

## **SECTION 02200**

### **SUPPORT OF EXCAVATION**

#### **PART 1 – GENERAL**

##### **1.01 DESCRIPTION**

- A. Section including specifications for design and installation of excavation support.
- B. Section also includes specifications for excavation support systems the design of which is indicated on the Contract Drawings, as applicable.

##### **1.02 GENERAL**

- A. Refer to General Conditions 7.15, Trench Excavation Safety Plan, for basic requirements related to this Section.

##### **1.03 REFERENCE STANDARDS**

- A. American Railway Engineering and Maintenance-of-Way Association (AREMA):
  - 1. Manual for Railway Engineering (Manual)
- B. ASTM (ASTM International):
  - 1. A36 Specification for Carbon Structural Steel
  - 2. A53 Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless
  - 3. A252 Specification for Welded and Seamless Steel Pipe Piles
  - 4. A328 Specification for Structural Steel for Steel Sheet Piling
  - 5. A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shape
  - 6. A572 Specification for High-Strength Low-Alloy columbium-Vanadium Structural Steel
  - 7. A992 Specification for Structural Shapes
- C. American Welding Society (AWS):
  - 1. D1.1 Structural Welding Code
- D. American Wood Preservers Association (AWPA):
  - 1. U1 User Specification for Treated Wood

- E. California Code of Regulations (CCR):
  - 1. Title 8, Chapter 4, Subchapter 4, Construction Safety Orders
- F. Caltrain Engineering Standards for Excavation Support Systems
- G. State of California, Department of Transportation (Caltrans):
  - 1. Trenching and Shoring Manual (including Appendix H, Memo 3 – Southern Pacific Transportation Company Guidelines for Design of Shoring in Connection with Highway Grade Separations, and Memo 5, Shoring Adjacent to Union Pacific Company Tracks).

**1.04 DEFINITIONS**

- A. Railroad Zone of Influence: Refer to Caltrain Engineering Standards for Excavation Support Systems.

**1.05 DESIGN CRITERIA**

- A. Temporary excavation support (shoring) shall conform to the requirements in the Caltrans Trenching and Shoring Manual and Caltrain Engineering Standards for Excavation Support Systems.
- B. Excavations adjacent to active tracks: Excavations below the Zone of Influence Line indicated in the Contract Drawings shall be supported in accordance with Caltrain Engineering Standards for Excavation Support Systems. The Contractor may request a waiver of railroad loading requirements when excavations are less than 4 feet deep, less than 4 feet square in area and are not closer than 10 feet from the center line at the track.
- C. Where physical conditions of design require the placing of excavation support closer than specified herein, the design shall be submitted to the Engineer for review and approval of a waiver.
- D. When support of track or tracks is necessary during construction (that is shoring adjacent to active tracks), interlocking steel sheet piling adequately braced and designed to carry Cooper E-80 live load is required. Soldier piles and lagging will be permitted for supporting adjacent track or tracks only when required penetration of steel sheet piling cannot be obtained or when, if approved by the Engineer, steel sheet piling would be impractical to place.
  - 1. Do not use soldier piles and lagging for any shoring systems within the Railroad Zone of Influence.
- E. The excavation support shall allow safe and expeditious construction of the permanent structure and shall be designed to carry the loads imposed upon it, including earth pressures, vehicular traffic loading, railroad loading, utility loads, loads from adjacent structures, ground water pressure, equipment and construction loads, without movement or settlement of adjacent structures, utilities, or tracks.
- F. Design splices in structural steel members to develop 100 percent of the strength of the member.

- G. Cover excavations. Protect excavations by handrails, barricades, and warning lights.

**1.06 SUBMITTALS**

- A. Excavation Shoring Systems: Submit the following showing the proposed methods of construction, design, and details:
  - 1. Detailed working drawings for temporary shoring including the following: Plans, elevations, sections and details that clearly describe the systems to be installed to include the methods and procedures of installation to be followed and a description of each material to be employed. Dimensions and spacing of members shall be clearly noted. Include existing utility locations and temporary supports for utilities.
  - 2. Design computations demonstrating that the required design parameters have been met.
  - 3. Product data for materials and equipment.
- B. For Owner-Designed Excavation Shoring Systems, as Applicable: Submit the following:
  - 1. Shop drawings showing excavation support elements, including layout of piles and bracing elements. Identify and show location of existing utilities in both plan and elevation.
  - 2. Include details showing how the excavation support system will be installed around utilities.
  - 3. Design of temporary supports for utilities to be maintained across the excavations.
- C. Submit the following as applicable to specific support systems:
  - 1. Construction and installation procedures, excavation sequence, interface details, protection measures for existing structures and facilities, and contingency plans for excessive movement of existing walls and other facilities.
  - 2. Concrete mix designs as specified in Section 03300, Cast-in-Place Concrete.
  - 3. Soil-cement design mixes, including test data demonstrating that the proposed mixes will meet required strength.
  - 4. Quality control/quality assurance plan for soil-mix wall construction. Coordinate with Section 01400, Quality Control and Assurance, suitable for demonstrating that the soil-mix walls have been installed to the required depths and dimensions and will have the required strength, continuity, and permeability at the time of excavation. Include the means of continuously monitoring the slurry injection process during soil mixing, soil-cement sampling methods and frequency, and soil-cement testing methods and frequency.

- D. Submit instrumentation and monitoring plan that includes the following information:
  - 1. Drawings showing planned locations and identification numbers for each settlement point, railroad settlement point, and monitoring well.
  - 2. Proposed schedule for installing and for monitoring settlement points, railroad settlement points, inclinometers, and monitoring wells.
  - 3. Descriptions and details for methods and materials to be used in the installation of settlement points, railroad settlement points, inclinometers, and monitoring wells.
  - 4. Manufacturer's literature including product descriptions, and operation and maintenance procedures for instruments.
  - 5. Details for abandoning instruments at the completion of the Work.
- E. Submit as-built drawings of instrumentation installation within 5 days of completion of instrument installation.

**1.07 DELIVERABLES**

- A. Submit written confirmation signed by the Civil Engineer of the temporary shoring systems that the shoring systems have been constructed in accordance with the approved submittals.
- B. Submit the following as applicable to specific support systems:
  - 1. Deliverables specified under Section 05200, Structural Steel.
  - 2. Soil-cement testing results within 3 days of tests being performed.
  - 3. Instrument readings within 3 days of the readings being taken.

**1.08 QUALITY ASSURANCE**

- A. Temporary Shoring:
  - 1. Temporary shoring designs including working drawings and calculations shall be prepared, sealed, and signed by a Civil Engineer hired by the Contractor who is currently registered in the State of California, has previous experience in the design of temporary shoring systems, and is qualified as required in the Caltrain Engineering Standards for Excavation Support Systems.
  - 3. Contractor's Civil Engineer for the shoring design shall inspect the as-built shoring system to verify that the system is constructed in accordance with the approved shoring plans. The number of site visits and the stage or stages of construction at which they shall be performed shall be as required by the Engineer as a condition of approval of the shoring system.
  - 4. Maintain sheeting, bracing and other temporary protective work in place and functioning until temporary protective work is no longer necessary, as determined by the Contractor's Civil Engineer.

- B. Track Monitoring:
  - 1. Railroad tracks shall be monitored in accordance with the requirements outlined in Caltrain Engineering Standards for Excavation Support Systems.
  - 2. Surveying for monitoring settlement points shall be performed by a Land Surveyor hired by the Contractor licensed who is currently registered in the State of California with previous experience surveying for the detection of structural or ground surface movements.
- C. Comply with the following regulatory requirements:
  - 1. CCR, Title 8, Chapter 4, Subchapter 4, Construction Safety Orders.

**1.09 CONTRACTOR ALTERNATIVES**

- A. Where excavation support systems and details are shown on the Contract Drawings, the Contractor may propose alternate systems and details provided such systems meet the design requirements and criteria specified herein and shown on the Contract Drawings and the limitations on shoring types specified herein.
- B. Alternate excavation support systems and details shall be submitted for the Engineer's approval as specified herein for Contractor-designed excavation shoring systems.
- C. Should the Contractor choose to modify the shoring system, the Contractor does so at the Contractor's own risk and no claims for additional time or compensation will be allowed as a result of any delays or difficulties suffered.

**PART 2 – PRODUCTS**

**2.01 TEMPORARY SHORING MATERIALS**

- A. Materials for temporary shoring systems may be new or used, provided they are sound and free from any strength-impairing defects.
- B. Materials shall conform to the following specifications as shown on the approved submittals for Contractor-designed systems or as indicated on the Contract Drawings:
  - 1. Structural, Plate, and Tube Steel: ASTM A36, A500, A572, or A992
  - 2. Steel Sheet Piling: ASTM A328 or A572
  - 3. Steel Pipe: ASTM A53 or A252
  - 4. Concrete: As specified in Section 03300, Cast-in-Place Concrete, and shown on the Contract Drawings or in the approved submittals. Lean concrete strength shall be so proportioned that the concrete retains its shape during excavation operations.

5. Timber Shoring Elements: Douglas Fir, No. 2, or better. Timber to remain permanently in place shall be pressure-treated with preservative material in accordance with AWWA U1, User Category UC4B or UC4C.

## **2.02 INSTRUMENTATION AND MONITORING MATERIALS**

- A. Settlement Points: For paved areas: An inscribed marking of approved surveyor's nail driven flush with the pavement surface. For unpaved areas, two (2) by two (2) inch timber stake (hub) driven flush with the ground. Each settlement point shall have an identification tag or marking.
- B. Inclinometer shall consist of the following:
  1. Inclinometer Casing: A special purpose grooved casing used in inclinometer installations. Casing manufactured by Slope Indicator Company, Geokon, Inc., or Engineer approved equal, including accessories necessary for installation as recommended by the manufacturer. Provide locking cap with padlock for each installed casing.
  2. Inclinometer Probe: Digitilt Inclinometer Probe manufactured by Slope Indicator Company, Model 6000 Inclinometer Probe manufactured by Geokon, Inc., Engineer approved equal, including cable, pulley assembly, case and any other necessary accessories.
  3. Readout Unit: Digitilt DataMate manufactured by Slope Indicator Company, Model GK-603 Inclinometer Readout manufactured by Geokon, Inc., or Engineer approved equal.
  4. Software: Computer software required to reduce, to analyze, and to plot inclinometer data.
  5. All inclinometer materials and equipment shall be compatible with all other inclinometer materials and equipment.
- C. Monitoring Wells: Provide monitoring well materials in conformance with Contractor's approved instrumentation and monitoring plan. Provide an instrument suitable for the purpose determining the groundwater elevation in the monitoring well.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Implement Instrumentation and Monitoring Program including establishing railroad settlement points by marking locations on the track using means acceptable to the ORR.
- B. Prior to placing and driving steel piles or sheeting, hand dig exploratory trenches in areas where railroad underground installations are known to exist. Backfill these trenches immediately after the exploratory work is finished. Perform this work in the presence of the Engineer.
- C. Coordinate support of excavation with dewatering specified in Section 02210, Dewatering, as applicable.

### 3.02 TEMPORARY EXCAVATION SUPPORT SYSTEMS

- A. Fill cavities adjacent to the excavation support system created by driving of sheet or soldier piling with sand.
- B. Unless otherwise noted or directed, all components of the support system shall be left in place, cut off at the top and the remaining portion removed as the backfill is being placed.
- C. Immediately restore and tamp any ballast disturbed during construction of excavation support systems.
- D. Remove any bracing tieback anchors or other support devices that are exposed.
- E. Immediately fill all voids created by the excavation support members with lean concrete or sand.
- F. Perform final backfilling of excavations in accordance with Section 02300, Earthwork.
- G. Perform welding in accordance with the provisions of AWS D1.1.
- H. Splices in structural steel members shall develop 100 percent of the strength of the member.
- I. Maintain sheeting, bracing and other temporary protective work in place and functioning until temporary protective work is no longer necessary. Refer to quality assurance requirements specified herein.
- J. If, at any time, existing or new construction, tracks, utilities, or similar facilities appear to be endangered, support such facilities, subject to approval of the Engineer. Provide additional bracing or shoring if considered necessary by the Engineer to safeguard against and prevent movement or settlement.
- K. During construction, cut off sheet piling at the elevation of the top of adjacent tie. After construction and backfilling has been completed, remove sheet piling completely unless otherwise required by the Engineer or indicated in the Contract Documents.
- L. Protect track ballast against contamination. Replace contaminated ballast.
- M. Prevent settlement points from being damaged during construction.

**END OF SECTION**