December 14, 2010

SPECIAL PROVISION

F-I80-4(118)141

PIN 6593

SECTION 02466S

MICROPILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials, equipment and procedures for installing micro piles used for bridge abutment foundations as approved by Engineer using injection bored elements (IBOs) or open hole methods with "stuffed" (solid)bars.

Provide and install micropiles, reinforcing steel, grout/concrete and all structural connections as shown on the drawings.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

A. AASHTO M 31: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

B. ASTM A615

C. ANSI/AASHTO/AWS D 1.1

1.4 MICROPILE SELECTION

A. Use either preferred micropile types as shown on the drawings.

B. Do not change the micropile type after the preconstruction conference without written approval from the Engineer.

1.5 SUBMITTALS

A. Certified mill test reports for the micropile steel and connection materials. The ultimate strength, yield strength, elongation, and material properties composition shall be included. Certification of compliance with "Buy American" provisions of contract shall accompany mill test report submittals.

B. Proposed Grouting Plan. The grouting plan shall include complete descriptions, and details for the following:
Grout mix design and type of materials to be used in the grout including certified test data and trial batch reports. The Contractor shall also provide specific gravity of the wet mix design.

C. Detailed plans for the proposed micropile load testing method. This shall include all proposed test pile locations drawings, details, and structural design calculations necessary to clearly describe the proposed test method, reaction load system capacity and equipment setup, types and accuracy of apparatus to be used for applying and measuring the test loads and pile top movements in accordance with this specification.

D. Calibration reports and data for each test jack, pressure gauge and master pressure gauge and electronic load cell to be used. The calibration tests shall have been performed by an independent testing laboratory, and tests shall have been performed within 90 calendar days of the date submitted. Testing shall not commence until the Engineer has reviewed and accepted the jack, pressure gauge, master pressure gauge and electronic load cell calibration data.

E. Work shall not begin until the construction submittals have been received, reviewed, and accepted in writing by the Engineer. Any submittals that are found to be unacceptable by the Engineer shall be revised, resubmitted and accepted prior to commencing work.

1.6 ACCEPTANCE

A. Micropiles may be accepted at a reduced price when the grout strength is below that specified. Acceptance and Price adjustment pay factor following Section 03055.

PART 2 PRODUCTS

2.1 MICROPILE STEEL

A. Use new bar materials as shown on the plans.

B. All bar shall be 75 ksi or greater.

2.2 PORTLAND CEMENT CONCRETE

A. Portland Cement Grout following Section 03055.

2.4 REINFORCING STEEL

A. Meet AASHTO M 31, Grade 60.

B. Refer to Section 03211.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete all foundation excavation before drilling micropiles. Dewater excavation a minimum of 3 feet below bottom of footing at all times during installation activities.

B. Compare designated position of micropiles with the locations of existing piles from previous construction, existing utilities, old foundations, and other potential conflicts. Notify the Engineer of any conflicts. The Engineer designates new pile locations as required to resolve conflicts with locations of existing piles or other conflicts.

3.2 INSTALLATION

A. Pre-drill/pre-auger as required to install micropile for "stuffed bar" option otherwise drill with IBO steel to minimum design diameter and length as shown on drawings.

B. Pile Splicing:

1. Use manufactures supplied connectors to develop full micropile bar length.

C. Keep drilled piles within 6 inches of the designated position and keep exposed portion of the pile within 1/4 inch/feet from vertical (or from direction otherwise shown for battered piles). Before proceeding with backfilling, grouting or other associated foundation work, verify that the criteria have been met at the ground surface at the end of pile installation. If either requirement is not met, contact the Engineer to determine the appropriate resolution. The Contractor bears all costs for any measures required to resolve the non-conformance.

D. Install additional micro piles at locations designated by the Engineer when replacing damaged piles and/or piles installed out of position and/or alignment as specified above.

E. Engineer evaluates the possible damage to piles from water collecting in open bore holes. Install additional piles as determined by the Engineer to resolve concerns with any such pile damage.

F. Remove all loose, displaced, and foreign materials from around the completed piles leaving clean, solid surfaces to receive the concrete.

G. Cutting and capping piles:
   1. Remove all damaged material from the top of the pile.
   2. Keep the sides of piles at least 9 inches away from the nearest edge of footing.
   3. Cut off piles with clean, straight-line cuts to the designated elevation at a right angle to the pile axis. Level all irregularities before placing concrete pile cap.

H. Receive approval from Engineer prior to concrete placement.

I. Embed the tops of piles in the concrete pile cap as shown on the plans.

3.3 CEMENT GROUT FILLING OF MICROPILES

A. Fill Solid Bar Micropile drill hole with specified cement grout shown on drawings, after compliance with all tolerances and required criteria have been established.

B. Avoid segregation of the grout ingredients.

C. Grout shall be pumped using tremie to assure complete filling of the annular space between the micropile steel and drill hole.

D. Do not chute grout directly into hole.

3.4 MICROPILE INSTALLATION RECORDS

A. The micropile Contractor shall prepare and submit to the Engineer full-length installation records for each micro installed. The records shall be submitted within one work shift after that pile installation is completed. The data shall be recorded on a micropile installation log. A separate log shall be provided for each micropile.

3.5 VERIFICATION AND PROOF TESTS

A. Perform verification and proof tests of piles at the locations specified on the plans. Perform compression load testing in accord with ASTM D1143 and tension load testing in accord with ASTM D3689, except as modified herein. Compression and tension load test may be performed on the same test pile.

B. Perform pre-production verification pile load test(s) to verify the design of the pile system and the construction methods proposed prior installing any production piles. Sacrificial verification test pile(s) shall be constructed in conformance with the approved Working Drawing Verification test pile(s) shall be installed at the location(s) shown on the plans or at a location(s) approved by the Engineer.

C. Verification load test(s) shall be performed to verify that the Contractor installed micropiles will meet the compression and/or tensile load capacities and load test acceptance criteria and to verify the length of the micropile load transfer bond zone is adequate. The micropile verification load test results must verify the design and Contractor's installation methods.

D. The drilling method, grouting method, casing length, micropile diameter (cased and uncased), reinforcing bar length and length of embedment for the verification test pile shall be identical to those specified for the production piles at the given locations. The verification test micropile structural steel sections shall be sized to safely resist the maximum test load.

E. The maximum verification test loads applied to the micropile shall not exceed 80 percent of the structural capacity of the micropile structural

elements; include steel yield in tension, steel yield or buckling in compression, or grout crushing in compression. Any required increase in strength of the verification and proof test pile elements above the strength required for the production piles shall be provided for in the Contractor's bid price and identified in the Contractor's test plan.

F. Testing equipment shall include dial gauges, dial gauge independent reference frame, jack and pressure gauge ,electronic load cell (with readout device), and a reaction frame. The load cell is required only for the creep test portion of the verification test. The contractor shall provide a description of test setup and jack, pressure gauge and load cell calibration curves in accordance with the Submittals Section.

G. Design the testing reaction frame to be sufficiently rigid and of adequate dimensions such that excessive deformation of the testing equipment does not occur. Align the jack, bearing plates and stressing anchorage such that unloading and repositioning of the equipment will not be required during the test.

H. Apply and measure the test load with a hydraulic jack and pressure gauge. The pressure gauge shall be graduated in 100 psi increments or less. The jack and pressure gauge shall have a pressure range not exceeding twice the anticipated maximum test pressure. Jack ram travel shall be sufficient to allow the test to be done without resetting the equipment. Monitor the creep test load hold during verification test with both the pressure gauge and the electronic load cell. Use the load cell to accurately maintain a constant load hold during the creep test load hold increment of the verification test.

I. Measure the pile top movement with a dial gauge capable of measuring to 0.001 inches. The dial gauge shall have a travel sufficient to allow the test to be done without having to reset the gauge. Visually align the gauge to be parallel with the axis of the micropile and support the gauge independently from the jack, pile or reaction frame. Use a minimum of two dial gauges when the test setup requires reaction against the ground or single reaction piles on each side of the test pile.

J. Test verification piles to a maximum test load of 2.0 times the maximum strength limit compressive load shown on the drawings, hereafter termed, “Service Load” shown on the Plans. The verification pile load tests shall be made by incrementally loading the micropile in accordance with the following cyclic load schedule for both compression and tension loading (test the compression prior to tension):

Verification Test Loading Schedule

AL = Alignment Load SL = Service Load

LOAD		HOLD TIME
1	AL (.05 SL) 0.25 SL	1 minute
2	0.50 SL	1 minute
3		1 minute
4	AL	1 minute
5	0.25 SL	1 minute
6	0.50 SL	1 minute
7	0.75 SL	1 minute
8	AL	1 minute
9	0.25 SL	1 minute
10	0.50 SL	1 minute
11	0.75 SL	1 minute
12	1.00 SL	1 minute
13	AL	1 minute
14	0.25 SL	1 minute
15	0.50 SL	1 minute
16	0.75 SL	1 minute
17	1.00 SL	1 minute
18	1.33 SL	60 minutes
19	1.75 SL	1 minute
20	2.00 SL (Maximum Test Load)	10 minutes
21	AL	1 minute

Proof Test Loading Schedule

K. The acceptance criteria for micropile verification load test are:

1. The Engineer shall determine the criteria for tolerable movement during the load test at the top of the micropile.

Proof Test Loading Schedule

2. At the end of the step 20 2.0xSL creep test load increment, test piles shall have a creep rate not exceeding 0.05 inch/log cycle time (1 to 10 minutes) or 0.1 inch/log cycle time (6 to 60 minutes or the last log cycle if held longer). The creep rate shall be linear or decreasing throughout the creep load hold period.

Proof Test Loading Schedule

Proof Test Loading Schedule

3. Failure does not occur at any load increment up to and including the 2.0 SL. max test load. Failure is defined as load at which attempts to further increase the test load simply result in continued pile movement.

L. Upon completion of the test, the Contractor shall submit a report stamped by a qualified Professional Engineer license din the State of Utah of the test results for review and acceptance by the Engineer prior to beginning installation of production micropiles. This report shall include written confirmation of the verification micropile's capacity.

M. If a verification tested micropile fails to meet the acceptance criteria, the Contractor shall modify the construction procedure, Engineer shall modify design or both. These modifications may include modifying the installation methods, increasing the bond length, or changing the micropile type. Any modification that necessitates changes to the structure shall be submitted as a revision to the working drawings and require the Engineer's review and acceptance. Any modifications of design or construction procedures or cost of additional verification test piles and load testing shall be at the Contractor's expense. At the completion of verification testing, test piles shall be removed down to the elevation specified by the Engineer.

N. Perform proof load tests at the micropile locations as shown on the plans. Perform proof load tests on the first set of production piles installed at each designated substructure unit prior t o the installation of the remaining production piles in that unit. The initial proof test piles shall be installed at the locations shown on the plans. Upon completion of each test, the Contractor shall submit a report stamped by a qualified Professional Engineer licensed in the State of Utah to the test results for review and acceptance by the Engineer

O. Proof test piles to a maximum test load of 1.67 time s the micropile Service Load shown on the Plans or Working Drawings.

Proof tests shall be made by incrementally loading the micropile in accordance with the following schedule to be used for compression loading:

Proof Test Loading Schedule		
AL=Alignment Load SL=Service Load		
LOAD		HOLD TIME
1	AL	1 minute
2	0.25 SL	1 minute
3	0.50 SL	1 minute
4	0.75 SL	1 minute
5	1.00 SL	1 minute
6	1.33 SL	60 minute Creep Test
7	1.67 SL (Maximum Test Load)	1 minute
8	AL	1 minute

P. Depending on performance, either a 10 minute or 60 minute creep test shall be performed at the 1.33 SL Test Load. Where the pile top movement between 1 and 10 minutes exceeds 1 mm ,the Maximum Test Load shall be maintained an additional 50 minutes. Movements shall be recorded at 1, 2, 3, 5, 6, 10, 20, 30, 50 and 60 minutes. The alignment load shall not exceed 5 percent of SL. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for micropile proof load tests are:

1. The Engineer shall determine the criteria for tolerable movement during the load test at the top of the micropile.

2. At the end of the 1.33 SL creep test load increment, test piles shall have a creep rate not exceeding 0.05 inch/log cycle time (1 to 10 minutes) or 0.1 inch/log cycle time (6 to 60 minutes).The creep rate shall be linear or decreasing throughout the creep load hold period.

3. Failure does not occur at the 1.67 SL maximum test load. Failure is defined as the load at which attempts to further increase the test load simply result in continued pile movement.

Q. If a proof-tested micropile fails to meet the acceptance criteria, the Contractor shall immediately proof test another micropile within that footing. For failed piles and further construction of other piles, the Contractor shall modify the design, the construction procedure, or both. These modifications may include installing replacement micropiles, incorporating piles at not more than 50% of the maximum load attained, post-grouting the tested pile and re-proof testing the pile, modifying installation methods, increasing the bond length, or changing the micropile type. Any modification that necessitates changes to the structure design shall require the Engineer’s prior review and acceptance.

Any modifications of construction procedures, or cost of additional verification test piles and verification and/or proof load testing, or replacement production micropiles, shall be at the Contractor's expense.

END OF SECTION