RTH 308-80

SUGGESTED METHOD OF DETERMINING ROCK BOLT TENSION USING A TORQUE WRENCH

1. Scope

1.1 This method can be used to apply a specified tension during rock bolt installation or to estimate loss of tension in a previously installed bolt. It can also be used to verify that anchor strength is greater than a specified value consistent with the maximum tension that can be applied with the wrench.

2. Apparatus

2.1 A torque wrench, preferably with a maximum applied torque indicator, capable of giving readings that are repeatable to 5 percent throughout the range of torques to be measured. It should be provided with sockets suitable for the nuts or bolt heads to be tested, should be used only for testing, and should be stored, together with its most recent calibration chart, in a dry place so as to preserve its accuracy of reading.

2.2 Equipment for calibrating the torque wrench (Fig. 1) including a rigidly fixed bolt head, a weight pan and weights, and a measuring tape.

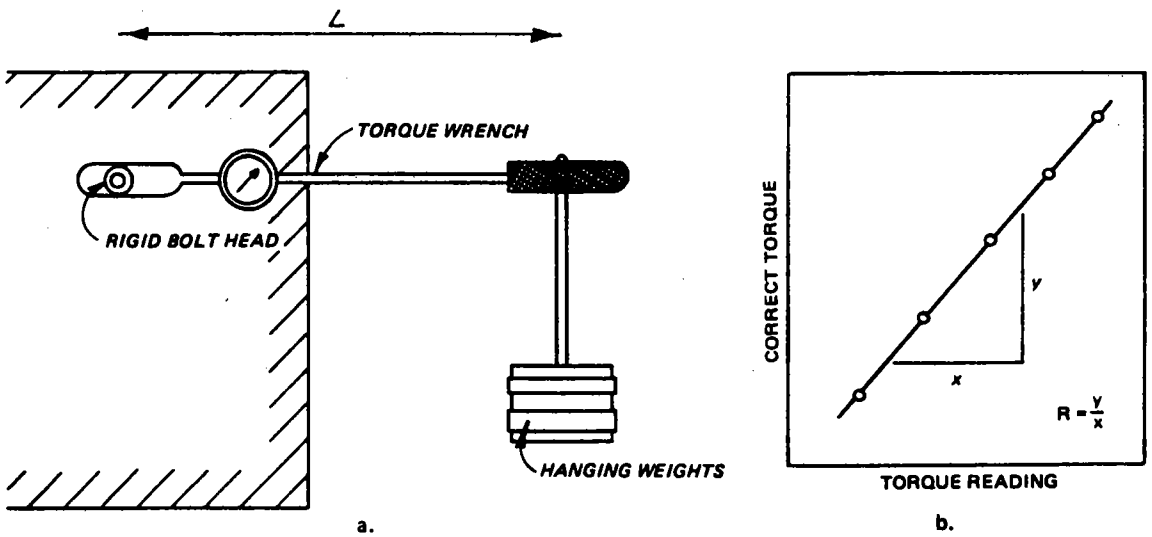

Fig. 1. Calibration of torque wrench.

2.3 Equipment for determining the relationship between tension and torque (Fig. 2), typically an installed rock bolt and faceplate assembly identical with that to be used in practice, and a hydraulic ram with handpump and pressure gage (to be used for tension measurement) or alternatively a rock bolt load cell. Tension should be measured with an accuracy better than 2 percent of the maximum reached in the test.

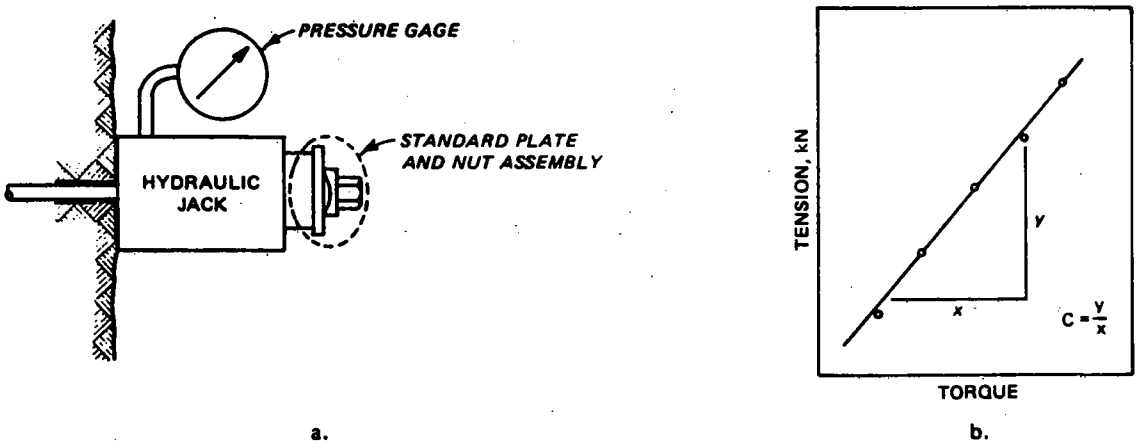

Fig. 2. Determination of ratio tension/torque.

3. Procedure

3.1 Calibration of the torque wrench should be accomplished as follows:

(a) With the wrench horizontal, the wrench socket is positioned on a rigid bolt head. A weight pan is suspended from the center of the wrench handle (Fig. 1) and weights are added. The torque reading is noted, also the weight of the pan together with the weights it contains. The procedure is repeated with increasing weights to obtain at least five torque readings covering the range of torques for which the wrench is to be used. The distance L between the center of the wrench handle and that of the bolt head is recorded.

(b) Correct torque values are calculated by multiplying the distance L by the applied weights. A graph is plotted of correct torque values against torque readings, and a straight line is fitted to the data points (Fig. 1b). The gradient of this line is measured, equal to the ratio R of correct torque divided by torque reading. Torque readings later obtained when using this wrench should be multiplied by the ratio R to obtain corrected values.

(c) Torque wrenches should be recalibrated at intervals not exceeding six months.

3.2 Determination of the ratio C of tension to torque is as follows:

(a) The load cell, or alternatively a hydraulic ram with the ram extended to 3/4 travel, is positioned concentrically and coaxially over the bolt to be tested, and the face nut is tightened to take up slack in the assembly (Fig. 2). Ram pressure should be increased to a nominally small value before the start of the test, and the pump valve firmly closed.

(b) The bolt diameter, state of lubrication, thread pitch, faceplate, and washers should be identical with the conditions expected in the actual rock bolt installation.

(c) Torque is applied in increasing increments to the nut, taking readings of torque and bolt tension. Torque application should be smooth and force should be applied through the center of the wrench handle only. At least five pairs of readings are required, covering the complete range of torques for which the wrench is to be used.

(d) A graph of tension versus torque is plotted, showing data points and a straight line fitted to these points. The gradient C of this line, the ratio of tension to torque, is measured (Fig. 2b).

(e) The ratio C is determined separately for each change in bolt diameter, thread pitch, and state of lubrication of for any other variation in the bolt/anchor/faceplace assembly that may result in a change in the tension/torque ratio.

3.3 Determination of bolt tension using the torque wrench is done as follows:

(a) If a torque wrench of the type that applies a preset torque is used, the torque setting should be increased in small increments until just sufficient to cause the face nut to rotate. The torque setting, the bolt identification, and the date are recorded.

(b) If a torque wrench with a maximum applied torque indicator is used, the torque may be applied steadily rather than in increments. Both types of torque wrench should be used with care to ensure that loading is smooth and that force is applied through the center of the wrench handle.

(c) Bolt tension is calculated using the correction R and a value of tension/torque ratio C determined for the identical bolt and faceplate assembly conditions using the method described in paragraph 3.2 above.

(d) An approximate check on minimum anchor strength may be obtained by applying an increasing torque, recording this torque as a function of number of rotations until no further torque can be applied, or until the anchor shows signs of failing.

4. Reporting of Results

4.1 The report should include diagrams and graphs as illustrated in Figs. 1 and 2, together with full details of:

(a) Torque wrench calibration; type of torque wrench, methods used for calibration, and results.

(b) Determination of the tension/torque ratio C; methods used and results obtained.

(c) The rock bolts tested; types, locations, dates installed, rock characteristics, methods used for drilling and installation, appearance, and condition of the faceplate assembly at time of testing.

(d) The method used for tension determination; tabulated values of bolt identification, applied torque to cause rotation of the

nut, corresponding bolt tension, and any other observations pertinent to the test results.

4.2 If the method is used as a check on minimum anchor strengths, data should be included in the form of graphs of torque versus nut rotation, with scales converted to show bolt tension versus displacement. The report may compare these results with an arbitrary acceptable performance established by previous extensive testing. The complete bolt tension versus displacement curve should be considered when making such a comparison.