

MICROPILES

****From Enosburg BRO 1448(40)**

xx. DESCRIPTION. This work shall consist of furnishing and installing micropiles at the locations and to the required capacities indicated in the Contract Documents.

xx. MATERIALS. Materials shall meet the following requirements:

(a) Permanent Casing. Permanent casing shall be new, 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. The permanent steel casing/pipe shall conform to the minimum requirements of ASTM A252 for Grade 3 pipe, or API 5CTN80. The casing/pipe shall have a minimum yield stress of 80 ksi.

(1) Certification. Certification for permanent casing pipe shall meet the following requirements.

a. A Type D Certification shall be furnished in accordance with Subsection 700.02.

(2) Additional Requirements. Additional requirements for permanent casing that is installed in coupled (spliced) sections shall meet the following requirements:

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

b. Welds shall meet the requirements of Subsection 506.10. The welding plan and procedures shall be approved by the VTrans Fabrication Supervisor.

(b) Bar Reinforcement. Bar reinforcement shall be Grade 520 (Grade 75), continuously threaded bar, meeting the requirements of AASHTO M 31M/M 31 (ASTM A 615/A 615M) or continuously threaded Uncoated High-Strength Steel Bars conforming to AASHTO M 275M/M 275 (ASTM A 722/A 722M), as used in the design submittal.

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

(c) Cement. Cement shall meet the requirements of Subsection 701.02.

(d) Grout. Grout shall be a neat cement or sand/cement mixture with a minimum compressive strength of 4,500 psi at 28 days. Water for mixing grout shall be potable. The use of Grout Sand and Fly Ash in the mix is optional.

During production, micropile grout shall be tested by the Contractor for compressive strength at an approved laboratory in accordance with AASHTO T 106 (ASTM C 109) 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 3 cubes tested.

Grout consistency as measured by grout density shall be determined by the Contractor per AASHTO T 133 (ASTM C 188) 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. The measured grout shall have a specific gravity of between 1.9 and 2.0, or as used in the mix design submittal.

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

- (e) Centralizers and Spacers. Centralizers and spacers shall be fabricated from Schedule 40 PVC pipe, tube, steel, or material non-detrimental to the reinforcing steel. Wood shall not be used.
- (f) Structural Steel. Structural steel shall meet the requirements of Subsection 714.02 or 714.03 as used in the design submittal.

xx. SUBMITTALS. The Contractor shall submit the following:

- (a) Qualifications. The micropile Contractor shall be fully experienced in all aspects of micropile and construction, and shall furnish all necessary plant, materials, skilled labor, and supervision to carry out the work under the Contract. The experience information outlined below shall be submitted to the Engineer for approval. This information shall be approved prior to any other work occurring under this specification. The Contractor shall allow 10 working days for the review of this material.
 - (1) Five projects in the past five years of similar scope and size to that indicated in the Contract Documents. A brief description of the scope of work and a reference shall be included for each project. As a minimum, the reference shall include an individual's name and current contact information. The micropile contractor shall not sublet the whole or any part of the work under the Contract without the written approval of the Engineer.
 - (2) The proposed On-Site Supervisor for this work having supervised the successful installation of micropiles on at least five projects in the past five years.
 - (3) The proposed key personnel (Superintendent, Driller, and Project Engineer/Manager) who will be materially involved, with each having at least three years of relevant experience.
- (b) Installation Procedure. Submit the installation procedure information outlined below to the Engineer for acceptance. The Contractor shall allow 20 working days for the review of this

material. Work shall not begin prior to receiving acceptance by the Engineer. Acceptance of the installation method by the Engineer does not constitute a guarantee of acceptable pile installations. Acceptable installations are the responsibility of the Contractor.

The submitted installation procedure shall include the following information:

- (1) Proposed steel drill casing/pipe.
- (2) Equipment for pile installation.
- (3) Procedures for pile installation, including but not limited to installation sequence and the approximate time required for each sequence step.
- (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 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 and pile batters 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. Welding procedures for all shop and/or field welds shall be submitted.
- (7) Procedures and equipment for placing grout.
 - a. Prepare the mix design for the grout and obtain documentation from an AMRL accredited laboratory showing the following:
 1. The mix design conforms to the submitted mix and meets the 28 day strength requirements.
 2. The compressive strength of the mix, tested at 3, 7, 14, and 28 days.
 3. 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.

- (8) If applicable, post-grouting equipment and procedures, including the method, sequence of operations, and equipment required.
 - (9) Layout drawings showing the proposed sequence of pile installation. Coordinate this sequence with the proposed phasing and scheduling. Layout drawings should include micropile number, type and size of bar reinforcement, minimum total bond length, total micropile length, and the pile top attachment details.
- (c) Record Information. Submit revisions to the installation procedure information outlined in part (b) of SUBMITTALS of this Section to the Engineer as required within 60 days from completion of micropile installation.

xx. CONSTRUCTION REQUIREMENTS.

- (a) Drilling and Excavation. Progress all micropiles using steel drill casing. The hole shall be advanced using a duplex drilling method without drilling or flushing ahead of the drill casing by more than 1 foot. Drilling and excavation shall be performed in such a manner as to prevent collapse of the hole. Use of bentonite slurry is not permitted. Use of polymer slurry to remove cuttings from the cased hole shall be approved by the Engineer.

An obstruction is defined as something encountered while advancing a micropile that is not expected based on boring log findings or known obstructions identified on the Plans. Boulders, cobbles, bedrock, and very dense till material are not considered obstructions. When obstructions are encountered during excavation for a pile, the hole shall be advanced by means of coring, a tricone roller bit, or other tooling approved by the Engineer. Use of drop-type impact hammers and blasting are not permitted. Use of down-the-hole hammers shall be approved by the Engineer.

The Contractor shall notify the Engineer in writing when a potential obstruction is encountered. Upon notification, the Engineer shall determine if an obstruction has been encountered that will cause an increase in the time required to accomplish the work. The Contractor will be notified of the Engineer's determination as to whether or not an adjustment of the Contract is warranted. If an adjustment is warranted, the Contract will be modified in writing accordingly. Any adjustment made will exclude loss of anticipated profits.

All tools and materials required to remove the obstruction shall be available at the site at all times during micropile installation and in sufficient quantities to avoid delays in the execution of this work.

Procedures and operations shall be controlled so as to prevent undermining, damage, or settlement to adjacent structures,

tunnels, utilities, or adjacent ground. All drilling operations shall be discontinued at the first sign of undermining, damage, or settlement and a written plan shall be provided to the Engineer for review with procedures to avoid reoccurrence. Work shall be resumed only after the Engineer has approved the plan in writing. All damage and settlement shall be repaired at no additional cost to VTrans.

The rate of fluid flow used to progress the holes shall be monitored. Drilling fluid shall be controlled and spoils shall be disposed of in accordance with the approved procedures.

Holes shall not be progressed, pressure-grouted, or post-grouted, within a radius of 5 feet of a micropile until the grout for that micropile has set for 24 hours.

The drill hole shall be open along its full length to at least the design minimum diameter prior to grout placement.

- (b) Reinforcement and Post Grout Tube Placement. Centralizers sized to position the reinforcement within 3/8 inch of plan location from the center of the pile shall be provided. The centralizers shall be sized to allow grout tremie pipe insertion to the bottom of the drill hole and to allow grout to freely flow up the drill hole and casing. The centralizers shall be securely attached to the reinforcement to withstand installation stresses. Centralizers shall be provided at centers not to exceed 10 foot spacing. Micropile reinforcement shall not be dropped into the hole. When a post grout tube is used, it shall be attached to the steel reinforcement prior to lowering it into the hole.
- (c) Grout Placement and Casing Removal. The Contractor shall perform grout testing in accordance with part (d) of MATERIALS of this Section.

Grout shall be placed by means of a tremie pipe from the bottom of the pile upward. The initial volume of grout required to fill the hole shall be recorded along with the grouting pressure and volume of grout being pumped into the pile during pressure grouting. Upon completion, the grout level shall be maintained at or above the pile cut-off elevation until the grout has set.

The grout pressure and volume measuring gages at the pile installation site shall be accessible and legible to the inspector during the grouting operations.

- (d) Construction Tolerances. Piles shall be installed so that the center of each micropile does not vary from the location indicated in the Plans by more than 6 inches. Micropiles shall not vary from the vertical or established batter by more than 1/4 inch per foot, as measured above ground. The top elevation of the completed micropile shall have a tolerance of plus or minus one inch.
- (f) Pile Acceptance Criteria. Pile(s) shall be accepted if all of the following criteria are met:

- (1) Pile meets Construction Tolerance criteria.
 - (2) Pile meets the MATERIALS requirements of this Section and was installed in accordance with the approved submittal.
 - (3) Pile is not damaged.
- (g) Unacceptable Piles. Unacceptable piles are piles which do not meet the acceptance criteria identified in part (f) above.

A written plan shall be submitted to the Engineer for remedial action, indicating how to correct the problem and prevent its reoccurrence. Unacceptable piles shall be repaired, augmented, or replaced in accordance with the approved remedial plan at no additional cost to VTrans.

- xx. METHOD OF MEASUREMENT. The quantities of Special Provision (Micropile, Cased) and Special Provision (Micropile, Uncased) of the size specified to be measured for payment will be the number of meters (linear feet) installed in the complete and accepted work.

The quantity of Special Provision (Furnishing Equipment for Installing Micropiles) to be measured for payment will be on a lump sum basis in the complete and accepted work.

The quantity of Unexpected Obstruction Drilling to be measured for payment will be the number of hours taken to advance the micropile through the obstruction.

- xx. BASIS OF PAYMENT. The accepted quantities of Special Provision (Micropile, Cased) and Special Provision (Micropile, Uncased) of the size specified will be paid for at the Contract unit price per meter (linear foot). Payment will be full compensation for providing all required submittals; for furnishing, transporting, storing, handling, and placing the materials specified, including but not limited to permanent casing, bar reinforcement, grout, centralizers, spacers, and pile top attachment; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

The Contractor shall be responsible for estimating the grout take. There will be no extra compensation allowed for grout overruns.

The accepted quantity of Special Provision (Furnishing Equipment for Installing Micropiles) will be paid for at the Contract lump sum price. Payment will be full compensation for furnishing and mobilizing to the project site all equipment required for installing the micropiles, operating and maintaining the equipment while in service on the project, and demobilizing the equipment from the project site.

When the equipment for installing the micropiles has been set up and installation of production piles has started, a payment of 50 percent of the Contract lump sum price will be allowed. The remaining 50 percent of the Contract lump sum price will be paid when the micropile installations are complete and the equipment has been removed from the site to the satisfaction of the Engineer.

The accepted quantity of Unexpected Obstruction Drilling will be paid for at the Contract unit price per hour. Payment will be full compensation for performing the work of overcoming encountered obstructions and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the task.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.630 Special Provision (Unexpected Obstruction Drilling)	Hour
900.640 Special Provision (Micropile, Cased)(X mm)(X")	Meter (Linear Foot)
900.640 Special Provision (Micropile, Uncased)(X mm)(X")	Meter (Linear Foot)
900.645 Special Provision (Furnishing Equipment for Installing Micropiles)	Lump Sum