

PART 1 - GENERAL

- 1.1 Scope of Work .1 The work to be done under this section comprises the drilling of holes in rock, supplying, fabricating, installing, tensioning and testing of rock bolts and accessories, and supplying, fabricating and installing rock-bolt extensions and accessories, as shown on the drawings, as required by the Departmental Representative, and as specified herein.
- .2 Typical layouts of rock bolting are shown on the drawings. Variations of these typical layouts may be required and will include modifications in the type, pattern, spacing and length of rock bolts and in the rock bolt accessories, and will be determined by the Departmental Representative as the excavation proceeds, to suit the conditions encountered.
- .3 The amount of rock bolting required may be increased or decreased after the rock surfaces are exposed and have been examined by the Departmental Representative.
- 1.2 Pre-Installation Protection .1 In the event that the Contractor elects to provide temporary protection for workmen prior to or during rock bolting in any excavation, the methods and procedure for providing such protection must be such as not to prejudice the proper installation of rock bolts as shown on the drawings and as required by the Departmental Representative, carry out such work at no additional cost to the Contract.

PART 2 - PRODUCTS

- 2.1 Materials .1 Williams R1H 25mm Diameter hollow core rock bolts with Type C14 head assembly c/w keyhole plates and grout tubes.
- .1 Acceptable alternate systems:
- .1 DYWIDAG DYWI System
- .2 Atlas Copco Swellex Rock Bolts
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- .2 Williams S5Z Wil-x-Cement Grout B or approved equivalent.
- .3 CELTITE polyester resin as manufactured by Celtite Inc. or approved equivalent.
- .4 CELTITE 21-30 Anchorite as manufactured by Celtite Inc. or approved equivalent.
- .5 Rock bolts will normally be required to have a separate flat steel bearing plate for each bolt; these will be 150mm by 150mm by 9.5mm in dimension. Alternatively, bearing plates of large steel flats, rolled steel sections, including channels, beams and angles, may be required by the Departmental Representative to interconnect rock bolts.

PART 3 - EXECUTION

3.1 Protection of Bolts

- .1 Coat the threads of the rock bolts, the nuts and the washers with a heavy rust-preventative grease or wax mastic such as "Rust-Ban 324", as manufactured by Imperial Oil Limited, or approved equivalent. The remaining portions of all rock bolts must be clean and free of all deleterious materials, including dirt, paint, grease and rust.

3.2 Installation - General

- .1 Clean surface to competent rock, free of overburden and loose rock.
 - .2 The procedures and equipment for drilling holes in rock, preparation, installing and tensioning of the bolts to be in accordance with these specifications, the manufacturer's instructions, and to the approval of the Departmental Representative. Approved rotary or percussion drilling equipment shall be used for drilling holes for bolts and anchors.
 - .3 Drill holes 41mm in diameter.
 - .4 Carry out rock bolting to the patterns and sequences shown on the drawings and as required by the Departmental Representative. Complete
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rock bolting promptly following the completion of each round, to the satisfaction of the Departmental Representative, prior to the excavation of the next round.

- .5 When the Contractor is notified by the Departmental Representative of a requirement for supplementary rock bolting, install the required bolts promptly and without delay.
- .6 Supply a standard torque wrench for calibrating impact and torque wrenches used in the work. Do not use this wrench for any other purpose.
- .7 Drilling of rock, and installation and tensioning of rock bolts to conform to the best modern practice for work of this type and shall be performed by personnel experienced in this type of work.

3.3 Installation of Rock Bolts

- .1 Install rock bolts in accordance with the following procedures:
 - .1 Immediately prior to installation of the bolt, flush and clean the hole of all drill cuttings and debris.
 - .2 After the hole is cleaned, insert the bolt in the hole and the anchorage firmly seated and tightened. The installation procedure must not cause damage to the thread on the projecting end of the rock bolt.
 - .3 Place the bearing plate over the projecting end of the bolt and bevelled washers being used, as necessary, to provide a uniform bearing at right angles to the longitudinal axis of the bolt. Use a flat washer between the last bevelled washer and the nut. Leave sufficient thread exposed to permit the use of coupling connectors where required. All threads, both on the bolt and the nut, must be free of rust and burrs, and the nut must be free running in the thread of the bolt.
 - .4 Use an approved grease or wax mastic between the nut and the flat washer.
 - .5 Tighten the nut to a torque required to cause a load in the bolt equal to two thirds of the bolt capacity. Determine the requisite torque for the bolts by in-place testing of bolts in accordance with the bolt
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manufacturer's directions. A controlled-torque impact wrench shall be used to tighten the nut, and the wrench shall have a control device that can be set to cut-off over the required range of torques. Replace bolts which are damaged or over-stressed by over-torquing at no additional expense to the Contract.

.6 After the bolt has been tensioned, do not relax the tension for any purpose unless required by the Departmental Representative.

.2 Torque all bolts within 9.14m of a blasting operation or tension test within four (4) hours after each blast and re-tightened, if necessary, to the approved torque. If, at any subsequent time, any rock bolts have become loose or have lost their tension due to spalling of rock under the bearing plate or any other cause, promptly retension these bolts to the specified torque to the satisfaction of the Departmental Representative.

.3 If it is found that any bolt will not take the required torque without anchorage slip, install another bolt in a new hole in the immediate vicinity of the unsatisfactory bolt.

.4 Install rock bolts to a tolerance of plus or minus 75mm where exact locations are specified.

3.4 Rock Bolts

.1 Bolting will comprise of two (2) rows of 7m long, 25mm diameter anchors with approximately 5m spacing.

.2 Place anchors between chainage 1+060 and 1+180, which amounts to approximately 50.

.3 Set the first row of anchors approximately 5m back from the crest of the new rock face.

.4 Confirm all anchor locations once the upper slope has been properly cleared.

.5 Conduct pre-reinforcement (i.e., prior to excavation) on the upper slope to prevent relaxation and dilation of the rock mass along the principal joint set (bedding).

- .6 Preserve the existing shear strength along potential failure planes that could otherwise be significantly compromised during blasting.
- 3.5 In-Place Testing of Rock Bolts
- .1 Conduct a pullout test on bolts selected by the Departmental Representative. A pullout test which indicates that the bolt will take a tension equal to 90 percent of the minimum yield strength of the bolt as specified herein, without significant yield of the bolt or any anchorage slip, will be deemed acceptable. For the purpose of this test, anchorage slip will be deemed significant if an outward movement of the bolt anchorage occurs and continues without increase in the hydraulic jack loading or with a decrease in the hydraulic jack loading.
- .2 If the bolt fails to meet this requirement, additional adjacent bolts will be tested as selected by the Departmental Representative.
- .3 Replace bolts which fail to meet the requirements in Item 1 above by another bolt in a new hole, drilled as close as practicable to the rejected bolt, at no additional cost to the Commission.
- .4 Supply and maintain in good working order, one (1) set of approved pullout test equipment. The set consists of a suitable hydraulic jack having a centre bore in the ram for installation of the jack concentrically over the longitudinal axis of the bolt, a means of attaching the jack to the end of the bolt, a hydraulic pump, and all other necessary accessories.