force Time History (Static) for C&D Canal, Pier 21 at depth of 65 ft



Figure D.30d: Bottom Force Time History (Dynamic) for C&D Canal, Pier 21 at depth of 65 ft



Figure D.31a: Top F-V Time History for C&D Canal, Pier 21, DE at depth of 70 ft



Figure D.31b: Bottom F-V Time History for C&D Canal, Pier 21, DE at depth of 70 ft



Figure D.32a: Top F-V Time History for C&D Canal, Pier 21, DE at depth of 71 ft



Figure D.32b: Bottom F-V Time History for C&D Canal, Pier 21, DE at depth of 71 ft



Figure D.32c: Bottom Force Time History (Static) for C&D Canal, Pier 21 at depth of 71 ft



Figure D.32d: Bottom Force Time History (Dynamic) for C&D Canal, Pier 21 at depth of 71 ft



Figure D.33a: Top F-V Time History for White City Bridge, TP3, FL at depth of 20 ft



Figure D.33b: Bottom F-V Time History for White City Bridge, TP3, FL at depth of 20 ft

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Figure D.34a: Top F-V Time History for White City Bridge, TP3, FL at depth of 29 ft



Figure D.34b: Bottom F-V Time History for White City Bridge, TP3, FL at depth of 29 ft



Figure D.34c: Bottom Force Time History (Dynamic) for White City, TP3, FL at depth of 29 ft



Figure D.35a: Top F-V Time History for White City Bridge, TP3, FL at depth of 31 ft



Figure D.35b: Bottom F-V Time History for White City Bridge, TP3, FL at depth of 31 ft



Figure D.36a: Top F-V Time History for White City Bridge, TP3, FL at depth of 32 ft



Figure D.36b: Bottom F-V Time History for White City Bridge, TP3, FL at depth of 32 ft



Figure D.36c: Bottom Force Time History (Static) for White City Bridge at depth of 32 ft



Figure D.36d: Bottom Force Time History (Dynamic) for White City Bridge at depth of 32 ft



Figure D.37a: Top F-V Time History for White City Bridge, TP3, FL at depth of 35 ft



Figure D.37b: Bottom F-V Time History for White City Bridge, TP3, FL at depth of 35 ft



Figure D.37c: Bottom Force Time History (Static) for White City Bridge at depth of 35 ft



Figure D.37d: Bottom Force Time History (Dynamic) for White City Bridge at depth of 35 ft



Figure D.38a: Top F-V Time History for White City Bridge, TP6, FL at depth of 16 ft



Figure D.38b: Bottom F-V Time History for White City Bridge, TP6, FL at depth of 16 ft



Figure D.39a: Top F-V Time History for White City Bridge, TP6, FL at depth of 32 ft



Figure D.39b: Bottom F-V Time History for White City Bridge, TP6, FL at depth of 32 ft



Figure D.39c: Bottom Force Time History (Dynamic) for White City, TP6, FL at depth of 32 ft



Figure D.40a: Top F-V Time History for White City Bridge, TP6, FL at depth of 33 ft



Figure D.40b: Bottom F-V Time History for White City Bridge, TP6, FL at depth of 33 ft



Figure D.41a: Top F-V Time History for Apalachicola River Bridge, FL at depth of 20 ft



Figure D.41b: Bottom F-V Time History for Apalachicola River Bridge, FL at depth of 20 ft



Figure D.42a: Top F-V Time History for Apalachicola River Bridge, FL at depth of 25 ft



Figure D.42b: Bottom F-V Time History for Apalachicola River Bridge, FL at depth of 25 ft



Figure D.42c: Bottom Force Time History (Dynamic) for Apalachicola, FL at depth of 25 ft



Figure D.43a: Top F-V Time History for Apalachicola River Bridge, FL at depth of 25 ft (14 h)



Figure D.43b: Bottom F-V Time History for Apalachicola Bridge, FL at depth of 25 ft (14 h)



Figure D.43c: Bottom Force Time History (Static) for Apalachicola, FL at depth of 25 ft (14 h)



Figure D.44a: Top F-V Time History for Apalachicola River Bridge at depth of 55 ft



Figure D.44b: Bottom F-V Time History for Apalachicola River Bridge, FL at depth of 55 ft



Figure D.44c: Bottom Force Time History (Static) for Apalachicola, FL at depth of 55 ft



Figure D.44d: Bottom Force Time History (Dynamic) for Apalachicola, FL at depth of 55 ft



Figure D.45a: Top F-V Time History for Apalachicola River Bridge, FL at depth of 55 ft (1 h)



Figure D.45b: Bottom F-V Time History for Apalachicola, FL at depth of 55 ft (1 h)



Figure D.45c: Bottom Force Time History (Static) for Apalachicola, FL at depth of 55 ft (1 h)



Figure D.45d: Bottom Force Time History (Dynamic) for Apalachicola at depth of 55 ft (1 h)



Figure D.46a: Top F-V Time History for Apalachicola River Bridge, FL at depth of 75 ft



Figure D.46b: Bottom F-V Time History for Apalachicola River Bridge, FL at depth of 75 ft







Figure D.46d: Bottom Force Time History (Dynamic) for Apalachicola River at depth of 75 ft



Figure D.47a: Top F-V Time History for Apalachicola River Bridge, FL at depth of 75 ft (1 h)



Figure D.47b: Bottom F-V Time History for Apalachicola, FL at depth of 75 ft (1 h)



Figure D.47c: Bottom Force Time History (Static) for Apalachicola, FL at depth of 75 ft (1 h)



Figure D.47d: Bottom Force Time History (Dynamic) for Apalachicola at depth of 75 ft (1 h)



Figure D.48a: Top F-V Time History for Apalachicola River Bridge, FL at depth of 89 ft



Figure D.48b: Bottom F-V Time History for Apalachicola River Bridge, FL at depth of 89 ft



Figure D.48c: Bottom Force Time History (Static) for Apalachicola River at depth of 89 ft



Figure D.48d: Bottom Force Time History (Dynamic) for Apalachicola River at depth of 89 ft



Figure D.49a: Top F-V Time History for Aucilla River Bridge, FL at depth of 5 ft



Figure D.49b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 5 ft



Figure D.49c: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 5 ft



Figure D.50a: Top F-V Time History for Aucilla River Bridge, FL at depth of 10 ft



Figure D.50b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 10 ft



Figure D.50c: Bottom Force Time History (Static) for Aucilla River, FL at depth of 10 ft



Figure D.50d: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 10 ft



Figure D.51a: Top F-V Time History for Aucilla River Bridge, FL at depth of 15 ft



Figure D.51b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 15 ft



Figure D.51c: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 15 ft



Figure D.52a: Top F-V Time History for Aucilla River Bridge, FL at depth of 20 ft



Figure D.52b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 20 ft



Figure D.52c: Bottom Force Time History (Static) for Aucilla River, FL at depth of 20 ft



Figure D.52d: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 20 ft



Figure D.53a: Top F-V Time History for Aucilla River Bridge, FL at depth of 20 ft (1 h)



Figure D.53b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 20 ft (1 h)



Figure D.53c: Bottom Force Time History (Static) for Aucilla River, FL at depth of 20 ft (1 h)



Figure D.53d: Bottom Force Time History (Dynamic) for Aucilla River at depth of 20 ft (1 h)



Figure D.54a: Top F-V Time History for Aucilla River Bridge, FL at depth of 25 ft



Figure D.54b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 25 ft



Figure D.54c: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 25 ft



Figure D.55a: Top F-V Time History for Aucilla River Bridge, FL at depth of 30 ft



Figure D.55b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 30 ft



Figure D.55c: Bottom Force Time History (Static) for Aucilla River, FL at depth of 30 ft



Figure D.55d: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 30 ft



Figure D.56a: Top F-V Time History for Aucilla River Bridge, FL at depth of 30 ft (11 h)



Figure D.56b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 30 ft (11 h)



Figure D.56c: Bottom Force Time History (Static) for Aucilla River, FL at depth of 30 ft (11 h)



Figure D.56d: Bottom Force Time History (Dynamic) for Aucilla, FL at depth of 30 ft (11 h)



Figure D.57a: Top F-V Time History for Aucilla River Bridge, FL at depth of 35 ft



Figure D.57b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 35 ft



Figure D.57c: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 35 ft



Figure D.58a: Top F-V Time History for Aucilla River Bridge, FL at depth of 40 ft



Figure D.58b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 40 ft



Figure D.58c: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 40 ft



Figure D.59a: Top F-V Time History for Aucilla River Bridge, FL at depth of 42 ft



Figure D.59b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 42 ft



Figure D.59c: Bottom Force Time History (Static) for Aucilla River, FL at depth of 42 ft



Figure D.59d: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 42 ft



Figure D.60a: Top F-V Time History for Aucilla River Bridge, FL at depth of 45 ft



Figure D.60b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 45 ft



Figure D.60c: Bottom Force Time History (Static) for Aucilla River, FL at depth of 45 ft



Figure D.60d: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 45 ft



Figure D.61a: Top F-V Time History for Aucilla River Bridge, FL at depth of 50 ft



Figure D.61b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 50 ft



Figure D.61c: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 50 ft



Figure D.62a: Top F-V Time History for Aucilla River Bridge, FL at depth of 55 ft



Figure D.62b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 55 ft



Figure D.62c: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 55 ft



Figure D.63a: Top F-V Time History for Aucilla River Bridge, FL at depth of 60 ft



Figure D.63b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 60 ft



Figure D.63c: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 60 ft



Figure D.64a: Top F-V Time History for Aucilla River Bridge, FL at depth of 63 ft



Figure D.64b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 63 ft



Figure D.64c: Bottom Force Time History (Static) for Aucilla River, FL at depth of 63 ft



Figure D.64d: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 63 ft



Figure D.65a: Top F-V Time History for Aucilla River Bridge, FL at depth of 65 ft



Figure D.65b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 65 ft



Figure D.65c: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 65 ft



Figure D.66a: Top F-V Time History for Aucilla River Bridge, FL at depth of 67.5 ft



Figure D.66b: Bottom F-V Time History for Aucilla River Bridge, FL at depth of 67.5 ft



Figure D.66c: Bottom Force Time History (Static) for Aucilla River, FL at depth of 67.5 ft



Figure D.66d: Bottom Force Time History (Dynamic) for Aucilla River, FL at depth of 67.5 ft



Figure D.67a: Top F-V Time History for Vilano Bridge - East, FL at depth of 10 ft



Figure D.67b: Bottom F-V Time History for Vilano Bridge - East, FL at depth of 10 ft



Figure D.68a: Top F-V Time History for Vilano Bridge - East, FL at depth of 15 ft (Tip)



Figure D.68b: Bottom F-V Time History for Vilano Bridge - East, FL at depth of 15 ft (Tip)



Figure D.68c: Bottom Force Time History (Static) for Vilano - East, FL at depth of 15 ft (Tip)



Figure D.68d: Bottom Force Time History (Dynamic) for Vilano - East at depth of 15 ft (Tip)



Figure D.69a: Top F-V Time History for Vilano Bridge - East, FL at depth of 15 ft



Figure D.69b: Bottom F-V Time History for Vilano Bridge - East, FL at depth of 15 ft



Figure D.69c: Bottom Force Time History (Dynamic) for Vilano - East, FL at depth of 15 ft


Figure D.70a: Top F-V Time History for Vilano Bridge - East, FL at depth of 20 ft



Figure D.70b: Bottom F-V Time History for Vilano Bridge - East, FL at depth of 20 ft



Figure D.70c: Bottom Force Time History (Static) for Vilano - East, FL at depth of 20 ft



Figure D.70d: Bottom Force Time History (Dynamic) for Vilano - East, FL at depth of 20 ft



Figure D.71a: Top F-V Time History for Vilano Bridge - East, FL at depth of 25 ft (Tip)



Figure D.71b: Bottom F-V Time History for Vilano Bridge - East, FL at depth of 25 ft (Tip)



Figure D.71c: Bottom Force Time History (Static) for Vilano - East, FL at depth of 25 ft (Tip)



Figure D.71d: Bottom Force Time History (Dynamic) for Vilano - East at depth of 25 ft (Tip)



Figure D.72a: Top F-V Time History for Vilano Bridge - East, FL at depth of 25 ft



Figure D.72b: Bottom F-V Time History for Vilano Bridge - East, FL at depth of 25 ft



Figure D.72c: Bottom Force Time History (Dynamic) for Vilano - East, FL at depth of 25 ft



Figure D.73a: Top F-V Time History for Vilano Bridge - East, FL at depth of 30 ft (Tip)



Figure D.73b: Bottom F-V Time History for Vilano Bridge - East, FL at depth of 30 ft (Tip)



Figure D.73c: Bottom Force Time History (Static) for Vilano - East, FL at depth of 30 ft (Tip)



Figure D.73d: Bottom Force Time History (Dynamic) for Vilano - East at depth of 30 ft (Tip)



Figure D.74a: Top F-V Time History for Vilano Bridge - East, FL at depth of 30 ft



Figure D.74b: Bottom F-V Time History for Vilano Bridge - East, FL at depth of 30 ft



Figure D.74c: Bottom Force Time History (Static) for Vilano - East, FL at depth of 30 ft



Figure D.74d: Bottom Force Time History (Dynamic) for Vilano - East, FL at depth of 30 ft



Figure D.75a: Top F-V Time History for Vilano Bridge - East, FL at depth of 35 ft (Tip)



Figure D.75b: Bottom F-V Time History for Vilano Bridge - East, FL at depth of 35 ft (Tip)



Figure D.75c: Bottom Force Time History (Static) for Vilano - East, FL at depth of 35 ft (Tip)



Figure D.75d: Bottom Force Time History (Dynamic) for Vilano - East at depth of 35 ft (Tip)



Figure D.76a: Top F-V Time History for Vilano Bridge - East, FL at depth of 35 ft



Figure D.76b: Bottom F-V Time History for Vilano Bridge - East, FL at depth of 35 ft



Figure D.76c: Bottom Force Time History (Dynamic) for Vilano - East, FL at depth of 35 ft



Figure D.77a: Top F-V Time History for Vilano Bridge - East, FL at depth of 40 ft



Figure D.77b: Bottom F-V Time History for Vilano Bridge - East, FL at depth of 40 ft



Figure D.77c: Bottom Force Time History (Static) for Vilano - East, FL at depth of 40 ft



Figure D.77d: Bottom Force Time History (Dynamic) for Vilano - East, FL at depth of 40 ft



Figure D.78a: Top F-V Time History for Vilano Bridge - West, FL at depth of 30 ft



Figure D.78b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 30 ft



Figure D.78c: Bottom Force Time History (Static) for Vilano - West, FL at depth of 30 ft



Figure D.78d: Bottom Force Time History (Dynamic) for Vilano - West, FL at depth of 30 ft



Figure D.79a: Top F-V Time History for Vilano Bridge - West, FL at depth of 35 ft



Figure D.79b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 35 ft



Figure D.79c: Bottom Force Time History (Static) for Vilano - West, FL at depth of 35 ft



Figure D.79d: Bottom Force Time History (Dynamic) for Vilano - West, FL at depth of 35 ft



Figure D.80a: Top F-V Time History for Vilano Bridge - West, FL at depth of 35 ft (1 h)



Figure D.80b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 35 ft (1 h)



Figure D.80c: Bottom Force Time History (Static) for Vilano - West, FL at depth of 35 ft (1 h)



Figure D.80d: Bottom Force Time History (Dynamic) for Vilano - West at depth of 35 ft (1 h)



Figure D.81a: Top F-V Time History for Vilano Bridge - West, FL at depth of 40 ft



Figure D.81b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 40 ft



Figure D.81c: Bottom Force Time History (Static) for Vilano - West, FL at depth of 40 ft



Figure D.81d: Bottom Force Time History (Dynamic) for Vilano - West, FL at depth of 40 ft



Figure D.82a: Top F-V Time History for Vilano Bridge - West, FL at depth of 42 ft



Figure D.82b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 42 ft



Figure D.82c: Bottom Force Time History (Dynamic) for Vilano - West, FL at depth of 42 ft



Figure D.83a: Top F-V Time History for Vilano Bridge - West, FL at depth of 45 ft



Figure D.83b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 45 ft



Figure D.83c: Bottom Force Time History (Static) for Vilano - West, FL at depth of 45 ft



Figure D.83d: Bottom Force Time History (Dynamic) for Vilano - West, FL at depth of 45 ft



Figure D.84a: Top F-V Time History for Vilano Bridge - West, FL at depth of 45 ft (1 h)



Figure D.84b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 45 ft (1 h)



Figure D.84c: Bottom Force Time History (Static) for Vilano - West, FL at depth of 45 ft (1 h)



Figure D.84d: Bottom Force Time History (Dynamic) for Vilano - West at depth of 45 ft (1 h)



Figure D.85a: Top F-V Time History for Vilano Bridge - West, FL at depth of 50 ft



Figure D.85b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 50 ft



Figure D.86a: Top F-V Time History for Vilano Bridge - West, FL at depth of 50 ft (1 h)



Figure D.86b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 50 ft (1 h)



Figure D.86c: Bottom Force Time History (Dynamic) for Vilano - West at depth of 50 ft (1 h)



Figure D.87a: Top F-V Time History for Vilano Bridge - West, FL at depth of 50 ft (14 h)



Figure D.87b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 50 ft (14 h)



Figure D.88a: Top F-V Time History for Vilano Bridge - West, FL at depth of 52 ft



Figure D.88b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 52 ft



Figure D.88c: Bottom Force Time History (Static) for Vilano - West, FL at depth of 52 ft



Figure D.88d: Bottom Force Time History (Dynamic) for Vilano - West, FL at depth of 52 ft



Figure D.89a: Top F-V Time History for Vilano Bridge - West, FL at depth of 55 ft



Figure D.89b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 55 ft



Figure D.89c: Bottom Force Time History (Static) for Vilano - West, FL at depth of 55 ft



Figure D.89d: Bottom Force Time History (Dynamic) for Vilano - West, FL at depth of 55 ft



Figure D.90a: Top F-V Time History for Vilano Bridge - West, FL at depth of 55 ft (1 h)



Figure D.90b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 55 ft (1 h)



Figure D.90c: Bottom Force Time History (Static) for Vilano - West, FL at depth of 55 ft (1 h)



Figure D.90d: Bottom Force Time History (Dynamic) for Vilano - West at depth of 55 ft (1 h)



Figure D.91a: Top F-V Time History for Vilano Bridge - West, FL at depth of 55 ft (1 h and 20 in Drop)



Figure D.91b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 55 ft (1 h and 20 in Drop)



Figure D.92a: Top F-V Time History for Vilano Bridge - West, FL at depth of 59 ft



Figure D.92b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 59 ft



Figure D.92c: Bottom Force Time History (Static) for Vilano - West, FL at depth of 59 ft



Figure D.92d: Bottom Force Time History (Dynamic) for Vilano - West, FL at depth of 59 ft



Figure D.93a: Top F-V Time History for Vilano - West, FL at depth of 59 ft (1 h and 5 in)



Figure D.93b: Bottom F-V Time History for Vilano - West, FL at depth of 59 ft (1 h and 5 in)



Figure D.93c: Bottom Force Time History (Static) for Vilano - West at depth of 59 ft (5 in)



Figure D.93d: Bottom Force Time History (Dynamic) for Vilano - West at depth of 59 ft (5 in)



Figure D.94a: Top F-V Time History for Vilano - West, FL at depth of 59 ft (1 h and 30 in)



Figure D.94b: Bottom F-V Time History for Vilano - West, FL at depth of 59 ft (1 h and 30 in)



Figure D.94c: Bottom Force Time History (Static) for Vilano - West at depth of 59 ft (30 in)



Figure D.94d: Bottom Force Time History (Dynamic) for Vilano - West, depth of 59 ft (30 in)



Figure D.95a: Top F-V Time History for Vilano Bridge - West, FL at depth of 62 ft



Figure D.95b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 62 ft



Figure D.96a: Top F-V Time History for Vilano Bridge - West, FL at depth of 62 ft (ASLT)



Figure D.96b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 62 ft (ASLT)



Figure D.96c: Bottom Force Time History (Static) for Vilano - West at depth of 62 ft (ASLT)



Figure D.96d: Bottom Force Time History (Dynamic) for Vilano-West at depth of 62 ft (ASLT)



Figure D.97a: Top F-V Time History for Vilano Bridge - West, FL at depth of 64 ft



Figure D.97b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 64 ft



Figure D.97c: Bottom Force Time History (Dynamic) for Vilano - West, FL at depth of 64 ft



Figure D.98a: Top F-V Time History for Vilano Bridge - West, FL at depth of 67 ft



Figure D.98b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 67 ft



Figure D.99a: Top F-V Time History for Vilano Bridge - West, FL at depth of 67 ft (ASLT)



Figure D.99b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 67 ft (ASLT)



Figure D.99c: Bottom Force Time History (Static) for Vilano - West at depth of 67 ft (ASLT)



Figure D.99d: Bottom Force Time History (Dynamic) for Vilano-West at depth of 67 ft (ASLT)



Figure D.100a: Top F-V Time History for Vilano Bridge - West, FL at depth of 68 ft



Figure D.100b: Bottom F-V Time History for Vilano Bridge - West, FL at depth of 68 ft

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## APPENDIX E

## SUMMARY OF SPT ROD TOP MEASUREMENTS

The performance of an SPT system can be evaluated by measuring the force and velocity near the top of the SPT drill string during sampler driving and then calculating the energy transferred to the top of the drill sting. Several important SPT quantities will be obtained from force and velocity, including the maximum force at time T1 (FT1), maximum velocity at time T1 (VT1), and the maximum transferred energy (EMX). T1 is defined as the time immediately after impact when the velocity reaches its first major maximum. These three quantities are calculated by the Pile Driving Analyzer (PDA) and are presented in table E.1 averaged over 18 in of sampler driving. For the purpose of this project, the sampler was sometimes replaced with an oversized tip as indicated in table E.1. As indicated in the table, spacers were sometimes installed in the drill string to prevent its buckling during a static compression test

The PDA calculates the energy transferred to the transducer location using the recorded force and velocity records and displays the maximum transferred energy (EMX). This energy is computed by numerically integrating the product of force and velocity. The same technique has been used in impact pile driving, for determining the energy transferred from the hammer to the pile. To evaluate the performance of an SPT system, the term "transfer efficiency" is used. Transfer Efficiency (Eff) is defined as the ratio of maximum transferred energy (EMX) to the theoretical hammer potential energy. For a 140-lb (625 N) hammer freely falling from 30 in (760 mm) height, the theoretical hammer potential energy is 0.35 kip-ft (475 N-m or J). The averaged transfer efficiency at each test depth is summarized in table E.1.

A Hammer Performance Analyzer (HPA) was also used to measure the hammer velocity. The HPA recorded the hammer velocity time history on the strip chart. The maximum hammer velocity just prior to impact (also called hammer impact velocity,  $V_{impact}$ ) was then used to calculate the hammer kinetic energy. Theoretically, assuming free fall and a drop height of 30 in (760 mm),  $V_{impact}$  = 12.68 ft/s (3.86 m/s). Averaged  $V_{impact}$  values, measured at each test depth, are summarized in table E.1. The hammer kinetic energy can be calculated using the hammer's mass, m, and the measured impact velocity from

$$E_{k} = \frac{1}{2}m(v_{impact})^{2}$$
(E.1)

The hammer efficiency is the kinetic energy divided by the potential energy of .35 kip-ft (475 J). Eight different SPT systems were used in performing field tests for this project. Table E.1 summarizes the SPT rod top measurements at different depths for each of the eight systems. Seven of the systems tested utilized a safety hammer with cathead and rope, and one system

utilized a donut hammer with hydraulic hoist. A further evaluation of the transfer efficiency and the hammer impact velocity was also performed on the seven safety hammer systems. Since only one donut hammer was tested, no further evaluation was carried out for this system.

The SPT N-value presented in table E.1 can be normalized for 60 percent transferred energy  $(N_{60})$  using the average transfer efficiency of table E.1. This correction is a simple proration. For example, St. Mary at depth of 40 ft, the number of blows for the 18-in sampler driving was 1-4-4 or an SPT N-value of 8. The average calculated transfer efficiency was 43 percent. Therefore,

$$N_{60} = \frac{43}{60} 8 = 6 \tag{E.2}$$

Figure E.1 shows the transferred energies and transfer efficiencies for various safety hammer systems identified as "Rig #" in the figure. Based on the seven safety hammer systems, the transfer efficiency ranges between 30 and 80 percent with an average of 0.20 kip-ft (266 J) or 56 percent. Figure E.2 shows the hammer kinetic energy for the various systems indicated in figure E.1. The average hammer impact velocity based on the seven systems was about 11.1 ft/s which resulted in an average hammer kinetic energy of 0.27 kip-ft (366 J). Comparing with the theoretical potential energy, the average hammer efficiency (kinetic divided by potential energy) was about 77 percent. Thus, on the average, 21 percent of the rated energy were lost during the impact.

Table E.1: SPT Rod Top Measurements										
Depth	FT1	VT1	EMX	V _{impact}	E _{kinetic}	Hammer Efficiency	Transfer Efficiency	N	N ₆₀	Remarks
[ft]	[kips]	[ft/s]	[kip-ft]	[ft/s]	[kip-ft]	[%]	[%]	[6"-6"-6"]	[12"]	
Site: St. Mary Cement, Cleveland, OH										
Hammer Type: Safety Hammer with Cathead and Rope										
40	18.4	8.3	0.15	8.5	0.1572	45	43	1-4-4	6	
65	18.3	8.7	0.15	9.1	0.1802	51	43	10-16-19	25	
100	18.9	8.8	0.15	8.9	0.1724	49	43	12-22-40	44	
103.5	18.0	8.0	0.13	9.0	0.1763	50	37	22-37-64	62	
105	17.5	8.3	0.11	8.9	0.1724	49	31	33blows/6"	N/A	Flat&Spacer
Site: Fore River Bridge, Portland, ME										
Hammer Type: Donut Hammer with Hydraulic Hoist										
20	9.7	5.3	0.06	8.7	0.1647	47	17	9-7-7	4	
30	9.1	5.4	0.06	8.5	0.1572	45	17	14-8-11	5	

Table E.1: SPT Rod Top Measurements (continued)											
Depth	FT1	VT1	EMX	V _{impact}	E _{kinetic}	Hammer Efficiency	Transfer Efficiency	N	N ₆₀	Remarks	
[ft]	[kips]	[ft/s]	[kip-ft]	[ft/s]	[kip-ft]	[%]	[%]	[6"-6"-6"]	[12"]		
				Site: Fore	River Bride	ge, Portland,	ME (continued	d)			
Hammer Type: Donut Hammer with Hydraulic Hoist											
40	7.9	3.7	0.05	8.3	0.1499	43	14	67-76-89	39		
42	7.8	3.7	0.05	8.4	0.1535	44	14	50blows/2"	N/A	Cone&Spacer	
54	8.0	4.1	0.06	8.7	0.1647	47	17	40blows/6"	N/A	Flat&Spacer	
56	7.8	3.7	0.05	8.6	0.1609	46	14	25blows/6"	N/A	Cone&Spacer	
Site: C&D Canal, Pier 17, DE											
Hammer Type: Safety Hammer with Cathead and Rope											
14	19.6	11.7	0.14	10.6	0.2445	70	40	4-3-3	4		
40	21.4	13.6	0.19	11.4	0.2828	81	54	1-2-3	5		
50	16.5	8.6	0.13	11.1	0.2681	77	37	4-5-5	6		
55	20.7	12.1	0.17	10.7	0.2491	71	49	3-5-7	10		
60	20.9	10.4	0.19	10.5	0.2399	69	54	7-20-18	34		
65	20.5	11.0	0.23	10.9	0.2585	74	66	6-12-22	31		
70	22.2	10.9	0.20	10.9	0.2585	74	57	25blows/12"	N/A	Cone&Spacer	
				S	Site: C&D	Canal, Pier 2	1, DE				
			Har	nmer Type	: Safety H	ammer with (	Cathead and F	Rope			
40	18.1	9.5	0.14	9.9	0.2133	61	40	2-3-4	5		
55	21.7	12.1	0.19	10.2	0.2264	65	54	5-7-10	15		
65	20.4	11.5	0.17	10.7	0.2491	71	49	5-7-13	16		
70	18.0	10.8	0.14	10.6	0.2445	70	40	7 blows/6"	N/A	Cone&Spacer	
71	19.0	10.0	0.19	10.7	0.2491	71	54	9 blows/6"	N/A	Flat&Spacer	
Site: White City Bridge, TP3, FL											
Hammer Type: Safety Hammer with Cathead and Rope											
20	18.6	9.2	0.17	11.1	0.2681	77	49	1-1-2	2		
29	17.0	8.4	0.15	9.6	0.2005	57	43	1-1-1	1		
30.5	19.2	10.5	0.18	11.2	0.273	78	51	2-3-3	5		
32	19.7	9.0	0.17	11.2	0.273	78	49	15blows/2"	N/A	Flat	
35	17.9	8.5	0.17	10.6	0.2445	70	49	25blows/6"	N/A	Flat	

Table E.1: SPT Rod Top Measurements (continued)											
Depth	FT1	VT1	EMX	V _{impact}	E _{kinetic}	Hammer Efficiency	Transfer Efficiency	N	N ₆₀	Remarks	
[ft]	[kips]	[ft/s]	[kip-ft]	[ft/s]	[kip-ft]	[%]	[%]	[6"-6"-6"]	[12"]		
	Site: White City Bridge, TP6, FL										
Hammer Type: Safety Hammer with Cathead and Rope											
15.5	19.1	9.8	0.19	11.2	0.273	78	54	5-6-6	11		
32	18.9	9.5	0.17	10.5	0.2399	69	49	35blows/6"	N/A	Flat	
33	18.9	8.4	0.14	9.8	0.209	60	30	50blows/6"	N/A	Flat	
Site: Apalachicola River Bridge, FL											
Hammer Type: Safety Hammer with Cathead and Rope											
20	20.3	9.9	0.19	11.4	0.2828	81	54	2-4-4	7		
25	20.0	9.7	0.20	11.1	0.2681	77	57	1-2-2	4		
55	18.8	9.8	0.18	11.2	0.273	78	51	2-2-4	5		
75	20.3	9.1	0.19	11.0	0.2633	75	54	4-4-3	6		
89	22.3	9.9	0.22	11.3	0.2779	79	57	8 blows/6"	N/A	Flat	
				Site	e: Sunshin	e Skyway Bri	dge, FL				
			Ha	mmer Type	: Safety H	ammer with (	Cathead and F	Rope			
5	17.5	8.7	0.14	10.4	0.2354	67	40	6-6-3	6		
10	17.2	9.3	0.13	10.9	0.2585	74	37	1-2-3	3		
15	17.4	8.9	0.12	10.1	0.222	63	34	4-3-2	3		
20	18.6	9.0	0.15	10.9 _.	0.2585	74	43	4-5-10	11		
25	17.4	8.1	0.15	10.2	0.2264	65	43	1-0-1	1		
27.5	19.2	8.2	0.11	11.2	0.273	78	31	1-0-1	1		
30	19.3	9.1	0.18	11.7	0.2979	85	51	1-4-3	6		
35	16.8	7.7	0.13	10.2	0.2264	65	37	1-3-4	4		
40	18.9	10.2	0.18	12.4	0.3346	96	51	2-3-3	5		
45	17.5	10.4	0.19	11.2	0.273	78	54	40blows/6"	N/A	Flat	
45.5	17.4	9.4	0.16	10.3	0.2309	66	46	8-21-26	36		
50	19.7	11.0	0.21	11.9	0.3081	88	60	8-11-13	24		
53	17.6	9.6	0.17	10.6	0.2445	70	49	58blows/6"	N/A	Flat	
			Т	able E.1: S	SPT Rod To	op Measurem	ents (continue	ed)			
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Depth	FT1	VT1	EMX	V _{impact}	E _{kinetic}	Hammer Efficiency	Transfer Efficiency	N	N ₆₀	Remarks	
[ft]	[kips]	[ft/s]	[kip-ft]	[ft/s]	[kip-ft]	[%]	[%]	[6"-6"-6"]	[12"]		
				ę	Site: Aucilla	a River Bridge	e, FL				
			Hamme	er Type: Sa	fety Hamm	er with Cathe	ead and Rope	; Rig #5			
5	18.9	10.4	0.19	11.7	0.2979	85	54	7-8-10	16		
10	26.0	12.2	0.21	12.0	0.3133	90	60	4-2-2	4		
15	27.4	13.0	0.24	11.7	0.2979	85	69	3-3-3	7		
20	25.6	12.0	0.22	11.5	0.2878	82	63	3-2-2	4		
25	22.2	11.5	0.21	11.8	0.303	87	60	3-2-2	4		
30	24.5	11.6	0.23	11.9	0.3081	88	66	3-2-2	4		
35	23.5	10.9	0.24	11.4	0.2828	81	69	1-2-3	6		
40	25.2	11.8	0.23	11.7	0.2979	85	66	4-3-4	8		
45	24.8	11.5	0.22	11.2	0.273	78	63	1-2-2	4		
55	25.4	12.1	0,27	11.5	0.2878	82	77	19-28-29	73		
60	23.7	11.2	0.25	11.5	0.2878	82	71	18-19-26	53		
65	24.2	11.4	0.25	11.6	0.2928	84	71	33-35-31	78		
				Si	te: Vilano	Bridge - East	, FL78				
			На	mmer Type	e: Safety H	ammer with C	Cathead and F	lope			
5	22.0	11.6	0.21	12.1	0.3186	91	60	3-2-2	4		
10	22.7	11.8	0.21	11.9	0.3081	88	60	3-2-1	3		
15	25.3	12.0	0.22	12.3	0.3292	94	63	2-1-1	2		
20	18.1	9.0	0,15	12.3	0.3292	94	43	1-1-4	4		
25	24.6	11.6	0.25	12.9	0.3621	103	71	9 blows/6"	N/A	Flat	
25	24.0	11.7	0.23		0	0	66	1-1-2	3		
30	24.0	11.8	0.25	12.7	0.351	100	71	2-4-10	17		
35	25.5	11.8	0.25	12.1	0.3186	91	71	43blows/12"	N/A	Flat	
35	23.3	11.9	0.28	12.7	0.351	100	80	1-2-7	12		
40	25.6	12.1	0.26	12.1	0.3186	91	74	35blows/6"	N/A	Flat	
40	24.7	11.7	0.24	12.2	0.3239	93	69	7-10-9	22		

			Ta	able E.1: S	PT Rod To	p Measurem	ents (continue	ed)		
Depth	FT1	VT1	EMX	V _{impact}	E _{kinetic}	Hammer Efficiency	Transfer Efficiency	N	N ₆₀	Remarks
[ft]	[kips]	[ft/s]	[kip-ft]	[ft/s]	[kip-ft]	[%]	[%]	[6"-6"-6"]	[12"]	
				S	ite: Vilano	Bridge - Wes	st, FL			
			Ha	mmer Type	: Safety Ha	ammer with C	Cathead and R	оре		
30	23.9	11.8	0.25		0	0	71	1-0-1	1	
35	25.9	11.8	0.25		0	0	71	1-0-1	1	
42	23.5	12.0	0.27	12.5	0.34	97	77	1-0-1	1	
45	26.2	12.9	0.28		0	0	80	1-0-1	1	
50	23.7	11.7	0.25	12.8	0.3565	102	71	1-1-1	2	
55	21.7	10.7	0.21	12.2	0.3239	93	60	1-1-1	2	
59	24.0	12.2	0.25	12.5	0.34	97	71	1-0-1	1	
64	24.4	12.0	0.25	12.5	0.34	97	71	2-3-5	9	
67	24.1	11.9	0.24		0	0	69	3 blows/6"	N/A	Flat
68	23.0	11.9	0.25	12.5	0.34	97	71	3-2-3	6	



Figure E.1: Transfer Efficiencies of Various SPT Safety Hammer Systems



Figure E.2: Hammer Kinetic Energies of Various SPT Safety Hammer Systems

## APPENDIX F

#### TEST SITES INFORMATION

Appendix F presents detailed test site information including site plan, soil, pile, and hammer information, pile driving record, static load test results and cone penetration test results wherever available. The test sites are presented in the following order: St. Mary, Cleveland, OH; Fore River Bridge, Portland, ME; C&D Canal Pier 17 and Pier 21, DE; White City Bridge Test Pile 3 and Test Pile 6, FL; Apalachicola River Bridge, FL; Aucilla River Bridge, FL; Vilano Bridge East and West Embankment, FL.

## F.1 ST. MARY, CLEVELAND, OH (DB_ID # 43)

Pile Information:	
Туре:	H-Section 12x53 (F' _y =36 ksi or 248 MPa).
Cross Sectional Area:	15.50 in ² or 10 000 mm ² .
Length:	120 ft or 36.6 m.
Date Driven:	2/26/1992.
Penetration:	105 ft or 32 m.
Hammer Information:	
Manufacturer - Model:	Vulcan 506.
Туре:	Single Acting Air Hammer.
Helmet Weight:	Unknown (Standard: 0.75 kips or 3.3 kN).
Hammer Cushion Material:	Unknown (Standard: Hamortex).
Hammer Cushion Area:	Unknown (Standard: 99.4 in ² or 64 133 mm ² ).
Hammer Cushion Thickness:	Unknown (Standard: 7.38 in or 4 762 mm ² ).
Pile Cushion Material:	None.
Pile Cushion Area:	None.
Pile Cushion Thickness:	None.
Soil Boring Log No.:	L-4.
CPT Results No.:	None.
Static Load Test Information:	
Test Date:	3/18/1992.
Maximum Load:	330 kips or 1 468 kN.
Davisson's Failure Criterion:	315 kips or 1 401 kN.



Figure F.1a: Site Plan - St. Mary

	Description	Blows	Depth		Summar	y of Test	Results	
		on	to	Col.1 -	Natural	Moisture	, %	
		Spoon	bottom	Col.2 -	Unconfi	ned Shea	ar Stress	, #/SF
		for	of	Col.3 -	Strain, 9	6		
		12"	Sample	Col.4 -	Loss on	lanition	@ 600°0	
				Col 5	Unit Drv	Weight	#/cu-ft	
Ef+1	Surface Elevation: 502+		[ft]	1	2		4	5
	Fill: cinders sand gravel brick slag some			· · · · · · · · · · · · · · · · · · ·			· · ·	
<u> </u>	rubble: gray w/ brown silty sandy clay w/slag							
	Tubble, gray w/ brown sinty sandy cray w/siag	10	4.0					┣───┫
		13	4.0					
		14	.0.5					
	Slit, gray, clayey, sandy w/s organic material	<u> </u>	10.0					
10	gary, sandy, w/s sand seams & organic	3	10.0	30.4			3.7	
	materials	* S-1	12.0	32.1	455	10.5	3.6	93
		2/1.5	13.5	27.2			4.6	
	Sand, gray, silty w/tr. gravel, wood & organic	4	15.0	32.6			4.0	
	material		1					
20	gray w/tr. silt	8	20.0					
		1					<u> </u>	
	w/s organic material	10	25.0				4.6	
					<u> </u>			
30		11	30.0				ł	
			00.0					
	dray w/sand & dravel seams	6	25.0		<u> </u>			
	glay w/salld & glaver searns	0	35.0					
							<u></u>	
40	Sand & Gravel, gray, slity w/ small cobbles	30	40.0					
		34	45.0					
	Clay, gray, silty w/s sand, tr. gravel							
50		25	50.0	19.1	2705	17.1		112
		42	55.0	19.1	2625	16.3		112
						1		
						1		
60	gray, silty	34	60.0	19.4	2695	20.0		111
		28	65.0	21.1	2330	14.8		109
								┝───┦
70	· · · · · · · · · · · · · · · · · · ·	26	70.0	01.4	1050	20.0		100
		20	70.0	21,4	1050	20.0		100
			75.0					
		39	75.0	***				
80	· · · · · · · · · · · · · · · · · · ·	27	80.0	21.1	1775	13.3		107
	gray, silty w/tr. sand							
		10	85.0	33.2	560	13.9		90
	(continue)							
		• · · · · · · · · · · · · · · · · · · ·						

Figure F.1b: Soil Boring Log - St. Mary

T	Description	Blows	Depth		Summar	y of Test	Results	
		on	to	Col.1 -	Natural	Moisture,	%	
		Spoon	bottom	Col.2 -	Unconfi	ned Shea	ar Stress,	#/SF
		for	of	Col.3 -	Strain, %	6		
		12"	Sample	Col.4 -	Loss on	Ignition	@ 600°C	;
				Col.5 -	Unit Dry	Weight,	#/cu-ft	
[ft]	Surface Elevation: 502±		[ft]	1	2	3	4	5
90		10	90.0	32.0				
		* S-2	93.0	24.5	1670	8.0		<b>9</b> 5
		14	95.0	29.0	560	20.0		95
	· · · · · · · · · · · · · · · · · · ·							
	grav, silty, sandy w/ gravel & rock			1				
100	frags., tr. small sand lavers & cobbles	42	100.0	15.7	3340	13.1		118
		**104	105.0	17.7				
	gray, silty, w/s sand, tr. gravel & rock	+		<u> </u>		h		
110	frags. & some silt seams	50	110.0	20.4	2130	11.7	<b> </b>	107
						<u> </u>	<b></b>	
		37	115.0	26.5	<u> </u>			
	· · · · · · · · · · · · · · · · · · ·				<u> </u>			
	gray, silty w/tr, gravel & rock frags,			1	[	1	f	
120		16	120.0	30.5	780	16.7		95
		1						
		12	125.0	31.3	515	13.8		93
	······································						<u> </u>	
		* S-3	128.5	31.4	1335	14.4		95
130		17	130.0	30.1				
	······································	1			<u> </u>			<u> </u>
		13	135.0	25.1	705	17.4		102
			1	1	<u> </u>		<u> </u>	
140		11	140.0	29.4	790	20.0		97
<b> </b>					1	1	†	í——
<b></b>	gray silty w/tr. sand, some silt seams	20	145.0	27.0	<u> </u>		<u> </u>	
			<u> </u>		†		†	
		1	1	1	1	1		
150		17	150.0	26.1	1	1	1	(
<b> </b> ────†	End of Boring at 150.0 ft	1	1	†	<u> </u>	1	1	1
	REMARKS:	1	1		1	1	†	1
	Encountered water at 5.0 ft		1		†	1	T	
	Water at 1.0 ft on completion				1	1	T	1
	* Shelby Tube		1	1	1	1	1	1
	** Drove Rock		1	1		1	1	1
	*** No Recovery		† – – – – – – – – – – – – – – – – – – –	1	T	1	†	1
<b>┣</b> ━━━━ <u></u> †	Boring Completed: 7/25/91			1	1	1	T	1
	Location: Cleveland, OH				<u> -</u>	1	T	<u> </u>
┣━━━━╋	Job No : C4775	1		1	1	1	†	
			L	1				1

Figure F.1b: Soil Boring Log - St. Mary (continued)

Pile Driving Report Location: St. Mary's Concrete Copr. Pile Type: H Pile Dimensions: 12x53x60' Tip Elevation: 478' ± Ground Surface Elev. 583' ± Pile No. 5 Date: 2/26/92 Hammer: Vulcan 506 Energy: 32,500 ft-lb. Contractor: Great Lakes (Test Pile)

Depth	Blows								
[ft]	/ft								
1		29	2	57	14	85	24	113	
2		30	2	58	20	86	27	114	
3		31	2	59	18	87	25	115	
4		32	2	60	17	88	28	116	
5		33	3	61	17	89	27	117	
6		34	2	62	21	90	27	118	
7		35	3	63	20	91	26	119	
8		36	3	64	20	92	28	120	
9		37	3	65	21	93	29	121	
10		38	4	66	22	94	25	122	
11		39	3	67	22	95	29	123	
12		40	4	68	22	96	29	124	
13		41	4	69	23	97	31	125	
14		42	3	70	23	98	29	126	
15		43	4	71	22	99	34	127	
16		44	4	72	23	100	34	128	
17		45	4	73	27	101	43	129	
18		46	5	74	24	102	44	130	
19		47	6	75	24	103	46	131	
20		48	8	76	27	104	50	132	
21		49	7	77	24	105	52	133	
22		50	6	78	25	106		134	
23		51	8	79	26	107		135	
24		52	8	80	28	108		136	
25		53	6	81	28	109		137	
26		54	11	82	30	110		138	
27		55	10	83	27	111		139	
28	10	56	10	.84	27	112		140	

÷

Remarks: Encountered concrete footing to -4' below grade. Bottom 2' of pile was damaged and removed. Obstruction was removed by a backhoe. Splice @ -60', weld time = 8:00 - 9:00. End of Driving at 105 ft. Signed: SDK

Figure F.1c: Pile Driving Record - St. Mary



# F.2 FORE RIVER BRIDGE, PORTLAND, ME (DB_ID # 24)

Pile Information:	
Туре:	Closed End Steel Pipe, concrete filled before load test. 18 in or 457 mm O.D.: 0.5 in or 12.7 mm Wall Thickness
Cross Sectional Area:	27.50 in ² or 17 743 mm ² .
Length:	59.8 ft or 18.2 m.
Date Driven:	1/19/1990.
Penetration:	50.67 ft or 15.44 m.
Hammer Information:	
Manufacturer - Model:	Kobelco K45.
Type:	Open End Diesel Hammer.
Helmet Weight:	3.25 kips or 14.46 kN.
Hammer Cushion Material:	Micarta. $576 \text{ in}^2 \text{ or } 371 \text{ cos} \text{ mm}^2$
Hammer Cushion Thickness	3.5 in or 80 mm
Pile Cushion Material:	None
Pile Cushion Area:	None
Pile Cushion Thickness:	None.
Soil Borina Loa No.:	B-558.
CPT Results No.:	None.
Static Load Test Information:	
Test Date:	2/8/1990.
Maximum Load:	400 kips or 1 779 kN.
Davisson's Failure Criterion:	350 kips or 1 557 kN.



Figure F.2a: Site Plan - Portland

The following i	is transcribed fro	om Haley and A	drich's Boring No. 6558-88
Date Aug. 30,	1988		
Elevation	SPT - N	Depth-ft	Description
12.33	22	11.50	Sand
7.33	18	13	Silty Sand
2.33	3	42	Sand
-2.67	300	35.00	Sand and Gravel
-7.67	33	30.00	Sand
-12.67	29		
-17.67	34		Notes:
-22.67	23		Depth 0 = El. 12.33
-27.67	15		Water at depth 9.6 ft
-32.67	34 [°]		Sampler 140 lbs, h = 30"
-37.67	32		
-42.67	39		
-47.67	30		
-52.67	57		
-57.67	38		
-62.67	90		
-67.67	28		
-72.67	17		
-77.67	22		
-82.67	26		
-84.67	29		
-87.67	38		
-92.67	60	· · ·	
-97.67	133		
-102.67	206		



Pile Driving Record

Project: Fore River Bridge Replacement.

Client: T.Y. LIN International.

Pile Contractor: Same as general.

Pile Type: 18" O.D. x 0.5" wall thich; Closed End;

Pile Hammer: Kobelco K-45.

Date Driven: 1/19/1990.

File No. B946-00 General Contractor: Reed & Reed, Inc. Pile No.: T23 Design Capacity: N/A Rated Energy: 92,760 ft.lbs. Date Concrete: 1/26/1990.

Measured Length: 59' 9"; Length deducted after driving: 6' 1"; Total final length: 53'8". Pile Elevations: Top - 12.5 ft; Tip - -41.2 ft.

Depth	Blows	Stroke	Depth	Blows	Stroke	Depth	Blows	Stroke
[ft]	/ft	[ft]	[ft]	/ft	[ft]	[ft]	/ft	[ft]
1	Auger		26	17		51	16	
2	Auger		27	16		52		
3	Auger		28	18		53		
4	Auger		29	18		54		
5	Auger		30	18		55		
6	2		31	18		56		
7	1		32	.20	2.5	57		
8	1		33	18		58		
9	1		34	21		59		
10	2		35	22		. 60		
11	6	Fall	36	20				
12	10		37	21		F	lestrike Tes	st
13	11		38	22		Depth	Blows	Stroke
14	8	0.5	39	19		[in]	/in	[ft]
15	8		40	22		1	2	
16	10		41	17		2	1	
17	11	soft	42	16		3	1	
18	10	blows	43	15		4	1	
19	11	1.5	44	13		5	1	
20	12		45	13		6	1	
21	14	2.0	46	12		12	6	
22	15		47	13	2.0	24	12	
23	13		48	13				
24	13	2.0	49	15				
25	15		50	15				

Remarks: Stop Driving 1/19/1990 at 51.0 ft. Restrike 1/25/1990, 2 ft down to 53.0 ft.

Figure F.2c: Pile Driving Record



Figure F.2d: Static Load Test Result - Portland

#### F.3 C&D CANAL, PIER 17, DE (DB_ID # 204)

Pile Information: Type: Cross Sectional Area: Length: Date Driven: Penetration:

Hammer Information: Manufacturer - Model: Type: Helmet Weight: Hammer Cushion Material: Hammer Cushion Area: Hammer Cushion Area: Pile Cushion Material: Pile Cushion Area: Pile Cushion Thickness:

Soil Boring Log No.: CPT Results No.:

Static Load Test Information: Test Date: Maximum Load: Davisson's Failure Criterion: 24 in (610 mm) Square Prestressed Concrete Pile. 576 in² or 371 635 mm². 75.0 ft or 22.9 m. 3/10/1993. 66.0 ft or 20.1 m.

Delmag D46-32. Open End Diesel Hammer. 6.0 kips or 26.7 kN. Aluminum and Micarta. 415.5 in² or 268 080 mm². 3.0 in or 76 mm. Oak. 576 in² or 371 635 mm². 8 in or 203 mm.

SB #424. None.

3/31/1993.

1,200 kips or 53 376 kN. 1,150 kips or 51 152 kN.



Figure F.3a: Site Plan - CD17

			STATE OF DELAWARE DEPARTHENT OF TRANSPORTATION DIVISION OF HIGHWAYS		PAGE 2 OF 5
89-1	10-06 M: STA.	C AND D CAN 145+80, 65'	AL BRIDGE ( ST. GEORGES ) SUBSURFACE INVESTIG Rt. CENTERLINE ( S.R. 1, U.S. 13, RELIEF R	ATION OUTE )	BORING NO. SB # 424
NC.	SAMPL DEPTH	E BLOWS/6"	SAMPLE DESCRIPTION	CLASS/G.I.	REMARKS
1	3.5* 5.0*	3 3 5	Moist to wet firm seams of fine sandy clay w/light brown thin seams of silty sand, some organic matter, trace of gravel. ( Spoil Area ) 16# Sample 16# Recovery	A-7-5 (11)	Field Penetrometer Reading : 0.5-1.5 T.S.F.
2	8.5'	3 7 8	Wet stiff gray-green clayey fine sandy silt W/seams of dark gray silt, some organic matter, trace of coarse sand and gravel. ( Spoil Area ) 14" Sample 14" Recovery	_ A-4 (0)	
3	13.5	4 8 6	Wet medium dense gray-green gravelly fine to coarse sand w/seams of <u>gray_silt</u> , trace of organic matter. ( Spoil Area ) 10 ^m Sample 10 ^m Recovery	A-2-4 (0)	
4	18.5 [,] 20.0 [,]	3 3 3	Saturated loose gray-green fine sand w/some silt and mica, trace of organic matter and coarse sand. ( Spoil Area ) 12 ^m Sample 12 ^m Recovery	A-2-4 (0)	3/8/89 8:00 a.m. Vater 2 19.0/
5	23.5'	1 2 2	Saturated very loose gray-green micaceous silty fine sand w/trace of organic matter and coarse sand. ( Spoil Area ) 16" Sample 16" Recovery	A-2-4 (0)	
6	28.5	; ; ;	Saturated soft gray-green micaceous clayey- fine to coarse sandy-silt u/trace of gravel		<del>2282183933234242823</del> 12424
7	30.01	2	Saturated soft light brown organic silty fine sandy clay w/trace of coarse sand. (9 ^m Sample) ( Spoil Area ) 18 ^m Recovery	A-7-5 (9)	
8	33.5' 35.0'	W/W W/H R/W	Saturated very loose light brown silty coarse to fine sand w/some gravel.	A-2-4 (0)	

Figure F.3b: Soil Boring Log - CD17

STATE OF DELAWARE PAGE 4 OF 6 DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS BORING NO. SE # 424 89-110-06 C AND D CANAL BRIDGE ( ST. GEORGES ) SUBSURFACE INVESTIGATION LOCATION: STA. 145+80, 65' Rt. CENTERLINE ( S.R. 1, U.S. 13, RELIEF ROUTE ) SAMPLE. XO. DEFTH BLOUS/6H SAMPLE DESCRIPTION CLASS/G.1. REMARKS .... ----------------******** -----Saturated dense brown to gray-green silty 18 73.51 22 A-2-4 (0) 17 fine sand w/some mics, trace of organic 75.01 19 matter. 26 12^m Sample 12" Recovery tereverselevelevelevelevele energy and the sector subsection and the sector of the sec 19 78.51 14 Saturated medium dense gray-green micaceous A-2-4 (0) Field Penetrometer 13 silty fine sand w/some organic matter, Reading: 1.0 T.S.F. 80.0/ 12 trace of coarse sand. 15 12" Sample 12" Recovery STREFT INTERNATION CONTRACTOR CONTRACT -----Saturated very stiff gray-green micaceous A-7-5 (2) Field Penetrometer 83.51 20 6 9 silty fine sandy clay w/some organic matter. Reading : 1.0-1.5 T.S.F. 85.01 11 14" Sample 14[#] Recovery ********** ****** 21 88.57 7 Saturated very stiff gray-green micaceous A-7-5 (1) Field Penetrometer 10 silty fine sandy clay w/some organic matter. Reading : 1.5 T.S.F. 90.01 12 12[™] Sample 12" Recovery 22 93.51 4 Saturated very stiff gray-green silty fine A-7-6 (9) Field Penetrometer 9 sandy clay w/some organic matter, trace of Reading: 1.5 T.S.F. 95.01 13 mica. 16^m Sample 16[#] Recovery Interneties interneties in the second s 322 3333333 23 98.51 9 Saturated very stiff dark gray organic A-7-6 (25) Field Penetrometer 14 silty fine sandy clay w/trace of mica. Reading: 2.0 T.S.F. 100.04 14 17[™] Sample 17^M Recovery 333 U-2 100.0/ Press Saturated dark gray organic silty clay. ........ 24 Sample 102.04 . 23" Recovery 222 8 Saturated very stiff dark gray organic A-7-6 (36) Field Penetrometer 25 103.51 12 Reading: 2.25 T.S.F. silty fine sandy clay w/trace of mica. 105.01 14

Figure F.3b: Soil Boring Log - CD17 (continued)

STATE OF DELAWARE PAGE 4 OF 6 DEPARTHENT OF TRANSPORTATION DIVISION OF HIGHWAYS BORING NO. SE # 424 C AND D CANAL BRIDGE ( ST. GEORGES ) SUBSURFACE INVESTIGATION 89-110-06 LOCATION: STA. 145+80, 65' Rt. CENTERLINE ( S.R. 1, U.S. 13, RELIEF ROUTE ) SAMPLE DEFTH CLASS/G.I. NO_ BLOKS/5" SAMPLE DESCRIPTION REMARKS ___ ____ --------------------18 73.5' 22 Saturated dense brown to gray-green silty A-2-4 (0) 17 fine sand w/some mica, trace of organic 75.0' 19 matter. 26 12" Sample 12" Recovery 19 78.51 14 Saturated medium dense gray-green micaceous ... A-2-4 (0) - Field Penetrometer 13 silty fine sand w/some organic matter, Reading : 1.0 T.S.F. 80.01 12 trace of coarse sand. 15 12" Sample 12" Recovery 83.51 20 A-7-5 (2) Field Penetrometer δ. Saturated very stiff gray-green micaceous 9 Reading : 1.0-1.5 T.S.F. silty fine sandy clay w/some organic matter. 85.0' 11 14" Sample 14* Recovery 21 88.51 7 Saturated very stiff gray-green micaceous A-7-5 (1) Field Penetrometer 10 silty fine sandy clay w/some organic matter. Reading : 1.5 T.S.F. 90.01 12 12^H Sample 12" Recovery ARCHIC: STREETERS 22 93.51 4 Saturated very stiff gray-green silty fine A-7-6 (9) Field Penetrometer 9 sandy clay w/some organic matter, trace of Reading : 1.5 T.S.F. 95.01 13 mica. 16¹⁴ Sample 16[#] Recovery 23 98.51 9 Saturated very stiff dark gray organic A-7-6 (25) Field Penetrometer 14 Reading : 2.0 T.S.F. silty fine sandy clay w/trace of mica. 100.01 14 17^w Sample 17* Recovery U-2 100.0/ Press Saturated dark gray organic silty clay. 24 Sample 102.01 : 23" Recovery 1000 25 103.5/ 8 Saturated very stiff dark gray organic A-7-6 (36) Field Penetrometer 12 silty fine sandy clay w/trace of mica. Reading : 2.25 T.S.F. 105.01 14 ·. •

Figure F.3b: Soil Boring Log - CD17 (continued)

	SUMMARY OF SOIL ANALYSIS TESTS PAGE 1															
	CONTRACT- 89-110-06 DATE MARCH 16, 1				-06 16, 19	NAME 1989					C AND D CANAL BRIDGE(ST.GEO.) SUBSURFACE INVESTIGATION (S.R. 1,U.S. 13, RELIEF ROUTE)					
LOCATION	DEPTH	2.5	2	1	***** 3/8	******* 4	PERCEN 10	<b>F PAS</b> 40	SING ** 200	LL	***** PL	MO	OR	PI	CLASS	GI
	( FIELD D	ATA :	3/8/8	9,3/9/8	9,3/10	/89 )										
SB # 424 STA.	S#1 (T 3.5-5.0	EST # 100	4959- 100	4 <b>9</b> 94 ) 100	99	99	98	94	55	54	31	38	5	23	<b>∧-</b> 7-5	11
65' Rt. CENTER	8.5-10.0 S#3	100	100	100	96	95	94	85	40	29	22	25	4	7	۸-4	0
LINE	13,5-15,0 S#4	100	100	100	94	85	75	53	17			15	3	NP	A-2-4	0
	18.5-20.0 S#5 23.5-25.0	100	100	100	100	100	100	99 99	17			37	2	NP	A-2-4	0
	S#6 28.5-29.2	100	100	100	100	99	96	74	45	24	17	19	2	7	A-4	0
	S#7 29,2-30,0 S#8	100	100	100	100	100	100	97	54	53	32	52	6	21	A-7-5	9
	33.5-35.0 S#9	<b>10</b> 0	100	100	97	94	89	48	27			16		NP	<b>∧-2-4</b>	0
	38.5-40.0 S#10 43.5-45.0	100	100	100	100	100	100	92 100	80 67	64	37	55	11	27	A-7-5	25
	S#11 & U- 46.9-47.0	1 100	100	100	100	98	97	78	50	21	17	19	1	4	۸-4	0
	S#12 48:5-50.0	190	100	100	100	100	100	97	31	30	18	25	3	12	A-2-6	0
	57.5-54.5 \$#14	100	100	100	100	100	100	98	34	37	25	29	4	12	A-2-6	0
	54.5-55.0 \$#15	100	100	100	100	100	100	98	71	48	21	32	6	27	A-7-6	18
	58.5-60.0 S#16 63.5-65.0	100	100	100	99 100	99 100	98 100	93 08	19 21			27 28		NP	A-2-4	0
	S#17	100	100	100	TOO	TOO	100	70	21			28		nr	A-2-4	U

Figure F.3b: Soil Boring Log - CD17 (continued)

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					SUMMA	RY OF	SOIL A	ALYSI	S TESTS	5		PAGI		2		
		CONTRACT DATE	<b>T</b> - •-	89-110 March (	- <b>06</b> 16, 19	89			NAME-	• <b></b>	C AND D CANAL BRIDGE(ST.GEO.) SUBSURFACE INVESTIGATION (S.R. 1,U.S. 13,RELIEF ROUTE)					
					****	*****	PERCEN	IT PAS	SING **	****	****					
LOCATION	DEPTH	2.5	2	1	3/8	4	10	40	200	LL	PL	MO	OR	Pl	CLASS	GL
	C#18															
	73.5-75.0	0 100	100	100	100	100	100	100	25	29		28	3	NP	A-2-4	0
	S#19															_
	78.5-80.0	0 100	100	100	100	100	100	99	28	30		27	4	NP	<b>∧</b> -2-4	0
	S#20										20	~~	,	36		•
	83.5-85.0	0 100	100	100	100	100	100	100	37	40	30	28	4	12	N~/-J	2
	5#21 88 5-90 (	0 100	100	100	100	100	100	100	60	42	31	31	5	11	A-7-5	1
	S#22	• 100	100	100	100	100	100	100					-			-
	93.5-95.0	0 100	100	100	100	100	100	100	54	49	28	31	5	21	A-7-6	9
	S#23	( 98.5'-	100.0	')												
	98.5-100	.0 100	100	100	100	100	100	100	73	61	28	31	7	33	<b>∧</b> -7-6	25
	S#24 & 1	U-2 ()	101.9	'-102.0	<u>'</u> )					70	30	41	7	4.0		
	101.9-102	.U PRES	5 5AM	PLE - M	O STEA	E ANAL	1212			79	30	41		47		
	103.5-105	.0 100	100	100	100	100	100	100	77	73	29	33	6	44	A-7-6	36
	S#26	( 108.54	-110.	0')						• -						
	108,5-110	.0 100	100	100	100	100	100	99	65	74	30	34	7	44	A-7-5	28
	S#27	( 113.5'	-115.	0')	100		100	~		74			7			3.
	113.3-113	.0 100	-120	100	100	100	100	33	/•	/0	32	دد		44	V-/-7	20
	118 5-120	0 100	100	0 100	100	100	100	89	<b>A</b> 5	41	21	26	9	20	A-7-6	5
	S#29	( 123.5'	-125.	0' 5								_			-	
	123.5-125	0 100	100	100	99	97	95	92	46	41	22	21	8	19	A-7-6	5
	S#30	( 128.5'	-130.	0')												•
	128.5-130		100	100	100	100	100	98	51	35	25	25	6	10	¥-4	3
	3731 133 5.135	0 100	100 101	u') 100	100	100	100	90	69	37	24	25	7	13	A-6	8
	S#32	( 130.5	-139	0' )	100	100	100	,,	47	51	*-4		•			-
	138.5-139	0 100	100	100	97	97	97	95	52	34	21	21	6	13	<b>A-6</b>	4
	S#33	( 139.0'	-139.	6')										-		
	139,0-139	.6 100	100	100	100	100	100	99	66	19	16	15		3	¥-4	0
	S#34	( 143.5'	-145.	0')	100	100	100	100		17		10		ND	A .	0
	143.3-143	.u 100	100	100	100	100	100	100	47	10		13		nr	A-4	U

Figure F.3b: Soil Boring Log - CD17 (continued)

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SR-1 Cor	nstruction	I		Test Pile Dri	iving Rec	ord		Dat	te: 3/10/1993
Location:	C&D Ca	nal Bridg	e; Ref. Bo	ot. of Ft Elev.	: 45.1		C	Casting Date	e: 12/18/1992
Hammer	Type: Die	esel;	Make & M	odel: Delmaç	g D46-32				
Pile Type	: 24 sq ir	n. Prec. P	rest. Conc.;	Bent: 17 (I	NBL); Pile	e No.: 2;	Pile Leng	th: 75 ft	
Pile Cush	nion: 8" oa	ak; R	equired Bea	ring: 500 ton	IS.				
Depth	No. of	No. of	Hammer	Remark	Depth	No. of	No. of	Hammer	Remark
of Tip	Blows	Blows	Stroke		of Tip	Blows	Blows	Stroke	
[ft]	/ft	/min.	[ft]		[ft]	/ft	/min.	[ft]	
5	9	45	6.8	Fuel #1	40	8	46	6.7	
6	10	45	6.8		41	9	45	6.7	
7	9	45	6.7		42	7	45	6.8	
8	10	45	6.7		43	5	45	7.0	
9	11	46	6.7		44	6	45	7.0	
10	9	46	6.7		45	13	45	7.0	
11	9	45	6.7		46	15	45	7.0	
12	9	46	6.7		47	22	44	7.2	
13	9	45	6.7		48	46	43	7.6	
14	10	45	6.7		49	70	43	7.7	
15	8	46	6.6		50	94	43	7.7	
16	6	46	6.6		51	86	41	8.4	Fuel #3
17	5	46	6.6		52	87	37	10.1	Fuel #4
18	5	46	6.6		53	83	37	10.1	
19	5	46	6.6		54	76	37	10.1	
20	6	46	6.6		55	70	37	10.2	
21	5	46	6.6		56	59	37	10.3	
22	4	46	6.6		57	55	37	10.1	
23	5	46	6.6		58	53	38	9.8	Fuel #3
24	5	45	6.7		59	52	38	9.7	
25	7	45	6.8		60	51	38	9.7	
26	8	45	6.8		61	47	38	9.7	
27	8	45	6.7		62	49	38	9.6	
28	7	45	6.8		63	48	38	9.6	
29	7	45	6.8		64	50	38	9.7	
30	7	45	6.7		65	47	38	9.7	
31	7	45	6.7		66	49	38	9.7	
32	7	46	6.7		67				
33	6	46	6.6		68				
34	7	45	6.7		69				
35	7	45	6.7		70				
36	7	45	6.7		71				
37	7	45	6.7		72				
38	8	45	6.8		73				
39	6	46	6.7		74				
Poetriko	(2/10/100	2) · Dilo D	opotration 5	1 ft. 20 blow	10 of 0 5	ft Stroko	(Euol#4)	and 0 172	novement or

Restrike (3/19/1993): Pile Penetration 51 ft; 20 blows at 9.5 ft Stroke (Fuel#4) and 0.173 movement or 116 blows/ft. Then continue driving.

Restrike (3/25/1993): Pile Penetration 66 ft; 20 blows at 8.9 ft Stroke and 0.155 movement or 129 blows/ft.

Figure F.3c: Pile Driving Log - CD17





## F.4 C&D CANAL, PIER 21, DE (DB_ID # 203)

Pile Information: Type: Cross Sectional Area: Length: Date Driven: Penetration:

Hammer Information: Manufacturer - Model: Type: Helmet Weight: Hammer Cushion Material: Hammer Cushion Area: Hammer Cushion Thickness: Pile Cushion Material: Pile Cushion Area: Pile Cushion Thickness:

Soil Boring Log No.: CPT Results No.:

Static Load Test Information: Test Date: Maximum Load: Davisson's Failure Criterion: 24 in Square Prestressed Concrete Pile. 576 in² or 371 612 mm². 75.0 ft or 22.8 m. 3/9/1993. 72.0 ft or 21.9 m.

Delmag D46-32. Open End Diesel Hammer. 6.0 kips or 26.7 kN. Aluminum and Micarta. 415.5 in² or 268 063 mm². 3.0 in or 76.2 mm. Oak. 576 in² or 371 612 mm². 8 in or 203.2 mm.

SB #428. None.

4/14/1993. 1300 kips or 5 785 kN. 1300 kips or 5 785 kN.



Figure F.4a: Site Plan - CD21

STATE OF DELAWARE PAGE 2 OF 5 DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS BORING NO. 58 # 428 VTRACT: 89-110-06 C AND D CANAL BRIDGE ( ST. GEORGES ) SUBSURFACE INVESTIGATION NING LOCATION: STA. 153+20, 65' Lt. CENTERLINE ( S.R. 1, U.S. 13, RELIEF ROUTE ) SAMPLE MLY. GRESS NO. DEPTH BLOWS/6" SAMPLE DESCRIPTION CLASS/G.I. REMARKS ****** ......... -----****** ... ..... ...... 3 Wet firm gray fine sendy silt w/some mics, A-4 (0) 29/89 3.51 1 3 trace of organic matter. 5.04 3 84 Sample 8ª Recovery 8.5/ A-2-4 (0) 2 4 Wet loose gray-green silty fine sand 3 w/some mics, trace of organic matter. 10.04 Z 8^H Sample 8" Recovery 3 13.51 W/H Saturated soft gray-green organic silty A-7-5 (14) W/H clay w/some fine sand, trace of mica. 15.01 W/H 10" Sample 10" Recovery 18.54 L W/H Saturated soft gray-green organic clayey A-4 (3) W/H fine sandy silt s/trace of mics. 20.01 W/H 10^H Sample 10" Recovery 5 23.5/ Saturated soft gray-green organic silty ----- Seams of clay in top of W/H W/H spoon. clay. 25.01 1 Seams of pest in bottom of spoon. 8" Sample 8" Recovery 28.5 Saturated loose gray-green silty fine sand A-2-4 (0) 3/29/89 8:30 a.m. 3 . Vater 2 30.0' 4 w/some mica, trace of organic matter. 30.0' 5 9^H Sample 9" Recovery 7 33.51 A-2-4 (0) 2 Saturated Loose gray-green fine sand w/some silt and mics, trace of organic 3 35.0' 3 matter and coarse sand. 12" Sample 12^M Recovery 38.5 Saturated stiff gray-green fine sandy silt = A-4 (0) Seams of clay in bottom 5 w/some organic matter and mica, trace of of spoon. 6 40.01 5 coarse sand. 12" Sample 12" Recovery BORING NO. SE # 428 SURFACE ELEV. + 46.8" ELEV. REF. : TOPOGRAPHY/PLANS

Figure F.4b: Soil Boring Log - CD21

STATE OF DELAWARE PAGE 3 OF 5 DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS BORING NO. SE # 428 AACT: 27-110-05 C AND D CANAL BRIDGE ( ST. GEORGES ) SUBSURFACE INVESTIGATION RING LOCATION: STA. 153+20, 654 Lt. CENTERLINE ( S.R. 1, U.S. 13, RELIEF ROUTE ) ******* SAMPLE ILY. TRESS NO. DEPTH BLOUS/6" SAMPLE DESCRIPTION CLASS/G.I. REMARKS ...... .... ----...... ---------------0/89 9 43.51 3 Saturated firm gray-green fine sandy silt A-4 (0) 2 W/some organic matter, trace of coarse sand. (8" Sample) 45.01 3 10 Saturated soft gray-green organic silty ----clay. (6¹⁰ Sample) 14" Recovery -----U-1 45.01 Press Saturated brown silt w/trace of clay and A-4 (3) 11 Sample fine to coarse sand. ( Sample # 11 ( 46.9'-47.0' ) removed from 47.01 bottom of tube U-1. ) 17" Sample 18" Recovery 22.0 diam dent 12 48.54 7 Wet to saturated very stiff gray organic A-7-5 (61) 8 silty clay w/trace of fine to coarse sand. 50.01 10 14ⁿ Sample 14ⁿ Recovery ------13 53.5/ 8 Saturated brown pest. (6" Sample) ********* 14 55.0' 10 Saturated very stiff gray-green organic A-4 (0) 9 fine sandy silt w/trace of coarse sand. (8" Sample) 14" Recovery بيروج محجاذ الجوات 15 58.51 9 Wet to saturated very stiff gray-green fine A-4 (0) 12 sandy silt w/some organic matter and mics. 60.0' 12 14" Sample 14" Recovery والشبا بالمراج 16 63.5 5 Saturated stiff gray fine sandy silt A-4 (0) 6 W/some organic matter and mice. 65.01 7 13ⁿ Sample 13" Recovery 2 X 1 17 68.51 4 Saturated stiff gray fine sandy silt A-4 (0) 7 w/some organic matter, mics and clay. 70.01 8 14^m -Sample 14ª Recovery STANGES 18 73.51 Seturated stiff gray clayey fine sandy silt A-4 (4) 5 6 w/some organic matter end mica. 75.01 7 13" Sample 13" Recovery BORING NO. SE # 428 SURFACE ELEY. + 46.8' FIEV BEE . TOPOGRAPHY /PLANS

Figure F.4b: Soil Boring Log - CD21 (continued)

STATE OF DELAWARE PAGE 4 OF 5 DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS BORING NO. SE # 428 TTEACT: 89-110-06 C AND D CANAL BRIDGE ( ST. GEORGES ) SUBJURFACE INVESTIGATION MING LOCATION: STA. 153+20, 454 Lt. CENTERLINE ( S.R. 1, U.S. 13, RELIEF MAUTE ) SAMPLE VILY GRESS NO. DEPTH ILOWS/6" SAMPLE DESCRIPTION CLASS/G.I. REMARKS ******** ...... -------------...... 29/89 19 78.51 7 Wet very stiff gray organic silty fine A-7-5 (19) 8 sandy clay w/trace of mica. 80.01 9 -----20 83.5/ 9 Wet very stiff gray organic silty clay A-7-6 (35) 10 W/some fine sand, trace of mica. 85.01 11 13^M Sample 13^H Recovery ---------21 88.54 9 Wet very stiff gray organic silty clay A-7-6 (52) 10 w/trace of fine send and mics. 90.0/ 10 14¹¹ Sample 14" Recovery ------*** -----22 93.54 17 Wet hard gray organic silty clay w/some A-7-6 (46) 19 mics, trace of fine sand. 95.01 23 16" Recovery 16^a Sample -30/89 23 98.51 14 Wet hard gray organic silty fine sandy clay A-7-6 (42) 15 W/some mics, trace of coarse sand. 100.01 23 18" Sample 18" Recovery 888 **BERREA** 24 103.5/ 7 Wet hard gray organic silty fine sandy clay A-7-6 (23) 24 W/some mice, trace of coarse sand. 105.0/ 26 18" Sample 18^H Recovery --25 108.51 23 Wet hard gray organic silty fine sandy clay A-7-6 (7) 30 w/some mice, trace of coarse sand. 110.04 37 18^H Sample 18" Recovery 26 113.54 15 Wet hard gray silty fine sandy clay w/some A-7-6 (7) 28 organic matter and mics, trace of coarse 115.0' 37 sand, 18^H Sample 18" Recovery BORING NO. 55 # 428 SURFACE ELEV. + 46.8" ELEY. REF. : TOPOGRAPHY/PLANS

Figure F.4b: Soil Boring Log - CD21 (continued)

					SUMMA	RY OF	SOIL AN	ALYSI	S TESI	S		PAG	E	1		
		CONTRA DATE	CT-	89-11( April	)-06 6, 198	9			NAME		C AND Subsu (S.R.	D CA RFACE 1,U.	NAL B Inve S. 13	RIDGE STICA , RELI	(ST.GEO. TION EF ROUTE	)
LOCATION	DEPTH	2.5	2	1	***** 3/8	***** 4	PERCEN 10	<b>T PAS</b> 40	SING * 200	***** LL	**** PL	мо	OR	PI	CLASS	GI
	( FIELD	DATA :	3/29/	789,3/30	)/89 )											
SB # 428	S#1 (	TEST #	6261-	6291 1												
STA.	3.5- 5.0	100	100	100	100	100	100	100	39			37	з	NP	<b>A</b> -4	0
65' Lt. CENTER	3#2 8.5-10.0 S#3	100	100	100	100	100	100	100	21			36	2	NP	A-2-4	0
LINE	13.5-15.0 S#4	100	100	100	100	100	100	100	84	44	30	51	8	14	<b>▲</b> -7-5	14
	18.5-20.0 S#5	100	100	100	100	100	100	100	62	35	28	43	9	7	▲-4	3
	23.3-25.0 S#6	NO	SIEVE /	ANALYSI	S					36	28	56	12	8		
	28.5-30.0	100	100	100	100	100	100	100	23			39	2	NP	A-2-4	0
	33.5-35.0 S#8	100	100	100	100	100	100	99	15			35	2	NP	A-2-4	0
	38.5-40.0 S#9	100	100	100	100	100	100	99	47	30		34	5	NP	۸-4	0
	43,5-44.5 S#10	100	100	100	100	100	100	99	42	29		30	5	NP	▲-4	0
	S#11 & U	-1 PE	LESS SA	MALYSI: MPLE	5							62	11			- •
	46.9-47.0 S#12	100	100	100	100	100	100	99	96	27	24	32		3	<b>∆-4</b>	3
	48.5-50.0 S#13	100	100	100	100	100	100	99	90	97	41	50	14	56	A-7-5	61
	53.5-54.0 S#14	NO S	IEVE /	NALYSI	S							7 <b>9</b>	28			
	54.0-55.0 S#15	100	100	100	100	100	100	96	40		•-	35	6	NP	۸-4	0
	57.5-60.0 S#16	100	100	100	100	100	100	100	48	29		27	5	NP	۸-4	0
	S#17	100	100	100	100	100	100	100	52	30		29	5	NP	▲-4	0
	68.5-70.0	100	100	100	100	100	100	100	48	33	29	30	5	4	A - 4	0

Figure F.4b: Soil Boring Log - CD21 (continued)

	MATERIALS AND RESEARCH DIVISION Summary of soil analysis tests					DN S	PAGE 2									
		CONTRAC DATE	<b>T</b> -	89-110 APRIL	)-06 6, 19 <b>8</b>	9			NAME		C AND SUBSU (S.R.	D CA RFACE 1,U.	NAL B Inve S. 13	RIDGE STIGA , RELI	(ST.GEO. TION EF ROUTE	)
		• -	-		*****	*****	PERCEN	T PAS	SING **	*****						
UCATION	DEPTH	2.5	2	1	3/8	4	10	40	200	LL	PL.	HO	OR.	PI	CLASS	GI
	S#18															
	73.5-75.0	100	100	100	100	100	100	100	66	36	29	31	5	7	A-4	4
	78.5-80.0	100	100	100	100	100	100	100	77	67	10	20	e			10
	S#20			100	100	100	100	100		23	30	20	Q	23	<b>A-/-</b> )	19
	83.5-85.0	100	100	100	100	100	100	100	86	63	26	31	6	37	A-7-6	35
	5#21 88.5-90.0	100	100	100	100	100	100	100	03	76		54	-			~~
	S#22	100	200	100	100	100	100	100	93	/5	20	34	'	47	<b>A-/-</b> b	52
	93.5-95.0	100	100	100	100	100	100	100	92	71	28	33	7	43	A-7-6	46
	S₩23 ( 98.5-100 (	98.3'- D 100	100.0	') 100	100	100	100	00	76				-			
	S#24 (	103.51	-105.0	) )	100	100	100	77	/5	80	26	34	1	54	<b>A-</b> 7-6	42
	103.5-105.0	0 100	100	100	100	100	100	96	53	79	27	25	9	52	A-7-6	23
	5#25 ( 108 5-110 (	108.51	-110.0	)') 100	100	100	100			~ ~		~				_
	S#26 (	113.51	-115.0	) )	100	100	100	39	41	22	25	24	6	30	<b>A-</b> 7-6	7
	113.5-115.0	0 100	100	100	100	100	100	99	50	43	23	26	5	20	<b>▲</b> -7-6	7
	S#2/ ( 118.5-120.0	118.5	-120.0	)') 100	100	100	100	00	<b>( B</b>			47				
	S#28 (	123.5'	-125.0	)	100	100	100	77	00	43	24	27	Q	13	<b>A-</b> /-6	12
	123.5-125.0	) 100	100	100	100	99	97	93	41	30	20	23	5	10	۸-4	1
	128.5-129.0	$128.5^{\circ}$	- 129.0	100	100	100	00	Q.R.	63	14		15		110		~
	S#30 (	133.5'	-135.0	ו יו	100	100	,,	70	LO L	10		13	• •	22	<b>N-4</b>	U
	133.5-135.(		100	100	100	100	100	97	92	23	15	17	• •	8	∧-4	5
	138.5-140.0	130.5	-140.0 100	100	100	100	100	05	77	31	14	16		•		
	END	- 100	744	100	100	100	100	73	//	24	TO	13		a	∆-4	4

Figure F.4b: Soil Boring Log - CD21 (continued)

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SR-1 Co	nstruction			Test Pile Dr	iving Rec	ord		Da	ate: 3/9/1993
Location	cation: C&D Canal Bridge; Ref. Bot. of Ft Elev.: 37.5 Casting Date: 12/18							e: 12/18/1992	
Hammer	Type: Di	esel;	Make & M	odel: Delma	g D46-32				
Pile Type	: 24 sq ir	n. Prec. P	rest. Conc.;	Bent: 21 (	NBL); Pil∉	e No.: 2;	Pile Leng	th: 75 ft	
Pile Cush	nion: 8" o	ак; К	equired Bea	aring: 500 tor	IS.				
Depth	No. of	No. of	Hammer	Remark	Depth	No. of	No. of	Hammer	Remark
of Tip	Blows	Blows	Stroke		of Tip	Blows	Blows	Stroke	
[ft]	/ft	/min.	[ft]		[ft]	/ft	/min.	[ft]	
0-19				Pile set	54	33	44	7.1	Fuel #1
20	14			Fuel #1	55	31	44	7.1	
21	4	46	6.7		56	27	44	7.1	
22	3				57	54	38	9.9	Fuel #4
23	3				58	44	38	9.9	÷
24	3				59	40	38	9.8	
25	2				60	41	39	9.4	Fuel #3
26	3				61	38	38	9.5	
27	3				62	35	38	9.6	
28	2				63	33	38	9.6	
29	2			······	64	32	38	9.6	
30	3				65	32	33	9.3	
31	3				66	37	41	8.4	Fuel #2
32	3				67	36	41	8.5	
33	4				68	38	41	8.4	
34	4				69	33	40	8.6	
35	7	47	6.6		70	36	41	8.5	
36	9	46	6.6		71	34	40	8.7	
37	11	45	6.7		72	34	40	8.8	
38	12	45	6.7		73				
39	14	45	7.0		74				
40	20	44	7.1		75				
41	31	44	7.2		76				
42	45	44	7.3		77				
43	40	44	7.2		78				┟────┤
44	40	44	7.2		79				[[
45	27	42	7.9	Fuel #2	80				
46	25	42	7.9		81				
47	22	42	8.8		82				
48	21	42	7 9		83				
40	20	42	7.6	L	84				
50	10	43	7.0		85	·			
51	21	43	7.6	· · · · · · · · · · · · · · · · · · ·	86				
52	21	40	7.0	<u></u>	87				
11 JC	<u> </u>	40	1.0		01		1		1

Test Pile Driving Record

Date: 3/9/1993

43 7.6 88 Restrike (3/19/1993): Pile Penetration 56 ft; 21 blows at 9.7 ft Stroke (Fuel#4) and 0.307 movement or 68 blows/ft. Then continue driving.

Restrike (3/25/1993): Pile Penetration 72 ft; at 9.6 ft Stroke (Fuel#4) and 125 blows/ft.

53

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Figure F.4c: Pile Driving Log - CD21



Figure F.4d: Static Load Test Result - CD21

## F.5 WHITE CITY BRIDGE, FL ; TP3 AND TP6 (DB_ID # 62 AND 63)

Pile Information: Type: Cross Sectional Area: Length: Date Driven: Penetration: Hammer Information: Manufacturer - Model: Type: Helmet Weight: Hammer Cushion Material: Hammer Cushion Material: Hammer Cushion Area: Hammer Cushion Thickness: Pile Cushion Material: Pile Cushion Area:

Soil Boring Log No.: CPT Results No.:

Pile Cushion Thickness:

Static Load Test Information: Test Date: Maximum Load: Davisson's Failure Criterion: 24 in Square Prestressed Concrete Pile. 576 in² or 371 612 mm². (50.42 ft or 15.4 m for TP3) and (43.50 ft or 13.3 m for TP6). (3/22/1990 for TP3) and (3/13/1990 for TP6). (37.45 ft or 11.4 m for TP3) and (28.70 ft or 8.7 m for TP6).

Delmag D46-32. Open End Diesel Hammer. 10.14 kips or 45.1 kN. Conbest. 415.3 in² or 267 934 mm². 3.5 in or 88.9 mm². Plywood. 551.0 in² or 355 483 mm². 7.50 in or 190.5 mm.

(B-4 for TP3) and (B-8 for TP6). None.

TP3TP63/29/1990.3/23/1990.700 kips or 3 115 kN.600 kips or 2 670 kN.630 kips or 2 803 kN.460 kips or 2 047 kN.



Figure F.5a: Site Plan - White City

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Figure F.5b: Soil Boring Log - White City

	Test Pile	Driving Record	
Job No.:11120-016	Name: W	hite City Bridge	Date 3-22-90
Job Location: White City, FL			Pile No. Test Pile #3
Pile Location: Pier #5			Datum: MSL
Pile Type: Square Prestressed	Concrete	Hammer: Make ar	nd Model: Delmag D46-02
Tip Diam. 24 in; Butt Diam. 24 i	n	Tim	ne: Start Driving: 10:20 am
Length 50 ft 5 in			Finish Driving: 11:15 am
Penetration:		Remarks: Fuel se	etting #2
Ground Elev. Before Driving: +	4.6 ft	PDA -	450 to 500 kips @ EOD
Tip Elev. After Driving: -32.6 ft		15 m	in restrike at 28 blows / 3"

Depth	No. of	Remarks	Depth	No. of	Remarks
of Tip	Blows		of Tip	Blows	
[ft]			[ft]		
0			21	9	
1			22	6	
2			23	5	
3			24	4	
4			25	4	
5			26	4	
6			27	8	
7			28	8	
8			29	8	
9	4		30	8	
10	6	-	31	77	
11	9		32	6	
12	10		33	9	
13	10		34	12	
14	10		35	30	
15	10		36	65	
16	11		37	85	
17	9			28/3"	EOD
18	8				
19	10				
20	11				

Figure F.5c: Pile Driving Log - White City, TP3

	Test Plie Driving Record	
Job No.:11120-016	Name: White City Bridge	Date 3-13-90
Job Location: White City, FL		Pile No. Test Pile #6
Pile Location: Pier #8		Datum: MSL
Pile Type: Square Prestressed Con	crete Hammer: Mak	e and Model: Delmag D46-02
Tip Diam. 24 in; Butt Diam. 24 in		Time: Start Driving: 11:40 am
Length 43 ft 6 in		Finish Driving: 11:52 am
Penetration:	Remarks: Pile	e cushion = 7.5 " plywood
Ground Elev. Before Driving: +2.7	ft Ha	mmer fuel setting #2
Tip Elev. After Driving: -25.8 ft	* PC	0A - 17 kip-ft

**D**11

Depth	No. of	Remarks	Depth	No. of	Remarks
of Tip	Blows		of Tip	Blows	
[ft]			[ft]		
0			21	0	
1			22	2	
2			23	0	
3			24	0	
4			25	2	
5			26	8	
6			27	42	
7			28	65	
8				15/3"	EOD
9				20/2.5"	R1
10	1				
11	1				
12	3				
13	9				
14	15				
15	13				
16	11				
17	9				
18	5				
19	3				
20	2				

Figure F.5d: Pile Driving Log - White City, TP6



Figure F.5e: Static Load Test Result - White City, TP3



Figure F.5f: Static Load Test Result - White City, TP6

## F.6 APALACHICOLA RIVER BRIDGE, FL (DB_ID # 1)

Pile Information: Type:

Cross Sectional Area: Length: Date Driven: Penetration:

Hammer Information: Manufacturer - Model: Type: Helmet Weight: Hammer Cushion Material: Hammer Cushion Area: Hammer Cushion Thickness: Pile Cushion Material: Pile Cushion Area: Pile Cushion Thickness:

Soil Boring Log No.: CPT Results No.:

Static Load Test Information: Test Date: Maximum Load: Davisson's Failure Criterion: 24 in Square Prestressed Concrete Pile with 12 in diameter hollow.
462.90 in² or 27 677 mm².
98.0 ft or 29.9 m.
9/4/1986.
90.62 ft or 27.6 m.

Vulcan 020. Single Acting Air Hammer. Unknown (Standard: 5.20 kips). Blue Nylon. 298.7 in² or 192 709 mm². 6.0 in or 152.4 mm. Plywood. 576 in² or 371 612 mm². 9 in or 228.6 mm.

Hole No. 3. CP3.

9/16/1986. 960 kips or 4 272 kN. 958 kips or 4 263 kN.


Figure F.6a: Site Plan - Apalachicola

10 Occurence of blow back of materials into casing Ø which indicates presence Gray Se p of pirtometric pressure N Ą -10 įŧ Gray changer 5 Sert (10000) 5 -20 7 đ -30 3 Grey Cloyer sand my shell 3 2 (Very lossa) 4 -00 ł (loose) ł 7 -50 Groy Sandy Clay 8 (Stirr) 9 Gray Clay (Stiff) q 40 11 ĸ Grey Sand Ń (Lemmert) 15 -70 lo 12 Gray Clayey Sand 19 W Shell Hate Mar. 3 14 (Com real) 5/10.96+0 (18.5'L+. 4) 19 Gray Clayer Sand (Dense) 33 Eler 5.6 25 Hole Terminoteke 100.5 Groy Cloyey S 32 H Lime (Danse) - k 41

Figure F.6b: Soil Boring Log - Apalachicola



## Figure F.6c: CPT Results - Apalachicola

## APALACHICOLA RIVER BRIDGE TEST PILE RECORD

Location: PIER 3 Original Driven Length: 98 ft Date Driven: 4 SEP 1986 Hammer No.1 (Original Driving): Pile Number: 7 Length at Redrive: 93.25 ft Date Final Redrive: 17 SEP 1986 Vulcan 020 Pile Type: 24" SQ. CONC. Point Protector: No Final No. of Splices: 0

Energy: 60,000 ft-lb

Pile Cushion: 9" Pine Plywood

Ram Weight: 20,000 lb ood Capblock: 6" Blue Polymer Approximate Mudline Elevation: +5.22

Reference Elevation: +7.62

Elev.	Distance	No.	Blows	Notes	Elev.	Distance	No.	Blows	Notes
Pile	driven	of	per		Pile	driven	of	per	
Tip	[ft or in]	blows	in		Tip	[ft or in]	blows	in	
-24.04				half	-62.04	1'	36	3.00	
-25.04	1'	10	0.83	strokes,	-63.04	1'	37	3.08	
-26.04	1'	9	0.75	instr.	-64.04	1'	36	3.00	
-27.04	1'	9	0.75	attached	-65.04	1'	37	3.08	
-28.04	1'	8	0.67		-66.04	1'	34	2.83	
-29.04	1'	8	0.67		-67.04	1'	34	2.83	
-30.04	1'	8	0.67		-68.04	1'	35	2.92	
-31.04	1'	6	0.67		-69.04	1'	35	2.92	
-32.04	1'	6	0.5		-70.04	1'	39	3.25	
-33.04	1'	5	0.5		-71.04	1'	39	3.25	
-34.04	1'	7	0.42		-72.04	1'	41	3.42	
-35.04	1'	7	0.58		-72.92	10.50"	35	3.33	
-36.04	1'	7	0.58		-73.04	1.50"	1	0.67	15 mins
-37.04	1'	8	0.58		-73.13	1.00"	1	1.00	set chk
-38.04	1'	9	0.67		-73.21	1.00*	1	1.00	
-39.04	1'	11	0.75		-73.29	1.00"	1	1.00	
-40.04	1'	10	0.92		-73.54	3.00"	7	2.33	
-41.04	1'	10	0.83		-74.04	6.00"	23	3.83	
-42.04	1'	9	0.83		-75.04	1'	37	3.08	
-43.04	1'	8	0.75		-76.04	1'	33	2.75	
-44.04	1'	8	0.67		-77.04	1'	31	2.58	
-45.04	1'	10	0.67		-78.04	1'	31	2.58	
-46.04	1'	10	0.83		-79.04	1'	34	2.83	
-47.04	1'	11	0.83		-80.04	1'	31	2.58	
-48.04	1'	11	0.92		-81.04	1'	34	2.83	
-49.04	1'	12	0.92		-82.04	1'	41	3.42	
-50.04	1'	15	1.0		-83.04	1'	44	3.67	
-51.04	1'	14	1.25		-84.04	1'	42	3.50	
-52.04	1'	13	1.17		-85.04	1'	41	3.42	
-53.04	1'	13	1.08		-85.08	0.50"	2	4.00	15 min.
-54.04	1'	16	1.08		-85.17	1.00"	4	4.00	set chk
-55.04	1'	24	1.33		-85.25	1.00"	5	5.00	
-56.04	1'	35	2.00		-85.33	1.00"	4	4.00	
-57.04	1'	78	2.92		-85.40	0.75"	3	4.00	
-58.04	1'	61	6.5		-85.44	0.50"	15	30.00	Final drv
-58.13	1"	9	5.08	(56 half	-85.48	0.50"	9	18.00	
-59.04	11"	58	9.00	5 full)	-85.50	0.25"	3	12.00	
-60.04	1'	43	5.27	full stk					
-61.04	1'	37	3.58	hose brk					

Figure F.6d: Pile Driving Log - Apalachicola



Figure F.6e: Static Load Test Result - Apalachicola

## F.7 AUCILLA RIVER BRIDGE, FL (VERIFICATION SITE)

Pile Information: 18 in square Prestressed Concrete Pile. Type: 324 in² or 209 032 mm². Cross Sectional Area: Length: 70 ft or 21.3 m. Date Driven: 3/30/1994. Penetration: 62.96 ft or 19.2 m. Hammer Information: Manufacturer - Model: Fairchild F32. Type: Single Acting Air Hammer. Helmet Weight: 1.50 kips or 6.7 kN. Hammer Cushion Material: Blue Polymer. 235.6 in² or 151 999 mm². Hammer Cushion Area: Hammer Cushion Thickness: 5.0 in or 127 mm. Pile Cushion Material: Plvwood. 324 in² or 2 090 318 mm². Pile Cushion Area: Pile Cushion Thickness: 6 in or 152.4 mm. Soil Boring Log No .: E-9. CPT Results No .: CPT125. Static Load Test Information: Test Date: 3/31/1994. Maximum Load: ?? kips. Davisson's Failure Criterion: ?? kips. mostly with 3 ft stroke. Driving Condition:



Bor. No. E-9 Bl Sta 494+31 73' RT. Elev. 53'

Depth ft	SPT-N	Description
3	12	Grayish brown clayey sand
5	13	Grayish brown fine to medium sand (SP, SP-SM)
7	14	
9	19	Light gray to brown sandy clay (CL)
11	27	
14	11	Grayish brown fine to medium sand (SP, SP-SM)
17	11	
19	7	Greenish gray to dark brown silty clay (CH)
21	9	
24	9	
26	10	Gray slightly clayey fine sand with trace of consolidated sand (SM-SC)
29	12	
31	4	Greenish gray to dark brown silty clay (CH)
36	8	
39	5	Light to brown sandy clay (CL)
42	4	Dark brown sandy clay with some to abundant gravel (CH)
44	9	Greenish gray to dark brown silty clay (CH)
46	9	
49	4	Light brown clayey silt (ML-MH)
51	7	
54	4	Dark brown sandy clay with some to abundant gravel (CH)
56	3	Brown sandy limestone
59	1	Dark brown sandy clay with some to abundant gravel (CH)
61	26	
63	30	
66	122	White sandy limestone
69	45	
71	44	Brown sandy limestone
76	50/2	White sandy limestone
78	30	Brown sandy limestone
81	23	
84	18	
86	30	White sandy limestone
88	33	
90	<u>  31</u>	

Figure F.7b: Soil Boring Log - Aucilla



Figure F.7c: CPT Results - Aucilla

# F.8 VILANO BRIDGE - EAST AND WEST EMBANKMENT, FL (VERIFICATION SITE)

Pile Information: Type: Cross Sectional Area: Length: Date Driven: Penetration:	<ul> <li>18 in square Prestressed Concrete Pile.</li> <li>324 in² or 209 032 mm².</li> <li>37 ft or 11.3 m for East.</li> <li>55.5 ft or 16.9 m for West.</li> <li>4/14/1994 for East.</li> <li>to be driven for West.</li> <li>35.03 ft or 10.7 m for East.</li> <li>to be determined for West.</li> </ul>
Hammer Information: Manufacturer - Model: Type: Helmet Weight: Hammer Cushion Material: Hammer Cushion Area: Hammer Cushion Thickness: Pile Cushion Material: Pile Cushion Area: Pile Cushion Thickness:	Delmag D46-23. Open End Diesel Hammer. 5.62 kips or 25 kN. Micarta and Aluminum. 241 in ² or 155 484 mm ² . 2.0 in Micarta and 1½ in Aluminum. Plywood. 324 in ² or 209 032 mm ² . 9.75 in or 248 m.
Soil Boring Log No.: CPT Results No.:	DOT-7 for East. SL-1 for West. CPT186 for East. CPT180 for West.
Static Load Test Information: East: Test Date: Maximum Load: Davisson's Failure Criterion: West:	4/14/1994. ??. ??. to be performed.
Driving Condition:	Ground Elev. 3.57 ft (1.09 m) to -18.96 ft (-5.78 m) with hammer seting 2. -18.96 ft (-5.78m) to -24.44 ft (-7.45 m) with hammer setting 3. -24.44 ft (-7.45 m) to -27.81 ft (-8.48 m) with hammer setting 4. -27.81 ft (-8.48 m) to -31.46 ft (-9.59m ) with hammer setting 3. End of Driving at -31.46 ft or -9.59 m.
SPT N-value for DOT-7: SPT N-value for SL-1:	2,2,8,14,20,22,20,22,22,20,28,26,11,18,16,17,16,12,14, 15,14,12,11,12,13,22,21,20,20,9,8,8,9,8,9,7,7,8,9 6,15,5,WOH,4,4,3,3,3,3,WOH,3,20,20,12,17,5,10,16,32, 18,24,21,21



Figure F.8a: Site Plan - Vilano - West



## Figure F.8b: Site Plan - Vilano - Center



Figure F.8c: Site Plan - Vilano - East



Figure F.8d: Soil Borings - Vilano - West



Figure F.8e: Soil Borings - Vilano - Center



Figure F.8f: Soil Borings - Vilano - East



Figure F.8g: CPT Results - Vilano East



Figure F.8h: CPT Results - Vilano West

## APPENDIX G

#### TRANSDUCER CALIBRATION RESULTS

#### G.1 TRANSDUCERS CALIBRATION

Four types of transducers were used for Modified SPT field tests during this study: accelerometers, load transducers for static and dynamic measurements, displacement transducers, and torque transducers. Each of these transducers were calibrated before they were used in the field. The calibration results are presented in figures G.1 through G.10. The accelerometers were calibrated by Pile Dynamics, Inc., OH. The load and torque transducers were calibrated by Thomas P. Kicher & Co., OH. The displacement transducers were calibrated by GRL, Inc., OH.



Figure G.1: Piezoresistive Accelerometer (SN# P035) Calibration Results



Figure G.2: Piezoresistive Accelerometer (SN# P036) Calibration Results



Figure G.3: Piezoelectric Accelerometer (SN# 10469) Calibration Results



Figure G.4: Piezoelectric Accelerometer (SN# 10470) Calibration Results



Figure G.5a: Load Transducer (SPT Rod #22) Calibration Results





Figure G.6a: Load Transducer (SPT Rod #23) Calibration Results





Figure G.7: Displacement Transducer (PSITRONIX, No. 93-310) Calibration Results



Figure G.8: Displacement Transducer (PSITRONIX No. 93-311) Calibration Results



Figure G.9: Torque Transducer (SPT Rod 7A) Calibration Results



Figure G.10: Torque Transducer (SPT Rod 7B) Calibration Results

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## APPENDIX H

## LABORATORY TESTING RESULTS

## H.1 SOIL CLASSIFICATION

Soil classifications according to ASTM Specifications were based on the Unified Soil Classification System (USCS). The grain size tests were based on ASTM D422 and the Atterberg limit tests on ASTM D4318. The tests were performed by either Case Western Reserve University or EDP Consultants, Inc., both in Ohio. Soil samples were obtained from the split-spoon sampler extracted after the standard penetration tests. The results are summarized in table H.1. The complete test results are presented in figures H.1 through H.38 and are arranged in the same order as in table H.1.

## H.2 UNCONFINED COMPRESSIVE TEST

A Shelby tube sampler was used at the Apalachicola site to extract a soil sample from a depth of 56.5 to 58.5 ft. Unconfined compressive tests according to ASTM Specifications were performed on this sample at Case Western Reserve University. Two tests were performed on the soil sample taken from depths of 56.5 to 57.0 ft and 57.0 to 57.5 ft. The test results are plotted as unconfined compressive strength versus strain and are presented in figure H.39. The following summarized the test results.

<u>Depth</u>	Unconfined Compressive Strength	Moisture Content
56.5 - 57.0	3.55 psi	83 percent
57.0 - 57.5	21.6 psi	109 percent

	Table H.1: Summary of Soil Classifications								
	Test Site	Test	D ₁₀	D ₃₀	D ₆₀	LL	PL	PI	Soil
		Depth							Туре
		[ft]	[mm]	[mm]	[mm]	[%]	[%]	[%]	
1.	St. Mary	40.0	0.150	0.240	0.400				SP-SM
		65.0			0.650	20	15	5	SC
		100.0				32	18	14	CL
		103.5				28	19	9	CL
2.	Portland	30.0	0.150	0.300	0.750	3			SP-SM
		40.0	0.150	4.750					GP-GM
		50.0	0.150	0.840					SP-SM
3.	CD17	14.0			0.380	33	26	7	SM
		30.0		0.075	0.085				SM
		40.0			0.250	31	18	13	CL
		50.0			0.120				SM
		55.0				71	26	45	СН
		60.0		0.088	0.13				SM .
		65.0		0.090	0.140				SM
4.	CD21	41.0		0.090	0.150				SM
		55.0		0.080	0.130				SM
		65.0		0.075	0.140				SM
5.	WC3	30.5			0.140				SM
6.	WC6	15.5	0.150	0.280	0.300				SP
7.	AP	20.0	0.130	0.250	0.300				SP
		25.0	0.100	0.210	0.300				SP-SM
		55.0			0.075	84	53	31	МН
		75.0	0.075	0.200	0.300				SM
8.	Skyway	15.0	0.082	0.130	0.220				SP-SM
		25.0	0.075	0.150	0.220				SP-SM
		27.5	0.088	0.150	0.280				SP-SM
		30.0	0.120	0.200	0.280				SP
		35.0	0.075	0.140	0.420				SM

		Table H.1:	Summa	ry of Soil	Classific	ations (c	ontinued	)	
	Test Site	Test	D ₁₀	D ₃₀	D ₆₀	LL	PL	PI	Soil
		Depth							Туре
1		[ft]	[mm]	[mm]	[mm]	[%]	[%]	[%]	
8.	Skyway	40.0	0.100	0.220	0.350				SP
	(continued)	45.5	0.140	0.220	0.240				SP
		50.0	0.075	0.095	0.200				SM
9.	Aucilla	5.0	0.075	0.110	0.220				SM
		10.0			0.120		ŧ		SM
		20.0				72	33	39	СН
		25.0				50	20	30	СН
		30.0				65	26	39	СН
		35.0				53	34	19	MH
		40.0				25	17	8	CL
		45.0				77	30	47	СН
10.	VE	5.0	0.090	0.140	0.240				SP
		25.0	0.130	0.210	0.420				SP
		35.0	0.082	0.130	0.210				SP
		45.0	0.140	0.450	1.400				SW
11.	VW	30.0				77	31	46	ОН
		42.0				95	36	59	ОН
		45.0				85	34	51	СН
		55.0				92	30	62	ОН
		59.0				94	28	66	ОН
		64.0			0.150				ML

Notes: D_n is grain diameter corresponding to n percent passing. LL, PL, and PI are the liquid limit, plastic limit, and plasticity index. Soil type is based on Unified Soil Classification System.

### DETERMINATION - OF - MOISTURE - CONTENT

Description of soil: St. Mary 40 Location:

Sample No.: 0

No.	Weight of	Weight of can	Weight of can	W2-W3
of can	can, ¥1 (g)	& wet soil, W2 (g)	& dry soil, W3 (g)	ม(X)=x100 ม3-พ1
1	150.30	351.10	312.80	23.57

### SIEVE-ANALYSIS

Description of soil: St. Nery 40 Location: Sample No.: 0 Weight of oven dry sample, W (g): 162.39

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	21.38	13.17	13.17	86.83
10	2.000	9.81	6.04	19.21	80.79
20	0.850	9.12	5.62	24.82	75.18
40	0.425	12.58	7.75	32.57	67.43
60	0.250	49.79	30.66	63.23	36.77
100	0.150	41.45	25.52	88.76	11.24
200	0.075	5.21	3.21	91.96	8.04
Pan		11.93			

∑ 161.27 = W1

Loss during sieve analysis=[(W-W1)/W]x100= 0.69% (OK if less than 2%)

Figure H.1: Soil Classification for St. Mary, Cleveland, OH at depth of 40 ft



Figure H.1: Soil Classification for St. Mary, Cleveland, OH at depth of 40 ft (continued)

#### DETERMINATION - OF - MOISTURE - CONTENT

Description of soil: St. Mary 65 Location: Sample No.: 0

No.	Weight of	Weight of can	Weight of can	W2-W3
of   can	can, W1 (g)	& wet soil, W2 (g)	& dry soil, W3 (g)	w(%)=x100 W3-W1
1	149.20	318.60	305.90	8.10

SIEVE-ANALYSIS

Description of soil: St. Mary 65 Location: Sample No.: 0 Weight of oven dry sample, W (g): 131.83

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	6.17	4.68	4.68	95.32
10	2.000	16.65	12.63	17.31	82.69
20	0.850	26.00	19.72	37.03	62.97
40	0.425	13.27	10.07	47.10	52.90
60	0.250	6.87	5.21	52.31	47.69
100	0.150	5.87	4.45	56.76	43.24
200	0.075	5.92	4.49	61.25	38.75
Pan		50.27			

Σ 131.02 = W1 Loss during sieve analysis=[(W-W1)/W]x100= 0.61% (OK if less than 2%)

Figure H.2: Soil Classification for St. Mary, Cleveland, OH at depth of 65 ft



Figure H.2: Soil Classification for St. Mary, Cleveland, OH at depth of 65 ft (continued)



Figure H.2: Soil Classification for St. Mary, Cleveland, OH at depth of 65 ft (continued)
#### DETERMINATION - OF - MOISTURE - CONTENT

## Description of soil: St. Mary 100 Location: Sample No.: 0

No. of	Weight of can, W1	Weight of can & wet soil, W2	Weight of can & dry soil, W3	W2-W3 W(%)=x100
can	(g)	(g)	(g)	W3-W1
1	529.30	771.80	738.40	15.97

# SIEVE - ANALYSIS |

Description of soil: St. Mary 100 Location: Sample No.: 0 Weight of oven dry sample, W (g): 180.7

Sieve No.	Sieve opening	Weight retained on each sieve	Percent of weight retained	Cumulative percent	Percent finer
	(mm)	(g)	on each sieve	retained	
4	4.750	2.00	1.11	1.11	98.89
10	2.000	4.80	Z.66	3.76	96.24
20	0.850	6.40	3.54	7.30	92.70
40	0.425	4.80	2.66	9.96	90.04
60	0.250	4.70	2.60	12.56	87.44
100	0.150	5.70	3.15	15.72	84.28
200	0.075	6.70	3.71	19.42	80.58
Pan		146.50			

Loss during sieve analysis=[(W-W1)/W]x100=-0.50% (OK if less than 2%)

Figure H.3: Soil Classification for St. Mary, Cleveland, OH at depth of 100 ft



Figure H.3: Soil Classification for St. Mary, Cleveland, OH at depth of 100 ft (continued)



Figure H.3: Soil Classification for St. Mary, Cleveland, OH at depth of 100 ft (continued)

#### DETERNINATION-OF-NOISTURE-CONTENT

Description of soil: St. Nary 105 Location: Sample No.: 0

ļ	No. Weight of		t of Weight of can   Weight of can		W2-W3
	of can	can, Vî (g)	& wet soil, W2 (g)	£ dry soil, W3 (g)	w(%)=%100 V3-V1
	1	148.60	369.50	338.80	16.14

## SIEVE-ANALYSIS

Description of soil: St. Mary 105 Location:

Sample No.: 0 Weight of oven dry sample, W (g): 159.17

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	0.96	0.60	0.60	99.40
10	2.000	3.79	2.38	2.98	97.02
20	0.850	3.11	1.95	4.94	95.06
40	0.425	3.05	1.92	6.85	93.15
60	0.250	2.99	1.88	8.73	91.27
100	0.150	3.94	2.48	11.21	88.79
200	0.075	6.43	4.04	15.25	84.75
Pan		134.48			j

#### ∑ 158.75 = W1

Loss during sieve analysis=[(W-W1)/W]x100= 0.26% (OK if less than 2%)

Figure H.4: Soil Classification for St. Mary, Cleveland, OH at depth of 103.5 ft



Figure H.4: Soil Classification for St. Mary, Cleveland, OH at depth of 103.5 ft (continued)



# DETERMINATION-OF-HOISTURE-CONTENT

```
Description of soil: F. R. 30-31.5
Location:
Sample No.: 0
```

No.	Weight of	Weight of can	Weight of can	W2-W3
of	can, W1	& wet soil, W2	& dry soil, W3	W(%)=x100
can	(g)	(g)	(g)	W3-W1
1	212.70	640.80	580.00	16.55

SIEVE - ANALYSIS

Description of soil: F. R. 30-31.5 Location: Sample No.: 0 Weight of oven dry sample, W (g): 367.4

No.	opening (mm)	on each sieve (g)	Percent of Weight retained on each sieve	cumulative percent retained	Percent finer
4	4.750	36.28	9.87	9.87	90.13
10	2.000	50.75	13.81	23.69	76.31
20	0.850	45.03	12.26	35.94	64.06
40	0.425	72.82	19.82	55.76	44.24
60	0.250	73.60	20.03	75.80	24.20
100	0.150	50.00	13.61	89.41	10.59
200	0.075	18.83	5.13	94.53	5.47
Pan		19.44		j	

Figure H.5: Soil Classification for Fore River Bridge, Portland, ME at depth of 30 ft



Figure H.5: Soil Classification for Fore River Bridge, Portland at depth of 30 ft (continued)

# DETERMINATION - OF - NOISTURE - CONTENT |

Description of soil: F. R. 40-42 Location: Sample No.: 0

	No.	Weight of	Weight of can	Weight of can	W2-W3
ļ	of	can, ¥1	<b>£</b> wet soil, W2	& dry soil, ₩3	w(%)=x100
ļ	can	(g)	(g)	(g)	W3-W1
	1	22.60	187.30	183.50	2.36

SIEVE-ANALYSIS |

Description of soil: F. R. 40-42 Location: Sample No.: 0 Weight of oven dry sample, W (g): 160.77

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative   percent   retained	Percent finer
4	4.750	111.00	69.04	69.04	30.96
10	2.000	8.85	5.50	74.55	25.45
20	0.850	6.32	3.93	78.48	21.52
40	0.425	6.61	4.11	82.59	17.41
60	0.250	5.80	3.61	86.20	13.80
100	0.150	6.00	3.73	89.93	10.07
200	0.075	5.02	3.12	93.05	6.95
Pan		11.38			

#### ∑ 160.98 = W1

Loss during sieve analysis=[(U-W1)/W]x100=-0.13% (OK if less than 2%)

Figure H.6: Soil Classification for Fore River Bridge, Portland, ME at depth of 40 ft



Figure H.6: Soil Classification for Fore River Bridge, Portland at depth of 40 ft (continued)

#### DETERMINATION - OF - MOISTURE - CONTENT

```
Description of soil: F. R. 50-52
Location:
Sample No.: 0
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No. of	Weight of can, W1	Weight of can & wet soil, W2	Weight of can & dry soil, W3	W2-W3 w(%)=x100
can	(g)	(g)	(g)	V3-V1
1	193.60	439.70	423.70	6.95

| SIEVE-ANALYSIS |

Description of soil: F. R. 50-52 Location: Sample No.: 0 Weight of oven dry sample, W (g): 230.23

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of Weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	103.87	45.12	45.12	54.88
10	2.000	24.34	10.57	55.69	44.31
20	0.850	29.43	12.78	68.47	31.53
40	0.425	22.13	9.61	78.08	21.92
60	0.250	13.84	6.01	84.09	15.91
100	0.150	12.63	5.49	89.58	10.42
200	0.075	8.34	3.62	93.20	6.80
Pan		15.45			

Figure H.7: Soil Classification for Fore River Bridge, Portland, ME at depth of 50 ft



Figure H.7: Soil Classification for Fore River Bridge, Portland at depth of 50 ft (continued)

# DETERMINATION - OF - NOISTURE - CONTENT |

# Description of soil: pier 17 14-15.5

Location:

Sample No.: 0

No.   of   can	Weight of can, W1 (g)	Weight of can & wet soil, W2 (g)	Weight of can & dry soil, W3 (g)	W2-W3 W(%)=x100 W3-W1
1	150.20	415.70	355.60	29.26

# SIEVE-ANALYSIS

Description of soil: pier 17 14-15.5 Location:

Sample No.: 0 Weight of oven dry sample, W (g): 206.8

	Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
	4	4.750	22.23	10.75	10.75	89.25
Ì	10	2.000	12.97	6.27	17.02	82.98
I	20	0.850	18.77	9.08	26.10	73.90
İ	40	0.425	23.81	11.51	37.61	62.39
Ì	60	0.250	18.57	8.98	46.59	53.41
Ì	100	0.150	11.66	5.64	52.23	47.77
Ì	200	0.075	17.70	8.56	60.79	39.21
	Pan		81.02			

# $\Sigma$ 206.73 = W1 Loss during sieve analysis=[(W-W1)/W]x100= 0.03% (OK if less than 2%)

Figure H.8: Soil Classification for C&D Canal, Pier 17, DE at depth of 14 ft



Figure H.8: Soil Classification for C&D Canal, Pier 17, DE at depth of 14 ft (continued)



Figure H.8: Soil Classification for C&D Canal, Pier 17, DE at depth of 14 ft (continued)

# DETERNINATION-OF-MOISTURE-CONTENT

Description of soil: pier 17 30-31.5 Location: Sample No.: 0

No.	Weight of	Weight of can	Weight of can	W2-W3
of	can, W1	& wet soil, W2	& dry soil, W3	w(%)=x100
can	(g)	(g)	(g)	W3-W1
1	148.90	434.20	349.60	42.15

# SIEVE-ANALYSIS

Description of soil: pier 17 30-31.5 Location:

Sample No.: 0 Weight of oven dry sample, W (g): 202.6

1			1	1 I	
Sieve	Sieve	Weight retained	Percent of	Cumulative	Percent
No.	opening	on each sieve	weight retained	percent	finer
	(mn)	(g)	on each sieve	retained	
4	4.750	0.00	0.00	0.00	100.00
10	2.000	0.00	0.00	0.00	100.00
20	0.850	0.00	0.00	0.00	100.00
40	0.425	0.46	0.23	0.23	99.77
60	0.250	3.46	1.71	1.93	98.07
100	0.150	22.23	10.97	12.91	87.09
200	0.075	108.95	53.78	66.68	33.32
Pan		67.05			
					L
	•	Σ 202.15 = ₩1			

## Loss during sieve analysis=[(V-V1)/V]x100= 0.22% (OK if less than 2%)

Figure H.9: Soil Classification for C&D Canal, Pier 17, DE at depth of 30 ft



Figure H.9: Soil Classification for C&D Canal, Pier 17, DE at depth of 30 ft (continued)

## | DETERMINATION - OF - MOISTURE - CONTENT |

Description of soil: pier 17 40-41.5 Location: Sample No.: 0

No.	Weight of	Weight of can	Weight of can	₩2-₩3
of	can, W1	& wet soil, W2	& dry soil, W3	₩(%)=x100
can	(g)	(g)	(g)	₩3-₩1
1	195.80	560.50	503.10	18.68

# SI.EVE - ANALYSIS

Description of soil: pier 17 40-41.5 Location:

Sample No.: 0 Weight of oven dry sample, W (g): 309.86

Sieve No.	Sieve opening	Weight retained on each sieve	Percent of weight retained	Cumulative percent	Percent finer
	(##	(g)	on each sieve	retained	
4	4.750	2.66	0.86	0.86	99.14
10	2.000	9.82	3.17	4.03	95.97
20	0.850	29.71	9.59	13.62	86.38
40	0.425	43.92	14.17	27.79	72.21
60	0.250	32.22	10.40	38.19	61.81
100	0.150	12.74	4.11	42.30	57.70
200	0.075	5.96	1.92	44.22	55.78
Den		172.81			

## Loss during sieve analysis=[(W-W1)/W]x100= 0.01% (OK if less than 2%)

Figure H.10: Soil Classification for C&D Canal, Pier 17, DE at depth of 40 ft



Figure H.10: Soil Classification for C&D Canal, Pier 17, DE at depth of 40 ft (continued)



Figure H.10: Soil Classification for C&D Canal, Pier 17, DE at depth of 40 ft (continued)

### | DETERNINATION - OF - NOISTURE - CONTENT |

```
Description of soil: pier 17 50-52
Location:
Sample No.: 0
```

No.	Weight of	Weight of can	Weight of can	W2-W3
of	can, W1	& wet soil, W2	& dry soil, W3	· w(%)=x100
can	(g)	(g)	(g)	W3-W1
1	193.82	502.40	429.20	31.10

#### SIEVE-ANALYSIS

Description of soil: pier 17 50-52 Location: Sample No.: 0 Weight of oven dry sample, W (g): 241.6

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	0.00	0.00	0.00	100.00
10	2.000	0.45	0.19	0.19	99.81
20	0.850	0.61	0.25	0.44	99.56
40	0.425	1.51	0.62	1.06	98.94
60	0.250	16.07	6.65	7.72	92.28
100	0.150	66.99	27.73	35.44	64.56
200	0.075	58.21	24.09	59.54	40.46
Pan		96.60			

# $\Sigma$ 240.44 = W1 Loss during sieve analysis=[(W-W1)/W]x100= 0.48% (OK if less than 2%)

Figure H.11: Soil Classification for C&D Canal, Pier 17, DE at depth of 50 ft



Figure H.11: Soil Classification for C&D Canal, Pier 17, DE at depth of 50 ft (continued)

# DETERMINATION - OF - NOISTURE - CONTENT

```
Description of soil: pier 17 55-57
Location:
Sample No.: 0
```

No. of	Weight of can, W1	Weight of can & wet soil, W2	Weight of can	₩2-₩3 ₩(%)=x100
can	(g)	(g)	(g)	V3-V1
1	149.20	334.30	283.30	38.03

#### SIEVE-ANALYSIS |

Description of soil: pier 17 55-57 Location:

- . . ..

Sample No.: 0 Weight of oven dry sample, W (g): 138.6

Sieve No.	Sieve opening	Weight retained on each sieve	Percent of weight retained	Cumulative percent	Percent finer
	(mm)	(g)	on each sieve	retained	 
4	4.750	0.00	0.00	0.00	100.00
10	2.000	0.00	0.00	0.00	100.00
20	0.850	0.10	0.07	0.07	99.93
40	0.425	0.35	0.25	0.32	99.68
60	0.250	1.38	1.00	1.32	98.68
100	0.150	3.49	2.52	3.84	96.16
200	0.075	3.40	2.45	6.29	93.71
Pan		129.87			
		1			

 $\Sigma$  138.59 = W1 Loss during sieve analysis=[(W-W1)/W]x100= 0.01% (OK if less than 2%)

Figure H.12: Soil Classification for C&D Canal, Pier 17, DE at depth of 55 ft



Figure H.12: Soil Classification for C&D Canal, Pier 17, DE at depth of 55 ft (continued)

#### ATTERBERG LIMITS DETERMINATION

Data Sheet 3



Figure H.12: Soil Classification for C&D Canal, Pier 17, DE at depth of 55 ft (continued)

# DETERMINATION-OF-MOISTURE-CONTENT

Description of soil: pier 17 60-61.5 Location: Sample No.: 0

No.	Weight of	Weight of can	Weight of can	₩2-₩3
of	can, W1	& wet soil, W2	& dry soil, W3	₩(%)≖x100
can	(g)	(g)	(g)	₩3-₩1
1	147.70	394.60	336.30	30.91

SIEVE-ANALYSIS

Description of soil: pier 17 60-61.5 Location: Sample No.: 0 Weight of oven dry sample, W (g): 189.02

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	0.00	0.00	0.00	100.00
10	2.000	0.09	0.05	0.05	99.95
20	0.850	0.24	0.13	0.17	99.83
40	0.425	0.22	0.12	0.29	99.71
60	0.250	7.19	3.80	4.09	95.91
100	0.150	75.23	39.80	43.89	56.11
200	0.075	69.27	36.65	80.54	19.46
Pan		36.56			



Figure H.13: Soil Classification for C&D Canal, Pier 17, DE at depth of 60 ft



Figure H.13: Soil Classification for C&D Canal, Pier 17, DE at depth of 60 ft (continued)

#### | DETERMINATION - OF - MOISTURE - CONTENT |

Description of soil: pier 17 65-66.5 Location: Sample No.: 0

No.	Weight of	Weight of can	Weight of can	W2-W3
of	can, W1	& wet soil, W2	& dry soil, W3	W(%)=x100
can	(g)	(g)	(g)	W3-W1
1	150.44	492.70	418.40	27.73

## SIEVE - ANALYSIS

Description of soil: pier 17 65-66.5 Location:

Sample No.: 0 Weight of oven dry sample, W (g): 268.9

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	0.00	0.00	0.00	100.00
10	2.000	0.50	0.19	0.19	99.81
20	0.850	0.72	0.27	0.45	99.55
40	0.425	0.85	0.32	0.77	99.23
60	0.250	9.19	3.42	4.19	95.81
100	0.150	106.29	39.53	43.72	56.28
200	0.075	102.47	38.11	81.82	18.18
Pan		48.38			h

Loss during sieve analysis=[(W-W1)/W]x100= 0.19% (OK if less than 2%)

Figure H.14: Soil Classification for C&D Canal, Pier 17, DE at depth of 65 ft



Figure H.14: Soil Classification for C&D Canal, Pier 17, DE at depth of 65 ft (continued)

# DETERMINATION - OF - NOISTURE - CONTENT

Description of soil: pier 21 41-41.5 Location: Sample No.: 0

No.	Weight of can, W1	Weight of can & wet soil, W2	Weight of can & dry soil, W3	W2-W3 w(%)=x100
can	(g)	(g)	(g)	W3-W1
1	148.75	513.60	418.60	35.20

SIEVE-ANALYSIS

Description of soil: Pier 21 41-41.5 Location: Sample No.: 0 Weight of oven dry sample, W (g): 270.7

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of Weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	0.00	0.00	0.00	100.00
10	2.000	0.00	0.00	0.00	100.00
20	0.850	0.00	0.00	0.00	100.00
40	0.425	1.40	0.52	0.52	99.48
60	0.250	12.80	4.73	5.25	94.75
100	0.150	88.70	32.77	38.01	61.99
200	0.075	124.08	45.84	83.85	16.15
Pan		42.65			
		Σ 269.63 = ¥1			

Loss during sieve analysis=[(W-W1)/W]x100= 0.40% (OK if less than 2%)

Figure H.15: Soil Classification for C&D Canal, Pier 21, DE at depth of 41 ft



Figure H.15: Soil Classification for C&D Canal, Pier 21, DE at depth of 41 ft (continued)



Figure H.15: Soil Classification for C&D Canal, Pier 21, DE at depth of 41 ft (continued)

# DETERMINATION-OF-NOISTURE-CONTENT

Description of soil: pier 21 55-56.5 Location: Sample No.: 0

No.	Weight of   can. W1	Weight of can	Weight of can & dry soil, W3	₩2-₩3   ₩(%)=x100
can	(g)	(g)	(g)	N3-N1
1	197.00	541.10	452.00	34.94

SIEVE-ANALYSIS |

Description of soil: pier 21 55-56.5 Location: Sample No.: 0 Weight of oven dry sample, W (g): 257.8

No. 0	pening (mm)	on each sieve (g)	weight retained	percent	finer
	(mn)	(g)	on each sieve		
				retained	
	4.750	0_00	0.00	0.00	100.00
10 2	2.000	0.00	0.00	0.00	100.00
20   1	0.850	0.00	0.00	0.00	100.00
40 0	0.425	0.35	0.14	0.14	99.86
60 0	0.250	7.23	2.80	2.94	97.06
100   (	0.150	86.90	33.71	36.65	63.35
200   (	0.075	101.08	39.21	75.86	24.14
Pan	j	61.75			1



Figure H.16: Soil Classification for C&D Canal, Pier 21, DE at depth of 55 ft



Figure H.16: Soil Classification for C&D Canal, Pier 21, DE at depth of 55 ft (continued)

# DETERMINATION-OF-MOISTURE-CONTENT

# Description of soil: pier 21 65-66.5 Location:

Sample No.: 0

No.	Weight of	Weight of can	Weight of can	₩2-₩3
of	can, W1	& wet soil, W2	& dry soil, W3	₩(%)=x100
can	(g)	(g)	(g)	₩3-₩1
1	147.50	461.40	384.58	32.40

SIEVE-ANALYSIS

Description of soil: pier 21 65-66.5 Location:

Sample No.: 0 Weight of oven dry sample, W (g): 239.96

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	0.00	0.00	0.00	100.00
10	2.000	0.00	0.00	0.00	100.00
20	0.850	0.00	0.00	0.00	100.00
40	0.425	0.30	0.13	0.13	99.87
60	0.250	4.70	1.96	2.08	97.92
100	0.150	34.40	14.34	16.42	83.58
200	0.075	128.00	53.34	69.76	30.24
Pan		72.10			



Figure H.17: Soil Classification for C&D Canal, Pier 21, DE at depth of 65 ft



Figure H.17: Soil Classification for C&D Canal, Pier 21, DE at depth of 65 ft (continued)
Description of soil: Location: White City Bridge - 30.5 ft Sample No.: 14

No.	Weight of	Weight of can	Weight of can	W2-W3
of	can, V1	🕹 wet soil, W2	Ł dry soil, W3	w(%)=x100
can	(g)	(g)	(g)	W3-W1
1	8.90	22.50	20.40	18.26

| S I E V E - A N A L Y S I S |

Description of soil:

Location: White City Bridge - 30.5 ft

Sample No.: 14 Weight of oven dry sample, W (g): 168.25

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative   percent   retained	Percent finer
4	4.750	0.00	0.00	0.00	100.00
10	2.000	0.00	0.00	0.00	100.00
20	0.850	0.30	0.18	0.18	99.82
40	0.425	2.50	1.49	1.66	98.34
60	0.250	9.40	5.59	7.25	92.75
100	0.150	47.80	28.41	35.66	64.34
200	0.075	51.50	30.61	66.27	33.73
Pan		56.15	I		l

 $\Sigma$  167.65 = W1 Loss during sieve analysis=[(W-W1)/W]x100= 0.36% (OK if less than 2%)

Figure H.18: Soil Classification for White City Bridge, TP3, FL at depth of 30.5 ft



Figure H.18: Soil Classification for White City Bridge, TP3, FL at depth of 30.5 ft (continued)

Description of soil: Location: White City Bridge - 15.5 ft Sample No.: 13

No.	Weight of	Weight of can	Weight of can	W2-W3
of	can, W1	& wet soil, W2	& dry soil, W3	w(%)=x100
can	(g)	(g)	(g)	W3-W1
1	8.80	22.20	19.70	22.94

Description of soil: Location: White City Bridge - 15.5 ft Sample No.: 13 Weight of oven dry sample, W (g): 177.5

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	0.00	0.00	0.00	100.00
10	2.000	0.00	0.00	0.00	100.00
20	0.850	1.40	0.79	0.79	99.21
40	0.425	10.30	5.80	6.59	93.41
60	0.250	39.80	22.42	29.01	70.99
100	0.150	109.60	61.75	90.76	9.24
200	0.075	8.70	4.90	95.66	4.34
Pan		7_10	I		

 $\Sigma$  176.90 = W1 Loss during sieve analysis=[(W-W1)/W]x100= 0.34% (OK if less than 2%)

Figure H.19: Soil Classification for White City Bridge, TP6, FL at depth of 15.5 ft



Figure H.19: Soil Classification for White City Bridge, TP6, FL at depth of 15.5 ft (continued)

Description of soil: Location: Appal. River Bridge - 20 ft Sample No.: 9

No.	Weight of can, W1	Weight of can & wet soil, W2	Weight of can & dry soil, W3	W2-W3 W(%)=x100
can	(g)	(g)	(g)	W3-W1
1	9.00	23.90	20.80	26.27

Description of soil:

Location: Appal. River Bridge - 20 ft

Sample No.: 9 Weight of oven dry sample, W (g): 166.9

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	D.00	0.00	0.00	100.00
10	2.000	0.00	0.00	0.00	100.00
20	0.850	0.00	0.00	0.00	100.00
40	0.425	1.40	0.84	0.84	99.16
60	0.250	14.80	8.87	9.71	90.29
100	0.150	130.20	78.01	87.72	12.28
200	0.075	14.10	8.45	96.17	3.83
Pan		5.80			

		Σ1	66.30 = W1							
Loss	during	sieve	analysis=[(W-W	i1)/W]x100=	0.36%	(OK	if	less	than	2%)

Figure H.20: Soil Classification for Apalachicola River Bridge, FL at depth of 20 ft



Figure H.20: Soil Classification for Apalachicola River Bridge at depth of 20 ft (continued)

## Description of soil:

Location: Appal. River Bridge - 25 ft Sample No.: 10

No.	Weight of can. W1	Weight of can & wet soil, W2	Weight of can & dry soil, W3	₩2-₩3   ₩(%)=x100
can	(g)	(g)	(g)	V3-W1
1	8.80	22.75	20.00	24.55

### SIEVE - ANALYSIS

Description of soil: (All materials retained on #20 are organic) Location: Appal. River Bridge - 25 ft

Sample No.: 10 Weight of oven dry sample, W (g): 99.8

Sieve   No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	1.00	1.00	1.00	99.00
10	2.000	1.40	1.40	2.40	97.60
20	0.850	1.40	1.40	3.81	96.19
j 40	0.425	3.00	3.01	6.81	93.19
60	0.250	9.00	9.02	15.83	84.17
100	0.150	69.20	69.34	85.17	14.83
200	0.075	8.00	8.02	93.19	6.81
Pan		6.40			

~	00	ΖΛ		111
2	· 77.	.4U	-	

Loss during sieve analysis=[(W-W1)/W]x100= 0.40% (OK if less than 2%)

Figure H.21: Soil Classification for Apalachicola River Bridge, FL at depth of 25 ft



Figure H.21: Soil Classification for Apalachicola River Bridge at depth of 25 ft (continued)

# DETERMINATION-OF-MOISTURE-CONTENT|

Description of soil: Location: Appal. River Bridge - 55 ft Sample No.: 11

No.	Weight of	Weight of can	Weight of can	W2-W3
of	can, W1	& wet soil, W2	& dry soil, W3	W(%)=x100
can	(g)	(g)	(g)	W3-W1
1	8.80	18.20	13.90	84.31

### SIEVE - ANALYSIS

Description of soil: Location: Appal. River Bridge - 55 ft Sample No.: 11 Weight of oven dry sample, W (g): 42.7

Sieve No.	Sieve  opening   (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	0.00	0.00	0.00	100.00
10	2.000	0.00	0.00	0.00	100.00
20	0.850	0.00	0.00	0.00	100.00
40	0.425	0.00	0.00	0.00	100.00
60	0.250	0.00	0.00	0.00	100.00
100	0.150	9.00	21.08	21.08	78.92
200	0.075	7.10	16.63	37.70	62.30
Pan	•••	26.30			
[		$\Sigma$ 42.40 = W1			

Loss during sieve analysis=[(W-W1)/W]x100= 0.70% (OK if less than 2%)

Figure H.22: Soil Classification for Apalachicola River Bridge, FL at depth of 55 ft







Description of soil: Location: Appal. River Bridge - 75 ft Sample No.: 12

No.	Weight of	Weight of can	Weight of can	W2-W3
of	can, W1	& wet soil, W2	& dry soil, W3	w(%)=x100
can	(g)	(g)	(g)	<b>V3-V1</b>
	8,95	19,90	17_80	23.73

Description of soil:

Location: Appal. River Bridge - 75 ft Sample No.: 12 Weight of oven dry sample, W (g): 154.15

Sieve   No. 	Sieve  opening   (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	0.00	·0 <b>.</b> 00	0.00	100.00
10	2.000	1.40	0.91	0.91	99.09
20	0.850	17.30	11.22	12.13	87.87
40	0.425	30.70	19.92	32.05	67.95
60	0.250	45.40	29.45	61.50	38.50
100	0.150	35.50	23.03	84.53	15.47
200	0.075	4.90	3.18	87.71	12.29
Pan		18.00			

∑ 153.20 = W1
Loss during sieve analysis=[(W-W1)/W]x100= 0.62% (OK if less than 2%)

Figure H.23: Soil Classification for Apalachicola River Bridge, FL at depth of 75 ft



Figure H.23: Soil Classification for Apalachicola River Bridge, FL at depth of 75 ft (continued)

Description of soil: Location: Skyway Bridge - 15 ft Sample No.: 1

No. Veight of		Weight of can	eight of can   Weight of can	
OT Cen	(g)	2 Wet soil, W2 (g)	(g)	W(%)=%100 W3-W1
1	22.45	50.60	45.50	22.13

# SIEVE - ANALYSIS

Description of soil: (All Materials retained on #40 are shells) Location: Skyway Bridge - 15 ft

Sample No.: 1 Weight of oven dry sample, W (g): 178.9

Sieve No.	Sieve opening (mm)	Weight retained ON each sieve (g)	Percent of Weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	6.70	3.75	3.75	96.25
10	2.000	3.20	1.79	5.53	94.47
20	0.850	5.00	2.79	8.33	91.67
40	0.425	3.40	1.90	10.23	89.77
60	0.250	10.30	5.76	15.99	84.01
100	0.150	102.80	57.46	73.45	26.55
200	0.075	36.50	20.40	93.85	6.15
Pan		8.20			

Σ 176.10 = W1

Loss during sieve analysis=[(W-W1)/W]x100= 1.57% (OK if less than 2%)

Figure H.24: Soil Classification for Sunshine Skyway Bridge, FL at depth of 15 ft



Figure H.24: Soil Classification for Sunshine Skyway Bridge, FL at depth of 15 ft (continued)

Description of soil: Location: Skyway Bridge - 25 ft Sample No.: 2

No.	Weight of	Weight of can	Weight of can	W2-W3
of	can, V1	& wet soil, W2	& dry soil, W3	w(%)=x100
can	(g)	(g)	(g)	V3-V1
	22.40	46.50	41.90	23.59

SIEVE - ANALYSIS

Description of soil: (All the materials retained on #60 are shells) Location: Skyway Bridge - 25 ft

Sieve	Sieve	Weight retained	Percent of	Cumulative	Percent
No.	opening	on each sieve	weight retained	percent	finer
	(mm)	(g)	on each sieve	retained	
4	4.750	10.70	9.04	9.04	90.96
10	2.000	7.50	6.34	15.38	84.62
20	0.850	6.20	5.24	20.63	79.37
40	0.425	3.30	2.79	23.42	76.58
60	0.250	7.10	6.00	29.42	70.58
100	0.150	46_10	38.97	68.39	31.61
200	0.075	25.70	21.72	90.11	9.89
Pan		11.60		i	,

Figure H.25: Soil Classification for Sunshine Skyway Bridge, FL at depth of 25 ft



Figure H.25: Soil Classification for Sunshine Skyway Bridge, FL at depth of 25 ft (continued)

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Description of soil:
Location: Skyway Bridge - 27.5 ft
Sample No.: 3
```

No.	Weight of	Weight of can	Weight of can	₩2-₩3
of	can, Wi	£ wet soil, W2	L dry soil, W3	₩(%)=x100
can	(g)	(g)	(g)	₩3-₩1
1	22.50	33.45	31.05	

# | SIEVE-ANALYSIS |

Description of soil: (All materials retained on #20 are shells) Location: Skyway Bridge - 27.5 ft

Sample No.: 3 Weight of oven dry sample, W (g): 117.5

	Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
	4	4.750	5.60	4.77	4.77	95.23
	10	2.000	4.20	3.57	8.34	91.66
	20	0.850	4.50	3.83	12.17	87.83
	40	0.425	3.60	3.06	15.23	84.77
1	60	0.250	8.30	7.06	22.30	77.70
	100	0.150	60.60	51.57	73.87	26.13
i	200	0.075	21.60	18.38	92.26	7.74
1	Pan		7.80	· · ·		
•						

## $\Sigma$ 116.20 = W1 Loss during sieve analysis=[(W-W1)/W]x100= 1.11% (OK if less than 2%)

Figure H.26: Soil Classification for Sunshine Skyway Bridge, FL at depth of 27.5 ft



Figure H.26: Soil Classification for Sunshine Skyway Bridge at depth of 27.5 ft (continued)

### DETERMINATION-OF-MOISTURE-CONTENT |

Description of soil: Location: Skyway Bridge - 30 ft Sample No.: 4

No.	Weight of	Weight of can	Weight of can & dry soil, W3	¥2-¥3
can	(g)	(g)	(g)	V3-V1
1	22.60	40.20	36.20	29.41

## SIEVE-ANALYSIS

Description of soil: (All materials retained on #20 are shells) Location: Skyway Bridge - 30 ft

Sample No.: 4 Weight of oven dry sample, W (g): 145

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	14.50	10.00	10.00	90.00
10	2.000	1.70	1.17	11.17	88.83
20	0.850	3.50	2.41	13.59	86.41
40	0.425	2.90	2.00	15.59	84.41
60	0.250	10.50	7.24	22.83	77.17
100	0.150	90.80	62.62	85.45	14.55
200	0.075	18.40	12.69	98.14	1.86
Pan		5.30			
				f	

 $\Sigma$  147.60 = W1 Loss during sieve analysis=[(W-W1)/W]x100=-1.79% (OK if less than 2%)

Figure H.27: Soil Classification for Sunshine Skyway Bridge, FL at depth of 30 ft



Figure H.27: Soil Classification for Sunshine Skyway Bridge, FL at depth of 30 ft (continued)

# Description of soil: Location: Skyway Bridge - 35 ft Sample No.: 5

No.	Weight of	Weight of can	Weight of can	W2-W3
of	can, V1	& wet soil, W2	& dry soil, W3	W(%)=x100
can	(g)	(g)	(g)	W3-W1
1	8.70	16.90	14.80	

| SIEVE - ANALYSIS |

Description of soil: Location: Skyway Bridge - 35 ft Sample No.: 5 Weight of oven dry sample, W (g): 92

Sieve   No. 	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
4	4.750	9.20	10.00	10.00	90.00
10	2.000	7.00	7.61	17.61	82.39
20	0.850	9.90	10.76	28.37	71.63
40	0.425	7.50	8.15	36.52	63.48
60	0.250	8.90	9.67	46.20	53.80
100	0.150	30.20	32.83	79.02	20.98
200	0.075	7.50	8.15	87.17	12.83
Pan	•	10.20			

 $\Sigma$  90.40 = W1 Loss during sieve analysis=[(W-W1)/W]x100= 1.74% (OK if less than 2%)

Figure H.28: Soil Classification for Sunshine Skyway Bridge, FL at depth of 35 ft



Figure H.28: Soil Classification for Sunshine Skyway Bridge, FL at depth of 35 ft (continued)

# Description of soil: Location: Skyway Bridge - 40 ft Sample No.: 6

No.	Weight of	Weight of can	Weight of can	42-45
of	can, V1	& wet soil, W2	& dry soil, W3	4(%)=X100
can	(g)	(g)	(g)	43-41
1	8.90	16.70	14.95	28.93

## | SIEVE - ANALYSIS |

Description of soil:

Location: Skyway Bridge - 40 ft

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Sample No.: 6 Weight of oven dry sample, W (g): 107.5
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	Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
	4	4.750	12.80	11.91	11.91	88.09
ĺ	10	2.000	4.40	4.09	16.00	84.00
I	20	0.850	5.30	4.93	20.93	79.07
İ	40	0.425	4.60	4.28	25.21	74.79
Ì	60	0.250	9.00	8.37	33.58	66.42
İ	100	0.150	56.40	52.47	86.05	13.95
İ	200	0.075	12.90	12.00	98.05	1.95
ł	Pan		1.90			

 $\Sigma$  107.30 = W1 Loss during sieve analysis=[(W-W1)/W]x100= 0.19% (OK if less than 2%)

Figure H.29: Soil Classification for Sunshine Skyway Bridge, FL at depth of 40 ft



Figure H.29: Soil Classification for Sunshine Skyway Bridge, FL at depth of 40 ft (continued)

Description of soil: Location: Skyway Bridge - 45.5 ft Sample No.: 7

No.	Weight of	Weight of can	Weight of can	₩2-₩3
of	can, W1	& wet soil, W2	& dry soil, W3	₩(%)=x100
can	(g)	(g)	(g)	₩3-₩1
1	8.90	17.75	16.20	21.23

## SIEVE - ANALYSIS

Description of soil:

Location: Skyway Bridge - 45.5 ft

Sample No.: 7 Weight of oven dry sample, W (g): 124

Sieve No.	Sieve opening	Weight retained on each sieve	Percent of Weight retained	Cumulative percent	Percent finer
 	(1778)	(g)	on each sieve	retained	
4	4.750	0.00	0.00	0.00	100.00
10	2.000	0.00	0.00	0.00	100.00
20	0.850	0.00	0.00	0.00	100.00
4	4.750	0.50	0.40	0.40	99.60
60	0.250	3.10	2.50	2.90	97.10
100	0.150	110.00	88.71	91.61	8.39
200	0.075	6.40	5.16	96.77	3.23
Pan		2.80			

 $\Sigma$  122.80 = W1 Loss during sieve analysis=[(W-W1)/W1x100= 0.97% (OK if less than 2%)

Figure H.30: Soil Classification for Sunshine Skyway Bridge, FL at depth of 45.5 ft



Figure H.30: Soil Classification for Sunshine Skyway Bridge at depth of 45.5 ft (continued)

Description of soil: Location: Skyway Bridge - 50 ft Sample No.: 8

No.	Weight of	Weight of can	Weight of can	W2-W3
of	can, Wi	& wet soil, W2	& dry soil, W3	W(%)=x100
can	(g)	(g)	(g)	W3-W1
1	8.95	22.00	20.00	18.10

SIEVE-ANALYSIS

Description of soil: (All materials retained on #40 are shells) Location: Skyway bridge - 50 ft

Sample No.: 8 Weight of oven dry sample, W (g): 146.8

Sieve No.	Sieve opening (mm)	Weight retained •on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent   finer 
4	4.750	2.40	1.63	1.63	98.37
10	2.000	9.00	6.13	7.77	92.23
20	0.850	10.00	.6.81	14.58	85.42
40	0.425	6.30	4.29	18.87	81.13
60	0.250	6.00	4.09	22.96	77.04
100	0.150	43.70	29.77	52.72	47.28
200	0.075	49.40	33.65	86.38	13.62
Pan		19.20			I

Loss during sieve analysis=[(W-W1)/W]x100= 0.54% (OK if less than 2%)

Figure H.31: Soil Classification for Sunshine Skyway Bridge, FL at depth of 50 ft



Figure H.31: Soil Classification for Sunshine Skyway Bridge, FL at depth of 50 ft (continued)



Figure H.32: Soil Classification for Aucilla River Bridge, FL at depth of 5 ft



Figure H.33: Soil Classification for Aucilla River Bridge, FL at depth of 10 ft



Figure H.34: Soil Classification for Vilano Bridge - East, FL at depth of 5 ft



Figure H.35: Soil Classification for Vilano Bridge - East, FL at depth of 25 ft



Figure H.36: Soil Classification for Vilano Bridge - East, FL at depth of 35 ft



Figure H.37: Soil Classification for Vilano Bridge - East, FL at depth of 45 ft



Figure H.38: Soil Classification for Vilano Bridge - West, FL at depth of 64 ft


Figure H.39: Unconfined Compression Test Results for Apalachicola River Bridge, FL

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