Matthew G. Bevin
Governor

COMMONWEALTHOFKENTUCKY
TRANSPORTATION CABINET
Frankfort,Kentucky40622
www.transportation.ky.gov/

Greg Thomas
Secretary

October 23, 2019

CALL NO. 101
CONTRACT ID NO. 191056
ADDENDUM # 2

Subject: MASON COUNTY, STP BRO 5462(028)
Letting October 25, 2019

(1)Revised - Special Notes - Pages 21-32(a) of 111

Proposal revisions are available at http://transportation.ky.gov/Construction-Procurement/.

If you have any questions, please contact us at 502-564-3500.

Sincerely,

Rachel Mills, P.E.
Director
Division of Construction Procurement

RM:mr
Enclosures

SPECIAL NOTE FOR MICROPILES
US 68 BRIDGE OVER LAWRENCE CREEK
MASON COUNTY ITEM NO. 9-1095.00

1.0 DESCRIPTION. This work shall consist of constructing micropiles as shown on the Plans, accepted working drawings and approved shop drawings and as specified herein. The micropile specialty Contractor is responsible for furnishing all required working\shop drawings, materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques required for installation and testing of micropiles and pile top attachments for this project. The micropile load capacities shall be verified by verification and proof load testing as required and must meet the test acceptance criteria specified herein. Section references herein are to the Department's 2019 Standard Specifications for Road and Bridge Construction.

2.0 MATERIALS.

2.1 Admixtures for Grout. Conform to Section 802. 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. Accelerators are not permitted.

2.2 Cement. Conform to Section 801. Use types I, II, III or V

2.3 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.

2.4 Epoxy Coating. Conform to subsection 811.10. 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.

2.5 Fine Aggregate. If sand / cement grout is used, sand shall conform to Section 804.

2.6 Grout. Neat cement or sand / cement mixture with a minimum 28-day compressive strength of 5,000 psi per AASHTO T106/ASTM C109, unless shown otherwise on the Plans.

2.7 Permanent Casing. Permanent steel casing / pipe shall have the diameter and at least minimum wall thickness shown on the Plans. The permanent steel casing / pipe:

1) shall meet the Tensile Requirements of ASTM A252, Grade 3, except the yield strength shall be a minimum of 80 ksi, unless shown otherwise on the plans.
2) may be new "Structural Grade" (a.k.a. "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.

Where allowed on the Plans, flush threaded casing joints shall be completely shouldered with no stripped threads.

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

2.9 Reinforcing Bars. Reinforcing steel shall be deformed bars in accordance with ASTM A615/AASHTO M31, Grade 60 or Grade 75 or ASTM A722/AASHTO M275, Grade 150, as shown on the plans. 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 (e.g., 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 couplers, if required, shall develop the ultimate tensile strength of the bars without evidence of any failure.

2.10 Water. Conform to Section 803.

3.0 CONSTRUCTION.

3.1 Preconstruction.

3.1.1 Experience Requirements. The micropile Contractor shall be experienced in the construction and load testing of micropiles and have successfully constructed at least 5 projects in the last 5 years involving construction totaling at least 100 micropiles 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 an Engineer to supervise the work with experience on at least 3 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 3 projects over the past 5 years installing micropiles of equal or greater capacity than required in these plans and specifications.

At least 45 calendar days before the planned start of micropile construction, the Contractor shall submit electronically in PDF format 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 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.

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.

3.1.2 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.

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.

3.1.3 Construction Submittals. At least 21 calendar days before the planned start of micropile construction, submit to the Engineer, for review and approval, electronically in PDF format the following for the micropile system or systems to be constructed:

1) Detailed step-by-step description of the proposed micropile construction and testing procedures 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.
3) Working drawings for micropiles including items that are either not shown on the contract plans or deviations due to specific installation equipment/methods such as final bond zone drill hole diameters; splice types and locations; and reinforcing centralizers and spacers.
4) Shop drawings for all structural steel elements used in the micropiles, including the top bearing plate.
5) If welding of casing is proposed, submit the proposed welding procedure, by a qualified welding specialist.
6) Information on headroom and space requirements for installation equipment that verify the proposed equipment can perform at the site.
7) Sample micropile installation log to be used per Section 3.2.9.
8) Plan describing how surface water, drill flush, and excess waste grout will be controlled and disposed.
9) Method for measuring and determining vertical and horizontal alignment during construction. Some form of hole telemetry shall be used to measure the vertical alignment of each micropile.
10) 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.
11) 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 Section 3.2.8.

e) Procedure and equipment for Contractor monitoring of grout quality.

12) Detailed plans for the proposed micropile load testing method. This shall include all 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 Section 3.3, Pile Load Tests.

13) 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.

All drawings and calculations shall be signed and sealed by the Contractor's Professional Engineer licensed in the State of Kentucky.

Work shall not begin until the construction submittals have been received, reviewed, and accepted in writing by the Engineer. Changes or deviations from the approved submittals must be re-submitted for approval.

3.1.4 Micropile Pre-Construction Meeting. A micropile 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, and excavation contractor 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.

3.2 General Construction.

3.2.1 Site Drainage Control. The Contractor shall control and properly dispose of drill flush and construction related waste, including excess grout, in accordance 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.

3.2.2 Excavation. Coordinate the work and the excavation so the micropiles are safely constructed. Perform the micropile construction and related excavation in accordance with the Plans and approved submittals. No excavations steeper than those specified herein or shown on the Plans will be made above or below the micropile structure locations without written approval of the Engineer.

3.2.3 Micropile Allowable Construction Tolerances. Centerline of piling shall not be more than 3 inches from indicated plan location. Pile shall be plumb within 1

percent of total-length plan alignment. Top elevation of pile shall be plus 1 inch or minus 2 inches maximum from vertical elevation indicated. Centerline of reinforcing steel shall not be more than 3/4 inch from indicated location.

3.2.4 Micropile Installation. Unless shown otherwise on the Plans, the micropile Contractor shall propose the drilling method, the grouting procedure, and the grouting pressure used for the installation of the micropiles, subject to approval by the Engineer. Final approval of this proposed method is contingent upon the satisfactory results of the verification load tests. The micropile Contractor shall also determine the final bond zone drill hole diameter for the selected drilling equipment, and central reinforcing sizing for test piles. The final drill hole diameter shall not be less than that shown on the Plans. The micropile Contractor is also responsible for estimating the grout take. There will be no extra payment for grout overruns.

3.2.5 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. Upon drilling completion ensure drill cuttings and/or other loose debris is removed from the bottom of the hole. The drill hole must be open along its full length to at least the design minimum drill hole diameter prior to placing grout and reinforcement. Develop methods of stabilizing borehole that do not have a deleterious effect on the grout-to-ground bond development. All installation techniques shall be determined and scheduled such that there will be no interconnection or damage to piles in which grout has not achieved final set. Use of drilling fluid containing bentonite is not allowed.

3.2.6 Hole Telemetry. Upon advancing the micropile to the bedrock surface and prior to advancing the micropile into the bond zone, the Contractor shall measure the vertical alignment of the cased section of each micropile using a method of hole telemetry that is approved by the Department. Where the micropile is determined to be out of tolerance, the out-of-tolerance hole shall be grouted and the micropile redrilled. There will be no extra payment for grouting and redrilling out-of-tolerance micropiles, except if the existing H-piles cause the micropile to deviate from the acceptable vertical tolerances.

3.2.7 Pipe Casing and Reinforcing Bar Placement and Splicing. Reinforcement shall be placed into the drill hole prior to grouting. Reinforcement surface 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.

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

Centralizers and spacers shall be provided at 10-foot centers maximum spacing. The upper and lower most centralizer shall be located a maximum of 2 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 2.0. 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.

3.2.8 Grouting. Micropiles shall be fully grouted the same day the load transfer bond length is drilled. 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 constant agitation prior to pumping. 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.

Tremie grout from the lowest point of the drill hole 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. All grouting operations, including tremie grout pumping, casing extraction and subsequent pressure grouting operations, must ensure complete continuity of the grout column. 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.

Grout within the micropiles shall be allowed to attain the required design strength prior to being loaded.

If the Contractor elects to use a post-grouting system, Working Drawings and details shall be submitted to the Engineer for review in accordance with Section 3.1.3, Construction Submittals.

3.2.9 Grout Testing. Grout within the micropile verification and proof test piles shall attain the required minimum 28-day compressive strength shown on the Plans 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 verification test 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~~ nine 2-inch grout cubes from each grout plant each day of operation or per every 10 piles, whichever occurs more frequently. At a minimum, compressive strength tests shall be taken at 3, 7 and 28 days after grouting. For each time interval, the compressive strength shall be the average of ~~the set of~~ 3 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 pile, 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.

Grout samples shall be taken directly from the grout plant. Provide grout cube compressive strength and grout density test results to the Engineer within 24 hours of testing.

3.2.10 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 records shall include the following minimum information:

1) Reference number of micropile
2) Date and time begun and completed for both drilling and grouting
3) Equipment used and operator
4) Factored Design load (compression and/or tension)
5) Micropile drilling logs indicating:
    a) penetration rates (feet depth per minute)
    b) downpressure
    c) materials encountered, including flush return description
    d) elevation of obstructions, if any
    e) elevation of karst, solutions features or voids, if any
    f) ground elevation
    g) elevation of groundwater or seepage encountered
    h) final tip elevation
    i) casing length above and below bottom of footing
    j) plunge length
    k) bond length
    l) total micropile length
    m) description of unusual installation behavior or conditions
6) grouting rates (cubic yards per feet depth)
7) grouting pressures (pounds per square inch per feet depth)
8) total grout quantities (cubic yards)
9) casing materials and dimensions
10) reinforcing material, size and lengths, and
11) compliance with tolerances.

The data shall be recorded on a micropile installation log. A separate log shall be provided for each micropile.

3.3 Pile Load Tests. Perform verification and proof testing of piles at the locations specified herein or designated by the Engineer based on the design axial load(s) as shown in the Plans. Perform tension load testing in accordance with ASTM D3689, except as modified herein. The load test shall be performed in tension regardless of load direction.

3.3.1 Testing Equipment and Data Recording. Testing equipment shall include dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, 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.

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.

Apply and measure the test load with a hydraulic jack and pressure gauge, or load cell when present. 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 tests 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.

Measure the pile top movement with a dial gauge capable of measuring to 0.001 inch. 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.

Production piles may be utilized as reaction piles for proof tests. The Contractor is responsible for any modifications to the production piles to facilitate testing. No additional payment will be made to repair or replace damaged production piles utilized as reaction piles. Production piles may not be utilized as reaction piles for verification tests.

3.3.2 Verification Tests. Perform pre-production verification pile load testing on sacrificial (non-production) test piles, unless noted otherwise in the Plans, to verify the design of the pile system and the construction methods proposed prior to installing any production piles. Sacrificial verification test piles shall be constructed in conformance with the Plans and the accepted Working Drawings. The number and approximate locations of verification test piles shall be as shown on the Plans.

Verification load tests shall be performed to verify that the Contractor installed micropiles will meet the required compression and tension load capacities and load test acceptance criteria and to verify that the length of the micropile bond zone is adequate. Provide the Engineer a written report confirming micropile geometry, construction, testing details, and verification test results within 7 working days following completion of the pre-production verification load tests. The micropile verification load test results must verify the design and installation methods,and be reviewed and accepted by the Engineer prior to beginning installation of production micropiles.

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

The maximum verification and proof test loads applied to the micropile shall not exceed 80 percent of the structural capacity of the micropile structural elements, to include steel yield in tension, steel yield or buckling in compression, or grout crushing in compression. Any required increase in strength of the verification test pile elements above the strength required for the production piles shall be provided for in the contractor's bid price.

The jack shall be positioned at the beginning of the test such that unloading and repositioning during the test will not be required.

3.3.3 Verification Test Loading Schedule. Test verification piles designated for tension load testing to a maximum test load equal to the required nominal geotechnical resistance, or Nominal Resistance (NR) shown on the Plans. NR is typically calculated by dividing the Factored Design Load (FDL) for the micropile by the Geotechnical Resistance Factor (Φ).

The verification pile load tests shall be made by incrementally loading the micropile in accordance with the following cyclic load schedule:

VERIFICATION TEST LOADING SCHEDULE			
STEP	**LOADING**	**APPLIED LOAD**	**HOLD TIME (Min.)**
1	Apply AL		2.5
2	Cycle 1	0.10 NR	2.5
		0.20 NR	2.5
		0.30 NR	2.5
		AL	1
3	Cycle 2	0.10 NR	1

VERIFICATION TEST LOADING SCHEDULE			
STEP	**LOADING**	**APPLIED LOAD**	**HOLD TIME (Min.)**
		0.20 NR	1
		0.30 NR	1
		0.40 NR	2.5
		0.50 NR	2.5
		AL	1
4*	Cycle 3*	0.10 NR	1
		0.50 NR	1
		0.60 NR	2.5
		0.70 NR	60 minutes (Creep Test)
		0.80 NR	2.5
		AL	1
5	Cycle 4	0.10 NR	1
		0.80 NR	1
		0.90 NR	2.5
		1.00 NR	10
		0.75 NR	5
		0.50 NR	5
		0.25 NR	5
		AL	5

AL = Alignment Load not to exceed 0.05 NR
NR = Nominal Geotechnical Resistance (As Shown on Plans)
*Loading Cycle 3 shall be repeated 5 times. During the initial 4 times of performing Loading Cycle 3, each applied load only needs to be held for 1 minute. During the fifth instance of repeating Load Cycle 5, the applied loads shall be held for the times indicated in the above schedule.

To reduce the contribution of the overburden soils on the resistance, Loading Cycle 3 of the Verification Test Loading Schedule in the project-specific "Special Note for Micropiles" shall be repeated 5 times between Loading Cycles 2 and 4. During the initial 4 times of performing Loading Cycle 3, each applied load only needs to be held for 1 minute. During the fifth instance of repeating Load Cycle 5, the applied loads shall be held for the times indicated in the referenced schedule.

Pile top movement shall be measured at each load increment relative to a fixed reference. The load-hold period shall start as soon as each test load increment is applied. The verification test pile shall be monitored for creep at the 0.70 Nominal Resistance (NR). Pile movement during the creep test shall be measured and recorded at 1, 2, 3, 4, 5, 6, 10, 20, 30, 50 and 60 minutes. The alignment load shall not exceed 5 percent of the NR load. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for micropile verification load tests are:

1) The pile shall sustain the first 0.50 NR test load (compression or tension) with no more than 1/2" total vertical movement at the top of the pile, relative to the position of the top of the pile prior to testing.
2) At the end of the 0.70 NR creep test load increment, test piles shall have a creep rate not exceeding 0.040 inch/log cycle time (1 to 10 minutes) or 0.080 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.
3) Failure does not occur at the NR maximum test load. Failure is defined as load where the slope of the load versus head settlement curve first exceeds 0.025

inch/kip.

3.3.4 Verification Test Pile Rejection. If the micropile verification test fails to meet the acceptance criteria, establish the cause(s) and provide modifications to the design, the construction procedures, or both. Retest the new system, as directed by the Engineer. These modifications include, but are not limited to, installing replacement test micropiles, modifying the installation methods, increasing the bond length, regrouting via pre-placed re-grout tubes, or changing the micropile type. Any modification which requires changes to the structure must have prior review and acceptance of the Engineer through submittals. Determine the cause for any modifications of design or construction procedures to appropriately determine any additional cost implications.

3.3.5 Proof Load Tests. Unless shown otherwise on the Plans, perform proof tests on 5 percent of the production piles with a minimum of 1 pile per substructure unit. The proof test piles or locations shall be as shown on the Plans or as directed by the Engineer. Provide the Engineer a written report confirming micropile geometry, construction, testing details, and proof test results within 7 working days following completion of the production pile proof load tests.

3.3.6 Proof Test Loading Schedule. Test piles designated for proof load testing to a maximum test load of the Factored Design Load (FDL) shown on the Plans or Working Drawings. Proof tests shall be made by incrementally loading the micropile in accordance with the following schedule:

PROOF TEST LOADING SCHEDULE			
STEP	**LOADING**	**APPLIED LOAD**	**HOLD TIME (Min.)**
1	Apply AL		2.5
2	Load Cycle	0.10 FDL	2.5
		0.20 FDL	2.5
		0.30 FDL	2.5
		0.40 FDL	2.5

		0.50 FDL	2.5
		0.60 FDL	2.5
		0.70 FDL	2.5
		0.80 FDL	10 to 60 minutes (Creep Test)
		0.90 FDL	2.5
		1.00 FDL	2.5
3	Unload Cycle	0.75 FDL	4
		0.50 FDL	4
		0.25 FDL	4
		AL	4
AL = Alignment Load not to exceed 0.05 FDL FDL = Factored Design Load (As Shown on Plans)			

Depending on performance, either a 10-minute or 60-minute creep test shall be performed at the 0.80 FDL Test Load. Where the pile top movement between 1 and 10 minutes exceeds 0.040 inch, the 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 FDL. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for micropile proof load tests are:

1) The pile shall sustain a 0.70 FDL test load (compression or tension) with no more than 1/2" total vertical movement at the top of the pile, relative to the position of the top of the pile prior to testing.
2) At the end of the 0.80 FDL creep test load increment, test piles shall have a creep rate not exceeding 0.040 inch/log cycle time (1 to 10 minutes) or 0.080 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 FDL maximum test load. Failure is defined as load where the slope of the load versus head settlement curve first exceeds 0.025 inch/kip.

3.3.7 Proof Test Pile Rejection. If a proof-tested micropile fails to meet the acceptance criteria, proof test another micropile in the immediate vicinity. For failed piles and further construction of other piles, modify the design, the construction procedure, or both. These modifications include, but are not limited to, installing replacement micropiles, incorporating piles of reduced load capacities, modifying the installation methods, increasing the bond length, or changing the micropile type. Any modification which requires changes to the structure must have prior review and acceptance of the Engineer through submittals. Determine the cause for any modifications of design or construction procedures to appropriately determine any additional cost implications.

3.4 Abandoned Holes. In the event a micropile cannot be advanced to the design tip elevation due to interference from the existing H-piles below grade (i.e., the bottom of pile cap elevation), the micropile location shall be abandoned, the permanent casing shall be extracted and reused (if possible), and the hole shall be grouted. The hole may be tremie grouted with flowable fill or an approved mixture of grout with a minimum compressive strength of 250 psi at 28 days. The grout mixture shall consider the effects of the rather porous in-situ pile core and shot-rock fill materials. There will be no extra payment for grout or flowable fill overruns.

4.0 MEASUREMENT.

4.1 Micropile. The Department will not measure for payment any non-production trial piles, failed test piles or reaction piles. No distinction in measurement is made between cased or uncased piling. The contractor is responsible for estimating the grout take. There will be no extra payment for grout overruns or special installation materials, procedures or equipment to prevent or reduce grout overruns. Where piles are out of vertical tolerance, there will be no extra payment for replacement piles, or for grouting and redrilling piles to achieve the required tolerance, unless the pile is interfered by the existing H-piles (see Pay Items for Abandoned Micropile Hole and for Damaged Casing from H-Pile Interference).

4.1.1 Micropile, Common. The Department will measure the length, in linear feet, of installed and complete production micropiles from the cut-off elevation to the approved top of competent, relatively unweathered bedrock elevation, minus any additional length installed at the contractor's option such as, but not limited to, facilitating the use of whole casing segments. This item also includes advancing the minimum plunge length, including the casing, through the competent unweathered bedrock, per the plans.

4.1.2 Micropile, Rock Socket. The Department will measure each installed and complete production micropile rock socket/bond zone length in the competent unweathered bedrock per the plans.

4.2 Micropile Verification Test. For each verification test micropile installed according to the plans and is tested and accepted, the Department will measure the quantity by "each." The unit price will include the sacrificial pile as well as the reaction system, ancillaries, and any other materials and labor required to perform the test. Additional verification test micropiles installed to verify alternative micropile installation methods proposed by the Contractor will not be measured for payment.

4.3 Micropile Proof Test. The Department will measure the quantity by each for each test performed on a production micropile that is accepted and incorporated into the completed structure.

4.4 Abandoned Micropile Hole. The Department will measure the length, in linear feet, of abandoned micropile holes, resulting from unforeseen interferences with the existing H-piles. The unit price will include the drilling of the hole to the depth at which the casing was advanced and the placement of the grout. The cost of damaged casing is not included in this pay item.

4.5 Damaged Casing from H-Pile Interference. The Department will measure the length, in linear feet, of casing that is damaged or unable to be extracted from abandoned micropile holes, resulting from unforeseen interferences with the existing H-piles. The unit price will include the length of casing that is unable to be extracted or the length of damaged (nonreusable) casing segments that are able to be extracted.

4.6 Vertical Tolerance Measurements of Micropiles Using Hole Telemetry. The Department will measure the quantity by each production pile that is determined to be within the acceptable vertical tolerance using hole telemetry and incorporated into the completed structure. When piles are determined to be out of tolerance, requiring replacement piles or

grouting and redrilling, the Contractor will not be paid for the out of tolerance piles.

5.0 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Pay Item	Pay Unit
Micropile, 9 5/8 “, Common	Linear Foot
Abutment Micropile, Rock Socket	Each
Pier Micropile, Rock Socket	Each
Micropile Verification Test	Each
Micropile Proof Test	Each
Abandoned Micropile Holes	Linear Foot
Damaged Casing from H-Pile Interference	Linear Foot
Vertical Tolerance Measurements of Micropiles Using Hole Telemetry	Each

The Department will consider payment as full compensation for all work required in this note.