



Iowa Department of Transportation

SPECIAL PROVISIONS FOR DRILLED-IN SOLDIER PILE AND LAGGING WALL WITH AESTHETIC CONCRETE FACING

Linn County
NHSX-100-1(77)--3H-57

Effective Date
January 22, 2014

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

120102.01 DESCRIPTION.

- A. This work shall consist of furnishing and constructing Drilled-in Soldier Pile and Lagging Wall with aesthetic concrete facing in accordance with this Special Provision and with the lines, grades and dimensions shown on the contract drawings and per the shop drawings prepared by the specialty wall contractor.
- B. A drilled-in soldier pile and lagging wall is a wall system composed of drilled-in steel soldier piles placed in a pre-bored hole, then encased in concrete; timber lagging between the soldier piles to temporarily support lateral soil loading; a permanent textured concrete structural wall facing attached to the soldier piles; and safety fencing along the top of the finished wall. The intent of this texturized facing is to precisely match the concrete color, texture and rustication of the adjacent Mechanically Stabilized Earth (MSE) retaining wall concrete panels
- C. Sequence of construction for the drilled-in soldier pile and lagging wall and adjacent MSE wall and backfill is shown on the contract drawings. The current sequence will require excavation to facilitate the construction of the abutment drilled-in piles and the MSE wall. Then the soldier piles will be drilled in from the excavated grade to the tip elevation, followed by placing the timber lagging and the drainage material. The fill behind the drilled-in soldier pile and lagging wall will be placed against the timber lagging. Finally, the cast-in-place facing will be constructed.

120102.02 MATERIALS.

A. Steel Soldier Pile.

- 1. Conform to Section 4167 of the Standard Specifications.
- 2. Storing, transporting, and handling shall be performed in a manner to prevent bending stresses or other damage.

B. Concrete for Drilled in Soldier Piles.

1. All materials, proportioning, air entraining, mixing, slump, and transporting of PCC shall be according to Section 2403 of the Standard Specifications, except as modified herein.
2. Water/cement ratio: not to exceed 0.45.
3. Drilled-in soldier pile construction: use Class D PCC mixture with a slump of 8 inches \pm 1.5 inches.
4. Portland cement: meet the requirements of ASTM C 150 Type I / II and Section 4101 of the Standard Specifications.
5. Air entrainment: apply Section 2403 of the Standard Specifications.
6. Mid-range water reducer is required according to Materials I.M. 403.
7. Retarder is required according to Materials I.M. 403 to maintain workable concrete.
8. Do not use Ground Granulated Blast Furnace Slag (GGBFS).

C. Timber Lagging.

Graded for extreme fiber stress of at least 1000 psi and with the full dimension thickness shown in the shop drawings.

D. Granular Backfill Material.

Ensure the backfill material meets the requirements of Section 4133 of the Standard Specifications, except that the percent passing the No. 200 sieve is not to exceed 5.0%.

E. Structural Concrete.

Apply Section 2403 of the Standard Specifications.

F. Geocomposite Drainage Material.

Geocomposite drainage material shall be Miradrain 9000 drainage panels or equivalent material approved by the Engineer.

G. Weep Hole Drainage .

Materials shall conform to the details and specifications provided in the contract drawings.

H. Steel Reinforcement..

Apply Section 2404 of the Standard Specifications.

I. Polyvinyl Chloride (PVC) Waterstop.

Greenstreak Base Seal Waterstop Shape #938, or approved equivalent.

J. Integrally Colored Concrete.

Cast-in-place (CIP) concrete facing for the drilled-in soldier pile and lagging wall shall utilize integrally colored concrete to match the color of the adjacent MSE retaining wall concrete panels and provide a uniform aesthetic appearance.

1. Concrete Strength: Concrete strength shall be as specified in the contract drawings or Standard Specifications.
2. Color: The final color of the drilled-in soldier pile and lagging wall CIP concrete facing shall be a light buff limestone color that matches the adjacent MSE wall concrete panel color. Obtain the concrete mix design and color pigment information from the MSE wall panel manufacturer

to aid the color matching process. If possible, match the sources and composition of sand and cement used in the manufacturing of the adjacent MSE wall panels.

3. Cement pigments shall comply with ASTM C 979. Pigments shall be lightfast, wettable, weather resistant, alkali resistant and free of deleterious fillers and extenders. The pigments shall be composed of inorganic natural and/or synthetic iron oxides to obtain the specified color. The amount of incorporated cement pigment shall not exceed 7% by weight of Portland cement in the concrete mix.
4. The contractor shall verify with the pigment manufacturer the compatibility of cement pigment with concrete admixtures, form release compounds and cleaning and curing methods. The sources and composition of sands and aggregate shall remain consistent for all applications involving integrally colored concrete.
5. For integrally colored concrete, Class 3 durability coarse aggregate is required. Fly ash and calcium chloride shall not be used. GGBFS may be used if it is in accordance with the pigment manufacturer's recommendations.
6. Water to cement ratio shall be kept as consistent as possible, and in accordance with the Standard Specifications.
7. Use only the identical integral concrete color supplier and pigment as were used in the manufacturing of the adjacent MSE wall concrete panels. Approved cement pigment suppliers include the following:
 - a. Scofield Systems (800) 800-9900
 - b. Davis Colors (800) 835-0849
 - c. Dynamic Color Solutions (800) 657-0737
 - d. Other suppliers submitted to and approved by the Iowa DOT Office of Materials.

K. Concrete Form Liners.

1. Form liners used shall be identical to those used to create the textures on the adjacent MSE retaining wall concrete panels. Obtain form liner materials that precisely match the manufacturers and pattern numbers used for casting the MSE panels.
2. Form liner systems shall be made of high-strength urethane elastomer, plastic or flexible foam materials capable of withstanding anticipated concrete pour pressures without leakage or causing physical defects.
3. Form liners shall easily attach to forms and be removable without causing concrete surface damage. Follow the manufacturer's recommendations for attaching form liners to the concrete forms. If recommended by the form liner manufacturer, use structural backers to prevent deformation of the liner during loading of forms. The liners shall be designed to form surfaces conforming to the design intent including shape, lines and dimensions specified in the contract drawings and to avoid visible pattern repeats.
4. Release agents shall be compatible with form liner materials and shall be non-staining. Apply release agents in accordance with the form liner manufacturer's recommendations.
5. If used, ties shall be made of non-corrosive materials when the portion permanently embedded in the concrete is less than 1 1/2 inches from the finished surface.

L. Concrete Rustication.

1. Inserts used within the forms to create the rustication features may be made of wood, steel, plastic or other nonporous material capable of withstanding anticipated concrete pour pressures without physical defects. Wood inserts, if used, shall be free of warp, twist, checks or cracks, and shall be presoaked prior to placement of concrete in the forms.
2. Rustication inserts shall not allow leakage of concrete between the form and the insert. When steel forms are used, rustication strips may be rigidly attached to the inside form surface. When steel forms are not used, fasten rustication strips to the forms in a manner which will permit them to remain in the concrete when the forms are removed. Leave inserts in place until they can be removed without damaging surrounding concrete.
3. The inserts shall be designed to form surfaces and features conforming to the shape, lines, depths and dimensions shown in the contract drawings. Create inserts using a minimum number of splice joints in their length. Splices, if used, shall be tightly joined so as not to allow gaps or leaks, and shall not create any change in alignment or shape of the rustication feature in the formed concrete surface.

M. Vinyl Coated Chain Link Fence.

Materials shall conform to the details and specifications provided in the contract drawings.

120102.03 CONSTRUCTION.

A. Contractor Qualifications.

Prior to the commencement of the drilled-in soldier pile and lagging wall work, the Contractor shall submit to the Engineer a report which identifies the Contractor's personnel who will be performing and supervising the work. The report shall include the names of an engineer-in-charge, on-site supervisors, and drill operators. The report shall also contain a list of employer's names and telephone numbers, location and dates of previous projects, and the extent of work performed. This information must be verifiable.

1. An on-site supervisor shall be present at the job site at all times during the performance of the work. The on-site supervisor shall have 1 year of construction experience in the installation of permanent soldier pile and lagging walls and shall have supervised the successful installation of three walls. The work experience time period is computed by the addition of all documented durations of the work time on construction projects.
2. Drill operators shall have successfully installed three permanent soldier pile and lagging walls.

B. Submittals.

The Contractor shall submit their proposed drilled-in soldier pile and lagging wall installation plans to the Engineer for review. The submission shall consist of details required to completely describe the retaining wall system and shall include the following:

1. Shop drawings for the drilled-in soldier pile and lagging wall shown on the contract drawings at least 2 weeks before beginning the work, which indicate the following, at a minimum:
 - a. Grade and strengths of all construction materials used.
 - b. Materials, details, arrangement, and method of construction of the proposed soldier pile and lagging retaining wall system.
 - c. Details for the timber lagging.
 - d. Method for installing soldier piles, including pre-drilling procedures. Driven soldier piles are not permitted.
 - e. Mix designs for structural concrete and procedures for placing the structural concrete in accordance with the provisions outlined in the Materials Section of this special provision.

- f. Sequence of construction with respect to adjacent MSE wall, fill placement, and final cast in place facing.
2. Welder qualifications and welding procedures in accordance with American Welding Society Standard AWS D 1.5, "Bridge Welding Code."
3. Descriptive data and operating procedure for all equipment to be used. This shall include, at a minimum; machinery required to install soldier piles (including drilling procedures), timber lagging, excavate soil, and remove obstructions. Submit all pertinent equipment data including sizes, weights, capacities, torques, and operating frequencies.
4. Review of the above submittals for the soldier pile and lagging retaining wall by the Engineer will not relieve the Contractor from the responsibility for the adequacy of the construction of drilled-in soldier pile and lagging wall to achieve the required results.
5. Provide manufacturer's literature and two colored concrete manufacturer's chip samples for the proposed concrete color pigment.
6. Submit a 1 foot by 1 foot sample of each of the proposed form liners. Samples may either be actual form liner materials or foam castings from the form liners proposed for use on the project.
7. Provide a drilled-in soldier pile and lagging wall concrete facing layout shop drawing for proposed surface treatment showing form liner locations and rustication details matching and aligned with the features on the adjacent MSE retaining wall panels. Vertical rustications shall be placed at 5 foot intervals beginning 5 feet east of the construction joint between the MSE retaining wall panels and the drilled-in soldier pile and lagging retaining wall concrete facing. Horizontal rustications shall be placed at 2.5 foot intervals matching the locations of the horizontal panel center rustications and the horizontal joints between panels on the adjacent MSE retaining wall. See the drawings for further information.

C. General Construction Methods.

1. Install and maintain the drilled-in soldier pile and lagging wall in accordance with the design as shown on the contract drawings and on the accepted shop drawings, and in such a manner as to minimize movement, settlement, or loss of ground, removal of fines from adjacent ground, and damage to or movement of adjacent structures or utilities.
2. Perform field welding by certified welders in accordance with the requirements of Section 4167 of the Standard Specifications.
3. Ensure no gaps or pockets occur between the placed fill and timber lagging.

D. Drilled-in Soldier Pile and Lagging Construction.

1. Excavate or fill as needed to provide a level working pad at the proposed bottom of permanent facing elevation shown in the contract drawings.
2. Pre-drill all soldier piles. Diameter of the pre-drilled holes shall meet the dimensions shown on the contract drawings. Prior to inserting the soldier pile, the Contractor shall make the necessary provisions to allow the Engineer to sound each hole to assure that loose soil has been removed to the Engineer's satisfaction. Once the design depth has been reached and loose soil removed from the bottom of the hole, the bottom of the hole shall be cleaned such that no more than 1 inch of muck remains at the bottom. The soldier pile section shall then be lowered into the hole to the minimum tip elevation specified on the contract drawings and structural concrete shall be immediately tremied to the proposed bottom of permanent facing

elevation. Concrete shall be over poured to the top of the shaft portion and remove the top contaminated concrete. If casing is used for the construction of the soldier pile excavation remove the casing as concrete placement progresses, and throughout concrete placement, the Contractor shall maintain the bottom of the casing at least 3 feet below the level of structural concrete. Drilling for soldier piles shall not be permitted until concrete in adjacent drilled holes has set for a period of at least 24 hours.

3. Place lagging and geocomposite drainage boards as detailed in the contract drawings.
4. Carefully place fill against the lagging to minimize the formation of voids. Place fill in accordance with Article 2432.03.G.4 of the Standard Specifications.
5. Fill placement shall proceed at a pace that prevents movement of the wall and loss of ground.

E. Construction Tolerances.

Soldier pile excavations and completed soldier piles not constructed within the required tolerances will be considered unacceptable. Correct all unacceptable excavations and completed soldier piles to the Engineer's satisfaction. Furnish materials and work necessary, including engineering analysis and redesign, to complete corrections for out of tolerance excavations (without either cost to the Contracting Authority or an extension of the completion dates of the project).

1. Ensure the drilled-in soldier pile is within 3 inches of plan position.
2. Ensure the vertical alignment of soldier pile excavation does not vary from the plan alignment by more than 1/4 inch per foot.
3. Casing dimensions are subject to American Pipe Institute tolerances applicable to regular steel pipe.

F. Cast in Place Facing

Permanent cast-in-place facing with architectural textured projections and rustications in accordance with the details shown in the contract drawings. PVC Waterstop shall be placed in accordance with the details shown in the contract drawings.

G. Weep Hole Drainage

Weep hole drainage system shall be constructed in accordance with the details shown in the contract drawings.

H. Mock Up Panel

1. The contractor shall construct a 5 foot wide, 5 foot tall, 6 inch (min.) thick mockup for review by the Engineer. Construct the mockup in close proximity to the adjacent MSE retaining wall and facing the same direction to accommodate direct color and texture comparison by the Engineer. The mockup shall be cast vertically and shall utilize integrally colored concrete with the proposed mix proportions and pigment color that are intended for use in final production work. The mockup shall also utilize the proposed form liners, shall demonstrate typical forming operations, use and position of ties, if required, and shall demonstrate typical rustication details as specified in the contract drawings. The mockup shall include a single plane of reinforcing located 2 inches clear from the nearest part of the front face. Following removal of mockup forms, patching methods for defects and form tie holes shall be demonstrated on the mockup. Patching of voids and tie holes may require adjustment of the mortar mix proportions so that the patches match or are slightly lighter than the surrounding concrete. White cement may be required to lighten the patching mix.

2. Mockup shall be produced at least 10 days before start of production concrete wall facing work to allow for adequate curing and final color evaluation when compared to the adjacent MSE retaining wall concrete panels by the Engineer. Additional mockup(s) may be ordered by the Engineer until an acceptable result is achieved. Actual drilled-in soldier pile and lagging wall concrete facing production may not proceed until final approval of the mockup following curing time deemed adequate by the Engineer for assessing the final concrete color.
3. The mockup shall remain at the project site for comparison to actual production concrete facing as it is placed. Upon completion of the project, the mockup shall become the property of the Contractor and shall be removed from the project site.
4. Complete records of the casting process, including mix design, water content, cement pigment and rate of incorporation, mixing sequence, form release compounds and patching, curing and cleaning methods used on the approved mockup shall be submitted to the Engineer prior to the start of concrete facing production work.

I. Execution of Facing

1. The Contractor shall take particular care in all aspects of casting the drilled-in soldier pile and lagging wall concrete facing in order to achieve a consistent color and quality in the finished surface. All colored concrete for the drilled-in soldier pile and lagging wall concrete facing shall be produced and placed in a single day and under a single production run.
2. Match patterns of form liner joints to make formed concrete surfaces appear uniform and continuous without visible seams and form marks. When joints are unavoidable, make joints along main features of the pattern in accordance with the manufacturer's recommendations. Use adequate blocking, sealing or other means in order to maintain the appropriate depth and character of texture at cut edges of form liners and to prevent mortar leakage. Do not locate ties within concrete rustications. Forms shall be watertight.
3. Concrete mixing, batching and transporting equipment shall be thoroughly rinsed prior to mixing and delivering colored concrete to the forms. The contractor shall follow pigment manufacturer's specifications for measuring pigment and distribution throughout the concrete prior to placement.
4. During loading of forms with concrete, take extra care to adequately vibrate concrete in order to maintain all intended features of the form liner and rustication in the formed surfaces. The completed surface shall be free of blemishes, surface voids and conspicuous form marks to the satisfaction of the Engineer. The Contractor shall correct any surface defects at no additional cost to the project.
5. Strip formwork using techniques in accordance with liner manufacturer's recommendations after the concrete has achieved the strengths or cure times required by the contract drawings and applicable specifications. Clean and repair form liner surfaces prior to re-use. Do not re-use damaged form liners or rustication strips on the project.
6. After removal of forms, the colored concrete surfaces are to be cleaned with potable water and a stiff, non-staining wire brush only. Do not stain or damage the surfaces during cleaning operations. Patching of voids and tie holes may require adjustment of the mortar mix proportions so that the patches match or are slightly lighter than the surrounding concrete. White cement may be required to lighten the patching mix. Finish minor defects to match the surrounding surface texture.
7. Cure concrete in accordance with the Standard Specifications.

J. Vinyl Coated Chain Link Fence.

Construction shall be done in accordance with the materials, methodologies, and to the dimensions specified in the contract drawings.

120102.04 METHOD OF MEASUREMENT.

Measurement for Drilled-in Soldier Pile and Lagging Wall will be lump sum.

120102.05 BASIS OF PAYMENT.

Lump Sum. Payment for Drilled-in Soldier Pile and Lagging Wall is full compensation for furnishing and placing all material, equipment, and labor necessary to satisfactorily build a drilled-in soldier pile and lagging wall as shown in contract drawings, including, but not limited to:

- Any earthwork to support the installation of the wall system,
- Predrilling soldier piles,
- Furnishing and placing soldier piles and concrete encasement,
- Furnishing and placing temporary timber lagging and clips,
- Furnishing and placing geocomposite drainage board,
- Furnishing and placing granular fill behind the wall,
- Furnishing and placing cast-in-place wall facing, including integrally colored concrete for soldier pile retaining wall CIP concrete facing, furnishing and placing form liners and rustication, and constructing mockup panel(s),
- Furnishing and installing weep hole drainage system including drilling of the concrete facing,
- Furnishing and placing of polyvinyl chloride waterstop, and
- Furnishing and placing vinyl coated chain link fence along the top of the wall.