INFRASTRUCTURE
CONSULTING & ENGINEERING

January 23, 2023

Mr. Billy Hardwick
Senior Project Manager
Archer-United Joint Venture
billy.hardwick@uig.net

Re: **Report of Dynamic Pile Testing**
Bent 4 Pile 11
Bridge 36 - Colonial Life Blvd. Ramp B Bridge over I-126, I-126 Ramp & S-287 (Arrowwood Road)
Project ID: P039718
Richland County, South Carolina

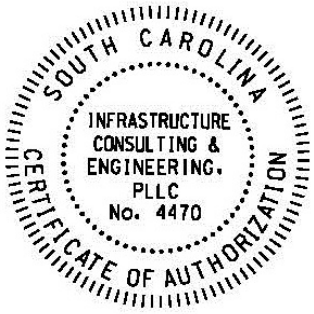
Dear Mr. Hardwick:

The attached results of dynamic pile testing for the subject pile and project includes measurements and analysis performed by Infrastructure Consulting & Engineering in accordance with ASTM D4945. Measurements were made with the Pile Dynamics, Inc. Model 8G and signal matching analysis was performed with CAPWAP version 2014. For further information on the test method please refer to the ASTM.

Also included are the production pile driving recommendations for Bent 4 of the subject project. The Geotechnical Engineer of Record should ultimately make final recommendations for foundation design and construction.

Thank you for the opportunity to provide these services.

Sincerely,
Infrastructure Consulting & Engineering (ICE), PLLC



Michael J. Simpson 2023.01.23 09:16:53 -05'00'

Michael J. Simpson, P.E.
Geotechnical Testing Manager
Certified PDA Signatory "Advanced"
South Carolina Registration Number: 35396

Sally G. Thomson, P.E.
Geotechnical Designer
Certified PDA Signatory "Advanced"

Appendix A

Dynamic Pile Testing, Signal Matching Results, and Calibration WEAP

Bridge 36, Bent 4, Pile 11

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Summary of Provided Project and Pile Driving Information

Project Description	Colonial Life Blvd. Ramp B Bridge over I-126, I-126 Ramp & S-287 (Arrowwood Road) Richland County, South Carolina
Pile Driving Contractor	Archer United Joint Venture
Project ID	P039718
ICE Field Personnel	Sally G. Thomson, P.E.
ICE Responsible Engineer	Michael J. Simpson, P.E.

Bent Number	**Station**	**Pile Type**	**Pile Batter**	**Hammer Used**	**Pile Cushion Type and Thickness**
Bent 4	35+34.51	HP14x89 with Pile Tip	Plumb	ICE I-19v2	N/A

Pile Number	**Total Pile Length (feet)**	**Pile Length Below Gages (feet)**	**Pile Splice Location(s) above Pile Tip (feet)**	**Initial Drive Test Date**	**Restrike Test Date**
11	50.0	47.7	N/A	1/18/23	N/A

Factored Design Load (kips)	**Geotechnical Resistance Factor**	**Nominal Resistance of Pile (kips)**	**Required Driving Resistance of Pile (kips)**	**Minimum Tip Elevation of Pile (feet)**
273	0.65	420	420	$^{+}$187.0

Installation Records Provided to ICE	Please Refer to SCDOT Pile Driving Logs
Project Information and Soil Borings Provided to ICE	Yes, Attached in Appendix C
Pile Driving Equipment Data Form Provided to ICE	ICE I-19v2 Data Hammer Sheet Attached in Appendix D
Strain and Accelerometer Calibrations Attached	Yes, Attached in Appendix E

Steel Acceptable Compression Driving Stress Limit (ksi)*	45
Steel Acceptable Tension Driving Stress Limit (ksi)*	45

*For steel piles based on Section 711.4.2.2 and a steel yield strength (Fy) of 50 ksi.

Approximate Reference Elevation (feet)	$^{+}$208.0
Approximate Ground/Mudline Elevation (feet)	$^{+}$207.0
Approximate Final Pile Penetration Below Reference at End of Initial Drive (feet)	43.1
Approximate Final Pile Tip Elevation at End of Initial Drive (feet)	$^{+}$164.9
Approximate Final Pile Penetration Below Reference at End of Restrike (feet)	N/A
Approximate Final Pile Tip Elevation at End of Restrike (feet)	N/A

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Additional Notes on Pile Installation
-Pile 11 was monitored with instrumentation for the entire initial drive. -For additional detailed information on the hammer driving system, bridge plans, and soils information please refer to the project documents. -The blows per foot of penetration for the pile was kept by the PDA operator on the PDA during the initial drive. A pile driving log was also maintained by a SCDOT representative.

Summary of Results

Dynamic Pile Testing Results (Detailed Results in Appendix A)

Location*	Capacity (kips)	Case Method	Max. Comp. Stress (ksi)	Avg. Comp. Stress (ksi)	Max. Comp. Stress at Pile Bottom (ksi)	Avg. Comp. Stress at Pile Bottom (ksi)	Avg. Transferred Energy (k-ft)	Avg. Stroke (feet)
EOD	519	RX7	31.1	22.0	26.2	11.6	15.5	6.9

Signal Matching Analyses Results (Detailed Result in Appendix A)

Location*	R_{ult} (kips)	R_{side} / R_{end} (kips)	Equiv. BPF*	Stroke (ft)	EMX (k-ft)	Qs (in)	Qt (in)	Ss (sec/ft)	St (sec/ft)	MQN*
EOD (Blow 979)	520	287 / 233	188	8.9	20.6	0.23	0.12	0.19	0.07	3.27

*EOD – End of Drive; BPF – Blows per foot; MQN – Match Quality Number

Dynamic Pile Testing Interpretation and Commentary

The capacity listed in the Summary of Dynamic Pile Testing Results is based on the RX7 (Maximum Case Method with J(c)=0.7) solution for the average for the last increment of the initial drive. The summary plot and table attached for the dynamic pile testing results are based on the same capacity solution.

Signal matching analysis was performed for a blow (Blow 979) near the end of the initial drive. The signal matching ultimate capacity near the end of initial drive was above the required driving resistance of 420 kips for Bent 4.

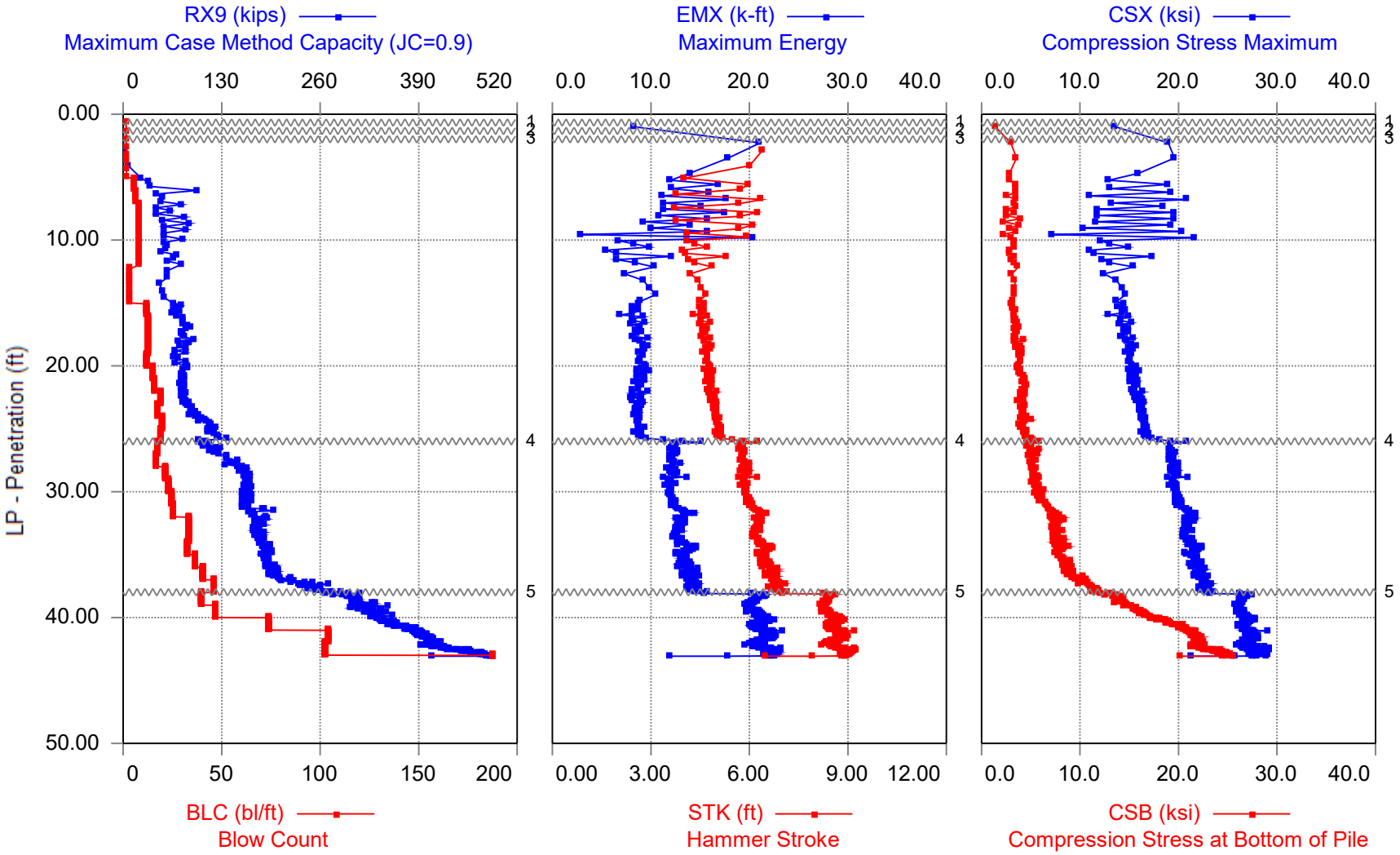
Compression and tension pile driving stresses were below the acceptable limit for the pile tested during the initial drive. The pile tested did not show any signs of integrity problems below the gage locations based on the test results.

Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 20-January-2023

Test started: 18-January-2023

CCRP1 Bridge 36 Bent 4 - Pile 11



1 - Template Reference Elevation 208.0
2 - Ground Elevation 207.0
3 - Fuel Setting 1
4 - Fuel Setting 2
5 - Fuel Setting 3

CCRP1 Bridge 36 Bent 4 - Pile 11 HP 14x89 w tips
OP: ICE Date: 18-January-2023

AR: 26.10 in² SP: 0.492 k/ft³
LE: 47.67 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

RX7: Maximum Case Method Capacity (JC=0.7) TSX: Tension Stress Maximum - Full Record Search
EMX: Maximum Energy DMX: Maximum Displacement
STK: Hammer Stroke DFN: Final Displacement
CSX: Compression Stress Maximum BTA: Integrity Factor (1)
CSB: Compression Stress at Bottom of Pile

BL#	Depth	BLC	TYPE	RX7	EMX	STK	CSX	CSB	TSX	DMX	DFN	BTA
	ft	bl/ft		kips	k-ft	ft	ksi	ksi	ksi	in	in	(%)
3	2.00	2	AV3	0	11.0	**	14.1	1.9	10.5	8.02	8.00	93.0
			STD	0	3.9	**	1.0	0.8	0.5	0.03	0.00	5.0
			MAX	0	16.4	**	15.2	3.0	11.2	8.07	8.00	100.0
			@BL	1	3	**	3	3	2	3	1	1
8	5.00	2	AV5	10	17.9	5.81	18.8	3.1	12.5	7.45	7.20	98.0
			STD	6	4.5	0.92	3.3	0.4	2.2	0.49	0.00	4.0
			MAX	15	25.7	7.10	22.8	3.6	15.0	8.43	7.20	100.0
			@BL	6	4	4	4	6	4	4	8	4
14	6.00	6	AV6	49	13.7	4.87	15.0	3.3	9.2	3.21	2.00	97.8
			STD	27	7.1	1.56	4.9	0.8	3.7	1.09	0.00	4.8
			MAX	109	23.5	7.54	24.0	4.6	16.8	4.64	2.00	100.0
			@BL	14	11	11	11	14	11	11	13	9
21	7.00	7	AV7	55	13.3	5.28	15.9	3.1	10.1	2.84	1.71	96.9
			STD	15	8.7	1.87	7.1	0.7	5.6	1.18	0.00	5.0
			MAX	86	25.1	8.04	26.0	4.1	18.2	4.36	1.72	100.0
			@BL	15	19	19	19	15	19	19	17	17
29	8.00	8	AV8	57	13.6	5.17	15.4	3.1	9.3	2.62	1.50	97.4
			STD	16	9.3	2.02	6.8	0.8	5.4	1.13	0.00	4.6
			MAX	88	27.7	8.30	26.4	4.1	18.5	4.12	1.50	100.0
			@BL	22	27	27	27	22	27	27	25	22
37	9.00	8	AV8	70	12.3	5.17	15.2	3.1	9.0	2.29	1.49	97.1
			STD	19	9.0	2.18	7.9	1.0	6.1	0.86	0.03	5.0
			MAX	90	24.7	8.40	27.5	4.3	18.6	3.71	1.50	100.0
			@BL	30	31	35	35	31	35	31	37	30
45	10.00	8	AV8	68	13.2	5.42	16.1	3.2	9.6	2.07	1.47	96.8
			STD	19	8.0	2.11	7.0	0.8	5.6	0.57	0.05	5.6
			MAX	98	23.6	8.55	26.6	4.3	18.8	3.03	1.50	100.0
			@BL	44	44	44	44	38	44	38	42	38
53	11.00	8	AV8	55	7.1	4.20	12.3	3.1	6.4	1.51	1.50	98.6
			STD	5	2.4	0.40	2.2	0.3	1.5	0.03	0.00	3.6
			MAX	63	10.7	4.84	15.7	3.6	8.5	1.60	1.50	100.0
			@BL	49	49	49	49	49	49	49	53	46
61	12.00	8	AV8	69	9.4	4.66	14.5	3.3	7.7	1.56	1.50	100.0
			STD	13	2.7	0.60	2.5	0.3	1.9	0.11	0.00	0.0
			MAX	96	14.2	5.88	19.1	3.7	11.5	1.83	1.50	100.0
			@BL	61	55	55	55	60	55	55	60	54

CCRP1 Bridge 36 Bent 4 - Pile 11 HP 14x89 w tips
OP: ICE Date: 18-January-2023

BL#	Depth ft	BLC bl/ft	TYPE	RX7 kips	EMX k-ft	STK ft	CSX ksi	CSB ksi	TSX ksi	DMX in	DFN in	BTA (%)
72	15.00	4	AV11	57	9.1	4.47	13.8	3.3	7.1	3.27	3.27	96.9
			STD	6	1.3	0.19	0.9	0.2	0.6	0.00	0.00	5.1
			MAX	69	11.9	4.89	15.5	3.9	8.4	3.27	3.27	100.0
			@BL	62	69	69	69	62	69	64	64	62
84	16.00	12	AV12	72	8.3	4.53	14.1	3.3	7.1	1.09	1.00	97.0
			STD	5	0.7	0.15	0.7	0.2	0.6	0.06	0.01	5.2
			MAX	83	9.3	4.77	15.3	3.6	8.3	1.17	1.00	100.0
			@BL	75	74	74	74	80	74	74	84	73
97	17.00	13	AV13	82	8.8	4.65	14.6	3.5	7.1	1.08	0.92	97.2
			STD	8	0.8	0.17	0.8	0.3	0.7	0.06	0.01	5.1
			MAX	96	10.0	4.92	15.8	4.0	8.2	1.18	0.92	100.0
			@BL	96	86	91	91	96	91	86	88	86
110	18.00	13	AV13	81	8.7	4.65	14.7	3.6	7.2	1.06	0.92	96.9
			STD	7	0.6	0.10	0.5	0.5	0.4	0.06	0.01	4.6
			MAX	101	10.1	4.89	15.9	5.1	7.9	1.17	0.92	100.0
			@BL	109	108	108	108	109	108	108	104	98
123	19.00	13	AV13	81	9.3	4.75	15.2	3.7	7.2	1.07	0.92	96.7
			STD	11	0.5	0.12	0.5	0.3	0.5	0.04	0.00	5.0
			MAX	100	9.9	4.90	15.9	4.2	8.1	1.11	0.92	100.0
			@BL	115	115	113	123	119	113	119	122	113
135	20.00	12	AV12	75	9.2	4.74	15.2	3.9	6.9	1.03	1.00	96.1
			STD	7	0.5	0.11	0.5	0.2	0.3	0.03	0.00	5.6
			MAX	88	10.3	4.92	16.0	4.3	7.6	1.10	1.00	100.0
			@BL	131	135	135	135	124	135	135	128	125
150	21.00	15	AV15	82	9.1	4.79	15.5	4.0	7.0	0.96	0.80	100.0
			STD	6	0.4	0.09	0.4	0.3	0.4	0.04	0.00	0.0
			MAX	94	9.9	4.91	16.1	4.7	7.6	1.04	0.80	100.0
			@BL	149	142	143	141	149	138	142	144	136
166	22.00	16	AV16	80	8.8	4.80	15.5	4.4	6.6	0.87	0.75	99.3
			STD	5	0.5	0.08	0.4	0.2	0.3	0.05	0.00	2.7
			MAX	92	9.5	4.90	15.9	4.7	7.2	0.95	0.75	100.0
			@BL	158	153	153	154	160	164	153	152	151
185	23.00	19	AV19	86	8.8	4.92	16.0	4.2	6.4	0.76	0.63	97.2
			STD	5	0.7	0.10	0.4	0.3	0.3	0.07	0.01	4.8
			MAX	99	10.4	5.10	16.7	4.8	7.0	0.94	0.63	100.0
			@BL	185	167	167	167	171	167	167	178	167
203	24.00	18	AV18	101	8.7	4.98	16.3	4.2	6.2	0.71	0.66	99.4
			STD	9	0.3	0.06	0.2	0.2	0.3	0.02	0.01	2.5
			MAX	119	9.3	5.12	16.9	4.7	6.6	0.75	0.67	100.0
			@BL	202	198	198	198	188	198	188	186	187
223	25.00	20	AV20	119	8.8	5.05	16.6	4.3	6.0	0.69	0.59	100.0
			STD	8	0.4	0.09	0.4	0.5	0.4	0.02	0.01	0.0
			MAX	134	9.8	5.25	17.2	5.3	6.9	0.74	0.60	100.0

CCRP1 Bridge 36 Bent 4 - Pile 11 HP 14x89 w tips
OP: ICE Date: 18-January-2023

BL#	Depth ft	BLC bl/ft	TYPE	RX7 kips	EMX k-ft	STK ft	CSX ksi	CSB ksi	TSX ksi	DMX in	DFN in	BTA (%)
			@BL	220	222	222	207	209	218	222	205	204
242	26.00	19	AV19	125	9.6	5.20	17.2	4.7	6.1	0.71	0.63	100.0
			STD	11	1.6	0.30	1.0	0.5	0.7	0.09	0.00	0.0
			MAX	144	13.5	5.92	19.7	6.0	7.6	0.93	0.63	100.0
			@BL	239	240	240	240	241	241	240	232	224
260	27.00	18	AV18	126	12.7	5.84	19.5	5.2	7.2	0.84	0.66	99.4
			STD	11	1.0	0.19	0.6	0.6	0.4	0.06	0.01	2.3
			MAX	140	16.1	6.55	21.8	7.0	8.5	1.03	0.67	100.0
			@BL	253	243	243	243	254	243	243	245	243
277	28.00	17	AV17	147	12.3	5.83	19.4	5.3	7.1	0.76	0.70	100.0
			STD	8	0.4	0.11	0.4	0.5	0.3	0.02	0.01	0.0
			MAX	160	13.4	6.11	20.3	6.6	7.6	0.81	0.71	100.0
			@BL	268	274	274	274	261	266	262	274	261
299	29.00	22	AV22	164	12.3	5.90	19.7	5.5	6.9	0.71	0.54	100.0
			STD	8	1.0	0.23	0.8	0.5	0.7	0.04	0.01	0.0
			MAX	181	15.9	6.76	22.6	6.5	9.2	0.85	0.55	100.0
			@BL	294	295	295	295	295	295	295	295	278
322	30.00	23	AV23	165	12.0	5.88	19.7	5.6	6.5	0.67	0.52	100.0
			STD	5	0.3	0.07	0.3	0.4	0.3	0.02	0.01	0.0
			MAX	177	12.8	6.04	20.1	6.8	6.9	0.72	0.52	100.0
			@BL	320	308	308	317	320	300	308	316	300
347	31.00	25	AV25	165	12.2	5.97	20.0	6.1	6.1	0.63	0.47	99.6
			STD	6	0.3	0.06	0.3	0.5	0.3	0.02	0.01	2.2
			MAX	178	12.7	6.10	20.5	6.8	6.5	0.69	0.48	100.0
			@BL	328	339	346	346	347	335	323	342	323
373	32.00	26	AV26	185	13.1	6.25	20.9	7.1	5.8	0.60	0.46	100.0
			STD	15	0.6	0.16	0.5	0.4	0.3	0.02	0.00	0.0
			MAX	221	14.7	6.62	22.2	8.2	6.5	0.64	0.47	100.0
			@BL	356	365	365	365	372	348	366	364	348
407	33.00	34	AV34	187	13.0	6.28	21.0	7.6	5.3	0.55	0.35	100.0
			STD	10	0.4	0.09	0.4	0.4	0.2	0.02	0.00	0.0
			MAX	217	14.0	6.52	21.8	8.5	5.9	0.60	0.36	100.0
			@BL	379	390	391	375	384	391	390	400	374
441	34.00	34	AV34	187	12.7	6.22	20.8	7.7	5.0	0.54	0.35	100.0
			STD	9	0.5	0.12	0.5	0.5	0.3	0.01	0.00	0.0
			MAX	211	13.9	6.52	22.5	9.0	5.7	0.58	0.36	100.0
			@BL	414	434	434	434	434	411	411	416	408
474	35.00	33	AV33	194	13.6	6.48	21.6	7.9	5.1	0.55	0.36	100.0
			STD	9	0.7	0.16	0.6	0.5	0.4	0.03	0.00	0.0
			MAX	221	15.2	6.87	22.8	9.4	6.1	0.60	0.37	100.0
			@BL	468	453	453	456	454	453	459	443	442
511	36.00	37	AV37	199	13.5	6.49	21.7	8.4	4.8	0.52	0.32	100.0

CCRP1 Bridge 36 Bent 4 - Pile 11 HP 14x89 w tips
OP: ICE Date: 18-January-2023

BL#	Depth ft	BLC bl/ft	TYPE	RX7 kips	EMX k-ft	STK ft	CSX ksi	CSB ksi	TSX ksi	DMX in	DFN in	BTA (%)
			STD	5	0.5	0.14	0.5	0.5	0.3	0.02	0.00	0.0
			MAX	211	14.7	6.81	22.6	9.6	5.5	0.56	0.33	100.0
			@BL	475	507	490	490	493	484	507	486	475
552	37.00	41	AV41	220	14.0	6.70	22.3	9.2	4.4	0.51	0.29	100.0
			STD	15	0.6	0.15	0.5	0.8	0.4	0.02	0.00	0.0
			MAX	274	15.3	7.00	23.4	11.2	5.3	0.55	0.30	100.0
			@BL	549	542	542	542	551	523	542	512	512
598	38.00	46	AV46	277	14.4	6.86	22.7	10.9	2.8	0.48	0.26	100.0
			STD	21	0.6	0.16	0.5	0.7	0.6	0.02	0.01	0.0
			MAX	346	15.9	7.27	23.9	12.1	3.7	0.52	0.26	100.0
			@BL	596	598	590	590	596	562	564	583	553
638	39.00	40	AV40	340	20.2	8.25	26.2	13.6	3.4	0.57	0.30	100.0
			STD	19	1.8	0.44	1.1	1.0	0.8	0.04	0.01	0.0
			MAX	376	22.3	8.78	27.5	15.2	4.9	0.65	0.30	100.0
			@BL	605	613	606	606	631	606	613	636	599
685	40.00	47	AV47	364	20.6	8.40	26.5	16.0	1.8	0.54	0.25	100.0
			STD	17	0.7	0.16	0.4	0.8	0.2	0.02	0.01	0.0
			MAX	418	22.3	8.81	27.3	17.8	2.3	0.58	0.26	100.0
			@BL	663	681	681	681	682	639	671	666	639
759	41.00	74	AV74	389	21.2	8.59	26.9	19.3	2.5	0.53	0.16	100.0
			STD	13	0.7	0.17	0.5	1.1	0.3	0.02	0.00	0.0
			MAX	416	22.7	8.92	28.3	21.1	3.0	0.56	0.17	100.0
			@BL	752	702	702	692	755	752	757	705	686
863	42.00	104	AV104	426	21.9	8.79	27.4	21.7	3.2	0.54	0.11	100.0
			STD	8	0.7	0.18	0.6	0.5	0.2	0.01	0.00	0.0
			MAX	449	24.4	9.40	29.6	23.0	3.6	0.57	0.12	100.0
			@BL	856	765	765	765	840	850	830	832	760
966	43.00	103	AV103	469	21.7	8.79	27.7	23.1	3.9	0.53	0.11	100.0
			STD	35	1.0	0.28	1.1	1.3	0.5	0.02	0.00	0.0
			MAX	534	24.5	9.58	31.1	26.0	4.9	0.57	0.12	100.0
			@BL	958	907	907	897	963	962	869	961	864
981	43.08	188	AV15	519	20.9	8.61	27.1	24.9	5.0	0.52	0.06	100.0
			STD	28	3.1	0.75	1.9	1.4	0.2	0.05	0.01	0.0
			MAX	543	22.9	9.10	29.6	26.2	5.4	0.60	0.07	100.0
			@BL	971	970	973	971	971	979	971	978	967
			Average	254	15.5	6.89	22.0	11.6	4.9	0.80	0.52	99.5
			Std. Dev.	145	5.3	1.59	4.9	7.4	2.3	0.82	0.79	2.3
			Maximum	543	27.7	9.58	31.1	26.2	18.8	8.43	8.00	100.0
			@ Blow#	971	27	907	897	971	44	4	1	1

Total number of blows analyzed: 981

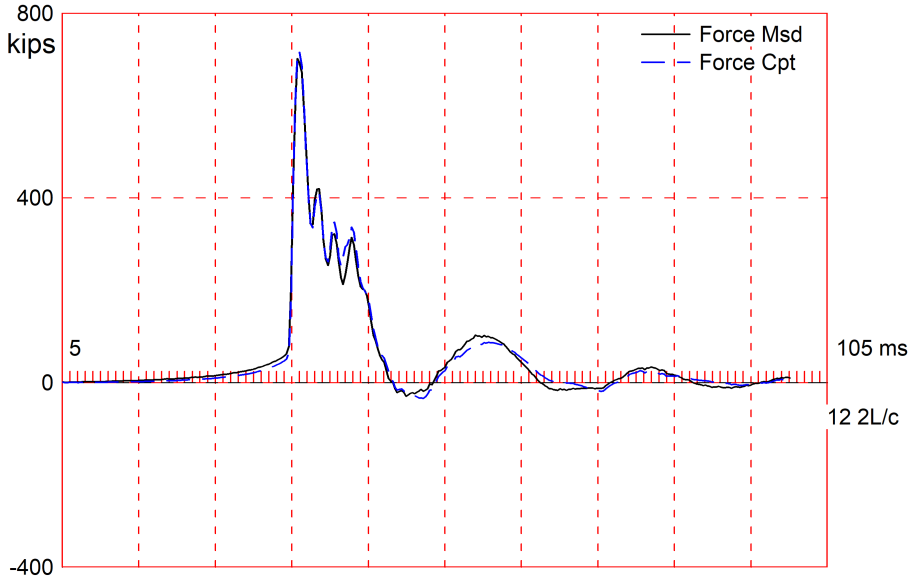
BL#	Sensors
1-889	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)

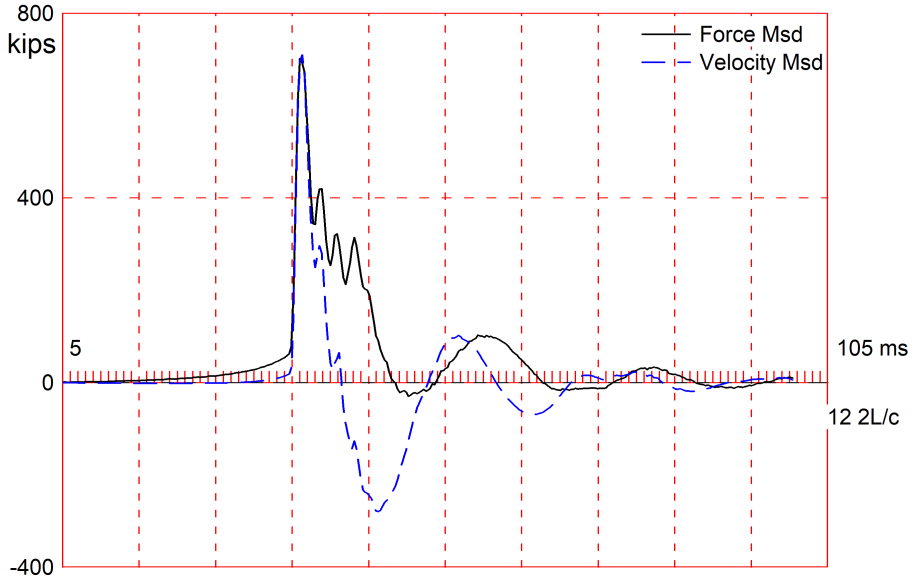
890	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
891-896	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
897	F4: [S868] 145.1 (1.00); A3: [K12388] 451.0 (1.00)
898-981	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)

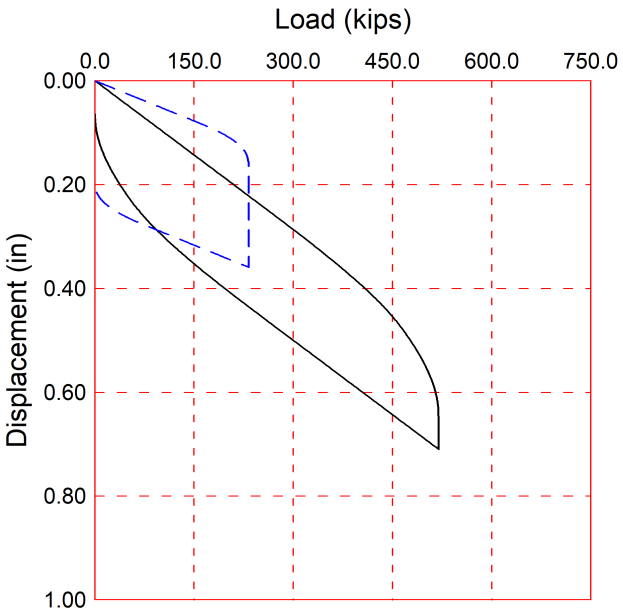
BL#	Comments
1	Template Reference Elevation 208.0
2	Ground Elevation 207.0
3	Fuel Setting 1
242	Fuel Setting 2
598	Fuel Setting 3

Time Summary

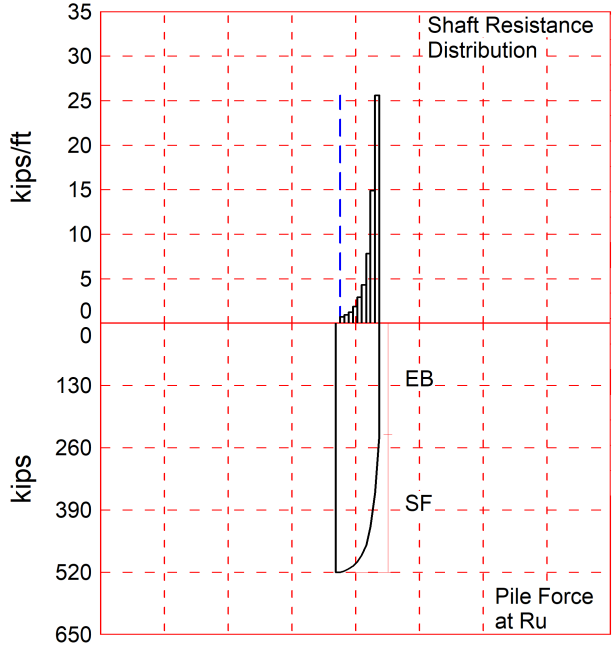
Drive	26 minutes 38 seconds	10:40 AM - 11:07 AM	BN 1 - 981







RU =	519.8 kips
SF =	287.2 kips
EB =	232.6 kips
Dy =	0.65 in
Dx =	0.71 in
SET/Bl =	0.06 in



Length b. Sensors	47.7 ft
Embedment	42.1 ft
Top Area	26.1 in^2
End Bearing Area	203.2 in^2
Top Perimeter	4.75 ft
Top E-Modulus	30000 ksi
Top Spec. Weight	492.0 lb/ft^3
Top Wave Spd.	16808 ft/s
Overall W.S.	16808 ft/s
Match Quality	3.27
Top Compr. Stress	27.6 ksi
Max Compr. Stress	28.4 ksi
Max Tension Stress	-3.81 ksi
Avg. Shaft Quake	0.23 in
Toe Quake	0.12 in
Avg. Shaft Smith Dpg.	0.19 s/ft
Toe Smith Damping	0.07 s/ft

CAPWAP(R) 2014-3 Licensed to Infrastructure Consulting & Eng., PLLC

About the CAPWAP Results

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

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

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

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

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

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

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

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

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 519.8; along Shaft 287.2; at Toe 232.6 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Quake in
				519.8				
1	9.5	3.9	2.9	516.9	2.9	0.74	0.16	0.24
2	14.3	8.7	4.5	512.4	7.4	0.94	0.20	0.24
3	19.1	13.5	5.9	506.5	13.3	1.24	0.26	0.24
4	23.8	18.2	8.9	497.6	22.2	1.87	0.39	0.24
5	28.6	23.0	13.9	483.7	36.1	2.92	0.61	0.24
6	33.4	27.8	20.6	463.1	56.7	4.32	0.91	0.24
7	38.1	32.5	37.4	425.7	94.1	7.85	1.65	0.24
8	42.9	37.3	71.1	354.6	165.2	14.92	3.14	0.24
9	47.7	42.1	122.0	232.6	287.2	25.59	5.38	0.23
Avg. Shaft			31.9			6.83	1.44	0.23
Toe			232.6				164.81	0.12

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.19	0.07
Case Damping Factor		1.17	0.35
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	79	100
Reloading Level	(% of Ru)	100	100

CAPWAP match quality = 3.27 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.06 in; Blow Count = 188 b/ft
Computed: Final Set = 0.06 in; Blow Count = 188 b/ft

max. Top Comp. Stress = 27.6 ksi (T= 36.6 ms, max= 1.028 x Top)
max. Comp. Stress = 28.4 ksi (Z= 33.4 ft, T= 38.3 ms)
max. Tens. Stress = -3.81 ksi (Z= 28.6 ft, T= 50.5 ms)
max. Energy (EMX) = 20.6 kip-ft; max. Measured Top Displ. (DMX)= 0.49 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	4.8	721.5	-47.8	27.6	-1.83	20.6	14.6	0.50
2	9.5	729.7	-66.9	28.0	-2.56	20.2	14.4	0.47
3	14.3	730.8	-81.3	28.0	-3.11	19.6	14.2	0.45
4	19.1	731.0	-88.7	28.0	-3.40	18.8	13.9	0.42
5	23.8	733.3	-96.4	28.1	-3.69	17.8	13.5	0.39
6	28.6	735.9	-99.4	28.2	-3.81	16.5	13.0	0.36
7	33.4	741.4	-94.8	28.4	-3.63	15.0	12.2	0.32
8	38.1	723.1	-86.7	27.7	-3.32	13.2	11.0	0.29
9	42.9	632.4	-73.3	24.2	-2.81	11.0	11.3	0.26
10	47.7	584.9	-54.5	22.4	-2.09	4.6	10.1	0.23
Absolute	33.4			28.4			(T =	38.3 ms)
	28.6				-3.81		(T =	50.5 ms)

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	851.3	794.4	737.6	680.8	623.9	567.1	510.3	453.4	396.6	339.8
RX	864.0	811.3	758.7	706.2	653.6	601.1	548.5	519.9	497.5	476.3
RU	872.6	817.9	763.2	708.6	653.9	599.2	544.5	489.8	435.1	380.4

RAU = 436.1 (kips); RA2 = 510.9 (kips)

Current CAPWAP Ru = 519.8 (kips); Corresponding J(RP)= 0.58; J(RX) = 0.70

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
15.5	36.02	720.6	699.0	720.8	0.49	0.06	0.06	21.2	917.4	1938

PILE PROFILE AND PILE MODEL

Depth ft	Area in^2	E-Modulus ksi	Spec. Weight lb/ft^3	Perim. ft
0.0	26.1	30000.0	492.000	4.75
47.7	26.1	30000.0	492.000	4.75

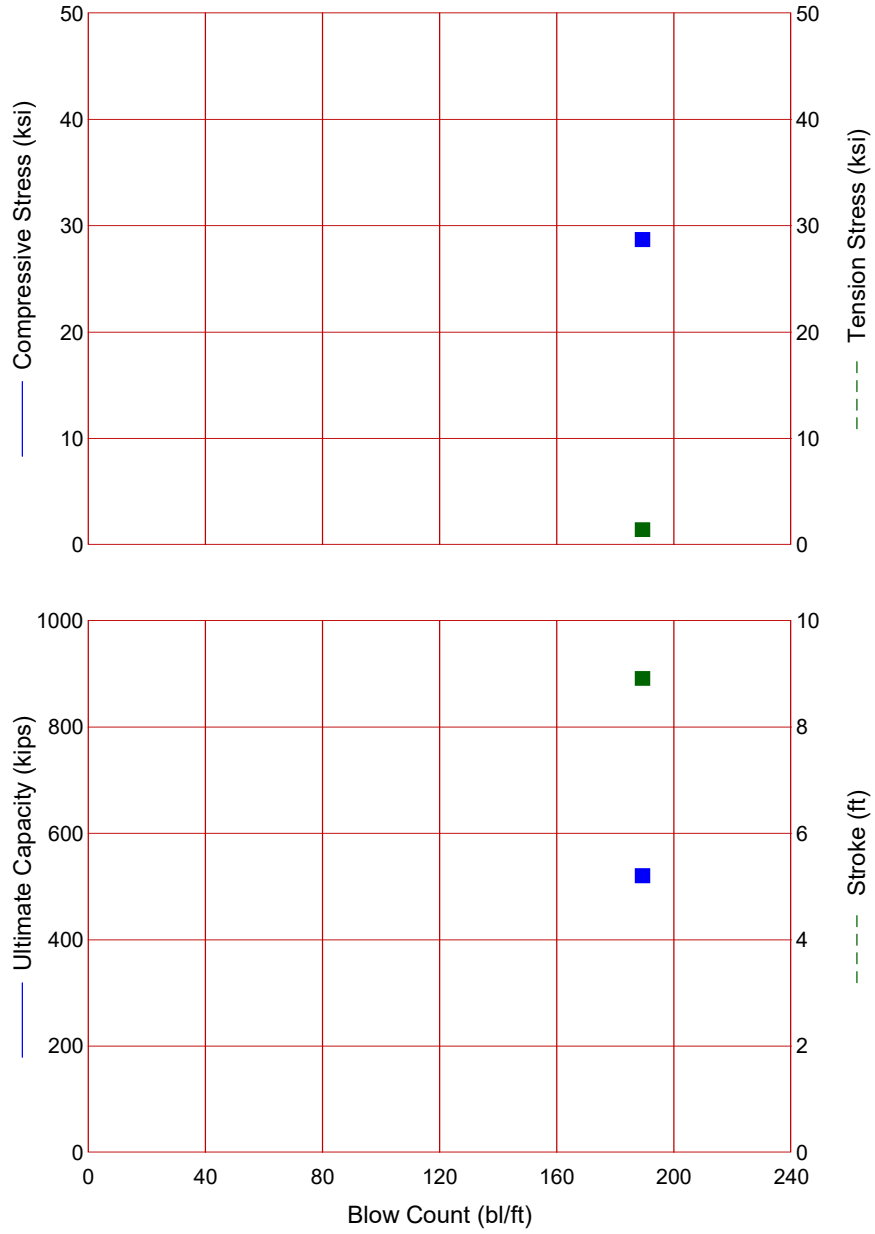
Toe Area 203.2 in^2

Top Segment Length 4.77 ft, Top Impedance 47 kips/ft/s

Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16807.9 ft/s
Pile Damping 1.00 %, Time Incr 0.284 ms, 2L/c 5.7 ms
Total volume: 8.640 ft^3; Volume ratio considering added impedance: 1.000

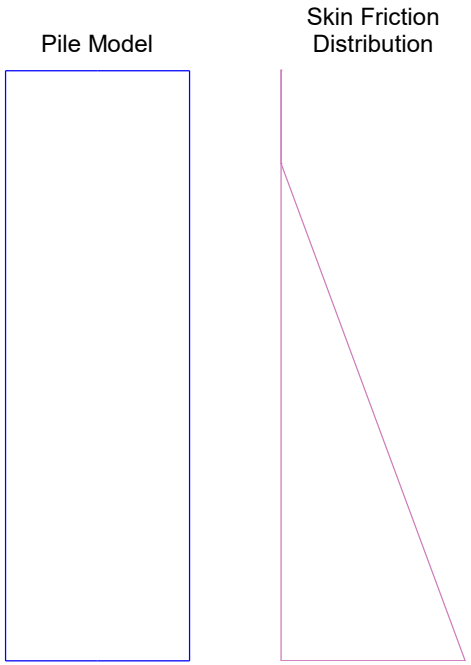
ICE of Carolinas, PLLC
CCR 1 Bridge 36 BT4 Pl 11 EOD CAL

20-Jan-2023
GRLWEAP Version 2010



ICE I-19v2

Ram Weight	4.01	kips
Efficiency	0.950	
Pressure	1431 (90%)	psi
Helmet Weight	2.31	kips
Hammer Cushion	34825	kips/in
COR of H.C.	0.900	
Skin Quake	0.230	in
Toe Quake	0.120	in
Skin Damping	0.190	s/ft
Toe Damping	0.070	s/ft
Pile Length	50.00	ft
Pile Penetration	42.10	ft
Pile Top Area	26.10	in2



Res. Shaft = 55 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
520.0	28.69	1.40	189.3	8.91	20.61

Appendix B

Pile Driving Criteria

Bent 4

Recommended Production Pile Driving Criteria

The recommended drive criteria for the up to 50.0 feet long HP 14x89 steel piles in Bent 4 is based on the wave equation analysis and the dynamic testing results. Please see the attached wave equation outputs for additional information.

The driving criteria also only apply to piles driven with the ICE I-19v2 hammer driving system. A hammer helmet weight of 2.3 kips and a hammer cushion of 2.0 total inches of nylon, based on the project pile installation plan, was used to develop the production pile driving criteria. A change in the hammer driving system, installation procedures, and/or pile type would require re-analysis and likely would warrant modifications to the driving criteria. ICE should be notified immediately should any changes occur.

Bent 4

The up to 50.0 foot HP 14x89 steel piles at Bent 4 may be stopped if one of the following conditions is met, provided pile rebound is less than ¼ inch per blow and the minimum tip elevation or minimum penetration requirements in the project plans and/or specifications are met.

1. Practical refusal (20 blows per one inch or ½ inch in 10 blows with at least a stroke of 7.5 feet) is reached during driving.
2. The following maximum set per 10 blows is not exceeded for the respective stroke during driving:

Stroke (feet)	Maximum Set in inches per 10 blows	Minimum Blows Per Foot
8.0	3/4	160
8.5	1	120
9.0	1-1/8	107
9.5 or greater	1-1/4	96

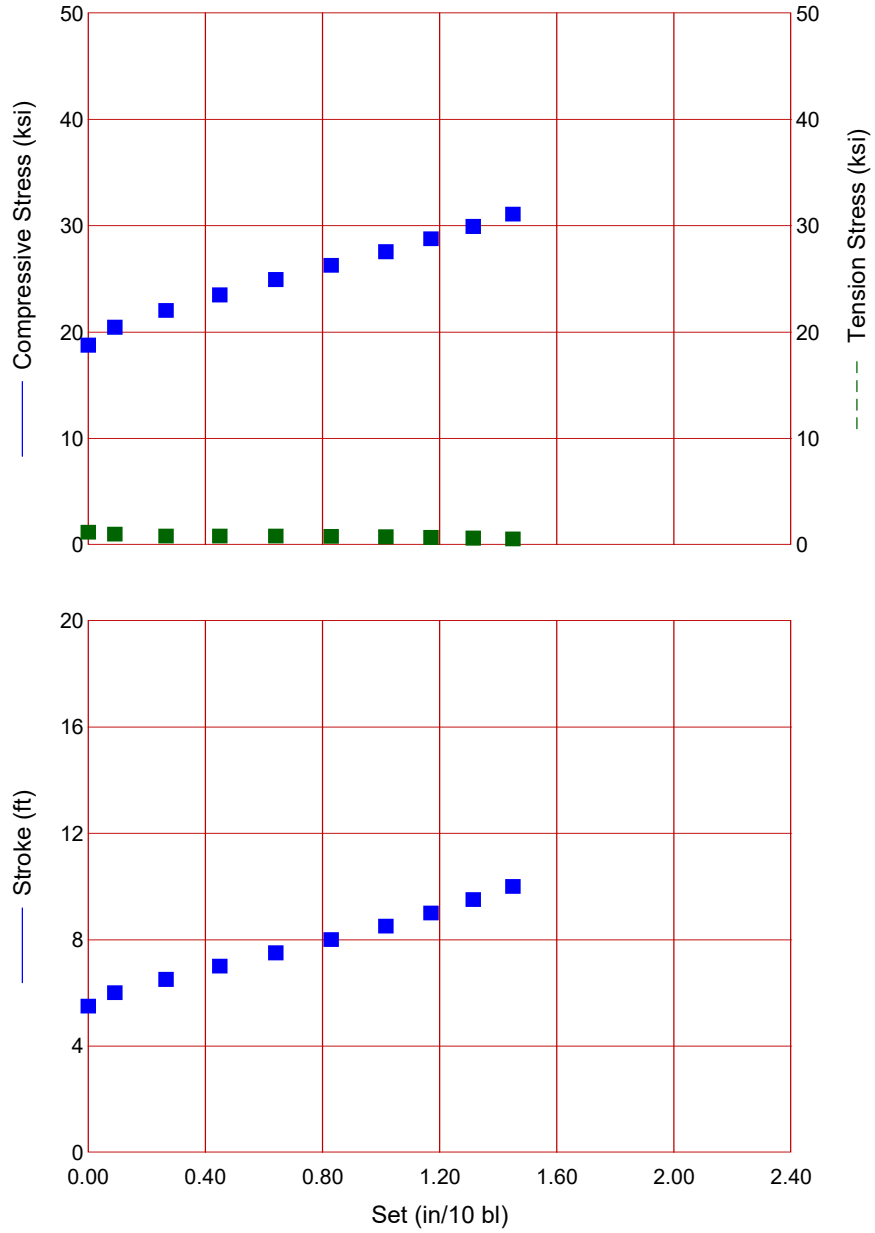
Piles not meeting the above requirements should be brought to the Engineer's attention and may require additional testing and/or driving to meet the requirements.

Limitations

This report presents test measurement made by ICE. Interpretations were made based upon the measurements made by ICE with the latest techniques available and currently accepted standards of care recognized by Geotechnical Engineering professionals. The Geotechnical Engineer of Record should ultimately make final recommendations for foundation design and construction.

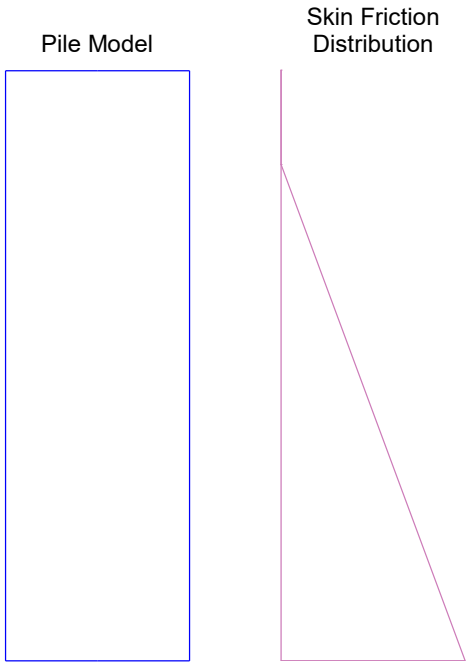
ICE of Carolinas, PLLC
CCR 1 Bridge 36 Bent 4 Criteria

23-Jan-2023
GRLWEAP Version 2010



ICE I-19v2

Capacity	420.0	kips
Ram Weight	4.01	kips
Efficiency	0.950	
Pressure	1431 (90%)	psi
Helmet Weight	2.31	kips
Hammer Cushion	34825	kips/in
COR of H.C.	0.900	
Skin Quake	0.250	in
Toe Quake	0.150	in
Skin Damping	0.200	s/ft
Toe Damping	0.080	s/ft
Pile Length	50.00	ft
Pile Penetration	42.00	ft
Pile Top Area	26.10	in2



Res. Shaft = 55 %
(Proportional)

ICE of Carolinas, PLLC
CCR 1 Bridge 36 Bent 4 Criteria

23-Jan-2023
GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Set in/10 bl	Stroke ft	Energy kips-ft
420.0	18.76	1.18	0.0	5.50	9.08
420.0	20.44	1.00	0.1	6.00	10.79
420.0	22.03	0.80	0.3	6.50	12.53
420.0	23.48	0.81	0.5	7.00	14.29
420.0	24.93	0.81	0.6	7.50	16.10
420.0	26.27	0.78	0.8	8.00	17.91
420.0	27.54	0.73	1.0	8.50	19.75
420.0	28.76	0.67	1.2	9.00	21.33
420.0	29.92	0.61	1.3	9.50	22.86
420.0	31.06	0.54	1.5	10.00	24.34

Appendix C

Project Information and Nearby Soil Borings

BRIDGE PLANS ID	SHEET NO.
P039718-B36	17

34+00 35+00 36+00 37+00 38+00

* 1'-0" MASH BARRIER WITH 1½" SLAB EXTENSION

℄ S-287 (ARROWWOOD RD.)

FACE OF BARRIER

EXIST. 6" DIP

EXIST. WATER LINE

S-287 (ARROWWOOD RD.) N 34°05'50" W

203+00

LIMITS OF 4" CONC. SLOPE PROTECTION (TYP.)

PROPOSED DRAINAGE SEE ROADWAY PLANS (TYP.)

ROADWAY BARRIER. SEE ROADWAY PLANS.

2'-6"

G-066 A

G-066

B-042

END BRIDGE STA. 36+14.51

℄ BENT 3 STA. 34+14.51

℄ BENT 4 STA. 35+34.51

MIN. VERTICAL CLR. (F)

DECK DRAIN (TYP.)

1'-1½"*

36-BT 3 LT

36-BT 3 RT

EXP. JT.

56'-3" OUT-TO-OUT

54'-0" CLEAR ROWY. WIDTH

32'-0"

22'-0"

5'-0"

℄ BRIDGE

MATCH LINE STA. 34+00

(C)

(D)

90 °00'00" TO LOCAL TANGENT (TYP. U.N.O.)

36-BT 4 LT

36-BT 4 RT

EXP. JT.

G-065

PCC STA. 35+66.38

202+00

APPROACH SLAB NO. 2

36-EB 5 LT

G-078

DEF. JT.

36-EB 5 RT

20'-0" SHLDR.

12'-0" LANE

12'-0" LANE

10'-0" SHLDR.

36-EMBK 2

TO BUSH RIVER ROAD

℄ RAMP B

END APPR. SLAB STA. 36+34.51

ROADWAY BARRIER. SEE ROADWAY PLANS.

EXIST. GAS LINE TO BE RELOCATED

MSE WALL NO. 2

EXIST. SIDEWALK (E) G-088

EXIST. WATER LINE TO BE RELOCATED

G-063

2 LANES VARIES

EXIST. OVER HEAD ELEC. TO BE RELOCATED

EXIST. FIBER OPTIC CABLE

UNKNOWN UTILITY

TIE EQUALITY
STA. 35+81.35 ℄ RAMP B =
STA. 202+28.48 ℄ S-287 (ARROWWOOD RD.)

EXIST. GAS SERVICE LINE TO BE REMOVED

EXIST. OVER HEAD ELECTRICAL

PROPOSED PAVED DITCH

PROPOSED ITS LINE

RIGID BARRIER. SEE ROADWAY PLANS

HORIZONTAL CURVE DATA

CURVE COLRB-4
P.I. = 38+17.42
Δ = 35° 40' 54.27" (LT)
D = 7° 20' 44.21"
T = 251.04'
L = 485.76'
E = 39.40'
R = 780.00'
D.S. = 40 MPH
eMAX = 8.0%
e = 6.8%

PLAN

NOTES:

U.N.O. = UNLESS NOTED OTHERWISE.

DECK DRAINS AS NOTED.

SKEW ANGLE AT END BENT 5 IS MEASURED AT END BRIDGE.

(C) 27'-4½" MIN. HORIZONTAL CLEARANCE

(D) 21'-4 13/16" MIN. HORIZONTAL CLEARANCE

(E) EXISTING SIDEWALK TO REMAIN OR BE RECONSTRUCTED. SEE ROADWAY PLANS.

(F) STA. 35+61.83, OFFSET = 30' LT. (℄ RAMP B)
EXISTING ARROWWOOD PAVEMENT ELEV. 218.657

TEST BORING LOCATIONS

BORING	STATION	OFFSET
B-042	35+92.76	53.3' LT.
G-078	36+36.11	11.1' LT.
G-088	36+57.90	78.6' RT.
G-063	36+09.00	87.0' RT.
G-065	35+70.00	13.0' LT.
G-066	36+31.02	63.7' LT.
G-066 A	36+20.39	62.7' LT.
36-BT 3 LT	34+24.00	21.0' LT.
36-BT 3 RT	34+18.00	8.0' RT.
36-BT 4 LT	35+30.00	20.0' LT.
36-BT 4 RT	35+34.00	18.0' RT.
36-EB 5 LT	36+30.73	23.0' LT.
36-EB 5 RT	36+35.14	10.0' RT.
36-EMBK 2	36+91.29	19.4' LT.

STATIONS AND OFFSETS ARE REFERENCED TO PROPOSED ℄ RAMP B.

586'-0" TOTAL LENGTH (4 SPAN STEEL GIRDER BRIDGE)

386'-0" TWO SPAN CONTINUOUS UNIT 1 | 120'-0" SINGLE SPAN UNIT 2 | 80'-0" SINGLE SPAN UNIT 3

167'-0" SPAN B | 120'-0" SPAN C | 80'-0" SPAN D | 20'-0" APPR. SLAB NO. 2

EXP. JT. (STRIP SEAL)

EXP. JT. (COMPRESSION SEAL)
MIN. VERT. CLR.
16'-0" REQUIRED
16'-0 3/8" PROPOSED

VPT STA. 34+11.00 ELEV. 231.89

℄ BENT 3 STA. 34+14.51 ELEV. 232.101

VPC STA. 35+11.00 ELEV. 237.89

℄ BENT 4 STA. 35+34.51 ELEV. 239.238

℄ END BENT 5 STA. 36+13.18 ELEV. 242.845

1'-4" END BRIDGE (DEFL. JT.) STA. 36+14.51 ELEV. 242.894

END APPR. SLAB STA. 36+34.51 ELEV. 243.582

FINISHED GRADE

BARRIER PARAPET NOT SHOWN

MSE WALL NO. 2

4'-0" DIA. COLUMN (TYP.)

PROPOSED GROUND LINE

HP14X117 STEEL PILES ENCASED THRU MSE WALL BACKFILL

APPROX. EXIST. GROUND LINE

℄ S-287 (ARROWWOOD RD.)

EXIST. SIDEWALK

(E) RIGID BARRIER ADJACENT TO WALL (TL4)

HP14X89 STEEL PILES (TYP.)

EST. PILE TIP ELEV. 165.000

EST. PILE TIP ELEV. 169.000

EST. PILE TIP ELEV. 138.000

BENT NO. ➡ 3 4 5

(G) 61'-7 9/16" MIN. HORIZONTAL CLEARANCE

E = EXPANSION
F = FIXED
I = INTEGRAL

280 260 240 220 200 180 160 140 120 100

34+00 35+00 36+00 37+00 38+00

SECTION ALONG ℄ RAMP B

(+) 6.000% (+) 0.819%

VPI = 36+26.00
ELEV. = 244.79

VPC STA. 35+11.00 ELEV. 237.89

V.C. = 230'

VPT STA. 37+41.00 ELEV. 245.73

VERTICAL GRADE DATA

280 260 240 220

ARCHER UNITED JOINT VENTURE UNITED INFRASTRUCTURE GROUP

INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 26987 J. PRESTON FELKEL

INFRASTRUCTURE CONSULTING & ENGINEERING, PLLC No. 4470 CERTIFICATE OF AUTHORIZATION

J. Preston Felkel 2022.09.01 13:54:59-04'00'

REV. 0	JPF	09-01-22	RFC PLANS
REV. 1			
REV.			
REVIEWED	J. FELKEL		
QUAN.			
DR.	BFS	DKY	04-22
DES.	CSB	DKY	04-22
	BY	CHK.	DATE

BRIDGE PLAN AND PROFILE (2)

COLONIAL LIFE BLVD. RAMP B BRIDGE OVER I-126, I-126 RAMP & S-287 (ARROWWOOD ROAD)

COUNTY RICHLAND | ROUTE RAMP B

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9/1/2022
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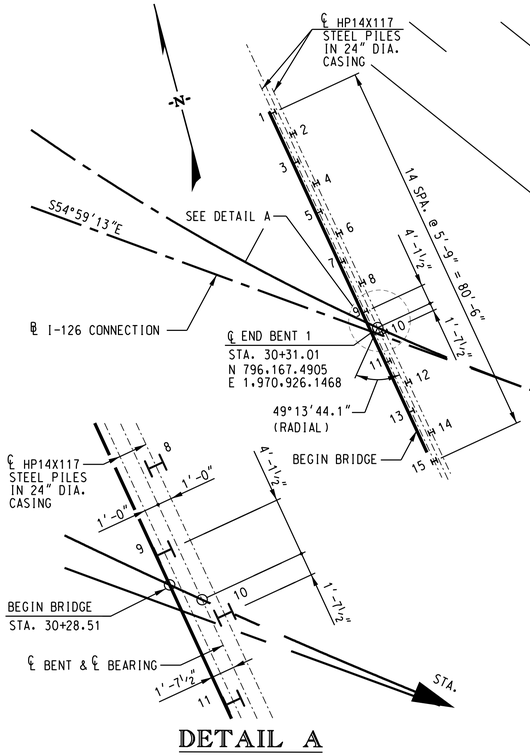
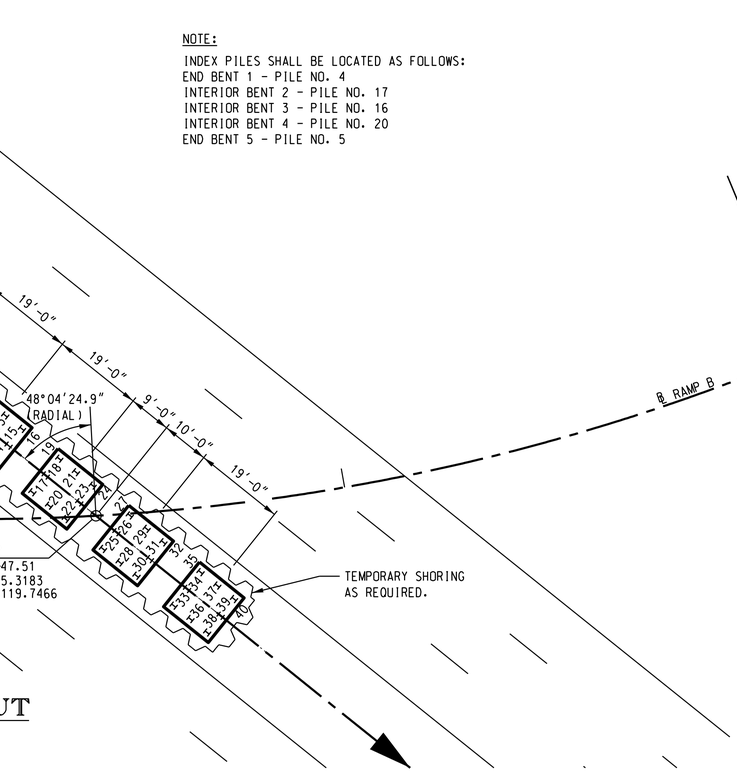
BRIDGE PLANS ID	SHEET NO.
P039718-B36	27



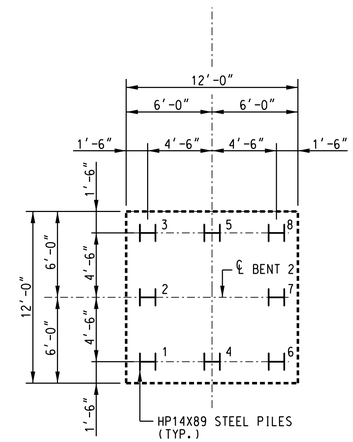
DETAIL A



FOUNDATION LAYOUT

NOTE:

INDEX PILES SHALL BE LOCATED AS FOLLOWS:
END BENT 1 - PILE NO. 4
INTERIOR BENT 2 - PILE NO. 17
INTERIOR BENT 3 - PILE NO. 16
INTERIOR BENT 4 - PILE NO. 20
END BENT 5 - PILE NO. 5



TYPICAL PILE LAYOUT AT BENT 2

FOOTING NO. 1 SHOWN.
FOOTING NO. 2 THRU 5 SIMILAR

GENERAL NOTES - PILE BEARING:

BENT I.D.	END BENT 1	INT. BENT 2	INT. BENT 3	INT. BENT 4	END BENT 5
PILE SECTION	HP14X117	HP14X89	HP14X89	HP14X89	HP14X117
CONTROL LIMIT STATE	STRENGTH	STRENGTH	STRENGTH	STRENGTH	STRENGTH
FACTORED DESIGN LOAD (KIPS)	477	360	345	273	338
GEOTECHNICAL RESISTANCE FACTOR	0.65	0.65	0.65	0.65	0.65
NOMINAL RESISTANCE (KIPS)	734	554	531	420	520
LIQUEFACTION INDUCED DOWNDRAG (KIPS)	0	0	0	0	0
SETTLEMENT INDUCED UNFACTORED DOWNDRAG (KIPS)	0	0	0	0	0
SETTLEMENT INDUCED FACTORED DOWNDRAG (KIPS)	0	0	0	0	0
REQUIRED DRIVING RESISTANCE (KIPS)	734	554	531	420	520
REQUIRED MINIMUM TIP ELEVATION TO ACHIEVE LATERAL STABILITY (FEET MSL)	164	156	163	187	202
ESTIMATED PILE TIP ELEVATION (FEET MSL)	159	152	138	165	169

Initially drive End Bent 1 and End Bent 5 piles to at least the required minimum tip elevation and no deeper than tip elevation 164 at End Bent 1 and 185 at End Bent 5 before MSE wall and bridge embankment construction.

Method of controlling installation of piles and verifying their resistance: Resistance and stresses will be verified by Pile Driving Analyzer (PDA) and CAPWAP analysis of index piles during driving. A Pile Installation Chart developed from the analysis will be used to verify the resistance of production piles.

Perform Pile Driving Analyzer (PDA) testing on one (1) index pile per Bent. An index pile shall be the first pile driven at each required bent location. Include an additional two feet of (HP14x117 or HP14x89) length to accommodate the initial PDA testing. If a CAPWAP analysis determines that capacity has not been achieved, restrike one of the production piles. Perform the restrike on the production pile exhibiting the least blows per foot. On initial drive, piles shall be stopped at the highest allowable finished grade on the plans to accommodate a restrike while remaining within an allowable plan finished grade elevation. Perform PDA testing during the restrike. The Geotechnical Engineer of Record will determine the time between initial driving and any required restrikes.

PDA testing is only required during final driving at End Bent 1 and End Bent 5.

Reinforced pile tips are required to penetrate partially weathered rock at all bents. Install the reinforced pile tips in accordance with the manufacturer's installation recommendations.

The top of partially weathered rock elevation may vary across each bent and result in varying pile lengths. Practical refusal of a pile is defined as 20 blows per inch.

If required minimum tip elevation cannot be achieved by driving alone, predrill pile locations at End Bent 1 to an elevation no lower than 164 feet with equipment that will result in a maximum predrilling diameter of 20". For predrilling for piles, see section 711.4.5.2 of the Standard Specifications.

Drive piles at End Bent 1 and 5 to a minimum pile movement of 0.5 inches during final driving to negate any induced downdrag loads from prior MSE wall settlement.

Reference the Standard Specifications for Highway Construction for Driven Pile Foundations, Section 711. Notes included in these plans are in addition to the requirements of the Standard Specifications.

The following estimated parameters were used for performing a drivability analysis for End Bent 1, Interior Bents 2 thru 4, & End Bent 5:

DRIVABILITY ANALYSIS

BENT I.D.	END BENT 1	INT. BENT 2	INT. BENT 3	INT. BENT 4	END BENT 5
SKIN QUAKE (QS)	0.10 in	0.10 in	0.10 in	0.10 in	0.10 in
TOE QUAKE (QT)	0.10 in	0.10 in	0.10 in	0.10 in	0.10 in
SKIN DAMPING (SD)	0.20 s/ft	0.20 s/ft	0.20 s/ft	0.20 s/ft	0.20 s/ft
TOE DAMPING (TD)	0.15 s/ft	0.15 s/ft	0.15 s/ft	0.15 s/ft	0.15 s/ft
% SKIN FRICTION	3%	15%	20%	40%	18%
DISTRIBUTION SHAPE NO.	0	0	0	0	0
PILE INSTALLATION CHART	PROPORTIONAL	PROPORTIONAL	PROPORTIONAL	PROPORTIONAL	PROPORTIONAL
PILE PENETRATION	26%	83%	86%	85%	58%
HAMMER ENERGY RANGE	60 to 90 kip-ft	40 to 80 kip-ft	40 to 80 kip-ft	40 to 80 kip-ft	40 to 80 kip-ft

Note: GRLWEAP 2010-7 was used to perform the wave equation analysis.

A pile hammer having the rated energy as indicated above is considered suitable for driven pile installation. However, final hammer approval is based on a wave equation analysis that accurately reflects the Contractor's proposed driving system.

The Contractor shall retain a geotechnical engineering firm to perform the pre-construction condition assessment and Earth-borne Vibration Monitoring in accordance with the RFP.

SCDOT Supplemental Technical Specification SC-M-713 (01/19) shall apply to the project except as modified herein.

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 26987 J. PRESTON FELKEL

SOUTH CAROLINA INFRASTRUCTURE CONSULTING & ENGINEERING, PLLC No. 4470 CERTIFICATE OF AUTHORIZATION

2022.09.01 13:57:04-04'00'

REV.	JPF	09-01-22
0	RFC PLANS	
REV. 1		
REV.		
REVIEWED	J. FELKEL	
QUAN.		
DR.	BFS	DKY 05-22
DES.	VD	DVW 05-22
	BY	CHK. DATE

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JE INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

FOUNDATION LAYOUT (1)

COLONIAL LIFE BLVD. RAMP B BRIDGE OVER I-126, I-126 RAMP & S-287 (ARROWWOOD ROAD)

COUNTY RICHLAND | ROUTE RAMP B

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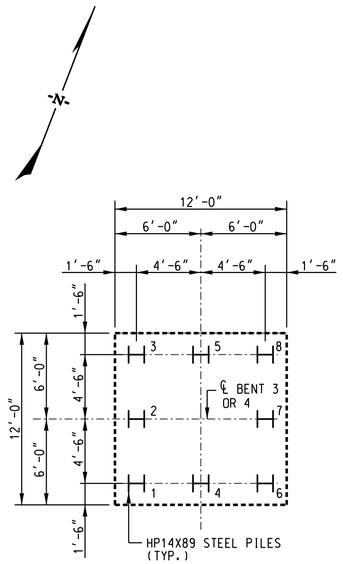
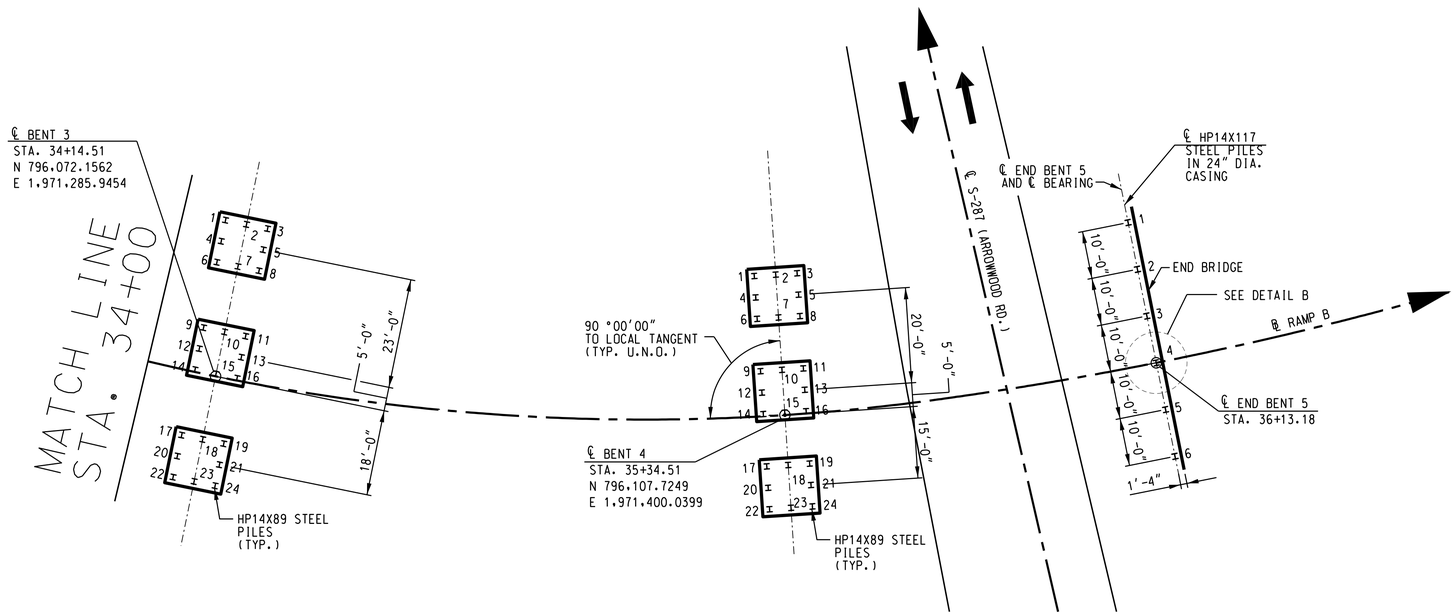
BRIDGE PLANS ID	SHEET NO.
P039718-B36	28

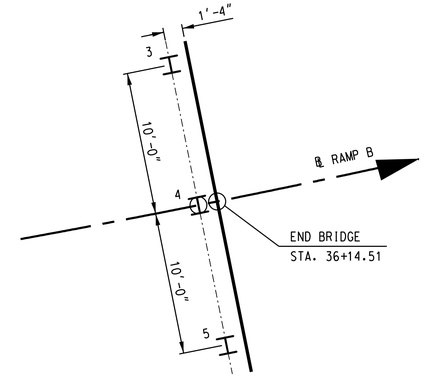


TYPICAL PILE LAYOUT AT BENT 3 AND 4

FOOTING NO. 1 SHOWN.
FOOTING NO. 2 AND NO.3 SIMILAR



FOUNDATION LAYOUT



DETAIL B

Temporary Shoring Notes:

Designer shall determine appropriate water level and consider all unbalanced water forces in design. Design shall accommodate live loading. Use the following soil strength parameters for determining earth pressure coefficients.

Temporary Shoring Wall Soil Design Parameters

	Elevation Top/Bottom	Stress State	Internal Friction, φ (deg)	Cohesion, c (psf)
Roadway Embankment/ Alluvial	189	Total	0	500
	176	Effective	32	0
Coastal Plain	176	Total	18	700
	159	Effective	34	100
Residual	159	Total	0	1800
	156	Effective	30	0

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 26987 J. PRESTON FELKEL

SOUTH CAROLINA INFRASTRUCTURE CONSULTING & ENGINEERING, PLLC No. 4470 CERTIFICATE OF AUTHORIZATION

J. Preston Felkel 2022.09.07 13:57:32-04'00'

REV.	BY	DATE
0	JPF	09-01-22
	RFC PLANS	
1		
REV.		
REVIEWED	J. FELKEL	
QUAN.		
DR.	BFS	DKY 05-22
DES.	VD	DVW 05-22

FOUNDATION LAYOUT (2)

COLONIAL LIFE BLVD. RAMP B BRIDGE OVER I-126, I-126 RAMP & S-287 (ARROWWOOD ROAD)

COUNTY RICHLAND

ROUTE RAMP B

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9/1/2022
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BRIDGE PLANS ID	SHEET NO.
P039718-B36	47

INTERIOR BENT 4

REINFORCING STEEL SCHEDULE

LOCATION	MARK	NO. REQ'D	DIMENSION					LENGTH
			"a"	"b"	"c"	"d"	"e"	
CAP	A1650	18	53'-8"	------	------	------	------	53'-8"
			------	------	------	------	------	------
FOOTING	A1951	48	3'-0"	------	------	------	------	3'-0"
FOOTING	A1952	96	11'-6"	------	------	------	------	11'-6"
			------	------	------	------	------	------
FOOTING	A3250	6	7'-2"	------	------	------	------	7'-2"
			------	------	------	------	------	------
CAP	A3650	18	53'-8"	------	------	------	------	53'-8"
			------	------	------	------	------	------
COLUMN 1	C3250	18	21'-8 1/2"	2'-0"	------	------	------	23'-8"
COLUMN 2	C3251	18	23'-1"	2'-0"	------	------	------	25'-1"
COLUMN 3	C3252	18	24'-5 1/2"	2'-0"	------	------	------	26'-5"
			------	------	------	------	------	------
CAP	J1650	18	3'-9"	4'-9"	------	------	------	13'-3"
CAP	J1651	75	2'-0"	4'-6"	------	------	------	11'-0"
CAP	J1652	10	4'-4 1/2"	1'-3"	------	------	------	6'-11"
CAP	J1653	10	4'-6 1/2"	1'-3"	------	------	------	7'-1"
FOOTING	J1654	96	2'-0"	2'-2"	------	------	------	6'-4"
BUILDUP	J1655	60	1'-8 1/4"	1'-9"	------	------	------	5'-2"
BUILDUP	J1656	24	4'-2"	1'-9"	------	------	------	7'-8"
BUILDUP	J1657	12	3'-10"	1'-9"	------	------	------	7'-4"
			------	------	------	------	------	------
FOOTING	J3250	96	11'-6"	1'-10"	------	------	------	15'-2"
			------	------	------	------	------	------
CAP	S1650	132	3'-2"	4'-8"	0'-8"	------	------	17'-0"
			------	------	------	------	------	------
COLUMN	TA1950	132	3'-8"	------	------	------	------	11'-6"
			------	------	------	------	------	------
FOOTING	V1950	48	2'-5"	------	------	------	------	4'-10"
			------	------	------	------	------	------
CAP	1 3/4" ANCHOR BOLT	24	------	------	------	------	------	2'-10"

END BENT 5

REINFORCING STEEL SCHEDULE

LOCATION	MARK	NO. REQ'D	DIMENSION					LENGTH
			"a"	"b"	"c"	"d"	"e"	
CAP	A1640	10	58'-8 1/2"	------	------	------	------	58'-9"
			------	------	------	------	------	------
CAP	A3240	12	58'-8 1/2"	------	------	------	------	58'-9"
			------	------	------	------	------	------
BT. 5 DIAPH.	B1640	144	4'-4"	0'-7"	------	------	------	4'-11"
			------	------	------	------	------	------
WINGWALL 3 & 4	C1640	16	14'-6"	0'-10"	------	------	------	15'-4"
			------	------	------	------	------	------
WINGWALL 3 & 4	C3240	16	14'-6"	1'-10"	------	------	------	16'-4"
			------	------	------	------	------	------
CAP	J1640	5	8'-3"	0'-10"	------	------	------	9'-11"
WINGWALL 3 & 4	J1641	30	0'-11"	4'-10 1/2"	------	------	------	10'-8"
BUILD-UP	J1642	30	3'-4"	1'-9"	------	------	------	6'-10"
BUILD-UP	J1643	30	3'-8"	1'-9"	------	------	------	7'-2"
			------	------	------	------	------	'-"
CAP	S1640	60	3'-8"	3'-7"	0'-8"	------	------	15'-10"
			------	------	------	------	------	------
CAP	SA1640	6	3'-8"	3'-7"	0'-7"	------	------	12'-0"
			------	------	------	------	------	------
CAP	V1940	12	2'-5"	------	------	------	------	4'-10"
			------	------	------	------	------	------
CAP	1 3/4" ANCHOR BOLT	24	------	------	------	------	------	------

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SOUTH CAROLINA PROFESSIONAL ENGINEER No. 26987 J. PRESTON FELKEL

SOUTH CAROLINA INFRASTRUCTURE CONSULTING & ENGINEERING, PLLC No. 4470 CERTIFICATE OF AUTHORIZATION

J. Preston Felkel 2022.09.01 14:08:26-04'00'

REV.	BY	CHK.	DATE
0	JPF		09-01-22
	RFC PLANS		
1			
REV.			
REVIEWED	J. FELKEL		
QUAN.			
DR.	TAC	DVW	05-22
DES.	VD	DVW	05-22

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

SUBSTRUCTURE REINFORCEMENT SCHEDULE (2)

COLONIAL LIFE BLVD. RAMP B BRIDGE OVER I-126, I-126 RAMP & S-287 (ARROWWOOD ROAD)

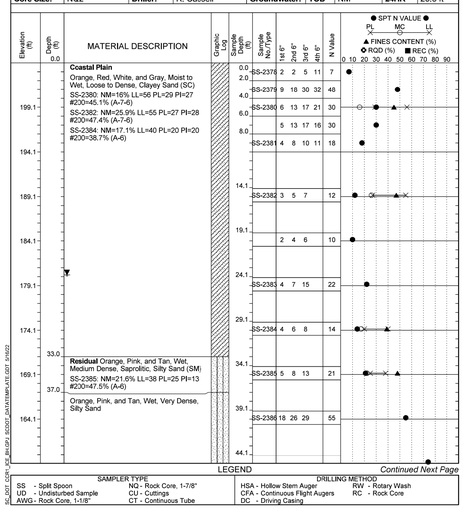
COUNTY RICHLAND

ROUTE RAMP B

BRIDGE PLANS ID	SHEET NO.
P039718-B36	21

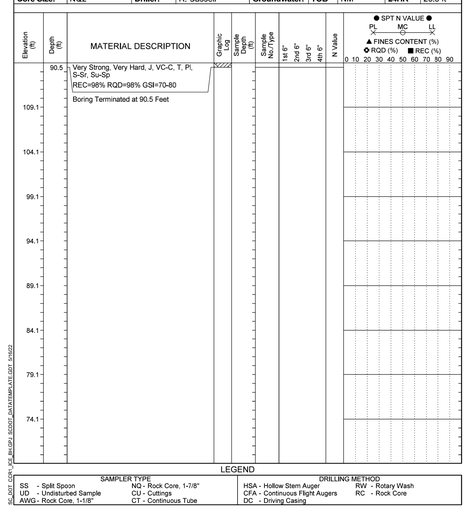
INFRASTRUCTURE CONSULTING & ENGINEERING

Project ID:	P039718	**County:**	Richland	**Boring No.:**	36-Bent 3 RT		
Site Description:	Carolina Crossroads Phase 1 - Bridge 36			**Route:**	Bridge 36		
Eng./Geo.:	CM & NM	**Boring Location:**	34+18	**Offset:**	8 RT	**Alignment:**	COLRB
Elev.:	204.1 ft	**Latitude:**	34.02129878	**Longitude:**	-81.09474778	**Date Started:**	12/9/2021
Total Depth:	90.5 ft	**Soil Depth:**	69.1 ft	**Core Depth:**	20.5 ft	**Date Completed:**	12/10/2021
Bore Hole Diameter (in):	2.25	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	D-50 #0439	**Drill Method:**	Casing w/ Adv	**Hammer Type:**	Automatic	**Energy Ratio:**	91%
Core Size:	NQ2	**Driller:**	R. Cassell	**Groundwater:**	TOB NM	**24HR**	23.8 ft



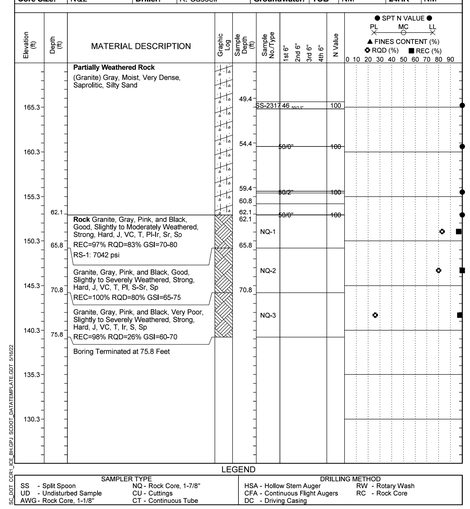
INFRASTRUCTURE CONSULTING & ENGINEERING

Project ID:	P039718	**County:**	Richland	**Boring No.:**	36-Bent 3 RT		
Site Description:	Carolina Crossroads Phase 1 - Bridge 36			**Route:**	Bridge 36		
Eng./Geo.:	CM & NM	**Boring Location:**	34+18	**Offset:**	8 RT	**Alignment:**	COLRB
Elev.:	204.1 ft	**Latitude:**	34.02129878	**Longitude:**	-81.09474778	**Date Started:**	12/9/2021
Total Depth:	90.5 ft	**Soil Depth:**	69.1 ft	**Core Depth:**	20.5 ft	**Date Completed:**	12/10/2021
Bore Hole Diameter (in):	2.25	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	D-50 #0439	**Drill Method:**	Casing w/ Adv	**Hammer Type:**	Automatic	**Energy Ratio:**	91%
Core Size:	NQ2	**Driller:**	R. Cassell	**Groundwater:**	TOB NM	**24HR**	23.8 ft



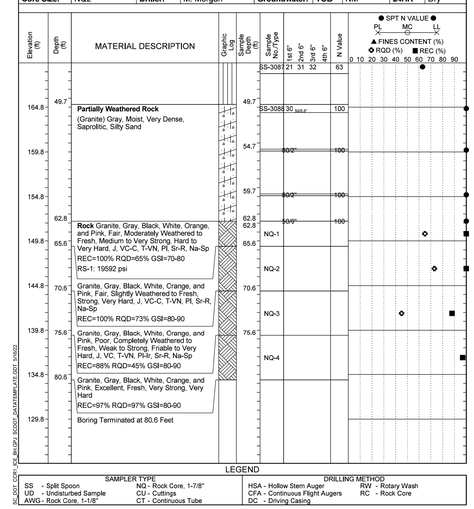
INFRASTRUCTURE CONSULTING & ENGINEERING

Project ID:	P039718	**County:**	Richland	**Boring No.:**	36-Bent 4 LT		
Site Description:	Carolina Crossroads Phase 1 - Bridge 36			**Route:**	Bridge 36		
Eng./Geo.:	CS & NM	**Boring Location:**	35+30	**Offset:**	20 LT	**Alignment:**	COLRB
Elev.:	215.3 ft	**Latitude:**	34.02146137	**Longitude:**	-81.09442741	**Date Started:**	11/22/2021
Total Depth:	75.8 ft	**Soil Depth:**	62.1 ft	**Core Depth:**	13.7 ft	**Date Completed:**	11/23/2021
Bore Hole Diameter (in):	2.25	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	D-50 #0439	**Drill Method:**	Casing w/ Adv	**Hammer Type:**	Automatic	**Energy Ratio:**	91%
Core Size:	NQ2	**Driller:**	R. Cassell	**Groundwater:**	TOB NM	**24HR**	NM



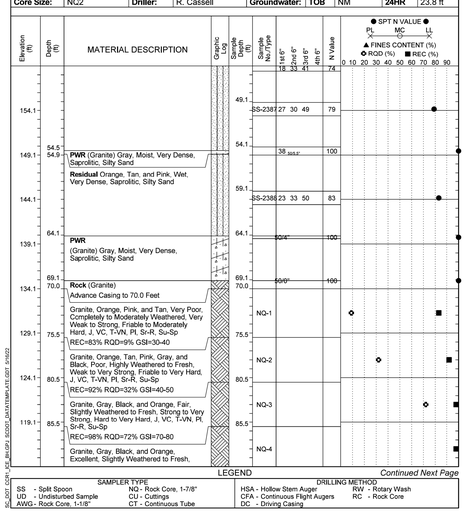
INFRASTRUCTURE CONSULTING & ENGINEERING

Project ID:	P039718	**County:**	Richland	**Boring No.:**	36-Bent 4 RT		
Site Description:	Carolina Crossroads Phase 1 - Bridge 36			**Route:**	Bridge 36		
Eng./Geo.:	CM & NM	**Boring Location:**	35+34	**Offset:**	18 RT	**Alignment:**	COLRB
Elev.:	214.8 ft	**Latitude:**	34.02137098	**Longitude:**	-81.09436322	**Date Started:**	11/22/2021
Total Depth:	80.6 ft	**Soil Depth:**	62.8 ft	**Core Depth:**	17.8 ft	**Date Completed:**	11/23/2021
Bore Hole Diameter (in):	2.25	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	D-50 #0435	**Drill Method:**	Casing w/ Adv	**Hammer Type:**	Automatic	**Energy Ratio:**	84%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	TOB NM	**24HR**	Dry



INFRASTRUCTURE CONSULTING & ENGINEERING

Project ID:	P039718	**County:**	Richland	**Boring No.:**	36-Bent 3 RT		
Site Description:	Carolina Crossroads Phase 1 - Bridge 36			**Route:**	Bridge 36		
Eng./Geo.:	CM & NM	**Boring Location:**	34+18	**Offset:**	8 RT	**Alignment:**	COLRB
Elev.:	204.1 ft	**Latitude:**	34.02129878	**Longitude:**	-81.09474778	**Date Started:**	12/9/2021
Total Depth:	90.5 ft	**Soil Depth:**	69.1 ft	**Core Depth:**	20.5 ft	**Date Completed:**	12/10/2021
Bore Hole Diameter (in):	2.25	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	D-50 #0439	**Drill Method:**	Casing w/ Adv	**Hammer Type:**	Automatic	**Energy Ratio:**	91%
Core Size:	NQ2	**Driller:**	R. Cassell	**Groundwater:**	TOB NM	**24HR**	23.8 ft



INFRASTRUCTURE CONSULTING & ENGINEERING

Project ID:	P039718	**County:**	Richland	**Boring No.:**	36-Bent 4 LT		
Site Description:	Carolina Crossroads Phase 1 - Bridge 36			**Route:**	Bridge 36		
Eng./Geo.:	CS & NM	**Boring Location:**	35+30	**Offset:**	20 LT	**Alignment:**	COLRB
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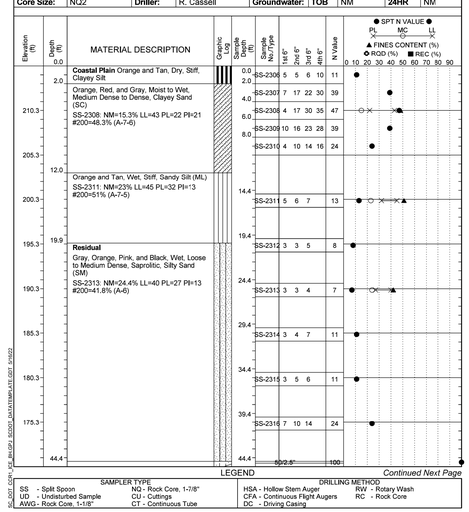
Bore Hole Diameter (in):	2.25	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	D-50 #0439	**Drill Method:**	Casing w/ Adv	**Hammer Type:**	Automatic	**Energy Ratio:**	91%
Core Size:	NQ2	**Driller:**	R. Cassell	**Groundwater:**	TOB NM	**24HR**	NM



INFRASTRUCTURE CONSULTING & ENGINEERING

Project ID:	P039718	**County:**	Richland	**Boring No.:**	36-Bent 4 RT		
Site Description:	Carolina Crossroads Phase 1 - Bridge 36			**Route:**	Bridge 36		
Eng./Geo.:	CM & NM	**Boring Location:**	35+34	**Offset:**	18 RT	**Alignment:**	COLRB
Elev.:	214.8 ft	**Latitude:**	34.02137098	**Longitude:**	-81.09436322	**Date Started:**	11/22/2021
Total Depth:	80.6 ft	**Soil Depth:**	62.8 ft	**Core Depth:**	17.8 ft	**Date Completed:**	11/23/2021
Bore Hole Diameter (in):	2.25	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	D-50 #0435	**Drill Method:**	Casing w/ Adv	**Hammer Type:**	Automatic	**Energy Ratio:**	84%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	TOB NM	**24HR**	Dry

ARCHER UNITED JOINT VENTURE — UNITED INFRASTRUCTURE GROUP

INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

FOR INFORMATION ONLY

REV.	BY	CHK.	DATE
0	JPF		09-01-22
	RFC PLANS		
1			
REVIEWED	J. FELKEL		
QUAN.			
DR.	BFS	DKY	05-22
DES.	DKY	CSB	05-22

BORING LOGS (4)

COLONIAL LIFE BLVD. RAMP B BRIDGE OVER I-126, I-126 RAMP & S-287 (ARROWWOOD ROAD)

COUNTY: RICHLAND

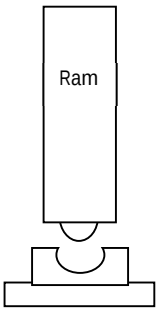
ROUTE: RAMP B

T:\Projects\20-6\CCR Phase 1\Structures\BR_36\FinalPlans\2LBRIDGE 36_BORING LOGS (4).dgn
9/1/2022
10:00:59 AM

Appendix D

Pile Driving Hammer Information

County:	Lexington/Richland	Bridge Plans ID:	P039718
Route:	I- S-2963 Road Colonial Life Blvd. Ramp B Bridge		
Description:	Carolina Crossroads Phase 1 Bridge 36		
Contractor:	Archer United		



Hammer

Manufacturer:	ICE			Model:	I-19		
Type:	Single Act Diesel			Serial No.	TBD		
Rated Energy (k-ft)	46.17	at	11.5	Length of stroke (ft)			
Lead Size (in):	26						
Modifications:	None						

Note: Attach any hammer modification specifications. Manufacturer's Specifications may be required if hammer is not found in Wave Equation database.

Date of Last Maintenance:	TBD
Type of Maintenance:	TBD
Performed By:	TBD

Striker Plate

Weight (kips):	.46		
Diameter (in):	22.5	Thickness (in):	4

Hammer Cushion

Description:				
	Material Description	No. of Layers	Modulus of Elasticity (ksi)	Thickness (in)
1	MC-904 Blue Nylon	1	175	2
2				
Area (sq. in):	398	Total Thickness (in)		2.0
Coefficient of Restitution:	.90			

Pile Cap (Helmet)

Dimension:	DCB-1 Drive Cap & DCH-1 Cap Insert
Pile Cap Weight (kips):	1.065
Inserts Weight (kips):	.78

Pile Cushion

Material:	N/A		
Thickness (in.)	N/A	Area (sq. in):	N/A
Modulus of Elasticity (ksi):	N/A		
Coefficient of Restitution:	N/A		

Pile

Pile Type/Size & Pile Point:	HP 14X89 and HP14X117 14X89 & 14X117 Reinf. Pile Tips		
Total Pile & Point Length (ft):	BR36 IB2 – 31 IB3 – 43.5 IB4 – 44 EB5 - 67	Exposed Pile Point Length (ft):	N/A
Pile Cross-Sectional Area (sq.in):	26.1		
Pipe Pile Wall Thickness (in):	N/A		
Pile Tip Description:	Welded Reinf. Tip		
Splice Description:	Bevel butt weld per SCDOT Specs		
Splice Location From Pile Top (ft):	N/A		

Appendix E

Instrumentation Calibrations

Accelerometer Calibration Certificate
Pile Dynamics, Inc.

Calibrated by Pile Dynamics, Inc.
Calibration performed on OCT 2 2 2021

Serial No:	K12388	**Temperature:**	22.6 °C
Model:	PR	**Humidity:**	44%
Calibrated on:	Channel 3 on 8G 5161 LE		

Ref Acc 1:	69132! 960 g's/volt	**Cal on:**	09Feb2021
Ref Acc 2:	69096! 978 g's/volt	**Cal on:**	27Jan2021

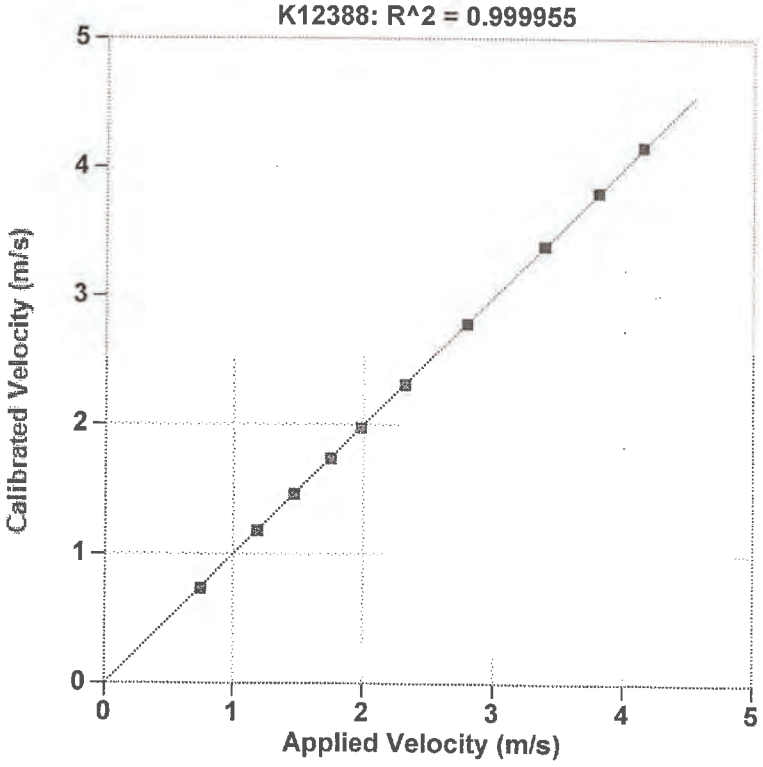
Reference accelerometer calibrations are traceable to the United States National Institute of Standards and Technology (NIST).

PDA CALIBRATION FACTOR

451.0 mv/5000g
(90.2 µv/g)
R^2: 0.999955 [Chip programmed]

Operator: William Johnson

Signed



Reference Velocity	S/N K12388 Velocity
m/s	m/s
0.741	0.734
1.184	1.178
1.464	1.459
1.744	1.739
1.980	1.976
2.319	2.306
2.790	2.783
3.384	3.388
3.798	3.805
4.147	4.158

Maximum Acceleration: 919 g's

Accelerometer Calibration Certificate
Pile Dynamics, Inc.

Calibrated by Pile Dynamics, Inc.
Calibration performed on OCT 2 2 2021

Serial No:	K12389	**Temperature:**	22.8 °C
Model:	PR	**Humidity:**	44%
Calibrated on:	Channel 3 on 8G 5161 LE		

Ref Acc 1:	69132! 960 g's/volt	**Cal on:**	09Feb2021
Ref Acc 2:	69096! 978 g's/volt	**Cal on:**	27Jan2021

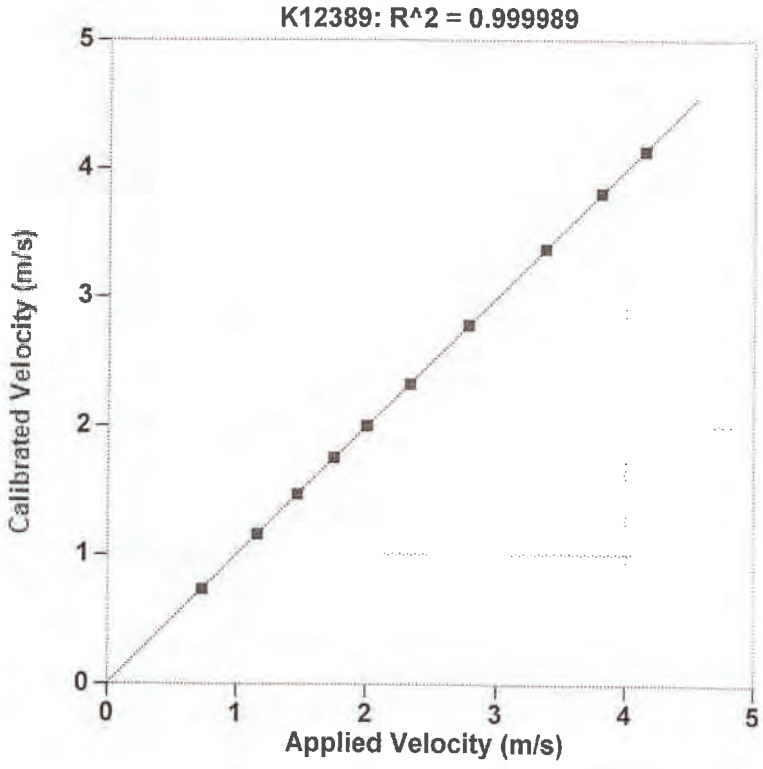
Reference accelerometer calibrations are traceable to the United States National Institute of Standards and Technology (NIST).

PDA CALIBRATION FACTOR

483.2 mv/5000g
(96.6 µv/g)
R^2: 0.999989 [Chip programmed]

Operator: William Johnson

Signed



Reference Velocity	S/N K12389 Velocity
m/s	m/s
0.730	0.728
1.158	1.158
1.470	1.471
1.748	1.755
2.001	2.004
2.330	2.326
2.780	2.782
3.372	3.373
3.803	3.807
4.144	4.137

Maximum Acceleration: 914 g's

Certificate of Calibration

Pile Dynamics, Inc.

Transducer Model: PDI Transducer

Serial Number: P821

PDI Gage Factor: 145.1 me/V

General Gage Factor: 503.9 me/mV/Vext

Initial Offset Voltage 0.006 mV/Vext

[illegible]

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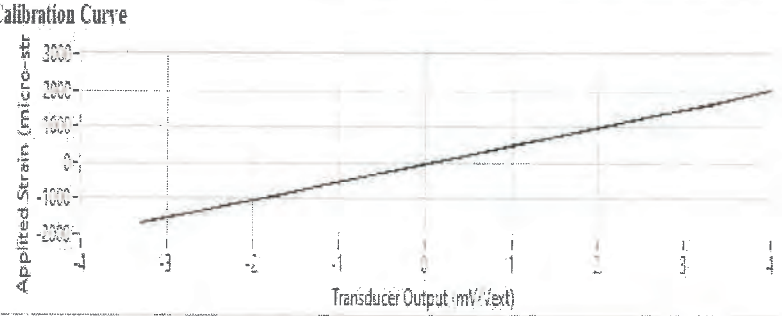
Calibration Curve



Mean Linear Correlation Coefficient (LCC): 0.999973

LCC Standard Deviation: 1.354270E-6

Calibrated By: DJC

Signature:

Date and Time: 9/9/2021 8:53 AM

Temperature (Degrees C): 24.2

Certificate of Calibration

Transducer Model: PDI Transducer

Pile Dynamics, Inc.

Serial Number: S868

PDI Gage Factor: 145.1 me/V

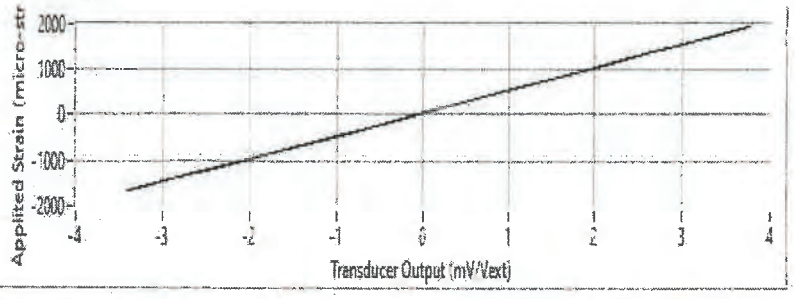
General Gage Factor: 503.9 me/mV/V$_{ext}$

Initial Offset Voltage: -0.058 mV/V$_{ext}$

Table 1. Representative Calibration Data

Applied Strain (micro-strain)	Transducer Output (mV/Vext)	Applied Strain (micro-strain)	Transducer Output (mV/Vext)
17.468	-0.059	166.844	0.227
-126.729	-0.284	451.162	0.797
-418.764	-0.925	751.082	1.404
-668.733	-1.425	1070.886	2.039
-917.547	-1.918	1386.164	2.657
-1166.458	-2.414	1690.648	3.278
-1411.172	-2.896	1982.867	3.769
-1620.474	-3.307	1899.336	3.660
-1676.977	-3.409	1574.565	3.030
-1601.650	-3.250	1251.019	2.389
-1367.026	-2.824	945.462	1.791
-1100.829	-2.290	663.515	1.225
-831.346	-1.752	409.555	0.711
-582.670	-1.223	164.516	0.224
-303.691	-0.709	17.951	-0.057
-29.718	-0.165	17.211	-0.059

Calibration Curve



Mean Linear Correlation Coefficient (LCC): 0.999993

LCC Standard Deviation: 1.772938E-6

Calibrated By: DJC

Signature: DJC

Date and Time: 2/10/2021 7:16 AM

Temperature (Degrees C): 25.2

Specifications

PDI Automated Strain Transducer Calibration System (PDI - ASTCS)

ASTCS Serial Number:	PDI CAL 2015-02
ASTCS Software Version Number:	3.001
ASTCS Independant Verification Date:	9/22/2015 1:48 PM
Transducer Gage Length:	3 inches (76.2 mm)
Full Scale Displacement Range:	+/- 0.0075 (inches)
Method for Applying Displacement:	Precision Stepper Motor Connected to Linear Stage
Excitation Voltage for Calibration:	2.5 VDC
Displacement Measurements:	Dual Precision LVDTs, Output Averaged
Displacement Certification:	NIST 274437-07
Linearity Verification Technique:	Linear Correlation Coefficient < 0.9996
Repeatability Verification Technique	Standard Deviation < 0.5% of mean

ASTCS System Check

Reference Strain Transducer:	B5580
Reference General Gage Factor:	529.70 micro-strain/mv/V
LVDT #1 Sensitivity (inches/volt):	0.0079
LVDT #2 Sensitivity (inches/volt):	0.0081
System Temperature Status	Passed
Date/Time of Last System Check	9/22/2015 1:48 PM

PDI Strain Transducer Connections

Black	Excitation +
Green	Excitation -
Red	Signal +
White	Signal -
Grey BARE	Shield

NIST Reference:

PDI certifies the above PDI-ASTCS instrument meets or exceeds published specifications and has been verified using standards and instruments whose accuracies are traceable to the National Institute of Standards and Technology (NIST), an accepted value of a natural physical constant or a ratio calibration technique. The calibration of this instrument was performed in accordance with the PDI Quality Assurance program. Measurements and information provided on this report are valid at the time of calibration only.

Appendix F

PDA Proficiency Certifications

PDCA
PILE DRIVING CONTRACTORS ASSOCIATION

Pile Dynamics, Inc.

This documents that

Sally Thomson
Infrastructure Consulting Engineering

has on August 11, 2021 achieved the rank of

ADVANCED

on the **Dynamic Measurement and Analysis Proficiency Test**.

The individual identified on this document demonstrated to the degree granted above an understanding of theory, data quality evaluation, interpretation and signal matching for high strain dynamic testing of deep foundations. ***It is recommended*** **that Individuals at the Advanced level seek Master or Expert levels through additional study within six years of the date of this document.**

The ability of the individual named to provide appropriate knowledge and advice on a specific project is not implied or warranted by the Pile Driving Contractors Association or Pile Dynamics, Inc. **This certificate can be verified at www.PDAproficiencytest.com.** The Pile Driving Contractors Association or Pile Dynamics, Inc. assumes no liability for foundation testing and analysis work performed by the bearer of this certificate.

Frank T. Peters, Executive Director
Pile Driving Contractors Association

SEAL
OHIO

Garland Likins, Senior Partner
Pile Dynamics, Inc.

No. 3139

PDCA
PILE DRIVING CONTRACTORS ASSOCIATION

Pile Dynamics, Inc.

This documents that

Michael Simpson
Infrastructure Consulting & Engineering

has on August 25, 2021 achieved the rank of

ADVANCED

on the Dynamic Measurement and Analysis Proficiency Test.

The individual identified on this document demonstrated to the degree granted above an understanding of theory, data quality evaluation, interpretation and signal matching for high strain dynamic testing of deep foundations. ***It is recommended*** **that Individuals at the Advanced level seek Master or Expert levels through additional study within six years of the date of this document.**

The ability of the individual named to provide appropriate knowledge and advice on a specific project is not implied or warranted by the Pile Driving Contractors Association or Pile Dynamics, Inc. **This certificate can be verified at www.PDAproficiencytest.com.** The Pile Driving Contractors Association or Pile Dynamics, Inc. assumes no liability for foundation testing and analysis work performed by the bearer of this certificate.

Frank T. Peters, Executive Director
Pile Driving Contractors Association

SEAL
1972
OHIO

Garland Likins, Senior Partner
Pile Dynamics, Inc.

No. 3149