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SECTION 05120 - STRUCTURAL STEEL

This Section uses the term Architect. Change this term as necessary to match the actual term used to identify the design professional as defined in the General and Supplementary Conditions.

1. GENERAL
	* + 1. RELATED DOCUMENTS
				1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
			2. SUMMARY

Retain above or below.

* + - * 1. This Section includes structural steel and architecturally exposed structural steel.
				2. Related Sections: The following Sections contain requirements that relate to this Section:

List below only products, construction, and equipment for this Project that the reader might expect to find in this Section but are specified elsewhere. Verify that the Section titles listed below for this Project's Specifications are correct.

Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.

Division 5 Section "Metal Fabrications" for miscellaneous steel framing.

Division 5 Section "Steel Decking" for field installation of shear connectors through deck.

Division 9 Section "Painting" for surface preparation and priming requirements.

* + - 1. PERFORMANCE REQUIREMENTS

Retain this Article when fabricator is made responsible for designing any structural steel connections. Coordinate requirements of this Article with the structural engineer. See AIA Document A201, 3.12.11 for Contractor's responsibility for calculations if paragraph below is retained with "Professional Engineer Qualifications" Paragraph under "Quality Assurance" Article. Delete or modify paragraphs below where Architect assumes or is required by law to assume design responsibility.

* + - * 1. Engineering Responsibility: Engage a fabricator who utilizes a qualified registered professional structural engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.
			1. SUBMITTALS
				1. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
				2. Product Data for each type of product specified.
				3. Shop Drawings detailing fabrication of structural steel components.

Include details of cuts, connections, splices, camber, holes, and other pertinent data.

Include embedment drawings.

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

Retain subparagraph below when "Performance Requirements" Article is retained, to meet requirements of authorities having jurisdiction, or to follow customary practice in Project's location.

Indicate type, size and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.

Include computations for all connections signed and sealed by the registered structural engineer responsible for their preparation.

* + - * 1. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
				2. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.

Edit list below to suit requirements. Add twist-off tension control bolts or other alternative design bolts, if required.

Structural steel, including chemical and physical properties.

Bolts, nuts, and washers, including mechanical properties and chemical analysis.

Direct-tension indicators.

Shear stud connectors.

* + - 1. QUALITY ASSURANCE
				1. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
				2. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

Retain subparagraphs below if required.

* + - * 1. Comply with applicable provisions of the following specifications and documents:

Delete references below if not applicable. Add others as required.

AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."

AISC's "Load and Resistance Factor Design (LFRD) Specification for Structural Steel Buildings."

AISC's "Specification for Allowable Stress Design of Single-Angle Members."

AISC's "Specification for Load and Resistance Factor Design of Single-Angle Members."

AISC's "Seismic Provisions for Structural Steel Buildings."

ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."

Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

Retain below if qualified engineer is required under "Performance Requirements" or "Submittals" articles.

* + - * 1. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.
				2. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."

Insert a time period for welder requalification in subparagraph below if required. AWS states welder qualifications remain in effect indefinitely unless the welder has not welded for more than 6 months or there is a specific reason to question a welder's ability.

Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

Retain below if required for architecturally exposed structural steel. If retaining, indicate location, size, and other details of mockups on Drawings or by inserts.

Delete below if work of this Section is not extensive or complex enough to justify a preinstallation conference. If retaining, coordinate paragraph below with Division 1 Section "Project Meetings."

* + - 1. DELIVERY, STORAGE, AND HANDLING
				1. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.
				2. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.

Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

* + - 1. SEQUENCING
				1. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.
1. PRODUCTS
	* + 1. MATERIALS
				1. Structural Steel Shapes, Plates, and Bars: As follows:

Select steel from list below or revise if necessary. Distinguish locations if more than one steel type is proposed.

Rolled W Shapes & Channels: ASTM A572 Grade 50 or A992.

Plates, Bars and Angles: ASTM A36

Below is a weathering steel.

* + - * 1. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B or C.
				2. Hot-Formed Structural Steel Tubing: ASTM A 501.
				3. Steel Pipe: ASTM A 500, Grade B or C.

Select pipe weight from below or revise to suit Project. Relationship between weight class and schedule no. or wall thickness varies as pipe diameter increases. See ASTM A 53 tables for further information.

Select appropriate materials from below or revise if other materials are required. AISC now uses the generic term "anchor rods" to include unheaded rods and headed bolts. Revise to add proprietary post-installed anchors, such as expansion bolts, drop-in anchors, sleeve anchors, adhesive capsule anchors, or injection adhesive anchors, when permitted.

* + - * 1. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
				2. Unheaded Anchor Rods: ASTM F 1554, Grade 36 and ASTM A 449.

Configuration: Straight and Hooked.

Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.

Plate Washers: ASTM A 36/A 36M carbon steel.

Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.

Finish: Plain.

* + - * 1. Threaded Rods: ASTM A 36/A 36M or ASTM A 449.

Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.

Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.

Finish: Plain.

Select 1 of 3 below.

When weathering steel is used, change Type 1 bolts to Type 3 below.

* + - * 1. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

Select 1 of 3 below.

When weathering steel is used, change Type 1 bolts to Type 3 below.

* + - * 1. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated.

Retain compressible-washer devices below where applicable. Replace with or add option of proprietary tension-control bolts when permitted.

* + - * 1. Welding Electrodes: Comply with AWS requirements.
			1. PRIMER

Delete this Article if shop painting is not required. Add proprietary primers when required as part of a special coating or painting system. Coordinate selection with surface preparation and topcoats. Coordinate with sprayed-on fireproofing.

The title of FS TT-P-664 primer below includes the words "VCO-compliant." The current version, FS TT-P-664D, allows up to 420 g/L volatile organic compounds (VOC's). Verify governing VOC limits in Project location if selecting below as a field repair primer. Shop priming may be subject to different VOC limits.

Verify that fabricators offer primers meeting limitations and characteristics below. Fabricator's standard primer usually provides minimal protection.

Below includes a range of inexpensive primers for one-coat shop-painting application. These primers usually provide limited steel protection.

* + - * 1. Primer: None
			1. GROUT

Cement grout is usually limited to light-duty applications.

Delete above or below if not required. For critical installations, require manufacturer to provide field assistance.

* + - * 1. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.
			1. FABRICATION
				1. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.

Camber structural steel members where indicated.

Identify high-strength structural steel according to ASTM A 6 (ASTM A 6M) and maintain markings until steel has been erected.

Mark and match-mark materials for field assembly.

Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.

Delete below if shop priming is not required.

Complete structural steel assemblies, including welding of units, before starting shop-priming operations.

Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

Retain paragraph and subparagraphs below when architecturally exposed structural steel is required.

* + - * 1. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.

Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.

Tolerance limits for architecturally exposed structural steel are generally one-half those permitted by AISC for structural steel. Revise when stricter limits are required.

Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

* + - * 1. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

Plane thermally cut edges to be welded.

* + - * 1. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

Retain paragraph below if shear connectors are shop installed to structural steel in composite construction.

Retain below if steel wall framing is required and included in this Section.

Retain below if steel wall framing is required and included in this Section. Coordinate requirements with drawing details.

* + - * 1. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

Weld threaded nuts to framing and other specialty items as indicated to receive other work.

* + - 1. SHOP CONNECTIONS
				1. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

When high-strength bolts are required, retain paragraph and applicable subparagraphs below, with or without paragraph above. Distinguish locations of both types of high-strength bolts where used on same Project.

* + - * 1. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
				2. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

Delete below if built-up sections are not required.

Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

Retain below when architecturally exposed structural steel is required.

Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

Delete subparagraph below if paragraph above suffices. Stripe painting adds cost but helps ensure that hard-to-reach areas, such as crevices, inside corners, and welds, are thoroughly coated and that sharp edges receive adequate coverage.

Delete "Surface Preparation" and "Priming" paragraphs above when retaining paragraph below. SSPC's "Painting System Guide No. 7.00" includes either SSPC-SP 2 or SP 3 surface preparation and a limited choice of nonlead primers. These 1-coat shop-painting systems may protect weather-exposed steel for up to 6 months.

* + - 1. GALVANIZING

Revise locations where galvanizing is required in paragraph below to suit Project. Delete galvanizing when not required.

* + - * 1. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.
			1. SOURCE QUALITY CONTROL

Retain this Article when shop testing is required. Revise if Contractor engages agency. Revise to suit local practices and local jurisdiction requirements.

* + - * 1. Owner will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.

Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.

Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.

* + - * 1. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
				2. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

AISC and RCSC allow turn-of-nut, calibrated wrench, alternative design bolts, and direct-tension indicators for bolt-tension testing. Add actual requirements if other than AISC "10 percent" will be inspected.

* + - * 1. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

Retain above or below.

* + - * 1. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

Retain applicable inspection procedures from below. Include extent of weld inspections for Contractor's information.

Liquid Penetrant Inspection: ASTM E 165.

Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."

Ultrasonic Inspection: ASTM E 164.

Retain paragraph and subparagraphs below when shop-welded shear connectors are required.

1. EXECUTION
	* + 1. EXAMINATION
				1. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.
				2. Do not proceed with erection until unsatisfactory conditions have been corrected.
			2. PREPARATION
				1. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

Retain below when design of composite or diaphragm construction is based on shoring. Revise subparagraph to suit Project.

* + - 1. ERECTION
				1. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.

Add leveling plates to paragraph below if required.

* + - * 1. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.

Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

Comply with manufacturer's instructions for proprietary grout materials.

* + - * 1. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

Retain below when architecturally exposed structural steel is required.

Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

* + - * 1. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

Level and plumb individual members of structure.

Review subparagraph below with structural engineer and revise as required. Delete temperature allowances if not required.

Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

* + - * 1. Splice members only where indicated.

Retain paragraph below when welded, architecturally exposed structural steel is required.

* + - * 1. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
				2. Do not use thermal cutting during erection.

Select above or below.

* + - * 1. Finish sections thermally cut during erection equal to a sheared appearance.
				2. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.
				3. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
			1. FIELD CONNECTIONS
				1. Install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

When high-strength bolts are required, retain paragraph and applicable subparagraphs below, with or without paragraph above. Distinguish locations of both types of high-strength bolts where used on same Project.

* + - * 1. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
				2. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

Delete below if built-up sections are not required.

Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

Retain below when architecturally exposed structural steel is required.

Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

* + - 1. REPAIRS AND PROTECTION

Retain paragraph below if galvanizing repair is required.

* + - * 1. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

Retain paragraph and subparagraphs below if on-site paint repair is in this Section. Touchup painting may be unnecessary if building is immediately enclosed and building in-service conditions require no permanent paint protection.

Delete paragraph and subparagraphs above and retain below if touchup painting is required for Project but is not part of the Work of this Section.

* + - 1. FIELD QUALITY CONTROL

Retain this Article when field testing is required. Revise if Contractor engages agency. Revise to suit local practices and local jurisdiction requirements.

* + - * 1. Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.

Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

* + - * 1. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
				2. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

AISC and RCSC allow turn-of-nut, calibrated wrench, alternative design bolts, and direct-tension indicators for bolt-tension testing. Add actual requirements if other than AISC "10 percent" will be inspected.

* + - * 1. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

Retain above or below.

* + - * 1. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

Retain applicable inspection procedures from below. Include extent of weld inspections for Contractor's information.

Liquid Penetrant Inspection: ASTM E 165.

Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."

Ultrasonic Inspection: ASTM E 164.

Retain paragraph and subparagraphs below when field-welded shear connectors are required.

Retain below when galvanizing repairs are required.

END OF SECTION 05120