

WIRE MESH SLOPE STABILIZATION SYSTEM

****From Highgate STP 0297(8) (Re-advertised)**

- xx. DESCRIPTION. This work shall consist of furnishing, installing, and testing a mesh-faced slope stabilization system, referred to in these specifications as "Wire Mesh for Slope Stabilization" (WMSS), and soil anchors at the location indicated in the Plans and as directed by the Engineer.
- xx. GENERAL WORK REQUIREMENTS. Work required for the WMSS includes but is not limited to the following: slope clearing and scaling as needed; installation and testing of soil anchors of length and orientation as indicated in the Contract Documents; placement of stone facing; installation of steel wire mesh and related materials, and attachment to soil anchors at specified pre-tensioned levels.
- It is prescribed that a system commonly used for such applications such as TECCO wire mesh and related materials available from GeoBrugg North America, LLC, New London CT, (860) 442-9945, or an equivalent system approved by the Engineer will be installed.
- xx. DESIGN REQUIREMENTS. The installation of the WMSS shall follow the manufacturer's standards and requirements. Soil anchor design and testing shall follow guidelines presented in "Recommendations for Prestressed Rock and Soil Anchors" prepared by the Post Tensioning Institute, Third Edition, 1996.
- xx. SUBSURFACE INFORMATION. Available information concerning subsurface soil, rock, and groundwater conditions at WMSS designated areas is presented in the "Geotechnical Evaluation of Embankment Erosion, Bridge 6, VT 207, Highgate, Vermont" report dated November 5, 2008 and included in the Contract Documents. If the Contractor requires additional subsurface information, the Contractor may obtain such information at no additional cost to VTrans.
- xx. EXISTING SITE CONDITIONS. The Contractor shall verify all existing dimensions and site slope conditions where WMSS and soil anchors are required, and shall be responsible for determining actual locations of all existing utilities shown on the Plans, and those utilities or underground obstructions not shown on the Plans that may impact or conflict with the WMSS and soil anchors installation.
- xx. PRE-INSTALLATION MEETING. A pre-installation meeting shall be held prior to the start of work on the WMSS and shall be attended by the Engineer, subcontractor(s), and the Contractor. The pre-installation meeting shall be conducted to clarify the construction requirements for the work, to coordinate construction activities, and to identify contractual relationships and responsibilities.

xx. CONSTRUCTION METHODS AND SEQUENCE.

- (a) The Contractor is responsible for construction means and methods and control of the work associated with WMSS construction, including soil anchor and wire mesh installation. This includes, but is not limited to, the construction sequence, the safety of the workers, temporary handrails, work area access, barriers, and lifting of materials and construction equipment into and out of the work area.
- (b) The construction sequence shall be in accordance with the approved WMSS manufacturer's instructions, unless approved otherwise by the Engineer.

xx. SUBMITTALS.

- (a) Qualifications. Not less than two weeks prior to beginning the work, qualifications shall be submitted to the Engineer for approval. Qualifications shall be provided for the WMSS and soil anchors subcontractors and on-site superintendent responsible for slope clearing and scaling, anchor installation and testing, and wire mesh installation. A reference list shall be provided for the company and the on-site superintendent listing at least three projects completed within the last three years requiring the installation of anchors and tensioned wire mesh facing on soil slopes of similar or greater height and similar or greater steepness as the WMSS system required for this project. A brief description of each project with the owner's name and current phone number shall be included.
- (b) Work Plan. Not less than two weeks prior to beginning construction of the WMSS, the Contractor shall submit a detailed Work Plan for the WMSS and soil anchors. The Work Plan shall include but not be limited to:
 - (1) The proposed construction sequence and schedule.
 - (2) The proposed rope access methods and safety plan.
 - (3) The proposed drilling method and equipment, including drill rig type and drillhole diameter; and the method of cuttings removal.
 - (4) Grout mix design, including brand and type of Portland cement; source, gradation, and quality of all aggregates; proportions of mix by weight and water-cement ratio; and manufacturer and brand name of all admixtures.
 - (5) Anchor grout placement procedures and equipment.

- (c) Testing. The following information concerning testing of permanent soil anchors shall be submitted to the Engineer:
- (1) The number and locations of anchors to be subjected to performance testing, and the Test Load to be used in testing.
 - (2) Anchor performance testing equipment, including details of the jacking frame and appurtenant bracing, and methods of installing test anchors. Identification numbers and certified calibration records for each test jack and pressure gauge pair to be used. Calibration records shall include the date tested, device identification number, and the calibration test results and shall be certified for an accuracy of at least 2% of the applied certification loads by a qualified independent testing laboratory within 90 days prior to submittal.
- (d) Mill Tests. Certified mill test results for anchors from each heat specifying the ultimate strength, elongation, and composition prior to delivery.
- (e) Certifications. Manufacturer certifications for the anchor centralizers, couplers, and galvanizing.
- (f) Wire Mesh System Materials. Prior to installation, the Contractor shall submit to the Engineer certifications stating the technical data of the wire mesh, compression claws, spike plates, and boundary ropes. As applicable, the certifications from the manufacturer shall include tensile strength, wire quality, mesh shape, corrosion protection, spike plate dimensions, and boundary rope breaking force.
- (g) Record Drawings. Accurate records documenting the WMSS as-built construction shall be maintained by the Contractor and submitted to the Engineer. The Contractor shall obtain as-built anchor locations and all other information as required by VTrans.
- xx. CLEARING AND CLEANING OF SLOPE. The limits of clearing shall extend ten feet outside the limits of the slope protection system or as approved by the Engineer.

Vegetation shall be cut flush with ground surface so that the stone course can be placed in a manner that promotes complete contact of the wire mesh with the protected surface. Should removal of face protrusions result in voids beneath the mesh, contractor shall determine the appropriate method of backfilling based on field conditions. The proposed method shall be approved by the Engineer.

xx. SOIL ANCHORS.

(a) Materials. Materials for construction shall be furnished new and without defects. Defective materials rejected by the Engineer shall be removed by the Contractor. The materials for soil anchors shall consist of the following:

- (1) Anchor bars, nuts, and plates shall conform to AASHTO M 31, grade 75 or higher. All anchor bars and end hardware shall be hot-dipped galvanized conforming to ASTM A 767. Bar couplers shall be hot-dipped galvanized conforming to ASTM A 767 and shall develop the ultimate tensile strength of the bars, as certified by the manufacturer.
- (2) Centralizers shall be constructed of Schedule 40 PVC, shall be securely attached to the anchor bar, sized to position the anchor bar within 1 inch of the center of the drillhole, sized to allow tremie pipe insertion to the bottom of the drillhole, and sized to allow grout to flow freely up the drillhole.
- (3) Anchor grout shall be a neat cement, with a minimum 3-day compressive strength of 1500 psi and a minimum 28-day compressive strength of 4000 psi per AASHTO T 106. Cement shall conform to AASHTO M 85, Type 1.

(b) Material Handling and Storage.

- (1) Cement shall be adequately stored to prevent moisture degradation and partial hydration. Cement that has become caked or lumpy shall not be used. Aggregates shall be stored so that segregation and the inclusion of foreign materials are prevented. The bottom 6 inches of aggregate piles in contact with the ground shall not be used.
- (2) All anchor bars shall be carefully handled and shall be stored on supports to keep the steel from contact with the ground. Steel bars shall be picked up in such a way as to prevent overstressing. Damage to the steel or galvanized coating as a result of overstressing, abrasion, cuts, nicks, welds, and weld spatter shall be cause for rejection by the Engineer. Grounding of welding leads to the dowel steel will not be allowed. Anchor steel shall be protected from and sufficiently free of dirt, rust, and other deleterious substances prior to installation. Heavy corrosion or pitting of anchors shall be cause for rejection by the Engineer. For damaged galvanized anchors, the coating shall be repaired in accordance with the manufacturer's recommendations.

(c) Anchor Installation.

- (1) Successful anchor performance tests shall be performed as described in part (f) of this Subsection prior to starting installation of production anchors.
- (2) Anchors shall be installed at the locations and to the lengths indicated on the Plans and/or as directed by the Engineer during construction. The Engineer may add, eliminate, or relocate anchors to accommodate actual field conditions.
- (3) The Contractor shall select the drilling equipment and methods suitable for the ground conditions. The drillhole diameter shall be selected to provide the minimum specified grout cover over the anchor bar and to develop the specified pullout resistance. If caving conditions are encountered in the drillhole, the Contractor shall use cased or augercast drilling methods to support the sides of the drillhole. Water, drilling mud, or other fluids used to assist in cuttings removal shall not be allowed. Uncased drillholes shall be observed for cleanliness prior to insertion of the anchor.
- (4) Anchor bars shall be inserted into the drillhole to the required length without difficulty and in such a manner as to prevent damage to the drillhole. Anchor bars that cannot be fully inserted to the design depth shall be removed from the drillhole and the drillhole shall be cleaned sufficiently to allow unobstructed installation of the bar.
- (5) The anchor shall be installed in a local depression with an approximate relative depth shown on the Plans.
- (6) Anchor bar couplers may be used in accordance with the manufacturer's recommendation as required.

(d) Grouting.

- (1) Grout equipment shall produce a uniformly mixed grout free of lumpy and undispersed cement. A positive displacement grout pump shall be used. The pump shall be equipped with a pressure gauge that can measure at least twice but no more than three times the intended grout pressure. The grouting equipment shall be sized to enable the entire anchor bar to be grouted in one continuous operation. The mixer shall be capable of continuously agitating the grout during usage.

- (2) Grouting prior to insertion of the anchor bar may be allowed by the Engineer provided the anchor bar is less than 7.5 feet long, neat cement grout is used, a stabilized grout level is achieved (as described below), and the anchor bar is immediately inserted through the grout to the specified length without difficulty. No portion of the anchor hole shall be left open for more than 1 hour prior to grouting unless approved otherwise by the Engineer. The grout shall be injected at the lowest point of each drillhole through a tremie pipe with the drillhole filled in one continuous operation. Grout pressures shall be controlled to prevent excessive ground heave or fracturing. Once the hole is full, the grout level shall be observed for five minutes. If the grout level does not drop by more than one inch in five minutes, insert the anchor. If the grout drops more than one inch, re-fill the hole to the level desired. If grout continues to drop for more than fifteen minutes, thicken grout mix as directed by the Engineer. The anchor should only be inserted once the grout level has stabilized. If the grout has reached first set before the grout level has stabilized, the grout should be allowed to set and then the hole should be re-drilled at the direction of the Engineer. The quantity of grout and grouting pressures shall be recorded for each anchor.
- (3) Anchors more than than 7.5 feet long shall be inserted prior to grouting and cement grout shall be placed using a 0.75 inch diameter polyethylene (or similar) permanent grout tube attached to the anchor. The grout tube shall have three openings cut into the lower 4.0 foot bond zone to allow free flow of grout. If the grout tube bottom opening becomes clogged, grout shall be placed by pumping grout into the grout tube.
- (4) A grout sock may be used to reduce grout loss as determined by the Contractor based on drilling conditions encountered.
- (5) During casing removal for drill holes advanced by either cased or augercast methods, the grout surface within the casing shall be continually monitored for maintenance of "head" sufficient to offset the external groundwater/soil pressure.
- (6) Anchor grout shall be tested in accordance with ASTM C 1107. The work shall be performed by VTrans and at a frequency of no less than one test for every ten anchors and at a minimum frequency of every third grouting day.
- (7) The Engineer shall verify that the Contractor is using the approved grout mix on a daily basis. Any deviations from the approved mix will require additional testing.

- (e) Tolerances. The anchors shall not extend beyond the limits shown of the Plans unless approved otherwise by the Engineer. Anchor bars shall be centered within 1 inch of the center of the drillhole. Individual anchors shall be positioned no more than one foot from the design spacing shown on the Plans. Anchor inclination shall be within plus or minus 3 degrees of that shown on the Plans. Anchors that encounter unanticipated obstructions during drilling shall be relocated by the Contractor with the approval of the Engineer. Anchors that do not satisfy the specified tolerances due to the Contractor's installation methods shall be replaced to the Engineer's satisfaction at no additional cost to VTrans.
- (f) Anchor Testing. Anchor testing shall be performed in accordance with part (f) Rock Anchor Testing of CONSTRUCTION REQUIREMENTS of ROCK ANCHORS of Section 900.

xx. WIRE MESH.

(a) Materials.

- (1) Mesh. Diamond pattern high-tensile steel wire mesh made from 3 mm (0.125 inch) (high strength wire with a minimum tensile strength of 1770 N/mm² (256,000 psi) or an equivalent system successfully used for similar stabilization projects as approved by the Engineer shall be used. Wire mesh shall be provided with corrosion protection with zinc coating as specified by the manufacturer. Mesh size shall be of a size to retain the stone materials to be placed on the slope as indicated in the Plans.
- (2) Fasteners. Compression claws or other approved fasteners meeting manufacturer's specifications and approval by the Engineer shall be used to fasten the wire mesh panels together. Compression claws and fasteners shall be hot-dipped galvanized for corrosion protection in accordance with the manufacturer's requirements.
- (3) Spike Plates. Diamond-shaped spike plates recommended by the WMSS manufacturer shall be used to hold the mesh firmly against the soil. Spike plates shall be hot-dipped galvanized for corrosion protection in accordance with the manufacturer's requirements.
- (4) Boundary Ropes. Boundary ropes shall be used as called for in the design. Boundary rope shall be galvanized steel wire rope with minimum breaking force and corrosion protection requirements as shown on the Plans.
- (5) Miscellaneous Materials. Miscellaneous materials such as wire rope clips, thimbles, or any other connectors needed for the design.

(b) Installation.

- (1) The WMSS shall be installed after placement of anchors and fill/stone courses following the manufacturer's guidelines. The top and sides of the mesh shall be secured as recommended by the manufacturer. Horizontal and vertical connectors shall be as recommended by the manufacturer.
- (2) Recess ground around the anchor as shown on the Plans.
- (3) Spike plates must fit well between the mesh and be pressed firmly in the ground.
- (4) Following installation of the spike plates, the nuts on the anchors should be tightened to the prestress level or tightening torque levels shown on the Plans using methods recommended by the manufacturer.

xx. METHOD OF MEASUREMENT. The quantity of Special Provision (Soil Anchor) to be measured for payment will be the number of meters (linear feet) of anchor installed in the complete and accepted work, as obtained from the Contractor's daily field reports approved by the Engineer.

The quantity of Special Provision (Wire Mesh Slope Stabilization System) to be measured for payment will be the number of square meters (square feet) of wire mesh installed in the complete and accepted work.

xx. BASIS OF PAYMENT. The accepted quantity of Special Provision (Soil Anchor) will be paid for at the Contract unit price per meter (linear foot). Payment will be full compensation for furnishing, drilling, installing, and grouting the soil anchor and for furnishing all labor, tools, equipment, and incidentals to complete the work.

Payment for any soil anchor testing will be paid under Contract item 900.620 Special Provision (Rock Anchor Testing).

The accepted quantity of Special Provision (Wire Mesh Slope Stabilization System) will be paid for at the Contract unit price per square meter (square foot). Payment will be full compensation for furnishing and installing the specified materials for a complete in place wire mesh slope stabilization system in accordance with the Contract Documents, including all required submittals and with the exception of soil anchors and anchor testing, and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.640 Special Provision (Soil Anchor)	Meter (Linear Foot)
900.670 Special Provision (Wire Mesh Slope Stabilization System)	Square Meter (Square Foot)