SECTION 316213 - PRECAST CONCRETE PILES

Revise this section by deleting and inserting text to meet project-specific requirements.

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 [**hollow**] [**solid**], precast, prestressed concrete 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**].

If needed, insert list of conference participants not mentioned in Section 013100 "Project Management and Coordination."

* + - 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 each type of precast structure 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 concrete piles. Prepared by or under the supervision of a qualified Professional Engineer, licensed in the State of New York, detailing fabrication and lifting devices necessary for handling and driving piles.

Indicate pile dimensions, cross sections, locations, sizes. Show details of pile splices and shoes.

Indicate types of reinforcement, including prestressing strand, and detail fabricating, bending, and placing.

Indicate layout and dimensions and identify each pile. Indicate welded connections by AWS standard symbols. Detail cast-in hardware.

Indicate transportation, storage, and lifting points.

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.

Retain "delegated-design submittal" paragraph below if design services have been delegated to contractor.

* + - * 1. Delegated-Design Submittal: For concrete piles.

Indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer, licensed in the State of New York, responsible for their preparation.

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**] [**manufacturer**] [**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.

Retain "material certificates" paragraph below to require submittal of material certificates from manufacturers.

* + - * 1. Material Certificates: For [**steel reinforcements**] [**prestressing strand**] [**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, pre-boring, 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.
        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**] **[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. Preinstallation Survey Report: Submit existing conditions survey conducted by licensed NYS Land Surveyor of area in vicinity of proposed pile installation including adjacent buildings and utilities. Additionally, provide photographic/video documentation of existing conditions identifying existing irregularities.
      1. QUALITY ASSURANCE
         1. Manufacturer Qualifications:

Retain "engineering responsibility" subparagraph below if contractor is required to assume responsibility for design.

Engineering Responsibility: Assumes engineering responsibility to comply with requirements in "Performance Requirements" Article by engaging a qualified Professional Engineer, licensed in the State of New York, to prepare design calculations, Shop Drawings, and other structural data for piles.

Revise "PCI plant certification program" subparagraph below, or delete if not required. Pile fabricators are usually certified for both B2 and C2 product groups and categories. Product Group B refers to bridge construction; Group C refers to commercial structural precast concrete.

PCI Plant Certification Program: Participates in PCI's Plant Certification Program and is designated a PCI-Certified Plant for [**B2**] [**and**] [**C2**] product group and category, or better.

* + - * 1. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

Installer's responsibility includes engaging a qualified Professional Engineer, licensed in the State of New York, to prepare pile-driving records.

Retain "testing agency qualifications" paragraph below if contractor or manufacturer selects testing agency or if contractor is required to provide services of a qualified testing agency in "Field Quality Control" article.

* + - * 1. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated[**and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025**] **<Insert Accreditation Requirements>**.
        2. Design Practices: Comply with ACI 318-19 and the recommendations in PCI Committee Report: "Recommended Practice for Design, Manufacture and Installation of Prestressed Concrete Piling."
        3. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for piles, comply with applicable requirements in PCI MNL-116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
        4. 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 "informational submittals" article.

* + - * 1. Welding Qualifications: Qualify procedures and personnel according to the following:

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

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

* + - 1. PRECONSTRUCTION TESTING

Retain this article if load testing is required to verify design assumptions. 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**] 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**] **[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**].

* + - * 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**].

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**].

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 cracking, distorting, warping, or other physical damage, and so markings are visible.
         2. Lift and support piles only at designated lifting or supporting points as shown on Shop Drawings.
      2. 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.

Retain "preconstruction photographs" paragraph below if adjacent construction is sensitive to vibrational effects of pile driving. Delete if not required or if director’s representative provides preconstruction photographs.

* + - * 1. 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. MANUFACTURERS

Delete this article unless naming pile manufacturers. See PCI's web site at https://www.pci.org/pci/pci-certification/pci\_certified\_plants\_search for current PCI-certified plant listings.

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

* + - * 1. 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. PERFORMANCE REQUIREMENTS

Retain "delegated design" paragraph below if contractor is required to assume responsibility for design.

* + - * 1. Delegated Design: Engage a qualified Professional Engineer, licensed in the State of New York, to design piles, including comprehensive engineering analysis, using performance requirements and design criteria indicated.
        2. Structural Performance: Piles shall withstand transportation, erection, and driving stresses and design loads within limits indicated and under conditions existing at Project site.

Consult a structural engineer experienced in engineering driven piles of type indicated to quantify design loads applicable to project.

Retain "design loads" subparagraph below if design loads are not indicated on drawings.

Design Loads: <**Insert loads**>.

* + - 1. FORM MATERIALS
         1. Forms: Provide molds of metal, plastic, wood, or another material that is nonreactive with concrete and that produces required finish surfaces.
      2. STEEL REINFORCEMENT
         1. Reinforcing Bars: ASTM A615, Grade 60; deformed.

Retain "low-alloy-steel reinforcing bars" paragraph below when anticipating welding of reinforcing bars.

* + - * 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**] **<Insert Reference Standard>**, 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 A1064, [**as drawn**] [**galvanized**].
        2. Deformed-Steel Wire: ASTM A1064.
        3. Epoxy-Coated-Steel Wire: ASTM A884, Class A coated, [**plain**] [**deformed**].
      1. PRESTRESSING TENDONS

ASTM A416 establishes low-relaxation strand as the standard. Revise this article for stress-relieved strand if required.

* + - * 1. Prestressing Strand: ASTM A416, Grade 250 or 270; uncoated, seven-wire, low-relaxation strand.
      1. CONCRETE MATERIALS
         1. General: Limit water-soluble chloride ions in concrete to the maximum percentage by mass of cementitious material permitted by ACI 318, but not more than 0.06 percent.

Retain one of two options in "Portland Cement" paragraph below for cement type. Type I is used in freshwater or land environments, Type II is used in marine environments, and Type III is for high early strength. Revise to type v for severe sulfate resistance.

* + - * 1. Portland Cement: ASTM C150, [**Type I or Type III**] [**Type II**], of same type, brand, and source.

Retain mineral or cementitious admixtures in "fly ash" and "silica fume" subparagraphs below if permitted.

Fly Ash: ASTM C618, Class C or F.

Silica Fume: ASTM C1240, amorphous silica.

Retain one of three options in "normal-weight aggregates" paragraph below for class of aggregate, 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 PCI MNL-116 or in first two options, are specified.

* + - * 1. Normal-Weight Aggregates: Except as modified by PCI MNL-116, ASTM C33, with coarse aggregates complying with [**Class 4S**] [**Class 4M**] [**Class 1N**] <**Insert class**>. Provide aggregates from single source.

Retain one of two options in "nominal maximum size of aggregate" subparagraph below; revise aggregate size or replace with gradation if required.

Nominal Maximum Size of Aggregate: **[3/4] [1] [inch].**

* + - * 1. Water: Potable, free of deleterious material that may affect color stability, setting, or strength of concrete, and complying with chemical limits of PCI MNL-116.
        2. Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures.

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.

Water-Reducing and Accelerating Admixture: ASTM C494, Type E.

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 "pile shoes" paragraph below if pile-tip protection is required for very hard strata. Revise title and description if using steel points or stubs instead of shoes.

* + - * 1. Pile Shoes: 1-inch-thick minimum, carbon-steel plate fabricated to match shape of pile tip.

Retain "pile splices" paragraph below if manufactured splices are permitted. Replace general description with particulars of a proprietary splice if required.

* + - * 1. Pile Splices: Manufactured from carbon-steel plates or castings and capable of developing strength of continuous pile at splice location.
      1. CONCRETE MIXES
         1. Prepare design mixes for each type of concrete required.

Retain subparagraph below if fly ash or silica fume is permitted.

Limit use of fly ash and silica fume to not exceed, in total, [**25**] percent of portland cement by weight.

* + - * 1. Design mixes may be prepared by a qualified independent testing agency or by qualified personnel at precast manufacturing plant at precast manufacturer's option.
        2. Proportion mixes by either laboratory trial batch or field-test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the FOLLOWING PROPERTIES:

Retain one option in "compressive strength (28 days)" subparagraph below or revise to suit project. Verify availability with manufacturers.

Compressive Strength (28 Days): [**8000 psi**] [**7000 psi**] [**6000 psi**] [**5000 psi**].

A maximum water-cementitious material ratio of 0.40 is usual for precast, prestressed concrete. Lower ratios are possible with use of high-range water reducers. Revise ratio in "maximum water-cementitious material ratio" subparagraph to suit project.

Maximum Water-Cementitious Material Ratio: 0.40.

Retain 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.
      1. FABRICATION

Check PCI tolerances to verify suitability for project.

* + - * 1. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete placement and temperature changes and for pretensioning and detensioning operations. Maintain molds to provide completed piles of shapes, lines, and dimensions indicated, within fabrication tolerances specified in PCI MNL-116 and PCI MNL-135.

Unless molds are stripped before detensioning, design molds so stresses are not induced in piles due to deformation of concrete under prestress or movement during detensioning.

Retain subparagraph below if using square piles.

Chamfer edges and corners of square piles.

* + - * 1. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

Accurately position, support, and secure reinforcement against displacement by molds, construction, or concrete placement. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.

Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

* + - * 1. Prestress tendons for piles by either pretensioning or post-tensioning methods. Comply with PCI MNL-116.
        2. Pile Shoes: Accurately position and secure pile shoes at pile tips so as to not affect pile alignment during driving. Weld pile shoes to longitudinal reinforcements.

Retain "pile splices" paragraph below if pile splices are required.

* + - * 1. Pile Splices: Accurately position and secure pile-splice segments requiring embedding in tips of piles.
        2. Mix concrete according to PCI MNL-116 and requirements in this Section. After initial concrete batching, no additional water may be added.
        3. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in piles. Comply with requirements in PCI MNL-116 for measuring, mixing, transporting, and placing concrete.

Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL-116.

Comply with ACI 306.1 procedures for cold-weather concrete placement.

Comply with ACI 305R recommendations for hot-weather concrete placement.

* + - * 1. Identify pickup points of piles with permanent markings that correspond with markings indicated on Shop Drawings. Imprint casting date on each pile.
        2. Cure concrete, according to requirements in PCI MNL-116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.

Retain first paragraph below if pretensioning piles. Revise release strength to another percentage or an actual compressive strength as required. PCI permits release strength as low as 2500 PSI (17.2 MPA).

* + - * 1. Delay detensioning piles until concrete has attained at least [**70**] percent of its compressive strength as established by test cylinders cured under the same conditions as concrete.

If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.

Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.

* + - * 1. Where ends of strands are not enclosed or covered, cut flush and cover with a high-strength mortar bonded to unit with an epoxy-resin bonding agent.
        2. Fabricate precast, prestressed concrete piles straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL-116 and PCI MNL-135 product tolerances.

Include subparagraph below only for projects containing piles exposed above grade.

* + - * 1. Finish: Fabricate concrete piles with normal plant-run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are tolerated. Major or unsightly imperfections, honeycombs, or structural defects are not permitted.

Finish unformed surfaces by trowel unless otherwise indicated. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.

* + - * 1. 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. SOURCE QUALITY CONTROL

Retain "Testing Agency" paragraph below if required. Independent certification may be acceptable to authorities having jurisdiction without further monitoring of plant's quality-control and testing program by Director’s Representative.

* + - * 1. Testing Agency: [**Director’s Representative will engage**] a qualified testing agency to evaluate pile manufacturer's quality-control and testing methods.

Allow Director's Representative’s testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Director’s Representative's testing agency and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.

Always retain "testing" paragraph below because it establishes the minimum standard of plant testing and inspecting.

* + - * 1. Testing: Test and inspect piles according to PCI MNL-116.

Strength of piles will be considered deficient if units fail to comply with requirements.

Review testing and acceptance criteria with structural engineer. Insert criteria for load tests in "testing" paragraph below if required.

* + - * 1. If there is evidence that strength of piles may be deficient or may not comply with PCI MNL-116 requirements, Director’s Representative will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C42.

A minimum of three representative cores shall be taken from piles of suspect strength, from locations directed by Director’s Representative.

Retain one of first two subparagraphs below depending on in-service conditions.

Cores shall be tested, following immersion in water, in a wet condition per ACI 301 if piles are wet under service conditions.

Cores shall be tested in an air-dry condition per ACI 301 if piles are dry under service conditions.

Strength of concrete for each series of three cores shall be considered satisfactory if average compressive strength is at least 85 percent of the 28-day design compressive strength and no core compressive strength is less than 75 percent of the 28-day design compressive strength.

Test results shall be reported in writing on same day that tests are performed, with copies to Director’s Representative and pile manufacturer. Test reports shall include the following:

Project identification name and number.

Date when tests were performed.

Name of precast concrete manufacturer.

Name of concrete testing agency.

Identification letter, name, and type of pile represented by core tests; design compressive strength; type of break; compressive strength at break, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

* + - * 1. Patching: If core test results are satisfactory and piles comply with requirements, solidly fill core holes with patching mortar and finish to match adjacent pile surfaces.
        2. Piles will be considered defective if they do not pass tests and inspections.
        3. Prepare test and inspection reports.

1. EXECUTION
   * + 1. EXAMINATION

Revise this article to suit project.

* + - * 1. Site Conditions: Do not start pile-driving operations until earthwork fills have been completed or excavations have reached an elevation of [**6**]to [**12**] [**inches**] above bottom of footing or pile cap.
        2. Perform Preinstallation Survey and document existing conditions using photographs and videos.
      1. 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.

Retain subparagraph below if easy driving conditions result in tensile strength of pile reinforcement being exceeded.

Use pile hammer capable of adjustment to deliver reduced impact to maintain tensile stress within 70 percent of yield strength of pile reinforcement.

* + - * 1. 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. 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 Director’s Representative, 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.
        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: **[4] [inches]** from location indicated after initial driving, and 6 inches after pile driving is completed.

Plumb: Maintain **[1 in 48] [in] [inch]** 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 in 48] [in] [inch]** from required angle, measured when pile is aboveground in leads.

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.

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

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.
        2. Cut off tops of driven piles square with pile axis and at elevations indicated.

Retain "buildups" paragraph below if required. Revise concrete strength to suit project.

* + - * 1. Buildups: Construct buildups to elevations indicated of cast-in-place reinforced concrete with compressive strength not less than [**5000] [psi**] at 28 days.
        2. 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.

Type of pile and date of casting.

Pile location in pile group and designation of pile group.

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 "informational submittals" article.

* + - * 1. Certified Piles Survey: Engage a [**Land Surveyor**] [**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 Director’s Representative 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 "Informational Submittals" article. See "Special Inspection" article in the evaluations.

* + - * 1. Inspection:

Directors Representative will engage an inspector to monitor pile driving operations and perform final inspection of completed work.

Notify Director’s Representative and testing 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.

Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents. 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 "informational submittals" article.

Retain "tests and inspections" paragraph below to describe tests and inspections to be performed.

* + - * 1. Testing:

Directors Representative will engage a testing agency to perform required tests.

Test Piles: Required test piles are indicated on the Drawings. Test piles shall be the first piles driven in the group. Keep the Director’s Representative informed of the schedule for driving test piles. Drive test piles with the same equipment to be used for the remainder of the group.

Dynamically load test the test piles during the driving operation with instrumentation furnished by the Contractor. The test shall consist of intermittent pile driving while pile bearing capacity is electronically evaluated. Record load test data and furnish a copy to the Director’s Representative. After pile capacity has been obtained from the dynamic load test, instructions will be given by the Director’s Representative relative to penetration.

Test piles, if properly located and successfully tested, will be accepted as permanent piles and may be left in place.

* + - * 1. Driving Records: Obtain and record the data (required under Quality Control Submittals) on the Driving Records.
        2. Equipment Acceptance:

Unacceptable Piles: Piles that fail tests, are placed out of position, are below cutoff elevations, or are damaged.

Provide additional piles or replace piles to meet specified requirements.

* + - 1. ADJUSTING
         1. Remove improperly located piles and piles found defective after driving. In lieu of removing a pile, at the option of the Director, additional pile(s) may be driven adjacent to the deficient pile providing that this can be done without injury to the structure. Such additional piles shall be at the expense of the Contractor.
      2. DISPOSAL
         1. Remove withdrawn piles and cutoff sections of piles from site and legally dispose of them off Director’s Representative's property.

END OF SECTION 316213