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None issued

DIVISION 32 - EXTERIOR IMPROVEMENTS

None issued

DIVISION 33 - UTILITIES

None issued

END OF SECTION 00 01 10

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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:
   1. Contracting Requirements of Div. 00 Documents apply to, and are a component part of, this Section.
   2. General Requirements of Div. 01 Specification Sections apply to, and are a component part of, this Section.

1.02 REFERENCES

A. Definitions:
   1. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
   2. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.
   3. SOF_F: Specified Overall Flatness value.
   4. SOF_L: Specified Overall Levelness value.
   5. MLF_F: Minimum Local Value for Flatness value.
   6. MLF_L: Minimum Local Value for Levelness value.

B. Reference Standards: Perform Work per standards specified and as follows unless modified by requirements in the Contract Documents.
   1. Make available via internet access or maintain on site a copy of each standard affecting the Work of this Section.
   2. American Concrete institute (ACI):
      a. ACI 301-20 - Specifications for Structural Concrete, Sections 1 through 5.
      b. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct at Project site per Div. 01 Section "PROJECT MEETINGS" minimum one weekprior to commencing work of this Section.
   1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.
      e. Insulating concrete forming subcontractor.
      f. Polished concrete finish Subcontractor.
   2. Review the following:
      a. Special inspection and testing and inspecting agency procedures for field quality control.

a. Construction joints, control joints, isolation joints, and joint-filler strips.
b. Steel-reinforcement installation.
c. Semirigid joint fillers.
d. Vapor-retarder installation.
e. Anchor rod and anchorage device installation tolerances.
f. Cold and hot weather concreting procedures.
g. Concrete finishes and finishing.
h. Curing procedures.
i. Forms and form-removal limitations.
j. Shoring and reshoring procedures.
k. Methods for achieving specified floor and slab flatness and levelness.
l. Floor and slab flatness and levelness measurements.
m. Concrete repair procedures.
n. Concrete protection.

1.02 SUBMITTALS, GENERAL

A. Process and transmit per Div. 01 Section "SUBMITTAL PROCEDURES."

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
1. For admixtures, include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Slump limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Synthetic micro-fiber content.
9. Indicate amounts of mixing water to be withheld for later addition at Project site if permited.
10. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
11. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
12. Intended placement method.
13. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings as follows:
1. Formwork detailing fabrication, assembly, and support of formwork.
2. Steel reinforcement placing drawings detailing fabrication, bending, and placement. Comply with ACI SP-066.

a. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

3. Construction joint layout for formed concrete and flatwork, indicating proposed construction joints not indicated on Drawings.
   a. Location of construction joints is subject to approval of the Architect.

D. Samples: For the following:
   1. Vapor retarder, 12 inches square.

E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
   1. Concrete Class designation.
   2. Location within Project.
   3. Exposure Class designation.
   4. Formed Surface Finish designation and final finish.
   5. Final finish for floors.
   6. Curing process.
   7. Floor treatment if any.

1.04 INFORMATIONAL SUBMITTALS

A. Certificates: Per Div. 01 Section "SUBMITTAL PROCEDURES" and as follows:
   1. Welding certificates.
   2. Material certificates for the following:
      a. Form materials and form-release agents.
      b. Cementitious materials.
      c. Admixtures.
      d. Fiber reinforcement.
      e. Curing compounds.
      f. Floor and slab treatments.
      g. Bonding agents.
      h. Adhesives.
      i. Vapor retarders.
      j. Joint-filler strips.
      k. Repair materials.

B. Test and Evaluation Reports: As follows:
   1. Research Reports: For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
   2. Preconstruction test reports for each mix design.
   3. Material test reports for the following:
      a. Steel Reinforcement:
         1) For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
      b. Portland cement.
      c. Fly ash.
      d. Slag cement.
      e. Blended hydraulic cement.

f. Silica fume.
g. Performance-based hydraulic cement.
h. Aggregates.
i. Admixtures:
1) Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

4. Floor surface flatness and levelness measurements report, indicating compliance or non-compliance with specified tolerances.

C. Quality Control Submittals: As follows
1. Special inspection reports.
2. Field quality control test and inspection reports.

D. Qualification Statements for ready-mix manufacturer, installer, welders, and Contractor's testing agency.
1. Include copies of installer's applicable ACI certificates.

1.05 QUALITY ASSURANCE

A. Qualifications: Per Div. 01 Section "QUALITY ASSURANCE" and as follows:
1. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C 94M requirements for production facilities and equipment.
a. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
2. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.
a. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
3. Welder Qualifications: AWS certified within past 12 months per AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
4. Contractor's Testing Agency Qualifications: Per Div. 01 Section "TESTING AND INSPECTING SERVICES" and employing an ACI-certified Concrete Quality Control Technical Manager.
a. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

B. Preconstruction Testing: Engage a qualified testing agency to perform preconstruction testing per Div. 01 Section "TESTING AND INSPECTING SERVICES" and as follows:
1. Perform material evaluation tests and design concrete mixtures. Include the following information in each test report:
a. Admixture dosage rates.
b. Slump.
c. Air content.

d. 7-day compressive strength.
e. 28-day compressive strength.
f. Permeability.

C. Mockups: Per Div. 01 Section "MOCKUPS" and as follows:
1. Field Mockups:
a. Location: As directed.
b. Slab-On-Ground: Divide panel into four equal panels to demonstrate saw joint cutting.
1) Size: Minimum 100 sq. ft. for polishing.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Per Div. 01 Section "PRODUCT DELIVERY AND STORAGE REQUIREMENTS" and as follows:

B. Comply with ASTM C94/C94M and ACI 301.

C. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. and to avoid damaging coatings on steel reinforcement.
1. Store reinforcement to avoid contact with earth.

D. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.07 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.01 COMMON REQUIREMENTS

A. See Div. 01 Section "COMMON PRODUCT REQUIREMENTS" for general requirements common to products.

B. See Div. 01 Section "PRODUCT SELECTION OPTIONS" for Contractor's options when selecting Products and procedures for offering comparable products.

2.02 DESCRIPTION

A. Assemblies:
   1. Concrete Sidewalks and Median Barrier: 3,000 psi 28 day concrete, 4 inches thick, buff color portland cement, exposed aggregate finish, unless otherwise indicated.
   2. Parking Area Pavement: 4,000 psi 28 day concrete, 5 inches thick, 6/6 - 6 x 6 inch mesh reinforcement, wood float finish, unless otherwise indicated.

2.03 FORM-FACING MATERIALS

A. General: Provide form-facing panels that will not adversely affect surface of concrete and will provide or facilitate obtaining specified surface finish. Furnish in largest practicable sizes to minimize number of joints.

B. Surface Finish-1.0 (SF-1.0) (Rough-Formed) Finished Concrete: Contractor's option. Plywood, lumber, metal, glass-fiber-reinforced plastic, or other approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns: Metal, glass-fiber-reinforced plastic, paper, or spirally wound laminated fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

2.04 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60, deformed bars, assembled with clips.

C. Plain-Steel Welded Wire Reinforcement: ASTM A185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.05 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
   1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
      a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

C. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced; mechanical-lap type.

D. Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
   1. Finish: Plain.

2.06 FIBER REINFORCEMENT

A. Synthetic Macro-Fiber: Synthetic macro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, 1 to 2-1/4 inches long.

2.07 CONCRETE MATERIALS

A. Source Limitations:
   1. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
   2. Obtain aggregate from single source.
   3. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C150, Type I, Type I/II, or Type II, gray. Where not exposed as a finished surface in the final construction, supplement with the following:
      a. Fly Ash: ASTM C618, Class F.
      b. Slag Cement: ASTM C989, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33, graded.
   1. Maximum Coarse-Aggregate Size: As indicated.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4.

2.08 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those

permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C 494M, Type A.
2. Retarding Admixture: ASTM C494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C 1017M, Type II.
7. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).
    a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRC C48 at a hydraulic pressure of 200 psi for 14 days.

2.09 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

2.10 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.11 LIQUID FLOOR TREATMENTS

A. As specified in Div. 03 Section "POLISHED CONCRETE FINISHING."

2.12 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
    1. Color:
        a. Ambient Temperature Below 50 deg F: Black.
        b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
        c. Ambient Temperature Above 85 deg F: White.

D. Curing Paper: Eight-feet- wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.

E. Water: Potable or complying with ASTM C1602/C1602M.

F. Curing Compound, Clear, Membrane-Forming:
   1. Waterborne, Dissipating: ASTM C309, Type 1, Class B.
   2. Uses: Concrete to be polished.
   3. Waterborne: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
   4. Uses: Concrete to be covered with applied floor coverings and for first coat where "sealed" concrete is indicated.

G. Curing and Sealing Compound, Clear, Membrane-Forming:
   1. Waterborne: ASTM C1315, Type 1, Class A.
   2. Uses: For second coat where "sealed" concrete is indicated. "SEALED" concrete is concrete to be permanently exposed and otherwise unfinished.

2.13 RELATED MATERIALS

A. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

B. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

C. Construction Joint Forms: Formed galvanized steel, minimum 0.0478 inch, with keyway.

D. Expansion- and Isolation-Joint-Filler Strips: Closed cell polypropylene foam complying with ASTM D8139, and with ASTM D1751 for extrusion, compression recovery and water absorption as tested per ASTM D545 or ASTM D1752, cork or self-expanding cork or ASTM D1751, asphalt-saturated cellulosic fiber.

E. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

F. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, for bonding hardened or freshly mixed concrete to hardened concrete. Capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Non-Load Bearing Conditions: Types I and II.

G. Floor Slab Protective Covering for Polished Concrete: Eight feet wide cellulose fabric.

H. Anchors and Fasteners: Size as required, sufficient strength to maintain forms in place while concrete is placed.

2.14 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.15 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: For concealed and non-decorative exposed concrete, Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Do not add the following cementitious materials to the following concrete:
      a. Concrete to be polished.
   2. Fly Ash or Other Pozzolans: 25 percent by mass.
   3. Slag Cement: 50 percent by mass.
   4. Silica Fume: 10 percent by mass.
   5. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
   6. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, and concrete with a water-cementitious materials ratio below 0.50.
   4. Use permeability-reducing admixture in concrete mixtures where indicated to receive applied floor coverings.

2.16 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
   2. Design mixtures shall meet the specified strength and durability requirements listed below or as indicated on Drawings, whichever is more stringent. Exposure classes listed below are defined by ACI 318, and the design mixture shall comply with the durability requirements of each exposure class.

CLASS	LOCATION	UNIT DENSITY	NOMINAL MAX AGGREGATE SIZE	EXPOSURE CLASSES F / S / W / C	MAX W/CM	MIN. f'_c, PSI
A	Footings, Grade Beams, Tie Beams	Normalweight	1-1/2 inch	F0 / S0 / W0 / C0	0.45	4000
B	Foundation Walls, Grade Beams	Normalweight	1 inch	F1 / S1 / W0 / C1	0.45	4000
C	Slabs-on-Grade (interior)	Normalweight	1 inch	F0 / S0 / W1 / C0	0.45	4000
D	Slabs-on-Grade (exterior)	Normalweight	1 inch	F2 / S1 / W0 / C2	0.45	4000
H	ICF Building Walls	Normalweight	1 inch	F1 / S1 / W1 / C1	0.45	4000

2.17 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.18 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C 94M and ASTM C1116/C 1116M, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 90 minutes to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Per Div. 01 Section "EXAMINATION AND PREPARATION " and as follows:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class C, 1/2 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

M. Formwork Installation Tolerances:
1. Construct formwork to maintain tolerances required by ACI 301.

3.03 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.04 INSTALLATION OF WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.05 INSTALLATION OF VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
   1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
   2. Face laps away from exposed direction of concrete pour.
   3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
   4. Lap joints 6 inches and seal with manufacturer's recommended tape.
   5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
   6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
   7. Protect vapor retarder during placement of reinforcement and concrete.
      a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.06 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.
   1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
   2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.
   1. Stagger splices in accordance with ACI 318.

2. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

G. Install welded-wire reinforcement in longest practicable lengths.
1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
   a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
2. Lap edges and ends of adjoining sheets at least one mesh spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.07 JOINTS

A. Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.
   a. Continue reinforcement across construction joints unless otherwise indicated.
   b. Do not continue reinforcement through sides of strip placements of floors and slabs.
3. Form keyed joints as indicated on Drawings.
4. Locate joints for beams, slabs where indicated on Drawings.
5. Locate horizontal joints in walls at underside of floors, slabs only where indicated on Drawings.
6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use a bonding agent or epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Div. 07 Section "JOINT SEALANTS," are indicated.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

F. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

3.08 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
   1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
   2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Water may be added at Project site before test sampling and placing concrete, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
   1. If a section cannot be placed continuously, provide construction joints as indicated on Drawings or as approved by Architect for visual effect.
   2. Deposit concrete to avoid segregation.
   3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
   4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
      a. Do not use vibrators to transport concrete inside forms.
      b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
      c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
      d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Do not place concrete floors and slabs in a checkerboard sequence.
   2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   3. Maintain reinforcement in position on chairs during concrete placement.
   4. Screed slab surfaces with a straightedge and strike off to correct elevations.
   5. Level concrete, cut high areas, and fill low areas.
   6. Slope surfaces uniformly to drains where required.

7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.09 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.10 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:
   1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
      a. Locations: Apply to concrete surfaces not exposed to public view.
      b. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
      c. Remove projections larger than 1 inch.
      d. Tie holes do not require patching.
      e. Surface Tolerance: ACI 117 Class D.

B. Rubbed Finish: Apply one of the following at Contractor's option to as-cast concrete surfaces exposed to public view:
   1. Smooth-Rubbed Finish:
      a. Perform no later than one day after form removal.
      b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
      c. Use a grout made from the same cementitious materials used in the in-place concrete.
   2. Grout-Cleaned Rubbed Finish:
      a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
      b. Do not clean concrete surfaces as Work progresses.
      c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.

d. Wet concrete surfaces.
e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish:
   a. Mix 1 part portland cement to 1 part fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint.
   b. Mix 1 part portland cement and 1 part fine sand with sufficient water to produce a mixture of stiff grout. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
   c. Wet concrete surfaces.
   d. Compress grout into voids by grinding surface.
   e. In a swirling motion, finish surface with a cork float.

C. Related Unformed Surfaces:
1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:
1. Locations: Apply float finish as initial finish for surfaces to receive subsequent trowel finish.
2. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats
3. Restraighten, cut down high spots, and fill low spots.
4. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.

C. Trowel Finish:
1. Locations: Apply a trowel finish to surfaces exposed to view, and to surfaces to be covered with ceramic or quarry tile set over a crack-control, or waterproofing membrane, resilient flooring, carpet, or another thin-film-finish coating system and where indicated.
2. Coordinate required final finish with Architect before application.
3. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
4. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
5. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
6. Do not add water to concrete surface.
7. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.

8. Finish surfaces to the following ACI 117 tolerances, measured per ASTM E1155, for a randomly trafficked floor surface:

ACI 302.1R Flatness and Levelness Requirements				
Slabs on Ground	SOV F_F	SOV F_L	MLV F_F	MLV F_L
Noncritical Spaces †	20	15		
Carpet	25	20	17	15
Thin Coverings	30-35	20-25	24	17
Polished	50	25	40	17

†Mechanical Rooms, Back-Of-House, Parking, Areas To Receive Thick-Set Tile

SOV = Specified overall values - MLV = minimum local values

F_F values are linear i.e. F_F 25 is twice what F_F 50 is, etc.

F_F 20 may have a single 5/16" defect across 10-feet

F_F 25 may have a single 1/4" defect across 10-feet

F_F 32 may have a single 3/16" defect across 10-feet

F_F 50 may have a single 1/8" defect across 10-feet

D. Trowel and Fine-Broom Finish:
1. Locations: Surfaces where ceramic or quarry tile is to be installed by thin-set method and where indicated.
2. Coordinate required final finish with Architect before application.
3. Apply a first trowel finish and, while concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
4. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Broom Finish:
1. Locations: Exterior concrete platforms, steps, ramps, and where indicated.
2. Coordinate required final finish with Architect before application.
3. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route

3.12 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:
1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of

supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.

3. Minimum Compressive Strength: 5000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.
   a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   b. Cast anchor-bolt insert into bases.
   c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.13 CONCRETE PROTECTING AND CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
   1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
   2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
   1. Cure formed concrete surfaces.
   2. If forms remain during curing period, moist cure after loosening forms.
   3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
      a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
      b. Continuous Sprinkling: Maintain concrete surface continuously wet.
      c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
      d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
      e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
         1) Recoat areas subject to heavy rainfall within three hours after initial application.
         2) Maintain continuity of coating and repair damage during curing period.

D. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
   1. Begin curing immediately after finishing concrete.
   2. Interior Concrete Floors:
      a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
   a) Lap edges and ends of absorptive cover not less than 12-inches.
   b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
   a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
   b) Cure for not less than seven days.
3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
   a) Water.
   b) Continuous water-fog spray.

b. Floors to Receive Polished Finish: Contractor has option of the following:
   1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
      a) Lap edges and ends of absorptive cover not less than 12 inches.
      b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
   2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
      a) Water.
      b) Continuous water-fog spray.

c. Floors to Receive Curing Compound:
   1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
   2) Recoat areas subjected to heavy rainfall within three hours after initial application.
   3) Maintain continuity of coating, and repair damage during curing period.
   4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

d. Floors to Receive Curing and Sealing Compound:
   1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
   2) Recoat areas subjected to heavy rainfall within three hours after initial application.
   3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.14 TOLERANCES

A. Conform to ACI 117.

3.15 APPLICATION OF LIQUID FLOOR TREATMENTS AFTER POLISHING

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than 28 days' old.
   3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
   4. Rinse with water; remove excess material until surface is dry.

3.16 REPAIR

A. Defective Concrete:
   1. Repair and patch defective areas when approved by Architect.
   2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
      a. Limit cut depth to 3/4 inch.
      b. Make edges of cuts perpendicular to concrete surface.
      c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
      d. Fill and compact with patching mortar before bonding agent has dried.
      e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
      a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
      b. Compact mortar in place and strike off slightly higher than surrounding surface.
   3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:
   1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
      a. Correct low and high areas.
      b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas to be polished during, or immediately after, completing surface-finishing operations by cutting out areas full-depth and replacing with matching concrete mix.
    a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
    a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
    b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
    a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
    b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
    a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    d. Place, compact, and finish to blend with adjacent finished concrete.
    e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
    a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    b. Dampen cleaned concrete surfaces and apply bonding agent.
    c. Place patching mortar before bonding agent has dried.
    d. Compact patching mortar and finish to match adjacent concrete.
    e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. See Div. 01 Section "TESTING AND INSPECTING SERVICES" for administrative and procedural requirements for obtaining services of independent testing laboratories and agencies to perform specified testing and inspecting including special inspections.

B. Special Inspections: Owner will engage a qualified special inspector to perform on-site special tests and inspections per the Statement of Special Inspections.

C. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare reports.
   1. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
   2. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
      a. Test reports shall include reporting requirements of ASTM C31/C31M and ASTM C39/C39M, including the following as applicable to each test and inspection:
         1) Project name.
         2) Name of testing agency.
         3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
         4) Name of concrete manufacturer.
         5) Date and time of inspection, sampling, and field testing.
         6) Date and time of concrete placement.
         7) Location in Work of concrete represented by samples.
         8) Date and time sample was obtained.
         9) Truck and batch ticket numbers.
         10) Design compressive strength at 28 days.
         11) Concrete mixture designation, proportions, and materials.
         12) Field test results.
         13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
         14) Type of fracture and compressive break strengths at seven days and 28 days.

D. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

E. Inspections:
   1. Batch Plant Inspections: On a random basis, as determined by Architect.
   2. Forms and accessories to ensure forms are of proper size and required accessories are in place.
   3. Steel-reinforcement placement.
   4. Steel-reinforcement mechanical splice couplers.
   5. Headed bolts and studs.
   6. Verification of use of required design mixture.
   7. Concrete placement, including conveying and depositing.
   8. Curing procedures and maintenance of curing temperature.
   9. Verification of concrete strength before removal of shores and forms from beams and slabs.

F. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M:
    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M:
    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M:
    a. Cast and laboratory cure two sets of four 6 inch by 12 inch cylinder specimens for each composite sample.
    b. Cast and field cure two sets of four standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M.
    a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
    b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
    c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than one percent of specified compressive strength if specified compressive strength is greater than 5,000 psi.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests:
    a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
        1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

G. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 72 hours of completion of floor finishing and promptly report test results to Architect.

3.18 PROTECTION

A. Per Div. 01 Section "EXECUTION" and as follows:

B. Protect concrete surfaces as follows:
1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 03 30 00

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S?ECTION 07 41 13 - METAL ROOF PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Standing-seam metal roof panels **for Municipal Building Bid Package #1**.
   2. Metal soffit panels.

~~B.Products Specified in This Section for Installation Under Other Sections:~~
   ~~1.Install metal roof panels on Community Center building as specified in Div. 13 Section "METAL BUILDING SYSTEMS."~~

~~C.~~**B.** Related Requirements:
   1. Contracting Requirements of Div. 00 Documents apply to, and are a component part of, this Section.
   2. General Requirements of Div. 01 Specification Sections apply to, and are a component part of, this Section.
   3. Div. 07 Section "SNOW GUARDS" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.
   4. Div. 13 Section "METAL BUILDING SYSTEMS" for metal roof panels on Community Center Building Bid Package #2.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct at Project site per Div. 01 Section "PROJECT MEETINGS" minimum one week prior to commencing work of this Section.
   1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
   2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
   4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
   5. Review structural loading limitations of deck, purlins and rafters during and after roofing.
   6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
   7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
   8. Review temporary protection requirements for metal panel systems during and after installation.
   9. Review procedures for repair of metal panels damaged after installation.
   10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

B. Coordination: Per Div. 01 Section "PROJECT COORDINATION" and as follows:
   1. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of decks, purlins and rafters, walls, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
   2. Coordinate sizes and locations of roof penetrations with actual equipment provided.

1.03 SUBMITTALS, GENERAL

A. Process and transmit per Div. 01 Section "SUBMITTAL PROCEDURES."

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:
   1. Include roof plans showing openings and penetrations in metal panels.
   2. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
   3. Include and coordinate details of the flashing, trim, gutters and downspouts, and anchorage systems, at minimum scale of 1-1/2 inches per foot.

C. Samples: For each type and color of metal panel for verification. Include samples of trim and accessories involving color selection. Include fasteners, closures, and other metal panel accessories.
   1. Sample Size:
      a. Color Samples: 6 inches square for sheet materials.
      b. Trim and Accessory Samples: 12 inches in length for linear materials.
      c. Panel Profile Samples: 12 inches long by actual panel width of each panel profile in predominant color specified.

1.05 INFORMATIONAL SUBMITTALS

A. Delegated-design submittal per Div. 01 Section "DELEGATED DESIGN REQUIREMENTS." Include design data for products indicated to comply with design loads for which design is assigned to Contractor.

B. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installers of the items involved:
   1. Roof panels and attachments.
   2. Purlins and rafters.
   3. Roof-mounted items including penetrations, lighting fixtures, and items mounted on roof curbs.

C. Test and Evaluation Reports:
   1. Product test reports for metal panels.

D. Quality Control Submittals:
   1. Field quality control test and inspection reports.

E. Sample warranties.

F. Qualification Statements for installer.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance data per Div. 01 Section "OPERATION AND MAINTENANCE DATA."

B. Executed warranties per Div. 01 Section "WARRANTIES."

1.07 QUALITY ASSURANCE

A. Qualifications: Per Div. 01 Section "QUALITY ASSURANCE" and as follows:
   1. Installer Qualifications: Minimum 5 years experience under current organizational structure.
      a. Company: An employer of workers and supervisors trained and approved by manufacturer for installation of Products specified in this Section.
      b. Project Experience: Minimum 5 years experience on at least 5 projects of similar nature in past 5 years.
      c. Staff: Employ a competent foreman to supervise Work of this Section.Foreman shall be present whenever Work is in progress.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Per Div. 01 Section "PRODUCT DELIVERY AND STORAGE REQUIREMENTS" and as follows:

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

C. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

D. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, 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.

E. Retain strippable protective covering on metal panels during installation.

1.09 FIELD CONDITIONS

A. Ambient Conditions: Per Div. 01 Section "EXECUTION" and as follows:

B. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed per manufacturers' written instructions and warranty requirements.

1.10 WARRANTY

A. Process and transmit per Div. 01 Section "WARRANTIES."

B. Standard Warranty: Furnish manufacturer's standard 2 year warranty providing coverage against failuresin materials or workmanship. Failures include, but are not limited to, the following:
   1. Structural failures including rupturing, cracking, or puncturing.
   2. Deterioration of metals and other materials beyond normal weathering.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
   1. Weathertight Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 COMMON REQUIREMENTS

A. See Div. 01 Section "COMMON PRODUCT REQUIREMENTS" for general requirements common to products.

B. See Div. 01 Section "PRODUCT SELECTION OPTIONS" for Contractor's options when selecting Products and procedures for offering comparable products.

2.02 MANUFACTURERS

A. Basis of Design Product for Municipal Building: Cee-Lock Panel by Berridge Manufacturing Co. or a comparable product by one of the following:
   1. AEP Span; a BlueScope Steel Co.
   2. CENTRIA Architectural Systems.
   3. Firestone Metal Products
   4. MBCI; a division of NCI Building Systems, L.P.
   5. Morin; a Kingspan Group Co.
   6. Comparable products by other manufacturers will be considered.

B. Source Limitations: Obtain each type of metal roof panel from single source from a single manufacturer.
   1. Obtain secondary and incidental components from same manufacturer as metal roof panels or manufacturer approved by metal roof panel manufacturer.
   2. Provide secondary and incidental components approved by metal roof manufacturer for their full system warranty requirements.

2.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Professional design services are specifically required of Contractor. Engage a qualified design professional, as defined in Div. 01 Section "DELEGATED DESIGN REQUIREMENTS," to design secondary metal subgirt framing using performance requirements and design criteria specified herein.

B. Structural Performance Requirements: Provide metal roof systems, including anchorages, capable of withstanding, without failure, the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing per ASTM E1592:
   1. Design Wind Loads: As indicated on Drawings.
      a. Deflection Limits: For wind loads, no greater than 1/180 of the span.
   2. Snow Loads Including Drifting Snow: ASCE 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," Chapter 7.
   3. Rain Loads: ASCE 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," Chapter 8.
   4. Ice Loads: ASCE 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," Chapter 10.
   5. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
   6. Combustion Characteristics: ASTM E136.

C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested per ASTM E1680 at 1.57 lbf/sq. ft. test-pressure difference:

D. Water Penetration under Static Pressure: No water penetration when tested per ASTM E1646 at 2.86 lbf/sq. ft. test-pressure difference:

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
   1. Uplift Rating: UL 60.

F. Thermal Performance Requirements:
   1. Provide metal roof panel system that allows 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, reduction of performance, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
      a. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.04 STANDING-SEAM METAL ROOF PANELS FOR MUNICIPAL BUILDING

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
   1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges with striated 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, and snapping panels together.
   1. Basis of Design Product: Cee-Lock Panel by Berridge Manufacturing Co. Provide the named product or a comparable product by one of the following:
      a. AEP-Span.
      b. Butler Manufacturing; a BlueScope Steel company.
      c. CENTRIA Architectural Systems.
      d. IMETCO.
      e. MBCI; a division of NCI Building Systems, L. P.
      f. Metecno-Morin; Division of Metecno Inc.
      g. Comparable products by other manufacturers will be considered.
   2. Material: Zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet, 0.028-inch nominal thickness.
      a. Exterior Finish: 2-coat fluoropolymer.
      b. Color: As indicated or, if not indicated, as selected from manufacturer's full **standard** range.
   3. Clips: Floating to accommodate thermal movement.
      a. Material: 0.028-inch-nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet or 0.025-inch thick, stainless-steel sheet.
   4. Panel Coverage: 16 inches nominal.
   5. Panel Height: 1.5 inches nominal.

2.05 METAL SOFFIT PANELS

A. Municipal Building Soffit Profile: Solid panels formed with vertical panel edges and a flat pan between panel edges; with a V-groove joint between panels.
   1. Basis of Design Product: Vee-Lock Panel by Berridge Manufacturing Co. Provide the named product or a comparable product by one of the following:
   2. Panel Coverage: ~~12~~ **Nominal 12-3/4** inches.
   3. Panel Height: 3/8 inches.

B. Municipal Building Carport and Patio Profile: Solid panels formed with vertical panel edges and **two** intermediate stiffening ribs symmetrically spaced between panel edges~~; with a V-groove joint between panels~~.
   1. Basis of Design Product: FW-12 Panel by Berridge Manufacturing Co. Provide the named product or a comparable product by one of the following:
   2. Panel Coverage: 12 inches.
   3. Panel Height: 1-1/2 inches.

C. Material: Same material, finish, and color as metal ~~wall~~ **roof** panels.

D. Finish: Match finish and color of metal ~~wall~~ **roof** panels..

~~E.Sealant: Factory applied within interlocking joint.~~

2.06 EQUIPMENT

A. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

2.07 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A 755M.
   1. Nominal Thickness: 0.028 inch.
   2. Surface: Smooth, flat finish.
   3. Exterior Finish: Superior-performance organic finish.

2.08 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.
   1. Products:
      a. WIP 300HT by Carlisle Coatings & Waterproofing Inc.
      b. Grace Ice and Water Shield HT **(40 mil) or Grace Ultra (30 mil)** by Grace Construction Products, a unit of W. R. Grace & Co.-Conn.
      c. Blueskin PE200 HT by Henry Company.
      d. Quik-Stick HT Pro (60 mil) by Mid-States Asphalt.
      e. Ultra HT Wind & Water Seal (45 mil) by MFM Building Products Group.
      f. Polystick MTS Plus (60 mil) by Polyglass.
      g. Lastobond Shield HT (40 mil) by Soprema.
      h. TW Underlayment (40 mil) or TW Metal & Tile Underlayment (40 mil) by Tamko Building Products LLC.
      ~~d.~~i. Comparable products by other manufacturers will be considered.
   2. Thermal Stability: Stable after testing at 220 deg F; ASTM D1970.
   3. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.09 MISCELLANEOUS MATERIALS

A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
   1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal 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 panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels 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. Finish flashing and trim with same finish system as adjacent metal panels.

C. **Municipal Building** Gutters and Downspouts: Per Div. 07 Section "FLASHING AND SHEET METAL" and as follows:
   1. Gutters: ~~Formed from same material roof panels. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required.~~ Finish gutters to match metal roof panels.
   2. Downspouts: ~~Formed from same material as wall panels.~~ Finish downspouts to match gutters.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
   1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

E. Panel Sealants: Compatible with adjacent materials and complying with requirements in Div. 07 Section "JOINT SEALANTS."

F. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

G. 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.

2.10 PANEL FABRICATION

A. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

B. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

C. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate per equipment manufacturer's written instructions and to comply with details shown.

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

E. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

2.11 FLASHING AND ACCESSORIES FABRICATION

A. Flashing and Sheet Metal: Comply with Div.07 Section "FLASHING AND SHEET METAL," metal panel manufacturer's recommendations.

B. Ridge Vent:
   1. Basis of Design Product: Hi-Perf Ridge Vent slope-to-slope, standing seam version by Metal-Era, LLC. Provide the named product or a comparable product.
   2. Ridge Vent Cover Material: 24-gauge galvanized steel.
      a. Formed Lengths: 12’-0”, with slotted fastening holes.
   3. Cover Plates: At each joint, 8 inches wide.
   4. Continuous Z-Brackets: 20-gauge galvanized steel.
   5. Intermittent Spacers: 0.050-inch aluminum, 12 inches on center.
   6. Expanded Metal Support Screens: 0.050-inch aluminum.
   7. Endcaps: Style A.
   8. Deflectors: For roof pitch less than 4/12.
      a. Formed Lengths: 12’-0”.
      b. Deflector Baffles: At deflector joints, 3-1/2 inches wide.

C. Vented Fascia:
   1. Basis of Design Product: Hi-Perf Vented Fascia, attic-vented version by Metal-Era, LLC. Provide the named product or a comparable product.
   2. Fascia Cover Material: 24-gauge galvanized steel.
      a. Formed Lengths: 12’-0”, with slotted fastening holes.
   3. Concealed Splice Plates: At each joint, 8 inches wide.
   4. Vertical Z-Brackets: 0.050-inch aluminum, 12 inches on center.
   5. Backer: 24-gauge galvanized steel.
      a. Factory assembled to vertical Z-brackets and continuous roof flange.
   6. Perforated Closures: 24-gauge galvanized steel.
      a. Net Free Area: 54 percent.
      b. Color: As selected by Architect from manufacturer's full range.
   7. Continuous Roof Flange: 24-gauge galvanized steel.
   8. Top of Sheathing to Bottom of Fascia: As indicated on Drawings.

2.12 FINISHES

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

B. Steel Panels and Accessories:

1. Superior-Performance Organic Finish: AAMA 621 PVDF fluoropolymer superior performing coating per Div. 05 Section "SHOP-APPLIED PAINT COATINGS FOR METAL."
2. Color: As indicated or, if not indicated, as selected from manufacturer's full range.
3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Per Div. 01 Section "EXAMINATION AND PREPARATION" and as follows:

B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
   1. Examine primary and secondary roof framing to verify that rafters, purlins, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
   2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
      a. Verify that air-barriers or water-resistive barriers have been installed over sheathing to prevent air infiltration or water penetration.

C. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

D. Where elements of metal roof panel system will come into contact with dissimilar materials, 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. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.
   1. Apply over the entire roof surface.

B. Flashings: Install flashings to cover underlayment to comply with requirements specified in Div. 07 Section "FLASHING AND SHEET METAL."

3.03 METAL PANEL INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions and recommendations and approved submittals.
   1. Field cutting of metal panels by torch is not permitted.

B. Thermal Movement. Rigidly fasten metal roof panels to structure at one and only one location for each panel. Allow remainder of panel to move freely for thermal expansion and contraction. Predrill panels for fasteners.
   1. Point of Fixity: Fasten each panel along a single line of fixing located at ~~center~~ **top** of panel length.
   2. Avoid attaching accessories through roof panels in a manner that will inhibit thermal movement.

C. Install metal panels in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Commence metal roof panel installation and install minimum of 300 sq. ft. <Insert size> in presence of factory-authorized representative.
   2. Shim or otherwise plumb substrates receiving metal panels.
   3. Apply panels and associated items true to line for neat and weathertight enclosure.
   4. Locate and space exposed fasteners in uniform vertical and horizontal alignment.
   5. Install screw fasteners in predrilled or prepunched holes.
   6. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
   7. Use proper tools to obtain controlled uniform compression adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels.
   8. Locate panel end splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
   9. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
   10. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.
   1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
   2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.04 METAL PANEL INSTALLATION

A. 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.

3.05 METAL SOFFIT PANEL INSTALLATION

A. In addition to complying with requirements in "Metal Roof Panel Installation, General" Article, install metal soffit panels to comply with requirements in this article.

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

C. Metal Fascia Panels: Align bottom of panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.06 ACCESSORY AND FLASHING AND TRIM INSTALLATION

A. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install panel accessories, flashing, and trim components required for a complete metal panel system including sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended in writing by metal panel manufacturer.

B. Roof Ridge and Eave Vents: Install in accordance with manufacturer’s instructions at locations indicated on the Drawings. Seal watertight.

C. 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. Install work with laps, joints, and seams that are permanently watertight.
   1. Install flashing and trim as metal panel work proceeds.
   2. Install metal flashing to allow moisture to run over and off metal roof panels.
   3. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install flashing and sheet metal to fit substrates and achieve waterproof performance.

4. Flash and seal metal panels at perimeter of all openings. Do not begin metal panel installation until air-barriers or water-resistive barriers and flashings that are concealed by metal panels are installed.
5. 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 expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
6. Install ridge caps and hip caps as metal roof panel work proceeds. Provide metal closures at rake edges, rake walls, and each side of ridge caps and hip caps.
7. Flash and seal metal roof panels with weather closures at eaves, rakes, and perimeter of all openings.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels. Fasten and seal to metal roof panels as recommended by manufacturer

3.07 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.

3.08 REPAIR

A. Repairing Damaged Finishes: Immediately after installation, clean abraded and other areas where coatings are damaged.
   1. Galvanized Surfaces: Repair per Div. 05 Section "SHOP-APPLIED GALVANIC COATINGS FOR METAL."
   2. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish per manufacturer's written instructions.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures to Architect's and Owner's satisfaction.

3.09 CLEANING

A. Per Div. 01 Sections "PROGRESS CLEANING" and "FINAL CLEANING" and as follows:

B. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

3.10 PROTECTION

A. Per Div. 01 Section "EXECUTION."

END OF SECTION 07 41 13

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SECTION 07 60 00 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes shop or field-formed and factory manufactured flashing and sheet metal and accessories.

B. Products Specified in This Section for Installation Under Other Sections:
   1. Furnish masonry joint flashing and reglets/receivers for installation under Div. 04 Section "COMMON WORK RESULTS FOR MASONRY."
   2. Furnish sheet metal items interfacing with membrane roofing for installation under Div. 07 Section "METAL ROOF PANELS."
   3. Furnish sheet metal items interfacing with membrane roofing for installation under Div. 07 Section "METAL WALL PANELS."

C. Related Requirements:
   1. Contracting Requirements of Div. 00 Documents apply to, and are a component part of, this Section.
   2. General Requirements of Div. 01 Specification Sections apply to, and are a component part of, this Section.
   3. Div. 02-49 Sections specifying flashing and sheet metal by referencing this Section.
   4. Div. 06 Section "ROUGH CARPENTRY" for wood nailers, curbs, and blocking.
   5. Div. 07 Section "JOINT SEALANTS" for field-applied sealants.
   6. **Div. 13 Section "METAL BUILDING SYSTEMS" for flashing and sheet metal on Community Center Building Bid Package #2.**

1.02 REFERENCES

A. Definitions:
   1. Manufactured: Products manufactured by a national or regional firm/vendor specializing in the fabrication of stock, semi-custom, and custom flashing and sheet metal. Where manufactured products are specified shop- or field formed products are not acceptable.
   2. Formed: Products shop- or field formed and fabricated by a local sheet metal shop specializing in the custom fabrication of flashing and sheet metal. Where shop- or field formed products are specified manufactured products may be substituted.

B. Reference Standards: Perform Work per standards specified and as follows unless modified by requirements in the Contract Documents.
   1. Make available via internet access or maintain on site a copy of each standard affecting the Work of this Section.
   2. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
      a. Architectural Sheet Metal Manual. Comply with recommendations that apply to design, dimensions, metal, and other characteristics of item indicated. Refer discrepancies between Drawings and SMACNA recommendations to Architect for resolution.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Roofing: Coordinate installation of flashing and sheet metal with installation of adjoining roofing and wall materials to provide watertight, secure, and noncorrosive installation.
   2. Walls: Coordinate installation of flashing and sheet metal with installation of wall-opening components such as windows, doors, and louvers to intercept and exclude penetrating moisture.
   3. Penetrations: Coordinate flashing and sheet metal layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Preinstallation Meetings: Conduct at Project site per Div. 01 Section "PROJECT MEETINGS" minimum one weekprior to commencing work of this Section.
   1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects roof specialties including installers of roofing materials and accessories.
   2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
   3. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect flashing and sheet metal.
   4. Review observation and repair procedures after sheet metal flashing installation.

1.04 SUBMITTALS, GENERAL

A. Process and transmit per Div. 01 Section "SUBMITTAL PROCEDURES."

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each product and accessory.

B. Shop Drawings: Distinguish between shop- or field-formed and factory manufactured items. Distinguish between shop- and field-assembled work. Shop Drawings for manufactured items shall be prepared by qualified design professional per Div. 01 Section "DELEGATED DESIGN REQUIREMENTS."
   1. Include plans, elevations, sections, and attachment details.
   2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details.
   3. Include identification of material, thickness, weight, and finish for each item and location in Project.
   4. Include details for forming, including profiles, shapes, seams, and dimensions.
   5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   6. Include details of termination points and assemblies.
   7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
   8. Include details of roof-penetration flashing.
   9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
   10. Include details of special conditions.

11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples: For verification.
1. Sample Size:
a. Finish Samples: 6 inches square for sheet materials in each color and finish of exposed metals.
b. Profile Samples: 12 inches long by actual width of unit for each exposed profile.
2. Include samples of each type moving and non-moving seam.
3. Include samples of each type fastener, cleat, clip, closure, and other attachments.

1.06 INFORMATIONAL SUBMITTALS

A. Delegated-design submittal per Div. 01 Section "DELEGATED DESIGN REQUIREMENTS." Include design data for manufactured and formed gutters and downspouts for which design is assigned to Contractor.

B. Sample warranties.

C. Qualification Statements for manufacturer,fabricator, and installer.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance data per Div. 01 Section "OPERATION AND MAINTENANCE DATA."

B. Executed warranties per Div. 01 Section "WARRANTIES."

1.08 QUALITY ASSURANCE

A. Qualifications: Per Div. 01 Section "QUALITY ASSURANCE" and as follows:
1. Manufacturer Qualifications: Minimum 5 years experience under current organizational structure.
2. Fabricator Qualifications: Minimum 5 years experience under current organizational structure.
3. Installer Qualifications: Minimum 5 years experience.
a. Company: An employer of workers trained for installation of Products specified in this Section.
b. Project Experience: Minimum 5 years experience on at least 5 projects of similar nature in past 5 years.
c. Staff: Employ a competent foreman to supervise Work of this Section.Foreman shall be present whenever Work is in progress.
4. Welder Qualifications: Procedures and personnel qualified by AWS within past 12 months for each type of joint required per AWS D9.1M/D9.1 and AWS B2.3/B2.3M.
5. Design Professional Qualifications: Per Div. 01 Section "DELEGATED DESIGN REQUIREMENTS."

1.09 DELIVERY, STORAGE, AND HANDLING

A. Per Div. 01 Section "PRODUCT DELIVERY AND STORAGE REQUIREMENTS and as follows:

1. Handle flashing and sheet metal in a manner to prevent bending, warping, twisting, and surface damage.
2. Store sheet metal materials to prevent contact with other materials that might cause staining, denting, or surface damage. Store sheet metal materials away from uncured concrete and masonry.
3. Protect strippable protective covering on flashing and sheet metal from exposure to sunlight and high humidity, except to the extent necessary for period of installation.

1.10 WARRANTY

A. Process and transmit per Div. 01 Section "WARRANTIES."

B. Warranty for Applied Finishes: As specified in Div. 05 Section "SHOP-APPLIED PAINT COATINGS FOR METAL."

PART 2 - PRODUCTS

2.01 COMMON REQUIREMENTS

A. See Div. 01 Section "COMMON PRODUCT REQUIREMENTS" for general requirements common to products.

B. See Div. 01 Section "PRODUCT SELECTION OPTIONS" for Contractor's options when selecting Products and procedures for offering comparable products.

2.02 MANUFACTURERS

A. Source Limitations: Obtain metal flashing and sheet metal trim including secondary and incidental components approved by Municipal Building metal roof manufacturer and Community Building manufacturer for their warranty requirements.

~~2.02~~2.03 DESCRIPTION

A. Product Options: Information on Drawings and in Specifications establishes requirements for sheet metal assemblies' aesthetic effects and performance characteristics.
1. 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. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
2. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

~~2.03~~2.04 PERFORMANCE REQUIREMENTS / DESIGN CRITERIA

A. Delegated Design: Professional design services are specifically required of Contractor. Engage a qualified design professional, as defined in Div. 01 Section "DELEGATED DESIGN REQUIREMENTS," to design manufactured and formed gutters and downspouts using performance requirements and design criteria specified herein.

B. Comply with applicable provisions of referenced standards and the following:
   1. Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather and shall remain watertight without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

C. Structural Performance Requirements: Manufacture and install flashing and sheet metal, including anchorages, capable of withstanding, without failure, the effects of the following loads and stresses, within limits and under conditions indicated, determined per applicable code requirements and as follows:
   1. Design Wind Loads: As indicated on Drawings.
   2. Rain Loads: Provide gutters and downspouts capable of withstanding the effects of rain loads determined per ASCE 7, "Minimum Design Loads for Buildings and Other Structures," Section 8, "Rain Loads."
   3. Snow Loads Including Drifting Snow: ASCE 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," Chapter 7.
   4. Ice Loads: ASCE 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," Chapter 10.

D. Thermal Performance Requirements: Provide flashing and sheet metal that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, reduction of performance, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. 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.

~~2.0~~42.05 ROOF DRAINAGE SYSTEM FABRICATIONS

A. **Municipal Building** Manufactured Hanging Gutters: Form to profile indicated, complete with rectangular gutter bead with **elbows, corners,** reinforcing bars, outlet tubes, end pieces, **clips, anchors, hangers, splash guards,** and other accessories as required.
   1. **Basis of Design** Product~~s~~: **Seal-Tite Industrial Gutter IG-B Version by Metal-Era or one of the following:**
      ~~a.Seal-Tite Industrial Gutter IG-B Version by Metal-Era.~~
      ~~b.~~a. Standard Gutter by Metal-Fab Manufacturing LLC.
      ~~c.~~b. Box Profile Gutter by OMG Roofing Products.
      ~~d.~~c. Comparable products by other manufacturers will be considered.
   2. Profile: As indicated on Drawings.
   3. Miters: Factory manufacture matching, watertight mitered corners and end caps by the following method.
      a. Joints for Metallic-Coated Steel Sheet: Mechanically clinched and sealed.
      b. Joints for Aluminum: Weld 0.040 inch and thicker. Mechanically clinched and sealed thinner metal.
   4. Section Length: ~~8~~ **12** feet minimum; 50 feet maximum from downspout to expansion joint or end.
   5. Expansion Joint Style: Butt with expansion space and 6 inch wide, exposed, matching cover plate (SMACNA Fig. 1-7) of material and thickness matching gutter.

6. Cleats: Continuous; 0.0336 inch galvanized-steel sheet with hooked front edge to overlap and engage hook in top of back edge of gutter.
7. Straps: Matching flat-stock fabricated from same material as gutters **or aluminum**; 1/8 by 1 inch size, but in no case shall bracket thickness be less than twice that of gutter.
8. Spacers: Flat-stock fabricated from same material as gutters in 1/16 by 1 inch minimum size or extruded aluminum in manufacturers standard profile.

B. Community Building Hanging Gutters: Form to profile indicated, complete with rectangular gutter bead with elbows, corners, reinforcing bars, outlet tubes, end pieces, clips, anchors, hangers, splash guards, and other accessories as required.
1. Profile: As indicated on Drawings.
2. Miters: Factory manufacture or form matching, watertight mitered corners and end caps by the following method.
a. Joints for Metallic-Coated Steel Sheet: Mechanically clinched and sealed.
b. Joints for Aluminum: Weld 0.040 inch and thicker. Mechanically clinched and sealed thinner metal.
3. Section Length: 12 feet minimum; 50 feet maximum from downspout to expansion joint or end.
4. Expansion Joint Style: Butt with expansion space and 6 inch wide, exposed, matching cover plate (SMACNA Fig. 1-7) of material and thickness matching gutter.
5. Cleats: Continuous; 0.0336 inch galvanized-steel sheet with hooked front edge to overlap and engage hook in top of back edge of gutter.
6. Straps: Matching flat-stock fabricated from same material as gutters or aluminum; 1/8 by 1 inch size, but in no case shall bracket thickness be less than twice that of gutter.
7. Spacers: Flat-stock fabricated from same material as gutters in 1/16 by 1 inch minimum size or extruded aluminum in manufacturers standard profile.

~~B.~~C. Formed Downspouts: Form to dimensions indicated**, complete with elbows, anchors, hangers, and other accessories as required**.
1. Style: Rectangular (**similar to** SMACNA Fig. 1-32B).
2. Miters: Factory manufacture matching, watertight mitered elbows by the following method.
   a. Joints for Metallic-Coated Steel Sheet: Mechanically clinched and sealed.
3. Section Length: 8 feet minimum; 10 feet maximum.
4. Joint Style: Joggle lap with expansion space (SMACNA Fig. 3-2, Style 13).
5. Hangers: U-shaped with concealed wall fasteners SMACNA Fig. 1-35A shop fabricated ~~from same material as downspouts~~ in 1/8 by 1 inch size.

~~C.~~D. Accessories: Fabricated from same metal as gutters.
1. Valley corner baffles of material and thickness matching gutter (SMACNA Fig. 1-24A).
2. Outlet tubes to fit downspout size and shape (SMACNA Fig. 1-33).
3. Wire ball downspout strainers at each outlet tube (SMACNA Fig. 1-24D).

~~2.05~~2.06 FORMED STEEP SLOPE METAL PANEL ROOF FLASHING

A. See Div. 07 Section "METAL ROOF PANELS" for manufactured roof panels.

B. General: Form steep slope metal panel roof flashing of material and thickness matching metal roof panels, unless otherwise indicated.
   1. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
      a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.
   2. Form flashing to profiles as indicated on Drawings or, if not indicated, similar to SMACNA figures indicated below.
   3. Section Length for Linear Flashing Members: 8 feet minimum; 12 feet maximum, unless otherwise indicated.

C. Metal Closure Strips: Cut and shape to match panel profile with flanged edges.

D. Ridge and Hip Flashing: Profile as indicated on Drawings, vented.

E. Apron Flashing: Per SMACNA Fig. 4-14 Detail 1.

F. Base Flashing: Form continuous bent flashing along side slope at junction of roof and walls and other vertical projections above the roof plane per SMACNA Fig. 6-18, Edge B. Extend flashing up the wall a minimum of 4 inches.
   1. At metal panel sidewalls, extend counterflashing behind metal wall panels.
   2. At EIFS or DAFS sidewalls, extend counterflashing behind EIFS or DAFS.

G. Change of Slope Break Flashing: Per SMACNA Fig. 6-14.

H. Valley Flashing: Per SMACNA Fig. 6-7.

I. Eave Flashing: Per SMACNA Fig. 6-15C.

J. Rake Flashing: Per SMACNA Fig. 6-18, Gable 3.

K. Wall-to-Roof Flashing: Per SMACNA Fig. 7-5C.

L. Penetrations Per SMACNA Fig. 8-1.
   1. Pipe and Conduit: Form per SMACNA Fig. 6-18A. Form umbrella with a draw-band. Form base to conform to roof panel profile.

M. Fabricate other flashing to shapes indicated on Drawings from material scheduled.

~~2.06~~2.07 FORMED MASONRY WALL JOINT FLASHING

A. Section Length for Linear Flashing Members: 8 feet minimum; 12 feet maximum, unless otherwise indicated.

B. Formed Smooth Through-Wall Flashing: Form continuous flashings where indicated.

~~2.07~~2.08 FORMED WALL FLASHING

A. Section Length for Continuous Linear Flashing Members: 8 feet minimum; 12 feet maximum, unless otherwise indicated.

B. Formed Opening and Penetration Flashing: Form head, sill, and similar flashings to extend minimum 4 inches beyond wall openings. Form head and sill flashing with 2 inch high end dams sealed or soldered watertight.
   1. Door and Window Head Flashing: As indicated on Drawings. Form with back and end dams.
   2. Window Sill Flashing: As indicated on Drawings. Form with back and end dams.
   3. Pipe and Conduit Penetrations:
      a. Vibrating and Non-Stationary: Similar to SMACNA Fig. 8-4.
      b. Stationary: Similar to SMACNA Fig. 8-4.
   4. Square or Rectangular Tube or Duct Penetrations: Similar to SMACNA Fig. 8-6.
   5. Flanged or Angle Steel Member Penetrations: Similar to SMACNA Fig. 8-7.

C. Form other flashing to shapes indicated on Drawings from material scheduled.

~~2.08~~2.09 FORMED METAL PANEL WALL FLASHING

A. See Div. 07 Section "METAL WALL PANELS" for manufactured wall panels including flashing and trim.
   1. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
   2. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
      a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

B. General: Form metal panel wall flashing of material and thickness matching metal wall panels, unless otherwise indicated.
   1. Section Length for Linear Flashing Members: 8 feet minimum; 12 feet maximum, unless otherwise indicated.

C. Metal Closure Strips: Form in 'Z' shape to match panel depth with flanged edges.

D. Head of Panel: Per SMACNA Fig. 7-5A.

E. Base of Panel: Per SMACNA Fig. 7-5C.

F. Base of Panel at Soffit: Per SMACNA Fig. 7-5B.

G. Outside Corner: Per SMACNA Fig. 7-8A.
   1. Endwalls: Similar to SMACNA Fig. 7-8A with double corners formed from a single sheet.

H. Inside Corner: Per SMACNA Fig. 7-8C.

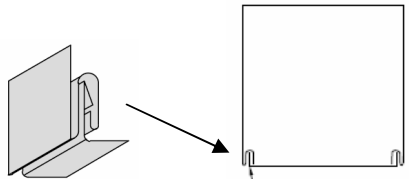
I. Opening and Penetration Flashing: Form head, sill, jamb, and similar flashings to extend beyond wall openings. Form head and sill flashing with 2 inch high end dams.
   1. Door and Window Head: Per SMACNA Fig. 7-5.
   2. Door and Window Jamb: Per SMACNA Fig. 7-5.
   3. Window Sill: Per SMACNA Fig. 7-5.
   4. Pipe and Conduit Penetrations:
      a. Vibrating and Non-Stationary: Per SMACNA Fig. 8-4.
      b. Stationary: Per SMACNA Fig. 8-5.
   5. Square or Rectangular Tube or Duct Penetrations: Per SMACNA Fig. 8-6.
   6. Flanged or Angle Steel Member Penetrations: Per SMACNA Fig. 8-7.

J. Fabricate other flashing to shapes indicated on Drawings from material scheduled.

~~2.09~~2.10 MISCELLANEOUS FORMED SHEET METAL FABRICATIONS

A. Formed Backup Support: Provide bent metal angles and 'Z' shapes where required for flashing and sheet metal attachment as required to prevent unsupported metal flashing edges; minimum 0.0217 inch thickness or same metal being supported.

B. Formed Beam Caps and Wraps: Form similar to an inverted Cornerstone Box with three-sided one-way sloped top and with button lock corner seams (SMACNA Fig. 3.2, Style 11) along both bottom edges to allow bottom to snap into top along lower side edges. Do not seal or solder joints.
   1. Beam Cap and Wrap Profile: Similar to SMACNA Fig. 11-4 Section A-A.



   2. Miters: Shop fabricate matching, watertight mitered corners and intersections.
   3. Section Length: 8 feet minimum; 12 feet maximum.
   4. Face Joint Style: Butt with expansion space and 6 inch wide, concealed backup plate (SMACNA Fig. 3-3, Style 18) of material and thickness matching beam cap.
   5. Top Joint Style: Double lock standing seam (SMACNA Fig. 3-3, Style 25 of material and thickness matching beam cap.

C. Formed Column/Post Wrap: Form similar to SMACNA Fig. 11-4, Section A-A. Do not seal or solder joints.
   1. Section Length: 8 feet minimum; 12 feet maximum.
   2. Joint Style: Button lock corner seam (SMACNA Fig. 3-2, Style 11)

D. Form other flashing to shapes indicated on Drawings from material scheduled.

~~2.10~~2.11 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead soft, fully annealed; with smooth, flat surface; finished per ASTM A480 as follows:

1. No. 2D Mill Finish - Cold-rolled, dull finish.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M zinc-coated (galvanized) or zinc-iron alloy-coated (galvannealed) steel sheet with Class G90 coating designation or ASTM A 792/A 792M aluminum-zinc alloy-coated (Galvalume®) steel sheet with Class AZ50 coating designation, Grade 40 with smooth, flat surface; finished per ASTM A 755/A 755M as follows:
   1. Superior-performance organic finish per Div. 05 Section "SHOP-APPLIED PAINT COATINGS FOR METAL."

D. Aluminum Sheet: ASTM B 209, alloy and temper as standard with manufacturer for finish and forming operations and performance required; with smooth, flat surface; finished as follows:
   1. Anodized finish per Div. 05 Section "SHOP-APPLIED ANODIC COATINGS FOR METAL."

~~2.11~~2.12 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: ASTM D 1970/D 1970M; minimum 40 mils thick, consisting of rubberized asphalt laminated on one side to a slip-resistant polyethylene- or polypropylene-film reinforcement, and with release liner on adhesive side; specifically designed to withstand high metal temperatures beneath sheet metal. Provide primer per written recommendations of underlayment manufacturer.
   1. Products:
      a. WIP 300HT by Carlisle Coatings & Waterproofing Inc.
      b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT.
      c. Blueskin PE200 HT by Henry Company.
      d. Comparable products by other manufacturers will be considered.
   2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
   3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

~~2.12~~2.13 MISCELLANEOUS MATERIALS

A. General: Provide materials as required for complete flashing and sheet metal installation and as recommended by referenced standards and manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Designed to withstand design loads and recommended by fastener manufacturer for intended use.
   1. Screws: Series 300 stainless steel with hex-washer head, self-drilling screws with metal-backed EPDM or PVC sealing washers under heads. Where exposed to view, provide plastic caps or factory-applied coating matching color of sheet metal.
   2. Tinner's Rivets: Solid rivets with a flat head of same material as sheet metal to be fastened.
   3. Blind Rivets: Closed-end, high-strength type of same material as sheet metal to be fastened. Where rivets of same material are not available, provide Series 300 stainless steel rivets.

C. Solder and Flux: Select according to AWS specifications, cited standard, and as recommended by solder manufacturer for metals to be joined. Use lead-free compositions.
   1. For Zinc-Coated (Galvanized) Steel and Stainless Steel: ASTM B 32, Grade Sn96.

D. Brazing and Welding Rods and Bare Electrodes: Select according to AWS specifications and as recommended by rod manufacturer for metals to be joined.

E. Sealant Tape: Pressure-sensitive, permanently elastic, nonsag, nontoxic, nonstaining, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing; 3/8 to 1/2 inch wide by 1/8 inch thick.

F. Sealant: Provide sealant compatible with adjacent materials and complying with requirements in Div. 07 Section "JOINT SEALANTS."

G. Bituminous Coating: ASTM D 1187 cold-applied asphalt emulsion or ASTM D4479, Type I asphalt roof coating.

H. Splash Blocks: Precast concrete units; nominal 12 by 24 by 3 inch size shaped to channel water away from walls at downspout locations.

I. Downspout Boots: Cast iron body with straight outlet. Cast with lugs for bolt attachment to wall and with side cleanout access with plug.
   1. Manufacturers:
      a. Barry Pattern & Foundry.
      b. Neenah Foundry.
      c. Comparable products by other manufacturers will be considered.
   2. Length: As indicated or, if not indicated, as selected from manufacturer's full range.
   3. Inlet Size and Shape: Match downspout.
   4. Outlet Size and Shape: To suit storm drain pipe size.
   5. Finish: Powdercoat in color as selected by Architect from manufacturer's full range.

~~2.13~~2.14 FABRICATION

A. Custom fabricate flashing and sheet metal, in shop to greatest extent possible, to comply with details shown and recommendations in cited sheet metal standards that apply to design, dimensions, geometry, and other characteristics of item required.
   1. Fabricate flashing and sheet metal in thickness or weight needed to comply with performance requirements, but not less than that scheduled or indicated for each application and metal.
   2. Obtain field measurements for accurate fit before shop fabrication.
   3. Form flashing and sheet metal to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
   4. Conceal fasteners where possible.
   5. Do not use graphite pencils to mark metal surfaces.

B. Fabricate flashing and sheet metal that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8 inch offset of adjoining faces and of alignment of adjacent profiles.

C. Form metal flashing and trim for installation allowing for thermal expansion.

D. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured. Fabricate from same material as accessory being anchored, unless otherwise indicated.

E. Seams and Joints: Form flashing and sheet metal seams and joints per cited sheet metal standard to allow for proper installation, to accommodate thermal expansion, and to accommodate field jointing. Where moving joints are required, form metal to allow for proper installation and concealment of sealant.

F. Fixed Seams and Joints in Shop Fabricated Assemblies: Form seams and seal as follows, unless otherwise indicated:
   1. Metal Less Than 0.040 Inch Thick: Flat-lock seams (SMACNA Fig. 3-2, Style 2); treat as follows.
      a. Metals With Painted Finish: Seal with butyl sealant concealed within joint. Rivet joints where necessary for strength.
      b. Anodized Aluminum: Seal with butyl sealant concealed within joint. Rivet joints where necessary for strength.
      c. Other Metals: Tin edges to be seamed, form seams, and solder as specified in Fabrication Article in PART 2 PRODUCTS above. Neutralize flux after soldering.
   2. Metal Greater Than or Equal to 0.040 Inch Thick: Butt seams with backup plates, fastened one side and sealed with butyl sealant (SMACNA Fig. 3-3, Style 19); concealed within joint.

G. Soldered, Brazed, and Welded (i.e. "Fused") Joints: Comply with AWS and cited standards and filler metal manufacturer's recommendations.
   1. Unless otherwise specified, do not fuse prepainted metal or anodized aluminum sheet.
   2. Pretin edges of sheets to be soldered to a width of 1-1/2 inches. Reduce width to minimize pretinned surface visibility in finished Work. Promptly remove acid flux residue from metal after tinning.
   3. Fuse entire joint. Neutralize flux promptly after soldering. Completely remove flux and spatter from exposed surfaces.

H. Sealed Joints: Provide sealant compatible with adjacent materials and complying with requirements in Div. 07 Section "JOINT SEALANTS."

~~2.14~~2.15 FINISHES, GENERAL

A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Per Div. 01 Section "EXAMINATION AND PREPARATION" and as follows:

3.02 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify roof openings, curbs, penetrating pipes, sleeves, ducts, and vents through roof are solidly set, reglets are in place, and nailing strips are located.
   3. Verify roofing termination and base flashings are in place, sealed, and secure.
   4. Verify that substrates are sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   5. Verify that air- or water-resistant barriers have been installed over backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 INSTALLATION, GENERAL

A. General: Install flashing and sheet metal to comply with performance requirements, cited sheet metal standards, manufacturer's written installation instructions, and approved submittals to result in permanently watertight and weather resistant performance.
   1. Install starter and edge strips, and cleats before starting sheet metal installation. Space cleats per cited sheet metal standards. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
   2. Install surface-mounted reglets and seal top of reglets with sealant.
   3. Install to fit substrates true to line, levels, and slopes indicated. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
   4. Anchor flashing and sheet metal and other components of the Work securely in place, with provisions for thermal expansion and structural movement. Install miscellaneous items as required to complete flashing and sheet metal system.
   5. Install work with laps, joints, and seams that are permanently watertight and weather resistant. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
   6. Install exposed flashing and sheet metal with limited oil canning, and free of buckling and tool marks.
   7. Torch cutting of flashing and sheet metal is not permitted.
   8. Do not use graphite pencils to mark metal surfaces.
   9. Remove temporary protective coverings and strippable films as installation of flashing and sheet metal progresses unless otherwise indicated in manufacturer's written installation instructions.

B. Metal Protection: Protect sheet metal against galvanic action or corrosion as follows:
   1. Where dissimilar metals contact each other and where sheet metal contacts ferrous metal or other corrosive substrates, coat contact surfaces of sheet metal with bituminous coating.
   2. Where sheet metal is installed directly on wood substrates or cementitious materials, install sheet metal over self-adhering sheet underlayment and slip sheet.
      a. Install self-adhering sheet underlayment, wrinkle free. Comply with priming requirements and temperature restrictions of underlayment manufacturer for installation. Apply in shingle fashion to shed water, with end laps of not less than 6

inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Do not leave underlayment exposed to the elements for more than 14 days.

b. Apply slip sheet, wrinkle free, over underlayment before installing flashing and sheet metal. Secure in place with tape or adhesive.

C. Fasteners: Use fastener sizes that penetrate substrate as recommended by fastener manufacturer to achieve maximum pull-out resistance, but in no case less than 1-1/4 inches for nails and 3/4 inch for wood screws in wood blocking or sheathing.

1. Rivet joints where indicated and where necessary for strength.
2. Conceal fasteners where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a secure, watertight installation.

3.04 SEAMS AND JOINTS

A. Expansion Provisions: Form and install metal flashing and trim with expansion joints to accommodate thermal expansion and structural movement.

1. Space movement joints per cited standards with no joints within 24 inches of corner or intersection.
2. Size joint expansion space to allow for movement potential based on metal material coefficient of expansion and accounting for ambient temperature at time of installation but never less than 1 inch size. Allow for compression and elongation limitations of sealants to be applied.
   a. When ambient temperature at time of installation is between 50 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher or lower temperatures.

B. Moving Seams and Joints: As follows, unless otherwise indicated:

1. Metal Less Than 0.040 Inch Thick: Interlocking hook seam (SMACNA Fig. 3-2, Style 1), of depth to accommodate anticipated movement but not less than one inch deep, filled with butyl sealant concealed within joint.
2. Metal Greater Than or Equal to 0.040 Inch Thick: Butt seams with expansion space with backup plates fastened to substrate (SMACNA Fig. 3-3, Style 18) with no fasteners exposed through covers; seal with butyl sealant concealed within joint.
3. Use lapped expansion joints only where specified or indicated on Drawings.

C. Fixed Seams and Joints: Form seams and seal as follows, unless otherwise indicated:

1. Metal Less Than 0.040 Inch Thick: Flat-lock seams (SMACNA Fig. 3-2, Style 2); treat as follows.
   a. Metals With Painted Finish: Form seams and seal with butyl sealant concealed within joint. Rivet joints where necessary for strength.
   b. Anodized Aluminum: Form seams and seal with butyl sealant concealed within joint. Rivet joints where necessary for strength.
   c. Other Metals: Tin edges to be seamed, form seams, and solder as specified in Fabrication Article in PART 2 PRODUCTS above. Neutralize flux after soldering.
2. Metal Greater Than or Equal to 0.040 Inch Thick: Butt seams with backup plates, fastened one side and sealed with butyl sealant (SMACNA Fig. 3-3, Style 19); concealed within joint.

D. Seal moving and fixed joints as required for watertight construction, unless otherwise indicated. Conceal sealant within joints where possible. Comply with requirements in Div. 07 Section "JOINT SEALANTS."

E. Field Soldered Joints: Comply with AWS and cited standards and filler metal manufacturer's recommendations.
   1. Do not use torches for soldering.
   2. Do not solder prepainted metal or anodized aluminum sheet.
   3. Pretin edges of sheets to be soldered to a width of 1-1/2 inches. Reduce width to minimize pretinned surface visibility in finished Work. Promptly remove acid flux residue from metal after tinning.
   4. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Neutralize flux after soldering. Completely remove flux and spatter from exposed surfaces.

3.05 ROOF DRAINAGE SYSTEM INSTALLATION

A. Install sheet metal roof-drainage items to produce complete roof-drainage system per cited sheet metal standard, unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters: Join sections with joints sealed with sealant. Firmly anchor gutters in position allowing for thermal expansion and sloped to downspouts. Install end closures sealed watertight.
   1. Fasten gutter spacers to front and back of gutter.
   2. Anchor and loosely lock back edge of gutter to continuous eave flashing.
   3. Support gutters with straps and aluminum spacers spaced not more than 36 inches apart, unless otherwise indicated, and loosely lock to front gutter bead.
   4. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart.

C. Downspouts: Join telescoping joint sections with upper sections inserted into lower sections allowing for thermal expansion.
   1. Install hangers with appropriate fasteners and wall anchors designed to hold downspouts securely to walls at top and bottom and at approximately 60 inches o.c.
   2. Connect downspouts to underground drainage system.

D. Accessories:
   1. Install valley corner baffles at internal corners of gutters.
   2. Install outlet tubes in gutters at each downspout.Rivet and seal in place.
   3. Install wire ball downspout strainers at each downspout outlet tube.

E. Splash Blocks: Install where downspouts discharge at grade. Set loose on turf or paving at grade.

F. Downspout Boots: Install at bottom of downspouts with downspout inserted into boot allowing for thermal expansion.
   1. Install boots with appropriate fasteners and wall anchors designed to hold boot securely to walls
   2. Provide boots at base of downspouts where indicated. Connect downspouts to underground drainage system.

3.06 STEEP SLOPE METAL PANEL ROOF FLASHING

A. Sheet metal flashing and trim installation is specified in Div. 07 Section "METAL ROOF PANELS."

3.07 MASONRY WALL JOINT FLASHING INSTALLATION

A. Sheet metal flashing and trim installation is specified in Div. 04 Section "COMMON WORK RESULTS FOR MASONRY." and Div. 04 Section "ADHERED STONE MASONRY VENEER."

3.08 FRAMED WALL FLASHING INSTALLATION

A. Opening Flashings:
   1. Set sill flashing in a bed of butyl sealant.
      a. Extend flashing slightly beyond wall surface below and turn down flashing terminating in a hemmed drip edge.
   2. Set jamb flashings to overlap sill flashings.
   3. Set head flashings to overlap jamb flashings and direct water beyond door or window frame.

B. Penetration Flashing: Coordinate installation of wall-penetration flashing with installation of items penetrating walls.

3.09 METAL PANEL WALL FLASHING

A. Sheet metal flashing and trim installation is specified in Div. 07 Section "METAL WALL PANELS."

3.10 MISCELLANEOUS SHEET METAL FABRICATION INSTALLATION

A. Beam Wrap: Encase members with sheet metal wrap. Secure at one end only in concealed or lease visible locations.

3.11 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align flashing and sheet metal within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.

3.12 ADJUSTING

A. Per Div. 01 Section "EXECUTION" and as follows:

B. Finish Touchup:
   1. Immediately after installation, repairing damage to paint finishes per Div. 05 Section "SHOP-APPLIED PAINT COATINGS FOR METAL."
   2. Immediately after installation, repairing damage to anodic finishes per Div. 05 Section "SHOP-APPLIED ANODIC COATINGS FOR METAL."

C. Replace flashing and sheet metal that has been damaged or that has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.13 CLEANING

A. Per Div. 01 Sections "PROGRESS CLEANING" and "FINAL CLEANING" and as follows:
   1. On completion of flashing and sheet metal installation, clean finished surfaces as recommended by referenced standards and flashing and sheet metal manufacturer.
   2. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
   3. Clean and neutralize flux materials. Clean off excess solder.
   4. Clean off excess sealants.
   5. Maintain flashing and sheet metal in clean condition during construction.

B. Waste Management: Per Div. 01 Section "CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL."

3.14 PROTECTION

A. Per Div. 01 Section "EXECUTION."

3.15 ATTACHMENTS

A. Schedule: Refer to separate “FLASHING AND SHEET METAL SCHEDULE” for areas of application and sheet metal material, thickness, and finish.

END OF SECTION 07 60 00

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FLASHING AND SHEET METAL SCHEDULE

Sheet Metal Item	Visible / Concealed †	Metal Material	Minimum Thickness ††	Finish ‡	Notes
ROOF DRAINAGE SHEET METAL FABRICATIONS					
Hanging Gutters with Girth 20 Inches	Visible	Prepainted, Metallic-Coated Steel	**0.0336**	AAMA 621 Superior-performance organic coil coating	
Hanging Gutters with Girth 20 to 25 Inches	**Visible**	**Aluminum**	**0.0500**	**AAMA 2605 Superior-performance organic coil coating**	
Downspouts	**Visible**	**Aluminum**	**0.0500**	**AAMA 2605 Superior-performance organic coil coating**	
Downspouts	Visible	Prepainted, Metallic-Coated Steel	**0.0336**	AAMA 621 Superior-performance organic coil coating	
STEEP-SLOPE METAL ROOF FLASHING					
Ridge and Hip Flashing	Visible	Prepainted, Metallic-Coated Steel	0.0217	AAMA 621 Superior-performance organic coil coating	
Apron, Base, Cricket, and Step Flashing	Visible	Prepainted, Metallic-Coated Steel	0.0217	AAMA 621 Superior-performance organic coil coating	
Rake and Eave Flashing	Visible	Prepainted, Metallic-Coated Steel	0.0217	AAMA 621 Superior-performance organic coil coating	
Drip Edges	Visible	Prepainted, Metallic-Coated Steel	0.0217	AAMA 621 Superior-performance organic coil coating	
Roof Penetration Flashing	Visible	Prepainted, Metallic-Coated Steel	0.0276	AAMA 621 Superior-performance organic coil coating	
MASONRY WALL FLASHING					
Smooth Through-Wall Flashing	Concealed	Stainless Steel	0.0156	2D dull annealed	
Stone Cap Flashing	Visible	Prepainted, Metallic-Coated Steel	0.0276	AAMA 621 Superior-performance organic coil coating	
FRAMED WALL FLASHING					
Opening Flashing in Frame Construction	Visible	Prepainted, Metallic-Coated Steel	0.0217	AAMA 621 Superior-performance organic coil coating	
Aluminum Glazing Frame Flashing	Visible	Aluminum	0.0320	AAMA 2605 Superior-performance organic coil coating	
MISCELLANEOUS SHEET METAL FABRICATIONS					
Beam Caps	Visible	Prepainted, Metallic-Coated Steel	0.0276	AAMA 621 Superior-performance organic coil coating	
Beam Wrap	Visible	Prepainted, Metallic-Coated Steel	0.0276	AAMA 621 Superior-performance organic coil coating	

GENERAL NOTES
† Visible is defined as "able to be seen from normal public areas in the finished structure[, excluding lower level roofs visible from higher floors]." Provide factory finished material in visible locations, unless otherwise indicated.
†† Thicknesses shown are minimums. Increase thickness as required to compy with SMACNA recommendations and to meet performance requirements. Flashing thickness measurements are indicated in decimal inches, unless otherwise indicated.
‡ Refer to Div. 05 Section "SHOP-APPLIED ANODIC COATINGS FOR METAL" for anodized finishes and to Div. 05 Section "SHOP-APPLIED PAINT COATINGS FOR METAL" for paint finishes and colors.
Where more than one material is scheduled for the same item, provide sheet metal as standard with manufacturer/fabricator to match color and finish of adjacent metal wall or roof material and as required to comply with specified performance requirements.

END OF SCHEDULE 07 60 00.13

C:\ABA Dropbox\David Oglesby_Specifications Projects\2023\2023.S07 Frenchtown Muni\04 Specs\2023-03-24 Add-06\[07 60 00.13_wsx flashing and sheet metal schedule add-06.xlsx]SHEET METAL FLASHING AND

SECTION 07 72 53 - SNOW GUARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes snow guards for standing-seam metal panel roofing.
   1. Rail-type, seam-mounted snow guards.

B. Related Requirements:
   1. Contracting Requirements of Div. 00 Documents apply to, and are a component part of, this Section.
   2. General Requirements of Div. 01 Specification Sections apply to, and are a component part of, this Section.
   3. Div. 07 Section "METAL ROOF PANELS" for metal panel roofing **on Municipal Building Bid Package #1**.
   4. **Div. 13 Section "METAL BUILDING SYSTEMS" for metal panel roofing on Community Center Building Bid Package #2.**

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct at Project site per Div. 01 Section "PROJECT MEETINGS" minimum one week prior to commencing work of this Section.

B. Coordination: Per Div. 01 Section "PROJECT COORDINATION" and as follows:
   1. Coordinate Work of this Section with Div. 07 Section "METAL ROOF PANELS."

1.03 SUBMITTALS, GENERAL

A. Process and transmit per Div. 01 Section "SUBMITTAL PROCEDURES."

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for snow guards.

B. Shop Drawings~~ prepared by qualified design professional per Div. 01 Section "DELEGATED DESIGN REQUIREMENTS."~~**.**
   1. Include roof plans showing layouts and attachment details of snow guards.
   2. Include details of rail-type snow guards.

C. Samples: Base, bracket, and 12-inch-long rail.

~~Delegated-design submittal per Div. 01 Section "DELEGATED DESIGN REQUIREMENTS."~~
~~Include design data for snow guards for which design is assigned to Contractor.~~
   ~~Include calculations for size, number, and location of snow guards.~~
   ~~Include in-service vector load in pounds per linear foot of eave.~~

1.05 INFORMATIONAL SUBMITTALS

A. Test Reports: As follows:
   1. Product Test Reports: For each type of snow guard specified, for tests performed by manufacturer and witnessed by a qualified testing agency, showing ultimate load-to-failure value of attachment.

PART 2 - PRODUCTS

2.01 COMMON REQUIREMENTS

A. See Div. 01 Section "COMMON PRODUCT REQUIREMENTS" for general requirements common to products.

B. See Div. 01 Section "PRODUCT SELECTION OPTIONS" for Contractor's options when selecting Products and procedures for offering comparable products.

2.02 DESCRIPTION

A. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels, and complete with clamps for securement.

B. Attachment system to provide attachment to standing seam metal roofs:
   1. With only minor dimpling of panel seams.
   2. Without penetrations through roof seams or panels.
   3. Without use of sealers or adhesives.
   4. Without voiding roof warranty.

2.03 PERFORMANCE / DESIGN CRITERIA

~~Delegated Design: Professional design services are specifically required of Contractor. Engage a qualified design professional, as defined in Div. 01 Section "DELEGATED DESIGN REQUIREMENTS," to design snow guards, including attachment to building.~~
   ~~Use performance requirements and design criteria based on the following.~~
      ~~Roof snow load.~~
      ~~Snow drifting~~
      ~~Roof slope.~~
      ~~Roof type and finish.~~
      ~~Roof dimensions.~~
      ~~Roofing substrate type and thickness.~~
      ~~Snow guard type.~~
      ~~Snow guard fastening method and strength.~~
      ~~Snow guard spacing.~~
      ~~Coefficient of Friction Between Snow and Roof Surface: 0.~~
      ~~Factor of Safety: Equal to or greater than 3.~~
   ~~Calculate recommended number of rows and number of rails per row.~~

A. Design attachments to accommodate anticipated movement with no possibility of loosening, weakening, or fracturing connections between adjoining system components or between system components and roof structure.

B. Structural Performance Requirements: Provide snow guards , including anchorages, capable of withstanding, without failure, the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, determined per the following code requirements:
   1. Snow Loads Including Drifting Snow: ASCE 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," Chapter 7.

C. Thermal Performance Requirements:
   1. Provide snow guards that withstand exposure to weather and resist thermally induced movement resulting from the following maximum change (range) in ambient and surface temperatures without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
      a. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.04 STANDING-SEAM METAL PANEL ROOF SNOW GUARDS

A. Seam-Mounted, Bar-Type Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels, and complete with clamps for anchoring.
   1. Basis of Design Manufacturer: 1” Square Sno Blockade™ by Sno Gem, Inc. or a comparable product by one of the following:
      a. Alpine SnowGuards; a division of Vermont Slate & Copper Services, Inc.
      b. Metal Roof Innovations, Ltd.; S-5! Attachment Solutions.
      c. Polar Blox.
      d. SnoGuard.
      e. Snow Management Systems; a division of Contek, Inc.
      f. TRA-MAGE, Inc.
      g. Comparable products by other manufacturers will be considered.
   2. Description: Snow guard bars fabricated from aluminum bars, or extrusions, anchored to brackets and equipped with one rail
   3. Metal Roof Supports: Aluminum extrusions clamps with round nose pointed stainless steel set screws. Clamps designed to fit roof seam profile and clamp on without damaging roof.
   4. Material and Finish: Aluminum or stainless steel, powder coated to match roof panels.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
   1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean and prepare substrates for bonding snow guards.

B. Prime substrates according to snow guard manufacturer's written instructions.

3.03 INSTALLATION

A. Install snow guards according to manufacturer's written instructions. Space rows as recommended by manufacturer.

B. Attachment for Standing-Seam Metal Roofing:
   1. Do not use fasteners that will penetrate metal roofing, or fastening methods that void metal roofing finish warranty.
   2. Seam-Mounted, Rail-Type Snow Guards: Aluminum or stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels .

END OF SECTION 07 72 53

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SECTION 13 34 19 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes pre-engineered metal building systems composed of the following:
   1. Structural-steel framing.
   2. Thermal insulation.
   3. Accessories.

B. Related Requirements:
   1. Contracting Requirements of Div. 00 Documents apply to, and are a component part of, this Section.
   2. General Requirements of Div. 01 Specification Sections apply to, and are a component part of, this Section.
   3. Div. 07 Section "FLASHING AND SHEET METAL" for metal flashing, trim, gutters, and downspouts on metal building systems.
   4. Div. 07 Section "SNOW GUARDS" for prefabricated devices designed to hold snow on the roof surface.
   5. Div. 08 Section "HOLLOW METAL DOORS AND FRAMES" for swinging personnel doors and frames in metal building systems.
   6. Div. 08 Section "SECTIONAL DOORS" for sectional vehicular doors in metal building systems.
   7. Div. 08 Section "WINDOWS" for windows in metal building systems.

1.02 REFERENCES

A. Definitions:
   1. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct at Project site per Div. 01 Section "PROJECT MEETINGS" minimum one week prior to commencing work of this Section.
   1. Review methods and procedures related to metal building systems including, but not limited to, the following:
      a. Condition of foundations and other preparatory work performed by other trades.
      b. Structural load limitations.
      c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
      d. Required tests, inspections, and certifications.

e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.

2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
   a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
   b. Structural limitations of purlins and rafters during and after roofing.
   c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
   d. Temporary protection requirements for metal roof panel assembly during and after installation.
   e. Roof observation and repair after metal roof panel installation.
3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
   a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
   b. Structural limitations of girts and columns during and after wall panel installation.
   c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
   d. Temporary protection requirements for metal wall panel assembly during and after installation.
   e. Wall observation and repair after metal wall panel installation.

B. Coordination: Per Div. 01 Section "PROJECT COORDINATION" and as follows:
1. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Div. 03 Section "CAST-IN-PLACE CONCRETE."
2. 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.

1.04 SUBMITTALS, GENERAL

A. Process and transmit per Div. 01 Section "SUBMITTAL PROCEDURES."

1.05 ACTION SUBMITTALS

A. Product Data: For each type of metal building system component.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
   a. Metal roof panels.
   b. Metal wall panels.
   c. Foamed-insulation-core metal panels.
   d. Metal soffit panels.

e. Thermal insulation and vapor-retarder facings.
f. Personnel doors and frames.
g. Windows.
h. Translucent roof panels.
i. Roof ventilators.
j. Louvers.

B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
2. 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.
3. Metal Roof and Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, 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, and items mounted on roof curbs.
b. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.
c. Show translucent panels.
4. 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.
b. Gutters.
c. Downspouts.
d. Service walkways.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Samples for Verification: For the following products:
1. 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-Retarder Facings: Nominal 6-inch- square Samples.
4. Windows: Full-size, nominal 12-inch- long frame Samples showing typical profile.

5. Accessories: Nominal 12-inch- long Samples for each type of accessory.

E. Delegated-design submittal per Div. 01 Section "DELEGATED DESIGN REQUIREMENTS." Include design data for metal building systems for which design is assigned to Contractor.
   1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.06 INFORMATIONAL SUBMITTALS

A. Certificates: Per Div. 01 Section "SUBMITTAL PROCEDURES" and as follows:
   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.
   2. Welding certificates from fabricator and installer.
   3. Erector certificates from manufacturer.

B. Test and Evaluation Reports: As follows:
   1. Material test reports for each of the following products:
      a. Structural steel including chemical and physical properties.
      b. Bolts, nuts, and washers including mechanical properties and chemical analysis.
      c. Tension-control, high-strength, bolt-nut-washer assemblies.
      d. Shop primers.
      e. Nonshrink grout.

C. Sample warranties.

D. Quality Control Submittals: As follows
   1. Source quality control test and inspection reports.

2. Field quality control test and inspection reports.

E. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.

F. Qualification Statements for manufacturer, welders, design professional, and erector.
   1. Include manufacturer's approval for erector.
   2. Include list of past Projects and contacts evidencing compliance with specified qualifications.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance data per Div. 01 Section "OPERATION AND MAINTENANCE DATA."
   1. Maintenance Data: For metal panel finishes to include in maintenance manuals.

1.08 QUALITY ASSURANCE

A. Qualifications: Per Div. 01 Section "QUALITY ASSURANCE" and as follows:
   1. Manufacturer Qualifications: A qualified manufacturer.
      a. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
      b. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.
   2. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
   3. Welder Qualifications: AWS certified within past 12 months for each type of weld required.
   4. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Per Div. 01 Section "PRODUCT DELIVERY AND STORAGE REQUIREMENTS" and as follows:

B. 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.

C. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

D. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, 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.

E. Protect foam-plastic insulation as follows:
   1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
   3. Complete installation and concealment of foam-plastic materials as rapidly as possible in each area of construction.

1.10 FIELD CONDITIONS

A. Ambient Conditions: Per Div. 01 Section "EXECUTION" and as follows:
   1. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

A. Process and transmit per Div. 01 Section "WARRANTIES."

B. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
   1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. American Buildings Company.

2. Butler Manufacturing Company.
3. Metallic Building Co.
4. Robertson Building Systems.
5. Comparable products by other manufacturers will be considered.

B. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.02 DESCRIPTION

A. Provide a complete, integrated set of 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.

B. Product Options: Information on Drawings and in Specifications establishes requirements for assemblies' 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 preconstruction testing, field testing, and in-service performance.
1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

C. Primary-Frame Type:
1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.

D. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of load-bearing end-wall and corner columns and rafters.

E. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.

F. Eave Height: Manufacturer's standard height, as indicated by nominal height on Drawings.

G. Bay Spacing: 25 feet.

H. Roof Slope: 2 inches per 12 inches.

I. Roof System: Manufacturer's standard standing-seam, vertical-rib, metal roof panels.
1. Liner Panels: Tapered rib.

J. Exterior Wall System: Manufacturer's standard exposed-fastener, reverse-rib, metal wall panels.
   1. Liner Panels: Tapered rib.

2.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Professional design services are specifically required of Contractor. Engage a qualified design professional, as defined in Div. 01 Section "DELEGATED DESIGN REQUIREMENTS," to design metal building system, using performance requirements and design criteria specified herein.

B. Structural Performance Requirements: Provide metal building systems, including anchorages, capable of withstanding, without failure, the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
   1. Design Loads: As indicated on Drawings.
   2. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
   3. Deflection and Drift Limits: No greater than the following:
      a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
      b. Girts: Horizontal deflection of 1/240 of the span.
      c. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
      d. Lateral Drift: Maximum of 1/400 of the building height.
   4. Seismic Performance: ASCE/SEI 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," Chapters 11-23.

C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested per ASTM E1680 at 1.57 lbf/sq. ft. test-pressure difference:

D. Water Penetration under Static Pressure: No water penetration when tested per ASTM E1646 at 2.86 lbf/sq. ft. test-pressure difference:

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
   1. Uplift Rating: UL 60.

F. Thermal Performance Requirements:
   1. Provide metal roof panel system that allows 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, reduction of performance, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

2. Provide the following maximum U-factors and minimum R-values when tested according to ASTM C1363 or ASTM C518:
   a. Roof (with thermal spacer blocks):
      1) U-Factor: 0.037.
      2) R-Value: R-19+R-11Ls or R-25+R-8Ls.
   b. Walls:
      1) U-Factor: 0.050.
      2) R-Value: R-0 + R-19c.i.

2.04 STRUCTURAL-STEEL FRAMING

A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

D. Primary Framing: Manufacturer's standard 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 comply with 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.
   4. Exterior Column: Tapered.
   5. Rafter: Tapered.

E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
   1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
   2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.

F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and

other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:

1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch- wide flanges.
    a. Depth and Thickness: As needed to comply with system performance requirements.
2. Purlins: Steel joists of depths indicated on Drawings.
3. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch- wide flanges.
    a. Depth and Thickness: As required to comply with system performance requirements.
4. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
5. 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.
6. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
7. Base or Sill Angles or Channels: Manufacturer's standard base angle, minimum 3-by-2-inch, fabricated from zinc-coated (galvanized) steel sheet.
8. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
9. Framing for Openings: Channel shapes; fabricated from 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.

G. 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.

H. Bracing: Provide adjustable wind bracing using any method as follows:
    1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch- diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
    2. Cable: ASTM A475, minimum 1/4-inch- diameter, extra-high-strength grade, Class B, zinc-coated, seven-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: Fabricated 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: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

I. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.

J. Materials:
1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
4. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
5. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.
   a. Finish: Mechanically deposited zinc coating, ASTM B695, Class 50.
6. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M,Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
   a. Finish: Mechanically deposited zinc coating, ASTM B695, Class 50.
7. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
8. Unheaded Anchor Rods: ASTM F1554, Grade 36.
   a. Configuration: Straight.
   b. Nuts: ASTM A563 heavy-hex carbon steel.
   c. Plate Washers: ASTM A36/A36M carbon steel.
   d. Washers: ASTM F436 hardened carbon steel.
   e. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
9. Headed Anchor Rods: ASTM F1554, Grade 36.
   a. Configuration: Straight.
   b. Nuts: ASTM A563 heavy-hex carbon steel.
   c. Plate Washers: ASTM A36/A36M carbon steel.

d. Washers: ASTM F436 hardened carbon steel.
e. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

10. Threaded Rods: ASTM A36/A36M.
    a. Nuts: ASTM A563 heavy-hex carbon steel.
    b. Washers: ASTM F436 hardened carbon steel.
    c. Finish: Mechanically deposited zinc coating, ASTM B695, Class 50.

K. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
1. Clean and prepare in accordance with SSPC-SP2.
2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
    a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.05 METAL ROOF PANELS

A. Metal Roof Panels: Vertical-rib, seamed-joint, standing-seam 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, and mechanically seaming panels together.
1. Basis of Design Product: Loc Seam Standing Seam Roof Panel by Nucor Buildings Group or a comparable product.
2. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.023-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    a. Exterior Finish: Two-coat fluoropolymer.
    b. Color: As indicated or, if not indicated, as selected from manufacturer's full range..
3. Clips: Two-piece floating to accommodate thermal movement.
4. Joint Type: Mechanically seamed.
5. Panel Coverage: 16 inches.
6. Panel Height: 2 inches.

B. Exposed-Fastener, Tapered-Rib, Metal Liner Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    a. Exterior Finish: Polyester.
    b. Color: As indicated or, if not indicated, as selected from manufacturer's full range..
2. Major-Rib Spacing: 12 inches o.c.

3. Panel Coverage: 36 inches.
4. Panel Height: 1.25 inches.

2.06 METAL WALL PANELS

A. Exposed-Fastener, Reverse-Rib, Metal Wall Panels: Formed with recessed, trapezoidal major valleys and intermediate stiffening valleys symmetrically spaced between major valleys; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
   1. Basis of Design Product: Reverse R-Panel by Nucor Buildings Group or a comparable product.
   2. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.022-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
      a. Exterior Finish: Fluoropolymer.
      b. Color: As indicated or, if not indicated, as selected from manufacturer's full range..
   3. Major-Rib Spacing: 12 inches o.c.
   4. Panel Coverage: 36 inches.
   5. Panel Height: 1.25 inches.

B. Tapered-Rib, Metal Liner Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
   1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
      a. Exterior Finish: Polyester.
      b. Color: As indicated or, if not indicated, as selected from manufacturer's full range..
   2. Major-Rib Spacing: 12 inches o.c.
   3. Panel Coverage: 36 inches.
   4. Panel Height: 1.25 inches.

2.07 THERMAL INSULATION

A. Faced Metal Building Insulation: ASTM C991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch- wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.

B. Retainer Strips: For securing insulation between supports, 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.

C. Vapor-Retarder Facing: ASTM C1136, with permeance not greater than 0.02 perm when tested according to ASTM E96/E96M, Desiccant Method.
   1. Composition: White metallized-polypropylene film facing, fiberglass scrim reinforcement, and kraft-paper backing.

D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.08 PERSONNEL DOORS AND FRAMES

A. Swinging Personnel Doors and Frames: As specified in Div. 08 Section "HOLLOW METAL DOORS AND FRAMES."

2.09 HORIZONTAL SLIDING DOORS

A. Horizontal-Sliding Doors: Manufacturer's standard horizontal-sliding door assembly including structural frame, door panels, brackets, guides, tracks, hardware, and installation accessories.
   1. Door Frames: Channels and zees; metallic-coated steel sheet or structural-steel shapes, 0.060-inch nominal uncoated steel thickness.
   2. Door Panels: Same material and finish as metal wall panels.
   3. Hardware: Manufacturer's standard metallic-coated steel track, bottom guides, lock angles for side closure, and brackets. Support each door leaf by two four-wheel trolleys. Provide metallic-coated steel handle for each leaf, and slide bolt or padlock hasp. Flash top of track with metallic-coated steel sheet hood.

2.10 WINDOWS

A. Aluminum Windows: As specified in Div. 08 Section "ALUMINUM WINDOWS."

2.11 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 and with 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 stainless-steel sheet, designed to withstand negative-load requirements.
3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless-steel sheet or nylon-coated aluminum 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: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, 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: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.

E. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.12 FABRICATION

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" for fabrication and erection tolerances.

C. 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.
   1. Make shop connections by welding or by using high-strength bolts.
   2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
   3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
   4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
   5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.

D. 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.
   1. Make shop connections by welding or by using non-high-strength bolts.
   2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

2.13 SOURCE QUALITY CONTROL

A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.
   1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
      a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Per Div. 01 Section "EXAMINATION AND PREPARATION" and as follows:

B. Verification of Conditions:
   1. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   2. 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.
      a. Engage land surveyor to perform surveying.
   3. Proceed with erection only after unsatisfactory conditions have been corrected.

C. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

D. 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.

3.02 ERECTION OF STRUCTURAL FRAMING

A. Erect metal building system according to manufacturer's written instructions and 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, 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 level, plumb, rigid, secure, and true to line. 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 High-Strength Bolts" for bolt type and joint type specified.
   a. Joint Type: Snug tightened or pretensioned as required by manufacturer.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.

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. 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 303.

3.03 METAL PANEL INSTALLATION, GENERAL

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. 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 seams before metal panel installation.

D. 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 structural supports with end laps in alignment.
   6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, 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.

F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

G. 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, provide types recommended by metal panel manufacturer.
   1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
   2. Prepare joints and apply sealants to comply with requirements in Div. 07 Section "JOINT SEALANTS."

3.04 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. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
   1. Install clips to supports with self-drilling or 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 that 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 for thermal expansion and contraction. Predrill panels for fasteners.
   6. Provide metal closures at peaks, rake edges, and each side of ridge caps.

C. 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 and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.05 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 for thermal expansion and contraction. Predrill panels.
   6. Flash and seal metal wall panels with weather closures at eaves and 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 on Drawings; if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet, noncumulative; level, plumb, and on location lines; and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.06 THERMAL INSULATION INSTALLATION

A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.

B. Blanket Roof Insulation: Comply with the following installation method:
1. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. 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.
   a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.

C. Board Wall Insulation: Extend board insulation in thickness indicated to cover entire wall. Hold in place by metal wall panels fastened to secondary framing. Comply with manufacturers' written instructions.
1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3.07 DOOR AND FRAME INSTALLATION

A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' 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 as specified in Div. 08 Section "HOLLOW METAL DOORS AND FRAMES."

C. Overhead Doors: Install as specified in Div. 08 Section "SECTIONAL DOORS."

D. Door Hardware: Install as specified in Div. 08 Section "DOOR HARDWARE."

3.08 WINDOW INSTALLATION

A. Install windows as specified in Div. 08 Section "ALUMINUM WINDOWS."

3.09 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 contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant 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, Div. 07 Section "FLASHING AND SHEET METAL," 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. 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 flashing and sheet metal 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).

C. Gutters: Comply with Div. 07 Section "FLASHING AND SHEET METAL." **Form to match profile of gable trim.** Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion. **Finish gutters to match metal roof panels.**

D. Downspouts: Comply with Div. 07 Section "FLASHING AND SHEET METAL." Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between. **Finish downspouts to match metal roof panels.**
   1. Provide elbows at base of downspouts to direct water away from building.
   2. Tie downspouts to underground drainage system as indicated.

E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.10 REPAIR

A. Repairing Damaged Finishes: Immediately after installation, clean field welds and abraded and other areas where coatings are damaged.
   1. Shop-Primed Surfaces: Touch up shop-applied primers per Div. 05 Section "SHOP-APPLIED PRIME COATINGS FOR METAL."
   2. Galvanized Surfaces: Repair per Div. 05 Section "SHOP-APPLIED GALVANIC COATINGS FOR METAL."
   3. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish per manufacturer's written instructions.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

3.11 FIELD QUALITY CONTROL

A. See Div. 01 Section "TESTING AND INSPECTING SERVICES" for administrative and procedural requirements for obtaining services of independent testing laboratories and agencies to perform specified special inspections.

B. Special Inspections: Owner will engage a qualified special inspector to perform on-site special inspections per the Statement of Special Inspections and to submit reports.

3.12 ADJUSTING

A. Per Div. 01 Section "EXECUTION" and as follows:

B. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.

C. 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.

D. Windows: Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and at weather stripping to ensure smooth operation and weathertight closure. Lubricate hardware and moving parts.

3.13 CLEANING

A. Per Div. 01 Sections "PROGRESS CLEANING" and "FINAL CLEANING" and as follows:

B. 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.

C. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.
   1. Immediately before final inspection, remove protective wrappings from doors and frames.

D. Windows: Clean metal surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances. Clean factory-glazed glass immediately after installing windows.

END OF SECTION 13 34 19

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