

January 27, 2011

## **SPECIAL PROVISION**

### **SECTION 225 -- ROCK BOLTS**

#### **Item 225.3 - Rock Dowels (Untensioned Rock Bolt)**

##### **Description**

**1.1** This work shall consist of furnishing, drilling and installing, grouted rock dowels and accessories at the locations and in the patterns shown on the plans or as ordered. On this project, it may be necessary to install rock dowels at any location on the rock face. A rock dowel is a fully grouted, untensioned rock bolt.

##### **Materials**

#### **2.1 Rock Bolt Bars.**

**2.1.1** Rock dowel bars shall be straight shaft, deformed, solid, continuous thread bar, new, and undamaged.

**2.1.2** Rock dowel bars shall be galvanized ASTM A722 Grade 150 steel. The minimum diameter shall be determined by the Engineer.

#### **2.2 Anchorage Assembly, Couplers, Covers and Centralizers.**

**2.2.1** 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 dowel bar.

**2.2.2 Surface Bearing Plates.** Surface bearing plates shall be fabricated from A36 steel and shall have a minimum size of 7" x 7.5" x 1.25".

**2.2.3 Beveled Washers, Flat Washers and Wedges.** Beveled washers, hardened flat washers, and wedges for the anchorage shall be designed to preclude premature failure of the steel due to notch or pinching effects.

**2.2.4 Heavy 2H Hex Nuts.** Heavy 2H hex nuts shall be constructed for threaded engagement with the outer end of the rock dowel bar. The nut should be heavy-duty type with round head, conforming to ASTM A-325.

**2.2.5 Centralizer.** Centralizers are required and shall be fabricated from Schedule 40 PVC, or other material not detrimental to the steel rock dowel bar (wood shall not be used) and

shall be capable of being securely attached to the bar. The centralizers shall be sized to meet the tolerance requirements for the grout cover defined in section 3.2.

**2.2.6 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 2.5, overlapping the adjacent sheathed bar by at least 1 inch. The two joints shall be sealed each by a coated heat shrink sleeve of at least 6 inches length, or approved equal. The corrosion proof compound shall completely fill the space inside the cover tube.

### **2.3 Cement Grout.**

**2.3.1** Rock dowel grout shall be a non-shrink neat cement with a maximum water to cement ratio of 0.45 by weight.

**2.3.2** Water for mixing grout shall be potable and free from substances which might be deleterious or corrosive to concrete or steel.

**2.3.3** Grout strength accelerators shall not be used. Admixtures which control bleed and retard set may be used. Admixtures shall be mixed and placed in accordance with the manufacturer's recommendations.

**2.3.4** The cement grout mix shall provide a minimum compressive strength of 3000 psi.

**2.3.5** Appropriate measures shall be taken to preclude freezing of the grout prior to its reaching design strength.

**2.3.6** Cement shall conform to AASHTO M 85/ASTM C 150, Type I, II, or III Portland cement.

## **Construction Requirements**

**3.1 Contractor Qualifications.** The work defined in this section is specialty construction requiring a Contractor who is highly knowledgeable and experienced in the installation of rock bolts and/or dowels. The Contractor performing the work in this section shall submit proof of five projects within five years on which the Contractor has successfully installed rock bolts of similar types and capacities required for this project. A brief description of each project with the owner's name and current phone number shall be included.

### **3.2 Tolerance and Construction Criteria.**

**3.2.1** The minimum hole diameter shall be selected such that a minimum of 1.25 inches of grout cover is provided around the entire length of the rock dowel bar within the anchor zone.

**3.2.2** The length shall be as directed by the Engineer.

**3.2.3** Centralizers shall have a maximum spacing of 10 feet and the lowest centralizer shall be located 5 feet or less from the end of the rock dowel bar.

**3.2.4** All damage to the galvanized surfaces, and threaded portions of all fittings and fasteners and cut ends of bolts after assembly, shall be repaired by thoroughly wire brushing the damaged area and painting it with two to four coats or to a thickness equivalent to the surrounding galvanizing, of an approved organic zinc-rich repair paint containing 92 percent (min) zinc by weight.

**3.2.4** The deviation of the drilled hole entry angle from the specified inclination and direction shall be no more than 3 degrees.

**3.3 Drilling.** Rotary percussion equipment shall be used to drill the holes. The drill hole diameter shall conform to the requirements of this special provision. As a minimum, the drill hole shall extend 12 inches below the design depth of the rock dowel bar. In down bolting situations, the drill holes shall extend 16 inches beyond the length of the rock dowel 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 dowel bar is inserted into the hole.

**3.4** The contractor shall keep and provide a borehole log for each borehole drilled for rock anchors. The log shall include, but not limited to the following: hole location, hole diameter, hole length, angle from horizontal, date/time of drilling, drilling equipment used, encountered subsurface conditions(groundwater, joints, voids, soil/weak rock, etc.), and name of driller. The borehole logs shall be submitted to the NHDOT on a daily basis.

### **3.5 Installation.**

**3.5.1** As a minimum, the bottom of the rock dowel bar shall be positioned 12 inches above the bottom of the drilled hole. In down bolting situations, the bottom of the rock bolt bar shall be positioned 16 inches above the bottom of the drilled hole.

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

**3.5.3** Chipping out the rock may be required to provide a level surface for the bearing plate. All voids behind the bearing plate shall be completely filled with cement grout. Cement grout shall be used to provide a smooth surface for the bearing plate.

**3.5.4** All damage to the galvanized surfaces, and threaded portions of all fittings and fasteners and cut ends of bolts after assembly, shall be repaired by thoroughly wire brushing the damaged area and painting it with two to four coats or to a thickness equivalent to the surrounding galvanizing, of an approved organic zinc-rich repair paint containing 92 percent (min) zinc by weight.

### **3.6 Grouting.**

**3.6.1** Grouting of the annular space around the rock dowel shall be accomplished by pressure grouting with a grout pump, providing a minimum of 90 psi capacity. Mixers and pumps shall have adequate capacity and hoses shall be sized to allow continuous grouting of an individual dowel within one hour or less.

**3.6.2** All grout pipes, tubes and fittings shall be clean and free from dirt particles, grease, hardened grout, or other contamination before grouting is commenced for any rock dowel. 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.

**3.6.3** The grout shall be injected at a pressure, which is sufficient to overcome hydrostatic head. The pressure, which is used shall be approved by the Engineer. Dewatering or pre-grouting may be required for proper grouting of the rock dowel in groundwater or poor rock conditions.

**3.6.4** Rock dowels in upward inclination shall use a sealing grout to seal the opening around the dowel prior to grouting through a short tube, which extends through the sealing grout. Such rock dowels shall be considered grouted when there is a full return of grout through a vent hole within the sealing grout.

**3.6.5** The rock dowel shall be grouted by injecting grout at the lowest point in the rock dowel bar.

**3.7 Submittals.** Submit a rock dowel installation plan, for approval, that includes the Contractor's qualifications, proposed construction sequence and schedule, proposed rope access methods if applicable and safety plan, proposed drilling methods and equipment, the assembly of the rock dowel with its accessories, proposed mix design for the grouting, the method of rock dowel installation, and the method for providing a level surface for the bearing plate. The installation plan shall be submitted ten days prior to commencement of work in accordance with 105.02. Submit manufacture's certificates of compliance for the following: Rock dowel threadbar, complete rock dowel head assembly including nuts, wedges, washers, plates, covers, centralizers and grout design with admixtures.