



Delivering water and power™

Construction Specification Manual

Salt River Project

Technical Specification Index – September 2021

Division 5

Division	Title	Updated
DIVISION 5: METALS		
051200	Structural Steel Framing	Revised 08/21
051213	Arch Exposed Struct Steel Framing	Revised 08/21
052100	Steel Joist Framing	Revised 08/21
053100	Steel Decking	Revised 08/21
054000	Cold Formed Metal Framing	Revised 08/21
054300	Slotted Channel Framing	Revised 08/21
055000	Metal Fabrications	Revised 08/21
055113	Metal Pan Stairs	Revised 08/21
055119	Metal Grating Stairs	Revised 08/21
055213	Steel Pipe and Tube Railings	Revised 08/21
055313	Metal Bar Gratings	Revised 08/21
055516	Metal Stair Nosings	Revised 08/21
057313	Glazed Decorative Metal Railings	Revised 08/21
057500	Decorative Formed Metal	Revised 08/21

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Prefabricated building columns.
3. Shear stud connectors.
4. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 05 12 13 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 05 31 00 "Steel Decking" for field installation of shear stud connectors through deck.
3. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame and other steel items not defined as structural steel.
4. Section 13 34 19 "Metal Building Systems" for structural steel.

1.2 DEFINITIONS

- A. Structural Steel:** Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. 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.
- C. Heavy Sections:** Rolled and built-up sections as follows:
1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches (38 mm).
 2. Welded built-up members with plates thicker than 2 inches (50 mm).
 3. Column base plates thicker than 2 inches (50 mm).
- D. 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.

- E. 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.

1.3 COORDINATION

- A. 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.
- B. 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.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data:
 - 1. Structural-steel materials.
 - 2. High-strength, bolt-nut-washer assemblies.
 - 3. Shear stud connectors.
 - 4. Anchor rods.
 - 5. Threaded rods.
 - 6. Forged-steel hardware.
 - 7. Prefabricated building columns.
 - 8. Shop primer.
 - 9. Galvanized-steel primer.
 - 10. Etching cleaner.
 - 11. Galvanized repair paint.
 - 12. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. 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.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 - 5. Identify members and connections of the seismic-load-resisting system.

6. Indicate locations and dimensions of protected zones.
 7. Identify demand-critical welds.
 8. Identify members not to be shop primed.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand-critical welds.

1.6 INFORMATIONAL SUBMITTALS

- A. 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 responsible for their preparation.
- B. Qualification Data: For Installer, fabricator, shop-painting applicators, and professional engineer.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Mill test reports for structural-steel materials, including chemical and physical properties.
- F. Product Test Reports: For the following:
 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 4. Shear stud connectors.
- G. Survey of existing conditions.
- H. Source quality-control reports.
- I. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
 - 1. 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/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. 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.
 - 1. 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.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 341.
 - 3. ANSI/AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Option 1: Connection designs have been completed and connections indicated on the Drawings.
 - 2. Option 2: Fabricator's experienced steel detailer shall select or complete connections in accordance with ANSI/AISC 303.

- a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
- b. Use Allowable Stress Design; data are given at service-load level unless otherwise indicated on Drawings.
3. 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.
 - a. Use Allowable Stress Design; data are given at service-load level unless otherwise indicated on Drawings.
4. 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.
 - a. Use Allowable Stress Design; data are given at service-load level unless otherwise indicated on Drawings.

C. Moment Connections: As indicated on Drawings.

D. Construction: As indicated on Drawings.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles, M-Shapes, S-Shapes: ASTM A36/A36M.

C. Plate and Bar: ASTM A36/A36M unless otherwise indicated on Drawings.

D. Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars: ASTM A588/A588M, 50 ksi (345 MPa).

E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B, or ASTM A1085/ASTMA1085M structural tubing.

F. Corrosion-Resisting (Weathering), Cold-Formed Hollow Structural Sections: ASTM A847/A847M structural tubing.

G. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

1. Weight Class: As indicated on Drawings.
2. Finish: Black except where indicated to be galvanized.

H. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.

I. Steel Forgings: ASTM A668/A668M.

J. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with plain finish.
- B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490 (Grade A490M), Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 490-1 (Type 10.9-1), compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip or mechanically deposited zinc coating.
 - 2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with mechanically deposited zinc coating finish.
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Mechanically deposited zinc coating.
- E. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 36, unless otherwise indicated.
 - 1. Configuration: Hooked unless otherwise indicated on Drawings.
 - 2. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A36/A36M carbon steel.
 - 4. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
 - 5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.
- B. Headed Anchor Rods: ASTM F1554, Grade 36, straight, unless otherwise indicated.
 - 1. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A36/A36M carbon steel.

3. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
4. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C, unless otherwise indicated on Drawings.

C. Threaded Rods: ASTM A36/A36M.

1. Nuts: ASTM A63 (ASTM A563M) heavy-hex carbon steel.
2. Washers: ASTM A36/A36M carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

- A. Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
- B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
- C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 PRIMER

- A. Steel Primer:
 1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanized-Steel Primer: MPI#134.
 1. Etching Cleaner: MPI#25, for galvanized steel.
 2. Galvanizing Repair Paint: ASTM A780/A780M.

2.7 SHRINKAGE-RESISTANT GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.8 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.

4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.
- F. 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/D1.1M and manufacturer's written instructions.
- G. 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.
- H. 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 (250 mm) o.c. unless otherwise indicated on Drawings.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
- 2.9 SHOP CONNECTIONS
- A. 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.
1. Joint Type: As indicated on Drawings.

- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.10 PREFABRICATED BUILDING COLUMNS

- A. Prefabricated building columns, consisting of load-bearing structural-steel members protected by concrete fireproofing encased in an outer non-load-bearing steel shell.
- B. Fire-Resistance Ratings: Provide prefabricated building column listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for ratings indicated, based on testing in accordance with ASTM E119.
 - 1. Fire-Resistance Design: UL Design No. as indicated on Drawings.
 - 2. Fire-Resistance Rating: As indicated on Drawings.

2.11 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
 - 1. 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.
 - 2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

2.12 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
 - 6. Corrosion-resisting (weathering) steel surfaces.
 - 7. Surfaces enclosed in interior construction.
- B. 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:
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7 (WAB)/NACE WAB-4.

4. SSPC-SP 14 (WAB)/NACE WAB-8.
 5. SSPC-SP 11.
 6. SSPC-SP 6 (WAB)/NACE WAB-3.
 7. SSPC-SP 10 (WAB)/NACE WAB-2.
 8. SSPC-SP 5 (WAB)/NACE WAB-1.
 9. SSPC-SP 8.
- C. 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.
- D. 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 (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. 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.

2.13 SOURCE (Fabricator's Shop) QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
 5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. 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.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten 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.
 - 4. 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.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

- D. 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.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. 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.
 - 1. Joint Type: As indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. 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.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 INSTALLATION OF PREFABRICATED BUILDING COLUMNS

- A. Install prefabricated building columns to comply with ANSI/AISC 360, manufacturer's written recommendations, and requirements of testing and inspecting agency that apply to the fire-resistance rating indicated.

3.6 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

- B. Touchup Painting:
 - 1. 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.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION

SECTION 05 12 13

ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Architecturally exposed structural steel (AESS).
2. Section 05 12 00 "Structural Steel Framing" requirements that also apply to AESS.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other metal items not defined as structural steel.

1.2 DEFINITIONS

A. AESS: Architecturally exposed structural steel.

B. Category AESS 1: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 1 and may be designated AESS 1 or Category AESS 1 in the Contract Documents.

C. Category AESS 2: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 2 and is designated as AESS 2 or Category AESS 2 in the Contract Documents.

D. Category AESS 3: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 3 and is designated as AESS 3 or Category AESS 3 in the Contract Documents.

E. Category AESS 4: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 4 and is designated as AESS 4 or Category AESS 4 in the Contract Documents.

F. Category AESS C: Structural steel with custom characteristics that is categorized by ANSI/AISC 303, Section 10, as AESS C and is designated as AESS C or Category AESS C in the Contract Documents.

G. SEAC/RMSCA Guide Specification: SEAC/RMSCA's "Sample Specification, Section 05 02 13: Architecturally Exposed Structural Steel."

1.3 COORDINATION

- A. Coordinate surface preparation requirements for shop-primed items.
- B. 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.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data:
 - 1. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 2. Corrosion-resisting (weathering steel), tension-control, high-strength, bolt-nut-washer assemblies.
 - 3. Filler.
 - 4. Primer.
 - 5. Galvanized-steel primer.
 - 6. Etching cleaner.
 - 7. Galvanized repair paint.
- B. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS.
 - 1. Identify AESS category for each steel member and connection, including transitions between AESS categories and between AESS and non-AESS.
 - 2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 3. Include embedment Drawings.
 - 4. Indicate orientation of mill marks and HSS seams.
 - 5. 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 grinding, finish, and profile of welds.
 - 6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation and location of bolt heads.
 - 7. Indicate exposed surfaces and edges and surface preparation being used.
 - 8. Indicate special tolerances and erection requirements.
 - 9. Indicate weep holes for HSS and vent holes for galvanized HSS.
 - 10. Indicate surface preparation, primer, and coating requirements, including systems specified in other Sections.

- C. Samples: Submit Samples to set quality standards for AESS.
 - 1. Two steel plates, 3/8 by 8 by 4 inches (9.5 by 200 by 100 mm), with long edges joined by a groove weld and with weld ground smooth.
 - 2. Steel plate, 3/8 by 8 by 8 inches (9.5 by 200 by 200 mm), with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches (100 by 150 by 9.5 mm), welded to plate with a continuous fillet weld and with weld ground smooth and blended.
 - 3. Round steel tube or pipe, minimum 8 inches (200 mm) in diameter, with end of another round steel tube or pipe, approximately 4 inches (100 mm) in diameter, welded to its side at a 45-degree angle with a continuous fillet weld and with weld ground smooth and blended.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172) and is experienced in fabricating AESS similar to that indicated on this Project.
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program, is designated an AISC-Certified Erector, Category ACSE, and is experienced in erecting AESS similar to that indicated on this Project.
- C. Mockups: Build mockups of AESS to set quality standards for fabrication and installation.
 - 1. Build mockup of typical portion of AESS as shown on Drawings.
 - 2. Coordinate high-performance coatings requirements with Section 09 96 00 "High-Performance Coatings."
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling AESS to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AESS members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect AESS members and packaged materials from corrosion and deterioration.

1. Do not store AESS 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.

1.9 FIELD CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength, Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round-head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, (ASTMA563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 1. Finish: Plain.
- B. Corrosion-Resisting (Weathering) Steel, Tension-Control, High-Strength, Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 3, round-head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 3, hardened carbon-steel washers.

2.3 FILLER

- A. Polyester filler intended for use in repairing dents in automobile bodies.

2.4 PRIMER

- A. Steel Primer:
 1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanized-Steel Primer: MPI#134.
 1. Etching Cleaner: MPI#25, for galvanized steel.
 2. Galvanizing Repair Paint: ASTM A780/A780M.

2.5 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
1. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.
- B. Category AESS 1:
1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
 3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
 4. Make intermittent welds appear continuous, using filler or additional welding.
 5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
 6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
 7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 8. Remove weld spatter, slivers, and similar surface discontinuities.
 9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
 10. Grind tack welds smooth unless incorporated into final welds.
 11. Remove backing and runoff tabs, and grind welds smooth.
- C. Category AESS 2:
1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
 3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
 4. Make intermittent welds appear continuous, using filler or additional welding.
 5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
 6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
 7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 8. Remove weld spatter, slivers, and similar surface discontinuities.

9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
10. Grind tack welds smooth unless incorporated into final welds.
11. Remove backing and runoff tabs, and grind welds smooth.
12. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
13. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
14. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
15. Conceal fabrication and erection markings from view in the completed structure.
16. Make welds uniform and smooth.

D. Category AESS 3:

1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
4. Make intermittent welds appear continuous, using filler or additional welding.
5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
8. Remove weld spatter, slivers, and similar surface discontinuities.
9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
10. Grind tack welds smooth unless incorporated into final welds.
11. Remove backing and runoff tabs, and grind welds smooth.
12. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
13. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
14. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
15. Conceal fabrication and erection markings from view in the completed structure.
16. Make welds uniform and smooth.
17. Cut out mill marks from mill material or hide these markings from view in the completed structure. Where neither method is possible, remove mill marks by grinding and filling surfaces as approved by Architect.

18. Grind butt and plug welds smooth or fill, removing weld splatter exposed to view.
19. Orient HSS seams as indicated or away from view.
20. Align and match abutting member cross sections.
21. At visible open joints of copes, miters, and cuts, maintain uniform clear gaps of 1/8 inch (3.2 mm). At closed joints, maintain uniform contact within 1/16 inch (1.6 mm).
22. Fabricate with exposed surfaces smooth, square, and of surface quality approved by Architect.

E. Category AESS 4:

1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
4. Make intermittent welds appear continuous, using filler or additional welding.
5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
8. Remove weld spatter, slivers, and similar surface discontinuities.
9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
10. Grind tack welds smooth unless incorporated into final welds.
11. Remove backing and runoff tabs, and grind welds smooth.
12. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
13. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
14. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
15. Conceal fabrication and erection markings from view in the completed structure.
16. Make welds uniform and smooth.
17. Cut out mill marks from mill material or hide these markings from view in the completed structure. Where neither method is possible, remove mill marks by grinding and filling surfaces as approved by Architect.
18. Grind butt and plug welds smooth or fill, removing weld splatter exposed to view.
19. Orient HSS seams as indicated or away from view.
20. Align and match abutting member cross sections.

21. At visible open joints of copes, miters, and cuts, maintain uniform clear gaps of 1/8 inch (3.2 mm). At closed joints, maintain uniform contact within 1/16 inch (1.6 mm).
22. Fabricate with exposed surfaces smooth, square, and of surface quality approved by Architect.
23. Treat HSS seams to appear seamless.
24. Contour and blend welds and weld transitions between members, removing splatter exposed to view.
25. Fill surface imperfections with filler and sand smooth to achieve surface quality approved by Architect.
26. Minimize weld show-through and distortion on the opposite side of exposed connections by grinding to a smooth profile aligned with adjacent material.

- F. Erection marks, painted marks, and other marks are permitted on corrosion-resisting (weathering) steel surfaces of completed structure.
- G. Cleaning Corrosion-Resisting (Weathering) AESS: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6 (WAB)/NACE WAB-3.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
1. Joint Type: As noted in the Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123/A123M.
1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 3. Galvanize AESS lintels attached to structural-steel frame and located in exterior walls.

2.8 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).

2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Corrosion-resisting (weathering) steel surfaces.
 5. Galvanized surfaces.
- B. Surface Preparation: Clean nongalvanized surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 2.
 2. SSPC-SP 3.
 3. SSPC-SP 7 (WAB)/NACE WAB-4.
 4. SSPC-SP 14 (WAB)/NACE WAB-8.
 5. SSPC-SP 11.
 6. SSPC-SP 6 (WAB)/NACE WAB-3.
 7. SSPC-SP 10 (WAB)/NACE WAB-2.
 8. SSPC-SP 5 (WAB)/NACE WAB-1.
 9. SSPC-SP 8.
- C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner or according to SSPC-SP 16.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and eased edges.
 2. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments, showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS 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.

3.3 ERECTION

- A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.
 - 1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
 - 2. Grind tack welds smooth.
 - 3. Remove backing and runoff tabs, and grind welds smooth.
 - 4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 - 5. Remove erection bolts in Category AESS 4 AESS, fill holes with weld metal or filler, and grind or sand smooth to achieve surface quality approved by Architect.
 - 6. Fill weld access holes in Category AESS 4 AESS with weld metal or filler and grind, or sand smooth to achieve surface quality as approved by Architect.
 - 7. Conceal fabrication and erection markings from view in the completed structure.
- B. In addition to ANSI/AISC 303, Section 10 requirements, comply with the following.
 - 1. Erection of Category AESS 1 and Category AESS 2:
 - a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
 - b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 - c. Remove weld spatter, slivers, and similar surface discontinuities.
 - d. Grind off butt and plug weld projections larger than 1/16 inch (1.6 mm).
 - e. Continuous welds shall be of uniform size and profile.
 - f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
 - g. Splice members only where indicated on Drawings.
 - h. No torch cutting or field fabrication is permitted.
 - 2. Erection of Category AESS 3:
 - a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
 - b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.

- c. Remove weld spatter, slivers, and similar surface discontinuities.
 - d. Grind off butt and plug weld projections larger than 1/16 inch (1.6 mm).
 - e. Continuous welds shall be of uniform size and profile.
 - f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
 - g. Splice members only where indicated on Drawings.
 - h. No torch cutting or field fabrication is permitted.
 - i. Weld profiles, quality, and finish shall be as approved by Architect.
 - j. Make joint welds, including tack welds, appear continuous by filling intermittent welds.
3. Erection of Category AESS 4:
- a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
 - b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 - c. Remove weld spatter, slivers, and similar surface discontinuities.
 - d. Grind off butt and plug weld projections larger than 1/16 inch (1.6 mm).
 - e. Continuous welds shall be of uniform size and profile.
 - f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
 - g. Splice members only where indicated on Drawings.
 - h. No torch cutting or field fabrication is permitted.
 - i. Weld profiles, quality, and finish shall be as approved by Architect.
 - j. Make joint welds, including tack welds, appear continuous by filling intermittent welds.
 - k. Grind welds smooth.
 - l. Minimize weld show-through and distortion on the opposite side of exposed connections by grinding to a smooth profile aligned with adjacent material.
 - m. Oversize welds where ground, contoured, or blended, and grind to provide a smooth transition, matching profile approved by Architect.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: As noted in the Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

3.5 REPAIR

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and touchup galvanizing to comply with ASTM A780/A780M.

- B. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting, to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Cleaning and touchup painting are specified in Section 09 96 00 "High-Performance Coatings."
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 09 96 00 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to inspect AESS as specified in Section 05 12 00 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

END OF SECTION

SECTION 05 21 00
STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. K-series steel joist substitutes.
3. LH-series long-span steel joists.
4. DLH-series long-span steel joists.
5. CJ-series composite steel joists.
6. Steel joist girders.
7. Steel joist accessories.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Section 04 20 00 "Unit Masonry" for installing bearing plates in unit masonry.
3. Section 05 12 00 "Structural Steel Framing" for field-welded shear connectors.

1.2 DEFINITIONS

- A. SJI's "Specifications":** Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists:** Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Welding certificates.
- C. Manufacturer certificates.
- D. Mill Certificates: For each type of bolt.
- E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
- F. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.7 SEQUENCING

- A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.
 - 1. Use ASD; data are given at service-load level unless otherwise indicated on Drawings.

2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Floor Joists: Vertical deflection of 1/360 of the span.
 - b. Roof Joists: Vertical deflection of 1/240 of the span.

2.2 STEEL JOISTS

- A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 1. Joist Type: K-series steel joists.
 2. K-Series Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
 3. Provide holes in chord members for connecting and securing other construction to joists.
 4. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
 5. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
 6. Do not camber joists.
 7. Camber joists according to SJI's "Specifications."
 8. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).
- B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on Drawings.
 1. Joist Type: LH-series long-span steel joists and DLH-series long-span steel joists.
 2. End Arrangement: Underslung unless otherwise indicated on Drawings.
 3. Top-Chord Arrangement: Parallel unless otherwise indicated on Drawings.
 4. Provide holes in chord members for connecting and securing other construction to joists.
 5. Camber long-span steel joists according to SJI's "Specifications."
 6. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.3 STEEL JOIST GIRDERS

- A. Manufactured joist girders according to "Standard Specification for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated on Drawings.

1. End Arrangement: Underslung with bottom-chord extensions unless otherwise indicated on Drawings.
2. Top-Chord Arrangement: Parallel unless otherwise indicated on Drawings.
3. Provide holes in chord members for connecting and securing other construction to joist girders.
4. Camber joist girders according to SJI's "Specifications."
5. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.4 PRIMERS

A. Primer:

1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.5 STEEL JOIST ACCESSORIES

A. Bridging:

1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
2. Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
3. Fabricate as indicated on Drawings and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated on Drawings. Shop prime paint.

C. Steel bearing plates with integral anchorages are specified in Section 05 50 00 "Metal Fabrications."

D. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.

1. Extend ends to within 1/2 inch (13 mm) of finished wall surface unless otherwise indicated on Drawings.
2. Finish: Plain, uncoated.

E. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, (ASTM A563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Plain.

F. Welding Electrodes: Comply with AWS standards.

- G. Galvanizing Repair Paint: ASTM A780/A780M.
- H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.6 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories scheduled to receive sprayed fire-resistive materials.
- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 REPAIRS

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Touchup Painting:
 - 1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - b. Apply a compatible primer of same type as primer used on adjacent surfaces.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709.
 - c. Ultrasonic Testing: ASTM E164.
 - d. Radiographic Testing: ASTM E94.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

END OF SECTION

SECTION 05 31 00

STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.
3. Noncomposite form deck.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 03 52 16 "Lightweight Insulating Concrete" for lightweight insulating concrete fill over steel deck.
3. Section 05 12 00 "Structural Steel Framing" for shop- and field-welded shear connectors.
4. Section 05 50 00 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Roof deck.
2. Composite floor deck.
3. Noncomposite form deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

- D. Research Reports: For steel deck, from ICC-ES.
- E. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- C. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its RoofNav for Class 1 fire rating and Class 1-90 windstorm ratings. Identify materials with FM Approvals Certification markings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 - 1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 40 (275) minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Gray.

2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 40 (275), zinc coating.
3. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 40 (275), G60 (Z180) zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Gray.
4. Deck Profile: As indicated on Drawings.
5. Profile Depth: As indicated on Drawings.
6. Design Uncoated-Steel Thickness: As indicated on Drawings.
7. Span Condition: As indicated.
8. Side Laps: Interlocking seam.

2.3 COMPOSITE FLOOR DECK

- A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 40 (275) minimum, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard gray baked-on, rust-inhibitive primer.
 2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
 3. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard gray baked-on, rust-inhibitive primer.
 1. Profile Depth: As indicated on Drawings.
 1. Design Uncoated-Steel Thickness: As indicated on Drawings.
 2. Span Condition: As indicated.

2.4 NONCOMPOSITE FORM DECK

- A. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Uncoated Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 40 (275) minimum.
 2. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 40 (275) minimum, with underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer, and Gray top surface.
 3. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 40 (275), G60 (Z180) zinc coating.

4. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Gray.
 1. Profile Depth: As indicated on Drawings.
 1. Design Uncoated-Steel Thickness: As indicated on Drawings.
 2. Span Condition: As indicated.
 3. Side Laps: Interlocking seam.

2.5 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch (1.90 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.
- J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Galvanizing Repair Paint: ASTM A780/A780M.
- L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
 - 1. Weld Diameter: As indicated on Drawings.
 - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.

3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or as indicated, and as follows:
 1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
 2. Mechanically clinch or button punch.
 3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.
 - C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
 1. End Joints: Lapped 2 inches (51 mm) minimum.
 - D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least one weld at each corner.
 1. Install reinforcing channels or zees in ribs to span between supports and weld.
 - E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
 - F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 1. Weld Diameter: As indicated on Drawings.
 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.
 3. Weld Spacing: Space and locate welds as indicated.
 4. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches (914 mm), and as follows:
 1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
 2. Mechanically clinch or button punch.

3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches (51 mm), with end joints as follows:
 1. End Joints: Lapped.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Install piercing hanger tabs at 14 inches (355 mm) apart in both directions, within 9 inches (228 mm) of walls at ends, and not more than 12 inches (305 mm) from walls at sides unless otherwise indicated.

3.5 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Repair Painting:
 1. Wire brush and clean rust spots, welds, and abraded areas on **[both surfaces]** **[top surface]** of prime-painted deck immediately after installation, and apply repair paint.
 2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 05 40 00

COLD FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Soffit framing.
4. Interior non-load bearing wall framing exceeding height limitations of standard, non-structural metal framing.

B. Related Requirements:

1. Section 09 22 16 "Non-Structural Metal Framing" for interior non-load-bearing, metal stud framing and ceiling suspension assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Meet with Owner, Architect, testing and inspecting agency representative, metal framing Installer, Metal Framing Engineer, exterior sheathing Installer, and installers whose work interfaces with or affects cold-formed metal framing.

C. Review methods and procedures related to cold-formed metal framing installation, including those contained in metal framing engineer's delegated design submittal.

D. Review design loads imposed on building structure.

1. Review and clearly identify locations of interior and corner wind load zones of building façade.
2. Review design wind speeds, and resulting positive and negative loads imposed on metal framing and exterior sheathing at interior zones and corner zones of building façade.
3. Review securement of system components required to withstand design wind loads, including the following:
 - a. Attachment of bottom track to floor structure, and type and spacing of fasteners.
 - b. Attachment of top track to overhead structure, and type and spacing of fasteners.
 - c. Attachment of studs to top and bottom tracks.
 - d. Attachment of vertical deflection and drift clips to overhead structure.
 - e. Attachment of studs to vertical deflection and drift clips.

- f. Review required minimum edge clearance from edge of slab, and size, spacing, and required penetration of fasteners.
 - E. Review size and location of exterior wall framing mockup.
 - F. Review requirements and understanding of Field Quality Control article.
- 1.3 ACTION SUBMITTALS
 - A. Product Data: For each type of cold-formed steel framing product and accessory.
 - B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- 1.4 INFORMATIONAL SUBMITTALS
 - A. Delegated Design Submittal: Submit For cold formed steel framing to verify compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - B. Product Certificates:
 - 1. Submit for each type of code compliance certification for studs and tracks.
 - 2. Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment, indicating steel sheet complies with requirements, including base metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic coating thickness.
 - C. Research Reports: Submit ICC-ES evaluation report for:
 - 1. Nonstandard cold formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Sill sealer gasket/termite barrier showing compliance with ICC-ES AC380.
 - D. Field Quality Control:
 - 1. Photographic documentation of approved exterior wall framing mockup, in digital form. Include pan and close-up photos of the following:
 - a. Attachment of bottom track to floor structure.
 - b. Attachment of top track to overhead structure.
 - c. Attachment of studs to bottom track and top track/clips.
 - d. Attachment of vertical deflection clips to overhead structure.
 - e. Attachment of horizontal drift clips to overhead structure.
 - f. Attachment of studs to vertical deflection clips.

- g. Attachment of studs to horizontal drift clips.
 - h. Attachment of sheathing to studs.
2. Pre-Inspection Notification: Submit written report that work has been reviewed for compliance by Contractor, Installer, and Metal Framing Engineer, and is ready for inspection by Testing Agency.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the IBC as adopted and amended by the AHJ including special inspections.
- B. Code Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with the product certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.
- C. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with:
 - 1. AWS D1.1/D1.1M Structural Welding Code - Steel.
 - 2. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
- E. Mockups: Build mockups to verify quality standards for materials and execution, and to demonstrate compliance with structural performance criteria and delegated design submittals.
 - 1. Unless otherwise requested by Owner or Architect, build mockup of typical exterior non-load-bearing wall, one structural bay wide by one story high, at an outside corner.
 - 2. Include studs, top track, bottom track, sealer gasket, deflection clips, and bridging.
 - 3. Cover approximately 25 percent of wall framing with specified sheathing. Include sheathing at outside corner.
 - 4. Mockup shall be reviewed by Metal Framing Engineer.
 - 5. Mockup will be inspected by testing and inspection agency.
 - 6. Provide photographic documentation of approved mockup.
 - 7. Subject to compliance with requirements, approved mockup may become part of the completed Work.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver to site in bundles, fully identified with name, type and grade. Store off ground in dry, ventilated space or protect with suitable, venting waterproof coverings.

- B. Inspect cold formed steel framing upon delivery for corrosion and damage to temporary primer. Remove corrosion and repair temporary primer.
- C. Protect cold formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AllSteel & Gypsum Products, Inc.
 - 2. CEMCO; California Expanded Metal Products Co.
 - 3. ClarkDietrich Building Systems.
 - 4. Formetal Co. Inc. (The).
 - 5. MarinoWARE.
 - 6. Nuconsteel, A Nucor Company.
 - 7. SCAFCO Corporation.
 - 8. Southeastern Stud & Components, Inc.
 - 9. Steel Network, Inc. (The).

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer (Metal Framing Engineer), as defined in Section 01 40 00 "Quality Requirements," to design cold-formed steel framing, including fasteners and connections to building structure.
- B. Structural Performance: Provide cold-formed steel framing members, connectors, and fasteners capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: Indicated on Drawings.
 - 2. Seismic Loads: Indicated on Drawings.
 - 3. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing:
 - 1) Framing Behind Brick or Stone Masonry Veneer: Horizontal deflection of L/600 of the unbraced wall height in feet.
 - 2) Framing Behind Metal Panels: Horizontal deflection of L/360 of the unbraced wall height in feet.
 - 3) Framing Behind EIFS: Horizontal deflection of L/360 of the unbraced wall height in feet.
 - 4) Soffit Framing: Vertical deflection of L/240 of the span for live loads and 1/240 for total loads of the span.

- b. Interior Load Bearing Framing: Horizontal deflection of L/240 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
 - c. Interior Non-load-Bearing Framing: Horizontal deflection of L/240 of the unbraced wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
 - d. Interior Non-load-Bearing Framing: Horizontal deflection of L/360 of the unbraced wall height under a horizontal load of 10 lbf/sq. ft. (478 Pa), for partitions scheduled to receive wall tile.
 4. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 degrees F (67 degrees C).
 5. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1 inch (25 mm) unless otherwise indicated.
 6. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
 - C. Cold Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200:
 1. Floor and Roof Systems: AISI S210.
 2. Wall Studs: AISI S211.
 3. Headers: AISI S212.
 4. Lateral Design: AISI S213.
 - D. Fire Resistance Ratings: Comply with ASTM E 119; testing by UL. Identify products with appropriate markings.
 1. Indicate design designations from the UL Fire Resistance Directory.
 - E. AISI Specifications and Standards: Comply with AISI North American Specification for the Design of Cold Formed Steel Structural Members and Standard for Cold Formed Steel Framing - General Provisions.
 1. Comply with AISI S100 and AISI S200 unless more stringent requirements are indicated.
- 2.3 COLD FORMED STEEL FRAMING MATERIALS
 - A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation:
 1. Grade: As required by structural performance.
 2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZM150), or GF30 (ZGF90).
 - B. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180).

2.4 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 1. Minimum Base Metal Thickness: As required by design, but not less than 0.0538 inch (1.37 mm).
 2. Flange Width: As required by design, but not less than 1-5/8 inches (41 mm).
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges:
 1. Minimum Base Metal Thickness: Match steel studs.
 2. Flange Width: 1-1/4 inches (32 mm).
- C. Steel Box or Back to Back Headers: C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
 1. Minimum Base Metal Thickness: As required by design, but not less than 0.0538 inch (1.37 mm).
 2. Flange Width: As required by design.
- D. Steel Single or Double L Headers: L-shapes used to form header beams, of web depths indicated:
 1. Minimum Base Metal Thickness: As required by design, but not less than 0.0538 inch (1.37 mm).
 2. Flange Width: As required by design.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges:
 1. Minimum Base Metal Thickness: As required by design, but not less than 0.0538 inch (1.37 mm).
 2. Flange Width: As required by design, but not less than 1-5/8 inches (41 mm).
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges:
 1. Minimum Base Metal Thickness: Match steel studs.
 2. Flange Width: 1-1/4 inches (32 mm).
- C. Slip-Type Head Joints for Vertical Deflection: Provide one of the following:
 1. Vertical Deflection Clips: Manufacturer's standard Head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) ClarkDietrich Building Systems; "Fast Top Clip", 0.0677 inch (1.72 mm), used in conjunction with minimum 0.033 inch (0.8 mm) deep leg track.
 - 2) MarinoWARE; DEFLEX slide clips, used in conjunction with minimum 0.033 inch (0.8 mm) deep leg track.
 - 3) SCAFCO Corporation, Deflection Clips ESC or DESC.
 - 4) Steel Network, Inc. (The); VertiClip SL Series, or VertiTrack VTX Series (0.0677 inch (1.72 mm), used in conjunction with minimum 0.033 inch (0.8 mm) deep leg track).
 2. Single Deflection Tracks: Not permitted.
 3. Double Deflection Tracks: Manufacturer's standard double, deep leg, U shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 - a. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure:
 - 1) Minimum Base Metal Thickness: As required by design, but not less than 0.0538 inch (1.37 mm).
 - 2) Flange Width: 1 inch (25 mm) plus twice the design gap.
 - b. Inner Track: Of web depth indicated:
 - 1) Minimum Base Metal Thickness: As required by design, but not less than 0.0538 inch (1.37 mm).
 - 2) Flange Width: Equal to sum of outer deflection track flange width plus 1 inch (25 mm).
 - D. Drift Clips: Bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.
- 2.6 INTERIOR NONLOAD BEARING WALL FRAMING
- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges:
 1. Minimum Base Metal Thickness: As required by design, but not less than 0.0428 inch (1.09 mm).
 2. Flange Width: As required by design, but not less than 1-5/8 inches (41 mm).
 - B. Steel Track: Manufacturer's standard U shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 1. Minimum Base Metal Thickness: Matching steel studs.
 2. Flange Width: 1-1/4 inches (32 mm).
 - C. Vertical Deflection Clips: Bypass and Head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Manufacturers: Subject to compliance with requirements, provide products from framing manufacturer, or compatible products by one of the following:
 - a. AllSteel & Gypsum Products, Inc.
 - b. ClarkDietrich Building Systems.
 - c. Marino\WARE.
 - d. SCAFCO Corporation.
 - e. Simpson Strong-Tie Co., Inc.
 - f. Steel Network, Inc. (The).
 - g. Steeler, Inc.

- D. Double Deflection Tracks: Manufacturer's standard Double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure:
 - a. Minimum Base Metal Thickness: As required by design, but not less than 0.0428 inch (1.09 mm).
 - b. Flange Width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.
 2. Inner Track: Of web depth indicated:
 - a. Minimum Base Metal Thickness: As required by design, but not less than 0.0428 inch (1.09 mm).
 - b. Flange Width: Equal to sum of outer deflection track flange width plus 1 inch (25 mm).

- E. Drift Clips: Bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.7 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C shaped steel sections, of web depths indicated, with stiffened flanges:
 1. Minimum Base Metal Thickness: As required by design, but not less than 0.0329 inch (0.84 mm).
 2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.8 FRAMING ACCESSORIES

- A. General: Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

- B. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 3/4 inch (19 mm), minimum base-steel thickness of 0.0538 inch (1.37 mm), and depth required to accommodate continuous insulation thickness or as indicated on Drawings.

- C. Provide other accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers and knee braces.
 - 9. Joist hangers and end closures.
 - 10. Hole-reinforcing plates.
 - 11. Backer plates.

2.9 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon steel hex headed bolts, carbon steel nuts, and flat, hardened steel washers; zinc coated by hot dip process in accordance with ASTM A 153/A 153M, Class C.
- C. Post Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.
 - 1. Uses: Securing cold formed steel framing to structure.
 - 2. Material for Interior Locations: Carbon steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion resistant coated, self-drilling, self tapping, steel drill screws.
 - 1. Head Type: Low profile head beneath sheathing.
- F. Welding Electrodes: Comply with AWS standards.

2.10 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: High zinc dust content galvanizing repair paint ASTM A 780/A 780M or SSPC-Paint 20.
- B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sill Sealer Gasket/Termite Barrier: Minimum 68-mil (1.7-mm) nominal thickness, self-adhering sheet consisting of 64 mils (1.6 mm) of rubberized asphalt laminated on one side to a 4-mil- (0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side.
 - 1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. Polygard Products.
 - 2. Physical Properties:
 - a. Peel Adhesion: 17.0 lb/in of width (2.9 N/mm of width) when tested in accordance with ASTM D412.
 - b. Low Temperature Flexibility: Pass at minus 25 degrees F (minus 32 degrees C) when tested in accordance with ASTM D146/D146M.
 - c. Water Vapor Permeance: 0.05 perm (0.44 ng/Pa x s x sq. m) maximum when tested in accordance with ASTM E96/E96M, Method B.
 - d. Resistance to Termite Penetration: Comply with ICC-ES AC380.

2.11 FABRICATION

- A. Fabricate cold formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, in accordance with referenced AISI specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

- b. Locate mechanical fasteners and install in accordance with Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
 4. Fasten other materials to cold formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, in accordance with approved Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960):
 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire resistive materials.
- B. After applying sprayed fire resistive materials, remove only as much of the material as necessary to complete installation of cold formed framing without reducing thickness of fire resistive materials below that required to obtain fire resistance ratings indicated. Protect remaining fire resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Commence installation of cold-formed steel framing in presence of Metal Framing Engineer.
- D. Install cold formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install in accordance with approved Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
 - 1) Make connection to concrete with self-tapping screws designed specifically for connection to concrete, with pre-drilled holes.
- E. Install framing members in one piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation as specified in Section 07 21 00, in framing assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings:
 - 1. Anchor Spacing: To match stud spacing indicated on Shop Drawings.

- B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 - 1. Fasten both flanges of studs to top and bottom tracks.
 - 2. Space studs as follows: As required to meet design requirements but not greater than 16 inches (406 mm) on center.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs in accordance with AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
 - 2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced vertically 48 inches (1220 mm). Fasten at each stud intersection.
 - 1. Channel Bridging: Cold rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
 - 2. Bar Bridging: Proprietary bridging bars installed in accordance with manufacturer's written instructions.
- J. For shear walls and elsewhere as indicated on Shop Drawings, install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip angle connectors to multiple studs at ends of bracing and anchor to structure.

- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall framing system.

3.5 INSTALLATION OF EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to bottom track unless otherwise indicated.
 - 1. Stud Spacing: As required to comply with performance criteria but not greater than 16 inches (406 mm) on center.
 - 2. Decrease spacing between studs (or increase minimum base-metal thickness) where required to ensure cold-formed metal framing system installation will withstand positive and negative wind pressures imposed by design wind speeds, as indicated in Shop Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Single deep-leg deflection track: Not permitted.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure. Fasten both flanges of studs to inner track. Do not secure inner track to outer track.
 - 3. Connect vertical deflection clips to bypassing or infill studs (as applicable) and anchor to building structure.
 - 4. For seismic applications, connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on approved Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Bar Bridging: Proprietary bridging bars installed in accordance with manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall framing system.

3.6 INSTALLATION OF INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

- B. Fasten both flanges of studs to bottom track unless otherwise indicated.
 - 1. Stud Spacing: As required to comply with performance criteria but not greater than 16 inches (406 mm).
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support. Provide one of the following:
 - 1. Install double deep leg deflection tracks and anchor outer track to building structure. Fasten both flanges of studs to inner track. Do not secure inner track to outer track.
 - a. Single deep-leg deflection track: Not permitted.
 - 2. Connect vertical deflection clips to studs and anchor to building structure.
 - 3. For seismic applications, connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection. Provide one of the following:
 - 1. Channel Bridging: Cold rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall framing system.

3.7 INSTALLATION OF SOFFIT FRAMING

- A. Install perimeter soffit track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install soffit framing bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install soffit framing over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
- C. Space soffit framing not more than 2 inches (51 mm) from abutting walls, and as follows:
 - 1. Soffit Framing Spacing: As required by design, but not greater than 16 inches (406 mm) on center.
- D. Frame openings with built-up framing.

- E. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each framing intersection as follows:
 - 1. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and framing-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- F. Install miscellaneous framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable framing assembly.

3.8 INSTALLATION TOLERANCES

- A. Install cold formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960):
 - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.9 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Submit written report that work has been reviewed for compliance by Contractor, Installer, and Metal Framing Engineer, and is ready for inspection by Testing Agency.
- C. The following items will be subject to testing and inspecting:
 - 1. Field and shop welds.
 - 2. Attachment of bottom track to floor structure, including the following:
 - a. Spacing of fasteners.
 - b. Edge clearance.
 - c. Embedment / penetration of fasteners.
 - 3. Attachment of top track to overhead structure, including the following:
 - a. Spacing of fasteners.
 - b. Edge clearance.
 - c. Embedment / penetration of fasteners.
 - 4. Attachment of studs to bottom track and top track/clips.
 - 5. Attachment of vertical deflection clips to overhead structure, including the following:
 - a. Edge clearance.
 - b. Embedment / penetration of fasteners.
 - 6. Attachment of horizontal drift clips to overhead structure, including the following:
 - a. Edge clearance.
 - b. Embedment / penetration of fasteners.
 - 7. Attachment of studs to vertical deflection clips.
 - 8. Attachment of studs to horizontal drift clips.

9. Installation of bridging and bracing.
- D. Testing agency will report test results promptly and in writing to Contractor, Architect, and Metal Framing Engineer.
 - E. Inspection Frequency:
 1. Owner and Architect will select approximately 10 random locations, roughly 12 to 15 feet wide by one story high, to be inspected by Testing Agency. Testing Agency will inspect the following at each location:
 - a. Top and Bottom Track:
 - 1) Each lineal foot of bottom track to structure.
 - 2) Each lineal foot of outer track (of double deflection track) to structure.
 - b. Studs:
 - 1) Attachment of each stud to bottom track.
 - 2) Attachment of each stud to inner track of double deflection track.
 - 3) Attachment of each vertical deflection clip to structure.
 - 4) Attachment of each horizontal drift clip to structure.
 - 5) Attachment of each stud to vertical deflection clip.
 - 6) Attachment of each stud to horizontal drift clip.
 - F. Cold formed steel framing will be considered defective if it does not pass tests and inspections.
 1. If inspections reveal repeat deficiencies or a pattern of noncompliance with requirements, as determined by the Owner, Architect, and Testing Agency, work of this Section for the entire balance of the Project will be inspected by the Testing Agency at the Contractor's expense.
 - G. Remove and replace work where inspections indicate that it does not comply with specified requirements. Do not cover or conceal corrected work until it has been reinspected for compliance with requirements.
 - H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 3.10 REPAIRS AND PROTECTION
- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
 - B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 43 00
SLOTTED CHANNEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Slotted channel framing for equipment.
 - 2. Slotted channel framing for mechanical and electrical equipment.
 - 3. Slotted channel framing for applications where framing and supports are not specified in other Sections.

1.2 COORDINATION

- A. Coordinate installation of slotted channel framing that is anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Indicate plan layout, typical elevations, details and anchoring methods.

1.4 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, within the State of the Project, responsible for their preparation.
- B. Submit following:
 - 1. Certificates verifying AWS qualifications within previous 12 months for each welder employed for Work.
 - 2. Manufacturer's certification that products furnished for Project meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Engineer Qualifications: Registered professional engineer licensed to practice structural engineering in jurisdiction where Project is located, with minimum of five years experience in design of slotted channel framing support systems.
- B. Manufacturer Qualifications: Company specializing in manufacturing, fabricating, and installing Products specified in this Section with minimum five years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Division 01 Section "Product Requirements."
 - 1. Deliver components of system required to be installed by other trades in sufficient time not to delay work of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Slotted Channel Framing:
 - 1. Atkore Unistrut, Harvey, IL.
 - 2. Cooper B-Line Strut Systems, Inc., Highland, IL.
 - 3. Flex-Strut, Inc. Metal Framing Products, Warren, OH.
 - 4. GS Metals Corporation, "Globe Strut."
 - 5. Hilti, Inc., "Hilti Strut MQ."

2.2 PERFORMANCE REQUIREMENTS

- A. Requirements: Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, ceiling heights, and profiles of units.
- B. Manufacturer: Responsible for designing system, including anchorage to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
 - 1. Employ registered professional engineer, licensed to practice structural engineering in jurisdiction where Project is located, to engineer each component of support systems.
- C. Attachment Considerations: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between units and building structure or between components themselves.
 - 1. Make modifications only to meet field conditioned and ensure fitting of system components.

2. Obtain Architect's approval of modifications and for connections to building elements at locations other than indicated on Drawings.
- D. Support Structure: Locate support members in order to maintain scheduled ceiling planes indicated on Drawings. Make possible attachment of equipment support rails at any point along support system without drilling or welding into system.
1. Ceiling Anchorage: For framing scheduled to be mounted to ceilings, attach to ceiling by means of imbedded concrete inserts, through bolts or direct attachment to structural framing.
 2. Rigidly fix and brace support structure against sway.
- E. Loading: Design support structure to support vertical load, maximum eccentricity of vertical load from support point, transverse force acting on longitudinal rail, longitudinal force acting on longitudinal rail, and deflection criteria established for each piece of supported equipment.
1. If loads are not defined for piece of supported equipment assume concentrated load of 1500 pounds at any point along equipment rails. Concentrated load is maximum encountered by positioning of equipment at extremities of its travel (maximum load configuration).
 2. Safety Factor: Design support structure for minimum safety factor of three based on ultimate strength under static loading conditions. Structure shall not deflect more than 1/720 span vertically or horizontally when maximum loading conditions of equipment operation are applied on either rail.
- F. Interface with Adjacent Systems: Integrate design and connections with adjacent construction.
1. Accommodate allowable tolerances and deflections for structural members in installation.
 2. Coordinate with reflected ceiling plan and other items indicated to be placed in or above ceiling to ensure support system does not interfere with or dislocate other items.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.4 SLOTTED CHANNEL FRAMING

- A. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm), with flange edges returned toward web with 9/16 inch wide slotted holes in webs at 2 inches on center.

2. Material: Cold-rolled steel, ASTM A1008/A1008M, commercial steel, Type B or structural steel, Grade 33 (Grade 230).
3. Metal Thickness: As required by design, but not less than 0.0528-inch (1.35-mm) minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel for interior applications, and hot-dip galvanized after fabrication for exterior applications.
4. Width, Depth, Thickness: As required by design to meet structural performance.

B. Materials:

1. Steel Sheet Structural Quality: ASTM A 570, Grade 33.
2. Zinc-Coated Steel Sheet: ASTM A 653, Quality SQ, Grade 33, G90.
3. Hot-Rolled Steel Bar: ASTM A 575.
4. Hot-Rolled Steel Sheet and Strip: ASTM A 569.

C. Finishes:

1. Framing System Components: Manufacturer's standard corrosion resistant factory-painted acrylic enamel finish.
2. Hardware: Electro-galvanized.

2.5 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use, and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, for interior use. Select fasteners for type, grade, and class required.
- B. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

3.3 INSTALLATION OF SLOTTED CHANNEL FRAMING AND SUPPORTS

- A. Support Systems: Install in accordance with approved Shop Drawings and manufacturer's installation instructions and recommendations.
- B. Structural Assembly: Install supporting framework plumb and true.
- C. Installation Tolerances:
 - 1. Mount surfaces of support structure horizontal within tolerance of 1/32 inch in 24 inches and within 1/16 inch in 18 foot length.
 - 2. Elevation of one rail mounting surface to other shall be within 1/16 inch in any 24 inches length of rails.

3.4 PROTECTION

- A. Protect finished installation under provisions of Division 01 Section "Execution."

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for operable partitions.
2. Steel shape track supports for overhead doors.
3. Steel framing and supports for equipment.
4. Steel tube reinforcement for low partitions.
5. Steel framing and supports for mechanical and electrical equipment, where loads exceed the capacity of slotted channel framing.
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
7. Elevator hoistway fabrications:
 - a. Machine beams and hoist beams.
 - b. Steel framing and supports for elevator guide rails.
 - c. Steel shapes for supporting elevator door sills.
 - d. Steel grate covers for elevator sump pit.
 - e. Elevator pit ladder.
8. Shelf angles.
9. Roof access ladders.
10. Mezzanine access ladders.
11. Steel angle corner guards.
12. Metal bollards.
13. Metal downspout boots.
14. Pipe and downspout guards.
15. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 04 22 00 "Concrete Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

2. Section 05 12 00 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.
3. Section 05 43 00 "Slotted Channel Framing" for metal support systems for plumbing, mechanical, electrical, and other equipment applications requiring support.
4. Section 05 55 16 "Metal Stair Nosings" for surface-mounted abrasive metal stair nosings.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 1. Fasteners.
 2. Shop primers.
 3. Shrinkage-resisting grout.
 4. Manufactured metal ladders.
 5. Metal downspout boots.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 1. Steel framing and supports for operable partitions.
 2. Structural steel door frames for overhead doors.
 3. Steel framing and supports for equipment.
 4. Steel tube reinforcement for low partitions.
 5. Steel framing and supports for mechanical and electrical equipment.
 6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 7. Elevator machine beams, hoist beams.
 8. Steel framing and supports for elevator guide rails.
 9. Steel shapes for supporting elevator door sills.
 10. Steel grate covers for elevator sump pit.

11. Metal ladders.
12. Shelf angles.
13. Steel angle corner guards.
14. Metal bollards.
15. Pipe and downspout guards.
16. Loose bearing and leveling plates not specified in other Sections.

1.4 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation, licensed in the state where the Project is located.
- B. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.
- C. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
- D. Welding certificates.
- E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- F. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," using performance requirements and design criteria indicated.
 - 1. Design Calculations: Submit design calculations for the following:
 - a. Ladders.
 - b. Gratings and supports.
 - c. Partial height partitions.
- B. Structural Performance of Ladders: Ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- C. Gratings and Supports: Provide sizes and spacing of bars as required to support a minimum live load of 100 lbs. per sq. ft., or concentrated load of 2,000 lbf, whichever produces the greater stress.
- D. Support for Partial Height Partitions:
 - 1. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - 2. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Maximum deflection of L/240.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Slotted Channel Framing: Refer to Section 05 43 00.

- F. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- G. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.
- H. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless steel fasteners for fastening aluminum or stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.4 MISCELLANEOUS MATERIALS

- A. Zinc-Rich Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carbozinc 621; Carboline Company.
 - b. Aquapon Zinc-Rich Primer 97-670; PPG Industries, Inc.
 - c. Series 90-97 - Tneme-Zinc; Tnemec Company, Inc.
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Concrete: Comply with requirements in Section 03 30 53 "Miscellaneous Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3,000 psi (20 MPa) unless otherwise indicated.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) on center unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
1. Fabricate units from slotted channel framing where indicated.
 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Partial-Height Partition Supports: At Contractor's option provide one of the following:
1. Fabricate supports for partial height partition supports from steel shapes of size required to limit the specified deflection with attached bearing plates, anchors, and braces.

2. Manufactured minimum 14 gage steel tube and 3/8-inch thick steel base plate assembly, of height required to brace less than full-height, free-standing gypsum board partitions, with pre-punched holes for attachment or anchorage to concrete subfloor substrate.
 - a. Acceptable Products:
 - 1) NoFlex Corporation, Huntington Beach, CA.
 - 2) "R-15" bank rail support post as manufactured by RACO.
- E. Prime miscellaneous framing and supports with zinc-rich primer, galvanize exterior components or where indicated on Drawings.

2.7 STEEL ANGLE SUPPORTS FOR OVERHEAD DOORS

- A. Fabricate door track supports for overhead doors from continuous steel angles of sizes indicated with anchors and braces as required to secure angles to wall construction. Continuously weld exposed joints.
- B. Shop Finishes for Support Angles:
 1. Exterior Overhead Doors: Galvanize and shop prime paint.
 2. Interior Overhead Doors: Shop prime paint.

2.8 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
 1. Provide mitered and welded units at corners.
 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls or where otherwise indicated.
- D. Prime shelf angles located in interior walls with zinc-rich primer.
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.9 METAL LADDERS

- A. General:
 1. Comply with ANSI A14.3 unless otherwise indicated.
 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
3. Ladder Rungs: Serrated steel channel with slip-resistant finish, and as follows:
 - a. Material: Carbon steel, hot rolled pickled and oiled (HRPO), mill finish, 0.1196 inches thick (11 gage), with 2-rows of sheared-hole serrations.
 - b. Minimum Load Capacity: 515 lbs (234 kg) concentrated load at mid-span, for 48-inch (1220 mm) length.
 - c. Size: 1-1/4 inches (31.8 mm) wide by 1-1/2 inches (38 mm) channel depth.
 - d. Basis of Design: "TRACTION TREAD" ladder rung plank, model number M6LRST2448 as manufactured by McNichols.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
6. Provide self-closing safety gate at the top of all ladders.
7. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
8. Galvanize exterior ladders and ladders in elevator pits, including brackets and fasteners.
9. Prime interior ladders, including brackets and fasteners, unless noted otherwise.
10. Label load rating at access points for platforms and ladders.

2.10 ELEVATOR PIT SUMP COVERS

- A. Metal Bar-Grating: Form elevator sump pit cover to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
1. Manufacturers: Subject to compliance with requirements, provide metal bar grating products by one of the following:
 - a. Alabama Metal Industries Corporation.
 - b. All American Grating, Inc.
 - c. Barnett/Bates Corp.
 - d. IKG Industries; a Harsco Company.
 - e. Ohio Gratings, Inc.
 2. Fabricate from welded steel grating with 1-1/4-by-3/16-inch (32-by-5-mm) bearing bars at 15/16 inch (24 mm) o.c. and crossbars at 4 inches (100 mm) o.c., NAAMM designation: W-15-4 (1-1/4 x 3/16) STEEL.
 3. Surface: Serrated.
 4. Finish: Galvanized.

2.11 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize and shop prime exterior miscellaneous steel trim.

2.12 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
 - 1. Where bollards are indicated to receive metal cap, cap bollards with 1/4-inch- (6.4-mm-) thick, steel plate with flat top. Continuously weld and grind smooth.
 - a. Omit cap where bollards are indicated to receive concrete fill.
 - 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 - 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Surface-Mount on In-Place Construction: Fabricate bollards with 3/8-inch- (9.5-mm-) thick, steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch (19-mm) anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Within Grade / Paving: Fabricate bollards to extend a minimum of 36-inches below grade / paving with four (4) 12-inch long pieces of #4 rebar welded to each side of pipe.
- D. Galvanize and shop prime steel bollards.

2.13 METAL DOWNSPOUT BOOTS

- A. Source Limitations: Obtain downspout boots from single source from single manufacturer.
- B. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
 - 1. Outlet to Grade: Discharge onto splash block or pavement.
 - 2. Outlet to Storm Drainage System: Horizontal, to discharge into pipe.

2.14 PIPE AND DOWNSPOUT GUARDS

- A. Fabricate pipe and downspout guards from 3/8-inch- (9.5-mm-) thick by 12-inch- (300-mm-) wide, steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch (50-mm) clearance between pipe and pipe guard. Drill each end for two 3/4-inch (19-mm) anchor bolts.
- B. Galvanize and prime steel pipe and downspout guards.
- C. Prime steel pipe and downspout guards with zinc-rich primer.

2.15 METAL DOWNSPOUT BOOTS

- A. Source Limitations: Obtain downspout boots from single source from single manufacturer.
- B. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
 - 1. Outlet to Grade: Discharge onto splash block or pavement.
 - 2. Outlet to Storm Drainage System: Horizontal, to discharge into pipe.

2.16 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.

2.17 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.18 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.19 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. Items Indicated to Receive Primers Specified in Section 09 96 00 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
 5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
 - E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
 - F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 1. Cast Aluminum: Heavy coat of bituminous paint.
 2. Extruded Aluminum: Two coats of clear lacquer.
- 3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS
- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
 - B. Anchor supports for operable partitions and overhead doors securely to, and rigidly brace from, building structure.
 - C. Anchor shelf angles securely to existing construction with through-bolts.
- 3.3 INSTALLATION OF METAL BOLLARDS
- A. Surface-Mount on In-Place Construction: Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each bollard unless otherwise indicated.
 1. Embed anchor bolts at least 4 inches (100 mm) in concrete.
 - B. Within Grade / Paving: Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
 - C. Bollards Indicated to Receive Concrete Fill: Fill bollards solidly with concrete, mounding top surface to shed water.
 1. Do not fill metal-capped bollards with concrete.
 2. Do not fill removable bollards with concrete.

3.4 INSTALLATION OF BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 REPAIRS

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 05 51 13
METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. NAAMM Commercial Class preassembled steel stairs with concrete filled treads.

B. Related Requirements:

1. Section 03 30 53 "Miscellaneous Cast-in-Place Concrete" for concrete fill for metal pan stair treads.
2. Section 05 52 13 "Pipe and Tube Railings" for steel tube railings attached to metal stairs, and steel tube handrails attached to walls adjacent to metal stairs.

1.2 COORDINATION

- A. 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.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Ensure delivery to site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire resistance rated stair enclosure.
- D. Schedule installation of railings and guards so wall attachments are made to completed walls.
 1. Do not support railings and guards temporarily by means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data: Technical data for metal pan stairs including:

1. Prefilled metal pan stair treads.
2. Paint products.

B. Shop Drawings: Submit plans, elevations, sections, details, and attachments to other work.

1. Show detailed construction, metal thickness, jointing, methods of installation, fastening and supports location and sizes of welds, anchoring, hangers and other pertinent data.
2. Submit plans and section of steel stairs, drawn to scale at not less than 1/4 inch (6 mm) per foot (3005 mm). Where conditions in three or more consecutive stories are exactly alike, drawings may be broken and noted to include duplicate runs
3. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
4. Include plan at each level.

1.4 INFORMATIONAL SUBMITTALS

- A. Delegated Design Submittal: Submit data for stair assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Welding certificates.
- C. Paint Compatibility Certificates: Certification from manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal stairs similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Fabricator of products.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M Structural Welding Code - Steel.
 2. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
- D. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 1. Preassembled Stairs: Commercial class.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
 1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
 2. Protect steel members and packaged materials from corrosion and deterioration.
 3. Do not store materials on structure that contributes to distortion, damage, or overload to members or supporting structures.

- a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design stair assemblies, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated:
 1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 3. Uniform and concentrated loads need not be assumed to act concurrently.
 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.
- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
 3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

2.2 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Alfab, Inc.
 2. American Stair, Inc.
 3. Lapeyre Stair Inc.
 4. Pacific Stair Corporation.
 5. Sharon Stair, Duvinage, LLC.

- B. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- E. Uncoated, Cold Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- F. Uncoated, Hot Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.
- G. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.
- H. Fasteners: Provide zinc plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
 - 1. Bolts and Nuts: Regular hexagon head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
 - 2. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
 - a. Provide mechanically deposited or hot dip, zinc coated anchor bolts for stairs indicated to be galvanized and stairs indicated to be shop primed with zinc rich primer.
 - 3. Post Installed Anchors: Torque controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 - a. Material for Interior Locations: Carbon steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
- I. Accessories:
 - 1. Welding Electrodes: Comply with AWS requirements.

2.3 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer for Ferrous Metal: Fast curing, lead free and chromate free universal modified alkyd primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
 - 1. Product: Provide 10-99 (red) or 10-09 (gray) by Tnemec Company.
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
- C. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
 - 1. Product: Provide Tneme-Zinc 90-97 by Tnemec Company.
- D. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D 1187 ASTM D 1187/D 1187M.
- E. Concrete Fill for Metal Pan Subtreads: Comply with requirements in Section 03 30 53 "Miscellaneous Cast-in-Place Concrete" for normal weight, air entrained, ready mix concrete with a minimum 28 day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.
- F. Welded Wire Reinforcement: ASTM A 185/A 185M, 6 inches by 6 inches (152 mm by 152 mm), W1.4 by W1.4, unless otherwise indicated.
- G. Plain Steel Welded Wire Reinforcement: ASTM A1064/A10645M, steel, 6 inches by 6 inches (152 mm by 152 mm), W1.4 by W1.4, unless otherwise indicated on Drawings.
- H. Reinforcement Supports: Bolsters, chairs, spacers, and devices for spacing, supporting, and fastening welded wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI Manual of Standard Practice of greater compressive strength than concrete.
- I. For galvanized reinforcement, use galvanized wire or dielectric polymer coated wire bar supports.

2.4 FABRICATION

- A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.

- B. Assembled Stairs: Shop assemble stairs greatest extent possible. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 1. Obtain fusion without undercut or overlap.
 - 2. Remove welding flux immediately.
 - 3. Weld exposed corners and seams continuously unless otherwise indicated.
 - 4. At exposed connections, finish exposed welds to comply with NOMMA Voluntary Joint Finish Standards for Finish #2 welds: Completely sanded joint, some undercutting and pinholes okay.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.5 STEEL FRAMED STAIR FABRICATION

- A. NAAMM Stair Standard: Comply with Recommended Voluntary Minimum Standards for Fixed Metal Stairs in NAAMM AMP 510 Metal Stairs Manual, Commercial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
 - 1. Fabricate stringers steel channels or steel rectangular tubes as indicated on Drawings.
 - a. Stringer Size: As required to comply with performance requirements.
 - b. Provide closures for exposed ends of channel and rectangular tube stringers.
 - c. Finish: Shop primed.
 - 2. Construct platforms of steel channel or rectangular tube headers and miscellaneous framing members as required to comply with performance requirements.
 - a. Provide closures for exposed ends of channel and rectangular tube framing.
 - b. Finish: Shop primed.
 - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.

4. Where stairs are enclosed by gypsum board shaft wall assemblies, provide hanger rods or struts to support landings from floor construction above or below.
 - a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire resistance rated stair enclosure.
 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness necessary to comply with performance requirements, but not less than 0.067 inch (1.7 mm).
1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
 2. Steel Sheet: Uncoated cold rolled steel sheet unless otherwise indicated.
 3. Directly weld metal pans to stringers; locate welds on top of subtreads where they are concealed by concrete fill. Do not weld risers to stringers.
 4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
 5. Shape metal pans to include nosing integral with riser.
 6. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
 7. Provide subplatforms of configuration indicated or the same as subtreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.6 FINISHES

- A. Finish metal stairs after assembly.
- B. Galvanizing: Hot dip galvanize components to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for steel and iron products.
- C. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3 Power Tool Cleaning.
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel, for shop painting.
- E. Field Finish: Refer to finish schedule and Section 09 96 00 for field applied paints and coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
 - 1. For wall mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLING METAL PAN STAIR ASSEMBLY

- A. Fastening to In Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in place construction. Include threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
 - 1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond reducing materials and roughen surfaces prior to setting plates.
 - a. Clean bottom surface of plates.
 - b. Set plates for structural members on wedges, shims, or setting nuts.
 - c. Tighten anchor bolts after supported members have been positioned and plumbed.
 - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
 - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
 - 2) Comply with manufacturer's written installation instructions for shrinkage resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with requirements for welding.
- G. Place and finish concrete fill for treads and platforms to comply with Section 03 30 53.

1. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

3.3 REPAIR, ADJUSTING, AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 05 51 19
METAL GRATING STAIRS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. NAAMM Industrial Class preassembled steel stairs with steel grating treads.
- B. Related Sections include the following:
 - 1. Section 05 52 13 "Pipe and Tube Railings" for steel tube railings attached to metal stairs, and steel tube handrails attached to walls adjacent to metal stairs.
 - 2. Division 09 Section "High-Performance Coatings" for surface preparation, priming, and field painting requirements.

1.2 COORDINATION

- A. 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.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For metal grating stairs and the following:
 - 1. Gratings.
 - 2. Paint products.
 - 3. Grout.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachment to other work.
 - 2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
 - 3. Include plan at each level.
 - 4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.
- C. Samples for Verification: For grating tread products in manufacturer's standard sizes.

1.4 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Welding Certificates: Copies of certificates for welding procedures and personnel.
- C. Qualification Data: For firms and persons specified in "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.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal stairs similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Arrange for metal stairs specified in this Section to be fabricated and installed by the same firm.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
 - 1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
 - 2. Protect steel members and packaged materials from corrosion and deterioration.
 - 3. Do not store materials on structure that contributes to distortion, damage, or overload to members or supporting structures.
 - a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 3. Uniform and concentrated loads need not be assumed to act concurrently.
 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.
- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
 3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
- D. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
1. Preassembled Stairs: Industrial class.

2.2 FERROUS METALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- E. Expanded Metal Galvanized Steel: ASTM F1267, Class 2, Grade A.
- F. Steel Wire Rod for Grating Crossbars: ASTM A510/A510M.

- G. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- H. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed).
 - 1. Provide galvanized finish for exterior installations and where indicated.
- I. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- J. Welded-Wire Mesh: Diamond or Square pattern, 2-inch (50-mm) welded-wire mesh, made from 0.236-inch (6.0-mm) nominal-diameter steel wire complying with ASTM A510/A510M.
- K. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.
- C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- E. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).
- F. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).
- G. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers or cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for exterior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding, unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
 - 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
 5. At exposed connections, finish exposed welds to comply with the following:
 - a. Stairs: NAAMM Standard AMP 510, "Industrial Class."
 - b. Handrails and Railings: NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed.
 6. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.
- B. Stair Framing: Fabricate stringers of structural-steel channels, plates, or a combination of both, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural-steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to stringers; bolt or weld framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
1. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
1. Fabricate treads and platforms from welded steel grating with 1-1/4-by-3/16-inch (32-by-5-mm) bearing bars at 15/16 inch (24 mm) o.c. and crossbars at 4 inches (100 mm) o.c, NAAMM Designation W-15-4 (1-1/4 by 3/16) Steel.
 - a. Surface: Serrated.
 - b. Finish: Galvanized.
 - c. Fabricate grating treads with rolled-steel floor plate nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

- d. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.
 - 2. At Contractor's option, stair treads may be fabricated from expanded metal grating material, with serrated surface and galvanized finish.
- D. Risers: Open.
- E. Toe Plates: Provide toe plates around openings and at edge of open-sided floors and platforms, and at open ends and open back edges of treads.
- 1. Material and Finish: Steel plate to match finish of other steel items.
 - 2. Fabricate to dimensions and details indicated.

2.7 FABRICATION OF STAIR RAILINGS AND GUARDS

- A. Comply with applicable requirements in Section 05 52 13 "Pipe and Tube Railings."
- B. Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
- C. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
- 1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed.
- D. Form changes in direction of railings as follows:
- 1. As detailed.
 - 2. By bending or by inserting prefabricated elbow fittings.
- E. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of railing members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
- 1. Connect posts to stair framing by direct welding unless otherwise indicated.

2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
 - I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

- A. General: Comply with NAAMM'S "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.
- C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
 1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.
 - 1. Label load rating at stair and platform access points.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.3 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.
- B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonmetallic, nonshrink grout unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 INSTALLATION OF RAILINGS AND GUARDS

- A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints.
 - 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
 - 2. Plumb posts in each direction.
 - 3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

4. Secure posts and rail ends to building construction as follows:
 - a. Anchor posts to steel by welding directly to steel supporting members.
 - b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.

3.5 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 05 52 13

STEEL PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings attached to stair stringers and walls.
2. Infill panels, balusters, and fittings.

B. Related Requirements:

1. Section 05 51 12 "Metal Pan Stairs" for metal pan stairs to which metal infill panels are attached.
2. Section 06 10 53 "Miscellaneous Rough Carpentry" for in-wall wood blocking for anchoring railings.

1.2 COORDINATION

- A. 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.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver to project site in time for installation.
- C. Schedule installation so wall attachments are made to completed walls. Do not support railings temporarily by means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Expanded metal infill panels.
2. Woven-wire mesh infill panels.
3. Post-installed anchors.
4. Handrail brackets.
5. Shop primer.
6. Bituminous paint.
7. Nonshrink, nonmetallic grout.
8. Anchoring cement.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
 - 2. Fittings and brackets.
 - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

1.4 INFORMATIONAL SUBMITTALS

- A. Delegated Design Submittal: Submit analysis data including structural design calculations for specified load requirements signed and sealed by the qualified professional engineer responsible for preparation.
- B. Qualification Data: For installer and fabricator.
- C. Welding Certificates: Submit current certificates for each welder certifying it had passed AWS qualifications testing for welding process.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- E. Product Test Reports: Submit test reports performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935 for handrails and railings.
- F. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal stair guards and railing assemblies similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Fabricator of products.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M Structural Welding Code - Steel.
- D. Pipe Railing Standard: Comply with applicable provisions of ANSI/NAAMM AMP 521 Pipe and Railing Systems Manual.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

STEEL PIPE AND TUBE RAILINGS

05 52 13 - 2

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Steel Pipe and Tube Railings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. VIVA Railings, LLC.
 - b. Wagner, R & B, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer experienced in the design of railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C, material surfaces).

2.3 METALS, GENERAL

- A. Metal Surfaces: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

STEEL PIPE AND TUBE RAILINGS

05 52 13 - 3

- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2 inch (38 mm) clearance from inside face of handrail to finished wall surface.

2.4 STEEL RAILINGS

- A. Tubing: ASTM A 500 (cold formed).
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- E. Expanded Metal Infill Panels: ASTM F1267, Type I (expanded) or Type II (expanded and flattened), as indicated on Drawings, Class 1 (uncoated).
 - 1. Style Designation: 1-1/2 number 10.
- F. Woven-Wire Mesh Infill Panels: Intermediate-crimp, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.134-inch- (3.42-mm-) diameter steel wire complying with ASTM A510 (ASTM A510M).

2.5 FASTENERS

- A. Fastener Materials:
 - 1. Ungalvanized Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
 - 2. Hot Dip Galvanized Railings: Type 304 stainless steel or hot dip zinc coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 - 3. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 - 2. Provide square or hex socket flat head machine screws for exposed fasteners unless otherwise indicated.

STEEL PIPE AND TUBE RAILINGS

05 52 13 - 4

- D. Post Installed Anchors: Torque controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS:

- A. Handrail Brackets: Cast iron center of handrail 3-1/8 inches (79.4 mm) from wall.
- B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- C. Etching Cleaner for Galvanized Metal: Solution of acid and detergents designed to remove grease and oil residue from metal surfaces resulting in clean, lightly etched surface promoting adhesion of coating system.
- D. Galvanizing Repair Paint: High zinc dust content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
- F. Zinc-Rich Shop Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carbozinc 621; Carboline Company.
 - b. Aquapon Zinc-Rich Primer 97-670; PPG Industries, Inc.
 - c. Series 90-97 - Tneme-Zinc; Tnemec Company, Inc.
- G. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
- H. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- I. Nonshrink, Nonmetallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- J. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 1. Clearly mark units for reassembly and coordinated installation.
 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather to excludes water.
 1. Provide weep holes where water may accumulate.
 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
 5. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
 6. Comply with NOMMA Voluntary Joint Finish Standards for Finish #2 welds: Completely sanded joint, some undercutting and pinholes okay.
- I. Form Changes in Direction: By radius bends of radius indicated on Drawings or by inserting prefabricated elbow fittings of radius indicated.

- J. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- L. Provide wall returns at ends of wall mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- N. Provide inserts and anchorage devices for connecting railings to concrete or masonry work.
 - 1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 - 2. Coordinate anchorage devices with supporting structure.
- O. For railing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.
- P. Expanded-Metal Infill Panels: Fabricate infill panels from expanded-metal sheet of same metal as railings.
 - 1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than 0.043 inch (1.1 mm) thick.
 - 2. Orient expanded metal with long dimension of diamonds as indicated on Drawings.
- Q. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) metal channel frames.
 - 1. Fabricate wire mesh and frames from same metal as railings in which they are installed.
 - 2. Orient wire mesh with wires perpendicular and parallel to top rail unless otherwise indicated on Drawings.
- R. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot dip galvanize exterior steel railings, and where indicated, including hardware, after fabrication.

2. Comply with ASTM A 123/A 123M for hot dip galvanized railings.
 3. Comply with ASTM A 153/A 153M for hot dip galvanized hardware.
 4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 5. Fill vent and drain holes that are exposed in the finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. Nongalvanized Steel Railings: Provide nongalvanized ferrous metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning or SSPC-SP 3 Power Tool Cleaning requirements based on exposure and conditions of use:
1. Exterior Railings: SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning.
 2. Railings Indicated to Receive Zinc Rich Primer: SSPC-SP 6/NACE No. 3, Commercial Blast Cleaning.
 3. Railings Indicated to Receive Field Applied Primers: SSPC-SP 6/NACE No. 3, Commercial Blast Cleaning.
 4. Other Railings: SSPC-SP 3 Power Tool Cleaning.
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 Shop, Field, and Maintenance Painting of Steel for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
1. Shop prime uncoated railings with universal shop primer.
 2. Do not apply primer to galvanized surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine field conditions for acceptability and ready to receive Work.
- B. Attached Railings: Examine gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Furnish items necessary to cast into concrete, embedded in masonry, or placed in partitions with setting templates.

3.3 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 - 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in place construction.

3.4 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.5 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, attached to post with set screws.
- D. Leave anchorage joint exposed with anchoring material flush with adjacent surface.
- E. Anchor posts to metal surfaces with flanges, angle type, or floor type as necessary for conditions, connected to posts and to metal supporting members:
 - 1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.

3.6 ATTACHING RAILINGS

- A. Anchor railing ends to walls with brackets on underside of rails connected to railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
- C. Attach railings to wall with wall brackets. Locate brackets as indicated or at spacing required to support structural loads.
 - 1. Provide brackets with 1-1/2 inch (38 mm) clearance from inside face of handrail and finished wall surface.
 - 2. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt or predrilled hole for exposed bolt anchorage, as applicable to suit conditions.
- D. Secure wall brackets and railing end flanges to building construction:
 - 1. For concrete and solid masonry anchorage, use drilled in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For steel framed partitions, when anchoring between studs:
 - a. Use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
 - b. Where in-wall wood blocking is not permitted by authorities having jurisdiction, use self-tapping screws fastened to concealed heavy-gage steel backing plates mounted to stud framing.

STEEL PIPE AND TUBE RAILINGS

05 52 13 - 10

4. For steel framed partitions, when anchoring to studs, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.7 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

3.8 CLEANING

- #### A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.9 PROTECTION

- #### A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- #### B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 05 53 13
METAL BAR GRATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel bar gratings.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Clips and anchorage devices for gratings.
 - 2. Paint products.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal: For gratings, including manufacturers' published load tables and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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:
 1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
 2. All American Grating.
 3. Fisher & Ludlow; Division of Harris Steel Limited.
 4. Grating Pacific, Inc
 5. McNichols, Inc.
 6. Ohio Gratings, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design gratings.
- B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 1. Floors and Trench Covers: Uniform load of 125 lbf/sq. ft. or concentrated load of 2000 lbf, whichever produces the greater stress.
 2. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft.
 3. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft.
 4. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. or concentrated load of 8000 lbf, whichever produces the greater stress.
 5. Limit deflection to L/360 or 1/4 inch, whichever is less.

2.3 METAL BAR GRATINGS

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual" and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."
- B. Welded Steel Grating:
 1. Bearing Bar Spacing: 11/16 inch o.c.
 2. Bearing Bar Depth: As required to comply with structural performance requirements.
 3. Bearing Bar Thickness: 3/16 inch.

4. Crossbar Spacing: 2 inches o.c.
5. Traffic Surface: Serrated.
6. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.

2.4 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- C. Wire Rod for Bar Grating Crossbars: ASTM A 510.

2.5 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M,) and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F593 (ASTM F738M) for bolts and ASTM F594 (ASTM F836M) for nuts, Alloy Group 1 (A1).
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M,) and, where indicated, flat washers.
 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Post-Installed Anchors: Torque-controlled expansion or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.

- B. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
- G. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
 - 1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- H. Do not notch bearing bars at supports to maintain elevation.

2.8 STEEL FINISHES

- A. Finish gratings, frames, and supports after assembly.
- B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- C. Shop prime gratings, frames, and supports unless otherwise indicated.
 1. Shop prime with universal shop primer.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. Other Items: SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Attach toeplates to gratings by welding at locations indicated.
- F. Field Welding: Comply with AWS recommendations and the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
- G. Label load rating at grating system access points.

3.2 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding unless materials are galvanized; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 05 55 00
METAL STAIR NOSINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Slip resistant abrasive metal stair nosings.

1.2 ACTION SUBMITTALS

- A. Product Data: Technical data, specifications and anchor details.
- B. Samples for Initial Selection: Physical samples illustrating full range of colors available for abrasive inserts.
- C. Samples for Verification: Physical samples 6 inches long, finished product samples, showing selected color and product.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials dry during delivery and storage. Store materials with provisions for air circulation.

PART 2 - PRODUCTS

2.1 METAL STAIR NOSINGS

- A. Source Limitations: Obtain each type of stair nosing from single source from single manufacturer.
- B. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
- C. Nosings for Cast-in-Place Concrete Stairs: Cast-in-place nosing consisting of extruded aluminum type 6063-T6 base; 3 inch (75 mm) wide, 1/2-inch (13 mm) lip, and 1/4-inch (6 mm) thick with full length, integrally cast 3/4-inch (19 mm) anchor.
 - 1. Inserts: Filled with mixture of aluminum oxide and silicon carbide abrasive granules in an epoxy binder; color selected by Architect.
 - 2. Product: Subject to Compliance with requirements, provide one of the following:
 - a. Style 3511 by American Safety Tread, Inc.
 - b. Type S25-C by Armstrong Products Inc.
 - c. Type 231BF by Wooster Products, Inc.

- D. Nosings for Concrete-Filled Steel Pan Stairs: Cast in place nosing consisting of extruded aluminum type 6063-T6 base; 3 inch (75 mm) wide, 1/2 inch (13 mm) lip, and 1/4 inch (6 mm) thick with full length, integrally cast. 3/4 inch (19 mm) anchor.
1. Inserts: Filled with mixture of aluminum oxide and silicon carbide abrasive granules in an epoxy binder; color selected by Architect.
 2. Product: Subject to Compliance with requirements, provide one of the following:
 - a. Style 9511 by American Safety Tread Inc.
 - b. Type S25-C by Armstrong Products Inc.
 - c. Type 231BF by Wooster Products, Inc.
 3. Nosings: Cross hatched units, 3 inches (75 mm) wide, 1/4 inch (6 mm) thickness, and 1 inch (25 mm) lip, for casting into concrete.

2.2 MATERIALS

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.
- C. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

2.3 ACCESSORIES

- A. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
1. Fasteners for Aluminum: Type 304 stainless steel.
- B. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION

- A. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- B. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
1. Provide two rows of holes for units more than 5 inches (125 mm) wide, with two holes aligned at ends and intermediate holes staggered.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's recommendations, square, plumb and level, accurately fitted and free of defects.
- B. Place concrete into the stair forms or steel pans as quickly as possible; schedule pour to install the metal nosings before the initial set of concrete occurs. Puddle concrete, tamp safety nosings to insure proper concrete formation around anchors.
- C. Close stairway to traffic after pour for minimum 24 hours.

3.2 INSTALLATION OF NOSINGS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Remove protective tape (if used) as soon as practical.
- D. Separate aluminum from concrete with protective coating of bituminous paint to prevent electrolytic action.

END OF SECTION

SECTION 05 73 13

GLAZED DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass- and plastic-supported railings.
2. Post-supported railings with glass infill.

B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood blocking for anchoring railings.

1.2 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

1.3 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Glass products.
3. Glazing cement and accessories for structural glass railings.
4. Sealant and accessories for structural glass railings.
5. Nonshrink, nonmetallic grout.
6. Anchoring cement.

- B. Shop Drawings: Include plans, elevations, sections, and attachment details.

GLAZED DECORATIVE METAL RAILINGS

05 73 13 - 1

- C. Samples for Initial Selection: For products involving selection of color, texture, or design.
- D. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Each type of glass required.
 - 3. Fittings and brackets.
 - 4. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.

1.6 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Qualification Data: For professional engineer.
- C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- E. Preconstruction test reports.
- F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockups as shown on Drawings.
 - 2. Build mockups for each form and finish of glass-infill panel railing consisting of two posts, top rail, handrail, glass-infill panel, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.
 - 3. Build mockups for each form and finish of structural glass railing consisting of top rail, structural glass, base channel, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made by Owner. Retesting of products that fail to meet specified requirements shall be undertaken at Contractor's expense.
1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
 2. Test railings according to ASTM E 894 and ASTM E 935.
 3. Notify Architect seven days in advance of the dates and times when laboratory mockups will be tested.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Laminated Glass: Glazed decorative metal railing manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Architectural Railings & Grilles, Inc.
 2. Blum, Julius & Co., Inc.
 3. C. R. Laurence Co., Inc.
 4. CraneVeyor Corp.
 5. Livers Bronze Co.
 6. Newman Brothers, Inc.
 7. P & P Artec.
 8. Tri Tech, Inc.
 9. VIVA Railings, LLC.

- B. Source Limitations for Laminated Glass: Obtain from single source from single manufacturer.
- C. Source Limitations for Decorative Metal Railing Components: Obtain from single source from single manufacturer for each component and installation method.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Stainless Steel: 60 percent of minimum yield strength.
 - 2. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
 - 3. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."
- C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. applied in any direction.
 - 1) Deflection Limits: Maximum horizontal deflection of 1/2-inch (12.7 mm) when tested in accordance with ASTM E 935.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
 - 3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.

- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Extruded Bars and Shapes, Including Extruded Tubing: ASTM B 221, Alloy 6063-T5/T52.
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209, Alloy 5005-H32.
- F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.5 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 304.
- B. Pipe: ASTM A 312/A 312M, Grade TP 304.
- C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.
- D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666 or ASTM A 240/A 240M, Type 304.
- E. Bars and Shapes: ASTM A 276, Type 304.

2.6 GLASS AND GLAZING PRODUCTS, GENERAL

- A. Glazing Publications: Comply with written instructions of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. NGA/GANA Publications: "GANA Laminated Glazing Reference Manual" and "GANA Glazing Manual."
- B. Safety Glazing: Glazing shall comply with 16 CFR 1201, Category II.
- C. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- D. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Class 1 and low-iron clear, or Class 2 (tinted) as indicated, Quality-Q3.
- E. Glazing Cement and Accessories for Structural Glass Railings: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal base channels.
- F. Sealant and Accessories for Structural Glass Railings: Sealant, gaskets, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal base channels.
- G. Glazing Gaskets for Glass-Infill Panels: Glazing gaskets and related accessories as recommended or supplied by railing manufacturer for installing glass-infill panels in post-supported railings.

2.7 GLASS HANDRAILS AND GUARDS

- A. Tempered Glass Handrails and Guards: Provide products that have been tested for surface and edge compression in accordance with ASTM C1048 and for impact strength in accordance with 16 CFR 1201 for Category II materials.
 - 1. Glass Color: Clear.
 - 2. Thickness for Structural Glass Balusters and Glass-Infill Panels: As required by structural loads, but not less than 6.0 mm, as a component of laminated glass unit.
- B. Laminated Glass Handrails and Guards: ASTM C1172, Type II with two plies of glass bonded together by an interlayer.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
 - 2. Interlayer Thickness: 0.030 inch (0.76 mm).
 - 3. Kind: LT (laminated tempered).

4. Glass Color: Inner-ply clear; outer-ply clear.
5. Interlayer Color: Clear.
6. Glass Plies for Structural Glass Balusters: Thickness required by structural loads, but not less than 6.0 mm thick each.
7. Glass Plies for Glass-Infill Panels: Thickness required by structural loads, but not less than 6.0 mm each.

2.8 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 1. Stainless-Steel Components: Type 304 stainless-steel fasteners.
 2. Aluminum Components: Type 304 stainless-steel fasteners.
 3. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.
 1. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193[or ICC-ES AC308].
 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.9 MISCELLANEOUS MATERIALS

- A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- B. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- C. Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.10 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- H. Form changes in direction as follows:
 1. As detailed.
 2. By bending to smallest radius that will not result in distortion of railing member.
- I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of hollow railing members with prefabricated end fittings.
- K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- M. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.11 GLAZING PANEL FABRICATION

- A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.
 1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces.
 2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.
- B. Infill Panels: Provide tempered glass panels for both straight sections.

2.12 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.13 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 1. Run grain of directional finishes with long dimension of each piece.
 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Stainless Steel Tubing Finishes:

1. 180-Grit Polished Finish: Uniform, directionally textured finish.
2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
3. Polished and Buffed Finish: 320-grit finish followed by buffing to a high luster finish to match Architect's sample.

D. Stainless Steel Sheet, Strip, Plate, and Bar Finishes:

1. Directional Satin Finish: ASTM A480/A480M, No. 4.
2. High Luster Finish: ASTM A480/A480M, No. 7.

2.14 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: As selected by Architect from full range of industry colors.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with Drawings and manufacturer's written instructions for installing glazed decorative metal railings, accessories, and other components.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of metal railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

GLAZED DECORATIVE METAL RAILINGS

05 73 13 - 10

- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post.
- D. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For stainless-steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
 - 2. For aluminum railings, attach posts as indicated using fittings designed and engineered for this purpose.
- E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.4 INSTALLING GLASS PANELS

- A. Structural Glass Railings:
 - 1. Install assembly to comply with railing manufacturer's written instructions.
 - 2. Attach base channel to building structure, then insert and connect factory-fabricated and -assembled glass balusters.

3. For field-assembled balusters, attach base channel to building structure, insert glass in base channel, and bond with glazing cement.
 - a. Support glass balusters in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement.
 - b. Fill remaining space in base channel with [glazing cement] [sealant] for uniform support of glass.
4. Adjust spacing of glass balusters so gaps between balusters are equal before securing in position.
5. Erect glass railings under direct supervision of manufacturer's authorized technical personnel.

B. Post-Supported Railings with Glass-Infill Panels:

1. Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles.
2. Erect posts and other metal railing components, and set factory-cut glass-infill panels.
3. Do not cut, drill, or alter glass-infill panels in field. Protect edges from damage.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner.
- B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.
- C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.
- D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.
- B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 05 75 00
DECORATIVE FORMED METAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes decorative formed metal for interior applications:
 - 1. Filler panels between dissimilar construction.
 - 2. Miscellaneous decorative formed metal items made primarily from sheet metal.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative formed metal.
 - 1. Include plans, elevations, component details, and attachment details.
 - 2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
- C. Samples: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments, and necessary clearances.
- B. Evaluation Reports: For post-installed anchors, from ICC-ES.

PART 2 - PRODUCTS

2.1 SHEET METAL

- A. General: Fabricate products from sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness.

2.2 MISCELLANEOUS MATERIALS

- A. Gaskets: As required to seal joints in decorative formed metal and remain air-tight, as recommended in writing by decorative formed metal manufacturer.
 - 1. ASTM D 1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain seal for application indicated.
 - 2. Closed-cell polyurethane foam, adhesive on two sides, release paper protected.
- B. Sealants, Interior: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834; of type and grade required to seal joints in decorative formed metal; and as recommended in writing by decorative formed metal manufacturer.
 - 1. Sealants shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated.
 - 1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Anchors: Provide fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
- E. Anchor Materials:
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
- F. Sound-Deadening Materials:
 - 1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
 - 2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- G. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal and is noncombustible after curing.
 - 1. Metal-to-Metal Adhesive: VOC content of not more than 30 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch-wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.

- C. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness and sufficient strength for indicated use.
 - 1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
- D. Where welding is indicated, weld joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

2.4 CLOSURES AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fry Reglet Corporation.
 - 2. Pittcon Industries.

2.5 FILLER PANELS

- A. Form from two sheets of metal, separated by channels formed from the same material, producing a panel of same thickness as partitions, mullions, or adjacent assembly unless otherwise indicated. Incorporate reveals, trim, and concealed anchorages for attaching to adjacent surfaces.
 - 1. Finish: As indicated on the Drawings.
- B. Fill interior of panel with sound-deadening insulation permanently attached to inside panel faces.
- C. Adhesively attach gaskets to filler panel edges where they abut mullions or glazing.

2.6 MISCELLANEOUS DECORATIVE FORMED METAL ITEMS

- A. Custom fabricate units of metal and finish indicated, to comply with design and details indicated. Coordinate with adjacent finishes to provide integrated, closely fitted assemblies.

2.7 GENERAL FINISH REQUIREMENTS

- A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable.

1. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 1. Run grain of directional finishes with long dimension of each piece.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.
- D. Directional Satin Finish: No. 4.
- E. Dull Satin Finish: No. 6.
- F. Satin, Reflective, Directional Polish: No. 7.
- G. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
- D. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION