

These photos show approximate locations for Rock Bolts, Rock Anchors, and Weep holes. The final locations will be determined in the field by the Engineer. There are no photos available for the other sites.

PROJECT SPECIAL PROVISIONS

ROADWAY

GLASS BEADS:

(7-18-06)

SP10 R35

Revise the *2006 Standard Specifications* as follows:

Page 10-223, 1087-4(C) Gradation & Roundness

Replace the second sentence of the first paragraph with the following:

All Drop-On and Intermixed Glass Beads shall be tested in accordance with ASTM D1155.

Delete the last paragraph.

CHANGEABLE MESSAGE SIGNS:

(11-21-06)

SP11 R11

Revise the *2006 Standard Specifications* as follows:

Page 11-9, Article 1120-3, Replace the 3rd sentence with the following:

Sign operator will adjust flash rate so that no more than two messages will be displayed and be legible to a driver when approaching the sign at the posted speed.

PAVEMENT MARKING LINES:

(11-21-06) (Rev. 9-18-07)

SP12 R01

Revise the *2006 Standard Specifications* as follows:

Page 12-2, 1205-3(D) Time Limitations for Replacement, add the following at the beginning of the chart:

Facility Type	Marking Type	Replacement Deadline
Full-control-of-access multi-lane roadway (4 or more total lanes) and ramps, including Interstates	All markings including symbols	By the end of each workday's operation if the lane is opened to traffic

Page 12-14, Subarticle 1205-10, Measurement and Payment, delete the first sentence of the first paragraph and replace with the following:

Pavement Marking Lines will be measured and paid for as the actual number of linear feet of pavement marking lines per application that has been satisfactorily placed and accepted by the Engineer.

PORTABLE CONCRETE BARRIER (Department Furnished)

Description

Obtain, and install Department Furnished Portable Concrete Barrier for traffic control use on the project in accordance with the traffic control provisions.

Materials

The Department will provide Portable Concrete Barrier in accordance with 1170-2 of the current NCDOT *Standard Specifications*. The barrier shall be obtained from the stockpile located adjacent to I-40 at approximately M.P.6 locally known as the Cotton Patch. Connecting pins for the Portable Concrete Barrier will be furnished by the Contractor.

Construction Methods

Install Department Furnished Portable Concrete Barrier in accordance with 1170-3 of the current NCDOT *Standard Specifications* at the location(s) specified in the plans and as directed by the Engineer. Upon completion barrier shall be returned to the Cotton Patch storage area.

Method of Measurement

Refer to 1170-4 of the current NCDOT *Standard Specifications*.

Basis of Payment

Payment for this work shall include loading, hauling, installing and returning the Department Furnished Portable Concrete Barrier. No separate payment will be made for the connecting pins as the cost of such shall be considered incidental to the Portable Concrete Barrier.

Payment will be made under:

Pay Item	Pay Unit
Portable Concrete Barrier (Department Furnished)	Linear Foot

REMOVE AND REPLACE PORTABLE CONCRETE BARRIER
(Department Furnished)

Description

Removed damaged cast in place barrier at site 1 – WBL outside shoulder and replace with Department Furnished Portable Concrete Barrier as directed by the Engineer.

Materials

The Department will provide Portable Concrete Barrier in accordance with 1170-2 of the current NCDOT *Standard Specifications*. The barrier shall be obtained from the stockpile located adjacent to 1-40 at approximately M.P.6 locally known as the Cotton Patch. Connecting pins for the Portable Concrete Barrier will **not** be available at this site and shall be furnished by the Contractor.

Construction Methods

After removal of existing damaged barrier, install Department Furnished Portable Concrete Barrier in accordance with 1170-3 of the current NCDOT *Standard Specifications* at the location(s) specified in the plans and as directed by the Engineer.

Method of Measurement

Refer to 1170-4 of the current NCDOT *Standard Specifications*.

Basis of Payment

Payment for this work shall include removal of the existing damaged barrier, preparing the area under the barrier, loading, hauling, and installing the Department Furnished Portable Concrete Barrier. Payment for removal and proper disposal of damaged barrier shall be considered incidental to this item.

Payment will be made under:

Pay Item	Pay Unit
Remove and Replace Portable Concrete Barrier (Department Furnished)	Linear Foot

WEEP HOLES:

(SPECIAL)

1.0 GENERAL

Install weep holes as specified in these special provisions and as directed by the Engineer.

2.0 CONSTRUCTION

Install weep holes as directed by the Engineer.

Drill weep holes a minimum of 40 feet with equipment capable of drilling 2 to 3 inch diameter holes at a grade of 10% +/- 5% or as directed by the Engineer.

3.0 METHOD OF MEASUREMENT

The quantity of weep holes to be paid for will be the actual linear feet of hole drilled. Measurement of horizontal drilling will be made by counting the number of drilling rod joints extended into the ground at each drill hole and multiplying by the length of the joint. Where the last joint extends partially into the ground, measurement will be made to the nearest foot. To obtain the total quantity of drilling for each hole, measure the drill bit to the nearest foot and add the length of drill rod.

4.0 BASIS OF PAYMENT

The quantity of weep hole, measured as provided above, will be paid for at the contract unit price per linear foot for Weep Holes.

The above prices and payments will be considered full compensation for furnishing all labor, materials, tools, equipment, and incidentals, any necessary scaling for access or safety, and for doing all the work involved in drilling the weep holes complete in place and accepted.

Payment will be made under:

Weep Holes.....Linear Feet

GROUT FOR ROCK BOLTS

(SPECIAL)

DESCRIPTION

This special provision addresses grout for use in tensioned and untensioned rock bolts, dowels, or pins. If necessary, use set controlling admixtures. Proportion, mix and place grout in accordance with the plans, the applicable section of the *Standard Specifications* or special provision for the application and this provision.

MATERIALS

Refer to Division 10 of the *Standard Specifications*:

Item	Article
Portland Cement	1024-1
Water	1024-4
Admixtures	1024-3

At the Contractor's option, use an approved packaged grout in lieu of the materials above with the exception of the water. Contact the Materials and Tests (M&T) Unit for a list of approved packaged grouts. Consult the manufacturer to determine if the packaged grout selected is suitable for the application and meets the compressive strength and shrinkage requirements.

REQUIREMENTS

Unless required elsewhere in the Contract, provide non-metallic, non-shrink grout with minimum compressive strengths as follows:

Property	Requirement
Compressive Strength @ 3 days	3000 psi (20.6 MPa)
Compressive Strength @ 28 days	5000 psi (34.4 MPa)

When using approved packaged grout, a grout mix design submittal is not required. Submit grout mix designs in terms of saturated surface dry weights on M&T Form 312U in accordance with the applicable section of the *Standard Specifications* or special provision for the structure. Use an approved testing laboratory to determine the grout mix proportions. Adjust proportions to compensate for surface moisture contained in the aggregates at the time of mixing. Changes in the saturated surface dry mix proportions will not be permitted unless a revised grout mix design submittal is accepted.

For each grout mix design, provide laboratory test results for compressive strength, density, flow and if applicable, aggregate gradation and shrinkage. Submit compressive strength for at least 3 cube and 2 cylinder specimens at the age of 3, 7, 14 and 28 days for a total of at least 20 specimens tested. Perform laboratory tests in accordance with the following:

Property	Test Method
Compressive Strength	AASHTO T106 and T22
Density	AASHTO T133
Flow for Neat Cement Grout (no fine aggregate)	Marsh Funnel and Cup API RP 13B-1, Section 2.2
Shrinkage for Non-shrink Grout	ASTM C1090

When grout mix designs are submitted, the Engineer will review the mix designs and notify the Contractor as to their acceptability. Do not use grout mix designs until written acceptance has been received. Acceptance of grout mix designs or use of approved packaged grouts does not relieve the Contractor of responsibility to furnish a product that meets the Contract requirements.

Upon written request from the Contractor, a grout mix design accepted and used satisfactorily on a Department project may be accepted for use on other projects.

SAMPLING AND PLACEMENT

The Engineer will determine the locations to sample grout and the number and type of samples collected for field and laboratory testing. Use API RP 13B-1 for field testing grout flow and density of neat cement grout. The compressive strength of the grout will be considered the average compressive strength test results of 3 cube or 2 cylinder specimens at 28 days.

Do not place grout if the grout temperature is less than 50°F (10°C) or more than 90°F (32°C) or if the air temperature measured at the location of the grouting operation in the shade away from artificial heat is below 40°F (4°C). It is the responsibility of the Contractor to protect the grouted components from freezing prior to reaching the minimum design strength.

Provide grout at a rate that permits proper handling, placing and finishing in accordance with the manufacturer's recommendations unless directed otherwise by the Engineer. Use grout free of any lumps and undispersed cement. Agitate grout continuously before placement.

Control grout delivery so the interval between placing batches in the same component does not exceed 20 minutes. Place grout before the time between adding the mixing water and placing the grout exceeds that in the table below.

ELAPSED TIME FOR PLACING GROUT (with continuous agitation)		
Air or Grout Temperature Whichever is Higher	Maximum Elapsed Time	
	No Set Retarding Admixture Used	Set Retarding Admixture Used
90°F (32°C) or above	30 min.	1 hr. 15 min.
80°F (27°C) through 89°F (31°C)	45 min.	1 hr. 30 min.
79°F (26°C) or below	60 min.	1 hr. 45 min.

MISCELLANEOUS

Comply with Articles 1000-9 through 1000-12 of the *Standard Specifications* to the extent applicable for grout in lieu of concrete.

TEMPORARY ROCKFALL CONTROL FENCE**(SPECIAL)****1.0 DESCRIPTION**

The Temporary Rockfall Control Fence is to protect traffic adjacent to Site 3 slope repair activities.

Design, prepare plans, furnish, and install energy absorbing and moveable Temporary Rockfall Control Fence system at approximate locations listed in these Special Provisions and or as directed by the Engineer. Work includes all barrier components, ring nets, steel posts, steel plates or foundations, anchors, and all other materials, labor, tools, equipment, and incidentals to complete the work.

The contractor retains ownership of the Temporary Rockfall Control Fence at the completion of the project.

STATION	TO	STATION	SIDE
70+00	-	75+00	LT

2.0 GENERAL

Prior to beginning work on Site 3, evaluate the slope to be bolted with respect to the potential rockfall heights. Based on this evaluation perform a rock fall analysis to determine projected bounce heights and rock fall energy. Design, furnish, and install energy absorbing and moveable Temporary Rockfall Control Fence system. Provide a temporary rockfall control fence system that is capable of controlling 90% of the potential rockfall from bolting activities. The temporary rockfall control fence system shall have sufficient structural capacity to absorb impact design loads determined by the contractor, without the passage of particles larger than 4 inches (100 mm) in diameter through the barrier.

Submit the rockfall design parameters used to design the temporary control fence for review and approval prior to beginning temporary rockfall control fence work. The parameters should include the following: boulder size, shape, anticipated bounce height and estimated impact energy. Allow 10 calendar days for review and approval from the date they are received by the Engineer until they are returned to the Contractor. Material specifications and review of calculations may be required following initial review.

Repair of pavement due to installation of Temporary Rockfall Control Fence, but not rockfall itself, is incidental to this item.

3.0 BASIS OF PAYMENT

The quantity of Temporary Rockfall Control Fence will be paid for at the contract lump sum price for "Temporary Rockfall Control Fence."

The above price and payment will be full compensation for all work covered by this provision including but not limited to design, analysis, plan preparation, submittals, furnishing and installing all wire rope netting, wire support rope, clips and other hardware, support columns, wire rope anchors, cable guide assemblies, spare parts, and any other materials necessary to install or move a complete system ready to use, and any repair of pavement due to installation, movement or removal of Temporary Rockfall Control Fence.

The Contractor retains ownership of the Temporary Rockfall Control Fence and must remove the system once the project has been completed.

Payment will be made under:

Temporary Rockfall Control Fence.....Lump Sum

TENSIONED ROCK BOLT**(SPECIAL)****1.0 DESCRIPTION**

This work consists of furnishing, drilling, installing, and testing, grouted rock bolts and accessories at the locations shown on the photographs for sites 1 and 2 in the plans, marked in the field, or as directed by the Engineer.

2.0 MATERIALS

Provide Type 3 Manufacturer's Certifications in accordance with Article 106-3 of the *Standard Specifications* for all rock bolt materials. Store steel materials on blocking a minimum of 12" (300 mm) above the ground and protect it at all times from damage; and when placing in the work make sure it is free from dirt, dust, loose mill scale, loose rust, paint, oil or other foreign materials. Load, transport, unload and store steel materials such that they are kept clean and free of damage. Damaged or bent materials will be rejected.

Galvanize all bars and accessories including plates, washers, wedges, clips, clamps, wires, rings and all incidentals necessary for installation, to the requirements of ASTM A-153-80.

Rock Bolt Bars

Rock bolt bars shall be straight shaft, deformed, solid, continuous thread bar, new, and undamaged. Rock bolt bars shall be ASTM A722 Grade 150 steel and shall have a minimum diameter of 1.25 inches.

Anchorage Assembly, Couplers, Covers and Centralizers

The anchorage, couplers and bearing plate shall be capable of developing a minimum of 100 percent of the guaranteed minimum ultimate tensile strength of the steel rock bolt bar.

Surface Bearing Plates

Surface bearing plates shall be fabricated from Grade 50 steel and shall have a minimum size of 7 X 7 X 1.25 in (177.8 X 177.8 X 38.1 mm).

Heavy 2H Spherical Hex Nuts

Heavy 2H spherical hex nuts shall be constructed for threaded engagement with the outer end of the rock bolt bar. The nut should be heavy duty type with round head, conforming to ASTM A-563.

Centralizer

Fabricate centralizers from schedule 40 polyvinyl chloride (PVC) plastic pipe or tube, steel or other material not detrimental to steel bars (no wood). Size centralizers to position the bar within 1/2 inch (12.5 mm) of the drill hole center and allow a tremie to be inserted to the bottom of the hole. Use centralizers that do not interfere with grout placement or flow around bars.

Coupler Protection

The coupler and any exposed bar section next to it shall be covered with a corrosion proof compound or wax impregnated cloth tape. The coupler area shall be covered by a smooth plastic tube complying with the requirements set forth in section addressing sheathing, overlapping the adjacent sheathed bar by at least 1 in (25 mm). The two joints shall be sealed each by a coated heat shrink sleeve of at least 6 in (150 mm) length, or approved equal. The corrosion proof compound shall completely fill the space inside the cover tube.

Cement Grout.

Cement grout according to Grout for Rock Bolts contract Special Provision.

Sheathing

Sheathing used over the rock bolt bar in the unbonded (free stressing) zone shall be made of material with the following properties: resistant to chemical attack from aggressive environments, grout or corrosion inhibiting compounds; resistant to aging by ultra-violet light; non-detrimental to the rock bolt bar and capable of withstanding abrasion, impact and bending during handling and installation. The minimum wall thickness for the sheathing shall be 0.060 in (1.5 mm) for polyethylene or polypropylene, 0.040 in (1.0 mm) for PVC tubing and 0.20 in (5.0 mm) for steel tubing or pipe. The sheathing shall permit the unobstructed elongation of the unbonded length during stressing. If couplers are included in the sheathed zone, sheath the couplers such that a minimum of 1.5 times the theoretical elongation of the unbonded zone can occur.

3.0 CONSTRUCTION METHODS**Contractor Qualifications**

Use a rock bolt installation contractor prequalified by the NCDOT Contractual Services Unit for rock slope stabilization work (work code 075). Submit documentation that the rock bolt installation contractor has successfully completed at least 5 rock bolt projects within the last 3 years similar to this project. Submit documentation that the Superintendent and Project Manager each have a minimum of 5 years experience in rock bolt installation with past projects of scope and complexity similar to that anticipated for this project. Documentation should include resumes, references, certifications, project

lists, experience descriptions and details, etc. Perform work with the personnel submitted and accepted. If personnel changes are required during construction, suspend work until replacement personnel are submitted and accepted.

Design Load, Tolerance and Construction Criteria.

The design load for the **TENSIONED ROCK BOLTS** is **75 kips**.

The Contactor shall submit the rock bolt bonded length based on drill hole diameter for approval by the Engineer. The bonded length shall be sufficient to provide a capacity of 2.5 times the specified design load.

The minimum hole diameter and minimum rock socket will be as shown on plans or as directed by the Engineer. A minimum of 0.5 in (12.7 mm) of grout cover is required around the rock bolt bar and couplers within the bonded zone.

The unbonded length shall be as directed by the Engineer or as shown on the plans.

Centralizers will be located as shown on the plan sheet or as directed by the Engineer.

Drilling

Rotary percussion equipment shall be used to drill the holes. The minimum drill hole diameter is shown on the plan sheets. The drill hole must extend 6 in (150 mm) below the design depth of the rock bolt bar. Care shall be taken to insure an accurate and straight hole. Drilled holes shall be cleaned of all drill cuttings, sludge and debris before the rock bolt bar is inserted into the hole. Drill holes which are found to be unsuitable due to undesirable conditions and which are abandoned should be grouted full as directed by the Engineer.

Installation

As a minimum, the bottom of the rock bolt bar shall be positioned 6 in (150 mm) above the bottom of the drilled hole.

The threaded outer end of the rock bolt bar shall extend the minimum length beyond the anchorage that will be capable of accepting the proof test and lift off equipment. The anchorage nut shall be tightened using an approved post tensioning hydraulic jack, which permits tightening of the nut during tensioning.

All equipment used for placing shall be such that it will not damage the rock bolt or its accessories.

For tensioned bolts, chipping out the rock may be required to provide a level surface for the bearing plate. Facing bits may also be used for this purpose.

No couplers will be allowed in the bonded zone. If couplers are used in the unbonded zone, the hole diameter must be increased to accommodate the coupler, sheathing, and grout tube.

Grouting

Remove oil, rust inhibitors, residual drilling fluids and similar foreign materials from holding tanks/hoppers, stirring devices, pumps, lines, grout tubes and all other equipment in contact with grout before use. All surplus water and diluted grout shall be flushed or blown from all lines before commencing injections. The grout line shall be attached to the grout injection tube with suitable fittings such that leakage is entirely prevented.

Grouting of the annular space around the rock bolt shall be accomplished by pressure grouting with a grout pump, capable of providing a minimum of 90 psi (620 kPa) capacity at the grouting location. Mixers and pumps shall have adequate capacity and hoses shall be sized to allow continuous grouting of an individual bolt within one hour or less.

The grout shall be injected at a pressure, which is sufficient to overcome hydrostatic head. Dewatering or pre-grouting may be required for proper grouting of the rock bolt in groundwater or poor rock conditions. Fill drill holes progressively from the bottom to top and withdraw grout tube at a slow even rate as the hole is filled to prevent voids in the grout. Extend grout tube into grout a minimum of 5 ft (1.5 m) at all times except when grout is initially placed in a drill hole.

Provide grout free of segregation, intrusions, contamination, structural damage or inadequate consolidation (honeycombing). Cold joints in grout are not allowed in bonded zone.

Proof Tests, Acceptance Criteria and Lock Off Procedures.

Each production rock bolt shall be proof tested in accordance with the requirements of this specification. Testing of the rock bolts shall not be performed until the rock bolt grout has attained at least 100 percent of the minimum required compressive strength. Rock bolts which do not meet the proof test criteria contained herein shall be rejected and a replacement rock bolt shall be installed.

The testing equipment shall be capable of stressing the rock bolt to the maximum specified test load within the rated capacity. The pump shall be capable of applying each load increment in less than 60 seconds. The equipment shall permit the rock bolt to be stressed in increments so that the load can be raised or lowered in accordance with the test specifications. Stressing equipment shall have been calibrated within an accuracy of $\pm 2\%$ within 60 days prior to use. The calibration certificate and graph shall be available on site at all times. The calibration shall be traceable to the National Institute of Standards and Technology (NIST). The production gauge shall have graduations not larger than 100 psi (690 kPa). One certified dial gauge, traceable to the National Institute

of Standards and Technology (NIST), shall be used which permit the measurement of total movement at every load increment to be read to the nearest 0.001 in (0.025 mm). The dial gauge shall have sufficient travel to record the total rock bolt movement at the maximum test load without the need to reset at an interim point.

Testing Equipment Setup

Prior to setting the dial gauge, the alignment load shall be accurately placed on the rock bolt. The alignment load shall be 10% percent of the design load (60 kips). The dial gauge shall bear on the pulling head of the jack and the stems shall be in alignment with the rock bolt direction. The dial gauge shall be supported on an independent fixed frame, such as a tripod, which will not move as a result of stressing or other construction activities during the test.

Testing Schedule

Proof tests shall be performed by incrementally loading the rock bolt to 133 percent of the design test load (DTL). The rock bolt movement at each load shall be measured and recorded by the contractor. At load increments other than the maximum test load, the load shall be held long enough to obtain a stable reading. Incremental loading for proof tests shall be in accordance with the following schedule:

AL
0.25 DTL
0.50 DTL
0.75 DTL
1.00 DTL
1.20 DTL
1.33 DTL
AL
Lock-off

All load increments shall be maintained within 5 percent of the intended load. Depending on performance, either 10 minute or 60 minute creep tests shall be performed at the maximum test load (1.33 DTL). The creep period shall start as soon as the maximum test load is applied and rock bolt movement shall be measured and recorded at 1, 2, 3, 4, 5, 6, and 10 minutes. Where the rock bolt movement between 1 and 10 minutes exceeds 0.040 in (1.00 mm), the maximum test load shall be maintained an additional 50 minutes and movements shall be recorded at 20, 30, 40, 50, and 60 minutes. Total creep movement must not exceed 0.080 in (2.0 mm) between the 6 and 60 minute readings.

31**Proof Test Acceptance Criteria**

Proof tests shall be considered acceptable when all of the following criteria are met.

- A total creep movement of less than 0.04 in (1.00 mm) is observed between the 1 and 10 minute readings or a total creep movement of less than 0.08 in (2.00 mm) is observed between the 6 and 60 minute readings.
- The creep rate is constant or decreasing throughout the creep test load hold period.
- The total movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the rock bolt unbonded length.
- A pullout failure does not occur at the maximum test load. Pullout failure is defined as the load at which attempts to increase the test load simply result in continued pullout movement of the rock bolt. The pullout failure load shall be recorded as part of the test data.

Although not a criterion for acceptance of an anchor, the total movement at the design test load should not exceed 100 percent of the theoretical elastic elongation of the rock bolt unbonded length plus 40 percent of the bonded length. Notify the Engineer immediately regarding rock bolts where the total movement exceeds the stated threshold. The Contractor should review and provide to the Engineer the installation records regarding such rock bolts for determination of the need to modify their anchor construction processes.

Lock Off Procedures

After completion and acceptance of the proof test, the rock bolt shall be locked off at the design load or at a load as directed by the Engineer.

Corrosion Protection

All accessible rock bolt bars, plates, washers, wedges and nuts, shall be protected against corrosion in accordance with ASTM A780, Standard Practice for Repair of Damaged Hot-Dipped Galvanized Coatings, Annex A2. This includes a minimum of 12 inches (300 mm) behind the rock face. Thoroughly clean areas to produce a clean, bare and dry bright metal surface with a roughened profile. For bolts use a thorough wire brushing and SP1 cleaning as a minimum. Apply an approved organic zinc-rich repair painting containing 92 percent (min.) zinc by weight in the dry film, according to the manufacturer's recommendations, in two to four coats. Paints shall be approved and may be a liquid and brushed on to achieve an aesthetic finish as long as cure is achieved.

4.0 METHOD OF MEASUREMENT

Rock bolts shall be measured by the linear foot (linear meter) to the nearest foot (0.3-meter) for the length of rock bolt bar installed. Only the embedded length of the installed rock bolt is measured for payment.

5.0 BASIS OF PAYMENT

The accepted quantity of rock bolts shall be paid for at the contract price per linear foot (linear meter) complete in place and passing the required proof test. No additional compensation will be provided for additional linear feet of tensioned rock bolt required by the contractor to satisfy the design load or constructed at the discretion of the contractor.

The unit price shall include all items for the anchor assembly, couplers, bearing plate, washers, wedges, hex nut, grout, drilling of the hole, installation, preparation of a bearing surface by chipping out the rock or using a facing bit, corrosion protection, and any other accessories or equipment required to install and test the rock bolts.

Drill holes which are found to be unsuitable for use due to undesirable conditions and which are abandoned will be paid for at 25 percent of the contract price per linear foot (linear meter) of the rock bolts.

The quantities in the contract are approximate only. There will be no adjustment in the contract price for differences between the estimated and the actual quantities.

Such price and payment will be full compensation for furnishing all labor, materials, equipment, any necessary scaling for access or safety, supervision for the actual installation of the rock bolts and the performance of pull out tests as specified by the Engineer.

Payment will be made under:

Tensioned Rock Bolt.....Linear Feet

UNTENSIONED ROCK ANCHORS AND WIRE MESH DRAPE (SPECIAL)

1.0 DESCRIPTION

Install untensioned rock anchors and wire mesh drape in accordance with details shown on the plans, at locations determined by and as directed by the Engineer. The wire mesh drape is anchored to the slope with untensioned rock anchors and wire rope five (5) feet behind the crest of the slope and is draped down the face so as to restrain and limit rockfall. The wire mesh is attached to the anchors using manufacturer approved methods or as directed by the Engineer.

2.0 MATERIALS

Provide Type 3 Manufacturer’s Certifications in accordance with Article 106-3 of the *Standard Specifications* for rock anchors materials. Store steel materials on blocking a minimum of 12” (300 mm) above the ground and protect it at all times from damage; and when placing in the work make sure it is free from dirt, dust, loose mill scale, loose rust, paint, oil or other foreign materials. Load, transport, unload and store all materials such that they are kept clean and free of damage. Damaged or bent materials will be rejected.

Galvanize all bars and accessories including plates, clips, clamps, shackles, cables, wires, rings and all incidentals necessary for installation, to the requirements of ASTM A-153-80.

A. Netting

The netting shall be woven construction and shall be diamond shaped with an inner-circle opening of 9.0 inches, minimum. The netting shall be made with 0.157 in (4 mm) diameter wire in a 1x3 strand construction with the ends of each wire formed into a loop and twisted. The loops of the wire netting shall be fastened together to prevent unraveling of the net. The wire shall be alloyed high strength carbon steel wire with a minimum tensile strength of 256 ksi (1,770 N/mm²). The mesh shall have a minimal load capacity tensile strength of 15 kips/ft (220 kN/m).

The size of the net opening shall be 11.5 inches by 19.7 inches (± 2%) and the twisted strand diameter will be 0.339 inches (8.6 mm). The net shall have a minimum of 1 mesh per foot going across the net and 0.61 meshes per foot going down the net.

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The wire shall be galvanized with a Zinc/Aluminum coating with a minimum weight of 150 g/m² or 0.0256 lb/ft². The coating shall be 95% Zinc and 5% Aluminum.

B. Wire Rope and Shackles

Net Support Ropes:

Support ropes shall have a minimum diameter of 5/8". The wire rope shall be of 6x19 construction (or equivalent), IWRC with a minimum breaking strength of 37,080 lbs.

All wire rope for the support ropes, seam ropes, and wire rope anchors shall meet the Federal Specifications RR-W-410D or equivalent

Shackles:

3/8" galv. SPA shackles are used to fasten the net panels to each other. An appropriate shackle sized to fit the support rope will be used.

C. Anchor Plates

Surface bearing plates shall be fabricated from Grade 50 steel and shall have a minimum size of 12 X 12 X 0.75 inches (254 mm X 254 mm X 19 mm) or an alternate approved by the Engineer.

D. Grout

Use *Grout for Rock Bolts* according to contract.

E. Untensioned Rock Anchors

Rock anchor bars shall be straight shaft, deformed, solid, continuous thread bar, new, and undamaged. Rock anchor bars shall be ASTM A722 Grade 150 steel and shall have a minimum diameter of 1.00 inch.

F. Spherical Hex Nuts.

Spherical hex nuts shall be constructed for threaded engagement with the outer end of the rock anchor bar. The nut should be heavy duty type with round head, conforming to ASTM A-563.

G. Centralizer.

Fabricate centralizers from schedule 40 polyvinyl chloride (PVC) plastic pipe or tube, steel or other material not detrimental to steel bars (no wood). Size centralizers to position the bar within 1/2 inch (12.5 mm) of the drill hole center and allow a grout tubes to be inserted to the bottom of the hole. Use centralizers that do not interfere with grout placement or flow around bars. Space centralizers at a four (4) foot typical spacing or as directed by the Engineer.

that do not interfere with grout placement or flow around bars. Space centralizers at a four (4) foot typical spacing or as directed by the Engineer.

3.0 CONSTRUCTION METHOD

Contractor Qualifications

Use a rock bolt installation contractor prequalified by the NCDOT Contractual Services Unit for rock slope stabilization work (work code 075). Submit documentation that the rock bolt installation contractor has successfully completed at least 5 rock bolt projects within the last 3 years similar to this project. Submit documentation that the Superintendent and Project Manager each have a minimum of 5 years experience in rock bolt installation with past projects of scope and complexity similar to that anticipated for this project. Documentation should include resumes, references, certifications, project lists, experience descriptions and details, etc. Perform work with the personnel submitted and accepted. If personnel changes are required during construction, suspend work until replacement personnel are submitted and accepted.

Drilling

Rotary percussion equipment shall be used to drill the holes. The minimum drill hole diameter is shown on the plan sheets. The drill hole must extend 6 in (150 mm) below the design depth of the rock anchor bar. Care shall be taken to insure an accurate and straight hole. Drilled holes shall be cleaned of all drill cuttings, sludge and debris before the rock anchor bar is inserted into the hole.

Installation of Rock Anchor

As a minimum, the bottom of the rock anchor bar shall be positioned 6 in (150 mm) above the bottom of the drilled hole. A minimum of 0.5 inches (12.7 mm) of grout cover is required around the rock anchor bar. Centralizers will be located on 4 foot centers and as shown on the plan sheet or as directed by the Engineer. The threaded outer end of the rock anchor bar shall extend the minimum length beyond the anchorage that will be capable of accepting the proof test equipment. All equipment used for placing shall be such that it will not damage the rock anchor or its accessories.

Grouting

Remove oil, rust inhibitors, residual drilling fluids and similar foreign materials from holding tanks/hoppers, stirring devices, pumps, lines, grout tubes and all other equipment in contact with grout before use. All surplus water and diluted grout shall be flushed or blown from all lines before commencing injections. The grout line shall be attached to the grout injection tube with suitable fittings such that leakage is entirely prevented.

Grouting of the annular space around the rock anchor shall be accomplished by pressure grouting with a grout pump, capable of providing a minimum of 90 psi (620 kPa) capacity at the grouting location. Mixers and pumps shall have adequate capacity and hoses shall be sized to allow continuous grouting of an individual anchors within one hour or less.

The grout shall be injected at a pressure, which is sufficient to overcome hydrostatic head. Dewatering or pre-grouting may be required for proper grouting of the rock anchor in groundwater or poor rock conditions. Fill drill holes progressively from the bottom to top and withdraw grout tube at a slow even rate as the hole is filled to prevent voids in the grout. Extend grout tube into grout a minimum of 5 ft (1.5 m) at all times except when grout is initially placed in a drill hole.

Provide grout free of segregation, intrusions, contamination, structural damage or inadequate consolidation (honeycombing). Cold joints in grout are not allowed in bonded zone.

Installation of Wire Mesh Drape

Thread top of mesh with wire rope. Attach the top of the wire mesh to the anchors and secure with anchor plate. Place the approved anchor plate on the anchor such that the wire mesh is positioned between the slope face and the steel plate. Torque nut to 265 ft-lbs. Lateral boundaries of mesh will also be threaded with wire rope. Overlap and connect adjacent rolls per manufactures recommendations.

Corrosion Protection

All accessible rock anchor bars, plates, washers, wedges and nuts, shall be protected against corrosion in accordance with ASTM A780, Standard Practice for Repair of Damaged Hot-Dipped Galvanized Coatings, Annex A2. This includes a minimum of 12 inches (300 mm) behind the rock face. Thoroughly clean areas to produce a clean, bare and dry bright metal surface with a roughened profile. For anchors use a thorough wire brushing and SP1 cleaning as a minimum. Apply an approved organic zinc-rich repair painting containing 92 percent (min.) zinc by weight in the dry film, according to the manufacturer's recommendations, in two to four coats. Paints shall be approved, be a liquid, and brushed on to achieve an aesthetic finish as long as cure is achieved.

4.0 METHOD OF MEASUREMENT

The quantity of wire mesh drape to be paid for will be the number of square yards, measured along the surface or hanging, over which mesh has been accepted and completed in place.

The quantity of untensioned rock anchors to be paid for will be the actual number of linear feet installed in the completed work. The anchor is measured from the lower end of the threaded bar to the surface of the rock.

5.0 BASIS OF PAYMENT

The quantity of wire mesh, measured as provided for above, will be paid for at the contract unit price per square yard for "Wire Mesh Drape". Such price and payment will be full compensation for all work covered by this provision, including but not limited to furnishing all wire mesh, ties, locking clips, clamps, rings, wire, cable; placing and securing the wire mesh, and for all incidentals necessary to complete the work satisfactorily.

The quantity of rock anchors, measured as provided for above, will be paid for at the contract unit price per linear foot for "Untensioned Rock Anchors". Such price and payment will be full compensation for furnishing all labor, materials, equipment, any necessary scaling for access or safety, and supervision for the actual installation of the rock anchors.

Payment will be made under:

Wire Mesh Drape.....	Square Yard
Untensioned Rock Anchors.....	Linear Feet