ALABAMA DEPARTMENT OF TRANSPORTATION

General Application Special Provision

DATE: March 21, 2025 GASP No.22-GA0047

EFFECTIVE DATE: July 1, 2025

SUBJECT: Soldier Pile Retaining Wall

Alabama Standard Specifications, 2022 Edition, SECTION 572 and 833 shall be replaced with the following:

SECTION 572
SOLDIER PILE RETAINING WALL

572.01 Description.

The work of this Section shall cover designing and constructing a soldier pile retaining wall with permanent ground anchors consisting of steel piles and lagging. The soil and rock behind the wall shall be retained by lagging set in the pile flanges.

572.02 Materials.

(a) Steel Piles.

Steel piles shall meet the requirements given in Section 834.

(b) Structural and Reinforcing Steel.

Structural steel shall meet the requirements given in Section 836.
Reinforcing steel shall meet the requirements given in Section 835.

(c) Concrete for Anchoring Piles in Drilled Holes.

Concrete for anchoring piles in drilled holes shall meet the requirements given in Section 501 for Class A concrete.

(d) Grout.

1. Low Strength Cement Mortar for Stabilizing Drilled Holes.

   Low strength cement mortar shall meet the requirements given in Section 260 for Cement Mortar Flowable Backfill, Mix 2.

2. Grout for Ground Anchors.

   The grout shall be a neat cement or sand/cement grout. The Contractor shall submit the proposed grout mix design to the Materials and Tests Engineer for approval no later than 30 calendar days prior to production. The Contractor shall make arrangements for an ALDOT approved testing laboratory to test the proposed grout mix design. The mix design shall include the following:

   - A list of all the materials used in the design of the mix with the source and vendor code indicated.
   - Compressive strength test results verifying that the proposed mix design will have a minimum compressive strength of 1500 psi at 3 days, and a minimum compressive strength of 3000 psi at 28 days. Compressive strength shall be tested in accordance with the requirements given in AASHTO T 106, "*Compressive Strength of Hydraulic Cement Mortar (Using 50 mm or 2 inch Specimens)*".

   Test results for the proposed grout mix that have been completed within one year of the start of work, and that have been performed by an ALDOT approved testing laboratory, may be submitted for verification of the mix design.

(e) Lagging.

All Timber lagging for the wall facing shall meet the requirements given in Section 833 and shall be a minimum of 3 inches thick.

(f) Ground Anchors.

1. Ground anchors shall conform to the following requirements:
   - All materials for ground anchors shall comply with the current "Recommendations for Prestressed Rock and Soil Anchors" from the Post-Tensioning Institute (PTI).
   - Tie back tendons shall be fabricated from prestressing steel meeting the requirements given in Section 835.
   - The Contractor shall provide “Class 1” corrosion protection (double corrosion protection) for all ground anchors in accordance with the "Recommendations for Prestressed Rock and Soil Anchors" from the Post-Tensioning Institute.
2. Corrosion protection for the tieback tendons shall be fabricated from the following:
   Corrosion-inhibiting grease shall conform to the requirements of Section 3.2.5 of the PTI "Specification for Unbonded Single Strand Tendons."
   The bondbreaker for strand tendon unbonded length shall be:
   - A polyethylene tube pulled or pushed over a strand. The polyethylene shall be Type II, III or IV as defined by ASTM D-1248 (or approved equal). The tubing shall have a minimum wall thickness of 60 mils +/- 10 mils; or
   - A hot-melt extruded polypropylene tube applied over a corrosion inhibiting grease coated strand. The polypropylene shall be cell classification PP 210 B5554211, as defined by ASTM D-4101 (or approved equal). The tubing shall have a minimum wall thickness of 60 mils +/- 10 mils; or
   - A hot-melt extruded polyethylene tube applied over a corrosion inhibiting grease coated strand. The polyethylene shall be high density Type III as defined by ASTM D-3350 and ASTM D-1248 (or approved equal). The tubing shall have a minimum wall thickness of 60 mils +/-10 mils.
3. The bondbreaker for bar anchor unbonded length shall be a low density polyethylene tubing, polypropylene tubing or polyvinyl chloride tubing with a minimum wall thickness of 40 mils +/- 10 mils.
4. Corrugated tubes shall be:
   - High density corrugated polyethylene tubing conforming to the requirement of AASHTO M 252 with a minimum wall thickness of 30 mils; or
   - Corrugated polyvinyl chloride tubes manufactured from rigid PVC compounds conforming to ASTM D-1784, Class 13464-8; or
   - Deformed steel tubing or pipes with a minimum wall thickness of 25 mils.
5. Fusion bonded, epoxy coating shall be in accordance with AASHTO M284, except that it shall have a film thickness of 15 mils.
6. Heat-shrink tubing shall be an irradiated, heat shrinkable polyethylene tube internally coated with a thixotropic sealant. Prior to shrinking the tube shall have a nominal wall thickness of 24 mils. The adhesive sealant inside the tube shall have a nominal thickness of 20 mils.
7. A trumpet shall be used to provide a transition from the anchorage to the unbonded length corrosion protection and shall be fabricated from a steel pipe or tube conforming to the requirements of ASTM A-53 for pipe or ASTM A-500 for tubing.
8. The trumpet shall have a minimum wall thickness of 0.125 inches for diameters up to 4 inches and 0.20 inches for larger diameters.

(g) Wall Drainage System.

The wall drainage system shall meet the requirements given in the working drawings.

(h) Concrete Fascia Panels.

Precast concrete fascia panels shall meet the requirements as given in Section 831. Concrete for cast in place fascia panels shall meet the requirements as given in Section 501 for Class A concrete.

(i) Shotcrete Fascia.

Shotcrete concrete fascia shall meet the requirements as given in Section 571.

572.03 Design Requirements and Submittals.

(a) Design Requirements for Soldier Pile Wall.

The design for the soldier pile retaining wall shall be in accordance with the plans and the latest edition of the AASHTO "LRFD Bridge Design Specifications" with interims. If ground anchors are required, the design shall be in accordance with the "Recommendations for Prestressed Rock and Soil Anchors" from the Post-Tensioning Institute. The design shall be based on the wall layout, locations, cross sections, soil borings, and ground water information as shown in the plans. A copy of the geotechnical investigation report can be provided upon request. The design shall consider the internal and global stability of the wall system. The overall stability of the earth mass being retained shall be checked and shall have a minimum factor of safety of 1.3. For ground anchors, the maximum allowed bond length shall not exceed 40 feet unless otherwise approved by the State Geotechnical Engineer. The Contractor shall not use consultants or manufacturer's representatives in order to meet the requirements of this Article.

(b) Working Drawings for Soldier Pile Wall.

The Contractor shall submit Working Drawings of the soldier pile and lagging system. Include details of the following:

- Details of the soldier piles and a description of their installation method
- Pile Hammer specifications shall be submitted in accordance with 505.03(d).
- Details of the lagging and a description of their installation method, and
- Details for the construction of drainage facilities associated with the soldier pile and lagging retaining walls shall be clearly indicated

(c) Working Drawings for Ground Anchors.

1. The Contractor shall submit Working Drawings and procedures including:
   - Details of the connections and anchorage system of the tie back anchors to the soldier piles
   - A detailed description of the construction procedure proposed for use
   - A description of the tie back installation including drilling procedures
   - The grout mix design and placement method, and any stressing information.
   - The methods and materials used in filling the annulus over the unbonded length of the anchor
   - A description of any temporary supports needed to support the soldier pile and lagging wall until the tie back anchors have been installed and loaded to the design load
2. The Contractor shall submit Working Drawings of the ground anchor tendon and the corrosion protection system. Include details of the following:
   - Spacers and their location
   - Centralizers and their location
   - Unbonded length corrosion protection system, including the permanent rubber seal between the trumpet and the tendon unbonded length corrosion protection
   - Bond length corrosion protection system
   - Anchorage and trumpet
   - Anchorage corrosion protection system
   - Anchors using non-restressable anchorage device (if applicable)

The Contractor shall submit the proposed method to be followed for the permanent ground anchor testing. This submittal shall include all necessary drawings and details to clearly describe the method proposed.

3. The Contractor shall submit a ground anchor schedule giving:
   - Ground anchor number
   - Ground anchor factored design load
   - Type and size of tendon
   - Minimum total bond length
   - Minimum anchor length
   - Minimum tendon bond length
   - Minimum unbonded length.

   The Contractor shall also submit a profile view indicating the elevation at the top of the wall, the elevation at the bottom of the wall, all horizontal and vertical break points and showing tie back anchor identification number, and a plan view of the wall indicating the offset from the construction centerline to the face of the wall at all changes in horizontal alignment.

(d) Working Drawings for Concrete Fascia Panels.

The Contractor shall submit working drawings for the concrete fascia panels, l. These panels may be precast, cast in place, or as shown in the plans.

If cast-in-place concrete fascia is used the following requirements apply.

1. Where the lateral pressure from concrete placement is less than or equal to the design earth pressure, the Contractor may tie forms directly to the soldier piles.

2. Where the lateral pressure from concrete placement is greater than the design earth pressure, the Contractor shall follow one of the following procedures:
   - Tie the forms to strongbacks behind the lagging, or use some other system that confines the pressure from concrete placement between the lagging and the form panels, in addition to the ties to the soldier piles.
   - Reduce the rate of placing concrete to reduce the pressure from concrete placement to less than or equal to the design earth pressure in addition to the ties to the soldier piles.
   - Follow a procedure with a combination of both.

3. The Contractor shall design the forms for an appropriate rate of placing concrete so that no cold joints occur, considering the wall thickness and height, and volume of concrete to be placed.

Precast concrete fascia when used shall be designed in accordance with current AASHTO LRFD Bridge Design Specifications for retaining wall facing elements. The contractor shall submit design calculations for panel connection and working drawings showing the proposed panel layout with construction joints, underdrains, and all utilities. The working drawings shall also detail the procedures for panel connection, erection, and any closure pours. The initial submittal of the design calculations and Working Drawings shall be sealed by a Professional Engineer licensed in the State of Alabama. Limits of the wall will be in accordance with the retaining wall layout. Slight modifications of the bottom of the wall may be allowed as necessary to accommodate precast concrete fascia design and construction.

(e)Working Drawings for Shotcrete Fascia.

The Contractor shall submit working drawings for the shotcrete fascia. Shotcrete fascia design shall meet the requirements of 571.03(k) and any requirements shown in the plans.

The Contractor shall design the shotcrete placement and reinforcement, and connection of reinforcing steel to the soldier piles to accommodate the wall thickness and height, and volume of shotcrete to be placed.

The Contractor shall submit design calculations for shotcrete fascia connection and working drawings showing any proposed construction joints, drains, and all utilities. Limits of the wall will be in accordance with the retaining wall layout. Slight modifications of the bottom of the wall may be allowed as necessary to accommodate shotcrete fascia design and construction.

(f) Submittal of Design Calculations and Working Drawings.

The Contractor shall submit the design calculations and working drawings to the Construction Engineer in accordance with the requirements given in Article 105.02 for working drawings. The initial

submittal shall also identify the Contractor Qualifications requirements as given in Article 572.04. Changes in personnel will not be permitted without a written request by the Contractor. This submittal shall be made within 30 calendar days after the date of the "Notice to Proceed".

If clarifications are required, the calculations and drawings will be returned to the Contractor with comments for clarification. The initial submittal will be returned to the Contractor for clarification within 14 calendar days after the receipt of the submittal.

The Contractor will be allowed 7 calendar days for each clarification of the initial submittal and the Construction Engineer will be allowed 7 calendar days to determine if further clarification is necessary.

The Construction Engineer will not approve the submittal of design calculations and Working Drawings but will review the submittal for completeness.

The submittal of the design calculations and Working Drawings shall be sealed by a Professional Engineer licensed in the State of Alabama.

The Contractor shall not begin wall construction or incorporate materials into the work until the Construction Engineer returns one set of the completed design calculations and Working Drawings to the Contractor.

572.04 Contractor Experience Requirements.

The Contractor or Subcontractor performing this work shall have installed permanent ground anchors for a minimum of three (3) years. Prior to the beginning of construction, the Contractor shall submit a list containing at least five (5) projects on which the Contractor has installed permanent ground anchors. A brief description of each project and a reference shall be included for each project listed. As a minimum, the reference shall include an individual's name and current phone number.

The Contractor shall assign an engineer to supervise the work with at least three (3) years of experience in the design and construction of permanently anchored Structures. The Contractor shall not use consultants or manufacturer's representatives in order to meet the requirements of this Article. Drill operators and on-site supervisors shall have a minimum of 1 year experience installing permanent ground anchors.

The Contractor shall allow up to 15 calendar days for the Engineer's review of the qualifications and staff as noted above. Work shall not be started on any anchored wall system nor materials ordered until written approval of the Contractor's qualifications is given.

572.05 Construction Requirements.

(a) Preconstruction Conference.

A permanent ground anchor preconstruction conference, to discuss construction procedures, personnel, and equipment to be used, shall be held at least 5 working days prior to the Contractor beginning any permanent ground anchor work at the site. The list of materials for this item of Work will also be discussed. Those attending shall include:

1. The superintendent, on site supervisors, and all foremen in charge of drilling the ground anchor holes, placing the permanent ground anchors and grout, and tensioning and testing the permanent ground anchor.
2. The Project Manager, key inspection personnel, and representatives from Materials and Tests.

(b) Installation of Soldier Piles.

The Contractor shall either drive piles or excavate holes for the placement of the soldier piles, concrete and flowable fill. Piles installed by driving shall be installed in accordance with the requirements given in Section 505. The location and alignment of the soldier piles shall be in accordance with the working drawings. The Contractor shall be fully responsible for all costs for replacing misaligned piles and lagging that will not properly fit into the flanges of the soldier piles.

For soldier piles installed in excavated holes the Contractor shall use equipment that will drill through soil, rock, boulders and debris that may be encountered during drilling. Blasting is not permitted to advance excavations. In the event that blasting is deemed critical by the Contractor for rock core removal, a request must be submitted to the Materials and Tests Engineer and may only be commenced after written approval has been returned. The Contractor shall provide the means and

materials necessary to keep the sides of the excavated holes from collapsing. Casing drilling mud shall be used to stabilize a hole if it is unstable.

During construction the Contractor shall control drainage in the vicinity of the soldier pile wall. The Contractor shall direct run off away from the soldier pile wall and areas above and behind the wall.

A soldier pile shall be installed with a minimum clearance of 3 inches within the excavated hole and shall be within 1.5 inches of the horizontal location shown on the working drawings. The installed soldier pile shall be vertical within a tolerance of 1 %.

A soldier pile shall be installed in the drilled hole and braced against movement prior to the final placement of the concrete. A maximum of 2 feet of concrete may be placed in the drilled hole prior to the final placement of concrete to help stabilize the pile during final placement of the concrete. The pile shall be centered in the hole so that there is uniform coverage of concrete around the pile.

Concrete shall be placed through a tremie to the bottom of the hole if drilling mud is used to stabilize the excavation.

(c) Excavation of the Soil in front of the Wall.

The Contractor shall perform the excavation using procedures that prevent ground loss, swelling, and loosening of the soil that will be retained by the wall. Concrete and flowable fill placed in the holes to brace the soldier piles shall be cured a minimum of 7 days before beginning excavation at the face of the wall. The Contractor shall excavate in lifts not to exceed 5 feet in height.

If the excavation face becomes unstable at any time, the Contractor shall suspend soldier pile wall construction and temporarily stabilize the face by immediately placing an earth berm against the unstable face. Soldier pile wall construction may not proceed until remedial measures are proposed by the Contractor and accepted by the Engineer.

All drainage materials shall be installed in accordance with the working drawings.

(d) Ground Anchor Fabrication.

Ground anchors may be either shop or field fabricated. Ground anchors shall be fabricated as shown on the approved Working Drawings.

The Contractor shall select the type of tendon to be used. The tendon shall be sized so the factored design load does not exceed 80 percent of the minimum guaranteed ultimate tensile strength of the tendon. In addition, the tendon shall be sized so the maximum test load does not exceed 80 percent of the minimum guaranteed ultimate tensile strength of the tendon.

The Contractor shall be responsible for determining the bond length and tendon bond length necessary to develop the factored design load indicated in the Plans in accordance with Item 572.05(g)1 and Item 572.05(g)2. The minimum bond length shall be 10 feet in rock and 15 feet in soil.

The tendon bond length portion of the tendon shall be corrosion protected by encapsulating the tendon in a grout-filled corrugated tubes. The tendons can be grouted inside the encapsulation prior to inserting the tendon in the drill hole or after the tendon has been placed in the drill hole. Expansive admixtures can be mixed with the encapsulation grout if the tendon is grouted inside the encapsulation while outside the drill hole. The tendon shall be centralized within the bond length encapsulation with a minimum of 0.20 inches of grout cover. Spacers shall be used along the tendon bond length of multi-element tendons to separate the elements of the tendon so the prestressing steel will bond to the encapsulation grout.

Centralizers shall be used to provide a minimum of 0.5 inches of grout cover over the tendon bond length encapsulation. Centralizers shall be securely attached to the encapsulation and the center-to-center spacing shall not exceed 10 feet. In addition, the upper centralizer shall be located a maximum of 5 feet from the top of the tendon bond length and the lower centralizer shall be located a maximum of 1 foot from the bottom of the tendon bond length.

The centralizer shall be able to support the tendon in the drill hole and position the tendon so that a minimum of 0.5 inches of grout cover is provided and shall permit free flow of grout.

Centralizers are not required on encapsulated, pressure-injected ground anchor tendons if the ground anchor is installed in coarse grained soils (more than 50 percent of the soil larger than the number 200 sieve) using grouting pressures greater than 150 psi.

Centralizers are not required on encapsulated, hollow-stem-augered ground anchor tendons if the ground anchor is grouted through and the hole is maintained full of a stiff grout (8-inch slump or less) during extraction of the auger.

The minimum unbonded length of the tendon shall be 15 feet or as shown in the plans.

Corrosion protection of the unbonded length shall be provided by a sheath completely filled with corrosion inhibiting grease or grout. If grease is used under the sheath, provisions shall be made to prevent the grease from escaping at the ends of the sheath. The grease shall completely coat the tendon and fill the voids between the tendon and the sheath. The Working Drawings shall show how the Contractor will provide a transition between the tendon bond length and the unbonded tendon length corrosion protection.

If the sheath is not fabricated from a smooth tube, a separate bond breaker shall be provided. The bond breaker shall prevent the tendon from bonding to the anchor grout surrounding the tendon unbonded length.

The total anchor length shall not be less than that indicated in the plans or the approved Working Drawings.

Anchorage devices shall be capable of developing 95 percent of the minimum guaranteed ultimate tensile strength of the prestressing steel tendon. The anchorage devices shall conform to the static strength requirements of of the Post Tensioning Institute, "Specification for Unbonded Single Strand Tendons,."

Non-restressable anchorage devices may be used except where indicated in the plans.

Restressable anchorages shall be provided on those ground anchors that require reloading. The post-tensioning supplier shall provide a restressable anchorage compatible with the post-tensioning system provided.

The bearing plates shall be sized so the bending stresses in the plate do not exceed the yield strength of the steel when a load equal to 95 percent of the minimum guaranteed ultimate tensile strength of the tendon is applied, and the average bearing stress on the concrete does not exceed that recommended in of the Post Tensioning Institute, "Specification for Unbonded Single Strand Tendons,."

The trumpet shall have an inside diameter equal to or larger than the hole in the bearing plate. The trumpet shall be long enough to accommodate movements of the structure during testing and stressing. For strand tendons with encapsulation over the unbonded length, the trumpet shall be long enough to enable the tendon to make a transition from the diameter or the tendon in the unbonded length to the diameter of the tendon at the anchor head without damaging the encapsulation. Trumpets filled with corrosion-inhibiting grease shall have a permanent rubber seal, as approved by the Engineer, provided between the trumpet and the tendon unbonded length corrosion protection. Trumpets filled with grout shall have a temporary seal provided between the trumpet and the tendon unbonded length corrosion protection or the trumpet shall overlap the tendon unbonded length corrosion protection.

(e) Tendon Storage and Handling.

Tendons shall be handled and stored in such a manner as to avoid damage or corrosion. Damage to the prestressing steel as a result of abrasions, cuts, nicks, welds and weld splatter will be cause for rejection by the Engineer. The prestressing steel shall be protected if welding is to be performed in the vicinity. Grounding of welding leads to the prestressing steel is forbidden. Prestressing steel shall be protected from dirt, rust, and deleterious substances. A light coating of rust on the steel is acceptable. If heavy corrosion or pitting is noted, the Engineer will reject the affected tendons.

The Contractor shall use care in handling and storing the tendons at the site. Prior to inserting a tendon in the drill hole, the Contractor and the Engineer will examine the tendon for damage to the encapsulation and the sheathing. If, in the opinion of the Engineer, the encapsulation is damaged, the Contractor shall repair the encapsulation in accordance with the tendon supplier's recommendations and as approved by the Engineer. If, in the opinion of the Engineer, the smooth sheathing has been damaged, the Contractor shall repair it with ultra high molecular weight polyethylene (PE) tape. The tape shall be spiral wound around the tendon so as to completely seal the damaged area. The pitch of the spiral shall ensure a double thickness at all points.

(f) Installing Permanent Ground Anchors.

The Contractor shall select the drilling method, the grouting procedure, and the grouting pressure used for the installation of the ground anchor.

When caving conditions are encountered, no further drilling will be allowed until the Contractor selects a method to prevent ground movement. The Contractor may use a temporary casing. The Contractor's method to prevent ground movement shall be approved by the Engineer. The casings for the anchor holes, if used, shall be removed. The drill hole shall be located so the longitudinal axis of the drill hole and the longitudinal axis of the tendon are parallel. The ground anchor shall not be drilled

in a location that requires the tendon to be bent in order to enable the bearing plate to be connected to the supported Structure. At the point of entry the ground anchor shall be installed within plus or minus 3 degrees of the inclination from horizontal shown in the Plans or the approved Working Drawings.

The tendon shall be inserted into the drill hole to the desired depth. When the tendon cannot be completely inserted without difficulty, the Contractor shall remove the tendon from the drill hole and clean or redrill the hole to permit insertion. Partially inserted tendons shall not be driven or forced into the hole.

The grout equipment shall produce a grout free of lumps and undispersed cement. A positive displacement grout pump shall be used. The pump shall be equipped with a pressure gauge near the discharge end to monitor grout pressures. The pressure gauge shall be capable of measuring pressures of at least 150 psi or twice the actual grout pressures used by the Contractor, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The mixer shall be capable of continuously agitating the grout.

The grout shall be injected from the lowest point of the drill hole. The grout may be pumped through grout tubes, casing, or drill rods. The grout can be placed before or after insertion of the tendon. The quantity of the grout and the grout pressures shall be recorded. The grout pressures and grout takes shall be controlled to prevent excessive heave in soils or fracturing of rock formations.

After grouting, the tendon shall not be loaded for a minimum of 3 days.

No grout shall be placed above the top of the bond length during the time the bond length grout is placed. The grout at the top of the drill hole shall not contact the back of the Structure or the bottom of the trumpet. Except as otherwise noted, only nonstructural filler shall be placed above the bond length grout prior to testing and acceptance of the anchor. The Contractor may place structural grout above the bond length grout prior to testing and acceptance of the anchor subject to the following conditions:

1. The anchor unbonded length shall be increased by 8 feet minimum.
2. The grout in the unbonded zone shall not be placed by pressure grouting methods.

The corrosion protection surrounding the unbonded length of the tendon shall extend up beyond the bottom seal of the trumpet or 1 foot into the trumpet if no trumpet seal is provided. If the protection does not extend beyond the seal or sufficiently far enough into the trumpet, the Contractor shall extend the corrosion protection or lengthen the trumpet.

The corrosion protection surrounding the no load zone length of the tendon shown in the Plans shall not contact the bearing plate or the anchor head during testing and stressing. If the protection is too long, the Contractor shall trim the corrosion protection to prevent contact.

The bearing plate and anchor head shall be placed so the axis of the tendon and the drill hole are both perpendicular to the bearing plate within plus or minus 3 degrees and the axis of the tendon passes through the center of the bearing plate at the intersection of the trumpet and the bearing plate when fully seated with the alignment load.

The trumpet shall be completely filled with corrosion inhibiting grease or grout. Trumpet grease can be placed anytime during construction. Trumpet grout shall be placed after the ground anchor has been tested. The Contractor shall demonstrate to the Engineer that the procedure selected by the Contractor for placement of either grease or grout produces a completely filled trumpet.

All anchorages permanently exposed to the atmosphere shall be covered with a corrosion inhibiting grease-filled or grout-filled cover. The Contractor shall demonstrate to the Engineer that the procedures selected by the Contractor for placement of either grease or grout produces a completely filled cover. If the Plans require restressable anchorages, corrosion inhibiting grease shall be used to fill the anchorage cover and trumpet.

(g) Testing and Stressing.

Each ground anchor shall be tested. The test load shall be simultaneously applied to the entire tendon. Stressing of single elements of multi-element tendons will not be permitted. The Engineer will record test data.

The testing equipment shall consist of a dial gauge or vernier scale capable of measuring to 0.001 inch and shall be used to measure the ground anchor movement. The movement-measuring device shall have a minimum travel equal to the theoretical elastic elongation of the total anchor length plus 1 inch. The dial gauge or vernier scale shall be aligned so that its axis is within 5 degrees from the axis of the tieback. A hydraulic jack and pump shall be used to apply the test load.

All jacks, pressure gauges, pumps and load cells shall have been calibrated with each other within the last 6 months by an independent AASHTO accredited laboratory or by a Department laboratory. Calibrated jacks, gages, pumps and load cells shall have identifiable serial numbers to insure traceability to calibration tests.

The pressure gauge shall be graduated in increments of either 100 psi or 2 percent of the maximum test load, whichever is less. The pressure gauge will be used to measure the applied load. The pressure gauge shall be selected to place the maximum test load within the middle ⅔ of the range of the gauge. The ram travel of the jack shall not be less than the theoretical elastic elongation of the total anchor length at the maximum test load plus 1 inch. The jack shall be independently supported and centered over the tendon so that the tendon does not carry the weight of the jack. The Contractor shall have a second calibrated jack pressure gauge at the site. Calibration data shall provide a specific reference to the jack and the pressure gauge.

The loads on the ground anchors during the performance and verification tests shall be monitored to verify consistency of load where the test load is maintained within 5% of the specified value. Performance test loads, and verification test loads when specified, sustained for 5 minutes or less, and all proof test leads, shall be monitored by the jack pressure gauge alone. Performance test loads, and verification test loads when specified, sustained for longer than 5 minutes shall be monitored with the assistance of an electric or hydraulic load cell. The Contractor shall provide the load cell and a readout device. The load cell shall be mounted between the jack and the anchor plate. The load cell shall be selected to place the maximum test load within the middle ⅔ of the range of the load cell. The stressing equipment shall be placed over the ground anchor tendon in such a manner that the jack, bearing plates, load cell and stressing anchorage are in alignment.

The permanent ground anchor load monitoring procedure for performance test loads, and verification test loads, sustained for longer than 5 minutes shall be as follows:

Step 1: For each increment of load, attainment of the load shall be initially established and confirmed by the reading taken from the jack gauge.

Step 2: Once the permanent ground anchor load has been stabilized, based on the jack gauge reading, the load cell readout device shall immediately be read and recorded to establish the load cell reading to be used at this load. The load cell reading is intended only as a confirmation of a stable permanent ground anchor load, and shall not be taken as the actual load on the permanent ground anchor.

Step 3: During the time period that the load on the permanent ground anchor is held at this load increment, the Contractor shall monitor the load cell reading. The Contractor shall adjust the jack pressure as necessary to maintain the initial load cell reading. Jack pressure adjustment for any other reason will not be allowed.

Step 4: Permanent ground anchor elongation measurements shall be taken at each load increment as specified in Item 572.05(g)1.

Step 5: Steps 1 through 4 shall be repeated at each increment of load, in accordance with the load sequence specified in Item 572.05(g)1.

1. Performance Testing.

Performance tests shall be done in accordance with the following procedures. Five percent of the ground anchors and at any other locations as determined by the Engineer shall be performance tested. The Engineer will select the ground anchors to be performance tested. The initial three production anchors shall be performance tested.

The performance test shall be made by incrementally loading and unloading the ground anchor in accordance with the following schedule, consistent with the Contractor design. The load shall be raised from one increment to another immediately after a deflection reading.

PERFORMANCE TEST SCHEDULE

INCREMENT	LOAD	INCREMENT	LOAD
1	AL	15	AL
2	0.25DL *	16	0.25DL
3	AL	17	0.50DL
4	0.25DL	18	0.75DL
5	0.50DL	19	1.00DL
6	AL	20	1.20DL *
7	0.25DL	21	AL
8	0.50DL	22	0.25DL
9	0.75DL *	23	0.50DL
10	AL	24	0.75DL
11	0.25DL	25	1.00DL
12	0.50DL	26	1.20DL
13	0.75 DL	27	1.33DL *
14	1.00DL *	28	REDUCE TO LOCK-OFF LOAD
Where: AL – is the alignment load DL – is the tie back anchor design load			

The maximum test load in a performance test shall be held for 10 minutes. The load-hold period shall start as soon as the maximum test load is applied and the anchor movement, with respect to a fixed reference, shall be measured and recorded at 1, 2, 3, 4, 5, 6, and 10 minutes. If the anchor movement between 1 and 10 minutes exceeds 0.04 inches, the maximum test load shall be held for an additional 50 minutes. If the load-hold is extended, the anchor movement shall be recorded at 20, 30, 40, 50, and 60 minutes. If an anchor fails in creep, retesting will not be allowed. All anchors not performance tested shall be proof tested.

2. Proof Testing.

Proof tests shall be performed by incrementally loading the ground anchor in accordance with the following schedule, consistent with the Contractor's design. The load shall be raised from one increment to another immediately after a deflection reading. The anchor movement shall be measured and recorded to the nearest 0.001 inches with respect to an independent fixed reference point at the alignment load and at each increment of load. The load shall be monitored with a pressure gauge. At load increments other than the maximum test load, the load shall be held just long enough to obtain the movement reading.

Proof Test Schedule
Load
AL
0.25 DL
0.50 DL
0.75 DL
1.00 DL
1.2 DL
1.33 DL
AL
Jack to lock-off load
Where: AL – is the alignment load DL – is the design load

The maximum test load in a proof test shall be held for 10 minutes. The load-hold period shall start as soon as the maximum test load is applied and the anchor movement with respect to a fixed reference shall be measured and recorded at 1, 2, 3, 4, 5, 6, and 10 minutes. If the anchor movement between 1 and 10 minutes exceeds 0.04 inches, the maximum test load shall be held of an additional 50 minutes. If the load-hold is extended, the anchor movements shall be recorded at 20, 30, 40, 50, and 60 minutes. If an anchor fails in creep, retesting will not be allowed.

(h) Permanent Ground Anchor Acceptance Criteria.

1. A performance or proof tested ground anchor with a 10-minute load hold is acceptable if the:
   - Ground anchor carries the maximum test load with less than 0.04 inches of movement between 1 and 10 minutes; and
   - Total movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the tendon unbonded length.
2. A verification, performance or proof tested ground anchor with a 60-minute load hold is acceptable if the:
   - Ground anchor carries the maximum test load with a creep rate that does not exceed 0.08 inches/log cycle of time and is a linear or decreasing creep rate.
   - Total movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the tendon unbonded length.

If the total movement of the ground anchors at the maximum test load does not exceed 80 percent of the theoretical elastic elongation of the tendon unbonded length, the Contractor shall replace the ground anchor at no additional cost to the Department. Retesting of a ground anchor will not be allowed.

Ground anchors that have a creep rate greater than 0.08 inches/log cycle of time can be incorporated in the finished Work at a load equal to ½ its failure load. The failure load is the load carried by the anchor after the load has been allowed to stabilize for 10 minutes.

When a ground anchor fails, the Contractor shall modify the design, the construction procedures, or both. These modifications may include, but are not limited to, installing replacement ground anchors, modifying the installation methods, increasing the bond length or changing the ground anchor type. Any modification that requires changes to the Structure shall have prior approval of the Engineer. Any modifications of design or construction procedures shall be at the Contractor's expense.

Upon completion of the test, the load shall be adjusted to the lock-off load indicated in the plans and transferred to the anchorage device. The ground anchor may be completely unloaded prior to lock-off. After transferring the load and prior to removing the jack a lift-off reading shall be made. The lift-off reading shall be within 10 percent of the specified lock-off load.

572.06 Method of Measurement.

The Soldier Pile Retaining Wall will be measured in units of square feet of the exposed face of the wall as designated in the plans. If the working drawings show vertical and horizontal limits that are less than what is shown on the plans, then the measurement will be made on the limits shown on the working drawings.

572.07 Basis of Payment.

(a) Unit Price Coverage.

The Soldier Pile Retaining Wall will be paid for at the contract unit price.

This payment shall be full compensation for all submittals, labor, equipment, tools, materials (concrete, flowable backfill, reinforcing steel, piling, structural steel, ground anchor and corrosion protection systems, lagging, drainage, Shotcrete, concrete panels, etc.), material tests, field tests and incidentals necessary to acceptably fabricate and test the wall components and construct the wall. This payment shall also be full compensation for furnishing and placing the reinforcing steel for the wall facing.

Excavation will be covered under other items of work.

(b) Payment will be made under Item No.:

572-B Soldier Pile Retaining Wall, *, **, *** – per square feet
* "Temporary", "Permanent", or "with Permanent Ground Anchors"
**Type Wall Fascia (Shotcrete, Concrete Panels, Lagging)
***Wall Identification, if required. (i.e. Number 1, Number 2, etc.)

SECTION 833
LUMBER AND TIMBER - UNTREATED AND TREATED

833.01 Structural Lumber and Timber.

Structural lumber and timber shall be Southern Yellow Pine, unless otherwise noted on the plans or in the proposal, meeting the requirements of AASHTO M 168 "Standard Specification for Wood Products". The grade of structural wood shall be as shown on the plans.

833.02 Preservative Treatment.

Preservatives for treated wood shall meet the requirements of AASHTO M 133 "Preservatives and Pressure Treatment Processes for Timber".

833.03 Lagging Timber.

Lagging timber shall be fresh, rough cut hardwood. Lagging timber design and selection to be the responsibility of the contractor.