APPENDIX 4

LOAD TEST RESULTS AT OLYMPIA, WASHINGTON (SITE 4)

Hollow Bar Soil Nail Testing Research
Olympia, Washington
Schnabel Reference 07150064

FOR

ADSC

14180 Dallas Parkway, Pacific Center I, Dallas, TX 75254

January 26, 2010

PREPARED BY

Schnabel Engineering

510 East Gay Street, West Chester, Pennsylvania 19380
Phone (610) 696-6066 Fax (610) 696-7771

Schnabel Engineering, LLC

510 East Gay Street
West Chester, PA 19380

Phone: (610) 696-6066
Fax: (610) 696-7771
www.schnabel-eng.com

January 26, 2010

Mr. Mike Moore
ADSC
14180 Dallas Parkway
Pacific Center I
Dallas, TX 75254

Subject: **Project 07150064, Hollow Bar Soil Nail Testing Research – Load Test Results at Olympia, Washington (Site 4)**

Dear Mr. Moore:

Schnabel Engineering, LLC (Schnabel), is pleased to present the data from pullout load tests performed at Wheeler Road and Jefferson Street in Olympia, Washington.

DBM Contractors installed and tested 12 soil nails as part of the load test matrix for the research program. The nail installation process was in general accordance with the installation methods indicated in the research test protocol with variances noted below. Personnel from Schnabel observed the installation of all the soil nails and the load testing.

Schnabel measured the axial movement of the test nail during loading and unloading using two dial gauges. Schnabel also measured axial strain with four strain gages in three soil nails with modified Geokon 1400 strain gages. Loads from a hydraulic jacking system were applied to the test nail through a steel plate. DBM monitored the loads using a calibrated jack-pressure dial gauge.

Method C was performed as noted in the research protocol with the exception that the nails were flushed out with water through a tremie tube from the excavation surface to the top of the bond zone. Typically, no flushing is performed in Method C.

The contractor installed Method D nails in the same manner as Method C; however, they predrilled and grouted the unbonded length about 24 hours before nail installation. The contractor predrilled with the hollow core bar equipment used for installation; however, they removed the bar after completion of grout flushing.

Appendix A summarizes the results from the load tests. Appendix B includes the load-movement and movement-time diagrams based on the test data. Appendix C includes the results from strain gage measurements. Appendix D includes the nail installation logs. Appendix E includes grout

compressive strength test results. Jack calibrations are included in Appendix F. Haley & Aldrich, Inc. performed a geotechnical investigation for the project site; Appendix G includes test borings and soil laboratory tests in the vicinity of hollow core bar tests.

Sincerely,

SCHNABEL ENGINEERING, LLC

Andrew C. Baxter, P.G.
Senior Scientist

Allen W. Cadden, P.E.
Principal

AEG:ACB:AWC:jlm

Appendix A: Summary of Load Test Results
Appendix B: Load-Movement and Movement-Time Diagrams
Appendix C: Strain Gage Data
Appendix D: Soil Nail Installation Logs
Appendix E: Grout Compressive Strength
Appendix F: Jack Calibrations
Appendix G: Geotechnical Information

Distribution:
ADSC (3)
Attn: Mr. Mike Moore

APPENDIX A

Summary of Load Test Results

SCHNABEL ENGINEERING

By: Andrew Graziano Date: 10/22/2009 Sheet: 1 of 1
Checked: Andrew C Baxter Date: 10/26/2009 Job No: 07150064
Subject: Hollow Bar Soil Nail Research - Load Test Data Summary - Olympia, WA

TABLE 1: LOAD TEST RESULTS SUMMARY

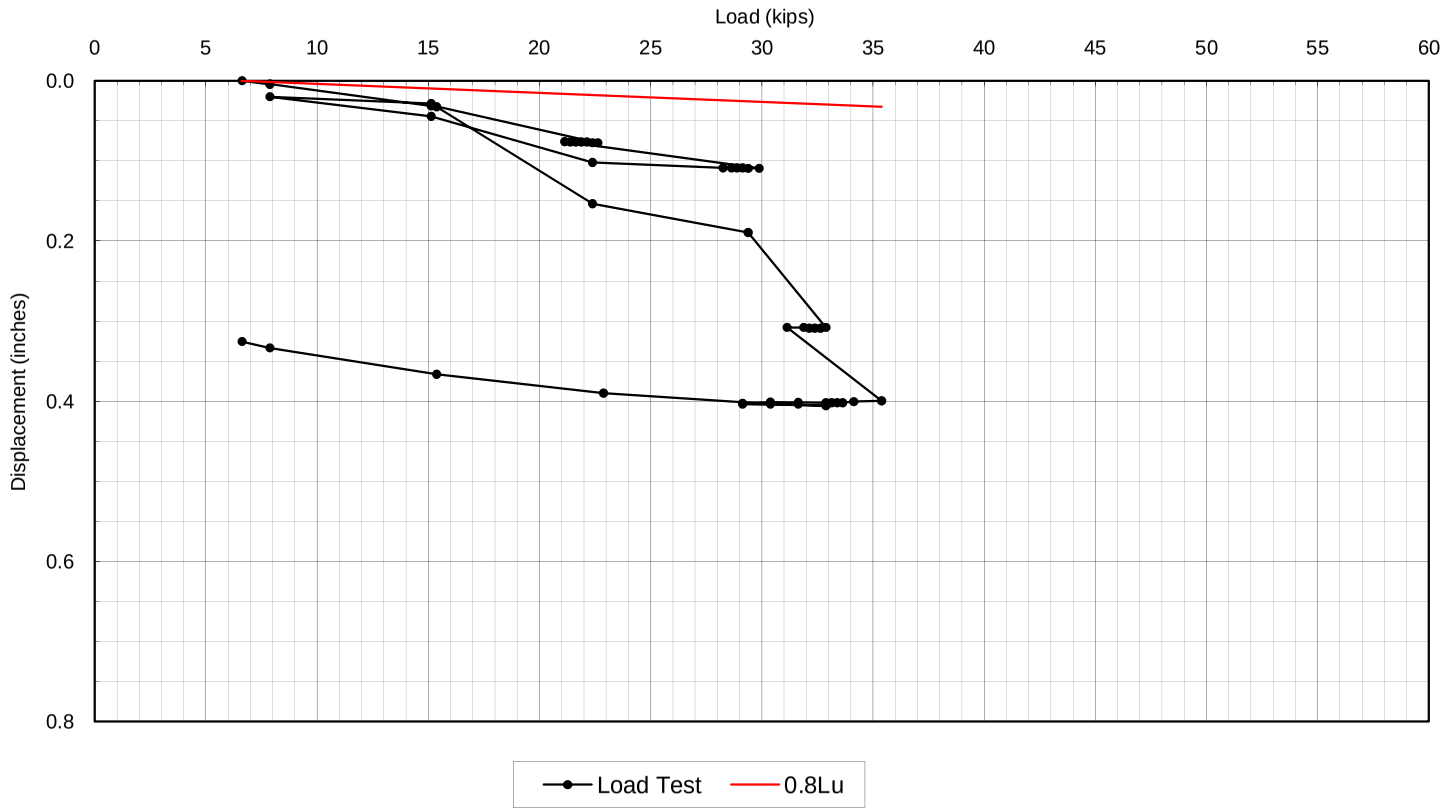
Nail ID	Installation Method	Design Test Load (kip)	Maximum Test Load (kip)	Maximum Movement (in)	Residual Movement (4) (in)	Failure	Max Creep Rate (1)	Load at Creep Test (kip)	Unbonded Length (2) (ft)	Bonded Length (ft)	Drill Bit / Casing Diameter (in)	Average Drilling Rate (3) (ft/min)	Estimated Average Bond Strength (psi)	Soil Type Along Bond Zone
A1	A	30	35.4	0.400	NA	Yes	.002/.004	33.0	11.60	10.0	6.25	5.0	15.0	Clayey Sand
A2	A	30	40.4	0.676	NA	Yes	0.0040	37.0	7.50	10.0	6.25	3.5	17.1	Clayey Sand
A3	A	30	30.1	NA	NA	Yes	NA	NA	7.50	10.0	6.25	3.0	12.8	Clayey Sand
B1	B	20	22.9	0.676	NA	Yes	0.076	20.4	10.75	7.0	4.53	4.5	19.2	Clayey Sand
B2	B	20	24.1	2.273	NA	Yes	NA	NA	10.60	7.0	4.53	3.5	20.2	Clayey Sand
B3	B	20	22.3	1.317	NA	Yes	0.024	20.4	10.30	7.0	4.53	5.0	18.7	Clayey Sand
C1	C	20	31.6	1.155	NA	Yes	0.040	29.0	7.75	10.0	4.53	5.7	18.5	Clayey Sand
C2	C	20	25.4	0.175	NA	Yes	.037/.049	25.4	7.50	10.0	4.53	5.3	14.9	Clayey Sand
C3	C	20	41.6	2.201	NA	Yes	0.011	30.4	7.50	10.0	4.53	4.4	24.4	Clayey Sand
D1	D	30	40.4	NA	NA	Yes	0.026	40.4	7.50	10.0	4.53	2.5	23.7	Clayey Sand
D2	D	20	30.4	0.404	NA	Yes	.054/.046	30.4	7.80	10.0	4.53	3.8	17.8	Clayey Sand
D3	D	20	32.9	1.142	NA	Yes	0.009	29.1	7.30	10.0	4.53	3.1	19.3	Clayey Sand

Notes:
(1) Creep rate measured at the 1 to 10 minute interval / 6 to 60 minute interval.
(2) Tail length as measured at the time of load test. The tail length reported in the installation logs refers to the tail length at completion of drilling.
(3) Drilling rate along bond zone.
(4) Residual Movement not applicable at final pullout cycle. Residual movement observed at intermittent cycles in data and plots.

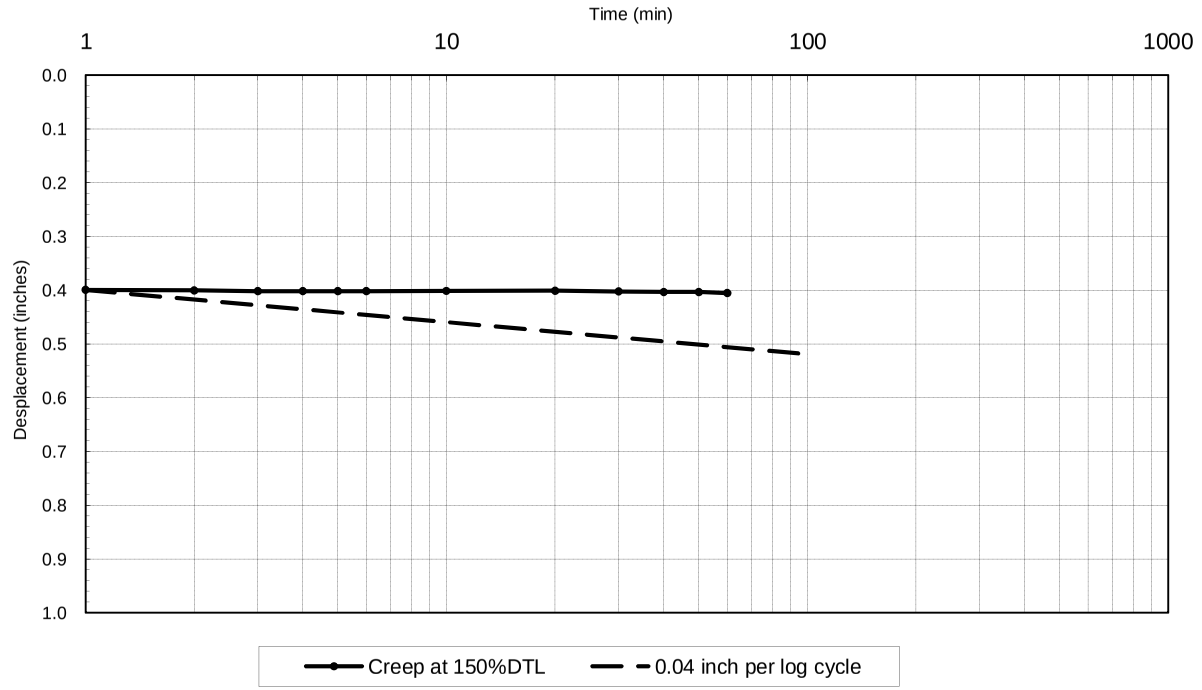
APPENDIX B

Load-Movement and Movement-Time Diagrams

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 10 ft Unbonded 7.6 ft	Diameter: 1.86 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: A1	**SCHNABEL ENGINEERING, LLC**	
				Verification Soil Nail Load Test	
Design Test Load (P) : 30 kip	Comments:			Hollow Core Bar Soil Nail Research	
				Olympia, WA	
Maximum Test Load: 150% P = 35.4 kip				Date: 10/02/09	07150064



Type of Test: Verification	Bond: 10 ft Unbonded 7.6 ft	Diameter: 1.86 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: A1	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test Hollow Core Bar Soil Nail Research Olympia, WA
Design Test Load (P) : 30 kip	Comments:			
Maximum Test Load: 150% P = 35.4 kip				Date: 10/02/09 — 07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: A1
Date: 10/2/2009

Design Test Load (P): 30 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.5	45.1	250.0	6.6	1		0.000	0.000			0.000	tail length = 28 inches
25%	7.5	285.0	300.0	7.9	1		0.009	0.000			0.005	
	7.5	285.0	300.0	7.9	2		0.009	0.000			0.005	
	7.5	285.0	300.0	7.9	3		0.009	0.000			0.005	
	7.5	285.0	300.0	7.9	4		0.009	0.000			0.005	
	7.5	285.0	300.0	7.9	5		0.009	0.000			0.005	
	7.5	285.0	300.0	7.9	6		0.009	0.000			0.005	
	7.5	285.0	300.0	7.9	10		0.008	0.000			0.004	
50%	15.0	584.9	600.0	15.4	1		0.059	0.006			0.033	
	15.0	584.9	590.0	15.1	2		0.058	0.005			0.032	
	15.0	584.9	590.0	15.1	3		0.057	0.004			0.031	
	15.0	584.9	590.0	15.1	4		0.057	0.004			0.031	
	15.0	584.9	590.0	15.1	5		0.057	0.004			0.031	
	15.0	584.9	590.0	15.1	6		0.057	0.004			0.031	
	15.0	584.9	590.0	15.1	10		0.057	0.004			0.031	
75%	22.5	884.7	890.0	22.6	1		0.115	0.040			0.078	
	22.5	884.7	880.0	22.4	2		0.115	0.040			0.078	
	22.5	884.7	870.0	22.1	3		0.114	0.039			0.077	
	22.5	884.7	860.0	21.9	4		0.114	0.039			0.077	
	22.5	884.7	850.0	21.6	5		0.114	0.039			0.077	
	22.5	884.7	840.0	21.4	6		0.114	0.039			0.077	
	22.5	884.7	830.0	21.1	10		0.113	0.039			0.076	
100%	30.0	1184.6	1180.0	29.9	1		0.205	0.014			0.109	
	30.0	1184.6	1160.0	29.4	2		0.205	0.014			0.109	
	30.0	1184.6	1150.0	29.1	3		0.204	0.014			0.109	
	30.0	1184.6	1140.0	28.9	4		0.204	0.014			0.109	
	30.0	1184.6	1130.0	28.6	5		0.204	0.014			0.109	
	30.0	1184.6	1130.0	28.6	6		0.204	0.014			0.109	
	30.0	1184.6	1115.0	28.3	10		0.204	0.014			0.109	
75%	22.5	884.7	880.0	22.4	1		0.186	0.018			0.102	
50%	15.0	584.9	590.0	15.1	1		0.078	0.011			0.045	
25%	7.5	285.0	300.0	7.9	1		0.052	-0.012			0.020	
50%	15.0	584.9	590.0	15.1	1		0.062	-0.005			0.029	
75%	22.5	884.7	880.0	22.4	1		0.188	0.119			0.154	
100%	30.0	1184.6	1160.0	29.4	1		0.221	0.158			0.190	
125%	37.5	1484.5	1300.0	32.9	1		0.339	0.277			0.308	
	37.5	1484.5	1290.0	32.6	2		0.340	0.278			0.309	
	37.5	1484.5	1280.0	32.4	3		0.340	0.278			0.309	
	37.5	1484.5	1270.0	32.1	4		0.340	0.278			0.309	
	37.5	1484.5	1260.0	31.9	5		0.339	0.277			0.308	
	37.5	1484.5	1260.0	31.9	6		0.339	0.277			0.308	
	37.5	1484.5	1230.0	31.1	10		0.339	0.277			0.308	

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

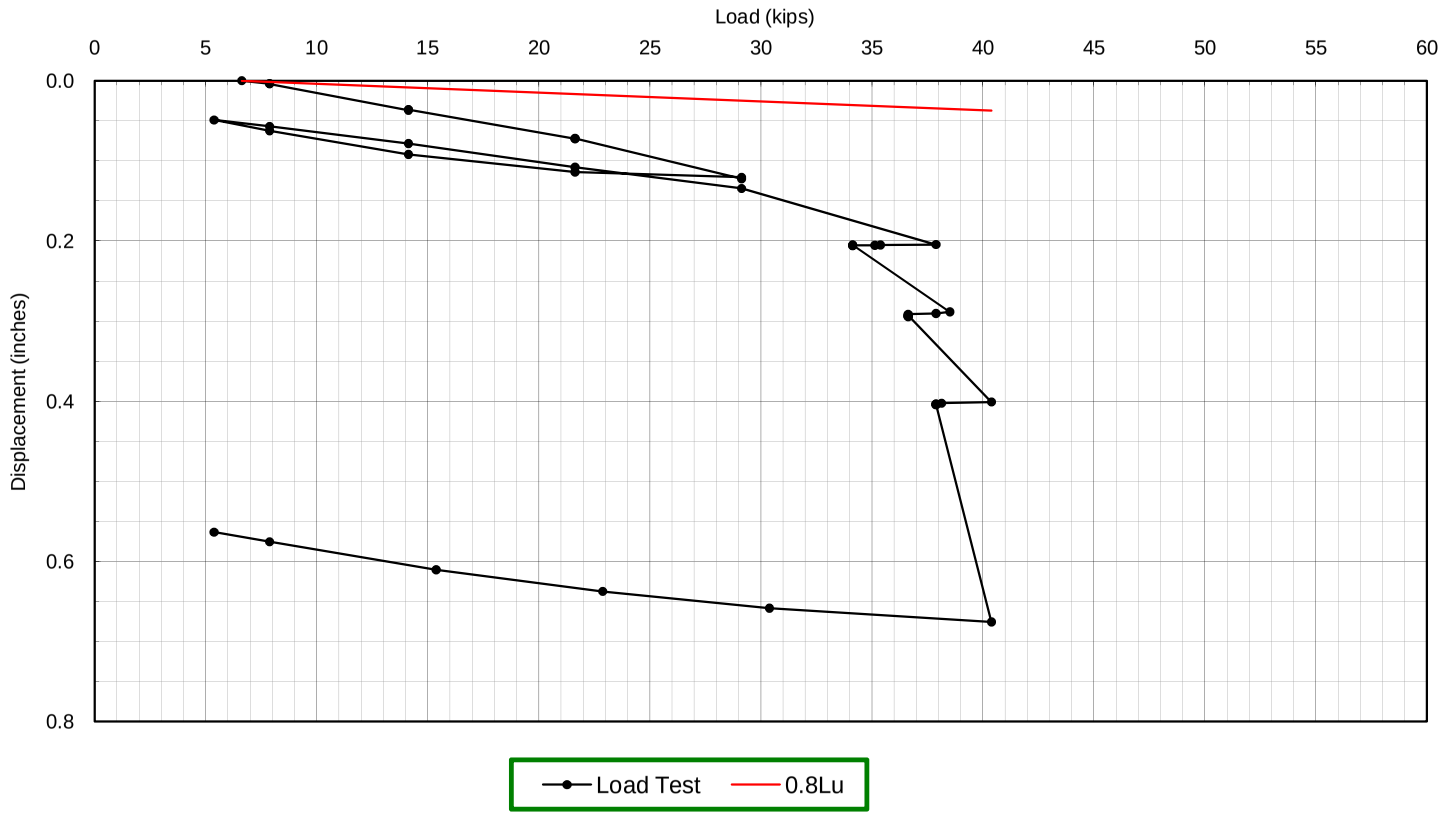
Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: A1
Date: 10/2/2009

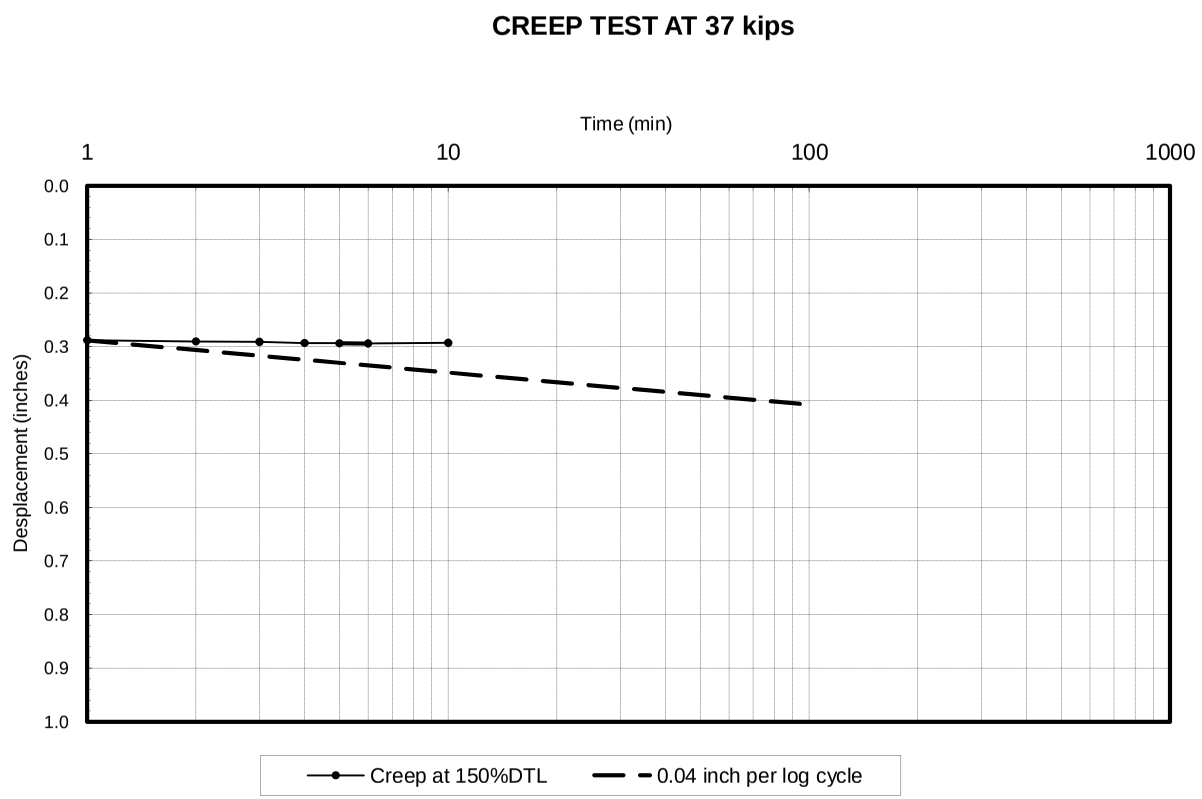
Design Test Load (P): 30 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
150%	45.0	1784.4	1400.0	35.4	1		0.431	0.368			0.400	
	45.0	1784.4	1350.0	34.1	2		0.432	0.369			0.401	
	45.0	1784.4	1330.0	33.6	3		0.433	0.371			0.402	
	45.0	1784.4	1320.0	33.4	4		0.433	0.371			0.402	
	45.0	1784.4	1310.0	33.1	5		0.433	0.371			0.402	
	45.0	1784.4	1300.0	32.9	6		0.433	0.371			0.402	
	45.0	1784.4	1250.0	31.6	10		0.433	0.370			0.402	
	45.0	1784.4	1200.0	30.4	20		0.432	0.370			0.401	
	45.0	1784.4	1150.0	29.1	30		0.434	0.371			0.403	
	45.0	1784.4	1250.0	31.6	40		0.435	0.372			0.404	
	45.0	1784.4	1150.0	29.1	50		0.435	0.372			0.404	
	45.0	1784.4	1300.0	32.9	60		0.437	0.374			0.406	
100%	30.0	1184.6	1200.0	30.4	1		0.435	0.372			0.404	
75%	22.5	884.7	900.0	22.9	1		0.421	0.359			0.390	
50%	15.0	584.9	600.0	15.4	1		0.398	0.335			0.367	
25%	7.5	285.0	300.0	7.9	1		0.357	0.310			0.334	
AL	1.5	45.1	250.0	6.6	1		0.342	0.309			0.326	

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia,WA



Type of Test: Verification	Bond: 10 ft Unbonded 7.5 ft	Diameter: 1.86 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: A2	**SCHNABEL ENGINEERING, LLC**	
				Verification Soil Nail Load Test	
Design Test Load (P) : 30 kip	Comments:			Hollow Core Bar Soil Nail Research	
				Olympia, WA	
Maximum Test Load: 150% P = 40.4 kip				Date: 10/02/09	07150064



Type of Test: Verification	Bond: 10 ft Unbonded 7.5 ft	Diameter: 1.86 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: A2	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test Hollow Core Bar Soil Nail Research Olympia, WA
Design Test Load (P) : 30 kip	Comments:			
Maximum Test Load: 150% P = 40.4 kip				Date: 10/02/09 — 07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: A2
Date: 10/2/2009

Design Test Load (P): 30 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.5	45.1	250.0	6.6	1		0.000	0.000			0.000	tail length = approx. 30 inches
25%	7.5	285.0	300.0	7.9	1		0.005	0.002			0.004	
	7.5	285.0	300.0	7.9	2		0.005	0.003			0.004	
50%	15.0	584.9	550.0	14.1	1		0.042	0.032			0.037	
	15.0	584.9	550.0	14.1	2		0.041	0.031			0.036	
75%	22.5	884.7	850.0	21.6	1		0.085	0.060			0.073	
	22.5	884.7	850.0	21.6	2		0.084	0.060			0.072	
100%	30.0	1184.6	1150.0	29.1	1		0.144	0.101			0.123	
	30.0	1184.6	1150.0	29.1	2		0.142	0.099			0.121	
75%	22.5	884.7	850.0	21.6	1		0.135	0.093			0.114	
50%	15.0	584.9	550.0	14.1	1		0.110	0.074			0.092	
25%	7.5	285.0	300.0	7.9	1		0.068	0.057			0.063	
AL	1.5	45.1	200.0	5.4	1		0.045	0.053			0.049	
25%	7.5	285.0	300.0	7.9	1		0.060	0.054			0.057	
50%	15.0	584.9	550.0	14.1	1		0.092	0.065			0.079	
75%	22.5	884.7	850.0	21.6	1		0.128	0.088			0.108	
100%	30.0	1184.6	1150.0	29.1	1		0.158	0.111			0.135	
125%	37.5	1484.5	1500.0	37.9	1		0.235	0.174			0.205	
	37.5	1484.5	1400.0	35.4	2		0.235	0.175			0.205	
	37.5	1484.5	1390.0	35.1	3		0.236	0.175			0.206	
	37.5	1484.5	1350.0	34.1	4		0.236	0.175			0.206	
	37.5	1484.5	1350.0	34.1	5		0.236	0.176			0.206	
	37.5	1484.5	1350.0	34.1	6		0.236	0.176			0.206	
	37.5	1484.5	1350.0	34.1	10		0.235	0.175			0.205	
150%	45.0	1784.4	1525.0	38.5	1		0.322	0.255			0.289	
	45.0	1784.4	1500.0	37.9	2		0.324	0.257			0.291	
	45.0	1784.4	1450.0	36.6	3		0.325	0.258			0.292	
	45.0	1784.4	1450.0	36.6	4		0.327	0.260			0.294	
	45.0	1784.4	1450.0	36.6	5		0.328	0.260			0.294	
	45.0	1784.4	1450.0	36.6	6		0.328	0.261			0.295	
	45.0	1784.4	1450.0	36.6	10		0.326	0.260			0.293	
175%	50.5	2002.3	1600.0	40.4	1		0.436	0.366			0.401	
	50.5	2002.3	1510.0	38.1	2		0.438	0.367			0.403	
	50.5	2002.3	1500.0	37.9	3		0.439	0.368			0.404	
	50.5	2002.3	1500.0	37.9	4		0.440	0.369			0.405	
	50.5	2002.3	1500.0	37.9	5		0.439	0.369			0.404	
	50.5	2002.3	1600.0	40.4	1		0.715	0.636			0.676	
100%	30.0	1184.6	1200.0	30.4	1		0.696	0.621			0.659	
	30.0	1184.6	1200.0	30.4	2		0.696	0.621			0.659	
75%	22.5	884.7	900.0	22.9	1		0.674	0.601			0.638	
	22.5	884.7	900.0	22.9	2		0.674	0.601			0.638	
50%	15.0	584.9	600.0	15.4	1		0.641	0.580			0.611	
	15.0	584.9	600.0	15.4	2		0.641	0.580			0.611	

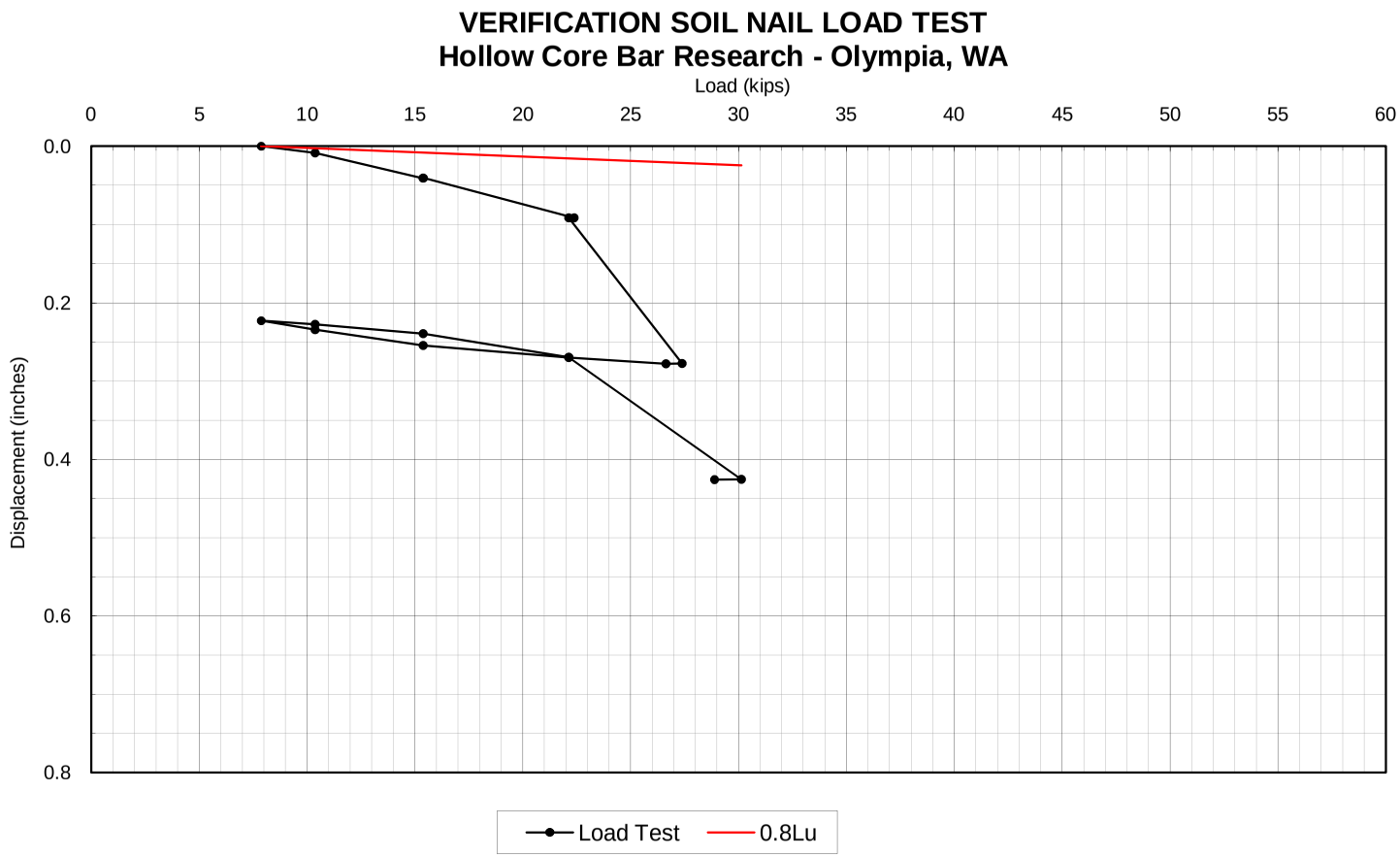
Soil Nail Verification Load Test Data

Schnabel Engineering

Project:	Hollow Core Bar Soil Nail Research	**Performed:**	DBM Contractors	**Soil Nail:**	**A2**
Location:	Olympia, WA	**Observed:**	M. Rohrbach		
Client:	ADSC	**Data by:**	M. Rohrbach	**Date:**	10/2/2009

Design Test Load (P): 30 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
25%	7.5	285.0	300.0	7.9	1		0.590	0.561			0.576	
AL	1.5	45.1	200.0	5.4	1		0.570	0.557			0.564	



Type of Test: Verification	Bond: 10 ft Unbonded 7.5 ft	Diameter: 1.86 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: A3	**SCHNABEL ENGINEERING, LLC**	
				Verification Soil Nail Load Test	
Design Test Load (P) : 30 kip	Comments:			Hollow Core Bar Soil Nail Research	
				Olympia, WA	
Maximum Test Load: 100% P = 30.1 kip				Date: 10/02/09	07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

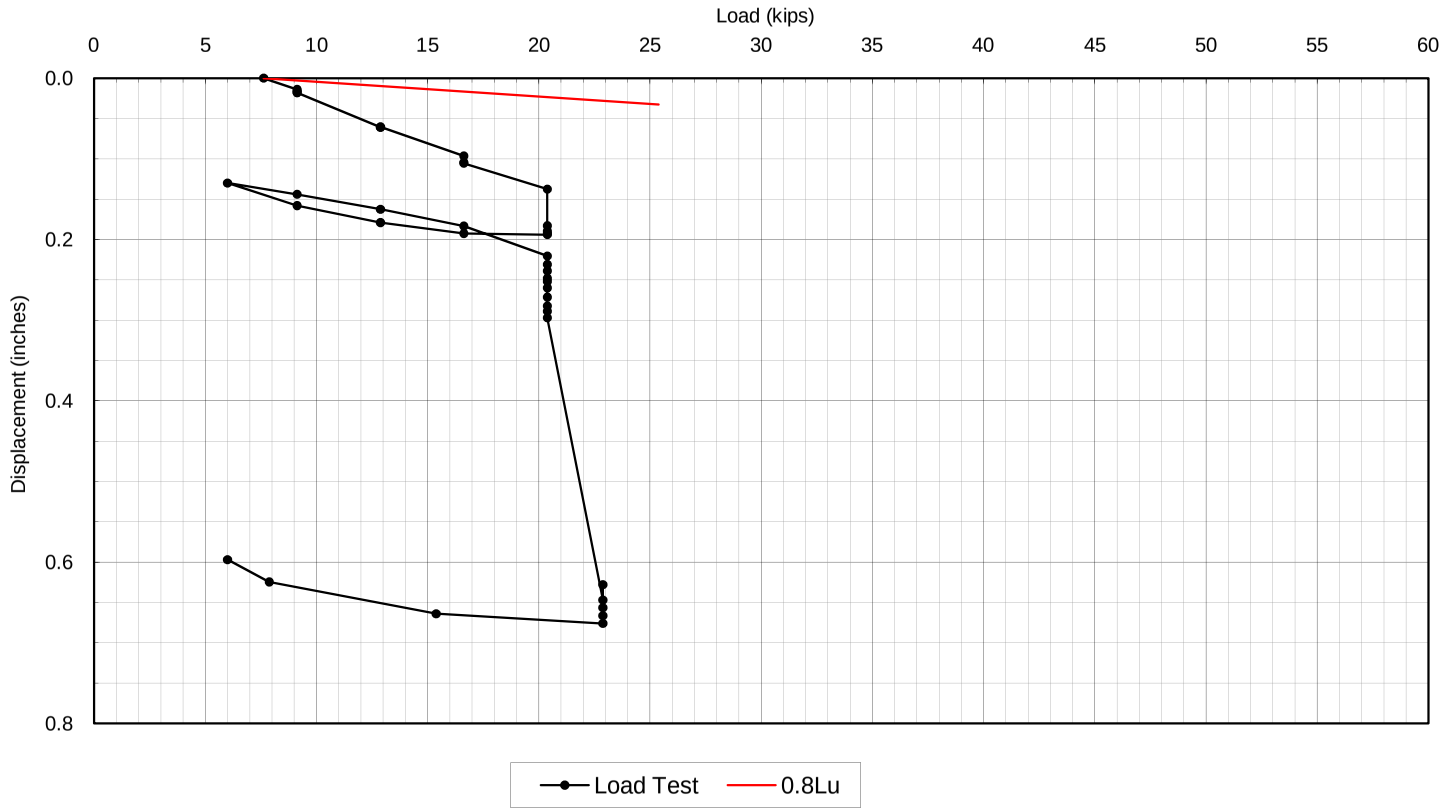
Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: A3
Date: 10/2/2009

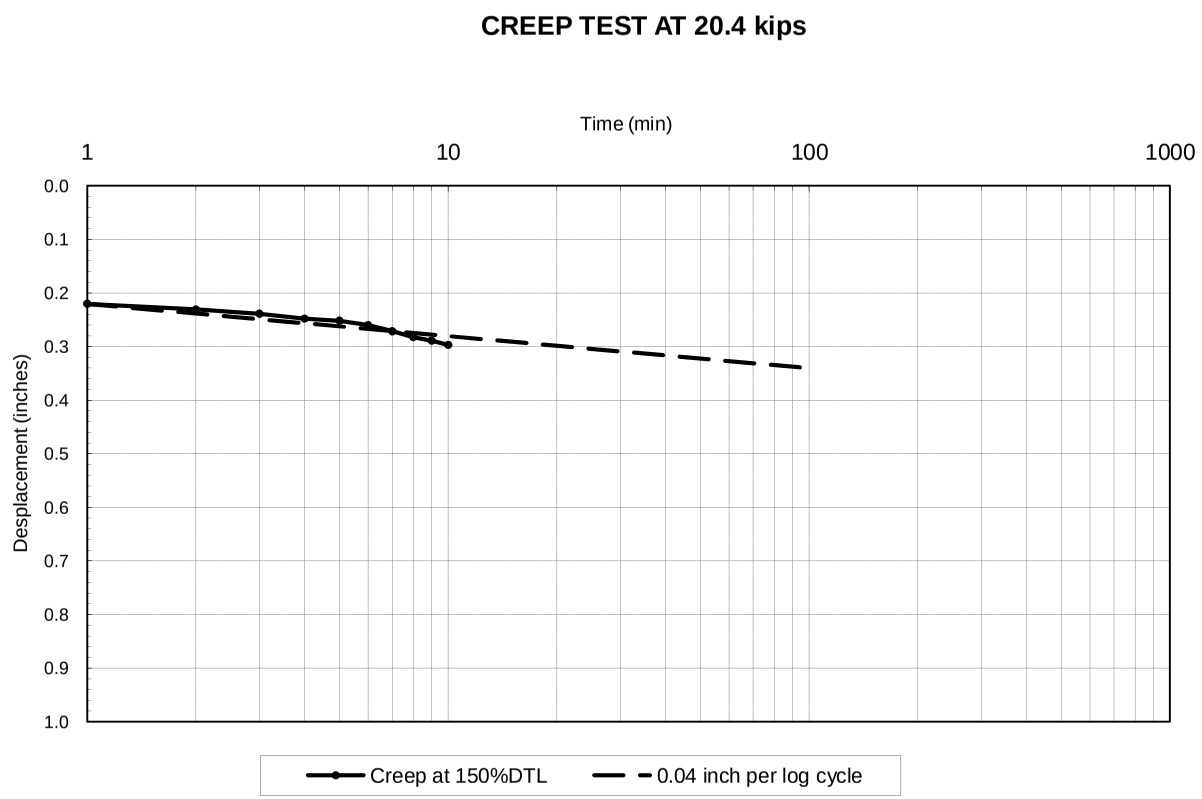
Design Test Load (P): 30 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.5	45.1	300.0	7.9	1		0.000	0.000			0.000	tail length = approx. 30 inches
25%	7.5	285.0	400.0	10.4	1		0.003	0.014			0.009	
	7.5	285.0	400.0	10.4	2		0.003	0.014			0.009	
50%	15.0	584.9	600.0	15.4	1		0.022	0.060			0.041	
	15.0	584.9	600.0	15.4	2		0.022	0.059			0.041	
75%	22.5	884.7	880.0	22.4	1		0.060	0.123			0.092	
	22.5	884.7	870.0	22.1	2		0.061	0.122			0.092	
100%	30.0	1184.6	1080.0	27.4	1		0.238	0.317			0.278	
	30.0	1184.6	1050.0	26.6	2		0.238	0.318			0.278	
75%	22.5	884.7	870.0	22.1	1		0.233	0.307			0.270	
50%	15.0	584.9	600.0	15.4	1		0.224	0.285			0.255	
25%	7.5	285.0	400.0	10.4	1		0.214	0.255			0.235	
AL	1.5	45.1	300.0	7.9	1		0.210	0.236			0.223	
25%	7.5	285.0	400.0	10.4	1		0.210	0.245			0.228	
50%	15.0	584.9	600.0	15.4	1		0.214	0.265			0.240	
75%	22.5	884.7	870.0	22.1	1		0.233	0.306			0.270	
100%	30.0	1184.6	1190.0	30.1	1		0.383	0.468			0.426	
	30.0	1184.6	1140.0	28.9	2		0.384	0.468			0.426	

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 7 ft Unbonded 10.75 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: B1	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test
Design Test Load (P) : 20 kip	Comments:			Hollow Core Bar Soil Nail Research Olympia, WA
Maximum Test Load: 150% P = 22.9 kip				Date: 10/02/09 — 07150064



Type of Test: Verification	Bond: 7 ft Unbonded 10.75 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: B1	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test Hollow Core Bar Soil Nail Research Olympia, WA
Design Test Load (P) : 20 kip	Comments:			
Maximum Test Load: 150% P = 22.9 kip				Date: 10/02/09 — 07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: B1
Date: 10/2/2009

Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.0	25.1	290.0	7.6	1		0.000	0.000			0.000	tail length = 27 inches
50%	10.0	384.9	350.0	9.1	1		0.015	0.013			0.014	
	10.0	384.9	350.0	9.1	2		0.018	0.014			0.016	
	10.0	384.9	350.0	9.1	3		0.020	0.015			0.018	
	10.0	384.9	350.0	9.1	4		0.020	0.015			0.018	
	10.0	384.9	350.0	9.1	5		0.020	0.016			0.018	
75%	15.0	584.9	500.0	12.9	1		0.071	0.051			0.061	
	15.0	584.9	500.0	12.9	2		0.070	0.051			0.061	
	15.0	584.9	500.0	12.9	3		0.070	0.051			0.061	
	15.0	584.9	500.0	12.9	4		0.070	0.051			0.061	
	15.0	584.9	500.0	12.9	5		0.070	0.051			0.061	
	15.0	584.9	650.0	16.6	1		0.109	0.084			0.097	
	15.0	584.9	650.0	16.6	2		0.118	0.091			0.105	
	15.0	584.9	650.0	16.6	3		0.119	0.092			0.106	
	15.0	584.9	650.0	16.6	4		0.119	0.092			0.106	
100%	20.0	784.8	800.0	20.4	1		0.118	0.157			0.138	
	0.0	-14.9	800.0	20.4	2		0.198	0.168			0.183	
	0.0	-14.9	800.0	20.4	3		0.205	0.174			0.190	
	0.0	-14.9	800.0	20.4	4		0.208	0.177			0.193	
	0.0	-14.9	800.0	20.4	5		0.210	0.178			0.194	
75%	15.0	584.9	650.0	16.6	1		0.208	0.177			0.193	
	0.0	-14.9	500.0	12.9	1		0.194	0.164			0.179	
50%	10.0	384.9	350.0	9.1	1		0.170	0.146			0.158	
25%	5.0	185.0	225.0	6.0	1		0.140	0.120			0.130	
50%	10.0	384.9	350.0	9.1	1		0.158	0.130			0.144	
75%	15.0	584.9	500.0	12.9	1		0.177	0.148			0.163	
	0.0	-14.9	650.0	16.6	1		0.199	0.168			0.184	
100%	20.0	784.8	800.0	20.4	1		0.236	0.205			0.221	
	0.0	-14.9	800.0	20.4	2		0.247	0.215			0.231	
	0.0	-14.9	800.0	20.4	3		0.255	0.223			0.239	
	0.0	-14.9	800.0	20.4	4		0.264	0.232			0.248	
	0.0	-14.9	800.0	20.4	5		0.268	0.236			0.252	
	0.0	-14.9	800.0	20.4	6		0.276	0.244			0.260	
	0.0	-14.9	800.0	20.4	7		0.285	0.258			0.272	
	0.0	-14.9	800.0	20.4	8		0.298	0.267			0.283	
	0.0	-14.9	800.0	20.4	9		0.304	0.274			0.289	
	0.0	-14.9	800.0	20.4	10		0.312	0.282			0.297	
125%	25.0	984.7	900.0	22.9	1		0.665	0.629			0.647	
	0.0	-14.9	900.0	22.9	2		0.674	0.639			0.657	
	0.0	-14.9	900.0	22.9	3		0.684	0.649			0.667	
	0.0	-14.9	900.0	22.9	4		0.691	0.565			0.628	
	0.0	-14.9	900.0	22.9	5		0.694	0.658			0.676	
75%	15.0	584.9	600.0	15.4	1		0.680	0.648			0.664	
50%	10.0	384.9	300.0	7.9	1		0.636	0.613			0.625	

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

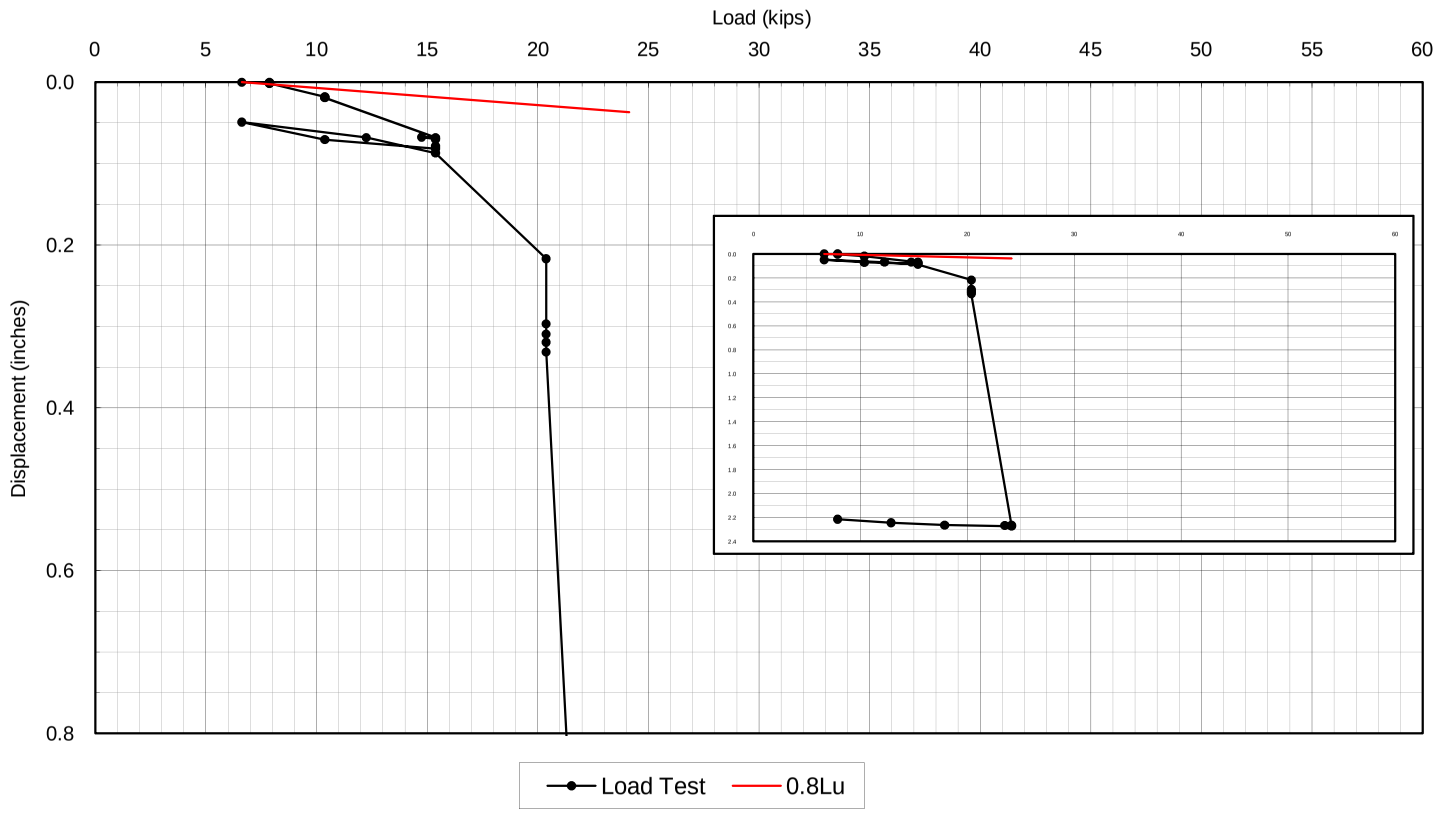
Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: B1
Date: 10/2/2009

Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
25%	5.0	185.0	225.0	6.0	1		0.608	0.586			0.597	
50%	10.0	384.9	400.0	10.4	1		0.636	0.604			0.620	
75%	15.0	584.9	600.0	15.4	1		0.660	0.627			0.644	
100%	20.0	784.8	800.0	20.4	1		0.689	0.653			0.671	
125%	25.0	984.7	1000.0	25.4	1		2.049	2.060			2.055	
100%	20.0	784.8	750.0	19.1	1		2.049	2.011			2.030	
75%	15.0	584.9	500.0	12.9	1		2.023	1.988			2.006	
25%	5.0	185.0	225.0	6.0	1		1.969	1.942			1.956	

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 7 ft Unbonded 10.6 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: B2	**SCHNABEL ENGINEERING, LLC**	
				Verification Soil Nail Load Test	
Design Test Load (P) : 20 kip	Comments:			Hollow Core Bar Soil Nail Research	
				Olympia, WA	
Maximum Test Load: 125% P = 24.1 kip				Date: 10/02/09	07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

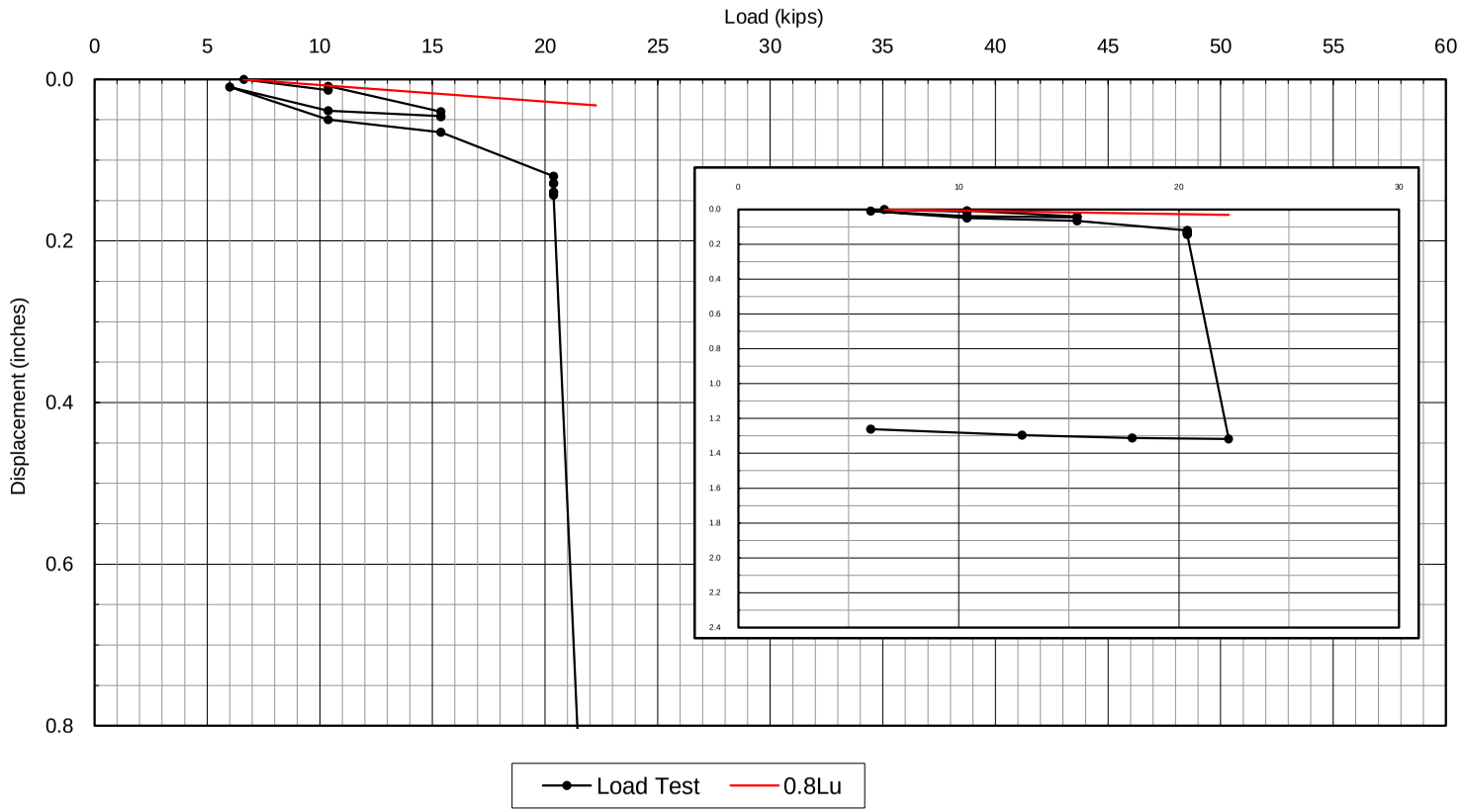
Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: B2
Date: 10/2/2009

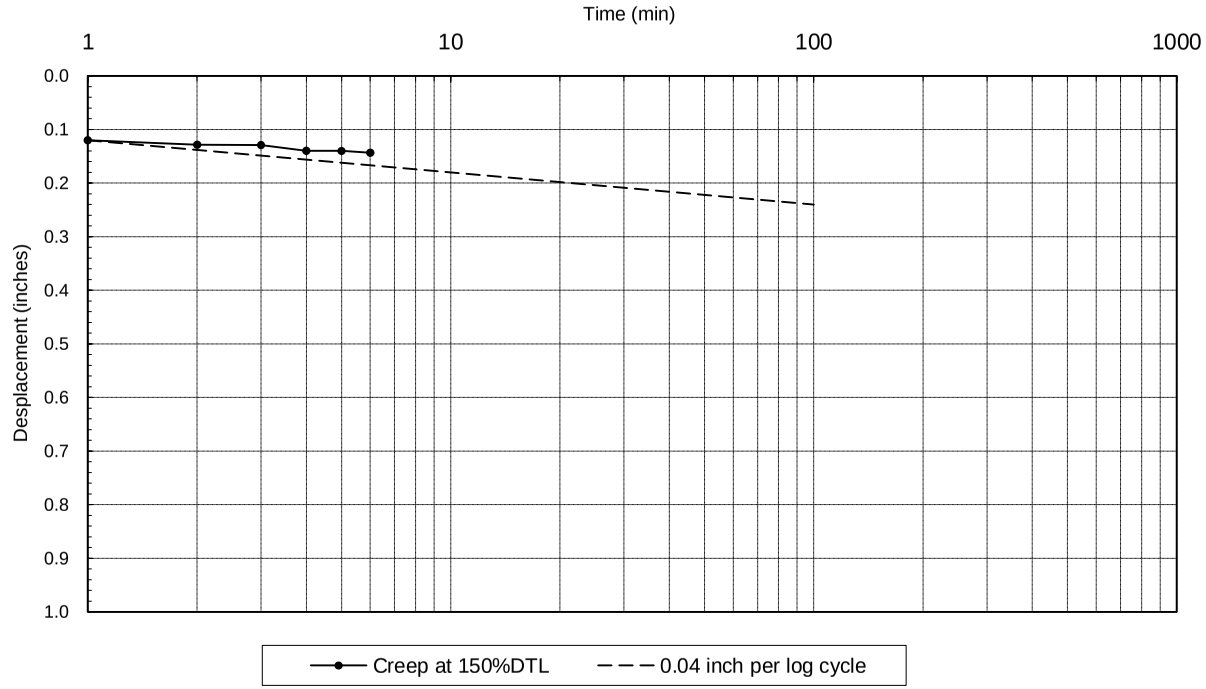
Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.0	25.1	250.0	6.6	1		0.000	0.000			0.000	tail length = 29 inches
25%	5.0	185.0	300.0	7.9	1		0.000	0.000			0.000	
	5.0	185.0	300.0	7.9	2		0.001	0.001			0.001	
	5.0	185.0	300.0	7.9	3		0.001	0.002			0.002	
	5.0	185.0	300.0	7.9	4		0.001	0.002			0.002	
50%	10.0	384.9	400.0	10.4	1		0.021	0.015			0.018	
	10.0	384.9	400.0	10.4	2		0.023	0.014			0.019	
	10.0	384.9	400.0	10.4	3		0.023	0.014			0.019	
	10.0	384.9	400.0	10.4	4		0.023	0.014			0.019	
	10.0	384.9	400.0	10.4	5		0.024	0.014			0.019	
75%	15.0	584.9	600.0	15.4	1		0.078	0.058			0.068	
	15.0	584.9	575.0	14.8	2		0.078	0.057			0.068	
	15.0	584.9	600.0	15.4	3		0.080	0.060			0.070	
	15.0	584.9	600.0	15.4	4		0.089	0.068			0.079	
	15.0	584.9	600.0	15.4	5		0.091	0.072			0.082	
50%	10.0	384.9	400.0	10.4	1		0.082	0.059			0.071	
25%	5.0	185.0	250.0	6.6	1		0.059	0.039			0.049	
50%	10.0	384.9	475.0	12.3	1		0.078	0.058			0.068	
75%	15.0	584.9	600.0	15.4	1		0.097	0.077			0.087	
100%	20.0	784.8	800.0	20.4	1		0.232	0.202			0.217	
	20.0	784.8	800.0	20.4	2		0.315	0.279			0.297	
	20.0	784.8	800.0	20.4	3		0.327	0.292			0.310	
	20.0	784.8	800.0	20.4	4		0.337	0.302			0.320	
	20.0	784.8	800.0	20.4	5		0.349	0.314			0.332	
125%	25.0	984.7	950.0	24.1	0		2.285	2.245			2.265	
	25.0	984.7	925.0	23.5	1		2.285	2.248			2.267	
	25.0	984.7	950.0	24.1	2		2.294	2.251			2.273	
100%	20.0	784.8	700.0	17.9	1		2.288	2.239			2.264	
75%	15.0	584.9	500.0	12.9	1		2.268	2.220			2.244	
50%	10.0	384.9	300.0	7.9	1		2.237	2.193			2.215	

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 7 ft Unbonded 10.3 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: B3	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test
Design Test Load (P) : 20 kip	Comments:			Hollow Core Bar Soil Nail Research Olympia, WA
Maximum Test Load: 125% P = 22.3 kip				Date: 10/02/09 — 07150064



Type of Test: Verification	Bond: 7 ft Unbonded 10.3 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: B3	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test Hollow Core Bar Soil Nail Research Olympia, WA
Design Test Load (P) : 20 kip	Comments:			
Maximum Test Load: 125% P = 22.3 kip				Date: 10/02/09 — 07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

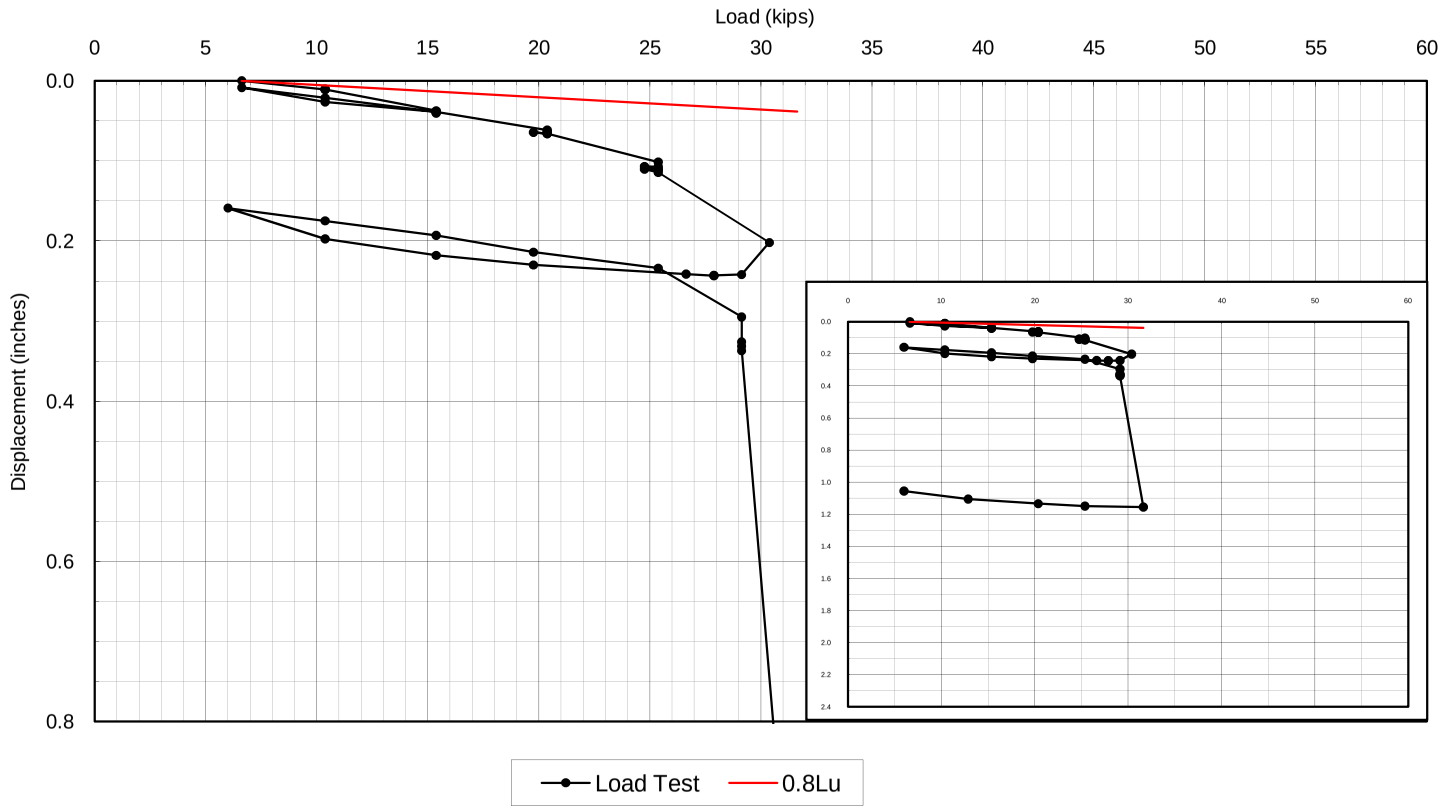
Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: B3
Date: 10/2/2009

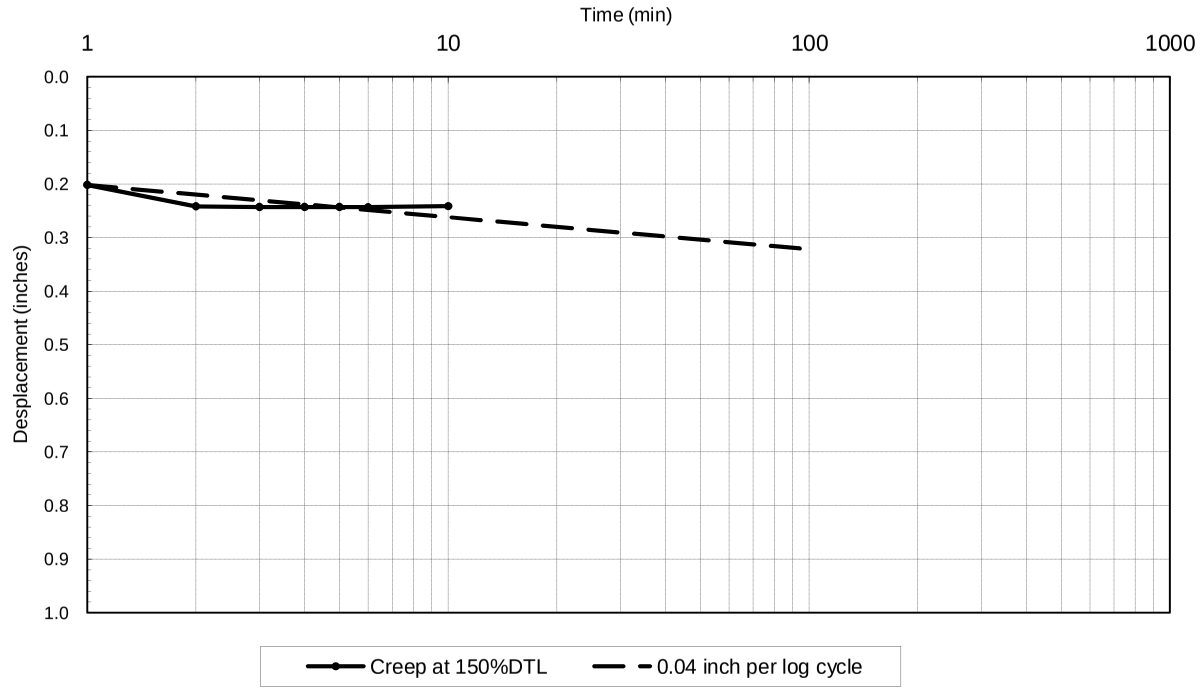
Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.0	25.1	250.0	6.6	1		0.000	0.000			0.000	tail length = 32 inches
25%	5.0	185.0	250.0	6.6	1		0.000	0.000			0.000	
50%	10.0	384.9	400.0	10.4	1		0.022	0.005			0.014	
	10.0	384.9	400.0	10.4	2		0.022	-0.005			0.009	
75%	15.0	584.9	600.0	15.4	1		0.093	-0.013			0.040	
	15.0	584.9	600.0	15.4	2		0.105	-0.012			0.047	
	15.0	584.9	600.0	15.4	3		0.102	-0.011			0.046	
	15.0	584.9	600.0	15.4	4		0.102	-0.011			0.046	
50%	10.0	384.9	400.0	10.4	1		0.085	-0.007			0.039	
25%	5.0	185.0	225.0	6.0	1		0.029	-0.010			0.010	
50%	10.0	384.9	400.0	10.4	1		0.091	0.009			0.050	
75%	15.0	584.9	600.0	15.4	1		0.103	0.028			0.066	
100%	20.0	784.8	800.0	20.4	1		0.142	0.098			0.120	
	20.0	784.8	800.0	20.4	2		0.152	0.105			0.129	
	20.0	784.8	800.0	20.4	3		0.153	0.105			0.129	
	20.0	784.8	800.0	20.4	4		0.163	0.116			0.140	
	20.0	784.8	800.0	20.4	5		0.163	0.117			0.140	
	20.0	784.8	800.0	20.4	6		0.167	0.120			0.144	
	20.0	784.8	875.0	22.3	1		1.341	1.293			1.317	
75%	15.0	584.9	700.0	17.9	1		1.337	1.287			1.312	
50%	10.0	384.9	500.0	12.9	1		1.321	1.270			1.296	
25%	5.0	185.0	225.0	6.0	1		1.267	1.255			1.261	

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 10 ft Unbonded 7.75 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: C1	**SCHNABEL ENGINEERING, LLC**	
				Verification Soil Nail Load Test	
Design Test Load (P) : 20 kip	Comments:			Hollow Core Bar Soil Nail Research	
				Olympia, WA	
Maximum Test Load: 150% P = 31.6 kip				Date: 10/05/09	07150064



Type of Test: Verification	Bond: 10 ft Unbonded 7.75 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: C1	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test Hollow Core Bar Soil Nail Research Olympia, WA
Design Test Load (P) : 20 kip	Comments:			
Maximum Test Load: 150% P = 31.6 kip				Date: 10/05/09 — 07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: C1
Date: 10/5/2009

Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.0	25.1	250.0	6.6	1		0.000	0.000			0.000	tail length = 27 inches
25%	5.0	185.0	250.0	6.6	1		0.000	0.000			0.000	
50%	10.0	384.9	400.0	10.4	1		0.034	-0.012			0.011	
	10.0	384.9	400.0	10.4	2		0.033	-0.012			0.011	
	10.0	384.9	400.0	10.4	3		0.033	-0.012			0.011	
	10.0	384.9	400.0	10.4	4		0.033	-0.011			0.011	
	10.0	384.9	400.0	10.4	5		0.033	-0.011			0.011	
75%	15.0	584.9	600.0	15.4	1		0.081	-0.006			0.038	
	15.0	584.9	600.0	15.4	2		0.078	-0.003			0.038	
	15.0	584.9	600.0	15.4	3		0.078	-0.003			0.038	
	15.0	584.9	600.0	15.4	4		0.083	-0.002			0.041	
	15.0	584.9	600.0	15.4	5		0.081	-0.002			0.040	
	15.0	584.9	600.0	15.4	6		0.080	-0.002			0.039	
	15.0	584.9	600.0	15.4	7		0.080	-0.002			0.039	
50%	10.0	384.9	400.0	10.4	1		0.058	-0.005			0.027	
25%	5.0	185.0	250.0	6.6	1		0.011	0.006			0.009	
50%	10.0	384.9	400.0	10.4	1		0.049	-0.006			0.022	
75%	15.0	584.9	600.0	15.4	1		0.080	-0.002			0.039	
100%	20.0	784.8	800.0	20.4	1		0.108	0.015			0.062	
	20.0	784.8	800.0	20.4	2		0.111	0.018			0.065	
	20.0	784.8	800.0	20.4	3		0.109	0.018			0.064	
	20.0	784.8	800.0	20.4	4		0.112	0.020			0.066	
	20.0	784.8	775.0	19.8	5		0.110	0.019			0.065	
	20.0	784.8	800.0	20.4	6		0.112	0.020			0.066	
	20.0	784.8	800.0	20.4	10		0.111	0.021			0.066	
125%	25.0	984.7	1000.0	25.4	1		0.148	0.055			0.102	
	25.0	984.7	1000.0	25.4	2		0.153	0.062			0.108	
	25.0	984.7	975.0	24.8	3		0.152	0.062			0.107	
	25.0	984.7	1000.0	25.4	4		0.156	0.066			0.111	
	25.0	984.7	1000.0	25.4	5		0.155	0.066			0.111	
	25.0	984.7	975.0	24.8	6		0.155	0.066			0.111	
	25.0	984.7	1000.0	25.4	10		0.158	0.071			0.115	
150%	30.0	1184.6	1200.0	30.4	1		0.247	0.157			0.202	
	30.0	1184.6	1150.0	29.1	2		0.286	0.198			0.242	
	30.0	1184.6	1100.0	27.9	3		0.287	0.199			0.243	
	30.0	1184.6	1100.0	27.9	4		0.287	0.199			0.243	
	30.0	1184.6	1100.0	27.9	5		0.287	0.199			0.243	
	30.0	1184.6	1100.0	27.9	6		0.287	0.200			0.244	
	30.0	1184.6	1050.0	26.6	10		0.285	0.198			0.242	
100%	20.0	784.8	775.0	19.8	1		0.272	0.188			0.230	
75%	15.0	584.9	600.0	15.4	1		0.258	0.178			0.218	
50%	10.0	384.9	400.0	10.4	1		0.229	0.166			0.198	
25%	5.0	185.0	225.0	6.0	1		0.150	0.168			0.159	

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

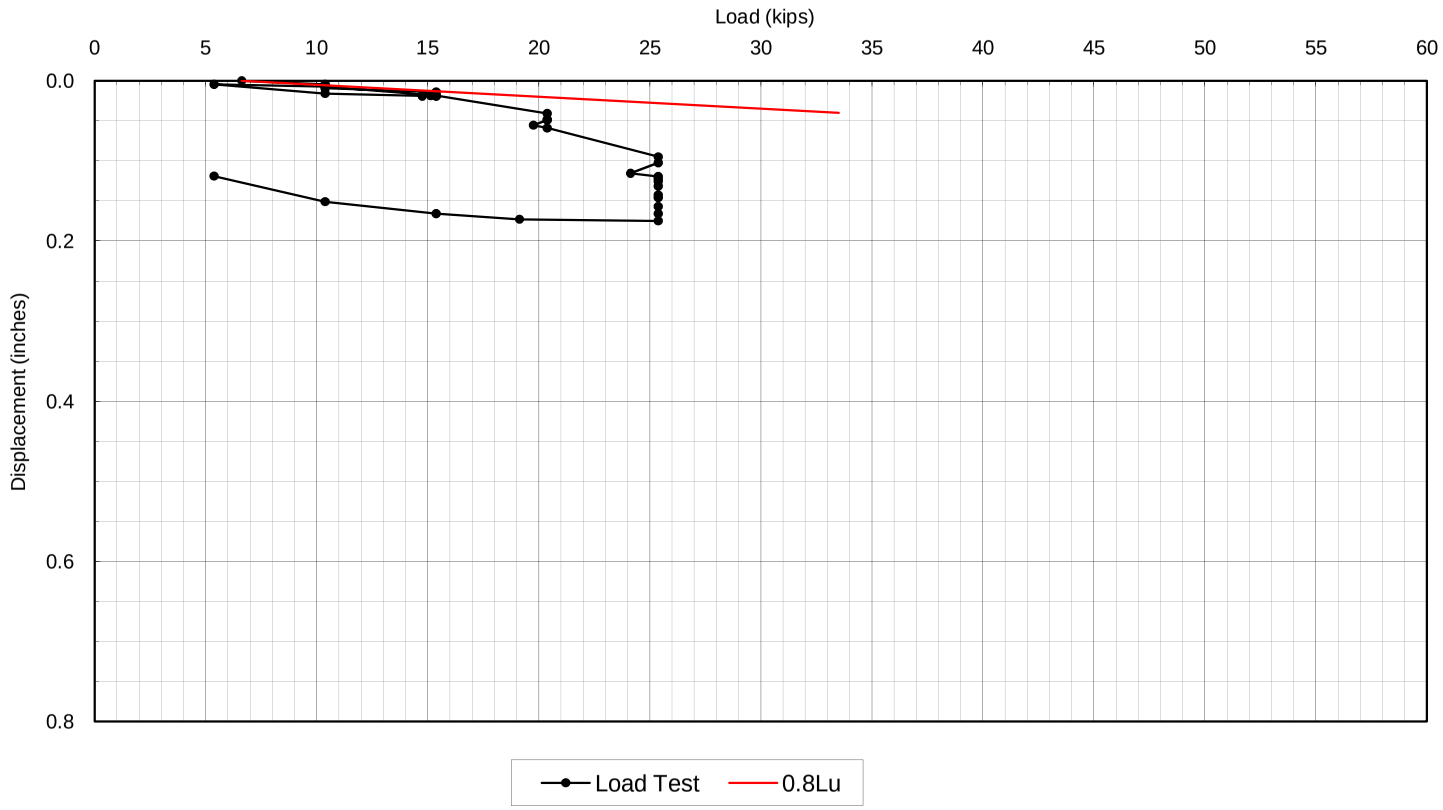
Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: C1
Date: 10/5/2009

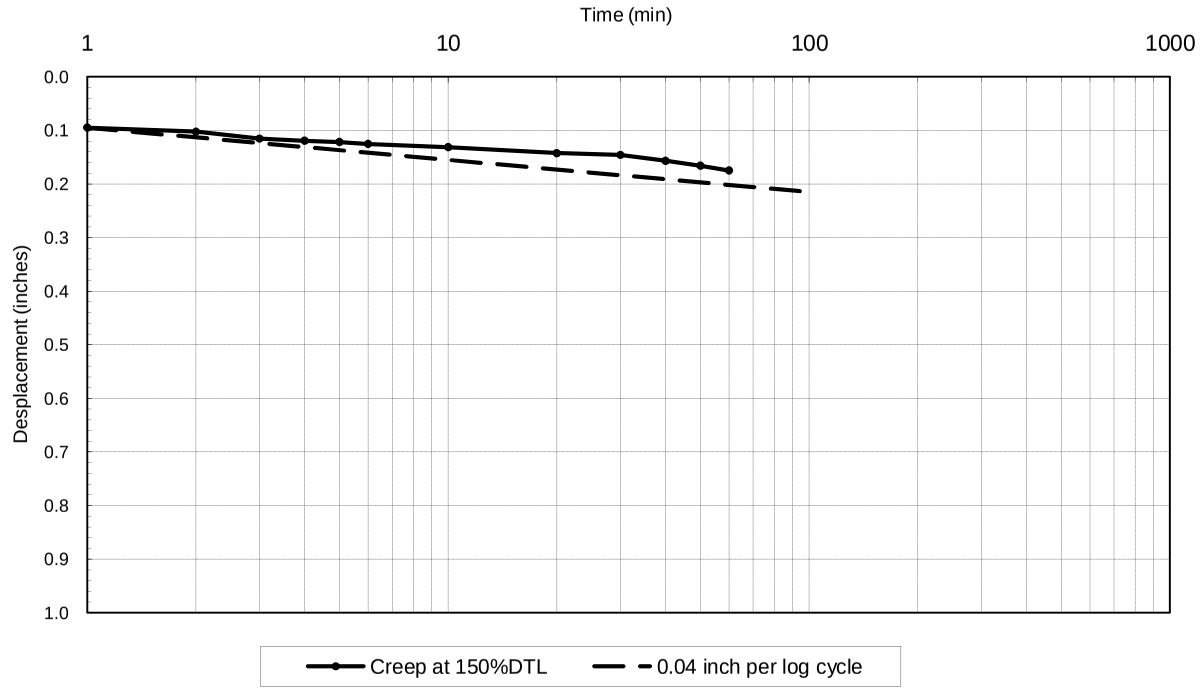
Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
50%	10.0	384.9	400.0	10.4	1		0.195	0.155			0.175	
75%	15.0	584.9	600.0	15.4	1		0.229	0.157			0.193	
100%	20.0	784.8	775.0	19.8	1		0.254	0.174			0.214	
125%	25.0	984.7	1000.0	25.4	1		0.277	0.191			0.234	
150%	30.0	1184.6	1150.0	29.1	1		0.339	0.251			0.295	
	30.0	1184.6	1150.0	29.1	1		0.370	0.282			0.326	
	30.0	1184.6	1150.0	29.1	2		0.375	0.288			0.332	
	30.0	1184.6	1150.0	29.1	3		0.381	0.293			0.337	
	30.0	1184.6	1250.0	31.6	4		1.198	1.111			1.155	
125%	25.0	984.7	1000.0	25.4	1		1.193	1.105			1.149	
100%	20.0	784.8	800.0	20.4	1		1.176	1.092			1.134	
75%	15.0	584.9	500.0	12.9	1		1.143	1.067			1.105	
25%	5.0	185.0	225.0	6.0	1		1.050	1.061			1.056	

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 10 ft Unbonded 7.5 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: C2	**SCHNABEL ENGINEERING, LLC**	
				Verification Soil Nail Load Test	
Design Test Load (P) : 20 kip	Comments:			Hollow Core Bar Soil Nail Research	
				Olympia, WA	
Maximum Test Load: 150% P = 33.5 kip				Date: 10/05/09	07150064



Type of Test: Verification	Bond: 10 ft Unbonded 7.5 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: C2	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test
Design Test Load (P) : 20 kip	Comments:			Hollow Core Bar Soil Nail Research Olympia, WA
Maximum Test Load: 150% P = 33.5 kip				Date: 10/05/09 — 07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: C2
Date: 10/2/2009

Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.0	25.1	250.0	6.6	1		0.000	0.000			0.000	tail length =
25%	5.0	185.0	250.0	6.6	1		0.000	0.000			0.000	
50%	10.0	384.9	400.0	10.4	1		0.003	0.006			0.005	
	10.0	384.9	400.0	10.4	2		0.004	0.006			0.005	
	10.0	384.9	400.0	10.4	3		0.004	0.006			0.005	
	10.0	384.9	400.0	10.4	4		0.007	0.006			0.007	
	10.0	384.9	400.0	10.4	5		0.012	0.007			0.010	
	10.0	384.9	400.0	10.4	6		0.012	0.007			0.010	
75%	15.0	584.9	600.0	15.4	1		0.020	0.008			0.014	
	15.0	584.9	575.0	14.8	2		0.029	0.006			0.018	
	15.0	584.9	600.0	15.4	3		0.030	0.007			0.019	
	15.0	584.9	590.0	15.1	4		0.030	0.007			0.019	
	15.0	584.9	590.0	15.1	5		0.030	0.007			0.019	
	15.0	584.9	575.0	14.8	6		0.032	0.007			0.020	
	15.0	584.9	600.0	15.4	10		0.032	0.007			0.020	
50%	10.0	384.9	400.0	10.4	1		0.030	0.002			0.016	
25%	5.0	185.0	200.0	5.4	1		0.015	-0.006			0.005	
50%	10.0	384.9	400.0	10.4	1		0.021	-0.006			0.008	
75%	15.0	584.9	600.0	15.4	1		0.038	-0.001			0.019	
100%	20.0	784.8	800.0	20.4	1		0.069	0.013			0.041	
	20.0	784.8	800.0	20.4	2		0.084	0.013			0.049	
	20.0	784.8	800.0	20.4	3		0.084	0.014			0.049	
	20.0	784.8	775.0	19.8	4		0.098	0.013			0.056	
	20.0	784.8	800.0	20.4	5		0.101	0.017			0.059	
125%	25.0	984.7	1000.0	25.4	1		0.136	0.054			0.095	
	25.0	984.7	1000.0	25.4	2		0.145	0.060			0.103	
	25.0	984.7	950.0	24.1	3		0.157	0.074			0.116	
	25.0	984.7	1000.0	25.4	4		0.161	0.078			0.120	
	25.0	984.7	1000.0	25.4	5		0.164	0.080			0.122	
	25.0	984.7	1000.0	25.4	6		0.167	0.084			0.126	
	25.0	984.7	1000.0	25.4	10		0.172	0.091			0.132	
	25.0	984.7	1000.0	25.4	20		0.183	0.102			0.143	
	25.0	984.7	1000.0	25.4	30		0.187	0.105			0.146	
	25.0	984.7	1000.0	25.4	40		0.197	0.117			0.157	
	25.0	984.7	1000.0	25.4	50		0.206	0.126			0.166	
	25.0	984.7	1000.0	25.4	60		0.215	0.135			0.175	
100%	20.0	784.8	750.0	19.1	1		0.217	0.129			0.173	
75%	15.0	584.9	600.0	15.4	1		0.212	0.120			0.166	
50%	10.0	384.9	400.0	10.4	1		0.196	0.106			0.151	
25%	5.0	185.0	200.0	5.4	1		0.157	0.081			0.119	
50%	10.0	384.9	400.0	10.4	1		0.185	0.080			0.133	
75%	15.0	584.9	600.0	15.4	1		0.192	0.080			0.136	
100%	20.0	784.8	800.0	20.4	1		0.231	0.093			0.162	

Soil Nail Verification Load Test Data

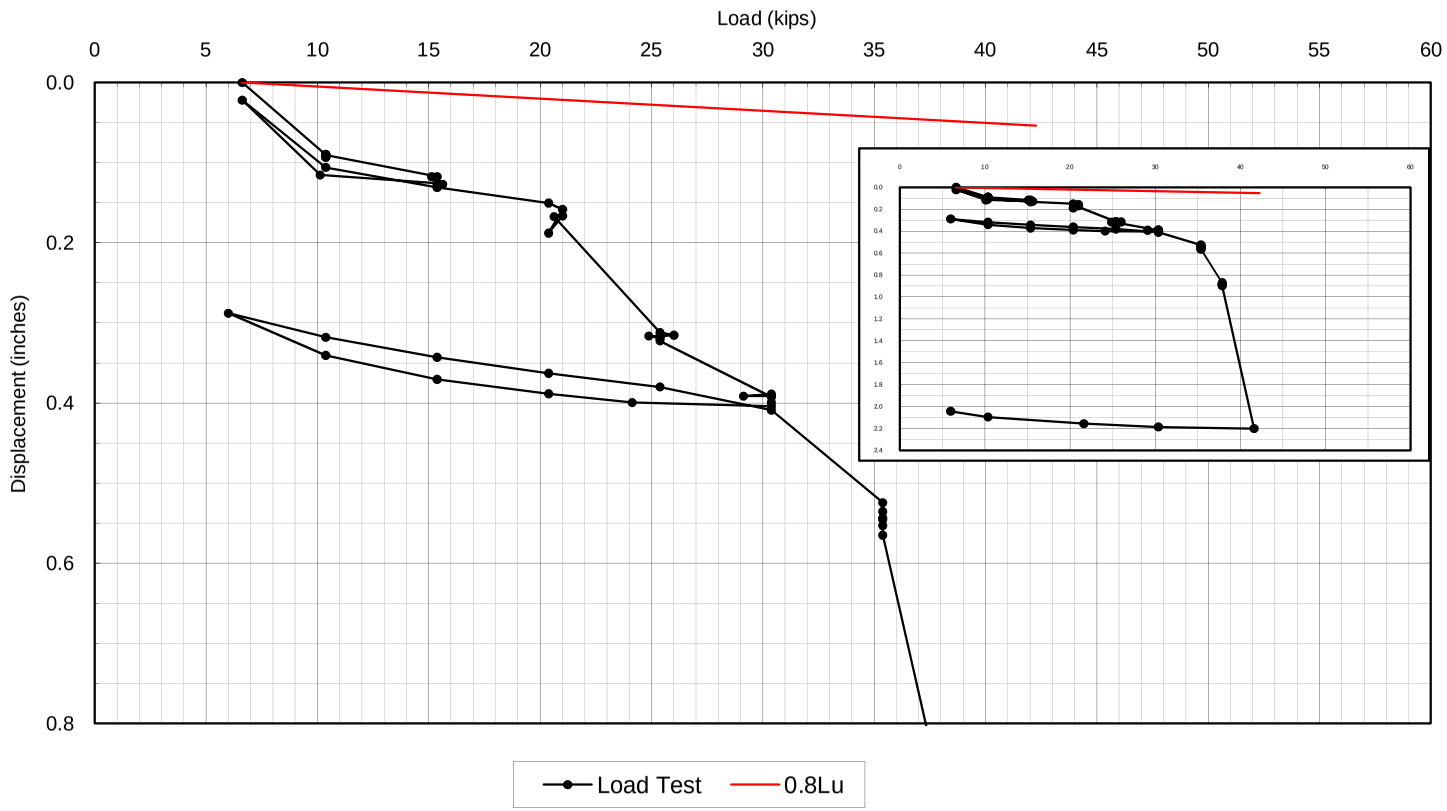
Schnabel Engineering

Project:	Hollow Core Bar Soil Nail Research	**Performed:**	DBM Contractors	**Soil Nail:**	**C2**
Location:	Olympia, WA	**Observed:**	M. Rohrbach		
Client:	ADSC	**Data by:**	M. Rohrbach	**Date:**	10/2/2009

Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

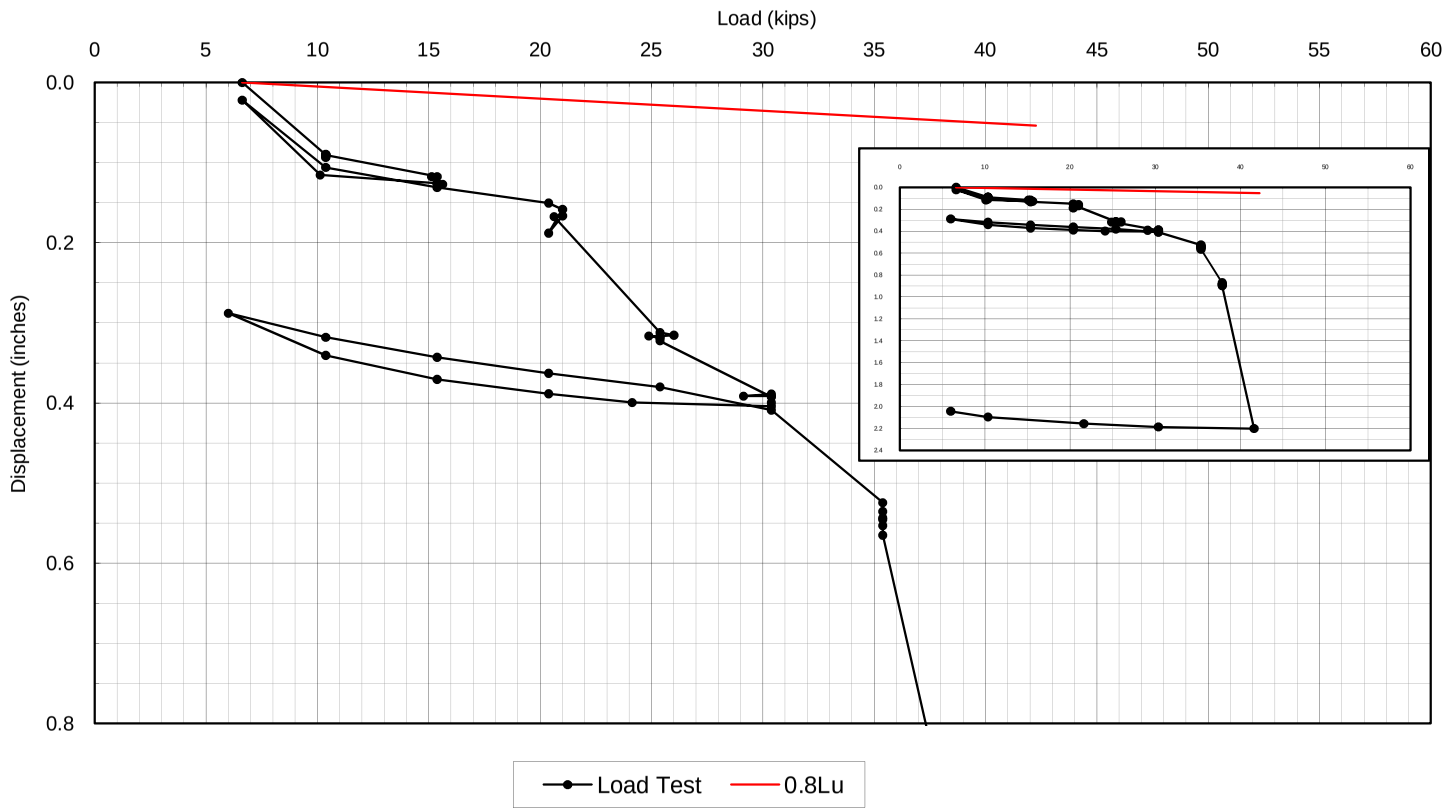
Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
125%	25.0	984.7	1000.0	25.4	1		0.268	0.132			0.200	
150%	30.0	1184.6	1200.0	30.4	1		0.715	0.568			0.642	
	30.0	1184.6	1200.0	30.4	2		0.731	0.581			0.656	
	30.0	1184.6	1200.0	30.4	3		0.731	0.581			0.656	
	30.0	1184.6	1200.0	30.4	4		0.735	0.584			0.660	
	30.0	1184.6	1200.0	30.4	5		0.735	0.584			0.660	
175%	35.0	1384.5	1325.0	33.5	1		1.077	0.920			0.999	
	35.0	1384.5	1325.0	33.5	1		2.256	2.060			2.158	

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 10 ft Unbonded 7.5 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: C3	**SCHNABEL ENGINEERING, LLC**	
				Verification Soil Nail Load Test	
Design Test Load (P) : 20 kip	Comments:			Hollow Core Bar Soil Nail Research	
				Olympia, WA	
Maximum Test Load: 200% P = 37.3 kip				Date: 10/05/09	07150064

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 10 ft Unbonded 7.5 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: C3	**SCHNABEL ENGINEERING, LLC**	
				Verification Soil Nail Load Test	
Design Test Load (P) : 20 kip	Comments:			Hollow Core Bar Soil Nail Research	
				Olympia, WA	
Maximum Test Load: 200% P = 37.3 kip				Date: 10/05/09	07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: C3
Date: 10/5/2009

Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.0	25.1	250.0	6.6	1		0.000	0.000			0.000	tail length = 29 inches
25%	5.0	185.0	250.0	6.6	1		0.000	0.000			0.000	
50%	10.0	384.9	400.0	10.4	1		0.002	0.003			0.090	
	10.0	384.9	400.0	10.4	2		0.125	0.062			0.094	
	10.0	384.9	400.0	10.4	3		0.122	0.062			0.092	
	10.0	384.9	400.0	10.4	4		0.121	0.061			0.091	
	10.0	384.9	400.0	10.4	5		0.119	0.060			0.090	
	10.0	384.9	400.0	10.4	6		0.120	0.061			0.091	
75%	15.0	584.9	600.0	15.4	1		0.163	0.072			0.118	
	15.0	584.9	590.0	15.1	2		0.164	0.071			0.118	
	15.0	584.9	610.0	15.6	3		0.174	0.080			0.127	
	15.0	584.9	600.0	15.4	4		0.172	0.080			0.126	
	15.0	584.9	600.0	15.4	5		0.171	0.080			0.126	
50%	10.0	384.9	390.0	10.1	1		0.155	0.076			0.116	
25%	5.0	185.0	250.0	6.6	1		0.026	0.018			0.022	
50%	10.0	384.9	400.0	10.4	1		0.141	0.071			0.106	
75%	15.0	584.9	600.0	15.4	1		0.181	0.081			0.131	
100%	20.0	784.8	800.0	20.4	1		0.215	0.086			0.151	
	20.0	784.8	825.0	21.0	2		0.219	0.098			0.159	
	20.0	784.8	800.0	20.4	3		0.276	0.100			0.188	
	20.0	784.8	825.0	21.0	4		0.225	0.108			0.167	
	20.0	784.8	810.0	20.6	5		0.226	0.109			0.168	
125%	25.0	984.7	1000.0	25.4	1		0.296	0.328			0.312	
	25.0	984.7	1025.0	26.0	2		0.300	0.331			0.316	
	25.0	984.7	1000.0	25.4	3		0.299	0.334			0.317	
	25.0	984.7	980.0	24.9	4		0.299	0.334			0.317	
	25.0	984.7	1000.0	25.4	5		0.303	0.334			0.319	
	25.0	984.7	1000.0	25.4	6		0.304	0.334			0.319	
	25.0	984.7	1000.0	25.4	10		0.308	0.337			0.323	
150%	30.0	1184.6	1200.0	30.4	1		0.385	0.400			0.393	
	30.0	1184.6	1200.0	30.4	2		0.383	0.400			0.392	
	30.0	1184.6	1150.0	29.1	3		0.383	0.400			0.392	
	30.0	1184.6	1200.0	30.4	4		0.372	0.406			0.389	
	30.0	1184.6	1200.0	30.4	5		0.392	0.407			0.400	
	30.0	1184.6	1200.0	30.4	6		0.392	0.407			0.400	
	30.0	1184.6	1200.0	30.4	10		0.397	0.411			0.404	
125%	25.0	984.7	950.0	24.1	1		0.391	0.408			0.400	
100%	20.0	784.8	800.0	20.4	1		0.379	0.398			0.389	
75%	15.0	584.9	600.0	15.4	1		0.358	0.383			0.371	
50%	10.0	384.9	400.0	10.4	1		0.315	0.366			0.341	
25%	5.0	185.0	225.0	6.0	1		0.225	0.351			0.288	
50%	10.0	384.9	400.0	10.4	1		0.281	0.355			0.318	

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

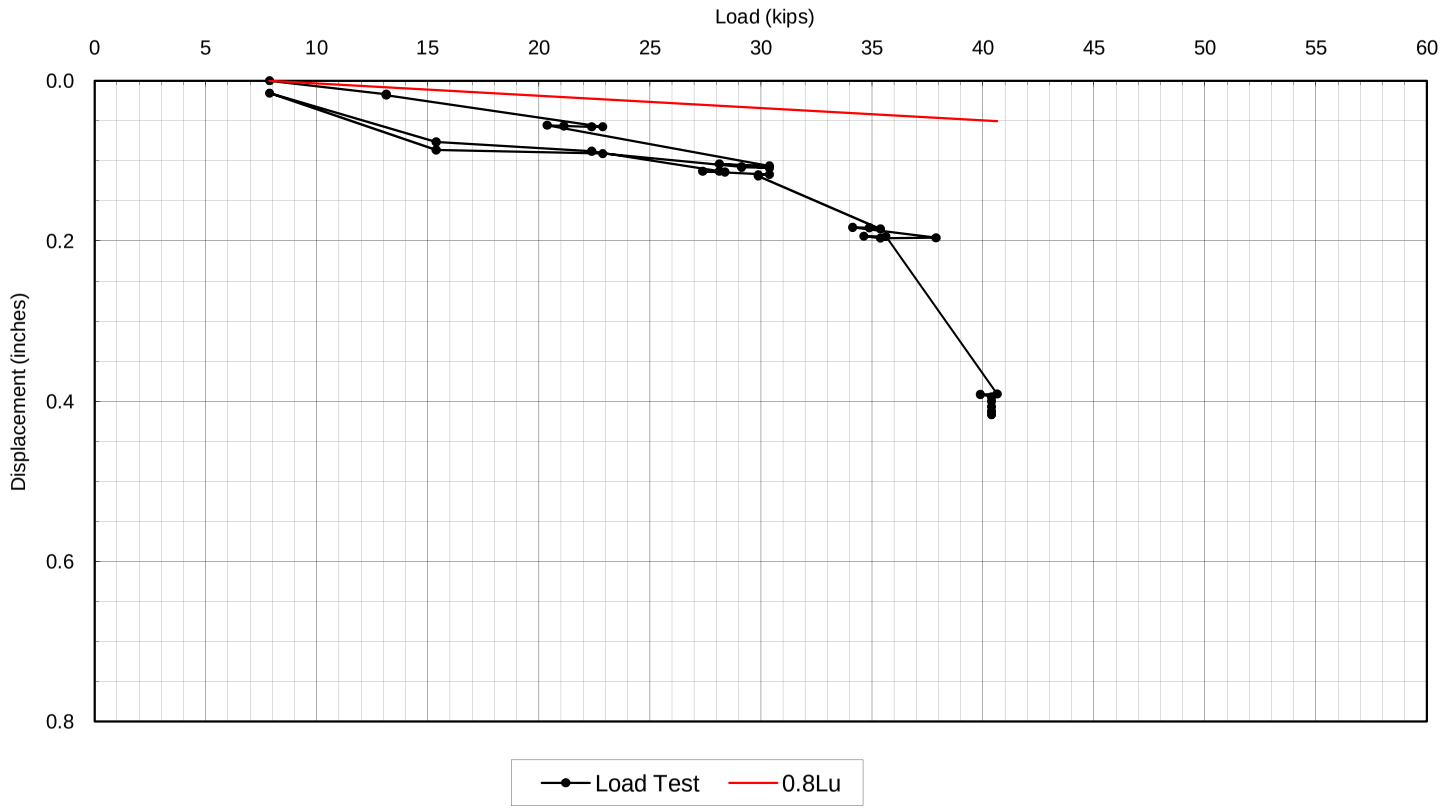
Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: C3
Date: 10/5/2009

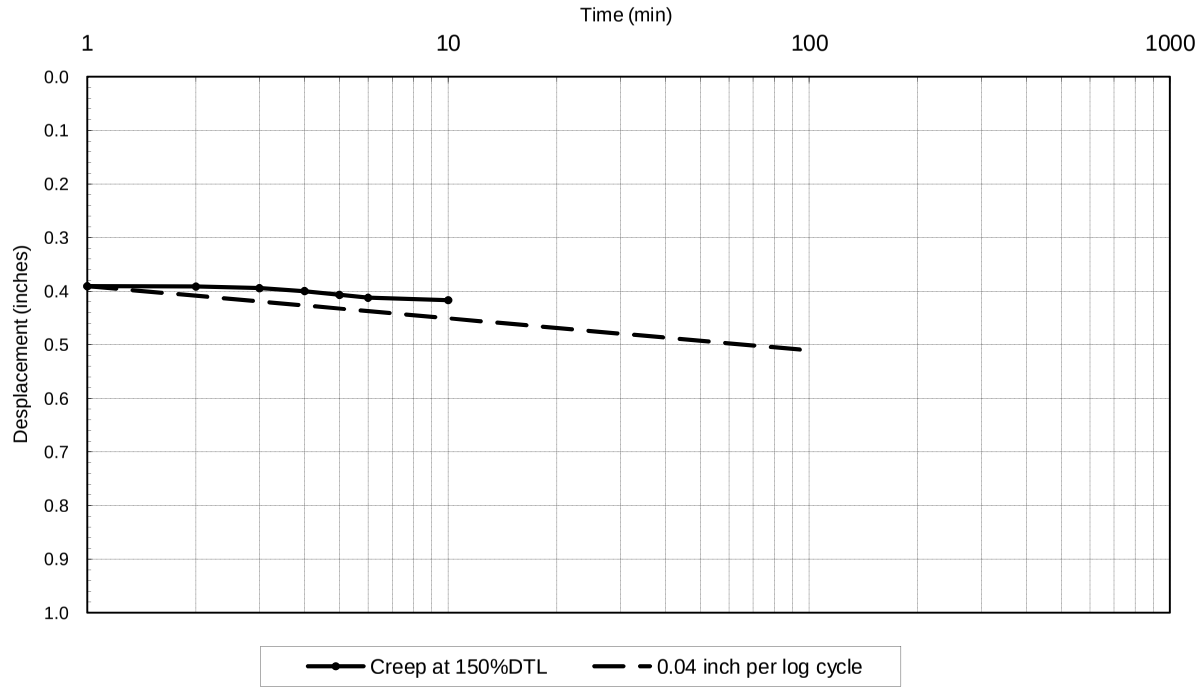
Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
75%	15.0	584.9	600.0	15.4	1		0.325	0.361			0.343	
100%	20.0	784.8	800.0	20.4	1		0.354	0.372			0.363	
125%	25.0	984.7	1000.0	25.4	1		0.375	0.385			0.380	
150%	30.0	1184.6	1200.0	30.4	1		0.406	0.412			0.409	
175%	35.0	1384.5	1400.0	35.4	1		0.529	0.520			0.525	
	35.0	1384.5	1400.0	35.4	2		0.540	0.531			0.536	
	35.0	1384.5	1400.0	35.4	3		0.548	0.539			0.544	
	35.0	1384.5	1400.0	35.4	4		0.549	0.542			0.546	
	35.0	1384.5	1400.0	35.4	5		0.549	0.542			0.546	
	35.0	1384.5	1400.0	35.4	6		0.556	0.550			0.553	
	35.0	1384.5	1400.0	35.4	10		0.566	0.564			0.565	
200%	40.0	1584.5	1500.0	37.9	1		0.877	0.864			0.871	
	40.0	1584.5	1500.0	37.9	2		0.886	0.874			0.880	
	40.0	1584.5	1500.0	37.9	3		0.892	0.879			0.886	
	40.0	1584.5	1500.0	37.9	4		0.893	0.882			0.888	
	40.0	1584.5	1500.0	37.9	5		0.899	0.887			0.893	
	40.0	1584.5	1500.0	37.9	6		0.904	0.891			0.898	
	40.0	1584.5	1650.0	41.6	1		2.211	2.190			2.201	
150%	30.0	1184.6	1200.0	30.4	1		2.194	2.178			2.186	
100%	20.0	784.8	850.0	21.6	1		2.161	2.152			2.157	
50%	10.0	384.9	400.0	10.4	1		2.083	2.108			2.096	
25%	5.0	185.0	225.0	6.0	1		2.043	2.043			2.043	

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 10 ft Unbonded 7.75 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: D1	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test
Design Test Load (P) : 30 kip	Comments:			Hollow Core Bar Soil Nail Research Olympia, WA
Maximum Test Load: 150% P = 40.4 kip				Date: 10/02/09 — 07150064



Type of Test: Verification	Bond: 10 ft Unbonded 7.75 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: D1	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test Hollow Core Bar Soil Nail Research Olympia, WA
Design Test Load (P) : 30 kip	Comments:			
Maximum Test Load: 150% P = 40.4 kip				Date: 10/02/09 — 07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: D1
Date: 10/2/2009

Design Test Load (P): 30 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.5	45.1	300.0	7.9	1		0.000	0.000			0.000	tail length = 27 inches
50%	15.0	584.9	510.0	13.1	1		0.048	-0.014			0.017	
	15.0	584.9	510.0	13.1	2		0.048	-0.014			0.017	
	15.0	584.9	510.0	13.1	3		0.048	-0.012			0.018	
	15.0	584.9	510.0	13.1	4		0.048	-0.012			0.018	
	15.0	584.9	510.0	13.1	5		0.048	-0.012			0.018	
	15.0	584.9	510.0	13.1	6		0.048	-0.012			0.018	
75%	22.5	884.7	900.0	22.9	1		0.119	-0.004			0.058	
	22.5	884.7	880.0	22.4	2		0.119	-0.004			0.058	
	22.5	884.7	830.0	21.1	3		0.117	-0.004			0.057	
	22.5	884.7	800.0	20.4	4		0.115	-0.004			0.056	
	22.5	884.7	800.0	20.4	5		0.115	-0.004			0.056	
	22.5	884.7	800.0	20.4	6		0.115	-0.004			0.056	
100%	30.0	1184.6	1200.0	30.4	1		0.188	0.025			0.107	
	0.0	-14.9	1110.0	28.1	2		0.186	0.022			0.104	
	0.0	-14.9	1200.0	30.4	3		0.193	0.025			0.109	
	0.0	-14.9	1150.0	29.1	4		0.192	0.024			0.108	
	0.0	-14.9	1150.0	29.1	5		0.192	0.023			0.108	
	0.0	-14.9	1150.0	29.1	6		0.192	0.023			0.108	
75%	22.5	884.7	900.0	22.9	1		0.173	0.009			0.091	
50%	15.0	584.9	600.0	15.4	1		0.168	0.005			0.087	
AL	1.5	45.1	300.0	7.9	1		0.031	0.000			0.016	
50%	15.0	584.9	600.0	15.4	1		0.154	-0.001			0.077	
75%	22.5	884.7	880.0	22.4	1		0.168	0.008			0.088	
100%	30.0	1184.6	1120.0	28.4	1		0.200	0.028			0.114	
	30.0	1184.6	1110.0	28.1	2		0.199	0.027			0.113	
	30.0	1184.6	1080.0	27.4	3		0.199	0.027			0.113	
	30.0	1184.6	1200.0	30.4	4		0.204	0.030			0.117	
	30.0	1184.6	1180.0	29.9	5		0.205	0.030			0.118	
	30.0	1184.6	1180.0	29.9	6		0.206	0.032			0.119	
125%	37.5	1484.5	1400.0	35.4	1		0.281	0.089			0.185	
	37.5	1484.5	1380.0	34.9	2		0.280	0.087			0.184	
	37.5	1484.5	1350.0	34.1	3		0.280	0.086			0.183	
	37.5	1484.5	1500.0	37.9	4		0.294	0.098			0.196	
	37.5	1484.5	1400.0	35.4	5		0.295	0.098			0.197	
	37.5	1484.5	1400.0	35.4	6		0.296	0.097			0.197	
	37.5	1484.5	1370.0	34.6	7		0.293	0.095			0.194	
	37.5	1484.5	1410.0	35.6	10		0.295	0.094			0.195	
150%	45.0	1784.4	1610.0	40.6	1		0.501	0.281			0.391	
	45.0	1784.4	1580.0	39.9	2		0.502	0.281			0.392	
	45.0	1784.4	1600.0	40.4	3		0.506	0.283			0.395	
	45.0	1784.4	1600.0	40.4	4		0.512	0.288			0.400	
	45.0	1784.4	1600.0	40.4	5		0.518	0.296			0.407	

Soil Nail Verification Load Test Data

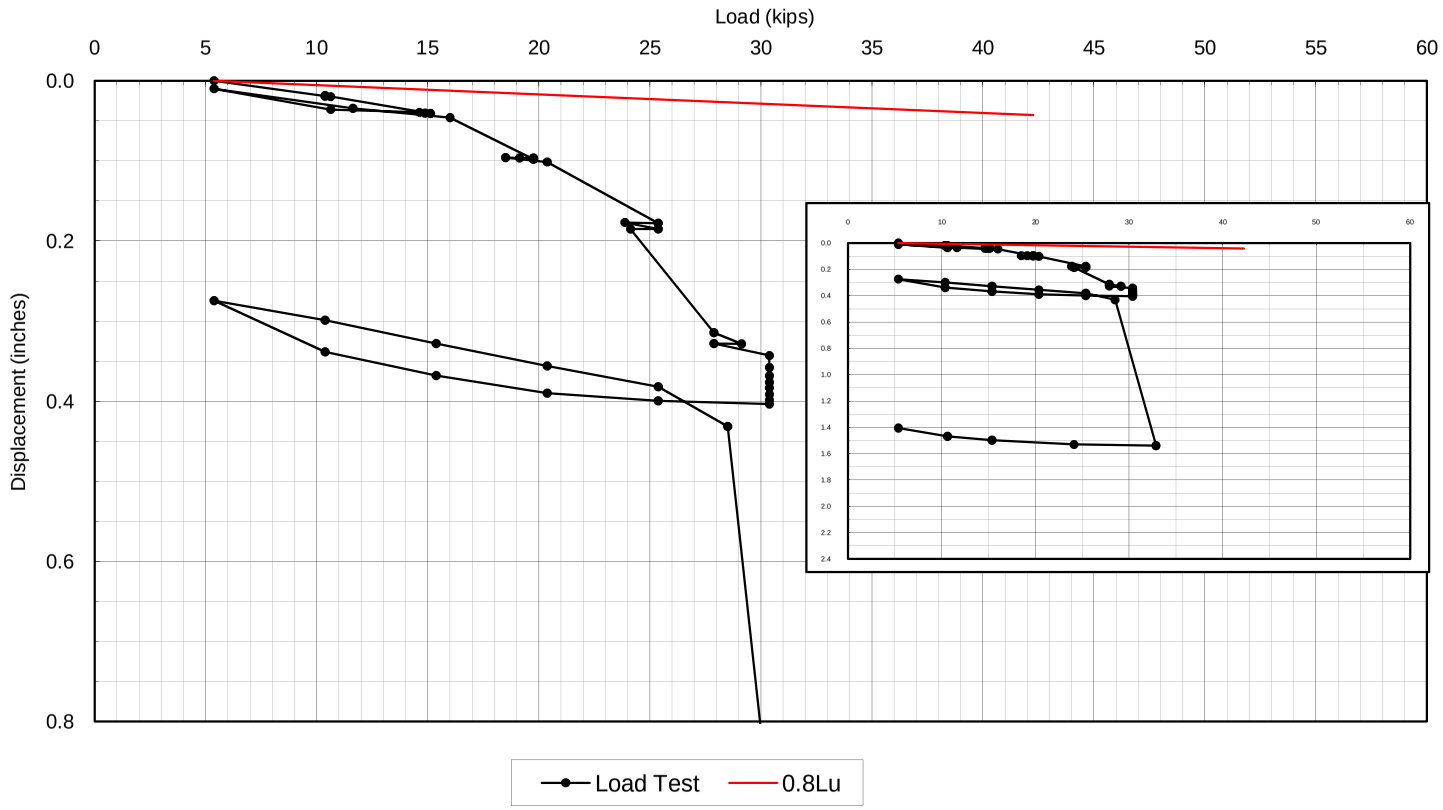
Schnabel Engineering

Project:	Hollow Core Bar Soil Nail Research	**Performed:**	DBM Contractors	**Soil Nail:**	**D1**
Location:	Olympia, WA	**Observed:**	M. Rohrbach		
Client:	ADSC	**Data by:**	M. Rohrbach	**Date:**	10/2/2009

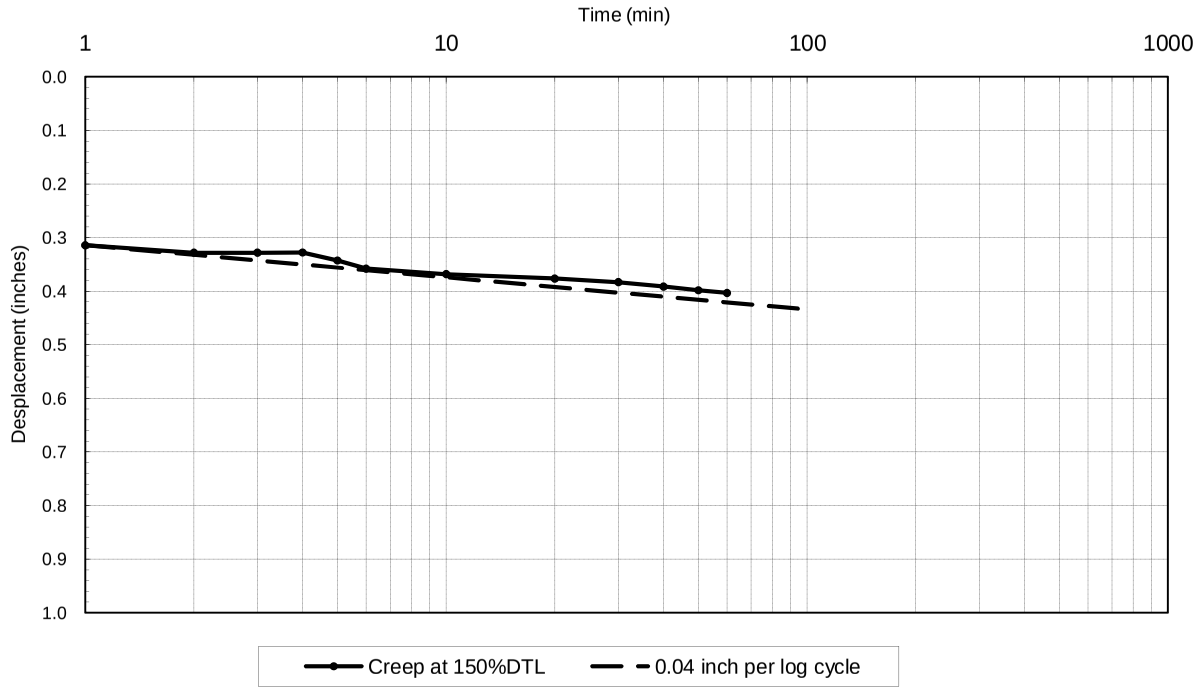
Design Test Load (P): 30 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
	45.0	1784.4	1600.0	40.4	6		0.524	0.301			0.413	
	45.0	1784.4	1600.0	40.4	10		0.528	0.306			0.417	

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 10 ft Unbonded 7.8 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: D2	**SCHNABEL ENGINEERING, LLC**	
				Verification Soil Nail Load Test	
Design Test Load (P) : 30 kip	Comments:			Hollow Core Bar Soil Nail Research	
				Olympia, WA	
Maximum Test Load: 175% P = 32.9 kip				Date: 10/02/09	07150064



Type of Test: Verification	Bond: 10 ft Unbonded 7.8 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: D2	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test
Design Test Load (P) : 30 kip	Comments:			Hollow Core Bar Soil Nail Research Olympia, WA
Maximum Test Load: 175% P = 32.9 kip				Date: 10/02/09 — 07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

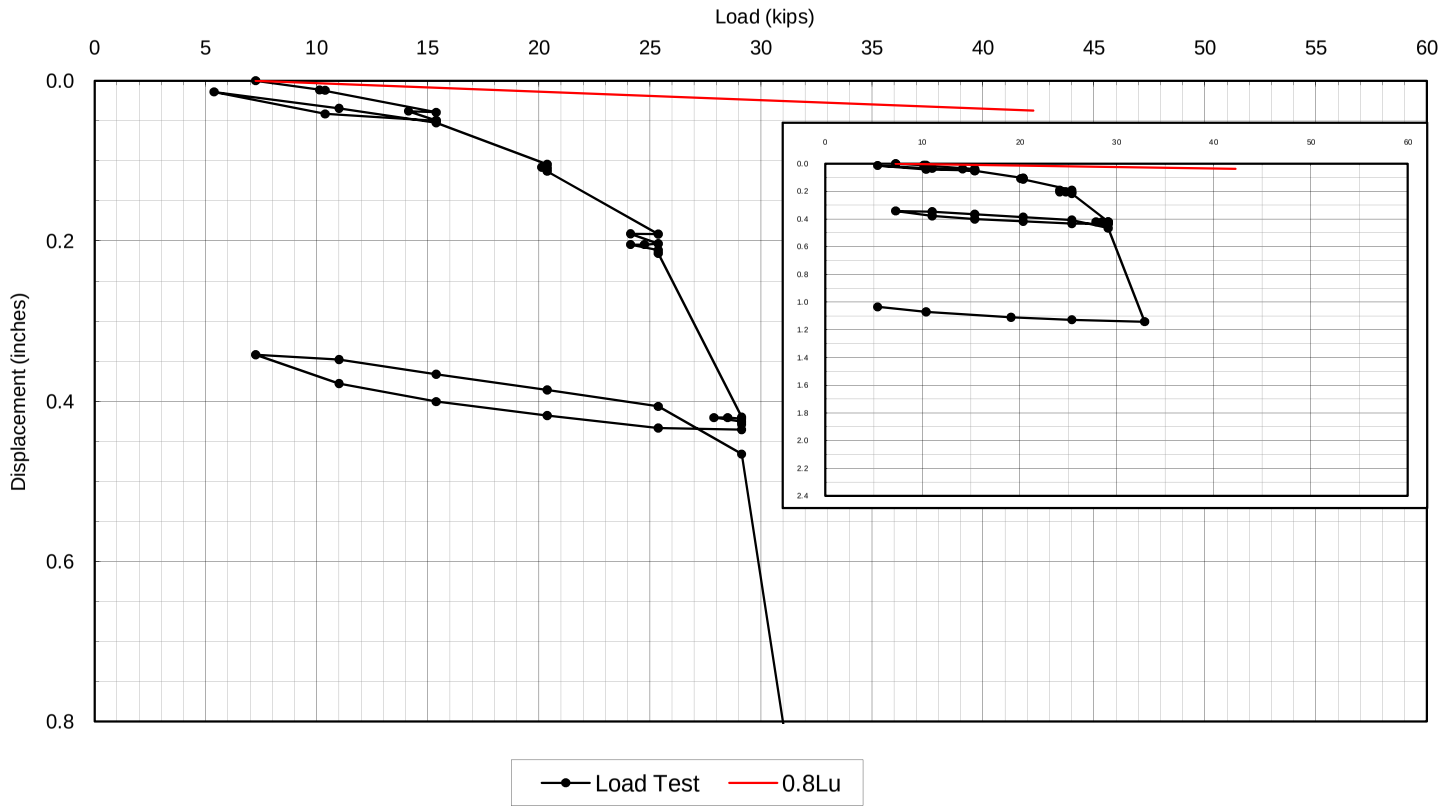
Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: D2
Date: 10/2/2009

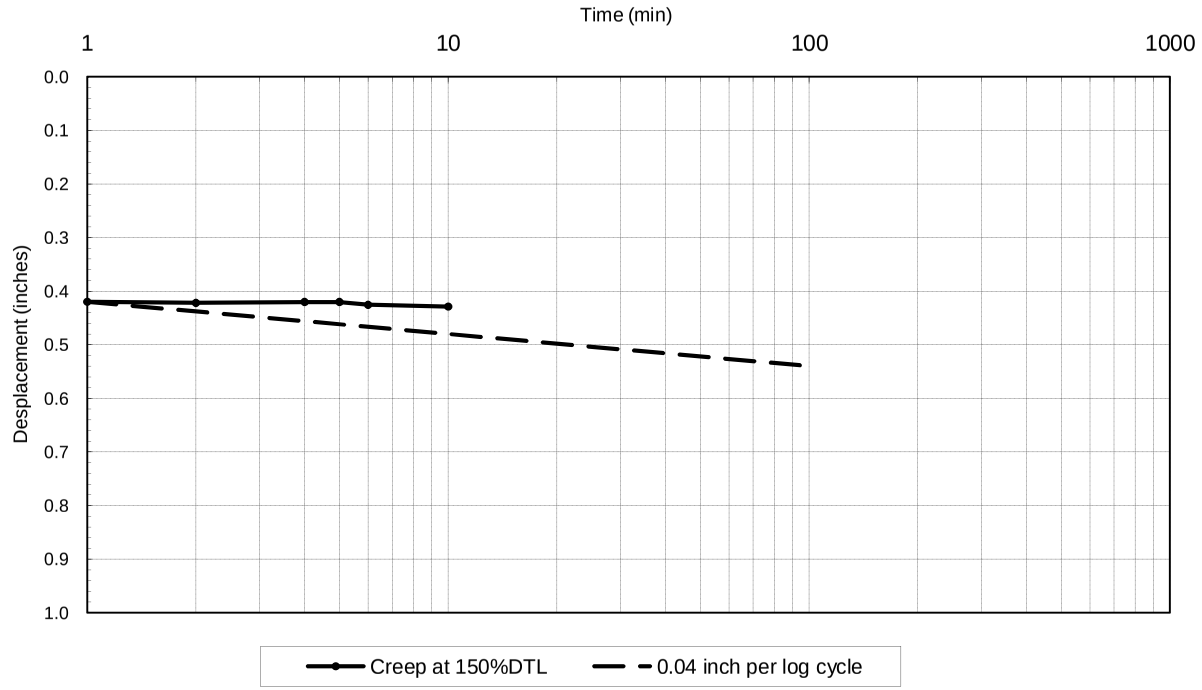
Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.0	25.1	200.0	5.4	1		0.000	0.000			0.000	tail length = 26.5 inches
50%	10.0	384.9	410.0	10.6	1		0.017	0.023			0.020	
	10.0	384.9	400.0	10.4	2		0.016	0.023			0.020	
	10.0	384.9	400.0	10.4	3		0.015	0.022			0.019	
	10.0	384.9	400.0	10.4	4		0.015	0.022			0.019	
	10.0	384.9	400.0	10.4	5		0.015	0.022			0.019	
	10.0	384.9	400.0	10.4	6		0.015	0.022			0.019	
75%	15.0	584.9	590.0	15.1	1		0.042	0.040			0.041	
	15.0	584.9	580.0	14.9	2		0.041	0.040			0.041	
	15.0	584.9	580.0	14.9	3		0.041	0.040			0.041	
	15.0	584.9	580.0	14.9	4		0.041	0.040			0.041	
	15.0	584.9	580.0	14.9	5		0.041	0.040			0.041	
	15.0	584.9	570.0	14.6	6		0.040	0.039			0.040	
50%	10.0	384.9	410.0	10.6	1		0.035	0.037			0.036	
25%	5.0	185.0	200.0	5.4	1		0.008	0.012			0.010	
25%	5.0	185.0	200.0	5.4	1		0.008	0.012			0.010	
50%	10.0	384.9	450.0	11.6	1		0.033	0.036			0.035	
75%	15.0	584.9	625.0	16.0	1		0.047	0.045			0.046	
100%	20.0	784.8	775.0	19.8	1		0.105	0.091			0.098	
	20.0	784.8	775.0	19.8	2		0.104	0.091			0.098	
	20.0	784.8	775.0	19.8	3		0.103	0.090			0.097	
	20.0	784.8	750.0	19.1	4		0.103	0.090			0.097	
	20.0	784.8	750.0	19.1	5		0.103	0.090			0.097	
	20.0	784.8	750.0	19.1	6		0.103	0.090			0.097	
	20.0	784.8	725.0	18.5	10		0.102	0.090			0.096	
	20.0	784.8	800.0	20.4	11		0.109	0.094			0.102	
125%	25.0	984.7	1000.0	25.4	1		0.191	0.165			0.178	
	25.0	984.7	940.0	23.9	3		0.189	0.165			0.177	
	25.0	984.7	1000.0	25.4	4		0.198	0.172			0.185	
	25.0	984.7	1000.0	25.4	5		0.198	0.172			0.185	
	25.0	984.7	1000.0	25.4	6		0.198	0.172			0.185	
	25.0	984.7	950.0	24.1	7		0.198	0.172			0.185	
150%	30.0	1184.6	1100.0	27.9	1		0.336	0.293			0.315	
	30.0	1184.6	1150.0	29.1	2		0.351	0.306			0.329	
	30.0	1184.6	1150.0	29.1	3		0.351	0.306			0.329	
	30.0	1184.6	1100.0	27.9	4		0.350	0.306			0.328	
	30.0	1184.6	1200.0	30.4	5		0.364	0.322			0.343	
	30.0	1184.6	1200.0	30.4	6		0.383	0.333			0.358	
	30.0	1184.6	1200.0	30.4	10		0.394	0.343			0.369	
	30.0	1184.6	1200.0	30.4	20		0.403	0.350			0.377	
	30.0	1184.6	1200.0	30.4	30		0.411	0.356			0.384	
	30.0	1184.6	1200.0	30.4	40		0.420	0.363			0.392	
	30.0	1184.6	1200.0	30.4	50		0.428	0.369			0.399	

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 10 ft Unbonded 7.3 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: D3	**SCHNABEL ENGINEERING, LLC**	
				Verification Soil Nail Load Test	
Design Test Load (P) : 20 kip	Comments:			Hollow Core Bar Soil Nail Research	
				Olympia, WA	
Maximum Test Load: 150% P = 29.1 kip				Date: 10/02/09	07150064



Type of Test: Verification	Bond: 10 ft Unbonded 7.3 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: D3	**SCHNABEL ENGINEERING, LLC** Verification Soil Nail Load Test Hollow Core Bar Soil Nail Research Olympia, WA
Design Test Load (P) : 20 kip	Comments:			
Maximum Test Load: 150% P = 29.1 kip				Date: 10/02/09 — 07150064

Soil Nail Verification Load Test Data

Schnabel Engineering

Project: Hollow Core Bar Soil Nail Research
Location: Olympia, WA
Client: ADSC

Performed: DBM Contractors
Observed: M. Rohrbach
Data by: M. Rohrbach

Soil Nail: D3
Date: 10/2/2009

Design Test Load (P): 20 kips **# Dials:** 2 **Jack Calibration:** Pressure = 39.984 X reading (kip) + -14.9 (psi)

Sequence of Loading	Estimated Load [kip]	Dial Load [psi]	Applied Pressure [psi]	Applied Load [kip]	Time [min]	Time of Test	Dial 1 Deformation [in.]	Dial 2 Deformation [in.]	Dial 3 Deformation [in.]	Dial 4 Deformation [in.]	Average Deformation [in.]	Comments:
AL	1.0	25.1	275.0	7.3	1		0.000	0.000			0.000	tail length = 32 inches
50%	10.0	384.9	400.0	10.4	1		0.017	0.007			0.012	
	10.0	384.9	390.0	10.1	2		0.016	0.007			0.012	
	10.0	384.9	390.0	10.1	3		0.016	0.007			0.012	
	10.0	384.9	390.0	10.1	4		0.016	0.007			0.012	
75%	15.0	584.9	600.0	15.4	1		0.054	0.025			0.040	
	15.0	584.9	550.0	14.1	2		0.051	0.025			0.038	
	15.0	584.9	600.0	15.4	3		0.064	0.035			0.050	
	15.0	584.9	600.0	15.4	4		0.064	0.036			0.050	
50%	10.0	384.9	400.0	10.4	1		0.054	0.029			0.042	
25%	5.0	185.0	200.0	5.4	1		0.023	0.005			0.014	
50%	10.0	384.9	425.0	11.0	1		0.046	0.023			0.035	
75%	15.0	584.9	600.0	15.4	1		0.067	0.038			0.053	
100%	20.0	784.8	800.0	20.4	1		0.130	0.079			0.105	
	20.0	784.8	800.0	20.4	2		0.134	0.084			0.109	
	20.0	784.8	790.0	20.1	3		0.133	0.083			0.108	
	20.0	784.8	790.0	20.1	4		0.133	0.083			0.108	
	20.0	784.8	790.0	20.1	5		0.133	0.083			0.108	
	20.0	784.8	800.0	20.4	6		0.138	0.088			0.113	
125%	25.0	984.7	1000.0	25.4	1		0.227	0.156			0.192	
	25.0	984.7	950.0	24.1	2		0.226	0.156			0.191	
	25.0	984.7	1000.0	25.4	3		0.238	0.169			0.204	
	25.0	984.7	975.0	24.8	4		0.239	0.170			0.205	
	25.0	984.7	950.0	24.1	5		0.239	0.170			0.205	
	25.0	984.7	1000.0	25.4	6		0.246	0.177			0.212	
	25.0	984.7	1000.0	25.4	10		0.250	0.181			0.216	
150%	30.0	1184.6	1150.0	29.1	1		0.464	0.376			0.420	
	30.0	1184.6	1150.0	29.1	2		0.466	0.378			0.422	
	30.0	1184.6	1125.0	28.5	4		0.464	0.377			0.421	
	30.0	1184.6	1100.0	27.9	5		0.464	0.377			0.421	
	30.0	1184.6	1150.0	29.1	6		0.469	0.382			0.426	
	30.0	1184.6	1150.0	29.1	10		0.473	0.385			0.429	
	30.0	1184.6	1150.0	29.1	15		0.479	0.392			0.436	
125%	25.0	984.7	1000.0	25.4	1		0.477	0.390			0.434	
100%	20.0	784.8	800.0	20.4	1		0.461	0.375			0.418	
75%	15.0	584.9	600.0	15.4	1		0.443	0.358			0.401	
50%	10.0	384.9	425.0	11.0	1		0.419	0.337			0.378	
25%	5.0	185.0	275.0	7.3	1		0.376	0.308			0.342	
25%	5.0	185.0	275.0	7.3	1		0.376	0.308			0.342	
50%	10.0	384.9	425.0	11.0	1		0.387	0.309			0.348	
75%	15.0	584.9	600.0	15.4	1		0.412	0.321			0.367	
100%	20.0	784.8	800.0	20.4	1		0.435	0.337			0.386	
125%	25.0	984.7	1000.0	25.4	1		0.458	0.355			0.407	
150%	30.0	1184.6	1150.0	29.1	1		0.521	0.411			0.466	
175%	35.0	1384.5	1300.0	32.9	1		1.250	1.033			1.142	
125%	25.0	984.7	1000.0	25.4	4		1.236	1.019			1.128	
100%	20.0	784.8	750.0	19.1	5		1.218	1.002			1.110	
50%	10.0	384.9	400.0	10.4	6		1.178	0.964			1.071	
25%	5.0	185.0	200.0	5.4	6		1.035	1.035			1.035	

APPENDIX C

Strain Gage Data

Compression Micropile Load Test - Strain Gage Data

Schnabel Engineering

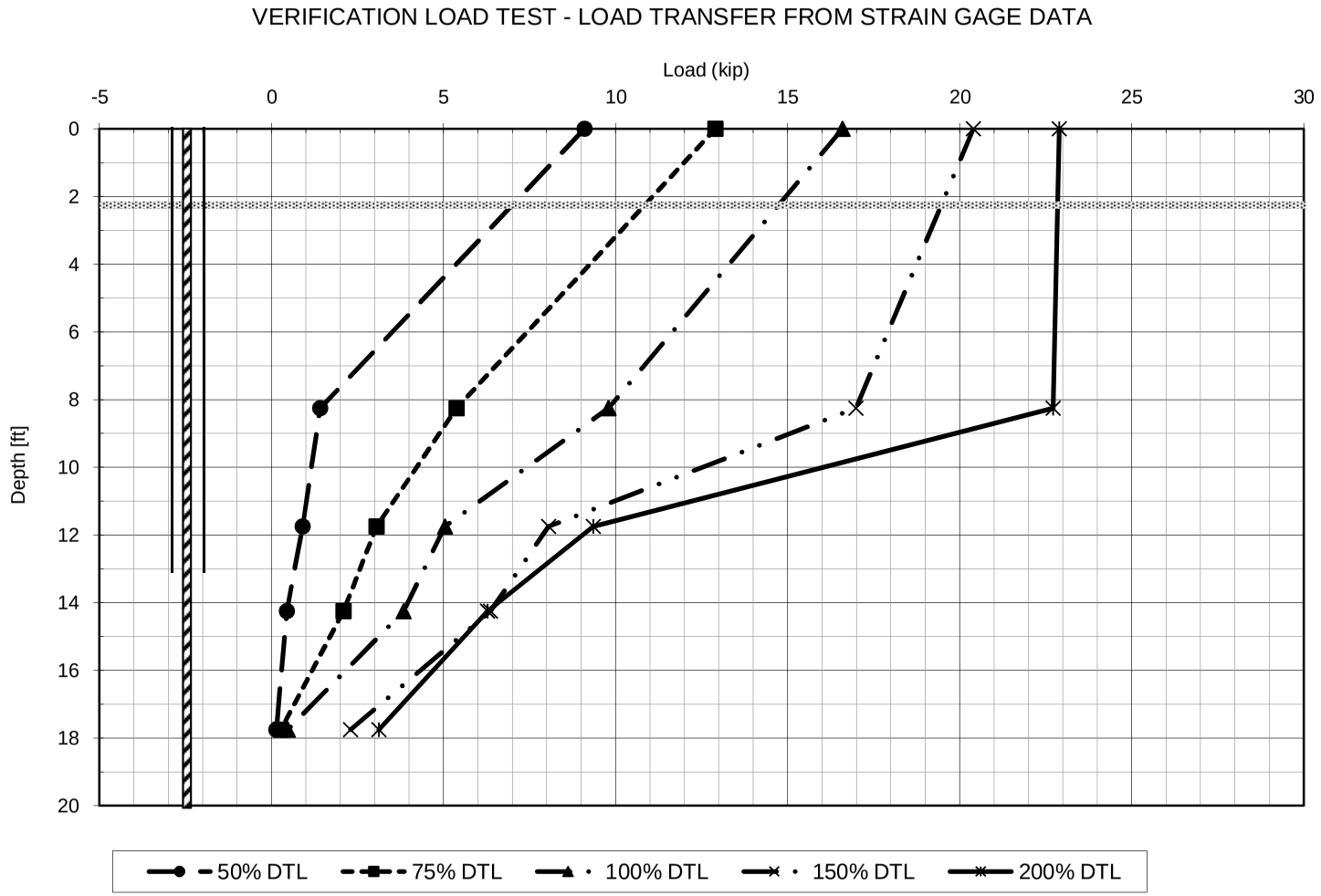
Project:	Hollow Core Bar Research	**Performed:**	DBM	**Pile:**	**B1**
Location:	Olympia, WA	**Inspection:**	Schnabel Engineering / A. C.		
Client:	ADSC, FHWA	**Data by:**	Schnabel Engineering / M. R.	**Date:**	10/28/2009

Soil Nail Steel Area: 1.66 inches
Soil Nail Length: 20.0 ft
Bond Length: 7.0 ft
Young's Modulus: 29,000,000 psi
Drill Bit Dia. 4.53 in

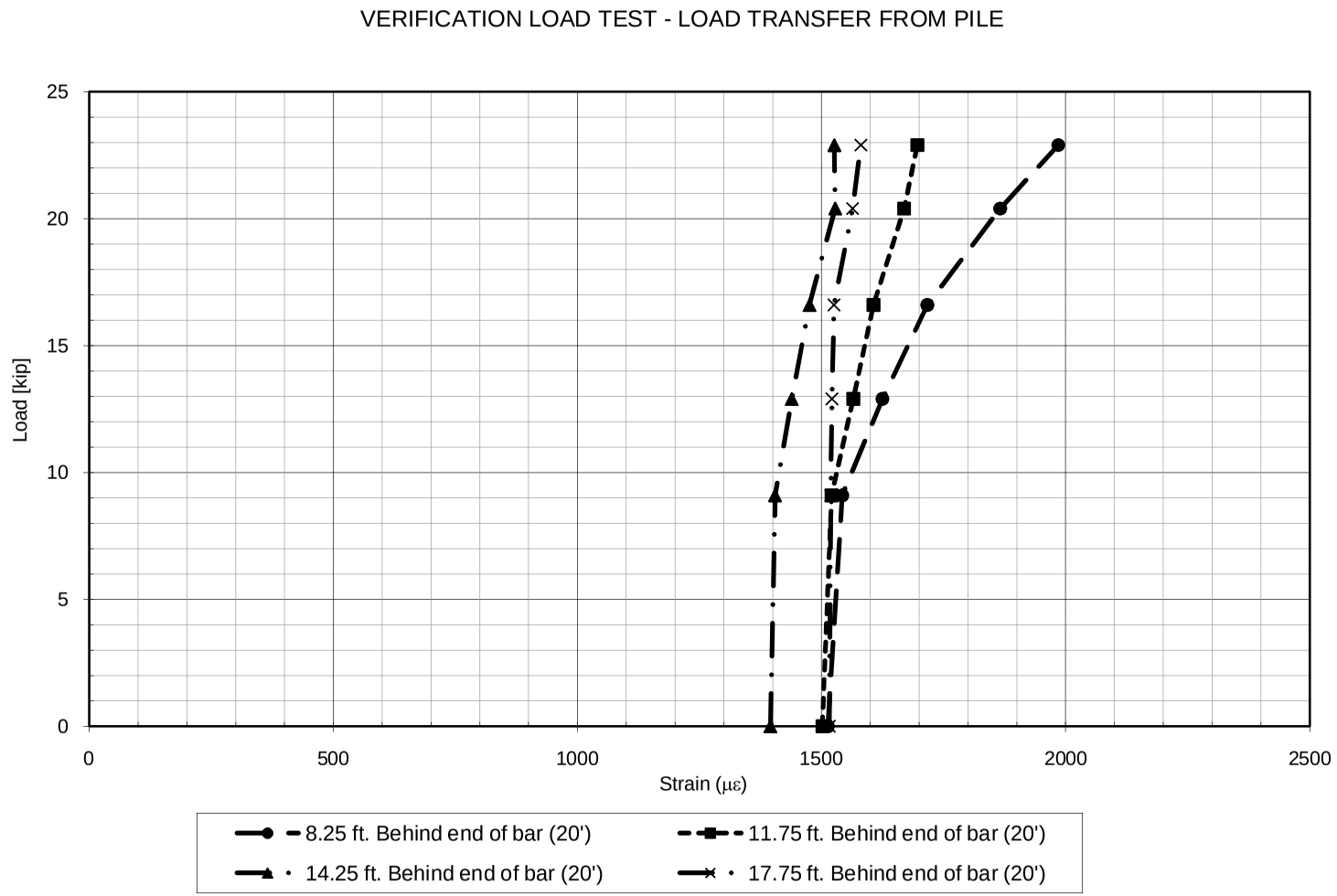
	Strain Gage	**11**			**Strain Gage**	**7**			**Strain Gage**	**5**			**Strain Gage**	**1**		
	Gage Factor	0			Gage Factor	0			Gage Factor	0			Gage Factor	0		
Load [kip]	Reading Digits	με [10^{-6}]	Deformation [in]	Load [kip]	Reading Digits	με [10^{-6}]	Deformation [in]	Load [kip]	Reading Digits	με [10^{-6}]	Deformation [in]	Load [kip]	Reading Digits	με [10^{-6}]	Deformation [in]	Load [kip]
0.0		1513.1000		0.0		1501.8000		0.0		1395.6000		0.0		1515.9000		0.0
9.1		1542.6000		1.4		1520.6000		0.9		1404.9000		0.4		1518.8000		0.1
12.9		1624.8000		5.4		1565.3000		3.1		1439.1000		2.1		1521.5000		0.3
16.6		1716.6000		9.8		1606.6000		5.0		1475.4000		3.8		1525.7000		0.5
20.4		1866.0000		17.0		1669.2000		8.1		1527.8000		6.4		1563.7000		2.3
22.9		1985.1000		22.7		1696.2000		9.4		1526.0000		6.3		1580.7000		3.1

Strain Gage	**Depth**	**Load Estimate from Strain Gage [kip]**					
		Load Increment (as a percentage of the design load)					
	[ft]	**0**	**50**	**75**	**100**	**150**	**200**
-	0.00	0	9	13	17	20	23
11	8.25	0	1	5	10	17	23
7	11.75	0	1	3	5	8	9
5	14.25	0	0	2	4	6	6
1	17.75	0	0	0	0	2	3

Strain Gage Spacing [ft]		**Lateral Area**	**Load Transfer**	**Mobilized Bond Stress**
From	**To**	**[ft²]**	**[kip]**	**[psi]**
0.00	8.25	9.78	0	0.1
8.25	11.75	4.15	13	22.4
11.75	14.25	2.96	3	7.2
14.25	17.75	4.15	3	5.3



Type of Test: Compression	Length: 20 ft	Diameter: 1.66 in	Olympia, WA Pile: B1	**SCHNABEL ENGINEERING, LLC** Verification Load Test (Compression)
	Comments:			Hollow Core Bar Research Olympia, WA
Maximum Test Load: 175% P =22.9 kips				Date: 10/28/2009 Project No. 7150064



Type of Test: Compression	Length: 20 ft	Diameter: 1.66 in	Olympia, WA Pile: B1	**SCHNABEL ENGINEERING, LLC** Verification Load Test (Compression)
	Comments:			Hollow Core Bar Research Olympia, WA
Maximum Test Load: 175% P =22.9 kips				Date: 10/28/2009 Project No. 7150064

Compression Micropile Load Test - Strain Gage Data

Schnabel Engineering

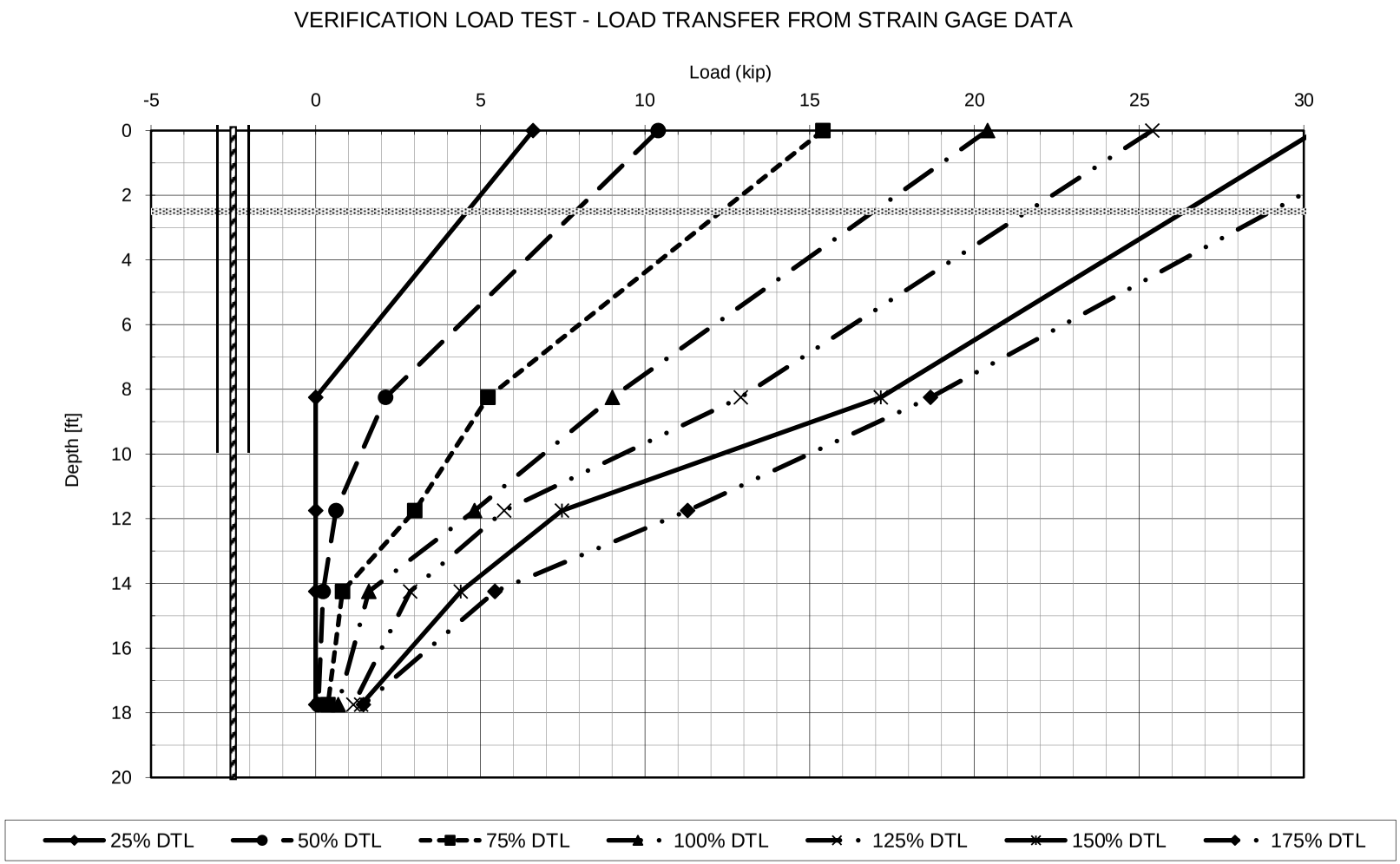
Project:	Hollow Core Bar Research	**Performed:**	DBM	**Pile:**	**C2**
Location:	Olympia, WA	**Inspection:**	Schnabel Engineering / A. C.		
Client:	ADSC, FHWA	**Data by:**	Schnabel Engineering / M. R.	**Date:**	10/28/2009

Soil Nail Steel Area: 1.66 inches
Soil Nail Length: 20.0 ft
Bond Length: 7.5 ft
Young's Modulus: 29,000,000 psi
Drill Bit Dia. 4.53 in

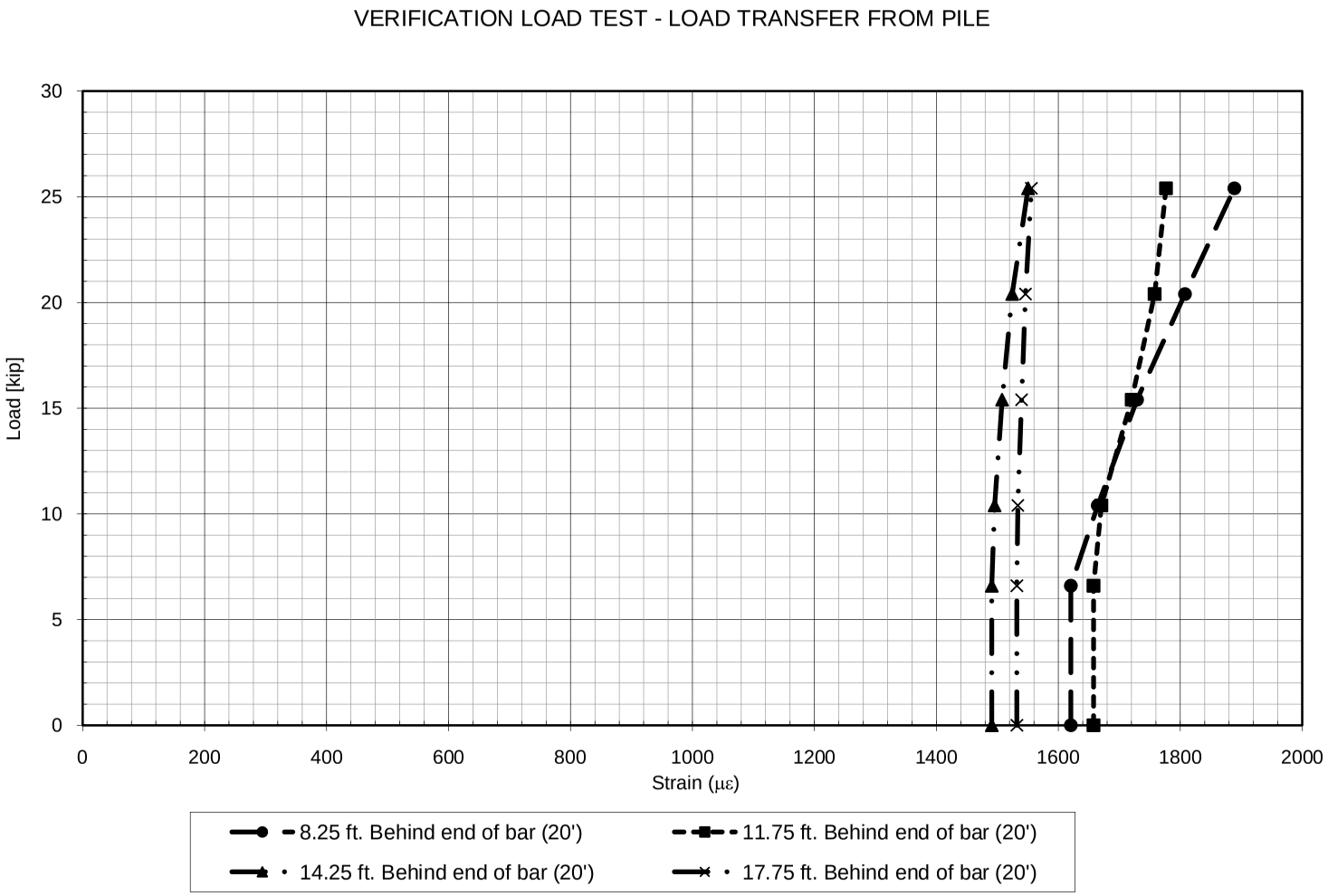
	Strain Gage		**12**		**Strain Gage**		**8**		**Strain Gage**		**6**		**Strain Gage**		**2**	
	Gage Factor		0		Gage Factor		0		Gage Factor		0		Gage Factor		0	
Load [kip]	Reading Digits	$\mu\varepsilon$ [10^{-6}]	Deformation [in]	Load [kip]	Reading Digits	$\mu\varepsilon$ [10^{-6}]	Deformation [in]	Load [kip]	Reading Digits	$\mu\varepsilon$ [10^{-6}]	Deformation [in]	Load [kip]	Reading Digits	$\mu\varepsilon$ [10^{-6}]	Deformation [in]	Load [kip]
0.0		1620.5000		0.0		1657.7000		0.0		1490.9000		0.0		1532.0000		0.0
6.6		1620.5000		0.0		1657.7000		0.0		1490.9000		0.0		1532.0000		0.0
10.4		1664.6000		2.1		1670.5000		0.6		1495.6000		0.2		1533.6000		0.1
15.4		1729.1000		5.2		1720.2000		3.0		1507.8000		0.8		1539.7000		0.4
20.4		1807.6000		9.0		1757.9000		4.8		1524.4000		1.6		1546.2000		0.7
25.4		1888.6000		12.9		1776.6000		5.7		1550.5000		2.9		1555.8000		1.1
30.4		1976.9000		17.2		1813.0000		7.5		1582.4000		4.4		1560.7000		1.4
33.5		2008.3000		18.7		1892.3000		11.3		1604.0000		5.4		1562.1000		1.4

Strain Gage	**Depth**	**Load Estimate from Strain Gage [kip]**							
		Load Increment (as a percentage of the design load)							
	[ft]	**0**	**25**	**50**	**75**	**100**	**125**	**150**	**175**
-	0.00	0	7	10	15	20	25	30	34
12	8.25	0	0	2	5	9	13	17	19
8	11.75	0	0	1	3	5	6	7	11
6	14.25	0	0	0	1	2	3	4	5
2	17.75	0	0	0	0	1	1	1	1

Strain Gage Spacing [ft]		**Lateral Area**	**Load Transfer**	**Mobilized Bond Stress**
From	**To**	**[ft²]**	**[kip]**	**[psi]**
0.00	8.25	9.78	15	10.5
8.25	11.75	4.15	7	12.3
11.75	14.25	2.96	6	13.7
14.25	17.75	4.15	4	6.7



Type of Test: Compression	Length: 20 ft	Diameter: 1.66 in	Olympia, WA Pile: C2	**SCHNABEL ENGINEERING, LLC** Verification Load Test (Compression)
	Comments:			Hollow Core Bar Research Olympia, WA
Maximum Test Load: 175% P =33.5 kips				Date: 10/28/2009 Project No. 7150064



Type of Test: Compression	Length: 20 ft	Diameter: 1.66 in	Olympia, WA Pile: C2	**SCHNABEL ENGINEERING, LLC** Verification Load Test (Compression)
	Comments:			Hollow Core Bar Research Olympia, WA
Maximum Test Load: 175% P =33.5 kips				Date: 10/28/2009 Project No. 7150064

Compression Micropile Load Test - Strain Gage Data

Schnabel Engineering

Project:	Hollow Core Bar Research	**Performed:**	DBM	**Pile:**	**D2**
Location:	Olympia, WA	**Inspection:**	Schnabel Engineering / A. C.		
Client:	ADSC, FHWA	**Data by:**	Schnabel Engineering / M. R.	**Date:**	10/28/2009

Soil Nail Steel Area: 1.66 inches
Soil Nail Length: 20.0 ft
Bond Length: 10.0 ft
Young's Modulus: 29,000,000 psi
Drill Bit Dia. 4.53 in

	Strain Gage		**10**		**Strain Gage**		**9**		**Strain Gage**		**4**		**Strain Gage**		**3**	
	Gage Factor		0		Gage Factor		0		Gage Factor		0		Gage Factor		0	
Load [kip]	Reading Digits	$\mu\varepsilon$ [10^{-6}]	Deformation [in]	Load [kip]	Reading Digits	$\mu\varepsilon$ [10^{-6}]	Deformation [in]	Load [kip]	Reading Digits	$\mu\varepsilon$ [10^{-6}]	Deformation [in]	Load [kip]	Reading Digits	$\mu\varepsilon$ [10^{-6}]	Deformation [in]	Load [kip]
0.0		1594.7000		0.0		1609.6000		0.0		1543.9000		0.0		1502.3000		0.0
10.4		1642.3000		2.3		1627.7000		0.9		1555.2000		0.5		1506.6000		0.2
14.6		1753.3000		7.6		1641.7000		1.5		1622.2000		3.8		1510.2000		0.4
18.5		1881.1000		13.8		1651.7000		2.0		1633.4000		4.3		1521.4000		0.9
25.4		2035.4000		21.2		1692.2000		4.0		1682.4000		6.7		1532.5000		1.5
30.4		2177.5000		28.1		1756.2000		7.1		1710.5000		8.0		1534.4000		1.5

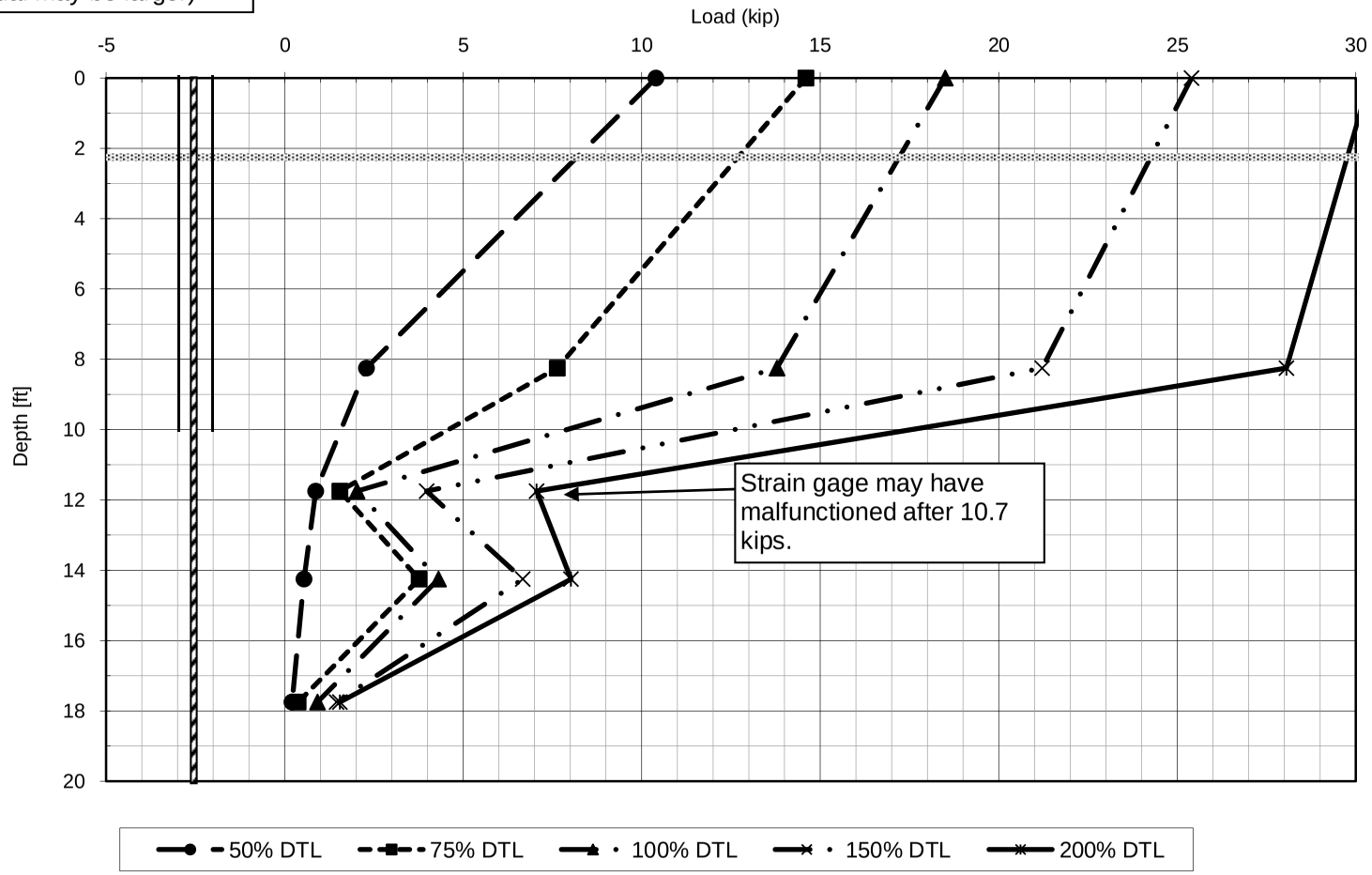
Strain Gage	**Depth**	**Load Estimate from Strain Gage [kip]**					
		Load Increment (as a percentage of the design load)					
	[ft]	**0**	**50**	**75**	**100**	**150**	**200**
-	0.00	0	10	15	19	25	30
10	8.25	0	2	8	14	21	28
9*	11.75	0	1	2	2	4	7
4	14.25	0	1	4	4	7	8
3	17.75	0	0	0	1	1	2

Strain Gage Spacing [ft]		**Lateral Area**	**Load Transfer**	**Mobilized Bond Stress**
From	**To**	**[ft²]**	**[kip]**	**[psi]**
0.00	8.25	9.78	2	1.7
8.25	11.75	4.15	21	35.2
11.75	14.25	2.96	-1	-2.4
14.25	17.75	4.15	6	10.8

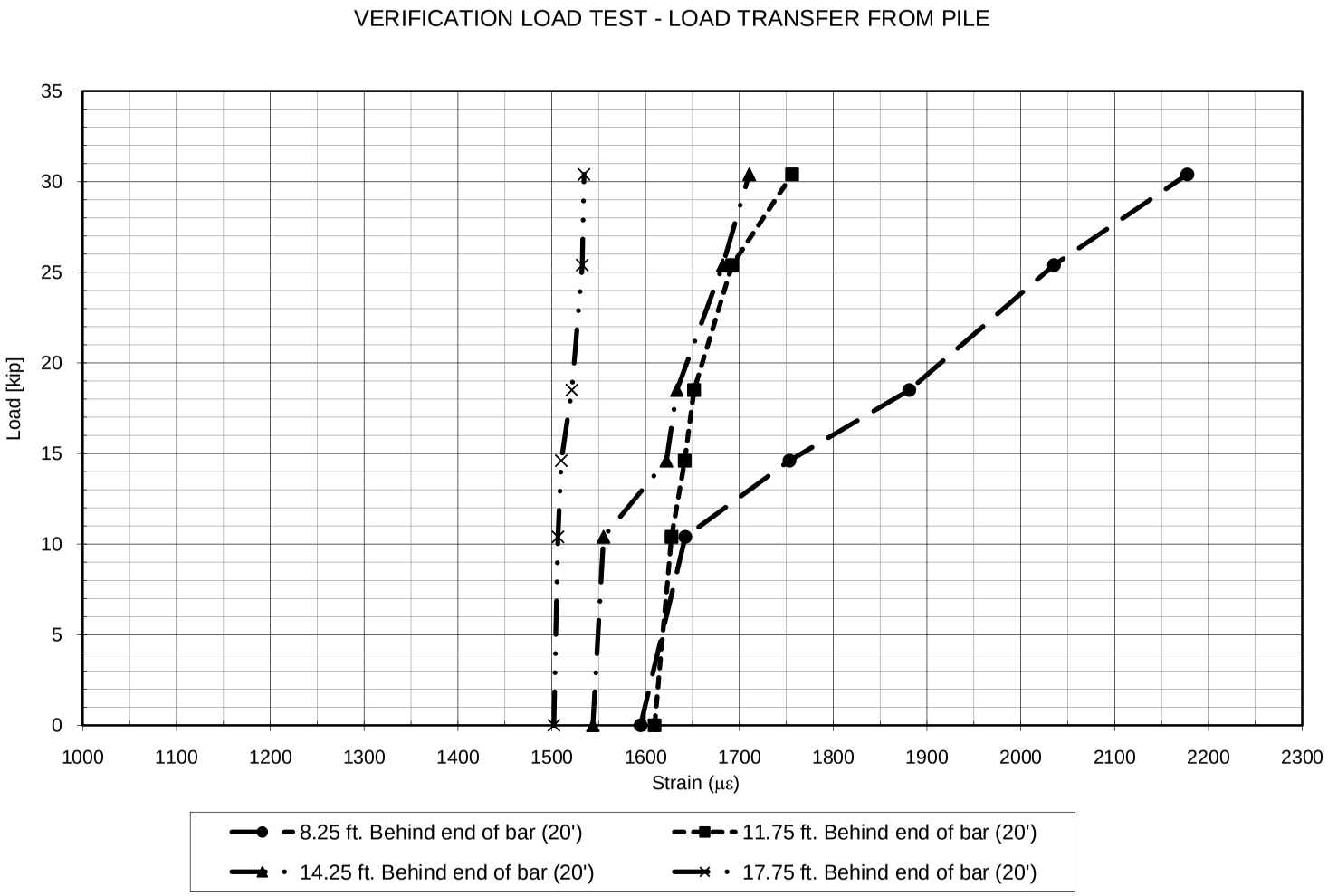
*Note: Strain Gage 9 may have debonded after 10.4 kip load

Assumes a ø7" grout body (actual may be larger)

VERIFICATION LOAD TEST - LOAD TRANSFER FROM STRAIN GAGE DATA



Type of Test: Compression	Length: 20 ft	Diameter: 1.66 in	Olympia, WA Pile: D2	**SCHNABEL ENGINEERING, LLC** Verification Load Test (Compression)
	Comments:			Hollow Core Bar Research Olympia, WA
Maximum Test Load: 175% P =22.9 kips				Date: 10/28/2009 Project No. 7150064



Type of Test: Compression	Length: 20 ft	Diameter: 1.66 in	Olympia, WA Pile: D2	**SCHNABEL ENGINEERING, LLC** Verification Load Test (Compression)
	Comments:			Hollow Core Bar Research Olympia, WA
Maximum Test Load: 175% P =22.9 kips				Date: 10/28/2009 Project No. 7150064

APPENDIX D

Soil Nail Installation Logs

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs	Observations of Grouting
	0				1:00		Interroc 109 drill						tremie grout hole and top off as casing was pulled. Flush with water to about 10 ft below tip of bar.
	1											1.87	
	2						F-M Clayey Sand (SC)						
	3						moist, brown and gray						
	4												
	5				2:00								4 bags used. About 4.5 cf, 35 gal+-
	6												
	7												
	8												
	9						grades to prooly graded sand						
	10						with clay in some areas						
	11												
	12						denser zone from about 10-14 ft						
	13				5:00		F-M Clayey Sand, moist to wet						
	14						brown and gray						
	15												
	16												
	17												
	18					6:00							
	19												
	20												
							drilling 6" casing into ground						

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

389

Schnabel Engineering

SOIL NAIL:	A1		
Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	19' 9"		ft
Total hole depth	~ 18'		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	10 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft		
Bit type	crosscut		
Bit diameter	4" (casing 6.25)		in
Hole inclination	25		degrees
Centralizers	(2) 3 ft and 9.5 ft		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description	(133 mm)		
Diameter	6.25 in.	Type	1/4 in. T
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	1.75 in	1.75	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lkafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.87		
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	4 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	

Page: 1 of 1

n/a
Installer Representative
(Name and Date)

Allen Cadden
Schnabel's Representative
(Name and Date)

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs	Observations of Grouting
	0				11:35:00		Interroc 109 drill						11:50 set bar, tremie grout hole and top off as casing was pulled. Flush with water to about 10 ft below tip of bar. 8 ft PVC casing sleveve over unbond length 4 bags used. About 4.5 cf, 35 gal+-
	1								11:52			1.87	
	2						F-M Clayey Sand (SC)						
	3						moist, brown and gray						
	4												
	5												
	6					6:00							
	7												
	8												
	9					7:00	grades to prooly graded sand						
	10						with clay in some areas						
	11												
	12						denser zone from about 10-14 ft						
	13						F-M Clayey Sand, moist to wet						
	14						brown and gray						
	15												
	16					9:00							
	17												
	18												
	19												
	20												
390							drilling 6" casing into ground						
							begin drilling at 12:02						

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

Schnabel Engineering

SOIL NAIL:	A2		
Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	19' 9"		ft
Total hole depth	~ 19.5'		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	10 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft	4"	
Bit type	crosscut		
Bit diameter	4" (casing 6.25)		in
Hole inclination	25		degrees
Centralizers	(2) 3 ft and 9.5 ft		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description	(133 mm)		
Diameter	6.25 in.	Type	1/4 in. T
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	1.75 in	1.75	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lkafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.87		
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	4 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	

Page: 1 of 1

n/a
Installer Representative
(Name and Date)

Allen Cadden
Schnabel's Representative
(Name and Date)

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs	Observations of Grouting
	0				12:02:00		Interroc 109 drill						12:15 set bar, tremie grout hole and top off as casing was pulled. Flush with water to about 10 ft below tip of bar. 8 ft PVC casing sleveve over unbond length 4 bags used. About 4.5 cf, 35 gal+-
	1								12:15			1.87	
	2						F-M Clayey Sand (SC)						
	3						moist, brown and gray						
	4												
	5												
	6												
	7												
	8												
	9						grades to prooly graded sand						
	10						with clay in some areas						
	11												
	12					6:00	denser zone from about 10-14 ft						
	13						F-M Clayey Sand, moist to wet						
	14						brown and gray						
	15												
	16												
	17												
	18					8:00							
	19												
	20												
							drilling 6" casing into ground						
							begin drilling at 12:02						

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

391

Schnabel Engineering

SOIL NAIL:	A3		
Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	19' 9"		ft
Total hole depth	~ 19'		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	10 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft	10"	
Bit type	crosscut		
Bit diameter	4" (casing 6.25)		in
Hole inclination	25		degrees
Centralizers	(2) 3 ft and 9.5 ft		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description	(133 mm)		
Diameter	6.25 in.	Type	1/4 in. T
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	1.75 in	1.75	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lkafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.87		
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	4 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	
				Page:	1 of 1

n/a
Installer Representative
(Name and Date)

Allen Cadden
Schnabel's Representative
(Name and Date)

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs	Observations of Grouting
	0				12:21:00		Interroc 109 drill						8 ft PVC casing sleveve over unbond length
	1											1.84	
	2						F-M Clayey Sand (SC)						
	3						moist, brown and gray						9 bags used. About 10 cf, 80 gal+-
	4												
	5												
	6												injection bore from bottom of casing was likely about 6-7 ft. Flushing to 13' from bar end to try to isolate area where injection happened. pvc casing stopped by coupler.
	7												
	8												
	9						grades to prooly graded sand						
	10					25:00	with clay in some areas						
	11												
	12					25:30	denser zone from about 10-14 ft						
	13						F-M Clayey Sand, moist to wet						sounded hole with tape measure to 13'-4" from end of bar.
	14					25:45	brown and gray						
	15												
	16												
	17					27:00							Installed Strain Gage string finished 1:55
	18												
	19												
	20												
							drilling 6" casing qbout 10 ft into ground						
							drilling took about 2-3 minutes						
							Hollow abar drilling began at 10 ft						
							start 1:25 PM						
							stroke hole once to clean cuttings						

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

392

Schnabel Engineering

SOIL NAIL:	B1		
Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	13'3"		ft
Total hole depth	~ 16'8"		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	~7 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft	33"	
Bit type	crosscut		
Bit diameter	4.52"		in
Hole inclination	25		degrees
Centralizers	none		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description	(133 mm)		
Diameter	6.25 in.	Type	1/4 in. T
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	1.75 in	1.75	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.84		
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	10 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	
				Page:	1 of 1

n/a
Installer Representative
(Name and Date)

Allen Cadden
Schnabel's Representative
(Name and Date)

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs	Observations of Grouting
	0				12:30:00		Interroc 109 drill						8 ft PVC casing sleveve over unbond length
	1											1.84	
	2						F-M Clayey Sand (SC)						
	3						moist, brown and gray						9 bags used. About 10 cf, 80 gal+-
	4												
	5												
	6												injection bore from bottom of casing was likely about 6-7 ft. Flushing to 13' from bar end to try to isolate area where injection happened. pvc casing stopped by coupler.
	7												
	8												
	9						grades to prooly graded sand						
	10					19:00	with clay in some areas						
	11												
	12						denser zone from about 10-14 ft						
	13						F-M Clayey Sand, moist to wet						
	14						brown and gray						sounded hole with tape measure to 13'-10" from end of bar.
	15												
	16												
	17					21:00							
	18												
	19												
	20												
393							drilling 6" casing qbout 10 ft into ground						
							drilling took about 2-3 minutes						
							Hollow abar drilling began at 10 ft						
							start 1:19 PM						
							stroke hole once to clean cuttings						

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

Schnabel Engineering

SOIL NAIL:	B2		
Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	13'3"		ft
Total hole depth	~ 16'8"		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	~7 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft	38"	
Bit type	crosscut		
Bit diameter	4.52"		in
Hole inclination	25		degrees
Centralizers	none		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description	(133 mm)		
Diameter	6.25 in.	Type	1/4 in. T
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	1.75 in	1.75	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.84		
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	10 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	
				Page:	1 of 1

n/a
Installer Representative
(Name and Date)

Allen Cadden
Schnabel's Representative
(Name and Date)

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs	Observations of Grouting
	0				12:21:00		Interroc 109 drill						8 ft PVC casing sleveve over unbond length
	1											1.84	
	2						F-M Clayey Sand (SC)						
	3						moist, brown and gray						10 bags used. About 11 cf, 86 gal+-
	4												
	5												
	6												injection bore from bottom of casing was likely about 6-7 ft. Flushing to 13' from bar end to try to isolate area where injection happened. pvc casing stopped by coupler.
	7												
	8					11:00							
	9						grades to prooly graded sand						
	10					12:00	with clay in some areas						
	11												
	12					12:20	denser zone from about 10-14 ft						
	13						F-M Clayey Sand, moist to wet						sounded hole with tape measure to 13'-8" from end of bar.
	14					12:40	brown and gray						
	15												
	16												
	17					13:30							
	18												
	19												
	20												
394							drilling 6" casing qbout 10 ft into ground						
							drilling took about 2-3 minutes						
							Hollow abar drilling began at 8 ft						
							start 1:11 PM						
							stroke hole once to clean cuttings						

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

Schnabel Engineering

SOIL NAIL: B3

Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	13'3"		ft
Total hole depth	~ 16'8"		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	~7 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft	40"	
Bit type	crosscut		
Bit diameter	4.52"		in
Hole inclination	25		degrees
Centralizers	none		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description	(133 mm)		
Diameter	6.25 in.	Type	1/4 in. T
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	1.75 in	1.75	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.84		
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	10 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	
				Page:	1 of 1

n/a
Installer Representative
(Name and Date)

Allen Cadden
Schnabel's Representative
(Name and Date)

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs	Observations of Grouting
	0				9:27:00		Interroc 109 drill						8 ft PVC casing sleveve over unbond length
	1											1.83	
	2						F-M Clayey Sand (SC)						
	3						moist, brown and gray						12 bags used. About 13 cf, 100 gal+-
	4												
	5												
	6												injection bore from ground surface. Water flushing to 10' from bar end
	7												
	8												
	9						grades to prooly graded sand						
	10					27:00	with clay in some areas						sounded hole with tape measure to 7'-6" from end of bar.
	11										50		
	12					27:20	denser zone from about 10-14 ft						
	13						F-M Clayey Sand, moist to wet						
	14					27:32	brown and gray						
	15					27:50							
	16					28:05							
	17					28:25							
	18					28:35					50		
	19												
	20												
395							harder from about 11-13 ft						
							stroke hole once to clean cuttings						

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

Schnabel Engineering

SOIL NAIL:	C1		
Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	0		ft
Total hole depth	17		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	~10 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft	33"	
Bit type	crosscut		
Bit diameter	4.52"		in
Hole inclination	25		degrees
Centralizers	none		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description			
Diameter		Type	
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	51 N	51N	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.83		
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	12 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	

Page: 1 of 1

n/a
Installer Representative
(Name and Date)

Allen Cadden
Schnabel's Representative
(Name and Date)

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs	Observations of Grouting
	0				9:40:00		Interroc 109 drill						8 ft PVC casing sleveve over unbond length
	1											1.83	
	2						F-M Clayey Sand (SC)						
	3						moist, brown and gray						12 bags used. About 13 cf, 100 gal+-
	4					40:30					75		
	5					41:00	F Sandy Lean Clay (CL) moist						
	6						gray brown				100		injection bore from ground surface. Water flushing to 10' from bar end
	7					41:30							
	8				44:30	44:50					60		
	9						grades to prooly graded sand						
	10					45:45	with clay in some areas						sounded hole with tape measure to 7'-4" from end of bar.
	11												
	12					46:30	denser zone from about 10-14 ft				100		
	13						F-M Clayey Sand, moist to wet				90		
	14					47:40	brown and gray						Stroke once at 8 ft before adding rod, stroke once at end
	15					47:45							
	16					48:00							
	17					48:10							add grout to bar center
	18					48:15					90		
	19												Strain Gages installed
	20												
							harder from about 10-13 ft						
							stroke hole once to clean cuttings						

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

396

Schnabel Engineering

SOIL NAIL:	C2		
Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	0		ft
Total hole depth	17		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	~10 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft	34"	
Bit type	crosscut		
Bit diameter	4.52"		in
Hole inclination	25		degrees
Centralizers	none		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description			
Diameter	NA	Type	
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	51N	51N	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.83	YES	
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	12 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	

Page: 1 of 1

n/a
Installer Representative
(Name and Date)

Allen Cadden
Schnabel's Representative
(Name and Date)

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs	Observations of Grouting
	0				10:01:00		Interroc 109 drill						8 ft PVC casing sleveve over unbond length
	1											1.83	
	2					1:20	F-M Clayey Sand (SC)				50		12 bags used. About 13 cf, 100 gal+-
	3						moist, brown and gray						
	4					1:50					30		injection bore from ground surface. Water flushing to 10' from bar end
	5						F Sandy Lean Clay (CL) moist						
	6					2:25	gray brown				80		
	7					2:45							
	8				5:30						90		sounded hole with tape measure to 7'-8" from end of bar.
	9						grades to prooly graded sand						
	10					6:00	with clay in some areas				100		
	11												
	12					6:20	denser zone from about 10-14 ft				30		
	13						F-M Clayey Sand, moist to wet						
	14					7:00	brown and gray				150		Stroke once at 8 ft before adding rod, stroke once at end
	15					7:20					130		
	16					7:35					80		
	17					7:45					100		add grout to bar center
	18										100		
	19												
	20												
							harder from about 10-13 ft						
							stroke hole once to clean cuttings						

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

397

Schnabel Engineering

SOIL NAIL:	C3		
Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	0		ft
Total hole depth	17'		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	~10 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft	33"	
Bit type	crosscut		
Bit diameter	4.52"		in
Hole inclination	25		degrees
Centralizers	none		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description			
Diameter	NA	Type	
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	51N	51N	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.83		
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	12 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	
				Page:	1 of 1

n/a
Installer Representative
(Name and Date)

Allen Cadden
Schnabel's Representative
(Name and Date)

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs
	0				7:46:45		Interroc 109 drill					
	1				R	47:10						1.83
	2				E	48:15	F-M Clayey Sand (SC)				25	
	3				D	49:10	moist, brown and gray					
	4				R	49:40						
	5				I	50:00						
	6				L	50:25						
	7				L	50:40						
	8				7:54						40	
	9						grades to prooly graded sand					
	10					54:45	with clay in some areas				100	
	11										300	
	12					55:55	denser zone from about 10-14 ft					
	13				8;11	8:13	F-M Clayey Sand, moist to wet				100	
	14					13;30	brown and gray				100	
	15					14:00					80	
	16					14:40						
	17					15:00						
	17.5					15:15						
	19											
	20											
398							harder from about 11-13 ft					
							plug bit with metal shavings at 12 ft pull and clean					
							stroke hole once to clean cuttings					

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

Observations of Grouting

Predrilled 10 ft with hollow bar 9/23 took 2-3 min stroke 2 times to clean hole, 12 bags, redrill through grout zone 9/24. redrill generally penetrated grout but rode to top left side

8 ft PVC casing sleveve over unbond length

28 bags used 9/24. About 32 cf, 240 gal+-

injection bore from ground surface. Water flushing to 10' from bar end

sounded hole with tape measure to 8'-8" from end of bar.

Schnabel Engineering

SOIL NAIL: D1

Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	0		ft
Total hole depth	17		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	~10 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft	38"	
Bit type	crosscut		
Bit diameter	4.52"		in
Hole inclination	25		degrees
Centralizers	none		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description			
Diameter		Type	
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	51 N	51N	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.8		
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	12 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	

Page: 1 of 1

n/a
Installer Representative
(Name and Date)

Allen Cadden
Schnabel's Representative
(Name and Date)

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs
	0				8:30:30		Interroc 109 drill					
	1				R							1.83
	2				E		F-M Clayey Sand (SC)					
	3				D	31:45	moist, brown and gray				25	
	4				R	33:00						
	5				I	33:40						
	6				L	33:55					50	
	7				L	34:05					75	
	8				36:00						100	
	9						grades to prooly graded sand					
	10					36:40	with clay in some areas				80	
	11					37:25						
	12					37:35	denser zone from about 10-14 ft				50	
	13						F-M Clayey Sand, moist to wet					
	14					39:30	brown and gray				80	
	15					39:50					60	
	16											
	17					40:15					60	
	17.5					40:20						
	19											
	20											
399							harder from about 11-13 ft					
							stroke hole once to clean cuttings					

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

Observations of Grouting

Predrilled 8 ft with hollow bar 9/23 took 6 min stroke 1 time to clean hole, 8 bags, redrill through grout zone 9/24. redrill generally penetrated grout but rode to top left side

8 ft PVC casing sleveve over unbond length

18 bags used 9/24. About 20 cf, 200 gal+-

injection bore from ground surface. Water flushing to 10' from bar end

sounded hole with tape measure to 4'-5"" from end of bar. possible cave soil?

Schnabel Engineering

SOIL NAIL:	D2		
Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	0		ft
Total hole depth	17		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	~10 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft	34"	
Bit type	crosscut		
Bit diameter	4.52"		in
Hole inclination	25		degrees
Centralizers	none		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description			
Diameter		Type	
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	51 N	51N	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.83		
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	14 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	

Page: 1 of 1

n/a
Installer Representative
(Name and Date)

Allen Cadden
Schnabel's Representative
(Name and Date)

Sketch	Depth [feet]	Casing	Bars	Grout	Time (min:sec) Start	Time (min:sec) End	Description and Observations of Drilling	Stage	Time (hr:min) Start	Time (hr:min) End	Pressure	Gs
	0				8:55:30		Interroc 109 drill					
	1				R							1.83
	2				E		F-M Clayey Sand (SC)					
	3				D		moist, brown and gray				25	
	4				9:00	00:30						
	5				I							
	6				L	01:00					50	
	7				L	1:30					75	
	8				4:00						100	
	9						grades to prooly graded sand					
	10					4:30	with clay in some areas				80	
	11											
	12					5:45	denser zone from about 10-14 ft				50	
	13						F-M Clayey Sand, moist to wet					
	14					6:30	brown and gray				80	
	15										60	
	16					7:00						
	17					7:30					60	
	17.5					7:45						
	19											
	20											
400							harder from about 11-13 ft					
							clog with metal shavings @4'					
							stroke hole once to clean cuttings					

Sketch: top and bottom of temporary casing, location of temporary casing sections and location of centralizers.

Sketch: top and bottom of bar, location of bar sections and locatio of centralizers.

Observations of Grouting

Predrilled 8 ft with hollow bar 9/23 took 4 min stroke 2 times to clean hole, 9 bags, redrill through grout zone 9/24. redrill generally penetrated grout but rode to top left side

8 ft PVC casing sleveve over unbond length

14 bags used 9/24. About 16 cf, 160 gal+-

injection bore from ground surface. Water flushing to 10' from bar end

sounded hole with tape measure to 6'-8"" from end of bar. possible cave soil?

Schnabel

Schnabel Engineering

SOIL NAIL: D3

Soil Boring:	GEI-2		
Soil Nail Geometry:	Perp. to face		
Soil Nail elev.			ft
Total casing length	0		ft
Total hole depth	17		ft
Total grout length			ft
	Design	As-built	
Total bar length	20 ft	20 ft	
Bonded length	10 ft	~10 ft	
Unbonded length	10 ft	10 ft	
Tail length	3 ft	36"	
Bit type	crosscut		
Bit diameter	4.52"		in
Hole inclination	25		degrees
Centralizers	none		
Reinforcing steel:			
Date of installation	9/25/2009		
Supplier	DSI		
Casing description			
Diameter		Type	
Nail description			
	Design	As-built	
No. Bars	1	1	
Diameter	51 N	51N	in
Primary grouting			
Date of grouting	9/24/2009		
Cement typ. & supp	Lafarge Type 1/11		
Dosage / Admixture			
Grouting method	gravity		
Batch ID	GS	Cubes	
1	1.83		
2	-	-	
3	-	-	
Final	-	-	
Volume	Theor.	As-built	
Drilling Grout			gal
Final Grout	-	14 bags	gal

Project:	HBSN Testing Research Program	Manager:	Andrew Baxter	Date Drilled:	9/24/2009
Location:	Olympia, WA	Engineer:	Allen Cadden	Date Grouted:	9/24/2009
Client:	FHWA/ ADSC	Superint.:	Richey		
Job No.:	07150064	Weather:	Sunny, 70 deg.	Capacity:	

Page: 1 of 1

n/a

Installer Representative (Name and Date)

Allen Cadden

Schnabel's Representative (Name and Date)

APPENDIX E

Grout Compressive Strength

Grout Test Data Unavailable for Issue Insert

APPENDIX F

Jack Calibrations

DYWIDAG-SYSTEMS INTERNATIONAL

DYWIDAG-Systems International U.S.A., Inc.

Business Unit
Post Tensioning/Reinforcing
3280 E. 59th Street
Long Beach, CA 90805
Phone (562) 529-2109
Fax (562) 529-2225
dsiamerica@dsiamerica.com
www.dsiamerica.com

REPORT OF CALIBRATION

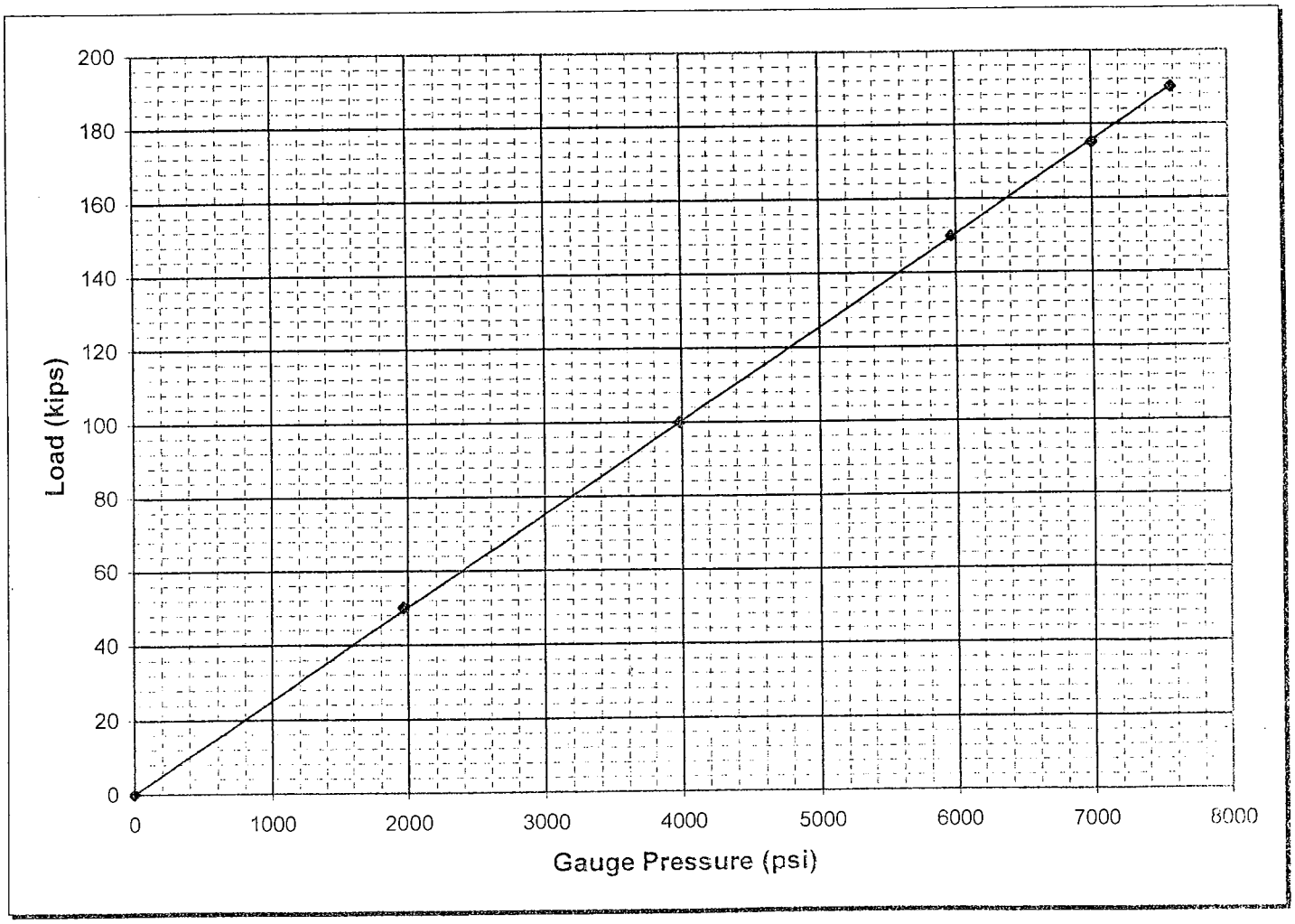
Ram ID: **WC-089**

Gauge: **6-30009**

Calibration Date: **3/4/2009**

Ram Model	Simplex
Capacity (Tons)	100
Area (sq. in.)	24.69
Stroke (in.)	6.50
Load Cell	Cal Trans #6903

Gauge Press. (psi)	Load (kips)
0	0
1967	50
3983	100
5967	150
7000	175
7583	190



POST-TENSIONING INSTITUTE
CERTIFIED PLANT

An Equal Opportunity Employer

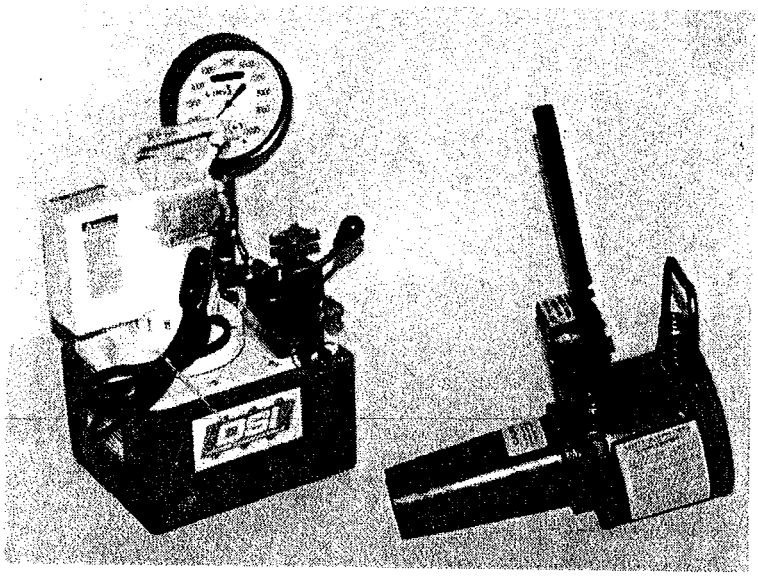
DYWIDAG-SYSTEMS INTERNATIONAL

SAFETY AND OPERATING INSTRUCTIONS

THREADBAR ® STRESSING

Dywidag Systems
INTERNATIONAL, U.S.A., INC.
Corporate Headquarters
320 Marmon Drive
Bolingbrook, IL60440-3078
Phone: (630) 739-1100
Fax: (630) 972-9604
EQUIPMENT DEPARTMENT
Fax: (630) 739-5139

Post-Tensioning Systems
Special Construction Methods



WARNING

Read all safety and operating instructions and warnings before starting any work or operation. NEVER stand or allow anyone to stand directly behind, above or below a jack when stressing operations are under way.

1. **EQUIPMENT COVERED HERE:**

   A: Jack: 110 Mp Series 01,02,03
   60 Mp Series 04,05
   25 Mp Series 01
   B: Pump OTC PE554 115 volt single phase, 30 amp.
   C: Hoses: 19,000 psi bursting pressure
   D: Pressure Gauges: 10,000 psi. 100 psi gradations

2. **SAFETY INSTRUCTIONS**

   1. Observe all relevant OSHA standards e.g. use of protective clothing and devices, grounding of electrical equipment, control of work area, etc.
   2. All system components must be in good working condition prior to use. Inspect daily for signs of wear or damage. Do not use if grippers are worn excessively, hoses are cracked, pressure gauge is in operable, or other defects are observed.
   3. After inspection, test run system (see Operating instructions) to insure all components are in proper working order.
   4. Stressing operations must be under the direct control of a superintendent experienced in such operations.
   5. Operators must wear proper personal protective equipment (hard hats, safety glasses and shoes, gloves and long sleeves, etc.) while operating equipment.
   6. Stressing unit should be securely tethered to the structure at all times. In the event a tendon breaks during the stressing operation, the tether will prevent the unit from falling.
   7. Operating personnel must keep feet from becoming entangled in the hydraulic hoses while stressing.
   8. **No one should be allowed to stand behind, directly above, or below the jack when stressing operations are under way.**
   9. Never exceed the maximum allowable stressing pressure. (Check Calibrations accompanying equipment)
   10. Make certain jack is in the fully closed position when moving from tendon to tendon. Do not activate pump while moving the jack.
   11. Do not attempt to service the equipment beyond that described in the operating instructions. All other servicing should be referred to qualified DSI service personnel.

3. **OPERATING INSTRUCTIONS**

A. PREPARATION

1. Proper and complete connection of the hydraulic lines is vital to the safe operation of the equipment. Connect hydraulic hoses from pump stress port to jack stress port, from pump return port to jack return port and from the pump seating port to ram seating port. Fully engage all fittings hand tight.

WARNING

Improper or incomplete coupling of hydraulic hoses may cause injury or death to personnel, or severe damage to equipment.

2. Visually inspect concrete around the anchor. It should be free of voids.

pti POST-TENSIONING INSTITUTE
CERTIFIED PLANT

3. Be sure jack is equipped for the bar size to be stressed. Check the wrench sleeve for fit over the hex or anchor nut. Be sure the pull rod, pull rod nut, and coupler are the correct size and in good condition.
4. Check that oil level in pump is adequate.
5. Connect the hydraulic pump to 115V AC 60HZ 30amp power source. Extension cords should be 3 wire, 12 gauge minimum with a maximum length of 50 ft. Further distances will damage the pump motor and will interfere with stressing.
6. Proper lifting equipment must be available prior to commencing.
7. Lift equipment by lifting harness only. Never use hydraulic lines for moving, carrying or adjusting of equipment.

B. BLEEDING THE JACK
(See Stressing for operation of Jack)

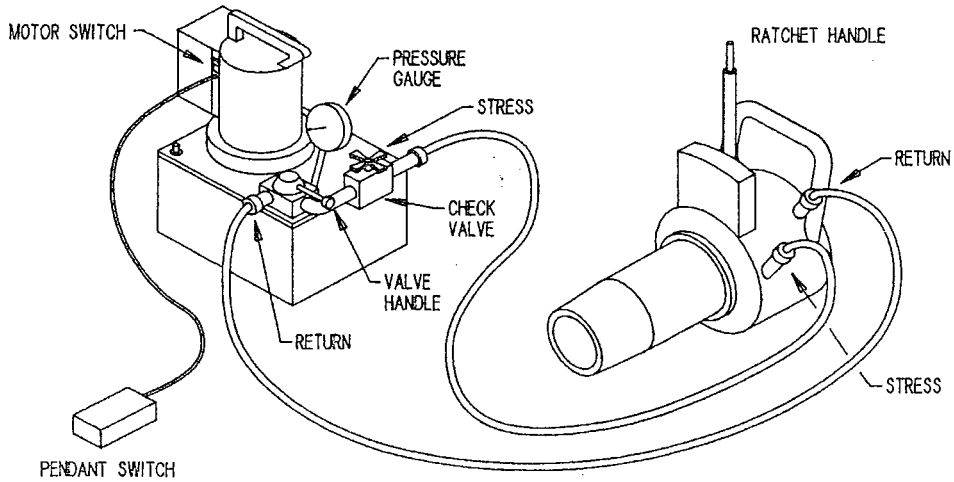
1. Tilt jack so rear fitting is higher than front (approximately 30 degrees) and facing up.
2. Advance ram until piston is fully extended. When piston is fully extended, the gauge pressure will rise sharply. **(DO NOT EXCEED 500PSI)**
3. Tilt jack front fitting higher than rear and facing up. Return the piston fully. **(DO NOT EXCEED 500PSI)**
4. Repeat the cylce 2 or 3 times to remove air from the system.

C. STRESSING

1. Put pump motor switch in "Remote" position.
2. Place pump valve handle in return position, Pos B.
3. Depress pendant switch and return piston fully.
4. Hand tighten anchor nut on bar until plate is contacted. Failure to do so can damage the internal components of the jack.
5. Be sure bar extension beyond anchor nut is at least ½ coupler length plus 1 inch.
6. Engage pull rod coupler ½ length on pull rod, using the proper size allen wrench tighten set screw.
7. Engage pull rod and couplet fully on to the bar. **WARNING: TO AVOID SERIOUS ACCIDENTS, PULL ROD COUPLER MUST BE FULLY ENGAGED.**
8. Place pump valve in Stress position, Pos A, close check valve on stressing line (if installed)
9. Extend piston between ¼" and ½".
10. Place jack over bar, nut, pull rod coupler and pull rod. Jack wrench sleeve must slide over hex on anchor and bearing nose must be flat on bearing plate.
11. Install pull not until it contact the ball plate on rear of the jack.
12. Depress remote pendant switch on pump and stress tendon to desired load. Never exceed the following pressures (P).

Jack Size (Tons)	Bar Size (Inches)	P (PSI) Grade 150	P (PSI) Grade 160
25	5/8	4,500	—
60	1	5,000	5,400
60	1¼	7,400	-
110	1¼	4,100	4,400
110	13/8	5,200	5,600

13. Measure total bar elongation between bearing plate and any fixed reference point on bar before and after stressing.
14. Using ratchet handle to tighten nut to plate. **DO NOT** use "cheater" bar. **CAUTION:** Tightening of anchor nut with ratchet should be performed while ram is in motion.
15. Switch valve to Pos B. and slowly open the check valve. Once the pressure on the gauge is zero, activate the pump retracting the ram. **WARNING: NEVER EXCEED 500PSI IN RETRACT.**



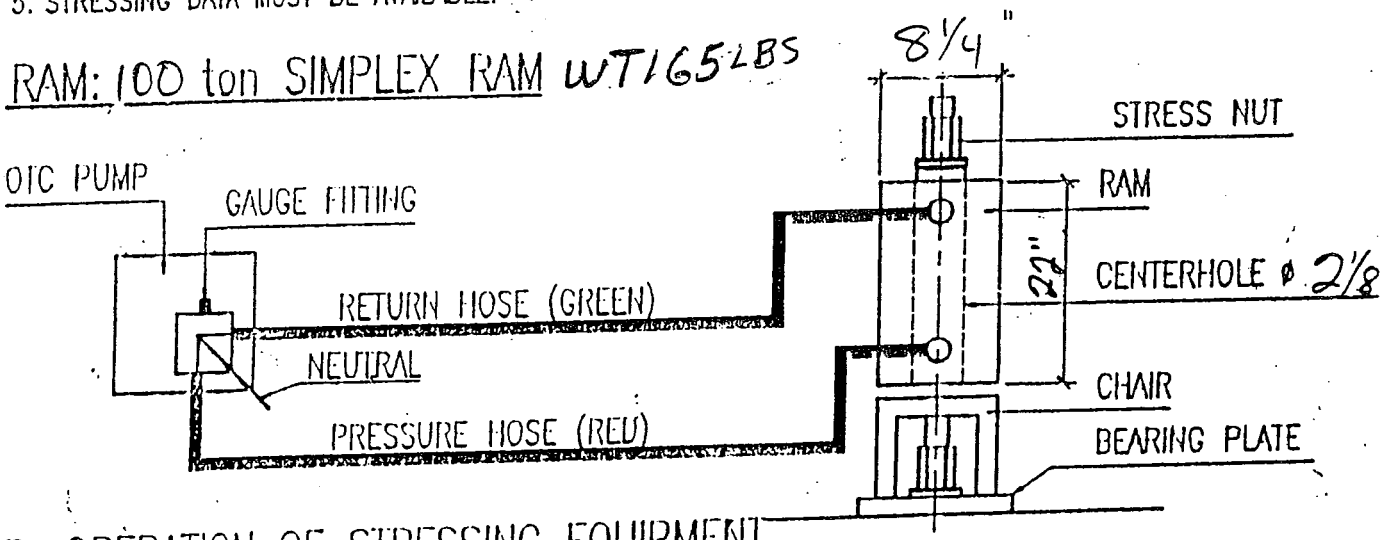
DYWIDAG SYSTEMS INTERNATIONAL, USA, INC.
2154 SOUTH STREET
LONG BEACH, CA 90805
PH. (310) 531-6161
FAX (310) 531-2667

HYDRAULIC RAM OPERATION

A. PREPARATION

1. CONCRETE QUALITY AND STRENGTH SHOULD BE ACCORDING TO SPECIFICATIONS AND APPROVED BEFORE STRESSING OPERATION.
2. VISUALLY INSPECT CONCRETE AROUND THE ANCHOR. IT SHOULD BE FREE OF VOIDS.
3. CHECK CLEARANCE FOR JACK INSTALLATION TO ANCHORHEAD.
4. PROPER LIFTING EQUIPMENT FOR JACK MUST BE AVAILABLE.
5. STRESSING DATA MUST BE AVAILABLE.

RAM: 100 ton SIMPLEX RAM WT165LBS



B. OPERATION OF STRESSING EQUIPMENT

1. CONNECT PRESSURE HOSES (PER COLOR CODING). ENSURE THAT QUICK CONNECTORS ON THE PRESSURE HOSES AND THE PRESSURE GAUGE ARE FULLY ENGAGED WHEN ATTACHED TO RAM AND HYDRAULIC PUMP.
2. INSTALL RAM OVER BAR, USE STRESS COUPLER AND BAR EXTENSION, IF NEEDED.
3. INSTALL STRESS NUT, ENSURE BAR EXTENDS BEYOND THE STRESS NUT.
4. STRESS BAR TO DESIRED LOAD BY MOVING THE LEVER TO "PRESSURE" POSITION. TIGHTEN NUT AT BEARING PLATE AND SLOWLY RELEASE PRESSURE.
5. NOTE: MAXIMUM STROKE OF RAM = 6 IN.
6. RETRACT THE RAM BY MOVING LEVER TO "RETURN" POSITION. THE RETURN PRESSURE SHALL NOT EXCEED 1000 PSI.

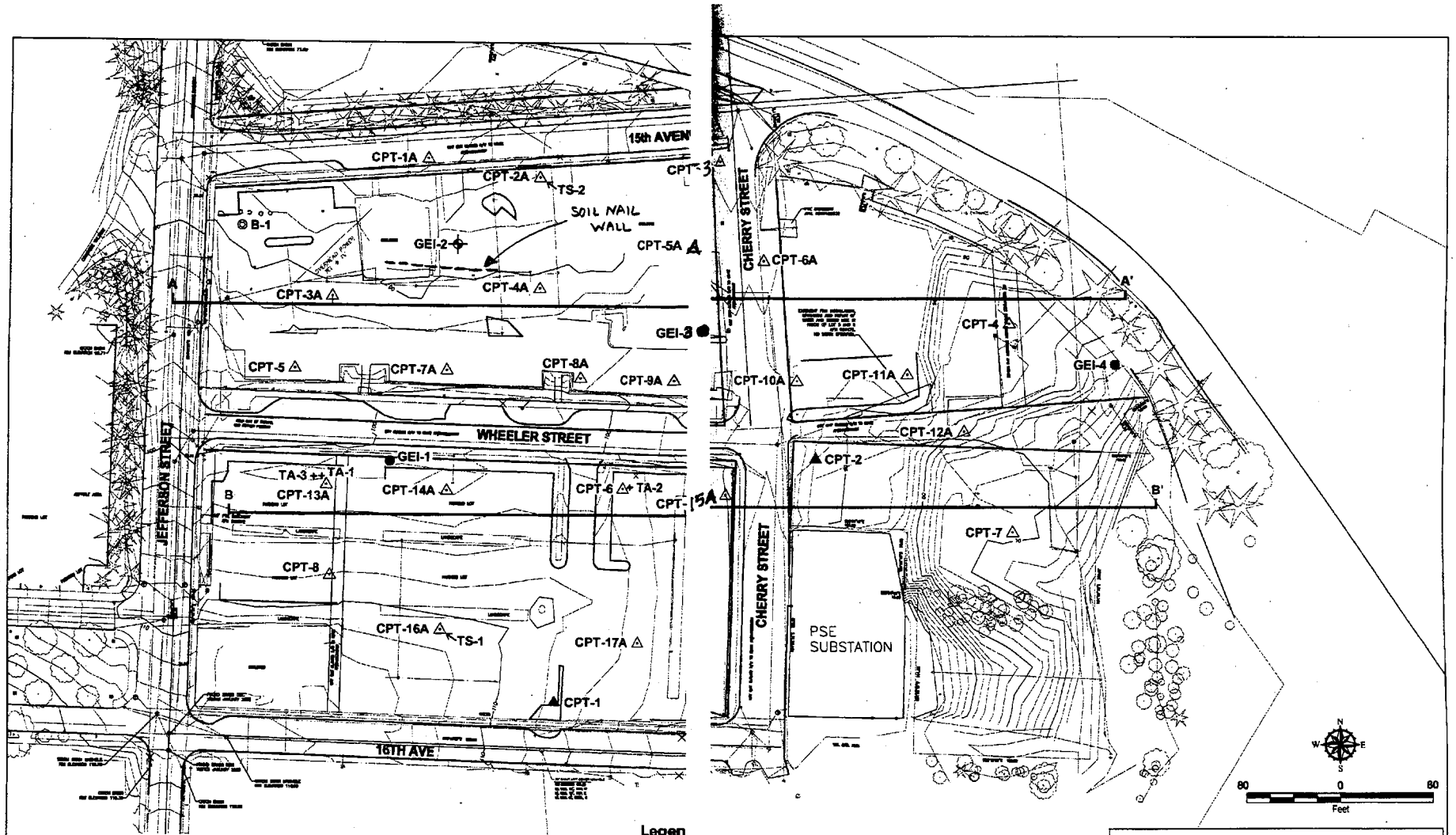
C. IMPORTANT SAFETY NOTES

NEVER EXCEED APPLICABLE GAUGE PRESSURE WHILE STRESSING, NOR EXCEED 1000 PSI WHEN RETRACTING RAM.
AT NO TIME DURING STRESSING AND REMOVAL OF JACKS SHALL PERSONS STAND IN LINE WITH TENDON/JACK OR BEND OVER ALREADY STRESSED TENDONS.
OPERATORS SHOULD WEAR SAFETY GOGGLES DURING STRESSING OPERATION.

CALL DSI (310) 531-6161 IF YOU HAVE ANY FURTHER QUESTIONS!

APPENDIX G

Geotechnical Information



Legen

GEI-1 ● Moni

GEI-3 Borin

CPT-4 △ Cone

B-1 ◎ Borin

CPT-1 ▲ Cone

A A' Loca

g Well by GeoEngineers (2007)

/ GeoEngineers (2007)

netrometer Test by GeoEngineers (2008)

/ Pan Geo (2007)

netrometer Test by Pan Geo (2007)

of Subsurface Profile

TA-2 + Test Anchor Location

TS-1 → Test Shaft Location

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Survey completed by Parametrix January 2008 and modified by GeoEngineers.

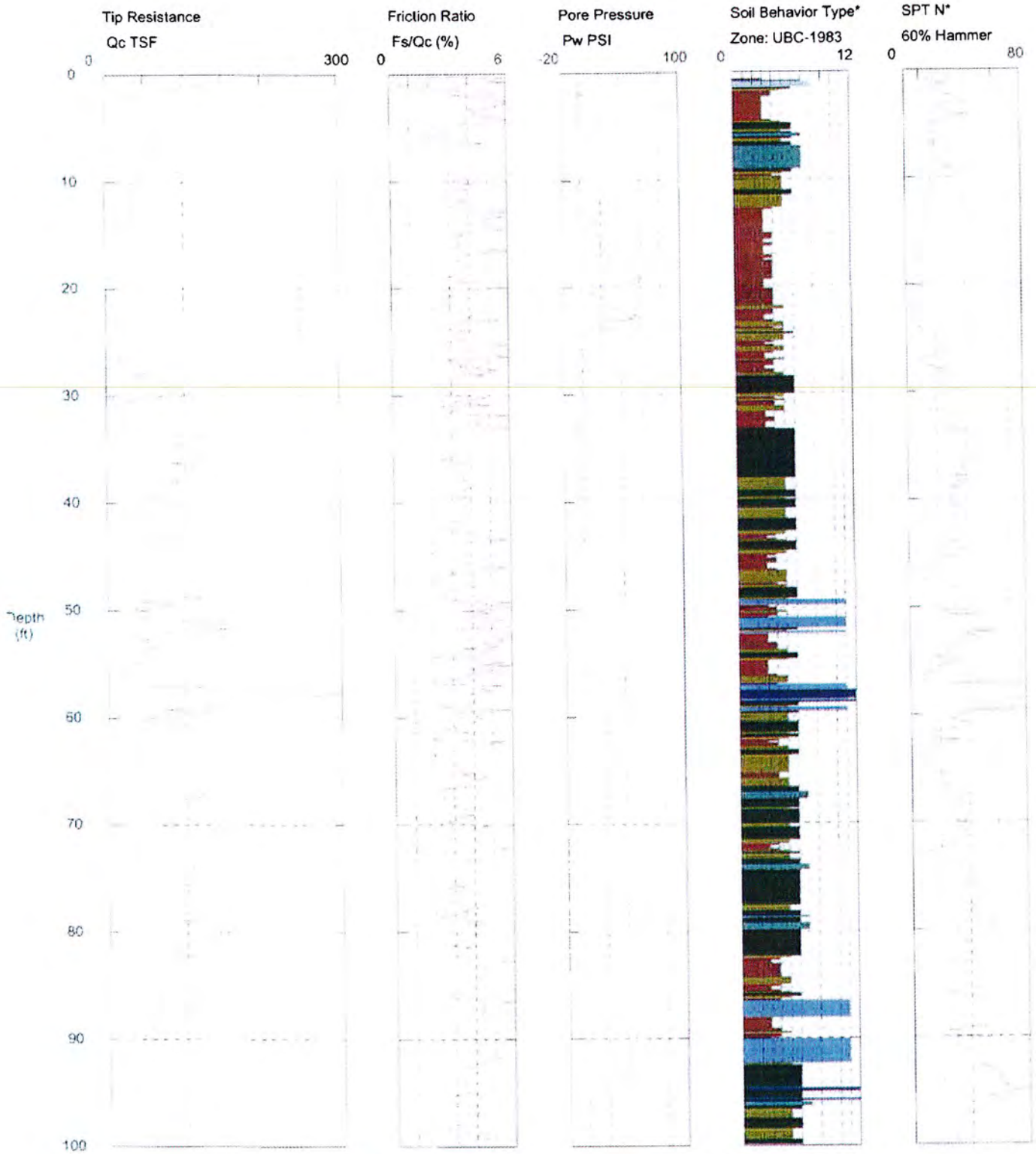
Site Plan
DIS Wheeler Site Olympia, Washington
Figure 2

REDM\P:\10389008\00\CAD\1038900800.dwg LCF:TJM 04/02/08

GeoEngineers

Operator: Nowak
Sounding: CPT-3a
Cone Used: DSG1029

CPT Date/Time: 3/14/2008 6:51:46 AM
Location: DIS-Wheeler Site
Job Number: 10389-008-00



Maximum Depth = 100.39 feet

Depth Increment = 0.164 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

In Situ Engineering

Date(s) Drilled	12/18/07	Logged By	BPD	Checked By	LCF
Drilling Contractor	Geologic Drill	Drilling Method	Hollow-stem Auger	Sampling Methods	SPT
Auger Data	3¼-inch I.D., 7¼-inch O.D.	Hammer Data	140 lb hammer/30 in drop rope and cathead	Drilling Equipment	Trailer Mounted
Total Depth (ft)	65	Surface Elevation (ft)	88	Groundwater Elevation (ft)	41
Vertical Datum	City of Olympia "City MSL"	Datum/ System		Easting(x): Northing(y):	

Elevation feet	Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	0								AC	5 inches asphalt concrete pavement			
									GM	5 inches of silty gravel base course			
									ML	Light brown silt (stiff, moist) (recessional outwash)			
85			18	10		1							(oxidation staining)
	5		12	12		2			SM	Brown silty sand (medium dense, moist)			
80			18	11		3				Occasional silt lenses			
									ML	Light brown silt (soft to medium stiff, moist to wet)			
	10		18	5		4							(trace oxidation staining)
75			18	4		5				Becomes wet	40		AL
	15												(dilatant)
70			18	3		6					41		AL
	20												
65			18	5		7							(oxidation staining)
	25								SM	Brown silty fine sand (medium dense, moist)			
60			12	12		8							
	30												
55			12	16		9				%F = 28	13		
	35												

Note: See Figure A-1 for explanation of symbols.

V6 GTBORING P:\10\10389008\00\FINALS\1038900800.GPJ GEIV6_1.GDT 4/16/08

LOG OF BORING GEI-2

GEOENGINEERS

Project: DIS Wheeler Site
Project Location: Olympia, Washington
Project Number: 10389-008-00

Figure A-3
Sheet 1 of 2

Elevation feet	Depth feet	Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
	35												
-50	40		12	16		10							
-45	45		12	17		11							
-40	50		18	9		12				Becomes loose, wet	31		AL
-35	55		18	14		13			ML	Brown sandy silt (stiff to very stiff, wet) %F = 55	34		
-30	60		18	12		14				%F = 51	31		
-25	65		18	16		15			SM	Brown silty fine sand (medium dense, wet)	33		AL
-20	70												
-15	75												
-10													

V6 GTBORING P:\10\10389008\00\FINALS\10389008.00.GPJ GEIV6 1.GDT 4/15/08

LOG OF BORING GEI-2 (continued)

GEOENGINEERS

Project: DIS Wheeler Site
Project Location: Olympia, Washington
Project Number: 10389-008-00

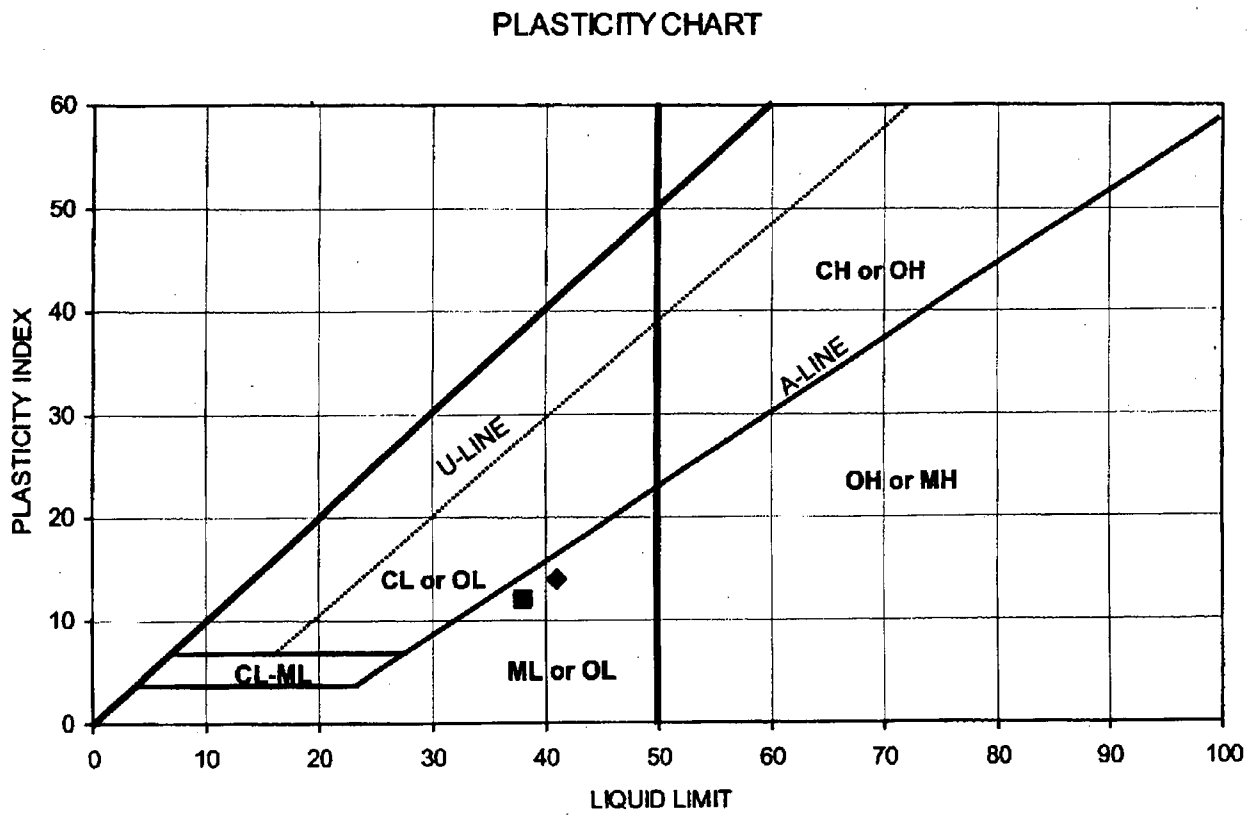
Figure A-3
Sheet 2 of 2

10389-008-00 LCF : CTS : saw 1-3-08 (Atterbergs.ppt)

GEOENGINEERS

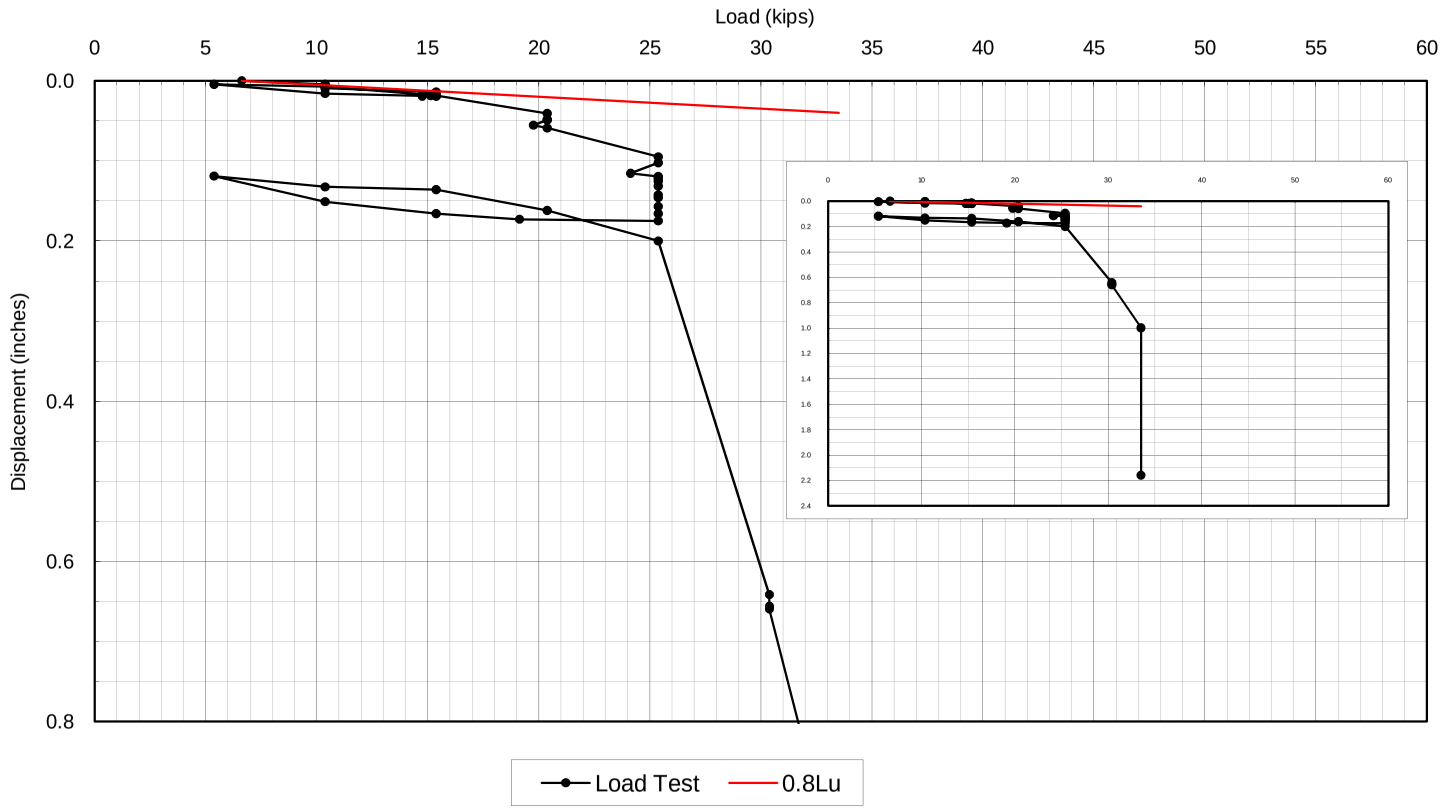
FIGURE B-2

ATTERBERG LIMITS TEST RESULTS



SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	SOIL DESCRIPTION
◆	GEI-2	13.5'	40	41	14	Light brown silt (ML)
■	GEI-2	18.5'	41	38	12	Light brown silt (ML)
▲	GEI-2	48.5'	31	0	0	Brown silty fine sand (SM) [NON-PLASTIC]
●	GEI-2	63.5'	33	0	0	Brown silty fine sand (SM) [NON-PLASTIC]

VERIFICATION SOIL NAIL LOAD TEST
Hollow Core Bar Research - Olympia, WA



Type of Test: Verification	Bond: 10 ft Unbonded 7.5 ft	Diameter: 2 in (nominal)	Hollow Core Bar Research Olympia, WA Test Nail: C2	**SCHNABEL ENGINEERING, LLC**	
				Verification Soil Nail Load Test	
Design Test Load (P) : 20 kip	Comments:			Hollow Core Bar Soil Nail Research	
				Olympia, WA	
Maximum Test Load: 150% P = 33.5 kip				Date: 10/05/09	07150064

MAYES TESTING ENGINEERS, INC

Tacoma
10029 S. Tacoma Way
Suite E-2
Tacoma WA 98499
ph 253.584.3720
fax 253.584.3707

CONCRETE LABORATORY TEST REPORT

Project Name: DBM - DIS Wheeler Site
Site Address: 14th Avenue SE/Jefferson St. SE
Olympia, WA
Client: DBM Contractors
Engineer:
Contractor: DBM Contractors

Project No: T09138
Issued on: 10/26/09
Sample Set ID: 19911
Permit # (s):
Original: ☑
Revised: ☐

FIELD DATA

ASTM C31 and C172

Air Temperature: NR
Weather:
Product: Concrete
Supplier:
Batch Plant Location:
Ticket Number : N/A
MixDesign ID :

Mix Proportions:

Sample Temp. (ASTM C1064)	Initial Storage Temp. (ASTM C31)	Entrained Air (ASTM C231)
NR	NR	NR

Slump (ASTM C143)	Sample(s) Rec'd:
NR	09/24/09

Required Strength: (f'c)
4000 psi @ 28 days

Placement Location and Notes:

Set 2: For test program. No other information was supplied.

COMPRESSION TEST RESULTS

(ASTM C31, C39, C109, C617, C780, C1019, C1231 or AASHTO T22 when applica

Date Made	Sample #	Lab #	Date Tested	Age	Size (in)	Load (lbs)	Dia (in)	Area	Strength (psi)	Type of Fracture	
09/23/09	0002	6221	09/30/09	7	2 x 2 x 2	14255	0.00	4.08	3490	Type 4	*
09/23/09	0002	6222	10/21/09	28	2 x 2 x 2	26880	0.00	3.96	6790	Type 1	*
09/23/09	0002	6223	10/21/09	28	2 x 2 x 2	28195	0.00	3.92	7190	Type 1	*

Remarks:

Technician(s): Contractor
Tested by: Davis, D.

Reviewed by:
Shaun W. Sevigny
Branch Manager

NOTES:
Information in this report applies only to the actual samples tested and shall not be reproduced without the approval of Mayes Testing Engineers, Inc.
See ASTM C39 for full description of the Type of Fracture.
All testing performed in accordance with applicable ASTM's except C-31, 10.1.2 - "recording field temperature"

MTE 1050-1C, Rev 3, 07/19/07

MAYES TESTING ENGINEERS, INC

Tacoma
10029 S. Tacoma Way
Suite E-2
Tacoma WA 98499
ph 253.584.3720
fax 253.584.3707

CONCRETE LABORATORY TEST REPORT

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Site Address: 14th Avenue SE/Jefferson St. SE
Olympia, WA
Client: DBM Contractors
Engineer:
Contractor: DBM Contractors

Project No: T09138
Issued on: 10/26/09
Sample Set ID: 19910
Permit # (s): N/A
Original: ☑
Revised: ☐

FIELD DATA

ASTM C31 and C172

Air Temperature: NR
Weather:
Product: Concrete
Supplier:
Batch Plant Location:
Ticket Number : N/A
MixDesign ID :

Mix Proportions:

Sample Temp. (ASTM C1064)	Initial Storage Temp. (ASTM C31)	Entrained Air (ASTM C231)
NR	NR	NR

Slump (ASTM C143)	Sample(s) Rec'd:
NR	09/24/09

Required Strength: (f'c)
4000 psi @ 28 days

Placement Location and Notes:

Set 1: For test program. No other information was supplied.

COMPRESSION TEST RESULTS

(ASTM C31, C39, C109, C617, C780, C1019, C1231 or AASHTO T22 when applica

Date Made	Sample #	Lab #	Date Tested	Age	Size (in)	Load (lbs)	Dia (in)	Area	Strength (psi)	Type of Fracture	
09/23/09	0001	6220	09/30/09	7	2 x 2 x 2	15385	0.00	3.84	4010	Type 4	*
09/23/09	0001	6218	10/21/09	28	2 x 2 x 2	23845	0.00	3.98	5990	Type 1	*
09/23/09	0001	6219	10/21/09	28	2 x 2 x 2	28585	0.00	4.37	6540	Type 2	*

Remarks:

Technician(s): Contractor
Tested by: Davis, D.

Reviewed by:
Shaun W. Sevigny
Branch Manager

NOTES:
Information in this report applies only to the actual samples tested and shall not be reproduced without the approval of Mayes Testing Engineers, Inc.
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MTE 1050-1C, Rev 3, 07/19/07