



**SPECIAL PROVISIONS
FOR
MICROPILE RETAINING WALL**

Hardin County
BRFN-065-6(42)--39-42

Effective Date

July 20, 2010

THE STANDARD SPECIFICATIONS, SERIES OF 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

090076.01 DESCRIPTION.

This work shall consist of constructing a micropile retaining wall as shown on the contract plans and approved working drawings and as specified herein. The micropile specialty Contractor is responsible for furnishing of all design, materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques required for design, installation and testing of micropiles and pile top attachments for this project.

The micropile Contractor may propose an alternative micropile design that meets the requirements set forth in these specifications and plans.

The micropile Contractor shall select and provide the micropile type, size, pile top attachment, installation means and methods, the required rock embedment length and final micropile details. The micropile load capacities shall be verified by a lateral load test, as required, and must meet the deflection criteria specified on the plans.

The Contractor shall be responsible for vibration and crack monitoring during demolition/construction activities near vulnerable structures. Refer to Special Provisions for Vibration Monitoring for requirements.

A. MICROPILE CONTRACTOR'S EXPERIENCE REQUIREMENTS AND SUBMITTALS.

The micropile Contractor shall be experienced in the construction and load testing of micropiles and have at least 10 years experience and constructed at least five projects of similar size and capacity to those required in these plans and specifications.

The Contractor shall have previous micropile drilling and grouting experience in soil / rock similar to project conditions. The Contractor shall submit construction details, structural details and load test results for at least three previous successful micropile load tests from different projects of similar scope to this project.

The Contractor shall assign a supervising project engineer to supervise the work with experience on at least three projects of similar scope to this project completed over the past 5 years. The Contractor shall not use consultants or manufacturers' representatives to satisfy the supervising engineer requirements of this section. The on-site foremen and drill rig operators shall also have experience on at least three projects over the past 5 years installing micropiles/pre-bored pile retaining wall structures.

If modifications to the micropile design are proposed, the micropiles shall be designed by a Professional Engineer licensed in the State of Iowa with experience in the design of at least three successfully completed micropile projects over the past 5 years, with micropiles of similar capacity to those required in these plans and specifications. The micropile design engineer may be either an employee of the Contractor or a separate consultant design engineer meeting the stated experience requirements.

At least 45 calendar days before the planned start of micropile construction, the Contractor shall submit 5 copies of the completed project reference list and a personnel list. The project reference list shall include a brief project description with the owner's name and current phone number and load test reports. The personnel list shall identify the micropile system design engineer (if applicable), supervising project engineer, drill rig operators, and on-site foremen to be assigned to the project. The personnel list shall contain a summary of each individual's experience and be complete enough for the Engineer to determine whether each individual satisfies the required qualifications. The Engineer will approve or reject the Contractor's qualifications within 15 calendar days after receipt of a complete submission. Additional time required due to incomplete or unacceptable submittals will not be cause for time extension or impact or delay claims. All costs associated with incomplete or unacceptable submittals shall be borne by the Contractor.

Work shall not be started, nor materials ordered, until the Engineer's written approval of the Contractor's experience qualifications is given. The Engineer may suspend the work if the Contractor uses non-approved personnel. If work is suspended, the Contractor shall be fully liable for all resulting costs and no adjustment in contract time will result from the suspension.

B. RELATED SPECIFICATIONS.

None.

C. DEFINITIONS.

1. Admixture:

Substance added to the grout to control bleed and / or shrinkage, improve flowability, reduce water content, or retard setting time.

2. Alignment Load (AL):

A minimum initial load (no greater than 10% of the Design Load) applied to micropile during testing to keep the testing equipment correctly positioned.

3. Bond Length:

The length of the micropile that is bonded to the ground and used to transfer the applied axial loads to the surrounding soil or rock.

4. Bond-Breaker:

A sleeve placed over the steel reinforcement to prevent load transfer.

- 5. Casing:**
Steel tube introduced during the drilling process in overburden soil to temporarily stabilize the drill hole. This is usually withdrawn as the pile is grouted, although in certain types of micropiles, some casing is permanently left in place to provide added pile reinforcement.
- 6. Centralizer:**
A device to support and position the reinforcing steel in the drill hole and / or casing so that a minimum grout cover is provided.
- 7. Contractor:**
The person / firm responsible for performing the micropile work.
- 8. Coupler:**
The means by which load capacity can be transmitted from one partial length of reinforcement to another.
- 9. Creep Movement:**
The movement that occurs during the creep test of a micropile under constant load.
- 10. Design Load (DL):**
The maximum load expected to be applied to the micropile during its service life.
- 11. Encapsulation:**
A corrugated or deformed tube protecting the reinforcing steel against corrosion.
- 12. Engineer:**
The Department or Department's authorized representative.
- 13. Free (Unbonded) Length:**
The designed length of the micropile that is not bonded to the surrounding ground or grout.
- 14. Micropile:**
A small-diameter, bored, cast-in-place composite pile in which the applied load is resisted by steel reinforcement, cement grout and frictional grout / ground bond.
- 15. Maximum Test Load:**
The maximum load to which the micropile is subjected during testing.
- 16. Overburden:**
Soil material, natural or placed, that may require cased drilling methods to provide an open borehole to underlying strata.
- 17. Post-Grouting:**
The injection of additional grout into the load transfer length of a micropile after the primary grout has set. Also known as regrouting or secondary grouting.
- 18. Primary Grout:**
Portland-cement-based grout injected into the micropile hole prior to or after the installation of the reinforcement to direct the load transfer to the surrounding ground along the micropile.
- 19. Reinforcement:**
The steel component of the micropile that accepts and / or resists applied loadings.

20. Sheathing:

Smooth or corrugated piping or tubing that protects the reinforcing steel against corrosion.

21. Spacer:

A device to separate elements of a multiple-element reinforcement.

22. Supervising Project Engineer

The Contractor's engineer, either an employee or consultant, that is assigned to supervise the design and construction of the micropiles.

23. Ultimate Grout-to-Ground Bond Values:

The estimated ultimate geotechnical unit grout-to-ground bond strength selected for use in design.

24. Lateral Load Test:

Lateral pile load test performed to verify the design of the pile system and the construction methods proposed, prior to installation of production piles.

D. REFERENCED CODES AND STANDARDS.

The following publications form a part of this specification to the extent indicated by the references. The latest publication as of the issue date of this specification shall govern, unless indicated otherwise.

1. American Society for Testing and Materials (ASTM) and American Association of State Highway and Transportation Officials (AASHTO).

| ASTM | AASHTO | Specification/Test |
|-----------|------------|--|
| A36, A572 | M183, M223 | Structural Steel |
| A82 | M55 | Cold-Drawn Steel Wire for Concrete Reinforcement |
| A123 | - | Zinc Coatings on Iron and Steel |
| A143 | - | Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel |
| A252 | - | Welded and Seamless Steel Pipe Piles |
| A384 | - | Safeguarding Against Warping and Distortion During Hot-Dip Galvanizing of Steel Assemblies |
| A385 | - | Providing High-Quality Zinc Coatings |
| A615 | M31 | Deformed and Plain Billet Steel Bars for Concrete Reinforcement |
| A722 | M275 | Uncoated High-Strength Steel Bar for Prestressing Concrete |
| A775 | - | Epoxy-Coated Reinforcing Steel Bars |
| A934 | - | Epoxy-Coated Prefabricated Steel Reinforcing Bars |
| C33 | M80 | Concrete Aggregates |
| C109 | T106 | Compressive Strength of Hydraulic Cement Mortar |
| C188 | T133 | Density of Hydraulic Cement |
| C144 | M45 | Aggregate for Masonry Mortar |

| | | |
|-------|------|--|
| C150 | M85 | Portland Cement |
| C494 | M194 | Chemical Admixtures for Concrete |
| D1143 | - | Method of Testing Piles Under Static Axial Compressive Load |
| D1784 | - | Polyvinyl Chloride (PVC) Pipe (Class 13464-B) |
| D3350 | M252 | Polyethylene Corrugated Tubing |
| D3689 | - | Method of Testing Individual Piles Under Static Axial Tensile Load |
| D3966 | | Standard Test Method for Deep Foundations Under Lateral Load |
| - | T26 | Quality of Water to be Used in Concrete |

2. American Welding Society (AWS).

D1.1 Structural Welding Code-Steel

D1.4 Structural Welding Code-Reinforcing Steel

3. American Petroleum Institute (API).

5CT(N-80) Specification for Casing and Tubing

RP 13B-1 Recommended Practice – Standard Procedure for Field Testing Water Based Drilling Fluids

E. AVAILABLE INFORMATION.

Available information developed by the Engineer, or by Contractor includes the following geotechnical reports by Terracon:

- “Geotechnical Engineering Report for Preliminary Design of the Proposed US 65 Arch Bridge over the Iowa River, Iowa Falls, Iowa,” dated April 15, 2008.
- “Review of Proposed Bond Stress for Micropile Design, US 65 Arch Bridge over Iowa River, Iowa Falls, Iowa,” dated April 17, 2009.
- “Design Memorandum, US 65 Oak Street Bridge over the Iowa River, Iowa Falls, Iowa,” dated July 29, revised August 3, 2009.

F. CONSTRUCTION SITE SURVEY.

Before bidding the work, the Contractor shall review the available subsurface information and visit the site to assess the site geometry, equipment access conditions, and location of existing structures and above ground facilities.

The Contractor is responsible for field locating and verifying the location of all utilities shown on the plans prior to starting the Work. Maintain uninterrupted service for those utilities designated to remain in service throughout the work. Notify the Engineer of any utility locations different from shown on the plans that may require micropile relocations or structure design modification. Subject to the Engineer’s approval, additional cost to the Contractor due to micropile relocations and / or structure design modification resulting from utility locations different from shown on the plans will be paid as extra work.

Prior to start of any micropile construction activity, the Contractor and Engineer shall jointly inspect the site to observe and document the pre-construction condition of the site, existing structures and facilities.

G. CONSTRUCTION SUBMITTALS.

The Contractor shall prepare and submit to the Engineer, for review of completeness, seven copies of the following for the micropile system or systems to be constructed:

1. Detailed step-by-step description of the proposed micropile construction procedure, including personnel, testing and equipment to assure quality control. This step-by-step procedure shall be shown on the working drawings in sufficient detail to allow the Engineer to monitor the construction and quality of the micropiles.
2. Proposed start date and time schedule and micropile installation schedule providing the following:
 - Micropile Number
 - Micropile Design Load
 - Type and Size of Reinforcing Steel
 - Minimum Grouted Length
 - Total Micropile Length
 - Micropile to Precast Panel Attachment
3. Submit the proposed welding procedure, including a test weld to qualify procedure, by a qualified welding specialist.
4. Information on headroom and space requirements for installation equipment that verify the proposed equipment can perform at the site.
5. Plan describing how surface water, drill flush, and excess waste grout will be controlled and disposed.
6. Certified mill test reports for the reinforcing steel or coupon test results for permanent casing without mill certification. The ultimate strength, yield strength, elongation, and material properties composition shall be included. For API N-80 pipe casing, coupon test results may be submitted in lieu of mill certification.
7. Proposed Grouting Plan. The grouting plan shall include complete descriptions, details, and supporting calculations for the following:
 - a. Grout mix design and type of materials to be used in the grout, including certified test data and trial batch reports.
 - b. Methods and equipment for accurately monitoring and recording the grout depth, grout volume and grout pressure as the grout is being placed.
 - c. Grouting rate calculations, when requested by the Engineer. The calculations shall be based on the initial pump pressures or static head on the grout and losses throughout the placing system, including anticipated head of drilling fluid (if applicable) to be displaced.
 - d. Estimated curing time for grout to achieve specified strength. Previous test results for the proposed grout mix completed within one year of the start of grouting may be submitted for initial verification and acceptance and start of production work. During production, grout shall be tested in accordance with Grout Testing section.
 - e. Procedure and equipment for Contractor monitoring of grout quality.

H. PRE-CONSTRUCTION MEETING.

A pre-construction meeting will be scheduled by the Engineer and held prior to the start of micropile construction. The Engineer, prime Contractor, micropile specialty Contractor, micropile design engineer, excavation Contractor and geotechnical instrumentation specialist (if applicable) shall attend the meeting. Attendance is mandatory. The pre-construction meeting will be conducted to clarify the construction requirements for the work, to coordinate the construction schedule and activities, and to identify contractual relationships and delineation of responsibilities amongst the prime Contractor and the various

Subcontractors—specifically those pertaining to excavation for micropile structures, anticipated subsurface conditions, micropile installation and testing, micropile structure survey control and site drainage control.

090076.02 MATERIALS.

Furnish materials new and without defects. Remove defective materials from the jobsite at no additional cost. Materials for micropiles shall consist of the following:

A. ADMIXTURES FOR GROUT:

Admixtures shall conform to the requirements of ASTM C494 / AASHTO M194. Admixtures that control bleed, improve flowability, reduce water content, and retard set may be used in the grout, subject to the review and acceptance of the Engineer. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations. Expansive admixtures shall only be added to the grout used for filling sealed encapsulations and anchorage covers. Accelerators are not permitted. Admixtures containing chlorides are not permitted.

B. CEMENT:

All cement shall be Portland cement conforming to ASTM C150 / AASHTO M85, Types I, II, III or V.

C. CENTRALIZERS AND SPACERS:

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

D. ENCAPSULATION:

If used, encapsulation (double corrosion protection) shall be shop fabricated using high-density, corrugated polyethylene tubing conforming to the requirements of ASTM D3350 / AASHTO M252 with a nominal wall thickness of 0.003 inch. The inside annulus between the reinforcing bars and the encapsulating tube shall be a minimum of 0.2 inch and be fully grouted with non-shrink grout conforming to Materials Section.

E. EPOXY COATING:

The minimum thickness of coating applied electrostatically to the reinforcing steel shall be 0.01 inch. Epoxy coating shall be in accordance with ASTM A775 or ASTM A934. Bend test requirements are waived. Bearing plates and nuts encased in the pile concrete footing need not be epoxy coated unless the footing reinforcement is epoxy coated.

F. FINE AGGREGATE:

If sand / cement grout is used, sand shall conform to ASTM C144 / AASHTO M45.

G. GALVANIZATION:

Galvanization shall meet the requirements of ASTM A123, ASTM A153, and ASTM A385. Contractor shall notify fabricator and galvanizer of the project requirements. Galvanized pipe piles will be exposed to plastic/wet Portland cement grout. Repair of galvanization shall be in accordance with IM 410.

H. GROUT:

Neat cement or sand / cement mixture with a minimum 3 day compressive strength of 2000 psi and a 28 day compressive strength of 4000 psi per AASHTO T106 / ASTM C109.

I. PERMANENT CASING PIPE:

Permanent steel casing / pipe shall have the diameter and at least minimum wall thickness shown on the approved working drawings. The permanent steel casing / pipe:

1. Shall meet the Tensile Requirements of API N80, Grade3, or C; the yield strength shall be at least 45 ksi as used in the design submittal.
2. May be new "Structural Grade" (also known as "Mill Secondary") steel pipe meeting above but without Mill Certification, free from defects (dents, cracks, tears) and with two coupon tests per truckload delivered to the fabricator.

For permanent casing / pipe that will be welded for structural purposes, the following material conditions apply:

1. The carbon equivalency (CE) as defined in AWS D1.1, Section X15.1, shall not exceed 0.45, as demonstrated by mill certifications.
2. The sulfur content shall not exceed 0.05%, as demonstrated by mill certifications.

For permanent casing / pipe that will be shop or field welded, the following fabrication or construction conditions apply:

1. The steel pipe shall not be joined by welded lap splicing.
2. Welded seams and splices shall be complete penetration welds.
3. Partial penetration welds may be restored in conformance with AWS D1.1.
4. The proposed welding procedure certified by a welding specialist shall be submitted for approval.
5. A test weld shall be performed to qualify procedures.

Threaded casing joints shall develop at least the required compressive, tensile, and / or bending strength used in the design of the micropile.

J. PLATES AND SHAPES:

Structural steel plates and shapes for pile top attachments shall conform to ASTM A709 / AASHTO M270, Grade 50.

K. REINFORCING BARS:

If used, reinforcing steel shall be deformed bars in accordance with ASTM A615 / AASHTO M31, of appropriate Grade. When a bearing plate and nut are required to be threaded onto the top end of reinforcing bars for the pile top to footing anchorage, the threading may be continuous spiral deformed ribbing provided by the bar deformations (for example, Dywidag or Williams continuous threadbars) or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, the next larger bar number designation from that shown on the Plans shall be provided, at no additional cost.

Bar tendon couplers, if required, shall develop the ultimate tensile strength of the bars without evidence of any failure.

L. REINFORCING BAR CORROSION PROTECTION:

The corrosion protection shall be as indicated on the plans.

M. SHEATHING:

Smooth plastic sheathing, including joints, shall be watertight. Polyvinyl chloride (PVC) sheathing shall conform to ASTM D1784, Class 13464-B.

N. WATER:

Water used in the grout mix shall conform to AASHTO T26 and shall be potable, clean, and free from substances that may be injurious to cement and steel.

090076.03 CONSTRUCTION REQUIREMENTS.**A. SITE DRAINAGE CONTROL.**

The Contractor shall control and properly dispose of drill flush and construction related waste, including excess grout, in accord with the standard specifications and all applicable local codes and regulations. Provide positive control and discharge of all surface water that will affect construction of the micropile installation. Maintain all pipes or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost. Upon substantial completion of the work, remove surface water control pipes or conduits from the site. Alternatively, with the approval of the Engineer, pipes or conduits that are left in place, may be fully grouted and abandoned or left in a way that protects the structure and all adjacent facilities from migration of fines through the pipe or conduit and potential ground loss.

Immediately contact the Engineer if unanticipated existing subsurface drainage structures are discovered during excavation or drilling. Suspend work in these areas until remedial measures meeting the Engineer's approval are implemented. Cost of remedial measures or repair work resulting from encountering unanticipated subsurface drainage structures will be paid for as extra work.

B. EXCAVATION.

Coordinate the work and the excavation so the micropile structures are safely constructed. Perform the micropile construction and related excavation in accordance with the plans and approved submittals. No excavations will be made above or below the micropile structure locations without written approval of the Engineer.

C. MICROPILE ALLOWABLE CONSTRUCTION TOLERANCES.

1. Centerline of piling shall not be more than 1 inch from indicated plan location.
2. Pile shall be installed to the inclinations shown on the plans within 1% of total-length plan alignment.
3. Top elevation of pile shall be plus 0 inch or minus 1 inch maximum from vertical elevation indicated.
4. Centerline of reinforcing steel shall not be more than 0.75 inch from indicated location.

D. MICROPILE INSTALLATION.

The micropile Contractor shall select the drilling method, the grouting procedure, and the grouting pressure used for the installation of the micropiles. The micropile Contractor shall also verify the final micropile casing size, final drillhole diameter and bond length, and central reinforcement steel sizing necessary to develop the specified load capacities and load testing requirements. The micropile Contractor is also responsible for estimating the grout take. There will be no extra payment for grout overruns.

1. Drilling.

The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, without causing damage to any overlying or adjacent structures or services. The drillhole must be open along its full length to at least the design minimum drillhole diameter prior to placing grout and reinforcement.

Drilling should not be performed adjacent to a recently installed micropile for a period of at least 24 hours or adjacent to unset grout, whichever is period longer, to avoid damage to any of the micropiles and grout.

Temporary casing or other approved method of pile drillhole support will be required in caving or unstable ground to permit the pile shaft to be formed to the minimum design drillhole diameter. The Contractor's proposed method(s) to provide drillhole support and to prevent detrimental ground movements shall be reviewed by the Engineer. Detrimental ground movement is defined as movement which requires remedial repair measures. Use of drilling fluid containing bentonite is not allowed.

Costs of removal or remedial measures due to encountering unanticipated subsurface obstructions will be paid for as extra work.

2. Ground Heave or Subsidence.

During construction, the Contractor shall observe the conditions in the vicinity of the micropile construction site on a daily basis for signs of ground heave or subsidence. Immediately notify the Engineer if signs of movements are observed. Contractor shall immediately suspend or modify drilling or grouting operations if ground heave or subsidence is observed, if the micropile structure is adversely affected, or if adjacent structures are damaged from the drilling or grouting. If the Engineer determines that the movements require corrective action, the Contractor shall take corrective actions necessary to stop the movement or perform repairs. When due to the Contractor's methods or operations or failure to follow the specified / approved construction sequence, as determined by the Engineer, the costs of providing corrective actions will be borne by the Contractor. When due to differing site conditions, as determined by the Engineer, the costs of providing corrective actions will be paid as extra work.

3. Pipe Casing and Reinforcing Bars Placement and Splicing.

Reinforcement may be placed either prior to grouting or placed into the grout-filled drillhole before temporary casing (if used) is withdrawn. Surfaces of the reinforcement (bars and casings) shall be free of deleterious substances, such as soil, mud, grease or oil that might contaminate the grout or coat the reinforcement and impair bond. Pile cages and reinforcement groups, if used, shall be sufficiently robust to withstand the installation and grouting process and the withdrawal of the drill casings without damage or disturbance.

The Contractor shall check pile top elevations and adjust all installed micropiles to the planned elevations.

Centralizers and spacers (if used) shall be provided at 10 foot centers maximum spacing. The upper and lower most centralizer shall be located a maximum of 5 feet from the top and bottom of the micropile. Centralizers and spacers shall permit the free flow of grout without misalignment of the reinforcing bar(s) and permanent casing. The central reinforcement bars with centralizers shall be lowered into the stabilized drillhole and set. The reinforcing steel shall be inserted into the drill hole to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole. Contractor shall redrill and reinsert reinforcing steel when necessary to facilitate insertion.

Lengths of casing and reinforcing bars to be spliced shall be secured in proper alignment and in a manner to avoid eccentricity or angle between the axes of the two lengths to be spliced. Splices and threaded joints shall meet the requirements of Materials Section. Threaded pipe casing joints shall be located at least two casing diameters (OD) from a splice in any reinforcing bar. When multiple bars are used, the bar splices shall be staggered at least 1 foot.

4. Grouting.

Micropiles shall be primary grouted the same day the load transfer bond length is drilled. The Contractor shall use a stable neat cement grout or a sand cement grout with a minimum 28 day unconfined compressive strength of 4000 psi. Admixtures, if used, shall be mixed in accordance with manufacturer's recommendations. The grouting equipment used shall produce a grout free of lumps and undispersed cement. The Contractor shall have means and methods of measuring the grout quantity and pumping pressure during the grouting operations. The grout pump shall be equipped with a pressure gauge to monitor grout pressures. A second pressure gauge shall be placed at the point of injection into the pile top. The pressure gauges shall be capable of measuring pressures of at least 150 psi or twice the actual grout pressures used, whichever is greater. The grout shall be kept in agitation prior to mixing. Grout shall be placed within one hour of mixing. The grouting equipment shall be sized to enable each pile to be grouted in one continuous operation.

The grout shall be injected from the lowest point of the drill hole and injection shall continue until uncontaminated grout flows from the top of the pile. The grout may be pumped through grout tubes, casing, hollow-stem augers, or drill rods. Temporary casing, if used, shall be extracted in stages ensuring that after each length of casing is removed, the grout level is brought back up to the ground level before the next length is removed. The tremie pipe or casing shall always extend below the level of the existing grout in the drillhole. The grout pressures and grout takes shall be controlled to prevent excessive heave or fracturing of rock or soil formations. Upon completion of grouting, the grout tube may remain in the hole, but must be filled with grout.

Grouting shall be performed in accordance with ACI 306R during cold weather. Grout within the micropiles shall be allowed to attain the required design strength prior to being loaded.

If the Contractor elects to use a postgrouting system, working drawings and details shall be submitted to the Engineer for review.

5. Grout Testing.

Grout within the micropile lateral load test pile shall attain the minimum required 3 day compressive strength of 2000 psi prior to load testing. Previous test results for the proposed grout mix completed within one year of the start of work may be submitted for initial verification of the required compressive strengths for installation of pre-production lateral load test pile and initial production piles. During production, micropile grout shall be tested by the Contractor for compressive strength in accordance with AASHTO T106 / ASTM C109 at a frequency of no less than one set of three 2 inch grout cubes from each grout plant each day of operation or per every 10 piles, whichever occurs more frequently. The compressive strength shall be the average of the three cubes tested.

Grout consistency, as measured by grout density, shall be determined by the Contractor per ASTM C188 / AASHTO T133 or API RP-13B-1 at a frequency of at least one test per day, conducted just prior to start of pile grouting. The Baroid Mud Balance used in accordance with API RP-13B-1 is an approved device for determining the grout density of neat cement grout.

The Department or its authorized representative shall take grout samples directly from the grout plant.

E. MICROPILE INSTALLATION RECORDS.

Contractor shall prepare and submit to the Engineer full-length installation records for each micropile installed. The records shall be submitted within one work shift after that pile

installation is completed. The data shall be recorded on the micropile installation log. A separate log shall be provided for each micropile.

F. WELDING OF GALVANIZED STEEL SECTIONS.

Galvanizing shall be removed in areas to be field welded by grinding or chemical means prior to welding. Approximately 2 inches of zinc shall be removed in the area of welds. Surfaces shall be cleaned prior to welding.

Contractor shall perform a test weld of a galvanized WT section to a galvanized pipe section to demonstrate and qualify the procedure prior to any welding of sections for the micropile retaining wall.

090076.04 METHOD OF MEASUREMENT.

Measurement will be made as follows for the quantity, as specified or directed by the Engineer:

- The installed micropiles for the retaining wall will be measured on a linear foot basis.
- The constructed micropile retaining wall will be measured on a square foot basis.
- Micropile Lateral Load Test for Micropile Retaining Wall will be measured per each.

The final pay quantities will be the design quantity increased or decreased by any changes authorized by the Engineer.

090076.05 BASIS OF PAYMENT.

The quantities accepted for payment will be paid for at the contract unit prices for the following items:

| Pay Item | Unit |
|--|-------------|
| Micropiles for Retaining Wall | Linear Foot |
| Micropile Retaining Wall | Square Foot |
| Micropile Lateral Load Test for Retaining Wall | Each |

The contract unit price for the Micropiles for Retaining Wall pay item will be full and complete payment for providing all design, materials, labor, equipment, and incidentals to furnish and install the micropiles. The Unit contract amount for the Micropiles for Retaining Wall shall include the drilling, removal of drilling spoils, drilling fluids, and excess grout to a pre-determined off-site location, furnishing, and placing the casing, grouting, pile to precast concrete lagging attachments, and repair of galvanized steel sections. The micropile Contractor is also responsible for estimating the grout take. There will be no extra payment for grout overruns, or overhaul for disposal of drilling spoils, rock, stone, organic material, or soil.

The contract unit price for the Micropile Retaining Wall pay item will be full and complete payment for providing all design, materials, labor, equipment, and incidentals to furnish and install reinforced Portland cement pre-cast concrete panels. The Unit contract amount for the Micropile Retaining Wall shall include the removal of soil to shape the slope, organic material, and the existing rubble wall to a pre-determined off-site location. It shall include precast concrete lagging, geocomposite drainage material and filter fabric, and drainage backfill and placement. There will be no extra payment for overhaul for removal of rock, stone, organic material, or soil.

The contract unit price for the Micropile Lateral Load Test for Retaining Wall pay item will be full and complete payment for providing all design, materials, labor, equipment, and incidentals to furnish and install a sacrificial micropile in accordance with the production micropile plans, and design, setup, perform, document, and report the lateral load test in accordance with ASTM D 3966 and plans. Five copies of the report shall be provided for review and acceptance by the Engineer. Upon acceptance of the load test, the contractor shall remove the test pile as indicated on the plans.