



February 24, 2023

Mr. Jonny Macfarlane
Mays Construction Specialties
2399 Riverside Parkway
Grand Junction, Colorado 81505
970-245-0834 ph

RE: 183 River Ridge Court, Grand Junction, CO – Micropile Verification and Proof Testing Review and acceptance criteria

Dear Mr. Macfarlane,

Attached, please find the results of micropile verification test performed on 2/17/23 and proof test performed on 2/21/23.

The pile installation for the micropile verification test #2 was accomplished using simultaneous drilling and grouting operations to an overall installation depth of 45' through a T30/11 hollow reinforcing bar using a 4" diameter sacrificial steel drill bit. The verification test micropile has a 10'-0" bond length, a 35' PVC sleeved length and 3'-0" above ground free length. The pile installation for all production micropiles are identical to the verification test installation. Proof tested micropiles are production piles installed after verifying the design bond adhesion through verification testing. I have reviewed all proof test results and am using test #3 as an reference.

Verification Test Pile #2 – Tension Test – The pile was installed to a 45' total length below grade with 10' bond length and 35' below ground free length and 3'-0" above grade using the drilling method described above. At 200% of the design load, the micropile experienced permanent and elastic movement of 0.113" and 0.383"; respectively. At the end of the test, the micropile debonded (-12.55') and has an apparent bond length of 22.55. Since the micropile head movement at 200% design load (0.495") is less than (0.025 in/kip * 40 kip = 1.00") load versus micropile head settlement and the creep criteria was satisfied, the test passes the micropile verification test per NHI-05-039 "Micropile Design and Construction Manual". The creep test was held for 10 minutes in accordance with NHI-05-039, as movement in the first 10 minutes was less than 0.040".

Proof Test Pile #3 – Tension Test – The production micropile was installed to a 45' total length below grade with 10' bond length, 35' below ground free length and 5'-0" above grade. At 160% of the design load, the micropile experienced permanent and elastic movement of 0.0370" and 0.176"; respectively. At the end of the test, the micropile debonded (-24.44') and has an apparent bond length of 34.44'. Since the micropile head movement at 160% design load (0.213") is less than (0.025 in/kip * 40 kip = 1.00") load versus micropile head settlement and the creep criteria was satisfied, the test passes the micropile verification test per NHI-05-039

PRINTZ ENGINEERING SERVICES, LLC
1248 W. EL TORO WAY
PUEBLO WEST, CO 81007
TPRINTZ@PRINTZENGINEERINGSERVICES.COM



"Micropile Design and Construction Manual". The creep test was held for 10 minutes in accordance with NHI-05-039, as movement in the first 10 minutes was less than 0.040".

The micropiles did not debond the entire sleeved length; therefore, debonding is showing as a negative number. There is residual bonding occurring in the sleeved (cased) length of the micropile, as indicated by the elastic movement of the micropile at maximum test load. The micropiles have additional geotechnical capacity due to the residual bonding in the sleeved length. Swelling soils that may act on this length of micropile in the form of uplift is not a concern due to the combination of dead load pressure on the micropile and sufficient bond length below the expansive soils that should prevent foundation uplift. Movement will occur; however, they will be small movements, corresponding with the elastic movement of the micropile reinforcing. Very small permanent movement was realized during testing. This movement can be attributed to mechanical movement and movement along the grout to ground interface to mobilize the shear strength of the soil.

Please do not hesitate to contact me with any questions or concerns that you may have.

Kind Regards,

Thomas A. Printz, P.E.
President
Printz Engineering Services, LLC

Attachments:

Verification Test #2 (5 pages)
Proof Test #3 (5 pages)
Hydraulic Testing Equipment Calibration (1 page)



2-24-2023

Kelly Residence																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
-----------------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Kelly Residence

Pile:

Starting Free Length:

Starting Bond Length:

Below Ground Free Length:

Above Ground Free Length:

Total Length:

Sacrificial Test Pile installed

35.00	ft	420	in
10.00	ft	120	in
35.00	ft	420	in
3.00	ft	36	in
45.00	ft	540	in

Test Date:

02/17/23

Design Load (100%):

20 kip

Max Test Load (200% DL):

40 kip

No. of Elements:

1

Modulus of Elasticity:

29000 kip/in2

Element Area:

0.94 in2

Casing OD:

in

Casing TW:

in

Casing ID:

in

Jack-Gauge Factor:

0.012025265 kip/psi

Load Cell Serial Number:

-

Load Cell Zero reading (avg.):

-

Load Cell Scale Factor:

-

Load Cell Offset:

-

Casing Area:

0 in^2

Theoretical Elongation (calculate at max test load):

0.616 inches

Apparent Free Length:

Debonding:

Apparent Bond Length:

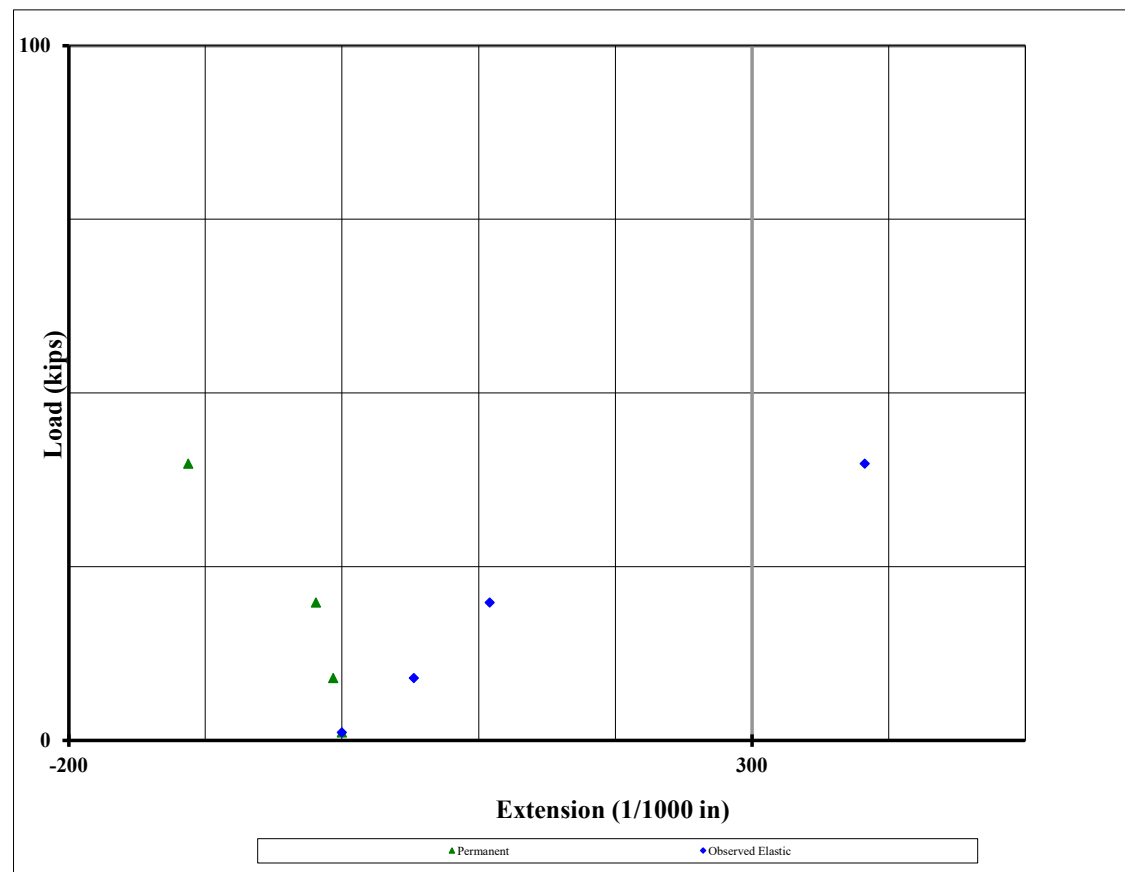
At 200% design load

269.3	inches	22.45	ft
-150.7	inches	-12.55	ft
270.7	inches	22.55	ft

% Design Load (%)	Holding Time (min)	Spec. Load (klps)	Time of Reading (24h)	Calc. Jack Press. (psi)	Observed Jack Press. (psi)	Observed Jack Load (kips)	Dial Gauge			Total Movement (in)	Perm. Movement (in)	Elastic Movement (in)	Elastic Movement (theory)
							G1 (in)	G2 (in)	Corrected (in)				
5%	2.5	1.0		89	100	1.1			0.000	0.000			0.015
15%	2.5	3.0		255	260	3.0			0.010	0.010			0.046
30%	2.5	6.0		504	507	6.0			0.027	0.027			0.092
45%	2.5	9.0		753	755	9.0			0.046	0.046	0.007	0.053	0.139
5%	1	1.0		89	95	1.1			0.007	0.007			0.015
													0.000
15%	1	3.0		255	265	3.1			0.017	0.017			0.046
45%	1	9.0		753	768	9.1			0.049	0.049			0.139
60%	2.5	12.0		1002	1005	12.0			0.069	0.069			0.185
75%	2.5	15.0		1251	1245	14.9			0.089	0.089			0.231
90%	2.5	18.0		1500	1495	17.9			0.113	0.113			0.277
100%	2.5	20.0		1666	1660	19.8			0.127	0.127	0.019	0.108	0.308
5%	1	1.0		89	100	1.1			0.019	0.019			0.015
													0.000
15%	1	3.0		255	280	3.3			0.038	0.038			0.046
100%	1	20.0		1666	1678	20.1			0.132	0.132			0.308
115%	2.5	23.0		1915	1911	22.9			0.152	0.152			0.354
130%	1	26.0		2164	2164	25.9			0.174	0.174			0.401
130%	1	26.0		2164	2160	25.8			0.176	0.176			0.401
130%	1	26.0		2164	2164	25.9			0.176	0.176			0.401
130%	1	26.0		2164	2164	25.9			0.177	0.177			0.401
130%	1	26.0		2164	2161	25.9			0.178	0.178			0.401
130%	1	26.0		2164	2170	26.0			0.179	0.179			0.401
130%	4	26.0		2164	2164	25.9			0.179	0.179	0.005	creep	0.401
130%	10	26.0		2164		-0.1			0.000	0.000			0.401
130%	10	26.0		2164		-0.1			0.000	0.000			0.401
130%	20	26.0		2164		-0.1			0.000	0.000			0.401
130%	10	26.0		2164		-0.1			0.000	0.000			0.401
145%	2.5	29.0		2413	2413	28.9			0.209	0.209	0.038	0.172	0.447
5%	1	1.0		89	100	1.1			0.038	0.038			0.015
													0.000
15%	1	3.0		255	269	3.2			0.051	0.051			0.046
145%	1	29.0		2413	2415	28.9			0.220	0.220			0.447
160%	1	32.0		2662	2660	31.8			0.312	0.312			0.493
175%	2.5	35.0		2911	2910	34.8			0.384	0.384			0.539
200%	10	40.0	-	3326	3326	39.8			0.495	0.495	0.113	0.383	0.616
150%	5	30.0		2496	2490	29.8			0.437	0.437			0.462
100%	5	20.0		1666	1663	19.9			0.379	0.379			0.308
50%	5	10.0		836	850	10.1			0.266	0.266			0.154
5%	5	1.0		89	87	1.0			0.113	0.113			0.015

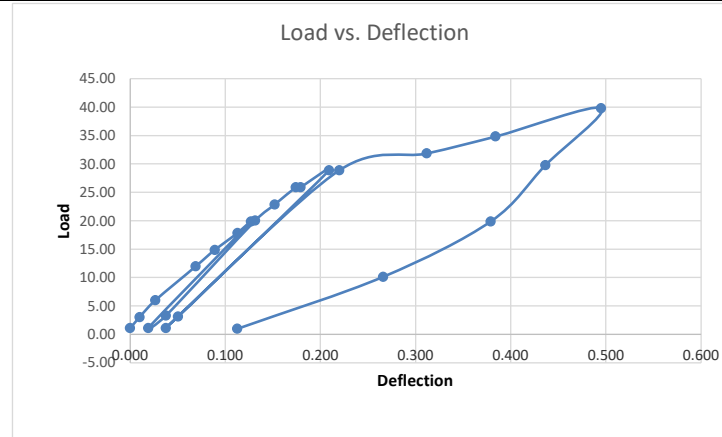
Pile: _____ Sacrificial Test Pile installed

Target % Des. Load (%)	Target % Des. Load (KIPS)	Calculated Load (kips)	Total Movement (0.001 in)	Perm. Movement (0.001 in)	Elastic Movement (0.001 in)
5%	1	1.124	0	0	0
45%	9	9	46.0	-6.5	52.5
100%	20	20	127.0	-19.0	108.0
200%	40	40	495.0	-112.5	382.5

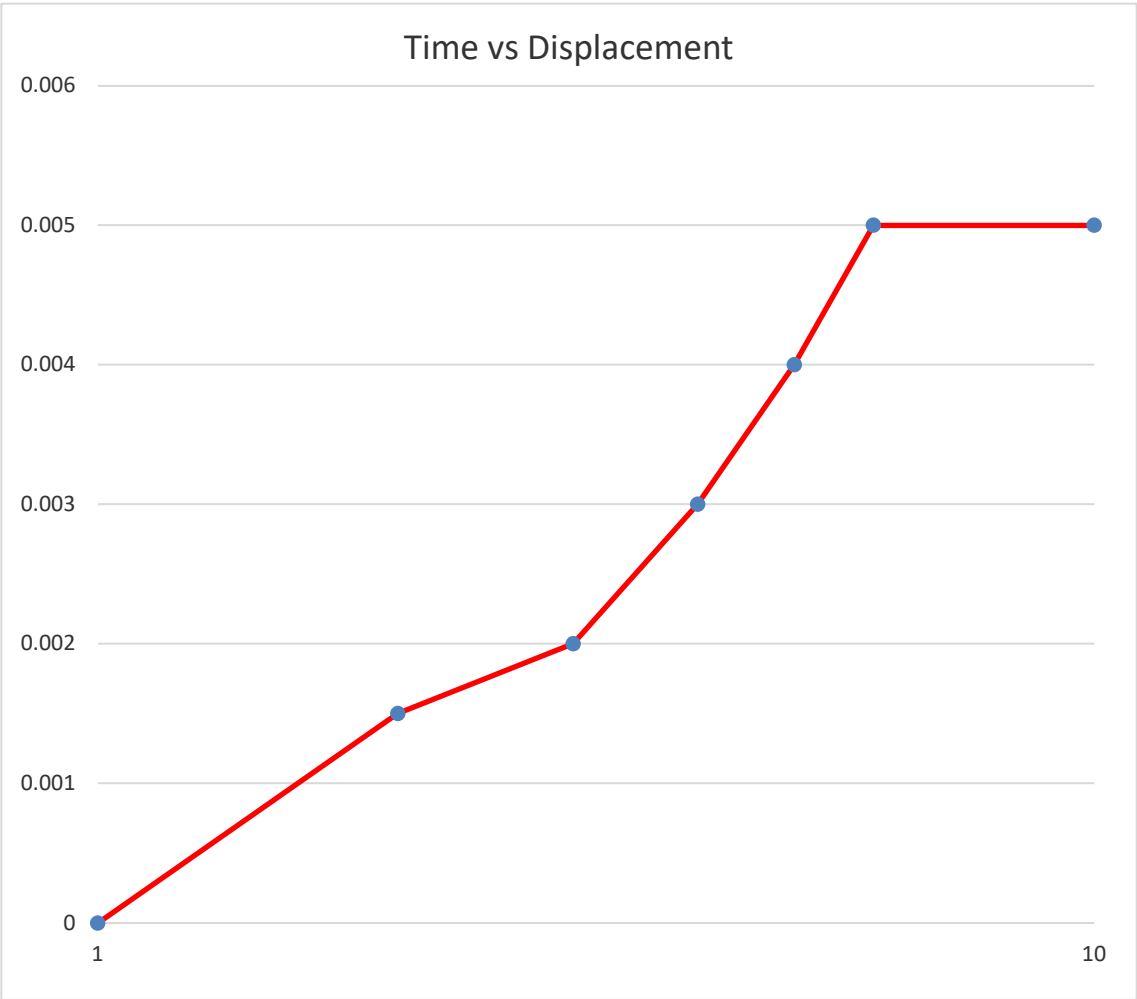


Pile: _____ Sacrificial Test Pile installed

Target % Des. Load	Spec. Load	Observed Load Jack (psi)	Observed Load Jack (kips)	Total Movement (in)	Total Movement (1/1000in)
(%)	(kips)				
5.0%	1	100.00	1.12	0.000	0
15.0%	3	260.00	3.04	0.010	10
30.0%	6	507.00	6.01	0.027	27
60.0%	12	1005.00	11.98	0.069	69
75.0%	15	1245.00	14.86	0.089	89
90.0%	18	1495.00	17.86	0.113	113
100.0%	20	1660.00	19.84	0.127	127
5.0%	1	100.00	1.12	0.019	19
15.0%	3	280.00	3.28	0.038	38
100.0%	20	1678.00	20.06	0.132	132
115.0%	23	1911.00	22.86	0.152	152
130.0%	26	2164.00	25.89	0.174	174
130.0%	26	2164.00	25.89	0.179	179
145.0%	29	2413.00	28.88	0.209	209
5.0%	1	100.00	1.12	0.038	38
15.0%	3	269.00	3.15	0.051	51
145.0%	29	2415.00	28.90	0.220	220
160.0%	32	2660.00	31.84	0.312	312
175.0%	35	2910.00	34.84	0.384	384
200.0%	40	3326.00	39.84	0.495	495
150.0%	30	2490.00	29.80	0.437	437
100.0%	20	1663.00	19.88	0.379	379
50.0%	10	850.00	10.12	0.266	266
5.0%	1	87.00	0.97	0.113	113



Test Load	Time	Dial Gauge	Creep
(kips)	(min)	(in)	(in)
26	1	0.174	0
26	2	0.1755	0.0015
26	3	0.176	0.002
26	4	0.177	0.003
26	5	0.178	0.004
26	6	0.179	0.005
26	10	0.179	0.005



Kelly - 20 kip micropile proof test

Anchor:

Starting Free Length:

Starting Bond Length:

Below Ground Free Length:

Above Ground Free Length:

Total Length:

PT #3			
2.75	ft	33	in
10.00	ft	120	in
35.00	ft	420	in
5.00	ft	60	in
50.00	ft	600	in

Test Date:

Design Load:

Est. Lock-off Load:

Max Test Load (160%):

02/21/23	
20	kip
0	kip
32	kip

No. of Strands:

Modulus of Elasticity:

Strand Area:

G.U.T.S per strand:

G.U.T.S. per anchor:

1	
29000	kip/in2
1.13	in2
0	kip
0	kip

Theoretical Elongation (calculate at max test load):

0.032 inches

Apparent Free Length:

Debonding:

Apparent Bond Length:

186.7	inches	15.56	ft
-293.3	inches	-24.44	ft
413.3	inches	34.44	ft

Jack-Gauge Factor:

Load Cell Serial Number:

Load Cell Zero reading (avg.):

Load Cell Scale Factor:

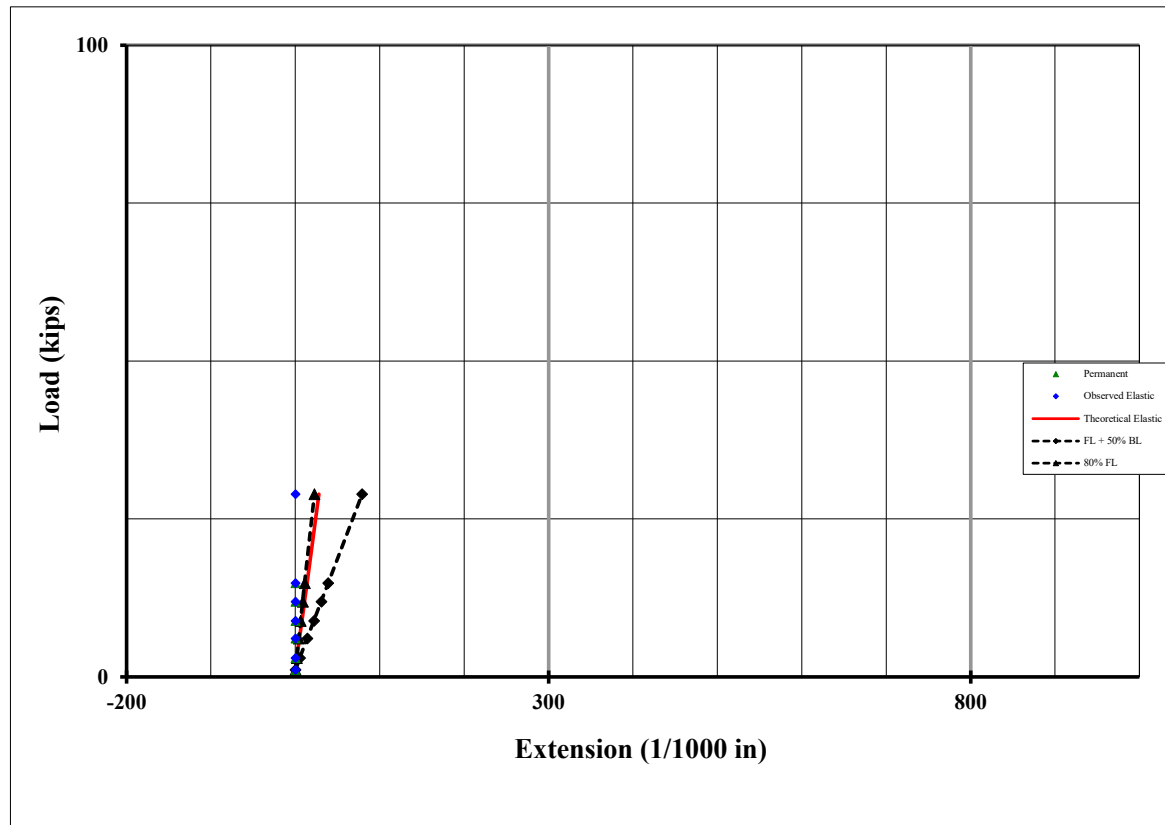
Load Cell Offset:

0.010967217	kip/psi
-	
-	
-	
-	

% Design Load (%)	Holding Time (min)	Spec. Load (kips)	Time of Reading (24h)	Calc. Jack Press. (psi)	Observed Jack Press. (psi)	Observed Jack Press. (kips)	Dial Gauge			Total Movement (in)	Perm. Movement (in)	Elastic Movement (in)	Elastic Movement (theory)
							G1 (in)	G2 (in)	Corrected (in)				
5%	2.5	1.0	10:56	214	224	1.1	0.0000	0.0090	0.0090	0.0090			0.0010
15%	2.5	3.0	10:59	374	373	3.0	0.0090	0.0080	0.0085	0.0085			0.0030
30%	2.5	6.0	11:02	614	622	6.1	0.0310	0.0280	0.0295	0.0295			0.0060
45%	2.5	9.0	11:05	854	844	8.9	0.0490	0.0450	0.0470	0.0470			0.0091
60%	2.5	12.0	11:08	1094	1090	11.9	0.0650	0.0610	0.0630	0.0630			0.0121
75%	2.5	15.0	11:11	1334	1323	14.9	0.0870	0.0820	0.0845	0.0845			0.0151
90%	2.5	18.0	11:15	1574	1570	17.9	0.1090	0.0990	0.1040	0.1040			0.0181
100%	2.5	20.0	11:17	1734	1730	19.9	0.1190	0.1090	0.1140	0.1140			0.0201
115%	2.5	23.0	11:20	1974	1970	22.9	0.1430	0.1300	0.1365	0.1365			0.0232
130%	0	26.0	11:22	2214	2210	25.9	0.1640	0.1460	0.1550	0.1550			
130%	1	26.0	11:23	2214	2200	25.8	0.1660	0.1460	0.1560	0.1560			0.0262
130%	2	26.0	11:24	2214	2214	26.0	0.1660	0.1460	0.1560	0.1560			0.0262
130%	3	26.0	11:25	2214	2220	26.1	0.1700	0.1490	0.1595	0.1595			0.0262
130%	4	26.0	11:26	2214	2214	26.0	0.1700	0.1490	0.1595	0.1595			0.0262
130%	5	26.0	11:27	2214	2210	25.9	0.1710	0.1490	0.1600	0.1600			0.0262
130%	6	26.0	11:28	2214	2210	25.9	0.1730	0.1490	0.1610	0.1610			
130%	10	26.0	11:32	2214	2210	25.9	0.1790	0.1540	0.1665	0.1665			
145%	2.5	29.0	11:35	2454	2450	28.9	0.2040	0.1740	0.1890	0.1890			0.0292
160%	2.5	32.0	11:38	2694	2690	31.9	0.2300	0.1950	0.2125	0.2125	0.0370	0.1755	0.0322
130%	4	26.0	11:42	2214	2217	26.0	0.2010	0.1660	0.1835	0.1835			0.0262
100%	4	20.0	11:46	1734	1730	19.9	0.1700	0.1350	0.1525	0.1525			0.0201
75%	4	15.0	11:50	1334	1350	15.2	0.1370	0.1010	0.1190	0.1190			0.0151
50%	4	10.0	11:54	934	930	9.9	0.1120	0.0750	0.0935	0.0935			0.0101
25%	4	5.0	11:58	534	540	5.1	0.0820	0.0470	0.0645	0.0645			0.0050
5%	4	1.0	12:02	214	210	0.9	0.0480	0.0260	0.0370	0.0370			0.0010

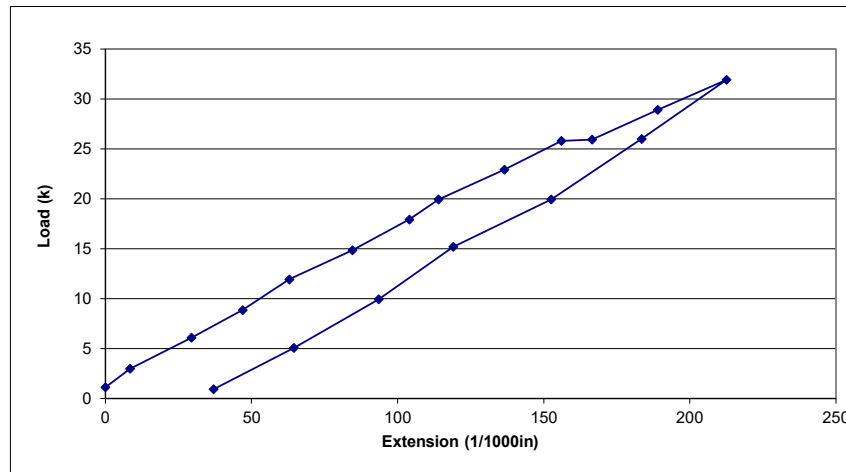
Anchor: Kelly - 20 kip micropile proof test

Target % Des. Load	Target % Des. Load	Calculated Load	Total Movement	Perm. Movement	Elastic Movement	Theoretical Elast. Move.	Free + 50% Bond Length	80% Free Length
(%)	(KIPS)	(kips)	(0.001 in)	(0.001 in)	(0.001 in)	(0.001 in)	(0.001 in)	(0.001 in)
5%	1	1	0.0	0.0	0.0	0	0	0
25%	3	3	8.5	0.0	0.0	2	5	1
50%	6	6	29.5	0.0	0.0	5	14	4
75%	9	9	47.0	0.0	0.0	8	22	6
100%	12	12	63.0	0.0	0.0	11	31	9
120%	15	15	84.5	0.0	0.0	14	39	11
167%	29	29	189.0	0.0	0.0	28	79	22

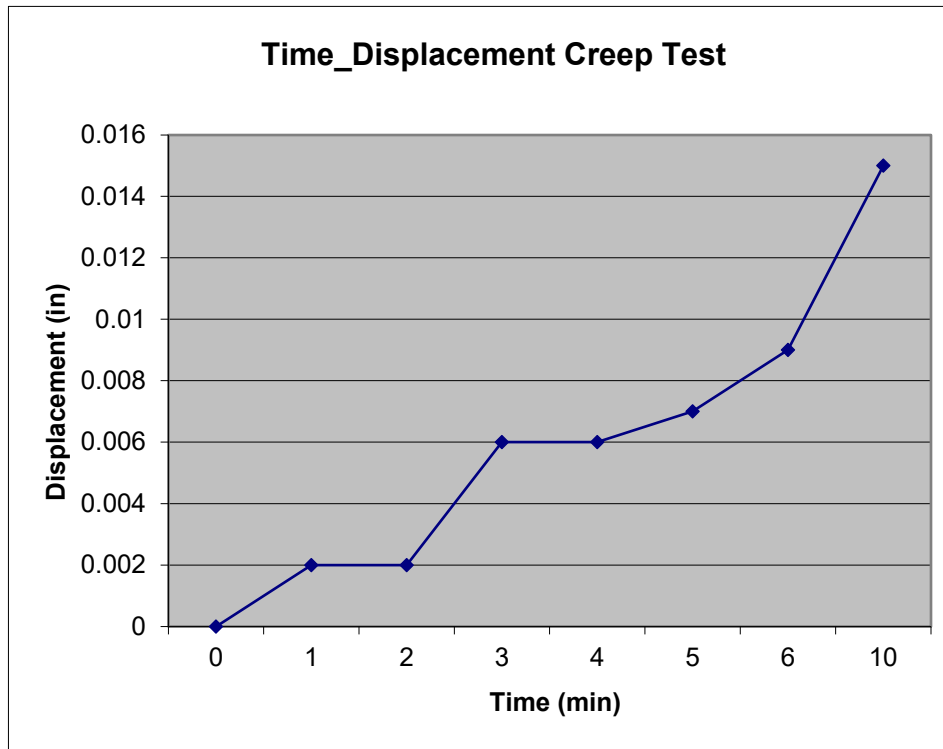


Anchor: Kelly - 20 kip micropile proof test

Target % Des. Load	Spec. Load	Observed Load Jack	Observed Load Jack	Total Movement	Total Movement
(%)	(kisp)	(psi)	(kips)	(in)	(1/1000in)
5.0%	1	224.00	1.12	0.000	0
15.0%	3	373.00	2.98	0.009	9
30.0%	6	622.00	6.09	0.030	30
45.0%	9	844.00	8.87	0.047	47
60.0%	12	1090.00	11.94	0.063	63
75.0%	15	1323.00	14.85	0.085	85
90.0%	18	1570.00	17.94	0.104	104
100.0%	20	1730.00	19.94	0.114	114
115.0%	23	1970.00	22.93	0.137	137
130.0%	26	2200.00	25.81	0.156	156
130%	26	2210.00	25.93	0.167	167
145%	29	2450.00	28.93	0.189	189
160%	32	2690.00	31.93	0.213	213
130%	26	2217.00	26.02	0.184	184
100%	20	1730.00	19.94	0.153	153
75%	15	1350.00	15.19	0.119	119
50%	10	930.00	9.94	0.094	94
25%	5	540.00	5.07	0.065	65
5%	1	210.00	0.95	0.037	37



Test Load	Time	Dial Gauge	Creep
(kips)	(min)	(in)	(in)
25.93132	0	0.164	0
25.8064	1	0.166	0.002
25.98129	2	0.166	0.002
26.05624	3	0.17	0.006
25.98129	4	0.17	0.006
25.93132	5	0.171	0.007
25.93132	6	0.173	0.009
25.93132	10	0.179	0.015



Anchor: Kelly - 20 kip micropile proof test

