ITEM 551.9946 17 - MICROPILES (CONTRACTOR DESIGNED)

ITEM 551.9947 17 - MICROPILES (CONTRACTOR DESIGNED) - WITH EXTENDED LENGTHS

DESCRIPTION

A. General. This work shall consist of designing micropiles, furnishing all labor and materials, and performing all operations necessary to install micropiles at the locations and to the required resistances indicated in the contract documents.

Micropiles with extended lengths include an additional pile length as described in the Definitions below. The Contractor's Engineer shall incorporate this requirement into the design of the micropile with extended lengths.

B. Definitions. Definitions that apply within this specification are:

API Mill Secondary or Mill Seconds. Mill reject American Petroleum Institute (API) casing, a.k.a. "Mill Rejects," "Structural Grade," "Limited Service," or "Minimum Test Pipe." Mill seconds cannot be used for reinforcement.

API Prime Pipe. Pipe meeting all the specified inspection and testing requirements set forth by API and having accompanying certifications. API standardized several grades of steel that have different chemical content, manufacture processes, and heat treatments and, therefore, different mechanical properties. The API grade letter designation is arbitrary and the numbers in the grade designation indicate the minimum yield strength of the steel in thousand psi. N80 is a relatively old grade with essentially open chemical requirements and is normally less expensive than L80 grade.

Bond Breaker. A device or special treatment incorporated into a length of a micropile that will allow no load to be transferred to the soil over that length. A bond breaker also provides full lateral support of the pile over the length of the bond breaker.

Grout placed in contact with the soil using gravity pressure only will not be considered to constitute a bond breaker.

Bond Zone. The gravity grouted, pressure grouted, and/or post grouted length of a micropile that provides the pile's resistance.

Drill Casing. Steel pipe of flush joint type used in the drilling process to stabilize the drill hole.

Duplex drilling. A method of progressing and cleaning out a hole for installing a micropile in which the outer drill casing is progressed simultaneously with an inner drill rod string. The drill casing is cleaned using reverse circulation. Intimate contact between the soil and an outer drill casing is maintained during drilling.

Extended Length. An additional pile length resulting from a requirement that the pile resistance be achieved below a given elevation. Typically, extended lengths are prompted by a conflict with subsurface elements (e.g., underground structure, utilities, etc.) or unreliable soil strata. Bond breakers may be required.

Micropile. A small-diameter (typically less than 300 mm), friction pile formed by removing material using non-vibratory and non-displacement methods to create a cased cylindrical open hole in the ground, which is subsequently filled with grout and steel reinforcement.

Non-production pile. Non-production piles are piles that are not incorporated into the substructure. For example, test piles which are abandoned after testing has been completed.

Permanent Casing. A steel casing installed in the upper portion of a micropile to increase the pile's moment resistance and lateral resistance against horizontal loads.

Positive circulation or flush. A method of progressing and cleaning out a hole for a micropile wherein drilling fluid is injected into the hole and returns upward along the outside of the drill casing.

Post grouting. A method used to increase pile resistance after the grout column has reached initial set by pumping grout at very high pressure (up to 7000 kPa) through a sleeved port pipe (post grout tube).

Pressure grouting. A method used to develop pile resistance wherein pressure is applied continuously to the top of the fluid grout column through the drill head as the casing is removed from the bond zone.

Production pile. A pile which will be incorporated into the structure's foundation.

Recirculation. A method of handling drilling fluid where the fluid coming back out of the hole is captured in a pan and reused.

Reverse circulation. A method of cleaning the inside of the drill casing. Drilling fluid is circulated down through the drill rods and returns upwards through the inside of the drill casing to flush the drill casing clean.

Static Pile Load Test. A test to verify design assumptions and the adequacy of the Contractor’s installation methods.

Telltale. A simple mechanical device, a.k.a. “strain rod,” that is used to measure deflection in concrete or steel. The device consists of a small-diameter steel rod that is fixed at a selected point along or within the pile. This rod is encased, and free to move, in a slightly larger pipe or tube which extends up to the pile top. Dial gages are used to measure the deflections at the top of the rod.

Tremie grouting. A method used to place grout in a wet hole. A grout tube is placed to the bottom of the drill hole. While keeping the tube opening submerged in the grout, grout is pumped into the hole, causing the drilling fluid to be displaced.

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MATERIALS

For all steel remaining as a permanent part of the work, all Buy America provisions shall apply. Mill certifications are required to meet Buy America provisions.

A. Drill Casing. Provide drill casing consisting of flush joint type steel pipe of appropriate thickness to withstand the stresses associated with advancing it into the ground, in addition to the stresses due to hydrostatic and earth pressures.

B. Drill Casing/Pipe Used As Reinforcement. Provide steel drill casing/pipe used as reinforcement meeting, at a minimum, the strength requirements of ASTM A252, with the exception that spiral welded pipe shall not be allowed. Mill seconds cannot be used for reinforcement.

Approval of the steel drill casing/pipe used as reinforcement shall be done in accordance with the following procedure:

1. Requirements for Micropile Structural Casing. Structural casing that is installed in coupled (spliced) sections shall meet the following requirements:

The casing shall be flush joint and the pipe joint shall be completely shouldered and with no stripped threads.

All welded connections shall be performed by a NYSDOT Certified Welder in conformance with NYSDOT Steel Construction Manual (SCM), the approved Welding Procedure Specification (WPS) and the Approved Welding Procedure Qualification Record (WPQR). Welds shall be full penetration welds for full structural load capacity. For piles with bending or tension stress, welds shall be Ultrasonic (UT) or Radiograph Tested (RT). These requirements do not apply to minor welding that does not carry structural load, such as cutting teeth and tacking on bearing plates.

If significant tension loads are being considered, the Department will require the Contractor to provide data demonstrating the adequacy of the proposed detail.

The design shall limit the maximum yield stress of steel (Fy) to 600 MPa.

C. Bar Reinforcement. Provide Bar reinforcement meeting the requirements of §709-01, Bar Reinforcement Grade 420, or continuously threaded "Uncoated High-Strength Steel Bars for Prestressing Concrete" - ASTM A722.

D. Grout. Provide a pumpable grout consisting of, as a minimum, Portland Cement - Type 2 and Water meeting the following Specification requirements:

Material	Subsection
Portland Cement, Type 2	§701-01
Grout Sand	§703-04
Fly Ash	§711-10
Water	§712-01

The use of Grout Sand and Fly Ash in the mix is optional. Field sampling and testing shall be done in accordance with the current procedural directives of the Materials Bureau of the Office of Technical Services.

E. Centralizers and Spacers. Provide centralizers and spacers fabricated from schedule 40 PVC pipe, tube, steel, or material non-detrimental to the reinforcing steel. Wood shall not be used.

CONSTRUCTION DETAILS

Engage a professional engineer, licensed and registered to practice in New York State, to design the piles in accordance with NYSDOT LRFD Bridge Design Specifications Article 10.9 *Micropiles* for LRFD design and FHWA's *Micropile Design and Construction, Reference Manual*, Publication No. FHWA-NHI-05-039 for ASD design. The Contractor's Engineer shall design the piles to perform satisfactorily for both structural and geotechnical requirements. The Contractor's Engineer shall design the diameter, length, reinforcement, pile connections, grout strengths, and grouting pressures, and select the equipment, procedures and methods so that each pile meets the pile acceptance criteria, can provide the required structural and geotechnical resistances, and meet other requirements indicated in the contract documents.

Progress all micropiles using steel drill casing.

The Contractor performing the work described in this specification shall submit proof of the following:

1. Experience in the construction and load testing of micropiles, having successfully constructed at least 5 projects in the last 5 years involving construction totaling at least 100 micropiles of similar resistances to those required in the contract documents.

2. The proposed On-Site Supervisor for this work having supervised the successful installation of micropiles on at least 3 projects of similar scope over the past 5 years.

A. Submittals. Submit the design and method-of-installation information outlined below to the Engineer for approval by the Deputy Chief Engineer Structures (DCES). The DCES will require 20 work days to review the submittal. Do not begin work prior to receiving approval by the DCES. Approval of the installation method by the DCES does not constitute a guarantee of acceptable pile installations. Acceptable installations are the responsibility of the Contractor.

Include in the submittal:

1. Pile computations and details for each required load case including, but not limited to, nominal diameter, length, reinforcement, pile connections, post grout tube and grouting pressures.
2. Details of equipment for pile installation.
3. Details of the general procedures for pile installation including, but not limited to, installation sequence and the approximate time required for each sequence step. Actual sequence will be agreed to in the field with the Engineer based on field conditions at the time of installation.
4. Procedures for advancing through boulders and other obstructions.
5. Procedures for containment of drilling fluid and spoil, and disposal of spoil.
6. Where applicable, drawings that show the specific work can be performed under limited headroom conditions and as close to obstructions, as site conditions warrant, to install the piles at the locations indicated in the contract documents. Provide information on the length of the casing sections to be used, as dictated by the length of the drill mast and by the available overhead clearance, and the resulting location of joints.
7. When steel drill casing/pipe is used as reinforcement, account for the reduced area of the threaded joint in the structural design of the pile, particularly for resistance in tension and bending. Identify any joint location restrictions that must be followed in construction.
8. Procedures and equipment for placing grout.
    a. Prepare the mix design for the grout and obtain documentation from an independent laboratory showing the following:
        i. The mix design conforms to the submitted mix and meets the strength requirements set by the Contractor.
        ii. The compressive strength of the mix, tested at 3, 7, 14, and 28 days.
        iii. The specific gravity of the mix.
    b. Identify a method for monitoring quality control of the mix. At a minimum, the Contractor shall use a Baroid Mud Balance per American Petroleum Institute (API) Recommended Practice (RP) 13B-1: Standard Procedure for Testing Water-Based Drilling Fluids, to check the specific gravity of the mixed grout prior to placement of the grout into each micropile.
    c. Provide pressure gages capable of measuring the actual grout pressures used and such that actual pressure readings are within the middle third of the gage's range.
    d. Methods and equipment for accurately monitoring and recording the grout volume and grout pressure as the grout is being placed.

9. If proposed, details of post-grouting equipment and procedures, including the method, sequence of operations and equipment required.
10. Layout drawings showing the proposed sequence of pile installation. Coordinate this sequence with the proposed phasing and scheduling.

B. Drilling and Excavation. Advance the hole using a duplex drilling method. Do not drill or flush ahead of the drill casing by more than 0.3 m. Perform drilling and excavation in such a manner as to prevent the collapse of the hole. Use of bentonite slurry is not permitted. Use of polymer slurry to remove cuttings from the cased hole must be approved by the Engineer.

If obstructions are encountered during excavation for a pile, progress through them by means of coring or a tricone roller bit or other approved method. Use of drop type impact hammers and blasting are not permitted. Use of a down-the-hole hammer may only be used when approved by the DCES.

Control the procedures and operations so as to prevent mining, damage or settlement to adjacent structures, tunnels, utilities or adjacent ground. If any mining, damage or settlement occurs, halt operations. Provide a written plan to the Engineer for review with procedures to avoid reoccurrence. Resume work only after the Engineer has approved the plan in writing. Repair all damage and settlement at no additional cost to the State.

Control the procedures and operations so as to prevent the soil at the bottom of the hole from flowing into the hole at all times during installation and cleaning out. Monitor the rate of fluid flow used to progress the holes.

Control drilling fluid and dispose of spoil in accordance with the approved procedure.

Do not progress a hole, pressure grout, or post-grout, within a radius of 5 pile diameters or 1.5 m, whichever is greater, of a micropile until the grout for that micropile has set for 24 hours or longer if a retarder is used.

C. Piles with Extended Lengths. Design and install piles with extended lengths at the locations shown on the plans. The specified tension and compression resistance derived from the soil and/or bedrock will be achieved below the elevations indicated in the contract documents.

D. Reinforcement and Post Grout Tube Placement. Provide centralizers sized to position the reinforcement within 19 mm of plan location from the center of the pile; sized to allow grout tremie pipe insertion to the bottom of the drillhole; and sized to allow grout to freely flow up the drill hole and casing and between adjacent reinforcing bars. Centralizers, spaced not to exceed 3 m, must be used to center the reinforcement for its entire length. Securely attach the centralizers to withstand installation stresses. Do not drop, but lower the steel reinforcement to its specified location in the hole. If a post grout tube is used, attach it to the steel reinforcement prior to lowering it.

E. Grout Placement and Casing Removal. Provide quality control of the mix by monitoring grout quality. Measure grout consistency by determining grout density per API Recommended Practice (RP) 13B-1 by the *Baroid Mud Balance Test* at a frequency, of at least one test per micropile, and provide the information to the inspector.

The Engineer will perform quality assurance of the mix in accordance with the Geotechnical Engineering Manual (GEM-25) *Micropile Inspector Guidelines* and the Materials Test Method No. NY 701-19E *Grout Cube Molding Procedure*.

Place grout by means of a tremie pipe from the bottom of the pile upward. Record the initial volume of grout required to fill the hole. Record grouting pressure and volume of grout being pumped into the pile during pressure grouting. Upon completion, maintain the grout level at or above the pile cut off elevation until the grout has set.

Locate the grout pressure and volume measuring gages at the pile installation site so that they are accessible and legible to the inspector.

F. Post Grouting. Provide the equipment and materials to perform post grouting. Perform post grouting after the grout has reached initial set. Record the pressure at which the grout was pumped, the total volume pumped, and the volume pumped through each port (if applicable).

G. Construction Tolerances. Install the piles so that the center of each micropile does not vary from the plan location by more than 75 mm. Do not allow the micropile to vary from the vertical or established batter by more than 20 mm per meter, as measured above ground.

Cut off the top of the pile at the elevation indicated in the contract documents.

If the soil at the pile tip is post grouted, monitor the elevation of the pile top during post grouting. If movement occurs, the Engineer will immediately notify the DCES.

H. Pile Acceptance Criteria

1. Pile meets Construction Tolerance criteria.
2. Pile was installed in accordance with the approved submittal.
3. Pile is not damaged.
4. Pile was installed using the same method, grout volumes, and pressures as the accepted test pile, if applicable.

I. Unacceptable Piles. Unacceptable piles are piles which do not meet the acceptance criteria identified in Paragraph H above.

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Submit to the Engineer a written plan of remedial action, for approval by the DCES, showing how to correct the problem and prevent its reoccurrence. Repair, augment, or replace the unacceptable pile in accordance with the approved remedial plan at no additional cost to the State.

METHOD OF MEASUREMENT

This work will be measured as the number of acceptable micropiles installed.

BASIS OF PAYMENT

The unit price bid shall include the cost of the design of the micropiles and furnishing all labor and materials necessary to satisfactorily complete the work. Micropiles that fail to meet the acceptance criteria will be rejected and no payment will be made for these piles. Furnishing equipment for installing micropiles will be paid for separately under the appropriate item.

Payment will be made under:

Item No.	Item	Pay Unit
551.9946--17	Micropiles (Contractor Designed)	Each
551.9947--17	Micropiles (Contractor Designed) – With Extended Lengths	Each