MICHIGAN

DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

FOR

**SOLDIER PILE WALL**

BRG:AJM 1 of 9 APPR:SCK:RWS:11-21-23

**a. Description.** This work consists of furnishing, fabricating, and installing a soldier pile wall at the location shown on the plans. Install piles in drilled holes that are backfilled with concrete and non-structural flowable fill, where shown on the plans. Excavate as required, install temporary timber lagging, and then install permanent concrete facing where shown on the plans. Perform this work in accordance with the plans, the standard specifications and this special provision.

**b. Materials.**

1. Soldier Piles. Furnish hot-rolled steel shapes, of the size shown on the plans, in accordance with section 906 of the Standard Specifications for Construction. Use soldier piles with a yield strength not less than 50,000 psi.

2. Timber Lagging. Furnish 4-inch-thick rough-sawn, mixed hardwoods, select structural grade with a minimum allowable bending stress (Fb) of 1200 psi and a maximum moisture content of 19 percent. Ensure the minimum lagging nominal width is not less than 10 inches.

3. Concrete Backfill. Furnish concrete mix as specified in subsection 718.02 of the Standard Specifications for Construction except ensure the aggregate is modified to 26A gradation. Air entrainment is required for this project per subsection 1004.03.D of the Standard Specifications for Construction. For the plug piles shown on the plans, use flowable fill in accordance with the Special Provision for Non-Structural Flowable Fill instead of concrete.

4. Concrete Wall Facing. Furnish Grade 3500HP concrete in accordance with subsection 706.02 of the Standard Specifications for Construction.

5. Steel Reinforcement. Furnish epoxy coated steel reinforcement in accordance with section 905 of the Standard Specifications for Construction.

6. Geocomposite Drain Board. Furnish a geocomposite drain board in accordance with subsection 910.05.A of the Standard Specifications for Construction.

7. Slurry. Furnish slurries in accordance with subsection 718.03.E of the Standard Specifications for Construction.

8. Casing. Furnish casings in accordance with subsection 919.10 of the Standard Specifications for Construction unless otherwise shown on the plans.

9. Shear Developers. Furnish shear studs in accordance with subsection 707.02 of the Standard Specifications for Construction.

10. Premolded Fiber Joint Filler. Furnish joint filler in accordance with subsection 914.03 of the Standard Specifications for Construction.

11. Void Backfill. Furnish expansive foam, hand-packed granular material Class II or grout as approved by the Engineer to backfill voids.

12. Drain Pipe. Furnish a PVC drain pipe meeting the approval of the Engineer.

13. Geotextile Blanket. Furnish geotextile blanket in accordance with section 910 of the Standard Specifications for Construction.

14. Flowable Fill. Furnish flowable fill in accordance with the Special Provision for Non-Structural Flowable Fill.

**c. Construction.** Perform construction in accordance with the standard specifications except as specified herein.

To minimize the risk for disturbance of the existing railroad bridge and adjacent facilities, install soldier piles near the existing abutment in drilled shafts.

1. Qualifications.

A. Contractor Qualifications. Submit proof detailing a minimum of 5 years of successful experience in the construction of this type of wall to the Engineer at the preconstruction meeting.

B. Drilled Shaft Contractor. Ensure the drilled shaft contractor performing the work described in the contract is prequalified in the N9-5E Drilled Shafts/Complex work classification.

C. Drilled shaft supervisor and drillers must provide:

(1) Three projects with installed drilled shafts with diameters and lengths through soil similar to those shown on the plans.

(2) Drilled shaft contractor's fulltime onsite supervisor and driller(s) must have at least 5 years of acceptable experience in installing similar types of drilled shafts in similar subsurface conditions to this project. Projects performed at other companies will count toward the supervisor’s and driller’s experience.

D. At least 45 calendar days before the planned start of drilled shaft construction, the drilled shaft contractor must electronically submit the completed project reference list from subsection c.1.C of this special provision and a personnel list, limited to the supervisor and driller(s). The personnel list must provide a summary of each individual’s experience and be complete enough for the Engineer to determine whether each individual satisfies the required qualifications. The Engineer will approve or reject the drilled shaft contractor's supervisor and drillers qualifications within 15 calendar days after receipt of a complete submission. Additional time required due to incomplete or unacceptable submittals will not be justification for time extension or impact or delay claims. All such costs associated with incomplete or unacceptable submittals must be borne by the Contractor.

Do not start work until the Engineer’s written approval of the drilled shaft contractor's personnel qualifications is received. The Engineer may suspend the work if the drilled shaft contractor uses non-approved supervisors and drillers. If work is suspended, the Contractor will be fully liable for all resulting costs and no adjustment in contract time will result from the suspension.

2. Drilled Shaft Construction. Unless directed otherwise by the Engineer, construct the drilled shaft foundation in accordance with the details on the plans, section 718 of the Standard Specification for Construction, and this special provision.

A. Drilled Shaft Installation Plan. Submit a drilled shaft installation plan as described in subsection 718.03.A of the Standard Specifications for Construction. In addition, a procedure for lifting, splicing (if required) and installing the reinforcing steel cage needs to be submitted with the drilled shaft installation plan.

B. Preconstruction Meeting. The preconstruction meeting will take place at the project site and will be scheduled by the Engineer. The meeting will occur a minimum of 21 days prior to mobilization, with the drilled shaft installation plan submitted 7 days prior to the preconstruction meeting. The drilled shaft contractor may attend the meeting.

C. Survey. From existing survey control complete the detailed shaft layout. Do layout for each shaft to the lines and levels required before excavation, and the actual measurements of each shaft's horizontal axial location, bottom and top elevations, deviations from specified tolerances, and other data as required. Record and maintain all information pertinent to each shaft and cooperate with any other testing and inspection personnel of the Engineer to provide data for required reports.

D. Construction Method Log. The drilled shaft contractor must submit to the Engineer a daily construction method log during drilled shaft excavation and construction. This log must contain the following information for each drilled shaft:

(1) Date (start date and completion date).

(2) Drilled shaft identification number.

(3) Location.

(4) Actual top and bottom elevation of drilled shaft.

(5) Shaft diameter.

(6) Final centerline location at top.

(7) Variation of drilled shaft from plumb.

(8) Top and bottom elevations as well as diameter of all casing used.

(9) Description of each soil and rock material encountered during excavating and their approximate top and bottom depths or elevations.

(10) Depth drilled into bearing stratum.

(11) Top and bottom elevations of obstructions encountered.

(12) Amount of obstruction time, if any.

(13) Depth or elevation of encountered seepage or groundwater.

(14) Quantity of concrete placed.

(15) Remarks.

E.Subsurface Data. The geotechnical report outlining the subsurface exploration conducted during the design phase is included in the Reference Information Documents. The soil boring logs represent point information. Presentation of this information in no way implies that subsurface conditions are the same at locations other than the exact location of the boring. It is expressly understood that the Department will not be responsible for interpretations or conclusions drawn therefore by the Contractor. Additional soil test borings and other exploratory procedures may be performed by the Contractor at no additional cost to the contract.

F. Casing. Case the shaft excavation as determined by the Contractor and as shown on the plans. Install casing such that intimate contact with the surrounding earth or rock is maintained. Take precautions to prevent damaging existing structures and utilities by selecting appropriate casing installation methods and procedures.

G. Protection of Existing Structures. Control operations to prevent damage to the existing structures and utilities. Preventative measures must include, but are not limited to, selecting construction methods and procedures that will prevent caving of the shaft excavation, monitoring and controlling the vibrations from construction activities (such as installation of casing and drilling of the shaft), and monitoring and controlling the depth of excavation. Repair any damage to existing structures or utilities at the Contractors expense to the satisfaction of the Engineer, including engineering analysis and redesign, and without any extension of the completion dates for the project.

H. Construction Tolerances.

(1) Horizontal Alignment. Ensure the drilled shaft actual centerlines are within 2 inches of plan centerlines at the plan elevation for the top of the shaft. The pile must be within 1 inch of the plan centerline at the plan elevation for the top of the pile.

(2) Plumb. At the drilled shaft actual bottom elevation, ensure the out of plumb is no greater than 1 percent of the drilled shaft length as measured from the actual center of the shaft at the shaft design top elevation. For the pile, ensure that the out of plumb is no greater than 1/8 inch over 3 feet.

(3) Top of Shaft Elevation. Ensure the top elevation of the shaft is within ±1 inch from the plan top of shaft elevation.

(4) Reinforcing Steel. After all the shaft concrete is placed, ensure the top of the reinforcing steel cage is no more than 3 inches above or below plan position.

Drilled shaft excavations and completed shafts not constructed within the required tolerances will be considered unacceptable. The Contractor must correct all unacceptable shaft excavations and completed shafts to the satisfaction of the Engineer. Materials and work necessary to complete corrections for out of tolerance drilled shafts, including engineering analysis and redesign, is at the Contractors expense, and without an extension of the completion dates for the project.

I. Ensure reinforcing steel cage construction and placement is in accordance with subsection 718.03.G of the Standard Specifications for Construction and the following:

(1) Ensure a reinforcing cage, when called for on the plans, consisting of longitudinal bars, stiffener bars, centralizers and tie reinforcement or spiral reinforcement is completely assembled prior to placement in the shaft excavation. Place the steel reinforcement as a unit immediately after the shaft excavation is inspected and accepted, and prior to concrete placement.

(2) Use non-corrosive spacers on the exterior of the reinforcing cage, near the bottom of the cage and at sufficient intervals to ensure concentric spacing of the cage for its entire length within the shaft excavation. Ensure the spacers are of adequate dimensions to ensure a minimum 3 inches annular space between the outside of the reinforcing cage and the perimeter of the excavated shaft. Maintain the bottom of the cage the proper distance above the shaft base using approved concrete bottom supports, by supporting the cage with cables hooked to a crane, or by other methods approved by the Engineer.

(3) Tie and support the reinforcing steel in the shaft during concrete placement and temporary casing removal such that the reinforcing steel will remain within the allowable tolerances. Check the elevation of the top of the steel cage before and after the concrete is placed. If the reinforcing steel cage is not maintained within the specified tolerances, make corrections to the satisfaction of the Engineer. No additional shafts can be constructed until the Contractor has modified the steel cage support in a manner satisfactory to the Engineer.

J. Excavations. Maintain the stability of the excavation sidewalls and extend the shaft excavation to a stratum approved by the Engineer. Extend drilled shaft tip elevations when the Engineer determines the bearing stratum encountered during excavation is unsuitable and/or differs from that anticipated in the design of the drilled shaft. Variations in the bearing layer elevation from that shown on the plans may occur. Have equipment on-site capable of excavating an additional 20 percent of depth below that shown on the plans. Provide the Engineer access to auger cuttings and/or rock cores/cuttings of the bearing material for additional analysis. Fill in over-excavation of shafts with concrete which will be paid for at the unit rate specified for that type of formation. Fill in unauthorized shaft excavations extended below required depths/elevations with concrete at no additional cost to the contract.

Dispose of excavated materials removed from shaft excavations in accordance with section 205 of the Standard Specifications for Construction. Keep excavated materials away from each open shaft excavation. Direct surface water away from shaft excavations. Ensure no excavated materials are allowed to enter the waters of the state or storm drainage system when present.

K. Obstructions. Remove surface and subsurface obstructions encountered in the length of excavation at drilled shaft locations. Such obstructions may include materials such as old concrete foundations, boulders, abandoned utilities and riprap. Employ special procedures and/or tools after the excavation cannot be advanced using conventional augers fitted with soil or rock teeth, drilling buckets and/or under-reaming tools. Such special procedures/tools may include, but are not limited to: chisels, boulder breakers, core barrels, air tools (i.e. down hole air hammer), hand excavation, temporary casing, and enlarging the hole diameter. Removal of such obstructions will be paid as Obstruction Rem. Payment for Obstruction Removal will be made only when such special procedures/tools are utilized and approved by the Engineer.

L. Ensure excavation inspection is in accordance with subsection 718.03.F.1 of the Standard Specifications for Construction, with the following addition: After shaft excavation, provide access and time for the Engineer to inspect the shaft through video methods as long as a tremie pour is not required. Provide suitable lighting.

M. Concrete and Flowable Fill Placement. Perform concrete and flowable fill placement for drilled shafts in accordance with the applicable portions of section 706 and subsection 718.03.H of the Standard Specifications for Construction, the Special Provision for Non-Structural Flowable Fill, and as modified herein.

(1) Placement Methods. Deliver concrete and flowable fill to the site from the batch plant in a continuous manner to help avoid interruption of placement. Place concrete and flowable fill either by free-fall or through a tremie or concrete pump the same day the shaft is excavated. If concrete is not placed the same day as shaft excavation, additional excavations may be required by the Engineer to satisfy design elevations at no additional cost to the contract. After the shaft concrete backfill is completed, wait at least 15 hours before placing the flowable fill.

Free-fall placement is permitted only in dry excavations where free water accumulation of 3 inches or less can be maintained immediately prior to concrete and flowable fill placement.

(2) Temporary Casing. Coordinate temporary casing withdrawal, except for where plans specify it to be left in place), carefully with concrete and flowable fill placement. When temporary casing is being withdrawn, maintain a sufficient head of concrete and flowable fill above the bottom of the casing to prevent reduction in the shaft diameter due to earth and/or hydrostatic pressure on the fresh concrete or flowable fill, and to prevent extraneous material from mixing with fresh concrete or flowable fill. Check the concrete and flowable fill levels in the temporary casing prior to, and after casing withdrawal to confirm that separation of the shaft concrete or flowable fill has not occurred.

(3) Protection of Concrete and Flowable Fill. Protect fresh concrete and flowable fill from flowing water and damage from mechanical equipment and nearby construction vibrations. Vibrations from construction operations (vibratory casing installation, concrete demolition etc.) are not permitted within a radius of 25 feet until the concrete and flowable fill has attained 75 percent of its specified minimum strength. Protect concrete and flowable fill from strength reduction caused by heat, frost, or freezing actions.

(4) Concrete and Flowable Fill Volume. Check the actual volumes of concrete and flowable fill placed with the theoretically calculated concrete and flowable fill volumes to detect any large voids or intrusions of extraneous material. Provide results to the Engineer in Construction Method Log.

(5) Removal of Portions of Flowable Fill (where in conflict with the proposed excavation or placement of the timber lagging). Stage the partial removal of the flowable fill with the excavation in front of the wall and the placement of the timber lagging. Ensure the method of the removal is such as it assures the integrity of the remaining portions as shown on the plans subject to the Engineer’s approval.

3. Piles. Do not field splice piles. In drilled shafts, install the bottom of piles to the elevation or embedment shown on the plans. Piles may be installed in the drilled shafts prior to or directly after concrete placement in the finished hole. After installation, the position of each pile at cutoff elevation must be within 1 inch of the position shown on the plans. Cut off piles normal to the longitudinal axis of the pile within 1 inch of the elevations and dimensions shown on the plans. The piles, timber lagging and drain board must not encroach on the concrete wall thickness shown on the plans. In drilled shafts, temporarily brace or support piles in position until at least 15 hours after the concrete backfill is completed.

Fabricate the pile to conform to the details shown on the plans and in accordance with section 707 of the Standard Specifications for Construction.

Do not perform field welding except when installing shear developers.

Do not drive piles.

4. Timber Lagging. Remove concrete as necessary to expose the flange of the soldier pile. Install timber lagging using either bottom up or top down construction methods. Prevent loss of soil from behind the wall. Smooth the vertical soil surface to provide uniform soil contact with lagging. Maintain a gap not less than 1/8 inches and not more than 1/2 inches between each vertically adjacent lagging boards to allow for drainage. Backfill voids produced behind lagging in a manner, meeting the approval of the Engineer, that does not significantly prevent drainage through the lagging. All costs associated with filling of voids will be borne by the Contractor. Do not excavate nor place timber lagging until the concrete in the finished holes has attained a compressive strength not less than 80 percent of its 28-day compressive strength.

5. Geocomposite Drain Board. Install drain board, where specified on the plans, wide enough to completely fill the gap between adjacent solider beam pile flanges as shown on plans and with the pervious side facing the timber lagging. Place drain board in sections and spliced, or in a continuous roll so that as each timber is placed, the drain can be properly located as the excavation proceeds. Fasten drain board to timber lagging to prevent movement during placement of concrete wall facing. Connect the drain board to the connector pipe forming the weepholes centered between piles as shown on the plans.

6. Shear Developers. Install shear developers in accordance with section 707 of the Standard Specifications for Construction and as shown on the plans.

7. Steel Reinforcement. Place steel reinforcement as shown on the plans in accordance with subsection 706.03.E of the Standard Specifications for Construction. Extend steel reinforcement through construction joints. Do not extend steel reinforcement through expansion joints. Do not weld to steel reinforcement.

8. Concrete Wall Facing. Construct the cast-in-place wall facing in accordance with subsection 706.03 of the Standard Specifications for Construction and as shown on the plans. Forming on both sides of the wall may be necessary to allow proper wall construction. Construct joints as shown on the plans.

**d. Measurement and Payment.** The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

**Pay Item Pay Unit**

Drilled Shaft, Standard, \_\_ inch Foot

Drilled Shaft Equipment, Furn, Spec (Structure Identification) Lump Sum

Soldier Pile Wall, Furn and Install Square Foot

1. **Drilled Shaft, Standard, \_\_ inch** includes the drilled shaft excavation, temporary casings (except for where plans specify it to be left in place), slurry, shaft concrete, steel reinforcement cage, backfilling, disposal of excavated material and slurry necessary for construction, and preventative measures required to prevent cuttings or slurry from entering the rivers or drains when present. **Drilled Shaft, Standard, \_\_ inch** includes excavation of all materials including sand, silt, clay, peat, cobbles, boulders, weathered rock, rock, and combinations thereof.

2. **Drilled Shaft Equipment, Furn, Spec (Structure Identification)** includes furnishing and removing equipment for constructing the drilled shaft. This will include furnishing and removing equipment for soil and/or rock excavation.

3. **Soldier Pile Wall, Furn, and Install** includes furnishing, fabricating and installing the soldier piles, partially removing the non-structural flowable fill above the drilled shafts to facilitate the placement of the timber lagging/wall facing, furnishing and installing timber lagging, geotextile blanket, backfilling of voids behind lagging, geocomposite drain board, forming hardware, and shear developers. Costs associated with removal and proper disposal of excess materials will be borne by the Contractor.

The concrete wall facing will be paid for separately as **Conc, Grade 3500HP** in accordance with section 706 of the Standard Specifications for Construction.

The flowable fill will be paid for separately as **Flowable Fill, Non-Structural** in accordance with the Special Provision for Non-Structural Flowable Fill.

The steel reinforcement for the concrete wall facing will be paid for separately as **Reinforcement, Steel, Epoxy Coated** in accordance with section 706 of the Standard Specifications for Construction.

In areas where obstructions are present, the removal will be paid for separately as **Obstruction Rem** in accordance with section 718 of the Standard Specifications for Construction.

In areas where new backfill is required behind the lagging and/or the concrete facing, the backfill will be paid for separately as **Embankment, CIP, Spec** in accordance with the Special Provision for Embankment, CIP, Special and as shown on the plans.