Special Specification 4055
Micropiling

1. DESCRIPTION

Furnish and place micropiling consisting of small diameter steel casing, grouted in place, and conforming to the details shown in the plans and this special specification.

Select the micropile type and the installation method, and determine the length and diameter. Install micropiling in accordance with the testing subsection of this specification.

2. MATERIALS

Use materials that meet the requirements of the following:

- Item 440, “Reinforcement for Concrete;”
- Item 441, “Steel Structures;”
- Item 442, “Metal for Structures;”
- Item 421, “Hydraulic Cement Concrete;”
- Provide Type B stud connectors as defined in AWS D1.5, Section 7;
- Provide Grade 75 All-Thread reinforcement;
- Provide grout in accordance with Item 421, “Hydraulic Cement Concrete,” and in accordance with the plans; and
- Admixtures which control bleed, improve flowability, reduce water content and retard set may be used in the grout subject to the approval of the engineer. Comply with manufacturer’s recommendations for use of admixtures.

3. WORKING DRAWINGS

Submit complete project specific working drawings for the micropile system to the Engineer, in conformance with Item 5.2, “Plans and Working Drawings” of the Standard Specifications.

Include all information required for the construction and quality control of the piling, including the following:

- Information on headroom and space requirements for installation equipment that verify the proposed equipment can perform at the site;
- Step-by-step procedure describing all aspects of pile installation including personnel, testing, and equipment to assure quality control. Indicate the step-by-step procedures on the working drawings in sufficient detail so that the Engineer can monitor the construction and quality of the micropiles:
- Details for drilling a plumb hole;
- Details of centralizers:
- Grout mix designs;
- Details and procedures involved in testing components, including grout;
- Pipe and reinforcement splice type and locations;
- Details of equipment and operation for grouting. Include provisions for monitoring grout quality, volume installed, and pressure during installation;
- Information on the minimum cure time and strength requirements of the pile system for test piles;
- Drawing showing micropile location, number, design load, type, and size: and

- Submit the following post-construction, within 30 calendar days after completion of work: as-built drawing showing locations of micropiles and lengths; detailed drilling records; grouting records indicating the cement type and quantity injected; micropile test results and graphs.

Allow the Engineer sufficient time to review the working drawing submittal after a complete set has been received. Do not install micropiling until the Engineer has approved, in writing, the working drawing submittal.

4. CONSTRUCTION

Dispose of cuttings and micropile installation and spilled or wasted grout in accordance with the plans and federal, state, and local laws.

Use core drilling, rotary drilling, percussion drilling, auger drilling, driven casing or other acceptable means unless otherwise directed. The micropile can be installed in the drill hole after drilling or it can be advanced by the drill.

Do not use drilling mud or chemical stabilizers.

Remove foreign material dislodged or drawn into the hole during construction of the micropiles. Remove loose material existing at the bottom of the hole after drilling operations are complete before placing grout.

Use centralizers when installing steel casing and bar reinforcement.

Provide a positive means of support for maintaining the position of the casing and reinforcement until the grout has set.

Use a neat cement grout or a sand-cement grout with a minimum 28 day unconfined compressive strength of 4,000 psi.

Mix the grout to produce a uniform mixture free of lumps and undispersed cement. Equip the pump with a pressure gauge to monitor grout pressures. Provide a pressure gauge capable of measuring pressure of at least 150 psi or twice the actual grout pressures used by the contractor, whichever is greater. Use grouting equipment capable of pumping the grout in one continuous operation. Continuously agitate the mixed grout during pumping operations.

Inject grout from the lowest point of the drilled hole. The grout may be pumped through grout tubes, casing, hollow-stem-augers, or drill rods.

Record the quantity of the grout and the grout pressures.Control the grout pressures and grout takes to prevent excessive heave. Fill the entire micropile with grout.

The grout tube may remain in the hole provided it is filled with grout.

Do not load the micropile until three days after grouting.

5. PERFORMANCE AND TESTING

Load test micropiles as follows:

Install a minimum of one (1) non-production test pile for performance testing outside of the proposed footing in conformance with the micropile load test pile details shown on the plans. Load the test pile to twice the design load and evaluate the ultimate pile capacity in accordance with FHWA-HI-97-014, “Design and Construction of Driven Pile Foundations, Volumes 2”, Section 19.8.3 to ensure compliance with job

performance requirements. Notify the Engineer one week before installing test micropile groups that are to be performance tested.

Apply the load with a calibrated hydraulic jack.

Perform the tests in accordance with ASTM D 3689-07, "Testing of Piles under Static Axial Tensile Load," Paragraph 8.1.2 – Quick Pile Test.

Apply the test load in increments of 5% of the anticipated failure load to maximum of a 200 percent of the foundation load shown on the Bridge Layout. Add load increments until reaching a failure load, but do not exceed the maximum testing load (200% of the foundation load). During each load interval, maintain load increments for 5 minutes and record test readings taken at 0.5, 1, 2 and 4 minutes after completing the application of each load increment. Use the same time interval for all loading increments through the test. Remove the load in six approximately equal decrements. Keep the load constant for 5 minutes using the same time intervals for all unloading decrements. Record test readings taken at 1 and 4 minutes after completing each load decrements. Take and record readings at 1, 4, 8 and 15 minutes after removing all loads. Refer to a constant elevation benchmark for readings of settlements and rebounds. Record them to 0.01 inches for each increment or decrement of load.

Test piles will be considered acceptable if results meet the following:

- No failure occurs or
- The ultimate pile capacity from load test is not less than 200% of its foundation load.

The test pile may not be a production pile.

If the test pile fails to give acceptable results, modify the design and install and test another pile at no additional expense to the Department.

6. MEASURMENT

This Item will be measured by each micropiling installed.

7. PAYMENT

The contract unit price paid for micropile includes full compensation for designing and furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing micropiles, including casings, grout, reinforcement, cutting tips, drill bits, pile anchorage, and disposing of materials resulting from pile installation, complete in place, as shown on the plans, as specified in the Standard Specifications and this special specification, and as directed by the Engineer. Performance test micropiling, including anchor piles, will not be paid for directly but will be subsidiary to the micropiling.

No payment will be made for micropiles that are damaged either during installation or after the micropiles are complete in place. No payment will be made for additional excavation, backfill, concrete, reinforcement, nor other costs incurred from footing enlargement resulting from replacing rejected micropiles.