

## SECTION 133419 - METAL BUILDING SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes metal building systems that consist of integrated sets of mutually dependent components including structural framing, roof panels, wall panels, soffit panels, insulation, doors, windows frames and accessories.
- B. Related Sections include the following:
  - 1. Division 3 Section "Cast-in-Place Concrete" for concrete foundations, slabs, and anchor-bolt installation.
  - 2. Division 8, Section "Sectional Doors".
  - 3. Division 9 installing gypsum board and metal framing.
  - 4. Division 9 painting Sections for finish painting.

#### 1.3 DEFINITIONS

- A. Bay: Dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured normal to end wall (outside face of end-wall girt) for end bays.
- B. Building Length: Dimension of the building measured perpendicular to main framing from end wall to end wall (outside face of girt to outside face of girt).
- C. Building Width: Dimension of the building measured parallel to main framing from sidewall to sidewall (outside face of girt to outside face of girt).
- D. Clear Span: Distance between supports of beams, girders, or trusses (measured from lowest level of connecting area of a column and a rafter frame or knee).
- E. Eave Height: Vertical dimension from finished floor to eave (the line along the sidewall formed by intersection of the planes of the roof and wall).
- F. Clear Height under Structure: Vertical dimension from finished floor to lowest point of any part of primary or secondary structure, not including crane supports, located within clear span.
- G. Terminology Standard: Refer to MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

#### 1.4 SYSTEM DESCRIPTION

- A. General: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, metal roof panels, metal wall panels, and accessories complying with requirements indicated.
  - 1. Provide metal building system of size and with spacings, slopes, and spans indicated. The building shall be designed according to the Contract requirements and the State of Connecticut Building Code.
- B. Primary Frame Type:
  - 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing: Engineer end walls to be expandable. Provide primary frame, capable of supporting full-bay design loads, and end-wall columns.
- D. Secondary Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.
- E. Eave Height: As shown on the drawings.
- F. Bay Spacing: As shown on the drawings.
- G. Roof Slope: As shown on the drawings.
- H. Roof System: Manufacturer's standard vertical-rib, standing-seam metal roof panels with insulation.
- I. Exterior Wall System: Manufacturer's standard field-assembled, insulated metal wall panels.

#### 1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F , ambient; 180 deg F , material surfaces.
- B. Thermal Performance: Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C 1363 or ASTM C 518:
  - 1. Metal Roof Panel Assemblies:
    - a. R-Value: R-30
  - 2. Metal Wall Panel Assemblies:
    - a. R-Value: R-19
- C. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at negative test-pressure difference of 1.57 lbf/sq. ft. .
- D. Air Infiltration for Metal Wall Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at static-air-pressure difference of 6.24 lbf/sq. ft. .

- E. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of 2.86 lbf/sq. ft. .
- F. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. and not more than 12 lbf/sq. ft. .
- G. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 90.
- H. Verify all Municipal construction requirements with the Authority having permitting jurisdiction, such as the need to anchor the building to resist flotation, collapse, and lateral movement, prior to submitting the plans for permit review. For additional information about these requirements, contact the community that has permitting jurisdiction.
- I. All of the building's structural components must be coordinated with FEMA Flood proofing requirements, specifically Technical Bulletins #2-93 and #3-93, and capable of resisting specific flood-related forces that would be exerted upon the building as a result of floodwaters, including the following:
  - 1. Hydrostatic Flood Force
  - 2. Buoyancy
  - 3. Hydrodynamic Force
  - 4. Debris Impact Force

## 1.6 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of the following metal building system components:
  - 1. Structural-framing system.
  - 2. Metal roof panels.
  - 3. Metal wall panels.
  - 4. Insulation and vapor retarders.
  - 5. Flashing and trim.
  - 6. Doors.
  - 7. Accessories.
- B. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.
  - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Anchor-Bolt Plans: Submit anchor-bolt plans before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.
  - 3. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
  - 4. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
    - a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, snow guards, and items mounted on roof curbs.
    - b. Show wall-mounted items including doors, windows, louvers, and lighting fixtures.

5. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches :
  - a. Flashing and trim.
- C. Samples for Initial Selection: For each type of building component with factory-applied color finish.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below.
  1. Metal Roof and Wall Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
  2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
  3. Vapor Retarders: Nominal 6-inch- square Samples.
  4. Accessories: Nominal 12-inch- long Samples for each type of accessory.
- E. Product Certificates: For each type of metal building system, signed by product manufacturer.
  1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
    - a. Name and location of Project.
    - b. Order number.
    - c. Name of manufacturer.
    - d. Name of Contractor.
    - e. Building dimensions including width, length, height, and roof slope.
    - f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
    - g. Governing building code and year of edition.
    - h. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
    - i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
    - j. Building-Use Category: Indicate category of building use and its effect on load importance factors.
    - k. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.
- F. Welding certificates.
- G. Erector Certificate: Signed by manufacturer certifying that erector complies with requirements.
- H. Manufacturer Certificate: Signed by manufacturer certifying that products comply with requirements.
- I. Qualification Data: For Erector, manufacturer and professional engineer.
- J. Material Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
  1. Structural steel including chemical and physical properties.
  2. Bolts, nuts, and washers including mechanical properties and chemical analysis.

3. Tension-control, high-strength, bolt-nut-washer assemblies.
  4. Shop primers.
  5. Nonshrink grout.
- K. Field quality-control test reports.
- L. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for insulation and vapor retarders. Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.
- M. Maintenance Data: For metal panel finishes and door hardware to include in maintenance manuals.
- N. Other Action Submittals:
1. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
    - a. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.
    - b. Keying Schedule: Detail Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

#### 1.7 QUALITY ASSURANCE

- A. Erector Qualifications: An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- B. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.
1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.
  2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- C. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.
- D. Source Limitations: Obtain primary metal building system components, including structural framing and metal panel assemblies, through one source from a single manufacturer.
- E. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal building system and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
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.
- F. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

- G. Structural Steel: Comply with AISC's "Specification for Structural Steel Buildings--Allowable Stress Design, Plastic Design," or AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings," for design requirements and allowable stresses.
- H. Cold-Formed Steel: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members," or AISI's "Load and Resistance Factor Design Specification for Steel Structural Members," for design requirements and allowable stresses.
- I. Fire-Resistance Ratings: Where indicated, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
  2. Metal panels shall be identified with appropriate markings of applicable testing and inspecting agency.
- J. Surface-Burning Characteristics: Provide field-insulated metal panels having thermal insulation and vapor-retarder-facing materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame-Spread Index: 25 or less, unless otherwise indicated.
  2. Smoke-Developed Index: 450 or less, unless otherwise indicated.
- K. Preinstallation Roof Assembly Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
1. Examine purlin and rafter conditions for compliance with requirements, including flatness and attachment to structural members.
  2. Review structural limitations of purlins and rafters during and after roofing.
  3. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
  4. Review temporary protection requirements for metal roof panel assembly during and after installation.
  5. Review roof observation and repair procedures after metal roof panel installation.
- L. Preinstallation Wall Assembly Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
1. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  2. Review structural limitations of girts and columns during and after wall panel installation.
  3. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
  4. Review temporary protection requirements for metal wall panel assembly during and after installation.
  5. Review wall observation and repair procedures after metal wall panel installation.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness and with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

#### 1.9 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements:
  - 1. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
  - 2. Established Dimensions for Metal Panels: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

#### 1.10 COORDINATION

- A. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

### PART 2 - PRODUCTS

#### 2.1 METAL BUILDING SYSTEMS

- A. Description: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.

#### 2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Butler Building System, Widespan™ Structural System, Clearspan LRF Frame with tapered columns, as indicated on Drawings, or comparable product by one of the following manufacturers, or approved equal:
  - 1. Ceco Building Systems; Division of NCI Building Systems, L.P.
  - 2. Kirby Building Systems; Division of Magnatrax Corp.

3. Metallic Building Company; Division of NCI Building Systems, L.P.
4. Metco Metal Supply.
5. Nucor Building Systems.
6. Star Building Systems; an NCI company.

### 2.3 STRUCTURAL-FRAMING MATERIALS

- A. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55 or ASTM A 529/A 529M, Grade 50 or 55.
- B. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
- C. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 or ASTM A 529/A 529M, Grade 50 or 55.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.
- E. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70; or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80, or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70.
- F. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G60 coating designation; mill phosphatized.
- G. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G90 coating designation.
  2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 50 or 80; with Class AZ50 coating.
- H. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
  1. Finish: Plain
- I. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
  1. Finish: Plain
  2. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with splined ends.
    - a. Finish: Plain.
- J. Unheaded Anchor Rods: ASTM F 1554, Grade 36 ASTM A 572/A 572M, Grade 50 ASTM A 36/A 36M ASTM A 307, Grade A.
  1. Configuration: Straight.
  2. Nuts: ASTM A 563 hex carbon steel.

3. Plate Washers: ASTM A 36/A 36M carbon steel.
  4. Washers: ASTM F 436 hardened carbon steel.
  5. Finish: Plain.
- K. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
1. Nuts: ASTM A 563 hex carbon steel.
  2. Plate Washers: ASTM A 36/A 36M carbon steel.
  3. Washers: ASTM F 436 hardened carbon steel.
  4. Finish: Plain.
- L. Threaded Rods: ASTM A 193/A 193M ASTM A 572/A 572M, Grade 50 ASTM A 36/A 36M ASTM A 307, Grade A.
1. Nuts: ASTM A 563 hex carbon steel.
  2. Washers: ASTM F 436 ASTM A 36/A 36M carbon steel.
  3. Finish: Plain .
- M. Primer: SSPC-Paint 15, Type I, red oxide.

## 2.4 MATERIALS FOR FIELD-ASSEMBLED METAL PANELS

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 , with G90 coating designation.
  2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 50 or 80 ; with Class AZ50 coating designation.
  3. Surface: Smooth, flat finish.
  4. Exposed Finishes: Apply the following coil coating:
    - a. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coatings; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight), with a minimum total dry film thickness of 1.5 mil. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions, except as modified below:
      - 1) Humidity Resistance: 2000 hours.
      - 2) Salt-Spray Resistance: 2000 hours.

## 2.5 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL PANELS

- A. Metal Building Insulation: ASTM C 991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch- wide, continuous, vapor-tight edge tabs; and with a flame-spread index of 25 or less.
- B. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm when tested according to ASTM E 96, Desiccant Method.
1. Composition: White metallized-polypropylene film facing, fiberglass scrim reinforcement, and kraft-paper backing.

2. Composition: White polypropylene film facing and fiberglass-polyester blend fabric backing.
- C. Retainer Strips: 0.019-inch- thick, formed, galvanized steel or PVC retainer clips colored to match insulation facing.
- D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

## 2.6 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
  1. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.
  2. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with nylon or polypropylene washer.
  3. Fasteners for Metal Roof and Wall Panels: Self-drilling Type 410 stainless-steel or self-tapping Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal panels.
  4. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
  5. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- C. Gypsum Board: Type X, of thicknesses indicated, complying with ASTM C 442/C 442M or ASTM C 36/C 36M.
- D. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- E. Metal Panel Sealants:
  1. Joint Sealant: ASTM C 920; one-part elastomeric polyurethane, polysulfide, or silicone-rubber sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

## 2.7 FABRICATION, GENERAL

- A. General: Design components and field connections required for erection to permit easy assembly.
  1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
  2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."

- C. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

## 2.8 STRUCTURAL FRAMING

### A. General:

1. Primary Framing: Shop fabricate framing components to indicated size and section with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
  - a. Make shop connections by welding or by using high-strength bolts.
  - b. Join flanges to webs of built-up members by a continuous submerged arc-welding process.
  - c. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
  - d. Weld clips to frames for attaching secondary framing members.
  - e. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary structural members with specified primer after fabrication.
2. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
  - a. Make shop connections by welding or by using non-high-strength bolts.
  - b. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary structural members with specified primer after fabrication.

- B. Primary Framing: Manufacturer's standard structural primary framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
  - a. Slight variations in span and spacing may be acceptable if necessary to meet manufacturer's standard, as approved by Architect.
2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
3. Frame Configuration: Single gable and One-directional sloped.
4. Exterior Column Type: Uniform depth or tapered.
5. Rafter Type: Uniform depth or tapered.

- C. Secondary Framing: Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet prepainted with coil coating, unless otherwise indicated, to comply with the following:

1. Purlins: C- or Z-shaped sections; fabricated from minimum 0.0598-inch- thick steel sheet, built-up steel plates, or structural-steel shapes; minimum 2-1/2-inch- wide flanges.
    - a. Depth: 6-1/2 inches required to comply with system performance requirements.
  2. Girts: C- or Z-shaped sections; fabricated from minimum 0.0598-inch- thick steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange and with minimum 2-1/2-inch- wide flanges.
    - a. Depth: 8 inches.
  3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from 0.0598-inch- thick steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.
  4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary frame flanges.
  5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
  6. Base or Sill Angles: Minimum 3-by-2-by-0.0598-inch zinc-coated (galvanized) steel sheet.
  7. Purlin and Girt Clips: Minimum 0.0598-inch- thick, steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
  8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from minimum 0.0598-inch- thick, structural-steel sheet.
  9. Framing for Openings: Channel shapes; fabricated from minimum 0.0598-inch- thick, cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.
  10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- D. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads, fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.
1. Type: Straight-beam, eave type or purlin-extension type.
- E. Bracing: Provide adjustable wind bracing as follows:
1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 ; or ASTM A 529/A 529M, Grade 50 ; minimum 1/2-inch- diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
  2. Cable: ASTM A 475, 1/4-inch- diameter, extra-high-strength grade, Class B zinc-coated, 7-strand steel; with threaded end anchors.
  3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
  4. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
  5. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
  6. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
  7. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.
- F. Bolts: Provide plain finish bolts for structural-framing components that are primed or finish painted. Provide zinc-plated bolts for structural-framing components that are galvanized.
- G. Factory-Primed Finish: Apply specified primer immediately after cleaning and pretreating.

1. Prime primary, secondary, and end-wall structural-framing members to a minimum dry film thickness of 1 mil.
  - a. Prime secondary steel framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.
2. Prime galvanized members with specified primer, after phosphoric acid pretreatment.

## 2.9 METAL ROOF PANELS

- A. Vertical-Rib, Standing-Seam Metal Roof Panels : Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.

1. Material: Zinc-coated (galvanized) steel sheet, 0.0159 inch thick.
  - a. Exterior Finish: Fluoropolymer.
  - b. Color: As selected by Architect from manufacturer's full range.
2. Clips: Manufacturer's standard, floating type to accommodate thermal movement; fabricated from zinc-coated (galvanized) steel sheet.
3. Joint Type: Panels snapped together.
4. Joint Type: Mechanically seamed, folded as standard with manufacturer.
5. Panel Coverage: 16 inches .
6. Panel Height: 2 inches .
7. Uplift Rating: UL 90.

## 2.10 FIELD-ASSEMBLED METAL WALL PANELS

- A. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced or flat pan between major ribs; designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) steel sheet, 0.0159 inch thick.
  - a. Exterior Finish: Fluoropolymer.
  - b. Color: As selected by Architect from manufacturer's full range.
2. Major-Rib Spacing: 12 inches o.c.
3. Panel Coverage: 36 inches.
4. Panel Height: 0.75 inch.

## 2.11 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Tapered-Rib-Profile, Exposed-Fastener Metal Soffit Panels : Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced or flat pan between major ribs; designed to be field

assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) steel sheet, 0.0159 inch thick.
  - a. Exterior Finish: Fluoropolymer.
  - b. Color: As selected by Architect from manufacturer's full range.
2. Major-Rib Spacing 12 inches o.c.
3. Panel Coverage: 36 inches.
4. Panel Height: 0.75 inch.

## 2.12 DOORS AND FRAMES

A. Swinging Personnel Doors and Frames: Metal building system manufacturer's standard doors and frames; prepared and reinforced at strike and hinges to receive factory- and field-applied hardware according to ANSI/DHI A115 Series.

1. Steel Doors: 1-3/4 inches thick; fabricated from 0.0329-inch- uncoated thickness, metallic-coated steel face sheets; of styles indicated; seamless at both vertical edges; with 0.0528-inch- uncoated thickness, inverted metallic-coated steel channels welded to face sheets at top and bottom of door.
  - a. Core: Polystyrene foam with U-factor rating of at least 0.16 Btu/sq. ft. x h x deg F .
2. Steel Frames: Fabricate 2-inch-wide face frames from 0.0528-inch- uncoated thickness, metallic-coated steel sheet.
  - a. Type: Knocked down for field assembly or Factory welded.
3. Fabricate concealed stiffeners, reinforcement, edge channels, and moldings from either cold- or hot-rolled steel sheet.
4. Hardware: Comply with ANSI/DHI A115 Series and as follows:
  - a. Provide hardware for each door leaf, as follows:
    - 1) Hinges: Three antifriction-bearing, standard weight, full-mortise, stainless-steel or bronze, template-type hinges; 4-1/2 by 4-1/2 inches, with nonremovable pin.
    - 2) Lockset: Key-in-lever mortise type.
    - 3) Threshold: Extruded aluminum.
    - 4) Silencers: Pneumatic rubber; three silencers on strike jambs of single door frames and two silencers on heads of double door frames.
    - 5) Closer: Surface-applied, standard-duty hydraulic type.
    - 6) Weather Stripping: Vinyl applied to head and jambs, with vinyl sweep at sill.
5. Anchors and Accessories: Manufacturer's standard units, galvanized according to ASTM A 123/A 123M.
6. Fabrication: Fabricate doors and frames to be rigid; neat in appearance; and free from defects, warp, or buckle. Provide continuous welds on exposed joints; grind, dress, and make welds smooth, flush, and invisible.
7. Finishes for Personnel Doors and Frames:
  - a. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

- 1) Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- b. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply the primer specified below immediately after cleaning and pretreating.
  - 1) Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria.
- c. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat.

## 2.13 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles, dimensional and structural requirements.
  1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
  1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
  2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
  3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
  4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
  6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1 inch standoff; fabricated from extruded polystyrene.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
  1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D. Flashing and Trim: Formed from minimum 0.0159-inch- thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.

1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
  2. Opening Trim: Minimum 0.0159-inch-thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating roof panel, with predrilled holes and clamps or hooks for anchoring. To be located on garage door side of roof.
1. Metal-Type Guard: Consisting of aluminum or stainless-steel rods or bars held in place by supports clamped to vertical ribs of standing-seam roof.
    - a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - b. Products: Subject to compliance with requirements, provide one of the following:
      - 1) LMCurbs; S-5! SnoFence.
      - 2) Riddell & Company, Inc.; Snobar.
      - 3) Snow Management Systems; Vermont Snowguard.

#### 2.14 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. 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. 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.

#### 2.15 SOURCE QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified testing and inspecting agency to perform the following tests and inspections and to submit reports.
- B. Tests and Inspections:
  1. Bolted Connections: Shop-bolted connections shall be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
  2. Welded Connections: In addition to visual inspection, shop-welded connections shall be tested and inspected according to AWS D1.1 and the following inspection procedures, at inspector's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
    - d. Radiographic Inspection: ASTM E 94.
- C. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  - 1. For the record, prepare written report, endorsed by Erector, listing conditions detrimental to performance of work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with Erector present, for compliance with requirements and metal building system manufacturer's tolerances.
  - 1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

### 3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing 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. 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.
  - 3. Promptly pack 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 shrinkage-resistant grouts.

- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing true to line, level, plumb, rigid, and secure. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist cure grout for not less than seven days after placement.
1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
    - a. Joint Type: Snug tightened or pretensioned.
- G. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips with field connections using non-high-strength bolts.
1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
  2. Locate and space wall girts to suit openings such as doors and windows.
  3. Locate canopy framing as indicated.
  4. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
1. Tighten rod and cable bracing to avoid sag.
  2. Locate interior end-bay bracing only where indicated.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

### 3.4 METAL PANEL INSTALLATION, GENERAL

- A. Examination: Examine primary and secondary framing to verify that structural panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
1. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before metal panel installation.
- B. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
    - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.

2. Install metal panels perpendicular to structural supports, unless otherwise indicated.
  3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
  4. Locate and space fastenings in uniform vertical and horizontal alignment.
  5. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- C. Lap-Seam Metal Panels: Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or metal panels. Install screws in predrilled holes.
1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- D. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal panel manufacturer.
1. Seal metal panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal panel manufacturer.
  2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

### 3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations.
1. Install ridge caps as metal roof panel work proceeds.
  2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Field-Assembled, Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
1. Install clips to supports with self-tapping fasteners.
  2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
  6. Provide metal closures at peaks rake edges rake walls and each side of ridge caps.

- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
- D. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
  - 2. Shim or otherwise plumb substrates receiving metal wall panels.
  - 3. When two rows of metal panels are required, lap panels 4 inches minimum.
  - 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
  - 5. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Pre-drill panels.
  - 6. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
  - 7. Install screw fasteners in predrilled holes.
  - 8. Install flashing and trim as metal wall panel work proceeds.
  - 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated, or if not indicated, as necessary for waterproofing.
  - 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws.
  - 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Field-Assembled, Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
  - 1. Field-Insulated Assemblies: Install thermal insulation as specified. Install metal liner panels over insulation on interior side of girts at locations indicated. Fasten with exposed fasteners as recommended by manufacturer.
- C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet, nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.7 METAL SOFFIT PANEL INSTALLATION

- A. Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

### 3.8 THERMAL INSULATION INSTALLATION FOR FIELD-ASSEMBLED METAL PANELS

- A. General: Install insulation concurrently with metal wall panel installation, in thickness indicated to cover entire wall, according to manufacturer's written instructions.
- B. Blanket Roof Insulation: Comply with the following installation method:
1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Hold in place by metal roof panels fastened to secondary framing.
  2. Between-Purlin Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder facing tabs up and over purlin, overlapping adjoining facing of next insulation course maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.
  3. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
  4. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder facing tabs up and over purlin, overlapping adjoining facing of next insulation course maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.
  5. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
  6. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Hold in place by metal wall panels fastened to secondary framing.
1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
  2. Sound-Absorption Insulation: Where sound-absorption requirement is indicated for metal liner panels, cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.

### 3.9 DOOR AND FRAME INSTALLATION

- A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturer's written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.
- B. Personnel Doors and Frames: Install doors and frames according to ANSI A250.8. Shim as necessary to comply with DHI A115.IG. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
1. Between Doors and Frames at Jambs and Head: 1/8 inch.
  2. Between Edges of Pairs of Doors: 1/8 inch .
  3. At Door Sills with Threshold: 3/8 inch .
  4. At Door Sills without Threshold: 3/4 inch .
- C. Sliding Service Doors: Bolt support angles to opening head members through factory-punched holes. Bolt door tracks to support angles at maximum 24 inches o.c. Set doors and operating equipment with necessary hardware, jamb and head mold stops, continuous hood flashing, anchors, inserts, hangers, and equipment supports.
- D. Field Glazing: Comply with installation requirements in Division 8 Section "Glazing."

- E. Door Hardware: Mount units at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
1. Install surface-mounted items after finishes have been completed on substrates involved.
  2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
  4. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Sealants."

### 3.10 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  2. Install components for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  3. Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

### 3.11 ADJUSTING

- A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.
- B. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.
1. Door Closers: Adjust door closers to compensate for final operation of heating and ventilating equipment. Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

### 3.12 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
  - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
  - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- D. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.
- E. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
  - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- F. Doors and Frames: Immediately after installation, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
  - 1. Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 133419