

EXPECTED IMPLEMENTATION JANUARY 2018

451 PRESTRESSED SOIL ANCHORS. (REV 5-10-17) (FA 6-20-17) (1-18)

ARTICLE 451-7 is deleted and the following substituted:

451-7 Prestressed Soil Anchor Testing and Stressing.

451-7.1 General: Test each prestressed soil anchor. The Engineer will select the prestressed soil anchors to be performance tested and those to be creep tested, and at his discretion, may increase or decrease the number of tests.

Perform creep testing and performance testing at the beginning of the anchor installation, prior to installation of the remaining soil anchors, unless directed otherwise by the Engineer. In projects with multiple anchor row levels, the Engineer may request performance and creep testing at the beginning of the installation of soil anchors for subsequent levels. The purpose of these initial tests is to verify the Contractor's installation procedures, the performance of the bond length, and the calibration of testing equipment.

Perform creep testing as follows:

1. as shown in the Plans
2. on 5% of the prestressed soil anchors.

Perform performance testing as follows:

1. as shown in the Plans
2. on 10% of the prestressed soil anchors or a minimum of three,

whichever is greater.

Perform proof tests on all prestressed soil anchors, not subjected to a performance test or a creep test. Record the results of each test on form 700-020-04 Soil Anchor Forms. Submit a separate form for each test. Submit the test results to the Engineer on a weekly basis within one week of testing. Do not apply a load greater than 10% of the factored design load to the prestressed soil anchor prior to testing. For the maximum test load, do not exceed 90% of the minimum yield strength of the tendon. Simultaneously apply the test load to the entire tendon. Do not perform stressing of single elements of multi-element tendons.

Provide testing equipment that consists of:

1. A dial gauge or vernier scale capable of measuring to 0.001 inch to measure the ground anchor movement. Use a movement-measuring device that has a minimum travel equal to the theoretical elastic elongation of the total anchor length at the maximum test load and that has adequate travel so the prestressed soil anchor movement can be measured without resetting the device.

2. A hydraulic jack and pump to apply the test load. Use the jack, with a minimum ram travel of not less than the theoretical elastic elongation of the total anchor length at the maximum test load, and a calibrated pressure gauge, graduated in 100 psi increments or less, or calibrated load cell with readout box, to measure the applied load. Ensure that the jack and pressure gauge are calibrated by an independent firm as a unit, and that the calibration is performed within 60 calendar days of the date submitted.

3. Provide an electrical resistance load cell and readout to be used when performing a creep test. Load cell may also be used in performance and proof tests, at the Contractor's discretion. Ensure that the load cell is calibrated by an independent firm and that the calibration is performed within 60 calendar days of the date submitted. Obtain the Engineer's approval of the calibration before testing commences.

EXPECTED IMPLEMENTATION JANUARY 2018

4. Keep a calibrated reference pressure gauge at the site in possession of the Engineer. Ensure that the reference gauge is calibrated with the test jack and pressure gauge.

5. Place the reference pressure gauge in series with the pressure gauge during each performance test and creep test.

6. Place the stressing equipment over the prestressed soil anchor tendon in such a manner that the jack, bearing plates, load cells and stressing anchorage are axially aligned with the tendon and the tendon is centered within the equipment.

If, during the performance of any load test (proof, performance, or creep), the load determined by the load cell or the load determined by the reference gauge differs by more than 10% from the load determined by the pressure gauge when the pressure gauge measures 80% of the Factored Design Load (0.80 DL), suspend the test, unload the anchor being tested, recalibrate the load cell, jack, pressure gauge, and reference pressure gauge, and repeat the test at no expense to the Department. Obtain the Engineer's approval of the recalibration data prior to resuming testing.

If, at any time, a pressure gauge, reference pressure gauge, or load cell is repaired or replaced, obtain the Engineer's written approval of calibration data of the repaired or the new measuring device (load cell or pressure gauge, or reference gauge) prior to resuming testing. Perform additional performance tests, at no expense to the Department, on the first two soil anchors using the repaired or new measuring device to verify the calibration of the equipment.

451-7.2 Criteria for Performing a Performance Test and a Proof Test: Raise the load from one increment to another immediately after recording the prestressed soil anchor movement. Measure and record the prestressed soil anchor movement to the nearest 0.001 inch with respect to an independent fixed reference point at the alignment load and at each increment of load. Monitor the load with a pressure gauge or load cell. At load increments other than the maximum test load, hold the load just long enough to obtain the movement reading.

Hold the maximum test load for at least 10 minutes. Pump the jack as necessary in order to maintain a constant load. Start the load-hold period as soon as the maximum test load is applied, and measure and record the prestressed soil anchor movement, with respect to an independent fixed reference, at 1, 2, 3, 4, 5, 6, and 10 minutes. If the prestressed soil anchor movement between 1 minute and 10 minutes exceeds 0.04 inches, hold the maximum test load for an additional 50 minutes. If extending the load-hold, record the prestressed soil anchor movements at 15 minutes, 20, 25, 30, 40, 50 and 60 minutes.

451-7.2.1 Performance Test: Perform the performance test by incrementally loading and unloading the prestressed soil anchor in accordance with the following schedule:

Performance Test Schedule	
Load	Load
AL	AL
0.20 DL*	0.20 DL
AL	0.40 DL
0.20 DL	0.60 DL
0.40 DL*	0.80 DL
AL	0.90 DL*
0.20 DL	AL
0.40 DL	0.20 DL
0.60 DL*	0.40 DL

EXPECTED IMPLEMENTATION JANUARY 2018

D

Performance Test Schedule	
Load	Load
AL	0.60 DL
0.20 DL	0.80 DL
0.40 DL	0.90 DL
0.60 DL	1.00 DL*
0.80 DL*	Reduce to lock-off load

AL - is the alignment load.
DL - is the prestressed soil anchor factored design load.

R

Plot the prestressed soil anchor movement versus load for each load increment marked with an asterisk (*) in the performance test schedule, and plot the residual movement of the tendon at each alignment load versus the highest previously applied load.

451-7.2.2 Proof Test: Perform the proof test by incrementally loading the prestressed soil anchor in accordance with the following schedule:

Proof Test Schedule	
Load	Load
AL	0.80 DL
0.20 DL	0.90 DL
0.40 DL	1.00 DL
0.60 DL	Reduce to lock-off load

A

Compare the proof test results to the performance test results. If there is any significant variation from the performance test results, perform a performance test on the next anchor.

Plot the prestressed soil anchor movement versus load for each load increment in the proof test.

451-7.3 Criteria for Performing a Creep Test: Perform the creep test by incrementally loading and unloading the prestressed soil anchor in accordance with the performance test schedule given above. At the end of each loading cycle, hold the load constant for the observation period indicated in the creep test schedule below. Use the following times for reading and recording the prestressed soil anchor movement during each observation period: 1, 2, 3, 4, 5, 6, 10, 15, 20, 25, 30, 40, 50, 60, 75, 90, 100, 120, 150, 180, 210, 240, 270, and 300 minutes as appropriate. Start each load-hold period as soon as applying the test load. Pump the jack as necessary in order to maintain a constant load.

Plot the prestressed soil anchor movement and the residual movement measured in a creep test as described for the performance test above, and plot the creep movement for each load-hold as a function of the logarithm of time.

F

Creep Test Schedule	
Load	Observation Period (minutes.)
AL	
0.20 DL	10
0.40 DL	30

T

EXPECTED IMPLEMENTATION JANUARY 2018

Creep Test Schedule	
Load	Observation Period (minutes.)
0.60 DL	30
0.80 DL	40
0.90 DL	60
1.00 DL	300

451-7.4 Lock-Off: Upon satisfactory completion of all testing, reduce the load to the lock-off load, and transfer the load to the anchorage device. Use a lock-off load that is 80% of the prestressed soil anchor service load. The Contractor may completely unload the prestressed soil anchor prior to lock-off. After transferring the load and prior to removing the jack, take a lift-off reading. Use a lift-off reading that is within 10% of the specified lock-off load. If the load is not within 10% of the specified lock-off load, reset the anchorage, and take another lift-off reading. Repeat this process until obtaining the desired lock-off load.

451-7.5 Cutting of Tendon Protrusions: After an anchor has been accepted by the Engineer, saw cut the portion of the anchor tendon extending beyond the anchorage. Take care not to damage the tendon or the tendon anchorage.

451-7.6 Prestressed Soil Anchor Load Test Acceptance Criteria: The Engineer will accept a performance or proof-tested prestressed soil anchor with a 10 minute load hold if the:

1. Prestressed soil anchor carries the maximum test load with less than 0.04 inches of movement between 1 minute and 10 minutes; and
2. For performance tests, net movement at the maximum test load cycle (movement between alignment load after 0.90 DL and the final movement reading at 1.00 DL) exceeds 80% of the theoretical elastic elongation of the test stressing length. For proof tests, net movement at the maximum test load (movement between alignment load and the final movement reading at 1.00 DL) exceeds 80% of the theoretical elastic elongation of the test stressing length.

The Engineer will accept a performance or proof-tested prestressed soil anchor with a 60 minute load hold if the:

1. Prestressed soil anchor carries the maximum test load with a deformation rate that does not exceed 0.08 inches in the last log cycle of time; and
2. For performance tests, net movement at the maximum test load cycle (movement between alignment load after 0.90 DL and the final movement reading at 1.00 DL) exceeds 80% of the theoretical elastic elongation of the test stressing length. For proof tests, net movement at the maximum test load (movement between alignment load and the final movement reading at 1.00 DL) exceeds 80% of the theoretical elastic elongation of the test stressing length.

The Engineer will accept a creep tested prestressed soil anchor if the:

1. Prestressed soil anchor carries the maximum test load with a creep rate that does not exceed 0.08 inches/log cycle of time; and
2. Net movement at the maximum test load cycle (movement between alignment load after 0.90 DL and the final movement reading at 1.00 DL) exceeds 80% of the theoretical elastic elongation of the test stressing length.

If the total movement of the prestressed soil anchors at the maximum test load does not exceed 80% of the theoretical elastic elongation of the test stressing length, replace the prestressed soil anchor at no cost to the Department.

Stop the creep test as soon as the creep rate exceeds 0.08 inches/log cycle of time. Incorporate prestressed soil anchors which have a creep rate greater than 0.08 inches/log

EXPECTED IMPLEMENTATION JANUARY 2018

cycle of time in the finished work at a load equal to one-half its failure load. The failure load is the load carried by the prestressed soil anchor after the load has been allowed to stabilize for 10 minutes without exceeding 0.04 inches of movement between 1 and 10 minutes.

When a prestressed soil anchor does not satisfy the load test acceptance criteria, the Contractor may modify the design and/or the construction procedures. These modifications may include, but are not limited to, installing replacement prestressed soil anchors, reducing the factored design load by increasing the number of prestressed soil anchors, modifying the installation methods, increasing the bond length or changing the prestressed soil anchor type. Obtain the Engineer's approval prior to making any modification which requires changes to the structure. Perform any modifications at no additional cost to the Department. The Department will not allow additional Contract Time for modifications. The Engineer will not allow retesting of the failed prestressed soil anchor except to determine the anchor failure load.

D

R

A

F

T