ITEM 203.17111017– CHAIN LINK ROCK CATCHMENT FENCE

DESCRIPTION

This work consists of furnishing and installing a chain link fence and appurtenances in accordance with the contract documents, two detail drawings and as directed by the Engineer.

MATERIALS

1. **Aluminum coated steel fence fabric** shall be six (6) gauge, chain link type with twist selvage edges and shall conform to the requirements of §710-04, except for gauge.

2. **Galvanized guide rail cables** shall be 19 mm in diameter and shall consist of three (3) strands (seven (7) wires per strand) and have a minimum tensile strength of 110 kN.

3. **No. 36 steel rebar posts and No. 29 hook bar anchors** shall conform to the requirements of §709-01; Bar Reinforcement, Grade 400. The rebar posts and hook bar anchors shall be galvanized in accordance with the requirements of §719-01; Material Requirements; Type I. Exposed cut ends shall be field repaired in accordance with the requirements of that Subsection. Hook bar anchors shall have a 180° hook with an outside diameter of 286mm.

4. **Grout** to fill the annular space around the No. 36 steel rebar posts, No. 29 hook bar anchors and for backfilling below the anchor angle, shall consist of concrete grouting material conforming to the requirements of §701-05.

5. **Anchor angles** shall be 610mm long sections of 200mm by 150mm by 25mm steel angle. The steel shall meet the requirements of ASTM A36M and shall be galvanized in accordance with §719-01; Material Requirements; Type I. The anchor angle shall have two (2) 50mm diameter holes (for the bolts) bored through the 200mm side. The holes shall be centered 105mm in from each end along a line 75mm in from the edge opposite the angle. The anchor angle shall also have three (3) 21mm diameter holes drilled on 100mm centers along the centerline, with the middle hole located in the center of the 150mm side for attachment of the steel turnbuckles (see DETAIL "D").

6. **Bolts** shall be Grade 1035 (ASTM-A722) 32mm nominal diameter steel bars and 1450mm long. Bolts must have rolled threadlike deformations over the entire length. Larger diameter bolts (up to 36mm) are acceptable if supplied at no additional cost to the State. Basis of acceptance shall be the manufacturer's certification of compliance with specification requirements.

   Bolt appurtenances shall consist of a convex bottomed anchor nut and two (2) beveled or wedge washers per bolts. The upper, or bearing washer, shall be countersunk on the side opposite the bevel to match the bottom of the anchor nut.

7. **Resin** cartridges shall be specifically manufactured for rock bolting and be of the appropriate diameter as recommended by the manufacturer for the bolt/drill hole diameter combination used. Use only resin that is within the unexpired shelf life designated by the manufacturer on the package. Furnish sufficient resin to fill the holes and to fully encapsulate the bolts.

8. **Chain link rock catchment fence appurtenances** shall be:
   a) Galvanized **thimbles** (see DETAIL "F") for 19mm guide rail cable.
   b) Galvanized **cable clips** (see DETAIL "F") for 19mm guide rail cable.
   c) Galvanized 9.5mm x 63.5mm throat by 114mm depth **"U" bolts** (see DETAIL "C") with 3.5mm thread length to clamp 19mm guide rail cables to No. 36 rebar posts.
   d) Galvanized **steel turnbuckle cable end assemblies** (see DETAIL "G").
   f) Galvanized **cable splices** (see DETAIL "H").

08/28/01
11/25/03
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g) **Wedges** (see DETAIL "X") for cable splices and cable ends.
h) Galvanized steel **wire ties** (12 gauge).

CONSTRUCTION DETAILS

1. Install galvanized No. 36 steel rebar posts in 50mm diameter vertical holes drilled to a minimum depth of 610mm into rock. Post spacing shall be 2440mm (see DETAIL "A"). Pour a sufficient amount of concrete grouting material into the hole before inserting the post to allow overflow after insertion.

2. Install anchor angles for terminal sections. The location of the anchor angles shall be in line with the corresponding fence section and shall be determined by the angle (60° minimum) between the top longitudinal cable and the end post. The angle between any longitudinal cable and the end post shall not exceed 90°. Drill bolt holes for anchor angles into the rock spaced 400mm on center to a depth of 1220mm. The bolt hole diameter shall be compatible with the bolt/drill hole/resin cartridge diameter, as recommended by the bolt manufacturer, but in no case shall the bolt hole diameter exceed the resin cartridge diameter by more than 10mm. Install the anchor angle within 90°± 15° to the axis of the rock bolt and in intimate contact with the rock surface for its entire contact area. The method of leveling the rock surface shall be approved by the Engineer. Acceptable methods include, but are not limited to, the following:
   a) Chipping the rock surface.
   b) Applying a special mix supplied by the bolt manufacturer for leveling purposes.
   c) A combination of chipping and leveling.

   Clean out the bolt hole to its full depth with air or water. Place the appropriate amount of resin in the hole. Insert the bolt into the hole and rotate at approximately 100 rpm while pushing the bolt down through the resin cartridges to the bottom of the hole by a means approved by the Engineer. Rotate the bolt in this position for thirty to sixty seconds to insure mixing of the resin in the hole. Do not rotate the bolt longer than the setting time of the resin. Leave the bolts undisturbed in the hole for the time required for the resin to harden. Place the anchor angle over the bolts on the prepared surface and add the appurtenances (see DETAIL "D"). Tension the bolts to 180 kN by means of hollow-ram hydraulic jack, or as ordered by the Engineer. Support the base of the jack at 90°± 2° to the axis of the bolt.

   If a failure of the bolt or anchorage occurs, a determination of the cause of failure will be made by a Departmental Engineering Geologist. Correct, as ordered by the Engineer, at no cost to the State, failures attributable to causes other than failure of the rock in the anchorage zone.

   The State reserves the right to sample and test delivered materials.

3. Install No.29 hook bar anchors on the uphill side of the fence (see DETAIL "C"), one hook bar anchor at each post located in a direction normal to the fence alignment (see DETAIL "A").The location of the hook anchor on the ground surface shall be determined by the angle (60°± 5°) between the tie-back cable and the post at the top longitudinal cable (see DETAIL "C"). Construct hook bar anchorage according to depth of overburden (see DETAIL "E").

4. Install No. 29 hook bar anchors at intermediate fence sections. The location of the hook bar anchors shall be in line with the corresponding fence section and shall be determined by the angle between the longitudinal cables and the intermediate anchorage post. This angle shall be between a minimum of 60°± 5° and a maximum of 90°. Construct hook bar anchorages according to depth of overburden (see DETAIL "E").

5. Secure longitudinal cables to anchor angles at terminal sections (see DETAIL "A") with steel turnbuckle cable end assemblies (see DETAIL "G").Secure longitudinal cables at intermediate fence sections to hook bar anchors with one (1) thimble, and four (4) cable clips per cable loop (see DETAIL "F").

   The maximum distance between terminal sections, and/or intermediate anchorage sections, shall be 60 meters.

6. Secure 19mm longitudinal guide rail cables to rebar posts with "U" bolts (see DETAIL "C") so as to have minimum sag without bending posts. Cable splices (see DETAIL "H") shall be staggered a minimum of six (6) meters on adjacent cables. Splices shall be spaced a minimum of thirty (30) meters on the same cable.

   Recommended installation sequence:
   a) Start with lowest longitudinal cable working from one terminal anchorage (see DETAIL "A") toward another or toward an intermediate anchorage, if used (see DETAIL "B").
   b) Draw cable taut and secure with "U" bolt to posts.
   c) Complete tightening entire length of lower cable between anchorages before starting next higher cable.

7. Install fence fabric on uphill side of posts (see DETAIL "C"). Attach fence fabric to longitudinal cables with 12 gauge galvanized steel wire ties at 305mm intervals. Fence fabric splices shall be overlapped a minimum of four chain link rows. Attach fabric sections by tying both ends of the overlap at 305mm intervals, or by a method approved by the Engineer.

8 Bottom of fence fabric shall be in contact with the ground surface. Add fence fabric material as necessary. Added material shall be overlapped a minimum of four chain link rows. Tie both ends of the overlap at 305mm intervals, or as approved by the Engineer.

9 Attach tie-back cables on uphill side of rebar posts (see DETAIL "C") after longitudinal cables have been tightened and chain link fence fabric has been installed. Tie-back cables shall have a maximum sag of 19mm measured at the center.

METHOD OF MEASUREMENT

This work will be measured as the number of meters of fence satisfactorily furnished and installed, measured along the top of the fence between the terminal posts, in accordance with the contract documents and as directed by the Engineer. An allowance of three (3) linear meters will be added for each terminal section anchorage and for each intermediate section anchorage installed.

BASIS OF PAYMENT

The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.