SECTION 051200 - STRUCTURAL STEEL FRAMING

Revise this Section by deleting and inserting text to meet Project-specific requirements.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section Includes:

Structural steel.

Shear stud connectors.

Shrinkage-resistant grout.

* + - * 1. Related Requirements:

Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.

Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.

Section 055000 "Metal Fabrications" for **[steel lintels and shelf angles not attached to structural-steel frame] [miscellaneous steel fabrications]** and other steel items not defined as structural steel.

**[Section 099123 "Interior Painting"] [and] [Section 099600 "High-Performance Coatings"]** for painting requirements.

Section 133419 "Pre-Engineered Metal Building Systems" for structural steel.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

See the Evaluations for information about what items are and are not classified as structural steel in ANSI/AISC 303.

* + - * 1. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

Retain "Seismic-Load-Resisting System," "Heavy Sections," "Protected Zone," and "Demand-Critical Welds" paragraphs below if required for "high-seismic applications," as defined in ANSI/AISC 360.

* + - * 1. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
				2. Heavy Sections: Rolled and built-up sections as follows:

Shapes included in ASTM A6 with flanges thicker than 1-1/2 inches.

Welded built-up members with plates thicker than 2 inches.

Column base plates thicker than 2 inches.

* + - * 1. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

ANSI/AISC 341 requires that structural Drawings show locations of demand-critical welds, which must comply with additional quality and toughness requirements.

* + - * 1. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.
			1. COORDINATION

Retain first paragraph below if primers are specified in this Section rather than in painting Sections.

* + - * 1. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
				2. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
			1. PREINSTALLATION MEETINGS

Retain "Preinstallation Conference" Paragraph below if Work of this Section is extensive or complex enough to justify a conference.

* + - * 1. Preinstallation Conference: A minimum of 14 days prior to the initial submission of shop drawings, a meeting will be held at the Site for the purpose of reviewing the Contract Documents and discussing the requirements and procedures for submittals and for the Work. The meeting will be conducted by the Director’s Representative. The Contractor and the fabricator’s project coordinator and certified welding inspector must attend the meeting. The Director’s Representative and a Representative of OGS D&C Structural Engineering will also attend.
			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:

Structural-steel materials.

High-strength, bolt-nut-washer assemblies.

Shear stud connectors.

Anchor rods.

Threaded rods.

Forged-steel hardware.

Slide bearings.

Prefabricated building columns.

Shop primer.

Galvanized-steel primer.

Etching cleaner.

Galvanized repair paint.

Shrinkage-resistant grout.

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

* + - * 1. Submit an Environmental Product Declaration (EPD) from the manufacturer for structural steel 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: Show fabrication of structural-steel components.

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

Include erection drawings indicating sizes, weights, and locations of all structural members.

Include embedment and base plate Drawings.

Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

Retain first three subparagraphs below for "high-seismic applications," as defined in ANSI/AISC 360.

Identify members and connections of the seismic-load-resisting system.

Indicate locations and dimensions of protected zones.

Identify demand-critical welds.

Identify members not to be shop primed.

Retain "Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs)" Paragraph below for "high-seismic applications," as defined in ANSI/AISC 360. ANSI/AISC 341 requires that WPSs be submitted for review.

* + - * 1. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1 for each welded joint **[whether prequalified or qualified by testing] [qualified by testing]**, including the following:

Power source (constant current or constant voltage).

Electrode manufacturer and trade name, for demand-critical welds.

Retain "Delegated-Design Submittal" Paragraph below if fabricator is responsible for design of structural-steel connections. Retain option in paragraph for jurisdictions that require deferred connection design to be signed and sealed by fabricator's qualified professional engineer.

* + - * 1. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data**[ signed and sealed by the qualified professional engineer in New York State responsible for their preparation]**.

Coordinate "Qualification Data" Paragraph below with qualification requirements in "Quality Assurance" Article.

* + - * 1. Qualification Data: For **[Installer] [fabricator] [shop-painting applicators] [professional engineer] [testing agency]**.

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

* + - * 1. Welding certificates.

Consider retaining "Paint Compatibility Certificates" Paragraph below if primers are fully specified in this Section rather than in painting Sections.

* + - * 1. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
				2. Mill test reports for structural-steel materials, including chemical and physical properties.
				3. Product Test Reports: For the following:

Revise list below to suit Project. Insert alternative design bolts if required.

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

Direct-tension indicators.

Tension-control, high-strength, bolt-nut-washer assemblies.

Shear stud connectors.

* + - * 1. Survey of existing conditions.

Retain "Source quality-control reports" Paragraph below if Contractor is responsible for source quality-control testing and inspecting.

* + - * 1. Source quality-control reports.

Use subparagraph below for projects over $100,000. See Article 1.6. below.

Documentation to confirm compliance with General Conditions Article 25.4 Domestic Steel.

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

* + - * 1. Field quality-control reports.
			1. QUALITY ASSURANCE
				1. Fabricator Qualifications: The fabricator of the structural steel shall be regularly engaged in the fabrication of structural steel for a minimum of 5 years and shall be subject to the approval of the Director.

AISC Quality Certified Fabricators (latest list issued) are approved.

* + - * 1. Installer Qualifications: The structural steel erector shall be regularly engaged in the erection of structural steel for a minimum of 5 years, and shall be subject to the approval of the Director.

Retain "Shop-Painting Applicators" Paragraph below if qualifying shop-painting applicators, usually for high-performance coatings rather than for customary shop priming. Before retaining, verify that fabricators or shop-painting applicators serving Project area are qualified. AISC's program qualifies fabricators as an endorsement to plant certification; SSPC: The Society for Protective Coatings program usually qualifies paint shops rather than steel fabricators. AISC's Sophisticated Paint Endorsement is based on industry standards and manufacturers' storage, surface-preparation, application, and curing requirements; P1 is for enclosed facilities, P2 is for covered facilities, and P3 is for outside facilities.

* + - * 1. Shop-Painting Applicators: Qualified in accordance with AISC's Sophisticated Paint **[Endorsement P1] [Endorsement P2] [Endorsement P3]** or to SSPC-QP 3.

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 in accordance with AWS D1.1.

Subparagraph below applies to "high-seismic applications," as defined in ANSI/AISC 360.

Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

Use paragraph below for projects over $100,000. Paragraph is taken from Article 25.4 of the General Conditions.

* + - * 1. If the value of the contract exceeds $100,000 all structural steel, reinforcing steel and other major steel items to be incorporated in the Work of this Contract shall be produced and made in whole or substantial part in the United States, its territories or possessions.
			1. DELIVERY, STORAGE, AND HANDLING
				1. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

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

* + - * 1. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

Fasteners may be repackaged provided Director’s Representative's testing and inspecting agency observes repackaging and seals containers.

Clean and relubricate bolts and nuts that become dry or rusty before use.

Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

1. PRODUCTS

Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

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

Retain references in subparagraphs below if applicable. Insert others to suit Project.

ANSI/AISC 303.

First subparagraph below applies to "high-seismic applications," as defined in ANSI/AISC 360.

ANSI/AISC 341.

ANSI/AISC 360.

RCSC's "Specification for Structural Joints Using High-Strength Bolts."

* + - * 1. Connection Design Information:

Retain one or more of first four subparagraphs below. If more than one subparagraph is applicable, distinguish connections that belong to each subparagraph on the Drawings. Connection design practices among structural engineers vary nationwide; subparagraphs below are alternatives recognized by ANSI/AISC 303.

Retain "Option 1" Subparagraph below if the completed connection designs are shown on the Drawings.

Option 1: Connection designs have been completed and connections indicated on the Drawings.

Retain "Option 2" Subparagraph below if the fabricator is responsible for selecting and completing each connection.

Option 2: Fabricator's experienced steel detailer shall select or complete connections in accordance with ANSI/AISC 303.

Select and complete connections using **[schematic details indicated] [and] [ANSI/AISC 360] <Insert source>**.

Use **[Load and Resistance Factor Design; data are given at factored-load level] [Allowable Stress Design; data are given at service-load level]**.

Retain "Option 3 and 3A" Subparagraph below if connection design is delegated to fabricator's qualified professional engineer and member reinforcement at connections is shown on the Drawings.

Option 3 and 3A: Design connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer. Member reinforcement at connections is indicated on Drawings.

Use **[Load and Resistance Factor Design; data are given at factored-load level] [Allowable Stress Design; data are given at service-load level]**.

Retain "Option 3 and 3B" Subparagraph below if connection design and final configuration of member reinforcement at connections is delegated to fabricator's qualified professional engineer.

Option 3 and 3B: Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.

Use **[Load and Resistance Factor Design; data are given at factored-load level] [Allowable Stress Design; data are given at service-load level]**.

* + - * 1. Moment Connections: **[Type PR, partially] [Type FR, fully]** restrained.
				2. Construction: **[Moment frame] [Braced frame] [Shear wall system] [Combined system of moment frame and braced frame] [Combined system of moment frame and shear walls] [Combined system of braced frame and shear walls] [Combined system of moment frame, braced frame, and shear walls]**.
			1. STRUCTURAL-STEEL MATERIALS

Materials complying with first and second options in "W-Shapes" Paragraph below are widely available. Third and fourth options include specialty-steel materials; verify availability if required.

* + - * 1. W-Shapes: **[ASTM A992] [ASTM A572, Grade 50] [ASTM A529, Grade 50] [ASTM A913, Grade 50]**.

Materials complying with third and fourth options in "Channels, Angles(, M-Shapes) (, S-Shapes)" Paragraph below are widely available. Fifth and sixth options include specialty-steel materials; verify availability if required.

* + - * 1. Channels, Angles**[, M-Shapes] [, S-Shapes]: [ASTM A36] [ASTM A572, Grade 50] [ASTM A529, Grade 50] [ASTM A913, Grade 50]**.

Materials complying with first option in "Plate and Bar" Paragraph below are widely available; those complying with second option are less so. Third option is a specialty-steel material; verify availability if required.

* + - * 1. Plate and Bar: **[ASTM A36] [ASTM A572, Grade 50] [ASTM A529, Grade 50]**.

Retain "Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars" Paragraph below for corrosion-resisting (weathering) structural steel, and indicate locations on Drawings.

* + - * 1. Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars: ASTM A588, 50 ksi.
				2. Cold-Formed Hollow Structural Sections: **[ASTM A500, Grade B] [ASTM A500, Grade C] [ASTM A1085]** structural tubing.

Retain "Corrosion-Resisting (Weathering), Cold-Formed Hollow Structural Sections" Paragraph below for corrosion-resisting (weathering) hollow structural sections and indicate locations on Drawings.

* + - * 1. Corrosion-Resisting (Weathering), Cold-Formed Hollow Structural Sections: ASTM A847 structural tubing.
				2. Steel Pipe: ASTM A53, Type E or Type S, Grade B.

Retain "Weight Class" Subparagraph below if weight of steel pipe is not indicated on Drawings. Relationship between weight class and schedule number of wall thickness varies as pipe diameter increases. See ASTM A53 tables for further information.

Weight Class: **[Standard] [Extra strong] [Double-extra strong]**.

Finish: **[Black] [Galvanized] [Black except where indicated to be galvanized]**.

* + - * 1. Steel Castings: ASTM A216, Grade WCB, with supplementary requirement S11.
				2. Steel Forgings: ASTM A668.
				3. Welding Electrodes: Comply with AWS requirements.
			1. BOLTS AND CONNECTORS

If using more than one description and grade of high-strength bolt in this article, indicate location of each on Drawings.

If using corrosion-resisting (weathering) steel, revise Type 1 bolts and washers to Type 3 and Grade DH nuts to Grade DH3 (Class 10S to Class 10S3) in "High-Strength A325 Bolts, Nuts, and Washers" Paragraph below.

* + - * 1. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

Retain "Direct-Tension Indicators" Subparagraph below if applicable. If using corrosion-resisting (weathering) steel, revise Type 325-1 to Type 325-3; ASTM F959 does not include a designation for corrosion-resistant steel.

Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with plain finish.

If using corrosion-resisting (weathering) steel, revise Type 1 bolts and washers to Type 3 and Grade DH nuts to Grade DH3 (Class 10S to Class 10S3) in "High-Strength A490 Bolts, Nuts, and Washers" Paragraph below. Retain option below if applicable.

* + - * 1. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125, Grade A490, Type 1, heavy-hex steel structural bolts**[ or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends]**; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

Retain "Direct-Tension Indicators" Subparagraph below if applicable. If using corrosion-resisting (weathering) steel, revise Type 490-1 to Type 490-3; ASTM F959 does not include a designation for corrosion-resistant steel.

Direct-Tension Indicators: ASTM F959, Type 490-1, compressible-washer type with plain finish.

* + - * 1. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

Finish: **[Hot-dip zinc coating] [Mechanically deposited zinc coating] [Hot-dip or mechanically deposited zinc coating]**.

Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with **[mechanically deposited zinc coating] [mechanically deposited zinc coating, baked epoxy-coated]** finish.

Tension-control (twist-off) bolt assemblies in "Tension-Control, High-Strength Bolt-Nut-Washer Assemblies" Paragraph below correspond to strength of ASTM F3125, Grade A325 bolts. If using corrosion-resisting (weathering) steel, revise Type 1 assemblies to Type 3 below and delete "Finish" Subparagraph.

* + - * 1. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125, Grade F1852, Type 1, **[heavy-hex] [round]** head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

Finish: **[Plain] [Mechanically deposited zinc coating]**.

Retain "Shear Stud Connectors" Paragraph below if shop welding of shear studs to steel framing is required.

* + - * 1. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
			1. RODS

Retain appropriate materials in "Unheaded Anchor Rods" Paragraph below or revise if other materials are required. AISC uses the generic term "anchor rods" to include unheaded rods and headed bolts and notes that "ASTM F1554 is the preferred material specification for anchor rods." Verify availability of ASTM F1554, Grade 55, weldable, before specifying. Plate washers are used with oversized baseplate holes to resist nut pull-through and transfer shear from baseplate to anchor rod.

* + - * 1. Unheaded Anchor Rods: **[ASTM F1554, Grade 36] [ASTM F1554, Grade 55, weldable] [ASTM A354] [ASTM A449] [ASTM A572, Grade 50] [ASTM A36]**.

Configuration: **[Straight] [Hooked]**.

Nuts: ASTM A563 **[heavy-]**hex carbon steel.

Plate Washers: ASTM A36 carbon steel.

Washers: ASTM F436, Type 1, hardened carbon steel.

Finish: **[Plain] [Hot-dip zinc coating, ASTM A153, Class C] [Mechanically deposited zinc coating, ASTM B695, Class 50]**.

Retain appropriate materials in "Headed Anchor Rods" Paragraph below or revise if other materials are required. AISC uses the generic term "anchor rods" to include unheaded rods and headed bolts and notes that "ASTM F1554 is the preferred material specification for anchor rods." Verify availability of ASTM F1554, Grade 55, weldable, before specifying. Plate washers are used with oversized baseplate holes to resist nut pull-through and transfer shear from baseplate to anchor rod.

* + - * 1. Headed Anchor Rods: **[ASTM F1554, Grade 36] [ASTM F1554, Grade 55, weldable] [ASTM A354] [ASTM A449]**, straight.

Nuts: ASTM A563 **[heavy-]**hex carbon steel.

Plate Washers: ASTM A36 carbon steel.

Washers: ASTM F436, Type 1, hardened carbon steel.

Finish: **[Plain] [Hot-dip zinc coating, ASTM A153, Class C] [Mechanically deposited zinc coating, ASTM B695, Class 50]**.

* + - * 1. Threaded Rods: **[ASTM A36] [ASTM A193, Grade B7] [ASTM A354, Grade BD] [ASTM A449] [ASTM A572, Grade 50]**.

Nuts: ASTM A63 **[heavy-]**hex carbon steel.

Washers: **[ASTM F436, Type 1, hardened] [ASTM A36]** carbon steel.

Finish: **[Plain] [Hot-dip zinc coating, ASTM A153, Class C] [Mechanically deposited zinc coating, ASTM B695, Class 50]**.

* + - 1. FORGED-STEEL STRUCTURAL HARDWARE
				1. **[Clevises] [and] [Turnbuckles]**: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
				2. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
				3. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.
			2. SLIDE BEARINGS

Revise "Structural Slide Bearings" Paragraph below if bearing is required to allow movement along more than one axis.

* + - * 1. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Amscot Structural Products Corp.

Fluorocarbon Company Limited.

GRM Custom Products.

R.J. Watson Bridge & Structural Engineered Systems.

Approved equivalent.

Mating Surfaces: **[PTFE and PTFE] [PTFE and mirror-finished stainless steel]**.

Coefficient of Friction: Not more than **[0.03] [0.04] [0.05] [0.06] [0.10] [0.12] <Insert value>**.

Design Load: Not less than **[13.7 MPa] [34 MPa] [41 MPa] <Insert value>**.

Total movement capability includes movement in both directions and is generally twice the dimension of the expansion joint.

Total Movement Capability: **[50 mm] <Insert dimension>**.

* + - 1. PRIMER
				1. Steel Primer:

Retain one of three subparagraphs below. Insert proprietary primers if required as part of special coating or painting system. Coordinate primer selection with surface preparation and topcoats, requirements for slip-critical joints, and limitations of sprayed fire-resistive materials. Insert color if required.

Comply with **[Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."]**

Primer in first subparagraph below requires SSPC-SP 6 (WAB)/NACE WAB-3 commercial blast-cleaning surface preparation or better and 24 hours' drying before recoating. SSPC recommends two primer coats before exposing steel to exterior, and one or two topcoats.

SSPC-Paint 23, latex primer.

Fabricator's standard primer below requires SSPC-SP 2 surface preparation or better and usually provides minimal protection.

Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

Retain "Galvanized-Steel Primer" Paragraph below for painted, hot-dip galvanized structural steel.

* + - * 1. Galvanized-Steel Primer: **[MPI#26] [MPI#80,] [MPI#134]**.

Etching Cleaner: MPI#25, for galvanized steel.

Galvanizing Repair Paint: **[MPI#18, MPI#19, or SSPC-Paint 20] [ASTM A780]**.

* + - 1. SHRINKAGE-RESISTANT GROUT

Shrinkage-resistant grouts in "Metallic, Shrinkage-Resistant Grout" and "Nonmetallic, Shrinkage-Resistant Grout" paragraphs below have high compressive strength. For critical installations, require grout manufacturer to provide field assistance to Contractor. Retain first paragraph for heavy-duty grouting applications. Do not use in wet areas or on exterior.

* + - * 1. Metallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

Retain "Nonmetallic, Shrinkage-Resistant Grout" Paragraph below for grouting applications where nonstaining grout is required.

* + - * 1. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
			1. FABRICATION
				1. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

Camber structural-steel members where indicated.

Fabricate beams with rolling camber up.

Identify high-strength structural steel in accordance with ASTM A6 and maintain markings until structural-steel framing has been erected.

Mark and match-mark materials for field assembly.

Retain subparagraph below if shop priming is required.

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

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

Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

Retain option in "Bolt Holes" Paragraph below if permitted. RCSC's "Specification for Structural Joints Using High-Strength Bolts" permits thermally cut bolt holes if approved by Director’s Representative. Revise standard bolt holes to oversized, short-slotted, or long-slotted bolt holes if permitted, and indicate locations of each type on Drawings.

* + - * 1. Bolt Holes: Cut, drill, **[mechanically thermal cut, ]**or punch standard bolt holes perpendicular to metal surfaces.
				2. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

Retain "Cleaning" Paragraph below for unpainted structural steel. Delete if shop coating is required and retain applicable requirements in "Shop Priming" Article. Default cleaning in ANSI/AISC 303 describes SSPC-SP 1 solvent cleaning and approximates SSPC-SP 2 hand-tool cleaning.

* + - * 1. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with **[SSPC-SP 1.] [SSPC-SP 2.] [SSPC-SP 3.]**

Retain "Shear Stud Connectors" Paragraph below if shear connectors are shop installed to structural steel.

* + - * 1. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1 and manufacturer's written instructions.

Retain "Steel Wall-Opening Framing" Paragraph below if steel wall-opening framing is required and included in this Section.

* + - * 1. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

Retain "Welded-Steel Door Frames" Paragraph below if structural-steel welded door frames attached to structural-steel frame are required. Welded door frames are usually used in industrial buildings, but they may be used in other types of buildings for large door openings. Coordinate requirements with Drawings.

* + - * 1. Welded-Steel Door Frames: Build up welded-steel door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated on Drawings.
				2. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

Delete option in first subparagraph below if allowing thermally cut holes.

Cut, drill, or punch holes perpendicular to steel surfaces.**[ Do not thermally cut bolt holes or enlarge holes by burning.]**

Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

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

* + - 1. SHOP CONNECTIONS
				1. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

RCSC requires that joint types be specified in the Contract Documents for most loading conditions. See the Evaluations for a discussion of the joint types in "Joint Type" Subparagraph below, which are the three types RCSC now recognizes. Insert particular bolt-pretensioning method for pretensioned or slip-critical joints if required; RCSC states that each type can provide satisfactory results.

Joint Type: **[Snug tightened] [Pretensioned] [Slip critical]**.

Retain option in "Weld Connections" Paragraph below for "high-seismic applications," as defined in ANSI/AISC 360.

* + - * 1. Weld Connections: Comply with AWS D1.1**[ and AWS D1.8]** for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

Retain subparagraph below if built-up sections are required.

Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

* + - 1. GALVANIZING

Retain this article if galvanizing of structural steel is required.

* + - * 1. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.

Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

Revise locations below where galvanizing is required to suit Project. Subparagraph below is an example only; delete and indicate items to be galvanized on Drawings if preferred.

Galvanize **[lintels] [shelf angles] [and] [welded door frames]** attached to structural-steel frame and located in exterior walls.

* + - 1. SHOP PRIMING

Retain this article if shop priming is required.

* + - * 1. Shop prime steel surfaces, except the following:

Retain, revise, or delete any of seven subparagraphs below to suit Project.

Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.

Surfaces to be field welded.

Surfaces of high-strength bolted, slip-critical connections.

Surfaces to receive sprayed fire-resistive materials (applied fireproofing).

Galvanized surfaces **[unless indicated to be painted]**.

Corrosion-resisting (weathering) steel surfaces.

Surfaces enclosed in interior construction.

* + - * 1. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

Retain surface-preparation standards in nine subparagraphs below or revise to suit Project. Subparagraphs are listed from least to most comprehensive surface preparation and from lowest to highest cost. Coordinate minimum surface-preparation requirements with selection of primers, paint, and coating systems. See the Evaluations.

"SSPC-SP 2" and "SSPC-SP 3" subparagraphs below require complete removal of loose rust, mill scale, and paint. SSPC-SP 2 is minimum surface preparation accepted by AISC for painted steel.

SSPC-SP 2.

SSPC-SP 3.

"SSPC-SP 7 (WAB)/NACE WAB-4" Subparagraph below permits tight residues of rust, mill scale, and coatings to remain.

SSPC-SP 7 (WAB)/NACE WAB-4.

"SSPC-SP 14 (WAB)/NACE WAB-8" Subparagraph below exceeds SSPC-SP 7 (WAB)/NACE WAB-4 requirements but is less strict than cleaning specified in SSPC-SP 6 (WAB)/NACE WAB-3.

SSPC-SP 14 (WAB)/NACE WAB-8.

"SSPC-SP 11" Subparagraph below requires complete removal of rust, mill scale, and paint by power tools. SSPC-SP 11 uses nonabrasive methods and bridges the gap between the marginal cleaning required in SSPC-SP 2, SSPC-SP 3, and SSPC-SP 7 (WAB)/NACE WAB-4, and the more thorough cleaning required in SSPC-SP 6 (WAB)/NACE WAB-3, SSPC-SP 10 (WAB)/NACE WAB-2, and SSPC-SP 5 (WAB)/NACE WAB-1.

SSPC-SP 11.

"SSPC-SP 6 (WAB)/NACE WAB-3" Subparagraph below requires that two-thirds of surface area be free of visible residue.

SSPC-SP 6 (WAB)/NACE WAB-3.

"SSPC-SP 10 (WAB)/NACE WAB-2" Subparagraph below requires that 95 percent of surface area be free of visible residue.

SSPC-SP 10 (WAB)/NACE WAB-2.

"SSPC-SP 5 (WAB)/NACE WAB-1" Subparagraph below requires complete removal of visible rust, mill scale, paint, and foreign matter.

SSPC-SP 5 (WAB)/NACE WAB-1.

"SSPC-SP 8" Subparagraph below requires complete removal of rust and mill scale by acid, duplex, or electrolytic pickling. Pickling is not widely available.

SSPC-SP 8.

Retain "Surface Preparation of Galvanized Steel" Subparagraph below if galvanized steel is to be shop primed.

* + - * 1. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner **[or in accordance with SSPC-SP 16]**.
				2. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

Retain first subparagraph below if "Priming" Paragraph above does not suffice. 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.

Stripe paint corners, crevices, bolts, welds, and sharp edges.

Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

* + - 1. SOURCE QUALITY CONTROL

Retain this article if fabricator's shop testing is required and revise to suit local practices and requirements of authorities having jurisdiction. Consider deleting article if requiring AISC-certified fabricators and if authorities having jurisdiction approve fabrication work without special inspections. Coordinate with "Fabricator Qualifications" Paragraph in "Quality Assurance" Article.

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] [Engage]** a qualified testing agency to perform shop tests and inspections.

Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

RCSC prescribes inspection for snug-tightened joints and testing and inspection for each method of pretensioning joints.

Bolted Connections: Inspect**[ and test]** shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:

Retain applicable nondestructive testing methods in "Liquid Penetrant Inspection," "Magnetic Particle Inspection," "Ultrasonic Inspection," and "Radiographic Inspection" subparagraphs below. Revise to indicate extent of weld inspections if applicable and to insert alternative acceptance criteria to AWS D1.1 if required.

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.

Ultrasonic Inspection: ASTM E164.

Radiographic Inspection: ASTM E94.

Retain first subparagraph below if shop-welded shear stud connectors are required.

In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1 for stud welding and as follows:

Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.

Revise first subparagraph below if an actual amount or percentage of shear connectors requires testing.

Conduct tests in accordance with requirements in AWS D1.1 on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.

Prepare test and inspection reports.

1. EXECUTION
	* + 1. EXAMINATION
				1. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

Retain subparagraph below if required.

Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

* + - * 1. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. 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 on Drawings.

Retain subparagraph below if design of composite or diaphragm construction is based on shoring of structural steel framing. Revise to suit Project.

Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

* + - 1. ERECTION
				1. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
				2. Baseplates **[Bearing Plates] [and] [Leveling Plates]**: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

Revise requirements in subparagraphs below to suit Project.

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

Weld plate washers to top of baseplate.

**[Snug-tighten] [Pretension]** anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.**[ Comply with manufacturer's written installation instructions for grouting.]**

* + - * 1. Maintain erection tolerances of structural steel within ANSI/AISC 303.
				2. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.

Review subparagraph below with structural engineer and revise to suit Project. Retain temperature allowances if required.

Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

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

Retain option in first paragraph below if thermal cutting is permitted.

* + - * 1. Do not use thermal cutting during erection**[ unless approved by the Director’s Representative. Finish thermally cut sections within smoothness limits in AWS D1.1]**.
				2. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
			1. FIELD CONNECTIONS
				1. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

RCSC requires that joint types be specified in the Contract Documents for most loading conditions. See the Evaluations for a discussion of the joint types in "Joint Type" Subparagraph below, which are the three types RCSC recognizes. Insert particular bolt-pretensioning method for pretensioned or slip-critical joints if required; RCSC states that each type can provide satisfactory results.

Joint Type: **[Snug tightened] [Pretensioned] [Slip critical]**.

Retain option in "Weld Connections" Paragraph below for "high-seismic applications," as defined in ANSI/AISC 360.

* + - * 1. Weld Connections: Comply with AWS D1.1**[ and AWS D1.8]** for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

Retain first subparagraph below if required. Indicate locations if limited to certain areas. ANSI/AISC 303 permits backing bars and runoff tabs to remain in place.

Remove backing bars or runoff tabs**[ where indicated]**, back gouge, and grind steel smooth.

Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

* + - 1. REPAIR
				1. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780.
				2. Touchup Painting:

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

Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

Retain subparagraph below if touchup painting/priming is required for Project but is not part of the Work of this Section.

Cleaning and touchup painting are specified in **[Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."]**

Retain "Touchup Priming" Paragraph below if touchup painting is required for Project but is not part of the Work of this Section.

* + - * 1. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."
			1. FIELD QUALITY CONTROL
				1. Special Inspections: Director’s Representative will engage a special inspector and a qualified testing agency to perform tests and inspections in accordance with the requirements of BDC 406 Summary of Special Inspections and BDC 406.1 Statement of Special Inspections and as directed by the Code Compliance Manager.

END OF SECTION 051200