SECTION 316216 - STEEL PILES

1. GENERAL
	* + 1. RELATED DOCUMENTS
				1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			2. SUMMARY
				1. Section includes steel H piles.
			3. PREINSTALLATION MEETINGS

Retain paragraph below if Work of this Section is extensive or complex enough to justify a conference.

* + - * 1. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.
			1. SUBMITTALS
				1. Submittals for this Section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.

USE PARAGRAPH BELOW WITH EPD REQUIREMENT WHEN PROJECT ESTIMATE IS $1M OR MORE.

* + - * 1. Submit an Environmental Product Declaration (EPD) from the manufacturer for steel H piles within this specification section, if available. A statement of the contractor’s good faith effort to obtain the EPD shall be provided if not available.

Manufacturer-provided EPDs must be Product Specific Type III (Third-Party Reviewed), in adherence with ISO 14025 *Environmental labels and declarations*, ISO 14044 *Environmental management – Life cycle assessment*, and ISO 21930 *Core rules for environmental product declarations of construction products and services.*

* + - * 1. Shop Drawings: For steel H piles. Show fabrication and installation details for piles, including details of driving points, splices, and pile caps.

Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

Retain subparagraph below if specifying static pile tests.

Include arrangement of static pile reaction frame, test and anchor piles, equipment, and instrumentation. Submit structural analysis data signed and sealed by the qualified professional engineer, licensed in the State of New York, responsible for their preparation.

Include pile numbering plan.

* + - * 1. Qualification Data: For [**Installer**] [**professional engineer**] [**and**] [**testing agency**].

Retain paragraph below if retaining “Welding Qualifications” paragraph in “Quality Assurance” Article.

* + - * 1. Welding certificates.
				2. Mill Test Reports: For [**steel H piles**] [**steel castings**] [**and**] [**steel plate**], signed by manufacturer.

"Pile-Driving Equipment Data" Paragraph below is based on impact equipment. Revise equipment data submittal if vibratory hammers, or other nonimpact equipment, are required or revise to include special driving assistance such as jetting, preboring, spudding, or followers if permitted.

* + - * 1. Pile-Driving Equipment Data: Include type, make, and rated energy range; weight of striking part of hammer; weight of drive cap; and, type, size, and properties of hammer cushion.

Three weeks prior to delivery of pile driving equipment to the site, complete and submit the NYSDOT Pile And Driving Equipment Data form BD 138 (in the APPENDIX) to the Director’s Representative. The submitted information on this form will be used to determine a driving blow count. Each separate combination of pile and pile driving equipment proposed by the Contractor will require the submission of a corresponding NYSDOT form BD 138.

* + - * 1. Pile load testing plan.
				2. Static Pile Test Reports: Submit within three days of completing each test.
				3. Pile-Driving Records: Submit within three days of driving each pile.
				4. Certified Piles Survey: Submit within [**seven**] <**Insert number**> days of pile driving completion.

Retain Paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
				2. Preconstruction Survey: Submit before work begins.

Preconstruction Photographs: Photographs or video of existing conditions of adjacent construction.

Preconstruction Survey: Existing conditions survey conducted by licensed NYS land surveyor of area in vicinity of proposed pile installation including adjacent buildings and utilities.

* + - 1. QUALITY ASSURANCE
				1. Installer Qualifications: The firm performing the Work of this Section shall have been regularly engaged in pile work for a period of not less than 5 years and shall be properly equipped to execute the Work. If directed, furnish a list of projects of a similar type and magnitude executed by the firm.

Retain "Welding Qualifications" Paragraph below if shop or field welding is required. If retaining, also retain "Welding certificates" Paragraph in "Submittals" Article.

* + - * 1. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

Welders: AWS qualified within previous 12 months for employed weld types.

Welding shall be performed only by welders, welding operators, and tackers who have been qualified by tests as prescribed in the AWS Code to perform the type of welding required.

Welding Procedure Qualification

Shielded metal arc welding procedures which conform to the provisions of the AWS Code shall be considered to be prequalified.

The welding procedures for flux cored arc welding shall be qualified in accordance with the following subparagraphs. Welding, specimen preparation, specimen testing, and test results required shall be in accordance with Procedure Qualification Sheets A thru F. Welding and machining shall be at the contractor’s expense. Prepared specimens shall be turned over to the Director’s Representative for testing at the State’s expense.

For welding procedures not previously approved by the Director, the test plate and required specimens shall be as shown on Procedure Qualification Sheet A.

For welding procedures previously approved by the Director, the test plate and required specimens shall be as shown on Procedure Qualification Sheet B.

To qualify a fillet welding procedure, the requirements of the appropriate foregoing subparagraph shall be met. In addition, a T-test fillet weld shall be made and tested in accordance with paragraph 5.10.3.1 of the AWS code.

Procedure Qualification Sheets A thru F will be supplied to the Contractor upon request.

* + - 1. PRECONSTRUCTION TESTING

Retain this article if load testing is required to verify design assumptions during pile installation. Load testing is usually performed before permanent pile installation.

* + - * 1. General: Static pile tests are used to verify driving criteria and pile lengths and to confirm allowable load of piles.

Revise subparagraphs below to suit Project.

Furnish test piles [**60 inches**] <**Insert dimension**> longer than production piles.

Determination of actual length of piles is based on results of static pile tests.

* + - * 1. Pile Tests: Arrange and perform the following pile tests:

Retain appropriate tests in subparagraphs below. Insert optional loading apparatus and loading procedures if required.

Axial Compressive Static Load Test: ASTM D1143. Procedure A, Quick Test [**and the following Procedures:**][**.**]

Delete, edit, or add other Procedures in subparagraphs below to suit project. Retain option in "Axial Compressive Static Load Test" Subparagraph above if retaining below.

Procedure B, Maintained Test.

Procedure C, Loading in Excess of Maintained Test.

Procedure G, Cyclic Loading Test.

Axial Tension Static Load Test: ASTM D3689.

Lateral Load Test: ASTM D3966.

Retain first paragraph below if required. Telltale rods or strain rods are used for incremental strain measurements, an optional test described in ASTM D1143.

* + - * 1. Equip each test pile with two telltale rods, according to ASTM D1143, for measuring deformation during load test.
				2. Provide pile reaction frame, anchor piles, equipment, and instrumentation with enough reaction capacity to perform tests. Notify Director’s Representative at least 48 hours in advance of performing tests. On completion of testing, remove testing structure, anchor piles, equipment, and instrumentation.

Allow a minimum of [**seven**] <**Insert number**> days to elapse after driving test piles before starting pile testing.

Revise "Number of Test Piles" Subparagraph below to suit Project.

Number of Test Piles: [**One pile**] [**As indicated**] <**Insert number**>.

* + - * 1. Drive test piles at locations indicated to the minimum penetration or driving resistance indicated. Use test piles identical to those required for Project, and drive with appropriate pile-driving equipment operating at rated driving energy to be used in driving permanent piles.

Revise "Pile Design Load" Subparagraph below to include pile design loads if required. Respective ASTM load-test standards include default loading procedures as percentages of pile design loads. Revise if piles are loaded to failure.

Pile Design Load: [**As indicated**] <**Insert load**>.

Revise "Approval Criteria" Paragraph below to suit Project. Criteria are examples only.

* + - * 1. Approval Criteria: Allowable load shall be the load acting on the test pile when[**the lesser of**] the following criteria are met, divided by a factor of safety of [**2**] <**Insert value**>:

Retain one or more of three subparagraphs below, or insert other criteria to suit Project.

Net settlement, after deducting rebound, of not more than 0.01 inch/ton of test load.

Total settlement exceeds the pile elastic compression by 0.15 inch, plus 1.0 percent of the tip diagonal dimension.

A plunging failure or sharp break in the load settlement curve.

* + - * 1. Test Pile-Driving Records: Prepare driving records for each test pile[**, compiled and attested to by a professional engineer, licensed in the State of New York**]. Include same data as required for driving records of permanent piles.
				2. Test piles that comply with requirements, including location tolerances, may be used on Project.
			1. DELIVERY, STORAGE, AND HANDLING
				1. Deliver piles to Project site in such quantities and at such times to ensure continuity of installation. Handle and store piles at Project site to prevent buckling or physical damage.

Retain "Painted Piles" Subparagraph below if piles are painted.

Painted Piles: Protect finish and touch up paint damage before driving piles.

* + - 1. FIELD CONDITIONS
				1. Protect structures, underground utilities, and other construction from damage caused by pile driving.

Revise "Site Information" Paragraph below to suit Project and office practice.

* + - * 1. Site Information: A geotechnical report has been prepared for this Project and is [**included**] [**referenced**] elsewhere in the Project Manual for information only.
				2. Preconstruction Photographs: Inventory and record the condition of adjacent structures, underground utilities, and other construction. Document conditions that might be misconstrued as damage caused by pile driving. Comply with Section 013233 "Photographic Documentation."
1. PRODUCTS
	* + 1. STEEL H PILES

Retain one or more of three paragraphs in this article or revise to include other types of steel. Indicate locations and lengths on Drawings if more than one steel type is proposed; for example, for permanently immersed and marine splash zones.

ASTM A572, Grade 50 (Grade 345) in "High-Strength, Low-Alloy, Columbium-Vanadium Structural Steel" Paragraph below is the most commonly used type of steel for H piles.

* + - * 1. High-Strength, Low-Alloy, Columbium-Vanadium Structural Steel: ASTM A572, [**Grade 50**] [**Grade 60**] <**Insert grade**>.

Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

<**Insert, in separate subparagraphs, manufacturer's name**>.

Steel types in "High-Strength, Low-Alloy, Nickel, Copper, Phosphorous Steel H Piles" and "High Strength, Low-Alloy, Structural Steel" paragraphs below have greater corrosion resistance but also have higher costs and longer delivery time. Both types have yield strengths of 50 ksi. Verify availability with manufacturers.

* + - * 1. High-Strength, Low-Alloy, Nickel, Copper, Phosphorous Steel H Piles: ASTM A690.

Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

<**Insert, in separate subparagraphs, manufacturer's name**>.

* + - * 1. High-Strength, Low-Alloy, Structural Steel: ASTM A588.

Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

<**Insert, in separate subparagraphs, manufacturer's name**>.

* + - 1. PILE ACCESSORIES
				1. Driving Points: Manufacturer's standard one-piece driving point, fabricated from steel castings as follows to provide full bearing of web and flange of pile tip:

Retain "Carbon-Steel Castings" or "High-Strength Steel Castings" Subparagraph below or revise to suit Project. Types are examples only. Carbon-steel castings are used more than high-strength steel castings. Verify, with manufacturers, availability of steel castings of specific grades.

Carbon-Steel Castings: ASTM A27, [**Grade 65-35, heat treated**] [**or**] [**Grade N1**].

High-Strength Steel Castings: ASTM A148, [**Grade 80-40**] [**or**] [**Grade 90-60**].

Retain "Splice Unit" Paragraph below if using manufactured splice units.

* + - * 1. Splice Unit: Manufacturer's standard splice unit, fabricated from two connected steel plates, of same material as steel H pile or material of equal strength, shaped to encase web and part of each flange.
			1. PAINT

Retain this article if protective painting is required. Painting of piles is rare except in marine environments and adds considerable expense to Project.

If a separate primer is required, supplement this article with epoxy-resin, zinc-rich, or other rust-inhibiting primers. Revise to a proprietary coating system if required.

* + - * 1. Paint: SSPC-Paint 16; self-priming, two-component, coal-tar epoxy polyamide, [**black**] [**red**] [**manufacturer's standard color**].
			1. FABRICATION
				1. Fabricate and assemble piles in shop to greatest extent possible.
				2. Pile-Length Markings: Mark each pile with horizontal lines at 12-inch intervals; label the distance from pile tip at 60-inch intervals. Maintain markings on piles until driven.

Retain one of first two paragraphs below. Piles less than 60 feet long should not need splices unless lengths of different steel material are required.

* + - * 1. Fabricate full-length piles to eliminate splicing during driving, with ends square.
				2. Fabricate full-length piles by splicing lengths of steel H pile together. Accurately mill meeting ends of piles and bevel for welding. Maintain axial alignment of pile lengths. Maintain structural properties of pile across splice.

Retain "Splice Units" or "Continuously Welded Splices" Subparagraph below. If retaining first subparagraph, indicate splice-unit details on Drawings; if retaining second, indicate type and size of weld on Drawings.

Splice Units: Notch web of pile, fit splice unit into position, and weld according to manufacturer's written instructions and AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

Continuously Welded Splices: Splice piles by continuously welding according to AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

Retain option in subparagraph below if field splicing is permitted.

Splice piles during fabrication[**or field installation**].

* + - * 1. Fit and weld driving points to tip of pile according to manufacturer's written instructions and AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
			1. SHOP PAINTING

Retain this article if shop painting is required. Painting of piles is rare except in marine environments and adds considerable expense to Project.

* + - * 1. General: Shop paint steel pile surfaces, except for surfaces to be encased in concrete, as follows:

Extend painting to a depth of 60 inches below [**finished grade**] [**low-tide level**] to top of exposed pile.

* + - * 1. Surface Preparation: Clean surfaces to be painted. Remove loose rust and loose mill scale, spatter, slag, and flux deposits. Prepare surfaces according to SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
				2. Painting: Immediately after surface preparation, apply coat of paint according to manufacturer's written instructions to provide a dry film thickness of not less than 8 mils.

Retain first subparagraph below if two-coat paint system is required; retain second subparagraph if three-coat paint system is required. Delete both if only one coat of paint is required.

Apply second coat to provide a dry film thickness of not less than 8 mils, resulting in a two-coat paint system thickness of not less than 16 mils.

Apply second and third coats with each coat having a dry film thickness of not less than 8 mils, resulting in a three-coat paint system thickness of not less than 24 mils.

Mark pile lengths after shop painting.

1. EXECUTION
	* + 1. EXAMINATION
				1. Perform Preinstallation Survey and document existing conditions using photographs and videos.
			2. DRIVING EQUIPMENT

Revise "Pile Hammer" Paragraph below by inserting a rated energy range if required.

* + - * 1. Pile Hammer: Air-, steam-, hydraulic-, or diesel-powered type capable of consistently delivering adequate peak-force duration and magnitude to develop the ultimate capacity required for type and size of pile driven and character of subsurface material anticipated.
				2. Hammer Cushions and Driving Caps: Between hammer and top of pile, provide hammer cushion and steel driving cap as recommended by hammer manufacturer and as required to drive pile without damage.

Revise "Leads" Paragraph below if templates may be used in lieu of leads.

* + - * 1. Leads: Use fixed, semifixed, or hanging-type pile-driver leads that hold the full length of pile firmly in position and in axial alignment with hammer.
			1. PREPARATION
				1. Notify the Director’s Representative of intent to drive piles at least 5 working days before scheduled start of pile driving.
			2. DRIVING PILES

Indicate tip elevations and limiting penetration resistance on Drawings or insert here if retaining "General" Paragraph below without retaining option. If retaining option, coordinate with "Preconstruction Testing" Article.

* + - * 1. General: Continuously drive piles to elevations or penetration resistance indicated[**or established by static load testing of piles**]. Establish and maintain axial alignment of leads and piles before and during driving.
				2. If obstructions are encountered in the driving operation which cannot be displaced, break up the obstructions to permit the unobstructed passage of the pile. If necessary, partially withdraw such a pile or remove it entirely as necessary to clear the obstruction and protect the pile from damage.

Retain "Predrilling" Paragraph below if predrilling is permitted. Predrilling is generally prohibited for friction pilings but, if approved by engineer, predrilling can be an effective method of penetrating hardpan, cemented strata, hard clay, or dense compacted clay. Revise to suit Project or if prejetting or other methods to facilitate pile driving are permitted.

* + - * 1. Predrilling: Provide pre-excavated holes where indicated, to depths indicated. Drill holes with a diameter less than the largest cross-section dimension of pile.

Firmly seat pile in predrilled hole by driving with reduced energy before starting final driving.

* + - * 1. Heaved Piles: Redrive heaved piles to tip elevation at least as deep as original tip elevation with a driving resistance at least as great as original driving resistance, or as directed. Additional driving shall be at the expense of the Contractor.
				2. Driving Tolerances: Drive piles without exceeding the following tolerances, measured at pile heads:

Review tolerances in "Location," "Plumb," and "Batter Angle" subparagraphs below, and revise to suit Project or office standards.

Location: 3 inches from location indicated, measured from center of pile.

Plumb: Maintain 1 inch in 48 inches from vertical, or a maximum of 4 inches, measured when pile is aboveground in leads.

Retain "Batter Angle" Subparagraph below for battered piles.

Batter Angle: Maximum 1 inch in 48 inches from required angle, measured when pile is aboveground in leads.

Cutoff Elevation: Top of pile shall be not more than 2 inches from its designed cutoff elevation.

Retain one of first two paragraphs below.

* + - * 1. Withdraw damaged or defective piles and piles that exceed driving tolerances, and install new piles within driving tolerances. Such additional piles shall be at the expense of the Contractor.

If retaining paragraph above, retain one of two subparagraphs below.

Fill holes left by withdrawn piles using cohesionless soil material such as gravel, broken stone, and gravel-sand mixtures. Place and compact in lifts not exceeding 72 inches.

Fill holes left by withdrawn piles as directed by Director’s Representative.

* + - * 1. Abandon and cut off rejected piles as directed by Director’s Representative. Leave rejected piles in place, and install new piles in locations as directed by Director’s Representative. Such additional piles shall be at the expense of the Contractor.
				2. Cut off tops of driven piles square with pile axis and at elevations indicated.
				3. Pile-Driving Records: Maintain accurate driving records for each pile[**, compiled and attested to by a qualified professional engineer, licensed in the State of New York**]. Include the following data:

Project name and number.

Name of Contractor.

Date of installation.

Pile location in pile group and designation of pile group and pile numbering.

Sequence of driving in pile group.

Pile dimensions.

Ground elevation.

Elevation of tips after driving.

Final tip and cutoff elevations of piles after driving pile group.

Records of redriving.

Elevation of splices.

Type, make, model, and rated energy of hammer.

Weight and stroke of hammer.

Type of pile-driving cap used.

Cushion material and thickness.

Actual stroke and blow rate of hammer.

Pile-driving start and finish times, and total driving time.

Time, pile-tip elevation, and reason for interruptions.

Number of blows for every 12 inches of penetration, and number of blows per 1 inch for the last 6 inches of driving.

Pile deviations from location and plumb.

Preboring, jetting, or special procedures used.

Unusual occurrences during pile driving.

If retaining "Certified Piles Survey" Paragraph below, retain "Certified Piles Survey" Paragraph in "Submittals" Article.

* + - * 1. Certified Piles Survey: Engage a [**land surveyor, licensed in the State of New York**] [**Professional Engineer, licensed in the State of New York**] to prepare a piles survey showing final location of piles in relation to the property survey and existing benchmarks.

Notify Director’s Representative when deviations from locations exceed allowable tolerances.

* + - 1. FIELD QUALITY CONTROL

Retain first option in "Special Inspections" Paragraph below if Owner engages special inspector. Consider retaining second option if authorities having jurisdiction allow Contractor to engage special inspector. If retaining second option, retain "Field quality-control reports" Paragraph in "Submittals" Article. See "Special Inspection" Article in the Evaluations.

* + - * 1. Special Inspections: Director’s Representative will engage a qualified special inspector to monitor pile driving operations and perform final inspection of completed work.

Notify Director’s Representative and inspection agencies 24 hours prior to commencement of pile driving operations.

Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

Retain "Testing Agency" Paragraph below, with or without "Special Inspections" Paragraph above, to identify who shall perform tests and inspections. If retaining second option in "Testing Agency" Paragraph, retain "Field quality-control reports" Paragraph in "Submittals" Article.

* + - * 1. Testing Agency: Director’s Representative will engage a qualified testing agency to perform tests and inspections.

Notify Director’s Representative and testing agencies 24 hours prior to commencement of pile driving operations.

Additional testing, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

Retain "Test and Inspections" Paragraph below to describe tests and inspections to be performed.

* + - * 1. Tests and Inspections:

Revise number or percentage of piles in "Dynamic Pile Testing" Subparagraph below to suit Project. Numbers are examples only.

Dynamic Pile Testing: High-strain dynamic monitoring shall be performed and reported according to ASTM D4945 during initial driving and during restriking on [**five single**] [**3 percent of**] <**Insert number or percent of**> piles.

Retain "Weld Testing" Subparagraph below if pile splices are permitted.

Weld Testing: In addition to visual inspection, welds shall be tested and inspected according to AWS D1.1 and inspection procedures listed below, at testing agency's option. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.

Retain one or more of "Liquid Penetrant Inspection," "Magnetic Particle Inspection," "Radiographic Inspection," and "Ultrasonic Inspection," subparagraphs below for applicable inspection procedures. Include extent of weld inspections for Contractor's information.

Liquid Penetrant Inspection: ASTM E165.

Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.

Radiographic Inspection: ASTM E94, minimum quality level "2-2T."

Ultrasonic Inspection: ASTM E164.

* + - * 1. Steel H piles will be considered defective if they do not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. TOUCHUP PAINTING
				1. Clean field welds, splices, and abraded painted areas and field-apply paint according to SSPC-PA 1. Use same paint and apply same number of coats as specified for shop painting.

Apply touchup paint before driving piles to surfaces that are immersed or inaccessible after driving.

* + - 1. CLEANING
				1. Subsequent to driving, clean the top section of each pile which will be embedded in concrete free of adhering soil, loose rust and scale, and other deleterious substances.
			2. DISPOSAL
				1. Remove withdrawn piles and cutoff sections of piles from site, and legally dispose of them off State's property.

END OF SECTION 316216