December 2, 2022

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

Re: **Report of Dynamic Pile Testing**
Bent 3 Pile 12
Bridge 34 - Colonial Life Blvd. Ramp A Bridge over 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. 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

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER No. 35396 MICHAEL JOEL SIMPSON

Michael J. Simpson 2022.12.02 11:04:05 -05'00'

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

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"

INFRASTRUCTURE CONSULTING & ENGINEERING

Summary of Provided Project and Pile Driving Information

Project Description	Colonial Life Blvd. Ramp A Bridge over 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 3	3032+22.00	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**
12	55.0	52.7	N/A	12/2/22	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)**
222	0.65	342	342	+182.5

Installation Records Provided to ICE	Please Refer to SCDOT Pile Driving Logs
Project Information and Soil Borings Provided to ICE	Yes, Attached in Appendix B
Pile Driving Equipment Data Form Provided to ICE	APE D30-52 Data Hammer Sheet Attached in Appendix C
Strain and Accelerometer Calibrations Attached	Yes, Attached in Appendix D

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)	+205.0
Approximate Ground/Mudline Elevation (feet)	+205.0
Approximate Final Pile Penetration Below Reference at End of Initial Drive (feet)	51.5
Approximate Final Pile Tip Elevation at End of Initial Drive (feet)	+153.5
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

INFRASTRUCTURE CONSULTING & ENGINEERING

Additional Notes on Pile Installation
-Pile 12 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	437	RX5	30.3	26.4	23.2	13.6	20.5	8.2

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 1251)	444	368 / 76	75	8.7	20.2	0.10	0.30	0.11	0.15	2.90

*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 RX5 (Maximum Case Method with J(c)=0.5) solution for the maximum value 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 1251) 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 342 kips for Bent 3.

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.

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.

Appendix A

Dynamic Pile Testing, Signal Matching Results, and Calibration WEAP

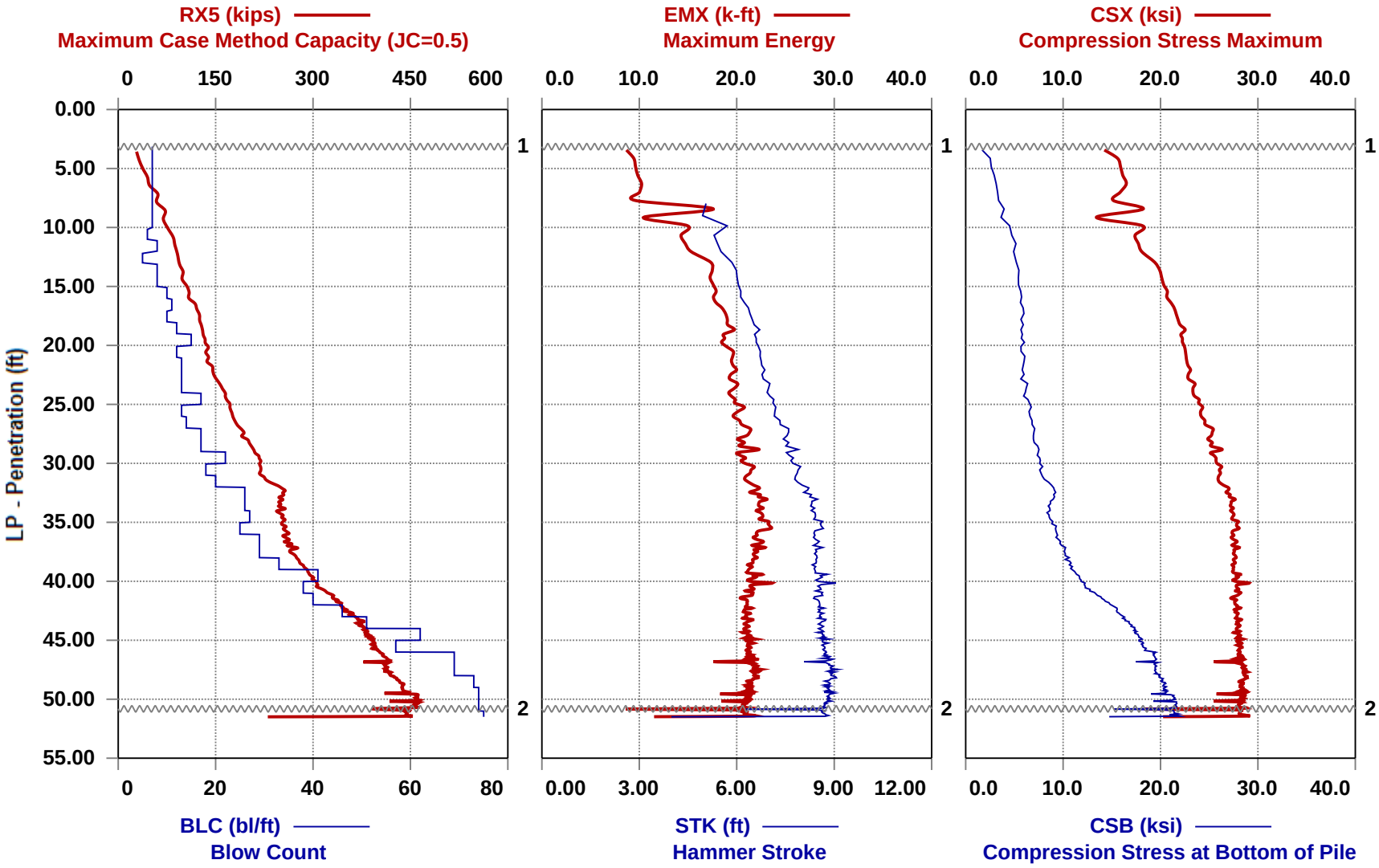
Bridge 34, Bent 3, Pile 12

Pile Dynamics, Inc. - PDIPLOT2 Ver 2020.1.60.3 - Case Method & iCAP® Results

Printed: 02-December-2022 Test started: 01-December-2022

CCRP1 Bridge 34 Bent 3 - Pile 12

HP 14x89 w tips



1 - GSE +205 ft. / FS 3

2 - Stop driving to move shackle

Case Method & iCAP® Results

CCRP1 Bridge 34 Bent 3 - Pile 12 HP 14x89 w tips
OP: ICE Date: 01-December-2022

AR: 26.10 in² SP: 0.492 k/ft³
LE: 52.67 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.50

RX5: Maximum Case Method Capacity (JC=0.5)
EMX: Maximum Energy
STK: Hammer Stroke
CSX: Compression Stress Maximum
CSB: Compression Stress at Bottom of Pile
TSX: Tension Stress Max-Full Rec Search
RA2: Auto Capacity Friction Piles
DFN: Final Displacement
BTA: Integrity Factor (1)

BL#	Depth ft	BLC bl/ft	TYPE	RX5 kips	EMX k-ft	STK ft	CSX ksi	CSB ksi	TSX ksi	RA2 kips	DFN in	BTA (%)
35	8.00	7	AV35	43	9.6	4.37	15.6	2.8	10.2	21	1.71	99.7
			STD	14	1.3	0.07	1.2	0.6	1.1	7	0.00	1.7
			MAX	66	12.3	4.46	16.9	3.7	11.0	41	1.71	100.0
			@BL	28	34	33	34	34	14	23	35	1
42	9.00	7	AV7	69	16.1	5.89	17.6	4.0	9.6	38	1.71	100.0
			STD	11	9.2	1.77	5.8	0.9	4.0	19	0.00	0.0
			MAX	89	31.7	8.55	26.7	5.4	15.7	73	1.72	100.0
			@BL	39	39	39	39	40	39	42	37	36
49	10.00	7	AV7	72	12.6	5.15	15.6	4.0	7.4	39	1.71	100.0
			STD	10	7.6	1.77	6.2	0.8	4.6	9	0.00	0.0
			MAX	91	26.2	8.92	28.4	4.6	17.7	52	1.72	100.0
			@BL	46	46	46	46	48	46	46	44	43
55	11.00	6	AV6	83	14.1	5.26	17.2	4.7	8.1	35	2.00	100.0
			STD	8	0.6	0.20	0.8	0.4	0.7	6	0.00	0.0
			MAX	95	15.4	5.67	18.8	5.3	9.3	43	2.00	100.0
			@BL	55	55	55	55	52	55	55	54	50
63	12.00	8	AV8	89	15.1	5.52	18.1	5.0	8.4	54	1.50	100.0
			STD	6	2.5	0.47	1.8	0.3	1.3	23	0.00	0.0
			MAX	97	18.8	6.25	20.7	5.4	10.5	95	1.50	100.0
			@BL	63	59	59	59	60	59	61	61	56
68	13.00	5	AV5	90	17.1	5.70	18.8	5.2	8.5	52	2.40	100.0
			STD	5	2.5	0.45	1.6	0.2	1.2	23	0.00	0.0
			MAX	94	20.0	6.22	20.8	5.5	10.0	97	2.40	100.0
			@BL	66	66	67	67	65	67	64	64	64
76	14.00	8	AV8	98	16.8	5.88	19.5	5.4	8.8	43	1.50	100.0
			STD	5	1.4	0.32	1.1	0.5	0.9	5	0.01	0.0
			MAX	112	19.8	6.67	22.0	6.1	11.0	50	1.50	100.0
			@BL	74	74	74	74	71	74	72	75	69
84	15.00	8	AV8	100	17.4	6.04	20.2	5.3	8.8	77	1.50	100.0
			STD	3	0.5	0.05	0.1	0.4	0.2	16	0.00	0.0
			MAX	105	18.5	6.11	20.4	5.7	9.1	85	1.50	100.0
			@BL	84	83	84	84	83	80	82	84	77
94	16.00	10	AV10	109	17.7	6.12	20.7	5.8	8.6	95	1.20	100.0
			STD	6	0.7	0.13	0.4	0.4	0.4	14	0.00	0.0
			MAX	119	19.4	6.43	21.7	6.5	9.3	124	1.20	100.0
			@BL	90	90	90	90	89	90	89	86	85

Case Method & iCAP® Results

CCRP1 Bridge 34 Bent 3 - Pile 12 HP 14x89 w tips
OP: ICE Date: 01-December-2022

BL#	Depth ft	BLC bl/ft	TYPE	RX5 kips	EMX k-ft	STK ft	CSX ksi	CSB ksi	TSX ksi	RA2 kips	DFN in	BTA (%)
105	17.00	11	AV11	118	18.2	6.28	21.2	5.7	8.4	100	1.09	100.0
			STD	5	0.8	0.16	0.5	0.3	0.4	12	0.00	0.0
			MAX	126	19.8	6.57	22.2	6.3	8.9	135	1.09	100.0
			@BL	103	103	103	103	105	103	101	98	95
115	18.00	10	AV10	124	18.9	6.44	21.7	5.8	8.2	102	1.20	100.0
			STD	5	0.6	0.09	0.3	0.2	0.3	20	0.00	0.0
			MAX	132	19.5	6.61	22.2	6.2	8.7	142	1.20	100.0
			@BL	114	107	112	112	110	108	106	109	106
127	19.00	12	AV12	128	19.2	6.60	22.2	5.8	8.0	104	1.00	100.0
			STD	7	1.1	0.22	0.6	0.2	0.4	15	0.01	0.0
			MAX	146	22.6	7.29	24.2	6.3	9.3	123	1.00	100.0
			@BL	125	125	125	125	118	125	124	126	116
142	20.00	15	AV15	133	18.7	6.61	22.3	5.8	7.6	77	0.79	100.0
			STD	3	0.4	0.07	0.3	0.4	0.2	25	0.00	0.0
			MAX	139	19.3	6.70	22.6	6.6	7.9	117	0.80	100.0
			@BL	141	133	142	129	138	131	139	134	128
154	21.00	12	AV12	138	19.5	6.72	22.6	5.8	7.5	113	1.00	100.0
			STD	4	0.4	0.05	0.2	0.2	0.2	14	0.00	0.0
			MAX	147	19.9	6.84	23.0	6.3	7.8	120	1.00	100.0
			@BL	144	149	153	153	151	149	145	146	143
167	22.00	13	AV13	141	19.5	6.76	22.8	6.0	7.2	105	0.92	100.0
			STD	5	0.4	0.11	0.3	0.3	0.3	26	0.01	0.0
			MAX	148	20.2	6.95	23.1	6.6	7.8	145	0.93	100.0
			@BL	162	156	156	166	158	156	158	156	155
180	23.00	13	AV13	148	19.5	6.82	22.9	5.8	7.0	88	0.92	100.0
			STD	4	0.6	0.10	0.4	0.3	0.3	31	0.00	0.0
			MAX	153	20.6	6.98	23.4	6.4	7.7	161	0.93	100.0
			@BL	180	170	170	170	174	170	169	179	168
193	24.00	13	AV13	159	19.8	6.99	23.4	6.3	7.0	68	0.92	100.0
			STD	6	0.9	0.22	0.6	0.3	0.5	5	0.01	0.0
			MAX	169	22.4	7.60	25.2	7.1	8.4	74	0.92	100.0
			@BL	192	185	185	185	185	185	190	184	181
210	25.00	17	AV17	168	19.6	7.07	23.7	6.3	7.0	143	0.70	100.0
			STD	4	0.9	0.21	0.6	0.3	0.5	45	0.01	0.0
			MAX	174	22.2	7.74	25.5	7.1	8.3	182	0.71	100.0
			@BL	210	205	205	205	207	205	210	206	194
223	26.00	13	AV13	173	20.3	7.18	24.2	6.6	6.7	141	0.92	100.0
			STD	3	0.7	0.10	0.3	0.3	0.3	46	0.00	0.0
			MAX	181	21.3	7.36	24.6	7.1	7.1	192	0.93	100.0
			@BL	220	214	220	215	223	218	216	213	211
237	27.00	14	AV14	182	20.4	7.36	24.7	6.8	6.6	188	0.85	100.0
			STD	5	1.1	0.23	0.7	0.2	0.4	12	0.00	0.0
			MAX	190	23.4	8.05	26.7	7.3	7.5	205	0.86	100.0

Case Method & iCAP® Results

CCRP1 Bridge 34 Bent 3 - Pile 12 HP 14x89 w tips
OP: ICE Date: 01-December-2022

BL#	Depth ft	BLC bl/ft	TYPE	RX5 kips	EMX k-ft	STK ft	CSX ksi	CSB ksi	TSX ksi	RA2 kips	DFN in	BTA (%)
			@BL	235	236	236	236	230	236	231	235	224
254	28.00	17	AV17	193	20.9	7.54	25.2	7.0	6.5	202	0.70	100.0
			STD	4	1.2	0.22	0.6	0.3	0.5	12	0.01	0.0
			MAX	199	24.1	8.19	27.0	7.9	7.7	219	0.71	100.0
			@BL	244	247	247	247	239	247	250	246	238
271	29.00	17	AV17	205	21.0	7.64	25.5	7.3	6.2	218	0.70	100.0
			STD	7	1.2	0.24	0.7	0.3	0.5	13	0.01	0.0
			MAX	218	24.0	8.14	26.8	7.8	7.2	238	0.71	100.0
			@BL	270	269	269	268	268	270	264	267	255
293	30.00	22	AV22	217	20.5	7.66	25.5	7.5	5.7	241	0.54	100.0
			STD	7	0.7	0.19	0.5	0.3	0.5	31	0.01	0.0
			MAX	228	22.9	8.36	27.2	8.1	7.1	294	0.55	100.0
			@BL	292	285	285	285	282	285	292	285	272
311	31.00	18	AV18	218	21.5	7.89	26.1	7.7	5.4	261	0.67	100.0
			STD	5	0.8	0.18	0.4	0.4	0.4	11	0.00	0.0
			MAX	229	23.2	8.37	27.3	8.8	6.7	283	0.67	100.0
			@BL	306	298	298	300	298	298	307	308	294
331	32.00	20	AV20	233	21.2	7.88	26.1	8.4	4.4	276	0.60	100.0
			STD	9	0.8	0.21	0.6	0.4	0.4	33	0.00	0.0
			MAX	255	24.2	8.66	28.1	9.2	5.0	328	0.60	100.0
			@BL	331	330	330	330	326	313	331	327	312
357	33.00	26	AV26	253	22.0	8.20	27.0	9.1	4.1	242	0.46	100.0
			STD	5	0.7	0.18	0.5	0.2	0.4	26	0.00	0.0
			MAX	263	23.8	8.71	28.2	9.7	5.0	317	0.47	100.0
			@BL	333	349	349	349	343	349	332	338	332
383	34.00	26	AV26	251	22.5	8.36	27.4	8.7	4.7	246	0.46	100.0
			STD	9	1.2	0.31	0.8	0.4	0.5	24	0.00	0.0
			MAX	276	25.1	8.99	28.9	9.6	5.7	329	0.47	100.0
			@BL	381	358	368	359	358	368	371	377	358
410	35.00	27	AV27	252	22.6	8.45	27.5	8.6	4.7	249	0.44	100.0
			STD	10	1.0	0.28	0.7	0.3	0.4	19	0.01	0.0
			MAX	271	24.9	9.07	29.3	9.2	5.8	331	0.44	100.0
			@BL	406	406	406	406	408	390	387	400	384
435	36.00	25	AV25	257	22.9	8.53	27.7	9.2	4.2	260	0.48	100.0
			STD	8	1.0	0.27	0.7	0.3	0.5	12	0.00	0.0
			MAX	278	25.3	9.19	29.3	9.8	5.5	281	0.49	100.0
			@BL	427	419	419	425	434	415	424	412	411
464	37.00	29	AV29	260	22.1	8.43	27.5	9.6	3.9	272	0.41	100.0
			STD	9	0.8	0.19	0.5	0.2	0.4	15	0.00	0.0
			MAX	280	24.7	9.11	29.0	10.0	4.7	306	0.42	100.0
			@BL	450	455	455	455	463	455	460	447	436
493	38.00	29	AV29	269	22.1	8.47	27.7	10.3	3.5	280	0.41	100.0

Case Method & iCAP® Results

CCRP1 Bridge 34 Bent 3 - Pile 12 HP 14x89 w tips
OP: ICE Date: 01-December-2022

BL#	Depth	BLC	TYPE	RX5	EMX	STK	CSX	CSB	TSX	RA2	DFN	BTA
	ft	bl/ft		kips	k-ft	ft	ksi	ksi	ksi	kips	in	(%)
			STD	12	0.8	0.21	0.5	0.3	0.4	17	0.00	0.0
			MAX	325	24.8	9.23	29.7	10.9	4.6	307	0.42	100.0
			@BL	468	468	468	468	468	468	482	488	465
526	39.00	33	AV33	282	21.5	8.42	27.5	10.7	3.1	296	0.36	100.0
			STD	5	0.6	0.13	0.3	0.4	0.3	14	0.00	0.0
			MAX	292	22.7	8.66	28.2	11.8	3.7	316	0.37	100.0
			@BL	525	496	497	520	520	512	519	499	494
567	40.00	41	AV41	296	21.5	8.52	27.7	11.5	2.7	315	0.29	100.0
			STD	4	0.9	0.22	0.5	0.3	0.4	10	0.00	0.0
			MAX	303	24.8	9.36	29.4	12.1	4.1	336	0.29	100.0
			@BL	563	545	545	555	565	545	552	533	527
605	41.00	38	AV38	312	21.8	8.62	28.1	12.5	2.2	330	0.31	100.0
			STD	7	1.0	0.22	0.6	0.5	0.4	11	0.00	0.0
			MAX	325	25.0	9.43	29.9	13.7	3.1	355	0.32	100.0
			@BL	602	572	572	572	604	572	572	570	568
645	42.00	40	AV40	335	21.0	8.52	27.7	14.1	1.2	342	0.30	100.0
			STD	8	0.6	0.15	0.4	0.5	0.3	15	0.00	0.0
			MAX	350	22.5	8.92	28.7	15.2	2.2	374	0.31	100.0
			@BL	645	608	608	608	640	607	637	633	606
691	43.00	46	AV46	352	21.0	8.57	27.9	15.6	0.7	363	0.26	100.0
			STD	10	0.5	0.12	0.4	0.4	0.2	8	0.00	0.0
			MAX	376	22.7	8.94	28.8	16.4	1.1	379	0.26	100.0
			@BL	691	677	677	677	687	650	667	668	646
742	44.00	51	AV51	373	21.1	8.61	28.0	16.7	0.6	376	0.23	100.0
			STD	7	0.6	0.17	0.5	0.4	0.1	12	0.00	0.0
			MAX	386	22.7	9.01	29.3	17.6	0.8	397	0.24	100.0
			@BL	742	733	703	733	736	701	710	695	692
804	45.00	62	AV62	385	21.1	8.64	28.0	17.6	0.5	393	0.19	100.0
			STD	6	0.6	0.16	0.4	0.4	0.1	13	0.00	0.0
			MAX	401	22.8	8.99	29.0	18.7	0.8	432	0.20	100.0
			@BL	798	799	788	799	800	798	795	761	743
861	46.00	57	AV57	395	21.3	8.69	28.1	18.3	0.5	406	0.21	100.0
			STD	7	0.6	0.14	0.4	0.5	0.1	12	0.00	0.0
			MAX	415	22.6	9.04	29.1	19.6	0.7	433	0.21	100.0
			@BL	850	816	839	851	861	829	861	860	805
930	47.00	69	AV69	408	21.1	8.72	28.0	19.3	0.4	409	0.17	100.0
			STD	22	2.2	0.66	1.6	1.3	0.0	20	0.00	0.0
			MAX	422	23.3	10.48	29.1	20.0	0.5	435	0.18	100.0
			@BL	916	902	919	902	915	890	865	881	862
999	48.00	69	AV69	414	21.8	8.92	28.6	19.5	0.5	415	0.17	100.0
			STD	5	0.6	0.17	0.4	0.3	0.1	10	0.00	0.0
			MAX	425	24.1	9.56	30.3	20.4	0.7	448	0.17	100.0
			@BL	995	980	980	980	995	964	963	999	931

Case Method & iCAP® Results

CCRP1 Bridge 34 Bent 3 - Pile 12 HP 14x89 w tips
OP: ICE Date: 01-December-2022

BL#	Depth ft	BLC bl/ft	TYPE	RX5 kips	EMX k-ft	STK ft	CSX ksi	CSB ksi	TSX ksi	RA2 kips	DFN in	BTA (%)
1072	49.00	73	AV73	433	21.6	8.87	28.5	20.2	0.4	428	0.16	100.0
			STD	6	0.8	0.21	0.5	0.4	0.0	10	0.00	0.0
			MAX	445	24.5	9.69	30.3	20.9	0.6	455	0.17	100.0
			@BL	1051	1001	1013	1001	1047	1001	1030	1021	1000
1146	50.00	74	AV74	447	21.0	8.84	28.2	20.7	0.3	435	0.16	99.8
			STD	27	1.9	0.15	1.7	1.3	0.1	28	0.00	1.4
			MAX	477	23.0	9.44	29.6	22.3	0.8	467	0.17	100.0
			@BL	1121	1109	1108	1109	1138	1130	1121	1106	1073
1220	51.00	74	AV74	445	19.7	8.56	27.2	20.9	0.4	430	0.16	99.9
			STD	43	3.7	0.74	3.1	2.2	0.1	49	0.00	1.2
			MAX	484	22.8	9.20	29.2	23.1	1.1	463	0.17	100.0
			@BL	1193	1172	1172	1172	1217	1205	1211	1208	1147
1257	51.49	75	AV37	437	20.4	8.57	27.9	21.2	0.5	437	0.16	100.0
			STD	35	3.0	0.78	2.8	2.0	0.3	42	0.00	0.0
			MAX	456	22.2	9.02	29.2	23.2	2.2	462	0.17	100.0
			@BL	1238	1246	1246	1256	1238	1256	1229	1241	1221
			Average	309	20.5	8.21	26.4	13.6	3.0	307	0.46	100.0
			Std. Dev.	119	2.9	0.93	3.3	6.0	3.1	128	0.43	0.5
			Maximum	484	31.7	10.48	30.3	23.2	17.7	467	2.40	100.0
			@ Blow#	1193	39	919	1001	1238	46	1121	64	1

Total number of blows analyzed: 1257

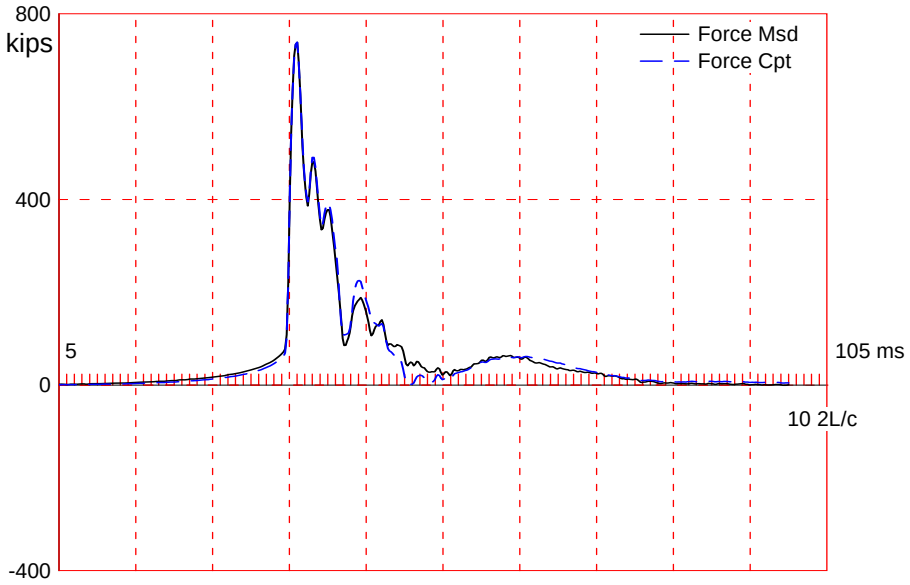
BL#	Sensors
1-242	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
243	F4: [S868] 145.1 (1.00); A3: [K12388] 451.0 (1.00)
244	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
245	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
246-1103	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1104	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
1105-1115	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1116	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
1117-1120	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1121	F4: [S868] 145.1 (1.00); A3: [K12388] 451.0 (1.00)
1122-1127	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1128	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
1129	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1130	F4: [S868] 145.1 (1.00); A3: [K12388] 451.0 (1.00)
1131-1156	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1157	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
1158-1192	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00);

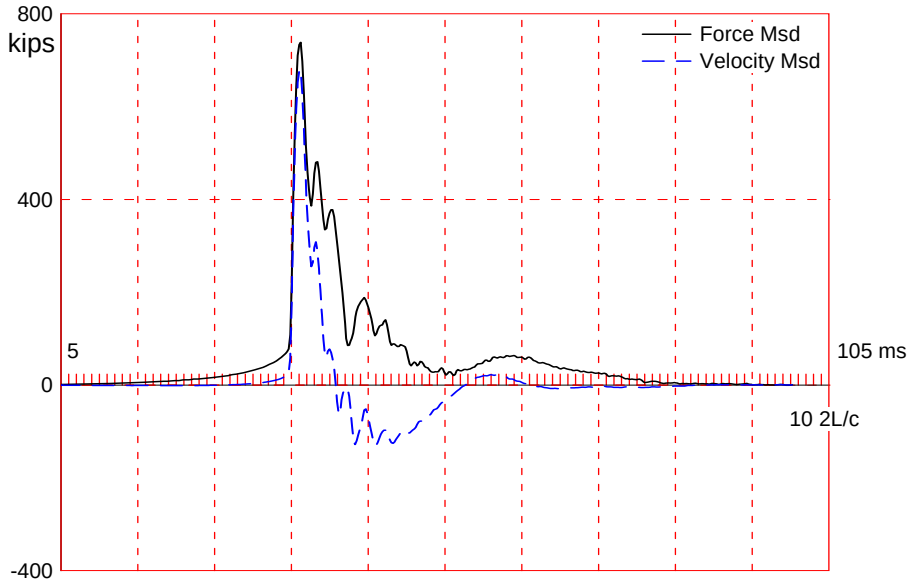
	A3: [K12388] 451.0 (1.00)
1193	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
1194-1195	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1196	F4: [S868] 145.1 (1.00); A3: [K12388] 451.0 (1.00)
1197-1207	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1208	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
1209-1210	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1211	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
1212	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1213-1214	F4: [S868] 145.1 (1.00); A3: [K12388] 451.0 (1.00)
1215-1216	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1217	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
1218	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1219	F4: [S868] 145.1 (1.00); A3: [K12388] 451.0 (1.00)
1220-1237	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1238	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
1239-1240	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1241	F4: [S868] 145.1 (1.00); A3: [K12388] 451.0 (1.00)
1242-1251	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1252	F2: [P821] 145.1 (1.00); A1: [K12389] 483.2 (1.00)
1253-1255	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)
1256	F4: [S868] 145.1 (1.00); A3: [K12388] 451.0 (1.00)
1257	F2: [P821] 145.1 (1.00); F4: [S868] 145.1 (1.00); A1: [K12389] 483.2 (1.00); A3: [K12388] 451.0 (1.00)

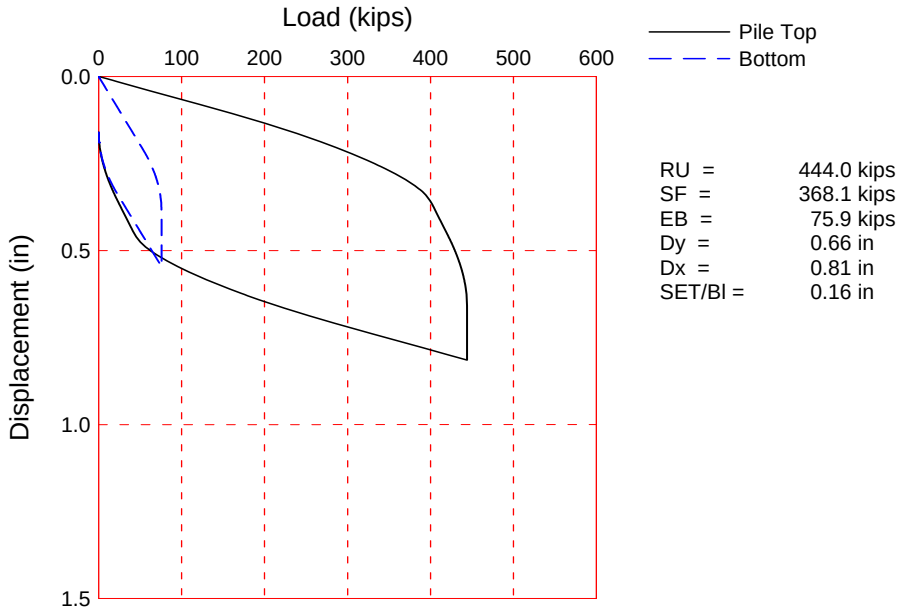
BL#	Comments
1	GSE +205 ft. / FS 3
1207	Stop driving to move shackle

Time Summary

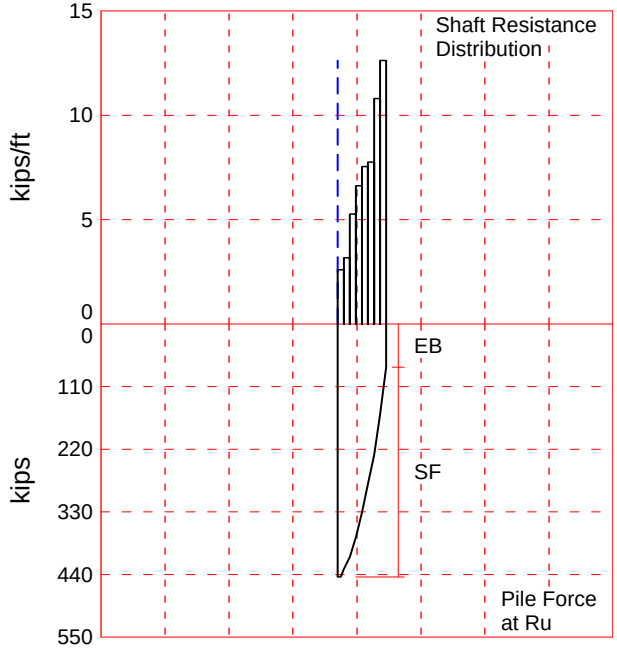
Drive 51 minutes 19 seconds 3:41 PM - 4:32 PM BN 1 - 1257







RU =	444.0 kips
SF =	368.1 kips
EB =	75.9 kips
Dy =	0.66 in
Dx =	0.81 in
SET/Bl =	0.16 in



Length b. Sensors	52.7 ft
Embedment	51.4 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.	16721 ft/s
Match Quality	2.90
Top Compr. Stress	28.7 ksi
Max Compr. Stress	29.1 ksi
Max Tension Stress	-0.19 ksi
Avg. Shaft Quake	0.10 in
Toe Quake	0.30 in
Avg. Shaft Smith Dpg.	0.11 s/ft
Toe Smith Damping	0.15 s/ft

About the CAPWAP Results

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

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

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

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

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

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

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

The CAPWAP analysis software is one of many means by which the capacity of a deep foundation can be assessed. The engineer performing the analysis is responsible for proper software application and the analysis results. Pile Dynamics accepts

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 444.0; along Shaft 368.1; at Toe 75.9 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
				444.0			
1	6.6	5.3	13.9	430.1	13.9	2.61	0.55
2	13.2	11.9	20.9	409.2	34.8	3.17	0.67
3	19.8	18.5	34.7	374.5	69.5	5.27	1.11
4	26.3	25.1	43.6	330.9	113.1	6.62	1.39
5	32.9	31.7	49.7	281.2	162.8	7.55	1.59
6	39.5	38.3	51.1	230.1	213.9	7.76	1.63
7	46.1	44.8	71.1	159.0	285.0	10.80	2.27
8	52.7	51.4	83.1	75.9	368.1	12.62	2.65
Avg. Shaft			46.0			7.16	1.51
Toe			75.9				53.78

Soil Model Parameters/Extensions		Shaft	Toe
Smith Damping Factor		0.11	0.15
Quake	(in)	0.10	0.30
Case Damping Factor		0.87	0.24
Damping Type		Viscous	Smith
Unloading Quake	(% of loading quake)	100	94
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	8	
Soil Plug Weight	(kips)		0.088

CAPWAP match quality = 2.90 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.16 in; Blow Count = 75 b/ft
Computed: Final Set = 0.16 in; Blow Count = 75 b/ft
Transducer F2 (P821) CAL: 145.1; RF: 1.00; F4 (S868) CAL: 145.1; RF: 1.00
A1 (K12389) CAL: 483; RF: 1.00; A3 (K12388) CAL: 451; RF: 1.00

max. Top Comp. Stress = 28.7 ksi (T= 36.4 ms, max= 1.015 x Top)
max. Comp. Stress = 29.1 ksi (Z= 6.6 ft, T= 36.6 ms)
max. Tens. Stress = -0.19 ksi (Z= 3.3 ft, T= 50.8 ms)
max. Energy (EMX) = 20.2 kip-ft; max. Measured Top Displ. (DMX)= 0.46 in

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	749.3	-5.0	28.7	-0.19	20.2	14.4	0.46
2	6.6	760.6	-5.0	29.1	-0.19	20.1	14.1	0.45
3	9.9	740.9	-0.0	28.4	-0.00	19.1	13.9	0.44
4	13.2	757.9	-0.0	29.0	-0.00	19.0	13.5	0.43
5	16.5	727.1	-0.0	27.9	-0.00	17.6	13.1	0.42
6	19.8	748.1	-0.0	28.7	-0.00	17.5	12.6	0.41
7	23.0	689.8	-0.0	26.4	-0.00	15.5	12.2	0.40
8	26.3	713.4	-0.0	27.3	-0.00	15.3	11.6	0.38
9	29.6	639.2	-0.0	24.5	-0.00	13.0	11.2	0.37
10	32.9	663.6	-0.0	25.4	-0.00	12.8	10.6	0.36
11	36.2	582.0	-0.0	22.3	-0.00	10.5	10.2	0.35
12	39.5	610.6	-0.0	23.4	-0.00	10.4	9.6	0.33
13	42.8	513.6	-0.0	19.7	-0.00	8.2	9.8	0.32
14	46.1	489.0	-0.1	18.7	-0.00	8.1	11.5	0.31
15	49.4	298.6	-0.1	11.4	-0.01	5.2	12.3	0.31
16	52.7	268.1	-0.0	10.3	-0.00	1.8	12.3	0.30
Absolute	6.6			29.1			(T =	36.6 ms)
	3.3				-0.19		(T =	50.8 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	761.0	694.4	627.7	561.1	494.4	427.8	361.2	294.5	227.9	161.2
RX	764.9	698.8	634.0	569.5	505.1	444.1	396.5	359.6	330.7	304.0
RU	803.6	741.3	678.9	616.5	554.2	491.8	429.4	367.0	304.7	242.3

RAU = 225.9 (kips); RA2 = 433.5 (kips)

Current CAPWAP Ru = 444.0 (kips); Corresponding J(RP)= 0.48; J(RX) = 0.50

VMX ft/s	TVP ms	VT1*Z kips	FT1 kips	FMX kips	DMX in	DFN in	SET in	EMX kip-ft	QUS kips	KEB kips/in
14.7	36.03	686.9	740.4	742.8	0.46	0.16	0.16	20.8	801.9	255

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
52.7	26.1	30000.0	492.000	4.75

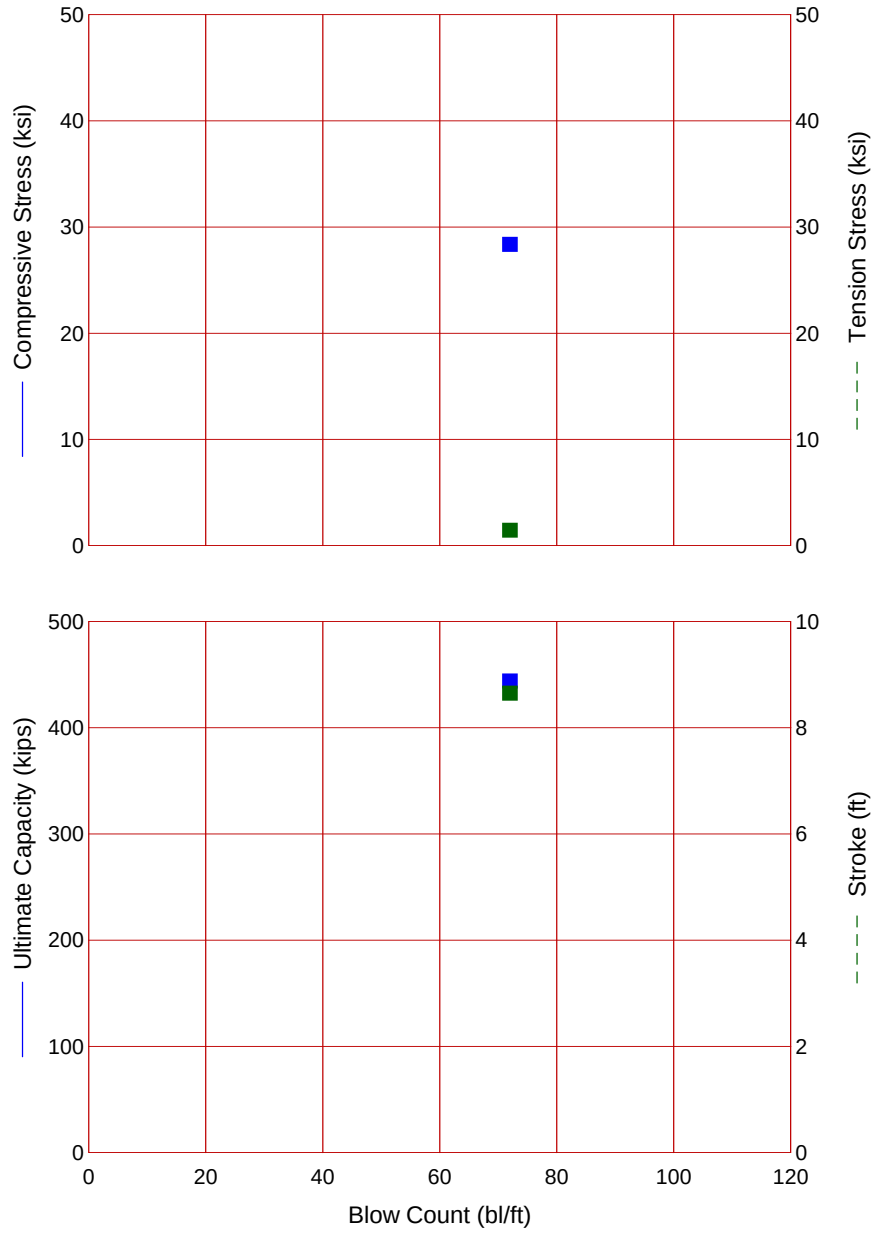
Toe Area 203.2 in^2

Top Segment Length 3.29 ft, Top Impedance 47 kips/ft/s

Wave Speed: Pile Top 16807.9, Elastic 16807.9, Overall 16720.6 ft/s
Pile Damping 1.00 %, Time Incr 0.197 ms, 2L/c 6.3 ms
Total volume: 9.546 ft^3; Volume ratio considering added impedance: 1.000

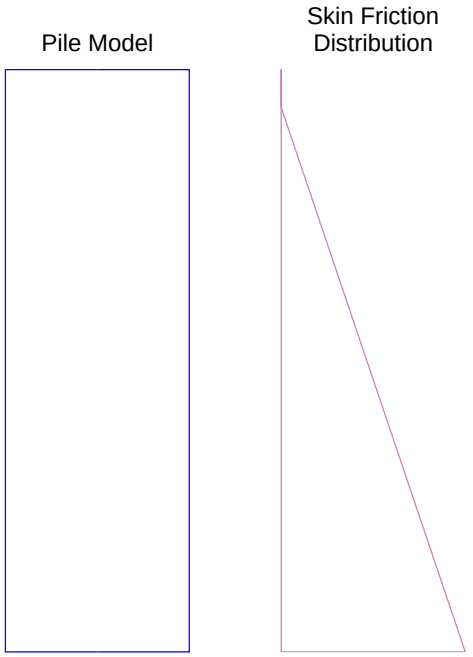
ICE of Carolinas, PLLC
CCR 1 Bridge 34 BT3 Pl 12 EOD CAL

02-Dec-2022
GRLWEAP Version 2010



ICE I-19v2

Ram Weight	4.01	kips
Efficiency	0.970	
Pressure	1431 (90%)	psi
Helmet Weight	2.31	kips
Hammer Cushion	34825	kips/in
COR of H.C.	0.900	
Skin Quake	0.100	in
Toe Quake	0.300	in
Skin Damping	0.110	s/ft
Toe Damping	0.150	s/ft
Pile Length	55.00	ft
Pile Penetration	51.42	ft
Pile Top Area	26.10	in2

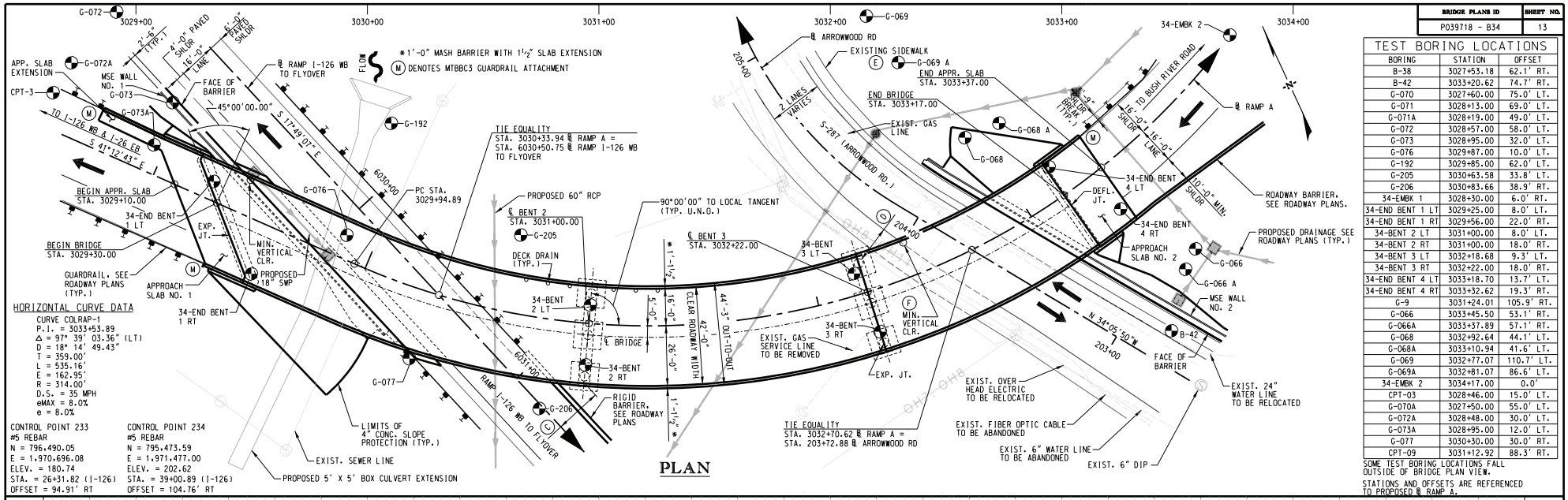


Res. Shaft = 83 %
(Proportional)

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
444.0	28.37	1.45	72.0	8.65	20.12

Appendix B

Project Information and Nearby Soil Borings



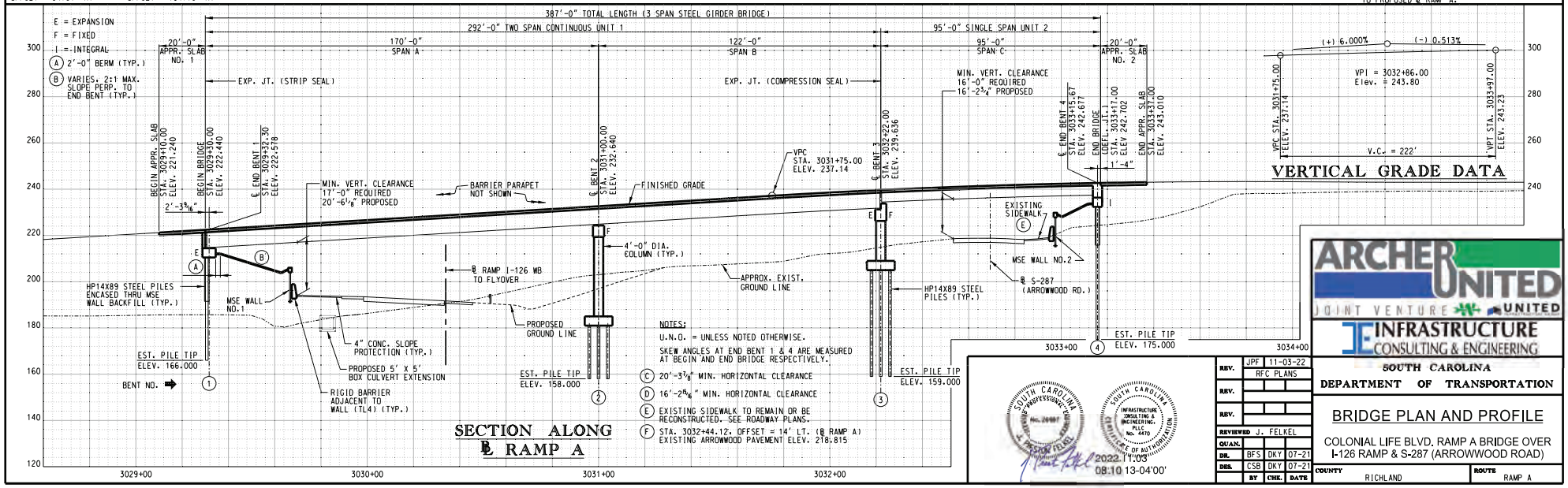
BRIDGE PLANS ID	SHEET NO.
P039718 - B34	13

TEST BORING LOCATIONS

BORING	STATION	OFFSET
B-38	3027+53.18	62.1' RT.
B-42	3033+20.62	74.7' RT.
G-070	3027+60.00	75.0' LT.
G-071	3028+13.00	69.0' LT.
G-071A	3028+19.00	49.0' LT.
G-072	3028+57.00	58.0' LT.
G-073	3028+95.00	32.0' LT.
G-076	3029+87.00	10.0' LT.
G-192	3029+85.00	62.0' LT.
G-205	3030+63.58	33.8' LT.
G-206	3030+83.66	38.9' RT.
34-EMBK 1	3028+30.00	6.0' RT.
34-END BENT 1 LT	3029+25.00	8.0' LT.
34-END BENT 1 RT	3029+56.00	22.0' RT.
34-BENT 2 LT	3031+00.00	8.0' LT.
34-BENT 2 RT	3031+00.00	18.0' RT.
34-BENT 3 LT	3032+18.68	9.3' LT.
34-BENT 3 RT	3032+22.00	18.0' RT.
34-END BENT 4 LT	3033+18.70	13.7' LT.
34-END BENT 4 RT	3033+32.62	19.3' RT.
G-9	3031+24.01	105.9' RT.
G-066	3033+45.50	53.1' RT.
G-066A	3033+37.89	57.1' RT.
G-068	3032+92.64	44.1' LT.
G-068A	3033+10.94	41.6' LT.
G-069	3032+77.07	110.7' LT.
G-069A	3032+81.07	86.6' LT.
34-EMBK 2	3034+17.00	0.0'
CPT-03	3028+46.00	15.0' LT.
G-070A	3027+50.00	55.0' LT.
G-072A	3028+48.00	30.0' LT.
G-073A	3028+95.00	12.0' LT.
G-077	3030+30.00	30.0' RT.
CPT-09	3031+12.92	88.3' RT.

SOME TEST BORING LOCATIONS FALL OUTSIDE OF BRIDGE PLAN VIEW.

STATIONS AND OFFSETS ARE REFERENCED TO PROPOSED ℄ RAMP A.



REV.	JPF	11-03-22
	RFC PLANS	
REV.		
REV.		
REVIEWED	J. FELKEL	
QUAN.		
DR.	BFS	DKY 07-21
DES.	CSB	DKY 07-21
	BY	CHK. DATE

ARCHER UNITED JOINT VENTURE
INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

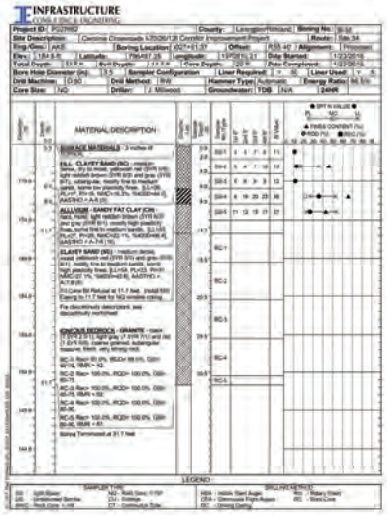
BRIDGE PLAN AND PROFILE

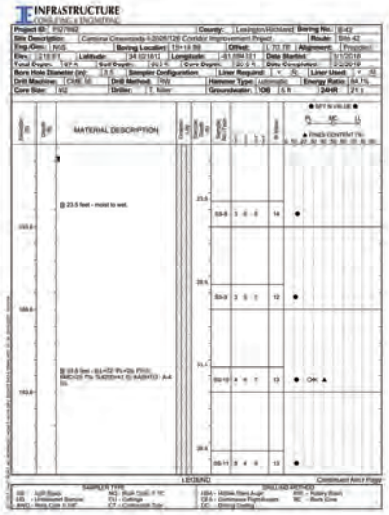
COLONIAL LIFE BLVD. RAMP A BRIDGE OVER I-126 RAMP & S-287 (ARROWWOOD ROAD)

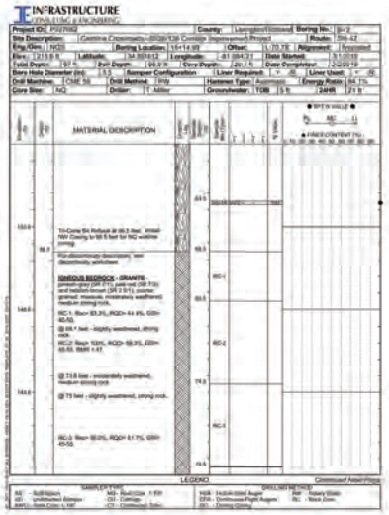
COUNTY	ROUTE
RICHLAND	RAMP A

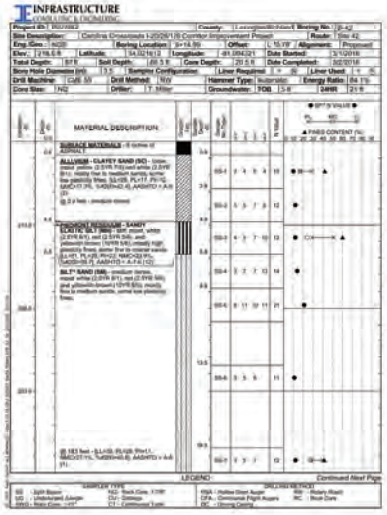
Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_FinalPlans\03_BRIDGE 34_BRIDGE PLAN & PROFILE.dgn
11/2/2022
9:40:07 AM

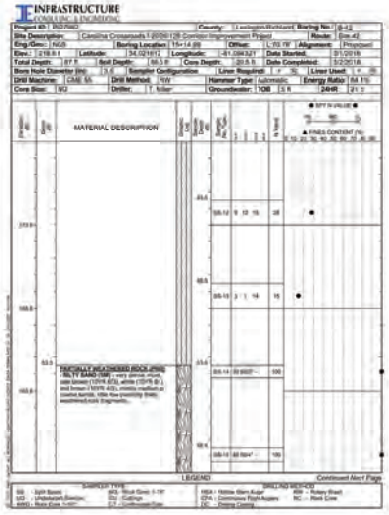
BRIDGE PLANS ID	SHEET NO.
P039718-B34	14

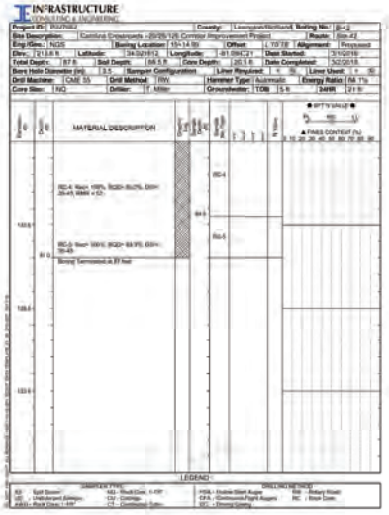












NOTE:

BORING LOGS FROM BASELINE REPORT PROVIDED WITH FINAL RFP.

FOR INFORMATION ONLY

REV.	JPF	11-03-22
	RFC PLANS	
REV.		
REV.		
REVIEWED	J. FELKEL	
QUAN.		
DR.	ADG	DKY 05-22
DES.		
	BY	CHK. DATE

ARCHER UNITED JOINT VENTURE

INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

BORING LOGS (1)

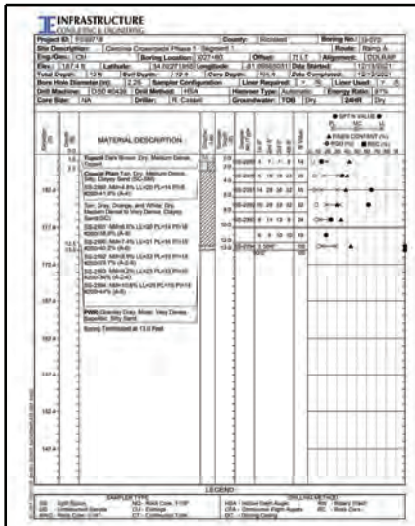
COLONIAL LIFE BLVD. RAMP A BRIDGE OVER I-126 RAMP & S-287 (ARROWWOOD ROAD)

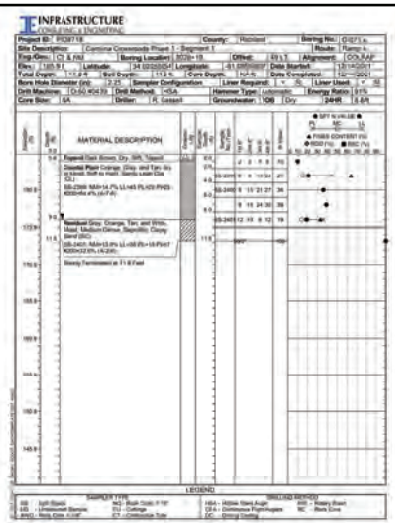
COUNTY: RICHLAND

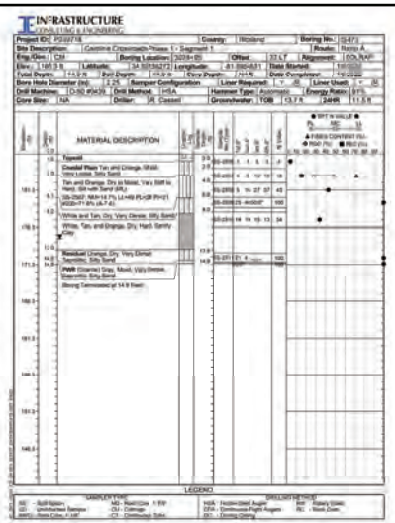
ROUTE: RAMP A

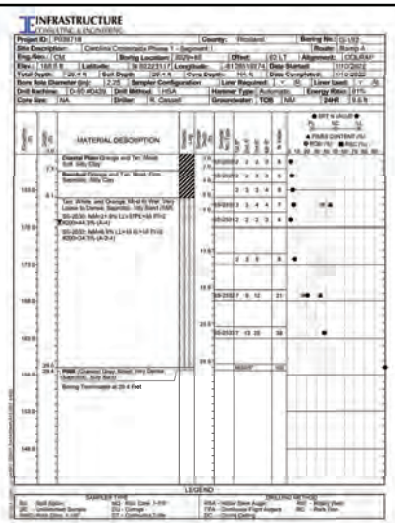
Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\M_BRIDGE 34_BORING LOGS (1).dgn
11/2/2022
9:40:08 AM

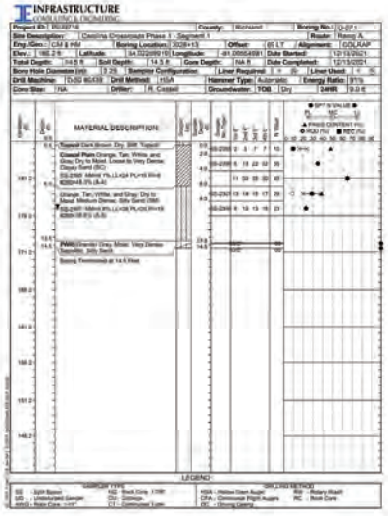
BRIDGE PLANS ID	SHEET NO.
P039718-B34	15

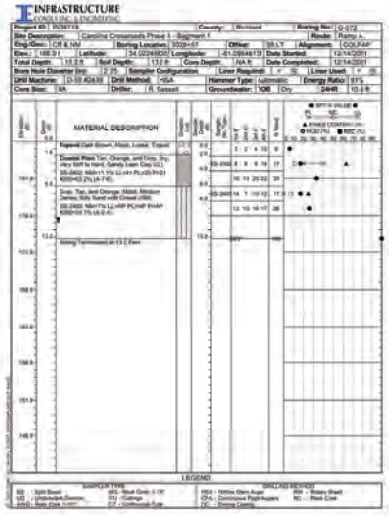


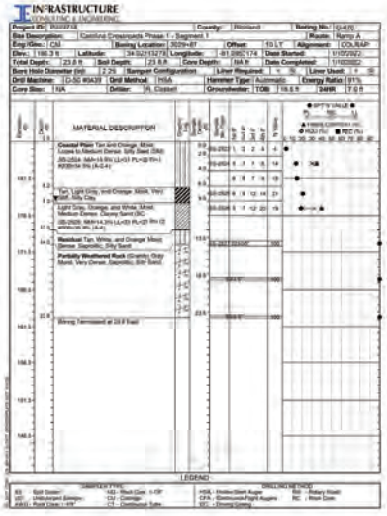


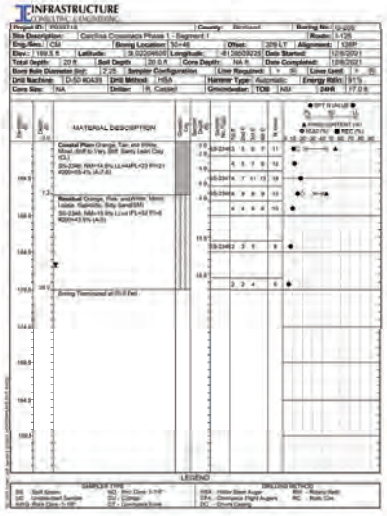












FOR INFORMATION ONLY

REV.	JPF	11-03-22
	RFC PLANS	
REV.		
REV.		
REVIEWED	J. FELKEL	
QUAN.		
DR.	ADG	DKY 05-22
DES.		
	BY	CHK. DATE

ARCHER UNITED JOINT VENTURE

INFRASTRUCTURE CONSULTING & ENGINEERING

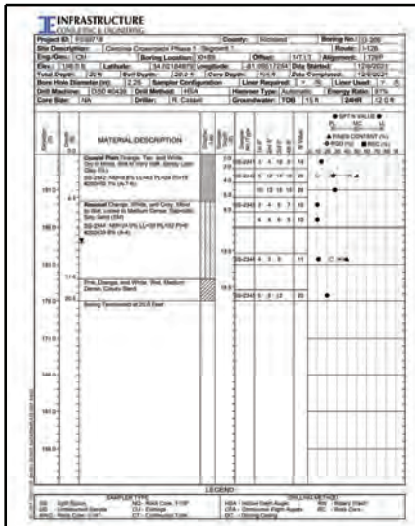
SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION

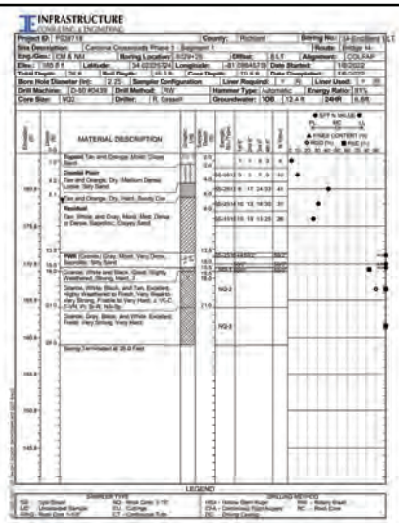
BORING LOGS (2)

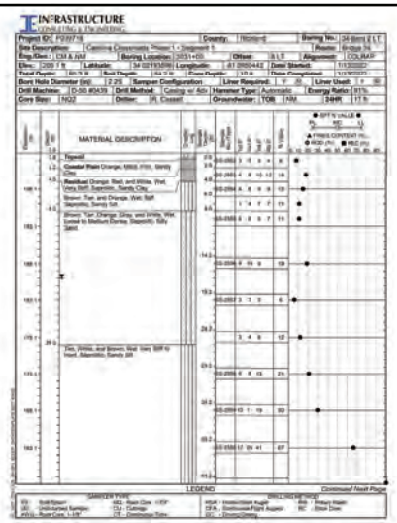
COLONIAL LIFE BLVD. RAMP A BRIDGE OVER I-126 RAMP & S-287 (ARROWWOOD ROAD)

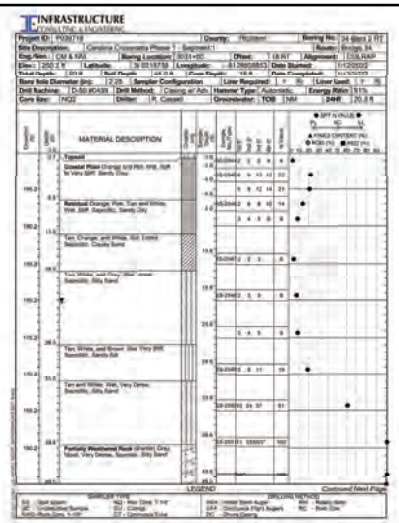
COUNTY	ROUTE
RICHLAND	RAMP A

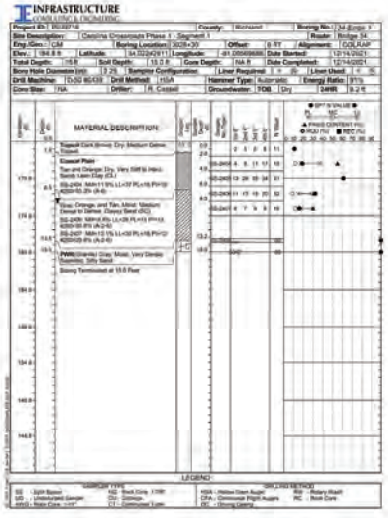
Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\05_BRIDGE 34_BORING LOGS (2).dgn
11/2/2022
9:40:30 AM

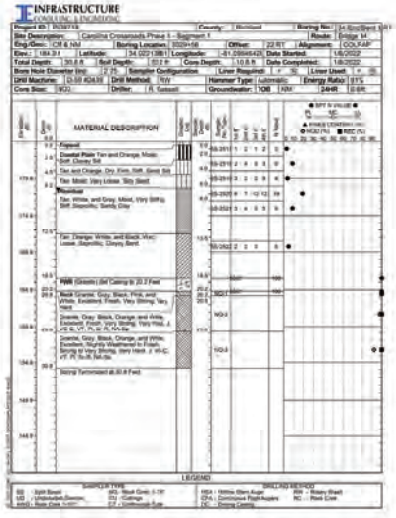


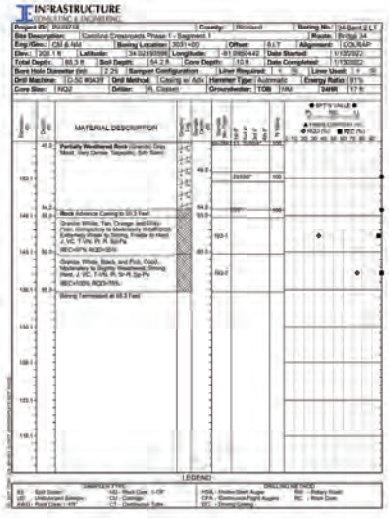


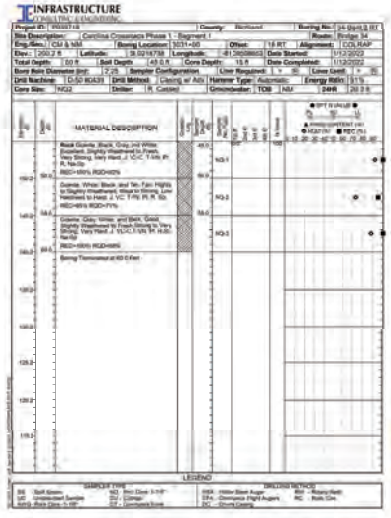












BRIDGE PLANS ID	SHEET NO.
P039718-B34	16

ARCHER UNITED JOINT VENTURE

INFRASTRUCTURE CONSULTING & ENGINEERING

FOR INFORMATION ONLY

REV.	BY	CHK.	DATE
	JPF		11-03-22
	RFC PLANS		
REV.			
REV.			
REVIEWED	J. FELKEL		
QUAN.			
DR.	ADG	DKY	05-22
DES.			

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION

BORING LOGS (3)

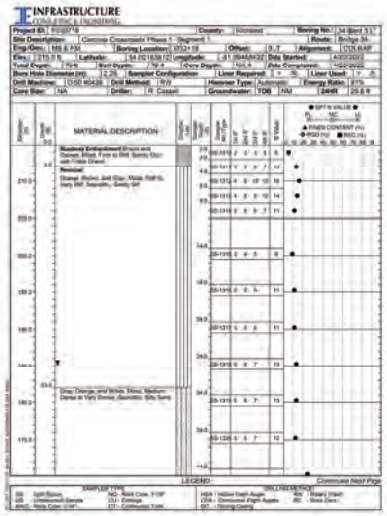
COLONIAL LIFE BLVD. RAMP A BRIDGE OVER I-126 RAMP & S-287 (ARROWWOOD ROAD)

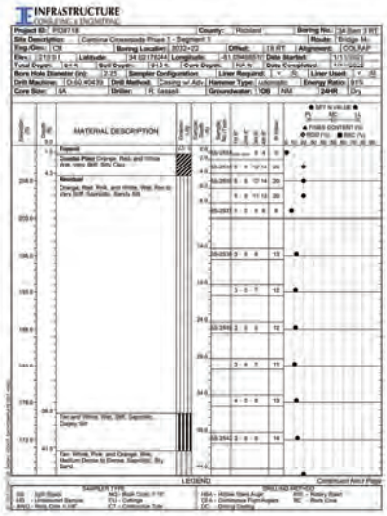
COUNTY: RICHLAND

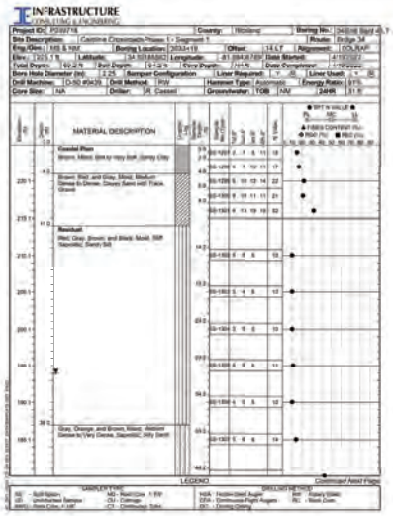
ROUTE: RAMP A

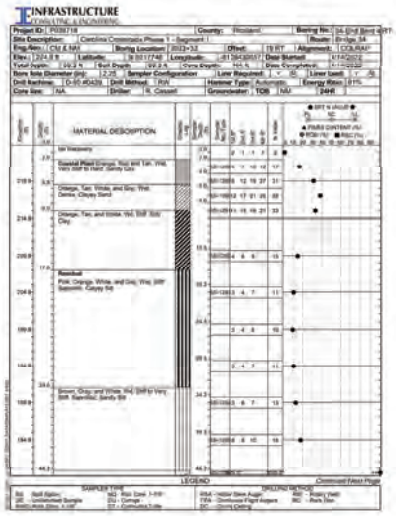
Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\06_BRIDGE 34_BORING LOGS (3).dgn
11/2/2022
9:40:59 AM

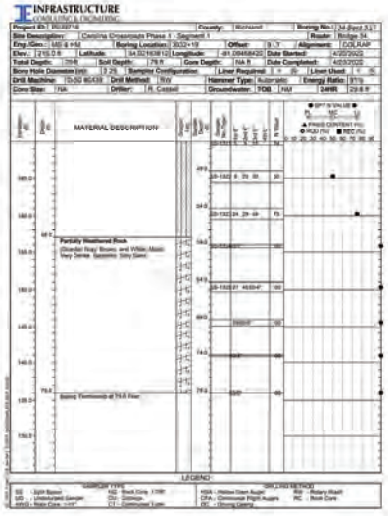
BRIDGE PLANS ID	SHEET NO.
P039718-B34	17

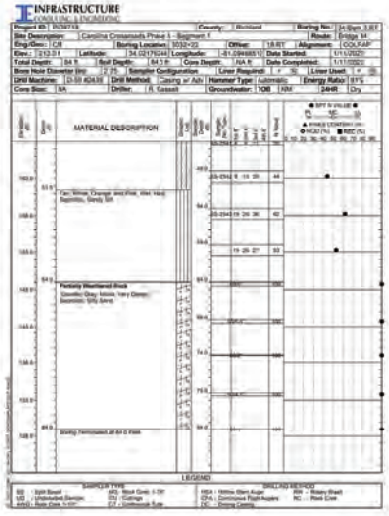


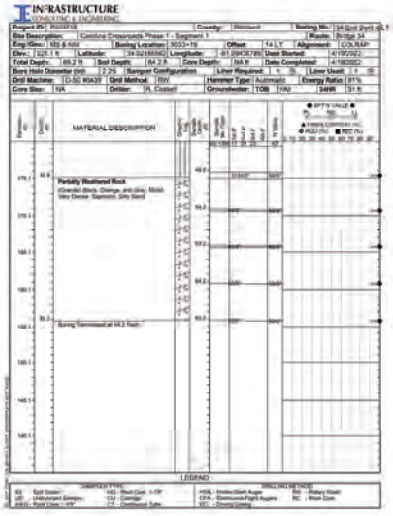


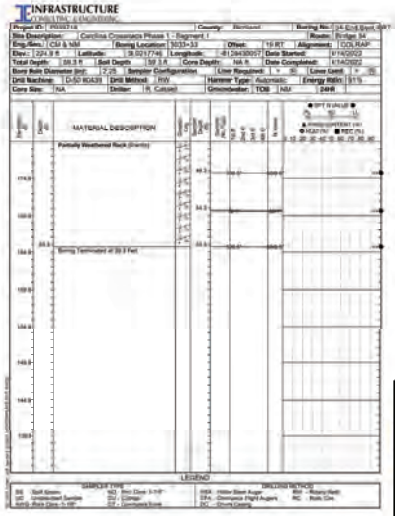












FOR INFORMATION ONLY

REV.	JPF	11-03-22
	RFC PLANS	
REV.		
REV.		
REVIEWED	J. FELKEL	
QUAN.		
DR.	ADG	DKY 05-22
DES.		
	BY	CHK. DATE

ARCHER UNITED JOINT VENTURE

INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

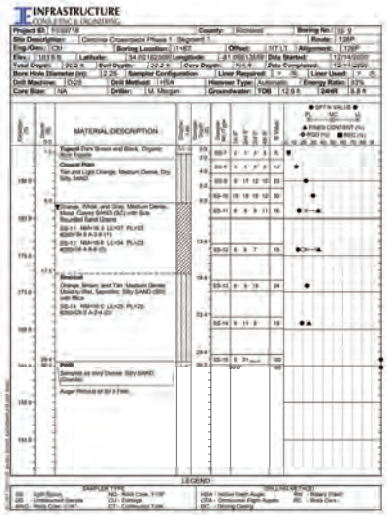
BORING LOGS (4)

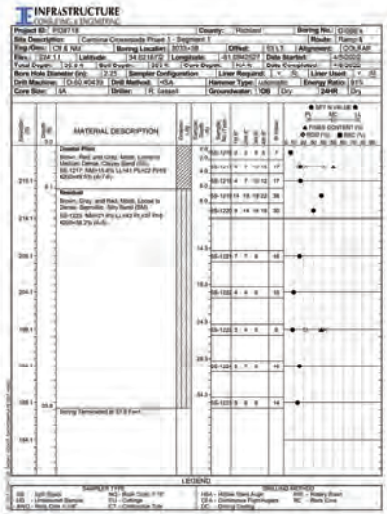
COLONIAL LIFE BLVD. RAMP A BRIDGE OVER I-126 RAMP & S-287 (ARROWWOOD ROAD)

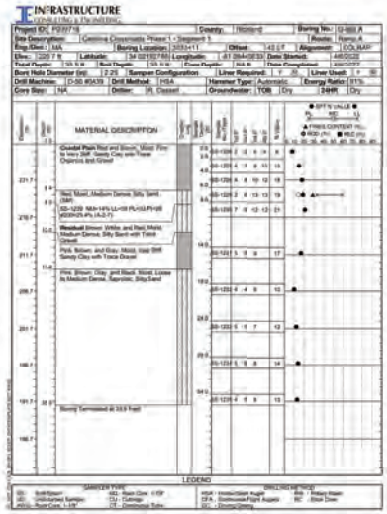
COUNTY	ROUTE
RICHLAND	RAMP A

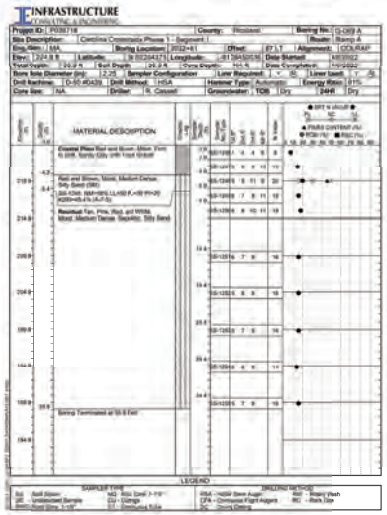
Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\17_BRIDGE 34_BORING LOGS (4).dgn
11/2/2022
9:16:28 AM

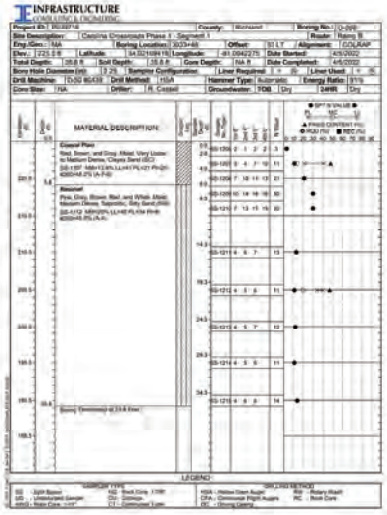
BRIDGE PLANS ID	SHEET NO.
P039718-B34	18

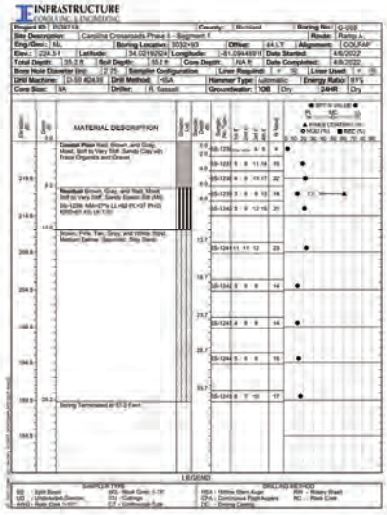


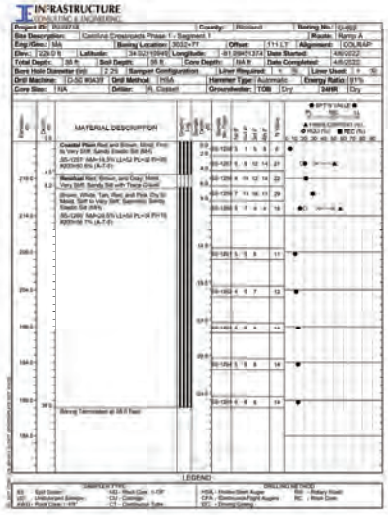












ARCHER UNITED
JOINT VENTURE UNITED

INFRASTRUCTURE CONSULTING & ENGINEERING

FOR INFORMATION ONLY

REV.	BY	CHK.	DATE
	JPF		11-03-22
	RFC PLANS		
REV.			
REV.			
REVIEWED	J. FELKEL		
QUAN.			
DR.	ADG	DKY	05-22
DES.			

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION

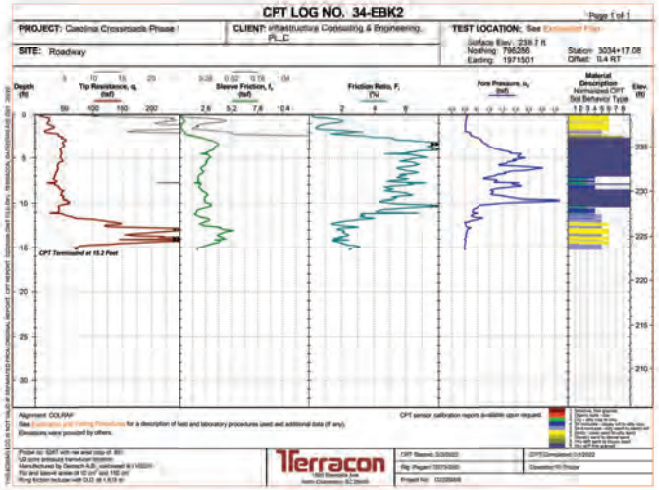
BORING LOGS (5)

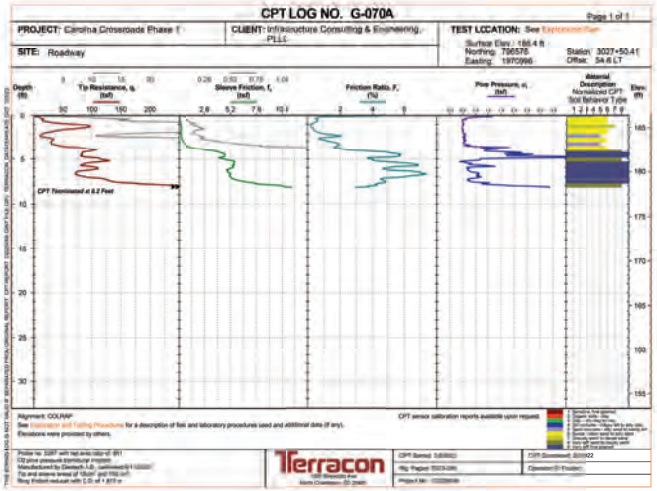
COLONIAL LIFE BLVD. RAMP A BRIDGE OVER I-126 RAMP & S-287 (ARROWWOOD ROAD)

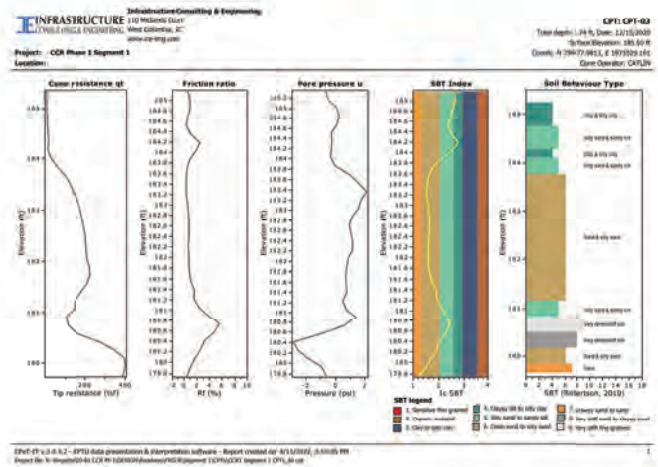
COUNTY	ROUTE
RICHLAND	RAMP A

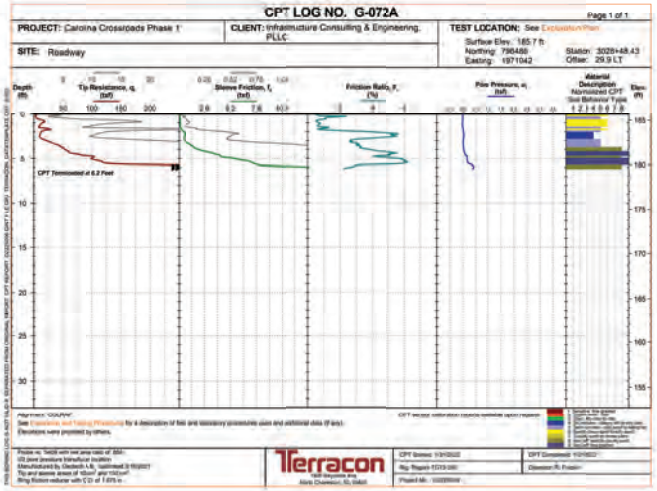
Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\08_BRIDGE 34_BORING LOGS (5).dgn
11/2/2022
9:16:56 AM

BRIDGE PLANS ID	SHEET NO.
P039718-B34	19









REV.	BY	CHK.	DATE
	JPF		11-03-22
	RFC PLANS		
REV.			
REV.			
REVIEWED	J. FELKEL		
QUAN.			
DR.	ADG	DKY	05-22
DES.			

FOR INFORMATION ONLY

ARCHER UNITED JOINT VENTURE

INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

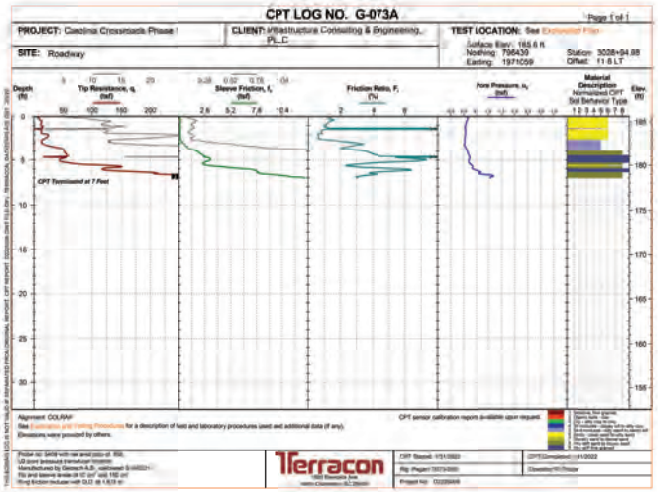
BORING LOGS (6)

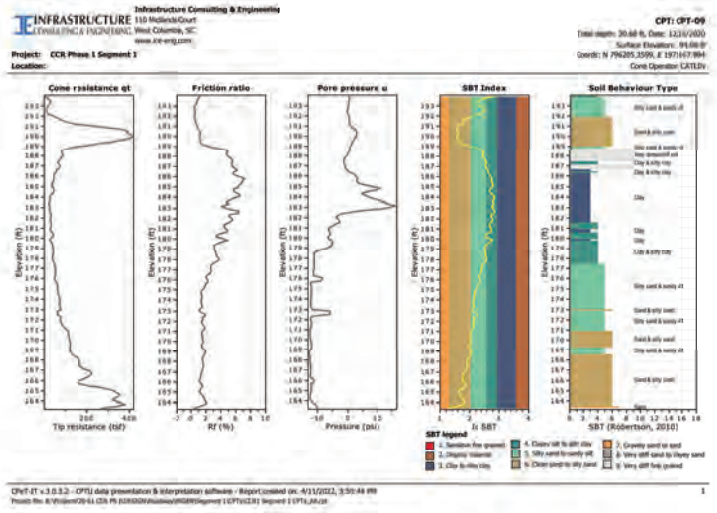
COLONIAL LIFE BLVD. RAMP A BRIDGE OVER I-126 RAMP & S-287 (ARROWWOOD ROAD)

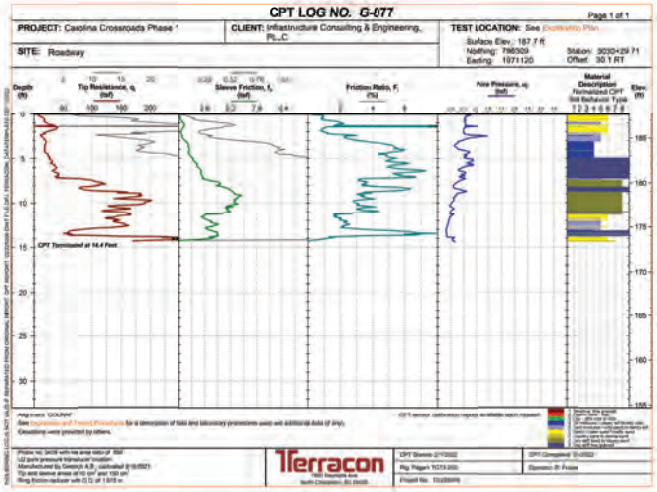
COUNTY	ROUTE
RICHLAND	RAMP A

Z:\Projects\20-61CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\09_BRIDGE 34_BORING LOGS (6).dgn
11/2/2022
9:42:22 AM

BRIDGE PLANS ID	SHEET NO.
P039718-B34	20







FOR INFORMATION ONLY

REV.		JPF	11-03-22
		RFC PLANS	
REV.			
REV.			
REVIEWED	J. FELKEL		
QUAN.			
DR.	ADG	DKY	05-22
DES.			
	BY	CHK.	DATE

ARCHER UNITED JOINT VENTURE
INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

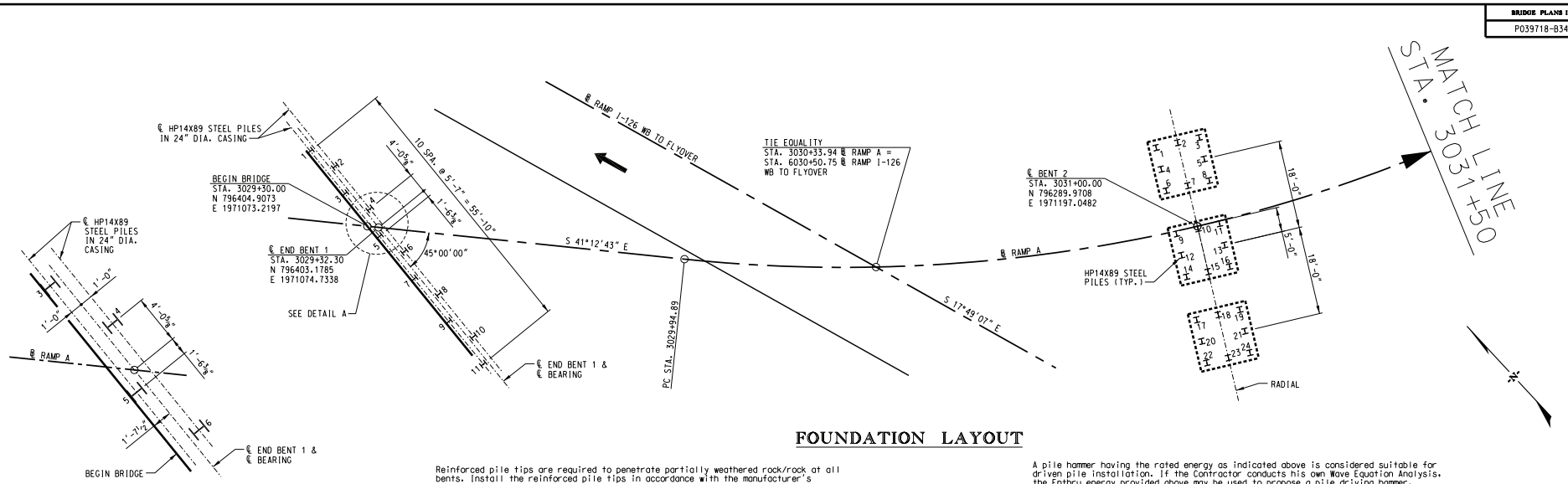
BORING LOGS (7)

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

COUNTY: RICHLAND
ROUTE: RAMP A

Z:\Projects\20-61CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\20_BRIDGE 34_BORING LOGS (7).dgn
11/2/2022
9:42:47 AM

BRIDGE PLANS ID	SHEET NO.
P039718-B34	23



DETAIL A

FOUNDATION LAYOUT

GENERAL NOTES - PILE BEARING:

BENT I.D.	END BENT 1	INT. BENT 2	INT. BENT 3	END BENT 4
PILE SECTION	HP14X89	HP14X89	HP14X89	HP14X89
CONTROL LIMIT STATE	STRENGTH	STRENGTH	STRENGTH	STRENGTH
FACTORED DESIGN LOAD (KIPS)	283	365	222	409
GEOTECHNICAL RESISTANCE FACTOR	0.65	0.65	0.65	0.65
NOMINAL RESISTANCE (KIPS)	435	562	342	629
ESTIMATED SCOUR	0	0	0	0
LIQUEFACTION INDUCED DOWNDRAG (KIPS)	0	0	0	0
SETTLEMENT INDUCED UNFACTORED DOWNDRAG (KIPS)	0	0	0	0
SETTLEMENT INDUCED FACTORED DOWNDRAG (KIPS)	0	0	0	0
REQUIRED DRIVING RESISTANCE (KIPS)	435	562	342	629
REQUIRED MINIMUM TIP ELEVATION TO ACHIEVE LATERAL STABILITY (FEET MSL)	182.5[1]	165[1]	182.5[1]	204.5[1]
ESTIMATED PILE TIP ELEVATION (FEET MSL)	166[2]	158[2]	159[2]	175[2]

Notes:
[1]Minimum Tip Elevation based on Lateral Pile Analysis
[2]Estimated Tip Elevation Based on Axial Pile Analysis

Bridge end bent piles are to be driven before Mechanically Stabilized Earth (MSE) wall and embankment construction. Piles shall be stopped approximately 10 feet above the estimated tip elevation during initial driving and settlement monitoring completed prior to driving to the estimated tip elevation.

Settlement monitoring shall be completed during MSE wall and embankment construction in accordance with South Carolina Department of Transportation (SCDOT) supplemental technical specification SC-M-203-4 by installing one settlement plate within each bridge abutment footprint. The location of these settlement plates shall be coordinated between the contractor and geotechnical engineer of record (EOR) during construction. The results of this monitoring shall be used by the EOR to determine when the piles may be driven to the final tip elevation. We estimate that a wait time of one month may be required prior to final pile installation.

When driving piles to the estimated tip elevations (after the settlement wait period for end bent piles), piles shall be stopped at the highest allowable finished grade on the plans to accomodate a restrike while still remaining within an allowable plan finished grade elevation.

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

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

Each production pile is to be installed in one continuous operation. Details of any anticipated temporary driving discontinuances, including anticipated time intervals in the Pile Installation Plan, shall be included.

Method of controlling installation of piles and verifying their capacity: Capacity will be verified by pile driving analyzer (PDA) and Case Pile Wave Analysis Program (CAPWAP) analysis on one production index pile at Bents 1 and 3 during initial driving. The results of the PDA and CAPWAP analysis will be used to develop pile driving criteria that relate pile capacity versus driving blow count.

Pile capacity analysis should be performed on the indicated index piles during pile driving to the estimated tip elevation (after the settlement wait period for end bent piles) before other production piles at that pile bent are driven. If a CAPWAP analysis determines that the required capacity has not been achieved, wait 3 days and re-strike the production pile exhibiting the least blows per foot of driving with CAPWAP analysis to verify capacity.

The minimum tip elevation to achieve lateral stability and the estimated tip elevation for the bridge bent driven piles on site are presented in the following tables. All piles are HP 14x89 steel piles.

Planned temporary slopes required for pile installation shall be provided to GeoEngineers for review prior to construction. The contractor is responsible for the stability of temporary slopes and should follow all SCDOT and Occupational Safety and Heath Administration (OSHA) temporary slope guidelines.

Temporary dewatering may be required to install the interor Bent 2 piles if excavations extend below the groundwater elevation encountered in this location.

Reference the Standard Specifications for Highway Construction for Driven Pile Foundations, Section 711. Notest 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 Bent 2 and 3, and End Bent 4

DRIVABILITY ANALYSIS

BENT I.D.	END BENT 1	INT. BENT 2	INT. BENT 3	END BENT 4
SKIN QUAKE (QS)	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
SKIN DAMPING (SD)	0.05 s/ft	0.05 s/ft	0.05 s/ft	0.05 s/ft
TOE DAMPING (TD)	0.15 s/ft	0.15 s/ft	0.15 s/ft	0.15 s/ft
% SKIN FRICTION	5 to 80	5 to 80	5 to 80	5 to 80
% END BEARING	20 to 95	20 to 95	20 to 95	20 to 95
DISTRIBUTION SHAPE NO.	VARIABLE	VARIABLE	VARIABLE	VARIABLE
PILE PENETRATION	40 to 100%	40 to 100%	40 to 100%	40 to 100%
HAMMER RATED ENERGY[1]	46 ft-kips/kW	46 ft-kips/kW	46 ft-kips/kW	46 ft-kips/kW
HAMMER ENTHRU ENERGY[2]	20 to 30 ft-kips	20 to 30 ft-kips	20 to 30 ft-kips	20 to 30 ft-kips

Notes:
[1]Hammer rated energy is based on GRLWEAP maximum rated energy database for diesel hammers.
[2]Hammer energy is based on wave equation transferred energy (Enthru).
GRLWEAP (2005) was used to perform wave equation analysis.

A pile hammer having the rated energy as indicated above is considered suitable for driven pile installation. If the Contractor conducts his own Wave Equation Analysis, the Enthru energy provided above may be used to propose a pile driving hammer. However, final hammer approval is based on a wave equation analysis that accurately reflects the Contractor's proposed driving system.

END BENT PILE INSTALLATION SEQUENCING

The end bent piles are to be located within or immediately adjacent to the reinforced areas of the MSE abutments. SCDOT specifies the construction sequence in supplemental technical specification SC-M-713 (January 2019), Section 411 of this document stipulates that abutment piles placed within reinforced zone are to be cased through the reinforced backfill, and that the construction sequence will be as follows:

a. Drive all piles within the reinforced zone prior to MSE wall construction. Piles should be driven to the initial estimated tip elevation.

b. Encase each pile in a smooth wall or corrugated galvanized steel (SWCGS) pipe of sufficient thickness to prevent buckling or distortion during placement and compaction of wall backfill.

c. Externally stabilize the SWCGS pipe to prevent the pipe from coming in contact with the pile during backfilling of the wall.

d. Extend the SWCGS pipe from the bottom of the backfill to 2 inches min. to 6 inches max. below the bottom of the bridge abutment cap.

e. After positioning, seal the top of the SWCGS pipe to prevent debris accumulation during placement of wall backfill, and keep the pipe sealed until the pipe is filled with granular material.

f. Unseal the pipe and fill the SWCGS pipe loosely with granular material after completion of the wall construction.

NOTES:

FOR TYPICAL PILE LAYOUT AT BENT 2, SEE "FOUNDATION LAYOUT (2)" SHEET.

ARCHER UNITED JOINT VENTURE
INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 26987 — 2022.11.03 08:13:08-04'00'
SOUTH CAROLINA INFRASTRUCTURE CONSULTING & ENGINEERING, PLLC No. 4470 CERTIFICATE OF AUTHORIZATION

REV.	BY	CHK.	DATE
	JPF		11-03-22
			RFC PLANS
REVIEWED	J. FELKEL		
QUAN.			
DR.	BFS	WLH	06-22
DES.	DKY	CSB	07-22

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

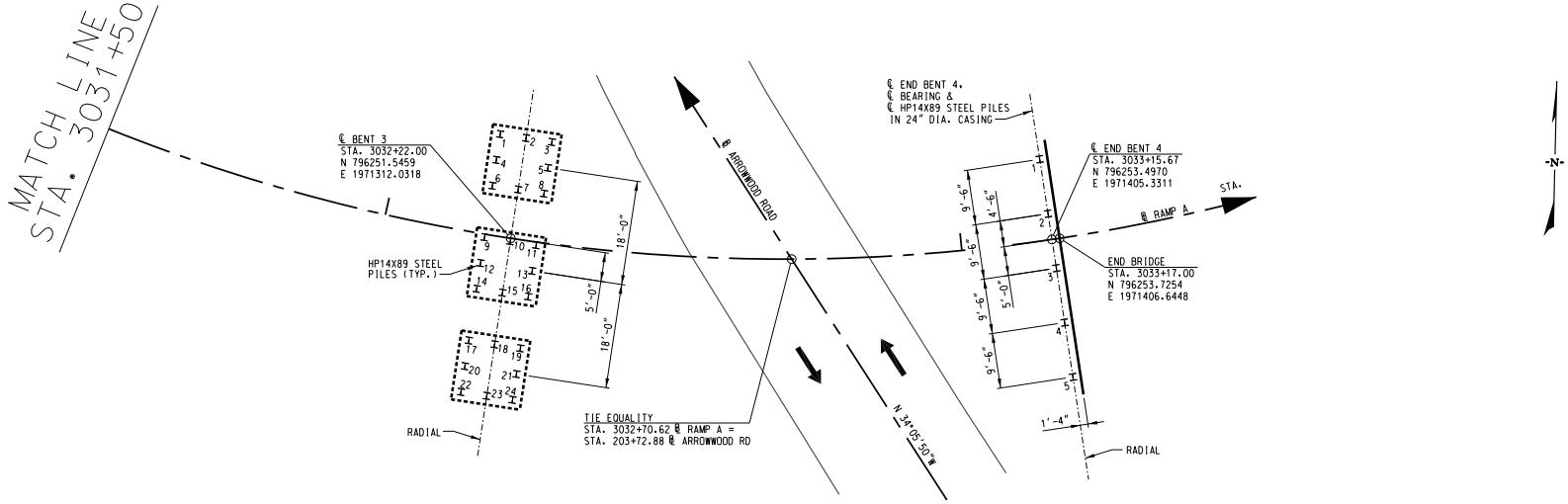
FOUNDATION LAYOUT (1)

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

COUNTY: RICHLAND
ROUTE: RAMP A

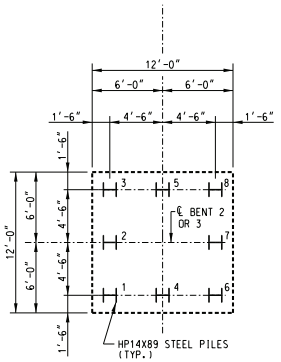
Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\23_BRIDGE 34_FOUNDATION LAYOUT (1).dgn
11/2/2022
9:43:09 AM

BRIDGE PLANS ID	SHEET NO.
P039718-B34	24



FOUNDATION LAYOUT

NOTES:
FOR FOUNDATION NOTES, SEE "FOUNDATION LAYOUT (1)" SHEET.



TYPICAL PILE LAYOUT AT BENT 2 & 3

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

REV.	JPF	11-03-22
	RFC PLANS	
REV.		
REV.		
REVIEWED	J. FELKEL	
QUAN.		
DR.	BFS	DKY 06-22
DES.	DKY	CSB 07-22
	BY	CHK. DATE

ARCHER UNITED JOINT VENTURE
INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION

FOUNDATION LAYOUT (2)

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

COUNTY	ROUTE
RICHLAND	RAMP A

Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\24_BRIDGE 34_FOUNDATION LAYOUT (2).dgn
11/2/2022
9:43:09 AM

BRIDGE PLANS ID	SHEET NO.
P039718-B34	33

TOP OF BUILD-UP ELEVATIONS					
LOCATION	GIRDER ①	GIRDER ②	GIRDER ③	GIRDER ④	GIRDER ⑤
BACK	230.403	231.165	231.927	232.688	233.450
AHEAD	233.795	233.824	234.582	235.341	236.099

NOTES:

TOC - TANGENT OF CURVE

EF-DENOTES EACH FACE

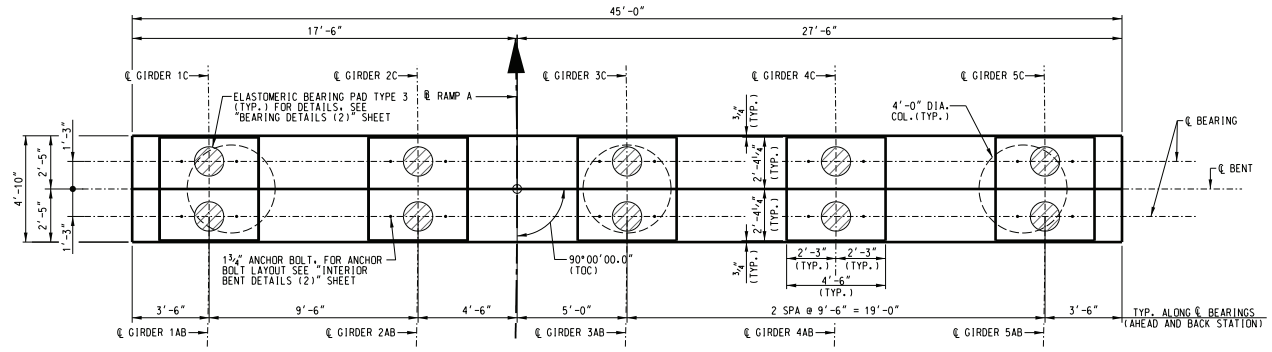
BARS MAY BE SHIFTED SLIGHTLY TO CLEAR COLUMN BARS.

FOR SECTIONS A-A AND B-B, SEE "INTERIOR BENT DETAILS (1)" SHEET.

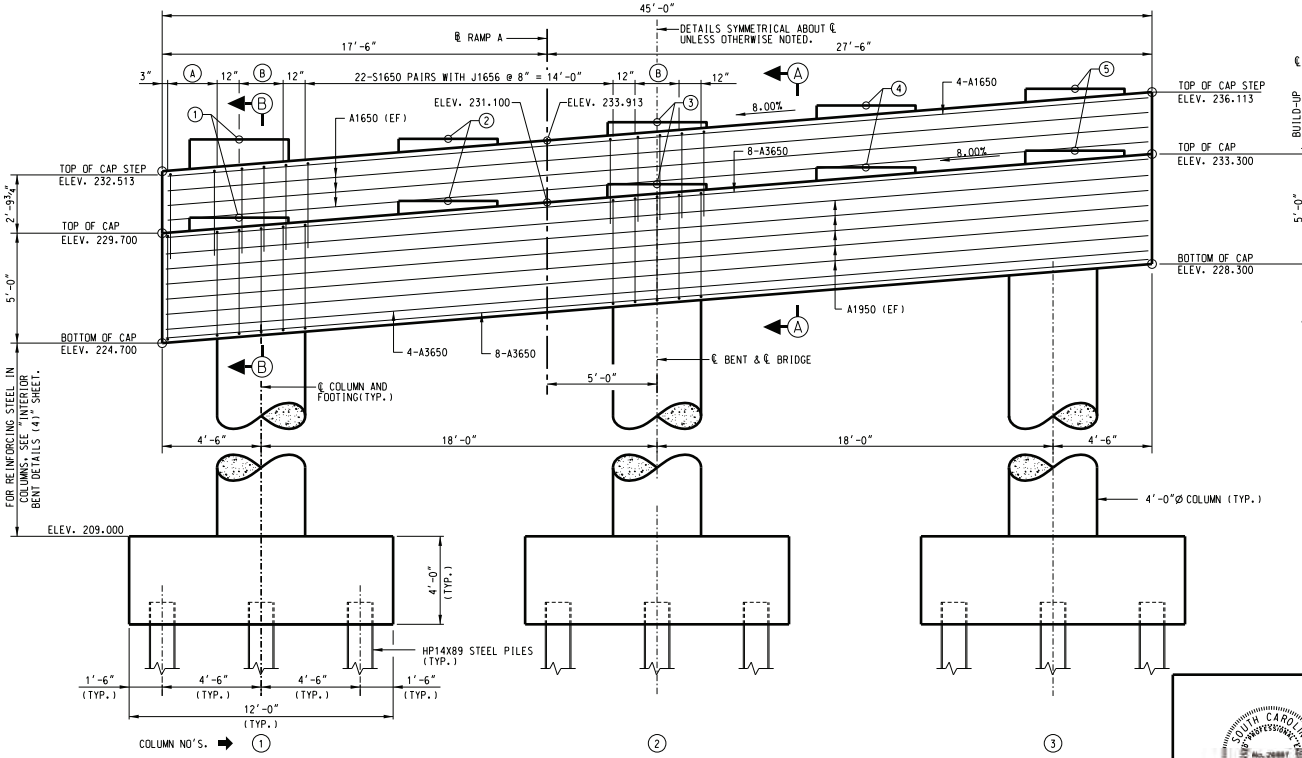
FOR BUILD-UP DETAILS, SEE "INTERIOR BENT DETAILS (3)" SHEET.

Ⓐ 6-S1650 PAIRS WITH J1656 @ 6" MAX. = 2'-3"

Ⓑ 3-J1650 PAIRS WITH J1656 @ 12" = 2'-0"

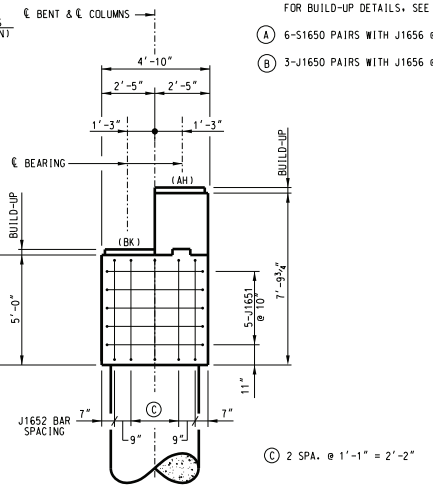


PLAN



ELEVATION

LOOKING IN DIRECTION OF STATIONING



END ELEVATION

REV.	JPF	11-03-22
	RFC PLANS	
REV.		
REV.		
REVIEWED	J. FELKEL	
QUAN.		
DR.	BFS	DKY 07-22
DES.	DKY	CSB 07-22
	BY	CHK. DATE

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 29881 J. PAUL FELKEL

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

2022.11.03 08:19:37-04'00'

ARCHER UNITED JOINT VENTURE

INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

INTERIOR BENT 3

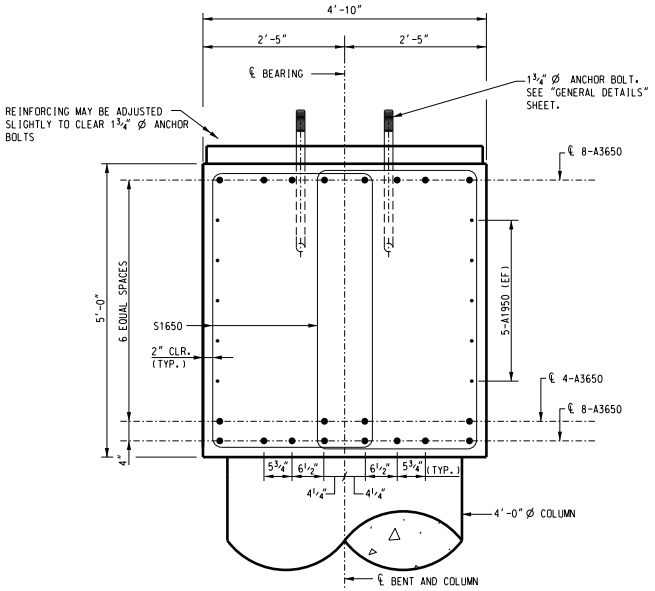
COLONIAL LIFE BLVD. RAMP A BRIDGE OVER I-126 RAMP & S-287 (ARROWWOOD ROAD)

COUNTY: RICHLAND

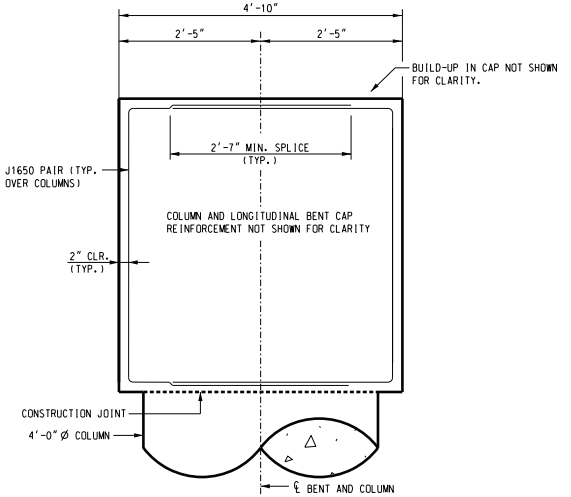
ROUTE: RAMP A

Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\33_BRIDGE 34_INTERIOR BENT 3.dgn
11/2/2022
9:43:17 AM

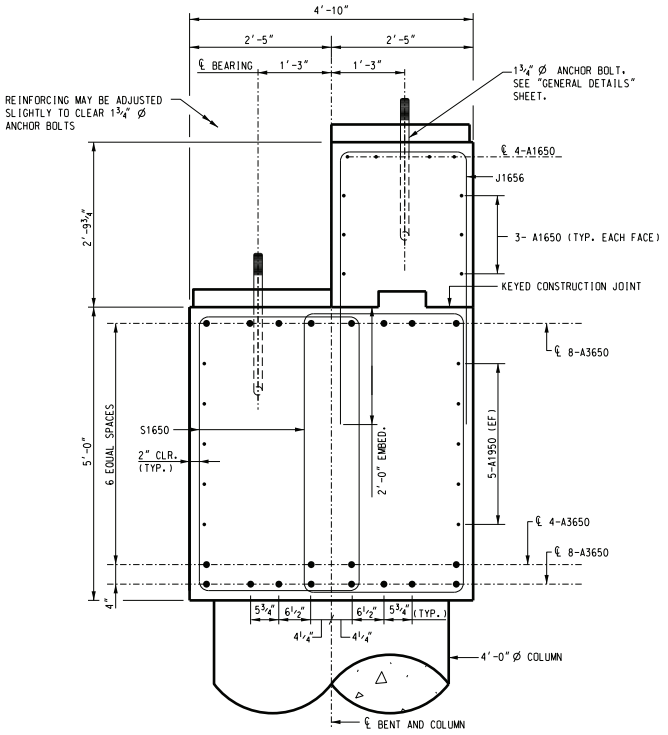
BRIDGE PLANS ID	SHEET NO.
P039718-B34	34



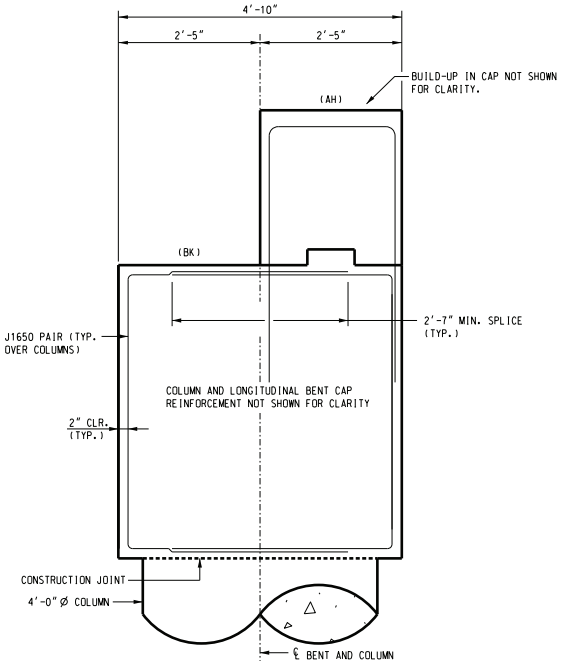
SECTION A-A
(INTERIOR BENT 2)



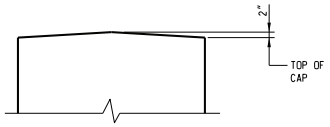
SECTION B-B
(INTERIOR BENT 2)



SECTION A-A
(INTERIOR BENT 3)



SECTION B-B
(INTERIOR BENT 3)



TOP OF CAP SLOPING DETAIL
(INTERIOR BENT 3)

ARCHER UNITED JOINT VENTURE
INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 26987 — PRELIMINARY NOT FOR CONSTRUCTION
SOUTH CAROLINA INFRASTRUCTURE CONSULTING & ENGINEERING, PLLC No. 4470 CERTIFICATE OF AUTHORIZATION
2022.11.03 08:20:05-04'00'

REV.			
	JPF	11-03-22	RFC PLANS
REV.			
REV.			
REVIEWED	J. FELKEL		
QUAN.			
DR.	BFS	DKY	07-22
DES.	DKY	CSB	07-22
	BY	CHK.	DATE

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

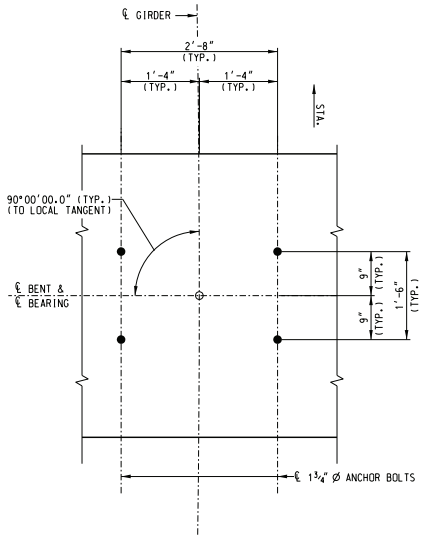
INTERIOR BENT DETAILS (1)

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

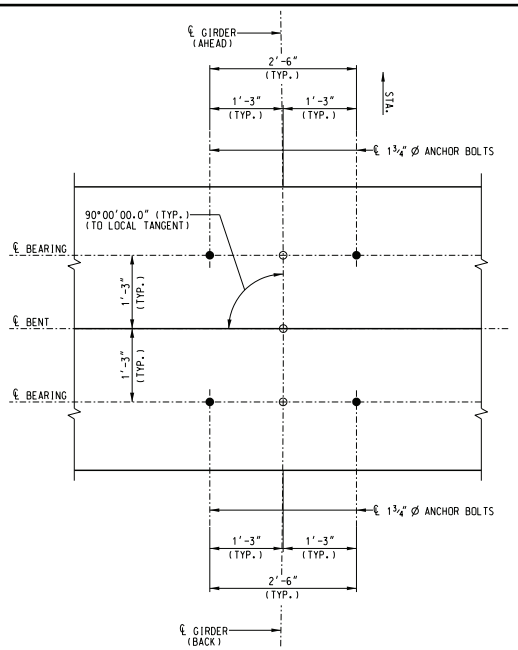
COUNTY	ROUTE
RICHLAND	RAMP A

Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\34_BRIDGE 34_INTERIOR BENT DETAILS (1).dgn
11/2/2022
9:43:48 AM

BRIDGE PLANS ID	SHEET NO.
P039718-B34	35



ANCHOR BOLT LAYOUT
BENT 2



ANCHOR BOLT LAYOUT
BENT 3

ESTIMATED QUANTITIES			
ITEM	UNIT	QUANTITY	
		BENT 2	BENT 3
WET & DRY EXCAVATION FOR BRIDGES	CY	376	259
CONCRETE FOR STRUCTURES, CLASS 4000	CY	152.2	141.9
REINFORCING STEEL FOR STRUCTURES (BRIDGE) (1)	LBS.	26,938	24,824
HOOP REINFORCING STEEL FOR STRUCTURES (BRIDGE)	LBS.	3,166	2,383
DYNAMIC PILE ANALYZER TEST SET-UP	EACH	--	1
PILE DRIVING SET-UP	EACH	24	24
REINFORCED PILE TIPS (HP14X89)	EACH	24	24
STEEL H BEARING PILING (HP14X89)	LF	612	1,130
ELASTOMERIC BEARING	EACH	5	10

(1) INCLUDES 462 LBS. AT BENT 2 AND 449 LBS. AT BENT 3 FOR ANCHOR BOLT ASSEMBLIES.
PILE QUANTITY IS BASED ON 1'-0" PILE EMBEDMENT.

ARCHER UNITED JOINT VENTURE
INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 26987
SOUTH CAROLINA INFRASTRUCTURE CONSULTING & ENGINEERING, PLLC No. 4470 CERTIFICATE OF AUTHORIZATION
2022.11.09 08:20:35-04'00'

REV.	BY	CHK.	DATE
REV.	JPF		11-03-22 RFC PLANS
REV.			
REV.			
REVIEWED	J. FELKEL		
QUAN.	DKY	RWS	08-22
DR.	BFS	DKY	07-22
DES.	DKY	CSB	07-22

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

INTERIOR BENT DETAILS (2)

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

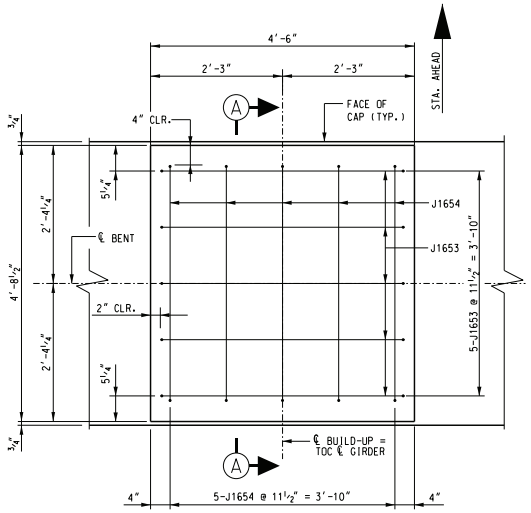
COUNTY: RICHLAND
ROUTE: RAMP A

Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\35_BRIDGE 34_INTERIOR BENT DETAILS (2).dgn
11/2/2022
9:43:48 AM

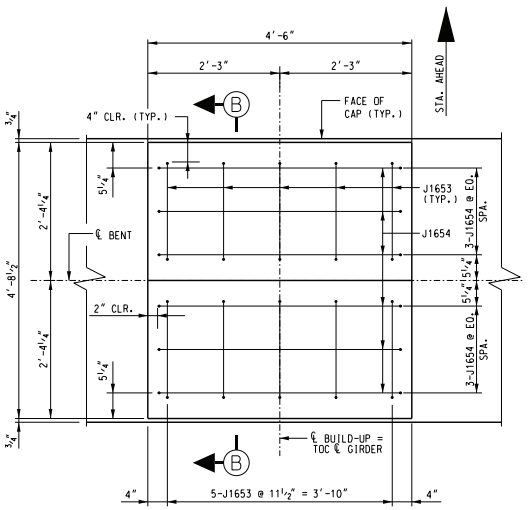
BRIDGE PLANS ID	SHEET NO.
P039718-B34	36

NOTE:

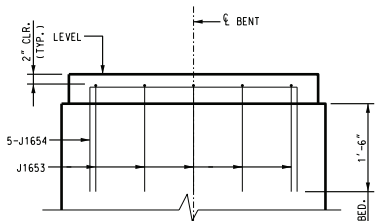
BARS MAY BE SHIFTED SLIGHTLY TO CLEAR CAP AND COLUMN REINFORCEMENT AND ANCHOR BOLTS.



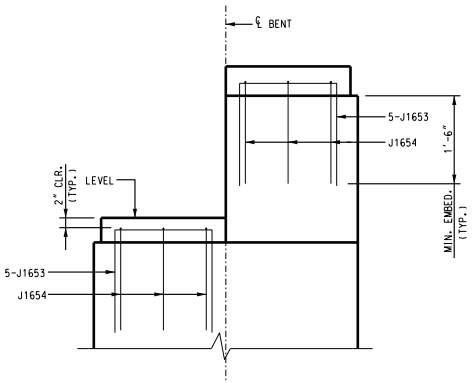
PLAN OF BUILD-UP
BENT 2



PLAN OF BUILD-UP
BENT 3



SECTION A-A



SECTION B-B

ARCHER UNITED JOINT VENTURE
INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

INTERIOR BENT DETAILS (3)

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

COUNTY: RICHLAND | ROUTE: RAMP A

REV.	JPF		11-03-22	RFC PLANS
REV.				
REV.				
REVIEWED	J. FELKEL			
QUAN.				
DR.	BFS	DKY	07-22	
DES.	DKY	CSB	07-22	
	BY	CHK.	DATE	

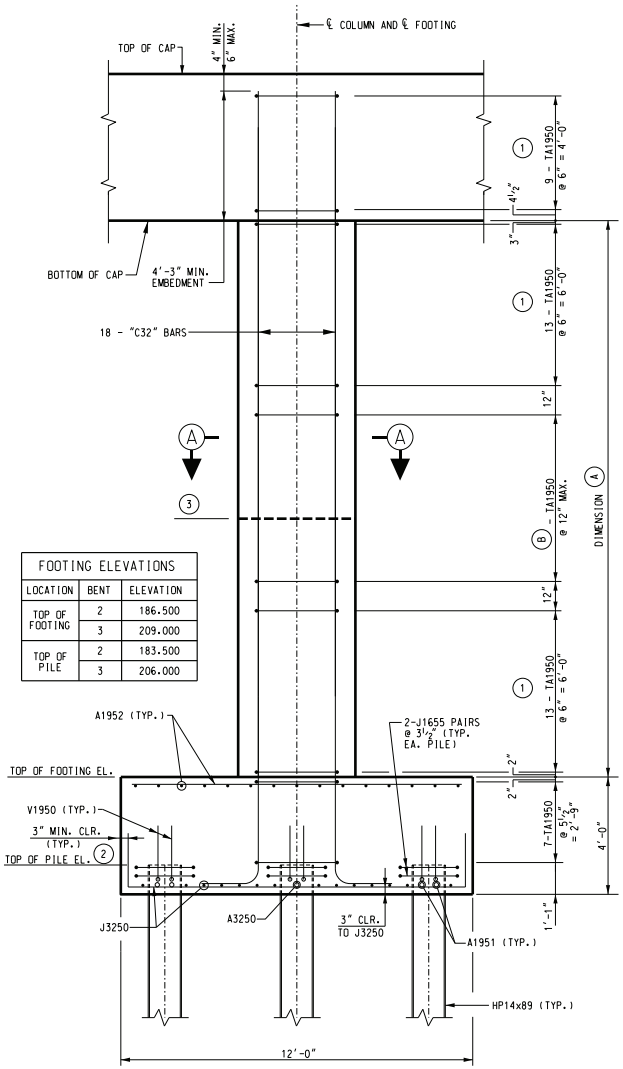
SOUTH CAROLINA PROFESSIONAL ENGINEER No. 26987 — PRELIMINARY PLANS NOT FOR CONSTRUCTION

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

2022.11.03 08:21:02-04'00'

Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\36_BRIDGE 34_INTERIOR BENT DETAILS (3).dgn
11/2/2022
9:43:19 AM

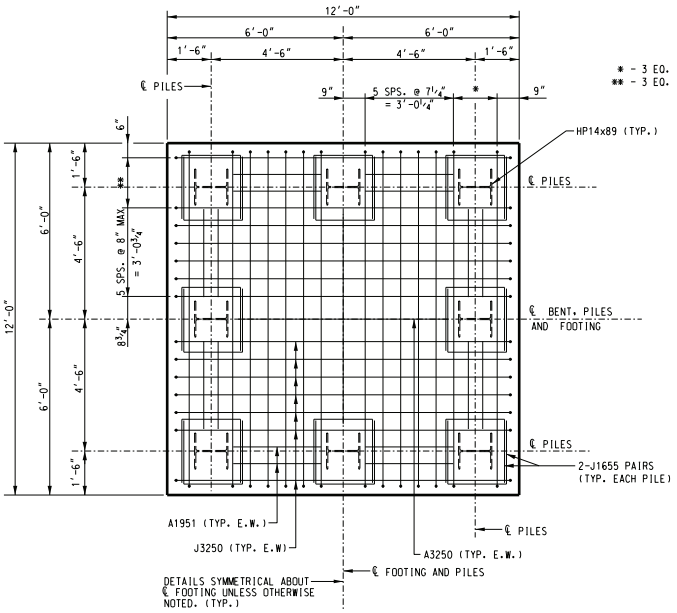
BRIDGE PLANS ID	SHEET NO.
P039718-B34	37



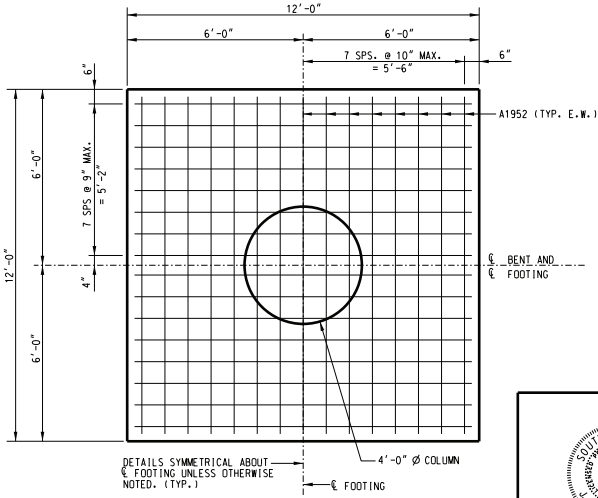
FOOTING ELEVATIONS		
LOCATION	BENT	ELEVATION
TOP OF FOOTING	2	186.500
	3	209.000
TOP OF PILE	2	183.500
	3	206.000

COLUMN AND FOOTING ELEVATION

(3) PERMISSIBLE CONSTR. JOINT
ELEV. 204.000 (BENT 2, COLUMNS 1 THRU 3)



FOOTING PLAN - BOTTOM MAT



FOOTING PLAN - TOP MAT

NOTES:

THE LOCATION OF WELDED SPLICES ON ADJACENT HOOPS SHALL BE STAGGERED AROUND PERIMETER OF COLUMN BY A MINIMUM OF ⅓ OF THE HOOP CIRCUMFERENCE.

(1) NO SPLICE ALLOWED IN LONGITUDINAL REINFORCING STEEL.

(2) PILE EMBED = 1'-6" MAX., 1'-0" MIN.

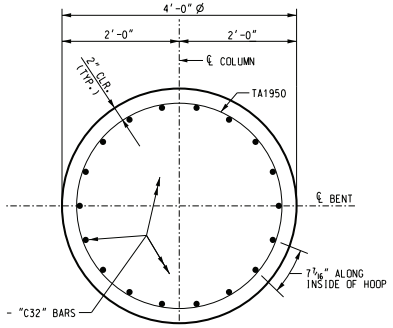
SHIFT TA1950 BARS TO AVOID FOOTING REINFORCING.

SHIFT A1952 BARS TO AVOID VERTICAL COLUMN REINFORCEMENT.

FOR STEEL H-PILE ANCHORAGE DETAIL, SEE "END BENT 1 DETAILS (1)" SHEET.

ALL DIMENSIONS IN COLUMN AND FOOTING MEASURED AT ℄ OF COLUMN.

E.W. - DENOTES EACH WAY



SECTION A-A

TABLES OF VARIABLES - COLUMNS			
BENT NO.	COLUMN NO.	DIMENSION (A)	(B)
2	1	31'-5 5/16"	19
	2	32'-10 11/16"	20
	3	34'-4 1/8"	21
3	1	16'-0 3/4"	3
	2	17'-6"	5
	3	18'-11 1/4"	6

REV.	BY	CHK.	DATE
REV.	JPF		11-03-22
	RFC PLANS		
REV.			
REV.			
REVIEWED	J. FELKEL		
QUAN.			
DR.	BFS	DKY	07-22
DES.	DKY	CSB	07-22

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 26987
SOUTH CAROLINA INFRASTRUCTURE CONSULTING & ENGINEERING, PLLC CERTIFICATE OF AUTHORIZATION No. 4470
2022.11.03 08:21:26-04'00'

ARCHER UNITED JOINT VENTURE
INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

INTERIOR BENT DETAILS (4)

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

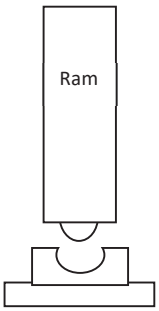
COUNTY	ROUTE
RICHLAND	RAMP A

Z:\Projects\20-6\CCR Ph I\Structures\01_New Bridges\Bridge 34\04_Final Plans\37_BRIDGE 34_INTERIOR BENT DETAILS (4).dgn
11/2/2022
9:43:9 AM

Appendix C

Pile Driving Hammer Information

County:	Richland	Bridge Plans ID:	P039718
Route:	Bridge over Ramp I-126 WB to Flyover and Road S-287 (Arrowwood Rd.)		
Description:	Carolina Crossroads Phase 1 Bridge 34 14X89 H-Piles		
Contractor:	Archer United		



Hammer

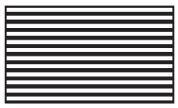
Manufacturer:	ICE			Model:	I-19
Type:	Single Act Diesel			Serial No.	TBD
Rated Energy (k-ft)	46.17	at	11.5	Length of stroke (ft)	
Lead Size (in):	26				
Modifications:	None				

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

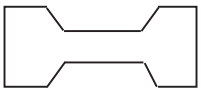


Hammer Cushion

Description:

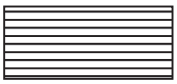
Material Description		No. of Layers	Modulus of Elasticity (ksi)	Thickness (in)
1	MC-904 Blue Nylon	1	175	2
2				

Area (sq. in):	398	Total Thickness (in)	2.5
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:	14X89 H-Piles & 14X89 Reinforced pile tips		
Total Pile & Point Length (ft):	BR34 EB1 – 46.5 IB2 – 26 IB3 – 47.5 EB4 – 60.5	Exposed Pile Point Length (ft):	N/A
Pile Cross-Sectional Area (sq.in):	N/A		
Pipe Pile Wall Thickness (in):	N/A		
Pile Tip Description:	N/A		
Splice Description:	N/A		

		Splice Location From Pile Top (ft):	N/A
		Concrete Pile Strength, f'_c (psi):	N/A
		Steel Pile Yield Strength, F_y (ksi):	50

Note: Within 30 calendar days after award of contract or no later than 30 days before driving the first pile, submit form and Pile Installation Plan to the Geotechnical Design Engineer, with copy to the Bridge Construction Engineer and RCE.

SCDOT – Design-Build Section
Geotechnical Design Engineer
P.O. Box 191
Columbia, SC 29202-0191
Telephone (803) 737-0766
FAX (803) 737-9868

Submitted By:	Josh Bennett		
Title:	Project Engineer		
Telephone No.	(803)374-9108	Date:	10/14/2022

Appendix D

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

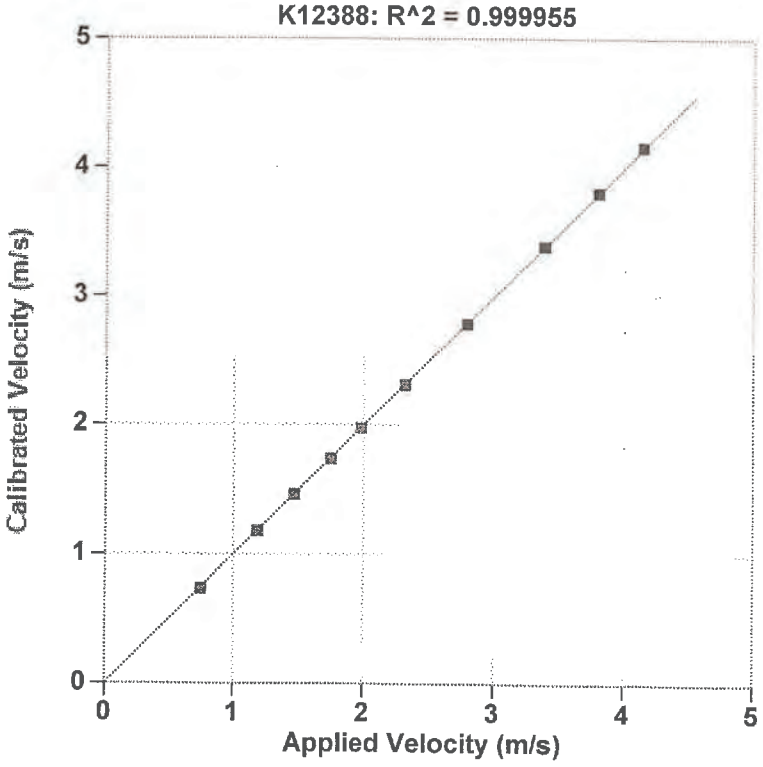
Reference accelerometer calibrations are traceable to the United States National Institute of Standards and Technology (NIST).

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

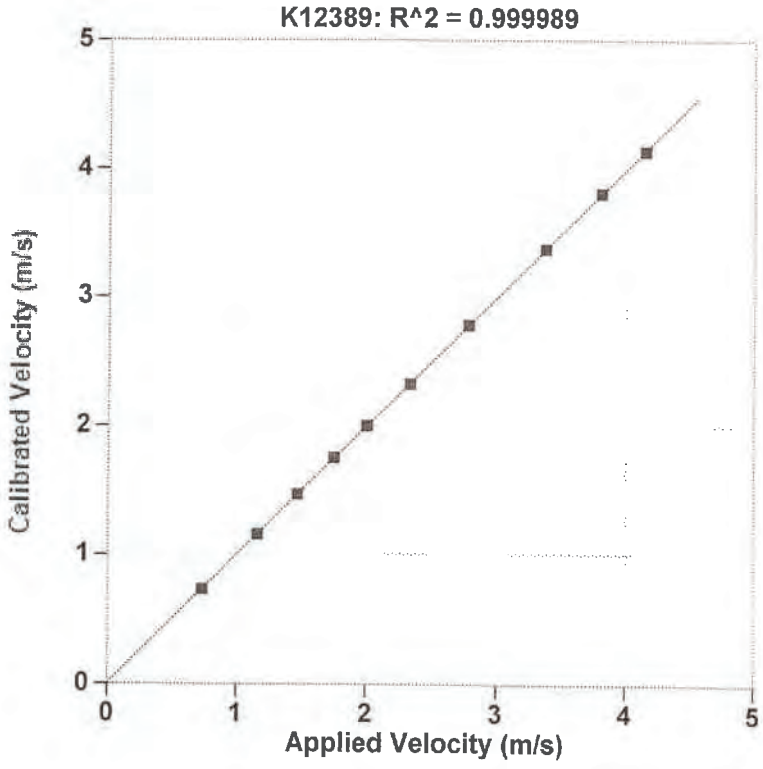
Reference accelerometer calibrations are traceable to the United States National Institute of Standards and Technology (NIST).

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

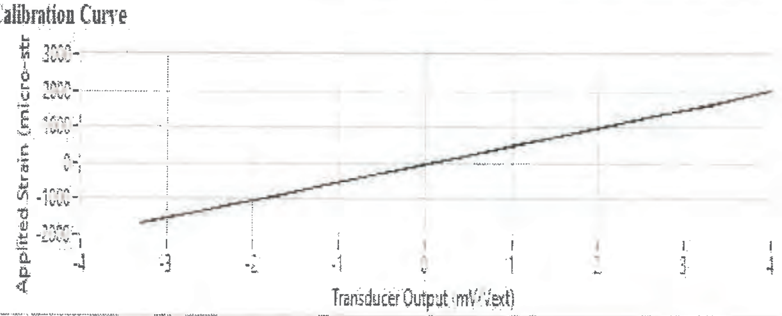
General Gage Factor: 503.9 **me**/mV/V_{ext}

Initial Offset Voltage 0.006 mV/V_{ext}

Table 1 Representative Calibration Data

Applied Strain (microstrain)	Transducer Output (mV/Vext)	Applied Strain (microstrain)	Transducer Output (mV/Vext)
-41.039	-0.142	223.451	0.442
-101.916	-0.145	522.711	1.034
-391.374	-0.725	912.048	1.645
-659.231	-1.235	1125.332	2.252
-903.922	-1.740	1485.617	2.653
-1151.022	-2.242	1751.401	3.563
-1421.538	-2.738	2007.564	3.936
-1628.524	-3.132	1988.853	3.919
-1697.401	-3.333	1622.651	3.234
-1565.939	-3.135	1306.004	2.646
-1332.939	-2.455	998.220	2.028
-1054.345	-2.092	691.373	1.420
-796.582	-1.550	418.391	0.885
-526.002	-1.035	156.582	0.354
-274.157	-0.511	41.451	0.145
-55.234	-0.139	40.035	0.143

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

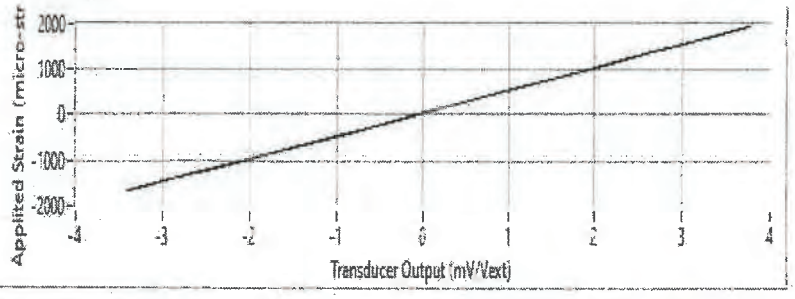
General Gage Factor: 503.9 me/mV/V$_{ext}$

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 E

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