SECTION 316223 - COMPOSITE 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 concrete-filled [**steel-shell**] [**steel pipe**] piles.
			3. PREINSTALLATION MEETINGS

Retain "Preinstallation Conference" 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.
				5. Shop Drawings: For composite piles. Show fabrication and installation details for piles, including splices and tip details.

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

Indicate locations, sizes, type, and arrangement of reinforcement.

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.

Coordinate "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.

* + - * 1. Qualification Data: For [**Installer**] [**Professional Engineer**] [**and**] [**testing agency**].

Retain "Welding certificates" Paragraph below if retaining "Welding Qualifications" Paragraph in "Quality Assurance" Article.

* + - * 1. Welding certificates.
				2. Design Mixes: For each concrete mix. Include revised mix proportions when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

Retain "Material Certificates" Paragraph below to require submittal of material certificates from manufacturers.

* + - * 1. Material Certificates: For [**steel-shell piles and accessories**] [**steel pipe piles and accessories**] [**steel reinforcement**] [**and**] [**concrete admixtures**].

Retain "Material Test Reports" Paragraph below for material test reports that are Contractor's responsibility.

* + - * 1. Material Test Reports: For concrete materials.

"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.

Retain subparagraph below if specifying mandrel-driven, steel-shell piles.

Include mandrel type and details.

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 "Field quality-control reports" 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.
				2. Comply with requirements in ACI 301, "Specifications for Structural Concrete."

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 the following:

AWS D1.1, "Structural Welding Code - Steel."

AWS D1.3, "Structural Welding Code - Sheet Steel."

AWS D1.4, "Structural Welding Code - Reinforcing Steel."

* + - 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, revise, or add other Procedures in first three subparagraphs below to suit Project. Retain first 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 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 qualified 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 physical damage.

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

Painted Piles: Protect finish and touch up 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.
1. PRODUCTS
	* + 1. STEEL-SHELL PILES

Retain "Fluted Pile Shells" Paragraph below if fluted pile shells are required.

* + - * 1. Fluted Pile Shells: Manufacturer's standard, vertically fluted, pile shells; cold formed from steel sheet; 50,000-psi minimum yield strength after forming. Fabricate watertight, uniformly tapered sections with forged-steel conical nose welded to tip.

Retain "Constant Diameter Extensions" Subparagraph below if extension sections are required.

Constant Diameter Extensions: Fabricate with splice overlap capable of telescoping into tapered section.

Retain one of three options in "Taper" Subparagraph below.

Taper: [**0.14 inch in 12 inches**] [**0.25 inch in 12 inches**] [**0.40 inch in 12 inches**].

Retain one of four options in "Thickness" Subparagraph below, corresponding to obsolete 9-, 7-, 5-, or 3-gage steel designations, respectively.

Thickness: [**0.150 inch**] [**0.179 inch**] [**0.209 inch**] [**0.239 inch**].

Retain "Helically Corrugated Pile Shells" Paragraph below if helically corrugated pile shells are required.

* + - * 1. Helically Corrugated Pile Shells: Manufacturer's standard, helically corrugated, uniform-diameter, steel sheet shell piles; of enough strength and thickness to remain watertight and resist distortion and buckling due to soil pressure, internal mandrel operation, or redriving. Fabricate in one-piece lengths with minimum 3/16-inch- thick steel-plate boot continuously welded to tip and as follows:

Retain one of six options in "Nominal Diameter" Subparagraph below.

Nominal Diameter: [**8-5/8 inches**] [**10-5/8 inches**] [**11-1/8 inches**] [**12-1/4 inches**] [**14 inches**] [**16-1/8 inches**].

Retain one of four options in "Thickness" Subparagraph below or revise to suit Project. Thicknesses correspond to obsolete 18-, 16-, 14-, or 12-gage steel designations, respectively. If Contractor is responsible for choosing nonstructural shell thickness, delete thicknesses below or retain a default minimum thickness.

Thickness: [**0.048 inch, minimum**] [**0.060 inch, minimum**] [**0.075 inch, minimum**] [**0.105 inch**] <**Insert dimension**>.

* + - 1. STEEL PIPE PILES

Yield strength of Grade 2 pipe is 35 ksi (240 MPa); Grade 3 pipe, 45 ksi (310 MPa).

* + - * 1. Steel Pipe: ASTM A252, [**Grade 2**] [**Grade 3**]; seamless or welded.
			1. STEEL REINFORCEMENT
				1. Reinforcing Bars: ASTM A615, Grade 60; deformed.

Retain "Low-Alloy-Steel Reinforcing Bars" Paragraph below when welding of reinforcing bars is anticipated.

* + - * 1. Low-Alloy-Steel Reinforcing Bars: ASTM A706.
				2. Galvanized Reinforcing Bars: ASTM A767, Class II zinc coated, hot-dip galvanized after fabrication and bending, as follows:

Retain one of two options in "Steel Reinforcement" Subparagraph below for type of reinforcement to be galvanized.

Steel Reinforcement: [**ASTM A615, Grade 60**] [**ASTM A706**]; deformed.

* + - * 1. Epoxy-Coated Reinforcing Bars: ASTM A775 or ASTM A934, as follows:

Retain one of two options in "Steel Reinforcement" Subparagraph below for type of reinforcement to be epoxy coated.

Steel Reinforcement: [**ASTM A615, Grade 60**] [**ASTM A706**]; deformed.

* + - * 1. Plain Steel Wire: ASTM A82, [**as drawn**] [**galvanized**].
				2. Deformed-Steel Wire: ASTM A496.
				3. Epoxy-Coated-Steel Wire: ASTM A884, Class A coated, [**plain**] [**deformed**].
			1. CONCRETE MATERIALS

Retain materials in this article if required. Revise to suit Project.

* + - * 1. Portland Cement: ASTM C150, Type I or II.

Retain mineral or cementitious admixtures in both "Fly Ash" and "Ground Granulated Blast-Furnace Slag" subparagraphs below if permitted. Ready-mix plant blends these materials with portland cement.

Fly Ash: ASTM C618, Class C or F.

Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.

Retain "Blended Hydraulic Cement" Paragraph below if blended hydraulic cement, blended at cement plant, is permitted. Retain one of four options below. Retain selections in "Portland Cement" Paragraph above with selections below if Contractor's choice.

* + - * 1. Blended Hydraulic Cement: ASTM C595, [**Type IS, portland blast-furnace slag**] [**Type IP, portland-pozzolan**] [**Type I (PM), pozzolan-modified portland**] [**Type I (SM), slag-modified portland**] cement.

Retain one of three options in "Normal-Weight Aggregates" Paragraph below or revise to suit Project. ASTM C33 limits deleterious substances in coarse aggregate depending on climate severity and in-service location of concrete. Classes 3S, 3M, and 1N apply to severe, moderate, and negligible weathering regions, respectively, unless stricter limits, such as those in first two options, are specified. Insert aggregate gradation if required.

* + - * 1. Normal-Weight Aggregates: ASTM C33, [**Class 4S**] [**Class 4M**] [**Class 1N**] <**Insert class**>, uniformly graded, 3/4-inch maximum aggregate size. Provide aggregates from a single source.
				2. Water: Potable, complying with ASTM C94 requirements.
				3. Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent chloride ions by mass of cementitious material.

Retain one or more admixtures in subparagraphs below.

Air-Entraining Admixture: ASTM C260.

Water-Reducing Admixture: ASTM C494, Type A.

Retarding Admixture: ASTM C494, Type B.

Water-Reducing and Retarding Admixture: ASTM C494, Type D.

High-Range, Water-Reducing Admixture: ASTM C494, Type F.

High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.

Plasticizing and Retarding Admixture: ASTM C1017, Type II.

* + - 1. PILE ACCESSORIES

Retain this article if manufactured pile accessories are required for steel pipe piles. Delete if steel-shell piles are required.

Retain "Driving Points" Paragraph below if tip of steel pipe pile is closed.

* + - * 1. Driving Points: Manufacturer's standard 60-degree conical driving point, with integral reinforcing ribs, to provide full bearing of pipe pile tip. Fabricate from steel castings as follows:

Retain "Inside Cutting Shoes" or "Outside Cutting Shoes" Paragraph below if cutting shoes are required in open-ended, steel pipe piles.

* + - * 1. Inside Cutting Shoes: Manufacturer's standard, inside-flanged, open-ended cutting shoe, to provide full bearing of pipe pile tip. Fabricate from steel castings as follows:
				2. Outside Cutting Shoes: Manufacturer's standard, outside-flanged, open-ended cutting shoe, to provide full bearing of pipe pile tip. Fabricate from steel castings as follows:

Retain type and grade of steel castings in "Carbon-Steel Castings" or "High-Strength Steel Castings" subparagraphs below with paragraph retained above. 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**].

* + - * 1. Splice Coupling: Manufacturer's standard splice coupling, rolled from ASTM A36, carbon-steel bar or cast from heat-treated carbon steel, ASTM A27, Grade 65-35, with interior stop and internally tapered for friction fit driving.
			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.

Paint system below may be unsuitable for steel-shell piles. If a separate primer is required, supplement this article with epoxy-resin, zinc-rich, or other compatible rust-inhibitive 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. CONCRETE MIXES
				1. Prepare concrete design mixes according to ACI 301, determined by either laboratory trial batch or field test data basis.

Use a qualified testing agency for preparing and reporting proposed mix designs determined by laboratory trial batch.

* + - * 1. Proportion mixes according to ACI 301 to provide normal-weight concrete suitable for piles with the following properties:

Retain one of three options in "Compressive Strength (28 Days)" Subparagraph below or revise to suit Project.

Compressive Strength (28 Days): [**5000 psi**] [**4000 psi**] [**3000 psi**] <**Insert value**>.

Retain one of two options in "Maximum Water-Cementitious Material Ratio at Point of Placement" Subparagraph below or revise to suit Project.

Maximum Water-Cementitious Material Ratio at Point of Placement: [**0.45**] [**0.50**] <**Insert ratio**>.

Retain one of two options in "Slump Limit" Subparagraph below or revise to suit Project.

Slump Limit: [**5 inches**] [**8 inches**] <**Insert dimension**>, plus or minus 1 inch.

Retain first paragraph below if required and retain applicable option.

* + - * 1. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content of [**6.0 percent, plus or minus 1.5**] [**2.5 to 4.5**] percent.
				2. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.

Retain first option in first paragraph below if piles are exposed to chlorides in service; retain second option for situations that are not dry or protected from moisture in service. Percentages are derived from ACI 301.

* + - * 1. Limit water-soluble, chloride-ion content in hardened concrete to [**0.15**] [**0.30**] percent by weight of cement.
				2. Concrete-mix design adjustments may be considered if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant. Resubmit and obtain approval from Director’s Representative of proposed changes to concrete-mix proportions.
			1. FABRICATION
				1. Fabricate and assemble piles in shop to greatest extent possible.

Retain one of first two paragraphs below.

* + - * 1. Fabricate full-length piles to eliminate splicing during driving.
				2. Fabricate full-length piles by splicing pile lengths together. Maintain axial alignment of pile lengths. Maintain structural properties of pile across splice.

Retain "Splice Coupling" Subparagraph below for pipe piles if splice coupling is welded and work takes place in fabricator's shop.

Splice Coupling: Fit splice coupling into position and weld to adjoining steel pipe pile sections according to manufacturer's written instructions and AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

Retain first "Welded Splices" Subparagraph below if welded splices are required for pipe piles. Indicate type and size of weld on Drawings.

Welded Splices: Accurately mill meeting ends of steel pipe piles, and bevel for welding. Continuously weld pile according to AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

Retain "Welded Splices" Subparagraph below if welded splices are permitted or required for steel-shell piles.

Welded Splices: Continuously weld steel-shell pile according to manufacturer's written instructions and AWS D1.1 [**and AWS D1.3**] for procedures, appearance and quality of welds, and methods used in correcting welding work.

Revise subparagraph below if limiting option to shop fabrication.

Splice piles during fabrication or field installation.

Retain one of first two paragraphs below, if applicable, for steel pipe piles. Delete both if specifying steel-shell piles.

* + - * 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.
				2. Fit and weld cutting shoes 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.
				3. 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.
			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.

"Surface Preparation" Paragraph below describes steel pipe preparation. Contact manufacturers for steel-shell painting recommendations.

* + - * 1. Surface Preparation: Clean surfaces to be painted. Remove loose rust and loose mill scale, and remove spatter, slag, or 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 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. CONCRETE MIXING
				1. Ready-Mixed Concrete: Comply with ASTM C94.

Retain first subparagraph below unless water may be added after mixing. ACI 301 permits water to be added at point of delivery, up to amount allowed in approved design mix unless otherwise indicated.

Do not add water to concrete mix after mixing.

Maintain concrete temperature to not exceed 90 deg F.

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.

Retain "Mandrel" Paragraph below if specifying mandrel-driven, steel-shell piles.

* + - * 1. Mandrel: Expandable mandrel, capable of distributing driving energy throughout length of steel-shell pile.
			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. STEEL REINFORCEMENT
				1. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
				2. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.
				3. Fabricate and install reinforcement cages symmetrically about axis of pile [**shell**] [**pipe**] in a single unit.
				4. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover on reinforcement.
				5. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.
			3. CONCRETE PLACEMENT

Revise first paragraph below to suit soil conditions of Project.

* + - * 1. Do not place concrete until other piles within a radius of [**20 feet**] <**Insert value**> have been driven and approved.

Revise "Inspection" Paragraph below to suit Project.

* + - * 1. Inspection: Before placing concrete, allow testing and inspecting agency to visually inspect and verify that each pile [**shell**] [**pipe**] is clean, watertight, plumb, and free of distortion or other defects.
				2. Place concrete in a continuous operation and without segregation immediately after cleaning out pile [**shell**] [**pipe**].

Revise first paragraph below to suit Project.

* + - * 1. Place concrete by means of bottom discharge bucket, flexible drop chute, or steep-sided funnel hopper or tremie or pump concrete into place.
				2. Place concrete in a dry pile [**shell**] [**pipe**] unless placement underwater is approved by Director’s Representative.

Revise subparagraphs below if required.

Place concrete underwater by tremie method or pumping. Control placement operations to ensure tremie is embedded no less than 60 inches into concrete, and flow of tremied concrete is continuous from bottom to top of pile [**shell**] [**pipe**].

Other methods of depositing concrete may be used if approved by Director’s Representative.

* + - * 1. Consolidate final 10 feet of concrete during placement to ensure that concrete is thoroughly worked around steel reinforcement and into corners.
				2. Screed concrete level at cutoff elevation and apply a scoured, rough finish.
			1. 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.

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 cl**ay. 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. Pile Splices: Splice piles during installation and align pile segments concentrically.
				3. 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.

Retain "Excavation" Paragraph below for open-ended, steel pipe piles filled with concrete.

* + - * 1. Excavation: Clean out steel pipe pile by removing soil and debris from inside pile before placing steel reinforcement or concrete.

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 last 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 special inspector to monitor pile driving operations and 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 first 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 "Tests 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.

Revise first subparagraph below to a percentage of piles to be tested if required. Low-strain integrity testing is not subject to consensus-standard testing procedures. Consider adding particular tests and acceptance criteria.

Low-strain integrity measurement shall be performed and reported for each pile.

Retain welding inspection in "Welding 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 the inspection procedures listed in subparagraphs below, at testing agency's option. Correct deficiencies in Work that test reports and inspections indicate does 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.

Concrete: Sampling and testing of concrete for quality control shall include the following:

Sampling Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.

Slump: ASTM C143; one test at point of placement for each compressive-strength test, but no fewer than one test for each concrete load.

Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F and below or when 80 deg F and above, and one test for each set of compressive-strength specimens.

Compression Test Specimens: ASTM C31; one set of [**four**] <**Insert number**> standard cylinders for each compressive-strength test unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens unless field-cured test specimens are required.

Revise number of test cylinders in "Compression Test Specimens" Subparagraph above and number of tests in "Compressive-Strength Tests" Subparagraph below if required.

Compressive-Strength Tests: ASTM C39; one set for each truck load. One specimen shall be tested at seven days, two specimens shall be tested at 28 days, and one specimen shall be retained in reserve for later testing if required.

When frequency of testing provides fewer than five strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing in-place concrete.

Strength level of concrete is considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

Test results shall be reported in writing to Director’s Representative, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, concrete type and class, location of concrete batch in piles, design compressive strength at 28 days, concrete-mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as sole basis for acceptance or rejection.

Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate concrete strengths or other requirements have not been met.

* + - * 1. Concrete-filled steel 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 316223