SPECIAL SPECIFICATION

4500

Soil Nail Proof Testing

1. Description

Conduct proof testing of soil nails at random locations specified by the Engineer to verify that the contractor’s methods and/or soil conditions have not changed and the production nails can safely withstand design loads. The soil nail assemblies shall be tested up to the proof test load indicated in the plans, and are termed proof test soil nails. Testing shall be performed against a temporary bearing yoke that bears directly on the shotcrete facing or excavated face cut. The temporary bearing yoke shall be designed so that test loads transmitted through the shotcrete will not fracture the shotcrete facing or cause displacement or sloughing of the soil surrounding the drilled hole. For proof test nails, the grout body shall not be in contact with the shotcrete; the shotcrete shall be removed so that it remains a minimum of 1” from the face of grout on the soil nail. At the conclusion of testing, the shotcrete shall be replaced at the test nail. The total number of proof test soil nails shall be determined by the Engineer but not to exceed 5% of the total number of production nails.

The Contractor shall supply all material, equipment, and labor to perform the tests. The Contractor shall measure and record all required data in an acceptable manner.

Testing or stressing of soil nails shall not be performed within 3 days of grouting nails or unless the strength of the grout has reached 50 percent of the 7 day strength. No testing or stressing of soil nails shall be performed within three 3 days of shotcrete application if the reaction frame bears on the shotcrete unless the shotcrete has developed 50 percent of its 28 day strength.

2. Testing Equipment

Testing equipment shall include two dial gauges, a dial gauge support (typically a surveyor’s tripod), hydraulic pump, hydraulic jack, calibrated pressure gauge, and a reaction frame. A minimum of two dial gauges capable of measuring to 0.001 inch shall be provided at the site to measure the soil nail movement. The dial gauges shall have a minimum stroke equal to the theoretical elastic elongation of the total soil nail length plus 1 inch. The dial gauges shall be aligned within 5 degrees from the axis of the soil nail. A hydraulic jack and pump shall be used to apply the test load. The hydraulic jack/gauge/pump unit shall have sufficient capacity required for proof testing, as noted on drawings for this project, and shall have a precision equal to 1 percent of that capacity.

The hydraulic jack, pressure gauge and pump will be calibrated as a unit by an independent testing laboratory within the 6 months prior to beginning work on the wall. The Contractor will submit to the Engineer, the most recent calibration curves for approval prior to the start of work. The calibrated and approved hydraulic jack/pressure gauge/pump unit will be used as a unit for the proof testing.
The pressure gauge shall be graduated in 100 psi increments or less and shall have a range not exceeding twice the anticipated maximum pressure during testing unless otherwise approved by Engineer. The pressure gauge shall be used to determine the applied load. The minimum ram travel of the jack shall not be less than the theoretical elastic elongation of the total nail length at the maximum test load plus 1 inch. The jack shall be capable of applying each load in less than 1 minute.

3. Testing Procedure

A. The stressing equipment shall be placed over the nail in such a manner that the jack, bearing plates, and stressing anchorage are in alignment. The jack shall be positioned at the beginning of the test such that unloading and repositioning of the jack during the test will not be required.

B. The reaction frame shall be sufficiently rigid and of adequate dimension such that excessive deformation of the test apparatus requiring repositioning of any components shall be avoided. Where the reaction frame bears directly on the shotcrete, the reaction frame shall be designed to preclude fracture of the shotcrete. No part of the reaction frame shall bear within 6 inches of the edge of the test nail blockout unless otherwise approved by Engineer.

C. The Contractor shall construct the proof test soil nails as normal production soil nails except that the grout shall not be placed around the outer 3 feet length of the proof test soil nails.

D. For every length of nail used on this project, test load requirements will be as shown in the plans.

E. Proof tests shall be performed by incrementally loading the nail to the proof test load (PTL) indicated on the drawings. The nail movement at each load shall be measured and recorded by the Contractor in the same manner as for verification tests. The load shall be monitored by a pressure gauge with sensitivity and range meeting the requirements of pressure gauges used for verification test nails. At load increments other than 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.

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\begin{align*}
\text{AL} &: \text{Nail Alignment Load} \\
0.25 \text{ PTL} & \\
0.50 \text{ PTL} & \\
0.75 \text{ PTL} & \\
1.00 \text{ PTL} & \\
\end{align*}
\]

F. 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. The creep period shall start as soon as the maximum test load is applied and the soil nail movement with respect to a fixed reference shall be measured and recorded at 1 minute, 2, 3, 5, 6, and 10 minutes.
Where nail movement between 1 minute and 10 minutes exceeds 0.04 inch, the maximum test load shall be maintained an additional 50 minutes and movements shall be recorded at 20 minutes, 30, 50, and 60 minutes. Nails which fail in creep shall be brought to the attention of Engineer.

4. **Test Soil Nail Acceptance**

A proof test soil nail shall be considered acceptable when:

A. Less than 0.04 inches of movement is observed between the 1 minute and 10 minute interval during the 10 minute creep test or a creep rate less than 0.08 inches per log cycle of time is observed during the 60 minute creep test and the creep rate is linear or decreasing throughout the load hold period.

B. The total movement at the maximum test load must exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

C. The maximum test load is sustained without reaching the failure point (pullout). The failure point shall be the point where the movement of the proof test soil nail continues without an increase in the load. The failure load corresponding to the failure point shall be recorded as part of the test data.

D. Proof test soil nails may be incorporated into the production nail schedule provided that (1) the unbonded length of the nail hole has not collapsed during testing, (2) the minimum required hole diameter has been maintained, and (3) the test nail length is equal to or greater than the scheduled production nail. Test nails meeting these requirements shall be completed by grouting the unbonded length. Maintaining the unbonded length for subsequent grouting is the Contractors responsibility. If the unbonded length of production test soil nails cannot be grouted subsequent to testing due to caving conditions or other reasons, the Contractor shall supplement the test nail with a similar production nail at his cost and to the satisfaction of Engineer.

5. **Test Soil Nail Rejection**

A nail that does not meet the requirements of 4 above will be considered a failure. For proof test nails, the Engineer may require the Contractor to replace some or all of the installed production nails between a failed proof test nail and the adjacent passing proof test nail. Alternatively, the Engineer may require the proof testing of additional nails to verify that adjacent production nails have sufficient load carrying capacity. Proof testing of additional nails or installation of additional nails as a result of proof test nail failure(s) will not be paid for separately but will be considered subsidiary to this item.

6. **Post Treatment Of Proof Test Soil Nail**

Following each proof test, the unbonded length of each soil nail shall be grouted in accordance with the plans. In addition, shotcrete or concrete shall be placed at the test location to join the soil nail to the existing shotcrete facing. The cost of this work shall be incidental to the task of completing soil nail proof tests.

7. **Measurement**

Soil nail proof testing will be measured by each successful soil nail proof test that is approved by the Engineer.
8. Payment

The work performed and materials and equipment furnished in accordance with this Special Specification and measured as provided under “Measurement” will be paid for by the unit price bid for each “Soil Nail Proof Test”.